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J. I.	Jules Isaac. Professor of History at the Lycée of Lyons.	**Louis XII. of France.**
J. J. T.	Sir Joseph John Thomson, D.Sc., LL.D., Ph.D., F.R.S. Cavendish Professor of Experimental Physics and Fellow of Trinity College, Cambridge. President of the British Association, 1909–1910. Author of *A Treatise on the Motion of Vortex Rings; Application of Dynamics to Physics and Chemistry; Recent Researches in Electricity and Magnetism*; &c.	**Magneto-Optics;** **Matter.**
J. L. W.	Jessie Laidlay Weston. Author of *Arthurian Romances unrepresented in Malory.*	**Malory, Sir Thomas;** **Map, Walter.**
J. M. Gr.	James Moncrieff Grierson, C.B., C.M.G., C.V.O. Major-General, R.A. Commanding 1st Division Aldershot Command. Director of Military Operations at Headquarters, 1904–1906. Served through South African War, 1900–1901. Author of *Staff Duties in the Field*; &c.	**Manœuvres, Military.**
J. M. M.	John Malcolm Mitchell. Sometime Scholar of Queen's College, Oxford. Lecturer in Classics, East London College (University of London). Joint-editor of Grote's *History of Greece.*	**Mandeville, Bernard de;** **Marcus Aurelius Antoninus.**
J. P. P.	John Percival Postgate, M.A., Litt.D. Professor of Latin in the University of Liverpool. Fellow of Trinity College, Cambridge. Fellow of the British Academy. Editor of the *Classical Quarterly.* Editor-in-chief of the *Corpus Poëtarum Latinorum*; &c.	**Lucan** (*in part*).
Jno. S.	Sir John Scott, K.C.M.G., D.C.L. (1841–1904). Deputy Judge Advocate-General to the Forces, 1898–1904. Judicial Adviser to the Khedive of Egypt, 1890–1898. Hon. Fellow of Pembroke College, Oxford.	**Martial Law.**
J. Si.*	Rev. James Sibree, F.R.G.S. Principal Emeritus, United College (L.M.S. and F.F.M.A.), Antanànarivo, Madagascar. Membre de l'Académie Malgache. Author of *Madagascar and its People; Madagascar before the Conquest; A Madagascar Bibliography*; &c.	**Madagascar;** **Mauritius.**
J. S. Bl.	John Sutherland Black, M.A., LL.D. Assistant-editor of the 9th edition of the *Encyclopaedia Britannica.* Joint-editor of the *Encyclopaedia Biblica.*	**Mary: Mother of Jesus** (*in part*). **Mazzini.**
J. S. Co.	James Sutherland Cotton, M.A. Editor of the *Imperial Gazetteer of India.* Hon. Secretary of the Egyptian Exploration Fund. Formerly Fellow and Lecturer of Queen's College, Oxford. Author of *India*; &c.	**Mahrattas** (*in part*).
J. S. F.	John Smith Flett, D.Sc., F.G.S. Petrographer to the Geological Survey. Formerly Lecturer on Petrology in Edinburgh University. Neill Medallist of the Royal Society of Edinburgh. Bigsby Medallist of the Geological Society of London.	**Marble;** **Marl.**
J. T. Be.	John Thomas Bealby. Joint-author of Stanford's *Europe.* Formerly Editor of the *Scottish Geographical Magazine.* Translator of Sven Hedin's *Through Asia, Central Asia and Tibet*; &c.	**Maritime Province** (*in part*).
J. T. C.	Joseph Thomas Cunningham, M.A., F.Z.S. Lecturer on Zoology at the South-Western Polytechnic, London. Formerly Fellow of University College, Oxford. Assistant Professor of Natural History in the University of Edinburgh and Naturalist to the Marine Biological Association.	**Mackerel** (*in part*).
J. T. M.	John Theodore Merz, LL.D., Ph.D., D.C.L. Chairman of the Newcastle-upon-Tyne Electric Supply Co., Ltd. Author of *History of European Thought in the XIXth Century*; &c.	**Lotze** (*in part*).

J. T. S.*	James Thomson Shotwell, Ph.D. Professor of History in Columbia University, New York City.	**Louis VI., VII., IX., X. and XI. of France.**
J. V.*	Jules Viard. Archivist at the National Archives, Paris. Officer of Public Instruction, France. Author of *La France sous Philippe VI de Valois*; &c.	**Lore, Ambroise de;** **Louvet, Jean;** **Marcel, Étienne.**
J. V. B.	James Vernon Bartlet, M.A., D.D. (St Andrews). Professor of Church History, Mansfield College, Oxford. Author of *The Apostolic Age*; &c.	**Mark, St** (*in part*); **Matthew, St; Luke, St.**
K. G. J.	Kingsley Garland Jayne. Sometime Scholar of Wadham College, Oxford. Matthew Arnold Prizeman, 1903. Author of *Vasco da Gama and his Successors.*	**Malay Archipelago.**
K. K.	Konrad Kessler, Ph.D. Formerly Professor of Semitic Languages at the University of Greifswald.	**Mandaeans** (*in part*).
K. L.	Rev. Kirsopp Lake, M.A. Lincoln College, Oxford. Professor of Early Christian Literature and New Testament Exegesis in the University of Leiden. Author of *The Text of the New Testament*; *The Historical Evidence for the Resurrection of Jesus Christ*; &c.	**Mary, Mother of Jesus** (*in part*).
K. S.	Kathleen Schlesinger. Editor of *Portfolio of Musical Archaeology.* Author of *The Instruments of the Orchestra.*	**Lute** (*in part*); **Lyre** (*in part*); **Mandoline.**
L. J. S.	Leonard James Spencer, M.A., F.G.S. Assistant, Department of Mineralogy, Natural History Museum, South Kensington. Formerly Scholar of Sidney Sussex College, Cambridge, and Harkness Scholar. Editor of the *Mineralogical Magazine.*	**Manganite;** **Marcasite.**
L. V.*	Luigi Villari. Italian Foreign Office (Emigration Dept.). Formerly Newspaper Correspondent in East of Europe. Author of *Italian Life in Town and Country*; &c.	**Mazzini:** *Bibliography.*
L. W. V-H.	L. W. Vernon-Harcourt (d. 1909). Barrister-at-Law. Author of *His Grace the Steward and the Trial of Peers.*	**Lord High Steward.**
M. A. W.	Mary A. Ward (Mrs Humphry Ward). See the biographical article: Ward, Mary Augusta.	**Lyly.**
M. Br.	Margaret Bryant.	**Louis VIII. and XVII. of France.**
M. Ja.	Morris Jastrow, Jr., Ph.D. Professor of Semitic Languages, University of Pennsylvania. Author of *Religion of the Babylonians and Assyrians*; &c.	**Marduk.**
M. N. T.	Marcus Niebuhr Tod, M.A. Fellow and Tutor of Oriel College, Oxford. University Lecturer in Epigraphy. Joint-author of *Catalogue of the Sparta Museum.*	**Lycurgus:** *Spartan Lawgiver*; **Lysander.**
M. O. B. C.	Maximilian Otto Bismarck Caspari, M.A. (Oxon.). Reader in Ancient History at London University. Lecturer in Greek at Birmingham University, 1905–1908.	**Mantineia** (*in part*); **Manuel I., Comnenus;** **Marathon** (*in part*).
M P.	Mark Pattison, LL.D. See the biographical article: Pattison, Mark.	**Macaulay.**
N. D. M.	Newton Dennison Mereness, A.M., Ph.D. Author of *Maryland as a Proprietary Province.*	**Maryland.**
N. V.	Joseph Marie Noel Valois. Member of Académie des Inscriptions et Belles-Lettres, Paris. Honorary Archivist at the Archives Nationales. Formerly President of the Société de l'Histoire de France, and of the Société de l'École des Chartes.	**Marsilius of Padua;** **Martin I.-V.:** *Popes.*
N. W. T.	Northcote Whitridge Thomas, M.A. Government Anthropologist to Southern Nigeria. Corresponding Member of the Société d'Anthropologie de Paris. Author of *Thought Transference*; *Kinship and Marriage in Australia*; &c.	**Lycanthropy;** **Magic.**
O. R.	Osborne Reynolds, M.A., LL.D., F.R.S. M.Inst.C.E. Formerly Professor of Engineering, Victoria University, Manchester Honorary Fellow of Queens' College, Cambridge.	**Lubrication.**
P. A. A.	Philip A. Ashworth, M.A., Doc. Juris. New College, Oxford. Barrister-at-Law.	**Lübeck** (*in part*).
P. A. K.	Prince Peter Alexeivitch Kropotkin. See the biographical article: Kropotkin, Prince, P. A.	**Maritime Province** (*in part*).
P. G.	Percy Gardner, M.A., Litt.D., LL.D. See the biographical article: Gardner, Percy.	**Lysippus.**
P. Gi.	Peter Giles, M.A., LL.D., Litt.D. Fellow and Classical Lecturer of Emmanuel College, Cambridge, and University Reader in Comparative Philology. Formerly Secretary of the Cambridge Philological Society.	**M.**

P. G. T.	PETER GUTHRIE TAIT, LL.D. See the biographical article: TAIT, PETER GUTHRIE.	**Maxwell, James Clerk.**
P. Vi.	PAUL VINOGRADOFF, D.C.L., LL.D. See the biographical article: VINOGRADOFF, PAUL.	**Manor** (*in part*).
R. A.*	ROBERT ANCHEL. Archivist to the Department de l'Eure.	**Louis XVI.; Marat.**
R. B. McK.	RONALD BRUNLEES MCKERROW, M.A. Trinity College, Cambridge. Editor of *The Works of Thomas Nashe*; &c.	**Marprelate Controversy.**
R. C. J.	SIR RICHARD CLAVERHOUSE JEBB, D.C.L., LL.D. See the biographical article: JEBB, SIR RICHARD CLAVERHOUSE.	**Lysias** (*in part*).
R. G.	RICHARD GARNETT, LL.D., D.C.L. See the biographical article: GARNETT, RICHARD.	**Lucan** (*in part*); **Max Müller.**
R. H. C.	REV. ROBERT HENRY CHARLES, M.A., D.LITT. Grinfield Lecturer on the Septuagint at Oxford, 1905–1907. Fellow of the British Academy. Professor of Biblical Greek at Trinity College, Dublin, 1898–1906. Hibbert Lecturer at Oxford, 1898; Jowett Lecturer, 1898–1899. Author of *Critical History of a Future Life*; &c.	**Manasses, Prayer of.**
R. J. M.	RONALD JOHN MCNEILL, M.A. Christ Church, Oxford. Barrister-at-law. Formerly Editor of the *St James's Gazette*, London.	**Lundy, Robert;** **Macdonnell, Sorley Boy;** **McNeile, Hugh;** **Manchester, Earls and Dukes of;** **March, Earls of;** **Margaret, Queen of Scotland;** **Masham, Abigail.**
R. K. D.	SIR ROBERT KENNAWAY DOUGLAS. Formerly Professor of Chinese, King's College, London. Keeper of Oriental Printed Books and MSS. at British Museum, 1892–1907. Member of the Chinese Consular Service, 1858–1865. Author of *The Language and Literature of China*; *China*; *Europe and the Far East*; &c.	**Manchuria.**
R. L.*	RICHARD LYDEKKER, F.R.S., F.G.S., F.Z.S. Member of the Staff of the Geological Survey of India, 1874–1882. Author of *Catalogues of Fossil Mammals, Reptiles and Birds in the British Museum*; *The Deer of all Lands*; *The Game Animals of Africa*; &c.	**Loris; Macaque;** **Machaerodus;** **Mammalia** (*in part*); **Mammoth** (*in part*); **Manati;** **Mandrill; Marmot;** **Marsupialia; Mastodon.**
R. M'L.	ROBERT M'LACHLAN, F.R.S. Editor of the *Entomologists' Monthly Magazine*.	**May-Fly** (*in part*).
R. M. D.	RICHARD MOUNTFORD DEELEY, M.INST.C.E., M.I.MECH.E., F.G.S. Late Locomotive Superintendent, Midland Railway. Joint-author of *Lubrication and Lubricants*.	**Lubricants.**
R. N. B.	ROBERT NISBET BAIN (d. 1909). Assistant Librarian, British Museum, 1883–1909. Author of *Scandinavia, the Political History of Denmark, Norway and Sweden, 1513–1900*; *The First Romanovs, 1613 to 1725*; *Slavonic Europe, the Political History of Poland and Russia from 1469 to 1796*; &c.	**Louis I. and II. of Hungary;** **Malachowski;** **Margaret, Queen; Martinuzzi;** **Matthias I., Hunyadi;** **Matvyeev;** **Mazepa-Koledinsky.**
R. P.	REINHOLD PAULI. See the biographical article: PAULI, REINHOLD.	**Lübeck** (*in part*).
R. P. S.	R. PHENÉ SPIERS, F.S.A., F.R.I.B.A. Formerly Master of the Architectural School, Royal Academy, London. Past President of Architectural Association. Associate and Fellow of King's College, London. Corresponding Member of the Institute of France. Editor of Fergusson's *History of Architecture*. Author of *Architecture: East and West*; &c.	**Manor-House.**
R. Po.	RENÉ POUPARDIN, D. ÈS L. Secretary of the École des Chartes. Honorary Librarian at the Bibliothèque Nationale, Paris. Author of *Le Royaume de Provence sous les Carolingiens*; *Recueil des chartes de Saint-Germain*; &c.	**Lorraine;** **Louis IV. and V. of France.**
R. S. C.	ROBERT SEYMOUR CONWAY, M.A., D.LITT. (Cantab.). Professor of Latin and Indo-European Philology in the University of Manchester. Formerly Professor of Latin in University College, Cardiff; and Fellow of Gonville and Caius College, Cambridge. Author of *The Italic Dialects*.	**Mamertini;** **Marrucini;** **Marsi.**
R. T.	SIR RICHARD TEMPLE. See the biographical article: TEMPLE, SIR RICHARD.	**Mahrattas** (*in part*).
R. We.	RICHARD WEBSTER, A.M. (Princeton). Formerly Fellow in Classics, Princeton University. Editor of *The Elegies of Maximianus*; &c.	**Mather, Increase;** **Mather, Richard.**
S. A. C.	STANLEY ARTHUR COOK, M.A. Lecturer in Hebrew and Syriac, and formerly Fellow, Gonville and Caius College, Cambridge. Editor for Palestine Exploration Fund. Examiner in Hebrew and Aramaic, London University, 1904–1908. Author of *Glossary of Aramaic Inscriptions*; *The Laws of Moses and the Code of Hammurabi*; *Critical Notes on Old Testament History*; *Religion of Ancient Palestine*; &c.	**Lot;** **Manasseh.**

S. Bi.	Shelford Bidwell, M.A., D.Sc., F.R.S. (1848–1909). Gonville and Caius College, Cambridge. Formerly President of the Physical Society and Member of Council of the Royal Society.	**Magnetism.**
S. C.	Sidney Colvin, LL.D. See the biographical article: Colvin, Sidney.	**Marcantonio.**
S. N.	Simon Newcomb, LL.D., D.Sc. See the biographical article: Newcomb, Simon.	**Mars:** *Planet.*
T. As.	Thomas Ashby, M.A., D.Litt., F.S.A. Director of the British School of Archaeology at Rome. Corresponding Member of the Imperial German Archaeological Institute. Formerly Scholar of Christ Church, Oxford; Craven Fellow, Oxford, 1897. Author of *The Classical Topography of the Roman Campagna*; &c.	**Lucania; Lucca; Lucena; Lucretilis, Mons; Lucus Feroniae; Luna; Magna Graecia; Manduria; Manfredonia; Marches, The; Marino; Marzabotto.**
T. Ba.	Sir Thomas Barclay. Member of the Institute of International Law. Member of the Supreme Council of the Congo Free State. Officer of the Legion of Honour. Author of *Problems of International Practice and Diplomacy*; &c. M.P. for Blackburn, 1910.	**Mare Clausum.**
T. F. C.	Theodore Freylinghuysen Collier, Ph.D. Assistant Professor of History, Williams College, Williamstown, Mass., U.S.A.	**Marcellus.**
T. G. Br.	Thomas Gregor Brodie, M.D., F.R.S. Professor of Physiology in the University of Toronto. Author of *Essentials of Experimental Physiology.*	**Lymph and Lymph Formation.**
T. H. H.*	Sir Thomas Hungerford Holdich, K.C.M.G., K.C.I.E., D.Sc. Superintendent, Frontier Surveys, India, 1892–1898. Gold Medallist, R.G.S., London, 1887. Author of *The Indian Borderland*; *The Countries of the King's Award*; *India*; *Tibet.*	**Makran.**
T. M. L.	Thomas Martin Lindsay, LL.D., D.D. Principal of the United Free Church College, Glasgow. Formerly Assistant to the Professor of Logic and Metaphysics in the University of Edinburgh. Author of *History of the Reformation*; *Life of Luther*; &c.	**Luther, Martin; Lutherans.**
T. R. R. S.	Thomas Roscoe Rede Stebbing, M.A., F.R.S., F.L.S., F.Z.S. Fellow of King's College, London. Hon. Fellow of Worcester College, Oxford. Zoological Secretary of Linnaean Society, 1903–1907. Author of *A History of Crustacea*; *The Naturalist of Cumbrae*; &c.	**Malacostraca.**
T. Se.	Thomas Seccombe, M.A. Balliol College, Oxford. Lecturer in History, East London and Birkbeck Colleges, University of London. Stanhope Prizeman, Oxford, 1887. Assistant Editor of *Dictionary of National Biography*, 1891–1901. Author of *The Age of Johnson*; &c.	**Marlowe, Christopher** (*in part*); **Marston, Philip Bourke.**
T. W. R. D.	Thomas William Rhys Davids, M.A., Ph.D., LL.D. Professor of Comparative Religion in the University of Manchester. Professor of Pali and Buddhist Literature, University College, London, 1882–1904. President of the Pali Text Society. Fellow of the British Academy. Secretary and Librarian of Royal Asiatic Society, 1885–1902. Author of *Buddhism*; &c.	**Lumbinī; Mahāvamsa; Maitreya.**
V. H. S.	Rev. Vincent Henry Stanton, M.A., D.D. Ely Professor of Divinity in the University of Cambridge. Canon of Ely. Formerly Fellow, Dean, Tutor and Lecturer of Trinity College, Cambridge. Author of *The Jewish and the Christian Messiahs*; &c.	**Mark, Gospel of St; Matthew, Gospel of St; Luke, Gospel of St.**
W. A. B. C.	Rev. William Augustus Brevoort Coolidge, M.A., F.R.G.S. Fellow of Magdalen College, Oxford. Professor of English History, St David's College, Lampeter, 1880–1881. Author of *Guide to Switzerland*; *The Alps in Nature and in History*; &c. Editor of the *Alpine Journal*, 1880–1889.	**Lötschen Pass; Lucerne: Canton, Town, Lake of; Lugano, Lake of; Maggiore, Lago.**
W. A. G.	Walter Armstrong Graham. His Siamese Majesty's Resident Commissioner for the Siamese Malay State of Kelantan. Adviser to his Siamese Majesty's Minister for Lands and Agriculture. Author of *Kelantan, a Handbook*; &c.	**Malay States:** *Non-Federated.* **Malay States:** *Siamese.*
W. A. P.	Walter Alison Phillips, M.A. Formerly Exhibitioner of Merton College and Senior Scholar of St John's College, Oxford. Author of *Modern Europe*; &c.	**Louis Philippe; Mahmud II.; Mass:** *Church.*
W. D. L.	William Draper Lewis, LL.B., Ph.D. Dean of the Law School, University of Pennsylvania. Lecturer on Economics, Haverford College, Pennsylvania, 1890–1896. Editor of *Great American Lawyers*; &c.	**Marshall, John.**
W. E. A. A.	William Edmund Armytage Axon, LL.D. Formerly Deputy Chief Librarian of the Manchester Free Libraries. On Literary Staff of *Manchester Guardian*, 1874–1905. Member of the Gorsedd, with the bardic name of Manceinion. Author of *Annals of Manchester*; &c.	**Manchester.**
W. E. D.	William Ernest Dalby, M.A., M.Inst.C.E., M.I.M.E. Professor of Civil and Mechanical Engineering at the City and Guilds of London Institute Central Technical College, South Kensington. Formerly University Demonstrator in the Engineering Department, Cambridge. Author of *The Balancing of Engines*; *Valves and Valve-Gear Mechanism*; &c.	**Mechanics:** *Applied* (*in part*).
W. E. G. F.	William Edward Garrett Fisher, M.A. Author of *The Transvaal and the Boers.*	**Marbles.**

W. F.*	Rev. William Fairweather, M.A., D.D. Minister of Dunnikier United Free Church, Kirkcaldy, N.B. Author of *Maccabees* (Cambridge Bible for Schools); *The Background of the Gospels*; &c.	**Maccabees;** **Maccabees, Books of.**
W. Ho.	Wynnard Hooper, M.A. Clare College, Cambridge. Financial Editor of *The Times*, London.	**Market.**
W. H. F.	Sir William Henry Flower, F.R.S. See the biographical article: Flower, Sir W. H.	**Mammalia** (*in part*); **Mammoth** (*in part*); **Mandrill** (*in part*); **Marten.**
W. J. M. R.	William John Macquorn Rankine, LL.D. See the biographical article: Rankine, William John Macquorn.	**Mechanics:** *Applied* (*in part*).
W. L. C.*	William Lee Corbin, A.M. Associate Professor of English, Wells College, Aurora, New York.	**Mather, Cotton.**
W. L. F.	Walter Lynwood Fleming, A.M., Ph.D. Professor of History in Louisiana State University. Author of *Documentary History of Reconstruction*; &c.	**Lynch Law;** **McGillivray, Alexander.**
W. L. G.	William Lawson Grant, M.A. Professor at Queen's University, Kingston, Canada. Formerly Beit Lecturer in Colonial History at Oxford University. Editor of *Acts of the Privy Council*, ("Colonial" series); *Canadian Constitutional Development* (in collaboration).	**Mackenzie, William Lyon;** **Manitoba** (*in part*).
W. M. R.	William Michael Rossetti. See the biographical article: Rossetti, Dante G.	**Luini; Mantegna;** **Martini; Masaccio;** **Masolino da Panicale.**
W. M. Ra.	Sir William Mitchell Ramsay, LL.D., D.C.L. See the biographical article: Ramsay, Sir William Mitchell.	**Lycaonia.**
W. P. C.	William Prideaux Courtney, D.C.L. See the article: Courtney, L. H., Baron.	**Marlborough, 1st Duke of.**
W. R. S.	William Robertson Smith, LL.D. See the biographical article: Smith, William Robertson.	**Malachi** (*in part*); **Mecca.**
W. Wn.	William Watson, D.Sc., F.R.S. Assistant Professor of Physics, Royal College of Science, London. Vice-President of the Physical Society.	**Magnetograph;** **Magnetometer.**
W. W. F.*	William Warde Fowler, M.A. Fellow of Lincoln College, Oxford. Sub-Rector, 1881–1904. Gifford Lecturer, Edinburgh University, 1908. Author of *The City-State of the Greeks and Romans*; *The Roman Festivals of the Republican Period*; &c.	**Mars:** *Mythology*; **Mauretania.**
W. Y. S.	William Young Sellar, LL.D. See the biographical article: Sellar, William Young.	**Martial;** **Lucilius** (*in part*); **Lucretius.**

PRINCIPAL UNSIGNED ARTICLES

Lord Chamberlain.
Lotteries.
Louisiana.
Lourdes.
Loyalists.
Luchu Archipelago.
Lützen.
Lyons.
Macabre.
McKinley, William.
Madeira.
Madison, James.
Madras.
Madrid.
Mafia.
Magnesium.
Magnolia.
Maine, U.S.A.
Maize.
Malplaquet.
Malta.
Mandamus.
Manganese.
Manila.
Manipur.
Manna.
Maori.
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Marengo.
Marionettes.
Marriage.
Marseilles.
Marshal.
Marston Moor.
Maryland.
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Match.
Mayo.
Mayor.
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Mecklenburg.

THE ENCYCLOPÆDIA BRITANNICA

VOLUME 17

LORD CHAMBERLAIN TO MECKLENBURG

LORD CHAMBERLAIN, in England, an important officer of the king's household, to be distinguished from the lord great chamberlain (*q.v.*). He is the second dignitary of the court, and is always a member of the government of the day (before 1782 the office carried cabinet rank), a peer and a privy councillor. He carries a white staff, and wears a golden or jewelled key, typical of the key of the palace, which is supposed to be in his charge, as the ensigns of his office. He is responsible for the necessary arrangements connected with state ceremonies, such as coronations and royal marriages, christenings and funerals; he examines the claims of those who desire to be presented at court; all invitations are sent out in his name by command of the sovereign, and at drawing-rooms and levees he stands next to the sovereign and announces the persons who are approaching the throne. It is also part of his duty to conduct the sovereign to and from his carriage.[1] The bedchamber, privy chamber and presence chamber, the wardrobe, the housekeeper's room, the guardroom and the chapels royal are in the lord chamberlain's department. He is regarded as chief officer of the royal household, and he has charge of a large number of appointments, such as those of the royal physicians, tradesmen and private attendants of the sovereign. All theatres in the cities of London and Westminster (except patent theatres), in certain of the London boroughs and in the towns of Windsor and Brighton, are licensed by him and he is also licenser of plays (see THEATRE: *Law*; and REVELS, MASTER OF THE). His salary is £2000 a year.

The vice-chamberlain of the household is the lord chamberlain's assistant and deputy. He also is one of the ministry, a white-staff officer and the bearer of a key; and he is generally a peer or the son of a peer as well as a privy councillor. He receives £700 a year. Next to the vice-chamberlain comes the groom of the stole, an office only in use during the reign of a king. He has the charge of the vestment called the stole worn by the sovereign on state occasions. In the lord chamberlain's department also are the master, assistant master, marshal of the ceremonies and deputy-marshal of the ceremonies, officers whose special function it is to enforce the observance of the *etiquette* of the court. The reception of foreign potentates and ambassadors is under their particular care, and they assist in the ordering of all entertainments and festivities at the palace.[2] The gentleman usher of the black rod—the black rod which he carries being the ensign of his office—is the principal usher of the court and kingdom. He is one of the original functionaries of the order of the Garter, and is in constant attendance on the House of Lords, from whom, either personally or by his deputy, the yeoman usher of the black rod, it is part of his duty to carry messages and summonses to the House of Commons. There are six lords and six grooms "in waiting" who attend on the sovereign throughout the year and whose terms of attendance are of a fortnight's or three weeks' duration at a time. Usually "extra" lords and grooms in waiting are nominated by the sovereign, who, however, are unpaid and have no regular duties. Among the serjeants-at-arms there are two to whom special duties are assigned: the one attending the speaker in the House of Commons, and the other attending the lord chancellor in the House of Lords, carrying their maces and executing their orders.[3] The comptroller and examiner of accounts, the paymaster of the household, the licenser of plays, the dean and subdean of the chapels royal, the clerk and deputy clerks of the closet, the groom of the robes, the pages of the backstairs, of the chamber and of the presence, the poet laureate, the royal physicians and surgeons, chaplains, painters and sculptors, librarians and musicians, &c., are all under the superintendence of the lord chamberlain of the household.[4]

The queen consort's household is also in the department of the lord chamberlain of the household. It comprises a lord chamberlain, a vice-chamberlain and treasurer, equerry and the various ladies of the royal household, a groom and a clerk of the robes. The ladies of the household are the mistress of the robes, the ladies of the bedchamber, the bedchamber women and the maids of honour. The mistress of the robes in some measure occupies the position of the groom of the stole.[5] She is the only lady of the court who comes into office and goes out with the administration. She is always a duchess, and attends the queen consort at all state ceremonies and entertainments, but is never in permanent residence at the palace.[6] The ladies of the bedchamber share the personal attendance on the queen consort throughout the year. Of these there are eight, always peeresses, and each is in waiting for a fortnight or three weeks at a time. But the women of the bedchamber, of whom there are also eight, appear only at court ceremonies and entertainments according to a roster annually issued under the authority of the lord chamberlain of the queen consort. They are usually the daughters of peers or the wives of the sons of peers, and formerly, like the mistress of the robes and the ladies of the bedchamber, habitually assisted the queen at her daily toilette. But this has long ceased to be done by any of them. The eight maids of honour have the same terms of waiting as the ladies of the bedchamber. They are commonly if not always the daughters or granddaughters of peers, and when they have no superior title and precedence by birth are called "honourable" and placed next after the daughters of barons.

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[1] The lord chamberlain of the household at one time discharged some important political functions, which are described by Sir Harris Nicolas (*Proceedings of the Privy Council*, vol. vi., Preface, p. xxiii).

[2] The office of master of the ceremonies was created by James I. The master of the ceremonies wears a medal attached to a gold chain round his neck, on one side being an emblem of peace with the motto "Beati pacifici," and on the other an emblem of war with the motto "Dieu et mon droit" (see *Finetti Philoxensis*, by Sir John Finett, master of the ceremonies to James I. and Charles I., 1656; and D'Israeli's *Curiosities of Literature*, 10th ed., p. 242 seq.).

[3] See May, *Parliamentary Practice*, pp. 236, 244.

[4] The offices of master of the great wardrobe and master of the jewel house in the lord chamberlain's department were abolished in 1782.

[5] In the reign of Queen Anne, Sarah duchess of Marlborough from 1704, and Elizabeth duchess of Somerset from 1710, held the combined offices of mistress of the robes and groom of the stole.

[6] Since the great "bedchamber question" of 1839 the settled practice has been for all the ladies of the court except the mistress of the robes to receive and continue in their appointments independently of the political connexions of their husbands, fathers and brothers (see Gladstone's *Gleanings of Past Years*, i. 40; and Torrens's *Memoirs of Lord Melbourne*, ii. 304).

LORD CHIEF JUSTICE, in England, the presiding judge of the king's bench division of the High Court of Justice, and in the absence of the lord chancellor, president of the High Court. He traces his descent from the justiciar of the Norman kings. This officer appears first as the lieutenant or deputy of the king, exercising all the functions of the regal office in the absence of the sovereign. "In this capacity William Fitz-Osbern, the steward of Normandy, and Odo of Bayeux, acted during the Conqueror's visit to the continent in 1067; they were left, according to William of Poitiers, the former to govern the north of England, the latter to hold rule in Kent, vice sua; Florence of Worcester describes them as "custodes Angliae," and Ordericus Vitalis gives to their office the name of "praefectura." It would seem most probable that William Fitz-Osbern at least was left in his character of steward, and that the Norman seneschalship was thus the origin of the English justiciarship" (Stubbs's *Constitutional History*, i. 346). The same authority observes that William of Warenne and Richard Clare (Bienfaite), who were left in charge of England in 1074, are named by a writer in the next generation "praecipui Angliae justitiarii"; but he considers the name to have not yet been definitely attached to any particular office, and that there is no evidence to show that officers appointed to this trust exercised any functions at all when the king was at home, or in his absence exercised supreme judicial authority to the exclusion of other high officers of the court. The office became permanent in the reign of William Rufus, and in the hands of Ranulf Flambard it became co-extensive with the supreme powers of government. But it was not till the reign of Henry II. that the chief officer of the crown acquired the exclusive right to the title of *capitalis* or *totius Angliae justitiarius.* Stubbs considers that the English form of the office is to be accounted for by the king's desire to prevent the administration falling into the hands of an hereditary noble. The early justiciars were clerics, in whom the possession of power could not become hereditary. The justiciar continued to be the chief officer of state, next to the king, until the fall of Hubert de Burgh (in the reign of King John), described by Stubbs as the last of the great justiciars. Henceforward, according to Stubbs, the office may be said to have survived only in the judicial functions, which were merely part of the official character of the chief justiciar. He was at the head of the curia regis, which was separating itself into the three historical courts of common law about the time when the justiciarship was falling from the supreme place. The chancellor took the place of the justiciar in council, the treasurer in the exchequer, while the two offshoots from the curia regis, the common pleas and the exchequer, received chiefs of their own. The king's bench represented the original stock of the curia regis, and its chief justice the great justiciar. The justiciar may, therefore, be said to have become from a political a purely judicial officer. A similar development awaited his successful rival the chancellor. Before the Judicature Act the king's bench and the common pleas were each presided over by a lord chief justice, and the lord chief justice of the king's bench was nominal head of all the three courts, and held the title of lord chief justice of England. The titles of lord chief justice of the common pleas and lord chief baron were abolished by the Judicature Act 1873, and all the common law divisions of the High Court united into the king's bench division, the president of which is the lord chief justice of England.

The lord chief justice is, next to the lord chancellor, the highest judicial dignitary in the kingdom. He is an *ex-officio* judge of the court of appeal. He holds office during good behaviour, and can only be removed by the crown (by whom he is appointed) after a joint address of both houses of parliament. He is now the only judicial functionary privileged to wear the collar of SS. There has been much discussion as to the origin and history of this collar;[1] it was a badge or insignia attached to certain offices entitling the holders to wear it only so long as they held those offices. The collar of SS. was worn by the chiefs of the three courts previous to their amalgamation in 1873, and that now worn by the lord chief justice of England was provided by Sir A. Cockburn in 1859 and entailed by him on all holders of the office. The salary is £8000 a year.

In the United States the supreme court consists of a chief justice and eight associate justices, any six of whom make a quorum. The salary of the chief justice is $13,000 and that of the associates $12,500. The chief justice takes rank next after the president, and he administers the oath on the inauguration of a new president and vice-president. The principal or presiding judge in most of the state judicatures also takes the title of chief justice.

LORD GREAT CHAMBERLAIN, in England, a functionary who must be carefully distinguished from the lord chamberlain; he is one of the great officers of state, whose office dates from Norman times; and the only one who still holds it under a creation of that period. As his name implies, he was specially connected by his duties with the king's chamber (*camera curie*); but this phrase was also used to denote the king's privy purse, and the chamberlain may be considered as originally the financial officer of the household. But as he was always a great baron, deputies performed his financial work, and his functions became, as they are now, mainly ceremonial, though the emblem of his office is still a key. The office had been held by Robert Malet, son of a leading companion of the Conqueror, but he was forfeited by Henry I., who, in 1133, gave the great chamberlainship to Aubrey de Vere and his heirs. Aubrey's son was created earl of Oxford, and the earls held the office, with some intermission, till 1526, when the then earl left female heirs. His heir-male succeeded to the earldom, but the crown, as is now established, denied his right to the office, which was thenceforth held under grants for life till Queen Mary and Elizabeth admitted in error the right of the earls on the strength of their own allegation. So matters continued till 1626, when an earl died and again left an heir-male and an heir-female. After an historic contest the office was adjudged to the former, Lord Willoughby d'Eresby. No further question arose till 1779, when his heirs were two sisters. In 1781 the House of Lords decided that it belonged to them jointly, and that they could appoint a deputy, which they did. Under a family arrangement the heirs of the two sisters respectively appointed deputies in alternate reigns till the death of Queen Victoria, when Lord Ancaster, the heir of the elder, who was then in possession, claimed that he, as such, had sole right to the office. Lord Cholmondeley and Lord Carrington as co-heirs of the younger sister, opposed his claim, and the crown also claimed for itself on the ground of the action taken by the king in 1526. After a long and historic contest, the House of Lords (1902) declined to re-open the question, and merely re-affirmed the decision of 1781, and the office, therefore, is now vested jointly in the three peers named and their heirs.

The lord great chamberlain has charge of the palace of Westminster, especially of the House of Lords, in which he has an office; and when the sovereign opens parliament in person he is responsible for the arrangements. At the opening or closing of the session of parliament by the sovereign in person he disposes of the sword of state to be carried by any peer he may select, and walks himself in the procession on the right of the sword of state, a little before it and next to the sovereign. He issues the tickets of admission on the same occasions. He assists at the introduction of all peers into the House of Lords on their creation, and at the homage of all bishops after their consecration. At coronations he emerges into special importance; he still asserts before the court of claims his archaic right to bring the king his "shirt, stockings and drawers" and to dress him on coronation day and to receive his ancient fees, which include the king's bed and "night robe." He also claims in error to serve the king with water before and after the banquet, which was the function of the "ewry," a distinct office held by the earls of Oxford. At the actual coronation ceremony he takes an active part in investing the king with the royal insignia.

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[1] *Notes and Queries*, series 1, vol. ii.; series 4, vols. ii. ix. x.; series 6, vols. ii. iii.; Planché, *Dictionary of Costume*, p. 126; Foss, *Lives of the Judges*, vol. vii.; Dugdale, *Orig. Jud.* fol. 102.

See J. H. Round, "The Lord Great Chamberlain" (*Monthly Review*, June 1902) and "Notes on the Lord Great Chamberlain Case" (*Ancestor*, No. IV.). (J. H. R.)

LORD HIGH CHANCELLOR, one of the great officers of state of the United Kingdom, and in England the highest judicial functionary. The history of the office and of the growth of the importance of the lord chancellor will be found under CHANCELLOR. The lord chancellor is in official rank the highest civil subject in the land outside the royal family, and takes precedence immediately after the archbishop of Canterbury. His functions have sometimes been exercised by a lord keeper of the great seal (see LORD KEEPER), the only real difference between the two offices being in the appointment of the keeper by mere delivery of the seal, while a lord chancellor receives letters patent along with it. He is by office a privy councillor, and it has long been the practice to make him a peer and also a cabinet minister. He is by prescription Speaker or prolocutor of the House of Lords, and as such he sits upon the woolsack, which is not strictly within the House. Unlike the Speaker of the House of Commons, the lord chancellor takes part in debates, speaking from his place in the House. He votes from the woolsack instead of going into the division lobby. The only function which he discharges as Speaker practically is putting the question; if two debaters rise together, he has no power to call upon one, nor can he rule upon points of order. Those taking part in debates address, not the lord chancellor, but the whole House, as "My Lords." The lord chancellor always belongs to a political party and is affected by its fluctuations. This has often been denounced as destructive of the independence and calm deliberativeness essential to the purity and efficiency of the bench. In defence, however, of the ministerial connexion of the chancellor, it has been said that, while the other judges should be permanent, the head of the law should stand or fall with the ministry, as the best means of securing his effective responsibility to parliament for the proper use of his extensive powers. The transference of the judicial business of the chancery court to the High Court of Justice removed many of the objections to the fluctuating character of the office. As a great officer of state, the lord chancellor acts for both England and Scotland, and in some respects for the United Kingdom, including Ireland (where, however, an Irish lord chancellor is at the head of the legal system). By Article XXIV. of the Act of Union (1705) one great seal was appointed to be kept for all public acts, and in this department the lord chancellor's authority extends to the whole of Britain, and thus the commissions of the peace for Scotland as well as England issue from him.[1] As an administrative officer, as a judge and as head of the law, he acts merely for England. His English ministerial functions are thus briefly described by Blackstone: "He became keeper of the king's conscience, visitor, in right of the king, of all hospitals and colleges of the king's foundation, and patron of all the king's livings under the value of twenty marks per annum in the king's books. He is the general guardian of all infants, idiots and lunatics, and has the general superintendence of all charitable uses in the kingdom." But these duties and jurisdiction by modern statutes have been distributed for the most part among other offices or committed to the judges of the High Court (see CHARITY AND CHARITIES; INFANT; INSANITY). Under the Judicature Act 1873 the lord chancellor is a member of the court of appeal, and, when he sits, its president, and he is also a judge of the High Court of Justice. He is named as president of the chancery division of the latter court. His judicial patronage is very extensive, and he is by usage the adviser of the crown in the appointment of judges[2] of the High Court. He presides over the hearing of appeals in the House of Lords. His proper title is "Lord High Chancellor of Great Britain and Ireland." His salary is £10,000 per annum, and he is entitled to a pension of £5000 per annum.

AUTHORITIES.—*Observations concerning the Office of Lord Chancellor* (1651), attributed to Lord Chancellor Ellesmere; Blackstone's *Commentaries*; Campbell's *Lives of the Chancellors*; and D. M. Kerly, *Historical Sketch of the Equitable Jurisdiction of the Court of Chancery* (1890).

LORD HIGH CONSTABLE, in England, the seventh of the great officers of state. His office is now called out of abeyance for coronations alone. The constable was originally the commander of the royal armies and the master of the horse. He was also, in conjunction with the earl marshal, president of the court of chivalry or court of honour. In feudal times martial law was administered in the court of the lord high constable. The constableship was granted as a grand serjeanty with the earldom of Hereford by the empress Maud to Milo of Gloucester, and was carried by his heiress to the Bohuns, earls of Hereford and Essex. Through a coheiress of the Bohuns it descended to the Staffords, dukes of Buckingham; and on the attainder of Edward Stafford, third duke of Buckingham, in the reign of Henry VIII. it became merged in the crown. The Lacys and Verduns were hereditary constables of Ireland from the 12th to the 14th century; and the Hays, earls of Erroll, have been hereditary constables of Scotland from early in the 14th century.

LORD HIGH STEWARD. The Lord High Steward of England, who must not be confused with the Lord Steward, ranks as the first of the great officers of state. Appointments to this office are now made only for special occasions, such as the coronation of a sovereign or the trial of a peer by his peers. The history of the office is noteworthy. The household of the Norman and Angevin kings of England included certain persons of secondary rank, styled dapifers, seneschals or stewards (the prototypes of the lord steward), who were entrusted with domestic and state duties; the former duties were those of purveyors and sewers to the king, the latter were undefined. At coronations, however, and great festivals it became the custom in England and elsewhere to appoint magnates of the first rank to discharge for the occasion the domestic functions of the ordinary officials. In accordance with this custom Henry II. appointed both Robert II., earl of Leicester, and Hugh Bigod, earl of Norfolk, to be his honorary hereditary stewards; and at the Christmas festival of 1186 the successors in title of these two earls, with William, earl of Arundel, who held the similar honorary office of hereditary butler, are described as serving the king at the royal banqueting table. Subsequently the earls of Leicester bought out the rights of the earls of Norfolk for ten knights' fees.

The last of these earls of Leicester to inherit the hereditary stewardship was Simon V. de Montfort; how he served as steward at the coronation of Eleanor, queen of Henry III., is described in the Exchequer Red Book. The office of steward in France, then recently suppressed, had for some time been the highest office of state in that kingdom, and Simon de Montfort appears to have considered that his hereditary stewardship entitled him to high official position in England; and after his victory at Lewes he repeatedly figures as steward of England in official documents under the great seal. After Simon's death at Evesham his forfeited estates were conferred on his son Edmund of Lancaster, who also obtained a grant of the stewardship, but only for life. Edmund was succeeded by Thomas, earl of Lancaster, who received a fresh grant of the stewardship to himself and the heirs of his body from Edward II.; and this earl it was who, during the weak administration of the last-mentioned king, first put forward in a celebrated tract the claim of the steward to be the second personage in the realm and supreme judge in parliament, a claim which finds some slight recognition in the preamble to the statute passed against the Despencers in the first year of Edward III.

Earl Thomas was executed for treason, and though his attainder was reversed he left no issue, and was succeeded in the earldom by his brother Henry. The subsequent earls and dukes of Lancaster were all recognized as stewards of England, the office apparently being treated as annexed to the earldom, or honor, of Leicester. John of Gaunt, indeed, at a time when it was possible that he would never obtain the Leicester moiety of the Lancastrian estates, seems to have made an ingenious but quite unfounded claim to the office as annexed to the honor of Hinckley. Strictly speaking, none of the Lancasters after Thomas had any clear title either by grant or otherwise; such title as they had merged in the crown when Henry IV. usurped the throne. Meanwhile the stewardship had increased in importance. On the accession of Edward III., Henry, earl of Lancaster, as president of the council, had superintended the coronation of the infant king; John of Gaunt did the same for the infant Richard II.; and, as part of the duties involved, sat in the White Hall of Westminster to hear and determine the claims to perform coronation services. The claims were made by petition, and included amongst others: the claim of Thomas of Woodstock to act as constable, the rival claims of John Dymock and Baldwin de Frevile to act as champion, and the claim of the barons of the Cinque Ports to carry a canopy over the king. Minutes of these proceedings, in which the duke is stated to have sat "as steward of England," were enrolled by his order. This is the origin of what is now called the Court of Claims. The precedent of Richard II. has been followed on all subsequent occasions, except that in modern times it has been the practice to appoint commissioners instead of a steward to superintend this court. In 1397 John of Gaunt created a notable precedent in support of the steward's claim to be supreme judge in parliament by presiding at the trial of the earl of Arundel and others.

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[1] The great seal, which exists in duplicate for Irish use, is the great seal of the United Kingdom.

[2] Except the lord chief justice, who is appointed on the nomination of the prime minister.

When Henry IV. came to the throne he appointed his young son Thomas, afterwards duke of Clarence, to the office of steward. Clarence held the office until his death. He himself never acted as judge in parliament; but in 1415 he was appointed to preside at the judgment of peers delivered in Southampton against Richard, earl of Cambridge, and Lord Scrope of Masham, who had been previously tried by commissioners of oyer and terminer. No permanent steward was ever again created; but a steward was always appointed for coronations to perform the various ceremonial services associated with the office, and, until the Court of Claims was entrusted to commissioners, to preside over that court. Also, in the 15th century, it gradually became the custom to appoint a steward *pro hac vice* to preside at the trial, or at the proceedings upon the attainder of a peer in parliament; and later, to preside over a court, called the court of the lord high steward, for the trial of peers when parliament was not sitting. To assist in establishing the latter court a precedent of 1400 appears to have been deliberately forged. This precedent is reported in the printed *Year-Book* of 1400, first published in 1553; it describes the trial of "the earl of H" for participation in the rebellion of that year, and gives details of procedure. John Holand, earl of Huntingdon, is undoubtedly the earl indicated, but the evidence is conclusive that he was murdered in Essex without any trial. The court of the lord high steward seems to have been first definitely instituted in 1499 for the trial of Edward Plantagenet, earl of Warwick; only two years earlier Lord Audley had been condemned by the court of chivalry, a very different and unpopular tribunal. The Warwick trial was most carefully schemed: the procedure, fundamentally dissimilar to that adopted in 1415, follows exactly the forged precedent; but the constitution of the court was plainly derived from the Southampton case. The record of the trial was consigned to a new repository (commonly but wrongly called the Baga de Secretis), which thenceforth became the regular place of custody for important state trials. Latterly, and possibly from its inception, this repository consisted of a closet with three locks, of which the keys were entrusted, one to the chief justice of England, another to the attorney-general and the third to the master of the crown office, or coroner. Notwithstanding the irregular origin of the steward's court, for which Henry VII. must be held responsible, the validity of its jurisdiction cannot be questioned. The Warwick proceedings were confirmed by act of parliament, and ever since this court has been fully recognized as part of the English constitution.

For about a century and a half prior to the reign of James I. the criminal jurisdiction of parliament remained in abeyance, and bills of attainder were the vogue. The practice of appointing a steward on these occasions to execute judgment upon a peer was kept up till 1477, when George, duke of Clarence, was attainted, and then dropped. Under the Stuarts the criminal jurisdiction of parliament was again resorted to, and when the proceedings against a peer were founded on indictment the appointment of a steward followed as a matter of settled practice. The proper procedure in cases of impeachment had, on the contrary, never been defined. On the impeachment of Strafford the lords themselves appointed Arundel to be high steward. In Danby's case a commission under the great seal issued in the common form adopted for the court of the steward; this was recalled, and the rule agreed to by a joint committee of both houses that a steward for trials of peers upon impeachments was unnecessary. But, as such an appointment was obviously convenient, the lords petitioned for a steward; and a fresh commission was accordingly issued in an amended form, which recited the petition, and omitted words implying that the appointment was necessary. This precedent has been treated as settling the practice of parliament with regard to impeachments.

Of the proceedings against peers founded upon indictment very few trials antecedent to the revolution took place in parliament. The preference given to the steward's court was largely due to the practice, founded upon the Southampton case, of summoning only a few peers selected by the steward, a practice which made it easy for the king to secure a conviction. This arrangement has been partially abrogated by the Treason Act of William III., which in cases of treason and misprision of treason requires that all peers of parliament shall be summoned twenty days at least before every such trial. The steward's court also differed in certain other particulars from the high court of parliament. For example, it was ruled by Lord Chancellor Jeffreys, as steward at the trial of Lord Delamere, that, in trials of peers which take place during the recess of parliament in the steward's court, the steward is the judge of the court, the court is held before him, his warrant convenes the prisoner to the bar, his summons convenes the peers for the trial, and he is to determine by his sole authority all questions of law that arise in the course of the trial, but that he is to give no vote upon the issue of guilty or not guilty; during a session of parliament, on the contrary, all the peers are both triers and judges, and the steward is only as chairman of the court and gives his vote together with the other lords. Lord Delamere was tried in 1685 in the steward's court; since then all trials of peers have taken place before the lords in parliament. The most recent trial was that of Earl Russell in 1901, when Lord Chancellor Halsbury was made lord high steward. The steward is addressed as "his grace," he has a rod of office, and the commission appointing him is dissolved according to custom by breaking this rod.

A court of claims sat and a steward was appointed for the coronation of Edward VII.; and during the procession in Westminster Abbey the duke of Marlborough, as steward, carried "St Edward's crown" in front of the bearer of the Bible (the bishop of London), who immediately preceded the king; this function of the steward is of modern origin. The steward's ancient and particular services at coronations are practically obsolete; the full ceremonies, procession from Westminster Hall and banquet in which he figured prominently, were abandoned on the accession of William IV.

For the early history of the steward see L. W. Vernon-Harcourt, *His Grace the Steward and Trial of Peers* (1907); for the later history of the office see Sir E. Coke, *Institutes* (1797); Cobbett and Howell, *State Trials* (1809, seq.); S. M. Phillipps, *State Trials* (1826); John Hatsell, *Precedents*, vol. 4 (1818); and Sir M. Foster, *Crown Law* (1809). See also the various works on *Coronations* for the steward's services on these occasions. (L. W. V.-H.)

LORD HIGH TREASURER, in England, once the third great officer of state. The office was of Norman origin and dated from 1216. The duty of the treasurer originally was to act as keeper of the royal treasure at Winchester, while as officer of the exchequer he sat at Westminster to receive the accounts of the sheriffs, and appoint officers to collect the revenue. The treasurer was subordinate to both the justiciar and the chancellor, but the removal of the chancery from the exchequer in the reign of Richard I., and the abolition of the office of justiciars in the reign of Henry III., increased his importance. Indeed, from the middle of the reign of Henry III. he became one of the chief officers of the crown. He took an important part in the equitable jurisdiction of the exchequer, and was now styled not merely king's treasurer or treasurer of the exchequer, but lord high treasurer and treasurer of the exchequer. The first office was conferred by delivery of a white staff, the second by patent. Near the end of the 16th century he had developed into an official so occupied with the general policy of the country as to be prevented from supervising personally the details of the department, and Lord Burleigh employed a secretary for this purpose. On the death of Lord Salisbury in 1612 the office was put in commission; it was filled from time to time until 1714, when the duke of Shrewsbury resigned it; since that time it has always been in commission (see TREASURY). The Scottish treasury was merged with the English by the Act of Union, but the office of lord high treasurer for Ireland was continued until 1816.

LORD HOWE, an island of the southern Pacific Ocean, lying about 31° 36′ S., 159° 5′ E., 520 m. E.N.E. of Sydney. Pop. 120. It was discovered in 1778 by Lieutenant Ball (whose name is commemorated in the adjacent islet of Ball's Pyramid), and is a dependency of New South Wales. It measures about 5½ m. by 1 m., and is well wooded and hilly (reaching a height of 2840 ft. at the southern end), being of volcanic formation, while there are coral reefs on the western shore. It has a pleasant climate. The name Lord Howe is given also to an islet of the Santa Cruz group, and to two islands, also known under other names—Mopiha, of the Society group, and Ongtong Java of the Solomon Islands.

LORD JUSTICE CLERK, in Scotland, a judge next in rank to the lord justice-general. He presides in the second division of the court of session, and in the absence of the lord justice-general, presides in the court of justiciary. The justice clerk was originally not a judge at all, but simply clerk and legal assessor of the justice court. In course of time he was raised from the clerk's table to the bench, and by custom presided over the court in the absence of the justice-general. Up to 1672 his position was somewhat anomalous, as it was doubtful whether he was a clerk or a judge, but an act of that year, which suppressed the office of justice-depute, confirmed his position as a judge, forming him, with the justice-general and five of the lords of session into the court of justiciary. The lord justice clerk is also one of the officers of state for Scotland, and one of the commissioners for keeping the Scottish Regalia. His salary is £4800 a year.

LORD JUSTICE-GENERAL, the highest judge in Scotland, head of the court of justiciary, called also the lord president, and as such head of the court of session and representative of the sovereign. The office of justice-general was for a considerable time a sinecure post held by one of the Scottish nobility, but by the Court of Session Act 1830, it was enacted that, at the termination of the existing interest, the office should be united with that of lord president of the court of session, who then became presiding judge of the court of justiciary. The salary is £5000 a year.

LORD KEEPER OF THE GREAT SEAL, in England, formerly a great officer of state. The Great Seal of England, which is affixed on all solemn occasions to documents expressing the pleasure of the sovereign, was first adopted by Edward the Confessor (see SEALS), and entrusted to a chancellor for keeping. The office of chancellor from the time of Becket onwards varied much in importance; the holder being an ecclesiastic, he was not only engaged in the business of his diocese, but sometimes was away from England. Consequently, it became not unusual to place the personal custody of the great seal in the hands of a vice-chancellor or keeper; this, too, was the practice followed during a temporary vacancy in the chancellorship. This office gradually developed into a permanent appointment, and the lord keeper acquired the right of discharging all the duties connected with the great seal. He was usually, though not necessarily, a peer, and held office during the king's pleasure, he was appointed merely by delivery of the seal, and not, like the chancellor, by patent. His status was definitely fixed (in the case of lord keeper Sir Nicholas Bacon) by an act of Elizabeth, which declared him entitled to "like place, pre-eminence, jurisdiction, execution of laws, and all other customs, commodities, and advantages" as the lord chancellor. In subsequent reigns the lord keeper was generally raised to the chancellorship, and retained the custody of the seal. The last lord keeper was Sir Robert Henley (afterwards Lord Northington), who was made chancellor on the accession of George III.

LORD MAYOR'S DAY, in England, the 9th of November, the date of the inauguration of the lord mayor of London (see Vol. XVI., p. 966), marked by a pageant known as the Lord Mayor's Show. The first of these pageants was held in 1215. The idea originated in the stipulation made in a charter then granted by John that the citizen chosen to be mayor should be presented to the king or his justice for approval. The crowd of citizens who accompanied the mayor on horseback to Westminster developed into a yearly pageant, which each season became more elaborate. Until the 15th century the mayor either rode or walked to Westminster, but in 1453 Sir John Norman appears to have set a fashion of going by water. From 1639 to 1655 the show disappeared owing to Puritan opposition. With the Restoration the city pageant was revived, but interregnums occurred during the years of the plague and fire, and in 1683 when a quarrel broke out between Charles and the city, ending in the temporary abrogation of the charter. In 1711 an untoward accident befell the show, the mayor Sir Gilbert Heathcote (the original of Addison's Sir Andrew Freeport) being thrown by his horse. The next year a coach was, in consequence, provided for the chief magistrate. In 1757 this was superseded by a gilded and elaborately decorated equipage costing £10,065 which was used till 1896, when a replica of it was built to replace it.

LORD PRESIDENT OF THE COUNCIL, in England, one of the great officers of state, and a member of the ministry. It was only in 1679 that the office of lord president became permanent. Previously either the lord chancellor, the lord keeper of the seal, or some particular court official took formal direction of the Privy Council. In the reign of Charles I. a special lord president of the council was appointed, but in the following reign the office was left unfilled. The office was of considerable importance when the powers of the Privy Council, exercised through various committees, were of greater extent than at the present time. For example, a committee of the lords of the council was formerly responsible for the work now dealt with by the secretary of state for foreign affairs; so also with that now discharged by the Board of Trade. The lord president up to 1855—when a new post of vice-president of the council was created—was responsible for the education department. He was also responsible for the duties of the council in regard to public health, now transferred to the Local Government Board, and for duties in regard to agriculture, now transferred to the Board of Agriculture and Fisheries. The duties of the office now consist of presiding on the not very frequent occasions when the Privy Council meets, and of the drawing up of minutes of council upon subjects which do not belong to any other department of state. The office is very frequently held in conjunction with other ministerial offices, for example, in Gladstone's fourth ministry the secretary of state for India was also lord president of the council, and in the conservative ministry of 1903 the holder of the office was also president of the Board of Education. The lord president is appointed by a declaration made in council by the sovereign. He is invariably a member of the House of Lords, and he is also included in the cabinet.

LORDS JUSTICES OF APPEAL, in England, the ordinary judges of the court of appeal, the appellate division of the High Court of Justice. Their style was provided for by the Supreme

Court of Judicature Act 1877. The number was fixed at five by the Supreme Court of Judicature Act 1881, s. 3. Their salary is £5000 a year (see APPEAL).

LORDS OF APPEAL IN ORDINARY, in England, certain persons (limited to four), who, having held high judicial office or practised at the bar for not less than fifteen years, sit as members of the House of Lords to adjudicate in cases before that House in its legal capacity, and also to aid the judicial committee of the Privy Council in hearing appeals. Of the four lords of appeal in ordinary one is usually appointed from the Irish bench or bar and one from Scotland. Their salary is £6000 a year. They hold office on the same conditions as other judges. By the Appellate Jurisdiction Act 1876, under which they are appointed, lords of appeal in ordinary are, by virtue of and according to the date of their appointment, entitled during life to rank as barons and during the time that they continue in office are entitled to a writ of summons to attend, and to sit and vote in the House of Lords. They are life peers only. The patent of a lord of appeal in ordinary differs from that of a baron in that he is not "created" but "nominated and appointed to be a Lord of Appeal in Ordinary by the style of Baron."

LORD STEWARD, in England, an important official of the king's household. He is always a member of the government, a peer and a privy councillor. Up to 1782, the office was one of considerable political importance and carried cabinet rank. The lord steward receives his appointment from the sovereign in person, and bears a white staff as the emblem and warrant of his authority. He is the first dignitary of the court. In the *Statutes of Eltham* he is called "the lord great master," but in the *Household Book* of Queen Elizabeth "the lord steward," as before and since. In an act of Henry VIII. (1539) "for placing of the lords," he is described as "the grand master or lord steward of the king's most honourable household." He presides at the Board of Green Cloth.[1] In his department are the treasurer and comptroller of the household, who rank next to him. These officials are usually peers or the sons of peers and privy councillors. They sit at the Board of Green Cloth, carry white staves, and belong to the ministry. But the duties which in theory belong to the lord steward, treasurer and comptroller of the household are in practice performed by the master of the household, who is a permanent officer and resides in the palace. He is a white-staff officer and a member of the Board of Green Cloth but not of the ministry, and among other things he presides at the daily dinners of the suite in waiting on the sovereign. In his case history repeats itself. He is not named in the *Black Book* of Edward IV. or in the *Statutes* of Henry VIII., and is entered as "master of the household and clerk of the green cloth" in the *Household Book* of Queen Elizabeth. But he has superseded the lord steward of the household, as the lord steward of the household at one time superseded the lord high steward of England.

In the lord steward's department are the officials of the Board of Green Cloth, the coroner ("coroner of the verge"), and paymaster of the household, and the officers of the almonry (see ALMONER). Other offices in the department were those of the cofferer of the household, the treasurer of the chamber, and the paymaster of pensions, but these, with six clerks of the Board of Green Cloth, were abolished in 1782. The lord steward had formerly three courts besides the Board of Green Cloth under him. First, the lord steward's court, superseded (1541) by—second—the Marshalsea court, a court of record having jurisdiction, both civil and criminal within the verge (the area within a radius of 12 m. from where the sovereign is resident), and originally held for the purpose of administering justice between the domestic servants of the sovereign, "that they might not be drawn into other courts and their service lost." Its criminal jurisdiction had long fallen into disuse and its civil jurisdiction was abolished in 1849. Third, the palace court, created by letters patent in 1612 and renewed in 1665 with jurisdiction over all personal matters arising between parties within 12 m. of Whitehall (the jurisdiction of the Marshalsea court, the City of London, and Westminster Hall being excepted). It differed from the Marshalsea court in that it had no jurisdiction over the sovereign's household nor were its suitors necessarily of the household. The privilege of practising before the palace court was limited to four counsel. It was abolished in 1849. The lord steward or his deputies formerly administered the oaths to the members of the House of Commons. In certain cases (messages from the sovereign under the sign-manual) "the lords with white staves" are the proper persons to bear communications between the sovereign and the houses of parliament.

AUTHORITIES.—*Statutes of Eltham*; *Household Book* of Queen Elizabeth; Coke, *Institutes*; Reeves, *History of the Law of England*; Stephen, *Commentaries on the Laws of England*; Hatsell, *Precedents of Proceedings in the House of Commons*; May, *Parliamentary Practice*.

LORÉ, AMBROISE DE (1396–1446), baron of Ivry in Normandy and a French commander, was born at the château of Loré (Orne, arrondissement of Domfront). His first exploit in arms was at the battle of Agincourt in 1415; he followed the party of the Armagnacs and attached himself to the dauphin Charles. He waged continual warfare against the English in Maine until the advent of Joan of Arc. He fought at Jargeau, at Meung-sur-Loire and at Patay (1429). Using his fortress of Saint Céneri as a base of operations during the next few years, he seized upon Matthew Gough near Vivoin in 1431, and made an incursion as far as the walls of Caen, whence he brought away three thousand prisoners. Taken captive himself in 1433, he was exchanged for Talbot. In 1435 he and Dunois defeated the English near Meulan, and in 1436 he helped the constable Arthur, earl of Richmond (de Richmond), to expel them from Paris. He was appointed provost of Paris in February 1437, and in 1438 he was made "judge and general reformer of the malefactors of the kingdom." He was present in 1439 at the taking of Meaux, in 1441 at that of Pontoise, and he died on the 24th of May 1446.

See the *Nouvelle Biographie Générale*, vol. xxxi., and the *Revue Historique du Maine*, vols. iii. and vi. (J. V.*)

LORE, properly instruction, teaching, knowledge. The O. Eng. *lár*, as the Dutch *leer* and Ger. *Lehre*, represents the Old Teutonic root, meaning to impart or receive knowledge, seen in "to learn," "learning." In the *Gentleman's Magazine* for June 1830 it was suggested that "lore" should be used as a termination instead of the Greek derivative *-ology* in the names of the various sciences. This was never done, but the word, both as termination and alone, is frequently applied to the many traditional beliefs, stories, &c., connected with the body of knowledge concerning some special subject; *e.g.* legendary lore, bird-lore, &c. The most familiar use is in "folk-lore" (*q.v.*).

LORELEI (from Old High Ger. *Lur*, connected with modern Ger. *lauern*, "to lurk," "be on the watch for," and equivalent to elf, and *lai*, "a rock"). The Lorelei is a rock in the Rhine near St Goar, which gives a remarkable echo, which may partly account for the legend. The tale appears in many forms, but is best known through Heinrich Heine's poem, beginning *Ich weiss nicht was soll es bedeuten.* In the commonest form of the story the Lorelei is a maiden who threw herself into the Rhine in despair over a faithless lover, and became a siren whose voice lured fishermen to destruction. The 13th-century minnesinger, known as Der Marner, says that the Nibelungen treasure was hidden beneath the rock. The tale is obviously closely connected with the myth of Holda, queen of the elves. On the Main she sits combing her locks on the Hullenstein, and the man who sees her loses sight or reason, while he who listens is condemned to wander with her for ever. The legend, which Clemens Brentano claimed as his own invention when he wrote his poem "Zu Bacharach am Rheine" in his novel of *Godwi* (1802), bears all the marks of popular mythology. In the 19th century it formed material for a great number of songs, dramatic sketches, operas and even tragedies, which are enumerated by Dr Hermann Seeliger in his *Loreleysage in Dichtung und Musik* (Leipzig-Reudnitz, 1898). The favourite poem with composers was Heine's, set to music by some twenty-five musicians, the settings by Friedrich Silcher (from an old folk-song) and by Liszt being the most famous.

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[1] A committee of the king's household, consisting of the lord steward and his subordinates, charged with the duty of examining and passing all the accounts of the household. The board had also power to punish all offenders within the verge or jurisdiction of the palace, which extended in every direction for 200 yds. from the gates of the court yard. The name is derived from the green-covered table at which the transactions of the board were originally conducted.

LORETO, an episcopal see and pilgrimage resort of the Marches, Italy, in the province of Ancona, 15 m. by rail S.S.E. of that town. Pop. (1901) 1178 (town), 8033 (commune). It lies upon the right bank of the Musone, at some distance from the railway station, on a hill-side commanding splendid views from the Apennines to the Adriatic, 341 ft. above sea-level. The town itself consists of little more than one long narrow street, lined with shops for the sale of rosaries, medals, crucifixes and similar objects, the manufacture of which is the sole industry of the place. The number of pilgrims is said to amount to 50,000 annually, the chief festival being held on the 8th of September, the Nativity of the Virgin. The principal buildings, occupying the four sides of the piazza, are the college of the Jesuits, the Palazzo Apostolico, now Reale (designed by Bramante), which contains a picture gallery with works of Lorenzo Lotto, Vouet and Caracci and a collection of majolica, and the cathedral church of the Holy House (Chiesa della Casa Santa), a Late Gothic structure continued by Giuliano da Maiano, Giuliano da Sangallo and Bramante. The handsome façade of the church was erected under Sixtus V., who fortified Loreto and gave it the privileges of a town (1586); his colossal statue stands in the middle of the flight of steps in front. Over the principal doorway is a life-size bronze statue of the Virgin and Child by Girolamo Lombardo; the three superb bronze doors executed at the latter end of the 16th century and under Paul V. (1605–1621) are also by Lombardo, his sons and his pupils, among them Tiburzio Vergelli, who also made the fine bronze font in the interior. The doors and hanging lamps of the Santa Casa are by the same artists. The richly decorated campanile, by Vanvitelli, is of great height; the principal bell, presented by Leo X. in 1516, weighs 11 tons. The interior of the church has mosaics by Domenichino and Guido Reni and other works of art. In the sacristies on each side of the right transept are frescoes, on the right by Melozzo da Forli, on the left by Luca Signorelli. In both are fine intarsias.

But the chief object of interest is the Holy House itself. It is a plain stone building, 28 ft. by 12½ and 13½ ft. in height; it has a door on the north side and a window on the west; and a niche contains a small black image of the Virgin and Child, in Lebanon cedar, and richly adorned with jewels. St Luke is alleged to have been the sculptor; its workmanship suggests the latter half of the 15th century. Around the Santa Casa is a lofty marble screen, designed by Bramante, and executed under Popes Leo X., Clement VII. and Paul III., by Andrea Sansovino, Girolamo Lombardo, Bandinelli, Guglielmo della Porta and others. The four sides represent the Annunciation, the Nativity, the Arrival of the Santa Casa at Loreto and the Nativity of the Virgin respectively. The treasury contains a large variety of rich and curious votive offerings. The architectural design is finer than the details of the sculpture. The choir apse is decorated with modern German frescoes, which are somewhat out of place.

The legend of the Holy House seems to have sprung up (how is not exactly known) at the close of the crusading period.

It is briefly referred to in the *Italia Illustrata* of Flavius Blondus, secretary to Popes Eugenius IV., Nicholas V., Calixtus III. and Pius II. (*ob.* 1464); it is to be read in all its fullness in the "Redemptoris mundi Matris Ecclesiae Lauretana historia," by a certain Teremannus, contained in the *Opera Omnia* (1576) of Baptista Mantuanus. According to this narrative the house at Nazareth in which Mary had been born and brought up, had received the annunciation, and had lived during the childhood of Jesus and after His ascension, was converted into a church by the apostles. In 336 the empress Helena made a pilgrimage to Nazareth and caused a basilica to be erected over it, in which worship continued until the fall of the kingdom of Jerusalem. Threatened with destruction by the Turks, it was carried by angels through the air and deposited (1291) in the first instance on a hill at Tersatto in Dalmatia, where an appearance of the Virgin and numerous miraculous cures attested its sanctity, which was confirmed by investigations made at Nazareth by messengers from the governor of Dalmatia. In 1294 the angels carried it across the Adriatic to a wood near Recanati; from this wood (lauretum), or from the name of its proprietrix (Laureta), the chapel derived the name which it still retains ("sacellum gloriosae Virginis in Laureto"). From this spot it was afterwards (1295) removed to the present hill, one other slight adjustment being required to fix it in its actual site. Bulls in favour of the shrine at Loreto were issued by Pope Sixtus IV. in 1491 and by Julius II. in 1507, the last alluding to the translation of the house with some caution ("ut pie creditur et fama est"). The recognition of the sanctuary by subsequent pontiffs has already been alluded to. In the end of the 17th century Innocent XII. appointed a "missa cum officio proprio" for the feast of the Translation of the Holy House, and the feast is still enjoined in the Spanish Breviary as a "greater double" (December 10).

See also U. Chevalier, *Notre-Dame de Lorette* (Paris, 1906).

LORETO, an inland department of Peru, lying E. of the Andean Cordilleras and forming the N.E. part of the republic. Extensive territories, nominally parts of this department, are in dispute between Peru and the neighbouring republics of Brazil, Colombia and Ecuador (see PERU), and the northern and eastern boundaries of the territory are therefore not definitely determined. Loreto is bounded W. by the departments of Amazonas and San Martin (the latter a new department, with an area of 30,744 sq. m., taken from Loreto, lying between the central and eastern Cordilleras and extending from the 6th to the 9th parallels, approximately), and S. by Huánuco and Cuzco. The area of the department, including the territories claimed by Peru, is estimated at 257,798 sq. m. The population is estimated (1906) at 120,000. The aboriginal population is not numerous, as the thick, humid forests are inhabited only where lakes and streams make open spaces for sunlight and ventilation. With the exception of the eastern Andean slopes and a little-known range of low mountains on the Brazilian frontier, called the Andes Conomamas, the surface is that of a thickly wooded plain sloping gently towards the Marañon, or Upper Amazon, which crosses it from W. to E. There are open plains between the Ucayali and Huallaga, known as the Pampas del Sacramento, but otherwise there are no extensive breaks in the forest. The elevation of the plain near the base of the Andes is 526 ft. on the Ucayali, 558 on the Huallaga, and 453 at Barranca, on the Marañon, a few miles below the Pongo de Manseriche. The eastward slope of the plain is about 250 ft. in the 620 m. (direct) between this point and Tabatinga, on the Brazilian frontier; this not only shows the remarkably level character of the Amazon valley of which it forms a part, but also the sluggish character of its drainage. From the S. the principal rivers traversing Loreto are the Ucayali and Huallaga, the former entering from Cuzco across its southern boundary and skirting the eastern base of the Andes for about four degrees of latitude before it turns away to the N.E. to join the Marañon, and the latter breaking through the Eastern Cordillera between the 6th and 7th parallels and entering the Marañon 143 m. below Yurimaguas, where navigation begins. The lower Ucayali, which has a very tortuous course, is said to have 868 m. of navigable channel at high water and 620 m. at low water. North of the Marañon several large rivers pass through Peruvian territory between the Santiago and Napo (see ECUADOR), nearly all having navigable channels. On the level plains are a number of lakes, some are formed by the annual floods and are temporary in character. Among the permanent lakes are the Gran Cocama, of the Pampas del Sacramento, the Caballococha—a widening of the Amazon itself about 60 m. N.W. of Tabatinga—and Rimachuma, on the north side of the Marañon, near the lower Pastaza.

The natural resources of this extensive region are incalculable, but their development has been well nigh impossible through lack of transport facilities. They include the characteristic woods of the Amazon valley, rubber, nuts, cinchona or Peruvian bark, medicinal products, fish, fruits and fibres. The cultivated products include cocoa, coffee, tobacco and fruits. Straw hats and hammocks are manufactured to some extent. The natural outlet of this region is the Amazon river, but this involves 2500 m. of river navigation from Iquitos before the ocean is reached. Communication with the Pacific coast cities and ports of Peru implies the crossing of three high, snow-covered ranges of the Andes by extremely difficult trails and passes. A rough mountain road has been constructed from Oroya to Puerto Bermudez, at the head of navigation on the Pachitea, and is maintained by the government pending the construction of a railway, but the distance is 210 m. and it takes nine days for a mule train to make the journey. At Puerto Bermudez a river steamer connects with Iquitos, making the distance of 930 m. in seven days. From Lima to Iquitos by this route, therefore, involves 17 days travel over a distance of 1268 m. The most feasible route from the department to the Pacific coast is that which connects Puerto Limon, on the Marañon, with the Pacific port of Payta, a distance of 410 m., it being possible to cross the Andes on this route at the low elevation of 6600 ft. The climate of Loreto is hot and humid, except on the higher slopes of the Andes. The year is divided into a wet and a dry season, the first from May to October, and the average annual rainfall is estimated at 70 in. though it varies widely between distant points. The capital and only town of importance in the department is Iquitos.

LORIENT, a maritime town of western France, capital of an arrondissement in the department of Morbihan, on the right bank of the Scorff at its confluence with the Blavet, 34 m. W. by N. of Vannes by rail. Pop. (1906) 40,848. The town is modern and regularly built. Its chief objects of interest are the church of St Louis (1709) and a statue by A. Mercié of Victor Massé, the composer, born at Lorient in 1822. It is one of the five maritime prefectures in France and the first port for naval construction in the country. The naval port to the east of the town is formed by the channel of the Scorff, on the right bank of which the chief naval establishments are situated. These include magazines, foundries, forges, fitting-shops, rope-works and other workshops on the most extensive scale, as well as a graving dock, a covered slip and other slips. A floating bridge connects the right bank with the peninsula of Caudan formed by the union of the Scorff and Blavet. Here are the shipbuilding yards covering some 38 acres, and comprising nine slips for large vessels and two others for smaller vessels, besides forges and workshops for iron shipbuilding. The commercial port to the south of the town consists of an outer tidal port protected by a jetty and of an inner dock, both lined by fine quays planted with trees. It separates the older part of the town, which is hemmed in by fortifications from a newer quarter. In 1905, 121 vessels of 28,785 tons entered with cargo and 145 vessels of 38,207 tons cleared. The chief export is pit-timber, the chief import is coal. Fishing is actively carried on. Lorient is the seat of a sub-prefect, of commercial and maritime tribunals and of a tribunal of first instance, and has a chamber of commerce, a board of trade-arbitrators, a lycée, schools of navigation, and naval artillery. Private industry is also engaged in iron-working and engine making. The trade in fresh fish, sardines, oysters (which are reared near Lorient) and tinned vegetables is important and the manufacture of basket-work, tin-boxes and passementerie, and the preparation of preserved sardines and vegetables are carried on. The roadstead, formed by the estuary of the Blavet, is accessible to vessels of the largest size; the entrance, 3 or 4 m. south from Lorient, which is defended by numerous forts, is marked on the east by the peninsula of Gâvres (an artillery practising ground) and the fortified town of Port Louis; on the west are the fort of Loqueltas and, higher up, the battery of Kernevel. In the middle of the channel is the granite rock of St Michel, occupied by a powder magazine. Opposite it, on the right bank of the Blavet, is the mouth of the river Ter, with fish and oyster breeding establishments from which 10 millions of oysters are annually obtained. The roadstead is provided with six lighthouses. Above Lorient on the Scorff, here spanned by a suspension bridge, is Kérentrech, a pretty village surrounded by numerous country houses.

Lorient took the place of Port Louis as the port of the Blavet. The latter stands on the site of an ancient hamlet which was fortified during the wars of the League and handed over by Philip Emmanuel, duke of Morcœur, to the Spaniards. After the treaty of Vervins it was restored to France, and it received its name of Port Louis under Richelieu. Some Breton merchants trading with the Indies had established themselves first at Port Louis, but in 1628 they built their warehouses on the other bank. The Compagnie des Indes Orientales, created in 1664, took possession of these, giving them the name of l'Orient. In 1745 the Compagnie des Indes, then at the acme of its prosperity, owned thirty-five ships of the largest class and many others of considerable size. Its decadence dates from the English conquest of India, and in 1770 its property was ceded to the state. In 1782 the town was purchased by Louis XVI. from its owners, the Rohan-Guéméné family. In 1746 the English under Admiral Richard Lestock made an unsuccessful attack on Lorient.

LORINER, or LORIMER (from O. Fr. *loremier* or *lorenier*, a maker of *lorains*, bridles, from Lat. *lorum*, thong, bridle; the proper form is with the *n*; a similar change is found in Latimer for Latiner, the title of an old official of the royal household, the king's interpreter), one who makes bits and spurs and the metal mountings for saddles and bridles; the term is also applied to a worker in wrought iron and to a maker of small iron ware. The word is now rarely used except as the name of one of the London livery companies (see LIVERY COMPANY).

LORIS, a name of uncertain origin applied to the Indo-Malay representatives of the lemurs, which, together with the African pottos, constitute the section *Nycticebinae* of the family *Nycticebidae* (see PRIMATES). From their extremely slow movements and lethargic habits in the daytime these weird little creatures are commonly called sloths by Anglo-Indians. Their soft fur, huge staring eyes, rudimentary tails and imperfectly developed index-fingers render lorises easy of recognition. The smallest is the slender loris (*Loris gracilis*) of the forests of Madras and Ceylon, a creature smaller than a squirrel. It is of such exceeding strangeness and beauty that it might have been thought it would be protected by the natives; but they hold it alive before a fire till its beautiful eyes burst in order to afford a supposed remedy for ophthalmia! The mainland and Cingalese animals form distinct races. Both in this species and the slow loris there is a pair of rudimentary abdominal teats in addition to the normal pectoral pair. The slow loris (*Nycticebus tardigradus*) is a heavier built and larger animal, ranging from eastern Bengal to Cochin China, Siam, the Malay Peninsula, Java and Sumatra. There are several races, mostly grey in colour, but the Sumatran *N. t. hilleri* is reddish. (R. L.*)

LORIS-MELIKOV, MICHAEL TARIELOVICH, COUNT (1825?–1888), Russian statesman, son of an Armenian merchant, was born at Tiflis in 1825 or 1826, and educated in St Petersburg, first in the Lazarev School of Oriental Languages, and afterwards in the Guards' Cadet Institute. He joined a hussar regiment, and four years afterwards (1847) he was sent to the Caucasus, where he remained for more than twenty years, and made for himself during troublous times the reputation of a distinguished cavalry officer and an able administrator. In the latter capacity, though a keen soldier, he aimed always at preparing the warlike and turbulent population committed to his charge for the transition from military to normal civil administration, and in this work his favourite instrument was the schoolmaster. In the Russo-Turkish War of 1877–78 he commanded a separate corps d'armée on the Turkish frontier in Asia Minor. After taking the fortress of Ardahan, he was repulsed by Mukhtar Pasha at Zevin, but subsequently defeated his opponent at Aladja Dagh, took Kars by storm, and laid siege to Erzerum. For these services he received the title of Count. In the following year he was appointed temporary governor-general of the region of the Lower Volga, to combat an outbreak of the plague. The measures he adopted proved so effectual that he was transferred to the provinces of Central Russia to combat the Nihilists and Anarchists, who had adopted a policy of terrorism, and had succeeded in assassinating the governor of Kharkov. His success in this struggle led to his being appointed chief of the Supreme Executive Commission which had been created in St Petersburg to deal with the revolutionary agitation in general. Here, as in the Caucasus, he showed a decided preference for the employment of ordinary legal methods rather than exceptional extra-legal measures, and an attempt on his own life soon after he assumed office did not shake his convictions. In his opinion the best policy was to strike at the root of the evil by removing the causes of popular discontent, and for this purpose he recommended to the emperor a large scheme of administrative and economic reforms. Alexander II., who was beginning to lose faith in the efficacy of the simple method of police repression hitherto employed, lent a willing ear to the suggestion; and when the Supreme Commission was dissolved in August 1880, he appointed Count Loris-Melikov Minister of the Interior with exceptional powers. The proposed scheme of reforms was at once taken in hand, but it was never carried out. On the very day in March 1881 that the emperor signed a ukaz creating several commissions, composed of officials and eminent private individuals, who should prepare reforms in various branches of the administration, he was assassinated by Nihilist conspirators; and his successor, Alexander III., at once adopted a strongly reactionary policy. Count Loris-Melikov immediately resigned, and lived in retirement until his death, which took place at Nice on the 22nd of December 1888. (D. M. W.)

LORIUM, an ancient village of Etruria, Italy, on the Via Aurelia, 12 m. W. of Rome. Antoninus Pius, who was educated here, afterwards built a palace, in which he died. It was also a favourite haunt of Marcus Aurelius. Remains of ancient buildings exist in the neighbourhood of the road on each side (near the modern Castel di Guido) and remains of tombs, inscriptions, &c., were excavated in 1823–1824. Two or three miles farther west was probably the post-station of Bebiana, where inscriptions show that some sailors of the fleet were stationed—no doubt a detachment of those at Centumcellae, which was reached by this road.

LÖRRACH, a town in the grand-duchy of Baden, in the valley of the Wiese, 6 m. by rail N.E. of Basel. Pop. (1905) 10,794. It is the seat of considerable industry, its manufactures including calico, shawls, cloth, silk, chocolate, cotton, ribbons, hardware and furniture, and has a trade in wine, fruit and timber. There is a fine view from the neighbouring Schützenhaus, 1085 ft. high. In the neighbourhood also is the castle of Rötteln, formerly the residence of the counts of Hachberg and of the margraves of Baden; this was destroyed by the French in 1678, but was rebuilt in 1867. Lörrach received market rights in 1403, but did not obtain municipal privileges until 1682.

See Höchstetter, *Die Stadt Lörrach* (Lörrach, 1882).

LORRAINE, one of the former provinces of France. The name has designated different districts in different periods. Lotharingia, or Lothringen, *i.e. regnum Lotharii*, is derived from the *Lotharingi* or *Lotharienses* (O.G. *Lotheringen*, Fr. *Loherains*, *Lorrains*), a term applied originally to the Frankish subjects of Lothair, but restricted at the end of the 9th century to those who dwelt north of the southern Vosges.

Lorraine in Medieval Times.—The original kingdom of Lorraine was the northern part of the territories allotted by the treaty of Verdun (August 843) to the emperor Lothair I., and in 855 formed the inheritance of his second son, King Lothair. This kingdom of Lorraine was situated between the realms of the East and the West Franks, and originally extended along the North Sea between the mouths of the Rhine and the Ems, including the whole or part of Frisia and the cities on the right bank of the Rhine. From Bonn the frontier followed the Rhine as far as its confluence with the Aar, which then became the boundary, receding from the left bank in the neighbourhood of Bingen so as to leave the cities of Worms and Spires to Germany, and embracing the duchy of Alsace. After crossing the Jura, the frontier joined the Saône a little south of its confluence with the Doubs, and followed the Saône for some distance, and finally the valleys of the Meuse and the Scheldt. Thus the kingdom roughly comprised the region watered by the Moselle and the Meuse, together with the dioceses of Cologne, Trier, Metz, Toul, Verdun, Liége and Cambrai, Basel, Strassburg and Besançon, and corresponded to what is now Holland and Belgium, parts of Rhenish Prussia, of Switzerland, and of the old province of Franche-Comté, and to the district known later as Upper Lorraine, or simply Lorraine. Though apparently of an absolutely artificial character, this kingdom corresponded essentially to the ancient Francia, the cradle of the Carolingian house, and long retained a certain unity. It was to the inhabitants of this region that the name of *Lotharienses* or *Lotharingi* was primitively applied, although the word *Lotharingia*, as the designation of the country, only appears in the middle of the 10th century.

The reign of King Lothair (*q.v.*), which was continually disturbed by quarrels with his uncles, Charles the Bald and Louis the German, and by the difficulties caused by the divorce of his queen Teutberga, whom he had forsaken for a concubine called Waldrada, ended on the 8th of August 869. His inheritance was disputed by his uncles, and was divided by the treaty of Meersen (8th of August 870), by which Charles the Bald received part of the province of Besançon and some land between the Moselle and the Meuse. Then for a time the emperor Charles the Fat united under his authority the whole of the kingdom of Lorraine with the rest of the Carolingian empire. After the deposition of Charles in 888 Rudolph, king of Burgundy, got himself recognized in Lorraine. He was unable to maintain himself there, and succeeded in detaching definitively no more than the province of Besançon. Lorraine remained in the power of the emperor Arnulf, who in 895 constituted it a distinct kingdom in favour of his son Zwentibold. Zwentibold quickly became embroiled with the nobles and the bishops, and especially with Bishop Radbod of Trier. Among the lay lords the most important was Regnier (incorrectly called Long-neck), count of Hesbaye and Hainault, who is styled duke by the Lotharingian chronicler Reginon, though he does not appear ever to have borne the title. In 898 Zwentibold stripped Regnier of his fiefs, whereupon the latter appealed to the king of France, Charles the Simple, whose intervention, however, had no enduring effect. After the death of Arnulf in 899, the Lotharingians appealed to his successor, Louis the Child, to replace Zwentibold, who, on the 13th of August 900, was killed in battle. In spite of the dissensions which immediately arose between him and the Lotharingian lords, Louis retained the kingdom till his death. The Lotharingians, however, refused to recognize the new German king, Conrad I., and testified their attachment to the Carolingian house by electing as sovereign the king of the West Franks, Charles the Simple. Charles was at first supported by Giselbert, son and successor of Regnier, but was abandoned by his ally, who in 919 appealed to the German king, Henry I. The struggle ended in the treaty of Bonn (921), by which apparently the rights of Charles over Lorraine were recognized. The revolt of the Frankish lords in 922 and the captivity of Charles finally settled the question. After an unsuccessful attack by Rudolph or Raoul, king of France, Henry became master of Lorraine in 925, thanks to the support of Giselbert, whom he rewarded with the hand of his daughter Gerberga and the title of duke of Lorraine. Giselbert at first remained faithful to Henry's son, Otto the Great, but in 938 he appears to have joined the revolt directed against Otto by Eberhard, duke of Franconia. In 939, in concert with Eberhard and Otto's brother, Henry of Saxony, he declared open war against Otto and appealed to Louis d'Outremer, who penetrated into Lorraine and Alsace, but was soon called back to France by the revolt of the count of Vermandois. In the same year Giselbert and Eberhard were defeated and killed near Andernach, and Otto at once made himself recognized in the whole of Lorraine, securing it by a treaty with Louis d'Outremer, who married Giselbert's widow Gerberga, and entrusting the government of it to Count Otto, son of Ricuin, until Giselbert's son Henry should have attained his majority.

After the deaths of the young Henry and Count Otto in 944, Otto the Great gave Lorraine to Conrad the Red, duke of

Franconia, the husband of his daughter Liutgard, a choice which was not completely satisfactory to the Lotharingians. In 953 Conrad, in concert with Liudulf, the son of the German king, revolted against Otto, but was abandoned by his supporters. Otto stripped Conrad of his duchy, and in 954 gave the government of it to his own brother Bruno, archbishop of Cologne. Bruno had to contend against the efforts of the last Carolingians of France to make good their claims on Lorraine, as well as against the spirit of independence exhibited by the Lotharingian nobles; and his attempts to raze certain castles built by brigand lords and to compel them to respect their oath of fidelity resulted in serious sedition. To obviate these difficulties Bruno divided the ducal authority, assigning Lower Lorraine to a certain Duke Godfrey, who was styled *dux Ripuariorum*, and Upper Lorraine to Frederick (d. 959), count of Bar, a member of the house of Ardenne and son-in-law of Hugh the Great, with the title of *dux Mosellanorum*; and it is probable that the partition of the ancient kingdom of Lorraine into two new duchies was confirmed by Otto after Bruno's death in 965. In 977 the emperor Otto II. gave the government of Lower Lorraine to Charles I., a younger son of Louis d'Outremer, on condition that that prince should acknowledge himself his vassal and should oppose any attempt of his brother Lothair on Lorraine. The consequent expedition of the king of France in 978 against Aix-la-Chapelle had no enduring result, and Charles retained his duchy till his death about 992. He left two sons, Otto, who succeeded him and died without issue, and Henry, who is sometimes regarded as the ancestor of the landgraves of Thuringia. The duchy of Lower Lorraine, sometimes called *Lothier* (*Lotharium*), was then given to Godfrey (d. 1023), son of Count Godfrey of Verdun, and for some time the history of Lorraine is the history of the attempts made by the dukes of Lothier to seize Upper Lorraine. Gothelon (d. 1043), son of Duke Godfrey, obtained Lorraine at the death of Frederick II., duke of Upper Lorraine, in 1027, and victoriously repulsed the incursions of Odo (Eudes) of Blois, count of Champagne, who was defeated and killed in a battle near Bar (1037). At Gothelon's death in 1043, his son Godfrey the Bearded received from the emperor only Lower Lorraine, his brother Gothelon II. obtaining Upper Lorraine. Godfrey attempted to seize the upper duchy, but was defeated and imprisoned in 1045. On the death of Gothelon in 1046, Godfrey endeavoured to take Upper Lorraine from Albert of Alsace, to whom it had been granted by the emperor Henry III. The attempt, however, also failed; and Godfrey was for some time deprived of his own duchy of Lower Lorraine in favour of Frederick of Luxemburg. Godfrey took part in the struggles of Pope Leo IX. against the Normans in Italy, and in 1053 married Beatrice, daughter of Duke Frederick of Upper Lorraine and widow of Boniface, margrave of Tuscany. On the death of Frederick of Luxemburg in 1065 the emperor Henry IV. restored the duchy of Lower Lorraine to Godfrey, who retained it till his death in 1069, when he was succeeded by his son Godfrey the Hunchback (d. 1076), after whose death Henry IV. gave the duchy to Godfrey of Bouillon, the hero of the first crusade, son of Eustace, count of Boulogne, and Ida, sister of Godfrey the Hunchback. On the death of Godfrey of Bouillon in 1100 Lower Lorraine was given to Henry, count of Limburg. The new duke supported the emperor Henry IV. in his struggles with his sons, and in consequence was deposed by the emperor Henry V., who gave the duchy in 1106 to Godfrey, count of Louvain, a descendant of the Lotharingian dukes of the beginning of the 10th century. This Godfrey was the first hereditary duke of Brabant, as the dukes of Lower Lorraine came to be called.

Upper Lorraine.—The duchy of Upper Lorraine, or Lorraine *Mosellana*, to which the name of Lorraine was restricted from the 11th century, consisted of a tract of undulating country watered by the upper course of the Meuse and Moselle, and bounded N. by the Ardennes, S. by the table-land of Langres, E. by the Vosges and W. by Champagne. Its principal fiefs were the countship of Bar which Otto the Great gave in 951 to Count Frederick of Ardenne, and which passed in 1093 to the lords of Montbéliard; the countship of Chiny, formed at the end of the 10th century, of which, since the 13th, Montmédy was the capital; the lordship of Commercy, whose rulers bore the special title of *damoiseau*, and which passed in the 13th century to the house of Saarebrücken; and, finally the three important ecclesiastical lordships of the bishops of Metz, Toul and Verdun. Theodoric, or Thierri (d. 1026), son of Frederick, count of Bar and first duke of Upper Lorraine, was involved in a war with the emperor Henry II., a war principally remarkable for the siege of Metz (1007). After having been the object of numerous attempts on the part of the dukes of Lower Lorraine, Upper Lorraine was given by the emperor Henry III. to Albert of Alsace, and passed in 1048 to Albert's brother Gerard, who died by poison in 1069, and who was the ancestor of the hereditary house of Lorraine. Until the 15th century the representatives of the hereditary house were Theodoric II., called the Valiant (1069–1115), Simon (1115–1139), Matthew (1139–1176), Simon II. (1176–1205), Ferri I. (1205–1206), Ferri II. (1206–1213), Theobald (Thibaut) I. (1213–1220), Matthew II. (1220–1251), Ferri III. (1251–1304), Theobald II. (1304–1312), Ferri IV., called the Struggler (1312–1328), Rudolph, or Raoul (1328–1346), John (1346–1391) and Charles II. or I., called the Bold (1391–1431). The 12th century and the first part of the 13th were occupied with wars against the counts of Bar and Champagne. Theobald I. intervened in Champagne to support Erard of Brienne against the young count Theobald IV. The regent of Champagne, Blanche of Navarre, succeeded in forming against the duke of Lorraine a coalition consisting of the count of Bar and the emperor Frederick II., who had become embroiled with Theobald over the question of Rosheim in Alsace. Attacked by the emperor, the duke of Lorraine was forced at the treaty of Amance (1218) to acknowledge himself the vassal of the count of Champagne, and to support the count in his struggles against his ancient ally the count of Bar. The long government of Ferri III. was mainly occupied with wars against the feudal lords and the bishop of Metz, which resulted in giving an impulse to the municipal movement through Ferri's attempt to use the movement as a weapon against the nobles. The majority of the municipal charters of Lorraine were derived from the charter of Beaumont in Argonne, which was at first extended to the Barrois and was granted by Ferri, in spite of the hostility of his barons, to La Neuveville in 1257, to Frouard in 1263 and to Lunéville in 1265. In the church lands the bishops of Toul and Metz granted liberties from the end of the 12th century to the communes in their lordship, but not the Beaumont charter, which, however, obtained in the diocese of Verdun in the 14th and 15th centuries.

By the will of Duke Charles the Bold, Lorraine was to pass to his daughter Isabella, who married René of Anjou, duke of Bar, in 1420. But Anthony of Vaudemont, Charles's nephew and heir male, disputed this succession with René, who obtained from the king of France an army commanded by Arnault Guilhem de Barbazan. René, however, was defeated and taken prisoner at the battle of Bulgnéville, where Barbazan was killed (2nd of July 1431). The negotiations between René's wife and Anthony had no result, in spite of the intervention of the council of Basel and the emperor Sigismund, and it was not until 1436 that René obtained his liberty by paying a ransom of 200,000 crowns, and was enabled to dispute with Alfonso of Aragon the kingdom of Naples, which he had inherited in the previous year. In 1444 Charles VII. of France and the dauphin Louis went to Lorraine, accompanied by envoys from Henry VI. of England, and procured a treaty (confirmed at Chalons in 1445), by which Yolande, René's eldest daughter, married Anthony's son, Ferri of Vaudemont, and René's second daughter Margaret became the wife of Henry VI. of England. After his return to Lorraine in 1442, René was seldom in the duchy. Like his successor John, duke of Calabria, who died in 1470, he was continually occupied with expeditions in Italy or in Spain. John's son and successor, Nicholas (d. 1473), who supported the duke of Burgundy, Charles the Bold, against the king of France, died without children, and his heir was René, son of Frederick of Vaudemont. The duke of Burgundy, however, disputed this inheritance, and carried off the young René and his mother, but on the intervention of Louis XI. had to set them at liberty. René helped the Swiss during their wars with Charles the Bold, who invaded Lorraine and was killed under the walls of Nancy (1477). René's last years were mainly spent in expeditions in Provence and Italy. He died in 1508, leaving by his second wife three sons—Anthony, called the Good, who succeeded him; Claude, count (and afterwards duke) of Guise, the ancestor of the house of Guise; and John (d. 1550), known as the cardinal of Lorraine. Anthony, who was declared of age at his father's death by the estates of Lorraine, although his mother had tried to seize the power as regent, had been brought up from the age of twelve at the French court, where he became the friend of Louis XII., whom he accompanied on his Italian expeditions. In 1525 he had to defend Lorraine against the revolted Alsatian peasants known as *rustauds* (boors), whom he defeated at Lupstein and Scherweiler; and he succeeded in maintaining a neutral position in the struggle between Francis I. of France and the emperor Charles V. He died on the 14th of June 1544, and was succeeded by his son Francis I., who died of apoplexy (August 1545) at the very moment when he was negotiating peace between the king of France and the emperor.

Lorraine in Modern Times.—Francis's son Charles III. or II., called the Great, succeeded under the tutelage of his mother and Nicholas of Vaudemont, bishop of Metz. Henry II. of France took this opportunity to invade Lorraine, and in 1552 seized the three bishoprics of Metz, Toul and Verdun. In the same year the emperor laid siege to Metz, but was forced to retreat with heavy loss before the energetic resistance of Duke Francis of Guise. On leaving Lorraine, Henry II. took Charles to France, brought him up at the court and married him to his daughter Claude. After the accession of Francis II., the young duke returned to Lorraine, and, while his cousins the Guises endeavoured to make good the claims of the house of Lorraine to the crown of France by virtue of its descent from the Carolingians through Charles, the son of Louis d'Outremer, he devoted himself mainly to improving the administration of his duchy. He reconstituted his domain by revoking the alienations irregularly granted by his predecessors, instructed his *chambre des comptes* to institute inquiries on this subject, and endeavoured to ameliorate the condition of industry and commerce by reorganizing the working of the mines and saltworks, unifying weights and measures and promulgating edicts against vagabonds. His duchy suffered considerably from the passage of German bands on their way to help the Protestants in France, and also from disturbances caused by the progress of Calvinism, especially in the neighbourhood of the three bishoprics. To combat Calvinism Charles had recourse to the Jesuits, whom he established at Pont-à Mousson, and to whom he gave over the university he had founded in that town in 1572. To this foundation he soon added chairs of medicine and law, the first professor of civil law being the *maître des requêtes*, the Scotsman William Barclay, and the next Gregory of Toulouse, a pupil of the jurist Cujas. Charles died on the 14th of May 1608, and was succeeded by his eldest son Henry II., called the Good, who rid Lorraine of the German bands and died in 1624 without issue.

Henry was succeeded by his brother Francis II., who abdicated on the 26th of November 1624 in favour of his son Charles IV. or III. At the beginning of the reign of Louis XIII. Charles embroiled himself with France by harbouring French malcontents. Louis entered Lorraine, and by the treaty of Vic (31st of December 1631) bound over Charles to desist from supporting the enemies of France, and compelled him to cede the fortress of Marsal. Charles's breach of this treaty led to a renewal of hostilities, and the French troops occupied St Mihiel, Bar-le-duc, Pont-à-Mousson and Nancy, which the duke was forced to cede for four years (1633). In 1632, by the treaty of Liverdun, he had already had to abandon the fortresses of Stenay and Clermont in Argonne. On the 19th of January 1634 he abdicated in favour of his younger brother Francis Nicholas, cardinal of Lorraine, and withdrew to Germany, the parlement of Paris declaring him guilty of rebellion and confiscating his estates. After vain attempts to regain his estates with the help of the emperor, he decided to negotiate with France; and the treaty of St Germain (29th of March 1641) re-established him in his duchy on condition that he should cede Nancy, Stenay and other fortresses until the general peace. This treaty he soon broke, joining the Imperialists in the Low Countries and defeating the French at Tuttlingen (December 1643). He was restored, however, to his estates in 1644, and took part in the wars of the Fronde. He was arrested at Brussels in 1654, imprisoned at Toledo and did not recover his liberty until the peace of the Pyrenees in 1659. On the 28th of February 1661 the duchies of Lorraine and Bar were restored to him by the treaty of Vincennes, on condition that he should demolish the fortifications of Nancy and cede Clermont, Saarburg and Pfalzburg. In 1662 Hugues de Lionne negotiated with him the treaty of Montmartre, by which Charles sold the succession to the duchy to Louis XIV. for a life-rent; but the Lorrainers, perhaps with the secret assent of their prince, refused to ratify the treaty. Charles, too, was accused of intriguing with the Dutch, and was expelled from his estates, Marshal de Créqui occupying Lorraine. He withdrew to Germany, and in 1673 took an active part in the coalition of Spain, the Empire and Holland against France. After an unsuccessful invasion of Franche-Comté he took his revenge by defeating Créqui at Conzer Brücke (11th of August 1675) and forcing him to capitulate at Trier. On the 18th of September 1675 died this adventurous prince, who, as Voltaire said, passed his life in losing his estates. His brother Francis, in favour of whom he had abdicated, was a cardinal at the age of nineteen and subsequently bishop of Toul, although he had never taken orders. He obtained a dispensation to marry his cousin, Claude of Lorraine, and died in 1670. He had one son, Charles, who in 1675 took the title of duke of Lorraine and was recognized by all the powers except France. After an unsuccessful attempt to seize Lorraine in 1676, Charles vainly solicited the throne of Poland, took an active part in the wars in Hungary, and married Eleanor of Austria, sister of the emperor Leopold I., in 1678. At the treaty of Nijmwegen France proposed to restore his estates on condition that he should abandon a part of them; but Charles refused, and passed the rest of his life in Austria, where he took part in the wars against the Turks, whom he defeated at Mohacz (1687). He died in 1690.

Leopold, Charles's son and successor, was restored to his estates by the treaty of Ryswick (1697), but had to dismantle all the fortresses in Lorraine and to disband his army with the exception of his guard. Under his rule Lorraine flourished. While diminishing the taxes, he succeeded in augmenting his revenues by wise economy. The population increased enormously during his reign—that of Nancy, for instance, almost trebling itself between the years 1699 and 1735. Leopold welcomed French immigrants, and devoted himself to the development of commerce and industry, particularly to the manufacture of stuffs and lace, glass and paper. He was responsible, too, for the compilation of a body of law which was known as the "Code Léopold." Some time after his death, which occurred on the 27th of March 1729, his heir Francis III. was betrothed to Maria Theresa of Austria, the daughter and heiress of the emperor Charles VI. France, however, could not admit the possibility of a union of Lorraine with the Empire; and in 1735, at the preliminaries of Vienna, Louis XV. negotiated an arrangement by which Francis received the duchy of Tuscany, which was vacant by the death of the last Medici, in exchange for Lorraine, and Stanislaus Leszczynski, the dethroned king of Poland and father-in-law of Louis XV., obtained Lorraine, which after his death would pass to his daughter—in other words, to France. These arrangements were confirmed by the treaty of Vienna (18th of November 1738). In 1736, by a secret agreement, Stanislaus had abandoned the financial administration of his estates to Louis XV. for a yearly subsidy. The intendant, Chaumont de la Galaizière, was instructed to apply the French system of taxation in Lorraine; and in spite of the severity of the administration Lorraine preserved a grateful memory of the good king Stanislaus, who held his brilliant little court at Lunéville, and founded an academy and several libraries and hospitals. At his death in February 1766 the two duchies of Lorraine and Bar became definitively incorporated in the kingdom of France. The treaties of 1735 and 1736, however, guaranteed their legislation, the privileges enjoyed by the three orders, and their common law and customs tariffs, which they retained until the French Revolution. Lorraine and Barrois formed a large government corresponding, together with the little government of the three bishoprics, to the *intendance* of Lorraine and the *généralité* of Metz. For legal purposes, Metz had been the seat of a parlement since 1633, and the parlement of Nancy was created in 1776. There was, too, a *chambre des comptes* at Metz, and another at Bar-le-duc. (For the later history see ALSACE-LORRAINE.)

See Dom. A. Calmet, *Histoire ecclésiastique et civile de Lorraine* (2nd ed., Nancy, 1747–1757); A. Digot, *Histoire de Lorraine* (1879–1880); E. Huhn, *Geschichte Lothringens* (Berlin, 1877); R. Parisot, *Le Royaume de Lorraine sous les Carolingiens* (Paris, 1899); Comte D'Haussonville, *Histoire de la réunion de la Lorraine à la France* (2nd ed., Paris, 1860); E. Bonvalot, *Histoire du droit et des institutions de la Lorraine et des Trois-Évêchés* (Paris, 1895); and E. Duvernoy, *Les États Généraux des duchés de Lorraine et de Bar jusqu'à la majorité de Charles III.* (Paris, 1904). (R. Po.)

LORTZING, GUSTAV ALBERT (1801–1851), German composer, was born at Berlin on the 23rd of October 1801. Both his parents were actors, and when he was nineteen the son began to play youthful lover at the theatres of Düsseldorf and Aachen, sometimes also singing in small tenor or baritone parts. His first opera *Ali Pascha von Jannina* appeared in 1824, but his fame as a musician rests chiefly upon the two operas *Der Wildschütz* (1842) and *Czar und Zimmermann* (1837). The latter, although now regarded as one of the masterpieces of German comic opera, was received with little enthusiasm by the public of Leipzig. Subsequent performance in Berlin, however, provoked such a tempest of applause that the opera was soon placed on all the stages of Germany. It was translated into English, French, Swedish, Danish, Dutch, Bohemian, Hungarian and Russian. *Der Wildschütz* was based on a comedy of Kotzebue, and was a satire on the unintelligent and exaggerated admiration for the highest beauty in art expressed by the *bourgeois gentilhomme.* Of his other operas it is only necessary to note *Der Pole und sein Kind*, produced shortly after the Polish insurrection of 1831, and *Undine* (1845). Lortzing died at Berlin on the 21st of January 1851.

LORY, CHARLES (1823–1889), French geologist, was born at Nantes on the 30th of July 1823. He graduated *D. ès Sc.* in 1847; in 1852 he was appointed to the chair of geology at the University of Grenoble, and in 1881 to that of the *École Normale Supérieure* in Paris. He was distinguished for his researches on the geology of the French Alps, being engaged on the geological survey of the departments of Isère, Drôme and the Hautes Alpes, of which he prepared the maps and explanatory memoirs. He dealt with some of the disturbances in the Savoy Alps, describing the fan-like structures, and confirming the views of J. A. Favre with regard to the overthrows, reversals and duplication of the strata. His contributions to geological literature include also descriptions of the fossils and stratigraphical divisions of the Lower Cretaceous and Jurassic rocks of the Jura. He died at Grenoble on the 3rd of May 1889.

LORY (a word of Malayan origin signifying parrot, in general use with but slight variation of form in many European languages), the name of certain birds of the order *Psittaci*, mostly from the Moluccas and New Guinea, remarkable for their bright scarlet or crimson colouring, though also, and perhaps subsequently, applied to some others in which the plumage is chiefly green. The lories have been referred to a considerable number of genera, of which *Lorius* (the *Domicella* of some authors), *Eos* and *Chalcopsittacus* may be here particularized, while under the name of "lorikeets" may be comprehended such genera as *Trichoglossus*, *Charmosyna*, *Loriculus* and *Coriphilus*. By most systematists some of these forms have been placed far apart, even in different families of *Psittaci*, but A. H. Garrod has shown (*Proc. Zool. Society*, 1874, pp. 586–598, and 1876, p. 692) the many common characters they possess, which thus goes some way to justify the relationship implied by their popular designation. A full account of these birds is given in the first part of Count T. Salvadori's *Ornitologia della Papuasia e delle Molucche* (Turin 1880), whilst a later classification appeared in Salvadori's section of the British Museum *Catalogue of Birds*, xx., 1891.

Though the name lory has often been used for the species of *Eclectus*, and some other genera related thereto, modern writers would restrict its application to the birds of the genera *Lorius*, *Eos*, *Chalcopsittacus* and their near allies, which are often placed in a subfamily, *Loriinae*, belonging to the so-called family of *Trichoglossidae* or "brush-tongued" parrots. Garrod in his investigations on the anatomy of *Psittaci* was led not to attach much importance to the structure indicated by the epithet "brush-tongued" stating (*Proc. Zool. Society*, 1874, p. 597) that it "is only an excessive development of the papillae which are always found on the lingual surface." The birds of this group are very characteristic of the New Guinea subregion,[1] in which occur, according to Count Salvadori, ten species of *Lorius*, eight of *Eos* and four of *Chalcopsittacus*; but none seem here to require any further notice,[2] though among them, and particularly in the genus *Eos*, are included some of the most richly-coloured birds in the whole world; nor does it appear that more need be said of the lorikeets.

The family is the subject of an excellent monograph by St George Mivart (London, 1896). (A. N.)

LOS ANDES, a former state of Venezuela under the redivision of 1881, which covered the extreme western part of the republic N. of Zamora and S. of Zulia. In the redivision of 1904 Los Andes was cut up into three states—Mérida Táchira and Trujillo.

LOS ANGELES, a city and the county-seat of Los Angeles county, in southern California, U.S.A., along the small Los Angeles river, in the foothills of the San Gabriel Mountains; a narrow strip, 18 m. long, joins the main part of the city to its water front on the ocean, San Pedro Bay. Pop. (1880) 11,183, (1890) 50,395, (1900) 102,479, of whom 19,964 were foreign-born;[3] the growth in population since 1900 has been very rapid and in 1910 it was 319,198. The city had in 1910 an area of 85·1 sq. m., of which more than one-half has been added since 1890. Los Angeles is served by the Southern Pacific, the Atchison, Topeka & Santa Fé, and the San Pedro, Los Angeles & Salt Lake railways; by steamers to San Francisco; and by five systems of urban and suburban electric railways, which have 300 m. of track within the city and 700 m. within a radius of 30 m. beyond its limits. Inclined railways ascend Third Street Hill and Court Street Hill, in the heart of the city; and a system of subways extends from the centre of the city to its western limits. The harbour, San Pedro Bay, originally open and naturally poor, has been greatly improved by the Federal government; a breakwater 9250 ft. long was begun in 1898 and the bar has been deepened, and further improvements of the inner harbour at Wilmington (which is nearly landlocked by a long narrow island lying nearly east and west across its mouth) were begun in 1907. Important municipal docks have been built by the city.

The situation of the city between the mountains and the sea is attractive. The site of the business district is level, and its plan regular; the suburbs are laid out on hills. Although not specifically a health resort, Los Angeles enjoys a high reputation for its climate. From July 1877 to 1908 (inclusive) the mean of the minima for January, the coldest month of the year, was 44·16° F.; the mean of the minima for August, the warmest month, was 60·1° F.; and the difference of the mean temperature of the coldest and the warmest month was about 18° F.; while on five days only in this period (and on no day in the years 1904–1908) did the official thermometer fall below 32° F. There are various pleasure resorts in the mountains, and among seaside resorts are Santa Monica, Ocean Park, Venice, Playa del Rey, Hermosa, Redondo, Terminal Island, Long Beach, Alamitos Bay, Huntington Beach, Newport, Balboa and Corona del Mar. There are excellent roads throughout the country. Los Angeles has beautiful shade trees and a wealth of semi-tropic vegetation. Its residential portions are characterized by detached homes set in ample and beautiful grounds. Towering eucalyptus, graceful pepper trees, tropic palms, rubber trees, giant bananas, yuccas and a wonderful growth of roses, heliotrope, calla lilies in hedges, orange trees, jasmine, giant geraniums and other flowers beautify the city throughout the year. There are 22 parks, with about 3800 acres within or on the borders of the city limits; among the parks are Griffith (3015 acres), Elysian (532 acres), Eastlake (57 acres), Westlake (35 acres) and Echo (38 acres). The old Spanish-Moorish mission architecture has considerably influenced building styles. Among the important buildings are the Federal Building, the County Court House, the City Hall, a County Hall of Records, the Public Library with about 110,000 volumes in 1908, the large Auditorium and office buildings and the Woman's Club. The exhibit in the Chamber of Commerce Building illustrates the resources of southern California. Here also are the Coronel Collection, given in 1901 by Dona Mariana, the widow of Don Antonio Coronel, and containing relics of the Spanish and Mexican régime in California; and the Palmer Collection of Indian antiquities. In Los Angeles also are the collections of the Southwest Society (1904; for southern California, Arizona and New Mexico) of the Archaeological Institute of America. On the outskirts of the city, near Eastlake Park, is the Indian Crafts Exhibition, which contains rare collections of aboriginal handiwork, and where Indians may be seen making baskets, pottery and blankets. Of interest to visitors is that part of the city called Sonora Town, with its adobe houses, Mexican quarters, old Plaza and the Church of Our Lady, Queen of the Angels (first erected in 1822; rebuilt in 1861), which contains interesting paintings by early Indian converts. Near Sonora Town is the district known as Chinatown. The principal educational institutions are the University of Southern California (Methodist Episcopal, 1880), the Maclay College of Theology and a preparatory school; Occidental College (Presbyterian, 1887), St Vincent's College (Roman Catholic, founded 1865; chartered 1869) and the Los Angeles State Normal School (1882).

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[1] They extend, however, to Fiji, Tahiti and Fanning Island.

[2] Unless it be *Oreopsittacus arfaki*, of New Guinea, remarkable as the only parrot known as yet to have fourteen instead of twelve rectrices.

[3] In addition to the large foreign-born population (4023 Germans, 3017 English, 2683 English Canadians, 1885 Chinese, 1720 Irish and smaller numbers of French, Mexicans, Swedes, Italians, Scots, Swiss, Austrians, Danes, French Canadians, Russians, Norwegians, Welsh and Japanese) 26,105 of the native white inhabitants were of foreign parentage (*i.e.* had one or both parents not native born), so that only 54,121 white persons were of native parentage. German, French and Italian weekly papers are published in Los Angeles.

The economic interests of Los Angeles centre in the culture of fruits. The surrounding country is very fertile when irrigated, producing oranges, lemons, figs and other semi-tropical fruits. Thousands of artesian wells have been bored, the region between Los Angeles, Santa Clara and San Bernardino being one of the most important artesian well regions of the world. The city, which then got its water supply from the Los Angeles river bed, in 1907 authorized the issue of $23,000,000 worth of 4 % bonds for the construction of an aqueduct 209 m. long, bringing water to the city from the Owens river, in the Sierra Nevada Mountains. It was estimated that the project would furnish water for one million people, beside supplying power for lighting, manufacturing and transportation purposes. All the water in excess of the city's actual needs may be employed for irrigation. Work on the aqueduct was begun in 1908, and it was to be completed in five years. From 1900 to 1905 the value of the factory products increased from $15,133,696 to $34,814,475 or 130 %, and the capital employed in manufactures from $10,045,095 to $28,181,418 or 180·5 %. The leading manufacturing industries in 1905, with the product-value of each in this year, were slaughtering and meat-packing ($4,040,162), foundry and machine shop work ($3,146,914), flour and grist milling ($2,798,740), lumber manufacturing and planing ($2,519,081), printing and publishing (newspapers and periodicals, $2,097,339; and book and job printing, $1,278,841), car construction and repairing ($1,549,836)—in 1910 there were railway shops here of the Southern Pacific, Pacific Electric, Los Angeles Street, Salt Lake and Santa Fé railways—and the manufacture of confectionery ($953,915), furniture ($879,910) and malt liquors ($789,393). The canning and preserving of fruits and vegetables are important industries. There is a large wholesale trade with southern California, with Arizona and with the gold-fields of Nevada, with which Los Angeles is connected by railway. Los Angeles is a port of entry, but its foreign commerce is relatively unimportant. The value of its imports increased from $721,705 in 1905 to $1,654,549 in 1907; in 1908 the value was $1,193,552. The city's exports were valued at $45,000 in 1907 and at $306,439 in 1908. The coastwise trade is in lumber (about 700,000,000 ft. annually), shipped from northern California, Oregon and Washington, and in crude oil and general merchandise. There are rich oil-fields N. and W. of the city and wells throughout the city; petroleum is largely employed as fuel in factories. The central field, the Second Street Park field in the city, was developed between 1892 and 1895 and wells were drilled farther E. until in 1896 the eastern field was tapped with wells at Adobe and College streets; the wells within the city are gradually being abandoned. The western field and the western part of the central field were first worked in 1899–1900. The Salt Lake field, controlled by the Salt Lake Oil Company, near Rancho de Brea, W.S.W. of the city, first became important in 1902 and in 1907 it was the most valuable field in California, S. of Santa Barbara county, and the value of its product was $1,749,980. In 1905 the value of petroleum refined in Los Angeles was $461,281.

Land has not for many years been cheap (*i.e.* absolutely) in the southern Californian fruit country, and immigration has been, generally, of the comparatively well-to-do. This fact has greatly affected the character and development of the city. The assessed valuation of property increased more than threefold from 1900 to 1910, being $276,801,517 in the latter year, when the bonded city debt was $17,259,312·50. Since 1896 there has been a strong independent movement in politics, marked by the organization of a League for Better City Government (1896) and a Municipal League (1900), and by the organization of postal primaries to secure the co-operation of electors pledged to independent voting. Since 1904 the public school system has been administered by a non-partisan Board of Education chosen from the city at large, and not by wards as theretofore.

Los Angeles, like all other Californian cities, has the privilege of making and amending its own charter, subject to the approval of the state legislature. In 1902 thirteen amendments were adopted, including provisions for the initiative, the referendum and the recall. The last of these provides that 25% of the voters choosing a municipal officer may, by signing a petition for his recall, force a new election during his term of office and thereby remove him if another candidate receives a greater number of votes. This provision, introducing an entirely new principle into the American governmental system, came into effect in January 1903, and was employed in the following year when a previously elected councilman who was "recalled" by petition and was unsuccessful in the 1904 election brought suit to hold his office, and on a mere technicality the Supreme Court of the state declared the recall election invalid. In 1909 there was a recall election at which a mayor was removed and another chosen in his place.

The Pueblo de Nuestra Señora la Reina de los Angeles was founded in 1781. The Franciscan mission of San Gabriel—still a famous landmark—had been established ten years earlier a few miles eastward. Beginning about 1827, Los Angeles, being the largest pueblo of the territory, became a rival of Monterey for the honour of being the capital of California, was the seat of conspiracies to overthrow the Mexican authority, and the stronghold of the South California party in the bickerings and struggles that lasted down to the American occupation. In 1835 it was made a city by the Mexican Congress, and declared the capital, but the last provision was not enforced and was soon recalled. In 1836–1838 it was the headquarters of C. A. Carrillo, a legally-named but never *de facto* governor of California, whose jurisdiction was never recognized in the north; and in 1845–1847 it was the actual capital. The city was rent by factional quarrels when war broke out between Mexico and the United States, but the appearance of United States troops under Commodore Robert F. Stockton and General John C. Frémont before Los Angeles caused both factions to unite against a common foe. The defenders of Los Angeles fled at the approach of the troops, and on the 13th of August 1846 the American flag was raised over the city. A garrison of fifty men, left in control, was compelled in October to withdraw on account of a revolt of the inhabitants, and Los Angeles was not retaken until

General Philip Kearny and Commodore Stockton entered the city on the 18th of January 1847. This was the only important overt resistance to the establishment of the new régime in California. The city was chartered in 1850. It continued to grow steadily thereafter until it attained railway connexion with the Central Pacific and San Francisco in 1876, and with the East by the Santa Fé system in 1885. The completion of the latter line precipitated one of the most extraordinary of American railway wars and land booms, which resulted in giving southern California a great stimulus. The growth of the city since 1890 has been even more remarkable. In 1909 the township of Wilmington (pop. in 1900, 2983), including the city of San Pedro (pop. in 1900, 1787), Colegrove, a suburb W.N.W. of the city, Cahuenga (pop. in 1900, 1586), a township N.W. of the former city limits, and a part of Los Feliz were annexed to the city.

LOS ISLANDS (Islas de los Idolos), a group of islands off the coast of French Guinea, West Africa, lying south of Sangarea Bay, between 9° 25′ and 9° 31′ N. and 13° 46′ and 13° 51′ W., and about 80 m. N.N.W. of Freetown, Sierra Leone. There are five principal islands: Tamara, Factory, Crawford, White (or Ruma) and Coral. The two largest islands are Tamara and Factory, Tamara, some 8 m. long by 1 to 2 m. broad, being the largest. These two islands lie parallel to each other, Tamara to the west; they form a sort of basin, in the centre of which is the islet of Crawford. The two other islands are to the south. The archipelago is of volcanic formation, Tamara and Factory islands forming part of a ruined crater, with Crawford Island as the cone. The highest point is a knoll, some 450 ft. above sea-level, in Tamara. All the islands are richly clothed with palm trees and flowering underwood. Tamara has a good harbour, and contains the principal settlement. The inhabitants, about 1500, are immigrants of the Baga tribe of Senegambian negroes, whose home is the coast land between the Pongo and Nunez rivers. These are chiefly farmers. The Church of England has a flourishing mission, with a native pastorate. At one time the islands were a great seat of slave-traders and pirates. The latter are supposed to have buried large amounts of treasure in them. In an endeavour to stop the slave trade and piracy, the islands were garrisoned (1812–1813) by British troops, but the unhealthiness of the climate led to their withdrawal. In 1818 Sir Charles McCarthy, governor of Sierra Leone, obtained the cession of the islands to Great Britain from the chiefs of the Baga country, and in 1882 France recognized them to be a British possession. They were then the headquarters of several Sierra Leone traders. By article 6 of the Anglo-French convention of the 8th of April 1904, the islands were ceded to France. They were desired by France because of their geographical position, Konakry, the capital of French Guinea, being built on an islet but 3 m. from Factory Island, and at the mercy of long range artillery planted thereon. The islands derive their name from the sacred images found on them by the early European navigators.

See A. B. Ellis, *West African Islands* (London, 1885), and the works cited under French Guinea.

LOSSIEMOUTH, a police burgh of Elginshire, Scotland. Pop. (1901) 3904. It embraces the villages of Lossiemouth, Branderburgh and Stotfield, at the mouth of the Lossie, 5½ m. N.N.E. of Elgin, of which it is the port, by a branch line of the Great North of Scotland railway. The industries are boat-building and fishing. Lossiemouth, or the Old Town, dates from 1700; Branderburgh, farther north, grew with the harbour and began about 1830; Stotfield is purely modern and contiguous to the splendid golf-course. The cliffs at Covesea, 2 m. W., contain caves of curious shape. Sir Robert Gordon of Gordonstown used one as a stable in the rebellion of 1745; weapons of prehistoric man were found in another, and the roof of a third is carved with ornaments and emblems of early Celtic art.

Kinneddar Castle in the parish of Drainie—in which Lossiemouth is situated—was a seat of the bishops of Moray, and Old Duffus Castle, 2½ m. S.W., was built in the reign of David II. The estate of Gordonstown, close by, was founded by Sir Robert Gordon (1580–1656), historian of the Sutherland family, and grandfather of the baronet who, because of his inventions and scientific attainments, was known locally as "Sir Robert the Warlock" (1647–1704). Nearly midway between Lossiemouth and Elgin stand the massive ruins of the palace of Spynie, formerly a fortified residence of the bishops of Moray. "Davie's Tower," 60 ft. high with walls 9 ft. thick, was built by Bishop David Stewart about 1470. The adjacent loch is a favourite breeding-place for the sea-birds, which resort to the coast of Elginshire in enormous numbers. A mile S.E. of the lake lies Pitgaveny, one of the reputed scenes of the murder of King Duncan by Macbeth.

LOSSING, BENSON JOHN (1813–1891), American historical writer, was born in Beekman, New York, on the 12th of February 1813. After editing newspapers in Poughkeepsie he became an engraver on wood, and removed to New York in 1839 for the practice of his profession, to which he added that of drawing illustrations for books and periodicals. He likewise wrote or edited the text of numerous publications. His *Pictorial Field-Book of the Revolution* (first issued in 30 parts, 1850–1852, and then in 2 volumes) was a pioneer work of value in American historical literature. In its preparation he travelled some 9000 m. during a period of nearly two years; made more than a thousand sketches of extant buildings, battlefields, &c.; and presented his material in a form serviceable to the topographer and interesting to the general reader. Similar but less characteristic and less valuable undertakings were a *Pictorial Field-Book of the War of 1812* (1868), and a *Pictorial History of the Civil War in the United States of America* (3 vols. 1866–1869). His other books were numerous: an *Outline History of the Fine Arts*; many illustrated histories, large and small, of the United States; popular descriptions of Mount Vernon and other localities associated with famous names; and biographical sketches of celebrated Americans, of which *The Life and Times of Major-General Philip Schuyler* (2 vols. 1860–1873) was the most considerable. He died at Dover Plains, New York, on the 3rd of June 1891.

LÖSSNITZ, a district in the kingdom of Saxony, extending for about 5 m. along the right bank of the Elbe, immediately N.W. of Dresden. Pop. (1905) 6929. A line of vine-clad hills shelters it from the north winds, and so warm and healthy is the climate that it has gained for the district the appellation of the "Saxon Nice." Asparagus, peaches, apricots, strawberries, grapes and roses are largely cultivated and find a ready market in Dresden.

LOST PROPERTY. The man who loses an article does not lose his right thereto, and he may recover it from the holder whoever he be, unless his claim be barred by some Statute of Limitations or special custom, as sale in market overt. The rights and duties of the finder are more complex. If he know or can find out the true owner, and yet convert the article to his own use, he is guilty of theft. But if the true owner cannot be discovered, the finder keeps the property, his title being superior to that of every one except the true owner. But this is only if the find be in public or some public place. Thus if you pick up bank notes in a shop where they have been lost by a stranger, and hand them to the shopkeeper that he may discover and repossess the true owner, and he fail to do so, then you can recover them from him. The owner of private land, however, is entitled to what is found on it. Thus a man sets you to clear out his pond, and you discover a diamond in the mud at the bottom. The law will compel you to hand it over to the owner of the pond. This applies even against the tenant. A gas company were lessees of certain premises; whilst making excavations therein they came upon a prehistoric boat; and they were forced to surrender it to their lessor. An aerolite becomes the property of the owner of the land on which it falls, and not of the person finding or digging it out. The principle of these three last cases is that whatever becomes part of the soil belongs to the proprietor of that soil.

Property lost at sea is regulated by different rules. Those who recover abandoned vessels are entitled to salvage. Property absolutely lost upon the high seas would seem to belong to the finder. It has been claimed for the crown, and the American courts have held, that apart from a decree the finder is only entitled to salvage rights, the court retaining the rest, and thus practically taking it for the state on the original owner not being found. The modern English law on the subject of wreck (including everything found on the shore of the sea or tidal river) is contained in the Merchant Shipping Act 1894. The finder must forthwith make known his discovery to the receiver of wreck under a penalty. He is entitled to a salvage reward, but the property belongs to the crown or its grantee unless the true owner claims within a year. In the United States unclaimed wreck after a year generally becomes the property of the state. In Scotland the right to lost property is theoretically in the crown, but the finder would not in practice be interfered with except under the provisions of the Burgh Police (Scotland) Act 1892. Section 412 requires all persons finding goods to deliver them forthwith to the police under a penalty. If the true owner is not discovered within six months the magistrates may hand them over to the finder. If the owner appears he must pay a reasonable reward. Domestic animals, including swans, found straying without an owner may be seized by the crown or lord of the manor, and if not claimed within a year and a day they become the property of the crown or the lord, on the observance of certain formalities. In Scotland they were held to belong to the crown or its donatory, usually the sheriff of a county. By the Burgh Police Act above quoted provision is made for the sale of lost animals and the disposal of the free proceeds for the purposes of the act unless such be claimed. In the United States there is diversity of law and custom. Apart from special rule, lost animals become the property of the finder, but in many cases the proceeds of their sale are applied to public purposes. When property is lost by carriers, innkeepers or railway companies, special provisions as to their respective responsibilities apply. As to finds of money or the precious metals, see TREASURE TROVE.

LOSTWITHIEL, a market town and municipal borough in the Bodmin parliamentary division of Cornwall, England, $30\frac{1}{2}$ m. W. of Plymouth by the Great Western railway. Pop. (1901) 1379. It is pleasantly situated on the banks of the river Fowey. The church of St Bartholomew is remarkable for a fine Early English tower surmounted by a Decorated spire; there are also beautiful Decorated windows and details in the body of the church, and a richly carved octagonal font. A bridge of the 14th century crosses the river. The shire hall includes remains of a building, called the Stannary prison, dating from the 13th century. The Great Western railway has workshops at Lostwithiel.

Lostwithiel owed its ancient liberties—probably its existence—to the neighbouring castle of Restormel. The Pipe Rolls (1194–1203) show that Robert de Cardinan, lord of Restormel, paid ten marks yearly for having a market at Lostwithiel. By an undated charter still preserved with the corporation's muniments he surrendered to the burgesses all the liberties given them by his predecessors (*antecessores*) when they founded the town. These included hereditary succession to tenements, exemption from sullage, the right to elect a reeve (*praepositus*) if the grantor thought one necessary and the right to marry without the lord's interference. By Isolda, granddaughter of Robert de Cardinan, the town was given to Richard, king of the Romans, who in the third year of his reign granted to the burgesses a gild merchant sac and soc, toll, team and infangenethef, freedom from pontage, lastage, &c., throughout Cornwall, and exemption from the jurisdiction of the hundred and county courts, also a yearly fair and a weekly market. Richard transferred the assizes from Launceston to Lostwithiel. His son Edmund, earl of Cornwall, built a great hall at Lostwithiel and decreed that the coinage of tin should be at Lostwithiel only. In 1325 Richard's charter was confirmed and the market ordered to be held on Thursdays. In 1386 the assizes were transferred back to Launceston. In 1609 a charter of incorporation provided for a mayor, recorder, six capital burgesses and seventeen assistants and courts of record and pie powder. The boundaries of the borough were extended in 1733. Under the reformed charter granted in 1885 the corporation consists of a mayor, four aldermen and twelve councillors. From 1305 to 1832 two members represented Lostwithiel in parliament. The electors after 1609 were the twenty-five members of the corporation. Under the Reform Act (1832) the borough became merged in the county. For the Thursday market granted in 1326 a Friday market was substituted in 1733, and this continues to be held. The fair granted in 1326 and the three fairs granted in 1733 have all given place to others. The archdeacon's court, the sessions and the county elections were long held at Lostwithiel, but all have now been removed. For the victory gained by Charles I. over the earl of Essex in 1644, see GREAT REBELLION.

LOT, in the Bible, the legendary ancestor of the two Palestinian peoples, Moab and Ammon (Gen. xix. 30-38; cp. Ps. lxxxiii. 8); he appears to have been represented as a Horite or Edomite (cp. the name Lotan, Gen. xxxvi. 20, 22). As the son of Haran and grandson of Terah, he was Abraham's nephew (Gen. xi. 31), and he accompanied his uncle in his migration from Haran to Canaan. Near Bethel[1] Lot separated from Abraham, owing to disputes between their shepherds, and being offered the first choice, chose the rich fields of the Jordan valley which were as fertile and well irrigated as the "garden of Yahweh" (*i.e.* Eden, Gen. xiii. 7 sqq.). It was in this district that the cities of Sodom and Gomorrah were situated. He was saved from their fate by two divine messengers who spent the night in his house, and next morning led Lot, his wife, and his two unmarried daughters, out of the city. His wife looked back and was changed to a pillar of salt,[2] but Lot with his two daughters escaped first to Zoar and then to the mountains east of the Dead Sea, where the daughters planned and executed an incest by which they became the mothers of Moab and Ben-Ammi (*i.e.* Ammon; Gen. xix). The account of Chedorlaomer's invasion and of Lot's rescue by Abraham belongs to an independent source (Gen. xiv.), the age and historical value of which has been much disputed. (See further ABRAHAM; MELCHIZEDEK.) Lot's character is made to stand in strong contrast with that of Abraham, notably in the representation of his selfishness (xiii. 5 sqq.), and reluctance to leave the sinful city (xix. 16 sqq.); relatively, however, he was superior to the rest (with the crude story of his insistence upon the inviolable rights of guests, xix. 5 sqq.; cf. Judges xix. 22 sqq.), and is regarded in 2 Pet. ii. 7 seq. as a type of righteousness.

Lot and his daughters passed into Arabic tradition from the Jews. The daughters are named Zahy and Ra'wa by Mas'ūdī ii. 139; but other Arabian writers give other forms. Paton (*Syria and Palestine*, pp. 43, 123) identifies Lot-Lotan with *Ruten*, one of the Egyptian names for Palestine; its true meaning is obscure. For traces of mythical elements in the story see Winckler, *Altorient. Forsch.* ii. 87 seq. See further, J. Skinner, *Genesis*, pp. 310 sqq. (S. A. C.)

LOT (Lat. *Oltis*), a river of southern France flowing westward across the central plateau, through the departments of Lozère, Aveyron, Lot and Lot-et-Garonne. Its length is about 300 m., the area of its basin 4444 sq. m. The river rises in the Cévennes on the Mont du Goulet at a height of 4918 ft. about 15 m. E. of Mende, past which it flows. Its upper course lies through gorges between the Causse of Mende and Aubrac Mountains on the north and the tablelands (*causses*) of Sauveterre, Severac and Comtal on the south. Thence its sinuous course crosses the plateau of Quercy and entering a wider fertile plain flows into the Garonne at Aiguillon between Agen and Marmande. Its largest tributary, the Truyère, rises in the Margeride mountains and after a circuitous course joins it on the right at Entraygues (department of Aveyron), its affluence more than doubling the volume of the river. Lower down it receives the Dourdou de Bozouls (or du Nord) on the left and on the right the Célé above Cahors (department of Lot), which is situated on a peninsula skirted by one of the river's many windings. Villeneuve-sur-Lot (department of Lot-et-Garonne) is the only town of any importance between this point and its mouth. The Lot is canalized between Bouquiès, above which there is no navigation, and the Garonne (160 m.).

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[1] The district is thus regarded as the place where the Hebrews, on the one side, and the Moabites and Ammonites, on the other, commence their independent history. Whilst the latter settle across the Jordan, Abraham moves down south to Hebron.

[2] Tradition points to the *Jebel Usdum* (cp. the name Sodom) at the S.W. end of the Dead Sea. It consists almost entirely of pure crystallized salt with pillars and pinnacles such as might have given rise to the story (see Driver, *Genesis*, p. 201; and cf. also *Palestine Explor. Fund, Quart. Statements*, 1871, p. 16, 1885, p. 20; Conder, *Syrian Stone-lore*, p. 279 seq.). Jesus cites the story of Lot and his wife to illustrate the sudden coming of the Kingdom of God (Luke xvii. 28-32). The history of the interpretation of the legend by the early and medieval church down to the era of rational and scientific investigation will be found in A. D. White, *Warfare of Science with Theology*, ii. ch. xviii.

LOT, a department of south-western France, formed in 1790 from the district of Quercy, part of the old province of Guyenne. It is bounded N. by Corrèze, W. by Dordogne and Lot-et-Garonne, S. by Tarn-et-Garonne, and E. by Aveyron and Cantal. Area 2017 sq. m. Pop. (1906) 216,611. The department extends over the western portion of the Massif Central of France; it slopes towards the south-west, and has a maximum altitude of 2560 ft. on the borders of Cantal with a minimum of 213 ft. at the point where the river Lot quits the department. The Lot, which traverses it from east to west, is navigable for the whole distance (106 m.) with the help of locks; its principal tributary within the department is the Célé (on the right). In the north of the department the Dordogne has a course of 37 m.; among its tributaries are the Cère, which has its rise in Cantal, and the Ouysse, a river of no great length, but remarkable for the abundance of its waters. The streams in the south of Lot all flow into the Tarn. The eastern and western portions of the department are covered by ranges of hills; the north, the centre, and part of the south are occupied by a belt of limestone plateaus or *causses*, that to the north of the Dordogne is called the Causse de Martel; between the Dordogne and the Lot is the Causse de Gramat or de Rocamadour; south of the Lot is the Causse de Cahors. The *causses* are for the most part bare and arid owing to the rapid disappearance of the rain in clefts and chasms in the limestone, which are known as *igues.* These are most numerous in the Causse de Gramat and are sometimes of great beauty; the best known is the Gouffre de Padirac, 7 m. N.E. of Rocamadour. The altitude of the *causses* (from 700 to 1300 ft., much lower than that of the similar plateaus in Lozère, Hérault and Aveyron) permits the cultivation of the vine; they also yield a small quantity of cereals and potatoes and some wood. The deep intervening valleys are full of verdure, being well watered by abundant springs. The climate is on the whole that of the Girondine region; the valleys are warm, and the rainfall is somewhat above the average for France. The difference of temperature between the higher parts of the department belonging to the central plateau and the sheltered valleys of the south-west is considerable. Wheat, maize, oats and rye are the chief cereals. Wine is the principal product, the most valued being that of Cahors grown in the valley of the Lot, which is, in general, the most productive portion of the department. It is used partly for blending with other wines and partly for local consumption. The north-east cantons produce large quantities of chestnuts; walnuts, apples and plums are common, and the department also grows potatoes and tobacco and supplies truffles. Sheep are the most abundant kind of live stock; but pigs, horned cattle, horses, asses, mules and goats are also reared, as well as poultry and bees. Iron and coal are mined, and there are important zinc deposits (Planioles). Limestone is quarried. There are oil-works and numerous mills, and wool spinning and carding as well as cloth making, tanning, currying, brewing and the making of agricultural implements are carried on to some extent. The three arrondissements are those of Cahors, the capital, Figeac and Gourdon; there are 29 cantons and 329 communes.

Lot belongs to the 17th military district, and to the *académie* of Toulouse, and falls within the circumscription of the court of appeal at Agen, and the province of the archbishop of Albi. It is served by the Orleans railway. Cahors, Figeac and Rocamadour are the principal places. Of the interesting churches and châteaux of the department, may be mentioned the fine feudal fortress at Castelnau occupying a commanding natural position, with an audience hall of the 12th century, and the Romanesque abbey-church at Souillac with fine sculpturing on the principal entrance. The plateau of Puy d'Issolu, near Vayrac, is believed by most authorities to be the site of the ancient Uxcellodunum, the scene of the last stand of the Gauls against Julius Caesar in 51 B.C. Lot has many dolmens, the finest being that of Pierre Martine, near Livernon (arr. of Figeac).

LOT-ET-GARONNE, a department of south-western France, formed in 1790 of Agenais and Bazadais, two districts of the old province of Guienne, and of Condomois, Lomagne, Brullois and pays d'Albret, formerly portions of Gascony. It is bounded W. by Gironde, N. by Dordogne, E. by Lot and Tarn-et-Garonne, S. by Gers and S.W. by Landes. Area 2079 sq. m. Pop. (1906) 274,610. The Garonne, which traverses the department from S.E. to N.W., divides it into two unequal parts. That to the north is a country of hills and deep ravines, and the slope is from east to west, while in the region to the south, which is a continuation of the plateau of Lannemezan and Armagnac, the slope is directly from south to north. A small portion in the south-west belongs to the sterile region of the Landes (*q.v.*); the broad valleys of the Garonne and of its affluent the Lot are proverbial for their fertility. The wildest part is towards the north-east on the borders of Dordogne, where a region of *causses* (limestone plateaus) and forests begins; the highest point (896 ft.) is also found here. The Garonne, where it quits the department, is only some 20 ft. above the sea-level; it is navigable throughout, with the help of its lateral canal, as also are the Lot and Baise with the help of locks. The Drot, a right affluent of the Garonne in the north of the department, is also navigable in the lower part of its course. The climate is that of the Girondine region—mild and fine—the mean temperature of Agen being 56·6° Fahr., or 5° above that of Paris; the annual rainfall, which, in the plain of Agen, varies from 20 to 24 in., is nearly the least in France. Agriculturally the department is one of the richest. Of cereals wheat is the chief, maize and oats coming next. Potatoes, vines and tobacco are important sources of wealth. The best wines are those of Clairac and Buzet. Vegetable and fruit-growing are prosperous. Plum-trees (*pruniers d'ente*) are much cultivated in the valleys of the Garonne and Lot, and the apricots of Nicole and Tonneins are well known. The chief trees are the pine and the oak; the cork-oak flourishes in the Landes, and poplars and willows are abundant on the borders of the Garonne. Horned cattle, chiefly of the Garonne breed, are the principal live stock. Poultry and pigs are also reared profitably. There are deposits of iron in the department. The forges, blast furnaces and foundries of Fumel are important; and agricultural implements and other machines are manufactured. The making of lime and cement, of tiles, bricks and pottery, of confectionery and dried plums (pruneaux d'Agen) and other delicacies, and brewing and distilling, occupy many of the inhabitants. At Tonneins (pop. 4691 in 1906) there is a national tobacco manufactory. Cork cutting, of which the centre is Mézin, hat and candle making, wool spinning, weaving of woollen and cotton stuffs, tanning, paper-making, oil-making, dyeing and flour and saw-milling are other prominent industries. The peasants still speak the Gascon patois. The arrondissements are 4—Agen, Marmande, Nérac and Villeneuve-sur-Lot—and there are 35 cantons and 326 communes.

Agen, the capital, is the seat of a bishopric and of the court of appeal for the department of Lot-et-Garonne. The department belongs to the region of the XVII. army corps, the *académie* of Bordeaux, and the province of the archbishop of Bordeaux. Lot-et-Garonne is served by the lines of the Southern and the Orleans railways, its rivers afford about 160 m. of navigable waterway, and the lateral canal of the Garonne traverses it for 54 m. Agen, Marmande, Nérac and Villeneuve-sur-Lot, the principal places, are treated under separate headings. The department possesses Roman remains at Mas d'Agenais and at Aiguillon. The churches of Layrac, Monsempron, Mas d'Agenais, Moirax, Mézin and Vianne are of interest, as also are the fortifications of Vianne of the 13th century, and the châteaux of Xaintrailles, Bonaguil, Gavaudun and of the industrial town of Casteljaloux.

LOTHAIR I. (795–855), Roman emperor, was the eldest son of the emperor Louis I., and his wife Irmengarde. Little is known of his early life, which was probably passed at the court of his grandfather Charlemagne, until 815 when he became ruler of Bavaria. When Louis in 817 divided the Empire between his sons, Lothair was crowned joint emperor at Aix-la-Chapelle and given a certain superiority over his brothers. In 821 he married Irmengarde (d. 851), daughter of Hugo, count of Tours; in 822 undertook the government of Italy; and, on the 5th of April 823, was crowned emperor by Pope Paschal I. at Rome. In November 824 he promulgated a statute concerning the relations of pope and emperor which reserved the supreme power to the secular potentate, and he afterwards issued various ordinances for the good government of Italy. On his return to his father's court his step-mother Judith won his consent to her plan for securing a kingdom for her son Charles, a scheme which was carried out in 829. Lothair, however, soon changed his attitude, and spent the succeeding decade in constant strife over the division of the Empire with his father. He was alternetely master of the Empire, and banished and confined to Italy; at one time taking up arms in alliance with his brothers and at another fighting against them; whilst the bounds of his appointed kingdom were in turn extended and reduced. When Louis was dying in 840, he sent the imperial *insignia* to Lothair, who, disregarding the various partitions, claimed the whole of the Empire. Negotiations with his brother Louis and his half-brother Charles, both of whom armed to resist this claim, were followed by an alliance of the younger brothers against Lothair. A decisive battle was fought at Fontenoy on the 25th of June 841, when, in spite of his personal gallantry, Lothair was defeated and fled to Aix. With fresh troops he entered upon a war of plunder, but the forces of his brothers were too strong for him, and taking with him such treasure as he could collect, he abandoned to them his capital. Efforts to make peace were begun, and in June 842 the brothers met on an island in the Sâone, and agreed to an arrangement which developed, after much difficulty and delay, into the treaty of Verdun signed in August 843. By this Lothair received Italy and the imperial title, together with a stretch of land between the North and Mediterranean Seas lying along the valleys of the Rhine and the Rhone. He soon abandoned Italy to his eldest son, Louis, and remained in his new kingdom, engaged in alternate quarrels and reconciliations with his brothers, and in futile efforts to defend his lands from the attacks of the Normans and the Saracens. In 855 he became seriously ill, and despairing of recovery renounced the throne, divided his lands between his three sons, and on the 23rd of September entered the monastery of Prüm, where he died six days later. He was buried at Prüm, where his remains were found in 1860. Lothair was entirely untrustworthy and quite unable to maintain either the unity or the dignity of the empire of Charlemagne.

See "Annales Fuldenses"; Nithard, "Historiarum Libri," both in the *Monumenta Germaniae historica. Scriptores*, Bände i. and ii. (Hanover and Berlin, 1826 fol.); E. Mühlbacher, *Die Regesten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881); E. Dümmler, *Geschichte des ostfränkischen Reichs* (Leipzig, 1887–1888); B. Simson, *Jahrbücher des deutschen Reiches unter Ludwig dem Frommen* (Leipzig, 1874–1876).

LOTHAIR II. or **III.** (*c.* 1070–1137), surnamed the "Saxon," Roman emperor, son of Gebhard, count of Supplinburg, belonged to a family possessing extensive lands around Helmstadt in Saxony, to which he succeeded on his father's death in 1075. Gebhard had been a leading opponent of the emperor Henry IV. in Saxony, and his son, taking the same attitude, assisted Egbert II., margrave of Meissen, in the rising of 1088. The position and influence of Lothair in Saxony, already considerable, was increased when in 1100 he married Richenza, daughter of Henry, count of Nordheim, who became an heiress on her father's death in 1101, and inherited other estates when her brother Otto died childless in 1116. Having assisted the German king, Henry V., against his father in 1104, Lothair was appointed duke of Saxony by Henry, when Duke Magnus, the last of the Billungs, died in 1106. His first care was to establish his authority over some districts east of the Elbe; and quickly making himself independent of the king, he stood forth as the representative of the Saxon race. This attitude brought him into collision with Henry V., to whom, however, he was forced to submit after an unsuccessful rising in 1112. A second rising was caused when, on the death of Ulrich II., count of Weimar and Orlamünde, without issue in 1112, Henry seized these counties as vacant fiefs of the empire, while Lothair supported the claim of Siegfried, count of Ballenstädt, whose mother was a relative of Ulrich. The rebels were defeated, and Siegfried was killed at Warnstädt in 1113, but his son secured possession of the disputed counties. After the defeat by Lothair of Henry's forces at Welfesholz on the 11th of February 1115, events called Henry to Italy; and Lothair appears to have been undisturbed in Saxony until 1123, when the death of Henry II., margrave of Meissen and Lusatia raised a dispute as to the right of appointment to the vacant margraviates. A struggle ensued, in which victory remained with the duke. The Saxony policy of Lothair during these years had been to make himself independent, and to extend his authority; to this end he allied himself with the papal party, and easily revived the traditional hostility of the Saxons to the Franconian emperors.

When Henry V. died in 1125, Lothair, after a protracted election, was chosen German king at Mainz on the 30th of August 1125. His election was largely owing to the efforts of Adalbert, archbishop of Mainz, and the papal party, who disliked the candidature of Henry's nephew and heir, Frederick II. of Hohenstaufen, duke of Swabia. The new king was crowned at Aix-la-Chapelle on the 13th of September 1125. Before suffering a severe reverse, brought about by his interference in the internal affairs of Bohemia, Lothair requested Frederick of Hohenstaufen to restore to the crown the estates bequeathed to him by the emperor Henry V. Frederick refused, and was placed under the ban. Lothair, unable to capture Nüremberg, gained the support of Henry the Proud, the new duke of Bavaria, by giving him his daughter, Gertrude, in marriage, and that of Conrad, count of Zähringen, by granting him the administration of the kingdom of Burgundy, or Arles. As a counterstroke, however, Conrad of Hohenstaufen, the brother of Frederick, was chosen German king in December 1127, and was quickly recognized in northern Italy. But Lothair gained the upper hand in Germany, and by the end of 1129 the Hohenstaufen strongholds, Nüremberg and Spires, were in his possession. This struggle was accompanied by disturbances in Lorraine, Saxony and Thuringia, but order was soon restored after the resistance of the Hohenstaufen had been beaten down. In 1131 the king led an expedition into Denmark, where one of his vassals had been murdered by Magnus, son of the Danish king, Niels, and where general confusion reigned; but no resistance was offered, and Niels promised to pay tribute to Lothair.

The king's attention at the time was called to Italy where two popes, Innocent II. and Anacletus II., were clamouring for his support. At first Lothair, fully occupied with the affairs of Germany, remained heedless and neutral; but in March 1131 he was visited at Liége by Innocent, to whom he promised his assistance. Crossing the Alps with a small army in September 1132, he reached Rome in March 1133, accompanied by Innocent. As St Peter's was held by Anacletus, Lothair's coronation as emperor took place on the 4th of June 1133 in the church of the Lateran. He then received as papal fiefs the vast estates of Matilda, marchioness of Tuscany, thus securing for his daughter and her Welf husband lands which might otherwise have passed to the Hohenstaufen. His efforts to continue the investiture controversy were not very serious. He returned to Germany, where he restored order in Bavaria, and made an expedition against some rebels in the regions of the lower Rhine. Resuming the struggle against the Hohenstaufen, Lothair soon obtained the submission of the brothers, who retained their lands, and a general peace was sworn at Bamberg. The emperor's authority was now generally recognized, and the annalists speak highly of the peace and order of his later years. In 1135, Eric II., king of Denmark, acknowledged himself a vassal of Lothair;

Boleslaus III., prince of the Poles, promised tribute and received Pomerania and Rügen as German fiefs; while the eastern emperor, John Comnenus, implored Lothair's aid against Roger II. of Sicily.

The emperor seconded the efforts of his vassals, Albert the Bear, margrave of the Saxon north mark, and Conrad I., margrave of Meissen and Lusatia, to extend the authority of the Germans in the districts east of the Elbe, and assisted Norbert, archbishop of Magdeburg, and Albert I., archbishop of Bremen, to spread Christianity. In August 1136, attended by a large army, Lothair set out upon his second Italian journey. The Lombard cities were either terrified into submission or taken by storm; Roger II. was driven from Apulia; and the imperial power enforced over the whole of southern Italy. A mutiny among the German soldiers and a breach with Innocent concerning the overlordship of Apulia compelled the emperor to retrace his steps. An arrangement was made with regard to Apulia, after which Lothair, returning to Germany, died at Breitenwang, a village in the Tirol, on the 3rd or 4th of December 1137. His body was carried to Saxony and buried in the monastery which he had founded at Königslutter. Lothair was a strong and capable ruler, who has been described as the "imitator and heir of the first Otto." Contemporaries praise his justice and his virtue, and his reign was regarded, especially by Saxons and churchmen, as a golden age for Germany.

The main authorities for the life and reign of Lothair are: "Vita Norberti archiepiscopi Magdeburgensis"; Otto von Freising, "Chronicon Annalista Saxo" and "Narratio de electione Lotharii" all in the *Monumenta Germaniae historica. Scriptores*, Bände vi., xii. and xx. (Hanover and Berlin, 1826–1892). The best modern works are: L. von Ranke, *Weltgeschichte*, pt. viii. (Leipzig, 1887–1888); W. von Giesebrecht, *Geschichte der Deutschen Kaiserzeit*, Band iv. (Brunswick, 1877), Band v. (Leipzig, 1888); Ph. Jaffe, *Geschichte des Deutschen Reiches unter Lothar* (Berlin, 1843); W. Bernhardi, *Lothar von Supplinburg* (Leipzig, 1879); O. von Heinemann, *Lothar der Sachse und Konrad III.* (Halle, 1869); and Ch. Volkmar, "Das Verhältniss Lothars III. zur Investiturfrage," in the *Forschungen zur Deutschen Geschichte*, Band xxvi. (Göttingen, 1862–1886).

LOTHAIR (941–986), king of France, son of Louis IV., succeeded his father in 954, and was at first under the guardianship of Hugh the Great, duke of the Franks, and then under that of his maternal uncle Bruno, archbishop of Cologne. The beginning of his reign was occupied with wars against the vassals, particularly against the duke of Normandy. Lothair then seems to have conceived the design of recovering Lorraine. He attempted to precipitate matters by a sudden attack, and in the spring of 978 nearly captured the emperor Otto II. at Aix-la-Chapelle. Otto took his revenge in the autumn by invading France. He penetrated as far as Paris, devastating the country through which he passed, but failed to take the town, and was forced to retreat with heavy loss. Peace was concluded in 980 at Margut-sur-Chiers, and in 983 Lothair was even chosen guardian to the young Otto III. Towards 980, however, Lothair quarrelled with Hugh the Great's son, Hugh Capet, who, at the instigation of Adalberon, archbishop of Reims, became reconciled with Otto III. Lothair died on the 2nd of March 986. By his wife Emma, daughter of Lothair, king of Italy, he left a son who succeeded him as Louis V.

See F. Lot, *Les Derniers Carolingiens* (Paris, 1891); and the *Recueil des actes de Lothaire et de Louis V.*, edited by L. Halphen and F. Lot (1908).

LOTHAIR (825–869), king of the district called after him Lotharingia, or Lorraine, was the second son of the emperor Lothair I. On his father's death in 855, he received for his kingdom a district lying west of the Rhine, between the North Sea and the Jura mountains, which was called *Regnum Lotharii* and early in the 10th century became known as Lotharingia or Lorraine. On the death of his brother Charles in 863 he added some lands south of the Jura to this inheritance, but, except for a few feeble expeditions against the Danish pirates, he seems to have done little for its government or its defence. The reign was chiefly occupied by efforts on the part of Lothair to obtain a divorce from his wife Teutberga, a sister of Hucbert, abbot of St Maurice (d. 864); and his relations with his uncles, Charles the Bald and Louis the German, were influenced by his desire to obtain their support to this plan. Although quarrels and reconciliations between the three kings followed each other in quick succession, in general it may be said that Louis favoured the divorce, and Charles opposed it, while neither lost sight of the fact that Lothair was without male issue. Lothair, whose desire for the divorce was prompted by his affection for a certain Waldrada, put away Teutberga; but Hucbert took up arms on her behalf, and after she had submitted successfully to the ordeal of water, Lothair was compelled to restore her in 858. Still pursuing his purpose, he won the support of his brother, the emperor Louis II., by a cession of lands, and obtained the consent of the local clergy to the divorce and to his marriage with Waldrada, which was celebrated in 862. A synod of Frankish bishops met at Metz in 863 and confirmed this decision, but Teutberga fled to the court of Charles the Bald, and Pope Nicholas I. declared against the decision of the synod. An attack on Rome by the emperor was without result, and in 865 Lothair, convinced that Louis and Charles at their recent meeting had discussed the partition of his kingdom, and threatened with excommunication, again took back his wife. Teutberga, however, either from inclination or compulsion, now expressed her desire for a divorce, and Lothair went to Italy to obtain the assent of the new pope Adrian II. Placing a favourable interpretation upon the words of the pope, he had set out on the return journey, when he was seized with fever and died at Piacenza on the 8th of August 869. He left, by Waldrada, a son Hugo who was declared illegitimate, and his kingdom was divided between Charles the Bald and Louis the German.

See Hincmar, "Opusculum de divortio Lotharii regis et Tetbergae reginae," in *Cursus completus patrologiae*, tome cxxv., edited by J. P. Migne (Paris, 1857–1879); M. Sdralek, *Hinkmars von Rheims Kanonistisches Gutachten über die Ehescheidung des Königs Lothar II.* (Freiburg, 1881); E. Dümmler, *Geschichte des ostfränkischen Reiches* (Leipzig, 1887–1888); and E. Mühlbacher, *Die Regenten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881).

LOTHIAN, EARLS AND MARQUESSES OF. Mark Kerr, 1st earl of Lothian (d. 1609), was the eldest son of Mark Kerr (d. 1584), abbot, and then commendator, of Newbattle, or Newbottle, and was a member of the famous border family of Ker of Cessford. The earls and dukes of Roxburghe, who are also descended from the Kers of Cessford, have adopted the spelling Ker, while the earls and marquesses of Lothian have taken the form Kerr. Like his father, the abbot of Newbattle, Mark Kerr was an extraordinary lord of session under the Scottish king James VI.; he became Lord Newbattle in 1587 and was created earl of Lothian in 1606. He was master of inquests from 1577 to 1606, and he died on the 8th of April 1609, having had, as report says, thirty-one children by his wife, Margaret (d. 1617), daughter of John Maxwell, 4th Lord Herries. His son Robert, the 2nd earl, died without sons in July 1624. He had, in 1621, obtained a charter from the king enabling his daughter Anne to succeed to his estates provided that she married a member of the family of Ker. Consequently in 1631 she married William Ker, son of Robert, 1st earl of Ancrum (1578–1654), a member of the family of Ker of Ferniehurst, whose father, William Ker, had been killed in 1590 by Robert Ker, afterwards 1st earl of Roxburghe. Robert was in attendance upon Charles I. both before and after he came to the throne, and was created earl of Ancrum in 1633. He was a writer and a man of culture, and among his friends were the poet Donne and Drummond of Hawthornden. His elder son William was created earl of Lothian in 1631, the year of his marriage with Anne Kerr, and Sir William Kerr of Blackhope, a brother of the 2nd earl, who had taken the title of earl of Lothian in 1624, was forbidden to use it (see *Correspondence of Sir Robert Ker, earl of Ancrum, and his son William, third earl of Lothian*, 1875).

William Ker (*c.* 1605–1675), who thus became 3rd earl of Lothian, signed the Scottish national covenant in 1638 and marched with the Scots into England in 1640, being present when the English were routed at Newburn, after which he became governor of Newcastle-on-Tyne. During the Civil War he was prominent rather as a politician than as a soldier; he became a Scottish secretary of state in 1649, and was one of the commissioners who visited Charles II. at Breda in 1650. He died at Newbattle Abbey, near Edinburgh, in October 1675. William's eldest son Robert, the 4th earl (1636–1703), supported the Revolution of 1688 and served William III. in several capacities; he became 3rd earl of Ancrum on the death of his uncle Charles in 1690, and was created marquess of Lothian in 1701. His eldest son William, the 2nd marquess (*c.* 1662–1722), who had been a Scottish peer as Lord Jedburgh since 1692, was a supporter of the union with England. His son William, the 3rd marquess (*c.* 1690–1767), was the father of William Henry, the 4th marquess, who was wounded at Fontenoy and was present at Culloden. He was a member of parliament for some years and had reached the rank of general in the army when he died at Bath on the 12th of April 1775. His grandson William, the 6th marquess (1763–1824), married Henrietta (1762–1805), daughter and heiress of John Hobart, 2nd earl of Buckinghamshire, thus bringing Blickling Hall and the Norfolk estates of the Hobarts into the Kerr family. In 1821 he was created a peer of the United Kingdom as Baron Ker and he died on the 27th of April 1824. In 1900 Robert Schomberg Kerr (b. 1874) succeeded his father, Schomberg Henry, the 9th marquess (1833–1900), as 10th marquess of Lothian.

LOTHIAN. This name was formerly applied to a considerably larger extent of country than the three counties of Linlithgow, Edinburgh and Haddington. Roxburghshire and Berwickshire at all events were included in it, probably also the upper part of Tweeddale (at least Selkirk). It would thus embrace the eastern part of the Lowlands from the Forth to the Cheviots, *i.e.* all the English part of Scotland in the 11th century. This region formed from the 7th century onward part of the kingdoms of Bernicia and Northumbria, though we have no definite information as to the date or events by which it came into English hands. In Roman times, according to Ptolemy, it was occupied by a people called Otadini, whose name is thought to have been preserved in Manaw Gododin, the home of the British king Cunedda before he migrated to North Wales. There is no reason to doubt that the district remained in Welsh hands until towards the close of the 6th century; for in the *Historia Brittonum* the Bernician king Theodoric, whose traditional date is 572–579, is said to have been engaged in war with four Welsh kings. One of these was Rhydderch Hen who, as we know from Adamnan, reigned at Dumbarton, while another named Urien is said to have besieged Theodoric in Lindisfarne. If this statement is to be believed it is hardly likely that the English had by this time obtained a firm footing beyond the Tweed. At all events there can be little doubt that the whole region was conquered within the next fifty years. Most probably the greater part of it was conquered by the Northumbrian king Æthelfrith, who, according to Bede, ravaged the territory of the Britons more often than any other English king, in some places reducing the natives to dependence, in others exterminating them and replacing them by English settlers.

In the time of Oswic the English element became predominant in northern Britain. His supremacy was acknowledged both by the Welsh in the western Lowlands and by the Scots in Argyllshire. On the death of the Pictish king Talorgan, the son of his brother Eanfrith, he seems to have obtained the sovereignty over a considerable part of that nation also. Early in Ecgfrith's reign an attempt at revolt on the part of the Picts proved unsuccessful. We hear at this time also of the establishment of an English bishopric at Abercorn, which, however, only lasted for a few years. By the disastrous overthrow of Ecgfrith in 685 the Picts, Scots and some of the Britons also recovered their independence. Yet we find a succession of English bishops at Whithorn from 730 to the 9th century, from which it may be inferred that the south-west coast had already by this time become English. The Northumbrian dominions were again enlarged by Eadberht, who in 750 is said to have annexed Kyle, the central part of Ayrshire, with other districts. In conjunction with Œngus mac Fergus, king of the Picts, he also reduced the whole of the Britons to submission in 756. But this subjugation was not lasting, and the British kingdom, though now reduced to the basin of the Clyde, whence its inhabitants are known as Strathclyde Britons, continued to exist for nearly three centuries. After Eadberht's time we hear little of events in the northern part of Northumbria, and there is some reason for suspecting that English influence in the south-west began to decline before long, as our list of bishops of Whithorn ceases early in the 9th century; the evidence on this point, however, is not so decisive as is commonly stated. About 844 an important revolution took place among the Picts. The throne was acquired by Kenneth mac Alpin, a prince of Scottish family, who soon became formidable to the Northumbrians. He is said to have invaded "Saxonia" six times, and to have burnt Dunbar and Melrose. After the disastrous battle at York in 867 the Northumbrians were weakened by the loss of the southern part of their territories, and between 883 and 889 the whole country as far as Lindisfarne was ravaged by the Scots. In 919, however, we find their leader Aldred calling in Constantine II., king of the Scots, to help them. A few years later together with Constantine and the Britons they acknowledged the supremacy of Edward the Elder. After his death, however, both the Scots and the Britons were for a time in alliance with the Norwegians from Ireland, and consequently Æthelstan is said to have ravaged a large portion of the Scottish king's territories in 934. Brunanburh, where Æthelstan defeated the confederates in 937, is believed by many to have been in Dumfriesshire, but we have no information as to the effects of the battle on the northern populations. By this time, however, the influence of the Scottish kingdom certainly seems to have increased in the south, and in 945 the English king Edmund gave Cumberland, *i.e.* apparently the British kingdom of Strathclyde, to Malcolm I., king of the Scots, in consideration of his alliance with him. Malcolm's successor Indulph (954–962) succeeded in capturing Edinburgh, which thenceforth remained in possession of the Scots. His successors made repeated attempts to extend their territory southwards, and certain late chroniclers state that Kenneth II. in 971–975 obtained a grant of the whole of Lothian from Edgar. Whatever truth this story may contain, the cession of the province was finally effected by Malcolm II. by force of arms. At his first attempt in 1006 he seems to have suffered a great defeat from Uhtred, the son of earl Waltheof. Twelve years later, however, he succeeded in conjunction with Eugenius, king of Strathclyde, in annihilating the Northumbrian army at Carham on the Tweed, and Eadulf Cudel, the brother and successor of Uhtred, ceded all his territory to the north of that river as the price of peace. Henceforth in spite of an invasion by Aldred, the son of Uhtred, during the reign of Duncan, Lothian remained permanently in possession of the Scottish kings. In the reign of Malcolm III. and his son, the English element appears to have acquired considerable influence in the kingdom. Some three years before he obtained his father's throne Malcolm had by the help of earl Siward secured the government of Cumbria (Strathclyde) with which Lothian was probably united. Then in 1068 he received a large number of exiles from England, amongst them the Ætheling Eadgar, whose sister Margaret he married. Four other sons in succession occupied the throne, and in the time of the youngest, David, who held most of the south of Scotland as an earldom from 1107–1124 and the whole kingdom from 1124–1153, the court seems already to have been composed chiefly of English and Normans.

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LOTI, PIERRE [the pen-name of LOUIS MARIE JULIEN VIAUD] (1850–), French author, was born at Rochefort on the 14th of January 1850. The Viauds are an old Protestant family, and Pierre Loti consistently adhered, at least nominally, to the faith of his fathers. Of the picturesque and touching incidents of his childhood he has given a very vivid account in *Le Roman d'un enfant* (1890). His education began in Rochefort, but at the age of seventeen, being destined for the navy, he entered the naval school, Le Borda, and gradually rose in his profession, attaining the rank of captain in 1906. In January 1910 he was placed on the reserve list. His pseudonym is said to be due to his extreme shyness and reserve in early life, which made his comrades call him after *le Loti*, an Indian flower which loves to blush unseen. He was never given to books or study (when he was received at the French Academy, he had the courage to say, "Loti ne sait pas lire"), and it was not until 1876 that he was persuaded to write down and publish some curious experiences at Constantinople, in *Aziyadé*, a book which, like so many of Loti's, seems half a romance, half an autobiography. He proceeded to the South Seas, and on leaving Tahiti published the Polynesian idyl, originally called *Rarahu* (1880), which was reprinted as *Le Mariage de Loti*, and which first introduced to the wider public an author of remarkable originality and charm. *Le Roman d'un spahi*, a record of the melancholy adventures of a soldier in Senegambia, belongs to 1881. In 1882 Loti issued a collection of short studies under the general title of *Fleurs d'ennui*. In 1883 he achieved the widest celebrity, for not only did he publish *Mon frère Yves*, a novel describing the life of a French bluejacket in all parts of the world—perhaps his most characteristic production—but he was involved in a public discussion in a manner which did him great credit. While taking part as a naval officer in the Tongking War, Loti had exposed in the *Figaro* a series of scandals which followed on the capture of Hué (1883), and was suspended from the service for more than a year. He continued for some time nearly silent, but in 1886 he published a novel of life among the Breton fisherfolk, called *Pêcheur d'islande*, the most popular of all his writings. In 1887 he brought out a volume of extraordinary merit, which has not received the attention it deserves; this is *Propos d'exil*, a series of short studies of exotic places, in his peculiar semi-autobiographic style. The fantastic novel of Japanese manners, *Madame Chrysanthème*, belongs to the same year. Passing over one or two slighter productions, we come in 1890 to *Au Maroc*, the record of a journey to Fez in company with a French embassy. A collection of strangely confidential and sentimental reminiscences, called *Le Livre de la pitié et de la mort*, belongs to 1891. Loti was on board his ship at the port of Algiers when news was brought to him of his election, on the 21st of May 1891, to the French Academy. In 1892 he published *Fantôme d'orient*, another dreamy study of life in Constantinople, a sort of continuation of *Aziyadé*. He described a visit to the Holy Land, somewhat too copiously, in three volumes (1895–1896), and wrote a novel, *Ramuntcho* (1897), a story of manners in the Basque province, which is equal to his best writings. In 1900 he visited British India, with the view of describing what he saw; the result appeared in 1903—*L'Inde* (*sans les Anglais*). At his best Pierre Loti was unquestionably the finest descriptive writer of the day. In the delicate exactitude with which he reproduced the impression given to his own alert nerves by unfamiliar forms, colours, sounds and perfumes, he was without a rival. But he was not satisfied with this exterior charm; he desired to blend with it a moral sensibility of the extremest refinement, at once sensual and ethereal. Many of his best books are long sobs of remorseful memory, so personal, so intimate, that an English reader is amazed to find such depth of feeling compatible with the power of minutely and publicly recording what is felt. In spite of the beauty and melody and fragrance of Loti's books his mannerisms are apt to pall upon the reader, and his later books of pure description were rather empty. His greatest successes were gained in the species of confession, half-way between fact and fiction, which he essayed in his earlier books. When all his limitations, however, have been rehearsed, Pierre Loti remains, in the mechanism of style and cadence, one of the most original and most perfect French writers of the second half of the 19th century. Among his later works were: *La Troisième jeunesse de Mme Prune* (1905); *Les Désenchantées* (1906, Eng. trans. by C. Bell); *La Mort de Philae* (1908); *Judith Renaudin* (Théâtre Antoine, 1904), a five-act historical play based on an earlier book; and, in collaboration with Émile Vedel, a translation of *King Lear*, also produced at the Théâtre Antoine in 1904. (E.G.)

LÖTSCHEN PASS, or LÖTSCHBERG, an easy glacier pass (8842 ft.) leading from Kandersteg in the Bernese Oberland to the Lötschen valley in the Valais. It is a very old pass, first mentioned distinctly in 1352, but probably crossed previously by the Valaisans who colonized various parts of the Bernese Oberland. In 1384 and again in 1419 battles were fought on it between the Bernese and the Valaisans, while in 1698 a mule path (of which traces still exist) was constructed on the Bernese slope, though not continued beyond owing to the fear of the Valaisans that the Bernese would come over and alter their religion. In 1906 the piercing of a tunnel (8½ m. long) beneath this pass was begun, starting a little above Kandersteg and ending at Goppenstein near the mouth of the Lötschen valley. Subsidies were granted by both the confederation and the canton of Bern. This pass is to be carefully distinguished from the Lötschenlücke (10,512 ft.), another easy glacier pass which leads from the head of the Lötschen valley to the Great Aletsch glacier. (W. A. B. C.)

LOTTERIES. The word lottery[1] has no very definite signification. It may be applied to any process of determining prizes by lot, whether the object be amusement or gambling or public profit. In the Roman Saturnalia and in the banquets of aristocratic Romans the object was amusement; the guests received *apophoreta*. The same plan was followed on a magnificent scale by some of the emperors. Nero gave such prizes as a house or a slave. Heliogabalus introduced an element of absurdity—one ticket for a golden vase, another for six flies. This custom descended to the festivals given by the feudal and merchant princes of Europe, especially of Italy; and it formed a prominent feature of the splendid court hospitality of Louis XIV. In the Italian republics of the 16th century the lottery principle was applied to encourage the sale of merchandise. The lotto of Florence and the seminario of Genoa are well known, and Venice established a monopoly and drew a considerable revenue for the state. The first letters patent for a lottery in France were granted in 1539 by Francis I., and in 1656 the Italian, Lorenzo Tonti (the originator of "Tontines") opened another for the building of a stone bridge between the Louvre and the Faubourg St Germain. The institution became very popular in France, and gradually assumed an important place in the government finance. The parlements frequently protested against it, but it had the support of Mazarin, and L. Phelypeaux, comte de Pontchartrain, by this means raised the expenses of the Spanish Succession War. Necker, in his *Administration des finances*, estimates the public charge for lotteries at 4,000,000 livres per annum. There were also lotteries for the benefit of religious communities and charitable purposes. Two of the largest were the *Loteries de Piété* and *Des Enfans Trouvés*. These and also the great *Loterie de l'École militaire* were practically merged in the *Loterie Royale* by the decree of 1776, suppressing all private lotteries in France. The financial basis of these larger lotteries was to take $\frac{5}{24}$ths for expenses and benefit, and return $\frac{19}{24}$ths to the public who subscribed. The calculation of chances had become a familiar science. It is explained in detail by Caminade de Castres in *Enc. méth. finances*, ii. *s.v.* "Loterie." The names of the winning numbers in the first drawing were (1) *extrait*, (2) *ambe*, (3) *terne*, (4) *quaterne*, (5) *quine*. After this there were four drawings called *primes gratuites*. The *extrait* gave fifteen times the price of the ticket; the *quine* gave one million times the price. These are said to be much more favourable terms than were given in Vienna, Frankfort and other leading European cities at the end of the 18th century. The *Loterie Royale* was ultimately suppressed in 1836. Under the law of the 29th of May 1844 lotteries may be held for the assistance of charity and the fine arts. In 1878 twelve million lottery tickets of one franc each were sold in Paris to pay for prizes to exhibitors in the great Exhibition and expenses of working-men visitors. The first prize was worth £5000; the second, £4000, and the third and fourth £2000 each. The Société du Crédit Foncier, and many of the large towns, are permitted to contract loans, the periodical repayments of which are determined by lot. This practice, which is prohibited in Germany and England, resembles the older system of giving higher and lower rates of interest for money according to lot. Lotteries were suppressed in Belgium in 1830, Sweden in 1841 and Switzerland in 1865, but they still figure in the state budgets of Austria-Hungary, Prussia and other German States, Holland, Spain, Italy and Denmark. In addition to lottery loans, ordinary lotteries (*occasion lotteries*) are numerous in various countries of the continent of Europe. They are of various magnitude and are organized for a variety of purposes, such as charity, art, agriculture, church-building, &c. It is becoming the tendency, however, to discourage private and indiscriminate lotteries, and even state lotteries which contribute to the revenue. In Austria-Hungary and Germany, for instance, every year sees fewer places where tickets can be taken for them receive licenses. In 1904 a proposal for combining a working-class savings bank with a national lottery was seriously considered by the Prussian ministry. The scheme, which owes its conception to August Scherl, editor of the Berlin *Lokalanzeiger*, is an endeavour to utilize the love of gambling for the purpose of promoting thrift among the working-classes. It was proposed to make weekly collections from subscribers, in fixed amounts, ranging from sixpence to four shillings. The interest on the money deposited would not go to the depositors but would be set aside to form the prizes. Three hundred thousand tickets, divisible into halves, quarters and eighths, according to the sum deposited weekly, would form a series of 12,500 prizes, of a total value of £27,000. At the same time, the subscriber, while having his ordinary lottery chances of these prizes, still has to his credit intact the amount which he has subscribed week by week.

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[1] The word "lottery" is directly derived from Ital. *lotteria*, cf. Fr. *loterie*, formed from *lotto*, lot, game of chance. "Lot" is in origin a Teutonic word, adopted into Romanic languages. In O. Eng. it appears as *hlot*, cf. Dutch *lot*, Ger. *Loos*, Dan. *lod*, &c. The meaning of the Teutonic root *hleut* from which these words have derived is unknown. Primarily "lot" meant the object, such as a disk or counter of wood, a pebble, bean or the like, which was drawn or cast to decide by chance, under divine guidance, various matters, such as disputes, divisions of property, selection of officers and frequently as a method of divination in ancient times. From this original sense the meaning develops into that which falls to a person by lot, chance or fate, then to any portion of land, &c., allotted to a person, and hence, quite generally, of a quantity of anything.

In England the earliest lotteries sanctioned by government were for such purposes as the repair of harbours in 1569, and the Virginia Company in 1612. In the lottery of 1569, 40,000 chances were sold at ten shillings each, the prizes being "plate, and certain sorts of merchandises." In 1698 lotteries, with the exception of the Royal Oak lottery for the benefit of the Royal Fishing Company, were prohibited as common nuisances, by which children, servants and other unwary persons had been ruined. This prohibition was in the 18th century gradually extended to illegal insurances on marriages and other events, and to a great many games with dice, such as faro, basset, hazard, except backgammon and games played in the royal palace. In spite of these prohibitions, the government from 1709 down to 1824 annually raised considerable sums in lotteries authorized by act of parliament. The prizes were in the form of terminable or perpetual annuities. The £10 tickets were sold at a premium of say 40% to contractors who resold them in retail (sometimes in one-sixteenth parts) by "morocco men," or men with red leather books who travelled through the country. As the drawing extended over forty days, a very pernicious system arose of insuring the fate of tickets during the drawing for a small premium of 4d. or 6d. This was partly cured by the Little Go Act of 1802, directed against the itinerant wheels which plied between the state lotteries, and partly by Perceval's Act in 1806, which confined the drawing of each lottery to one day. From 1793 to 1824 the government made an average yearly profit of £346,765. Cope, one of the largest contractors, is said to have spent £36,000 in advertisements in a single year. The English lotteries were used to raise loans for general purposes, but latterly they were confined to particular objects, such as the improvement of London, the disposal of a museum, the purchase of a picture gallery, &c. Through the efforts of Lord Lyttleton and others a strong public opinion was formed against them, and in 1826 they were finally prohibited. An energetic proposal to revive the system was made before the select committee on metropolitan improvements in 1830, but it was not listened to. By a unique blunder in legislation, authority was given to hold a lottery under an act of 1831 which provided a scheme for the improvement of the city of Glasgow. These "Glasgow lotteries" were suppressed by an act of 1834. Art Unions were legalized by the Art Unions Act 1846. The last lottery prominently before the public in England was that of Dethier's twelfth-cake lottery, which was suppressed on the 27th of December 1860. As defined at the beginning of this article, the word lottery has a meaning wide enough to include missing-word competitions, distributions by tradesmen of prize coupons, sweepstakes, &c. See *Report of Joint Select Committee on Lotteries, &c.* (1908). The statute law in Scotland is the same as in England. At common law in Scotland it is probable that all lotteries and raffles, for whatever purpose held, may be indicted as nuisances. The art unions are supposed to be protected by a special statute.

United States.—The American Congress of 1776 instituted a national lottery. Most states at that time legalized lotteries for public objects, and before 1820 the Virginia legislature passed seventy acts authorizing lotteries, for various public purposes, such as schools, roads, &c.—about 85% of the subscriptions being returned in prizes. At an early period (1795) the city of Washington was empowered to set up lotteries as a mode of raising money for public purposes; and this authorization from the Maryland legislature was approved by an act of the Federal Congress in 1812. In 1833 they were prohibited in New York and Massachusetts and gradually in the other states, until they survived only in Louisiana. In that state, the Louisiana State Lottery, a company chartered in 1868, had a monopoly for which it paid $40,000 to the state treasury. Its last charter was granted in 1879 for a period of twenty-five years, and a renewal was refused in 1890. In 1890 Congress forbade the use of the mails for promoting any lottery enterprise by a statute so stringent that it was held to make it a penal offence to employ them to further the sale of Austrian government bonds, issued under a scheme for drawing some by lot for payment at a premium (see *Horner* v. *United States*, 147 United States Reports, 449). This had the effect of compelling the Louisiana State Lottery to move its quarters to Honduras, in which place it still exists, selling its bonds to a considerable extent in the Southern States.

Since lotteries have become illegal there have been a great number of judicial decisions defining a lottery. In general, where skill or judgment is to be exercised there is no lottery, the essential element of which is chance or lot. There are numerous statutes against lotteries, the reason being given that they "tend to promote a gambling spirit," and that it is the duty of the state to "protect the morals and advance the welfare of the people." In New York the Constitution of 1846 forbade lotteries, and by § 324 of the Penal Code a lottery is declared "unlawful and a public nuisance." "Contriving" and advertising lotteries is also penal. The following have been held illegal lotteries: In New York, a concert, the tickets for which entitled the holder to a prize to be drawn by lot; in Indiana, offering a gold watch to the purchaser of goods who guesses the number of beans in a bottle; in Texas, selling "prize candy" boxes; and operating a nickel-in-the-slot machine—so also in Louisiana; in Massachusetts, the "policy" or "envelope game," or a "raffle"; in Kentucky (1905), prize coupon packages, the coupons having to spell a certain word (*U.S.* v. *Jefferson*, 134 Fed. R. 299); in Kansas (1907) it was held by the Supreme Court that the gift of a hat-pin to each purchaser was not illegal as a "gift enterprise," there being no chance or lot. In Oklahoma (1907) it was held that the making of contracts for the payment of money, the certainty in value of return being dependent on chance, was a lottery (*Fidelity Fund Co.* v. *Vaughan*, 90 Pac. Rep. 34). The chief features of a lottery are "procuring through lot or chance, by the investment of a sum of money or something of value, some greater amount of money or thing of greater value. When such are the chief features of any scheme whatever it may be christened, or however it may be guarded or concealed by cunningly devised conditions or screens, it is under the law a lottery" (*U.S.* v. *Wallace*, 58, Fed. Rep. 942). In 1894 and 1897 Congress forbade the importation of lottery tickets or advertisements into the United States. In 1899, setting up or promoting lotteries in Alaska was prohibited by Congress, and in 1900 it forbade any lottery or sale of lottery tickets in Hawaii. In Porto Rico lotteries, raffles and gift-enterprises are forbidden (Penal Code, 1902, § 291).

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LOTTI, ANTONIO (1667?–1740), Italian musical composer, was the son of Matteo Lotti, Kapellmeister to the court of Hanover. He was born, however, at Venice and as a pupil of Legrenzi. He entered the Doge's chapel as a boy, and in 1689 was engaged as an alto singer, succeeding later to the posts of deputy organist (1690), second organist (1692), first organist (1704), and, finally, in 1736 Maestro di Cappella at St Mark's church. He was also a composer of operas, and having attracted the interest of the crown prince of Saxony during his visit to Venice in 1712, he was invited to Dresden, where he went in 1717. After producing three operas there he was obliged to return to his duties at Venice in 1719. He died on the 5th of January 1740. Like many other Venetian composers he wrote operas for Vienna, and enjoyed a considerable reputation outside Italy. A volume of madrigals published in 1705 contains the famous *In una siepe ombrosa*, passed off by Bononcini as his own in London. Another is quoted by Martini in his *Saggio di Contrappunto*. Among his pupils were Alberti, Bassani, Galuppi, Gasparini and Marcello. Burney justly praises his church music, which is severe in style, but none the less modern in its grace and pathos. A fine setting of the *Dies Irae* is in the Imperial Library at Vienna, and some of his masses have been printed in the collections of Proske and Lück.

LOTTO, LORENZO (*c.* 1480–1556), Italian painter, is variously stated to have been born at Bergamo, Venice and Treviso, between 1475 and 1480, but a document published by Dr Bampo proves that he was born in Venice, and it is to be gathered from his will that 1480 was probably the year of his birth. Overshadowed by the genius of his three great contemporaries, Titian, Giorgione and Palma, he had been comparatively neglected by art historians until Mr Bernhard Berenson devoted to him an "essay in constructive art criticism," which not only restores to him his rightful position among the great masters of the Renaissance, but also throws clear light upon the vexed question of his artistic descent. Earlier authorities have made Lotto a pupil of Giovanni Bellini (Morelli), of Previtali (Crowe and Cavalcaselle), of Leonardo da Vinci (Lomazzo), whilst others discovered in his work the influences of Cima, Carpaccio, Dürer, Palma and Francia. Mr Berenson has, however, proved that he was the pupil of Alvise Vivarini, whose religious severity and asceticism remained paramount in his work, even late in his life, when he was attracted by the rich glow of Giorgione's and Titian's colour. What distinguishes Lotto from his more famous contemporaries is his psychological insight into character and his personal vision—his unconventionality, which is sufficient to account for the comparative neglect suffered by him when his art is placed beside the more typical art of Titian and Giorgione, the supreme expression of the character of the period.

That Lotto, who was one of the most productive painters of his time, could work for thirty years without succumbing to the mighty influence of Titian's sumptuous colour, is explained by the fact that during these years he was away from Venice, as is abundantly proved by documents and by the evidence of signed and dated works. The first of these documents, dated 1503, proves him to have lived at Treviso at this period. His earliest authentic pictures, Sir Martin Conway's "Danaë" (about 1498) and the "St Jerome" of the Louvre (a similar subject is at the Madrid Gallery ascribed to Titian), as indeed all the works executed before 1509, have unmistakable Vivarinesque traits in the treatment of the drapery and landscape, and cool grey tonality. To this group belong the Madonnas at Bridgewater House, Villa Borghese, Naples, and Sta Cristina near Treviso, the Recanati altarpiece, the "Assumption of the Virgin" at Asolo, and the portrait of a young man at Hampton Court. We find him at Rome between 1508 and 1512, at the time Raphael was painting in the Stanza della Signatura. A document in the Corsini library mentions that Lotto received 100 ducats as an advance payment for fresco-work in the upper floor of the Vatican, but there is no evidence that this work was ever executed. In the next dated works, the "Entombment" at Jesi (1512), and the "Transfiguration," "St James," and "St Vincent" at Recanati, Lotto has abandoned the dryness and cool colour of his earlier style, and adopted a fluid method and a blonde, joyful colouring. In 1513 we find him at Bergamo, where he had entered into a contract to paint for 500 gold ducats an altarpiece for S. Stefano. The picture was only completed in 1516, and is now at S. Bartolommeo. From the next years, spent mostly at Bergamo, with intervals in Venice and Jesi in the Marches, date the Dresden "Madonna," "Christ taking leave of his Mother" at the Berlin Gallery, the "Bride and Bridegroom" at Madrid, the National Gallery "Family Group" and portrait of the Protonothary Giuliano, several portraits in Berlin, Milan and Vienna, numerous altarpieces in and near Bergamo, the strangely misnamed "Triumph of Chastity" at the Rospigliosi Palace in Rome, and the portrait of Andrea Odoni at Hampton Court. In 1526 or 1527 Lotto returned to Venice, where Titian ruled supreme in the world of art; and it was only natural that the example of the great master should have fired him to emulation, though his experiments in this direction were confined to an attempt at rivalling the master's rich and ruddy colour-schemes. Even in the Carmine altarpiece, the "St Nicholas of Bari," which is his nearest approach to Titian, he retained his individualized, as opposed to Titian's generalized, expression of emotion. But it was only a passing phase, and he soon returned to the cooler schemes of his earlier work. Among his chief pictures executed in Venice between 1529 and 1540 are the "Christ and the Adulteress," now at the Louvre, the "Visitation" at the Jesi Library, the "Crucifixion" at Monte S. Giusto, the Madonna at the Uffizi, the "Madonna and Saints" at Cingoli, and some portraits at the Berlin and Vienna museums, the Villa Borghese and Doria Palace in Rome, and at Dorchester House. He is again to be found at Treviso from 1542–1545, at Ancona in 1550, the year in which he entirely lost his voice; and in 1552 he "devoted his person and all his property to the Holy Virgin of Loreto" and took up his abode with the monks of that shrine. He died in 1556. A codex in his own handwriting, discovered in the archives of Loreto, not only includes a complete statement of his accounts from about 1539 to his death, but has a most interesting entry from which we gather that in 1540 Lotto completed the portraits of Martin Luther and his wife. These portraits could not have been painted from life; they were presumably executed from some contemporary engraving.

See *Lorenzo Lotto*, by Bernard Berenson (London, 1901).

LOTTO (Ital. for "lot"), a gambling game usually called *Keno* in America, played by any number of persons upon large boards or cards, each of which is divided into three horizontal rows of nine spaces, four spaces in each row being left blank and the other five marked with numbers up to 90. Each card is designated by a general number. The cards usually lie on the gambling-table, and a player may buy from the bank as many as he cares to use, each card being registered or *pegged* on an exposed table as soon as bought. Ninety small ivory markers, generally balls flattened on one side, numbered from 1 to 90, are placed in a bag and shaken out one by one, or, more usually, in a so-called *keno-goose*, a kind of urn with a spout through which the balls are allowed to roll by means of a spring. When a number falls out, the banker, or *keno-roller*, calls it out distinctly, and each player upon whose card that number occurs places a mark over it. This is repeated until one player has all the numbers in one row of his card covered, upon which he calls out "Keno!" and wins all the money staked excepting a percentage to the bank.

LOTUS, a popular name applied to several plants. The lotus fruits of the Greeks belonged to *Zizyphus Lotus*, a bush native in south Europe with fruits as large as sloes, containing a mealy substance which can be used for making bread and also a fermented drink. In ancient times the fruits were an important article of food among the poor; whence "lotophagi" or lotus-eaters. *Zizyphus* is a member of the natural order Rhamnaceae to which belongs the British buckthorn. The Egyptian lotus was a water-lily, *Nymphaea Lotus*; as also is the sacred lotus of the Hindus, *Nelumbium speciosum*. The lotus tree, known to the Romans as the Libyan lotus, and planted by them for shade, was probably *Celtis australis*, the nettle-tree (*q.v.*), a southern European tree, a native of the elm family, with fruits like small cherries, which are first red and then black. *Lotus* of botanists is a genus of the pea-family (*Leguminosae*), containing a large number of species of herbs and undershrubs widely distributed in the temperate regions of the old world. It is represented in Britain by *L. corniculatus*, bird's foot trefoil, a low-growing herb, common in pastures and waste places, with clusters of small bright yellow pea-like flowers, which are often streaked with crimson; the popular name is derived from the pods which when ripe spread like the toes of a bird's foot.

LOTUS-EATERS (Gr. Λωτοφάγοι), a Libyan tribe known to the Greeks as early as the time of Homer. Herodotus (iv. 177) describes their country as in the Libyan district bordering on the Syrtes, and says that a caravan route led from it to Egypt. Victor Bérard identifies it with the modern Jerba. When Odysseus reached the country of the Lotophagi, many of his sailors after eating the lotus lost all wish to return home. Both Greeks and Romans used the expression "to eat the lotus" to denote forgetfulness (cf. Tennyson's poem "The Lotus-Eaters").

There has been considerable discussion as to the identification of the Homeric lotus. Some have held that it is a prickly shrub, Zizyphus Lotus, which bears a sweet-tasting fruit, and still grows in the old home of the Lotophagi. It is eaten by the natives, who also make a kind of wine from the juice. P. Champault (*Phéniciens et Grecs en Italie d'après l'Odyssée*, p. 400, note 2), however, maintains that the lotus was a date; Victor Bérard (*Les Phéniciens et l'Odyssée*, 1902–1903, ii. 102) is doubtful, but contends that it was certainly a tree-fruit. If either of these be correct, then the lotus of *Od.* iv. 603–604 is quite a different plant, a kind of clover. Now Strabo (xvii. 829*a*) calls the lotus πόαν τινὰ καὶ ῥίζαν. Putting these two references together with Sulpicius Severus, *Dialogi* i. 4. 4, R. M. Henry suggests that the Homeric lotus was really the πόα of Strabo, *i.e.* a kind of clover (*Classical Review*, December 1906, p. 435).

LOTZE, RUDOLF HERMANN (1817–1881), German philosopher, was born in Bautzen on the 21st of May 1817, the son of a physician. He received his education in the gymnasium of Zittau under teachers who inspired him with an enduring love of the classical authors, as we see from his translation of the *Antigone* of Sophocles into Latin verse, published when he had reached middle life. He went to the university of Leipzig as a student of philosophy and natural sciences, but entered officially as a student of medicine. He was then only seventeen. It appears that thus early Lotze's studies were governed by two distinct interests. The first was scientific, based upon mathematical and physical studies under the guidance of E. H. Weber, W. Volckmann and G. T. Fechner. The other was his aesthetical and artistic interest, which was developed under the care of C. H. Weisse. To the former he owes his appreciation of exact investigation and a complete knowledge of the aims of science, to the latter an equal admiration for the great circle of ideas which had been diffused by the teaching of Fichte, Schelling and Hegel. Each of these influences, which early in life must have been familiar to him, tempered and modified the other. The true method of science which he possessed forced him to condemn as useless the entire form which Schelling's and Hegel's expositions had adopted, especially the dialectic method of the latter, whilst his love of art and beauty, and his appreciation of moral purposes, revealed to him the existence of a transphenomenal world of values into which no exact science could penetrate. It is evident how this initial position at once defined to him the tasks which philosophy had to perform. First there were the natural sciences, themselves only just emerging from a confused conception of their true method; especially those which studied the borderland of physical and mental phenomena, the medical sciences; and pre-eminently that science which has since become so popular, the science of biology.

Lotze's first essay was his dissertation *De futurae biologiae principibus philosophicis*, with which he gained (1838) the degree of doctor of medicine, after having only four months previously got the degree of doctor of philosophy. Then, secondly, there arose the question whether the methods of exact science sufficed to explain the connexion of phenomena, or whether for the explanation of this the thinking mind was forced to resort to some hypothesis not immediately verifiable by observation, but dictated by higher aspirations and interests. And, if to satisfy these we were forced to maintain the existence of a world of moral standards, it was, thirdly, necessary to form some opinion as to the relation of these moral standards of value to the forms and facts of phenomenal existence. These different tasks, which philosophy had to fulfil, mark pretty accurately the aims of Lotze's writings, and the order in which they were published. He laid the foundation of his philosophical system very early in his *Metaphysik* (Leipzig, 1841) and his *Logik* (1843), short books published while he was still a junior lecturer at Leipzig, from which university he migrated to Göttingen, succeeding Herbart in the chair of philosophy. But it was only during the last decade of his life that he ventured, with much hesitation, to present his ideas in a systematic and final form. The two books mentioned remained unnoticed by the reading public, and Lotze first became known to a larger circle through a series of works which aimed at establishing in the study of the physical and mental phenomena of the human organism in its normal and diseased states the same general principles which had been adopted in the investigation of inorganic phenomena. These works were his *Allgemeine Pathologie und Therapie als mechanische Naturwissenschaften* (Leipzig, 1842, 2nd ed., 1848), the articles "Lebenskraft" (1843) and "Seele und Seelenleben" (1846) in Rud. Wagner's *Handwörterbuch der Physiologie*, his *Allgemeine Physiologie des Körperlichen Lebens* (Leipzig, 1851), and his *Medizinische Psychologie oder Physiologie der Seele* (Leipzig, 1852).

When Lotze published these works, medical science was still much under the influence of Schelling's philosophy of nature. The mechanical laws, to which external things were subject, were conceived as being valid only in the inorganic world; in the organic and mental worlds these mechanical laws were conceived as being disturbed or overridden by other powers, such as the influence of final causes, the existence of types, the work of vital and mental forces. This confusion Lotze, who had been trained in the school of mathematical reasoning, tried to dispel. The laws which govern particles of matter in the inorganic world govern them likewise if they are joined into an organism. A phenomenon *a*, if followed by *b* in the one case, is followed by the same *b* also in the other case. Final causes, vital and mental forces, the soul itself can, if they act at all, only act through the inexorable mechanism of natural laws. As we therefore have only to do with the study of existing complexes of material and spiritual phenomena, the changes in these must be explained in science by the rule of mechanical laws, such as obtain everywhere in the world, and only by such. One of the results of these investigations was to extend the meaning of the word mechanism, and comprise under it all laws which obtain in the phenomenal world, not excepting the phenomena of life and mind. Mechanism was the unalterable connexion of every phenomenon *a* with other phenomena *b*, *c*, *d*, either as following or preceding it; mechanism was the inexorable form into which the events of this world are cast, and by which they are connected. The object of those writings was to establish the all-pervading rule of mechanism. But the mechanical view of nature is not identical with the materialistic. In the last of the above-mentioned works the question is discussed at great length how we have to consider mind, and the relation between mind and body; the answer is—we have to consider mind as an immaterial principle, its action, however, on the body and vice versa as purely mechanical, indicated by the fixed laws of a psycho-physical mechanism. These doctrines of Lotze—though pronounced with the distinct and reiterated reserve that they did not contain a solution of the philosophical question regarding the nature, origin, or deeper meaning of this all-pervading mechanism, neither an explanation how the action of external things on each other takes place nor yet of the relation of mind and body, that they were merely a preliminary formula of practical scientific value, itself requiring a deeper interpretation—these doctrines were nevertheless by many considered to be the last word of the philosopher who, denouncing the reveries of Schelling or the idealistic theories of Hegel, established the science of life and mind on the same basis as that of material things. Published as they were during the years when the modern school of German materialism was at its height,[1] these works of Lotze were counted among the opposition literature which destroyed the phantom of Hegelian wisdom and vindicated the independent and self-sufficing position of empirical philosophy. Even philosophers of the eminence of I. H. Fichte (the younger) did not escape this misinterpretation of Lotze's true meaning, though they had his *Metaphysik* and *Logik* to refer to, though he promised in his *Allgemeine Physiologie* (1851) to enter in a subsequent work upon the "bounding province between aesthetics and physiology," and though in his *Medizinische Psychologie* he had distinctly stated that his position was neither the idealism of Hegel nor the realism of Herbart, nor materialism, but that it was the conviction that the essence of everything is the part it plays in the realization of some idea which is in itself valuable, that the sense of an all-pervading mechanism is to be sought in this, that it denotes the ways and means by which the highest idea, which we may call the idea of the good, has voluntarily chosen to realize itself.

The misinterpretations which he had suffered induced Lotze to publish a small pamphlet of a polemical character (*Streitschriften*, Leipzig, 1857), in which he corrected two mistakes. The opposition which he had made to Hegel's formalism had induced some to associate him with the materialistic school, others to count him among the followers of Herbart. Lotze publicly and formally denied that he belonged to the school of Herbart, though he admitted that historically the same doctrine which might be considered the forerunner of Herbart's teachings might lead to his own views, viz. the monadology of Leibnitz.

When Lotze wrote these explanations, he had already given to the world the first volume of his great work, *Mikrokosmus* (vol. i. 1856, vol. ii. 1858, vol. iii. 1864; 3rd ed., 1876–1880). In many passages of his works on pathology, physiology, and psychology Lotze had distinctly stated that the method of research which he advocated there did not give an explanation of the phenomena of life and mind, but only the means of observing and connecting them together; that the meaning of all phenomena, and the reason of their peculiar connexions, was a philosophical problem which required to be attacked from a different point of view; and that the significance especially which lay in the phenomena of life and mind would only unfold itself if by an exhaustive survey of the entire life of man, individually, socially, and historically, we gain the necessary data for deciding what meaning attaches to the existence of this microcosm, or small world of human life, in the macrocosm of the universe. This review, which extends, in three volumes, over the wide field of anthropology, beginning with the human frame, the soul, and their union in life, advancing to man, his mind, and the course of the world, and concluding with history, progress, and the connexion of things, ends with the same idea which was expressed in Lotze's earliest work, his *Metaphysik*. The view peculiar to him is reached in the end as the crowning conception towards which all separate channels of thought have tended, and in the light of which the life of man in nature and mind, in the individual and in society, had been surveyed. This view can be briefly stated as follows: Everywhere in the wide realm of observation we find three distinct regions,—the region of facts, the region of laws and the region of standards of value. These three regions are separate only in our thoughts, not in reality. To comprehend the real position we are forced to the conviction that the world of facts is the field in which, and that laws are the means by which, those higher standards of moral and aesthetical value are being realized; and such a union can again only become intelligible through the idea of a personal Deity, who in the creation and preservation of a world has voluntarily chosen certain forms and laws, through the natural operation of which the ends of His work are gained.

Whilst Lotze had thus in his published works closed the circle of his thought, beginning with a conception metaphysically gained, proceeding to an exhaustive contemplation of things in the light it afforded, and ending with the stronger conviction of its truth which observation, experience, and life could afford, he had all the time been lecturing on the various branches of philosophy according to the scheme of academical instruction transmitted from his predecessors. Nor can it be considered anything but a gain that he was thus induced to expound his views with regard to those topics, and in connexion with those problems, which were the traditional forms of philosophical utterance. His lectures ranged over a wide field: he delivered annually lectures on psychology and on logic (the latter including a survey of the entirety of philosophical research under the title *Encyclopädie der Philosophie*), then at longer intervals lectures on metaphysics, philosophy of nature, philosophy of art, philosophy of religion, rarely on history of philosophy and ethics. In these lectures he expounded his peculiar views in a stricter form, and during the last decade of his life he embodied the substance of those courses in his *System der Philosophie*, of which only two volumes have appeared (vol. i. *Logik*, 1st ed., Leipzig, 1874, 2nd ed., 1880; vol. ii. *Metaphysik*, 1879). The third and concluding volume, which was to treat in a more condensed form the principal problems of practical philosophy, of philosophy of art and religion, never appeared. A small pamphlet on psychology, containing the last form in which he had begun to treat the subject in his lectures (abruptly terminated through his death on the 1st of July 1881) during the summer session of 1881, has been published by his son. Appended to this volume is a complete list of Lotze's writings, compiled by Professor Rehnisch of Göttingen.

To understand this series of Lotze's writings, it is necessary to begin with his definition of philosophy. This is given after his exposition of logic has established two points, viz. the existence in our mind of certain laws and forms according to which we connect the material supplied to us by our senses, and, secondly, the fact that logical thought cannot be usefully employed without the assumption of a further set of connexions, not logically necessary, but assumed to exist between the data of experience and observation. These connexions of a real not formal character are handed to us by the separate sciences and by the usage and culture of everyday life. Language has crystallized them into certain definite notions and expressions, without which we cannot proceed a single step, but which we have accepted without knowing their exact meaning, much less their origin. In consequence the special sciences and the wisdom of common life entangle themselves easily and frequently in contradictions. A problem of a purely formal character thus presents itself, viz. this—to try to bring unity and harmony into the scattered thoughts of our general culture, to trace them to their primary assumptions and follow them into their ultimate consequences, to connect them all together, to remodel, curtail or amplify them, so as to remove their apparent contradictions, and to combine them in the unity of an harmonious view of things, and especially to investigate those conceptions which form the initial assumptions of the several sciences, and to fix the limits of their applicability. This is the formal definition of philosophy. Whether an harmonious conception thus gained will represent more than an agreement among our thoughts, whether it will represent the real connexion of things and thus possess objective not merely subjective value, cannot be decided at the outset. It is also unwarranted to start with the expectation that everything in the world should be explained by one principle, and it is a needless restriction of our means to expect unity of method. Nor are we able to start our philosophical investigations by an inquiry into the nature of human thought and its capacity to attain an objective knowledge, as in this case we would be actually using that instrument the usefulness of which we were trying to determine. The main proof of the objective value of the view we may gain will rather lie in the degree in which it succeeds in assigning to every element of culture its due position, or in which it is able to appreciate and combine different and apparently opposite tendencies and interests, in the sort of justice with which it weighs our manifold desires and aspirations, balancing them in due proportions, refusing to sacrifice to a one-sided principle any truth or conviction which experience has proven to be useful and necessary. The investigations will then naturally divide themselves into three parts, the first of which deals with those to our mind inevitable forms in which we are obliged to think about things, if we think at all (metaphysics), the second being devoted to the great region of facts, trying to apply the results of metaphysics to these, specially the two great regions of external and mental phenomena (cosmology and psychology), the third dealing with those standards of value from which we pronounce our aesthetical or ethical approval or disapproval. In each department we shall have to aim first of all at views clear and consistent within themselves, but, secondly, we shall in the end wish to form some general idea or to risk an opinion how laws, facts and standards of value may be combined in one comprehensive view. Considerations of this latter kind will naturally present themselves in the two great departments of cosmology and psychology, or they may be delegated to an independent research under the name of religious philosophy. We have already mentioned the final conception in which Lotze's speculation culminates, that of a personal Deity, Himself the essence of all that merits existence for its own sake, who in the creation and government of a world has voluntarily chosen certain laws and forms through which His ends are to be realized. We may add that according to this view nothing is real but the living spirit of God and the world of living spirits which He has created; the things of this world have only reality in so far as they are the appearance of spiritual substance, which underlies everything. It is natural that Lotze, having this great and final conception always before him, works under its influence from the very beginning of his speculations, permitting us, as we progress, to gain every now and then a glimpse of that interpretation of things which to him contains the solution of our difficulties.

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[1] See Vogt, *Physiologische Briefe* (1845–1847); Moleschott, *Der Kreislauf des Lebens* (1852); Büchner, *Kraft und Stoff* (1855).

The key to Lotze's theoretical philosophy lies in his metaphysics, to the exposition of which important subject the first and last of his larger publications have been devoted. To understand Lotze's philosophy, a careful and repeated perusal of these works is absolutely necessary. The object of his metaphysics is so to remodel the current notions regarding the existence of things and their connexions with which the usage of language supplies us as to make them consistent and thinkable. The further assumption, that the modified notions thus gained have an objective meaning, and that they somehow correspond to the real order of the existing world which of course they can never actually describe, depends upon a general confidence which we must have in our reasoning powers, and in the significance of a world in which we ourselves with all the necessary courses of our thoughts have a due place assigned. The principle therefore of these investigations is opposed to two attempts frequently repeated in the history of philosophy, viz.: (1) the attempt to establish general laws or forms, which the development of things must have obeyed, or which a Creator must have followed in the creation of a world (Hegel); and (2) the attempt to trace the genesis of our notions and decide as to their meaning and value (modern theories of knowledge). Neither of these attempts is practicable. The world of many things surrounds us; our notions, by which we manage correctly or incorrectly to describe it, are also ready made. What remains to be done is, not to explain how such a world manages to be what it is, nor how we came to form these notions, but merely this—to expel from the circle and totality of our conceptions those abstract notions which are inconsistent and jarring, or to remodel and define them so that they may constitute a consistent and harmonious view. In this endeavour Lotze discards as useless and untenable many favourite conceptions of the school, many crude notions of everyday life. The course of things and their connexion is only thinkable by the assumption of a plurality of existences, the reality of which (as distinguished from our knowledge of them) can be conceived only as a multitude of relations. This quality of standing in relation to other things is that which gives to a thing its reality. And the nature of this reality again can neither be consistently represented as a fixed and hard substance nor as an unalterable something, but only as a fixed order of recurrence of continually changing events or impressions. But, further, every attempt to think clearly what those relations are, what we really mean, if we talk of a fixed order of events, forces upon us the necessity of thinking also that the different things which stand in relations or the different phases which follow each other cannot be merely externally strung together or moved about by some indefinable external power, in the form of some predestination or inexorable fate. The things themselves which exist and their changing phases must stand in some internal connexion; they themselves must be active or passive, capable of doing or suffering. This would lead to the view of Leibnitz, that the world consists of monads, self-sufficient beings, leading an inner life. But this idea involves the further conception of Leibnitz, that of a pre-established harmony, by which the Creator has taken care to arrange the life of each monad, so that it agrees with that of all others. This conception, according to Lotze, is neither necessary nor thoroughly intelligible. Why not interpret at once and render intelligible the common conception originating in natural science, viz. that of a system of laws which governs the many things? But, in attempting to make this conception quite clear and thinkable, we are forced to represent the connexion of things as a universal substance, the essence of which we conceive as a system of laws which underlies everything and in its own self connects everything, but imperceptible, and known to us merely through the impressions it produces on us, which we call things. A final reflection then teaches us that the nature of this universal and all-pervading substance can only be imagined by us as something analogous to our own mental life, where alone we experience the unity of a substance (which we call self) preserved in the multitude of its (mental) states. It also becomes clear that only where such mental life really appears need we assign an independent existence, but that the purposes of everyday life as well as those of science are equally served if we deprive the material things outside of us of an independence, and assign to them merely a connected existence through the universal substance by the action of which alone they can appear to us.

The universal substance, which we may call the absolute, is at this stage of our investigations not endowed with the attributes of a personal Deity, and it will remain to be seen by further analysis in how far we are able—without contradiction—to identify it with the object of religious veneration, in how far that which to metaphysics is merely a postulate can be gradually brought nearer to us and become a living power. Much in this direction is said by Lotze in various passages of his writings; anything complete, however, on the subject is wanting. Nor would it seem as if it could be the intention of the author to do much more than point out the lines on which the further treatment of the subject should advance. The actual result of his personal inquiries, the great idea which lies at the foundation of his philosophy, we know. It may be safely stated that Lotze would allow much latitude to individual convictions, as indeed it is evident that the empty notion of an absolute can only become living and significant to us in the same degree as experience and thought have taught us to realize the seriousness of life, the significance of creation, the value of the beautiful and the good, and the supreme worth of personal holiness. To endow the universal substance with moral attributes, to maintain that it is more than the metaphysical ground of everything, to say it is the perfect realization of the holy, the beautiful and the good, can only have a meaning for him who feels within himself what real not imaginary values are clothed in those expressions.

We have still to mention that aesthetics formed a principal and favourite study of Lotze's, and that he has treated this subject also in the light of the leading ideas of his philosophy. See his essays *Ueber den Begriff der Schönheit* (Gottingen, 1845) and *Ueber Bedingungen der Kunstschönheit*, ibid. (1847); and especially his *Geschichte der Aesthetik in Deutschland* (Munich, 1868).

Lotze's historical position is of much interest. Though he disclaims being a follower of Herbart, his formal definition of philosophy and his conception of the object of metaphysics are similar to those of Herbart, who defines philosophy as an attempt to remodel the notions given by experience. In this endeavour he forms with Herbart an opposition to the philosophies of Fichte, Schelling and Hegel, which aimed at objective and absolute knowledge, and also to the criticism of Kant, which aimed at determining the validity of all human knowledge. But this formal agreement includes material differences, and the spirit which breathes in Lotze's writings is more akin to the objects and aspirations of the idealistic school than to the cold formalism of Herbart. What, however, with the idealists was an object of thought alone, the absolute, is to Lotze only inadequately definable in rigorous philosophical language; the aspirations of the human heart, the contents of our feelings and desires, the aims of art and the tenets of religious faith must be grasped in order to fill the empty idea of the absolute with meaning. These manifestations of the divine spirit again cannot be traced and understood by reducing (as Hegel did) the growth of the human mind in the individual, in society and in history to the monotonous rhythm of a speculative schematism; the essence and worth which is in them reveals itself only to the student of detail, for reality is larger and wider than philosophy; the problem, "how the one can be many," is only solved for us in the numberless examples in life and experience which surround us, for which we must retain a lifelong interest and which constitute the true field of all useful human work. This conviction of the emptiness of terms and abstract notions, and of the fulness of individual life, has enabled Lotze to combine in his writings the two courses into which German philosophical thought had been moving since the death of its great founder, Leibnitz. We may define these courses by the terms esoteric and exoteric—the former the philosophy of the school, cultivated principally at the universities, trying to systematize everything and reduce all our knowledge to an intelligible principle, losing in this attempt the deeper meaning of Leibnitz's philosophy; the latter the unsystematized philosophy of general culture which we find in the work of the great writers of the classical period, Lessing, Winkelmann, Goethe, Schiller and Herder, all of whom expressed in some degree their indebtedness to Leibnitz. Lotze can be said to have brought philosophy out of the lecture-room into the market-place of life. By understanding and combining what was great and valuable in those divided and scattered endeavours, he became the true successor of Leibnitz.

The age in which Lotze lived and wrote in Germany was not one peculiarly fitted to appreciate the position he took up. Frequently misunderstood, yet rarely criticized, he was nevertheless greatly admired, listened to by devoted hearers and read by an increasing circle. But this circle never attained to the unity of a philosophical school. The real meaning of Lotze's teaching is reached only by patient study, and those who in a larger or narrower sense call themselves his followers will probably feel themselves indebted to him more for the general direction he has given to their thoughts, for the tone he has imparted to their inner life, for the seriousness with which he has taught them to consider even small affairs and practical duties, and for the indestructible confidence with which his philosophy permits them to disregard the materialism of science, the scepticism of shallow culture, the disquieting results of philosophical and historical criticism.

See E. Pfleiderer, *Lotze's philosophische Weltanschauung nach ihren Grundzügen* (Berlin, 1882; 2nd ed., 1884); E. von Hartmann, *Lotze's Philosophie* (Leipzig, 1888); O. Caspari, *H. Lotze in seiner Stellung zu der durch Kant begründeten neuesten Geschichte der Philosophie* (Breslau, 1883; 2nd ed., 1894); R. Falckenberg, *Hermann Lotze* (Stuttgart, 1901); Henry Jones, *A Critical Account of the Philosophy of Lotze* (Glasgow, 1895); Paul Lange, *Die Lehre vom Instincte bei Lotze und Darwin* (Berlin, 1896); A. Lichtenstein, *Lotze und Wundt* (Bern, 1900). (J. T. M.; H. St.)

LOUBET, ÉMILE FRANÇOIS (1838–), 7th president of the French republic, was born on the 30th of December 1838, the son of a peasant proprietor at Marsanne (Drôme), who was more than once mayor of Marsanne. He was admitted to the Parisian bar in 1862, and took his doctorate-in-law next year. He was still a student when he witnessed the sweeping triumph of the Republican party in Paris at the general election in 1863. He settled down to the exercise of his profession in Montélimar, where he married in 1869 Marie Louis Picard. He also inherited a small estate at Grignan. At the crisis of 1870 he became mayor of Montélimar, and thenceforward was a steady supporter of Gambetta's policy. Elected to the Chamber of Deputies in 1876 by Montélimar he was one of the famous 363 who in June 1877 passed the vote of want of confidence in the ministry of the duc de Broglie. In the general election of October he was re-elected, local enthusiasm for him being increased by the fact that the government had driven him from the mayoralty. In the Chamber he occupied himself especially with education, fighting the clerical system established by the Loi Falloux, and working for the establishment of free, obligatory and secular primary instruction. In 1880 he became president of the departmental council in Drôme. His support of the second Jules Ferry ministry and his zeal for the colonial expansion of France gave him considerable weight in the moderate Republican party. He had entered the Senate in 1885, and he became minister of public works in the Tirard ministry (December 1887 to March 1888). In 1892 President Sadi Carnot, who was his personal friend, asked him to form a cabinet. Loubet held the portfolio of the interior with the premiership, and had to deal with the anarchist crimes of that year and with the great strike of Carmaux, in which he acted as arbitrator, giving a decision regarded in many quarters as too favourable to the strikers. He was defeated in November on the question of the Panama scandals, but he retained the ministry of the interior in the next cabinet under Alexandre Ribot, though he resigned on its reconstruction in January. His reputation as an orator of great force and lucidity of exposition and as a safe and honest statesman procured for him in 1896 the presidency of the Senate, and in February 1899 he was chosen president of the republic in succession to Félix Faure by 483 votes as against 279 recorded by Jules Méline, his only serious competitor. He was marked out for fierce opposition and bitter insult as the representative of that section of the Republican party which sought the revision of the Dreyfus case. On the day of President Faure's funeral Paul Déroulède met the troops under General Roget on their return to barracks, and demanded that the general should march on the Élysée. Roget sensibly took his troops back to barracks. At the Auteuil steeplechase in June the president was struck on the head with a cane by an anti-Dreyfusard. In that month President Loubet summoned Waldeck-Rousseau to form a cabinet, and at the same time entreated Republicans of all shades of opinion to rally to the defence of the state. By the efforts of Loubet and Waldeck-Rousseau the Dreyfus affair was settled, when Loubet, acting on the advice of General Galliffet, minister of war, remitted the ten years' imprisonment to which Dreyfus was condemned at Rennes. Loubet's presidency saw an acute stage of the clerical question, which was attacked by Waldeck-Rousseau and in still more drastic fashion by the Combes ministry. The French ambassador was recalled from the Vatican in April 1905, and in July the separation of church and state was voted in the Chamber of Deputies. Feeling had run high between France and England over the mutual criticisms passed on the conduct of the South African War and the Dreyfus case respectively. These differences were composed by the Anglo-French *entente*, and in 1904 a convention between the two countries secured the recognition of French claims in Morocco in exchange for non-interference with the English occupation of Egypt. President Loubet was a typical example of the peasant-proprietor class, and had none of the aristocratic, not to say monarchical, proclivities of President Faure. He inaugurated the Paris Exhibition of 1900, received the tsar Nicholas II. in September 1901 and paid a visit to Russia in 1902. He also exchanged visits with King Edward VII., with the king of Italy and the king of Spain. The king of Spain's visit in 1905 was the occasion of an attempt on his life, a bomb being thrown under his carriage as he was proceeding with his guest to the opera. His presidency came to an end in January 1906, when he retired into private life.

LOUDON, ERNST GIDEON, Freiherr von (1717–1790), Austrian soldier, was born at Tootzen in Livonia, on the 2nd of February 1717. His family, of Scottish origin,[1] had been settled in that country since before 1400. His father was a lieutenant-colonel, retired on a meagre pension from the Swedish service, and the boy was sent in 1732 into the Russian army as a cadet. He took part in Field Marshal Münnich's siege of Danzig in 1734, in the march of a Russian corps to the Rhine in 1735 and in the Turkish war 1738–1739. Dissatisfied with his prospects he resigned in 1741 and sought military employment elsewhere. He applied first to Frederick the Great, who declined his services. At Vienna he had better fortune, being made a captain in Trenck's free corps. He took part in its forays and marches, though not in its atrocities, until wounded and taken prisoner in Alsace. He was shortly released by the advance of the main Austrian army. His next active service, still under Trenck, was in the Silesian mountains in 1745, in which campaign he greatly distinguished himself as a leader of light troops. He was present also at Soor. He retired shortly afterwards, owing to his distaste for the lawless habits of his comrades in the irregulars, and after long waiting in poverty for a regular commission he was at last made a captain in one of the frontier regiments, spending the next ten years in half-military, half-administrative work in the Carlstadt district. At Bunich, where he was stationed, he built a church and planted an oak forest now called by his name. He had reached the rank of lieutenant-colonel when the outbreak of the Seven Years' War called him again into the field. From this point began his fame as a soldier. Soon promoted colonel, he distinguished himself repeatedly and was in 1757 made a General-feldwacht-meister (major-general of cavalry) and a knight of the newly founded order of Maria Theresa. In the campaign of 1758 came his first opportunity for fighting an action as a commander-in-chief, and he used it so well that Frederick the Great was obliged to give up the siege of Olmütz and retire into Bohemia (action of Dom-stadtl, 30th of June). He was rewarded with the grade of lieutenant-field-marshal and having again shown himself an active and daring commander in the campaign of Hochkirch, he was created a Freiherr in the Austrian nobility by Maria Theresa and in the peerage of the Holy Roman Empire by her husband the emperor Francis. Maria Theresa gave him, further, the grand cross of the order she had founded and an estate near Kuttenberg in Bohemia. He was placed in command of the Austrian contingent sent to join the Russians on the Oder. At Kunersdorf he turned defeat into a brilliant victory, and was promoted Feldzeugmeister and made commander-in-chief in Bohemia, Moravia and Silesia. In 1760 he destroyed a whole corps of Frederick's army under Fouqué at Landshut and stormed the important fortress of Glatz. In 1760 he sustained a reverse at Frederick's hands in the battle of Liegnitz (Aug. 15th, 1760), which action led to bitter controversy with Daun and Lacy, the commanders of the main army, who, Loudon claimed, had left his corps unsupported. In 1761 he operated, as usual, in Silesia, but he found his Russian allies as timid as they had been after Kunersdorf, and all attempts against Frederick's entrenched camp of Bunzelwitz (see SEVEN YEARS' WAR) failed. He brilliantly seized his one fleeting opportunity, however, and stormed Schweidnitz on the night of Sept. 30/October 1st, 1761. His tireless activity continued to the end of the war, in conspicuous contrast with the temporizing strategy of Daun and Lacy. The student of the later campaigns of the Seven Years' War will probably admit that there was need of more aggressiveness than Daun displayed, and of more caution than suited Loudon's genius. But neither recognized this, and the last three years of the war are marked by an ever-increasing friction between the "Fabius" and the "Marcellus," as they were called, of the Austrian army.

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[1] His name is phonetically spelt Laudon or Laudohn by Germans, and the latter form was that adopted by himself and his family. In 1759, however, he reverted to the original Scottish form.

After the peace, therefore, when Daun became the virtual commander-in-chief of the army, Loudon fell into the background. Offers were made, by Frederick the Great amongst others, to induce Loudon to transfer his services elsewhere. Loudon did not entertain these proposals, although negotiations went on for some years, and on Lacy succeeding Daun as president of the council of war Loudon was made inspector-general of infantry. Dissensions, however, continued between Loudon and Lacy, and on the accession of Joseph II., who was intimate with his rival, Loudon retired to his estate near Kuttenberg. Maria Theresa and Kaunitz caused him, however, to be made commander-in-chief in Bohemia and Moravia in 1769. This post he held for three years, and at the end of this time, contemplating retirement from the service, he settled again on his estate. Maria Theresa once more persuaded him to remain in the army, and, as his estate had diminished in value owing to agrarian troubles in Bohemia, she repurchased it from him (1776) on generous terms. Loudon then settled at Hadersdorf near Vienna, and shortly afterwards was made a field-marshal. Of this Carlyle (*Frederick the Great*) records that when Frederick the Great met Loudon in 1776 he deliberately addressed him in the emperor's presence as "Herr Feldmarschall." But the hint was not taken until February 1778.

In 1778 came the War of the Bavarian Succession. Joseph and Lacy were now reconciled to Loudon, and Loudon and Lacy commanded the two armies in the field. On this occasion, however, Loudon seems to have in a measure fallen below his reputation, while Lacy, who was opposed to Frederick's own army, earned new laurels. For two years after this Loudon lived quietly at Hadersdorf, and then the reverses of other generals in the Turkish War called him for the last time into the field. Though old and broken in health, he was commander-in-chief in fact as well as in name, and he won a last brilliant success by capturing Belgrade in three weeks, 1789. He died within the year, on the 14th of July at Neu-Titschein in Moravia, still on duty. His last appointment was that of commander-in-chief of the armed forces of Austria, which had been created for him by the new emperor Leopold. Loudon was buried in the grounds of Hadersdorf. Eight years before his death the emperor Joseph had caused a marble bust of this great soldier to be placed in the chamber of the council of war.

His son JOHANN LUDWIG ALEXIUS, Freiherr von Loudon (1762–1822) fought in the Revolutionary and Napoleonic Wars with credit, and rose to the rank of lieutenant-field-marshal.

See memoir by v. Arneth in *Allgemeine deutsche Biographie*, s.v. "Laudon," and life by G. B. Malleson.

LOUDOUN, JOHN CAMPBELL, 1ST EARL OF (1598–1663), Scottish politician, eldest son of Sir James Campbell of Lawers, became Baron Loudoun in right of his wife Margaret, granddaughter of Hugh Campbell, 1st Baron Loudoun (d. 1622). He was created earl on the 12th of May 1633, but in consequence of his opposition to Charles I.'s church policy in Scotland the patent was stopped in Chancery. In 1637 he was one of the supplicants against the introduction of the English liturgy; and with John Leslie, 6th earl of Rothes, he took a leading part in the promulgation of the Covenant and in the General Assembly which met at Glasgow in the autumn of 1638. He served under General Leslie, and was one of the Scottish commissioners at the Pacification of Berwick in June 1639. In November of that year and again in 1640 the Scottish estates sent Loudoun with Charles Seton, 2nd earl of Dunfermline, to London on an embassy to Charles I. Loudoun intrigued with the French ambassador and with Thomas Savile, afterwards earl of Sussex, but without much success. He was in London when John Stewart, earl of Traquair, placed in Charles's hands a letter signed by Loudoun and six others and addressed to Louis XIII. In spite of his protest that the letter was never sent, and that it would in any case be covered by the amnesty granted at Berwick, he was sent to the Tower. He was released in June, and two months later he re-entered England with the Scottish invading army, and was one of the commissioners at Ripon in October. In the following August (1641) Charles opened parliament at Edinburgh in person, and in pursuance of a policy of conciliation towards the leaders of the Covenant Loudoun was made lord chancellor of Scotland, and his title of earl of Loudoun was allowed. He also became first commissioner of the treasury. In 1642 he was sent by the Scottish council to York to offer to mediate in the dispute between Charles and the parliament, and later on to Oxford, but in the second of these instances Charles refused to accept his authority. He was constantly employed in subsequent negotiations, and in 1647 was sent to Charles at Carisbrooke Castle, but the "Engagement" to assist the king there made displeased the extreme Covenanters, and Loudoun was obliged to retract his support of it. He was now entirely on the side of the duke of Argyll and the preachers. He assisted in the capacity of lord chancellor at Charles II.'s coronation at Scone, and was present at Dunbar. He joined in the royalist rising of 1653, but eventually surrendered to General Monk. His estates were forfeited by Cromwell, and a sum of money settled on the countess and her heirs. At the Restoration he was removed from the chancellorship, but a pension of £1000 granted him by Charles I. in 1643 was still allowed him. In 1662 he was heavily fined. He died in Edinburgh on the 15th of March 1663.

The earl's elder son, James (d. 1684), 2nd earl of Loudoun, passed his life out of Great Britain, and when he died at Leiden was succeeded by his son Hugh (d. 1731). The 3rd earl held various high positions in England and Scotland, being chosen one of the representative peers for Scotland at the union of the parliaments in 1707. He rendered good service to the government during the rising of 1715, especially at the battle of Sheriffmuir, and was succeeded as 4th earl by his son John (1705–1782), who fought against the Jacobites in 1745, was commander-in-chief of the British force in America in 1756 and died unmarried. The title then passed to James Mure Campbell (d. 1786), a grandson of the 2nd earl, and was afterwards borne by the marquesses of Hastings, descendants of the 5th earl's daughter and heiress, Flora (1780–1840). Again reverting to a female on the death of Henry, 4th marquess of Hastings, in 1868, it came afterwards to Charles (b. 1855), a nephew of this marquess, who became 11th earl of Loudoun.

LOUDUN, a town of western France, capital of an arrondissement in the department of Vienne, on an eminence overlooking a fertile plain, 45 m. by rail S.W. of Tours. Pop. (1906) 3931. It was formerly surrounded by walls, of which a single gateway and two towers remain. Of the old castle of the counts of Anjou which was destroyed under Richelieu, the site now forming a public promenade, a fine rectangular donjon of the 12th century is preserved; at its base traces of Roman constructions have been found, with fragments of porphyry pavement, mosaics and mural paintings. The Carmelite convent was the scene of the trial of Urban Grandier, who was burnt alive for witchcraft in 1634; the old Romanesque church of Sainte Croix, of which he was curé, is now used as a market. The church of St Pierre-du-Marché, Gothic in style with a Renaissance portal, has a lofty stone spire. There are several curious old houses in the town.

Théophraste Renaudot (d. 1653), founder of the *Gazette de France*, was born at Loudun, where there is a statue of him. The manufacture of lace and upholstery trimming and of farm implements is carried on, and there is a considerable trade in agricultural products, wine, &c. Loudun (*Laudunum* in ancient times) was a town of importance during the religious wars and gave its name in 1616 to a treaty favourable to the Protestants.

LOUGHBOROUGH, a market town and municipal borough in the Loughborough (Mid) parliamentary division of Leicestershire, England, near the river Soar and on the Loughborough canal. Pop. (1901) 21,508. It is 110 m. N.N.W. of London by the Midland railway, and is served by the Great Central and a branch of the London and North-Western railways. The neighbourhood is a rich agricultural district, and to the S.W. lies the hilly tract known as Charnwood Forest. The church of All Saints stands on rising ground, and is a conspicuous object for many miles round; it is of Decorated work, and the tower is Perpendicular. The other churches are modern. Public buildings include the town hall and exchange, town offices, county hall and free library. The grammar school, founded in 1495 under the charity of Thomas Burton, occupies modern buildings in pleasant grounds. There is also a girls' grammar school partly dependent on the same foundation. The principal industry is hosiery making; there are also engineering, iron and dye works and bell foundries. The great bell for St Paul's cathedral, London, was cast here in 1881. Loughborough was incorporated in 1888. Area, 3045 acres.

The manor of Loughborough (*Lucteburne*, *Lucteburg*, *Lughteburgh*) was granted by William the Conqueror to Hugh Lupus, from whom it passed to the Despensers. In 1226–1227 when it belonged to Hugh Despenser he obtained various privileges for himself and his men and tenants there, among which were quittance from suits at the county and hundred courts, of sheriffs' aids and of view of frankpledge, and also a market every Thursday and a fair on the vigil, day and morrow of St Peter ad vincula. The market rights were purchased by the town in 1880 from the trustees of Thomas Cradock, late lord of the manor. Edward II. visited the manor several times when it belonged to his favourite, Hugh Despenser the elder. Among the subsequent lords were Henry de Beaumont and Alice his wife, Sir Edward Hastings, created Baron Hastings of Loughborough in 1558, Colonel Henry Hastings, created baron in 1645, and the earls of Huntingdon. Alexander Wedderburn was created Baron Loughborough in 1780 when he became chief justice of the common pleas. During the 19th century most of the manorial rights were purchased by the local board. Loughborough was at first governed by a bailiff, afterwards by a local board, and was finally incorporated in 1888 under a mayor, 6 aldermen and 18 councillors. It has never been represented in parliament. Lace-making was formerly the chief industry, but machines for making lace set up in the town by John Heathcote were destroyed by the Luddites in 1816, and the manufacture lost its importance. Bell-founding was introduced in 1840. John Cleveland, the Royalist poet, was born at Loughborough in 1613, John Howe the painter in 1630 and Richard Pulteney the botanist in 1730.

See *Victoria County History, Leicestershire*; W. G. D. Fletcher, *Chapters in the History of Loughborough* (1883); Sir Thomas Pochin, "Historical Description of Loughborough" (1770) (vol. viii. of *Bibliotheca topographica Britannica*).

LOUGHREA, a market town of Co. Galway, Ireland, pleasantly situated on the N. shore of Lough Rea, 116 m. W. from Dublin by a branch from Attymon Junction on the Midland Great Western railway. Pop. (1901), 2815. There are slight remains of an Early English Carmelite friary dating *c.* 1300, which escaped the Dissolution. Loughrea is the seat of the Roman Catholic bishop of Clonfert, and has a cathedral built in 1900–1905. A part of the castle of Richard de Burgh, the founder of the friary, still survives, and there are traces of the town fortifications. In the neighbourhood are a cromlech and two ruined towers, and crannogs, or ancient stockaded islands, have been discovered in the lough. Apart from the surroundings of the lough, the neighbouring country is peculiarly desolate.

LOUGHTON, an urban district in the Epping parliamentary division of Essex, England, 11½ m. N.N.E. of Liverpool Street station, London, by the Great Eastern railway. Pop. (1901), 4730. This is one of the villages which has become the centre of a residential district, and is frequented by holiday-makers from London, owing to its proximity to the pleasant woodland scenery of Epping Forest. It lies on the eastern outskirts of the Forest, near the river Roding. There are several modern churches. The lordship of the manor was granted to Waltham Abbey. In the vicinity are large earthworks, probably of British origin, known as Loughton Camp.

LOUHANS, a town of east-central France in the old province of Franche-Comté, now capital of an arrondissement in the department of Saône-et-Loire, 34 m. N.N.E. of Mâcon by road. Pop. (1906), 3216. Its church has a fine tower of the 15th century, of which the balustrade is carved so as to form the first words of the Ave Maria. There are also a hospital of the 17th century with a collection of ancient earthenware, a town-hall of the 18th century and remains of ramparts of the 16th and 17th century. The town is the central market of the agricultural plain of Bresse; chickens form the chief article of commerce. There is also a large felt-hat manufactory.

LOUIS, or LEWIS (from the Frankish *Chlodowîch*, *Chlodwig*, Latinized as *Chlodowius*, *Lodhuwicus*, *Lodhuvicus*, whence—in the Strassburg oath of 842—O. Fr. *Lodhuwigs*, then *Chlovis*, *Loys* and later *Louis*, whence Span. *Luiz* and—through the Angevin kings—Hungarian *Lájos*; cf. Ger. *Ludwig* or *Ludewig*, from O. H. Ger. *Hluduwîc*, *Hludwîg*, *Ludhuwîg*, M. H. Ger. *Ludewîc*; Ital. *Lodovico*), a masculine proper name, meaning "Fame-fight" or "Famous in fight," from old Frankish *chlud*, *chlod* (O. H. Ger. *hlud*, *hlod*), "fame," and *wîch* (O. H. Ger. *wîc.*, *wîg*, A.S. *wîg*) "war," "battle" (cf. Gr. Κλυτόμαχος). The name has been borne by numerous European sovereigns and others, of whom some are noticed below in the following order: (1) Roman emperors and Frankish and German kings, (2) kings of Bavaria, (3) kings of France, (4) kings of Hungary, (5) kings of Naples, (6) Louis of Nassau. (Louis Philippe, king of the French, is dealt with separately.)

LOUIS I. (778–840), surnamed the "Pious," Roman emperor, third son of the emperor Charlemagne and his wife Hildegarde, was born at Chasseneuil in central France, and crowned king of Aquitaine in 781. He received a good education; but as his tastes were ecclesiastical rather than military, the government of his kingdom was mainly conducted by his counsellors. Louis, however, gained sound experience in warfare in the defence of Aquitaine, shared in campaigns against the Saxons and the Avars, and led an army to Italy in 792. In 794 or 795 he married Irmengarde, daughter of Ingram, count of Haspen. After the deaths of his two elder brothers, Louis, at his father's command, crowned himself co-emperor at Aix-la-Chapelle on the 11th of September 813, and was formally associated in the government of the Empire, of which he became sole ruler, in the following January. He earned the surname of "Pious" by banishing his sisters and others of immoral life from court; by attempting to reform and purify monastic life; and by showing great liberality to the church. In October 816 he was crowned emperor at Reims by Pope Stephen IV.; and at Aix in July 817, he arranged for a division of his Empire among his sons. This was followed by a revolt of his nephew, Bernard, king of Italy; but the rising was easily suppressed, and Bernard was mutilated and killed. The emperor soon began to repent of this cruelty, and when his remorse had been accentuated by the death of his wife in 818, he pardoned the followers of Bernard and restored their estates, and in 822 did public penance at Attigny. In 819 he married Judith, daughter of Welf I., count of Bavaria, who in 823 bore him a son Charles, afterwards called the Bald. Judith made unceasing efforts to secure a kingdom for her child; and with the support of her eldest step-son Lothair, a district was carved out for Charles in 829. Discontent at this arrangement increased to the point of rebellion, which broke out the following year, provoked by Judith's intrigues with Bernard, count of Barcelona, whom she had installed as her favourite at court. Lothair and his brother Pippin joined the rebels, and after Judith had been sent into a convent and Bernard had fled to Spain, an assembly was held at Compiègne, when Louis was practically deposed and Lothair became the real ruler of the Empire. Sympathy was, however, soon aroused for the emperor, who was treated as a prisoner, and a second assembly was held at Nimwegen in October 830 when, with the concurrence of his sons Pippin and Louis, he was restored to power and Judith returned to court.

Further trouble between Pippin and his father led to the nominal transfer of Aquitaine from Pippin to his brother Charles in 831. The emperor's plans for a division of his dominions then led to a revolt of his three sons. Louis met them in June 833 near Kolmar, but owing possibly to the influence of Pope Gregory IV., who took part in the negotiations, he found himself deserted by his supporters, and the treachery and falsehood which marked the proceedings gave to the place the name of *Lügenfeld*, or the "field of lies." Judith, charged with infidelity, was again banished; Louis was sent into the monastery of St Medard at Soissons; and the government of the Empire was assumed by his sons. The emperor was forced to confess his sins, and declare himself unworthy of the throne, but Lothair did not succeed in his efforts to make his father a monk. Sympathy was again felt for Louis, and when the younger Louis had failed to induce Lothair to treat the emperor in a more becoming fashion, he and Pippin took up arms on behalf of their father. The result was that in March 834 Louis was restored to power at St Denis; Judith once more returned to his side and the kingdoms of Louis and Pippin were increased. The struggle with Lothair continued until the autumn, when he submitted to the emperor and was confined to Italy. To make the restoration more complete, a great assembly at Diedenhofen declared the deposition of Louis to have been contrary to law, and a few days later he was publicly restored in the cathedral of Metz. In December 838 Pippin died, and a new arrangement was made by which the Empire, except Bavaria, the kingdom of Louis, was divided between Lothair, now reconciled to his father, and Charles. The emperor was returning from suppressing a revolt on the part of his son Louis, provoked by this disposition, when he died on the 20th of June 840 on an island in the Rhine near Ingelheim. He was buried in the church of St Arnulf at Metz. Louis was a man of strong frame, who loved the chase, and did not shrink from the hardships of war. He was, however, easily influenced and was unequal to the government of the Empire bequeathed to him by his father. No sustained effort was made to ward off the inroads of the Danes and others, who were constantly attacking the borders of the Empire. Louis, who is also called *Le Débonnaire*, counts as Louis I., king of France.

See *Annales Fuldenses*; *Annales Bertiniani*; Thegan, *Vita Hludowici*; the *Vita Hludowici* attributed to Astronomus; Ermoldus Nigellus, *In honorem Hludowici imperatoris*; Nithard, *Historiarum libri*, all in the *Monumenta Germaniae historica. Scriptores*, Bände i. and ii. (Hanover and Berlin, 1826 fol.); E. Mühlbacher, *Die Regesten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881); and *Deutsche Geschichte unter den Karolingern* (Stuttgart, 1886); B. Simson, *Jahrbücher des fränkischen Reichs unter Ludwig dem Frommen* (Leipzig, 1874–1876); and E. Dümmler, *Geschichte des ostfränkischen Reiches* (Leipzig, 1887–1888).

(A. W. H.*)

LOUIS II. (825–875), Roman emperor, eldest son of the emperor Lothair I., was designated king of Italy in 839, and taking up his residence in that country was crowned king at Rome by Pope Sergius II. on the 15th of June 844. He at once preferred a claim to the rights of an emperor in the city, which was decisively rejected; but in 850 he was crowned joint emperor at Rome by Pope Leo IV., and soon afterwards married his cousin, Engelberga, a daughter of King Louis the German, and undertook the independent government of Italy. He took the field against the Saracens; quashed some accusations against Pope Leo; held a diet at Pavia; and on the death of his father in September 855 became sole emperor. The division of Lothair's dominions, by which he obtained no territory outside Italy, aroused his discontent, and in 857 he allied himself with Louis the German against his brother Lothair, king of Lorraine, and King Charles the Bald. But after Louis had secured the election of Nicholas I. as pope in 858, he became reconciled with his brother, and received some lands south of the Jura in return for assistance given to Lothair in his efforts to obtain a divorce from his wife, Teutberga. In 863, on the death of his brother Charles, Louis received the kingdom of Provence, and in 864 came into collision with Pope Nicholas I. over his brother's divorce. The archbishops, who had been deposed by Nicholas for proclaiming this marriage invalid, obtained the support of the emperor, who reached Rome with an army in February 864; but, having been seized with fever, he made peace with the pope and left the city. In his efforts to restore order in Italy, Louis met with considerable success both against the turbulent princes of the peninsula and against the Saracens who were ravaging southern Italy. In 866 he routed these invaders, but could not follow up his successes owing to the want of a fleet. So in 869 he made an alliance with the eastern emperor, Basil I., who sent him some ships to assist in the capture of Bari, the headquarters of the Saracens, which succumbed in 871. Meanwhile his brother Lothair had died in 869, and owing to his detention in southern Italy he was unable to prevent the partition of Lorraine between Louis the German and Charles the Bald. Some jealousy between Louis and Basil followed the victory at Bari, and in reply to an insult from the eastern emperor Louis attempted to justify his right to the title "emperor of the Romans." He had withdrawn into Benevento to prepare for a further campaign, when he was treacherously attacked in his palace, robbed and imprisoned by Adelchis, prince of Benevento, in August 871. The landing of fresh bands of Saracens compelled Adelchis to release his prisoner a month later, and Louis was forced to swear he would take no revenge for this injury, nor ever enter Benevento with an army. Returning to Rome, he was released from his oath, and was crowned a second time as emperor by Pope Adrian II. on the 18th of May 872. He won further successes against the Saracens, who were driven from Capua, but the attempts of the emperor to punish Adelchis were not very successful. Returning to northern Italy, he died, somewhere in the province of Brescia, on the 12th of August 875, and was buried in the church of St Ambrose at Milan, having named as his successor in Italy his cousin Carloman, son of Louis the German. Louis was an excellent ruler, of whom it was said "in his time there was great peace, because every one could enjoy his own possessions."

See *Annales Bertiniani*, *Chronica S. Benedicti Casinensis*, both in the *Monumenta Germaniae historica. Scriptores*, Bände i. and iii. (Hanover and Berlin, 1826 fol.); E. Mühlbacher, *Die Regesten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881); Th. Sickel, *Acta regum et imperatorum Karolinorum, digesta et enarrata* (Vienna, 1867–1868); and E. Dümmler, *Geschichte des ostfränkischen Reiches* (Leipzig, 1887–1888). (A. W. H.*)

LOUIS III. (*c.* 880–928), surnamed the "Blind," Roman emperor, was a son of Boso, king of Provence or Lower Burgundy, and Irmengarde, daughter of the emperor Louis II. The emperor Charles the Fat took Louis under his protection on the death of Boso in 887; but Provence was in a state of wild disorder, and it was not until 890, when Irmengarde had secured the support of the Bavarian king Arnulf and of Pope Stephen V., that Louis was recognized as king. In 900, after the death of the emperor Arnulf, he went to Italy to obtain the imperial crown. He was chosen king of the Lombards at Pavia, and crowned emperor at Rome in February 901 by Pope Benedict IV. He gained a temporary authority in northern Italy, but was soon compelled by his rival Berengar, margrave of Friuli, to leave the country and to swear he would never return. In spite of his oath he went again to Italy in 904, where he secured the submission of Lombardy; but on the 21st of July 905 he was surprised at Verona by Berengar, who deprived him of his sight and sent him back to Provence, where he passed his days in enforced inactivity until his death in September 928. He married Adelaide, possibly a daughter of Rudolph I., king of Upper Burgundy. His eldest son, Charles Constantine, succeeded to no more than the county of Vienne.

See *Forschungen zur deutschen Geschichte*, Bände ix. and x. (Göttingen, 1862–1886); E. Dümmler, *Geschichte des ostfränkischen Reichs* (Leipzig, 1887–1888); and *Gesta Berengarii imperatoris* (Halle, 1871); and F. de Gingins-la-Sarra, *Mémoires pour servir à l'histoire de Provence et de Bourgogne Jurane* (Zürich, 1851). (A. W. H.*)

LOUIS IV., or **V.** (*c.* 1287–1347), surnamed the Bavarian, Roman emperor and duke of Upper Bavaria, was the second son of Louis II., duke of Upper Bavaria and count palatine of the Rhine, and Matilda, daughter of the German king Rudolph I. Having lost his father in 1294 he inherited, jointly with his elder brother Rudolph, Upper Bavaria and the Palatinate, but passed his time mainly at the court of the Habsburgs in Vienna, while his early experiences of warfare were gained in the campaigns of his uncle, the German king Albert I. He was soon at variance with his brother over their joint possessions. Albert taking the part of Louis in this quarrel, Rudolph promised in 1301 to admit his brother to a share in the government of Bavaria and the Palatinate. When Albert was murdered in May 1308, Louis became a candidate for the German throne; but his claim was not strongly supported. The new king, Henry VII., was very friendly with Rudolph, and as the promise of 1301 had not been carried out, Louis demanded a partition of their lands. Upper Bavaria was accordingly divided in 1310, and Louis received the north-western part of the duchy; but Rudolph refused to surrender any part of the Palatinate. In 1310, on the death of Stephen I., duke of Lower Bavaria, Louis undertook the guardianship of his two young sons. This led to a war between the brothers, which lasted till June 1313, when peace was made at Munich. Many of the nobles in Lower Bavaria, however, angered at Louis, called in the aid of Frederick I. (the Fair), duke of Austria; but he was defeated at Gammelsdorf on the 9th of November 1313, a victory which not only led to peace, but conferred considerable renown on Louis.

In August 1313 the German throne had again become vacant, and Louis was chosen at Frankfort on the 20th of October 1314 by a majority of the electors, and his coronation followed at Aix-la-Chapelle on the 25th of November. A minority of princes had, however, supported Frederick of Austria; and a war followed between the rivals, during which Louis was supported by the cities and the districts of the middle and lower Rhine. His embarrassments were complicated by a renewal of the dispute with his brother; but when this had been disposed of in 1317 by Rudolph's renunciation of his claims on upper Bavaria and the Palatinate in consideration of a yearly subsidy, Louis was able to give undivided attention to the war with Frederick, and obtained several fresh allies. On the 28th of September 1322 a battle was fought at Mühldorf, which ended in a complete victory for Louis, owing mainly to the timely aid of Frederick IV. of Hohenzollern, burgrave of Nüremburg. Frederick of Austria was taken prisoner, but the struggle was continued by his brother Leopold until the latter's death in 1326. Attempts to enable the two kings to rule Germany jointly failed, and about 1326 Frederick returned to Austria, leaving Louis in undisputed possession of the country. Before this conclusion, however, a new enemy had taken the field. Supported by Philip V. of France in his desire to free Italy entirely from German influence, Pope John XXII. refused to recognize either Frederick or Louis, and asserted his own right to administer the empire during a vacancy. After the battle of Mühldorf Louis sent Berthold of Neifen, count of Marstetten, into Italy with an army, which soon compelled the papal troops to raise the siege at Milan. The pope threatened Louis with excommunication unless he resigned his kingdom within three months. The king thereupon appealed to a general council, and was placed under the papal ban on the 23rd of March 1324, a sentence which he answered by publishing his charges against the pope. In the contest Louis was helped by the Minorites, who were upholding against John the principal of clerical poverty, and by the writings of Marsilius of Padua (who dedicated to Louis his *Defensor pacis*), William of Occam, John of Jandun and others. Taking the offensive, Louis met his Ghibelline supporters at Trent and reached Italy in March 1327; and in May he received the Lombard crown at Milan. Although the pope renewed his fulminations Louis compelled Pisa to surrender, and was hailed with great rejoicing in Rome. On the 17th of January 1328 he was crowned emperor in St Peter's by Sciarra Colonna, a Roman noble; and he answered the continued attacks of Pope John by pronouncing his deposition, and proclaiming Peter of Corvara pope as Nicholas V. He then undertook an expedition against John's ally, Robert, king of Naples, but, disunion among his troops and scarcity of money and provisions, drove him again to Rome, where, finding that his exactions had diminished his popularity, he left the city, and after passing six months at Pisa, returned to Germany in January 1330. The struggle with the pope was renewed in Germany, and when a formidable league had been formed against Louis, his thoughts turned to a reconciliation. He was prepared to assent to very humiliating terms, and even agreed to abdicate; but the negotiations, which were prolonged by further demands on the part of the pope, were interrupted by his death in December 1334. John's successor, Benedict XII., seemed more anxious to come to an arrangement, but was prevented from doing so by the influence of Philip VI. of France. Overtures for peace were made to Philip, but without success; and in July 1337 Louis concluded an alliance with Edward III., king of England, and made active preparations for war. During these years his attention was also occupied by a quarrel with John, king of Bohemia, over the possession of Tirol, by a campaign in Lower Bavaria, and a futile expedition against Nicholas I., bishop of Constance. But although his position was shaken by the indifferent success which attended these campaigns, it was improved when the electors meeting at Rense in July 1338 banded themselves together to defend their elective rights, and when the diet at Frankfort confirmed a decree which declared that the German king did not need the papal approbation to make his election valid.

Louis devoted considerable thought and time to extending the possessions of the Wittelsbach family, to which he belonged. Tirol had for some time been a subject of contention between the emperor and other princes. The heiress of this county, Margaret Maultasch, had married John Henry, margrave of Moravia, son of King John of Bohemia. Having quarrelled with her husband, Margaret fled to the protection of Louis, who seized the opportunity to declare her marriage void and to unite her in 1342 with his son Louis. The emperor also increased his possessions by his own marriage. In 1322 his first wife, Beatrice, daughter of Henry III., count of Glogau, had died after thirteen years of married life, and Louis then married Margaret, daughter of William III., count of Holland. When her brother, count William IV., died childless in 1345, the emperor obtained possession of Holland, Zealand and Friesland. In 1341 he recovered a portion of the Palatinate, and soon deserted Edward of England and came to terms with Philip of France. The acquisition of the territories, and especially of Tirol, had provided Louis with many enemies, prominent among whom were John of Bohemia and his family, that of Luxemburg. John, therefore, entered into an alliance with Pope Clement VI. The course of the war which ensued in Germany was such as to compel the emperor to submit to humiliating terms, though he stopped short of accepting the election of Charles, margrave of Moravia (afterwards the emperor Charles IV.) as German king in July 1346. Charles consequently attacked Tirol; but Louis, who appeared to have considerable chances of success, died suddenly at a bear-hunt near Munich on the 11th of October 1347. He was buried in the Frauenkirche at Munich, where a statue was erected to his memory in 1622 by Maximilian I., elector of Bavaria, and where a second was unveiled in 1905. He had seven sons, three of whom were subsequently electors of Brandenburg, and ten daughters.

Various estimates have been formed of the character of Louis. As a soldier he possessed skill as well as bravery, but he lacked perseverance and decision in his political relations. At one time haughtily defying the pope, at another abjectly craving his pardon, he seems a very inglorious figure; and the fact that he remained almost undisturbed in the possession of Germany in spite of the utmost efforts of the popes, is due rather to the political and intellectual tendencies of the time than to his own good qualities. Nevertheless he ruled Bavaria with considerable success. He befriended the towns, encouraged trade and commerce and gave a new system of laws to the duchy. German took the place of Latin in the imperial charters, and although not a scholar, the emperor was a patron of learning. Louis was a man of graceful appearance, with ruddy countenance and prominent nose.

Bibliography.—Many of the authorities for the life and reign of Louis are found in the *Fontes rerum Germanicarum*, Bände i. and iv., edited by J. F. Böhmer (Stuttgart, 1843–1868). Among these is the *Vita Ludovici IV.*, by an unknown author. A number of important documents are found in the *Regesta imperii 1314–1347*, edited by J. F. Böhmer and J. Ficker (Innsbruck, 1865); *Acta imperii selecta*, edited by J. F. Böhmer and J. Ficker (Innsbruck, 1870); *Urkunden zur Geschichte des Römerzuges Königs Ludwigs des Bayern*, edited by J. Ficker (Innsbruck, 1865); *Urkundliche Beiträge zur Geschichte Kaisers Ludwigs IV.*, edited by C. Höfler (Munich, 1839); *Vatikanische Urkunden zur Geschichte Kaisers Ludwigs des Bayern*, Bände v. and vi. (Stuttgart, 1877–1888); *Vatikanische Akten zur Deutschen Geschichte in der Zeit Kaisers Ludwigs des Bayern*, edited by S. Riezler (Innsbruck, 1891). In the *Forschungen zur Deutschen Geschichte* (Göttingen, 1862–1886), Band xx., is found *Urkunden zur Bairischen und Deutschen Geschichte 1256–1343*, edited by S. Riezler; and in Band xiii. is C. Häutle's *Beiträge zum Itinerar Kaiser Ludwigs.*

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LOUIS (804–876) surnamed the "German," king of the East Franks, was the third son of the emperor Louis I. and his wife Irmengarde. His early years were partly spent at the court of his grandfather Charlemagne, whose special affection he is said to have won. When the emperor Louis divided his dominions between his sons in 817, Louis received Bavaria and the neighbouring lands, but did not undertake the government until 825, when he became involved in war with the Slavonic tribes on his eastern frontier. In 827 he married Emma, daughter of Welf I., count of Bavaria, and sister of his stepmother Judith; and he soon began to interfere in the quarrels arising from Judith's efforts to secure a kingdom for her own son Charles, and the consequent struggles of Louis and his brothers with the emperor Louis I. (*q.v.*). When the elder Louis died in 840 and his eldest son Lothair claimed the whole Empire, Louis in alliance with his half-brother, king Charles the Bald, defeated Lothair at Fontenoy on the 25th of June 841. In June 842 the three brothers met on an island in the Saône to negotiate a peace, and each appointed forty representatives to arrange the boundaries of their respective kingdoms. This developed into the treaty of Verdun concluded in August 843, by which Louis received the bulk of the lands of the Carolingian empire lying east of the Rhine, together with a district around Spires, Worms and Mainz, on the left bank of the river. His territories included Bavaria, where he made Regensburg the centre of his government, Thuringia, Franconia and Saxony. He may truly be called the founder of the German kingdom, though his attempts to maintain the unity of the Empire proved futile. Having in 842 crushed a rising in Saxony, he compelled the Abotrites to own his authority, and undertook campaigns against the Bohemians, the Moravians and other tribes, but was not very successful in freeing his shores from the ravages of Danish pirates. At his instance synods and assemblies were held where laws were decreed for the better government of church and state. In 853 and the following years Louis made more than one attempt to secure the throne of Aquitaine, which the people of that country offered him in their disgust with the cruel misrule of Charles the Bald. But though he met with sufficient success to encourage him to issue a charter in 858, dated "the first year of the reign in West Francia," treachery and desertion in his army, and the loyalty to Charles of the Aquitanian bishops brought about the failure of the enterprise, which Louis renounced by a treaty signed at Coblenz on the 7th of June 860.

In 855 the emperor Lothair died, and was succeeded in Italy by his eldest son Louis II., and in the northern part of his kingdom by his second son, Lothair. The comparative weakness of these kingdoms, together with the disorder caused by the matrimonial troubles of Lothair, afforded a suitable opening for the intrigues of Louis and Charles the Bald, whose interest was increased by the fact that both their nephews were without male issue. Louis supported Lothair in his efforts to divorce his wife Teutberga, for which he received a promise of Alsace, while Charles opposed the divorce. But in 865 Louis and Charles meeting near Toul, renewed the peace of Coblenz, and doubtless discussed the possibility of dividing Lothair's kingdom. In 868 at Metz they agreed definitely to a partition; but when Lothair died in 869, Louis was lying seriously ill, and his armies were engaged with the Moravians. Charles the Bald accordingly seized the whole kingdom; but Louis, having recovered, compelled him by a threat of war to agree to the treaty of Mersen, which divided it between the claimants. The later years of Louis were troubled by risings on the part of his sons, the eldest of whom, Carloman, revolted in 861 and again two years later; an example that was followed by the second son Louis, who in a further rising was joined by his brother Charles. A report that the emperor Louis II. was dead led to peace between father and sons. The emperor, however, was not dead, but a prisoner; and as he was not only the nephew, but also the son-in-law of Louis, that monarch hoped to secure both the imperial dignity and the Italian kingdom for his son Carloman. Meeting his daughter Engelberga, the wife of Louis II., at Trent in 872, Louis made an alliance with her against Charles the Bald, and in 874 visited Italy doubtless on the same errand. The emperor, having named Carloman as his successor, died in August 875, but Charles the Bald reached Italy before his rival, and by persuading Carloman, when he did cross the Alps, to return, secured the imperial crown. Louis was preparing for war when he died on the 28th of September 876 at Frankfort, and was buried at Lorsch, leaving three sons and three daughters. Louis was in war and peace alike, the most competent of the descendants of Charlemagne. He obtained for his kingdom a certain degree of security in face of the attacks of Normans, Hungarians, Moravians and others. He lived in close alliance with the Church, to which he was very generous, and entered eagerly into schemes for the conversion of his heathen neighbours.

See *Annales Fuldenses*; *Annales Bertiniani*; Nithard, *Historiarum Libri*, all in the *Monumenta Germaniae historica. Scriptores*, Bände i. and ii. (Hanover and Berlin, 1826 seq.); E. Dümmler, *Geschichte des ostfränkischen Reiches* (Leipzig, 1887–1888); Th. Sickel, *Die Urkunden Ludwigs des Deutschen* (Vienna, 1861–1862); E. Mühlbacher, *Die Regesten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881); and A. Krohn, *Ludwig der Deutsche* (Saarbrücken, 1872). (A. W. H.*)

LOUIS I., king of Bavaria (1786–1868), son of the then prince, afterwards duke and elector, Max Joseph of Zweibrücken and his wife Princess Augusta of Hesse-Darmstadt (–1796), was born at Strassburg on the 25th of August 1786. He received a careful education at home, afterwards (in 1803) going to the Bavarian national university of Landshut and to Göttingen. As a young man he was drawn into the Romantic movement then at its height; but both the classics and contemporary classical poetry took hold upon his receptive mind (he visited Goethe in 1827). He had himself strong artistic tendencies, though his numerous poems show but little proof of this, and as a patron of the arts he proved himself as great as any who had ever occupied a

German throne, and more than a mere dilettante. His first visit to Italy, in 1804, had an important influence upon this side of his development.

But even in Italy the crown prince (his father had become elector in 1799 and king of Bavaria in 1805) did not forget his nationality. He soon made himself leader of the small anti-French party in Bavaria. Napoleon sought in vain to win him over, and Louis fell more and more out of favour with him. Napoleon was even reported to have said: "Qui m'empêche de laisser fusiller ce prince?" Their relations continued to be strained, although in the campaigns of 1807 and 1809, in which Bavaria was among the allies of France, Louis won his laurels in the field.

The crown prince was also averse from a Napoleonic marriage, and preferred to marry (October 12, 1810) the Princess Therese of Saxe-Hildburghausen (1792–1854). Three daughters and four sons were born of this marriage, one of whom succeeded him as Maximilian II., while another, Luitpold, became prince regent of Bavaria on the death of Louis II.

During the time that he was crown prince Louis resided chiefly at Innsbruck or Salzburg as governor of the circle of the Inn and Salzach. In 1815 he attended the Congress of Vienna, where he was especially occupied in endeavouring to obtain the restoration of Alsace and Lorraine to Germany; and later in the year he was with the allies in Paris, using his influence to secure the return of the art treasures carried off by the French.

After 1815 also the crown prince maintained his anti-French attitude, and it was mainly his influence that in 1817 secured the fall of Montgelas, the minister with French sympathies. Opposed to absolutism, Louis took great interest in the work of organizing the Bavarian constitution (1818) and defended it against Metternich and the Carlsbad Decrees (1819); he was also one of the most zealous of the ardent Philhellenes in Germany at the time. He succeeded to the crown of Bavaria on the 12th of October 1825, and at once embarked upon a moderate constitutional policy, in which he found himself in general agreement with the parliament. Although he displayed a loyal attachment to the Catholic Church, especially owing to his artistic sympathies, he none the less opposed all its more exaggerated pretensions, especially as represented by the Jesuits, whom he condemned as un-German. In the year of his accession he abolished an old edict concerning the censorship. He also furthered in many ways the internal administration of the state, and especially that of the finances. His personal tastes, apart from his activities as a Maecenas, being economical, he endeavoured also to limit public expenditure, in a way which was not always a benefit to the country. Bavaria's power of self-defence especially was weakened by his economies and by his lack of interest in the military aspect of things.

He was a warm friend of learning, and in 1826 transferred the university of Landshut to Munich, where he placed it under his special protection. Prominent scholars were summoned to it, mostly belonging to the Romantic School, such as Goerres, Schubert and Schelling, though others were not discouraged. In the course of his visits to Italy he formed friendships with famous artists such as Thorwaldsen and Cornelius. He was especially anxious to obtain works of art, mainly sculpture, for the famous Munich collections which he started, and in this he had the advantage of the assistance of the painter Martin Wagner. He also set on foot movements for excavation and the collection of works of art in Greece, with excellent results.

Under the influence of the July revolution of 1830, however, he also began to be drawn into the current of reaction; and though he still declared himself openly against absolutism, and never took up such a hostile attitude towards constitutional ideas as his brother-in-law King Frederick William IV., he allowed the reactionary system of surveillance which commended itself to the German Confederation after 1830 to be introduced into Bavaria (see BAVARIA: *History*). He continued, on the other hand, to do much for the economic development of the country. As a follower of the ideas of Friedrich List, he furthered the foundation of the Zollverein in the year 1833 and the making of canals. Railways he looked upon as a "necessary evil."

In external politics peace was maintained on the whole after 1825. Temporary diplomatic complications arose between Bavaria and Baden in connexion with Louis's favourite project of winning back the part then belonging to Baden of the old Palatinate, the land of his birth, which was always very dear to him.

Of European importance was his enthusiasm for the liberation of Greece from the rule of Turkey. Not only did he erect the *Propyläen* at Munich in her honour, but he also helped her in the most generous way both with money and diplomatic resources. And after his second son Otto had become king of Greece in 1832, Greek affairs became from time to time the central point of his foreign policy. In 1835 he made a visit to Greece, partly political, partly inspired by his old interest in art. But his son proved unequal to his task, and in 1862 was forced to abdicate (see OTHO, king of Greece). For this unfortunate issue Louis was not without blame; for from the very first, owing to an exaggerated idealism and love of antiquity, he had totally misunderstood the national character of the Greeks and the problems involved in the attempts to govern them by bureaucratic methods.

In Bavaria, too, his government became more and more conservative, especially after Karl Abel became the head of the ministry in 1837. The king had not yet, it is true, altogether committed himself to the clerical ultras, and on the occasion of the dispute about the bishops in Prussia in the same year had taken up a wise attitude of compromise. But in Bavaria itself the strict Catholic party influenced affairs more and more decisively. For a while, indeed, this opposition did not impair the king's popularity, due to his amiable character, his extraordinary services in beautifying his capital of Munich, and to his benevolence (it has been reckoned that he personally received about 10,000 letters asking for help every year, and that the money he devoted to charity amounted to about a fifth of his income). The year 1846, however, brought a change which had sad consequences. This was due to the king's relations with the Spanish dancer Lola Montez, who appeared in Munich in October 1846, and soon succeeded by her beauty and wit in fascinating the king, who was always susceptible to feminine charms. The political importance of this lay in the fact that the royal mistress began to use her great influence against the clerical policy of the Abel ministry. So when the king was preparing the way for ennobling her, in order to introduce her into court circles, which were unwilling to receive her, the ministry protested in the famous memorandum of the 11th of February 1847 against the king's demand for her naturalization as a Bavarian, the necessary preliminary to her ennoblement. The position was still further embittered by the fact that, owing to an indiscretion, the memorandum became known to the public. Thereupon the king, irritated and outraged, replaced Abel's Clerical ministry by a more accommodating Liberal one under Zu Rhein under which Lola Montez without more difficulty became Countess Landsberg. Meanwhile, the criticism and opposition of the people, and especially of the students, was turned against the new leader of the court of Munich. On top of this came the revolutionary movement of 1848. The king's position became more and more difficult, and under the pressure of popular opposition he was forced to banish the countess. But neither this nor the king's liberal proclamation of the 6th of March succeeded in establishing peace, and in the capital especially the situation became increasingly threatening. All this made such a deep impression on the king, that on the 20th of March 1848 he abdicated in favour of his son Maximilian.

He now retired entirely into private life, and continued to play the Maecenas magnificently, frequently staying at his villa in Rome, the Villa Malta, and enjoying extraordinary vigour of mind and body up to the end of his days. His popularity, which had been shaken by the Montez affair, he soon recovered, especially among artists. To him Munich owes her finest art collections and most remarkable buildings. The monarch's artistic sense led him not only to adorn his house with a number of works of antique art, but also to study German medieval art, which he did to good effect. To him Munich owes the acquisition of the famous Rhenish collection of the Boisserée brothers. The king also worked with great zeal for the care of monuments, and the cathedrals of Spires and Cologne enjoyed his special care. He was also an unfailing supporter of contemporary painting, in so far as it responded to his romantic tendencies, and he gave a fresh impulse to the arts of working in metal and glass. As visible signs of his permanent services to art Munich possesses the Walhalla, the Glyptothek, the two Pinakotheken, the Odeon, the University, and many other magnificent buildings both sacred and profane. The rôle which the Bavarian capital now plays as the leading art centre of Germany would have been an impossibility without the splendid munificence of Louis I.

He died on the 28th of February 1868 at Nice, and on the 9th of March was buried in Munich, amid demonstrations of great popular feeling.

The chief part of Louis's records is contained in seven sealed chests in the archives of his family, and by the provisions of his will these were not to be opened till the year 1918. These records contain an extraordinarily large and valuable mass of historical material, including, as one item, 246 volumes of the king's diary.

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(J. HN.)

LOUIS II., king of Bavaria (1845–1886), son of his predecessor Maximilian II. and his wife Maria, daughter of Prince William of Prussia, was born at Nymphenburg on the 25th of August 1845. Together with his brother Otto, three years younger than himself, Louis received, in accordance with the wishes of his learned father, a simple and serious education modelled on that of the German *Gymnasien*, of which the classical languages are the chief feature. Of modern languages the crown prince learnt only French, of which he remained fond all his life. The practical value of the prince's training was small. It was not till he was eighteen years old that he received his first pocket-money, and at that age he had no ideas about money and its value. Military instruction, physical exercises and sport, in spite of the crown prince's strong physique, received little attention. Thus Louis did not come enough into contact with young men of his own age, and consequently soon developed a taste for solitude, which was found at an early age to be combined with the romantic tendencies and musical and theatrical tastes traditional in his family.

Louis succeeded to the throne on the 10th of March 1864, at the age of eighteen. The early years of his reign were marked by a series of most serious political defeats for Bavaria. In the Schleswig-Holstein question, though he was opposed to Prussia and a friend of Duke Frederick VIII. of Augustenburg, he did not command the material forces necessary effectively to resist the powerful policy of Bismarck. Again, in the war of 1866, Louis and his minister von der Pfordten took the side of Austria, and at the conclusion of peace (August 22) Bavaria had, in addition to the surrender of certain small portions of her territory, to agree to the foundation of the North German Confederation under the leadership of Prussia. The king's Bavarian patriotism, one of the few steadfast ideas underlying his policy, was deeply wounded by these occurrences, but he was face to face with the inevitable, and on the 10th of August wrote a letter of reconciliation to King William of Prussia. The defeat of Bavaria in 1866 showed clearly the necessity for a reform of the army. Under the new Liberal ministry of Hohenlohe (December 29, 1866–February 13, 1870) and under Prauckh as minister of war, a series of reforms were carried through which prepared for the victories of 1870. As regards his ecclesiastical policy, though Louis remained personally true to the Catholic Church, he strove for a greater independence of the Vatican. He maintained friendly relations with Ignaz von Döllinger, the leader of the more liberal Catholics who opposed the definition of papal infallibility, but without extending his protection to the anti-Roman movement of the Old Catholics. In spite of this the Old Bavarian opposition was so aroused by the Liberalism of the Hohenlohe ministry that at the beginning of 1870 Louis had to form a more Conservative cabinet under Count Bray-Steinburg. On the outbreak of the Franco-Prussian War he at once took the side of Prussia, and gave orders for mobilization. In 1871 it was he who offered the imperial crown to the king of Prussia; but this was not done on his own initiative. Bismarck not only determined the king of Bavaria to take the decisive step which put an end to a serious diplomatic crisis, but actually drafted the letter to King William which Louis copied and despatched without changing a word. Louis placed very few difficulties in the way of the new German Empire under the leadership of Prussia, though his Bavarian particularism remained unchanged.

Though up till the beginning of the year 1880 he did not cease to give some attention to state affairs, the king's interests lay in quite other spheres. His personal idiosyncrasies had, in fact, developed meanwhile in a most unhappy direction. His enthusiasm for all that is beautiful soon led him into dangerous bypaths. It found its most innocent expression in the earliest years of his reign when he formed an intimate friendship with Richard Wagner, whom from May 1864 to December 1865 he had constantly in his company. Louis was entirely possessed by the soaring ideas of the master, and was energetic in their realization. He not only established Wagner's material position at the moment by paying 18,000 gulden of debts for him and granting him a yearly income of 4000 gulden (afterwards increased to 8000), but he also proceeded to realize the ambitious artistic plans of the master. A series of brilliant model performances of the Wagnerian music-dramas was instituted in Munich under the personal patronage of the king, and when the further plan of erecting a great festival theatre in Munich for the performance of Wagner's "music of the future" broke down in the face of the passive resistance of the local circles interested, the royal enthusiast conceived the idea of building at Bayreuth, according to Wagner's new principles, a theatre worthy of the music-dramas. For a time Louis was entirely under Wagner's influence, the fantastic tendencies of whose art cast a spell over him, and there is extant a series of emotional letters of the king to Wagner. Wagner, on the whole, used his influence in artistic and not in political affairs.[1] In spite of this the opposition to him became permanent. Public opinion in Bavaria for the most part turned against him. He was attacked for his foreign origin, his extravagance, his intrigues, his artistic utopias, and last but by no means least, for his unwholesome influence over the king. Louis in the end was compelled to give him up. But the relations between king and artist were by no means at an end. In face of the war which was imminent in 1866, and in the midst of the preparation for war, the king hastened in May to Triebschen, near Lucerne, in order to see Wagner again.[1] In 1868 they were seen together in public for the last time at the festival performances in Munich. In 1876 Wagner's *Ring des Nibelungen* was performed for the first time at Bayreuth in the presence of the king. Later, in 1881, the king formed a similar friendship with Joseph Kainz the actor, but it soon came to an end. In January 1867 the young king became betrothed to Duchess Sophie of Bavaria (afterwards Duchesse d'Alençon), daughter of Duke Max and sister of the empress of Austria; but the betrothal was dissolved in October of the same year.

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[1] It was on Wagner's advice that the king appointed Hohenlohe prime minister in 1866. See Hohenlohe-Schillingfurst, Prince Chlodwig zu, under HOHENLOHE. [ED.]

Though even in his later years he remained interested in lofty and intellectual pursuits, as may be gathered, apart from his enthusiasm for art and nature, from his wide reading in history, serious poetry and philosophy, yet in his private life there became increasingly marked the signs of moral and mental weakness which gradually gained the mastery over his once pure and noble nature. A prominent feature was his blind craving for solitude. He cut himself off from society, and avoided all intercourse with his family, even with his devotedly affectionate mother. With his ministers he came to communicate in writing only. At the end he was surrounded only by inferior favourites and servants. His life was now spent almost entirely in his castles far from the capital, which irked him more and more, or in short and hasty journeys, in which he always travelled incognito. Even the theatre he could now only enjoy alone. He arranged private performances in his castles or in Munich at fabulous cost, and appointed an official poet to his household. Later his avoidance of society developed into a dread of it, accompanied by a fear of assassination and delusions that he was being followed.

Side by side with this pathological development his inborn self-consciousness increased apace, turning more and more to megalomania, and impelling the weak-willed monarch to those extraordinary displays of magnificence which can still be admired to-day in the castles built or altered by him, such as Berg on the Starnberger See, Linderhof, Herrenchiemsee, Hohenschwangau, Neuschwanstein, &c., which are among the most splendid buildings in Germany. It is characteristic of the extravagance of the king's ideas that he adopted as his model the style of Louis XIV. and fell into the habit of imitating the *Roi Soleil.* He no longer stayed for any length of time in one castle. Often he scoured the country in wild nocturnal rides, and madness gained upon him apace. His mania for buying things and making presents was comparatively harmless, but more serious matters were the wild extravagance which in 1880 involved him in financial ruin, his fits of destructive rage, and the tendency to the most cruel forms of abnormal vice. None the less, at the time when the king's mental weakness was increasing, his character still retained lovable traits—his simple sense of beauty, his kindliness, and his highly developed understanding of art and artistic crafts. Louis's love of beauty also brought material profit to Bavaria.

But the financial and political dangers which arose from the king's way of life were so great that interference became necessary. On the 8th of June 1886 medical opinion declared him to be affected with chronic and incurable madness and he was pronounced incapable of governing. On the 10th of June his uncle, Prince Luitpold, assumed the regency, and after violent resistance the late king was placed under the charge of a mental specialist. On the 13th of June 1886 he met with his death by drowning in the Starnberger See, together with his doctor von Gudden, who had unwisely gone for a walk alone with his patient, whose physical strength was enormous. The details of his death will never be fully known, as the only possible eye-witness died with him. An examination of the brain revealed a condition of incurable insanity, and the faculty submitted a report giving the terrible details of his malady. Louis's brother Otto, who succeeded him as king of Bavaria, was also incurably insane.

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LOUIS II.[2] (846–879), king of France, called "le Bègue" or "the Stammerer," was a son of Charles II. the Bald, Roman emperor and king of the West Franks, and was born on the 1st of November 846. After the death of his elder brother Charles in 866 he became king of Aquitaine, and in October 877 he succeeded his father as king of the West Franks, but not as emperor. Having made extensive concessions to the nobles both clerical and lay, he was crowned king by Hincmar, archbishop of Reims, on the 8th of December following, and in September 878 he took advantage of the presence of Pope John VIII. at the council of Troyes to be consecrated afresh. After a feeble and ineffectual reign of eighteen months Louis died at Compiègne on the 10th or 11th of April 879. The king is described as "un homme simple et doux, aimant la paix, la justice et la religion." By his first wife, Ansgarde, a Burgundian princess, he had two sons, his successors, Louis III. and Carloman; by his second wife, Adelaide, he had a posthumous son, Charles the Simple, who also became king of France. (A. W. H.*)

LOUIS III. (*c.* 863–882), king of France, was a son of Louis II. and with his brother Carloman succeeded his father as king in April 879. A strong party, however, cast some doubts upon the legitimacy of the young princes, as the marriage of their parents had not been recognized by the emperor Charles the Bald; consequently it was proposed to offer the crown to the East Frankish ruler Louis, a son of Louis the German. But this plan came to nothing, and in September 879 the brothers were crowned at Ferrières by Ansègisus, archbishop of Sens. A few months later they divided their kingdom, Louis receiving the part of France north of the Loire. They acted together against the Northmen, over whom in August 881 they gained a memorable victory. They also turned against Boso who had been set up as king in Burgundy and Provence. On the 5th of August 882 Louis died at St Denis. He left no sons and Carloman became sole king. (A. W. H.*)

LOUIS IV. (921–954), king of France, surnamed "d'Outremer" (*Transmarinus*), was the son of Charles III. the Simple. In consequence of the imprisonment of his father in 922, his mother Odgiva (Eadgyfu), sister of the English king Æthelstan, fled to England with the young Louis—a circumstance to which he owes his surname. On the death of the usurper Rudolph (Raoul), Ralph of Burgundy, Hugh the Great, count of Paris, and the other nobles between whom France was divided, chose Louis for their king, and the lad was brought over from England and consecrated at Laon on the 19th of June 936. Although his *de facto* sovereignty was confined to the town of Laon and to some places in the north of France, Louis displayed a zeal beyond his years in procuring the recognition of his authority by his turbulent vassals. The beginning of his reign was marked by a disastrous irruption of the Hungarians into Burgundy and Aquitaine (937). In 939 Louis became involved in a struggle with the emperor Otto the Great on the question of Lorraine, the nobles of which district had sworn an oath of fidelity to the king of France. When Louis married Gerberga, sister of Otto, and widow of Giselbert, duke of Lorraine, there seemed to be a fair prospect of peace; but the war was resumed, Otto supporting the rebel lords of the kingdom of France, and peace was not declared until 942, at the treaty of Visé-sur-Meuse. On the death of William Longsword, duke of Normandy, who had been assassinated by Arnulf, count of Flanders, in December 942, Louis endeavoured to obtain possession of the person of Richard, the young son and heir of the late duke. After an unsuccessful expedition into Normandy, Louis fell into the hands of his adversaries, and was for some time kept prisoner at Rouen (945), and subsequently handed over to Hugh the Great, who only consented to release him on condition that he should surrender Laon. Menaced, however, by Louis' brother-in-law, Otto the Great, and excommunicated by the council of Ingelheim (948), the powerful vassal was forced to make submission and to restore Laon to his sovereign. The last years of the reign were troubled by fresh difficulties with Hugh the Great and also by an irruption of the Hungarians into the south of France. Louis died on the 10th of September 954, and was succeeded by his son Lothair.

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[1] Hohenlohe (*Denkwürdigkeiten*) comments on the fact that the king did not even take the trouble to review the troops proceeding to the war. [Ed.]

[2] The emperor Louis I. is counted as Louis I., king of France.

The chief authority for the reign is the chronicler Flodoard. See also Ph. Lauer, *La Règne de Louis IV d'Outre-Mer* (Paris, 1900); and A. Heil, *Die politischen Beziehungen zwischen Otto dem Grossen und Ludwig IV. von Frankreich* (Berlin, 1904). (R. Po.)

LOUIS V. (967–987), king of France, succeeded his father Lothair in March 986 at the age of nineteen, and finally embroiled the Carolingian dynasty with Hugh Capet and Adalberon, archbishop of Reims. From the absence of any important event in his one year's reign the medieval chroniclers designated him by the words "qui nihil fecit," *i.e.* "le Fainéant" or "do-nothing." Louis died in May 987, his mother Emma being accused of having poisoned him. He had married Adelaide, sister of Geoffrey Grisegonelle, count of Anjou, but had no issue. His heir by blood was Charles, duke of Lower Lorraine, son of Louis IV., but the defection of the bishops and the treason of Adalberon (Ascelinus), bishop of Laon, assured the success of Hugh Capet.

See F. Lot, *Les Derniers Carolingiens* (Paris, 1891); and the *Recueil des actes de Lothaire et de Louis V*, edited by L. Halphen and F. Lot (1908). (R. Po.)

LOUIS VI. (1081–1137), king of France, surnamed "the Fat," was the son of Philip I. of France and Bertha of Holland. He was also surnamed the "Wide-awake" and "the Bruiser," and lost none of his energy when he earned the nickname by which he is known in history. In 1098 Louis was made a knight, and about the same time was associated with his father in the government, which the growing infirmities of Philip left more and more to his son, in spite of the opposition of Bertrada, the queen, whose criminal union with Philip had brought the anathema of the church. From 1100 to 1108 Louis by his victorious wars on the English and brigands had secured the army on his side, while the court supported Bertrada. Unable to make headway against him in war she attempted to poison him, and contemporary chroniclers attributed to this poison the pallor of his face, which seems to have been in remarkable contrast to his stalwart, and later his corpulent figure. Louis' reign is one of the most important in the history of France. He is little less than the second founder of the Capetian dynasty. When the feeble and incompetent Philip I. died (29th of July 1108) Louis was faced by feudal barons as powerful as himself, and ready to rise against him. He was forced to have himself hurriedly crowned at Orleans, supported by a handful of vassals and some ecclesiastics. As king he continued the policy he had followed during the previous eight years, of securing the roads leading to Paris by putting down feudal brigands and destroying their strongholds in the Île-de-France. The castle of the most notorious of these, Hugues du Puiset, was three times taken and burned by the king's men, but Hugues was spared to go back each time to his robber life, until he died on a crusade. In the north, Thomas de Marle, son of Enguerrand de Coucy, carried on a career of rapine and murder for almost thirty years before the king succeeded in taking him prisoner (1130). Twenty-four years of continuous war finally rooted out the robber barons who lived on the plunder of the roads leading to Paris: the lords of Montlhéri, who commanded the roads to Orleans, Melun and the south, those of Montmorency near St Denis on the north (who had to restore what they had robbed the abbey of St Denis), those of Le Puiset toward the west, on the way to Chartres, and many others. Parallel with this consolidation of his power in the ancestral domains Louis met energetically the Anglo-Norman danger, warring with Henry I. of England for twenty-five years. After the victory of Tinchebray (1106) Louis supported the claims of William Clito, son of Robert, duke of Normandy, against Henry I. A ruthless war followed, in which Louis was at times reduced to the sorest straits. In 1119, at a council held at Reims under the presidency of Pope Calixtus II., the enemies were reconciled; but William Clito's claims were not satisfied, and in 1123 war began again on a larger scale. Henry I. induced the emperor Henry V. to join in the attack upon France; and, his heir having been drowned in the loss of the "White Ship," won the count of Anjou by marrying his only daughter Matilda to Geoffrey, the Angevin heir (1127). The invasion of Henry V. was met by something like a national army, which gathered under Louis at Reims. "For a few days at least, the lord of the Île-de-France was truly a king of France" (Luchaire). Suger proudly gives the list of barons who appeared. Henry V. came no farther than Metz. Royalty had won great prestige. Even Theobald, count of Chartres, the king's greatest enemy, the soul of feudal coalitions, came with his contingent. Shortly afterwards (1126), Louis was able to overawe the great count of Aquitaine, William IX., and force his vassal, the count of Auvergne, to treat justly the bishop of Clermont. In Flanders Louis interfered upon the assassination of Charles the Good. He caused the barons to elect as their count in Arras the same William Clito who claimed Normandy, and who was closely bound to the king. For a while Louis had Flanders absolutely at his disposal, but he had hardly left William alone (1127) when his brutal oppression roused both towns and nobles, who declared that Louis had no right to interfere in Flanders. The death of William Clito, and a savage war with his own seneschal, prevented Louis from effectually resenting this attitude; but Thierry of Alsace, the new count, consented in 1128 to receive from Louis the investiture of all his French fiefs, and henceforth lived on good terms with him. In all his wars—those mentioned are but a part of them—Louis fought in person. Proud of his strength, reckless in the charge as on the march, plunging into swollen rivers, entering blazing castles, he gained the reputation of a national hero, the protector of the poor, the church, the peasants and the towns. The communal movement grew during his reign, and he encouraged it on the fiefs of his vassals in order to weaken them; but the title "Father of the Communes" by which he was known in history is not deserved, though he did grant some privileges to towns on his domains. Neither was Louis the author of the movement for the emancipation of the serfs, as was formerly claimed. His attitude toward the movement was like that of his predecessors and contemporaries, to favour emancipation when it promised greater chance of profit, greater scope for exploitation of the peasants; otherwise to oppose it. He was a great benefactor to the church, aided the new, reformed monastic congregations of Cîteau, Prémontré and Fontevrault, and chose his two chief ministers from the clergy. Étienne de Garlande, whom Louis raised from obscurity to be archdeacon of Notre Dame at Paris, chancellor and seneschal of France, was all-powerful with the king from 1108 to 1127. His relatives monopolized the highest offices of the state. But the queen Adelaide became his enemy; both Ivo of Chartres and St Bernard bitterly attacked him; and the king suddenly stripped him of all his offices and honours. Joining the rebellious barons, Étienne then led a bitter war against the king for three years. When Louis had reduced him to terms he pardoned him and restored him to the chancellorship (1132), but not to his old power. Suger (*q.v.*), administrator of St Denis, enters the scene toward the close of this reign, but his great work belongs to the next. Louis VI. died on the 1st of August 1137, just a few days after his son, Louis the Young, had set out for the far south-west, the Aquitaine which had been won by the marriage with Eleanor. His wife was Adelaide, or Alice, daughter of Humbert II., count of Savoy, by whom he had seven sons and a daughter.

See A. Luchaire, *Louis le Gros, annales de sa vie et son règne* (1890); and the same writer's volume, *Les Premiers Capétiens*, in E. Lavisse's *Histoire de France.* (J. T. S.*)

LOUIS VII. (*c.* 1121–1180), king of France, son of Louis VI. the Fat, was associated with his father and anointed by Innocent II. in 1131. In 1137 he succeeded his father, and in the same year married at Bordeaux Eleanor, heiress of William II., duke of Aquitaine. In the first part of his reign he was vigorous and jealous of his prerogatives, but after his crusade his religiosity developed to such an extent as to make him utterly inefficient. His accession was marked by no disturbances, save the risings of the burgesses of Orleans and of Poitiers, who wished to organize communes. But soon he came into violent conflict with Pope Innocent II. The archbishopric of Bourges became vacant, and the king supported as candidate the chancellor Cadurc, against the pope's nominee Pierre de la Châtre, swearing upon relics that so long as he lived Pierre should never enter Bourges. This brought the interdict upon the king's lands. At the same time he became involved in a war with Theobald, count of Champagne, by permitting Rodolphe (Raoul), count of Vermandois and seneschal of France, to repudiate his wife, Theobald's niece, and to marry Petronille of Aquitaine, sister of the queen of France. The war, which lasted two years (1142–44), was marked by the occupation of Champagne by the royal army and the capture of Vitry, where many persons perished in the burning of the church. Geoffrey the Handsome, count of Anjou, by his conquest of Normandy threatened the royal domains, and Louis VII. by a clever manœuvre threw his army on the Norman frontier and gained Gisors, one of the keys of Normandy. At his court which met in Bourges Louis declared on Christmas Day 1145 his intention of going on a crusade. St Bernard assured its popularity by his preaching at Vézelay (Easter 1146), and Louis set out from Metz in June 1147, on the overland route to Syria. The expedition was disastrous, and he regained France in 1149, overcome by the humiliation of the crusade. In the rest of his reign he showed much feebleness and poor judgment. He committed a grave political blunder in causing a council at Beaugency (on the 21st of March 1152) to annul his marriage with Eleanor of Aquitaine, under pretext of kinship, but really owing to violent quarrels during the crusade. Eleanor married Henry II. of England in the following May, and brought him the duchy of Aquitaine. Louis VII. led a half-hearted war against Henry for having married without the authorization of his suzerain; but in August 1154 gave up his rights over Aquitaine, and contented himself with an indemnity. In 1154 Louis married Constance, daughter of the king of Castile, and their daughter Marguerite he affianced imprudently by the treaty of Gisors (1158) to Henry, eldest son of the king of England, promising as dowry the Vexin and Gisors. Five weeks after the death of Constance, on the 4th of October 1160, Louis VII. married Adèle of Champagne, and Henry II. to counterbalance the aid this would give the king of France, had the marriage of their infant children celebrated at once. Louis VII. gave little sign of understanding the danger of the growing Angevin power, though in 1159 he made an expedition in the south to aid Raymond V., count of Toulouse, who had been attacked by Henry II. At the same time the emperor Frederick I. in the east was making good the imperial claims on Arles. When the schism broke out, Louis took the part of the pope Alexander III., the enemy of Frederick, and after two comedy-like failures of Frederick to meet Louis VII. at Saint Jean de Losne (on the 29th of August and the 22nd of September 1162), Louis definitely gave himself up to the cause of Alexander, who lived at Sens from 1163 to 1165. Alexander gave the king, in return for his loyal support, the golden rose. Louis VII. received Thomas Becket and tried to reconcile him with King Henry II. He supported Henry's rebellious sons, but acted slowly and feebly, and so contributed largely to the break up of the coalition (1173–1174). Finally in 1177 the pope intervened to bring the two kings to terms at Vitry. By his third wife, Adèle, Louis had an heir, the future Philip Augustus, born on the 21st of August 1165. He had him crowned at Reims in 1179, but, already stricken with paralysis, he himself was not able to be present at the ceremony, and died on the 18th of September 1180. His reign from the point of view of royal territory and military power, was a period of retrogression. Yet the royal authority had made progress in the parts of France distant from the royal domains. More direct and more frequent connexion was made with distant feudatories, a result largely due to the alliance of the clergy with the crown. Louis thus reaped the reward for services rendered the church during the least successful portion of his reign.

See R. Hirsch, *Studien zur Geschichte König Ludwigs VII. von Frankreich* (1892); A. Cartellieri, *Philipp II. August von Frankreich bis zum Tode seines Vaters, 1165–1180* (1891); and A. Luchaire in E. Lavisse's *Histoire de France*, tome iii. 1st part, pp. 1-81. (J. T. S.*)

LOUIS VIII. (1187–1226), king of France, eldest son of Philip Augustus and of Isabella of Hainaut, was born in Paris on the 5th of September 1187. Louis was short, thin, pale-faced, with studious tastes, cold and placid temper, sober and chaste in his life. He left the reputation of a saint, but was also a warrior prince. In 1213 he led the campaign against Ferrand, count of Flanders; in 1214, while Philip Augustus was winning the victory of Bouvines, he held John of England in check, and was victorious at La Roche-aux-Moines. In the autumn of 1215 Louis received from a group of English barons, headed by Geoffrey de Mandeville, a request to " pluck them out of the hand of this tyrant " (John). Some 7000 French knights were sent over to England during the winter and two more contingents followed, but it was only after twenty-four English hostages had arrived in Paris that Louis himself prepared to invade England. The expedition was forbidden by the papal legate, but Louis set out from Calais on the 20th and landed at Stonor on the 22nd of May 1216. In three months he had obtained a strong foothold in eastern England, and in the end of July he laid siege to Dover, while part of his army besieged Windsor with a view to securing the safety of London. The pretexts on which he claimed the English crown were set down in a memorandum drawn up by French lawyers in 1215. These claims—that John had forfeited the crown by the murder of his nephew, Arthur of Brittany, and that the English barons had the right to dispose of the vacant throne—lost their plausibility on the death of King John and the accession of his infant son as Henry III. in October 1216. The papal legate, Gualo, who had forbidden the enterprise, had arrived in England at the same time as Louis. He excommunicated the French troops and the English rebels, and Henry III. found a valiant defender in William Marshal, earl of Pembroke. After the " Fair of Lincoln," in which his army was defeated, Louis was compelled to resign his pretensions, though by a secret article of the treaty of Lambeth (September 1217) he secured a small war indemnity. Louis had assisted Simon de Montfort in his war against the Albigenses in 1215, and after his return to France he again joined the crusade. With Simon's son and successor, Amauri de Montfort, he directed the brutal massacre which followed the capture of Marmande. Philip II., suspicious of his son until the close of his life, took precautions to assure his obedience, narrowly watched his administration in Artois, which Louis held from his mother Isabella, and, contrary to the custom of the kings of France, did not associate his son with him by having him crowned. Philip Augustus dying on the 14th of July 1223, Louis VIII. was anointed at Reims on the 6th of August following. He surrounded himself with councillors whom his father had chosen and formed, and continued his father's policy. His reign was taken up with two great designs: to destroy the power of the Plantagenets, and to conquer the heretical south of France. An expedition conquered Poitou and Saintonge (1224); in 1226 he led the crusade against the Albigenses in the south, forced Avignon to capitulate and received the submission of Languedoc. While passing the Auvergne on his return to Paris, he was stricken with dysentery, and died at Montpensier on the 8th of

November 1226. His reign, short as it was, brought gains both to the royal domains and to the power of the crown over the feudal lords. He had married in 1200 Blanche of Castile, daughter of Alphonso IX. of Castile and granddaughter of Henry II. of England, who bore him twelve children; his eldest surviving son was his successor, Louis IX.

See C. Petit-Dutaillis, *Étude sur la vie et le règne de Louis VIII.* (Paris, 1894); and E. Lavisse, *Histoire de France*, tome iii. (1901). (M. Br.)

LOUIS IX. (1214–1270), king of France, known as Saint Louis, was born on the 25th of April 1214, and was baptized at Poissy. His father, Louis VIII., died in 1226, leaving the first minority since the accession of the Capetians, but his mother, Queen Blanche of Castile, proved more than a match for the feudal nobility. She secured her son's coronation at Reims on the 29th of November 1226; and, mainly by the aid of the papal legate, Romano Bonaventura, bishop of Porto (d. 1243), and of Thibaut IV., count of Champagne, was able to thwart the rebellious plans of Pierre Mauclerc, duke of Brittany, and Philippe Hurepel, a natural son of Philip Augustus. Mauclerc's opposition was not finally overcome, however, until 1234. Then in 1236 Thibaut, who had become king of Navarre, turned against the queen, formed an alliance with Brittany, marrying his daughter without royal consent to Jean le Roux, Mauclerc's son, and attempted to make a new feudal league. The final triumph of the regent was shown when the king's army assembled at Vincennes. His summons met with such general and prompt obedience as to awe Thibaut into submission without striking a blow. Thus the reign of Louis IX. began with royal prerogatives fully maintained; the kingdom was well under control, and Mauclerc and Thibaut were both obliged to go on crusade. But the influence of the strong-willed queen-mother continued to make itself felt to the close of her life. Louis IX. did not lack independence of character, but his confidence in his mother had been amply justified and he always acted in her presence like a child. This confidence he withheld from his wife, Margaret, daughter of Raymond Berenger, count of Provence, whom he married at Sens in May 1234. The reign was comparatively uneventful. A rising of the nobles of the south-west, stirred up by Isabella, widow of King John of England, and her husband, Hugh de Lusignan, count of the Marche, upon the occasion of the investment of Alphonse of Poitiers with the fiefs left him by Louis VIII. as a result of the Albigensian crusade, reached threatening dimensions in 1242, but the king's armies easily overran Count Hugh's territories, and defeated Henry III. of England, who had come to his aid, at Saintes. Isabella and her husband were forced to submit, and Raymond VII., count of Toulouse, yielded without resistance upon the advent of two royal armies, and accepted the peace of Lorris in January 1243. This was the last rising of the nobles in Louis's reign.

At the end of 1244, during an illness, Louis took the cross. He had already been much distressed by the plight of John of Brienne, emperor at Constantinople, and bought from him the crown of thorns, parts of the true cross, the holy lance, and the holy sponge. The Sainte Chapelle in Paris still stands as a monument to the value of these relics to the saintly king. But the quarrel between the papacy and the emperor Frederick II., in which Louis maintained a watchful neutrality—only interfering to prevent the capture of Innocent IV. at Lyons—and the difficulties of preparation, delayed the embarkation until August 1248. His defeat and capture at Mansura, in February 1250, the next four years spent in Syria in captivity, in diplomatic intrigues, and finally in raising the fortifications of Caesarea and Joppa,—these events belong to the history of the crusades (*q.v.*). His return to France was urgently needed, as Blanche of Castile, whom he had left as regent, had died in November 1252, and upon the removal of her strong hand feudal turbulence had begun to show itself.

This period between his first and second crusades (1254–1269) is the real age of Saint Louis in the history of France. He imposed peace between warring factions of his nobility by mere moral force, backed up by something like an awakened public opinion. His nobles often chafed under his unrelenting justice but never dared rebel. The most famous of his settlements was the treaty of Paris, drawn up in May 1258 and ratified in December 1259, by which the claims of Henry III. of England were adjusted. Henry renounced absolutely Normandy, Anjou, Touraine, Maine and Poitou, and received, on condition of recognizing Louis as liege suzerain, all the fiefs and domains of the king of France in the dioceses of Limoges, Cahors and Perigueux, and the expectation of Saintonge south of the Charente, and Agenais, if they should fall to the crown of France by the death of Alphonse of Poitiers. In addition, Louis promised to provide Henry with sufficient money to maintain 500 knights for two years. This treaty was very unpopular in France, since the king surrendered a large part of France that Henry had not won; but Louis was satisfied that the absolute sovereignty over the northern provinces more than equalled the loss in the south. Historians still disagree as to its wisdom. Louis made a similar compromise with the king of Aragon in the treaty of Corbeil, 1258, whereby he gave up the claims of kings of France to Roussillon and Barcelona, which went back to the conquest of Charlemagne. The king of Aragon in his turn gave up his claims to part of Provence and Languedoc, with the exception of Narbonne. Louis's position was strikingly shown in 1264 when the English barons submitted their attempt to bind Henry III. by the Provisions of Oxford to his arbitration. His reply in the "Dit" or Mise of Amiens was a flat denial of all the claims of the barons and failed to avert the civil war. Louis was more successful in preventing feuds between his own nobles: between the counts of Brittany and Champagne over the succession to Navarre; the dauphin of Vienne (Guigues VII.) and Charles of Anjou; the count of Burgundy and the count of Châlons; Henry of Luxemburg and the duke of Lorraine with the count of Bar. Upon the whole he maintained peace with his neighbours, although both Germany and England were torn with civil wars. He reluctantly consented to sanction the conquest of Naples by his brother, Charles, duke of Anjou, and it is possible that he yielded here in the belief that it was a step toward another crusade.

On the 24th of March 1267, Louis called to Paris such of his knights as were not with Charles of Anjou in Naples. No one knew why he had called them; but when the king in full assembly proclaimed his purpose of going on a second crusade, few ventured to refuse the cross. Three years of preparation followed; then on the 1st of July 1270 they sailed from Aigues Mortes for Tunis, whither the expedition seems to have been directed by the machinations of Charles of Anjou, who, it is claimed, persuaded his brother that the key to Egypt and to Jerusalem was that part of Africa which was his own most dangerous neighbour. After seventeen days' voyage to Carthage, one month of the summer's heat and plague decimated the army, and when Charles of Anjou arrived he found that Louis himself had died of the plague on the 25th of August 1270.

Saint Louis stands in history as the ideal king of the middle ages. An accomplished knight, physically strong in spite of his ascetic practices, fearless in battle, heroic in adversity, of imperious temperament, unyielding when sure of the justness of his cause, energetic and firm, he was indeed "every inch a king." Joinville says that he was taller by a head than any of his knights. His devotions would have worn out a less robust saint. He fasted much, loved sermons, regularly heard two masses a day and all the offices, dressing at midnight for matins in his chapel, and surrounded even when he travelled by priests on horseback chanting the hours. After his return from the first crusade, he wore only grey woollens in winter, dark silks in summer. He built hospitals, visited and tended the sick himself, gave charity to over a hundred beggars daily. Yet he safeguarded the royal dignity by bringing them in at the back door of the palace, and by a courtly display greater than ever before in France. His naturally cold temperament was somewhat relieved by a sense of humour, which however did not prevent his making presents of haircloth shirts to his friends. He had no favourite, nor prime minister. Louis was canonized in 1297, As a statesman Louis IX. has left no distinct monument. The famous "*Établissements* of St Louis" has been shown in our own day to have been private compilation. It was a *coutumier* drawn up before 1273, including, as well as some royal decrees, the civil and feudal law of Anjou, Maine and the Orléanais. Recent researches have also denied Louis the credit of having aided the communes. He exploited them to the full. His standpoint in this respect was distinctly feudal. He treated his clergy as he did his barons, enforcing the supremacy of royal justice, and strongly opposing the exactions of the pope until the latter part of his reign, when he joined forces with him to extort as much as possible from the clergy. At the end of the reign most of the sees and monasteries of France were in debt to the Lombard bankers. Finally, the reign of Saint Louis saw the introduction of the pontifical inquisition into France.

There are numerous portraits of St Louis, but they are unauthentic and contradictory. In 1903 M. Salomon Reinach claimed to have found in the heads sculptured in the angles of the arches of the chapel at St Germain portraits of St Louis, his brothers and sisters, and Queen Marguerite, or Blanche, made between 1235 and 1240. This conjectured portrait somewhat resembles the modern type, which is based upon a statue of Charles V. once in the church of the Celestins in Paris, and which Lenoir mistakenly identified as that of Louis IX. The king had eleven children, six sons and five daughters, among them being his successor, Philip III., and Robert, count of Clermont, the ancestor of Henry IV.

The best contemporary accounts of Louis IX. are the famous Memoirs of the Sire Jean de Joinville (*q.v.*), published by N. de Wailly for the *Soc. de l'Hist. de France*, under the title *Histoire de Saint Louis* (Paris, 1868), and again with translation (1874); English translation by J. Hutton (1868). See also William of Nangis, *Gesta Ludovici IX.*, edited by M. Bouquet in vol. xx. of the *Recueil des historiens des Gaules et de la France*. Of modern works may be mentioned C. V. Langlois in E. Lavisse's *Histoire de France*, tome iii., with references to literature; Frederick Perry, *Saint Louis, the Most Christian King* (New York, 1901); E. J. Davis, *The Invasion of Egypt by Louis IX. of France* (1898); H. A. Wallon, *Saint Louis et son temps* (1875); A. Lecoy de la Marche, *Saint Louis* (Tours, 1891); and E. Berger, *Saint Louis et Innocent IV* (Paris, 1893), and *Histoire de Blanche de Castille* (1895). See also *The Court of a Saint*, by Winifred F. Knox (1909). (J. T. S.*)

LOUIS X. (1289–1316), king of France and Navarre, called *le Hutin* or "the Quarreller," was the son of Philip IV. and of Jeanne of Navarre. He was born at Paris on the 4th of October 1289, took the title king of Navarre on the death of his mother, on the 2nd of April 1305, and succeeded Philip IV. in France on the 29th of November 1314, being crowned at Reims in August 1315. The origin of his surname is uncertain. Louis X. is a somewhat indistinct figure among the kings of France, the preponderating influence at court during his short reign being that of his uncle, Charles of Valois. The reign began with reaction against the policy of Philip IV. Private vengeance was wreaked on Enguerrand de Marigny, who was hanged, Pierre de Latilli, bishop of Châlons and chancellor, and Raoul de Presle, advocate of the parlement, who were imprisoned. The leagues of the lesser country gentry, formed in 1314 before the accession of Louis, continued to demand the ancient privileges of the nobility,—tourneys, private wars and judgment of nobles not by king's officers but by their peers—and to protest against the direct call by the king of their vassals to the royal army. Louis X. granted them charters in which he made apparent concessions, but used evasive formulas which in reality ceded nothing. There was a charter to the Normans, one to the Burgundians, one to the Languedocians (1315). Robert de Béthune, count of Flanders, refused to do homage, and his French fiefs were declared confiscate by a court of his peers. In August 1315 Louis X. led an army toward Lille, but the flooded Lys barred his passage, the ground was so soaked with rains that the army could not advance, and it was thrown back, without a battle, on Tournai. Need of money inspired one famous ordinance of this reign; in 1315 the serfs of the royal domains were invited to buy their civil liberty,—an invitation which did not meet with great enthusiasm, as the freedman was merely freed for further exploitation, and Philip V. was obliged to renew it in 1318. Louis X. died suddenly on the 5th of June 1316. His first wife was Margaret, daughter of Robert II., duke of Burgundy; she was accused of adultery and died a prisoner in the château Gaillard. By her he had one daughter, Jeanne, wife of Philip, count of Evreux and king of Navarre. By his second wife Clémence, daughter of Charles Martel, titular king of Hungary, he left a posthumous son, King John I.

See Ch. Dufayard, "La réaction feodale sous les fils de Philippe le Bel," in *Revue historique* (1894); Paul Lehugeur, *Histoire de Philippe le Long, roi de France* (Paris, 1897); and Joseph Petit, *Charles de Valois* (Paris, 1900). (J. T. S.*)

LOUIS XI. (1423–1483), king of France, the son of Charles VII. and his queen, Marie of Anjou, was born on the 3rd of July 1423, at Bourges, where his father, then nicknamed the "King of Bourges," had taken refuge from the English. At the birth of Louis XI. part of France was in English hands; when he was five years old, Joan of Arc appeared; he was just six when his father was crowned at Reims. But his boyhood was spent apart from these stirring events, in the castle of Loches, where his father visited him rarely. John Gerson, the foremost theologian of France, wrote a manual of instructions (still extant) for the first of his tutors, Jean Majoris, a canon of Reims. His second tutor, Bernard of Armagnac, was noted for his piety and humility. If, as has been claimed, Louis owed to them any of his tendency to prefer the society of the poor, or rather of the *bourgeois*, to that of the nobility, their example was his best lesson in the craft of kingship. In June 1436, when scarcely thirteen, he was married to Margaret (*c.* 1425–1445), daughter of James I. of Scotland, a princess of about his own age, but sickly and romantic, and in every way his opposite. Three years after this unhappy marriage Louis entered upon his stormy political career. Sent by his father in 1439 to direct the defence of Languedoc against the English, and to put down the brigandage in Poitou, he was induced by the rebellious nobles to betray his trust and place himself at the head of the Praguerie (*q.v.*). Charles VII. pardoned him this rebellion, due to his ambition and the seductive proposal of the nobles to make him regent. The following year he was fighting the English, and in 1443 aided his father to suppress the revolt of the count of Armagnac. His first important command, however, was in the next year, when he led an army of from 15,000 to 20,000 mercenaries and brigands,—the product of the Hundred Years' War,—against the Swiss of the canton of Basel. The heroism of some two hundred Swiss, who for a while held thousands of the French army at bay, made a great impression on the young prince. After an ineffective siege of Basel, he made peace with the Swiss confederation, and led his robber soldiers into Alsace to ravage the country of the Habsburgs, who refused him the promised winter quarters. Meanwhile his father, making a parallel campaign in Lorraine, had assembled his first brilliant court at Nancy, and when Louis returned it was to find the king completely under the spell of Agnes Sorel. He at first made overtures to members of her party, and upon their rejection through fear of his ambition, his deadly hatred of her and of them involved the king. The death in 1445 of his wife Margaret, who was a great favourite of Charles VII., made the rupture complete. From that year until the death of the king father and son were enemies. Louis began his rebellious career by a futile attempt to seduce the cities of Agenais into treason, and then he prepared a plot to seize the king and his minister Pierre de Brézé. Antoine de Chabannes, who was to be the instrument of the plot, revealed it to Charles, and Louis was mildly punished by being sent off to Dauphiné (1447). He never saw his father again.

Louis set out to govern his principality as though it were an independent state. He dismissed the governor; he determined advantageously to himself the boundaries between his state and the territories of the duke of Savoy and of the papacy; and he enforced his authority over perhaps the most unruly nobility in western Europe, both lay and ecclesiastical. The right of private warfare was abolished; the bishops were obliged to give up most of their temporal jurisdiction, the scope of their courts was limited, and appeals to Rome were curtailed. On the other hand, Louis granted privileges to the towns and consistently used their alliance to overthrow the nobility. He watched the roads, built new ones, opened markets, protected the only bankers of the country, the Jews, and reorganized the administration so as to draw the utmost revenue possible from the prosperity thus secured. His ambition led him into foreign entanglements; he made a secret treaty with the duke of Savoy which was to give him right of way to Genoa, and made arrangements for a partition of the duchy of Milan. The alliance with Savoy was sealed by the marriage of Louis with Charlotte, daughter of Duke Lodovico, in 1452, in spite of the formal prohibition of Charles VII. The king marched south, but withdrew again leaving his son unsubdued. Four years later, as Charles came to the Bourbonnais, Louis, fearing for his life, fled to Flanders to the court of Philip the Good, duke of Burgundy, leaving Dauphiné to be definitely annexed to the crown of France. The policy of the dauphin was reversed, his ten years' work was undone. Meanwhile he was installed in the castle of Genappe, in Brabant, where he remained until the death of his father. For this he waited impatiently five years, keeping himself posted by spies of every stage of the king's last illness, and thus laying himself open to the accusation, believed in by Charles himself, that he had hastened the end by poison, a charge which modern historians deny.

On the 15th of August 1461, Louis was anointed at Reims, and Philip of Burgundy, as *doyen* of the peers of France, placed the crown on his head. For two months Philip acted as though the king were still his protégé. But in the midst of the festivities with which he was entertaining Paris, the duke found that Louis ventured to refuse his candidates for office, and on the 24th of September the new king left abruptly for Touraine. His first act was to strike at the faithful ministers of Charles VII. Pierre de Brézé and Antoine de Chabannes were captured and imprisoned, as well as men of sterling worth like Étienne Chevalier. But the king's shrewdness triumphed before long over his vengeance, and the more serviceable of the officers of Charles VII. were for the most part soon reinstated, Louis' advisers were mostly men of the middle class. He had a ready purse for men of talent, drawing them from England, Scotland, Italy, Spain and Portugal. Such a motley throng of competent men had never before been seen at the court of France. Their origin, their previous crimes or virtues, their avarice or brutality, were indifferent to him so long as they served him loyally. Torture and imprisonment awaited them, whether of high or low degree, if he fancied that they were betraying him. Among the most prominent of these men in addition to Brézé, Chevalier and Chabannes, were Tristan Lermite, Jean de Daillon, Olivier le Dain (the barber), and after 1472, Philippe de Commines, drawn from the service of Charles the Bold of Burgundy, who became his most intimate adviser and biographer. Surrounded by men like these Louis fought the last great battle of French royalty with feudalism.

Louis XI. began his reign with the same high-handed treatment of the nobles which had marked his rule in Dauphiné, going so far as to forbid them to hunt without his permission. He forced the clergy to pay long-neglected feudal dues, and intrigued against the great houses of Anjou and Orleans in Italy. The malcontent nobles soon began to plan revolt. Discharged officers of Charles VII. like Jean Dunois and John II. duke of Bourbon, stirred up hostility to the new men of the king, and Francis II. duke of Brittany was soon embroiled with Louis over an attempt to assert royal control over that practically independent duchy. The dissatisfied nobility found their greatest ally in Charles the Bold, afterwards duke of Burgundy, and in 1465 formed a "league of public welfare" and declared war on their king. The nominal head was the king's brother Charles, duke of Berry, then eighteen years old, a weak character, the tool of the rebels as he was later the dupe of the king. Every great noble in France was in the league, except Gaston de Foix—who kept the south of France for the king,—and the counts of Vendôme and Eu. The whole country seemed on the verge of anarchy. It was saved by the refusal of the lesser gentry to rise, and by the alliance of the king with the citizen class, which was not led astray by the pretences of regard for the public weal which cloaked the designs of the leaguers. After a successful campaign in the Bourbonnais, Louis fought an indecisive battle with the Burgundians who had marched on Paris at Montlhéry, on the 16th of July 1465, and then stood a short siege in Paris. On the 28th of September he made a truce with Charles the Bold, and in October the treaties of Conflans and Saint Maur-les-Fossés, ended the war. The king yielded at all points; gave up the "Somme towns" in Picardy, for which he had paid 200,000 gold crowns, to Philip the Good, thus bringing the Burgundians close to Paris and to Normandy. Charles, the king's brother, was given Normandy as an apanage, thus joining the territories of the rebellious duke of Brittany with those of Charles the Bold. The public weal was no longer talked about, while the kingdom was plundered both by royal tax gatherers and by unsubdued feudal lords to pay the cost of the war.

After this failure Louis set to work to repair his mistakes. The duke of Bourbon was won over by the gift of the government of the centre of France, and Dunois and Chabannes by restoring them their estates. Two months after he had granted Normandy to Charles, he took advantage of a quarrel between the duke of Brittany and his brother to take it again, sending the duke of Bourbon "to aid" Charles, while Dunois and Chabannes prepared for the struggle with Burgundy. The death of Duke Philip, on the 15th of June 1467, gave Charles the Bold a free hand. He gained over Edward IV. of England, whose sister Margaret he married; but while he was celebrating the wedding Louis invaded Brittany and detached Duke Francis from alliance with him. Normandy was completely reduced. The king had won a great triumph. It was followed by his greatest mistake. Eager as he always was to try diplomacy instead of war, Louis sent a gift of 60,000 golden crowns to Charles and secured a safe conduct from him for an interview. The interview took place on the 9th of October 1468 at Péronne. News came on the 11th that, instigated by the king of France, the people of Liége had massacred their bishop and the ducal governor. The news was false, but Charles, furious at such apparent duplicity, took Louis prisoner, only releasing him, three days later, on the king signing a treaty which granted Flanders freedom from interference from the parlement of Paris, and agreeing to accompany Charles to the siege of his own ally, Liége. Louis made light of the whole incident in his letters, but it marked the greatest humiliation of his life, and he was only too glad to find a scapegoat in Cardinal Jean Balue, who was accused of having plotted the treason of Péronne. Balue thereupon joined Guillaume de Harancourt, bishop of Verdun, in an intrigue to induce Charles of France to demand Champagne and Brie in accordance with the king's promise to Charles the Bold, instead of distant Guienne where the king was determined to place him. The discovery of this conspiracy placed these two high dignitaries in prison (April 1469). Balue (*q.v.*) spent eleven years in prison quarters, comfortable enough, in spite of the legend to the contrary, while Harancourt was shut up in an iron cage until 1482. Then Louis, inducing his brother to accept Guienne,—where, surrounded by faithful royal officers, he was harmless for the time being,—undertook to play off the Lancastrians against Edward IV. who, as the ally of Charles the Bold, was menacing the coast of Normandy. Warwick, the king-maker, and Queen Margaret were aided in the expedition which in 1470 again placed Henry VI. upon the English throne. In the autumn Louis himself took the offensive, and royal troops overran Picardy and the Maconnais to Burgundy itself. But the tide turned against Louis in 1471. While Edward IV. won back England by the battles of Barnet and Tewkesbury, Charles the Bold besieged Amiens, and Louis was glad to make a truce, availing himself of the double dealing of the constable, the count of Saint Pol, who, trying to win an independent position for himself in Picardy, refused his aid to Charles unless he would definitely join the French nobility in another rising against the king. This rising was to be aided by the invasion of France by John II. of Aragon, Yolande, duchess of Savoy, and Edward IV.

of England, who was to be given the old Plantagenet inheritance. The country was saved a desperate civil war by the death of the king's brother, Charles, the nominal head of the coalition, on the 24th of May 1472. Louis' joy on receiving news of this death knew no bounds. Charles the Bold, who had again invaded France, failed to take Beauvais, and was obliged to make a lasting truce. His projects were henceforth to be directed towards Germany. Louis then forced the duke of Brittany to make peace, and turned against John V. count of Armagnac, whose death at the opening of March 1473 ended the power of one of the most dangerous houses of the south. The first period of Louis' reign was closed, and with it closed for ever the danger of dismemberment of France. John of Aragon continued the war in Roussillon and Cerdagne, which Louis had seized ten years before, and a most desperate rising of the inhabitants protracted the struggle for two years. After the capture of Perpignan on the 10th of March 1475, the wise and temperate government of Imbert de Batarnay and Boffile de Juge slowly pacified the new provinces. The death of Gaston IV. count of Foix in 1472 opened up the long diplomatic struggle for Navarre, which was destined to pass to the loyal family of Albret shortly after the death of Louis. His policy had won the line of the Pyrenees for France.

The overthrow of Charles the Bold was the second great task of Louis XI. This he accomplished by a policy much like that of Pitt against Napoleon. Louis was the soul of all hostile coalitions, especially urging on the Swiss and Sigismund of Austria, who ruled Tirol and Alsace. Charles's ally, Edward IV., invaded France in June 1475, but Louis bought him off on the 29th of August at Picquigny—where the two sovereigns met on a bridge over the Somme, with a strong grille between them, Edward receiving 75,000 crowns, and a promise of a pension of 50,000 crowns annually. The dauphin Charles was to marry Edward's daughter. Bribery of the English ministers was not spared, and in September the invaders recrossed to England. The count of Saint Pol, who had continued to play his double part, was surrendered by Charles to Louis, and executed, as was also Jacques d'Armagnac, duke of Nemours. With his vassals terrorized and subdued, Louis continued to subsidize the Swiss and René II. of Lorraine in their war upon Charles. The defeat and death of the duke of Burgundy at Nancy on the 5th of January 1477 was the crowning triumph of Louis' diplomacy. But in his eagerness to seize the whole inheritance of his rival, Louis drove his daughter and heiress, Mary of Burgundy, into marriage with Maximilian of Austria (afterwards the emperor Maximilian I.), who successfully defended Flanders after a savage raid by Antoine de Chabannes. The battle of Guinegate on the 7th of August 1479 was indecisive, and definite peace was not established until after the death of Mary, when by the treaty of Arras (1482) Louis received Picardy, Artois and the Boulonnais, as well as the duchy of Burgundy and Franche Comté. The Austrians were left in Flanders, a menace and a danger. Louis failed here and in Spain; this failure being an indirect cause of that vast family compact which surrounded France later with the empire of Charles V. His interference in Spain had made both John II. of Aragon and Henry IV. of Castile his enemies, and so he was unable to prevent the marriage of their heirs, Ferdinand and Isabella. But the results of these marriages could not be foreseen, and the unification of France proved of more value than the possession of so wide-spread an empire. This unification was completed (except for Brittany) and the frontiers enlarged by the acquisition, upon the death of René of Anjou in 1480, of the duchies of Anjou and Bar, and in 1481 of Maine and Provence upon the death of Charles II., count of Maine. Of the inheritance of the house of Anjou only Lorraine escaped the king.

Failure in Spain was compensated for in Italy. Without waging war Louis made himself virtual arbiter of the fate of the principalities in the north, and his court was always besieged by ambassadors from them. After the death of Charles the Bold, Yolande, duchess of Savoy, was obliged to accept the control of Louis, who was her brother. In Milan he helped to place Lodovico il Moro in power in 1479, but he reaped less from this supple tyrant than he had expected. Pope Sixtus IV. the enemy of the Medici, was also the enemy of the king of France. Louis, who at the opening of his reign had denounced the Pragmatic Sanction of 1438, had played fast and loose with the papacy. When Sixtus threatened Florence after the Pazzi conspiracy, 1478, Louis aided Lorenzo dei Medici to form a alliance with Naples, which forced the papacy to come to terms.

More than any other king of France, Louis XI. was a "bourgeois king." The upper bourgeois, the aristocracy of his "good cities," were his allies both against the nobles and against the artisan class, whenever they revolted, driven to desperation by the oppressive royal taxes which furnished the money for his wars or diplomacy. He ruled like a modern capitalist; placed his bribes like investments in the courts of his enemies; and, while draining the land of enormous sums, was pitiless toward the two productive portions of his realm, the country population and the artisans. His heartlessness toward the former provoked even an accomplice like Commines to protest. The latter were kept down by numerous edicts, tending to restrict to certain privileged families the rank of master workman in the gilds. There was the paternalism of a Frederick the Great in his encouragement of the silk industry,—"which all idle people ought to be made to work at,"—in his encouragement of commerce through the newly acquired port of Marseilles and the opening up of market placed. He even dreamed of a great trading company "of two hundred thousand livres or more," to monopolize the trade of the Mediterranean, and planned to unify the various systems of weights and measures. In 1479 he called a meeting of two burgesses from each "good city" of his realm to consider means for preventing the influx of foreign coin. Impatient of all restraint upon his personal rule, he was continually in violent dispute with the parlement of Paris, and made "justice" another name for arbitrary government; yet he dreamed of a unification of the local customary laws (*coûtumes*) of France. He was the perfect model of a tyrant. The states-general met but once in his reign, in 1468, and then no talk of grievances was allowed; his object was only to get them to declare Normandy inalienable from the crown. They were informed that the king could raise his revenue without consulting them. Yet his budgets were enormously greater than ever before. In 1481 the *taille* alone brought in 4,600,000 livres, and even at the peaceful close of his reign his whole budget was 4,655,000 livres—as against 1,800,000 livres at the close of his father's reign.

The king who did most for French royalty would have made a sorry figure at the court of a Louis XIV. He was ungainly, with rickety legs. His eyes were keen and piercing, but a long hooked nose lent grotesqueness to a face marked with cunning rather than with dignity. Its ugliness was emphasized by the old felt hat which he wore,—its sole ornament the leaden figure of a saint. Until the close of his life, when he tried to mislead ambassadors as to the state of his health by gorgeous robes, he wore the meanest clothes. Dressed in grey like a pilgrim, and accompanied by five or six trustworthy servants, he would set out on his interminable travels, "ambling along on a good mule." Thus he traversed France, avoiding all ceremony, entering towns by back streets, receiving ambassadors in wayside huts, dining in public houses, enjoying the loose manners and language of his associates, and incidentally learning at first hand the condition of his people and the possibilities of using or taxing them—his needs of them rather than theirs of him. He loved to win men, especially those of the middle class, by affability and familiarity, employing all his arts to cajole and seduce those whom he needed. Yet his honied words easily turned to gall. He talked rapidly and much, sometimes for hours at a time, and most indiscreetly. He was not an agreeable companion, violent in his passions, nervous, restless, and in old age extremely irascible. Utterly unscrupulous, and without a trace of pity, he treated men like pawns, and was content only with absolute obedience.

But this Machiavellian prince was the genuine son of St Louis.

His religiosity was genuine if degenerate. He lavished presents on influential saints, built shrines, sent gifts to churches, went on frequent pilgrimages and spent much time in prayer—employing his consummate diplomacy to win celestial allies, and rewarding them richly when their aid secured him any advantage. St Martin of Tours received 1200 crowns after the capture of Perpignan. He tried to bribe the saints of his enemies, as he did their ministers. An unfaltering faith taught him the value of religion—as a branch of politics. Finally, more in the spirit of orthodoxy, he used the same arts to make sure of heaven. When the ring of St Zanobius and the blood of Cape Verde turtles gave him no relief from his last illness, he showered gifts upon his patron saints, secured for his own benefit the masses of his clergy, and the most potent prayers in Christendom, those of the two most effective saints of his day, Bernardin of Doulins and Francis of Paolo.

During the last two or three years of his life Louis lived in great isolation, "seeing no one, speaking with no one, except such as he commanded," in the château of Plessis-les-Tours, that "spider's nest" bristling with watch towers, and guarded only by the most trusty servitors. A swarm of astrologers and physicians preyed upon his fears—and his purse. But, however foolish in his credulity, he still made his strong hand felt both in France and in Italy, remaining to the last "the terrible king." His fervent prayers were interrupted by instructions for the regency which was to follow. He died on the 30th of August 1483, and was buried, according to his own wish, without royal state, in the church at Cléry, instead of at St Denis. He left a son, his successor, Charles VIII., and two daughters.

See the admirable résumé by Charles Petit-Dutaillis in Lavisse's *Histoire de France*, tome iv. pt. ii. (1902), and bibliographical indications given there. Michelet's wonderful depiction in his *Histoire de France* (livres 13 to 17) has never been surpassed for graphic word-painting, but it is inaccurate in details, and superseded in scholarship. Of the original sources for the reign the *Lettres de Louis XI.* (edited by Charavay and Vaesen, 8 vols., 1883–1902), the celebrated *Mémoires* of Philippe de Commines and the *Journal* of Jean de Royl naturally come first. The great mass of literature on the period is analysed in masterly fashion by A. Molinier, *Sources de l'histoire de France* (tome v. pp. 1-146), and to this exhaustive bibliography the reader is referred for further research. See also C. Hare, *The Life of Louis XI.* (London, 1907). (J. T. S.*)

LOUIS XII. (1462–1515), king of France, was grandson of Louis of Orleans, the brother of Charles VI., and son of the poet prince, Charles of Orleans, who, after the battle of Agincourt, spent twenty-five years of captivity in England. Louis was duke of Orleans until his accession to the throne, and he was fourteen years old when Louis XI. gave him the hand of his second daughter, Joan the Lame. In the first years of the reign of Charles VIII., Louis made a determined stand against the government of the Beaujeus, stirred up coalitions of the feudal nobles against them, and was finally defeated and taken prisoner at St Aubin du Cormier in 1488. Charles VIII. set him at liberty in 1491. These successive checks tamed him a little. In the Italian expedition of 1494 he commanded the vanguard of the royal army, occupied Genoa, and remained in the north of Italy, menacing Milan, on which he was already dreaming of asserting his rights. The children of Charles VIII. having died in infancy, he became heir-presumptive to the throne, and succeeded Charles in 1499. Louis was then thirty-six years old, but he seems to have grown old prematurely. He was fragile, narrow-shouldered and of a sickly constitution. His intelligence was mediocre, his character weak, and he allowed himself to be dominated by his wife, Anne of Brittany, and his favourite the Cardinal d'Amboise. He was a good king, full of moderation and humanity, and bent upon maintaining order and improving the administration of justice. He enjoyed a genuine popularity, and in 1506 the estates of Tours conferred on him the surname of *Père du Peuple*. His foreign policy, which was directed wholly towards Italy, was for the most part unskilful; to his claims on Naples he added those on Milan, which he based on the marriage of his grandfather, Louis of Orleans, with Valentina Visconti. He led in person several armies into Italy, and proved as severe and pitiless towards his enemies as he was gentle and clement towards his subjects. Louis had two daughters. After his accession he had divorced his virtuous and ill-favoured queen, Joan, and had married, in 1499, Anne of Brittany, the widow of Charles VIII. On her death in January 1514, in order to detach England from the alliance against him, he married on the 9th of October 1514, Mary Tudor, sister of Henry VIII. of England (see MARY, queen of France). He died on the 1st of January 1515.

For a bibliography of the printed sources see Henri Hauser, *Les Sources de l'histoire de France, XVI^e siècle*, vol. 1. (Paris, 1906). The principal secondary authorities are De Maulde, *Histoire de Louis XII.* (Paris, 1889–1893); Le Roux de Lincy, *Vie de la reine Anne de Bretagne* (Paris, 1860); H. Lemonnier, *Les Guerres d'Italie* (Paris, 1903) in the *Histoire de France* by E. Lavisse. (J. I.)

LOUIS XIII. (1601–1643), king of France, was the son of Henry IV. and of Marie de' Medici. He became king on his father's assassination in 1610; but his mother at once seized the full powers of regent. She determined to reverse the policy of her husband and to bring France into alliance with Spain and the Austrian house, upon which power Henry had been meditating an attack at the time of his death. Two marriages were designed to cement this alliance. Louis was to marry Anne of Austria, daughter of the Spanish king, Philip III., and the Spanish prince, afterwards Philip IV., himself was to marry the Princess Elizabeth, the king's sister. Notwithstanding the opposition of the Protestants and nobles of France, the queen carried through her purpose and the marriages were concluded in 1615. The next years were full of civil war and political intrigue, during which the queen relied upon the Marshal d'Ancre. Louis XIII. was a backward boy, and his education had been much neglected. We have the fullest details of his private life, and yet his character remains something of a mystery. He was fond of field sports and seemed to acquiesce in his mother's occupation of power and in the rule of her favourites. But throughout his life he concealed his purposes even from his closest friends; sometimes it seems as if he were hardly conscious of them himself. In 1617 he was much attached to Charles d'Albert, sieur de Luynes; and with his help he arrested Marshal d'Ancre, and on his resistance had him assassinated. From this time to her death the relation between the king and his mother was one of concealed or open hostility. The article on FRANCE must be consulted for the intricate events of the following years.

The decisive incident for his private life as well as for his reign was the entrance of Cardinal Richelieu, hitherto the queen's chief adviser, into the king's council in 1624. Henceforth the policy of France was directed by Richelieu, who took up in its main features the system of Protestant alliances and opposition to the power of Austria and Spain, which had been begun by Henry IV. and had been interrupted by the queen-mother during the regency; while he asserted the power of the crown against all rivals at home. This policy had remarkable results for the king's private life. It not only brought him into unremitting conflict with the Protestants and the nobles of France, but also made him the enemy of his mother, of his brother Gaston of Orleans, who made himself the champion of the cause of the nobles, and sometimes even of his wife. It is not easy to define his relations to Richelieu. He was convinced of his loyalty and of his genius, and in the end always supported his policy. But he disliked the friction with his family circle which this policy produced. In the difficulty with which he expressed himself and in a certain indecision of character the king was curiously unlike his father, the frank and impetuous Henry of Navarre, and his absolute son Louis XIV. He took a great interest in all the externals of war. He was present, and is said to have played an important part at the passage of Susa in 1629, and also eagerly participated in the siege of Rochelle, which surrendered in the same year. But for the most part his share in the great events of the reign was a passive one. The one all-important fact was that he supported his great minister. There were certain occasions when it seemed as if that support would be denied. The chief of these was what is known as the "Day of Dupes" (1630). Then the queen-mother and the king's brother passionately attacked the minister, and for a moment it was believed that Richelieu was dismissed and that the queen-mother and a Spanish policy had triumphed. But the sequel only strengthened the power of the minister. He regained his ascendancy over the king, punished his enemies and forced Marie de' Medici and Gaston of Orleans to sue for pardon. In 1631 Gaston fled to Lorraine and the queen-mother to Brussels. Gaston soon returned, to plot, to fail and to sue for pardon again and again; but Marie de'Medici ended her life in exile.

Richelieu's position was much strengthened by these incidents, but to the end of life he had to struggle against conspiracies which were designed to deprive him of the king's support, and usually Gaston of Orleans had some share in these movements. In 1632 the duke of Montmorency's conspiracy brought its leader to the scaffold. But the last great effort to overthrow Richelieu was closely connected with the king. Louis XIII. had from the beginning of his reign had favourites—young men for the most part with whom he lived freely and intimately and spoke of public affairs lightly and unreservedly; and who in consequence often exaggerated their influence over him. Henri d'Effiat, marquis de Cinq-Mars, was the last of these favourites. The king is said to have allowed him to speak hostilely of Richelieu and even to recall the assassination of Marshal d'Ancre. Cinq-Mars believed himself secure of the king's favour. He entered into negotiations with Spain and was secretly supported by Gaston of Orleans. But Richelieu discovered his treasonous relations with Spain and by this means defeated his plot. Louis was reconciled to his minister. "We have lived too long together to be separated" he is reported to have said (September 1642). Yet when Richelieu died in December of the same year he allowed himself to speak of him in a jealous and satirical tone. He died himself a few months later (May 1643).

His nature was timid, lethargic and melancholy, and his court was not marked by the scandals which had been seen under Henry IV. Yet Mademoiselle de la Fayette and Madame d'Hautefort and others are said to have been his mistresses. His brother Gaston survived him, but gave unexpectedly little trouble during the wars of the Fronde which ensued on the death of Louis XIII.

The chief source of information on Louis XIII.'s life is to be found in the contemporary memoirs, of which the chief are: Bassompierre, Fontenay-Mareuil, Gaston d'Orléans, Montrésor, Omer Talon. Richelieu's own Memoirs are chiefly concerned with politics and diplomacy. Of modern works those most directly bearing on the king's personal life are R. de Beauchamp, *Louis XIII. d'après sa correspondance avec le cardinal de Richelieu*; G. Hanotaux, *Histoire du cardinal de Richelieu* (1893–1896); Rossignol, *Louis XIII. avant Richelieu*; M. Topin, *Louis XIII. et Richelieu* (1876). See too Professor R. Lodge, *Richelieu*; J. B. H. R. Capefigue, *Richelieu, Mazarin et la Fronde* (1835–1836); and Dr J. H. Bridges, *Richelieu, Mazarin and Colbert* (1866).

For full bibliography see G. Monod, *Bibliographie de l'histoire de France*; *Cambridge Modern History*, vol. iv. ("The Thirty Years' War"); Lavisse et Rambaud, *Histoire générale*, vol. v. ("Guerres de religion"). (A. J. G.*)

LOUIS XIV. (1638–1715), king of France, was born at Saint-Germain-en-Laye on the 5th of September 1638. His father, Louis XIII., had married Anne of Austria, daughter of Philip III., king of Spain, in 1615, but for twenty years the marriage had remained without issue. The childlessness of the king was a constant threat to the policy of his great minister Richelieu; for the king's brother and heir, Gaston of Orleans, was a determined opponent of that policy. The birth of the prince who was destined to reign as Louis XIV. was therefore hailed as a triumph, not less important than any of those won by diplomacy or arms. The death of his father made Louis XIV. king on the 14th of May 1643, but he had to wait sixteen years before he began to rule. Power lay for some time in the hands of the queen-mother and in those of her minister, Cardinal Mazarin, who found it difficult to maintain the power of the throne and the integrity of French territory during the domestic troubles of the Fronde and the last stages of the Thirty Year's War. The minister was hated as a foreigner, and the childhood of the king weakened the royal authority. Twice the court had to flee from Paris; once when there was a rumour of intended flight the populace was admitted to see the king in his bed. The memory of these humiliations played their part in developing later the autocratic ideas of Louis. Mazarin, in spite of all disadvantages, triumphed alike over his domestic and his foreign opponents. The Fronde was at an end by 1653; the peace of Westphalia (1648) and the peace of the Pyrenees (1659) marked the success of the arms and of the diplomacy of France. Louis XIV. was now twenty-one years of age and was anxious to rule as well as to reign. The peace of the Pyrenees was a decisive event in his personal history as well as in that of France, for one of its most important stipulations referred to his marriage. He had already been strongly attracted to one of the nieces of Mazarin, but reasons of state triumphed over personal impulse; and it was agreed that the new friendship with Spain should be cemented by the marriage of Louis to his cousin, the Infanta Maria Theresa. A large dowry was stipulated for; and in consideration of this the king promised to forgo all claims that his wife might otherwise possess to the Spanish crown or any part of its territories. The dowry was never paid, and the king held himself free of his promise.

The marriage took place at once, and the king entered Paris in triumph in 1660. Mazarin died in the next year; but so strong was the feeling that the kings of France could only rule through a first minister that it was generally expected that Mazarin would soon have a successor. The king, however, at once announced his intention of being his own first minister; and from this resolution he never swerved. Whatever great qualities he may have lacked he certainly possessed industry and patience in the highest degree. He built up a thoroughly personal system of government, and presided constantly over the council and many of its committees. He was fond of gaiety and of sport; but neither ever turned him away from the punctual and laborious discharge of his royal duties. Even the greatest of his ministers found themselves controlled by the king. Fouquet, the finance minister, had accumulated enormous wealth during the late disturbances, and seemed to possess power and ambition too great for a subject. Louis XIV. found it necessary almost to conspire against him; he was overthrown and condemned to perpetual imprisonment. Those who had most of the king's confidence afterwards were Colbert for home affairs; Lionne for diplomacy; Louvois for war; but as his reign proceeded he became more self-confident and more intolerant of independence of judgment in his ministers.

His court was from the first one of great brilliance. In art and in literature, the great period, which is usually called by the king's name, had in some respects passed its zenith when he began to reign. But France was unquestionably the first state in Europe both in arms and arts, and within France the authority of the king was practically undisputed. The nation, proud of its pre-eminence and weary of civil war, saw in the king its true representative and the guarantee of its unity and success. Louis was singularly well fitted by his physical and intellectual gifts for the rôle of *Grand Monarque* and he played it to perfection. His wife Maria Theresa bore him children but there was no community of tastes between them, and the chief influence at court is to be found not in the queen but in the succession of avowed mistresses. Mademoiselle de la Vallière held the position from 1662 to 1670; she was then ousted by Madame de Montespan, who had fiercely intrigued for it, and whose proud and ambitious temper offered a great contrast to her rival. She held her position from 1670 to 1679 and then gave place to the still more famous Madame de Maintenon, who ruled, however, not as mistress but as wife. The events that brought about this incident form the strangest episode in the king's private life. Madame de Maintenon was the widow of the dramatist Scarron, and first came into relationship with the king as governess to his illegitimate children. She was a woman of unstained life and strongly religious temperament; and it was by this that she gained so great an influence over the king. Through her influence the king was reconciled to his wife, and, when Maria Theresa died in 1683, Madame de Maintenon shortly afterwards (in 1684) became the king's wife, though this was never officially declared. Under her influence the court lost most of its gaiety, and religion came to exercise much control over the life and the policy of the king.

The first years of the king's rule were marked by the great schemes of Colbert for the financial, commercial, industrial and naval reorganization of France, and in these schemes Louis took a deep interest. But in 1667 began the long series of wars, which lasted with little real intermission to the end of the reign (see FRANCE). In the steps that led to these wars and in their conduct the egotistic ambition and the vanity of the king played an important part; though he never showed real military skill and took no share in any military operations except in certain sieges. The War of Devolution (or the Queen's War) in 1667–68 to enforce the queen's claim to certain districts in the Spanish Netherlands, led to the Dutch War (1672–78), and in both these wars the supremacy of the French armies was clearly apparent. The next decade (1678–1688) was the real turning-point in the history of the reign, and the strength of France was seriously diminished. The chief cause of this is to be found in the revocation of the Edict of Nantes. The church had always opposed this settlement and had succeeded in altering it in many points. Now the new religious zeal and the autocratic temper of Louis XIV. came to the support of the church. The French Huguenots found their privileges decreased, and then, in 1685, the edict was altogether withdrawn. The results were ruinous to France. It was not only that she lost many thousands of her best citizens, but this blow against Protestantism deprived her of those Protestant alliances in Europe which had been in the past her great diplomatic support. Then the English Revolution came in 1688 and changed England from a wavering ally into the most determined of the enemies of France.

The war with the Grand Alliance, of which King William III. was the heart and soul, lasted from 1688 to 1697; and the treaty of Ryswick, which brought it to an end, deprived France of certain territories on her frontier. But Louis saw in the Spanish question a chance of more than making up for this loss. The Spanish king Charles II. was dying, and the future of the possessions of Spain was doubtful. The astute diplomacy of Louis succeeded in winning the inheritance for his grandson Philip. But this involved France and Europe in an immense war (1700) and by the peace of Utrecht (1713), though the French prince retained the Spanish crown, France had again to make concessions of territory.

Louis XIV. had shown wonderful tenacity of purpose during this disastrous war, and sometimes a nobler and more national spirit than during the years of his triumphs. But the condition of France was terrible. She was burdened with debt; the reforms of Colbert were ruined; and opposition to the king's régime began to make itself felt. Peace brought some relief to France, but the last years of the king's life were gloomy in the extreme. His numerous descendants seemed at one time to place the succession beyong all difficulty. But his eldest son, the dauphin, died in April 1711; his eldest grandson the duke of Burgundy in February 1712; and his great-grandson the duke of Brittany in March 1712. The heir to the throne was now the duke of Burgundy's son, the duke of Anjou, afterwards Louis XV. The king died on the 1st of September 1715, after the longest recorded reign in European history. The judgment of posterity has not repeated the flattering verdict of his contemporaries; but he remains the model of a great king in all that concerns the externals of kingship.

The reign of Louis XIV. is particularly rich in memoirs describing the life of the court. The chief are Madame de Motteville's memoirs for the period of the Fronde, and the letters of Madame de Sévigné and the memoirs of Saint-Simon for the later period. The king's ideas are best seen in the *Mémoires de Louis XIV. pour l'instruction du dauphin* (edited by Dreyss, 2 vols.). His private life is revealed in the letters of Madame de Maintenon and in those of Madame, Duchesse d'Orléans. Of the ordinary historians of France Michelet is fullest on the private life of the king. Mention may also be made of Voltaire, *Siècle de Louis XIV.*; P. Clément, *Histoire de la vie et de l'administration de Colbert*; Sainte-Beuve, *Causeries de lundi*. Full bibliographies of the reign will be found in G. Monod's *Bibliographie de l'histoire de France*; vol. v. ("The Age of Louis XIV.") of the *Cambridge Modern History*; and vol. vi. ("Louis XIV.") of the *Histoire générale* of Lavisse and Rambaud. (A. J. G.*)

LOUIS XV. (1710–1774), king of France, was the great-grandson of Louis XIV. and the third son of Louis, duke of Burgundy, and Marie Adelaide, princess of Savoy. The first son had died in 1705, and in 1712 the second son, the duke of Brittany, as well as his father and mother, was carried off by a mysterious disease. Louis was thus unexpectedly brought into the line of the succession, and was only five years old when Louis XIV. died. The dead king had endeavoured by his will to control the administration even after his death by a carefully selected council of regency, in which the duke of Orleans should have only the nominal presidency; but with the help of the parlement of Paris the arrangement was at once set aside, and the duke was declared regent with full traditional powers. The duke had capacity, but his life was so licentious that what influence he had upon the king was for evil. Fleury, bishop of Fréjus, was appointed his tutor, and the little king was sincerely attached to him. The king attained his legal majority at the age of thirteen, shortly before the death of the duke of Orleans. His first minister was the incapable duke of Bourbon, who in 1725 procured the repudiation of the Spanish princess, to whom the king had been betrothed, and his marriage to Maria Leszczynska, daughter of the exiled king of Poland, then resident in Alsace. In 1726 the duke of Bourbon was displaced by the king's tutor, Bishop (afterwards Cardinal) Fleury, who exercised almost absolute power, for the king took little interest in affairs of state. His administration was successful and peaceful until the year 1734, when a disputed succession in Poland brought about the interference of France on behalf of the queen's father. France was unsuccessful in her immediate object, but at the peace of Vienna (1735) secured the possession of Lorraine. Up to this point the reign had been prosperous; but from this time on it is a record of declining national strength, which was not compensated by some days of military glory. Fleury's great age (he died still in office at the age of ninety) prevented him from really controlling the policy of France and of Europe. In 1740 the war of the Austrian Succession broke out and France drifted into it as an ally of Frederick of Prussia and the enemy of England, and of Maria Theresa of Austria.

On Fleury's death in 1743 no one took his place, and the king professed to adopt the example of Louis XIV. and to establish a personal autocracy. But he was not strong enough in will or intellect to give unity to the administration. The marquis d'Argenson writes that at the council table Louis "opened his mouth, said little and thought not at all," and again that "under the appearance of personal monarchy it was really anarchy that reigned." He had followed too in his domestic life the example of his predecessors. The queen for some time seems to have secured his affections, and she bore him seven children. But soon we hear of the royal mistresses. The first to acquire notoriety was the duchess of Châteauroux, the third sister of one family who held this position. She was at least in part the cause of the only moment of popularity which the king enjoyed. She urged him to take part personally in the war. France had just received a humiliating check at Dettingen, and the invasion of the north-eastern frontier was feared. The king went to Metz in 1744, and his presence there did something to ward off the danger. While the nation felt genuine gratitude for his energy and its success, he was reported to have fallen dangerously ill. The king, of whom it was said that the fear of hell was the only part of religion which had any reality for him, now dismissed the duchess of Châteauroux and promised amendment. Prayers were offered everywhere for his recovery, and the country was swept by a delirium of loyal enthusiasm, which conferred on him the title of *Louis le bien aimé*. But his future life disappointed all these hopes. The duchess of Châteauroux died in the same year, but her place was taken in 1745 by Madame de Pompadour. This woman had philanthropic impulses and some real interest in art and letters; but her influence on public affairs was a fatal one. She had many rivals during her lifetime and on her death in 1764 she was succeeded by Madame du Barry (*q.v.*). But the mention of these three women gives no idea of the degradation of the king's life. There has doubtless been exaggeration as to certain details, and the story of his seraglio at the *Parc aux cerfs* is largely apocryphal. But it would be difficult to mention the name of any European king whose private life shows such a record of vulgar vice unredeemed by higher aims of any kind. He was not without ambition, but without sufficient tenacity of purpose to come near to realizing it. To the last he maintained the pretence of personal rule, but the machinery of government fell out of gear, and the disorder of the finances was never remedied before the revolution of 1789.

The peace of Aix-la-Chapelle (1748), which ended the war of the Austrian Succession, brought no gains to France in spite of her victories at Fontenoy and Raucoux; and the king was blamed for the diplomatic failure. The interval between this war and the Seven Years' War (1756) saw that great reversal of alliances which is sometimes called the "Diplomatic Revolution"; whereby France repudiated the alliance of Frederick the Great and joined hands with her old enemy Austria. The intrigues of Madame de Pompadour played in this change an important though not a decisive part. It was the cause of immense disasters to France; for after a promising beginning, both by land and sea, France suffered reverses which lost her both India and Canada and deprived her of the leading position which she had so long held in Europe. Her humiliation was declared by the peace of Paris (1763).

The article on the history of France (*q.v.*) shows how there arose during the last years of Louis XV.'s reign a strong reaction against the monarchy and its methods. Military success had given it its strength; and its prestige was ruined by military failure. In the parlements, provincial and Parisian; in religion and in literature, a note of opposition is struck which was never to die until the monarchy was overthrown. France annexed Corsica in 1768, but this was felt to be the work of the minister Chauvelin, and reflected no credit on the king. He died in 1774 of smallpox. If the reign of his predecessor shows us almost the ideal of personal monarchy we may see in that of Louis XV. all the vices and errors exemplified which lie in wait for absolute hereditary rule which has survived the period of its usefulness.

For the king's life generally see the memoirs of Saint-Simon, d'Argenson, Villars and Barbier, and for the details of his private life E. Boutaric, *Correspondance secrète de Louis XV.*; Madame de Pompadour's *Correspondance* published by P. Malassi; Dietric, *Les Maîtresses de Louis XV.*; and Fleury, *Louis XV. intimes et les petites maîtresses* (1909).

For the system of secret diplomacy and organized espionage, known as the *Secret du roi*, carried on under the auspices of Louis XV., see Albert duc de Broglie, *Le Secret du roi*. *Correspondance secrète de Louis XV. avec ses agents diplomatiques 1752–1774* (Paris, 1878); and for a general account of the reign, H. Carré, *La France sous Louis XV.* (Paris, 1891). For other works, general and special, see G. Monod, *Bibliographie de la France*, and the bibliography in the *Histoire générale* of Lavisse and Rambaud, vol. vii., and the *Cambridge Modern History*, vol. vi. (A. J. G.*)

LOUIS XVI. (1754–1793), king of France, was the son of Louis, dauphin of France, the son of Louis XV., and of Marie Joseph of Saxony, and was born at Versailles on the 23rd of August 1754, being baptized as Louis Augustus. His father's death in 1765 made him heir to the throne, and in 1770 he was married to Marie Antoinette, daughter of the empress Maria Theresa. He was just twenty years old when the death of Louis XV. on the 10th of May 1774 placed him on the throne. He began his reign under good auspices, with Turgot, the greatest living French statesman, in charge of the disorganized finances; but in less than two years he had yielded to the demand of the vested interests attacked by Turgot's reforms, and dismissed him. Turgot's successor, Necker, however, continued the régime of reform until 1781, and it was only with Necker's dismissal that the period of reaction began. Marie Antoinette then obtained that ascendancy over her husband which was partly responsible for the extravagance of the ministry of Calonne, and brought on the Revolution by the resulting financial embarrassment.[1] The third part of his reign began with the meeting of the states-general on the 4th of May 1789, which marked the opening of the Revolution. The revolt of Paris and the taking of the Bastille on the 14th of July were its results. The suspicion, not without justification, of a second attempt at a *coup d'état* led on the 6th of October to the "capture" of the king and royal family at Versailles by a mob from Paris, and their transference to the Tuileries. In spite of the growing radicalism of the clubs, however, loyalty to the king remained surprisingly strong. When he swore to maintain the constitution, then in progress of construction, at the festival of the federation on the 14th of July 1790, he was at the height of his popularity. Even his attempted flight on the 20th of June 1791 did not entirely turn the nation against him, although he left documents which proved his opposition to the whole Revolution. Arrested at Varennes, and brought back to Paris, he was maintained as a constitutional king, and took his oath on the 13th of September 1791. But already a party was forming in Paris which demanded his deposition. This first became noticeable in connexion with the affair of the Champ de Mars on the 17th of July 1791. Crushed for a time the party gained strength through the winter of 1791–1792. The declaration of war against the emperor Francis II., nephew of Marie Antoinette, was forced upon the king by those who wished to discredit him by failure, or to compel him to declare himself openly an enemy to the Revolution. Their policy proved effective. The failure of the war, which intensified popular hatred of the Austrian queen, involved the king; and the invasion of the Tuileries on the 20th of June 1792 was but the prelude to the conspiracy which resulted, on the 10th of August, in the capture of the palace and the "suspension" of royalty by the Legislative Assembly until the convocation of a national convention in September. On the 21st of September 1792 the Convention declared royalty abolished, and in January it tried the king for his treason against the nation, and condemned him to death. He was executed on the 21st of January 1793.

Louis XVI. was weak in character and mentally dull. His courage and dignity during his trial and on the scaffold has left him a better reputation than he deserves. His diary shows how little he understood, or cared for, the business of a king. Days on which he had not shot anything at the hunt were blank days for him. The entry on the 14th of July 1789 was "nothing"! The greater part of his time was spent hunting. He also amused himself making locks, and a little at masonry. Awkward and uncourtly, at heart shy, he was but a poor figure-head for the stately court of France. At first he did not care for Marie Antoinette, but after he came under her influence, her thoughtless conduct compromised him, and it was largely she who encouraged him in underhand opposition to the Revolution while he pretended to accept it. The only point on which he had of his own initiative shown a strong objection to revolutionary measures was in the matter of the civil constitution of the clergy. A devoted and sincere Roman Catholic, he refused at first to sanction a constitution for the church in France without the pope's approval, and after he had been compelled to allow the constitution to become law he resolved to oppose the Revolution definitely by intrigues. His policy was both feeble and false. He was singularly unfortunate even when he gave in, delaying his acquiescence until it had the air of a surrender. It is often said that Louis XVI. was the victim of the faults of his predecessors. He was also the victim of his own.

Having lost his elder son in 1789 Louis left two children, Louis Charles, usually known as Louis XVII., and Marie Thérèse Charlotte (1778–1851), who married her cousin, Louis, duke of Angoulême, son of Charles X., in 1799. The "orphan of the Temple," as the princess was called, was in prison for three years, during which time she remained ignorant of the fate which had befallen her parents. She died on the 19th of October 1851. Her life by G. Lenotre has been translated into English by J. L. May (1908).

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[1] The responsibility of Marie Antoinette for the policy of the king before and during the Revolution has been the subject of much controversy. In general it may be said that her influence on politics has been much exaggerated. (See MARIE ANTOINETTE.) [Ed.]

See the articles FRENCH REVOLUTION and MARIE ANTOINETTE. F. X. J. Droz, *Histoire du règne de Louis XVI.* (3 vols., Paris, 1860), a sane and good history of the period; and Arsène Houssaye, *Louis XVI.* (Paris, 1891). See also the numerous memoirs of the time, and the marquis de Ségur's *Au couchant de la monarchie, Louis XVI. et Turgot* (1910).

For bibliographies see G. Monod, *Bibl. de la France*; Lavisse et Rambaud, *Hist. Univ.*, vols. vii. and viii.; and the *Cambridge Modern History*, vol. viii. (R. A.*)

LOUIS XVII. (1785–1795?), titular king of France, second son of Louis XVI. and Marie Antoinette, was born at Versailles on the 27th of March 1785, was christened the same day Louis Charles, and given the title of duke of Normandy. Louis Charles became dauphin on the death of his elder brother on the 4th of June 1789. It is only with his incarceration in the Temple on the 13th of August 1792, that his history, apart from that of his parents, becomes of interest. The royal party included, beside the king and queen, their daughter Marie Thérèse Charlotte (Madame Royale), the king's sister Madame Élisabeth, the valet Cléry and others. The prisoners were lodged at first in the smaller Tower, but were removed to the larger Tower on the 27th of October. Louis Charles was then separated from his mother and aunt to be put in his father's charge, except for a few hours daily, but was restored to the women when Louis was isolated from his family at the beginning of his trial in December.

On the 21st of January 1793 Louis became, for the royalists, king of France, and a week later the comte de Provence arrogated to himself the title of regent. From that moment began new plots for the escape of the prisoners from the Temple, the chief of which were engineered by the Chevalier de Jarjayes,[1] the baron de Batz,[2] and the faithful Lady Atkyns.[3] On the 3rd of July the little dauphin was again separated from his mother, this time to be given into the keeping of the cobbler Antoine Simon[4] who had been named his guardian by the Committee of General Security. The tales told by the royalist writers of the barbarous cruelty inflicted by Simon and his wife on the child are not proven. Marie Jeanne, in fact, took great care of the child's person, and there is documentary evidence to prove that he had air and food. But the Simons were obviously grotesquely unfit guardians for a prince, and they doubtless caused much suffering to the impressionable child, who was made on occasion to eat and drink to excess, and learnt the language of the gutter. But the scenes related by A. de Beauchesne of the physical martyrdom of the child are not supported by any other testimony, though he was at this time seen by a great number of people. On the 6th of October Pache, Chaumette, Hébert and others visited him and secured from him admissions of infamous accusations against his mother, with his signature to a list of her alleged crimes since her entry in the Temple, and next day he was confronted with his sister Marie Thérèse for the last time.

Simon's wife now fell ill, and on the 19th of January 1794 the Simons left the Temple, after securing a receipt for the safe transfer of their prisoner, who was declared to be in good health. A large part of the Temple records from that time onwards were destroyed under the Restoration, so that exact knowledge of the facts is practically impossible. Two days after the departure of the Simons the prisoner is said by the Restoration historians to have been put in a dark room which was barricaded like the cage of a wild animal. The story runs that food was passed through the bars to the child, who survived in spite of the accumulated filth of his surroundings. Robespierre[5] visited Marie Thérèse on the 11th of May, but no one, according to the legend, entered the dauphin's room for six months until Barras visited the prison after the 9th Thermidor (July 27, 1794). Barras's account of the visit describes the child as suffering from extreme neglect, but conveys no idea of the alleged walling in. It is nevertheless certain that during the first half of 1794 he was very strictly secluded; he had no special guardian, but was under the charge of guards changed from day to day. The child made no complaint to Barras of his treatment, probably because he feared to do so. He was then cleansed and re-clothed, his room cleaned, and during the day he was visited by his new attendant, a creole and a compatriot of Joséphine de Beauharnais, named Jean Jacques Christophe Laurent (1770–1807), who had from the 8th of November onwards assistance for his charge from a man named Gomin. The child was now taken out to walk on the roof of the Tower. From about the time of Gomin's entrance the prisoner was inspected, not by delegates of the Commune, but by representatives of the civil committee of the 48 sections of Paris. The rare recurrence of the same inspectors would obviously facilitate fraud, if any such were intended. From the end of October onwards the child maintained an obstinate silence, explained by Laurent as a determination taken on the day he made his deposition against his mother. On the 19th of December 1794 he was visited by three commissioners from the Committee of General Security—J. B. Harmand de la Meuse, J. B. C. Mathieu and J. Reverchon—who extracted no word from him. On Laurent's retirement Étienne Lasne was appointed on the 31st of March 1795 to be the child's guardian. In May 1795 the prisoner was seriously ill, and a doctor, P. J. Desault, well acquainted with the dauphin, having visited him seven months earlier, was summoned. Desault died suddenly, not without suspicion of poison, on the 1st of June, and it was some days before doctors Pelletan and Dumangin were called. Then it was announced that on the 8th Louis Charles died. Next day an autopsy was held at which it was stated that a child apparently about ten years of age, "which the commissioners told us was the late Louis Capet's son," had died of a scrofulous affection of long standing. He was buried on the 10th in the cemetery of Ste Marguerite, but no stone was erected to mark the spot.

The weak parts of this story are the sudden and unexplained departure of the Simons; the subsequent useless cruelty of treating the child like a wild beast and keeping him in a dark room practically out of sight (unless any doubt of his identity was possible), while his sister was in comparative comfort; the cause of death, declared to be of long standing, but in fact developed with such rapidity; the insufficient excuse provided for the child's muteness under Gomin's régime (he had answered Barras) and the irregularities in the formalities in attending the death and the funeral, when a simple identification of the body by Marie Thérèse would have prevented any question of resuscitated dauphins. Both Barras and Harmand de la Meuse are said to have given leave for the brother and sister to see each other, but the meeting was never permitted. The argument from the sudden disappearance of persons in a position to know something of the truth is of a less convincing character. It may be noted that the more famous of the persons alleged by partisans of subsequent pretenders to have been hustled out of the world for their connexion with the secret are the empress Josephine, the duc d'Enghien and the duc de Berri.

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[1] F. A. Regnier de Jarjayes (1745–1822). See P. Gaulot, *Un Complot sous la Terreur.*

[2] Jean, baron de Batz (1761–1822), attempted to carry off the dauphin in 1794. See G. Lenôtre, *Un Conspirateur royaliste pendant la Terreur, le baron de Batz* (1896).

[3] Charlotte Walpole (*c.* 1785–1836), an English actress who married in 1779 Sir Edward Atkyns, and spent most of her life in France. She expended large sums in trying to secure the escape of the prisoners of the Temple. See F. Barbey, *A Friend of Marie Antoinette* (Eng. ed. 1906).

[4] Antoine Simon (1736–1794) married Marie Jeanne Aladame, and belonged to the section of the Cordeliers. They owed their position to Anaxagoras Chaumette, procureur of the Commune, and to the fact that Simon had prevented one of the attempts of the baron de Batz. Simon was sent to the guillotine with Robespierre in 1794, and two years later Marie Jeanne entered a hospital for incurables in the rue de Sèvres, where she constantly affirmed the dauphin's escape. She was secretly visited after the Restoration by the duchess of Angoulême. On the 16th of November 1816, she was interrogated by the police, who frightened her into silence about the supposed substitution of another child for the dauphin. She died in 1819 See G. Lenôtre, *Vieilles maisons, vieux papiers* (2nd series, 1903).

[5] In a bulletin dated May 17-24, Paris, and enclosed by Francis Drake (June 17, 1794) at Milan to Lord Grenville, it is stated (Hist. MSS. Comm. Fortescue Papers at Dropmore, vol. ii. 576-577) that Robespierre in the night of 23-24 May fetched the king (the dauphin) from the Temple and took him to Meudon. "The fact is certain, although only known to the Committee of Public Safety. It is said to be ascertained that he was brought back to the Temple the night of 24-25th, and that this was a test to assure the ease of seizing him." This police report at least serves to show the kind of rumour then current.

Immediately on the announcement of the dauphin's death there arose a rumour that he had escaped. Simien-Despréaux, one of Louis XVIII.'s own authors, stated at a later period (1814) that Louis XVII. was living and that among the signatories of the treaty of April 13th were some who possessed proofs of his existence; and Eckard, one of the mainstays of the official account, left among his unpublished papers a statement that many members of "an assembly of our wise men" obstinately named Louis XVII. as the prince whom their wishes demanded. Unfortunately the removal of the child suited the plans of the comte de Provence (now Louis XVIII. for the *émigrés*) as well as it suited the revolutionary government, and no serious attempt was made by the royal family to ascertain the truth, though they paid none of the tributes to the memory of the dead king which might reasonably have been expected, had they been convinced of his death. Even his sister wore no mourning for him until she arrived at Vienna and saw that this was expected of her. In spite of the mass of literature which has accumulated on the subject, neither his death in the Temple nor his escape therefrom has been definitely established, though a very strong presumption is established in favour of the latter.

Some forty candidates for his honours were forthcoming under the Restoration. The most important of these pretenders were Karl Wilhelm Naundorff and the comte de Richemont. Naundorff's story rested on a series of complicated intrigues. According to him Barras determined to save the dauphin in order to please Joséphine Beauharnais, the future empress, having conceived the idea of using the dauphin's existence as a means of dominating the comte de Provence in the event of a restoration. The dauphin was concealed in the fourth storey of the Tower, a wooden figure being substituted for him. Laurent, to protect himself from the consequences of the substitution, replaced the wooden figure by a deaf mute, who was presently exchanged for the scrofulous child of the death certificate. The deaf mute was also concealed in the Temple. It was not the dead child, but the dauphin who left the prison in the coffin, whence he was extracted by his friends on the way to the cemetery. Richemont's tale that the woman Simon, who was genuinely attached to him, smuggled him out in a basket, is simple and more credible, and does not necessarily invalidate the story of the subsequent operations with the deaf mute and the scrofulous patient, Laurent in that case being deceived from the beginning, but it renders them extremely unlikely. A third pretender, Eleazar Williams, did not affect to know anything of his escape. He possessed, he said, no consciousness of his early years, only emerging from idiocy at the age of thirteen, when he was living with an Indian family in New York State. He was a missionary to the Indians when the prince de Joinville, son of Louis Philippe, met him, and after some conversation asked him to sign a document abdicating his rights in favour of Louis Philippe, in return for which he, the dauphin (alias Eleazar Williams), was to receive the private inheritance which was his. This Eleazar refused to do. The wildness of this tale refutes itself.

Richemont (Henri Ethelbert Louis Victor Hébert) was in prison in Milan for seven years and began to put forward his claims in Paris in 1828. In 1833 he was again arrested, was brought to trial in the following year and was condemned to twelve years' imprisonment. He escaped after a few months and left the country, to return in 1840. He died at Gleize on the 10th of August 1853, the name of Louis Charles de France being inscribed on his tomb until the government ordered its removal.

Naundorff or Naündorff, who had arrived from nowhere in Berlin in 1810, with papers giving the name Karl Wilhelm Naundorff, in order to escape the persecutions of which he declared himself the object, settled at Spandau in 1812 as a clockmaker, and married in 1818 Johanna Einert. In 1822 he removed to Brandenburg, and in 1828 to Crossen, near Frankfort. He was imprisoned from 1825 to 1828 for coining, though apparently on insufficient evidence, and in 1833 came to push his claims in Paris, where he was recognized as the dauphin by many persons formerly connected with the court of Louis XVI. Expelled from France in 1836, the day after bringing a suit against the duchess of Angoulême for the restitution of the dauphin's private property, he lived in exile till his death at Delft on the 10th of August 1845, and his tomb was inscribed "Louis XVII., roi de France et de Navarre (Charles Louis, duc de Normandie)." The Dutch authorities who had inscribed on his death certificate the name of Charles Louis de Bourbon, duc de Normandie (Louis XVII.) permitted his son to bear the name de Bourbon, and when the family appealed in 1850–1851, and again in 1874, for the restitution of their civil rights as heirs of Louis XVI. no less an advocate than Jules Favre pleaded their cause. Of all the pretenders Naundorff has the best case. He was certainly not the Jew of Prussian Poland which his enemies declared him to be, and he has to this day a circle of devoted adherents. Since he was sincerely convinced of his own rights, it is surprising that he put forward no claim in 1814.

If the dauphin did escape, it seems probable that he perished shortly afterwards or lived in a safe obscurity. The account of the substitution in the Temple is well substantiated, even to the names of the substitutes. The curious imbroglio deceived royalists and republicans alike. Lady Atkyns was trying by every possible means to get the dauphin out of his prison when he was apparently already in safe hands, if not outside the Temple walls. A child was in fact delivered to her agents, but he was a deaf mute. That there was fraud, and complicated fraud, in the guardians of the dauphin may be taken as proved by a succession of writers from 1850 onwards, and more recently by Frédéric Barbey, who wisely attempts no ultimate solution. When the partisans of Richemont or Naundorff come to the post-Temple careers of their heroes, they become in most cases so uncritical as to be unconvincing.

The official version of the dauphin's history as accepted under the Restoration was drawn up by Simien Despréaux in his uncritical *Louis XVII.* (1817), and is found, fortified by documents, in M. Eckard's *Mémoires historiques sur Louis XVII.* (1817) and in A. de Beauchesne's *Louis XVII., sa vie, son agonie, sa mort. Captivité de la famille royale au Temple* (2 vols., 1852, and many subsequent editions), containing copies of original documents, and essential to the study of the question, although its sentimental pictures of the boy martyr can no longer be accepted. L. de la Sicotière, "Les faux Louis XVII.," in *Revue des questions historiques* (vol. xxxii., 1882), deals with the pretenders Jean Marie Hervagault, Mathurin Bruneau and the rest; see also Dr Cabanes, *Les Morts mystérieuses de l'histoire* (1901), and revised catalogue of the J. Sanford Saltus collection of Louis XVII. books (New York, 1908). Catherine Welch, in *The Little Dauphin* (1908) gives a résumé of the various sides of the question.

Madame Royale's own account of the captivity of the Temple was first printed with additions and suppressions in 1817, and often subsequently, the best edition being that from her autograph text by G. Lenôtre, *La Fille de Louis XVI., Marie Thérèse Charlotte de France, duchesse d'Angoulême, le Temple, l'échange, l'exil* (1907). There are two collections of writings on the subject: *Marie Thérèse de France*, compiled (1852) by the marquis de Pastoret, and comprising beside the memoir written by Marie Thérèse herself, articles by M. de Montbel, Sainte-Beuve, J. Lemoine, La Guéronnière and extracts from Joseph Weber's memoirs; and *Mémoires de Marie Thérèse duchesse d'Angoulême*, comprising extracts from the narratives of Charles Goret (*Mon Témoignage*, 1852), of C. F. Beaulieu (*Mémoire adressée à la nation*, 1795), of L. G. Michaud (*Opinion d'un Français, 1795*) and of Mme de Tourzel (*Mémoires* 1883). Cf. A. Lanne, *La Sœur de Louis XVII.*, and the articles on "Madame Royale," on the "Captivité de la famille royale au Temple" and on the "Mise en liberté de Madame" in M. Tourneux's *Bibliographie de l'histoire de Paris pendant la révolution française* (vol. iv., 1906, and vol. i., 1890).

Naündorff.—For the case of Naündorff see his own narrative, *Abrégé de l'histoire des infortunes du Dauphin* (London, 1836; Eng. trans., 1838); also Modeste Gruau de la Barre, *Intrigues* *dévoilées ou Louis XVII. . . .* (3 vols., Rotterdam, 1846–1848); O. Friedrichs, *Correspondance intime et inédite de Louis XVII.* (Naundorff) 1834–1838 (2 vols., 1904); *Plaidoirie de Jules Favre devant la cour d'appel de Paris pour les héritiers de feu Charles-Guillaume Naundorff* (1874); H. Provins, *Le Dernier roi légitime de France* (2 vols., the first of which consists of destructive criticism of Beauchesne and his followers, 1889); A. Lanne, "Louis XVII. et le secret de la Révolution," *Bulletin mensuel* (1893 et seq.) of the Société des études sur la question Louis XVII., also *La Légitimité* (Bordeaux, Toulouse, 1883–1898). See further the article "Naundorff" in M. Tourneux, *Bibl. de la ville de Paris pendant la Révolution*, vol. iv. (1906).

Williams.—J. H. Hanson, *The Lost Prince: Facts tending to prove the Identity of Louis XVII. of France and the Rev. Eleazer Williams* (London and New York, 1854).

De Richemont.—Mémoires du duc de Normandie, fils de Louis XVI., écrits et publiés par lui-même (Paris, 1831), compiled, according to Quérard, by E. T. Bourg, called Saint Edme; Morin de Guérivière, *Quelques souvenirs . . .* (Paris, 1832); and J. Suvigny, *La Restauration convaincue . . . ou preuves de l'existence du fils de Louis XVI.* (Paris, 1851).

The widespread interest taken in Louis XVII. is shown by the fact that since 1905 a monthly periodical has appeared in Paris on this subject, entitled *Revue historique de la question Louis XVII.*, also by the promised examination of the subject by the Société d'Histoire contemporaine. (M. Br.)

LOUIS XVIII. (Louis le Désiré) (1755–1824). Louis-Stanislas-Xavier, comte de Provence, third son of the dauphin Louis, son of Louis XV., and of Maria Josepha of Saxony, was born at Versailles on the 17th of November 1755. His education was supervised by the devout duc de la Vauguyon, but his own taste was for the writings of Voltaire and the encyclopaedists. On the 14th of May 1771 took place his marriage with Louise-Marie-Joséphine of Savoy, by whom he had no children. His position at court was uncomfortable, for though ambitious and conscious of possessing greater abilities than his brother (Louis XVI.), his scope for action was restricted; he consequently devoted his energies largely to intrigue, especially against Marie Antoinette, whom he hated.[1] During the long absence of heirs to Louis XVI., "Monsieur," as heir to the throne, courted popularity and took an active part in politics, but the birth of a dauphin (1781) was a blow to his ambitions.[2] He opposed the revival of the *parlements*, wrote a number of political pamphlets,[3] and at the Assembly of Notables presided, like the other princes of the blood, over a bureau, to which was given the name of the *Comité des sages*; he also advocated the double representation of the *tiers*. At the same time he cultivated literature, entertaining poets and writers both at the Luxembourg and at his château of Brunoy (see Dubois-Corneau, *Le Comte de Provence à Brunoy*, 1909), and gaining a reputation for wit by his verses and *mots* in the salon of the charming and witty comtesse de Balbi, one of Madame's ladies, who had become his mistress,[4] and till 1793 exerted considerable influence over him. He did not emigrate after the taking of the Bastille, but, possibly from motives of ambition, remained in Paris. Mirabeau thought at one time of making him chief minister in his projected constitutional government (see *Corr. de Mirabeau et La Marck*, ed. Bacourt, i. 434, 436, 442), but was disappointed by his caution and timidity. The *affaire Favras* (Dec. 1789) aroused great feeling against Monsieur, who was believed by many to have conspired with Favras, only to abandon him (see Lafayette's *Mems.* and *Corr. of Mirabeau*). In June 1791, at the time of the flight to Varennes, Monsieur also fled by a different route, and, in company with the comte d'Avaray[5]—who subsequently replaced Mme de Balbi as his confidant, and largely influenced his policy during the emigration—succeeded in reaching Brussels, where he joined the comte d'Artois and proceeded to Coblenz, which now became the headquarters of the emigration.

Here, living in royal state, he put himself at the head of the counter-revolutionary movement, appointing ambassadors, soliciting the aid of the European sovereigns, and especially of Catherine II. of Russia. Out of touch with affairs in France and surrounded by violent anti-revolutionists, headed by Calonne and the comte d'Artois, he followed an entirely selfish policy, flouting the National Assembly (see his reply to the summons of the National Assembly, in Daudet, *op. cit.* i. 96), issuing uncompromising manifestoes (Sept. 1791, Aug. 1792, &c.), and obstructing in every way the representatives of the king and queen.[6] After Valmy he had to retire to Hamm in Westphalia, where, on the death of Louis XVI., he proclaimed himself regent; from here he went south, with the idea of encouraging the royalist feeling in the south of France, and settled at Verona, where on the death of Louis XVII. (8th of June 1795) he took the title of Louis XVIII. At this time ended his *liaison* with Mme de Balbi, and the influence of d'Avaray reached its height. From this time onward his life is a record of constant wanderings, negotiations and conspiracies. In April 1796 he joined Condé's army on the German frontier, but was shortly requested to leave the country, and accepted the hospitality of the duke of Brunswick at Blanckenberg till 1797, when, this refuge being no longer open to him, the emperor Paul I. permitted him to settle at Mittau in Courland, where he stayed till 1801. All this time he was in close communication with the royalists in France, but was much embarrassed by the conflicting policy pursued by the comte d'Artois from England, and was largely at the mercy of corrupt and dishonest agents.[7] At Mittau was realized his cherished plan of marrying Madame Royale, daughter of Louis XVI., to the duc d'Angoulême, elder son of the comte d'Artois. From Mittau, too, was sent his well-known letter to Bonaparte (1799) calling upon him to play the part of Monk, a proposal contemptuously refused (E. Daudet, *Hist. de l'émigration*, ii. 371, 436), though Louis in turn declined to accept a pension from Bonaparte, and later, in 1803, though his fortunes were at their lowest ebb, refused to abdicate at his suggestion and accept an indemnity.

Suddenly expelled from Mittau in 1801 by the capricious Paul I., Louis made his way, in the depth of winter, to Warsaw, where he stayed for three years. All this time he was trying to convert France to the royalist cause, and had a "*conseil royal*" in Paris, founded at the end of 1799 by Royer-Collard, Montesquiou and Clermont-Gallerande, the actions of which were much impeded by the activity of the rival committee of the comte d'Artois (see E. Daudet, *op. cit.* ii., and Remâcle, *Bonaparte et les Bourbons*, Paris, 1899), but after 1800, and still more after the failure of the royalist conspiracy of Cadoudal, Pichegru and Moreau, followed by the execution of the duc d'Enghien (March 1804), and the assumption by Napoleon of the title of emperor (May 1804), the royalist cause appeared quite hopeless. In September 1804 Louis met the comte d'Artois at Calmar in Sweden, and they issued a protest against Napoleon's action, but being warned that he must not return to Poland, he gained permission from Alexander I. again to retire to Mittau. After Tilsit, however (1807), he was again forced to depart, and took refuge in England, where he stayed first at Gosfield in Essex, and afterwards (1809 onwards) at Hartwell in Buckinghamshire.

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[1] See Arneth and Geffroy, *Corr. de Marie-Thérèse avec le comte de Mercy-Argenteau*, vol. i., "Mercy to Maria Theresa, June 22nd, 1771," also i. 261, ii. 186, 352, 393. Marie Antoinette says (ii. 393): ". . . à un caractère très faible, il joint une marche souterraine, et quelquefois très basse."

[2] See his letters to Gustavus III. of Sweden in A. Geffroy, *Gustave III et la cour de France*, vol. ii. appendix.

[3] Two pamphlets at least are ascribed to him: "Les Mannequins, conte ou histoire, comme l'on voudra" (against Turgot; anon., Paris, 1776) and "Description historique d'un monstre symbolique pris vivant sur les bords du lac Fagua, près de Santa-Fé, par les soins de Francisco Xaveiro de Neunris" (against Calonne; Paris, 1784) (A. Debidour in *La Grande Encyclopédie*).

[4] It has frequently been alleged that his relations with Mme de Balbi, and indeed with women generally, were of a platonic nature. De Reiset (*La Comtesse de Balbi*, pp. 152-161) produces evidence to disprove this assertion.

[5] Antoine-Louis-François de Bésiade, comte, afterwards duc, d'Avaray. In spite of his loyalty and devotion, the effect of his influence on Louis XVIII. may be gathered from a letter of J. de Maistre to Blacas, quoted by E. Daudet, *Hist. de l'émigration*, ii. 11: "celui qui n'a pu dans aucun pays aborder aucun homme politique sans l'aliéner n'est pas fait pour les affaires."

[6] See Klinckowström, *Le Comte de Fersen et la cour de France.* Fersen says (i. 7), "Monsieur ferait mieux seul, mais il est entièrement subjugué par l'autre" (*i.e.* the comte d'Artois, who was in turn under the influence of Calonne). See Daudet, *op. cit.* vol. i.

[7] See E. Daudet, *La Conjuration de Pichegru* (Paris, 1901).

In 1810 his wife died, and in 1811 d'Avaray died, his place as favourite being taken by the comte de Blacas.[1] After Napoleon's defeats in 1813 the hopes of the royalists revived, and Louis issued a fresh manifesto, in which he promised to recognize the results of the Revolution. Negotiations were also opened with Bernadotte, who seemed willing to support his cause, but was really playing for his own hand.

In March 1814 the Allies entered Paris, and thanks to Talleyrand's negotiations the restoration of the Bourbons was effected, Louis XVIII. entering Paris on the 2nd of May 1814, after issuing the declaration of St Ouen, in which he promised to grant the nation a constitution (*octroyer une charte*). He was now nearly sixty, wearied by adversity, and a sufferer from gout and obesity. But though clear-sighted, widely read and a good diplomatist, his impressionable and sentimental nature made him too subject to personal and family influences. His concessions to the reactionary and clerical party of the *émigrés*, headed by the comte d'Artois and the duchesse d'Angoulême, aroused suspicions of his loyalty to the constitution, the creation of his *Maison militaire* alienated the army, and the constant presence of Blacas made the formation of a united ministry impossible. After the Hundred Days, during which the king was forced to flee to Ghent, the dismissal of Blacas was made one of the conditions of his second restoration. On the 8th of July he again entered Paris, "in the baggage train of the allied armies," as his enemies said, but in spite of this was received with the greatest enthusiasm[2] by a people weary of wars and looking for constitutional government. He was forced to retain Talleyrand and Fouché in his first ministry, but took the first opportunity of ridding himself of them when the elections of 1815 assured him of a strong royalist majority in the chamber (the *chambre introuvable*, a name given it by Louis himself). At this time he came into contact with the young comte (afterwards duc) Decazes, prefect of the police under Fouché, and minister of police in Richelieu's ministry, who now became his favourite and gained his entire confidence (see E. Daudet, *Louis XVIII. et le duc Decazes*). Having obtained a ministry in which he could trust, having as members the duc de Richelieu and Decazes, the king now gave it his loyal support and did his best to shield his ministers from the attacks of the royal family. In September 1816, alarmed at the violence of the *chambre introuvable*, he was persuaded to dissolve it. An attempt on the part of the Ultras to regain their ascendancy over the king, by conniving at the sudden return of Blacas from Rome to Paris,[3] ended in failure.

The events and ministerial changes of Louis XVIII.'s reign are described under the article FRANCE: *History*, but it may be said here that the king's policy throughout was one of prudence and common sense. His position was more passive than active, and consisted in giving his support as far as possible to the ministry of the day. While Decazes was still in power, the king's policy to a large extent followed his, and was rather liberal and moderate, but after the assassination of the duc de Berry (1820), when he saw that Decazes could no longer carry on the government, he sorrowfully acquiesced in his departure, showered honours upon him, and transferred his support to Richelieu, the head of the new ministry. In the absence of Decazes a new favourite was found to amuse the king's old age, Madame du Cayla (Zoé Talon, comtesse du Cayla), a protégée of the vicomte Sosthène de la Rochefoucauld and consequently a creature of the Ultras. As the king became more and more infirm, his power of resistance to the intrigues of the Ultras became weaker. The birth of a posthumous son to the duc de Berry (Sept. 1820), the death of Napoleon (5th of May 1821) and the resignation of Richelieu left him entirely in their hands, and after Villèle had formed a ministry of a royalist character the comte d'Artois was associated with the government, which passed more and more out of the king's hands. He died on the 16th of September 1824, worn out in body, but still retaining flashes of his former clear insight and scepticism. The character of Louis XVIII. may be summed up in the words of Bonaparte, quoted by Sorel (*L'Europe et la Rév. fr.* viii. 416 footnote), "C'est Louis XVI. avec moins de franchise et plus d'esprit." He had all the Bourbon characteristics, especially their love of power, combined with a certain nobility of demeanour, and a consciousness of his dignity as king. But his nature was cold, unsympathetic and calculating, combined with a talent for intrigue, to which was added an excellent memory and a ready wit. An interesting judgment of him is contained in *Queen Victoria's Letters*, vol. i., in a letter of Leopold I., king of the Belgians, to the queen before her accession, dated the 18th of November 1836, "Poor Charles X. is dead. . . . History will state that Louis XVIII. was a most liberal monarch, reigning with great mildness and justice to his end, but that his brother, from his despotic and harsh disposition, upset all the other had done and lost the throne. Louis XVIII. was a clever, hard-hearted man, shackled by no principle, very proud and false. Charles X. an honest man, a kind friend," &c. &c. This seems fairly just as a personal estimate, though it does not do justice to their respective political rôles.

BIBLIOGRAPHY.—There is no trustworthy or complete edition of the writings and correspondence of Louis XVIII. The *Mémoires de Louis XVIII. recueillis et mis en ordre par M. le duc de D. . .*, (12 vols., Paris, 1832–1833) are compiled by Lamothe-Langon, a well-known compiler of more or less apocryphal memoirs. From the hand of Louis XVIII. are: *Relation d'un voyage à Bruxelles et à Coblentz, 1791* (Paris, 1823, with dedication to d'Avaray); and *Journal de Marie-Thérèse de France, duchesse d'Angoulême, corrigé et annoté par Louis XVIII.*, ed. Imbert de St Amand (Paris, 1896). Some of his letters are contained in collections, such as *Lettres d'Artwell; correspondance politique et privée de Louis XVIII., roi de France* (Paris, 1830; letters addressed to d'Avaray); *Lettres et instructions de Louis XVIII. au comte de Saint-Priest*, ed. Barante (Paris, 1845); *Talleyrand et Louis XVIII., corr. pendant le congrès de Vienne, 1814–1815*, ed. Pallain (1881; trans., 2 vols., 1881); see also the corr. of Castlereagh, Metternich, J. de Maistre, the Wellington Dispatches, &c., and such collections as *Corr. diplomatique de Pozzo di Borgo avec le comte de Nesselrode* (2 vols., 1890–1897), the correspondence of C. de Rémusat, Villèle, &c. The works of E. Daudet are of the greatest importance, and based on original documents; the chief are: *La Terreur Blanche* (Paris, 1878); *Hist. de la restauration 1814–1830* (1882); *Louis XVIII. et le duc Decazes* (1899); *Hist. de l'émigration*, in three studies: (i.) *Les Bourbons et la Russie* (1886), (ii.) *Les Émigrés et la seconde coalition* (1886), (iii.) *Coblenz, 1789–1793* (1890). Developed from these with the addition of much further material is his *Hist. de l'émigration* (3 vols., 1904–1907). Also based on original documents is E. Romberg and A. Malet, *Louis XVIII. et les cent-jours à Gand* (1898). See also G. Stenger, *Le Retour des Bourbons* (1908); Cte. L. de Remâcle, *Bonaparte et les Bourbons. Relations secrèts des agents du cte. de Provence sous le consulat* (Paris, 1899). For various episodes, see Vicomte de Reiset, *La Comtesse de Balbi* (Paris, 1908; contains a long bibliography, chiefly of memoirs concerning the emigration, and is based on documents); J. B. H. R. Capefigue, *La Comtesse du Cayla* (Paris, 1866); J. Turquan, *Les Favorites de Louis XVIII.* (Paris, 1900); see also the chief memoirs of the period, such as those of Talleyrand, Chateaubriand, Guizot, duc de Broglie, Villèle, Vitrolles, Pasquier, the comtesse de Boigne (ed. Nicoullaud, Paris, 1907), the Vicomte L. F. Sosthène de la Rochefoucauld (15 vols., Paris, 1861–1864); and the writings of Benjamin Constant, Chateaubriand, &c.

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[1] Pierre-Louis-Casimir, comte (afterwards duc) de Blacas d'Aulps, was as rigidly royalist as d'Avaray, but more able. E. Daudet, *Hist. de l'émigration*, i. 458, quotes a judgment of him by J. de Maistre: "Il est né homme d'état et ambassadeur."

[2] See account by Decazes in E. Daudet, *Louis XVIII. et le duc Decazes*, pp. 48-49, and an interesting "secret and confidential" letter of Castlereagh to Liverpool (July 8, 1815) in the unpublished Foreign Office records: "The king sent for the duke and me this evening to the Thuilleries. . . . We found him in a state of great emotion and exaltation at the reception he had met with from his subjects, which appears to have been even more animated than on his former entrance. Indeed, during the long audience to which we were admitted, it was almost impossible to converse, so loud were the shouts of the people in the Thuilleries Gardens, which were full, though it was then dark. Previous to the king's dismissing us, he carried the duke and me to the open window. Candles were then brought, which enabled the people to see the king with the duke by his side. They ran from all parts of the Gardens, and formed a solid mass of an immense extent, rending the air with acclamations. The town is very generally illuminated, and I understand from men who have traversed the principal streets that every demonstration of joy was manifested by the inhabitants."

[3] It is as yet not proved that Blacas returned from his embassy in response to a summons from the Ultras. But whether it was on his own initiative or not, there can be no doubt as to the hopes which they built on his arrival (see Daudet, *Louis XVIII. et le duc Decazes*.

General Works.—See the histories of France, the Emigration, the Restoration and especially the very full bibliographies to chapters i., ii. and iii. of *Cambridge Modern History*, and Lavisse and Rambaud, *Hist. générale*, vol. x. (C. B. P.)

LOUIS I. (1326–1382), called "the great," king of Hungary and Poland, was the third son of Charles Robert, king of Hungary, and Elizabeth, daughter of the Polish king, Ladislaus Lokietek. In 1342 he succeeded his father as king of Hungary and was crowned at Székesfehérvár on the 21st of July with great enthusiasm. Though only sixteen he understood Latin, German and Italian as well as his mother tongue. He owed his relatively excellent education to the care of his mother, a woman of profound political sagacity, who was his chief counsellor in diplomatic affairs during the greater part of his long reign. Italian politics first occupied his attention. As a ruler of a rising great power in search of a seaboard he was the natural adversary of the Venetian republic, which already aimed at making the Adriatic a purely Venetian sea and resented the proximity of the Magyars in Dalmatia. The first trial of strength began in 1345, when the city of Zara placed herself under the protection of Hungary and was thereupon invested by the Venetians. Louis fought a battle beneath the walls of Zara (July 1st, 1346), which has been immortalized by Tintoretto, but was defeated and compelled to abandon the city to the republic. The struggle was renewed eleven years later when Louis, having formed, with infinite trouble, a league of all the enemies of Venice, including the emperor, the Habsburgs, Genoa and other Italian towns, attacked his maritime rival with such vigour that she sued for peace, and by the treaty of Zara (February 18th, 1358) ceded most of the Dalmatian towns and renounced the title of duke of Dalmatia and Croatia, hitherto borne by the doge. Far more important than the treaty itself was the consequent voluntary submission of the independent republic of Ragusa to the suzerainty of the crown of St Stephen the same year, Louis, in return for an annual tribute of 500 ducats and a fleet, undertaking to defend Ragusa against all her enemies. Still more glorious for Hungary was Louis's third war with Venice (1378–1381), when he was again aided by the Genoese. At an early stage of the contest Venice was so hardly pressed that she offered to do homage to Hungary for all her possessions. But her immense resources enabled her to rally her forces, and peace was finally concluded between all the powers concerned at the congress of Turin (1381), Venice virtually surrendering Dalmatia to Louis and undertaking to pay him an annual tribute of 7000 ducats. The persistent hostility of Venice is partially attributable to her constant fear lest Louis should inherit the crown of Naples and thus threaten her trade and her sea-power from two sides simultaneously. Louis's younger brother Andrew had wedded Joanna, grand-daughter and heiress of old King Robert of Naples, on whose death, in 1343, she reigned in her own right, refused her consort any share in the government, and is very strongly suspected of having secured his removal by assassination on the night of the 19th of September 1345. She then married Prince Louis of Taranto, and strong in the double support of the papal court at Avignon and of the Venetian republic (both of whom were opposed to Magyar aggrandisement in Italy) questioned the right of Louis to the two Sicilies, which he claimed as the next heir of his murdered brother. In 1347, and again in 1350, Louis occupied Naples and craved permission to be crowned king, but the papal see was inexorable and he was compelled to withdraw. The matter was not decided till 1378 when Joanna, having made the mistake of recognizing the antipope Clement VII., was promptly deposed and excommunicated in favour of Prince Charles of Durazzo, who had been brought up at the Hungarian court. Louis, always inexhaustible in expedients, determined to indemnify himself in the north for his disappointments in the south. With the Habsburgs, Hungary's natural rivals in the west, Louis generally maintained friendly relations. From 1358 to 1368, however, the restless ambition of Rudolph, duke of Austria, who acquired Tirol and raised Vienna to the first rank among the cities of Europe, caused Louis great uneasiness. But Louis always preferred arbitration to war, and the peace congresses of Nagyszombat (1360) and of Pressburg (1360) summoned by him adjusted all the outstanding differences between the central European powers. Louis's diplomacy, moreover, was materially assisted by his lifelong alliance with his uncle, the childless Casimir the Great of Poland, who had appointed him his successor; and on Casimir's death Louis was solemnly crowned king of Poland at Cracow (Nov. 17, 1370). This personal union of the two countries was more glorious than profitable. Louis could give little attention to his unruly Polish subjects and was never very happy among them. Immovably entrenched behind their privileges, they rendered him only the minimum of service; but he compelled their representatives, assembled at Kassa, to recognize his daughter Maria and her affianced husband, Count Sigismund of Brandenburg, as their future king and queen by locking the gates of the city and allowing none to leave it till they had consented to his wishes (1374). Louis is the first European monarch who came into collision with the Turks. He seems to have arrested their triumphant career (*c.* 1372), and the fine church erected by him at Maria-Zell is a lasting memorial of his victories. From the first he took a just view of the Turkish peril, but the peculiar local and religious difficulties of the whole situation in the Balkans prevented him from dealing with it effectually (see HUNGARY, *History*). Louis died suddenly at Nagyszombat on the 10th of September 1382. He left two daughters Maria and Jadwiga (the latter he destined for the throne of Hungary) under the guardianship of his widow, the daughter of the valiant ban of Bosnia, Stephen Kotromanić, whom he married in 1353, and who was in every way worthy of him.

See *Rationes Collectorum Pontif. in Hungaria, 1281–1375* (Budapest, 1887); Dano Gruber, *The Struggle of Louis I. with the Venetians for Dalmatia* (Croat.) (Agram, 1903); Antal Pór, *Life of Louis the Great* (Hung.) (Budapest, 1892); and *History of the Hungarian Nation* (Hung.) (vol. 3, Budapest, 1895). (R. N. B.)

LOUIS II. (1506–1526), king of Hungary and Bohemia, was the only son of Wladislaus II., king of Hungary and Bohemia, and the French princess Anne of Candale. Prematurely born at Buda on the 1st of July 1506, it required all the resources of medical science to keep the sickly child alive, yet he developed so precociously that at the age of thirteen he was well bearded and moustached, while at eighteen his hair was silvery white. His parts were good and he could speak and write six languages at a very early age, but the zeal of his guardians and tutors to make a man of him betimes nearly ruined his feeble constitution, while the riotous life led by him and his young consort, Maria of Austria, whom he wedded on the 13th of January 1522, speedily disqualified him for affairs, so that at last he became an object of ridicule at his own court. He was crowned king of Hungary on the 4th of June 1508, and king of Bohemia on the 11th of May 1509, and was declared of age when he succeeded his father on the 11th of December 1521. But during the greater part of his reign he was the puppet of the magnates and kept in such penury that he was often obliged to pawn his jewels to get proper food and clothing. His guardians, Cardinal Bakócz and Count George of Brandenburg-Anspach, shamefully neglected him, squandered the royal revenues and distracted the whole kingdom with their endless dissensions. Matters grew even worse on the death of Bakócz, when the magnates István Báthory, János Zapolya and István Verböczy fought each other furiously, and used the diets as their tools. Added to these troubles was the ever-present Turkish peril, which became acute after the king, with insensate levity, arrested the Ottoman envoy Berham in 1521 and refused to unite with Suleiman in a league against the Habsburgs. Nevertheless in the last extremity Louis showed more of manhood than any of his counsellors. It was he who restored something like order by intervening between the magnates and the gentry at the diet of 1525. It was he who collected in his camp at Tolna the army of 25,000 men which perished utterly on the fatal field of Mohács on the 29th of August 1526. He was drowned in the swollen stream of Csele on his flight from the field, being the second prince of the house of Jagiello who laid down his life for Hungary.

See *Rerum Hungaricarum libri* (vol. 2, ed. Ferencz Toldy, Budapest, 1867); and József Podhradczky, *King Louis* (Hung.) (Budapest, 1860). (R. N. B.)

LOUIS, the name of three kings of Naples, members of the house of Anjou.

Louis I., duke of Anjou and count of Maine (1339–1384), was the second son of John II., king of France, and was born at Vincennes on the 23rd of July 1339. Having been given the duchy of Anjou in 1356 he led a wing of the French army at the battle of Poitiers and was sent to England as a hostage after the conclusion of the treaty of Brétigny in 1360, but he broke his parole in 1363 and so brought about King John's return into captivity. He took part in the war against England which was renewed in 1369, uniting the rival houses of Foix and Armagnac in the common cause, and in other ways rendering good service to his brother, King Charles V. Anjou's entrance into the troubled politics of Italy was one result of the papal schism which opened in 1378. Anxious to secure the support of France, the antipope Clement VII. persuaded the queen of Naples, Joanna I., to name Louis as her heir, and about the same time the death of Charles V. (September 1380) placed the duke in the position of regent of France. Neglecting France to prosecute his ambitions in Italy, he collected money and marched on Naples; but although helped by Amadeus VI., count of Savoy, he was unable to drive his rival, Charles, duke of Durazzo, from Naples. His army was destroyed by disease and Louis himself died at Biseglia, near Bari, on the 20th of September 1384, leaving two sons, his successor, Louis II., and Charles, duke of Calabria.

Louis II., duke of Anjou (1377–1417), born at Toulon on the 7th of October 1377, took up the struggle for Naples after his father's death and was crowned king by Clement VII. in 1389. After carrying on the contest for some years his enemies prevailed and he was compelled to take refuge in France, where he took part in the intestine strife which was desolating that kingdom. A few years later he made other attempts to secure the kingdom of Naples, which was now in the possession of Ladislas, a son of his father's foeman, Charles of Durazzo, and he gained a victory at Roccoserra in May 1411. Soon, however, he was again driven back to France, and after sharing anew in the civil wars of his country he died at Angers on the 29th of April 1417. His wife was Yolande, a daughter of John I., king of Aragon, and his son was his successor, Louis III.

Louis III., duke of Anjou (1403–1434), born on the 25th of September 1403, made in his turn an attempt to conquer Naples. This was in 1420, and he had met with considerable success in his task when he died at Cosenza on the 15th of November 1434. In 1424 Louis received from King Charles VII. the duchy of Touraine.

Another titular king of Naples of this name was Louis, a son of Philip, prince of Taranto. In 1346 he became the husband of Joanna I., queen of Naples, and in 1352 he was crowned king. After making an attempt to conquer Sicily he died on the 26th of May 1362.

LOUIS (893–911), surnamed the "Child," king of the Franks, son of the emperor Arnulf, was born at Ottingen, designated by Arnulf as his successor in Germany in 897, and crowned on the 4th of February 900. Although he never received the imperial crown, he is sometimes referred to as the emperor Louis IV. His chief adviser was Hatto I., archbishop of Mainz; and during his reign the kingdom was ravaged by Hungarians and torn with internal strife. He appears to have passed his time in journeys from place to place, and in 910 was the nominal leader of an expedition against the Hungarians which was defeated near Augsburg. Louis, who was the last of the German Carolingians, died in August or September 911 and was buried at Regensburg.

See Regino von Prüm, "Chronicon," in the *Monumenta Germaniae historica. Scriptores*, Band i. (Hanover and Berlin, 1826); E. Dümmler, *Geschichte des ostfränkischen Reichs* (Leipzig, 1887–1888); O. Dietrich, *Beiträge zur Geschichte Arnolfs von Kärnthen und Ludwigs des Kindes* (Berlin, 1890); and E. Mühlbacher, *Die Regesten des Kaiserreichs unter den Karolingern* (Innsbruck, 1881). (A. W. H.*)

LOUIS OF NASSAU (1538–1574), son of William, count of Nassau, and Juliana von Stolberg, and younger brother of William the Silent, took an active part in the revolt of the Netherlands against Spanish domination. He was one of the leaders of the league of nobles who signed the document known as "the Compromise" in 1566, and a little later was a member of the deputation who presented the petition of grievances called "the Request" to the regent, Margaret of Parma. It was on this occasion that the appellation of "the Beggars" (*les Gueux*) was first given to the opponents of King Philip's policy. On the arrival of Alva at Brussels, Count Louis, with his brother William, withdrew from the Netherlands and raised a body of troops in defence of the patriot cause. In the spring of 1568 Louis invaded Friesland, and at Heiligerlee, on the 23rd of May, completely defeated a Spanish force under Count Aremberg, who was killed. Alva then advanced to meet the invaders with a large army, and at Jemmingen (July 21), with very slight loss, annihilated the levies of Louis, who himself escaped by swimming from the field across an estuary of the Ems. He now joined the army of his brother William, which had in October to beat a hasty retreat before Alva's superior skill. Then Louis, in company with his brothers William and Henry, made his way across the French frontier to the camp of the Huguenot leader, Admiral Coligny. Louis took an active part in the campaign and fought heroically at Jarnac and Moncontour. In 1572 Louis, not deterred by previous disaster, raised a small force in France, and, suddenly entering Hainaut, captured Mons (May 23). Here he was besieged by Don Frederick of Toledo, Alva's natural son, who blockaded all approach to the town. William made an attempt to relieve his brother, but failed, and Mons had to surrender (September 17). Louis, who was sick with fever, withdrew to his ancestral home, Dillenburg, to recruit his health, and then once more to devote his energies to the raising of money and troops for another invasion of the Netherlands. In the hope of drawing away the Spaniards from the siege of Leiden by a diversion in the south, Louis, with his brothers John and Henry, at the head of a force of mixed nationalities and little discipline, crossed the frontier near Maastricht, and advanced as far as the Mookerheide near Nijmwegen. Here he was attacked by a body of Spanish veterans under an experienced leader, Sancho d'Avila, and speedily routed. In the disorderly flight both Louis and his younger brother Henry, refusing to abandon the field, lost their lives. Their bodies were never recovered. Thus perished at the age of thirty-six one of the most chivalrous and gifted of a gallant band of brothers, four of whom laid down their lives in their country's cause.

See P. J. Blok, *Lodewijk von Nassau, 1538–1574* (The Hague, 1689), and the *Cambridge Modern History*, vol. iii. chs. vi. and vii., and bibliography (1904); also A. J. Van der Aa, *Biographisch woordenboek der Nederlanden* (22 vols., Haarlem, 1852–1878).

LOUIS, JOSEPH DOMINIQUE, Baron (1755–1837), French statesman and financier, was born at Toul (Meurthe) on the 13th of November 1755. At the outbreak of the Revolution the abbé Louis (he had early taken orders) had already some reputation as a financial expert. He was in favour of the constitutional movement, and on the great festival of federation (July 14, 1790) he assisted Talleyrand, then bishop of Autun, to celebrate mass at the altar erected in the Champ de Mars. In 1792, however, he emigrated to England, where he spent his time studying English institutions and especially the financial system of Pitt. Returning to France on the establishment of the Consulate he served successively in the ministry of war, the council of state, and in the finance department in Holland and in Paris. Made a baron of the empire in 1809 he nevertheless supported the Bourbon restoration and was minister of finance in 1814–1815. Baron Louis was deputy from 1815 to 1824 and from 1827 to 1832. He resumed the portfolio of finance in 1815, which he held also in the Decazes ministry of 1818; he was the first minister of finance under the government of Louis Philippe, and held the same portfolio in 1831–1832. In 1832 he was made a peer of France and he died on the 26th of August 1837.

LOUIS PHILIPPE I., king of the French (1773–1850), was the eldest son of Louis Philip Joseph, duke of Orleans (known during the Revolution as Philippe Egalité) and of Louise Marie Adelaide de Bourbon, daughter of the duc de Penthièvre, and was born at the Palais Royal in Paris on the 6th of October 1773. On his father's side he was descended from the brother of Louis XIV., on his mother's from the count of Toulouse, "legitimated" son of Louis XIV. and Madame de Montespan. The legend that he was a supposititious child, really the son of an Italian police constable named Chiapponi, is dealt with elsewhere (see MARIA STELLA, countess of Newborough). The god-parents of the duke of Valois, as he was entitled till 1785, were Louis XVI. and Queen Marie Antoinette; his governess was the famous Madame de Genlis, to whose influence he doubtless owed many of the qualities which later distinguished him: his wide, if superficial knowledge, his orderliness, and perhaps his parsimony. Known since 1785 as the duc de Chartres, he was sixteen at the outbreak of the Revolution, into which—like his father—he threw himself with ardour. In 1790 he joined the Jacobin Club, in which the moderate elements still predominated, and was assiduous in attendance at the debates of the National Assembly. He thus became a *persona grata* with the party in power; he was already a colonel of dragoons, and in 1792 he was given a command in the army of the North. As a lieutenant-general, at the age of eighteen, he was present at the cannonade of Valmy (Sept. 20) and played a conspicuous part in the victory of Jemappes (Nov. 6).

The republic had meanwhile been proclaimed, and the duc de Chartres, who like his father had taken the name of *Egalité*, posed as its zealous adherent. Fortunately for him, he was too young to be elected deputy to the Convention, and while his father was voting for the death of Louis XVI. he was serving under Dumouriez in Holland. He shared in the disastrous day of Neerwinden (March 18,1793); was an accomplice of Dumouriez in the plot to march on Paris and overthrow the republic, and on the 5th of April escaped with him from the enraged soldiers into the Austrian lines. He was destined not to return to France for twenty years. He went first, with his sister Madame Adelaide, to Switzerland where he obtained a situation for a few months as professor in the college of Reichenau under an assumed name,[1] mainly in order to escape from the fury of the *émigrés*. The execution of his father in November 1793 had made him duke of Orleans, and he now became the centre of the intrigues of the Orleanist party. In 1795 he was at Hamburg with Dumouriez, who still hoped to make him king. With characteristic caution Louis Philippe refused to commit himself by any overt pretensions, and announced his intention of going to America; but in the hope that something might happen in France to his advantage, he postponed his departure, travelling instead through the Scandinavian countries as far north as Lapland. But in 1796, the Directory having offered to release his mother and his two brothers, who had been kept in prison since the Terror, on condition that he went to America, he set sail for the United States, and in October settled in Philadelphia, where in February 1797 he was joined by his brothers the duc de Montpensier and the comte de Beaujolais. Two years were spent by them in travels in New England, the region of the Great Lakes, and of the Mississippi; then the news of the *coup d'état* of 18 Brumaire decided them to return to Europe. They returned in 1800, only to find Napoleon Bonaparte's power firmly established. Immediately on his arrival, in February 1800, the duke of Orleans, at the suggestion of Dumouriez, sought an interview with the comte d'Artois, through whose instrumentality he was reconciled with the exiled king Louis XVIII., who bestowed upon his brothers the order of the Saint Esprit. The duke, however, refused to join the army of Condé and to fight against France, an attitude in which he persisted throughout, while maintaining his loyalty to the king.[2] He settled with his brothers at Twickenham, near London, where he lived till 1807—for the most part in studious retirement.

On the 18th of May 1807 the duc de Montpensier died at Christchurch in Hampshire, where he had been taken for change of air, of consumption. The comte de Beaujolais was ill of the same disease and in 1808 the duke took him to Malta, where he died on the 29th of May. The duke now, in response to an invitation from King Ferdinand IV., visited Palermo where, on the 25th of November 1809 he married Princess Maria Amelia, the king's daughter. He remained in Sicily until the news of Napoleon's abdication recalled him to France. He was cordially received by Louis XVIII.; his military rank was confirmed, he was named colonel-general of hussars, and such of the vast Orleans estates as had not been sold were restored to him by royal ordinance. The object may have been, as M. Debidour suggests, to compromise him with the revolutionary parties and to bind him to the throne; but it is more probable that it was no more than an expression of the good will which the king had shown him ever since 1800. The immediate effect was to make him enormously rich, his wealth being increased by his natural aptitude for business until, after the death of his mother in 1821, his fortune was reckoned at some £8,000,000.

Meanwhile, in the heated atmosphere of the reaction, his sympathy with the Liberal opposition brought him again under suspicion. His attitude in the House of Peers in the autumn of 1815 cost him a two years' exile to Twickenham; he courted popularity by having his children educated *en bourgeois* at the public schools; and the Palais Royal became the rendezvous of all the leaders of that middle-class opinion by which he was ultimately to be raised to the throne.

His opportunity came with the revolution of 1830. During the three "July days" the duke kept himself discreetly in the background, retiring first to Neuilly, then to Raincy. Meanwhile, Thiers issued a proclamation pointing out that a Republic would embroil France with all Europe, while the duke of Orleans, who was "a prince devoted to the principles of the Revolution" and had "carried the tricolour under fire" would be a "citizen king" such as the country desired. This view was that of the rump of the chamber still sitting at the Palais Bourbon, and a deputation headed by Thiers and Laffitte waited upon the duke to invite him to place himself at the head of affairs. He returned with them to Paris on the 30th, and was elected by the deputies lieutenant-general of the realm. The next day, wrapped in a tricolour scarf and preceded by a drummer, he went on foot to the Hôtel de Ville—the headquarters of the republican party—where he was publicly embraced by Lafayette as a symbol that the republicans acknowledged the impossibility of realizing their own ideals and were prepared to accept a monarchy based on the popular will. Hitherto, in letters to Charles X., he had protested the loyalty of his intentions,[3] and the king now nominated him lieutenant-general and then, abdicating in favour of his grandson the comte de Chambord appointed him regent. On the 7th of August, however, the Chamber by a large majority declared Charles X. deposed, and proclaimed Louis Philippe "King of the French, by the grace of God and the will of the people."

The career of Louis Philippe as King of the French is dealt with elsewhere (see FRANCE: *History*). Here it must suffice to note something of his personal attitude towards affairs and the general effects which this produced. For the trappings of authority he cared little. To conciliate the revolutionary passion for equality he was content to veil his kingship for a while under a middle-class disguise. He erased the royal lilies from the panels of his carriages; and the Palais Royal, like the White House at Washington, stood open to all and sundry who cared to come and shake hands with the head of the state. This pose served to keep the democrats of the capital in a good temper, and so leave him free to consolidate the somewhat unstable foundation of his throne and to persuade his European fellow-sovereigns to acknowledge in him not a revolutionary but a conservative force. But when once his position at home and abroad had been established, it became increasingly clear that he possessed all the Bourbon tenaciousness of personal power. When a "party of Resistance" came into office with Casimir-Périer in March 1831, the speech from the throne proclaimed that "France has desired that the monarchy should become national, it does not desire that it should be powerless"; and the migration of the royal family to the Tuileries symbolized the right of the king not only to reign but to rule. Republican and Socialist agitation, culminating in a series of dangerous risings, strengthened the position of the king as defender of middle-class interest; and since the middle classes constituted the *pays légal* which alone was represented in Parliament, he came to regard his position as unassailable, especially after the suppression of the risings under Blanqui and Barbès in 1839. Little by little his policy, always supported by a majority in a house of representatives elected by a corrupt and narrow franchise, became more reactionary and purely dynastic. His position in France seeming to be unassailable, he sought to strengthen it in Europe by family alliances. The fact that his daughter Louise was the consort of Leopold I., king of the Belgians, had brought him into intimate and cordial relations with the English court, which did much to cement the *entente cordiale* with Great Britain. Broken in 1840 during the affair of Mehemet Ali (*q.v.*) the entente was patched up in 1841 by the Straits Convention and re-cemented by visits paid by Queen Victoria and Prince Albert to the Château d'Eu in 1843 and 1845 and of Louis Philippe to Windsor in 1844, only to be irretrievably wrecked by the affair of the "Spanish marriages," a deliberate attempt to revive the traditional Bourbon policy of French predominance in Spain. If in this matter Louis Philippe had seemed to sacrifice the international position of France to dynastic interests, his attempt to re-establish it by allying himself with the reactionary monarchies against the Liberals of Switzerland finally alienated from him the French Liberal opinion on which his authority was based. When, in February 1848, Paris rose against him, he found that he was practically isolated in France.

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[1] As M. Chabaud de la Tour. He was examined as to his fitness before being appointed. Gruyer, p. 165.

[2] This at least was his own claim and the *Orleanist* view. The matter became a question of partisan controversy, the legitimists asserting that he frequently offered to serve against France, but that his offers were contemptuously refused. A. Debidour in the article "Louis-Philippe" in *La Grande Encyclopédie* supports the latter view; but see Gruyer, *La Jeunesse*, and E. Daudet, "Une réconciliation de famille en 1800," in the *Revue des Deux Mondes*, Sept. 15, 1905, p. 301. M. Daudet gives the account of the interview left by the comte d'Artois, and he also makes it clear that Louis Philippe, while protesting his loyalty to the head of his house, did not disguise his opinion that a Restoration would only be possible if the king accepted the essential changes made by the Revolution.

[3] To say that these protestations were hypocritical is to assume too much. Personal ambition doubtless played a part; but he must have soon realized that the French people had wearied of "legitimism" and that a regency in the circumstances was impossible.

Charles X., after abdicating, had made a dignified exit from France, marching to the coast surrounded by the cavalry, infantry and artillery of his Guard. Louis Philippe was less happily situated. Escaping with the queen from the Tuileries by a back entrance, he made his way with her in disguise to Honfleur, where the royal couple found refuge in a gardener's cottage. They were ultimately smuggled out of the country by the British consul at Havre as Mr and Mrs Smith,[1] arriving at Newhaven "unprovided with anything but the clothes they wore." They settled at Claremont, placed at their disposal by Queen Victoria, under the *incognito* of count and countess of Neuilly. Here on the 26th of August 1850, Louis Philippe died.

The character of Louis Philippe is admirably traced by Queen Victoria in a memorandum of May 2, 1855, in which she compares him with Napoleon III. She speaks of his "vast knowledge upon all and every subject," and "his great activity of mind." He was, unlike Napoleon, "*thoroughly French* in character, possessing all the liveliness and talkativeness of that people." But she also speaks of the "tricks and over-reachings" practised by him, "who in great as well as in small things took a pleasure in being cleverer and more cunning than others, often when there was no advantage to be gained by it, and which was, unfortunately, strikingly displayed in the transactions connected with the Spanish marriages, which led to the king's downfall, and ruined him in the eyes of all Europe" (*Letters*, pop. ed., iii. 122).

Louis Philippe had eight children. His eldest son, the popular Ferdinand Philippe, duke of Orleans (b. 1810), who had married Princess Helena of Mecklenburg, was killed in a carriage accident on the 13th of July 1842, leaving two sons, the comte de Paris and the duc de Chartres. The other children were Louise, consort of Leopold I., king of the Belgians; Marie, who married Prince Alexander of Württemberg and died in 1839; Louis Charles, duc de Nemours; Clementine, married to the duke of Coburg-Kohary; François Ferdinand, prince de Joinville; Henri Eugène, duc d'Aumale (*q.v.*); Antoine Philippe, duc de Montpensier, who married the Infanta, younger sister of Queen Isabella of Spain.

AUTHORITIES.—F. A. Gruyer, *La Jeunesse du roi Louis-Philippe, d'après les pourtraits et des tableaux* (Paris, 1909), édition de luxe with beautiful reproductions of portraits, miniatures, &c.; Marquis de Flers, *Louis-Philippe, vie anecdotique, 1773–1850* (Paris, 1891); E. Daudet, *Hist. de l'émigration* (3 vols., Paris, 1886–1890). Of general works on Louis Philippe's reign may be mentioned Louis Blanc, *Hist. de Dix Ans, 1830–1840* (5 vols., Paris, 1841–1844), from the republican point of view; J. O. d'Haussonville, *Hist. de la politique extérieure de la monarchie de juillet, 1830–1848* (2 vols., Paris, 1850); V. de Nouvion, *Hist. de Louis-Philippe* (4 vols., Paris, 1857–1861); F. Guizot, *France under Louis Philippe, 1841–1847* (Eng. trans., 1865); Karl Hillebrand, *Geschichte Frankreichs von der Thronbesteigung Louis Philippes, 1830–1841* (2 vols., Gotha, 1877–1879); V. du Bled, *Hist. de la monarchie de juillet* (2 vols., Paris, 1887); P. Thureau-Dangin, *Hist. de la monarchie de juillet* (Paris, 1887, &c.); A. Malet, "La France sous la monarchie de juillet," in Lavisse and Rambaud's *Hist. Générale*, vol. x. ch. x. (Paris, 1898); G. Weill, *La France sous la monarchie de juillet* (Paris, 1902); Emile Bourgeois, "The Orleans Monarchy," ch. xv. of vol. x., and "The Fall of Constitutionalism in France," ch. ii. of vol. xi. of the *Cambridge Modern History* (Cambridge, 1907 and 1909). Further works will be found in the bibliographies attached by M. Bourgeois to his chapters (vol. x. p. 844, vol. xi. p. 874; the latter including works on the revolution of 1848 and the Second Republic). To the list of published correspondence and memoirs there mentioned may be added the *Chronique* of the duchesse de Dino (Paris, 1909).

Louis Philippe himself published the *Journal du duc de Chartres, 1790–1791*; *Mon Journal, événements de 1815* (2 vols., 1849); *Discours, allocutions et réponses de S. M. Louis-Philippe, 1830–1846*; and after his death was issued his *Correspondance, mémoire et discours inédits* (Paris, 1863). (W. A. P.)

LOUISBURG, a town and port of entry of Cape Breton county, Nova Scotia, Canada, on the Sydney & Louisburg railway, 39 m. from Sydney. Pop. (1901) 1588. Under the French *régime*, Louisburg was second only to Quebec. A fortress was erected at enormous expense, and the city was the centre of the cod-fisheries. The fortress was, however, captured in 1745 by the American colonists, under Sir William Pepperrell (1696–1759), assisted by the British fleet, and again in 1758 by a British land and sea force under General Jeffrey Amherst (1717–1797) and Admiral Boscawen. The jealousy of the British settlement of Halifax led to its almost utter destruction, and only a few casemates now remain. Under English rule a fishing village grew up on the other side of the harbour, and has now become the winter shipping port of the Dominion Coal Company. The harbour is deep, spacious and open all the year round, though occasionally blocked by drift ice in the spring.

LOUISE [AUGUSTE WILHELMINE AMALIE LUISE] (1776–1810), queen of Prussia, was born on the 10th of March 1776 in Hanover, where her father, Prince Charles of Mecklenburg-Strelitz, was field-marshal of the household brigade. Her mother was a princess of Hesse-Darmstadt. In 1793 Louise met at Frankfort the crown prince of Prussia, afterwards King Frederick William III., who was so fascinated by her beauty, and by the nobleness of her character, that he asked her to become his wife. They were married on the 24th of December of the same year. As queen of Prussia she commanded universal respect and affection, and nothing in Prussian history is more pathetic than the dignity and unflinching courage with which she bore the sufferings inflicted on her and her family during the war between Prussia and France. After the battle of Jena she went with her husband to Königsberg, and when the battles of Eylau and Friedland had placed Prussia absolutely at the mercy of France, she made a personal appeal to Napoleon at his headquarters in Tilsit, but without success. Early in 1808 she accompanied the king from Memel to Königsberg, whence, towards the end of the year, she visited St Petersburg, returning to Berlin on the 23rd of December 1809. During the war Napoleon attempted to destroy the queen's reputation, but the only effect of his charges in Prussia was to make her more deeply beloved. On the 19th of July 1810 she died in her husband's arms, while visiting her father in Strelitz. She was buried in the garden of the palace at Charlottenburg, where a mausoleum, containing a fine recumbent statue by Rauch, was built over her grave. In 1840 her husband was buried by her side. The Louise Foundation (Luisenstift) for the education of girls was established in her honour, and in 1814 Frederick William III. instituted the Order of Louise (Luisenorden). In 1880 a statue of Queen Louise was erected in the Thiergarten at Berlin.

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[1] There is a vivid account in Mr Featherstonhaugh to Lord Palmerston, Havre, March 3, 1848, in *The Letters of Queen Victoria* (pop. ed., ii. 156).

See F. Adami, *Luise, Königin von Preussen* (7th ed., 1875); E. Engel, *Königin Luise* (1876); A. Kluckhohn, *Luise, Königin von Preussen* (1876); Mommsen and Treitschke, *Königin Luise* (1876); in English, Hudson, *Life and Times of Louisa, Queen of Prussia* (1874); G. Horn, *Das Buch von der Königin Luise* (Berlin, 1883); A. Lonke, *Königin Luise von Preussen* (Leipzig, 1903); H. von Petersdorff, "Königin Luise," *Frauenleben*, Bd. i. (Bielefeld, 1903, 2nd ed., 1904).

LOUISE OF SAVOY (1476–1531), duchess of Angoulême, mother of Francis I. of France, was daughter of a cadet of the house of Savoy, Philip, count of Bresse, afterwards duke of Savoy. Through her mother, Marguerite de Bourbon, she was niece of Pierre de Bourbon, sire de Beaujeu, afterwards duke of Bourbon. At the age of twelve she was married to Charles of Valois, count of Angoulême, great-grandson of King Charles V. The count died in 1496, leaving her the mother of two children, Marguerite (b. 1492) and Francis (b. 1494). The accession of Louis XII., who was childless, made Francis of Angoulême the heir-presumptive to the throne of France. Louise brought her children to the court, and received Amboise as her residence. She lived henceforth in fear lest Louis should have a son; and in consequence there was a secret rivalry between her and the queen, Anne of Brittany. Finally, her son became king on the 1st of January 1515 by the death of Louis XII. From him Louise received the county of Angoulême, which was erected into a duchy, the duchy of Anjou, and the counties of Maine and Beaufort. She was then given the title of "Madame." From 1515 to her death, she took the chief share in the government. The part she played has been variously judged, and is not yet completely elucidated. It is certain that Louise had a clear head, practical good sense and tenacity. In the critical situation after the battle of Pavia (1525) she proved herself equal to the emergency, maintained order in the kingdom, and manœuvred very skilfully to detach Henry VIII. of England from the imperial alliance. But she appears to have been passionate, exceedingly rapacious and ever careful of her own interest. In her malignant disputes with the constable de Bourbon on the question of his wife's succession, she goaded him to extreme measures, and her rapacity showed itself also in her dealings with the *surintendant des finances*, J. de Beaune, baron de Samblançay (d. 1527), who diverted the money intended for the French soldiers in Italy into the coffers of the queen, and suffered death in consequence. She died in 1531, and Francis reunited to the crown her domains, which comprised the Bourbonnais, Beaujolais, Auvergne, la Marche, Angoumois, Maine and Anjou.

There is extant a *Journal* of Louise of Savoy, the authenticity of which seems certain. It consists of brief notes—generally very exact and sometimes ironical—which go as far as the year 1522. The only trustworthy text is that published by Guichenon in his *Histoire généalogique de la maison de Savoie* (ed. of 1778–1780, vol. iv.).

See *Poésies de François I^{er} et de Louise de Savoie* &c., ed. by Champollion-Figeac (1847); De Maulde, *Louise de Savoie et François I^{er}* (1895); G. Jacqueton, *La Politique extérieure de Louise de Savoie* . . . (1892); H. Hauser, "Étude critique sur le Journal de Louise de Savoie," in the *Revue historique*, vol. 86 (1904).

LOUISIADE ARCHIPELAGO, a chain of islands in the Pacific Ocean, extending south-eastward from the easternmost promontory of New Guinea, and included in the Australian territory of Papua (British New Guinea). The islands number over eighty, and are interspersed with reefs. They are rich in tropical forest products, and gold has been discovered on the chief island, Tagula or South-east (area 380 sq. m.) and on Misima or St Aignan. The natives are of Papuan type, and practise cannibalism. The islands were probably observed by Torres in 1606, but were named by L. A. de Bougainville in 1768 after Louis XV.

LOUISIANA, one of the Southern States of the United States of America, lying on the N. coast of the Gulf of Mexico. Beginning on the N., its boundary follows eastward the parallel of 33° N., separating Louisiana from Arkansas; then descends the Mississippi river, separating it from the state of Mississippi, southward to 31°; passes eastward on this parallel to the Pearl river, still with the state of Mississippi on the E.; and descends this river to the Gulf. On the W. the Sabine river, from the Gulf to 32° N., and, thence to the parallel of 33°, a line a little W. of (and parallel to) the meridian of 94° W., separate Louisiana from Texas. Including islands in the Gulf, the stretch of latitude is approximately 4° and of longitude 5°. The total area is 48,506 sq. m., of which 3097 sq. m. are water surface (including 1060 sq. m. of landlocked coastal bays called "lakes"). The coast line is about 1500 m.

Physical Features.—Geologically Louisiana is a very recent creation, and belongs to the "Coastal Plain Province." Most of the rocks or soils composing its surface were formed as submarine deposits; the easternmost and southernmost parts are true river deposits. These facts are the key to the state's chorography. The average elevation of the state above the sea is only about 75 ft., and practically the only parts more than 400 ft. high are hills in Sabine, Claiborne and Vernon parishes. The physiographic features are few and very simple. The essential elements are five[1]: diluvial plains, coast marshes, prairies, "bluffs" and "pine-hills" (to use the local nomenclature). These were successive stages in the geologic process which has created, and is still actively modifying, the state. They are all seen, spread from N. to S., west of the Mississippi, and also, save only the prairies, in the so-called "Florida parishes" E. of the Mississippi.

These different elements in the region W. of the Mississippi are arranged from N. to S. in the order of decreasing geologic age and maturity. Beginning with elevations of about 400 ft. near the Arkansas line, there is a gentle slope toward the S.E. The northern part can best be regarded as a low plateau (once marine sediments) sloping southward, traversed by the large diluvial valleys of the Mississippi, Red and Ouachita rivers, and recut by smaller tributaries into smaller plateaus and rather uniform flat-topped hills. The "bluffs" (remnants of an eroded plain formed of alluvion deposits over an old, mature and drowned topography) run through the second tier of parishes W. of the Mississippi above the Red river. Below this river prairie areas become increasingly common, constituting the entire S.W. corner of the state. They are usually only 20 to 30 ft. above the sea in this district, never above 70, and are generally treeless except for marginal timber along the sluggish, meandering streams. One of their peculiar features—the sandy circular "mounds," 2 to 10 ft. high and 20 to 30 or even 50 ft. in diameter, sometimes surmounted by trees in the midst of a treeless plain and sometimes arranged in circles and on radii, and decreasing in size with distance from the centre of the field—has been variously explained. The mounds were probably formed by some gentle eruptive action like that exhibited in the "mud hills" along the Mississippi below New Orleans; but no explanation is generally accepted. The prairies shade off into the coast marshes. This fringe of wooded swamp and sea marsh is generally 20 to 30, but in places even 50 and 60 m. in width. Where the marsh is open and grassy, flooded only at high tides or in rainy seasons, and the ground firm enough to bear cattle, it is used as range. Considerable tracts have also been diked and reclaimed for cotton, sugar and especially for rice culture. The tidal action of the gulf is so slight and the marshes are so low that perfect drainage cannot be obtained through tide gates, which must therefore be supplemented by pumping machinery when rains are heavy or landward winds long prevail. Slight ridges along the streams and bayous which traverse it, and occasional patches of slightly elevated prairie, relieve in a measure the monotonous expanse. It is in and along the borders of this coast swamp region that most of the rice and much of the sugar cane of the state are grown. Long bar-like “islands” (conspicuous high land rising above the marsh and prairie)—Orange, Petite Anse, Grand Cote, Cote Blanche and Belle Isle—offer very interesting topographical and geological problems. “Trembling prairies”—land that trembles under the tread of men or cattle—are common near the coast. Most of the swamp fringe is reclaimable. The marshes encroach most upon the parishes of St Charles, Orleans and Plaquemines. In St Charles the cultivable strip of land along the river is only about 3 m. wide. In Orleans the city of New Orleans occupies nearly all the high ground and encroaches on the swamps. In Plaquemines there is practically no cultivable land below Forts Jackson and St Philip, and above there is only a narrow strip.

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[1] A sixth, less characteristic, might be included, viz. the "pine flats," generally wet, which are N. of Lake Pontchartrain, between the alluvial lands and the pine hills, and, in the S.E. corner of the state, between the hills and the prairie.

The alluvial lands include the river flood plains. The principal rivers are the Mississippi, which flows nearly 600 m. through and along the border of the state, the Red river, the Ouachita (or Washita), Sabine and Pearl; all except the last are navigable at all stages of the water. There are many “bayous,” several of which are of great importance, both for navigation and for drainage. They may be characterized as secondary outlets of the rivers or flood distributaries. Among them are Bayou Teche, Bayou Plaquemine, Atchafalaya Bayou,[1] Bayou Lafourche and Bayou Bœuf. Almost all secondary water-courses, particularly if they have sluggish currents, are known as bayous. Some might well be called lakes, and others rivers. The alluvial portion of the state, especially below the mouth of the Red river, is an intricate network of these bayous, which, before their closure by a levee system, served partially, in time of flood, to carry off the escaping surplus of river waters. They are comparatively inactive at all seasons; indeed, the action of the tides and back-waters and the tangle of vegetation in the sombre swamps and forests through which they run, often render their currents almost imperceptible at ordinary water. Navigable waters are said to penetrate all but four of the parishes of the state, their total length approximating 3800 m.

Each of the larger streams, as well as a large proportion of the smaller ones, is accompanied by a belt of bottom land, of greater or less width, lying low as regards the stream, and liable to overflow at times of high water. These flood plains form collectively what is known as the alluvial region, which extends in a broad belt down the Mississippi, from the mouth of the Ohio to the Gulf of Mexico, and up the Ouachita and its branches and the Red river to and beyond the limits of the state. Its breadth along the Mississippi within Louisiana ranges from 10 to 50 or 60 m., and that along the Red river and the Ouachita has an average breadth of 10 m. Through its great flood-plain the Mississippi river winds upon the summit of a ridge formed by its own deposits. In each direction the country falls away in a succession of minor undulations, the summits of the ridges being occupied by the streams and bayous. Nearly all of this vast flood-plain lies below the level of high water in the Mississippi, and, but for the protection afforded by the levees, every considerable rise of its waters would inundate vast areas of fertile and cultivated land. The low regions of Louisiana, including the alluvial lands and the coast swamps, comprise about 20,000 sq. m., or nearly one-half the area of the state. The remainder consists of the uplands of prairie and forest.

The alluvial region of the state in 1909 was mainly protected against overflow from the Mississippi river by 754 m. of levee on the Mississippi river within the state, and 84 m. on the Mississippi river, Cypress and Amos Bayou in Arkansas, forming part of the general system which extends through other states, 1000 m. up to the highlands about the junction of the Ohio river. The state and the national government co-operate in the construction and maintenance of this system, but the Federal government did not give material aid (the only exception being the grant of swamp lands in 1850) until the exceptionally disastrous flood in 1882. For about a century and a half before that time, levee building had been undertaken in a more or less spasmodic and tentative way, first by riparian proprietors, then by local combinations of public and private interests, and finally by the state, acting through levee districts, advised by a Board of Engineers. The Federal government, after its participation in the work, acted through a Board of Engineers, known as the “Mississippi River Commission.” The system of 754 m. of Mississippi river levees, within the state, was built almost entirely after 1866, and represents an expenditure of about $43,000,000 for primary construction alone; of this sum, the national government contributed probably a third (the state expended about $24,000,000 on levees before the Civil War). Some of the levees, especially those in swampy regions where outlet bayous are closed, are of extraordinary solidity and dimensions, being 20 to 40 ft. high, or even more, across streams or bayous—formerly outlets—with bases of 8 or 10 ft. to one of height. The task of maintenance consists almost entirely in closing the gaps which occur when the banks on which the levees are built cave into the river. Levee systems on some of the interior or tributary rivers, aggregating some 602 m., are exclusively built and maintained by the state. Louisiana also contributes largely to the 84 m. of levee in Arkansas, necessary to its security from overflow. The improvement of bayous, channels, the construction of canals and the drainage of swamp lands also contribute to the protection of the state.

The lakes are mainly in three classes. First come the coast lagoons, many of which are merely land-locked salt-water bays, the waters of which rise and fall with the tides. Of this class are Pontchartrain, Borgne, Maurepas and Sabine. These are simply parts of the sea which have escaped the filling-in process carried on by the great river and the lesser streams. A second class, called “ox-bow” lakes, large in numbers but small in area, includes ordinary cut-off meanders along the Mississippi and Red rivers. A third class, those upon the Red river and its branches, are caused mainly by the partial stoppage of the water above Shreveport by the “raft,” a mass of drift such as frequently gathers in western rivers, which for a distance of 45 m. almost completely closed the channel until it was broken up by government engineers. These lakes are much larger at flood season than at other times, and have been much reduced in size by the cutting of a channel through the raft. Lakes of this class are sometimes formed by the choking of the mouth of feeble tributaries by silt deposited by the Red river where the currents meet.

Mineral Resources.—Mineral resources are few, but important. In the Tertiary region are found small quantities of iron ore and an indifferent brown coal. The important mineral products are salt, sulphur, petroleum and natural gas. The deposit of rock salt on Petite Anse Island, in the coast swamp region, has been extensively worked since its discovery during the Civil War. The deposit is in places 1000 ft. thick, and yields salt of extraordinary purity (sometimes 99 % pure). There are large deposits also on Orange Island (in places at least 1800 ft. thick), on Week's Island, on Belle Isle and probably beneath the intervening marshes. In 1907 Louisiana ranked sixth among the salt-producing states of the country (after New York, Michigan, Ohio, Kansas and California), its output being valued at $226,892, only a few hundred dollars more than that of Texas. Near Lake Charles, at Sulphur, are very extraordinary sulphur deposits. The beds lie several (for the most part four to six) hundred feet underground and are of disputed origin. Many regard them as products of an extinct volcano; according to others they are of vegetable origin (they are found in conjunction with gypsum). They were discovered before 1870 by searchers after petroleum, but their exploitation remained in the experimental stage until about 1900. The sulphur is dissolved by superheated water forced down pipes, and the water with sulphur in solution is forced upward by hot air pressure through other pipes; the sulphur comes, 99 % pure, to the surface of the ground, where it is cooled in immense bins, and then broken up and loaded directly upon cars for shipment. These mines divide with the Sicilian mines the control of the sulphur market of the world. The value of the sulphur taken from the mines of Louisiana in 1907 was a little more than $5,000,000. Evidences of petroleum were discovered long ago, in the very field where in recent years the Beaumont and Vinton wells were bored. In 1909 Jennings was the chief field in Louisiana, lesser fields being at Welsh, Anse la Butte, Caddo and Vinton. The Jennings field, one of the greatest in the United States, produced up to and including 1907 more than 26,000,000 barrels of high-grade oil, twelve-thirteenths of which came from an area of only 50 acres, one well producing a tenth of the entire output. In 1907 the state produced 5,000,221 barrels of petroleum, valued at $4,063,033. Natural gas is found in Caddo parish, about 20 m. N. of Shreveport. The depth of the wells is from 840 to 2150 ft.; two wells completed in 1907 had a daily capacity estimated at 35,000,000 to 50,000,000 ft. Shreveport, Oil City, Blanchard, Mooringsport, Bossier City and Texarkana are supplied with natural gas by pipe lines from this field. Kaolin is found in the state; in 1907 the total value of all clay products was $928,579.

Climate.—The climate is semi-tropical and exceptionally equable over large areas. In the S. and S.E. the equable temperature is largely the effect of the network of bays, bayous and lakes, and throughout the state the climate is materially influenced by the prevailing southerly winds from the Gulf of Mexico. Some daily variation in the temperature of adjoining localities is caused by a dark soil in the one and a light soil in the other, but the differences of mean annual temperature are almost wholly due to differences of latitude and elevation. The mean annual temperature for a period of nineteen years (Jan. 1888 to Dec. 1906) ranged from 70° F. at Port Eads, in the extreme S.E., to 65° F. at Lake Providence, in the N.E. The mean temperature of July, the hottest month, is comparatively uniform over the state, varying only from 81° to 83°; the mean for January, the coldest month, varies from 46° in the extreme north to 56° in the extreme south. Even in the coldest localities eight or nine months are wholly free from frost, and in the coast parishes frost occurs only a few days in each year. Rainfall is usually heavy in the S.E., but it decreases toward the N.W. As much as 85·6 in. have fallen within a year at New Orleans, but in this locality the average for a year is about 57·6 in.; at Shreveport the average is 46 in., and for the entire state it is 55 in. Much more rain falls in summer than in any other season, but in some parts the heaviest rainfall is in the spring and in others in the winter. A light fall of snow is not uncommon in the northern parishes, but in the southern part of the state snow falls not oftener than once in three to five years. Hailstorms are infrequent everywhere, but especially so

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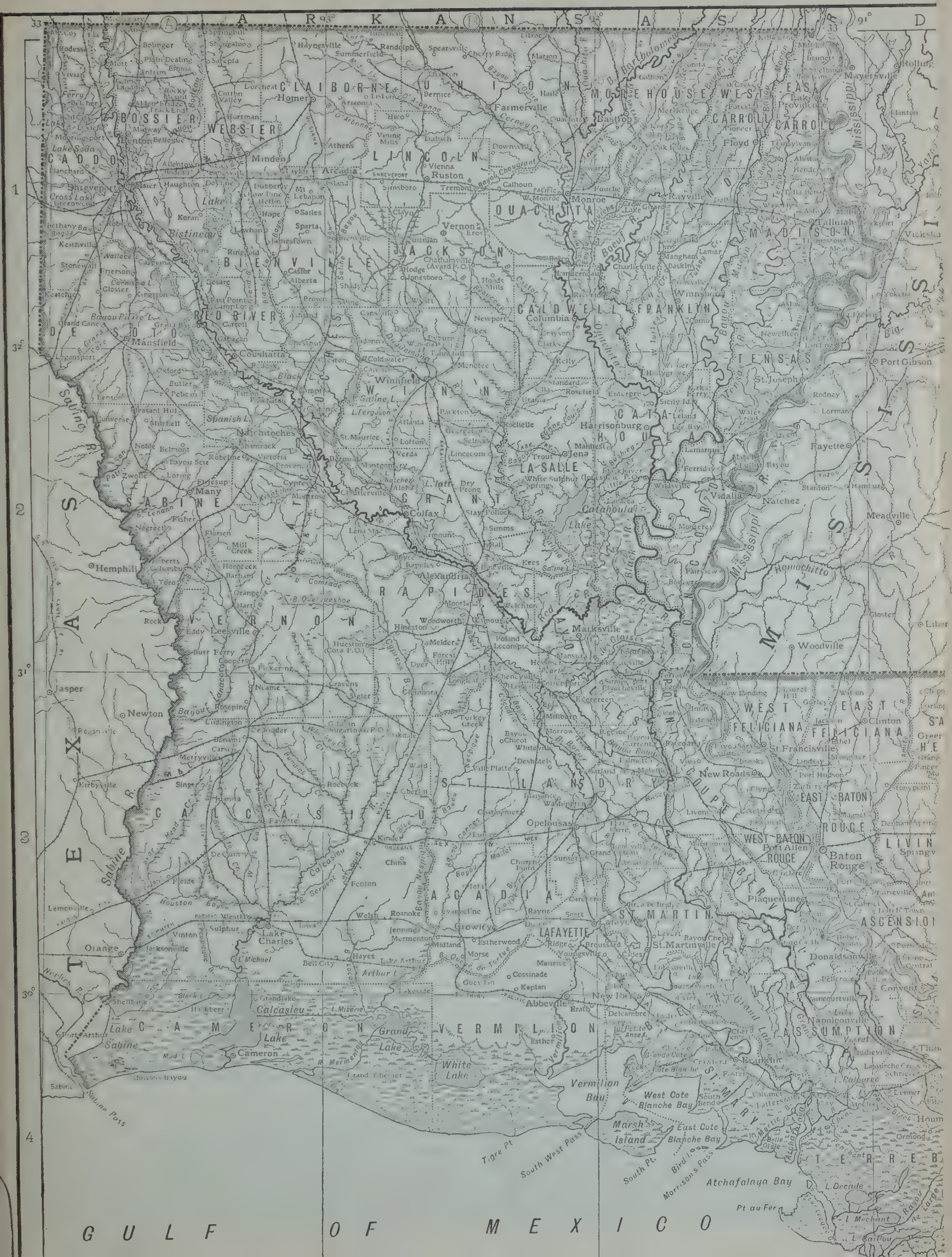
[1] The original channel of the Red river. It has been so useful in relieving the Mississippi of floods, that the Red river may possibly be permanently diverted again into the bayou artificially.


A R K A N S A S
M I S S I S S I P P I
T E X A S
G U L F O F M E X I C O
CADDO
BOSSIER
WEBSTER
CLAIBORNE
UNION
MOREHOUSE
WEST CARROLL
EAST CARROLL
LINCOLN
QUACHITA
RICHLAND
MADISON
BIENVILLE
JACKSON
DE SOTO
RED RIVER
CALDWELL
FRANKLIN
TENSAS
WINN
LA SALLE
CATAHOULA
NATCHITOCHES
SABINE
GRANT
CONCORDIA
RAPIDES
AVOYELLES
VERNON
WEST FELICIANA
EAST FELICIANA
POINTE COUPEE
EAST BATON ROUGE
WEST BATON ROUGE
ST LANDRY
CALCASIEU
ACADIA
ST MARTIN
IBERVILLE
ASCENSION
LAFAYETTE
IBERIA
ASSUMPTION
CAMERON
VERMILION
ST MARY
TERREBONNE
LIVINGSTON
Shreveport
Minden
Homer
Farmerville
Bastrop
Monroe
Ruston
Arcadia
Vernon
Columbia
Winnsboro
Tallulah
Mansfield
Coushatta
Winnfield
Harrisonburg
Natchitoches
Many
Colfax
Alexandria
Marksville
Leesville
Vidalia
Natchez
St. Joseph
Port Gibson
Woodville
St. Francisville
New Roads
Clinton
Baton Rouge
Plaquemine
Donaldsonville
Opelousas
Lafayette
Crowley
Lake Charles
Orange
Jennings
Abbeville
New Iberia
St. Martinville
Franklin
Cameron
Vicksburg
Hemphill
Jasper
Newton
Sabine
Sabine Pass
Lake Sabine
Calcasieu Lake
Grand Lake
White Lake
Vermilion Bay
West Cote Blanche Bay
East Cote Blanche Bay
Marsh Island
Atchafalaya Bay
Tigre Pt.
South West Pass
South Pt.
Bird I.
Morrisons Pass
Pt. au Fer
Catahoula Lake
Red R.
Black R.
Mississippi R.
Homochitto R.
93°
92°
91°
33
32°
31°
30°
A
B
C
D
1
2
3
4

in the south. Only a fourth to a half of the days of the different months are wholly or partly clear even in the north, and in the same district the monthly means of relative humidity vary from 65 to 70.

Fauna.—The entire state is included within the Austro-riparian life zone; the higher portions fall within the Carolinian area and the lower portions, including the Gulf and the Mississippi embayment almost to the N.E. corner of the state, constitute a special semi-tropical region. The native fauna of the state resembles in its general features that of the other Gulf states. The feral fauna was once rather varied. Black bears, wolves and deer are not yet extinct, and more rarely a "wild cat" (lynx) or "panther" (puma) is seen in the swamps. Of smaller mammals, raccoons, squirrels and opossums are very common. Every bayou contains alligators; and reptiles of various species, such as turtles, lizards, horned toads, rattlesnakes and moccasins are abundant. Shrimps, frogs (of great commercial importance), terrapin, clams and oysters are common. Only in very recent years have oysters, though plentiful, become of competitive importance in the national market; they are greatly favoured by state protective legislation. In 1904 a state oyster commission was created to supplant the independent control by the parishes. An important boundary dispute with Mississippi arose over beds lying near the state line. The state leases the beds at a low annual rental in tracts (limited for each person, firm or corporation to 1000 acres), and draws from them a considerable revenue. The avifauna is varied and abundant, comprising eagles, vultures (protected by law), hawks, owls, pelicans, cranes, turkeys, geese, "partridges" (called quail or "Bob White" elsewhere), ducks, &c., besides numerous smaller species, many of which are brilliant of plumage but harsh of voice.

Flora.—Heavy rainfall, high temperature and fertile soil combine to cover the greater part of the state, and particularly the alluvial regions and the coast swamps, with a most luxuriant subtropical vegetation, both arborescent and herbaceous. Louisiana is justly celebrated for the beauty and fragrance of its flowers. The range of temperature is not sufficient to give the variety of annual wild flowers of more northern climates; nevertheless flowers cover the bottom lands and uplands in great profusion. The upland flora is the more diversified. Flowering annuals are mainly aquatic. Water-lilies, water hyacinths, which are an obstruction in many streams, and irises in rich variety give colour to the coast wastes and sombre bayous. Notable among the flora are roses, japonicas, hibiscus shrubs of various species, poinsettias, tea olives, crepe myrtle, jasmines, magnolias, camellias, oleanders, chrysanthemums, geraniums and plumbagos. The value and variety of the timber are very great. Much of the river swamp region is covered with cypress trees festooned with Spanish moss. The most common species in the alluvial regions and, to a less degree, in the drier portions of the swamps and in the stream bottoms of the prairies are various oaks, black, sweet and tupelo gum, holly, cotton-wood, poplar, magnolia sweet bay, the tulip tree, catalpa, black walnut, pecans, hickories, ash, beech and short-leaf pine. On drier and higher soils are the persimmon, sassafras, red maple, elm, black haw, hawthorn, various oaks (in all 10 species occur), hickories and splendid forests of long-leaf and loblolly yellow pine.

Forestry.—These forests are the greatest and finest of their kind remaining in the United States. In 1898 it was estimated by Henry Gannett (followed by the Federal census of 1900) that the timbered area covered 28,300 sq. m. Professor C. S. Sargent estimated in 1884 that the stand of short-leaf and long-leaf pines aggregated respectively 21,625 and 26,558 million feet. The timber product of 1900 ($17,294,444) was almost ten times that of 1880 ($1,764,640); and in 1905 the product value ($35,192,374) was more than twice that of 1900. Nevertheless, in 1900 the cypress forests remained practically untouched, only slight impression had been made upon the pine areas, and the hard-wood forests, except that they had been culled of their choicest oak, remained in their primal state (U.S. census). Between 1900 and 1905 furniture factories and planing mills became somewhat important. Pond pine occurs only near the Pearl river. Curly pine is fairly abundant. The eastern pine belt is composed of the long-leaf pine, interspersed with some loblolly. It covers an area of about 3900 sq. m. The south-western pine belt contains the heaviest growth of long-leaf pine timber in the world, covering an area of about 4200 sq. m., and occasionally interspersed with short-leaf pine. The short-leaf growth is especially heavy in the north-western portion of the state, while the long-leaf is found mainly in large masses N. and S. of the Red river around Alexandria as a centre. The cypress forests of the alluvial and overflowed lands in the S. of the state are among the largest and the most heavily timbered known. The hard-woods are found in the river bottoms throughout the state.

Agriculture and Soils.—Agriculture is the chief industry of the state. In 1900 26·2% of the land was in farms, and of this area about two-fifths was improved. The size of the average farm decreased in the two preceding decades from 171·3 to 95·4 acres. The percentage of farms operated by owners (*i.e.* owners, part owners, owners and tenants, and managers) fell from 64·8 to 42·1% from 1880 to 1900, and the percentage operated by cash tenants increased from 13·8 in 1880 to 24·9 in 1900, and by share tenants from 21·5 in 1880 to 33·0 in 1900; the percentage of farms operated by white farmers was 49·8 in 1900. The value of farm property, $198,536,906 in 1900, increased 79·8% in the preceding decade. The value of live stock in the latter year was $28,869,506. The total value of all farm products in 1899 was $72,667,302, of which $59,276,092 was the value of the distinctive crops—cotton, sugar and rice. The state bureau of agriculture in 1903 estimated that of the total area 14·9 millions of acres were timber land, 5·7 millions pasture and marsh, and 5·0 millions cultivated farm land.

In the N. there are many sandy districts in the uplands, also sandy clays; in the "second bottoms" of the streams fertile sandy loams; abundant tertiary marls in the north-central region; some gypsum in the cretaceous "islands"; and some fossiliferous marls with decomposed limestones. The prairies of south-western Louisiana have much yellow marl underlying them. Alluvial soil and bluff, the location of which has been indicated, are of primary agricultural importance. Reclaimed marsh-land and fresh alluvium (the so-called "front-lands" on rivers and bayous) are choice soil for Indian corn, sugar-cane, perique tobacco, semi-tropical fruits and cotton. The bluff lands are simply old alluvium now well drained and above all floods. The prairies of the S.W. are devoted almost exclusively to rice. On the hills yellow-leaf tobacco can be grown. Cereals and forage plants can be successfully grown everywhere, and varied and profitable agriculture is possible even on the "pine-barrens" or uplands of the N.; but more intelligent and more intensive farming is necessary than that practised by the average "piney-woods" farmer. The alluvial section of lower Louisiana is mostly devoted to sugar, and farther northward to Indian corn and cotton.

Cotton is the principal crop. In 1907 Louisiana ranked eighth in acreage of cotton (1,622,000 acres) among the states of the United States, and in 1907–1908 the cotton crop (675,428 bales) was eighth among the crops of the states. The average yield per acre varies from about ·45 to ·75 bale according to the season. In good seasons and exceptional localities the yield may approach a bale per acre, as in Assumption parish, and in the Mississippi valley at the junction of Louisiana, Mississippi and Arkansas. For many years there has been a reaction against the all-cotton farming system. In general, the small cotton farmer was at the mercy of the commission merchant, to whom he mortgaged his crops in advance; but this evil has lessened, and in some districts the system of advancing is either non-existent or very slightly developed.

In 1907–1908 all the sugar produced from cane grown in the United States came from Louisiana (335,000 long tons) and Texas (12,000 tons); in the same year cane sugar from Hawaii amounted to 420,000 tons, from Porto Rico to 217,000 tons and from the Philippines to 135,000 tons; and the total yield of beet sugar from the United States was 413,954 tons. Of all the cane grown, an amount between one-sixth and one-quarter—and that the best—must be reserved for seed every other year, and this is a great handicap to the state in competing with other cane regions and with the sugar beet. Of the total sugar consumption of the country in 1899–1904 Louisiana produced somewhat more than a fifteenth. Since about 1880 there have been central factories, and their increase has been a very prominent factor in the development of the industry, as it has been in Cuba. Though very much of the region S. of the Red river is fairly well suited to sugar-growing, it is still true that sugar cannot, over much of this area, be grown to so great advantage as other crops. Its hold upon the delta region is, however, almost unchallenged, especially since the rice farmers have found in the prairie lands that excel the delta for their purposes. Sugar is grown also in St Landry and the eastern part of Attakapas—a name formerly loosely applied to what are now St Mary, Iberia, Vermilion, St Martin and Lafayette parishes. Though introduced with success from Santo Domingo about the middle of the 18th century, the sugar industry practically dates from 1796, when Étienne Boré first succeeded in crystallizing and clarifying the syrup. Steam motive power was first introduced on the plantations in 1822. The average product of the ten seasons 1894–1904 was 299,745 tons. A state sugar experiment station is maintained at Audubon Park in New Orleans, its work embracing the development of seedlings, the improvement of cane varieties, the study of fungus diseases of the cane, the improvement of mill methods and the reconciliation of such methods (for example, the use of sulphur as a bleaching and clarifying agent) with the requirements of "pure food" laws. Good work has also been done by the Audubon sugar school of the state university, founded "for the highest scientific training in the growing of sugar cane and in the technology of sugar manufacture."

Tobacco might be grown profitably over a large part of the state, but in reality very little is grown. The strong, black perique of the delta—cultivated very generally in the lower alluvial region before the Civil War, but now almost exclusively in St James parish—is a famous leaf, grown since early colonial times. Bright or yellow plug and smoking leaf are grown on the pine uplands and pine "flats," and a small amount of cigar tobacco on the flats, prairies and "bluffs." The total value of the tobacco crop of 35,000 ℔ in 1907 was only $10,000, an amount exceeded by each of the other 24 tobacco-growing states, and the crop was about one-twentieth of 1% of the product of the whole United States.

Rice farming, which had its beginning immediately after the Civil War and first became prominent in the 'seventies, has developed enormously since 1880. From 1879 to 1899 the product increased twenty-five fold. Formerly the grain was raised by preference in the river bottoms, which still yield, almost invariably, the earliest rice of the season and perhaps the finest. The "buckshot clays" of the backlands, which are so stiff that they can scarcely be ploughed until flooded and softened, and are remarkably retentive of moisture, are ideal rice soil; but none of the alluvial lands has an underlying hardpan, and they cannot as a rule be drained sufficiently to make the use of heavy harvesting machinery possible. In 1880 the prairies of the S.W. were opened to settlement by the railway. These prairies are traversed by ridges, which facilitate irrigation, and are underlaid by an impervious subsoil, which facilitates both effective storage and drainage. Thus the use of machinery became possible, and this revolutionized the entire industry. The year 1884 may be taken as the initial date of the new period, and the grain is now harvested exactly as is wheat in the west-central states. Previously the grain had ordinarily been cut with sickles and harvested by hand. The farms were also small, usually from 5 to 10 acres. They are now very much larger. All the prairies district—the centre of which is Crowley—is becoming one great rice field. Some rice also is grown on the lowlands of the Mississippi valley, notably in Plaquemines, Jefferson and Lafourche parishes. In the decade 1881–1890 Louisiana produced about half of the total yield of the country, and from 1891 to 1900 about five-sevenths. In 1904 and 1906 the Louisiana crop, about one-half of the total yield of the country, was larger than that of any other state; but in 1905 and in 1907 (6,192,955 ℔ and 7,378,000 ℔ respectively) the Louisiana crop was second in size to that of Texas. Carolina and Honduras rices were practically the only varieties until after 1896. Since that time select Japanese species, chosen for superior milling qualities, have been widely introduced, as the market prejudice in favour of head rice made the large percentage of broken rice a heavy handicap to the farmers. Hundreds of varieties have been tested by the state and federal agricultural experiment stations. A strong tendency to run to red rice (hardier, but not so marketable) has been a second great difficulty to overcome.

Irrigation is almost entirely confined to rice farms. In the prairie region there is abundant water at depths of 100 to 400 ft. beneath the surface, but this was little used for irrigation for the first few years of the development of this field, when water was pumped from the streams and canals. In 1902 nearly one-eighth of the acreage irrigated was by systems supplied from wells. The irrigated rice area increased 92·9% from 1899 to 1902, and the construction cost of irrigation works ($4,747,359 in 1902; $12.25 per irrigated acre) 87·7% in the same years. This increase was almost wholly in the prairie parishes. Of the total irrigated area for rice of 387,580 acres in 1902, 310,670 acres were in the parishes of Calcasieu, Acadia and Vermilion. In the Mississippi valley water is taken from the river by flumes in the levees or by siphons. The danger of floods and the difficulty of drainage make the extension of the practice unprofitable, and the opening of the prairies has made it unnecessary.

Many of the fruits of warm-temperate and semi-tropical lands, whether native or exotic, including oranges, olives, figs, grape-fruit, kumquats and pomegranates are cultivated. Oranges are grown especially on the coast. There are many fine groves on the Mississippi below New Orleans. The fig is a common door-yard tree as in other Gulf and South Atlantic states, and is never killed down by frost. Louisiana produced in 1899 only a fifth as great a value in subtropic fruits as Arizona and Texas combined. Orchard fruits are fairly varied, but, compared with other states, unimportant; and the production of small fruits is comparatively small, the largest crop being strawberries. Oranges and pears are seriously damaged by insect and fungus pests. The total value of fruit products in 1899 was $412,933. Among nuts the native pecan is exceptionally abundant, the product (637,470 ℔ in 1899) being much greater than that of any other state save Texas.

The total value of cereal products in 1899 was $14,491,796, including Indian corn valued at $10,327,723 and rice valued at $4,044,489; in 1907 it was more than $27,300,000, including Indian corn valued at $19,600,000, rice valued at $7,378,000 and oats valued at $223,000. Indian corn is grown only for home use. Dairying interests are not largely developed, and in Texas and the adjoining states the "Texas fever" and "charbon" have done great damage to cattle. Forage crops are little grown, though soil conditions are favourable. Cowpeas are a common fertilizer. Garden trucking is very slightly developed, but has been successful where it has been tried. The state maintains a crop pest commission, the duties of which include the inspection of all nursery stock sold in the state.

Manufactures.—The state's manufacturing interests have during the last few decades grown greatly in importance. From 1890 to 1900 the capital invested, the cost of materials used and the value of output (in 1900, $121,181,683) increased respectively 225·4, 147·3 and 109·6%. The value of the factory products in 1900 was $111,397,919; in 1905 it was $186,379,592. Slightly above one-half of the product of 1900 was from New Orleans, and in 1905 about 45·4%. A constitutional amendment of 1902 exempted from parochial and municipal taxes between 1900 and 1910 practically all factories and mines in the state, employing at least five hands. Manufacturing industries are for the most part closely related to the products of the soil, about two-thirds of the value of all manufactures in 1900 and in 1905 being represented by sugar and molasses refining, lumber and timber products, cotton-seed oil and cake, and rice cleaned and polished.

Rice is milled at New Orleans, Crowley, Abbeville, Gayden, Jennings and Lake Charles. Ramie fibre and jute are available for coarse cloth; cotton weaving is almost non-existent. The lumber industry is centred chiefly in Calcasieu parish. Lake Charles, Westlake, Bogalusa, Bon Ami, Carson, Fisher, Fullerton, Leesville, Oakdale and Pickering were the leading sawmill towns of the state in 1908. Of the rarer woods particular mention may be made of curly pine, yielding a wood of beautiful figure and polish; magnolia, hard, close-grained, of fine polish and of great lasting qualities; and cypress, light, strong, easily worked and never-rotting. The timber cut of 1900 was officially stated as 1,214,387 M. ft. B.M., of which two-thirds were of yellow pine and most of the remainder of cypress. In some localities, especially in the "Florida parishes," small quantities of rosin and turpentine are taken from the long-leaf pine, but this industry was unimportant in Louisiana before 1908. Sawdust, slabs, stumps and large quantities of logs are wasted. Other manufactures with a product value in 1905 of between $4,000,000 and $1,000,000 were: bags (not paper); foundry and machine-shop products; planing-mill products; railway cars, construction and repairs; malt liquors; men's clothing; cooperage; food preparations; roasted and ground coffee and spice; fertilizers; cigars and cigarettes; cotton goods; and manufactured ice.

Communications.—The length of railway in the state was 1740 m. in 1890 and 4943·55 m. at the end of 1908. By the state constitution of 1898 and by amendments of 1902 and 1904 tax exemptions for ten years were granted to newly-built railroads completed before 1909. The principal roads are the Missouri Pacific (St Louis, Iron Mountain & Southern, New Orleans & North-western and St Louis, Watkins & Gulf), the Southern Pacific (Morgan's Louisiana & Texas Railroad & Steamship Co. and the Louisiana Western), the Texas & Pacific, the Kansas City Southern, the Vicksburg, Shreveport & Pacific, the Louisiana Railway & Navigation Co., the Yazoo & Mississippi Valley, the Illinois Central, and the Louisiana & Arkansas. The Illinois Central, the first railway giving Louisiana connexion with the north, and of immense importance in the trade of New Orleans, has only about 100 m. of double track in the state. The problem of inland waterways has always been a most important one in northern, eastern and southern Louisiana, where there are systems of improved bayous, lakes and canals which, with the levees, make this region something like Holland, on a greater scale. Many bayous are convertible by improvement into excellent drainage and irrigation canals. The canal system is especially well developed in the parishes of the Mississippi delta, where, at the close of 1907, there were about 50 m. of these waterways of decided commercial importance. They serve the trade of Lake Pontchartrain and the Florida parishes, the lumber, coal, fish, oyster and truck trade of New Orleans, and to some extent are the highway of a miscellaneous coasting trade. The most important canal is probably the new Atchafalaya Bay canal (14 ft. deep), opened in 1907, connecting the Atchafalaya river and Morgan City with the Gulf of Mexico. In 1907 active preliminary work was begun on the Louisiana section of a great interstate inland waterway projected by the national government between the Mississippi and Rio Grande rivers, almost parallel to the Gulf Coast and running through the rice and truck-farm districts from the Teche to the Mermenton river (92 m.). The competition of the water lines is felt by all the railways, and the importance of water transportation is rapidly increasing. A state railroad commission, organized in 1899, has power to regulate railway, steamer, sleeping-car, express, telephone and telegraph rates within the state. Foreign commerce is almost wholly centred at New Orleans.

Population.—The population of the state increased in the ten decades from 1810 to 1910 successively by 100·4, 40·6, 63·4, 46·9, 36·7, 2·7, 29·3, 19·0, 23·5 and 19·9%. In 1910 it was 1,656,388 (36·5 per sq. m.).[1] In 1900 47·1% was of negro blood, as compared with 51·5 in 1890. In 1910 there were nine cities with more than 5000 inhabitants each: New Orleans (339,075); Shreveport (28,015); Baton Rouge (14,897), the capital; Lake Charles (11,449); Alexandria (11,213); Monroe (10,209); New Iberia (7449); Morgan (5477); Crowley (5099). The urban element is larger than in any other southern state, owing to the large population of New Orleans. The Acadians (see § *History* below) to-day are settled mainly in St Mary, Acadia and Vermilion parishes; lesser numbers are in Avoyelles and St Landry; and some are scattered in various other parishes. The parishes of St Mary, Iberia, Vermilion, St Martin and Lafayette are known as the Attakapas country from an Indian name. A colony of Germans sent over by John Law to the Arkansas removed to the Mississippi above New Orleans, and gave to its bank the name of the "German Coast," by which it is still known. In recent years there has been an immigration of Italians into Louisiana, which seems likely to prove of great social and economic importance. The industrial activity of the state has required more labour than has been available. The negroes have moved more and more from the country to the towns, where they easily secure work at good wages. Owing to the inadequate supply of labour two important immigration leagues of business men were formed in 1904 and 1905, and in 1907 the state government began officially to attempt to secure desirable foreign immigration, sending agents abroad to foster it. Roman Catholics greatly predominate among religious denominations, having in 1906 477,774 members out of a total of 778,901 for all denominations; in the same year there were 185,554 Baptists, 79,464 Methodists, 9070 Protestant Episcopalians and 8350 Presbyterians.

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[1] The population was 76,556 in 1810; 153,407 in 1820; 215,739 in 1830; 352,411 in 1840; 517,762 in 1850; 708,002 in 1860; 726,915 in 1870; 939,946 in 1880; 1,118,588 in 1890; and 1,381,825 in 1900.

Administration.—Since the admission of the state to the Union in 1812 there have been eight state constitutions (not counting that of 1861) admirably illustrating—and not less the Territorial government preceding them—the development of American democracy and the problems connected with the negroes. Under the Territorial government the legislative officers were not at first elective. The "parishes" date from 1807; they were based on an earlier Spanish division for religious purposes—whence the names of saints in parish nomenclature. The constitution of 1812 allowed the General Assembly to name the governor from the two candidates receiving the highest number of votes; gave the governor large powers of appointment, even of local functionaries; and required a property qualification for various offices, and even for voters. The constitution of 1845 made the popular suffrage final in the choice of the governor, abolished property qualifications, and began to pare executive powers for the benefit of the General Assembly or the people. From it dates also the constitutional recognition of the public schools. In 1852 even the judges of the supreme court were placed among the officers chosen by popular vote. The constitutions of 1864 and 1868 were of importance primarily as bearing on negro status and national politics. That of 1879 showed a profound distrust of legislative action, bred of reconstruction experiences. Nearly all special legislation was forbidden. The last constitution (1898, with 26 amendments 1898–1906), unlike all others after that of 1812, was not submitted to the people for ratification.

Under this constitution sessions of the General Assembly are biennial (meeting the second Monday in May in even-numbered years) and are limited to sixty days. The number of senators is fixed by the constitution at 39; the number of representatives is to be not more than 116 or less than 98. Any elector is eligible for election as a representative if he has been a citizen of the state for five years and a resident of the district or parish from which he is elected for two years immediately preceding the election; a change of residence from the district or parish from which he was elected vacates the seat of a representative or senator. A senator must be at least 25 years of age. Members of the legislature are elected for four years. Revenue or appropriation bills originate in the House of Representatives, but may be amended by the Senate. Contingent appropriations are forbidden, and the constitution contains a long list of subjects on which special laws may not be passed. The chief executive officers have four-year terms, neither the governor nor the treasurer being eligible for immediate re-election. The governor must be at least 30 years old and must have been a citizen of the United States and a resident of the state for 10 years next preceding his election. Within five days after the passage of any bill by the General Assembly he may veto this measure, which then becomes a law only if passed by a two-thirds vote of all members elected to each house of the General Assembly. The lieutenant governor (and then the secretary of state) succeeds to the office of governor if the governor is removed, dies or leaves the state. The five judges of the supreme court of the state are elected by the people for a term of twelve years. The supreme court is almost without exception a court of appeal with jurisdiction in cases involving at least $2000, in cases of divorce, in suits regarding adoption, legitimacy and custody of children and as regards the legality and constitutionality of taxes, fines, &c. The supreme court appoints courts of appeal to judge cases involving less than $2000. The constitution prohibits lotteries and the sale of lottery tickets.

The suffrage clauses are of particular interest, as they accomplish the practical disfranchisement of the negroes. The constitution requires that a voter must (in addition to other qualifications) either be able to show conclusively ability to read and write, or be the owner of property within the state assessed at not less than $300, on which, if personalty, all taxes are paid. But it excepts from these requirements—thus letting down the bars for illiterate whites excluded with negroes by the foregoing clauses—persons who were entitled to vote in some state on or before the 1st of January 1867 (*i.e.* before the adoption of the Fourteenth and Fifteenth Amendments of the United States Constitution); also the sons or grandsons of such voters, not under 21 years of age, on the 12th of May 1898; and males of foreign birth who have resided in the state for five years next preceding the date of application for registration and who were naturalized prior to 1898. The constitution provides that no person less than 60 years of age shall be permitted to vote unless he has paid an annual poll-tax of one dollar for the two years next preceding the year in which he offers to vote. Convicts not pardoned with an explicit restoration of suffrage privileges are disfranchised—a rare clause in the United States. Suffrage was by this constitution first extended to women tax-payers in questions "submitted to the tax-payers, as such." The creation of a railroad commission was ordered and the preparation of a code of criminal law.

The Louisiana Board of Levee Commissioners was organized in 1865. The state board of health was the first one effectively organized (1855) in the United States. It encountered many difficulties, and until the definite proof of the stegomyia hypothesis of yellow-fever inoculation made by the United States army surgeons in Cuba in 1900, the greatest problem seemed insoluble. Since that time conditions of health in New Orleans have been revolutionized (in 1907 state control of maritime quarantine on the Mississippi was supplanted by that of the national government), and smaller cities and towns have been stimulated to take action by her example. Sanitary institutes are held by the state board at various towns each year for the instruction of the public. Boards of appraisers and equalization oversee the administration of the tax system; the cost of collection, owing to the fee system for payment of collectors, was higher than in any other state of the Union until 1907, when the fees were greatly reduced. The state assessment in 1901 totalled $301,215,222 and in 1907 was $508,000,000. Schools and levees absorb about half of all revenues, leaving half for the payment of interest on the state debt (bonded debt on 1st of April 1908, $11,108,300) and for expenses of government. A general primary election law for the selection, by the voters, of candidates for state office came into effect in 1906.

Law.—Louisiana has been peculiar among the states of the Union in the history of the development of its legal system. In Louisiana alone (as the state is known to-day), out of all the territory acquired from France as the Louisiana Purchase in 1803, was the civil law so established under French and Spanish rule that it persisted under American dominion. In all the other states formed from the Purchase, the civil law, never existent practically, was early expressly abrogated, and the common law of England established in its place. After O'Reilly established his power in 1769 (see *History*, below), the Spanish law was supreme. All the old codes of the Peninsula, as well as the laws of the Indies and special royal decrees and schedules, were in force in the colony. The United States left the task of altering the laws to the people, as far as there was no conflict between them and the Constitution of the United States and fundamental American legal customs. Copies of the Spanish codes were very rare, and some of them could not be had in the colonies. Discussions of the Roman Institute and Pandects were common in the deliberations of the courts. Great confusion prevailed in the first years of American dominion owing to the diversities of languages and the grafting of such Anglo-Saxon institutions as the jury upon the older system. A provisional code of judicial procedure, prepared by Edward Livingston, was in effect in 1805 to 1825. The earliest digest, completed in 1808, was mainly a compilation of Spanish laws. The project of the *Code Napoléon*, however—the *code* itself not being available in Louisiana, though promulgated in France in 1804—was used by the compilers in the arrangement and substance of their work; and the French traditions of the colony, thus illustrated, were naturally introduced more and more into the organic commentaries and developments that grew up around the *Code Napoléon.* This evolution was little marked, so similar in large parts were the systems of France and Spain (although in other parts, due to the Gothic element in the Spanish, they were very different)—a similarity which explains the facility with which O'Reilly and his successors introduced the Spanish laws after 1769. The Louisiana code of 1808 was not, however, exhaustive; and the courts continued to go back to the old Spanish sources whenever the digest was inconclusive. Thus so late as 1819, when the legislature ordered the compilation of such parts of King Alfonso's *Siete Partidas* (the most common authority in the colony) as were considered in force, this compilation filled a considerable volume. In 1821 the legislature authorized Livingston to prepare the "Livingston Code" of criminal law and procedure, completed in 1824 (in French and English) and published in 1833, but never adopted by the state. In 1825 legislative sanction was given to the greater part of a civil code prepared by a commission (including Livingston) appointed in 1821, and the French element became steadily more important. In its present form the law shows plainly the Latin and English elements. English law has largely moulded, for example, criminal and commercial law and the law of evidence; the development of the law of corporations, damages, prohibitions and such extraordinary remedies as the mandamus has been very similar to that in other states; while in the fusion of law and equity, and the law of successions, family relations, &c., the civil law of Spain and France has been unaffected.

Education.—Schooling was very scant before the creation of the public schools in 1854. Very little was done for education in the French and Spanish period, although the Spanish governors made commendable efforts in this regard; the first American Territorial legislature began the incorporation of feeble "colleges" and "academies." To some of these the state gave financial aid ($1,613,898) before 1845. The public schools were flourishing at the outbreak of the Civil War. War and reconstruction threw upon them the new burden of the black children. The constitution of 1879 was illiberal in this respect, but a healthier public opinion soon prevailed. The money given by the state to the public schools is distributed among the parishes according to their school population, and the constitution of 1898 set a generous *minimum* to such aid. An annual poll-tax is also collected for the schools from every adult male. Local taxes, besides, are imposed, and these are becoming heavier. The parishes retain primary control of the schools. Institutes, summer schools and rural libraries have been introduced. The salaries of white teachers advanced from a monthly average of $38.87 in 1903 to $61.84 in 1906. The average attendance of enrolled black and white pupils is practically identical, but the enrolment of whites (about 52% in 1902) is somewhat higher and that of the blacks about a third lower than their ratio in the population. The school term for white children is much longer than for negroes, and white teachers are paid much better salaries—in 1906 the average monthly salary of a negro teacher was $29.15. The total enrolment is very low. But progress is now being made very rapidly in the improvement of the educational system. Higher schools include: the State University and Agricultural and Mechanical College (1860) at Baton Rouge (*q.v.*); Tulane University of Louisiana (1864) in New Orleans; Jefferson College (1864; Roman Catholic) at Convent; the College of the Immaculate Conception (1847; Roman Catholic) in New Orleans; St Charles College (1835; Roman Catholic) at Grand Couteau; St Joseph's College (1849; Roman Catholic) at Baton Rouge; the following colleges for women—Silliman Collegiate Institute (1852; Presbyterian) at Clinton, Mansfield Female College (1854; Methodist Episcopal, South) at Mansfield, the H. Sophie Newcomb Memorial College for women (a part of Tulane University) in New Orleans and the Louisiana Female College (1856; Baptist) at Keatchie; the State Normal School of Louisiana (1884) at Natchitoches and the New Orleans Normal and Training School; the South-western Louisiana Industrial Institute at Lafayette; the Louisiana Industrial Institute at Ruston; and, among schools for negroes, the Peabody State Normal and Industrial School at Alexandria and New Orleans University (1873; Methodist Episcopal), Luther College (Evangelical Lutheran), Leland University (1870; Baptist), Straight University (Congregational) and Southern University (1883; aided by the state), all in New Orleans.

Charitable and Penal Institutions.—The State Board of Charities and Correction, for which the constitution of 1898 first made provision, and which was organized under an act of 1904, is composed of six members, appointed by the governor for six years, with the governor as *ex-officio* chairman. The members of the board serve gratuitously, but elect a salaried secretary. The board has no administrative or executive power, but makes annual inspections of all public charitable, correctional or reformatory institutions, all private institutions which receive aid from, or are used by municipal or parochial authorities, and all private asylums for the insane; and reports annually to the governor on the actual condition of the institutions. Any suggestions as to improvements in institutions must be approved by the majority of the governing body of that institution before they may be put into effect. The charitable institutions include two charity hospitals—at New Orleans (1832) and Shreveport; an Eye, Ear, Nose and Throat Hospital, a Hôtel Dieu, the Touro Infirmary and a Home for Incurables, all at New Orleans; an Institute for the Deaf and Dumb (for whites—there is no state provision for negro deaf and dumb) and an Institute for the Blind, both at Baton Rouge; an Insane Hospital at Jackson and another at Pineville; and the Louisiana Retreat for the Insane at New Orleans. At Monroe there is a State Reform School, and at New Orleans a Coloured Industrial Home and School. There is also a state home for disabled Confederate soldiers at New Orleans on Bayou St John. The State Penitentiary is at Baton Rouge, and a House of Detention at New Orleans; and there are parish prisons. State convicts, and all places in which they are confined or employed, are under the supervision of a Board of Control appointed by the governor. This board may allow commutation or diminution of sentence for good behaviour, meritorious services or exemplary conduct. The leasing or hiring of state convicts is prohibited by the constitution, but parish convicts may be hired or leased for farm and factory work, work on roads and levees, and other public undertakings. Such convicts are classified according to physical ability and a minimum rate is fixed for their hire, for not more than ten hours a day. Many state convicts are employed in levee construction, and there are convict farms at Angola, Hope, Oakley and Monticello.

History.—The early history of Louisiana belongs to the romance of American history. It is possible that the mouth of the Mississippi was discovered in 1519 by Alonso Alvarez de Piñeda, but this interpretation of his vague manuscript remains conjectural; and that it was discovered by the expedition of Panfilo de Narvaez cannot be established. That Hernando de Soto entered the borders of the present state of Louisiana, and that his burial place in the Mississippi was where that river takes the waters of the Red, are probable enough, but incapable of conclusive proof. Survivors of de Soto's expedition, however, descended the Mississippi to its mouth in 1542. Spain set up no claim to the region, and when Robert Cavalier, Sieur de la Salle, came down the river in 1682 from the French possessions to the north, he took possession in the name of France, which hereby gained her first title to the vast drainage basin of the Mississippi. In honour of Louis XIV. the new possession was named "Louisiana"—a name then and until 1812 applied to a much larger area than that of the present state. La Salle attempted to settle a colony in 1684, but missed the Mississippi's mouth and landed in Texas, where he was murdered in 1687 by some of his followers. In 1697, after Ryswick, Pierre le Moyne d'Iberville (1662–1706) was chosen to lead another colony, which reached the Gulf coast early in 1699. Soon after Iberville had built Fort Maurepas (near the present city of Biloxi, Mississippi) in 1699, a fort was erected on the Mississippi river about 40 m. above the mouth.

This was the earliest settlement in what is now the state of Louisiana. It was unhealthy and unprosperous. From 1712 to 1717 "Louisiana," or the French possessions of the Mississippi valley, was held by Antoine Crozat (1655–1738) as a private grant from the king. It proved as great a drain upon his purse as it had proved to the crown, and he willingly parted with it to the so-called "Western Company," afterwards incorporated with the great Company of the Indies. The head of this company was John Law, who, after spreading glowing accounts of the new land, launched his famous "Mississippi scheme" (see Law, John. The company accomplished much for the colony of Louisiana. Jean Baptiste le Moyne, Sieur de Bienville (1680–1768), a brother of Iberville, was sent out as governor. For forty years he was the life of the colony. One of his first acts was to found the city of New Orleans on its present site in 1718. In this same year seven vessels were sent from France with stores and immigrants; eleven followed during the next year. Five hundred negroes from the Guinea coast were imported in 1719, and many hundreds more soon followed. The Law company eventually came to an end fatal to its creditors in France, but its misfortunes did not check the prosperity of "Louisiana." The company retained its grant of the colony until 1731, when it reverted to the crown. Meantime New Orleans had become the seat of government in 1722. In 1766 an official census showed a total population of 5552. The years of royal rule were uneventful. Cotton culture began in 1740, and sugar-cane was successfully introduced from Santo Domingo by the Jesuits in 1751. Tafia rum and a waxy, sticky sugar syrup subsequently became important products; but not until the end of the century were the means found to crystallize sugar and so give real prosperity to the industry.

By a secret treaty of the 3rd of November 1762, "Louisiana" was transferred from France to Spain. This treaty was not made public for a year and a half, and Spain did not take full possession of the colony until 1769. By a treaty between Spain and France on the one hand and Great Britain and Portugal on the other, signed at Paris in February 1763, all that portion lying E. of the Mississippi river, the Iberville river, and Lakes Maurepas and Pontchartrain was ceded to Great Britain. The international interests thus created, and others that sprang from them, heavily burdened the diplomacy, and even threatened the safety of the United States after they were placed in possession of the eastern bank of the Mississippi down to 31° in 1783.

The news of the cession of the colony to Spain roused strong discontent among the colonists. Antonio de Ulloa (1716–1795), a distinguished Spanish naval officer and scholar, came to New Orleans in 1766 to take possession for his king. Merchants, people, and many civil officers held toward him from the beginning a hostile attitude; the military, especially, refused to pass into the Spanish service as stipulated in the treaty; and Ulloa was compelled to continue in an ambiguous and anomalous position—which his lack of military force probably first compelled him to assume—ruling the colony through the French governor, Philippe Aubry (who loyally supported him throughout), without publicly exhibiting his powers. The fear of Spanish commercial laws powerfully stimulated resistance to the transfer, and though Ulloa made commercial and monetary concessions, they were not sufficient. When the colonists found protests at Paris unavailing, they turned to the idea of independence, but sought in vain the armed support of the British at Pensacola. Nevertheless they compelled Ulloa to leave the colony or exhibit his credentials. He took his leave in November 1768. The open resistance by the colonists (October 1768) was a carefully planned revolt. There is no doubt that the men who led the Creole opposition contemplated independence, and this gives the incident peculiar interest. In the summer of 1769 Alejandro O'Reilly came to New Orleans with a strong military force (3600 troops). Beginning his rule with an affability that allayed suspicions and securing from Aubry proofs against the popular leaders, he invited them to a reception and arrested them while they were his guests. Five were put to death and others were imprisoned at Havana. O'Reilly put down the rebellion with determination and in accord with the instructions of his king. Regarded without republican sympathies, and in the light of 18th-century doctrines of allegiance, his acts, however severe, in no way deserve the stigma of cruelty ordinarily put upon them. He was liberal and enlightened in his general rule.

Among the incidents of these troubled years was the arrival in Louisiana (after 1765) of some hundreds of French exiles from Acadia, who made their homes in the Attakapas country. There their descendants live to-day, still somewhat primitively, and still in somewhat of the glamour thrown over land and people by the *Evangeline* of Longfellow.

On the 18th of August 1769 Louisiana was formally transferred to Spain. Spanish law and Spanish tongue replaced the French officially, but the colony remained essentially French. The Spanish rulers made efforts to govern wisely and liberally, showing great complaisance, particularly in heeding the profit of the colony, even at the expense of Spanish colonial commercial regulations. The judicial system was much improved, a better grade of officials became the rule, many French Creoles were appointed to office, intermarriages of French and Spanish and even English were encouraged by the highest officials, and in general a liberal and conciliatory policy was followed, which made Louisiana under Spanish rule quiet and prosperous. Bernardo de Galvez (1756–1794), a brilliant young officer of twenty-one, when he became the governor of the colony, was one of the most liberal of the Spanish rulers and of all the most popular. During the American War of Independence he gave valuable aid to the United States; and when Spain finally joined in the war against Great Britain, Galvez, in a series of energetic and brilliant campaigns (1779–1781), captured all the important posts in the British colony of West Florida. The chief interest of the Spanish period lies in the advance of settlement in the western territories of the United States, the international intrigues—British, French and Spanish—involving the future of the valley, the demand of the United States for free navigation on the Mississippi, and the growing consciousness of the supreme importance of the river and New Orleans to the Union. With the Spanish governor Estevan Miro, who succeeded Galvez in 1785, James Wilkinson of Kentucky, arrested at New Orleans with a flat-boat of supplies in 1787, intrigued, promising him that Kentucky would secede from the United States and would join the Spanish; but Wilkinson was unsuccessful in his efforts to carry out this plan. In 1794 Spain, hard pressed by Great Britain and France, turned to the United States, and by the treaty of 1794 the Mississippi river was recognized by Spain as the western boundary of the United States, separating it from Louisiana, and free navigation of the Mississippi was granted to citizens of the United States, to whom was granted for three years the right "to deposit their merchandise and effects in the port of New Orleans, and to export them from thence without paying any other duty than a fair price for the hire of the stores." At the expiration of the three years the Spanish governor refused the use of New Orleans as a place of deposit, and contrary to the treaty named no other port in its place. Spanish rule, however, came unexpectedly to an end by the retrocession of Louisiana to France in 1800; and French dominion gave way in turn in 1803—as the result of a chain of events even more unexpected, startling, and for the United States fortunate—to the rule of the last-named country. On the 30th of November 1803 the representatives of the French republic received formal possession from the Spanish governor, and on the 20th of December lower Louisiana was transferred to the United States. (See LOUISIANA PURCHASE.)

By an Act of Congress of the 25th of March 1804,[1] that portion of the Louisiana Purchase S. of 33° was organized as the Territory of Orleans, and was given a government less democratic than might otherwise have been the case, because it was intended to prepare gradually for self-government the French and Spanish inhabitants of the territory, who desired immediate statehood. The foreign slave-trade was forbidden by this organic act. English was made the official language. The introduction of English law, and the changes made in the judicial and legal systems of Louisiana after 1804 have already been described.

The machinations of Aaron Burr are of interest in connexion with Louisiana annals, and likewise the settlement and revolutionizing of West Florida by Americans. In November 1811 a convention met at New Orleans and framed a constitution under which, on the 30th of April 1812, the Territory of Orleans became the state of Louisiana. A few days later the portion of West Florida between the Mississippi and Pearl rivers (the present "Florida Parishes") was included in its boundaries, making them as they are to-day. In this same year the first steamboat reached New Orleans. It descended the Ohio and Mississippi from Pittsburg, whence there had already been a thriving river trade to New Orleans for about thirty years. During the War of 1812 a decisive victory was won by the American forces at Chalmette, near New Orleans, on the 8th of January 1815. Up to 1860 the development of the state in population, agriculture and commerce was very rapid. Donaldsonville was the (nominal) capital in 1825–1831, Baton Rouge in 1849–1864 and again after 1882. At other times New Orleans has been the capital, and here too have always been various state offices which in other states ordinarily are in the state capital.

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[1] Other acts bearing on Territorial government are those of the 31st of October 1803 and the 23rd of March 1805.

By an ordinance of secession passed on the 26th of January 1861, Louisiana joined the Confederate States. In the first year there was very little military activity in the state, but in April 1862 Admiral D. G. Farragut, with a powerful fleet, ascended the Mississippi past Forts Jackson and St Philip, which defended the approach to New Orleans, and a military force under General B. F. Butler occupied that city. The navigation of the river being secured by this success and by later operations in the north ending in July 1863 with the capture of Vicksburg and Port Hudson, the state was wholly at the mercy of the Union armies. The intervening months were signalized by the capture of Baton Rouge in May 1862—the Confederates vainly attempting to recapture it in August. Later, in April 1864, the Confederates under General Richard Taylor won a success against the Unionists under General N. P. Banks at Sabine Cross Roads near Mansfield and were themselves repulsed at Pleasant Hill, these battles being incidental to a campaign undertaken by the Union forces to crush opposition in western Louisiana. A large portion of the state was occupied by them in 1862–1865. There were various minor skirmishes in 1862 and 1863 (including the capture of the Federal camp at Berwick Bay in June 1863).

As early as December 1862 the Union military government, at President Lincoln's direction, had ordered elections for Congress, and the men chosen were admitted in February 1863. In March 1864 also a state government to supersede the military rule was established under the president's auspices. By 1863 two parties had arisen among the loyal classes: one of radicals, who demanded the calling of a constitutional convention and the abolition of slavery; the other of conservatives. The former prevailed, and by a convention that assembled in April 1864 a constitution was framed closely following that of 1852 but repudiating the debt incurred by Louisiana as one of the Confederate states and abolishing slavery. Two-thirds of the delegates were from New Orleans. The legislature was ordered to establish free schools for the blacks, and was empowered to give them the suffrage: neither of these provisions, however, was carried out. The extent of the Union control is shown by the fact that the legislature of 1864 represented half of the area and two-thirds of the population of the state. The army stood at the back of the new government, and by the end of 1864 Louisiana was apparently "reconstructed." But in 1864 the opposition of Congress to presidential reconstruction had clearly developed, so that the electoral votes of Louisiana (like those of Tennessee) for president were not counted. By the spring of 1866 the ex-Confederates had succeeded in gaining possession of most of the local government and most of the state offices, although not of the governorship. The Republican party naturally became extremely radical. The radicals wished to have negro suffrage in order to get possession of the government. They, therefore, wanted still another constitutional convention. A clause in the constitution of 1864 provided for the reconvening of the convention in certain circumstances, but this clause referred only to necessities prior to the establishment of a government, and had therefore determined. Nevertheless, the radicals, because it was impossible to call a convention through the medium of the state government, took advantage of this clause to reconvoke the old convention at New Orleans. The day set was the 30th of July 1866. The ex-Confederate party determined to prevent the gathering, but the idea of interference by force seems to have been abandoned. A street riot was precipitated, however, incidental to a procession of armed negroes; the metropolitan police fired upon the assembled convention; and altogether some 200 persons, mostly negroes, were killed. This incident raised the crucial question of national politics in 1866: namely, whether the states reconstructed by the president should not again be reconstructed.

This being settled affirmatively, Louisiana was reconstructed with vigour. A constitution of 1868 gave suffrage to the blacks, and disfranchised all whites made ineligible to office under the proposed Fourteenth Amendment to the national Constitution, and also (practically) those who had by word, pen or vote defended secession. Then the state ratified the Fourteenth Amendment, and was declared readmitted to the Union in July 1868. Probably no other southern state suffered equally with Louisiana from the corruption of "carpet-bag," "scalawag," negro legislatures. For four years (1868–1872) the government expenses increased to ten times their normal volume, taxation was enormously increased, and about $57,000,000 of debt was created. But a quarrel broke out among the Republicans (1872), the result of which was the installation of two governors and legislatures, one supported by the Democrats and Liberal Republicans and the other by the radical Republicans, the former being certainly elected by the people. The rivalry of these two state governments, clashes of arms, the recognition by the Federal authorities of the radical Republican government (Pinchback and Kellogg, successively governors) followed. One historic clash in New Orleans (on the 14th of September 1874) between the "White League" ("White Man's Party") and the Republican police is commemorated by a monument, and the day is regarded by Louisianans as a sort of state independence-day. Finally, in 1876, Francis Tillon Nicholls (b. 1834), a Democrat, was chosen governor, but the Republican candidate, S. B. Packard, claimed the election, and with a Republican legislature for a time occupied the State House. In the national election of 1876 there were double returns (Republican: 75,315 for Hayes and 70,508 for Tilden; and Democratic: 83,723 for Tilden and 77,174 for Hayes) from Louisiana, which, as was the case with the double electoral returns from Florida, Oregon and South Carolina, were adjudicated by the Electoral Commission in favour of the Republican electors voting for Hayes. Civil war being threatened within the state President Hayes sent to Louisiana a commission composed of Wayne McVeagh, Gen. J. R. Hawley, Charles B. Lawrence, J. M. Harlan, and John C. Brown, ex-Governor of Tennessee, which was instructed to promote "an acknowledgment of one government within the state." The rival legislatures united, organizing under the Nicholls government, which the commission found was upheld by public opinion. The president ordered the withdrawal of Federal troops from the capitol on the 20th of April 1877, and the white party was thus left in control.

After 1877 the state prospered markedly in all material respects. Of subsequent political events perhaps the most notable, besides the practical disfranchisement of the negroes, are those connected with the Louisiana State Lottery Company (1868–1893). For the renewal of its privileges in 1890 the company finally agreed to give the state $1,250,000 yearly, and despite strenuous opposition by a powerful party the legislature voted a renewal, but this measure was vetoed by the governor. The United States government, however, forbade lotteries the use of the mails, and the company withdrew its offers. The constitution of 1898 prohibits lotteries and the sale of lottery tickets within the state. In 1891 the lynching of eleven Italians at New Orleans gave rise to grave difficulties involving Italy, the United States, and the state of Louisiana. Since 1900 a white Republican Party has made some headway in Louisiana politics, but in national and state elections the state has been uninterruptedly and overwhelmingly Democratic since 1877.

Governors of Louisiana[1]

French Domination 1682–1762.

A. le Moyne, Sieur de Sauvolle (died in office)	1699–1701
J. B. le Moyne, Sieur de Bienville	1701–1713
M. de Muys, appointed 1707, died en route, Bienville continuing to serve.	
Lamothe Cadillac	1713–1716
Sieur de Bienville, acting governor	1716–1717
De l'Épinay	1717–1718
Sieur de Bienville	1718–1724

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[1] Terms of *actual service in Louisiana*; Gayarré is the authority for the French and Spanish period.

Boisbriant, *ad interim*	1724–1726
Périer	1726–1733
Sieur de Bienville	1733–1743
Marquis de Vaudreuil	1743–1753
L. Billouart, Chevalier de Kerlerec	1753–1763
D'Abbadie	1763–1765
Philippe Aubry	1765–1769

Spanish Domination 1762 (1769)–1803.

Antonio de Ulloa[1]	1766–1768
Alejandro O'Reilly[2]	1769–1770
Luis de Unzaga	1770–1777
Bernardo de Galvez[3]	1777–1785
Estevan Miró (*ad interim* 1785–1786)	1785–1791
F. L. Hector, Baron de Carondelet	30 Dec. 1791–1797
M. Gayoso de Lemos (died in office)	1797–1799
Francisco Bouligny, José M. Vidal, acting military and civil-political governors	1799
Sebastian de Casa Calvo de la Puerta, Marquis de Casa Calvo	1799–1801
Juan M. de Salcedo	1801–1803

French Domination 1800–1803.[4]

Laussat, Colonial Prefect	30 Nov.–20 Dec. 1803

American Domination since 1803.

Territorial Period.

William C. C. Claiborne (appointed 1803)	1804–1812

Statehood Period.

William C. C. Claiborne, Democratic Republican	1812–1816
Jacques Villeré, Democratic Republican	1816–1820
Thomas B. Robertson, Democratic Republican (resigned)	1820–1822
Henry S. Thibodaux, Democratic Republican (acting)	1822–1824
Henry S. Johnson, Democratic Republican	1824–1828
Pierre Derbigny, Democratic Republican (died in office)	1828–1829
Armand Beauvais and Jacques Dupré (acting)	1829–1831
André B. Roman, Whig	1831–1835
Edward D. White, Whig	1835–1839
André B. Roman, Whig	1839–1843
Alfred Mouton, Whig	1843–1846
Isaac Johnson, Democrat	1846–1850
Joseph Walker, Democrat	1850–1853
Paul O. Hébert, Democrat	1853–1856
Robert C. Wickliffe, Democrat	1856–1860
Thomas O. Moore, Democrat	1860–1862
George F. Shepley, Military Governor	1862–1864
Henry W. Allen, Confederate	1864–1865
Michael Hahn, Unionist and Military	1864–1865
James M. Wells, Democrat (acting)	1865–1867
Benjamin F. Flanders, Military	1867
Joshua Baker, Military	1867–1868
Henry C. Warmoth, Republican	1868–1873
Pinckney B. S. Pinchback, Republican (acting)	1873
John McEnery,[5] Democrat-Liberal Republican	1873
William P. Kellogg, Radical Republican	1873–1877
Stephen B. Packard,[6] Radical Republican (contestant)	1877
Francis T. Nicholls, Democrat	1877–1880
Louis A. Wiltz, Democrat (died in office)	1880–1881
Samuel D. McEnery, Democrat (Lieutenant-Governor, succeeded)	1881–1884
Samuel D. McEnery, Democrat	1884–1888
Francis T. Nicholls, Democrat	1888–1892
Murphy J. Foster, Democrat	1892–1900
William W. Heard, Democrat	1900–1904
Newton C. Blanchard, Democrat	1904–1908
Jared Y. Sanders,[7] Democrat	1908

BIBLIOGRAPHY.—Compare the bibliography under NEW ORLEANS and consult also the following. For general description: *The Geology and Agriculture of Louisiana* (Baton Rouge, Agric. Exper. Station, pts. 1–6, 1892–1902); also publications of U.S. Geological Survey, *e.g. Water Supply and Irrigation Papers*, No. 101, "Underground Waters of Southern Louisiana" For fauna and flora: publications of U.S. Biological Survey (Department of Agriculture, Bibliographies). For climate: U.S. Department of Agriculture, *Climate and Crop Service*, Louisiana series (monthly). For soil and agriculture: the above state geological report and material on irrigation in publications of the U.S. Geological Survey and in the U.S. Census publications; also Commissioners of Agriculture of the State of Louisiana, *Annual Report* (Baton Rouge, biennial until 1899); State Agricultural Society, *Proceedings* (annual); Louisiana State University and Agricultural and Mechanical College, *Bulletin of the Agricultural Experiment Station* and *Biennial Report* of same (Baton Rouge); U.S. Department of Agriculture, various publications of the divisions of botany, agrostology, pomology, forestry, farmers' bulletins, &c. For manufactures and other industries: primarily the publications of the national Census, 1900, and preceding decades. For commerce and communications: Railroad Commissioners of Louisiana, *Annual Report* (New Orleans, 1900 ff.); U.S. Interstate Commerce Commission, *Statistics of Railways* (annual, Washington); on river navigation and river improvements, especially of the Mississippi, an enormous mass of material in the *Annual Reports* of the Chief of Engineers, U.S. Army (consult *Index to Reports* of same, 1866–1900, 3 vols., Washington, 1902, and cp. article on MISSISSIPPI RIVER); on river commerce see *U.S. Census of 1880*, vol. 4 (report on steam navigation of the United States by T. C. Purdy), and *Census of 1890* (report on transportation by T. J. Vivian; Rivers of the Mississippi Valley). For population: various national censuses and *Bulletins* of the Bureau of Census, 1900, *e.g.* No. 8, "Negroes in the United States"; on the Acadians, *In Acadia, The Acadians in Song and Story* (New Orleans, 1893; compiled by M. A. Johnston). For pictures of Creole life and traits, George W. Cable, *The Creoles of Louisiana* (New York, 1884), and his later writings; but Mr Cable's views of the Creoles are very unpopular in Louisiana; for other views of them, and for a guide to the English and Creole literature of Louisiana, consult Alcée Fortier, *Louisiana Studies—Literature, Customs and Dialects, History and Education* (New Orleans, 1894). For administration: see reports of the various executive officers of the state (Baton Rouge); the various constitutions are printed in the report of the Secretary of State, as well as in B. Perley Poore's *Constitutions* (2 vols., Washington, 1877); a special account of the government of the territorial period may be found in D. Y. Thomas, *History of Military Government in Newly Acquired Territory of the United States* (Columbia University Studies in History, Economics and Public Law, vol. xx. No. 2, 1904); for the Civil War and Reconstruction period compare below, also American Historical Association, *Annual Report*, 1892; (for courts during Civil War); also John R. Ficklen, *History and Civil Government of Louisiana* (Chicago, New York, *c.* 1899), a brief and popular account; on education, in addition to the Biennial Reports of the Board of Education, consult annual reports of the U.S. Commissioner of Education.

For history: the standard work is that of Charles E. A. Gayarré, coming down to the war, based on deep and scholarly research, and greatly altered in successive editions. The style is that of the classic school, that of Prescott and Motley, full of colour, characterization and spirit. The editions are as follows: *Romance of the History of Louisiana* (New York, 1837, 1848); *Histoire de la Louisiane* (2 vols., Nouvelle Orléans, 1846–1847); *Louisiana: its Colonial History and Romance* (N.Y., 1851); *Louisiana: its History as a French Colony*, Third Series of Lectures (N.Y., 1852); then, based upon the preceding, *History of Louisiana: The French Domination* (2 vols., N.Y., 1854) and *The Spanish Domination* (N.Y., 1854); *The American Domination* (N. Y., 1867); and third edition (4 vols., New Orleans, 1885). More important for the recent period is Alcée Fortier, *A History of Louisiana* (N.Y., 4 vols., 1904) devoting two volumes to American domination. The *History and General Description of New France* of P. F. X. de Charlevoix (best ed. by J. G. Shea, New York, 1866, 6 vols.) is a famous old work, but now negligible. Judge F. X. Martin's *History of Louisiana* (2 vols., New Orleans, 1827–1829, later ed. by J. F. Condon, continued to 1861, New Orleans, 1882) is also valuable and supplements Gayarré. Le Page du Pratz, author of *Histoire de la Louisiane* (3 vols., Paris, 1758; 2 vols., London, 1763), was the first historian of Louisiana. Berquin-Duvallon, *Vue de la colonie espagnole du Mississippi* (Paris, 1805; published in English under the name of John Davis, New York, 1806); L. N. Baudry de Lozières, *Voyage à la Louisiane* (Paris, 1802) and *Second Voyage à la Louisiane* (Paris, 1803) may be mentioned among the travels just preceding, and A. Stoddard, *Sketches of Louisiana* (New York, 1811), among those just following the establishment of American dominion. The *Histoire de la Louisiane, et de la cession de colonie par la France aux États-Unis* (Paris, 1829; in English, Philadelphia, 1830) by Barbé-Marbois has great importance in diplomatic history. The rarest and most valuable of early memoirs and much archive material are embodied in Benj. F. French's *Historical Collections of Louisiana* (5 series, N.Y., 1846–1853) and *Historical Collections of Louisiana and Florida*, New Series (N.Y., 1869, 1875). Documentary materials on the greater "Louisiana" between the Gulf of Mexico and Canada will be found in the *Jesuit Relations*, edited by R. G. Thwaites (Cleveland, 1896 ff.); and on early voyages in Pierre Margry, *Découvertes et établissements des Français* (6 vols., Paris, 1879–1888). John G. Shea published an edition of Louis Hennepin's *Description of Louisiana. . . . Translated from the Edition of 1683*, &c. (New York, 1880). On this greater "Louisiana" the student should also consult the works of Francis Parkman. And see publications of the Louisiana

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[1] Did not openly assume power or supersede Aubry.

[2] Captain-general charged to establish order and settle Unzaga as governor.

[3] At first, till 1779, only acting governor.

[4] Actual exercise of power 20 days.

[5] Counted out by partisan returning-board and not recognized by U.S. government.

[6] Not recognized by U.S. government.

[7] Elected U.S. Senator 1910; accepted, but afterward withdrew.

Historical Society (New Orleans). Of brief general histories there is that of J. R. Ficklen above cited, another by the same author in collaboration with Grace King (New Orleans, 1902) and another (more valuable) by Albert Phelps (Boston, 1905), in the American Commonwealth Series. For the Reconstruction period see bibliography under United States.

LOUISIANA, a city of Pike county, Missouri, U.S.A., situated below the mouth of the Salt river, on the western bank of the Mississippi, about 90 m. N. of St. Louis. Pop. (1900) 5131, including 1075 negroes and 161 foreign-born; (1910) 4454; there is also a considerable suburban population. Louisiana is served by the Chicago, Burlington & Quincy and the Chicago & Alton railways, and by several lines of river steamboats. The river is spanned here by a railway bridge. The city is laid out fairly regularly in the river valley and on bluffs along the river, and has attractive residential districts, commanding good views. It has very active and varied industries, and is a trade centre for a large grain- and fruit-producing and stock-raising region, and has one of the largest nurseries in the United States. Louisiana was laid out in 1818, was the county-seat from that date until 1825, was incorporated as a town in 1845 and was chartered as a city in 1849.

LOUISIANA PURCHASE, a large portion of the area of the United States of America, purchased from the French Republic in 1803. The territory to which France held explorer's title originally included the entire valley of the Mississippi (see Louisiana); but the "Louisiana" which was ceded by her to Spain in 1762 (England refusing it, preferring the Floridas), retroceded to France in 1800,[1] and ceded by Napoleon to the United States—in violation of his pledge to Spain that he would not alienate the province—embraced only the portion W. of the river and the island of New Orleans on the E. (and, as might be claimed with some show of argument, West Florida to the Perdido river).

With the settlement of the trans-Alleghany region, the freedom of the Mississippi had become of vital importance to the western settlements, and Spain had recognized these interests in her treaty with the United States of 1795, by guaranteeing freedom of navigation and the privilege of deposit at New Orleans. The transfer of Louisiana from a weak neighbour to so powerful and ambitious a state as France was naturally unwelcome to the United States, and Robert R. Livingston, the American minister in Paris, was instructed by Secretary-of-State Madison to endeavour to prevent the consummation of the retrocession; or, should that be irrevocable, to endeavour to buy the Floridas (either from France, if they had passed with Louisiana, or through her goodwill from Spain)—or at least West Florida—and if possible New Orleans, so as to give the United States a secure position on the Mississippi, and insure the safety of her commerce. The United States was also trying to collect claims of her merchants for spoliations by French cruisers during the late war between France and Great Britain. In his preliminary propositions Livingston lightly suggested to Talleyrand a cession of Louisiana to satisfy these claims; following it with the more serious demand that France should pledge observance of the Spanish concession to the Mississippi trade. This pledge Napoleon readily gave. But during these negotiations a suspension by the Spanish governor of the right of deposit aroused extreme apprehension in America and resulted in warlike votes in Congress. Of these, and of London reports of a British expedition against New Orleans preparing in anticipation of the imminent rupture of the peace of Amiens, Livingston made most capable use; and pressed for a cession of West Florida, New Orleans and Louisiana north of the Arkansas river. But without New Orleans Louisiana was of little present worth, and Napoleon—the collapse of whose American colonial schemes seemed involved in his failure in Santo Domingo, who was persuaded he could not hold Louisiana against Great Britain, and who was already turning from projects of colonial empire toward his later continental policy—suddenly offered to Livingston the whole of the province. Livingston disclaimed wanting the part below the Arkansas. In even mentioning Louisiana he had gone outside his instructions. At this stage James Monroe became associated with him in the negotiations. They were quickly closed, Barbé Marbois acting for Napoleon, and by three conventions signed on the 30th of April 1803 the American ministers, without instructions, boldly accepted for their country a territory approximately 1,000,000 sq. m. in area—about five times the area of continental France. For this imperial domain, perhaps the richest agricultural region of the world, the United States paid 60,000,000 francs ($11,250,000) outright, and assumed the claims of her citizens against France to the extent of 20,000,000 francs ($3,750,000) additional; the interest payments incidental to the final settlement raising the total eventually to $27,267,622, or about four cents an acre.

Different writers have emphasized differently the various factors in this extraordinary diplomatic episode. Unquestionably the western people were ready to war for the navigation of the Mississippi; but, that being guaranteed, it seems certain that France might peaceably have taken and held the western shore. The acquisition was not a triumph of American diplomacy, but a piece of marvellous diplomatic good fortune; for the records abundantly prove, as Madison said, that the cause of success was a sudden policy of Napoleon, forced by European contingencies. Livingston alone of the public men concerned showed indubitably before the event a conception of the feasibility and desirability of the acquisition of a vast territory beyond the Mississippi. Jefferson had wished to buy the Floridas, but alarmed by the magnitude of the cession, declared his belief that the United States had no power to acquire Louisiana. Though such strict construction of the constitution was a cardinal dogma of the Democratic party, this dogma was abandoned outright in practice, Jefferson finding "but one opinion as to the necessity of shutting up the constitution" (or amending it, which was not done) and seeking justification of the means in the end. The Federalist party, heretofore broad-constructionists, became strict-constructionists under the temptation of factious politics, and a very notable political struggle was thus precipitated—notable among other things for strong expressions of sectionalism. The net result was the establishment of the doctrine of "implied powers" in interpreting the constitution; a doctrine under which the Supreme Court presently found power to acquire territory implied in the powers to wage war and make peace, negotiate treaties, and "dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States."

The exact limits of the acquisition were not definitely drawn. The French archives show that Napoleon regarded the Rio Grande as the W. boundary of the territory of which he was to take possession, and the United States up to 1819 ably maintained the same claim. She also claimed all West Florida as part of Louisiana—which, in the usage of the second half of the 18th century, it apparently was not. When she acquired the Floridas in 1819–1821 she abandoned the claim to Texas. The line then adopted between the American and Spanish possessions on the W. followed the Sabine river from the Gulf of Mexico to the parallel of 32° N., ran thence due N. to the Red river, followed this to the meridian of 100° W. and this line N. to the Arkansas river, thence along this to its source, thence N. to the parallel of 42°, and along this line to the Pacific. Such is the accepted description of the W. boundary of the Louisiana Purchase—waiving Texas—thus retrospectively determined, except that that boundary ran with the crest of the Rocky Mountains N. of its intersection with the parallel of 42°. No portion of the Purchase lay west of the mountains, although for some years after 1870 the official maps of the United States government erroneously included Oregon as so acquired—an error finally abandoned by 1900.

On the 20th of December 1803, at New Orleans, the United States took possession of the lower part of the province, and on the 9th of March 1804, at St Louis, of the upper. The entire region then contained possibly 80,000 residents. The treaty of cession required the incorporation of Louisiana in the Union, and the admission of its inhabitants, "as soon as possible, according to the principles of the Federal Constitution, to the enjoyment of all the rights, advantages and immunities of citizens of the United States." By act of the 26th of March 1804 the region below 33° N. was organized as the Territory of Orleans (see Louisiana), and that above as the District of Louisiana. The region above 33°, renamed in 1805 the Territory of Louisiana, and in 1812 the Territory of Missouri, was divided as time went on into many Indian reservations, territories and states. Thus were carved from the great domain of the Purchase Louisiana, Missouri, Arkansas, Iowa, Minnesota, North and South Dakota, Nebraska and Oklahoma in their entirety, and much the greatest part of Kansas, Colorado, Wyoming and Montana. There is justification for the saying of Thiers that the United States were "indebted for their birth and for their greatness"—at least for an early assurance of greatness—"to the long struggle between France and England." The acquisition of so vast a territory proved thus of immense influence in the history of the United States. It made it possible for them to hold a more independent and more dignified position between France and England during the Napoleonic wars; it established for ever in practice the doctrine of implied powers in the interpretation of the Federal Constitution; it gave the new republic a grand basis for material greatness; assured its dominance in North America; afforded the field for a magnificent experiment in expansion, and new doctrines of colonization; fed the national land hunger; incidentally moulded the slavery issue; and precipitated its final solution.

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[1] By the treaty of San Ildefonso, signed the 1st of October 1800. This was never ratified by Charles IV. of Spain, but the treaty of Madrid of the 21st of March 1801, which confirmed it, was signed by him on the 15th of October 1802.

It is generally agreed that after the Revolution and the Civil War, the Louisiana Purchase is the greatest fact in American history. In 1904 a world's fair, the Louisiana Purchase Exposition, was held at St Louis in commemoration of the cession. After one hundred years the wilderness then acquired had become the centre of the power and wealth of the Union. It contained in 1903 15,000,000 inhabitants, and its taxable wealth alone was four hundred times the fifteen millions given to Napoleon.

Authorities.—The official literature is in the *American State Papers, Foreign Relations*, vol. 2, and *Public Lands*, vol. 2; diplomatic papers reprinted in *House Document 431, 57th Congress, 2nd Session* (1903); to which add the *Histoire de la Louisiane et de la cession* (Paris, 1829; Eng. trans., Philadelphia, 1830), by François Barbé-Marbois. This book abounds in supposed "speeches" of Napoleon, and "sayings" by Napoleon and Livingston that would have been highly prophetic in 1803, though no longer so in 1829. They have been used liberally and indiscriminatingly by the most prominent American historians. See also T. Donaldson, *The Public Domain, House Miscellaneous Document 45, pt. 4, 47th Congress, 2nd Session.* For the boundary discussions by J. Q. Adams and Don L. de Onis, 1818–1819, *American State Papers, Foreign Relations*, vol. 4; also in Onis's *Official Correspondence between Don Luis de Onis . . . and John Quincy Adams*, &c. (London, 1818), or *Memoria sobre las negociaciones entre España y los Estados Unidos que dieron motivo al tratado de 1819* (Madrid, 1820). See also discussion and map in *U.S. Census, 1900, Bulletin 74*; and the letters of Thomas Jefferson, James Madison, Rufus King and other statesmen of the time. By far the best general account of the diplomacy is in Henry Adams's *History of the United States*, vols. 1 and 2; and of Western conditions and American sentiment in J. B. McMaster's *History of the United States*, vols. 2 and 3. Consult also Justin Winsor, *Narrative and Critical History*, vol. 7; and various valuable periodical articles, especially in the *American Historical Review*, by F. J. Turner and others. Reference may be made to B. Hermann, *The Louisiana Purchase* (Washington, 1898), and Theodore Roosevelt's *Winning of the West*, vol. 4. Of the various special but popular accounts (by J. K. Hosmer, Ripley Hitchcock, R. Blanchard, K. E. Winship, &c.), not one is worthy of its subject, and all contain various inaccuracies.

LOUISVILLE, the largest city of Kentucky, U.S.A., and the county-seat of Jefferson county, on the Ohio river, 110 m. by rail and 130 m. by water S.W. of Cincinnati. Pop. (1890) 161,129; (1900) 204,731, of whom 21,427 were foreign-born (including 12,383 Germans and 4198 Irish) and 39,139 were negroes; (1910 census) 223,928.

Louisville occupies 40 sq. m. of a plain, about 70 sq. m. in extent, about 60 ft. above the low-water mark of the river, and nearly enclosed by hills. The city extends for 8 m. along the river (spanned here by three bridges), which falls 26 ft. in 2 m., but for 6 m. above the rapids spreads out into a beautiful sheet of quiet water about 1 m. wide. The streets intersect at right angles, are from 60 to 120 ft. wide, and are, for the most part, well-shaded. The wholesale district, with its great tobacco warehouses, is largely along Main Street, which runs E. and W. not far from the river; and the heart of the shopping district is along Fourth Street in the dozen blocks S. of Main Street. Adjoining the shopping district on the S. is the old residence section; the newer residences are on "The Highlands" at the E. end and also at the W. end. The city is served by the Baltimore & Ohio South-Western, the Chesapeake & Ohio, the Pittsburg, Cincinnati, Chicago & St Louis, the Louisville, Henderson & St Louis, the Illinois Central, the Chicago, Indiana & Louisville, the Cleveland, Cincinnati, Chicago & St Louis, the Southern and the Louisville & Nashville railways; by steamboat lines to Memphis, Cairo, Evansville, Cincinnati and Pittsburg; by an extensive system of inter-urban electric lines; and by ferries to Jeffersonville and New Albany, Indiana, two attractive residential suburbs.

Many of the business houses are old-fashioned and low. The principal public buildings are the United States government building, the Jefferson county court house and the city hall. In front of the court house stands a bronze statue of Thomas Jefferson, designed by Moses Ezekiel (b. 1844), and inside of the court house a marble statue of Henry Clay by Joel T. Hart (1810–1870). There are few or no large congested tenement-house districts; most of the wage-earners own their own homes or rent cottages. Louisville has an extensive park system, most of which was acquired after 1889 and is on the outskirts. From the heart of the city South Parkway, 150 ft. wide, extends S. 6 m. to the entrance to Iroquois Park (670 acres) on a wooded hill. At the E. end of Broadway is Cherokee Park (nearly 330 acres), near which is the beautiful Cave Hill Cemetery, containing the grave of George Rogers Clark, the founder of the city, and the graves of several members of the family of George Keats, the poet's brother, who lived in Louisville for a time; and at the W. end of Broadway, Shawnee Park (about 170 acres), with a long sandy river beach frequented by bathers. Central Park occupies the space of two city squares in the old fashionable residence districts. Through the efforts of a Recreation League organized in 1901 a few playgrounds are set apart for children. Louisville is a noted racing centre and has some fine tracks; the Kentucky Derby is held here annually in May.

The United States government has a marine hospital, and a life-saving station at the rapids of the river. The state has a school for the blind, in connexion with which is the American Printing House for the Blind. There are state hospitals and many other charitable institutions.

The principal educational institutions are the university of Louisville, which has a College of Liberal Arts (1907), a law department (1847), and a medical department (1837)—with which in 1907 were consolidated the Hospital College of Medicine (1873), the Medical Department of Kentucky University (1898), the Louisville Medical College (1869), and the Kentucky School of Medicine (1850); the Southern Baptist Theological Seminary (1859); the Presbyterian Theological Seminary of Kentucky, which was formed in 1901 by the consolidation of the Theological Seminary of the Presbyterian Church at Danville (1853) and the Louisville Presbyterian Theological Seminary (1893); the Louisville College of Pharmacy (1871), and the Louisville College of Dentistry (1887), a department of Central University. There are many musical clubs, and a spring festival for which a local chorus furnishes the nucleus, is held annually. The Louisville Public Library was established in 1902, and 1904 acquired the library, the small museum (containing the Troost collection of minerals) and the art gallery of the Polytechnic Society of Louisville (1878), which for many years had maintained the only public library in the city. The principal newspapers are the *Courier Journal* (Democratic, morning), the *Herald* (Republican, morning), the *Evening Post* (Independent Democratic), and the

Times (Democratic, evening). The *Courier Journal* is one of the most influential newspapers in the South. Henry Watterson became editor in 1868, when the *Courier* (1843), established and owned by Walter N. Haldeman, was consolidated with the *Journal* (1830), of which Watterson had become editor in 1867, and with the *Democrat* (1844).

The richness of the surrounding country in agricultural produce, timber, coal and iron, and its transport facilities have made Louisville a large commercial and manufacturing centre. The leaf-tobacco market is the largest in the world, most of the leaf-tobacco produced in Kentucky, which in 1900 was 34·9% of the entire crop of the United States, being handled in Louisville; the city's trade in whisky, mules and cement[1] is notably large, and that in pork, wheat, Indian corn, coal and lumber is extensive. The total value of the manufactured products increased from $54,515,226 in 1890 to $78,746,390 in 1900 or 44·4%, and between 1900 and 1905 the value of the factory-made product increased from $66,110,474 to $83,204,125, an increase of 25·9%. Large quantities of fine bourbon whisky are distilled here; in 1905 the value of the factory product of the city was $3,878,004. The most valuable manufacture in the same year was smoking and chewing tobacco (especially plug tobacco) and snuff valued at $11,635,367—which product with that of cigars and cigarettes ($1,225,347) constituted 15·5% of the value of the factory products of the city. Other important manufactures in 1905 were: packed meats, particularly pork; men's clothing, especially "Kentucky jeans"; flour and grist mill products; cotton-seed oil and cake; leather, especially sole leather; foundry and machine shop products; steam-railway cars; cooperage; malt liquors; carriages and wagons, especially farm wagons; and carriage and wagon materials; agricultural implements, especially ploughs; and plumbers' supplies, including cast-iron gas and water pipes. Besides, there were many other manufactures.

The city's water-supply is taken from the Ohio river a few miles above the city limits, and purified by large filtering plants. Nearly all the capital stock of the water-works company is owned by the municipality.

Louisville is governed under a charter of 1893, which is in the form of an act of the state legislature for the government of cities of the first class (Louisville is the only city of the first class in the state). The mayor is elected for four years, and appoints, subject to the approval of the board of aldermen, the controller and the members of the two principal executive boards—the board of public works and the board of public safety. The legislative power is vested in a general council composed of 12 aldermen and 24 councilmen. Both aldermen and councilmen serve without pay, and are elected on a general ticket for a term of two years; not more than two councilmen may be residents of the same ward, but there is no such limitation in regard to aldermen. The treasurer, tax-receiver, auditor, judge of the police court, clerk of the police court, members of the board of school trustees (1 from each legislative district) and members of the park commission are elected by popular vote; the assessor, by the general council. The duration of franchises given by the city is limited to 20 years.

History.—The site of the city was probably visited by La Salle in 1669 or 1670. In July 1773, Captain Thomas Bullitt,[2] acting under a commission from the College of William and Mary, surveyed a tract of 2000 acres, lying opposite the Falls of the Ohio, and laid out a town site upon this tract. Colonel William Preston, county surveyor of Fincastle county, within which the 2000-acre tract lay, refused to approve Captain Bullitt's survey, and had the lands resurveyed in the following year, nevertheless the tract was conveyed in December 1773 by Lord Dunmore to his friend Dr John Connolly, a native of Lancaster county, Pennsylvania, who had served in the British army, as commander of Fort Pitt (under Dunmore's appointment), was an instigator of Indian troubles which culminated in the Battle of Point Pleasant, and was imprisoned from 1775 until nearly the close of the War of American Independence for attempting under Dunmore's instructions to organize the "Loyal Foresters," who were to be sent against the rebellious colonists in the West. The city of Louisville was laid out on the upper half of this Connolly tract. It is possible that there was a settlement on what was afterward called Corn Island (which has now practically disappeared), at the Falls of the Ohio, as early as 1775; in May 1778, General George Rogers Clark, while proceeding, by way of the Ohio river, against the British posts in the Illinois territory, landed on this island and built block-houses for his stores and cabins for about twenty families of emigrants who had come with him. These emigrants (or the greater part of them) removed to the mainland in the winter of 1778–1779, and established themselves in a fort built within the present limits of Louisville. A town government was organized by them in April 1779, the settlement at this time being known as "the Falls of the Ohio." On the 14th of May 1780, the legislature of Virginia, in response to a petition of the inhabitants, declared that Connolly had forfeited his title, and incorporated the settlement under the name of Louisville, in recognition of the assistance given to the colonies in the War of Independence by Louis XVI. of France. In 1828 Louisville was chartered as a city; in 1851 it received a second city charter; in 1870, a third; and in 1893, a fourth. The city's growth was greatly promoted by the introduction of successful steam navigation on the Ohio in 1811 and still further by the opening of the canal around the rapids (generally called the "Falls of the Ohio"). This canal, which is 2½ m. in length and is known as the Louisville and Portland canal, was authorized by the legislature in 1825 and was opened in December 1830; between 1855 and 1872 Congress made appropriations for enlarging it, and in 1874 it passed entirely under Federal control. The first railway to serve the city, the Louisville & Frankfort, was completed in 1851. The 6th of August is locally known as "Bloody Monday"; on this day in 1855 some members of the Know Nothing Party incited a riot that resulted in the loss of several lives and of considerable property. In March 1890 a tornado caused great loss in life and property in the city. General Clark made his home in Louisville and the vicinity after his return from the Illinois country in 1779. Louisville was also the early home of the actress Mary Anderson; John James Audubon lived here in 1808–1812; and 5 m. E. of the city are the old home and the grave (with a monument) of Zachary Taylor.

See Reuben T. Durrett, *The Centenary of Louisville* (Louisville, 1893), being No. 8 of the Filson Club Publications; J. S. Johnston (ed.), *Memorial History of Louisville* (Chicago, 1896); and L. V. Rule, "Louisville, the Gateway City to the South," in L. P. Powell's *Historic Towns of the Southern States* (New York, 1900).

LOULÉ, a town of southern Portugal, in the district of Faro (formerly the province of Algarve); beautifully situated in an inland hilly district, 10 m N.N.W. of the seaport of Faro and 5 m. from São João da Venda on the Lisbon-Faro railway. Pop. (1900) 22,478. Apart from Lisbon, Oporto and Braga, Loulé is the most populous town in the kingdom. It is surrounded by walls and towers dating from the Moorish period. The neighbouring church of Nossa Senhora da Piedade is a favourite resort of pilgrims. Basket-making is the principal industry; leather, porcelain and various products of the palm, agave and esparto grass are also manufactured.

LOURDES, a town of south-western France in the department of Hautes-Pyrénées, at the foot of the Pyrenees, 12 m. S.S.W. of Tarbes on the main line of the Southern railway between that town and Pau. Pop. (1906) 7228. Lourdes is divided into an old and a new town by the Gave de Pau, which at this point leaves the valley of Argelès and turns abruptly to the west. The old quarter on the right bank surrounds on three sides a scarped rock, on which stands the fortress now used as a prison. Its large square keep of the 14th century is the chief survival of feudal times. Little is left of the old fortifications except a tower of the 13th or 14th century, surmounting a gateway known as the Tour de Garnabie. The old quarter is united with the new town by a bridge which is continued in an esplanade leading to the basilica, the church of the Rosary and the Grotto, with its spring of healing water. The present fame of Lourdes is entirely associated with this grotto, where the Virgin Mary is believed in the Roman Catholic world to have revealed herself repeatedly to a peasant girl named Bernadette Soubirous in 1858. A statue of the Virgin stands on a rock projecting above the grotto, the walls of which are covered with crutches and other votive offerings; the spot, which is resorted to by multitudes of pilgrims from all quarters of the world, is marked by a basilica built above the grotto and consecrated in 1876. In addition the church of the Rosary, a rich building in the Byzantine style, was erected in front of and below the basilica from 1884 to 1889. Not far from the grotto are several other caves, where prehistoric remains have been found. The Hospice de Notre-Dame de Douleurs is the chief of the many establishments provided for the accommodation of pilgrims.

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[1] Louisville cement, one of the best-known varieties of natural cement, was first manufactured in Shipping Port, a suburb of Louisville, in 1829 for the construction of the Louisville & Portland Canal; the name is now applied to all cement made in the Louisville District in Kentucky and Indiana. There is a large Portland cement factory just outside the city.

[2] Captain Thomas Bullitt (1730–1778), a Virginian, commanded a company under Washington at Great Meadows (July 4, 1754), was in Braddock's disastrous expedition in 1755, and after the defeat of Major James Grant in 1758 saved his disorganized army by a cleverly planned attack upon the pursuers. He became Adjutant-General of Virginia after the peace of 1763, and took part in the movements which forced Lord Dunmore to leave Norfolk. Subsequently he served in South Carolina under Colonel Lee.

Lourdes is a fortified place of the second class; and is the seat of the tribunal of first instance of the arrondissement of Argelès. There are marble and slate quarries near the town. The pastures of the neighbourhood support a breed of Aquitaine cattle, which is most highly valued in south-western France.

The origin of Lourdes is uncertain. From the 9th century onwards it was the most important place in Bigorre, largely owing to the fortress which is intimately connected with its history. In 1360 it passed by the treaty of Brétigny from French to English hands, and its governor was murdered by Gaston Phoebus viscount of Béarn, for refusing to surrender it to the count of Anjou. Nevertheless the fortress did not fall into the possession of the French till 1406 after a blockade of eighteen months. Again during the wars of religion the castle held out successfully after the town had been occupied by the troops of the Protestant captain Gabriel, count of Montgomery. From the reign of Louis XIV. to the beginning of the 19th century the castle was used as a state prison. Since the visions of Bernadette Soubirous, their authentication by a commission of enquiry appointed by the bishop of Tarbes, and the authorization by the pope of the cult of Our Lady of Lourdes, the quarter on the left bank of the Gave has sprung up and it is estimated that 600,000 pilgrims annually visit the town. The chief of the pilgrimages, known as the national pilgrimage, takes place in August.

Several religious communities have been named after Our Lady of Lourdes. Of these one, consisting of sisters of the third order of St Francis, called the Congregation of Our Lady of Lourdes (founded 1877), has its headquarters in Rochester, Minnesota. Another, the Order of Our Lady of Lourdes, was founded in 1883 for work in the archdiocese of New Orleans.

See G. Marès, *Lourdes et ses environs* (Bordeaux, 1894); Fourcade, *L'Apparition de la grotte de Lourdes* (Paris, 1862) and *L'Apparition . . . considérée au point de vue de l'art chrétien* (Bordeaux, 1862); Boissarie, *Lourdes, histoire médicale* (Paris, 1891); Bertrin, *Hist. critique des événements de Lourdes* (2nd ed., Paris, 1905), written under authority of the bishop of Tarbes; H. Lasserre, *Miraculous Episodes of Lourdes* (London, 1884, tr.); R. F. Clarke, *Lourdes and its Miracles* (*ib.*, 1889) and *Medical Testimony to the Miracles* (*ib.*, 1892); D. Barbé, *Lourdes hier, aujourd'hui, demain* (Paris, 1893; Eng. trans. by A. Meynell, London, 1894); J. R. Gasquet, *The Cures at Lourdes* (London, 1895); *Les Pèlerinages de Lourdes. Cantiques, insignes, costumes* (Lourdes, 1897); W. Leschner, *The Origin of Lourdes* (London, 1900). Zola's *Lourdes* (Paris, 1894), a criticism from the sceptical point of view, in the form of a realistic novel, has called forth many replies from the Catholic side.

LOURENÇO MARQUES, capital of Portuguese East Africa, or Mozambique, on the north bank of the Espirito Santo or English river, Delagoa Bay, and 396 m. by rail via Pretoria from Johannesburg. Pop. (1904) 9849, of whom 4691 were Europeans and 1690 Asiatics. The town is situated close to the mouth of the river in 25° 53′ S. and 32° 30′ E., and is built upon a low-lying spit of sand, formerly surrounded by swamps. The streets are regularly laid out and adorned by several fine buildings. The principal thoroughfare, the Avenida Aguiar, 2 m. long goes from the centre of the town to Reuben Point. The harbour is well equipped with piers, quays, landing sheds and electric cranes, which enable large steamers to discharge cargoes direct into the railway trucks. The depth of water at low tide is 18 ft. The streets are lit by electricity and there is an electric tramway system 7 m. in extent. At Reuben Point, which marks the spot where the English river enters the bay, are the lighthouse, barracks and the private residences of the wealthy citizens. At its mouth the English river is about 2 m. across. Lourenço Marques is the nearest seaport to the Rand gold mines. The port is 8374 m. from Southampton via Cape Town and 7565 m. via the Suez canal. It is served by British, Portuguese and German liners, the majority of the goods imported being shipped at Southampton, Lisbon or Hamburg. Over 50% of the import trade of Johannesburg is with Lourenço Marques. Great Britain and British possessions take some 40% of the import trade, Portugal, Germany, Norway, Sweden and America coming next in order. Most of the imports, being forwarded to the Transvaal, figure also as exports. The chief articles of import are food-stuffs and liquors, iron, mineral oils, inks and dyes, timber and live stock. These all form part of the transit trade. There is practically no export trade by sea save in coal, which is brought chiefly from the collieries at Middelburg in the Transvaal. At Port Matolla, 20 m. from the town, on the river of that name, one of the feeders of the English river, is a flourishing timber trade. The average value of the total trade of Lourenço Marques for the five years 1897–1899 and 1902–1903 (1900 and 1901 being years during which trade was disorganized by the Anglo-Boer War) was over £3,500,000. In 1905 the value of the trade of the port was £5,682,000; of this total the transit trade was worth over £4,500,000 and the imports for local consumption £1,042,000. The retail trade, and trade with the natives, is almost entirely in the hands of Indians. The chief import for local consumption is cheap wine from Portugal, bought by the Kaffirs to the extent of over £500,000 yearly. These natives form the bulk of the Africans who work in the Rand gold mines.

Lourenço Marques is named after a Portuguese navigator, who with a companion (Antonio Calderia) was sent in 1544 by the governor of Mozambique on a voyage of exploration. They explored the lower courses of the rivers emptying their waters into Delagoa Bay, notably the Espirito Santo. The various forts and trading stations which the Portuguese established, abandoned and reoccupied on the north bank of the river were all called Lourenço Marques. The existing town dates from about 1850, the previous settlement having been entirely destroyed by the natives. In 1871 the town was described as a poor place, with narrow streets, fairly good flat-roofed houses, grass huts, decayed forts and rusty cannon, enclosed by a wall 6 ft. high then recently erected and protected by bastions at intervals. The growing importance of the Transvaal led, however, to greater interest being taken in Portugal in the port. A commission was sent by the Portuguese government in 1876 to drain the marshy land near the settlement, to plant the blue gum tree, and to build a hospital and a church. It was not, however, until the end of the 19th century that any marked development took place in the town, and up to 1903 cargo had to be discharged in tugs and lighters.

In 1873–1877 Mr Burgers, president of the Transvaal, endeavoured, unsuccessfully, to get a railway built from Pretoria to Delagoa Bay. In 1878–1879 a survey was taken for a line from Lourenço Marques to the Transvaal, and in 1883 the Lisbon cabinet granted to Colonel Edward McMurdo, an American citizen, a concession—which took the place of others which had lapsed—for the building of a railway from Lourenço Marques to the Transvaal frontier, the Boer government having agreed (1883) to continue the line to Pretoria. Under this concession Colonel McMurdo formed in London in 1887 a company—the Delagoa Bay and East African Railway Company—to construct the line. Meantime a secret agreement had been come to between President Kruger and Portugal for the concession to the Transvaal of a "steam tramway" parallel to the projected railway, should the company not complete the line in the time specified. The company, however, built the line to the frontier shown on the Portuguese maps of 1883 within the time limit, the railway being opened on the 14th of December 1888. The frontier by this date had been fixed at Komati Poort, 5 m. farther from the coast. Portugal had previously agreed to grant the company "a reasonable extension of time" to complete the line if the frontier should be traced farther inland than shown on the 1883 maps. The Lisbon government required the extension to Komati Poort to be completed in eight months (five of which were in the rainy season), an impossible stipulation. The railway not being finished, the Portuguese seized the line on the 25th of June 1889 and cancelled the concession. Portugal in so doing acted, to all appearance, under pressure from the Transvaal. Great Britain and America at once protested, Portugal admitted the illegality of her act and consented to refer the amount of compensation to the decision of three Swiss jurists. This was in 1890, when Portugal paid £28,000 on account. It was not until the 29th of March 1900 that the award was made known. The arbitrators ordered Portugal to pay—in addition to the £28,000—a sum, including interest, of £950,000. The damages were promptly paid. Meantime the railway had been continued from Komati Poort and was opened for through traffic to Pretoria on the 8th of July 1895. In 1906–1910 another railway (47 m. long) was built from Lourenço Marques due west to the Swaziland frontier, being a link in a new line to shorten the distance by rail between the Rand and the sea by some 60 m.

See also Delagoa Bay and the authorities there cited. The text of the railway arbitration award was published in French at Berne in 1900. Annual reports on the trade of Lourenço Marques are issued by the British Foreign Office.

LOUSE (O. Eng. *lús*, cf. Du. *luis*, Ger. *Laus*, Dan. and Swed. *lus*), a term applied to small wingless insects, parasitic upon birds and mammals, and belonging strictly speaking to the order Anoplura, often included among the Hemiptera, though the term is frequently extended to the bird-lice constituting the suborder Mallophaga, formerly included among the Neuroptera. Both agree in having nothing that can be termed a metamorphosis; they are active from the time of their exit from the egg to their death, gradually increasing in size, and undergoing several moults or changes of skin. The true lice (or Anoplura) are found on the bodies of many Mammalia, and occasion by their presence intolerable irritation. The number of genera is few. Two species of *Pediculus* are found on the human body, and are known ordinarily as the head-louse (*P. capitis*) and the body-louse (*P. vestimenti*); *P. capitis* is found on the head, especially of children. The eggs, laid on the hairs, and known as "nits," hatch in about eight days, and the lice are full grown in about a month. Such is their fecundity that it has been asserted that one female (probably of *P. vestimenti*) may in eight weeks produce five thousand descendants. Want of cleanliness favours their multiplication in a high degree—the idea once existed, and is probably still held by the very ignorant, that they are directly engendered from dirt. The irritation is caused by the rostrum of the insect being inserted into the skin, from which the blood is rapidly pumped up. A third human louse, known as the crab-louse (*Phthirius pubis*) is found amongst the hairs on other parts of the body, particularly those of the pubic region, but probably never on the head. The louse of monkeys is now generally considered as forming a separate genus (*Pedicinus*), but the greater part of those infesting domestic and wild quadrupeds are mostly grouped in the large genus *Haematopinus*, and very rarely is the same species found on different kinds of animals.

The bird-lice (Mallophaga) are far more numerous in species, although the number of genera is comparatively small. With the exception of the genus *Trichodectes*, the various species of which are found on mammalia, all infest birds (as their English names implies) (see Bird-Louse). Louse-infestation is known as phthiriasis in medical and veterinary terminology.

Authorities.—The following works are the most important: Denny, *Monographia Anoplurorum Britanniae* (London, 1843); Giebel, *Insecta Epizoa* (which contains the working-up of Nitzsch's posthumous materials; Leipzig, 1874); van Beneden, *Animal Parasites* (London, 1876); Piaget, *Les Pédiculines* (Leiden, 1880); Mégnin, *Les Parasites et les maladies parasitaires* (Paris, 1880); Neumann, *Parasites and Parasitic Diseases of Domesticated Animals* (1892); Osborn, *Pediculi and Mallophaga affecting Man and the Lower Animals* (Washington, 1891; U.S. Dept. Agr.); Enderlein, "Läuse-Studien," *Zool. Anz.* xxviii. (1904).

LOUTH, a maritime county in the province of Leinster, Ireland, bounded N.E. by Carlingford Bay and Co. Down, E. by the Irish Sea, S.W. by Meath, and N.W. by Monaghan and Armagh. It is the smallest county in Ireland, its area being 202,731 acres or about 317 sq. m. The greater part of the surface is undulating, with occasionally lofty hills; in the north-east, on the borders of Carlingford Lough, there is a mountain range approaching 2000 ft. in height. Many of the hills are finely wooded, and towards the sea the scenery, in the more elevated districts, is strikingly picturesque. With the exception of the promontory of Clogher Head, which rises abruptly to a height of 180 ft., the coast is for the most part low and sandy. The narrow and picturesque Carlingford Lough is navigable beyond the limits of the county, and Carlingford and Greenore are well-known watering-places on the county Louth shore. The Bay of Dundalk stretches to the town of that name and affords convenient shelter. The principal rivers, the Fane, the Lagan, the Glyde and the Dee, flow eastwards. None of these is navigable, but the Boyne, which forms the southern boundary of the county, is navigable for large vessels as far as Drogheda.

Almost all this county is occupied by an undulating lowland of much-folded Silurian shales and fine-grained sandstones; but Carboniferous Limestone overlies these rocks north and east of Dundalk. Dolerite and gabbro, in turn invaded by granite, have broken through the limestone north of Dundalk Bay, and form a striking and mountainous promontory. There is now no doubt that these rocks, with those on the adjacent moorland of Slieve Gullion, belong to the early Cainozoic igneous series, and may be compared with similar masses in the Isle of Skye. A raised beach provides a flat terrace at Greenore. Lead ore has been worked in the county, as in the adjacent parts of Armagh and Monaghan.

In the lower regions the soil is a very rich deep mould, admirably adapted both for cereals and green crops. The higher mountain regions are covered principally with heath. Agriculture generally is in an advanced condition, and the farms are for the most part well drained. The acreage of tillage is but little below that of pasture. Oats, barley, flax, potatoes and turnips are all satisfactorily cultivated. Cattle, sheep, pigs and poultry represent the bulk of the live stock. Linen manufactures are of some importance. The deep-sea and coast fishery has its headquarters at Dundalk, and the salmon fisheries at Dundalk (Castletown river) and Drogheda (river Boyne). These fisheries, together with oyster beds in Carlingford Lough, are of great value. The county is traversed from S. to N. by the Great Northern railway, with a branch westward from Dundalk; while the same town is connected with the port of Greenore by a line owned by the London & North-Western railway of England. From Greenore the London & North-Western railway passenger steamers run regularly to Holyhead. The town of Ardee is served by a branch from the Great Northern line at Dromin.

The population (71,914 in 1891; 65,820 in 1901) decreases at about an average rate, and a considerable number of the inhabitants emigrate. Of the total population about 92% are Roman Catholics. The principal towns are Dundalk (pop. 13,076), Drogheda (12,760) and Ardee (1883). The county includes six baronies and sixty-four parishes. Assizes are held at Dundalk and quarter sessions at Ardee, Drogheda and Dundalk. Louth was represented by two county and ten borough members in the Irish parliament; the two present divisions are the north and south, each returning one member. The county is in the Protestant dioceses of Armagh and Clogher and the Roman Catholic diocese of Armagh.

The territory which afterwards became the county Louth was included in the principality of Uriel, Orgial or Argial, which comprehended also the greater part of Meath, Monaghan and Armagh. The chieftain of the district was conquered by John de Courcy in 1183, and Louth or Uriel was among the shires generally considered to have been created by King John, and peopled by English settlers. Until the time of Elizabeth it was included in the province of Ulster. County Louth is rich in antiquarian remains. There are ancient buildings of all dates, and spears, swords, axes of bronze, ornaments of gold, and other relics have been discovered in quantities. Among Druidical remains is the fine cromlech of Ballymascanlan, between Dundalk and Greenore. Danish raths and other forts are numerous. It is said that there were originally twenty religious houses in the county. Of the remains of these the most interesting are at Monasterboice and Mellifont, both near Drogheda. At the former site are two churches, the larger dating probably from the 9th century, the smaller from the 13th; a fine round tower, 110 ft. in height, but not quite perfect; and three crosses, two of which, 27 and 15 ft. in height respectively, are adorned with moulding, sculptured figures and tracery, and are among the finest in Ireland. At Mellifont are the remains of the first Cistercian monastery founded in Ireland, in 1142, with a massive gatehouse, an octagonal baptistery and chapter-house. Carlingford and Drogheda have monastic remains, and at Dromiskin is a round tower, in part rebuilt. Ardee, an ancient town, incorporated in 1376, has a castle of the 13th century. At Dunbar a charter of Charles II. (1679) gave the inhabitants the right to elect a sovereign. Louth, 5½ m. S.W. from Dundalk, is a decayed town which gave its name to the county, and contains ruins of an abbey to which was attached one of the most noted early schools in Ireland.

LOUTH, a market-town and municipal borough in the E. Lindsey or Louth parliamentary division of Lincolnshire, England, on the river Lud, 141½ m. N. of London by the Grimsby branch of the Great Northern railway. Pop. (1901) 9518. By a canal, completed in 1763, there is water communication with the Humber. The Perpendicular church of St James, completed about 1515, with a spire 300 ft. in height, is one of the finest ecclesiastical buildings in the county. Traces of a building of the 13th century are perceptible. There are a town hall, a corn exchange and a market-hall, an Edward VI. grammar school, which is richly endowed, a commercial school founded in 1676, a hospital and several almshouses. Thorpe Hall is a picturesque building dated 1584. In the vicinity are the ruins of a Cistercian abbey (Louth Park). The industries include the manufacture of agricultural implements, iron-founding, brewing, malting, and rope and brick-making. The town is governed by a mayor, 6 aldermen and 18 councillors. Area, 2749 acres.

Louth (*Ludes, Loweth*) is first mentioned in the Domesday record as a borough held, as it had been in Saxon times, by the bishop of Lincoln, who had a market there. The see retained the manor until it was surrendered by Bishop Holbeach to Henry VIII., who granted it to Edward, earl of Lincoln, but it was recovered by the Crown before 1562. Louth owed much of its early prosperity to the adjacent Cistercian abbey of Louth Park, founded in 1139 by Alexander bishop of Lincoln. The borough was never more than prescriptive, though burgesses were admitted throughout the middle ages and until 1711, their sole privilege being freedom from tolls. The medieval government of the town was by the manor court under the presidency of the bishop's high steward, the custom being for the reeve to be elected by eighteen ex-reeves. The original parish church was built about 1170. During the 13th and 14th centuries nine religious gilds were founded in the town. Fear of confiscation of the property of these gilds seems to have been one of the chief local causes of the Lincolnshire Rebellion, which broke out here in 1536. The disturbance began by the parishioners seizing the church ornaments to prevent their surrender. The bishop's steward, who arrived to open the manorial court for the election of a reeve, agreed to ride to ask the king the truth about the jewels, but this did not satisfy the people, who, while showing respect to a royal commission, seized and burnt the papers of the bishop's registrar. After swearing several country gentlemen to their cause, the rebels dispersed, agreeing to meet on the following day under arms. Edward VI. in 1551 incorporated Louth under one warden and six assistants, who were to be managers of the school founded by the same charter. This was confirmed in 1564 by Elizabeth, who granted the manor of Louth to the corporation with all rights and all the lands of the suppressed gilds at an annual fee-farm rent of £84. James I. gave the commission of the peace to the warden and one assistant in 1605; a further charter was obtained in 1830. Louth has never been a parliamentary borough. The markets said to have been held from ancient times and the three fairs on the third Sunday after Easter and the feasts of St Martin and St James were confirmed in 1551. Louth was a seat of the wool trade as early as 1297; the modern manufactures seem to have arisen at the end of the 18th century, when, according to the charter of 1830, there was a great increase in the population, manufactures, trade and commerce of the town.

See E. H. R. Tatham, *Lincolnshire in Roman Times* (Louth, 1902); Richard W. Goulding, *Louth Old Corporation Records* (Louth, 1891).

LOUVAIN (Flem. *Leuven*), a town of Belgium in the province of Brabant, of which it was the capital in the 14th century before the rise of Brussels. Pop. (1904) 42,194. Local tradition attributes the establishment of a permanent camp at this spot to Julius Caesar, but Louvain only became important in the 11th century as a place of residence for the dukes of Brabant. In 1356 Louvain was the scene of the famous *Joyeuse Entrée* of Wenceslas which represented the principal charter of Brabant. At that time it had a population of at least 50,000 and was very prosperous as the centre of the woollen trade in central Belgium. The gild of weavers numbered 2400 members. The old walls of Louvain were 4½ m. in circumference, and have been replaced by boulevards, but within them there is a considerable extent of cultivated ground. Soon after the *Joyeuse Entrée* a serious feud began between the citizens and the patrician class, and eventually the duke threw in his lot with the latter. After a struggle of over twenty years' duration the White Hoods, as the citizens called themselves, were crushed. In 1379 they massacred seventeen nobles in the town hall, but this crime brought down on them the vengeance of the duke, to whom in 1383 they made the most abject and complete surrender. With this civil strife the importance and prosperity of Louvain declined. Many weavers fled to Holland and England, the duke took up his residence in the strong castle of Vilvorde, and Brussels prospered at the expense of Louvain. What it lost in trade it partially recovered as a seat of learning, for in 1423, Duke John IV. of Brabant founded there a university and ever since Louvain University has enjoyed the first place in Belgium. It has always prided itself most on its theological teaching. In 1679 the university was established in the old Cloth Workers' Hall, a building dating from 1317, with long arcades and graceful pillars supporting the upper storeys. The library contains 70,000 volumes and some 500 manuscripts. Attached to the university are four residential colleges at which the number of students average two thousand. In the 16th century when the university was at the height of its fame it counted six thousand.

The most remarkable building in Louvain is the Hôtel de Ville, one of the richest and most ornate examples of pointed Gothic in the country. If less ornate than that of Oudenarde it is more harmonious in its details. It was the work of Mathieu de Layens, master mason, who worked at it from 1448 to 1463. The building is one of three storeys each with ten pointed windows forming the façade facing the square. Above is a graceful balustrade behind which is a lofty roof, and at the angles are towers perforated for the passage of the light. The other three sides are lavishly decorated with statuary. The interior is not noteworthy.

Opposite the Hôtel de Ville is the fine church of St Pierre, in the form of a cross with a low tower to which the spire has never been added. The existing edifice was built on the site of an older church between 1425 and 1497. It contains seven chapels, in two of which are fine pictures by Dierich Bouts formerly attributed to Memling. Much of the iron and brass work is by Jean Matseys. There is also an ancient tomb, being the monument of Henry I., duke of Brabant, who died in 1235. There are four other interesting churches in Louvain, viz. Ste Gertrude, St Quentin, St Michael and St Jacques. In the last-named is a fine De Crayer representing St Hubert. Some ruins on a hill exist of the old castle of the counts of Louvain whose title was merged in the higher style of the dukes of Brabant.

LOUVER, LOUVRE or LUFFER, in architecture, the lantern built upon the roof of the hall in ancient times to allow the smoke to escape when the fire was made on the pavement in the middle of the hall. The term is also applied to the flat overlapping slips of wood, glass, &c., with which such openings are closed, arranged to give ventilation without the admission of rain. Openings fitted with louvers are now utilized for the purposes of ventilation in schools and manufactories.

The word has been derived from the French *l'ouvert*, the "open" space. This, Minsheu's guess, is now generally abandoned. The Old French form, of which the English is an adaptation, was *lover* or *lovier*. The medieval Latin *lodium*, *lodarium*, is suggested as the ultimate origin. Du Cange (*Glossarium*, s.v. "lodia") defines it as *lugurium*, *i.e.* a small hut. The English form "louvre" is due to a confusion with the name of the palace in Paris. The origin of that name is also unknown; *louverie*, place of wolves, is one of the suggestions, the palace being supposed to have originally been a hunting-box (see PARIS).

LOUVET, JEAN (*c.* 1370–*c.* 1440), called the president of Provence, occupied the position of president of the Chambre des Comptes at Aix in 1415. Towards the end of that year he went to Paris with Louis II. of Anjou, king of Sicily, attached himself to the dauphin Charles, and after having been chief steward of the household to Queen Isabella he turned against her. He was one of the principal agents of the Armagnac party, and became the most influential adviser of Charles VII. during the first years of his reign. But his rapacity gained him enemies, and when the constable Arthur, earl of Richmond, attained a preponderating influence over Charles VII. Louvet retired to his captaincy of Avignon. He still remained a personage of importance in his exile, and played an influential part even in his last years.

See Vallet de Viriville in the *Nouvelle Biographie générale*, and G. du Fresne de Beaucourt, *Histoire de Charles VII.* (1881–1891). (J. V.*)

LOUVET DE COUVRAI, JEAN BAPTISTE (1760–1797), French writer and politician, was born in Paris on the 12th of June 1760, the son of a stationer. He became a bookseller's clerk, and first attracted attention with a not very moral novel called *Les Amours du chevalier de Faublas* (Paris, 1787–1789). The character of the heroine of this book, Lodoïska, was taken from the wife of a jeweller in the Palais Royal, with whom he had formed a *liaison.* She was divorced from her husband in 1792 and married Louvet in 1793. His second novel, *Émilie de Varmont*, was intended to prove the utility and necessity of divorce and of the marriage of priests, questions raised by the Revolution. Indeed all his works were directed to the ends of the Revolution. He attempted to have one of his unpublished plays, *L'Anobli conspirateur*, performed at the Théâtre Français, and records naïvely that one of its managers, M. d'Orfeuil, listened to the reading of the first three acts "with mortal impatience," exclaiming at last: "I should need cannon in order to put that piece on the stage." A "sort of farce" at the expense of the army of the *émigrés*, *La Grande Revue des armées noire et blanche*, had, however, better success: it ran for twenty-five nights.

Louvet was, however, first brought into notice as a politician by his *Paris justifié*, in reply to a "truly incendiary" pamphlet in which Mounier, after the removal of the king to Paris in October 1789, had attacked the capital, "at that time blameless," and argued that the court should be established elsewhere. This led to Louvet's election to the Jacobin Club, for which, as he writes bitterly in his Memoirs, the qualifications were then "a genuine *civisme* and some talent." A self-styled *philosophe* of the true revolutionary type, he now threw himself ardently into the campaign against "despotism" and "reaction," *i.e.* against the moderate constitutional royalty advocated by Lafayette, the Abbé Maury and other "Machiavellians." On the 25th of December 1791 he presented at the bar of the Assembly his *Pétition contre les princes*, which had "a prodigious success in the senate and the empire." Elected deputy to the Assembly for the department of Loiret, he made his first speech in January 1792. He attached himself to the Girondists, whose vague deism, sentimental humanitarianism and ardent republicanism he fully shared, and from March to November 1792 he published, at Roland's expense, a bi-weekly *journal-affiche*, of which the title, *La Sentinelle*, proclaimed its mission to be to "enlighten the people on all the plots" at a time when, Austria having declared war, the court was "visibly betraying our armies." On the 10th of August he became editor of the *Journal des débats*, and in this capacity, as well as in the Assembly, made himself conspicuous by his attacks on Robespierre, Marat and the other Montagnards, whom he declares he would have succeeded in bringing to justice in September but for the poor support he received from the Girondist leaders. It is more probable, however, that his ill-balanced invective contributed to their ruin and his own; for him Robespierre was a "royalist," Marat "the principal agent of England," the Montagnards Orleanists in masquerade. His courageous attitude at the trial of Louis XVI., when he supported the "appeal to the people," only served still further to discredit the Girondists. He defended them, however, to the last with great courage, if with little discretion; and after the crisis of the 31st of May 1793 he shared the perils of the party who fled from Paris (see GIRONDISTS). His wife, "Lodoïska," who had actively co-operated in his propaganda, was also in danger.

After the fall of Robespierre, he was recalled to the Convention, when he was instrumental in bringing Carrier and the others responsible for the *Noyades* of Nantes to justice. His influence was now considerable; he was elected a member of the Committee of the Constitution, president of the Assembly, and member of the Committee of Public Safety, against the overgrown power of which he had in earlier days protested. His hatred of the Mountain had not made him reactionary; he was soon regarded as one of the mainstays of the "Jacobins," and *La Sentinelle* reappeared, under his auspices, preaching union among republicans. Under the Directory (1795) he was elected a member of the Council of Five Hundred, of which he was secretary, and also a member of the Institute. Meanwhile he had returned to his old trade and set up a bookseller's shop in the Palais Royal. But, in spite of the fact that he had once more denounced the Jacobins in *La Sentinelle*, his name had become identified with all that the combative spirits of the *jeunesse dorée* most disliked; his shop was attacked by the "young men" with cries of "*À bas la Loupe, à bas la belle Lodoïska, à bas les gardes du corps de Louvet!*" he and his wife were insulted in the streets and the theatres: "*À bas les Louvets et les Louvetants!*" and he was compelled to leave Paris. The Directory appointed him to the consulship at Palermo, but he died on the 25th of August 1797 before taking up his post.

In 1795 Louvet published a portion of his Memoirs under the title of *Quelques notices pour l'histoire et le récit de mes périls depuis le 31 mai 1793*. They were mainly written in the various hiding-places in which Louvet took refuge, and they give a vivid picture of the sufferings of the proscribed Girondists. They form an invaluable document for the study of the psychology of the Revolution; for in spite of their considerable literary art, they are artless in their revelation of the mental and moral state of their author, a characteristic type of the honest, sentimental, somewhat hysterical and wholly unbalanced minds nurtured on the abstractions of the *philosophes*. The first complete edition of the *Mémoires de Louvet de Couvrai*, edited, with preface, notes and tables, by F. A. Aulard, was published at Paris in 1889.

LOUVIERS, a town of north-western France, capital of an arrondissement in the department of Eure, 17½ m. S.S.E. of Rouen by road. Pop. (1906) 9449. Louviers is pleasantly situated in a green valley surrounded by wooded hills, on the Eure, which here divides into several branches. The old part of the town, built of wood, stands on the left bank of the river; the more modern portions, in brick and hewn stone, on the right. There are spacious squares, and the place is surrounded by boulevards. The Gothic church of Notre-Dame has a south portal which ranks among the most beautiful works of the kind produced in the 15th century; it contains fine stained glass of the 15th and 16th centuries and other works of art. The hôtel-de-ville, a large modern building, contains a museum and library. The chief industry is cloth and flannel manufacture. There are wool-spinning and fulling mills, thread factories and manufactories of spinning and weaving machinery, and enamel ware; leather-working, dyeing, metal-founding and bell-founding are also carried on. The town is the seat of a sub-prefect and has a court of first instance, a tribunal of commerce, a chamber of arts and manufactures, and a council of trade arbitrators.

Louviers (*Lovera*) was originally a *villa* of the dukes of Normandy and in the middle ages belonged to the archbishops of Rouen; its cloth-making industry first arose in the beginning of the 13th century. It changed hands once and again during the Hundred Years' War, and from Charles VII. it received extensive privileges, and the title of Louviers le Franc for the bravery of its inhabitants in driving the English from Pont de l'Arche, Verneuil and Harcourt. It passed through various troubles successively at the period of the League of the Public Weal under Louis XI., in the religious wars (when the parlement of Rouen sat for a time at Louviers) and in the wars of the Fronde.

See G. Petit, *Hist. de Louviers* (Louviers, 1877).

LOUVOIS, FRANÇOIS MICHEL LE TELLIER, Marquis de (1641–1691), French statesman, war minister of Louis XIV., was born at Paris on the 18th of January 1641. His father, Michel le Tellier (*q.v.*), married him to an heiress, the marquise de Courtenvaux, and instructed him in the management of state business. The young man won the king's confidence, and in 1666 he succeeded his father as war minister. His talents were perceived by Turenne in the war of Devolution (1667–68), who gave him instruction in the art of providing armies. After the peace of Aix-la-Chapelle, Louvois devoted himself to organizing the French army. The years between 1668 and 1672, says Camille Rousset, "were years of preparation, when Lionne was labouring with all his might to find allies, Colbert to find money, and Louvois soldiers for Louis." The work of Louvois in these years is bound up with the historical development of the French army and of armies in general (see Army). Here need only be mentioned Louvois's reorganization of the military orders of merit, his foundation of the Hôtel des Invalides, and the almost forcible enrolment of the nobility and gentry of France, in which Louvois carried out part of Louis's measures for curbing the spirit of independence by service in the army or at court. The success of his measures is to be seen in the victories of the great war of 1672–78. After the peace of Nijmwegen Louvois was high in favour, his father had been made chancellor, and the influence of Colbert was waning. The ten years of peace between 1678 and 1688 were distinguished in French history by the rise of Madame de Maintenon, the capture of Strassburg and the revocation of the Edict of Nantes, in all of which Louvois bore a prominent part. The surprise of Strassburg in 1681 in time of peace was not only planned but executed by Louvois and Monclar. A saving clause in the revocation of the Edict of Nantes, which provided for some liberty of conscience, if not of worship, Louvois sharply annulled with the phrase "Sa majesté veut qu'on fasse sentir les dernières rigueurs à ceux qui ne voudront pas se faire de sa religion." He claimed also the credit of inventing the dragonnades, and mitigated the rigour of the soldiery only in so far as the licence accorded was prejudicial to discipline. Discipline, indeed, and complete subjection to the royal authority was the political faith of Louvois. Colbert died in 1683, and had been replaced by Le Pelletier, an adherent of Louvois, in the controller-generalship of finances, and by Louvois himself in his ministry for public buildings, which he took that he might be the minister able to gratify the king's two favourite pastimes, war and building. Louvois was able to superintend the successes of the first years of the war of the League of Augsburg, but died suddenly of apoplexy after leaving the king's cabinet on July 16, 1691. His sudden death caused a suspicion of poison. Louvois was one of the greatest of the rare class of great war ministers. French history can only point to Carnot as his equal. Both had to organize armies out of old material on a new system, both were admirable contrivers of campaigns, and both devoted themselves to the material well-being of the soldiers. In private life and in the means employed for gaining his ends, Louvois was unscrupulous and shameless.

The principal authority for Louvois's life and times is Camille Rousset's *Histoire de Louvois* (Paris, 1872), a great work founded on the 900 volumes of his despatches at the Depôt de la Guerre. Saint Simon from his class prejudices is hardly to be trusted, but Madame de Sévigné throws many side-lights on his times. *Testament politique de Louvois* (1695) is spurious.

LOUŸS, PIERRE (1870–), French novelist and poet, was born in Paris on the 10th of December 1870. When he was nineteen he founded a review, *La Conque*, which brought him into contact with the leaders of the Parnassians, and counted Swinburne, Maeterlinck, Mallarmé and others among its contributors. He won notoriety by his novel *Aphrodite* (1896), which gave a vivid picture of Alexandrian morals at the beginning of the Christian era. His *Chansons de Bilitis, roman lyrique* (1894), which purported to be a translation from the Greek, is a glorification of Sapphic love, which in subject-matter is objectionable in the highest degree; but its delicate decadent prose is typical of a modern French literary school, and some of the "songs" were set to music by Debussy and others. Later books are: *La Femme et le pantin* (1898); *Les Aventures du roi Pausole* (1900); *Sanguines* (1903); *Archipel* (1906). Louÿs married in 1899 Louise de Heredia, younger daughter of the poet.

LOVAT, SIMON FRASER, 12th Baron (*c.* 1667–1747), Scottish chief and Jacobite intriguer, was born about 1667 and was the second son of Thomas Fraser, third son of the 8th Lord Lovat. The barony of Lovat dates from about 1460, in the person of Hugh Fraser, a descendant of Simon Fraser (killed at Halidon Hill in 1338) who acquired the tower and fort of Lovat near Beauly, Inverness-shire, and from whom the clan Fraser was called "Macshimi" (sons of Simon). Young Simon was educated at King's College, Aberdeen, and his correspondence afterwards gives proof, not only of a command of good English and idiomatic French, but of such an acquaintance with the Latin classics as to leave him never at a loss for an apt quotation from Virgil or Horace. Whether Lovat ever felt any real loyalty to the Stuarts or was actuated by self-interest it is difficult to determine, but that he was a born traitor and deceiver there can be no doubt. One of his first acts on leaving college was to recruit three hundred men from his clan to form part of a regiment in the service of William and Mary, in which he himself was to hold a command,—his object being to have a body of well-trained soldiers under his influence, whom at a moment's notice he might carry over to the interest of King James. Among other outrages in which he was engaged about this time was a rape and forced marriage committed on the widow of the 10th Lord Lovat with the view apparently of securing his own succession to the estates; and it is a curious instance of influence that, after being subjected by him to horrible ill-usage, she is said to have become seriously attached to him. A prosecution, however, having been instituted against him by Lady Lovat's family, Simon retired first to his native strongholds in the Highlands, and afterwards to France, where he found his way in July 1702 to the court of St Germain. In 1699, on his father's death, he assumed the title of Lord Lovat. One of his first steps towards gaining influence in France seems to have been to announce his conversion to the Catholic faith. He then proceeded to put the project of restoring the exiled family into a practical shape. Hitherto nothing seems to have been known among the Jacobite exiles of the efficiency of the Highlanders as a military force. But Lovat saw that, as they were the only part of the British population accustomed to the independent use of arms, they could be at once put in action against the reigning power. His plan therefore was to land five thousand French troops at Dundee, where they might reach the north-eastern passes of the Highlands in a day's march, and be in a position to divert the British troops till the Highlands should have time to rise. Immediately afterwards five hundred men were to land on the west coast, seize Fort William or Inverlochy, and thus prevent the access of any military force from the south to the central Highlands. The whole scheme indicates Lovat's sagacity as a military strategist, and his plan was continuously kept in view in all future attempts of the Jacobites, and finally acted on in the outbreak of 1745. The advisers of the Pretender seem to have been either slow to trust their coadjutor or to comprehend his project. At last, however, he was despatched (1703) on a secret mission to the Highlands to sound those of the chiefs who were likely to rise, and to ascertain what forces they could bring into the field. He found, however, that there was little disposition to join the rebellion, and he then apparently made up his mind to secure his own safety by revealing all that he knew to the government of Queen Anne. He persuaded the duke of Queensberry that his rival, the duke of Atholl, was in the Jacobite plot, and that if Queensberry supported him he could obtain evidence of this at St Germain. Queensberry foolishly entered into the intrigue with him against Atholl, but when Lovat had gone to France with a pass from

Queensberry the affair was betrayed to Atholl by Robert Ferguson, and resulted in Queensberry's discomfiture. The story is obscure, and is complicated by partisanship on either side; but Lovat was certainly playing a double game. His agility, however, was not remunerative. On returning to Paris suspicions got afloat as to Lovat's proceedings, and he was imprisoned in the castle of Angoulême. He remained nearly ten years under supervision, till in November 1714 he made his escape to England. For some twenty-five years after this he was chiefly occupied in lawsuits for the recovery of his estates and the re-establishment of his fortune, in both of which objects he was successful. The intervals of his leisure were filled up by Jacobite and Anti-Jacobite intrigues, in which he seems to have alternately, as suited his interests, acted the traitor to both parties. But he so far obtained the confidence of the government as to secure the appointments of sheriff of Inverness and of colonel of an independent company. His disloyal practices, however, soon led to his being suspected; and he was deprived of both his appointments. When the rebellion of 1745 broke out, Lovat acted with characteristic duplicity. He represented to the Jacobites—what was probably in the main true—that though eager for their success his weak health and advanced years prevented him from joining the standard of the prince in person, while to the Lord President Forbes he professed his cordial attachment to the existing state of things, but lamented that his son, in spite of all his remonstrances, had joined the Pretender, and succeeded in taking with him a strong force from the clan of the Frasers. The truth was that the lad was unwilling to go, but was compelled by his father. Lovat's false professions of fidelity did not long deceive the government, and after the battle of Culloden he was obliged to retreat to the Highlands, after seeing from a distant height his castle of Dounie burnt by the royal army. Even then, broken down by disease and old age, carried on a litter and unable to move without assistance, his mental resources did not fail; and in a conference with several of the Jacobite leaders he proposed that they should raise a body of three thousand men, which would be enough to make their mountains impregnable, and at length force the government to give them advantageous terms. The project was not carried out, and Lovat, after enduring incredible hardships in his wanderings, was at last arrested on an island in Loch Morar. He was conveyed in a litter to London, and after a trial of five days sentence of death was pronounced on the 19th of March 1747. His execution took place on the 9th of April. His conduct to the last was dignified and even cheerful. Just before submitting his head to the block he repeated the line from Horace—

"Dulce et decorum est pro patria mori."

His son SIMON FRASER, Master of Lovat (1726–1782) (not to be confused with another Simon Fraser who saw somewhat similar service and was killed in 1777 at the battle of Saratoga), was a soldier, who at the beginning of the Seven Years' War raised a corps of Fraser Highlanders for the English service, and at the outbreak of the American War of Independence raised another regiment which took a prominent part in it. He fought under Wolfe in Canada, and also in Portugal, and rose to be a British major-general. The family estates were restored to him, but the title was not revived till 1837. On his death without issue, and also of his successor, his half-brother Archibald Campbell Fraser (1736–1815), the Lovat estates passed to the Frasers of Strichen, Aberdeenshire. The 16th Baron Lovat (b. 1871) raised a corps of mounted infantry (Lovat's Scouts) in the Boer war of 1899–1902.

See *Memoirs of Lord Lovat* (1746 and 1767); J. Hill Burton, *Life of Simon, Lord Lovat* (1847); J. Anderson, *Account of the Family of Frizell or Fraser* (Edinburgh, 1825); A. Mackenzie, *History of the Frasers of Lovat* (Inverness, 1896); Mrs A. T. Thomson, *Memoirs of the Jacobites* (1845-6); and W. C. Mackenzie, *Simon Fraser, Lord Lovat* (1908).

LOVE-BIRD, a name somewhat indefinitely bestowed, chiefly by dealers and their customers, on some of the smaller short-tailed parrots, from the affection which examples of opposite sexes exhibit towards each other. By many ornithologists the birds thus named, brought almost entirely from Africa and South America, have been retained in a single genus, *Psittacula*, though those belonging to the former country were by others separated as *Agapornis*. This separation, however, was neither generally approved nor easily justified, until Garrod (*Proc. Zool. Society*, 1874, p. 593) assigned good anatomical ground, afforded by the structure of the carotid artery, for regarding the two groups as distinct, and thus removed the puzzle presented by the geographical distribution of the species of *Psittacula* in a large sense, though Huxley (*op. cit.* 1868, p. 319) had suggested one way of meeting the difficulty. As the genus is now restricted, only one of the six species of *Psittacula* enumerated in the *Nomenclator Avium* of Sclater and Salvin is known to be found outside the Neotropical Region, the exception being the Mexican *P. cyanopygia*, and not one of the seven recognized by the same authors as forming the nearly allied genus *Urochroma*. On the other hand, of *Agapornis*, from which the so-called genus *Poliopsitta* can scarcely be separated, five if not six species are known, all belonging to the Ethiopian Region, and all but one, *A. cana* (which is indigenous to Madagascar, and thence has been widely disseminated), are natives of Africa. In this group probably comes also *Psittinus*, with a single species from the Malayan Subregion. One of the birds most commonly called love-birds, but with no near relationship to any of the above, being a long-tailed though very small parrot, is the budgerigar (*Melopsittacus undulatus*) now more familiar in Europe than most native birds, as it is used to "tell fortunes" in the streets, and is bred by hundreds in aviaries. Its native country is Australia. (A. N.)

LOVEDALE, a mission station in the Victoria East division of the Cape province, South Africa. It lies 1720 ft. above the sea on the banks of the Tyumie (Chumie) tributary of the Keiskama river, some 2 m. N. of Alice, a town 88 m. N.W. by rail of East London. The station was founded in 1824 by the Glasgow Missionary Society and was named after Dr John Love, one of the leading members of, and at the time secretary to, the society. The site first chosen was in the Ncera valley. But in 1834 the mission buildings were destroyed by the Kaffirs. On rebuilding, the station was removed somewhat farther north to the banks of the Tyumie. In 1846 the work at Lovedale was again interrupted, this time by the War of the Axe (see CAPE COLONY: *History*). On this occasion the buildings were converted into a fort and garrisoned by regular troops. Once more, in 1850, the Kaffirs threatened Lovedale and made an attack on the neighbouring Fort Hare,[1] built during the previous war.

Until 1841 the missionaries had devoted themselves almost entirely to evangelistic work; in that year the Lovedale Missionary Institute was founded by the Rev. W. Govan, who, save for brief intervals, continued at its head until 1870. He was then succeeded by the Rev. James Stewart (1831–1905), who had joined the mission in 1867, having previously (1861–1863), and partly in company with David Livingstone, explored the Zambezi regions. To Stewart, who remained at the head of the institute till his death, is due the existing organization at Lovedale. The institute, in addition to its purely church work—in which no sectarian tests are allowed—provides for the education of natives of both sexes in nearly all branches of learning (Stewart discontinued the teaching of Greek and Latin, adopting English as the classic); it also takes European scholars, no colour distinction being allowed in any department of the work. The institute gives technical training in many subjects and maintains various industries, including such diverse enterprises as farming and printing-works. It also maintains a hospital. The school buildings rival in accommodation and completeness those of the schools in large English cities. The sum paid in fees by scholars (of whom fully nine-tenths were Kaffirs) in the period 1841–1908 was £84,000. The educational and industrial methods initiated at Lovedale have been widely adopted by other missionary bodies. Lovedale is now a branch of the work of the United Free Church of Scotland.

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[1] This fort was named after Colonel John Hare (d. 1846) of the 27th Regiment, from 1838 lieutenant-governor of the eastern provinces and commander of the first division of the field force in the War of the Axe.

See R. Young, *African Wastes Reclaimed and Illustrated in the Story of the Lovedale Mission* (London, 1902); J. Stewart, *Lovedale, Past and Present* (London, 1884), and *Dawn in the Dark Continent* (London, 1903); J. Wells, *Stewart of Lovedale* (London, 1908).

LOVELACE, RICHARD (1618–1658), English poet, was born at Woolwich in 1618. He was a scion of a Kentish family, and inherited a tradition of military distinction, maintained by successive generations from the time of Edward III. His father, Sir William Lovelace, had served in the Low Countries, received the honour of knighthood from James I., and was killed at Grolle in 1628. His brother, Francis Lovelace, the "Colonel Francis" of *Lucasta*, served on the side of Charles I., and defended Caermarthen in 1644. His mother's family was legal; her grandfather had been chief baron of the exchequer. Richard was educated at the Charterhouse and at Gloucester Hall, Oxford, where he matriculated in 1634. Through the request of one of the queen's ladies on the royal visit to Oxford he was made M.A., though only in his second year at the university. Lovelace's fame has been kept alive by a few songs and the romance of his career, and his poems are commonly spoken of as careless improvisations, and merely the amusements of an active soldier. But the unhappy course of his life gave him more leisure for verse-making than opportunity of soldiering. Before the outbreak of the civil war in 1642 his only active service was in the bloodless expedition which ended in the Pacification of Berwick in 1640. On the conclusion of peace he entered into possession of the family estates at Bethersden, Canterbury, Chart and Halden in Kent. By that time he was one of the most distinguished of the company of courtly poets gathered round Queen Henrietta, who were influenced as a school by contemporary French writers of *vers de société*. He wrote a comedy, *The Scholar*, when he was sixteen, and a tragedy, *The Soldier*, when he was twenty-one. From what he says of Fletcher, it would seem that this dramatist was his model, but only the prologue and epilogue to his comedy have been preserved. When the rupture between king and parliament took place, Lovelace was committed to the Gatehouse at Westminster for presenting to the Commons in 1642 a petition from Kentish royalists in the king's favour. It was then that he wrote his most famous song, "To Althea from Prison." He was liberated, says Wood, on bail of £40,000 (more probably £4000), and throughout the civil war was a prisoner on parole, with this security in the hands of his enemies. He contrived, however, to render considerable service to the king's cause. He provided his two brothers with money to raise men for the Royalist army, and befriended many of the king's adherents. He was especially generous to scholars and musicians, and among his associates in London were Henry Lawes and John Gamble, the Cottons, Sir Peter Lely, Andrew Marvell and probably Sir John Suckling. He joined the king at Oxford in 1645, and after the surrender of the city in 1646 he raised a regiment for the service of the French king. He was wounded at the siege of Dunkirk, and with his brother Dudley, who had acted as captain in his brother's command, returned to England in 1648. It is not known whether the brothers took any part in the disturbances in Kent of that year, but both were imprisoned at Petre House in Aldersgate. During this second imprisonment he collected and revised for the press a volume of occasional poems, many if not most of which had previously appeared in various publications. The volume was published in 1649 under the title of *Lucasta*, his poetical name—contracted from *Lux Casta*—for a lady rashly identified by Wood as Lucy Sacheverell, who, it is said, married another during his absence in France, on a report that he had died of his wounds at Dunkirk. The last ten years of Lovelace's life were passed in obscurity. His fortune had been exhausted in the king's interest, and he is said to have been supported by the generosity of friends. He died in 1658 "in a cellar in Longacre," according to Aubrey, who, however, possibly exaggerates his poverty. A volume of Lovelace's *Posthume Poems* was published in 1659 by his brother Dudley. They are of inferior merit to his own collection.

The world has done no injustice to Lovelace in neglecting all but a few of his modest offerings to literature. But critics often do him injustice in dismissing him as a gay cavalier, who dashed off his verses hastily and cared little what became of them. It is a mistake to class him with Suckling; he has neither Suckling's easy grace nor his reckless spontaneity. We have only to compare the version of any of his poems in *Lucasta* with the form in which it originally appeared to see how fastidious was his revision. In many places it takes time to decipher his meaning. The expression is often elliptical, the syntax inverted and tortuous, the train of thought intricate and discontinuous. These faults—they are not of course to be found in his two or three popular lyrics, "Going to the Wars," "To Althea from Prison," "The Scrutiny"—are, however, as in the case of his poetical master, Donne, the faults not of haste but of over-elaboration. His thoughts are not the first thoughts of an improvisatore, but thoughts ten or twenty stages removed from the first, and they are generally as closely packed as they are far-fetched.

His poems were edited by W. C. Hazlitt in 1864.

LOVELL, FRANCIS LOVELL, VISCOUNT (1454–1487), supporter of Richard III., was son of John, 8th Baron Lovell. As a young man he served under Richard of Gloucester in the expedition to Scotland in 1480. After the death of Edward IV. he became one of his patron's strongest supporters. He had been created a viscount on the 4th of January 1483, and whilst still Protector Richard made him Chief Butler. As soon as Richard became king, Lovell was promoted to be Lord Chamberlain. Lovell helped in the suppression of Buckingham's rebellion, and as one of Richard's most trusted ministers was gibbeted in Collingbourne's couplet with Catesby and Ratcliffe:—

"The catte, the ratte and Lovell our dogge
Rulyth all England under a hogge."

He had command of the fleet which was to have stopped Henry Tudor's landing in 1485, but fought for Richard at Bosworth and after the battle fled to sanctuary at Colchester. Thence he escaped next year to organize a dangerous revolt in Yorkshire. When that failed he fled to Margaret of Burgundy in Flanders. As a chief leader of the Yorkist party he had a foremost part in Lambert Simnel's enterprise. With John de la Pole, earl of Lincoln, he accompanied the pretender to Ireland and fought for him at Stoke on the 16th of June 1487. He was seen escaping from the battle, but was never afterwards heard of; Bacon relates that according to one report he lived long after in a cave or vault (*Henry VII.*, p. 37, ed. Lumby). More than 200 years later, in 1708, the skeleton of a man was found in a secret chamber in the family mansion at Minster Lovell in Oxfordshire. It is supposed that Francis Lovell had hidden himself there and died of starvation.

Collingbourne's couplet is preserved by Fabyan, *Chronicle*, p. 672. For the discovery at Minster Lovell see *Notes and Queries*, 2nd ser. i. and 5th ser. x. (C. L. K.)

LOVER, SAMUEL (1797–1868), Irish novelist, artist, songwriter and musician, was born in Dublin on the 24th of February 1797. His father was a stockbroker. Lover began life as an artist, and was elected in 1828 a member of the Royal Hibernian Academy—a body of which two years afterwards he became secretary. He acquired repute as a miniature painter, and a number of the local aristocracy sat to him for their portraits. His love for music showed itself at an early age. At a dinner given to the poet Tom Moore in 1818 Lover sang one of his own songs, which elicited special praise from Moore. One of his best-known portraits was that of Paganini, which was exhibited at the Royal Academy. He attracted attention as an author by his *Legends and Stories of Ireland* (1832), and was one of the first writers for the *Dublin University Magazine*. He went to London about 1835, where, among others, he painted Lord Brougham in his robes as lord chancellor. His gifts rendered him popular in society; and he appeared often at Lady Blessington's evening receptions. There he sang several of his songs, which were so well received that he published them (*Songs and Ballads*, 1839). Some of them illustrated Irish superstitions, among these being "Rory O'More," "The Angel's Whisper," "The May Dew" and "The Four-leaved Shamrock." In 1837 appeared *Rory O'More, a National Romance*, which at once made him a reputation as a novelist; he afterwards dramatized it for the Adelphi Theatre, London. In 1842 was published his best-known work, *Handy Andy, an Irish Tale*. Meanwhile his pursuits had affected his health; and in 1844 he gave up writing for some time, substituting instead public entertainments, called by him "Irish Evenings," illustrative of his own works. These were successful both in Great Britain and in America. In addition to publishing numerous songs of his own, Lover edited a collection entitled *The Lyrics of Ireland*, which appeared in 1858. He died on the 6th of July 1868. Besides the novels already mentioned he wrote *Treasure Trove* (1844), and *Metrical Tales and Other Poems* (1860).

His *Life* was written in 1874 by Bayle Bernard.

LOVERE, a town of Lombardy, Italy, in the province of Bergamo, at the north-west end of the Lago d' Iseo, 522 ft. above sea-level. Pop. (1901) 3306. It is a picturesque town, the houses having the overhanging wooden roofs of Switzerland united with the heavy stone arcades of Italy, while the situation is beautiful, with the lake in front and the semicircle of bold mountains behind. The church of Santa Maria in Valvendra, built in 1473, has frescoes by Floriano Ferramola of Brescia (d. 1528). The Palazzo Tadini contains a gallery of old pictures, some sculptures by Benzoni and Canova, and a zoological collection. Lovere possesses a silk-spinning factory, and the Stablimento Metallurgico Gregorini, a large iron-work and cannon foundry, employs 1600 workmen. Lovere is reached by steamer from Sarnico at the south end of the lake, and there is a steam tramway through the Val Camonica, which is highly cultivated, and contains iron- and silk-works. From Cividate, the terminus, the road goes on to Edolo (2290 ft.), whence passes lead into Tirol and the Valtellina.

LOW, SETH (1850–), American administrator and educationist, was born in Brooklyn, New York, on the 18th of January 1850. He studied in the Polytechnic Institute of Brooklyn and in Columbia University, where he graduated in 1870. He became a clerk (1870) and then a partner (1875) in his father's tea and silk-importing house, A. A. Low & Brothers, which went out of business in 1888. In 1878 he organized, and became president of, the Brooklyn Bureau of Charities. In 1882–1886 he was mayor of the city of Brooklyn, being twice elected on an independent ticket; and by his administration of his office he demonstrated that a rigid "merit" civil-service system was practicable—in September 1884 the first municipal civil-service rules in the United Service were adopted in Brooklyn. He was president of Columbia University from 1890 to 1901, and did much for it by his business administration, his liberality (he gave $1,000,000 for the erection of a library) and his especial interest in the department of Political Science. In his term Columbia became a well-organized and closely-knit university. Its official name was changed from Columbia College to Columbia University. It was removed to a new site on Morningside Heights, New York City. The New York College for the Training of Teachers became its Teachers' College of Columbia; a Faculty of Pure Science was added; the Medical School gave up its separate charter to become an integral part of the university; Barnard College became more closely allied with the university; relations were entered into between the university and the General, Union and Jewish theological seminaries of New York City and with Cooper Union, the Metropolitan Museum of Fine Arts and the American Museum of Natural History; and its faculty and student body became less local in character. Dr Low was a delegate to the Hague Peace Conference in 1899. He was prominent among those who brought about the chartering of Greater New York in 1897, and in this year was an unsuccessful candidate, on an independent ticket, for mayor of New York City; in 1900, on a fusion ticket, he was elected mayor and served in 1901–1903.

LOW, WILL HICOK (1853–), American artist and writer on art, was born at Albany, New York, on the 31st of May 1853. In 1873 he entered the atelier of J. L. Gérôme in the École des Beaux Arts at Paris, subsequently joining the classes of Carolus-Duran, with whom he remained until 1877. Returning to New York, he became a member of the Society of American Artists in 1878 and of the National Academy of Design in 1890. His pictures of New England types, and illustrations of Keats, brought him into prominence. Subsequently he turned his attention to decoration, and executed panels and medallions for the Waldorf-Astoria Hotel, New York, a panel for the Essex County Court House, Newark, New Jersey, panels for private residences and stained-glass windows for various churches, including St Paul's Methodist Episcopal Church, Newark, N.J. He was an instructor in the schools of Cooper Union, New York, in 1882–1885, and in the school of the National Academy of Design in 1889–1892. Mr Low, who is known to a wider circle as the friend of R. L. Stevenson, published some reminiscences, *A Chronicle of Friendships, 1873–1900* (1908). In 1909 he married Mary (Fairchild), formerly the wife of the sculptor MacMonnies.

LOWBOY, a small table with one or two rows of drawers, so called in contradistinction to the tallboy, or double chest of drawers. Both were favourite pieces of the 18th century, both in England and America; the lowboy was most frequently used as a dressing-table, but sometimes as a side-table. It is usually made of oak, walnut or mahogany, with brass handles and escutcheons. The more elegant examples of the Chippendale period have cabriole legs, claw-and-ball feet and carved knees, and are sometimes sculptured with the favourite shell motive beneath the centre drawer.

LOW CHURCHMAN, a term applied to members of the Church of England or its daughter churches who, while accepting the hierarchical and sacramental system of the Church, do not consider episcopacy as essential to the constitution of the Church, reject the doctrine that the sacraments confer grace *ex opere operato* (*e.g.* baptismal regeneration) and lay stress on the Bible as the sole source of authority in matters of faith. They thus differ little from orthodox Protestants of other denominations, and in general are prepared to co-operate with them on equal terms.

The name was used in the early part of the 18th century as the equivalent of "Latitudinarian," *i.e.* one who was prepared to concede much latitude in matters of discipline and faith, in contradistinction to "High Churchman," the term applied to those who took a high view of the exclusive authority of the Established Church, of episcopacy and of the sacramental system. It subsequently fell into disuse, but was revived in the 19th century when the Tractarian movement had brought the term "High Churchman" into vogue again in a modified sense, *i.e.* for those who exalted the idea of the Catholic Church and the sacramental system at the expense both of the Establishment and of the exclusive authority of Scripture. "Low Churchman" now became the equivalent of "Evangelical," the designation of the movement, associated with the name of Simeon, which laid the chief stress on the necessity of personal "conversion." "Latitudinarian" gave place at the same time to "Broad Churchman," to designate those who lay stress on the ethical teaching of the Church and minimize the value of orthodoxy. The revival of pre-Reformation ritual by many of the High Church clergy led to the designation "ritualist" being applied to them in a somewhat contemptuous sense; and "High Churchman" and "Ritualist" have often been wrongly treated as convertible terms. Actually many High Churchmen are not Ritualists, though they tend to become so. The High Churchman of the "Catholic" type is further differentiated from the "old-fashioned High Churchman" of what is sometimes described as the "high and dry" type of the period anterior to the Oxford Movement.

LOWE, SIR HUDSON (1769–1844), English general, was the son of an army surgeon, John Lowe, and was born at Galway on the 28th of July 1769. His mother was a native of that county. His childhood was spent in various garrison towns but he was educated chiefly at Salisbury grammar school. He obtained a post as ensign in the East Devon Militia before his twelfth year, and subsequently entered his father's regiment, the 50th, then at Gibraltar (1787) under Governor-General O'Hara. After the outbreak of war with France early in 1793, Lowe saw active service successively in Corsica, Elba, Portugal and Minorca, where he was entrusted with the command of a battalion of Corsican exiles, called The Corsican Rangers. With these he did good work in Egypt in 1800–1801. After the peace of Amiens, Lowe, now a major, became assistant quartermaster-general; but on the renewal of war with France in 1803 he was charged, as lieutenant-colonel, to raise the Corsican battalion again and with it assisted in the defence of Sicily. On the capture of Capri he proceeded thither with his battalion and a Maltese regiment; but in October 1808 Murat organized an attack upon the island, and Lowe, owing to the unsteadiness of the Maltese troops and the want of succour by sea, had to agree to evacuate the island. The terms in which Sir William Napier and others have referred to Lowe's defence of Capri are unfair. His garrison consisted of 1362 men, while the assailants numbered between 3000 and 4000. In the course of the year 1809 Lowe and his Corsicans helped in the capture of Ischia and Procida, as well as of Zante, Cephalonia and Cerigo. For some months he acted as governor of Cephalonia and Ithaca, and later on of Santa Maura. He returned to England in 1812, and in January 1813 was sent to inspect a Russo-German legion then being formed, and he accompanied the armies of the allies through the campaigns of 1813 and 1814, being present at thirteen important battles. He won praise from Blücher and Gneisenau for his gallantry and judgment. He was chosen to bear to London the news of the first abdication of Napoleon in April 1814. He was then knighted and became major-general; he also received decorations from the Russian and Prussian courts. Charged with the duties of quartermaster-general of the army in the Netherlands in 1814–1815, he was about to take part in the Belgian campaign when he was offered the command of the British troops at Genoa; but while still in the south of France he received (on the 1st of August 1815) news of his appointment to the position of custodian of Napoleon, who had surrendered to H.M.S. "Bellerophon" off Rochefort. Lowe was to be governor of St Helena, the place of the ex-emperor's exile.

On his arrival there at Plantation House he found that Napoleon had already had scenes with Admiral Cockburn, of H.M.S. "Northumberland," and that he had sought to induce the former governor, Colonel Wilks, to infringe the regulations prescribed by the British government (see *Monthly Review*, January 1901). Napoleon and his followers at Longwood pressed for an extension of the limits within which he could move without surveillance, but it was not in Lowe's power to grant this request. Various matters, in some of which Lowe did not evince much tact, produced friction between them. The news that rescue expeditions were being planned by the Bonapartists in the United States led to the enforcement of somewhat stricter regulations in October 1816, Lowe causing sentries to be posted round Longwood garden at sunset instead of at 9 P.M. This was his great offence in the eyes of Napoleon and his followers. Hence their efforts to calumniate Lowe, which had a surprising success. O'Meara, the British surgeon, became Napoleon's man, and lent himself to the campaign of calumny in which Las Cases and Montholon showed so much skill. In one of the suppressed passages of his *Journal* Las Cases wrote that the exiles had to "reduce to a system our demeanour, our words, our sentiments, even our privations, in order that we might thereby excite a lively interest in a large portion of the population of Europe, and that the opposition in England might not fail to attack the ministry." As to the privations, it may be noted that Lowe recommended that the government allowance of £8000 a year to the Longwood household should be increased by one-half. The charges of cruelty brought against the governor by O'Meara and others have been completely refuted; and the most that can be said against him is that he was occasionally too suspicious in the discharge of his duties. After the death of Napoleon in May 1821, Lowe returned to England and received the thanks of George IV. On the publication of O'Meara's book he resolved to prosecute the author, but, owing to an unaccountable delay, the application was too late. This fact, together with the reserved behaviour of Lowe, prejudiced the public against him, and the government did nothing to clear his reputation. In 1825–1830 he commanded the forces in Ceylon, but was not appointed to the governorship when it fell vacant in 1830. In 1842 he became colonel of his old regiment, the 50th; he also received the G.C.M.G. He died in 1844.

See W. Forsyth, *History of the Captivity of Napoleon at St Helena* (3 vols., London, 1853); Gourgaud, *Journal inédite de Sainte-Hélène* (1815–1818; 2 vols., Paris, 1899); R. C. Seaton, *Napoleon's Captivity in relation to Sir Hudson Lowe* (London, 1903); Lieut.-Col. Basil Jackson, *Notes and Reminiscences of a Staff-Officer* (London, 1903); the earl of Rosebery, *Napoleon; the Last Phase* (London 1900); J. H. Rose, *Napoleonic Studies* (London, 1904). (J. Hl. R.)

LÖWE, JOHANN KARL GOTTFRIED (1796–1869), German composer, was born at Löbejün, near Halle, on the 30th of November 1796, and was a choir-boy at Köthen from 1807 to 1809, when he went to the Franke Institute at Halle, studying music with Türk. The beauty of Löwe's voice brought him under the notice of Madame de Staël, who procured him a pension from Jérôme Bonaparte, then king of Westphalia; this stopped in 1813, on the flight of the king. He entered the University of Halle as a theological student, but was appointed cantor at Stettin in 1820, and director of the town music in 1821, in which year he married Julie von Jacob, who died in 1823. His second wife, Auguste Lange, was an accomplished singer, and they appeared together in his oratorio performances with great success. He retained his office at Stettin for 46 years, when, after a stroke of paralysis, he was somewhat summarily dismissed. He retired to Kiel, and died on the 20th of April 1869. He undertook many concert tours during his tenure of the post at Stettin, visiting Vienna, London, Sweden, Norway and Paris. His high soprano voice (he could sing the music of the "Queen of Night" in *Die Zauberflöte* as a boy) had developed into a fine tenor. Löwe was a voluminous composer, and wrote five operas, of which only one, *Die drei Wünsche*, was performed at Berlin in 1834, without much success; seventeen oratorios, many of them for male voices unaccompanied, or with short instrumental interludes only; choral ballads, cantatas, three string quartets, a pianoforte trio; a work for clarinet and piano, published posthumously; and some piano solos. But the branch of his art by which he is remembered, and in which he must be admitted to have attained perfection, is the solo ballad with pianoforte accompaniment. His treatment of long narrative poems, in a clever mixture of the dramatic and lyrical styles, was undoubtedly modelled on the ballads of Zumsteeg, and has been copied by many composers since his day. His settings of the "Erlkönig" (a very early example), "Archibald Douglas," "Heinrich der Vogler," "Edward" and "Die Verfallene Mühle," are particularly fine.

LOWELL, ABBOTT LAWRENCE (1856–), American educationalist, was born in Boston, Massachusetts on the 13th of December 1856, the great-grandson of John Lowell, the "Columella of New England," and on his mother's side, a grandson of Abbott Lawrence. He graduated at Harvard College in 1877, with highest honours in mathematics; graduated at the Harvard Law School in 1880; and practised law in 1880–1897 in partnership with his cousin, Francis Cabot Lowell (b. 1855), with whom he wrote *Transfer of Stock in Corporations* (1884). In 1897 he became lecturer and in 1898 professor of government at Harvard, and in 1909 succeeded Charles William Eliot as president of the university. In the same year he was president of the American Political Science Association. In 1900 he had succeeded his father, Augustus Lowell (1830–1901), as financial head of the Lowell Institute of Boston. He wrote *Essays on Government* (1889), *Governments and Parties in Continental Europe* (2 vols., 1896), *Colonial Civil Service* (1900; with an account by H. Morse Stephens of the East India College at Haileybury), and *The Government of England* (2 vols., 1908).

His brother, Percival Lowell (1855–), the well-known astronomer, graduated at Harvard in 1876, lived much in Japan between 1883 and 1893, and in 1894 established at Flagstaff, Arizona, the Lowell Observatory, of whose *Annals* (from 1898) he was editor. In 1902 he became non-resident professor of astronomy at the Massachusetts Institute of Technology. He wrote several books on the Far East, including *Chosön* (1885), *The Soul of the Far East* (1886), *Noto, an Unexplored Corner* *of Japan* (1891), and *Occult Japan* (1895), but he is best known for his studies of the planet Mars—he wrote *Mars* (1895), *Mars and Its Canals* (1907), and *Mars, the Abode of Life* (1908)—and his contention that the "canals" of Mars are a sign of life and civilization on that planet (see MARS). He published *The Evolution of Worlds* in 1909.

LOWELL, CHARLES RUSSELL (1835–1864), American soldier, was born on the 2nd of January 1835 in Boston, Massachusetts. His mother, Anna Cabot Jackson Lowell (1819–1874), a daughter of Patrick Tracy Jackson, married Charles Russell Lowell, a brother of James Russell Lowell; she wrote verse and books on education. Her son graduated at Harvard in 1854, worked in an iron mill in Trenton, New Jersey, for a few months in 1855, spent two years abroad, and in 1858–1860 was local treasurer of the Burlington & Missouri river railroad. In 1860 he took charge of the Mount Savage Iron Works, in Cumberland, Maryland. He entered the Union army in June 1861 (commission May 14) as captain of the 3rd (afterwards 6th) U.S. cavalry; on the 15th of April 1863 he became colonel of the 2nd Massachusetts cavalry; he was wounded fatally at Cedar Creek on the 19th of October 1864, when he was promoted brigadier-general of U.S. Volunteers, and died on the next day at Middletown, Va. Lowell married in October 1863, Josephine Shaw (1843–1905), a sister of Colonel R. G. Shaw. Her home when she was married was on Staten Island, and she became deeply interested in the social problems of New York City. She was a member of the State Charities Aid Society, and from 1877 to 1889 was a member of the New York State Board of Charities, being the first woman appointed to that board. She founded the Charity Organization Society of New York City in 1882, and wrote *Public Relief and Private Charity* (1884) and *Industrial Arbitration and Conciliation* (1893).

See Edward E. Emerson (ed.), *The Life and Letters of Charles Russell Lowell* (Boston, 1907).

LOWELL, JAMES RUSSELL (1819–1891), American author and diplomatist, was born at Elmwood, in Cambridge, Massachusetts, on the 22nd of February 1819, the son of Charles Lowell (1782–1861).[1] On his mother's side he was descended from the Spences and Traills, who made their home in the Orkney Islands, his great-grandfather, Robert Traill, returning to England on the breaking out of hostilities in 1775. He was brought up in a neighbourhood bordering on the open country, and from his earliest years he found a companion in nature; he was also early initiated into the reading of poetry and romance, hearing Spenser and Scott in childhood, and introduced to old ballads by his mother. He had for schoolmaster an Englishman who held by the traditions of English schools, so that before he entered Harvard College he had a more familiar acquaintance with Latin verse than most of his fellows—a familiarity which showed itself later in his mock-pedantic accompaniment to *The Biglow Papers* and his macaronic poetry. He was a wide reader, but a somewhat indifferent student, graduating at Harvard without special honours in 1838. During his college course he wrote a number of trivial pieces for a college magazine, and shortly after graduating printed for private circulation the poem which his class asked him to write for their graduation festivities.

He was uncertain at first what vocation to choose, and vacillated between business, the ministry, medicine and law. He decided at last to practise law, and after a course at the Harvard law school, was admitted to the bar. While studying for his profession, however, he contributed poems and prose articles to various magazines. He cared little for the law, regarding it simply as a distasteful means of livelihood, yet his experiments in writing did not encourage him to trust to this for support. An unhappy adventure in love deepened his sense of failure, but he became betrothed to Maria White in the autumn of 1840, and the next twelve years of his life were deeply affected by her influence. She was a poet of delicate power, but also possessed a lofty enthusiasm, a high conception of purity and justice, and a practical temper which led her to concern herself in the movements directed against the evils of intemperance and slavery. Lowell was already looked upon by his companions as a man marked by wit and poetic sentiment; Miss White was admired for her beauty, her character and her intellectual gifts, and the two became thus the hero and heroine among a group of ardent young men and women. The first-fruits of this passion was a volume of poems, published in 1841, entitled *A Year's Life*, which was inscribed by Lowell in a veiled dedication to his future wife, and was a record of his new emotions with a backward glance at the preceding period of depression and irresolution. The betrothal, moreover, stimulated Lowell to new efforts towards self-support, and though nominally maintaining his law office, he threw his energy into the establishment, in company with a friend, Robert Carter, of a literary journal, to which the young men gave the name of *The Pioneer*. It was to open the way to new ideals in literature and art, and the writers to whom Lowell turned for assistance—Hawthorne, Emerson, Whittier, Poe, Story and Parsons, none of them yet possessed of a wide reputation—indicate the acumen of the editor. Lowell himself had already turned his studies in dramatic and early poetic literature to account in another magazine, and continued the series in *The Pioneer*, besides contributing poems; but after the issue of three monthly numbers, beginning in January 1843, the magazine came to an end, partly because of a sudden disaster which befell Lowell's eyes, partly through the inexperience of the conductors and unfortunate business connexions.

The venture confirmed Lowell in his bent towards literature. At the close of 1843 he published a collection of his poems, and a year later he gathered up certain material which he had printed, sifted and added to it, and produced *Conversations on some of the Old Poets*. The dialogue form was used merely to secure an undress manner of approach to his subject; there was no attempt at the dramatic. The book reflects curiously Lowell's mind at this time, for the conversations relate only partly to the poets and dramatists of the Elizabethan period; a slight suggestion sends the interlocutors off on the discussion of current reforms in church and state and society. Literature and reform were dividing the author's mind, and continued to do so for the next decade. Just as this book appeared Lowell and Miss White were married, and spent the winter and early spring of 1845 in Philadelphia. Here, besides continuing his literary contributions to magazines, Lowell had a regular engagement as an editorial writer on *The Pennsylvania Freeman*, a fortnightly journal devoted to the Anti-Slavery cause. In the spring of 1845 the Lowells returned to Cambridge and made their home at Elmwood. On the last day of the year their first child, Blanche, was born, but she lived only fifteen months. A second daughter, Mabel, was born six months after Blanche's death, and lived to survive her father; a third, Rose, died an infant. Lowell's mother meanwhile was living, sometimes at home, sometimes at a neighbouring hospital, with clouded mind, and his wife was in frail health. These troubles and a narrow income conspired to make Lowell almost a recluse in these days, but from the retirement of Elmwood he sent forth writings which show how large an interest he took in affairs. He contributed poems to the daily press, called out by the Slavery question; he was, early in 1846, a correspondent of the London *Daily News*, and in the spring of 1848 he formed a connexion with the *National Anti-Slavery Standard* of New York, by which he agreed to furnish weekly either a poem or a prose article. The poems were most frequently works of art, occasionally they were tracts; but the prose was almost exclusively concerned with the public men and questions of the day, and forms a series of incisive, witty and sometimes prophetic diatribes. It was a period with him of great mental activity, and is represented by four of his books which stand as admirable witnesses to the Lowell of 1848, namely, the second series of *Poems*, containing among others "Columbus," "An Indian Summer Reverie," "To the Dandelion," "The Changeling"; *A Fable for Critics*, in which, after the manner of Leigh Hunt's *The Feast of the Poets*, he characterizes in witty verse and with good-natured satire American contemporary writers, and in which, the publication being anonymous, he included himself; *The Vision of Sir Launfal*, a romantic story suggested by the Arthurian legends—one of his most popular poems; and finally *The Biglow Papers*.

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[1] See under LOWELL, JOHN.

Lowell had acquired a reputation among men of letters and a cultivated class of readers, but this satire at once brought him a wider fame. The book was not premeditated; a single poem, called out by the recruiting for the abhorred Mexican war, couched in rustic phrase and sent to the *Boston Courier*, had the inspiriting dash and electrifying rat-tat-tat of this new recruiting sergeant in the little army of Anti-Slavery reformers. Lowell himself discovered what he had done at the same time that the public did, and he followed the poem with eight others either in the *Courier* or the *Anti-Slavery Standard*. He developed four well-defined characters in the process—a country farmer, Ezekiel Biglow, and his son Hosea; the Rev. Homer Wilbur, a shrewd old-fashioned country minister; and Birdofredum Sawin, a Northern renegade who enters the army, together with one or two subordinate characters; and his stinging satire and sly humour are so set forth in the vernacular of New England as to give at once a historic dignity to this form of speech. (Later he wrote an elaborate paper to show the survival in New England of the English of the early 17th century.) He embroidered his verse with an entertaining apparatus of notes and mock criticism. Even his index was spiced with wit. The book, a caustic arraignment of the course taken in connexion with the annexation of Texas and the war with Mexico, made a strong impression, and the political philosophy secreted in its lines became a part of household literature. It is curious to observe how repeatedly this arsenal was drawn upon in the discussions in America about the "Imperialistic" developments of 1900. The death of Lowell's mother, and the fragility of his wife's health, led Lowell, with his wife, their daughter Mabel and their infant son Walter, to go to Europe in 1851, and they went direct to Italy. The early months of their stay were saddened by the death of Walter in Rome, and by the news of the illness of Lowell's father, who had a slight shock of paralysis. They returned in November 1852, and Lowell published some recollections of his journey in the magazines, collecting the sketches later in a prose volume, *Fireside Travels*. He took some part also in the editing of an American edition of the *British Poets*, but the low state of his wife's health kept him in an uneasy condition, and when her death (27th October 1853) released him from the strain of anxiety, there came with the grief a readjustment of his nature and a new intellectual activity. At the invitation of his cousin, he delivered a course of lectures on English poets before the Lowell Institute in Boston in the winter of 1855. This first formal appearance as a critic and historian of literature at once gave him a new standing in the community, and was the occasion of his election to the Smith Professorship of Modern Languages in Harvard College, then vacant by the retirement of Longfellow. Lowell accepted the appointment, with the proviso that he should have a year of study abroad. He spent his time mainly in Germany, visiting Italy, and increasing his acquaintance with the French, German, Italian and Spanish tongues. He returned to America in the summer of 1856, and entered upon his college duties, retaining his position for twenty years. As a teacher he proved himself a quickener of thought amongst students, rather than a close and special instructor. His power lay in the interpretation of literature rather than in linguistic study, and his influence over his pupils was exercised by his own fireside as well as in the relation, always friendly and familiar, which he held to them in the classroom. In 1856 he married Miss Frances Dunlap, a lady who had since his wife's death had charge of his daughter Mabel.

In the autumn of 1857 *The Atlantic Monthly* was established, and Lowell was its first editor. He at once gave the magazine the stamp of high literature and of bold speech on public affairs. He held this position only till the spring of 1861, but he continued to make the magazine the vehicle of his poetry and of some prose for the rest of his life; his prose, however, was more abundantly presented in the pages of *The North American Review* during the years 1862–1872, when he was associated with Mr Charles Eliot Norton in its conduct. This magazine especially gave him the opportunity of expression of political views during the eventful years of the War of the Union. It was in *The Atlantic* during the same period that he published a second series of *The Biglow Papers*. Both his collegiate and editorial duties stimulated his critical powers, and the publication in the two magazines, followed by republication in book form, of a series of studies of great authors, gave him an important place as a critic. Shakespeare, Dryden, Lessing, Rousseau, Dante, Spenser, Wordsworth, Milton, Keats, Carlyle, Thoreau, Swinburne, Chaucer, Emerson, Pope, Gray—these are the principal subjects of his prose, and the range of topics indicates the catholicity of his taste. He wrote also a number of essays, such as "My Garden Acquaintance," "A Good Word for Winter," "On a Certain Condescension in Foreigners," which were incursions into the field of nature and society. Although the great bulk of his writing was now in prose, he made after this date some of his most notable ventures in poetry. In 1868 he issued the next collection in *Under the Willows and other Poems*, but in 1865 he had delivered his "Ode recited at the Harvard Commemoration," and the successive centennial historical anniversaries drew from him a series of stately odes.

In 1877 Lowell, who had mingled so little in party politics that the sole public office he had held was the nominal one of elector in the Presidential election of 1876, was appointed by President Hayes minister resident at the court of Spain. He had a good knowledge of Spanish language and literature, and his long-continued studies in history and his quick judgment enabled him speedily to adjust himself to these new relations. Some of his despatches to the home government were published in a posthumous volume—*Impressions of Spain*. In 1880 he was transferred to London as American minister, and remained there till the close of President Arthur's administration in the spring of 1885. As a man of letters he was already well known in England, and he was in much demand as an orator on public occasions, especially of a literary nature; but he also proved himself a sagacious publicist, and made himself a wise interpreter of each country to the other. Shortly after his retirement from public life he published *Democracy and other Addresses*, all of which had been delivered in England. The title address was an epigrammatic confession of political faith as hopeful as it was wise and keen. The close of his stay in England was saddened by the death of his second wife in 1885. After his return to America he made several visits to England. His public life had made him more of a figure in the world; he was decorated with the highest honours Harvard could pay officially, and with degrees of Oxford, Cambridge, St Andrews, Edinburgh and Bologna. He issued another collection of his poems, *Heartsease and Rue*, in 1888, and occupied himself with revising and rearranging his works, which were published in ten volumes in 1890. The last months of his life were attended by illness, and he died at Elmwood on the 12th of August 1891. After his death his literary executor, Charles Eliot Norton, published a brief collection of his poems, and two volumes of added prose, besides editing his letters.

The spontaneity of Lowell's nature is delightfully disclosed in his personal letters. They are often brilliant, and sometimes very penetrating in their judgment of men and books; but the most constant element is a pervasive humour, and this humour, by turns playful and sentimental, is largely characteristic of his poetry, which sprang from a genial temper, quick in its sympathy with nature and humanity. The literary refinement which marks his essays in prose is not conspicuous in his verse, which is of a more simple character. There was an apparent conflict in him of the critic and the creator, but the conflict was superficial. The man behind both critical and creative work was so genuine, that through his writings and speech and action he impressed himself deeply upon his generation in America, especially upon the thoughtful and scholarly class who looked upon him as especially their representative. This is not to say that he was a man of narrow sympathies. On the contrary, he was democratic in his thought, and outspoken in his rebuke of whatever seemed to him antagonistic to the highest freedom. Thus, without taking a very active part in political life, he was recognized as one of the leaders of independent political thought. He found expression in so many ways, and was apparently so inexhaustible in his resources, that his very versatility and the ease with which he gave expression to his thought sometimes stood in the way of a recognition of his large, simple political ideality and the singleness of his moral sight.

WRITINGS.—The *Works of James Russell Lowell*, in ten volumes (Boston and New York, Houghton, Mifflin & Co., 1890); *édition de luxe*, 61 vols. (1904); *Latest Literary Essays and Addresses* (1891); *The Old English Dramatists* (1892); *Conversations on some of the Old Poets* (Philadelphia, David M'Kay; reprint of the volume published in 1843 and subsequently abandoned by its author, 1893); *The Power of Sound: a Rhymed Lecture* (New York, privately printed, 1896); *Lectures on English Poets* (Cleveland, The Rowfant Club, 1899).

MEMOIRS.—*Letters of James Russell Lowell*, edited by Charles Eliot Norton, in two volumes (New York, Harper & Brothers, 1899); *Life of James Russell Lowell* (2 vols.), by Horace E. Scudder (Houghton, Mifflin & Co., 1901); *James Russell Lowell and his Friends* (Boston, 1899), by Edward Everett Hale. (H. E. S.*)

LOWELL, JOHN (1743–1802), American jurist, was born in Newburyport, Massachusetts, on the 17th of June 1743, and was a son of the Reverend John Lowell, the first pastor of Newburyport, and a descendant of Perceval Lowle or Lowell (1571–1665), who emigrated from Somersetshire to Massachusetts Bay in 1639 and was the founder of the family in New England. John Lowell graduated at Harvard in 1760, was admitted to the bar in 1763, represented Newburyport (1776) and Boston (1778) in the Massachusetts Assembly, was a member of the Massachusetts Constitutional Convention of 1779–1780 and, as a member of the committee appointed to draft a constitution, secured the insertion of the clause, "all men are born free and equal," which was interpreted by the supreme court of the state in 1783 as abolishing slavery in the state. In 1781–1783 he was a member of the Continental Congress, which in 1782 made him a judge of the court of appeals for admiralty cases; in 1784 he was one of the commissioners from Massachusetts to settle the boundary line between Massachusetts and New York; in 1789–1801 he was a judge of the U.S. District Court of Massachusetts; and from 1801 until his death in Roxbury on the 6th of May 1802 he was a justice of the U.S. Circuit Court for the First Circuit (Maine, New Hampshire, Massachusetts and Rhode Island).

His son, JOHN LOWELL (1769–1840), graduated at Harvard in 1786, was admitted to the bar in 1789 (like his father, before he was twenty years old), and retired from active practice in 1803. He opposed French influence and the policies of the Democratic party, writing many spirited pamphlets (some signed "The Boston Rebel," some "The Roxbury Farmer"), including: *The Antigallican* (1797), *Remarks on the Hon. J. Q. Adams's Review of Mr Ames's Works* (1809), *New England Patriot, being a Candid Comparison of the Principles and Conduct of the Washington and Jefferson Administrations* (1810), *Appeals to the People on the Causes and Consequences of War with Great Britain* (1811) and *Mr Madison's War* (1812). These pamphlets contain an extreme statement of the anti-war party and defend impressment as a right of long standing. After the war Lowell abandoned politics, and won for himself the title of "the Columella of New England" by his interest in agriculture—he was for many years president of the Massachusetts Agricultural Society. He was a benefactor of the Boston Athenaeum and the Massachusetts General Hospital.

Another son of the first John Lowell, FRANCIS CABOT LOWELL (1775–1817), the founder in the United States of cotton manufacturing, was born in Newburyport on the 7th of April 1775, graduated at Harvard in 1793, became a merchant in Boston, and, during the war of 1812, with his cousin (who was also his brother-in-law), Patrick Tracy Jackson, made use of the knowledge of cotton-spinning gained by Lowell in England (whither he had gone for his health in 1810) and devised a power loom. Experiments were successfully carried on at Waltham in 1814. Lowell worked hard to secure a protective tariff on cotton goods. The city of Lowell, Massachusetts, was named in his honour. He died in Boston on the 10th of August 1817.

CHARLES LOWELL (1782–1861), brother of the last named, was born in Boston, graduated at Harvard in 1800, studied law and then theology, and after two years in Edinburgh and one year on the Continent was from 1806 until his death pastor of the West Congregational (Unitarian) Church of Boston, a charge in which Cyrus A. Bartol was associated with him after 1837. Charles Lowell had a rare sweetness and charm, which reappeared in his youngest son, James Russell Lowell (*q.v.*).

Francis Cabot Lowell's son, JOHN LOWELL (1799–1836), was born in Boston, travelled in India and the East Indies on business in 1816 and 1817, in 1832 set out on a trip around the world, and on the 4th of March 1836 died in Bombay. By a will made, said Edward Everett, "on the top of a palace of the Pharaohs," he left $237,000 to establish what is now known as the Lowell Institute (*q.v.*).

See the first lecture delivered before the Institute, Edward Everett's *A Memoir of Mr John Lowell, Jr.* (Boston, 1840).

A grandson of Francis Cabot Lowell, EDWARD JACKSON LOWELL (1845–1894), graduated at Harvard in 1867, was admitted to the Suffolk county (Mass.) bar in 1872, and practised law for a few years. He wrote *The Hessians and the Other German Auxiliaries of Great Britain in the Revolutionary War* (1884), *The Eve of the French Revolution* (1892) and the chapter, "The United States of America 1775–1782: their Political Relations with Europe," in vol. vii. (1888) of Winsor's *Narrative and Critical History of America*.

LOWELL, a city and one of the county-seats (Cambridge being the other) of Middlesex county, Massachusetts, U.S.A., situated in the N.E. part of the county at the confluence of the Concord and Merrimack rivers, about 25 m. N.W. of Boston. Pop. (1890) 77,696; (1900) 94,969, of whom 40,974 were foreign-born (14,674 being French Canadian, 12,147 Irish, 4485 English Canadian, 4446 English, 1203 Greek, 1099 Scotch); (1910 census), 106,294. Lowell is served by the Boston & Maine and the New York, New Haven & Hartford railways, and by interurban electric lines. The area of Lowell is 14·1 sq. m., much the larger part of which is S. of the Merrimack. The city is irregularly laid out. Its centre is Monument Square, in Merrimack Street, where are a granite monument to the first Northerners killed in the Civil War, Luther C. Ladd and A. O. Whitney (both of Lowell), whose regiment was mobbed in Baltimore on the 19th of April 1861 while marching to Washington; and a bronze figure of Victory (after one by Rauch in the Valhalla at Ratisbon), commemorating the Northern triumph in the Civil War. The Lowell textile school, opened in 1897, offers courses in cotton manufacturing, wool manufacturing, designing, chemistry and dyeing, and textile engineering; evening drawing schools and manual training in the public schools have contributed to the high degree of technical perfection in the factories. The power gained from the Pawtucket Falls in the Merrimack river has long been found insufficient for these. A network of canals supplies from 14,000 to 24,000 h.p.; and a small amount is also furnished by the Concord river, but about 26,000 h.p. is supplied by steam. In factory output ($46,879,212 in 1905; $41,202,984 in 1900) Lowell ranked fifth in value in 1905 and fourth in 1900 among the cities of Massachusetts; more than three-tenths of the total population are factory wage-earners, and nearly 19% of the population are in the cotton mills. Formerly Lowell was called the "Spindle City" and the "Manchester of America," but it was long ago surpassed in the manufacture of textiles by Fall River and New Bedford: in 1905 the value of the cotton product of Lowell, $19,340,925, was less than 60% of the value of cotton goods made at Fall River. Woollen goods made in Lowell in 1905 were valued at $2,579,363; hosiery and knitted goods, at $3,816,964; worsted goods, at $1,978,552. Carpets and textile machinery are allied manufactures of importance. There are other factories for machinery, patent medicines, boots and shoes, perfumery and cosmetics, hosiery and rubber heels. Lowell was the home of the inventor of rubber heels, Humphrey O'Sullivan.

The founders of Lowell were Patrick Tracy Jackson (1780–1847), Nathan Appleton (1779–1861), Paul Moody (1779–1831) and the business manager chosen by them, Kirk Boott (1790–1837). The opportunity for developing water-power by the purchase of the canal around Pawtucket Falls (chartered for navigation in 1792) led them to choose the adjacent village of East Chelmsford as the site of their projected cotton mills; they bought the Pawtucket canal, and incorporated in 1822 the Merrimack Manufacturing Company; in 1823 the first cloth was actually made, and in 1826 a separate township was formed from part of Chelmsford and was named in honour of Francis Cabot Lowell, who with Jackson had improved Cartwright's power loom, and had planned the mills at Waltham. In 1836 Lowell was chartered as a city. Lowell annexed parts of Tewksbury in 1834, 1874, 1888 and 1906, and parts of Dracut in 1851, 1874 and 1879. Up to 1840 the mill hands, with the exception of English dyers and calico printers, were New England girls. The "corporation," as the employers were called, provided from the first for the welfare of their employees, and Lowell has always been notably free from labour disturbances.

The character of the early employees of the mills, later largely displaced by French Canadians and Irish, and by immigrants from various parts of Europe, is clearly seen in the periodical, *The Lowell Offering*, written and published by them in 1840–1845. This monthly magazine,organized by the Rev. Abel Charles Thomas (1807–1880), pastor of the First Universalist Church, was from October 1840 to March 1841 made up of articles prepared for some of the many improvement circles or literary societies; it then became broader in its scope, received more spontaneous contributions, and from October 1842 until December 1845 was edited by Harriot F. Curtis (1813–1889), known by her pen name, "Mina Myrtle," and by Harriet Farley (1817–1907), who became manager and proprietor, and published selections from the *Offering* under the titles *Shells from the Strand of the Sea of Genius* (1847) and *Mind among the Spindles* (1849), with an introduction by Charles Knight. In 1854 she married John Intaglio Donlevy (d. 1872). Famous contributors to the *Offering* were Harriet Hanson (b. 1825) and Lucy Larcom (1824–1893). Harriet Hanson wrote *Early Factory Labor in New England* (1883) and *Loom and Spindle* (1898), an important contribution to the industrial and social history of Lowell. She was prominent in the anti-slavery and woman suffrage agitations in Massachusetts, and wrote *Massachusetts in the Woman Suffrage Movement* (1881). She married in 1848 William Stevens Robinson (1818–1876), who wrote in 1856–1876 the political essays signed "Warrington" for the *Springfield Republican*. Lucy Larcom,[1] born in Beverly, came to Lowell in 1835, where her widowed mother kept a "corporation" boarding-house, and where she became a "doffer," changing bobbins in the mills. She wrote much, especially for the *Offering*; became an ardent abolitionist and (in 1843) the friend of Whittier; left Lowell in 1846, and taught for several years, first in Illinois, and then in Beverly and Norton, Massachusetts. *An Idyl of Work* (1875) describes the life of the mills and *A New England Girlhood* (1889) is autobiographical; she wrote many stories and poems, of which *Hannah Binding Shoes* is best known.

Benjamin F. Butler was from boyhood a resident of Lowell, where he began to practise law in 1841. James McNeill Whistler was born here in 1834, and in 1907 his birthplace in Worthen Street was purchased by the Art Association to be used as its headquarters and as an art museum and gallery; it was dedicated in 1908, and in the same year a replica of Rodin's statue of Whistler was bought for the city.

See S. A. Drake, *History of Middlesex County*, 2, p. 53 et seq. (Boston, 1880); *Illustrated History of Lowell, Massachusetts* (Lowell, 1897); the books of Harriet H. Robinson and Lucy Larcom already named as bearing on the industrial conditions of the city between 1835 and 1850; and the famous description in the fourth chapter of Dickens's *American Notes*.

LOWELL INSTITUTE, an educational foundation in Boston, Massachusetts, U.S.A., providing for free public lectures, and endowed by the bequest of $237,000 left by John Lowell, junior, who died in 1836. Under the terms of his will 10% of the net income was to be added to the principal, which in 1909 was over a million dollars. None of the fund was to be invested in a building for the lectures; the trustees of the Boston Athenaeum were made visitors of the fund; but the trustee of the fund is authorized to select his own successor, although in doing so he must "always choose in preference to all others some male descendant of my grandfather John Lowell, provided there is one who is competent to hold the office of trustee, and of the name of Lowell," the sole trustee so appointed having the entire selection of the lecturers and the subjects of lectures. The first trustee was John Lowell junior's cousin, John Amory Lowell, who administered the trust for more than forty years, and was succeeded in 1881 by his son, Augustus Lowell, who in turn was succeeded in 1900 by his son Abbott Lawrence Lowell, who in 1909 became president of Harvard University.

The founder provided for two kinds of lectures, one popular, "and the other more abstruse, erudite and particular." The popular lectures have taken the form of courses usually ranging from half a dozen to a dozen lectures, and covering almost every subject. The fees have always been large, and many of the most eminent men in America and Europe have lectured there. A large number of books have been published which consist of those lectures or have been based upon them. As to the advanced lectures, the founder seems to have had in view what is now called university extension, and in this he was far in advance of his time; but he did not realize that such work can only be done effectively in connexion with a great school. In pursuance of this provision public instruction of various kinds has been given from time to time by the Institute. The first freehand drawing in Boston was taught there, but was given up when the public schools undertook it. In the same way a school of practical design was carried on for many years, but finally, in 1903, was transferred to the Museum of Fine Arts. Instruction for working men was given at the Wells Memorial Institute until 1908, when the Franklin Foundation took up the work. A Teachers' School of Science is maintained in co-operation with the Natural History Society. For many years advanced courses of lectures were given by the professors of the Massachusetts Institute of Technology, but in 1904 they were superseded by an evening school for industrial foremen. In 1907, under the title of "Collegiate Courses," a number of the elementary courses in Harvard University were offered free to the public under the same conditions of study and examination as in the university.

For the earlier period, see Harriett Knight Smith, *History of the Lowell Institute* (Boston, 1898).

LÖWENBERG, a town of Germany, in the Prussian province of Silesia, on the Bober, 39 m. E. of Görlitz by rail. Pop. 5682. It is one of the oldest towns in Silesia; its town hall dates from the 16th century, and it has a Roman Catholic church built in the 13th century and restored in 1862. The town has sandstone and gypsum quarries, breweries and woollen mills, and cultivates fruit and vegetables. Löwenberg became a town in 1217 and has been the scene of much fighting, especially during the Napoleonic wars. Near the town is the village and estate of Hohlstein, the property of the Hohenzollern family.

LÖWENSTEIN, a town of Germany, in the kingdom of Württemberg, capital of the mediatized county of that name, situated under the north slope of the Löwenstein range, 6 m. from Heilbronn. Pop. 1527. It is dominated by the ruined castle of the counts of Löwenstein, and enclosed by medieval walls. The town contains many picturesque old houses. There is also a modern palace. The cultivation of vines is the chief industry, and there is a brine spring (Theusserbad).

Löwenstein was founded in 1123 by the counts of Calw, and belonged to the Habsburgs from 1281 to 1441. In 1634 the castle was destroyed by the imperialists. The county of Löwenstein belonged to a branch of the family of the counts of Calw before 1281, when it was purchased by the German king Rudolph I., who presented it to his natural son Albert. In 1441 Henry, one of Albert's descendants, sold it to the elector palatine of the Rhine, Frederick I., and later it served as a portion for Louis (d. 1524), a son of the elector by a morganatic marriage, who became a count of the Empire in 1494. Louis's grandson Louis II. (d. 1611) inherited the county of Wertheim and other lands by marriage and called himself count of Löwenstein-Wertheim; his two sons divided the family into two branches. The heads of the two branches, into which the older and Protestant line was afterwards divided, were made princes by the king of Bavaria in 1812 and by the king of Württemberg in 1813; the head of the younger, or Roman Catholic line, was made a prince of the Empire in 1711. Both lines are flourishing, their present representatives being Ernst (b. 1854) prince of Löwenstein-Wertheim-Freudenberg, and Aloyse (b. 1871) prince of Löwenstein-Wertheim-Rosenberg. The lands of the family were mediatized after the dissolution of the Empire in 1806. The area of the county of Löwenstein was about 53 sq. m.

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[1] See D. D. Addison, *Lucy Larcom; Life, Letters and Diary* (Boston, 1897).

See C. Rommel, *Grundzüge einer Chronik der Stadt Löwenstein* (Löwenstein, 1893).

LOWESTOFT, a municipal borough, seaport and watering-place in the Lowestoft parliamentary division of Suffolk, England, 117½ m. N.E. from London by the Great Eastern railway. Pop. (1901) 29,850. It lies on either side of the formerly natural, now artificial outlet of the river Waveney to the North Sea, while to the west the river forms Oulton Broad and Lothing Lake. The northern bank is the original site. South Lowestoft arose on the completion of harbour improvements, begun in 1844, when the outlet of the Waveney, reopened in 1827, was deepened. The old town is picturesquely situated on a lofty declivity, which includes the most easterly point of land in England. The church of St Margaret is Decorated and Perpendicular. South Lowestoft has a fine esplanade, a park (Bellevue) and other adjuncts of a watering-place. Bathing facilities are good. There are two piers enclosing a harbour with a total area of 48 acres, having a depth of about 16 ft. at high tide. The fisheries are important and some 600 smacks belong to the port. Industries include ship and boat building and fitting, and motor engineering. The town is governed by a mayor, 8 aldermen and 24 councillors. Area 2178 acres.

Lowestoft (Lothu Wistoft, Lowistoft, Loistoft) owes its origin to its fisheries. In 1086 it was a hamlet in the demesne of the royal manor of Lothingland. The men of Lowestoft as tenants on ancient demesne of the crown possessed many privileges, but had no definite burghal rights until 1885. For several centuries before 1740 the fisheries were the cause of constant dispute between Lowestoft and Yarmouth. During the last half of the 18th century the manufacture of china flourished in the town. A weekly market on Wednesdays was granted to John, earl of Richmond, in 1308 together with an eight days' fair beginning on the vigil of St Margaret's day, and in 1445 John de la Pole, earl of Suffolk, one of his successors as lord of the manor, received a further grant of the same market and also two yearly fairs, one on the feast of St Philip and St James and the other at Michaelmas. The market is still held on Wednesdays, and in 1792 the Michaelmas fair and another on May-day were in existence. Now two yearly fairs for small wares are held on the 13th of May and the 11th of October. In 1643 Cromwell performed one of his earlier exploits in taking Lowestoft, capturing large supplies and making prisoners of several influential royalists. In the war of 1665 the Dutch under Admiral Opdam were defeated off Lowestoft by the English fleet commanded by the duke of York.

See *Victoria County History, Suffolk*; E. Gillingwater, *An Historical Account of the Town of Lowestoft* (ed. 1790).

LOWIN, JOHN (1576–1659), English actor, was born in London, the son of a carpenter. His name frequently occurs in Henslowe's Diary in 1602, when he was playing at the Rose Theatre in the earl of Worcester's company, and he was at the Blackfriars in 1603, playing with Shakespeare, Burbage and the others, and owning—by 1608—a share and a half of the twenty shares in that theatre. About 1623 he was one of the managers. He lived in Southwark, and Edward Alleyn speaks of his dining with him in 1620. "Lowin in his latter days kept an inn (the Three Pigeons) at Brentford, where he deyed very old." Two of his favourite parts were Falstaff, and Melanteus in *The Maid's Tragedy*.

LOWLAND, in physical geography, any broad expanse of land with a general low level. The term is thus applied to the landward portion of the upward slope from oceanic depths to continental highlands, to a region of depression in the interior of a mountainous region, to a plain of denudation or to any region in contrast to a highland. The Lowlands and Highlands of Scotland are typical.

LOWNDES, THOMAS (1692–1748), founder of the Lowndean professorship of astronomy at Cambridge university, England, was born in 1692, both his father and mother being Cheshire landowners. In 1725 he was appointed provost marshal of South Carolina, a post he preferred to fill by deputy. In 1727 Lowndes claimed to have taken a prominent part in inducing the British government to purchase Carolina, but he surrendered his patent when the transfer of the colony to the crown was completed. His patent was renewed in 1730, but he resigned it in 1733. He then brought various impractical schemes before the government to check the illicit trade in wool between Ireland and France; to regulate the paper currency of New England; and to supply the navy with salt from brine, &c. He died on the 12th of May 1748. By his will he left his inherited Cheshire properties to the university of Cambridge for the foundation of a chair of astronomy and geometry.

LOWNDES, WILLIAM THOMAS (1798–1843), English bibliographer, was born about 1798, the son of a London bookseller. His principal work, *The Bibliographer's Manual of English Literature*—the first systematic work of the kind—was published in four volumes in 1834. It took Lowndes fourteen years to compile, but, despite its merits, brought him neither fame nor money. Lowndes, reduced to poverty, subsequently became cataloguer to Henry George Bohn, the bookseller and publisher. In 1839 he published the first parts of *The British Librarian*, designed to supplement his early manual, but owing to failing health did not complete the work. Lowndes died on the 31st of July 1843.

LOW SUNDAY, the first Sunday after Easter, so called because of its proximity to the "highest" of all feasts and Sundays, Easter. It was also known formerly as White Sunday, being still officially termed by the Roman Catholic Church *Dominica in albis*, "Sunday in white garments," in allusion to the white garments anciently worn on this day by those who had been baptized and received into the Church just before Easter. Alb Sunday, Quasimodo and, in the Greek Church, Antipascha, and ἡ δευτεροπρώτη Κυριακή (literally "second-first Sunday," *i.e.* the second Sunday after the first) were other names for the day.

LOWTH, ROBERT (1710–1787), English divine and Orientalist, was born at Winchester on the 27th of November 1710. He was the younger son of William Lowth (1661–1732), rector of Buriton, Hampshire, a theologian of considerable ability. Robert was educated on the foundation of Winchester College, and in 1729 was elected to a scholarship at New College, Oxford. He graduated M.A. in 1737, and in 1741 he was appointed professor of poetry at Oxford, in which capacity he delivered the *Praelectiones Academicae de Sacra Poesi Hebraeorum*. Bishop Hoadly appointed him in 1744 to the rectory of Ovington, Hampshire, and in 1750 to the archdeaconry of Winchester. In 1753 he was collated to the rectory of East Woodhay, Hampshire, and in the same year he published his lectures on Hebrew poetry. In 1754 he received the degree of doctor of divinity from his university, and in 1755 he went to Ireland for a short time as first chaplain to the lord-lieutenant, the 4th duke of Devonshire. He declined a presentation to the see of Limerick, but accepted a prebendal stall at Durham and the rectory of Sedgefield. In 1758 he published his *Life of William of Wykeham*; this was followed in 1762 by *A Short Introduction to English Grammar*. In 1765, the year of his election into the Royal Societies of London and Göttingen, he engaged in controversy with William Warburton on the book of Job, in which he was held by Gibbon to have had the advantage. In June 1766 Lowth was consecrated bishop of St David's, and about four months afterwards he was translated to Oxford, where he remained till 1777, when he became bishop of London and dean of the Chapel Royal. In 1778 appeared his last work, *Isaiah, a new Translation, with a Preliminary Dissertation, and Notes, Critical, Philological, and Explanatory*. He declined the archbishopric of Canterbury in 1783, and died at Fulham on the 3rd of November 1787.

The *Praelectiones*, translated in 1787 by G. Gregory as *Lectures on the Sacred Poetry of the Hebrews*, exercised a great influence both in England and on the continent. Their chief importance lay in the idea of looking at the sacred poetry as poetry, and examining it by the ordinary standards of literary criticism. Lowth's aesthetic criticism was that of the age, and is now in great part obsolete, a more natural method having been soon after introduced by Herder. The principal point in which Lowth's influence has been lasting is his doctrine of poetic parallelism, and even here his somewhat mechanical classification of the forms of Hebrew sense-rhythm, as it should rather be called, is open to serious objections. Editions of the *Lectures* and of the *Isaiah* have been numerous, and both have been translated into German. A volume of *Sermons and other Remains*, with memoir by the topographer, Peter Hall (1802–1849), was published in 1834, and an edition of the *Popular Works* of Robert Lowth in 3 vols. appeared in 1843.

LOXODROME (from Gr. λοξός, oblique, and δρόμος, course), the line on the earth's surface making a constant angle with the meridian.

LOYALISTS or **TORIES**, in America, the name given to the colonists who were loyal to Great Britain during the War of Independence. In New England and the Middle Colonies loyalism had a religious as well as a political basis. It represented the Anglican as opposed to the Calvinistic influence. With scarcely an exception the Anglican ministers were ardent Loyalists, the writers and pamphleteers were the ministers and teachers of that faith, and virtually all the military or civil leaders were members of that church. The Loyalists north of Maryland represented the old Tory traditions. In the southern colonies, where Anglicanism predominated, the division did not follow religious lines so closely. In Virginia and South Carolina the Whig leaders were almost without exception members of the established church. Out of twenty Episcopal ministers in South Carolina only five were Loyalists. Although many of the wealthy Anglican planters of the tide-water section fought for the mother country, the Tories derived their chief support from the non-Anglican Germans and Scotch in the upper country. The natural leaders in these colonies were members of the same church as the governor and vied with him in their zeal for the support of that church. Since religion was not an issue, the disputes over questions purely political in character, such as taxation, distribution of land and appointment of officials, were all the more bitter. The settlers on the frontier were snubbed both socially and politically by the low-country aristocracy, and in North Carolina and South Carolina were denied courts of justice and any adequate representation in the colonial assembly. Naturally they refused to follow such leaders in a war in defence of principles in which they had no material interest. They did not drink tea and had little occasion for the use of stamps, since they were not engaged in commerce and had no courts in which to use legal documents. The failure of the British officers to realize that conditions in the south differed from those in the north, and the tendency on their part to treat all Dissenters as rebels, were partly responsible for the ultimate loss of their southern campaign. The Scotch-Irish in the south, influenced perhaps by memories of commercial and religious oppression in Ulster, were mostly in sympathy with the American cause.

Taking the Thirteen Colonies as a whole, loyalism drew its strength largely from the following classes: (1) the official class—men holding positions in the civil, military and naval services, and their immediate families and social connexions, as, for example, Lieutenant-Governor Bull in South Carolina, Governor Dunmore in Virginia and Governor Tryon in New York; (2) the professional classes—lawyers, physicians, teachers and ministers, such as Benjamin Kissam, Peter Van Schaack and Dr Azor Betts of New York and Dr Myles Cooper, president of King's College (now Columbia University); (3) large landed proprietors and their tenants, *e.g.* William Wragg in South Carolina and the De Lanceys, De Peysters and Van Cortlandts in New York; (4) the wealthy commercial classes in New York, Albany, Philadelphia, Baltimore and Charleston, whose business interests would be affected by war; (5) natural conservatives of the type of Joseph Galloway of Pennsylvania, and numerous political trimmers and opportunists. Before 1776 the Loyalists may be divided into two groups. There was a minority of extremists led by the Anglican ministers and teachers, who favoured an unquestioning obedience to all British legislation. The moderate majority disapproved of the mother country's unwise colonial policy and advocated opposition to it through legally organized bodies. Many even sanctioned non-importation and non-exportation agreements, and took part in the election of delegates to the First Continental Congress. The aggressive attitude of Congress, the subsequent adoption of the Declaration of Independence, and the refusal to consider Lord Howe's conciliatory propositions finally forced them into armed opposition. Very few really sanctioned the British policy as a whole, but all felt that it was their first duty to fight for the preservation of the empire and to leave constitutional questions for a later settlement. John Adams's estimate that one-third of all the people in the thirteen states in 1776 were Loyalists was perhaps approximately correct. In New England the number was small, perhaps largest in Connecticut and in the district which afterwards became the state of Vermont. New York was the chief stronghold. The "De Lancey party" or the "Episcopalian party" included the majority of the wealthy farmers, merchants and bankers, and practically all communicants of the Anglican church. New Jersey, Pennsylvania, Delaware, Maryland and Virginia contained large and influential Loyalist minorities; North Carolina was about equally divided; South Carolina probably, and Georgia certainly, had Loyalist majorities. Some of the Loyalists joined the regular British army, others organized guerilla bands and with their Indian allies inaugurated a reign of terror on the frontier from New York to Georgia. New York alone furnished about 15,000 Loyalists to the British army and navy, and about 8500 militia, making in all 23,500 Loyalist troops. This was more than any other colony supplied, perhaps more than all the others combined. Johnson's "Loyal Greens" and Butler's "Tory Rangers" served under General St Leger in the Burgoyne campaign of 1777, and the latter took part in the Wyoming and Cherry Valley massacres of 1778. The strength of these Loyalists in arms was weakened in New York by General Sullivan's success at Newtown (now Elmira) on the 29th of August 1779, and broken in the north-west by George Rogers Clark's victories at Kaskaskia and Vincennes in 1778 and 1779, and in the south by the battles of King's Mountain and Cowpens in 1780. Severe laws were passed against the Loyalists in all the states. They were in general disfranchised and forbidden to hold office or to practise law. Eight of the states formally banished certain prominent Tories either conditionally or unconditionally, and the remaining five, Connecticut, New Jersey, Delaware, Maryland and Virginia, did practically the same indirectly. Social and commercial ostracism forced many others to flee. Their property was usually confiscated for the support of the American cause. They went to England, to the West Indies, to the Bahamas, to Canada and to New York, Newport, Charleston and other cities under British control. According to a trustworthy estimate 60,000 persons went into exile during the years from 1775 to 1787. The great majority settled in Nova Scotia and in Upper and Lower Canada, where they and their descendants became known as "United Empire Loyalists." Those who remained in the United States suffered for many years, and all the laws against them were not finally repealed until after the War of 1812. The British government, however, endeavoured to look after the interests of its loyal colonists. During the war a number of the prominent Loyalists (*e.g.* Joseph Galloway) were appointed to lucrative positions, and rations were issued to many Loyalists in the cities, such as New York, which were held by the British. During the peace negotiations at Paris the treatment of the Loyalists presented a difficult problem, Great Britain at first insisting that the United States should agree to remove their disabilities and to act toward them in a spirit of conciliation. The American commissioners, knowing that a treaty with such provisions would not be accepted at home, and that the general government had, moreover, no power to bind the various states in such a matter, refused to accede; but in the treaty, as finally ratified, the United States agreed (by Article V.) to recommend to the legislatures of the various states that Loyalists should "have free liberty to go to any part or parts of any of the thirteen United States, and therein to remain twelve months, unmolested in their endeavours to obtain the restitution of such of their estates, rights and properties as may have been confiscated," that acts and laws in the premises be reconsidered and revised, and that restitution of estates, &c., should be made. The sixth article provided "that there shall be no future confiscations made, nor any prosecutions commenced against any person" for having taken part in the war; and that those in confinement on such charges should be liberated. In Great Britain opponents of the government asserted that the Loyalists had virtually been betrayed; in America the treaty aroused opposition as making too great concessions to them. Congress made the promised recommendations, but they were unheeded by the various states, in spite of the advocacy by Alexander Hamilton and others of a conciliatory treatment of the Loyalists; and Great Britain, in retaliation, refused until 1796 to evacuate the western posts as the treaty prescribed. Immediately after the war parliament appointed a commission of five to examine the claims of the Loyalists for compensation for services and losses; and to satisfy these claims and to establish Loyalists in Nova Scotia and Canada the British government expended fully £6,000,000.

See C. H. van Tyne, *The Loyalists in the American Revolution* (New York, 1902), which contains much valuable information but does not explain adequately the causes of loyalism. More useful in this respect is the monograph by A. C. Flick, *Loyalism in New York during the American Revolution* (New York, 1901). On the biographical side see Lorenzo Sabine, *Biographical Sketches of Loyalists of the American Revolution* (2 vols., Boston, 1864); on the literary side, M. C Tyler, *Literary History of the American Revolution, 1763–1783* (2 vols., New York, 1897).

LOYALTY, allegiance to the sovereign or established government of one's country, also personal devotion and reverence to the sovereign and royal family. The English word came into use in the early part of the 15th century in the sense of fidelity to one's oath, or in service, love, &c.; the later and now the ordinary sense appears in the 16th century. The O. Fr. *loialté*, mod. *loyauté*, is formed from *loial*, loyal, Scots *leal*, Lat. *legalis*, legal, from *lex*, law. This was used in the special feudal sense of one who has full legal rights, a *legalis homo* being opposed to the *exlex*, *utlegatus*, or outlaw. Thence in the sense of faithful, it meant one who kept faithful allegiance to his feudal lord, and so loyal in the accepted use of the word.

LOYALTY ISLANDS (Fr. *Iles Loyalty* or *Loyauté*), a group in the South Pacific Ocean belonging to France, about 100 m. E. of New Caledonia, with a total land area of about 1050 sq. m. and 20,000 inhabitants. It consists of Uea or Uvea (the northernmost), Lifu (the largest island, with an area of 650 sq. m.), Tiga and several small islands and Maré or Nengone. They are coral islands of comparatively recent elevation, and in no place rise more than 250 ft. above the level of the sea. Enough of the rocky surface is covered with a thin coating of soil to enable the natives to grow yams, taro, bananas, &c., for their support; cotton thrives well, and has even been exported in small quantities, but there is no space available for its cultivation on any considerable scale. Fresh water, rising and falling with the tide, is found in certain large caverns in Lifu, and by sinking to the sea-level a supply may be obtained in any part of the island. The chief product of the islands are bananas; the chief export sandal-wood.

The Loyalty islanders are Melanesians; the several islands have each its separate language, and in Uea one tribe uses a Samoan and another a New Hebridean form of speech. The Loyalty group was discovered at the beginning of the 19th century, and Dumont d'Urville laid down the several islands in his chart. For many years the natives had a reputation as dangerous cannibals, but they are now among the most civilized Melanesians. Christianity was introduced into Maré by native teachers from Rarotonga and Samoa; missionaries were settled by the London Missionary Society at Maré in 1854, at Lifu in 1859 and at Uea in 1865: Roman Catholic missionaries also arrived from New Caledonia; and in 1864 the French, considering the islands a dependency of that colony, formally instituted a commandant. An attempt was made by this official to put a stop to the English missions by violence; but the report of his conduct led to so much indignation in Australia and in England that the emperor Napoleon, on receipt of a protest from Lord Shaftesbury and others, caused a commission of inquiry to be appointed and free liberty of worship to be secured to the Protestant missions. A further persecution of Christians in Uea, during 1875, called forth a protest from the British government.

LOYOLA, ST IGNATIUS OF (1491–1556), founder of the Society of Jesus. Inigo Lopez de Recalde, son of Beltran, lord of the noble houses of Loyola and Oñaz, was born, according to the generally accepted opinion, on the 24th of December 1491 at the castle of Loyola, which is situated on the river Urola, about 1 m. from the town of Azpeitia, in the province of Guipuzcoa. He was the youngest of a family of thirteen. As soon as he had learnt the elements of reading and writing, he was sent as a page to the court of Ferdinand and Isabella; afterwards, until his twenty-sixth year, he took service with Antonio Maurique, duke of Nagera, and followed the career of arms. He was free in his relations with women, gambled and fought; but he also gave indications of that courage, constancy and prudence which marked his after life. In a political mission to settle certain disputes in the province he showed his dexterity in managing men.

Despite the treaty of Noyon (1516), Charles V. kept Pampeluna, the capital of Navarre. André de Foix, at the head of the French troops, laid siege to the town in 1521 and Ignatius was one of the defending garrison. In the hour of danger, the claims of religion reasserted themselves on the young soldier, and, following a custom when no priest was at hand, he made his confession to a brother officer, who in turn also confessed to him. During the final assault on the 19th of May 1521 a cannon ball struck him, shattering one of his legs and badly wounding the other. The victorious French treated him kindly for nearly two weeks, and then sent him in a litter to Loyola. The doctors declared that the leg needed to be broken and set again; and the operation was borne without a sign of pain beyond a clenching of his fist. His vanity made him order the surgeons to cut out a bone which protruded below the knee and spoilt the symmetry of his leg. He was lame for the rest of his days. Serious illness followed the operations, and, his life being despaired of, he received the last sacraments on the 28th of June. That night, however, he began to mend, and in a few days he was out of danger. During convalescence two books that were to influence his life were brought to him. These were a Castilian translation of *The Life of Christ* by Ludolphus of Saxony, and the popular *Flowers of the Saints*, a series of pious biographies. He gradually became interested in these books, and a mental struggle began. Sometimes he would pass hours thinking of a certain illustrious lady, devising means of seeing her and of doing deeds that would win her favour; at other times the thoughts suggested by the books got the upper hand. He began to recognize that his career of arms was over: so he would become the knight of Christ. He determined to make the pilgrimage to Jerusalem and to practise all the austerities that he read of in *The Flowers of the Saints*. Expiating his sins was not so much his aim as to accomplish great deeds for God. During the struggle that went on in his soul, he began to take note of his psychological state; and this was the first time that he exercised his reason on spiritual things; the experience thus painfully gained he found of great use afterwards in directing others. One night while he lay awake, he tells us, he saw the likeness of the Blessed Virgin with her divine Son; and immediately a loathing seized him for the former deeds of his life, especially for those relating to carnal desires; and he asserts that for the future he never yielded to any such desires. This was the first of many visions. Ignatius proposed after returning from Jerusalem to join the Carthusian order at Seville as a lay brother. About the same time Martin Luther was in the full course of his protest against the papal supremacy and had already burnt the pope's bull at Worms. The two opponents were girding themselves for the struggle; and what the Church of Rome was losing by the defection of the Augustinian was being counterbalanced by the conversion of the founder of the Society of Jesus.

As soon as Ignatius had regained strength, he started ostensibly to rejoin the duke of Nagera, but in reality to visit the great Benedictine abbey of Montserrato, a famous place of pilgrimage. On the way, he was joined by a Moor, who began to jest at some of the Christian doctrines, especially at the perpetual virginity of the Blessed Virgin. Ignatius was no controversialist; and the Moor rode off victorious. The chivalrous nature of Ignatius was aroused. Seized with a longing to pursue and kill the Moor on account of his insulting language, Ignatius, still doubting as to his best course, left the matter to his mule, which at the dividing of the ways took the path to the abbey, leaving the open road which the Moor had taken. Before reaching Montserrato, Ignatius purchased some sackcloth for a garment and hempen shoes, which, with a staff and gourd, formed the usual pilgrim's dress. Approaching the abbey he resolved to do as his favourite hero Amadis de Gaul did—keep a vigil all night before the Lady altar and then lay aside his worldly armour to put on that of Christ. He arrived at the abbey just about the feast of St Benedict (the 21st of March 1522), and there made a confession of his life to a priest belonging to the monastery. He found in use for the pilgrims a translation of the *Spiritual Exercises* of the former abbot, Garcia di Cisneros (d. 1510); and this book evidently gave Ignatius the first idea of his more famous work under the same title. Leaving his mule to the abbey, and giving away his worldly clothes to a beggar, he kept his watch in the church during the night of the 24th–25th of March, and placed on the Lady altar his sword and dagger. Early the next morning he received the Holy Eucharist and left before any one could recognize him, going to the neighbouring town of Manresa, where he first lived in the hospice. Here began a series of heavy spiritual trials which assailed him for many months. Seven hours a day he spent on his knees in prayer and three times a day he scourged his emaciated body. One day, almost overcome with scruples, he was tempted to end his miseries by suicide. At another time, for the same reason, he kept an absolute fast for a week. He tells us that, at this time, God wrought with him as a master with a schoolboy whom he teaches. But his energies were not confined to himself. He assisted others who came to him for spiritual advice; and seeing the fruit reaped from helping his neighbour, he gave up the extreme severities in which he had delighted and began to take more care of his person, so as not needlessly to offend those whom he might influence for good.

During his stay at Manresa, he lived for the most part in a cell at the Dominican convent; and here, evidently, he had severe illnesses. He recounts the details of at least two of these attacks, but says nothing about the much-quoted swoon of eight days, during which he is supposed to have seen in vision the scheme of the future Society. Neither does he refer in any way to the famous cave in which, according to the Ignatian myth, the *Spiritual Exercises* were written. Fortunately we have the first-hand evidence of his autobiography, which is a surer guide than the lines written by untrustworthy disciples. Ignatius remained at Manresa for about a year, and in the spring of 1523 set out for Barcelona on his way to Rome, where he arrived on Palm Sunday. After two weeks he left, having received the blessing of Pope Adrian VI., and proceeded by Padua to Venice, where he begged his bread and slept in the Piazza di San Marco until a rich Spaniard gave him shelter and obtained an order from the doge for a passage in a pilgrim ship bound for Cyprus, whence he could get to Jaffa. In due course Ignatius arrived at Jerusalem, where he intended to remain, in order continuously to visit the holy places and help souls. For this end he had obtained letters of recommendation to the guardian, to whom, however, he only spoke of his desire of satisfying his devotion, not hinting his other motive. The Franciscans gave him no encouragement to remain; and the provincial threatened him with excommunication if he persisted. Not only had the friars great difficulty in supporting themselves, but they dreaded an outbreak from the fanatical Turks who resented some imprudent manifestations of Loyola's zeal. Ignatius returned to Venice in the middle of January 1524; and, determining to devote himself for a while to study, he set out for Barcelona, where he arrived in Lent. Here he consulted Isabella Roser, a lady of high rank and piety, and also the master of a grammar school. These both approved his plan; the one promised to teach him without payment and the other to provide him with the necessaries of life. Here, in his thirty-third year, he began to learn Latin, and after two years his master urged him to go to Alcalá to begin philosophy. During his stay of a year and a half in this university, besides his classes, he found occasion to give to some companions his *Spiritual Exercises* in the form they had then taken and certain instructions in Christian doctrine. On account of these discourses Ignatius came into conflict with the Inquisition. He and his companions were denounced as belonging to the sects of *Sagati* and *Illuminati*. Their mode of life and dress was peculiar and hinted at innovation. But, always ready to obey authority, Ignatius was able to disarm any charges that, now and at other times, were brought against him. The Inquisition merely advised him and his companions to dress in a less extraordinary manner and to go shod. Four months later he was suddenly cast into prison; and, after seventeen days, he learnt that he was falsely accused of sending two noble ladies on a pilgrimage to Jaen. During their absence, from the 21st of April 1527 to the 1st of June, he remained in prison, and was then set free with a prohibition against instructing others until he had spent four years in study.

Seeing his way thus barred at Alcalá, he went with his companions to Salamanca. Here the Dominicans, doubting the orthodoxy of the new-comers, had them put into prison, where they were chained foot to foot and fastened to a stake set up in the middle of the cell. Some days afterwards Ignatius was examined and found without fault. His patience won him many friends; and when he and his companions remained in prison while the other prisoners managed to escape, their conduct excited much admiration. After twenty-two days they were called up to receive sentence. No fault was found in their life and teaching; but they were forbidden to define any sins as being mortal or venial until they had studied for four years. Hampered again by such an order, Ignatius determined to go to Paris to continue his studies. Up to the present he was far from having any idea of founding a society. The only question before him now was whether he should join an order, or continue his wandering existence. He decided upon Paris for the present, and before leaving Salamanca he agreed with his companions that they should wait where they were until he returned; for he only meant to see whether he could find any means by which they all might give themselves to study. He left Barcelona and, travelling on foot to Paris, he arrived there in February 1528. The university of Paris had reached its zenith at the time of the council of Constance (1418), and was now losing its intellectual leadership under the attacks of the Renaissance and the Reformation. In 1521 the university had condemned Luther's *Babylonish Captivity*, and in 1527 Erasmus's *Colloquies* met with the same fate. Soon after his arrival, Ignatius may have seen in the Place de Grève the burning of Louis de Berquin for heresy.[1] At this period there were between twelve and fifteen thousand students attending the university, and the life was an extraordinary mixture of licentiousness and devout zeal. When Ignatius arrived in Paris, he lodged at first with some fellow-countrymen; and for two years attended the lectures on humanities at the collège de Montaigu, supporting himself at first by the charity of Isabella Roser; but, a fellow-lodger defrauding him of his stock, he found himself destitute and compelled to beg his bread. He retired to the hospice of St Jacques; and, following the advice of a Spanish monk, spent his vacations in Flanders, where he was helped by the rich Spanish merchants. At Bruges he became acquainted with the famous Spanish scholar, Juan Luis Vives, with whom he lodged. In the summer of 1530 he went to London, where he received alms more abundantly than elsewhere. As he could only support himself at Paris with difficulty, it was impossible to send for his companions in Salamanca. Others, however, joined him in Paris, and to some of them he gave the *Spiritual Exercises*, with the result that the Inquisition made him give up speaking on religious subjects during the time he was a student. At the end of 1529 he came into contact with the men who were eventually to become the first fathers of the Society of Jesus. He won over the Savoyard Pierre Lefèvre (Faber), whose room he shared, and the Navarrese Francis Xavier, who taught philosophy in the college of St Barbara. Afterwards he became acquainted with the young Castilian, Diego Laynez, who had heard of him at Acalá and found him out in Paris. With Laynez came two other young men, the Toledan Alfonso Salmeron and the Portuguese Simon Rodriguez. Nicholas Bobadilla, a poor Spaniard who had finished his studies, was the next to join him. The little company of seven determined to consecrate their union by vows. On the 15th of August 1534, the Feast of the Assumption, they assembled in the crypt of the church of St Mary on Montmartre, and Faber, the only one who was a priest, said Mass. They then took the vows of poverty and chastity, and pledged themselves to go to the Holy Land as missionaries or for the purpose of tending the sick; or if this design should prove impracticable, to go to Rome and place themselves at the disposal of the pope for any purpose. But, whatever may have been the private opinion of Ignatius, there was on this occasion no foundation of any society. The vows were individual obligations which could be kept quite apart from membership in a society. A provision was made that if, after waiting a year at Venice, they were unable to go to Jerusalem, this part of the vow should be cancelled and they should at once betake themselves to Rome.

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[1] Louis de Berquin, who died on the 17th of April 1529, belonged to a noble family of Artois. He was a man of exemplary life and a friend of Erasmus and the humanists, besides being a *persona grata* at the court of Louise of Savoy and Francis I. His main offence was that he attacked the monks and clergy, and that he advocated the reading of the Scriptures by the people in the vulgar tongue.—(W. A. P.)

At this time Ignatius was again suffering from his former imprudent austerities; and he was urged to return for a while to his native air. He left Paris for Spain in the autumn of 1535, leaving Faber in charge of his companions to finish their studies. During the absence of Ignatius, Faber gained three more adherents. But before leaving Paris Ignatius heard once more that complaints had been lodged against him at the Inquisition; but these like the others were found to be without any foundation. When he arrived near Loyola he would not go to the castle, but lived at the public hospice at Azpeitia, and began his usual life of teaching Christian doctrine and reforming morals. Falling ill again he went to other parts of Spain to transact business for his companions. Then, sailing from Valencia to Genoa, he made his way to Venice, where he arrived during the last days of 1535. Here he waited for a year until his companions could join him, and meanwhile he occupied himself in his usual good works, gaining several more companions and meeting Giovanni Piero Caraffa, afterwards Paul IV., who had lately founded the Theatines. What happened between the two does not appear; but henceforth Caraffa seems to have borne ill will towards Ignatius and his companions. At Venice Ignatius was again accused of heresy, and it was said that he had escaped from the Inquisition in Spain and had been burnt in effigy at Paris. These charges he met successfully by insisting that the nuncio should thoroughly inquire into the matter.

After a journey of fifty-four days his companions arrived at Venice in January 1537; and here they remained until the beginning of Lent, when Ignatius sent them to Rome to get money for the proposed voyage to Palestine. He himself stayed behind, as he feared that, if he went with them, Caraffa at Rome, together with Dr Ortiz, a German opponent in Paris and now Charles V.'s ambassador at the Vatican, would prejudice the pope against them. But Ortiz proved a friend and presented them to Paul III., who gave them leave to go to Palestine to preach the Gospel, bestowing upon them abundant alms. He likewise gave licence for those not yet priests to be ordained by any catholic bishop on the title of poverty. They had returned to Venice where Ignatius and the others were ordained priests on the 24th of June 1537, after having renewed their vows of poverty and chastity to the legate Verallo. Ignatius, now a priest, waited for eighteen months before saying Mass, which he did for the first time on the 25th of December 1538 in the church of Santa Maria Maggiore in Rome.

The year of waiting passed away without any chance of going to the Holy Land. Finding it impossible to keep this part of their vow, the fathers met at Vicenza, where Ignatius was staying in a ruined monastery; and here after deliberation it was determined that he, Laynez and Faber should go to Rome to place the little band at the disposal of the pope. It was now that the Society began to take some visible form. A common rule was devised and a name adopted. Ignatius declared that having assembled in the name of Jesus, the association should henceforth bear the name of the "Company of Jesus." The word used shows Loyola's military ideal of the duties and methods of the nascent society.

On the road to Rome a famous vision took place, as to which we have the evidence of Ignatius himself. In a certain church, a few miles before Rome, whilst in prayer he was aware of a stirring and a change in his soul; and so openly did he see God the Father placing him with Christ, that he could not dare to doubt that God the Father had so placed him. Subsequent writers add that Christ, looking at him with a benign countenance, said: "I shall be propitious to you"; while others add the significant words, "at Rome." Ignatius, however, says nothing about so important a matter; indeed he understood the vision to mean that many things would be adverse to them, and told his companions when they reached the city that he saw the windows there closed against him. He also said: "We must of necessity proceed with caution; and we must not make the acquaintance of women unless they be of very high rank." They arrived in Rome in October 1537; and lived at first in a little cottage in a vineyard and near the Trinità dei Monti. The pope appointed Faber to teach Holy Scripture, and Laynez scholastic theology, in the university of the Sapienza. Ignatius was left free to carry on his spiritual work, which became so large that he was obliged to call his other companions to Rome. During the absence of the pope, a certain hermit began to spread heresy and was opposed by Ignatius and his companions. In revenge the hermit brought up the former accusations concerning the relations to the Inquisition, and proclaimed Ignatius and his friends to be false, designing men and no better than concealed heretics. The matter was examined and the legate ordered the suit to be quashed. But this did not suit Ignatius. It was necessary for his own good repute and the future of his work that a definitive sentence should be pronounced and his name cleared once and for all. The legate demurred; but on the pope's return sentence was formally given in his favour.

The life of Ignatius is now mainly identified with the formation and growth of his Society (see JESUITS), but his zeal found other outlets in Rome. He founded institutions for rescuing fallen women, started orphanages and organized catechetical instructions. He obtained, after difficulty, the official recognition of his Society from Paul III. on the 27th of September 1540, and successfully steered it through many perils that beset it in its early days. He was unanimously elected the first general in April 1541; and on the 22nd of that month received the first vows of the Society in the church of San Paolo *fuori la mura*. Two works now chiefly occupied the remainder of his life: the final completion of the *Spiritual Exercises* and the drawing up of the *Constitutions*, which received their final form after his death. These two are so constantly connected that the one cannot be understood without the other. The *Constitutions* are discussed in the article on the Jesuits. In these he taught his followers to respond to the call; by the *Spiritual Exercises* he moulded their character.

The Book of the Spiritual Exercises has been one of the world-moving books. In its strict conception it is only an application of the Gospel precepts to the individual soul. Its object is to convince a man of sin, of justice and of judgment. The idea of the book is not original to Ignatius. At Montserrato he had found in use a popular translation of the *Exercitatorio de la vida spiritual* (1500), written in Latin by Abbot Garcias de Cisneros (d. 1510), and divided into three ways or periods during which purity of soul, enlightenment and union are to be worked for; a fourth part is added on contemplation. This book evidently afforded the root idea of the Ignatian and more famous book. But the differences are great. While taking the title, the idea of division by periods and the subjects of most of the meditations from the older work, Ignatius skilfully adapted it to his own requirements. Above all the methods of the two are essentially different. The Benedictine work follows the old monastic tradition of the direct intercourse of the soul with God. Ignatius, with his military instinct and views of obedience, intervenes with a director who gives the exercises to the person who in turn receives them. If this introduction of the director is essential to the end for which Ignatius framed his *Exercises*, in it we also find dangers. A director, whose aim is only the personal advantage of the one who is receiving the exercises, will be the faithful interpreter of his founder's intentions: but in the case of one whose *esprit de corps* is unbalanced, the temporary and pecuniary advantage of the Society may be made of more importance than that of the exercitant. Another danger may come when minuteness of direction takes away the wholesome sense of responsibility. Apart from these abuses the *Spiritual Exercises* have proved their value over and over again, and have received the sincerest form of flattery in countless imitations. The original parts of the book are principally to be found in the meditations, which are clearly Ignatian in conception as well as method. These are *The Reign of Christ*, wherein Christ as an earthly king calls his subjects to war: and *Two Standards*, one of Jesus Christ and the other of Lucifer. Besides these there are various additions to the series of meditations, which are mostly the practical results of the experiences which Ignatius went through in the early stages of his conversion. He gives various methods of prayer; methods of making an election; his series of rules for the discernment of spirits; rules for the distribution of alms and the treatment of scruples; tests of orthodoxy. These additions are skilfully worked into the series of meditations; so that when the exercitant by meditation has moved his soul to act, here are practical directions at hand.

The exercises are divided into four series of meditations technically called "weeks," each of which may last as long as the director considers necessary to achieve the end for which each week is destined. But the whole period is generally concluded in the space of a month. The first week is the foundation, and has to do with the consideration of the end of man, sin, death, judgment and hell. Having purified the soul from sin and obtained a detestation thereof, the second week treats of the kingdom of Christ, and is meant to lead the soul to make an election of the service of God. The third and fourth weeks are intended to confirm the soul in the new way chosen, to teach how difficulties can be overcome, to inflame it with the love of God and to help it to persevere.

The Book of the Spiritual Exercises was not written at Manresa, although there is in that place an inscription testifying to the supposed fact. Ignatius was constantly adding to his work as his own personal experience increased, and as he watched the effects of his method on the souls of those to whom he gave the exercises. The latest critics, even those of the Society itself, give 1548 as the date when the book received its final touches; though Father Roothaan gives Rome, the 9th of July 1541, as the date at the end of the ancient MS. version. Ignatius wrote originally in Spanish, but the book was twice translated into Latin during his lifetime. The more elegant version (known as the common edition) differs but slightly from the Spanish. Francisco Borgia, while duke of Gandia, petitioned Paul III. to have the book examined and approved. The pope appointed censors for both translations, who found the work to be replete with piety and holiness, highly useful and wholesome. Paul III. on receiving this report confirmed it on the 31st of July 1548 by the breve *Pastoralis officii cura*. This book, which is rightly called the spiritual arm of the Society, was the first book published by the Jesuits.

The progress of the Society of Jesus in Loyola's lifetime was rapid (see JESUITS). Having always had an attraction for a life of prayer and retirement, in 1547 he tried to resign the generalship, and again in 1550, but the fathers unanimously opposed the project. One of his last trials was to see in 1556 the election as pope of his old opponent Caraffa, who soon showed his intention of reforming certain points in the Society that Ignatius considered vital. But at this difficult crisis he never lost his peace of mind. He said: "If this misfortune were to fall upon me, provided it happened without any fault of mine, even if the Society were to melt away like salt in water, I believe that a quarter of an hour's recollection in God would be sufficient to console me and to re-establish peace within me." It is clear that Ignatius never dreamed of putting his Society before the church nor of identifying the two institutions.

In the beginning of 1556 Ignatius grew very weak and resigned the active government to three fathers, Polanco, Madrid and Natal. Fever laid hold of him, and he died somewhat suddenly on the 31st of July 1556, without receiving or asking for the last sacraments. He was beatified in 1609 by Paul V. and canonized in 1628 by Gregory XV. His body lies under the altar in the north transept of the Gesù in Rome.

His portrait is well known. The olive complexion, a face emaciated by austerities, the large forehead, the brilliant and small eyes, the high bald head tell their own tale. He was of medium height and carried himself so well that his lameness was hardly noticeable. His character was naturally impetuous and enthusiastic, but became marked with great self-control as he gradually brought his will under his reason. There was always that love of overcoming difficulty inherent in a chivalrous nature; and this also accounts for that desire of surpassing every one else that marked his early days. Whilst other Christians, following St Paul, were content to do all things for the glory of God, Ignatius set himself and his followers to strive after the greater glory. Learning by his own experience and errors, he wisely developed a sovereign prudence which nicely adjusted means to the end in view. He impressed on his followers the doctrine that in all things the end was to be considered. Never would Ignatius have countenanced so perverted an idea as that the end justified the means, for with his spiritual light and zeal for God's glory he saw clearly that means in themselves unjust were opposed to the very end he held in view. As a ruler he displayed the same common sense. Obedience he made one of his great instruments, yet he never intended it to be a galling yoke. His doctrine on the subject is found in the well-known letter to the Portuguese Jesuits in 1553, and if this be read carefully together with the *Constitutions* his meaning is clear. If he says that a subject is to allow himself to be moved and directed, under God, by a superior just as though he were a corpse or as a staff in the hands of an old man, he is also careful to say that the obedience is only due in all things "wherein it cannot be defined (as it is said) that any kind of sin appears." The way in which his teaching on obedience is practically carried out is the best corrective of the false ideas that have arisen from misconceptions of its nature. His high ideas on the subject made him a stern ruler. There are certain instances in his life which, taken by themselves, show a hardness in treating individuals who would not obey; but as a rule, he tempered his authority to the capacity of those with whom he had to deal. When he had to choose between the welfare of the Society and the feelings of an individual it was clear to which side the balance would fall.

There was in his character a peculiar mixture of conservatism and a keen sense of the requirements of the day. In intellectual matters he was not in advance of his day. The Jesuit system of education, set forth in the *Ratio studiorum*, owes nothing to him. While he did not reject any approved learning, he abhorred any intellectual culture that destroyed or lessened piety. He wished to secure uniformity in the judgment of the Society even in points left open and free by the church: "Let us all think in the same way, let us all speak in the same manner if possible." Bartole, the official biographer of Ignatius, says that he would not permit any innovation in the studies; and that, were he to live five hundred years, he would always repeat "no novelties" in theology, in philosophy or in logic—not even in grammar. The revival of learning had led many away from Christ; intellectual culture must be used as a means of bringing them back. The new learning in religion had divided Christendom; the old learning of the faith, once delivered to the saints, was to reconcile them. This was the problem that faced Ignatius, and in his endeavour to effect a needed reformation in the individual and in society his work and the success that crowned it place him among the moral heroes of humanity.

BIBLIOGRAPHY.—The Ignatian literature is very large. Fortunately we have in the *Acta quaedam* what is in effect the autobiography of the saint. This has been translated into English under the title of *The testament of Ignatius Loyola, being sundry acts of our Father Ignatius, under God, the first founder of the Society of Jesus, taken down from the Saint's own lips by Luis Gonzales* (London, 1900); and the above account of Ignatius is taken in most places directly from this, which is not only the best of all sources but also a valuable corrective of the later and more imaginative works. Next to the *Acta quaedam* comes in value Polanco's *Vita Ignatii Loiolae*, which is published in the *Monumenta historica Societatis Jesu* now in progress. Polanco was the saint's secretary towards the end of his life. Ribadeneira, who as a youth had been associated with the founder, wrote his *Vida del S. Ignacio de Loyola* (Madrid, 1594), based on an early Latin work (Naples, 1572). Bartole, the official biographer, wrote his *Della vita e dell' instituto di S. Ignatio* (Rome, 1650, 1659); Genelli wrote *Das Leben des heiligen Ignatius von Loyola* (Innsbruck, 1848); Nicolas Orlandinus gives a life in the first volume of the *Historiae Societatis Jesu* (Rome, 1615). It would be impossible to give a list even of the other lives, most of which are without value as histories, being written mainly for edification. But the student may be referred to the modern books Henri Joli's *St Ignace de Loyola* (Paris, 1899), which is based on the best authorities, and to H. Müller's curious *Les Origines de la Compagnie de Jésus* (Paris, 1898), in which the author tries to establish a Mahommedan origin for many of the ideas adopted by the saint.

The literature connected with the *Spiritual Exercises* is also large. It will be sufficient here to mention: *A Book of Spiritual Exercises, written by Garcias de Cisneros* (London, 1876); the official Latin text in the third volume of the Avignon edition of the *Constitutions* (1830); Roothaan's *Exercitia spiritualia S. P. Ignatii de Loyola, cum versione litterali ex autographo Hispanico, notis illustrata* (Namur, 1841); Diertino, *Historia exercitiorum S. P. Ignatii de Loyola* (1887). Especially worthy of notice is P. Watrigant's *La Genèse des exercices de Saint Ignace de Loyola*, republished from *Les Études* (20th May, 20th July, 20th October 1897). (E. Tn.)

LOZENGE (from the Fr. *losenge*, or *losange*; the word also appears in Span. *losanje*, and Ital. *losanga*; perhaps derived from a word meaning a stone slab laid on a grave, which appears in forms such as Provençal *lousa*, Span. *losa*, the ultimate origin of which is unknown, the Lat. *lapis*, stone, or *laus*, praise, in the sense of epitaph, have been suggested), properly a four equal-sided figure, having two acute and two obtuse angles, a rhomb or "diamond." The figure is frequently used as a bearing in heraldry and especially as a shield so shaped on which the arms of a widow or spinster are emblazoned. It is used also to denote the diamond-shaped facets of a precious stone when cut, also the diamond panes of a casement window. In the 14th century the "lozenge pattern" was a favourite design for decoration. The word is also applied to a small tablet of sugar, originally diamond shaped, containing either medical drugs or some simple flavouring, or to a tablet of any concentrated substance, such as a meat-lozenge. In the reign of James I. of Scotland (1406–1437) a Scotch gold coin having a lozenge-shaped shield with the arms of Scotland on the obverse side was called a "lozenge-lion."

LOZÈRE, a department of south-eastern France belonging to the central plateau, composed of almost the whole of Gévaudan and of some portions of the old dioceses of Uzès and Alais, districts all formerly included in the province of Languedoc. Pop. (1906) 128,016. Area, 1999 sq. m. It is bounded N. by Cantal and Haute-Loire, E. by Ardèche and Gard, S. by Gard and Aveyron and W. by Aveyron and Cantal. Lozère is mountainous throughout and in average elevation is the highest of all the French departments. It has three distinct regions—the Cévennes proper to the south-east, the *causses* to the south-west and the mountain tracts which occupy the rest of its area. The Cévennes begin (within Lozère) with Mont Aigoual, which rises to a height of more than 5100 ft.; parallel to this are the mountains of Bougès, bold and bare on their southern face, but falling gently with wooded slopes towards the Tarn which roughly limits the Cévennes on the north. To the north of the Tarn is the range of Lozère, including the peak of Finiels, the highest point of the department (5584 ft.). Farther on occurs the broad marshy plateau of Montbel, which drains southward to the Lot, northwards to the Allier, eastward by the Chassezac to the Ardèche. From this plateau extend the mountains of La Margeride, undulating granitic tablelands partly clothed with woods of oak, beech and fir, and partly covered with pastures, to which flocks are brought from lower Languedoc in summer. The highest point (Truc de Randon) reaches 5098 ft. Adjoining the Margeride hills on the west is the volcanic range of Aubrac, a pastoral district where horned cattle take the place of sheep; the highest point is 4826 ft. The *causses* of Lozère, having an area of about 564 sq. m., are calcareous, fissured and arid, but separated from each other by deep and well-watered gorges, contrasting with the desolate aspect of the plateaus. The *causse* of Sauveterre, between the Lot and the Tarn, ranges from 3000 to 3300 ft. in height; that of Méjan has nearly the same average altitude, but has peaks some 1000 ft. higher. Between these two *causses* the Tarn valley is among the most picturesque in France. Lozère is watered entirely by rivers rising within its own boundaries, being in this respect unique. The climate of Lozère varies greatly with the locality. The mean temperature of Mende (50° F.) is below that of Paris; that of the mountains is always low, but on the *causses* the summer is scorching and the winter severe; in the Cévennes the climate becomes mild enough at their base (656 ft.) to permit the growth of the olive. Rain falls in violent storms, causing disastrous floods. On the Mediterranean versant there are 76 in., in the Garonne basin 46 and in that of the Loire only 28. Sheep and cattle-rearing and cheese-making are the chief occupations. Bees are kept, and, among the Cévennes, silkworms. Large quantities of chestnuts are exported from the Cévennes, where they form an important article of diet. In the valley of the Lot wheat and fruit are the chief products; elsewhere rye is the chief cereal, and oats, barley, meslin and potatoes are also grown. Fruit trees and leguminous plants are irrigated by small canals (*béals*) on terraces made and maintained with much labour. Lead, zinc and antimony are found. Saw-milling, the manufacture of wooden shoes and wool-spinning are carried on; otherwise industries are few and unimportant. Of mineral springs, those of Bagnols-les-Bains are most frequented. The line of the Paris-Lyon company from Paris to Nîmes traverses the eastern border of the department, which is also served by the Midi railway with the line from Neussargues to Béziers via Marvéjols. The arrondissements are Mende, Florac and Marvéjols; the cantons number 24, the communes 198. Lozère forms the diocese of Mende and part of the ecclesiastical province of Albi. It falls within the region of the XVI. army corps, the circumscriptions of the *académie* (educational division) of Montpellier and the appeal court of Nîmes. Mende (*q.v.*) is its most important town.

LUANG-PRABANG, a town of French Indo-China, capital of the Lao state of that name, on the left bank of the Me Kong river. It lies at the foot of the pagoda hill which rises about 200 ft. above the plain on the promontory of land round which the Nam Kan winds to the main river. It has a population of about 9000 and contains the "palace" of the king of the state and several pagodas. In 1887 it was taken and sacked by the Haw or Black Flags, robber bands of Chinese soldiery, many of them survivors of the Taiping rebellion. In 1893 Siam was compelled to renounce her claims to the left bank of the Me Kong, including Luang-Prabang and the magnificent highlands of Chieng Kwang. That portion of the state which was on the right bank of the Me Kong was not affected by the treaty, except in so far as a portion of it fell within the sixteen miles' zone within which Siam agreed not to keep troops. Trade is in the hands of Chinese or Shan traders; hill rice and other jungle products are imported from the surrounding districts by the Kha or hill people. The exports, which include rubber, gum benjamin, silk, wax, sticklac, cutch, cardamon, a little ebony, cinnamon, indigo, rhinoceros and deer horns, ivory and fish roe, formerly all passed by way of Paklai to the Me Nam, and so to Bangkok, but have now almost entirely ceased to follow that route, the object of the French government being to deflect the trade through French territory. Luang-Prabang is the terminus of navigation on the upper Me Kong and the centre of trade thereon.

LUBAO, a town in the south-western part of the province of Pampanga, Luzon, Philippine Islands, about 30 m. N.W. of Manila. Pop. (1903) 19,063. Lubao is served by the Manila & Dagupan railway, and has water communication with Manila by tidal streams and Manila Bay. Its products are, therefore, readily marketed. It lies in a low, fertile plain, suited to the growing of rice and sugar. Many of the inhabitants occupy themselves in the neighbouring nipa swamps, either preparing the nipa leaves for use in house construction, or distilling "nipa-wine" from the juice secured by tapping the blossom stalks. The language is Pampangan.

LÜBBEN, a town of Germany, in the Prussian province of Brandenburg, on the Spree, 47 m. S.S.E. of Berlin, on the railway to Görlitz. Pop. (1905) 7173. It is the chief town of the Spreewald, and has saw-mills and manufactories of hosiery, shoes and paper, and is famous for its *gurken*, or small pickling cucumbers. The poet Paul Gerhardt (1607–1676) was pastor here and is buried in the parish church.

LÜBECK, a state and city (*Freie und Hansestadt Lübeck*) of Germany. The *principality* of Lübeck, lying north of the state, is a constituent of the grand-duchy of Oldenburg (*q.v.*). The state is situated on an arm of the Baltic between Holstein and Mecklenburg-Schwerin. It consists of the city of Lübeck, the town of Travemünde, 49 villages and the country districts, embraces 115 sq. m. of territory, and had a population in 1907 of 109,265, of which 93,978 were included in the city and its immediate suburbs. The state lies in the lowlands of the Baltic, is diversified by gently swelling hills, and watered by the Trave and its tributaries, the Wakenitz and the Stecknitz. The soil is fertile, and, with the exception of forest land (14% of the whole area), is mostly devoted to market gardening. Trade is centred in the city of Lübeck.

The constitution of the free state is republican, and, by the fundamental law of 1875, amended in 1905 and again in 1907, consists of two assemblies. (1) The Senate of fourteen members, of whom eight must belong to the learned professions, and six of these again must be jurists, while of the remaining six, five must be merchants. The Senate represents the sovereignty of the state and is presided over by the *Oberbürgermeister*, who during his two years' term of office bears the title of "magnificence." (2) The House of Burgesses (Bürgerschaft), of 120 members, elected by free suffrage and exercising its powers partly in its collective capacity and partly through a committee of thirty members. Purely commercial matters are dealt with by the chamber of commerce, composed of a *praeses*, eighteen members and a secretary. This body controls the exchange and appoints brokers, shipping agents and underwriters. The executive is in the hands of the Senate, but the House of Burgesses has the right of initiating legislation, including that relative to foreign treaties; the sanction of both chambers is required to the passing of any new law. Lübeck has a court of first instance (*Amtsgericht*) and a high court of justice (*Landgericht*); from the latter appeals lie to the Hanseatic court of appeal (*Oberlandesgericht*) at Hamburg, and from this again to the supreme court of the empire (*Reichsgericht*) in Leipzig. The people are nearly all Lutherans, and education is compulsory between the ages of six and fourteen.

The estimated revenue for the year 1908–1909 amounted to about £650,000, and the expenditure to a like sum. The public debt amounted, in 1908, to about £2,518,000. Lübeck has one vote in the federal council (*Bundesrat*) of the German Empire, and sends one representative to the imperial parliament (*Reichstag*).

History of the Constitution.—At the first rise of the town justice was administered to the inhabitants by the *Vogt* (*advocatus*) of the count of Holstein. Simultaneously with its incorporation by Henry the Lion, duke of Saxony, who presented the city with its own mint toll and market, there appears a magistracy of six, chosen probably by the *Vogt* from the *Schöffen* (*scabini, probi homines*). The members of the town council had to be freemen, born in lawful wedlock, in the enjoyment of estates in freehold and of unstained repute. Vassals or servants of any lord, and tradespeople, were excluded. A third of the number had annually to retire for a year, so that two-thirds formed the sitting council. By the middle of the 13th century there were two burgomasters (*magistri burgensium*). Meanwhile, the number of magistrates (*consules*) had increased, ranging from twenty to forty and upwards. The council appointed its own officers in the various branches of the administration. In the face of so much self-government the *Vogt* presently disappeared altogether. There were three classes of inhabitants, full freemen, half freemen and guests or foreigners. People of Slav origin being considered unfree, all intermarriage with them tainted the blood; hence nearly all surnames point to Saxon, especially Westphalian, and even Flemish descent. The magistracy was for two centuries almost exclusively in the hands of the merchant aristocracy, who formed the companies of traders or "nations," such as the *Bergen-fahrer*, *Novgorod-fahrer*, *Riga-fahrer* and *Stockholm-fahrer*. From the beginning, however, tradesmen and handicraftsmen had settled in the town, all of them freemen of German parentage and with property and houses of their own. Though not eligible for the council, they shared to a certain extent in the self-government through the aldermen of each corporation or gild, of which some appear as early as the statutes of 1240. Naturally, there arose much jealousy between the gilds and the aristocratic companies, which exclusively ruled the republic. After an attempt to upset the merchants had been suppressed in 1384, the gilds succeeded, under more favourable circumstances, in 1408. The old patrician council left the city to appeal to the Hansa and to the imperial authorities, while a new council with democratic tendencies, elected chiefly from the gilds, took their place. In 1416, however, owing to the pressure brought to bear by the Hansa, by the emperor Sigismund and by Eric, king of Denmark, there was a restoration. The aristocratic government was again expelled under the dictatorship of Jürgen Wullenweber (*c.* 1492–1537), till the old order was re-established in 1535. In the constitution of 1669, under the pressure of a large public debt, the great companies yielded a specified share in the financial administration to the leading gilds of tradesmen. Nevertheless, the seven great companies continued to choose the magistrates by co-optation among themselves. Three of the four burgomasters and two of the senators, however, had henceforth to be graduates in law. The constitution, set aside only during the French occupation, has subsequently been slowly reformed. From 1813 the popular representatives had some share in the management of the finances. But the reform committee of 1814, whose object was to obtain an extension of the franchise, had made little progress, when the events of 1848 led to the establishment of a representative assembly of 120 members, elected by universal suffrage, which obtained a place beside the senatorial government. The republic has given up its own military contingent, its coinage and its postal dues to the German Empire; but it has preserved its municipal self-government and its own territory, the inhabitants of which enjoy equal political privileges with the citizens.

The City of Lübeck.—Lübeck, the capital of the free state, was formerly the head of the Hanseatic League. It is situated on a gentle ridge between the rivers Trave and Wakenitz, 10 m. S.W. of the mouth of the former in the bay of Lübeck, 40 m. by rail N.E. of Hamburg, at the junction of lines to Eutin, Büchen, Travemünde and Strassburg (in Mecklenburg-Schwerin) and consists of an inner town and three suburbs. The former ramparts between the Trave and the old town ditch have been converted into promenades. The city proper retains much of its ancient grandeur, despite the tendency to modernize streets and private houses. Foremost among its buildings must be mentioned its five chief churches, stately Gothic edifices in glazed brick, with lofty spires and replete with medieval works of art—pictures, stained glass and tombs. Of them, the Marienkirche, built in the 13th century, is one of the finest specimens of early Gothic in Germany. The cathedral, or *Domkirche*, founded in 1173, contains some curious sarcophagi and a magnificent altar-piece in one of the chapels, while the churches of St James (*Jakobikirche*), of St Peter (*Petrikirche*) and of St Aegidius (*Aegidienkirche*) are also remarkable. The *Rathaus* (town hall) of red and black glazed brick, dating from various epochs during the middle ages, is famous for its staircase, the vaulted wine cellar of the city council beneath and magnificent wood carving. There should also be mentioned the *Schiffershaus*; the medieval gates (Holstentor, Burgtor); and the Hospital of the Holy Ghost, remarkable for ancient frescoes and altars in rich wood carving, the entrance hall of which is a 13th-century chapel, restored in 1866 and decorated in 1898. The museum preserves the most remarkable municipal archives in existence as well as valuable collections of historical documents.

The poet, Emanuel Geibel (1889), and the painter, Johann Friedrich Overbeck (1789–1869), were natives of Lübeck. This city is famous for the number and wealth of its charitable institutions. Its position as the first German emporium of the west end of the Baltic has been to some extent impaired by Hamburg and Bremen since the construction of the North Sea and Baltic Canal, and by the rapid growth and enterprise of Stettin. In order to counterbalance their rivalry, the quays have been extended, a canal was opened in 1900 between the Trave and the Elbe, the river up to the wharves has been deepened to 25 ft. or more. The river is kept open in winter by ice-breakers. A harbour was made in 1899–1900 on the Wakenitz Canal for boats engaged in inland traffic, especially on the Elbe and Elbe-Trave Canal. Lübeck trades principally with Denmark, Sweden, Finland, Russia, the eastern provinces of Prussia, Great Britain and the United States. The imports amounted in value to about £4,850,000 in 1906 and the exports to over £10,000,000. The chief articles of import are coal, grain, timber, copper, steel and wine, and the exports are manufactured goods principally to Russia and Scandivania. The industries are growing, the chief being breweries and distilleries, saw-mills and planing-mills, shipbuilding, fish-curing, the manufacture of machinery, engines, bricks, resin, preserves, enamelled and tin goods, cigars, furniture, soap and leather. Pop. (1885) 55,399; (1905) 91,541.

History.—Old Lübeck stood on the left bank of the Trave, where it is joined by the river Schwartau, and was destroyed in 1138. Five years later Count Adolphus II. of Holstein founded new Lübeck, a few miles farther up, on the peninsula Buku, where the Trave is joined on the right by the Wakenitz, the emissary of the lake of Ratzeburg. An excellent harbour, sheltered against pirates, it became almost at once a competitor for the commerce of the Baltic. Its foundation coincided with the beginning of the advance of the Low German tribes of Flanders, Friesland and Westphalia along the southern shores of the Baltic—the second great emigration of the colonizing Saxon element. In 1140 Wagria, in 1142 the country of the Polabes (Ratzeburg and Lauenburg), had been annexed by the Holtsaetas (the Transalbingian Saxons). From 1166 onwards there was a Saxon count at Schwerin. Frisian and Saxon merchants from Soest, Bardowiek and other localities in Lower Germany, who already navigated the Baltic and had their factory in Gotland, settled in the new town, where Wendish speech and customs never entered. About 1157 Henry the Lion, duke of Saxony, forced his vassal, the count of Holstein, to give up Lübeck to him; and in 1163 he removed thither the episcopal see of Oldenburg (Stargard), founding at the same time the dioceses of Ratzeburg and Schwerin. He issued the first charter to the citizens, and constituted them a free Saxon community having their own magistrate, an advantage over all other towns of his dominions. He invited traders of the north to visit his new market free of toll and custom, providing his subjects were promised similar privileges in return. From the beginning the king of Denmark granted them a settlement for their herring fishery on the coast of Schoonen. Adopting the statutes of Soest in Westphalia as their code, Saxon merchants exclusively ruled the city. In concurrence with the duke's *Vogt* (*advocatus*) they recognized only one right of judicature within the town, to which nobles as well as artisans had to submit. Under these circumstances the population grew rapidly in wealth and influence by land and sea, so that, when Henry was attainted by the emperor, Frederick I., who came in person to besiege Lübeck in 1181, this potentate," in consideration of its revenues and its situation on the frontier of the Empire," fixed by charter, dated the 19th of September 1188, the limits, and enlarged the liberties, of the free town. In the year 1201 Lübeck was conquered by Waldemar II. of Denmark. But in 1223 it regained its liberty, after the king had been taken captive by the count of Schwerin. In 1226 it was made a free city of the Empire by Frederick II., and its inhabitants took part with the enemies of the Danish king in the victory of Bornhövede in July 1227. The citizens repelled the encroachments of their neighbours in Holstein and in Mecklenburg. On the other hand their town, being the principal emporium of the Baltic by the middle of the 13th century, acted as the firm ally of the Teutonic knights in Livonia. Emigrants founded new cities and new sees of Low German speech among alien and pagan races; and thus in the course of a century the commerce of Lübeck had supplanted that of Westphalia. In connexion with the Germans at Visby, the capital of Gotland, and at Riga, where they had a house from 1231, the people of Lübeck with their armed vessels scoured the sea between the Trave and the Neva. They were encouraged by papal bulls in their contest for the rights of property in wrecks and for the protection of shipping against pirates and slave-hunters. Before the close of the century the statutes of Lübeck were adopted by most Baltic towns having a German population, and Visby protested in vain against the city on the Trave having become the court of appeal for nearly all these cities, and even for the German settlement in Russian Novgorod. In course of time more than a hundred places were embraced in this relation, the last vestiges of which did not disappear until the beginning of the 18th century. From about 1299 Lübeck presided over a league of cities, Wismar, Rostock, Stralsund, Greifswald and some smaller ones, and this Hansa of towns became heir to a Hansa of traders simultaneously on the eastern and the western sea, after Lübeck and her confederates had been admitted to the same privileges with Cologne, Dortmund and Soest at Bruges and in the steelyards of London, Lynn and Boston. The union held its own, chiefly along the maritime outskirts of the Empire, rather against the will of king and emperor, but nevertheless Rudolph of Habsburg and several of his successors issued new charters to Lübeck. As early as 1241 Lübeck, Hamburg and Soest had combined to secure their highways against robber knights. Treaties to enforce the public peace were concluded in 1291 and 1338 with the dukes of Brunswick, Mecklenburg and Pomerania, and the count of Holstein. Though the great federal armament against Waldemar IV., the destroyer of Visby, was decreed by the city representatives assembled at Cologne in 1367, Lübeck was the leading spirit in the war which ended with the surrender of Copenhagen and the peace concluded at Stralsund on the 24th of May 1370. Her burgomaster, Brun Warendorp, who commanded the combined naval and land forces, died on the field of battle. In 1368 the seal of the city, a double-headed eagle, which in the 14th century took the place of the more ancient ship, was adopted as the common seal of the confederated towns (*civitates maritimae*), some seventy in number. Towards the end of the 15th century the power of the Hanseatic League began to decline, owing to the rise of Burgundy in the west, of Poland and Russia in the east and the emancipation of the Scandinavian kingdom from the union of Calmar. Still Lübeck, even when nearly isolated, strove to preserve its predominance in a war with Denmark (1501–12), supporting Gustavus Vasa in Sweden, lording it over the north of Europe during the years 1534 and 1535 in the person of Jürgen Wullenweber, the democratic burgomaster, who professed the most advanced principles of the Reformation, and engaging with Sweden in a severe naval war (1536–70).

But the prestige and prosperity of the town were beginning to decline. Before the end of the 16th century the privileges of the London Steelyard were suppressed by Elizabeth. As early as 1425 the herring, a constant source of early wealth, began to forsake the Baltic waters. Later on, by the discovery of a new continent, commerce was diverted into new directions. Finally, with the Thirty Years' War, misfortunes came thick. The last Hanseatic diet met at Lübeck in 1630, shortly after Wallenstein's unsuccessful attack on Stralsund; and from that time merciless sovereign powers stopped free intercourse on all sides. Danes and Swedes battled for the possession of the Sound and for its heavy dues. The often changing masters of Holstein and Lauenburg abstracted much of the valuable landed property of the city and of the chapter of Lübeck. Towards the end of the 18th century there were signs of improvement. Though the Danes temporarily occupied the town in 1801, it preserved its freedom and gained some of the chapter lands when the imperial constitution of Germany was broken up by the act of February 1803, while trade and commerce prospered for a few years. But in November 1806, when Blücher, retiring from the catastrophe of Jena, had to capitulate in the vicinity of Lübeck, the town was sacked by the French. Napoleon annexed it to his empire in December 1810. But it rose against the French in March 1813, was re-occupied by them till the 5th of December, and was ultimately declared a free and Hanse town of the German Confederation by the act of Vienna of the 9th of June 1815. The Hanseatic League, however, having never been officially dissolved, Lübeck still enjoyed its traditional connexion with Bremen and Hamburg. In 1853 they sold their common property, the London Steelyard; until 1866 they enlisted by special contract their military contingents for the German Confederation, and down to 1879 they had their own court of appeal at Lübeck. Lübeck joined the North German Confederation in 1866, profiting by the retirement from Holstein and Lauenburg of the Danes, whose interference had prevented as long as possible a direct railway between Lübeck and Hamburg. On the 27th of June 1867 Lübeck concluded a military convention with Prussia, and on the 11th of August 1868 entered the German Customs Union (*Zollverein*), though reserving to itself certain privileges in respect of its considerable wine trade and commerce with the Baltic ports.

See E. Deecke, *Die Freie und Hansestadt Lübeck* (4th ed., Lübeck, 1881) and *Lübische Geschichten und Sagen* (Lübeck, 1891); M. Hoffmann, *Geschichte der Freien und Hansestadt Lübeck* (Lübeck, 1889–1892) and *Chronik von Lübeck* (Lübeck, 1908); *Die Freie und Hansestadt Lübeck*, published by *Die geographische Gesellschaft in Lübeck* (Lübeck, 1891); C. W. Pauli, *Lübecksche Zustände im Mittelalter* (Lübeck, 1846–1878); J. Geffcken, *Lübeck in der Mitte des* 16^{ten} *Jahrhunderts* (Lübeck, 1905); P. Hasse, *Die Anfange Lübecks* (Lübeck, 1893); H. Bödeker, *Geschichte der Freien und Hansestadt Lübeck* (Lübeck, 1898); A. Holm, *Lübeck, die Freie und Hansestadt* (Bielefeld, 1900); G. Waitz, *Lübeck unter Jürgen Wullenweber* (Berlin, 1855–1856); Klug, *Geschichte Lübecks während der Vereinigung mit dem französischen Kaiserreich* (Lübeck, 1857); F. Frensdorff, *Die Stadt- und Gerichtsverfassung Lübecks im 12. und 13. Jahrhundert* (Lübeck, 1861); the *Urkundenbuch der Stadt Lübeck* (Lübeck, 1843–1904); the *Lübecker Chroniken* (Leipzig, 1884–1903); and the *Zeitschrift des Vereins für lübeckische Geschichte* (Lübeck, 1860 fol.).

(R. P.; P. A. A.)

LUBLIN, a government of Russian Poland, bounded N. by Siedlce, E. by Volhynia (the Bug forming the boundary), S. by Galicia, and W. by Radom (the Vistula separating the two). Area, 6499 sq. m. The surface is an undulating plain of Cretaceous deposits, 800 to 900 ft. in altitude, and reaching in one place 1050 ft. It is largely covered with forests of oak, beech and lime, intersected by ravines and thinly inhabited. A marshy lowland extends between the Vistula and the Wieprz. The government is drained by the Vistula and the Bug, and by their tributaries the Wieprz, San and Tanev. Parts of the government, being of black earth, are fertile, but other parts are sandy. Agriculture is in good condition. Many Germans settled in the government before immigration was stopped in 1887; in 1897 they numbered about 26,000. Rye, oats, wheat, barley and potatoes are the chief crops, rye and wheat being exported. Flax, hemp, buckwheat, peas, millet and beetroot are also cultivated. Horses are carefully bred. In 1897 the population was 1,165,122, of whom 604,886 were women. The Greek Orthodox (chiefly Little Russians in the south-east) amounted to 20·1% of the whole; Roman Catholics (*i.e.* Poles) to 62·8%; Jews to 14·2%; and Protestants to 2·8%. The urban population was 148,196 in 1897. The estimated population in 1906 was 1,362,500. Industrial establishments consist chiefly of distilleries, sugar-works, steam flour-mills, tanneries, saw-mills and factories of bent-wood furniture. Domestic industries are widely developed in the villages. River navigation employs a considerable portion of the population. The government is divided into ten districts, the chief towns of which, with their populations in 1897, are—Lublin, capital of the province (50,152); Biegoray (6286); Cholm (19,236); Hrubieszow (10,699); Yanów (7927); Krasnystaw or Kraznostav (8879); Lubartow (5249); Nova-Alexandrya or Pulawy (3892); Samostye (12,400); and Tomaszów (6224).

LUBLIN, a town of Russian Poland, capital of the government of the same name, 109 m. by rail S.E. of Warsaw, on a small tributary of the Wieprz. Pop. (1873) 28,900; (1897) 50,152. It is the most important town of Poland after Warsaw and Lodz, being one of the chief centres of the manufacture of thread-yarn, linen and hempen goods and woollen stuffs; there is also trade in grain and cattle. It has an old citadel, several palaces of Polish nobles and many interesting churches, and is the headquarters of the XIV. army corps, and the see of a Roman Catholic bishop. The cathedral dates from the 16th century. Of the former fortifications nothing remains except the four gates, one dating from 1342.

Lublin was in existence in the 10th century, and has a church which is said to have been built in 986. During the time the Jagellon dynasty ruled over Lithuania and Poland it was the most important city between the Vistula and the Dnieper, having 40,000 inhabitants (70,000 according to other authorities) and all the trade with Podolia, Volhynia and Red Russia. Indeed, the present town is surrounded with ruins, which prove that it formerly covered a much larger area. But it was frequently destroyed by the Tatars (*e.g.* 1240) and Cossacks (*e.g.* 1477). In 1568–1569 it was the seat of the stormy convention at which the union between Poland and Lithuania was decided. In 1702 another convention was held in Lublin, in favour of Augustus II. and against Charles XII. of Sweden, who carried the town by assault and plundered it. In 1831 Lublin was taken by the Russians. The surrounding country is rich in reminiscences of the struggle of Poland for independence.

LUBRICANTS. Machines consist of parts which have relative motion and generally slide and rub against each other. Thus the axle of a cart or railway vehicle is pressed against a metallic bearing surface supporting the body of the vehicle, and the two opposed surfaces slide upon each other and are pressed together with great force. If the metallic surfaces be clean, the speed of rubbing high, and the force pressing the surfaces together considerable, then the latter will abrade each other, become hot and be rapidly destroyed. It is possible, however, to prevent the serious abrasion of such opposing surfaces, and largely to reduce the frictional resistance they oppose to relative motion by the use of *lubricants* (Lat. *lubricare*, *lubricus*, slippery). These substances are caused to insinuate themselves between the surfaces, and have the property of so separating them as to prevent serious abrasion. The solid and semi-solid lubricants seem to act as rollers between the surfaces, or form a film between them which itself suffers abrasion or friction. The liquid lubricants, however, maintain themselves as liquid films between the surfaces, upon which the bearing floats. The frictional resistance is then wholly in the fluid. Even when lubricants are used the friction, *i.e.* the resistance to motion offered by the opposing surfaces, is considerable. In the article Friction will be found a statement of how friction is measured and the manner in which it is expressed. The coefficient of friction is obtained by dividing the force required to cause the surfaces to slide over each other by the load pressing them together. For clean unlubricated surfaces this coefficient may be as great as 0·3, whilst for well-lubricated cylindrical bearings it may be as small as 0·0006. Engineers have, therefore, paid particular attention to the design of bearings with the object of reducing the friction, and thus making use of as much as possible of the power developed by prime movers. The importance of doing this will be seen when it is remembered that the energy wasted is proportional to the coefficient of friction, and that the durability of the parts depends upon the extent to which they are separated by the lubricant and thus prevented from injuring each other.

There is great diversity in the shapes of rubbing surfaces, the loads they have to carry vary widely, and the speed of rubbing ranges from less than one foot to thousands of feet per minute. There is also a large number of substances which act as lubricants, some being liquids and others soft solids. In many instruments or machines where the surfaces in contact which have to slide upon each other are only lightly pressed together, and are only occasionally given relative motion, the lubricant is only needed to prevent abrasion. Microscopes and mathematical instruments are of this kind. In such cases, the lubricant which keeps the surfaces from abrading each other is a mere contamination film, either derived from the air or put on when the surfaces are finished. When such lubricating films are depended upon, the friction surfaces should be as hard as possible and, if practicable, of dissimilar metals. In the absence of a contamination film, most metals, if rubbed when in contact, will immediately adhere to each other. A large number of experiments have been made to ascertain the coefficient of friction under these imperfect conditions of lubrication. Within wide limits of load, the friction is proportional to the pressure normal to the surfaces and is, therefore, approximately independent of the area of the surfaces in contact. Although the static coefficient is often less than the kinetic at very low speeds, within wide limits the latter coefficient decreases with increasing speed. These laws apply to all bearings the velocity of rubbing of which is very small, or which are lubricated with solid or semi-solid materials.

When the speed of rubbing is considerable and the contamination film is liable to be destroyed, resort is had to lubricants which possess the power of keeping the surfaces apart, and thereby reducing the friction. The constant application of such substances is necessary in the case of such parts of machine tools as slide rests, the surfaces of which only move relatively to each other at moderate speeds, but which have to carry heavy loads. In all ordinary cases, the coefficient of friction of flat surfaces, such as those of slide blocks or pivot bearings, is high, owing to the fact that the lubricant is not easily forced between the surfaces. In the case of cylindrical bearing surfaces, such as those of journals and spindles, owing to the fact that the radius of the bearing surface is greater than that of the journal or spindle, the lubricant, if a liquid, is easily drawn in and entirely separates the surfaces (see LUBRICATION). Fortunately, cylindrical bearings are by far the most common and important form of bearing, and they can be so lubricated that the friction coefficient is very low. The lubricant, owing to its viscosity, is forced between the surfaces and keeps them entirely apart. This property of viscosity is one of the most important possessed by liquid lubricants. Some lubricants, such as the oils used for the light spindles of textile machinery, are quite thin and limpid, whilst others, suitable for steam engine cylinders and very heavy bearings, are, at ordinary temperatures, as thick as treacle or honey. Generally speaking, the greater the viscosity of the lubricant the greater the load the bearing will carry, but with thick lubricants the frictional coefficient is correspondingly high. True lubricants differ from ordinary liquids of equal viscosity inasmuch as they possess the property of "oiliness." This is a property which enables them to maintain an unbroken film between surfaces when the loads are heavy. It is possessed most markedly by vegetables and animal oils and fats, and less markedly by mineral oils. In the case of mineral lubricating oils from the same source, the lower the specific gravity the greater the oiliness of the liquid, as a rule. Mixtures of mineral oil with animal or vegetable oil are largely used, one class of oil supplying those qualities in which the other is deficient. Thus the mineral oils, which are comparatively cheap and possess the important property of not becoming oxidized into gummy or sticky substances by the action of the air, which also are not liable to cause spontaneous ignition of cotton waste, &c., and can be manufactured of almost any desired viscosity, but which on the other hand are somewhat deficient in the property of oiliness, are mixed with animal or vegetable oils which possess the latter property in marked degree, but are liable to gum and become acid and to cause spontaneous ignition, besides being comparatively expensive and limited in quantity. Oils which become acid attack the bearings chemically, and those which oxidize may become so thick that they fail to run on to the bearings properly.

The following table shows that the permissible load on bearings varies greatly:—

Description of Bearing.	Load in lb per sq. in.
Hard steel bearings on which the load is intermittent, such as the crank pins of shearing machines	3000
Bronze crosshead neck journals	1200
Crank pins of large slow engines	800–900
Crank pins of marine engines	400–500
Main crank-shaft bearings, slow marine	600
Main crank-shaft bearings, fast marine	400
Railway coach journals	300–400
Fly-wheel shaft journals	150–200
Small engine crank pins	150–200
Small slide blocks, marine engines	100
Stationary engine slide block	25–125
Stationary engine slide block, usually	30–60
Propeller thrust bearings	50–70
Shafts in cast iron steps, high speed	15

Solid Lubricants.—Solid substances, such as graphite or plumbago, soapstone, &c., are used as lubricants when there is some objection to liquids or soft solids, but the surfaces between which they are placed should be of very hard materials. They are frequently mixed with oils or greases, the lubricating properties of which they improve.

Semi-solid Lubricants.—The contrast in lubricating properties between mineral and fatty oils exists also in the case of a pure mineral grease like vaseline and an animal fat such as tallow, the latter possessing in a far greater degree the property of greasiness. A large number of lubricating greases are made by incorporating or emulsifying animal and vegetable fats with soap and water; also by thickening mineral lubricating oils with soap. Large quantities of these greases are used with very good results for the lubrication of railway waggon axles, and some of them are excellent lubricants for the bearings of slow moving machinery. Care must be taken, however, that they do not contain excess of water and are not adulterated with such useless substances as china clay; also, that they melt as a whole, and that the oil does not run down and leave the soap. This is liable to occur with badly made greases, and hot bearings are the result. Except in special cases, greases should not be used for quick-running journals, shafts or spindles, on account of the high frictional resistance which they offer to motion. In the case of fats and greases whose melting points are not much above the temperature of surrounding objects it generally happens that the lubricating films are so warmed by friction that they actually melt and act as oils. These lubricants are generally forced into the bearings by a form of syringe fitted with a spring piston, or are squeezed between the faces by means of a screw-plug.

Liquid Lubricants.—Generally speaking, all bearings which it is necessary should run with as little friction as possible must be supplied with liquid lubricants. These may be of animal, vegetable or mineral origin. The mineral oils are mixtures of hydrocarbons of variable viscosity, flashing-point, density and oiliness. They are obtained by distillation from American, Russian and other petroleums. The fixed oils obtained from animal and vegetable substances are not volatile without decomposition, and are found ready made in the tissues of animals and plants. Animal oils are obtained from the adipose tissue by simple heat or by boiling with water. They are usually either colourless or yellow. The oils of plants occur usually in the seeds or fruit, and are obtained either by expression or by means of solvents such as ether or petroleum. They are of various shades of yellow and green, the green colour being due to the presence of chlorophyll. The fundamental difference between fixed oils and mineral oils exists in their behaviour towards oxygen. Mineral oils at ordinary temperatures are indifferent to oxygen, but all fixed oils combine with it and thicken or gum more or less, generating heat at the same time. Such oils are, therefore, dangerous if dropped upon silk, cotton or woollen waste or other combustible fibrous materials, which are thus rendered liable to spontaneous ignition.

Liquid lubricants are used for all high speed bearings. In some cases the rubbing surfaces work in a bath of the lubricant, which can then reach all the rubbing parts with certainty. Small engines for motor cars or road waggons are often lubricated in this way. In the case of individual bearings, such as those of railway vehicles, a pad of cotton, worsted and horse hair is kept saturated with the lubricant and pressed against the under side of the journal. The journal is thus kept constantly wetted with oil, and the film is forced beneath the brass as the axle rotates. In many cases, oil-ways and grooves are cut in the bearings, and the lubricant is allowed to run by gravity into them and thus finds its way between the opposing surfaces. To secure a steady feed various contrivances are adopted, the most common being a wick of cotton or worsted used as a siphon. In cases where it is important that little if any wear should take place, the lubricant is forced by means of a pump between the friction surfaces and a constant film of oil is thereby maintained between them.

For the spindles of small machines such as clocks, watches and other delicate mechanisms, which are only lubricated at long intervals and are often exposed to extremes of temperature, the lubricant must be a fluid oil as free as possible from tendency to gum or thicken by oxidation or to corrode metal, and must often have a low freezing-point. It must also possess a maximum of "oiliness." The lubricants mostly used for such purposes are obtained from porpoise or dolphin jaw oils, bean oil, hazel nut oil, neatsfoot oil, sperm oil or olive oil. These oils are exposed for some time to temperatures as low as the mechanism is required to work at, and the portion which remains fluid is separated and used. Free acid should be entirely eliminated by chemical refining. A little good mineral oil may with advantage be mixed with the fatty oil.

For all ordinary machinery, ranging from the light ring spindles of textile mills to the heavy shafts of large engines, mineral oils are almost universally employed, either alone or mixed with fatty oils, the general rule being to use pure mineral oils for bath, forced or circulating pump lubrication, and mixed oils for drop, siphon and other less perfect methods of lubrication. Pure mineral oils of relatively low viscosity are used for high speeds and low pressures, mixed oils of greater viscosity for low speeds and high pressures. In selecting oils for low speeds and great pressures, viscosity must be the first consideration, and next to that "oiliness." If an oil of sufficiently high viscosity be used, a mineral oil may give a result as good or better than a pure fixed oil; a mixed oil may give a better result than either. If a mineral oil of sufficient viscosity be not available, then a fixed oil or fat may be expected to give the best result.

In special cases, such as in the lubrication of textile machines, where the oil is liable to be splashed upon the fabric, the primary consideration is to use an oil which can be washed out without leaving a stain. Pure fixed oils, or mixtures composed largely of fixed oils, are used for such purposes.

In other special cases, such as marine engines working in hot places, mixtures are used of mineral oil with rape or other vegetable oil artificially thickened by blowing air through the heated oil, and known as "blown" oil or "soluble castor oil."

In the lubrication of the cylinders and valves of steam, gas and oil engines, the lubricant must possess as much viscosity as possible at the working temperature, must not evaporate appreciably and must not decompose and liberate fatty acids which would corrode the metal and choke the steam passages with metallic soaps; for gas and oil engines the lubricant must be as free as possible from tendency to decompose and deposit carbon when heated. For this reason steam cylinders and valves should be lubricated with pure mineral oils of the highest viscosity, mixed with no more fixed oil than is necessary to ensure efficient lubrication. Gas and oil engines also should be lubricated with pure mineral oils wherever possible.

For further information on the theory and practice of lubrication and on the testing of lubricants, see *Friction and Lost Work in Machinery and Mill Work*, by R. H. Thurston (1903); and *Lubrication and Lubricants*, by L. Archbutt and R. M. Deeley (1906).

(R. M. D.)

LUBRICATION. Our knowledge of the action of oils and other viscous fluids in diminishing friction and wear between solid surfaces from being purely empirical has become a connected theory, based on the known properties of matter, subjected to the definition of mathematical analysis and verified by experiment. The theory was published in 1886 (*Phil. Trans.*, 1886, 177, pp. 157-234); but it is the purpose of this article not so much to explain its application, as to give a brief account of the introduction of the misconceptions that so long prevailed, and of the manner in which their removal led to its general acceptance.

Friction, or resistance to tangential shifting of matter over matter, whatever the mode and arrangement, differs greatly according to the materials, but, like all material resistance, is essentially limited. The range of the limits in available materials has a primary place in determining mechanical possibilities, and from the earliest times they have demanded the closest attention on the part of all who have to do with structures or with machines, the former being concerned to find those materials and their arrangements which possess the highest limits, and the latter the materials in which the limits are least. Long before the reformation of science in the 15th and 16th centuries both these limits had formed the subject of such empirical research as disclosed numerous definite although disconnected circumstances under which they could be secured; and these, however far from the highest and lowest, satisfied the exigencies of practical mechanics at the time, thus initiating the method of extending knowledge which was to be subsequently recognized as the only basis of physical philosophy. In this purely empirical research the conclusion arrived at represented the results for the actual circumstance from which they were drawn, and thus afforded no place for theoretical discrepancies. However, in the attempts at generalization which followed the reformation of science, opportunity was afforded for such discrepancies in the mere enunciation of the circumstances in which the so-called laws of friction of motion are supposed to apply. The circumstances in which the great amount of empirical research was conducted as to the resistance between the clean, plane, smooth surfaces of rigid bodies moving over each other under pressure, invariably include the presence of air at atmospheric pressure around, and to some extent between, the surfaces; but this fact had received no notice in the enunciation of these laws, and this constitutes a theoretical departure from the conditions under which the experience had been obtained. Also, the theoretical division of the law of frictional resistance into two laws—one dealing with the limit of rest, and the other asserting that the friction of motion, which is invariably less in similar circumstances than that of rest, is independent of the velocity of sliding—involves the theoretical assumption that there is no asymptotic law of diminution of the resistance, since, starting from rest, the rate of sliding increases. The theoretical substitution of ideal rigid bodies with geometrically regular surfaces, sliding in contact under pressure at the common regular surface, for the aërated surfaces in the actual circumstances, and the theoretical substitution of the absolute independence of the resistance of the rate of sliding for the limited independence in the actual circumstances, prove the general acceptance of the conceptions—(1) that matter can slide over matter under pressure at a geometrically regular surface; (2) that, however much the resistance to sliding under any particular pressure (the co-efficient of friction) may depend on the physical properties of the materials, the sliding under pressure takes place at the geometrically regular surface of contact of the rigid bodies; and (3) as the consequence of (1) and (2), that whatever the effect of a lubricant, such as oil, might have, it could be a physical surface effect. Thus not only did these general theoretical conceptions, resulting from the theoretical laws of friction, fail to indicate that the lubricant may diminish the resistance by the mere mechanical separation of the surfaces, but they precluded the idea that such might be the case. The result was that all subsequent attempts to reduce the empirical facts, where a lubricant was used, to such general laws as might reveal the separate functions of the complex circumstances on which lubrication depends, completely failed. Thus until 1883 the science of lubrication had not advanced beyond the empirical stage.

This period of stagnation was terminated by an accidental phenomenon observed by Beauchamp Tower, while engaged on his research on the friction of the journals of railway carriages. His observation led him to a line of experiments which proved that in these experiments the general function of the lubricant was the mechanical separation of the metal surfaces by a layer of fluid of finite thickness, thus upsetting the preconceived ideas as expressed in the laws of the friction of motion. On the publication of Tower's reports (*Proc. Inst. M.E.*, November 1883), it was recognized by several physicists (*B.A. Report*, 1884, pp. 14, 625) that the evidence they contained afforded a basis for further study of the actions involved, indicating as it did the circumstances—namely, the properties of viscosity and cohesion possessed by fluids—account of which had not been taken in previous conclusions. It also became apparent that continuous or steady lubrication, such as that of Tower's experiments, is only secured when the solid surfaces separated by the lubricant are so shaped that the thickness at the ingoing side is greater than that at the outgoing side.

When the general equations of viscous fluids had been shown as the result of the labours of C. L. M. H. Navier,[1] A. L. Cauchy,[2] S. D. Poisson,[3] A. J. C. Barré de St Venant,[4] and in 1845 of Sir G. Gabriel Stokes,[5] to involve no other assumption than that the stresses, other than the pressure equal in all directions, are linear functions of the distortional rates of strain multiplied by a constant coefficient, it was found that the only solutions of which the equations admitted, when applied to fluids flowing between fixed boundaries, as water in a pipe, were singular solutions for steady or steady periodic motion, and that the conclusions they entailed, that the resistance would be proportional to the velocity, were for the most part directly at variance with the common experience that the resistances varied with the square of the velocity. This discrepancy was sometimes supposed to be the result of eddies in the fluid, but it was not till 1883 that it was discovered by experiments with colour bands that, in the case of geometrically similar boundaries, the existence or non-existence of such eddies depended upon a definite relation between the mean velocity (U) of the fluid, the distance between the boundaries, and the ratio of the coefficient of viscosity to the density (μ/ρ), expressed by $UD\rho/\mu = K$, where K is a physical constant independent of units, which has a value between 1900 and 2000, and for parallel boundaries D is four times the area of the channel divided by the perimeter of the section (*Phil. Trans.*, 1883, part iii. 935–982). K is thus a criterion at which the law of resistance to the mean flow changes suddenly (as U increases), from being proportional to the flow, to a law involving higher powers of the velocity at first, but as the rates increase approaching an asymptote in which the power is a little less that the square.

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[1] *Mém. de l'Acad.* (1826), 6, p. 389.

[2] *Mém. des sav. étrang.* l. 40.

[3] *Mém. de l'Acad.* (1831), 10, p. 345.

[4] *B.A. Report* (1846)

[5] *Cambridge Phil. Trans.* (1845 and 1857).

This sudden change in the law of resistance to the flow of fluid between solid boundaries, depending as it does on a complete change in the manner of the flow—from direct parallel flow to sinuous eddying motion—serves to determine analytically the circumstances as to the velocity and the thickness of the film under which any fluid having a particular coefficient of viscosity can act the part of a lubricant. For as long as the circumstances are such that $UD\rho/\mu$ is less than K, the parallel flow is held stable by the viscosity, so that only one solution is possible—that in which the resistance is the product of μ multiplied by the rate of distortion, as $\mu\frac{du}{dy}$; in this case the fluid has lubricating properties. But when the circumstances are such that $UD\rho/\mu$ is greater than K, other solutions become possible, and the parallel flow becomes unstable, breaks down into eddying motion, and the resistance varies as ρu^n, which approximates to $\rho u^{1\cdot78}$ as the velocity increases; in this state the fluid has no lubricating properties. Thus, within the limits of the criterion, the rate of displacement of the momentum of the fluid is insignificant as compared with the viscous resistance, and may be neglected; while outside this limit the direct effects of the eddying motion completely dominate the viscous resistance, which in its turn may be neglected. Thus K is a criterion which separates the flow of fluid between solid surfaces as definitely as the flow of fluid is separated from the relative motions in elastic solids, and it is by the knowledge of the limit on which this distinction depends that the theory of viscous flow can with assurance be applied to the circumstance of lubrication.

Until the existence of this physical constant was discovered, any theoretical conclusions as to whether in any particular circumstances the resistance of the lubricant would follow the law of viscous flow or that of eddying motion was impossible. Thus Tower, being unaware of the discovery of the criterion, which was published in the same year as his reports, was thrown off the scent in his endeavour to verify the evidence he had obtained as to the finite thickness of the film by varying the velocity. He remarks in his first report that, "according to the theory of fluid motion, the resistance would be as the square of the velocity, whereas in his results it did not increase according to this law." The rational theory of lubrication does not, however, depend solely on the viscosity within the interior of fluids, but also depends on the surface action between the fluid and the solid. In many respects the surface actions, as indicated by surface tension, are still obscure, and there has been a general tendency to assume that there may be discontinuity in the velocity at the common surface. But whatever these actions may be in other respects, there is abundant evidence that there is no appreciable discontinuity in the velocity at the surfaces as long as the fluid has finite thickness. Hence in the case of lubrication the velocities of the fluid at the surfaces of the solids are those of the solid. In as far as the presence of the lubricant is necessary, such properties as cause oil in spite of its surface tension to spread even against gravity over a bright metal surface, while mercury will concentrate into globules on the bright surface of iron, have an important place in securing lubrication where the action is intermittent, as in the escapement of a clock. If there is oil on the pallet, although the pressure of the tooth causes this to flow out laterally from between the surfaces, it goes back again by surface tension during the intervals; hence the importance of using fluids with low surface tension like oil, or special oils, when there is no other means of securing the presence of the lubricant.

The differential equations for the equilibrium of the lubricant are what the differential equations of viscous fluid in steady motion become when subject to the conditions necessary for lubrication as already defined—(1) the velocity is below the critical value; (2) at the surfaces the velocity of the fluid is that of the solid; (3) the thickness of the film is small compared with the lateral dimensions of the surfaces and the radii of curvature of the surfaces. By the first of these conditions all the terms having ρ as a factor may be neglected, and the equations thus become the equations of equilibrium of the fluid; as such, they are applicable to fluid whether incompressible or elastic, and however the pressure may affect the viscosity. But the analysis is greatly simplified by omitting all terms depending on compressibility and by taking μ constant; this may be done without loss of generality in a qualitative sense. With these limitations we have for the differential equation of the equilibrium of the lubricant:—

$$\left.\begin{aligned} &0=\frac{dp}{dx}-\mu\nabla^2 u, \text{ \&c., \&c., } 0=\frac{du}{dx}+\frac{dv}{dy}+\frac{dw}{dz} \\ &0=p_{yx}-\mu\left(\frac{du}{dy}+\frac{dv}{dx}\right), \text{ \&c., \&c.} \end{aligned}\right\} \qquad (1)$$

These are subject to the boundary conditions (2) and (3). Taking x as measured parallel to one of the surfaces in the direction of relative motion, y normal to the surface and z normal to the plane of xy by condition (3), we may without error disregard the effect of any curvature in the surfaces. Also v is small compared with u and w, and the variations of u and w in the directions x and z are small compared with their variation in the direction y. The equations (1) reduce to

$$\left.\begin{aligned} &0=\frac{dp}{dx}-\mu\frac{d^2u}{dy^2},\ 0=\frac{dp}{dy},\ 0=\frac{dp}{dz}-\mu\frac{d^2w}{dy^2},\ 0=\frac{du}{dx}+\frac{dv}{dy}+\frac{dw}{dz} \\ &0=p_{yx}-\mu\frac{du}{dy},\ 0=p_{yz}-\mu\frac{dw}{dy},\ p_{zz}=0. \end{aligned}\right\} \qquad (2)$$

For the boundary conditions, putting $f(x, z)$ as limiting the lateral area of the lubricant, the conditions at the surfaces may be expressed thus:—

$$\left.\begin{aligned} &\text{when } y=0, \quad u=U_0, \quad w=0, \quad v=0 \\ &\text{when } y=h, \quad u=U_1, \quad w=0, \quad v_1=U_1\frac{dh}{dx}+V_1 \\ &\text{when } f(x, z)=0, \quad p=p_0 \end{aligned}\right\} \qquad (3)$$

Then, integrating the equations (2) over y, and determining the constants by equations (3), we have, since by the second of equations (2) p is independent of y,

$$\left.\begin{aligned} &u=\frac{1}{2\mu}\frac{dp}{dx}(y-h)y+U_0\frac{h-y}{h}+U_1\frac{y}{h} \\ &w=\frac{1}{2\mu}\frac{dp}{dz}(y-h)y \end{aligned}\right\} \qquad (4)$$

Then, differentiating equations (4) with respect to x and z respectively, and substituting in the 4th of equations (2), and integrating from $y=0$ to $y=h$, so that only the values of v at the surfaces may be required, we have for the differential equation of normal pressure at any point x, z, between the boundaries:—

$$\frac{d}{dx}\left(h^3\frac{dp}{dz}\right)+\frac{d}{dz}\left(h^3\frac{dp}{dz}\right)=6\mu\left\{(U_0+U_1)\frac{dh}{dx}+2V_1\right\} \qquad (5)$$

Again differentiating equations (4), with respect to x and z respectively, and substituting in the 5th and 6th of equations (2), and putting f_x and f_z for the intensities of the tangential stresses at the lower and upper surfaces:—

$$\left.\begin{aligned} &f_x=\mu(U_1-U_0)\frac{1}{h}\mp\frac{h}{2}\frac{dp}{dx} \\ &f_z=\mp\frac{h}{2}\frac{dp}{dx} \end{aligned}\right\} \qquad (6)$$

Equations (5) and (6) are the general equations for the stresses at the boundaries at x, z, when h is a continuous function of x and z, μ and ρ being constant.

For the integration of equations (6) to get the resultant stresses and moments on the solid boundaries, so as to obtain the conditions of their equilibrium, it is necessary to know how x and z at any point on the boundary enter into h, as well as the equation $f(x, z)=0$, which determines the limits of the lubricating film. If y, the normal to one of the surfaces, has not the same direction for all points of this surface, in other words, if the surface is not plane, x and z become curvilinear co-ordinates, at all points perpendicular to y. Since, for lubrication, one of the surfaces must be plane, cylindrical, or a surface of revolution, we may put $x=\mathrm{R}\theta$, $y=r-\mathrm{R}$, and z perpendicular to the plane of motion. Then, if the data are sufficient, the resultant stresses and moments between the surfaces are obtained by integrating the intensity of the stress and moments of intensity of stress over the surface.

This, however, is not the usual problem that arises. What is generally wanted is to find the thickness of the film where least (h_0) and its angular position with respect to direction of load, to resist a definite load with a particular surface velocity. If the surfaces are plane, the general solution involves only one arbitrary constant, the least thickness (h_0); since in any particular case the variation of h with x is necessarily fixed, as in this case lubrication affords no automatic adjustment of this slope. When both surfaces are curved in the plane of motion there are at least two arbitrary constants, h_0, and ϕ the angular position of h_0 with respect to direction of load; while if the surfaces are both curved in a plane perpendicular to the direction of motion as well as in the plane of motion, there are three arbitrary constants, h_0, ϕ_0, z_0. The only constraint necessary is to prevent rotation in the plane of motion of one of the surfaces, leaving this surface free to move in any direction and to adjust its position so as to be in equilibrium under the load.

The integrations necessary for the solutions of these problems are practicable—complete or approximate—and have been effected for circumstances which include the chief cases of practical lubrication, the results having been verified by reference to Tower's experiments. In this way the verified theory is available for guidance outside the limits of experience as well as for determining the limiting conditions. But it is necessary to take into account certain subsidiary theories. These limits depend on the coefficient of viscosity, which diminishes as the temperature increases. The total work in overcoming the resistance is spent in generating heat in the lubricant, the volume of which is very small. Were it not for the escape of heat by conduction through the lubricant and the metal, lubrication would be impossible. Hence a knowledge of the empirical law of the variation of the viscosity of the lubricant with temperature, the coefficients of conduction of heat in the lubricant and in the metal, and the application of the theory of the flow of heat in the particular circumstances, are necessary adjuncts to the theory of lubrication for determining the limits of lubrication. Nor is this all, for the shapes of the solid surfaces vary with the pressure, and more particularly with the temperature.

The theory of lubrication has been applied to the explanation of the slipperiness of ice (*Mem. Manchester Lit. and Phil. Soc.*, 1899).

(O. R.)

LUCAN [MARCUS ANNAEUS LUCANUS], (A.D. 39–65), Roman poet of the Silver Age, grandson of the rhetorician Seneca and nephew of the philosopher, was born at Corduba. His mother was Acilia; his father, Marcus Annaeus Mela, had amassed great wealth as imperial procurator for the provinces. From a memoir which is generally attributed to Suetonius we learn that Lucan was taken to Rome at the age of eight months and displayed remarkable precocity. One of his instructors was the Stoic philosopher, Cornutus, the friend and teacher of Persius. He was studying at Athens when Nero recalled him to Rome and made him quaestor. These friendly relations did not last long. Lucan is said to have defeated Nero in a public poetical contest; Nero forbade him to recite in public, and the poet's indignation made him an accomplice in the conspiracy of Piso. Upon the discovery of the plot he is said to have been tempted by the hope of pardon to denounce his own mother. Failing to obtain a reprieve, he caused his veins to be opened, and expired repeating a passage from one of his poems descriptive of the death of a wounded soldier. His father was involved in the proscription, his mother escaped, and his widow Polla Argentaria survived to receive the homage of Statius under Domitian. The birthday of Lucan was kept as a festival after his death, and a poem addressed to his widow upon one of these occasions and containing information on the poet's work and career is still extant (Statius's *Silvae*, ii. 7, entitled *Genethliacon Lucani*).

Besides his principal performance, Lucan's works included poems on the ransom of Hector, the nether world, the fate of Orpheus, a eulogy of Nero, the burning of Rome, and one in honour of his wife (all mentioned by Statius), letters, epigrams, an unfinished tragedy on the subject of Medea and numerous miscellaneous pieces. His minor works have perished except for a few fragments, but all that the author wrote of the *Pharsalia* has come down to us. It would probably have concluded with the battle of Philippi, but breaks off abruptly as Caesar is about to plunge into the harbour of Alexandria. The *Pharsalia* opens with a panegyric of Nero, sketches the causes of the war and the characters of Caesar and Pompey, the crossing of the Rubicon by Caesar, the flight of the tribunes to his camp, and the panic and confusion in Rome, which Pompey has abandoned. The second book describes the visit of Brutus to Cato, who is persuaded to join the side of the senate, and his marriage a second time to his former wife Marcia, Ahenobarbus's capitulation at Corfinium and the retirement of Pompey to Greece. In the third book Caesar, after settling affairs in Rome, crosses the Alps for Spain. Massilia is besieged and falls. The fourth book describes the victories of Caesar in Spain over Afranius and Petreius, and the defeat of Curio by Juba in Africa. In the fifth Caesar and Antony land in Greece, and Pompey's wife Cornelia is placed in security at Lesbos. The sixth book describes the repulses of Caesar round Dyrrhachium, the seventh the defeat of Pompey at Pharsalia, the eighth his flight and assassination in Egypt, the ninth the operations of Cato in Africa and his march through the desert, and the landing of Caesar in Egypt, the tenth the opening incidents of the Alexandrian war. The incompleteness of the work should not be left out of account in the estimate of its merits, for, with two capital exceptions, the faults of the *Pharsalia* are such as revision might have mitigated or rendered. No such pains, certainly, could have amended the deficiency of unity of action, or supplied the want of a legitimate protagonist. The *Pharsalia* is not true to history, but it cannot shake off its shackles, and is rather a metrical chronicle than a true epic. If it had been completed according to the author's design, Pompey, Cato and Brutus must have successively enacted the part of nominal hero, while the real hero is the arch-enemy of liberty and Lucan, Caesar. Yet these defects, though glaring, are not fatal or peculiar to Lucan. The false taste, the strained rhetoric, the ostentatious erudition, the tedious harangues and far-fetched or commonplace reflections so frequent in this singularly unequal poem, are faults much more irritating, but they are also faults capable of amendment, which the writer might not improbably have removed. Great allowance should also be made in the case of one who is emulating predecessors who have already carried art to its last perfection. Lucan's temper could never have brooked mere imitation; his versification, no less than his subject, is entirely his own; he avoids the appearance of outward resemblance to his great predecessor with a persistency which can only have resulted from deliberate purpose, but he is largely influenced by the declamatory school of his grandfather and uncle. Hence his partiality for finished antithesis, contrasting strongly with his generally breathless style and turbid diction. Quintilian sums up both aspects of his genius with pregnant brevity, "Ardens et concitatus et sententiis clarissimus," adding with equal justice, "Magis oratoribus quam poetis annumerandus." Lucan's oratory, however, frequently approaches the regions of poetry, *e.g.* the apotheosis of Pompey at the beginning of the ninth book, and the passage in the same book where Cato, in the truest spirit of the Stoic philosophy, refuses to consult the oracle of Jupiter Ammon. Though in many cases Lucan's rhetoric is frigid, hyperbolical, and out of keeping with the character of the speaker, yet his theme has a genuine hold upon him; in the age of Nero he celebrates the republic as a poet with the same energy with which in the age of Cicero he might have defended it as an orator.

But for him it might almost have been said that the Roman republic never inspired the Roman muse.

Lucan never speaks of himself, but his epic speaks for him. He must have been endowed with no common ambition, industry and self-reliance, an enthusiastic though narrow and aristocratic patriotism, and a faculty for appreciating magnanimity in others. But the only personal trait positively known to us is his conjugal affection, a characteristic of Seneca also.

Lucan, together with Statius, was preferred even to Virgil in the middle ages. So late as 1493 his commentator Sulpitius writes: "Magnus profecto est Maro, magnus Lucanus; adeoque prope par, ut quis sit major possis ambigere." Shelley and Southey, in the first transport of admiration, thought Lucan superior to Virgil; Pope, with more judgment, says that the fire which burns in Virgil with an equable glow breaks forth in Lucan with sudden, brief and interrupted flashes. Of late, notwithstanding the enthusiasm of isolated admirers, Lucan has been unduly neglected, but he has exercised an important influence upon one great department of modern literature by his effect upon Corneille, and through him upon the classical French drama.

Authorities.—The *Pharsalia* was much read in the middle ages, and consequently it is preserved in a large number of manuscripts, the relations of which have not yet been thoroughly made out. The most recent critical text is that of C. Hosius (2nd ed. 1906), and the latest complete commentaries are those of C. E. Haskins (1887, with a valuable introduction by W. E. Heitland) and C. M. Francken (1896). There are separate editions of book i. by P. Lejay (1894) and book vii. by J. P. Postgate (1896). Of earlier editions those of Oudendorp (which contains the continuation of the *Pharsalia* to the death of Caesar by Thomas May, 1728), Burmann (1740), Bentley (1816, posthumous) and Weber (1829) may be mentioned. There are English translations by C. Marlowe (book i. only, 1600), Sir F. Gorges (1614), Thomas May (1626), N. Rowe (1718) and Sir E. Ridley (2nd ed. 1905), the two last being the best.

(R. G.; J. P. P.)

LUCANIA, in ancient geography, a district of southern Italy, extending from the Tyrrhenian Sea to the Gulf of Tarentum. To the north it adjoined Campania, Samnium and Apulia, and to the south it was separated by a narrow isthmus from the district of Bruttii. It thus comprised almost all the modern province of the Basilicata, with the greater part of the province of Salerno and a portion of that of Cosenza. The precise limits were the river Silarus on the north-west, which separated it from Campania, and the Bradanus, which flows into the Gulf of Tarentum, on the north-east; while the two little rivers Laus and Crathis, flowing from the ridge of the Apennines to the sea on the west and east, marked the limits of the district on the side of the Bruttii.

Almost the whole is occupied by the Apennines, here an irregular group of lofty masses. The main ridge approaches the western sea, and is continued from the lofty knot of mountains on the frontiers of Samnium, nearly due south to within a few miles of the Gulf of Policastro, and thenceforward is separated from the sea by only a narrow interval till it enters the district of the Bruttii. Just within the frontier of Lucania rises Monte Pollino, 7325 ft., the highest peak in the southern Apennines. The mountains descend by a much more gradual slope to the coastal plain of the Gulf of Tarentum. Thus the rivers which flow to the Tyrrhenian Sea are of little importance compared with those that descend towards the Gulf of Tarentum. Of these the most important are—the Bradanus (Bradano), the Casuentus (Basiento), the Aciris (Agri), and the Siris (Sinno). The Crathis, which forms at its mouth the southern limit of the province, belongs almost wholly to the territory of the Bruttii, but it receives a tributary, the Sybaris (Coscile), from the mountains of Lucania. The only considerable stream on the western side is the Silarus (Sele), which constitutes the northern boundary, and has two important tributaries in the Calor (Calore) and the Tanager (Negro) which joins it from the south.

The district of Lucania was so called from the people bearing the name Lucani (Lucanians) by whom it was conquered about the middle of the 5th century B.C. Before that period it was included under the general name of Oenotria, which was applied by the Greeks to the southernmost portion of Italy. The mountainous interior was occupied by the tribes known as Oenotrians and Chones, while the coasts on both sides were occupied by powerful Greek colonies which doubtless exercised a protectorate over the interior (see Magna Graecia). The Lucanians were a southern branch of the Samnite or Sabelline race, who spoke the Osca Lingua (*q.v.*). We know from Strabo that they had a democratic constitution save in time of war, when a dictator was chosen from among the regular magistrates. A few Oscan inscriptions survive, mostly in Greek characters, from the 4th or 3rd century B.C., and some coins with Oscan legends of the 3rd century (see Conway, *Italic Dialects*, p. 11 sqq.; Mommsen, *C.I.L.* x. p. 21; Roehl, *Inscriptiones Graecae Antiquissimae*, 547). The Lucanians gradually conquered the whole country (with the exception of the Greek towns on the coast) from the borders of Samnium and Campania to the southern extremity of Italy. Subsequently the inhabitants of the peninsula, now known as Calabria, broke into insurrection, and under the name of Bruttians established their independence, after which the Lucanians became confined within the limits already described. After this we find them engaged in hostilities with the Tarentines, and with Alexander, king of Epirus, who was called in by that people to their assistance, 326 B.C. In 298 B.C. (Livy x. 11 seq.) they made alliance with Rome, and Roman influence was extended by the colonies of Venusia (291 B.C.), Paestum (273), and above all Tarentum (272). Subsequently they were sometimes in alliance, but more frequently engaged in hostilities, during the Samnite wars. On the landing of Pyrrhus in Italy (281 B.C.) they were among the first to declare in his favour, and found themselves exposed to the resentment of Rome when the departure of Pyrrhus left his allies at the mercy of the Romans. After several campaigns they were reduced to subjection (272 B.C.). Notwithstanding this they espoused the cause of Hannibal during the Second Punic War (216 B.C.), and their territory during several campaigns was ravaged by both armies. The country never recovered from these disasters, and under the Roman government fell into decay, to which the Social War, in which the Lucanians took part with the Samnites against Rome (90–88 B.C.) gave the finishing stroke. In the time of Strabo the Greek cities on the coast had fallen into insignificance, and owing to the decrease of population and cultivation the malaria began to obtain the upper hand. The few towns of the interior were of no importance. A large part of the province was given up to pasture, and the mountains were covered with forests, which abounded in wild boars, bears and wolves. There were some fifteen independent communities, but none of great importance.

For administrative purposes under the Roman empire, Lucania was always united with the district of the Bruttii. The two together constituted the third region of Augustus.

The towns on the east coast were—Metapontum, a few miles south of the Bradanus; Heraclea, at the mouth of the Aciris; and Siris, on the river of the same name. Close to its southern frontier stood Sybaris, which was destroyed in 510 B.C., but subsequently replaced by Thurii. On the west coast stood Posidonia, known under the Roman government as Paestum; below that came Elea or Velia, Pyxus, called by the Romans Buxentum, and Laus, near the frontier of the province towards Bruttium. Of the towns of the interior the most considerable was Potentia, still called Potenza. To the north, near the frontier of Apulia, was Bantia (Aceruntia belonged more properly to Apulia); while due south from Potentia was Grumentum, and still farther in that direction were Nerulum and Muranum. In the upland valley of the Tanagrus were Atina, Forum Popilii and Consilinum; Eburi (Eboli) and Volceii (Buccino), though to the north of the Silarus, were also included in Lucania. The Via Popillia traversed the district from N. to S., entering it at the N.W. extremity; the Via Herculia, coming southwards from the Via Appia and passing through Potentia and Grumentum, joined the Via Popillia near the S.W. edge of the district: while another nameless road followed the east coast and other roads of less importance ran W. from Potentia to the Via Popillia, N.E. to the Via Appia and E. from Grumentum to the coast at Heraclea. (T. As.)

LUCARIS, CYRILLOS (1572–1637), Greek prelate and theologian, was a native of Crete. In youth he travelled, studying at Venice and Padua, and at Geneva coming under the influence of the reformed faith as represented by Calvin. In 1602 he was elected patriarch of Alexandria, and in 1621 patriarch of Constantinople. He was the first great name in the Orthodox Eastern Church since 1453, and dominates its history in the 17th century. The great aim of his life was to reform the church on Calvinistic lines, and to this end he sent many young Greek theologians to the universities of Switzerland, Holland and England. In 1629 he published his famous *Confessio*, Calvinistic in doctrine, but as far as possible accommodated to the language and creeds of the Orthodox Church. It appeared the same year in two Latin editions, four French, one German and one English, and in the Eastern Church started a controversy which culminated in 1691 in the convocation by Dositheos, patriarch of Jerusalem, of a synod by which the Calvinistic doctrines were condemned. Lucaris was several times temporarily deposed and banished at the instigation of his orthodox opponents and of the Jesuits, who were his bitterest enemies. Finally, when Sultan Murad was about to set out for the Persian War, the patriarch was accused of a design to stir up the Cossacks, and to avoid trouble during his absence the sultan had him killed by the Janissaries (June 1637). His body was thrown into the sea, recovered and buried at a distance from the capital by his friends, and only brought back to Constantinople after many years.

The orthodoxy of Lucaris himself continued to be a matter of debate in the Eastern Church, even Dositheos, in view of the reputation of the great patriarch, thinking it expedient to gloss over his heterodoxy in the interests of the Church.

See the article "Lukaris" by Ph. Meyer in Herzog-Hauck, *Realencyklop.* (3rd ed., Leipzig, 1902), which gives further authorities.

LUCARNE, a French architectural term for a garret window, also for the lights or small windows in spires.

LUCAS, SIR CHARLES (d. 1648), English soldier, was the son of Sir Thomas Lucas of Colchester, Essex. As a young man he saw service in the Netherlands under the command of his brother, and in the "Bishops' War" he commanded a troop of horse in King Charles I.'s army. In 1639 he was made a knight. At the outbreak of the Civil War Lucas naturally took the king's side, and at the first cavalry fight, Powick Bridge, he was wounded. Early in 1643 he raised a regiment of horse, with which he defeated Middleton at Padbury on July 1st. In January 1644 he commanded the forces attacking Nottingham, and soon afterwards, on Prince Rupert's recommendation, he was made lieutenant-general of Newcastle's Northern army. When Newcastle was shut up in York, Lucas and the cavalry remained in the open country, and when Rupert's relieving army crossed the mountains into Yorkshire he was quickly joined by Newcastle's squadrons. At Marston Moor Lucas swept Fairfax's Yorkshire horse before him, but later in the day he was taken prisoner. Exchanged during the winter, he defended Berkeley Castle for a short time against Rainsborough, but was soon in the field again. As lieutenant-general of all the horse he accompanied Lord Astley in the last campaign of the first war, and, taken prisoner at Stow-on-the-Wold, he engaged not to bear arms against parliament in the future. This parole he must be held to have broken when he took a prominent part in the seizure of Colchester in 1648. That place was soon invested, and finally fell, after a desperate resistance, to Fairfax's army. The superior officers had to surrender "at mercy," and Lucas and Sir George Lisle were immediately tried by court martial and sentenced to death. The two Royalists were shot the same evening in the Castle of Colchester.

See Lloyd, *Memoirs of Excellent Personages* (1669); and Earl de Grey, *A Memoir of the Life of Sir Charles Lucas* (1845).

LUCAS, CHARLES (1713–1771), Irish physician and politician, was the son of a country gentleman of small means in Co. Clare. Charles opened a small business as an apothecary in Dublin, and between 1735 and 1741 he began his career as a pamphleteer by publishing papers on professional matters which led to legislation requiring inspection of drugs. Having been elected a member of the common council of Dublin in 1741 he detected and exposed encroachments by the aldermen on the electoral rights of the citizens, and entered upon a controversy on the subject, but failed in legal proceedings against the aldermen in 1744. With a view to becoming a parliamentary candidate for the city of Dublin he issued in 1748–1749 a series of political addresses in which he advocated the principles of Molyneux and Swift; and he made himself so obnoxious to the government that the House of Commons voted him an enemy to the country, and issued a proclamation for his arrest, thus compelling him to retire for some years to the continent. Having studied medicine at Paris, Lucas took the degree of M.D. at Leiden in 1752. In the following year he started practice as a physician in London, and in 1756 he published a work on medicinal waters, the properties of which he had studied on the continent and at Bath. The essay was reviewed by Dr Johnson, and although it was resented by the medical profession it gained a reputation and a considerable practice for its author. In 1760 he renewed his political pamphleteering; and having obtained a pardon from George III., he proceeded to Dublin, where he received a popular welcome and a Doctor's degree from Trinity College. He was elected member for the city of Dublin in 1761, his colleague in the representation being the recorder, Henry Grattan's father. On the appointment of Lord Halifax as lord lieutenant in the same year Lucas wrote him a long letter (19th of Sept. 1761, MSS. Irish State Paper Office) setting forth the grievances which Ireland had suffered in the past, chiefly on account of the exorbitant pensions enjoyed by government officials. The cause of these evils he declared to be the unrepresentative character of the Irish constitution; and among the remedies he proposed was the shortening of parliaments. Lucas brought in a bill in his first session to effect this reform, but was defeated on the motion to have the bill sent to England for approval by the privy council; and he insisted upon the independent rights of the Irish parliament, which were afterwards in fuller measure successfully vindicated by Grattan. He also defended the privileges of the Irish Protestants in the press, and especially in the *Freeman's Journal*, founded in 1763. His contributions to the press, and his *Addresses to the Lord Mayor* and other political pamphlets made him one of the most popular writers in Ireland of his time, although he was anti-catholic in his prejudices, and although, as Lecky observes, "there is nothing in his remains to show that he possessed any real superiority either of intellect or knowledge, or even any remarkable brilliancy of expression." He died on the 4th of November 1771, and was accorded a public funeral. As an orator Charles Lucas appears to have had little power, and he made no mark in the House of Commons.

See R. R. Madden, *Hist. of Irish Periodical Literature from the End of the 17th to the Middle of the 19th Century* (2 vols., London, 1867); Francis Hardy, *Memoirs of the Earl of Charlemont* (2 vols., London, 1812); W. E. H. Lecky, *History of Ireland in the Eighteenth Century*, vols. i. and ii. (5 vols., London, 1892).

LUCAS, JOHN SEYMOUR (1849–   ), English painter, was born in London, and was a student in the Royal Academy Schools. He was elected an associate of the academy in 1886 and academician in 1898, and became a constant exhibitor of pictures of historical and domestic incidents, notably of the Tudor and Stuart periods, painted with much skill and with close attention to detail. One of his most important works is a panel in the Royal Exchange, presented by the corporation of London, representing William the Conqueror granting the first charter to the city; and one of his earlier pictures, "After Culloden: Rebel Hunting," is in the National Gallery of British Art.

LUCAS VAN LEYDEN (*c.* 1494–1533), Dutch painter, was born at Leiden, where his father Huig Jacobsz gave him the first lessons in art. He then entered the painting-room of Cornelis Engelbrechtszen of Leiden, and soon became known for his capacity in making designs for glass, engraving copper-plates, painting pictures, portraits and landscapes in oil and distemper. According to van Mander he was born in 1494, and painted at the age of twelve a "Legend of St Hubert" for which he was paid a dozen florins. He was only fourteen when he finished a plate representing Mahomet taking the life of Sergius, the monk, and at fifteen he produced a series of nine plates for a "Passion," a "Temptation of St Anthony," and a "Conversion of St Paul." The list of his engravings in 1510, when, according to van Mander, he was only sixteen, includes subjects as various as a celebrated "Ecce Homo," "Adam and Eve expelled from Paradise," a herdsman and a milkmaid with three cows, and a little naked girl running away from a barking dog. Whatever may be thought of the tradition embodied in van Mander's pages as to the true age of Lucas van Leyden, there is no doubt that, as early as 1508, he was a master of repute as a copperplate engraver. It was the time when art found patrons among the public that could ill afford to buy pictures, yet had enough interest in culture to satisfy itself by means of prints. Lucas van Leyden became the representative man for the public of Holland as Dürer for that of Germany; and a rivalry grew up between the two engravers, which came to be so close that on the neutral market of Italy the products of each were all but evenly quoted. Vasari affirmed that Dürer surpassed Lucas as a designer, but that in the use of the graver they were both unsurpassed, a judgment which has not been reversed. But the rivalry was friendly. About the time when Dürer visited the Netherlands Lucas went to Antwerp, which then flourished as an international mart for productions of the pencil and the graver, and it is thought that he was the master who took the freedom of the Antwerp gild in 1521 under the name of Lucas the Hollander. In Dürer's diary kept during his travels in the Low Countries, we find that at Antwerp he met Lucas, who asked him to dinner, and that Dürer accepted. He valued the art of Lucas at its true figure, and exchanged the Dutchman's prints for eight florins' worth of his own. In 1527 Lucas made a tour of the Netherlands, giving dinners to the painters of the gilds of Middleburg, Ghent, Malines and Antwerp. He was accompanied during the trip by Mabuse, whom he imitated in his style as well as in his love of rich costume. On his return home he fell sick and remained ailing till his death in 1533, and he believed that poison had been administered to him by some envious comrade.

A few days before his death Lucas van Leyden was informed of the birth of a grandson, first-born of his only daughter Gretchen. Gretchen's fourth son JEAN DE HOEY followed the profession of his grandfather, and became well known at the Parisian court as painter and chamberlain to the king of France, Henry IV.

As an engraver Lucas van Leyden deserves his reputation. He has not the genius, nor had he the artistic tact, of Dürer; and he displays more cleverness of expression than skill in distribution or in refinement in details. But his power in handling the graver is great, and some of his portraits, especially his own, are equal to anything by the master of Nuremberg. Much that he accomplished as a painter has been lost, because he worked a good deal upon cloth in distemper. In 1522 he painted the "Virgin and Child with the Magdalen and a Kneeling Donor," now in the gallery of Munich. His manner was then akin to that of Mabuse. The "Last Judgment" in the town-gallery of Leiden is composed on the traditional lines of Cristus and Memling, with monsters in the style of Jerom Bosch and figures in the stilted attitudes of the South German school; the scale of colours in yellow, white and grey is at once pale and gaudy, the quaintest contrasts are produced by the juxtaposition of alabaster flesh in females and bronzed skin in males, or black hair by the side of yellow, or rose-coloured drapery set sharply against apple-green or black; yet some of the heads are painted with great delicacy and modelled with exquisite feeling. Dr Waagen gave a favourable opinion of a triptych now at the Hermitage at St Petersburg, executed, according to van Mander, in 1531, representing the "Blind Man of Jericho healed by Jesus Christ." Here too the German critic observed the union of faulty composition with great finish and warm flesh-tints with a gaudy scale of colours. The same defects and qualities will be found in such specimens as are preserved in public collections, among which may be mentioned the "Card Party" at Wilton House, the "Penitent St Jerome" in the gallery of Berlin, and the hermits "Paul" and "Anthony" in the Liechtenstein collection at Vienna. There is a characteristic "Adoration of the Magi" at Buckingham Palace.

LUCCA (anc. *Luca*), a town and archiepiscopal see of Tuscany, Italy, capital of the province of Lucca, 13 m. by rail N.E. of Pisa. Pop. (1901) 43,566 (town); 73,465 (commune). It is situated 62 ft. above the level of the sea, in the valley of the Serchio, and looks out for the most part on a horizon of hills and mountains. The fortifications, pierced by four gates, were begun in 1504 and completed in 1645, and long ranked among the most remarkable in the peninsula. They are still well-preserved and picturesque, with projecting bastions planted with trees.

The city has a well-built and substantial appearance, its chief attraction lying in the numerous churches, which belong in the main to a well-marked basilican type, and present almost too richly decorated exteriors, fine apsidal ends and quadrangular campaniles, in some cases with battlemented summits, and windows increasing in number as they ascend. In style they are an imitation of the Pisan. It is remarkable that in the arcades a pillar generally occupies the middle of the façade. The cathedral of St Martin was begun in 1063 by Bishop Anselm (later Pope Alexander II.); but the great apse with its tall columnar arcades and the fine campanile are probably the only remnants of the early edifice, the nave and transepts having been rebuilt in the Gothic style in the 14th century, while the west front was begun in 1204 by Guidetto (lately identified with Guido Bigarelli of Como), and "consists of a vast portico of three magnificent arches, and above them three ranges of open galleries covered with all the devices of an exuberant fancy." The ground plan is a Latin cross, the nave being 273 ft. in length and 84 ft. in width, and the transepts 144 ft. in length. In the nave is a little octagonal temple or chapel, which serves as a shrine for the most precious of the relics of Lucca, a cedar-wood crucifix, carved, according to the legend, by Nicodemus, and miraculously conveyed to Lucca in 782. The Sacred Countenance (*Volto Santo*), as it is generally called, because the face of the Saviour is considered a true likeness, is only shown thrice a year. The chapel was built in 1484 by Matteo Civitali, a local sculptor of the early Renaissance (1436–1501); he was the only master of Tuscany outside Florence who worked thoroughly in the Florentine style, and his creations are among the most charming works of the Renaissance. The cathedral contains several other works by him—the tomb of P. da Noceto, the altar of S. Regulus and the tomb of Ilaria del Carretto by Jacopo della Quercia of Siena (described by Ruskin in *Modern Painters*, ii.), the earliest of his extant works (1406), and one of the earliest decorative works of the Renaissance. In one of the chapels is a fine Madonna by Fra Bartolommeo; in the municipal picture gallery are a fine "God the Father" and another Madonna by him; also some sculptures by Civitali, and some good wood carving, including choir stalls. In the cathedral choir is good stained glass of 1485. The church of St Michael, founded in the 8th century, and built of marble within and without, has a lofty and magnificent western façade (1188)—an architectural screen rising much above the roof of the church. The interior is good but rather bare. The church of St Martino at Arliano near Lucca belongs to the first half of the 8th century; it is of basilican plan (see G. T. Rivoira, *Origini dell' Architettura Lombarda*, iii. [Rome, 1901] 138). St Frediano or Frigidian dates originally from the 7th century, but was built in the Romanesque style in 1112–1147, though the interior, originally with four aisles and nave, shows traces of the earliest structure; the front occupies the site of the ancient apse; in one of its chapels is the tomb of Santa Zita, patroness of servants and of Lucca itself. In S. Francesco, a fine Gothic church, is the tomb of Castruccio Castracane. San Giovanni (originally of the 12th century), S. Cristoforo, San Romano (rebuilt in the 17th century, by Vincenzo Buonamici), and Santa Maria Forisportam (of the 12th century) also deserve mention.

Among the secular buildings are the old ducal palace, begun in 1578 by Ammanati, and now the residence of the prefect and seat of the provincial officers and the public picture gallery; the early Renaissance Palazzo Pretorio, or former residence of the podestà, now the seat of the civil and correctional courts; the palace, erected in the 15th century by a member of the Guinigi family, of brick, in the Italian Gothic style, and now serving as a poor-house; the 16th-century palace of the marquis Guidiccioni, now used as a depository for the archives, the earliest documents going back to A.D. 790. The Palazzo Mansi contains a collection of Dutch pictures. There are several other fine late 16th-century palaces. The principal market-place in the city (*Piazza del Mercato*) has taken possession of the arena of the ancient amphitheatre, the outer arches of which can still be seen in the surrounding buildings. The whole building, belonging probably to the early Empire, measured 135 by 105 yds., and the arena $87\frac{1}{2}$ by 58 yds. The outline of the ancient theatre can be traced in the Piazza delle Grazie, and some of its substructure walls are preserved. The ancient forum was on the site of the Piazza S. Michele in the centre of the town; remains of a small public building or shrine were found not far off in 1906 (L. Pernier in *Notizie degli Scavi*, 1906, p. 117). The rectangular disposition of the streets in the centre of the town is a survival of Roman times. Besides the academy of sciences, which dates from 1584, there are several institutions of the same kind—a royal philomathic academy, a royal academy of arts and a public library of 50,000 volumes. The archiepiscopal library and archives are also important, while the treasury contains some fine goldsmith's work, including the 14th-century Croce dei Pisani, made by the Pisans for the cathedral.

The river Serchio affords water-power for numerous factories. The most important industries are the manufacture of jute goods (carried on at Ponte a Moriano in the Serchio valley, 6 m. N. of Lucca), tobacco, silks and cottons. The silk manufacture, introduced at Lucca about the close of the 11th century, and in the early part of the 16th the means of subsistence for 30,000 of its inhabitants, now gives employment (in reeling and throwing) to only about 1500. The bulk of the population is engaged in agriculture. The water supply is maintained by an aqueduct built in 1823–1832 with 459 arches, from the Pisan mountains.

The ancient Luca, commanding the valley of the Serchio, is first mentioned as the place to which Sempronius retired in 218 B.C. before Hannibal; but there is some doubt as to the correctness of Livy's statement, for, though there were continual wars with the Ligurians, after this time, it is not mentioned again until we are told that in 177 B.C. a Latin colony was founded there in territory offered by the Pisans for the purpose.[1] It must have become a municipium by the *lex Julia* of 90 B.C., and it was here that Julius Caesar in 56 B.C. held his famous conference with Pompey and Crassus, Luca then being still in Liguria, not in Etruria. A little later a colony was conducted hither by the triumvirs or by Octavian; whether after Philippi or after Actium is uncertain. In the Augustan division of Italy Luca was assigned to the 7th region (Etruria); it is little mentioned in the imperial period except as a meeting-point of roads—to Florentia (see CLODIA, VIA), Luna and Pisae. The road to Parma given in the itineraries, according to some authorities, led by Luna and the Cisa pass (the route taken by the modern railway from Sarzana to Parma), according to others up the Serchio valley and over the Sassalbo pass (O. Cuntz in *Jahreshefte des oesterr. arch. Instituts*, 1904, 53). Though plundered and deprived of part of its territory by Odoacer, Luca appears as an important city and fortress at the time of Narses, who besieged it for three months in A.D. 553, and under the Lombards it was the residence of a duke or marquis and had the privilege of a mint. The dukes gradually extended their power over all Tuscany, but after the death of the famous Matilda the city began to constitute itself an independent community, and in 1160 it obtained from Welf VI., duke of Bavaria and marquis of Tuscany, the lordship of all the country for 5 m. round, on payment of an annual tribute. Internal discord afforded an opportunity to Uguccione della Faggiuola, with whom Dante spent some time there, to make himself master of Lucca in 1314, but the Lucchesi expelled him two years afterwards, and handed over their city to Castruccio Castracane, under whose masterly tyranny it became "for a moment the leading state of Italy," until his death in 1328 (his tomb is in S. Francesco). Occupied by the troops of Louis of Bavaria, sold to a rich Genoese Gherardino Spinola, seized by John, king of Bohemia, pawned to the Rossi of Parma, by them ceded to Martino della Scala of Verona, sold to the Florentines, surrendered to the Pisans, nominally liberated by the emperor Charles IV. and governed by his vicar, Lucca managed, at first as a democracy, and after 1628 as an oligarchy, to maintain "its independence alongside of Venice and Genoa, and painted the word Libertas on its banner till the French Revolution." In the beginning of the 16th century one of its leading citizens, Francesco Burlamacchi, made a noble attempt to give political cohesion to Italy, but perished on the scaffold (1548); his statue by Ulisse Cambi was erected on the Piazza San Michele in 1863. As a principality formed in 1805 by Napoleon in favour of his sister Elisa and her husband Bacchiocchi, Lucca was for a few years wonderfully prosperous. It was occupied by the Neapolitans in 1814; from 1816 to 1847 it was governed as a duchy by Maria Luisa, queen of Etruria, and her son Charles Louis; and it afterwards formed one of the divisions of Tuscany.

The bishops of Lucca, who can be traced back to 347, received exceptional marks of distinction, such as the pallium in 1120, and the archiepiscopal cross from Alexander II. In 1726 Benedict XIII. raised their see to the rank of an archbishopric, without suffragans.

See A. Mazzarosa, *Storia di Lucca* (Lucca, 1833); E. Ridolfi, *L'Arte in Lucca studiata nella sua Cattedrale* (1882); *Guidi di Lucca; La Basilica di S. Michele in Foro in Lucca.* (T. As.)

LUCCA, BAGNI DI (Baths of Lucca, formerly *Bagno a Corsena*), a commune of Tuscany, Italy, in the province of Lucca, containing a number of famous watering-places. Pop. (1901) 13,685. The springs are situated in the valley of the Lima, a tributary of the Serchio; and the district is known in the early history of Lucca as the Vicaria di Val di Lima. Ponte Serraglio (16 m. N. of Lucca by rail) is the principal village (pop. 1312), but there are warm springs and baths also at Villa, Docce Bassi, Bagno Caldo, &c. The springs do not seem to have been known to the Romans. Bagno a Corsena is first mentioned in 1284 by Guidone de Corvaia, a Pisan historian (Muratori, *R.I.S.* vol. xxii.). Fallopius, who gave them credit for the cure of his own deafness, sounded their praises in 1569; and they have been more or less in fashion since. The temperature of the water varies from 98° to 130° Fahr.; in all cases it gives off carbonic acid gas and contains lime, magnesium and sodium products. In the village of Bagno Caldo there is a hospital constructed largely at the expense of Nicholas Demidoff in 1826. In the valley of the Serchio, 3 m. below Ponte a Serraglio, is the medieval Ponte del Diavolo (1322) with its lofty central arch.

LUCCEIUS, LUCIUS, Roman orator and historian, friend and correspondent of Cicero. A man of considerable wealth and literary tastes, he may be compared with Atticus. Disgusted at his failure to become consul in 60, he retired from public life, and devoted himself to writing a history of the Social and Civil Wars. This was nearly completed, when Cicero earnestly requested him to write a separate history of his (Cicero's) consulship. Cicero had already sung his own praises in both Greek and Latin, but thought that a panegyric by Lucceius, who had taken considerable interest in the affairs of that critical period, would have greater weight. Cicero offered to supply the material, and hinted that Lucceius need not sacrifice laudation to accuracy. Lucceius almost promised, but did not perform. Nothing remains of any such work or of his history. In the civil war he took the side of Pompey; but, having been pardoned by Caesar, returned to Rome, where he lived in retirement until his death.

Cicero's *Letters* (ed. Tyrrell and Purser), especially *Ad Fam.* v. 12; and Orelli, *Onomasticon Tullianum.*

LUCCHESINI, GIROLAMO (1751–1825), Prussian diplomatist, was born at Lucca on the 7th of May 1751, the eldest son of Marquis Lucchesini. In 1779 he went to Berlin where Frederick the Great gave him a court appointment, making use of him in his literary relations with Italy. Frederick William II., who recognized his gifts for diplomacy, sent him in 1787 to Rome to obtain the papal sanction for the appointment of a coadjutor to the bishop of Mainz, with a view to strengthening the German Fürstenbund. In 1788 he was sent to Warsaw, and brought about a rapprochement with Prussia and a diminution of Russian influence at Warsaw. He was accredited ambassador to the king and republic of Poland on the 12th of April 1789.

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[1] Some confusion has arisen owing to the similarity of the names Luca and Luna; the theory of E. Bormann in *Corp. Inscrip. Latin.* (Berlin, 1888), xi. 295 is here followed.

Frederick William was at that time intriguing with Turkey, then at war with Austria and Russia. Lucchesini was to rouse Polish feeling against Russia, and to secure for Prussia the concourse of Poland in the event of war with Austria and Russia. All his power of intrigue was needed in the conduct of these hazardous negotiations, rendered more difficult by the fact that Prussian policy excluded the existence of a strong Polish government. A Prusso-Polish alliance was concluded in March 1790. Lucchesini had been sent in January of that year to secure the alliance of Saxony against Austria, and in September he was sent to Sistova, where representatives of the chief European powers were engaged in settling the terms of peace between Austria and Turkey, which were finally agreed upon on the 4th of August 1791. Before he returned to Warsaw the Polish treaty of which he had been the chief author had become a dead letter owing to the engagements made between Prussia and Austria at Reichenbach in July 1790, and Prussia was already contemplating the second partition of Poland. He was recalled at the end of 1791, and in July 1792 he joined Frederick William in the invasion of France. He was to be Prussian ambassador in Paris when the allied forces should have reinstated the authority of Louis XVI. He was opposed alike to the invasion of France and the Austrian alliance, but his prepossessions did not interfere with his skilful conduct of the negotiations with Kellermann after the allies had been forced to retire by Dumouriez's guns at Valmy, nor with his success in securing the landgrave of Hesse-Darmstadt's assistance against France. In 1793 he was appointed ambassador to Vienna, with the ostensible object of securing financial assistance for the Rhenish campaign. He accompanied Frederick William through the Polish campaign of 1793–94, and in the autumn returned to Vienna. His anti-Austrian bias made him extremely unpopular with the Austrian court, which asked in vain for his recall in 1795. In 1797, after a visit to Italy in which he had an interview with Napoleon at Bologna, these demands were renewed and acceded to. In 1800 he was sent by Frederick William III. on a special mission to Paris. Despatches in which he expressed his distrust of Bonaparte's peaceful professions and his conviction of the danger of the continuance of a neutral policy were intercepted by the first consul, who sought his recall, but eventually accepted him as regular ambassador (1802). He consistently sought friendly relations between France and Prussia, but he warned his government in 1806 of Napoleon's intention of restoring Hanover to George III. and of Murat's aggressions in Westphalia. He was superseded as ambassador in Paris in September just before the outbreak of war. After the disaster of Jena on the 14th of October he had an interview with Duroc near Wittenberg to seek terms of peace. After two unsuccessful attempts at negotiation, the first draft being refused by Napoleon, the second by Frederick William, he joined the Prussian court at Königsberg only to learn that his services were no longer required. He then joined the court of Elisa, grand duchess of Tuscany, at Lucca and Florence, and after Napoleon's fall devoted himself to writing. He died on the 20th of October 1825.

He published in 1819 three volumes, *Sulle cause et gli effetti della confederazione rhenana*, at Florence, but revealed little that was not already available in printed sources. His memoirs remained in MS. His despatches are edited by Bailleu in *Preussen und Frankreich* (Leipzig, 1887, *Publikationen aus den preussischen Staatsarchiven*).

LUCENA, a town of southern Spain, in the province of Cordova, 37 m. S.S.E. of Cordova, on the Madrid-Algeciras railway. Pop. (1900) 21,179. Lucena is situated on the Cascajar, a minor tributary of the Genil. The parish church dates from the beginning of the 16th century. The chief industries are the manufacture of matches, brandy, bronze lamps and pottery, especially the large earthenware jars (*tinajas*) used throughout Spain for the storage of oil and wine, some of which hold more than 300 gallons. There is considerable trade in agricultural produce, and the horse fair is famous throughout Andalusia. Lucena was taken from the Moors early in the 14th century; it was in the attempt to recapture it that King Boabdil of Granada was taken prisoner in 1483.

LUCERA, a town and episcopal see of Apulia, Italy, 12½ m. W.N.W. by rail of Foggia. Pop. (1901) 16,962. It is situated upon a lofty plateau, the highest point of which (823 ft.), projecting to the W., was the ancient citadel, and is occupied by the well-preserved castle erected by Frederick II., and rebuilt by Pierre d'Angicourt about 1280. The cathedral, originally Romanesque, but restored after 1300 is in the Gothic style; the façade is good, and so is the ciborium. The interior was restored in 1882. The town occupies the site of the ancient Luceria, the key of the whole country. According to tradition the temple of Minerva, founded by Diomede, contained the Trojan Palladium, and the town struck numerous bronze coins; but in history it is first heard of as on the Roman side in the Samnite Wars (321 B.C.), and in 315 or 314 B.C. a Latin colony was sent here. It is mentioned in subsequent military history, and its position on the road from Beneventum, via Aecae (mod. *Troja*) to Sipontum, gave it some importance. Its wool was also renowned. It now contains no ancient remains above ground, though several mosaic pavements have been found and there are traces of the foundations of an amphitheatre outside the town on the E. The town-hall contains a statue of Venus, a mosaic and some inscriptions (but cf. Th. Mommsen's remarks on the local neglect of antiquities in *Corp. Inscr. Lat.* ix. 75). In 663 it was destroyed by Constans II., and was only restored in 1223 by Frederick II., who transported 20,000 Saracens hither from Sicily. They were at first allowed religious freedom, but became Christians under compulsion in 1300. Up to 1806 Lucera was the capital of the provinces of Basilicata and Molise. (T. As.)

LUCERNE (Ger. *Luzern*; Ital. *Lucerna*), one of the cantons of central Switzerland. Its total area is 579·3 sq. m., of which 530·2 sq. m. are classed as "productive" (forests covering 120·4 sq. m., and vineyards ·04 sq. m.). It contains no glaciers or eternal snows, its highest points being the Brienzer Rothhorn (7714 ft.) and Pilatus (6995 ft.), while the Rothstock summit (5453 ft.) and the Kaltbad inn, both on the Rigi, are included in the canton, the loftiest point of the Rigi range (the Kulm) being entirely in Schwyz. The shape of the canton is an irregular quadrilateral, due to the gradual acquisition of rural districts by the town, which is its historical centre. The northern portion, about 15½ sq. m., of the Lake of Lucerne is in the canton. Its chief river is the Reuss, which flows through it for a short distance only receiving the Kleine Emme that flows down through the Entlebuch. In the northern part the Wigger, the Suhr and the Wynen streams flow through shallow valleys, separated by low hills. The canton is fairly well supplied with railways. The lakes of Sempach and Baldegg are wholly within the canton, which also takes in small portions of those of Hallwil and of Zug.

In 1900 the population numbered 146,519, of which 143,337 were German-speaking, 2204 Italian-speaking and 747 French-speaking, while 134,020 were Romanists, 12,085 Protestants and 319 Jews. Its capital is Lucerne (*q.v.*); the other towns are Kriens (pop. 5951), Willisau (4131), Ruswil (3928), Littau (3699), Emmen (3162) and Escholzmatt (3127). The peasants are a fine race, and outside the chief centres for foreign visitors have retained much of their primitive simplicity of manners and many local costumes. In the Entlebuch particularly the men are of a robust type, and are much devoted to wrestling and other athletic exercises. That district is mainly pastoral and is famous for its butter and cheese. Elsewhere in the canton the pastoral industry (including swine-breeding) is more extended than agriculture, while chiefly in and around Lucerne there are a number of industrial establishments. The *industrie des étrangers* is greatly developed in places frequented by foreign visitors. The population as a whole is Conservative in politics and devotedly Romanist in religion. But owing to the settlement of many non-Lucerne hotel-keepers and their servants in the town of Lucerne the capital is politically Radical.

The canton ranks officially third in the Swiss confederation next after Zürich and Bern. It was formerly in the diocese of Constance, and is now in that of Basel. It contains 5 administrative districts and 107 communes. The existing cantonal constitution dates in its main features from 1875. The legislature or *Grossrath* consists of members elected in 55 electoral circles, in the proportion of 1 to every 1000 souls (or fraction over 500) of the Swiss population, and lasts for 4 years. On the 4th of April 1909 proportional representation was adopted for elections of members of the *Grossrath.* Since 1905 the executive of 7 members is elected by a popular vote for 4 years, as are the 2 members of the federal *Ständerath* and the 7 members of the federal *Nationalrath.* Five thousand citizens can demand a facultative referendum as to all legislative projects and important financial decrees, or as to the revision of the cantonal constitution, while the same number can also revoke the mandate of the cantonal legislature before its proper term of office has ended, though this revocation does not affect the executive. Four thousand citizens have the right of "initiative" as to constitutional amendments or legislative projects.

The canton is composed of the various districts which the town acquired, the dates being those at which the particular region was finally secured—Weggis (1380), Rothenburg, Kriens, Horw, Sempach and Hochdorf (all in 1394), Wolhusen and the Entlebuch (1405), the so-called "Habsburger region" to the N.E. of the town of Lucerne (1406), Willisau (1407), Sursee and Beromünster (1415), Malters (1477) and Littau (1481), while in 1803, in exchange for Hitzkirch, Merenschwand (held since 1397) was given up. (W. A. B. C.)

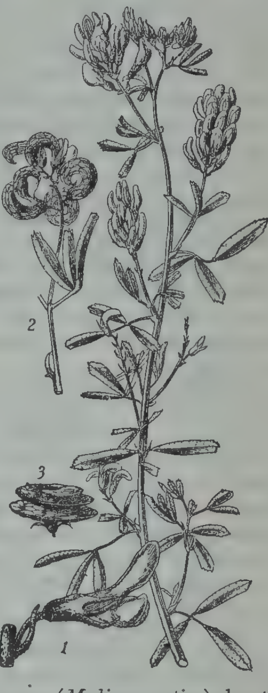
LUCERNE, the capital of the Swiss canton of the same name. It is one of the principal tourist centres of Switzerland, being situated on the St Gotthard railway line, by which it is 59 m. from Basel and 180 m. from Milan. Its prosperity has always been bound up with the St Gotthard Pass, so that the successive improvements effected on that route (mule path in the 13th century, carriage road 1820–1830, and railway tunnel in 1882) have had much effect on its growth. It is beautifully situated on the banks of the river Reuss, just as it issues from the Lake of Lucerne, while to the south-west rises the rugged range of Pilatus, balanced on the east by the more smiling ridge of the Rigi and the calm waters of the lake. The town itself is very picturesque. On the rising ground to its north still stand nine of the towers that defended the old town wall on the Musegg slope. The Reuss is still crossed by two quaint old wooden bridges, the upper being the Kapellbrücke (adorned by many paintings illustrating the history of Switzerland and the town and clinging to the massive Wasserthurm) and the lower the Mühlenbrücke (also with paintings, this time of the Dance of Death). The old Hofbrücke (on the site of the Schweizerhof quay) was removed in 1852, when the process of embanking the shore of the lake began, the result being a splendid series of quays, along which rise palatial hotels. The principal building is the twin-towered Hofkirche (dedicated to St Leger or Leodegar) which, though in its present form it dates only from 1633–1635, was the centre round which the town gradually gathered; originally it formed part of a Benedictine monastery, but since 1455 has been held by a college of secular canons. It has a fine 17th-century organ. The 16th-century town-hall (Rathhaus) now houses the cantonal museum of antiquities of all dates. Both the cantonal and the town libraries are rich in old books, the latter being now specially devoted to works (MS. or printed) relating to Swiss history before 1848. The Lion monument, designed by Thorwaldsen, dedicated in 1821, and consisting of a dying lion hewn out of the living sandstone, commemorates the officers and men of the Swiss Guard (26 officers and about 760 men) who were slain while defending the Tuileries in Paris in 1792, and is reflected in a clear pool at its foot. In the immediate neighbourhood is the Glacier Garden, a series of potholes worn in the sandstone rock bed of an ancient glacier. Among modern buildings are the railway station, the post office and the Museum of War and Peace, all in the new quarter on the left bank of the Reuss. In the interior of the town are many quaint old private houses. In 1799 the population numbered but 4337, but had doubled by 1840. Since then the rise has been rapid and continuous, being 29,255 in 1900. The vast majority are German-speaking (in 1900 there were 1242 Italian-speaking and 529 French-speaking persons) and Romanists (in 1900 there were 4933 Protestants and 299 Jews).

The nucleus of the town was a Benedictine monastery, founded about 750 on the right bank of the Reuss by the abbey of Murbach in Alsace, of which it long remained a "cell." It is first mentioned in a charter of 840 under the name of "Luciaria," which is probably derived from that of the patron saint of the monastery, St Leger or Leodegar (in O. Ger. *Leudegar* or *Lutgar*)—the form "Lucerrun" is first found in 1252. Under the shadow of this monastery there grew up a small village. The germs of a municipal constitution appear in 1252, while the growing power of the Habsburgs in the neighbourhood weakened the ties that bound Lucerne to Murbach. In 1291 the Habsburgs finally purchased Lucerne from Murbach, an act that led a few weeks later to the foundation of the Swiss Confederation, of which Lucerne became the fourth member (the first town to be included) in 1332. But it did not get rid of all traces of Habsburg domination till after the glorious victory of Sempach (1386). That victory led also to the gradual acquisition of territory ruled by and from the town. At the time of the Reformation Lucerne clave to the old faith, of which ever since it has been the great stronghold in Switzerland. The papal nuncio resided here from 1601 to 1873. In the 16th century, as elsewhere in Switzerland, the town government fell into the hands of an aristocratic oligarchy, whose power, though shaken by the great peasant revolt (1653) in the Entlebuch, lasted till 1798. Under the Helvetic republic (1798–1803) Lucerne was the seat of the central government, under the Act of Mediation (1803–1814) one of the six "Directorial" cantons and from 1815 to 1848 one of the three ruling cantons. The patrician government was swept away by the cantonal constitution of 1831. But in 1841 the Conservatives regained power, called in the Jesuits (1844) and so brought about the Sonderbund War (1847) in which they were defeated, the decisive battle taking place at Gisikon, not far from Lucerne. Since 1848 Lucerne has been in disfavour with the Radicals who control the federal government, and has not been chosen as the site of any great federal institution. The Radicals lost power in the canton in 1871, after which date the Conservatives became predominant in the canton, though in the town the Radicals were in the majority.

See J. J. Blumer, *Staats-und Rechtsgeschichte d. schweiz. Demokratien* (3 vols., St Gall, 1850–1859); A. L. Gassmann, *Das Volkslied im Luzerner Wiggerthal u. Hinterland* (Basel, 1906); *Geschichtsfreund* (organ of the Historical Society of the Forest Cantons) from 1843. A. von Liebenau, *Charakterbilder aus Luzern's Vergangenheit* (2 vols., Lucerne, 1884–1891); T. von Liebenau, *Das alte Luzern* (Lucerne, 1881) and "Der luzernische Bauernkrieg vom 1653" (3 articles in vols. xviii.-xx., 1893–1895, of the *Jahrbuch f. Schweizerische Geschichte*); *Heimathkunde für den Kanton Luzern* (6 vols., Lucerne, 1867–1883); A. Lütolf, *Sagen, Bräuche, Legenden aus d. Fünf Orten* (Lucerne, 1862); K. Pfyffer, *Der Kanton Luzern* (2 vols., 1858–1859) and *Geschichte d. Stadt u. Kanton Luzern* (2 vols., new ed., 1861); A. P. von Segesser, *Rechtsgeschichte d. Stadt u. Republik Luzern* (4 vols., 1850–1858) and *45 Jahre (1841–1887) im Luzernischen Staatsdienst* (Bern, 1887); J. Sowerby, *The Forest Cantons of Switzerland* (London, 1892). (W. A. B. C.)

LUCERNE, LAKE OF, the name usually given by foreigners to the principal lake of Central Switzerland. In French it is called the *Lac des Quatre Cantons*, and in German the *Vierwaldstättersee*, this term being often wrongly translated "Lake of the Four Forest Cantons," whereas it means the "Lake of the Four Valleys"—*valles*—which form the four Cantons of Lucerne, Unterwalden, Uri and Schwyz. It takes its name from the town of Lucerne, which is situated at its west end, just where the Reuss issues from the lake, after having entered it at Flüelen at the east end and so practically formed it; the Muota enters the lake at Brunnen (northern shore) and the two mountain streams called the Engelberg and the Sarnen Aa at Buochs and Alpnachstad respectively (S.). The lake is generally supposed to be, on the whole, the most beautiful in Switzerland. This is partly due to the steep limestone mountains between which it lies, the best known being the Rigi (5906 ft.) to the N., and Pilatus (6995 ft.) to the S.W., and to the great promontories that thrust themselves into its waters, such as those of Horw (S.), of Bürgenstock (S.), of Meggenhorn (N.) and of Seelisberg (S.), and partly to the irregularity of its shape. It is, in fact, composed of four main basins (with two side basins), which represent four different valleys, orographically distinct, and connected only by narrow and tortuous channels. There is, first, the most easterly basin, the *Bay of Uri*, extending from Flüelen on the south to Brunnen on the north. At Brunnen the great delta of the Muota forces the lake to the west, so that it forms the *Bay of Gersau* or the *Gulf of Buochs*, extending from the promontory of Seelisberg (E.) to that of the Bürgenstock (W.). Another narrow strait between the two "Noses" (*Nasen*) leads westwards to the *Basin of Weggis*, enclosed between the Rigi (N.) and the Bürgenstock promontory (S.). This last named bay forms the eastern arm of what is called the Cross of Lucerne, the western arm of which is formed by the Bay of Lucerne, while the northern arm is the Bay of Küssnacht and the southern that of *Hergiswil*, prolonged S.W. by the *Bay of Alpnach*, with which it is joined by a very narrow channel, spanned by the Acher iron bridge. The Bay of Uri offers the sternest scenery, but is the most interesting, by reason of its connexion with early Swiss history—at Brunnen the Everlasting League of 1315 was really made, while the legendary place of meeting of the founders of Swiss freedom was the meadow of the Rütli on the west (purchased by the Confederation in 1859), and the site of Tell's leap is marked by the Chapel of Tell (E.). Nearly opposite Brunnen, close to the west shore, an isolated rock (the *Schillerstein* or *Mythenstein*) now bears an inscription in honour of Friedrich Schiller, the author of the famous play of *William Tell* (1804). In the Bay of Gersau the most interesting spot is the village of Gersau (N.), which formed an independent republic from 1390 to 1798, but in 1818 was finally united to the canton of Schwyz. In the next basin to the west is Weggis (N.), also for long in the middle ages a small independent state; to the S.E. of Weggis, on the north shore of the lake, is Vitznau, whence a rack railway (1871) leads up to the top of the Rigi (4¼ m.), while S.W. of Weggis, on the south shore of the lake, is Kehrsiten, whence an electric railway leads up to the great hotels on the Bürgenstock promontory (2854 ft.). The town of Lucerne is connected with Flüelen by the main line of the St Gotthard railway (32 m.), though only portions of this line (from Lucerne to Küssnacht, 10½ m., and from Brunnen to Flüelen, 7 m.) run along the shore; Brunnen is also connected with Flüelen by the splendid carriage road known as the Axenstrasse (7¼ m.) and is the starting-point of an electric line (1905) up to Morschach (S.E.) and the great hotels of Axenstein and Axenfels near it. On the promontory between Lucerne and Küssnacht stands the castle of New Habsburg (modern), while from Küssnacht a carriage road leads through the remains of the "Hollow Way" (*Hohle Gasse*), the scene of the legendary murder of Gessler by William Tell. The west shore of the southern arm, or the basin of Hergiswil and the Bay of Alpnach, is traversed from Horw to Alpnachstad by the Brünig railway (5½ m.), which continues towards Sarnen (Obwalden) and the Bernese Oberland, S.W. from Alpnachstad, whence a rack railway leads N.W. up Pilatus (2¾ m.). Opposite Hergiswil, but on the east shore of the Basin of Hergiswil, is Stanstad, the port of Stans (Nidwalden), which is connected by an electric line with Engelberg (14 m.). The first steamer was placed on the lake in 1835. Lucerne is the only town of importance, but several spots serve as ports for neighbouring towns or large villages (Brunnen for Schwyz, Flüelen for Altdorf, Stanstad for Stans, Alpnachstad for Sarnen). Most of the villages on the shores are frequented in summer by visitors (Gersau also in winter), especially Hertenstein, Weggis, Gersau, Brunnen, Beckenried and Hergiswil, while great hotels, commanding magnificent views, have been built on heights above it, such as the Bürgenstock, Seelisberg, and near Morschach, above Brunnen, besides those on the Rigi, Pilatus and the Stanserhorn. The area of the lake is about 44½ sq. m., its length about 24 m., its greatest width only 2 m. and its greatest depth 702 ft., while the surface of the water is 1434 ft. above sea-level. Of the total area about 15½ sq. m. are in the Canton of Lucerne, 13 sq. m. in that of Nidwalden, 7½ sq. m. in that of Uri, 7½ sq. m. in that of Schwyz, and about 1 sq. m. in that of Obwalden. (W. A. B. C.)

LUCERNE, PURPLE MEDICK or ALFALFA, known botanically as *Medicago sativa*, a plant of the natural order Leguminosae. In England it is still commonly called "lucerne," but in America "alfalfa," an Arabic term ("the best fodder"), which, owing to its increasing cultivation in the western hemisphere, has come into widening usage since the introduction of the plant by the Spaniards. It is an erect perennial herb with a branched hollow stem 1 to 2 ft. high, trifoliolate leaves, short dense racemes of small yellow, blue or purple flowers, and downy pods coiled two or three times in a loose spiral. It has a characteristic long tap-root, often extending 15 ft. or more into the soil. It is a native of the eastern Mediterranean region, but was introduced into Italy in the 1st century A.D., and has become more widely naturalized in Europe; it occurs wild in hedges and fields in Britain, where it was first cultivated about 1650. It seems to have been taken from Spain to Mexico and South America in the 16th century, but the extension of its cultivation in the Western States of the American Union practically dates from the middle of the 19th century, and in Argentina its development as a staple crop is more recent. It is much cultivated as a forage crop in France and other parts of the continent of Europe, but has not come into such general use in Britain, where, however, it is frequently met with in small patches in districts where the soil is very light, with a dry subsoil. Its thick tap-roots penetrate very deeply into the soil; and, if a good cover is once obtained, the plants will yield abundant cuttings of herbage for eight or ten years, provided they are properly top-dressed and kept free from perennial weeds. The time to cut it is, as with clover and sainfoin, when it is in early flower.



Lucerne (*Medicago sativa*), ½ nat. size.
1, Flower, enlarged.
2, Half-ripe fruit, ¾ nat. size.
3, Fruit, enlarged.

In the United States alfalfa has become the staple leguminous forage crop throughout the western half of the country. Some idea of the increase in its cultivation may be obtained from the figures for Kansas, where in 1891 alfalfa was cultivated over 34,384 acres, while in 1907 the number was 743,050. The progress of irrigation has been an important factor in many districts. The plant requires a well-drained soil (deep and permeable as possible), rich in lime and reasonably free from weeds.

See, for practical directions as to cultivation, *Farmers' Bulletin* 339 of the U.S. Department of Agriculture, by J. M. Westgate (Washington, December 1908).

LUCHAIRE, DENIS JEAN ACHILLE (1846–1908), French historian, was born in Paris on the 24th of October 1846. In 1879 he became a professor at Bordeaux and in 1889 professor of medieval history at the Sorbonne; in 1895 he became a member of the *Académie des sciences morales et politiques*, where he obtained the Jean Reynaud prize just before his death on the 14th of November 1908. The most important of Achille Luchaire's earlier works is his *Histoire des institutions monarchiques de la France sous les premiers Capétiens* (1883 and again 1891); he also wrote a *Manuel des institutions françaises: période des Capétiens directs* (1892); *Louis VI. le Gros, annales de sa vie et de son règne* (1890); and *Étude sur les actes de Louis VII.* (1885). His later writings deal mainly with the history of the papacy, and took the form of an elaborate work on Pope Innocent III. This is divided into six parts: (i.) *Rome et Italie*

(1904); (ii.) *La Croisade des Albigeois* (1905); (iii.) *La Papauté et l'empire* (1905); (iv.) *La Question d'Orient* (1906); (v.) *Les Royautés vassales du Saint-Siège* (1908); and (vi.) *Le Concile de Latran et la réforme de l'Église* (1908). He wrote two of the earlier volumes of E. Lavisse's *Histoire de France.*

LUCHU ARCHIPELAGO (called also Riukiu, Loo-choo and Liukiu), a long chain of islands belonging to Japan, stretching from a point 80 m. S. of Kiushiu to a point 73 m. from the N.E. coast of Formosa, and lying between 24° and 30° N. and 123° and 130° E. Japanese cartographers reckon the Luchu islands as 55, having a total coast-line of 768 m., an area of 935 sq. m., and a population of about 455,000. They divide them into three main groups, of which the northern is called Oshima-shoto; the central, Okinawa-gunto; and the southern, Sakishima-retto. The terms *shoto, gunto* and *retto* signify "archipelago," "cluster of islands" and "string of islands" respectively. The last-named group is subdivided into Miyako-gunto and Yayeyama-gunto. The principal islands of these various groups are:—

Oshima-shoto—				
Amami-Oshima	34	m. long and	17	m. broad
Tokuno-shima	16	,,	8½	,,
Okinawa-gunto—				
Okinawa-shima (Great Luchu)	63½	m. long and	14½	m. broad
Kume-shima	9¾	,,	7½	,,
Okinoerabu-shima . . .	9½	,,	5	,,
Ihiya-shima	5	,,	2½	,,
Miyako-gunto—				
Miyako-shima	12¼	m. long and	12	m. broad
Erabu-shima	4¾	,,	3½	,,
Yayeyama-gunto—				
Ishigaki-shima	24½	m. long and	14½	m. broad
Iriomoto-shima	14½	,,	14	,,
Yonakuni-shima . . .	7⅓	,,	3½	,,

The remaining islands of the archipelago are of very small size, although often thickly populated. Almost at the extreme north of the chain are two islands with active volcanoes: Nakano-shima (3485 ft.) and Suwanose-shima (2697 ft.), but the remaining members of the group give no volcanic indications, and the only other mountain of any size is Yuwan-dake (2299 ft.) in Amami-Oshima. The islands "are composed chiefly of Palaeozoic rocks—limestones and quartzites found in the west, and clay, slate, sandstone and pyroxenite or amphibolite on the east. . . . Pre-Tertiary rocks have been erupted through these. The outer sedimentary zone is of Tertiary rocks."[1] The capital is Shuri in Okinawa, an old-fashioned place with a picturesque castle. The more modern town of Nafa, on the same island, possesses the principal harbour and has considerable trade.

The scenery of Luchu is unlike that of Japan. Though so close to the tropics, the islands cannot be said to present tropical features: the bamboo is rare; there is no high grass or tangled undergrowth; open plains are numerous; the trees are not crowded together; lakes are wanting; the rivers are insignificant; and an unusual aspect is imparted to the scenery by numerous coral crags. The temperature in Nafa ranges from a mean of 82° F. in July to 60° in January. The climate is generally (though not in all the islands) pleasant and healthy, in spite of much moisture, the rainfall being very heavy.

The fauna includes wild boars and deer, rats and bats. Excellent small ponies are kept, together with cattle, pigs and goats. The majority of the islands are infested with venomous snakes called *habu* (*Trimeresurus*), which attain a length of 6 to 7 ft. and a diameter of from 2½ to 3 in. Their bite generally causes speedy death, and in the island of Amami-Oshima they claim many victims every year. The most important cultivated plant is the sugar-cane, which provides the principal staple of trade.

Luchu is noted for the production of particularly durable vermilion-coloured lacquer, which is much esteemed for table utensils in Japan. The islands also manufacture certain fabrics which are considered a speciality. These are *Riukiu-tsumugi*, a kind of fine pongee; the so-called *Satsuma-gasuri*, a cotton fabric greatly used for summer wear; *basho-fu*, or banana-cloth (called also *aka-basho*), which is woven from the fibre of a species of banana; and *hoso-jofu*, a particularly fine hempen stuff, made in Miyako-shima, and demanding such difficult processes that six months are required to weave and dye a piece 9½ yds. long.

People.—Although the upper classes in Luchu and Japan closely resemble each other, there are palpable differences between the lower classes, the Luchuans being shorter and better proportioned than the Japanese; having higher foreheads, eyes not so deeply set, faces less flattened, arched and thick eyebrows, better noses, less marked cheek-bones and much greater hairiness. The last characteristic has been attributed to the presence of Ainu blood, and has suggested a theory that when the Japanese race entered south-western Japan from Korea, they drove the Ainu northwards and southwards, one portion of the latter finding their way to Luchu, the other to Yezo. Women of the upper class never appear in public in Luchu, and are not even alluded to in conversation, but women of the lower orders go about freely with uncovered faces. The Luchu costume resembles that of Japan, the only marked difference being that the men use two hairpins, made of gold, silver, pewter or wood, according to the rank of the wearer. Men shave their faces until the age of twenty-five, after which moustache and beard are allowed to grow, though the cheeks are kept free from hair. Their burial customs are peculiar and elaborate, and their large sepulchres, generally mitre-shaped, and scattered all over the country, according to Chinese fashion, form a striking feature of the landscape. The marriage customs are also remarkable. Preliminaries are negotiated by a middleman, as in China and Japan, and the subsequent procedure extends over several days. The chief staple of the people's diet is the sweet potato, and pork is the principal luxury. An ancient law, still in force, requires each family to keep four pigs. In times of scarcity a species of sago (obtained from the *Cycas revoluta*) is eaten. There is a remarkable absence of religious influence in Luchu. Places of worship are few, and the only function discharged by Buddhist priests seems to be to officiate at funerals. The people are distinguished by gentleness, courtesy and docility, as well as by marked avoidance of crime. With the exception of petty thefts, their Japanese administrators find nothing to punish, and for nearly three centuries no such thing as a lethal weapon has been known in Luchu. Professor Chamberlain states that the Luchuan language resembles the Japanese in about the same degree as Italian resembles French, and says that they are sister tongues, many words being identical, others differing only by letter changes which follow certain fixed analogies, and sentences in the one being capable of translation into the other word for word, almost syllable for syllable.

History.—Tinsunshi, "Grandson of Heaven," is the mythical founder of the Luchu monarchy. Towards the close of the 12th century his descendants were driven from the throne by rebellion, but the old national party soon found a victorious leader in Shunten, son of Tametomo, a member of the famous Minamoto family, who, having been expelled from Japan, had come to Luchu and married there. The introduction of the arts of reading and writing are assigned to Shunten's reign. Chinese invasions of Luchu may be traced back to A.D. 605, but they did not result in annexation; and it was in 1372 that China first obtained from the Luchuans recognition of supremacy. Luchuan relations with Japan had long been friendly, but at the end of the 16th century the king refused Japan assistance against Korea, and in 1609 the prince of Satsuma invaded the islands with 3000 men, took the capital by storm, captured the king and carried him off to Kagoshima. A few years later he was restored to his throne on condition of acknowledging Japanese suzerainty and paying tribute. The Luchuans nevertheless continued to pay tribute to China also.

The Chinese government, however, though taking a benevolent interest in the welfare of the islanders, never attempted to bring them under military sway. The incongruity of this state of affairs did not force itself upon Japan's attention so long as her own empire was divided into a number of semi-independent principalities. But in 1879 the Japanese government, treating Luchu as an integral part of the mikado's dominions, dethroned its prince, pensioned him as the other feudal chiefs had been pensioned, and converted Luchu into a prefecture under the name of Okinawa. This name signifies "extended rope," and alludes to the attenuated nature of the archipelago. China remonstrating, a conference was held in Peking, when plenipotentiaries of the two empires signed an agreement to the effect that the archipelago should be divided equally between the claimants. The Chinese government, however, refused to ratify this compromise, and the Japanese continued their measures for the effective administration of all the islands. Ultimately (1895) Formosa also came into Japan's possession, and her title to the whole chain of islands ceased to be disputed.

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[1] Note in *Geographical Journal*, xx., on S. Yoshiwara, "Raised Coral Reefs in the Islands of the Riukiu Curve," in *Journ. Coll. of Science, Imp. Univ., Tokyo* (1901).

Though Captain Broughton, of H.M.S. "Providence," was wrecked on Miyako-shima and subsequently visited Nafa in 1797, it was not till the "Alceste" and "Lyra" expedition in 1816–1817, under Captains Basil Hall and Murray Maxwell, that detailed information was obtained about Luchu. The people at that time showed a curious mixture of courtesy and shyness. From 1844 efforts were made by both Catholic (French) and Protestant missionaries to Christianize them, but though hospitable they made it clear that these efforts were unwelcome. Further visits were made by British vessels under Captain Beechey (1826) and Sir Edward Belcher (1845). The American expedition under Commodore M. C. Perry (1853) added largely to knowledge of the islands, and concluded a treaty with the Luchuan government.

See Basil Hall, *Account of a Voyage of Discovery to the West Coast of Corea and the Great Loo-choo Island* (London, 1818); Comm. M. C. Perry, *Narrative of the Expedition of an American Squadron to the China Seas and Japan, 1852–1854* (Washington, 1856); B. H. Chamberlain, "The Luchu Islands and their Inhabitants," in the *Geographical Journal*, vol. v. (1895); "Contributions to a Bibliography of Luchu," in *Trans. Asiatic Soc. Japan*, xxiv. (1896); C. S. Leavenworth, "History of the Loo-choo Islands," *Journ. China Br. Royal Asiatic Soc.* xxxvi. (1905).

LUCIA (or **LUCY**), **ST**, virgin and martyr of Syracuse, whose name figures in the canon of the mass, and whose festival is celebrated on the 13th of December. According to the legend, she lived in the reign of Diocletian. Her mother, having been miraculously cured of an illness at the sepulchre of St Agatha in Catania, was persuaded by Lucia to distribute all her wealth to the poor. The youth to whom the daughter had been betrothed forthwith denounced her to Pascasius, the prefect, who ordered that she should be taken away and subjected to shameful outrage. But it was found that no force which could be applied was able to move her from the spot on which she stood; even boiling oil and burning pitch had no power to hurt her, until at last she was slain with the sword. The most important documents concerning St Lucy are the mention in the *Martyrologium Hieronymianum* and the ancient inscription discovered at Syracuse, in which her festival is indicated. Many paintings represent her bearing her eyes in her hand or on a salver. Some artists have even represented her blind, but nothing in her *Acta* justifies this representation. It is probable that it originated in a play upon words (Lucia, from Lat. *lux*, light), just as St Clair is invoked in cases of eye-disease.

See O. Caietanus, *Vitae sanctorum Siculorum*, i. 114-121 (Palermo, 1657); Ioannes de Ioanne, *Acta sincera sanctae Luciae* (Palermo, 1758); *Analecta Bollandiana*, xxii. 492; Cahier, *Caractéristiques des saints*, i. 105 (Paris, 1867). (H. DE.)

LUCIAN (d. 312), Christian martyr, was born, like the famous, heathen writer of the same name, at Samosata. His parents, who were Christians, died when he was in his twelfth year. In his youth he studied under Macarius of Edessa, and after receiving baptism he adopted a strictly ascetic life, and devoted himself with zeal to the continual study of scripture. Settling at Antioch when Malchion was master of the Greek school he became a presbyter, and, while supporting himself by his skill as a rapid writer, became celebrated as a teacher, so that he is regarded as the founder of the famous theological school of Antioch. He did not escape suspicion of heresy, and is represented as the connecting link between Paul of Samosata and Arius. Indeed, on the deposition of the former (A.D. 268) he was excluded from ecclesiastical fellowship by three successive bishops of Antioch, while Arius seems to have been among his pupils (Theodoret, *Hist. Eccl.* i. 3, 4). He was, however, restored before the outbreak of persecution, and the reputation won by his high character and learning was confirmed by his courageous martyrdom. He was carried to Nicomedia before Maximin Daza, and persisting in his faith perished on the 7th of January 312, under torture and hunger, which he refused to satisfy with food offered to idols. His defence is preserved by Rufinus (ix. 6; on Eusebius, *Hist. Eccl.* ix. 9). His remains were conveyed to Drepanum in Bithynia, and under Constantine the town was founded anew in his honour with the name of Helenopolis, and exempted from taxes by the emperor (A.D. 327) (see *Chron. Pasch.*, Bonn ed., p. 527). Here in 387, on the anniversary of his death, Chrysostom delivered the panegyrical homily from which, with notices in Eusebius, Theodoret and the other ecclesiastical historians, the life by Jerome (*Vir. Ill.* cap. 77), but especially from the account by S. Metaphrastes (cited at length in Bernhardy's notes to Suidas, *s.v.* *νοθεύει*), the facts above given are derived. See also, for the celebration of his day in the Syriac churches, Wright, *Cat. of Syr. MSS.* p. 283.

Jerome says that Lucian wrote *Libelli de fide* and several letters, but only a short fragment of one epistle remains (*Chron. Pasch.*, ed. Dindorf, i. 516). The authorship of a confession of faith ascribed to Lucian and put forth at the semi-Arian synod of Antioch (A.D. 341) is questioned. Lucian's most important literary labour was his edition of the Greek Old Testament corrected by the Hebrew text, which, according to Jerome (*Adv. Ruf.* ii. 77), was in current use from Constantinople to Antioch. That the edition of Lucian is represented by the text used by Chrysostom and Theodoret, as well as by certain extant MSS., such as the Arundelian of the British Museum, was proved by F. Field (*Prol. ad Origenis Hexapla*, cap. ix.).

Before the publication of Field's *Hexapla*, Lagarde had already directed his attention to the Antiochian text (as that of Lucian may be called) and ultimately published the first part (Genesis, 2 Esdras, Esther) of a provisional reconstructed text. The distinguishing marks of the Lucianic recension are thus summarized by S. R. Driver, *Notes on Heb. Text of Samuel*, p. li. seq.: (1) The substitution of synonyms for the words employed by the Septuagint; (2) the occurrence of double renderings; (3) the occurrence of renderings "which presuppose a Hebrew original self-evidently superior in the passages concerned to the existing Massoretic text," a peculiarity which makes it very important for the criticism of the Hebrew Bible. From a statement of Jerome in his preface to the gospels it seems probable that Lucian had also a share in fixing the Syrian recension of the New Testament text, but of this it is impossible to speak with certainty. He was associated in his work with the Hebraist Dorotheus.

See, generally, A. Harnack's art. in Hauck-Herzog, *Realencyk.* vol. xi., and for "remains" Routh, *Rel. Sac.* iv. 3-17. A full account of his recension of the Septuagint is given in H. B. Swete's *Introduction to the Old Testament in Greek*, p. 81 sqq.; and a good account of his doctrinal position in the prolegomena to the volume on *Athanasius* in the series of Nicene and Post-Nicene Fathers (p. xxviii.) and A. Harnack's *History of Dogma*, especially vol. iv.

LUCIAN [Λουκιανός] (*c.* A.D. 120–180), Greek satirist of the Silver Age of Greek literature, was born at Samosata on the Euphrates in northern Syria. He tells us in the *Somnium* or *Vita Luciani*, 1, that, his means being small, he was at first apprenticed to his maternal uncle, a statuary, or rather sculptor of the stone pillars called Hermae. Having made an unlucky beginning by breaking a marble slab, and having been well beaten for it, he absconded and returned home. Here he had a dream or vision of two women, representing Statuary and Literature. Both plead their cause at length, setting forth the advantages and the prospects of their respective professions; but the youth chooses Παιδεία, and decides to pursue learning. For some time he seems to have made money as a ῥήτωρ, following the example of Demosthenes, on whose merits and patriotism he expatiates in the dialogue *Demosthenis Encomium.* He was very familiar with the rival schools of philosophy, and he must have well studied their teachings; but he lashes them all alike, the Cynics, perhaps, being the chief object of his derision. Lucian was not only a sceptic; he was a scoffer and a downright unbeliever. He felt that men's actions and conduct always fall far short of their professions and therefore he concluded that the professions themselves were worthless, and a mere guise to secure popularity or respect. Of Christianity he shows some knowledge, and it must have been somewhat largely professed in Syria at the close of the 2nd century.[1] In the *Philopatris* (*q.v.*), though the dialogue so called is generally regarded as spurious, there is a statement of the doctrine of the Trinity,[2] and the "Galilaean who had ascended to the third heaven" (12), and "renewed" (ἀνεκαίνισεν) by the waters of baptism, may possibly allude to St Paul. The doctrines of the Λόγος and the "Light of the world," and that God is in heaven making a record of the good and bad actions of men,[1] seem to have come from the same source, though the notion of a written catalogue of human actions to be used in judgment was familiar to Aeschylus and Euripides.

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[1] In the *Alexander* (25) we are told that the province of Pontus, due north of Syria, was "full of Christians."

[2] *Philopatris*, 12, *ὑψιμέδοντα Θεὸν μέγαν ἄμβροτον οὐρανίωνα, υἱὸν Πατρὸς, Πνεῦμα ἐκ πατρὸς ἐκπορευόμενον, ἓν ἐκ τριῶν καὶ ἐξ ἑνὸς τρία*, a passage which bears on the controverted procession "a Patre Filioque."

As a satirist and a wit Lucian occupies in prose literature the unique position which Aristophanes holds in Greek poetry. But whether he is a mere satirist, who laughs while he lashes, or a misanthrope, who hates while he derides, is not very clear. In favour of the former view it may be said that the two main objects of his ridicule are mythology and the sects of philosophy; in favour of the latter, his bitter exposure of imposture and chicanery in the *Alexander*, and the very severe attacks he makes on the "humbug" of philosophy,[2] which he everywhere assails with the most acrimonious and contemptuous epithets.

As a writer Lucian is fluent, easy and unaffected, and a close follower of the best Attic models, such as Plato and the orators. His style is simpler than Plutarch's, and some of his compositions, especially the *Dialogues of the Gods* (pp. 204-287) and *of the Marine Deities* (288-327), and, above all, the *Dialogues of the Dead* (329-454), are models of witty, polished and accurate Greek composition. Not less clever, though rather lax in morality, are the ἑταιρικοὶ διάλογοι (pp. 280-325), which remind us somewhat of the letters of Alciphron. The sarcasms on the popular mythology, the conversations of Pluto, Hermes, Charon and others of the powers in Hades, show a positive disbelief in any future state of existence. The model Lucian followed in these dialogues, as well in the style as in the sparkling and playful repartee, was the Platonic conversations, founded on the drama, of which the dialogue may be called the prose representative. Aristotle never adopted it, perhaps regarding it as beneath the true dignity of philosophy. The dialogue, in fact, was revived and improved by Lucian,[3] the old traditions of the λογοποιοὶ and λογογράφοι, and, above all, the immense influence of rhetoric as an art, having thrown some discredit on a style of composition which, as introduced by Plato, had formed quite a new era in Greek prose composition. For rhetoric loved to talk, expatiate and declaim, while dialectic strove to refute by the employment of question and answer, often in the briefest form.

Lucian evinces a perfect mastery over a language as wonderful in its inflections as in its immense and varied vocabulary; and it is a well-merited praise of the author to say that to a good Greek scholar the pages of Lucian are almost as easy and as entertaining as an English or French novel. It is true that he employs some forms and compounds which were not in use in the time of Plato or Demosthenes, and, as one who lived under Roman rule, has a tendency towards Latinisms. But his own sentiments on the propriety of diction are shown by his reproof to Lexiphanes, "if anywhere you have picked up an out-of-the-way word, or coined one which you think good, you labour to adapt the sense of it, and think it a loss if you do not succeed in dragging it in somewhere, even when it it not really wanted."

Lucian founded his style, or obtained his fluency, from the successful study of rhetoric, by which he appears to have made a good income from composing speeches which attracted much attention. At a later period in life he seems to have held a lucrative legal office in Egypt, which he retained till his death.

His extant works are so numerous that of some of the principal only a short sketch can be given. More than 80 pieces have come down to us under his name (including three collections of 71 shorter dialogues), of which about 20 are spurious or of doubtful authorship. To understand them aright we must remember that the whole moral code, the entire "duty of man," was included, in the estimation of the pagan Greek, in the various schools of philosophy. As these were generally rivals, and the systems they taught were more or less directly antagonistic, truth presented itself to the inquirer, not as one, but as manifold. The absurdity and the impossibility of this forms the burden of all Lucian's writings. He could only form one conclusion, viz. that there is no such thing as truth.

One of the best written and most amusing treatises of antiquity is Lucian's *True History*, forming a rather long narrative in two books, which suggested Swift's *Gulliver's Travels*, Rabelais's *Voyage of Pantagruel* and Cyrano de Bergerac's *Journey to the Moon.* It is composed, the author tells us in a brief introduction, not only as a pastime and a diversion from severer studies, but avowedly as a satire on the poets and logographers who had written so many marvellous tales. He names Ctesias and Homer; but Hellanicus and Herodotus, perhaps other λογοποιοὶ still earlier, appear to have been in his mind.[4] The only true statement in his *History*, he wittily says (p. 72), is that it contains nothing but lies from beginning to end.

The main purport of the story is to describe a voyage to the moon. He set out, he tells us, with fifty companions, in a well-provisioned ship, from the "Pillars of Hercules," intending to explore the western ocean. After eighty days' rough sailing they came to an island on which they found a Greek inscription, "This was the limit of the expedition of Heracles and Dionysus"; and the visit of the wine-god seemed attested by some miraculous vines which they found there. After leaving the island they were suddenly carried up, ship and all, by a whirlwind into the air, and on the eighth day came in sight of a great round island shining with a bright light (p. 77), and lying a little above the moon. In a short time they are arrested by a troop of gigantic "horse-vultures" and brought as captives to the "man in the moon," who proves to be Endymion. He is engaged in a war with the inhabitants of the sun, which is ruled by King Phaëthon, the quarrel having arisen from an attempt to colonize the planet Venus (Lucifer). The voyagers are enlisted as "Moonites," and a long description follows of the monsters and flying dragons engaged in the contest. A fight ensues, in which the slaughter is so great that the very clouds are tinged with red (p. 84). The long description of the inhabitants of the moon is extremely droll and original. After descending safely into the sea, the ship is swallowed by a huge "sea serpent" more than 100 miles long. The adventures during the long confinement in the creature's belly are most amusing; but at last they sail out through the chinks between the monster's teeth, and soon find themselves at the "Fortunate Islands." Here they meet with the spirits of heroes and philosophers of antiquity, on whom the author expatiates at some length. The tale comes to an abrupt end with an allusion to Herodotus in the promise that he "will tell the rest in his next books."

Another curious and rather long treatise is entitled Λούκιος ἢ Ὄνος, the authorship of which is regarded as doubtful. Parts of the story are coarse enough; the point turns on one Lucius visiting in a Thessalian family, in which the lady of the house was a sorceress. Having seen her changed into a bird by anointing herself with some potent drug, he resolves to try a similar experiment on himself, but finds that he has become an ass, retaining, however, his human senses and memory. The mistake arose from his having filched the wrong ointment; however, he is assured by the attendant, Palaestra, that if he can but procure roses to eat, his natural form will be restored. In the night a party of bandits break into the house and carry off the stolen goods into the mountains on the back of the unfortunate donkey, who gets well beaten for stumbling on the rough road. Seeing, as he fancies, some roses in a garden, he goes in quest of them, and again gets beaten as a thief by the gardener (p. 585). After many adventures with the bandits, he attempts to run away, but is caught. A council is held, and he is condemned to die together with a captive girl who had essayed to escape on his back. Suddenly, however, soldiers appear, and the bandits are arrested (p. 595). Again the ass escapes "to the great and populous city of Beroea in Macedonia" (p.603). Here he is sold to a strolling conjurer, afterwards to a market-gardener; and both experiences are alike painful. Again he passes into the possession of a cook, where he gets fat and sleek on food more suited to his concealed humanity than the hard fare he has of late lived upon (p. 614). At last, during an exhibition in the theatre, he sees some roses being carried past, and, making a successful rush to devour them, he recovers his former shape. "I am Lucius," he exclaims to the wondering president of the exhibition, "and my brother's name is Caius. It was a Thessalian witch that changed me into a donkey." Thus all ends well, and he returns safe to his country.

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[1] *Philopatris*, 13. Aesch. *Eum.* 265, δελτογράφῳ δὲ πάντ' ἐπωπᾷ φρενί.

[2] In *Hermotimus* (51) Hermotimus says to Lycinus (who must be assumed to represent Lucian himself), ὑβριστὴς ἀεὶ σὺ, καὶ οὐκ οἶδ' ὅ τι παθὼν μισεῖς φιλοσοφίαν καὶ ἐς τοὺς φιλοσοφοῦντας ἀποσκώπτεις. In *Icaromenippus* (5; see also 29) he says he always guessed who were the best physical philosophers "by their sour-faced looks, their paleness of complexion and the length of their beards."

[3] He says (speaking as Σύρος in *Bis accusatus*, 34) that he found dialogue somewhat out of repute from the too numerous questions (*i.e.* employed by Plato), and brought it up to a more human and natural standard, substituting banter and repartee for dialectic quibbles and close logical reasoning.

[4] He says (p. 127) that he saw punished in Hades, more severely than any other sinners, writers of false narratives, among whom were Ctesias of Cnidus and Herodotus. Yet in the short essay inscribed *Herodotus* (p. 831), he wishes it were possible for him to imitate the many excellencies of that writer.

The treatise *On the Syrian Goddess* (Mylitta, the moon-goddess, the Semitic Aphrodite) is written in the Ionic dialect in imitation perhaps of the style of Herodotus, though the resemblance is by no means close. The writer professes to be an Assyrian (p. 452), and to describe the wonders in the various temples of Palestine and Syria; he descants on the eunuchs of Syria and the origin of the self-imposed privation of manhood professed and practised by the Galli. The account of the temples, altars and sacrifices is curious, if really authentic; after the manner of Pausanias it is little more than a list, with the reasons in most cases added, or the origin of the custom explained.

De Morte Peregrini is a narrative of one Proteus, a Cynic, who after professing various doctrines, and among them those of Christianity, ended his own life by ascending a burning pyre (see PEREGRINUS PROTEUS).

Bis accusatus ("Twice Accused") is a dialogue beginning with a satire on the folly of the popular notion that the gods alone are happy. Zeus is represented as disproving this by enumerating the duties that fall to their lot in the government of the world, and Hermes remarks on the vast crowds of philosophers of rival sects, by whose influence the respect and worship formerly paid to the gods have seriously declined. A trial is supposed to be held under the presidency of the goddess *Δίκη*, between the Academy, the Porch, the schools of the Cynics and Epicureans, and Pleasure, Revelry, Virtue, Luxury, &c., as variously impugned or defended by them. Then Conversation and Rhetoric come before the court, each having an action for defamation to bring against Syrus the essayist, who of course is Lucian himself (p.823). His defence is heard, and in both cases he is triumphantly acquitted. This essay is brilliant from its clever parodies of Plato and Demosthenes, and the satire on the Socratic method of arguing by short questions and answers.

The *Lover of Lying* (Φιλοψεύδης) discusses the reason why some persons seem to take pleasure in falsehood for its own sake. Under the category of lying all mythology (*e.g.* that of Homer and Hesiod) is included, and the question is asked, why the hearers of such stories are amused by them? Quack remedies, charms and miraculous cures are included among the most popular kinds of falsehood; witchcraft, spiritualism, exorcism, expulsion of devils, spectres, are discussed in turn, and a good ghost story is told in p. 57. An anecdote is given of Democritus, who, to show his disbelief in ghosts, had shut himself up in a tomb, and when some young men, dressed up with death's heads, came to frighten him at night, he did not even look up, but called out to them, "Stop your joking" (p. 59). This treatise, a very interesting one, concludes with the reflection that truth and sound reason are the only remedies for vain and superstitious terrors.

The dialogue *Navigium seu Vota* ("The Ship or the Wishes") gives an apparently authentic account of the measurements and fittings of an Egyptian ship which has arrived with a cargo of corn at the Peiraeus, driven out of its course to Italy by adverse winds. The full length is 180 ft., the breadth nearly 50, the depth from deck to the bottom of the hold 43 ft. The "wishes" turn on a party of friends, who have been to see the ship, declaring what they would most desire to possess. One would have the ship filled with gold, another a fine house with gold plate; a third would be a "tyrant" with a large force devoted to his interests; a fourth would like to make himself invisible, enter any house that he pleased, and be transported through the air to the objects of his affection. After hearing them all, the first speaker, Lycinus (Lucian), says that he is content with the privilege of laughing heartily at the vanity of human wishes, especially when they are those of professed philosophers.

The dialogue between Philo and Lycinus, *Convivium seu Lapithae*, is a very amusing description of a banquet, at which a party of dignified philosophers quarrelled over their viands at a marriage feast, and came to blows. The style is a good imitation of Plato, and the scene reminds one of the "clients' dinner" in the fifth satire of Juvenal. Matters come to a climax by the attempt of one of the guests, Zenothemis, to secure for himself a fatter fowl which had been served to his next neighbour Hermon. Each seizes his bird and hits the other with it in the face, at the same time pulling his beard. Then a general fight ensues. The story is a satire on philosophy, the favourite topic of a writer who believed neither in gods nor in men.

The *Piscator* ("Fisherman"), a dialogue between Lucian, Socrates, Pythagoras, Empedocles, Plato and others, commences with a general attack on the author as the enemy of philosophy. Socrates proposes that the culprit should be tried, and that Philosophia should assist in the prosecution. Lucian declares that he does not know where such a person lives, long as he has been looking for her (11). She is found at last, but declares Lucian has never disparaged her, but only impostors and pretenders under her name (15). He makes a long defence (pp. 598-606), abusing the philosophers in the sort of language in which some schools of theologians abuse the monks of the middle ages (34). The trial is held in the Acropolis of Athens, and the sham philosophers, dreading a verdict against them, throw themselves from the rock. A Cynic flings away his scrip in the hurry, and on examination it is found to contain, not books or loaves of bread, but gold coins, dice and fragrant essences (44). At the end Lucian baits his hook with a fig and a gold coin, and catches gluttonous strollers in the city while seated on the wall of the Acropolis.

The *Voyage Home* (Κατάπλους) opens with the complaint that Charon's boat is kept waiting for Hermes, who soon appears with his troop of ghosts. Among them is a *τύραννος*, one Megapenthes, who, as his name is intended to express, mourns greatly over the life he has just left. Amusing appeals are made by other souls for leave to return to life, and even bribes are offered to the presiding goddess of destiny, but Clotho is inexorable. The moral of the piece is closely like that of the parable of Dives and Lazarus: the rich and prosperous bewail their fate, while the poor and afflicted find rest from their troubles, and have no desire to return to them. The *τύραννος* here is the man clothed in purple and fine linen, and Lucian shows the same bitter dislike of tyrants which Plato and the tragic writers display. The heavy penalty is adjudged to Megapenthes that he may ever remember in the other world the misdeeds done in life.

The *Sales of Lives* is an auction held by Zeus to see what price the lives of philosophers of the rival sects will bring. A Pythagorean, who speaks in the Ionic dialect, first undergoes an examination as to what he can teach, and this contains an enumeration of the doctrines usually ascribed to that sect, including metempsychosis. He is valued at 7s. 6d., and is succeeded by Diogenes, who avows himself the champion of truth, a cosmopolitan (8), and the enemy of pleasure. Socrates brings two talents, and is purchased by Dion, tyrant of Syracuse (19). Chrysippus, who gives some specimens of his clever quibbles,[1] is bought for fifty pounds, Aristotle for nearly a hundred, while Pyrrho the sceptic (or one of his school), who professes to "know nothing," brings four pounds, "*because* he is dull and stupid and has no more sense than a grub" (27). But the man raises a doubt, "whether or not he has really been bought," and refuses to go with the purchaser till he has fully considered the matter.

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[1] *E.g.* "A stone is a body; a living creature is a body; you are a living creature; therefore you are a stone." Again: "Is *every* body possessed of life?" "No." "Is a stone possessed of life?" "No." "Are *you* a body?" "Yes." "A *living* body?" "Yes." "Then, if a living body, you are not a stone."

Timon is a very amusing and witty dialogue. The misanthrope, once wealthy, has become a poor farm-labourer, and reproaches Zeus for his indifference to the injustice of man. Zeus declares that the noisy disputes in Attica have so disgusted him that he has not been there for a long time (9). He tells Hermes to conduct Plutus to visit Timon, and see what can be done to help him. Plutus, who at first refuses to go, is persuaded after a long conversation with Hermes, and Timon is found by them digging in his field (31). Poverty is unwilling to resign her votary to wealth; and Timon himself is with difficulty persuaded to turn up with his mattock a crock of gold coins. Now that he has once more become rich, his former flatterers come cringing with their congratulations and respects, but they are all driven off with broken heads or pelted with stones. Between this dialogue and the *Plutus* of Aristophanes there are many close resemblances.

Hermotimus (pp. 739-831) is one of the longer dialogues, Hermotimus, a student of the Stoic philosophy for twenty years (2), and Lucian (Lycinus) being the interlocutors. The long time—forty years at the least—required for climbing up to the temple of virtue and happiness, and the short span of life, if any, left for the enjoyment of it, are discussed. That the greatest philosophers do not always attain perfect indifference, the Stoic *ultimatum*, is shown by the anecdote of one who dragged his pupil into court to make him pay his fee (9), and again by a violent quarrel with another at a banquet (11). Virtue is compared to a city with just and good and contented inhabitants; but so many offer themselves as guides to the right road to virtue that the inquirer is bewildered (26). What is truth, and who are the right teachers of it? The question is argued at length, and illustrated by a peculiar custom of watching the pairs of athletes and setting aside the reserved combatant (πάρεδρος) at the Olympian games by the marks on the ballots (40-43). This, it is argued, cannot be done till all the ballots have been examined; so a man cannot select the right way till he has tried all the ways to virtue. But to know the doctrines of all the sects is impossible in the term of a life (49). To take a taste of each, like trying a sample of wine, will not do, because the doctrines taught are not, like the crock of wine, the same throughout, but vary or advance day by day (59). A suggestion is made (68) that the searcher after truth should begin by taking lessons in the science of discrimination, so as to be a good judge of truth before testing the rival claims. But who is a good teacher of such a science? (70). The general conclusion is that philosophy is not worth the pursuit. "If I ever again," says Hermotimus, "meet a philosopher on the road, I will shun him, as I would a mad dog."

The *Anacharsis* is a dialogue between Solon and the Scythian philosopher, who has come to Athens to learn the nature of the Greek institutions. Seeing the young men performing athletic exercises in the Lyceum, he expresses his surprise at such a waste of energy. This gives Socrates an opportunity of descanting at length on training as a discipline, and emulation as a motive for excelling. Love of glory, Solon says, is one of the chief goods in life. The argument is rather ingenious and well put; the style reminds us of the minor essays of Xenophon.

The *Alexander* or *False Prophet* is the subject of a separate article (see ALEXANDER the PAPHLAGONIAN).

These are the chief of Lucian's works. Many others, *e.g. Prometheus, Menippus, Life of Demonax, Toxaris, Zeus Tragoedus, The Dream or the Cock, Icaromenippus* (an amusing satire on the physical philosophers), are of considerable literary value. (F. A. P.)

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LUCIFER (d. 370/1), bishop of Cagliari (hence called *Caralitanus*), an ardent supporter of the cause of Athanasius. After the unfavourable result of the synod of Arles in 353 he volunteered to endeavour to obtain a new and impartial council. He was accordingly sent by Pope Liberius, with Pancratius the presbyter and Hilarius the deacon, but could not prevent the condemnation of Athanasius, which was renewed at Milan in 355. For his own persistent adherence to the orthodox creed he was banished to Germanicia in Commagene; he afterwards lived at Eleutheropolis in Palestine, and finally in the upper Thebaid. His exile came to an end with the publication of Julian's edict in 362. From 363 until his death in 371 he lived at Cagliari in a state of voluntary separation from ecclesiastical fellowship with his former friends Eusebius of Vercelli, Athanasius and the rest, on account of their mild decision at the synod of Alexandria in 362 with reference to the treatment of those who had unwillingly Arianized under the persecutions of Constantius. Lucifer was hardly sufficiently educated to appreciate the real question at issue, and the sect which he thus founded did not continue long after his death. It is doubtful whether it ever formulated any distinctive doctrine; certainly it developed none of any importance. The memory of Lucifer is still cherished in Sardinia; but, although popularly regarded there as a saint, he has never been canonized.

The controversial writings of Lucifer, dating from his exile, are chiefly remarkable for their passionate zeal, and for the boldness and violence of the language addressed to the reigning emperor, whom he did not scruple to call the enemy of God and a second Saul, Ahab and Jeroboam. Their titles, in the most probable chronological order, are *De non parcendis in Deum delinquentibus, De regibus apostaticis, Ad Constantium Augustum pro Athanasio libri ii., De non conveniendo cum haereticis* and *Moriendum esse pro Filio Dei*. Their quotations of Scripture are of considerable value to the critical student of the Latin text before Jerome. They were first collected and edited by Tilius (Paris, 1568); the best edition is that of W. Hartel in the Vienna *Corpus, Script. Eccl. Lat.* (1886). See also G. Krüger, *Lucifer Bischof von Cagliari und das Schisma der Luciferianer* (Leipzig, 1886); F. G. Kenyon, *Textual Criticism*, pp. 181, 221.

LUCIFER (the Latinized form of Gr. φωσφόρος, "light-bearer"), the name given to the "morning star," *i.e.* the planet Venus when it appears above the E. horizon before sunrise, and sometimes also to the "evening star," *i.e.* the same planet in the W. sky after sundown, more usually called Hesperus (*q.v.*). The term "day star" (so rendered in the Revised Version) was used poetically by Isaiah for the king of Babylon: "How art thou fallen from heaven, O Lucifer, son of the morning! how art thou cut down to the ground, which didst weaken the nations" (Is. xiv. 12, Authorized Version). The words ascribed to Christ in Luke x. 18: "I beheld Satan as lightning fall from heaven" (cf. Rev. ix. 1), were interpreted by the Christian Fathers as referring to the passage in Isaiah; whence, in Christian theology, Lucifer came to be regarded as the name of

Satan before his fall. This idea finds its most magnificent literary expression in Milton's *Paradise Lost*. In this sense the name is most commonly associated with the familiar phrase "as proud as Lucifer."

LUCILIUS, GAIUS (*c.* 180–103 B.C.), the earliest Roman satirist, of whose writings only fragments remain, was born at Suessa Aurunca in Campania. The dates assigned by Jerome for his birth and death are 148 and 103 or 102 B.C. But it is impossible to reconcile the first of these dates with other facts recorded of him, and the date given by Jerome must be due to an error, the true date being about 180 B.C. We learn from Velleius Paterculus that he served under Scipio at the siege of Numantia in 134. We learn from Horace that he lived on the most intimate terms of friendship with Scipio and Laelius, and that he celebrated the exploits and virtues of the former in his satires. Fragments of those books of his satires which seem to have been first given to the world (books xxvi.-xxix.) clearly indicate that they were written in the lifetime of Scipio. Some of these bring the poet before us as either corresponding with, or engaged in controversial conversation with, his great friend. One line—

> Percrepa pugnam Popilli, facta Corneli cane—

in which the defeat of M. Popillius Laenas, in 138, is contrasted with the subsequent success of Scipio, bears the stamp of having been written while the news of the capture of Numantia was still fresh. It is in the highest degree improbable that Lucilius served in the army at the age of fourteen; it is still more unlikely that he could have been admitted into the familiar intimacy of Scipio and Laelius at that age. It seems a moral impossibility that between the age of fifteen and nineteen—*i.e.* between 133 and 129, the year of Scipio's death—he could have come before the world as the author of an entirely new kind of composition, and one which, to be at all successful, demands especially maturity of judgment and experience. It may further be said that the well-known words of Horace (*Satires*, ii. 1, 33), in which he characterizes the vivid portraiture of his life, character and thoughts, which Lucilius bequeathed to the world,

> quo fit ut omnis
> Votiva pateat veluti descripta tabella
> Vita senis,[1]

lose much of their force unless *senis* is to be taken in its ordinary sense—which it cannot be if Lucilius died at the age of forty-six. He spent the greater part of his life at Rome, and died, according to Jerome, at Naples. Lucilius belonged to the equestrian order, a fact indicated by Horace's notice of himself as "infra Lucili censum." Though not himself belonging to any of the great senatorial families, he was in a position to associate with them on equal terms. This circumstance contributed to the boldness, originality and thoroughly national character of his literary work. Had he been a "semi-Graecus," like Ennius and Pacuvius, or of humble origin, like Plautus, Terence or Accius, he would scarcely have ventured, at a time when the senatorial power was strongly in the ascendant, to revive the rôle which had proved disastrous to Naevius; nor would he have had the intimate knowledge of the political and social life of his day which fitted him to be its painter. Another circumstance determining the bent of his mind was the character of the time. The origin of Roman political and social satire is to be traced to the same disturbing and disorganizing forces which led to the revolutionary projects and legislation of the Gracchi.

The reputation which Lucilius enjoyed in the best ages of Roman literature is proved by the terms in which Cicero and Horace speak of him. Persius, Juvenal and Quintilian vouch for the admiration with which he was regarded in the first century of the empire. The popularity which he enjoyed in his own time is attested by the fact that at his death, although he had filled none of the offices of state, he received the honour of a public funeral. His chief claim to distinction is his literary originality. He may be called the inventor of poetical satire, as he was the first to impress upon the rude inartistic medley, known to the Romans by the name of *satura*, that character of aggressive and censorious criticism of persons, morals, manners, politics, literature, &c. which the word satire has ever since denoted. In point of form the satire of Lucilius owed nothing to the Greeks. It was a legitimate development of an indigenous dramatic entertainment, popular among the Romans before the first introduction of the forms of Greek art among them; and it seems largely also to have employed the form of the familiar epistle. But the style, substance and spirit of his writings were apparently as original as the form. He seems to have commenced his poetical career by ridiculing and parodying the conventional language of epic and tragic poetry, and to have used the language commonly employed in the social intercourse of educated men. Even his frequent use of Greek words, phrases and quotations, reprehended by Horace, was probably taken from the actual practice of men, who found their own speech as yet inadequate to give free expression to the new ideas and impressions which they derived from their first contact with Greek philosophy, rhetoric and poetry. Further, he not only created a style of his own, but, instead of taking the substance of his writings from Greek poetry, or from a remote past, he treated of the familiar matters of daily life, of the politics, the wars, the administration of justice, the eating and drinking, the money-making and money-spending, the scandals and vices, which made up the public and private life of Rome in the last quarter of the 2nd century B.C. This he did in a singularly frank, independent and courageous spirit, with no private ambition to serve, or party cause to advance, but with an honest desire to expose the iniquity or incompetence of the governing body, the sordid aims of the middle class, and the corruption and venality of the city mob. There was nothing of stoical austerity or of rhetorical indignation in the tone in which he treated the vices and follies of his time. His character and tastes were much more akin to those of Horace than of either Persius or Juvenal. But he was what Horace was not, a thoroughly good hater; and he lived at a time when the utmost freedom of speech and the most unrestrained indulgence of public and private animosity were the characteristics of men who took a prominent part in affairs. Although Lucilius took no active part in the public life of his time, he regarded it in the spirit of a man of the world and of society, as well as a man of letters. His ideal of public virtue and private worth had been formed by intimate association with the greatest and best of the soldiers and statesmen of an older generation.

The remains of Lucilius extend to about eleven hundred, mostly unconnected lines, most of them preserved by late grammarians, as illustrative of peculiar verbal usages. He was, for his time, a voluminous as well as a very discursive writer. He left behind him thirty books of satires, and there is reason to believe that each book like the books of Horace and Juvenal, was composed of different pieces. The order in which they were known to the grammarians was not that in which they were written. The earliest in order of composition were probably those numbered from xxvi. to xxix., which were written in the trochaic and iambic metres that had been employed by Ennius and Pacuvius in their *Saturae*. In these he made those criticisms on the older tragic and epic poets of which Horace and other ancient writers speak. In them too he speaks of the Numantine War as recently finished, and of Scipio as still living Book i., on the other hand, in which the philosopher Carneades, who died in 128, is spoken of as dead, must have been written after the death of Scipio. Most of the satires of Lucilius were written in hexameters, but, so far as an opinion can be formed from a number o unconnected fragments, he seems to have written the trochaic tetrameter with a smoothness, clearness and simplicity which he never attained in handling the hexameter. The longer fragment produce the impression of great discursiveness and carelessness, bu at the same time of considerable force. He appears, in the composition of his various pieces, to have treated everything tha occurred to him in the most desultory fashion, sometimes adopting the form of dialogue, sometimes that of an epistle or an imaginary discourse, and often to have spoken in his own name, giving an account of his travels and adventures, or of amusing scenes that he had witnessed, or expressing the results of his private meditation and experiences. Like Horace he largely illustrated his own observations by personal anecdotes and fables. The fragments clearly show how often Horace has imitated him, not only in expression, bu in the form of his satires (see for instance i. 5 and ii. 2), in the topic which he treats of, and the class of social vices and the types o character which he satirizes. For students of Latin literature, th chief interest of studying the fragments of Lucilius consists in the light which they throw on the aims and methods of Horace in the composition of his satires, and, though not to the same extent, of his epistles. They are important also as materials for linguistic study; and they have considerable historical value.

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[1] "And so it happens that the whole life of the old man stands clearly before us, as if it were represented on a votive picture."

Editions by F. D. Gerlach (1846), L. Müller (1872), C. Lachmann (1876, posthumous), F. Marx (1905); see also L. Müller, *Leben und Werke des Lucilius* (1876); "Luciliana," by H. A. J. Munro, in the *Journal of Philology*, vii. (1877); Mommsen, *Hist. of Rome*, bk. iv. ch. 13; "Luciliana," by A. E. Housman, in *Classical Quarterly* (April, 1907); C. Cichorius, *Untersuchungen zu Lucilius* (Berlin, 1908). (W. Y. S.; X.)

LUCILIUS JUNIOR, a friend and correspondent of the younger Seneca, probably the author of *Aetna*, a poem on the origin of volcanic activity, variously attributed to Virgil, Cornelius Severus (epic poet of the Augustan age) and Manilius. Its composition has been placed as far back as 44 B.C., on the ground that certain works of art, known to have been removed to Rome about that date, are referred to as being at a distance from the city. But as the author appears to have known and made use of the *Quaestiones Naturales* of Seneca (written A.D. 65), and no mention is made of the great eruption of Vesuvius (A.D. 79), the time of its composition seems to lie between these two dates. In favour of the authorship of Lucilius are the facts that he was a friend of Seneca and acquainted with his writings; that he had for some time held the office of imperial procurator of Sicily, and was thus familiar with the locality; that he was the author of a poem on Sicilian subjects. It is objected that in the 79th letter of Seneca, which is the chief authority on the question, he apparently asks that Lucilius should introduce the hackneyed theme of Aetna merely as an episode in his contemplated poem, not make it the subject of separate treatment. The sources of the Aetna are Posidonius of Apamea, and perhaps the pseudo-Aristotelian *De Mundo*, while there are many reminiscences of Lucretius. It has come down in a very corrupt state, and its difficulties are increased by the unpoetical nature of the subject, the straining after conciseness, and the obtrusive use of metaphor.

Editions by J. Scaliger (1595), F. Jacob (1826), H. A. J. Munro (1867), M. Haupt (in his edition of Virgil, 1873), E. Bährens (in *Poetae latini minores*, ii.), S. Sudhaus (1898), R. Ellis (1901, containing a bibliography of the subject); see also M. Haupt's *Opuscula*, i. 40, ii. 27, 162, iii. 437 (notes, chiefly critical); R. Ellis in *Journal of Philology*, xvi. 292; P. R. Wagler, *De Aetna poemate quaestiones criticae* (1884); B. Kruczkiewicz, *Poema de Aetna Monte* (1883, in which the ancient view of the authorship of Virgil is upheld); L. Alzinger, *Studia in Aetnam collata* (1896); R. Hildebrandt, *Beiträge zur Erklärung des Gedichtes Aetna* (1900); J. Vessereau (text, translation and commentary, 1905); Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans. §§ 307, 308).

LUCINA, goddess of light, a title given to Juno and Diana as presiding over childbirth and bringing children into the light of the world. The full name is *lucina dea*, "the light-bringing goddess" (*lux*, light, hence adj. *lucinus*). It is also given to Hecate (Tibullus 3. 4. 13), as the bringer of terrible dreams, and is used metaphorically as a synonym for child-birth (Virg. *Georg*. iii. 60; Ovid, *Ars. Amat*. iii. 785).

LUCIUS, the name of three popes.

Lucius I., pope for eight months (253–254), spent a short period of his pontificate in exile. He is referred to in several letters of Cyprian (see *Epist*. lxviii. 5) as having been in agreement with his predecessor Cornelius in preferring the milder view on the question as to how the lapsed penitent should be treated. He is commemorated on the 4th of March. (L. D.*)

Lucius II. (Gherardo Caccianemici dal Orso), pope from the 12th of March 1144 to the 15th of February 1145, a Bolognese, successively canon at his native city, cardinal priest of Sta Croce in Gerusalemme, treasurer of the Roman Church, papal legate in Germany for Honorius II., chancellor and librarian under Innocent II., was the successor of Celestine II. His stormy pontificate was marked by the erection of a revolutionary republic at Rome which sought to deprive the pope of his temporal power, and by the recognition of papal suzerainty over Portugal. He was succeeded by Eugenius III.

His letters are in J. P. Migne, *Patrol. Lat*. vol. 179. A single unreliable writer, Godfrey of Viterbo (in J. M. Watterich, *Pontif. Roman. Vitae*), is authority for the statement that Lucius II. perished in an attempt to storm the Capitol. See Jaffé-Wattenbach, *Regesta pontif. Roman*. (1885–1888); J. Langen, *Geschichte der römischen Kirche von Gregor VII. bis Innocenz III.* (Bonn, 1893); F. Gregorovius, *Rome in the Middle Ages*, vol. 4, trans. by Mrs G. W. Hamilton (London, 1896).

Lucius III. (Ubaldo Allucingoli), pope from the 1st of September 1181 to the 25th of November 1185, a native of Lucca and a Cistercian monk, named cardinal-priest of Sta Prassede by Innocent II. and cardinal-bishop of Ostia and Velletri by Adrian IV., succeeded Alexander III. He lived at Rome from November 1181 to March 1182, but dissensions in the city compelled him to pass the remainder of his pontificate in exile, mainly at Velletri, Anagni and Verona. He disputed with the emperor Frederick I. the disposal of the territories of the Countess Matilda. In November 1184 he held a synod at Verona which condemned the Cathari, Paterines, Waldensians and Arnoldists, and anathematized all heretics and their abettors. Lucius died in the midst of preparations for a crusade in answer to appeals of Baldwin IV. of Jerusalem. His successor was Urban III.

His letters are in J. P. Migne, *Patrol. Lat*. vol. 201. Consult J. M. Watterich, *Pontif. Roman. Vitae*, vol. 2 (Leipzig, 1862); and Jaffé-Wattenbach, *Regesta Pontif. Roman*. (1885–1888). See J. Langen, *Geschichte der römischen Kirche von Gregor VII. bis Innocenz III.* (Bonn, 1893); F. Gregorovius, *Rome in the Middle Ages*, vol. 4, trans. by Mrs G. W. Hamilton (London, 1896); P. Scheffer-Boichorst, "Zu den mathildinischen Schenkungen," in *Mittheilungen des österreichen Instituts* (1888). (C. H. Ha.)

LUCK, a term for good or bad fortune, the unforeseen or unrecognized causes which bring success or failure in any enterprise, particularly used of the result of chances in games of skill or chance (see Probability). The word does not occur in English before the 16th century. It was taken from the Low Ger. *luk*, a shortened form of *geluk*, cf. Modern Ger. *Glück*, happiness, good fortune. The *New English Dictionary* considers the word to have been introduced from the Low Countries as a gambling term. The ultimate origin is doubtful; it has been connected with the German *gelingen*, to succeed (cf. *Druck*, pressure, from *dringen*), or with *locken*, to entice.

At Eden Hall in Cumberland, the seat of the Musgrave family, has been long preserved a vessel known as "the luck," supposed to be of Venetian or Byzantine make, and dating from the 10th century. It is a chalice of enamelled glass, and on its safe preservation the fortunes of the Musgrave family are supposed to depend, in accordance with the rhyme:—

> "Should this cup either break or fall,
> Farewell the luck of Edenhall."

LÜCKE, GOTTFRIED CHRISTIAN FRIEDRICH (1791–1855), German theologian, was born on the 24th of August 1791, at Egeln near Magdeburg, where his father was a merchant. He studied theology at Halle and Göttingen. In 1813 he became *repetent* at Göttingen, and in 1814 he received the degree of doctor in philosophy from Halle; in 1816 he removed to Berlin, where he became licentiate in theology, and qualified as *privatdocent*. He soon became intimate with Schleiermacher and de Wette, and was associated with them in 1819 in the redaction of the *Theologische Zeitschrift*. Meanwhile his lectures and publications (among the latter a *Grundriss der Neutestamentlichen Hermeneutik*, 1816) had brought him into considerable repute, and he was appointed professor extraordinarius in the new university of Bonn in the spring of 1818; in the following autumn he became professor ordinarius. From Bonn, where he had J. C. W. Augusti (1772–1841), J. K. L. Gieseler, and Karl Immanuel Nitzsch for colleagues, he was called in 1827 to Göttingen to succeed K. F. Stäudlin (1761–1826). In that year he helped to found the *Theologische Studien und Kritiken*, the chief organ of the "mediation" theology (*Vermittelungstheologie*). At Göttingen he remained, declining all further calls elsewhere, as to Erlangen, Kiel, Halle, Tübingen, Jena and Leipzig, until his death, which occurred on the 4th of February 1855.

Lücke, who was one of the most learned, many-sided and influential of the so-called "mediation" school of evangelical theologians (*Vermittelungstheologie*), is now chiefly known by his *Kommentar über die Schriften d. Evangelisten Johannes* (4 vols., 1820–1832); it has since passed through two new and improved editions (the last volume of the 3rd edition by E. Bertheau, 1856). He is an intelligent maintainer of the Johannine authorship of the Fourth Gospel; in connexion with this thesis he was one of the first to argue for the early date and non-apostolic authorship of the Apocalypse. His *Einleitung in die Offenbarung Johannis* was published in 1832 (2nd ed., 1848–1852). He also published a *Synopsis Evangeliorum*, conjointly with W. M. L. de Wette (1818, 2nd ed., 1840). See Herzog-Hauck, *Realencyklopädie*.

LUCKENWALDE, a town in the Prussian province of Brandenburg, on the Nuthe, 30 m. S. of Berlin, on the main line to Dresden and Leipzig. Pop. (1905) 22,263. Its cloth and wool manufactories are among the most extensive in Prussia. Among its other industries are cotton printing and dye works, brewing, and the making of metal and bronze goods.

The site of Luckenwalde was occupied in the 12th century by a Cistercian monastery, but the village did not spring up till the reign of Frederick the Great. It was made a town in 1808.

LUCKNOW, a city, district and division of British India. The city was the capital of Oudh from 1775 until it was merged in the United Provinces in 1901. Pop. (1901) 264,049. It lies mainly on the right bank of the winding river Gumti, which is crossed by two railway and three road bridges. It contains the Canning college (1864), with an Oriental department, and La Martinière college, where about 100 boys are educated, the institution being in part supported by an endowment left by General Claude Martin in 1800. There are native manufactures of gold and silver brocade, muslins, embroidery, brass and copper wares, pottery and moulding in clay. There are also important European industrial establishments, such as iron-works and paper-mills. Lucknow is the centre of the Oudh and Rohilkhand railway system, with large workshops. Lines radiate to Cawnpore, Bareilly, Gonda, Fyzabad and Rae Bareli. Lucknow is the headquarters of the 8th division of the northern army. The cantonments are situated 3 m. E. of the city.

Lucknow is chiefly notable in the history of British India as the capital of the nawabs who had dealings with Warren Hastings, and their successors the kings of Oudh, whose deposition by Lord Dalhousie was one of the chief causes of the Mutiny. Amongst the events of the Mutiny the defence of the residency of Lucknow comes only second in historic interest to the massacre at Cawnpore itself. For the two sieges, see INDIAN MUTINY. The name of the residency is now applied not only to the residency itself, but to the whole of the outbuildings and entrenchments in which Sir Henry Lawrence concentrated his small force. These entrenchments covered almost 60 acres of ground, and consisted of a number of detached houses, public edifices, outhouses and casual buildings, netted together, and welded by ditches, parapets, stockades and batteries into one connected whole. On the summit of the plateau stands the residency proper, the official residence of the chief commissioner, a lofty building three storeys high, with a fine portico. Near the residency comes the banqueting hall, and beyond the Baillie Guardgate lie the ruins of the surgeon's house, where Sir Henry Lawrence died of a shell-wound, and where the ladies of the garrison were sheltered in underground rooms. Round the line of the entrenchments are pillars marked with the name of the various "posts" into which the garrison was distributed. The most dangerous of these was the Cawnpore battery post, where the stockade was directly exposed to the enemy's fire. The mutineers had rifles fixed in rests in the house opposite, and swept the road that led through the residency enclosure at this point. Close to the residency is the Lawrence Memorial, an artificial mound 30 ft. high crowned by a marble cross.

Among the other buildings of interest in Lucknow is the Imambara, which is one of the largest rooms in the world (162 ft. by 54), having an arched roof without supports. This room was built by the Nawab Asaf-ud-dowlah in 1784, to afford relief to the famine-stricken people. The many monuments of his reign include his country palace of Bibiapur, outside the city. Among later buildings are the two palaces of Chhattar Manzil, erected for the wives of Ghazi-ud-din Haidar (1814), the remains of the Farhat Baksh, dating from the previous reign, and adjoining the greater Chhattar Manzil, the observatory (now a bank) of Nasir-ud-din Haidar (1827), the imambara or mausoleum and the unfinished great mosque (Jama Masjid) of Mahommed Ali Shah (1837), and the huge debased Kaisar Bagh, the palace of Wajid Ali Shah (1847–1856).

The DISTRICT OF LUCKNOW lies on both sides of the river Gumti, and has an area of 967 sq. m. Its general aspect is that of an open champaign, well studded with villages, finely wooded and in parts most fertile and highly cultivated. In the vicinity of rivers, however, stretch extensive barren sandy tracts (*bhúr*), and there are many wastes of saline efflorescence (*usár*). The country is an almost dead level, the average slope, which is from N.W. to S.E., being less than a foot per mile. The principal rivers are the Gumti and the Sai with their tributaries. The population in 1901 was 793,241, showing an increase of 2·5% in the preceding decade.

The DIVISION OF LUCKNOW contains the western half of the old province of Oudh. It comprises the six districts of Lucknow, Unao, Sitapur, Rae Bareli, Hardoi and Kheri. Its area is 12,051 sq. m. and its population in 1901 was 5,977,086, showing an increase of 2·06% in the decade.

See *Lucknow District Gazetteer* (Allahabad, 1904). For a fuller description of the city see G. W. Forrest, *Cities of India* (1903).

LUÇON, a town of western France, in the department of Vendée, 23 m. S.E. of La Roche-sur-Yon, on the railway from Nantes to Bordeaux, and on the canal of Luçon (9 m. long), which affords communication with the sea in the Bay of Aiguillon. Pop. (1906) 6163. Between Luçon and the sea stretch marshy plains, the bed of the former gulf, partly drained by numerous canals, and in the reclaimed parts yielding excellent pasturage, while in other parts are productive salt-marshes, and ponds for the rearing of mussels and other shell-fish. Luçon is the seat of a bishopric, established in 1317, and held by Richelieu from 1607 to 1624. The cathedral, partly of the 12th-century and partly of later periods, was originally an abbey church. The façade and the clock tower date from about 1700, and the tower is surmounted by a crocketed spire rising 275 ft. above the ground, attributed to the architect François Leduc of Tuscany. The cloisters are of the late 15th century. Adjacent is the bishop's palace, possessing a large theological library and Titian's "Disciples of Emmaus," and there is a fine public garden. A communal college and an ecclesiastical seminary are among the public institutions. During the Vendean wars, Luçon was the scene of several conflicts, notably in 1793.

LUCRE (Lat. *lucrum*, gain; the Indo-European root is seen in Gr. *ἀπολάυειν*, to enjoy, and in Ger. *Lohn*, wages), a term now only used in the disparaging sense of unworthy profit, or money that is the object of greed, especially in the expression "filthy lucre" (1 Tim. iii. 3). In the adjective "lucrative," profitable, there is, however, no sense of disparagement. In Scots law the term "lucrative succession" (*lucrativa acquisitio*) is used of the taking by an heir, during the lifetime of his ancestor, of a free grant of any part of the heritable property.

LUCRETIA, a Roman lady, wife of Lucius Tarquinius Collatinus, distinguished for her beauty and domestic virtues. Having been outraged by Sextus Tarquinius, one of the sons of Tarquinius Superbus, she informed her father and her husband, and, having exacted an oath of vengeance from them, stabbed herself to death. Lucius Junius Brutus, her husband's cousin, put himself at the head of the people, drove out the Tarquins, and established a republic. The accounts of this tradition in later writers present many points of divergence.

Livy i. 57-59; Dion. Halic. iv. 64-67, 70, 82; Ovid, *Fasti*, ii. 721-852; Dio Cassius, frag. 11 (Bekker); G. Cornewall Lewis, *Credibility of Early Roman History*, i.

LUCRETILIS MONS, a mountain of the Sabine territory, mentioned by Horace (*Od.* i. 17, 1) as visible from his Sabine farm, and probably identical with the "Mons Lucretius" mentioned in the *Liber Pontificalis* (ed. Duchesne, i. 183), which speaks of "possessio in territorio Sabinensi quae cognominatur ad duas casas sub monte Lucretio" in the time of Constantine. The name "ad duas casas" is supposed to survive in the chapel of the Madonna della Casa near Rocca Giovane, and the Mons Lucretilis is generally (and rightly) identified with Monte Gennaro, a limestone peak 4160 ft. high, which forms a prominent feature in the view N.E. of Rome. Excavations on the supposed site of Horace's farm were begun by Professor Pasqui in September 1909. (T. As.)

LUCRETIUS (TITUS LUCRETIUS CARUS) (*c.* 98–55 B.C.), the great Latin didactic poet. Our sole information concerning his life is found in the brief summary of Jerome, written more than four centuries after the poet's death. Jerome followed, often carelessly, the accounts contained in the lost work of Suetonius *De Viris Illustribus,* written about two centuries after the death of Lucretius; and, although it is likely that Suetonius used the information transmitted by earlier grammarians, there is nothing to guide us to the original sources. According to this account the poet was born in 95 B.C.; he became mad in consequence of the administration of a love-philtre; and after composing several books in his lucid intervals, which were subsequently corrected by Cicero, he died by his own hand in the forty-fourth year of his age. Donatus states in his life of Virgil, a work also based on the lost work of Suetonius, that Lucretius died on the same day on which Virgil assumed the *toga virilis*, that is, in the seventeenth year of Virgil's life, and on the very day on which he was born, and adds that the consuls were the same, that is Cn. Pompeius Magnus and M. Licinius Crassus, consuls in 70 and again in 55. The statements cannot be perfectly reconciled; but we may say with certainty that Lucretius was born between 98 and 95 B.C., and died in 55 or 54. A single mention of his poem, the *De rerum natura* (which from the condition in which it has reached us may be assumed to have been published posthumously) in a letter of Cicero's to his brother Quintus, written early in 54 B.C., confirms the date given by Donatus as that of the poet's death. The statements of Jerome have been questioned or disbelieved on the ground of their intrinsic improbability. They have been regarded as a fiction invented later by the enemies of Epicureanism, with the view of discrediting the most powerful work ever produced by any disciple of that sect. It is more in conformity with ancient credulity than with modern science to attribute a permanent tendency to derangement to the accidental administration of any drug, however potent. A work characterized by such strength, consistency and continuity of thought is not likely to have been composed "in the intervals of madness" as Jerome says. Donatus, in mentioning the poet's death, gives no hint of the act of suicide. The poets of the Augustan age, who were deeply interested both in his philosophy and in his poetry, are entirely silent about the tragical story of his life. Cicero, by his professed antagonism to the doctrines of Epicurus, by his inadequate appreciation of Lucretius himself and by the indifference which he shows to other contemporary poets, seems to have been neither fitted for the task of correcting the unfinished work of a writer whose genius was so distinct from his own, nor likely to have cordially undertaken such a task.

Yet these considerations do not lead to the absolute rejection of the story. The evidence afforded by the poem rather leads to the conclusion that the tradition contains some germ of fact. It is remarkable that in more than one passage of his poem Lucretius writes with extraordinary vividness of the impression produced both by dreams and by waking visions. It is true that the philosophy of Epicurus put great stress on these, as affording the explanation of the origin of supernatural beliefs. But the insistence with which Lucretius returns to the subject, and the horror with which he recalls the effects of such abnormal phenomena, suggest that he himself may have been liable to such hallucinations, which are said to be consistent with perfect sanity, though they may be the precursors either of madness or of a state of despair and melancholy. Other passages, where he describes himself as ever engaged, even in his dreams, on his task of inquiry and composition, produce the impression of an unrelieved strain of mind and feeling, which may have ended in some extreme reaction of spirit, or in some failure of intellectual power, that may have led him to commit suicide. But the strongest confirmation of the tradition is the unfinished condition in which the poem has reached us. The subject appears indeed to have been fully treated in accordance with the plan sketched out in the introduction to the first book. But that book is the only one which is finished in style and in the arrangement of its matter. In all the others, and especially in the last three, the continuity of the argument is frequently broken by passages which must have been inserted after the first draft of the arguments was written out. Thus, for instance, in his account of the transition from savage to civilized life, he assumes at v. 1011 the discovery of the use of skins, fire, &c., and the first beginning of civil society, and proceeds at 1028 to explain the origin of language, and then again returns, from 1090 to 1160, to speculate upon the first use of fire and the earliest stages of political life. These breaks in continuity show what might also be inferred from frequent repetitions of lines which have appeared earlier in the poem, and from the rough workmanship of passages in the later books, that the poem could not have received the final revision of the author. Nor is there any great difficulty in believing that Cicero edited it; the word "emendavit," need not mean more than what we call "preparing for press."

From the absence of any claim on the part of any other district of Italy to the honour of having given birth to Lucretius it is inferred that he was of purely Roman origin. No writer certainly is more purely Roman in personal character and in strength of understanding. His silence on the subject of Roman greatness and glory as contrasted with the prominence of these subjects in the poetry of men of provincial birth such as Ennius, Virgil and Horace, may be explained by the principle that familiarity had made the subject one of less wonder and novelty to him. The Lucretian *gens* to which he belonged was one of the oldest of the great Roman houses, nor do we hear of the name, as we do of other great family names, as being diffused over other parts of Italy, or as designating men of obscure or servile origin. It may well be assumed that Lucretius was a member of the Roman aristocracy, belonging either to a senatorian or to one of the great equestrian families. If the Roman aristocracy of his time had lost much of the virtue and of the governing qualities of their ancestors, they showed in the last years before the establishment of monarchy a taste for intellectual culture which might have made Rome as great in literature as in arms and law. A new taste for philosophy had developed among members of the governing class during the youth of Lucretius, and eminent Greek teachers of the Epicurean sect settled at Rome at the same time, and lived on terms of intimacy with them. The inference that Lucretius belonged to this class is confirmed by the tone in which he addresses Gaius Memmius, a man of an eminent senatorian family, to whom the poem is dedicated. His tone is quite unlike that in which Virgil or even Horace addresses Maecenas. He addresses him as an equal; he expresses sympathy with the prominent part he played in public life, and admiration for his varied accomplishments, but on his own subject claims to speak to him with authority.

Although our conception of the poet's life is necessarily vague and meagre, yet his personal force is so remarkable and so vividly impressed on his poem, that we seem able to form a consistent idea of his qualities and characteristics. We know, for example, that the choice of a contemplative life was not the result of indifference to the fate of the world, or of any natural coldness or even calmness of temperament. In the opening lines of the second and third books we can mark the recoil of a humane and sensitive spirit from the horrors of the reign of terror which he witnessed in his youth, and from the anarchy and confusion which prevailed at Rome during his later years. We may also infer that he had not been through his whole career so much estranged from the social life of his day as he seems to have been in his later years. Passages in his poem attest his familiarity with the pomp and luxury of city life, with the attractions of the public games and with the pageantry of great military spectacles. But much the greater mass of the illustrations of his philosophy indicate that, while engaged on his poem he must have passed much of his time in the open air, exercising at once the keen observation of a naturalist and the contemplative vision of a poet. He seems to have found a pleasure, more congenial to the modern than to the ancient temperament, in ascending mountains or wandering among their solitudes (vi. 469, iv. 575). References to companionship in these wanderings, and the well-known description of the charm of a rustic meal (ii. 29) speak of kindly sociality rather than of any austere separation from his fellows.

Other expressions in his poem (*e.g.* iii. 10, &c.) imply that he was also a student of books. Foremost among these were the writings of Epicurus; but he had also an intimate knowledge of the philosophical poem of Empedocles, and at least an acquaintance with the works of Democritus, Anaxagoras, Heraclitus, Plato and the Stoical writers. Of other Greek prose writers he knew Thucydides and Hippocrates; while of the poets he expresses in more than one passage the highest admiration of Homer, whom he imitated in several places. Next to Homer Euripides is most frequently reproduced by him. But his poetical sympathy was not limited to the poets of Greece. For his own countryman Ennius he expresses an affectionate admiration; and he imitates his language, his rhythm and his manner in many places. The fragments of the old tragedian Pacuvius and of the satirist Lucilius show that Lucretius had made use of their expressions and materials. In his studies he was attracted by the older writers, both Greek and Roman, in whose masculine temperament and understanding he recognized an affinity with his own.

His devotion to Epicurus seems at first sight more difficult to explain than his enthusiasm for Empedocles or Ennius. Probably he found in his calmness of temperament, even in his want of imagination, a sense of rest and of exemption from the disturbing influences of life; while in his physical philosophy he found both an answer to the questions which perplexed him and an inexhaustible stimulus to his intellectual curiosity. The combative energy, the sense of superiority, the spirit of satire, characteristic of him as a Roman, unite with his loyalty to Epicurus to render him not only polemical but intolerant and contemptuous in his tone toward the great antagonists of his system, the Stoics, whom, while constantly referring to them, he does not condescend even to name. With his admiration of the genius of others he combines a strong sense of his own power. He is quite conscious of the great importance and of the difficulty of his task; but he feels his own ability to cope with it.

It is more difficult to infer the moral than the intellectual characteristics of a great writer from the personal impress left by him on his work. Yet it is not too much to say that there is no work in any literature that produces a profounder impression of sincerity. No writer shows a juster scorn of all mere rhetoric and exaggeration. No one shows truer courage, not marred by irreverence, in confronting the great problems of human destiny, or greater strength in triumphing over human weakness. No one shows a truer humanity and a more tender sympathy with natural sorrow.

The peculiarity of the poem of Lucretius, that which makes it unique in literature, is that it is a reasoned system of philosophy, written in verse. The prosaic title *De Rerum Natura*, a translation of the Gr. περὶ φύσεως, implies the subordination of the artistic to a speculative motive. As in the case of nearly all the great works of Roman literary genius, the form of the poem was borrowed from the Greeks. The rise of speculative philosophy in Greece was coincident with the beginning of prose composition, and many of the earliest philosophers wrote in the prose of the Ionic dialect; others, however, and especially the writers of the Greek colonies in Italy and Sicily, expounded their systems in continuous poems composed in the epic hexameter. Most famous in connexion with this kind of poetry are Xenophanes and Parmenides, the Eleatics and Empedocles of Agrigentum. The last was less important as a philosopher, but greater than the others both as a poet and a physicist. On both of these grounds he had a greater attraction to Lucretius. The fragments of the poem of Empedocles show that the Roman poet regarded that work as his model. In accordance with this model he has given to his own poem the form of a personal address, he has developed his argument systematically, and has applied the sustained impetus of epic poetry to the treatment of some of the driest and abstrusest topics. Many ideas and expressions of the Sicilian have been reproduced by the Roman poet; and the same tone of impassioned solemnity and melancholy seems to have pervaded both works. But Lucretius, if less original as a thinker, was probably a much greater poet than Empedocles. What chiefly distinguishes him from his Greek prototypes is that his purpose is rather ethical than purely speculative; the zeal of a teacher and reformer is more strong in him than even the intellectual passion of a thinker. His speculative ideas, his moral teaching and his poetical power are indeed interdependent on one another, and this interdependence is what mainly constitutes their power and interest. But of the three claims which he makes to immortality, the importance of his subject, his desire to liberate the mind from the bonds of superstition and the charm and lucidity of his poetry—that which he himself regarded as supreme was the second. The main idea of the poem is the irreconcilable opposition between the truth of the laws of nature and the falsehood of the old superstitions. But, further, the happiness and the dignity of life are regarded by him as absolutely dependent on the acceptance of the true and the rejection of the false doctrine. In the Epicurean system of philosophy he believed that he had found the weapons by which this war of liberation could be most effectually waged. Following Epicurus he sets before himself the aim of finally crushing that fear of the gods and that fear of death resulting from it which he regards as the source of all the human ills. Incidentally he desires also to purify the heart from other violent passions which corrupt it and mar its peace. But the source even of these—the passions of ambition and avarice—he finds in the fear of death; and that fear he resolves into the fear of eternal punishment after death.

The selection of his subject and the order in which it is treated are determined by this motive. Although the title of the poem implies that it is a treatise on the "whole nature of things," the aim of Lucretius is to treat only those branches of science which are necessary to clear the mind from the fear of the gods and the terrors of a future state. In the two earliest books, accordingly, he lays down and largely illustrates the first principles of being with the view of showing that the world is not governed by capricious agency, but has come into existence, continues in existence, and will ultimately pass away in accordance with the primary conditions of the elemental atoms which, along with empty space, are the only eternal and immutable substances. These atoms are themselves infinite in number but limited in their varieties, and by their ceaseless movement and combinations during infinite time and through infinite space the whole process of creation is maintained. In the third book he applies the principles of the atomic philosophy to explain the nature of the mind and vital principle, with the view of showing that the soul perishes with the body. In the fourth book he discusses the Epicurean doctrine of the images, which are cast from all bodies, and which act either on the senses or immediately on the mind, in dreams or waking visions, as affording the explanation of the belief in the continued existence of the spirits of the departed. The fifth book, which has the most general interest, professes to explain the process by which the earth, the sea, the sky, the sun, moon and stars, were formed, the origin of life, and the gradual advance of man from the most savage to the most civilized condition. All these topics are treated with the view of showing that the world is not itself divine nor directed by divine agency. The sixth book is devoted to the explanation, in accordance with natural causes, of some of the more abnormal phenomena, such as thunderstorms, volcanoes, earthquakes, &c., which are special causes of supernatural terrors.

The consecutive study of the argument produces on most readers a mixed feeling of dissatisfaction and admiration. They are repelled by the dryness of much of the matter, the unsuitableness of many of the topics discussed for poetic treatment, the arbitrary assumption of premises, the entire failure to establish the connexion between the concrete phenomena which the author professes to explain and these assumptions, and the erroneousness of many of the doctrines which are stated with dogmatic confidence. On the other hand, they are constantly impressed by his power of reasoning both deductively and inductively, by the subtlety and fertility of invention with which he applies analogies, by the clearness and keenness of his observation, by the fulness of matter with which his mind is stored, and by the consecutive force, the precision and distinctness of his style, when employed in the processes of scientific exposition. The first two books enable us better than anything else in ancient literature to appreciate the boldness and, on the whole, the reasonableness of the ancient mind in forming hypotheses on great matters that still occupy the investigations of physical science. The third and fourth books give evidence of acuteness in psychological analysis; the fourth and sixth of the most active and varied observation of natural phenomena; the fifth of original insight and strong common sense in conceiving the origin of society and the progressive advance of man to civilization. But the chief value of Lucretius as a thinker lies in his firm grasp of speculative ideas, and in his application of them to the interpretation of human life and nature. All phenomena, moral as well as material, are contemplated by him in their relation to one great organic whole, which he acknowledges under the name of "Natura daedala rerum," and the most beneficent manifestations of which he seems to symbolize and almost to deify in the "Alma Venus," whom, in apparent contradiction to his denial of a divine interference with human affairs, he invokes with prayer in the opening lines of the poem. In this conception of nature are united the conceptions of law and order, of ever-changing life and interdependence, of immensity, individuality, and all-pervading subtlety, under which the universe is apprehended both by his intelligence and his imagination.

Nothing can be more unlike the religious and moral attitude of Lucretius than the old popular conception of him as an atheist and a preacher of the doctrine of pleasure. It is true that he denies the doctrines of a supernatural government of the world and of a future life. But his arguments against the first are really only valid against the limited and unworthy conceptions of divine agency involved in the ancient religions; his denial of the second is prompted by his vital realization of all that is meant by the arbitrary infliction of eternal torment after death. His war with the popular beliefs of his time is waged, not in the interests of licence, but in vindication of the sanctity of human feeling. The cardinal line of the poem,

"Tantum religio potuit suadere malorum,"

is elicited from him as his protest against the sacrifice of Iphigenia by her father. But in his very denial of a cruel, limited and capricious agency of the gods, and in his imaginative recognition of an orderly, all-pervading, all-regulating power, we find at least a nearer approach to the higher conceptions of modern theism than in any of the other imaginative conceptions of ancient poetry and art. But his conception even of the ancient gods and of their indirect influence on human life is more worthy than the popular one. He conceives of them as living a life of eternal peace and exemption from passion, in a world of their own; and the highest ideal of man is, through the exercise of his reason, to realize an image of this life. Although they are conceived of as unconcerned with the interest of our world, yet influences are supposed to emanate from them which the human heart is capable of receiving and assimilating. The effect of unworthy conceptions of the divine nature is that they render a man incapable of visiting the temples of the gods in a calm spirit, or of receiving the emanations that "announce the divine peace" in peaceful tranquillity. The supposed "atheism" of Lucretius proceeds from a more deeply reverential spirit than that of the majority of professed believers in all times.

His moral attitude is also far removed from that of ordinary ancient Epicureanism or of modern materialism. Though he acknowledges pleasure to be the law of life, yet he is far from regarding its attainment as the end of life. What man needs is not enjoyment, but "peace and a pure heart." The victory to be won by man is the triumph over fear, ambition, passion, luxury. With the conquest over these nature herself supplies all that is needed for happiness. Self-control and renunciation are the lessons which he preaches.

It has been doubted whether Cicero,[1] in his short criticism in the letter already referred to, concedes to Lucretius both the gifts of genius and the accomplishment of art or only one of them. Readers of a later time, who could compare his work with the finished works of the Augustan age, would certainly disparage his art rather than his power. But with Cicero it was different. He greatly admired, or professed to admire, the genius of the early Roman poets, while he shows indifference to the poetical genius of his younger contemporaries. Yet he could not have been insensible to the immense superiority in rhythmical smoothness which the hexameter of Lucretius has over that of Ennius and Lucilius. And no reader of Lucretius can doubt that he attached the greatest importance to artistic execution, and that he took a great pleasure, not only in "the long roll of his hexameter," but also in producing the effects of alliteration, assonance, &c., which are so marked a peculiarity in the style of Plautus and the earlier Roman poets. He allows his taste for these tricks of style to degenerate into mannerism. And this is the only drawback to the impression of absolute spontaneity which his style produces. He was unfortunate in living before the natural rudeness of Latin art had been successfully grappled with. His only important precursors in serious poetry were Ennius and Lucilius, and, though he derived from the first of these an impulse to shape the Latin tongue into a fitting vehicle for the expression of elevated emotion and imaginative conception, he could find in neither a guide to follow in the task he set before himself. The difficulty and novelty of his task enhances our sense of his power. His finest passages are thus characterized by a freshness of feeling and enthusiasm of discovery. But the result of these conditions and of his own inadequate conception of the proper limits of his art is that his best poetry is clogged with a great mass of alien matter, which no treatment in the world could have made poetically endurable. (W. Y. S.)

AUTHORITIES.—The two most ancient manuscripts of Lucretius, O and Q, are both at Leiden, one being a folio (*oblongus*) and the other a quarto (*quadratus*). Upon these alone the modern texts are founded. The scientific editing of the text began with C. C. Lachmann (1852) whose work still holds the field. The most important commentary is that of H. A. J. Munro (4th ed., 1886) with a prose translation. For the earlier editions it is sufficient to refer to the account in Munro's *Introduction*, vol. i. pp. 3 sqq. Giussani's complete edition (with Italian notes, 1896) and R. Heinze's edition of book iii. (1897) are also of value. So too are A. Brieger's numerous contributions in German periodicals and his text in the Teubner series (2nd ed., 1899).

The philosophy of Lucretius has been much studied in recent times. Amongst special treatises may be mentioned K. H. Usener's *Epicurea* (1887); J. Woltjer's *Lucretii philosophia cum fontibus comparata* (1877); John Masson's *Atomic Theory of Lucretius* (1884) and *Lucretius: Epicurean and Poet* (1909); and several papers and treatises by Brieger and Giussani.

On the characteristics of the poet as a whole, C. Martha's *Le Poème de Lucrèce* (4th ed., Paris, 1885) and W. Y. Sellar in chaps. xi. sqq. of the *Roman Poets of the Republic*, may be consulted. There are useful bibliographies in W. S. Teuffel's *History of Roman Literature* (English trans. by G. C. W. Warr) and Martin v. Schanz's *Geschichte der römischen Litteratur*.

The following translations into English verse are known: T. Creech (1683), J. M. Good (1805), T. Busby (1813), C. F. Johnson (New York, 1872), T. C. Baring (1884). There is also a translation by Cyril Bailey (Oxford, 1910).

LUCRINUS LACUS, or LUCRINE LAKE, a lake of Campania, Italy, about ½ m. to the N. of Lake Avernus, and only separated from the sea (Gulf of Pozzuoli) by a narrow strip of land, traversed by the coast road, Via Herculanea, which runs on an embankment, the construction of which was traditionally attributed to Heracles in Strabo's time—and the modern railway. Its size has been much reduced by the rise of the crater of the Monte-nuovo in 1538. Its greatest depth is about 15 ft. In Roman days its fisheries were important and were let out by the state to contractors. Its oyster-beds were, as at the present day, renowned; their foundation is attributed to one Sergius Orata, about 100 B.C. It was also in favour as a resort for pleasure excursions from Baiae (cf. Martial i. 63), and its banks were covered with villas, of which the best known was Cicero's Academia, on the E. bank. The remnants of this villa, with the village of Tripergola, disappeared in 1538.

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[1] *Ad Q. Fratr.* ii. 9 (11), 13. Both sense and words have been much disputed. The general sense is probably that given by the following restoration, "Lucretii poemata, ut scribis, ita sunt multis hominibus ingenii multae etiam (MSS. tamen) artis, sed cum *ad umbilicum* (omitted in MSS.) veneris, virum te putabo, si Sallustii Empedoclea legeris, hominem non putabo,". This would concede Lucretius both genius and art, but imply at the same time that he was not easy reading.

See J. Beloch, *Campanien*, ed. 2 (Breslau, 1890), 172.

LUCULLUS, the name of a Roman plebeian family of the Licinian *gens*. By far the most famous of its members was LUCIUS LICINIUS LUCULLUS (*c.* 110–56), surnamed Ponticus from his victories in Asia Minor over Mithradates VI. of Pontus. His father, of the same name, had held an important military command in Sicily, but on his return to Rome he was prosecuted on a charge of bribery and condemned to exile. His mother was Caecilia, of the family of the Metelli, and sister of Quintus Caecilius Metellus Numidicus. Early in life he attached himself to the party of Sulla, and to that party he remained constant. He attracted Sulla's notice in the Social War (90) and in 88, when Sulla was appointed to the command of the war against Mithradates, accompanied him as quaestor to Greece and Asia Minor. While Sulla was besieging Athens, Lucullus raised a fleet and drove Mithradates out of the Mediterranean. He won a brilliant victory off Tenedos, and had he been more of a patriot and less of a party man he might have ended a perilous war. In 84 peace was concluded with Mithradates. Sulla returned to Rome, while Lucullus remained in Asia, and by wise and generous financial reforms laid the foundation of the prosperity of the province. The result of his policy was that he became extremely popular with the provincials, but offended many of the *publicani*, a powerful class which farmed the public revenue. In 80 he returned to Rome as curule aedile, in which capacity he exhibited games of exceptional magnificence. Soon afterwards (77) he was elected praetor, and was next appointed to the province of Africa, where he again won a good name as a just and considerate governor. In 74 he became consul, and went to Asia at the head of about 30,000 foot and 2000 horse, to defend the province of Bithynia against Mithradates, who was besieging his colleague, Marcus Aurelius Cotta, in Chalcedon on the Propontis. Mithradates was forced to retire along the sea-coast till he halted before the strong city of Cyzicus, which he besieged. Lucullus, however, cut off his communications on the land side, and, aided by bad weather, forced him to raise the siege. In the autumn of 73 Lucullus marched to Cabeira or Neocaesarea, where the king had gone into winter quarters with a vague hope that his son-in-law, Tigranes, king of Armenia, and possibly even the Parthians, might come to his aid. Although the forces of Mithradates were far superior in numbers, his troops were no match for the Roman legionaries. A large detachment of his army having been cut up by one of Lucullus's lieutenant-generals, the king decided on instant retreat. The retreat soon became a disorderly flight, Mithradates himself escaping with difficulty into Lesser Armenia.

Thus Pontus, with the exception of some of the maritime cities, such as Sinope, Heraclea and Amisus, became Roman territory. Two years were occupied in the capture of these strongholds, while Lucullus busied himself with a general reform of the administration of the province of Asia. His next step was to demand the surrender of Mithradates and to threaten Tigranes with war in the event of refusal. In the spring of 69, at the head of only two legions, he marched through Sophene, the south-western portion of Armenia, crossed the Tigris, and pushed on to the newly-built royal city, Tigranocerta, situated on one of the affluents of that river. A motley host, made up out of the tribes bordering on the Black Sea and the Caspian, hovered round his small army, but failed to hinder him from laying siege to the town. Lucullus showed consummate military capacity, contriving to maintain the siege and at the same time to give battle to the enemy's vastly superior forces. There might now have been peace but for the interference of Mithradates, who pressed Tigranes to renew the war and to seek the aid and alliance of Parthia. The Parthian king, however, preferred a treaty with Rome to a treaty with Armenia, and desired simply to have the Euphrates recognized as his western boundary. Mithradates next appealed to the national spirit of the peoples of the East generally, and endeavoured to rouse them to a united effort. The position of Lucullus was critical. The home government was for recalling him, and his army was disaffected. Nevertheless, though continually harassed by the enemy, he persisted in marching northwards from Tigranocerta over the high table-land of central Armenia, in the hope of reaching Artaxata on the Araxes. But the open mutiny of his troops compelled him to recross the Tigris into the Mesopotamian valley. Here, on a dark tempestuous night, he surprised and stormed Nisibis, the capital of the Armenian district of Mesopotamia, and in this city, which yielded him a rich booty, he found satisfactory winter quarters. Meantime Mithradates was again in Pontus, and in a disastrous engagement at Ziela the Roman camp was taken and the army slaughtered to a man. Lucullus was obliged to retreat into Asia Minor, leaving Tigranes and Mithradates masters of Pontus and Cappadocia. The work of eight years of war was undone. In 66 Lucullus was superseded by Pompey. He had fairly earned the honour of a triumph, but his powerful enemies at Rome and charges of maladministration, to which his immense wealth gave colour, caused it to be deferred till 63. From this time, with the exception of occasional public appearances, he gave himself up to elegant luxury, with which he combined a sort of dilettante pursuit of philosophy, literature and art. As a general he does not seem to have possessed the entire confidence of his troops, owing probably to his natural hauteur and the strict discipline which he imposed on them. The same causes made him unpopular with the Roman capitalists, whose sole object was the accumulation of enormous fortunes by farming the revenue of the provinces.

Among the Roman nobles who revelled in the newly acquired riches of the East, Lucullus stood pre-eminent. His park and pleasure grounds near Rome, and the costly and laborious works in his parks and villas at Tusculum, near Naples, earned for him from Pompey (it is said) the title of the "Roman Xerxes." On one of his luxurious entertainments he is said to have spent upwards of £2000. He was a liberal patron of Greek philosophers and men of letters, and he collected a valuable library, to which such men had free access. He himself is said to have been a student of Greek literature, and to have written a history of the Marsian war in Greek, inserting solecisms to show that he was a Roman. He was one of the interlocutors in Cicero's *Academica*, the second book (first edition) of which was called *Lucullus*. Sulla also entrusted him with the revision of his *Memoirs*. The introduction of the cherry-tree from Asia into Europe is attributed to him. It appears that he became mentally feeble some years before his death, and was obliged to surrender the management of his affairs to his brother Marcus. The usual funeral panegyric was pronounced on him in the Forum, and the people would have had him buried by the side of Sulla in the Campus Martius, but at his brother's request he was laid in his splendid villa at Tusculum.

See Plutarch's *Lucullus*; Appian's *Mithridatic War*; the epitomes of the lost books of Livy; and many passages in Cicero. Some allusions will also be found in Dio Cassius, Pliny and Athenaeus. For the Mithradatic wars, see bibliography under MITHRADATES (VI. of Pontus); and generally G. Boissier, *Cicero and his Friends* (Eng. trans. by A. D. Jones, 1897); H. Peter, *Hist. Rom. Reliquiae*, i. p. cclxxxv.; W. Drumann, *Geschichte Roms*, iv. His *Elogium* is given in *C.I.L.* i. 292.

His brother, MARCUS LICINIUS LUCULLUS, was adopted by Marcus Terentius Varro, and was hence known as Marcus Terentius Varro Lucullus. In 82 B.C. he served under Sulla against Marius. In 79 he was curule aedile with his brother, in 77 praetor, in 73 consul with Gaius Cassius Varus. When praetor he forbade the carrying of arms by slaves, and with his colleague in the consulship passed the *lex Terentia Cassia*, to give authority for purchasing corn with the public money and retailing it at a fixed price at Rome. As proconsul in Macedonia he made war with great cruelty against the Dardani and Bessi, and compelled them to acknowledge the supremacy of Rome.

Having enjoyed a triumph, he was sent out to the East to settle the affairs of the provinces conquered by his brother. He sided with Cicero during the Catilinarian conspiracy, did his utmost to prevent his banishment, and subsequently supported his claim for the restoration of his house. He was one of the better representatives of the optimates, and enjoyed some reputation as an orator.

See Cicero, *De Domo*, 52; *Pro Tullio*, 8; *In Verrem*, iii. 70, v. 21; *Florus*, iii. 4, 7; Ammianus Marcellinus xxvii. 4, 11; Plutarch, *Sulla*, 27; *Lucullus*, 35, 36, 43; Orelli's *Onomasticon Tullianum*.

LUCUS FERONIAE, an ancient shrine in Etruria. It was visited both by Latins and Sabines even in the time of Tullus Hostilius and was plundered by Hannibal in 211 B.C. It was undoubtedly in the territory of Capena (*q.v.*); but in imperial times it became an independent community receiving a colony of Octavian's veterans (*Colonia Iulia felix Lucoferensis*) and possessing an amphitheatre. Its site has been disputed. Some authorities place it on the Colle Civitucola (but see CAPENA), others at the church of S. Abbondio near Rignano, others (and probably rightly) at Nazzano, which was reached by a branch road from the Via Flaminia, where remains of a circular temple have been found.

See E. Bormann in *Corp. Inscr. Lat.* xi. 569 sqq.; H. Nissen, *Italische Landeskunde*, ii. 369 sqq. (T. As.)

LUCY, RICHARD DE (d. 1179), called the "loyal," chief justiciar of England, appears in the latter part of Stephen's reign as sheriff and justiciar of the county of Essex. He became, on the accession of Henry II., chief justiciar conjointly with Robert de Beaumont, earl of Leicester; and after the death of the latter (1168) held the office without a colleague for twelve years. The chief servant and intimate of the king he was among the first of the royal party to incur excommunication in the Becket controversy. In 1173 he played an important part in suppressing the rebellion of the English barons, and commanded the royalists at the battle of Fornham. He resigned the justiciarship in 1179, though pressed by the king to continue in office, and retired to Lesues Abbey in Kent, which he had founded and where he died. Lucy's son, Godfrey de Lucy (d. 1204), was bishop of Winchester from 1189 to his death in September 1204; he took a prominent part in public affairs during the reigns of Henry II., Richard I. and John.

See J. H. Round, *Geoffrey de Mandeville* (1892); Sir J. H. Ramsay, *Angevin Empire* (1903); and W. Stubbs, *Constitutional History*, vol. i.

LUCY, SIR THOMAS (1532–1600), the English Warwickshire squire who is traditionally associated with the youth of William Shakespeare, was born on the 24th of April 1532, the son of William Lucy, and was descended, according to Dugdale, from Thurstane de Cherlecote, whose son Walter received the village of Charlecote from Henry de Montfort about 1190. Walter is said to have married into the Anglo-Norman family of Lucy, and his son adopted the mother's surname. Three of Sir Thomas Lucy's ancestors had been sheriffs of Warwickshire and Leicestershire, and on his father's death in 1552 he inherited Sherborne and Hampton Lucy in addition to Charlecote, which was rebuilt for him by John of Padua, known as John Thorpe, about 1558. By his marriage with Joyce Acton he inherited Sutton Park in Worcestershire, and became in 1586 high sheriff of the county. He was knighted in 1565. He is said to have been under the tutorship of John Foxe, who is supposed to have imbued his pupil with the Puritan principles which he displayed as knight of the shire for Warwick in the parliament of 1571 and as sheriff of the county, but as Mrs Carmichael Stopes points out Foxe only left Oxford in 1545, and in 1547 went up to London, so that the connexion must have been short. He often appeared at Stratford-on-Avon as justice of the peace and as commissioner of musters for the county. As justice of the peace he showed great zeal against the Catholics, and took his share in the arrest of Edward Arden in 1583. In 1585 he introduced into parliament a bill for the better preservation of game and grain, and his reputation as a preserver of game gives some colour to the Shakespearian tradition connected with his name. Nicholas Rowe, writing in 1710, told a story that Lucy prosecuted Shakespeare for deer-stealing from Charlecote Park in 1585, and that Shakespeare aggravated the offence by writing a ballad on his prosecutor. The trouble arising from this incident is said to have driven Shakespeare from Stratford to London. The tale was corroborated by Archdeacon Davies of Sapperton, Gloucestershire, who died in 1708. The story is not necessarily falsified by the fact that there was no deer park at Charlecote at the time, since there was a warren, and the term warren legally covers a preserve for other animals than hares or rabbits, roe-deer among others. Shakespeare is generally supposed to have caricatured the local magnate of Stratford in his portrait of Justice Shallow, who made his first appearance in the second part of *Henry IV.*, and a second in the *Merry Wives of Windsor*. Robert Shallow is a justice of the peace in the county of Gloucester and his ancestors have the dozen white luces in their coats, the arms of the Lucys being three luces, while in Dugdale's *Warwickshire* (ed. 1656) there is drawn a coat-of-arms in which these are repeated in each of the four quarters, making twelve in all. There are many considerations which make it unlikely that Shallow represents Lucy, the chief being the noteworthy difference in their circumstances. Lucy died at Charlecote on the 7th of July 1600. His grandson, Sir Thomas Lucy (1585–1640), was a friend of Lord Herbert of Cherbury, and was eulogized by John Davies of Hereford in 1610. The Charlecote estates eventually passed to the Rev. John Hammond through his marriage with Alice Lucy, and in 1789 he adopted the name of Lucy.

For a detailed account of Sir Thomas Lucy, with his son and grandson of the same name, see Mrs C. Carmichael Stopes, *Shakespeare's Warwickshire Contemporaries* (2nd ed., 1907). Cf. also an article by Mrs Stopes in the *Fortnightly Review* (Feb. 1903), entitled "Sir Thomas Lucy not the Original of Justice Shallow," and J. O. Halliwell-Phillipps, *Observations on the Charlecote Traditions* (Brighton, 1887).

LUDDITES, the name given to organized bands of English rioters for the destruction of machinery, who made their first appearance in Nottingham and the neighbouring districts towards the end of 1811. The origin of the name is given in Pellew's *Life of Lord Sidmouth* (iii. 80). In 1779 there lived in a village in Leicestershire a person of weak intellect, called Ned Ludd, who was the butt of the boys of the village. On one occasion Ludd pursued one of his tormentors into a house where were two of the frames used in stocking manufacture, and, not being able to catch the boy, vented his anger on the frames. Afterwards, whenever any frames were broken, it became a common saying that Ludd had done it. The riots arose out of the severe distress caused by the war with France. The leader of the riotous bands took the name of "General Ludd." The riots were specially directed against machinery because of the widespread prejudice that its use produced a scarcity in the demand for labour. Apart from this prejudice, it was inevitable that the economic and social revolution implied in the change from manual labour to work by machinery should give rise to great misery. The riots began with the destruction of stocking and lace frames, and, continuing through the winter and the following spring, spread into Yorkshire, Lancashire, Derbyshire and Leicestershire. They were met by severe repressive legislation, introduced by Lord Liverpool's government, a notable feature in the opposition to which was Lord Byron's speech in the House of Lords. In 1816 the rioting was resumed, caused by the depression which followed the peace of 1815 and aggravated by one of the worst of recorded harvests. In that year, although the centre of the rioting was again in Nottingham, it extended over almost the whole kingdom. The rioters were also thoroughly organized. While part of the band destroyed the machinery, sentinels were posted to give warning of the approach of the military. Vigorous repressive measures, and, especially, reviving prosperity, brought the movement to an end.

See G. Pellew, *Life and Correspondence of H. Addington, 1st Viscount Sidmouth* (London, 1847); Spencer Walpole, *History of England*, vol. i. (London, 1890); and the *Annual Register* for 1811, 1812 and 1816.

LÜDENSCHEID, a town in the Prussian province of Westphalia, 19 m. by rail S.S.E. of Hagen. Pop. (1905) 28,921. It is the seat of various hardware manufactures, among them metal-plated and tin-plated goods, buckles, fancy nails and brooches, and has iron-foundries and machine shops. From the counts of Altena Lüdenscheid passed to the counts of the Mark, with which district it was ceded to Brandenburg early in the 17th century.

LUDHIANA, a town and district of British India, in the Jullundur division of the Punjab. The town is 8 m. from the present left bank of the Sutlej, 228 m. by rail N.W. of Delhi. Pop. (1901) 48,649. It is an important centre of trade in grain, and has manufactures of shawls, &c., by Kashmiri weavers, and of scarves, turbans, furniture and carriages. There is an American Presbyterian mission, which maintains a medical school for Christian women, founded in 1894.

The District of Ludhiana lies south of the river Sutlej, and north of the native states of Patiala, Jind, Nabha and Maler Kotla. Area 1455 sq. m. The district consists for the most part of a broad plain, without hills or rivers, stretching northward from the native borders to the ancient bed of the Sutlej. The soil is a rich clay, broken by large patches of shifting sand. On the eastern edge, towards Umballa, the clay is covered by a bed of rich mould, suitable for the cultivation of cotton and sugar-cane. Towards the west the sand occurs in union with the superficial clay, and forms a light friable soil, on which cereals form the most profitable crop. Even here, however, the earth is so retentive of moisture that good harvests are reaped from fields which appear mere stretches of dry and sandy waste. These southern uplands descend to the valley of the Sutlej by an abrupt terrace, which marks the former bed of the river. The principal stream has shifted to the opposite side of the valley, leaving an alluvial strip, 10 m. in width, between its ancient and its modern bed. The Sutlej itself is here only navigable for boats of small burden. A branch of the Sirhind canal irrigates a large part of the western area. The population in 1901 was 673,097. The principal crops are wheat, millets, pulse, maize and sugar-cane. The district is crossed by the main line of the North-Western railway from Delhi to Lahore, with two branches.

During the Mussulman epoch, the history of the district is bound up with that of the Rais of Raikot, a family of converted Rajputs, who received the country as a fief under the Sayyid dynasty, about 1445. The town of Ludhiana was founded in 1480 by two of the Lodi race (then ruling at Delhi), from whom it derives its name, and was built in great part from the prehistoric bricks of Sunet. The Lodis continued in possession until 1620, when it again fell into the hands of the Rais of Raikot. Throughout the palmy days of the Mogul empire the Raikot family held sway, but the Sikhs took advantage of the troubled period which accompanied the Mogul decadence to establish their supremacy south of the Sutlej. Several of their chieftains made encroachments on the domains of the Rais, who were only able to hold their own by the aid of George Thomas, the famous adventurer of Hariana. In 1806 Ranjit Singh crossed the Sutlej and reduced the obstinate Mahommedan family, and distributed their territory amongst his co-religionists. Since the British occupation of the Punjab, Ludhiana has grown in wealth and population.

See *Ludhiana District Gazetteer* (Lahore, 1907).

LUDINGTON, a city and the county-seat of Mason county, Michigan, U.S.A., on Lake Michigan, at the mouth of the Marquette river, about 85 m. N.W. of Grand Rapids. Pop. (1900) 7166 (2259 foreign-born); (1904, state census) 7259; (1910) 9132. It is served by the Père Marquette, and the Ludington and Northern railways, and by steamboat lines to Chicago, Milwaukee and other lake ports. To Manitowoc, Milwaukee, Kewanee and Two Rivers, Wisconsin, on the W. shore of Lake Michigan, cars, especially those of the Père Marquette railway, are ferried from here. Ludington was formerly well known as a lumber centre, but this industry has greatly declined. There are various manufactures, and the city has a large grain trade. On the site of the city Père Marquette died and was buried, but his body was removed within a year to Point St Ignace. Ludington was settled about 1859, and was chartered as a city in 187
It was originally named Père Marquette, but was renamed i
1871 in honour of James Ludington, a local lumberman.

LUDLOW, EDMUND (*c.* 1617–1692), English parliamentarian
son of Sir Henry Ludlow of Maiden Bradley, Wiltshire, whos
family had been established in that county since the 15th century
was born in 1617 or 1618. He went to Trinity College, Oxford
and was admitted to the Inner Temple in 1638. When the Grea
Rebellion broke out, he engaged as a volunteer in the life guar
of Lord Essex. His first essay in arms was at Worcester, his nex
at Edgehill. He was made governor of Wardour Castle in 164
but had to surrender after a tenacious defence on the 18th o
March 1644. On being exchanged soon afterwards, he engage
as major of Sir A. Hesilrige's regiment of horse. He was presen
at the second battle of Newbury, October 1644, at the siege o
Basing House in November, and took part in an expedition t
relieve Taunton in December. In January his regiment wa
surprised by Sir M. Langdale, Ludlow himself escaping wit
difficulty. In 1646 he was elected M.P. for Wilts in the room o
his father and attached himself to the republican party. H
opposed the negotiations with the king, and was one of the chie
promoters of Pride's Purge in 1648. He was one of the king'
judges, and signed the warrant for his execution. In Februar
he was elected a member of the council of state. In Januar
1651 Ludlow was sent into Ireland as lieutenant-general of horse
holding also a civil commission. Here he spared neither healt
nor money in the public service. Ireton, the deputy of Irelan
died on the 26th of November 1651; Ludlow then held the chie
command, and had practically completed the conquest of th
island when he resigned his authority to Fleetwood in Octobe
1652. Though disapproving Cromwell's action in dissolving th
Long Parliament, he maintained his employment, but whe
Cromwell was declared Protector he declined to acknowledg
his authority. On returning to England in October 1655 he wa
arrested, and on refusing to submit to the government wa
allowed to retire to Essex. After Oliver Cromwell's deat
Ludlow was returned for Hindon in Richard's parliament o
1659, but opposed the continuance of the protectorate. He sa
in the restored Rump, and was a member of its council of stat
and of the committee of safety after its second expulsion, and
commissioner for the nomination of officers in the army. In Jul
he was sent to Ireland as commander-in-chief. Returning i
October 1659, he endeavoured to support the failing republica
cause by reconciling the army to the parliament. In Decembe
he returned hastily to Ireland to suppress a movement in favou
of the Long Parliament, but on arrival found himself almos
without supporters. He came back to England in January 166
and was met by an impeachment presented against him t
the restored parliament. His influence and authority had no
disappeared, and all chance of regaining them vanished wit
Lambert's failure. He took his seat in the Convention parliament as member for Hindon, but his election was annulled on th
18th of May. Ludlow was not excepted from the Act of Indemnity, but was included among the fifty-two for whom punishment less than capital was reserved. Accordingly, on th
proclamation of the king ordering the regicides to come i
Ludlow emerged from his concealment, and on the 20th of Jun
surrendered to the Speaker; but finding that his life was no
assured, he succeeded in escaping to Dieppe, travelled to Genev
and Lausanne, and thence to Vevey, then under the protectio
of the canton of Bern. There he remained, and in spite of plo
to assassinate him he was unmolested by the government o
that canton, which had also extended its protection to othe
regicides. He steadily refused during thirty years of exile t
have anything to do with the desperate enterprises of republica
plotters. But in 1689 he returned to England, hoping to b
employed in Irish affairs. He was however remembered onl
as a regicide, and an address from the House of Commons wa
presented to William III. by Sir Edward Seymour, requestin
the king to issue a proclamation for his arrest. Ludlow escape
again, and returned to Vevey, where he died in 1692. A monument raised to his memory by his widow is in the church

St Martin. Over the door of the house in which he lived was placed the inscription "Omne solum forti patria, quia Patris." Ludlow married Elizabeth, daughter of William Thomas, of Wenvoe, Glamorganshire, but left no issue.

His *Memoirs*, extending to the year 1672, were published in 1698–1699 at Vevey and have been often reprinted; a new edition, with notes and illustrative material and introductory memoir, was issued by C. H. Firth in 1894. They are strongly partisan, but the picture of the times is lifelike and realistic. Ludlow also published "a letter from Sir Hardress Waller . . . to Lieutenant-General Ludlow with his answer" (1660), in defence of his conduct in Ireland. See C. H. Firth's article in *Dict. Nat. Biog.*; Guizot's *Monk's Contemporaries*; A. Stein's *Briefe Englischer Flüchtlinge in der Schweiz.*

LUDLOW, a market town and municipal borough in the Ludlow parliamentary division of Shropshire, England, on the Hereford-Shrewsbury joint line of the Great Western and London & North Western railways, 162 m. W.N.W. from London. Pop. (1901) 4552. It is beautifully situated at the junction of the rivers Teme and Corve, upon and about a wooded eminence crowned by a massive ruined castle. Parts of this castle date from the 11th century, but there are many additions such as the late Norman circular chapel, the Decorated state rooms, and details in Perpendicular and Tudor styles. The parish church of St Lawrence is a cruciform Perpendicular building, with a lofty central tower, and a noteworthy east window, its 15th-century glass showing the martyrdom of St Lawrence. There are many fine half-timbered houses of the 17th century, and one of seven old town-gates remains. The grammar school, founded in the reign of John, was incorporated by Edward I. The principal public buildings are the guildhall, town-hall and market-house, and public rooms, which include a museum of natural history. Tanning and flour-milling are carried on. The town is governed by a mayor, 4 aldermen and 12 councillors. Area 416 acres.

The country neighbouring Ludlow is richly wooded and hilly, while the scenery of the Teme is exquisite. Westward, Vinnal Hill reaches 1235 ft., eastward lies Titterstone Clee (1749 ft.). Richard's Castle, 3 m. S. on the borders of Herefordshire, dates from the reign of Edward the Confessor, but little more than its great artificial mound remains. At Bromfield, 3 m. above Ludlow on the Teme, the church and some remains of domestic buildings belonged to a Benedictine monastery of the 12th century.

Ludlow is supposed to have existed under the name of Dinan in the time of the Britons. Eyton in his history of Shropshire identifies it with one of the "Ludes" mentioned in the Domesday Survey, which was held by Roger de Lacy of Osbern FitzRichard and supposes that Roger built the castle soon after 1086, while a chronicle of the FitzWarren family attributes the castle to Roger earl of Shrewsbury. The manor afterwards belonged to the Lacys, and in the beginning of the 14th century passed by marriage to Roger de Mortimer and through him to Edward IV. Ludlow was a borough by prescription in the 13th century, but the burgesses owe most of their privileges to their allegiance to the house of York. Richard, duke of York, in 1450 confirmed their government by 12 burgesses and 24 assistants, and Edward IV. on his accession incorporated them under the title of bailiffs and burgesses, granted them the town at a fee-farm of £24, 3s. 4d., a merchant gild and freedom from toll. Several confirmations of this charter were granted; the last, dated 1665, continued in force (with a short interval in the reign of James II.) until the Municipal Corporations Act of 1835. By the charter of Edward IV. Ludlow returned 2 members to parliament, but in 1867 the number was reduced to one, and in 1885 the town was disfranchised. The market rights are claimed by the corporation under the charters of Edward IV. (1461) and Edward VI. (1552). The court of the Marches was established at Ludlow in the reign of Henry VII., and continued to be held here until it was abolished in the reign of William III. Ludlow castle was granted by Edward IV. to his two sons, and by Henry VII. to Prince Arthur, who died here in 1502. In 1634 Milton's *Comus* was performed in the castle under its original style of "A Masque presented at Ludlow Castle," before the earl of Bridgewater, Lord President of Wales. The castle was garrisoned in 1642 by Prince Rupert, who went there after the battle of Naseby, but in 1646 it surrendered to Parliament and was afterwards dismantled.

See *Victoria County History*, Shropshire; Thomas Wright, *The History of Ludlow and its Neighbourhood* (1826).

LUDLOW GROUP, or LUDLOVIAN, in geology, the uppermost subdivision of the Silurian rocks in Great Britain. This group contains the following formations in descending order:—Tilestones, Downton Castle sandstones (90 ft.), Ledbury shales (270 ft.), Upper Ludlow rocks (140 ft.), Aymestry limestone (up to 40 ft.), Lower Ludlow rocks (350 to 780 ft.). The Ludlow group is essentially shaly in character, except towards the top, where the beds become more sandy and pass gradually into the base of the Old Red Sandstone. The Aymestry limestone, which is irregular in thickness, is sometimes absent, and where the underlying Wenlock limestones are absent the shales of the Ludlow group graduate downwards into the Wenlock shales. The group is typically developed between Ludlow and Aymestry, and it occurs also in the detached Silurian areas between Dudley and the mouth of the Severn.

The *Lower Ludlow rocks* are mainly grey, greenish and brown mudstones and sandy and calcareous shales. They contain an abundance of fossils. The series has been zoned by means of the graptolites by E. M. R. Wood; the following in ascending order, are the zonal forms: *Monograptus vulgaris*, *M. Nilssoni*, *M. scanicus*, *M. tumescens* and *M. leintwardinensis*. *Cyathaspis ludensis*, the earliest British vertebrate fossil, was found in these rocks at Leintwardine in Shropshire, a noted fossil locality. Trilobites are numerous (*Phacops caudatus*, *Lichas anglicus*, *Homolonotus delphinocephalus*, *Calymene Blumenbachii*); brachiopods (*Leptaena rhomboidalis*, *Rhynchonella Wilsoni*, *Atrypa reticularis*), pelecypods (*Cardiola interrupta*, *Ctenodonta sulcata*) and gasteropods and cephalopods (many species of *Orthoceras* and also *Gomphoceras*, *Trochoceras*) are well represented. Other fossils are *Ceratiocaris*, *Pterygotus*, *Protaster*, *Palaeocoma* and *Palaeodiscus*.

The *Upper Ludlow rocks* are mainly soft mudstones and shales with some harder sandy beds capable of being worked as building-stones. These sandy beds are often found covered with ripple-marks and annelid tracks; one of the uppermost sandy layers is known as the "Fucoid bed" from the abundance of the seaweed-like impressions it bears. At the top of this sub-group, near Ludlow, a brown layer occurs, from a quarter of an inch to 4 in. in thickness, full of the fragmentary remains of fish associated with those of *Pterygotus* and mollusca. This layer, known as the "Ludlow Bone bed," has been traced over a very large area (see BONE BED). The common fossils include plants (*Actinophyllum*, *Chondrites*), ostracods, phyllocarids, eurypterids, trilobites (less common than in the older groups), numerous brachiopods (*Lingula minima*, *Chonetes striatella*), gasteropods, pelecypods and cephalopods (*Orthoceras bullatum*). Fish include *Cephalaspis*, *Cyathaspis*, *Auchenaspis*. The Tilestones, Downton Castle Sandstone and Ledbury shales are occasionally grouped together under the term *Downtonian*. They are in reality passage beds between the Silurian and Old Red Sandstone, and were originally placed in the latter system by Sir R. I. Murchison. They are mostly grey, yellow or red micaceous, shaly sandstones. *Lingula cornea*, *Platyschisma helicites* and numerous phyllocarids and ostracods occur among the fossils.

In Denbighshire and Merionethshire the upper portion of the Denbighshire Grits belongs to this horizon: viz. those from below upwards, the Nantglyn Flags, the Upper Grit beds, the *Monograptus leintwardinensis* beds and the Dinas Bran beds. In the Silurian area of the Lake district the Coldwell beds, forming the upper part of the Coniston Flags, are the equivalents of the Lower Ludlow; they are succeeded by the Coniston Grits (4000 ft.), the Bannisdale Slates (5200 ft.) and the Kirkby Moor Flags (2000 ft.).

In the Silurian areas of southern Scotland, the Ludlow rocks are represented in the Kirkcudbright Shore and Riccarton district by the Raeberry Castle beds and Balmae Grits (500-750 ft.). In the northern belt—Lanarkshire and the Pentland Hills—the lower portion (or Ludlovian) consists of mudstones, flaggy shales and greywackes; but the upper (or Downtonian) part is made up principally of thick red and yellow sandstones and conglomerates with green mudstones. The Ludlow rocks of Ireland include the "Salrock beds" of County Galway and the "Croagmarhin beds" of Dingle promontory.

See SILURIAN, and, for recent papers, the *Q.J. Geol. Soc.* (London) and *Geological Literature* (Geol. Soc., London) annual.

LUDOLF (or LEUTHOLF), **HIOB** (1624–1704), German orientalist, was born at Erfurt on the 15th of June 1624. After studying philology at the Erfurt academy and at Leiden, he travelled in order to increase his linguistic knowledge. While in Italy he became acquainted with one Gregorius, an Abyssinian scholar, and acquired from him an intimate knowledge of the Ethiopian language. In 1652 he entered the service of the duke of Saxe-Gotha, in which he continued until 1678, when he retired to Frankfort-on-Main. In 1683 he visited England to promote a cherished scheme for establishing trade with Abyssinia, but his efforts were unsuccessful, chiefly through the bigotry of the authorities of the Abyssinian Church. Returning to Frankfort in 1684, he gave himself wholly to literary work, which he continued almost to his death on the 8th of April 1704. In 1690 he was appointed president of the *collegium imperiale historicum.*

The works of Ludolf, who is said to have been acquainted with twenty-five languages, include *Sciagraphia historiae aethiopicae* (Jena, 1676); and the *Historia aethiopica* (Frankfort, 1681), which has been translated into English, French and Dutch, and which was supplemented by a *Commentarius* (1691) and by *Appendices* (1693–1694). Among his other works are: *Grammatica linguae amharicae* (Frankfort, 1698); *Lexicon amharico-latinum* (Frankfort, 1698); *Lexicon aethiopico-latinum* (Frankfort, 1699); and *Grammatica aethiopica* (London, 1661, and Frankfort, 1702). In his *Grammatik der äthiopischen Sprache* (1857) August Dillmann throws doubt on the story of Ludolf's intimacy with Gregorius.

See C. Juncker, *Commentarius de vita et scriptis Jobi Ludolfi* (Frankfort, 1710); L. Diestel, *Geschichte des alten Testaments in der christlichen Kirche* (Jena, 1868); and J. Flemming, "Hiob Ludolf," in the *Beiträge zur Assyriologie* (Leipzig, 1890–1891).

LUDWIG, KARL FRIEDRICH WILHELM (1816–1895), German physiologist, was born at Witzenhausen, near Cassel, on the 29th of December 1816. He studied medicine at Erlangen and Marburg, taking his doctor's degree at Marburg in 1839. He made Marburg his home for the next ten years, studying and teaching anatomy and physiology, first as prosector to F. L. Fick (1841), then as *privat-docent* (1842), and finally as extraordinary professor (1846). In 1849 he was chosen professor of anatomy and physiology at Zürich, and six years afterwards he went to Vienna as professor in the Josephinum (school for military surgeons). In 1865 he was appointed to the newly created chair of physiology at Leipzig, and continued there until his death on the 23rd of April 1895. Ludwig's name is prominent in the history of physiology, and he had a large share in bringing about the change in the method of that science which took place about the middle of the 19th century. With his friends H. von Helmholtz, E. W. Brücke and E. Du Bois-Reymond, whom he met for the first time in Berlin in 1847, he rejected the assumption that the phenomena of living animals depend on special biological laws and vital forces different from those which operate in the domain of inorganic nature; and he sought to explain them by reference to the same laws as are applicable in the case of physical and chemical phenomena. This point of view was expressed in his celebrated *Text-book of Human Physiology* (1852–1856), but it is as evident in his earliest paper (1842) on the process of urinary secretion as in all his subsequent work. Ludwig exercised enormous influence on the progress of physiology, not only by the discoveries he made, but also by the new methods and apparatus he introduced to its service. Thus in regard to secretion, he showed that secretory glands, such as the submaxillary, are more than mere filters, and that their secretory action is attended by chemical and thermal changes both in themselves and in the blood passing through them. He demonstrated the existence of a new class of secretory nerves that control this action, and by showing that if the nerves are appropriately stimulated the salivary glands continue to secrete, even though the animal be decapitated, he initiated the method of experimenting with excised organs. He devised the kymograph as a means of obtaining a written record of the variations in the pressure of the blood in the blood-vessels; and this apparatus not only conducted him to many important conclusions respecting the mechanics of the circulation, but afforded the first instance of the use of the graphic method in physiological inquiries. For the purpose of his researches on the gases in the blood, he designed the mercurial blood-pump which in various modifications has come into extensive use, and by its aid he made many investigations on the gases of the lymph, the gaseous interchanges in living muscle, the significance of oxidized material in the blood, &c. There is indeed scarcely any branch of physiology, except the physiology of the senses, to which he did not make important contributions. He was als a great power as a teacher and the founder of a school. Unde him the Physiological Institute at Leipzig became an organize centre of physiological research, whence issued a steady strea of original work; and though the papers containing the result usually bore the name of his pupils only, every investigatio was inspired by him and carried out under his personal directio Thus his pupils gained a practical acquaintance with his metho and ways of thought, and, coming from all parts of Europ they returned to their own countries to spread and extend h doctrines. Possessed himself of extraordinary manipulativ skill, he abhorred rough and clumsy work, and he insisted tha experiments on animals should be planned and prepared wit the utmost care, not only to avoid the infliction of pain (whic was also guarded against by the use of an anaesthetic), but t ensure that the deductions drawn from them should have the full scientific value.

LUDWIG, OTTO (1813–1865), German dramatist, novelis and critic, was born at Eisfeld in Thuringia, on the 11th February 1813. His father, who was syndic of Eisfeld, died whe the boy was twelve years old, and he was brought up amids uncongenial conditions. He had devoted his leisure to poetr and music, which unfitted him for the mercantile career planne for him. The attention of the duke of Meiningen was directe to one of his musical compositions, an opera, *Die Köhlerin*, an Ludwig was enabled in 1839 to continue his musical studies unde Mendelssohn in Leipzig. But ill-health and constitutiona shyness caused him to give up a musical career, and he turne exclusively to literary studies, and wrote several stories an dramas. Of the latter, *Der Erbförster* (1850) attracted immediat attention as a masterly psychological study. It was followe by *Die Makkabäer* (1852), in which the realistic method *Der Erbförster* was transferred to an historical *milieu*, whic allowed more brilliant colouring and a freer play of the imagina tion. With these tragedies, to which may be added *Die Rech des Herzens* and *Das Fräulein von Scuderi*, the comedy *Han Frey*, and an unfinished tragedy on the subject of Agne Bernauer, Ludwig ranks immediately after Hebbel as Germany most notable dramatic poet at the middle of the 19th centur Meanwhile he had married and settled permanently in Dresde where he turned his attention to fiction. He published series of admirable stories of Thuringian life, characterized b the same attention to minute detail and careful psychologica analysis as his dramas. The best of these are *Die Heiteret und ihr Widerspiel* (1851), and Ludwig's masterpiece, the powe ful novel, *Zwischen Himmel und Erde* (1855). In his *Shakespear Studien* (not published until 1891) Ludwig showed himself a di criminating critic, with a fine insight into the hidden springs the creative imagination. So great, however, was his enthusias for Shakespeare, that he was led to depreciate Schiller in a wa which found little favour among his countrymen. He died Dresden on the 25th of February 1865.

Ludwig's *Gesammelte Schriften* were published by A. Stern ar E. Schmidt in 6 vols. (1891–1892); also by A. Bartels (6 vols., 190 See A. Stern, *Otto Ludwig, ein Dicnierleben* (1891; 2nd ed., 190 and A. Sauer, *Otto Ludwig* (1893).

LUDWIGSBURG, a town in the kingdom of Württember 9 m. to the N. of Stuttgart by rail and 1½ m. from the riv Neckar. Pop. (1905) 23,093. It was founded and laid out the beginning of the 18th century by the duke of Württember Eberhard Louis, and was enlarged and improved by Du Charles Eugene. Constructed as the adjunct of a palace the tow bears the impress of its origin, with its straight streets and spacio squares. It is now mainly important as the chief milita depot in Württemberg. The royal palace, one of the finest Germany, stands in a beautiful park and contains a portra gallery and the burial vault of the rulers of Württemberg. T industries include the manufacture of organs and pianos, of cotto woollen and linen goods, of chemicals, iron and wire goods, a brewing and brick-making. In the vicinity is the beautif royal residence of Monrepos, which is connected with the pa of Ludwigsburg by a fine avenue of lime trees. From 1758

1824 the town was famous for the production of a special kind of porcelain.

See Belschner, *Ludwigsburg in zwei Jahrhunderten* (Ludwigsburg, 1904).

LUDWIGSHAFEN, a town of Germany, in the Bavarian Palatinate, on the left bank of the Rhine, immediately opposite to Mannheim, with which it is connected by a steam ferry and a railway bridge. Pop. (1885) 21,042, (1900) 61,905, (1905) 72,168. It has an increasing trade in iron, timber, coal and agricultural products, a trade which is fostered by a harbour opened in 1897; and also large factories for making aniline dyes and soda. Other industries are the manufacture of cellulose, artificial manure, flour and malt; and there are saw-mills, iron foundries and breweries in the town. The place, which was founded in 1843 by Louis I., king of Bavaria, was only made a town in 1859.

See J. Esselborn, *Geschichte der Stadt Ludwigshafen* (Ludwigshafen, 1888).

LUDWIGSLUST, a town of Germany, in the grand-duchy of Mecklenburg-Schwerin, 22 m. by rail S. by E. of Schwerin. Pop. (1905) 6728. The castle was built by the duke of Mecklenburg-Schwerin, Frederick II., in 1772–1776. There is also another ducal residence, a fine park and a monument of the grand duke, Frederick Francis I. (d. 1837). The town has a church constructed on the model of a Greek temple. It has manufactures of chemicals and other small industries. Ludwigslust was founded by the duke Frederick, being named after this duke's father, Christian Louis II. It became a town in 1876.

LUG, a verb meaning to pull a heavy object, to drag, now mainly used colloquially. It is probably Scandinavian in origin; the Swedish *lugg*, forelock, lock of hair, gives *lugga*, to pull, tug; and "lug" in some north-eastern English dialects is still chiefly used in the sense of pulling a person's hair. "Luggage," passengers' baggage, means by origin that which has to be "lugged" about. The Scandinavian word may be also the source of "lug," in the sense of "ear," in Scotland the regular dialectical word, and in English commonly applied to the ear-shaped handles of metal or earthenware pots, pitchers, &c. If so the word means something that can be pulled or tugged. This is also possibly the origin of the "lug" or "lug-sail," a four-sided sail attached to a yard which is hung obliquely to the mast, whence probably the name "lugger" of a sailing-vessel with two or three masts and fore and aft lug-sails. The word may, however, be connected with the Dutch *logger*, a fishing-boat using drag-nets. "Lug" is also the name of a marine worm, *Arenicola marina*, used as bait.

LUGANO (Ger. *Lauis*), the most populous and most thriving town in the Swiss canton of Ticino or Tessin, situated (906 ft.) on the northern shore of the lake of Lugano. Pop. (1900) 9394, almost all Italian-speaking and Romanists. To the S. it is dominated by the Monte Salvatore (3004 ft.) and on the S.E. (across the lake) by the Monte Generoso (5591 ft.)—a magnificent view point. Both mountains are accessible by railways. By rail Lugano is 124 m. from Lucerne and 51½ m. from Milan. Situated on the main St Gotthard railway line, Lugano is now easily reached, so that it is much frequented by visitors (largely German) in spring and in autumn. Though politically Swiss since 1512, Lugano is thoroughly Italian in appearance and character. Of recent years many improvements have been made in the town, which has two important suburbs—Paradiso to the south and Cassarate to the east. The railway station (1109 ft.) is above the town, and is connected with the fine quays by a funicular railway. On the main quay is a statue of William Tell by the sculptor Vincenzo Vela (1820–1891), a native of the town, while other works by him are in the gardens of private villas in the neighbourhood. The principal church, San Lorenzo, in part dates back earlier than the 15th century, while its richly sculptured façade bears the figures 1517. This church is now the cathedral church of the bishop of Lugano, a see erected in 1888, with jurisdiction over the Italian parts of Switzerland. The church of Santa Maria degli Angioli, built about 1499, and till 1848 occupied by Franciscans, contains several very fine frescoes (particularly a Crucifixion) painted 1529-1530 by Bernardino Luini. A gallery containing modern pictures has been built on the site of the old palace of the bishops of Como. During the struggle of 1848–1866 to expel the Austrians from Lombardy, Lugano served as headquarters for Mazzini and his followers. Books and tracts intended for distribution in Italy were produced there and at Capolago (9 m. distant, at the S.E. end of the lake), and the efforts of the Austrian police to prevent their circulation were completely powerless. (W. A. B. C.)

LUGANO, LAKE OF (also called CERESIO), one of the smaller lakes in Lombardy, N. Italy, lying between Lago Maggiore (W.) and the Lake of Como (E). It is of very irregular shape, the great promontory of Monte Salvatore (3004 ft.) nearly cutting off the western arm from the main lake. The whole lake has an area of 19½ sq. m., its greatest length is about 22 m., its greatest width 2 m., and its greatest depth 945 ft., while its surface is 899 ft. above sea-level. Between Melide (S. of the town of Lugano) and Maroggia (on the east shore) the lake is so shallow that a great stone dam has been built across for the St Gotthard railway line and the carriage road. The chief town is Lugano (at its northern end), which by the St Gotthard line is 19 m. from Bellinzona and 9 m. from Capolago, the station at the south-eastern extremity of the lake, which is but 8 m. by rail from Como. At the south-western extremity a railway leads S.W. from Porto Ceresio to Varese (9 m.). Porlezza, at the east end of the lake, is 8 m. by rail from Menaggio on the Lake of Como, while Ponte Tresa, at the west end of the lake, is about the same distance by a steam tramway from Luino on Lago Maggiore. Of the total area of the lake, about 7½ sq. m. are in the Swiss Canton of Ticino (Tessin), formed in 1803 out of the conquests made by the Swiss from the Milanese in 1512. The remainder of the area is in Italy. The lake lies among the outer spurs of the Alps that divide the Ticino (Tessin) basin from that of the Adda, where the calcareous strata have been disturbed by the intrusion of porphyry and other igneous rocks. It is not connected with any considerable valley, but is fed by numerous torrents issuing from short glens in the surrounding mountains, while it is drained by the Tresa, an unimportant stream flowing into Lago Maggiore. The first steamer was placed on the lake in 1856. (W. A. B. C.)

LUGANSK (also LUGAÑ and LUGANSKIY ZAVŌD), a town of southern Russia, in the government of Ekaterinoslav. Pop. (1900) 34,175. It has a technical railway school and a meteorological observatory, stands on the small river Lugan, 10 m. from its confluence with the northern Donets, in the Lugan mining district, 213 m. E. of the city of Ekaterinoslav, and has prospered greatly since 1890. This district, which comprises the coal-mines of Lisichansk and the anthracite mines of Gorodishche, occupies about 110,000 acres on the banks of the Donets river. Although it is mentioned in the 16th century, and coal was discovered there at the time of Peter the Great, it was not until 1795 that an Englishman, Gascoyne or Gaskoin, established its first iron-works for supplying the Black Sea fleet and the southern fortresses with guns and shot. This proved a failure, owing to the great distance from the sea; but during the Crimean War the iron-works of Lugan again produced shot, shell and gun-carriages. Since 1864 agricultural implements, steam-engines, and machinery for beetroot sugar-works, distilleries, &c., have been the chief manufactures. There is an active trade in cattle, tallow, wools, skins, linseed, wine, corn and manufactured wares.

LUGARD, SIR FREDERICK JOHN DEALTRY (1858–), British soldier, African explorer and administrator, son of the Rev. F. G. Lugard, was born on the 22nd of January 1858. He entered the army in 1878, joining the Norfolk regiment. He served in the Afghan War of 1879–80, in the Sudan campaign of 1884–85, and in Burma in 1886–87. In May 1888, while on temporary half-pay, he took command of an expedition organized by the British settlers in Nyasaland against the Arab slave traders on Lake Nyasa, and was severely wounded. He left Nyasaland in April 1889, and in the same year was engaged by the Imperial

British East Africa Company. In their service he explored the Sabaki river and the neighbouring region, and elaborated a scheme for the emancipation of the slaves held by the Arabs in the Zanzibar mainland. In 1890 he was sent by the company to Uganda, where he secured British predominance and put an end to the civil disturbances, though not without severe fighting, chiefly notable for an unprovoked attack by the "French" on the "British" faction. While administering Uganda he journeyed round Ruwenzori to Albert Edward Nyanza, mapping a large area of the country. He also visited Albert Nyanza, and brought away some thousands of Sudanese who had been left there by Emin Pasha and H. M. Stanley. In 1892 Lugard returned to England, where he successfully opposed the abandonment of Uganda by Great Britain, a step then contemplated by the fourth Gladstone administration. In 1894 Lugard was despatched by the Royal Niger Company to Borgu, where, distancing his French and German rivals in a country up to then unvisited by any Europeans, he secured treaties with the kings and chiefs acknowledging the sovereignty of the British company. In 1896–1897 he took charge of an expedition to Lake Ngami on behalf of the British West Charterland Company. From Ngami he was recalled by the British government and sent to West Africa, where he was commissioned to raise a native force to protect British interests in the hinterland of Lagos and Nigeria against French aggression. In August 1897 he raised the West African Frontier Force, and commanded it until the end of December 1899. The differences with France were then composed, and, the Royal Niger Company having surrendered its charter, Lugard was chosen as high commissioner of Northern Nigeria. The part of Northern Nigeria under effective control was small, and Lugard's task in organizing this vast territory was rendered more difficult by the refusal of the sultan of Sokoto and many other Fula princes to fulfil their treaty obligations. In 1903 a successful campaign against the emir of Kano and the sultan of Sokoto rendered the extension of British control over the whole protectorate possible, and when in September 1906 he resigned his commissionership, the whole country was being peacefully administered under the supervision of British residents (see NIGERIA). In April 1907 he was appointed governor of Hong-Kong. Lugard was created a C.B. in 1895 and a K.C.M.G. in 1901. He became a colonel in 1905, and held the local rank of brigadier-general. He married in 1902 Flora Louise Shaw (daughter of Major-General George Shaw, C.B., R.A.), who for some years had been a distinguished writer on colonial subjects for *The Times*. Sir Frederick (then Captain) Lugard published in 1893 *The Rise of our East African Empire* (partly auto-biographical), and was the author of various valuable reports on Northern Nigeria issued by the Colonial Office. Throughout his African administrations Lugard sought strenuously to secure the amelioration of the condition of the native races, among other means by the exclusion, wherever possible, of alcoholic liquors, and by the suppression of slave raiding and slavery.

LUGO, a maritime province of north-western Spain, formed in 1833 of districts taken from the old province of Galicia, and bounded N. by the Atlantic, E. by Oviedo and Leon, S. by Orense, and W. by Pontevedra and Corunna. Pop. (1900) 465,386; area, 3814 sq. m. The coast, which extends for about 40 m. from the estuary of Rivadéo to Cape de Vares, is extremely rugged and inaccessible, and few of the inlets, except those of Rivadéo and Vivero, admit large vessels. The province, especially in the north and east, is mountainous, being traversed by the Cantabrian chain and its offshoots; the sierra which separates it from Leon attains in places a height of 6000 ft. A large part of the area is drained by the Miño. This river, formed by the meeting of many smaller streams in the northern half of the province, follows a southerly direction until joined by the Sil, which for a considerable distance forms the southern boundary. Of the rivers flowing north into the Atlantic, the most important are the Navia, which has its lower course through Oviedo; the Eo, for some distance the boundary between the two provinces; the Masma, the Oro and the Landrove.

Some of the valleys of Lugo are fertile, and yield not only corn but fruit and wine. The principal agricultural wealth, however, is on the Miño and Sil, where rye, maize, wheat, flax, hemp and a little silk are produced. Agriculture is in a very backward condition, mainly owing to the extreme division of land that prevails throughout Galicia. The exportation of cattle to Great Britain, formerly a flourishing trade, was ruined by American and Australian competition. Iron is found at Caurel and Incio, arsenic at Castroverde and Cervantes, argentiferous lead at Riotorto; but, although small quantities of iron and arsenic are exported from Rivadéo, frequent strikes and lack of transport greatly impeded the development of mining in the earlier years of the 20th century. There are also quarries of granite, marble and various kinds of slate and building-stone. The only important manufacturing industries are those connected with leather, preserves, coarse woollen and linen stuffs, timber and osier work. About 250 coasting vessels are registered at the ports, and about as many boats constitute the fishing fleet, which brings in lampreys, soles, tunny and sardines, the last two being salted and tinned for export. The means of communication are insufficient, though there are over 100 m. of first-class roads, and the railways from Madrid and northern Portugal to Corunna run through the province.

Lugo the capital (pop. 1900, 26,959) and the important towns of Chantada (15,003), Fonsagrada (17,302), Mondoñedo (10,590), Monforte (12,912), Panton (12,988), Villalba (13,572) and Vivero (12,843) are described in separate articles. The province contained in 1900 twenty-six towns of more than 7000 inhabitants, the largest being Sarria (11,998) and Saviñao (11,182). For a general description of the people and the history of this region see GALICIA.

LUGO, capital of the above Spanish province, is situated on the left bank of the river Miño and on the railway from Corunna to Madrid. Pop. (1900) 26,959. Lugo is an episcopal see, and was formerly the capital of Galicia. Suburbs have grown up round the original town, the form of which, nearly quadrangular, is defined by a massive Roman wall 30 to 40 ft. high and 20 ft. thick, with projecting semicircular towers which numbered 85 as late as 1809, when parts of the fortifications were destroyed by the French. The wall now serves as a promenade. The Gothic cathedral, on the south side of the town, dates from the 12th century, but was modernized in the 18th, and possesses no special architectural merit. The conventual church of Santo Domingo dates from the 14th century. The principal industries are tanning, and the manufacture of linen and woollen cloth. About 1 m. S., on the left bank of the Miño, are the famous hot sulphur baths of Lugo.

Lugo (*Lucus Augusti*) was a flourishing city under Roman rule (*c.* 19 B.C.–A.D. 409) and was made by Augustus the seat of a *conventus juridicus* (assize). Its sulphur baths were even then well known. It was sacked by barbarian invaders in the 5th century, and suffered greatly in the Moorish wars of the 8th century. The bishopric dates from a very early period, and it it said to have acquired metropolitan rank in the middle of the 6th century; it is now in the archiepiscopal province of Santiago de Compostela.

LUGOS, the capital of the county of Krassó-Szörény, Hungary, 225 m. S.E. of Budapest by rail. Pop. (1900) 16,126. It is situated on both banks of the river Temes, which divides the town in two quarters, the Rumanian on the right and the German on the left bank. It is the seat of a Greek-United (Rumanian) bishop. Lugos carries on an active trade in wine, and has severa important fairs, while the surrounding country, which is mountainous and well-wooded, produces large quantities of grapes and plums. Lugos was once a strongly fortified place and of greater relative importance than at present. It was the last seat of the Hungarian revolutionary government (August 1849) and the last resort of Kossuth and several other leaders of the national cause, previous to their escape to Turkey.

LUGUDUNUM, or LUGDUNUM, an old Celtic place-name (fort or hill of the god Lugos or Lug) used by the Romans for severa towns in ancient Gaul. The most important was the town at the confluence of the Saône and Rhone now called Lyons (*q.v.*). This place had in Roman times two elements. One was a Roman *colonia* (municipality of Roman citizens, self-governing) situated on the hill near the present Fourviéres (*Fōrum vetus*). The other, territorially distinct from it for reasons of statecraft, was the Temple of Roma and Augustus, to which the inhabitants of the 64 Gallic cantons in the three Roman provinces of Aquitania, Lugudunensis and Belgica—the so-called Tres Galliae—sent delegates every summer to hold games and otherwise celebrate the worship of the emperor which was supposed to knit the provincials to Rome. The two elements together composed the most important town of western Europe in Roman times. Lugudunum controlled the trade of its two rivers, and that which passed from northern Gaul to the Mediterranean or vice versa; it had a mint; it was the capital of all northern Gaul, despite its position in the south, and its wealth was such that, when Rome was burnt in Nero's reign, its inhabitants subscribed largely to the relief of the Eternal City. (F. J. H.)

LUINI, BERNARDINO (?1465–?1540), the most celebrated master of the Lombard school of painting founded upon the style of Leonardo da Vinci, was born at Luino, a village on Lago Maggiore. He wrote his name as "Bernardin Lovino," but the spelling "Luini" is now generally adopted. Few facts are known regarding his life, and until a comparatively recent date many even of his works had, in the lapse of years and laxity of attribution, got assigned to Leonardo da Vinci. It appears that Luini studied painting at Vercelli under Giovenone, or perhaps under Stephano Scotto. He reached Milan either after the departure of Da Vinci in 1500, or shortly before that event; it is thus uncertain whether or not the two artists had any personal acquaintance, but Luini was at any rate in the painting-school established in Milan by the great Florentine. In the later works of Luini a certain influence from the style of Raphael is superadded to that, far more prominent and fundamental, from the style of Leonardo; but there is nothing to show that he ever visited Rome. His two sons are the only pupils who have with confidence been assigned to him; and even this can scarcely be true of the younger, who was born in 1530, when Bernardino was well advanced in years. Guadenzio Ferrari has also been termed his disciple. One of the sons, Evangelista, has left little which can now be identified; the other, Aurelio, was accomplished in perspective and landscape work. There was likewise a brother of Bernardino, named Ambrogio, a competent painter. Bernardino, who hardly ever left Lombardy, had some merit as a poet, and is said to have composed a treatise on painting. The precise date of his death is unknown; he may perhaps have survived till about 1540. A serene, contented and happy mind, naturally expressing itself in forms of grace and beauty, seems stamped upon all the works of Luini. The same character is traceable in his portrait, painted in an upper group in his fresco of "Christ crowned with Thorns" in the Ambrosian library in Milan—a venerable bearded personage. The only anecdote which has been preserved of him tells a similar tale. It is said that for the single figures of saints in the church at Saronno he received a sum equal to 22 francs per day, along with wine, bread and lodging; and he was so well satisfied with this remuneration that, in completing the commission, he painted a Nativity for nothing.

A dignified suavity is the most marked characteristic of Luini's works. They are constantly beautiful, with a beauty which depends at least as much upon the loving self-withdrawn expression as upon the mere refinement and attractiveness of form. This quality of expression appears in all Luini's productions, whether secular or sacred, and imbues the latter with a peculiarly religious grace—not ecclesiastical unction, but the devoutness of the heart. His heads, while extremely like those painted by Leonardo, have less subtlety and involution and less variety of expression, but fully as much amenity. He began indeed with a somewhat dry style, as in the "Pietà" in the church of the Passione; but this soon developed into the quality which distinguishes all his most renowned works; although his execution, especially as regards modelling, was never absolutely equal to that of Leonardo. Luini's paintings do not exhibit an impetuous style of execution, and certainly not a negligent one; yet it appears that he was in fact a very rapid worker, as his picture of the "Crowning with Thorns," painted for the College del S. Sepolcro, and containing a large number of figures, is recorded to have occupied him only thirty-eight days, to which an assistant added eleven. His method was simple and expeditious, the shadows being painted with the pure colour laid on thick, while the lights are of the same colour thinly used, and mixed with a little white. The frescoes exhibit more freedom of hand than the oil pictures; and they are on the whole less like the work of Da Vinci, having at an early date a certain resemblance to the style of Mantegna, as later on to that of Raphael. Luini's colouring is mostly rich, and his light and shade forcible.

Among his principal works the following are to be mentioned. At Saronno are frescoes painted towards 1525, representing the life of the Madonna—her "Marriage," the "Presentation of the Infant Saviour in the Temple," the "Adoration of the Magi" and other incidents. His own portrait appears in the subject of the youthful "Jesus with the Doctors in the Temple." This series—in which some comparatively archaic details occur, such as gilded nimbuses—was partly repeated from one which Luini had executed towards 1520 in S. Croce. In the Brera Gallery, Milan, are frescoes from the suppressed church of La Pace and the Convent della Pelucca—the former treating subjects from the life of the Virgin, the latter, of a classic kind, more decorative in manner. The subject of girls playing at the game of "hot-cockles," and that of three angels depositing St Catherine in her sepulchre, are particularly memorable, each of them a work of perfect charm and grace in its way. In the Casa Silva, Milan, are frescoes from Ovid's *Metamorphoses*. The Monastero Maggiore of Milan (or church of S. Maurizio) is a noble treasure-house of Luini's art—including a large Crucifixion, with about one hundred and forty figures; "Christ, bound to the Column," between figures of Saints Catherine and Stephen, and the founder of the chapel kneeling before Catherine; the martyrdom of this saint; the "Entombment of Christ," and a large number of other subjects. In the Ambrosian library is the fresco (already mentioned), covering one entire wall of the Sala della S. Corona, of "Christ crowned with Thorns," with two executioners, and on each side six members of a confraternity; in the same building the "Infant Baptist playing with a Lamb"; in the Brera, the "Virgin Enthroned, with Saints" (dated 1521); in the Louvre, the "Daughter of Herodias receiving the Head of the Baptist"; in the Esterhazy Gallery, Vienna, the "Virgin between Saints Catherine and Barbara"; in the National Gallery, London, "Christ disputing with the Doctors" (or rather, perhaps, the Pharisees). Many or most of these gallery pictures used to pass for the handiwork of Da Vinci. The same is the case with the highly celebrated "Vanity and Modesty" in the Sciarra Palace, Rome, which also may nevertheless in all probability be assigned to Luini. Another singularly beautiful picture by him is in the Royal Palace in Milan—a large composition of "Women Bathing." That Luini was also pre-eminent as a decorative artist is shown by his works in the Certosa of Pavia.

A good account of Luini by Dr G. C. Williamson was published in 1900. (W. M. R.)

LUKE, the traditional author of the third Gospel and of the Book of Acts, and the most literary among the writers of the New Testament. He alone, too, was of non-Jewish origin (Col. iv. 11, 14), a fact of great interest in relation to his writings. His name, a more familiar form of Lucanus (cf. Silas for Silvanus, Acts xvii. 4; 1 Thess. i. 1, and see *Encycl. Bibl.* s.v., for instances of *Λουκᾶς* on Egyptian inscriptions), taken together with his profession of physician (Col. iv. 14), suggests that he was son of a Greek freedman possibly connected with Lucania in south Italy; and as Julius Caesar gave Roman citizenship to all physicians in Rome (Sueton. *Jul.* 42), Luke may even have inherited this status from his father. But in any case such a man would have the attitude to things Roman which appears in the works attributed to Luke. He was a fellow-worker of Paul's when in Rome (Philemon 24), where he seems to have remained in constant attendance on his leader, as physician as well as attached friend (Col. iv. 14; 2 Tim. iv. 11). That Luke, before he became a Christian, was an adherent of the synagogue—not a full proselyte, but one of those "worshippers" of God to whom Acts makes frequent reference—is fairly certain from the familiarity with the Septuagint indicated in Acts, as well as from its sympathy with the Hellenistic type of piety as distinct from specific Paulinism, of which there is but little trace.

The earliest extra-biblical reference to him is perhaps in the Muratonian Canon, which implies that his name already stood in MSS. of both Gospel (probably so even in Marcion's day) and Acts, and says that Paul took him for his companion *quasi ut juris studiosum* ("as being a student of law"). Here *juris* is almost certainly corrupt; and whether we take the sense to have been "as being devoted to travel" (*ut juris=itineris*) or "as skilled in disease" (νόσου passing into νόμου in the Greek original), it is probably a mere inference from biblical data. Beyond references in Irenaeus, Clement of Alexandria (cf. HEBREWS) and Tertullian, which add nothing to our knowledge, we have the belief to which Origen (*Hom.* i. *in Lucam*) witnesses as existing in his day, that Luke was the "brother" of 2 Cor. viii. 18, "whose praise in the Gospel" (as preached) was "throughout all the churches." Though the basis of the identification be a mistake, yet that this "brother," "who was also appointed by the churches (note the generality of this) to travel with us in the matter of the charity," was none other than Paul's constant companion Luke is quite likely; *e.g.* he seems to have been almost the only non-Macedonian (as demanded by 2 Cor. ix. 2-4) of Paul's circle available[1] at the time (see Acts xx. 4). Our next witness, a prologue to the Lucan writings (originally in Greek, now known only in Latin, see *Nov. Test. Latine* (Oxford), I. iii., II. i.), perhaps preserves a genuine tradition in stating that Luke died in Bithynia at the age of seventy-four. It is hard to see why this should be fiction, which usually took the form of martyrdom, as in a later tradition touching his end. The same prologue, and indeed all early tradition, connects him originally with Antioch (see Euseb. *Hist. Eccl.* iii. 4, 6, possibly after Julius Africanus in the first half of the 3rd century).

That he was actually a native of Antioch is as doubtful as the statement that he was a Syrian by race (Prologue). But internal evidence bears out the view that he practised his profession in Antioch, where (or in Tarsus) he probably first met Paul. Whether any of his information in Acts as to the Gospel in Antioch (xi. 19 ff., xiii. 1 ff., xiv. 26–xv. 35) was due to an Antiochene document used by him (cf. A. Harnack, *The Acts of the Apostles*, 245 ff.) or not, this knowledge in any case suggests Luke's connexion with that church. He shows, too, local knowledge on points unlikely to have stood in any such source (*e.g.* it was in Antioch that the name "Christians" was first coined, xi. 26), which points to his share in early Church life there. The Bezan reading in Acts xi. 27, "when *we* were assembled," may imply memory of this.

But while Luke probably met Paul in Antioch, and thence started with him on his second great missionary enterprise (xv. 36 ff.), partly at least as his medical attendant (cf. Gal. iv. 13), it is possible that he had also some special connexion with the north-eastern part of the Aegean. Sir W. M. Ramsay and others fancy that Luke's original home was Philippi, and that in fact he may have been the "certain Macedonian" seen in vision by Paul at Troas, inviting help for his countrymen (xvi. 9 f.). But this is as precarious as the view that, because "we" ceases at Philippi in xvi. 17, and then re-emerges in xx. 6, Luke must have resided there during all the interval. The use and disuse of the first person plural, identifying Paul and his party, has probably a more subtle and psychological[2] meaning (see ACTS). The local connexion in question may have been subsequent to that with Antioch, dating from his work with Paul in the province of Asia, and being resumed after Paul's martyrdom. This accords at once with Harnack's argument that Luke wrote Acts in Asia[3] (*Luke the Physician*, p. 149 ff.), and with the early tradition, above cited, that he died in Bithynia at the age of seventy-four, without ever having married (this touch may be due to an ascetic feeling current already in the 2nd century).

The later traditions about Luke's life are based on fanciful inference or misunderstanding, *e.g.* that he was one of the Seventy (Adamantius *Dial. de recta fide*, 4th century), or the story (in Theodorus Lector, 6th century) that he painted a portrait of the Virgin Mother. But a good deal can still be gathered by sympathetic study of his writings as to the manner of man he was. It was a beautiful soul from which came "the most beautiful book" ever written, as Renan styled his Gospel. The selection of stories which he gives us—especially in the section mainly peculiar to himself (ix. 51–xviii. 14)—reflects his own character as well as that of the source he mainly follows. His was indeed a *religio medici* in its pity for frail and suffering humanity, and in its sympathy with the triumph of the Divine "healing art" upon the bodies and souls of men (cf. Harnack, *The Acts, Excursus*, iii.). His was also a humane[4] spirit, a spirit so tender that it saw further than almost any save the Master himself into the soul of womanhood. In this, as in his joyousness, united with a feeling for the poor and suffering, he was an early Francis of Assisi. Luke, "the physician, the beloved physician," that was Paul's characterization of him; and it is the impression which his writings have left on humanity. How great his contribution to Christianity has been, in virtue of what he alone preserved of the historical Jesus and of the embodiment of his Gospel in his earliest followers, who can measure? Harnack even maintains (*The Acts*, p. 301) that his story of the Apostolic age was the indispensable condition for the incorporation of the Pauline epistles in the Church's canon of New Testament scriptures. Certainly his conception of the Gospel, viz. a Christian Hellenistic universalism (with some slight infusion of Pauline thought) passed through a Graeco-Roman mind, proved more easy of assimilation, and so more directly influential for the ancient Church, than Paul's own distinctive teaching (*ib.* 281 ff.; cf. *Luke the Physician*, pp. 139-145).

LITERATURE.—Introductions to commentaries like A. Plummer's on Luke's Gospel in the "Intern. Crit." series, R. B. Rackham's *Acts of the Apostles* ("Oxford Comm."); the article "Luke" in Hastings's *Dict. of the Bible* and *Dict. of Christ and the Gospels*, the *Encycl. Biblica* and Hauck's *Realencyklopädie*, vol. xi.; Sir W. M. Ramsay's *Paul the Traveller* and *Pauline and other Studies*, and A. Harnack's *Lukas der Arzt* (1906, Eng. trans. 1907) and *Die Apostelgeschichte* (1908, Eng. trans. 1909). For the Luke of legend, see authorities quoted under MARK. (J. V. B.)

LUKE, GOSPEL OF ST, the third of the four canonical Gospels of the Christian Church.

1. *Authorship and Date.*—The earliest indication which we possess of the belief that the author was Luke, the companion of the Apostle Paul (Col. iv. 14; Philem. 24; 2 Tim. iv. 11), is found in Justin Martyr, who, in his *Dialogue with Trypho* (c. 103), when making a statement found only in our Luke, instead of referring for it simply to the "Apostolic Memoirs," his usual formula, says that it is contained in the memoirs composed by "the Apostles and *those that followed them.*" But the first distinct mention of Luke as the author of the Gospel is that by Irenaeus in his famous passage about the Four Gospels (*Adv. Haer.* III. i. 2, *c.* A.D. 180).

This tradition is important in spite of the fact that it first comes clearly before us in a writer belonging to the latter part of the 2nd century, because the prominence and fame of Luke were not such as would of themselves have led to his being singled out to have a Gospel attributed to him. The question of the authorship cannot, however, be decided without considering the internal evidence, the interpretation of which in the case of the Third Gospel and the Acts (the other writing attributed to Luke) is a matter of peculiar interest. It is generally admitted that the same person is the author of both works in their present form. This is intimated at the beginning of the second of them (Acts i. 1); and both are marked, broadly speaking throughout, though in some parts much more strongly than in others, by stylistic characteristics which we may conveniently call "Lucan" without making a premature assumption as to the authorship. The writer is more versed than any other New Testament writer except the author of the Epistle to the Hebrews, and very much more than most of them, in the literary Greek of the period of the rise of Christianity; and he has, also, like other writers, his favourite words, turns of expression and thoughts. The variations in the degree to which these appear in different passages are in the main to be accounted for by his having before him in many cases documents or oral reports, which he reproduces with only slight alterations in the language, while at other times he is writing freely.

We have next to observe that there are four sections in Acts (xvi. 9-17, xx. 4-16, xxi. 1-17, xxvii. 1–xxviii. 16) in which the first person plural is used. Now it is again generally admitted that in these sections we have the genuine account of one who was a member of Paul's company, who may well have been Luke. But it has been and is still held by many critics that the author of Acts is a different person, and that as in the Third Gospel he has used documents for the Life of Christ, and perhaps also in the earlier half of the Acts for the history of the beginnings of the Christian Church, so in the "we" sections, and possibly in some other portions of this narrative of Paul's missionary life, he has used a kind of travel-diary by one who accompanied the Apostle on some of his journeys. That neither this, nor any other, companion of Paul can have been the author of the whole work is supposed to follow both from its theological temper and from discrepancies between its statements and those of the Pauline Epistles on matters of fact.

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[1] Tychicus may be the other "brother," in viii. 22.

[2] So also A. Hilgenfeld, *Zeit. f. theol. Wissenschaft* (1907), p. 214, argues that "we" marks the author's wish to give his narrative more vividness at great turning-points of the story—the passage from Asia to Europe, and again the real beginning of the solemn progress of Paul towards the crisis in Jerusalem, as yet later towards Rome, xxvii. 1 ff.

[3] Note that Luke is at pains to explain why Paul passed by Asia and Bithynia in the first instance (xvi. 6 f.).

[4] Compare what A. W. Verrall has said of the poet Statius and "the gentle doctrine of humanity" on Hellenic soil, as embodied in his description of The Altar of Mercy at Athens (*Oxford and Cambridge Review*, i. 101 ff.).

A careful examination, however, of the "we" sections shows that words and expressions characteristic of the author of the third Gospel and the Acts are found in them to an extent which is very remarkable, and that in many instances they belong to the very texture of the passages. This linguistic evidence, which is of quite unusual force, has never yet been fairly faced by those who deny Luke's authorship of Acts. Moreover, the difficulties in the way of supposing that the author of Acts could at an earlier period of his life have been a companion of St Paul do not seem to be so serious as some critics think. Indeed it is easier to explain some of the differences between the Acts and St Paul's Epistles on this assumption than on that of authorship by a writer who would have felt more dependent upon the information which might be gathered from those Epistles, and who would have been more likely to have had a collection of them at hand, if his work was composed *c.* A.D. 100, as is commonly assumed by critics who reject the authorship by Luke.

There is then strong reason for believing the tradition that Luke, the companion of the Apostle Paul, was the author of our third Gospel and the Acts. Another argument in support of this belief, upon which much reliance has been placed, is found in the descriptions of diseases, and the words common in Greek medical writers, contained in these two works. These, it is said, point to the author's having been a physician, as Luke (Col. iv. 14) was (see esp. Hobart, *The Medical Language of St Luke*, 1882). The instances alleged are, many of them at least, not very distinctive. Yet they have some value as confirming the conclusion based on a comparison of the "we" sections of the Acts, with the remainder of the two books.

If we may assume that the writer who uses the first person plural in Acts xvi. 10 sqq. was the author of the two works, they can hardly have been composed later than A.D. 96; he would then have been about 65 years old, even if he was a very young man when he first joined the Apostle. An earlier date than A.D. 96 cannot be assigned if it is held that his writings show acquaintance with the *Antiquities of the Jewish People* by Josephus. The grounds for supposing this appear, however, to be wholly insufficient (see article on Acts by Bishop Lightfoot in 2nd ed. of Smith's *Dict. of Bible*, p. 39) and it is not easy to see why he should have deferred writing so long. On the other hand, a comparison of Luke xxi. 20-24 with Mark xiii. 14 seq. seems to show that in using his document Luke here mingled with the prophecy the interpretation which events had suggested and that the siege of Jerusalem in A.D. 70 and dispersion of its inhabitants had already taken place some little time before. *Circa* A.D. 80 may with probability be given as the time of the composition of his Gospel.

2. *Contents, Sources and Arrangement.*—In the preface to his Gospel, i. 1-4, Luke alludes to other Gospel-records which preceded his own. He does not say whether he made any use of them, but he seems to imply that his own was more complete. And this was true in regard to the two which, from a comparison of his Gospel with the other two Synoptics, we know that he did use. These we may call his Marcan and his Logian document. Luke also claims that he has written "in order." The instances in which he has departed from the Marcan order, and the manner in which he has introduced his additional matter into the Marcan outline, do not suggest the idea that he had any independent knowledge of an exact kind of the chronological sequence of events. By the phrase "in order" he may himself have intended chiefly to contrast the orderliness and consecutiveness of his account with the necessarily fragmentary character of the catechetical instruction which Theophilus had received. He may, also, have had in view the fact that he has prefixed a narrative of the birth and infancy of Jesus and of John and so begun the history at what he considered to be its true point of departure; to this he plainly alludes when he says that he has "traced the course of all things accurately from the first." He may, also, in part be thinking of those indications which he—and he alone among the evangelists—has given of the points in the course of secular history at which Jesus was born and the Baptist began to preach (ii. 1-3, iii. 1, 2), though it may be doubted whether these are in all respects accurate.

Chap. i. 5–ii. 52. *The Birth and Infancy of John and of Jesus.*—This portion of the Gospel differs in style and character from all the remainder. Its source may be an Aramaic or a Hebrew document. Some critics, however, hold that it is wholly Luke's own composition, and that the Hebraic style—in which he was able to write in consequence of his familiarity with the LXX.—has been adopted by him as suitable to the subject in hand. Perhaps an intermediate view may be the most probable one; he may have obtained part of his materials, especially the hymns, from some source, and have skilfully worked these into his narrative.

Chap. iii. 1–iv. 13. *From the Commencement of the Preaching of the Baptist to the End of the Temptation in the Wilderness.*—The accounts of the Baptist's preaching and of the temptation are taken from the Logian document. The genealogy of Jesus here given is peculiar to this Gospel.

Chap. iv. 14–vi. 16. *From the Commencement of the Ministry of Jesus in Galilee to the Appointment of the Twelve.*—In the main Luke here follows his Marcan document. He has, however, independent narratives of the visit of Jesus to Nazareth (iv. 16-30) and the call of the first disciples (v. 1-11). The former, which in Mark is placed some way on in the Galilean ministry (vi. 1-6*a*), is given by Luke at the very beginning of it, perhaps because of the previous connexion of Jesus with Nazareth. But that it is not in its right position here, before any mention of the work in Capernaum, appears from verse 23. Luke has also slightly altered the position of the call of the first disciples in the sequence of events.

Chap. vi. 17–viii. 3.—This is an insertion into the Marcan outline of matter chiefly taken from the Logian document (the Address, Luke vi. 20-49, corresponds with portions of the Sermon on the Mount in Matt. v.-vii.; the healing of the centurion's servant, Luke vii. 1-10 = Matt. viii. 5-13; the message of the Baptist and the discourse for which it gave occasion, Luke vii. 18-35 = Matt. xi. 2-19). He includes besides, a few pieces peculiar to this Gospel which Luke had probably himself collected.

Chap. viii. 4–ix. 50. *From the Adoption of Parabolic Teaching to the End of the Ministry in Galilee.*—He begins again to follow his Marcan document for what he gives. Many sections, however, contained in the corresponding part of Mark have no parallel in Luke, while the parallel to one of them is placed later and differs considerably in form. Possibly this fact points to his Marcan document having been briefer than our Mark, and to its having afterwards received interpolations (see MARK, GOSPEL OF ST).

Chap. ix. 51–xviii. 14. *Incidents and Teaching connected with Journey towards Jerusalem.*—This is another insertion into the Marcan outline, much longer than the previous one, and consisting partly of matter taken from the Logian document (warnings to men who offer to become disciples, Luke ix. 57-60 = Matt. viii. 19-22; a mission-charge, Luke x. 2-16 = Matt. ix. 37 and x. 7-16, 40; thanksgiving that the Father reveals to the simple that which is hidden from the wise, Luke x. 21-24 = Matt. xi. 25-27 and xiii. 16, 17, &c., &c.) and partly of sections peculiar to Luke, about which the same remark may be made as before.

Chap. xviii. 15–xxii. 13. *From the Bringing of young Children to Jesus to the Preparation for the Passover.*—Luke again takes up his Marcan document, nearly at the point at which he left it, and follows it in the main, though he adds the story of Zacchaeus and the parable of the Minae (the Ten Pieces of Money), and omits the withering of the fig-tree and some matter at the end of the discourse on the Last Things, which are given in Mark.

Chap. xxii. 14 to end. *The Last Supper, Passion and Resurrection.*—Though in this portion of his Gospel signs of use of Mark are not wanting, he also has much that is peculiar to himself. It is supposed by some that he here made use of another document. It seems more likely that he had a good many distinct oral traditions for this part of the history and that he used them freely, sometimes substituting them for passages of the Marcan document, sometimes altering the latter in accordance therewith.

3. *Doctrinal, Ethical and Literary Characteristics.*—The thought of divine forgiveness, as set forth in the teaching of Jesus and manifested in His own attitude towards, and power over, the hearts of the outcasts among the people, is peculiarly prominent in this Gospel. This feature of Christ's ministry appears only in one passage of Mark; some other illustrations of it are mentioned in Matthew, but in Luke there are several more which are peculiar to himself (see the three individual cases vii. 36 sqq.; xix. 1 sqq., xxiii. 40 sqq.; also the description at xv. 1, and the three parables that follow). These were "lost sheep of the house of Israel"; but Christ's freedom from Jewish exclusiveness is also brought out (1) as regards Samaritans, by the rebuke

administered to the disciples at ix. 52 sqq., the parable in x. 30 sqq., and the incident at xvii. 15-19; whereas they are not mentioned in Mark, and in Matthew only in the saying (x. 5) in which the Twelve are forbidden to enter any village of theirs; (2) as regards Gentiles, by the words of Jesus at iv. 25-27, not to mention sayings which have parallels in the other Gospels. The promises of Old Testament prophets that the Gentiles would share in the blessing of the coming of Christ are also recalled, ii. 32-iii. 6. Once more the word εὐαγγελίζεσθαι ("to proclaim good tidings") is a favourite one with Luke. These are all traits which we should expect to find in one who was a companion of Paul and a Gentile (Col. iv. 11, 14).

With the breadth and depth of the Saviour's sympathy, which are so fully exhibited in this Gospel, we may connect the clearness with which His true humanity is here portrayed. An incident of His boyhood is related in which His sense of vocation is revealed, and this is followed by the years of quiet growth that succeeded (ii. 41-52). Further, during the years of His public ministry more glimpses of His inner life are given us than in either Matthew or Mark. His being engaged in prayer is mentioned several times where there is no parallel in those Gospels (iii. 21, v. 16, vi. 12, ix. 18, 28, 29, xi. 1). Again, besides narrating the Temptation in the Wilderness and the Agony in the Garden, this evangelist gives a saying which implies that Jesus had undergone many temptations, or rather a life of temptation (xxii. 28). Once more he records a saying that shows Christ's sense of the intense painfulness of the work He was sent into the world to do, arising from the divisions which it caused (xii. 49 sqq.).

Among practical duties, the stress laid on that of almsgiving is remarkable (see especially xi. 41, xii. 33, xvi. 9 sqq., which are peculiar to this Gospel). In the second of these passages the disciples are exhorted to choose a life of voluntary poverty; the nearest parallel is the ideal set before the rich young man at Mark x. 21 = Matt. xix. 21 = Luke xviii. 22. In the Beatitudes in Luke vi. 20, 21 a condition of physical want is contemplated, not, as in Matt. v. 3, 6, poverty of spirit and spiritual hunger, while woes are denounced against the rich and the full (vi. 24, 25). The folly of absorption in the amassing and enjoyment of wealth is also shown (xii. 15 sqq. and xvi. 19 sqq.). But it would be an exaggeration to say, as some have done, that the poor are represented as being the heirs of a blessed hereafter, simply on the ground that they are now poor. In the Beatitudes Christ's own disciples are addressed, who were blessed *though* poor, whereas the rich as a class were opposed or indifferent to the kingdom of God. Again, the contrast between Lazarus and Dives in the future state pictures vividly the reversals that are in store; but it is unreasonable to take it as implying that every poor man, whatever his moral character, will be blessed.

But while there is in Luke's Gospel this strain of asceticism—as to many in modern times it will appear to be—the prevailing spirit is gentle and tender, and there is in it a note of spiritual gladness, which is begun by the song and the messages of angels and the hymns and rejoicing of holy men and women, accompanying the birth of the Christ (chaps. i. and ii., *passim*), and prolonged by the expressions of joy, the ascriptions of thanksgiving and praise, called forth by the words and works of Christ and the wonders of the cross and resurrection, which are peculiarly frequent and full (iv. 15, v. 25, 26, vii. 16, x. 17, xiii. 13, 17, xvii. 15-18, xviii. 43, xix. 6, 37, 38, xxiii. 47, xxiv. 41, 52, 53. Cf. also xv. 5, 7, 10, 32).

The peculiar charm which this Gospel has been generally felt to possess is largely due to the spiritual and ethical traits which have been noted. But from a purely literary point of view, also, it is distinguished by great excellences. The evangelist's phraseology is indeed affected to some extent by the rhetorical style of the period when he wrote. Nevertheless his mode of narration is simple and direct. And the many fascinating character-sketches, which he has added to the portrait gallery of Scripture, are drawn clearly and without signs of effort. In some cases he has skilfully suggested parallelisms and contrasts. The chief instance is his careful interweaving of the accounts of the births and early years of John the Baptist and of Jesus. Later examples are the two sisters, Martha and Mary (x. 38-42), and the penitent and the impenitent thief (xxii 39-48). That he was a man of great versatility appears in th Acts from the speeches introduced on various occasions, if (a is probable) they were in part, at least, his own compositio In the Gospel he had no opportunity for showing his power in manner strictly analogous. But if the hymns in the two introductory chapters owe even their Greek form in any measure t him, he was a poet of no mean order. His style varies greatly at times, as in i. 1-4, it is Hellenistic; at others, as in i. 5 to en of ii., it is strongly Hebraic. Such differences are largely du no doubt, to the degree in which he was in various parts independent of, or dependent upon, sources. But he would seem i some degree to have adapted his manner of writing to the subject matter in hand. And at all events it is worthy of note that w pass without any sense of jar from passages in one style to thos in another.

See Godet, *Commentaire sur l'évangile de S. Luc* (Eng. trans 1875); Plummer's *Comm. on St Luke* (in international Serie 4th ed., 1906); W. Ramsay, *Was Christ born in Bethlehem?* (3r ed., 1905); A. Harnack, *Lukas der Arzt* (1906); B. Weiss, *D Quellen des Lukas-evangeliums* (1907); also books on the Fou Gospels, or the Synoptic Gospels, mentioned at end of article GOSPE
(V. H. S.)

LULEÅ, a seaport of Sweden, capital of the district (*län*) Norrbotten, on the peninsula of Sandö, at the mouth of th Lule river and the north-west corner of the Gulf of Bothni Pop. (1900) 9484. It is connected at Boden (22 m. N.) with th main line of railway from Stockholm to Gellivara and Narvi on Ofoten Fjord in Norway. By this line Luleå is 723 m N.N.E. of Stockholm. It is the shipping place for the iron or mined at Gellivara, 127 m. N. by W., and there are smeltin works at Karlsvik in the vicinity. Timber is also exported, bein floated in large quantities down the Lule. As a rule the port closed by ice from November to the end of May. The town wa almost entirely burnt down in 1887, and its buildings are new— the church (1888–1893), the Norrbotten Museum and a technica school being the most important. Luleå as founded by Gustavu Adolphus was 7 m. higher up the river, but was moved to th present site in 1649.

LULL (or LULLY), **RAIMON**, or RAYMOND (*c.* 1235–1315 Catalan author, mystic and missionary, was born at Palm (Majorca). Inheriting the estate conferred upon his father f services rendered during the victorious expedition (1229) agains the Balearic Islands, Lull was married at an early age Blanca Picany, and, according to his own account, led dissipated life till 1266 when, on five different occasions, beheld the vision of Christ crucified. After his conversio he resolved to devote himself to evangelical work among th heathen, to write an exposure of infidel errors, and to promot the teaching of foreign tongues in seminaries. He dedicate nine years to the study of Arabic, and in 1275 showed such sig of mental exaltation that, at the request of his wife and famil an official was appointed to administer his estate. He withdre to Randa, there wrote his *Ars major* and *Ars generalis*, visite Montpellier, and persuaded the king of Majorca to build Franciscan monastery at Miramar. There for ten years he acte as professor of Arabic and philosophy, and composed man controversial treatises. After a fruitless visit to Rome in 128 1286, he journeyed to Paris, residing in that city from 1287 1289, and expounding his bewildering theories to auditors wh regarded him as half insane. In 1289 he went to Montpellie wrote his *Ars veritatis inventiva*, and removed to Genoa whe he translated this treatise into Arabic. In 1291, after man timorous doubts and hesitations for which he bitterly blame himself, Lull sailed for Tunis where he publicly preached Chri tianity for a year; he was finally imprisoned and expelled. January 1293 he reached Naples where tradition alleges that studied alchemy; there appears to be no foundation for th story, and the treatises on alchemy which bear his name are apocryphal.[1] His efforts to interest Clement V. and Bonifa

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[1] The alchemical works ascribed to Lull, such as *Testamentu* *Codicillus seu Testamentum* and *Experimenta*, are of early althoug uncertain date. De Luanco ascribes some of them to a Raimun

VIII. in his favourite project of establishing missionary colleges were unavailing; but a visit to Paris in 1298 was attended with a certain measure of success. He was, however, disappointed in his main object, and in 1300 he sailed to Cyprus to seek support for his plan of teaching Oriental languages in universities and monasteries. He was rebuffed once more, but continued his campaign with undiminished energy. Between 1302 and 1305 he wrote treatises at Genoa, lectured at Paris, visited Lyons in the vain hope of enlisting the sympathies of Pope Clement V., crossed over to Bougie in Africa, preached the gospel, and was imprisoned there for six months. On being released he lectured with increasing effect at Paris, attended the General Council at Vienne in 1311, and there witnessed the nominal adoption of his cherished proposals. Though close on eighty years of age, Lull's ardour was unabated. He carried on his propaganda at Majorca, Paris, Montpellier and Messina, and in 1314 crossed over once more to Bougie. Here he resumed his crusade against Mahommedanism, raised the fanatical spirit of the inhabitants, was stoned outside the city walls and died of his wounds on the 29th of June 1315. There can be no reasonable doubt that these events actually occurred, but the scene is laid by one biographer at Tunis instead of Bougie.

The circumstances of Lull's death caused him to be regarded as a martyr, local patriotism helped to magnify his merits, and his fantastic doctrines found many enthusiastic partisans. The *doctor illuminatus* was venerated throughout Catalonia and afterwards throughout Spain, as a saint, a thinker and a poet; but his doctrines were disapproved by the powerful Dominican order, and in 1376 they were formally condemned in a papal bull issued at the instance of the inquisitor, Nicolas Emeric. The authenticity of this document was warmly disputed by Lull's followers, and the bull was annulled by Martin V. in 1417. The controversy was renewed in 1503 and again in 1578; but the general support of the Jesuits and the staunch fidelity of the Majorcans saved Lull from condemnation. His philosophical treatises abound with incoherent formulae to which, according to their inventor, every demonstration in every science may be reduced, and posterity has ratified Bacon's disdainful verdict on Lull's pretensions as a thinker; still the fact that he broke away from the scholastic system has recommended him to the historians of philosophy, and the subtle ingenuity of his dialectic has compelled the admiration of men so far apart in opinion as Giordano Bruno and Leibniz.

The speculations of Lull are now obsolete outside Majorca where his philosophy still flourishes, but his more purely literary writings are extremely curious and interesting. In *Blanquerna* (1283), a novel which describes a new Utopia, Lull renews the Platonic tradition and anticipates the methods of Sir Thomas More, Campanella and Harrington, and in the *Libre de Maravelles* (1286) he adopts the Oriental apologue from *Kalilah and Dimnah*. And as a poet Lull takes a prominent position in the history of Catalan literature; such pieces as *El Desconort* (1295) and *Lo Cant de Ramon* (1299) combine in a rare degree simple beauty of expression with sublimity of thought and impassioned sincerity.

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LULLABY, a cradle-song, a song sung to children to "lull" them to sleep; the melody being styled in Fr. *berceuse* and in Ger. *Wiegenlied*. "Lull," cf. Swed. *lulla*, Du. *lullen*, &c., is of echoic or onomatopoeic origin, cf. Lat. *lallare*, to chatter.

LULLY, JEAN-BAPTISTE (*c.* 1633–1687), Italian composer, was born in Florence. Through the duc de Guise he entered the services of Madame de Montpensier as scullery-boy, and with the help of this lady his musical talents were cultivated. A scurrilous poem on his patroness resulted in his dismissal. He then studied the theory of music under Métra and entered the orchestra of the French court, being subsequently appointed director of music to Louis XIV. and director of the Paris opera. The influence of his music produced a radical revolution in the style of the dances of the court itself. Instead of the slow and stately movements which had prevailed until then, he introduced lively ballets of rapid rhythm. In December 1661 he was naturalized as a Frenchman, his original name being Giovanni Battista Lulli. In 1662 he was appointed music master to the royal family. In 1681 he was made a court secretary to the king and ennobled. While directing a *Te Deum* on the 8th of January 1687 with a rather long baton he injured his foot so seriously that a cancerous growth resulted which caused his death on the 22nd of March. Having found a congenial poet in Quinault, Lully composed twenty operas, which met with a most enthusiastic reception. Indeed he has good claim to be considered the founder of French opera, forsaking the Italian method of separate recitative and aria for a dramatic consolidation of the two and a quickened action of the story such as was more congenial to the taste of the French public. He effected important improvements in the composition of the orchestra, into which he introduced several new instruments. Lully enjoyed the friendship of Molière, for some of whose best plays he composed illustrative music. His *Miserere*, written for the funeral of the minister Sequier, is a work of genius; and very remarkable are also his minor sacred compositions. On his death-bed he wrote *Bisogna morire, peccatore*.

LUMBAGO, a term in medicine applied to a painful ailment affecting the muscles of the lower part of the back, generally regarded as of rheumatic origin. An attack of lumbago may occur alone, or be associated with rheumatism in other parts of the body. It usually comes on by a seizure, often sudden, of pain in one or both sides of the small of the back, of a severe cutting or stabbing character, greatly aggravated on movement of the body, especially in attempting to rise from the recumbent posture and also in the acts of drawing a deep breath, coughing or sneezing. So intense is the suffering that it is apt to suggest the existence of inflammation in some of the neighbouring internal organs, such as the kidneys, bowels, &c., but the absence of the symptoms specially characteristic of these latter complaints, or of any great constitutional disturbance beyond the pain, renders the diagnosis a matter of no great difficulty. Lumbago seems to be brought on by exposure to cold and damp, and by the other exciting causes of rheumatism. Sometimes it follows a strain of the muscles of the loins. The attack is in general of short duration, but occasionally it continues for a long time, as a feeling of soreness and stiffness on movement. The treatment includes that for rheumatic affections in general (see RHEUMATISM) and the application of local remedies to allay the pain.

LUMBER, a word now meaning (1) useless discarded furniture or other rubbish, particularly if of a bulky or heavy character; (2) timber, when roughly sawn or cut into logs or beams (see TIMBER); (3) as a verb, to make a loud rumbling noise, to move in a clumsy heavy way, also to burden with useless material, to encumber. "Lumber" and "lumber-house" were formerly used for a pawnbroker's shop, being in this sense a variant of "Lombard," a name familiar throughout Europe for a banker, money-changer or pawnbroker. This has frequently been taken to be the origin of the word in sense (1), the reference being to the store of unredeemed and unsaleable articles accumulating in pawnbrokers' shops. Skeat adopts this in preference to the connexion with "lumber" in sense (3), but thinks that the word may have been influenced by both sources (*Etym. Dict.*, 1910). This word is probably of Scandinavian origin, and is cognate with a Swedish dialect word *lomra*, meaning "to roar," a frequentative of *ljumma*, "to make a noise." The English word may be of native origin and merely onomatopoeic. The *New English Dictionary*, though admitting the probability of the association with "Lombard," prefers the second proposed derivation. The application of the word to timber is of American origin; the *New English Dictionary* quotes from *Suffolk* (Mass.) *Deeds* of 1662—"Freighted in Boston, with beames . . . boards . . . and other lumber."

LUMBINĪ, the name of the garden or grove in which Gotama, the Buddha, was born. It is first mentioned in a very ancient Pali ballad preserved in the *Sutta Nipāta* (verse 583). This

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de Tárraga (*c.* 1370), a converted Jew who studied the occult. Others are ascribed by Morhof to a Raymundus Lullius Neophytus, who lived about 1440. See ALCHEMY, and also J. Ferguson, *Bibliotheca chemica* (1906).

is the *Song of Nalaka* (the Buddhist Simeon), and the words put in the mouth of the angels who announce the birth to him are: "The Wisdom-child, that jewel so precious, that cannot be matched, has been born at Lumbinī, in the Sākiya land, for weal and for joy in the world of men." The commentaries on the *Jātakas* (i. 52, 54), and on a parallel passage in the *Majjhima* (*J.R.A.S.*, 1895, p. 767), tell us that the mother of the future Buddha was on her way from Kapilavastu (Kapilavatthu), the capital of the Sākiyas, to her mother's home at Devadaha, the capital of the adjoining tribe, the Koliyas, to be confined there. Her pains came upon her on the way, and she turned aside into this grove, which lay not far from Devadaha, and gave birth there to her son. All later Buddhist accounts, whether Pali or Sanskrit, repeat the same story.

A collection of legends about Asoka, included in the *Divyāvadāna*, a work composed probably in the 1st or 2nd century A.D., tells us (pp. 389, 390) how Asoka, the Buddhist emperor, visited the traditional site of this grove, under the guidance of Upagupta. This must have been about 248 B.C. Upagupta (Tissa: see PALI) himself also mentions the site in his *Kathā Vatthu* (p. 559). The Chinese pilgrims, Fa Hien and Hsuan Tsang, visiting India in the 5th and 7th centuries A.D., were shown the site; and the latter (ed. Watters, ii. 15-19) mentions that he saw there an Asoka pillar, with a horse on the top, which had been split, when Hsuan Tsang saw it, by lightning. This pillar was rediscovered under the following circumstances.

The existence, a few miles beyond the Nepalese frontier, of an inscribed pillar had been known for some years when, in 1895, the discovery of another inscribed pillar at Niglīva, near by, led to the belief that this other, hitherto neglected, one must also be an Asoka pillar, and very probably the one mentioned by Hsuan Tsang. At the request of the Indian government the Nepalese government had the pillar, which was half buried, excavated for examination; and Dr Führer, then in the employ of the Archaeological Survey, arrived soon afterwards at the spot.

The stone was split into two portions, apparently by lightning, and was inscribed with Pali characters as used in the time of Asoka. Squeezes of the inscription were sent to Europe, where various scholars discussed the meaning, which is as follows: "His Majesty, Piyadassi, came here in the 21st year of his reign and paid reverence. And on the ground that the Buddha, the Sākiya sage, was born here, he (the king) had a flawless stone cut, and put up a pillar. And further, since the Exalted One was born in it, he reduced taxation in the village of Lumbinī, and established the dues at one-eighth part (of the crop)."

The inscription, having been buried for so many centuries beneath the soil, is in perfect preservation. The letters, about an inch in height, have been clearly and deeply cut in the stone. No one of them is doubtful. But two words are new, and scholars are not agreed in their interpretation of them. These are the adjective *vīgaḍabhī* applied to the stone, and rendered in our translation "flawless"; and secondly, the last word, rendered in our translation "one-eighth part (of the crop)." Fortunately these words are of minor importance for the historical value of this priceless document. The date, the twenty-first year after the formal coronation of Asoka, would be 248 B.C. The name Piyadassi is the official epithet always used by Asoka in his inscriptions when speaking of himself. The inscription confirms in every respect the Buddhist story, and makes it certain that, at the time when it was put up, the tradition now handed down in the books was current at the spot. Any further inference that the birth really took place there is matter of probability on which opinions will differ.

The grove is situate about 3 m. north of Bhagwanpur, the chief town of a district of the same name in the extreme south of Nepal, just over the frontier dividing Nepal from the district of Basti in British territory. It is now called Rummin-dei, *i.e.* the shrine of the goddess of Rummin, a name no doubt derived from the ancient name Lumbinī. There is a small shrine at the spot, containing a bas-relief representing the birth of the Buddha. But the Buddha is now forgotten there, and the bas-relief is reverenced only for the figure of the mother, who ha been turned into a tutelary deity of the place. Except so fa as the excavation of the pillar is concerned the site has not bee explored, and four small stupas there (already noticed b Hsuan Tsang) have not been opened.

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LUMP-SUCKER, or LUMP-FISH (*Cyclopterus lumpus*), marine fish, which with another British genus (*Liparis*) and few other genera forms a small family (Cyclopteridae). Lik many littoral fishes of other families, the lump-suckers hav the ventral fins united into a circular concave disk, whic acting as a sucker, enables them to attach themselves firmly t rocks or stones. The body (properly so called) is short and thic with a thick and scaleless skin, covered with rough tubercles the larger of which are arranged in four series along each sid of the body. The first dorsal fin is almost entirely concealed b the skin, appearing merely as a lump on the back. The lump sucker inhabits the coasts of both sides of the North Atlantic it is not rare on the British coasts, but becomes more commo farther north. It is so sluggish in its habits that individual have been caught with sea-weed growing on their backs. In th spring the fish approaches the shores to spawn, clearing out hollow on a stony bottom in which it deposits an immens quantity of pink-coloured ova. Fishermen assert that the mal watches the spawn until the young are hatched, a statemen which receives confirmation from the fact that the allied gobies or at least some of them, take similar care of their progen The vernacular name, "cock and hen paddle," given to the lump fish on some parts of the coast, is probably expressive of th difference between the two sexes in their outward appearanc the male being only half or one-third the size of the female, an assuming during the spawning season a bright blue coloratio with red on the lower parts. This fish is generally not esteeme as food, but Franz Faber (*Fische Islands*, p. 53) states that th Icelanders consider the flesh of the male as a delicacy.[1] Th bones are so soft, and contain so little inorganic matter, that th old ichthyologists placed the lump-sucker among the cartilagi ous fishes.

LUMSDEN, SIR HARRY BURNETT (1821–1896), Angl Indian soldier, son of Colonel Thomas Lumsden, C.B., was bor on the 12th of November 1821. He joined the 59th Beng Native Infantry in 1838, was present at the forcing of the Khybe Pass in 1842, and went through the first and second Sikh wars being wounded at Sobraon. Having become assistant to S Henry Lawrence at Lahore in 1846, he was appointed in 184 to raise the Corps of Guides. The object of this corps, compose of horse and foot, was to provide trustworthy men to act a guides to troops in the field, and also to collect intelligenc beyond as well as within the North-West frontier of India. Th regiment was located at Mardan on the Peshawar border, and ha become one of the most famous in the Indian army. For th equipment of this corps, Lumsden originated the *khaki* uniform In 1857 he was sent on a mission to Kandahar with his younge brother, Sir Peter Lumsden, in connexion with the subsidy pai by the Indian government to the amir, and was in Afghanista throughout the Mutiny. He took part in the Waziri Expeditio of 1860, was in command of the Hyderabad Contingent fro 1862, and left India in 1869. He became lieutenant-gener in 1875, and died on the 12th of August 1896.

See Sir Peter Lumsden and George Elsmie, *Lumsden of the Guid* (1899).

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[1] The "cock-padle" was formerly esteemed also in Scotland, an figures in the *Antiquary*, chap. xi.

LUNA, ÁLVARO DE (d. 1453), Constable of Castile, Grand Master of Santiago, and favourite of King John II. of Castile, was the natural son of Álvaro de Luna, a Castilian noble. He was introduced to the court as a page by his uncle Pedro de Luna, archbishop of Toledo, in 1410. Álvaro soon secured a commanding influence over John II., then a mere boy. During the regency of the king's uncle Ferdinand, which ended in 1412, he was not allowed to be more than a servant. When, however, Ferdinand was elected king of Aragon, and the regency remained in the hands of the king's mother, Constance, daughter of John of Gaunt, a foolish and dissolute woman, Álvaro became a very important person. The young king regarded him with an affection which the superstition of the time attributed to witchcraft. As the king was surrounded by greedy and unscrupulous nobles, among whom his cousins, the sons of Ferdinand, commonly known as the Infantes (princes) of Aragon, were perhaps the worst, his reliance on a favourite who had every motive to be loyal to him is quite intelligible. Álvaro too was a master of all the accomplishments the king admired—a fine horseman, a skilful lance and a writer of court verse. Until he lost the king's protection he was the central figure of the Castilian history of the time. It was a period of constant conflict conducted by shifting coalitions of the nobles, who under pretence of freeing the king from the undue influence of his favourite were intent on making a puppet of him for their own ends. The part which Álvaro de Luna played has been diversely judged. To Mariana he appears as a mere self-seeking favourite. To others he has seemed to be a loyal servant of the king who endeavoured to enforce the authority of the crown, which in Castile was the only alternative to anarchy. He fought for his own hand, but his supremacy was certainly better than the rule of gangs of plundering nobles. His story is in the main one of expulsions from the court by victorious factions, and of his return when his conquerors fell out among themselves. Thus in 1427 he was solemnly expelled by a coalition of the nobles, only to be recalled in the following year. In 1431 he endeavoured to employ the restless nobles in a war for the conquest of Granada. Some successes were gained, but a consistent policy was impossible with a rebellious aristocracy and a king of indolent character. In 1445 the faction of the nobles allied with Álvaro's main enemies, the Infantes de Aragon, were beaten at Olmedo, and the favourite, who had been constable of Castile and count of Santestéban since 1423, became Grand Master of the military order of Santiago by election of the Knights. His power appeared to be thoroughly established. It was, however, based on the personal affection of the king. The king's second wife, Isabella of Portugal, was offended at the immense influence of the constable, and urged her husband to free himself from slavery to his favourite. In 1453 the king succumbed, Álvaro was arrested, tried and condemned by a process which was a mere parody of justice, and executed at Valladolid on the 2nd of June 1453.

The *Chronicle of Álvaro de Luna* (Madrid, 1784), written by some loyal follower who survived him, is a panegyric and largely a romance. The other contemporary authority—the *Chronicle of John II.*—is much less favourable to the constable. Don Jose Quintana has summarized the two chronicles in his life of Luna in the *Vidas de Españoles célebres*; *Biblioteca de Autores Españoles* (Madrid, 1846–1880), vol. xix.

LUNA (mod. *Luni*), an ancient city of Etruria, Italy, 4½ m. S.E. of the modern Sarzana. It was the frontier town of Etruria, on the left bank of the river, Macra, the boundary in imperial times between Etruria and Liguria. When the Romans first appeared in these parts, however, the Ligurians were in possession of the territory as far as Pisa. It derived its importance mainly from its harbour, which was the gulf now known as the Gulf of Spezia, and not merely the estuary of the Macra as some authors have supposed. The town was apparently not established until 177 B.C., when a colony was founded here, though the harbour is mentioned by Ennius, who sailed hence for Sardinia in 205 B.C. under Manlius Torquatus. An inscription of 155 B.C., found in the forum of Luna in 1857, was dedicated to M. Claudius Marcellus in honour of his triumph over the Ligurians and Apuani. It lost much of its importance under the Empire, though traversed by the coast road (Via Aurelia), and it was renowned for the marble from the neighbouring mountains of Carrara, which bore the name of Luna marble. Pliny speaks of the quarries as only recently discovered in his day. Good wine was also produced. There are some remains of the Roman period on the site, and a theatre and an amphitheatre may be distinguished. No Etruscan remains have come to light. O. Cuntz's investigations (*Jahreshefte des Österr. Arch. Instituts*, 1904, 46) seem to lead to the conclusion that an ancient road crossed the Apennines from it, following the line of the modern road (more or less that of the modern railway from Sarzana to Parma), and dividing near Pontremoli, one branch going to Borgotaro, Veleia and Placentia, and the other over the Cisa pass to Forum Novum (Fornovo) and Parma. The town was destroyed by the Arabs in 1016, and the episcopal see transferred to Sarzana in 1204.

See G. Dennis, *Cities and Cemeteries of Etruria* (London, 1883), ii. 63. (T. As.)

LUNATION, the period of return of the moon (*luna*) to the same position relative to the sun; for example, from full moon to full moon. Its duration is 29·5305884 days.

LUNAVADA, a native state in India, in the Gujarat division of Bombay. Area, 388 sq. m.; pop. (1901) 63,967, showing a decrease of 28% in the decade, due to famine. The chief, whose title is maharana, is a Rajput of high lineage. Estimated revenue, £12,000; tribute, £1000. The capital is Lunavada town, said to have been founded in 1434; pop. (1901) 10,277.

LUNCHEON, in present usage the name given to a meal between breakfast and tea or dinner. When dinner was taken at an early hour, or when it is still the principal midday meal, luncheon was and is still a light repast. The derivation of the word has been obscured, chiefly owing to the attempted connexion with "nuncheon," with which the word has nothing to do etymologically. "Luncheon" is an extended form of "lunch" (another form of "lump," as "hunch" is of "hump"). Lunch and luncheon in the earliest meanings found are applied to a thick piece of bread, bacon, meat, &c.

The word "nuncheon," or "nunchion," with which "luncheon" has been frequently connected, appears as early as the 14th century in the form *noneschenche*. This meant a refreshment or distribution, properly of drink, but also accompanied with some small quantity of meat, taken in the early afternoon. The word means literally "noon-drink," from none or noon, *i.e. nona hora*, the ninth hour, originally 3 o'clock P.M., but later "midday"—the church office of "nones," and also the second meal of the day, having been shifted back—and *schenchen*, to pour out; cf. German *schenken*, which means to retail drink and to give, present. *Schenche* is the same as "shank," the shin-bone, and the sense development appears to be shin-bone, pipe, hence tap for drawing liquor. See also Skeat, *Etymological Dict. of English Language* (1910), s.v. "nunchion."

LUND, TROELS FREDERIK (1840–), Danish historian, was born in Copenhagen on the 5th of September 1840. He entered the university of Copenhagen in 1858. About the age of thirty he took a post which brought before his notice the treasures of the archives of Denmark. His first important work, *Historiske Skitser*, did not appear until 1876, but after that time his activity was stupendous. In 1879 was published the first volume of his *Danmarks og Norges Historie i Slutningen af det xvi. Aarhundrede*, a history of daily life in Denmark and Norway at the close of the 16th century. Troels Lund was the pioneer of the remarkable generation of young historians who came forward in northern Europe about 1880, and he remained the most original and conspicuous of them. Saying very little about kings, armies and governments, he concentrates his attention on the life, death, employments, pleasures and prejudices of the ordinary men and women of the age with which he deals, using to illustrate his theme a vast body of documents previously neglected by the official historian. Lund was appointed historiographer-royal to the king of Denmark and comptroller of the Order of the Dannebrog. There was probably no living man to whom the destruction of the archives, when Christiansborg Castle was accidentally burned in 1884, was so acute a matter of distress. But his favourite and peculiar province, the MSS. of the 16th century, was happily not involved in that calamity.

LUND, a city of Sweden, the seat of a bishop, in the district (*län*) of Malmöhus, 10 m. N.E. of Malmö by rail. Pop. (1900) 16,621. A university was founded here in 1668 by Charles XI., with faculties of law, medicine, theology and philosophy. The number of students ranges from 600 to 800, and there are about 50 professors. Its library of books and MSS. is entitled to receive a copy of every work printed in Sweden. Important buildings include the university hall (1882), the academic union of the students (1851) containing an art museum; the astronomical observatory, built in 1866, though observations have been carried on since 1760; the botanical museum, and ethnographical and industrial art collections, illustrating life in southern Sweden from early times. Each student belongs to one of twelve nations (*landskap*), which mainly comprises students from a particular part of the country. The Romanesque cathedral was founded about the middle of the 10th century. The crypt under the raised transept and choir is one of the largest in the world, and the church is one of the finest in Scandinavia. A statue of the poet Esaias Tegner stands in the Tegners Plads, and the house in which he lived from 1813 to 1826 is indicated by an inscribed stone slab. The chief industries are sugar-refining, iron and brick works, and the manufacture of furniture and gloves.

Lund (*Londinum Gothorum*), the "Lunda at Eyrarsund" of Egil's Saga, was of importance in Egil's time (*c.* 920). It appears that, if not actually a seaport, it was at least nearer the Sound than now. In the middle of the 11th century it was made a bishopric, and in 1103 the seat of an archbishop who received primatial rank over all Scandinavia in 1163, but in 1536 Lund was reduced to a bishopric. Close to the town, at the hill of Sliparabacke, the Danish kings used to receive the homage of the princes of Skare, and a monument records a victory of Charles XI. over the Danes (1676), which extinguished the Danish claim to suzerainty over this district.

LUNDY, BENJAMIN (1789–1839), American philanthropist, prominent in the anti-slavery conflict, was born of Quaker parentage, at Hardwick, Warren county, New Jersey, on the 4th of January 1789. As a boy he worked on his father's farm, attending school for only brief periods, and in 1808–1812 he lived at Wheeling, Virginia (now W. Va.), where he served an apprenticeship to a saddler, and where—Wheeling being an important headquarters of the inter-State slave trade—he first became deeply impressed with the iniquity of the institution of slavery, and determined to devote his life to the cause of abolition. In 1815, while living at Saint Clairsville, Ohio, he organized an anti-slavery association, known as the "Union Humane Society," which within a few months had a membership of more than five hundred men. For a short time he assisted Charles Osborne in editing the *Philanthropist*; in 1819 he went to St Louis, Missouri, and there in 1819–1820 took an active part in the slavery controversy; and in 1821 he founded at Mount Pleasant, Ohio, an anti-slavery paper, the *Genius of Universal Emancipation*. This periodical, first a monthly and later a weekly, was published successively in Ohio, Tennessee, Maryland, the District of Columbia and Pennsylvania, though it appeared irregularly, and at times, when Lundy was away on lecturing tours, was issued from any office that was accessible to him. From September 1829 until March 1830 Lundy was assisted in the editorship of the paper by William Lloyd Garrison (*q.v.*). Besides travelling through many states of the United States to deliver anti-slavery lectures, Lundy visited Haiti twice—in 1825 and 1829, the Wilberforce colony of freedmen and refugee slaves in Canada in 1830–1831, and in 1832 and again in 1833 Texas, all these visits being made, in part, to find a suitable place outside the United States to which emancipated slaves might be sent. Between 1820 and 1830, according to a statement made by Lundy himself, he travelled "more than 5000 m. on foot and 20,000 in other ways, visited nineteen states of the Union, and held more than 200 public meetings." He was bitterly denounced by slaveholders and also by such non-slaveholders as disapproved of all anti-slavery agitation, and in January 1827 he was assaulted and seriously injured by a slave-trader, Austin Woolfolk, whom he had severely criticized in his paper. In 1836–1838 Lundy edited in Philadelphia a new anti-slavery weekly, *The National Enquirer*, which he had founded, and which under the editorship of John G. Whittier, Lundy's successor, became *The Pennsylvania Freeman*. In 1838 Lundy removed to Lowell, La Salle county, Illinois, where he printed several copies of the *Genius of Universal Emancipation*. There, on the 22nd of August 1839, he died. Lundy is said to have been the first to deliver anti-slavery lectures in the United States.

See *The Life, Travels and Opinions of Benjamin Lundy* (Philadelphia, 1847), compiled (by Thomas Earle) "under the direction and on behalf of his children."

LUNDY, ROBERT (fl. 1689), governor of Londonderry. Nothing is known of Lundy's parentage or early life; but he had seen service in the foreign wars before 1688, when he was at Dublin with the rank of lieutenant-colonel in the regiment of Lord Mountjoy. When the apprentices of Derry closed the gates in the face of the earl of Antrim, who was approaching the city at the head of an Irish Catholic force in the interests of James II., the viceroy Tyrconnel despatched Mountjoy to pacify the Protestants. Mountjoy and his regiment were well received in the north, and the citizens of Derry permitted him to leave within their walls a small Protestant garrison under the command of Lundy, who assumed the title of governor. Popular feeling in Derry ran so strongly in favour of the prince of Orange that Lundy quickly declared himself an adherent of William; and he obtained from him a commission confirming his appointment as governor. Whether Lundy was a deliberate traitor to the cause he had embraced with explicit asseveration of fidelity in a signed document, or whether, as Macaulay suggests, he was only a cowardly poltroon, cannot certainly be known. What is certain is that from the moment Londonderry was menaced by the troops of King James, Lundy used all his endeavours to paralyse the defence of the city. In April 1689 he was in command of a force of Protestants who encountered some troops under Richard Hamilton at Strabane, when, instead of holding his ground, he told his men that all was lost and ordered them to shift for themselves; he himself was the first to take flight back to Derry. King James, then at Omagh on his way to the north, similarly turned in flight towards Dublin on hearing of the skirmish, but returned next day on receiving the true account of the occurrence. On the 14th of April English ships appeared in the Foyle with reinforcements for Lundy under Colonel Cunningham. Lundy dissuaded Cunningham from landing his regiments, representing that a defence of Londonderry was hopeless; and that he himself intended to withdraw secretly from the city. At the same time he sent to the enemy's headquarters a promise to surrender the city at the first summons. As soon as this became known to the citizens Lundy's life was in danger, and he was vehemently accused of treachery. When the enemy appeared before the walls Lundy gave orders that there should be no firing. But all authority had passed out of his hands. The people flew to arms under the direction of Major Henry Baker and Captain Adam Murray, who organized the famous defence in conjunction with the Rev. George Walker (*q.v.*). Lundy, to avoid popular vengeance, hid himself until nightfall, when by the connivance of Walker and Murray he made his escape in disguise. He was apprehended in Scotland and sent to the Tower of London. He was excluded from the Act of Indemnity in 1690, but his subsequent fate is unknown.

See Lord Macaulay, *History of England*, vol. iii. (Albany edition of complete works, London, 1898); Rev. George Walker, *A True Account of the Siege of Londonderry* (London, 1689); J. Mackenzie *Narrative of the Siege of Londonderry* (London, 1690); John Hempton *The Siege and History of Londonderry* (Londonderry, 1861); Rev John Graham, *A History of the Siege of Derry and Defence o Enniskillen, 1688–9* (Dublin, 1829). (R. J. M.)

LUNDY, an English island at the entrance of the Bristo Channel, 12 m. N.W. by N. of the nearest point on the mainland namely Hartland Point on the Devonshire coast. The nearest ports are Clovelly and Bideford. The extreme length of the island is 3 m. from N. to S., the mean breadth about half a mile, but at the south the breadth is nearly 1 m. The area is about 115 acres. The component rock is a hard granite, except at the south, where slate occurs. This granite was used in the construction of the Victoria Embankment, London. An extreme elevation of about 450 ft. is found in the southern half of the island; the northern sloping gently to the sea, but the greater part of the coast is cliff-bound and very beautiful. The landing, at the south-east, is sheltered by the small Rat Island, where the once common black rat survives. There are a few prehistoric remains on Lundy, and the foundations of an ancient chapel of St Helen. There are also ruins, and the still inhabited keep, of Marisco Castle, occupying a strong precipitous site on the south-east, held in the reign of Henry II. by Sir Jordan de Marisco. The Mariscos, in their inaccessible retreat, lived lawlessly until in 1242 Sir William Marisco was hanged for instigating an attempt on the life of Henry III. In 1625 the island was reported to be captured by Turkish pirates, and in 1633 by Spaniards. Later it became an object of attack and a hiding place for French privateers. The island, which is reckoned as extra-parochial, has some cultivable land and heath pasture, and had a population in 1901 of 94.

LÜNEBURG, a town of Germany, in the Prussian province of Hanover, situated near the foot of a small hill named the Kalkberg, on the navigable Ilmenau, 14 m. above its confluence with the Elbe and 30 m. by rail S.E. of Hamburg by the main line to Hanover. Pop. (1905) 26,751. Numerous handsome medieval buildings testify to its former prosperity as a prominent member of the Hanseatic league, and its many quaint houses with high gables and overhanging eaves have gained for it the appellation "the Nüremberg of the North." Portions of the old walls survive, but the greater part of the former circumvallation has been converted into promenades and gardens, outside which a modern town has sprung up. The finest of its squares are the market-place and the so-called Sand. The churches of St John, with five aisles and a spire 375 ft. in height; of St Michael, containing the tombs of the former princes of Lüneburg, and of St Nicolas, with a huge nave and a lofty spire, are fine Gothic edifices of the 14th and 15th centuries. The old town-hall in the market square is a huge pile, dating originally from the 13th century, but with numerous additions. It has an arcade with frescoes, restored by modern Munich artists, and contains a magnificent hall—the Fürstensaal—richly decorated with wood-carving and stained-glass windows. Galvanoplastic casts of the famous Lüneburg silver plate, consisting of 36 pieces which were acquired in 1874 by the Prussian government for £33,000 and are now housed in the art museum in Berlin, are exhibited here. Among other public edifices are the old palace; the convent of St Michael (now converted into a school and law court), and the Kaufhaus (merchants' hall). There are a museum, a library of 36,000 volumes, classical and commercial schools, and a teachers' seminary. Lüneburg owes its importance chiefly to the gypsum and lime quarries of the Kalkberg, which afford the materials for its cement works, and to the productive salt-spring at its base which has been known and used since the 10th century. Hence the ancient saying which, grouping with these the commercial facilities afforded by the bridge over the Ilmenau, ascribes the prosperity of Lüneburg to its *mons, fons, pons*. Other industries are the making of chemicals, ironware, soda and haircloth. There is a considerable trade in French wines, for which Lüneburg has for centuries been one of the chief emporia in north Germany, and also in grain and wool. Celebrated are its lampreys, *Lüneburger Bricken*.

Lüneburg existed in the days of Charlemagne, but it did not gain importance until after the erection of a convent and a castle on the Kalkberg in the 10th century. After the destruction of Bardowiek, then the chief commercial centre of North Germany, by Henry the Lion, duke of Saxony, in 1189, Lüneburg inherited much of its trade and subsequently became one of the principal towns of the Hanseatic league. Having belonged to the extensive duchy of Saxony it was the capital of the duchy of Brunswick-Lüneburg from 1235 to 1369; later it belonged to one or other of the branches of the family of Brunswick, being involved in the quarrels, and giving its name to cadet lines, of this house. From the junior line of Brunswick-Lüneburg the reigning family of Great Britain is descended. The reformed doctrines were introduced into the town in 1530 and it suffered heavily during the Thirty Years' War. It reached the height of its prosperity in the 15th century, and in the 17th century it was the depot for much of the merchandise exported from Saxony and Bavaria to the mouth of the Elbe; then after a period of decay the 19th century witnessed a revival of its prosperity. In 1813 the German war of liberation was begun by an engagement with the French near Lüneburg.

See W. F. Volger, *Urkundenbuch der Stadt Lüneburg* (3 vols., Lüneburg, 1872–1877); E. Bodemann, *Die älteren Zunfturkunden der Stadt Lüneburg* (Hanover, 1883); O. Jürgens, *Geschichte der Stadt Lüneburg* (Lüneburg, 1891); *Des Propstes Jakob Schomaker Lüneburger Chronik*, edited by T. Meyer (Hanover, 1904); A. Wrede, *Die Einführung der Reformation in Lüneburg* (Göttingen, 1887), and W. Reinecke, *Lüneburgs ältestes Stadtbuch und Verfasstungsregister* (Hanover, 1903). For the history of the principality see von Leuthe, *Archiv für Geschichte und Verfassung des Fürstentums Lüneburg* (Celle, 1854–1863).

LÜNEBURGER HEIDE, a district of Germany, in the Prussian province of Hanover, lying between the Aller and the Elbe and intersected by the railways Harburg-Hanover and Bremen-Stendal. Its main character is that of a broad saddle-back, running for 55 m. from S.E. to N.W. of a mean elevation of about 250 ft. and attaining its greatest height in the Wilseder Berg (550 ft.) at its northern end. The soil is quartz sand and is chiefly covered with heather and brushwood. In the north, and in the deep valleys through which the streams descend to the plain, there are extensive forests of oak, birch and beech, and in the south, of fir and larch. Though the climate is raw and good soil rare, the heath is not unfertile. Its main products are sheep—the celebrated Heidschnucken breed,—potatoes, bilberries, cranberries and honey. The district is also remarkable for the numerous Hun barrows found scattered throughout its whole extent.

See Rabe, *Die Lüneburger Heide und die Bewirthschaftung der Heidhöfe* (Jena, 1900); Kniep, *Führer durch die Lüneburger Heide* (Hanover, 1900); Linde, *Die Lüneburger Heide* (Lüneburg, 1905), and Kück, *Das alte Bauernleben der Lüneburger Heide* (Leipzig, 1906).

LUNETTE (French diminutive of *lune*, moon), a crescent-shaped, semi-circular object. The term is particularly applied in architecture to a circular opening at the intersection of vaulting by a smaller vault, as in a ceiling for the entrance of light or in the lower stories of towers for the passage of bells. It is also used of a panel space of semi-circular shape, filled by a fresco or other decorative treatment. In fortification a "lunette" was originally an earthwork of half-moon shape; later it became a redan with short flanks, in trace somewhat resembling a bastion standing by itself without curtains on either side. The gorge was generally open.

LUNÉVILLE, an industrial and garrison town of north-eastern France, capital of an arrondissement in the department of Meurthe-et-Moselle, 21 m. E.S.E. of Nancy on the railway to Strassburg. Pop. (1906) town, 19,199; commune, 24,266 (including troops). The town stands on the right bank of the Meurthe between that river and its affluent the Vezouze, a little above their confluence. Its château, designed early in the 18th century by the royal architect Germain Boffrand, was the favourite residence of Duke Leopold of Lorraine, where he gathered round him an academy composed of eminent men of the district. It is now a cavalry barracks, and the gardens form a public promenade. Lunéville is an important cavalry station with a large riding school. The church of St Jacques with its two domed towers dates from 1730–1745. There are statues of General Count Antoine de Lasalle, and of the Conventional Abbé Henri Grégoire. The town is the seat of a sub-prefect, and has a tribunal of first instance and a communal college. It carries on cotton-spinning and the manufacture of railway material, motor vehicles, porcelain, toys, hosiery, embroidery, straw-hats and gloves. Trade is in grain, wine, tobacco, hops and other agricultural produce.

The name of Lunéville (*Lunae villa*) is perhaps derived from an ancient cult of Diana, the moon goddess, a sacred fountain and medals with the effigy of this goddess having been found at Leormont, some 2 m. E. of the town. Lunéville belonged to Austrasia, and after various changes fell, in 1344, to the house of Lorraine. A walled town in the middle ages, it suffered in the Thirty Years' War and in the campaigns of Louis XIV. from war, plague and famine. The town flourished again under Dukes Leopold and Stanislas, on the death of the latter of whom, which took place at Lunéville, Lorraine was united to France (1766). The treaty of Lunéville between France and Austria (1801) confirmed the former power in the possession of the left bank of the Rhine.

LUNG, in anatomy, the name of each of the pair of organs of respiration in man and other air-breathing animals, the corresponding organs in fishes being the *branchiae* or gills (see RESPIRATORY SYSTEM). The word in Old English was *lungen*; it appears in many Teutonic languages, cf. Ger. *Lunge*, Du. *long*, Swed. *lunga*; the Teutonic root from which these are derived meant "light," and the lungs were so-called from their lightness. The word "lights" was formerly used as synonymous with "lungs," but is now confined to the lungs of sheep, pigs or cattle; it is etymologically connected with "lung," the pre-Teutonic root being seen in Sansk. *laghu*, Gr. ἐλαφρός.

SURGERY OF THE LUNG AND PLEURA.—When a person meets with a severe injury to the chest, as from a wheel passing over him, the ribs may be broken and driven into the lung. Air then entering into the pleural space, the lung collapses, and breathing becomes so difficult that death may ensue from asphyxia. Short of this, however, there is a cough with the spitting of frothy, blood-stained mucus or of bright red blood. All that can be done is to place the person on his back, slightly propped up by pillows, and to combat syncope by subcutaneous injections of ether and strychnia.

Empyema means the presence of an abscess between the lung and the chest wall, *i.e.* in the pleural space; it is the result of a septic inflammation of the pleura by the micro-organisms of pneumonia or of typhoid fever, or by some other germs. As the abscess increases in size, the lung is pushed towards the spine, and that side of the chest gives a dull note on percussion. If much fluid collects the heart may be pushed out of its place, and, the lung-space being taken up, respiration is embarrassed. Having made sure of the presence of an abscess by exploring with syringe and hollow needle, the surgeon opens and drains it. The drainage is made more effectual by removing an inch or so of one of the ribs, for, unless this is done, there is a risk of the rubber drainage tube being compressed as the ribs come closer together again.

The lung itself has sometimes to be operated on, as when it is the seat of an hydatid cyst, or when it contains an abscess cavity which cannot otherwise be drained, or when it becomes necessary to remove a foreign body the exact situation of which has been revealed by the X-rays. Portions of some of the ribs having been resected, the pleural cavity is opened, and if the lung has not already become glued to the chest-wall by inflammatory adhesions, it is stitched up to the chest-wall, and in a few days, when adhesions have taken place, an incision is safely made into the lung-tissue. See also RESPIRATORY SYSTEM. (E. O.*)

LUNG, one of the four symbolical creatures of Chinese legend. It is a dragon with a scaly snake-like body, long claws, horns, a bristly face, and its back-bone armed with spikes. Originally three-clawed, it has become, as the official dragon of the present dynasty, a five-clawed beast. The form is embroidered on the state robes of the emperor of China, and it is traditionally connected with the dynasty's history and fortunes.

LUNGCHOW, a town in the province of Kwangsi, China, in 22° 21′ N., 106° 45′ E., near the Tongking frontier, and at the junction of the Sung-chi and Kao-ping rivers. Pop. (estimate) 22,000. The town is prettily situated in a circular valley. From a military point of view it is considered important, and considerable bodies of troops are stationed here. It was selected as the seat of frontier trade by the French convention of 1886, and was opened in 1889. In 1898 the total value of its trade amounted to only £20,000, but in 1904 the figures increased to £56,692.

LUNGE, GEORG (1839–), German chemist, was born at Breslau on the 15th of September 1839. He studied at Heidelberg (under R. W. Bunsen) and Breslau, graduating at the latter university in 1859. Turning his attention to technical chemistry, he became chemist at several works both in Germany and England, and in 1876 he was appointed professor of technical chemistry at Zurich polytechnic. Lunge's original contributions cover a very wide field, dealing both with technical processes and analysis. In addition, he was a voluminous writer, enriching scientific literature with many standard works. His treatises *Coal Tar and Ammonia* (5th ed. 1909; 1st ed. 1867), *Destillation des Steinkohlentheers*) and *Sulphuric Acid and Alkali* (1st ed. 1878, 4th ed. 1909), established his position as the highest authority on these subjects, while the *Chemische-technische Untersuchungs-Methoden* (1899–1900; Eng. trans.), to which he contributed, testified to his researches in technical analysis. His jubilee was celebrated at Zurich on the 15th of September 1909.

LUPERCALIA, a very ancient, possibly pre-Roman, pastoral festival in honour of Lupercus. Its rites were under the superintendence of a corporation of priests called Luperci,[1] whose institution is attributed either to the Arcadian Evander, or to Romulus and Remus. In front of the Porta Romana, on the western side of the Palatine hill, close to the Ficus Ruminalis and the Casa Romuli, was the cave of Lupercus; in it, according to the legend, the she-wolf had suckled the twins, and the bronze wolf, which is still preserved in the Capitol, was placed in it in 296 B.C. But the festival itself, which was held on February 15th, contains no reference to the Romulus legend, which is probably later in origin, though earlier than the grecizing Evander legend. The festival began with the sacrifice by the Luperci (or the flamen dialis) of goats and a dog; after which two of the Luperci were led to the altar, their foreheads were touched with a bloody knife, and the blood wiped off with wool dipped in milk; then the ritual required that the two young men should laugh. The smearing of the forehead with blood probably refers to human sacrifice originally practised at the festival. The sacrificial feast followed, after which the Luperci cut thongs from the skins of the victims and ran in two bands round the walls of the old Palatine city, the line of which was marked with stones, striking the people who crowded near. A blow from the thong prevented sterility in women. These thongs were called *februa*, the festival Februatio, and the day *dies februatus* (*februare*=to purify): hence the name of the month February, the last of the old Roman year. The object of the festival was, by expiation and purification, to secure the fruitfulness of the land, the increase of the flocks and the prosperity of the whole people. The Lupercal (cave of Lupercus), which had fallen into a state of decay, was rebuilt by Augustus; the celebration of the festival had been maintained, as we know from the famous occurrence of it in 44 B.C. It survived until A.D. 494, when it was changed by Gelasius into the feast of the Purification. Lupercus, in whose honour the festival was held, is identified with Faunus or Inuus, Evander (Εὔανδρος), in the Greek legend being a translation of Faunus (the "kindly"). The Luperci were divided into two *collegia*, called Quinctiliani (or Quinctiales) and Fabiani, from the gens Quinctilia (or Quinctia)[2] and Fabia; at the head of each of these colleges was a magister. In 44 B.C. a third college, Luperci Julii, was instituted in honour of Julius Caesar, the first magister of which was Mark Antony. In imperial times the members were usually of equestrian standing.

See Marquardt, *Römische Staatsverwaltung*, iii. (1885) p. 438; W. Warde Fowler, *Roman Festivals* (1899), p. 390 foll., and article in Smith's *Dictionary of Greek and Roman Antiquities* (3rd ed. 1891).

LUPINE (*Lupinus*), in botany, a genus of about 100 species of annual and perennial herbaceous plants of the tribe *Genisteae* of the order Leguminosae. Species with digitate leaves range along the west side of America from British Columbia to northern Chile, while a few occur in the Mediterranean regions. A few others with entire leaves are found in Brazil and eastern North America. The leaves are remarkable for "sleeping" in three different ways. From being in the form of a horizontal star by day, the leaflets either fall and form a hollow cone with their bases upwards (*L. pilosus*), or rise and the cone is inverted (*L. luteus*), or else the shorter leaflets fall and the longer rise, and so together form a vertical star as in many species; the object in every case being to protect the surfaces of the leaflets from radiation and consequent wetting with dew (Darwin, *Movements of Plants*, p. 340). The flowers are of the usual "papilionaceous" or pea-like form, blue, white, purple or yellow, in long terminal spikes. The stamens are monadelphous and bear dimorphic anthers. The species of which earliest mention is made is probably *L. Termis*, which was cultivated by the ancient Egyptians. It is wild in some parts of the Mediterranean area and is extensively cultivated in Egypt. Its seeds are eaten by the poor after being steeped in water to remove their bitterness; the stems furnish fuel and charcoal for gunpowder. The lupine of the ancient Greeks and Romans was probably *L. albus*, which is still extensively cultivated in Italy, Sicily and other Mediterranean countries for forage, for ploughing in to enrich the land, and for its round flat seeds, which form an article of food. Yellow lupine (*L. luteus*) and blue lupine (*L. angustifolius*) are also cultivated on the European continent as farm crops for green manuring.

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[1] Many derivations are suggested, but it seems most probable that Luperci simply means "wolves" (the last part of the word exhibiting a similar formation to *nov-erca*), the name having its origin in the primitive worship of the wolf as a wolf-god.

[2] Mommsen considers the Quinctia to be the older gens, and the Quinctilia a later introduction from Alba.

Lupines are easily cultivated in moderately good garden soil; they include annuals which are among the most ornamental and most easily grown of summer flowering plants (sow in open borders in April and May), and perennials, which are grown from seed or propagated by dividing strong plants in March and April. Many of the forms in cultivation are hybrid. One of the best known of the perennial species is *L. polyphyllus*, a western North American species. It grows from 3 to 6 ft. high, and has numerous varieties, including a charming white-flowered one. The tree lupine (*L. arboreus*) is a Californian bush, 2 to 4 ft. high, with fragrant yellow flowers. It is only hardy in the most favoured parts of the kingdom.

LUPUS, PUBLIUS RUTILIUS, Roman rhetorician, flourished during the reign of Tiberius. He was the author of a treatise on the figures of speech (Σχήματα λέξεως), abridged from a similar work by the rhetorician Gorgias (of Athens, not the well-known sophist of Leontini), the tutor of Cicero's son. In its present form it is incomplete, as is clearly shown by the express testimony of Quintilian (*Instit.* ix. 2, 103, 106) that Lupus also dealt with figures of sense, rhetorical figures (Σχήματα διανοίας). The work is valuable chiefly as containing a number of examples, well translated into Latin, from the lost works of Greek rhetoricians. The author has been identified with the Lupus mentioned in the Ovidian catalogue of poets (*Ex Ponto*, iv. 16), and was perhaps the son of the Publius Rutilius Lupus, who was a strong supporter of Pompey.

Editions by D. Ruhnken (1768), F. Jacob (1837), C. Halm in *Rhetores latini minores* (1863); see also monographs by G. Dzialas (1860 and 1869), C. Schmidt (1865), J. Draheim (1874), Thilo Krieg (1896).

LUPUS (Lat. *lupus*, wolf), a disease characterized by the formation in the skin or mucous membrane of small tubercles or nodules consisting of cell growth which has an inclination to retrograde change, leading to ulceration and destruction of the tissues, and, if it heals, to the subsequent formation of permanent white scars. *Lupus vulgaris* is most commonly seen in early life, and occurs chiefly on the face, about the nose, cheeks or ears. But it may also affect the body or limbs. It first shows itself as small, slightly prominent, nodules covered with thin crusts or scabs. These may be absorbed and removed at one point whilst spreading at another. Their disappearance is followed by a permanent white cicatrix. The disease may be superficial, in which case both the ulceration and the resulting scar are slight (*lupus non-exedens*); or the ulcerative process may be deep and extensive, destroying a large portion of the nose or cheek, and leaving much disfigurement (*lupus exedens*). A milder form, *lupus erythematosus*, occurs on the nose and adjacent portions of the cheeks in the form of red patches covered with thin scales, underneath which are seen the widened openings of the sebaceous ducts. With a longitudinal patch on the nose and spreading symmetrical patches on each cheek the appearance is usually that of a large butterfly. It is slow in disappearing, but does not leave a scar. Lupus is more frequently seen in women than in men; it is connected with a tuberculous constitution. In the superficial variety the application of soothing ointments when there is much redness, and linear incisions, or scrapings with a sharp spoon, to destroy the increased blood supply, are often serviceable. In the ordinary form the local treatment is to remove the new tissue growth by solid points of caustic thrust into the tubercles to break them up, or by scraping with a sharp spoon. The light-treatment has been successfully applied in recent years. As medicines, cod-liver oil, iron and arsenic are useful. (E. O.*)

LUQMĀN, or LOKMAN, the name of two, if not of three (cf. note to Terminal Essay in Sir Rd. Burton's translation of the *Arabian Nights*), persons famous in Arabian tradition. The one was of the family of ʽĀd, and is said to have built the great dike of Mārib and to have received the gift of life as long as that of seven vultures, each of which lived eighty years. The name of the seventh vulture—Lubad—occurs in proverbial literature. The name of the second Luqmān, called "Luqmān the Sage," occurs in the Koran (31, 11). Two accounts of him are current in Arabian literature. According to Masʽūdī (i. 110) he was a Nubian freedman who lived in the time of David in the district of Elah and Midian. According to some commentators on the Koran (*e.g.*, Baidāwī) he was the son of Bāʽūrā, one of the sons of Job's sister or maternal aunt. Derenbourg in his *Fables de Loqmân le sage* (1850) identifies Bāʽūrā with Beor, and believes the name *Luqmān* to be a translation of *Balaam*. The grave of Luqmān was shown on the east coast of the lake of Tiberias, also in Yemen (cf. Yāqūt, vol. iii. p. 512).

The so-called *Fables of Luqmān* are known to have existed in the 13th century, but are not mentioned by any Arabian writer. They were edited by Erpenius (Leiden, 1615) and have been reprinted many times. For the relation of these to similar literature in other lands, see J. Jacobs's edition of Caxton's *Fables of Aesop*, vol. i. (London, 1889). The name of Luqmān also occurs in many old verses, anecdotes and proverbs; cf. G. Freytag's *Arabum Proverbia* (Bonn, 1838–1843) and such Arabian writers as Tabarī, Masʽūdī, Damīrī and the *Kitāb al-Muʽammarīn* (ed. by I. Goldziher, Leiden, 1899). (G. W. T.)

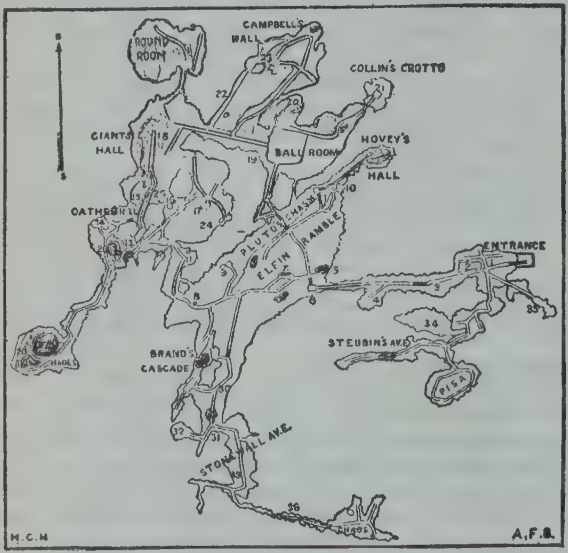
LURAY CAVERN, a large cave in Page county, Virginia, U.S.A., 39° 35′ N. and 78° 17′ W., near the village of Luray, on the Norfolk & Western railway. The valley, here 10 m. wide, extends from the Blue Ridge to the Massanutton Mountain. The ridges lie in vast folds and wrinkles; and elevations in the valley are often found to be pierced by erosion. Cave Hill, 300 ft. above the water-level, had long been an object of local interest on account of its pits and oval hollows or sink-holes, through one of which, on the 13th of August 1878, Andrew J. Campbell and others entered, thus discovering the cavern now described.

The Luray cavern does not date beyond the Tertiary period, though carved from the Silurian limestone. At some period, long subsequent to its original excavation, and after many large stalactites had grown, it was completely filled with glacial mud charged with acid, whereby the dripstone was eroded into singularly grotesque shapes. After the mud had been mostly removed by flowing water, these eroded forms remained amid the new growths. To this contrast may be ascribed some of the most striking scenes in the cave. The many and extraordinary monuments of aqueous energy include massive columns wrenched from their place in the ceiling and prostrate on the floor; the Hollow Column, 40 ft. high and 30 ft. in diameter, standing erect, but pierced by a tubular passage from top to bottom; the Leaning Column nearly as large, undermined and tilting like the campanile of Pisa; the Organ, a cluster of stalactites in the chamber known as the Cathedral; besides a vast bed of disintegrated carbonates left by the whirling flood in its retreat through the great space called the Elfin Ramble.

The stalactitic display exceeds that of any other cavern known. The old material is yellow, brown or red; and its wavy surface often shows layers like the gnarled grain of costly woods. The new stalactites growing from the old, and made of hard carbonates that had already once been used, are usually white as snow, though often pink, blue or amber-coloured. The Empress Column is a stalagmite 35 ft. high, rose-coloured, and elaborately draped. The double column, named from Professors Henry and Baird, is made of two fluted pillars side by side, the one 25 and the other 60 ft. high, a mass of snowy alabaster. Several stalactites in the Giant Hall exceed 50 ft. in length. The smaller pendants are innumerable; in the canopy above the Imperial Spring it is estimated that 40,000 are visible at once.

The "cascades" are wonderful formations like foaming cataracts caught in mid-air and transformed into milk-white or amber alabaster. The Chalcedony Cascade displays a variety of colours. Brand's Cascade, the finest of all, is 40 ft. high and 30 ft. wide, and is unsullied and wax-like white, each ripple and braided rill seeming to have been polished.

The Swords of the Titans are monstrous blades, eight in number, 50 ft. long, 3 to 8 ft. wide, hollow, 1 to 2 ft. thick, but drawn down to an extremely thin edge, and filling the cavern with tones like tolling bells when struck heavily by the hand. Their origin and also that of certain so-called scarfs and blankets is from carbonates deposited by water trickling down a sloping and corrugated surface. Sixteen of these alabaster scarfs hang side by side in Hovey's Balcony, three white and fine as crape shawls, thirteen striated like agate with every shade of brown, and all perfectly translucent. Down the edge of each a tiny rill glistens like silver, and this is the ever-plying shuttle that weaves the fairy fabric.



Luray Cavern. Scale 500 ft. to the inch.

1. The Vestibule.
2. Washington's Pillar.
3. Flower Garden.
4. Amphitheatre.
5. Natural Bridge.
6. Fish Market.
7. Crystal Spring.
8. Proserpine's Pillar.
9. The Spectral Column.
10. Hovey's Balcony.
11. Oberon's Grot.
12. Titania's Veil.
13. Saracen's Tent.
14. The Organ.
15. Tower of Babel.
16. Empress Column.
17. Hollow Column.
18. Henry-Baird Column.
19. Chalcedony Cascade.
20. Coral Spring.
21. The Dragon.
22. Bootjack Alley.
23. Scaly Column.
24. Lost Blanket.
25. Helen's Scarf.
26. Chapman's Lake.
27. Broaddus Lake.
28. Castles on the Rhine.
29. Imperial Spring.
30. The Skeleton.
31. The Twin Lakes.
32. The Engine Room.
33. Miller's Room.
34. Hawes Cabinet.
35. Specimen Avenue.
36. Proposed Exit.

Streams and true springs are absent, but there are hundreds of basins, varying from 1 to 50 ft. in diameter, and from 6 in. to 15 ft. in depth. The water in them is exquisitely pure, except as it is impregnated by the carbonate of lime, which often forms concretions, called according to their size, pearls, eggs and snowballs. A large one is known as the cannon ball. On fracture these spherical growths are found to be radiated in structure.

Calcite crystals, drusy, feathery or fern-like, line the sides and bottom of every water-filled cavity, and indeed constitute the substance of which they are made. Variations of level at different periods are marked by rings, ridges and ruffled margins. These are strongly marked about Broaddus Lake and the curved ramparts of the Castles on the Rhine. Here also are polished stalagmites, a rich buff slashed with white, and others, like huge mushrooms, with a velvety coat of red, purple or olive-tinted crystals. In some of the smaller basins it sometimes happens that, when the excess of carbonate acid escapes rapidly, there is formed, besides the crystal bed below, a film above, shot like a sheet of ice across the surface. One pool 12 ft. wide is thus covered so as to show but a third of its surface. The quantity of water in the cavern varies greatly at different seasons. Hence some stalactites have their tips under water long enough to allow tassels of crystals to grow on them, which, in a drier season, are again coated over with stalactitic matter; and thus singular distortions are occasioned. Contiguous stalactites are often inwrapped thus till they assume an almost globular form, through which by making a section the primary tubes appear. Twig-like projections, to which the term *helictite* has been applied by the present writer, are met with in certain portions of the cave, and are interesting by their strange and uncouth contortions. Their presence is due to lateral outgrowths of crystals shooting from the side of a growing stalactite, or to deflections caused by currents of air, or to the existence of a diminutive fungus peculiar to the locality and designated from its habitat *Mucor stalactitis*. The Toy-Shop is an amusing collection of these freaks of nature.

The dimensions of the various chambers included in Luray Cavern cannot easily be stated, on account of the great irregularity of their outlines. Their size may be seen from the diagram. But it should be understood that there are several tiers of galleries, and the vertical depth from the highest to the lowest is 260 ft. The large tract of land owned by the Luray Caverns Corporations covers all possible modes of entrance.

The waters of this cavern appear to be entirely destitute of life; and the existing fauna comprises only a few bats, rats, mice, spiders, flies and small centipedes. When the cave was first entered, the floor was covered with thousands of tracks of raccoons, wolves and bears—most of them probably made long ago, as impressions made in the tenacious clay that composes most of the cavern floor would remain unchanged for centuries. Layers of excrementitious matter appear, and also many small bones, along with a few large ones, all of existing species. The traces of human occupation are pieces of charcoal, flints, moccasin tracks and a single skeleton embedded in stalagmite in one of the chasms, estimated, from the present rate of stalagmitic growth, to have lain where found for not more than five hundred years.

The temperature is uniformly 54° Fahr., coinciding with that of Mammoth Cave, Kentucky. The air is very pure, and the avenues are not uncomfortably damp. The portions open to the public are now lighted by electric lamps. The registered number of visitors in 1906 was 18,000. A unique and highly successful experiment merits mention, by which the cool pure air of Luray Cavern is forced through all the rooms of the Limair sanatorium erected in 1901, by Mr T. C. Northcott, president of the Luray Caverns Corporation, on the summit of Cave Hill. Tests made for several successive years by means of culture media and sterile plates, demonstrated the perfect bacteriologic purity of the air, first drawn into the caverns through myriads of rocky crevices that served as natural filters, then further cleansed by floating over the transparent springs and pools, and finally supplied to the inmates of the sanatorium.

For a full description see an article by Dr G. L. Hunner, of Johns Hopkins University, in the *Popular Science Monthly* for April 1904. (H. C. H.)

LURCH, a word with several meanings, the etymological relationships of which are obscure. The chief uses which survive are—(1) in the phrase "to leave in the lurch," to abandon some one, to leave him in a position of great difficulty; (2) a stagger, sudden leaning over, originally a nautical expression of a sudden "list" made by a ship; (3) the name of a dog, the "lurcher" used by poachers, properly a cross between a sheep-dog or collie and a greyhound. In (1) "lurch" is the name of a game, of which nothing is known (it is supposed to have resembled backgammon), and also of a state of the score in various games, in which the loser either scores nothing or is beaten by very heavy points. In this sense the term is practically obsolete.

It was taken from Fr. *lourche*, connected with many German forms, now only dialectical such as *Lortsch*, *Lurtsch*, *Lorz*, *Lurz*, all for some kind of game, but also meaning left-hand, wrong, which the *New English Dictionary* thinks is the origin of the word, it being first used as a term in gambling. In (2) "lurch" occurs first in the form "lee-lurches," sudden rolls a ship takes to leeward in a heavy sea, which may be a corruption of "lee-latch," defined in Smyth's *Sailor's Word Book* as dropping to leeward of the course. In (3) "lurch" is probably another form of "lurk," to lie in wait for, watch stealthily, hence to pilfer, steal.

LURGAN, a market-town of Co. Armagh, Ireland, well situated on high ground overlooking Lough Neagh a few miles to the north; 20 m. S.W. of Belfast by the Great Northern railway. Pop. (1901) 11,782. The parish church of Shankill (this parish including Lurgan) has a finely proportioned tower. Contiguous to the town is Lurgan Castle, a fine modern Elizabethan structure, the seat of Lord Lurgan. Lurgan is famed for its diapers, and the linen trade is of the first importance, but there are also tobacco factories and coach factories. It is governed by an urban district council. Lurgan was founded by William Brownlow, to whom a grant of the town was made by James I. In 1619 it consisted of forty-two houses, all inhabited by English settlers. It was burned by the insurgents in 1641, and again by the troops of James II. After its restoration in 1690 a patent for a market and fair was obtained.

LURIA, ISAAC BEN SOLOMON (1534–1572), Jewish mystic, was born in Jerusalem. From his German descent he was surnamed *Ashkenazi* (the German), and we find that epithet applied to him in a recently discovered document of date 1559. In that year Isaac Luria was living in Cairo and trading as a spice merchant with his headquarters in Alexandria. He had come to Egypt as a boy after his father's death, and was brought up by his wealthy maternal uncle Mordecai Francis. The boy, according to the legends which soon grew round his life, was a "wonder-child," and early displayed marvellous capacity. He married as a lad of fifteen, his bride being his cousin. For some time he continued his studies; later on when engaged in business there was no break in this respect. Two years after his marriage he became possessed of a copy of the Kabbalistic "Bible"—the *Zohar* of Moses de Leon (*q.v.*). In order to meditate on the mystic lore he withdrew to a hut by the Nile, returning home for the Sabbath. Luria afterwards gave to the Sabbath a mystic beauty such as it had never before possessed. Thus passed several years; he was still young, but his new mode of life produced its effects on a man of his imagination and saintly piety. He became a visionary. Elijah, who had been his godfather in his babyhood, now paid him frequent visits, initiating him into sublime truths. By night Luria's soul ascended to heaven and conversed with celestial teachers who had once been men of renown on earth.

In 1566 at earliest Luria removed to Safed. This Palestinian town was in the 16th century the headquarters of the Kabbala. A large circle of Talmudists lived there; at their head Joseph Qaro, then over eighty years of age. Qaro's son married Luria's daughter, and Qaro rejoiced at the connexion, for he had a high opinion of Luria's learning. Mysticism is often the expression of a revolt against authority, but in Luria's case mysticism was not divorced from respect for tradition. After his arrival at Safed Luria lived at most six years, and died in 1572. But these years were momentous for Judaism. He established an extraordinary reputation; his personality had a winning attractiveness; and he founded a school of mystics who powerfully affected Judaism after the master's death. The Holy Spirit, we are told, rested on him, drawn to him by the usual means of the mystics—self-flogging, ablutions and penance. He had wonderful gifts of insight, and spoke to the birds. Miracles abounded. More soberly true is the statement that he went on long walks with enthusiastic disciples, whom he taught without books. Luria himself wrote no mystical works; what we know of his doctrines and habits comes chiefly from his Boswell, Ḥayim Vital.

There was little of originality in Luria's doctrines; the theory of emanations, the double belief in the process of the Divine Essence as it were self-concentrating (*Zimzum*) and on the other hand as expanding throughout creation; the philosophical "sceptism" which regards God as unknowable but capable of direct intuition by feeling—these were all common elements of mystical thought. Luria was an inspirer of saintly conduct rather than an innovator in theories. Not beliefs, he said, but believers need rebirth. As he rose in the morning he prayed: "O God, grant that throughout this coming day I may be able to love my neighbour as myself." Never would he retire to rest until he had fulfilled his definite engagements to those who had served him. Luria and his school altered the very look of the Jewish Prayer Book. Prayer was his main prop. By it men became controllers of the earthly world and reached God. He or his school introduced innumerable ritual customs, some of them beautiful enough. On Sabbath he dressed in white, wearing a four-fold garment to typify the four letters of the Divine Name. The Sabbath was to him an actual cult. It was a day of the most holy joy. Resuming the Talmudic idea of an Over-soul present in every Israelite on the Sabbath, Luria and his school made play with this Over-soul, fed it with spiritual and material dainties and evolved an intricate maze of mystic ceremonial, still observed by countless masses. Another strong point with Luria was penance. The confessions of sin which he introduced descend to minute ritual details and rise to the most exalted aspects of social and spiritual life. He deprecated general confessions and demanded that the individual must lay bare the recesses of his heart. Ḥayim Vital reports that on his death-bed Luria said to his disciples: "Be at peace with one another: bear with one another: and so be worthy of my coming again to reveal to you what no mortal ear has heard before." His mystic ceremonial became a guide to religious practice, and though with this there came in much meaningless and even bewildering formalism, yet the example of his life and character was a lasting inspiration to saintliness.

See S. Schecher, *Studies in Judaism*, second series, pp. 251 seq.; *Jewish Encyclopedia*, viii. 210; E. Worman in *Revue des Études Juives*, lvii. 281. (I. A.)

LURISTAN, in the wider sense (as its name implies) the "Land of the Lurs," namely that part of western Persia which is bounded by Turkish territory on the west and extends for about 400 m. N.W.-S.E. from Kermanshah to Fars with a breadth of 100 to 140 m. It is chiefly mountainous, being intersected by numerous ranges running N.W.-S.E. The central range has many summits which are almost within the line of perpetual snow, rising to 13,000 ft. and more, and in it are the sources of Persia's most important rivers, as the Zayendeh-rud, Jarahi, Karun, Diz, Abi, Kerkheh. Between the higher ranges are many fertile plains and low hilly districts, well watered but comparatively little cultivated in consequence of intertribal feuds. The Lurs are thought to be aboriginal Persians with a mixture of Semitic blood. Their language is a dialect of Persian and does not differ materially from Kurdish. Outwardly they are Mussulmans of the Shiah branch, but most of them show little veneration for either Prophet or Koran, and the religion of some of them seems to be a mixture of Ali-Illahism involving a belief in successive incarnations combined with mysterious, ancient, heathen rites. The northern part of Luristan, which was formerly known as Luri-kuchik (little Luristan), is inhabited by the Feili Lurs and these are divided into the Pishkuh (cis-montane) Lurs in the east and Pushtkuh (ultra-montane) Lurs in the west adjoining Turkish territory. They number about 350,000. Little Luristan was governed by a race of independent princes of the Khurshidi dynasty, and called atabegs, from 1155 to the beginning of the 17th century when the last atabeg, Shah Verdi Khan, was removed by Shah Abbas I. and the government of the province given to Husain Khan, the chief of a rival tribe, with the title of vali in exchange for that of atabeg. The descendants of Husain Khan have retained the title but now govern only the Pushtkuh Lurs, to whom only the denomination of Feili is at present applied. The southern part of Luristan was formerly known as Lur i Buzurg (great Luristan) and is composed of the Bakhtiari division of the Arabistan province and the districts of the Mamasennis and Kuhgilus which belong to Fars. The Bakhtiaris number about 200,000, the others 40,000. Great Luristan was an independent state under the Fazlevieh atabegs from 1160 until 1424, and its capital was Idaj, now represented by mounds and ruins at Malamir 60 m. S.E. of Shushter.

LUSATIA (Ger. *Lausitz*), a name applied to two neighbouring districts in Germany, Upper and Lower Lusatia, belonging now mainly to Prussia, but partly to Saxony. The name is taken from the Lusitzi, a Slav tribe, who inhabited Lower Lusatia in the 9th and 10th centuries.

In the earliest times Lower Lusatia reached from the Black Elster to the Spree; its inhabitants, the Lusitzi, were conquered by the German king, Henry the Fowler, and by the margrave Gero in the 10th century. Their land was formed into a separate march, which for about three centuries was sometimes attached to, and sometimes independent of, the margraviate of Meissen, its rulers being occasionally called margraves of Lusatia. In 1303 it was purchased by the margrave of Brandenburg, and after other changes it fell in 1368 into the hands of the king of Bohemia, the emperor Charles IV., who already possessed Upper Lusatia. During the Hussite wars its people remained loyal to the Roman Catholic Church. In 1469 they recognized Matthias Corvinus, king of Hungary, as their sovereign, but in 1490 they came again under the rule of the Bohemian king.

The district now known as Upper Lusatia was occupied by a Slav tribe, the Milzeni, who like the Lusitzi, were subdued by Henry the Fowler early in the 10th century. For about three centuries it was called Baudissin (Bautzen), from the name of its principal fortress. In the 11th and 12th centuries it was connected at different periods with Meissen, Poland and Bohemia. Towards 1160 the emperor Frederick I. granted it to Ladislas, king of Bohemia, and under this ruler and his immediate successors it was largely colonized by German immigrants. In 1253 it passed to the margrave of Brandenburg, and about the same time it was divided into an eastern and a western part, Baudissin proper and Görlitz. In 1319 the former was restored to Bohemia, which also recovered Görlitz in 1329. During the 14th century the nobles and the townsmen began to take part in the government, and about this time Upper Lusatia was known as the district of the six towns (*Sechsstädtelandes*), these being Bautzen, Görlitz, Zittau, Löbau, Lauban and Kamenz. From 1377 to 1396 Görlitz was a separate duchy ruled by John, a son of the emperor Charles IV., and, like Lower Lusatia, Upper Lusatia owned the authority of Matthias Corvinus from 1469 to 1490, both districts passing a little later with the kingdoms of Hungary and Bohemia to the German king, Ferdinand I. The "six towns" were severely punished for their share in the war of the league of Schmalkalden, and about this time the reformed teaching made very rapid progress in Lusatia, the majority of the inhabitants becoming Protestants. The name of Lusatia hitherto confined to Lower Lusatia, was soon applied to both districts, the adjectives Upper and Lower being used to distinguish them. In 1620, early in the Thirty Years' War, the two Lusatias were conquered by the elector of Saxony, John George I., who was allowed to keep them as the price of his assistance to the emperor Ferdinand I. In 1635 by the treaty of Prague they were definitely transferred from Bohemia to Saxony, although the emperor as king of Bohemia retained a certain supremacy for the purpose of guarding the rights and privileges of the Roman Catholics. They suffered much during the wars of the 18th century. By the peace of Vienna (1815) the whole of Lower Lusatia and part of Upper Lusatia were transferred from Saxony to Prussia.

The area of the part of Upper Lusatia retained by Saxony was slightly increased in 1845; it is now about 960 sq. m. In 1900 Lower Lusatia contained 461,973 inhabitants, of whom 34,837 were Wends; the portion of Upper Lusatia belonging to Prussia had 305,080 inhabitants, of whom 24,361 were Wends. There were 405,173 inhabitants, including 28,234 Wends, in Saxon Upper Lusatia. Laws relating to this district, after passing through the Saxon parliament must be submitted to the Lusatian diet at Bautzen. The chief towns of Upper Lusatia are Bautzen, Zittau, Löbau, Kamenz, Görlitz, Rothenburg, Hoyerswerda and Lauban; in Lower Lusatia they are Guben, Kottbus, Forst, Lubben and Spremberg. The principal rivers are the Spree with its tributaries, the Black Elster and the Neisse. Upper Lusatia is generally mountainous and picturesque, Lower Lusatia is flat and sandy. The chief industries are linen weaving, cloth making and coal mining.

For the history of Lusatia see the collections, *Scriptores rerum Lusaticarum antiqui et recentiores*, edited by C. G. Hoffmann (4 vols., Leipzig and Bautzen, 1719); and *Scriptores rerum Lusaticarum* (4 vols., Görlitz, 1839–1870). See also W. Lippert, *Wettiner und Wittelsbacher sowie die Niederlausitz im 14 Jahrhundert* (Dresden, 1894); T. Scheltz, *Gesamtgeschichte der Ober- und Niederlausitz*, Band i. (Halle, 1847), Band ii. (Görlitz, 1882); J. G. Worbs, *Urkundenbuch zur Geschichte des Markgraftums Niederlausitz* (Lübben 1897); and J. A. E. Kohler, *Die Geschichte der Oberlausitz* (Görlitz, 1867).

LUSHAI HILLS, a mountainous district of Eastern Bengal and Assam, south of Cachar, on the border between Assam and Burma. Area, 7227 sq. m.; pop. (1901) 82,434. The hills are for the most part covered with dense bamboo jungle and rank undergrowth; but in the eastern portion, owing probably to a smaller rainfall, open grass-covered slopes are found, with groves of oak and pine interspersed with rhododendrons. These hills are inhabited by the Lushais and cognate tribes, but the population is extremely scanty. From the earliest known times the original inhabitants were Kukis, and the Lushais were not heard of until 1840, when they invaded the district from the north. Their first attack upon British territory took place in November 1849, and after that date they proved one of the most troublesome tribes on the north-east frontier of India; but operations in 1890 resulted in the complete pacification of the northern Lushai villages, and in 1892 the eastern Lushais were reduced to order. The management of the South Lushai hill country was transferred from Bengal to Assam in 1898. To obtain more efficient control over the country the district has been divided into eighteen circles, each in charge of an interpreter, through whom all orders are transmitted to the chiefs. The Welsh Presbyterian Mission began work at Aijal in 1897, and the people have shown unexpected readiness to accept education. According to the census of 1901 the total number of Lushais in Assam was 63,452.

See Colonel T. H. Lewin, *Wild Races of N.E. India* (1870); *Lushai Hills Gazetteer* (Calcutta, 1906).

LUSIGNAN, the name of a family which sprang from Poitou[1] and distinguished itself by its connexion with the kingdom of Jerusalem, and still more by its long tenure of the kingdom of Cyprus (1192–1475). A Hugh de Lusignan appears in the ill-fated crusade of 1100–1101; another Hugh, the Brown, came as a pilgrim to the Holy Land in 1164, and was taken prisoner by Nureddin. In the last quarter of the 12th century the two brothers Amalric and Guy, sons of Hugh the Brown, played a considerable part in the history of the Latin East. About 1180 Amalric was constable of the kingdom of Jerusalem; and he is said to have brought his handsome brother Guy to the notice of Sibylla, the widowed heiress of the kingdom. Guy and Sibylla were married in 1180; and Guy thus became heir presumptive of the kingdom, if the young Baldwin V., Sibylla's son by her first marriage to William of Montferrat, should die without issue. He acted as regent in 1183, but he showed some incapacity in the struggle with Saladin, and was deprived of all right of succession. In 1186, however, on the death of Baldwin V., he succeeded in obtaining the crown, in spite of the opposition of Raymund of Tripoli. Next year he suffered a crushing defeat at the battle of Hittin, and was taken prisoner by Saladin. Released on parole in 1188, he at once broke his parole, and began the siege of Acre. Difficulties, however, had arisen with Conrad of Montferrat; and when Guy lost his wife Sibylla in 1190, and Conrad married Isabella, her sister, now heiress of the kingdom, these difficulties culminated in Conrad's laying claim to the crown. Guy found his cause espoused in 1191 by the overlord of his house, Richard I. of England; but Conrad's superior ability, and the support of the French crusaders, ultimately carried the day, and in 1192 Richard himself abandoned the pretensions of Guy, and recognized Conrad as king. Though Conrad was almost immediately assassinated, the crown did not return to Guy, but went to Henry of Champagne, who married the widowed Isabella. Guy found some satisfaction for his loss in buying from the Templars the island of Cyprus, and there he reigned for the last two years of his life (1192–1194). He is judged harshly by contemporary writers, as *simplex* and *insufficiens*; but Dodu (in his *Histoire des institutions du royaume de Jérusalem*) suggests that Guy was depreciated because the kingdom had been lost in his reign, in much the same way as Godfrey of Bouillon was exalted because Jerusalem had just been won at his accession. Guy was a brave if not a particularly able knight; and his instant attack on Acre after his release by Saladin shows that he had the *sentiment de ses devoirs*.

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[1] A branch of the line continued in Poitou during the 13th century, and ruled in LaMarche till 1303. Hugh de la Marche, whose betrothed wife, Isabella of Angoulême, King John of England seized (thus bringing upon himself the loss of the greater part of his French possessions), was a nephew of Guy of Lusignan. He ultimately married Isabella, after the death of John, and had by her a number of sons, half-brothers of Henry III. of England, who came over to England, amongst other foreign favourites, during his reign.

He was succeeded in Cyprus by his brother Amalric, who acquired the title of king of Cyprus from the emperor Henry VI., and became king of Jerusalem in 1197 by his marriage to Isabella, after the death of Henry of Champagne (see AMALRIC II.). Amalric was the founder of a dynasty of kings of Cyprus, which lasted till 1475, while after 1269 his descendants regularly enjoyed the title of kings of Jerusalem. The scions of the house of Lusignan proved themselves the most sincere of crusaders. They possessed in Cyprus a kingdom, in which they had vindicated for themselves a stronger hold over their feudatories than the kings of Jerusalem had ever enjoyed, and in which trading centres like Famagusta flourished vigorously; and they used the resources of their kingdom, in conjunction with the Hospitallers of Rhodes, to check the progress of the Mahommedans.

Among the most famous members of the house who ruled in Cyprus three may be mentioned. The first is Hugh III. (the Great), who was king from 1267 to 1285: to him, apparently, St Thomas dedicated his *De Regimine Principum*; and it is in his reign that the kingdom of Jerusalem becomes permanently connected with that of Cyprus. The second is Hugh IV. (1324–1359), to whom Boccaccio dedicated one of his works, and who set on foot an alliance with the pope, Venice and the Hospitallers, which resulted in the capture of Smyrna (1344). The last is Peter I., Hugh's second son and successor, who reigned from 1359 to 1369, when he was assassinated as the result of a conspiracy of the barons. Peter and his chancellor de Mezières represent the last flicker of the crusading spirit (see CRUSADES).

Before the extinction of the line in 1475, it had succeeded in putting a branch on the throne of Armenia. Five short-lived kings of the house ruled in Armenia after 1342, "Latin exiles," as Stubbs says, "in the midst of several strange populations all alike hostile." The kingdom of Armenia fell before the sultan of Egypt, who took prisoner its last king Leo V. in 1375, though the kings of Cyprus afterwards continued to bear the title; the kingdom of Cyprus itself continued to exist under the house of Lusignan for 100 years longer. The mother of the last king, James III. (who died when he was two years old), was a Venetian lady, Catarina Cornaro. She had been made a daughter of the republic at the time of her marriage to the king of Cyprus; and on the death of her child the republic first acted as guardian for its daughter, and then, in 1489, obtained from her the cession of the island.

See J. M. J. L. de Mas-Latrie, *Histoire de l'île de Chypre sous les princes de la maison de Lusignan* (Paris, 1852–1853); W. Stubbs, *Lectures on Medieval and Modern History* (3rd ed., Oxford, 1900).

LUSSIN, a small island in the Adriatic Sea, in the Gulf of Quarnero, forming together with the adjacent islands of Veglia and Cherso an administrative district in the Austrian crownland of Istria. Pop. (1900) 11,615. The island is 24 m. in length, is of an average breadth of 1·64 m., being little more than 300 yds. wide at its narrowest point, and has an area of 29 sq. m. The chief town and principal harbour is Lussinpiccolo (pop. 7207), which is the most important trading centre in the Quarnero group. The town has become a favourite winter resort, its climate resembling that of Nice. To the south-east of it is Lussingrande (pop. 2349), with an old Venetian palace and a shipbuilding wharf. The island was first peopled at the end of the 14th century. Its inhabitants are renowned seamen.

LUSTRATION, a term that includes all the methods of purification and expiation among the Greeks and Romans. Among the Greeks there are two ideas clearly distinguishable—that human nature must purify itself (κάθαρσις) from guilt before it is fit to enter into communion with God or even to associate with men, and that guilt must be expiated voluntarily (ἱλασμός) by certain processes which God has revealed, in order to avoid the punishment that must otherwise overtake it. It is not possible to make such a distinction among the Latin terms *lustratio*, *piacula*, *piamenta*, *caerimoniae*, and even among the Greeks it is not consistently observed. Guilt and impurity arose in various ways; among the Greeks, besides the general idea that man is always in need of purification, the species of guilt most insisted on by religion are incurred by murder, by touching a dead body, by sexual intercourse, and by seeing a prodigy or sign of the divine will. The last three spring from the idea that man had been without preparation and improperly brought into communication with God, and was therefore guilty. The first, which involves a really moral idea of guilt, is far more important than the others in Hellenic religion. Among the Romans we hear more of the last species of impurity; in general the idea takes the form that after some great disaster the people become convinced that guilt has been incurred and must be expiated. The methods of purification consist in ceremonies performed with water, fire, air or earth, or with a branch of a sacred tree, especially of the laurel, and also in sacrifice and other ceremonial. Before entering a temple the worshipper dipped his hand in the vase of holy water (περιῤῥαντήριον, *aqua lustralis*) which stood at the door; before a sacrifice bathing was common; salt-water was more efficacious than fresh, and the celebrants of the Eleusinian mysteries bathed in the sea (ἅλαδε, μύσται); the water was more efficacious if a firebrand from the altar were plunged in it. The torch, fire and sulphur (τὸ θεῖον) were also powerful purifying agents. Purification by air was most frequent in the Dionysiac mysteries; puppets suspended and swinging in the air (*oscilla*) formed one way of using the lustrative power of the air. Rubbing with sand and salt was another method. The sacrifice chiefly used for purification by the Greeks was a pig; among the Romans it was always, except in the Lupercalia, a pig, a sheep and a bull (*suovetaurilia*). In Athens a purificatory sacrifice and prayer was held before every meeting of the ecclesia; the Maimacteria,[1] in honour of Zeus Maimactes (the god of wrath), was an annual festival of purification, and at the Thargelia two men (or a woman and a man) were sacrificed on the seashore, their bodies burned and the ashes thrown into the sea, to avert the wrath of Apollo. On extraordinary occasions lustrations were performed for a whole city. So Athens was purified by Epimenides after the Cylonian massacre, and Delos in the Peloponnesian War (426 B.C.) to stop the plague and appease the wrath of Apollo. In Rome, besides such annual ceremonies as the *Ambarvalia*, *Lupercalia*, *Cerialia*, *Paganalia*, &c., there was a lustration of the fleet before it sailed, and of the army before it marched. Part of the ceremonial always consisted in leading or carrying the victims round the impure persons or things. After any disaster the *lustratio classium* or *exercitus* was often again performed, so as to make certain that the gods got all their due. The *Amburbium*, a solemn procession of the people round the boundaries of Rome, was a similar ceremonial performed for the whole city on occasions of great danger or calamity; the *Ambilustrium* (so called from the sacrificial victims being carried round the people assembled on the Campus Martius) was the purificatory ceremony which took place after the regular quinquennial census (*lustrum*) of the Roman people.

See C. F. Hermann, *Griechische Altertümer*, ii.; G. F. Schömann, *ib.* ii.; P. Stengel, *Die griechischen Kultusaltertümer* (1898); Marquardt, *Römische Staatsverwaltung*, iii. p. 200 (1885); P. E. von Lasaulx, *Die Sühnopfer der Griechen und Römer* (1841); J. Donaldson, "On the Expiatory and Substitutionary Sacrifices of the Greeks," in *Transactions of the Royal Society of Edinburgh*, xxvii., 1876; and the articles by A. Bouché-Leclercq in Daremberg and Saglio, *Dictionnaire des antiquités*, and by W. Warde Fowler in Smith's *Dictionary of Greek and Roman Antiquities* (3rd ed., 1891).

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[1] Maimacteria does not actually occur in ancient authorities as the name of a festival.

LUTE (Arabic *al'ūd*, "the wood"; Fr. *luth*; Ital. *liuto*; Span. *laud*; Ger. *Laute*; Dut. *luit*), an ancient stringed musical instrument, derived in form as well as name from the Arabs. The complete family consisted of the pandura, tanbur or mandoline as treble, the lute as alto or tenor, the barbiton or theorbo as bass, and the chitarrone as double bass. The Arab instrument, with convex sound-body, pointing to the resonance board or membrane having been originally placed upon a gourd, was strung with silk and played with a plectrum of shell or quill. It was adopted by the Arabs from Persia. Instruments with vaulted backs are all undoubtedly of Eastern origin; the distinct type, resembling the longitudinal section of a pear, is more specially traced in ancient India, Persia and the countries influenced by their civilization. This type of instrument includes many families which became known during the middle ages of western Europe, being introduced into southern Europe and Spain by the Moors, into southern Russia by the Persians of the Sassanian period, into Greece from the confines of the Byzantine Empire. As long as the strings were plucked by fingers or plectrum the large pear-shaped instrument may be identified as the archetype of the lute. When the bow, obtained from Persia, was applied to the instrument by the Arabs, a fresh family was formed, which was afterwards known in Europe as rebab and later rebec. The largest member of the ancient lute family—the bass lute or theorbo—has been identified with the barbiton.

Until recently the existence of these ancient stringed instruments was presumed on the evidence of the early medieval European instruments and of the meagre writings extant, such as those of Fārābī.[1] But a chain of plastic evidence can now be offered, beginning with the Greek post-Mycenaean age (*c.* 1000 B.C.). A statuette of a female musician playing upon a large lute with only an embryonic neck, on which nevertheless the left hand is stopping strings, was unearthed in Egypt in a tomb of the XXth Dynasty in the cemetery of Goshen by the members of the British School of Archaeology in Egypt,[2] under the direction of Professor Flinders Petrie, to whose courtesy we owe the photograph (fig. 1) here reproduced. It is difficult to form a conclusive opinion as to the number of strings the artist intended to represent, owing to the decorative figures following the direction of the strings, but, judging from the position of the right hand plucking a string, there may have been seven. Among a number of terra-cotta figures of musicians, brought to light during the excavations in a Tell at Suza and dating from the 8th century B.C.,[3] although there is no instrument that might be identified with the alto lute, the treble lute or tanbur is represented with a long, curved neck and a head bent back to increase the tension, and there is also an instrument having a smaller and more elongated body than the lute. On one of the friezes from Afghanistan presented to the British Museum by Major-General Cunningham, which formed the risers of steps leading to the tope at Jumal Garhi, dating from the 1st century A.D are represented scenes of music and dancing. Here the archetype of the lute appears several times; it had four strings, and the head was bent back at right angles to the neck. In the 6th century A.D. illustrations of this early lute are no longer rare, more especially on Persian silver-work of the Sassanian period[4] and in the paintings of the Buddhist cave-temples of Ajanta.[5] Several representations of the barbiton are extant from the classical Roman period.

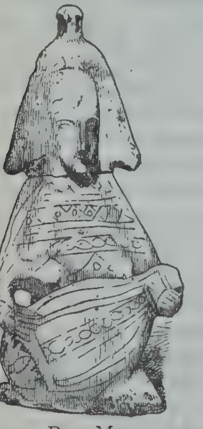
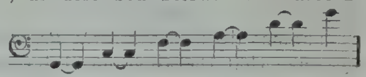
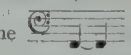


FIG. 1.—Post-Mycenaean terra-cotta figure, with ancient lute (1000 B.C.) from the cemetery at Goshen.

The modern Egyptian *'ūd* is the direct descendant of the Arabic lute, and, according to Lane, is strung with seven pairs of catgut strings played by a plectrum. A specimen in the Victoria and Albert Museum, given by the khedive, has four pairs only, which appears to have been the old stringing of the instrument. When frets (cross-lines dividing the neck or finger-board to show the fingering) are employed they are of catgut disposed according to the Arabic scale of seventeen intervals in the octave, consisting of twelve limmas, an interval rather less than our equal semitone, and five commas, which are very small but quite recognizable differences of pitch.

The lute family is separated from the guitars, also of Eastern origin, by the formation of the sound body, which is in all lutes pear-shaped, without the sides or ribs necessary to the structure of the flat-backed guitar and cither. Observing this distinction, we include with the lute the little Neapolitan mandoline of 2 ft. long and the large double-necked Roman chitarrone, not infrequently 6 ft. long. Mandolines are partly strung with wire, and are played with a plectrum, indispensable for metal or short strings. Perhaps the earliest lutes were so played, but the large lutes and theorbos strung with catgut have been invariably touched by the fingers only, the length permitting this more sympathetic means of producing the tone.

Praetorius,[6] writing when the lute was in universal favour, mentions seven varieties distinguished by size and tuning. The smallest would be larger than a mandoline, and the melody string, the "chanterelle," often a single string, lower in pitch. Praetorius calls this an octave lute, with the chanterelle C or D. The two discant lutes have respectively B and A, the alto G, the tenor E, the bass D, and the great octave bass G, an octave below the alto lute which may be taken as the model lute cultivated by the amateurs of the time. The bass lutes were theorbos, that is, double-necked lutes, as described below. The accordance of an alto lute was  founded upon that of the original eight-stringed European lute, to which the highest and lowest notes had, in course of time, been added. A later addition was the  also on the finger-board, and bass strings, double or single, known as diapasons, which, descending to the deep C of the violoncello, were not stopped with the fingers. The diapasons were tuned as the key of the piece of music required. Fig. 2 represents an Italian instrument made by one of the most celebrated lute makers, Venere of Padua, in 1600; it is 3 ft. 6 in. high, and has six pairs of unisons and eight single diapasons. The finger-board, divided into approximately equal half tones by the frets, as a rule eight in number, was often further divided on the higher notes, for ten, eleven, or, as in the woodcut, even twelve, semitones. The head, bearing the tuning pegs, was placed at an obtuse or a right angle to the neck, to increase the bearing of the strings upon the nut, and be convenient for sudden requirements of tuning during performance, the trouble of keeping a lute in tune being proverbial.

The lute was in general use during the 16th and 17th centuries. In the 18th it declined; still J. S. Bach wrote a "partita" for it. The latest date we have met with of an engraved publication for the lute is 1760.

The large double-necked lute, with two sets of tuning pegs, the lower for the finger-board, the higher for the diapason strings, was known as the theorbo; also, and especially in England, as the archlute; and, in a special form, the neck being then very long, as the chitarrone. Theorbo and chitarrone appear together at the close of the 16th century, and their introduction was synchronous with the rise of accompanied monody in music, that is, of the oratorio and the opera. Peri, Caccini and Monteverde used theorbos to

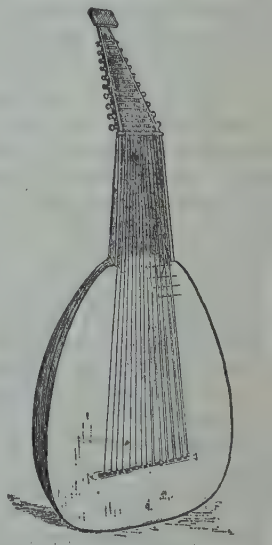


FIG. 2.—Lute, by Venere of Padua.

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[1] See Latin translation by J. G. L. Kosegarten, *Alii Ispahenensis Liber . . . Arabice editur adjectaque translatione adnotationibusque illustratus* (Greifswald, 1840).

[2] See *Hyksos and Israelite Cities*, by W. M. Flinders Petrie and J. Garrow Duncan, 1906 (double volume), Brit. Sch. of Arch.

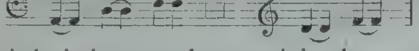
[3] J. de Morgan, *Délégation en Perse* (Paris, 1900), vol. i. pl. viii. Nos. 8, 7 and 9.

[4] See "The Treasures of the Oxus," catalogue of the Franks Bequest to the British Museum by Ormonde M. Dalton (London, 1905), pl. xxvi. No. 190; see also J. R. Aspelin, "Les antiquités du nord," No. 608; also for further references, Kathleen Schlesinger, "Precursors of the Violin Family," pt. ii. of *The Instruments of the Orchestra*, pp. 407-408, and appendix B, pp. 492-493; and *Gazette archéologique* (Paris, 1886), vol. xi. pl. x. and p. 70.

[5] By John Griffiths (London, 1896), vol. ii. pl. 105, cave I. 10, e.

[6] *Syntagm. Music.* pt. ii., "Organographie" (Wolfenbüttel, 1618), pp. 30 and 58-61.

accompany their newly-devised recitative, the invention of which in Florence, from the impulse of the Renaissance, is well known. The height of a theorbo varied from 3 ft. 6 in. to 5 ft., the Paduan being always the largest, excepting the Roman 6-ft. long chitarrone. These large lutes had very deep notes, and doubtless great liberties were allowed in tuning, but the strings on the finger-board followed the lute accordance already given, or another quoted by Baron (*Untersuchung des Instruments der Lauten*, Nuremberg, 1727) as the old theorbo or "violway" (see Mace, *Musick's Monument*, London, 1676):—



We find again both these accordances varied and transposed a tone higher, perhaps with thinner strings, or to accommodate local differences of pitch. Praetorius recommends the chanterelles of theorbos being tuned an octave lower on account of the great strain. By such a change, another authority, the Englishman Thomas Mace, says, the life and spruceness of airy lessons were quite lost. The theorbo or archlute had at last to give way to the violoncello and double bass, which are still used to accompany the "recitativo secco" in oratorios and operas. Handel wrote a part for a theorbo in *Esther* (1720); after that date it appears no more in orchestral scores, but remained in private use until nearly the end of the century.

The lute and the organ share the distinction of being the first instruments for which the oldest instrumental compositions we possess were written. For the lute, however, they were not written in our present notation, but in tablature, "lyrawise," a system by which as many lines were drawn horizontally as there were pairs of strings on the finger-board, the frets, distributed at intervals of a semitone, being distinguished by the letters of the alphabet, repeated from A, representing the open string, for each line. This was the English and French manner; the Italian was by numbers instead of letters. The signs of time were placed over the stave, and were not repeated unless the mensural values changed. (A. J. H.; K. S.)

LUTHARDT, CHRISTOPH ERNST (1823–1902), German Lutheran theologian, was born at Maroldsweisach, Bavaria, on the 22nd of March 1823. He studied theology at Erlangen and Berlin, and in 1856 became professor ordinarius of systematic theology and New Testament exegesis at Leipzig. In 1865 he was made a counsellor to the consistory, in 1871 canon of Meissen cathedral, and in 1887 a privy councillor to the church. He died at Leipzig on the 21st of September 1902. A strictly orthodox theologian, and a clear writer, though not a very profound scholar, Luthardt became widely appreciated as the author of apologetic lectures. These were collected under the title *Apologie des Christentums* (vol. i., 1864, 14th ed. 1896; vol. ii. 7th ed., 1901; vol. iii. 7th ed., 1898; vol. iv. 2nd ed., 1880), a work of which the first three volumes have been translated into English. In 1868 he founded and edited the *Allgemeine evang.-lutherische Kirchenzeitung*, with its supplement the *Theologisches Litteraturblatt*, and in 1880 became editor of the *Zeitschrift für kirchl. Wissenschaft und kirchl. Leben*.

His other works include *Das Johanneische Evangelium . . . erklärt* (1852–1853; 2nd ed. in 2 vols., 1875–1876), *Offenbarung Johannis erklärt* (1861), *Lehre von den letzten Dingen* (1861; 3rd ed. 1885); *Kompendium der Dogmatik* (1865; 9th ed., 1893), *Geschichte der christlichen Ethik* (2 vols., 1888–1893), *Gnade und Wahrheit* (1874), *Das Wort des Lebens* (1877) and *Gnade und Frieden* (1880). His autobiography was published with the title *Erinnerungen aus vergangenen Tagen* (1889; 2nd ed., 1891).

LUTHER, MARTIN (1483–1546), the great German religious reformer, was born at Eisleben on the 10th of November 1483. His father, Hans Luther (Lyder, Luder, Ludher), a peasant from the township of Möhra in Thuringia, after his marriage with Margarethe Ziegler, had settled in Mansfeld, attracted by the prospects of work in the mines there. The counts of Mansfeld, who, many years before, had started the mining industry, made a practice of building and letting out for hire small furnaces for smelting the ore. Hans Luther soon leased one, then three. In 1491 he became one of the four elected members of the village council (*vier Herren von der Gemeinde*); and we are told that the counts of Mansfeld held him in esteem. The boy grew up amid the poor, coarse surroundings of the German peasant life, imbibing its simple beliefs. He was taught that the Emperor protected the poor people against the Turk, that the Church was the "Pope's House," wherein the Bishop of Rome had all the rights of the house-father. He shared the common superstitions of the time and some of them never left him.

Young Martin went to the village school at Mansfeld; to a school at Magdeburg kept by the Brethren of the Common Lot; then to the well-known St George's school at Eisenach. At Magdeburg and Eisenach Luther was "a poor student," *i.e.* a boy who was received into a hospice where he lived rent-free, attended school without paying fees, and had the privilege of begging for his bread at the house-doors of the town; in return for which he sang as a chorister in the church to which the school was attached. Luther was never a "wandering student"; his parents were too careful of their child to permit him to lead the life of wandering licence which marked these pests of medieval German scholastic life. At Eisenach he attracted the notice of the wife of a wealthy merchant of Eisenach, whom his biographers usually identify as Frau Cotta.

After three happy years at Eisenach, Luther entered the university of Erfurt (1501), then the most famous in Germany. Hans Luther had been prospering, and was more than ever resolved to make his son a lawyer. Young Luther entered his name on the matriculation book in letters which can still be read "Martinus Ludher ex Mansfelt," a free student, no longer embarrassed by great poverty. In Luther's time Erfurt was the intellectual centre of Germany and its students were exposed to a variety of influences which could not fail to stimulate young men of mental ability.

Its theology was, of course, scholastic, but of what was then called the modern type, the Scotist; its philosophy was the nominalist system of William of Occam, whose great disciple, Gabriel Biel (d. 1495), had been one of its most famous professors; Nicholas de Lyra's (d. 1340) system of biblical interpretation had been long taught there by a succession of able teachers; Humanism had won an early entrance to the university; the anti-clerical teaching of John of Wessel, who had himself taught at Erfurt for fifteen years (1445–1460), had left its mark on the place and was not forgotten. Hussite propagandists, even in Luther's time, secretly visited the town and whispered among the students their anti-clerical Christian socialism. Papal legates to Germany seldom failed to visit the university and by their magnificence bore witness to the majesty of the Roman church.

A study of the scholastic philosophy was then the preliminary training for a course of law, and Luther worked so hard at the prescribed studies that he had little leisure, he said, for classical learning. He attended none of the Humanist lectures, but he read a good many of the Latin authors and also learned a little Greek. He never was a member of the Humanist circle; he was too much in earnest about religious questions and of too practical a turn of mind. The young Humanists would have gladly welcomed him into their select band. They dubbed him the "philosopher," the "musician," recalled in after days his fine social disposition, his skill in playing the lute, and his ready power in debate. He took the various degrees in an unusually brief time. He was bachelor in 1502 and master in 1505. His father, proud of his son's steady application and success, sent him the costly present of a *Corpus Juris*. He may have begun to study law. Suddenly he plunged into the Erfurt Convent of the Augustinian Eremites and after due noviciate became a monk.

The action was so unexpected that his contemporaries felt bound to give all manner of explanations which have been woven into accounts which are legendary. Nothing is known about the cause of the sudden plunge but what Luther has himself revealed. He has told us that he entered the monastery because he doubted of himself, and that his action was sudden because he knew that his father would have disapproved of his intention.

The word "doubt" has made historians think of intellectual difficulties—of the "theological scepticism" taught by Occam and Biel, of the disintegrating criticism of Humanism. But there is no trace of any theological difficulties in Luther's mind in the struggles which sent him into the convent and distracted him there. He was driven to do what he did by the pressure of a practical religious need, the desire to save his soul. The fires of hell and the shades of purgatory, which are the constant background of Dante's "Paradiso," were present to Luther from childhood.

Luther was the greatest religious genius which the 16th century produced, and the roots of the movement in which he was the central figure must be sought for in the popular religious life of the last decades of the 15th and opening decades of the 16th centuries—a field which has been neglected by almost all his biographers. When it is explored traces of at least five different types of religious sentiment can be discovered. Pious parents, whether among the burghers or peasants, seem to have taught their children a simple evangelical faith. Martin Luther and thousands of children like him were trained at home to know the creed, the ten commandments, the Lord's prayer, and such simple hymns as *Ein Kindelein so lobelich*, *Nun bitten wir den Heiligen Geist* and *Crist ist erstanden*; and they were taught to believe that God for Christ's sake freely pardons sin. They learned that simple faith which Luther afterwards expounded in his *Small Catechism* and called the *Kinderlehre*. When lads trained like himself entered school and college they came in contact with that religious revival which characterized the last half of the 15th century. Fear seemed to brood over the peoples of Western Europe. The plague devastated the badly drained towns, new diseases spread death, the fear of the Turks was permanent. All this went to feed revival, which, founded on fear, refused to see in Jesus Christ anything but a stern judge, and made the Virgin Mother and Anna the "grandmother" the intercessors; which found consolation in pilgrimages from shrine to shrine; which believed in crude miracles, and in the thought that God could be best served within convent walls. Luther's mind was caught in this current of feeling. He records how it was burnt into him by pictures which filled his boyish imagination. Jesus in the painted window of Mansfeld church, stern of face, sword in hand, sitting on a rainbow, coming to judge; an altarpiece at Magdeburg, in which a ship with its crew was sailing on to heaven, carrying no layman on board; the deeds of St Elizabeth emblazoned on the window of St George's parish church at Eisenach; the living pictures of a young nobleman who had turned monk to save his soul, of a monk, the holiest man Luther had ever known, who was aged far beyond his years by his maceration; and many others of the same kind.

Alongside this we can trace the growth of another religious movement of a different kind. We can see a sturdy common-sense religion taking possession of multitudes in Germany, which insisted that laymen might rule in many departments supposed to belong exclusively to the clergy. The *jus episcopale* which Luther afterwards claimed for the secular authorities had been practically exercised in Saxony and Brandenburg; cities and districts had framed police regulations which set aside ecclesiastical decrees about holidays and begging; the supervision of charity was passing from the hands of the church into those of laymen; and religious confraternities which did not take their guidance from the clergy were increasing. Lastly, the medieval Brethren were engaged in printing and distributing tracts, mystical, anti-clerical, sometimes socialist. All these influences abounded as Luther was growing to manhood and laid their marks upon him. It was the momentary power of the second which drove him into the convent, and he selected the monastic order which represented all that was best in the revival of the latter half of the 15th century—the Augustinian Eremites.

In the convent Luther set himself to find salvation. The last word of that Scotist theology which ruled at the close of the middle ages was that man must work out his own salvation, and Luther tried to do so in the most approved later medieval fashion by the strictest asceticism. He fasted and scourged himself; he practised all the ordinary forms of maceration and invented new ones, all to no purpose. His theological studies, part of the convent education, told him that pardon could be had through the Sacrament of Penance, and that the first part of the sacrament was sorrow for sin. The older theology declared that such sorrow must be based on love to God. Had he this love? God always appeared to him as an implacable judge, threatening punishment for breaking a law which it was impossible to keep. He confessed to himself that he often hated this arbitrary Will which Scotist theology called God. The later theology, taught in the convent by John of Palz and John Nathin, said that sorrow might be based on a meaner motive provided the Sacrament of Penance was continually resorted to. Luther wearied his superiors with his attendance at the confessional. He was looked upon as a young saint, and his reputation extended throughout the convents of his order. The young saint felt himself to be no nearer the pardon of God; he thought that he was "gallows-ripe." At last his superiors seemed to discover his real difficulties. Partly by their help, partly by study of the scriptures, he came to understand that God's pardon was to be won by trusting to His promises. Thus after two years of indescribable mental conflicts Luther found peace. The struggle marked him for life. His victory gave him a sense of freedom, and the feeling that life was given by God to be enjoyed. In all external things he remained unchanged. He was a faithful son of the medieval church, with its doctrines, ceremonies and usages.

Soon after he had attained inward peace, Luther was ordained. He continued his studies in theology, devoting himself to the more "experimental" portions of Augustine, Bernard and Gerson. He showed himself a good man of business and was advanced in his order. In 1508 he was sent with some other monks to Wittenberg to assist the small university which had been opened there in 1502 by Frederick the Wise, elector of Saxony. It was there that Luther began to preach, first in a small chapel to the monks of his order; later taking the place of one of the town's clergy who was in ill-health. From Wittenberg he was sent by the chiefs of the German Augustinian Eremites to Rome on a mission concerning the organization of the order. He went up with the feelings of the medieval pilgrim rather than with the intoxication of the ardent Humanist. On his return (1512) he was sent by Staupitz, his vicar-general, to Erfurt to take the necessary steps for higher graduation in theology, in order to succeed Staupitz himself as professor of theology in Wittenberg. He graduated as Doctor of the Holy Scripture, took the Wittenberg doctor's oath to defend the evangelical truth vigorously (*viriliter*), became a member of the Wittenberg Senate, and three weeks later succeeded Staupitz as professor of theology.

From the first Luther's lectures in theology differed from those ordinarily given at the time. He had no opinions on theological subjects at variance with the theology taught at Erfurt and elsewhere. No one attributed any heretical views to the young Wittenberg professor. He differed from others because he looked at theology in a more practical way. He thought it ought to be made useful to guide men to the grace of God and to tell them how to persevere in a life of joyous obedience to God and His commandments. His teaching was "experimental" from the beginning. Besides he believed that he had been specially set apart to lecture on the Holy Scriptures, and he began by commenting on the Psalms and on the Epistles of St Paul. He never knew much Hebrew and was not specially strong in Greek; so he used the Vulgate in his prelections. He had a huge widely printed volume on his desk, and wrote the notes for his lectures on the margins and between the lines. Some of the pages survive. They contain in the germ the leading thoughts of what became Lutheran theology. At first he expressed himself in the phrases common to scholastic theology, when these were found to be inadequate in words borrowed from the mystical writers of the 14th and 15th centuries, and then in new phrases more appropriate to the circle of fresh thoughts. Those new thoughts at first simply pushed aside the ordinary theology taught in the schools without staying to criticize it. Gradually, however, Luther began to find that there was some real opposition between what he was teaching and the theology he had been taught in the Erfurt convent. It appeared characteristically enough on the practical and not on the speculative side of theology in a sermon on *Indulgences* preached in July 1516.

Once begun the breach widened, until Luther could contrast "our theology" with what was taught at Erfurt, and by September he began to write against the scholastic theology, to declare that it was Pelagian at heart, that it repudiated the Augustinian doctrines of grace, and neglected to teach the supreme value of that faith "which throws itself upon God."

These lectures and the teaching they contained soon made a great impression. Students began to flock to the small obscure university of Wittenberg, and the elector grew proud of the teacher who was making his university famous. It was at this interesting stage of his own religious career that he felt himself compelled to stand forth in opposition to what he believed to be a great religious scandal, and almost unconsciously to become a Reformer.

Luther began his work as a Reformer by proposing to discuss the true meaning of Indulgences. The occasion was an Indulgence proclaimed by Pope Leo X., farmed by the archbishop of Mainz, and preached by John Tetzel, a Dominican monk and a famed seller of Indulgences. Many of the German princes had no great love for Indulgence sellers, and Frederick of Saxony had prohibited Tetzel from entering his territories. But it was easy to reach most parts of Electoral Saxony without actually crossing the frontiers. The Red Cross of the Indulgence seller had been set up at Zerbst and at Jüterbogk, and people had gone from Wittenberg to buy the *Papal Tickets*. Luther believed that the sales were injurious to the morals of the townsmen; he had heard reports of Tetzel's sermons; he had become wrathful on reading the letter of recommendation of the archbishop; and friends had urged him to interfere. He protested with a characteristic combination of caution and courage. The church of All Saints (the castle church) was closely connected with the university of Wittenberg. Its doors were commonly used for university proclamations. The Elector Frederick was a great collector of relics and had stored them in his church. He had procured an Indulgence for all who attended its services on All Saints' Day, and crowds commonly gathered. Luther nailed ninety-five *theses* on the church door on that day, the 1st of November 1517, when the crowd could see and read them.

The proceeding was strictly academic. The matter discussed, to judge by the writings of theologians, was somewhat obscure; and Luther offered his *theses* as an attempt to make it clearer. No one was supposed to be committed to every opinion he advanced in such a way. But the *theses* posted somehow touched heart and conscience in a way unusual in the common subjects of academic disputation. Every one wanted to read them. The University Press could not supply copies fast enough. They were translated into German, and were known throughout Germany in less than a fortnight. Within a month they had been heard of all over western and southern Europe. Luther himself was staggered at the way they were received. He said he had never meant to determine, but to debate.

The *theses* were singularly unlike what might have been expected from a professor of theology. They made no attempt at theological definition, no pretence at logical arrangement; they were anything but a brief programme of reformation. They were simply ninety-five sledge-hammer blows directed against the most flagrant ecclesiastical abuse of the age. They were addressed to the "common" man and appealed to his common sense of spiritual things.

The practice of offering, selling and buying Indulgences (see INDULGENCE) was everywhere common in the beginning of the 16th century. The beginnings go back more than a thousand years before the time of Luther. In the earliest church life, when Christians fell into sin, they were required to make public confession before the congregation, to declare their sorrow, and to vow to perform certain acts which were regarded as evidence of the sincerity of their repentance. When the custom of public confession before the congregation had changed to private confession to the clergy, it became the confessor's duty to impose these satisfactions. It was thought only right that there should be some uniformity in dealing with repentant sinners, and books appeared giving lists of sins and what were supposed to be suitable satisfactions. When the sins confessed were very heinous the satisfactions were correspondingly severe and sometimes lasted over many years. About the 7th century arose a custom of commuting or relaxing these imposed satisfactions. A penance of several years fasting might be commuted into saying so many prayers, or giving an arranged amount in alms, or even into a money-fine. In the last case the analogy of the Wergeld of the German tribal codes was commonly followed. The usage generally took the form that any one who visited a church, to which the Indulgence had been attached, on a day named, and gave a contribution to its funds, had his penance shortened by one-seventh, one-third or one-half, as might be arranged. This was the origin of Indulgences properly so-called. They were always mitigations of satisfactions or penances which had been imposed by the church as outward signs of inward sorrow, tests of fitness for pardon, and the needful precedents of absolution. Luther uttered no protest against Indulgences of this kind. He held that what the church had imposed the church could remit.

This old and simple conception of Indulgences had been greatly altered since the beginning of the 13th century. The institution of penance had been raised to the dignity of a sacrament, and this had changed both the place and the character of satisfactions. Under the older conception the order had been Sorrow (*Contritio*), Confession, Satisfaction (or due manifestation of sorrow in ways prescribed) and Absolution. Under the newer theory the order was Sorrow, Confession, Absolution, Satisfaction, and both satisfaction and sorrow took new meanings. It was held that Absolution removed guilt and freed from eternal punishment, but that something had to be done to free the penitent from temporal punishment whether in this life or in purgatory. Satisfactions took the new meaning of the temporal punishments due in this life and the substitute for the pains of purgatory. The new thought of a treasury of merits (*thesaurus meritorum*) introduced further changes. It was held that the good deeds over and above what were needed for their own salvation by the living or by the saints in heaven, together with the inexhaustible merits of Christ, were all deposited in a treasury out of which they could be taken by the pope and given by him to the faithful. They could be added to the satisfactions actually done by penitents. Thus Satisfactions became not merely signs of sorrow but actual merits, which freed men from the need to undergo the temporal pains here and in purgatory which their sins had rendered them liable to. By an Indulgence merits could be transferred from the storehouse to those who required them. The change made in the character of Sorrow made Indulgences all the more necessary for the indifferent penitent. On the older theory Sorrow (*Contritio*) had for its one basis love to God; but on the newer theory the starting-point might be a less worthy king of sorrow (*Attritio*) which it was held would be changed into the more worthy kind in the Sacrament of Penance. The conclusion was naturally drawn that a process of penitence which began with sorrow of the more unworthy kind needed a larger amount of Satisfactions or penance than what began with Contrition. Hence for the indifferent Christian, *Attrition*, *Confession* and *Indulgence* became the three heads in the scheme of the church of the later middle ages for his salvation. The one thing which satisfied his conscience was the burdensome thing he had to do, and that was to procure an Indulgence—a matter made increasingly easy for him as time went on.

This doctrine of *Attrition* had not the undivided support of the theologians of the later medieval church; but it was taught by the Scotists and was naturally a favourite theme with the sellers of Indulgences. Nor were all theologians at one upon the whole theory of Indulgences. The majority of the best theologians held that Indulgences had nothing to do with the pardoning of guilt, but only with freeing from temporal penalties in this life or in purgatory. But the common people did not discriminate, and believed that when they bought an Indulgence they were purchasing pardon from sin; and Luther placed himself in the position of the ordinary Christian uninstructed in the niceties of theological distinctions.

His *Ninety-five Theses* made six different assertions about Indulgences and their efficacy:—

i. An Indulgence is and can only be the remission of a merely ecclesiastical penalty; the church can remit what the church has imposed; it cannot remit what God has imposed.

ii. An Indulgence can never remit guilt; the pope himself cannot do such a thing; God has kept that in His own hand.

iii. It cannot remit the divine punishment for sin; that also is in the hands of God alone.

iv. It can have no efficacy for souls in Purgatory; penalties imposed by the church can only refer to the living; death dissolves them; what the pope can do for souls in Purgatory is by prayer, not by jurisdiction or the power of the keys.

v. The Christian who has true repentance has already received pardon from God altogether apart from an Indulgence, and does not need one; Christ demands this true repentance from every one.

vi. The Treasury of Merits has never been properly defined; it is hard to say what it is, and it is not properly understood by the people; it cannot be the merits of Christ and of His saints, because these act of themselves and quite apart from the intervention of the pope; it can mean nothing more than that the pope, having the power of the keys, can remit ecclesiastical penalties imposed by the church; the true Treasure-house of merits is the Holy Ghost of the grace and glory of God.

The unexpected effect of the *Theses* was that the sale of Indulgences began to decline rapidly, and the archbishop of Mainz, disappointed in his hopes of revenue, sent a copy to Rome. The pope thinking that the whole dispute was a monkish quarrel, contented himself with asking the general of the Augustinian Eremites to keep his monks quiet. This was not easy. Tetzel, in conjunction with a friend, Conrad Wimpina, had published a set of counter-theses. John Mayr of Eck, a noted controversialist and professor of theology in the university of Ingolstadt, scented the Hussite heresy in the *Theses*, and denounced them in a tract entitled *Obelisks*. Luther at once answered in his *Asterisks*. A controversy raged in Germany. Meanwhile, at Rome, Silvester Mazzolini of Prierio, a Dominican monk and Inquisitor, had been studying the *Theses*, was profoundly dissatisfied with them, and wrote a *Dialogue about the Power of the Pope, against the presumptuous conclusions of Martin Luther*. This book reached Germany about the middle of January 1518, and increased the tumult.

Luther's friends had been provokingly silent about the *Theses*; but in April 1518, at the annual chapter of the Augustinian Eremites held at Heidelberg, Luther heard his positions temperately discussed, and found somewhat to his astonishment that his views were not acceptable to all his fellow monks. On his return to Wittenberg he began an answer to his opponents. He carefully considered his positions, found them unassailable, and published his *Resolutions*, the most carefully written of all his works. The book practically discarded all the ideas and practices concerning Indulgences which had come into the medieval church since the beginning of the 13th century, and all the ingenious explanations of the scholastic theologians from Bonaventura and Thomas Aquinas downwards. The effect of the controversy was a great decrease in the sale of Indulgences in Germany, and the Papal Curia saw with alarm a prolific source of revenue decaying. It was felt that Luther must be silenced. He was accordingly summoned to Rome. To obey would have meant death; to refuse in his own name would have been contumacy. But the peremptory summons could be construed as an attack on the university of Wittenberg, and both the elector of Saxony and the emperor Maximilian so regarded it. The result was that Pope Leo cancelled the summons, and it was arranged that Luther should appear before the papal Legate to the German Diet, Thomas de Vio, Cardinal Cajedtan, at Augsburg. The interview was not very successful. At its conclusion Luther wrote two appeals—one from the pope ill-informed to the pope well-informed, and the other to a General Council. True to his habit of taking the German people into his confidence, he wrote an account of his interview with the Legate, and published it under the title of the *Acta Augustana*.

The publication greatly increased the sympathy of almost all classes in Germany for Luther. They saw in him a pious man, an esteemed professor, who had done nothing but propose a discussion on the notoriously intricate subject of Indulgences, peremptorily ordered to recant and to remain silent. The elector Frederick shared the common feelings and resolved to defend the man who had made his university so famous. His action compelled the Roman Curia to pause. Germany was on the eve, it was believed, of an election of a king of the Romans; it was possible that an imperial election was not far distant; Frederick was too important a personage to offend. So the condemnation by the Cardinal-Legate was withdrawn for the time, and the pope resolved to deal with the matter otherwise. He selected one of his chamberlains, Charles von Miltitz, the elector's private agent at Rome, and commissioned him to deal with the matter as he best could. Miltitz received the "golden rose" to give to Frederick, and was furnished with several letters in all of which the pope spoke of Luther as a "child of the devil." His holiness had probably forgotten the fact when he addressed Luther some months later as "his dear son."

When Miltitz arrived in Germany he discovered that the movement was much more important than the Roman Curia had imagined. He had not to deal with the opposition of a recalcitrant monk, but with the awakening of a nation. He resolved to meet with Tetzel and with Luther privately before he produced his credentials. Tetzel he could not see; the man was afraid to leave his convent; but he had lengthy interviews with Luther in the house of Spalatin the chaplain and private secretary of the elector Frederick. There he disowned the sermons of the pardon-sellers, let it be seen that he did not approve of the action of the Legate, and so prevailed with Luther that the latter promised to write a submissive letter to the pope, to exhort people to reverence the Roman See, to say that Indulgences were useful to remit canonical penances, and to promise to write no more on the matter unless he happened to be attacked. Luther did all this. A reconciliation might have taken place had the Roman Curia supported Miltitz. But the Curia did not support Miltitz, and placed more faith in Eck, who was eager to extinguish Luther in a public discussion.

Luther had been spending the time between his interview with the Legate at Augsburg (Oct. 1518) and the Leipzig Disputation (June 1519) in severe and disquieting studies. He had found that all his opponents had pursued one line of argument: the power to issue an Indulgence is simply one case of the universal papal jurisdiction; Indulgences are what the pope proclaims them to be, and to attack them is to attack the power of the pope; the pope represents the Roman church, which is actually the universal church, and to oppose the pope is to defy the whole church of Christ; whoever attacks such a long-established system as that of Indulgences is a heretic. Such was the argument. Luther felt himself confronted with the pope's absolute supremacy in all ecclesiastical matters. It was a plea whose full force he felt. The papal supremacy was one of his oldest inherited beliefs. He re-examined his convictions about justifying faith and whether they did lead to his declarations about Indulgences. He could come to no other conclusion. It then became necessary to examine the papal claims. He set himself to study the Decretals, and to his amazement and indignation he found that they were full of frauds. It is hard to say whether the discovery brought him more joy or more grief. His letters show him half-exultant and half-terrified While he was in this state of mind he received Eck's challenge to dispute with him at Leipzig on the papal supremacy.

This Leipzig Disputation was perhaps the most important point in Luther's career. He met Eck in June 1519. It soon appeared that the intention of that practised debater was to force Luther into some admission which would justify opponents in accusing him of holding the opinions of Huss, who had been condemned by the great German Council of Constance. In this he was eminently successful. Eck left Leipzig triumphant and Luther returned to Wittenberg much depressed. As usua he wrote out and published an account of the Disputation which was an appeal to his fellow Germans. The result surpassed his expectations. The Disputation made him see that his protest against the abuses of Indulgences was no criticism of an excrescence on the medieval ecclesiastical system, but an attack on its centre of existence. He saw that he stood for the spiritua priesthood of all believers and that medievalism in religion meant that man cannot approach God without a priestly mediator. The people also saw his position and rallied round him; and the Humanists discerned in him a champion against the old intolerance against which they had been revolting in vain. Luther's depression fled. Sermons, pamphlets, letters from his tireless pen flooded the land, and Luther began to be the leader of a German revolt against Rome.

The year 1520 saw the publication of his three most important works, all written at a time when he was fully convinced that he had broken for ever with Rome. They were, *On the Liberty of a Christian Man*, *An Address to the Nobility of the German Nation*, and *On the Babylonian Captivity of the Church of God*—the three primary treatises, as they have been called.

Meanwhile at Rome the pope had entrusted Eck and Prierias with the preparation of a bull (*Exurge Domine*) against Luther—a bull which followed the line of Eck's charges at Leipzig. The reformer had been expecting it ever since the Disputation at Leipzig, and had resolved to answer it by one striking act which would impress the imagination of every man. He posted up a notice inviting the Wittenberg students to witness the burning of the bull (10th of December 1520). Rome had shot its last ecclesiastical bolt. Nothing remained but an appeal to the secular power, and this was at once prepared.

The emperor Maximilian had died suddenly (12th January 1519), and for long Germany was disturbed with intrigues about the succession—the papal policy being specially tortuous. The widely expressed desire for a German emperor secured the unanimous election of Charles, the grandson of Maximilian and the king of Spain. Never were a people more mistaken and disappointed. The veins of Charles were full of German blood, but he was his mother's son. It was the Spaniard, not the German, who faced Luther at Worms.

Charles was crowned at Aachen, 23rd of October 1520, and opened his first German diet at Worms, 22nd of January 1521. The pope had selected two envoys to wait on the young emperor, one of them, Jerome Aleander, being specially appointed to secure the outlawry of Luther. The agenda of the diet contained many things seriously affecting all Germany, but the one problem which every one was thinking about was how Luther would be dealt with. The Electoral College was divided. The archbishop of Cologne, the elector of Brandenburg and his brother the archbishop of Mainz were for instant outlawry, while the elector of Saxony, who was resolved to protect Luther, had great influence with the archbishop of Trier and the Count Palatine of the Rhine.

Aleander had no difficulty in persuading Charles, while both were still in the Netherlands, to put Luther under the ban within his hereditary dominions, and the papal nuncio expected that the decree would be extended to the whole German empire. But Charles at first refused to deal summarily with Luther so far as Germany was concerned. The emperor even wrote to the elector of Saxony, asking him to bring Luther with him to the diet for examination. Gradually he came to think that Luther might be condemned without appearing. The members of the diet were slow to come to any conclusion. At last they made up their minds, and presented a memorial to the emperor (19th of February 1521) in which they reminded him that no imperial edict could be published against Luther without their sanction, and proposed that he should be invited to Worms under a safe-conduct and be there examined. They also suggested that Luther should be heard upon the papal claims, and ended by asking the emperor to deliver Germany from the papal tyranny. The emperor agreed to summon Luther under a safe-conduct, and that he should be heard; but he refused to mix his case with that of grievances against Rome. He had no sooner made the promise than he seems to have repented it. He saw no need for Luther's appearance. He tried to get him condemned unheard. An edict against Luther had been drafted (15th of February) which the diet refused to sanction. A few days later a second edict was drafted which ordered the burning of Luther's books. The diet again objected. Finally four days after the safe-conduct had been despatched the emperor revised this second edict, limited it to the seizure of Luther's books, and published it on his own authority without consulting the diet (10th March). After Luther had begun his journey, this edict was posted up along his route in order to intimidate him; other means were taken to make him turn aside from Worms; but he was resolved to go there and nothing daunted him. He reached the town (16th April) and was met by encouraging crowds. He was summoned to appear before the diet on the 17th and measures were taken to prevent him doing more than answering definite questions put to him. He was asked whether certain books had been written by him and whether he was prepared to maintain or to abjure what he had written. He asked time to prepare an answer to the second question. The diet was anxious to hear Luther, if the emperor was not, and his request was granted. He thus defeated the plot to keep him silent. On the 18th he made his second appearance and delivered the speech, which electrified his audience. At the close he was threatened by Spaniards in the diet. The Germans ringed him round, and, with their hands raised high in the fashion of a landsknecht who had struck a successful blow, passed out into the street and escorted him to his lodgings. Next day (April 19th) the emperor proposed to place Luther under the ban of the empire and read to the assembly a brief statement of his own views. The diet objected, and asked for a conference between Luther and some selected members. Conferences were held, but came to nothing. No compromise was possible between the declaration that man's conscience could only be bound by the Word of God and the emperor's belief in the infallibility of a general council. The commission had to report that its efforts had failed. Luther was ordered to leave Worms and to return to Wittenberg. His safe-conduct was to expire twenty-one days after the 16th of April. Then he was liable to be seized and put to death as a pestilent heretic. There only remained to draft and publish the edict containing the ban. Days passed and it did not appear. Suddenly the startling news reached Worms that Luther had disappeared, no one knew where. It was reported that his body had been found in a silver-mine pierced with a dagger. The news flew over Germany and beyond it that he had been slain by papal emissaries. At Worms the indignation of the populace was intense. The public buildings were placarded during the night with an intimation that four hundred knights had sworn not to leave Luther unavenged, and the ominous words *Bundschuh, Bundschuh, Bundschuh* (the watchword of peasant revolts) were written at the foot. The combination suggested an alliance between the lesser knights and the peasants, dreaded by all the ruling classes. The true story of Luther's disappearance was not known until long afterwards. After the failure of the conference the elector of Saxony had commissioned two of the councillors to convey Luther to a place of safety without telling him where it was. Many weeks elapsed before Frederick himself learned that Luther was safe in his own castle of the Wartburg. The disappearance did not mean that Luther had ceased to be a leader of men; but it marked the beginning of an organized national opposition to Rome.

It was not till the 25th of May that the edict against Luther was presented to a small number of members of the diet, after the elector of Saxony and many important members had left Worms. It threatened all Luther's sympathisers with extermination, and practically proclaimed an Albigensian war in Germany. But few public documents prepared with so much care have proved so futile. The latter half of 1521 saw the silent spread of Lutheran opinions all over Germany. This was not unaccompanied with dangers. Every movement for reform carries within it the seeds of revolution, and Luther's was no exception to the rule.

The revolution began in Wittenberg during Luther's seclusion in the Wartburg. Andrew Boden of Carlstadt, a colleague of Luther's in the university of Wittenberg, was strongly impressed with the contradiction which he believed to exist between evangelical teaching and the usages of medieval ecclesiastical life. He denounced monastic vows, a distinctive dress for the clergy, the thought of a propitiatory mass, and the presence of images and pictures in the churches. Zwilling, a young Augustinian Eremite, added his fiery denunciations. His preaching stirred the commonalty. Turbulent crowds invaded two of the churches and rioted inside. The excitement of the people was increased by the arrival of three men known in history as the *Zwickau prophets*. Melanchthon felt himself powerless to restrain the tumult. The magistrates of the town were won over and issued an ordinance which attempted to express in legislation the new evangelical ideas. Duke George of Saxony, a resolute opponent of the Reformation, threatened to make the diet interfere. Luther became alarmed, and, not without a private hint from the elector of Saxony,[1] left his retreat and appeared among his townsmen. His presence and exertions restored order, and the conservative reformation resumed its quiet course. From this time onwards to the outbreak of the Peasants' War (1525) Luther was the real leader of the German nation, and everything seemed to promise a gradual reformation without tumult.

The Peasants' War ended this anticipation. From one point of view this insurrection was simply the last, the most widespreading and the most disastrous of these revolts, which had been almost chronic in Germany during the later decades of the 15th and earlier years of the 16th century and which had been almost continuous between 1503 and 1517. All the social and economic causes which produced them were increasingly active in 1524 and 1525. But it is undoubted that the religious revolt intensified the rebellion of the lower classes. Luther's voice awoke echoes he never dreamt of. The times were ripe for revolution, and the message which spoke of a religious democracy could not fail to suggest the social democracy also. In his appeal to the *Nobility of the German Nation* he had stated with severe precision the causes of social discontent. Himself a peasant's son and acquainted with the grievances under which the peasant lived, he had at various times formulated most of the demands which afterwards figured conspicuously in the Twelve Articles. The insurgents had good cause to regard him as a sympathiser. But Luther, rightly or wrongly, believed that of the two ways in which wrongs can be set right—the way of war and the path of peace—the latter is the only sure road in the long run. He did his best therefore to prevent the rising and risked his life among the infuriated peasants as readily as when he stood before the emperor and the diet. When the rebellion was at its height and Thomas Münzer had sent forth fiery proclamations urging the peasantry "not to let the blood cool on their swords," Luther issued the pamphlet, which casts a stain on his whole life, in which he hounds on the ruling classes to suppress the insurgents with all violence. In the end the rebellion, formidable as it seemed for a few months, was crushed, and a heavier yoke was laid on the shoulders of the unfortunate peasants.

This year, 1525, saw the parting of the ways in the movement for reform. It ceased to be national and became ecclesiastical. It divided into three separate parts. One, guided by Luther himself, ended, after a long struggle with pope and emperor, in the establishment of evangelical churches under the rule of the secular authorities of the territories which adopted the Lutheran Reformation. Another, remaining true to the principles, doctrines, usages and hierarchy of the medieval church, dreamt only of a purification of moral life, and saw its end realised in the reforms of the council of Trent. The third, gathering together the more revolutionary impulses, expanded into that complex movement called Anabaptism — which spread over western Europe from England to Poland and from Scandinavia to northern Italy, and endured a long and sanguinary persecution at the hands of the civil authorities in most European countries. Its strength and popularity, especially among the artizan classes, have been very much underrated by most historians.

During the storm of the Peasants' War (13th of June 1525) Luther married Catherine von Bora, the daughter of a noble but impoverished family belonging to Meissen. She had been a Cistercian nun in the convent of Nimtzch near Grimma—a convent reserved for ladies of noble birth. Luther's writings, circulating through Saxony, had penetrated the convent walls and had convinced most of the inmates of the unlawfulness of monastic vows. Catherine and eight companions resolved to escape. Their relatives refused to aid them, and they applied to Luther. He entrusted the business to Leonhard Koppe of Torgau, and the rescue was safely carried out (4th of April 1523). The rescued nuns found places of refuge in the families of Wittenberg burghers. The elector John of Saxony (who had succeeded his brother Frederick) gave Luther the house which had served as the Augustinian Convent. The family gathered in this three-storeyed building, with its back windows looking over the Elbe and its front door opening on a great garden, was latterly Luther and his wife, their three sons and two daughters, Magdelena von Bora, Catherine's aunt, two orphan nieces and a grandniece. At the beginning of his married life Luther must have been in straitened circumstances. He married a portionless nun. On to 1532 his salary was two hundred gulden annually (about £160 in present money); after 1532 the stipend was increased to £240 with various payments in kind—corn, wood, malt, wine, &c.—which meant a great deal more. The town added occasional gifts to enable Luther to entertain the great personages who came to consult him frequently. Princes made him presents in money. This enabled Luther to purchase from his wife's brother the small estate of Zulsdorf. Catherine, too, was an excellent house-wife. She made the long-neglected garden profitable; kept pigs and poultry; rented other gardens; stocked a fishpond; farmed in a small way; and had her house full of boarders. Luther had a high opinion of her intelligence; she took rank among those consulted on all important occasions; in one letter to her, seldom quoted, he gives the fairest statement he ever made about the views of Zwingli on the Sacrament of the Supper.

The diet of Speyer (1526) saw Germany divided into a Protestant and a Romanist party. After much debate a compromise was arrived at, which foreshadowed the religious peace of Augsburg of 1555. It was resolved that the Word of God should be preached without disturbance, that indemnity should be given for past offences against the edict of Worms, and that meanwhile each state should live religiously as it hoped to answer for its conduct to God and the emperor. The Lutherans interpreted this to mean the right to frame ecclesiastical regulations for various principalities and to make changes in public worship. Luther busied himself in simplifying the service, in giving advice, anxiously sought for, about the best modes of organising ecclesiastical affairs. In the diet held at Speyer in 1529 a compact Roman Catholic majority faced a weak Lutheran minority. The emperor declared through his commissioners that he abolished "by his imperial and absolute authority" the clause in the ordinance of 1526 on which the Lutherans had relied when they began to organize their territorial churches. The majority of the diet supported the emperor in this, and further proceeded to decree that no ecclesiastical body was to be deprived of its revenues or authority. This meant that throughout all Germany medieval ecclesiastical rule was to be upheld, and that none of the revenues of the medieval church could be appropriated for Protestant uses. On this a portion of the Protestant minority drafted a legal protest, in which the signers declared that they meant to abide by the decision of the diet of 1526 and refused to be bound by that of 1529. From this protest came the name *Protestant.*

A minority in such a case could only maintain their protest if they were prepared to defend each other by force in case of an attack. Three days after the protest had been read, many of the protesting cities and states concluded "a secret and particular treaty," and Philip of Hesse, the ablest statesman among the Protesters, saw the need for a general union of all evangelical Christians in the empire. The difficulties in the way were great. The Saxons and the Swiss, Luther and Zwingli, were in fierce controversy about the true doctrine of the sacrament of the Supper. Luther was a patriotic German who was for ever bewailing the disintegration of the Fatherland; Zwingli was full of plans for confederations of Swiss cantons with South German cities, which could not fail to weaken the empire. Luther had but little trust in the "common man"; Zwingli was a thorough democrat. When Luther thought of the Swiss reformer he muttered as Archbishop Parker did of John Knox—"God keep us from such visitations as Knox hath attempted in Scotland; the people to be orderers of things." Above all Luther had good grounds for believing that at the conference at Memmingen friends of Zwingli had helped to organize a Peasants' War and to link the social revolution to the religious awakening. All these suspicions were in Luther's mind when he consented very half-heartedly to meet Zwingli at a conference to be held in Philip of Hesse's castle at Marburg. The debate proceeded as such debates usually do. Zwingli attacked the weakest part of Luther's theory—the *ubiquity* of the body of Christ; and Luther attacked Zwingli's exegesis of the words of the institution. Neither sought to bring out their points of agreement. Yet the conference did good; it showed that the Protestants were agreed on all doctrinal points but one. If union was for the present impossible, there were hopes for it in the future.

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[1] Enders, *Dr Martin Luther's Briefwechsel*, iii. 292-295; von Bezold, *Zeitschrift für Kirchengeschichte* xx. 186 sqq.; Barge, *Andreas Bodenstein von Karlstadt*, i. 432 sqq.

In 1530 the emperor Charles, resolved to crush the Reformation, himself presided at the diet. The Protestant divisions were manifest. Three separate confessions were presented to the emperor—one from Zwingli, one by the theologians of the four cities of Strassbourg, Constance, Lindau and Memmingen (*Confessio Tetrapolitana*), and the *Augsburg Confession*, the future symbol of the Lutheran church. The third was the most important, and the emperor seriously set himself to see whether it might not be made the basis of a compromise. He found that reconciliation was hopeless. Thereupon the diet resolved that the edict of Worms was to be enforced against Luther and his partizans; that the ecclesiastical jurisdictions were to be preserved; and that all the church property taken possession of by the Lutheran princes was to be restored; and that in all cases of dispute the last court of appeal was to be the Imperial Court of Appeals. The last provision meant that the growing Protestantism was to be fought by harrassing litigation—*nicht fechten sondern rechten* was the phrase.

Luther was not present at the diet nor at the negotiations. He was still an outlaw according to imperial ideas. Melanchthon took his place as leader.

The decision of the diet compelled the Protestant princes to face the new and alarming situation. They met in conference in mid-winter at the little town of Schmalkald, and laid the foundations of what became the powerful Schmalkald League, which effectually protected the Protestants of Germany until it was broken up by the intrigues of the imperial party. From the time of the formation of this league, Luther retired gradually from the forefront of a reformation movement which had become largely political, and busied himself with reforms in public worship and suggestions for an organization of the polity of the Evangelical church. In this work his natural conservatism is apparent, and he contented himself with such changes as would make room for the action of evangelical principles. He disclaimed the right of suggesting a common order of worship or a uniform ecclesiastical polity; and Lutheran ritual and polity, while presenting common features, did not follow one common use. It may be said generally that while Luther insisted on a service in the vernacular, including the singing of German hymns, he considered it best to retain most of the ceremonies, the vestments and the uses of lights on the altar, which had existed in the unreformed church, while he was careful to explain that their retention might be dispensed with if thought necessary. To the popular mind the great distinction between the Lutheran and the medieval church service, besides the use of the vernacular and the supreme place assigned to preaching, was that the people partook of the cup in the sacrament of the Lord's Supper; and the Lutheran service became popularly distinguished from the Reformed because it retained, while the Reformed did away with, most of the medieval ceremonies and vestments (see LUTHERANS). The variations in the details of the polity of the Lutheran churches were very numerous, but they all preserved the same distinctive principles. Two conceptions lay at the basis—the thought of the spiritual priesthood of all believers and the belief that the state was a divine ordinance, that the magistracy might represent the whole body of believers and that discipline and administration might be exercised through courts constituted somewhat like the consistorial courts of the medieval bishops, their members being appointed by the magistracy.

The last years of Luther's life were spent in incessant labour disturbed by almost continuous ill-health. He was occupied in trying to unite firmly together the whole evangelical movement; he laboured to give his countrymen a good system of schools; he was on the watch to defeat any attempt of the Roman Curia to regain its hold over Germany; and he was the confidential adviser of a large number of the evangelical princes. Luther's intimacy with his own elector, first John, then John Frederick, helped to give him the place accorded to him by the princes. The chiefs of the Houses of Anhalt and Lüneburg, Duke Henry of Saxony, Joachim II. of Brandenburg, Albert of Brandenburg and the counts of Mansfeld, were among Luther's most devoted supporters and most frequently sought his advice. Princely correspondence was not always pleasant. It took its most disagreeable form when Philip of Hesse besieged Luther with requests to give his sanction to taking a second wife while his first was still alive. Luther's weakness brought the second great blot on his career. The document sanctioning the bigamy of the landgrave was signed by Martin Bucer, Luther and Melanchthon, and is a humiliating paper. It may be thus summarized. According to the original commandment of God, marriage is between one man and one woman, and this original precept has been confirmed by our Lord; but sin brought it about that first Lamech, then the heathen, and then Abraham, took more than one wife, and this was permitted under the law. We are now living under the Gospel, which does not give prescribed rules for the external life and has not expressly prohibited bigamy. The law of the land expresses the original commandment of God, and the plain duty of the pastorate is to denounce bigamy. Nevertheless, the pastorate, in single cases of the direst need and to prevent worse, may sanction bigamy in a purely exceptional way. Such a bigamous marriage is a true marriage in the sight of God (the necessity being proved), but it is not a true marriage in the eye of public law and custom. Such a marriage and the dispensation for it ought to be kept secret; if it is made known, the dispensation becomes *eo ipso* invalid and the marriage is mere concubinage. The principle which underlies this extraordinary paper is probably the conception that the Protestant church has the same dispensing power which the medieval church claimed, but that it was to be exercised altogether apart from fees of any kind.

In his later years Luther became more tolerant on the sacramental question which divided him from the South German cities, although he never departed from his strong opposition to the supposed views of Zwingli himself. He consented to a conference, which, as he was too ill to leave home, met at Wittenberg (May–June 1536). After prolonged discussion the differences were narrowed to one point—the presence of the body of Christ *extended in space* in the sacrament of the Supper. It was agreed in the *Wittenberg Concord* to leave this an open question. Thus North and South Germany were united. It is possible that had Luther lived longer his followers might have been united with the Swiss. He repeatedly expressed an admiration for Calvin's writings on the subject of the sacrament; and Melanchthon believed that if the Swiss accepted Calvin's theory of the Supper, the Wittenberg Concord could be extended to include them. But the *Consensus Tigurinus*, which dates the adhesion of the Swiss to the views of Calvin, was not signed until 1549, when Luther was already dead.

Year by year Luther had been growing weaker, his attacks of illness more frequent and his bodily pains more continuous.

Despite the entreaties of wife and elector he resolved to do what he could to end some trifling dispute about inheritance which threatened the peace of the House of Mansfeld. He left Wittenberg in bitterly cold weather on the 23rd of January 1546, and the journey was tedious and hazardous. He was accepted as arbiter and his decision brought an end to the strife. He preached in Eisleben (February 14) with all his old fervour; but suddenly said quietly: " This and much more is to be said about the Gospel; but I am too weak and we will close here." These were his last words in the pulpit. On the 16th and 17th the deeds of reconciliation were signed and Luther's work was done. The end came swiftly. He was very ill on the evening of the 17th; he died on the early morning of the 18th of February 1546 in his sixty-third year.

The elector of Saxony and Luther's family resolved that he must be buried at Wittenberg, and on the 20th the funeral procession began its long march. The counts of Mansfeld, the magistrates of the city and all the burghers of Eisleben accompanied the coffin to the gates of their town. A company of fifty light-armed troops commanded by the young counts of Mansfeld headed the procession and went with it all the way to Wittenberg. The following was temporarily swelled as it passed through villages and towns. Delegates from the elector of Saxony met it as it crossed the boundaries of the principality. Luther was laid to rest in the Castle church on whose door he had nailed the *theses* which had kindled the great conflagration.

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(T. M. L.)

LUTHERANS, the general title given to those Christians who have adopted the principles of Martin Luther in his opposition to the Roman Church, to the followers of Calvin, and to the sectaries of the times of the Reformation. Their distinctive name is the *Evangelical*, as opposed to the *Reformed* church. Their dogmatic symbols are usually said to include nine separate creeds which together form the *Book of Concord* (*Liber Concordiae*). Three belong to the Early Christian church—the *Apostles' Creed*, the *Nicene Creed* (in its Western form, *i.e.* with the *filioque*), and the so-called *Athanasian Creed*; six come from the 16th century—the *Augsburg Confession*, the *Apology for the Augsburg Confession*, the *Schmalkald Articles*, Luther's two *Catechisms*, and the *Form of Concord*. But only the three early creeds and the Augsburg Confession are recognized by all Lutherans. Luther's Catechisms, especially the shorter of the two, have been almost universally accepted, but the Form of Concord was and is expressly rejected by many Lutheran churches. The Augsburg Confession and Luther's Short Catechism may therefore be said to contain the distinctive principles which all Lutherans are bound to maintain, but, as the principal controversies of the Lutheran church all arose after the publication of the Augsburg Confession and among those who had accepted it, it does not contain all that is distinctively Lutheran. Its universal acceptance is perhaps due to the fact that it exists in two forms (the *variata* and the *invariata*) which vary slightly in the way in which they state the doctrine of the sacrament of the Supper. The *variata* edition was signed by Calvin, in the meaning, he said, of its author Melanchthon.

After Luther's death the more rigid Lutherans declared it to be their duty to preserve the *status religionis in Germania per Lutherum instauratus*, and to watch over the *depositum Jesu Christi* which he had committed to their charge. As Luther was a much greater preacher than a systematic thinker, it was not easy to say exactly what this deposit was, and controversies resulted among the Lutheran theologians of the 16th century. The Antinomian controversy was the earliest (1537–1560). It arose from differences about the precise meaning of the word " law " in Luther's distinction between law and gospel. Luther limited the meaning of the word to mean a definite command accompanied by threats, which counts on terror to produce obedience. He declared that Christ was not under the dominion of the law in this sense of the word, and that believers enter the Christian life only when they transcend a rule of life which counts on selfish motives for obedience. But law may mean ethical rule, and the Antinomians so understood it, and interpreted Luther's declaration to mean that believers are not under the dominion of the moral law. The controversy disturbed the Lutheran church for more than twenty years.

The Arminian controversy in the Reformed church, the Jansenist controversy in the Roman Catholic church, had their parallel in three separate disputes among the Lutherans lasting from 1550 to 1580. (1) George Major, discussing the relation of good works to conversion, declared that such works were both useful and necessary to holiness. He was attacked by Flacius and Amsdorf, and after a long controversy, full of ambiguities and lacking in the exhibition of guiding principles, he was condemned because his statement savoured of Pelagianism. (2) The same problem took a new form in the Synergist controversy, which discussed the first impulse in conversion. One party taught that while the first impulse must come from the Holy Spirit the work might be compared to reviving a man *apparently* dead. It was answered that the sinner was *really* dead, and that the work of the Spirit was to give an actually new life. The latter assertion was generally approved of. (3) Then a fresh controversy was started by the assertion that sin was part of the substance of man in his fallen condition. It was answered that sin had not totally destroyed man's ethical nature, and that grace changed what was morally insensitive into what was morally sensitive, so that there could be a co-operation between God's grace and man's will.

The controversy raised by Andrew Osiander was more important. He felt that Luther had omitted to make adequate answer to an important practical question, how Christ's death on the cross could be brought into such actual connexion with every individual believer as to be the ground of his actual justification. The medieval church had spanned the centuries by supposing that Christ's death was continuous down through the age in the sacrifice of the Mass; Protestant theology had nothing equivalent. He proposed to supply the lack by the theory that justification is a real work done in the individual by the same Christ who died so many centuries ago. Redemption, he said, was the result of the historical work of Christ; but justification was the work of the living risen Christ, dwelling within the believer and daily influencing him. Osiander's theory did not win much support, but it was the starting-point of two separate doctrines. In the Lutheran church, Striegel taught that the principal effect of Christ's work on the cross was to change the attitude of God towards the whole human race, and that, in consequence, when men come into being and have faith, they can take advantage of the change of attitude effected by the past historical work of Christ. The Reformed church, on the other hand, constructed their special doctrine of the limited reference in the atonement.

The other controversies concerned mainly the doctrine of the sacrament of the Supper, and Luther's theory of Consubstantiation. This required a doctrine of *Ubiquity*, or the omnipresence of the body of Christ extended in space, and therefore of its presence in the communion elements. Calvin had taught that the true way to regard substance was to think of its power (*vis*), and that the presence of a substance was the immediate application of its power. The presence of the body of Christ in the sacramental elements did not need a presence extended in space. Melanchthon and many Lutherans accepted the theory of Calvin, and alleged that Luther before his death had approved of it. Whereupon the more rigid Lutherans accused their brethren of Crypto-Calvinism, and began controversies which dealt with that charge and with a defence of the idea of ubiquity.

The university of Jena, led by Matthias Flacius, was the headquarters of the stricter Lutherans, while Wittenberg and Leipzig were the centres of the Philippists or followers of Melanchthon. Conferences only increased the differences. The Lutheran church seemed in danger of falling to pieces. This alarmed both parties. New conferences were held and various articles of agreement were proposed, the most notable being the *Torgau Book* (1576). In the end, the greater proportion adopted the *Book of Concord* (1577), drafted chiefly by Jacob Andreae of Tübingen, Martin Chemnitz of Brunswick and Nicolas Selnecker of Leipzig. Its recognition was mainly due to the efforts of Augustus, elector of Saxony. This *Book of Concord* was accepted by the Lutheran churches of Sweden and of Hungary in 1593 and 1597; but it was rejected by the Lutheran churches of Denmark, of Hesse, of Anhalt, of Pomerania and of several of the imperial cities. It was at first adopted and then rejected by Brunswick, the Palatinate and Brandenburg. The churches within Germany which refused the *Book of Concord* became for the most part Calvinistic or Reformed. They published, as was the fashion among the Reformed churches, separate creeds for themselves, but almost all accepted the *Heidelberg Catechism.* These differences in the German Protestant churches of the second half of the 16th century are reflected in the great American Lutheran church. The church exists in three separate organizations. The General Synod of the Evangelical Church of the United States, organized in 1820, has no other creed than the *Augsburg Confession*, so liberally interpreted as not to exclude Calvinists. The Synodical Conference of North America, organized in 1872, compels its pastors to subscribe to the whole of the nine creeds contained in the Book of Concord. The General Council, a secession from the General Synod, was organized in 1867, and accepts the "unaltered" (*invariata*) *Augsburg Confession* in its original sense, and the other Lutheran symbols as explanatory of the Augsburg Confession.

The divided state of German Protestantism, resulting from these theological differences, contributed in no small degree to the disasters of the Thirty Years' War, and various attempts were made to unite the two confessions. Conferences were held at Leipzig (1631), Thorn (1645), Cassel (1661); but without success. At length the union of the two churches was effected by the force of the civil authorities in Prussia (1817), in Nassau (1817), in Hesse (1823), in Anhalt-Dessau (1827) and elsewhere. These unions for the most part aimed, not at incorporating the two churches in doctrine and in worship, but at bringing churches or congregations professing different confessions under one government and discipline. They permitted each congregation to use at pleasure the *Augsburg Confession* or the *Heidelberg Catechism.* The enforced union in Prussia was combined with the publication of a new liturgy intended for common use. This led to secessions from the state church. These seceders were at first treated with great harshness, but have won their way to toleration, and form the Lutheran Free churches of Germany.

The most important of these latter is the Evangelical Lutheran church of Prussia, sometimes called the Old Lutherans. It came into being in 1817 and gradually gained the position of a tolerated nonconformist church (1845 being the date of its complete recognition by the state). At the 1905 census it numbered 51,600 members under 75 pastors. Its affairs are managed by an *Oberkirchencollegium*, with four ordained and two lay members. The Evangelical Lutheran Immanuel Synod came into being in 1864, and has a membership of 5300 with 13 ordained pastors. Its headquarters is Liegnitz. The Independent Evangelical Lutheran church in the lands of Hesse arose partly on account of the slumbering opposition to the union of 1823 and more particularly in consequence of an attempt made at a stricter union in 1874. It has a membership of about 1800. The *renitente* church of Lower Hesse has a membership of 2400. The Evangelical Lutheran Free Church of Hanover has a membership of 3050 under 10 ordained pastors. The Hermannsburg Free Church has a membership of about 2000 under 2 pastors. The Evangelical Lutheran Community in Baden has a membership of about 1100 with 2 ordained pastors. The Evangelical Lutheran Free Church of Saxony has a membership of about 3780 with 15 ordained pastors. These free churches exist separate from the State Evangelical United Church (*Evangelische unirte Landskirche*).

The general system of ecclesiastical government which prevails among all Lutheran churches is called the *consistorial.* It admits of great variety of detail under certain common features of organization. It arose partly from the makeshift policy of the times of the Reformation, and partly from Luther's strong belief that the *jus episcopale* belonged in the last resort to the civil authorities. It may be most generally described by saying that the idea was taken from the consistorial courts through which the medieval bishops managed the affairs of their dioceses. Instead of the appointments to the membership of the consistories being made by the bishops, they were made by the supreme civil authority, whatever that might be. Richter, in his *Evangelische Kirchenordnungen des 16ten Jahrhunderts* (2 vols., 1846), has collected more than one hundred and eight separate ecclesiastical constitutions, and his collection is confessedly imperfect. The publication of a complete collection by Emil Sehling was begun in 1902.

The liturgies of the Lutheran churches exhibit the same diversities in details as appear in their constitutions. It may be said in general that while Luther insisted that public worship ought to be conducted in a language understood by the people, and that all ideas and actions which were superstitious and obscured the primary truth of the priesthood of all believers should be expurged, he wished to retain as much as possible of the public service of the medieval church. The external features of the medieval churches were retained; but the minor altars, the *tabernacula* to contain the Host, and the light permanently burning before the altar, were done away with. The ecclesiastical year with its fasts and festivals was retained in large measure. In 1526 Luther published the *German Mass and order of Divine Service,* which, without being slavishly copied, served as a model for Lutheran communities. It retained the altar, vestments and lights, but explained that they were not essential and might be dispensed with. The peril attending the misuse of pictures in churches was recognized, but it was believed to be more than counterbalanced by the instruction given through them when their presence was not abused. In short Luther contented himself with setting forth general principles of divine service, leaving them to be applied as his followers thought best. The consequence was that there is no uniform Lutheran liturgy. In his celebrated *Codex Liturgicus Ecclesiae Lutheranae in epitomen redactus* (Leipzig, 1848), Daniel has used 98 different liturgies and given specimens to show the differences which they exhibit.

The divergences in ritual and organization, the principle underlying all the various ecclesiastical unions, viz. to combine two different confessions under one common government, and, resulting from it, the possibility of changing from one confession to another, have all combined to free the state churches from any rigid interpretation of their theological formulas. A liberal and a conservative theology (rationalist and orthodox) exist side by side within the churches, and while the latter clings to the theology of the 16th century, the former ventures to raise doubts about the truth of such a common and simple standard as the Apostles' Creed. The extreme divergence in doctrinal position is fostered by the fact that the theology taught in the universities is in a great measure divorced from the practical religious life of the people, and the theological opinions uttered in the theological literature of the country cannot be held to express the thoughts of the members of the churches. In each state the sovereign is still held to be the *summus episcopus.* He appoints a minister of public worship, and through him nominates the members of the governing body, the *Oberkirchenrath* or *Consistorium* or *Directorium.* This council deals with the property, patronage and all other ecclesiastical matters. But each parish elects its own council for parochial affairs, which has a legal status and deals with such matters as the ecclesiastical assessments. Delegates from these parish councils form the *Landessynode.* In cases that call for consultation together, the *Consistorium* and the Synod appoint committees to confer. In Alsace-Lorraine about half of those entitled to vote appear at the polls; but in other districts of Germany very little interest is shown in the elections to the parish councils.

The income of the state churches is derived from four sources. The state makes an annual provision for the stipends of the clergy, for the maintenance of fabrics and for other ecclesiastical needs. The endowments for church purposes, of which there are many, and which are destined to the support of foreign missions, clerical pensions, supply of books to the clergy, &c. are administered by the supreme council. The voluntary contributions of the people are all absorbed in the common income of the national churches and are administered by the supreme council. Each parish is legally entitled to levy ecclesiastical assessments for defined purposes.

Appointments to benefices are in the hands of the state (sometimes with consent of parishes), of private patrons and of local parish councils. The number of these benefices is always increasing; and in 1897 they amounted to 16,400, or 300 more than in 1890. The state appoints to 56%, private and municipal patrons to 34%, and congregations to 10% of the whole. Customs vary in different states; thus in Schleswig-Holstein the state nominates but the parish elects; in Alsace-Lorraine the directorium or supreme consistory appoints, but the appointment must be confirmed by the viceroy; in Baden the state offers the parish a selection from six names and then appoints the one chosen.

The Lutheran state churches of Denmark, Sweden and Norway have retained the episcopate. In all of them the king is recognized to be the *summus episcopus* or supreme authority in all ecclesiastical matters, but in Norway and Sweden his power is somewhat limited by that of parliament. The king exercises his ecclesiastical authority through a minister who superintends religion and education. The position and functions of the bishops vary in the different countries. In all the rite of ordination is in their hands. In Denmark they are the inspectors of the clergy and of the schools. In Sweden they preside over local consistories composed of clerical and lay members. The episcopate in all three countries accommodates itself to something like the Lutheran consistorial system of ecclesiastical government.

The two leading religions within Germany are the Evangelical (Lutheran) and the Roman Catholic, including respectively 58 and 39% of the population. The proportions are continually varying, owing to the new migratory habits of almost every class of the population. Generally speaking, the Roman Catholics are on the increase in Prussia, Bavaria, Saxony and Württemburg; and the Evangelicals in the other districts of Germany, especially in the large cities. There is a growing tendency to mixed marriages, which are an important factor in religious changes.

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LUTHER LEAGUE, a religious association for young people in the United States of America. It began with a local society founded by delegates of six Lutheran church societies in New York City in 1888. The first national convention was held at Pittsburg, Pennsylvania, on the 30th and 31st of October 1895. The basis of the league is the Augsburg Confession. Its membership is open to "any society of whatever name connected with a Lutheran congregation or a Lutheran institution of learning." According to the constitution its objects are "to encourage the formation of the young people's societies in all Lutheran congregations in America, to urge their affiliation with their respective state or territorial leagues, and with this league to stimulate the various young people's societies to greater Christian activity and to foster the spirit of loyalty to the church." The league publishes a monthly paper, *The Luther League Review*, in Washington. According to its official report it had 70,000 members in 1906, which had increased to more than 100,000 in 1910.

LUTON, a market town and municipal borough in the southern or Luton parliamentary division of Bedfordshire, England, 30 m. N.W. by N. of London by the Midland railway, served also by a branch of the Great Northern. Pop. (1901) 36,404. It lies in a narrow valley on the south flank of the Chiltern Hills, on the upper part of the river Lea. The church of St Mary is mainly Decorated, but has portions of Early English and Perpendicular work. It has brasses and monuments of interest and a late Decorated baptistery of stone, an ornate roofed structure, octagonal in form. The font within it is Early English. Luton is the principal seat in England of the straw-plait manufacture, and large quantities of hats and other straw goods have been exported, though in recent years the industry has suffered from increased foreign competition. The industry originated with the colony of straw-plaiters transplanted by James I. from Scotland, whither they had been brought from Lorraine by Queen Mary. The town has also foundries, motor car works and other manufactures. The borough is under a mayor, 6 aldermen and 18 councillors. Area, 3133 acres.

LUTSK (Polish, *Luck*), a town of southern Russia, in the government of Volhynia, on the Styr, 51 m. by rail N.W. of Kovel. Pop. (1900) 17,701. It is supposed to have been founded in the 7th century; in the 11th century it was known as Luchesk, and was the chief town of an independent principality. In the 15th century it was the seat of a bishop and became wealthy, but during the wars between Russia and Poland in the second half of the 16th century, and especially after the extermination of its 40,000 inhabitants, it lost its importance. In 1791 it was taken by Russia. Its inhabitants, many of them Jews, live mainly by shipping goods on the Styr. Among its buildings is a 16th-century castle. Lutsk is the seat of a Roman Catholic bishop.

LUTTERWORTH, a market town in the Harborough parliamentary division of Leicestershire, England; 90 m. N.N.W. from London by the Great Central railway. Pop. (1901) 1734. It lies in a pleasant undulating country on the small river Swift, an affluent of the Avon. The church of St Mary is a fine building, mainly Decorated and Perpendicular, wherein are preserved relics of John Wycliffe, who was rector here from 1374 until his death in 1384. The exhumation and burning of his body in 1428, when the ashes were cast into the Swift, gave rise to the saying that their distribution by the river to the ocean resembled that of Wycliffe's doctrines over the world. Wycliffe is further commemorated by a modern obelisk in the town. Trade is principally agricultural.

LUTTRELL, HENRY (*c.* 1765–1851), English wit and writer of society verse, was the illegitimate son of Henry Lawes Luttrell, 2nd earl of Carhampton (1743–1821), a grandson of Colonel Henry Luttrell (*c.* 1655–1717), who served James II. in Ireland in 1689 and 1690, and afterwards deserted him, being murdered in Dublin in November 1717. Colonel Luttrell's son Simon (1713–1787) was created earl of Carhampton in 1785, and the latter's son was Henry Lawes Luttrell. Before succeeding to the peerage, the 2nd earl, then Colonel Luttrell, had won notoriety by opposing John Wilkes at the Middlesex election of 1769. He was beaten at the poll, but the House of Commons declared that he and not Wilkes had been elected. In 1796 he was made commander of the forces in Ireland and in 1798 he became a general. Being an Irish peer, Carhampton was able to sit in the English parliament until his death in April 1821. The earldom became extinct on the death of his brother John, the 3rd earl, in 1829.

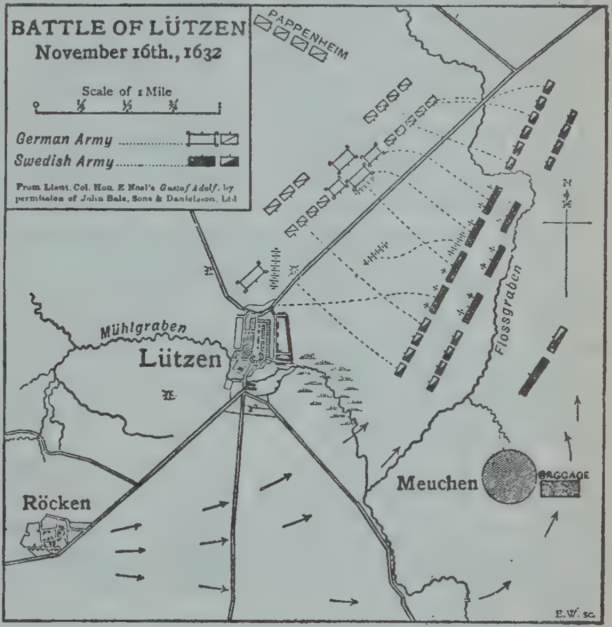
Henry Luttrell secured a seat in the Irish parliament in 1798 and a post in the Irish government, which he commuted for a pension. Introduced into London society by the duchess of Devonshire, his wit made him popular. Soon he began to write verse, in which the foibles of fashionable people were outlined. In 1820 he published his *Advice to Julia*, of which a second edition, altered and amplified, appeared in 1823 as *Letters to Julia in Rhyme*. This poem, suggested by the ode to Lydia in the first book of Horace's *Odes*, was his most important work. His more serious literary contemporaries nicknamed it "Letters of a Dandy to a Dolly." In 1827 in *Crockford House* he wrote a satire on the high play then in vogue. Byron characterized him as "the best sayer of good things, and the most epigrammatic conversationist I ever met"; Sir Walter Scott wrote of him as "the great London wit," and Lady Blessington described him as the one talker "who always makes me think." Luttrell died in London on the 19th of December 1851.

LÜTTRINGHAUSEN, a town of Germany, in the Prussian Rhine province, 6 m. S.E. of Elberfeld by rail. Pop. (1905) 11,829. It is the seat of various iron and other metal industries, and has cloth and calico mills.

LÜTZEN, a town in Prussian Saxony, in the circle of Merseburg (pop. in 1905, 3981), chiefly famous as the scene of a great battle fought on the 6/16th of November 1632 between the Swedes, under King Gustavus Adolphus, and the Imperialists, under Wallenstein. On the 5/15th November, Gustavus, with some 20,000 men, advanced from Naumburg on the Saale to meet a contingent of his German allies at Grimma, S.E. of Leipzig, but becoming aware of the presence of Wallenstein's army near Lützen, and that it had been weakened by a large detachment sent away under Pappenheim towards Halle, he turned towards Lützen. Wallenstein's posts at Weissenfels and Rippach prevented him from fighting his main battle the same evening, and the Swedes went into camp near Rippach, a little more than an hour's march from Lützen.

Wallenstein made ready to give battle on the following day and recalled Pappenheim. The latter had taken a small castle, the reduction of which was one of the objects of his expedition, but his men had dispersed to plunder and could not be rallied before the following morning. Gustavus had now to choose between proceeding to Grimma and fighting Wallenstein on the chance that Pappenheim had not rejoined. He chose the latter. In the mist of the early morning Wallenstein's army was formed in line of battle along the Leipzig road with its right on Lützen. Its left was not carried out as far as the Flossgraben in order to leave room on that flank for Pappenheim. His infantry was arranged in five huge oblongs, four of which (in lozenge formation) formed the centre and one the right wing at Lützen. These "battalias" had their angles strengthened in the old-fashioned way that had prevailed since Marignan, with small outstanding bodies of musketeers, so that they resembled rectangular forts with bastions. On either side of this centre was the cavalry in two long lines, while in front of the centre and close to the right at Lützen were the two batteries of heavy artillery. Lützen was set on fire as a precaution. Skirmishers lined the bank and the ditch of the Leipzig road. The total strength of the Imperial army was about 12,000 foot and 8000 horse.

Gustavus's hopes of an early decision were frustrated by the fog, which delayed the approach and deployment of the Swedes. It was 8 A.M. before all was ready. The royal army was in two lines. The infantry in the centre was arrayed in the small and handy battalions then peculiar to Gustavus's army, the horse on either wing extended from opposite Lützen to some distance beyond Wallenstein's left, which Pappenheim was to extend on his arrival. By the accident of the terrain, or perhaps, following the experience of Breitenfeld (*q.v.*), by design, the right of the Swedes was somewhat nearer to the enemy than the left. In front, near the centre, were the heavy guns and each infantry battalion had its own light artillery. The force of infantry and cavalry on either side was about equal, the Swedes had perhaps rather less cavalry and rather more infantry, but their artillery was superior to Wallenstein's. Not until 11 was it possible to open fire, for want of a visible target, but about noon, after a preliminary cannonade, Gustavus gave the word to advance.



From Lieut.-Col. Hon. E. Noel's *Gustaf Adolf*, by permission of John Bale, Sons & Danielsson, Ltd

The king himself commanded the right wing, which had to wait until small bodies of infantry detached for the purpose had driven in the Imperialist skirmish line, and had then to cross a ditch leading the horses. They were not charged by the Imperialists at this moment, for Pappenheim had not yet arrived, and the usual cavalry tactics of the day were founded on the pistol and not on the sword and the charging horse. Gaining at last room to form, the Swedes charged and routed the first line of the Imperial cavalry but were stopped by the heavy squadrons of cuirassiers in second line, and at that moment Gustavus galloped away to the centre, where events had taken a serious turn. The Swedish centre (infantry) had forced their way across the Leipzig road and engaged Wallenstein's living forts at close quarters. The "Blue" brigade—Gustavus's infantry wore distinctive colours—overran the battery of heavy guns, and the "Swedish"[1] and "Yellow" brigades engaged the left face of the Imperialist lozenge with success. But a gap opened between the right of the infantry and the left of the cavalry and Wallenstein's second line squadrons pressed into it. It was this which brought Gustavus from the extreme right, and he was killed here in leading a counter charge.

On the extreme left, meanwhile, the "Green" brigade had come to close quarters with Wallenstein's infantry and guns about Lützen, and the heavy artillery had gone forward to close range between the "Green" and the "Yellow" infantry. But the news of Gustavus's death spread and the fire of the assault died out. Wallenstein advanced in his turn, recaptured his guns and drove the Swedes over the road.

But the fiery Duke Bernhard of Saxe-Weimar took up the command and ordered a fresh advance. He was too good a soldier to waste his reserves and only brought up a few units of the second line to help the disordered brigades of the first. Again the Imperialists were driven in and their guns recaptured, this time all along the line. About three in the afternoon the Swedes were slowly bearing back Wallenstein's stubborn infantry when Pappenheim appeared. The famous cavalry leader had brought on his mounted men ahead of the infantry and asking, "Where is the king of Sweden?" charged at once in the direction of the enemy's right. Wallenstein thus gained time to re-establish his order, and once more the now exhausted brigades of the Swedish first line were driven over the road. But Pappenheim fell in the moment of victory and his death disheartened the Imperialists almost as much as the fall of Gustavus had disheartened the Swedes. For the last time Bernhard, wounded as he was, forced the Swedish army to the attack. The three infantry brigades of his second line had not been engaged,[2] and as usual the last closed reserve, resolutely handled, carried the day. Wallenstein's army gave way at all points and the Swedes slept on the battlefield. The infantry of Pappenheim's corps did not appear on the field until the battle was over. Of the losses on either side no accurate statement can be given, but the Swedish "Green" and "Yellow" brigades are said to have lost five-sixths of their numbers. Near the spot where Gustavus fell a granite boulder was placed in position on the day after the battle. A canopy of cast-iron was erected over this "Schwedenstein" in 1832, and close by, a chapel, built by Oskar Ekman, a citizen of Gothenburg (d. 1907), was dedicated on the 6th of November 1907.

Lützen is famous also as the scene of a victory of Napoleon over the Russians and Prussians on the 2nd of May 1813 (see NAPOLEONIC CAMPAIGNS). This battle is often called Gross Görschen.

BIBLIOGRAPHY.—The foregoing account of Gustavus's last victory is founded chiefly upon Lieut.-Colonel Hon. E. Noel's *Gustaf Adolf* (London, 1904) and a paper by the same officer in the *Journal of the United States Institution of India* (Oct. 1908), which should be consulted for further details.

LÜTZOW, ADOLF, FREIHERR VON (1782–1834), Prussian lieutenant-general, entered the army in 1795, and eleven years later as a lieutenant took part in the disastrous battle of Auerstädt. He achieved distinction in the siege of Colberg, as the leader of a squadron of Schill's volunteers. In 1808, as a major, he retired from the Prussian army, indignant at the humiliating treaty of Tilsit. He took part in the heroic venture of his old chief Schill in 1809; wounded at Dodendorf and left behind, he thereby escaped the fate of his comrades. In 1811 he was restored to the Prussian army as major, and at the outbreak of the "war of liberation" received permission from Scharnhorst to organize a "free corps" consisting of infantry, cavalry and Tirolese marksmen, for operating in the French rear and rallying the smaller governments into the ranks of the allies. This corps played a marked part in the campaign of 1813. But Lützow was unable to coerce the minor states, and the wanderings of the corps had little military influence. At Kitzen (near Leipzig) the whole corps, warned too late of the armistice of Poischwitz, was caught on the French side of the line of demarcation and, as a fighting force, annihilated. Lützow himself, wounded, cut his way out with the survivors, and immediately began reorganizing and recruiting. In the second part of the campaign the corps served in more regular warfare under Wallmoden. Lützow and his men distinguished themselves at Gadebusch (where Körner fell) and Göhrde (where Lützow himself, for the second time, received a severe wound at the head of the cavalry). Sent next against Denmark, and later employed at the siege of Jülich, Lützow in 1814 fell into the hands of the French. After the peace of 1814 the corps was dissolved, the infantry becoming the 25th Regiment, the cavalry the 6th Ulans. At Ligny he led the 6th Ulans to the charge, but they were broken by the French cavalry, and he finally remained in the hands of the enemy, escaping, however, on the day of Waterloo. Made colonel in this year, his subsequent promotions were: major-general 1822, and lieutenant-general (on retirement) 1830. He died in 1834. One of the last acts of his life for which Lützow is remembered is his challenge (which was ignored) to Blücher, who had been ridden down in the rout of the 6th Ulans at Ligny, and had made, in his official report, comments thereon, which their colonel considered disparaging.

See Koberstein in *Preussisches Jahrbuch*, vol. xxiii (Berlin, 1868), and *Preussisches Bilderbuch* (Leipzig, 1889); K. von Lützow, *Adolf Lützows Freikorps* (Berlin, 1884); Fr. von Jagwitz, *Geschichte des Lützow'schen Freikorps* (Berlin, 1892); and the histories of the campaigns of 1813 and 1815.

LUXEMBURG, FRANÇOIS HENRI DE MONTMORENCY-BOUTEVILLE, DUKE OF (1628–1695), marshal of France, the comrade and successor of the great Condé, was born at Paris on the 8th of January 1628. His father, the comte de Montmorency-Bouteville, had been executed six months before his birth for killing the marquis de Beuvron in a duel, but his aunt, Charlotte de Montmorency, princess of Condé, took charge of him and educated him with her son, the duc d'Enghien. The young Montmorency (or Bouteville as he was then called) attached himself to his cousin, and shared his successes and reverses throughout the troubles of the Fronde. He returned to France in 1659 and was pardoned, and Condé, then much attached to the duchesse de Châtillon, Montmorency's sister, contrived the marriage of his adherent and cousin to the greatest heiress in France, Madeleine de Luxemburg-Piney, princesse de Tingry and heiress of the Luxemburg dukedom (1661), after which he was created duc de Luxembourg and peer of France. At the opening of the War of Devolution (1667–68), Condé, and consequently Luxemburg, had no command, but during the second campaign he served as Condé's lieutenant-general in the conquest of Franche Comté. During the four years of peace which followed Luxemburg cultivated the favour of Louvois, and in 1672 held a high command against the Dutch. He defeated the prince of Orange at Woerden and ravaged Holland, and in 1673 made his famous retreat from Utrecht to Maestricht with only 20,000 men in face of 70,000, an exploit which placed him in the first rank of generals. In 1674 he was made captain of the gardes du corps, and in 1675 marshal of France. In 1676 he was placed at the head of the army of the Rhine, but failed to keep the duke of Lorraine out of Philipsburg; in 1677 he stormed Valenciennes; and in 1678 he defeated the prince of Orange, who attacked him at St Denis after the signature of the peace of Nijmwegen. His reputation was now high, and it is reputed that he quarrelled with Louvois, who managed to involve him in the "affair of the poisons" (see LA VOISIN, CATHERINE) and get him sent to the Bastille. Rousset in his *Histoire de Louvois* has shown that this quarrel is probably apocryphal. There is no doubt that Luxemburg spent some months of 1680 in the Bastille, but on his release took up his post at court as *capitaine des gardes*. When the war of 1690 broke out, the king and Louvois recognized that Luxemburg was the only general fit to cope with the prince of Orange, and he was put in command of the army of Flanders. On the 1st of July 1690 he won a great victory over the prince of Waldeck at Fleurus. In the following year he commanded the army which covered the king's siege of Mons and defeated William III.

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[1] So called as being the only brigade containing no foreign elements in the army.

[2] They had, however, found detachments to reinforce the first line.

of England at Leuze on September 18, 1691. Again in the next campaign he covered the king's siege of Namur, and defeated William at Steenkirk (*q.v.*) on June 5, 1692; and on July 29, 1693, he won his greatest victory over his old adversary at Neerwinden, after which he was called *le tapissier de Nôtre Dame* from the number of captured colours that he sent to the cathedral. He was received with enthusiasm at Paris by all but the king, who looked coldly on a relative and adherent of the Condés. St Simon describes in the first volume of his *Memoirs* how, instead of ranking as eighteenth peer of France according to his patent of 1661, he claimed through his wife to be duc de Piney of an old creation of 1571, which would place him second on the roll. The affair is described with St Simon's usual interest in the peerage, and was chiefly checked through his assiduity. In the campaign of 1694, Luxemburg did little in Flanders, except that he conducted a famous march from Vignamont to Tournay in face of the enemy. On his return to Versailles for the winter he fell ill, and died on January 4, 1695. In his last moments he was attended by the famous Jesuit priest Bourdaloue, who said on his death, "I have not lived his life, but I would wish to die his death." Luxemburg's morals were bad even in those times, and he had shown little sign of religious conviction. But as a general he was Condé's grandest pupil. Though slothful like Condé in the management of a campaign, at the moment of battle he seemed seized with happy inspirations, against which no ardour of William's and no steadiness of Dutch or English soldiers could stand. His death and Catinat's disgrace close the second period of the military history of the reign of Louis XIV., and Catinat and Luxemburg, though inferior to Condé and Turenne, were far superior to Tallard and Villeroi. He was distinguished for a pungent wit. One of his retorts referred to his deformity. "I never can beat that cursed humpback," William was reputed to have said of him. "How does he know I have a hump?" retorted Luxemburg, "he has never seen my back." He left four sons, the youngest of whom was a marshal of France as Maréchal de Montmorency.

See, besides the various memoirs and histories of the time, Beaurain's *Histoire militaire du duc de Luxembourg* (Hague and Paris, 1756); *Mémoires pour servir a l'histoire du maréchal duc de Luxembourg* (Hague and Paris, 1758); Courcelles, *Dictionnaire des généraux français* (Paris, 1823), vol. viii. There are some interesting facts in Desormeaux's *Histoire de la maison de Montmorency* (1764), vols. iv. and v. Camille Rousset's *Louvois* and the recent biography of Luxemburg by Count de Ségur (1907) should also be studied.

LUXEMBURG, a district in the European low countries, of which the eastern part forms the grand-duchy of Luxemburg, and the western is the Belgian province of that name (for map, see BELGIUM). The name is derived from the chief town.

Under the Romans the district was included in the province of *Belgica prima*, afterwards forming part of the Frankish kingdom of Austrasia and of the empire of Charlemagne. About 1060 it came under the rule of Conrad (d. 1086), who took the title of count of Luxemburg. His descendants ruled the county, first in the male and then in the female line, until the death of the emperor Sigismund in 1437. Through the marriage of Sigismund's daughter, Elizabeth, with the German king, Albert II., Luxemburg, which had been made a duchy in 1354, passed to the house of Habsburg, but was seized in 1443 by Philip III. the Good, duke of Burgundy, who based his claim upon a bargain concluded with Sigismund's niece Elizabeth (d. 1451). Regained by the Habsburgs in 1477 when Mary, daughter and heiress of duke Charles the Bold, married the German king Maximilian I., the duchy passed to Philip II. of Spain in 1555, though subject to the laws of the empire, of which it still formed part. After a section had been ceded to France in 1659, the remainder was given to the emperor Charles VI. by the treaty of Utrecht in 1713. It was conquered by France in 1795, and retained by that power until the end of the Napoleonic wars. The congress of Vienna (1814–1815) erected Luxemburg into a grand-duchy, added part of the duchy of Bouillon to it, and assigned it to William I., king of the Netherlands, in return for the German territories of the house of Orange-Nassau, which Napoleon had confiscated in 1806, and which were given by the congress to the king of Prussia. In 1830 when the Belgian provinces separated from Holland, an effort was made to include Luxemburg in the new kingdom of the Belgians; but in November 1831 the powers decided that part of the grand-duchy should be retained by the king of Holland, who refused to accept this arrangement. Consequently the whole of Luxemburg remained in the possession of the Belgians until 1838, when the treaty of the 19th of April, concluded at the conference of London, enforced the partition of 1831.

The grand-duchy of Luxemburg, the portion under the rule of William I. retaining the name, was ruled by the kings of Holland until the death of William III. in 1890. William's daughter, Wilhelmina, succeeded to the throne of Holland, but under the Salic law[1] the grand-duchy passed to his kinsman, Adolphus, duke of Nassau, who died in 1905, and was succeeded by his son William (b. 1852).

By modifications of the treaty of Vienna the garrisoning of the fortress of Luxemburg had passed into Prussian hands, an arrangement which lasted until 1867. In the previous year the German Confederation, to which the grand-duchy of Luxemburg had belonged since 1815, had been dissolved; but the Prussians maintained their garrison in Luxemburg, which was not included in the new North German Confederation, while King William III. proposed to sell his rights over the grand-duchy to France. The Prussians were irritated by this proposal, but war was averted, and the question was referred to a conference of the powers in London. The treaty of London, signed on the 11th of May 1867, decided that the Prussian garrison must be withdrawn and the fortress dismantled, which was done in 1872. At the same time the great powers guaranteed the neutrality of the grand-duchy, and although a member of the German *Zollverein*, Luxemburg now forms a sovereign and independent state.

The GRAND-DUCHY lies S.E. of Belgium. Its area is 999 sq. m., with a population (1905) of 246,455. The people are nearly all Catholics. The country is rich in iron ore. The hills in the south of the duchy are a continuation of the Lorraine plateau, and the northern districts are crossed in all directions by outrunners from the Ardennes. The streams mostly join the Moselle, which forms the boundary between Luxemburg and the Rhine province for about 20 m. The Sure or Sauer, the most important stream in the duchy, rises at Vaux-les-Rosières in Belgian Luxemburg, crosses the duchy, and forms the eastern boundary from the confluence of the Our till it joins the Moselle after a course of 50 m., during which it receives the Wiltz, Attert, Alzette, White and Black Ernz, &c. The soil of Luxemburg is generally good; the southern districts are on the whole the most fertile as well as the most populous. Building materials of all sorts are obtained throughout the duchy. Besides the iron furnaces, situated in the south near the Lorraine plateau, there are tanneries, weaving and glove-making factories, paper-mills for all sorts of paper, breweries and distilleries, and sugar refineries. A German patois mixed with French words is spoken throughout the country; but French, which is employed by the commercial community, is also the common speech on the French and Belgian frontiers. Though liberty of worship prevails, Roman Catholicism is almost the sole form. The government is in the hands of the grand-duke, who sanctions and promulgates the laws. There is a council (*staatsrat*) of 15 members. There is a chamber of deputies with 48 members elected by the cantons (12 in number) for six years, half the body being elected every three years. No law can be passed without the consent of the chamber. Bills are introduced by the grand-duke, but the house has also the right of initiative. A single battalion (150) of volunteers composes the grand-ducal army. The gendarmerie consists of about 150 men. There are cantonal courts and two district courts, one at Luxemburg, the other at Diekirch, and a high court at Luxemburg. The bishopric of Luxemburg holds its authority directly from the Holy See. From 13,000,000 to 17,000,000 francs is the annual amount of the state budget, and the debt, consisting of loans contracted principally for the construction of railways, of which there are about 350 m., is 12,000,000 francs.

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[1] It should be noticed, however, that the Salic law is subordinate to the Nassau family law, which provides for the succession in the case of the *complete extinction* of males. Thus Article xlii. of the Nassau Pact of the 30th of June 1783 provides "that in the event of the extinction of males, the rights of succession pass to the daughter or nearest heiress of the last male."

Among towns next to the capital, Luxemburg, are Echternach and Diekirch, both worthy of note for their blast furnaces. Grevenmacher is the centre of a great wine district.

The Province of Luxemburg is the largest and least populous of the nine provinces of Belgium. Its capital is Arlon, which lies near the borders of the grand-duchy. A considerable part of the province is forested and the state requires systematic replanting. Marble, granite and slate quarries are worked in different districts. Successful attempts have been made to introduce fruit cultivation. The province is well watered by the Ourthe, the Semois and the Sûre. The general elevation of the country is about 500 ft., but the hills and plateaus which form the prominent feature in the scenery of Luxemburg range from 1200 to 1500 ft. The highest point of the province is the Baraque de Fraiture (1980 ft.), N.E. of La Roche. The woods are well stocked with red and roe deer, wild boar, hares, rabbits, pheasants, woodcock and snipe. The area of the province is 1725 sq. m. The population was 225,963 in 1904.

The House of Luxemburg was descended from Count Conrad (d. 1086), and its fortunes were advanced through the election of Count Henry IV. as German king in 1308 and his coronation as emperor under the title of Henry VII. Henry's son was John, king of Bohemia, who fell on the field of Crécy, and John's eldest son was the emperor Charles IV., while another famous member of the family was Baldwin, archbishop of Treves (1285–1354), who took an active part in imperial affairs. Two of the sons of Charles IV., Wenceslaus and Sigismund, succeeded in turn to the imperial throne, and one of his nephews, Jobst, margrave of Moravia, was chosen German king in opposition to Sigismund in 1410. The French branch of the Luxemburg family was descended from Waleran (d. 1288), lord of Ligny and Roussy, a younger son of Count Henry II. Waleran's great-grandson was Guy (d. 1371), who married Matilda, sister and heiress of Guy V., count of Saint-Pol (d. 1360), and was created count of Ligny in 1367. Guy's son, Waleran (d. 1417), who became constable of France in 1412, had been carried as a prisoner to England, and had married Matilda, daughter of Thomas Holland, earl of Kent (d. 1360) and half-sister of King Richard II. To avenge Richard's death he made a raid on the Isle of Wight, and then took part in the civil wars in France. He left no sons, and was succeeded by his nephew, Peter, count of Brienne (d. 1433), who, like his brother Louis (d. 1443), cardinal archbishop of Rouen and chancellor of France, was found on the side of the English in their struggle against France. Another of Peter's brothers, John (d. 1440), a stout supporter of England, was made governor of Paris by Henry V. He sold Joan of Arc to the English. Peter's son and successor, Louis, fought at first for England, but about 1440 he entered the service of France and obtained the office of constable. King Louis XI. accused him of treachery, and he took refuge with Charles the Bold, duke of Burgundy; but the duke handed him over to the king and he was beheaded in 1475. The elder branch of his descendants became extinct in the male line in 1482, and was merged through the female line in the house of Bourbon-Vendôme. Louis's third son, Anthony (d. 1510), founded the family of Luxemburg-Brienne, the senior branch of which became extinct in 1608. A junior branch, however, was the family of the duke of Luxemburg-Piney, whose last representative, Margaret-Charlotte (d. 1680), married firstly Léon d'Albert de Luynes (d. 1630) and secondly Charles Henry de Clermont-Tonnerre (d. 1674). Her daughter by her second husband, Madeleine Charlotte, married Francis Henry de Montmorenci (d. 1695) and de Luynes, and, subsequently, members of the family of Montmorenci claimed the title of duke of Luxemburg. The Luxembourg palace in Paris owes its name to the fact that it was built on a site belonging to the duke of Luxemburg-Piney.

See N. van Werveke, *Beiträge zur Geschichte des Luxemburger Landes* (Luxemburg, 1886–1887); J. Schötter, *Geschichte des Luxemburger Landes* (Luxemburg, 1882); and N. Vigner, *Histoire de la maison de Luxembourg* (Paris, 1619).

LUXEMBURG, or Lützelburg (*i.e.* the little fortress or town), the capital of the grand-duchy of the same name (see above), situated on the Alzette, a tributary of the Sûre. Pop. (1905) 20,984. The situation is romantic, steep cliffs overhanging the winding river, and the principal portion of the town with the palace and public buildings covering a central plateau. The more densely populated parishes of Clausen, Pfaffenthal and Grund lie in the valley. As a fortress Luxemburg was considered the strongest in Europe after Gibraltar, which it was supposed to resemble because many of its casemates were cut into the rock. It was dismantled in 1867. Two colossal viaducts carry the railway and the approach from the railway station to the town. Since the place ceased to be a fortress the population has more than doubled, and the Alzette is lined with tanneries, breweries and distilleries. The Hôtel de Ville dates from 1844 and contains a collection of antiquities. The church of Notre Dame was built in 1613, and that of St Michael, with parts dating from 1320, contains the tomb of blind John of Luxemburg, king of Bohemia, slain at Crécy. There are two annual fête days, one in honour of Our Lady of Luxemburg, patroness of the city, held on the Sunday before Ascension Day, and the other the annual fair or *Schobermesse* (tent fair), instituted in 1340 and held each year on the 24th of August.

LUXEUIL-LES-BAINS, a town of eastern France, in the department of Haute-Saône, 18 m. N.E. of Vesoul. Pop. (1906) 5195. It is situated in a region of forests on the right bank of the Breuchin. It has an abbey-church dating from the 13th and 14th centuries, containing a curious 17th-century organ loft in the form of an immense bracket supported by a colossal figure of Hercules. The abbot's palace (16th and 18th centuries) serves as presbytery and town hall. A cloister of the 15th century and other buildings of the 17th century also remain. There are several mansions and houses dating from various periods from the 14th to the 16th century. The Maison Carrée, once the town hall, an interesting specimen of 15th-century architecture, was built by Perrin Jouffroy, father of Cardinal Jouffroy. The cardinal, who was born at Luxeuil in 1412, built the house with a graceful balcony and turret which faces the Maison Carrée. The Maison de la Baille and the Maison François I. are of the Renaissance period. The fine modern Grammont Hospital is in the style of Louis XIII. Luxeuil is renowned for its mineral springs, of which there are seventeen, two being ferruginous, and the rest charged with chloride of sodium; their temperatures range from 70° to 158° F. The water is employed for drinking and for baths. The bathing establishment contains a museum of Gallo-Roman antiquities and there are also remains of Roman baths and aqueducts to be seen in or near it. Luxeuil has a communal college. Copper-founding, the spinning and weaving of cotton, lace-making, dyeing and the distilling of kirsch are carried on.

Luxeuil was the Roman *Lixovium* and contained many fine buildings at the time of its destruction by the Huns under Attila in 451. In 590 St Columban here founded a monastery, afterwards one of the most famous in Franche Comté. In the 8th century it was destroyed by the Saracens; afterwards rebuilt, monastery and town were devastated by the Normans in the 9th century and pillaged on several occasions afterwards. The abbey schools were celebrated in the middle ages and the abbots had great influence; but their power was curtailed by the emperor Charles V. and the abbey was suppressed at the Revolution.

See H. Beaumont, *Étude hist. sur l'abbaye de Luxeuil, 590–1790* (Lux. 1895); Grandmongin and A. Garnier, *Hist. de la ville et des thermes de Luxeuil* (Paris, 1866), with 16 plates.

LUXOR, more properly El-Aksur, "The Castles" (plur. of kasr), a town of Upper Egypt, on the east bank of the Nile 450 m. above Cairo by river and 418 by rail. Pop. (1907 census) 12,644. It is the centre for visitors to the ruins of and about Thebes, and is frequented by travellers and invalids in the winter season, several fine hotels having been built for their accommodation. There are Anglican and Roman Catholic churches, and a hospital for natives, opened in 1891. The district is the seat of an extensive manufacture of forged antiques.

The temple of Luxor is one of the greatest of the monuments of Thebes (*q.v.*). It stands near the river bank on the S.W. side of the town and measures nearly 300 yds. from back to front. There may have been an earlier temple here, but the present structure, dedicated to the Theban triad of Ammon, Mut and

Khons, was erected by Amenophis III. The great colonnade, which is its most striking feature, was apparently intended for the nave of a hypostyle hall like that of Karnak, but had to be hastily finished without the aisles. After the heresy of Amenophis IV. (Akhenaton), the decoration of this incomplete work was taken in hand by Tutenkhamun and Haremhib. The axis of the temple ran from S.W. to N.E.; a long paved road bordered by recumbent rams led from the façade to the temples of Karnak (*q.v.*) in a somewhat more easterly direction, and Rameses II. adopted the line of this avenue in adding an extensive court to the work of Amenophis, producing a curious change of axis. He embellished the walls and pylons of his court with scenes from his victories over Hittites and Syrians, and placed a number of colossal statues within it. In front of the pylon Rameses set up colossi and a pair of obelisks (one of which was taken to Paris in 1831 and re-erected in the Place de la Concorde). A few scenes and inscriptions were added by later kings, but the above is practically the history of the temple until Alexander the Great rebuilt the sanctuary itself. The chief religious festival of Thebes was that of "Southern Opi," the ancient name of Luxor. The sacred barks of the divinities preserved in the sanctuary of Karnak were then conveyed in procession by water to Luxor and back again; a representation of the festal scenes is given on the walls of the great colonnade. The Christians built churches within the temple. The greater part of the old village of Luxor lay inside the courts: it was known also as Abu 'l Haggag from a Moslem saint of the 7th century, whose tomb-mosque, mentioned by Ibn Batuta, stands on a high heap of débris in the court of Rameses. This is the last of the buildings and rubbish which encumbered the temple before the expropriation and clearances by the Service des Antiquités began in 1885. The principal street of Luxor follows the line of the ancient avenue.

See G. Daressy, *Notice explicative des ruines du temple de Louxor* (Cairo, 1893); Baedeker's *Egypt*. (F. Ll. G.)

LUXORIUS, Roman writer of epigrams, lived in Africa during the reigns of the Vandal kings Thrasamund, Hilderic and Gelimer (A.D. 496–534). He speaks of his poor circumstances, but from the superscription *clarissimus* and *spectabilis* in one MS., he seems to have held a high official position. About a hundred epigrams by him in various metres (the elegiac predominating) have been preserved. They are after the manner of Martial, and many of them are coarse. They deal chiefly with the games of the circus and works of art, and the language shows the author to have been well acquainted with the legends and antiquities of the classical period of Rome.

Luxorius also wrote on grammatical subjects (see R. Ellis in *Journal of Philology*, viii., 1879). The epigrams are contained in the *Anthologia Latina*, edited by F. Bücheler and A. Riese (1894).

LUYNES, a territorial name belonging to a noble French house. The family of Albert, which sprang from Thomas Alberti (d. 1455), seigneur de Boussargues, *bailli* of Viviers and Valence, and *viguier* of Bagnols and Pont St Esprit in Languedoc, acquired the estate of Luynes (dep. of Indre-et-Loire) in the 16th century. Honoré d'Albert (d. 1592), seigneur de Luynes, was in the service of the three last Valois kings and of Henry IV., and became colonel of the French bands, commissary of artillery in Languedoc and governor of Beaucaire. He had three sons: Charles (1578–1621), first duke of Luynes, and favourite of Louis XIII.; Honoré (1581–1649), seigneur de Cadenet, who married Charlotte Eugénie d'Ailly, countess of Chaulnes, in 1619, and was created duke of Chaulnes in 1621; and Léon, seigneur de Brantes, who became duke of Luxemburg-Piney by his marriage in 1620 with Margaret Charlotte of Luxemburg.

By her marriage with Claude of Lorraine, duke of Chevreuse, Marie de Rohan, the widow of the first duke of Luynes, acquired in 1655 the duchy of Chevreuse, which she gave in 1663 to Louis Charles d'Albert, her son by her first husband; and from that time the title of duke of Chevreuse and duke of Luynes was borne by the eldest sons of the family of Luynes, which also inherited the title of duke of Chaulnes on the extinction of the descendants of Honoré d'Albert in 1698. The branch of the dukes of Luxemburg-Piney became extinct in 1697.

Charles (1578–1621), the first duke of Luynes, was brought up at court and attended the dauphin, who later became Louis XIII. The king shared his fondness for hunting and rapidly advanced him in favour. In 1615 he was appointed commander of the Louvre and counsellor, and the following year grand falconer of France. He used his influence over the king in the court intrigues against the queen-mother Marie de Medici and her favourite Concini. It was Luynes who, with Vitry, captain of the guard, arranged the plot that ended in Concini's assassination (1617) and secured all the latter's possessions in Italy and France. In the same year he was appointed captain of the Bastille and lieutenant-general of Normandy, and married Marie de Rohan, daughter of the duke of Montbazon. He employed extreme measures against the pamphleteers of the time, but sought peace in Italy and with the Protestants. In 1619 he negotiated the treaty of Angoulême by which Marie de Medici was accorded complete liberty. He was made governor of Picardy in 1619; suppressed an uprising of nobles in 1620; and in 1621, with slight military ability or achievement, was appointed constable of France. His rapid rise to power made him a host of enemies, who looked upon him as but a second Concini. In order to justify his newly-won laurels, Luynes undertook an expedition against the Protestants, but died of a fever in the midst of the campaign, at Longueville in Guienne, on the 15th of December 1621.

His brother Honoré (1581–1649), first duke of Chaulnes, was governor of Picardy and marshal of France (1619), and defended his province successfully in 1625 and 1635. Louis Auguste d'Albert d'Ailly (1676–1744), duke of Chaulnes, also became marshal of France (1741). Louis Joseph d'Albert de Luynes (1670–1750), prince of Grimberghen, was in the service of the emperor Charles VII., and became field-marshal and ambassador in France.

Several members of the family of Albert were distinguished in letters and science. Louis Charles d'Albert (1620–1690), duke of Luynes, son of the constable, was an ascetic writer and friend of the Jansenists; Paul d'Albert de Luynes (1703–1788), cardinal and archbishop of Sens, an astronomer; Michel Ferdinand d'Albert d'Ailly (1714–1769), duke of Chaulnes, a writer on mathematical instruments, and his son Marie Joseph Louis (1741–1793), a chemist; and Honoré Théodore Paul Joseph (1802–1867), duke of Luynes, a writer on archaeology.

For the first duke see *Recueil des pièces les plus curieuses qui ont esté faites pendant le règne du connestable M. de Luynes* (2nd ed., 1624); Le Vassor, *Histoire de Louis XIII.* (Paris, 1757); Griffet, *Histoire du règne de Louis XIII., roi de France et de Navarre* (Paris, 1758); V. Cousin, "Le Duc et connétable de Luynes," in *Journal des savants* (1861–1863); B. Zeller, *Études critiques sur le règne de Louis XIII.: le connétable de Luynes, Montauban et la Valteline* (Paris, 1879); E. Pavie, *La Guerre entre Louis XIII. et Marie de Médicis* (Paris, 1899); Lavisse, *Histoire de France*, vi.^{2}, 141-216 (Paris, 1905).

LUZÁN CLARAMUNT DE SUELVES Y GURREA, IGNACIO (1702–1754), Spanish critic and poet, was born at Saragossa on the 28th of March 1702. His youth was passed under the care of his uncle, and, after studying at Milan, he graduated in philosophy at the university of Catania. In 1723 he took minor orders, but abandoned his intention of entering the church and took up his residence at Naples, where he read assiduously. Business took him to Spain in 1733, and he became known in Madrid as a scholar with a tendency towards innovations in literature. *La Poética, ó Reglas de la poesía en general y de sus principales especies* (1737) proved that this impression was correct. He at once took rank as the leader of the literary reformers, and his courteous determination earned him the respect of his opponents. In 1747 he was appointed secretary to the Spanish embassy in Paris and, on returning to Madrid in 1750, was elected to the "Academia Poética del Buen Gusto," where, on account of his travels, he was known by the sobriquet of *El Peregrino*. He became master of the mint and treasurer of the royal library. He died at Madrid, after a short illness, on the 19th of May 1754. Luzán was not the pioneer of Franco-Italian theories in Spain, but he was their most powerful exponent, and his *Poëtica* is an admirable example of destructive criticism. The defects of Lope de Vega and Calderón are indicated with vigilant severity, but on the constructive side Luzán is notably weak, for he merely proposes to substitute one exhausted convention for another. The doctrine of the dramatic unities had not the saving virtues which he ascribed to it, and, though he succeeded in banishing the older dramatists from the boards, he and his school failed to produce a single piece of more than mediocre merit. His theories, derived chiefly from Muratori, were ineffective in practice; but their ingenuity cannot be denied, and they acted as a stimulus to the partisans of the national tradition.

LUZ-SAINT-SAUVEUR, a town of south-western France in the department of Hautes-Pyrénées, 21 m. S. of Lourdes by rail. Pop. (1906) 1069. Luz is beautifully situated at a height of 2240 ft. on the Bastan. It has a remarkable church, built by the Templars in the 12th and 13th centuries and fortified later. The crenelated ramparts with which it is surrounded, and the tower to the north of the apse resembling a keep, give it the aspect of a fortress; other interesting features are the Romanesque north door and a chapel of the 16th century. The village of St Sauveur lies a little above Luz on the left bank of the gorge of the Gave de Pau, which is crossed higher up by the imposing Pont Napoléon (1860). It is a pleasant summer resort, and is visited for its warm sulphurous springs. Discovered in the 16th century, the waters came into vogue after 1820, in which year they were visited by the duchesses of Angoulême and Berry. There is much picturesque mountain scenery in the vicinity; 12 m. to the south is the village of Gavarnie, above which is the magnificent rock amphitheatre or *cirque* of Gavarnie, with its cascade, one of the highest in Europe.

LUZZATTI, LUIGI (1841–), Italian economist and financier, was born of Jewish parents at Venice on the 11th of March 1841. After completing his studies in law at the university of Padua, he attracted the attention of the Austrian police by his lectures on political economy, and was obliged to emigrate. In 1863 he obtained a professorship at the Milan Technical Institute; in 1867 he was appointed professor of constitutional law at Padua, whence he was transferred to the university of Rome. Gifted with eloquence and energy, he popularized in Italy the economic ideas of Schultze-Delitzsch, worked for the establishment of a commercial college at Venice, and contributed to the spread of people's banks on a basis of limited liability throughout the country. In 1869 he was appointed by Minghetti under secretary of state to the ministry of agriculture and commerce, in which capacity he abolished government control over commercial companies and promoted a state inquiry into the conditions of industry. Though theoretically a free trader, he was largely instrumental in creating the Italian protective system. In 1877 he participated in the commercial negotiations with France, in 1878 compiled the Italian customs tariff, and subsequently took a leading part in the negotiations of all the commercial treaties between Italy and other countries. Appointed minister of the treasury in the first Di Rudinì cabinet of 1891, he imprudently abolished the system of frequent clearings of bank-notes between the state banks, a measure which facilitated the duplication of part of the paper currency and hastened the bank crisis of 1893. In 1896 he entered the second Di Rudinì cabinet as minister of the treasury, and by timely legislation helped to save the bank of Naples from failure. After his fall from office in June 1898, his principal achievement was the negotiation of the Franco-Italian commercial treaty, though, as deputy, journalist and professor, he continued to take an active part in all political and economic manifestations. He was again minister of the treasury from November 1903 to March 1905 in Giolitti's second administration, and for the third time from February to May 1906, under Sonnino's premiership. During the latter term of office he achieved the conversion of the Italian 5% debt (reduced to 4% by the tax) to 3¾% to be eventually lowered to 3½%, an operation which other ministers had attempted without success; although the actual conversion was not completed until after the fall of the cabinet of which he formed part the merit is entirely his. In 1907 he was president of the co-operative congress at Cremona.

See L. Carpi's *Risorgimento Italiano*, vol. ii. (Milan, 1886), which contains a biographical sketch of Luzzatti.

LUZZATTO, MOSES ḤAYIM (1707–1747), Hebrew dramatist and mystic, was born in Padua 1707, and died at Acre 1747. He was influenced by Isaac Luria (*q.v.*) on the mystical side, and on the poetical side by Italian drama of the school of Guarini (*q.v.*). He attacked Leon of Modena's anti-Kabbalistic treatises, and as a result of his conflict with the Venetian Rabbinate left Italy for Amsterdam, where, like Spinoza, he maintained himself by grinding lenses. Here, in 1740, he wrote his popular religious manual the *Path of the Upright* (*Messilath Yesharim*) and other ethical works. He visited London, but finally settled in Palestine, where he died. Luzzatto's most lasting work is in the realm of Hebrew drama. His best-known compositions are: the *Tower of Victory* (*Migdal 'Oz*) and *Glory to the Upright* (*Layesharim Tehillah*). Both of these dramas, which were not printed at the time but were widely circulated in manuscript, are of the type which preceded the Shakespearean age—they are allegorical and all the characters are types. The beautiful Hebrew style created a new school of Hebrew poetry, and the Hebrew renaissance which resulted from the career of Moses Mendelssohn owed much to Luzzatto.

See Grätz, *History of the Jews*, v. ch. vii.; I. Abrahams, *Jewish Life in the Middle Ages*, pp. 190, 268; N. Slouschz, *The Renascence of Hebrew Literature*, ch. i. (I. A.)

LUZZATTO, SAMUEL DAVID (1800–1865), Jewish scholar, was born at Trieste in 1800, and died at Padua in 1865. He was the most distinguished of the Italian Jewish scholars of the 19th century. The first Jew to suggest emendations to the text of the Hebrew Bible, he edited Isaiah (1856–1867), and wrote a commentary on the Pentateuch (1871). His grammatical works were mostly written in Italian. He also contributed to the history of the Synagogue liturgy, and enjoys with Geiger (*q.v.*) and Zunz (*q.v.*) the honour of reviving interest in the medieval Hebrew hymnology and secular verse.

See Grätz, *History of the Jews* (Eng. trans.), v. 622 seq.; N. Slouschz, *The Renascence of Hebrew Literature*, pp. 84-92; the *Jewish Encyclopedia*, viii. 225-226, with list of works. (I. A.)

LYALL, SIR ALFRED COMYN (1835–), Anglo-Indian civil servant and man of letters, son of the Rev. Alfred Lyall, was born in 1835, and educated at Eton and Haileybury. He entered the Bengal civil service in 1855, saw service during the Mutiny in the Bulandshahr district, at Meerut, and with the Khaki Risala of volunteers. He was commissioner in Berar (1867), secretary to the government of India in the Home and Foreign departments, lieutenant-governor of the North-western Provinces (1882–1887), and member of the Council of India (1888–1903). Among his writings, his *Verses Written in India* (1889) attained considerable popularity, and in his *Asiatic Studies* (1882 and 1899) he displays a deep insight into Indian life and character. He wrote the *Life* of Lord Dufferin (1905), and made numerous contributions to periodical literature.

LYALL, EDNA, the pen-name of Ada Ellen Bayly (1857–1903), English novelist. She was born at Brighton in 1857, the daughter of a barrister. Her parents died while she was a child, and she was brought up at Caterham, Surrey. At Eastbourne, where most of her life was spent, she was well known for her philanthropic activity. She died on the 8th of February 1903. Edna Lyall's vogue as a novelist was the result of a combination of the story-teller's gift with a sincere ethical and religious spirit of Christian tolerance, which at the time was new to many readers. Though her *Won by Waiting* (1879) had some success, it was with *Donovan* (1882) and *We Two* (1884), in which the persecuted atheist was inevitably identified with Charles Bradlaugh, that she became widely popular. Other novels were *In the Golden Days* (1885), a story of the Great Rebellion; *Knight Errant* (1887); *Autobiography of a Slander* (1887); *A Hardy Norseman* (1889); *Derrick Vaughan, The Story of a Novelist* (1889); *To Right the Wrong* (1892); *Doreen* (1894), a statement of the case for Irish Home Rule; *The Autobiography of a Truth* (1896), the proceeds of which were devoted to the

Armenian Relief Fund; *In Spite of All* (1901), which had originally been produced by Mr Ben Greet as a play; and *The Bruges Letters* (1902), a book for children.

A *Life* by J. N. Escreet appeared in 1904, and a shorter account of her by the Rev. G. A. Payne was printed at Manchester in 1903.

LYALLPUR, a district of India, in the Multan division of the Punjab. It was constituted in 1904 to comprise the "Chenab Colony," being the waste portion of the former Jhang district that is now irrigated by the Lower Chenab canal. Area, 3075 sq. m.; pop. (1906) 654,666. It is traversed by a section of the North-western railway. The headquarters are at Lyallpur town (pop. in 1906, 13,483), named after Sir James Lyall, a lieutenant-governor. It contains several factories for ginning and pressing cotton.

See *Chenab Colony Gazetteer* (Lahore, 1904).

LYCAEUS (Mons Lycaeus, *Λύχαιον ὄρος*: mod. *Diaphorti*), a mountain in Arcadia, sacred to Zeus Lycaeus, who was said to have been born and brought up on it, and the home of Pelasgus and his son Lycaon, who is said to have founded the ritual of Zeus practised on its summit. This seems to have involved a human sacrifice, and a feast in which the man who received the portion of a human victim was changed to a wolf, as Lycaon had been after sacrificing a child. The altar of Zeus consists of a great mound of ashes with a retaining wall. It was said that no shadows fell within the precincts; and that any who entered it died within the year.

LYCANTHROPY (Gr. *λύκος*, wolf, *ἄνθρωπος*, man), a name employed (1) in folk-lore for the liability or power of a human being to undergo transformation into an animal; (2) in pathology for a form of insanity in which the patient believes that he is transformed into an animal and behaves accordingly.

I. Although the term lycanthropy properly speaking refers to metamorphosis into a wolf (see Werwolf), it is in practice used of transformation into any animal. The Greeks also spoke of kynanthropy (*κύων*, dog); in India and the Asiatic islands the tiger is the commonest form, in North Europe the bear, in Japan the fox, in Africa the leopard or hyena, sometimes also the lion, in South America the jaguar; but though there is a tendency for the most important carnivorous animal of the area to take the first place in stories and beliefs as to transformation, the less important beasts of prey and even harmless animals like the deer also figure among the wer-animals.

Lycanthropy is often confused with transmigration; but the essential feature of the wer-animal is that it is the alternative form or the double of a living human being, while the soul-animal is the vehicle, temporary or permanent, of the spirit of a dead human being. The vampire is sometimes regarded as an example of lycanthropy; but it is in human form, sometimes only a head, sometimes a whole body, sometimes that of a living person, at others of a dead man who issues nightly from the grave to prey upon the living.

Even if the denotation of lycanthropy be limited to the animal-metamorphosis of living human beings, the beliefs classed together under this head are far from uniform, and the term is somewhat capriciously applied. The transformation may be voluntary or involuntary, temporary or permanent; the wer-animal may be the man himself metamorphosed, it may be his double whose activity leaves the real man to all appearance unchanged, it may be his soul, which goes forth seeking whom it may devour and leaving its body in a state of trance; or it may be no more than the messenger of the human being, a real animal or a familiar spirit, whose intimate connexion with its owner is shown by the fact that any injury to it is believed, by a phenomenon known as repercussion, to cause a corresponding injury to the human being.

The phenomenon of repercussion, the power of animal metamorphosis, or of sending out a familiar, real or spiritual, as a messenger, and the supernormal powers conferred by association with such a familiar, are also attributed to the magician, male and female, all the world over; and witch superstitions are closely parallel to, if not identical with, lycanthropic beliefs, the occasional involuntary character of lycanthropy being almost the sole distinguishing feature. In another direction the phenomenon of repercussion is asserted to manifest itself in connexion with the bush-soul of the West African and the *nagual* of Central America; but though there is no line of demarcation to be drawn on logical grounds, the assumed power of the magician and the intimate association of the bush-soul or the *nagual* with a human being are not termed lycanthropy. Nevertheless it will be well to touch on both these beliefs here.

In North and Central America, and to some extent in West Africa, Australia and other parts of the world, every male acquires at puberty a tutelary spirit (see Demonology); in some tribes of Indians the youth kills the animal of which he dreams in his initiation fast; its claw, skin or feathers are put into a little bag and become his "medicine" and must be carefully retained, for a "medicine" once lost can never be replaced. In West Africa this relation is said to be entered into by means of the blood bond, and it is so close that the death of the animal causes the man to die and vice versa. Elsewhere the possession of a tutelary spirit in animal form is the privilege of the magician. In Alaska the candidate for magical powers has to leave the abodes of men; the chief of the gods sends an otter to meet him, which he kills by saying "O" four times; he then cuts out its tongue and thereby secures the powers which he seeks. The Malays believe that the office of *pawang* (priest) is only hereditary if the soul of the dead priest, in the form of a tiger, passes into the body of his son. While the familiar is often regarded as the alternative form of the magician, the *nagual* or bush-soul is commonly regarded as wholly distinct from the human being. Transitional beliefs, however, are found, especially in Africa, in which the power of transformation is attributed to the whole of the population of certain areas. The people of Banana are said to change themselves by magical means, composed of human embryos and other ingredients, but in their leopard form they may do no hurt to mankind under pain of retaining for ever the beast shape. In other cases the change is supposed to be made for the purposes of evil magic and human victims are not prohibited. We can, therefore, draw no line of demarcation, and this makes it probable that lycanthropy is connected with nagualism and the belief in familiar spirits, rather than with metempsychosis, as Dr Tylor argues, or with totemism, as suggested by J. F. M'Lennan. A further link is supplied by the Zulu belief that the magician's familiar is really a transformed human being; when he finds a dead body on which he can work his spells without fear of discovery, the wizard breathes a sort of life into it, which enables it to move and speak, it being thought that some dead wizard has taken possession of it. He then burns a hole in the head and through the aperture extracts the tongue. Further spells have the effect of changing the revivified body into the form of some animal, hyena, owl or wild cat, the latter being most in favour. This creature then becomes the wizard's servant and obeys him in all things; its chief use is, however, to inflict sickness and death upon persons who are disliked by its master.

Lycanthropy in Europe.—The wolf is the commonest form of the wer-animal (see Werwolf), though in the north the bear disputes its pre-eminence. In ancient Greece the dog was also associated with the belief. Marcellus of Sida, who wrote under the Antonines, gives an account of a disease which befell people in February; but a pathological state seems to be meant.

Lycanthropy in Africa.—In Abyssinia the power of transformation is attributed to the Boudas, and at the same time we have records of pathological lycanthropy (see below). Blacksmiths are credited with magical powers in many parts of the world, and it is significant that the Boudas are workers in iron and clay; in the *Life of N. Pearce* (i. 287) a European observer tells a story of a supposed transformation which took place in his presence and almost before his eyes; but it does not appear how far hallucination rather than coincidence must be invoked to explain the experience.

The Wer-tiger of the East Indies.—The Poso-Alfures of central Celebes believe that man has three souls, the *inosa*, the *angga* and the *tanoana*. The *inosa* is the vital principle; it can be detected in the veins and arteries; it is given to man by one of the great natural phenomena, more especially the wind. The *angga* is the intellectual part of man; its seat is unknown; after death it goes to the under-world, and, unlike the *inosa*, which is believed to be dissolved into its original elements, takes possession of an immaterial body. The *tanoana* is the divine in man and after death returns to its lord, Poewempala boeroe. It goes forth during sleep, and all that it sees it whispers into the sleeper's ear and then he dreams. According to another account, the *tanoana* is the substance by which man lives, thinks and acts; the *tanoana* of man, plants and animals is of the same nature. A man's *tanoana* can be strengthened by those of others; when the *tanoana* is long away or destroyed the man dies. The *tanoana* seems to be the soul of which lycanthropic feats are asserted.

Among the Toradjas of central Celebes it is believed that a man's " inside " can take the form of a cat, wild pig, ape, deer or other animal, and afterwards resume human form; it is termed *lamboyo*. The exact relation of the *lamboyo* to the *tanoana* does not seem to be settled; it will be seen below that the view seems to vary. According to some the power of transformation is a gift of the gods, but others hold that werwolfism is contagious and may be acquired by eating food left by a werwolf or even by leaning one's head against the same pillar. The Todjoers hold that any one who touches blood becomes a werwolf. In accordance with this view is the belief that werwolfism can be cured; the breast and stomach of the werman must be rubbed and pinched, just as when any other witch object has to be extracted. The patient drinks medicine, and the contagion leaves the body in the form of snakes and worms. There are certain marks by which a werman can be recognized. His eyes are unsteady and sometimes green with dark shadows underneath. He does not sleep soundly and fireflies come out of his mouth. His lips remain red in spite of betel chewing, and he has a long tongue. The Todjoers add that his hair stands on end.

Some of the forms of the *lamboyo* are distinguishable from ordinary animals by the fact that they run about among the houses; the wer-buffalo has only one horn, and the wer-pig transforms itself into an ants' nest, such as hangs from trees. Some say that the werman does not really take the form of an animal himself, but, like the sorcerer, only sends out a messenger. The *lamboyo* attacks by preference solitary individuals, for he does not like to be observed. The victim feels sleepy and loses consciousness; the *lamboyo* then assumes human form (his body being, however, still at home) and cuts up his victim, scattering the fragments all about. He then takes the liver and eats it, puts the body together again, licks it with his long tongue and joins it together. When the victim comes to himself again he has no idea that anything unusual has happened to him. He goes home, but soon begins to feel unwell. In a few days he dies, but before his death he is able sometimes to name the werman to whom he has fallen a victim.

From this account it might be inferred that the *lamboyo* was identical with the *tanoana*; the absence of the *lamboyo* seems to entail a condition of unconsciousness, and it can assume human form. In other cases, however, the *lamboyo* seems to be analogous to the familiar of the sorcerer. The Toradjas tell a story of how a man once came to a house and asked the woman to give him a rendezvous; it was night and she was asleep; the question was put three times before the answer was given " in the tobacco plantation." The husband was awake, and next day followed his wife, who was irresistibly drawn thither. The werman came to meet her in human form, although his body was engaged in building a new house, and caused the woman to faint by stamping three times on the ground. Thereupon the husband attacked the werman with a piece of wood, and the latter to escape transformed himself into a leaf; this the husband put into a piece of bamboo and fastened the ends so that he could not escape. He then went back to the village and put the bamboo in the fire. The werman said " Don't," and as soon as it was burnt he fell dead.

In another case a woman died, and, as her death was believed to be due to the malevolence of a werwolf, her husband watched by her body. For, like Indian witches, the werwolf, for some reason, wishes to revive his victim and comes in human form to carry off the coffin. As soon as the woman was brought to life the husband attacked the werwolf, who transformed himself into a piece of wood and was burnt. The woman remained alive, but her murderer died the same night.

According to a third form of the belief, the body of the werman is itself transformed. One evening a man left the hut in which a party were preparing to pass the night; one of his companions heard a deer and fired into the darkness. Soon after the man came back and said he had been shot. Although no marks were to be seen he died a few days later.

In Central Java we meet with another kind of wer-tiger. The power of transformation is regarded as due to inheritance, to the use of spells, to fasting and will-power, to the use of charms, &c. Save when it is hungry or has just cause for revenge it is not hostile to man; in fact, it is said to take its animal form only at night and to guard the plantations from wild pigs, exactly as the *balams* (magicians) of Yucatan were said to guard the corn fields in animal form. Variants of this belief assert that the werman does not recognize his friends unless they call him by name, or that he goes out as a mendicant and transforms himself to take vengeance on those who refuse him alms. Somewhat similar is the belief of the Khonds; for them the tiger is friendly; he reserves his wrath for their enemies, and a man is said to take the form of a tiger in order to wreak a just vengeance.

Lycanthropy in South America.—According to K. F. P. v. Martius the *kanaima* is a human being who employs poison to carry out his function of blood avenger; other authorities represent the *kanaima* as a jaguar, which is either an avenger of blood or the familiar of a cannibalistic sorcerer. The Europeans of Brazil hold that the seventh child of the same sex in unbroken succession becomes a wer-man or woman, and takes the form of a horse, goat, jaguar or pig.

II. As a pathological state lycanthropy may be described as a kind of hysteria, and may perhaps be brought into connexion with the form of it known as *latah*. It is characterized by the patient's belief that he has been metamorphosed into an animal, and is often accompanied by a craving for strange articles of food, including the flesh of living beings or of corpses. In the lower stages of culture the state of the patient is commonly explained as due to possession, but where he leaves the neighbourhood of man real metamorphosis may be asserted, as in ordinary lycanthropic beliefs. Marcellus of Sida says that in Greece the patients frequented the tombs at night; they were recognizable by their yellow complexion, hollow eyes and dry tongue. The Garrows of India are said to tear their hair when they are seized with the complaint, which is put down to the use of a drug applied to the forehead; this recalls the stories of the witch's salve in Europe. In Abyssinia the patient is usually a woman; two forms are distinguished, caused by the hyena and the leopard respectively. A kind of trance ushers in the fit; the fingers are clenched, the eyes glazed and the nostrils distended; the patient, when she comes to herself, laughs hideously and runs on all fours. The exorcist is a blacksmith; as a rule, he applies onion or garlic to her nose and proceeds to question the evil spirit.

Bibliography.—For the anthropological side of the subject see bibliography to Werwolf; also *Tijdskrift voor indische Taal, Land en Volkenkunde*, xxviii. 338, xli. 548, 568; *Med. Zendelingsgenootschap*, xxxix. 3, 16; O. Stoll, *Suggestion*, p. 418; W. H. Brett, *Indians of British Guiana*. For the pathological side, see Hack Tuke, *Dict. of Psychological Medicine*, s.v. " Lycanthropy "; *Dict. des sciences médicales*; Waldmeier, *Autobiography*, p. 64; A. J. Hayes, *Source of Blue Nile*, p. 286 seq.; *Abh. phil.-hist. Klasse kgl. sächsische Gesellschaft der Wiss.* 17, No. 3. (N. W. T.)

LYCAON, in Greek mythology, son of Pelasgus, the mythical first king of Arcadia. He, or his fifty impious sons, entertained Zeus and set before him a dish of human flesh; the god pushed away the dish in disgust and either killed the king and his sons by lightning or turned them into wolves (Apollodorus iii. 8; Ovid, *Metam*. i. 198). Some say that Lycaon slew and dished up his own son Nyctimus (Clem. Alex. *Protrept*. ii. 36; Nonnus, *Dionys*. xviii. 20; Arnobius iv. 24). The deluge was said to have been sent by Zeus in the time of Deucalion in consequence of the sons' impiety. Pausanias (viii. 2) says that Lycaon sacrificed a child to Zeus on the altar on mount Lycaeus, and immediately after the sacrifice was turned into a wolf. This gave rise to the story that a man was turned into a wolf at each annual sacrifice to Zeus Lycaeus, but recovered his human form if he abstained from human flesh for ten years. The oldest city, the oldest cultus (that of Zeus Lycaeus), and the first civilization of Arcadia are attributed to Lycaon. His story has been variously interpreted. According to Weizsäcker, he was an old Pelasgian or pre-Hellenic god, to whom human sacrifice was offered, bearing a non-Hellenic name similar to λύκος, whence the story originated of his metamorphosis into a wolf. His cult was driven out by that of the Hellenic Zeus, and Lycaon himself was afterwards represented as an evil spirit, who had insulted the new deity by setting human flesh before him. Robertson Smith considers the sacrifices offered to the wolf-Zeus in Arcadia to have been originally cannibal feasts of a wolf-tribe, who recognized the wolf as their totem. Usener and others identify Lycaon with Zeus Lycaeus, the god of light, who slays his son Nyctimus (the dark) or is succeeded by him, in allusion to the perpetual succession of night and day. According to Ed. Meyer, the belief that Zeus Lycaeus accepted human sacrifice in the form of a wolf was the origin of the myth that Lycaon, the founder of his cult, became a wolf, *i.e.* participated in the nature of the god by the act of sacrifice, as did all who afterwards duly performed it. W. Mannhardt sees in the ceremony an allusion to certain agricultural rites, the object of which was to prevent the failure of the crops and to avert pestilence (or to protect them and the flocks against the ravages of wolves). Others (*e.g.* V. Bérard) take Zeus Lycaeus for a Semitic Baal, whose worship was imported into Arcadia by the Phoenicians; Immerwahr identifies him with Zeus Phyxios, the god of the exile who flees on account of his having shed blood. Another explanation is that the place of the sacred wolf once worshipped in Arcadia was taken in cult by Zeus Lycaeus, and in popular tradition by Lycaon, the ancestor of the Arcadians, who was supposed to have been punished for his insulting treatment of Zeus. It is possible that the whole may be merely a reminiscence of a superstition similar to the familiar werwolf stories.

See articles by P. Weizsäcker in Roscher's *Lexikon* and by G. Fougères (*s.v.* "Lykaia") in Daremberg and Saglio's *Dictionnaire des antiquités*; W. Immerwahr, *Die Kulte und Mythen Arkadiens*, I. (1891), p. 14; L. R. Farnell, *Cults of the Greek States*, i. (1896), p. 40; A. Lang, *Myth, Ritual and Religion* (1899); C. Pascal, *Studii di antichità e mitologia* (1896), who sees in Lycaon a god of death honoured by human sacrifice; Ed. Meyer, *Forschungen zur alten Geschichte*, i. (1892), p. 60; W. Mannhardt, *Wald- und Feldkulte*, ii. (1905); G. Fougères, *Mantinée et l'Arcadie orientale* (1898), p. 202; V. Bérard, *De l'origine des cultes arcadiens* (1894); H. D. Müller, *Mythologie der griechischen Stämme*, ii. (1861), p. 78; H. Usener, *Rheinisches Museum*, liii. (1898), p. 375; G. Görres, *Berliner Studien für classische Philologie*, x. 1 (1889), who regards the Lycaea as a funeral festival connected with the changes of vegetation; Vollgraf, *De Ovidii mythopoeia*; a concise statement of the various forms of the legend in O. Gruppe, *Griechische Mythologie*, ii. p. 920, n. 4; see also LYCANTHROPY; D. Bassi, "Apollo Liceo," in *Rivisia di storia antica*, i. (1895); and Frazer's *Pausanias*, iv. p. 189.

(J. H. F.)

LYCAONIA, in ancient geography, a large region in the interior of Asia Minor, north of Mount Taurus. It was bounded on the E. by Cappadocia, on the N. by Galatia, on the W. by Phrygia and Pisidia, while to the S. it extended to the chain of Mount Taurus, where it bordered on the country popularly called in earlier times Cilicia Tracheia and in the Byzantine period Isauria; but its boundaries varied greatly at different times. The name is not found in Herodotus, but Lycaonia is mentioned by Xenophon as traversed by Cyrus the younger on his march through Asia. That author describes Iconium as the last city of Phrygia; and in Acts xiv. 5 St Paul, after leaving Iconium, crossed the frontier and came to Lystra in Lycaonia. Ptolemy, on the other hand, includes Lycaonia as a part of the province of Cappadocia, with which it was associated by the Romans for administrative purposes; but the two countries are clearly distinguished both by Strabo and Xenophon and by authorities generally.

Lycaonia is described by Strabo as a cold region of elevated plains, affording pasture to wild asses and to sheep; and at the present day sheep abound, but asses are practically unknown. Amyntas, king of Galatia, to whom the district was for a time subject, maintained there not less than three hundred flocks. It forms part of the interior tableland of Asia Minor, and has an elevation of more than 3000 ft. It suffers from want of water, aggravated in some parts by abundance of salt in the soil, so that the northern portion, extending from near Iconium to the salt lake of Tatta and the frontiers of Galatia, is almost wholly barren, only small patches being cultivated near Iconium and the large villages. The soil, where water is supplied, is productive. In ancient times great attention was paid to storing and distributing the water, so that much land now barren was formerly cultivated and supported a large number of cities.

The plain is interrupted by some minor groups of mountains, of volcanic character, of which the Kara Dagh in the south, a few miles north of Karaman, rises above 7000 ft., while the Karadja Dagh, north-east of it, though of inferior elevation, presents a striking range of volcanic cones. The mountains in the north-west, near Iconium and Laodicea, are the termination of the Sultan Dagh range, which traverses a large part of Phrygia.

The Lycaonians appear to have been in early times to a great extent independent of the Persian empire, and were like their neighbours the Isaurians a wild and lawless race of freebooters; but their country was traversed by one of the great natural lines of high road through Asia Minor, from Sardis and Ephesus to the Cilician gates, and a few considerable towns grew up along or near this line. The most important was Iconium, in the most fertile spot in the country, of which it was always regarded by the Romans as the capital, although ethnologically it was Phrygian. It is still called Konia, and it was the capital of the Seljuk Turkish empire for several centuries. A little farther north, immediately on the frontier of Phrygia, stood Laodicea (Ladik), called Combusta, to distinguish it from the Phrygian city of that name; and in the south, near the foot of Mount Taurus, was Laranda, now called Karaman, which has given name to the province of Karamania. Derbe and Lystra, which appear from the Acts of the Apostles to have been considerable towns, were between Iconium and Laranda. There were many other towns, which became bishoprics in Byzantine times. Lycaonia was Christianized very early; and its ecclesiastical system was more completely organized in its final form during the 4th century than that of any other region of Asia Minor.

After the defeat of Antiochus the Great, Lycaonia was given by the Romans to Eumenes II., king of Pergamos. About 160 B.C. part of it, the "Tetrarchy of Lycaonia," was added to Galatia; and in 129 B.C. the eastern half (usually called during the following 200 years Lycaonia proper) was given to Cappadocia as an eleventh strategia. In the readjustment of the Provinciae, 64 B.C., by Pompey after the Mithradatic wars, he gave the northern part of the tetrarchy to Galatia and the eastern part of the eleventh strategia to Cappadocia. The remainder was attached to Cilicia. Its administration and grouping changed often under the Romans. In A.D. 371 Lycaonia was first formed into a separate province. It now forms part of the Konia vilâyet.

The Lycaonians appear to have retained a distinct nationality in the time of Strabo, but their ethnical affinities are unknown. The mention of the Lycaonian language in the Acts of the Apostles (xiv. 11) shows that the native language was spoken by the common people at Lystra about A.D. 50; and probably it was only later and under Christian influence that Greek took its place.

See Sir W. M. Ramsay, *Historical Geography of Asia Minor* (1890), *Historical Commentary on Galatians* (1899) and *Cities of St Paul* (1907); also an article on the topography in the *Jahreshefte des Oesterr. Archaeolog. Instituts*, 194 (Beiblatt) pp. 57-132.

(W. M. RA.)

LYCEUM, the latinized form of Gr. *Λύκειον*, the name of a gymnasium and garden with covered walks, near the temple of Apollo Lyceus (Ἀπόλλων Λύκειος) at Athens. Aristotle taught here, and hence the name was applied to his school of philosophy. The name had been used in many languages for places of instruction, &c. In France the term *lycée* is given to the secondary schools which are administered by the state, in contradistinction to the communal *collèges*.

LYCIA, in ancient geography, a district in the S.W. of Asia Minor, occupying the coast between Caria and Pamphylia, and extending inland as far as the ridge of Mt Taurus. The region thus designated is a peninsula projecting southward from the great mountain masses of the interior. It is for the most part a rugged mountainous country, traversed by offshoots of the Taurus range, which terminate on the coast in lofty promontories. The coast, though less irregular than that of Caria, is indented by a succession of bays—the most marked of which is the Gulf of Macri (anc. *Glaucus Sinus*) in the extreme west. A number of smaller bays, and broken rocky headlands, with a few small islets, constitute the coast-line thence to the S.E. promontory of Lycia, formed by a long narrow tongue of rocky hill, known in ancient times as the "Sacred Promontory" (Hiera Acra), with three small adjacent islets, called the Chelidonian islands, which was regarded by some ancient geographers as the commencement of Mt. Taurus. Though the mountain ranges of Lycia are all offshoots of Mt. Taurus, in ancient times several of them were distinguished by separate names. Such were Daedala in the west, adjoining the Gulf of Macri, Cragus on the sea-coast, west of the valley of the Xanthus, Massicytus (10,000 ft.) nearly in the centre of the region, and Solyma in the extreme east above Phaselis (7800 ft.). The steep and rugged pass between Solyma and the sea, called the Climax ("Ladder"), was the only direct communication between Lycia and Pamphylia.

The only two considerable rivers are: (1) the Xanthus, which descends from the central mass of Mt Taurus, and flows through a narrow valley till it reaches the city of the same name, below which it forms a plain of some extent before reaching the sea, and (2) the Limyrus, which enters the sea near Limyra. The small alluvial plains at the mouths of these rivers are the only level ground in Lycia, but the hills that rise thence towards the mountains are covered with a rich arborescent vegetation. The upper valleys and mountain sides afford good pasture for sheep, and the main Taurus range encloses several extensive upland basin-shaped valleys (*vailas*), which are characteristic of that range throughout its extent (see ASIA MINOR).

The limits of Lycia towards the interior seem to have varied at different times. The high and cold upland tract to the north-east, called Milyas, was by some writers included in that province, though it is naturally more connected with Pisidia. According to Artemidorus (whose authority is followed by Strabo), the towns that formed the Lycian league in the days of its integrity were twenty-three in number; but Pliny states that Lycia once possessed seventy towns, of which only twenty-six remained in his day. Recent researches have fully confirmed the fact that the sea-coast and the valleys were thickly studded with towns, many of which are proved by existing remains to have been places of importance. By the aid of inscriptions the position of the greater part of the cities mentioned in ancient authors can be fixed. On the gulf of Glaucus, near the frontiers of Caria, stood Telmessus, an important place, while a short distance inland from it were the small towns of Daedala and Cadyanda. At the entrance of the valley of the Xanthus were Patara, Xanthus itself, and, a little higher up, Pinara on the west and Tlos on the east side of the valley, while Araxa stood at the head of the valley, at the foot of the pass leading into the interior. Myra, one of the most important cities of Lycia, occupied the entrance of the valley of the Andriacus; on the coast between this and the mouth of the Xanthus stood Antiphellus, while in the interior at a short distance were found Phellus, Cyaneae and Candyba. In the alluvial plain formed by the rivers Arycandus and Limyrus stood Limyra, and encircling the same bay the three small towns of Rhodiapolis, Corydalla and Gagae. Arycanda commanded the upper valley of the river of the same name. On the east coast stood Olympus, one of the cities of the league, while Phaselis, a little farther north, which was a much more important place, never belonged to the Lycian league and appears always to have maintained an independent position.

The cold upland district of the Milyas does not seem to have contained any town of importance. Podalia appears to have been its chief place. Between the Milyas and the Pamphylian Gulf was the lofty mountain range of Solyma, which was supposed to derive its name from the Solymi, a people mentioned by Homer in connexion with the Lycians and the story of Bellerophon. In the flank of this mountain, near a place called Deliktash, was the celebrated fiery source called the Chimaera, which gave rise to many fables. It has been visited in modern times by Captain F. Beaufort, T. A. B. Spratt and Edward Forbes, and other travellers, and is merely a stream of inflammable gas issuing from crevices in the rocks, such as are found in several places in the Apennines. No traces of recent volcanic action exist in Lycia.

History.—The name of the Lycians, *Lukki*, is first met with in the Tel el-Amarna tablets (1400 B.C.) and in the list of the nations from the eastern Mediterranean who invaded Egypt in the reign of Mineptah, the successor of Rameses II. At that time they seem to have occupied the Cilician coast. Their occupation of Lycia was probably later, and since the Lycian inscriptions are not found far inland, we may conclude that they entered the country from the sea. On the other hand the name appears to be preserved in Lycaonia, where some bands of them may have settled. According to Herodotus they called themselves Termilae, written Trmmile in the native inscriptions, and he further states that the original inhabitants of the country were the Milyans and Solymi, the Lycians being invaders from Crete. In this tradition there is a reminiscence of the fact that the Lycians had been sea-rovers before their settlement in Lycia. The Lycian Sarpedon was believed to have taken part in the Trojan war. The Lydians failed to subdue Lycia, but after the fall of the Lydian empire it was conquered by Harpagus the general of Cyrus, Xanthus or Arnna, the capital, being completely destroyed. While acknowledging the suzerainty of Persia, however, the Lycians remained practically independent, and for a time joined the Delian league. "The son of Harpagus" on the obelisk of Xanthus boasts of having sacked numerous cities in alliance with the Athenian goddess. The Lycians were incorporated into the empire of Alexander and his successors, but even after their conquest by the Romans, preserved their federal institutions as late as the time of Augustus. According to Strabo the principal towns in the league were Xanthus, Patara, Pinara, Olympus, Myra and Tlos; each of these had three votes in the general assembly, while the other towns had only two or one. Taxation and the appointment of the Lyciarch and other magistrates were vested in the assembly. Under Claudius Lycia was formally annexed to the Roman empire, and united with Pamphylia: Theodosius made it a separate province.

Antiquities.—Few parts of Asia Minor were less known in modern times than Lycia up to the 19th century. Captain Beaufort was the first to visit several places on the sea-coast, and the remarkable rock-hewn tombs of Telmessus had been already described by Dr Clarke, but it was Sir Charles Fellows who first discovered and drew attention to the extraordinary richness of the district in ancient remains, especially of a sepulchral character. His visits to the country in 1838 and 1840 were followed by an expedition sent by the British government in 1842 to transport to England the valuable monuments now in the British Museum, while Admiral Spratt and Edward Forbes explored the interior, and laid down its physical features on an excellent map. The monuments thus brought to light are among the most interesting of those discovered in Asia Minor, and prove the existence of a distinct native architecture, especially in the rock-cut tombs. But the theatres found in almost every town, some of them of very large size, are sufficient to attest the pervading influence of Greek civilization; and this is confirmed by the sculptures, which are for the most part wholly Greek. None of them, indeed, can be ascribed to a very early period, and hardly any trace can be found of the influence of Assyrian or other Oriental art.

One of the most interesting results of these recent researches has been the discovery of numerous inscriptions in the native language of the country, and written in an alphabet peculiar to Lycia. A few of these inscriptions are bilingual, in Greek and Lycian, and the clue thus afforded to their interpretation has been followed up, first by Daniel Sharpe and Moritz Schmidt, and in more recent years by J. Imbert, W. Arkwright, V. Thomsen, A. Torp, S. Bugge and E. Kalinka.

The alphabet was derived from the Doric alphabet of Rhodes, but ten other characters were added to it to express vocalic and other sounds not found in Greek. The attempts to connect the language with the Indo-European family have been unsuccessful; it belongs to a separate family of speech which we may term "Asianic." Most of the inscriptions are sepulchral; by far the longest and most important is that on an obelisk found at Xanthus, which is a historical document, the concluding part of it being in a peculiar dialect, supposed to be an older and poetical form of the language. Among the deities mentioned are Trzzube (Trosobis) and Trqqiz or Trqqas.

Lycian art was modelled on that of the Greeks. The rock-cut tomb usually represented the house of the living, with an elaborate façade, but in one or two instances, notably that of the so-called Harpy-tomb, the façade is surmounted by a tall, square tower, in the upper part of which is the sepulchral chamber. Lycian sculpture followed closely the development of Greek sculpture, and many of the sculptures with which the tombs are adorned are of a high order of merit. The exquisite bas-reliefs on a Lycian sarcophagus now in the museum of Constantinople are among the finest surviving examples of classical art. The bas-reliefs were usually coloured. For the coinage, see NUMISMATICS, section "Asia Minor."

AUTHORITIES.—C. Fellows, *Journal in Asia Minor* (1839) and *Discoveries in Lycia* (1841); T. A. B. Spratt and E. Forbes, *Travels in Lycia* (1847); O. Benndorf and G. Niemann, *Reisen im südwestlichen Kleinasien* (1884); E. Petersen and F. von Luschan, *Reisen in Lykien* (1889); O. Treuber, *Geschichte der Lykier* (1887); G. Perrot and C. Chipiez, *Histoire de l'art dans l'antiquité*, v. (1890); P.

Kretschmer, *Einleitung in die Geschichte der griechischen Sprache* (1896); S. Bugge, *Lykische Studien* (from 1897); A. Torp, *Lykische Beiträge* (from 1898); V. Thomsen, *Études lyciennes* (1899); E. Kalinka and R. Heberdey, *Tituli Asiae Minoris*, i. (1901); see also articles XANTHUS, MYRA, PATARA. (A. H. S.)

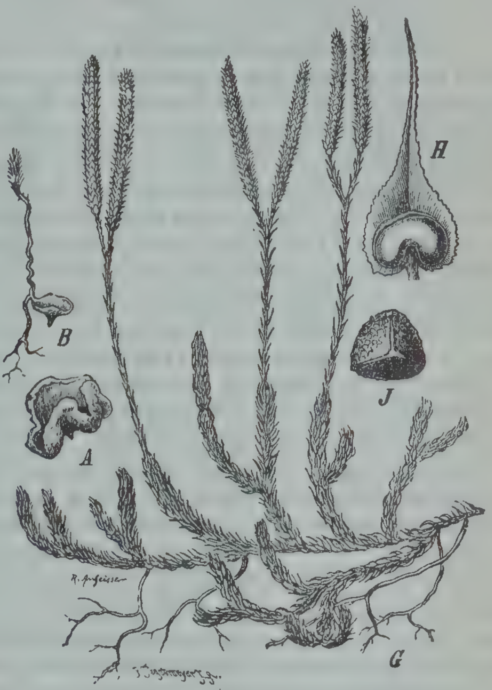
LYCK, or LYK, a town of Germany, in the Prussian province of East Prussia, 112 m. by rail S.E. of Königsberg, and close to the frontier of Poland, on a lake and river of the same name. Pop. (1900) 11,386. It is the chief town of the region known as Masuria. On an island in the lake is a castle formerly belonging to the Teutonic order, and dating from 1273, now used as a prison. There are iron-foundries, distilleries, breweries, tanneries, paper mills and flour mills, and a trade in grain and cattle.

LYCOPHRON, Greek poet and grammarian, was born at Chalcis in Euboea. He flourished at Alexandria in the time of Ptolemy Philadelphus (285–247 B.C.). According to Suïdas, he was the son of Socles, but was adopted by Lycus of Rhegium. He was entrusted by Ptolemy with the task of arranging the comedies in the Alexandrian library, and as the result of his labours composed a treatise *On Comedy*. His own compositions, however, chiefly consisted of tragedies (Suïdas gives the titles of twenty, of which very few fragments have been preserved), which secured him a place in the Pleiad of Alexandrian tragedians. One of his poems, *Alexandra* or *Cassandra*, containing 1474 iambic lines, has been preserved entire. It is in the form of a prophecy uttered by Cassandra, and relates the later fortunes of Troy and of the Greek and Trojan heroes. References to events of mythical and later times are introduced, and the poem ends with a reference to Alexander the Great, who was to unite Asia and Europe in his world-wide empire. The style is so enigmatical as to have procured for Lycophron, even among the ancients, the title of "obscure" (σκοτεινός). The poem is evidently intended to display the writer's knowledge of obscure names and uncommon myths; it is full of unusual words of doubtful meaning gathered from the older poets, and many long-winded compounds coined by the author. It has none of the qualities of poetry, and was probably written as a show-piece for the Alexandrian school. It was very popular in the Byzantine period, and was read and commented on very frequently; the collection of scholia by Isaac and John Tzetzes is very valuable, and the MSS. of the *Cassandra* are numerous.[1] A few well-turned lines which have been preserved from Lycophron's tragedies show a much better style; they are said to have been much admired by Menedemus of Eretria, although the poet had ridiculed him in a satyric drama. Lycophron is also said to have been a skilful writer of anagrams.

Editio princeps (1513); J. Potter (1697, 1702); L. Sebastiani (1803); L. Bachmann (1830); G. Kinkel (1880); E. Scheer (1881–1908), vol. ii. containing the scholia. The most complete edition is by C. von Holzinger (with translation, introduction and notes, 1895). There are translations by F. Dehèque (1853) and Viscount Royston (1806; a work of great merit). See also Wilamowitz-Möllendorff, *De Lycophronis Alexandra* (1884); J. Konze, *De Dictione Lycophronis* (1870). The commentaries of the brothers Tzetzes have been edited by C. O. Müller (1811).

LYCOPODIUM, the principal genus of the Lycopodiaceae, a natural order of the Fern-allies (see PTERIDOPHYTA). They are flowerless herbs, with an erect, prostrate or creeping widely-branched stem, with small simple leaves which thickly cover the stem and branches. The "fertile" leaves are arranged in cones, and bear spore-cases (sporangia) in their axils, containing spores of one kind only. The prothallium developed from the spore is a subterranean mass of tissue of considerable size, and bears the male and female organs (*antheridia* and *archegonia*). There are about a hundred species widely distributed in temperate and tropical climates; five occur in Britain on heaths and moors, chiefly in mountainous districts, and are known as club-mosses. The commonest species, *L. clavatum*, is also known as stag-horn moss.

Gerard, in 1597, described two kinds of lycopodium (*Herball*, p. 1373) under the names *Muscus denticulatus* and *Muscus clavatus* (*L. clavatum*) as "Club Mosse or Woolfes Clawe Mosse," the names being in Low Dutch, "Wolfs Clauwen," from the resemblance of the club-like or claw-shaped shoots to the toes of a wolf, "whereupon we first named it *Lycopodion*." Gerard also speaks of its emetic and many other supposed virtues. *L. Selago* and *L. catharticum* (a native of the Andes) have been said to be, at least when fresh, cathartic; but, with the exception of the spores of *L. clavatum* ("lycopodium powder"), lycopodium as a drug has fallen into disuse. The powder is used for rolling pills in, as a dusting powder for infants' sores, &c. A *tinctura lycopodii*, containing one part of the powder to ten of alcohol (90 %), has been given, in doses of 15 to 60 minims, in cases of irritation and spasm of the bladder. The powder is highly inflammable, and is used in pyrotechny and for artificial lightning on the stage. If the hand be covered with the powder it cannot be wetted on being plunged into water. Another use of lycopodium is for dyeing; woollen cloth boiled with species of lycopodium, as *L. clavatum*, becomes blue when dipped in a bath of Brazil wood.



From Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.

FIG. 1.—Lycopodium clavatum.

A, Old prothallus.
B, Prothallus bearing a young sporophyte.
G, Polian of a mature plant, showing the creeping habit, the adventitious roots and the specialized erect branches bearing the strobile or cones.
H, Sporophyte bearing the single sporangium on its upper surface.
J, Spore.

LYCOSURA (mod. *Palaeokastro* or *Siderokastro*), a city of Arcadia, reputed to be the most ancient city in Greece, and to have been founded by Lycaon the son of Pelasgus. Its fame in later times was chiefly associated with the temple of Despoena, containing the colossal group made by Damophon of Messene, of Despoena and Demeter seated, with Artemis and the Titan Anytus standing beside them. The temple and considerable remains of the group of sculpture were found in 1889. The date of both has been a matter of dispute, Damophon being placed at dates varying from the 4th century B.C. to the age of Hadrian. But it has now been shown that he lived in the 2nd century B.C. Remains of a portico, altars and other structures have also been found.

See Πρακτικὰ τῆς Ἀρχ. Ἑταιρίας (1896); G. Dickens, *Annual of British School at Athens*, xii. and xiii.

LYCURGUS (Gr. Λυκοῦργος), in Greek history, the reputed founder of the Spartan constitution. Plutarch opens his biography of Lycurgus with these words: "About Lycurgus the lawgiver it is not possible to make a single statement that is not called in question. His genealogy, his travels, his death, above all, his legislative and constitutional activity have been variously recorded, and there is the greatest difference of opinion as to his date." Nor has modern historical criticism arrived at any certain results. Many scholars, indeed, suppose him to be in reality a god or hero, appealing to the existence of a temple and cult of Lycurgus at Sparta as early as the time of Herodotus, (i. 66), and to the words of the Delphic oracle (Herod. i. 65)—

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[1] Two passages of the *Cassandra*, 1446–1450 and 1226–1282, in which the career of the Roman people and their universal empire are spoken of, could not possibly have been written by an Alexandrian poet of 250 B.C. Hence it has been maintained by Niebuhr and others that the poem was written by a later poet mentioned by Tzetzes, but the opinion of Welcker that these paragraphs are a later interpolation is generally considered more probable.

δίζω ἤ σε θεὸν μαντεύσομαι ἢ ἄνθρωπον·
ἀλλ' ἔτι καὶ μᾶλλον θεὸν ἔλπομαι, ὦ Λυκόοργε.

If this be so, he is probably to be connected with the cult of Apollo Lycius or with that of Zeus Lycaeus. But the majority of modern historians agree in accepting Lycurgus as an historical person, however widely they may differ about his work.

According to the Spartan tradition preserved by Herodotus, Lycurgus was a member of the Agiad house, son of Agis I. and brother of Echestratus. On the death of the latter he became regent and guardian of his nephew Labotas (Leobotes), who was still a minor. Simonides, on the other hand, spoke of him as a Eurypontid, son of Prytanis and brother of Eunomus, and later the tradition prevailed which made him the son of Eunomus and Dionassa, and half-brother of the king Polydectes, on whose death he became guardian of the young king Charillus. According to Herodotus he introduced his reforms immediately on becoming regent, but the story which afterwards became generally accepted and is elaborated by Plutarch represented him as occupying for some time the position of regent, then spending several years in travels, and on his return to Sparta carrying through his legislation when Charillus was king. This latter version helped to emphasize the disinterestedness of the lawgiver, and also supplied a motive for his travels—the jealousy of those who accused him of trying to supplant his nephew on the throne. He is said to have visited Crete, Egypt and Ionia, and some versions even took him to Spain, Libya and India.

Various beliefs were held as to the source from which Lycurgus derived his ideas of reform. Herodotus found the tradition current among the Spartans that they were suggested to Lycurgus by the similar Cretan institutions, but even in the 5th century there was a rival theory that he derived them from the Delphic oracle. These two versions are united by Ephorus, who argued that, though Lycurgus had really derived his system from Crete, yet to give it a religious sanction he had persuaded the Delphic priestess to express his views in oracular form.

The Reforms.—Herodotus says that Lycurgus changed "all the customs," that he created the military organization of ἐνωμοτίαι (*enomoties*), τριηκάδες (*triecades*) and συσσίτια (*syssitia*), and that he instituted the ephorate and the council of elders. To him, further, are attributed the foundation of the apella (the citizen assembly), the prohibition of gold and silver currency, the partition of the land (γῆς ἀναδασμός) into equal lots, and, in general, the characteristic Spartan training (ἀγωγή). Some of these statements are certainly false. The council of elders and the assembly are not in any sense peculiar to Sparta, but are present in the heroic government of Greece as depicted in the Homeric poems. The ephors, again, are almost universally held to be either an immemorial heritage of the Dorian stock or —and this seems more probable—an addition to the Spartan constitution made at a later date than can be assigned to Lycurgus. Further, the tradition of the Lycurgan partition of the land is open to grave objections. Grote pointed out (*History of Greece*, pt. ii. ch. 6) that even from the earliest historical times we find glaring inequalities of property at Sparta, and that the tradition was apparently unknown to all the earlier Greek historians and philosophers down to Plato and Aristotle: Isocrates (xii. 259) expressly denied that a partition of land had ever taken place in the Spartan state. Again, the tradition presupposes the conquest by the Spartans of the whole, or at least the greater part, of Laconia, yet Lycurgus must fall in the period when the Spartans had not yet subjugated even the middle Eurotas plain, in which their city lay. Finally, we can point to an adequate explanation of the genesis of the tradition in the ideals of the reformers of the latter part of the 3rd century, led by the kings Agis IV. and Cleomenes III. (*q.v.*). To them the cause of Sparta's decline lay in the marked inequalities of wealth, and they looked upon a redistribution of the land as the reform most urgently needed. But it was characteristic of the Greeks to represent the ideals of the present as the facts of the past, and so such a story as that of the Lycurgan γῆς ἀναδασμός may well have arisen at this time. It is at least noteworthy that the plan of Agis to give 4500 lots to Spartans and 15,000 to perioeci suspiciously resembles that of Lycurgus, in whose case the numbers are said to have been 9000 and 30,000 respectively. Lastly, the prohibition of gold and silver money cannot be attributed to Lycurgus, for at so early a period coinage was yet unknown in Greece.

Lycurgus, then, did not create any of the main elements of the Spartan constitution, though he may have regulated their powers and defined their position. But tradition represented him as finding Sparta the prey of disunion, weakness and lawlessness, and leaving her united, strong and subject to the most stable government which the Greek world had ever seen. Probably Grote comes near to the truth when he says that Lycurgus "is the founder of a warlike brotherhood rather than the lawgiver of a political community." To him we may attribute the unification of the several component parts of the state, the strict military organization and training which soon made the Spartan hoplite the best soldier in Greece, and above all the elaborate and rigid system of education which rested upon, and in turn proved the strongest support of, that subordination of the individual to the state which perhaps has had no parallel in the history of the world.

Lycurgus's legislation is very variously dated, and it is not possible either to harmonize the traditions or to decide with confidence between them. B. Niese (*Hermes*, xlii. 440 sqq.) assigns him to the first half of the 7th century B.C. Aristotle read Lycurgus's name, together with that of Iphitus, on the discus at Olympia which bore the terms of the sacred truce, but even if the genuineness of the document and the identity of this Lycurgus with the Spartan reformer be granted, it is uncertain whether the discus belongs to the so-called first Olympiad, 776 B.C., or to an earlier date. Most traditions place Lycurgus in the 9th century: Thucydides, whom Grote follows, dates his reforms shortly before 804, Isocrates and Ephorus go back to 869, and the chronographers are divided between 821, 828 and 834 B.C. Finally, according to a tradition recorded by Xenophon (*Resp. Laced.* x. 8), he was contemporary with the Heraclidae, in which case he would belong to the 10th century B.C.

AUTHORITIES.—Our chief ancient authorities, besides Plutarch's biography, are:—Herodotus i. 65; Xenophon, *Respublica Lacedaemoniorum*; Ephorus *ap.* Strabo x. 481, 482; Aristotle, *Politics*, ii.; Pausanias iii. and v. 4; and scattered passages in Plato, Isocrates, Polybius, Diodorus, Polyaenus, &c. Of modern works the most important are: E. Meyer, "Lykurgos von Sparta," in *Forschungen zur alten Geschichte* (Halle, 1892), i. 211 sqq.; A. Kopstadt, *De rerum Laconicarum constitutionis Lycurgeae origine et indole* (Greifswald, 1849); H. K. Stein, *Kritik der Überlieferung über den spartanischen Gesetzgeber Lykurg* (Glatz, 1882); S. Wide, "Bemerkungen zur spartanischen Lykurglegende," in *Skand. Archiv.* i. (1891), 90 sqq.; E. Nusselt, *Das Lykurgproblem* (Erlangen, 1898); H. Bazin, *De Lycurgo* (Paris, 1885); C. Reuss, *De Lycurgea quae fertur agrorum divisione* (Pforzheim, 1878); A. Busson, *Lykurgos und die grosse Rhetra* (Innsbruck, 1887); H. Gelzer, "Lykurg und die delphische Priesterschaft" in *Rhein. Mus.* xxviii. 1 sqq.; F. Winicker, *Stand der Lykurgischen Frage* (Graudenz, 1884); G. Attinger, *Essai sur Lycurgue et ses institutions* (Neuchâtel, 1892); the general Greek histories, and the works on the Spartan constitution cited under SPARTA. (M. N. T.)

LYCURGUS (*c.* 396–325 B.C.), one of the "ten" Attic orators. Through his father, Lycophron, he belonged to the old Attic priestly family of the Eteobutadae. He is said to have been a pupil both of Plato and of Isocrates. His early career is unknown, but after the real character of the struggle with Philip of Macedon became manifest he was recognized, with Demosthenes and Hypereides, as one of the chiefs of the national party. He left the care of external relations to his colleagues, and devoted himself to internal organization and finance. He managed the finances of Athens for twelve successive years (338–326), at first directly as treasurer of the revenues (ὁ ἐπὶ τῇ διοικήσει) for four years, and in two succeeding terms, when the actual office was forbidden him by law, through his son and a nominal official chosen from his party. Part of one of the deeds in which he rendered account of his term of office is still preserved in an inscription. During this time he raised the public income from 600 to 1200 talents yearly. He increased the navy, repaired the dockyards, and completed an arsenal, the *σκευοθήκη* designed by the architect Philo. He was also appointed to various other offices connected with the preservation and improvement of the city. He was very strict in his superintendence of the public morals, and passed a sumptuary law to restrain extravagance. He did much to beautify the city; he reconstructed the great Dionysiac theatre and the gymnasium in the Lyceum, and erected the Panathenaic stadium on the Ilissus. He is mentioned as the proposer of five laws, of which the most famous was that statues of the three great tragedians should be erected in the theatre, and that their works should be carefully edited and preserved among the state archives. For his services he was honoured with crowns, statues and a seat in the town hall; and after his death his friend Stratocles drew up a decree (still extant in pseudo-Plutarch, *Vit. dec. orat.* p. 851; see also E. L. Hicks, *Greek Historical Inscriptions*, 1st ed., No. 145), ordering the erection of a statue of bronze to Lycurgus, and granting the honours of the Prytaneum to his eldest son. He was one of the orators whose surrender was demanded by Alexander the Great, but the people refused to give him up. He died while president of the theatre of Dionysus, and was buried on the road leading to the Academy at the expense of the state.

Lycurgus was a man of action; his orations, of which fifteen were published, are criticized by the ancients for their awkward arrangement, harshness of style, and the tendency to digressions about mythology and history, although their noble spirit and lofty morality are highly praised. The one extant example, *Against Leocrates*, fully bears out this criticism. After the battle of Chaeroneia (338), in spite of the decree which forbade emigration under pain of death, Leocrates had fled from Athens. On his return (probably about 332) he was impeached by Lycurgus, but acquitted, the votes of the judges being equally divided.

The speech has been frequently edited. Editio princeps (Aldine, 1513); F. G. Kiessling (1847) with M. H. E. Meier's commentary on pseudo-Plutarch's *Life of Lycurgus* and the fragments of his speeches; C. Rehdantz (1876); T. Thalheim (1880); C. Scheibe (1885); F. Blass (ed. major, 1889), with bibliography of editions and articles (ed. minor, 1902); E. Sofer (Leipzig, 1905), with notes and introd. There is an index to Andocides, Lycurgus and Dinarchus by L. L. Forman (Oxford, 1897). The exhaustive treatise of F. Dürrbach, *L'Orateur Lycurgue* (1890), contains a list of the most important review articles on the financial and naval administration of Lycurgus and on his public works; see also C. Droege, *De Lycurgo publicarum pecuniarum administratore* (Minden, 1880). Several fragments of his various laws have been preserved in inscriptions (*Corpus inscriptionum atticarum*, ii. 162, 163, 173, 176, 180). On the history of the period see authorities under DEMOSTHENES.

LYCURGUS, "THE LOGOTHETE" (1772–1851), Greek leader in the War of Independence, was born in the island of Samos. He was educated at Constantinople, received the usual training, and followed the customary career of a Phanariot Greek. He accompanied Constantine Ypsilanti when he was appointed hospodar of Walachia, as secretary, and served Ypsilanti's successor, Alexander Soutzos, as treasurer and chancellor (Logothete). In 1802 he returned to Samos, and having become suspected by the Turkish government was imprisoned. He fled to Smyrna, when he was pardoned and released by the Turks. When the War of Independence began he induced his countrymen to declare Samos independent, and was chosen ruler. His share in the War of Independence is chiefly memorable because he provoked the massacre of Chios in 1822. Lycurgus conducted an expedition of 2500 to that island, which was held by a Turkish garrison under Velna Pasha. His force was insufficient, the time was ill-chosen, for a strong Turkish fleet was at sea, and Lycurgus displayed utter incapacity as a military leader. After these events, he was deposed by the Samians, but recovered some influence and had a share in the defence of Samos against the Turks in 1824. When the island was left under the authority of Turkey by the protocol of the 3rd of February 1830, he helped to obtain autonomy for the Samians. He retired to Greece and died on the 22nd of May 1851.

See G. Finlay, *History of the Greek Revolution* (London, 1861).

LYDD, a market town and municipal borough in the southern parliamentary division of Kent, England, $71\frac{1}{2}$ m. S.E. by E. of London by a branch of the South-Eastern & Chatham railway. Pop. (1901) 2675. It lies in the open lowland of Dunge Marsh. To the south-east are the bare shingle banks of the promontory of Dungeness. Its church of All Saints has a beautiful Perpendicular tower with rich vaulting within. The neighbourhood affords pasture for large flocks of sheep. On the land known as the Rypes, in the neighbourhood, there is a military camp, with artillery and rifle ranges; hence the name given to the explosive "lyddite." The town is governed by a mayor, 4 aldermen and 12 councillors. Area, 12,043 acres.

The first settlement at Lydd (Hlide, Lide, Lyde) was probably due to its convenience as a fishing-station. After the Conquest it became a seaport of some consequence and although now, owing to the alteration of the coast, it stands nearly 3 m. inland a number of its inhabitants are still fishermen. In 774 land in Lydd was granted by Offa to the monks of Christ Church, Canterbury, and the archbishop of Canterbury evidently held the lordship of the town from an early date. At some time before the reign of Edward I. Lydd was made a member of the Cinque Port of Romney, and in 1290 was granted the same liberties and free customs as the Cinque Ports on condition of aiding the service of its head-port to the crown with one ship. This charter was confirmed by Edward III. in 1365. The corporation also possesses documents of 1154, 1399 and 1413, granting to the archbishop's men of Lydd the privileges enjoyed by the Cinque Ports and confirming all former privileges. Lydd is called a borough in the Hundred Rolls. Its incorporation under a bailiff, of which there is evidence in the 15th century, may have been due to the archbishop or to the court of Shepway, but it was not incorporated by the crown until 1885, when, by a charter under the Municipal Acts, the last bailiff was elected the first mayor. In 1494 a grant was made to the bailiff, jurats and commonalty of a yearly fair on the 12th of July and two days following. A fair was held under this grant until 1874.

LYDENBURG, a town and district of the Transvaal, South Africa. The town is 60 m. by rail N.N.E. of Belfast on the Pretoria-Delagoa Bay railway. Pop. (1904) 1523. It is picturesquely situated on the Spekboom tributary of the Olifants river at an altitude of 4900 ft. Some 15 m. E. is the Mauchberg (8725 ft.), the highest point in the Transvaal. The town is the chief centre for the Lydenburg goldfields. Next to Lydenburg the most important settlement in these goldfields is Pilgrim's Rest, pop. (1904) 1188, 23 m. N.E. of Lydenburg. Lydenburg (the town of suffering) was founded in 1846 by Boers who two years previously had established themselves farther north at Ohrigstad, which they abandoned on account of the fever endemic there. Lydenburg at once became the capital of a district (of the same name) which then embraced all the eastern part of the Transvaal. In 1856 the Boers of Lydenburg separated from their brethren and proclaimed an independent republic, which was, however, incorporated with the South African Republic in 1860. The discovery of gold near the town was made in 1869, and in 1873 the first successful goldfield in the Transvaal was opened here. It was not until 1910, however, that Lydenburg was placed in railway communication with the rest of the country. The present district of Lydenburg consists of the north-east and central parts of the original district. In the Lulu Mountains, a spur of the Drakensberg, and some 40 m. N.W. of Lydenburg, was the stronghold of the Kaffir chief Sikukuni, whose conflict with the Boers in 1876 was one of the causes which led to the annexation of the Transvaal by Great Britain in 1877. (See TRANSVAAL: *History*.)

LYDFORD, or **Lidford**, a village, once an important town, in the western parliamentary division of Devonshire, England, near the western confines of Dartmoor, 27 m. N. of Plymouth by the London & South-Western railway. From its Perpendicular church of St Petrock fine views of the Dartmoor tors are seen. The village stands on the small river Lyd, which traverses a deep narrow chasm, crossed by a bridge of single span; and at a little distance a tributary stream forms a cascade in an exquisite glen. Close to the church are slight remains of the castle of Lydford.

Lydford (*Lideford*) was one of the four Saxon boroughs of Devon, and possessed a mint in the days of Æthelred the Unready. It first appears in recorded history in 997, when the Danes made a plundering expedition up the Tamar and Tavy as far as "Hlidaforda." In the reign of Edward the Confessor it was the most populous centre in Devonshire after Exeter, but the Domesday Survey relates that forty houses had been laid waste since the Conquest, and the town never recovered its former prosperity; the history from the 13th century centres round the castle, which is first mentioned in 1216, when it was granted to William Briwere, and was shortly afterwards fixed as the prison of the stannaries and the meeting-place of the Forest Courts of Dartmoor. A gild at Lideford is mentioned in 1180, and the pipe roll of 1195 records a grant for the re-establishment of the market. In 1238 the borough, which had hitherto been crown demesne, was bestowed by Henry III. on Richard, earl of Cornwall, who in 1268 obtained a grant of a Wednesday market and a three days' fair at the feast of St Petrock. The borough had a separate coroner and bailiff in 1275, but it was never incorporated by charter, and only once, in 1300, returned members to parliament. Lydford prison is described in 1512 as "one of the most hainous, contagious and detestable places in the realm," and "Lydford Law" was a by-word for injustice. At the time of the Commonwealth the castle was entirely in ruins, but in the 18th century it was restored and again used as a prison and as the meeting-place of the manor and borough courts.

LYDGATE, JOHN (*c.* 1370–*c.* 1451), English poet, was born at the village of Lydgate, some 6 or 7 m. from Newmarket. It is, however, with the Benedictine abbey of Bury St Edmunds that he is chiefly associated. Probably he was educated at the school attached to the monastery, and in his *Testament* he has drawn a lively picture of himself as a typical orchard-robbing boy, who had scant relish for matins, fought, and threw creed and paternoster at the cock. He was ordained sub-deacon in 1389, deacon in 1393, and priest in 1397. These dates are valuable as enabling us to fix approximately the date of his birth, which must have occurred somewhere about 1370. Lydgate passed as a portent of learning, and, according to Bale, he pursued his studies not only at both the English universities but in France and Italy. Koeppel (see *Laurents de Premierfait und John Lydgates Bearbeitungen von Boccaccios De Casibus*, Munich, 1885) has thrown much doubt on this statement as regards Italy, but Lydgate knew France and visited Paris in an official capacity in 1426. Bale is also the authority for another assertion that figures in what has been aptly termed the poet's "traditional biography," viz. that Lydgate, on completing his own education, kept school for the sons of noblemen and gentlemen. This "traditional biography" prolongs his life to the year 1461, but it is quite improbable that he lived many years after 1446, when Abbot Curteys died and John Baret, treasurer of Bury, signed an extant receipt for a pension which he shared with Lydgate, and which continued to be paid till 1449. If it be true, as Bishop Alcock of Ely affirms, that Lydgate wrote a poem on the loss of France and Gascony, it seems necessary to suppose that he lived two years longer, and thus indications point to the year 1451, or thereabouts, as the date of his death.

Lydgate had a consuming passion for literature, and it was probably that he might indulge this taste more fully that in 1434 he retired from the priorate of Hatfield Broadoak (or Hatfield Regis), to which he had been appointed in June 1423. After 1390—but whilst he was still a young man—he made the acquaintance of Geoffrey Chaucer, with whose son Thomas he was on terms of considerable intimacy. This friendship appears to have decided Lydgate's career, and in his *Troy-book* and elsewhere are reverent and touching tributes to his "master." The passages in question do not exaggerate his obligations to the "well of English." The themes of all his more ambitious poems can be traced to Chaucerian sources. The *Story of Thebes*, for instance, was doubtless suggested by the "romance" which Cressida and her companions are represented as reading when interrupted by Pandarus (*Troilus and Cressida*, II. xii.-xvi.). The *Falls of Princes*, again, is merely the *Monk's Tale* "writ large."

Lydgate is a most voluminous writer. The *Falls of Princes* alone comprises 7000 stanzas; and his authentic compositions reach the enormous total of 150,000 lines. Cursed with such immoderate fluency Lydgate could not sustain himself at the highest level of artistic excellence; and, though imbued with a sense of the essentials of poetry, and eager to prove himself in its various manifestations, he stinted himself of the self-discipline necessary to perfection of form. As the result the bulk of his composition is wholly or comparatively rough-hewn. That he was capable of better work than is suggested by his average accomplishment is shown by two allegorical poems—the *Complaint of the Black Knight* and the *Temple of Glass* (once attributed to Hawes). In these he reveals himself as a not unworthy successor of Chaucer, and the pity of it is that he should have squandered his powers in a futile attempt to create an entire literature. For a couple of centuries Lydgate's reputation equalled, if it did not surpass, that of his master. This was in a sense only natural, since he was the real founder of the school of which Stephen Hawes was a distinguished ornament, and which "held the field" in English letters during the long and dreary interval between Chaucer and Spenser. One of the most obvious defects of this school is excessive attachment to polysyllabic terms. Lydgate is not quite so great a sinner in this respect as are some of his successors, but his tendency cannot be mistaken, and John Metham is amply justified in his censure—

> Eke John Lydgate, sometime monk of Bury,
> His books indited with terms of rhetoric
> And half-changed Latin, with conceits of poetry.

Pedantry was an inevitable effect of the early Renaissance. French literature passed through the same phase, from which indeed it was later in emerging; and the ultimate consequence was the enrichment of both languages. It must be conceded as no small merit in Lydgate that, in an age of experiment he should have succeeded so often in hitting the right word. Thomas Warton remarks on his lucidity. Since his writings are read more easily than Chaucer's, the inference is plain—that he was more effectual as a maker of our present English. In spite of that, Lydgate is characteristically medieval—medieval in his prolixity, his platitude, his want of judgment and his want of taste; medieval also in his pessimism, his Mariolatry and his horror of death. These attributes jarred on the sensitive Ritson, who racked his brains for contumelious epithets such as "stupid and disgusting," "cart-loads of rubbish," &c.; and during the greater part of the 18th and 19th centuries Lydgate's reputation was at its lowest ebb. Recent criticism has been far more impartial, and almost too much respect has been paid to his attainments, especially in the matter of metre, though Lydgate himself, with offensive lightheartedness, admits his poor craftsmanship.

Lydgate's most doughty and learned apologist is Dr Schick, whose preface to the *Temple of Glass* embodies practically all that is known or conjectured concerning this author, including the chronological order of his works. With the exception of the *Damage and Destruction in Realms*—an account of Julius Caesar, his wars and his death—they are all in verse and extremely multifarious—narrative, devotional hagiological, philosophical and scientific, allegorical and moral, historical, satirical and occasional. The *Troy-book*, undertaken at the command of Henry V., then prince of Wales, dates from 1412–1420; the *Story of Thebes* from 1420–1422; and the *Falls of Princes* towards 1430. His latest work was *Secreta Secretorum* or *Secrets of Old Philosophers*, rhymed extracts from a pseudo-Aristotelian treatise. Lydgate certainly possessed extraordinary versatility, which enabled him to turn from elaborate epics to quite popular poems like the *Mumming at Hertford*, *A Ditty of Women's Horns* and *London Lickpenny*. The humour of this last is especially bright and effective, but, unluckily for the author, the piece is believed to have been retouched by some other hand. The longer efforts partake of the nature of translations from sundry medieval compilations like those of Guido di Colonna and Boccaccio, which are in Latin.

See publications of the Early English Text Society, especially the *Temple of Glass*, edited by Dr Schick; Koeppel's *Lydgate's Story of Thebes, eine Quellenuntersuchung* (Munich, 1884), and the same scholar's *Laurents de Premierfait und John Lydgates Bearbeitungen von Boccaccios De Casibus Illustrium Virorum* (Munich, 1885); Warton's *History of English Poetry*; Ritson's *Bibliotheca Anglo-Poetica*; Furnivall's *Political Poems* (E. E. T. S.); and Sidney Lee's article in the *Dict. Nat. Biog.* (F. J. S.)

LYDIA, in ancient geography, a district of Asia Minor, the boundaries of which it is difficult to fix, partly because they varied at different epochs. The name is first found under the form of *Luddi* in the inscriptions of the Assyrian king Assur-bani-pal, who received tribute from Gyges about 660 B.C. In Homer we read only of Maeonians (*Il.* ii. 865, v. 43, x. 431), and the place of the Lydian capital Sardis is taken by Hydē (*Il.* xx. 385), unless this was the name of the district in which Sardis stood (see Strabo xiii. p. 626).[1] The earliest Greek writer who mentions the name is Mimnermus of Colophon, in the 37th Olympiad. According to Herodotus (i. 7), the Meiones (called Maeones by other writers) were named Lydians after Lydus, the son of Attis, in the mythical epoch which preceded the rise of the Heraclid dynasty. In historical times the Maeones were a tribe inhabiting the district of the upper Hermus, where a town called Maeonia existed (Pliny, *N.H.* v. 30; Hierocles, p. 670). The Lydians must originally have been an allied tribe which bordered upon them to the north-west, and occupied the plain of Sardis or Magnesia at the foot of Tmolus and Sipylus. They were cut off from the sea by the Greeks, who were in possession, not only of the Bay of Smyrna, but also of the country north of Sipylus as far as Temnus in the pass (*boghaz*), through which the Hermus forces its way from the plain of Magnesia into its lower valley.[2] In a Homeric epigram the ridge north of the Hermus, on which the ruins of Temnus lie, is called Sardenē. Northward the Lydians extended at least as far as the Gygaean Lake (Lake Coloe, mod. Mermereh), and the Sardenē range (mod. Dumanli Dagh). The plateau of the Bin Bir Tepē, on the southern shore of the Gygaean Lake, was the chief burial-place of the inhabitants of Sardis, and is still thickly studded with tumuli, among which is the "tomb of Alyattes" (260 ft. high). Next to Sardis the chief city was Magnesia ad Sipylum (*q.v.*), in the neighbourhood of which is the famous seated figure of "Niobe" (*Il.* xxiv. 614-617), cut out of the rock, and probably intended to represent the goddess Cybele, to which the Greeks attached their legend of Niobe. According to Pliny (v. 31), Tantalis, afterwards swallowed up by earthquake in the pool Salē or Saloē, was the ancient name of Sipylus and "the capital of Maeonia" (Paus. vii. 24; Strabo xii. 579). Under the Heraclid dynasty the limits of Lydia must have been already extended, since according to Strabo (xiii. 590), the authority of Gyges reached as far as the Troad. Under the Mermnads Lydia became a maritime as well as an inland power. The Greek cities were conquered, and the coast of Ionia included within the Lydian kingdom. The successes of Alyattes and of Croesus finally changed the Lydian kingdom into a Lydian empire, and all Asia Minor westward of the Halys, except Lycia, owned the supremacy of Sardis. Lydia never again shrank back into its original dimensions. After the Persian conquest the Maeander was regarded as its southern boundary, and in the Roman period it comprised the country between Mysia and Caria on the one side and Phrygia and the Aegean on the other.

Lydia proper was exceedingly fertile. The hill-sides were clothed with vine and fir, and the rich broad plain of Hermus produced large quantities of corn and saffron. The climate of the plain was soft but healthy, though the country was subject to frequent earthquakes. The Pactolus, which flowed from the fountain of Tarnē in the Tmolus mountains, through the centre of Sardis, into the Hermus, was believed to be full of golden sand; and gold mines were worked in Tmolus itself, though by the time of Strabo the proceeds had become so small as hardly to pay for the expense of working them (Strabo xiii. 591). Maeonia on the east contained the curious barren plateau known to the Greeks as the Katakekaumenē ("Burnt country"), once a centre of volcanic disturbance. The Gygaean lake (where remains of pile dwellings have been found) still abounds with carp.

Herodotus (i. 171) tells us that Lydus was a brother of Mysus and Car. The statement is on the whole borne out by the few Lydian, Mysian and Carian words that have been preserved, as well as by the general character of the civilization prevailing among the three nations. The race was probably a mixed one, consisting of aborigines and Aryan immigrants. It was characterized by industry and a commercial spirit, and, before the Persian conquest, by bravery. The religion of the Lydians resembled that of the other civilized nations of Asia Minor. It was a nature worship, which at times became wild and sensuous. By the side of the supreme god Medeus stood the sun-god Attis, as in Phrygia the chief object of the popular cult. He was at once the son and bridegroom of Cybele (*q.v.*) or Cybebe, the mother of the gods, whose image carved by Broteas, son of Tantalus, was adored on the cliffs of Sipylus (Paus. iii. 22). The cult may have been brought westward by the Hittites who have left memorials of themselves in the pseudo-Sesostris figures of Kara-bel (between Sardis and Ephesus) as well as in the figure of the Mother-goddess, the so-called Niobe. At Ephesus, where she was adored under the form of a meteoric stone, she was identified with the Greek Artemis (see also Great Mother of the Gods). Her mural crown is first seen in the Hittite sculptures of Boghaz Keui (see Pteria and Hittites) on the Halys. The priestesses by whom she was served are depicted in early art as armed with the double-headed axe, and the dances they performed in her honour with shield and bow gave rise to the myths which saw in them the Amazons, a nation of woman-warriors. The pre-Hellenic cities of the coast—Smyrna, Samorna (Ephesus), Myrina, Cyme, Priene and Pitane—were all of Amazonian origin; and the first three of them have the same name as the Amazon Myrina, whose tomb was pointed out in the Troad. The prostitution whereby the Lydian girls gained their dowries (Herod. i. 93) was a religious exercise, as among the Semites, which marked their devotion to the goddess Cybele. In the legend of Heracles, Omphale takes the place of Cybele, and was perhaps her Lydian title. Heracles is here the sun-god Attis in a new form; his Lydian name is unknown, since E. Meyer has shown (*Zeitschr. d. Morg. Gesell.* xxxi. 4) that Sandon belongs not to Lydia but to Cilicia. By the side of Attis stood Manes or Men, identified later with the Moon-god.

According to the native historian Xanthus (460 B.C.) three dynasties ruled in succession over Lydia. The first, that of the Attiads, is mythical. It was headed by a god, and included geographical personages like Lydus, Asies and Meles, or such heroes of folk-lore as Cambletes, who devoured his wife. To this mythical age belongs the colony which, according to Herodotus (i. 94), Tyrsenus, the son of Attis, led to Etruria. Xanthus, however, puts Torrhebus in the place of Tyrsenus, and makes him the eponym of a district in Lydia. It is doubtful whether Xanthus recognized the Greek legends which brought Pelops from Lydia, or rather Maeonia, and made him the son of Tantalus. The second dynasty was also of divine origin, but the names which head it prove its connexion with the distant East. Its founder, a descendant of Heracles and Omphale, was, Herodotus tells us (i. 7), a son of Ninus and grandson of Belus. The Assyrian inscriptions have shown that the Assyrians had never crossed the Halys, much less known the name of Lydia, before the age of Assur-bani-pal, and consequently the theory which brought the Heraclids from Nineveh must be given up. But the Hittites, another Oriental people, deeply imbued with the elements of Babylonian culture, had overrun Asia Minor and established themselves on the shores of the Aegean before the reign of the Egyptian king Rameses II.

The subject allies who then fight under their banners include the Masu or Mysians and the Dardani of the Troad, while the

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[1] Pliny (v. 30) makes it the Maeonian name.

[2] See Sir W. M. Ramsay in the *Journal of Hellenic Studies*, ii. 2.

Hittites have left memorials in Lydia. G. Dennis discovered an inscription in Hittite hieroglyphics attached to the figure of "Niobe" on Sipylus, and a similar inscription accompanies the figure (in which Herodotus, ii. 106, wished to see Sesostris or Rameses II.) in the pass of Karabel. We learn from Eusebius that Sardis was first captured by the Cimmerii 1078 B.C.; and since it was four centuries later before the real Cimmerii (*q.v.*) appeared on the horizon of history, we may perhaps find in the statement a tradition of the Hittite conquest. As the authority of the Hittite satraps at Sardis began to decay the Heraclid dynasty arose. According to Xanthus, Sadyattes and Lixus were the successors of Tylon the son of Omphale. After lasting five hundred and five years, the dynasty came to an end in the person of Sadyattes, as he is called by Nicolas of Damascus, whose account is doubtless derived from Xanthus. The name Candaules, given him by Herodotus, meant "dog strangler" and was a title of the Lydian Hermes. Gyges (*q.v.*) put him to death and established the dynasty of the Mermnads, 687 B.C. Gyges initiated a new policy, that of making Lydia a maritime power; but towards the middle of his reign the kingdom was overrun by the Cimmerii. The lower town of Sardis was taken, and Gyges sent tribute to Assur-bani-pal, as well as two Cimmerian chieftains he had himself captured in battle. A few years later Gyges joined in the revolt against Assyria, and the Ionic and Carian mercenaries he despatched to Egypt enabled Psammetichus to make himself independent. Assyria, however, was soon avenged. The Cimmerian hordes returned, Gyges was slain in battle (652 B.C.), and Ardys his son and successor returned to his allegiance to Nineveh. The second capture of Sardis on this occasion was alluded to by Callisthenes (Strabo xiii. 627). Alyattes, the grandson of Ardys, finally succeeded in extirpating the Cimmerii, as well as in taking Smyrna, and thus providing his kingdom with a port. The trade and wealth of Lydia rapidly increased, and the Greek towns fell one after the other before the attacks of the Lydian kings. Alyattes's long reign of fifty-seven years saw the foundation of the Lydian empire. All Asia Minor west of the Halys acknowledged his sway, and the six years' contest he carried on with the Medes was closed by the marriage of his daughter Aryenis to Astyages. The Greek cities were allowed to retain their own institutions and government on condition of paying taxes and dues to the Lydian monarch, and the proceeds of their commerce thus flowed into the imperial exchequer. The result was that the king of Lydia became the richest prince of his age. Alyattes was succeeded by Croesus (*q.v.*), who had probably already for some years shared the royal power with his father, or perhaps grandfather, as V. Floigl thinks (*Geschichte des semitischen Alterthums*, p. 20). He reigned alone only fifteen years, Cyrus the Persian, after an indecisive battle on the Halys, marching upon Sardis, and capturing both acropolis and monarch (546 B.C.). The place where the acropolis was entered was believed to have been overlooked by the mythical Meles when he carried the lion round his fortress to make it invulnerable; it was really a path opened by one of the landslips, which have reduced the sandstone cliff of the acropolis to a mere shell, and threaten to carry it altogether into the plain below. The revolt of the Lydians under Pactyas, whom Cyrus had appointed to collect the taxes, caused the Persian king to disarm them, though we can hardly credit the statement that by this measure their warlike spirit was crushed. Sardis now became the western capital of the Persian empire, and its burning by the Athenians was the indirect cause of the Persian War. After Alexander the Great's death, Lydia passed to Antigonus; then Achaeus made himself king at Sardis, but was defeated and put to death by Antiochus. The country was presented by the Romans to Eumenes, and subsequently formed part of the proconsular province of Asia. By the time of Strabo (xiii. 631) its old language was entirely supplanted by Greek.

The Lydian empire may be described as the industrial power of the ancient world. The Lydians were credited with being the inventors, not only of games such as dice, huckle-bones and ball (Herod. i. 94), but also of coined money. The oldest known coins are the electrum coins of the earlier Mermnads (Madden, *Coins of the Jews*, pp. 19-21), stamped on one side with a lion's head or the figure of a king with bow and quiver; these were replaced by Croesus with a coinage of pure gold and silver. To the latter monarch were probably due the earliest gold coins of Ephesus (Head, *Coinage of Ephesus*, p. 16). The electrum coins of Lydia were of two kinds, one weighing 168·4 grains for the inland trade, and another of 224 grains for the trade with Ionia. The standard was the silver mina of Carchemish (as the Assyrians called it) which contained 8656 grains. Originally derived by the Hittites from Babylonia, but modified by themselves, this standard was passed on to the nations of Asia Minor during the period of Hittite conquest, but was eventually superseded by the Phoenician mina of 11,225 grains, and continued to survive only in Cyprus and Cilicia (see also Numismatics). The inns, which the Lydians were said to have been the first to establish (Herod. i. 94), were connected with their attention to commercial pursuits. Their literature has wholly perished. They were celebrated for their music and gymnastic exercises, and their art formed a link between that of Asia Minor and that of Greece. R. Heberdey's excavations at Ephesus since 1896, like those of D. G. Hogarth in 1905, belong to the history of Greek and not native art. The ivory figures, however, found by Hogarth on the level of the earliest temple of Artemis show Asiatic influence, and resemble the so-called "Phoenician" ivories from the palace of Sargon at Calah (Nimrud). For a description of a pectoral of white gold, ornamented with the heads of animals, human faces and the figure of a goddess, discovered in a tomb on Tmolus, see *Academy*, January 15, 1881, p. 45. Lydian sculpture was probably similar to that of the Phrygians. Phallic emblems, for averting evil, were plentiful; the summit of the tomb of Alyattes is crowned with an enormous one of stone, about 9 ft. in diameter. The tumulus itself is 281 yds. in diameter and about half a mile in circumference. It has been partially excavated by G. Spiegelthal and G. Dennis, and a sepulchral chamber discovered in the middle, composed of large well-cut and highly polished blocks of marble, the chamber being 11 ft. long, nearly 8 ft. broad and 7 ft. high. Nothing was found in it except a few ashes and a broken vase of Egyptian alabaster. The stone basement which, according to Herodotus, formerly surrounded the mound has disappeared.

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LYDUS ("The Lydian"), **JOANNES LAURENTIUS,** Byzantine writer on antiquarian subjects, was born at Philadelphia in Lydia about A.D. 490. At an early age he set out to seek his fortune in Constantinople, and held high court and state offices under Anastasius and Justinian. In 552 he lost favour, and was dismissed. The date of his death is not known, but he was probably alive during the early years of Justin II. (reigned 565–578). During his retirement he occupied himself in the compilation of works on the antiquities of Rome, three of which have been preserved: (1) *De Ostentis* (Περὶ διοσημειῶν), on the origin and progress of the art of divination; (2) *De Magistratibus reipublicae Romanae* (Περὶ ἀρχῶν τῆς Ῥωμαίων πολιτείας), especially valuable for the administrative details of the time of Justinian; (3) *De Mensibus* (Περὶ μηνῶν), a history of the different festivals of the year. The chief value of these books consists in the fact that the author made use of the works (now lost) of old Roman writers on similar subjects. Lydus was also commissioned by Justinian to compose a panegyric on the emperor, and a history of his successful campaign against Persia; but these, as well as some poetical compositions, are lost.

Editions of (1) by C. Wachsmuth (1897), with full account of the authorities in the prolegomena; of (2) and (3) by R. Wünsch (1898–1903); see also the essay by C. B. Hase (the first editor of the *De Ostentis*) prefixed to I. Bekker's edition of Lydus (1837) in the Bonn *Corpus scriptorum hist. Byzantinae.*

LYE (O. Eng. *léag*, cf. Dutch *loog*, Ger. *Lauge*, from the root meaning to wash, see in Lat. *lavare*, and Eng. "lather," froth of soap and water, and "laundry"), the name given to the solution of alkaline salts obtained by leaching or lixiviating wood ashes with water, and sometimes to a solution of a caustic alkali. Lixiviation (Lat. *lixivium*, lye, *lix*, ashes) is the action of separating, by the percolation of water, a soluble from an insoluble substance. "Leaching," the native English term for this process, is from "leach," to water, the root probably being the same as in "lake."

LYELL, SIR CHARLES (1797–1875), British geologist, was the eldest son of Charles Lyell of Kinnordy, Forfarshire, and was born on the 14th of November 1797, on the family estate in Scotland. His father (1767–1849) was known both as a botanist and as the translator of the *Vita Nuova* and the *Convito* of Dante: the plant *Lyellia* was named after him. From his boyhood Lyell had a strong inclination for natural history, especially entomology, a taste which he cultivated at Bartley Lodge in the New Forest, to which his family had removed soon after his birth. In 1816 he entered Exeter College, Oxford, where the lectures of Dr Buckland first drew his attention to geological study. After taking his degree of B.A. in 1819 (M.A. in 1821) he entered Lincoln's Inn, and in 1825, after a delay caused by chronic weakness of the eyes, he was called to the bar, and went on the western circuit for two years. During this time he was slowly gravitating towards the life of a student of science. In 1819 he had been elected a fellow of the Linnean and Geological Societies, communicating his first paper, "On a Recent Formation of Freshwater Limestone in Forfarshire," to the latter society in 1822, and acting as one of the honorary secretaries in 1823. In that year he went to France, with introductions to Cuvier, Humboldt and other men of science, and in 1824 made a geological tour in Scotland in company with Dr Buckland. In 1826 he was elected a fellow of the Royal Society, from which in later years he received both the Copley and Royal medals; and in 1827 he finally abandoned the legal profession, and devoted himself to geology.

At this time he had already begun to plan his chief work, *The Principles of Geology*. The subsidiary title, "An Attempt to Explain the Former Changes of the Earth's Surface by Reference to Causes now in Operation," gives the keynote of the task to which Lyell devoted his life. A journey with Murchison in 1828 gave rise to joint papers on the volcanic district of Auvergne and the Tertiary formations of Aix-en-Provence. After parting with Murchison he studied the marine remains of the Italian Tertiary Strata and then conceived the idea of dividing this geological system into three or four groups, characterized by the proportion of recent to extinct species of shells. To these groups, after consulting Dr Whewell as to the best nomenclature, he gave the names now universally adopted—Eocene (*dawn of recent*), Miocene (*less of recent*), and Pliocene (*more of recent*); and with the assistance of G. P. Deshayes he drew up a table of shells in illustration of this classification. The first volume of the *Principles of Geology* appeared in 1830, and the second in January 1832. Received at first with some opposition, so far as its leading theory was concerned, the work had ultimately a great success, and the two volumes had already reached a second edition in 1833 when the third, dealing with the successive formations of the earth's crust, was added. Between 1830 and 1872 eleven editions of this work were published, each so much enriched with new material and the results of riper thought as to form a complete history of the progress of geology during that interval. Only a few days before his death Sir Charles finished revising the first volume of the 12th edition; the revision of the second volume was completed by his nephew Mr (afterwards Sir) Leonard Lyell; and the work appeared in 1876.

In August 1838 Lyell published the *Elements of Geology*, which, from being originally an expansion of one section of the *Principles*, became a standard work on stratigraphical and palaeontological geology. This book went through six editions in Lyell's lifetime (some intermediate editions being styled *Manual of Elementary Geology*), and in 1871 a smaller work, the *Student's Elements of Geology*, was based upon it. His third great work, *The Antiquity of Man*, appeared in 1863, and ran through three editions in one year. In this he gave a general survey of the arguments for man's early appearance on the earth, derived from the discoveries of flint implements in post-Pliocene strata in the Somme valley and elsewhere; he discussed also the deposits of the Glacial epoch, and in the same volume he first gave in his adhesion to Darwin's theory of the origin of species. A fourth edition appeared in 1873.

In 1831–1833 Lyell was professor of geology at King's College, London, and delivered while there a course of lectures, which became the foundation of the *Elements of Geology*. In 1832 he married Mary (1809–1873) eldest daughter of Leonard Horner (*q.v.*), and she became thenceforward associated with him in all his work, and by her social qualities making his home a centre of attraction. In 1834 he made an excursion to Denmark and Sweden, the result of which was his Bakerian lecture to the Royal Society "On the Proofs of the gradual Rising of Land in certain Parts of Sweden." He also brought before the Geological Society a paper "On the Cretaceous and Tertiary Strata of Seeland and Möen." In 1835 he became president of the Geological Society. In 1837 he was again in Norway and Denmark, and in 1841 he spent a year in travelling through the United States, Canada and Nova Scotia. This last journey, together with a second one to America in 1845, resulted not only in papers, but also in two works not exclusively geological, *Travels in North America* (1845) and *A Second Visit to the United States* (1849). During these journeys he estimated the rate of recession of the falls of Niagara, the annual average accumulation of alluvial matter in the delta of the Mississippi, and studied those vegetable accumulations in the "Great Dismal Swamp" of Virginia, which he afterwards used in illustrating the formation of beds of coal. He also studied the coal-formations in Nova Scotia, and discovered in company with Dr (afterwards Sir J. W.) Dawson (*q.v.*) of Montreal, the earliest known landshell, *Pupa vetusta*, in the hollow stem of a Sigillaria. In bringing a knowledge of European geology to bear upon the extended formations of North America Lyell rendered immense service. Having visited Madeira and Teneriffe in company with G. Hartung, he accumulated much valuable evidence on the age and deposition of lava-beds and the formation of volcanic cones. He also revisited Sicily in 1858, when he made such observations upon the structure of Etna as refuted the theory of "craters of elevation" upheld by Von Buch and Élie de Beaumont (see *Phil. Trans.*, 1859).

Lyell was knighted in 1848, and was created a baronet in 1864, in which year he was president of the British Association at Bath. He was elected corresponding member of the French Institute and of the Royal Academy of Sciences at Berlin, and was created a knight of the Prussian Order of Merit.

During the later years of his life his sight, always weak, failed him altogether. He died on the 22nd of February 1875, and was buried in Westminster Abbey. Among his characteristics were his great thirst for knowledge, his perfect fairness and sound judgment; while the extreme freshness of his mind enabled him to accept and appreciate the work of younger men.

The LYELL MEDAL, established in 1875 under the will of Sir Charles Lyell, is cast in bronze and is to be awarded annually (or from time to time) by the Council of the Geological Society. The medallist may be of any country or either sex. Not less than one-third of the annual interest of a sum of £2000 is to be awarded with the medal; the remaining interest, known as the LYELL GEOLOGICAL FUND, is to be given in one or more portions at the discretion of the Council for the encouragement of geological science.

See *Life, Letters and Journals of Sir Charles Lyell, Bart.*, edited by his sister-in-law, Mrs Lyell (2 vols., 1881); *Charles Lyell and Modern Geology*, by T. G. Bonney (1895). (H. B. Wo.)

LYLY (LILLY, or LYLIE), **JOHN** (1553–1606), English writer, the famous author of *Euphues*, was born in Kent in 1553 or 1554. At the age of sixteen, according to Wood, he became a student of Magdalen College, Oxford, where in due time he proceeded to his bachelor's and master's degrees (1573 and 1575), and from whence we find him in 1574 applying to Lord Burghley "for the queen's letters to Magdalen College to admit him fellow." The fellowship, however, was not granted, and Lyly shortly after left the university. He complains of what seems to have been a sentence of rustication passed upon him at some period in his academical career, in his address to the gentlemen scholars of Oxford affixed to the second edition of the first part of *Euphues*, but in the absence of any further evidence it is impossible to fix either its date or its cause. If we are to believe Wood, he never took kindly to the proper studies of the university. "For so it was that his genius being naturally bent to the pleasant paths of poetry (as if Apollo had given to him a wreath of his own bays without snatching or struggling) did in a manner neglect academical studies, yet not so much but that he took the degrees in arts, that of master being compleated 1575." After he left Oxford, where he had already the reputation of "a noted wit," Lyly seems to have attached himself to Lord Burghley. "This noble man," he writes in the "Glasse for Europe," in the second part of *Euphues* (1580), "I found so ready being but a straunger to do me good, that neyther I ought to forget him, neyther cease to pray for him, that as he hath the wisdom of Nestor, so he may have the age, that having the policies of Ulysses he may have his honor, worthy to lyve long, by whom so many lyve in quiet, and not unworthy to be advaunced by whose care so many have been preferred." Two years later we possess a letter of Lyly to the treasurer, dated July 1582, in which the writer protests against some accusation of dishonesty which had brought him into trouble with his patron, and demands a personal interview for the purpose of clearing his character. What the further relations beween them were we have no means of knowing, but it is clear that neither from Burghley nor from the queen did Lyly ever receive any substantial patronage. In 1578 he began his literary career by the composition of *Euphues, or the Anatomy of Wit*, which was licensed to Gabriel Cawood on the 2nd of December, 1578, and published in the spring of 1579. In the same year the author was incorporated M.A. at Cambridge, and possibly saw his hopes of court advancement dashed by the appointment in July of Edmund Tylney to the office of master of the revels, a post at which, as he reminds the queen some years later, he had all along been encouraged to "aim his courses." *Euphues and his England* appeared in 1580, and, like the first part of the book, won immediate popularity. For a time Lyly was the most successful and fashionable of English writers. He was hailed as the author of "a new English," as a "raffineur de l'Anglois"; and, as Edmund Blount, the editor of his plays, tells us in 1632, "that beautie in court which could not parley Euphuism was as little regarded as she which nowe there speakes not French." After the publication of *Euphues*, however, Lyly seems to have entirely deserted the novel form himself, which passed into the hands of his imitators, and to have thrown himself almost exclusively into play-writing, probably with a view to the mastership of revels whenever a vacancy should occur. Eight plays by him were probably acted before the queen by the children of the Chapel Royal and the children of St Paul's between the years 1584 and 1589, one or two of them being repeated before a popular audience at the Blackfriars Theatre. Their brisk lively dialogue, classical colour and frequent allusions to persons and events of the day maintained that popularity with the court which *Euphues* had won. Lyly sat in parliament as member for Hindon in 1589, for Aylesbury in 1593, for Appleby in 1597 and for Aylesbury a second time in 1601. In 1589 Lyly published a tract in the Martin Marprelate controversy, called *Pappe with an hatchet, alias a figge for my Godsonne; Or Crack me this nut; Or a Countrie Cuffe, &c.*[1] About the same time we may probably date his first petition to Queen Elizabeth. The two petitions, transcripts of which are extant among the Harleian MSS., are undated, but in the first of them he speaks of having been ten years hanging about the court in hope of preferment, and in the second he extends the period to thirteen years. It may be conjectured with great probability that the ten years date from 1579, when Edmund Tylney was appointed master of the revels with a tacit understanding that Lyly was to have the next reversion of the post. "I was entertained your Majestie's servaunt by your own gratious favor," he says, "strengthened with condicions that I should ayme all my courses at the Revells (I dare not say with a promise, but with a hopeful Item to the Revercion) for which these ten yeres I have attended with an unwearyed patience." But in 1589 or 1590 the mastership of the revels was as far off as ever—Tylney in fact held the post for thirty-one years—and that Lyly's petition brought him no compensation in other directions may be inferred from the second petition of 1593. "Thirteen yeres your highnes servant but yet nothing. Twenty freinds that though they saye they will be sure, I finde them sure to be slowe. A thousand hopes, but all nothing; a hundred promises but yet nothing. Thus casting up the inventory of my friends, hopes, promises and tymes, the *summa totalis* amounteth to just nothing." What may have been Lyly's subsequent fortunes at court we do not know. Edmund Blount says vaguely that Elizabeth "graced and rewarded" him, but of this there is no other evidence. After 1590 his works steadily declined in influence and reputation; other stars were in possession of the horizon; and so far as we know he died poor and neglected in the early part of James I.'s reign. He was buried in London at St Bartholomew the Less on the 20th of November, 1606. He was married, and we hear of two sons and a daughter.

Comedies.—In 1632 Edmund Blount published "Six Court Comedies," including *Endymion* (1591), *Sappho and Phao* (1584), *Alexander and Campaspe* (1584), *Midas* (1592), *Mother Bombie* (1594) and *Gallathea* (1592). To these should be added the *Woman in the Moone* (Lyly's earliest play, to judge from a passage in the prologue and therefore earlier than 1584, the date of *Alexander and Campaspe*), and *Love's Metamorphosis*, first printed in 1601. Of these, all but the last are in prose. *A Warning for Faire Women* (1599) and *The Maid's Metamorphosis* (1600) have been attributed to Lyly, but on altogether insufficient grounds. The first editions of all these plays were issued between 1584 and 1601, and the majority of them between 1584 and 1592, in what were Lyly's most successful and popular years. His importance as a dramatist has been very differently estimated. Lyly's dialogue is still a long way removed from the dialogue of Shakespeare. But at the same time it is a great advance in rapidity and resource upon anything which had gone before it; it represents an important step in English dramatic art. His nimbleness, and the wit which struggles with his pedantry, found their full development in the dialogue of *Twelfth Night* and *Much Ado about Nothing*, just as "Marlowe's mighty line" led up to and was eclipsed by the majesty and music of Shakespearian passion. One or two of the songs introduced into his plays are justly famous and show a real lyrical gift. Nor in estimating his dramatic position and his effect upon his time must it be forgotten that his classical and mythological plots, flavourless and dull as they would be to a modern audience, were charged with interest to those courtly hearers who saw in Midas Philip II., Elizabeth in Cynthia and perhaps Leicester's unwelcome marriage with Lady Sheffield in the love affair between Endymion and Tellus which brings the former under Cynthia's displeasure. As a matter of fact his reputation and popularity as a play-writer were considerable. Gabriel Harvey dreaded lest Lyly should make a play upon their quarrel; Meres, as is well known, places him among "the best for comedy"; and Ben Jonson names him among those foremost rivals who were "outshone" and outsung by Shakespeare.

Euphues.—It was not, however, as a dramatist, but as the author of *Euphues*, that Lyly made most mark upon the Elizabethan world. His plays amused the court circle, but the "new English" of his novel threatened to permanently change the course of English style. The plot of *Euphues* is extremely simple. The hero, whose name may very possibly have been suggested by a passage in Ascham's *Schoolmaster*, is introduced to us as still in bondage to the follies of youth, "preferring fancy before friends, and this present humour before honour to come." His travels bring him to Naples, where he falls in love with Lucilla, the governor's light-minded daughter. Lucilla is already pledged to Euphues's friend Philautus, but Euphues's passion betrays his friendship, and the old lover finds himself thrown over by both friend and mistress. Euphues himself, however, is very soon forsaken for a more attractive suitor. He and Philautus make up their quarrel, and Euphues writes his friend "a cooling card," to be "applied to all lovers," which is so severe upon the fair sex that Lyly feels it necessary to balance it by a sort of apology addressed "to the grave matrons and honest maidens of Italy." Euphues then leaves Naples for his native Athens, where he gives himself up to study, of which the first fruits are two long treatises—the first, "Euphues and his Ephoebus," a disquisition on the art of education addressed to parents, and the second, "Euphues and Atheos," a discussion of the first principles of religion. The remainder of the book is filled up with correspondence between Euphues and his friends. We have letters from Euphues to Philautus on the death of Lucilla, to another friend on the death of his daughter, to one Botonio "to take his exile patiently," and to the youth Alcius, remonstrating with him on his bad behaviour at the university. Finally a pair of letters, the first from Livia "at the emperour's court to Euphues at Athens," answered by "Euphues to Livia," wind up the first part, and announce to us Euphues's intention of visiting England. An address from Lyly to Lord Delawarr is affixed, to which was added in the second edition "An Address to the Gentlemen Scholars of England."

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[1] The evidence for his authorship may be found in Gabriel Harvey's *Pierce's Supererogation* (written November 1589, published 1593), in Nash's *Have with you to Saffron Walden* (1596), and in various allusions in Lyly's own plays. See Fairholt's *Dramatic Works of John Lilly*, i. 20.

Euphues and his England is rather longer than the first part. Euphues and Philautus travel from Naples to England. They arrive at Dover, halt for the night at Fidus's house at Canterbury, and then proceed to London, where they make acquaintance with Surius, a young English gentleman of great birth and noble blood; Psellus, an Italian nobleman reputed "great in magick"; Martius, an elderly Englishman; Camilla, a beautiful English girl of insignificant family; Lady Flavia and her niece Fraunces. After endless correspondence and conversation on all kinds of topics, Euphues is recalled to Athens, and from there corresponds with his friends. "Euphues' Glasse for Europe" is a flattering description of England sent to Livia at Naples. It is the most interesting portion of the book, and throws light upon one or two points of Lyly's own biography. The author naturally seized the opportunity for paying his inevitable tribute to the queen, and pays it in his most exalted style. "O fortunate England that hath such a queene, ungratefull if thou praye not for hir, wicked if thou do not love hir, miserable if thou lose hir!"—and so on. The book ends with Philautus's announcement of his marriage to Fraunces, upon which Euphues sends characteristic congratulations and retires, "tormented in body and grieved in mind," to the Mount of Silexedra, "where I leave him to his musing or Muses."

Such is a brief outline of the book which for a time set the fashion for English prose. Two editions of each part appeared within the first year after publication, and thirteen editions of both are enumerated up to 1636, after which, with the exception of a modernized version in 1718, *Euphues* was never reprinted until 1868, when Dr Arber took it in hand. The reasons for its popularity are not far to seek. As far as matter was concerned it fell in with all the prevailing literary fashions. Its long disquisitions on love, religion, exile, women or education, on court life and country pleasures, handled all the most favourite topics in the secularized speculation of the time; its foreign background and travel talk pleased a society of which Lyly himself said "trafic and travel hath woven the nature of all nations into ours and made this land like arras full of device which was broadcloth full of workmanship"; and, although Lyly steered clear in it of the worst classical pedantries of the day, the book was more than sufficiently steeped in classical learning, and based upon classical material, to attract a literary circle which was nothing if not humanist. A large proportion of its matter indeed was drawn from classical sources. The general tone of sententious moralizing may be traced to Plutarch, from whom the treatise on education, "Euphues and his Ephoebus," and that on exile, "Letter to Botonio to take his exile patiently," are literally translated, as well as a number of other shorter passages either taken direct from the Latin versions or from some of the numerous English translations of Plutarch then current. The innumerable illustrations based upon a kind of pseudo natural history are largely taken from Pliny, while the mythology is that of Virgil and Ovid.

It was not the matter of *Euphues*, however, so much as the style which made it famous (see EUPHUISM). The source of Lyly's peculiar style has been traced by Dr Landmann (*Der Euphuismus, sein Wesen, seine Quelle, seine Geschichte*, &c. Giessen, 1881) to the influence of Don Antonio de Guevara, whose *Libro Aureo de Marco Aurelio* (1529)—a sort of historical romance based upon Plutarch and upon Marcus Aurelius's *Meditations*, the object of which was to produce a "mirror for princes," of the kind so popular throughout the Renaissance—became almost immediately popular in England. The first edition, or rather a French version of it, was translated into English by Lord Berners in 1531, and published in 1534. Before 1560 twelve editions of Lord Berners's translation had been printed, and before 1578 six different translators of this and later works of Guevara had appeared. The translation, however, which had most influence upon English literature was that by North, the well-known translator of Plutarch, in 1557, called *The Dial for Princes, Compiled by the Reverend Father in God Don Antony of Guevara, Byshop of Guadix, &c., Englished out of the Frenche by Th. North.* The sententious and antithetical style of the *Dial for Princes* is substantially that of *Euphues*, though Guevara on the whole handles it better than his imitator, and has many passages of real force and dignity. The general plan of the two books is also much the same. In both the biography is merely a peg on which to hang moral disquisitions and treatises. The use made of letters is the same in both. Even the names of some of the characters are similar. Thus Guevara's Lucilla is the flighty daughter of Marcus Aurelius, Lyly's Lucilla is the flighty daughter of Ferardo, governor of Naples; Guevara's Livia is a lady at the court of Marcus Aurelius, Lyly's Livia is a lady at the court "of the emperor," of whom no further description is given. The 9th, 10th, 11th and 12th chapters of the *Dial for Princes* suggested the discussion between Euphues and Atheos. The letter from Euphues to Alcius is substantially the same in subject and treatment as that from Marcus Aurelius to his nephew Epesipo. Both Guevara and Lyly translated Plutarch's work *De educatione liberorum*, Lyly, however, keeping closer than the Spanish author to the original. The use made by Lyly of the university of Athens was an anachronism in a novel intended to describe his own time. He borrowed it, however, from Guevara, in whose book a university of Athens was of course entirely in place. The "cooling card for all fond lovers" and the address to the ladies and gentlemen of Italy have their counterparts among the miscellaneous letters by Guevara affixed by North to the *Dial for Princes*; and other instances of Lyly's use of these letters, and of two other treatises by Guevara on court and country life, could be pointed out.

Lyly was not the first to appropriate and develop the Guevaristic style. The earliest book in which it was fully adopted was *A petite Pallace of Pettie his Pleasure*, by George Pettie, which appeared in 1576, a production so closely akin to *Euphues* in tone and style that it is difficult to believe it was not by Lyly. Lyly, however, carried the style to its highest point, and made it the dominant literary fashion. His principal followers in it were Greene, Lodge and Nash, his principal opponent Sir Philip Sidney; the *Arcadia* in fact supplanted *Euphues*, and the Euphuistic taste proper may be said to have died out about 1590 after a reign of some twelve years. According to Landmann, Shakespeare's *Love's Labour Lost* is a caricature of the Italianate and pedantic fashions of the day, not of the peculiar style of *Euphues*. The only certain allusion in Shakespeare to the characteristics of Lyly's famous book is to be found in *Henry IV.*, where Falstaff, playing the part of the king, says to Prince Hal, "Harry, I do not only marvel where thou spendest thy time, but also how thou art accompanied; for, though the camomile the more it is trodden on the faster it grows, yet youth the more it is wasted the sooner it wears." Here the pompous antithesis is evidently meant to caricature the peculiar Euphuistic sentence of court parlance. (M. A. W.)

See Lyly's *Complete Works*, ed. R. W. Bond (3 vols., 1902); *Euphues*, from early editions, by Edward Arber (1868); A. W. Ward, *English Dramatic Literature*, i. 151; J. P. Collier, *History of Dramatic Poetry*, iii. 172; "John Lilly and Shakespeare," by C. C. Hense in the *Jahrbuch der deutschen Shakesp. Gesellschaft*, vols. vii. and viii. (1872, 1873); F. W. Fairholt, *Dramatic Works of John Lilly* (2 vols.

1858); *Shakespeare's Euphuism*, by W. L. Rushton; H. Morley, "Euphuism" in the *Quarterly Review* (1861); R. W. Bond, "John Lyly, Novelist and Dramatist," in the *Quarterly Review* (Jan. 1896); J. A. Symonds, *Shakespeare's Predecessors* (1883); J. D. Wilson, *John Lyly* (Cambridge, 1905); A. Ainger, "Euphuism," in *Lectures and Essays* (1905); and Albert Feuillerat, *John Lyly. Contribution à l'histoire de la Renaissance en Angleterre* (1910).

LYME REGIS, a market town and municipal borough and watering-place in the western parliamentary division of Dorsetshire, England, 151 m. W.S.W. of London by the London & South Western railway, the terminus of a light railway from Axminster. Pop. (1901) 2095. It is situated at the mouth of a narrow combe or valley opening upon a fine precipitous coast-line; there is a sandy shore affording excellent bathing, and the country inland is beautiful. The church of St Michael and All Angels is mainly Perpendicular, but the tower (formerly central) and the portion west of it are Norman. A guildhall and assembly rooms are the chief public buildings. The principal industries are stone-quarrying and the manufacture of cement. There is a curved pier of ancient foundation known as the Cobb. The harbour, with a small coasting trade, is under the authority of the corporation. The borough is under a mayor, 4 aldermen and 12 councillors. Area, 1237 acres.

No evidence of settlement on the site of Lyme Regis exists before that afforded by a grant, dated 774, purporting to be by Cynewulf, king of the West-Saxons, of land here to the church of Sherborne, and a similar grant by King Æthelstan to the church of Glastonbury. In 1086 three manors of Lyme are mentioned: that belonging to Sherborne abbey, which was granted at the dissolution to Thomas Goodwin, who alienated it in the following year; that belonging to Glastonbury, which seems to have passed into lay lands during the middle ages, and that belonging to William Belet. The last was acquired by the family of Bayeux, from whom it passed by marriage to Elias de Rabayne, whose nephew, Peter Baudrat, surrendered it to the crown in 1315–1316 when the king became lord of one moiety of the borough, henceforth known as Lyme Regis. Lyme ranked as a port in 1234, and Edward I. in 1284 granted to the town a charter making it a free borough, with a merchant gild, and in the same year the mayor and bailiffs are mentioned. In the following January the bailiffs were given freedom from pleading without the borough, freedom from toll and privileges implying considerable foreign trade; the importance of the port is also evident from the demand of two ships for the king's service in 1311. In 1332–1333 Edward III. granted Lyme to the burgesses at a fee-farm of 32 marks; on the petition of the inhabitants, who were impoverished by tempests and high tides, this was reduced to 100 shillings in 1410 and to 5 marks in 1481. In 1591 Elizabeth incorporated Lyme, and further charters were obtained from James I., Charles II. and William III. Lyme returned two members to parliament from 1295 to 1832 when the representation was reduced to one. The borough was disfranchised in 1867. The fairs granted in 1553 for the 1st of February and the 20th of September are now held on altered dates. Trade with France in wine and cloth was carried on as early as 1284, but was probably much increased on the erection of the Cobb, first mentioned in 1328 as built of timber and rock. Its medieval importance as the only shelter between Portland Roads and the river Exe caused the burgesses to receive grants of quayage for its maintenance in 1335 and many subsequent years, while its convenience probably did much to bring upon Lyme the unsuccessful siege by Prince Maurice in 1644. In 1685 Lyme was the scene of the landing of James, duke of Monmouth, in his attempt upon the throne.

LYMINGTON, a municipal borough and seaport in the New Forest parliamentary division of Hampshire, England, 98 m. S.W. from London by the London & South Western railway. Pop. (1901) 4165. It lies on the estuary of the Lymington, which opens into the Solent. The church of St Thomas à Becket is an irregular structure, dating from the reign of Henry VI., but frequently restored. There is some coasting trade, and yacht-building is carried on. Regular passenger steamers serve Yarmouth in the Isle of Wight. In summer the town is frequented for sea-bathing. It is governed by a mayor, 4 aldermen and 12 councillors. Area, 1515 acres.

There was a Roman camp near Lymington (*Lentune, Lementon*), and Roman relics have been found, but there is no evidence that a town existed here until after the Conquest. Lymington dates its importance from the grant of the town to Richard de Redvers, earl of Devon, in the reign of Henry I. No charter has been found, but a judgment given under a writ of *quo warranto* in 1578 confirms to the burgesses freedom from toll, passage and pontage, the tolls and stallage of the quay and the right to hold two fairs—privileges which they claimed under charters of Baldwin de Redvers and Isabel de Fortibus, countess of Albemarle, in the 13th century, and Edward Courtenay, earl of Devon, in 1405. The town was governed by the mayor and burgesses until the corporation was reformed in 1835. A writ for the election of a member to parliament was issued in the reign of Edward III., but no return was made. From 1585 two members were regularly returned; the number was reduced to one in 1867, and in 1885 the representation was merged in that of the county. Fairs on the 13th and 14th of May and the 2nd and 3rd of October, dating from the 13th century, are still held. The Saturday market probably dates from the same century. Lymington was made a port in the reign of Henry I., and its large shipping trade led to frequent disputes with Southampton as to the levying of duties. The case was tried in 1329 and decided against Lymington, but in 1750 the judgment was reversed, and since then the petty customs have been regularly paid. From an early date and for many centuries salt was the staple manufacture of Lymington. The rise of the mineral salt-works of Cheshire led to its decline in the 18th century, and later the renewed importance of Southampton completed its decay.

See E. King, *Borough and Parish of Lymington* (London, 1879).

LYMPH and **LYMPH FORMATION.** Lying close to the blood-vessels of a limb or organ a further set of vessels may be observed. They are very pale in colour, often almost transparent and very thin-walled. Hence they are frequently difficult to find and dissect. These are the lymphatic vessels, and they are found to be returning a fluid from the tissues to the blood-stream. When traced back to the tissues they are seen to divide and ultimately to form minute anastomosing tubules, the *lymph capillaries*. The capillaries finally terminate in the spaces between the structures of the tissue, but whether their free ends are closed or are in open communication with the tissue spaces is still undecided. The study of their development shows that they grow into the tissue as a closed system of minute tubes, which indicates that in all probability they remain permanently closed. If we trace the lymphatic vessels towards the thorax we find that in some part of their course they terminate in structures known as lymphatic glands. From these again fresh lymphatic vessels arise which carry the fluid towards the main lymph-vessel, the *thoracic duct*. This runs up the posterior wall of the thorax close to the aorta, and finally opens into the junction of the internal jugular and left subclavian veins. The lymph-vessels from the right side of the head and neck and from the right arm open, however, into the right subclavian vein (see Lymphatic System below).

Chemical Constitution of Lymph.—The lymph collected from the thoracic duct during hunger is almost water clear and yellowish in colour. Its specific gravity varies from 1015 to 1025. It tastes salt and has a faint odour. It is alkaline in reaction, but is much less alkaline than blood-serum. Like blood it clots, but clots badly, only forming a soft clot which quickly contracts. The lymph collected from a lymphatic before it has passed through a lymph gland contains a few leucocytes, and though the number of lymphocytes is greater in the lymph after it has flowed through a gland it is never very great. In normal states there are no red blood corpuscles.

The total solids amount to 3·6 to 5·7%, the variations depending upon the amount of protein present. The lymph during hunger contains only a minute quantity of fat. Sugar (dextrose) is present in the same concentration as in the blood. The inorganic constituents are the same as in blood, but apparently the amounts of Ca, Mg and P_2O_5 are rather less than in serum. Urea is present to the same amount as in blood. If the lymph be collected after a meal, one important alteration is to be found. It now contains an abundance of fat in a very fine state of subdivision, if fat be present in the food. The concentrations of protein and dextrose are not altered during the absorption of these substances.

The Significance of Lymph.—In considering the significance and use of lymph we must note in the first place that it forms an alternative medium for the removal of water, dissolved materials, formed elements or particles away from the tissues. All materials supplied to a tissue are brought to it by the blood, and are discharged from the blood through the capillary wall. They thus come to lie in the tissue spaces between the cells, and from this supply of material in a dissolved state the cells take up the food they require. In the opposite direction the cell discharges its waste products into this same tissue fluid. The removal of material from the tissue fluid may be effected either by its being absorbed through the capillary wall into the bloodstream, or by sending it into the lymphatic vessels and thus away from the tissue. From this point of view the lymphatics may be looked upon in a sense as a drainage system of the tissues. Again, besides discharging fluid and dissolved material into the tissue spaces, the blood may also discharge leucocytes, and under many conditions this emigration of leucocytes may be very extensive. These also may leave the tissue space by the path of the lymph channels. Moreover, the tissues are at any time liable to be injured, and the injury as well as damaging many cells may cause rupture of capillaries (as in bruising) with escape of red blood-cells into the tissue spaces. If this occurs we know that the damaged cells are destroyed and their débris removed either by digestion by leucocytes or by disintegration and solution. The damage of a tissue also commonly involves an infection of the damaged area with living micro-organisms, and these are at once admitted to the tissue spaces. Hence we see that the lymphatics may be provided as channels by which a variety of substances can be removed from the tissue spaces. The question at once arises, is the lymph channel at all times open to receive the materials present in the tissue space? If such be the case, lymph is simply tissue fluid, and anything that modifies the constitution or amount of the tissue fluid should in like proportion lead to a variation in the amount and constitution of the lymph. But if the lymph capillary is a closed tubule at its commencement this does not follow.

From these considerations we see that in the first instance the whole problem of lymph formation is intimately bound up with the study of the interchanges of material between the blood and the various tissue cells. The exchange of material between blood and tissue cell may possibly be determined in one or both of two ways. Either it may result from changes taking place within the tissue cell, or the tissue cell remaining passive material may be sent to or withdrawn from it owing to a change occurring either in the composition of the blood or to a change in the circulation through the tissue. Let us take first the results following increased activity of a tissue. We know that increased activity of a tissue means increased chemical change within the tissue and the production of new chemical bodies of small molecular size (*e.g.* water, carbonic acid, &c.). The production of these metabolites means the destruction of some of the tissue substance, and to make good this loss the tissue must take a further amount of material from the blood. We know that this takes place, and moreover that the waste products resulting from activity are ultimately removed. The question then becomes: When does this restoration take place, and what is the intermediate state of the tissue? We know that increased activity is always accompanied by an increase in the blood-supply, indicating a greater supply of nutritive material, though it may be that the increased supply required at the actual time of activity is oxygen only. Simultaneously the opportunity for a more rapid removal of the waste products is provided. We have to inquire then: Does this increased vascularity necessarily mean an increased outpouring of water and dissolved material into the tissues, for this might follow directly from the greater filling of the capillaries, or from the increased attracting power of the tissues to water (osmotic effect) due to the sudden production of substances of small molecular size within the tissue? The other possibility is that the increased volume of blood sent to the tissue is for the sole purpose of giving it a more rapid supply of oxygen, and that the ordinary normal blood-supply would amply suffice for renewing the chemical material used up during activity. Tissues undoubtedly vary among themselves in the amount of water and other materials they take from the blood when thrown into activity, and their behaviour in this respect depends upon the work they are called upon to perform. We must discriminate between the substance required by and consumed by the tissue, the chemical food which on combustion yields the energy by which the tissue performs work, and, on the other hand, the substance taken from the blood and either with or without further elaboration discharged from the tissue (as, for instance, in the process of secretion). The tissue contains in itself a store of food amply sufficient to enable it to continue working for a long time after its blood-supply has been stopped, and everything indicates that the supply of chemical energy to the tissue may be slow or even withheld for a considerable time. Hence we are led to conclude that the increased flow of blood sent to a tissue when it is thrown into activity is first and foremost to give that tissue an increased oxygen supply; secondly, to remove waste carbonic acid; thirdly, and only in the case of some tissues, to provide water salts and other materials for the outpouring of a secretion, as an instance of which we may take the kidney as a type. Hence there is no need to suppose that an extensive accumulation of fluid and dissolved substances takes place within a tissue when it becomes active. This must be an accumulation which would lead to an engorgement of the tissue spaces and then to a discharge of fluid along the lymph channels. To enable us to determine the various points just raised we must know whether an increased blood-supply to a tissue necessarily means an increased exudation of fluid into the tissue spaces, and moreover we must study the exchange of fluid between a tissue and the blood under as varied a series of conditions as possible, subsequently examining whether exchange of fluid and other substances between the tissue and the blood necessarily determines quantitatively the amount of lymph flowing from the tissue. Hence we will first study the exchanges between the blood and a tissue, and then turn our attention to the lymph-flow from the tissues.

The Exchanges of Fluids and dissolved Substances between the Blood and the Tissues.—Numerous experiments have been performed in studying the conditions under which fluid passes into the tissues and tissue spaces—or in the reverse direction into the blood. We may group them into (1) conditions during which the total volume of circulating fluid is increased or decreased; (2) conditions in which the character of the blood is altered, *e.g.* it is made more watery or its saline concentration is altered; (3) conditions in which the blood-supply to the part is altered; (4) conditions in which the physical character of the capillary wall is altered.

1. The total volume of blood in an animal has been increased among other ways by the transfusion of the blood of one animal directly into the veins of a second of the same species. It is found that within a very short time a large percentage of the plasma has been discharged from the blood-vessels. It has been sent into the tissues, notably the muscles, and it may be noted in passing without producing any increase in the lymph-flow from these vessels. An analogous experiment, but one which avoids the fallacy introduced by injecting a second animal's blood, has been performed by driving all the blood out of one hind limb by applying a rubber bandage tightly round it from the foot upwards. This increases the volume of blood circulating in the rest of the body, and again a rapid disappearance of the fluid part of the blood from the vessels was observed—the fluid being mainly sent into the muscles, as was indicated by showing that the specific gravity of the muscles fell during the experiment. The experiments converse to these have also been studied.

Bleeding is very rapidly followed by a large inflow of fluid into the circulating blood—this fluid being derived from all the tissues, and especially again from the muscles. Or again, when the bandage from the limb in the above-cited experiment was removed, the total capacity of the circulatory system was thereby suddenly increased, and it was found that the total volume of blood increased correspondingly, the increased volume of fluid being drawn from the tissues and especially again from the muscles. The rapidity with which this movement of fluid into or out of the blood takes place is very striking. The explanation usually offered is that the movement is effected by changes in the capillary pressure due to the alteration in the volume of blood circulating. While this seems feasible when the volume of blood is increased, it does not offer a satisfactory explanation of the rapid movement of fluid from the tissues when the volume of the blood is decreased. One must therefore look for yet further factors in this instance.

2. Let us next turn attention to the second of our three main variations, viz. that in which the composition of the blood is altered. It has long been known that the injection of water, or of solutions of soluble bodies such as salts, urea, sugar, &c., leads to a very rapid exchange of water and salts between the blood and the tissues. Thus if a solution less concentrated than the blood be injected, the blood is thereby diluted, but with very great rapidity water leaves the blood and is taken up by the tissues. Again, if a strong sugar or salt solution be injected, the first effect is a big discharge of water from the tissues into the blood and the movement of fluid is effected with great rapidity. In these instances a new physical factor is brought into play, viz. that of osmosis. When a solution of lower osmotic pressure than the blood is injected the osmotic pressure of the blood falls temporarily below that of the tissues, and water is therefore attracted to the tissues. The converse is the case when a solution of osmotic pressure higher than the blood is injected. This at first sight seems to be an all-sufficient explanation of the results recorded, but difficulties arise when we find that the tissues are not equally active in producing the effects. Thus it is found that the muscles and skin act as the chief water depot, while such tissues as the liver, intestines or pancreas take a relatively small share in the exchange. Again, when a strong sodium chloride solution is injected a considerable part of the sodium chloride is soon found to have left the blood, and it has been shown that the chloride depot is not identical with the water depot. The lung, for instance, is found to take up relatively far more of the salt than other tissues. Simultaneously with the passage of the salt into the tissue an exchange of water from the tissue into the blood can be observed, both processes being carried out very rapidly. The result is that the blood very quickly returns to a state in which its osmotic pressure is only slightly raised; the tissue, on the other hand, loses water and gains salt, and its osmotic pressure and specific gravity therefore rises. Again, the tissues do not participate equally in producing the final result, nor is the tissue which gives up the largest amount of water necessarily that which gains the largest amount of salt. The results following the injection of solutions of other bodies of small molecular size, *e.g.* urea or sugar, are quite analogous to those above described in the case of the non-toxic salt solutions. Hence we see that the rate of exchange of fluid and dissolved substance between a tissue and the blood can be extremely rapid and that the exchange can take place in either direction. We may also conclude that the main cause of the exchange, and possibly the only one, is the osmotic action set up by the solution injected, and that muscle tissue is particlarly active in the process.

Seeing that a very considerable amount of water or of dissolved substance can be taken up from the blood into a tissue, the question next arises: Where is this material held, in the tissue cell or in the tissue space? Immediately the water or salt leaves the blood it reaches the tissue space, but unless the process be extreme in amount it probably passes at once into the tissue cell itself and is stored there. If the process is excessive oedema is set up and fluid accumulates in the tissue space.

These, taken quite briefly, are some of the more important conditions under which fluid exchanges take place. They are selected here because of the extent and rapidity of the changes effected.

3. The third factor which may bring about a change in the amount of fluid sent to a tissue is a variation in the capillary pressure. A rise in capillary pressure will, if filtration can occur through the capillary wall, cause an increased exudation of fluid from the blood. Thus the rise in general blood-pressure following the injection of a salt solution could cause an increased filtration into the tissues. Or again, the hydraemia following a salt injection would favour an increased exudation because the blood would be more readily filtrable. We, however, know very little of the effect of changes in capillary pressure upon movement of fluid into the tissue spaces and tissues, most of such observations being confined to a study of their effect upon lymph-flow. We will therefore return to them in this connexion.

4. The remaining factor to be mentioned is a change in the character of the capillary wall. It is well known that many poisons can excite an increased exudation from the blood and the tissue may become oedematous. Of such bodies we may mention cantharidin and the lymphogogues of Class 1 (see later). A like change is also probably the cause of the oedema of nephritis and of heart disease. It has also been suggested that the capillaries of different organs show varying degrees of permeability, a suggestion to which we will return later.

Lymph Formation.—There are two theories current at the present day offering explanations of the manner in which lymph is formed. The first, which owes its inception to Ludwig, explains lymph formation upon physical grounds. Thus according to this theory the lymphatics are open capillary vessels at their origin in the tissues along which the tissue fluid is driven. The tissue fluid is discharged from the blood by filtration, and therefore its amount varies directly with the capillary pressure. The amount of fluid movement also is further determined by osmotic actions and by the permeability of the capillary wall.

The second theory first actively enunciated by Heidenhain regards lymph formation as a secretory process of the capillary wall, *i.e.* one in the discharge of which these cells perform work and are not merely passive as in the former theory. As we shall see, it is now probable that neither theory is completely correct.

In considering lymph formation we have to examine both the total amount of lymph formed in the body and the variations in amount leaving each separate organ under different conditions. In most investigations the lymph was collected from the thoracic duct, *i.e.* it was the lymph returned from all parts of the body with the exception of the right arm and right side of the head and neck. The collection of the lymph from organs is much more difficult to effect, and hence has not, to the present, been so extensively studied. We will consider first variations in the amount of the thoracic duct lymph. Lymph is always flowing along the thoracic duct, and if the body is at rest, it has been shown that this lymph is coming practically entirely from the intestines and liver, chiefly, moreover, from the liver. The variations in the amount flowing under various conditions has been extensively studied. We will discuss them under the following headings: Changes brought about (*a*) by altered circulatory conditions, (*b*) by the injection of various substances, and (*c*) as a result of throwing an organ into activity.

Ligature of the portal vein leads to an increased flow of duct lymph. Ligature of the inferior vena cava above the diaphragm also leads to a large increase in the flow of duct lymph. Ligature of the aorta may result in either an increased or decreased flow of direct lymph. One explanation of these results has been offered from a study of the changes in capillary pressure set up in the main organs involved. Thus, after ligature of the portal vein the capillary pressure in the intestines rises, and it was proved that the increase in thoracic duct lymph came from the intestines. Ligaturing the inferior vena cava causes a big rise in the pressure in the liver capillaries, the intestinal capillary pressure remaining practically unaltered. Here it was proved that the increase in lymph-flow came from the liver and was more copious in amount than in the former instance. A further difference is that this lymph is more concentrated, a feature which always characterizes liver lymph. Ligature of the aorta may or may not cause a rise in the liver capillary pressure, and it has been shown that if the pressure rises there is an increased lymph-flow from the liver and conversely. The increase of lymph comes entirely in this instance also from the liver. It is in fact but a special instance of the former experiment. From these results it has been argued that lymph formation is simply a filtration fundamentally, and the lymph-flow is determined mainly by the capillary pressure. Variations in the quantity of lymph issuing from different organs have been on this theory ascribed to differences in the permeability of the capillaries of the organs. Thus as liver lymph is richest in protein content and is produced in greatest amount, it has been concluded that the liver capillaries possess the highest permeability. The intestines stand next in producing a concentrated lymph, and their capillaries are therefore assumed to stand second as regards permeability. Lastly, the lymph coming from limbs and other organs is much poorer in solids and much less copious in amount. Hence it is argued that their capillaries show the least permeability. It is, however, very unsafe to compare the liver capillaries with those of other organs, since they are not in reality capillaries but rather venous sinuses, and their relation to the liver cells is characteristically different from that of ordinary capillaries. If an animal is at rest, no lymph flows from the hind limbs. To obtain a sample of limb lymph it is necessary to massage the limb. If, however, the veins to the limb be ligatured, we obtain a flow of lymph. The ligature of course causes a rise of the capillary pressure, and it has been argued that this rise of pressure starts a filtration through the capillary wall and hence a flow of lymph. But the stoppage of the blood-flow also damages the capillary wall and tissue cells by asphyxiation, and the resulting lymph-flow is in all probability the resultant of many complex processes. This case is analogous to the production of oedema in cases of heart disease where the circulation is feeble and the oxygen supply to the parts deficient. The results of these experiments form the main evidence in support of the filtration theory of lymph formation. They were first systematically studied by Heidenhain, to whom we owe so much of our knowledge of lymph formation. He did not, however, conclude that they established the filtration theory.

In continuing his observations Heidenhain next studied the results following the injection of a number of substances into the blood. He found many which on injection gave rise to an increased lymph-flow from the thoracic duct, and arranged them in two classes. As instances of lymphogogues of the first class we may mention extract of mussels, leech extract, peptone, extract of crayfish muscle, extract of strawberries, of raspberries and many other like substances. Lymphogogues of the second class comprise neutral salt solutions, urea, sugar, &c. Considering the latter class first we may take as a type a solution of sodium chloride. Injection of such a solution causes a large increase in the lymph-flow, and it has been proved that the lymph comes from the liver and intestines only—chiefly from the former. It is especially to be noted that there is no lymph-flow from the limbs, and the same is true for all lymphogogues of this class. As indicated above, the injection of a saline solution leads to a large and rapidly effected transport of fluid from the blood into muscle tissue, but though there is this large increase in tissue fluid, no lymph flows from the tissue. This result very powerfully disfavours the filtration theory of lymph formation. It practically refutes the idea that lymph formation is solely dependent upon such processes as filtration, osmosis and capillary permeability only. It brings out quite clearly that the exchange of fluid and dissolved salts, &c., between the blood and a tissue, and the flow of lymph from that tissue, are two separate and distinct processes, and especially that the first does not determine the second. Also it is to be noted that the injection of a strong salt solution also excites a flow of duct lymph, again arising from the liver and intestines, but none from the limbs. In this instance, as previously stated, the muscles of the limbs are losing water, and so presumably are the liver and intestinal cells. This independence of tissue-blood exchange and lymph-flow is distinctly in favour of the view, which is rapidly gaining ground from histological observations, that in all instances the lymphatics commence in a tissue as closed capillary vessels.

Turning, in the next place, to the lymphogogues of the first class, it has been proved that the origin of this increase of flow is again from the liver. Very many of the substances of this class are bodies which may when taken cause urticarial (nettle-rash) eruptions, a state which is generally regarded as being due to an action upon the capillary endothelium. Their action as lymphogogues is also generally ascribed to an effect upon the capillary wall rendering it according to some more permeable, according to others leading to a direct secretory action on the part of the endothelium. We also know that many of the bodies of this class act upon the liver in other directions than in exciting an increased lymph production. Thus they may cause an increase in bile secretion, or, as in the case of peptone, the liver cells may be excited to produce a new chemical material, in this instance an antithrombin.

We have now to consider the effect of throwing an organ into activity upon the lymph-flow from the organ. In all cases in which it has been examined it is found that increased activity is accompanied by increased lymph-flow. Thus, to take the instance of the submaxillary gland, which at rest does not discharge any lymph, stimulation of the chorda tympani is followed by a flow of lymph accompanying the flow of saliva simultaneously excited. The stimulation of the nerve also produces dilatation of the blood-vessels and therefore a rise in capillary pressure. But that this vascular change is not the factor determining the lymph-flow is proved by the administration of a small dose of atropine, which arrests the secretion without influencing the vascular reaction following chorda stimulation. After the atropine no lymph-flow occurs on stimulating the nerve. Many other instances of a similar kind might be adduced. Thus, we have seen that peptone specifically excites the liver cells and also causes an increased lymph-flow from the liver; or, as a last instance, the injection of bile salt excites a flow of bile and also excites a flow of lymph from the liver. The supporters of the filtration theory have argued that as activity of a tissue is necessarily accompanied by the discharge of metabolites from the active tissue cells, and as these are of small molecular size, they must set up an osmotic effect. Water is therefore drawn into the tissue spaces, and this rise in fluid content results mechanically in a flow of lymph from the organ. The lymph simply drains away along the open lymphatics. This argument, however, loses all its force when we recall the fact that we may set up an enormous flow of fluid and salt into a tissue and its tissue spaces without causing the least flow of lymph. Further, there is no reason to suppose that the metabolites discharged from a tissue during activity are produced in large quantities. The chief metabolite is undoubtedly carbonic acid, and this diffuses very rapidly and is quickly carried away by the blood. If, moreover, as is probably the case, the lymphatics commence as closed capillaries, we have a further difficulty in explaining how the fluid is driven through the lymphatic wall. Either we must imagine the wall to be porous or there must be a greater pressure outside than inside, and it is very difficult to conceive how this is possible. As a general conclusion, then, it seems much more probable that we are here dealing with a secretory process, and that the active tissue produces some substance or substances—it may be carbonic acid—which throws the lymphatic capillary cells into activity.

To sum up in a few words the present state of our knowledge as to lymph formation we may say that the exchange of water and salts between the blood and the tissues is probably entirely determined by processes of filtration and osmosis. Further, that the physical condition of the capillary cells is frequently altered by many chemical substances, and that in consequence it may permit exudation into the tissue spaces much more freely. In the next place, the flow of lymph from a tissue is not solely determined by the amount of the tissue fluids. The lymph capillaries start as closed tubules, and the endothelial walls of these tubules play an active part (secretory) in determining when water and other substances shall be admitted into the capillary and further determine the quantity of such discharge. Apparently, too, these cells are specifically excited when the tissue is thrown into activity, the exciting substance being a metabolite from the active tissue. Leucocytes also are capable of passing through or between the endothelial cells of the lymph capillary. (T. G. Br.)

LYMPHATIC SYSTEM. In anatomy, the lymphatic system (Lat. *lympha*, clear water) comprises the *lymphoid* or *adenoid* tissue so plentifully distributed about the body, especially in the course of the alimentary canal (see Connective Tissues), *lymph spaces*, *lymphatic vessels* of which the lacteals are modifications, *lymphatic glands*, *haemolymph glands*, and the *thoracic* and *right lymphatic ducts* by which the lymph (*q.v.*) finally reaches the veins.

Lymph spaces are mere spaces in the connective tissue, which usually have no special lining, though sometimes there is a layer of endothelial cells like those of the lymphatic and blood vessels. Most of these spaces are very small, but sometimes, as in the case of the *sub-epicranial space* of the scalp, the *capsule of Tenon* in the orbit, and the *retropharyngeal space* in the neck, they are large and are adaptations to allow free movement. Opening from these spaces, and also communicating with the serous membranes by small openings called stomata,[1] are the *lymph capillaries* (see Vascular System), which converge to the *lymphatic vessels*. These resemble veins in having an internal layer of endothelium, a middle unstriped muscular coat, and an external coat of fibrous tissue, though in the smaller vessels the middle coat is wanting. They have numerous endothelial valves, formed of two crescentic segments allowing the lymph to pass toward the root of the neck. When the vessels are engorged these valves are marked by a constriction, and so the lymphatics have a beaded appearance. The vessels divide and anastomose very freely, and for this reason they do not, like the veins, increase in calibre as they approach their destination. It is usual to divide the lymphatic vessels into a superficial and a deep set; speaking generally, the superficial ones are found near the course of the superficial veins, while the deeper ones accompany the arteries. Probably any single drop of lymph passes sooner or later through one or more lymphatic glands, and so those vessels which are approaching a gland are called *afferent*, while those leaving are spoken of as *efferent lymphatics*. The *lacteals* are special lymphatic vessels which carry the chyle from the intestine; they begin in lymphatic spaces in the villi and round the solitary and agminated glands, and pass into the mesentery, where they come in contact with a large number of *mesenteric glands* before reaching the *receptaculum chyli*.

The *lymphatic glands* are pink bodies situated in the course of the lymphatic vessels, to which they act as filters. They are generally oval in shape and about the size of a bean, but sometimes, especially in the groin, they form irregular flattened masses 2 in. long, while, at other times, they are so small as almost to escape notice. They are usually found in groups.

Each gland has a fibrous capsule from which trabeculae pass toward the centre, where they break up and interlace, forming a network, and in this way a cortical and medullary region for each gland is distinguished; the intervals are nearly filled by lymphoid tissue, but close to the trabeculae is a lymph path or sinus, which is only crossed by the reticular stroma of the lymphoid tissue, and this probably acts as a mechanical sieve, entangling foreign particles; as an example of this the bronchial glands are black from carbon strained off in its passage from the lungs, while the axillary glands in a tattooed arm are blue. The blood-vessels enter at one spot, the *hilum*, and are distributed along the trabeculae. In addition to their function as filters the lymphatic glands are probably one of the sources from which the leucocytes are derived.

The exact position of the various groups of glands is very important from a medical point of view, but here it is only possible to give a brief sketch which will be helped by reference to the accompanying diagram. In the head are found *occipital* and *mastoid glands* (fig. 1, β), which drain the back of the scalp; *internal maxillary glands*, in the zygomatic fossa, draining the orbit, palate, nose and membranes of the brain; *preauricular glands* (fig. 1, α), embedded in the parotid, draining the side of the scalp, pinna, tympanum and lower eyelid; and *buccal glands*, draining the cheek region. In the neck are the *superficial cervical glands* (fig. 1, γ), along the course of the external jugular vein, draining the surface of the neck; the *submaxillary glands* (fig. 1, δ), lying just above the salivary gland of the same name and draining the front of the face and scalp; the *submental glands* (fig. 1, ε), beneath the chin, draining the lower lip, as well as sometimes the upper, and the front of the tongue; the *retropharyngeal glands*, draining the naso-pharynx and tympanum; the *pretracheal glands*, draining the trachea and lower part of the thyroid body; and the *deep cervical glands*, which are by far the most important and form a great mass close to the internal jugular vein; they receive afferent vessels from most of the glands already mentioned and so are liable to be affected in any trouble of the head or neck, especially of the deeper parts. Into them the lymphatics of the brain pass directly. The lower part of this mass is sometimes distinguished as a separate group called the *supra-clavicular glands*, which drain the back of the neck and receive afferents from the occipital and axillary glands. The efferents from the deep cervical glands join to form a common vessel known as the *jugular lymphatic trunk*, and this usually opens into the thoracic duct on the left side and the right lymphatic duct on the right.

In the thorax are found *intercostal glands* (fig. 2, I.), near the vertebral column draining the back of the thoracic walls and pleura; *internal mammary glands*, draining the front of the same parts as well as the inner part of the breast and the upper part of the abdominal wall; *diaphragmatic glands*, draining that structure and the convex surface of the liver; *anterior, middle, posterior and superior mediastinal glands*, draining the contents of those cavities. The *bronchial glands*, draining the lungs, have already been referred to.

In the abdomen and pelvis the glands are usually grouped round the large arteries and are divided into visceral and parietal. Among the visceral are the *gastric glands*, draining the stomach (these are divided into *coronary*, *subpyloric* and *retropyloric* groups); the *splenic glands* at the hilum of the spleen, draining that organ, the tail of the pancreas and the fundus of the stomach; the *hepatic glands* in the small omentum, draining the lower surface and deep parts of the liver; the *pancreatic glands*, behind the lesser sac of the peritoneum, draining the head and body of the pancreas, the *superior mesenteric glands*; from one to two hundred in number, lying in the mesentery and receiving the lacteals; the *ileo-caecal glands*, draining the caecum, one of which is known as the *appendicular* gland and drains the vermiform appendix and right ovary; the *colic glands* along the right and middle colic arteries, draining the ascending and transverse colon; the *inferior mesenteric glands* in the course of that artery, draining the descending iliac and pelvic colons; the *rectal* glands, behind the rectum, draining its upper part.

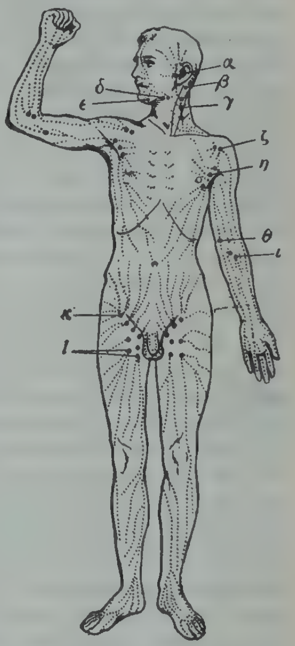

Fig. 1.—Superficial Lymphatic Vessels and Glands.

α,	Preauricular.
β,	Mastoid.
γ,	Superficial cervical.
δ,	Submaxillary.
ε,	Submental.
ζ,	Infraclavicular.
η,	Anterior axillary.
θ,	Supratrochlear.
ι,	Antecubital.
κ,	Inguinal.
l,	Superficial femoral.

Among the parietal glands are the *external iliac glands*, divided into a lateral and mesial set (see fig. 2, E.I.), and receiving the inguinal efferent vessels and lymphatics from the bladder, prostate, cervix uteri, upper part of the vagina, glans penis vel clitoridis and urethra. The *supra* and *infra-umbilical glands* receive the deep lymphatics of the abdominal wall, the former communicating with the liver, the latter with the bladder. From the latter, vessels pass to the epigastric gland lying in front of the termination of the external iliac artery. The *internal iliac glands* (fig. 2, I. I.) are situated close to the branches of this artery and drain the rectum, vagina, prostate, urethra, buttock and perinaeum. *Common iliac glands* (fig. 2, C.I.) lie around that artery and receive afferents from the external and internal iliac glands as well as a few from the pelvic viscera.[2] The

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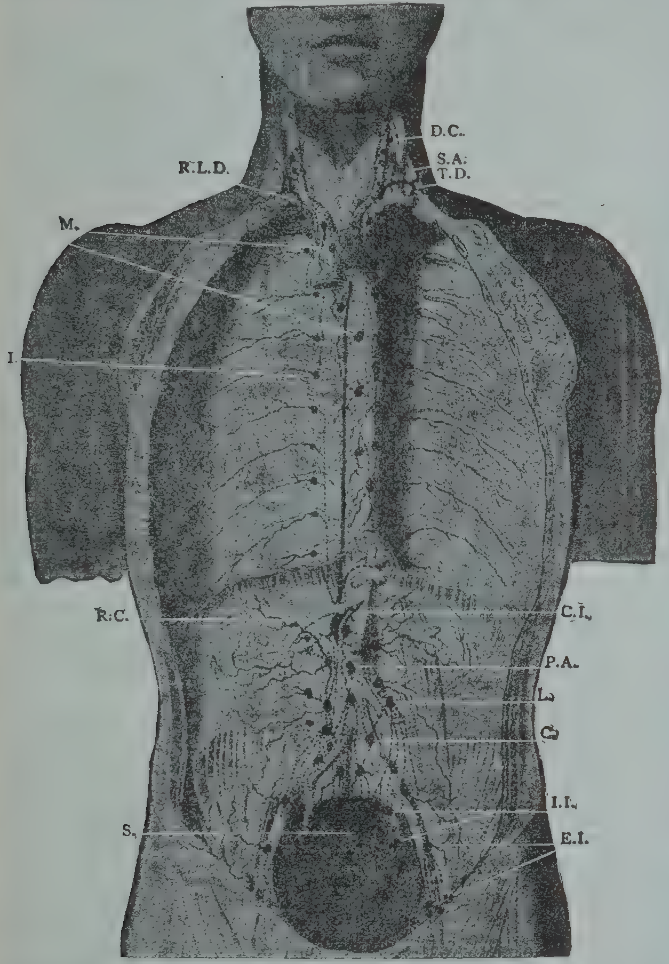
[1] It has recently been stated that stomata do not exist in the peritoneum.

[2] For further details of the pelvic glands see "Seventh Report of the Committee of Collective Investigation," *Journ. Anat. and Phys.* xxxii. 164.

aortic glands are grouped all round the length of the aorta, and are divided into *pre-*, *retro-* and *lateral aortic* groups (fig. 2 P.A. and L), all of which communicate freely. The upper preaortic glands are massed round the coeliac axis, and receive afferents from the gastric, hepatic, splenic and pancreatic glands; they are known as *coeliac glands*. The *lateral aortic glands* drain the kidney, adrenal, testis, ovary, fundus of uterus and lateral abdominal walls. In the upper extremity a few small glands are sometimes found near the deep arteries of the forearm. At the bend of the elbow are the *antecubital* glands (fig. 1 λ) and just above the internal condyle, one or two *supra-trochlear glands* (fig. 1, θ). The *axillary glands* (fig. 1, η) are perhaps the most practically important in the body. They are divided into four sets: (1) *external*, along the axillary vessels, draining the greater part of the arm; (2) *anterior*, behind the lower border of the pectoralis major muscle, draining the surface of the thorax including the breast and upper part of the abdomen; (3) *posterior* along the subscapular artery, draining the back and side of the trunk as low as the umbilical zone; (4) superior or *infra-clavicular glands* (fig. 1, ζ), receiving the efferents of the former groups as well as lymphatics accompanying the cephalic vein. In the lower limb all the superficial lymphatics pass up to the groin, where there are two sets of glands arranged like a T. The *superficial femoral* glands (fig. 1, λ) are the vertical ones, and are grouped round the internal saphenous vein; they are very large, drain the surface of the leg, and are usually in two parallel rows. The *inguinal glands* form the cross bar of the T (fig. 1, κ), and drain part of the buttock, the surface of the abdomen below the umbilicus and the surface of the genital organs. The deep lymphatics of the leg drain into the *anterior tibial gland* on that artery, the *popliteal glands* in that space, and the *deep femoral glands* surrounding the common femoral vein.



From A. M. Paterson, Cunningham's *Text-book of Anatomy.*

FIG. 2.—Deep Lymphatic Glands and Vessels of the Thorax and Abdomen (diagrammatic). Afferent vessels are represented by continuous lines and efferent and interglandular vessels by dotted lines.

C.	Common iliac glands.	M.	Mediastinal glands and vessels.
C.I.	Common intestinal trunk.	P.A.	Pre-aortic glands and vessels.
D.C.	Deep cervical glands.	R.C.	Receptaculum chylii.
E.I.	External iliac glands.	R.L.D.	Right lymphatic duct.
I.	Intercostal glands and vessels.	S.	Sacral glands.
I.I.	Internal iliac glands.	S.A.	Scalenus anticus muscle.
L.	Lateral aortic glands.	T.D.	Thoracic duct.

The *thoracic duct* begins as an irregular dilatation known as the *receptaculum chyli*, opposite the first and second lumbar vertebrae, which receives all the abdominal lymphatics as well as those of the lower intercostal spaces. The duct runs up on the right of the aorta through the posterior mediastinum and then traverses the superior mediastinum to the left of the oesophagus. At the root of the neck it receives the lymphatics of the left arm and left side of the neck and opens into the beginning of the left innominate vein, usually by more than one opening.

The *right lymphatic duct* collects the lymphatics from the right side of the neck and thorax, the right arm, right lung, right side of the heart and upper surface of the liver; it is often represented by several ducts which open separately into the right innominate vein.

Haemolymph glands are structures which have only been noticed since 1884. They differ from lymphatic glands in their much greater vascularity. They assist the spleen in the destruction of red blood corpuscles, and probably explain or help to explain the fact that the spleen can be removed without ill effects. In man they extend along the vertebral column from the coeliac axis to the pelvis, but are specially numerous close to the renal arteries.

T. Lewis suggests that lymphatic and haemolymph glands should be classified in the following way:—

Haemolymph Glands.	Haemal glands.	Simple. Specialized (Spleen).
	Haemal lymphatic glands.	1. Blood and lymph sinuses separate. 2. Blood lymph sinuses. 3. Other combined forms.
	Lymphatic glands.	

Details and references will be found in papers by T. Lewis, *J. Anat. & Phys.* vol. xxxviii. p. 312; W. B. Drummond, *Journ. Anat. and Phys.* vol. xxxiv. p. 198; A. S. Warthin, *Journ. Med. Research*, 1901, p. 3, and H. Dayton, *Am. Journ. of Med. Sciences*, 1904, p. 448. For further details of man's lymphatic system see *The Lymphatics* by Delamere, Poirier and Cuneo, translated by C. H. Leaf (London, 1903).

Embryology.—The lymphatic vessels are possibly developed by the hollowing out of mesenchyme cells in the same way that the arteries are; these cells subsequently coalesce and form tubes (see VASCULAR SYSTEM). There is, however, a good deal of evidence to show that they are originally offshoots of the venous system, and that their permanent openings into the veins are either their primary points of communication or are secondarily acquired. The lymphatic and haemolymph glands are probably formed by the proliferation of lymphocytes around networks of lymphatic vessels; the dividing lymphocytes form the lymphoid tissue, and eventually the network breaks up to form distinct glands into which blood vessels penetrate. If the blood vessels enlarge more than the lymphatic, haemolymph glands result, but if the lymphatic vessels become predominant ordinary lymphatic glands are formed. At an early stage in the embryo pig two thoracic ducts are formed, one on either side of the aorta, and the incomplete fusion of these may account for the division often found in man's duct. In the embryo pig too there have been found two pairs of lymph hearts for a short period.

See A. S. Warthin, *Journ. Med. Research*, vol. vii. p. 435; F. R. Sabin, *Am. Journ. of Anat.* i., 1902; and, for literature, *Development of the Human Body*, by J. P. McMurrich (London, 1906), and Quain's *Anatomy* (vol. i., London, 1908).

Comparative Anatomy.—A lymphatic system is recognized in all the Craniata, and in the lower forms (fishes and Amphibia) it consists chiefly of lymph spaces and sinuses in communication with the coelom. In fishes, for instance, there is a large *subvertebral lymph sinus* surrounding the aorta and another within the spinal canal. In Amphibia the subvertebral sinus is also found, and in the Anura (frogs and toads) there is a great *subcutaneous lymph sinus*. *Lymph hearts* are muscular dilatations of vessels and are found in fishes, amphibians, reptiles and bird embryos, and drive the lymph into the veins; they are not known in adult mammals.

In birds the thoracic duct is first recognized, and opens into both right and left precaval veins, as it always does in some mammals. In birds, however, some of the lymphatics open into the sacral veins, and it is doubtful whether true lymphatic glands ever occur. In birds and mammals lymphatic vessels become more definite and numerous and are provided with valves.

Haemolymph glands are present in mammals and birds, but have not been seen lower in the scale, though S. Vincent and S. Harrison point out the resemblance of the structure of the head kidney of certain Teleostean fishes to them (*Journ. Anat. and Phys.* vol. xxxi. p. 176).

For further details see *Comparative Anat. of Vertebrates*, by R. Wiedersheim (London, 1907). (F. G. P.)

Diseases of the Lymphatic System and Ductless Glands.

Lymphadenitis or inflammatory infection of the lymphatic glands, is a condition characterized by hyperaemia of and exudation into the gland, which becomes redder, firmer and larger than usual. Three varieties may be distinguished: simple, suppurative and tuberculous. The cause is always the absorption of some toxic or infective material from the periphery. This may take place in several of the acute infectious diseases, notably in scarlet fever, mumps, diphtheria and German measles, or may be the result of poisoned wounds. The lymphatic glands are also affected in constitutional diseases such as syphilis. Simple lymphadenitis usually subsides of its own accord, but if toxins are produced in the inflamed area the enlargement is obvious and painful, while if pyogenic organisms are absorbed the inflammation progresses to suppuration.

Tuberculous lymphadenitis (scrofula) is due to the infection of the lymph glands by Koch's tubercle bacillus. This was formerly known as "King's Evil," as it was believed that the touch of the royal hand had power to cure it. It occurs most commonly in children and young adults whose surroundings are unhealthy, and who are liable to develop tuberculous disease from want of sufficient food and fresh air. Some local focus of irritation is usually present. The ways in which the tubercle bacillus enters the body are much disputed, but catarrh of the mucous membranes is regarded as a predisposing factor, and the tonsils as a probable channel of infection. Any lymphoid tissue in the body may be the seat of tuberculous disease, but the glands of the neck are the most commonly involved. The course of the disease is slow and may extend over a period of years. The earliest manifestation is an enlargement of the gland. It is possible in this stage for spontaneous healing to take place, but usually the disease progresses to caseation, in which tuberculous nodules are found diffused throughout the gland. Occasionally this stage may end in calcification of the caseous matter, the gland shrinking and becoming hard; but frequently suppuration follows from liquefaction of the caseating material. Foci of pus occur throughout the gland, causing destruction of the tissue, so that the gland may become a single abscess cavity. If left to itself the abscess sooner or later bursts at one or several points, leaving ulcerated openings through which a variable amount of pus escapes. Temporary healing may take place, to be again followed by further breaking down of the gland. This condition, if untreated, may persist for years and may finally give rise to a general tuberculosis. The treatment consists mainly in improving the general health with good diet, fresh air (particularly sea air), cod-liver oil and iron, and the removal of all sources of local irritation such as enlarged tonsils, adenoids, &c. Vaccination with tuberculin (TR) may be useful. Suppuration and extension of the disease require operative measures, and removal of the glands *en masse* can now be done through so small an opening as to leave only a very slight scar.

In *Tabes mesenterica* (tuberculosis of the mesenteric glands), usually occurring in children, the glands of the mesentery and retroperitonaeum become enlarged, and either caseate or occasionally suppurate. The disease may be primary or may be secondary to tuberculous disease of the intestines or to pulmonary phthisis. The patients are pale, wasted and anaemic, and the abdomen may be enormously enlarged. There is usually moderate fever, and thin watery diarrhoea. The caseating glands may liquefy and give rise to an inflammatory attack which may simulate appendicitis. Limited masses are amenable to surgical treatment and may be removed, while in the earlier stages constitutional treatment gives good results. Tuberculous peritonitis frequently supervenes on this condition.

Lymphadenoma (Hodgkin's Disease), a disease which was first fully described by Hodgkin in 1832, is characterized by a progressive enlargement of the lymphatic glands all over the body, and generally starts in the glands of the neck. The majority of cases occur in young adults, and preponderate in the male sex. The first symptom is usually enlargement of a gland in the neck, with generally progressive growth of the glands in the submaxillary region and axilla. The inguinal glands are early involved, and after a time the internal lymph glands follow. The enlargements are at first painless, but in the later stages symptoms are caused by pressure on the surrounding organs, and when the disease starts in the deeper structures the first symptoms may be pain in the chest and cough, pain in the abdomen, pain and oedema in the legs. The glands may increase until they are as large as eggs, and later may become firmly adherent one to another, forming large lobulated tumours. Increase of growth in this manner in the neck may cause obstructive dyspnoea and even death. In the majority of cases the spleen enlarges, and in rare instances lymphoid tumours may be found on its surface. Anaemia is common and is secondary in character; slight irregular fever is present, and soon a great and progressive emaciation takes place. The cases are of two types, the acute cases in which the enlargements take place rapidly and death may occur in two to three months, and the chronic cases in which the disease may remain apparently stationary. In acute lymphadenoma the prognosis is very unfavourable. Recovery sometimes takes place in the chronic type of the disease. Early surgical intervention has in some cases been followed by success. The application of X-rays is a valuable method of treatment, superficial glands undergoing a rapid diminution in size. Of drugs arsenic is of the most service, and mercurial inunction has been recommended by Dreschfeld. Organic extracts have of late been used in the treatment of lymphadenoma.

Glandular Fever is an acute infectious fever, generally occurring in epidemics, and was first described by E. Pfeiffer in 1889. It usually affects childrenand has a tendency to run through all the children of a family. The incubation period is said to be about 7 days. The onset is sudden, with pain in the neck and limbs, headache, vomiting, difficulty in swallowing and high temperature. On the second day, or sometimes on the first, swelling of the cervical glands is noticed, and later the posterior cervical, axillary and inguinal glands become enlarged and tender. In about half the cases the spleen and liver are enlarged and there is abdominal tenderness. West found the mesenteric nodes enlarged in 37 cases. Nephritis is an occasional complication, and constipation is very usual. The disease tends to subside of itself, and the fever usually disappears after a few days; the glandular swellings may, however, persist from one to three weeks. Considerable anaemia has been noticed to follow the illness. Rest in bed while the glands are enlarged, and cod-liver oil and iron to meet the anaemia, are the usual treatment.

Status lymphaticus (lymphatism) is a condition found in children and some adults, characterized by an enlargement of the lymphoid tissues throughout the body and more particularly by enlargement of the thymus gland. There is a special lowering of the patient's powers of resistance, and it has been said to account for a number of cases of sudden death. In all cases of status lymphaticus the thymus has been found enlarged. At birth the gland (according to Bovaird and Nicoll) weighs about 6 grammes, and does not increase after birth. In lymphatism it may weigh from 10 to 50 grammes. The clinical features are indefinite, and the condition frequently passes unrecognized during life. In most cases there is no hint of danger until the fatal syncope sets in, which may be after any slight exertion or shock, the patient becoming suddenly faint, gasping and cyanosed, and the heart stopping altogether before the respirations have ceased. The most trifling causes have brought on fatal issues, such as a wet pack (Escherich) or a hypodermic injection, or even a sudden plunge into water though the head is not immersed. The greater number of deaths occur during the administration of anaesthetics, which seem peculiarly dangerous to these subjects. When an attack of syncope takes place no treatment is of any avail.

Virchow, West and Goodhardt have described a form of asthma in adults which they ascribe to a hypertrophied thymus gland and term "thymic asthma."

Diseases of the Spleen.—Physiological variations and abnormalities and absence of the spleen are so rare as to require no comment. The most usual pathological condition which gives rise to symptoms is that of *wandering spleen*, which may or may not be secondary to a wandering left kidney. It may produce symptoms of dragging and discomfort, dyspepsia, vomiting and abdominal pain, and sometimes jaundice (Treves), or the pedicle may become twisted, producing extremely severe symptoms. The treatment is entirely surgical. Abscess in the spleen occasionally occurs, usually in association with infective endocarditis or with general pyaemia. The spleen may be the seat of primary *new growths*, but these are rare, and only in a small portion of cases does it share in the metastatic reproduction of carcinoma. Infection of the spleen plays a prominent part in many diseases, such as malaria, typhoid fever, lymphadenoma and leucaemia.

Diseases of the thyroid gland (see GOITRE) and *Addison's disease* (of the suprarenal glands) are treated separately. (H. L. H.)

LYNCH, PATRICIO (1825–1886) Chilean naval officer, was born in Valparaiso on the 18th of December 1825, his father being a wealthy Irish merchant resident in Chile, and his mother, Carmen Solo de Saldiva, a descendant of one of the best-known families in the country. Entering the navy in 1837, he took part in the operations which led to the fall of the dictator, Santa Cruz. Next, he sought a wider field, and saw active service in the China War on board the British frigate "Calliope." He was mentioned in despatches for bravery, and received the grade of midshipman in the British service. Returning to Chile in 1847 he became lieutenant, and seven years later he received the command of a frigate, but was deprived of his command for refusing to receive on board his ship political suspects under arrest. The Spanish War saw him again employed, and he was successively maritime prefect of Valparaiso, colonel of National Guards, and, finally, captain and minister of marine in 1872. In the Chile-Peruvian War a brilliant and destructive naval raid, led by him, was followed by the final campaign of Chorrillos and Miraflores (1880), in which he led at first a brigade (as colonel) and afterwards a division under Baquedano. His services at the battle of Chorrillos led to his appointment to command the Army of Occupation in Peru. This difficult post he filled with success, but his action in putting the Peruvian president, Garcia Calderon, under arrest excited considerable comment. His last act was to invest Iglesias with supreme power in Peru, and he returned to his own country in 1883. Promoted rear-admiral, he served as Chilean Minister at Madrid for two years, and died at sea in 1886. Lynch is remembered as one of the foremost of Chile's naval heroes.

LYNCHBURG, a city of Campbell county, Virginia, U.S.A., on the James river, about 125 m. W. by S. of Richmond. Pop. (1900) 18,891, of whom 8254 were negroes; (1910) 29,494. It is served by the Southern, the Chesapeake & Ohio and the Norfolk & Western railways. Its terraced hills command fine views of mountain, valley and river scenery, extending westward to the noble Peaks of Otter and lesser spurs of the Blue Ridge about 20 m. distant. On an elevation between Rivermont Avenue and the James river are the buildings of Randolph-Macon Woman's college (opened in 1893), which is conducted by a self-perpetuating board under the auspices of the Methodist Episcopal Church, South, and is one of the Randolph-Macon system of colleges and academies (see ASHLAND, VA.). In Lynchburg, too, are the Virginia Christian college (co-educational, 1903), and the Virginia collegiate and industrial school for negroes. The city has a public library, well-equipped hospitals, public parks and the Rivermont Viaduct, 1100 ft. long and 140 ft. high. Lynchburg is the see of a Protestant Episcopal bishop. Tobacco of a superior quality and large quantities of coal, iron ore and granite are produced in the neighbourhood. Good water power is furnished by the James river, and Lynchburg is one of the principal manufacturing cities of the state. The boot and shoe industry was established in 1900, and is much the most important. In 1905 the city was the largest southern manufacturer of these articles and one of the largest distributors in the country. The factory products increased in value from $2,993,551 in 1900 to $4,965,435 in 1905, or 65·9%.

Lynchburg, named in honour of John Lynch, who inherited a large tract of land here and in 1757 established a ferry across the James, was established as a village by Act of Assembly in 1786, was incorporated as a town in 1805, and became a city in 1852. During the Civil War it was an important base of supplies for the Confederates; on the 16th of June 1864 it was invested by Major-General David Hunter (1802–1886), but three days later he was driven away by General Jubal A. Early. In 1908 the city's corporate limits were extended.

LYNCH LAW, a term loosely applied to various forms of executing rough popular justice, or what is thought to be justice, for the punishment of offenders by a summary procedure, ignoring, or even contrary to, the strict forms of law. The word *lynching* "originally signified a whipping for reformatory purposes with more or less disregard for its legality" (Cutler), or the infliction of minor punishments without recourse to law; but during and after the Reconstruction Period in the United States, it came to mean, generally, the summary infliction of capital punishment. Lynch law is frequently prevalent in sparsely settled or frontier districts where government is weak and officers of the law too few and too powerless to enforce law and preserve order. The practice has been common in all countries when unsettled frontier conditions existed, or in periods of threatened anarchy. In what are considered civilized countries it is now found mainly in Russia, south-eastern Europe and in America, but it is essentially and almost peculiarly an American institution. The origin of the name is obscure; different writers have attempted to trace it to Ireland, to England, to South Carolina, to Pennsylvania and to Virginia. It is certain that the name was first used in America, but it is not certain whether it came from Lynch's Creek, South Carolina, where summary justice was administered to outlaws, or from Virginia and Pennsylvania, where men named Lynch were noted for dealing out summary punishment to offenders.[1] In Europe early examples of a similar phenomenon are found in the proceedings of the Vehmgerichte in medieval Germany, and of Lydford law, gibbet law or Halifax law, Cowper justice and Jeddart justice in the thinly settled and border districts of Great Britain; and since the term "lynch law" came into colloquial use, it is loosely employed to cover any case in which a portion of the community takes the execution of its ideas of justice into its own hands, irrespective of the legal authorities.

In America during the 18th and 19th centuries the population expanded westward faster than well-developed civil institutions could follow, and on the western frontier were always desperadoes who lived by preying on the better classes. To suppress these desperadoes, in the absence of strong legal institutions, resort was continually made to lynch law. There was little necessity for it until the settlement crossed the Alleghany Mountains, but the following instances of lynching in the East may be mentioned: (1) the mistreatment of Indians in New England and the Middle Colonies in disregard of laws protecting them; (2) the custom found in various colonies of administering summary justice to wife-beaters, idlers and other obnoxious persons; (3) the acts of the Regulators of North Carolina, 1767–1771; (4) the popular tribunals of the Revolutionary period, when the disaffection toward Great Britain weakened the authority of the civil governments and the war replaced them by popular governments, at a time when the hostilities between "Patriots" and "Tories" were an incentive to extra-legal violence. In the South, lynching methods were long employed in dealing with agitators, white and black, who were charged with endeavouring to excite the slaves to insurrection or to crime against their masters, and in dealing with anti-slavery agitators generally.

In the West, from the Alleghanies to the Golden Gate, the pioneer settlers resorted to popular justice to get rid of bands of outlaws, and to regulate society during that period when laws were weak or confused, when the laws made in the East did not suit western conditions, and when courts and officials were scarce and distant. The Watauga settlements and the "State" of Franklin furnished examples of lynch law procedure almost reduced to organization. Men trained in the rough school of the wilderness came to have more regard for quick, ready-made, personal justice than for abstract justice and statutes; they were educated to defend themselves, to look to no law for protection or regulation; consequently they became impatient of legal forms and lawyers' technicalities; an appeal to statute law was looked upon with suspicion, and, if some personal matter was involved, was likely to result in deadly private feuds. Thus were formed the habits of thought and action of the western pioneers. Lynch law, not civil law, cleared the western forests, valleys and mountain passes of horse and cattle thieves, and other robbers and outlaws, gamblers and murderers. This was especially true of California and the states of the far West. H. H. Bancroft, the historian of *Popular Tribunals*, wrote in 1887 that "thus far in the history of these Pacific States far more has been done toward righting wrongs and administering justice outside the pale of law than within it." However, the lack of regard for law fostered by the conditions described led to a survival of the lynching habit after the necessity for it passed away. In parts of the Southern states, where the whites are few and greatly outnumbered by the blacks, certain of the conditions of the West have prevailed, and since emancipation released the blacks from restraint many of the latter have been lawless and turbulent. The Reconstruction, by giving the blacks temporary political supremacy, increased the friction between the races, and greatly deepened prejudice. The numerous protective societies of whites, 1865–1876, culminating in the Ku Klux movement, may be described as an application of lynch law. With the increase of negro crimes came an increase of lynchings, due to prejudice, to the fact that for some time after Reconstruction the governments were relatively weak, especially in the districts where the blacks outnumber the whites, to the fact that negroes nearly always shield criminals of their own race against the whites, and to the frequent occurrence of the crime of rape by negro men upon white women.

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[1] The usual explanation is that the name was derived from Charles Lynch (1736–1796), a justice of the peace in Virginia after 1774, who in 1780, toward the close of the War of Independence, greatly exceeded his powers in the punishment of Tories or Loyalists detected in a conspiracy in the neighbourhood of his home in Bedford county, Va. Lynch was a man of influence in his community, was for many years a member of the Virginia legislature, was a member of the famous Virginia Convention of 1776 and was later (in 1781) an officer in the American army. See an article, "The Real Judge Lynch," in the *Atlantic Monthly*, vol. lxxxviii. (Boston, 1901).

Since 1882 the Chicago *Tribune* has collected statistics of lynching, and some interesting facts may be deduced from these tables.[1] During the twenty-two years from 1882 to 1903 inclusive, the total number of persons lynched in the United States was 3337, the number decreasing during the last decade; of these 2385 were in the South and 752 in the North; of those lynched in the East and West 602 were white and 75 black, and of those in the South 567 were white and 1985 black.[2] Lynchings occur mostly during periods of idleness of the lower classes; in the summer more are lynched for crimes against the person and in the winter (in the West) for crimes against property; the principal causes of lynching in the South are murder and rape, in the North and West, murder and offences against property; more blacks than whites were lynched between 1882 and 1903, the numbers being 2060 negroes, of whom 40 were women, and 1169 whites, of whom 23 were women; of the 707 blacks lynched for rape 675 were in the South; 783 blacks were lynched for murder, and 753 of these were in the South; most of the lynchings of whites were in the West; the lynching of negroes increased somewhat outside of the South and decreased somewhat in the South. Lynching decreases and disappears in a community as the population grows denser and civil institutions grow stronger; as better communications and good police make it harder to commit crime; and as public sentiment is educated to demand legal rather than illegal and irregular infliction of punishment for even the most horrible of crimes.

See James E. Cutler, *Lynch Law* (New York, 1905), an admirable and unbiased discussion of the subject; H. H. Bancroft, *Popular Tribunals* (2 vols., San Francisco, 1887); C. H. Shinn, *Mining Camps: A Study in American Frontier Government* (New York, 1885); and J. C. Lester and D. L. Wilson, *Ku Klux Klan* (New York, 1905). (W. L. F.)

LYNDHURST, JOHN SINGLETON COPLEY, Baron (1772–1863), lord chancellor of England, was born at Boston, Massachusetts, in 1772. He was the son of John Singleton Copley, the painter. He was educated at a private school and Cambridge university, where he was second wrangler and fellow of Trinity. Called to the bar at Lincoln's Inn in 1804, he gained a considerable practice. In 1817 he was one of the counsel for Dr J. Watson, tried for his share in the Spa Fields riot. On this occasion Copley so distinguished himself as to attract the attention of Castlereagh and other Tory leaders, under whose patronage he entered parliament as member for Yarmouth in the Isle of Wight. He afterwards sat for Ashburton, 1818–1826, and for Cambridge university 1826–1827. He was solicitor-general in 1819, attorney-general in 1824, master of the rolls in 1826 and lord chancellor in 1827, with the title of Lord Lyndhurst. Before being taken up by the Tories, Copley was a man of the most advanced views, a republican and Jacobin; and his accession to the Tories excited a good deal of comment, which he bore with the greatest good humour. He gave a brilliant and eloquent but by no means rancorous support to all the reactionary measures of his chief. The same year that he became solicitor-general he married the beautiful and clever widow of Lieut.-Colonel Charles Thomas of the Coldstream Guards, and began to take a conspicuous place in society, in which his noble figure, his ready wit and his never-failing *bonhomie* made him a distinguished favourite.

As solicitor-general he took a prominent part in the trial of Queen Caroline. To the great Liberal measures which marked the end of the reign of George IV. and the beginning of that of William IV. he gave a vigorous opposition. He was lord chief baron of the exchequer from 1831 to 1834. During the Melbourne administration from 1835 to 1841 he figured conspicuously as an obstructionist in the House of Lords. In these years it was a frequent practice with him, before each prorogation of parliament, to entertain the House with a "review of the session," in which he mercilessly attacked the Whig government. His former adversary Lord Brougham, disgusted at his treatment by the Whig leaders, soon became his most powerful ally in opposition; and the two dominated the House of Lords. Throughout all the Tory governments from 1827 Lyndhurst held the chancellorship (1827–1830 and 1834–1835); and in the Peel administration (1841–1846) he resumed that office for the last time. As Peel never had much confidence in Lyndhurst, the latter did not exert so great an influence in the cabinet as his position and experience entitled him to do. But he continued a loyal member of the party. As in regard to Catholic emancipation, so in the agitation against the corn laws, he opposed reform till his chief gave the signal for concession, and then he cheerfully obeyed. After 1846 and the disintegration of the Tory party consequent on Peel's adoption of free trade, Lord Lyndhurst was not so assiduous in his attendance in parliament. Yet he continued to an extreme old age to take a lively interest in public affairs, and occasionally to astonish the country by the power and brilliancy of his speeches. That which he made in the House of Lords on the 19th of June 1854, on the war with Russia, made a sensation in Europe; and throughout the Crimean War he was a strong advocate of the energetic prosecution of hostilities. In 1859 he denounced with his old energy the restless ambition of Napoleon III. When released from office he came forward somewhat as the advocate of liberal measures. His first wife had died in 1834, and in August 1837 he had married Georgina, daughter of Lewis Goldsmith. She was a Jewess; and it was therefore natural that he strenuously supported the admission of Jews into parliament. He also advocated women's rights in questions of divorce. At the age of eighty-four he passed the autumn at Dieppe, "helping to fly paper kites, and amusing himself by turns with the writings of the Greek and Latin fathers on divorce and the amorous novels of Eugene Sue." His last speech, marked by "his wonted brilliancy and vigour," was delivered in the House of Lords at the age of eighty-nine. He died in London on the 12th of October 1863. He left no male issue and the title became extinct.

See *Lives of the Lord Chancellors of England*, vol. viii. (Lords Lyndhurst and Brougham), by Lord Campbell (1869). Campbell was a personal friend, but a political opponent. Brougham's *Memoirs; Greville Memoirs; Life of Lord Lyndhurst* (1883) by Sir Theodore Martin; J. B. Atlay, *The Victorian Chancellors* (1906).

LYNDSAY, SIR DAVID (*c.* 1490–*c.* 1555), Scottish poet, was the son of David Lyndsay of the Mount, near Cupar-Fife, and of Garmylton, near Haddington. His place of birth and his school are undetermined. It is probable that his college life was spent at St Andrews university, on the books of which appears an entry "Da Lindesay" for the session 1508–1509. He was engaged at court, first as an equerry, then as an "usher" to the young Prince James, afterwards James V. In 1522 he married Janet Douglas, a court seamstress, and seven years later was appointed Lyon King of Arms, and knighted. He was several times engaged in diplomatic business (twice on embassies abroad—to the Netherlands and France), and he was, in virtue of his heraldic office, a general master of ceremonies. After the death of James V., in 1542, he continued to sit in parliament as commissioner for Cupar-Fife; and in 1548 he was member of a mission to Denmark which obtained certain privileges for Scottish merchants. There is reason to believe that he died in or about 1555.

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[1] They have been corrected and somewhat modified by Dr. J. E. Cutler, from whose book the figures above have been taken. Lynching as used in this connexion applies exclusively to the illegal infliction of capital punishment.

[2] For present purposes the former slave states (of 1860) constitute the South; the West is composed of the territory west of the Mississippi river, excluding Missouri, Arkansas, Louisiana, Texas and Oklahoma; the East includes those states east of the Mississippi river not included in the Southern group; the East and the West make up the North as here used—that is, the former free states of 1860.

Most of Lyndsay's literary work, by which he secured great reputation in his own day and by which he still lives, was written during the period of prosperity at court. In this respect he is unlike his predecessor Gavin Douglas (*q.v.*), who forsook literature when he became a politician. The explanation of the difference is partly to be found in the fact that Lyndsay's muse was more occasional and satirical, and that the time was suitable to the exercise of his special gifts. It is more difficult to explain how he enjoyed a freedom of speech which is without parallel even in more secure times. He chastised all classes, from his royal master to the most simple. There is no evidence that he abjured Catholicism; yet his leading purpose was the exposure of its errors and abuses. His aid was readily accepted by the reforming party, and by their use of his work he shared with their leaders throughout many generations a reputation which is almost exclusively political and ecclesiastical.

Lyndsay's longer poems are *The Dreme* (1134 lines), *The Testament and Complaynt of the Papynago* (1190 lines), *The Testament of Squyer Meldrum* (1859 lines), *Ane Dialog betwix Experience and ane Courteour of the Miserabyll Estait of the World* (6333 lines), and *Ane Pleasant Satyre of the Thrie Estaitis* (over 4000 lines). These represent, with reasonable completeness, the range of Lyndsay's literary talent. No single poem can give him a chief place, though here and there, especially in the last, he gives hints of the highest competence. Yet the corporate effect of these pieces is to secure for him the allowance of more than mere intellectual vigour and common sense. There is in his craftsmanship, in his readiness to apply the traditional methods to contemporary requirements, something of that accomplishment which makes even the second-rate man of letters interesting.

Lyndsay, the last of the Makars, is not behind his fellow-poets in acknowledgment to Chaucer. As piously as they, he reproduces the master's forms; but in him the sentiment and outlook have suffered change. His nearest approach to Chaucer is in *The Testament of Squyer Meldrum*, which recalls the sketch of the "young squire"; but the reminiscence is verbal rather than spiritual. Elsewhere his memory serves him less happily, as when he describes the array of the lamented Queen Magdalene in the words which Chaucer had applied to the eyes of his wanton Friar. So too, in the *Dreme*, the allegorical tradition survives only in the form. "Remembrance" conducts the poet over the old-world itinerary, but only to lead him to speculation on Scotland's woes and to an "Exhortatioun to the Kingis Grace" to bring relief. The tenor is well expressed in the motto from the Vulgate—"*Prophetias nolite spernere. Omnia autem probate: quod bonum est tenete.*" This didactic habit is freely exercised in the long *Dialog* (sometimes called the *Monarche*), a universal history of the medieval type, in which the falls of princes by corruption supply an object lesson to the unreformed church of his day. The *Satyre* is more direct in its attack on ecclesiastical abuse; and its dramatic form permits more lively treatment. This piece is of great historical interest, being the only extant example of a complete Scottish morality. It is in respect of literary quality Lyndsay's best work, and in dramatic construction and delineation of character it holds a high place in this *genre*. The farcical interludes (in places too coarse for modern taste) supply many touches of genuine comedy; and throughout the play there are passages, as in the speeches of Veritie in the First Part and of Dame Chastitie in the "Interlude of the Sowtar and the Taylor," in which word and line are happily conceived. The *Testament of the Papyngo* (popinjay), drawn in the familiar medieval manner, is another tract for the time, full of admonition to court and clergy. Of his shorter pieces, *The Complaynt and Publict Confessions of the Kingis Auld Hound, callit Bagsche, directit to Bawtie, the Kingis best belovit Dog, and his companyeonis*, and the *Answer to the Kingis Flyting* have a like pulpit resonance. The former is interesting as a forerunner of Burns's device in the "Twa Dogs." The *Deploratioun of the Deith of Queen Magdalene* is in the extravagant style of commemoration illustrated in Dunbar's Elegy on the Lord Aubigny. The *Justing betwix James Watsoun and Jhone Barbour* is a contribution to the popular taste for boisterous fun, in spirit, if not in form, akin to the *Christis Kirk on the Grene* series; and indirectly, with Dunbar's *Turnament* and *Of ane Blak-Moir*, a burlesque of the courtly tourney. Lyndsay approaches Dunbar in his satire *The Supplicatioun in contemptioun of syde taillis* ("wide" trains of the ladies), which recalls the older poet's realistic lines on the filthy condition of the city streets. In Lyndsay's *Descriptioun of Pedder Coffeis* (pedlars) we have an early example of the studies in vulgar life which are so plentiful in later Scottish literature. In *Kitteis Confessioun* he returns, but in more sprightly mood, to his attack on the church.

In Lyndsay we have the first literary expression in Scotland of the Renaissance. His interest lies on the theological side of the revival; he is in no sense a humanist, and he is indifferent to the artistic claims of the movement. Still he appeals to the principle which is fundamental to all. He demands first-hand impression. He feels that men must get their lesson direct, not from intermediaries who understand the originals no more "than they do the ravyng of the rukis." Hence his persistent plea for the vernacular, nowhere more directly put than in the *Dialog*, in the "Exclamatioun to the Redar, toucheyng the wrytting of the vulgare and maternall language." Though he is concerned only in the theological and ecclesiastical application of this, he undoubtedly stimulated the use of the vernacular in a Scotland which in all literary matters beyond the concern of the irresponsible poet still used the *lingua franca* of Europe.

A complete edition of Lyndsay's poetical works was published by David Laing in 3 vols. in 1879. This was anticipated during the process of preparation by a cheaper edition (slightly expurgated) by the same editor in 1871 (2 vols.). The E.E.T.S. issued the first part of a complete edition in 1865 (ed. F. Hall). Five parts have appeared, four edited by F. Hall, the fifth by J. A. H. Murray. For the bibliography see Laing's 3 vol. edition, *u.s.* iii. pp. 222 et seq., and the E.E.T.S. edition *passim*. See also the editions by Pinkerton (1792), Sibbald (1803), and Chalmers (1806); and the critical accounts in Henderson's *Scottish Vernacular Literature* (1898), Gregory Smith's *Transition Period* (1900), and J. H. Millar's *Literary History of Scotland* (1903). A professional work prepared by Lyndsay in the Lyon Office, entitled the *Register of Scottish Arms* (now preserved in MS. in the Advocates' Library), was printed in 1821 and reprinted in 1878. It remains the most authoritative document on Scottish heraldry. (G. G. S.)

LYNEDOCH, THOMAS GRAHAM, 1st Baron (1748–1843), British general, was the son of Thomas Graeme, laird of Balgowan, and was born on the 19th of October 1748. He was educated by private tutors, among whom was James Macpherson (*q.v.*), and was a gentleman commoner of Christ Church, Oxford, between 1766 and 1768. He then travelled on the continent of Europe, and in 1772 unsuccessfully contested a parliamentary seat in Perthshire. In 1774 he married a daughter of the ninth Lord Cathcart, and took a house in the Leicestershire hunting country. After a few years, owing to the state of his wife's health, Graham was compelled to live mainly in the south of Europe, though while at home he was a prominent sportsman and agriculturist. In 1787 he bought the small estate of Lynedoch or Lednock, a few miles from Perth. In 1791 his wife died in the Mediterranean, off Hyères. Graham tried to find distraction in renewed travels, and during his wanderings fell in with Lord Hood's fleet on its way to Toulon. He joined it as a volunteer, served on Lord Mulgrave's staff during the British occupation of Toulon, and returned, after the failure of the expedition, to Scotland, where he organized a regiment of infantry, the 90th Foot, Perthshire Volunteers (now 2nd Battalion Scottish Rifles). Graham's men were the first regiment in the army to be equipped and trained wholly as light infantry, though they were not officially recognized as such for many years. In the same year (1794) Graham became member of parliament, in the Whig interest, for the county of Perth. He saw some active service in 1795 in "conjunct expeditions" of the army and navy, and in 1796, being then a brevet colonel, he was appointed British commissioner at the headquarters of the Austrian army in Italy. He took part in the operations against Napoleon Bonaparte, was shut up in Mantua with Würmser's army, escaped in disguise, and after many adventures reached the relieving army of Alvinzi just before the battle of Rivoli. On returning to his regiment he served in more "conjunct" expeditions, in one of which, at Messina, he co-operated with Nelson, and in 1799 he was sent as brigadier-general to invest the fortress of Valetta, Malta. He blockaded the place for two years, and though Major-General Pigot arrived shortly before the close of the blockade and assumed command, the conquest of Malta stands almost wholly to the credit of Graham and his naval colleague Sir Alexander Ball. In 1801 Graham proceeded to Egypt, where his regiment was engaged in Abercromby's expedition, but arrived too late to take part in any fighting. He took the opportunity afforded by the peace of Amiens to visit Turkey, Austria, Germany and France, and only resumed command of his regiment in 1804. When the latter was ordered to the West Indies he devoted himself to his duties as a member of parliament. He sat for Perthshire until 1807, when he was defeated, as he was again in 1812. Graham was with Moore in Sweden in 1808 and in Spain 1808–1809, and was present at his death at the battle of Corunna. In 1809 he became a major-general, and after taking part in the disastrous Walcheren expedition he was promoted lieutenant-general and sent to Cadiz (1810).

In 1811, acting in conjunction with the Spanish army under General la Peña (see PENINSULAR WAR), he took the offensive, and won the brilliant action of Barossa (5th of March). The victory was made barren of result by the timidity of the Spanish generals. The latter nevertheless claimed more than their share of the credit, and Graham answered them with spirit. One of the Spanish officers he called out, fought and disarmed, and after refusing with contempt the offer of a Spanish dukedom, he resigned his command in the south and joined Wellington in Portugal. His seniority as lieutenant-general made him second in command of Wellington's army. He took part in the siege of Ciudad Rodrigo, and commanded a wing of the army in the siege of Badajoz and the advance to Salamanca. In July 1812, his eyesight becoming seriously impaired, he went home, but rejoined in time to lead the detached wing of the army in the wide-ranging manœuvre which culminated in the battle of Vittoria. Graham was next entrusted with the investment and siege of San Sebastian, which after a desperate defence fell on the 9th of September 1813. He then went home, but in 1814 accepted the command of a corps to be despatched against Antwerp. His assault on Bergen op Zoom was, however, disastrously repulsed (3rd of February 1814).

At the peace Graham retired from active military employment. He was created Baron Lynedoch of Balgowan in the peerage of the United Kingdom, but refused the offered pension of £2000 a year. In 1813 he proposed the formation of a military club in London, and though Lord St Vincent considered such an assemblage of officers to be unconstitutional, Wellington supported it and the officers of the army and navy at large received the idea with enthusiasm. Lynedoch's portrait, by Sir T. Lawrence, is in possession of this club, the (Senior) United Service. In his latter years he resumed the habits of his youth, travelling all over Europe, hunting with the Pytchley so long as he was able to sit his horse, actively concerned in politics and voting consistently for liberal measures. At the age of ninety-two he hastened from Switzerland to Edinburgh to receive Queen Victoria when she visited Scotland after her marriage. He died in London on the 18th of December 1843. He had been made a full general in 1821, and at the time of his death was a G.C.B., Colonel of the 1st (Royal Scots) regiment, and governor of Dumbarton Castle.

See biographies by John Murray Graham (2nd ed., Edinburgh, 1877) and Captain A. M. Delavoye (London, 1880); also the latter's *History of the 90th (Perthshire Volunteers)* (London, 1880), *Philippart's' Royal Military Calendar* (1820), ii. 147, and *Gentleman's Magazine*, new series, xxi. 197.

LYNN, a city and seaport of Essex county, Massachusetts, 9 m. N.E. of Boston, on the N. shore of Massachusetts Bay. Pop. (1900) 68,513, of whom 17,742 were foreign-born (6609 being English Canadians, 5306 Irish, 1527 English and 1280 French Canadians), and 784 were negroes; (1910 census) 89,336. It is served by the Boston & Maine and the Boston, Revere Beach & Lynn railways, and by an interurban electric railway, and has an area of 10·85 sq. m. The business part is built near the shore on low, level ground, and the residential sections are on the higher levels. Lynn Woods, a beautiful park, covers more than 2000 acres. On the shore, which has a fine boulevard, is a state bath house. The city has a handsome city hall, a free public library, founded in 1862, a soldiers' monument and two hospitals. Lynn is primarily a manufacturing city. The first smelting works in New England were established here in 1643. More important and earlier was the manufacture of boots and shoes, an industry introduced in 1636 by Philip Kertland, a Buckingham man; a corporation of shoemakers existed here in 1651, whose papers were lost in 1765. There were many court orders in the seventeenth century to butchers, tanners, bootmakers and cordwainers; and the business was made more important by John Adam Dagyr (d. 1808), a Welshman who came here in 1750 and whose work was equal to the best in England. In 1767 the output was 80,000 pairs; in 1795 about 300,000 pairs of women's shoes were made by 600 journeymen and 200 master workmen. The product of women's shoes had become famous in 1764, and about 1783 the use of morocco had been introduced by Ebenezer Breed. In 1900 and 1905 Lynn was second only to Brockton among the cities of the United States in the value of boots and shoes manufactured, and outranked Brockton in the three allied industries, the manufacture of boots and shoes, of cut stock and of findings. In the value of its total manufactured product Lynn ranked second to Boston in the state in 1905, having been fifth in 1900; the total number of factories in 1905 was 431; their capital was $23,139,185; their employees numbered 21,540; and their product was valued at $55,003,023 (as compared with $39,347,493 in 1900). Patent medicines and compounds and the manufacture of electrical machinery are prominent industries. The Lynn factories of the General Electric Company had in 1906 an annual product worth between $15,000,000 and $20,000,000. The foreign export of manufactured products is estimated at $5,000,000 a year.

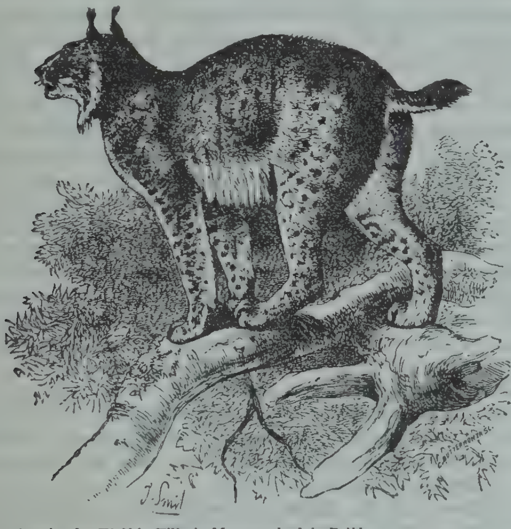
Lynn was founded in 1629 and was called Saugus until 1637, when the present name was adopted, from Lynn Regis, Norfolk, the home of the Rev. Samuel Whiting (1597–1679), pastor at Lynn from 1636 until his death. From Lynn Reading was separated in 1644, Lynnfield in 1782, Saugus in 1815, and, after the incorporation of the city of Lynn in 1850, Swampscott in 1852, and in 1853 Nahant, S. of Lynn, on a picturesque peninsula and now a fashionable summer resort.

See James R. Newhall, *History of Lynn* (Lynn, 1883), and H. K. Sanderson, *Lynn in the Revolution* (1910).

LYNTON and **LYNMOUTH**, two seaside villages in the Barnstaple parliamentary division of Devonshire, England, on the Bristol Channel; 17 m. E. of Ilfracombe, served by the Lynton light railway, which joins the South Western and Great Western lines at Barnstaple. Both are favoured as summer resorts. Lynmouth stands where two small streams, the East Lyn and West Lyn, flow down deep and well-wooded valleys to the sea. Lynton is on the cliff-edge, 430 ft. above. A lift connects the villages. The industries are fishing and a small coasting trade. Not far off are the Doone Valley, part of the vale of the East Lyn, here called Badgeworthy water, once the stronghold of a notorious band of robbers and famous through R. D. Blackmore's novel *Lorna Doone*; Watersmeet, where two streams, the Tavy and Walkham, join amid wild and beautiful scenery; and the Valley of Rocks, a narrow glen strewn with immense boulders. Lynton is an urban district, with a population (1901) of 1641.

LYNX (Lat. *Lynx*, Gr. λύγξ, probably connected with λεύσσειν, to see), a genus of mammals of the family *Felidae*, by some naturalists regarded only as a subgenus or section of the typical genus *Felis* (see CARNIVORA). As an English word (lynx) the name is used of any animal of this group. It is not certain to which of these, if to any of them, the Greek name λύγξ was especially applied, though it was more probably the caracal (*q.v.*) than any of the northern species. The so-called lynxes of Bacchus were generally represented as resembling leopards rather than any of the species now known by the name. Various fabulous properties were attributed to the animal, whatever it was, by the ancients, that of extraordinary powers of vision, including ability to see through opaque substances, being one; whence the epithet "lynx-eyed," which has survived to the present day.

Lynxes are found in the northern and temperate regions of both the Old and New World; they are smaller than leopards, and larger than true wild cats, with long limbs, short stumpy tail, ears tufted at the tip, and pupil of the eye linear when contracted. Their fur is generally long and soft, and always longish upon the cheeks. Their colour is light brown or grey, and generally spotted with a darker shade. The naked pads of the feet are more or less covered by the hair that grows between them. The skull and skeleton do not differ markedly from those of the other cats. Their habits are exactly those of the other wild cats. Their food consists of any mammals or birds which they can overpower. They commit extensive ravages upon sheep and poultry. They generally frequent rocky places and forests, being active climbers, and passing much of their time among the branches of the trees. Their skins are of considerable value in the fur trade. The northern lynx (*L. lynx* or *L. borealis*) of Scandinavia, Russia, northern Asia, and till lately the forest regions of central Europe, has not inhabited Britain during the historic period, but its remains have been found in cave deposits of Pleistocene age. Dr W. T. Blanford says that the characters on which E. Blyth relied in separating the Tibetan lynx (*L. isabellinus*) from the European species are probably due to the nature of its habitat among rocks, and that he himself could find no constant character justifying separation. The pardine lynx (*L. pardinus*) from southern Europe is a very handsome species; its fur is rufous above and white beneath.



From a drawing by Wolf in Elliot's *Monograph of the Felidae.*

European Lynx.

Several lynxes are found in North America; the most northerly has been described as the Canadian lynx (*L. canadensis*); the bay lynx (*L. rufus*), with a rufous coat in summer, ranges south to Mexico, with spotted and streaked varieties—*L. maculatus* in Texas and southern California, and *L. fasciatus* in Washington and Oregon. The first three were regarded by St George Mivart as local races of the northern lynx. A fifth form, the plateau lynx (*L. baileyi*), was described by Dr C. H. Merriam in 1890, but the differences between it and the bay lynx are slight and unimportant.

LYON, MARY MASON (1797–1849), American educationalist, was born on the 28th of February 1797 on a farm near Buckland, Franklin county, Massachusetts. She began to teach when she was seventeen, and in 1817, with the earnings from her spinning and weaving, she went to Sanderson Academy, Ashfield. She supported herself there, at Amherst Academy, where she spent one term, and at the girls' school in Byfield, established in 1819 by Joseph Emerson (1777–1833), where she went in 1821, by teaching in district schools and by conducting informal normal schools. In 1822–1824 she was assistant principal of Sanderson Academy, and then taught in Miss Zilpah P. Grant's Adams Female Academy, in Londonderry (now Derry), N.H. This school had only summer sessions, and Miss Lyon spent her winters in teaching, especially at Buckland and at Ashfield, and in studying chemistry and natural science with Edward Hitchcock, the geologist. In 1828–1834 she taught in Miss Grant's school, which in 1828 had been removed to Ipswich, and for two years managed the school in Miss Grant's absence. In 1828–1830 she had kept up her winter "normal" school at Buckland, and this was the beginning of her greater plan, "a permanent institution consecrated to the training of young women for usefulness ... designed to furnish every advantage which the state of education in this country will allow ... to put within reach of students of moderate means such opportunities that none can find better." She was assisted by Dr Hitchcock, and her own mystical enthusiasm and practical common sense secured for her plan ready financial support. In 1835 a site was selected near the village of South Hadley and Mount Holyoke; in 1836 the school was incorporated as Mount Holyoke Female Seminary; and on the 8th of November 1837 it opened with Mary Lyon as principal, and, as assistant, Miss Eunice Caldwell, afterwards well known as Mrs J. P. Cowles of Ipswich Academy. Miss Lyon died at Mount Holyoke on the 5th of March 1849, having served nearly twelve years as principal of the seminary, on a salary of $200 a year. From her work at Holyoke sprang modern higher education for women in America.

See Edward Hitchcock, *Life and Labors of Mary Lyon* (1851); B. B. Gilchrist, *Life of Mary Lyon* (Boston, 1910).

LYON, NATHANIEL (1818–1861), American soldier, was born in Ashford, Connecticut, on the 14th of July 1818, and graduated at West Point in 1841. He was engaged in the Seminole War and the war with Mexico, won the brevet of captain for his gallantry at Contreras and Churubusco, and was wounded in the assault on the city of Mexico. In 1850, while serving in California, he conducted a successful expedition against the Indians. He was promoted captain in 1851, and two years later was ordered to the East, when he became an ardent opponent of "States' Rights" and slavery. He was stationed in Kansas and in Missouri on the eve of the Civil War. In Missouri not only was sentiment divided, but the two factions were eager to resort to force long before they were in the other border states. Lyon took an active part in organizing the Union party in Missouri, though greatly hampered, at first by the Federal government which feared to provoke hostilities, and afterwards by the military commander of the department, General W. S. Harney. On Harney's removal in April 1861, Lyon promptly assumed the command, called upon Illinois to send him troops, and mustered the Missouri contingent into the United States' service. He broke up the militia camp at St Louis established by the secessionist governor of Missouri, Claiborne F. Jackson, and but for the express prohibition of Harney, who had resumed the command, would have proceeded at once to active hostilities. In all this Lyon had co-operated closely with Francis P. Blair, Jr., who now obtained from President Lincoln the definitive removal of Harney and the assignment of Lyon to command the Department of the West, with the rank of brigadier-general. On Lyon's refusal to accede to the Secessionists' proposal that the state should be neutral, hostilities opened in earnest, and Lyon, having cleared Missouri of small hostile bands in the central part of the state, turned to the southern districts, where a Confederate army was advancing from the Arkansas border. The two forces came to action at Wilson's Creek on the 10th of August 1861. The Union forces, heavily outnumbered, were defeated, and Lyon himself was killed while striving to rally his troops. He bequeathed almost all he possessed, some $30,000, to the war funds of the national government.

See A. Woodward, *Memoir of General Nathaniel Lyon* (Hartford, 1862); James Peckham, *Life of Lyon* (New York, 1866); and T. L. Snead, *The Fight for Missouri* (New York, 1886). Also *Last Political Writings of General Nathaniel Lyon* (New York, 1862).

LYONNESSE, Lyonesse, Leonnoys or Leonais, a legendary country off the south coast of Cornwall, England. Lyonnesse is the scene of many incidents in the Arthurian romances, and especially in the romances of Tristram and Iseult. It also plays an important part in purely Cornish tradition and folklore. Early English chronicles, such as the *Chronicon e chronicis* of Florence of Worcester, who died in 1118, described minutely and without a suggestion of disbelief the flourishing state of Lyonnesse, and its sudden disappearance beneath the sea. The legend may be a greatly exaggerated version of some actual subsidence of inhabited land. There is also a very ancient local tradition, apparently independent of the story of Lyonnesse, that the Scilly Islands formed part of the Cornish mainland within historical times.

See *Florentii Wigorniensis monachi Chronicon ex chronicis*, &c., ed. B. Thorpe (London, 1848–1849).

LYONS, EDMUND LYONS, Baron (1790–1858), British admiral, was born at Burton, near Christchurch, Hampshire, on the 21st of November 1790. He entered the navy, and served in the Mediterranean, and afterwards in the East Indies, where in 1810 he won promotion by distinguished bravery. He became post-captain in 1814, and in 1826 commanded the "Blonde" frigate at the blockade of Navarino, and took part with the French in the capture of Kasteo Morea. Shortly before his ship was paid off in 1835 he was knighted. From 1840 till 1853 Lyons was employed on the diplomatic service, being successively minister to Greece, Switzerland and Sweden. On the outbreak of the war with Russia he was appointed second in command of the British fleet in the Black Sea under Admiral Dundas, whom he succeeded in the chief command in 1854. As admiral of the inshore squadron he had the direction of the landing of the troops in the Crimea, which he conducted with marvellous energy and despatch. According to Kinglake, Lyons shared the "intimate counsels" of Lord Raglan in regard to the most momentous questions of the war, and toiled, with a "painful consuming passion," to achieve the object of the campaign. His principal actual achievements in battle were two—the support he rendered with his guns to the French at the Alma in attacking the left flank of the Russians, and the bold and brilliant part he took with his ship the "Agamemnon" in the first bombardment of the forts of Sebastopol; but his constant vigilance, his multifarious activity, and his suggestions and counsels were much more advantageous to the allied cause than his specific exploits. In 1855 he was created vice-admiral; in June 1856 he was raised to the peerage with the title of Baron Lyons of Christchurch. He died on the 23rd of November 1858.

See Adam S. Eardley-Wilmot, R.N., *Life of Lord Lyons* (1898).

LYONS, RICHARD BICKERTON PEMELL LYONS, 1st Earl (1817–1887), British diplomatist, son of the preceding, was born at Lymington on the 26th of April 1817. He entered the diplomatic service, and in 1859–1864 was British minister at Washington, where, after the outbreak of the Civil War, the extremely important negotiations connected with the arrest of the Confederate envoys on board the British mail-steamer "Trent" devolved upon him. After a brief service at Constantinople, he succeeded Lord Cowley at the Paris embassy in 1867. In the war of 1870 he used his best efforts as a mediator, and accompanied the provisional government to Tours. He continued to hold his post with universal acceptance until November 1887. He died on the 5th of December 1887, when the title became extinct.

LYONS (Fr. *Lyon*), a city of eastern France, capital of the department of Rhône, 315 m. S.S.E. of Paris and 218 m. N. by W. of Marseilles on the Paris-Lyon railway. Pop. (1906) town, 430,186; commune, 472,114. Lyons, which in France is second only to Paris in commercial and military importance, is situated at the confluence of the Rhone and the Saône at an altitude of 540 to 1000 ft. above sea-level. The rivers, both flowing south, are separated on the north by the hill on which lies the populous working quarter of Croix-Rousse, then by the narrow tongue of land ending in the Perrache Quarter. The peninsula thus formed is over 3 m. long and from 650 to 1000 yds. broad. It is traversed lengthwise by the finest streets of the city, the rue de la République, the rue de l'Hôtel de Ville, and the rue Victor Hugo. Where it enters Lyons the Saône has on its right the faubourg of Vaise and on its left that of Serin, whence the ascent is made to the top of the hill of Croix-Rousse. Farther on, its right bank is bordered by the scarped heights of Fourvière, St Irénée, Ste Foy, and St Just, leaving room only for the quays and one or two narrow streets; this is the oldest part of the city. The river sweeps in a semicircle around this eminence (410 ft. above it), which is occupied by convents, hospitals and seminaries, and has at its summit the famous church of Notre-Dame de Fourvière, the resort of many thousands of pilgrims annually.

On the peninsula between the rivers, at the foot of the hill of Croix-Rousse, are the principal quarters of the town: the Terreaux, containing the hôtel de ville, and the chief commercial establishments; the wealthy residential quarter, centring round the Place Bellecour, one of the finest squares in France; and the Perrache. The Rhone and Saône formerly met on the site of this quarter, till, in the 18th century, the sculptor Perrache reclaimed it; on the peninsula thus formed stands the principal railway station, the Gare de Perrache with the Cours du Midi, the most extensive promenade in Lyons, stretching in front of it. Here, too, are the docks of the Saône, factories, the arsenal, gas-works and prisons. The Rhone, less confined than the Saône, flows swiftly in a wide channel, broken when the water is low in spring by pebbly islets. On the right hand it skirts first St Clair, sloping upwards to Croix-Rousse, and then the districts of Terreaux, Bellecour and Perrache; on the left it has a low-lying plain, occupied by the Parc de la Tête d'Or and the quarters of Brotteaux and Guillotière. The park, together with its lake, comprises some 285 acres, and contains a zoological collection, botanical and pharmaceutical gardens, and the finest greenhouses in France, with unique collections of orchids, palm-trees and *Cycadaceae*. It is defended from the Rhone by the Quai de la Tête d'Or, while on the east the railway line to Geneva separates it from the race-course. Brotteaux is a modern residential quarter. Guillotière to the south consists largely of workmen's dwellings, bordering wide, airy thoroughfares. To the east extend the manufacturing suburbs of Villeurbanne and Montchat. The population, displaced by the demolition of the lofty old houses and the widening of the streets on the peninsula, migrates to the left bank of the Rhone, the extension of the city into the plain of Dauphiné being unhindered.

The Rhone and the Saône are bordered by fine quays and crossed by 24 bridges—11 over the Rhone, 12 over the Saône, and 1 at the confluence. Of these the Pont du Change over the Saône and the Pont de la Guillotière over the Rhone have replaced medieval bridges, the latter of the two preserving a portion of the old structure.

Public Buildings.

Of the ancient buildings Notre-Dame de Fourvière is the most celebrated. The name originally applied to a small chapel built in the 9th century on the site of the old forum (*forum vetus*) from which it takes its name. It has been often rebuilt, the chief feature being a modern Romanesque tower surmounted by a cupola and statue of the Virgin. In 1872 a basilica was begun at its side in token of the gratitude of the city for having escaped occupation by the German troops. The building, finished in 1894, consists of a nave without aisles flanked at each exterior corner by a turret and terminating in an apse. The façade, the lower half of which is a lofty portico supported on four granite columns, is richly decorated on its upper half with statuary and sculpture. Marble and mosaic have been lavishly used in the ornamentation of the interior and of the crypt. Round the apse runs a gallery from which, according to an old custom, a benediction is pronounced upon the town annually on the 8th of September. From this gallery a magnificent view of the city and the surrounding country can be obtained. At the foot of the hill of Fourvière rises the cathedral of St Jean, one of the finest examples of early Gothic architecture in France. Begun in the 12th century, to the end of which the transept and choir belong, it was not finished till the 15th century, the gable and flanking towers of the west front being completed in 1480. A triple portal surmounted by a line of arcades and a rose window gives entrance to the church. Two additional towers, that to the north containing one of the largest bells in France, rise at the extremities of the transept. The nave and choir contain fine stained glass of the 13th and 14th centuries as well as good modern glass. The chapel of St Louis or of Bourbon, to the right of the nave, is a masterpiece of Flamboyant Gothic. To the right and left of the altar stand two crosses preserved since the council of 1274 as a symbol of the union then agreed upon between the Greek and Latin churches. Adjoining St Jean is the ancient Manécanterie or singers' house, much mutilated and frequently restored, but still preserving graceful Romanesque arcades along its front. St Martin d'Ainay, on the peninsula, is the oldest church in Lyons, dating from the beginning of the 6th century and subsequently attached to a Benedictine abbey. It was rebuilt in the 10th and 11th centuries and restored in modern times, and is composed of a nave with four aisles, a transept and choir terminating in three semicircular apses ornamented with paintings by Hippolyte Flandrin, a native of Lyons. The church is surmounted by two towers, one in the middle of the west front, the other at the crossing; the four columns supporting the latter are said to have come from an altar to Augustus. A mosaic of the 12th century, a high altar decorated with mosaic work and a beautifully carved confessional are among the works of art in the interior. St Nizier, in the heart of the city, was the first cathedral of Lyons; and the crypt in which St Pothinus officiated still exists. The present church is a Gothic edifice of the 15th century, with the exception of the porch, constructed by Philibert Delorme, a native of Lyons, in the 16th century. The Church of St Paul (12th and 15th centuries), situated on the right bank of the Saône, preserves an octagonal central tower and other portions of Romanesque architecture; that of St Bonaventure, originally a chapel of the Cordeliers, was rebuilt in the 15th and 19th centuries. With the exception of the imposing prefecture, the vast buildings of the faculties, which are in the Guillotière quarter, and the law court, the colonnade of which overlooks the Saône from its right bank, the chief civil buildings are in the vicinity of the Place des Terreaux. The east side of this square (so called from the *terreaux* or earth with which the canal formerly connecting the Rhone and the Saône hereabouts was filled) is formed by the hôtel de ville (17th century), the east façade of which, towards the Grand Theatre, is the more pleasing. The south side of the square is occupied by the Palais des Arts, built in the 17th century as a Benedictine convent and now accommodating the school of fine arts, the museums of painting and sculpture, archaeology and natural history, and the library of science, arts and industry. The museums are second in importance only to those of Paris. The collection of antiquities, rich in Gallo-Roman inscriptions, contains the bronze tablets discovered in 1528, on which is engraved a portion of a speech delivered in A.D. 48, by the emperor Claudius, advocating the admission of citizens of Gallia Comata to the Roman senate. The "Ascension," a masterpiece of Perugino, is the chief treasure of the art collection, in which are works by nearly all the great masters. A special gallery contains the works of artists of Lyons, among whom are numbered Antoine Berjon, Meissonier, Paul Chenavard, Puvis de Chavannes. In the Rue de la Republique, between the Place de la Bourse and the Place des Cordeliers, each of which contains one of its highly ornamented fronts, stands the Palais du Commerce et de la Bourse, the finest of the modern buildings of Lyons. The Bourse (exchange) has its offices on the ground floor round the central glass-roofed hall; the upper storeys accommodate the commercial tribunal, the council of trade arbitration, the chamber of commerce and the *Musée historique des Tissus*, in which the history of the weaving industry is illustrated by nearly 400,000 examples. In the buildings of the lycée on the right bank of the Rhone are the municipal library and a collection of globes, among them the great terrestrial globe made at Lyons in 1701, indicating the great African lakes.

The Hôtel Dieu, instituted according to tradition in the beginning of the 6th century by King Childebert, is still one of the chief charitable establishments in the city. The present building dates from the 18th century; its façade, fronting the west quay of the Rhone for over 1000 ft., was begun according to the designs of Soufflot, architect of the Pantheon at Paris. The Hospice de la Charité and the military hospital are on the same bank slightly farther down stream. The Hospice de l'Antiquaille, at Fourvière, occupies the site of the palace of the praetorian prefects, in which Germanicus, Claudius and Caracalla were born. Each of these hospitals contains more than 1000 beds. Lyons has many other benevolent institutions, and is also the centre of the operations of the Société de la Propagation de la Foi. The chief monuments are the equestrian statue of Louis XIV. in the Place Bellecour, the monuments of President Carnot, Marshal Suchet, the physicist André-Marie Ampère, and those in honour of the Republic and in memory of the citizens of the department who fell in the war of 1870–71. The most noteworthy fountain is that in the Place des Terreaux with the leaden group by Bartholdi representing the rivers on their way to the ocean.

There are Roman remains—baths, tombs and the relics of a theatre—in the St Just quarter on the right bank of the Saône. Three ancient aqueducts on the Fourvière level, from Montromant, Mont d'Or and Mont Pilat, can still be traced. Magnificent remains of the latter work may be seen at St Irénée and Chaponost. Traces also exist along the Rhone of a subterranean canal conveying the water of the river to a *naumachia* (lake for mimic sea-fights). Agrippa made Lyons the starting-point of the principal Roman roads throughout Gaul; and it remains an important centre in the general system of communication owing to its position on the natural highway from north to south-eastern France. The Saône above the town and the Rhone below have large barge and steamboat traffic. The main line of the Paris-Lyon-Méditerranée railway runs first through the station at Vaise, on the right bank of the Saône, and thence to that of Perrache, the chief station in the city. The line next in importance, that to Geneva, has its station in the Brotteaux quarter, and the line of the eastern Lyonnais to St Genix d'Aoste has a terminus at Guillotière; both these lines link up with the Paris-Lyon main line. The railway to Montbrison starts from the terminus of St Paul in Fourvière and that to Bourg, Trévoux and the Dombes region from the station of Croix-Rousse. A less important line to Vaugneray and Mornant has a terminus at St Just. Besides the extensive system of street tramways, cable tramways (*ficelles*) run to the summits of the eminences of Croix-Rousse, Fourvière and St Just.

Defence.

Lyons is, next to Paris, the principal fortress of the interior of France, and, like the capital, possesses a military governor. The immediate protection of the city is provided for on the east side by a modern enceinte, of simple trace, in the plain (subsidiary to this is a group of fairly modern detached forts forming an advanced position at the village of Bron), and on the west by a line of detached forts, not of recent design, along the high ground on the right bank of the Saône. Some older forts and a portion of the old enceinte are still kept up in the city itself, and two of these forts, Montessuy and Caluire, situated on the peninsula, serve with their annexes to connect the northern extremities of the two lines above mentioned. The main line of defence is as usual the outer fort-ring, the perimeter of which is more than 40 m., and the mean distance from the centre of the city 6½ m. This naturally divides into four sections. In the eastern plain, well in advance of the enceinte, eight principal sites have been fortified, Feyzin, Corbas, St Priest, Genas, Azieu, Meyzieux, Décines and Chaurant. These form a semicircle from the lower to the upper reaches of the Rhone. The northern (or north eastern) section, between the Rhone and the Saône, has forts Neyron and Vancia as its principal defences; these and their subsidiary batteries derive some additional support from the forts Montessuy and Caluire mentioned above. On the north-west side there is a strong group of works disposed like a redan, of which the salient, fort Verdun and annexes, is on the high plateau of Mont d'Or pointing northward, and the faces, represented by forts Frêta and Paillet, are lower down on the spurs of the ridge, facing north-east and north-west respectively. The south-western section comprises three principal groups, Bruisson, Côte-Lorette and Montcorin-Champvillard, the last-named crossing its fire over the Lower Rhone with Fort Feyzin. Lastly a connecting battery was built near Chapoly in 1895 to close the gap between the north-western and south-western sections and to command the westward approaches by the valley of Charbonnières.

Lyons is the headquarters of the XIV. army-corps, the seat of an archbishop who holds the title of primate of the Gauls and also that of archbishop of Vienne, and of a prefect, a court of appeal, a court of assizes, tribunals of commerce and of first instance, and of two boards of trade arbitration (*conseils de prud'hommes*). It is the centre of an *académie* (educational division) and has a university with faculties of law, letters, science and medicine and pharmacy. There are also Catholic faculties (*facultés libres*) of law, theology, science and letters, three *lycées*, training colleges for teachers and numerous minor educational establishments. There are besides many special schools at Lyons, the more important being the school of fine arts which was founded in the 18th century to train competent designers for the textile manufactures, but has also done much for painting and sculpture; an army medical school, schools of drawing, agriculture, music, commerce (*école supérieure de commerce*), weaving, tanning, watch-making and applied chemistry, and the écoles La Martinière for free instruction in science and art as applied to industry. The veterinary school, instituted in 1761, was the first of its kind in Europe; its laboratory for the study of comparative physiology is admirably equipped. Besides the *Académie des Sciences, Belles Lettres et Arts* (founded in 1700), Lyons possesses societies of agriculture, natural history, geography, horticulture, &c.

Industry and trade.

Its trade in silk and silk goods has formed the basis of the prosperity of Lyons for several centuries. Derived from Italy, this industry rapidly developed, thanks to the monopoly granted to the city in 1450 by Charles VII. and to the patronage of Francis I., Henry II. and Henry IV. From time to time new kinds of fabrics were invented—silk stuffs woofed with wool or with gold and silver threads, shawls, watered silks, poplins, velvets, satinades, moires, &c. In the beginning of the 19th century J. M. Jacquard introduced his famous loom by which a single workman was enabled to produce elaborate fabrics as easily as the plainest web, and by changing the "cartoons" to make the most different textures on the same looms. In the 17th century the silk manufacture employed at Lyons, 9000 to 12,000 looms. After the revocation of the edict of Nantes the number sank to 3000 or 4000; but after the Reign of Terror was past it rose again about 1801 to 12,000. Towards the middle of the 19th century the weaving branch of the industry began to desert Lyons for the surrounding districts. The city remains the business centre for the trade and carries on dyeing, printing and other accessory processes. Lyons disputes with Milan the position of the leading silk market of Europe. In 1905 the special office (*la Condition des soies*) which determines the weight of the silk examined over 4700 tons of silk. France furnished barely one-tenth of this quantity, two-thirds came from China and Japan, the rest from Italy and the Levant. The traders of Lyons re-export seven-twelfths of these silks, the industries of the town employing the remainder. An almost equal quantity of cotton, wool and waste-silk threads is mixed with the silk. A few thousand hand-looms are still worked in the town, more especially producing the richest materials, 50,000 or 55,000 in the surrounding districts, and some 33,000 machine looms in the suburbs and neighbouring departments. Allied industries such as dyeing, finishing and printing, employ 12,000 workers. Altogether 300,000 workpeople depend upon the silk industry. In 1905 the total value of the manufacture was £15,710,000, the chief items being pure silk textures (plain) £3,336,000; textures of silk mixed with other materials £3,180,000; silk and foulards £1,152,000; muslins £3,800,000, this product having increased from £100,000 in 1894. Speaking roughly the raw material represents half the value, and the value of the labour the remaining half. About 30% of the silk goods of Lyons finds a market in France. Great Britain imported them to the value of over £6,000,000, and the United States to the value of over £1,600,000, notwithstanding the heavy duty. The dyeing industry and the manufacture of chemicals have both developed considerably to meet the requirements of the silk trade. Large quantities of mineral and vegetable colouring matters are produced and there is besides a large output of glue, gelatine, superphosphates and phosphorus, all made from bones and hides, of picric, tartaric, sulphuric and hydrochloric acids, sulphates of iron and copper, and pharmaceutical and other chemical products.

Lyons does a large trade in metals, iron, steel and copper, and utilizes them in the manufacture of iron buildings, framework, bridges, machinery, railway material, scales, metal cables, pins and needles, copper-founding and the making of clocks and bronzes. Gold and silver-working is of importance, especially for embroidery and articles used in religious ceremonies. Other industries are those of printing, the manufacture of glass goods, of tobacco (by the state), the preparation of hides and skins (occupying 20,000 workmen), those connected with the miller's trade, the manufacture of various forms of dried flour-paste (macaroni, vermicelli, &c.), brewing, hat-making, the manufacture of chocolate, and the pork-butcher's industry. Apart from the dealings in silk and silk goods, trade is in cloth, coal and charcoal, metals and metal goods, wine and spirits, cheese and chestnuts. Four miles south-west of Lyons is Oullins (pop. 9859) which has the important works of the Paris-Lyon railway.

Lyons is the seat of important financial companies; of the Crédit Lyonnais, which does business to the amount of £200,000,000 annually in Lyons alone; also of coal and metallurgical companies and gas companies, the former extending their operations as far as Russia, the latter lighting numerous towns in France and foreign countries.

History.—The earliest Gallic occupants of the territory at the confluence of the Rhone and the Saône were the Segusians. In 59 B.C. some Greek refugees from the banks of the Hérault, having obtained permission of the natives to establish themselves beside the Croix-Rousse, called their new town by the Gallic name Lugudunum (*q.v.*) or Lugdunum; and in 43 B.C. Lucius Munatius Plancus brought a Roman colony to Fourvières from Vienne. This settlement soon acquired importance, and was made by Agrippa the starting-point of four great roads. Augustus, besides building aqueducts, temples and a theatre, gave it a senate and made it the seat of an annual assembly of deputies from the sixty cities of Gallia Comata. At the same time the place became the Gallic centre for the worship of Rome and the emperor. Under the emperors the colony of Forum Vetus and the municipium of Lugdunum were united, receiving the *jus senatus*. The town was burnt in A.D. 59 and afterwards rebuilt in a much finer style with money given by Nero; it was also adorned by Trajan, Adrian and Antoninus. The martyrdom of Pothinus and Blandina occurred under Marcus Aurelius (A.D. 177), and some years later a still more savage persecution of the Christians took place under Septimius Severus, in which Irenaeus, according to some authors, perished.

After having been ravaged by the barbarians and abandoned by the empire, Lyons in 478 became capital of the kingdom of the Burgundians. It afterwards fell into the hands of the Franks, and suffered severely from the Saracens, but revived under Charlemagne, and after the death of Charles the Bald became part of the kingdom of Provence. From 1032 it was a fief of the emperor of Germany. Subsequently the authority over the town was a subject of dispute between the archbishops of Lyons and the counts of Forez; but the supremacy of the French kings was established under Philip the Fair in 1312. The citizens were constituted into a commune ruled by freely elected consuls (1320). In the 13th century two ecclesiastical councils were held at Lyons—one in 1245, presided over by Innocent IV., at which the emperor Frederick II. was deposed; the second, the oecumenical, under the presidency of Gregory X., in 1274, at which five hundred bishops met. Pope Clement V. was crowned here in 1305, and his successor, John XXII., elected in 1316. The Protestants obtained possession of the place in 1562; their acts of violence were fiercely avenged in 1572 after the St Bartholomew massacre. Under Henry III. Lyons sided with the League; but it pronounced in favour of Henry IV. The executions of Henri d'Effiat, marquis of Cinq-Mars, and of François de Thou, who had plotted to overthrow Richelieu, took place on the Place des Terreaux in 1642. In 1793 the Royalists and Girondists, powerful in the city, rose against the Convention, but were compelled to yield to the army of the republic under General Kellermann after enduring a siege of seven weeks (October 10). Terrible chastisement ensued: the name of Lyons was changed to that of Ville-affranchie; the demolition of its buildings was set about on a wholesale scale; and vast numbers of the proscribed, whom the scaffold had spared, were butchered with grape shot. The town resumed its old name after the fall of Robespierre, and the terrorists in their turn were drowned in large numbers in the Rhone. Napoleon rebuilt the Place Bellecour, reopened the churches, and made the bridge of Tilsit over the Saône between Bellecour and the cathedral. In 1814 and 1815 Lyons was occupied by the Austrians. In 1831, 1834, 1849, 1870 and 1871 it was the scene of violent industrial or political disturbances. In 1840 and 1856 disastrous floods laid waste portions of the city. International exhibitions were held here in 1872 and 1894, the latter occasion being marked by the assassination of President Carnot.

See S. Charléty, *Histoire de Lyon* (Lyon, 1903); J. Godart, *L'Ouvrier en soie. Monographie du tisseur lyonnais* (Lyon, 1899); A. Vachet, *A travers les rues de Lyon* (Lyon, 1902); A. Steyert, *Nouvelle Histoire de Lyon et des provinces de Lyonnais Forez, Beaujolais* (3 vols., Lyon, 1895–1899).

LYONS, COUNCILS OF. The first Council of Lyons (the thirteenth general council) met at the summons of Pope Innocent

IV. in June and July of 1245, to deliberate on the conflict between Church and emperor, on the assistance to be granted to the Holy Land and the Eastern empire, on measures of protection against the Tatars, and on the suppression of heresy. Among the tasks of the council mentioned in the writs of convocation, the most important, in the eyes of the pope, was that it should lend him effectual aid in his labours to overthrow the emperor Frederick II.; and, with this object in view, he had described the synod as a general council. Since its numbers were not far in excess of 150 bishops and archbishops, and the great majority of these came from France, Italy and Spain; while the schismatic Greeks and the other countries—especially Germany, whose interests were so deeply involved—were but weakly represented; the ambassador of Frederick, Thaddaeus of Suessa, contested its oecumenicity in the assembly itself. The condemnation of the emperor was a foregone conclusion. The articles of indictment described him as the "prince of tyranny, the destroyer of ecclesiastical dogma, the annihilator of the faith, the master of cruelty," and so forth; while the grossest calumnies were treated as approved facts. The objections of the ambassador, that the accused had not been regularly cited, that the pope was plaintiff and judge in one, and that therefore the whole process was anomalous, achieved as little success as his appeal to the future pontiff and to a truly oecumenical council. The representatives of the kings of England and France were equally unfortunate in their claim for a prorogation of the decision. On the 17th of July the verdict was pronounced by Innocent IV., excommunicating Frederick and dethroning him on the grounds of perjury, sacrilege, heresy and felony. All oaths of fealty sworn to him were pronounced null and void, and the German princes were commanded to proceed with the election of a new sovereign. In addition the council enacted decrees against the growing irregularities in the Church, and passed resolutions designed to support the Crusaders and revive the struggle for the Holy Land.

See Mansi, *Collectio conciliorum*, tom. xxiii.; Huillard-Bréholles, *Historia diplomatica Frederici II.*, 6 tom. (Paris, 1852–1861); Hefele, *Conciliengeschichte*, ed. 2, vol. v. (1886), pp. 1105-1126; Fr. W. Schirrmacher, *Kaiser Friederich der Zweite* (4 vols., Göttingen, 1859–1865); H. Schulz, in Herzog-Hauck, *Realencyklopädie*, ed. 3, vol. ix. (1901), p. 122 sqq., *s.v.* "Innocenz IV. ; A. Folz, *Kaiser Friedrich II. u. Papst Innocenz IV.* (Strassburg, 1905).

The second Council of Lyons (the fourteenth general council) met from the 7th of May to the 17th of July 1274, under the presidency of Pope Gregory X., and was designed to resolve three problems: to terminate the Greek schism, to decree a new Crusade, and to counteract the moral corruption among clerics and laity. The council entered on its third task at a very late period, with the result that the requisite time for an adequate deliberation was not available. Nevertheless, on the 1st of November, Gregory was enabled to publish thirty-one constitutions, which may be taken to represent the fruits of the synod and its labours. The most important of the enactments passed is that regulating the papal election. It prescribed that the new election conducted by the college of cardinals should be held in conclave (*q.v.*), and its duration abridged by progressive simplification of the cardinal's diet. The motive for this decision, which has maintained its ground in ecclesiastical law, was given by the circumstances which followed the death of Clement IV. (1268). The pope felt a peculiar interest in the Holy Land, from which he was recalled by his elevation to the pontifical throne. He succeeded in bringing influential interests to work in the cause; but his scheme of a great enterprise backed by the whole force of the West came to nothing, for the day of the Crusades was past. His projected Crusade was interwoven with his endeavours to end the schism; and the political straits of the emperor Michael Palaeologus in Constantinople came to the aid of these aspirations. To ensure his safety against the attacks of King Charles of Sicily, who had pledged himself to assist the ex-emperor Baldwin in his reconquest of the Latin empire, Michael was required to own the supremacy of the pope in the spiritual domain; while Gregory, in return, would restrain the Sicilian monarch from his bellicose policy with regard to the Eastern empire. The ambassadors of the emperor appeared at the council with letters acknowledging the Roman pontiff and the confession of faith previously dispatched from the eternal city, and submitted similarly-worded declarations from the heads of the Byzantine Church. One member of the embassy, the Logothete Georgius Acropolites, was authorized by the emperor to take an oath in his name, renouncing the schism. In short, the subjection of the East to the Roman see was completed in the most binding forms, and the long-desired union seemed at last assured. Gregory himself did not live to discover its illusory character. The Council of Lyons was, moreover, of importance for the German dynastic struggle: for Gregory took the first public step in favour of Count Rudolph of Habsburg, the king-elect, by receiving his deputy and denying an audience to the delegate of the rival claimant, King Alphonso of Castile.

See Mansi, *Collectio conciliorum*, tom. xxiv.; Hefele, *Conciliengeschichte*, vol. vi. ed. 2 (1890), p. 119 sqq. Also C. Mirbt, in Herzog-Hauck, *Realencyklop. f. protestantische Theologie*, vol. vii. (1899), p. 122, *s.v.* "Gregor X." (C. M.)

LYRA ("The Harp"), in astronomy, a constellation in the northern hemisphere, mentioned by Eudoxus (4th century B.C.) and Aratus (3rd century B.C.). Ptolemy catalogued 10 stars in this constellation; Tycho Brahe 11 and Hevelius 17. *α Lyrae* or Vega, is the second brightest star in the northern hemisphere, and notable for the whiteness of its light, which is about 100 times that of the sun. The name "vega" is a remnant of an Arabic phrase meaning "falling eagle," "Altair," or *α Aquilae*, is the similar remnant of "flying eagle." *ε Lyrae* is a multiple star, separated by the naked eye or by a small telescope into two stars; these are each resolved into two stars by a 3″ telescope, while a more powerful instrument (4″) reveals three smaller stars between the two pairs. *β Lyrae* and *R. Lyrae* are short period variables. There is the famous ring or annular nebula, *M. 57 Lyrae*, in the middle of which is a very faint star, which is readily revealed by photography; and also the meteoric swarm named the *Lyrids*, which appear in April and have their radiant in this constellation (see METEOR).

LYRE (Gr. λύρα), an ancient stringed musical instrument. The recitations of the Greeks were accompanied by it. Yet the lyre was not of Greek origin; no root in the language has been discovered for λύρα, although the special names bestowed upon varieties of the instrument are Hellenic. We have to seek in Asia the birthplace of the genus, and to infer its introduction into Greece through Thrace or Lydia. The historic heroes and improvers of the lyre were of the Aeolian or Ionian colonies, or the adjacent coast bordering on the Lydian empire, while the mythic masters, Orpheus, Musaeus and Thamyris, were Thracians. Notwithstanding the Hermes tradition of the invention of the lyre in Egypt, the Egyptians seem to have adopted it from Assyria or Babylonia.

To define the lyre, it is necessary clearly to separate it from the allied harp and guitar. In its primal form the lyre differs from the harp, of which the earliest, simplest notion is found in the bow and bowstring. While the guitar (and lute) can be traced back to the typical "nefer" of the fourth Egyptian dynasty, the fretted finger-board of which, permitting the production of different notes by the shortening of the string, is as different in conception from the lyre and harp as the flute with holes to shorten the column of air is from the syrinx or Pandean pipes. The frame of a lyre consists of a hollow body or sound-chest (ἠχεῖον). From this sound-chest are raised two arms (πήχεις), which are sometimes hollow, and are bent both outward and forward. They are connected near the top by a crossbar or yoke (ζυγόν, ζύγωμα, or, from its having once been a reed, κάλαμος). Another crossbar (μάλας, ὑπολύριον), fixed on the sound-chest, forms the bridge which transmits the vibrations of the strings. The deepest note was the farthest from the player; but, as the strings did not differ much in length, more weight may have been gained for the deeper notes by thicker strings, as in the violin and similar modern instruments, or they were turned with slacker tension. The strings were of gut (χορδή, whence chord). They were stretched between the yoke and bridge, or to a tailpiece below the bridge. There were two ways of tuning: one was to fasten the strings to pegs which might be turned (*κόλλαβοι, κόλλοπες*); the other was to change the place of the string upon the crossbar; probably both expedients were simultaneously employed. It is doubtful whether *ἡ χορδοτόνος* meant the tuning key or the part of the instrument where the pegs were inserted. The extensions of the arms above the yoke were known as *κέρατα*, horns.

The number of strings varied at different epochs, and possibly in different localities—four, seven and ten having been favourite numbers. They were used without a finger-board, no Greek description or representation having ever been met with that can be construed as referring to one. Nor was a bow possible, the flat sound-board being an insuperable impediment. The plectrum, however (*πλῆκτρον*), was in constant use. It was held in the right hand to set the upper strings in vibration (*κρέκειν, κρούειν τῷ πλήκτρῳ*); at other times it hung from the lyre by a ribbon. The fingers of the left hand touched the lower strings (*ψάλλειν*).

With Greek authors the lyre has several distinct names; but we are unable to connect these with anything like certainty to the varieties of the instrument. Chelys (*χέλυς*, "tortoise") may mean the smallest lyre, which, borne by one arm or supported by the knees, offered in the sound-chest a decided resemblance to that familiar animal. That there was a difference between lyre and cithara (*κιθάρα*) is certain, Plato and other writers separating them. Hermes and Apollo had an altar at Olympia in common because the former had invented the lyre and the latter the cithara. The lyre and chelys on the one hand, and the cithara and phorminx on the other, were similar or nearly identical. Apollo is said to have carried a golden phorminx. (A. J. H.)

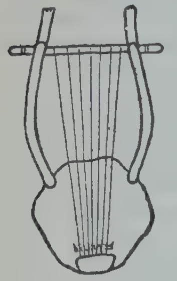
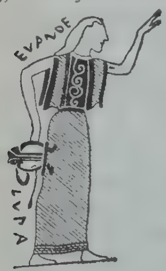


FIG. 1.—Chelys or Lyre from a vase in the British Museum, where also are fragments of such an instrument, the back of which is of shell.

There are three lines of evidence that establish the difference between the lyre and cithara: (1) There are certain vase paintings in which the name *λύρα* accompanies the drawing of the instrument, as, for instance, in fig. 2 where the tortoise-shell lyre is obviously represented.[1] (2) In all legends accounting for the invention of the lyre, the shell or body of the tortoise is invariably mentioned as forming the back of the instrument, whereas the tortoise has never been connected with the cithara. (3) The lyre is emphatically distinguished as the most suitable instrument for the musical training of young men and maidens and as the instrument of the amateur, whereas the cithara was the instrument of *citharoedus* or *citharista*, professional performers at the Pythian Games, at ceremonies and festivals, the former using his instrument to accompany epic recitations and odes, the latter for purely instrumental music. The costume worn by citharoedus and citharista was exceedingly rich and quite distinct from any other.[2]



Gerhard, *Auserl. griech. Vasenbilder.*

FIG. 2.—Tortoise-shell Lyre from a Greek vase in Munich.

We find the lyre represented among scenes of domestic life, in lessons, receptions, at banquets and in mythological scenes; it is found in the hands of women no less than men, and the costume of the performer is invariably that of an ordinary citizen. Lyres were of many sizes and varied in outline according to period and nationality.

We therefore possess irrefutable evidence of identification in both cases, all of which tallies exactly. Examination of the construction of the instruments thus indentified reveals the fact that both possessed characteristics which have persisted throughout the middle ages to the present day in various instruments evolved from these two archetypes. The principal feature of both lyre and cithara was the peculiar method of construction adopted in the sound-chest, which may be said to have been almost independent of the outline. In the lyre the sound-chest consisted of a vaulted back, in imitation of the tortoise, over which was directly glued a flat sound-board of wood or parchment. In the cithara (*q.v.*) the sound-chest was shallower, and the back and front were invariably connected by sides or ribs. These two methods of constructing the sound-chests of stringed instruments were typical, and to one or the other may be referred every stringed instrument with a neck which can be traced during the middle ages in miniatures, early printed books, on monuments and other works of art. (K. S.)

Passing by the story of the discovery of the lyre from a vibrating tortoise-shell by Hermes, we will glance at the real lyres of Egypt and Semitic Asia. The Egyptian lyre is unmistakably Semitic. The oldest representation that has been discovered is in one of the tombs of Beni Hassan, the date of the painting being in the XIIth Dynasty, that is, shortly before the invasion of "the shepherd kings" (the Hyksos). In this painting, which both Rosellini and Lepsius have reproduced, an undoubted Semite carries a seven or eight-stringed lyre, or rather cithara in transition, similar to the *rotta* of the middle ages. The instrument has a four-cornered body and an irregular four-cornered frame above it, and the player carries it horizontally from his breast, just as a modern Nubian would his kissar. He plays as he walks, using both hands, a plectrum being in the right. Practical knowledge of these ancient instruments may be gained through two remarkable specimens preserved in the museums of Berlin (fig. 3) and Leiden (see CITHARA). During the rule of the Hyksos the lyre became naturalized in Egypt, and in the 18th dynasty it is frequently depicted, and with finer grace of form. In the 19th and 20th dynasties the lyre is sometimes still more slender, or is quite unsymmetrical and very strong, the horns surmounted by heads of animals as in the Berlin one, which has horses' heads at those extremities. Prokesch copied one in the ruins of Wadi Halfa, splendid in blue and gold, with a serpent wound round it. The Egyptians always strung their lyres fan-shaped, like the modern Nubian kissar. Their paintings show three to eight or nine strings, but the painters' accuracy may not be unimpeachable; the Berlin instrument had fifteen. The three-stringed lyre typified the three seasons of the Egyptian year—the water, the green and the harvest; the seven, the planetary system from the moon to Saturn. The Greeks had the same notion of the harmony of the spheres.

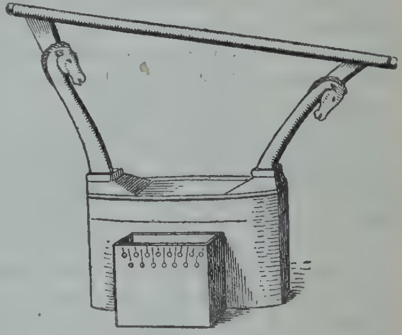
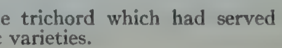


FIG. 3.—Egyptian Cithara now at Berlin.

There is no evidence as to what the stringing of the Greek lyre was in the heroic age. Plutarch says that Olympus and Terpander used but three strings to accompany their recitation. As the four strings led to seven and eight by doubling the tetrachord, so the trichord is connected with the hexachord or six-stringed lyre depicted on so many archaic Greek vases. We cannot insist on the accuracy of this representation, the vase painters being little mindful of the complete expression of details; yet we may suppose their tendency would be rather to imitate than to invent a number. It was their constant practice to represent the strings as being damped by the fingers of the left hand of the player, after having been struck by the plectrum which he held in the right hand. Before the Greek civilization had assumed its historic form, there was likely to be great freedom and independence of different localities in the matter of lyre stringing, which is corroborated by the antique use of the chromatic (half-tone) and enharmonic (quarter-tone) tunings, pointing to an early exuberance, and perhaps also to an Asiatic bias towards refinements of intonation, from which came the *χρόαι*, the hues of tuning, old Greek modifications of tetrachords entirely disused in the classic period. The common scale of Olympus



remained, a double trichord which had served as the scaffolding for the enharmonic varieties.

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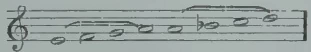
[1] See Ed. Gerhard, *Auserlesene griech. Vasenbilder*, part iii. (Berlin, 1847), pl. 236 and p. 157.

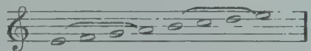
[2] See Aristotle, *Polit.* v. 6. 5.

We may regard the Olympus scale, however, as consisting of two tetrachords, eliding one interval in each, for the tetrachord, or series of four notes, was very early adopted as the fundamental principle of Greek music, and its origin in the lyre itself appears sure. The basis of the tetrachord is the employment of the thumb and first three fingers of the left hand to twang as many strings, the little finger not being used on account of natural weakness. As a succession of three whole tones would form the disagreeable and untunable interval of a tritonus, two whole tones and a half-tone were tuned, fixing the tetrachord in the consonant interval of the perfect fourth. This succession of four notes being in the grasp of the hand was called συλλαβή, just as in language a group of letters incapable of further reduction is called syllable. In the combination of two syllables or tetrachords the modern diatonic scales resemble the Greek so-called disjunct scale, but the Greeks knew nothing of our categorical distinctions of major and minor. We might call the octave Greek scale minor, according to our descending minor form, were not the keynote in the middle the thumb note of the deeper tetrachord. The upper tetrachord, whether starting from the keynote (conjunct) or from the note above (disjunct), was of exactly the same form as the lower, the position of the semitones being identical. The semitone was a limma (λεῖμμα), rather less than the semitone of our modern equal temperament, the Greeks tuning both the whole tones in the tetrachord by the same ratio of 8:9, which made the major third a dissonance, or rather would have done so had they combined them in what we call harmony. In melodious sequence the Greek tetrachord is decidedly more agreeable to the ear than the corresponding series of our equal temperament. And although our scales are derived from combined tetrachords, in any system of tuning that we employ, be it just, mean-tone, or equal, they are less logical than the conjunct or disjunct systems accepted by the Greeks. But modern harmony is not compatible with them, and could not have arisen on the Greek melodic lines.

The conjunct scale of seven notes

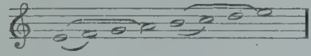


attributed to Terpander, was long the norm for stringing and tuning the lyre. When the disjunct scale

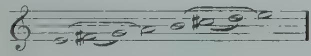


the octave scale attributed to Pythagoras, was admitted, to preserve the time-honoured seven strings one note had to be omitted; it was therefore customary to omit the C, which in Greek practice was a dissonance. The Greek names for the strings of seven and eight stringed lyres, the first note being highest in pitch and nearest the player, were as follows: *Nete, Paranete, Paramese*; *Mese, Lichanos, Parhypate, Hypate*; or *Nete, Paranete, Trite, Paramese*; *Mese, Lichanos, Parhypate, Hypate*—the last four from Mese to Hypate being the finger tetrachord, the others touched with the plectrum. The highest string in pitch was called the last, νεάτη; the lowest in pitch was called the highest, ὑπάτη, because it was, in theory at least, the longest string. The keynote and thumb string was μέση, middle; the next lower was λίχανος, the first finger or lick-finger string; τρίτη, the third, being in the plectrum division, was also known as ὀξεῖα, sharp, perhaps from the dissonant quality to which we have referred as the cause of its omission. The plectrum and finger tetrachords together were διαπασῶν, through all; in the disjunct scale, an octave.

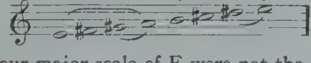
In transcribing the Greek notes into our notation, the absolute pitch cannot be represented; the relative positions of the semitones are alone determined. We have already quoted the scale of Pythagoras, the Dorian or true Greek succession:—



Shifting the semitone one degree upwards in each tetrachord, we have the Phrygian



Another degree gives the Lydian



which would be our major scale of E were not the keynote A. The names imply an Asiatic origin. We need not here pursue further the much-debated question of Greek scales and their derivation; it will suffice to remark that the outside notes of the tetrachords were fixed in their tuning as perfect fourths—the inner strings being, as stated, in diatonic sequence, or when chromatic two half-tones were tuned, when enharmonic two quarter-tones, leaving respectively the wide intervals of a minor and major third, and both impure, to complete the tetrachord. (A. J. H.)

See the article by Théodore Reinach in Daremberg and Saglio, *Antiquités grecques et romaines*; Wilhelm Johnsen, *Die Lyra, ein Beitrag zur griechischen Kunstgeschichte* (Berlin, 1876); Hortense Panum, "Harfe und Lyra in Nord Europa," *Intern. Mus. Ges.*, Sbd. vii. 1, pp. 1-40 (Leipzig, 1905); A. J. Hipkins, "Dorian and Phrygian, reconsidered from a non-harmonic point of view," in *Intern. Mus Ges.* (Leipzig. 1903), iv. 3.

LYRE-BIRD, the name by which one of the most remarkable birds of Australia is commonly known, the *Menura superba* or *M. novae-hollandiae* of ornithologists. It was first observed in 1798 in New South Wales, and though called by its finders a "pheasant"—from its long tail—the more learned of the colony seem to have regarded it as a bird-of-Paradise.[1] A specimen having reached England in 1799, it was described by General Davies as forming a new genus of birds, in the Linnean Society's *Transactions* (vi. p. 207, pl. xxii.), no attempt, however, being made to fix its systematic place. In 1802 L. P. Vieillot figured and described it in a supplement to his *Oiseaux Dorés* as a bird-of-Paradise (ii. pp. 30 seq., pls. 14-16), from drawings by Sydenham Edwards, sent him by Parkinson, the manager of the Leverian Museum. The first to describe any portion of its anatomy was T. C. Eyton, who in 1841 (*Ann. Nat. History*, vii. pp. 49-53) perceived that it was a Passerine bird and that it presented some points of affinity to the South American genus *Pteroptochus*. In 1867 Huxley stated that he was disposed to divide his very natural assemblage the *Coracomorphae* (essentially identical with Eyton's *Insessores*) into two groups, "one containing *Menura*, and the other all the other genera which have yet been examined" (*Proc. Zool. Soc.*, 1867, p. 472)—a still further step in advance.[2] In 1875 A. Newton put forth the opinion in his article on birds, in the 9th edition of this *Encyclopaedia*, that *Menura* had an ally in another Australian form, *Atrichia* (see Scrub-Bird), which he had found to present peculiarities hitherto unsuspected, and he regarded them as standing by themselves, though each constituting a distinct family. This opinion was partially adopted in the following year by A. H. Garrod, who (*Proc. Zool. Society*, 1876, p. 518) formally placed these two genera together in his group of Abnormal Acromyodian *Oscines* under the name of *Menurinae*; ornithologists now generally recognize at once the alliance and distinctness of the families Menuridae and Atrichiidae, and place them together to form the group *Suboscines* of the Diacromyodian *Passeres*.

Since the appearance in 1865 of J. Gould's *Handbook to the Birds of Australia*, little important information has been published concerning the habits of this form, and the account therein given must be drawn upon for what here follows. Of all birds, says that author, the *Menura* is the most shy and hard to procure. He has been among the rocky and thick "brushes"—its usual haunts—hearing its loud and liquid call-notes for days together without getting sight of one. Those who wish to see it must advance only while it is singing or scratching up the earth and leaves; and to watch its actions they must keep perfectly still. The best way of procuring an example seems to be by hunting it with dogs, when it will spring upon a branch to the height of 10 ft. and afford an easy shot ere it has time to ascend farther or escape as it does by leaps. Natives are said to hunt it by fixing on their heads the erected tail of a cock-bird, which alone is allowed to be seen above the brushwood. The greater part of its time is said to be passed upon the ground, and seldom are more than a pair to be found in company. One of the habits of the cock is to form small round hillocks, which he constantly visits during the day, mounting upon them and displaying his tail by erecting it over his head, drooping his wings, scratching and pecking at the soil, and uttering various cries—some his own natural notes, others an imitation of those of other animals. The tail, his most characteristic feature, only attains perfection in the bird's third or fourth year, and then not until the month of June, remaining until October, when the feathers are shed to be renewed the following season. The food consists of insects, especially beetles and myriapods, as well as snails. The nest is placed near to or on the ground, at the base of a rock or foot of a tree, and is closely woven of fine but strong roots or other fibres, and lined with feathers, around all which is heaped a mass, in shape of an oven, of sticks, grass, moss and leaves, so as to project over and shelter the interior structure, while an opening in the side affords entrance and exit. Only one egg is laid, and this of rather large size in proportion to the bird, of a purplish-grey colour, suffused and blotched with dark purplish-brown.

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[1] Collins, *Account of New South Wales*, ii. 87-92 (London, 1802).

[2] Owing to the imperfection of the specimen at his disposal, Huxley's brief description of the bones of the head in *Menura* is not absolutely correct. A full description of them, with elaborate figures, is given by Parker in the same Society's *Transactions* (ix. 306-309, pl. lvi. figs. 1-5).

Incubation is believed to begin in July or August, and the young is hatched about a month later. It is at first covered with dark down, and appears to remain for some weeks in the nest. It is greatly to be hoped that so remarkable a form as the lyre-bird, the nearly sole survivor apparently of a very ancient race of beings, will not be allowed to become extinct—its almost certain fate so far as can be judged—without many more observations of its manners being made. Several examples of *Menura* have been brought alive to Europe, and some have long survived in captivity.

Three species of *Menura* have been indicated—the old *M. superba*, the lyre-bird proper, which inhabits New South Wales, the southern part of Queensland, and perhaps some parts of Victoria; *M. victoriae*, separated from the former by Gould (*Proc. Zool. Soc.*, 1862, p. 23), and said to take its place near Melbourne; and *M. alberti*, first described by C. L. Bonaparte (*Consp. Avium*, i. 215) on Gould's authority, and, though discovered on the Richmond river in New South Wales, having apparently a more northern range than the other two. All those have the apparent bulk of a hen pheasant, but are really much smaller, and their general plumage is of a sooty brown, relieved by rufous on the chin, throat, some of the wing-feathers and the tail-coverts. The wings, consisting of twenty-one remiges, are rather short and rounded; the legs[1] and feet very strong, with long, nearly straight claws. In the immature and female the tail is somewhat long, though affording no very remarkable character, except the possession of sixteen rectrices; but in the fully-plumaged male of *M. superba* and *M. victoriae* it is developed in the extraordinary fashion that gives the bird its common English name. The two exterior feathers (fig. 1, *a*, *b*) have the outer web very narrow, the inner very broad, and they curve at first outwards, then somewhat inwards, and near the tip outwards again, bending round forwards so as to present a lyre-like form. But this is not all; their broad inner web, which is of a lively chestnut colour, is apparently notched at regular intervals by spaces that, according to the angle at which they are viewed, seem either black or transparent; and this effect is, on examination, found to be due to the barbs at those spaces being destitute of barbules. The middle pair of feathers (fig. 2, *a*, *b*) is nearly as abnormal. These have no outer web, and the inner web very narrow; near their base they cross each other, and then diverge, bending round forwards near their tip. The remaining twelve feathers (fig. 3) except near the base are very thinly furnished with barbs, about ¼ in. apart, and those they possess, on their greater part, though long and flowing, bear no barbules, and hence have a hair-like appearance. The shafts of all are exceedingly strong. In the male of *M. alberti* the tail is not only not lyriform, but the exterior rectrices are shorter than the rest. (A. N.)

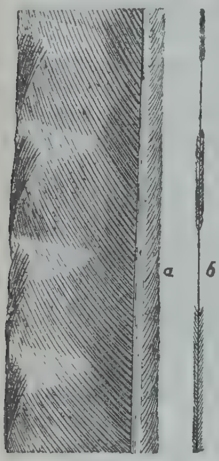

FIG. 1.

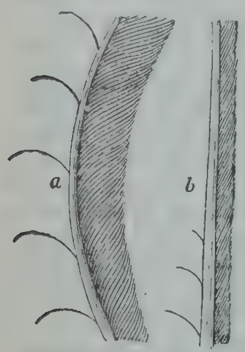

FIG. 2.

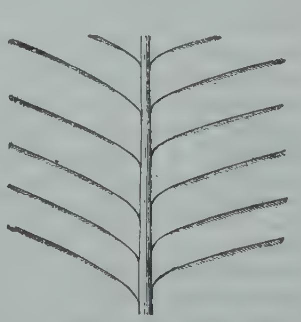

FIG. 3.

LYRICAL POETRY, a general term for all poetry which is, or can be supposed to be, susceptible of being sung to the accompaniment of a musical instrument. In the earliest times it may be said that all poetry was of its essence lyrical. The primeval oracles were chanted in verse, and the Orphic and Bacchic Mysteries, which were celebrated at Eleusis and elsewhere, combined, it is certain, metre with music. Homer and Hesiod are each of them represented with a lyre, yet if any poetry can be described as non-lyrical, it is surely the archaic hexameter of the *Iliad* and the *Erga*. These poems were styled epic, in direct contradistinction to the lyric of Pindar and Bacchylides. But inexactly, since it is plain that they were recited, with a plain accompaniment on a stringed instrument. However, the distinction between epical and lyrical, between τὰ ἔπη, what was said, and τὰ μέλη, what was sung, is accepted, and neither Homer nor Hesiod is among the lyrists. This distinction, however, is often without a difference, as for example, in the case of the so-called *Hymns* of Homer, epical in form but wholly lyrical in character. Hegel, who has gone minutely into this question in his *Esthetik*, contends that when poetry is objective it is epical, and when it is subjective it is lyrical. This is to ignore the metrical form of the poem, and to deal with its character only. It would constrain us to regard Wordsworth's *Excursion* as a lyric, and Tennyson's *Revenge* (where the subject is treated exactly as one of the Homeridae would have treated an Ionian myth) as an epic. This is impossible, and recalls us to the importance of taking the form into consideration. But, with this warning, the definition of Hegel is valuable. It is, as he insists, the personal thought, or passion, or inspiration, which gives its character to lyrical poetry.

The lyric has the function of revealing, in terms of pure art, the secrets of the inner life, its hopes, its fantastic joys, its sorrows, its delirium. It is easier to exclude the dramatic species from lyric than to banish the epic. There are large sections of drama which it is inconceivable should be set to music, or sung, or even given in recitative. The tragedies of Racine, for example, are composed of the purest poetry, but they are essentially non-lyrical, although lyrical portions are here and there attached to them. The intensity of feeling and the melody of verse in *Othello* does not make that work an example of lyrical poetry, and this is even more acutely true of *Le Misanthrope*, which is, nevertheless, a poem. The tendency of modern drama is to divide itself further and further from lyric, but in early ages the two kinds were indissoluble. Tragedy was goat-song, and the earliest specimens of it were mainly composed of choruses. As Prof. G. G. Murray says, in the *Suppliants* of Aeschylus, the characters "are singing for two-thirds of the play," accompanied by tumultuous music. This primitive feature has gradually been worn away; the chorus grew less and less prominent, and disappeared; the very verse-ornament of drama tends to vanish, and we have plays essentially so poetical as those of Ibsen and Maeterlinck written from end to end in bare prose.

To return again to Greece, there was an early distinction, soon accentuated, between the poetry chanted by a choir of singers, and the song which expressed the sentiments of a single poet. The latter, the μέλος or song proper, had reached a height of technical perfection in "the Isles of Greece, where burning Sappho loved and sung," as early as the 7th century B.C. That poetess, and her contemporary Alcaeus, divide the laurels of the pure Greek song of Dorian inspiration. By their side, and later, flourished the great poets who set words to music for choirs, Alcman, Arion, Stesichorus, Simonides and Ibycus, who lead us at the close of the 5th century to Bacchylides and Pindar, in whom the magnificent tradition of the dithyrambic odes reached its highest splendour of development. The practice of Pindar and Sappho, we may say, has directed the course of lyrical poetry ever since, and will, unquestionably, continue to do so. They discovered how, with the maximum of art, to pour forth strains of personal magic and music, whether in a public or a private way. The ecstasy, the uplifted magnificence, of lyrical poetry could go no higher than it did in the unmatched harmonies of these old Greek poets, but it could fill a much wider field and be expressed with vastly greater variety. It did so in their own age. The gnomic verses of Theognis were certainly sung; so were the satires of Archilochus and the romantic reveries of Mimnermus.

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[1] The metatarsals are very remarkable in form, as already noticed by Eyton (*loc. cit.*), and their tendons strongly ossified.

At the Renaissance, when the traditions of ancient life were taken up eagerly, and hastily comprehended, it was thought proper to divide poetry into a diversity of classes. The earliest English critic who enters into a discussion of the laws of prosody, William Webbe, lays it down, in 1586, that in verse "the most usual kinds are four, the heroic, elegiac, iambic and lyric." Similar confusion of terms was common among the critics of the 15th and 16th centuries, and led to considerable error. It is plain that a border ballad is heroic, and may yet be lyrical; here the word "heroic" stands for "epic." It is plain that whether a poem is lyrical or not had nothing to do with the question whether it is composed in an iambic measure. Finally, it is undoubted that the early Greek "elegies" were sung to an accompaniment on the flute, whether they were warlike, like those of Tyrtaeus, or philosophical and amatory like those of Theognis. But (see Elegy) the present significance of "elegy," and this has been the case ever since late classical times, is funereal; in modern parlance an elegy is a dirge. Whether the great Alexandrian dirges, like those of Bion and of Moschus, on which our elegiacal tradition is founded, were actually sung to an accompaniment or not may be doubted; they seem too long, too elaborate, and too ornate for that. But, at any rate, they were composed on the convention that they would be sung, and it is conceivable that music might have been wedded to the most complex of these Alexandrian elegies. Accordingly, although *Lycidas* and *Adonais* are not habitually "set to music," there is no reason why they should not be so set, and their rounded and limited although extensive form links them with the song, not with the epic. There are many odes of Swinburne's for which it would be more difficult to write music than for his *Ave atque Vale*. In fact, in spite of its solemn and lugubrious regularity, the formal elegy or dirge is no more nor less than an ode, and is therefore entirely lyrical.

More difficulty is met with in the case of the sonnet, for although no piece of verse, when it is inspired by subjective passion, fits more closely with Hegel's definition of what lyrical poetry should be, yet the rhythmical complication of the sonnet, and its rigorous uniformity, seem particularly ill-fitted to interpretation on a lyre. When F. M. degli Azzi put the book of Genesis (1700) into sonnets, and Isaac de Benserade the *Metamorphoses* of Ovid (1676) into rondeaux, these eccentric and laborious versifiers produced what was epical rather than lyrical poetry, if poetry it was at all. But the sonnet as Shakespeare, Wordsworth and even Petrarch used it was a cry from the heart, a subjective confession, and although there is perhaps no evidence that a sonnet was ever set to music with success, yet there is no reason why that might not be done without destroying its sonnet-character.

Jouffroy was perhaps the first aesthetician to see quite clearly that lyrical poetry is, really, nothing more than another name for poetry itself, that it includes all the personal and enthusiastic part of what lives and breathes in the art of verse, so that the divisions of pedantic criticism are of no real avail to us in its consideration. We recognize a narrative or epical poetry; we recognize drama; in both of these, when the individual inspiration is strong, there is much that trembles on the verge of the lyrical. But outside what is pure epic and pure drama, all, or almost all, is lyrical. We say almost all, because the difficulty arises of knowing where to place descriptive and didactic poetry. The *Seasons* of Thomson, for instance, a poem of high merit and lasting importance in the history of literature—where is that to be placed? What is to be said of the *Essay on Man*? In primitive times, the former would have been classed under epic, the second would have been composed in the supple iambic trimeter which so closely resembled daily speech, and would not have been sharply distinguished from prose. Perhaps this classification would still serve, were it not for the element of versification, which makes a sharp line of demarcation between poetic art and prose. This complexity of form, rhythmical and stanzaic, takes much of the place which was taken in antiquity by such music as Terpander is supposed to have supplied. In a perfect lyric by a modern writer the instrument is the metrical form, to which the words have to adapt themselves. There is perhaps no writer who has ever lived in whose work this phenomenon may be more fruitfully studied than it may be in the songs and lyrics of Shelley. The temper of such pieces as "Arethusa" and "The Cloud" is indicated by a form hardly more ambitious than a guitar; Hellas is full of passages which suggest the harp; in his songs Shelley touches the lute or viol de gamba, while in the great odes to the "West Wind" and to "Liberty" we listen to a verse-form which reminds us by its volume of the organ itself. On the whole subject of the nature of lyric poetry no commentary can be more useful to the student than an examination of the lyrics of Shelley in relation to those of the song-writers of ancient Greece.

See Hegel, *Die Phänomenologie des Geistes* (1807); T. S. Jouffroy, *Cours d'esthétique* (1843); W. Christ, *Metrik der Griechen und Römer*, 2te. Aufl. (1879). (E. G.)

LYSANDER (Gr. Λύσανδρος), son of Aristocritus, Spartan admiral and diplomatist. Aelian (*Var. Hist.* xii. 43) and Phylarchus (*ap.* Athen. vi. 271 e) say that he was a *mothax*, *i.e.* the son of a helot mother (see Helots), but this tradition is at least doubtful; according to Plutarch he was a Heraclid, though not of either royal family. We do not know how he rose to eminence: he first appears as admiral of the Spartan navy in 407 B.C. The story of his influence with Cyrus the Younger, his naval victory off Notium, his quarrel with his successor Callicratidas in 406, his appointment as ἐπιστολεύς in 405, his decisive victory at Aegospotami, and his share in the siege and capitulation of Athens belong to the history of the Peloponnesian War (*q.v.*). By 404 he was the most powerful man in the Greek world and set about completing the task of building up a Spartan empire in which he should be supreme in fact if not in name. Everywhere democracies were replaced by oligarchies directed by bodies of ten men (decarchies, δεκαρχίαι) under the control of Spartan governors (harmosts, ἁρμοσταί). But Lysander's boundless influence and ambition, and the superhuman honours paid him, roused the jealousy of the kings and the ephors, and, on being accused by the Persian satrap Pharnabazus, he was recalled to Sparta. Soon afterwards he was sent to Athens with an army to aid the oligarchs, but Pausanias, one of the kings, followed him and brought about a restoration of democracy. On the death of Agis II., Lysander secured the succession of Agesilaus (*q.v.*), whom he hoped to find amenable to his influence. But in this he was disappointed. Though chosen to accompany the king to Asia as one of his thirty advisers (σύμβουλοι), he was kept inactive and his influence was broken by studied affronts, and finally he was sent at his own request as envoy to the Hellespont. He soon returned to Sparta to mature plans for overthrowing the hereditary kingship and substituting an elective monarchy open to all Heraclids, or even, according to another version, to all Spartiates. But his alleged attempts to bribe the oracles were fruitless, and his schemes were cut short by the outbreak of war with Thebes in 395. Lysander invaded Boeotia from the west, receiving the submission of Orchomenus and sacking Lebadea, but the enemy intercepted his despatch to Pausanias, who had meanwhile entered Boeotia from the south, containing plans for a joint attack upon Haliartus. The town was at once strongly garrisoned, and when Lysander marched against it he was defeated and slain. He was buried in the territory of Panopeus, the nearest Phocian city. An able commander and an adroit diplomatist, Lysander was fired by the ambition to make Sparta supreme in Greece and himself in Sparta. To this end he shrank from no treachery or cruelty; yet, like Agesilaus, he was totally free from the characteristic Spartan vice of avarice, and died, as he had lived, a poor man.

See the biographies by Plutarch and Nepos; Xen. *Hellenica*, i. 5–iii. 5; Diod. Sic. xiii. 70 sqq., 104 sqq., xiv. 3, 10, 13, 81; Lysias xii. 60 sqq.; Justin v. 5-7; Polyaenus i. 45, vii. 19; Pausanias iii., ix. 32, 5-10, x. 9, 7-11; C. A. Gehlert, *Vita Lysandri* (Bautzen, 1874); W. Vischer, *Alkibiades und Lysandros* (Basel, 1845); O. H. J. Nitzsch, *De Lysandro* (Bonn, 1847); and the Greek histories in general.

(M. N. T.)

LYSANIAS, tetrarch of Abilene (see ABILA), according to Luke iii. 1, in the time of John the Baptist. The only Lysanias mentioned in profane history as exercising authority in this district was executed in 36 B.C. by M. Antonius (Mark Antony). This Lysanias was the son of Ptolemy Mennaeus, the ruler of an independent state, of which Abilene formed only a small portion. According to Josephus (*Ant.* xix. 5, 1) the emperor Claudius in A.D. 42 confirmed Agrippa I. in the possession of "Abila of Lysanias" already bestowed upon him by Caligula, elsewhere described as "Abila, which had formed the tetrarchy of Lysanias." It is argued that this cannot refer to the Lysanias executed by M. Antonius, since his paternal inheritance, even allowing for some curtailment by Pompey, must have been of far greater extent. It is therefore assumed by some authorities that the Lysanias in Luke (A.D. 28–29) is a younger Lysanias, tetrarch of Abilene only, one of the districts into which the original kingdom was split up after the death of Lysanias I. This younger Lysanias may have been a son of the latter, and identical with, or the father of, the Claudian Lysanias. On the other hand, Josephus knows nothing of a younger Lysanias, and it is suggested by others that he really does refer to Lysanias I. The explanation given by M. Krenkel (*Josephus und Lucas*, Leipzig, 1894, p. 97) is that Josephus does not mean to imply that Abila was the only possession of Lysanias, and that he calls it the tetrarchy or kingdom of Lysanias because it was the last remnant of the domain of Lysanias which remained under direct Roman administration until the time of Agrippa. The expression was borrowed from Josephus by Luke, who wrongly imagined that Lysanias I. had ruled almost up to the time of the bestowal of his tetrarchy upon Agrippa, and therefore to the days of John the Baptist. Two inscriptions are adduced as evidence for the existence of a younger Lysanias—Böckh, *C.I.G.* 4521 and 4523. The former is inconclusive, and in the latter the reading Λυσ[ανιου] is entirely conjectural; the name might equally well be Lysimachus or Lysias.

See E. Schürer, *Geschichte des jüdischen Volkes* (3rd ed., 1901), i. p. 712; and (especially on the inscriptional evidence) E. Renan, "Mémoire sur la dynastie des Lysanias d'Abilène" in *Mémoires de l'institut impérial de France* (xxvi., 1870); also P. W. Schmiedel in the *Encyclopaedia Biblica*, s.v.

LYSIAS, Attic orator, was born, according to Dionysius of Halicarnassus and the author of the life ascribed to Plutarch, in 459 B.C. This date was evidently obtained by reckoning back from the foundation of Thurii (444 B.C.), since there was a tradition that Lysias had gone thither at the age of fifteen. Modern critics would place his birth later,—between 444 and 436 B.C.,—because, in Plato's *Republic*, of which the scene is laid about 430 B.C., Cephalus, the father of Lysias, is among the *dramatis personae*, and the emigration of Lysias to Thurii was said to have followed his father's death. The latter statement, however, rests only on the Plutarchic life; nor can Plato's dialogue be safely urged as a minutely accurate authority. The higher date assigned by the ancient writers agrees better with the tradition that Lysias reached, or passed, the age of eighty.[1] Cephalus, his father, was a native of Syracuse, and on the invitation of Pericles had settled at Athens. The opening scene of Plato's *Republic* is laid at the house of his eldest son, Polemarchus, in Peiraeus. The tone of the picture warrants the inference that the Sicilian family were well known to Plato, and that their houses must often have been hospitable to such gatherings.

At Thurii, the colony newly planted on the Tarentine Gulf (see PERICLES), the boy may have seen Herodotus, now a man in middle life, and a friendship may have grown up between them. There, too, Lysias is said to have commenced his studies in rhetoric—doubtless under a master of the Sicilian school—possibly, as tradition said, under Tisias, the pupil of Corax, whose name is associated with the first attempt to formulate rhetoric as an art. In 413 B.C. the Athenian armament in Sicily was annihilated. The desire to link famous names is illustrated by the ancient ascription to Lysias of a rhetorical exercise purporting to be a speech in which the captive general Nicias appealed for mercy to the Sicilians. The terrible blow to Athens quickened the energies of an anti-Athenian faction at Thurii. Lysias and his elder brother Polemarchus, with three hundred other persons, were "accused of Atticizing." They were driven from Thurii and settled at Athens (412 B.C.).

Lysias and Polemarchus were rich men, having inherited property from their father; and Lysias claims that, though merely resident aliens, they discharged public services with a liberality which shamed many of those who enjoyed the franchise (*In Eratosth.* 20). The fact that they owned house property shows that they were classed as ἰσοτελεῖς, *i.e.* foreigners who paid only the same tax as citizens, being exempt from the special tax (μετοίκιον) on resident aliens. Polemarchus occupied a house in Athens itself, Lysias another in the Peiraeus, near which was their shield manufactory, employing a hundred and twenty skilled slaves. In 404 the Thirty Tyrants were established at Athens under the protection of a Spartan garrison. One of their earliest measures was an attack upon the resident aliens, who were represented as disaffected to the new government. Lysias and Polemarchus were on a list of ten singled out to be the first victims. Polemarchus was arrested, and compelled to drink hemlock. Lysias had a narrow escape, with the help of a large bribe. He slipped by a back-door out of the house in which he was a prisoner, and took boat to Megara. It appears that he had rendered valuable services to the exiles during the reign of the tyrants, and in 403 Thrasybulus proposed that these services should be recognized by the bestowal of the citizenship. The Boulē, however, had not yet been reconstituted, and hence the measure could not be introduced to the ecclesia by the requisite "preliminary resolution" (προβούλευμα). On this ground it was successfully opposed.

During his later years Lysias—now probably a comparatively poor man owing to the rapacity of the tyrants and his own generosity to the Athenian exiles—appears as a hard-working member of a new profession—that of writing speeches to be delivered in the law-courts. The thirty-four extant are but a small fraction. From 403 to about 380 B.C. his industry must have been incessant. The notices of his personal life in these years are scanty. In 403 he came forward as the accuser of Eratosthenes, one of the Thirty Tyrants. This was his only direct contact with Athenian politics. The story that he wrote a defence for Socrates, which the latter declined to use, probably arose from a confusion. Several years after the death of Socrates the sophist Polycrates composed a declamation against him, to which Lysias replied. A more authentic tradition represents Lysias as having spoken his own *Olympiacus* at the Olympic festival of 388 B.C., to which Dionysius I. of Syracuse had sent a magnificent embassy. Tents embroidered with gold were pitched within the sacred enclosure; and the wealth of Dionysius was vividly shown by the number of chariots which he had entered. Lysias lifted up his voice to denounce Dionysius as, next to Artaxerxes, the worst enemy of Hellas, and to impress upon the assembled Greeks that one of their foremost duties was to deliver Sicily from a hateful oppression. The latest work of Lysias which we can date (a fragment of a speech *For Pherenicus*) belongs to 381 or 380 B.C. He probably died in or soon after 380 B.C.

Lysias was a man of kindly and genial nature, warm in friendship, loyal to country, with a keen perception of character.

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[1] [W. Christ, *Gesch. der griech. Litt.*, gives the date of birth as about 450.]

and a fine though strictly controlled sense of humour. The literary tact which is so remarkable in the extant speeches is that of a singularly flexible intelligence, always obedient to an instinct of gracefulness. He owes his distinctive place to the power of concealing his art. It was obviously desirable that a speech written for delivery by a client should be suitable to his age, station and circumstances. Lysias was the first to make this adaptation really artistic. His skill can be best appreciated if we turn from the easy flow of his graceful language to the majestic emphasis of Antiphon, or to the self-revealing art of Isaeus. Translated into terms of ancient criticism, he became the model of the "plain style" (ἰσχνὸς χαρακτήρ, ἰσχνὴ, λιτὴ, ἀφελὴς λέξις: *genus tenue* or *subtile*). Greek and then Roman critics distinguished three styles of rhetorical composition—the "grand" (or "elaborate"), the "plain" and the "middle," the "plain" being nearest to the language of daily life. Greek rhetoric began in the "grand" style; then Lysias set an exquisite pattern of the "plain"; and Demosthenes might be considered as having effected an almost ideal compromise.

The vocabulary of Lysias is pure and simple. Most of the rhetorical "figures" are sparingly used—except such as consist in the parallelism or opposition of clauses. The taste of the day—not yet emancipated from the influence of the Sicilian rhetoric—probably demanded a large use of antithesis. Lysias excels in vivid description; he has also a happy knack of marking the speaker's character by light touches. The structure of his sentences varies a good deal according to the dignity of the subject. He has equal command over the "periodic" style (κατεστραμμένη λέξις) and the non-periodic or "continuous" (εἰρομένη, διαλελυμένη). His disposition of his subject-matter is always simple. The speech has usually four parts—introduction (προοίμιον), narrative of facts (διήγησις), proofs (πίστεις), which may be either external, as from witnesses, or internal, derived from argument on the facts, and, lastly, conclusion (ἐπίλογος). It is in the introduction and the narrative that Lysias is seen at his best. In his greatest extant speech—that *Against Eratosthenes*—and also in the fragmentary *Olympiacus*, he has pathos and fire; but these were not characteristic qualities of his work. In Cicero's judgment (*De Orat.* iii. 7, 28) Demosthenes was peculiarly distinguished by force (*vis*), Aeschines by resonance (*sonitus*), Hypereides by acuteness (*acumen*), Isocrates by sweetness (*suavitas*); the distinction which he assigns to Lysias is *subtilitas*, an Attic refinement—which, as he elsewhere says (*Brutus*, 16, 64) is often joined to an admirable vigour (*lacerti*). Nor was it oratory alone to which Lysias rendered service; his work had an important effect on all subsequent Greek prose, by showing how perfect elegance could be joined to plainness. Here, in his artistic use of familiar idiom, he might fairly be called the Euripides of Attic prose. And his style has an additional charm for modern readers, because it is employed in describing scenes from the everyday life of Athens.[1]

Thirty-four speeches (three fragmentary) have come down under the name of Lysias; one hundred and twenty-seven more, now lost, are known from smaller fragments or from titles. In the Augustan age four hundred and twenty-five works bore his name, of which more than two hundred were allowed as genuine by the critics. Our thirty-four works may be classified as follows:—

A. EPIDEICTIC.—1. *Olympiacus*, xxxiii. 388 B.C.; 2. *Epitaphius*, ii. (purporting to have been spoken during the Corinthian War; certainly spurious), perhaps composed about 380–340 B.C. ("soon after 387," Blass).

B. DELIBERATIVE.—Plea for the Constitution, xxxiv., 403 B.C.

C. FORENSIC, IN PUBLIC CAUSES.—I. *Relating to Offences directly against the State* (γραφαὶ δημοσίων ἀδικημάτων); *such as treason, malversation in office, embezzlement of public moneys.* 1. For Polystratus, xx., 407 B.C.; 2. Defence on a Charge of Taking Bribes, xxi., 402 B.C.; 3. Against Ergocles, xxviii., 389 B.C.; 4. Against Epicrates, xxvii., 389 B.C.; 5. Against Nicomachus, xxx., 399 B.C.; 6. Against the Corndealers, xxii., 386 B.C. (?) II. *Cause relating to Unconstitutional Procedure* (γραφὴ παρανόμων). On the Property of the Brother of Nicias, xviii., 395 B.C. III. *Causes relating to Claims for Money withheld from the State* (ἀπογραφαί). 1. For the Soldier, ix. (probably not by Lysias, but by an imitator, writing for a real cause), 394 B.C. (?); 2. On the Property of Aristophanes, xix., 387 B.C.; 3. Against Philocrates, xxix., 389 B.C. IV. *Causes relating to a Scrutiny* (δοκιμασία); *especially the Scrutiny, by the Senate, of Officials Designate.* 1. Against Evandrus, xxvi., 382 B.C.; 2. For Mantitheus, xvi., 392 B.C.; 3. Against Philon, xxxi., between 404 and 395 B.C.; 4. Defence on a Charge of Seeking to Abolish the Democracy, xxv., 401 B.C.; 5. For the Invalid, xxiv., 402 B.C. (?) V. *Causes relating to Military Offences* (γραφαὶ λιποταξίου, ἀστρατείας). 1. Against Alcibiades, I. and II. (xiv., xv.), 395 B.C. VI. *Causes relating to Murder or Intent to Murder* (γραφαὶ φόνου, τραύματος ἐκ προνοίας). 1. Against Eratosthenes, xii., 403 B.C.; 2. Against Agoratus, xiii., 399 B.C.; 3. On the Murder of Eratosthenes, i. (date uncertain); 4. Against Simon, iii., 393 B.C.; 5. On Wounding with Intent, iv. (date uncertain). VII. *Causes relating to Impiety* (γραφαὶ ἀσεβείας). 1. Against Andocides, vi. (certainly spurious, but perhaps contemporary); 2. For Callias, v. (date uncertain); 3. On the Sacred Olive, vii., not before 395 B.C.

D. FORENSIC, IN PRIVATE CAUSES.—I. *Action for Libel* (δίκη κακηγορίας). Against Theomnestus, x., 384–383 B.C. (the so-called second speech, xi., is merely an epitome of the first). II. *Action by a Ward against a Guardian* (δίκη ἐπιτροπῆς). Against Diogeiton, xxxii., 400 B.C. III. *Trial of a Claim to Property* (διαδικασία). On the property of Eraton, xvii., 397 B.C. IV. *Answer to a Special Plea* (πρὸς παραγραφήν). Against Pancleon, xxiii. (date uncertain).

E. MISCELLANEOUS.—1. To his Companions, a Complaint of Slanders, viii. (certainly spurious); 2. The ἐρωτικός in Plato's *Phaedrus*, pp. 230 E-234. This has generally been regarded as Plato's own work; but the certainty of this conclusion will be doubted by those who observe (1) the elaborate preparations made in the dialogue for a recital of the ἐρωτικός which shall be *verbally exact*, and (2) the closeness of the criticism made upon it. If the satirist were merely analysing his own composition, such criticism would have little point. Lysias is the earliest writer who is known to have composed ἐρωτικοί; it is as representing both rhetoric and a false ἔρως that he is the object of attack in the *Phaedrus*.

F. FRAGMENTS.—Three hundred and fifty-five of these are collected by Sauppe, *Oratores Attici*, ii. 170–216. Two hundred and fifty-two of them represent one hundred and twenty-seven speeches of known title; and of six the fragments are comparatively large. Of these, the fragmentary speech *For Pherenicus* belongs to 381 or 380 B.C., and is thus the latest known work of Lysias.[2]

In literary and historical interest, the first place among the extant speeches of Lysias belongs to that *Against Eratosthenes* (403 B.C.), one of the Thirty Tyrants, whom Lysias arraigns as the murderer of his brother Polemarchus. The speech is an eloquent and vivid picture of the reign of terror which the Thirty established at Athens; the concluding appeal, to both parties among the citizens, is specially powerful. Next in importance is the speech *Against Agoratus* (399 B.C.), one of our chief authorities for the internal history of Athens during the months which immediately followed the defeat at Aegospotami. The *Olympiacus* (388 B.C.) is a brilliant fragment, expressing the spirit of the festival at Olympia, and exhorting Greeks to unite against their common foes. The *Plea for the Constitution* (403 B.C.) is interesting for the manner in which it argues that the wellbeing of Athens—now stripped of empire—is bound up with the maintenance of democratic principles. The speech *For Mantitheus* (392 B.C.) is a graceful and animated portrait of a young Athenian ἱππεύς, making a spirited defence of his honour against the charge of disloyalty. The defence *For the Invalid* is a humorous character-sketch. The speech *Against Pancleon* illustrates the intimate relations between Athens and Plataea, while it gives us some picturesque glimpses of Athenian town life. The defence of the person who had been charged with destroying a *moria*, or sacred olive, places us amidst the country life of Attica. And the speech *Against Theomnestus* deserves attention for its curious evidence of the way in which the ordinary vocabulary of Athens had changed between 600 and 400 B.C.

All MSS. of Lysias yet collated have been derived, as H. Sauppe first showed, from the Codex Palatinus X. (Heidelberg). The next most valuable MS. is the Laurentianus C (15th century), which I. Bekker chiefly followed. Speaking generally, we may say that these two MSS. are the only two which carry much weight where the text is seriously corrupt. In *Oratt.* i.-ix. Bekker occasionally consulted eleven other MSS., most of which contain only the above nine speeches: viz., Marciani F, G, I, K (Venice); Laurentiani D, E (Florence); Vaticani M, N; Parisini U, V; Urbinas O.

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[1] See further Jebb, *The Attic Orators from Antiphon to Isaeus*, i. 142-316.

[2] [Some remains of the speech against Theozotides have been found in the Hibeh papyri; see W. H. D. Rouse's *The Year's Work in Classical Studies* (1907)].

LYSIMACHUS (*c.* 355–281 B.C.), Macedonian general, son of Agathocles, was a citizen of Pella in Macedonia. During Alexander's Persian campaigns he was one of his immediate bodyguard and distinguished himself in India. After Alexander's death he was appointed to the government of Thrace and the Chersonese. For a long time he was chiefly occupied with fighting against the Odrysian king Seuthes. In 315 he joined Cassander, Ptolemy and Seleucus against Antigonus, who, however, diverted his attention by stirring up Thracian and Scythian tribes against him. In 309, he founded Lysimachia in a commanding situation on the neck connecting the Chersonese with the mainland. He followed the example of Antigonus in taking the title of king. In 302 when the second alliance between Cassander, Ptolemy and Seleucus was made, Lysimachus, reinforced by troops from Cassander, entered Asia Minor, where he met with little resistance. On the approach of Antigonus he retired into winter quarters near Heraclea, marrying its widowed queen Amastris, a Persian princess. Seleucus joined him in 301, and at the battle of Ipsus Antigonus was slain. His dominions were divided among the victors, Lysimachus receiving the greater part of Asia Minor. Feeling that Seleucus was becoming dangerously great, he now allied himself with Ptolemy, marrying his daughter Arsinoë. Amastris, who had divorced herself from him, returned to Heraclea. When Antigonus's son Demetrius renewed hostilities (297), during his absence in Greece, Lysimachus seized his towns in Asia Minor, but in 294 concluded a peace whereby Demetrius was recognized as ruler of Macedonia. He tried to carry his power beyond the Danube, but was defeated and taken prisoner by the Getae, who, however, set him free on amicable terms. Demetrius subsequently threatened Thrace, but had to retire in consequence of a rising in Boeotia, and an attack from Pyrrhus of Epirus. In 288 Lysimachus and Pyrrhus in turn invaded Macedonia, and drove Demetrius out of the country. Pyrrhus was at first allowed to remain in possession of Macedonia with the title of king, but in 285 he was expelled by Lysimachus. Domestic troubles embittered the last years of Lysimachus's life. Amastris had been murdered by her two sons; Lysimachus treacherously put them to death. On his return Arsinoë asked the gift of Heraclea, and he granted her request, though he had promised to free the city. In 284 Arsinoë, desirous of gaining the succession for her sons in preference to Agathocles (the eldest son of Lysimachus), intrigued against him with the help of her brother Ptolemy Ceraunus; they accused him of conspiring with Seleucus to seize the throne, and he was put to death. This atrocious deed of Lysimachus aroused great indignation. Many of the cities of Asia revolted, and his most trusted friends deserted him. The widow of Agathocles fled to Seleucus, who at once invaded the territory of Lysimachus in Asia. Lysimachus crossed the Hellespont, and in 281 a decisive battle took place at the plain of Corus (Corupedion) in Lydia. Lysimachus was killed; after some days his body, watched by a faithful dog, was found on the field, and given up to his son Alexander, by whom it was interred at Lysimachia.

See Arrian, *Anab.* v. 13, vi. 28; Justin xv. 3, 4, xvii. 1; Quintus Curtius v. 3, x. 30; Diod. Sic. xviii. 3; Polybius v. 67; Plutarch, *Demetrius*, 31. 52, *Pyrrhus*, 12; Appian, *Syriaca*, 62; Thirlwall, *History of Greece*, vol. viii. (1847); J. P. Mahaffy, *Story of Alexander's Empire*; Droysen, *Hellenismus* (2nd ed., 1877); A. Holm, *Griechische Geschichte*, vol. iv. (1894); B. Niese, *Gesch. d. griech. u. maked. Staaten*, vols. i. and ii. (1893, 1899); J. Beloch, *Griech. Gesch.* vol. iii. (1904); Hünerwadel, *Forschungen zur Gesch. des Königs Lysimachus* (1900); Possenti, *Il Re Lisimaco di Tracia* (1901); Ghione, *Note sul regno di Lisimaco* (*Atti d. real. Accad. di Torino*, xxxix.); and MACEDONIAN EMPIRE. (E. R. B.)

LYSIPPUS, Greek sculptor, was head of the school of Argos and Sicyon in the time of Philip and Alexander of Macedon. His works are said to have numbered 1500, some of them colossal. Some accounts make him the continuer of the school of Polyclitus; some represent him as self-taught. The matter in which he especially innovated was the proportions of the male human body; he made the head smaller than his predecessors, the body more slender and hard, so as to give the impression of greater height. He also took great pains with hair and other details. Pliny (*N.H.* 34, 61) and other writers mention many of his statues. Among the gods he seems to have produced new and striking types of Zeus (probably of the Otricoli class), of Poseidon (compare the Poseidon of the Lateran, standing with raised foot), of the Sun-god and others; many of these were colossal figures in bronze. Among heroes he was specially attracted by the mighty physique of Hercules. The Hercules Farnese of Naples, though signed by Glycon of Athens, and a later and exaggerated transcript, owes something, including the motive of rest after labour, to Lysippus. Lysippus made many statues of Alexander the Great, and so satisfied his patron, no doubt by idealizing him, that he became the court sculptor of the king, from whom and from whose generals he received many commissions. The extant portraits of Alexander vary greatly, and it is impossible to determine which among them go back to Lysippus. The remarkable head from Alexandria (Plate II. fig. 56, in GREEK ART) has as good a claim as any.

As head of the great athletic school of Peloponnese Lysippus naturally sculptured many athletes; a figure by him of a man scraping himself with a strigil was a great favourite of the Romans in the time of Tiberius (Pliny, *N.H.* 34, 61); and this has been usually regarded as the original copied in the Apoxyomenus of the Vatican (GREEK ART, Plate VI. fig. 79). If so, the copyist has modernized his copy, for some features of the Apoxyomenus belong to the Hellenistic age. With more certainty we may see a copy of an athlete by Lysippus in the statue of Agias found at Delphi (GREEK ART, Plate V. fig. 74), which is proved by inscriptions to be a replica in marble of a bronze statue set up by Lysippus in Thessaly. And when the Agias and the Apoxyomenus are set side by side their differences are so striking that it is difficult to attribute them to the same author, though they may belong to the same school. (P. G.)

LYSIS OF TARENTUM (d. *c.* 390 B.C.), Greek philosopher. His life is obscure, but it is generally accepted, that in the persecution of the Pythagoreans at Crotona and Metapontum he escaped and went to Thebes, where he came under the influence of Philolaus. The friend and companion of Pythagoras, he has been credited with many of the works usually attributed to Pythagoras himself. Diogenes Laertius viii. 6 gives him three, and Mullach even assigns to him the *Golden Verses*. But it is generally held that these verses are a collection of lines by many authors rather than the work of one man.

LYSISTRATUS, a Greek sculptor of the 4th century B.C., brother of Lysippus of Sicyon. We are told by Pliny (*Nat. Hist.* 35, 153) that he followed a strongly realistic line, being the first sculptor to take impressions of human faces in plaster.

LYTE, HENRY FRANCIS (1793–1847), Anglican divine and hymn-writer, was born near Kelso on the 1st of June 1793, and was educated at Enniskillen school and at Trinity College, Dublin. He took orders in 1815, and for some time held a curacy near Wexford. Owing to infirm health he came to England, and after several changes settled, in 1823, in the parish of Brixham. In 1844 his health finally gave way; and he died at Nice on the 20th of November 1847.

Lyte's first work was *Tales in Verse illustrative of Several of the Petitions in the Lord's Prayer* (1826), which was written at Lymington and was commended by Wilson in the *Noctes Ambrosianae*. He next published (1833) a volume of *Poems, chiefly Religious*, and in 1834 a little collection of psalms and hymns entitled *The Spirit of the Psalms*. After his death, a volume of *Remains* with a memoir was published, and the poems contained in this, with those in *Poems, chiefly Religious*, were afterwards issued in one volume (1868). His best known hymns are "Abide with me! fast falls the eventide"; "Jesus, I my cross have taken"; "Praise, my soul, the King of Heaven"; and "Pleasant are Thy courts above."

LYTHAM, an urban district and watering-place in the Blackpool parliamentary division of Lancashire, England, on the north shore of the estuary of the Ribble, 13½ m. W. of Preston by a joint line of the London & North Western and Lancashire & Yorkshire railways. Pop. (1901) 7185. It has a pier, a pleasant promenade and drive along the shore, and other appointments of a seaside resort, but it is less wholly devoted to holiday visitors than Blackpool, which lies 8 m. N.W. A Benedictine cell was founded here at the close of the 12th century by the lord of the manor, Richard Fitz-Roger.

LYTTELTON, GEORGE LYTTELTON, 1st Baron (1709–1773), English statesman and man of letters, born at Hagley, Worcestershire, was a descendant of the great jurist Sir Thomas Littleton (*q.v.*). He was the eldest son of Sir Thomas Lyttelton, 4th bart. (d. 1751), who at the revolution of 1688 and during the following reign was one of the ablest Whig debaters of the House of Commons.[1] Lyttelton was educated at Eton and Oxford, and in 1728 set out on the grand tour, spending considerable periods at Paris and Rome. On his return to England he sat in parliament for Okehampton, Devonshire, beginning public life in the same year with Pitt. From 1744 to 1754 he held the office of a lord commissioner of the treasury. In 1755 he succeeded Legge as chancellor of the exchequer, but in 1756 he quitted office, being raised to the peerage as Baron Lyttelton, of Frankley, in the county of Worcester. In the political crisis of 1765, before the formation of the Rockingham administration, it was suggested that he might be placed at the head of the treasury, but he declined to take part in any such scheme. The closing years of his life were devoted chiefly to literary pursuits. He died on the 22nd of August 1773.

Lyttelton's earliest publication (1735), *Letters from a Persian in England to his Friend at Ispahan*, appeared anonymously. Much greater celebrity was achieved by his *Observations on the Conversion and Apostleship of St Paul*, also anonymous, published in 1747. It takes the form of a letter to Gilbert West, and is designed to show that St Paul's conversion is of itself a sufficient demonstration of the divine character of Christianity. Dr Johnson regarded the work as one "to which infidelity has never been able to fabricate a specious answer." Lord Lyttelton's *Dialogues of the Dead*, a creditable performance, though hardly rivalling either Lucian or Landor, appeared in 1760. His *History of Henry II.* (1767–1771), the fruit of twenty years' labour, is not now cited as an authority, but is painstaking and fair. Lyttelton was also a writer of verse; his *Monody* on his wife's death has been praised by Gray for its elegiac tenderness, and his *Prologue* to the *Coriolanus* of his friend Thomson shows genuine feeling. He was also the author of the well-known stanza in the *Castle of Indolence*, in which the poet himself is described. A complete collection of the *Works* of Lord Lyttelton was published by his nephew, G. E. Ayscough in 1774.

His son Thomas (1744–1779), who succeeded as 2nd baron, played some part in the political life of his time, but his loose and prodigal habits were notorious, and he is known, in distinction to his father "the good lord," as the wicked Lord Lyttelton. He left no lawful issue, and the barony became extinct; but it was revived in 1794 in the person of his uncle William Henry, 1st baron of the new creation (1724–1808), who was governor of S. Carolina and later of Jamaica, and ambassador to Portugal. The new barony went after him to his two sons. The 3rd baron (1782–1837) was succeeded by his son George William Lyttelton, 4th baron (1817–1876), who was a fine scholar, and brother-in-law of W. E. Gladstone, having married Miss Mary Glynne. He did important work in educational and poor law reform. He had eight sons, of whom the eldest, Charles George (b. 1842), became 5th baron, and in 1889 succeeded, by the death of the 3rd duke of Buckingham and Chandos, to the viscounty of Cobham, in which title the barony of Lyttelton is now merged. Other distinguished sons were Arthur Temple Lyttelton (d. 1903), warden of Selwyn College, Cambridge, and bishop-suffragan of Southampton; Edward Lyttelton (b. 1855), headmaster of Haileybury (1890–1905) and then of Eton; and Alfred Lyttelton (b. 1857), secretary of state for the colonies (1903–1906). It was a family of well-known cricketers, Alfred being in his day the best wicket-keeper in England as well as a fine tennis player.

For the 1st baron see Sir R. Phillimore's *Memoirs and Correspondence of Lord Lyttelton, 1734–1773* (2 vols., 1845).

LYTTELTON, a borough of New Zealand, the port of Christchurch (*q.v.*) on the E. coast of South Island, on an inlet on the north-western side of Banks Peninsula. Pop. (1906) 3941. It is surrounded by abrupt hills rising to 1600 ft., through which a railway communicates with Christchurch (7 m. N.W.) by a tunnel 1¾ m. long. Great breakwaters protect the harbour, which has an area of 110 acres, with a low-tide depth of 20 to 27 ft. There is a graving dock accessible for vessels of 6000 tons. The produce of the rich agricultural district of Canterbury is exported, frozen or preserved. Lyttelton, formerly called Port Cooper and Port Victoria, was the original settlement in this district (1850).

LYTTON, EDWARD GEORGE EARLE LYTTON, BULWER-LYTTON, 1st Baron (1803–1873), English novelist and politician, the youngest son of General William Earle Bulwer of Heydon Hall and Wood Dalling, Norfolk, was born in London on the 25th of May 1803. He had two brothers, William (1799–1877) and Henry (1801–1872), afterwards Lord Dalling (*q.v.*). Bulwer's father died when the boy was four years old. His mother, Elizabeth Barbara, daughter of Richard Warburton Lytton of Knebworth, Hertfordshire, after her husband's death settled in London. Bulwer, who was delicate and neurotic, gave evidence of precocious talent and was sent to various boarding schools, where he was always discontented, until in the establishment of a Mr Wallington at Ealing he found in his master a sympathetic and admiring listener. Mr Wallington induced him to publish, at the age of fifteen, an immature volume entitled *Ishmael and other Poems*. About this time Bulwer fell in love, and became extremely morbid under enforced separation from the young lady, who was induced by her father to marry another man. She died about the time that Bulwer went to Cambridge, and he declared that her loss affected all his after-life. In 1822 he entered Trinity College, Cambridge, but removed shortly afterwards to Trinity Hall, and in 1825 won the Chancellor's medal for English verse with a poem on "Sculpture." In the following year he took his B.A. degree and printed for private circulation a small volume of poems, *Weeds and Wild Flowers*, in which the influence of Byron was easily traceable. In 1827 he published *O'Neill, or the Rebel*, a romance, in heroic couplets, of patriotic struggle in Ireland, and in 1831 a metrical satire, *The Siamese Twins*. These juvenilia he afterwards ignored.

Meanwhile he had begun to take his place in society, being already known as a dandy of considerable pretensions, who had acted as second in a duel and experienced the fashionable round of flirtation and intrigue. He purchased a commission in the army, only to sell it again without undergoing any service, and in August 1827 married, in opposition to his mother's wishes, Rosina Doyle Wheeler (1802–1882), an Irish beauty, niece and adopted daughter of General Sir John Doyle. She was a brilliant but passionate girl, and upon his marriage with her, Bulwer's mother withdrew the allowance she had hitherto made him. He had £200 a year from his father, and less than £100 a year with his wife, and found it necessary to set to work in earnest. In the year of his marriage he published *Falkland*, a novel which was only a moderate success, but in 1828 he attracted general attention with *Pelham*, a novel for which he had gathered material during a visit to Paris in 1825. This story, with its intimate study of the dandyism of the age, was immediately popular, and gossip was busy in identifying the characters of the romance with the leading men of the time. In the same year he published *The Disowned*, following it up with *Devereux* (1829), *Paul Clifford* (1830), *Eugene Aram* (1832) and *Godolphin* (1833). All these novels were designed with a didactic purpose, somewhat upon the German model. To embody the leading features of a period, to show how a criminal may be reformed by the development of his own character, to explain the secrets of failure and success in life, these were the avowed objects of his art, and there were not wanting critics ready to call in question his sincerity and his morality. Magazine controversy followed, in which Bulwer was induced to take a part, and about the same time he began to make a mark in politics. He became a follower of Bentham, and in 1831 was elected member for St Ives in Huntingdon. During this period of feverish activity his relations with his wife grew less and less satisfactory. At first she had cause to complain that he neglected her in the pursuit of literary reputation; later on his disregard became rather active than passive. After a series of distressing differences they decided to live apart, and were legally separated in 1836. Three years later his wife published a novel called *Cheveley, or the Man of Honour*, in which Bulwer was bitterly caricatured, and in June 1858, when her husband was standing as parliamentary candidate for Hertfordshire, she appeared at the hustings and indignantly denounced him. She was consequently placed under restraint as insane, but liberated a few weeks later. For years she continued her attacks upon her husband's character, and outlived him by nine years, dying at Upper Sydenham in March 1882. There is little doubt that her passionate imagination gravely exaggerated the tale of her wrongs, though Bulwer was certainly no model for husbands. It was a case of two undisciplined natures in domestic bondage, and the consequences of their union were as inevitable as they were unfortunate.

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[1] Sir Thomas (or Thomas de) Littleton, the jurist, had three sons, William, Richard and Thomas. From the first, William, was descended Sir Thomas Lyttelton, 1st bart. of Frankley (1596–1650), whose sons were Sir Henry, 2nd bart. (d. 1693), and Sir Charles, 3rd bart. (1629–1716), governor of Jamaica. The latter's son was Sir Thomas, 4th bart., above mentioned, who was also the father of Charles Lyttelton (1714–1768), bishop of Carlisle, and president of the Society of Antiquaries. The male descendants of the second, Richard, died out with Sir Edward Littleton, bart., of Pillaton, Staffordshire, in 1812, but the latter's grandnephew, Edward John Walhouse (1791–1863) of Hatherton, took the estates by will and also the name of Littleton, and was created 1st Baron Hatherton in 1835; he was chief secretary for Ireland (1833–1834). From Thomas, the third son, was descended, in one line, Edward, Lord Littleton, of Munslow (1589–1645), recorder of London, chief justice of the common pleas, and eventually lord keeper; and in another line, the baronets of Stoke St Milborough, Shropshire, of whom the best known and last was Sir Thomas Littleton, 3rd bart. (1647–1710), speaker of the House of Commons (1698–1700), and treasurer of the navy.

Bulwer, meanwhile, was full of activity, both literary and political. After representing St Ives, he was returned for Lincoln in 1832, and sat in parliament for that city for nine years. He spoke in favour of the Reform Bill, and took the leading part in securing the reduction, after vainly essaying the repeal, of the newspaper stamp duties. His pamphlet, issued when the Whigs were dismissed from office in 1834, and entitled "A Letter to a Late Cabinet Minister on the Crisis," was immensely influential, and Lord Melbourne offered him a lordship of the admiralty, which he declined as likely to interfere with his activity as an author. At this time, indeed, his pen was indefatigable. *Godolphin* was followed by *The Pilgrims of the Rhine* (1834), a graceful fantasy, too German in sentiment to be quite successful in England, and then in *The Last Days of Pompeii* (1834) and *Rienzi* (1835) he reached the height of his popularity. He took great pains with these stories, and despite their lurid colouring and mannered over-emphasis, they undoubtedly indicate the high-water mark of his talent. Their reception was enthusiastic, and *Ernest Maltravers* (1837) and *Alice, or the Mysteries* (1838) were hardly less successful. At the same time he had been plunging into journalism. In 1831 he undertook the editorship of the *New Monthly*, which, however, he resigned in the following year, but in 1841, the year in which he published *Night and Morning*, he started the *Monthly Chronicle*, a semi-scientific magazine, for which he wrote *Zicci*, an unfinished first draft afterwards expanded into *Zanoni* (1842). As though this multifarious fecundity were not sufficient, he had also been busy in the field of dramatic literature. In 1838 he produced *The Lady of Lyons*, a play which Macready made a great success at Covent Garden: in 1839 *Richelieu* and *The Sea Captain*, and in 1840 *Money*. All, except *The Sea Captain*, were successful, and this solitary failure he revived in 1869 under the title of *The Rightful Heir*. Of the others it may be said that, though they abound in examples of strained sentiment and false taste, they have nevertheless a certain theatrical *flair*, which has enabled them to survive a whole library of stage literature of greater sincerity and truer feeling. *The Lady of Lyons* and *Money* have long held the stage, and to the last-named, at least, some of the most talented of modern comedians have given new life and probability.

In 1838 Bulwer, then at the height of his popularity, was created a baronet, and on succeeding to the Knebworth estate in 1843 added Lytton to his surname, under the terms of his mother's will. From 1841 to 1852 he had no seat in parliament, and spent much of his time in continental travel. His literary activity waned somewhat, but was still remarkably alert for a man who had already done so much. In 1843 he issued *The Last of the Barons*, which many critics have considered the most historically sound and generally effective of all his romances; in 1847 *Lucretia, or the Children of the Night*, and in 1848 *Harold, the last of the Saxon Kings*. In the intervals between these heavier productions he had thrown off a volume of poems in 1842, another of translations from Schiller in 1844, and a satire called *The New Timon* in 1846, in which Tennyson, who had just received a Civil List pension, was bitterly lampooned as "school miss Alfred," with other unedifying amenities; Tennyson retorted with some verses in which he addressed Bulwer-Lytton as "you band-box." These poetic excursions were followed by his most ambitious work in metre, a romantic epic entitled *King Arthur*, of which he expected much, and he was greatly disappointed by its apathetic reception. Having experienced some rather acid criticism, questioning the morality of his novels, he next essayed a form of fiction which he was determined should leave no loophole to suspicion, and in *The Caxtons* (1849), published at first anonymously, gave further proof of his versatility and resource. *My Novel* (1853) and *What will he do with it?* were designed to prolong the same strain.

In 1852 he entered the political field anew, and in the conservative interest. He had differed from the policy of Lord John Russell over the corn laws, and now separated finally from the liberals. He stood for Hertfordshire and was elected, holding the seat till 1866, when he was raised to the peerage as Baron Lytton of Knebworth. His eloquence gave him the ear of the House of Commons, and he often spoke with influence and authority. In 1858 he was appointed secretary for the colonies. In the House of Lords he was comparatively inactive. His last novels were *A Strange Story* (1862), a mystical romance with spiritualistic tendencies; *The Coming Race* (1871), *The Parisians* (1873)—both unacknowledged at the time of his death; and *Kenelm Chillingly*, which was in course of publication in *Blackwood's Magazine* when Lytton died at Torquay on the 18th of January 1873. The last three of his stories were classed by his son, the 2nd Lord Lytton, as a trilogy, animated by a common purpose, to exhibit the influence of modern ideas upon character and conduct.

Bulwer-Lytton's attitude towards life was theatrical, the language of his sentiments was artificial and over-decorated, and the tone of his work was often so flamboyant as to give an impression of false taste and judgment. Nevertheless, he built up each of his stories upon a deliberate and careful framework: he was assiduous according to his lights in historical research; and conscientious in the details of workmanship. As the fashion of his day has become obsolete the immediate appeal of his work has diminished. It will always, however, retain its interest, not only for the merits of certain individual novels, but as a mirror of the prevailing intellectual movement of the first half of the 19th century.

See T. H. S. Escott, *Edward Bulwer, 1st Baron Lytton of Knebworth* (1910). (A. Wa.)

LYTTON, EDWARD ROBERT BULWER-LYTTON, 1st Earl of (1831–1891), English diplomatist and poet, was the only son of the 1st Baron Lytton. He was born in Hertford Street, Mayfair, on the 8th of November 1831. Robert Lytton and his sister were brought up as children principally by a Miss Green. In 1840 the boy was sent to a school at Twickenham, in 1842 to another at Brighton, and in 1845 to Harrow. From his earliest childhood Lytton read voraciously and wrote copiously, quickly developing a genuine and intense love of literature and a remarkable facility of expression. In 1849 he left Harrow and studied for a year at Bonn with an English tutor, and on his return with another tutor in England. In 1850 he entered the diplomatic service as unpaid *attaché* to his uncle, Sir Henry Bulwer, who was then minister at Washington. His advance in the diplomatic service was continuous, his successive appointments being: as second secretary—1852, Florence; 1854, Paris; 1857, The Hague; 1859, Vienna; as first secretary or secretary of legation—1863, Copenhagen; 1864, Athens; 1865, Lisbon; 1868, Madrid; 1868, Vienna; 1873, Paris; as minister—1875, Lisbon. In 1887 he was appointed to succeed Lord Lyons as ambassador at Paris, and held that office until his death in 1891. This rapid promotion from one European court to another indicates the esteem in which Lytton was held by successive foreign secretaries. In 1864, immediately before taking up his appointment at Athens, he married Edith, daughter of Edward Villiers, brother of the earl of Clarendon, and in 1873, upon the death of his father, he succeeded to the peerage and the estate of Knebworth in Hertfordshire.

Early in 1875 Lord Lytton declined an offer of appointment as governor of Madras, and in November of that year he was nominated governor-general of India by Disraeli. The moment was critical in the history of India. In Central Asia the advance of Russia had continued so steadily and so rapidly that Shere Ali, the amir of Afghanistan, had determined to seek safety as the vassal of the tsar. Lytton went out to India with express instructions from the British government to recover the friendship of the amir if possible, and if not so to arrange matters on the north-west frontier as to be able to be indifferent to his hostility. For eighteen months Lytton and his council made every effort to conciliate the friendship of the amir, but when a Russian agent was established at Kabul, while the mission of Sir Neville Chamberlain was forcibly denied entrance into the amir's dominions, no choice was left between acknowledging the right of a subsidized ally of Great Britain to place himself within Russian control and depriving him of the office which he owed to British patronage and assistance. The inevitable war began in November 1878, and by the close of that year the forces prepared by Lytton for that purpose had achieved their task with extraordinary accuracy and economy. Shere Ali fled from Kabul, and shortly afterwards died, and once more it fell to the Indian government to make provision for the future of Afghanistan. By the treaty of Gandamak in May 1879 Yakub Khan, a son of Shere Ali, was recognized as amir, the main conditions agreed upon being that the districts of Kuram, Pishin and Sibi should be "assigned" to British administration, and the Khyber and other passes be under British control; that there should be a permanent British Resident at Kabul, and that the amir should be subsidized in an amount to be afterwards determined upon. The endeavour of the Indian government was to leave the internal administration of Afghanistan as little affected as possible, but considerable risk was run in trusting so much, and especially the safety of a British envoy, to the power and the goodwill of Yakub Khan. Sir Louis Cavagnari, the British envoy entered Kabul at the end of July, and was, with his staff, massacred in the rising which took place on the 3rd of September. The war of 1879–80 immediately began, with the occupation of Kandahar by Stewart and the advance upon Kabul by Roberts, and the military operations which followed were not concluded when Lytton resigned his office in April 1880.

A complete account of Lytton's viceroyalty, and a lucid exposition of the principles of his government and the main outlines of his policy, may be found in *Lord Lytton's Indian Administration*, by his daughter, Lady Betty Balfour (London, 1899). The frontier policy which he adopted, after the method of a friendly and united Afghanistan under Yakub Khan had been tried and had failed, was that the Afghan kingdom should be destroyed. The province of Kandahar was to be occupied by Great Britain, and administered by a vassal chief, Shere Ali Khan, who was appointed "Wali" with a solemn guarantee of British support (unconditionally withdrawn by the government succeeding Lytton's). The other points of the Indian frontier were to be made as secure as possible, and the provinces of Kabul and Herat were to be left absolutely to their own devices. In consequence of what had been said of Lytton by the leaders of the parliamentary opposition in England, it was impossible for him to retain his office under a government formed by them, and he accordingly resigned at the same time as the Beaconsfield ministry. This part of his policy was thereupon revoked. Abdur Rahman, proving himself the strongest of the claimants to the throne left vacant by Yakub Khan's deposition, became amir as the subsidized ally of the Indian government.

The two most considerable events of Lytton's viceroyalty, besides the Afghan wars, were the assumption by Queen Victoria of the title of empress of India on the 1st of January 1877, and the famine which prevailed in various parts of India in 1876–78. He satisfied himself that periodical famines must be expected in Indian history, and that constant preparation during years of comparative prosperity was the only condition whereby their destructiveness could be modified. Accordingly he obtained the appointment of the famine commission of 1878, to inquire, upon lines laid down by him, into available means of mitigation. Their report, made in 1880, is the foundation of the later system of irrigation, development of communications, and "famine insurance." The equalization and reduction of the salt duty were effected, and the abolition of the cotton duty commenced, during Lytton's term of office, and the system of Indian finance profoundly modified by decentralization and the regulation of provincial responsibility, in all which matters Lytton enthusiastically supported Sir John Strachey, the financial member of his council.

Upon Lytton's resignation in 1880 an earldom was conferred upon him in recognition of his services as viceroy. He lived at Knebworth until 1887, in which year he was appointed to succeed Lord Lyons as ambassador at Paris. He died at Paris on the 24th of November 1891, of a clot of blood in the heart, when apparently recovering from a serious illness. He was succeeded by his son (b. 1876) as 2nd earl.

Lytton is probably better known as a poet—under the pen-name of "Owen Meredith"—than as a statesman. The list of his published works is as follows: *Clytemnestra, and other Poems*, 1855; *The Wanderer*, 1858; *Lucile*, 1860; *Serbski Pesme, or National Songs of Servia*, 1861, *Tannhäuser* (in collaboration with Mr Julian Fane), 1861; *Chronicles and Characters*, 1867; *Orval, or The Fool of Time*, 1868; *Fables in Song* (2 vols.), 1874; *Glenaveril, or The Metamorphoses*, 1885; *After Paradise, or the Legends of Exile, and other Poems*, 1887; *Marah*, 1892; *King Poppy*, 1892. The two last-mentioned volumes were published posthumously. A few previously unpublished pieces are included in a volume of *Selections* published, with an introduction by Lady Betty Balfour, in 1894. His metrical style was easy and copious, but not precise. It often gives the impression of having been produced with facility, because the flow of his thought carried him along, and of not having undergone prolonged or minute polish. It was frequently suggestive of the work of other poets, especially in his earlier productions. The friend who wrote the inscription for the monument to be erected to him at St Paul's described him as "a poet of many styles, each the expression of his habitual thoughts." *Lucile*, a novel in verse, presents a romantic style and considerable wit; and *Glenaveril*, which also contains many passages of great beauty and much poetic thought, has much of the same narrative character. Besides his volumes of poetry, Lytton published in 1883 two volumes of a biography of his father. The second of these contains the beginning of the elder Lytton's unfinished novel, *Greville*, and his life is brought down only to the year 1832, when he was twenty-six years of age, so that the completion of the book upon the same scale would have required at least four more volumes. The executrix of Lytton's mother chose to consider that the publication was injurious to that lady's memory, and issued a volume purporting to contain Bulwer-Lytton's letters to his wife. This Lytton suppressed by injunction, thereby procuring a fresh exposition of the law that the copyright in letters remains in the writer or his representatives, though the property in them belongs to the recipient. Lytton's appointment to the Parisian embassy caused the biography of his father to be finally laid aside.

The *Personal and Literary Letters of Robert, 1st Earl of Lytton*, have been edited by Lady Betty Balfour (1906). (H. S*.)

M The thirteenth letter of the Phoenician and Greek alphabets, the twelfth of the Latin, and the thirteenth of the languages of western Europe. Written originally from right to left, it took the form 𐌌 which survives in its earliest representations in Greek. The greater length of the first limb of *m* is characteristic of the earliest forms. From this form, written from left to right, the Latin abbreviation M' for the praenomen Manius is supposed to have developed, the apostrophe representing the fifth stroke of the original letter. In the early Greek alphabets the four-stroke M with legs of equal length represents not *m* but *s*; *m* when written with four strokes is M. The five-stroke forms, however, are confined practically to Crete, Melos and Cumae; from the last named the Romans received it along with the rest of their alphabet. The Phoenician name of the symbol was *mem*, the Greek name μῦ is formed on the analogy of the name for *n*. M represents the bilabial nasal sound, which was generally voiced. It is commonly a stable sound, but many languages, *e.g.* Greek, Germanic and Celtic, change it when final into -*n*, its dental correlative. It appears more frequently as an initial sound in Greek and Latin than in the other languages of the same stock, because in these *s* before *m* (as also before *l* and *n*) disappeared at the beginning of words. The sounds *m* and *b* are closely related, the only difference being that, in pronouncing *m*, the nasal passage is not closed, thus allowing the sound to be prolonged, while *b* is an instantaneous or explosive sound. In various languages *b* is inserted between *m* and a following consonant, as in the Gr. *μεσημβρία* "mid-day," or the English "number," Fr. *nombre* from Lat. *numerus*. The sound *m* can in unaccented syllables form a syllable by itself without an audible vowel, *e.g.* the Enghlish word *fathom* comes from an Anglo-Saxon *faþm*, where the *m* was so used. (For more details as to this phonetic principle, which has important results in the history of language, see under N.) (P. Gi.)

MAAS, JOSEPH (1847–1886), English tenor singer, was born at Dartford, and became a chorister in Rochester Cathedral. He went to study singing in Milan in 1869; in February 1871 he made his first success by taking Sims Reeves's place at a concert in London. In 1878 he became principal tenor in Carl Rosa's company, his beautiful voice and finished style more than compensating for his poor acting. He died in London on the 16th of January 1886.

MAASIN, a town on the S.W. coast of the island of Leyte, Philippine Islands, at the mouth of the Maasin River. Pop. (1903), 21,638. Maasin is an important port for hemp and copra. The well-built town occupies a narrow coastal plain. The river valleys in the vicinity produce cotton, pepper, tobacco, rice, Indian corn and fruit. Native cloths and pottery are manufactured. Maasin is the only place on the west coast of Leyte where a court of justice is held. The language is Visayan.

MAASSLUIS, a river port of Holland, in the province of South Holland, on the New Waterway, 10 m. by rail W. of Rotterdam. Pop. (1903), 8011. It rose into importance as a fishing harbour towards the end of the 16th century, and its prosperity rapidly increased after the opening of the New Waterway (the Maas ship canal) from Rotterdam to the sea. The fort erected here in 1572 by Philip of Marnix, lord of St Aldegonde, was captured by the Spanish in 1573.

MAASTRICHT, or MAESTRICHT, a frontier town and the capital of the province of Limburg, Holland, on the left bank of the Maas at the influx of the river Geer, 19 m. by rail N.N.E. of Liége in Belgium. Pop. (1904), 36,146. A small portion of the town, known as Wyk, lies on the right bank. A stone bridge connecting the two replaced a wooden structure as early as 1280, and was rebuilt in 1683. Formerly a strong fortress, Maastricht is still a considerable garrison town, but its ramparts were dismantled in 1871–1878. The town-hall, built by Pieter Post and completed in 1683, contains some interesting pictures and tapestry. The old town-hall (Oud Stadhuis), a Gothic building of the 15th century, is now used as a museum of antiquities. The church of St Servatius is said to have been founded by Bishop Monulphus in the 6th century, thus being the oldest church in Holland; according to one account it was rebuilt and enlarged as early as the time of Charlemagne. The crypt with the tomb of the patron saint dates from the original building. The varied character of its late Romanesque and later Gothic architecture bears evidence of the frequency with which the church has been restored and altered. Over the porch is the fine emperor's hall, and the church has a marble statue of Charlemagne. The church of Our Lady, a late Romanesque building, has two ancient crypts and a 13th-century choir of exceptional beauty, but the nave suffered severely from a restoration in 1764. The present Gothic building of St Martin (in Wyk) was erected in 1859; the original church is said by tradition to have occupied the site of an old heathen temple. The Protestant St Janskerk, a Gothic building of the 13th and 15th centuries, with a fine tower, was formerly the baptistery of the cathedral. The various hospitals, the poor-house, the orphanage and most of the other charitable foundations are Roman Catholic institutions. Maastricht contains the provincial archives, a library and geological collections. Though mainly indebted for its commercial prosperity to its position on the river, the town did not begin to reap the full advantages of its situation till the opening of the railways between 1853 and 1865. At first a trade was carried on in wine, colonial wares, alcoholic liquors and salt; there are now manufactures of earthenware, glass and crystal, arms, paper, woollens, tools, lead, copper and zinc work, as well as breweries, and tobacco and cigar factories, and a trade in corn and butter.

A short distance south of Maastricht are the great sandstone quarries of Pietersberg, which were worked from the time of the Romans to near the end of the 19th century; the result is one of the most extraordinary subterranean labyrinths in the world, estimated to cover an area 15 m. by 9 m. In the time of the Spanish wars these underground passages served to hide the peasants and their cattle.

Maastricht was originally the *trajectus superior* (upper ford) of the Romans, and was the seat of a bishop from 382 to 721. Having formed part of the Frankish realm, it was ruled after 1204 jointly by the dukes of Brabant and the prince-bishops of Liége. In 1579 it was besieged by the Spaniards under the duke of Parma, being captured and plundered after a heroic resistance. It was taken by the French in 1673, 1748 and 1794.

MABILLON, JOHN (1632–1707), Benedictine monk of the Congregation of St Maur (see MAURISTS), was the son of a peasant near Reims. In 1653 he became a monk in the abbey of St Remi at Reims. In 1664 he was placed at St Germain-des-Prés in Paris, the great literary workshop of the Maurists, where he lived and worked for twenty years, at first under d'Achery, with whom he edited the nine folio volumes of *Acta* of the Benedictine Saints. In Mabillon's Prefaces (reprinted separately) these lives were for the first time made to illustrate the ecclesiastical and civil history of the early middle ages. Mabillon's masterpiece was the *De re diplomatica* (1681; and a supplement, 1704) in which were first laid down the principles for determining the authenticity and date of medieval charters and manuscripts. It practically created the science of Latin palaeography, and is still the standard work on the subject. In 1685–1686 Mabillon visited the libraries of Italy, to purchase MSS. and books for the King's Library. On his return to Paris he was called upon to defend against de Rancé, the abbot of La Trappe, the legitimacy for monks of the kind of studies to which the Maurists devoted themselves: this called forth Mabillon's *Traité des études monastiques* and his *Réflexions sur la réponse de M. l'abbé de la*

Trappe (1691–1692), works embodying the ideas and programme of the Maurists for ecclesiastical studies. Mabillon produced in all some twenty folio volumes and as many of lesser size, nearly all works of monumental erudition (the chief are named in the article MAURISTS). A very competent judge declared that, "he knew well the 7th, 8th, 9th, 10th and 11th centuries, but nothing earlier or later." Mabillon never allowed his studies to interfere with his life as a monk; he was noted for his regular attendance at the choral recitation of the office and the other duties of the monastic life, and for his deep personal religion, as well as for a special charm of character. He died on the 26th of December 1707, in the midst of the production of the colossal Benedictine Annals.

The chief authority for his life is the *Abrégé de la vie de D. J. M.* (also in Latin), by his disciple and friend Ruinart (1709). See also, for a full summary of his works, Tassin, *Hist. littéraire de la congr. de St Maur* (1770), pp. 205–269. Of modern biographies the best are those of de Broglie (2 vols., 1888) and Bäumer (1892)—the former to be especially recommended. A brief sketch by E. C. Butler may be found in the *Downside Review* (1893). (E. C. B.)

MABINOGION (plural of Welsh *mabinogi*, from *mabinog*, a bard's apprentice), the title given to the collection of eleven Welsh prose tales (from the Red Book of Hergest) published (1838) by Lady Charlotte Guest, but applied in the Red Book to four only. (See CELT: *Welsh Literature*.)

MABUSE, JAN (d. 1532), the name adopted (from his birthplace, Maubeuge) by the Flemish painter JENNI GOSART, or JENNYN VAN HENNEGOUWE (Hainault), as he called himself when he matriculated in the gild of St Luke, at Antwerp, in 1503. We know nothing of his early life, but his works tell us that he stood in his first period under the influence of artists to whom plastic models were familiar; and this leads to the belief that he spent his youth on the French border rather than on the banks of the Scheldt. Without the subtlety or power of Van der Weyden, he had this much in common with the great master of Tournai and Brussels, that his compositions were usually framed in architectural backgrounds. But whilst Mabuse thus early betrays his dependence on the masters of the French frontier, he also confesses admiration for the great painters who first gave lustre to Antwerp; and in the large altar-pieces of Castle Howard and Scawby he combines in a quaint and not unskilful medley the sentiment of Memling, the bright and decided contrasts of pigment peculiar to coloured reliefs, the cornered and packed drapery familiar to Van der Weyden, and the bold but Socratic cast of face remarkable in the works of Quentin Matsys. At Scawby he illustrates the legend of the count of Toulouse, who parted with his wordly goods to assume the frock of a hermit. At Castle Howard he represents the Adoration of the Kings, and throws together some thirty figures on an architectural background, varied in detail, massive in shape and fanciful in ornament. He surprises us by pompous costume and flaring contrasts of tone. His figures, like pieces on a chess-board, are often rigid and conventional. The landscape which shows through the colonnades is adorned with towers and steeples in the minute fashion of Van der Weyden. After a residence of a few years at Antwerp, Mabuse took service with Philip, bastard of Philip the Good, at that time lord of Somerdyk and admiral of Zeeland. One of his pictures had already become celebrated—a Descent from the Cross (50 figures), on the high altar of the monastery of St Michael of Tongerloo. Philip of Burgundy ordered Mabuse to execute a replica for the church of Middelburg; and the value which was then set on the picture is apparent from the fact that Dürer came expressly to Middelburg (1521) to see it. In 1568 the altar-piece perished by fire. In 1508 Mabuse accompanied Philip of Burgundy on his Italian mission; and by this accident an important revolution was effected in the art of the Netherlands. Mabuse appears to have chiefly studied in Italy the cold and polished works of the Leonardesques. He not only brought home a new style, but he also introduced the fashion of travelling to Italy; and from that time till the age of Rubens and Van Dyck it was considered proper that all Flemish painters should visit the peninsula. The Flemings grafted Italian mannerisms on their own stock; and the cross turned out so unfortunately that for a century Flemish art lost all trace of originality.

In the summer of 1509 Philip returned to the Netherlands, and, retiring to his seat of Suytburg in Zeeland, surrendered himself to the pleasures of planning decorations for his castle and ordering pictures of Mabuse and Jacob of Barbari. Being in constant communication with the court of Margaret of Austria at Malines, he gave the artists in his employ fair chances of promotion. Barbari was made court painter to the regent, whilst Mabuse received less important commissions. Records prove that Mabuse painted a portrait of Leonora of Portugal, and other small pieces, for Charles V. in 1516. But his only signed pictures of this period are the Neptune and Amphitrite of 1516 at Berlin, and the Madonna, with a portrait of Jean Carondelet of 1517, at the Louvre, in both of which we clearly discern that Vasari only spoke by hearsay of the progress made by Mabuse in "the true method of producing pictures full of nude figures and poesies." It is difficult to find anything more coarse or misshapen than the Amphitrite, unless we except the grotesque and ungainly drayman who figures for Neptune. In later forms of the same subject—the Adam and Eve at Hampton Court, or its feebler replica at Berlin—we observe more nudity, combined with realism of the commonest type. Happily, Mabuse was capable of higher efforts. His St Luke painting the portrait of the Virgin in Sanct Veit at Prague, a variety of the same subject in the Belvedere at Vienna, the Madonna of the Baring collection in London, or the numerous repetitions of Christ and the scoffers (Ghent and Antwerp), all prove that travel had left many of Mabuse's fundamental peculiarities unaltered. His figures still retain the character of stone; his architecture is as rich and varied, his tones are as strong as ever. But bright contrasts of gaudy tints are replaced by soberer greys; and a cold haze, the *sfumato* of the Milanese, pervades the surfaces. It is but seldom that these features fail to obtrude. When they least show, the master displays a brilliant palette combined with smooth surface and incisive outlines. In this form the Madonnas of Munich and Vienna (1527), the likeness of a girl weighing gold pieces (Berlin), and the portraits of the children of the king of Denmark at Hampton Court, are fair specimens of his skill. As early as 1523, when Christian II. of Denmark came to Belgium, he asked Mabuse to paint the likenesses of his dwarfs. In 1528 he requested the artist to furnish to Jean de Hare the design for his queen Isabella's tomb in the abbey of St Pierre near Ghent. It was no doubt at this time that Mabuse completed the portraits of John, Dorothy and Christine, children of Christian II., which came into the collection of Henry VIII. No doubt, also, these portraits are identical with those of three children at Hampton Court, which were long known and often copied as likenesses of Prince Arthur, Prince Henry and Princess Margaret of England. One of the copies at Wilton, inscribed with the forged name of "Hans Holbein, ye father," and the false date of 1495, has often been cited as a proof that Mabuse came to England in the reign of Henry VII.; but the statement rests on no foundation whatever. At the period when these portraits were executed Mabuse lived at Middelburg. But he dwelt at intervals elsewhere. When Philip of Burgundy became bishop of Utrecht, and settled at Duerstede, near Wyck, in 1517, he was accompanied by Mabuse, who helped to decorate the new palace of his master. At Philip's death, in 1524, Mabuse designed and erected his tomb in the church of Wyck. He finally retired to Middelburg, where he took service with Philip's brother, Adolph, lord of Veeren. Van Mander's biography accuses Mabuse of habitual drunkenness; yet it describes the splendid appearance of the artist as, dressed in gold brocade, he accompanied Lucas of Leyden on a pleasure trip to Ghent, Malines and Antwerp in 1527. The works of Mabuse are those of a hardworking and patient artist; the number of his still extant pictures practically demonstrates that he was not a debauchee. The marriage of his daughter with the painter Henry Van der Heyden of Louvain proves that he had a home, and did not live habitually in taverns, as Van Mander suggests. His death at Antwerp, on the 1st of October 1532, is recorded in the portrait engraved by Jerome Cock. (J. A. C.)

MACABEBE, a town of the province of Pampanga, island of Luzon, Philippine Islands, on the Pampanga Grande river, about 10 m. above its mouth and about 25 m. N.W. of Manila. Pop. (1903), after the annexation of San Miguel, 21,481. The language is Pampango. Many of the male inhabitants serve in the U.S. Army as scouts. Macabebe's principal industries are the cultivation of rice and sugar cane, the distilling of nipa alcohol, and the weaving of hemp and cotton fabrics.

MACABRE, a term applied to a certain type of artistic or literary composition, characterized by a grim and ghastly humour, with an insistence on the details and trappings of death. Such a quality, deliberately adopted, is hardly to be found in ancient Greek and Latin writers, though there are traces of it in Apuleius and the author of the *Satyricon*. The outstanding instances in English literature are John Webster and Cyril Tourneur, with E. A. Poe and R. L. Stevenson. The word has gained its significance from its use in French, *la danse macabre*, for that allegorical representation, in painting, sculpture and tapestry, of the ever-present and universal power of death, known in English as the "Dance of Death," and in German as *Totentanz*. The typical form which the allegory takes is that of a series of pictures, sculptured or painted, in which Death appears, either as a dancing skeleton or as a shrunken corpse wrapped in grave-clothes to persons representing every age and condition of life, and leads them all in a dance to the grave. Of the numerous examples painted or sculptured on the walls of cloisters or churchyards through medieval Europe few remain except in woodcuts and engravings. Thus the famous series at Basel, originally at the Klingenthal, a nunnery in Little Basel, dated from the beginning of the 14th century. In the middle of the 15th century this was moved to the churchyard of the Predigerkloster at Basel, and was restored, probably by Hans Kluber, in 1568; the fall of the wall in 1805 reduced it to fragments, and only drawings of it remain. A Dance of Death in its simplest form still survives in the Marienkirche at Lübeck in a 15th-century painting on the walls of a chapel. Here there are twenty-four figures in couples, between each is a dancing Death linking the groups by outstretched hands, the whole ring being led by a Death playing on a pipe. At Dresden there is a sculptured life-size series in the old Neustädter Kirchhoff, removed here from the palace of Duke George in 1701 after a fire. At Rouen in the *aitre* (atrium) or cloister of St Maclou there also remains a sculptured *danse macabre*. There was a celebrated fresco of the subject in the cloister of Old St Paul's in London, and another in the now destroyed Hungerford Chapel at Salisbury, of which a single woodcut, "Death and the Gallant," alone remains. Of the many engraved reproductions, the most celebrated is the series drawn by Holbein. Here the long ring of connected dancing couples is necessarily abandoned, and the Dance of Death becomes rather a series of *imagines mortis*.

Concerning the origin of this allegory in painting and sculpture there has been much dispute. It certainly seems to be as early as the 14th century, and has often been attributed to the overpowering consciousness of the presence of death due to the Black Death and the miseries of the Hundred Years' War. It has also been attributed to a form of the Morality, a dramatic dialogue between Death and his victims in every station of life, ending in a dance off the stage (see Du Cange, *Gloss.*, *s.v.* "Machabaeorum chora"). The origin of the peculiar form the allegory has taken has also been found, somewhat needlessly and remotely, in the dancing skeletons on late Roman sarcophagi and mural paintings at Cumae or Pompeii, and a false connexion has been traced with the "Triumph of Death," attributed to Orcagna, in the Campo Santo at Pisa.

The etymology of the word *macabre* is itself most obscure. According to Gaston Paris (*Romania*, xxiv., 131; 1895) it first occurs in the form *macabré* in Jean le Févre's *Respit de la mort* (1376), "Je lis de Macabré la danse," and he takes this accented form to be the true one, and traces it in the name of the first painter of the subject. The more usual explanation is based on the Latin name, *Machabaeorum chora*. The seven tortured brothers, with their mother and Eleazar (2 Macc. vi., vii.) were prominent figures on this hypothesis in the supposed dramatic dialogues. Other connexions have been suggested, as for example with St Macarius, or Macaire, the hermit, who, according to Vasari, is to be identified with the figure pointing to the decaying corpses in the Pisan "Triumph of Death," or with an Arabic word *magbarah*, "cemetery."

See Peignot, *Recherches sur les danses des morts* (1826); Douce, *Dissertation on the Dance of Death* (1833); Massmann, *Litteratur der Totentänze* (1840); J. Charlier de Gerson, *La Danse macabre des Stes Innocents de Paris* (1874); Seelmann, *Die Totentänze des Mittelalters* (1893).

McADAM, JOHN LOUDON (1756–1836), Scottish inventor, who gave his name to the system of road-making known as "macadamizing," was born at Ayr, Scotland, on the 21st of September 1756, being descended on his father's side from the clan of the McGregors. While at school he constructed a model road-section. In 1770 he went to New York, entering the counting-house of a merchant uncle. He returned to Scotland with a considerable fortune in 1783, and purchased an estate at Sauhrie, Ayrshire. Among other public offices he held that of road trustee. The highways of Great Britain were at this time in a very bad condition, and McAdam at once began to consider how to effect reforms. At his own expense he began at Sauhrie, despite much opposition, a series of experiments in road-making. In 1798 he removed to Falmouth, where he had received a government appointment, and continued his experiments there. His general conclusion was that roads should be constructed of broken stone (see Roads). In 1815, having been appointed surveyor-general of the Bristol roads, he was able to put his theories into practice. In 1819 he published a *Practical Essay on the Scientific Repair and Preservation of Roads*, followed, in 1820, by the *Present State of Road-making*. As the result of a parliamentary inquiry in 1823 into the whole question of road-making, his views were adopted by the public authorities, and in 1827 he was appointed general surveyor of roads. In pursuing his investigations he had travelled over thirty thousand miles of road and expended over £5000. Parliament recouped him for his expenses and gave him a handsome gratuity, but he declined a proffered knighthood. He died at Moffat, Dumfriesshire, on the 26th of November 1836.

MACAIRE, a French *chanson de geste*. *Macaire* (12th century) and *La reine Sibille* (14th century) are two versions of the story of the false accusation brought against the queen of Charlemagne, called Blanchefleur in *Macaire* and Sibille in the later poem. *Macaire* is only preserved in the Franco-Venetian *geste* of Charlemagne (Bibl. St Mark MS. fr. xiii.). *La Reine Sibille* only exists in fragments, but the tale is given in the chronicle of Alberic Trium Fontium and in a prose version. *Macaire* is the product of the fusion of two legends: that of the unjustly repudiated wife and that of the dog who detects the murderer of his master. For the former motive see Geneviève of Brabant. The second is found in Plutarch, *Script. moral.*, ed. Didot ii. (1186), where a dog, like Aubri's hound, stayed three days without food by the body of its master, and subsequently attacked the murderers, thus leading to their discovery. The duel between Macaire and the dog is paralleled by an interpolation by Giraldus Cambrensis in a MS. of the *Hexameron* of Saint Ambrose. Aubri's hound received the name of the "dog of Montargis," because a representation of the story was painted on a chimney-piece in the château of Montargis in the 15th century. The tale was early divorced from Carolingian tradition, and Jean de la Taille, in his *Discours notable des duels* (Paris, 1607), places the incident under Charles V.

See *Macaire* (Paris, 1866), ed. Guessard in the series of *Anc. poètes de la France*; P. Paris in *Hist. litt. de la France*, vol. xxiii. (1873); L. Gautier, *Épopées françaises*, vol. iii. (2nd ed., 1880); G. Paris, *Hist. poét. de Charlemagne* (1865); M. J. G. Isola, *Storie nerbonesi*, vol. i. (Bologna, 1877); F. Wolf, *Über die beiden . . . Volksbücher von der K. Sibille u. Huon de Bordeaux* (Vienna, 1857) and *Über die neuesten Leistungen der Franzosen* (Vienna, 1833). *The Dog of Montargis; or, The Forest of Bondy*, imitated from the play of G. de Pixérécourt, was played at Covent Garden (Sept. 30, 1814).

"Robert Macaire" was the name given to the modern villain in the *Auberge des Adrets* (1823), a melodrama in which Frédérick

Lemaître made his reputation. The type was sensibly modified in *Robert Macaire* (1834), a sequel written by Lemaître in collaboration with Benjamin Antier, and well-known on the English stage as *Macaire*. R. L. Stevenson and W. E. Henley used the same type in their play *Macaire*.

McALESTER, a city and the county-seat of Pittsburg county, Oklahoma, about 110 m. E.S.E. of Guthrie. Pop. (1900), 3479; (1907) 8144 (1681 negroes and 105 Indians); (1910) 12,954. McAlester is served by the Chicago, Rock Island & Pacific and the Missouri, Kansas & Texas railways and is an important railway junction; it is connected with the neighbouring mining district by an electric line. There are undeveloped iron deposits and rich coal-mines in the surrounding country, and coke-making is the principal manufacturing industry of the city. There is a fine Scottish Rite Masons' consistory and temple in McAlester. The city owns its waterworks. The vicinity was first settled in 1885. The city of South McAlester was incorporated in 1899, and in 1906 it annexed the town of McAlester and adopted its name.

MACALPINE (or MACCABEUS), **JOHN** (d. 1557), Protestant theologian, was born in Scotland about the beginning of the 16th century, and graduated at some Scottish university. From 1532 to 1534 he was prior of the Dominican convent of Perth; but having in the latter year been summoned with Alexander Ales (*q.v.*) and others to answer for heresy before the bishop of Ross, he fled to England, where he was granted letters of denization on the 7th of April 1537, and married Agnes Macheson, a fellow-exile for religion; her sister Elizabeth became the wife of Miles Coverdale. The reaction of 1539 made England a doubtful refuge, and on the 25th of November 1540 Macalpine matriculated at the university of Wittenberg. He had already graduated B.A. at Cologne, and in 1542 proceeded to his doctorate at Wittenberg. In that year, being now known as Maccabeus, he accepted Christian III.'s offer of the chair of theology at the university of Copenhagen, which had been endowed out of the spoils of the Church. Melanchthon spoke well of Macalpine, and with Peter Plade (Palladius), who had also studied at Wittenberg, Macalpine took a prominent part in building up the Lutheran Church of Denmark. A joint exposure by Plade and Macalpine of Osiander's errors was published in 1552 and reprinted at Leipzig and Copenhagen in 1768; and Macalpine was one of the four translators of Luther's German Bible into Danish. He also encouraged Sir David Lindsay, who visited him in 1548, to publish his *Monarchie*, and persuaded Christian III. to intercede with Queen Mary Tudor on behalf of Coverdale and invite him to Denmark. Macalpine died at Copenhagen on the 6th of December 1557.

See *Dict. Nat. Biog.* and authorities there cited; *Corpus reformatorum*, iii. (1066), iv. 771, 793; Foerstemann, *Album academiae vitebergensis* (1841), p. 186, and *Liber decanorum* (1838), p. 32; Rockwell, *Die Doppelehe des Landgrafen Philipp* (1904), pp. 114–116; *Letters and Papers of Henry VIII.* (1537), i. 1103 (12); (1542), pp. 46,218. (A. F. P.)

MACAO (A-Ma-ngao, "Harbour of the goddess A-Ma"; Port. *Macau*), a Portuguese settlement on the coast of China, in 22° N., 132° E. Pop. (1896), Chinese, 74,568; Portuguese, 3898; other nationalities, 161—total, 78,627. It consists of a tongue of land 2½ m. in length and less than 1 m. in breadth, running S.S.W. from the island of Hiang Shang (Port. *Ançam*) on the western side of the estuary of the Canton River. Bold and rocky hills about 300 ft. high occupy both extremities of the peninsula, the picturesque city, with its flat-roofed houses painted blue, green and red, lying in the undulating ground between. The forts are effective additions to the general view, but do not add much to the strength of the place. Along the east side of the peninsula runs the Praya Grande, or Great Quay, the chief promenade in Macao, on which stand the governor's palace, the administrative offices, the consulates and the leading commercial establishments. The church of St Paul (1594–1602), the seat of the Jesuit college in the 17th century, was destroyed by fire in 1835. The Hospital da Misericordia (1569) was rebuilt in 1640. The Camoens grotto, where the exiled poet found leisure to celebrate the achievements of his ungrateful country, lies in a secluded spot to the north of the town, which has been partly left in its native wildness strewn with huge granite boulders and partly transformed into a fine botanical garden. During the south-west (summer) monsoon great quantities (67 in.) of rain fall, especially in July and August. The mean temperature is 74·3° F.; in July, the hottest month, the temperature is 84·2°; in February, the coldest, it is 59°. On the whole the climate is moist. Hurricanes are frequent. Of the Portuguese inhabitants more than three-fourths are natives of Macao—a race very inferior in point of physique to their European ancestors. Macao is connected with Hong-Kong by a daily steamer. Being open to the south-west sea breezes, it is a favourite place of resort from the oppressive heat of Hong-Kong. It is ruled by a governor, and, along with Timor (East Indies), constitutes a bishopric, to which belong also the Portuguese Christians in Malacca and Singapore. Though most of the land is under garden cultivation, the mass of the people is dependent more or less directly on mercantile pursuits; for, while the exclusive policy both of Chinese and Portuguese which prevented Macao becoming a free port till 1845–1846 allowed what was once the great emporium of European commerce in eastern Asia to be outstripped by its younger and more liberal rivals, the local, though not the foreign, trade of the place is still of very considerable extent. Since the middle of the 19th century, indeed, much of it has run in the most questionable channels; the nefarious coolie traffic gradually increased in extent and in cruelty from about 1848 till it was prohibited in 1874, and much of the actual trade is more or less of the nature of smuggling. The commodities otherwise mostly dealt in are opium, tea, rice, oil, raw cotton, fish and silk. The total value of exports and imports was in 1876–1877 upwards of £1,536,000. In 1880 it had increased to £2,259,250, and in 1898 to £3,771,615. Commercial intercourse is most intimate with Hong-Kong, Canton, Batavia and Goa. The preparation and packing of tea is the principal industry in the town. In fishing a large number of boats and men are employed.

In 1557 the Portuguese were permitted to erect factories on the peninsula, and in 1573 the Chinese built across the isthmus the wall which still cuts off the barbarian from the rest of the island. Jesuit missionaries established themselves on the spot; and in 1580 Gregory XIII. constituted a bishopric of Macao. A senate was organized in 1583, and in 1628 Jeronimo de Silveira became first royal governor of Macao. Still the Portuguese remained largely under the control of the Chinese, who had never surrendered their territorial rights and maintained their authority by means of mandarins—these insisting that even European criminals should be placed in their hands. Ferreira do Amaral, the Portuguese governor, put an end to this state of things in 1849, and left the Chinese officials no more authority in the peninsula than the representatives of other foreign nations; and, though his antagonists procured his assassination (Aug. 22), his successors succeeded in carrying out his policy.

Although Macao is de facto a colonial possession of Portugal, the Chinese government persistently refused to recognize the claim of the Portuguese to territorial rights, alleging that they were merely lessees or tenants at will, and until 1849 the Portuguese paid to the Chinese an annual rent of £71 per annum. This diplomatic difficulty prevented the conclusion of a commercial treaty between China and Portugal for a long time, but an arrangement for a treaty was come to in 1887 on the following basis: (1) China confirmed perpetual occupation and government of Macao and its dependencies by Portugal; (2) Portugal engaged never to alienate Macao and its dependencies without the consent of China; (3) Portugal engaged to co-operate in opium revenue work at Macao in the same way as Great Britain at Hong-Kong. The formal treaty was signed in the same year, and arrangements were made whereby the Chinese imperial customs were able to collect duties on vessels trading with Macao in the same way as they had already arranged for their collection at the British colony of Hong-Kong. For a short time in 1802, and again in 1808, Macao was occupied by the English as a precaution against seizure by the French.

MACAQUE, a name of French origin denoting the monkeys of the mainly Asiatic genus *Macacus*, of which one species, the Barbary ape, inhabits North Africa and the rock of Gibraltar. Displaying great variability in the length of the tail, which is reduced to a mere tubercle in the Barbary ape, alone representing the subgenus *Inuus*, macaques are heavily-built monkeys, with longer muzzles than their compatriots the langurs (see PRIMATES), and large naked callosities on the buttocks. They range all over India and Ceylon, thence northward to Tibet, and eastwards to China, Japan, Formosa, Borneo, Sumatra and Java; while by some naturalists the black ape of Celebes (*Cynopithecus niger*) is included in the same genus. Mention of some of the more important species, typifying distinct sub-generic groups, made in the article PRIMATES. Like most other monkeys, macaques go about in large troops, each headed by an old male. They feed on seeds, fruits, insects, lizards, &c.; and while some of the species are largely terrestrial, the Barbary ape is wholly so. Docile and easily tamed when young, old males of many of the species become exceedingly morose and savage in captivity. (R. L.*)

MACARONI (from dialectic Ital. *maccare*, to bruise or crush), a preparation of a glutinous wheat originally peculiar to Italy, where it is an article of food of national importance. The same substance in different forms is also known as *vermicelli*, *pasta* or Italian pastes, *spaghetti*, *taglioni*, *fanti*, &c. These substances are prepared from the hard, semi-translucent varieties of wheat which are largely cultivated in the south of Europe, Algeria and other warm regions, and distinguished by the Italians as *grano duro* or *grano da semolino*. These wheats are much richer in gluten and other nitrogenous compounds than the soft or tender wheats of more northern regions, and their preparations are more easily preserved. The various preparations are met with as fine thin threads (vermicelli), thin sticks and pipes (spaghetti, macaroni), small lozenges, stars, disks, ellipses, &c. (pastes). These various forms are prepared in a uniform manner from a granular product of hard wheat, which, under the name of semolina or middlings, is a commercial article. The semolina is thoroughly mixed with boiling water and incorporated in a kneading machine, such as is used in bakeries, into a stiff paste or dough. It is then further kneaded by passing frequently between rollers or under edge runners, till a homogeneous mass has been produced which is placed in a strong steam-jacketed cylinder, the lower end of which is closed with a thick disk pierced with openings corresponding with the diameter or section of the article to be made. Into this cylinder an accurately fitting plunger or piston is introduced and subjected to very great pressure, which causes the stiff dough to squeeze out through the openings in the disk in continuous threads, sticks or pipes, as the case may be. Vermicelli is cut off in short bundles and laid on trays to dry, while macaroni is dried by hanging it in longer lengths over wooden rods in stoves or heated apartments through which currents of air are driven. It is only genuine macaroni, rich in gluten, which can be dried in this manner; spurious fabrications will not bear their own weight, and must, therefore, be laid out flat to be dried. In making pastes the cylinder is closed with a disk pierced with holes having the sectional form of the pastes, and a set of knives revolving close against the external surface of the disk cut off the paste in thin sections as it exudes from each opening. True macaroni can be distinguished by observing the flattened mark of the rod over which it has been dried within the bend of the tubes; it has a soft yellowish colour, is rough in texture, elastic and hard, and breaks with a smooth glassy fracture. In boiling it swells up to double its original size without becoming pasty or adhesive. It can be kept any length of time without alteration or deterioration; and it is on that account, in many circumstances, a most convenient as well as a highly nutritious and healthful article of food.

MACARONICS, a species of burlesque poetry, in which words from a modern vernacular, with Latin endings, are introduced into Latin verse, so as to produce a ridiculous effect. Sometimes Greek is used instead of Latin. Tisi degli Odassi issued a *Carmen macaronicum de Patavinis* in 1490. The real founder of the practice, however, was Teofilo Folengo (1491–1544), whose mock-heroic *Liber Macaronices* appeared in 1517. Folengo (*q.v.*) was a Benedictine monk, who escaped from his monastery and wandered through Italy, living a dissolute life, and supporting himself by his absurd verses, which he described as an attempt to produce in literature something like macaroni, a gross, rude and rustic mixture of flour, cheese and butter. He wrote under the pseudonym of Merlinus Coccaius, and his poem is an elaborate burlesque epic, in twenty-five books, or *macaronea*; it is an extraordinary medley of chivalrous feats, ridiculous and squalid adventures, and satirical allegory. Its effect upon the mind of Rabelais was so extraordinary that no examination of *Pantagruel* can be complete without a reference to it (cf. *Gargantua*, i. 19). It was immediately imitated in Italy by a number of minor poets; and in France a writer whose real name was Antoine de la Sablé, but who called himself Antonius de Arena (d. 1544), published at Avignon in 1573 a *Meygra entrepriza*, which was a burlesque account of Charles V.'s disastrous campaign in Provence. Folengo in Italy and Arena in France are considered as the macaronic classics. In the 17th century, Joannes Caecilius Frey (1580–1631) published a *Recitus veritabilis*, on a skirmish between the vine-growers of Rueil and the bowmen of Paris. Great popularity was achieved later still by an anonymous macaronic, entitled *Funestissimus trepassus Micheli Morini*, who died by falling off the branch of an elm-tree:—

> De branche in brancham degringolat, et faciens pouf
> Ex ormo cadit, et clunes obvertit Olympo.

Molière employed macaronic verse in the ceremonial scene with the doctors in *Le Malade imaginaire*. Works in macaronic prose are rarer. An *Anti-Clopinus* by Antony Hotman may be mentioned and the amusing *Epistolae obscurorum virorum* (1515). Macaronic prose was not unknown as an artifice of serious oratory, and abounds (*e.g.*) in the sermons of Michel Menot (1440–1518), who says of the prodigal son, *Emit sibi pulcheras caligas d'écarlate, bien tirées.*

The use of true macaronics has never been frequent in Great Britain, where the only prominent example of it is the *Polemo-Middinia* ascribed to William Drummond of Hawthornden. This short epic was probably composed early in the 17th century, but was not published until 1684. The *Polemo-Middinia* follows the example set by Arena, and describes with burlesque solemnity a quarrel between two villages on the Firth of Forth. Drummond shows great ingenuity in the tacking on of Latin terminations to his Lowland Scots vernacular:—

> Lifeguardamque sibi saevas vocat improba lassas,
> Maggaeam, magis doctam milkare cowaeas,
> Et doctam sweepare flooras, et sternere beddas,
> Quaeque novit spinnare, et longas ducere threedas.

There is a certain macaronic character about many poems of Skelton and Dunbar, as well as the famous *Barnabae itinerarium* (1638) of Richard Brathwait (1588–1673), but these cannot be considered legitimate specimens of the type as laid down by Folengo.

See Ch. Nodier, *Du Langage factice appelé macaronique* (1834); Genthe, *Histoire de la poésie macaronique* (1831). (E. G.)

MACARSCA (Serbo-Croatian, *Makarska*), the chief town of an administrative district in Dalmatia, Austria; situated opposite to the island of Brazza, about 32 m. S.E. of Spalato. Pop. (1900), of town 1805; of commune, 11,016, chiefly Serbo-Croatian. Macarsca is a port of call for the Austrian Lloyd steamers, and has a brisk trade in wine, grain and fruit. Under the name of *Mocrum*, Macarsca was a thriving Roman city, and a bishopric until 639, when it was destroyed by the Avars. In the 10th century it is mentioned by Constantine Porphyrogenitus as a city of the pagan Narentines. Its bishopric was revived in 1320, but the bishops resided at Almissa. In 1481 the city was purchased from the duke of Herzegovina by Venice; in 1499 it was conquered by the Turks; and in 1646, after a successful revolt, it again welcomed the sovereignty of Venice. The see of Macarsca was merged in that of Spalato in 1830.

MACARTNEY, GEORGE MACARTNEY, Earl (1737–1806), was descended from an old Scottish family, the Macartneys of Auchinleck, who had settled in 1649 at Lissanoure, Antrim, Ireland, where he was born on the 14th of May 1737. After graduating at Trinity College, Dublin, in 1759, he became a student of the Temple, London. Through Stephen Fox, elder brother of C. J. Fox, he was taken up by Lord Holland. Appointed envoy extraordinary to Russia in 1764, he succeeded in negotiating an alliance between England and that country. After occupying a seat in the English parliament, he was in 1769 returned for Antrim in the Irish parliament, in order to discharge the duties of chief secretary for Ireland. On resigning this office he was knighted. In 1775 he became governor of the Caribbee Islands (being created an Irish baron in 1776), and in 1780 governor of Madras, but he declined the governor-generalship of India, and returned to England in 1786. After being created Earl Macartney in the Irish peerage (1792), he was appointed the first envoy of Britain to China. On his return from a confidential mission to Italy (1795) he was raised to the English peerage as a baron in 1796, and in the end of the same year was appointed governor of the newly acquired territory of the Cape of Good Hope, where he remained till ill health compelled him to resign in November 1798. He died at Chiswick, Middlesex, on the 31st of May 1806, the title becoming extinct, and his property, after the death of his widow (daughter of the 3rd earl of Bute), going to his niece, whose son took the name.

An account of Macartney's embassy to China, by Sir George Staunton, was published in 1797, and has been frequently reprinted. The *Life and Writings of Lord Macartney*, by Sir John Barrow, appeared in 1807. See Mrs Helen Macartney Robbins's biography, *The First English Ambassador to China* (1908), based on previously unpublished materials in possession of the family.

MACASSAR (Makassar, Mangkasar), the capital of a district of the same name in the island of Celebes, Dutch East Indies, and the chief town of the Dutch government of Celebes. Pop. 17,925 (940 Europeans, 2618 Chinese, 168 Arabs). It stands on the west coast of the southern peninsula of the island, near the southern extremity of the Macassar Strait, which separates Celebes from Borneo. Macassar consists of the Dutch town and port, known as Vlaardingen, and the Malay town which lies inland. Macassar's trade amounts to about £1,250,000 annually, and consists mainly of coffee, trepang, copra, gums, spices and valuable timber.

For the Macassar people and for the Strait, see Celebes. "Macassar oil" is a trade name, not geographical: see Antimacassar.

MACAULAY, THOMAS BABINGTON MACAULAY, Baron (1800–1859), English historian, essayist and politician, was born at Rothley Temple, Leicestershire, on the 25th of October 1800. His father, Zachary Macaulay (1768–1838), had been governor of Sierra Leone, and was in 1800 secretary to the chartered company which had founded that colony; an ardent philanthropist, he did much to secure the abolition of the slave trade, and he edited the abolitionist organ, the *Christian Observer*, for many years. Happy in his home, the son at a very early age gave proof of a determined bent towards literature. Before he was eight years of age he had written a *Compendium of Universal History*, which gave a tolerably connected view of the leading events from the creation to 1800, and a romance in the style of Scott, in three cantos, called *The Battle of Cheviot*. A little later he composed a long poem on the history of Olaus Magnus, and a vast pile of blank verse entitled *Fingal, a Poem in Twelve Books*. After being at a private school, in October 1818 young Macaulay went to Trinity College, Cambridge, where he afterwards became a fellow. He gained in 1824 a college prize for an essay on the character of William III. He also won a prize for Latin declamation and a Craven scholarship, and wrote the prize poems of 1819 and 1821.

In 1826 Macaulay was called to the bar and joined the northern circuit. But he soon gave up even the pretence of reading law, and spent many more hours under the gallery of the house of commons than in the court. His first attempt at a public speech, made at an anti-slavery meeting in 1824, was described by the *Edinburgh Review* as "a display of eloquence of rare and matured excellence." His first considerable appearance in print was in No. 1 of Knight's *Quarterly Magazine*, a periodical which enjoyed a short but brilliant existence, and which was largely supported by Eton and Cambridge. In August 1825 began Macaulay's connexion with the periodical which was to prove the field of his literary reputation. The *Edinburgh Review* was at this time at the height of its power, not only as an organ of the growing opinion which leant towards reform, but as a literary tribunal from which there was no appeal. His essay on Milton (Aug. 1825), so crude that the author afterwards said that "it contained scarcely a paragraph such as his matured judgment approved," created for him at once a literary reputation which suffered no diminution to the last, a reputation which he established and confirmed, but which it would have been hardly possible to make more conspicuous. The publisher John Murray declared that it would be worth the copyright of *Childe Harold* to have Macaulay on the staff of the *Quarterly Review*; and Robert Hall, the orator, writhing with pain, and wellnigh worn out with disease, was discovered lying on the floor employed in learning by aid of grammar and dictionary enough Italian to enable him to verify the parallel between Milton and Dante.

This sudden blaze of popularity, kindled by a single essay, is partly to be explained by the dearth of literary criticism in England at that epoch. For, though a higher note had already been sounded by Hazlitt and Coleridge, it had not yet taken hold of the public mind, which was still satisfied with the feeble appreciations of the *Retrospective Review*, or the dashing and damnatory improvisation of Wilson in *Blackwood* or Jeffrey in the *Edinburgh*. Still, allowance being made for the barbarous partisanship of the established critical tribunals of the period, it seems surprising that a social success so signal should have been the consequence of a single article. The explanation is that the writer of the article on Milton was, unlike most authors, also a brilliant conversationalist. There has never been a period when an amusing talker has not been in great demand at London tables; but when Macaulay made his début witty conversation was studied and cultivated as it has ceased to be in the more busy age which has succeeded. At the university Macaulay had been recognized as pre-eminent for inexhaustible talk and genial companionship among a circle of such brilliant young men as Charles Austin, Romilly, Praed and Villiers. He now displayed these gifts on a wider theatre. Launched on the best that London had to give in the way of society, Macaulay accepted and enjoyed with all the zest of youth and a vigorous nature the opportunities opened for him. He was courted and admired by the most distinguished personages of the day. He was admitted at Holland House, where Lady Holland listened to him with deference, and scolded him with a circumspection which was in itself a compliment. Samuel Rogers spoke of him with friendliness and to him with affection. He was treated with almost fatherly kindness by "Conversation" Sharp.

Thus distinguished, and justifiably conscious of his great powers, Macaulay began to aspire to a political career. But the shadow of pecuniary trouble early began to fall upon his path. When he went to college his father believed himself to be worth £100,000. But commercial disaster overtook the house of Babington & Macaulay, and the son now saw himself compelled to work for his livelihood. His Trinity fellowship of £300 a year became of great consequence to him, but it expired in 1831; he could make at most £200 a year by writing; and a commissionership of bankruptcy, which was given him by Lord Lyndhurst in 1828, and which brought him in about £400 a year, was swept away, without compensation, by the ministry which came into power in 1830. Macaulay was reduced to such straits that he had to sell his Cambridge gold medal.

In February 1830 the doors of the House of Commons were opened to him through what was then called a "pocket borough." Lord Lansdowne, who had been struck by two articles on James Mill and the Utilitarians, which appeared in the *Edinburgh Review* in 1829, offered the author the seat at Calne. The offer was accompanied by the express assurance that the patron had no wish to interfere with Macaulay's freedom of voting. He thus entered parliament at one of the most exciting moments of English domestic history, when the compact phalanx of reactionary administration which for nearly fifty years had commanded a crushing majority in the Commons was on the point of being broken by the growing strength of the party of reform. Macaulay made his maiden speech on the 5th of April 1830, on the second reading of the Bill for the Removal of Jewish Disabilities. In July the king died and parliament was dissolved; the revolution took place in Paris. Macaulay, who was again returned for Calne, visited Paris, eagerly enjoying a first taste of foreign travel. On the 1st of March 1831 the Reform Bill was introduced, and on the second night of the debate Macaulay made the first of his reform speeches. It was, like all his speeches, a success. Sir Robert Peel said of it that "portions were as beautiful as anything I have ever heard or read."

Encouraged by this first success, Macaulay now threw himself with ardour into the life of the House of Commons, while at the same time he continued to enjoy to the full the social opportunities which his literary and political celebrity had placed within his reach. He dined out almost nightly, and spent many of his Sundays at the suburban villas of the Whig leaders, while he continued to supply the *Edinburgh Review* with articles. On the triumph of Earl Grey's cabinet, and the passing of the Reform Act in June 1832, Macaulay, whose eloquence had signalized every stage of the conflict, became one of the commissioners of the board of control, and applied himself to the study of Indian affairs. Giving his days to India and his nights to the House of Commons, he could only devote a few hours to literary composition by rising at five when the business of the house had allowed of his getting to bed in time on the previous evening. Between September 1831 and December 1833 he furnished the *Review* with eight important articles, besides writing his ballad on the Armada.

In the first Reform Parliament, January 1833, Macaulay took his seat as one of the two members for Leeds, which up to that date had been unrepresented in the House of Commons. He replied to O'Connell in the debate on the address, meeting the great agitator face to face, with high, but not intemperate, defiance. In July he defended the Government of India Bill in a speech of great power, and he was instrumental in getting the bill through committee without unnecessary friction. When the abolition of slavery came before the house as a practical question, Macaulay had the prospect of having to surrender office or to vote for a modified abolition, viz. twelve years' apprenticeship, which was proposed by the ministry, but condemned by the abolitionists. He was prepared to make the sacrifice of place rather than be unfaithful to the cause to which his father had devoted his life. He placed his resignation in Lord Althorp's hands, and spoke against the ministerial proposal. But the sense of the house was so strongly expressed as unfavourable that, finding they would be beaten if they persisted, the ministry gave way, and reduced apprenticeship to seven years, a compromise which the abolition party accepted; and Macaulay remained at the board of control.

While he was thus growing in reputation, and advancing his public credit, the fortunes of the family were sinking, and it became evident that his sisters would have no provision except such as their brother might be enabled to make for them. Macaulay had but two sources of income, both of them precarious—office and his pen. As to office, the Whigs could not have expected at that time to retain power for a whole generation; and, even while they did so, Macaulay's resolution that he would always give an independent vote made it possible that he might at any moment find himself in disagreement with his colleagues, and have to quit his place. As to literature, he wrote to Lord Lansdowne (1833), "it has been hitherto merely my relaxation; I have never considered it as the means of support. I have chosen my own topics, taken my own time, and dictated my own terms. The thought of becoming a bookseller's hack, of spurring a jaded fancy to reluctant exertion, of filling sheets with trash merely that sheets may be filled, of bearing from publishers and editors what Dryden bore from Tonson and what Mackintosh bore from Lardner, is horrible to me." Macaulay was thus prepared to accept the offer of a seat in the supreme council of India, created by the new India Act. The salary of the office was fixed at £10,000, out of which he calculated to be able to save £30,000 in five years. His sister Hannah accepted his proposal to accompany him, and in February 1834 the brother and sister sailed for Calcutta.

Macaulay's appointment to India occurred at the critical moment when the government of the company was being superseded by government by the Crown. His knowledge of India was, when he landed, but superficial. But at this juncture there was more need of statesmanship directed by general liberal principles than of a practical knowledge of the details of Indian administration. Macaulay's presence in the council was of great value; his minutes are models of good judgment and practical sagacity. The part he took in India has been described as "the application of sound liberal principles to a government which had till then been jealous, close and repressive." He vindicated the liberty of the press; he maintained the equality of Europeans and natives before the law; and as president of the committee of public instruction he inaugurated the system of national education.

A clause in the India Act 1833 occasioned the appointment of a commission to inquire into the jurisprudence of the Eastern dependency. Macaulay was appointed president of that commission. The draft of a penal code which he submitted became, after a revision of many years, and by the labour of many experienced lawyers, the Indian criminal code. Of this code Sir James Stephen said that "it reproduces in a concise and even beautiful form the spirit of the law of England, in a compass which by comparison with the original may be regarded as almost absurdly small. The Indian penal code is to the English criminal law what a manufactured article ready for use is to the materials out of which it is made. It is to the French code pénal, and to the German code of 1871, what a finished picture is to a sketch. It is simpler and better expressed than Livingston's code for Louisiana; and its practical success has been complete."

Macaulay's enlightened views and measures drew down on him, however, the abuse and ill-will of Anglo-Indian society. Fortunately for himself he was enabled to maintain a tranquil indifference to political detraction by withdrawing his thoughts into a sphere remote from the opposition and enmity by which he was surrounded. Even amid the excitement of his early parliamentary successes literature had balanced politics in his thoughts and interests. Now in his exile he began to feel more strongly each year the attraction of European letters and European history. He wrote to his friend Ellis: "I have gone back to Greek literature with a passion astonishing to myself. I have never felt anything like it. I was enraptured with Italian during the six months which I gave up to it; and I was little less pleased with Spanish. But when I went back to the Greek I felt as if I had never known before what intellectual enjoyment was." In thirteen months he read through, some of them twice, a large part of the Greek and Latin classics. The fascination of these studies produced their inevitable effect upon his view of political life. He began to wonder what strange infatuation leads men who can do something better to squander their intellect, their health and energy, on such subjects as those which most statesmen are engaged in pursuing. He was already, he says, "more than half determined to abandon politics and give myself wholly to letters, to undertake some great historical work, which may be at once the business and the amusement of my life, and to leave the pleasures of pestiferous rooms, sleepless nights, and diseased stomachs to Roebuck and to Praed."

In 1838 Macaulay and his sister Hannah, who had married Charles Trevelyan in 1834, returned to England. He at once entered parliament as member for Edinburgh. In 1839 he became secretary at war, with a seat in the cabinet in Lord Melbourne's ministry. His acceptance of office diverted him for a time from prosecuting the plan he had already formed of a great historical work. But in less than two years the Melbourne ministry fell. In 1842 appeared his *Lays of Ancient Rome*, and in the next year he collected and published his *Essays*. He returned to office in 1846, in Lord John Russell's administration, as paymaster-general. His duties were very light, and the contact with official life and the obligations of parliamentary attendance were even of benefit to him while he was engaged upon his *History*. In the sessions of 1846–1847 he spoke only five times, and at the general election of July 1847 he lost his seat for Edinburgh. The balance of Macaulay's faculties had now passed to the side of literature. At an earlier date he had relished crowds and the excitement of ever new faces; as years went forward, and absorption in the work of composition took off the edge of his spirits, he recoiled from publicity. He began to regard the prospect of business as worry, and had no longer the nerve to brace himself to the social efforts required of one who represents a large constituency.

Macaulay retired into private life, not only without regret, but with a sense of relief. He gradually withdrew from general society, feeling the bore of big dinners and country-house visits, but he still enjoyed close and constant intercourse with a circle of the most eminent men that London then contained. At that time social breakfasts were in vogue. Macaulay himself preferred this to any other form of entertainment. Of these brilliant reunions nothing has been preserved beyond the names of the men who formed them—Rogers, Hallam, Sydney Smith, Lord Carlisle, Lord Stanhope, Nassau Senior, Charles Greville, Milman, Panizzi, G. C. Lewis, Van de Weyer. His biographer thus describes Macaulay's appearance and bearing in conversation: "Sitting bolt upright, his hands resting on the arms of his chair, or folded over the handle of his walking-stick, knitting his eyebrows if the subject was one which had to be thought out as he went along, or brightening from the forehead downwards when a burst of humour was coming, his massive features and honest glance suited well with the manly sagacious sentiments which he set forth in his sonorous voice and in his racy and intelligible language. To get at his meaning people had never the need to think twice, and they certainly had seldom the time."

But, great as was his enjoyment of literary society and books, they only formed his recreation. In these years he was working with unflagging industry at the composition of his *History*. His composition was slow, his corrections both of matter and style endless; he spared no pains to ascertain the facts. He sacrificed to the prosecution of his task a political career, House of Commons fame, the allurements of society. The first two volumes of the *History of England* appeared in December 1848. The success was in every way complete beyond expectation. The sale of edition after edition, both in England and the United States, was enormous.

In 1852, when his party returned to office, he refused a seat in the cabinet, but he could not bring himself to decline the compliment of a voluntary amende which the city of Edinburgh paid him in returning him at the head of the poll at the general election in July of that year. He had hardly accepted the summons to return to parliamentary life before fatal weakness betrayed itself in deranged action of the heart; from this time forward till his death his strength continued steadily to sink. The process carried with it dejection of spirits as its inevitable attendant. The thought oppressed him that the great work to which he had devoted himself would remain a fragment. Once again, in June 1853, he spoke in parliament, and with effect, against the exclusion of the master of the rolls from the House of Commons, and at a later date in defence of competition for the Indian civil service. But he was aware that it was a grievous waste of his small stock of force, and that he made these efforts at the cost of more valuable work.

In November 1855 vols. iii. and iv. of the *History* appeared and obtained a vast circulation. Within a generation of its first appearance upwards of 140,000 copies of the *History* were printed and sold in the United Kingdom alone; and in the United States the sales were on a correspondingly large scale. The *History* was translated into German, Polish, Danish, Swedish, Hungarian, Russian, Bohemian, Italian, French, Dutch and Spanish. Flattering marks of respect were heaped upon the author by foreign academies. His pecuniary profits were (for that time) on a scale commensurate with the reputation of the book: the cheque he received for £20,000 has become a landmark in literary history.

In May 1856 he quitted the Albany, in which he had passed fifteen happy years, and went to live at Holly Lodge, Campden Hill, then, before it was enlarged, a tiny bachelor's dwelling, but with a lawn whose unbroken slope of verdure gave it the air of a considerable country house. In the following year (1857) he was raised to the peerage by the title of Baron Macaulay of Rothley. "It was," says Lady Trevelyan, "one of the few things that everybody approved; he enjoyed it himself, as he did everything, simply and cordially." It was a novelty in English life to see eminence which was neither that of territorial opulence nor of political or military services recognized and rewarded by elevation to the peerage.

But Macaulay's health, which had begun to give way in 1852, was every year visibly failing. In May 1858 he went to Cambridge for the purpose of being sworn in as high steward of the borough, to which office he had been elected on the death of Earl Fitzwilliam. When his health was given at a public breakfast in the town-hall he was obliged to excuse himself from speaking. In the upper house he never spoke. Absorbed in the prosecution of his historical work, he had grown indifferent to the party politics of his own day. Gradually he had to acquiesce in the conviction that, though his intellectual powers remained unimpaired, his physical energies would not carry him through the reign of Anne; and, though he brought down the narrative to the death of William III., the last half-volume wants the finish and completeness of the earlier portions. The winter of 1859 told on him, and he died on the 28th of December. On the 9th of January 1860 he was buried in Westminster Abbey, in Poets' Corner, near the statue of Addison.

Lord Macaulay never married. A man of warm domestic affections, he found their satisfaction in the attachment and close sympathy of his sister Hannah, the wife of Sir Charles Trevelyan. Her children were to him as his own. Macaulay was a steadfast friend, and no act inconsistent with the strictest honour and integrity was ever imputed to him. When a poor man, and when salary was of consequence to him, he twice resigned office rather than make compliances for which he would not have been severely blamed. In 1847, when his seat in parliament was at stake, he would not be persuaded to humour, to temporize, even to conciliate. He had a keen relish for the good things of life, and desired fortune as the means of obtaining them; but there was nothing mercenary or selfish in his nature. When he had raised himself to opulence, he gave away with an open hand, not seldom rashly. His very last act was to write a letter to a poor curate enclosing a cheque for £25. The purity of his morals was not associated with any tendency to cant.

The lives of men of letters are often records of sorrow or suffering. The life of Macaulay was eminently happy. Till the closing years (1857–1859), he enjoyed life with the full zest of healthy faculty, happy in social intercourse, happy in the solitude of his study, and equally divided between the two. For the last fifteen years of his life he lived for literature. His writings were remunerative to him far beyond the ordinary measure, yet he never wrote for money. He lived in his historical researches; his whole heart and interest were unreservedly given to the men and the times of whom he read and wrote. His command of literature was imperial. Beginning with a good classical foundation, he made himself familiar with the imaginative, and then with the historical, remains of Greece and Rome. He went on to add the literature of his own country, of France, of Italy, of Spain. He learnt Dutch enough for the purposes of his history. He read German, but for the literature of the northern nations he had no taste, and of the erudite labours of the Germans he had little knowledge and formed an inadequate estimate. The range of his survey of human things had other limitations more considerable still. All philosophical speculation was alien to his mind; nor did he seem aware of the degree in which such speculation had influenced the progress of humanity. A large—the largest—part of ecclesiastical history lay outside his historical view. Of art he confessed himself ignorant, and even refused a request to furnish a critique on Swift's poetry to the *Edinburgh Review*. Lessing's *Laocoon*, or Goethe's criticism on Hamlet, "filled" him "with wonder and despair."

Of the marvellous discoveries of science which were succeeding each other day by day he took no note; his pages contain no reference to them. It has been told already how he recoiled from the mathematical studies of his university. These deductions made, the circuit of his knowledge still remains very wide—as extensive perhaps as any human brain is competent to embrace. His literary outfit was as complete as has ever been possessed by any English writer; and, if it wants the illumination of philosophy, it has an equivalent resource in a practical acquaintance with affairs, with administration, with the interior of cabinets, and the humour of popular assemblies. Nor was the knowledge merely stored in his memory; it was always at his command. Whatever his subject, he pours over it his stream of illustration, drawn from the records of all ages and countries. His *Essays* are not merely instructive as history; they are, like Milton's blank verse, freighted with the spoils of all the ages. As an historian Macaulay has not escaped the charge of partisanship. He was a Whig; and in writing the history of the rise and triumph of Whig principles in the latter half of the 17th century he identified himself with the cause. But the charge of partiality, as urged against Macaulay, means more than that he wrote the history of the Whig revolution from the point of view of those who made it. When he is describing the merits of friends and the faults of enemies his pen knows no moderation. He has a constant tendency to glaring colours, to strong effects, and will always be striking violent blows. He is not merely exuberant but excessive. There is an overweening confidence about his tone; he expresses himself in trenchant phrases, which are like challenges to an opponent to stand up and deny them. His propositions have no qualifications. Uninstructed readers like this assurance, as they like a physician who has no doubt about their case. But a sense of distrust grows upon the more circumspect reader as he follows page after page of Macaulay's categorical affirmations about matters which our own experience of life teaches us to be of a contingent nature. We inevitably think of a saying attributed to Lord Melbourne: "I wish I were as cocksure of any one thing as Macaulay is of everything." Macaulay's was the mind of the advocate, not of the philosopher; it was the mind of Bossuet, which admits no doubts or reserves itself and tolerates none in others, and as such was disqualified from that equitable balancing of evidence which is the primary function of the historian.

Macaulay, the historian no less than the politician, is, however, always on the side of justice, fairness for the weak against the strong, the oppressed against the oppressor. But though a Liberal in practical politics, he had not the reformer's temperament. The world as it is was good enough for him. The glories of wealth, rank, honours, literary fame, the elements of vulgar happiness, made up his ideal of life. A successful man himself, every personage and every cause is judged by its success. "The brilliant Macaulay," says Emerson, "who expresses the tone of the English governing classes of the day, explicitly teaches that 'good' means good to eat, good to wear, material commodity." Macaulay is in accord with the average sentiment of orthodox and stereotyped humanity on the relative values of the objects and motives of human endeavour. And this commonplace materialism is one of the secrets of his popularity, and one of the qualities which guarantee that that popularity will be enduring. (M. P.)

Macaulay's whole works were collected in 1866 by his sister, Lady Trevelyan, in 8 vols. The first four volumes are occupied by the *History*; the next three contain the *Essays*, and the *Lives* which he contributed to the *Encyclopaedia Britannica*. In vol. viii. are collected his *Speeches*, the *Lays of Ancient Rome*, and some miscellaneous pieces. The "life" by Dean Milman, printed in vol. viii. of the edition of 1858–1862, is prefixed to the "People's Edition" (4 vols., 1863–1864). Messrs. Longmans, Green & Co. published a complete edition, the "Albany," in 12 vols., in 1898. There are numerous editions of the *Critical and Historical Essays*, separately and collectively; they were edited in 1903 by F. C. Montagu.

The Life and Letters of Lord Macaulay (2 vols., 1876), by his nephew, Sir George Otto Trevelyan, is one of the best biographies in the English language. The life (1882) in the "English Men of Letters" series was written by J. Cotter Morison. For further criticism, see Hepworth Dixon, in his *Life of Penn* (1841); John Paget, *The New Examen: Inquiry into Macaulay's History* (1861) and *Paradoxes and Puzzles* (1874); Walter Bagehot, in the *National Review* (Jan. 1856), reprinted in his *Literary Studies* (1879); James Spedding, *Evenings with a Reviewer* (1881), discussing his essay on Bacon; Sir L. Stephen, *Hours in a Library*, vol. ii. (1892); Lord Morley, *Critical Miscellanies* (1877), vol. ii.; Lord Avebury, *Essays and Addresses* (1903); Thum, *Anmerkungen zu Macaulay's History of England* (Heilbronn, 1882). A bibliography of German criticism of Macaulay is given in G. Körting's *Grd. der engl. Literatur* (4th ed., Münster, 1905).

MACAW, or, as formerly spelt, MACCAW, the name given to some fifteen or more species of large, long-tailed birds of the parrot-family, natives of the neotropical region, and forming a very well-known and easily recognized genus *Ara*, and to the four species of Brazilian Hyacinthine macaws of the genera *Anodorhynchus* and *Cyanopsittacus*. Most of the macaws are remarkable for their gaudy plumage, which exhibits the brightest scarlet, yellow, blue and green in varying proportion and often in violent contrast, while a white visage often adds a very peculiar and expressive character.[1] With one exception the known species of *Ara* inhabit the mainland of America from Paraguay to Mexico, being especially abundant in Bolivia, where no fewer than seven of them (or nearly one half) have been found (*Proc. Zool. Soc.*, 1879, p. 634). The single extra-continental species, *A. tricolor*, is one of the most brilliantly coloured, and is peculiar to Cuba, where, according to Gundlach (*Ornitologia Cubana*, p. 126), its numbers are rapidly decreasing so that there is every chance of its becoming extinct.[2]

Of the best known species of the group, the blue-and-yellow macaw, *A. ararauna*, has an extensive range in South America from Guiana in the east to Colombia in the west, and southwards to Paraguay. Of large size, it is to be seen in almost every zoological garden, and it is very frequently kept alive in private houses, for its temper is pretty good, and it will become strongly attached to those who tend it. Its richly coloured plumage, sufficiently indicated by its common English name, supplies feathers eagerly sought by salmon-fishers for the making of artificial flies. The red-and-blue macaw, *A. macao*, is even larger and more gorgeously clothed, for, besides the colours expressed in its ordinary appellation, yellow and green enter into its adornment. It inhabits Central as well as South America as far as Bolivia, and is also a common bird in captivity, though perhaps less often seen than the foregoing. The red-and-yellow species, *A. chloroptera*, ranging from Panama to Brazil, is smaller, or at least has a shorter tail, and is not quite so usually met with in menageries. The red-and-green, *A. militaris*, smaller again than the last, is not unfrequent in confinement, and presents the colours of the name it bears. This has the most northerly extension of habitat, occurring in Mexico and thence southwards to Bolivia. In *A. manilata* and *A. nobilis* the prevailing colour is green and blue. The Hyacinthine macaws *A. hyacinthinus*, *A. leari*, *A. glaucus* and *Cyanopsittacus spixi* are almost entirely blue.

The macaws live well in captivity, either chained to a perch or kept in large aviaries in which their strong flight is noticeable. The note of these birds is harsh and screaming. The sexes are alike; the lustreless white eggs are laid in hollow trees, usually two at a time. The birds are gregarious but apparently monogamous. (A. N.)

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[1] This serves to separate the macaws from the long-tailed parakeets of the New World (*Conurus*), to which they are very nearly allied.

[2] There is some reason to think that Jamaica may have formerly possessed a macaw (though no example is known to exist), and if so it was most likely a peculiar species. Sloane (*Voyage*, ii. 297), after describing what he calls the "great maccaw" (*A. ararauna*), which he had seen in captivity in that island, mentions the "small maccaw" as being very common in the woods there, and P. H. Gosse (*Birds of Jamaica*, p. 260) gives, on the authority of Robinson, a local naturalist of the last century, the description of a bird which cannot be reconciled with any species now known, though it must have evidently been allied to the Cuban *A. tricolor*.

MACBETH, king of Scotland (d. 1058), was the son of Findlaech, *mormaer* or hereditary ruler of Moreb (Moray and Ross), who had been murdered by his nephews in 1020. He probably became mormaer on the death of Malcolm, one of the murderers, in 1029, and he may have been one of the chiefs (the Maclbaethe of the *Saxon Chronicle*) who submitted to Canute in 1031. Marianus records that in 1040 Duncan, the grandson and successor of Malcolm king of Scotland, was slain by Macbeth. Duncan had shortly before suffered a severe defeat at the hands of Thorfinn, the Norwegian earl of Orkney and Caithness, and it was perhaps this event which tempted Macbeth to seize the throne. As far as is known he had no claim to the crown except through his wife Gruach, who appears to have been a member of the royal family. Macbeth was apparently a generous benefactor to the Church, and is said to have made a pilgrimage to Rome in 1050. According to S. Berchan his reign was a time of prosperity for Scotland. The records of the period, however, are extremely meagre, and much obscurity prevails, especially as to his relations with the powerful earl Thorfinn. More than one attempt was made by members of the Scottish royal family to recover the throne; in 1045 by Crinan, the lay abbot of Dunkeld, son-in-law of Malcolm II., and in 1054 by Duncan's son Malcolm with the assistance of Siward the powerful earl of Northumbria, himself a connexion of the ousted dynasty. Three years later in 1057 Malcolm and Siward again invaded Scotland and the campaign ended with the defeat and death of Macbeth, who was slain at Lumphanan. Macbeth is, of course, chiefly famous as the central figure of Shakespeare's great tragedy.

See W. F. Skene, *Chronicles of the Picts and Scots* (1867) and *Celtic Scotland* (1876); Sir John Rhys, *Celtic Britain* (1904).

MACCABEES, the name (in the plural) of a distinguished Jewish family dominant in Jerusalem in the 2nd century B.C. According to 1 Macc. ii. 4, the name Maccabaeus (Gr. Μακκαβαῖος—? Heb. מַקָּבִי) was originally the distinctive surname of Judas, third son of the Jewish priest Mattathias, who struck the first blow for religious liberty during the persecution under Antiochus IV. (Epiphanes). Subsequently, however, it obtained a wider significance, having been applied first to the kinsmen of Judas, then to his adherents, and ultimately to all champions of religion in the Greek period. Thus the mother of the seven brethren, whose martyrdom is related in 2 Macc. vi., vii., is called by early Christian writers "the mother of the Maccabees." The name is used still more loosely in the titles of the so-called Third, Fourth and Fifth Books of Maccabees. It is now customary to apply it only to the sons and descendants of Mattathias. As, however, according to Josephus (*Ant.* xii. 6. 1), this brave priest's great-great-grandfather was called *Ḥasmon* (*i.e.* "rich" = magnate; cf. Ps. lxviii. 31 [32]), the family is more correctly designated by the name of Hasmonaeans or Asmoneans (*q.v.*). This name Jewish authors naturally prefer to that of Maccabees; they also style 1 and 2 Macc. "Books of the Hasmonaeans."

If Maccabee (*maqqābi*) is the original form of the name, the most probable derivation is from the Aramaic *maqqābā* (Heb. מַקֶּבֶת, Judg. iv. 21, &c.) = "hammer." The surname "hammerer" might have been applied to Judas either as a distinctive title pure and simple or symbolically as in the parallel case of Edward I., "Scotorum *malleus*." Even if *māqqāba* does denote the ordinary workman's hammer, and not the great smith's hammer which would more fitly symbolize the impetuosity of Judas, this is not a fatal objection. The doubled *k* of the Greek form is decisive against (1) the theory that the name Maccabee was made up of the initials of the opening words of Exod. xv. 11; (2) the derivation from מַכְבִּי = "extinguisher" (cf. Isa. xliii. 17), based by Curtiss (*The Name Machabee*, Leipzig, 1876) on the Latin spelling Machabaeus = Μακκαβαῖος, which Jerome probably adopted in accordance with the usage of the times.

The Maccabaean revolt was caused by the attempt of Antiochus IV. (Epiphanes), king of Syria (175–164 B.C.), to force Hellenism upon Judaea (see Seleucid Dynasty; Hellenism). Ever since the campaigns of Alexander the Great, Greek habits and ideas had been widely adopted in Palestine. Over the higher classes especially Hellenism had cast its spell. This called forth the organized opposition of the Ḥasīdīm (= "the pious"), who constituted themselves champions of the Law. Joshua, who headed the Hellenistic faction, graecized his name into Jason, contrived to have the high-priesthood taken from his brother Onias III., and conferred upon himself, and set up a gymnasium hard by the Temple. After three years' tenure of office Jason was supplanted by the Benjamite Menelaus, who disowned Judaism entirely. Antiochus punished an outburst of strife between the rivals by plundering the Temple and slaying many of the inhabitants (170 B.C.). Two years later Jerusalem was devastated by his general Apollonius, and a Syrian garrison occupied the citadel (Akra). The Jews were ordered under pain of death to substitute for their own observances the Pagan rites prescribed for the empire generally. In December 168 sacrifice was offered to Zeus upon an idol altar ("the abomination of desolation," Dan. x. 27) erected over the great altar of burnt-offering. But Antiochus had miscalculated, and by his extreme measures unwittingly saved Judaism from its internal foes. Many hellenizers rallied round those who were minded to die rather than abjure their religion. The issue of an important edict ordaining the erection of heathen altars in every township of Palestine, and the appointment of officers to deal with recusants, brought matters to a crisis. At Modin, Mattathias, an aged priest, not only refused to offer the first sacrifice, but slew an apostate Jew who was about to step into the breach. He also killed the king's commissioner and pulled down the altar. Having thus given the signal for rebellion, he then with his five sons took to the mountains. In view of the ruthless slaughter of a thousand sabbatarians in the wilderness, Mattathias and his friends decided to resist attack even on the sabbath. Many, including the Ḥasīdīm, thereupon flocked to his standard, and set themselves to revive Jewish rites and to uproot Paganism from the land. In 166 Mattathias died, after charging his sons to give their lives for their ancestral faith, and nominating Judas Maccabaeus as their leader in the holy campaign.

The military genius of Judas made this the most stirring chapter in Israelitish history. In quick succession he overthrew the Syrian generals Apollonius, Seron and Gorgias, and after the regent Lysias had shared the same fate at his hands he restored the Temple worship (165). These exploits dismayed his opponents and kindled the enthusiasm of his friends. When, however, Lysias returned in force to renew the contest, Judas had to fall back upon the Temple mount, and escaped defeat only because the Syrian leader was obliged to hasten back to Antioch in order to prevent a rival from seizing the regency. Under these circumstances Lysias unexpectedly guaranteed to the Jews their religious freedom (162). But though they had thus gained their end, the struggle did not cease; it merely assumed a new phase. The Ḥasīdīm indeed were satisfied, and declined to fight longer, but the Maccabees determined not to desist until their nation was politically as well as religiously free. In 161 Judas defeated Nicanor at Adasa, but within a few weeks thereafter, in a heroic struggle against superior numbers under Bacchides at Elasa, he was himself cut off. Even this, however, did not prove fatal to the cause which Judas had espoused. If in his brother Jonathan it did not possess so brilliant a soldier, it had in him an astute diplomatist who knew how to exploit the internal troubles of Syria. In the contest between Demetrius I. and Alexander Balas for the throne, Jonathan supported the latter, who in 153 nominated him high priest, and conferred on him the order of "King's Friend," besides other honours. After the accession of Demetrius II. (145) Jonathan contrived to win his favour, and helped him to crush a rebellion in Antioch on condition that the Syrian garrisons should be withdrawn from Judaea. When, however, Demetrius failed to keep his word, Jonathan transferred his allegiance to Antiochus VI., whom Tryphon had crowned as king. After subjugating the territory between Jerusalem and Damascus, he routed the generals of Demetrius on the plain of Hazor. But as the Maccabees had now in the name of the Syrians cleared the Syrians out of Palestine, Tryphon's jealousy was aroused, and he resolved to be rid of Jonathan, who, with all his cunning, walked into a trap at Ptolemais, was made prisoner and ultimately slain (143). The leadership now devolved upon Simon, the last survivor of the sons of Mattathias. He soon got the better of Tryphon, who vainly tried to reach Jerusalem. Allying himself to Demetrius, Simon succeeded in negotiating a treaty whereby the political independence of Judaea was at length secured. The garrison in the Akra having been starved into submission, Simon triumphantly entered that fortress in May 142. In the following year he was by popular decree invested with absolute powers, being appointed leader, high priest and ethnarch. As these offices were declared hereditary in his family, he became the founder of the Hasmonaean dynasty. The first year of his reign (Seleucid year 170 = 143–142 B.C.) was made the beginning of a new era, and the issue of a Jewish coinage betokened the independence of his sovereignty. Under Simon's administration the country enjoyed signal prosperity. Its internal resources were assiduously developed; trade, agriculture, civic justice and religion were fostered; while at no epoch in its post-exilic history did Israel enjoy an equal measure of social happiness (1 Macc. xiv. 4 seq.). Simon's beneficent activities came, however, to a sudden and tragic end. In 135 he and two of his sons were murdered by Ptolemy his son-in-law, who had an eye to the supreme power. But Simon's third son, John Hyrcanus, warned in time, succeeded in asserting his rights as hereditary head of the state. All the sons of Mattathias had now died for the sake of "The Law"; and the result of their work, so valorously prosecuted for over thirty years, was a new-born enthusiasm in Israel for the ancestral faith. The Maccabaean struggle thus gave fresh life to the Jewish nation.

After the death of Antiochus VII. Sidetes in 128 left him a free hand, Hyrcanus (135–105) soon carved out for himself a large and prosperous kingdom, which, however, was rent by internal discord owing to the antagonism developed between the rival parties of the Pharisees and Sadducees. Hyrcanus was succeeded by his son Aristobulus, whose reign of but one year was followed by that of his brother, the warlike Alexander Jannaeus (104–78). The new king's Sadducean proclivities rendered him odious to the populace, which rose in revolt, but only to bring upon itself a savage revenge. The accession of his widow Salome Alexandra (78–69) witnessed a complete reversal of the policy pursued by Jannaeus, for she chose to rule in accordance with the ideals of the Pharisees. Her elder son, Hyrcanus II., a pliable weakling, was appointed high priest; her younger son, the energetic Aristobulus, who chafed at his exclusion from office, seized some twenty strongholds and with an army bore down upon Jerusalem. At this crisis Alexandra died, and Hyrcanus agreed to retire in favour of his masterful brother. A new and disturbing element now entered into Jewish politics in the person of the Idumaean Antipater, who for selfish ends deliberately made mischief between the brothers. An appeal to M. Aemilius Scaurus, who in 65 came into Syria as the legate of Pompey, led to the interference of the Romans, the siege of Jerusalem by Pompey, and the vassalage of the Jews (*q.v.*). Hyrcanus II. was appointed high priest and ethnarch, without the title of king (63). Repeated but fruitless attempts were made by the Hasmonaeans and their patriotic supporters to throw off the Roman yoke. In 47 Antipater, who curried favour with Rome, was made procurator of Judaea, and his sons Phasael and Herod governors of Jerusalem and Galilee respectively. Six years later the Idumaean brothers were appointed tetrarchs of Judaea. At length, in 40, the Parthians set up as king Antigonus, sole surviving son of Aristobulus. Thereupon Phasael committed suicide in prison, but Herod effected his escape and with the help of the Romans seated himself on the throne of Judaea (37 B.C.). Through the execution of Antigonus by M. Antonius (Mark Antony) the same year the Hasmonaean dynasty became extinct.

LITERATURE.—1 and 2 Macc. and Josephus are the main sources for the Maccabaean history. For references in classical authors see E. Schürer, *Geschichte des jüdischen Volkes* (1901, p 106 seq.). Besides the numerous modern histories of Israel (*e.g.* those by Dérenbourg, Ewald, Stanley, Stade, Renan, Schürer, Kent, Wellhausen, Guthe), see also Madden, *Coins of the Jews* (1881), H. Weiss's *Judas Makkabaeus* (1897), and the articles in the *Ency. Bib.*, Hastings's *Dict. Bible*, the *Jewish Encyclopedia*. Among more popular sketches are Moss's *From Malachi to Matthew* (1893); Streanes' *The Age of the Maccabees* (1898); Morrison's *The Jews under Roman Rule* ("Story of the Nations" series); W. Fairweather's *From the Exile to the Advent* (1901); E. R. Bevan's *Jerusalem under the High Priests* (1904); F. Henderson's *The Age of the Maccabees* (1907); also articles JEWS; SELEUCID DYNASTY. (W. F.*)

MACCABEES, BOOKS OF, the name given to several Apocryphal books of the Old Testament. The Vulgate contains two books of Maccabees which were declared canonical by the council of Trent (1546) and found a place among the Apocrypha of the English Bible. Three other books of this name are extant. Book iii. is included in the Septuagint but not in the Vulgate. Book iv. is embraced in the Alexandrian, Sinaitic, and other MSS. of the Septuagint, as well as in some MSS. of Josephus. A "Fifth" book is contained in the Ambrosian Peshitta, but it seems to be merely a Syriac reproduction of the sixth book of Josephus's history of the *Jewish War*. None of the books of Maccabees are contained in the Vatican (B); all of them are found in a Syriac recension.

1 Maccabees was originally written in Hebrew, but is preserved only in a Greek translation. Origen gives a transliteration of "its semitic title,"[1] and Jerome says distinctly: "The First Book of Maccabees I found in Hebrew." The frequent Hebraisms which mark the Greek translation, as well as the fact that some obscure passages in the Greek text are best accounted for as mistranslations from the Hebrew, afford internal evidence of the truth of this testimony. There are good reasons for regarding the book as a unity, although some scholars (Destinon, followed by Wellhausen) consider the concluding chapters (xiii.–xvi.) a later addition unknown to Josephus, who, however, seems to have already used the Greek. It probably dates from about the beginning of the first century B.C.[2]

As it supplies a detailed and accurate record of the forty years from the accession of Antiochus Epiphanes to the death of Simon (175–135 B.C.), without doubt the most stirring chapter in Jewish history, the book is one of the most precious historical sources we possess. In its careful chronology, based upon the Seleucid era, in the minuteness of its geographical knowledge, in the frankness with which it records defeat as well as victory, on the restraint with which it speaks of the enemies of the Jews, in its command of details, it bears on its face the stamp of genuineness. Not that it is wholly free from error or exaggeration, but its mistakes are due merely to defective knowledge of the outside world, and its overstatements, virtually confined to the matter of numbers, proceed from a patriotic desire to magnify Jewish victories. While the author presumably had some written sources at his disposal,[3] his narrative is probably for the most part founded upon personal knowledge and recollection of the events recorded, and upon such first-hand information as, living in the second generation after, he would still be in a position to obtain. His sole aim is honestly to relate what he knew of the glorious struggles of his nation.

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[1] Σαρβὴθ Σαβαναιέλ (Sarbēth Sabanaiel). No satisfactory explanation of this title has yet been given from the Hebrew (see the commentaries). The book may, however, have been known to Origen only in an Aramaic translation, in which case, according to the happy conjecture of Dalman (*Gramm.* 6) the two words may have represented the Aramaic ספר ביה חשמונאי ("book of the Hasmonaean house").

[2] If the book is a unity, ch. xvi. 23 implies that it was written after the death of Hyrcanus which occurred in 105 B.C. On the other hand the friendly references to Rome in ch. viii. show that it must have been written before the siege of Jerusalem by Pompey in 63 B.C.

[3] Cf. ix. 22, xi. 37, xiv. 18, 27.

Although written in the style of the historical books of the old Testament, the work is characterized by a religious reticence which avoids even the use of the divine name, and by the virtual absence of the Messianic hope. The observance of the law is strongly urged, and the cessation of prophecy deplored (iv. 46; xiv. 41). There is no allusion either to the immortality of the soul or to the resurrection of the dead. The rewards to which the dying Mattathias points his sons are all for this life. Many scholars are of opinion that the unknown author was a Sadducee,[1] but all that can be said with certainty is that he was a Palestinian Jew devotedly attached to the national cause.

Until the council of Trent 1 Maccabees had only "ecclesiastical" rank, and although not accepted as canonical by the Protestant churches, it has always been held in high estimation. Luther says "it closely resembles the rest of the books of Holy Scripture, and would not be unworthy to be enumerated with them."

2 Maccabees, the epitome of a larger work in five books by one Jason of Cyrene, deals with the same history as its predecessor, except that it begins at a point one year earlier (176 B.C.), and stops short at the death of Nicanor (161 B.C.), thus covering a period of only fifteen years. First of all[2] the writer describes the futile attempt of Heliodorus to rob the Temple, and the malicious intrigues of the Benjamite Simon against the worthy high priest Onias III. (iii. 1–iv. 6). As throwing light upon the situation prior to the Maccabaean revolt this section of the book is of especial value. Chapters iv. 7–vii. 42 contain a more detailed narrative of the events recorded in 1 Macc. i. 10–64. The remainder of the book runs parallel to 1 Macc. iii.–vii.

Originally written in excellent Greek, from a pronouncedly Pharisaic standpoint, it was possibly directed against the Hasmonaean dynasty. It shows no sympathy with the priestly class. Both in trustworthiness and in style it is inferior to 1 Macc. Besides being highly coloured, the narrative does not observe strict chronological sequence. Instead of the sober annalistic style of the earlier historian we have a work marked by hyperbole, inflated rhetoric and homiletic reflection. Bitter invective is heaped upon the national enemies, and strong predilection is shown for the marvellous. The fullness and inaccuracy of detail which are a feature of the book suggest that Jason's information was derived from the recollections of eye-witnesses orally communicated. In spite of its obvious defects, however, it forms a useful supplement to the first book.

The writer's interests are religious rather than historical. In 1 Macc. there is a keen sense of the part to be played by the Jews themselves, of the necessity of employing their own skill and valour; here they are made to rely rather upon divine intervention. Fantastic apparitions of angelic and supernatural beings, gorgeously arrayed and mostly upon horseback, are frequently introduced. In general, the views reflected in the book are those of the Pharisees. The ungodly will be punished mercilessly, and in exact correspondence to their sins.[3] The chastisements of erring Jews are of short duration, and intended to recall them to duty. If the faithful suffer martyrdom, it is in order to serve as an example to others, and they shall be compensated by being raised up "unto an eternal renewal of life." The eschatology of 2 Macc. is singularly advanced, for it combines the doctrine of a resurrection with that of immortality. It is worthy of note that the Roman Church finds support in this book for its teaching with reference to prayers for the dead and purgatory (xii. 43 seq.). An allusion to Jeremiah as "he who prayeth much for the people and the holy city" (xv. 14) it likewise appeals to as favouring its views respecting the intercession of the saints.

Neither of Jason's work, nor of the epitomizer's, can the precise date be determined. The changed relations with Rome (viii. 10, 36) prove, however, that the latter was written later than 1 Macc.; and it is equally clear that it was composed before the destruction of Jerusalem, A.D. 70.

The account given of the martyrs in chs. vi. and vii. led to frequent allusions to this book in early patristic literature. Only Augustine, however, was minded to give it the canonical rank to which it has been raised by the Roman Church. Luther judged of it as unfavourably as he judged of 1 Macc. favourably, and even "wished it had never existed."

3 Maccabees, although purporting to be an historical narrative, is really an animated, if somewhat vapid, piece of fiction written in Greek somewhere between 100 B.C. and A.D. 70,[4] and apparently preserved only in part.[5] It has no connexion with the Hasmonaeans, but is a story of the deliverance experienced by the Egyptian Jews from impending martyrdom at the hands of Ptolemy IV. Philopator, who reigned in the century previous to the Maccabaean rising (222–205 B.C.). The title is of later origin, and rendered possible only by the generalization of the name Maccabee so as to embrace all who suffered for the ancestral faith. Josephus refers the legend on which it is based to the time of Ptolemy VII. Physcon (146–117 B.C.). Some scholars (Ewald, Reuss, Hausrath) think that what the story really points to is the persecution under Caligula, but in that case Ptolemy would naturally have been represented as claiming divine honours. No other source informs us of a visit to Jerusalem, or of a persecution of the Jews, on the part of Philopator. Possibly, however, the story may be founded on some historical situation regarding which we have no definite knowledge. The purpose of the writer was evidently to cheer his Egyptian brethren during some persecution at Alexandria. Although the book was favourably regarded in the Syrian, it was apparently unknown to the Latin Church. Among the Jews it was virtually ignored.

Briefly, the tale is as follows:—After the battle of Raphia[6] (217 B.C.), Ptolemy IV. Philopator insisted on entering the sanctuary at Jerusalem, but was struck down by the Almighty in answer to the prayers of the horrified Jews. On his return to Egypt he revenged himself by curtailing the religious liberty of the Alexandrian Jews, and by depriving of their civic rights all who refused to worship Bacchus. Exasperated by their loyalty to their religion, the king ordered all the Jews in Egypt to be imprisoned in the hippodrome of Alexandria. Clerks were told off to prepare a list of the prisoners' names, but after forty days constant toil they had exhausted their writing materials without finishing their task. Ptolemy further commanded that 500 elephants should be intoxicated and let loose upon the occupants of the racecourse. Only an accident prevented the carrying out of this design; the king had slept until it was past the time for his principal meal. On the following day, in virtue of a divinely induced forgetfulness, Ptolemy recollected nothing but the loyalty of the Jews to his throne. The same evening, nevertheless, he repeated his order for their destruction. Accordingly, on the morning of the third day, when the king attended to see his commands executed, things had reached a crisis. The Jews prayed to the Lord for mercy, and two angels appeared from heaven, to the confusion of the royal troops, who were trampled down by the elephants. Ptolemy now vented his wrath upon his counsellors, liberated the Jews, and feasted them for seven days. They determined that these should be kept as festal days henceforth in commemoration of their deliverance. The provincial governors were enjoined to take the Jews under their protection, and leave was given to the latter to slay those of their kinsmen who had deserted the faith. They further celebrated their deliverance at Ptolemais, where they built a synagogue, and they reached their various abodes to find themselves not only reinstated in their possessions, but raised in the esteem of the Egyptians.

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[1] See especially Geiger, *Urschrift und Uebersetzungen der Bibel*, 206 seq.

[2] Prefixed to the book are two spurious letters from Palestinian Jews (i., ii. 18), having no real connexion with it, or even with one another, further than that they both urge Egyptian Jews to observe the Feast of the Dedication. Between these and the main narrative is inserted the writer's own preface, in which he explains the source and aim of his work (ii. 19–32).

[3] iv. 38, 42; v. 9 seq.; ix. 5–18.

[4] The date of composition can be only approximately determined. As the writer is acquainted with the Greek additions to Daniel (vi. 6), the first century B.C. forms the superior limit; and as the book found favour in the Eastern Church, the first century A.D. forms the inferior limit.

[5] Apart from its abrupt commencement, the references in i. 2 to "the plot" as something already specified, and in ii. 25 to the king's "before-mentioned" companions, of whom, however, nothing is said in the previous section of the book, point to the loss of at least an introductory chapter.

[6] The statements with reference to the war between Antiochus the Great and Ptolemy Philopator are in general agreement with those of the classical historians, and to this extent the tale may be said to have an historical setting. By Grimm (*Einl.* § 3), the observance of the two yearly festivals (vi. 26; vii. 19), and the existence of the synagogue at Ptolemais when the book was written, are viewed as the witness of tradition to the fact of some great deliverance. Fritzsche has well pointed out, however (art. "Makkabäer" in Schenkel's *Bibel-Lexicon*) that in the hands of Jewish writers of the period nearly every event of consequence has a festival attached to it.

4 Maccabees differs essentially from the other books of this name. While it does not itself aim at being a history, it makes striking use of Jewish history for purposes of edification. It bears, moreover, a distinctly philosophical character, and takes the form of a "tractate" or discourse, addressed to Jews only,[1] upon "the supremacy of pious reason over the passions."[2] The material is well arranged and systematically handled. In the prologue (i. 1–12) the writer explains the aim and scope of his work. Then follows the first main division (i. 13–iii. 18), in which he treats philosophically the proposition that reason is the mistress of the passions, inquiring what is meant by "reason" and what by "passion," as well as how many kinds of passion there are, and whether reason rules them all. The conclusion reached is that with the exception of forgetfulness and ignorance all the affections are under the lordship of reason, or at all events of *pious* reason. To follow the dictates of pious reason in opposition to natural inclination is to have learned the secret of victory over the passions. In the second part of the book (iii. 19–xviii. 5) the writer goes on to prove his thesis from Jewish history, dwelling in particular upon the noble stand made against the tyranny of Antiochus IV. Epiphanes by the priest Eleazar, the seven brothers and their mother—all of whom chose torture and death rather than apostatize from the faith. Finally he appeals to his readers to emulate these acts of piety (xvii. 7–xviii. 24). In his gruesome descriptions of physical sufferings the author offends against good taste even more than the writer of 2 Macc., while both contrast very unfavourably in this respect with the sober reserve of the gospel narratives.

The book is written in a cultured, if somewhat rhetorical, Greek style, and is unmistakably coloured by the Stoic philosophy. The four cardinal virtues are represented as forms of wisdom, which again is inseparable from the Mosaic law. That the writer owes no slavish adherence to any philosophical system is plain from his independent treatment of the affections. Although influenced by Hellenism, he is a loyal Jew, earnestly desirous that all who profess the same faith should adhere to it in spite of either Greek allurements or barbaric persecution. It is not to reason as such, but only to pious reason (*i.e.* to reason enlightened and controlled by the divine law), that he attributes lordship over the passions. While in his zeal for legalism he virtually adopts the standpoint of Pharisaism, he is at one with Jewish Hellenism in substituting belief in the soul's immortality for the doctrine of a bodily resurrection.

The name of the author is unknown. He was, however, clearly a Hellenistic Jew, probably resident in Alexandria or Asia Minor. In the early Church the work was commonly ascribed to Josephus and incorporated with his writings. But apart from the fact that it is found also in several MSS. of the Septuagint, the language and style of the book are incompatible with his authorship. So also is the circumstance that 2 Macc., which forms the basis of 4 Macc., was unknown to Josephus. Moreover, several unhistorical statements (such as, *e.g.* that Seleucus was succeeded by his *son* Antiochus Epiphanes, iv. 15) militate against the view that Josephus was the author. The date of composition cannot be definitely fixed. It is, however, safe to say that the book must have been written later than 2 Macc., and (in view of the acceptance it met with in the Christian Church) prior to the destruction of Jerusalem. Most likely it is a product of the Herodian period.

5 Maccabees. Writing in 1566 Sixtus Senensis mentions having seen at Lyons a manuscript of a so-called "Fifth Book of Maccabees" in the library of Santas Pagninus, which was soon afterwards destroyed by fire. It began with the words: "After the murder of Simon, John his son became high priest in his stead." Sixtus conjectures that it may have been a Greek translation of the "chronicles" of John Hyrcanus, alluded to in 1 Macc. xvi. 24. He acknowledges that it is a history of Hyrcanus practically on the lines of Josephus, but concludes from its Hebraistic style that it was not from that writer's pen. The probability, however, is that it was "simply a reproduction of Josephus, the style being changed perhaps for a purpose" (Schürer).

The Arabic "Book of Maccabees" contained in the Paris and London Polyglotts, and purporting to be a history of the Jews from the affair of Heliodorus (186 B.C.) to the close of Herod's reign, is historically worthless, being nothing but a compilation from 1 and 2 Macc. and Josephus. In the one chapter (xii.) where the writer ventures to detach himself from these works he commits glaring historical blunders. The book was written in somewhat Hebraistic Greek subsequent to A.D. 70. In Cotton's English translation of *The Five Books of Maccabees* it is this book that is reckoned the "Fifth."

The best modern editions of the Greek text of the four books of Maccabees are those of O. F. Fritzsche (1871) and H. B. Swete (Cambridge Septuagint, vol. iii., 1894). C. J. Ball's *The Variorum Apocrypha* will be found specially useful by those who cannot conveniently consult the Greek. The best modern commentary is that of C. L. W. Grimm (1853–1857). C. F. Keil's commentary on 1 and 2 Macc. is very largely indebted to Grimm. More recently there have appeared commentaries by E. C. Bissell on 1, 2 and 3 Macc. in Lange-Schaff's commentary, 1880—the whole Apocrypha being embraced in one volume, and much of the material being transferred from Grimm; G. Rawlinson on 1 and 2 Macc. in the *Speaker's Commentary* 1888 (containing much useful matter, but marred by too frequent inaccuracy); O. Zöckler, on 1, 2 and 3 Macc., 1891 (slight and unsatisfactory); W. Fairweather and J. S. Black on 1 Macc. in the *Cambridge Bible for Schools* (1897); E. Kautzsch on 1 and 3 Macc., A. Kamphausen on 2 Macc. and A. Deissmann on 4 Macc. in *Die Apok. u. Pseudepigr. des Alt. Test.*, 1898 (a most serviceable work for the student of apocryphal literature). Brief but useful introductions to all the four books of Maccabees are given in E. Schürer's *Geschichte des Jüdischen Volkes im Zeitalter Jesu Christi* (3rd ed., 1898–1901; Eng. tr. of earlier edition, 1886–1890). (W. F.*)

MacCARTHY, DENIS FLORENCE (1817–1882), Irish poet, was born in Dublin on the 26th of May 1817, and educated there and at Maynooth. His earlier verses appeared in *The Dublin Satirist*, and in 1843 he became a regular contributor of political verse to the recently founded *Nation.* He also took an active part in the Irish political associations. In 1846 he edited *The Poets and Dramatists of Ireland* and the *Book of Irish Ballads.* His collected *Ballads, Poems and Lyrics* (1850), including translations from nearly all the modern languages, took immensely with his countrymen on account of their patriotic ring. This was followed by *The Bellfounder* (1857), *Under-glimpses* and other poems (1857) and *The Early Life of Shelley* (1871). In 1853 he began a number of translations from the Spanish of Calderon's dramas, which won for him a medal from the Royal Spanish Academy. He had already been granted a civil list pension for his literary services. He died in Ireland on the 7th of April 1882.

M'CARTHY, JUSTIN (1830–), Irish politician, historian and novelist, was born in Cork on the 22nd of November 1830, and was educated at a school in that town. He began his career as a journalist, at the age of eighteen, in Cork. From 1853 to 1859 he was in Liverpool, on the staff of the *Northern Daily Times*, during which period he married (in March 1855) Miss Charlotte Allman. In 1860 he removed to London, as parliamentary reporter to the *Morning Star*, of which he became editor in 1864.

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[1] Even if with Freudenthal we regard the work as a homily actually delivered to a Jewish congregation—and there are difficulties in the way of this theory, particularly the absence of a Biblical text—it was clearly intended for publication. It is essentially a book in the form of a discourse, whether it was ever orally delivered or not. So Deissmann in Kautzsch, *Die Apok. u. Pseudepigr. des A. T.* ii. 151.

[2] Hence the title sometimes given to it: αὐτοκράτορος λογισμοῦ ("On the supremacy of reason"). It is also styled Μακκαβαίων δʹ, Μακκαβαϊκόν, εἰς τοὺς Μακκαβαίους.

He gave up his post in 1868, and, after a lecturing tour in the United States, joined the staff of the *Daily News* as leader-writer in 1870. In this capacity he became one of the most useful and respected upholders of the Liberal politics of the time. He lectured again in America in 1870–1871, and again in 1886–1887. He represented Co. Longford in Parliament as a Liberal and Home Ruler from 1879 to 1885; North Longford, 1885–1886; Londonderry, 1886–1892; and North Longford from 1892 to 1900. He was chairman of the Anti-Parnellites from the fall of C. S. Parnell in 1890 until January 1896; but his Nationalism was of a temperate and orderly kind, and though his personal distinction singled him out for the chairmanship during the party dissensions of this period, he was in no active sense the political leader. His real bent was towards literature. His earliest publications were novels, some of which, such as *A Fair Saxon* (1873), *Dear Lady Disdain* (1875), *Miss Misanthrope* (1878), *Donna Quixote* (1879), attained considerable popularity. His most important work is his *History of Our Own Times* (vols. i.–iv., 1879–1880; vol. v., 1897), which treats of the period between Queen Victoria's accession and her diamond jubilee. Easily and delightfully written, and on the whole eminently sane and moderate, these volumes form a brilliant piece of narrative from a Liberal standpoint. He also began a *History of the Four Georges* (1884–1901), of which the latter half was written by his son, Justin Huntly M'Carthy (b. 1860), himself the author of various clever novels, plays, poetical pieces and short histories. Justin M'Carthy, amongst other works, wrote biographies of Sir Robert Peel (1891), Pope Leo XIII. (1896) and W. E. Gladstone (1898); *Modern England* (1898); *The Reign of Queen Anne* (1902) and *Reminiscences* (2 vols., 1899).

McCHEYNE, ROBERT MURRAY (1813–1843), Scottish divine, was born at Edinburgh on the 21st of May 1813, was educated at the University and at the Divinity Hall of his native city, and held pastorates at Larbert, near Falkirk, and Dundee. A mission of inquiry among the Jews throughout Europe and in Palestine, and a religious revival at his church in Dundee, made him feel that he was being called to evangelistic rather than to pastoral work, but before he could carry out his plans he died, on the 25th of March 1843. McCheyne, though wielding remarkable influence in his lifetime, was still more powerful afterwards, through his *Memoirs and Remains*, edited by Andrew Bonar, which ran into far over a hundred English editions. Some of his hymns, *e.g.* "When this passing world is done," are well known.

See his *Life*, by J. C. Smith (1910).

McCLELLAN, GEORGE BRINTON (1826–1885), American soldier, was born in Philadelphia on the 3rd of December 1826. After passing two years (1840–1842) in the university of Pennsylvania, he entered the United States military academy, from which he graduated with high honours in July 1846. Sent as a lieutenant of engineers to the Mexican War, he took part in the battles under General Scott, and by his gallantry won the brevets of first-lieutenant at Contreras-Churubusco and captain at Chapultepec; he was afterwards detailed as assistant-instructor at West Point, and employed in explorations in the South-West and in Oregon. Promoted in 1855 captain of cavalry, he served on a military commission sent to Europe to study European armies and especially the war in the Crimea. On his return he furnished an able and interesting report, republished (1861) under the title of *Armies of Europe.* In 1856 he designed a saddle, which was afterwards well known as the McClellan. Resigning his commission in 1857, McClellan became successively chief engineer and vice-president of the Illinois Central railroad (1857–1860), general superintendent of the Mississippi & Ohio railroad, and, a little later, president of the eastern branch of the same, with his residence in Cincinnati. When the Civil War broke out he was, in April 1861, made major-general of three months' militia by the governor of Ohio; but General Scott's favour at Washington promoted him rapidly (May 14) to the rank of major-general, U.S.A., in command of the department of the Ohio. Pursuant to orders, on the 26th of May, McClellan sent a small force across the Ohio river to Philippi, dispersed the Confederates there early in June, and immensely aided the Union cause in that region by rapid and brilliant military successes, gained in the short space of eight days. These operations, though comparatively trivial as the Civil War developed, brought great results, in permanently dividing old Virginia by the creation of the state of West Virginia, and in presenting the first sharp, short and wholly successful campaign of the war.

Soon after the first Bull Run disaster he was summoned to Washington, and the Union hailed him as chieftain and preserver. Only thirty-four years old, and with military fame and promotion premature and quite in excess of positive experience, he reached the capital late in July and assumed command there. At first all was deference and compliance with his wishes. In November Scott retired that the young general might control the operations of the whole Union army. McClellan proved himself extraordinarily able as an organizer and trainer of soldiers. During the autumn, winter and spring he created the famous Army of the Potomac, which in victory and defeat retained to the end the impress of McClellan's work. But he soon showed petulance towards the civil authorities, from whom he came to differ concerning the political ends in view; and he now found severe critics, who doubted his capacity for directing an offensive war; but the government yielded to his plans for an oblique, instead of a direct, movement upon Richmond and the opposing army. At the moment of starting he was relieved as general-in-chief. By the 5th of April a great army was safely transported to Fortress Monroe, and other troops were sent later, though a large force was (much against his will) retained to cover Washington. McClellan laid slow siege to Yorktown, not breaking the thin line first opposed to him, but giving Johnston full time to reinforce and then evacuate the position. McClellan followed up the Confederate rearguard and approached Richmond, using White House on the Pamunkey as a base of supplies; this entailed a division of his forces on either bank of the Chickahominy. At Fair Oaks (Seven Pines) was fought on the 31st of May a bloody battle, ending the following day in a Confederate repulse. Johnston being severely wounded, Lee came to command on the Southern side. After a pause in the operations McClellan felt himself ready to attack at the moment when Lee, leaving a bare handful of men in the Richmond lines, despatched two-thirds of his entire force to the north of the Chickahominy to strike McClellan's isolated right wing. McClellan himself made little progress, and the troops beyond the Chickahominy were defeated after a strenuous defence; whereupon McClellan planned, and during the celebrated Seven Days' Battle triumphantly executed, a change of base to the James river. But the result was strategically a failure, and General Halleck, who was now general-in-chief, ordered the army to reinforce General Pope in central Virginia. The order was obeyed reluctantly.

Pope's disastrous defeats brought McClellan a new opportunity to retrieve his fame. Again in command of the Army of the Potomac, he was sent with all available forces to oppose Lee, who had crossed the Potomac into Maryland early in September. McClellan advanced slowly and carefully, reorganizing his army as he went. The battle of South Mountain placed him in a position to attack Lee, and a few days later was fought the great battle of Antietam, in which Lee was worsted. But the Confederates safely recrossed the Potomac, and McClellan showed his former faults in a tardy pursuit. On the eve of an aggressive movement, which he was at last about to make, he was superseded by Burnside (Nov. 7). McClellan was never again ordered to active command, and the political elements opposed to the general policy of Lincoln's administration chose him as presidential candidate in 1864, on a platform which denounced the war as a failure and proposed negotiating with the South for peace. McClellan, while accepting his candidacy, repudiated the platform, like a soldier and patriot. At the polls on the 8th of November Lincoln was triumphantly re-elected president. McClellan had previously resigned his commission in the army, and soon afterwards went to Europe, where he remained until 1868. Upon his return he took up his residence in New York City, where (1868–1869) he was engaged in superintending the construction of an experimental floating battery. In 1870–1872 he was engineer-in-chief of the city's department of docks. With Orange, N.J., as his next principal residence, he became governor of New Jersey (1878–1881). During his term he effected great reforms in the administration of the state and in the militia. He was offered, but declined, a second nomination. During his last years he made several tours of Europe, visited the East, and wrote much for the magazines. He also prepared monographs upon the Civil War, defending his own action. He died suddenly of heart-disease on the 29th of October 1885 at Orange.

McClellan was a clear and able writer and effective speaker, and his *Own Story*, edited by a friend and published soon after his death, discloses an honourable character, sensitive to reproach, and conscientious, even morbidly so, in his patriotism. He carried himself well in civil life and was of irreproachable private conduct. During the Civil War, however, he was promoted too early and rapidly for his own good, and the strong personal magnetism he inspired while so young developed qualities injurious to a full measure of success and usefulness, despite his great opportunities. The reasons for his final displacement in 1862 were both civil and military, and the president had been forbearing with him. As a soldier he possessed to an extraordinary degree the enthusiastic affection of his men. With the army that he had created the mere rumour of his presence was often a spur to the greatest exertions. That he was slow, and perhaps too tender-hearted, in handling armed masses for action may be admitted, and though admirable for defensive war and a safe strategist, he showed himself unfitted to take the highly essential initiative, both because of temperament and his habitual exaggeration of obstacles and opposing numbers. But he met and checked the armies of the Confederacy when they were at their best and strongest, and his work laid the foundations of ultimate success.

His son, GEORGE BRINTON McCLELLAN (b. 1865), graduated in 1886 at Princeton (from which he received the degree of LL.D. in 1905), and became a newspaper reporter and editor in New York City. He identified himself with the Tammany Hall organization, and in 1889–1892 was treasurer of the New York and Brooklyn Bridge under the city government. In 1892 he was admitted to the bar, and was elected to the board of aldermen, of which he was president in 1893 and 1894. In 1895–1903 he was a Democratic representative in Congress; in 1903 he was elected mayor of New York City on the Tammany ticket, defeating mayor Seth Low, the "Fusion" candidate; and in 1905 he was re-elected for a four-year term, defeating William M. Ivins (Republican) and William R. Hearst (Independence League). He published *The Oligarchy of Venice* (1904).

Besides the report mentioned above, General McClellan wrote a *Bayonet Exercise* (1852); *Report on Pacific Railroad Surveys* (1854); *Report on the Organization, &c., of the Army of the Potomac* (1864), a government publication which he himself republished with the addition of a memoir of the West Virginian campaign. He also wrote a series of articles on the Russo-Turkish War for *The North American Review*. See memoir prefaced to *McClellan's Own Story*, and Michie, *General McClellan* (" Great Commanders " series).

McCLERNAND, JOHN ALEXANDER (1812–1900), American soldier and lawyer, was born in Breckinridge county, Kentucky, on the 30th of May 1812. He was admitted to the bar in Shawneetown, Illinois, in 1832; in the same year served as a volunteer in the Black Hawk War, and in 1835 founded the *Shawneetown Democrat*, which he thereafter edited. As a Democrat he served in 1836 and in 1840–1843 in the Illinois House of Representatives, and in 1843–1851 and in 1859–1861 was a representative in Congress, where in his first term he vigorously opposed the Wilmot proviso, but in his second term was a strong Unionist and introduced the resolution of the 15th of July 1861, pledging money and men to the national government. He resigned from congress, raised in Illinois the " McClernand Brigade," and was commissioned (May 17, 1861) brigadier-general of volunteers. He was second in command at the battle of Belmont (Missouri) in November 1861, and commanded the right wing at Fort Donelson. On the 21st of March he became a major-general of volunteers. At Shiloh he commanded a division, which was practically a reserve to Sherman's. In October 1861 Stanton, secretary of war, ordered him north to raise troops for the expedition against Vicksburg; and early in January 1864, at Milliken's Bend, McClernand, who had been placed in command of one of the four corps of Grant's army, superseded Sherman as the leader of the force that was to move down the Mississippi. On the 11th of January he took Arkansas Post. On the 17th, Grant, after receiving the opinion of Admiral Foote and General Sherman that McClernand was unfit, united a part of his own troops with those of McClernand and assumed command in person, and three days later ordered McClernand back to Milliken's Bend. During the rest of this Vicksburg campaign there was much friction between McClernand and his colleagues; he undoubtedly intrigued for the removal of Grant; it was Grant's opinion that at Champion's Hill (May 16) he was dilatory; and because a congratulatory order to his corps was published in the press (contrary to an order of the department and another of Grant) he was relieved of his command on the 18th of June, and was replaced by General E. O. C. Ord. President Lincoln, who saw the importance of conciliating a leader of the Illinois War-Democrats, restored him to his command in 1864, but McClernand resigned in November of that year. He was district judge of the Sangamon (Illinois) District in 1870–1873, and was president of the National Democratic Convention in 1876. He died in Springfield, Illinois, on the 20th of September 1900.

His son, EDWARD JOHN McCLERNAND (b. 1848), graduated at the U.S. Military Academy in 1870. He served on the frontier against the Indians, notably in the capture of Chief Joseph in October 1877, became lieutenant-colonel and assistant adjutant-general of volunteers in 1898, and served in Cuba in 1898–99. He was then ordered to the Philippines, where he commanded various districts, and from April 1900 to May 1901, when he was mustered out of the volunteer service, was acting military governor.

MACCLESFIELD, CHARLES GERARD, 1ST EARL OF (*c.* 1618–1694), eldest son of Sir Charles Gerard, was a member of an old Lancashire family, his great-grandfather having been Sir Gilbert Gerard (d. 1593) of Ince, in that county, one of the most distinguished judges in the reign of Elizabeth. His mother was Penelope Fitton of Gawsworth, Cheshire. Charles Gerard was educated abroad, and in the Low Countries learnt soldiering, in which he showed himself proficient when on the outbreak of the Civil War in England he raised a troop of horse for the king's service. Gerard commanded a brigade with distinction at Edgehill, and gained further honours at the first battle of Newbury and at Newark in 1644, for which service he was appointed to the chief command in South Wales. Here his operations in 1644 and 1645 were completely successful in reducing the Parliamentarians to subjection; but the severity with which he ravaged the country made him personally so unpopular that when, after the defeat at Naseby in June 1645, the king endeavoured to raise fresh forces in Wales, he was compelled to remove Gerard from the local command. Gerard was, however, retained in command of the king's guard during Charles's march from Wales to Oxford, and thence to Hereford and Chester in August 1645; and having been severely wounded at Rowton Heath on the 23rd of September, he reached Newark with Charles on the 4th of October. On the 8th of November 1645 he was created Baron Gerard of Brandon in the county of Suffolk; but about the same time he appears to have forfeited Charles's favour by having attached himself to the party of Prince Rupert, with whom after the surrender of Oxford Gerard probably went abroad. He remained on the Continent throughout the whole period of the Commonwealth, sometimes in personal attendance on Charles II., at others serving in the wars under Turenne, and constantly engaged in plots and intrigues. For one of these, an alleged design on the life of Cromwell, his cousin Colonel John Gerard was executed in the Tower in July 1654. At the Restoration Gerard rode at the head of the king's life-guards in his triumphal entry into London; his forfeited estates were restored, and he received lucrative offices and pensions. In 1668 he retired from the command of the king's guard to make room for the duke of

Monmouth, receiving, according to Pepys, the sum of £12,000 as solatium. On the 23rd of July 1679 Gerard was created earl of Macclesfield and Viscount Brandon. A few months later he entered into relations with Monmouth, and co-operated with Shaftesbury in protesting against the rejection of the Exclusion Bill. In September 1685, a proclamation having been issued for his arrest, Macclesfield escaped abroad, and was outlawed. He returned with William of Orange in 1688, and commanded his body-guard in the march from Devonshire to London. By William he was made a privy councillor, and lord lieutenant of Wales and three western counties. Macclesfield died on the 7th of January 1694. By his French wife he left two sons and two daughters.

His eldest son Charles, 2nd earl of Macclesfield (*c.* 1659–1701), was born in France and was naturalized in England by act of parliament in 1677. Like his father he was concerned in the intrigues of the duke of Monmouth; in 1685 he was sentenced to death for being a party to the Rye House plot, but was pardoned by the king. In 1689 he was elected member of parliament for Lancashire, which he represented till 1694, when he succeeded to his father's peerage. Having become a major-general in the same year, Macclesfield saw some service abroad; and in 1701 he was selected first commissioner for the investiture of the elector of Hanover (afterwards King George I.) with the order of the Garter, on which occasion he also was charged to present a copy of the Act of Settlement to the dowager electress Sophia. He died on the 5th of November 1701, leaving no legitimate children.

In March 1698 Macclesfield was divorced from his wife Anna, daughter of Sir Richard Mason of Sutton, by act of parliament, the first occasion on which a divorce was so granted without a previous decree of an ecclesiastical court. The countess was the mother of two children, who were known by the name of Savage, and whose reputed father was Richard Savage, 4th Earl Rivers (d. 1712). The poet Richard Savage (*q.v.*) claimed that he was the younger of these children. The divorced countess married Colonel Henry Brett about the year 1700, and died at the age of eighty-five in 1753. Her daughter Anna Margaretta Brett was a mistress of George I. The 2nd earl of Macclesfield was succeeded by his brother Fitton Gerard, 3rd earl (*c.* 1665–1702), on whose death without heirs the title became extinct in December 1702.

In 1721 the title of earl of Macclesfield was revived in favour of Thomas Parker (*c.* 1666–1732). The son of Thomas Parker, an attorney at Leek, young Parker was a student at Trinity College, Cambridge, and became a barrister in 1691. In 1705 he was elected member of parliament for Derby, and having gained some reputation in his profession, he took a leading part in the proceedings against Sacheverell in 1710. In the same year he was appointed lord chief justice of the queen's bench, but he refused to become lord chancellor in the following year; however he accepted this office in 1718, two years after he had been made Baron Parker of Macclesfield by George I., who held him in high esteem. In 1721 he was created Viscount Parker and earl of Macclesfield, but when serious charges of corruption were brought against him he resigned his position as lord chancellor in 1725. In the same year Macclesfield was impeached, and although he made a very able defence he was found guilty by the House of Lords. His sentence was a fine of £30,000 and imprisonment until this was paid. He was confined in the Tower of London for six weeks, and after his release he took no further part in public affairs. The earl, who built a grammar school at Leek, died in London on the 28th of April 1732.

Macclesfield's only son, George, (*c.* 1697–1764), 2nd earl of Macclesfield of this line, was celebrated as an astronomer. As Viscount Parker he was member of parliament for Wallingford from 1722 to 1727, but his interests were not in politics. In 1722 he became a fellow of the Royal Society, and he spent most of his time in astronomical observations at his Oxfordshire seat, Shirburn Castle, which had been bought by his father in 1716; here he built an observatory and a chemical laboratory. The earl was very prominent in effecting the change from the old to the new style of dates, which came into operation in 1752. His action in this matter, however, was somewhat unpopular, as the opinion was fairly general that he had robbed the people of eleven days. From 1752 until his death on the 17th of March 1764 Macclesfield was president of the Royal Society, and he made some observations on the great earthquake of 1755. His successor was his son Thomas (1723–1795), from whom the present earl is descended.

For the earls of the Gerard family see Lord Clarendon, *History of the Rebellion*, ed. by W. D. Macray; E. B. G. Warburton, *Memoirs of Prince Rupert and the Cavaliers* (3 vols., 1849); *State Papers of John Thurloe* (7 vols., 1742); J. R. Phillips, *Memoirs of the Civil War in Wales and the Marches, 1642–49* (2 vols., 1874); and the duke of Manchester, *Court and Society from Elizabeth to Anne* (2 vols., 1864). For Lord Chancellor Macclesfield, see Lord Campbell, *Lives of the Lord Chancellors and Keepers of the Great Seal* (1845–1869).

MACCLESFIELD, a market town and municipal borough in the Macclesfield parliamentary division of Cheshire, England, 166 m. N.W. by N. of London, on the London & North-Western, North Staffordshire and Great Central railways. Pop. (1901), 34,624. It lies on and above the small river Bollin, the valley of which is flanked by high ground to east and west, the eastern hills rising sharply to heights above 1000 ft. The bleak upland country retains its ancient name of Macclesfield Forest. The church of St Michael, standing high, was founded by Eleanor, queen of Edward I., in 1278, and in 1740 was partly rebuilt and greatly enlarged. The lofty steeple by which its massive tower was formerly surmounted was battered down by the Parliamentary forces during the Civil War. Connected with the church there are two chapels, one of which, Rivers Chapel, belonged to a college of secular priests founded in 1501 by Thomas Savage, afterwards archbishop of York. Both the church and chapels contain several ancient monuments. The free grammar school, originally founded in 1502 by Sir John Percival, was refounded in 1552 by Edward VI., and a commercial school was erected in 1840 out of its funds. The county lunatic asylum is situated here. The town-hall is a handsome modern building with a Grecian frontage on two sides. Originally the trade of Macclesfield was principally in twist and silk buttons, but this has developed into the manufacture of all kinds of silk. Besides this staple trade, there are various textile manufactures and extensive breweries; while stone and slate quarries, as well as coal-mines, are worked in the neighbourhood. Recreation grounds include Victoria Park and Peel Park, in which are preserved the old market cross and stocks. Water communication is provided by the Macclesfield canal. The borough is under a mayor, 12 aldermen and 36 councillors. Area, 3214 acres. The populous suburb of Sutton, extending S.S.E. of the town, is partly included in the borough.

Previous to the Conquest, Macclesfield (Makesfeld, Mackerfeld, Macclesfeld, Meulefeld, Maxfield) was held by Edwin, earl of Mercia, and at the time of the Domesday Survey it formed a part of the lands of the earl of Chester. The entry speaks of seven hedged enclosures, and there is evidence of fortification in the 13th century, to which the names Jordangate, Chestergate and Wallgate still bear witness. In the 15th century Henry Stafford, duke of Buckingham, had a fortified manor-house here, traces of which remain. There is a tradition, supported by a reference on a plea roll, that Randle, earl of Chester (1181–1232) made Macclesfield a free borough, but the earliest charter extant is that granted by Edward, prince of Wales and earl of Chester, in 1261, constituting Macclesfield a free borough with a merchant gild, and according certain privileges in the royal forest of Macclesfield to the burgesses. This charter was confirmed by Edward III. in 1334, by Richard II. in 1389, by Edward IV. in 1466 and by Elizabeth in 1564. In 1595 Elizabeth issued a new charter to the town, confirmed by James I. in 1605 and Charles II. in 1666, laying down a formal borough constitution under a mayor, 2 aldermen, 24 capital burgesses and a high steward. In 1684 Charles II. issued a new charter, under which the borough was governed until the Municipal Reform Act 1835. The earliest mention of a market is in a grant by James I. to Charles, prince of Wales and earl of Chester, in 1617. In the charter of 1666 a market is included among the privileges confirmed to the borough as those which had been granted in 1605, or by any previous kings and queens of England. The charter of Elizabeth in 1595 granted an annual fair in June, and this was supplemented by Charles II. in 1684 by a grant of fairs in April and September. Except during the three winter months fairs are now held monthly, the chief being "Barnaby" in June, when the town keeps a week's holiday. Macclesfield borough sent two members to parliament in 1832 for the first time. In 1880 it was disfranchised for bribery, and in 1885 the borough was merged in the county division of Macclesfield. The manufacture of silk-covered buttons began in the 16th century, and flourished until the early 18th. The first silk mill was erected about 1755, and silk manufacture on a large scale was introduced about 1790. The manufacture of cotton began in Macclesfield about 1785.

See J. Corry, *History of Macclesfield* (1817).

M'CLINTOCK, SIR FRANCIS LEOPOLD (1819–1907), British naval officer and Arctic explorer, was born at Dundalk, Ireland, on the 8th of July 1819, of a family of Scottish origin. In 1831 he entered the royal navy, joining the "Samarang" frigate, Captain Charles Paget. In 1843 he passed his examination for lieutenancy and joined the "Gorgon" steamship, Captain Charles Hotham, which was driven ashore at Montevideo and salved, a feat of seamanship on the part of her captain and officers which attracted much attention. Hitherto, and until 1847, M'Clintock's service was almost wholly on the American coasts, but in 1848 he joined the Arctic expedition under Sir James Ross in search of Sir John Franklin's ships, as second lieutenant of the "Enterprise." In the second search expedition (1850) he was first lieutenant of the "Assistance," and in the third (1854) he commanded the "Intrepid." On all these expeditions M'Clintock carried out brilliant sleigh journeys, and gained recognition as one of the highest authorities on Arctic travel. The direction which the search should follow had at last been learnt from the Eskimo, and M'Clintock accepted the command of the expedition on board the "Fox," fitted out by Lady Franklin in 1857, which succeeded in its object in 1859 (see FRANKLIN, SIR JOHN). For this expedition M'Clintock had obtained leave of absence, but the time occupied was afterwards counted in his service. He was knighted and received many other honours on his return. Active service now occupied him in various tasks, including the important one of sounding in the north Atlantic, in connexion with a scheme for a north Atlantic cable route, until 1868. In that year he became naval aide-de-camp to Queen Victoria. In 1865 he had been elected a fellow of the Royal Society. He unsuccessfully contested a seat in parliament for the borough of Drogheda, where he made the acquaintance of Annette Elizabeth, daughter of R. F. Dunlop of Monasterboice; he married her in 1870. He became vice-admiral in 1877, and commander-in-chief on the West Indian and North American station in 1879. In 1882 he was elected an Elder Brother of Trinity House, and served actively in that capacity. In 1891 he was created K.C.B. He was one of the principal advisers in the preparations for the Antarctic voyage of the "Discovery" under Captain Scott. His book, *The Voyage of the "Fox" in the Arctic Seas*, was first published in 1859, and passed through several editions. He died on the 17th of November 1907.

See Sir C. R. Markham, *Life of Admiral Sir Leopold M'Clintock* (1909).

McCLINTOCK, JOHN (1814–1870), American Methodist Episcopal theologian and educationalist, was born in Philadelphia on the 27th of October 1814. He graduated at the university of Pennsylvania in 1835, and was assistant professor of mathematics (1836–1837), professor of mathematics (1837–1840), and professor of Latin and Greek (1840–1848) in Dickinson College, Carlisle, Pennsylvania. He opposed the Mexican War and slavery, and in 1847 was arrested on the charge of instigating a riot, which resulted in the rescue of several fugitive slaves; his trial, in which he was acquitted, attracted wide attention. In 1848–1856 he edited *The Methodist Quarterly Review* (after 1885 *The Methodist Review*); from 1857 to 1860 he was pastor of St Paul's (Methodist Episcopal) Church, New York City; and in 1860–1864 he had charge of the American chapel in Paris, and there and in London did much to turn public opinion in favour of the Northern States. In 1865–1866 he was chairman of the central committee for the celebration of the centenary of American Methodism. He retired from the regular ministry in 1865, but preached in New Brunswick, New Jersey, until the spring of 1867, and in that year, at the wish of its founder, Daniel Drew, became president of the newly established Drew theological seminary at Madison, New Jersey, where he died on the 4th of March 1870. A great preacher, orator and teacher, and a remarkably versatile scholar, McClintock by his editorial and educational work probably did more than any other man to raise the intellectual tone of American Methodism, and, particularly, of the American Methodist clergy. He introduced to his denomination the scholarly methods of the new German theology of the day—not alone by his translation with Charles E. Blumenthal of Neander's *Life of Christ* (1847), and of Bungener's *History of the Council of Trent* (1855), but by his great project, McClintock and Strong's *Cyclopaedia of Biblical, Theological and Ecclesiastical Literature* (10 vols., 1867–1881; Supplement, 2 vols., 1885–1887), in the editing of which he was associated with Dr James Strong (1822–1894), professor of exegetical theology in the Drew Theological Seminary from 1868 to 1893, and the sole editor of the last six volumes of the *Cyclopaedia* and of the supplement. With George Richard Crooks (1822–1897), his colleague at Dickinson College and in 1880–1897 professor of historical theology at Drew Seminary, McClintock edited several elementary textbooks in Latin and Greek (of which some were republished in Spanish), based on the pedagogical principle of "imitation and constant repetition." Among McClintock's other publications are: *Sketches of Eminent Methodist Ministers* (1863); an edition of Richard Watson's *Theological Institutes* (1851); and *The Life and Letters of Rev. Stephen Olin* (1854).

See G. R. Crooks, *Life and Letters of the Rev. Dr John McClintock* (New York, 1876).

McCLOSKEY, JOHN (1810–1885), American cardinal, was born in Brooklyn, New York, on the 20th of March 1810. He graduated at Mt St Mary's College, Emmitsburg, Maryland, in 1827, studied theology there, was ordained a priest in 1834, and in 1837, after two years in the college of the Propaganda at Rome, became rector of St Joseph's, New York City, a charge to which he returned in 1842 after one year's presidency of St John's College (afterwards Fordham University), Fordham, New York, then just opened. In 1844 he was consecrated bishop of Axieren *in partibus*, and was made coadjutor to Bishop Hughes of New York with the right of succession; in 1847 he became bishop of the newly created see of Albany; and in 1864 he succeeded to the archdiocese of New York, then including New York, New Jersey, and New England. In April 1875 he was invested as a cardinal, with the title of Sancta Maria supra Minervam, being the first American citizen to receive this dignity. He attended the conclave of 1878, but was too late to vote for the new pope. In May 1879 he dedicated St Patrick's Cathedral in New York City, whose corner-stone had been laid by Archbishop Hughes in 1858. Archbishop Corrigan became his coadjutor in 1880 because of the failure of McCloskey's always delicate health. The fiftieth anniversary of his ordination to the priesthood was celebrated in 1884. He died in New York City on the 10th of October 1885. He was a scholar, a preacher, and a man of affairs, temperamentally quiet and dignified; and his administration differed radically from that of Archbishop Hughes; he was conciliatory rather than polemic and controversial, and not only built up the Roman Catholic Church materially, but greatly changed the tone of public opinion in his diocese toward the Church.

M'CLURE, SIR ROBERT JOHN LE MESURIER (1807–1873), English Arctic explorer, born at Wexford, in Ireland, on the 28th of January 1807, was the posthumous son of one of Abercrombie's captains and spent his childhood under the care of his godfather, General Le Mesurier, governor of Alderney, by whom he was educated for the army. He entered the navy, however, in 1824, and twelve years later gained his first experience of Arctic exploration as mate of the "Terror" in the expedition (1836–1837) commanded by Captain (afterwards Sir) George Back. On his return he obtained his commission as lieutenant, and from 1838 to 1839 served on the Canadian lakes, being subsequently attached to the North American and West Indian naval stations, where he remained till 1846. Two years later he joined the Franklin search expedition (1848–1849) under Sir J. C. Ross as first lieutenant of the "Enterprise," and on the return of this expedition was given the command of the "Investigator" in the new search expedition (1850–1854) which was sent out by way of Bering Strait to co-operate with another from the north-west. In the course of this voyage he achieved the distinction of completing (1850) the work connected with the discovery of a North-West Passage (see POLAR REGIONS). On his return to England, M'Clure was awarded gold medals by the English and French geographical societies, was knighted and promoted to post-rank, his commission being dated back four years in recognition of his special services. From 1856 to 1861 he served in Eastern waters, commanding the division of the naval brigade before Canton in 1858, for which he received a C.B. in the following year. His latter years were spent in a quiet country life; he attained the rank of rear-admiral in 1867, and of vice-admiral in 1873.

See Admiral Sherard Osborn, *The Discovery of a North-West Passage* (1856).

MACCOLL, MALCOLM (*c.* 1838–1907), British clergyman and publicist, was the son of a Scottish farmer. He was educated at Trinity College, Glenalmond, for the Scotch Episcopal ministry, and after further study at the university of Naples was ordained in 1859, and entered on a succession of curacies in the Church of England, in London and at Addington, Bucks. He quickly became known as a political and ecclesiastical controversialist, wielding an active pen in support of W. E. Gladstone, who rewarded him with the living of St George's, Botolph Lane, in 1871, and with a canonry of Ripon in 1884. The living was practically a sinecure, and he devoted himself to political pamphleteering and newspaper correspondence, the result of extensive European travel, a wide acquaintance with the leading personages of the day, strong views on ecclesiastical subjects from a high-church standpoint, and particularly on the politics of the Eastern Question and Mahommedanism. He took a leading part in ventilating the Bulgarian and Armenian "atrocities," and his combative personality was constantly to the fore in support of the campaigns of Gladstonian Liberalism. He died in London on the 5th of April 1907.

McCOMBIE, WILLIAM (1805–1880), Scottish agriculturist, was born at Tillyfour, Aberdeenshire, where he founded the herd of black-polled cattle with which his name is associated. He was the first tenant farmer to represent a Scottish constituency, and was returned to parliament, unopposed, as Liberal member for the western division of Aberdeen in 1868. He died unmarried in February 1880. His work *Cattle and Cattle-breeders* (1867) passed into a fourth edition in 1886.

McCOOK, ALEXANDER McDOWELL (1831–1903), American soldier, was born in Columbiana county, Ohio, on the 22nd of April 1831. He graduated at the U. S. military academy in 1852, served against the Apaches and Utes in New Mexico in 1853–57, was assistant instructor of infantry tactics at the military academy in 1858–1861, and in April 1861 became colonel of the 1st Ohio Volunteers. He served in the first battle of Bull Run; commanded a brigade in Kentucky in the winter of 1861, a division in Tennessee and Mississippi early in 1862, and the 1st Corps in Kentucky in October of the same year; was in command of Nashville in November and December of that year; and was then engaged in Tennessee until after the battle of Chickamauga, after which he saw no active service at the front during the Civil War. He was promoted to be brigadier-general of volunteers in September 1861, and to be major-general of volunteers in July 1862, earned the brevet of lieutenant-colonel in the regular army at the capture of Nashville, Tennessee, that of colonel at Shiloh, and that of brigadier-general at Perryville, and in March 1865 was breveted major-general for his services during the war. In February–May 1865 he commanded the district of Eastern Arkansas. He resigned from the volunteer service in October 1865, was commissioned lieutenant-colonel of the 26th Infantry in March 1867, served in Texas, mostly in garrison duty, until 1874, and in 1886–1890 (except for brief terms of absence) commanded Fort Leavenworth, Kansas, and the infantry and cavalry school there. He became a brigadier-general in 1890, and a major-general in 1894; retired in 1895; and in 1898–1899 served on a commission to investigate the United States department of war as administered during the war with Spain.

His father, DANIEL McCOOK (1798–1863), killed at Buffington's Island during General John H. Morgan's raid in Ohio, and seven of his eight brothers (three of whom were killed in battle) all served in the Civil War; this family and that of JOHN McCOOK (1806–1865), Daniel's brother, a physician, who served as a volunteer surgeon in the Civil War, are known as the "fighting McCooks"—four of John's sons served in the Union army and one in the Union navy.

JOHN JAMES McCOOK (b. 1845), the youngest brother of Alexander McDowell McCook, served in the West and afterwards in the army of the Potomac, was wounded at Shady Grove, Virginia, in 1864, and in 1865 was breveted lieutenant-colonel of volunteers; he graduated at Kenyon College in 1866, subsequently practised law in New York City, where he became head of the firm Alexander & Green; was a prominent member of the Presbyterian Church, and was a member of the prosecuting committee in the Briggs heresy trial in 1892–1893.

His cousin, ANSON GEORGE McCOOK (b. 1835), a son of John, was admitted to the Ohio bar in 1861, served throughout the Civil War in the Union Army, and was breveted brigadier-general of volunteers; he was a Republican representative in Congress from New York in 1877–1883; and in 1884–1893 was secretary of the United States Senate.

Another son of John McCook, EDWARD MOODY McCOOK (1833–1909), was an efficient cavalry officer in the Union army, was breveted brigadier-general in the regular army and major-general of volunteers in 1865, was United States minister to Hawaii in 1866–1869, and was governor of Colorado Territory in 1869–1873, and in 1874–1875.

His brother, HENRY CHRISTOPHER McCOOK (b. 1837), was first lieutenant and afterwards chaplain of the 41st Illinois, was long pastor of the Tabernacle Presbyterian Church in Philadelphia, and was president of the American Presbyterian Historical Society, but is best known for his popular and excellent works on entomology, which include: *The Mound-making Ants of the Alleghanies* (1877); *The Natural History of the Agricultural Ants of Texas* (1879); *Tenants of an Old Farm* (1884); *American Spiders and their Spinning-work* (3 vols., 1889–1893), *Nature's Craftsmen* (1907) and *Ant Communities* (1909).

Another brother, JOHN JAMES McCOOK (b. 1843), a cousin of the lawyer of the same name, was a 2nd lieutenant of volunteers in the Union army in 1861; graduated at Trinity College, Hartford, Connecticut, in 1863, and at the Berkeley divinity school in 1866; entered the Protestant Episcopal ministry in 1867, and in 1869 became rector of St John's, East Hartford, Connecticut; became professor of modern languages in Trinity College, Hartford, in 1883; in 1895–1897 was president of the board of directors of the Connecticut reformatory; and wrote on prison reform and kindred topics.

MACCORMAC, SIR WILLIAM, BART. (1836–1901), Irish surgeon, was born at Belfast on the 17th of January 1836, being the son of Dr Henry MacCormac. He studied medicine and surgery at Belfast, Dublin and Paris, and graduated in arts, medicine and surgery at the Queen's University of Ireland, in which he afterwards became an examiner in surgery. He began practice in Belfast, where he became surgeon to the General Hospital, but left it for London on his marriage in 1861 to Miss Katherine M. Charters. In the Franco-German War of 1870 he was surgeon-in-chief to the Anglo-American Ambulance, and was present at Sedan; and he also went through the Turco-Servian War of 1876. He became in this way an authority on gun-shot wounds, and besides being highly successful as a surgeon was very popular in society, his magnificent physique and Irish temperament making him a notable and attractive personality. In 1881 he was appointed assistant-surgeon at St Thomas's Hospital, London, and for twenty years continued his work there as surgeon, lecturer and consulting surgeon. In 1881 he acted as honorary secretary-general of the International Medical Congress in London, and was knighted for his services. In 1883 he was elected member of the council of the College of Surgeons, and in 1887 a member of the court of examiners; in 1893 he delivered the Bradshaw lecture, and in 1896 was elected president, being re-elected to this office in 1897, 1898,1899, and 1900 (the centenary year of the college), an unprecedented record. In 1897 he was created a baronet, and appointed surgeon-in-ordinary to the prince of Wales. In 1899 he was Hunterian Orator. In the same year he volunteered to go out to South Africa as consulting surgeon to the forces, and from November 1899 to April 1900 he saw much active service both in Cape Colony and Natal, his assistance being cordially acknowledged on his return. In 1901 he was appointed honorary serjeant-surgeon to the king. But during 1898 he had suffered from a prolonged illness, and he had perhaps put too much strain on his strength, for on the 4th of December 1901 he died somewhat suddenly at Bath. Besides treatises on *Surgical Operations* and *Antiseptic Surgery*, and numerous contributions to the medical journals, MacCormac was the author of *Work under the Red Cross* and of an interesting volume commemorating the centenary of the Royal College of Surgeons in 1900. The latter contains biographical notices of all the masters and presidents up to that date.

McCORMICK, CYRUS HALL (1809–1884), American inventor of grain-harvesting machinery, was born at Walnut Grove, in what is now Roane county, W.Va., U.S.A., on the 15th of February 1809. His father was a farmer who had invented numerous labour-saving devices for farmwork, but after repeated efforts had failed in his attempts to construct a successful grain-cutting machine. In 1831, Cyrus, then twenty-two years old, took up the problem, and after careful study constructed a machine which was successfully employed in the late harvest of 1831 and patented in 1834. The McCormick reaper after further improvements proved a complete success; and in 1847 the inventor removed to Chicago, where he established large works for manufacturing his agricultural machines. William H. Seward has said of McCormick's invention, that owing to it "the line of civilization moves westward thirty miles each year." Numerous prizes and medals were awarded for his reaper, and he was elected a corresponding member of the French Academy of Sciences, "as having done more for the cause of agriculture than any other living man." He died in Chicago on the 13th of May 1884.

See Herbert N. Casson, *Cyrus Hall McCormick: his Life and Work* (Chicago, 1909).

McCOSH, JAMES (1811–1894), Scottish philosophical writer, was born of a Covenanting family in Ayrshire, on the 1st of April 1811. He studied at Glasgow and Edinburgh, receiving at the latter university his M.A., at the suggestion of Sir William Hamilton, for an essay on the Stoic philosophy. He became a minister of the Established Church of Scotland, first at Arbroath and then at Brechin, and took part in the Free Church movement of 1843. In 1852 he was appointed professor of logic and metaphysics in Queen's College, Belfast; and in 1868 was chosen president and professor of philosophy of the college of New Jersey, at Princeton. He resigned the presidency in 1888, but continued as lecturer on philosophy till his death on the 16th of November 1894. He was most successful in college administration, a good lecturer and an effective preacher. His general philosophical attitude and method were Hamiltonian; he insisted on severing religious and philosophical data from merely physical, and though he added little to original thought, he clearly restated and vigorously used the conclusions of others. In his controversial writings he often failed to understand the real significance of the views which he attacked, and much of his criticism is superficial.

His chief works are: *Method of Divine Government, Physical and Moral* (Edinburgh, 1850, 5th ed., 1856, and frequently republished in New York); *The Typical Forms and Special Ends in Creation* (Edinburgh, 1855; new editions, New York, 1867–1880); *Intuitions of the Mind inductively investigated* (London and New York, 1860; 3rd rev. ed., 1872); *An Examination of Mr J. S. Mill's Philosophy* (London and New York, 1866; enlarged 1871, several eds.); *Philosophical Papers* containing (1) "Examination of Sir W. Hamilton's Logic," (2) "Reply to Mr Mill's third edition," and (3) "Present State of Moral Philosophy in Britain;" *Religious Aspects of Evolution* (New York, 1888, 2nd ed., 1890). For a complete list of his writings see J. H. Dulles, *McCosh Bibliography* (Princeton, 1895).

McCOY, SIR FREDERICK (1823–1899), British palaeontologist, the son of Dr Simon McCoy, was born in Dublin in 1823, and was educated in that city for the medical profession. His interests, however, became early centred in natural history, and especially in geology, and at the age of eighteen he published a *Catalogue of Organic Remains* compiled from specimens exhibited in the Rotunda at Dublin (1841). He assisted Sir R. J. Griffith (*q.v.*) by studying the fossils of the carboniferous and silurian rocks of Ireland, and they prepared a joint *Synopsis of the Silurian Fossils of Ireland* (1846). In 1846 Sedgwick secured his services, and for at least four years he devoted himself to the determination and arrangement of the fossils in the Woodwardian Museum at Cambridge. Sedgwick wrote of him as "an excellent naturalist, an incomparable and most philosophical palaeontologist, and one of the steadiest and quickest workmen that ever undertook the arrangement of a museum" (*Life and Letters of Sedgwick*, ii. 194). Together they prepared the important and now classic work entitled *A Synopsis of the Classification of the British Palaeozoic Rocks, with a Systematic Description of the British Palaeozoic Fossils in the Geological Museum of the University of Cambridge* (1855). Meanwhile McCoy in 1850 had been appointed professor of geology in Queen's College, Belfast, and in 1854 he accepted the newly founded professorship of natural science in the university of Melbourne. There he lectured for upwards of thirty years; he established the National Museum of Natural History and Geology in Melbourne, of which he was director; and becoming associated with the geological survey of Victoria as palaeontologist, he issued a series of decades entitled *Prodromus of the Palaeontology of Victoria*. He also issued the *Prodromus of the Zoology of Victoria*. To local societies he contributed many papers, and he continued his active scientific work for fifty-eight years—his last contribution, "Note on a new Australian Pterygotus," being printed in the *Geological Magazine* for May 1899. He was elected F.R.S. in 1880, and was one of the first to receive the Hon. D.Sc. from the university of Cambridge. In 1886 he was made C.M.G., and in 1891 K.C.M.G. He died in Melbourne on the 16th of May 1899.

Obituary (with bibliography) in *Geol. Mag.* 1899, p. 283.

M'CRIE, THOMAS (1772–1835), Scottish historian and divine, was born at Duns in Berwickshire in November 1772. He studied in Edinburgh University, and in 1796 he was ordained minister of the Second Associate Congregation, Edinburgh. In 1806, however, with some others M'Crie seceded from the "general associate synod," and formed the "constitutional associate presbytery," afterwards merged in the "original seceders." He was consequently deposed by the associate synod, and his congregation withdrew with him and built another place of worship in which he officiated until his death. M'Crie devoted himself to investigations into the history, constitution and polity of the churches of the Reformation; and the first-fruits of his study were given to the public in November 1811 as *The Life of John Knox, containing Illustrations of the History of the Reformation in Scotland*, which procured for the author the degree of D.D. from Edinburgh University, an honour conferred then for the first time upon a Scottish dissenting minister. This work, of great learning and value, exercised an important influence on public opinion at the time.

At the solicitation of his friend Andrew Thomson, M'Crie became a contributor to *The Edinburgh Christian Instructor*, and in 1817 he subjected some of Sir W. Scott's works to a criticism which took the form of a vindication of the Covenanters. Preserving the continuity of his historical studies, he followed up his first work with *The Life of Andrew Melville* (1819). In 1827 he published a *History of the Progress and Suppression of the Reformation in Italy*, and in 1829 a *History of the Progress and Suppression of the Reformation in Spain*.

His latest literary undertaking was a life of John Calvin. Only three chapters were completed when the writer died on the 5th of August 1835, leaving four sons and one daughter.

See Thomas M'Crie (1797–1875), *Life of T. M'Crie* (1840), and Hugh Miller, *My Schools and Schoolmasters* (1869).

MACCULLAGH, JAMES (1809–1847), Irish mathematician and physicist, was born in 1809, near Strabane, Ireland. After a brilliant career at Trinity College, Dublin, he was elected fellow in 1832. From 1832 to 1843 he held the chair of mathematics; and during his tenure of this post he improved in a most marked manner the position of his university as a mathematical centre. In 1843 he was transferred to the chair of natural philosophy. Overwork, mainly on subjects beyond the natural range of his powers, induced mental disease; and he died by his own hand in October 1847.

His *Works* were published in 1880. Their distinguishing feature is the geometry—which has rarely been applied either to pure space problems or to known physical questions such as the rotation of a rigid solid or the properties of Fresnel's wave-surface with such singular elegance; in this respect his work takes rank with that of Louis Poinsot. One specially remarkable geometrical discovery of MacCullagh's is that of the "modular generation of surfaces of the second degree"; and a noteworthy contribution to physical optics is his "theorem of the polar plane." But his methods, which, in less known subjects, were almost entirely tentative, were altogether inadequate to the solution of the more profound physical problems to which his attention was mainly devoted, such as the theory of double refraction, &c. See G. G. Stokes's "Report on Double Refraction" (*B. A. Report*, 1862).

MACCULLOCH, HORATIO (1805–1867), Scottish landscape painter, was born in Glasgow. He studied for a year under John Knox, a Glasgow landscapist of some repute, was then engaged at Cumnock, painting the ornamental lids of snuff-boxes, and afterwards employed in Edinburgh by Lizars, the engraver, to colour the illustrations in Selby's *British Birds* and similar works. Meanwhile he was working unweariedly from nature, greatly influenced in his early practice by the water-colours of H. W. Williams. Returning to Glasgow in some four or five years, he was employed on several large pictures for the decoration of a public hall in St George's Place, and he did a little as a theatrical scene-painter. About this time he was greatly impressed with a picture by Thomson of Duddingston. Gradually MacCulloch asserted his individuality, and formed his own style on a close study of nature; his works form an interesting link between the old world of Scottish landscape and the new. In 1829 MacCulloch first figured in the Royal Scottish Academy's exhibition, and year by year, till his death on the 24th of June 1867, he was a regular exhibitor. In 1838 he was elected a member of the Scottish Academy. The subjects of his numerous landscapes were taken almost exclusively from Scottish scenery.

Several works by MacCulloch were engraved by William Miller and William Forrest, and a volume of photographs from his landscapes, with an excellent biographical notice of the artist by Alexander Fraser, R.S.A., was published in Edinburgh in 1872.

McCULLOCH, HUGH (1808–1895), American financier, was born at Kennebunk, Maine, on the 7th of December 1808. He was educated at Bowdoin College, studied law in Boston, and in 1833 began practice at Fort Wayne, Indiana. He was cashier and manager of the Fort Wayne branch of the old state bank of Indiana from 1835 to 1857, and president of the new state bank from 1857 to 1863. Notwithstanding his opposition to the National Banking Act of 1862, he was selected by Secretary Chase as comptroller of the currency in 1863 to put the new system into operation. His work was so successful that he was appointed secretary of the treasury by President Lincoln in 1865, and was continued in office by President Johnson until the close of his administration in 1869. In his first annual report, issued on the 4th of December 1865, he strongly urged the retirement of the legal tenders or greenbacks as a preliminary to the resumption of specie payments. In accordance with this suggestion an act was passed, on the 12th of March 1866, authorizing the retirement of not more than $10,000,000 in six months and not more than $4,000,000 per month thereafter, but it met with strong opposition and was repealed on the 4th of February 1868, after only $48,000,000 had been retired. He was much disappointed by the decision of the United States Supreme Court upholding the constitutionality of the legal tenders (12 Wallace 457). Soon after the close of his term of office McCulloch went to England, and spent six years (1870–1876) as a member of the banking firm of Jay Cooke, McCulloch & Co. From October 1884 until the close of President Arthur's term of office in March 1885 he was again secretary of the treasury. He died at his home near Washington, D.C., on the 24th of May 1895.

The chief authority for the life of McCulloch is his own book, *Men and Measures of Half a Century* (New York, 1888).

M'CULLOCH, SIR JAMES (1819–1893), Australian statesman, was born in Glasgow. He entered the house of Dennistoun Brothers, became a partner, and went to Melbourne to open a branch. In 1854, shortly after his arrival in Victoria, he was appointed a nominee member of the Legislative Council, and in the first Legislative Assembly under the new constitution was returned for the electorate of the Wimmera. In 1857 he was appointed minister of trade and customs in the second ministry of Haines, which lasted till 1858, and subsequently he became treasurer in the Nicholson administration, which held office from October 1859 to November 1860. In June 1862 the third O'Shanassy ministry was defeated by a combination between a section of its supporters led by M'Culloch and the opposition proper under Heales, and M'Culloch became premier and chief secretary. Hitherto he had been regarded as a supporter of the landed, squatting and importing interests, but the coalition ministry introduced a number of measures which at the time were regarded by the propertied classes in the colony as revolutionary. In addition to passing a Land Bill, which extended the principle of free selection and deferred payments, the ministry announced their intention of reducing the duties on the export of gold and the import duties upon tea and sugar, and of supplying the deficiency by the imposition of duties ranging from 5 to 10% upon a number of articles which entered into competition with the local industries, thus introducing protection. The mercantile community took alarm at the proposal, and at the general election of 1864 the ministerial policy was warmly opposed. But a majority was returned in its favour, and a new tariff was carried through the popular branch of the legislature. There was no probability of its being assented to by the Council, which, under the constitution, had the power of rejecting, although it could not amend, any money Bill. The government therefore decided upon tacking the tariff to the Appropriation Bill, and compelling the Council either to agree to the new fiscal proposals or to refuse to pay the public creditors and the civil servants. The Council accepted the challenge, and rejected the Appropriation Bill. But M'Culloch and his colleagues would not give way. They continued to collect the new duties under the authority of the Assembly, and took advantage of a clause in the Audit Act which directed the governor to sign the necessary warrants for the payment of any sum awarded by verdicts in the supreme court in favour of persons who had sued the government. M'Culloch borrowed £40,000 from the London Chartered Bank, of which he was a director, to meet pressing payments, and the bank at his instigation sued the government for the amount of the advance. The attorney-general at once accepted judgment, and the governor, who had placed himself unreservedly in the hands of his ministers, signed the necessary warrant, and the Treasury repaid to the bank the amount of its advance, plus interest and costs. In the next session the tariff was again sent up to the Council, which promptly rejected it, whereupon the ministry dissolved the assembly and appealed to the country. The result of the general election was to increase M'Culloch's majority, and the tariff was again sent to the Council, only to be again rejected. M'Culloch resigned, but no member of the opposition was willing to form a ministry, and he resumed office. Eventually a conference between the two houses was held, and the Council passed the tariff, after a few modifications in it had been agreed to by the Assembly. Just at the moment that peace was restored, the governor, Sir Charles Darling, was recalled by the home government, on the ground that he had displayed partisanship by assisting M'Culloch's government and their majority in the Assembly to coerce the Council. In order to show their gratitude to the dismissed governor, the Assembly decided to grant a sum of £20,000 to Lady Darling. The home government intimated that Sir Charles Darling must retire from the Colonial service if this gift were accepted by his wife, but M'Culloch included the money in the annual Appropriation Bill, with the result that it was rejected by the Council. The new governor, Viscount Canterbury, was less complaisant than his predecessor, but after an unsuccessful attempt to obtain other advisers, he agreed to recommend the Council to pass the Appropriation Bill with the £20,000 grant included. The Upper House declined to adopt this course, and again rejected the Bill. A long and bitter struggle between the two Chambers ended in another general election in 1868, which still further increased the ministerial majority; but Lord Canterbury, in obedience to instructions from the colonial office, declined to do anything to facilitate the passage of the Darling grant. M'Culloch resigned, and after protracted negotiations Sir Charles Sladen formed from the minority in the Assembly a ministry which only lasted two months. The deadlock seemed likely to become more stringent than ever, when a communication was received from Sir Charles Darling, that neither he nor his wife could receive anything like a donation from the people of Victoria. The attempt to pass the grant was therefore abandoned, and in July 1868 M'Culloch resumed office with different colleagues, but resigned in the following year, when he was knighted. He formed a third ministry in 1870. During this third administration he passed a measure through both Houses which secured a life annuity of £1000 per annum to Lady Darling. Additional taxation being necessary, Sir James M'Culloch was urged by his protectionist supporters to increase the import duties, but he refused, and proposed to provide for the deficit by levying a tax upon town, suburban and country property. This proposal was defeated in the Assembly; Sir James resigned in June 1871, and was appointed agent-general for Victoria in London. He held that appointment till 1873, was created K.C.M.G. in 1874, returned to the colony the same year, and in 1875 formed his fourth and last ministry, which kept power till May 1877, when his party was defeated at the general election. During his eighteen months of office he had to encounter a persistent opposition from Berry and his followers, who systematically obstructed the business of the Assembly, on the ground that the acting-governor, Sir William Stawell, had improperly refused a dissolution. Sir James M'Culloch, to counteract this obstruction, invented the closure, which was afterwards introduced with some modifications into the house of commons. After his defeat in 1877 Sir James retired from public life and returned to England, where he died on the 30th of January 1893 at Ewell, Surrey. He was twice married—first, in 1841, to Susan, daughter of the Rev. James Renwick, of Muirton, Scotland; secondly, in 1867, to Margaret, daughter of William Inglis, of Walflat, Dumbartonshire. He left the house of Dennistoun Brothers in 1862, and founded a new firm at Melbourne in conjunction with Leishman, Inglis & Co. of London, under the title of M'Culloch, Sellars & Co. He held several important commercial positions, and was president of the Melbourne Chamber of Commerce. (G. C. L.)

MACCULLOCH, JOHN (1773–1835), Scottish geologist, descended from the Maccullochs of Nether Ardwell in Galloway, was born in Guernsey, on the 6th of October 1773, his mother being a native of that island. Having displayed remarkable powers as a boy, he was sent to study medicine in the university of Edinburgh, where he qualified as M.D. in 1793, and then entered the army as assistant surgeon. Attaching himself to the artillery, he became chemist to the board of ordnance (1803). He still continued, however, to practise for a time as a physician, and during the years 1807–1811 he resided at Blackheath. In 1811 he communicated his first papers to the Geological Society. They were devoted to an elucidation of the geological structure of Guernsey, of the Channel Islands, and of Heligoland. The evidence they afforded of his capacity, and the fact that he already had received a scientific appointment, probably led to his being selected in the same year to make some geological and mineralogical investigations in Scotland. He was asked to report upon stones adapted for use in powder-mills, upon the suitability of the chief Scottish mountains for a repetition of the pendulum experiments previously conducted by Maskelyne and Playfair at Schiehallion, and on the deviations of the plumb-line along the meridian of the Trigonometrical Survey. In the course of the explorations necessary for the purposes of these reports he made extensive observations on the geology and mineralogy of Scotland. He formed also a collection of the mineral productions and rocks of that country, which he presented to the Geological Society in 1814. In that year he was appointed geologist to the Trigonometrical Survey; and in 1816–1817 he was president of the Geological Society. Comparatively little had been done in the investigation of Scottish geology, and finding the field so full of promise, he devoted himself to its cultivation with great ardour. One of his most important labours was the examination of the whole range of islands along the west of Scotland, at that time not easily visited, and presenting many obstacles to a scientific explorer. The results of this survey appeared (1819) in the form of his *Description of the Western Islands of Scotland, including the Isle of Man* (2 vols. 8vo, with an atlas of plates in 4to), which forms one of the classical treatises on British geology. He was elected F.R.S. in 1820. He continued to write papers, chiefly on the rocks and minerals of Scotland, and had at last gathered so large an amount of information that the government was prevailed upon in the year 1826 to employ him in the preparation of a geological map of Scotland. From that date up to the time of his death he returned each summer to Scotland and traversed every district of the kingdom, inserting the geological features upon Arrowsmith's map, the only one then available for his purpose. He completed the field-work in 1832, and in 1834 his map and memoir were ready for publication, but these were not issued until 1836, the year after he died. Among his other works the following may be mentioned: *A Geological Classification of Rocks with Descriptive Synopses of the Species and Varieties, comprising the Elements of Practical Geology* (1821); *The Highlands and Western Isles of Scotland*, in a series of letters to Sir Walter Scott (4 vols. 1824); *A System of Geology, with a Theory of the Earth and an Examination of its Connexion with the Sacred Records* (2 vols. 1831). During a visit to Cornwall he was killed by being dragged along in the wheel of his carriage, on the 21st of August 1835.

In penning an obituary notice, C. Lyell in 1836 (*Proc. Geol. Soc.* ii. 357) acknowledged "with gratitude" that he had "received more instruction from Macculloch's labours in geology than from those of any living writer."

M'CULLOCH, JOHN RAMSAY (1789–1864), British economist and statistician, was born on the 1st of March 1789 at Whithorn in Wigtownshire. His family belonged to the class of "statesmen," or small landed proprietors. He was for some time employed at Edinburgh as a clerk in the office of a writer to the signet. But, the *Scotsman* newspaper having been established at the beginning of 1817, M'Culloch sent a contribution to the fourth number, the merit of which was at once recognized; he soon became connected with the management of the paper, and during 1818 and 1819 acted as editor. Most of his articles related to questions of political economy, and he delivered lectures in Edinburgh on that science. He now also began to write on subjects of the same class in the *Edinburgh Review*, his first contribution being an article on Ricardo's *Principles of Political Economy* in 1818. Within the next few years he gave both public lectures and private instruction in London on political economy. In 1823 he was chosen to fill the lectureship established by subscription in honour of the memory of Ricardo. A movement was set on foot in 1825 by Jeffrey and others to induce the government to found in the university of Edinburgh a chair of political economy, separate from that of moral philosophy, the intention being to obtain the appointment for M'Culloch. This project fell to the ground; but in 1828 he was made professor of political economy in London University. He then fixed his residence permanently in London, where he continued his literary work, being now one of the regular writers in the *Edinburgh Review*. In 1838 he was appointed comptroller of the stationery office; the duties of this position, which he held till his death, he discharged with conscientious fidelity, and introduced important reforms in the management of the department. Sir Robert Peel, in recognition of the services he had rendered to political science, conferred on him a literary pension of £200 per annum. He was elected a foreign associate of the Institute of France (*Académie des sciences morales et politiques*). He died in London, after a short illness, on the 11th of November 1864, in the seventy-sixth year of his age. To his personal character and social qualities very favourable testimony was borne by those who knew him best. In general politics he always remained a Whig pure and simple; though he was in intimate relations with James Mill and his circle, he never shared the Radical opinions of that group.

M'Culloch cannot be regarded as an original thinker on political economy. He did not contribute any new ideas to that science, or introduce any noteworthy correction of the views, either as to method or doctrine, generally accepted by the dominant school of his day. But the work he did must be pronounced, in relation to the wants of his time, a very valuable one. His name will probably be less permanently associated with anything he has written on economic science, strictly so called, than with his great statistical and other compilations. His *Dictionary of Commerce and Commercial Navigation* (1832) and his *Statistical Account of the British Empire* (1837) remain imposing monuments of his extensive and varied knowledge and his indefatigable industry. Another useful work of reference, also the fruit of wide erudition and much labour, is his *Literature of Political Economy* (1845). Though weak on the side of the foreign literature of the science, it is very valuable as a critical and biographical guide to British writers.

McCULLOUGH, JOHN EDWARD (1837–1885), American actor, was born in Coleraine, Ireland, on the 2nd of November 1837. He went to America at the age of sixteen, and made his first appearance on the stage at the Arch Street Theatre, Philadelphia, in 1857. In support of Edwin Forrest and Edwin Booth he played second rôles in Shakespearian and other tragedies, and Forrest left him by will all his prompt books. Virginius was his greatest success, although even in this part and as Othello he was coldly received in England (1881). In 1884 he broke down physically and mentally, and he died in an asylum at Philadelphia on the 8th of November 1885.

MACCUNN, HAMISH (1868–), Scottish musical composer, was born at Greenock, the son of a shipowner, and was educated at the Royal College of Music. His first success was with the overture *Land of the Mountain and Flood* in 1887 at the Crystal Palace, and this was followed by other compositions, with a characteristic Scottish colouring. From 1888 to 1894 he was a professor at the Royal College of Music, and this latter year saw both his marriage to a daughter of John Pettie, R.A., and the production of his opera *Jeanie Deans* at Edinburgh. He was for some years conductor to the Carl Rosa Opera company, and subsequently to other companies. His opera *Diarmid* was produced at Covent Garden in 1897, and his other music includes cantatas, overtures, part-songs, instrumental pieces, and songs, all markedly Scottish in type.

MACDONALD, FLORA (1722–1790), Jacobite heroine, was the daughter of Ranald Macdonald of Milton in the island of South Uist in the Hebrides, and his wife Marion the daughter of Angus Macdonald, minister of South Uist. Her father died when she was a child, and her mother was abducted and married by Hugh Macdonald of Armadale. She was brought up under the care of the chief of her clan, Macdonald of Clanranald, and was partly educated in Edinburgh. In June 1746 she was living in Benbecula in the Hebrides when Prince Charles Edward (*q.v.*) took refuge there after the battle of Culloden. The prince's companion, Captain O'Neill, sought her help. The island was held for the government by the local militia, but the secret sympathies of the Macdonalds were with the Jacobite cause. After some hesitation Flora promised to help. At a later period she told the duke of Cumberland, son of George III. and commander-in-chief in Scotland, that she acted from charity and would have helped him also if he had been defeated and in distress, a statement which need not be accepted as quite literally true. The commander of the militia in the island, a Macdonald, who was probably admitted into the secret, gave her a pass to the mainland for herself, a manservant, an Irish spinning maid, Betty Burke, and a boat's crew of six men. The prince was disguised as Betty Burke. After a first repulse at Waternish, the party landed at Portree. The prince was hidden in a cave while Flora Macdonald found help for him in the neighbourhood, and was finally able to escape. He had left Benbecula on the 27th of June. The talk of the boatmen brought suspicion on Flora Macdonald, and she was arrested and brought to London. After a short imprisonment in the Tower, she was allowed to live outside of it, under the guard of a "messenger" or gaoler. When the Act of Indemnity was passed in 1747 she was left at liberty. Her courage and loyalty had gained her general sympathy, which was increased by her good manners and gentle character. Dr Johnson, who saw her in 1773, describes her as "a woman of soft features, gentle manners and elegant presence." In 1750 she married Allen Macdonald of Kingsburgh, and in 1773 they emigrated to America. In the War of Independence he served the British government and was taken prisoner. In 1779 his wife returned home in a merchant ship which was attacked by a privateer. She refused to leave the deck during the action, and was wounded in the arm. She died on the 5th of March 1790. There is a statue to her memory in Inverness. Flora Macdonald had a large family of sons, who mostly entered the army or navy, and two daughters.

See A. C. Ewald, *Life and Times of Prince Charles Edward* (1886). The so-called *Autobiography* of Flora Macdonald, published by her grand-daughter F. F. Walde (1870) is of small value.

MACDONALD, GEORGE (1824–1905), Scottish novelist and poet, was born at Huntly, Aberdeenshire. His father, a farmer, was one of the Macdonalds of Glencoe, and a direct descendant of one of the families that suffered in the massacre. Macdonald's youth was passed in his native town, under the immediate influence of the Congregational Church, and in an atmosphere strongly impregnated with Calvinism. He took his degree at Aberdeen University, and migrated thence to London, studying at Highbury College for the Congregational ministry. In 1850 he was appointed pastor of Trinity Congregational Church, Arundel, and, after resigning his cure there, was engaged in ministerial work in Manchester. His health, however, was unequal to the strain, and after a short sojourn in Algiers he settled in London and adopted the profession of literature. In 1856 he published his first book, *Within and Without*, a dramatic poem; following it in 1857 with a volume of *Poems*, and in 1858 by the delightful "faerie romance" *Phantastes*. His first conspicuous success was achieved in 1862 with *David Elginbrod*, the forerunner of a number of popular novels, which include *Alec Forbes of Howglen* (1865), *Annals of a Quiet Neighbourhood* (1866), *Robert Falconer* (1868), *Malcolm* (1875), *The Marquis of Lossie* (1877), and *Donal Grant* (1883). He was for a time editor of *Good Words for the Young*, and lectured successfully in America in 1872–1873. He wrote admirable stories for the young, and published some volumes of sermons. In 1877 he was given a civil list pension. He died on the 18th of September 1905.

Both as preacher and as lecturer on literary topics George Macdonald's sincerity and moral enthusiasm exercised great influence upon thoughtful minds. His verse is homely and direct, and marked by religious fervour and simplicity. As a portrayer of Scottish peasant-life in fiction he was the precursor of a large school, which has benefited by his example and surpassed its original leader in popularity. The religious tone of his novels is relieved by tolerance and a broad spirit of humour, and the simpler emotions of humble life are sympathetically treated.

MACDONALD, SIR HECTOR ARCHIBALD (1852–1903), British soldier, was born of humble parentage at Muir of Allan-Grange, Ross-shire, Scotland, in 1852. As a boy he was employed in a draper's shop at Dingwall, but in 1870 he enlisted in the 92nd (Gordon) Highlanders. He rose rapidly through the non-commissioned ranks, and had already been a colour-sergeant for some years when, in the Afghan War of 1879, he distinguished himself in the presence of the enemy so much as to be promoted to commissioned rank, his advancement being equally acceptable to his brother officers and popular with the rank and file. As a subaltern he served in the first Boer War of 1880–81, and at Majuba, where he was made prisoner, his bravery was so conspicuous that General Joubert gave him back his sword. In 1885 he served under Sir Evelyn Wood in the reorganization of the Egyptian army, and he took part in the Nile Expedition of that year. In 1888 he became a regimental captain in the British service, but continued to serve in the Egyptian army, being particularly occupied with the training of the Sudanese battalions. In 1889 he received the D.S.O. for his conduct at Toski and in 1891, after the action at Tokar, he was promoted substantive major. In 1896 he commanded a brigade of the Egyptian army in the Dongola Expedition, and during the following campaigns he distinguished himself in every engagement, above all in the final battle of Omdurman (1898) at the crisis of which Macdonald's Sudanese brigade, manœuvring as a unit with the coolness and precision of the parade ground, repulsed the most determined attack of the Mahdists. After this great service Macdonald's name became famous in England and Scotland, the popular sobriquet of "Fighting Mac" testifying the interest aroused in the public mind by his career and his soldierly personality. He was promoted colonel in the army and appointed an aide-de-camp to the queen, and in 1899 he was promoted major-general and appointed to a command in India. In December 1899 he was called to South Africa to command the Highland Brigade, which had just suffered very heavily and had lost its commander, Major-General A. G. Wauchope, in the battle of Magersfontein. He commanded the brigade throughout Lord Roberts's Paardeberg, Bloemfontein and Pretoria operations, and in 1901 he was made a K.C. B. In 1902 he was appointed to command the troops in Ceylon, but early in the following year (March 25, 1903) he committed suicide in Paris. A memorial to this brilliant soldier, in the form of a tower 100 ft. high, was erected at Dingwall and completed in 1907.

MACDONALD, JACQUES ÉTIENNE JOSEPH ALEXANDRE (1765–1840), duke of Taranto and marshal of France, was born at Sedan on the 17th of November 1765. His father came of an old Jacobite family, which had followed James II. to France, and was a near relative of the celebrated Flora Macdonald. In 1785 Macdonald joined the legion raised to support the revolutionary party in Holland against the Prussians, and after it was disbanded he received a commission in the regiment of Dillon. On the breaking out of the Revolution, the regiment of Dillon remained eminently loyal, with the exception of Macdonald, who was in love with Mlle Jacob, whose father was enthusiastic for the doctrines of the Revolution. Directly after his marriage he was appointed aide-de-camp to General Dumouriez. He distinguished himself at Jemmapes, and was promoted colonel in 1793. He refused to desert to the Austrians with Dumouriez, and as a reward was made general of brigade, and appointed to command the leading brigade in Pichegru's invasion of Holland. His knowledge of the country proved most useful, and he was instrumental in the capture of the Dutch fleet by French hussars. In 1797, having been made general of division, he served first in the army of the Rhine and then in that of Italy. When he reached Italy, the peace of Campo Formio had been signed, and Bonaparte had returned to France; but, under the direction of Berthier, Macdonald first occupied Rome, of which he was made governor, and then in conjunction with Championnet he defeated General Mack, and revolutionized the kingdom of Naples under the title of the Parthenopaean Republic. When Suvarov invaded northern Italy, and was winning back the conquests of Bonaparte, Macdonald collected all the troops in the peninsula and moved northwards. With but 30,000 men he attacked, at the Trebbia, Suvarov with 50,000, and after three days' fighting, during which he held the Russians at bay, and gave time for Moreau to come up, he retired in good order to Genoa. After this gallant behaviour he was made governor of Versailles, and acquiesced, if he did not co-operate, in the events of the 18th Brumaire. In 1800 he received the command of the army in Switzerland which was to maintain the communications between the armies of Germany and of Italy. He carried out his orders to the letter, and at last, in the winter of 1800–1, he was ordered to march over the Splügen Pass. This achievement is fully described by Mathieu Dumas, who was chief of his staff, and is at least as noteworthy as Bonaparte's famous passage of the St Bernard before Marengo, though followed by no such successful battle. On his return to Paris Macdonald married the widow of General Joubert, and was appointed French plenipotentiary in Denmark. Returning in 1805 he associated himself with Moreau and incurred the dislike of Napoleon, who did not include him in his first creation of marshals. Till 1809 he remained without employment, but in that year Napoleon gave him the command of a corps and the duties of military adviser to the young prince Eugène Beauharnais, viceroy of Italy. He led the army from Italy till its junction with Napoleon, and at Wagram commanded the celebrated column of attack which broke the Austrian centre and won the victory. Napoleon made him marshal of France on the field of battle, and presently created him duke of Taranto. In 1810 he served in Spain, and in 1812 he commanded the left wing of the grand army for the invasion of Russia. In 1813, after sharing in the battles of Lützen and Bautzen, he was ordered to invade Silesia, where Blücher defeated him with great loss at the Katzbach (see NAPOLEONIC CAMPAIGNS). After the terrible battle of Leipzig he was ordered with Prince Poniatowski to cover the evacuation of Leipzig; after the blowing up of the bridge, he managed to swim the Elster, while Poniatowksi was drowned. During the defensive campaign of 1814 Macdonald again distinguished himself; he was one of the marshals sent by Napoleon to take his abdication in favour of his son to Paris. When all were deserting their old master, Macdonald remained faithful to him. He was directed by Napoleon to give in his adherence to the new régime, and was presented by him with the sabre of Murad Bey for his fidelity. At the Restoration he was made a peer of France and knight grand cross of the order of St Louis; he remained faithful to the new order of things during the Hundred Days. In 1815 he became chancellor of the Legion of Honour (a post he held till 1831), in 1816 major-general of the royal bodyguard, and he took a great part in the discussions in the House of Peers, voting consistently as a moderate Liberal. In 1823 he married Mlle de Bourgony, by whom he had a son, Alexander, who succeeded on his death in 1840 as duke of Taranto. From 1830 his life was spent in retirement at his country place Courcelles-le-Roi (Seine et Oise), where he died on the 7th of September 1840.

Macdonald had none of that military genius which distinguished Davout, Masséna and Lannes, nor of that military science conspicuous in Marmont and St Cyr, but nevertheless his campaign in Switzerland gives him a rank far superior to such mere generals of division as Oudinot and Dupont. This capacity for independent command made Napoleon, in spite of his defeats at the Trebbia and the Katzbach, trust him with large commands till the end of his career. As a man, his character cannot be spoken of too highly; no stain of cruelty or faithlessness rests on him.

Macdonald was especially fortunate in the accounts of his military exploits, Mathieu Dumas and Ségur having been on his staff in Switzerland. See Dumas, *Événements militaires*; and Ségur's rare tract, *Lettre sur la campagne du Général Macdonald dans les Grisons en 1800 et 1801* (1802), and *Éloge* (1842). His memoirs were published in 1892 (Eng. trans., *Recollections of Marshal Macdonald*), but are brief and wanting in balance.

MACDONALD, SIR JOHN ALEXANDER (1815–1891), first premier of the dominion of Canada, was born in Glasgow on the 11th of January 1815, the third child of Hugh Macdonald (d. 1841), a native of Sutherlandshire. The family emigrated to Canada in 1820, settling first at Kingston, Ontario. At the age of fifteen Macdonald entered a law office; he was called to the bar in 1836, and began practice in Kingston, with immediate success. Macdonald entered upon his active career at a critical period in the history of Canada, and the circumstances of the time were calculated to stimulate political thought. It was the year before the rebellion of 1837; the condition of the whole country was very unsettled; and it seemed well-nigh impossible to reconcile differences arising from racial and political antagonisms. During the rebellion young Macdonald volunteered for active service, but his military career never went farther than drilling and marching. The mission of Lord Durham; the publication of his famous report; the union of the two Canadas; the administrations of Lord Sydenham, Sir Charles Bagot, and Sir Charles Metcalfe, filled the years immediately succeeding 1837 with intense political interest, and in their results have profoundly influenced the constitution of the British Empire.

Macdonald made his first acquaintance with public business as an alderman of Kingston. In 1844 Sir Charles Metcalfe, in his contest with the Reform party led by Baldwin and Lafontaine, appealed to the electors, and Macdonald was elected to the provincial assembly as Conservative member for Kingston. A sentence in his first address to the electors strikes the dominant note of his public career: "I therefore need scarcely state my firm belief that the prosperity of Canada depends upon its permanent connexion with the mother country, and that I shall resist to the utmost any attempt (from whatever quarter it may come) which may tend to weaken that union." He took his seat on the 28th of November as a supporter of the Draper government. During the first three or four years he spoke little, but devoted himself with assiduity to mastering parliamentary forms and the business of the house. His capacity soon attracted attention, and in 1847 he was made receiver-general with a seat in the executive council, an office soon exchanged for the more important one of commissioner of Crown-lands. Although the government of which he thus became a member held office for only ten months, being placed in a hopeless minority on making an appeal to the country, Macdonald from this time forward took a position of constantly increasing weight in his party.

One of the first acts of the Reform government which succeeded that of which Macdonald was a member was to pass the Rebellion Losses Bill, made famous in colonial history by the fact that it brought to a crucial test the principle of responsible government. The assent of Lord Elgin to the bill provoked in Montreal a riot which ended in the burning of the houses of parliament, and so great was the indignation of the hitherto ultra-loyal Conservative party that many of its most prominent members signed a document favouring annexation to the United States; Macdonald on the other hand took steps, in conjunction with others, to form a British-American league, having for its object the confederation of all the provinces, the strengthening of the connexion with the mother country, and the adoption of a national commercial policy. He remained in opposition from 1848 till 1854, holding together under difficult circumstances an unpopular party with which he was not entirely in sympathy. The two great political issues of the time were the secularization of the clergy reserves in Ontario, and the abolition of seigniorial tenure in Quebec. Both of these reforms Macdonald long opposed, but when successive elections had proved that they were supported by public opinion, he brought about a coalition of Conservatives and moderate reformers for the purpose of carrying them.

Out of this coalition was gradually developed the Liberal-conservative party, of which until his death Macdonald continued to be the most considerable figure, and which for more than forty years largely moulded the history of Canada. From 1854 to 1857 he was attorney-general of Upper Canada, and then, on the retirement of Colonel Taché, he became prime minister. This first coalition had now accomplished its temporary purpose, but so closely were parties divided at this period, that the defeat and reinstatement of governments followed each other in rapid succession.

The experiment of applying responsible government on party lines to the two Canadian provinces at last seemed to have come to a deadlock. Two general elections and the defeat of four ministries within three years had done nothing to solve the difficulties of the situation. At this critical period a proposal was made for a coalition of parties in order to carry out a broad scheme of British-American confederation. The immediate proposal is said to have come from George Brown; the large political idea had long been advocated by Macdonald and Alexander Galt in Upper Canada—by Joseph Howe and others in the maritime provinces. The close of the American Civil War, the Fenian raids across the American border, and the dangers incident to the international situation, gave a decisive impulse to the movement. Macdonald, at the head of a representative delegation from Ontario and Quebec, met the public men of the maritime provinces in conference at Charlottetown in 1864, and the outline of confederation then agreed upon was filled out in detail at a conference held at Quebec soon afterwards. The actual framing of the British North America Act, into which the resolutions of these two conferences were consolidated, was carried out at the Westminster Palace Hotel in London, during December 1866 and January 1867, by delegates from all the provinces working in co-operation with the law officers of the Crown, under the presidency of Lord Carnarvon, then secretary of state for the colonies. Macdonald took the leading part in all these discussions, and he thus naturally became the first premier of the Dominion. He was made a K.C.B. in recognition of his services to the empire.

The difficulties of organizing the new Dominion, the questions arising from diverse claims and the various conditions of the country, called for infinite tact and resource on the part of the premier. Federal rights were to be safeguarded against the provincial governments, always jealous of their privileges. The people of Nova Scotia in particular, dissatisfied with the way in which their province had been drawn into the Union, maintained a fierce opposition to the Ottawa government, until their leader, Joseph Howe, fearing an armed rising, came to an agreement with Macdonald and accepted a seat in his cabinet. The establishment of a supreme court also occupied the attention of Sir John, who had a strong sense of the necessity of maintaining the purity and dignity of the judicial office. The act creating this court was finally passed during the administration of Alexander Mackenzie. The pledge made at confederation with regard to the building of the Intercolonial railway to connect the maritime provinces with those of the St Lawrence was fulfilled. The North-West Territories were secured as a part of confederated Canada by the purchase of the rights of the Hudson's Bay Company, and the establishment of Manitoba as a province in 1870. Canada's interests were protected during the negotiations which ended in the treaty of Washington in 1871, and in which Sir John took a leading part as one of the British delegates. In this year British Columbia entered the confederation, one of the provisions of union being that a transcontinental railroad should be built within ten years. This was declared by the opposition to be impossible. It was possible only to a leader of indomitable will. Charges of bribery against the government in connexion with the contract for the building of this line led to the resignation of the cabinet in 1874, and for four years Sir John was in opposition. But he was by no means inactive. During the summer of 1876 he travelled through Ontario addressing the people on the subject of a commercial system looking to the protection of native industries. This was the celebrated "National Policy," which had been in his thoughts as long ago as the formation of the British-American League in 1850. The government of Alexander Mackenzie refused to consider a protection policy, and determined to adhere to Free Trade, with a tariff for revenue only. On these strongly defined issues the two parties appealed to the people in 1878. The Liberal party was almost swept away, and Sir John, on his return to power, put his policy into effect with a thoroughness that commanded the admiration even of his opponents, who, after long resistance, adopted it on their accession to office in 1896. He also undertook the immediate construction of the Canadian Pacific railway, which had been postponed by the former government. The line was begun late in 1880, and finished in November 1885—an achievement which Sir John ranked among his greatest triumphs. "The faith of Sir John," says one of his biographers, "did more to build the road than the money of Mount-Stephen."

During the remaining years of his life his efforts at administration were directed mainly towards the organization and development of the great North-West. From 1878 until his death in 1891 Sir John retained his position as premier of Canada, and his history is practically that of Canada (*q.v.*). For forty-six years of a stormy political life he remained true to the cardinal policy that he had announced to the electors of Kingston in 1844. "A British subject I was born; a British subject I will die," says his last political manifesto to the people of the Dominion. At his advanced age the anxiety and excitement of the contested election of 1891 proved too great. On the 29th of May he suffered a stroke of paralysis, which caused his death eight days later (June 6).

The career of Sir John Macdonald must be considered in connexion with the political history of Canada and the conditions of its government during the latter half of the 19th century. Trained in a school where the principles of responsible government were still in an embryonic state, where the adroit management of coalitions and cabals was essential to the life of a political party, and where plots and counterplots were looked upon as a regular part of the political game, he acquired a dexterity and skill in managing men that finally gave him an almost autocratic power among his political followers. But great personal qualities supplemented his political dexterity and sagacity. A strong will enabled him to overcome the passionate temper which marked his youth, and later in his career a habit of intemperance, which he at first shared with many public men of his time. He was a man of strong ambitions, but these were curbed by a shrewd foresight, which led him for a long time to submit to the nominal leadership of other and smaller men. Politics he made his business, and to this he devoted all his energies. He had the gift of living for the work in hand without feeling the distraction of other interests. He had a singular faculty for reading the minds and the motives of men, and to this insight he perhaps owed the power of adaptability (called by his opponents shiftiness) which characterized his whole career. To this power the successful guidance of the Dominion through its critical formative period must be ascribed. Few political leaders have ever had such a number of antagonistic elements to reconcile as presented themselves in the first Canadian parliament after confederation. The man who could manage to rule a congeries of jealous factions, including Irish Catholics and Orangemen, French and English anti-federationists and agitators for independence, Conservatives and Reformers, careful economists and prodigal expansionists, was manifestly a man of unusual power, superior to small prejudices, and without strong bias towards any creed or section. Such a man Macdonald proved himself to be. His personality stands out at this period as the central power in which each faction chiefly reposed trust, and under which it could join hands with the others in the service of the state. His singleness of purpose, personal independence and indomitable energy enabled him to achieve triumphs that to others seemed impossible. His methods cannot always be defended, and were explained by himself only on grounds of necessity and the character of the electorate with which he had to deal. After the "Pacific scandal" of 1874 the leader of the opposite party declared that "John A." (as he was generally called) "has fallen, never to rise again." Yet he not only cleared his own character from the charges laid against him, but succeeded four years later in achieving his most signal party triumph. His natural urbanity allowed him to rule without seeming to rule. When baffled in minor objects he gave way with a good-natured flexibility which brought upon him at times charges of inconsistency. Yet Canada has seen statesmen of more contracted view insist on such small points, fall, and drag down their party with them. He lived at a time when the exigencies of state seemed to require the peculiar talents which he possessed. Entering politics at the dreariest and least profitable stage in Canadian history, he took the foremost part in the movement which made of Canada a nation; he guided that nation through the nebulous stages of its existence, and left it united, strong and vigorous, a monument to his patriotic and far-sighted statesmanship. His statue adorns the squares of the principal Canadian towns. In the crypt of St Paul's Cathedral a memorial has rightly been placed to him as a statesman, not merely of Canada, but of the empire. In unveiling that memorial Lord Rosebery fitly epitomized the meaning of his life and work when he said: "We recognize only this, that Sir John Macdonald had grasped the central idea that the British Empire is the greatest secular agency for good now known to mankind; that that was the secret of his success; and that he determined to die under it, and strove that Canada should live under it." Macdonald became a member of the Imperial Privy Council in 1879, and in 1884 he received the Grand Cross of the Bath. His first wife was his cousin, Miss Isabella Clark, who died in 1858, leaving one surviving son, the Hon. Hugh John Macdonald, at one time premier of the province of Manitoba. By his second marriage, to Miss Bernard in 1867, Macdonald left an only daughter. On his death in 1891 his widow was created Baroness Macdonald of Earnscliffe.

The authorized and fullest biography of Sir John A. Macdonald is one written by his private secretary, Joseph Pope. Others have been written by his nephew, Colonel J. Pennington Macpherson, and by J. E. Collins. A bright and amusing anecdotal life has been compiled by E. D. Biggar. A condensed biography by G. R. Parkin forms one of the "Makers of Canada" series (Toronto, 1907; new ed., 1909). (G. R. P.)

MACDONALD, JOHN SANDFIELD (1812–1872), Canadian statesman, was born at St Raphael, Glengarry county, Ontario, on the 12th of December 1812. He was admitted to the bar in 1840, and settled in Cornwall. In the same year he married Miss Waggaman, the daughter of an American senator from Louisiana. In 1841 he was elected to the Canadian parliament for Glengarry, which seat he held for sixteen years. In 1842 he joined the Reformers in the cry for constitutional government, and from 1852 to 1854 was Speaker of the house. He was always uncertain in his party allegiance, and often attacked George Brown, the Liberal leader. Indeed, he well described himself as "the Ishmael of parliament." In 1862 he was called on by Lord Monck, the governor-general, to form a ministry, which by manifold shifts held office till February 1864. In the debates on federation he opposed the measure, but on its passage was in 1867 entrusted by the Conservatives with the task of organizing the provincial government of Ontario. He ruled the province with economy and efficiency, but was defeated in December 1871 by the Liberals, resigned the premiership, and died on the 1st of June 1872.

MACDONALD, LAWRENCE (1799–1878), British sculptor, was born at Findo-Gask, Perthshire, Scotland. In early life he served as a mason's apprentice. Having shown an aptitude for stone carving, he became an art student at the Trustees' Academy, Edinburgh. By the help of friends he was enabled to visit Rome, where together with other artists he helped to found the British Academy of Arts. He returned to Edinburgh in 1826. In 1829 he was elected a member of the Scottish Academy. From 1832 until his death his home was in Rome. Among his ideal works may be mentioned "Ulysses and his Dog Argos," "Andromeda chained to the Rock," "Eurydice," "Hyacinth," a "Siren," and a "Bacchante."

MACDONELL, JAMES (1841–1879), British journalist, was born at Dyce, Aberdeenshire. In 1858, after his father's death, he became clerk in a merchant's office. He began writing in the *Aberdeen Free Press*; in 1862 he was appointed to the staff of the *Daily Review* at Edinburgh, and at twenty-two he became editor of the *Northern Daily Express*. In 1865 he went to London to accept a position on the staff of the *Daily Telegraph*, which he retained until 1875, being special correspondent in France in 1870 and 1871. In 1873 he became a leader-writer on *The Times*. He died in London on the 2nd of March 1879. His posthumous *France since the First Empire*, though incomplete, gave a clever and accurate account of the French politics of his time.

MACDONNELL (or MACDONELL), **ALESTAIR** (*i.e.* Alexander) **RUADH** (*c.* 1725–1761), chief of Glengarry, a Scottish Jacobite who has been identified by Andrew Lang as the secret agent "Pickle," who acted as a spy on Prince Charles Edward after 1750. The family were a branch of the clan Macdonald, but spelt their name Macdonnell or Macdonell. His father was John, 12th chief of Glengarry, a violent and brutal man, who is said to have starved his first wife, Alestair's mother, to death on an island in the Hebrides. Alestair ran away to France while a mere boy in 1738, and there entered the Royal Scots, a regiment in the French service. In 1743 he commanded a company in it, and in 1744 was sent to Scotland as a Jacobite agent. In January 1745 he was sent back with messages, and was in France when Prince Charles Edward landed in Scotland. Late in 1745 he was captured at sea while bringing a picquet of the Royal Scots to help the prince. He remained a prisoner in the Tower for twenty-two months, and when released went abroad. In 1744 his father had made a transfer to him of the family estates, which were ruined. Alestair, who still affected to be a Jacobite, lived for a time in great poverty. In 1749 he was in London, and there is good reason to believe that he then offered his services as a spy to the British government, with which he communicated under the name of Pickle. His information enabled British ministers to keep a close watch on the prince and on the Jacobite conspiracies. Though he was denounced by a Mrs Cameron, whose husband he betrayed to death in 1752, he never lost the confidence of the Jacobite leaders. On the death of his father, in 1754, he succeeded to the estates, and proved himself a greedy landlord. He died on the 23rd of December 1761.

See Andrew Lang, *Pickle the Spy* (1897) and *The Companions of Pickle* (1898).

MACDONNELL, SORLEY BOY (*c.* 1505–1590), Scoto-Irish chieftain, son of Alexander Macdonnell, lord of Islay and Kintyre (Cantire), was born at Ballycastle, Co. Antrim. From an ancestor who about a hundred years earlier had married Margaret Bisset, heiress of the district on the Antrim coast known as the Glynns (or Glens), he inherited a claim to the lordship of that territory; and he was one of the most powerful of the Scottish settlers in Ulster whom the English government in the 16th century found difficulty in bringing into subjection. Many attempts were made to drive them out of Ireland, in one of which, about 1550, Sorley Boy Macdonnell was taken prisoner and conveyed to Dublin Castle, where, however, his confinement was brief. The chief rivals of the Macdonnells were the Mac Quillins who dominated the northern portion of Antrim, known as the Route, and whose stronghold was Dunluce Castle, near the mouth of the Bush. Sorley Boy Macdonnell took an active part in the tribal warfare between his own clan and the Mac Quillins; and in 1558, when the latter had been to a great extent overcome, his elder brother James committed to him the lordship of the Route, his hold on which he made good by decisively defeating the Mac Quillins in Glenshesk. Sorley Boy was now too powerful and turbulent to be neglected by Queen Elizabeth and her ministers, who were also being troubled by his great contemporary, Shane O'Neill; and the history of Ulster for the next twenty years consists for the most part of alternating conflict and alliance between Macdonnells and O'Neills, and attempts on the part of the English government to subdue them both. With this object Elizabeth aimed at fomenting the rivalry between the two clans; and she came to terms sometimes with the one and sometimes with the other. Sorley Boy's wife was an illegitimate half-sister of Shane O'Neill; but this did not deter him from leaguing himself with the government against the O'Neills, if by so doing he could obtain a formal recognition of his title to the lands of which he was in actual possession. In 1562 Shane O'Neill paid his celebrated visit to London, where he obtained recognition by Elizabeth of his claims as head of the O'Neills; and on his return to Ireland he attacked the Macdonnells, ostensibly in the English interest. He defeated Sorley Boy near Coleraine in the summer of 1564; in 1565 he invaded the Glynns, and at Ballycastle won a decisive victory, in which James Macdonnell and Sorley Boy were taken prisoners. James soon afterwards died, but Sorley Boy remained O'Neill's captive till 1567, when Shane was murdered by the Macdonnells at Cushendun (see O'NEILL). Sorley Boy then went to Scotland to enlist support, and he spent the next few years in striving to frustrate the schemes of Sir Thomas Smith, and later of the earl of Essex, for colonizing Ulster with English settlers. Sorley Boy was willing to come to terms with the government provided his claims to his lands were allowed, but Essex determined to reduce him to unconditional submission. John Norris was ordered to proceed by sea from Carrickfergus to Rathlin Island, where Sorley Boy's children and valuables, together with the families of his principal retainers, had been lodged for safety; and while the chieftain was himself at Ballycastle, within sight of the island, the women and children were massacred by the English. Sorley Boy retaliated by a successful raid on Carrickfergus and by re-establishing his power in the Glynns and the Route, which the Mac Quillins made ineffectual attempts to recover. Macdonnell's position was still further strengthened by an alliance with Turlough Luineach O'Neill, and by a formidable immigration of followers from the Scottish islands. In 1584 Sir John Perrot determined to make a further effort to subdue the turbulent chieftain. After another expedition to Scotland seeking help, Sorley Boy landed at Cushendun in January 1585, and his followers regained possession of Dunluce Castle. In these circumstances Sir John Perrot opened negotiations with Sorley Boy, who in the summer of 1586 repaired to Dublin and made submission to Elizabeth's representative. He obtained a grant to himself and his heirs of all the Route country between the rivers Bann and Bush, with certain other lands to the east, and was made constable of Dunluce Castle. For the rest of his life Sorley Boy gave no trouble to the English government. He died in 1590, and was buried in Bonamairgy Abbey, at Ballycastle. He is said to have married when over eighty years of age, as his second wife, a daughter of Turlough Luineach O'Neill, a kinswoman of his first wife; and two of his five daughters married members of the O'Neill family. Sorley Boy had several sons by his first marriage, one of whom, Randal, was created earl of Antrim (*q.v.*), and was ancestor of the present holder of that title.

See G. Hill, *An Historical Account of the Macdonnells of Antrim* (London, 1873); Richard Bagwell, *Ireland under the Tudors* (3 vols., London, 1885–1890); *Calendar of State Papers: Carew MSS.* i., ii., (6 vols., 1867–1873); Donald Gregory, *History of the Western Highlands and Isles of Scotland 1493–1625* (London, 1881); Sir J. T. Gilbert, *History of the Viceroys of Ireland* (Dublin, 1865). (R. J. M.)

MACDONOUGH, THOMAS (1786–1825), American sailor, was born in the state of Delaware, his father being an officer of the Continental Army, and entered the United States navy in 1800. During his long service as a lieutenant he took part in the bombardment of Tripoli, and on a subsequent occasion showed great firmness in resisting the seizure of a seaman as an alleged deserter from the British navy, his ship at the time lying under the guns of Gibraltar. When war with England broke out, in 1812, he was ordered to cruise in the lakes between Canada and the United States, with his headquarters on lake Champlain. He was instrumental in saving New York and Vermont from invasion by his brilliant victory of lake Champlain gained, on the 11th of September 1814, with a flotilla of 14 vessels carrying 86 guns, over Captain George Downie's 16 vessels and 92 guns. For this important achievement New York and Vermont granted him estates, whilst Congress gave him a gold medal.

MacDOWELL, EDWARD ALEXANDER (1861–1908), American musical composer, was born in New York City on the 18th of December 1861. His father, an Irishman of Belfast, had emigrated to America shortly before the boy's birth. He had a varied education in music, first under Spanish-American teachers, and then in Europe, at Paris (Debussy being a fellow pupil), Stuttgart, Wiesbaden and Weimar, where he was chiefly influenced by Joachim, Raff and Liszt. From 1879 to 1887 he lived in Germany, teaching and studying, and also appearing as solo pianist at important concerts. In 1884 he married Marian Nevins, of New York. In 1888 he returned to America, and settled in Boston till in 1896 he was made professor of music at Columbia University, New York. He resigned this post in 1904, and in 1905 overwork and insomnia resulted in a complete cerebral collapse. He died on the 24th of January 1908. MacDowell's work gives him perhaps the highest place among American composers. Deeply influenced by modern French models and by German romanticism, full of poetry and "atmosphere," and founded on the "programme," idea of composition, it is essentially creative in the spirit of a searcher after delicate truths of artistic expression. His employment of touches of American folk-song, suggested by Indian themes, is characteristic. This is notably the case with his orchestral *Indian Suite* (1896) and *Woodland Sketches* for the piano. His first concerto, in A minor, for piano and orchestra, and first pianoforte suite, were performed at Weimar in 1882. His works include orchestral suites and "poems," songs, choruses, and various pieces for pianoforte, his own instrument; they are numbered from *op.* 9 to *op.* 62, his first eight numbered works being destroyed by him.

See Lawrence Gilman, *Edward MacDowell* (1906).

McDOWELL, IRVIN (1818–1885), American soldier, was born in Columbus, Ohio, on the 15th of October 1818. He was educated in France, and graduated at the U. S. military academy in 1838. From 1841 to 1845 he was instructor, and later adjutant, at West Point. He won the brevet of captain in the Mexican War, at the battle of Buena Vista, and served as adjutant-general, chiefly at Washington, until 1861, being promoted major in 1856. In 1858–1859 he visited Europe. Whilst occupied in mustering volunteers at the capital, he was made brigadier-general in May 1861, and placed in command during the premature Virginian campaign of July, which ended in the defeat at Bull Run. Under McClellan he became a corps commander and major-general of volunteers (March 1862). When the Peninsular campaign began McDowell's corps was detained against McClellan's wishes, sent away to join in the fruitless chase of "Stonewall" Jackson in the Shenandoah Valley, and eventually came under the command of General Pope, taking part in the disastrous campaign of Second Bull Run. Involved in Pope's disgrace, McDowell was relieved of duty in the field (Sept. 1862), and served on the Pacific coast 1864–68. He became, on Meade's death in November 1872, major-general of regulars (a rank which he already held by brevet), and commanded successively the department of the east, the division of the south, and the division of the Pacific until his retirement in 1882. The latter years of his life were spent in California, and he died at San Francisco on the 4th of May 1885. As a commander he was uniformly unfortunate. Undoubtedly he was a faithful, unselfish and energetic soldier, in patriotic sympathy with the administration, and capable of great achievements. It was his misfortune to be associated with the first great disaster to the Union cause, to play the part of D'Erlon at Quatre-Bras between the armies of Banks and McClellan, and finally to be involved in the catastrophe of Pope's campaign. That he was perhaps too ready to accept great risks at the instance of his superiors is the only just criticism to which his military character was open.

MACDUFF, a police burgh and seaport of Banffshire, Scotland. Pop. (1901), 3431. It lies on the right bank of the mouth of the Deveron, 1 m. E. of Banff and 50¼ m. N.W. of Aberdeen by the Great North of Scotland railway. The site was originally occupied by the fishing village of Doune, but after its purchase by the 1st earl of Fife, about 1732, the name was altered to Macduff by the 2nd earl, who also procured for it in 1783 a royal charter constituting it a burgh. In honour of the occasion he rebuilt the market cross, in front of the parish church. The harbour, safer and more accessible than that of Banff, was constructed by the duke of Fife, and transferred to the burgh in 1898. The inhabitants are chiefly employed in the herring fishery, but there is some boat-building, besides rope-and-sail making, manure works, saw-mills and oilcake mills. A stone bridge across the Deveron communicates with Banff. Good bathing facilities, a bracing climate and a mineral well attract numerous visitors to Macduff every summer. The burgh unites with Banff, Cullen, Elgin, Inverurie, Kintore and Peterhead (the Elgin burghs) in returning one member to parliament.

McDUFFIE, GEORGE (1788–1851), American political leader, was born in Columbia county, Georgia. He was admitted to the bar in 1814, and served in the South Carolina General Assembly in 1818–1821, and in the national House of Representatives in 1821–1834. In 1821 he published a pamphlet in which strict construction and states' rights were strongly denounced; yet in 1832 there were few more uncompromising nullificationists. The change seems to have been gradual, and to have been determined in part by the influence of John C. Calhoun. When, after 1824, the old Democratic-Republican party split into factions, he followed Andrew Jackson and Martin Van Buren in opposing the Panama Congress and the policy of making Federal appropriations for internal improvements. He did not hesitate, however, to differ from Jackson on the two chief issues of his administration: the Bank and nullification. In 1832 he was a prominent member of the South Carolina Nullification Convention, and drafted its address to the people of the United States. He served as governor in 1834–1836, during which time he helped to reorganize South Carolina College. From January 1843 until January 1846 he was a member of the United States Senate. The leading Democratic measures of those years all received his hearty support. McDuffie, like Calhoun, became an eloquent champion of state sovereignty; but while Calhoun emphasized state action as the only means of redressing a grievance, McDuffie paid more attention to the grievance itself. Influenced in large measure by Thomas Cooper, he made it his special work to convince the people of the South that the downfall of protection was essential to their material progress. His argument that it is the producer who really pays the duty of imports has been called the economic basis of nullification. He died at Cherry Hill, Sumter district, South Carolina, on the 11th of March 1851.

MACE (Fr. *masse*, O. Fr. *mace*, connected with Lat. *mateola*, a mallet), originally a weapon of offence, made of iron, steel or latten, capable of breaking through the strongest armour.[1] The earliest *ceremonial* maces, as they afterwards became, though at first intended to protect the king's person, were those borne by the serjeants-at-arms, a royal body-guard established in France by Philip II., and in England probably by Richard I. By the 14th century a tendency towards a more decorative serjeant's mace, encased with precious metals, is noticeable. The history of the civic mace (carried by the serjeants-at-mace) begins about

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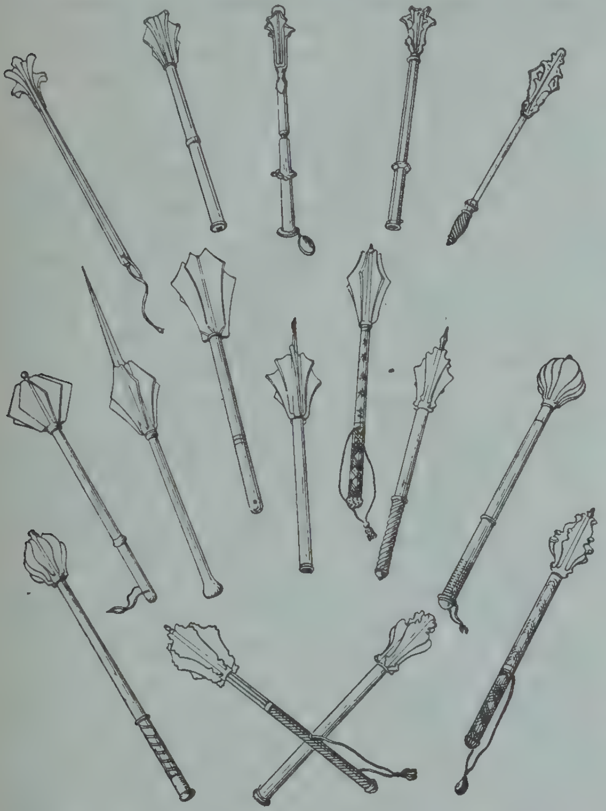
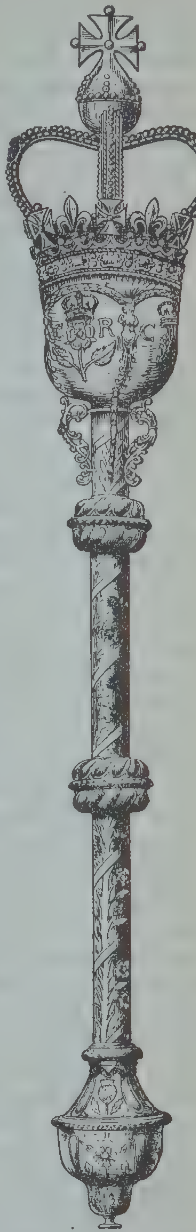
[1] The mace was carried in battle by medieval bishops (Odo of Bayeux is represented on the Bayeux tapestry as wielding one) instead of the sword, so as to conform to the canonical rule which forbade priests to shed blood.—[Ed.]



From Jewitt and Hope's *Corporation Plate and Insignia* (1895), by permission of Bemrose & Co.

FIG. 1.—Group of War Maces of the 15th and 16th centuries.

the middle of the 13th century, though no examples of that period are in existence to-day. Ornamented civic maces were considered an infringement of one of the privileges of the king's serjeants, who, according to the Commons' petition in 1344, were alone deemed worthy of having maces enriched with costly metals. This privilege was, however, granted to the serjeants of London, and later to those of York (in 1396), Norwich (in 1403/4) and Chester (in 1506). Maces covered with silver are known to have been used at Exeter in 1387/8; two were bought at Norwich in 1435, and others for Launceston in 1467/8. Several other cities and towns had silver maces in the next century, and in the 16th they were almost universally used. Early in the 15th century the flanged end of the mace, *i.e.* the head of the war mace, was borne uppermost, and the small button with the royal arms in the base. By the beginning of the Tudor period, however, these blade-like flanges, originally made for offence, degenerated into mere ornaments, while the greater importance of the end with the royal arms (afterwards enriched with a cresting) resulted in the reversal of the position. The custom of carrying the flanged end upward did not die out at once: a few maces were made to carry both ways, such as the beautiful pair of Winchcombe silver maces, dating from the end of the 15th century. The Guildford mace is one of the finest of the fifteen specimens of the 15th century. The flanged ends of the maces of this period were often beautifully pierced and decorated. These flanges gradually became smaller, and later (in the 16th and early 17th centuries) developed into pretty projecting scroll-brackets and other ornaments, which remained in vogue till about 1640. The next development in the embellishment of the shaft was the reappearance of these small scroll-brackets on the top, immediately under the head of the mace. They disappear altogether from the foot in the last half of the 17th century, and are found only under the heads, or, in rarer instances, on a knob on the shaft. The silver mace-heads were mostly plain, with a cresting of leaves or flowers in the 15th and 16th centuries. In the reign of James I. they began to be engraved and decorated with heraldic devices, &c. As the custom of having serjeants' maces ceased (about 1650), the large maces, borne before the mayor or bailiffs, came into general use. Thomas Maundy was the chief maker of maces during the Commonwealth. He made the mace for the House of Commons in 1649, which is the one at present in use there, though without the original head with the non-regal symbols, the latter having been replaced by one with regal symbols at the Restoration. There are two maces in the House of Lords, the earliest dating from the reign of William III. The dates of the eight large and massive silver-gilt maces of the serjeants-at-arms, kept in the jewel-house at the Tower of London, are as follows: two of Charles II., two of James II., three of William and Mary, and one of Queen Anne (the cypher of George I. was subsequently added to the latter). All the foregoing are of the type which was almost universally adopted, with slight differences, at the Restoration. The civic maces of the 18th century follow this type, with some modifications in shape and ornamentation. The historic English silver maces of the 18th century include the one of 1753 at Norfolk, Virginia, and that of 1756 of the state of South Carolina, both in the United States of America; two, made in 1753 and 1787, at Jamaica; that of 1791 belonging to the colony of Grenada, and the Speaker's mace at Barbados, dating from 1812; and the silver mace of the old Irish House of Commons, 1765–1766, now in the possession of Lord Massereene and Ferrard.



From Jewitt and Hope's *Corporation Plate and Insignia* (1895), by permission of Bemrose & Co.

FIG. 2.—Mace of the House of Commons.

Among other maces, more correctly described as staves, in use at the present time, are those carried before ecclesiastical dignitaries and clergy in cathedrals and parish churches and the maces of the universities. At Oxford there are three of the second half of the 16th century and six of 1723–1724, while at Cambridge there are three of 1626 and one of 1628, but altered at the Commonwealth and again at the Restoration. The silver mace with crystal globe of the lord high treasurer of Scotland, at Holyrood Palace, was made about 1690 by Francis Garthorne. The remarkable mace or sceptre of the lord mayor of London is of crystal and gold and set with pearls; the head dates from the 15th century, while the mounts of the shaft are early medieval. A mace of an unusual form is that of the Tower ward of London, which has a head resembling the White Tower in the Tower of London, and which was made in the reign of Charles II. The beautiful mace of the Cork gilds, made by Robert Goble of Cork in 1696 for the associated gilds, of which he had been master, is in the Victoria and Albert Museum, where there is also a large silver mace of the middle of the 18th century, with the arms of Pope Benedict XIV., which is said to have been used at the coronation of Napoleon as king of Italy at Milan in 1805.

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MACEDO, JOSÉ AGOSTINHO DE (1761–1831), Portuguese poet and prose writer, was born at Beja of plebeian family, and studied Latin and rhetoric with the Oratorians in Lisbon. He became professed as an Augustinian in 1778, but owing to his turbulent character he spent a great part of his time in prison, and was constantly being transferred from one convent to another, finally giving up the monastic habit to live licentiously in the capital. In 1792 he was unfrocked, but by the aid of powerful friends he obtained a papal brief which secularized him and permitted him to retain his ecclesiastical status. Taking to journalism and preaching he now made for himself a substantial living and a unique position. In a short time he was recognized as the leading pulpit orator of the day, and in 1802 he became one of the royal preachers. Macedo was the first to introduce from abroad and to cultivate didactic and descriptive poetry, the best example of which is his notable transcendental poem *Meditation* (1813). His colossal egotism made him attempt to supersede Camoens as Portugal's greatest poet, and in 1814 he produced *Oriente*, an insipid epic notwithstanding its correct and vigorous verse, dealing with the same subject as the *Lusiads*—Gama's discovery of the sea route to India. This amended paraphrase met with a cold reception, whereupon Macedo published his *Censura dos Lusiadas*, containing a minute examination and virulent indictment of Camoens. Macedo founded and wrote for a large number of journals, and the tone and temper of these and his political pamphlets induced his leading biographer to name him the "chief libeller" of Portugal, though at the time his jocular and satirical style gained him popular favour. An extreme adherent of absolutism, he expended all his brilliant powers of invective against the Constitutionalists, and advocated a general massacre of the opponents of the Miguelite régime. Notwithstanding his priestly office and old age, he continued his aggressive journalistic campaign, until his own party, feeling that he was damaging the cause by his excesses, threatened him with proceedings, which caused him in 1829 to resign the post of censor of books for the Ordinary, to which he had been appointed in 1824. Though his ingratitude was proverbial, and his moral character of the worst, when he died in 1831 he left behind him many friends, a host of admirers, and a great but ephemeral literary reputation. His ambition to rank as the king of letters led to his famous conflict with Bocage (*q.v.*), whose poem *Pena de Talião* was perhaps the hardest blow Macedo ever received. His malignity reached its height in a satirical poem in six cantos, *Os Burros* (1812–1814), in which he pilloried by name men and women of all grades of society, living and dead, with the utmost licence of expression. His translation of the *Odes* of Horace, and his dramatic attempts, are only of value as evidence of the extraordinary versatility of the man, but his treatise, if his it be, *A Demonstration of the Existence of God*, at least proves his possession of very high mental powers. As a poet, his odes on Wellington and the emperor Alexander show true inspiration, and the poems of the same nature in his *Lyra anacreontica*, addressed to his mistress, have considerable merit.

See *Memorias para la vida intima de José Agostinho de Macedo* (ed. Th. Braga, 1899); *Cartas e opusculos* (1900); *Censuras á diversas obras* (1901). (E. Pr.)

MACEDONIA, the name generally given to that portion of European Turkey which is bounded on the N. by the Kara-Dagh mountain range and the frontier of Bulgaria, on the E. by the river Mesta, on the S. by the Aegean Sea and the frontier of Greece, and on the W. by an ill-defined line coinciding with the mountain chains of Shar (ancient *Scardus*) Grammus and Pindus. The Macedonia of antiquity was originally confined to the inland region west of the Axius, between that river and the Scardus range, and did not include the northern portion, known as Paeonia, or the coast-land, which, with the eastern districts, was inhabited by Thracian tribes; the people of the country were not Hellenic. In modern Macedonia are included the vilayet of Salonica (Turk. *Selanik*), the eastern and greater portion of the vilayet of Monastir (sanjaks of Monastir, Servia [Turk. *Selfije*], and part of that of Kortcha), and the south-eastern portion of the vilayet of Kossovo (sanjak of Usküb). The greater part of Macedonia is inhabited by a Slavonic population, mainly Bulgarian in its characteristics; the coast-line and the southern districts west of the Gulf of Salonica by Greeks, while Turkish, Vlach and Albanian settlements exist sporadically, or in groups, in many parts of the country.

Geographical Features.—The coast-line is broken by the remarkable peninsula of Chalcidice, with its three promontories of Athos (ancient *Acte*), Longus (*Sithonia*) and Cassandra (*Pallene*). The country is divided into two almost equal portions by the river Vardar (*Axius*), the valley of which has always constituted the principal route from Central Europe to the Aegean. Rising in the Shar mountains near Gostivar (Bulgarian *Kostovo*), the Vardar, flowing to the N.E., drains the rich elevated plain of Tetovo (Turk. *Kalkandelen*) and, turning to the S.E. at the foot of Mt Liubotrn, traverses the town and plain of Usküb, leaving to the left the high plateau of Ovchepolye ("the sheep-plain"); then flowing through the town of Veles, it receives on its right, near the ruins of the ancient Stobi, the waters of its principal tributary, the Tcherna (*Erigon*), which drains the basin of Monastir and the mountainous region of Morichovo, and after passing through the picturesque gorge of Demir-Kapu (the Iron Gate) finds its way to the Gulf of Salonica through the alluvial tract known as the Campania, extending to the west of that town. The other important rivers are the Struma (*Strymon*) and Mesta (*Nestus*) to the east, running almost parallel to the Vardar, and the Bistritza in the south, all falling into the Aegean. (The Black Drin, issuing from Lake Ochrida and flowing N.W. to the Adriatic, is for the greater part of its course an Albanian river.) The Struma, which rises in Mt Vitosha in Bulgaria, runs through a narrow defile till, within a short distance of the sea, it expands into Lake Tachino, and falls into the Aegean near the site of the ancient Amphipolis. The Mesta, rising in the Rhodope range, drains the valley of Razlog and forms a delta at its entrance into the Aegean opposite the island of Thasos. The Bistritza, which has its source in the eastern slope of Mt Grammus, receives early in its course the outflow from Lake Castoria on the left; it flows to the S.E. towards the frontier of Greece, where its course is arrested by the Cambunian mountains; then turning sharply to the N.E., and passing through the districts of Serfije and Verria, it reaches the Campania and enters the Gulf of Salonica at a point a few miles to the S.W. of the mouth of the Vardar. The valleys of most of the rivers and their tributaries broaden here and there into fertile upland basins, which were formerly lakes. Of these the extensive plateau of Monastir, the ancient plain of Pelagonia, about 1500 ft. above the sea, is the most remarkable; the basins of Tetovo, Usküb, Kotchané, Strumnitza, Nevrokop, Melnik, Serres and Drama furnish other examples. The principal lakes are Ochrida (*Lychnitis*) on the confines of Albania; Prespa, separated from Ochrida by the Galinitza mountains, and supposed to be connected with it by a subterranean channel; Castoria, to the S.E. of Prespa; Ostrovo, midway between Prespa and the Vardar; Tachino (*Cercinitis*) on the lower course of the Struma; Beshik (*Bolbe*), separating the Chalcidian peninsula from the mainland, and Doiran (probably *Prasias*), beneath the southern declivity of the Belasitza mountains; the smaller lakes of Amatovo and Yenije are in the alluvial plain on either side of the lower Vardar. Lake Ochrida (*q.v.*) finds egress into the Black Drin (*Drilon*) at Struga, where there are productive fisheries. The lacustrine habitations of the Paeonians on Lake Prasias described by Herodotus (v. 16) find a modern counterpart in the huts of the fishing population on Lake Doiran. The surface of the country is generally mountainous; the various mountain-groups present little uniformity in their geographical contour. The great chain of Rhodope, continued to the N.W. by the Rilska and Osogovska Planina, forms a natural boundary on the north; the principal summit, Musallá (9031 ft.), is just over the Bulgarian frontier. The adjoining Dospat range culminates in Belmeken (8562 ft.), also just over the Bulgarian frontier. Between the upper courses of the Mesta and Struma is the Perim Dagh or Pirin Planina (*Orbelos*) with Elin (8794 ft.), continued to the south by the Bozo Dagh (6081 ft.); still further south, overlooking the bay of Kavala, are the Bunar Dagh and Mt Pangaeus, famous in antiquity for its gold and silver mines. Between the Struma and the Vardar are the Belasitza, Krusha and other ranges. West of the Vardar is the lofty Shar chain (*Scardus*) overlooking the plain of Tetovo and terminating at its eastern extremity in the pyramidal Liubotrn (according to some authorities, 10,007 ft., and consequently the highest mountain in the Peninsula; according to others 8989, 8856, or 8200 ft.). The Shar range, with the Kara Dagh to the east, forms the natural boundary of Macedonia on the N.W.; this is prolonged on the west by the Yaina-Bistra and Yablanitza mountains with several summits exceeding 7000 ft. in height, the Odonishta Planina overlooking Lake Ochrida on the west, the Morova Planina, the Grammus range, and Pindus with Smolika (8546 ft.). The series of heights is broken by the valleys of the Black Drin and Devol, which flow to the Adriatic. Between the Vardar and the plain of Monastir the Nija range culminates in Kaimakchalan (8255 ft.); south-west of Monastir is Mt Peristeri (7720 ft.) overlooking Lake Prespa on the east; on the west is the Galinitza range separating it from Lake Ochrida. Between Lake Ostrovo and the lower Bistritza are the Bermius and Kitarion ranges with Doxa (5240 ft.) and Turla (about 3280 ft.). South of the Bistritza are the Cambunian mountains forming the boundary of Thessaly and terminating to the east in the imposing mass of Elymbos, or Olympus (9794 ft.). Lastly, Mt Athos, at the extremity of the peninsula of that name, reaches the height of 6350 ft. The general aspect of the country is bare and desolate, especially in the neighbourhood of the principal routes; the trees have been destroyed, and large tracts of land remain uncultivated. Magnificent forests, however, still clothe the slopes of Rhodope, Pirin and Pindus. The well-wooded and cultivated districts of Grevena and Castoria, which are mainly inhabited by a Vlach population, are remarkably beautiful, and the scenery around Lakes Ochrida and Prespa is exceedingly picturesque. For the principal geological formations see BALKAN PENINSULA.

The climate is severe; the spring is often rainy, and the melted snows from the encircling mountains produce inundations in the plains. The natural products are in general similar to those of southern Bulgaria and Servia—the fig, olive and orange, however, appear on the shores of the Aegean and in the sheltered valleys of the southern region. The best tobacco in Europe is grown in the Drama and Kavala districts; rice and cotton are cultivated in the southern plains.

Population.—The population of Macedonia may perhaps be estimated at 2,200,000. About 1,300,000 are Christians of various churches and nationalities; more than 800,000 are Mahommedans, and about 75,000 are Jews. Of the Christians, the great majority profess the Eastern Orthodox faith, owning allegiance either to the Greek patriarchate or the Bulgarian exarchate. Among the Orthodox Christians are reckoned some 4000 Turks. The small Catholic minority is composed chiefly of Uniate Bulgarians (about 3600), occupying the districts of Kukush and Doiran; there are also some 2000 Bulgarian Protestants, principally inhabiting the valley of Razlog. The Mahommedan population is mainly composed of Turks (about 500,000). In addition to these there are some 130,000 Bulgars, 120,000 Albanians, 35,000 gipsies and 14,000 Greeks, together with a smaller number of Vlachs, Jews and Circassians, who profess the creed of Islam. The untrustworthy Turkish statistics take religion, not nationality, as the basis of classification. All Moslems are included in the *millet*, or nation, of Islam. The *Rûm*, or Roman (*i.e.* Greek) *millet* comprises all those who acknowledge the authority of the Oecumenical patriarch, and consequently includes, in addition to the Greeks, the Servians, the Vlachs, and a certain number of Bulgarians; the Bulgar *millet* comprises the Bulgarians who accept the rule of the exarchate; the other *millets* are the *Katolik* (Catholics), *Ermeni* (Gregorian Armenians), *Musevi* (Jews) and *Prodesdan* (Protestants). The population of Macedonia, at all times scanty, has undoubtedly diminished in recent years. There has been a continual outflow of the Christian population in the direction of Bulgaria, Servia and Greece, and a corresponding emigration of the Turkish peasantry to Asia Minor. Many of the smaller villages are being abandoned by their inhabitants, who migrate for safety to the more considerable towns—usually situated at some point where a mountain pass descends to the outskirts of the plains. In the agricultural districts the Christian peasants, or *rayas*, are either small proprietors or cultivate holdings on the estates of Turkish landowners. The upland districts are thinly inhabited by a nomad pastoral population.

Towns.—The principal towns are Salonica (pop. in 1910, about 130,000), Monastir (60,000), each the capital of a vilayet, and Üsküb (32,000), capital of the vilayet of Kossovo. In the Salonica vilayet are Serres (28,000), pleasantly situated in a fertile valley near Lake Tachino; Nevrokop (6200), Mehomia (5000), and Bansko (6500), in the valley of the Upper Mesta; Drama (9000), at the foot of the Bozo Dagh, with its port Kavala (9500); Djumaia (6440), Melnik (4300) and Demir Hissar (5840) in the valley of the Struma, with Strumnitza (10,160) and Petrich (7100) in the valley of its tributary, the Strumnitza; Veles (Turk. *Koprülü*) on the Vardar (19,700); Doiran (6780) and Kukush (7750); and, to the west of the Vardar, Verria (Slav. *Ber*, anc. *Beroea*, Turk. *Karaferia*, 10,500), Yenijé-Vardar (9599) and Vodena (anc. *Edessa*, *q.v.*, 11,000). In the portion of the Kossovo vilayet included in Macedonia are Kalkandelen (Slav. *Tetovo*, 19,200), Kumanovo (14,500) and Shtip (Turk. *Istib*, 21,000). In the Monastir vilayet are Prilep (24,000) at the northern end of the Pelagonian plain, Krushevo (9350), mainly inhabited by Vlachs, Resen (4450) north of Lake Prespa, Florina (Slav. *Lerin*, 9824); Ochrida (14,860), with a picturesque fortress of Tsar Samuel, and Struga (4570), both on the north shore of Lake Ochrida; Dibra (Slav. *Debr*) on the confines of Albania (15,500), Castoria (Slav. *Kostur*), on the lake of that name (6190), and Kozhané (6100). (Dibra, Kavala, Monastir, Ochrida, Salonica, Serres, Usküb and Vodena are described in separate articles.)

The Turks.

Races.—Macedonia is the principal theatre of the struggle of nationalities in Eastern Europe. All the races which dispute the reversion of the Turkish possessions in Europe are represented within its borders. The Macedonian probably may therefore be described as the quintessence of the Near Eastern Question. The Turks, the ruling race, form less than a quarter of the entire population, and their numbers are steadily declining. The first Turkish immigration from Asia Minor took place under the Byzantine emperors before the conquest of the country. The first purely Turkish town, Yenijé-Vardar, was founded on the ruins of Vardar in 1362. After the capture of Salonica (1430), a strong Turkish population was settled in the city, and similar colonies were founded in Monastir, Ochrida, Serres, Drama and other important places. In many of these towns half or more of the population is still Turkish. A series of military colonies were subsequently established at various points of strategic importance along the principal lines of communication. Before 1360 large numbers of nomad shepherds, or Yuruks, from the district of Konia, in Asia Minor, had settled in the country; their descendants are still known as Konariotes. Further immigration from this region took place from time to time up to the middle of the 18th century. After the establishment of the feudal system in 1397 many of the Seljuk noble families came over from Asia Minor; their descendants may be recognized among the beys or Moslem landowners in southern Macedonia. At the beginning of the 18th century the Turkish population was very considerable, but since that time it has continuously decreased. A low birth-rate, the exhaustion of the male population by military service, and great mortality from epidemics, against which Moslem fatalism takes no precautions, have brought about a decline which has latterly been hastened by emigration. On the other hand, there has been a considerable Moslem immigration from Bosnia, Servia, Bulgaria and Greece, but the newcomers, *mohajirs*, do not form a permanent colonizing element. The Turkish rural population is found in three principal groups: the most easterly extends from the Mesta to Drama, Pravishta and Orfano, reaching the sea-coast on either side of Kavala, which is partly Turkish, partly Greek. The second, or central, group begins on the sea-coast, a little west of the mouth of the Strymon, where a Greek population intervenes, and extends to the north-west along the Kara-Dagh and Belasitza ranges in the direction of Strumnitza, Veles, Shtip and Radovisht. The third, or southern, group is centred around Kaïlar, an entirely Turkish town, and extends from Lake Ostrovo to Selfijé (Servia). The second and third groups are mainly composed of Konariot shepherds. Besides these fairly compact settlements there are numerous isolated Turkish colonies in various parts of the country. The Turkish rural population is quiet, sober and orderly, presenting some of the best characteristics of the race. The urban population, on the other hand, has become much demoralized, while the official classes, under the rule of Abdul Hamid II. and his predecessors, were corrupt and avaricious, and seemed to have parted with all scruple in their dealings with the Christian peasantry. The Turks, though still numerically and politically strong, fall behind the other nationalities in point of intellectual culture, and the contrast is daily becoming more marked owing to the educational activity of the Christians.

The Greeks and Vlachs.

The Greek and Vlach populations are not always easily distinguished, as a considerable proportion of the Vlachs have been hellenized. Both show a remarkable aptitude for commerce; the Greeks have maintained their language and religion, and the Vlachs their religion, with greater tenacity than any of the other races. From the date of the Ottoman conquest until comparatively recent times, the Greeks occupied an exceptional position in Macedonia, as elsewhere in the Turkish Empire, owing to the privileges conferred on the patriarchate of Constantinople, and the influence subsequently acquired by the great Phanariot families. All the Christian population belonged to the Greek *millet* and called itself Greek; the bishops and higher clergy were exclusively Greek; Greek was the language of the upper classes, of commerce, literature and religion, and Greek alone was taught in the schools. The supremacy of the patriarchate was consummated by the suppression of the autocephalous Slavonic churches of Ipek in 1766 and Ochrida in 1767. In the latter half of the 18th century Greek ascendancy in Macedonia was at its zenith; its decline began with the War of Independence, the establishment of the Hellenic kingdom, and the extinction of the Phanariot power in Constantinople. The patriarchate, nevertheless, maintained its exclusive jurisdiction over all the Orthodox population till 1870, when the Bulgarian exarchate was established, and the Greek clergy continued to labour with undiminished zeal for the spread of Hellenism. Notwithstanding their venality and intolerance, their merits as the only diffusers of culture and enlightenment in the past should not be overlooked. The process of hellenization made greater progress in the towns than in the rural districts of the interior, where the non-Hellenic populations preserved their languages, which alone saved the several nationalities from extinction. The typical Greek, with his superior education, his love of politics and commerce, and his distaste for laborious occupations, has always been a dweller in cities. In Salonica, Serres, Kavala, Castoria, and other towns in southern Macedonia the Hellenic element is strong; in the northern towns it is insignificant, except at Melnik, which is almost exclusively Greek. The Greek rural population extends from the Thessalian frontier to Castoria and Verria (*Beroea*); it occupies the whole Chalcidian peninsula and both banks of the lower Strymon from Serres to the sea, and from Nigrita on the west to Pravishta on the east; there are also numerous Greek villages in the Kavala district. The Mahommedan Greeks, known as *Valachides*, occupy a considerable tract in the upper Bistritza valley near Grevena and Liapsista. The purely Greek population of Macedonia may possibly be estimated at a quarter of a million. The Vlachs, or Rumans, who call themselves *Aromuni* or *Aromâni* (*i.e.* Romans), are also known as *Kutzovlachs* and *Tzintzars:* the last two appellations are, in fact, nicknames, "Kutzovlach" meaning "lame Vlach," while "Tzintzar" denotes their inability to pronounce the Rumanian *cincĭ* (five). The Vlachs are styled by some writers "Macedo-Rumans," in contradistinction to the "Daco-Rumans," who inhabit the country north of the Danube. They are, in all probability, the descendants of the Thracian branch of the aboriginal Thraco-Illyrian population of the Balkan Peninsula, the Illyrians being represented by the Albanians. This early native population, which was apparently hellenized to some extent under the Macedonian empire, seems to have been latinized in the period succeeding the Roman conquest, and probably received a considerable infusion of Italian blood. The Vlachs are for the most part either highland shepherds or wandering owners of horses and mules. Their settlements are scattered all over the mountains of Macedonia: some of these consist of permanent dwellings, others of huts occupied only in the summer. The compactest groups are found in the Pindus and Agrapha mountains (extending into Albania and Thessaly), in the neighbourhood of Monastir, Grevena and Castoria, and in the district of Meglen. The Vlachs who settle in the lowland districts are excellent husbandmen. The urban population is considerable; the Vlachs of Salonica, Monastir, Serres and other large towns are, for the most part, descended from refugees from Moschopolis, once the principal centre of Macedonian commerce. The towns of Metzovo, on the confines of Albania, and Klisura, in the Bistritza valley, are almost exclusively Vlach. The urban and most of the rural Vlachs are bilingual, speaking Greek as well as Rumanian; a great number of the former have been completely hellenized, partly in consequence of mixed marriages, and many of the wealthiest commercial families of Vlach origin are now devoted to the Greek cause. The Vlachs of Macedonia possibly number 90,000, of whom only some 3000 are Mahommedans. The Macedonian dialect of the Rumanian language differs mainly from that spoken north of the Danube in its vocabulary and certain phonetic peculiarities; it contains a number of Greek works which are often replaced in the northern speech by Slavonic or Latin synonyms.

The Albanians, Circassians, &c.

The Albanians, called by the Turks and Slavs *Arnauts*, by the Greeks Ἀρβανῖται, and by themselves *Shkyipetar*, have always been the scourge of western Macedonia. After the first Turkish invasion of Albania many of the chiefs or beys adopted Mahommedanism, but the conversion of the great bulk of the people took place in the 16th and 17th centuries. Professing the creed of the dominant power and entitled to bear arms, the Albanians were enabled to push forward their limits at the expense of the defenceless population around them, and their encroachments have continued to the present day. They have not only advanced themselves, but have driven to the eastward numbers of their Christian compatriots and a great portion of the once-prosperous Vlach population of Albania. Albanian revolts and disturbances have been frequent along the western confines of Macedonia, especially in the neighbourhood of Dibra: the Slavonic peasants have been the principal sufferers from these troubles, while the Porte, in pursuance of the "Islamic policy" adopted by the sultan Abdul Hamid II., dealt tenderly with the recalcitrant believers. In southern Macedonia the Albanians of the Tosk race extend over the upper Bistritza valley as far west as Castoria, and reach the southern and western shores of Lakes Prespa and Ochrida: they are also numerous in the neighbourhood of Monastir. In northern Macedonia the Albanians are of the Gheg stock: they have advanced in large numbers over the districts of Dibra, Kalkandelen and Usküb, driving the Slavonic population before them. The total number of Albanians in Macedonia may be estimated at about 120,000, of whom some 10,000 are Christians (chiefly orthodox Tosks). The Circassians, who occupy some villages in the neighbourhood of Serres, now scarcely number 3000: their predatory instincts may be compared with those of the Albanians. The Jews had colonies in Macedonia in the time of St Paul, but no trace remains of these early settlements. The Jews now found in the country descend from refugees who fled from Spain during the persecutions at the end of the 15th century: they speak a dialect of Spanish, which they write with Hebrew characters. They form a flourishing community at Salonica, which numbers more than half the population: their colonies at Monastir, Serres and other towns are poor. A small proportion of the Jews, known as *Deunmê* by the Turks, have embraced Mahommedanism.

The Slavonic Population.

With the exception of the southern and western districts already specified, the principal towns, and certain isolated tracts, the whole of Macedonia is inhabited by a race or races speaking a Slavonic dialect. If language is adopted as a test, the great bulk of the rural population must be described as Slavonic. The Slavs first crossed the Danube at the beginning of the 3rd century, but their great immigration took place in the 6th and 7th centuries. They overran the entire peninsula, driving the Greeks to the shores of the Aegean, the Albanians into the Mirdite country, and the latinized population of Macedonia into the highland districts, such as Pindus, Agrapha and Olympus. The Slavs, a primitive agricultural and pastoral people, were often unsuccessful in their attacks on the fortified towns, which remained centres of Hellenism. In the outlying parts of the peninsula they were absorbed, or eventually driven back, by the original populations, but in the central region they probably assimilated a considerable proportion of the latinized races. The western portions of the peninsula were occupied by Serb and Slovene tribes: the Slavs of the eastern and central portions were conquered at the end of the 7th century by the Bulgarians, a Ugro-Finnish horde, who established a despotic political organization, but being less numerous than the subjected race were eventually absorbed by it. The Mongolian physical type, which prevails in the districts between the Balkans and the Danube, is also found in central Macedonia, and may be recognized as far west as Ochrida and Dibra. In general, however, the Macedonian Slavs differ somewhat both in appearance and character from their neighbours beyond the Bulgarian and Servian frontiers: the peculiar type which they present is probably due to a considerable admixture of Vlach, Hellenic, Albanian and Turkish blood, and to the influence of the surrounding races. Almost all independent authorities, however, agree that the bulk of the Slavonic population of Macedonia is Bulgarian. The principal indication is furnished by the language, which, though resembling Servian in some respects (*e.g.* the case-endings, which are occasionally retained), presents most of the characteristic features of Bulgarian (see BULGARIA: *Language*). Among these may be mentioned the suffix-article, the nasal vowels (retained in the neighbourhood of Salonica and Castoria, but modified elsewhere as in Bulgarian), the retention of *l* (*e.g. vulk* "wolf," *bel* "white"; Servian *vuk*, *beo*), and the loss of the infinitive. There are at least four Slavonic dialects in Macedonia, but the suffix-article, though varying in form, is a constant feature in all. The Slavs of western Macedonia are of a lively, enterprising character, and share the commercial aptitude of the Vlachs: those of the eastern and southern regions are a quiet, sober, hardworking agricultural race, more obviously homogeneous with the population of Bulgaria. In upper Macedonia large family communities, resembling the Servian and Bulgarian *zadruga*, are commonly found: they sometimes number over 50 members. The whole Slavonic population of Macedonia may be estimated at about 1,150,000, of whom about 1,000,000 are Christians of the Orthodox faith. The majority of these own allegiance to the Bulgarian exarchate, but a certain minority still remains faithful to the Greek patriarchate. The Moslem Bulgarians form a considerable element: they are found principally in the valley of the upper Mesta and the Rhodope district, where they are known as *Pomaks* or "helpers," *i.e.* auxiliaries to the Turkish army.

The Racial Propaganda.—The embittered struggle of the rival nationalities in Macedonia dates from the middle of the 19th century. Until that period the Greeks, owing to their superior culture and their privileged position, exercised an exclusive influence over the whole population professing the Orthodox faith. All Macedonia was either Moslem or Orthodox Christian, without distinction of nationalities, the Catholic or Protestant *millets* being inconsiderable. The first opposition to Greek ecclesiastical ascendancy came from the Bulgarians. The Bulgarian literary revival, which took place in the earlier part of the 19th century, was the precursor of the ecclesiastical and national movement which resulted in the establishment of the exarchate in 1870 (see BULGARIA). In the course of the struggle some of the Bulgarian leaders entered into negotiations with Rome; a Bulgarian Uniate church was recognized by the Porte, and the pope nominated a bishop, who, however, was mysteriously deported to Russia a few days after his consecration (1861). The first exarch, who was elected in 1871, was excommunicated with all his followers by the patriarch, and a considerable number of Bulgarians in Macedonia—the so-called "Bulgarophone Greeks"—fearing the reproach of schism, or influenced by other considerations, refrained from acknowledging the new spiritual power. Many of the recently converted uniates, on the other hand, offered their allegiance to the exarch. The firman of the 28th of February 1870 specified a number of districts within the present boundaries of Bulgaria and Servia, as well as in Macedonia, to which Bulgarian bishops might be appointed; other districts might be subjected to the exarchate should two-thirds of the inhabitants so desire. In virtue of the latter provision the districts of Veles, Ochrida and Usküb declared for the exarchate, but the Turkish government refrained from sanctioning the nomination of Bulgarian bishops to these dioceses. It was not till 1891 that the Porte, at the instance of Stamboloff, the Bulgarian prime minister, whose demands were supported by the Triple Alliance and Great Britain, issued the *berat*, or exequatur, for Bulgarian bishops at Ochrida and Usküb; the sees of Veles and Nevrokop received Bulgarian prelates in 1894, and those of Monastir, Strumnitza and Dibra in 1898. The Bulgarian position was further strengthened in the latter year by the establishment of "commercial agents" representing the principality at Salonica, Usküb, Monastir and Serres. During this period (1891–1898) the Bulgarian propaganda, entirely controlled by the spiritual power and conducted within the bounds of legality, made rapid and surprising progress. Subsequently the interference of the Macedonian committee at Sofia, in which the advocates of physical force predominated, and the rivalry of factions did much to injure the movement; the hostility of the Porte was provoked and the sympathy of the powers alienated by a series of assassinations and other crimes. According to the official figures, the Bulgarian schools, which in 1893 were 554, with 30,267 pupils and 853 teachers, in 1900 numbered 785 (including 5 gymnasia and 58 secondary schools), with 39,892 pupils and 1250 teachers. A great number of the schools were closed by the Turkish authorities after the insurrection of 1903 and many had not been reopened in 1909; the teachers were imprisoned or had fled into exile.

The Rumanian movement comes next to the Bulgarian in order of time. The Vlachs had shown greater susceptibility to Greek influence than any of the other non-Hellenic populations of Macedonia, and, though efforts to create a Rumanian propaganda were made as early as 1855, it was not till after the union of the principalities of Wallachia and Moldavia in 1861 that any indications of a national sentiment appeared amongst them. In 1886 the principal apostle of the Rumanian cause, a priest named Apostol Margaritis, founded a gymnasium at Monastir, and the movement, countenanced by the Porte, supported by the French Catholic missions, and to some extent encouraged by Austria, has made no inconsiderable progress since that time. There are now about forty Rumanian schools in Macedonia, including two gymnasia, and large sums are devoted to their maintenance by the ministry of education at Bucharest, which also provides qualified teachers. The Rumanian and Servian movements are at a disadvantage compared with the Bulgarian, owing to their want of a separate ecclesiastical organization, the orthodox Vlachs and Serbs in Turkey owning allegiance to the Greek patriarchate. The governments of Bucharest and Belgrade therefore endeavoured to obtain the recognition of Vlach and Servian *millets*, demanding respectively the establishment of a Rumanian bishopric at Monastir and the restoration of the patriarchate of Ipek with the appointment of a Servian metropolitan at Usküb. The Vlach *millet* was recognized by the Porte by iradé on the 23rd of May 1905, but the aims of the Servians, whose active interference in Macedonia is of comparatively recent date, have not been realized. Previously to 1878 the hopes of the Servians were centred on Bosnia, Herzegovina and the vilayet of Kossovo; but when the Berlin Treaty assigned Bosnia and Herzegovina to Austria, the national aspirations were directed to Macedonia, the Slavonic population of which was declared to be Servian. The strained relations existing between Russia and Bulgaria from 1886 to 1895 were to the advantage of the Servian propaganda, which after 1890 made remarkable progress. Great expenditure has been incurred by the Servian government in the opening and maintenance of schools. At the beginning of 1899 there were stated to be 178 Servian schools in the vilayets of Usküb, Salonica and Monastir (including fifteen gymnasia), with 321 teachers and 7200 pupils.

The Albanian movement is still in an inceptive stage; owing to the persistent prohibition of Albanian schools by the Turks, a literary propaganda, the usual precursor of a national revival, was rendered impossible till the outbreak of the Young Turk revolution in July 1908. After that date numerous schools were founded and an Albanian committee, meeting in November 1908, fixed the national alphabet and decided on the adoption of the Latin character. The educational movement is most conspicuous among the Tosks, or southern Albanians. Notwithstanding the encroachments of their rivals, the impoverishment of the patriarchate, and the injury inflicted on their cause by the Greco-Turkish War of 1897, the Greeks still maintain a large number of schools; according to statistics prepared at Athens there were in 1901, 927 Greek schools in the vilayets of Salonica and Monastir (including five gymnasia), with 1397 teachers and 57,607 pupils. The great educational activity displayed by the proselytizing movements in Macedonia, while tending to the artificial creation of parties, daily widens the contrast between the progressive Christian and the backward Moslem populations.

Antiquities.—Macedonia, like the neighbouring Balkan countries, still awaited exploration at the beginning of the 20th century, and little had been learned of the earlier development of civilization in these regions. The ancient indigenous population has left many traces of its presence in the tumuli which occur on the plains, and more especially along the valley of the Vardar. The unquiet state of the country went far to prevent any systematic investigation of these remains; excavations, however, were made by Körte and Franke at Niausta and near Salonica (see Kretschner, *Einleitung in die Geschichte der griechischen Sprache*, pp. 176, 421), and fragments of primitive pottery, with peculiar characteristics, were found by Perdrizet at Tchepelje, on the left bank of Lake Tachino. The oldest archaeological monuments of Macedonia are its coins, for which the mines of Crenides (the later Philippi), at the foot of Mt Pangaeus, of Chalcidice, of the island of Thasos, and of the mountains between Lake Prasias and the ancient Macedonian kingdom (Herod. v. 17), furnished abundance of metal. From the reign of Alexander I., in the epoch of the Persian wars (502–479 B.C.), the Macedonian dynasty issued silver coins of a purely Greek style. The Thracian communities around Mt Pangaeus also produced a variety of coins, especially at the beginning of the 5th century. The great octodrachms of this period were perhaps struck for the purpose of paying tribute to the Persians when the country between the Strymon and the Nestos was in their possession; most of the specimens have been found in Asia Minor. These large pieces present many characteristics of the Ionian style; it is evident that the Thracians derived the arts of minting and engraving from the neighbouring Thasos, itself a colony from the Ionian Paros. The monarchs of Pella were enthusiastic admirers of Hellenic culture, and their court was doubtless frequented by Greek sculptors as well as men of letters, such as Herodotus and Euripides. At Pella has been found a funerary *stele* of the late 5th or early 4th century representing a Macedonian *hetaerus*—a beautiful specimen of the best Greek art, now preserved in the Imperial Ottoman Museum at Constantinople. To the Hellenic period belong the vaulted tombs under tumuli discovered at Pella, Pydna, Palatitza, and other places; the dead were laid in marble couches ornamented with sculptures, like those of the so-called sarcophagus of Alexander at Constantinople. These tombs doubtless received the remains of the Macedonian nobles and *hetaeri*: in one of them a fresco representing a conflict between a horseman and a warrior on foot has been brought to light by Kinch. Similarly constructed places of sepulture have been found at Eretria and elsewhere in Greece. At Palatitza the ruins of a remarkable structure, perhaps a palace, have been laid bare by Heuzey and Daumet. Unlike Greece, where each independent city had its acropolis, Macedonia offers few remnants of ancient fortification; most of the country towns appear to have been nothing more than open market-centres. The most interesting ruins in the country are those of the Roman and Byzantine epochs, especially those at Salonica (*q.v.*). The Byzantine fortifications and aqueduct of Kavala are also remarkable. At Verria (*Beroea*) may be seen some Christian remains, at Melnik a palace of the age of the Comneni, at Serres a fortress built by the Servian tsar Stephen Dushan (1336–1356). The remains at Filibejik (*Philippi*) are principally of the Roman and Byzantine periods; the numerous *ex voto* rock-tablets of the acropolis are especially interesting. The Roman inscriptions found in Macedonia are mainly funerary, but include several ephebic lists. The funerary tablets afford convincing proof of the persistence of the Thracian element, notwithstanding hellenization and latinization; many of them, for instance, represent the well-known Thracian horseman hunting the wild boar. The monastic communities on the promontory of Athos (*q.v.*), with their treasures of Byzantine art and their rich collections of manuscripts, are of the highest antiquarian interest.

History.—For the history of ancient Macedonia see MACEDONIAN EMPIRE.[1] After its subjugation by the Romans the country was divided into four districts separated by rigid political and social limitations. Before long it was constituted a province, which in the time of Augustus was assigned to the senate. Thenceforward it followed the fortunes of the Roman empire, and, after the partition of that dominion, of its eastern branch. Its Thraco-Illyrian inhabitants had already been largely latinized when Constantine the Great made Byzantium the imperial residence in A.D. 330; they called themselves Romans and spoke Latin. Towards the close of the 4th century the country was devastated by the Goths and Avars, whose incursions possessed no lasting significance. It was otherwise with the great Slavonic immigration, which took place at intervals from the 3rd to the 7th century. An important ethnographic change was brought about, and the greater part of Macedonia was colonized by the invaders (see BALKAN PENINSULA).

Byzantine and Bulgarian Domination.

The Slavs were in their turn conquered by the Bulgarians (see BULGARIA: *History*) whose chief Krum (802–815) included central Macedonia in his dominions. The Byzantines retained the southern regions and Salonica, which temporarily fell into the hands of the Saracens in 904. With the exception of the maritime districts, the whole of Macedonia formed a portion of the empire of the Bulgarian tsar Simeon (893–927); the Bulgarian power declined after his death, but was revived in western Macedonia under the Shishman dynasty at Ochrida; Tsar Samuel (976–1014), the third ruler of that family, included in his dominions Usküb, Veles, Vodena and Melnik. After his defeat by the emperor Basil II. in 1014 Greek domination was established for a century and a half. The Byzantine emperors endeavoured to confirm their positions by Asiatic colonization; Turkish immigrants, afterwards known as Vardariotes, the first of their race who appeared in Macedonia, were settled in the neighbourhood of Salonica in the 9th century; colonies of Uzes, Petchenegs and Kumans were introduced at various periods from the 11th to the 13th century. While Greeks and Bulgarians disputed the mastery of Macedonia the Vlachs, in the 10th century, established an independent state in the Pindus region, which, afterwards known as Great Walachia, continued to exist till the beginning of the 14th century. In 1185 southern Macedonia was exposed to a raid of the Normans under William of Sicily, who captured Salonica and massacred its inhabitants. After the taking of Constantinople in 1204 by the Franks of the fourth crusade, the Latin empire of Romania was formed and the feudal kingdom of Thessalonica was bestowed on Boniface, marquis of Montferrat; this was overthrown in 1222 by Theodore, despot of Epirus, a descendant of the imperial house of the Comneni, who styled himself emperor of Thessalonica and for some years ruled over all Macedonia. He was defeated and captured by the Bulgarians in 1230 and the remnant of his possessions, to which his son John succeeded, was absorbed in the empire of Nicaea in 1234. Bulgarian rule was now once more established in Macedonia under the powerful monarch Ivan Asen II. (1218–1241) whose dynasty, of Vlach origin, had been founded at Trnovo in 1186 after a revolt of the Vlachs and Bulgars against the Greeks. A period of decadence followed the extinction of the Asen dynasty in 1257; the Bulgarian power was overthrown by the Servians at Velbuzhd (1330), and Macedonia was included in the realm of the great Servian tsar Dushan (1331–1355) who fixed his capital at Usküb. Dushan's empire fell to pieces after his death, and the anarchy which followed prepared the way for the advance of the Turks, to whom not only contending factions at Constantinople but Servian and Bulgarian princes alike made overtures.

Turkish Rule.

Macedonia and Thrace were soon desolated by Turkish raids; when it was too late the Slavonic states combined against the invaders, but their forces, under the Servian tsar Lazar, were routed at Kossovo in 1389 by the sultan Murad I. Salonica and Larissa were captured in 1395 by Murad's son Bayezid, whose victory over Sigismund of Hungary at Nicopolis in 1396 sealed the fate of the peninsula. The towns in the Struma valley were yielded to the Turks by John VII. Palaeologus in 1424; Salonica was taken for the last time in 1428 by Murad II. and its inhabitants were massacred. Large tracts of land were distributed among the Ottoman chiefs; a system of feudal tenure was developed by Mahommed II. (1451–1481), each fief furnishing a certain number of armed warriors. The Christian peasant owners remained on the lands assigned to the Moslem feudal lords, to whom they paid a tithe. The condition of the subject population was deplorable from the first, and became worse during the period of anarchy which coincided with the decadence of the central power in the 17th and 18th centuries; in the latter half of the 17th century efforts to improve it were made by the grand viziers Mehemet and Mustafa of the eminent house of Koprülü. The country was policed by the janissaries (*q.v.*). Numbers of the peasant proprietors were ultimately reduced to serfdom, working as labourers on the farms or *tchifliks* of the Moslem beys. Towards the end of the 18th century many of the local governors became practically independent; western Macedonia fell under the sway of Ali Pasha of Iannina; at Serres Ismail Bey maintained an army of 10,000 men and exercised a beneficent despotism. For more than two centuries Albanian incursions, often resulting in permanent settlements, added to the troubles of the Christian population. The reforms embodied in the Hatt-i-Sherif of Gulhané (1839) and in the Hatt-i-humayun (1856), in both of which the perfect equality of races and religions was proclaimed, remained a dead letter; the first "Law of the Vilayets" (1864), reforming the local administration, brought no relief, while depriving the Christian communities of certain rights which they had hitherto possessed.

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[1] Also Alexander, Perdiccas, Philip, &c.

European Intervention. Treaties of San Stefano and Berlin.

In 1876 a conference of the powers at Constantinople proposed the reorganization of the Bulgarian provinces of Turkey in two vilayets under Christian governors-general aided by popular assemblies. The "western" vilayet, of which Sofia was to be the capital, included northern, central and western Macedonia, extending south as far as Castoria. The *projet de règlement* elaborated by the conference was rejected by the Turkish parliament convoked under the constitution proclaimed on the 23rd of December 1876; the constitution, which was little more than a device for eluding European intervention, was shortly afterwards suspended. Under the treaty of San Stefano (March 3, 1878) the whole of Macedonia, except Salonica and the Chalcidic peninsula, was included in the newly formed principality of Bulgaria; this arrangement was reversed by the Treaty of Berlin (July 13) which left Macedonia under Turkish administration but provided (Art. xxiii.) for the introduction of reforms analogous to those of the Cretan Organic Statute of 1868. These reforms were to be drawn up by special commissions, on which the native element should be largely represented, and the opinion of the European commission for eastern Rumelia was to be taken before their promulgation. The Porte, however, prepared a project of its own, and the commission, taking this as a basis, drew up the elaborate "Law of the Vilayets" (Aug. 23, 1880). The law never received the sultan's sanction, and European diplomacy proved unequal to the task of securing its adoption.

The Macedonian Question.

The Berlin Treaty, by its artificial division of the Bulgarian race, created the difficult and perplexing "Macedonian Question." The population handed back to Turkish rule never acquiesced in its fate; its discontent was aggravated by the deplorable misgovernment which characterized the reign of Abdul Hamid II., and its efforts to assert itself, stimulated by the sympathy of the enfranchised portion of the race, provoked rival movements on the part of the other Christian nationalities, each receiving encouragement and material aid from the adjacent and kindred states. Some insignificant risings took place in Macedonia after the signature of the Berlin Treaty, but in the interval between 1878 and 1893 the population remained comparatively tranquil, awaiting the fulfilment of the promised reforms.

Bulgarian Conspiracies.

In 1893, however, a number of secret revolutionary societies (*druzhestva*) were set on foot in Macedonia, and in 1894 similar bodies were organized as legal corporations in Bulgaria. The fall of Stamboloff in that year and the reconciliation of Bulgaria with Russia encouraged the revolutionaries in the mistaken belief that Russia would take steps to revive the provisions of the San Stefano treaty. In 1895 the "Supreme Macedo-Adrianopolitan Committee" (*Vrkhoven Makedoni-Odrinski Komitet*) was formed at Sofia and forthwith despatched armed bands into northern Macedonia; the town of Melnik was occupied for a short time by the revolutionaries under Boris Sarafoff, but the enterprise ended in failure. Dispirited by this result, the "Vrkhovists," as the revolutionaries in Bulgaria were generally styled, refrained from any serious effort for the next five years; the movement was paralysed by dissensions among the chiefs, and rival parties were formed under Sarafoff and General Tzoncheff. Meanwhile the "Centralist" or local Macedonian societies were welded by two remarkable men, Damian Grueff and Gotzé Delcheff, into a formidable power known as the "Internal Organization," founded in 1893, which maintained its own police, held its own tribunals, assessed and collected contributions, and otherwise exercised an *imperium in imperio* throughout the country, which was divided into rayons or districts, and subdivided into departments and communes, each with its special staff of functionaries. The Internal Organization, as a rule, avoided co-operation with the revolutionaries in Bulgaria; it aimed at the attainment of Macedonian autonomy, and at first endeavoured, but unsuccessfully, to enlist the sympathies of the Greeks and Servians for the programme of "Macedonia for the Macedonians."

Greek Action.

The principle of autonomy was suspected at Athens and Belgrade as calculated to ensure Bulgarian predominance and to delay or preclude the ultimate partition of the country. At Athens, especially, the progress of the Bulgarian movement was viewed with much alarm; it was feared that Macedonia would be lost to Hellenism, and in 1896 the *Ethniké Hetaerea* (see Greece and Crete) sent numerous bands into the southern districts of the country. The Hetaerea aimed at bringing about a war between Greece and Turkey, and the outbreak of trouble in Crete enabled it to accomplish its purpose. During the Greco-Turkish War (*q.v.*) Macedonia remained quiet, Bulgaria and Servia refraining from interference under pressure from Austria, Russia and the other great powers. The reverses of the Greeks were to the advantage of the Bulgarian movement, which continued to gain strength, but after the discovery of a hidden dépôt of arms at Vinitza in 1897 the Turkish authorities changed their attitude towards the Bulgarian element; extreme and often barbarous methods of repression were adopted, and arms were distributed among the Moslem population. The capture of an American missionary, Miss Stone, by a Bulgarian band under Sandansky in the autumn of 1901 proved a windfall to the revolutionaries, who expended her ransom of £T16,000 in the purchase of arms and ammunition.

Troubles in 1902: Intervention of the Powers.

In 1902 the Servians, after a prolonged conflict with the Greeks, succeeded with Russian aid in obtaining the nomination of Mgr. Firmilian, a Servian, to the archbishopric of Usküb. Contemporaneously with a series of Russo-Bulgarian celebrations in the Shipka pass in September of that year, an effort was made to provoke a rising in the Monastir district by Colonel Yankoff, the lieutenant of General Tzoncheff; in November a number of bands entered the Razlog district under the general's personal direction. These movements, which were not supported by the Internal Organization, ended in failure, and merciless repression followed. The state of the country now became such as to necessitate the intervention of the powers, and the Austrian and Russian governments, which had acted in concert since April 1897, drew up an elaborate scheme of reforms. The Porte, as usual, endeavoured to forestall foreign interference by producing a project of its own, which was promulgated in November 1902, and Hilmi Pasha was appointed Inspector General of the Rumelian vilayets and charged with its application. The two powers, however, persevered in their intention and on the 21st of February 1903 presented to the Porte an identic memorandum proposing a series of reforms in the administration, police and finance, including the employment of "foreign specialists" for the reorganization of the gendarmerie.

Bulgarian Insurrection in 1903.

At the same time the Bulgarian government, under pressure from Russia, arrested the revolutionary leaders in the principality, suppressed the committees, and confiscated their funds. The Internal Organization, however, was beyond reach, and preparations for an insurrection went rapidly forward. In March a serious Albanian revolt complicated the situation. At the end of April a number of dynamite outrages took place at Salonica; public opinion in Europe turned against the revolutionaries and the Turks seized the opportunity to wreak a terrible vengeance on the Bulgarian population. On the 2nd of August, the feast of St Elias, a general insurrection broke out in the Monastir vilayet, followed by sporadic revolts in other districts. The insurgents achieved some temporary successes and occupied the towns of Krushevo, Klisura and Neveska, but by the end of September their resistance was overcome; more than 100 villages were burned by the troops and bashi-bazouks, 8400 houses were destroyed and 60,000 peasants remained homeless in the mountains at the approach of winter.

The "Mürzsteg Programme."

The Austrian and Russian governments then drew up a further series of reforms known as the "Mürzsteg programme" (Oct. 9, 1903) to which the Porte assented in principle, though many difficulties were raised over details. Two officials, an Austrian and a Russian, styled "civil agents" and charged with the supervision of the local authorities in the application of reforms, were placed by the side of the inspector-general while the reorganization of the gendarmerie was entrusted to a foreign general in the Turkish service aided by a certain number of officers from the armies of the great powers. The latter task was entrusted to the Italian General de Giorgis (April 1904), the country being divided into sections under the supervision of the officers of each power. The reforms proved a failure, mainly owing to the tacit opposition of the Turkish authorities, the insufficient powers attributed to the European officials, the racial feuds and the deplorable financial situation. In 1905 the powers agreed on the establishment of a financial commission on which the representatives of Great Britain, France, Germany and Italy would sit as colleagues of the civil agents. The Porte offered an obstinate resistance to the project and only yielded (Dec. 5) when the fleets of the powers appeared near the Dardanelles. Some improvement was now effected in the financial administration, but the general state of the country continued to grow worse; large funds were collected abroad by the committees at Athens, which despatched numerous bands largely composed of Cretans into the southern districts, the Servians displayed renewed activity in the north, while the Bulgarians offered a dogged resistance to all their foes.

The "Reval Programme."

The Austro-Russian *entente* came to an end in the beginning of 1908 owing to the Austrian project of connecting the Bosnian and Macedonian railway systems, and Great Britain and Russia now took the foremost place in the demand for reforms. After a meeting between King Edward VII. and the emperor Nicholas II. at Reval in the early summer of 1908 an Anglo-Russian scheme, known as the "Reval programme," was announced; the project aimed at more effective European supervision and dealt especially with the administration of justice. Its appearance was almost immediately followed by the military revolt of the Young Turk or constitutional party, which began in the Monastir district under two junior officers, Enver Bey and Niazi Bey, in July. The restoration of the constitution of 1876 was proclaimed (July 24, 1908), and the powers, anticipating the spontaneous adoption of reforms on the part of regenerated Turkey, decided to suspend the Reval programme and to withdraw their military officers from Macedonia.

See Lejean, *Ethnographie de la Turquie d'Europe* (Gotha, 1861); Hahn, *Reise von Belgrad nach Salonik* (Vienna, 1868); Yastreboff, *Obichai i pesni turetskikh Serbov* (St Petersburg, 1886); "Ofeicoff" (Shopoff), *La Macédoine au point de vue ethnographique, historique et philologique* (Philippopolis, 1888); Gopchevitch, *Makedonien und Alt-Serbien* (Vienna, 1889); Verkovitch, *Topografichesko-ethnographicheskii ocherk Makedonii* (St Petersburg, 1889); Burada, *Cercetari despre scoalele Romanesci din Turcia* (Bucharest, 1890); Tomaschek, *Die heutigen Bewohner Macedoniens* (Sonderabdruck aus den Verhandlungen des IX. D. Geographen-Tages in Wien, 1891) (Berlin, 1891); *Die alten Thräker* (Vienna, 1893); Berard, *La Turquie et l'Hellénisme contemporain*, (Paris, 1893); *La Macédoine* (Paris, 1900); Shopoff, *Iz zhivota i polozhenieto na Bulgarite v vilayetite* (Philippopolis, 1894); Weigand, *Die Aromunen* (Leipzig, 1895); *Die nationalen Bestrebungen der Balkanvölker* (Leipzig, 1898); Nikolaides, *La Macédoine* (Berlin, 1899); "Odysseus," *Turkey in Europe* (London, 1900); Kunchoff, *Makedonia: etnografia i statistika* (Sofia, 1900); *La Macédoine et la Vilayet d'Andrinople* (Sofia, 1904), anonymous; L. Villari, *The Balkan Question* (London, 1905); H. N. Brailsford, *Macedonia: its Races and their Future* (London, 1906); J. Cvijić, *Grundlinien der Geographie und Geologie von Mazedonien und Altserbien* (Gotha, 1908). For the antiquities, see Texier and Pullan, *Byzantine Architecture* (London, 1864); Heuzey and Daumet, *Mission archéologique en Macédoine* (Paris, 1865); Duchesne and Bayet, *Mémoire sur une mission en Macédoine et au Mont Athos* (Paris, 1876); Barclay V. Head, *Catalogue of Greek Coins*; Macedonia (London, 1879); Kinch, *L'Arc de triomphe de Salonique* (Paris, 1890); *Beretnung om en archaeologisk Reise i Makedonien* (Copenhagen, 1893); Mommsen, Suppl. to vol. iii. *Corpus inscript. latinarum* (Berlin, 1893); Perdrizet, Articles on Macedonian archaeology and epigraphy in *Bulletin de correspondance hellénique*, since 1894.

(J. D. B.)

MACEDONIAN EMPIRE, the name generally given to the empire founded by Alexander the Great of Macedon in the countries now represented by Greece and European Turkey, Asia Minor, Egypt, Syria, Persia and eastwards as far as northern India.[1] The present article contains a general account of the empire in its various aspects. It falls naturally into two main divisions:—I. The reign of Alexander. II. The period of his successors, the "Diadochi" and their dynasties.

1. Greeks and Persians.

I. *The Reign of Alexander.*—At the beginning of the 4th century B.C. two types of political association confronted each other in the lands of the Eastern Mediterranean,—the Persian monarchy with its huge agglomeration of subject peoples, and the Greek city-state. Each had a different principle of strength. The Persian monarchy was strong in its size, in the mere amount of men and treasure it could dispose of under a single hand; the Greek state was strong in its *morale*, in the energy and discipline of its soldiery. But the smallness of the single city-states and their unwillingness to combine prevented this superiority in quality from telling destructively upon the bulk of the Persian empire. The future belonged to any power that could combine the advantages of both systems, could make a state larger than the Greek *polis*, and animated by a spirit equal to that of the Greek soldier. This was achieved by the kings of Macedonia. The work, begun by his predecessors, of consolidating the kingdom internally and making its army a fighting-machine of high power was completed by the genius of Philip II. (359–336 B.C.), who at the same time by war and diplomacy brought the Greek states of the Balkan peninsula generally to recognize his single predominance. At the synod of Corinth (338) Philip was solemnly declared the captain-general (στρατηγὸς αὐτοκράτωρ) of the Hellenes against the Great King. The attack on Persia was delayed by the assassination of Philip in 336, and it needed some fighting before the young Alexander had made his position secure in Macedonia and Greece. The recognition as captain-general he had obtained at another synod in Corinth, by an imposing military demonstration in Greece immediately upon his accession. Then came the invasion of the Persian empire by Alexander in 334 at the head of an army composed both of Macedonians and contingents from the allied Greek states. Before this force the Persian monarchy went down, and when Alexander died eleven years later (323) a Macedonian empire which covered all the territory of the old Persian empire, and even more, was a realized fact.

2. Extent of the Empire.

The empire outside of Macedonia itself consisted of 22 provinces. *In Europe*, (1) Thrace; *in Asia Minor*, (2) Phrygia on the Hellespont, (3) Lydia, (4) Caria, (5) Lycia and Pamphylia, (6) Great Phrygia, (7) Paphlagonia and Cappadocia; *between the Taurus and Iran*, (8) Cilicia, (9) Syria, (10) Mesopotamia, (11) Babylonia, (12) Susiana; *in Africa*, (13) Egypt; *in Iran*, (14) Persis, (15) Media, (16) Parthia and Hyrcania, (17) Bactria and Sogdiana, (18) Areia and Drangiana, (19) Carmania, (20) Arachosia and Gedrosia; lastly *the Indian provinces*, (21) the Paropanisidae (the Kabul valley), and (22) the province assigned to Pithon, the son of Agenor, upon the Indus (J. Beloch, *Griech, Gesch.* III. [ii.],p. 236 seq.; for the Indian provinces cf. B. Niese, *Gesch. der griech. und maked. Staaten*, I. p. 500 seq.). Hardly provinces proper, but rather client principalities, were the two native kingdoms to which Alexander had left the conquered land beyond the Indus—the kingdoms of Taxiles and Porus.

3. System of Government.

The conquered empire presented Alexander with a system of government ready-made, which it was natural for the new masters to take over. For the Asiatic provinces and Egypt, the old Persian name of *satrapy* (see Satrap) was still retained, but the governor seems to have been styled officially in Greek *strategos*, although the term *satrap* certainly continued current in common parlance. The governors appointed by Alexander were, in the west of the empire, exclusively Macedonians; in the east, members of the Old Persian nobility were still among the satraps at Alexander's death, Atropates in Media, Phrataphernes in Parthia and Hyrcania, and Alexander's father-in-law Oxyartes in the Paropanisidae. Alexander had at first trusted Persian grandees more freely in this capacity; in Babylonia, Bactria, Carmania, Susiana he had set Persian governors, till the ingrained Oriental tradition of misgovernment so declared itself that to the three latter provinces certainly Macedonians had been appointed before his death. Otherwise the only eastern satrapy whose governor was not a Macedonian, was Areia, under Stasanor, a Cypriote Greek. In the case of certain provinces, possibly in the empire generally, Alexander established a double control. The financial administration was entrusted to separate officials; we hear of such in Lydia (Arr. i. 17, 7), Babylonia (id. iii. 16, 4), and notably in Egypt (id. iii. 5, 4). Higher financial controllers seem to have been over groups of provinces (Philoxenus over Asia Minor, Arr. i. 17, 7; see Beloch, *Gr. Gesch.* III. [i] p. 14), and Harpalus over the whole finances of the empire, with his seat in Babylon. Again the garrisons in the chief cities, such as Sardis, Babylon, Memphis Pelusium and Susa, were under commands distinct from those of the provinces. The old Greek cities of the motherland were not formally subjects of the empire, but sovereign states, which assembled at Corinth as members of a great alliance, in which the Macedonian king was included as a member and held the office of captain-general. The Greek cities of Asia Minor stood to him in a similar relation, though not included in the Corinthian alliance, but in federations of their own (Kaerst, *Gesch. d. hellenist. Zeitalt.* i. 261 seq.). Their territory was not part of the king's country (*Inscr. in the Brit. Mus.* No. 400). Of course, in fact, the power of the king was so vastly superior that the Greek cities were in reality subject to his dictation, even in so intimate a matter as the readmission of their exiles, and might be obliged to receive his garrisons. Within the empire itself, the various communities were allowed, subject to the interference of the king or his officials, to manage their own affairs. Alexander is said to have granted the Lydians to be "free" and "to use the laws of the ancient Lydians," whatever exactly these expressions may mean (Arr. i. 17, 4). So too in Egypt, the native monarchs were left as the local authorities (Arr. iii. 5, 4). Especially to the gods of the conquered people Alexander showed respect. In Egypt and in Babylon he appeared as the restorer of the native religions to honour after the unsympathetic rule of the Persians. The temple of Marduk in Babylon which had fallen began to rise again at his command. It is possible that he offered sacrifice to Yahweh in Jerusalem. In Persia, the native aristocracy retained their power, and the Macedonian governor adopted Persian dress and manners (Diod. xix. 48, 5; Arr. vi. 30). A new factor introduced by Alexander was the foundation of Greek cities at all critical points of intercourse in the conquered lands. These, no doubt, possessed municipal autonomy with the ordinary organization of the Greek state; to what extent they were formally and regularly controlled by the provincial authorities we do not know; Pithon, the satrap of the Indian province is specially described as sent "in colonias in Indis conditas" (Just. xiii. 4, 21). The empire included large tracts of mountain or desert, inhabited by tribes, which the Persian government had never subdued. The subjugation of such districts could only be by a system of effective military occupation and would be a work of time; but Alexander made a beginning by punitive expeditions, as occasion offered, calculated to reduce the free tribes to temporary quiet; we hear of such expeditions in the case of the Pisidians, the tribes of the Lebanon, the Uxii (in Khuzistan), the Tapyri (in the Elburz), the hill-peoples of Bajaor and Swat, the Cossaei (in Kurdistan); an expedition against the Arabs was in preparation when Alexander died.

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[1] For the events which brought this empire into being see Alexander the Great. For the detailed accounts of the separate dynasties into which it was divided after Alexander's death, see Seleucid Dynasty, Antigonus, Pergamum, &c., and for its effect on the spread of Hellenic culture see Hellenism.

See A. Köhler, *Reichsverwaltung u. Politik Alexanders des Grossen* in *Klio*, v. 303 seq. (1905).

4. Court.

Alexander, who set out as king of the Macedonians and captain-general of the Hellenes, assumed after the death of Darius the character of the Oriental great king. He adopted the Persian garb (Plutarch, *de fort. Al.* i. 8) including a head-dress, the *diadema*, which was suggested by that of the Achaemenian king (*Just.* xii. 3, 8). We hear also of a sceptre as part of his insignia (*Diod.* xviii. 27, 1). The pomps and ceremonies which were traditional in the East were to be continued. To the Greeks and Macedonians such a régime was abhorrent, and the opposition roused by Alexander's attempt to introduce among them the practice of *proskynesis* (prostration before the royal presence), was bitter and effectual. The title of *chiliarch*, by which the Greeks had described the great king's chief minister, in accordance with the Persian title which described him as "commander of a thousand," *i.e.* of the royal body-guard, was conferred by Alexander upon his friend Hephaestion. The Greek Chares held the position of chief usher (*εἰσαγγελεύς*). Another Greek, Eumenes of Cardia, was chief secretary (*ἀρχιγραμματεύς*). The figure of the eunuch, so long characteristic of the Oriental court, was as prominent as ever (*e.g.* Bagoas, Plut. *Alex.* 67, &c.; cf. Arr. vii. 24).

Alexander, however, who impressed his contemporaries by his sexual continence, kept no harem of the old sort. The number of his wives did not go beyond two, and the second, the daughter of Darius, he did not take till a year before his death. In closest contact with the king's person were the seven, or latterly eight, body-guards, *σωματοφύλακες*, Macedonians of high rank, including Ptolemy and Lysimachus, the future kings of Egypt, and Thrace (Arr. vi. 28, 4). The institution, which the Macedonian court before Alexander had borrowed from Persia, of a corps of pages composed of the young sons of the nobility (*παῖδες βασίλειοι* or *βασιλικοί*) continued to hold an important place in the system of the court and in Alexander's campaigns (see Arr. iv. 13, 1; Curt. viii. 6, 6; Suid. *βασίλειοι παῖδες*; cf. the *παῖδες* of Eumenes, Diod. xix. 28, 3).

See Spiecker, *Der Hof und die Hofordnung Alex. d. Grossen* (1904).

5. Army.

The army of Alexander was an instrument which he inherited from his father Philip. Its core was composed of the Macedonian peasantry who served on foot in heavy armour ("the Foot-companions")*πεζεταῖροι*). They formed the phalanx, and were divided into 6 brigades (*τάξεις*), probably on the territorial system. Their distinctive arm was the great Macedonian pike (*sarissa*), some 14 ft. long, of further reach than the ordinary Greek spear. They were normally drawn up in more open order than the heavy Greek phalanx, and possessed thereby a mobility and elasticity in which the latter was fatally deficient. Reckoning 1,500 to each brigade, we got a total for the phalanx of 9,000 men. Of higher rank than the *pezetaeri* were the royal foot-guards (*βασιλικοὶ ὑπασπίσται*), some 3,000 in number, more lightly armed, and distinguished (at any rate at the time of Alexander's death) by silver shields. Of these 1,000 constituted the royal corps (*τὸ ἄγημα τὸ βασιλικόν*). The Macedonian cavalry was recruited from a higher grade of society than the infantry, the *petite noblesse* of the nation. They bore by old custom the name of the king's Companions (*ἑταῖροι*), and were distributed into 8 territorial squadrons (*ἶλαι*) of probably some 250 men each, making a normal total of 2,000. In the cavalry also the most privileged squadron bore the name of the *agema*. The ruder peoples which were neighbors to the Macedonians (Paeonians, Agrianes, Thracians) furnished contingents of light cavalry and javelineers (*ἀκοντισταί*). From the Thessalians the Macedonian king, as overlord, drew some thousand excellent troopers. The rest of Alexander's army was composed of Greeks, not formally his subjects. These served partly as mercenaries, partly in contingents contributed by the states in virtue of their alliance. According to Diodorus (xvii. 17, 3) at the time of Alexander's passage into Asia, the mercenaries numbered 5,000, and the troops of the alliance 7,000 foot and 600 horse. All these numbers take no account of the troops left behind in Macedonia, 12,000 foot and 1,500 horse, according to Diodorus. When Alexander was lord of Asia, innovations followed in the army. Already in 330 at Persepolis, the command went forth that 30,000 young Asiatics were to be trained as Macedonian soldiers (the *epigoni*, Arr. vii., 6, 1). Contingents of the fine Bactrian cavalry followed Alexander into India. Persian nobles were admitted into the *agema* of the Macedonian cavalry. A far more radical remodelling of the army was undertaken at Babylon in 323, by which the old phalanx system was to be given up for one in which the unit was to be composed of Macedonians with pikes and Asiatics with missile arms in combination—a change calculated to be momentous both from a military point of view in the coming wars, and from a political, in the close fusion of Europeans and Asiatics. The death of Alexander interrupted the scheme, and his successors reverted to the older system. In the wars of Alexander the phalanx was never the most active arm; Alexander delivered his telling attacks with his cavalry, whereas the slow-moving phalanx held rather the position of a reserve, and was brought up to complete a victory when the cavalry charges had already taken effect. Apart from the pitched battles, the warfare of Alexander was largely hill-fighting, in which the *hypaspistae* took the principal part, and the contingents of light-armed hillmen from the Balkan region did excellent service.

For Alexander's army and tactics, beside the regular histories (Droysen, Niese, Beloch, Kaerst), see D. G. Hogarth, *Journal of Philol.*, xvii. 1 seq. (corrected at some points in his *Philip and Alexander*).

6. Fusion of Greeks and Asiatics.

The modifications in the army system were closely connected with Alexander's general policy, in which the fusion of Greeks and Asiatics held so prominent a place. He had himself, as we have seen, assumed to some extent the guise of a Persian king. The Macedonian Peucestas received special marks of his favour for adopting the Persian dress. The most striking declaration of his ideals was the marriage feast at Susa in 324, when a large number of the Macedonian nobles were induced to marry Persian princesses, and the rank and file were encouraged by special rewards to take Eastern wives. We are told that among the schemes registered in the state papers and disclosed after Alexander's death was one for transplanting large bodies of Asiatics into Europe and Europeans into Asia, for blending the peoples of the empire by intermarriage into a single whole (Diod. xviii. 4, 4). How far did Alexander intend that in such a fusion Hellenic culture should retain its pre-eminence? How far could it have done so, had the scheme been realized? It is not impossible that the question may yet be raised again whether the Eurasian after all is the heir of the ages.

7. Divine Honours.

High above all the medley of kindreds and tongues, untrammelled by national traditions, for he had outgrown the compass of any one nation, invested with the glory of achievements in which the old bounds of the possible seemed to fall away, stood in 324 the man Alexander. Was he a man? The question was explicitly suggested by the report that the Egyptian priest in the Oasis had hailed him in the god's name as the son of Ammon. The Egyptians had, of course, ascribed deity by old custom to their kings, and were ready enough to add Alexander to the list. The Persians, on the other hand, had a different conception of the godhead, and we have no proof that from them Alexander either required or received divine honours. From the Greeks he certainly received such honours; the ambassadors from the Greek states came in 323 with the character of *theori*, as if approaching a deity (Arr. vii. 23, 2). It has been supposed that in offering such worship the Greeks showed the effect of "Oriental" influence, but indeed we have not to look outside the Greek circle of ideas to explain it. As early as Aeschylus (*Supp.* 991) the proffering of divine honours was a form of expression for intense feelings of reverence or gratitude towards men which naturally suggested itself—as a figure of speech in Aeschylus, but the figure had been translated into action before Alexander not in the well-known case of Lysander only (cf. the case of Dion, Plut. *Dio*, 29). Among the educated Greeks rationalistic views of the old mythology had become so current that they could assimilate Alexander to Dionysus without supposing him to be supernatural, and to this temper the divine honours were a mere form, an elaborate sort of flattery. Did Alexander merely receive such honours? Or did he claim them himself? It would seem that he did. Many of the assertions as to his action in this line do not stand the light of criticism (see Hogarth, *Eng. Hist. Rev.* ii., 1887, p. 317 seq.; Niese, *Historische Zeitschrift*, lxxix., 1897, p. 1, seq.); even the explicit statement in Arrian as to Alexander and the Arabians is given as a mere report; but we have well-authenticated utterances of Attic orators when the question of the cult of Alexander came up for debate, which seem to prove that an intimation of the king's pleasure had been conveyed to Athens.

8. Intercourse and Discovery.

A new life entered the lands conquered by Alexander. Human intercourse was increased and quickened to a degree not before known. Commercial enterprise now found open roads between the Aegean and India; the new Greek cities made stations in what had been for the earlier Greek traders unknown lands; an immense quantity of precious metal had been put into circulation which the Persian kings had kept locked up in their treasuries (cf. Athen. vi. 231 e). At the same time Alexander himself made it a principal concern to win fresh geographical knowledge, to open new ways. The voyage of Nearchus from the Indus to the Euphrates was intended to link India by a waterway with the Mediterranean lands. So too Heraclides was sent to explore the Caspian; the survey, and possible circumnavigation, of the Arabian coasts was the last enterprise which occupied Alexander. The improvement of waterways in the interior of the empire was not neglected, the Babylonian canal system was repaired, the obstructions in the Tigris removed. A canal was attempted across the Mimas promontory (Plin. *N.H.* v. 116). The reports of the *βηματισταί*, Baeton and Diognetus, who accompanied the march of Alexander's army, gave an exacter knowledge of the geographical conformation of the empire, and were accessible for later investigators (Susemihl, *Gesch. d. griech. Litt.*, I. p. 544). Greek natural science was enriched with a mass of new material from the observations of the philosophers who went with Alexander through the strange lands (H. Bretzl, *Botanische Forschungen d. Alexanderzuges*, 1903); whilst on the other hand attempts were made to acclimatize the plants of the motherland in the foreign soil (Theophr., *Hist. Plant.* iv. 4, 1).

9. Coinage.

The accession of Alexander brought about a change in the monetary system of the kingdom. Philip's bimetallic system, which had attempted artificially to fix the value of silver in spite of the great depreciation of gold consequent upon the working of the Pangaean mines, was abandoned. Alexander's gold coinage, indeed (possibly not struck till after the invasion of Asia), follows in weight that of Philip's staters; but he seems at once to have adopted for his silver coins (of a smaller denomination than the tetradrachm) the Euboic-Attic standard, instead of the Phoenician, which had been Philip's. With the conquest of Asia, Alexander conceived the plan of issuing a uniform coinage for the empire. Gold had fallen still further from the diffusion of the Persian treasure, and Alexander struck in both metals on the Attic standard, leaving their relation to adjust itself by the state of the market. This imperial coinage was designed to break down the monetary predominance of Athens (Beloch, *Gr. Gesch.* iii. [i.], 42). None of the coins with Alexander's own image can be shown to have been issued during his reign; the traditional gods of the Greeks still admitted no living man to share their prerogative in this sphere. Athena and Nike alone figured upon Alexander's gold; Heracles and Zeus upon his silver.

See L. Müller, *Numismatique d'Alexandre le Grand* (1855); also NUMISMATICS: § I. "Greek Coins, Macedonian."

1. History of the "Successors."

II. *After Alexander.*—The external fortunes of the Macedonian Empire after Alexander's death must be briefly traced before its inner developments be touched upon.[1] There was, at first, when Alexander suddenly died in 323, no overt disruption of the empire. The dispute between the Macedonian infantry and the cavalry (*i.e.* the commonalty and the nobles) was as to the person who should be chosen to be the king, although it is true that either candidate, the half-witted son of Philip II., Philip Arrhidaeus, or the posthumous son of Alexander by Roxana, opened the prospect of a long regency exercised by one or more of the Macedonian lords. The compromise, by which both the candidates should be kings together, was, of course, succeeded by a struggle for power among those who wished to rule in their name. The resettlement of dignities made in Babylon in 323, while it left the eastern commands practically undisturbed as well as that of Antipater in Europe, placed Perdiccas (whether as regent or as chiliarch) in possession of the kings' persons, and this was a position which the other Macedonian lords could not suffer. Hence the first intestine war among the Macedonians, in which Antipater, Antigonus, the satrap of Phrygia, and Ptolemy, the satrap of Egypt, were allied against Perdiccas, who was ultimately murdered in 321 on the Egyptian frontier (see PERDICCAS [4], EUMENES). A second settlement, made at Triparadisus in Syria in 321, constituted Antipater regent and increased the power of Antigonus in Asia. When Antipater died, in 319, a second war broke out, the wrecks of the party of Perdiccas, led by Eumenes, combining with Polyperchon, the new regent, and later on (318) with the eastern satraps who were in arms against Pithon, the satrap of Media. Cassander, the son of Antipater, disappointed of the regency, had joined the party of Antigonus. In 316 Antigonus had defeated and killed Eumenes and made himself supreme from the Aegean to Iran, and Cassander had ousted Polyperchon from Macedonia. But now a third war began, the old associates of Antigonus, alarmed by his overgrown power, combining against him—Cassander, Ptolemy, Lysimachus, the governor of Thrace, and Seleucus, who had fled before Antigonus from his satrapy of Babylonia. From 315 to 301 the war of Antigonus against these four went on, with one short truce in 311. Antigonus never succeeded in reaching Macedonia, although his son Demetrius won Athens and Megara in 307 and again (304–302) wrested almost all Greece from Cassander; nor did Antigonus succeed in expelling Ptolemy from Egypt, although he led an army to its frontier in 306; and after the battle of Gaza in 312, in which Ptolemy and Seleucus defeated Demetrius, he had to see Seleucus not only recover Babylonia but bring all the eastern provinces under his authority as far as India. Meanwhile the struggle changed its character in an important respect. King Philip had been murdered by Olympias in 317; the young Alexander by Cassander in 310; Heracles, the illegitimate son of Alexander the Great, by Polyperchon in 309. Thus the old royal house became extinct in the male line, and in 306 Antigonus assumed the title of king. His four adversaries answered this challenge by immediately doing the same. Even in appearance the empire was no longer a unity. In 301 the coalition triumphed over Antigonus in the battle of Ipsus (in Phrygia) and he himself was slain. Of the four kings who now divided the Macedonian Empire amongst them, two were not destined to found durable dynasties, while the house of Antigonus, represented by Demetrius, was after all to do so. The house of Antipater came to an end in the male line in 294, when Demetrius killed the son of Cassander and established himself on the throne of Macedonia. He was however expelled by Lysimachus and Pyrrhus in 288; and in 285 Lysimachus took possession of all the European part of the Macedonian Empire. Except indeed for Egypt and Palestine under Ptolemy, Lysimachus and Seleucus now divided the empire between them, with the Taurus in Asia Minor for their frontier. These two survivors of the forty years' conflict soon entered upon the crowning fight, and in 281 Lysimachus fell in the battle of Corupedion (in Lydia), leaving Seleucus virtually master of the empire. Seleucus' assassination by Ptolemy Ceraunus in the same year brought back confusion.

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[1] For details see separate articles on the chief generals.

Ptolemy Ceraunus (the son of the first Ptolemy, and half-brother of the reigning king of Egypt) seized the Macedonian throne, whilst Antiochus, the son of Seleucus, succeeded in holding together the Asiatic dominions of his father. The confusion was aggravated by the incursion of the Gauls into the Balkan Peninsula in 279; Ptolemy Ceraunus perished, and a period of complete anarchy succeeded in Macedonia. In 276 Antigonus Gonatas, the son of Demetrius, after inflicting a crushing defeat on the Gauls near Lysimachia, at last won Macedonia definitively for his house. Three solid kingdoms had thus emerged from all the fighting since Alexander's death: the kingdom of the Antigonids in the original land of the race, the kingdom of the Ptolemies in Egypt, and that of the Seleucids, extending from the Aegean to India. For the next 100 years these are the three great powers of the eastern Mediterranean. But already parts of the empire of Alexander had passed from Macedonian rule altogether. In Asia Minor, Philetaerus a Greek of Tios (Tieium) in Paphlagonia, had established himself in a position of practical independence at Pergamum, and his nephew, Attalus, was the father of the line of kings who reigned in Pergamum till 133—antagonistic to the Seleucid house, till in 189 they took over the Seleucid possessions west of the Taurus. In Bithynia a native dynasty assumed the style of kings in 297. In Cappadocia two Persian houses, relics of the old aristocracy of Achaemenian days had carved out principalities, one of which became the kingdom of Pontus and the other the kingdom of Cappadocia (in the narrower sense); the former regarding Mithradates (281–266) as its founder, the latter being the creation of the second Ariarathes (?302–?281). Armenia, never effectively conquered by the Macedonians, was left in the hands of native princes, tributary only when the Seleucid court was strong enough to compel. In India, Seleucus had in 302 ceded large districts on the west of the Indus to Chandragupta, who had arisen to found a native empire which annexed the Macedonian provinces in the Panjab.

Whilst the Antigonid kingdom remained practically whole till the Roman conquest ended it in 168 B.C., and the house of Ptolemy ruled in Egypt till the death of Cleopatra in 30 B.C., the Seleucid Empire perished by a slow process of disruption. The eastern provinces of Iran went in 240 or thereabouts, when the Greek Diodotus made himself an independent king in Bactria (*q.v.*) and Sogdiana, and Tiridates, brother of Arsaces, a "Scythian" chieftain, conquered Parthia (so Arrian, but see PARTHIA). Armenia was finally lost in 190, when Artaxias founded a new native dynasty there. Native princes probably ruled in Persis before 166, though the district was at least nominally subject to Antiochus IV. Epiphanes till his death in 164 (see PERSIS). In southern Syria, which had been won by the house of Seleucus from the house of Ptolemy in 198, the independent Jewish principality was set up in 143. About the same time Media was totally relinquished to the Parthians. Babylonia was Parthian from 129. Before 88 the Parthians had conquered Mesopotamia. Commagene was independent under a king, Mithradates Callinicus, in the earlier part of the last century B.C. Syria itself in the last days of the Seleucid dynasty is seen to be breaking up into petty principalities, Greek or native. From 83 to 69 is the transient episode of Armenian conquest, and in 64 the last shadow of Seleucid rule vanished, when Syria was made a Roman province by Pompey. From this time Rome formally entered upon the heritage of Alexander as far as the Euphrates, but many of the dynasties which had arisen in the days of Macedonian supremacy were allowed to go on for a time as client states. One of them, the royal house of Commagene, not deposed by the Romans till A.D. 72, had Seleucid blood in its veins through the marriage of a Seleucid princess with Mithradates Callinicus, and regarded itself as being a continuation of the Seleucid dynasty. Its kings bore the name of Antiochus, and were as proud of their Macedonian, as of their Persian, descent (see the Inscription of Nimrud Dagh, Michel, No. 735).

2. Constitution of the Macedonian Kingdom.

The Macedonians of Alexander were not mistaken in seeing an essential transformation of their national monarchy when Alexander adopted the guise of an Oriental great king. Transplanted into this foreign soil, the monarchy became an absolute despotism, unchecked by a proud territorial nobility and a hardy peasantry on familiar terms with their king. The principle which Seleucus is reported to have enunciated, that the king's command was the supreme law (App. *Syr.* 61), was literally the principle of the new Hellenistic monarchies in the East. But the rights belonging to the Macedonian army as Alexander inherited it did not altogether disappear. Like the old Roman people, the Macedonian people under arms had acted especially in the transference of the royal authority, conferring or confirming the right of the new chief, and in cases of the capital trials of Macedonians. In the latter respect the army came regularly into function under Alexander, and in the wars which followed his death (Diod. xviii. 4, 3; 36, 7; 37, 2, 39, 2; xix. 61, 3), and in Macedonia; although the power of life and death came *de facto* into the hands of the Antigonid king, the old right of the army to act as judge was not legally abrogated, and friction was sometimes caused by its assertion (Polyb. v. 27, 5). The right of the army to confer the royal power was still symbolized in the popular acclamation required on the accession of a new king, and at Alexandria in troubled times we hear of "the people" making its will effective in filling the throne, although it is here hard to distinguish mob-rule from the exercise of a legitimate function. Thus the people put Euergetes II. on the throne when Philometor was captured (Polyb. xxix. 23, 4); the people compelled Cleopatra III. to choose Soter II. as her associate (Just. xxxiv. 3, 2). In Syria, the usurper Tryphon bases his right upon an election by the "people" (Just. xxxvi. 1, 7) or "the army" (Jos. *Ant.* xiii. § 219). Where it is a case of delegating some part of the supreme authority, as when Seleucus I. made his son Antiochus king for the eastern provinces, we find the army convoked to ratify the appointment (App. *Syr.* 61). So too the people is spoken of as appointing the guardians of a king during his minority (Just. xxxiv. 3, 6). Nor was the power of the army a fiction. The Hellenistic monarchies rested, as all government in the last resort must, upon the loyalty of those who wielded the brute force of the state, and however unlimited the powers of the king might be in theory, he could not alienate the goodwill of the army with impunity. The right of primogeniture in succession was recognized as a general principle; a woman, however, might succeed only so long as there were no male agnates. Illegitimate children had no rights of succession. In disturbed times, of course, right yielded to might or to practical necessities.

The practice by which the king associated a son with himself, as secondary king, dates from the very beginning of the kingdoms of the Successors; Antigonus on assuming the diadem in 306 caused Demetrius also to bear the title of king. Some ten years later Seleucus appointed Antiochus as king for the eastern provinces. Thenceforth the practice is a common one. But the cases of it fall into two classes. Sometimes the subordinate or joint kingship implies real functions. In the Seleucid kingdom the territorial expanse of the realm made the creation of a distinct subordinate government for part of it a measure of practical convenience. Sometimes the joint-king is merely titular, an infant of tender years, as for instance Antiochus Eupator, the son of Antiochus Epiphanes, or Ptolemy Eupator, the son of Ptolemy Philometor. The object here is to secure the succession in the event of the supreme king's dying whilst his heir is an infant. The king's government was carried on by officials appointed by him and responsible to him alone. Government at the same time, as an Oriental despotism understands it, often has little in view but the gathering in of the tribute and compulsion of the subjects to personal service in the army or in royal works, and if satisfied in these respects will leave much independence to the local authorities. In the loosely-knit Seleucid realm it is plain that a great deal more independence was left to the various communities,—cities or native tribes,—than in Egypt, where the conditions made a bureaucratic system so easy to carry through. In their outlying possessions the Ptolemies may have suffered as much local independence as the Seleucids; the internal government of Jerusalem, for instance, was left to the high priests. In so far as the older Greek cities fell within their sphere of power, the successors of Alexander were forced to the same ambiguous policy as Alexander had been, between recognizing the cities' unabated claim to sovereign independence and the necessity of attaching them securely. In Asia Minor, the "enslavement" and liberation of cities alternated with the circumstances of the hour, while the kings all through professed themselves the champions of Hellenic freedom, and were ready on occasion to display munificence toward the city temples or in public works, such as might reconcile republicans to a position of dependence. Antiochus III. went so far as to write on one occasion to the subject Greek cities that if any royal mandate clashed with the civic laws it was to be disregarded (Plut. *Imp. et duc. apophth.*). But it was the old cry of the "autonomy of the Hellenes," raised by Smyrna and Lampsacus, which ultimately brought Antiochus III. into collision with Rome. How anxious the Pergamene kings, with their ardent Hellenism, were to avoid offence is shown by the elaborate forms by which, in their own capital, they sought to give their real control the appearance of popular freedom (Cardinali, *Regno di Pergamo*, p. 281 seq.). A similar problem confronted the Antigonid dynasty in the cities of Greece itself, for to maintain a predominant influence in Greece was a ground-principle of their policy. Demetrius had presented himself in 307 as the liberator, and driven the Macedonian garrison from the Peiraeus; but his own garrisons held Athens thirteen years later, when he was king of Macedonia, and the Antigonid dynasty clung to the points of vantage in Greece, especially Chalcis and Corinth, till their garrisons were finally expelled by the Romans in the name of Hellenic liberty.

3. Commerce.

The new movement of commerce initiated by the conquest of Alexander continued under his successors, though the break-up of the Macedonian Empire in Asia in the 3rd century and the distractions of the Seleucid court must have withheld many advantages from the Greek merchants which a strong central government might have afforded them. It was along the great trade-routes between India and the West that the main stream of riches flowed then as in later centuries. One of these routes was by sea to south-west Arabia (Yemen), and thence up the Red Sea to Alexandria. This was the route controlled and developed by the Ptolemaïc kings. Between Yemen and India the traffic till Roman times was mainly in the hands of Arabians or Indians; between Alexandria and Yemen it was carried by Greeks (Strabo ii. 118). The west coast of the Red Sea was dotted with commercial stations of royal foundation from Arsinoë north of Suez to Arsinoë in the south near the straits of Bab-el-Mandeb. From Berenice on the Red Sea a land-route struck across to the Nile at Coptos; this route the kings furnished with watering stations. That there might also be a waterway between Alexandria and the Red Sea, they cut a canal between the Delta and the northern Arsinoë. It was Alexandria into which this stream of traffic poured and made it the commercial metropolis of the world. We hear of direct diplomatic intercourse between the courts of Alexandria and Pataliputra, *i.e.* Patna (Plin. vi. § 58). An alternative route went from the Indian ports to the Persian Gulf, and thence found the Mediterranean by caravan across Arabia from the country of Gerrha to Gaza; and to control it was no doubt a motive in the long struggle of the Ptolemaic and Seleucid houses for Palestine, as well as in the attempt of Antiochus III. to subjugate the Gerrhaeans. Or from the Persian Gulf wares might be taken up the Euphrates and carried across to Antioch; this route lay altogether in the Seleucid sphere. With Iran Antioch was connected most directly by the road which crossed the Euphrates at the Zeugma and went through Edessa and Antioch-Nisibis to the Tigris. The trade from India which went down the Oxus and then to the Caspian does not seem to have been considerable (Tarn, *Journ. of Hell. Stud.* xxi. 10 seq.). From Antioch to the Aegean the land high-road went across Asia Minor by the Cilician Gates and the Phrygian Apamea.

4. Finance.

Of the financial organization of the Macedonian kingdoms we know practically nothing, except in the case of Egypt. Here the papyri and ostraca have put a large material at our disposal, but the circumstances in Egypt[1] were too peculiar for us to generalize upon these data as to the Seleucid and Antigonid realms. That the Seleucid kings drew in a principal part of their revenues from tribute levied upon the various native races, distributed in their village communities as tillers of the soil goes without saying.[2] In districts left in the hands of native chiefs these chiefs would themselves exploit their villages and pay the Seleucid court and tribute. To exact tribute from Greek cities was invidious, but both Antigonid and Seleucid kings often did so (Antigonid, Diog. Laërt. II., 140; Plut. *Dem.* 27; Seleucid, Michel, No. 37; Polyb. xxi. 43, 2). Sometimes, no doubt, this tribute was demanded under a fairer name, as the contribution of any ally (*σύνταξις*, not *φόρος*), like the *Γαλατικά* levied by Antiochus I. (Michel, No. 37; cf. Polyb. xxii. 27, 2). The royal domains, again, and royal monopolies, such as salt-mines, were a source of revenue.[3] As to indirect taxes, like customs and harbour dues, while their existence is a matter of course (cf. Polyb. v. 89, 8), their scale, nature and amount is quite unknown to us. Whatever the financial system of the Antigonid and Seleucid kingdoms may have been, it is clear that they were far from enjoying the affluence of the Ptolemaic. During the first Seleucid reigns indeed the revenues of Asia may have filled its treasuries (see Just. xvii. 2, 13), but Antiochus III. already at his accession found them depleted (Polyb. v. 50, 1), and from his reign financial embarrassment, coupled with extravagant expenditure, was here the usual condition of things. Perseus, the last of the Antigonid house, amassed a substantial treasure for the expenses of the supreme struggle with Rome (Polyb. xviii. 35, 4; Liv. xlv, 40), but it was by means of almost miserly economies.

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[1] For Ptolemaic Egypt, see PTOLEMIES and EGYPT.

[2] A *tenth* of the produce is suggested to have been the normal tax by what the Romans found obtaining in the Attalid kingdom. The references given by Beloch (*Griech. Gesch.* iii. [i.], p. 343) to prove it for the Seleucid kingdom are questionable. Beloch refers (1) to the letter of Demetrius II. to Lasthenes in which *αἱ δεκαταὶ καὶ τὰ τέλη* are mentioned, 1 Macc. 11, 35 (Beloch, by an oversight, refers to the paraphrase of the documents in Joseph. *Ant.* xiii. 4, § 126 seq., in which the mention of the *δεκαταὶ* is omitted!). The authenticity of this document is, however, very doubtful. He refers (2) to Dittenb. 171 (1st ed.), line 101; but here the tax seems to be, not an imperial one, but one paid to the city of Smyrna.

[3] The salt monopoly is mentioned in 1 Macc. 10, 29; 11, 35, a suspected source, but supported in this detail by the analogy of Ptolemaic Egypt and Rome. For domains in Antigonid, Attalid and Bithynian realms, see Cic. *De leg. agr.* ii. 19, 50.

Special officials were naturally attached to the service of the finances. Over the whole department in the Seleucid realm there presided a single chief (ὁ ἐπὶ τῶν προσόδων, App. *Syr.* 45). How far the financial administration was removed from the competence of the provincial governors, as it seems to have been in Alexander's system, we cannot say. Seleucus at any rate, as satrap of Babylonia, controlled the finances of the province (Diod. xix. 55, 3), and so, in the Ptolemaic system, did the governor of Cyprus (Polyb. xxvii. 13). The fact that provincial officials ἐπὶ τῶν προσόδων (in Eriza, *Bull. corr. hell.* xv. 556) are found does not prove anything, since it leaves open the question of their being subordinate to the governor.

5. Coinage.

With the exception of Ptolemaic Egypt, the Macedonian kingdoms followed in their coinage that of Alexander. Money was for a long while largely struck with Alexander's own image and superscription; the gold and silver coined in the names of Antigonid and Seleucid kings and by the minor principalities of Asia, kept to the Attic standard which Alexander had established. Only in Egypt Ptolemy I. adopted, at first the Rhodian, and afterwards the Phoenician, standard, and on this latter standard the Ptolemaic money was struck during the subsequent centuries. Money was also struck in their own name by the cities in the several dynasties' spheres of power, but in most cases only bronze or small silver for local use. Corinth, however, was allowed to go on striking staters under Antigonus Gonatas; Ephesus, Cos and the greater cities of Phoenicia retained their right of coinage under Seleucid or Ptolemaic supremacy.

6. The Court.

In language and manners the courts of Alexander's successors were Greek. Even the Macedonian dialect, which it was considered proper for the kings to use on occasion, was often forgotten (Plut. *Ant.* 27). The Oriental features which Alexander had introduced were not copied. There was no *proskynesis* (or certainly not in the case of Greeks and Macedonians), and the king did not wear an Oriental dress. The symbol of royalty, it is true, the *diadem*, was suggested by the head-band of the old Persian kings (Just. xii. 3, 8); but, whereas, that had been an imposing erection, the Hellenistic diadem was a simple riband. The king's state dress was the same in principle as that worn by the Macedonian or Thessalian horsemen, as the uniform of his own cavalry officers. Its features were the broad-brimmed hat (*kausia*), the cloak (*chlamys*) and the high-laced boots (*krepīdes*) (Plut. *Ant.* 54; Frontinus, iii. 2, 11). These, in the case of the king, would be of richer material, colour and adornment. The diadem could be worn round the kausia; the chlamys offered scope for gorgeous embroidery; and the boots might be crimson felt (see the description of Demetrius' chlamys and boots, Plut. *Dem.* 41). There were other traces in the Hellenistic courts of the old Macedonian tradition besides in dress. One was the honour given to prowess in the chase (Polyb. xxii. 3, 8; Diod. xxxiv. 34). Another was the fashion for the king to hold wassail with his courtiers, in which he unbent to an extent scandalous to the Greeks, dancing or indulging in routs and practical jokes.[1]

The prominent part taken by the women of the royal house was a Macedonian characteristic. The history of these kingdoms furnishes a long list of queens and princesses who were ambitious and masterful politicians, of which the great Cleopatra is the last and the most famous. The kings after Alexander, with the exception of Demetrius Poliorcetes and Pyrrhus, are not found to have more than one legitimate wife at a time, although they show unstinted freedom in divorce and the number of their mistresses. The custom of marriages between brothers and sisters, agreeable to old Persian as to old Egyptian ethics, was instituted in Egypt by the second Ptolemy when he married his full sister Arsinoë Philadelphus. It was henceforth common, though not invariable, among the Ptolemies. At the Seleucid court there seems to be an instance of it in 195, when the heir-apparent, Antiochus, married his sister Laodice. The style of "sister" was given in both courts to the queen, even when she was not the king's sister in reality (Strack, *Dynastie*, Nos. 38, 40, 43; *Archiv. f. Papyr*, i. 205). The "Friends" of the king are often mentioned. It is usual for him to confer with a council (συνέδριον) of his "Friends" before important decisions, administrative, military or judicial (*e.g.* Polyb. v. 16, 5; 22, 8). They form a definite body about the king's person (φίλων σύνταγμα, Polyb. xxxi. 3, 7; cf. οἱ φίλοι in contrast with αἱ δυνάμεις, id. v. 50, 9), admission into which depends upon his favour alone, and is accorded, not only to his subjects, but to aliens, such as the Greek refugee politicians (*e.g.* Hegesianax, Athen. iv. 155b; Hannibal and the Aetolian Thoas take part in the councils of Antiochus III). A similar body, with a title corresponding to φίλοι, is found in ancient Egypt (Erman, *Ancient Egypt*, Eng. trans., p. 72) and in Persia (Spiegel. *Eran. Alt.* iii. 626); but some such support is so obviously required by the necessities of a despot's position that we need not suppose it derived from any particular precedent. The Friends (at any rate under the later Seleucid and Ptolemaïc reigns) were distinguished by a special dress and badge of gold analogous to the stars and crosses of modern orders. The dress was of crimson (πορφύρα); this and the badges were the king's gift, and except by royal grant neither crimson nor gold might, apparently, be worn at court (1 Macc. 10, 20; 62; 89; 11, 58; Athen. v. 211b). The order of Friends was organized in a hierarchy of ranks, which were multiplied as time went on. In Egypt we find them classified as συγγενεῖς, ὁμότιμοι τοῖς συγγενέσιν, ἀρχισωματοφύλακες, πρῶτοι φίλοι, φίλοι (in the narrower sense), διάδοχοι. For the Seleucid kingdom συγγενεῖς, πρῶτοι φίλοι and φίλοι are mentioned. These classes do not appear in Egypt before the 2nd century; Strack conjectures that they were created in imitation of the Seleucid court. We have no direct evidence as to the institutions of the Seleucid court in the 3rd century. Certain σωματοφύλακες of Antiochus I. are mentioned, but we do not know whether the name was not then used in its natural sense (Strack, *Rhein. Mus.* LV., 1900, p. 161 seq.; Wilamowitz, *Archiv f. Pap.* I., p. 225; Beloch, *Gr. Gesch.* iii (i), p. 391). As to Macedonia, whatever may have been the constitution of the court, it is implied that it offered in its externals a sober plainness in comparison with the vain display and ceremonious frivolities of Antioch and Alexandria (Polyb. xvi, 22, 5; Plut. *Cleom.* 31; *Arat*, 15). The position of a Friend did not carry with it necessarily any functions; it was in itself purely honorary. The ministers and high officials were, on the other hand, regularly invested with one or other of the ranks specified. The chief of these ministers is denoted ὁ ἐπὶ τῶν πραγμάτων, and he corresponds to the *vizier* of the later East. All departments of government are under his supervision, and he regularly holds the highest rank of a kinsman. When the king is a minor, he acts as guardian or regent (ἐπίτροπος). Over different departments of state we find a state secretary (ἐπιστολογράφος or ὑπομνηματογράφος: Seleucid, Polyb. xxxi, 3, 16; Ptolemaic, Strack, *Inschriften* 103) and a minister of finance (ὁ ἐπὶ τῶν προσόδων in the Seleucid kingdom; App. *Syr.* 45; διοικήτης in Egypt, Lumbroso, *Econ. Pol.* p. 339). Under each of these great heads of departments was a host of lower officials, those, for instance, who held to the province a relation analogous to that of the head of the department of the realm. Such a provincial authority is described as ἐπὶ τῶν προσόδων in the inscription of Eriza (*Bull. corr. hell.*

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[1] Antiochus Epiphanes was an extreme case. For the Antigonid court see Diog. Laërt. vii. 13; Plut. *Arat.* 17; for the Seleucid, Athen. iv. 155b; v. 211a; for the Ptolemaic, Diog. L. vii. 177; Athen. vi. 246c; Plut. *Cleom.* 33; Just. xxx. 1.

xv. 556). Beside the officials concerned with the work of government we have those of the royal household: (1) the chief-physician, *ἀρχιατρός* (for the Seleucid see App. *Syr.* 59; Polyb. v. 56, 1; Michel, No. 1158; for the Pontic, *Bull. corr. hell.* vii. 354 seq.); (2) the chief-huntsman, *ἀρχικυνηγός* (Dittenb. *Orient. Graec.* 99); (3) the maître-d'hôtel *ἀρχεδέατρος* (Dittenb. *Orient. Graec.* 169) (4) the lord of the queen's bedchamber, *ὁ επὶ τοῦ κοιτῶνος τῆς βασιλίσσης* (Dittenb. *Orient. Graec.* 256). As in the older Oriental courts, the high positions were often filled by eunuchs (*e.g.* Craterus, in last mentioned inscription).

It was customary, as in Persia and in old Macedonia, for the great men of the realm to send their children to court to be brought up with the children of the royal house. Those who had been so brought up with the king were styled his *σύντροφοι* (for the Seleucid, Polyb. v. 82, 8 and xxxi. 21, 2; *Bull. corr. hell.* i. 285; 2 Macc. ix. 29; for the Ptolemaic *σύντροφοι παίδισκαι* of the queen, Polyb. xv. 33, 11; for the Pontic, *Bull. corr. hell.* vii. 355; for the Pergamene. Polyb. xxxii. 27, 10, &c.; for the Herodian, Acts 13). It is perfectly gratuitous to suppose with Deissmann that "the fundamental meaning had given place to the general meaning of intimate friend." With this custom we may perhaps bring into connexion the office of *τροφεύς* (Polyb. xxxi. 20, 3; Michel, No. 1158). As under Alexander, so under his successors, we find a corps of *βασιλικοί παῖδες*. They appear as a corps, 600 strong, in a triumphal procession at Antioch (Polyb. xxxi. 3, 17; cf. v. 82, 13; Antigonid, Livy, xlv. 6; cf. Curtius, viii. 6, 6).

7. Hellenic Culture.

All the Hellenistic courts felt it a great part of prestige to be filled with the light of Hellenic culture. A distinguished philosopher or man of letters would find them bidding for his presence, and most of the great names are associated with one or other of the contemporary kings. Antigonus Gonatas, bluff soldier-spirit that he was, heard the Stoic philosophers gladly, and, though he failed to induce Zeno to come to Macedonia, persuaded Zeno's disciple, Persaeus of Citium, to enter his service. Nor was it philosophers only who made his court illustrious, but poets like Aratus. The Ptolemaic court, with the museum attached to it, is so prominent in the literary and scientific history of the age that it is unnecessary to give a list of the philosophers, the men of letters and science, who at one time or other ate at King Ptolemy's table. One may notice that the first Ptolemy himself made a contribution of some value to historical literature in his account of Alexander's campaigns; the fourth Ptolemy not only instituted a cult of Homer but himself published tragedies; and even Ptolemy Euergetes II. issued a book of memoirs. The Pergamene court was in no degree behind the Ptolemaic in its literary and artistic zeal. The notable school of sculpture connected with it is treated elsewhere (see GREEK ART); to its literary school we probably owe in great part the preservation of the masterpieces of Attic prose (Susemihl I., p. 4), and two of its kings (Eumenes I. and Attalus III.) were themselves authors. The Seleucid court did not rival either of the last named in brilliance of culture; and yet some names of distinction were associated with it. Under Antiochus I. Aratus carried out a recension of the *Odyssey*, and Berossus composed a Babylonian history in Greek; under Antiochus III. Euphorion was made keeper of the library at Antioch. Antiochus IV., of course, the enthusiastic Hellenist, filled Antioch with Greek artists and gave a royal welcome to Athenian philosophers. Even in the degenerate days of the dynasty, Antiochus Grypus, who had been brought up at Athens, aspired to shine as a poet. The values recognized in the great Hellenistic courts and the Greek world generally imposed their authority upon the dynasties of barbarian origin. The Cappadocian court admitted the full stream of Hellenistic culture under Ariarathes V. (Diod. xxxi. 19, 8). One of the kings called Nicomedes in Bithynia offered immense sums to acquire the Aphrodite of Praxiteles from the Cnidians (Plin. *N.H.* xxxvi. 21), and to a king Nicomedes the geographical poem of the Pseudo-Scymnus is dedicated. Even Iranian kings in the last century B.C. found pleasure in composing, or listening to, Greek tragedies, and Herod the Great kept Greek men of letters beside him and had spasmodic ambitions to make his mark as an orator or author (Nicol. Dam. frag. 4; *F.H.G.* III. p. 350).

8. Divine Honours.

The offering of divine honours to the king, which we saw begin under Alexander, became stereotyped in the institutions of the succeeding Hellenistic kingdoms. Alexander himself was after his death the object of various local cults, like that which centred in the shrine near Erythrae (Strabo, xiv. 644). His successors in the first years after his death recognized him officially as a divinity, except Antipater (Suidas, *s.v.* Αντίπατρος), and coins began to be issued with his image. At Alexandria the state cult of him seems to have been instituted by the second Ptolemy, when his body was laid in the *Sema* (Otto, *Priester u. Tempel*, i. 139 seq.). The successors themselves received divine honours. Such worship might be the spontaneous homage of a particular Greek community, like that offered to Antigonus by Scepsis in 311 (*Journ. of Hell. Stud.* xix. 335 seq.), the Antigonus and Demetrius by Athens in 307, to Ptolemy I. by the Rhodians in 304, or by Cassandrea to Cassander, as the city's founder (Ditt. 2nd ed. 178); or it might be organized and maintained by royal authority. The first proved instance of a cult of the latter kind is that instituted at Alexandria by the second Ptolemy for his father soon after the latter's death in 283/2, in which, some time after, 279/8, he associated his mother Berenice also, the two being worshipped together as *θεοὶ σωτῆρες* (Theoc. xvii. 121 seq.). Antiochus I. followed the Ptolemaic precedent by instituting at Seleucia-in-Pieria a cult for his father as Seleucus Zeus Nicator. So far we can point to no instance of a cult of the living sovereign (though the cities might institute such locally) being established by the court for the realm. This step was taken in Egypt after the death of Arsinoë Philadelphus (271) when she and her still-living brother-husband, Ptolemy II., began to be worshipped together as *θεοὶ ἀδελφοί*. After this the cult of the reigning king and queen was regularly maintained in Greek Egypt, side by side with that of the dead Ptolemies. Under Antiochus II. (261–246) a document shows us a cult of the reigning king in full working for the Seleucid realm, with a high priest in each province, appointed by the king himself; the document declares that the Queen Laodice is now to be associated with the king. The official surname of Antiochus II., Theos, suggests that he himself had here been the innovator. Thenceforward, in the Hellenistic kingdoms of the East the worship of the living sovereign became the rule, although it appears to have been regarded as given in anticipation of an apotheosis which did not become actual till death. In the Pergamene kingdom at any rate, though the living king was worshipped with sacrifice, the title *θεός* was only given to those who were dead (Cardinali, *Regno di Pergamo*, p. 153). The Antigonid dynasty, simpler and saner in its manners, had no official cult of this sort. The divine honours offered on occasion by the Greek cities were the independent acts of the cities.

See Plut. *Arat.* 45; *Cleom.* 16; Kornemann, "Zur Gesch. d. antiken Herrscherkulte" in *Beiträge z. alt. Gesch.* i. 51 sqq.; Otto, *Priester u. Tempel*, pp. 138 seq.

9. Surnames.

There does not seem any clear proof that the surnames which the Hellenistic kings in Asia and Egypt bore were necessarily connected with the cult, even if they were used to describe the various kings in religious ceremonies. Some had doubtless a religious colour, *Theos*, *Epiphanes*, *Soter*; others a dynastic, *Philopator*, *Philometor*, *Philadelphus*. Under what circumstances, and by whose selection, the surname was attached to a king, is obscure. It is noteworthy that while modern books commonly speak of the surnames as *assumed*, the explanations given by our ancient authorities almost invariably suppose them to be given as marks of homage or gratitude (*English Historical Review*, xvi. 629 (1901). The official surnames must not, of course, be confused with the popular nicknames which were naturally not recognized by the court, *e.g.* *Ceraunus* ("Thunder"), *Hierax* ("Hawk"), *Physcon* ("Pot-belly"), *Lathyrus* ("Chick-pea").

10. Armies.

The armies of Alexander's successors were still in the main principles of their organization similar to the army with which Alexander had conquered Asia. During the years immediately after Alexander the very Macedonians who had fought under Alexander were ranged against each other under the banners of the several chiefs. The most noted corps of veterans, Argyraspides (*i.e.* the royal Hypaspistae) played a great part in the first wars of the successors, and covered themselves with infamy by their betrayal of Eumenes. As the soldiers of Alexander died off, fresh levies of home-born Macedonians could be raised only by the chief who held the motherland. The other chiefs had to supply themselves with Macedonians from the numerous colonies planted before the break-up of the empire in Asia or Egypt, and from such Macedonians they continued for the next two centuries to form their phalanx. The breed—at least if the statement which Livy puts into the mouth of a Roman general can be relied on—degenerated greatly under Asiatic and Egyptian skies (Liv. xxxviii. 17, 10); but still old names like that of *pezetaeri* attached to the phalangites (Plut. *Tib.* 17), and they still wielded the national *sarissa.* The latter weapon in the interval between Alexander and the time of Polybius had been increased to a length of 21 ft. (Polyb. xviii. 12), a proportion inconsistent with any degree of mobility; once more indeed the phalanx of the 2nd century seems to have become a body effective by sheer weight only and disordered by unevenness of ground. The Antigonid kings were never able from Macedonian levies to put in the field a phalanx of more than 20,000 at the utmost (Liv. xlii. 51); Antigonus Doson takes with him to Greece (in 222) one of 10,000 only. The phalanx of Antiochus III. at Raphia numbered 20,000, and Ptolemy Philopator was able at the same time to form one of 25,000 men (Polyb. v. 4). As these phalangites are distinguished both from the Greek mercenaries and the native Egyptian levies, it looks (although such a fact would be staggering) as if more Macedonians could be raised for military service in Egypt than in Macedonia itself (but see Beloch, p. 353). The royal foot-guards are still described in Macedonia in 171 as the *agema* (Polyb. v. 25, 1; 27, 3; Liv. xlii. 51), when they number 2000; at the Ptolemaic court in 217 the *agema* had numbered 3000 (Polyb. v. 65, 2); and a similar corps of *hypaspistae* is indicated in the Seleucid army (Polyb. vii. 16,2; xvi. 18, 7). So too the old name of "Companions" was kept up in the Seleucid kingdom for the Macedonian cavalry (see Polyb. v. 53, 4, &c.), and divisions of rank in it are still indicated by the terms *agema* and royal squadron (βασιλικὴ ἴλη, see Bevan, *House of Seleucus*, ii. 288). The Antigonid and Seleucid courts had much valuable material at hand for their armies in the barbarian races under their sway. The Balkan hill-peoples of Illyrian or Thracian stock, the hill-peoples of Asia Minor and Iran, the chivalry of Media and Bactria, the mounted bowmen of the Caspian steppes, the camel-riders of the Arabian desert, could all be turned to account. Iranian troops seem to have been employed on a large scale by the earlier Seleucids. At Raphia, Antiochus III. had 10,000 men drawn from the provinces, armed and drilled as Macedonians, and another corps of Iranians numbering 5000 under a native commander (Polyb. v. 79). The experiment of arming the native Egyptians on a large scale does not seem to have been made before the campaign of 217, when Ptolemy IV. formed corps of the Macedonian pattern from Egyptians and Libyans (cf. Polyb. v. 107, 2; Ptolemy I. had employed Egyptians in the army, though chiefly as carriers, Diod. xix. 80, 4). From this time native rebellions in Egypt are recurrent. To the troops drawn from their own dominions the mercenaries which the kings procured from abroad were an important supplement. These were mainly the bands of Greek *condottieri*, and even for their home-born troops Greek officers of renown were often engaged. The other class of mercenaries were Gauls, and from the time of the Gallic invasion of Asia Minor in 279 Gauls or Galatians were a regular constituent in all armies. They were a weapon apt to be dangerous to the employer, but the terror they inspired was such that every potentate sought to get hold of them. The elephants which Alexander brought back from India were used in the armies of his successors, and in 302 Seleucus procured a new supply. Thenceforward elephants, either brought fresh from India or bred in the royal stables at Apamea, regularly figured in the Seleucid armies. The Ptolemies supplied themselves with this arm from the southern coasts of the Red Sea, where they established stations for the capture and shipping of elephants, but the African variety was held inferior to the Indian. Scythed chariots such as had figured in the old Persian armies were still used by the Greek masters of Asia (Seleucus I., Diod. xx. 113, 4; Molon, Polyb. v. 53, 10; Antiochus III., Liv. xxxvii. 41), at any rate till the battle of Magnesia. The Hellenistic armies were distinguished by their external magnificence. They made a greater display of brilliant metal and gorgeous colour than the Roman armies, for instance. The description given by Justin of the army which Antiochus Sidetes took to the East in 130 B.C., boot-nails and bridles of gold, gives an idea of their standard of splendour (Just. xxxviii. 10, 1; cf. Polyb. xxxi. 3; Plut. *Eum.* 14; id. *Aemil.* 18; id. *Sulla,* 16).

During the 3rd century B.C. Egypt was the greatest sea power of the eastern Mediterranean, and maintained a large fleet (the figures in App. *Prooem,* 10 are not trustworthy, see Beloch III. [i.], 364). Its control of the Aegean was, however, contested not without success by the Antigonids, who won the two great sea-fights of Cos (*c.* 256) and Andros (227), and wrested the overlordship of the Cyclades from the Ptolemies. Of the numbers and constitution of the Antigonid fleet we know nothing.[1] At the Seleucid court in 222 the admiral (*ναύαρχος*) appears as a person of high consideration (Polyb. v. 43, 1); in his war with Rome Antiochus III. had 107 decked battleships on the sea at one time. By the Peace of Apamea (188) the Seleucid navy was abolished; Antiochus undertook to keep no more than 10 ships of war.

For the Hellenistic armies and fleets see A. Bauer in L. von Müller's *Handbuch*, vol. iv.; Delbrück, *Gesch. d. Kriegskunst* (1900).

11. Treatment of Subject Peoples.

To their native subjects the Seleucid and Ptolemaic kings were always foreigners. It was considered wonderful in the last Cleopatra that she learnt to speak Egyptian (Plut. *Anton.* 27). Natives were employed, as we have seen, in the army, and Iranians are found under the Seleucids holding high commands, *e.g.* Aspasianus the Mede (Polyb. v. 79, 7), Aribazus, governor of Cilicia (Flinders Petrie, *Papyri*, II., No. 45), Aribazus, governor of Sardis (Polyb. vii. 17, 9), and Omanes (Michel, No. 19, l. 104). Native cults the Hellenistic kings thought it good policy to patronize. Antiochus I. began rebuilding the temple of Nebo at Borsippa (*Keilinschr. Bibl.* iii. 2, 136 seq.) Antiochus III. bestowed favours on the Temple at Jerusalem. Even if the documents in Joseph. *Arch.* xii. §§ 138 seq. are spurious, their general view of the relation of Antiochus III. and Jerusalem is probably true. Even small local worships, like that of the village of Baetocaece, might secure royal patronage (*C.I.G.* No. 4474). Of course, financial straits might drive the kings to lay hands on temple-treasures, as Antiochus III. and Antiochus IV. did, but that was a measure of emergency.

12. Significance of Macedonian Rule.

The Macedonian kingdoms, strained by continual wars, increasingly divided against themselves, falling often under the sway of prodigals and debauchees, were far from realizing the Hellenic idea of sound government as against the crude barbaric despotisms of the older East. Yet, in spite of all corruption, ideas of the intelligent development of the subject lands, visions of the Hellenic king, as the Greek thinkers had come to picture him, haunted the Macedonian rulers, and perhaps fitfully, in the intervals of war or carousal, prompted some degree of action. Treatises "Concerning Kingship" were produced as a regular thing by philosophers, and kings who claimed the fine flower of Hellenism, could not but peruse them. Strabo regards the loss of the eastern provinces to the Parthians as their passage under a government of lower type, beyond the sphere of Hellenic ἐπιμέγεια (Strabo xi. 509). In the organization of the administrative machinery of these kingdoms, the higher power of the Hellene to adapt and combine had been operative; they were organisms of a richer, more complex type than the East had hitherto known. It was thus that when Rome became a world-empire, it found to some extent the forms of government ready made, and took over from the Hellenistic monarchies a tradition which it handed on to the later world.

Authorities.—For the general history of the Macedonian kingdoms, see Droysen, *Histoire de l'Hellenisme* (the French translation by Bouché-Leclercq, 1883–1885, represents the work in its final revision); A. Holm, *History of Greece*, vol. iv. (1894); B. Niese, *Geschichte der griechischen und makedonischen Staaten* (1893–1903); Kaerst, *Gesch. des hellenist. Zeitalters*, vol. i. (1901). A masterly conspectus of the general character of the Hellenistic kingdoms in their political, economic and social character, their artistic and intellectual culture is given by Beloch, *Griech. Gesch.* iii. (i.), 260–556; see also Kaerst, *Studien zur Entwickelung d. Monarchie*; E. Breccia, *Il Diritto dinastico nelle monarchie dei successori d'Alessandro Magno* (1903). Popular sketches of the history, enlightened by special knowledge and a wide outlook, are given by J. P. Mahaffy, *Alexander's Empire* ("Stories of the Nations Series"); *Progress of Hellenism in Alexander's Empire* (1905); *The Silver Age of the Greek World* (1906). See also Hellenism; Ptolemies; Seleucid Dynasty. (E. R. B.)

MACEDONIUS, (1) bishop of Constantinople in succession to Eusebius of Nicomedia, was elected by the Arian bishops in 341, while the orthodox party elected Paul, whom Eusebius had superseded. The partisans of the two rivals involved the city in a tumultuous broil, and were not quelled until the emperor Constantius II. banished Paul. Macedonius was recognized as patriarch in 342. Compelled by the intervention of Constans in 348 to resign the patriarchate in favour of his former opponent, he was reinstalled in 350. He then took vengeance on his opponents by a general persecution of the adherents of the

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[1] For the Antigonid *ναύαρχος* or admiral, see Polyb. xvi. 6.

Nicene Creed. In 359, on the division of the Arian party into Acacians (or pure Arians) and semi-Arians or Homoiousians, Macedonius adhered to the latter, and in consequence was expelled from his see by the council of Constantinople in 360. He now became avowed leader of the sect of Pneumatomachi, Macedonians or Marathonians, whose distinctive tenet was that the Holy Spirit is but a being similar to the angels, subordinate to and in the service of the Father and the Son, the relation between whom did not admit of a third. He did not long survive his deposition.

See the Church Histories of Socrates and Sozomen; Art. in *Dict. Chr. Biog.*; F. Loofs in Herzog-Hauck's *Realencyk.*; H. M. Gwatkin, *Arianism.*

Macedonius, (2) bishop of Mopsuestia, was present at the councils of Nicaea and Philippopolis, and inclined to the reactionary party who thought the Athanasians had gone too far.

Macedonius, (3) bishop of Constantinople (*fl.* 510), a strict Chalcedonian who vainly opposed the fanaticism of the monophysite Severus and was deposed in 513.

MACEIÓ or Maçayó, a city and port of Brazil and capital of the state of Alagôas, about 125 m. S.S.W. of Pernambuco, in lat. 9° 39′ 35″ S., long. 35° 44′ 36″ W. Pop. including a large rural district and several villages (1890), 31,498; (1908, estimate), 33,000. The city stands at the foot of low bluffs, about a mile from the shore line. The water-side village of Jaraguá, the port of Maceió, is practically a suburb of the city. South of the port is the shallow entrance to the Lagôa do Norte, or Lagôa Mundahú, a salt-water lake extending inland for some miles. Maceió is attractively situated in the midst of large plantations of coco-nut and *dendê* palms, though the broad sandy beach in front and the open sun-burned plain behind give a barren character to its surroundings. The heat is moderated by the S.E. trade winds, and the city is considered healthful. The public buildings are mostly constructed of broken stone and mortar, plastered outside and covered with red tiles, but the common dwellings are generally constructed of *tapia*—rough trellis-work walls filled in with mud. A light tramway connects the city and port, and a railway—the Alagôas Central—connects the two with various interior towns. The port is formed by a stone reef running parallel with and a half-mile from the shore line, within which vessels of light draft find a safe anchorage, except from southerly gales. Ocean-going steamers anchor outside the reef. The exports consist principally of sugar, cotton, and rum (*aguardiente*). Maceió dates from 1815 when a small settlement there was created a "villa." In 1839 it became the provincial capital and was made a city by the provincial assembly.

McENTEE, JERVIS (1828–1891), American artist, was born at Rondout, New York, on the 14th of July 1828, and was a pupil of Frederick E. Church. He was made an associate of the National Academy of Design, New York, in 1860, and a full academician in 1861. In 1869 he visited Europe, painting much in Italy. He was identified with the Hudson River School, and excelled in pictures of autumn scenery. He died at Rondout, N.Y., on the 27th of January 1891.

MACER, AEMILIUS, of Verona, Roman didactic poet, author of two poems, one on birds (*Ornithogonia*), the other on the antidotes against the poison of serpents (*Theriaca*), imitated from the Greek poet Nicander of Colophon. According to Jerome, he died in 16 B.C. It is possible that he wrote also a botanical work. The extant hexameter poem *De viribus* (or *virtutibus*) *herbarum*, ascribed to Macer, is a medieval production by Odo Magdunensis, a French physician. Aemilius Macer must be distinguished from the Macer called *Iliacus* in the Ovidian catalogue of poets, the author of an epic poem on the events preceding the opening of the Iliad. The fact of his being addressed by Ovid in one of the epistles *Ex Ponto* shows that he was alive long after Aemilius Macer. He had been identified with the son or grandson of Theophanes of Mytilene, the intimate friend of Pompey.

See Ovid, *Tristia*, iv. 10, 43; Quintilian, *Instit.* x. 1, 56, 87; R. Unger, *De Macro Nicandri imitatore* (Friedland, 1845); C. P. Schulze in *Rheinisches Museum* (1898), liii. p. 541; for Macer Iliacus see Ovid, *Ex Ponto*, ii. 10, 13, iv. 16, 6; *Amores*, ii. 18.

MACERATA, a city of the Marches, Italy, the chief town of the province of Macerata and a bishop's see, 44 m. by rail S. of Ancona. Pop. (1901), 6,176 (town), 22,473 (commune). Crowning a hill 919 ft. above sea-level, with a picturesque mass of buildings enclosed by walls and towers, Macerata looks out over the Adriatic. The cathedral is modern, but some of the churches and palaces are not without interest. Besides the university, agricultural school and industrial institute, Macerata has a communal library founded by Leo XII., containing a small but choice collection of early pictures, and in the municipal buildings, a collection of antiquities from Helvia Ricina. There is an enormous amphitheatre or *sferisterio* for *pallone*, a ball game which is very popular in the district. The industries comprise the making of bricks, matches, terra-cotta and chemicals.

Macerata, as well as Recanati, was founded by the inhabitants of Ricina after the destruction of their city by Alaric in 408. During the Lombard period it was a flourishing town; but it was raised from comparative insignificance by Nicholas IV. to be the seat of the governors of the March. It was enclosed in the 13th century by a new line of walls more than 2½ m. in circuit; and in the troubles of the next two hundred years it had frequent occasion to learn their value. For the most part it remained faithful to the popes, and in return it was rewarded by a multitude of privileges. Though in 1797 the inhabitants opened their gates to the French, two years afterwards, when the country people took refuge within the walls, the city was taken by storm and delivered to pillage. The bishopric of Macerata dates from the suppression of the see of Recanati (1320).

MACFARREN, SIR GEORGE ALEXANDER (1813–1887), English composer, was born in London on the 2nd of March 1813, and entered the Royal Academy of Music in 1829. A symphony by him was played at an Academy concert in 1830; for the opening of the Queen's Theatre in Tottenham Street, under the management of his father, in 1831, he wrote an overture. His *Chevy Chase* overture, the orchestral work by which he is perhaps best known, was written as early as 1836, and in a single night. On leaving the Academy in 1836, Macfarren was for about a year a music teacher in the Isle of Man, and wrote two unsuccessful operas. In 1837 he was appointed a professor at the Academy, and wrote his *Romeo and Juliet* overture. In the following year he brought out *The Devil's Opera*, one of his best works. In 1845 he became conductor at Covent Garden, producing the *Antigone* with Mendelssohn's music; his opera on *Don Quixote* was produced under Bunn at Drury Lane in 1846; his subsequent operas include *Charles II.* (1849), *Robin Hood* (1860), *She Stoops to Conquer* (1864), and *Helvellyn* (1864). A gradual failure of his eyesight, which had been defective from boyhood, resulted in total blindness in 1865, but he overcame the difficulties by employing an amanuensis in composition, and made hardly a break in the course of his work. He was made principal of the Royal Academy of Music in succession to Sterndale Bennett in February 1875, and in March of the same year professor of music in Cambridge University. Shortly before this he had begun a series of oratorios: *St John the Baptist* (Bristol, 1873); *Resurrection* (Birmingham, 1876); *Joseph* (Leeds, 1877); and *King David* (Leeds, 1883). In spite of their solid workmanship, and the skill with which the ideas are treated, it is difficult to hear or read them through without smiling at some of the touches of quite unconscious humour often resulting from the way in which the Biblical narratives have been, as it were, dramatized. He delivered many lectures of great and lasting value, and his theoretical works, such as the *Rudiments of Harmony*, and the treatise on counterpoint, will probably be remembered longer than many of his compositions. He was knighted in 1883, and died suddenly in London on the 31st of October 1887.

An excellent memoir by H. C. Banister appeared in 1891.

McGEE, THOMAS D'ARCY (1825–1868), Irish-Canadian politician and writer, second son of James McGee, a coast-guard, was born at Carlingford, Co. Louth, on the 13th of April 1825. He early showed a remarkable aptitude for oratory. At the age of thirteen he delivered a speech at Wexford, and when four years later he emigrated to America he quickly gained a reputation as a writer and public speaker in the city of Boston. He thus attracted the attention of O'Connell, and before he was twenty years of age he returned to London to become parliamentary correspondent of the *Freeman's Journal*, and shortly afterwards London correspondent of the *Nation*, to which he also contributed a number of poems. He married in 1847 Mary Theresa Caffry, by whom he had two children. In 1846 he became one of the moving spirits in the "Young Ireland" party, and in promoting the objects of that organization he contributed two volumes to the "Library of Ireland." On the failure of the movement in 1848 McGee escaped in the disguise of a priest to the United States, where between 1848 and 1853 he established two newspapers, the *New York Nation* and the *American Celt*. His writings at first were exceedingly bitter and anti-English; but as years passed he realized that a greater measure of political freedom was possible under the British constitution than under the American. He had now become well-known as an author, and as a lecturer of unusual ability. In 1857 McGee, driven from the United States by the scurrilous attacks of the extreme Irish revolutionaries, took up his abode in Canada, and was admitted to the bar of the province of Lower Canada in 1861. At the general election in 1858 he was returned to parliament as the member for Montreal, and for four years he was regarded as a powerful factor in the house. On the formation of the Sandfield-Macdonald-Sicotte administration in 1862 he accepted the office of president of the council. When the cabinet was reconstructed a year later the Irish were left without representation, and McGee sought re-election as a member of the opposite party. In 1864 he was appointed minister of agriculture in the administration of Sir E. P. Taché, and he served the country in that capacity until his death. He actively supported the policy of federation and was elected a member of the first Dominion parliament in 1867. On the 7th of April 1868, after having delivered a notable speech in the house, he was shot by an assassin as he was about to enter his house at Ottawa. His utterances against the Fenian invasion are believed to have been the cause of the crime for which P. J. Whelan was executed. McGee's loss was keenly felt by all classes, and within a few weeks of his death parliament granted an annuity to his widow and children. McGee had great faith in the future of Canada as a part of the empire. Speaking at St John, N.B., in 1863, he said: "There are before the public men of British America at this moment but two courses: either to drift with the tide of democracy, or to seize the golden moment and fix for ever the monarchical character of our institutions. I invite every fellow colonist who agrees with me to unite our efforts that we may give our province the aspect of an empire, in order to exercise the influence abroad and at home of a state, and to originate a history which the world will not willingly let die." Sir Charles Gavan Duffy considered that as a poet McGee was not inferior to Davis, and that as an orator he possessed powers rarer than those of T. F Meagher.

McGee's principal works are: *A Popular History of Ireland* (2 vols., New York, 1862; 1 vol., London, 1869); *Irish Writers of the Seventeenth Century* (Dublin, 1846); *Historical Sketches of O'Connell and his Friends* (Boston, 1844); *Memoirs of the Life and Conquests of Art McMurrogh, King of Leinster* (Dublin, 1847); *Memoir of C. G. Duffy* (Dublin, 1849); *A History of the Irish Settlers in North America* (Boston, 1851); *History of the Attempts to establish the Protestant Reformation in Ireland* (Boston, 1853); *Life of Edward Maginn, Coadjutor Bishop of Derry* (New York, 1857); *Catholic History of North America* (Boston, 1854); *Canadian Ballads and Occasional Pieces* (New York, 1858); *Notes on Federal Governments Past and Present* (Montreal, 1865); *Speeches and Addresses, chiefly on the Subject of the British American Union* (London, 1865); *Poems*, edited by Mrs M. A. Sadleir with introductory memoir (New York, 1869). See Fennings Taylor, *The Hon. Thomas D'Arcy McGee* (Montreal, 1867); J. K. Foran, *Thomas D'Arcy McGee as an Empire Builder* (Ottawa, 1904); H. J. O'C. French, *A Sketch of the Life of the Hon. T. D. McGee* (Montreal); Appleton's *Cyclopaedia of American Biography*, iv. 116; N. F. Dvin's *Irishman in Canada* (1887); C. G. Duffy, *Four Years of Irish History* (1883); Alfred Webb, *Compendium of Irish Biography* (Dublin, 1878). (A. G. D.)

McGIFFERT, ARTHUR CUSHMAN (1861–), American theologian, was born in Sauquoit, New York, on the 4th of March 1861, the son of a Presbyterian clergyman of Scotch descent. He graduated at Western Reserve College in 1882 and at Union theological seminary in 1885, studied in Germany (especially under Harnack) in 1885-1887, and in Italy and France in 1888, and in that year received the degree of doctor of philosophy at Marburg. He was instructor (1888–1890) and professor (1890–1893) of church history at Lane theological seminary, and in 1893 became Washburn professor of church history in Union theological seminary, succeeding Dr Philip Schaff. His published work, except occasional critical studies in philosophy, dealt with church history and the history of dogma. His best known publication is a *History of Christianity in the Apostolic Age* (1897). This book, by its independent criticism and departures from traditionalism, aroused the opposition of the General Assembly of the Presbyterian Church; though the charges brought against McGiffert were dismissed by the Presbytery of New York, to which they had been referred, a trial for heresy seemed inevitable, and McGiffert, in 1900, retired from the Presbyterian ministry and entered the Congregational Church, although he retained his position in Union theological seminary. Among his other publications are: *A Dialogue between a Christian and a Jew* (1888); a translation (with introduction and notes) of Eusebius's *Church History* (1890); and *The Apostles' Creed* (1902), in which he attempted to prove that the old Roman creed was formulated as a protest against the dualism of Marcion and his denial of the reality of Jesus's life on earth.

McGILLIVRAY, ALEXANDER (*c.* 1739–1793), American Indian chief, was born near the site of the present Wetumpka, in Alabama. His father was a Scotch merchant and his mother the daughter of a French officer and an Indian "princess." Through his father's relatives in South Carolina, McGillivray received a good education, but at the age of seventeen, after a short experience as a merchant in Savannah and Pensacola, he returned to the Muscogee Indians, who elected him chief. He retained his connexion with business life as a member of the British firm of Panton, Forbes & Leslie of Pensacola. During the War of Independence, as a colonel in the British army, he incited his followers to attack the western frontiers of Georgia and the Carolinas. Georgia confiscated some of his property, and after the peace of 1783 McGillivray remained hostile. Though still retaining his British commission, he accepted one from Spain, and during the remainder of his life used his influence to prevent American settlement in the south-west. So important was he considered that in 1790 President Washington sent an agent who induced him to visit New York. Here he was persuaded to make peace in consideration of a brigadier-general's commission and payment for the property confiscated by Georgia; and with the warriors who accompanied him he signed a formal treaty of peace and friendship on the 7th of August. He then went back to the Indian country, and remained hostile to the Americans until his death. He was one of the ablest Indian leaders of America and at one time wielded great power—having 5000 to 10,000 armed followers. In order to serve Indian interests he played off British, Spanish and American interests against one another, but before he died he saw that he was fighting in a losing cause, and, changing his policy, endeavoured to provide for the training of the Muscogees in the white man's civilization. McGillivray was polished in manners, of cultivated intellect, was a shrewd merchant, and a successful speculator; but he had many savage traits, being noted for his treachery, craftiness and love of barbaric display. (W. L. F.)

MACGILLIVRAY, WILLIAM (1796–1852), Scottish naturalist, was born at Aberdeen on the 25th of January 1796. At King's College, Aberdeen, he graduated in 1815, and also studied medicine, but did not complete the latter course. In 1823 he became assistant to R. Jameson, professor of natural history in Edinburgh University; and in 1831 he was appointed curator of the museum of the Royal College of Surgeons in Edinburgh, a post which he resigned in 1841 to become professor of natural history and lecturer on botany in Marischal College, Aberdeen. He died at Aberdeen on the 4th of September 1852. He possessed a wide and comprehensive knowledge of natural science, gained no less from personal observations in different parts of Scotland than from a study of collections and books. His industry and extensive knowledge are amply shown in his published works. He assisted J. J. Audubon in his classical works on the *Birds of America*, and edited W. Withering's *British Plants.* His larger works include biographies of A. von Humboldt, and of zoologists from Aristotle to Linnaeus, a *History of British Quadrupeds*, a *History of the Molluscous Animals of Aberdeen, Banff and Kincardine*, a *Manual of British Ornithology*, and a *History of British Birds*, in 5 vols. (1837–1852). The last work holds a high rank from the excellent descriptions of the structure, habits and haunts of birds, and from the use in classification of characters afforded by their anatomical structure. His *Natural History of Deeside*, posthumously published by command of Queen Victoria, was the result of a sojourn in the highlands of Aberdeenshire in 1850. He made large collections, alike for the instruction of his students and to illustrate the zoology, botany and geology of the parts of Scotland examined by him, especially around Aberdeen, and a number of his original water-colour drawings are preserved in the British Museum (Natural History).

His eldest son, John MacGillivray (1822–1867), published an account of the voyage round the world of H.M.S. "Rattlesnake," on board of which he was naturalist. Another son, Paul, published an *Aberdeen Flora* in 1853.

MacGREGOR, JOHN ["Rob Roy"] (1825–1892), Scottish canoeist, traveller and philanthropist, son of General Sir Duncan MacGregor, K.C.B., was born at Gravesend on the 24th of January 1825. He combined a roving disposition with a natural taste for mechanics and for literature. In 1839 he went to Trinity College, Dublin, and in 1844 to Trinity, Cambridge, where he was a wrangler. He was called to the bar in 1851, but did not pursue his profession. He travelled a great deal in Europe, Egypt, Palestine, Russia, Algeria and America, and between 1853 and 1863 was largely occupied with researches into the history and methods of marine propulsion. He was the pioneer of British canoeing. In 1865 he started on a long canoeing cruise in his "Rob Roy" canoe, and in this way made a prolonged water tour through Europe, a record of which he published in 1866 as *A Thousand Miles in the Rob Roy Canoe.* This book made MacGregor and his canoe famous. He made similar voyages in later years in Norway, Sweden and Denmark, the North Sea and Palestine. Another voyage, in the English Channel and on French waters, was made in a yawl. He published accounts of all these journeys. He did not, however, confine his energies to travelling. He was active in charity and philanthropic work, being one of the founders of the Shoe-black Brigade. In 1870 and again in 1873 he was elected on the London school board. He died at Boscombe on the 16th of July 1892.

MACH, ERNST (1838–), Austrian physicist and psychologist, was born on the 18th of February 1838 at Turas in Moravia, and studied at Vienna. He was professor of mathematics at Gratz (1864–1867), of physics at Prague (1867–1895), and of physics at Vienna (1895–1901). In 1879 and 1880 as *Rector Magnificus* he fought against the introduction of Czech instead of German in the Prague University. In 1901 he was made a member of the Austrian house of peers. In philosophy he began with a strong predilection for the physical side of psychology, and at an early age he came to the conclusion that all existence is sensation, and, after a lapse into noümenalism under the influence of Fechner's *Psychophysics*, finally adopted a universal physical phenomenalism. The Ego he considers not an entity sharply distinguished from the Non-ego, but merely, as it were, a medium of continuity of sensory impressions. His whole theory appears to be vitiated by the confusion of physics and psychology.

Works.—*Kompendium der Physik für Mediziner* (Vienna, 1863); *Einleitung in die Helmholtz'sche Musiktheorie* (Gratz, 1866); *Die Gesch. u. d. Wurzel d. Satzes von d. Erhaltung d. Arbeit* (Prague, 1872); *Grundlinien d. Lehre v. d. Bewegungsempfindungen* (Leipzig, 1875); *Die Mechanik in ihrer Entwickelung* (Leipzig, 1883; rev. ed., 1908; Eng. trans., T. J. McCormack, 1902); *Beiträge zur Analyse d. Empfindungen* (Jena, 1886), 5th ed., 1906, entitled *Die Analyse d. Empfindungen; Leitfaden d. Physik für Studierende* (Prague, 1881, in collaboration); *Populärwissenschaftliche Vorlesungen* (3rd ed., Leipzig, 1903); *Die Prinzipien d. Wärmelehre* (2nd ed., 1900); *Erkenntnis und Irrtum* (Leipzig, 1905).

MACHAERODUS, or Machairodus, the typical genus of a group of long-tusked extinct cats, commonly known as sabre-tooths. Although best regarded as a sub-family (*Machaerodontinae*) of the *Felidae*, they are sometimes referred to a separate family under the name *Nimravidae* (see Carnivora). The later forms, as well as some of the earlier ones, are more specialized as regards dentition than the modern *Felidae*, although in several other respects they exhibit more primitive features. The general type of dentition is feline, but in some instances more premolars are retained, as well as a small tubercular molar behind the lower carnassial. The characteristic feature is, however, the great development of the upper canines, which in the more specialized types reach far below the margin of the lower jaw, despite the development of a flange-like expansion of the extremity of the latter for their protection. In these extreme forms it is quite evident that the jaws could not be used in the ordinary manner; and it seems probable that in attacking prey the lower jaw was dropped to a vertical position, and the huge upper tusks used as stabbing instruments. The group is believed to be derived from a creodont allied to the Eocene *Palaeonictis* (see Creodonta).

Nimravus, of the American Oligocene, with two premolars and two molars in the lower jaw, and comparatively short upper canines, seems to be the least specialized type; next to which comes *Hoplophoneus*, another North American Oligocene genus, in which the tubercular lower molar is lost, and the upper canine is longer. It is noteworthy, however, that this genus retains the third trochanter to the femur, which is lost in *Nimravus. Machaerodus*, in the wider sense, includes the larger and more typical forms. In the Pliocene of France and Italy it is represented by *M. megantereon*, a species not larger than a leopard, and allied forms occur in the Pliocene of Greece, Hungary, Samos, Persia, India and China, as well as in the Middle Miocene of France and Germany. Far larger is the Pleistocene *M. cultridens* of the caverns of Europe, with serrated upper tusks several inches in length. From Europe and Asia the sabre-toothed tigers may be traced into North and thence into South America, the home of *M.* (*Smilodon*) *neogaeus*, the largest of the whole tribe, whose remains occur in the Brazilian caves and the silt of the Argentine pampas. This animal was as large as a tiger, with tusks projecting seven inches from the jaw and very complex carnassials; the feet were very short, with only four toes to the hind-pair, and the humerus has lost the foramen at the lower end. Very noteworthy is the occurrence of an imperfectly known specialized type—*Eusmilus*—in the Lower Oligocene of Europe and perhaps also North America. Unlike all other cats, it had only two pairs of lower incisors, and the large cheek-teeth were reduced to the carnassial and one premolar in advance of the same. (R. L.*)

MACHALE, JOHN (1791–1881), Irish divine, was born on the 15th of March 1791 at Tuber-na-Fian, Mayo, and was educated at Maynooth, where after graduating in 1814 he was ordained priest and appointed lecturer in theology, succeeding to the professoriate in 1820. In 1825 he became coadjutor bishop of Killala, and in July 1834 archbishop of Tuam and metropolitan. He visited Rome in 1831, and was there again at the proclamation of the dogma of the Immaculate Conception of the Virgin (Dec. 1854) and in 1869–1870 at the Vatican council. Though he did not favour the dogma of Papal Infallibility he submitted as soon as it was defined. Machale was an intensely patriotic Irishman, who fought hard for Catholic Emancipation, for separate Roman Catholic schools, and against the Queen's Colleges. He translated part of the *Iliad* (Dublin, 1861), and made an Irish version of some of Moore's melodies and of the Pentateuch. He died at Tuam on the 7th of November 1881.

MACHAULT D'ARNOUVILLE, JEAN BAPTISTE DE (1701–1794), French statesman, was a son of Louis Charles Machault d'Arnouville, lieutenant of police. In 1721 he was counsel to the parlement of Paris, in 1728 *maître des requêtes*, and ten years later was made president of the Great Council; although he had opposed the court in the *Unigenitus* dispute, he was appointed intendant of Hainaut in 1743. From this position, through the influence at court of his old friend René Louis, Marquis d'Argenson, he was called to succeed Orry de Fulvy as controller-general of the finances in December 1745. He found, on taking office, that in the four years of the War of the Austrian Succession the economies of Cardinal Fleury had been exhausted, and he was forced to develop the system of borrowings which was bringing French finances to bankruptcy. He attempted in 1749 a reform in the levying of direct taxes, which, if carried out, would have done much to prevent the later Revolutionary movement. He proposed to abolish the old tax of a tenth, which was evaded by the clergy and most of the nobility, and substitute a tax of one-twentieth which should be levied on all without exception. The cry for exceptions, however, began at once. The clergy stood in a body by their historical privileges, and the outcry of the nobility was too great for the minister to make headway against. Still he managed to retain his office until July 1754, when he exchanged the controllership for the ministry of marine. Foreseeing the disastrous results of the alliance with Austria, he was drawn to oppose more decidedly the schemes of Mme de Pompadour, whose personal ill-will he had gained. Louis XV. acquiesced in her demand for his disgrace on the 1st of February 1757. Machault lived on his estate at Arnouville until the Revolution broke out, when, after a period of hiding, he was apprehended in 1794 at Rouen and brought to Paris as a suspect. He was imprisoned in the Madelonnettes, where he succumbed in a few weeks, at the age of ninety-three.

His son, LOUIS CHARLES MACHAULT D'ARNOUVILLE (1737–1820), was bishop of Amiens from 1774 until the Revolution. He was famous for his charity; but proved to be a most uncompromising Conservative at the estates general of 1789, where he voted consistently against every reform. He emigrated in 1791, resigned his bishopric in 1801 to facilitate the concordat, and retired to the ancestral château of Arnouville, where he died in 1820.

MACHAUT, GUILLAUME DE (*c.* 1300–1377), French poet and musician, was born in the village of Machault near Réthel in Champagne. Machaut tells us that he served for thirty years the adventurous John of Luxembourg, king of Bohemia. He followed his master to Russia and Poland, and, though of peaceful tastes himself, saw twenty battles and a hundred tourneys. When John was killed at Crécy in 1346 Machaut was received at the court of Normandy, and on the accession of John the Good to the throne of France (1350) he received an office which enabled him to devote himself thenceforth to music and poetry. Machaut wrote about 1348 in honour of Charles III., king of Navarre, a long poem much admired by contemporaries, *Le Jugement du roi de Navarre*. When Charles was thrown into prison by his father-in-law, King John, Machaut addressed him a *Confort d'ami* to console him for his enforced separation from his young wife, then aged fifteen. This was followed about 1370 by a poem of 9000 lines entitled *La Prise d'Alexandrie*, one of the last chronicles cast in this form. Its hero was Pierre de Lusignan, king of Cyprus. Machaut is best known for the strange book telling of the love affair of his old age with a young and noble lady long supposed to be Agnes of Navarre, sister of Charles the Bad; Paulin Paris in his edition of the *Voir dit* (*Historie vraie*) identified her as Perronne d'Armentières, a noble lady of Champagne. In 1362, when Machaut must have been at least sixty-two years of age, he received a rondeau from Perronne, who was then eighteen, expressing her devotion. She no doubt wished to play Laura to his Petrarch, and the *Voir dit* contains the correspondence and the poems which they exchanged. The romance, which ended with Perronne's marriage and Machaut's desire to remain her *doux ami*, has gleams of poetry, especially in Perronne's verses, but its subject and its length are both deterrent to modern readers. But Machaut with Deschamps marks a distinct transition. The *trouvères* had been impersonal. It is difficult to gather any details of their personal history from their work. Machaut and Deschamps wrote of their own affairs, and the next step in development was to be the self-analysis of Villon. Machaut was also a musician. He composed a number of motets, songs and ballads, also a mass supposed to have been sung at the coronation of Charles V. This was translated into modern notation by Perne, who read a notice on it before the Institute of France in 1817.

Machaut's *Oeuvres choisies* were edited by P. Tarbé (Rheims and Paris, 1849); *La Prise d'Alexandrie*, by L. de Mas-Latrie (Geneva, 1877); and *Le Livre du voir-dit*, by Paulin Paris (1875). See also F. G. Fétis, *Biog. universelle des musiciens*, . . (Paris, 1862), and a notice on the *Instruments de musique au xiv^e siècle d'après Guillaume de Machaut*, by E. Travers (Paris, 1882).

MACHIAVELLI, NICCOLÒ (1469–1527), Italian statesman and writer, was born at Florence on the 3rd of May 1469. His ancestry claimed blood relationship with the lords of Montespertoli, a fief situated between Val di Pesa and Val d'Elsa, at no great distance from the city. Niccolò's father, Bernardo (b. 1428), followed the profession of a jurist. He held landed property worth something like £250 a year of our money. His son, though not wealthy, was never wholly dependent upon official income.

Of Niccolò's early years and education little is known. His works show wide reading in the Latin and Italian classics, but it is almost certain that he had not mastered the Greek language. To the defects of Machiavelli's education we may, in part at least, ascribe the peculiar vigour of his style and his speculative originality. He is free from the scholastic trifling and learned frivolity which tainted the rhetorical culture of his century. He made the world of men and things his study, learned to write his mother-tongue with idiomatic conciseness, and nourished his imagination on the masterpieces of the Romans.

The year of Charles VIII.'s invasion and of the Medici's expulsion from Florence (1494) saw Machiavelli's first entrance into public life. He was appointed clerk in the second chancery of the commune under his old master, the grammarian, Marcello Virgilio Adriani. Early in 1498 Adriani became chancellor of the republic, and Machiavelli received his vacated office with the rank of second chancellor and secretary. This post he retained till the year 1512. The masters he had to serve were the *dieci di libertà e pace*, who, though subordinate to the *signoria*, exercised a separate control over the departments of war and the interior. They sent their own ambassadors to foreign powers, transacted business with the cities of the Florentine domain, and controlled the military establishment of the commonwealth. The next fourteen years of Machiavelli's life were fully occupied in the voluminous correspondence of his bureau, in diplomatic missions of varying importance, and in the organization of a Florentine militia. It would be tedious to follow him through all his embassies to petty courts of Italy, the first of which took place in 1499, when he was sent to negotiate the continuance of a loan to Catherine Sforza, countess of Forlì and Imola. In 1500 Machiavelli travelled into France, to deal with Louis XII. about the affairs of Pisa. These embassies were the school in which Machiavelli formed his political opinions, and gathered views regarding the state of Europe and the relative strength of nations. They not only introduced him to the subtleties of Italian diplomacy, but also extended his observation over races very different from the Italians. He thus, in the course of his official business, gradually acquired principles and settled ways of thinking which he afterwards expressed in writing.

In 1502 Machiavelli married Marietta Corsini, who bore him several children, with whom, in spite of his own infidelities, he lived on good terms, and who survived him twenty-six years. In the same year Piero Soderini was chosen gonfalonier for life, in accordance with certain changes in the constitution of the state, which were intended to bring Florence closer to the Venetian type of government. Machiavelli became intimately connected with Soderini, assisted him in carrying out his policy, suggested important measures of military reform which Soderini adopted, and finally was involved in ruin by his fall.

The year 1502 was marked by yet another decisive incident in Machiavelli's life. In October he was sent, much against his will, as envoy to the camp of Cesare Borgia, duke of Valentinois. The duke was then in Romagna, and it was Machiavelli's duty to wait upon and watch him. He was able now to observe those intricate intrigues which culminated in Cesare's murder of his disaffected captains. From what remains of Machiavelli's official letters, and from his tract upon the *Modo che tenne il duca Valentino per ammazzar Vitellozzo Vitelli*, we are able to appreciate the actual relations which existed between the two men, and the growth in Machiavelli's mind of a political ideal based upon his study of the duke's character. Machiavelli conceived the strongest admiration for Cesare's combination of audacity with diplomatic prudence, for his adroit use of cruelty and fraud, for his self-reliance, avoidance of half-measures, employment of native troops, and firm administration in conquered provinces. More than once, in letters to his friend Vettori, no less than in the pages of the *Principe*, Machiavelli afterwards expressed his belief that Cesare Borgia's behaviour in the conquest of provinces, the cementing of a new state out of scattered elements, and the dealing with false friends or doubtful allies, was worthy of all commendation and of scrupulous imitation. As he watched Cesare Borgia at this, the most brilliant period of his adventurous career, the man became idealized in his reflective but imaginative mind. Round him, as a hero, he allowed his own conceptions of the perfect prince to cluster. That Machiavelli separated the actual Cesare Borgia, whom he afterwards saw, ruined and contemptible, at Rome, from this radiant creature of his political fancy, is probable. That the Cesare of history does not exactly match the Duca Valentino of Machiavelli's writings is certain. Still the fact remains that henceforth Machiavelli cherished the ideal image of the statesman which he had modelled upon Cesare, and called this by the name of Valentino.

On his return to Florence early in January 1503, Machiavelli began to occupy himself with a project which his recent attendance upon Cesare Borgia had strengthened in his mind. The duties of his office obliged him to study the conditions of military service as they then existed in Italy. He was familiar with the disadvantages under which republics laboured when they engaged professional captains of adventure and levied mercenary troops. The bad faith of the condottiere Paolo Vitelli (beheaded at Florence in 1499) had deeply impressed him. In the war with Pisa he had observed the insubordination and untrustworthiness of soldiers gathered from the dregs of different districts, serving under egotistical and irresponsible commanders. His reading in Livy taught him to admire the Roman system of employing armies raised from the body of the citizens; and Cesare Borgia's method of gradually substituting the troops of his own duchy for aliens and mercenaries showed him that this plan might be adopted with success by the Italians. He was now determined, if possible, to furnish Florence with a national militia. The gonfalonier Soderini entered into his views. But obstacles of no small magnitude arose. The question of money was immediately pressing. Early in 1503 Machiavelli drew up for Soderini a speech, *Discorso sulla provisione del danaro*, in which the duty and necessity of liberal expenditure for the protection of the state were expounded upon principles of sound political philosophy. Between this date and the last month of 1506 Machiavelli laboured at his favourite scheme, working out memorials on the subject for his office, and suggesting the outlines of a new military organization. On the 6th of December 1506 his plan was approved by the signoria, and a special ministry, called the *nove di ordinanza e milizia*, was appointed. Machiavelli immediately became their secretary. The country districts of the Florentine dominion were now divided into departments, and levies of foot soldiers were made in order to secure a standing militia. A commander-in-chief had to be chosen for the new troops. Italian jealousy shrank from conferring this important office on a Florentine, lest one member of the state should acquire a power dangerous to the whole. The choice of Soderini and Machiavelli fell, at this juncture, upon an extremely ineligible person, none other than Don Micheletto, Cesare Borgia's cut-throat and assassin. It is necessary to insist upon this point, since it serves to illustrate a radical infirmity in Machiavelli's genius. While forming and promoting his scheme, he was actuated by principles of political wisdom and by the purest patriotism. But he failed to perceive that such a ruffian as Micheletto could not inspire the troops of Florence with that devotion to their country and that healthy moral tone which should distinguish a patriot army. Here, as elsewhere, he revealed his insensibility to the ethical element in human nature.

Meanwhile Italy had been the scene of memorable events, in most of which Machiavelli took some part. Alexander VI. had died suddenly of fever. Julius II. had ascended the papal chair. The duke of Valentinois had been checked in mid-career of conquest. The collapse of the Borgias threw Central Italy into confusion; and Machiavelli had, in 1505, to visit the Baglioni at Perugia and the Petrucci at Siena. In the following year he accompanied Julius upon his march through Perugia into the province of Emilia, where the fiery pope subdued in person the rebellious cities of the Church. Upon these embassies Machiavelli represented the Florentine *dieci* in quality of envoy. It was his duty to keep the ministry informed by means of frequent despatches and reports. All this while the war for the recovery of Pisa was slowly dragging on, with no success or honour to the Florentines. Machiavelli had to attend the camp and provide for levies amid his many other occupations. And yet he found time for private literary work. In the autumn of 1504 he began his *Decennali*, or *Annals of Italy*, a poem composed in rough terza rima. About the same time he composed a comedy on the model of Aristophanes, which is unfortunately lost. It seems to have been called *Le Maschere*. Giuliano de' Ricci tells us it was marked by stringent satire upon great ecclesiastics and statesmen, no less than by a tendency to "ascribe all human things to natural causes or to fortune." That phrase accurately describes the prevalent bias of its author's mind.

The greater part of 1506 and 1507 was spent in organizing the new militia, corresponding on the subject, and scouring the country on enlistment service. But at the end of the latter year European affairs of no small moment diverted Machiavelli from these humbler duties. Maximilian was planning a journey into Italy in order to be crowned emperor at Rome, and was levying subsidies from the imperial burghs for his expenses. The Florentines thought his demands excessive. Though they already had Francesco Vettori at his court, Soderini judged it advisable to send Machiavelli thither in December. He travelled by Geneva, all through Switzerland, to Botzen, where he found the emperor. This journey was an important moment in his life. It enabled him to study the Swiss and the Germans in their homes; and the report which he wrote on his return is among his most effective political studies. What is most remarkable in it is his concentrated effort to realize the exact political weight of the German nation, and to penetrate the causes of its strength and weakness. He attempts to grasp the national character as a whole, and thence to deduce practical conclusions. The same qualities are noticeable in his *Ritratti delle cose di Francia*, which he drew up after an embassy to Louis XII. at Blois in 1510. These notes upon the French race are more scattered than the report on German affairs. But they reveal no less acumen combined with imaginative penetration into the very essence of national existence.

Michiavelli returned from Germany in June 1508. The rest of that year and a large part of 1509 were spent in the affairs of the militia and the war of Pisa. Chiefly through his exertions the war was terminated by the surrender of Pisa in June 1509. Meanwhile the league of Cambray had disturbed the peace of Italy, and Florence found herself in a perilous position between Spain and France. Soderini's government grew weaker. The Medicean party lifted up its head. To the league of Cambray succeeded the Holy League. The battle of Ravenna was fought, and the French retired from Italy. The Florentines had been spectators rather than actors in these great events. But they were now destined to feel the full effects of them. The cardinal Giovanni de' Medici, who was present at the battle of Ravenna, brought a Spanish army into Tuscany. Prato was sacked in the August of 1512. Florence, in extreme terror, deposed the gonfalonier, and opened her gates to the princes of the house of Medici.

The government on which Machiavelli depended had fallen, never to rise again. The national militia in which he placed unbounded confidence had proved inefficient to protect Florence in the hour of need. He was surrounded by political and personal enemies, who regarded him with jealousy as the ex-gonfalonier's right-hand man. Yet at first it appears that he still hoped to retain his office. He showed no repugnance to a change of masters, and began to make overtures to the Medici. The *nove della milizia* were, however, dissolved; and on the 7th of November 1512 Machiavelli was deprived of his appointments. He was exiled from Florence and confined to the dominion for one year, and on the 17th of November was futher prohibited from setting foot in the Palazzo Pubblico. Ruin stared him in the face; and, to make matters worse, he was implicated in the conspiracy of Pier Paolo Boscoli in February 1513. Machiavelli had taken no share in that feeble attempt against the Medici, but his name was found upon a memorandum dropped by Boscoli. This was enough to ensure his imprisonment. He was racked, and only released upon Giovanni de' Medici's election to the papacy in March 1513. When he left his dungeon he retired to a farm near San Casciano, and faced the fact that his political career was at an end.

Machiavelli now entered upon a period of life to which we owe the great works that have rendered his name immortal. But it was one of prolonged disappointment and annoyance. He had not accustomed himself to economical living; and, when the emoluments of his office were withdrawn, he had barely enough to support his family. The previous years of his manhood had been spent in continual activity. Much as he enjoyed the study of the Latin and Italian classics, literature was not his business; nor had he looked on writing as more than an occasional amusement. He was now driven in upon his books for the employment of a restless temperament; and to this irksomeness of enforced leisure may be ascribed the production of the *Principe*, the *Discorsi*, the *Arte della guerra*, the comedies, and the *Historie fiorentine*. The uneasiness of Machiavelli's mind in the first years of this retirement is brought before us by his private correspondence. The letters to Vettori paint a man of vigorous intellect and feverish activity, dividing his time between studies and vulgar dissipations, seeking at one time distraction in low intrigues and wanton company, at another turning to the great minds of antiquity for solace. It is not easy to understand the spirit in which the author of the *Principe* sat down to exchange obscenities with the author of the *Sommario della storia d'Italia*. At the same time this coarseness of taste did not blunt his intellectual sagacity. His letters on public affairs in Italy and Europe, especially those which he meant Vettori to communicate to the Medici at Rome, are marked by extraordinary fineness of perception, combined, as usual in his case, with philosophical breadth. In retirement at his villa near Percussina, a hamlet of San Casciano, Machiavelli completed the *Principe* before the end of 1513. This famous book is an analysis of the methods whereby an ambitious man may rise to sovereign power. It appears to have grown out of another scarcely less celebrated work, upon which Machiavelli had been engaged before he took the *Principe* in hand, and which he did not finish until some time afterwards. This second treatise is the *Discorsi sopra la prima deca di Tito Livio*.

Cast in the form of comments on the history of Livy, the *Discorsi* are really an inquiry into the genesis and maintenance of states. The *Principe* is an offshoot from the main theme of the *Discorsi*, setting forth Machiavelli's views at large and in detail upon the nature of principalities, the method of cementing them, and the qualities of a successful autocrat. Being more limited in subject and more independent as a work of literary art, this essay detaches itself from the main body of the *Discorsi*, and has attracted far more attention. We feel that the *Principe* is inspired with greater fervency, as though its author had more than a speculative aim in view, and brought it forth to serve a special crisis. The moment of its composition was indeed decisive. Machiavelli judged the case of Italy so desperate that salvation could only be expected from the intervention of a powerful despot. The unification of Italy in a state protected by a national army was the cherished dream of his life; and the peroration of the *Principe* shows that he meant this treatise to have a direct bearing on the problem. We must be careful, however, not to fall into the error of supposing that he wrote it with the sole object of meeting an occasional emergency. Together with the *Discorsi*, the *Principe* contains the speculative fruits of his experience and observation combined with his deductions from Roman history. The two works form one coherent body of opinion, not systematically expressed, it is true, but based on the same principles, involving the same conclusions, and directed to the same philosophical end. That end is the analysis of the conception of the state, studied under two main types, republican and monarchical. Up to the date of Machiavelli, modern political philosophy had always presupposed an ideal. Medieval speculation took the Church and the Empire for granted, as divinely appointed institutions, under which the nations of the earth must flourish for the space of man's probation on this planet. Thinkers differed only as Guelfs and Ghibellines, as leaning on the one side to papal, on the other to imperial supremacy. In the revival of learning, scholarship supplanted scholasticism, and the old ways of medieval thinking were forgotten. But no substantial philosophy of any kind emerged from humanism; the political lucubrations of the scholars were, like their ethical treatises, for the most part rhetorical. Still the humanists effected a delivery of the intellect from what had become the bondage of obsolete ideas, and created a new medium for the speculative faculty. Simultaneously with the revival, Italy had passed into that stage of her existence which has been called the age of despots. The yoke of the Empire had been shaken off. The Church had taken rank among Italian tyrannies. The peninsula was, roughly speaking, divided into principalities and sovereign cities, each of which claimed autocratic jurisdiction. These separate despotisms owned no common social tie, were founded on no common *jus* or right, but were connected in a network of conflicting interests and changeful diplomatic combinations. A keen and positive political intelligence emerged in the Italian race. The reports of Venetian and Florentine ambassadors at this epoch contain the first germs of an attempt to study politics from the point of view of science.

At this moment Machiavelli intervenes. He was conscious of the change which had come over Italy and Europe. He was aware that the old strongholds of medieval thought must be abandoned, and that the decaying ruins of medieval institutions furnished no basis for the erection of solid political edifices. He felt the corruption of his country, and sought to bring the world back to a lively sense of the necessity for reformation. His originality consists in having extended the positive intelligence of his century from the sphere of contemporary politics and special interests to man at large regarded as a political being. He founded the science of politics for the modern world, by concentrating thought upon its fundamental principles. He began to study men, not according to some preconception, but as he found them—men, not in the isolation of one century, but as a whole in history. He drew his conclusions from the nature of mankind itself, " ascribing all things to natural causes or to fortune." In this way he restored the right method of study, a method which had been neglected since the days of Aristotle. He formed a conception of the modern state, which marked the close of the middle ages, and anticipated the next phase of European development. His prince, abating those points which are purely Italian or strongly tinctured with the author's personal peculiarities, prefigured the monarchs of the 16th and 17th centuries, the monarchs whose motto was *L'état c'est moi!* His doctrine of a national militia foreshadowed the system which has given strength in arms to France and Germany. His insight into the causes of Italian decadence was complete; and the remedies which he suggested, in the perorations of the *Principe* and the *Arte della guerra*, have since been applied in the unification of Italy. Lastly, when we once have freed ourselves from the antipathy engendered by his severance of ethics from the field of politics, when we have once made proper allowance for his peculiar use of phrases like *frodi onorevoli* or *sceleratezze gloriose*, nothing is left but admiration for his mental attitude. That is the attitude of a patriot, who saw with open eyes the ruin of his country, who burned above all things to save Italy and set her in her place among the powerful nations, who held the duty of self-sacrifice in the most absolute sense, whose very limitations and mistakes were due to an absorbing passion for the state he dreamed might be reconstituted. It was Machiavelli's intense preoccupation with this problem—what a state is and how to found one in existing circumstances—which caused the many riddles of his speculative writings. Dazzled, as it were, with the brilliancy of his own discovery, concentrated in attention on the one necessity for organizing a powerful coherent nation, he forgot that men are more than political beings. He neglected religion, or regarded it as part of the state machinery. He was by no means indifferent to private virtue, which indeed he judged the basis of all healthy national existence; but in the realm of politics he postponed morals to political expediency. He held that the people, as distinguished from the nobles and the clergy, were the pith and fibre of nations; yet this same people had to become wax in the hands of the politician—their commerce and their comforts, the arts which give a dignity to life and the pleasures which make life liveable, neglected—their very liberty subordinated to the one tyrannical conception. To this point the segregation of politics from every other factor which goes to constitute humanity had brought him; and this it is which makes us feel his world a wilderness, devoid of atmosphere and vegetation. Yet some such isolation of the subject matter of this science was demanded at the moment of its birth, just as political economy, when first started, had to make a rigid severance of wealth from other units. It is only by a gradual process that social science in its whole complexity can be evolved. We have hardly yet discovered that political economy has unavoidable points of contact with ethics.

From the foregoing criticism it will be perceived that all the questions whether Machiavelli meant to corrupt or to instruct the world, to fortify the hands of tyrants or to lead them to their ruin, are now obsolete. He was a man of science—one who by the vigorous study of his subject matter sought from that subject-matter itself to deduce laws. The difficulty which remains in judging him is a difficulty of statement, valuation, allowance. How much shall we allow for his position in Renaissance Italy, for the corruption in the midst of which he lived, for his own personal temperament? How shall we state his point of departure from the middle ages, his sympathy with prevalent classical enthusiasms, his divination of a new period? How shall we estimate the permanent worth of his method, the residuum of value in his maxims?

After finishing the *Principe*, Machiavelli thought of dedicating it to one of the Medicean princes, with the avowed hope that he might thereby regain their favour and find public employment. He wrote to Vettori on the subject, and Giuliano de' Medici, duke of Nemours, seemed to him the proper person. The choice was reasonable. No sooner had Leo been made pope than he formed schemes for the aggrandizement of his family. Giuliano was offered and refused the duchy of Urbino. Later on, Leo designed for him a duchy in Emilia, to be cemented out of Parma, Piacenza, Reggio and Modena. Supported by the power of the papacy, with the goodwill of Florence to back him, Giuliano would have found himself in a position somewhat better than that of Cesare Borgia; and Borgia's creation of the duchy of Romagna might have served as his model. Machiavelli therefore was justified in feeling that here was an opportunity for putting his cherished schemes in practice, and that a prince with such alliances might even advance to the grand end of the unification of Italy. Giuliano, however, died in 1506. Then Machiavelli turned his thoughts towards Lorenzo, duke of Urbino. The choice of this man as a possible Italian liberator reminds us of the choice of Don Micheletto as general of the Florentine militia. To Lorenzo the *Principe* was dedicated, but without result. The Medici, as yet at all events, could not employ Machiavelli, and had not in themselves the stuff to found Italian kingdoms.

Machiavelli, meanwhile, was reading his *Discorsi* to a select audience in the Rucellai gardens, fanning that republican enthusiasm which never lay long dormant among the Florentines. Towards the year 1519 both Leo X. and his cousin, the cardinal Giulio de' Medici, were much perplexed about the management of the republic. It seemed necessary, if possible, in the gradual extinction of their family to give the city at least a semblance of self-government. They applied to several celebrated politicians, among others to Machiavelli, for advice in the emergency. The result was a treatise in which he deduced practical conclusions from the past history and present temper of the city, blending these with his favourite principles of government in general. He earnestly admonished Leo, for his own sake and for Florence, to found a permanent and free state system for the republic, reminding him in terms of noble eloquence how splendid is the glory of the man who shall confer such benefits upon a people. The year 1520 saw the composition of the *Arte della guerra* and the *Vita di Castruccio*.

The first of these is a methodical treatise, setting forth Machiavelli's views on military matters, digesting his theories respecting the superiority of national troops, the inefficiency of fortresses, the necessity of relying upon infantry in war, and the comparative insignificance of artillery. It is strongly coloured with his enthusiasm for ancient Rome; and specially upon the topic of artillery it displays a want of insight into the actualities of modern warfare. We may regard it as a supplement or appendix to the *Principe* and the *Discorsi*, since Machiavelli held it for a fundamental axiom that states are powerless unless completely armed in permanence. The peroration contains a noble appeal to the Italian liberator of his dreams, and a parallel from Macedonian history, which, read by the light of this century, sounds like a prophecy of Piedmont.

The *Vita di Castruccio* was composed at Lucca, whither Machiavelli had been sent on a mission. This so-called biography of the medieval adventurer who raised himself by personal ability and military skill to the tyranny of several Tuscan cities must be regarded in the light of an historical romance. Dealing freely with the outline of Castruccio's career, as he had previously dealt with Cesare Borgia, he sketched his own ideal of the successful prince. Cesare Borgia had entered into the *Principe* as a representative figure rather than an actual personage; so now conversely the theories of the *Principe* assumed the outward form and semblance of Castruccio. In each case history is blent with speculation in nearly the same proportions. But Castruccio, being farther from the writer's own experience, bears weaker traits of personality.

In the same year, 1520, Machiavelli, at the instance of the cardinal Giulio de' Medici, received commission from the officers of the *Studio pubblico* to write a history of Florence. They agreed to pay him an annual allowance of 100 florins while engaged upon the work. The next six years were partly employed in its composition, and he left a portion of it finished, with a dedication to Clement VII., when he died in 1527. In the *Historie fiorentine* Machiavelli quitted the field of political speculation for that of history. But, having already written the *Discorsi* and the *Principe*, he carried with him to this new task of historiography the habit of mind proper to political philosophy. In his hands the history of Florence became a text on which at fitting seasons to deliver lessons in the science he initiated. This gives the work its special character. It is not so much a chronicle of Florentine affairs, from the commencement of modern history to the death of Lorenzo de' Medici in 1492, as a critique of that chronicle from the point of view adopted by Machiavelli in his former writings. Having condensed his doctrines in the *Principe* and the *Discorsi*, he applies their abstract principles to the example of the Florentine republic. But the *History of Florence* is not a mere political pamphlet. It is the first example in Italian literature of a national biography, the first attempt in any literature to trace the vicissitudes of a people's life in their logical sequence, deducing each successive phase from passions or necessities inherent in preceding circumstances, reasoning upon them from general principles, and inferring corollaries for the conduct of the future. In point of form the *Florentine History* is modelled upon Livy. It contains speeches in the antique manner, which may be taken partly as embodying the author's commentary upon situations of importance, partly as expressing what he thought dramatically appropriate to prominent personages. The style of the whole book is nervous, vivid, free from artifice and rhetoric, obeying the writer's thought with absolute plasticity. Machiavelli had formed for himself a prose style, equalled by no one but by Guicciardini in his minor works, which was far removed from the emptiness of the latinizing humanists and the trivialities of the Italian purists. Words in his hands have the substance, the self-evidence of things. It is an athlete's style, all bone and sinew, nude, without superfluous flesh or ornament.

It would seem that from the date of Machiavelli's discourse to Leo on the government of Florence the Medici had taken him into consideration. Writing to Vettori in 1513, he had expressed his eager wish to "roll stones" in their service; and this desire was now gratified. In 1521 he was sent to Carpi to transact a petty matter with the chapter of the Franciscans, the chief known result of the embassy being a burlesque correspondence with Francesco Guicciardini. Four years later, in 1525, he received a rather more important mission to Venice. But Machiavelli's public career was virtually closed; and the interest of his biography still centres in his literary work. We have seen that already, in 1504, he had been engaged upon a comedy in the manner of Aristophanes, which is now unfortunately lost. A translation of the *Andria* and three original comedies from his pen are extant, the precise dates of which are uncertain, though the greatest of them was first printed at Rome in 1524. This is the *Mandragola*, which may be justly called the ripest and most powerful play in the Italian language.

The plot is both improbable and unpleasing. But literary criticism is merged in admiration of the wit, the humour, the vivacity, the satire of a piece which brings before us the old life of Florence in a succession of brilliant scenes. If Machiavelli had any moral object when he composed the *Mandragola*, it was to paint in glaring colours the corruption of Italian society. It shows how a bold and plausible adventurer, aided by the profligacy of a parasite, the avarice and hypocrisy of a confessor, and a mother's complaisant familiarity with vice, achieves the triumph of making a gulled husband bring his own unwilling but too yielding wife to shame. The whole comedy is a study of stupidity and baseness acted on by roguery. About the power with which this picture of domestic immorality is presented there can be no question. But the perusal of the piece obliges us to ask ourselves whether the author's radical conception of human nature was not false. The same suspicion is forced upon us by the *Principe*. Did not Machiavelli leave good habit, as an essential ingredient of character, out of account? Men are not such absolute fools as Nicia, nor such compliant catspaws as Ligurio and Timoteo; women are not such weak instruments as Sostrata and Lucrezia. Somewhere, in actual life, the stress of craft and courage acting on the springs of human vice and weakness fails, unless the hero of the comedy or tragedy, Callimaco or Cesare, allows for the revolt of healthier instincts. Machiavelli does not seem to have calculated the force of this recoil. He speculates a world in which *virtù*, unscrupulous strength of character, shall deal successfully with frailty. This, we submit, was a deep-seated error in his theory of life, an error to which may be ascribed the numerous stumbling-blocks and rocks of offence in his more serious writings.

Some time after the *Mandragola*, he composed a second comedy, entitled *Clizia*, which is even homelier and closer to the life of Florence than its predecessor. It contains incomparable studies of the Florentine housewife and her husband, a grave business-like citizen, who falls into the senile folly of a base intrigue. There remains a short piece without title, the *Commedia in prosa*, which, if it be Machiavelli's, as internal evidence of style sufficiently argues, might be accepted as a study for both the *Clizia* and the *Mandragola*. It seems written to expose the corruption of domestic life in Florence, and especially to satirize the friars in their familar part of go-betweens, tame cats, confessors and adulterers.

Of Machiavelli's minor poems, sonnets, *capitoli* and carnival songs there is not much to say. Powerful as a comic playwright, he was not a poet in the proper sense of the term. The little novel of *Belfagor* claims a passing word, if only because of its celebrity. It is a good-humoured satire upon marriage, the devil being forced to admit that hell itself is preferable to his wife's company. That Machiavelli invented it to express the irritation of his own domestic life is a myth without foundation. The story has a medieval origin, and it was almost simultaneously treated in Italian by Machiavelli, Straparola and Giovanni Brevio.

In the spring of 1526 Machiavelli was employed by Clement VII. to inspect the fortifications of Florence. He presented a report upon the subject, and in the summer of the same year received orders to attend Francesco Guicciardini, the pope's commissary of war in Lombardy. Guicciardini sent him in August to Cremona, to transact business with the Venetian *provveditori*. Later on in the autumn we find him once more with Guicciardini at Bologna. Thus the two great Italian historians of the 16th century, who had been friends for several years, were brought into relations of close intimacy.

After another visit to Guicciardini in the spring of 1527, Machiavelli was sent by him to Civita Vecchia. It seemed that he was destined to be associated in the papal service with Clement's viceroy, and that a new period of diplomatic employment was opening for him. But soon after his return to Florence he fell ill. His son Piero said that he took medicine on the 20th of June which disagreed with him; and on the 22nd he died, having received the last offices of the Church.

There is no foundation for the legend that he expired with profane sarcasms upon his lips. Yet we need not run into the opposite extreme, and try to fancy that Machiavelli, who had professed Paganism in his life, proved himself a believing Christian on his deathbed. That he left an unfavourable opinion among his fellow citizens is very decidedly recorded by the historian Varchi. The *Principe*, it seems, had already begun to prejudice the world against him; and we can readily believe that Varchi sententiously observes, that "it would have been better for him if nature had given him either a less powerful intellect or a mind of a more genial temper." There is in truth a something crude, unsympathetic, cynical in his mental attitude toward human nature, for which, even after the lapse of more than three centuries, we find it difficult to make allowance. The force of his intellect renders this want of geniality repulsive. We cannot help objecting that one who was so powerful could have been kindlier and sounder if he willed. We therefore do him the injustice of mistaking his infirmity for perversity. He was colour-blind to commonplace morality; and we are angry with him because he merged the hues of ethics in one grey monotone of politics.

In person Machiavelli was of middle height, black-haired, with rather a small head, very bright eyes and slightly aquiline nose. His thin, close lips often broke into a smile of sarcasm. His activity was almost feverish. When unemployed in work or study he was not averse to the society of boon companions, gave himself readily to transient amours, and corresponded in a tone of cynical bad taste. At the same time he lived on terms of intimacy with worthy men. Varchi says that "in his conversation he was pleasant, obliging to his intimates, the friend of virtuous persons." Those who care to understand the contradictions of which such a character was capable should study his correspondence with Vettori. It would be unfair to charge what is repulsive in their letters wholly on the habits of the times, for wide familiarity with the published correspondence of similar men at the same epoch brings one acquainted with little that is so disagreeable. (J. A. S.)

Among the many editions of Machiavelli's works the one in 8 vols., dated Italia, 1813, may be mentioned, and the more comprehensive ones published by A. Parenti (Florence, 1843) and by A. Usigli (Florence 1857). P. Fanfani and L. Passerini began another, which promised to be the most complete of all; but only 6 vols. were published (Florence, 1873–1877); the work contains many new and important documents on Machiavelli's life. The best biography is the standard work of Pasquale Villari, *La Storia di Niccolò Machiavelli e de' suoi tempi* (Florence, 1877–1882; latest ed., 1895; Eng. trans. by Linda Villari, London, 1892); in vol. ii. there is an exhaustive criticism of the various authors who have written on Machiavelli. See also T. Mundt, *Niccolò Machiavelli und das System der modernen Politik* (3rd ed., Berlin, 1867); E. Feuerlein, "*Zur Machiavelli-Frage*" in H. von Sybel's *Histor. Zeitschrift* (Munich, 1868); P. S. Mancini, *Prelezioni con un saggio sul Machiavelli*; F. Nitti, *Machiavelli nella vita e nelle opere* (Naples, 1876); O. Tomasini, *La Vita e gli scritti di Niccolò Machiavelli* (Turin, 1883); L. A. Burd, *Il Principe, by Niccolò Machiavelli* (Oxford, 1891); Lord Morley, *Machiavelli* (Romanes lecture, Oxford, 1897). *The Cambridge Modern History*, vol. i. (Cambridge, 1903), contains an essay on Machiavelli by L. A. Burd, with a very full biography.

MACHICOLATION (from Fr. *machicoulis*), an opening between a wall and a parapet, formed by corbelling out the latter, so that the defenders might throw down stones, melted lead, &c., upon assailants below.

MACHINE (through Fr. from Lat. form *machina* of Gr. *μηχανή*), any device or apparatus for the application or modification of force to a specific purpose. The term "simple machine" is applied to the six so-called mechanical powers—the lever, wedge, wheel and axle, pulley, screw, and inclined plane. For machine-tools see TOOLS. The word machine was formerly applied to vehicles, such as stage-coaches, &c., and is still applied to carriages in Scotland; a survival of this use is in the term "bathing machine." Figuratively, the word is used of persons whose actions seem to be regulated according to a rigid and unchanging system. In politics, especially in America, machine is synonymous with party organization. A stage device of the ancient Greek drama gave rise to the proverbial expression, "the god from the machine," Lat. *deus ex machina*, for the disentangling and conclusion of a plot by supernatural interference or by some accident extraneous to the natural development of the story. When a god had to be brought on the stage he was floated down from above by a *γέρανος* (crane) or other machine (*μηχανή*). Euripides has been reproached with an excessive use of the device, but it has been pointed out (A.E. Haigh, *Tragic Drama of the Greeks*, p. 245 seq.) that only in two plays (*Orestes* and *Hippolytus*) is the god brought on for the solution of the plot. In the others the god comes to deliver a kind of epilogue, describing the future story of the characters, or to introduce some account of a legend, institution, &c.

MACHINE-GUN, a weapon designed to deliver a large number of bullets or small shells, either by volleys[1] or in very quick succession, at a high rate of fire. Formerly the mechanism of machine-guns was hand operated, but all modern weapons are automatic in action, the gas of the explosion or the force of recoil being utilized to lock and unlock the breech mechanism, to load the weapon and to eject the fired cartridge cases. The smaller types approximate to the "automatic rifle," which is expected to replace the magazine rifle as the arm of the infantryman. The large types, generically called "pompoms," fire a light artillery projectile, and are considered by many artillery experts as "the gun of the future." The medium type, which takes the ordinary rifle ammunition but is fired from various forms of carriage, is the ordinary machine-gun of to-day, and the present article deals mainly with this.

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[1] The French term *mitrailleuse*, made famous by the War of 1870, reappears in other Latin tongues (*e.g.* Spanish *ametralladora*). It signifies a weapon which delivers a shower of small projectiles *mitraille*—grape or case shot), and has no special reference to its mechanical (hand or automatic) action.

HISTORICAL SKETCH

Machine-guns of a primitive kind are found in the early history of gunpowder artillery, in the form of a grouping or binding of several small-calibre guns for purposes of a volley or a rapid succession of shots. The earliest field artillery (*q.v.*) was indeed chiefly designed to serve the purpose of a modern machine-gun, *i.e.* for a mechanical concentration of musketry. Infantry fire (till the development of the Spanish arquebus, about 1520) was almost ineffective, and the disintegration of the masses of pikes, preparatory to the decisive cavalry charge, had to be effected by guns of one sort or another (see also INFANTRY). Hence the "cart with gonnes," although the prototype of the field gun of to-day was actually a primitive *mitrailleuse.*

Ribaudequins.

Weapons of this sort were freely employed by the Hussites, who fought in laager formation (*Wagenburg*), but the fitting of two or more hand-guns or small culverins to a two-wheeled carriage garnished with spikes and scythe blades (like the ancient war-chariots) was somewhat older, for in 1382 the men of Ghent put into the field 200 "chars de canon" and in 1411 the Burgundian army is said to have had 2000 "ribaudequins" (meaning probably the weapons, not the carts, in this case). These were of course hardly more than carts with hand-gun men; in fact most armies in those days moved about in a hollow square or lozenge of wagons, and it was natural to fill the carts with the available gunners or archers. The method of breaking the enemy's "battles" with these carts was at first, in the ancient manner, to drive into and disorder the hostile ranks with the scythes. But they contained at least the germ of the modern machine-gun, for the tubes (*cannes*, *canons*) were connected by a train of powder and fired in volleys. As however field artillery improved (latter half of 15th century), and a cannon-ball could be fired from a mobile carriage, the ribaudequin ceased to exist, its name being transferred to heavy hand-guns used as rampart pieces. The idea of the machine-gun reappeared however in the 16th century. The weapons were now called "organs" (*orgues*), from the number of pipes or tubes that they contained. At first used (defensively) in the same way as the ribaudequins, *i.e.* as an effective addition to the military equipment of a war-cart, they were developed, in the early part of the 16th century, into a really formidable weapon for breaking the masses of the enemy, not by scythes and spikes but by fire. Fleurange's memoirs assign the credit of this to the famous gunner and engineer Pedro Navarro, who made two hundred weapons of a design of his own for Louis XII. These "were not more than two feet long, and fired fifty shots at a round," but nevertheless "organs" were relatively rare in the armies of the 16th century, for the field artillery, though it grew in size and lost in mobility, had discovered the efficacy of case shot (then called "perdreaux") against uncovered animate targets, and for work that was not sufficiently serious for the guns heavy arquebuses were employed. Infantry fire, too, was growing in power and importance. In 1551 a French army contained 21 guns and 150 arquebuses *à croc* and one *pièce façon d'orgue*. By about 1570 it had been found that when an "organ" was needed all that was necessary was to mount some heavy arquebuses on a cart, and the organ, as a separate weapon, disappeared from the field, although under the name of "mantelet" (from the shield which protected the gunners), it was still used for the defence of breaches in siege warfare. Diego Ufano, who wrote in the early years of the 17th century, describes it as a weapon consisting of five or six barrels fired simultaneously by a common lock, and mentions as a celebrated example the "Triquetraque of Rome" which had five barrels. Another writer, Hanzelet, describes amongst other devices a mitrailleuse of four barrels which was fired from the back of an ass or pony. But such weapons as these were more curious than useful. For work in the open field the musket came more and more to the front, its bullet became at least as formidable as that of an "organ," and when it was necessary to obtain a concentrated fire on a narrow front arquebuses *à croc* were mounted for the nonce in groups of four to six. The "organ" maintained a precarious existence, and is described by Montecucculi a century later, and one of twelve barrels figures in the list of military stores at Hesdin in 1689. But its fatal defect was that it was neither powerful enough to engage nor mobile enough to evade the hostile artillery.

"Organs."

Enthusiastic inventors, of course, produced many models of machine-gun in the strict sense of the word—*i.e.* a gun firing many charges, in volleys or in rapid succession, by a mechanical arrangement of the lock. Wilhelm Calthoff, a German employed by Louis XIII., produced arquebuses and muskets that fired six to eight shots per round, but his invention was a secret, and it seems to have been more of a magazine small arm than a machine-gun (1640). In 1701 a Lorrainer, Beaufort de Mirecourt, proposed a machine-gun which had as its purpose the augmentation of infantry-fire power, so as to place an inferior army on an equality with a superior. At this time inventors were so numerous and so embarrassing that the French grand master of artillery, St Hilaire, in 1703 wrote that he would be glad to have done with "ces sortes de gens à secrets," some of whom demanded a grant of compensation even when their experiments had failed. The machine-gun of the 17th and 18th centuries in fact possessed no advantage over contemporary field artillery, and the battalion gun in particular, which possessed the long ranging and battering power that its rival lacked, and was moreover more efficacious against living targets with its case-shot or grape. As compared with infantry fire, too, it was less effective and slower than the muskets of a well-drilled company. Rapid fire was easily arranged, but the rapid *loading* which would have compensated for other defects was unobtainable in the then existing state of gun-making.

Thus a satisfactory machine-gun was not forthcoming until breech-loading had been, so to speak, rediscovered, that is until about 1860. At that time the tactical conditions of armament were peculiar. As regards artillery, the new (muzzle-loading) long-range rifle sufficed, in the hand of determined infantry, to keep guns out of case-shot range. This made the Napoleonic artillery attack an impossibility. At the same time the infantry rifle was a slow loader, and the augmentation of the volume of infantry fire attracted the attention of several inventors. The French, with their artillery traditions, regarded the machine-gun therefore as a method of restoring the lost superiority of the gunner, while the Americans, equally in accordance with traditions and local circumstances, regarded it as a musketry machine. The representative weapons evolved by each were the *canon à balles*, more commonly called *mitrailleuse*, and the Gatling gun.

The declared purpose of the *canon à balles* was to replace the old artillery case-shot attack. Shrapnel, owing to the defects of the time-fuzes then available, had proved disappointing in the Italian War of 1859, and the gun itself, of the existing model, was not considered satisfactory. Napoleon III., a keen student of artillery, maintained a private arsenal and workshop at the château of Meudon[1] and in 1866, in the alarm following upon

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[1] Meudon Château had long been used for military experiments. The peasantry credited it with mysterious and terrible secrets, asserting even that it contained a tannery of human skins, this tradition perhaps relating to the war balloon constructed there before the battle of Fleurus (1794). Reffye had also many non-military tasks, such as the reproduction of a famous set of bas-reliefs, construction of aeroplanes, and the reconstruction of triremes and balistas.

Königgrätz, he ordered Commandant Reffye (1821–1880), the artillery officer he had placed in charge of it, to produce a machine-gun. Reffye held that the work of a mitrailleuse should only begin where that of the infantry rifle ceased. The handbook to his gun issued to the French army in 1870 stated that it was "to carry balls to distances that the infantry, and the artillery firing case, could not reach." The most suitable range was given as 1500–2000 yards against infantry in close order, 2000–2700 against artillery. As the French shrapnel (*obus à balles*) of these days was only used to give its peculiar case-shot effect between 550 and 1350 yards, and even so sparingly and without much confidence in its efficacy, it is clear that the *canon à balles* was intended to do the field-gun's work, except at (what were then) extreme field artillery ranges (2800 and above), in which case the ordinary gun with common shell (time or percussion) alone was used.

The Canon à Balles, 1866-1870.

Constructed to meet these conditions, the Reffye machine-gun in its final form resembled outwardly an ordinary field gun, with wheeled carriage, limber and four-horse team. The gun barrel was in reality a casing for 25 rifle barrels disposed around a common axis (the idea of obtaining sweeping effect by disposing the barrels slightly fan-wise had been tried and abandoned). The barrels were held together at intervals by wrought-iron plates. They were entirely open at the breech, a removable false breech containing the firing mechanism (the cartridge cases were of brass, solid-drawn, like those of the American and unlike those of the British Gatlings). This false breech, held in the firing position by a strong screw—resembling roughly those of contemporary B.L. ordnance such as the Armstrong R. B. L.—consisted of a plate with 25 holes, which allowed the points of the strikers to pass through and reach the cartridges. The plate was turned by hand so that one striker was admitted at a time, the metal of the plate holding back the rest. To avoid any deflection of the bullet by the gases at an adjoining muzzle the barrels were fired in an irregular order. Each gun was provided with four chambers, which were loaded with their 25 cartridges apiece by a charger, and fixed to the breech one after the other as quickly as the manipulation of the powerful retaining screw permitted. The rates of fire were "slow," 3 rounds or 75 shots a minute, and "rapid," 5 rounds or 125 shots per minute. One advantage as against artillery that was claimed for the new weapon was rapidity of ranging. Any ordinary target, such as a hostile gun, would, it was expected, be accurately ranged by the mitrailleuse before it was ready to open fire for effect. The ordinary rifle bullet was employed, but to enhance the case-shot effect a heavy bullet made up in three parts, which broke asunder on discharge, was introduced in 1870 in the proportion of one round in nine. The weapon was sighted to 3000 metres (3300 yds.). The initial velocity was 1558 f.s.; and the weight of the gun 350 kg. (6·45 cwt.), of the carriage 371 kg. (6·86 cwt.); total behind the team, 1,485 kg. (27·1 cwt.).

For an artillery effect, dispersion had to be combined with accuracy. The rifle-barrels when carefully set gave a very close grouping of shots on the target, and dispersion was obtained by traversing the gun during the firing of a round. When this was skilfully performed a front of 18 metres (about 20 yds.) at 1,000 metres range was thoroughly swept by the cone of bullets.

The design and manufacture of these mitrailleuses under the personal orders and at the expense of the emperor enabled the French authorities to keep their new weapon most secret. Even though, after a time, mitrailleuses were constructed by scores, and could therefore no longer be charged to a "sundry" or "petty cash" account in the budget, secrecy was still maintained. The pieces were taken about, muffled in tarpaulins, by by-ways and footpaths. In 1869, two years after the definitive adoption of the weapon, only a few artillery captains were instructed in its mechanism; the non-commissioned officers who had to handle the gun in war were called up for practice in July 1870, when Major Reffye's energies were too much absorbed in turning out the material so urgently demanded to allow him to devote himself to their instruction. The natural consequence was that the mitrailleuses were taken into battle by officers and men of whom nine-tenths had never seen them fire one round of live cartridges. The purpose of this fatal secrecy was the maintenance of prestige. No details were given, but it was confidently announced that war would be revolutionized. One foreign officer only, Major Fosbery, R.A. (see *R.U.S.I. Journal*, v. xiii.), penetrated the secret, and he felt himself bound in honour to keep it to himself, not even communicating it to the War Office. But public attention was only too fully aroused by these mysterious prophecies. "The mitrailleuse paid dearly for its fame." The Prussians, who had examined mitrailleuses of the Gatling or infantry type, were well aware that the artillery machine-gun was at the least a most formidable opponent. They therefore ostentatiously rejected the Gatling gun, taught their troops that the new weapons were in the nature of scientific toys, and secretly made up their minds to turn the whole weight of their guns on to the mitrailleuse whenever and wherever it appeared on the field, and so to overwhelm it at once. This policy they carried into effect in the War of 1870; and although on occasions the new weapon rendered excellent service, in general it cruelly disappointed the over-high hopes of its admirers. And thus, although the Gatling and similar types of gun were employed to a slight extent by both sides in the later stage of the war, machine-guns, as a class of armament for civilized warfare, practically disappeared.

As a good deal of criticism—after the event—has been levelled at the French for their "improper use of the machine-gun as a substitute for artillery," it is necessary to give some summary of the ideas and rules which were inspired by the inventor or dictated by the authorities as to its tactical employment. The first principle laid down was that the gun should not be employed within the zone of the infantry fight. Officers commanding batteries were explicitly warned against infantry divisional generals who would certainly attempt to put the batteries, by sections, amongst the infantry. The second principle was that the mitrailleuses were to share the work of the guns, the latter battering obstacles with common shell, and the former being employed against troops in the open, and especially to cover and support the infantry advance. This tendency to classify the rôles of the artillery and to tell off the batteries each in its special task has reappeared in the French, and to a more limited extent in the British, field artillery of to-day (the Germans alone resolutely opposing the idea of subdivision). The mitrailleuse of 1870 was, in fact, intended to do what the perfected Shrapnel of 1910 does, to transfer the case-shot attack to longer ranges. But, as we have seen, secrecy had prevented any general spread of knowledge as to the uses to which the *canon à balles* was to be put, and consequently, after a few weeks of the war, we find Reffye complaining that the machine-guns were being used by their battery commanders "in a perfectly idiotic fashion. They are only good at a great distance and when used in masses, and they are being employed at close quarters like a rifle." The officers in the field, however, held that it was foolish to pit the mitrailleuse against the gun, which had a longer range, and exerted themselves to use it as an infantry weapon, a concentrated company, for which, unlike the Gatlings of 1870 and the machine-guns of to-day, it was never designed. As to which was right in the controversy it is impossible to dogmatize and needless to argue.

Very different was the Gatling gun, the invention of Richard Jordan Gatling (1818–1903), which came into existence and was to a slight extent used in the field in the latter years of the American Civil War,[1] and also to a still slighter extent by the Bavarians and the French in the latter part of the war of 1870. This was distinctively an infantry type weapon, a sort of revolving rifle, the ten barrels of which were set around an axis, and fired in turn when brought into position by the revolving mechanism. This weapon had a long reign, and was used side by side with the latest automatic machine gun in the Spanish-American War of 1898. The following account of the old British service Gatling (fig. 1), as used in the Egyptian and Sudanese campaigns, is condensed from that in the article "Gun-making," *Ency. Brit.* 9th ed.

Gatling Gun.

A block of ten barrels is secured round an axis, which is fixed in a frame *a a*. On turning the handle *h* (fig. 2) the spindle *g g* causes the worm *f* to act on the pinion *w*, making the axis and barrels revolve. A drum T (figs. 1 and 4) is placed on the top at the breech end of the barrels over a hopper, through a slot in which the cartridges drop into the carrier (fig. 3). The construction of the lock is shown in fig. 4. A A A A is a cam, sloping as in the drawing, which, it must be understood, represents the circular construction opened out and laid flat. As the barrels, carrier and locks revolve the slope of the cam forces the locks forward and backward alternately. At position I. the cartridge has just fallen into the carrier, the lock and bolt are completely withdrawn. At positions II., III., IV., the cam is forcing them forward, so that the bolt pushes the cartridge into the barrel. At IV. the cocking cam R begins to compress the spiral spring, releasing it at V. Position VI. shows the cartridge just after firing; the extractor is clutching the base of the cartridge case, which is withdrawn as the locks retreat down the slope of the cam, till at X it falls through an aperture to the ground. The drum consists of a number of vertical channels radiating from the centre. The cartridges are arranged horizontally, one above the other, in these channels, bullet ends inwards. The drum revolves on the pivot *b* (fig. 3), and the cartridges fall through the aperture B. When all the channels are emptied, a full drum is brought from the limber, and substituted for the empty one. Each barrel fires in turn as it comes to a certain position, so that by turning the handle quickly an almost continuous stream of bullets can be ejected. Experimental Gatlings were constructed which could be made to fire nearly 1000 shots a minute, and an automatic traversing arrangement was also fitted.

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[1] A machine-gun of the artillery or volley type, called the "Requa battery," which had its barrels disposed fan-wise, was also used in the Civil War.

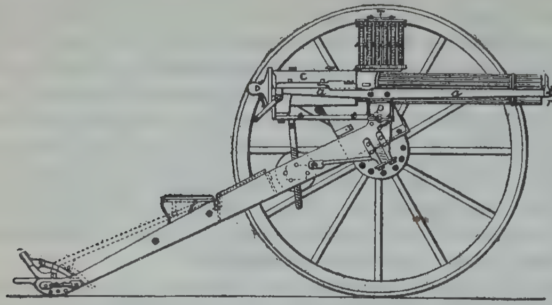

FIG. 1.—Gatling Gun.

As has been said, this weapon had a long reign. It was used with great effect in the Zulu War at Ulundi and in the Sudan.

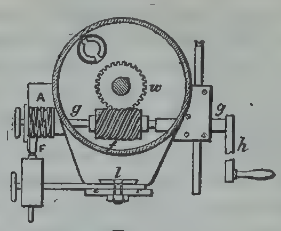

FIG. 2.

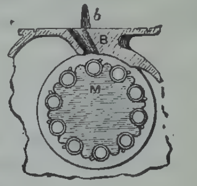

FIG. 3.

But a grave disadvantage of the English pattern was that it had to be used with the Boxer coiled cartridge supplied for the Martini-Henry rifle, and until this was replaced by a solid-drawn cartridge case it was impossible to avoid frequent "jams." The modern, fully automatic, machine gun suffers from this to a considerable extent, and it was an even more serious defect with a hand-operated weapon, as the British troops found in

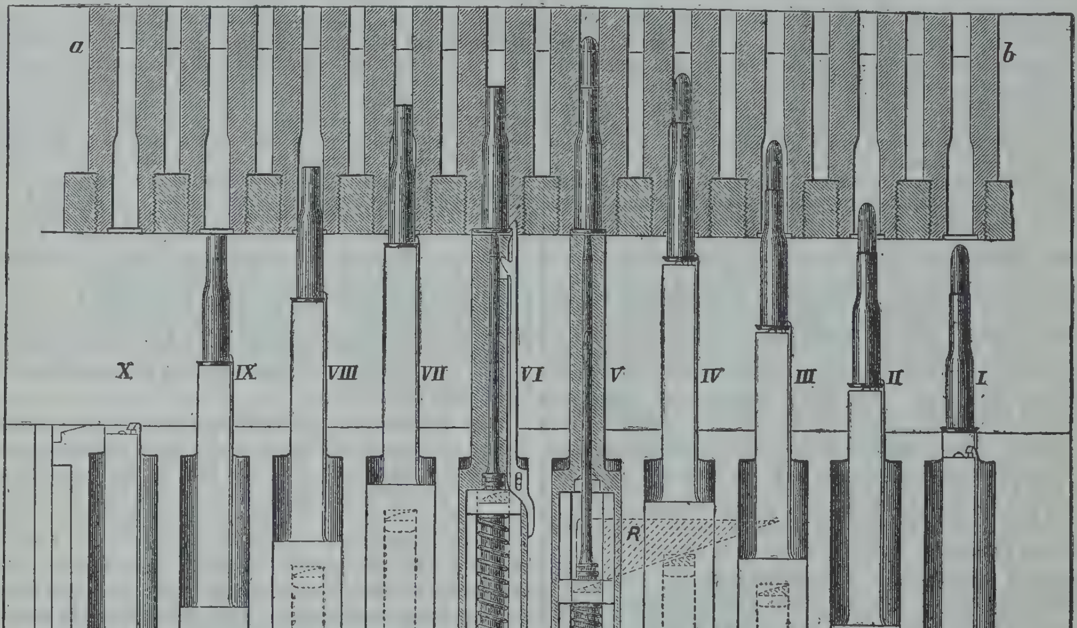

FIG. 4.—Lock of Gatling Gun.

their campaigns against the Mahdists. But the Gatling had many advantages over its newer rivals as regards simplicity and strength. Theodore Roosevelt, who commanded sections of both types in the Spanish-American War, speaks with enthusiasm of the old-fashioned weapon[1] while somewhat disparaging the Colt automatic.

The Gardner was another type which had a certain vogue[2] and was used by the British in savage warfare. But, next to the Gatling, the most important of the hand-operated machine guns was the Nordenfeldt, which was principally designed for naval use about the time when torpedo-boats were beginning to be regarded as dangerous antagonists.

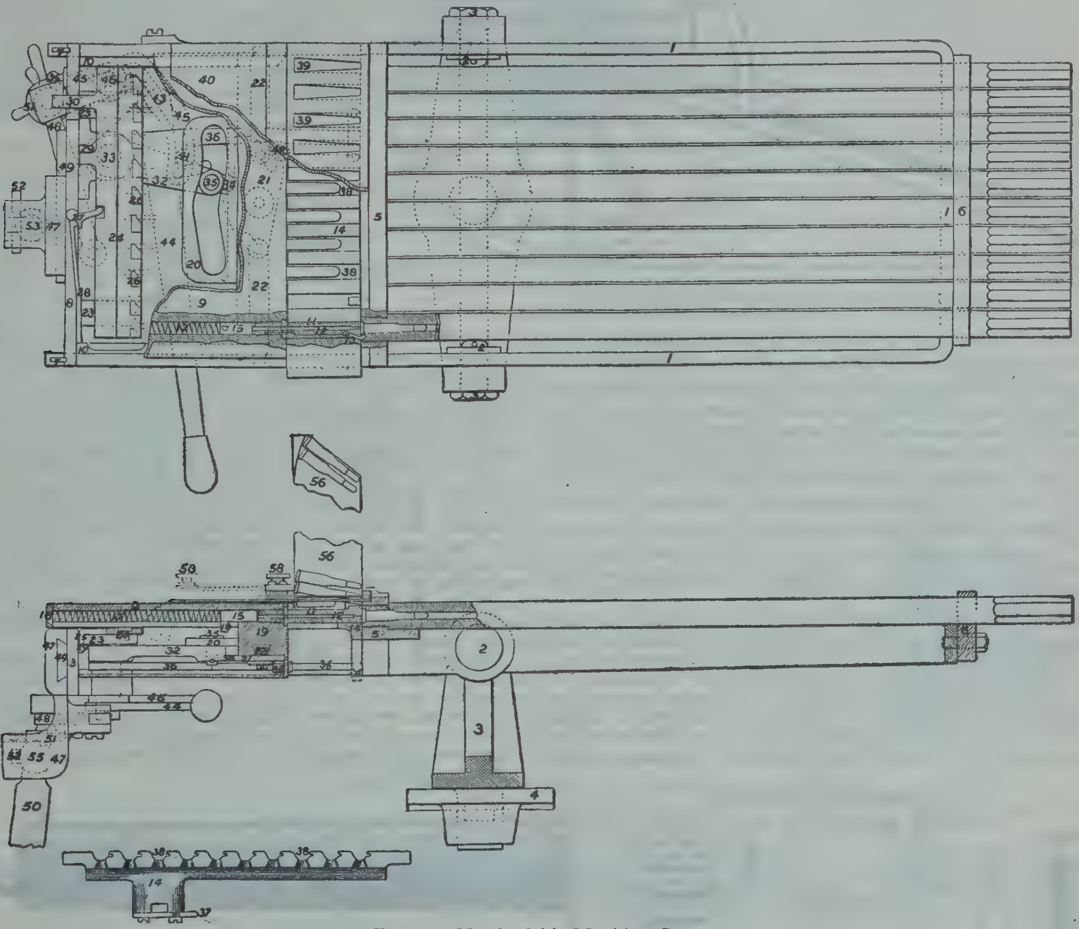

FIG. 5.—Nordenfeldt Machine-Gun.

1–10, Parts of frame;
11, Breech plug;
12, Striker;
13, Extractor;
14, Cartridge receiver;
15–18, 23–31, Lock and trigger parts;
19–22, Locking action;
32–35, Loading action;
36–39, Cartridge receiver;
40, Cover;
41–44, Parts of hand-lever;
45–49, Traversing action;
50–55, Elevating and trailing action;
56, 57, Hopper and slide.

Nordenfeldt Gun.

In this weapon the barrels are placed horizontally, and have no movement. A box containing the locks, bolts, strikers and spiral springs, one of each corresponding to each barrel, moves straight backwards and forwards when worked by the handle of the lever on the right. When the box is drawn back the cartridges fall from the holder on the top into the carriers simultaneously. When the box is pushed forward the bolts push the cartridges into the barrel, cocking-catches compress the spiral springs, the lever releases the catches one after the other at very minute intervals of time, and the cartridges are fired in rapid succession. In this piece, careful aim can be taken from a moving platform, and at the right moment the barrels can be fired at the object almost simultaneously.

PRESENT DAY MACHINE-GUNS

Hitherto we have been dealing with weapons worked by hand-power applied to a lever or winch-handle, the motion of this lever being translated by suitable mechanism into those by which the cartridges are loaded, fired, extracted and ejected—the cycle continuing as long as the lever is worked and there are cartridges in the "hoppers" which feed the gun. In the modern "automatic" machine-gun, moreover, the loading, firing, extracting and ejecting are all performed automatically by the gun itself, either by the recoil of its barrel, or by a small portion of the gases of explosion being allowed to escape through a minute hole in the barrel near the muzzle. The following details of the British Maxim, Hotchkiss and Colt types are reproduced from the article "Machine-guns," *Ency. Brit.* 10th ed.

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[1] The U.S. pattern Gatling hardly differed except in details from the model, above described, of twenty years earlier. The drum had been set horizontally instead of vertically and improved in details, and a "gravity feed," a tall vertical charger, was also used. The barrels were surrounded with a light casing. Tests made of the improved Gatling showed that the use of only one barrel at a time prevented overheating. On one trial 63,000 rounds were fired without a jam, and without stopping to clean the barrels. Smokeless powder and the modern cartridge case were of course used.

[2] The following particulars may be given of the 2-barrelled Gardner and 3-barrelled Nordenfeldt (land service) converted to take the ·303 cartridge: Weight, 92 and 110 lb respectively; parapet mounting in each case 168 lb; rate of fire of Gardner about 250 rounds per minute, of the Nordenfeldt about 350. A few of these guns are still used in fortresses and coast defences.

The idea of using the recoil, or a portion of the gases of explosion, for the working of the breech mechanism is by no means new, the latter system having been proposed and patented (certainly in a very crude and probably unworkable form) by (Sir) Henry Bessemer in 1854; but whatever might be discovered by a search in old patent and other records or in museums, there can be no doubt that (Sir) Hiram S. Maxim was the first to produce a finished automatic gun of practical value. His patents in connexion with this particular class of weapon date back to 1884, and his gun on the recoil system was, after extensive trials, adopted into the British army in 1889 and into the navy in 1892. It is very possible that Bessemer's idea did not bear fruit earlier because the fouling left by the old forms of "black" or smoky powders was apt to clog the moving parts and to choke any small port. With modern smokeless powders this difficulty does not arise.

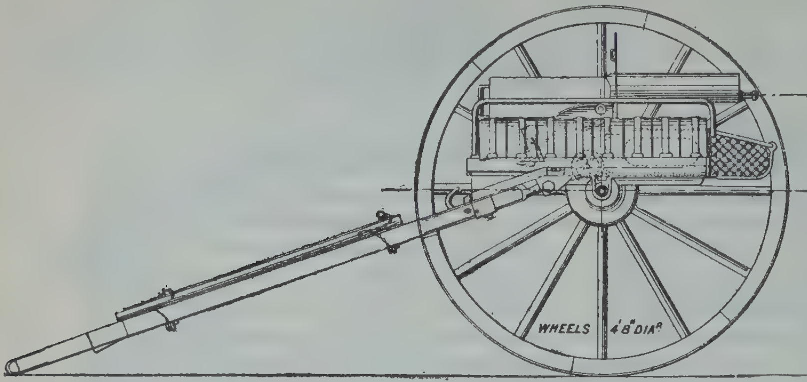
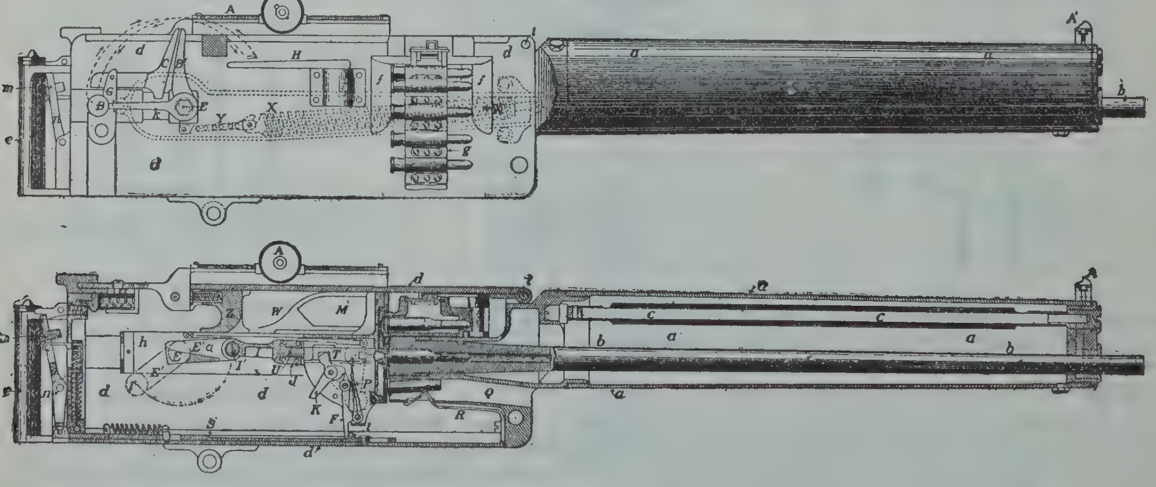


Fig. 6.—Maxim Gun on Wheeled Carriage (1900).

Maxim Gun.

The Maxim gun,[1] as will be seen from figs. 7 and 8, consists of two parts, the barrel casing (*a*) and breech casing (*d*), secured firmly together. The former (*a*), which is cylindrical in form, contains the barrel (*b*), and the water surrounding it to keep down the very high temperature attained by rapid fire, and the steam tube (*c*), which by the action of a sliding valve allows of the escape of steam but not of water. The barrel has asbestos packings at its front and rear bearings in the casing, which allow of its sliding in recoil without the escape of water. The breech casing (*d*) is a rectangular oblong box, and contains the lock and firing mechanism. At its rear end it has handles (*e*) by which the gun is directed, and the thumb-piece (*m*) by which the trigger is actuated. Its top is closed by a lid, hinged at (*i*). At its front is a recess holding the feed-block (*f*) through which the belt of cartridges (*g*) is fed to the gun.



Figs. 7 and 8.—Mechanism of Maxim Gun.

Attached to the rear of the barrel (*b*) on either side are two side plates (*h*), between which in guides O works the aggregation of parts D, F, J, K, L, P, T and V, which constitute the lock, and (in bearings) the crank axle E, crank E′, and connecting rod I (see figs. 7 to 11).

The connecting rod I joins the lock and crank, being attached to the side levers J of the former by means of the interrupted screw U; the latter enables the lock to be detached and removed.

The crank axle E extends through both sides of the breech casing (*d*), slots (*k*, fig. 7), allowing it a longitudinal movement of about an inch. To its left-hand end, outside the breech casing, is attached the fusee chain Y of the recoil spring X (see dotted lines in fig. 7), and to its right-hand end a bell trunk lever, B B′; the arm B, which terminates in a knob, being turned by the crank handle, the arm B′ working against the buffer stop C.

In figs. 8, 9 and 11 the breech is shown closed, and it will be noticed that the crank pin I′ is *above* the straight line joining the axis of the barrel, the striker T, and the crank axle E. As the crank is prevented from further movement *upwards* by the crank handle B taking against the check-lever G (fig. 7), it is clear that the pressure on discharge of the cartridge cannot cause the crank axle to rotate, and so open the breech as shown in figs. 10 and 12.

The withdrawal of the lock and opening of the breech are effected as follows: The *total* travel in recoil of the barrel is about one inch, but on discharge the barrel, the side plates and lock all recoil *together* for about a quarter of an inch without any disturbance of the locking as explained above, and by the time this short travel is completed the *bullet has left the muzzle.* The arm B′ of the crank handle then engages the buffer stop C and causes the crank axle E to *rotate* and the crank E′ to *fall* and so draw back the lock from, and open, the breech. At the same time the fusee chain Y is wound up round the left-hand end of the crank axle E and the spring X extended. In the meantime the knob of the buffer handle B swings over, and just as the lock reaches its rearmost position (as in figs. 10 and 12) strikes the flat buffer spring H, and, rebounding, assists the crank in revolving in the reverse direction; the spring X also contracts, and, unwinding the fusee chain, draws back the lock again and closes the breech, a fresh cartridge having been placed in the barrel as explained below.

The gun is fired by means of the trigger F, which is actuated by the projection (*l*) on the trigger bar (S), the latter being drawn back when the button (*m*) on the push lever (*n*) is pressed forwards. If, therefore, the button he kept permanently pressed, the projection (*l*) will always lie in the path of the trigger F just as the lock reaches its forward position and the breech is closed, and the gun will fire automatically, and continue to do so as long as there are cartridges in the belt.

The loading, extraction and ejection of the cartridges are effected as follows: The left-hand side-plate is extended forwards a little beyond the breech, and communicates the reciprocating motion of the barrel to a lever on the feed-block, which causes the cartridges in the belt to be fed forward one by one by a "step-by-step" pawl action, the cartridge which is next to be taken from the belt being arrested exactly above the breech, the ejector-tube Q being below in the same vertical plane.

The extractor D (see figs. 9 to 12) which performs the operations f inserting, extracting and ejecting the cartridges, travels vertically n guides on the face of the lock. Projecting outwards from each ide of its top are horns N (figs. 9 and 10). These travel round the dges of the cams M (fig. 8) situated on each side of the breech casing, nd in conjunction with the spring W (fig. 8), compel the top of the xtractor to take the path shown by the dotted lines and arrows in igs. 9 to 12.

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[1] Modern improvements in mechanical details are only slight, as may be found by reference to the official handbooks of the gun, editions of 1903 and 1907.

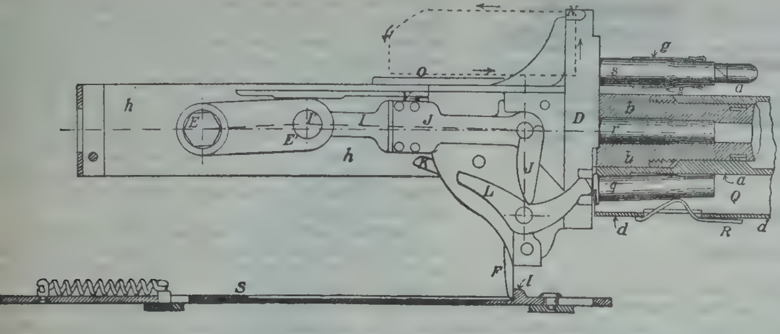


Fig. 9.—Maxim Gun Mechanism.

The extractor (figs. 11 and 12) is recessed to take a movable late (u) termed a "gib," behind which is a spring (v). In the face f the gib is a recess (w) into which the base of a cartridge can just nter. On either side of the gib the face of the extractor has underut flanges, open at the top and bottom, between which the base of cartridge can fit the rim, being held in the undercuts (figs. 9 and 10).

It is clear from this arrangement that the base of the cartridge aving been introduced between the flanges at the top of the xtractor, can be pushed down, the spring (v) yielding, till arrested t the recess (w); and, as the lower edges of this ecess are slightly sloped, further pressure will nake it leave the recess (w) and slide over the ace of the gib, leave it, and take up a position n front of the hole for the point of the striker x), being now only prevented from slipping out f the extractor by the extractor spring (y). If his last be clear of the extractor stop (z) it will ield to pressure and the cartridge will be free. This is the action in the gun except that the artridge is held firm and the extractor pushed gainst it.

In fig. 10 the extractor holds a cartridge (r) and fired case (q) ready to be pushed into the empty reech and ejector-tube Q respectively. In the atter there is already a fired case (p), which will e driven by the fired case (q) beyond the ejector pring R. As soon as the lock reaches the face of he breech, the cartridge (r) and case (q) are eposited in the breech and ejector-tube respectively, and the extractor D *rises* under the action of the levers L and J, lides, as already explained, by the bases of the cartridges (r) and ase (q), and then over the base of the cartridge (s) in the belt (g). Assuming the push-lever (n) to be pressed, the gun fires immediately his has occurred, and the bullet of the cartridge (r) is expelled. The osition is now that shown in fig. 9. The barrel now recoils and the ock is withdrawn, taking with it the fresh cartridge (s) from the belt nd the now fired case (r). The extractor travels horizontally for time and then drops (as shown by the dotted line and arrows), ssuming the position shown in fig. 12, which is exactly similar to hat in fig. 10 but with different cartridges; continuing the action, the position shown in fig. 11 is arrived at. It will thus be seen that ach cartridge makes two complete journeys with the extractor; the first as a live cartridge from the belt to the breech, the econd from the breech to the ejector-tube, the forward journey being always on a lower level than that of the backward one. The ections in figs. 11 and 12 clearly show the cocking and firing mechanism and the safety arrangement. The lock is cocked, after firing, by the arm of the "tumbler" K, being pressed down by the side lever J as it swings down when following the crank E′. Safety against firing before the breech is closed is provided by the projection on the safety lever V, which does not clear the striker T until lifted by the side lever J at the top of its travel, that is, when the crank E′ has passed the axial line as already explained.

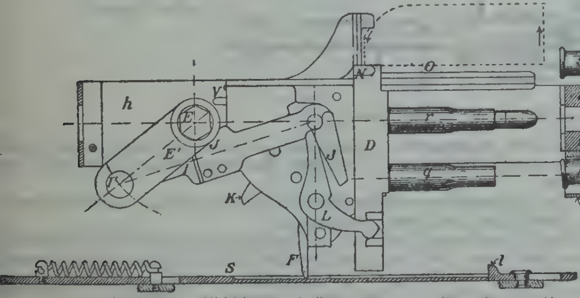


Fig. 10.—Maxim Gun Mechanism.

The lock in its rearmost position is kept in place by the block Z on the under side of the cover of the breech casing. When in this position it is clear of the guides O on the side-plates, and if the cover be opened it can be turned up, unscrewed by a turn through an eighth of a circle (the screw-thread U being interrupted in four places) and removed. To prepare the gun for firing, the crank handle is pushed over by hand to the buffer-spring, thus withdrawing the extractor, and held in this position; the tongue on the end of a filled belt is then pushed through the feed-block from the left and pulled as far as it will go from the opposite side. This places a cartridge above the breech ready to be seized by the extractor. The crank handle is now released and the lock flies forwards. The crank handle is now again pushed over and let go, and the first cartridge thus taken from the belt and placed in the breech. The gun is ready to fire.

To remove a partially filled belt, the crank handle must be pushed over, thus freeing the extractor from the belt, and the latter withdrawn after pressing a spring catch under the feed block which releases the pawls. The gun now has *two* live cartridges in it—both in the extractor. Letting go the crank handle, one of them is deposited in the ejector-tube, and again pushing over and letting go the crank handle does the same with the second.

Fig. 13 shows the feed-block and the cartridge belts. The greatest number usually carried in a belt is 250.

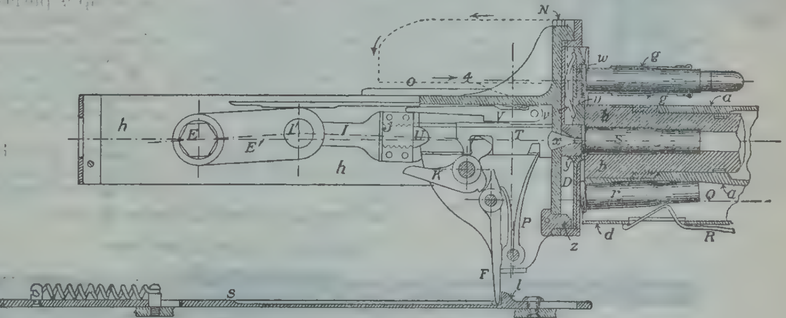


Fig. 11.—Maxim Gun Mechanism.

The gun is sighted to 2,500 yds. and has a folding tangent sight as shown. Its weight varies from 50 to 60 lb, and it can fire about 450 rounds per minute.

[The diagrams have been made from drawings, by permission of Messrs Vickers, Sons & Maxim.]

Hotchkiss Gun.

The Hotchkiss gun, figs. 14 to 16, which has been adopted by the French army and navy and elsewhere, depends for its action on the use of a small portion of the gases of the cartridge itself. The barrel A is firmly attached to the receiver or frame B, the latter containing the breech and firing mechanism. Under the barrel A, and communicating with it by a port (c) near the muzzle is a cylinder or tube C. When the gun is fired, and the bullet has passed the port (c), a portion of the gases of explosion passes into the cylinder C and drives back the piston F contained in it, a lug on the under part of the piston compressing the spring M, the latter, when the trigger N is pulled, driving back the piston again. The reciprocating motion of the piston performs all the processes of loading and firing the gun, and the action is continuous as long as the trigger is kept pressed back.

The piston F, enlarged and suitably shaped at the rear, actuates the breech-block H and firing pin or striker J; and, by suitable cam grooves (f) at about the centre of its length, works the larger feed-wheel U of the feed-box S; the smaller wheel U on the same axis in turn imparting a step-by-step motion to the metal feed-strips, each containing 30 cartridges, so that fresh cartridges are placed one by one before the face of the breech block ready to be pushed into the breech when the fired cartridge has been extracted and ejected.

On the under surface of the piston F, in rear, is a recess or sear (f) in which the nose of the trigger N engages, holding back the piston when it has been driven back by the gases. As already stated, a lug on the under surface just in rear of the cam (*f*) engages with the front of the mainspring.

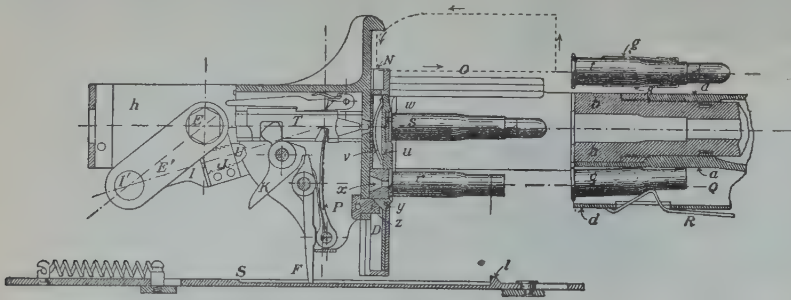


FIG. 12.—Maxim Gun Mechanism.

Taking first the position shown in fig. 15 with the breech closed and locked and the cartridge fired, it will be seen that the breech is locked by the *upper* cam (*f'*), on the end of the piston, F, having caused the movable locking-dog (*h*) to fall and bear against the recoil blocks Z (see fig. 14 also) on the walls of the *receiver* or frame B. Consequently the breech is not unlocked until the piston has moved sufficiently to the rear for the *lower* cam (*f'*) to lift the locking-dog (*h*) clear of the recoil blocks Z. As the piston F is not actuated by the gases until the bullet has passed the port (*c*), and then has to move a short distance before the locking-dog is raised, the bullet is clear of the muzzle *before* the breech is unlocked.

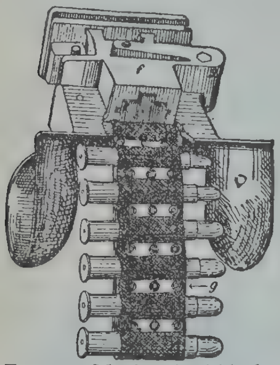
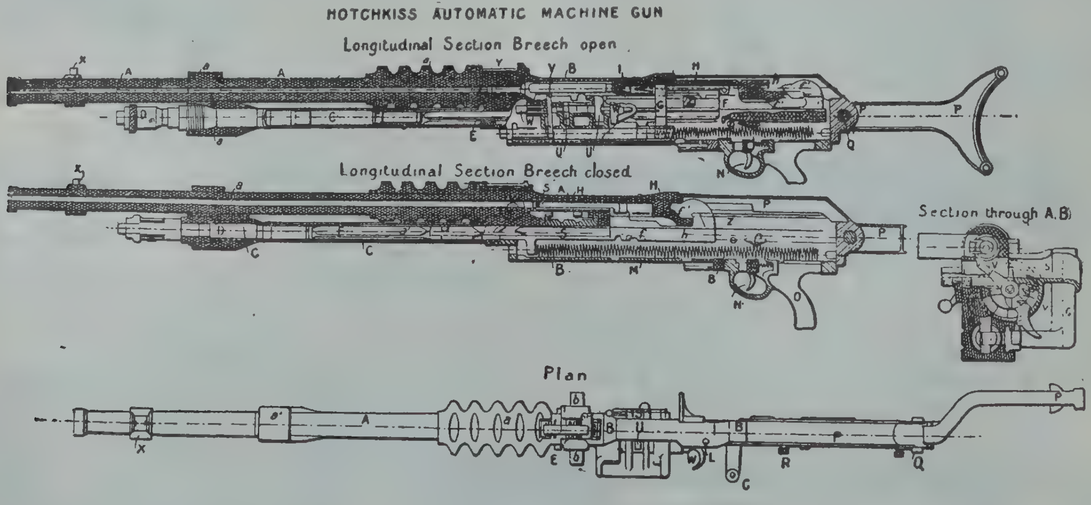


FIG. 13.—Maxim Feed-block.

As the piston continues to recoil it draws back the striker J and then the breech-block H, and is then caught and retained by the engagement of the sear (*f*) with the trigger N, and the position assumed is that shown in fig. 14.


HOTCHKISS AUTOMATIC MACHINE GUN
Longitudinal Section Breech open
Longitudinal Section Breech closed
Section through A.B
Plan
A
B
C
D
E
F
H
I
M
N
P
Q
R
S
U
V
W
X
Y
Z

FIGS. 14, 15, 16.—Hotchkiss Gun Mechanism.

From the head or nose-piece I of the breech-block projects the claw K of a spring extractor which, as the cartridge is pushed home by the breech-block, seizes it, extracting the fired case when the breech-block is withdrawn. Ejection of the fired case is effected by means of the ejector L (fig. 16) which catches against the base of the case, on the opposite side to the extractor claw, and so throws it sideways through the oblong-pointed opening in the receiver just in rear of the breech (see fig. 14).

The platform on the top of the feed-box through which the teeth of the smaller feed-wheel U project, and on which the feed-strips rest, lies *below* the axial line of the breech-block H, so that the face or nose-piece I of the latter only engages a *portion* of the base of the cartridge in the feed-strip as it pushes the cartridge into the breech, the bullet of the cartridge being guided into the breech by the incline at the opening of the latter. This point should be specially noted, the object of the arrangement being to enable the under surface of the breech-block to clear the clips which hold the cartridges in the feed-strips. The cartridge therefore, being extracted in the line of the axis of the block, is ejected through an opening *above* its plane of entry in the feed-strip.

Returning to the position shown in fig. 16, if the trigger be pulled, the compressed spring M reacts and drives the piston forwards, carrying the breech-block with it, the latter in turn driving a cartridge in front of it out of the feed-strip. When the block and cartridge are home, *and not till then*, the piston completes its travel, the upper cam (*f'*) locking the dog (*h*), and the firing-pin protrudes and fires the cartridge. Anything, therefore, which prevents the breech-block from being home against the breech, or the locking-dog from falling in front of the recoil blocks Z, renders firing of the cartridge impossible. Clearly if the trigger be kept depressed the action becomes automatic.

A special feature of this gun is the absence of a separate spring to actuate the firing-pin; the recoil spring M performing this function, in addition to that of driving the piston forwards.

The feed-strips have holes in them in which the teeth of the smaller feed-wheel U engage. The engagement of this feed with the piston F can be released by pulling out the feed arbor W, so that the strips can be removed at any time.

When the last shot in a feed-strip has been fired a stop (V) holds the piston and block ready for a fresh feed-strip to be inserted. As the stop V acts quite independently of the trigger, this action takes place even if the trigger be still depressed after the last cartridge in a strip has been fired.

To cock the gun, when in the locked position, a cocking handle G is provided. This has a long arm projecting to the front with a catch which takes against the front of the lug on the under side of the piston. To prepare the gun for action the gun is cocked, and a feed-strip is pushed into the feed-block.

The pressure of the gas on the piston is regulated by the regulator screw D, by means of which the space in the cylinder C in front of the piston F can be reduced or increased.

A safety lock R is furnished, which is a "half round" pin which can be turned so as to enter the semicircular slot just in front of the sear (*f*), and so hold back the piston when in the cocked position.

Radiation of the heat, generated in the barrel by rapid fire, is facilitated by the radiator (*a*), which consists of rings on the barrel close to the breech, which offer an increased surface to the air.

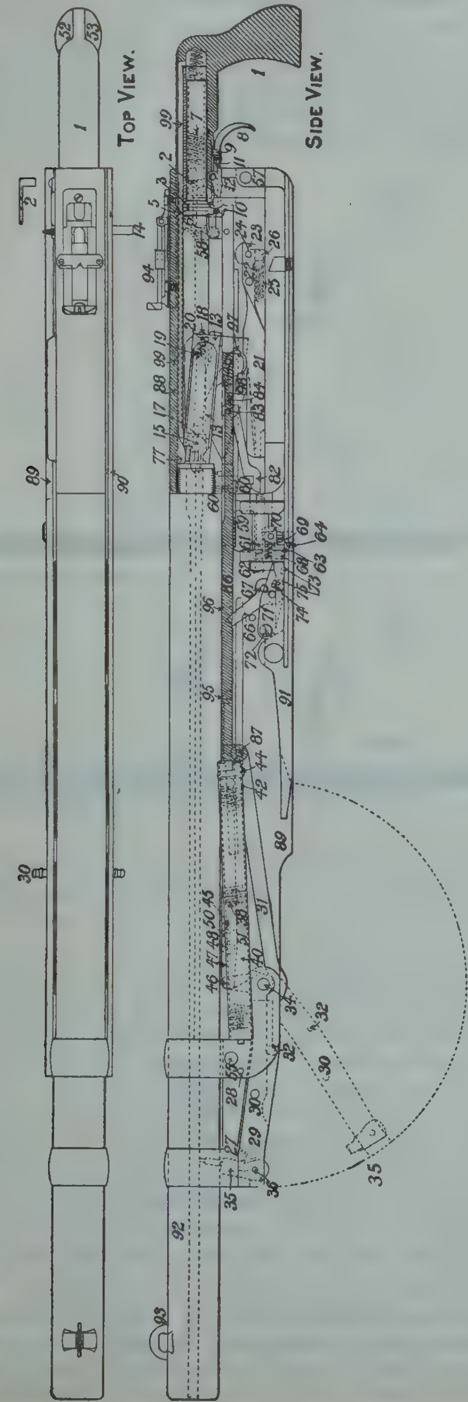
The gun is sighted to 2000 yds., with the ordinary flap back-sight, weighs about 53 lb, and can fire from 500 to 600 rounds per minute.

[The diagrams have been made from drawings, by permission of the Hotchkiss Ordnance Company.]

Colt Gun.

The Colt automatic gun, which has been adopted by the American army and navy, and was used by the British in S. Africa, depends for its action, similarly to the Hotchkiss, on the escape of a small portion of the gases of explosion through a port in the barrel a short distance from the muzzle. Figs. 17 and 18 give a plan, and side elevation with the left side plate removed, respectively. Into the recess in the barrel (92) just below the port fits the piston (35), capable of slight motion round the pivot (36), by which it is attached to the gas lever (29). The latter is a bell-crank lever pivoted at (34), its short arm being attached at (46) by a pivot to a long link with a cross head, termed the retracting connexion (45). This link extends from a point close to the figures (44), where the arms of the cross head bear against the ends of two long spiral retracting springs, (37) and (38), contained in two tubes, (39) and (40), which are slotted for a few inches of their length to allow the cross head to follow up and compress the springs. (Only (38) and (40) are shown, (37) and (39) lying in the same plane of projection.)

When the gun fires, and the bullet has passed the port, the gases drive the piston (35) and gas lever (29) downwards, and the momentum imparted causes them to swing back round the pivot (36), as shown by the dotted circle. The gas lever is brought up now by the bottom plate (91); and the retracting springs, compressed by the cross head of the long link (45) owing to the *forward* motion of the short arm of the gas lever, react and drive the gas lever into its forward position again.



FIGS. 17 and 18.—Colt Automatic Gun Mechanism.

The rotary movement of the gas lever is converted into a reciprocating movement of the slide (86) by means of the gas lever connexion rod (31) pivoted at (32) to the gas lever, and at (87) to the slide.

The slide (86) is a nearly flat bar, travelling in guides in the receiver, extending from (14) to (87). It is slotted completely through longitudinally for nearly the whole of its length, this slot affording an opening through which work the cartridge extractor (82) and carrier (21). At its rear end it engages by means of a pin (14) in a cam slot (97) in the bottom rib of the bolt (13), and at (83) it bears the pivot of the cartridge extractor (82). Its rear end is enlarged below to form a cam lug (98), and on its right side are two projections (95) and (96), which work the feed lever (66).

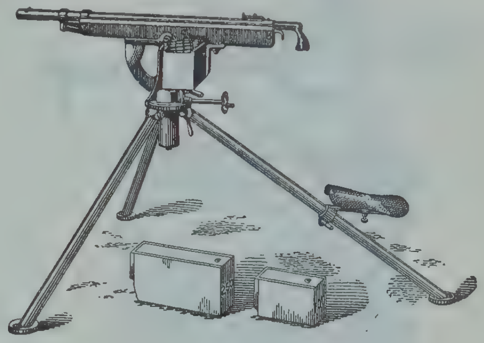


FIG. 19.—Colt Gun mounted.

The feed wheel (61), over which passes the belt containing the cartridges, is actuated by a pawl "step-by-step" gear by means of the feed lever (66).

The carrier (21) is a long trip lever pivoted at (22), and provided with a spring dog (23) pivoted at (24).

The bolt (13) is a cylinder with a guide rib extending from its under surface. It is actuated by the slide by means of the pin (14) and cam slot (97) as already stated, and is bored through to take the striker or firing pin (18). The rear end of the latter projects slightly beyond the rear face of the bolt, being retained in this position by the spring (19). When this projecting end is pushed into the bolt, the point protrudes from the front of the bolt and fires the cartridge. The bolt, when the breech is locked, is held firm by two recoil blocks on the receiver (not shown), as is explained later. At the front of the bolt is an extractor (15) with a spring claw for extracting the fired case. (This is of course quite distinct from the cartridge extractor (82).) Ejection is effected by means of an ejector projecting into the path of the fired case.

The firing of the gun is performed by the cylindrical hammer (6) hollowed out in rear to contain the mainspring (7). When pushed back and cocked as shown in fig. 18, it is held during a *portion* of the operations of the mechanism by *two* detents working independently of each other—the sear (10) and the nose of the trigger (8). The former is automatically released by a trip lever (not shown) as soon as the breech is locked, leaving the hammer held by the trigger only. This is the position shown in fig. 18. The necessity for the two detents is explained later.

The hammer, when cocked, can also be permanently locked by the handle lock (2) actuated by a thumb-piece on the outside of the receiver. The air compressed in rear of the hammer, as the latter is driven back, passes through the tube (99) to the breech; and a puff of air is therefore blown through the barrel after every shot, clearing out fouling and unconsumed powder, and assisting to an appreciable extent to keep down the temperature of the barrel.

Taking the position shown in fig. 18, the hammer is only held back by the trigger nose, the sear (10) having been released as stated above. A belt of cartridges (not shown) has been placed on the feed-wheel, and the cartridge next to be used after the one (not shown) now in the breech has its rim (or base with rimless cartridges) just above the hook on the extractor (82). If now the trigger be pulled, the hammer flies forwards, strikes the protruding end of the firing pin, and the cartridge fires; the gases cause the gas lever to swing round and drive back the slide. The pin (14) working in the cam groove (97) causes the rear of the bolt to *rise* and clear itself from the recoil blocks (not shown) on the receiver, and then to move rearwards horizontally, driving the hammer back until the latter is caught and held by the sear and trigger. In the meantime the extractor (82) has pulled a cartridge from the belt, and, assisted by two spring cartridge guides (80 and 81), of which only (80) is shown, deposits it on the carrier (21); the projection (95) strikes the feed-lever (66), and moves the feed mechanism so as to prepare to revolve the feed-wheel and place a fresh cartridge ready for the next round; and as the slide completes its travel backwards, the cam (98) strikes the dog (23) and slightly depresses it (the spring (25) yielding), the carrier and cartridge on it consequently rising a little and falling again (this latter action is incidental only to the form of the parts, and is not a necessity).

The retracting springs now react and pull the slide forwards; the cam (98) strikes the dog (23), which, as the spring arrangement is of the "non-return" class, does not yield but is depressed, and the front of the carrier and the cartridge on it are therefore raised sharply, and the latter placed in the path of the bolt. The bolt being now pulled forwards, the cartridge is driven off the carrier into the breech, and the bolt locked by the pin (14), causing the bolt to drop in front of the recoil blocks; the carrier is pushed down flat by the advance of the cam lug (98), the trip releases the sear (10), and the projection (96) pushes back the feed lever, completing the action of feeding a fresh cartridge forward. The position shown in fig. 17 is now resumed.

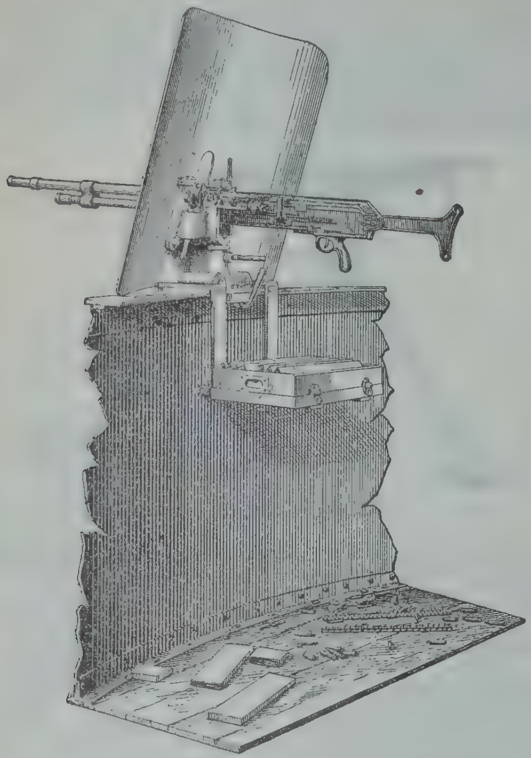


FIG. 20.—Hotchkiss Gun mounted.

It is clear that were the trigger kept permanently pulled the gun would fire immediately the bolt was locked and the sear (10) depressed, and the action would become automatic.

The object of two detents, though now probably obvious, may here be explained. The whole action of the gun depends upon the hammer after it is pushed back by the bolt being *held* back until the bolt has gone completely forwards and locked the breech. If only the trigger detent existed, and that were kept pressed down, the hammer, after being pushed back by the bolt, would immediately *follow up* the latter, and might fire the cartridge prematurely, or fail to fire it at all; hence the use of the sear in addition to the trigger.

To cock the lock, or work the mechanism by hand, the gas lever is pulled round by the pin (30) provided for the purpose, and by this means the gun is prepared for firing. A brass tongue on the end of the belt is pushed through the opening above the feed-wheel and then pulled from the other side of the gun as far as it will go. This places a cartridge in front of the extractor, and if the gas lever be now pulled right back and let go, this cartridge is placed in the breech as already described, and the gun is ready for firing. If it be desired to remove a belt from the feed, a button (68) is pressed and the feed-wheel is then free to revolve backwards.

The gun is sighted with the ordinary rifle-pattern sights, up to 2000 yds. or more if required. It weighs about 40 ℔, and can fire about 400 rounds per minute as usually adjusted, though this rate can be increased. There is no means of altering the gas pressure in the field as with the Hotchkiss.

[The diagrams have been made from drawings, by permission of the Colt Arms Company.]

Comparing the principle of employing a recoiling barrel with that of using a portion of the gas, the advantages of the former are that the recoil is made to do useful work instead of straining the gun and mounting in its absorption; the latter system, however, has undoubtedly the advantage in simplicity of mechanism (the Hotchkiss is extraordinarily simple in construction for an automatic gun), and in the large margin of power for working the mechanism with certainty in all conditions of exposure to climate, dust, and dirt. While inferior in this respect, it is nevertheless the fact that the Maxim has proved itself in the field even in savage warfare in the roughest country to be a very efficient and powerful weapon.

The great difficulty which has to be met in all single-barrel machine guns is the heating of the barrel. The 7½ pints of water in the water-jacket of the Maxim gun are raised to boiling point by 600 rounds of rapid fire—*i.e.* in about 1½ minutes—and if firing be continued, about 1½ pints of water are evaporated for every 1000 rounds. Assuming that the operation is continuous, the rate of waste of energy due to heat expended on the water *alone* is equivalent to about 20 horse-power (294 foot tons per minute). The water-jacket acts well in keeping down the temperature of the barrel; but apart from the complications entailed by its use, the provision of water for this purpose is at times exceedingly troublesome on service. In the Hotchkiss and Colt guns, which have no water-jacket, an attempt is made to meet the heating, in the one by the radiator, and in the other by a very heavy barrel.

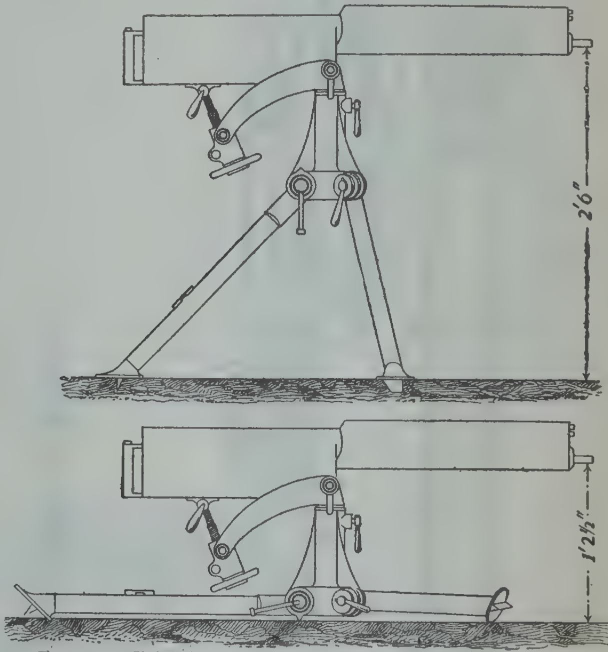


FIG. 21.—Tripod mounting (Mark IV.), for British Maxim.

One of the most modern types of gun is the Schwarzlose, which is manufactured at Steyr in Austria, and was adopted by the Austrian army in 1907. This weapon is remarkable for its simplicity. There are only 10 main working parts, and any of these can be replaced in a few seconds. It is operated by the gases of the explosion, has a water-jacket that allows 3000 rounds to be fired without refilling. The "life" of the gun-barrel is stated to be 35,000 rounds without serious loss of accuracy. The weight of the gun is 37·9 ℔. It is a belt loader.

The Italian Perino gun, adopted in 1907, is a recoil-operated weapon, and is loaded by a metal clip. The Skoda gun, some of which type are used in Japan and China, is loaded by a hopper feed, and is gas-operated. The Bergmann gun is a belt loader, but the belt passes down a "gravity feed" an arrangement which saves a number of working parts.

One defect common to all is that it is by no means easy to proportion the fire to the target, as there are only two rates of fire, viz. rapid automatic and slow single shots. To fire a single shot requires practice, since the gun will fire some 7 shots in one *second*, and to press the trigger and remove the finger or thumb instantly, and at the same time be ready to traverse to a fresh target, requires considerable skill. The result of these difficulties is that the target when struck is often riddled with bullets when one would have sufficed. The aiming of the gun, when rapid fire is taking place, may also be difficult even on firmly fixed mountings, owing to vibration. The greater delicacy of the modern machine gun has been alluded to above.[1] Nevertheless the advantages of safety, steadiness and lightness which the automatic weapon possesses, have ensured its victory over the older type of weapon, and although the simple strong and well-tried Gatling still has its advocates, every civilized army has adopted one or more of the automatic types.

ORGANIZATION AND TACTICAL EMPLOYMENT[2]

Although machine-gun tactics are still somewhat indefinite, at least there are well-marked tendencies which have a close relation to the general tactical scheme or doctrine adopted by each of the various armies as suited to its own purposes and conditions. For many years before the South African and Manchurian wars, the machine-gun had been freely spoken of as "a diabolical weapon before which nothing could live," but this did not contribute much to the science of handling it. Most military powers, indeed, distrusted it—actuated perhaps by the remembrance of the vain hopes excited by the *canon à balles*. It was not until the second half of the war of 1904-05 that the Japanese, taught by the effective handling of the Russian machine-guns at Liao-Yang, introduced it into their field armies, and although Great Britain had provided every regular battalion with a Maxim-gun section some years before the Boer War, and a Volunteer corps, the Central London Rangers (now 12th bn. London Regiment) had maintained a (Nordenfeldt) gun section since 1882, instruction in the tactics of the weapon was confined practically to the simple phrase "the machine-gun is a weapon of opportunity." More than this, at any rate, is attempted in the drill-books of to-day.

One important point is that, whether the guns are used as an arm, in numbers, or as auxiliaries, in sections, they should be free to move without having to maintain their exact position relatively to some other unit. It was in following the infantry firing lines of their own battalion over the open that the British Maxims suffered most heavily in South Africa. Another of equal importance is that the machine guns must co-operate with other troops of their side in the closest possible way; more, in this regard, is demanded of them than of artillery, owing to their mobility and the relative ease of obtaining cover. A third factor, which has been the subject of numerous experiments, is the precise value of a machine-gun, stated in terms of infantry, *i.e.* how many rifles would be required to produce the fire-effect of a machine-gun. A fourth—and on this the teaching of military history is quite definite—is the need of concealment and of evading the enemy's shrapnel. These points, once the datum of efficiency of fire has been settled, resolve themselves into two conclusions—the necessity for combining independence and co-operation, and the desirability of Mercury's winged feet and cap of darkness for the weapon itself. It is on the former that opinions in Europe vary most. Some armies ensure co-operation by making the machine-gun section an integral part of the infantry regimental organization, but in this case the officer commanding it must be taught and allowed to shake himself free from his comrades and immediate superiors when necessary. Others ensure co-operation of the machine-guns as an arm by using them, absolutely free of infantry control, on batteries; but this brings them face to face with the risks of showing, not one or two low-lying gun-barrels, but a number of carriages, limbers and gun teams, within range of the enemy's artillery.

Fire Effect.

French experiments are said to show that the fire-power of a machine-gun is equal to that of 150–200 rifles at exactly known range, and to 60–80 rifles at ranges judged by the French "instantaneous range-finder." The German drill-book gives it as equal approximately to that of 80 rifles on an average. The distinction of known and unknown ranges is due to the fact that the "cone of dispersion" of a large number of bullets in collective infantry fire is deeper than that of machine-gun fire. The latter therefore groups its bullets much more closely about the target if the latter is in the centre of the cone—viz. at known ranges—but if the distance be misjudged not only the close central group of 50% of the shots, but even the outlying rounds may fall well away from the target. At 1500 yards range the "50 per cent. zone" with the Maxim gun is only 34 yards deep as compared with the 60 yards of a half-company of rifles.[3] The accuracy of the gun is more marked when the breadth of the cone of dispersion is taken into account. The "75 per cent." zone is in the case of the machine-gun about as broad at 2000 yards as that of collective rifle fire at 500. At the School of Musketry, South Africa, a trial between 42 picked marksmen and a Maxim at an unknown range at service targets resulted in 408 rounds from the rifles inflicting a loss of 54% on the enemy's firing line represented by the targets, and 228 rounds from the Maxim inflicting one of 64%. Another factor is rapidity of fire. It is doubtful if infantry can keep up a rate of 12 rounds a minute for more than two or three minutes at a time without exhaustion and consequent wild shooting. The machine-gun, with all its limitations in this respect, can probably, taking a period of twenty or thirty minutes, deliver a greater volume of fire than fifty rifles, and assuming that, by one device or another (ranging by observing the strike of the bullets, the use of a telemeter, or the employment of "combined sights") the 75% cone of bullets has been brought on to the target, that fire will be more effective. The serious limiting condition is the need of accurate ranging. If this is unsatisfactory the whole (and not, as with infantry, a part) of the fire effect may be lost, and if the safe expedient of "combined sights"[4] be too freely resorted to, the consumption of ammunition may be out of all proportion.

Ranging.

Vulnerability.

The vulnerability of machine-guns is quite as important as is their accuracy. At a minimum, that is when painted a "service" colour, manœuvred with skill, and mounted on a low tripod—in several armies even the shield has been rejected as tending to make guns more conspicuous—the vulnerability of one gun should be that of one skirmisher lying down. At a maximum, vulnerability is that of a small battery of guns and wagons limbered up.

Mobility.

Mobility comes next. The older patterns of hand-operated guns weighed about 90 lb at least, without carriage, the earlier patterns of Maxims (such as that described in detail above) about 60 lb. But the most modern Maxims weigh no more than 35 lb. Now, such weapons with tripods can be easily carried to and fro by one or two men over ground that is impracticable for wheeled carriages. Nevertheless,

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[1] At San-de-pu 1905 the Japanese machine-guns (Hotchkiss) sustained damage averaging, 1 extractor broken per gun, 1 jam in every 300 rounds. It should be mentioned, however, that the machine-gun companies were only formed shortly before the battle.

[2] In field operations only. For siege warfare see FORTIFICATION AND SIEGECRAFT.

[3] For practical purposes in the field, the "effective" beaten zone, containing 75% of the bullets, is the basis of fire direction both for the machine-gun and the rifle. The depths of these "effective" zones are on an average:—

At	500 yds.	1,000 yds.	1,500 yds.	2,000 yds.
S.L.E. Rifle	220 yds.	120 yds.	100 yds.	—
Maxim Gun	150 yds.	70 yds.	60 yds.	50 yds.

[4] "Combined sights" implies firing with the sights set for two different ranges, the usual difference being 50 yds. With grouped machine guns, "progressive fire" with elevations increasing by 25 yds. is used. This artificially disperses the fire, and therefore lessens the chance of losing the target through ranging errors. One ingenious inventor has produced a two-barrelled automatic, in which the barrels are permanently set to give combined elevations. The British memorandum of August 1909 seems to regard the facility of employing combined sights as the principal advantage of the battery over the section.

wheeled carriages are often used for the ordinary transport of the gun and its equipment, especially with the heavier models. The simplest machine-gun has a number of accessories—tools, spare parts, &c.—that must be conveyed with it, and at the least a pack-animal is indispensable.

Reducing these conditions to a phrase—the fire effect that can be reasonably expected of machine-guns is that of fifty or sixty rifles, the space it takes up in the line can be made to equal that occupied by two men, and it possesses by turns the speed of a mounted man and the freedom of movement of an infantryman.

Machine-Guns as a Reserve of Fire.

Machine-Guns with Cavalry.

The use of the machine-gun (apart from savage warfare) that first commended itself in Europe was its use as a *mobile reserve of fire.* Now, the greatest difficulty attending the employment of a reserve of any sort is the selection of the right moment for its intervention in the struggle, and experience of manœuvres of all arms in Germany, where "machine-gun detachments" began to be formed in 1902, appears to have been that the machine-guns always came into action too late. On the other hand, the conditions of the cavalry *versus* cavalry combat were more favourable. Here there was every inducement to augment fire-power without dismounting whole regiments for the purpose. Moreover, vulnerability was not a fatal defect as against a battery or two of the enemy's horse artillery, whose main task is to fire with effect into the closed squadrons of mounted men on the verge of their charge, and above all to avoid a meaningless duel of projectiles. The use of wheeled carriages was therefore quite admissible (although in fact the equipment was detachable from the carriage) and, given the rapidity and sudden changes of cavalry fighting, both desirable and necessary. Thus, thanks to the machine-gun, the eternal problem of increasing the fire-power of mounted troops is at last partially solved, and the solution has appealed strongly both to armies exceptionally strong in cavalry, as for example the German, and to those exceptionally weak in that arm—Denmark, for instance, having two or three light machine-guns *per squadron.* The object of the weaker cavalry may be to cause the onset of the stronger to dwindle away into a dismounted skirmish, and this is most effectually brought about by a fire concentrated enough and heavy enough to discourage mounted manœuvres; on the other hand, the stronger party desires to avoid dismounting a single squadron that can be kept mounted; and this too may be effected by the machine-guns. What the result of such a policy on both sides may be, it would be hard to prophesy, but it is clear at any rate that, whether on the offensive or on the defensive, skilfully handled machine-guns may enable a cavalry commander to achieve the difficult and longed-for result—to *give the law* to his opponent. The principal difference between the tactics of the stronger and those of the weaker cavalry in this matter is, that it is generally advantageous for the former to act by batteries and for the latter to disperse his machine guns irregularly in pairs.

Machine-Guns in Combined Tactics.

It is not merely in cavalry tactics that the question of "section or battery" arises. It deeply affects the machine-gun tactics in the battle of all arms, and it is therefore decided in each service by the use to which the guns are intended to be put. One powerful current of opinion is in favour of employing them as a mobile reserve of fire. This opinion was responsible for the creation of the German machine-gun batteries or "detachments"; and in the drill regulations issued in 1902 for their guidance it was stated that the proper use of machine-guns required a comprehensive and accurate knowledge of the general situation, and that therefore only the superior leaders could employ them to advantage. Manœuvre experience, as mentioned above, has caused considerable modification in this matter, and while the large machine-gun "detachments" are now definitely told off to the cavalry, new and smaller units have been formed, with the title "companies" to indicate their attachment to the infantry arm. A recent official pronouncement as to the rôle of the "companies" (Amendments to *Exerzierreglement für die Infanterie,* 1909) is to the effect that the companies are an integral part of the infantry, that their mission is to augment directly the fire of the infantry, and that their employment is in the hands of the infantry regimental commander, who keeps the guns at his own disposition or distributes them to the battalions as he sees fit. It must be remembered that the regiment is a large unit, 3000 strong, and the idea of a "mobile reserve of fire" is tacitly maintained, although it has been found necessary to depart from the extreme measure of massing the guns and holding them at the disposal of a general officer. The Japanese regulations state that in principle the machine-gun battery fights as a unit; that although it may be advantageously employed with the advanced guard to assure the possession of supporting points, its true function is to intervene with full effect in the decisive attack, its use in the delaying action being "a serious error." In France, on the other hand, the system of independent sections is most rigidly maintained; when in barracks, the three sections belonging to an infantry regiment are combined for drill, but in the field they seem to be used exclusively as sections. They are not, however, restricted to the positions of their own battalions; taught probably by the experiences of the British in South Africa, they co-operate with instead of following the infantry. In Great Britain, *Field Service Regulations,* part i., 1909, lay down that "machine-guns are best used in pairs[1] in support of the particular body of troops to which they belong" (*i.e.* battalions). "The guns of two or more units may, if required,[2] be placed under a specially selected officer and employed as a special reserve of fire in the hands of a brigade commander" (corresponding to German regimental commander), but "if an overwhelming fire on a particular point is required, it can be obtained by concentrating the fire of dispersed pairs of guns." More explicitly still, "the movements and fire action of these weapons should be *regulated so as to enable them to open fire immediately a favourable opportunity arises.*"

Contrasting the German system with the French and English, we may observe that it is German tactics *as a whole* that impose a method of using machine-guns which the Germans themselves recognize as being in many respects disadvantageous. A German force in action possesses little depth, *i.e.* reserves, except on the flanks where the enveloping attack is intended to be made. Consequently, a German commander needs a reserve of fire in a mechanical, concentrated form more than a British or a French commander, and, further, as regards the decisive attack on the flanks, it is intended not merely to be sudden but even more to be powerful and overwhelming. These considerations tend to impose both the massing and the holding in reserve of machine-guns. The French and British doctrine (see TACTICS) is fundamentally different. Here, whether the guns be massed or not, there is rarely any question of using the machine-guns as a special reserve. In the decisive attack, and especially at the culmination of the decisive attack, when concealment has ceased and power is everything, the machine-guns can render the greatest services when grouped and boldly handled. Above all, they must reach the captured crest in a few minutes, so as to crush the inevitable offensive return of the enemy's reserves. The decisive attack, moreover, is not a prearranged affair, as in Germany, but the culmination, "at a selected point, of gradually increasing pressure relentlessly applied to the enemy at all points" (*F. S. Regulations*). The holding attack, as this "pressure" is called, is not a mere feint. It is launched and developed as a decisive attack, though not completed as such, as it lacks the necessary reserve strength. Here, then, the machine-gun is best employed in enabling relatively small forces to advance—not to assault—without undue loss, that is, in economizing rifles along the non-decisive front.[1]

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[1] The use of single guns facilitates concealment, but this is outweighed by the objection that when a jam or other breakdown occurs the fire ceases altogether. The use of guns in pairs not only obviates this, but admits of each gun in turn ceasing fire to economize ammunition, to cool down, &c. This is the old artillery principle—"one gun is no gun."

[2] In the instructions issued in August 1909 one of the principal advantages of grouped sections is stated to be the neutralization of ranging errors at ranges over 1000 yards. At a less range, it is laid down, grouped guns form too visible a target, unless the ground is very favourable.

Withal, there are certain principles, or rather details of principle, that find general acceptance. One of these is the employment of machine-guns with the advanced guard. In this case the value of the weapon lies in its enabling the advanced guard both to seize favourable ground and points of support without undue effort and to hold the positions gained against the enemy's counter-attack. This applies, further, to the preliminary stages of an action.[2] Another point is that as a rule the most favourable range for the machine-gun is "effective infantry," *i.e.* 600–1400 yards (which is, *mutatis mutandis*, the principle of Reffye's mitrailleuse). Its employment at close infantry range depends entirely on conditions of ground and circumstances—even supposing that the handiest and most inconspicuous type of weapon is employed. Thirdly—and this has a considerable bearing on the other points—the machine-gun both concentrates many rifles on a narrow front, and concentrates the bullets of many rifles on a narrow front. The first clause implies that it can be used where there is no room (physically or tactically) for the fifty or eighty riflemen it represents (as, for instance, in some slight patch of cover whence the gun can give effective cross-fire in support of the infantry attack, or in front of an advanced post, or can watch an exposed flank), and, further, that it can be swung round laterally on to a fresh target far more easily than a line of excited and extended infantry can be made to change front. The second means that the exit of a defile, an exposed turn in a lane or on a bridge, can be beaten by closely grouped fire at greater distances and with greater accuracy than is attainable with riflemen.

Further, the waste of ammunition and the strain on the weapon caused by unnecessarily prolonged firing at the rate for which its mechanism is set—varying between 350 and 700 rounds a minute—have caused it to be laid down as an axiom in all armies that machine-guns shall deliver their fire by "bursts" and only on favourable targets.

Lastly, the reports, both of observers and combatants, are unanimous as to the immense moral effect produced on the combatants by the unmistakable drumming sound of the machine-guns, an effect comparable even at certain stages of the fight to the boom of the artillery itself.

Equipments in Use.—Practically all nations have abandoned the simple wheeled carriage for machine-guns, or rather have adopted the tripod or table mounting, reserving the wheeled vehicle for the mere transport of the equipment. Since the Russo-Japanese War the tendency has been to sacrifice the slight protection afforded by the shield in order to reduce visibility. The Japanese, who had unprotected field guns and protected machine-guns in the war, found it advisable to reverse this procedure, for reasons that can easily be guessed in the cases of both weapons.

Great Britain.—The service machine-gun is the Maxim ·303 in., adjusted to a rate of 450 rounds per minute and sighted (except in a few weapons) to 2900 yards. The original patterns weighed 60 ℔, and were mounted on wheeled carriages. In the latest pattern, however, the weight of the gun has been reduced to 36 ℔. The old Mark I. cavalry Maxim carriage, complete with gun, ammunition, &c., weighed 13 cwt. behind the traces, and the gun was 5 ft. above the ground. It had no limber. The Mark III. cavalry carriage is much lower (3′ 6″ from the ground to the gun), and the gun carriage and limber together only weigh 13 cwt. Of infantry carriages there were various marks, one of which is shown in fig. 6. Now, however, all mountings for infantry are of the tripod type, transported on wheels or on pack animals, but entirely detachable from the travelling mounting, and in action practically never used except on the tripod. The Mark IV. tripod mounting, of which a sketch is given in fig. 21, weighs 48 ℔. The total weight of the fighting equipment is thus 84 ℔ only—an important consideration now that in action the gun is man-carried. The gun can be adjusted to fire at heights varying from 2′ 6″ to 1′ 2½″ only from the ground; in its lowest position, then, it is a little lower than the head of a man firing lying. All the later infantry machine-gun equipments are for pack transport and have no shields.

The organization of the machine-gun arm is regimental. Each cavalry regiment and each infantry battalion has a section of 2 guns under an officer.

France.—The guns in use are the Puteaux and the Hotchkiss. The unit is the regimental 2-gun section. Four-horsed carriages with limbers are used with cavalry, tripods with the infantry sections. No shields. Weight of the Hotchkiss in use, 50 ℔; of the tripod, 70 ℔. The Puteaux was lightened and improved in 1909.

Germany.—As already mentioned the German machine-gun units are classed as cavalry "detachments" and infantry "companies." The "detachment" or battery consists of 6 guns and 4 wagons, the vehicles being of a light artillery pattern and drawn by four horses. The gun (Maxim) weighs 61 ℔, and its fighting carriage 110 ℔. The "companies" have also 6 guns and 4 wagons, but the equipment is lighter (two-horse), and is not constructed on artillery principles, nor are the guns fired from their carriages as are those of the "detachments." The weight of the gun is 38 ℔, and that of the fighting carriage 75 (some accounts give 53 for the latter), the difference between these weights and those of the mounted equipments, affording a good illustration of the difference in the tactical requirements of the cavalry and of the infantry types of gun. The fighting carriage is a sort of sledge, which is provided with four legs for fire in the highest position, but can of course be placed on the ground; the height of the gun, therefore, can be varied from 3′ 6″ to 1′ 6″. The sledges can be dragged across country or carried by men stretcher fashion, and sometimes several sledges are coupled and drawn by a horse.

Japan.—The Japanese Hotchkiss, as modified since the war with Russia, is said to weigh 70 ℔, and its tripod mounting 40. Each regiment of infantry has a six-gun battery and each cavalry brigade one of eight guns. Pack transport is used.

Russia.—Since the war eight-gun companies have been formed in the infantry regiments, and each cavalry regiment has been provided with two guns. The var organization is, however, unknown. Both wheel and pack transport are employed for travelling, but the guns are fought from tripods. Early and somewhat heavy patterns of Maxim (with shield) are chiefly used, but a great number of very light guns of the Madsen type have been issued.

The *Austrian* gun is the Schwarzlose, of which some details are given above. Pack transport is used, one mule taking the whole equipment with 1000 rounds. Weight of the gun 37·9 ℔, of the tripod 41 ℔. The height of the tripod can be varied from 9¾ in. to 2 ft. above the ground. It is proposed that each cavalry regiment should have four guns, and each infantry regiment two. *Switzerland* adopted the Maxim in 1902. It is used principally as a substitute for horse artillery. *Denmark* and other small states have adopted the Madsen or Rexer light-type guns in relatively large numbers, especially for cavalry. In the *United States* the British organization was after many trials adopted, and each infantry and cavalry regiment has a two-gun section of Maxims, with tripod mounting and pack transport.

See P. Azan, *Les premières mitrailleuses* ("Revue d' Histoire de l'Armée," July 1907); *Le Canon à balles, 1870–1871* ("Revue d'Hist. de l'Armée, 1909); Lieut-Colonel E. Rogers in "Journal R. United Service Institution" of 1905; Capt. R. V. K. Applin, *Machine-gun Tactics* (London, 1910) and paper in "J. R. United Service Inst." (1910); War Office Handbook to the Maxim gun (1907); Capt. Cesbron Lavau, *Mitrailleuses de cavalerie*; Lieut. Buttin, *L'emploi des mitrailleuses d'infanterie*; Major J. Goots, *Les Mitrailleuses* (Brussels, 1908); and Merkatz, *Unterrichtsbuch für die Masch.-Gewehrabteilungen* (Berlin, 1906); Korzen & Kühn, *Waffenlehre*, &c.

(C. F. A.)

MACÍAS [*O NAMORODO*] (*fl.* 1360–1390), Galician *trovador*, held some position in the household of Enrique de Villena. He is represented by five poems in the *Cancionero de Baena*, and is the reputed author of sixteen others. Macías lives by virtue of the romantic legends which have accumulated round his name. The most popular version of his story is related by Hernán Nuñez. According to this tradition, Macías was enamoured of a great lady, was imprisoned at Arjonilla, and was murdered by the jealous husband while singing the lady's praises. There may be some basis of fact for this narrative, which became a favourite subject with contemporary Spanish poets and later writers. Macías is mentioned in Rocaberti's *Gloria de amor* as the Castilian equivalent of Cabestanh; he afforded a theme to Lope de Vega in *Porfiar hasta morir*; in the 19th century, at the outset of the romantic movement in Spain, he inspired Larra (*q.v.*) in the play *Macias* and in the historical novel entitled *El doncel de Don Enrique el doliente.*

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[1] The British instructions of August 1909 direct the grouping of guns in the *decisive* attack (if circumstances and ground favour this course) and their use by sections "if the brigade is deployed on a wide front," *i.e.* on the *non-decisive* front; further, that it is often advisable to disperse the sections of the leading battalions and to group those of units in reserve. In any case, while the 2, 4 or 8 guns must be ready to act independently as a special "arm," their normal work is to give the closest support to the neighbouring infantry (battalion in the holding, brigade in the decisive, attack).

[2] In Germany, however, the tendency is not to make holding attacks but to keep the troops out of harm's way (*i.e.* too far away for the enemy to counter-attack) until they can strike effectively.

See H. A. Rennert, *Macias, o namorado; a Galician trobador* (Philadelphia, 1900); Théodore J. de Puymaigre, *Les vieux auteurs castillans* (1889–1890), i. 54–74; *Cancioneiro Gallego-Castelhano* (New York and London, 1902), ed. H. R. Lang; Christian F. Bellermann, *Die alten Liederbücher der Portugiesen* (Berlin, 1840).

MACINTOSH, CHARLES (1766–1843), Scottish chemist and inventor of waterproof fabrics, was born on the 29th of December 1766 at Glasgow, where he was first employed as a clerk. He devoted all his spare time to science, particularly chemistry, and before he was twenty resigned his clerkship to take up the manufacture of chemicals. In this he was highly successful, inventing various new processes. His experiments with one of the by-products of tar, naphtha, led to his invention of waterproof fabrics, the essence of his patent being the cementing of two thicknesses of india-rubber together, the india-rubber being made soluble by the action of the naphtha. For his various chemical discoveries he was, in 1823, elected F.R.S. He died on the 25th of July 1843.

See George Macintosh, *Memoir of C. Macintosh* (1847).

MACKAY, CHARLES (1814–1889), Scottish writer, was born at Perth, on the 27th of March 1814, and educated at the Caledonian Asylum, London, and in Brussels. In 1830, being then private secretary to a Belgian ironmaster, he began writing verses and articles for local newspapers. Returning to London, he devoted himself to literary and journalistic work, and was attached to the *Morning Chronicle* (1835–1844). He published *Memoirs of Extraordinary Public Delusions* (1841), and gradually made himself known as an industrious and prolific journalist. In 1844 he was made editor of the Glasgow *Argus*. His literary reputation was made by the publication in 1846 of a volume of verses, *Voices from the Crowd*, some of which were set to music by Henry Russell and became very popular. In 1848 Mackay returned to London and worked for the *Illustrated London News*, of which he became editor in 1852. In it he published a number of songs, set to music by Sir Henry Bishop and Henry Russell, and in 1855 they were collected in a volume; they included the popular "Cheer, Boys! Cheer!" After his severance from the *Illustrated London News*, in 1859, Mackay started two unsuccessful periodicals, and acted as special correspondent for *The Times* in America during the Civil War. He edited *A Thousand and One Gems of English Poetry* (1867). Mackay died in London on the 24th of December 1889. Marie Corelli (*q.v.*) was his adopted daughter. His son, Eric Mackay (1851–1899), was known as a writer of verse, particularly by his *Love Letters of a Violinist* (1886).

MACKAY, HUGH (*c.* 1640–1692), Scottish general, was the son of Hugh Mackay of Scourie, Sutherlandshire, and was born there about 1640. He entered Douglas's (Dumbarton's) regiment of the English army (now the Royal Scots) in 1660, accompanied it to France when it was lent by Charles II. to Louis XIV., and though succeeding, through the death of his two elder brothers, to his father's estates, continued to serve abroad. In 1669 he was in the Venetian service at Candia, and in 1672 he was back with his old regiment, Dumbarton's, in the French army, taking part under Turenne in the invasion of Holland. In 1673 he married Clara de Bie of Bommel in Gelderland. Through her influence he became, as Burnet says, "the most pious man that I ever knew in a military way," and, convinced that he was fighting in an unjust cause, resigned his commission to take a captaincy in a Scottish regiment in the Dutch service. He had risen to the rank of major-general in 1685, when the Scots brigade was called to England to assist in the suppression of the Monmouth rebellion. Returning to Holland, Mackay was one of those officers who elected to stay with their men when James II., having again demanded the services of the Scots brigade, and having been met with a refusal, was permitted to invite the officers individually into his service. As major-general commanding the brigade, and also as a privy councillor of Scotland, Mackay was an important and influential person, and James chose to attribute the decision of most of the officers to Mackay's instigation. Soon after this event the Prince of Orange started on his expedition to England, Mackay's division leading the invading corps, and in January 1688–89 Mackay was appointed major-general commanding in chief in Scotland. In this capacity he was called upon to deal with the formidable insurrection headed by Graham of Claverhouse, Viscount Dundee. In the battle of Killiecrankie Mackay was severely defeated, but Dundee was killed, and the English commander, displaying unexpected energy, subdued the Highlands in one summer. In 1690 he founded Fort William at Inverlochy, in 1691 he distinguished himself in the brilliant victory of Aughrim, and in 1692, with the rank of lieutenant-general, he commanded the British division of the allied army in Flanders. At the great battle of Steinkirk Mackay's division bore the brunt of the day unsupported and the general himself was killed.

Mackay was the inventor of the ring bayonet which soon came into general use, the idea of this being suggested to him by the failure of the plug-bayonet to stop the rush of the Highlanders at Killiecrankie. Many of his despatches and papers were published by the Bannatyne Club in 1883.

See *Life* by John Mackay of Rockville (1836); and J. W. Fortescue, *History of the British Army*, vol. i.

MACKAY, JOHN WILLIAM (1831–1902), American capitalist, was born in Dublin, Ireland, on the 28th of November 1831. His parents brought him in 1840 to New York City, where he worked in a ship-yard. In 1851 he went to California and worked in placer gold-mines in Sierra county. In 1852 he went to Virginia City, Nevada, and there, after losing all he had made in California, he formed with James G. Fair, James C. Flood and William S. O'Brien the firm which in 1873 discovered the great Bonanza vein, more than 1200 ft. deep, in the Comstock lode (yielding in March of that year as much as $632 per ton, and in 1877 nearly $19,000,000 altogether); and this firm established the Bank of Nevada in San Francisco. In 1884, with James Gordon Bennett, Mackay formed the Commercial Cable Company—largely to fight Jay Gould and the Western Union Telegraph Company—laid two transatlantic cables, and forced the toll-rate for transatlantic messages down to twenty-five cents a word. In connexion with the Commercial Cable Company he formed the Postal Telegraph Company. Mackay died on the 20th of July 1902 in London. He gave generously, especially to the charities of the Roman Catholic Church, and endowed the Roman Catholic orphan asylum in Virginia City, Nevada. In June 1908 a school of mines was presented to the University of Nevada, as a memorial to him, by his widow and his son, Clarence H. Mackay.

MACKAY, a seaport of Carlisle county, Queensland, Australia, on the Pioneer river, 625 m. direct N.N.W. Pop. (1901), 4091. The harbour is not good. Sugar, tobacco and coffee thrive in the district. There are several important sugar mills, one of which, the largest in Queensland, is capable of an annual output of 8000 tons. Rum is distilled, and there are a brewery and a factory for tinning butter for export. Workable coal is found in the district. This is the port of the Mt Orange and Mt Gotthart copper mines, and the Mt Britten and Eungella gold-fields. It is a calling-station for the Queensland royal mail steamers. The town is named after Captain John Mackay, who discovered the harbour in 1860.

McKEESPORT, a city of Allegheny county, Pennsylvania, U.S.A., at the confluence of the Monongahela and Youghiogheny rivers (both of which are navigable), 14 m. S.E. of Pittsburg. Pop. (1890), 20,741; (1900), 34,227, of whom 9349 were foreign-born and 748 were negroes; (1910 census) 42,694. It is served by the Baltimore & Ohio, the Pittsburg & Lake Erie and the Pennsylvania railways. The city has a Carnegie library, a general hospital, and two business schools. Bituminous coal and natural gas abound in the vicinity, and iron, steel, and tin and terne plate are extensively manufactured in the city, the tin-plate plant being one of the most important in the United

States. The total value of the city's factory products was $36,058,447 in 1900 and $23,054,412 in 1905. The municipality owns and operates its water-works. The first white settler was David McKee, who established a ferry here in 1769. In 1795 his son John laid out the town, which was named in his honour, but its growth was very slow until after the discovery of coal in 1830. McKeesport was incorporated as a borough in 1842 and chartered as a city in 1890.

McKEES ROCKS, a borough of Allegheny county, Pennsylvania, U.S.A., on the Ohio river, about 3 m. N.W. of Pittsburg. Pop. (1890) 1687; (1900) 6352 (1264 foreign-born); (1910) 14,702. McKees Rocks is served by the Pittsburg & Lake Erie and the Pittsburg, Chartiers & Youghiogheny railways, the latter a short line extending (13 m.) to Beechmont. Bituminous coal and natural gas are found in the vicinity, and the borough ships coal and lumber, and has various important manufactures. There is an ancient Indian mound here. The first settlement was made in 1830, and the borough incorporated in 1892.

MACKENNAL, ALEXANDER (1835–1904), English Nonconformist divine, was born at Truro in Cornwall, on the 14th of January 1835, the son of Patrick Mackennal, a Scot, who had settled in Cornwall. In 1848 the family removed to London, and at sixteen he went to Glasgow University. In 1854 he entered Hackney College to prepare for the Congregational ministry, and in 1857 he graduated B.A. at London University. After holding pastorates at Burton-on-Trent (1856–1861), Surbiton (1862–1870), Leicester (1870–1876), he finally accepted the pastorate of the Congregational Church at Bowdon, Cheshire, in 1877, in which he remained till his death. In 1886 he was chairman of the Congregational Union, which he represented in 1889 at the triannual national council of the American Congregational churches. The first international council of Congregationalists held in London in 1891 was partly cause, partly consequence, of his visit, and Mackennal acted as secretary. In 1892 he became definitely associated in the public mind with a movement for free church federation which grew out of a series of meetings held to discuss the question of home reunion. When the Lambeth articles put forward as a basis of union were discussed, it was evident that all the free churches were agreed in accepting the three articles dealing with the Bible, the Creed and the Sacraments as a basis of discussion, and were also agreed in rejecting the fourth article, which put the historic episcopate on the same level as the other three. Omitting the Anglicans, the representatives of the remaining churches resolved to develop Christian fellowship by united action and worship wherever possible. Out of this grew the Free Church Federation, which secures a measure of co-operation between the Protestant Evangelical churches throughout England. Mackennal's public action brought him into association with many well-known political and religious leaders. He was a lifelong advocate of international peace, and made a remarkable declaration as to the Christian standard of national action when the Free Church Federation met at Leeds during the South African War in 1900.

Besides a volume of sermons under the title *Christ's Healing Touch*, Mackennal published *The Biblical Scheme of Nature and of Man*, *The Christian Testimony*, the *Letters to the Seven Churches of Asia*, *The Kingdom of the Lord Jesus* and *The Eternal God and the Human Sonship*. These are contributions to exegetical study or to theological and progressive religious thought, and have elements of permanent value. He also made some useful contributions to religious history. In 1893 he published the *Story of the English Separatists*, and later the *Homes and Haunts of the Pilgrim Fathers*; he also wrote the life of Dr J. A. Macfadyen of Manchester. In 1901 he delivered a series of lectures at Hartford Theological Seminary, Connecticut, U.S.A., published under the title *The Evolution of Congregationalism*. He died at Highgate on the 23rd of June 1904.

See D. Macfadyen, *Life and Letters of Alexander Mackennal* (1905). (D. Mn.)

MACKENZIE, SIR ALEXANDER (*c.* 1755–1820), Canadian explorer, was probably a native of Inverness. Emigrating to North America at an early age, he was for several years engaged in the fur trade at Fort Chippewyan, at the head of Lake Athabasca, and it was here that his schemes of travel were formed. His first journey, made in 1789, was from Fort Chippewyan along the Great Slave Lake, and down the river which now bears his name to the Arctic Ocean; and his second, made in 1792 and 1793, from Fort Chippewyan across the Rocky Mountains to the Pacific coast near Cape Menzies. He wrote an account of these journeys, *Voyages on the River St Lawrence and through the Continent of North America to the Frozen and Pacific Oceans* (London, 1801), which is of considerable interest from the information it contains about the native tribes. It is prefaced by an historical dissertation on the Canadian fur trade. Amassing considerable wealth, Mackenzie was knighted in 1802, and later settled in Scotland. He died at Mulnain, near Dunkeld, on the 11th of March 1820.

MACKENZIE, ALEXANDER (1822–1892), Canadian statesman, was born in Perthshire, Scotland, on the 28th of January, 1822. His father was a builder, and young Mackenzie emigrated to Canada in 1842, and worked in Ontario as a stone-mason, setting up for himself later as a builder and contractor at Sarnia with his brother. In 1852 his interest in questions of reform led to his becoming the editor of the *Lambton Shield*, a local Liberal paper. This brought him to the front, and in 1861 he became a member of the Canadian parliament, where he at once made his mark and was closely connected with the liberal leader, George Brown. He was elected for Lambton to the first Dominion house of commons in 1867, and soon became the leader of the liberal opposition; from 1871 to 1872 he also sat in the Ontario provincial assembly, and held the position of provincial treasurer. In 1873 the attack on Sir John Macdonald's ministry with regard to the Pacific Railway charter resulted in its defeat, and Mackenzie formed a new government, taking the portfolio of public works and becoming the first liberal premier of Canada. He remained in power till 1878, when industrial depression enabled Macdonald to return to office on a protectionist programme. In 1875 Mackenzie paid a visit to Great Britain, and was received at Windsor by Queen Victoria; he was offered a knighthood, but declined it. After his defeat he suffered from failing health, gradually resulting in almost total paralysis, but though in 1880 he resigned the leadership of the opposition, he retained a seat in parliament till his death at Toronto on the 17th of April 1892. While perhaps too cautious to be the ideal leader of a young and vigorous community, his grasp of detail, indefatigable industry, and unbending integrity won him the respect even of his political opponents.

His *Life and Times* by William Buckingham and the Hon. George W. Ross (Toronto, 1892) contains documents of much interest. See also George Stewart, *Canada under the Administration of the Earl of Dufferin* (Toronto, 1878).

MACKENZIE, SIR ALEXANDER CAMPBELL (1847–), British composer, son of an eminent Edinburgh violinist and conductor, was born on the 22nd of August 1847. On the advice of a member of Gung'l's band who had taken up his residence in Edinburgh, Mackenzie was sent for his musical education to Sondershausen, where he entered the conservatorium under Ulrich and Stein, remaining there from 1857 to 1861, when he entered the ducal orchestra as a violinist. At this time he made Liszt's acquaintance. On his return home he won the King's Scholarship at the Royal Academy of Music, and remained the usual three years in the institution, after which he established himself as a teacher of the piano, &c., in Edinburgh. He appeared in public as a violinist, taking part in Chappell's quartette concerts, and starting a set of classical concerts. He was appointed precentor of St George's Church in 1870, and conductor of the Scottish vocal music association in 1873, at the same time getting through a prodigious amount of teaching. He kept in touch with his old friends by playing in the orchestra of the Birmingham Festivals from 1864 to 1873. The most important compositions of this period of Mackenzie's life were the Quartette in E flat for piano and strings, Op. 11, and an overture, *Cervantes*, which owed its first performance to the encouragement and help of von Bülow. On the advice of this great pianist, he gave up his Edinburgh appointments, which had quite worn him out, and settled in Florence in order to compose. The cantatas *The Bride* (Worcester, 1881) and *Jason* (Bristol, 1882) belong to this time, as well as his first opera. This was commissioned for the Carl Rosa Company, and was written to a version of Merimée's *Colomba* prepared by Franz Hueffer. It was produced with great success in 1883, and was the first of a too short series of modern English operas; Mackenzie's second opera, *The Troubadour*, was produced by the same company in 1886; and his third dramatic work was *His Majesty*, an excellent comic opera (Savoy Theatre, 1897). In 1884 his *Rose of Sharon* was given with very great success at the Norwich Festival; in 1885 he was appointed conductor of Novello's oratorio concerts; *The Story of Sayid* came out at the Leeds Festival of 1886; and in 1888 he succeeded Macfarren as principal of the Royal Academy of Music. *The Dream of Jubal* was produced at Liverpool in 1889, and in London very soon afterwards. A fine setting of the hymn "Veni, Creator Spiritus" was given at Birmingham in 1891, and the oratorio *Bethlehem* in 1894. From 1892 to 1899 he conducted the Philharmonic Concerts, and was knighted in 1894. Besides the works mentioned he has written incidental music to plays, as, for instance, to *Ravenswood*, *The Little Minister*, and *Coriolanus*; concertos and other works for violin and orchestra, much orchestral music, and many songs and violin pieces. The romantic side of music appeals to Mackenzie far more strongly than any other, and the cases in which he has conformed to the classical conventions are of the rarest. In the orchestral ballad, *La Belle Dame sans Merci*, he touches the note of weird pathos, and in the nautical overture *Britannia* his sense of humour stands revealed. In the two "Scottish Rhapsodies" for orchestra, in the music to *The Little Minister*, and in a beautiful fantasia for pianoforte and orchestra on Scottish themes, he has seized the essential, not the accidental features of his native music.

MACKENZIE, SIR GEORGE (1636–1691), of Rosehaugh, Scottish lawyer, was the grandson of Kenneth, first Lord Mackenzie of Kintail, and the nephew of Colin and George, first and second earls of Seaforth; his mother was a daughter of Andrew Bruce, principal of St Leonard's College, St Andrews. He was born at Dundee in 1636, educated at the grammar school there and at Aberdeen, and afterwards at St Andrews, graduating at sixteen. He then engaged for three years in the study of the civil law at Bourges; on his return to Scotland he was called to the bar in 1659, and before the Restoration had risen into considerable practice. Immediately after the Restoration he was appointed a "justice-depute," and it is recorded that he and his colleagues in that office were ordained by the parliament in 1661 "to repair, once in the week at least, to Musselburgh and Dalkeith, and to try and judge such persons as are there or thereabouts delate of witchcraft." In the same year he acted as counsel for the marquis of Argyll; soon afterwards he was knighted, and he represented the county of Ross during the four sessions of the parliament which was called in 1669. He succeeded Sir John Nisbet as king's advocate in August 1677, and in the discharge of this office became implicated in all the worst acts of the Scottish administration of Charles II., earning for himself an unenviable distinction as "the bloody Mackenzie." His refusal to concur in the measures for dispensing with the penal laws against Catholics led to his removal from office in 1686, but he was reinstated in February 1688. At the Revolution, being a member of convention, he was one of the minority of five in the division on the forfeiture of the crown. King William was urged to declare him incapacitated for holding any public office, but refused to accede to the proposal. When the death of Dundee (July 1689) had finally destroyed the hopes of his party in Scotland, Mackenzie betook himself to Oxford, where, admitted a student by a grace passed in 1690, he was allowed to spend the rest of his days in the enjoyment of the ample fortune he had acquired, and in the prosecution of his literary labours. One of his last acts before leaving Edinburgh had been to pronounce (March 15, 1689), as dean of the faculty of advocates, the inaugural oration at the foundation of the Advocates' library. He died at Westminster on the 8th of May 1691, and was buried in Greyfriars churchyard, Edinburgh.

While still a young man Sir George Mackenzie appears to have aspired to eminence in the domain of pure literature, his earliest publication having been *Aretina, or a Serious Romance* (anon., 1661); it was followed, also anonymously, by *Religio Stoici, a Short Discourse upon Several Divine and Moral Subjects* (1663); *A Moral Essay, preferring Solitude to Public Employment* (1665); and one or two other disquisitions of a similar nature. His most important legal works are entitled *A Discourse upon the Laws and Customs of Scotland in Matters Criminal* (1674); *Observations upon the Laws and Customs of Nations as to Precedency, with the Science of Heraldry* (1680); *Institutions of the Law of Scotland* (1684); and *Observations upon the Acts of Parliament* (1686); of these the last-named is the most important, the *Institutions* being completely overshadowed by the similar work of his great contemporary Stair. In his *Jus Regium: or the Just and Solid Foundations of Monarchy in general, and more especially of the Monarchy of Scotland, maintained* (1684), Mackenzie appears as an uncompromising advocate of the highest doctrines of prerogative. His *Vindication of the Government of Scotland during the reign of Charles II.* (1691) is valuable as a piece of contemporary history. The collected *Works* were published at Edinburgh (2 vols. fol.) in 1716–1722; and *Memoirs of the Affairs of Scotland from the Restoration of King Charles II.*, from previously unpublished MSS., in 1821.

See A. Lang, *Sir George Mackenzie of Rosehaugh* (1909).

MACKENZIE, HENRY (1745–1831), Scottish novelist and miscellaneous writer, was born at Edinburgh in August 1745. His father, Joshua Mackenzie, was a distinguished physician, and his mother, Margaret Rose, belonged to an old Nairnshire family. Mackenzie was educated at the high school and the university of Edinburgh, and was then articled to George Inglis of Redhall, who was attorney for the crown in the management of exchequer business. In 1765 he was sent to London to prosecute his legal studies, and on his return to Edinburgh became partner with Inglis, whom he afterwards succeeded as attorney for the crown. His first and most famous work, *The Man of Feeling*, was published anonymously in 1771, and met with instant success. The "Man of Feeling" is a weak creature, dominated by a futile benevolence, who goes up to London and falls into the hands of people who exploit his innocence. The sentimental key in which the book is written shows the author's acquaintance with Sterne and Richardson, but he had neither the humour of Sterne nor the subtle insight into character of Richardson. One Eccles of Bath claimed the authorship of this book, bringing in support of his pretensions a MS. with many ingenious erasures. Mackenzie's name was then officially announced, but Eccles appears to have induced some people to believe in him. In 1773 Mackenzie published a second novel, *The Man of the World*, the hero of which was as consistently bad as the "Man of Feeling" had been "constantly obedient to his moral sense," as Sir Walter Scott says. *Julia de Roubigné* (1777), a story in letters, was preferred to his other novels by "Christopher North," who had a high opinion of Mackenzie (see *Noctes Ambrosianae*, vol. i. p. 155, ed. 1866). The first of his dramatic pieces, *The Prince of Tunis*, was produced in Edinburgh in 1773 with a certain measure of success. The others were failures. At Edinburgh Mackenzie belonged to a literary club, at the meetings of which papers in the manner of the *Spectator* were read. This led to the establishment of a weekly periodical called the *Mirror* (January 23, 1779–May 27, 1780), of which Mackenzie was editor and chief contributor. It was followed in 1785 by a similar paper, the *Lounger*, which ran for nearly two years and had the distinction of containing one of the earliest tributes to the genius of Robert Burns. Mackenzie was an ardent Tory, and wrote many tracts intended to counteract the doctrines of the French Revolution. Most of these remained anonymous, but he acknowledged his *Review of the Principal Proceedings of the Parliament of* 1784, a defence of the policy of William Pitt, written at the desire of Henry Dundas. He was rewarded (1804) by the office of comptroller of the taxes for Scotland. In 1776 Mackenzie married Penuel, daughter of Sir Ludovick Grant of Grant. He was, in his later years, a notable figure in

Edinburgh society. He was nicknamed the "man of feeling," but he was in reality a hard-headed man of affairs with a kindly heart. Some of his literary reminiscences were embodied in his *Account of the Life and Writings of John Home, Esq.* (1822). He also wrote a *Life of Doctor Blacklock*, prefixed to the 1793 edition of the poet's works. He died on the 14th of January 1831.

In 1807 *The Works of Henry Mackenzie* were published surreptitiously, and he then himself superintended the publication of his *Works* (8 vols., 1808). There is an admiring but discriminating criticism of his work in the *Prefatory Memoir* prefixed by Sir Walter Scott to an edition of his novels in Ballantyne's *Novelist's Library* (vol. v., 1823).

McKENZIE, SIR JOHN (1838–1901), New Zealand statesman, was born at Ard-Ross, Scotland, in 1838, the son of a crofter. He emigrated to Otago, New Zealand, in 1860. Beginning as a shepherd, he rose to be farm manager at Puketapu near Palmerston South, and then to be a farmer in a substantial way in Shag Valley. In 1865 he was clerk to the local road board and school committee; in 1871 he entered the provincial council of Otago; and on the 11th of December 1881 was elected member of the House of Representatives, in which he sat till 1900. He was also for some years a member of the education board and of the land board of Otago, and always showed interest in the national elementary school system. In the House of Representatives he soon made good his footing, becoming almost at once a recognized spokesman for the smaller sort of rural settlers and a person of influence in the lobbies. He acted as government whip for the coalition ministry of Sir Robert Stout and Sir Julius Vogel, 1884–1887, and, while still a private member, scored his first success as a land reformer by carrying the "McKenzie clause" in a land act limiting the area which a state tenant might thenceforth obtain on lease. He was still, however, comparatively unknown outside his own province when, in January 1891, his party took office and he aided John Ballance in forming a ministry, in which he himself held the portfolio of lands, immigration and agriculture. From the first he made his hand felt in every matter connected with land settlement and the administration of the vast public estate. Generally his aim was to break up and subdivide the great freehold and leasehold properties which in his time covered four-sevenths of the occupied land of the colony. In his Land Act of 1892 he consolidated, abolished or amended, fifty land acts and ordinances dealing with crown lands, and thereafter amended his own act four times. Though owning to a preference for state tenancy over freehold, he never stopped the selling of crown land, and was satisfied to give would-be settlers the option of choosing freehold or leasehold under tempting terms as their form of tenure. As a compromise he introduced the lease in perpetuity or holding for 999 years at a quit rent fixed at 4%; theoretical objections have since led to its abolition, but for fifteen years much genuine settlement took place under its conditions. Broadly, however, McKenzie's exceptional success as lands minister was due rather to unflinching determination to stimulate the occupation of the soil by working farmers than to the solution of the problems of agrarian controversy. His best-known experiment was in land repurchase. A voluntary law (1892) was displaced by a compulsory act (1894), under which between £5,000,000 and £6,000,000 had by 1910 been spent in buying and subdividing estates for closer settlements, with excellent results. McKenzie also founded and expanded an efficient department of agriculture, in the functions of which inspection, grading, teaching and example are successfully combined. It has aided the development of dairying, fruit-growing, poultry-farming, bee-keeping and flax-milling, and done not a little to keep up the standard of New Zealand products. After 1897 McKenzie had to hold on in the face of failing health. An operation in London in 1899 only postponed the end. He died at his farm on the 6th of August 1901, soon after being called to the legislative council, and receiving a knighthood.

MACKENZIE, SIR MORELL (1837–1892), British physician, son of Stephen Mackenzie, surgeon (d. 1851), was born at Leytonstone, Essex, on the 7th of July 1837. After going through the course at the London Hospital, and becoming M.R.C.S. in 1858, he studied abroad at Paris, Vienna and Pesth; and at Pesth he learnt the use of the newly-invented laryngoscope under J. N. Czermak. Returning to London in 1862, he worked at the London Hospital, and took his degree in medicine. In 1863 he won the Jacksonian prize at the Royal College of Surgeons for an essay on the "Pathology of the Larynx," and he then devoted himself to becoming a specialist in diseases of the throat. In 1863 the Throat Hospital in King Street, Golden Square, was founded, largely owing to his initiative, and by his work there and at the London Hospital (where he was one of the physicians from 1866 to 1873) Morell Mackenzie rapidly became recognized throughout Europe as a leading authority, and acquired an extensive practice. So great was his reputation that in May 1887, when the crown prince of Germany (afterwards the emperor Frederick III.) was attacked by the affection of the throat of which he ultimately died, Morell Mackenzie was specially summoned to attend him. The German physicians who had attended the prince since the beginning of March (Karl Gerhardt, and subsequently Tobold, E. von Bergmann, and others) had diagnosed his ailment on the 18th of May as cancer of the throat; but Morell Mackenzie insisted (basing his opinion on a microscopical examination by R. Virchow of a portion of the tissue) that the disease was not demonstrably cancerous, that an operation for the extirpation of the larynx (planned for the 21st of May) was unjustifiable, and that the growth might well be a benign one and therefore curable by other treatment. The question was one not only of personal but of political importance, since it was doubted whether any one suffering from an incapacitating disease like cancer could, according to the family law of the Hohenzollerns, occupy the German throne; and there was talk of a renunciation of the succession by the crown prince. It was freely hinted, moreover, that some of the doctors themselves were influenced by political considerations. At any rate, Morell Mackenzie's opinion was followed: the crown prince went to England, under his treatment, and was present at the Jubilee celebrations in June. Morell Mackenzie was knighted in September 1887 for his services, and decorated with the Grand Cross of the Hohenzollern Order. In November, however, the German doctors were again called into consultation, and it was ultimately admitted that the disease really was cancer; though Mackenzie, with very questionable judgment, more than hinted that it had become malignant since his first examination, in consequence of the irritating effect of the treatment by the German doctors. The crown prince (see FREDERICK III.) became emperor on the 9th of March 1888, and died on the 15th of June. During all this period a violent quarrel raged between Sir Morell Mackenzie and the German medical world. The German doctors published an account of the illness, to which Mackenzie replied by a work entitled *The Fatal Illness of Frederick the Noble* (1888), the publication of which caused him to be censured by the Royal College of Surgeons. After this sensational episode in his career, the remainder of Sir Morell Mackenzie's life was uneventful, and he died somewhat suddenly in London, on the 3rd of February 1892. He published several books on laryngoscopy and diseases of the throat.

MACKENZIE, WILLIAM LYON (1795–1861), Canadian politician, was born near Dundee, Scotland, on the 12th of March 1795. His father died before he was a month old, and the family were left in poverty. After some six years' work in a shop at Alyth, in April 1820 he emigrated with his mother to Canada. There he became a general merchant, first at York, then at Dundas, and later at Queenston. The discontented condition of Upper Canada drew him into politics, and on the 18th of May 1824 he published at Queenston the first number of the *Colonial Advocate*, in which the ruling oligarchy was attacked with great asperity. Most of the changes which he advocated were wise and have since been adopted; but the violence of Mackenzie's attacks roused great anger among the social and political set at York (Toronto), which was headed by John Beverley Robinson. In November

1824 Mackenzie removed to Toronto, but he had little capital; his paper appeared irregularly, and was on the point of suspending publication when his office was attacked and his type thrown into the bay by a number of the supporters of his opponents. In an action against the chief rioters he was awarded £625 and costs, was thus enabled to set up a much larger and more efficient plant, and the *Colonial Advocate* ran till the 4th of November 1834.

In 1828 he was elected member of parliament for York, but was expelled on the technical ground that he had published in his newspaper the proceedings of the house without authorization. Five times he was expelled and five times re-elected by his constituents, till at last the government refused to issue a writ, and for three years York was without one of its representatives. In May 1832 he visited England, where he was well received by the colonial office. Largely as the result of his representations, many important reforms were ordered by Lord Goderich, afterwards earl of Ripon, the colonial secretary. While in England, he published *Sketches of Canada and the United States*, in which, with some exaggeration, many of the Canadian grievances were exposed. On his return in March 1834 he was elected mayor of Toronto. During his year of office, the heroism with which he worked hand in hand with his old enemy, Bishop Strachan, in fighting an attack of cholera, did not prevent him from winning much unpopularity by his officiousness, and in 1835 he was not re-elected either as mayor or alderman. In October 1834 he was elected member of parliament for York, and took his seat in January 1835, the Reformers being now in the majority. A committee on grievances was appointed, as chairman of which Mackenzie presented the admirable *Seventh Report on Grievances*, largely written by himself, in which the case for the Reformers was presented with force and moderation, and the adoption of responsible government advocated as the remedy.

In the general election of June 1836 the Tory party won a complete victory, Mackenzie and almost all the prominent Reformers being defeated at the polls. This totally unexpected defeat greatly embittered him. On the 4th of July 1836, the anniversary of the adoption of the American Declaration of Independence, he began the publication of the *Constitution*, which openly advocated a republican form of government. Later in the year he was appointed "agent and corresponding secretary" of the extreme wing of the Reform party, and more and more openly, in his speeches throughout the province, advocated armed revolt. He was also in correspondence with Papineau and the other leaders of the Reformers in Lower Canada, who were already planning a rising. Early in December 1837 Mackenzie gathered a mob of his followers, to the number of several hundred, at Gallows Hill, some miles to the north of Toronto, with the intention of seizing the lieutenant-governor and setting up a provisional government. Misunderstandings among the leaders led to the total failure of the revolt, and Mackenzie was forced to fly to the United States with a price on his head. In the town of Buffalo he collected a disorderly rabble, who seized and fortified Navy Island, in the river between the two countries, and for some weeks troubled the Canadian frontier. After the failure of this attempt he was put to the most pitiful shifts to make a living. In June 1839 he was tried in the United States for a breach of the neutrality laws, and sentenced to eighteen months' imprisonment, of which he served over eleven. While in gaol at Rochester he published the *Caroline Almanac*, the tone of which may be judged from its references to "Victoria Guelph, the bloody queen of England," and by the title given to the British cabinet of "Victoria Melbourne's bloody divan." He returned to Canada in consequence of the Amnesty Act 1849. A closer inspection had cured him of his love for republican institutions.

In 1851 he was elected to parliament for Haldimand, defeating George Brown. He at once allied himself with the Radicals (the "Clear Grits"), and, on the leadership of that party being assumed by Brown, became one of his lieutenants. He was still miserably poor, but refused all offers to accept a government position. In 1858 he resigned his seat in the house, owing to incipient softening of the brain, of which he died on the 29th of August 1861.

Turbulent, ungovernable, vain, often the dupe of schemers, Mackenzie united with much that was laughable not a little that was heroic. He could neither be bribed, bullied, nor cajoled. Perhaps the best instance of this is that in 1832 he refused from Lord Goderich an offer of a position which would have given him great influence in Canada and an income of £1,500. He was a born agitator, and as such tended to exaggeration and misrepresentation. But the evils against which he struggled were real and grave; the milder measures of the Constitutional Reformers might have taken long to achieve the results which were due to his hot-headed advocacy.

The *Life and Times* by his son-in-law, Charles Lindsey (Toronto, 2 vols., 1862), is moderate and fair, though tending to smooth over his anti-British gasconnade while in the United States. An abridgment of this work was edited by G. G. S. Lindsey for the "Makers of Canada" series (1909). In *The Story of the Upper Canadian Rebellion* by J. C. Dent (2 vols., Toronto, 1885), a bitter attack is made on him, which drew a savage reply from another son-in-law, John King, K.C., called *The Other Side of the Story*. The best short account of his career is given by J. C. Dent in *The Canadian Portrait Gallery*, vol. ii. (Toronto, 1881). (W. L. G.)

MACKENZIE, a river of the North-West Territories, Canada, discharging the waters of the Great Slave Lake into the Arctic Ocean. It was discovered and first navigated by Sir Alexander Mackenzie in 1789. It has an average width of 1 m., an average fall of 6 in. to the mile; an approximate discharge, at a medium stage, of 500,000 cub. ft. per second; and a total length, including its great tributary the Peace, of 2,350 m. The latter rises, under the name of the Finlay, in the mountains of British Columbia, and flows north-east and then south-east in the great intermontane valley that bounds the Rocky Mountains on the west, to its confluence with the Parsnip. From the confluence the waters of the combined rivers, now called the Peace, flow east through the Rocky Mountains, and then north-east to unite with the river which discharges the waters of Lake Athabasca; thence to Great Slave Lake it is known as Slave river. Excluding the rivers which enter these lakes, the principal tributaries of the Peace are: Omineca, Nation, Parsnip, Halfway, North Pine, South Pine, Smoky, Battle, and Loon rivers; those of the Mackenzie are the Liard (650 m. long), which rises near the sources of the Pelly, west of the Rocky Mountains, and breaks through that range on its way to join the parent stream, Great Bear river, which drains Great Bear Lake, Nahanni, Dahadinni, Arctic Red, and Peel rivers. The Mackenzie enters the Arctic Ocean near 135° W. and 68° 50′ W., after flowing for 70 to 80 m. through a flat delta, not yet fully surveyed. With its continuation, Slave river, it is navigable from the Arctic Ocean to Fort Smith, a distance of over 1,200 m., and between the latter and the head of Lesser Slave Lake, a further distance of 625 m., there is only one obstruction to navigation, the Grand Rapids near Fort McMurray on the Athabasca river. The Peace is navigable from its junction with Slave river for about 220 m. to Vermilion Falls. The Mackenzie is navigable from about the 10th of June to the 20th of October, and Great Slave Lake from about the 1st of July to the end of October. All the waters and lakes of this great system are abundantly stocked with fish, chiefly white fish and trout, the latter attaining to remarkable size.

MACKEREL, pelagic fishes, belonging to a small family, *Scombridae*, of which the tunny, bonito, albacore, and a few other tropical genera are members. Although the species are fewer in number than in most other families of fishes, they are widely spread and extremely abundant, peopling by countless schools the oceans of the tropical and temperate zones, and approaching the coasts only accidentally, occasionally, or periodically.

The mackerel proper (genus *Scomber*) are readily recognized by their elegantly shaped, well-proportioned body, shining in iridescent colours. Small, thin, deciduous scales equally cover nearly the entire body. There are two dorsal fins, the anterior near the head, composed of 11–14 feeble spines, the second near the tail with all the rays soft except the first, and behind the second dorsal five or six finlets. The ventral is immediately below the second dorsal, and is also followed by finlets. The caudal fin is crescent-shaped, strengthened at the base by two short ridges on each side. The mouth is wide, armed above and below with a row of very small fixed teeth.

No other fish shows finer proportions in the shape of its body. Every "line" of its build is designed and eminently adapted for rapid progression through the water; the muscles massed along the vertebral column are enormously developed, especially on the back and the sides of the tail, and impart to the body a certain rigidity which interferes with abruptly sideward motions of the fish. Therefore mackerel generally swim in a straightforward direction, deviating sidewards only when compelled, and rarely turning about in the same spot. They are in almost continuous motion, their power of endurance being equal to the rapidity of their motions. Mackerel, like all fishes of this family, have a firm flesh; that is, the muscles of the several segments are interlaced, and receive a greater supply of blood-vessels and nerves than in other fishes. Therefore the flesh, especially of the larger kinds, is of a red colour; and the energy of their muscular action causes the temperature of their blood to be several degrees higher than in other fishes.

All fishes of the mackerel family are strictly carnivorous; they unceasingly pursue their prey, which consists principally of other fish and pelagic crustaceans. The fry of clupeoids, which likewise swim in schools, are followed by the mackerel until they reach some shallow place, which their enemies dare not enter.

Mackerel are found in almost all tropical and temperate seas, with the exception of the Atlantic shores of temperate South America. European mackerel are of two kinds, of which one, the common mackerel, *Scomber scomber*, lacks, while the other possesses, an air-bladder. The best-known species of the latter kind is *S. colias*, the "Spanish" mackerel;[1] a third, *S. pneumatophorus*, is believed by some ichthyologists to be identical with *S. colias*. Be this as it may, we have strong evidence that the Mediterranean is inhabited by other species different from *S. scomber* and *S. colias*, and well characterized by their dentition and coloration. Also the species from St Helena is distinct. Of extra-Atlantic species the mackerel of the Japanese seas are the most nearly allied to the European, those of New Zealand and Australia, and still more those of the Indian Ocean, differing in many conspicuous points. Two of these species occur in the British seas: *S. scomber*, which is the most common there, as well as in other parts of the North Atlantic, crossing the ocean to America, where it abounds; and the Spanish mackerel, *S. colias*, which is distinguished by a somewhat different pattern of coloration, the transverse black bands of the common mackerel being in this species narrower, more irregular or partly broken up into spots, while the scales of the pectoral region are larger, and the snout is longer and more pointed. The Spanish mackerel is, as the name implies, a native of the seas of southern Europe, but single individuals or small schools frequently reach the shores of Great Britain and of the United States.

The home of the common mackerel (to which the following remarks refer) is the North Atlantic, from the Canary Islands to the Orkneys, and from the Mediterranean and the Black Sea and the coasts of Norway to the United States.

Towards the spring large schools approach the coasts. Two causes have been assigned of this migration: first, the instinct of finding a suitable locality for propagating their species; and, secondly, the search and pursuit of food, which in the warmer season is more abundant in the neighbourhood of land than in the open sea. It is probable that the latter is the chief cause.

In the month of February, or in some years as early as the end of January, the first large schools appear at the entrance of the English Channel, and are met by the more adventurous of the drift-net fishers many miles west of the Scilly Islands. These early schools, which consist chiefly of one-year and two-year-old fishes, yield sometimes enormous catches, whilst in other years they escape the drift-nets altogether, passing them, for some hitherto unexplained reason, at a greater depth than that to which the nets reach, viz. 20 ft. As the season advances, the schools penetrate farther northwards into St George's Channel or eastwards into the English Channel. The fishery then assumes proportions which render it next in importance to the herring and cod fisheries. In Plymouth alone a fleet of some two hundred boats assembles; and on the French side of the Channel no less capital and labour are invested in it, the vessels employed being, though less in number, larger in size than on the English side. The chief centre, however, of the fishery in the west of England is at Newlyn, near Penzance, where the small local sailing boats are outnumbered by hundreds of large boats, both sail and steam, which come chiefly from Lowestoft for the season. Simultaneously with the drift-net the deep-sea-seine and shore-seine are used, which towards June almost entirely supersede the drift-net. Towards the end of May the old fish become heavy with spawn and are in the highest condition for the table; and the latter half of June or beginning of July may be regarded as the time at which the greater part of mackerel spawn. Considerable numbers of mackerel are taken off Norfolk and Suffolk in May and June, and also in September and October. There can be no doubt that they enter the North Sea from the English Channel, and return by the same route, but others travel round the north of Scotland and appear in rather small numbers off the east coast of that country. On the Norwegian coast mackerel fishing does not begin before May, whilst on the English coasts large catches are frequently made in March. Large cargoes are annually imported in ice from Norway to the English market.

After the spawning the schools break up into smaller companies which are much scattered, and offer for two or three months employment to the hand-line fishermen. They now begin to disappear from the coasts and return to the open sea. Single individuals or small companies are found, however, on the coast all the year round; they may have become detached from the main bodies, and be seeking for the larger schools which have long left on their return migration.

Although, on the whole, the course and time of the annual migration of mackerel are marked with great regularity, their appearance and abundance at certain localities are subject to great variations. They may pass a spot at such a depth as to evade the nets, and reappear at the surface some days after farther eastwards; they may deviate from their direct line of migration, and even temporarily return westwards. In some years between 1852 and 1867 the old mackerel disappeared off Guernsey from the surface, and were accidentally discovered feeding at the bottom. Many were taken at 10 fathoms and deeper with the line, and all were of exceptionally large size, several measuring 18 in. and weighing nearly 3 ℔; these are the largest mackerel on record.

The mackerel most esteemed as food is the common species, and individuals from 10 to 12 in. in length are considered the best flavoured. In more southern latitudes, however, this species seems to deteriorate, specimens from the coast of Portugal, and from the Mediterranean and Black Sea, being stated to be dry and resembling in flavour the Spanish mackerel (*S. colias*), which is not esteemed for the table. (A. C. G.; J. T. C.)

McKIM, CHARLES FOLLEN (1847–1909), American architect, was born in Chester county, Pennsylvania, on the 24th of August 1847. His father, James Miller McKim (1810–1874), originally a Presbyterian minister, was a prominent abolitionist and one of the founders (1865) of the New York *Nation*. The son studied at Harvard (1866–1867) and at Paris in the École des Beaux-Arts (1867–1870), and in 1872 became an architect in New York City, entering the office of H. H. Richardson; in 1877 he formed a partnership with William Rutherford Mead (b. 1846), the firm becoming in 1879 McKim, Mead & White, when Stanford White (1853–1906) became a partner. McKim was one of the founders of the American Academy in Rome; received a gold medal at the Paris exposition of 1900; in 1903, for his services in the promotion of architecture, received the King's Medal of the Royal Institute of British Architects; and in 1907 became a National Academician. He died at St James, Long Island, N.Y., on the 14th of September 1909. McKim's name is especially associated with the University Club in New York, with the Columbia University buildings, with the additions to the White House (1906), and, more particularly, with the Boston Public Library, for which the library of Ste Geneviève in Paris furnished the suggestion.

MACKINAC ISLAND, a small island in the N.W. extremity of Lake Huron and a part of Mackinac county, Michigan, and a city and summer resort of the same name on the island. The city is on the S.E. shore, at the entrance of the Straits of Mackinac, about 7 m. N.E. of Mackinaw City and 6 m. E.S.E. of St Ignace. Pop. (1900), 665; (1904), 736; (1910), 714. During the summer season, when thousands of people come here to enjoy the cool and pure air and the island's beautiful scenery, the city is served by the principal steamboat lines on the Great Lakes and by ferry to Mackinaw city (pop. in 1904, 696), which is served by the Michigan Central, the Grand Rapids & Indiana, and the Duluth, South Shore & Atlantic railways. The island is about 3 m. long by 2 m. wide. From the remarkably clear water of Lake Huron its shores rise for the most part in tall white limestone cliffs; inland there are strangely shaped rocks and forests of cedar, pine, fir, spruce, juniper, maple, oak, birch, and beech. Throughout the island there are numerous glens, ravines, and caverns, some of which are rich in associations with Indian legends. The city is an antiquated fishing and trading village with modern hotels, club-houses, and summer villas. Fort Mackinac and its grounds are included in a state reservation which embraces about one-half of the island.

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[1] The term "Spanish mackerel" is applied in America to *Cybium maculatum*.

The original name of the island was Michilimackinac (" place of the big lame person " or " place of the big wounded person "); the name was apparently derived from an Algonquian tribe, the Mishinimaki or Mishinimakinagog, now extinct. The island was long occupied by Chippewas, the Hurons had a village here for a short time after their expulsion from the East by the Iroquois, and subsequently there was an Ottawa village here. The first white settlement or station was established by the French in 1670 (abandoned in 1701) at Point Saint Ignace on the north side of the strait. In 1761 a fort on the south side (built in 1712) was surrendered to the British. By the treaty of Paris (1783) the right of the United States to this district was acknowledged; but the fort was held by the British until 1796. In July 1812 a British force surprised the garrison, which had not yet learned that war had been declared. In August 1814 an American force under Colonel George Croghan (1791–1849) attempted to recapture the island but was repulsed with considerable loss. By the treaty of Ghent, however, the island was restored, in July 1815, to the United States; Fort Mackinac was maintained by the Federal government until 1895, when it was ceded to the state. From 1820 to 1840 the village was one of the principal stations of the American Fur Company. A Congregational mission was established among the Chippewas on the island in 1827, but was discontinued before 1845. The city of Mackinac Island was chartered in 1899.

See W. C. Richards, "The Fairy Isle of Mackinac," in the *Magazine of American History* (July 1891); and R. G. Thwaites, "The Story of Mackinac," in vol. 14 of the *Collections* of the State Historical Society of Wisconsin (Madison, 1898).

MCKINLEY, WILLIAM (1843–1901), twenty-fifth president of the United States, was born in Niles, Trumbull county, Ohio, on the 29th of January 1843. His ancestors on the paternal side were Scotch-Irish who lived at Dervock, Co. Antrim, and spelled the family name "McKinlay." His great-great-grandfather settled in York county, Pennsylvania, about 1743, and from Chester county, Pennsylvania, his great-grandfather, David McKinley, who served as a private during the War of Independence, moved to Ohio in 1814. David's son James had gone in 1809 to Columbiana county, Ohio. His son William McKinley (b. 1807), like his father an iron manufacturer, was married in 1829 to Nancy Campbell Allison, and to them were born nine children, of whom William, the president, was the seventh. In 1852 the family removed to Poland, Mahoning county, where the younger William was placed at school. At seventeen he entered the junior class of Allegheny College, at Meadville, Pennsylvania; but he studied beyond his strength, and returned to Poland, where for a time he taught in a neighbouring country school. When the Civil War broke out in 1861 he promptly enlisted as a private in the 23rd Ohio Volunteer Infantry. He saw service in West Virginia, at South Mountain, where this regiment lost heavily, and at Antietam, where he brought up hot coffee and provisions to the fighting line; for this he was promoted second lieutenant on the 24th of September 1862. McKinley was promoted first lieutenant in February 1864, and for his services at Winchester was promoted captain on the 25th of July 1864. He was on the staff of General George Crook at the battles of Opequan, Fisher's Hill, and Cedar Creek in the Shenandoah valley, and on the 14th of March 1865 was brevetted major of volunteers for gallant and meritorious services. He also served on the staff of General Rutherford B. Hayes, who spoke highly of his soldierly qualities. He was mustered out with his regiment on the 26th of July 1865. Four years of army life had changed him from a pale and sickly lad into a man of superb figure and health.

After the war McKinley returned to Poland, and bent all his energy upon the study of law. He completed his preparatory reading at the Albany (N.Y.) law school, and was admitted to the bar at Warren, Ohio, in March 1867. On the advice of an elder sister, who had been for several years a teacher in Canton, Stark county, Ohio, he began his law practice in that place, which was to be his permanent home. He identified himself immediately with the Republican party, campaigned in the Democratic county of Stark in favour of negro suffrage in 1867, and took part in the campaign work on behalf of Grant's presidential candidature in 1868. In the following year he was elected prosecuting attorney on the Republican ticket; in 1871 he failed of re-election by 45 votes, and again devoted himself to his profession, while not relaxing his interest in politics.

In 1875 he first became known as an able campaign speaker by his speeches favouring the resumption of specie payments, and in behalf of Rutherford B. Hayes, the Republican candidate for governor of Ohio. In 1876 he was elected by a majority of 3304 to the national House of Representatives. Conditions both in Ohio and in Congress had placed him, and were to keep him for twenty years, in an attitude of aggressive and uncompromising partisanship. His Congressional district was naturally Democratic, and its boundaries were changed two or three times by Democratic legislatures for the purpose of so grouping Democratic strongholds as to cause his defeat. But he overcame what had threatened to be adverse majorities on all occasions from 1876 to 1890, with the single exception of 1882, when, although he received a certificate of election showing that he had been re-elected by a majority of 8, and although he served nearly through the long session of 1883–1884, his seat was contested and taken (May 28, 1884) by his Democratic opponent, Jonathan H. Wallace. McKinley reflected the strong sentiment of his manufacturing constituency in behalf of a high protective tariff, and he soon became known in Congress (where he particularly attracted the attention of James G. Blaine) as one of the most diligent students of industrial policy and question affecting national taxation. In 1878 he took part in the debates over the Wood Tariff Bill, proposing lower import duties; and in the same year he voted for the Bland-Allison Silver Bill. In December 1880 he was appointed a member of the Ways and Means committee, succeeding General James A. Garfield, who had been elected president in the preceding month, and to whose friendship, as to that of Rutherford B. Hayes, McKinley owed much in his earlier years in Congress. He was prominent in the debate which resulted in the defeat of the Democratic Morrison Tariff Bill in 1884, and, as minority leader of the Ways and Means committee, in the defeat of the Mills Bill for the revision of the tariff in 1887–1888. In 1889 he became chairman of the Ways and Means committee and Republican leader in the House of Representatives, after having been defeated by Thomas B. Reed on the third ballot in the Republican caucus for speaker of the House. On the 16th of April 1890 he introduced from the Ways and Means committee the tariff measure known commonly as the McKinley Bill, which passed the House on the 21st of May, passed the Senate (in an amended form, with a reciprocity clause, which McKinley had not been able to get through the House) on the 10th of September, was passed as amended, by the House, and was approved by the president on the 1st of October 1890. The McKinley Bill reduced revenues by its high and in many cases almost prohibitive duties; it put sugar on the free list with a discriminating duty of $\frac{1}{10}$th of one cent a pound on sugar imported from countries giving a bounty for sugar exported, and it gave bounties to American sugar growers; it attempted to protect many "infant" industries such as the manufacture of tin-plate; under its provision for reciprocal trade agreements (a favourite project of James G. Blaine, who opposed many of the "protective" features of the Bill) reciprocity treaties were made with Germany, France, Italy, and Belgium, which secured a market in those countries for American pork. Abroad, where the Bill made McKinley's name known everywhere, there was bitter opposition to it and reprisals were threatened by several European states. In the United States the McKinley Tariff Bill was one of the main causes of the Democratic victory in the Congressional elections of 1890, in which McKinley himself was defeated by an extraordinary Democratic gerrymander of his Congressional district. In November 1891 he was elected governor of Ohio with a plurality of more than 21,000 votes in a total of 795,000 votes cast. He was governor of Ohio in 1892–1895, being re-elected in 1893. His administration was marked by no important events, except that he had on several occasions in his second term to call out the militia of the state to preserve order; but it may be considered important because of the training it gave him in executive as distinguished from legislative work.

McKinley had been prominent in national politics even before the passage of the tariff measure bearing his name. In 1888 in the National Republican Convention in Chicago he was chairman of the committee on resolutions (*i.e.* the platform committee) and was leader of the delegation from Ohio, which had been instructed for John Sherman; after James G. Blaine withdrew his name there was a movement, begun by Republican congressmen, to nominate McKinley, who received 16 votes on the seventh ballot, but passionately refused to be a candidate, considering that his acquiescence would be a breach of faith toward Sherman. In 1892 McKinley was the permanent president of the National Republican Convention which met in Minneapolis and which renominated Benjamin Harrison on the first ballot, on which James G. Blaine received 182 $\frac{5}{6}$ votes, and McKinley, in spite of his efforts to the contrary, received 182 votes. In 1894 he made an extended campaign tour before the Congressional elections, and spoke even in the South. In 1896 he seemed for many reasons the most "available" candidate of his party for the presidency: he had no personal enemies in the party; he had carried the crucial state of Ohio by a large majority in 1893; his attitude on the coinage question had never been so pronounced as to make him unpopular either with the radical silver wing or with the conservative "gold-standard" members of the party. The campaign for his nomination was conducted with the greatest adroitness by his friend, Marcus A. Hanna, and in the National Republican Convention held in St Louis in June he was nominated for the presidency on the first ballot by 661 $\frac{1}{2}$ out of a total of 906 votes. The convention adopted a tariff plank drafted by McKinley, and, of far greater immediate importance, a plank, which declared that the Republican party was "opposed to the free coinage of silver, except by international agreement with the leading commercial nations of the world, which we pledge ourselves to promote, and until such agreement can be obtained the existing gold standard must be preserved." This "gold standard" plank drove out of the Republican party the Silver Republicans of the West, headed by Senator Henry M. Teller of Colorado. The Republican convention nominated for the vice-presidency Garrett A. Hobart of New Jersey. The National Democratic Convention declared for the immediate opening of the mints to the free and unlimited coinage of silver at the ratio with gold of 16 to 1; and it nominated for the presidency William Jennings Bryan of Nebraska, who also received the nomination of the People's party and of the National Silver party. There was a secession from the Democratic party of conservatives who called themselves the National Democratic party, who were commonly called Gold Democrats, and who nominated John M. Palmer (1817–1900) of Illinois for president. In this re-alignment of parties McKinley, who had expected to make the campaign on the issue of a high protective tariff, was diverted to the defence of the gold standard as the main issue. While his opponent travelled throughout the country making speeches, McKinley remained in Canton, where he was visited by and addressed many Republican delegations. The campaign was enthusiastic: the Republican candidate was called the "advance agent of prosperity"; "Bill McKinley and the McKinley Bill" became a campaign cry; the panic of 1893 was charged to the repeal of the McKinley tariff measure; and "business men" throughout the states were enlisted in the cause of "sound money" to support McKinley, who was elected in November by a popular vote of 7,106,779 to 6,502,925 for Bryan, and by an electoral vote of 271 to 176.

McKinley was inaugurated president of the United States on the 4th of March 1897. The members of his cabinet were: secretary of state, John Sherman (whose appointment created a vacancy in the Senate to which Marcus A. Hanna was elected), who was succeeded in April 1898 by William R. Day, who in turn was followed in September 1898 by John Hay; secretary of the treasury, Lyman J. Gage, a Gold Democrat; secretary of war, Russell A. Alger, who was succeeded in 1899 by Elihu Root; secretary of the navy, John D. Long; attorney-general, Joseph McKenna, succeeded in January 1898 by John William Griggs; postmaster-general, James A. Gary, succeeded in April 1898 by Charles Emory Smith; secretary of the interior, Cornelius N. Bliss, succeeded in February 1899 by Ethan Allen Hitchcock; and secretary of agriculture, James Wilson. (For the political history of McKinley's administration see UNITED STATES: *History*). Immediately after his inauguration the president summoned Congress to assemble in an extra session on the 15th of March. The Democratic tariff in 1893 had been enacted as part of the general revenue measure, which included an income-tax. The income-tax having been declared unconstitutional by the Supreme Court, the measure had failed to produce a sufficient revenue, and it had been necessary to increase the public debt. McKinley's message to the new Congress dwelt upon the necessity of an immediate revision of the tariff and revenue system of the country, and the so-called Dingley Tariff Bill was accordingly passed through both houses, and was approved by the president on the 24th of July.

The regular session of Congress which opened in December was occupied chiefly with the situation in Cuba. President McKinley showed himself singularly patient and self-controlled in the midst of the popular excitement against Spain and the clamour for intervention by the United States in behalf of the Cubans; but finally, on the 23rd of March, he presented an ultimatum to the Spanish government, and on the 25th of April, on his recommendation, Congress declared war upon Spain. During the war itself he devoted himself with great energy to the mastery of military details; but there was bitter criticism of the war department resulting in the resignation of the secretary of war, Russell A. Alger (*q.v.*). The signing of a peace protocol on the 12th of August was followed by the signature at Paris on the 10th of December of articles of peace between the United States and Spain. After a long discussion the peace treaty was ratified by the United States Senate on the 6th of February 1899; and in accordance with its terms Porto Rico, the Philippine Archipelago, and Guam were transferred by Spain to the United States, and Cuba came under American jurisdiction pending the establishment there of an independent government. Two days before the ratification of the peace treaty, a conflict took place between armed Filipinos under the leadership of Emilio Aguinaldo and the American forces that were in possession of Manila. The six months that had elapsed between the signing of the peace protocol and the ratification of the treaty had constituted a virtual interregnum, Spain's authority having been practically destroyed in the Philippines and that of the United States not having begun. In this period a formidable native Filipino army had been organized and a provisional government created. The warfare waged by these Filipinos against the United States, while having for the most part a desultory and guerilla character, was of a very protracted and troublesome nature. Sovereignty over the Filipinos having been accepted by virtue of the ratification of the Paris treaty, President McKinley was not at liberty to do otherwise than assert the authority of the United States and use every endeavour to suppress the insurrection. But there was bitter protest against this "imperialism," both within the party by such men as Senators George F. Hoar and Eugene Hale, and Thomas B. Reed and Carl Schurz, and, often for purely political reasons, from the leaders of the Democratic party. In the foreign relations of the United States, as directed by President McKinley, the most significant change was the cordial understanding established with the British government, to which much was contributed by his secretary of state, John Hay, appointed to that portfolio when he was ambassador to the court of St James, and which was due to some extent to the friendliness of the British press and even more markedly of the British navy in the Pacific during the Spanish War. Other important foreign events during McKinley's administration were: the annexation of the Hawaiian Islands (see HAWAII) in August 1898, and the formation of the Territory of Hawaii in April 1900; the cessation in 1899 of the tripartite (German, British, and French) government of the Samoan Islands, and the annexation by the United States of those of the islands east of 171°, including the harbour of Pago-Pago; the participation of American troops in the march of the allies on Pekin in August 1900, and the part played by McKinley's secretary of state, John Hay, in securing a guarantee of the integrity of the Chinese empire. In 1900 McKinley was unanimously renominated by the National Republican Convention which met in Philadelphia on the 19th of June, and which nominated Theodore Roosevelt, governor of New York, for the vice-presidency. The Republican convention demanded the maintenance of the gold standard, and pointed to the fulfilment of some of the most important of the pledges given by the Republican party four years earlier. The intervening period had been one of very exceptional prosperity in the United States, foreign commerce having reached an unprecedented volume, and agriculture and manufactures having made greater advancement than in any previous period of the country's history. The tendency towards the concentration of capital in great industrial corporations had been active to an extent previously undreamt of, with incidental consequences that had aroused much apprehension; and the Democrats accused President McKinley and the Republican party of having fostered the "trusts." But the campaign against McKinley and the Republican party was not only "anti-trust" but "anti-imperialistic." William Jennings Bryan, renominated by the Democratic party in July (and in May by the Fusion People's party) on a free silver platform, declared that imperialism was the "paramount issue" and made a second vigorous campaign; and the opposition to McKinley's re-election, whether based on opposition to his economic or to his foreign policy, was not entirely outside of his own party. As the result of the polling in November, 292 Republican presidential electors were chosen, and 155 Democratic electors, elected in Colorado, Idaho, Montana, Nevada, and the Southern states, represented the final strength of the Bryan and Stevenson ticket. The Republican popular vote was 7,207,923, and the Democratic 6,358,133. Since 1872 no president had been re-elected for a second consecutive term.

In the term of Congress immediately following the presidential election it was found possible to reduce materially the war taxes which had been levied on the outbreak of the Spanish-American War. Arrangements were perfected for the termination of the American military occupation of Cuba and the inauguration of a Cuban Republic as a virtual protectorate of the United States, the American government having arranged with the Cuban constitutional convention for the retention of certain naval stations on the Cuban coast. In the Philippines advanced steps had been taken in the substitution of civil government for military occupation, and a governor-general, Judge William H. Taft, had been appointed and sent to Manila. Prosperity at home was great, and foreign relations were free from complications. The problems which had devolved upon McKinley's administration had been far advanced towards final settlement. He retained without change the cabinet of his first administration. After an arduous and anxious term, the president had reached a period that promised to give him comparative repose and freedom from care. He had secured, through the co-operation of Congress, the permanent reorganization of the army and a very considerable development of the navy. In these circumstances, President McKinley, accompanied by the greater part of his cabinet, set forth in the early summer on a tour to visit the Pacific coast, where he was to witness the launching of the battleship "Ohio" at San Francisco. The route chosen was through the Southern states, where many stops were made, and where the president delivered brief addresses. The heartiness of the welcome accorded him seemed to mark the disappearance of the last vestige of sectional feeling that had survived the Civil War, in which McKinley had participated as a young man. After his return he spent a month in a visit at his old home in Canton, Ohio, and at the end of this visit, by previous arrangement, he visited the city of Buffalo, New York, in order to attend the Pan-American exposition and deliver a public address. This address (Sept. 5, 1901) was a public utterance designed by McKinley to affect American opinion and public policy, and apparently to show that he had modified his views upon the tariff. It declared that henceforth the progress of the nations must be through harmony and co-operation, in view of the fast-changing conditions of communication and trade, and it maintained that the time had come for wide-reaching modifications in the tariff policy of the United States, the method preferred by McKinley being that of commercial reciprocity arrangements with various nations. On the following day, the 6th of September 1901, a great reception was held for President McKinley in one of the public buildings of the exposition, all sorts and conditions of men being welcome. Advantage of this opportunity was taken by a young man of Polish parentage, by name Leon Czolgosz, to shoot at the president with a revolver at close range. One of the two bullets fired penetrated the abdomen. After the world had been assured that the patient was doing well and would recover, he collapsed and died on the 14th. The assassin, who, it was for a time supposed, had been inflamed by the editorials and cartoons of the demagogic opposition press, but who professed to hold the views of that branch of anarchists who believe in the assassination of rulers and persons exercising political authority, was promptly seized, and was convicted and executed in October 1901. McKinley's conduct and utterances in his last days revealed a loftiness of personal character that everywhere elicited admiration and praise. Immediately after his death Vice-President Roosevelt took the oath of office, announcing that it would be his purpose to continue McKinley's policy, while also retaining the cabinet and the principal officers of the government. McKinley's funeral took place at Canton, Ohio, on the 19th of September, the occasion being remarkable for the public manifestations of mourning, not only in the United States, but in Great Britain and other countries; in Canton a memorial tomb has been erected.

Though he had not the personal magnetism of James G. Blaine, whom he succeeded as a leader of the Republican party and whose views of reciprocity he formally adopted in his last public address, McKinley had great personal suavity and dignity, and was thoroughly well liked by his party colleagues. As a politician he was always more the people's representative than their leader, and that he "kept his ear to the ground" was the source of much of his power and at the same time was his greatest weakness: his address at Buffalo the day before his assassination seems to voice his appreciation of the change in popular sentiment regarding the tariff laws of the United States and is the more remarkable as coming from the foremost champion for years of a form of tariff legislation devised to stifle international competition. His apparently inconsistent record on the coinage question becomes consistent if considered in the same way, as the expression of the gradually changing views of his constituency. And it may not be fanciful to suggest that the obvious growth of McKinley in breadth and power during his term as president was due to his being the representative of a larger constituency, less local and less narrow-minded. He was an able but far from brilliant campaign speaker. His greatest administrative gift was a fine intuition in choosing men to serve him. McKinley's private life was irreproachable; and very fine was his devotion to his wife, Ida Saxton (d. 1907), whom he had married in Canton in 1871, who was throughout his political career a confirmed invalid. He was from his early manhood a prominent member of the Methodist Episcopal Church.

His *Speeches and Addresses* were printed in two volumes (New York, 1893 and 1901).

McKINNEY, a city and the county-seat of Collin county, Texas, U.S.A., about 30 m. N. by E. of Dallas. Pop. (1890), 2489; (1900), 4342 (917 negroes); (1910) 4714. It is served by the Missouri, Kansas & Texas and the Houston & Texas Central railways, and by the Dallas & Sherman inter-urban (electric) line, the central power plant of which is immediately north of the city. McKinney is in a fine farming region; there are also manufactures. The municipal water supply is obtained from artesian wells. The first settlement in Collin county was made about 10 m. north of what is now McKinney in 1841. McKinney was named, as was the county, in honour of Collin McKinney, a pioneer in the region and a signer of the Declaration of the Independence of Texas. It was settled in 1844, was laid out and became the county-seat in 1846, and was first chartered as a city in 1874.

MACKINTOSH, SIR JAMES (1765–1832), Scottish publicist, was born at Aldourie, 7 m. from Inverness, on the 24th of October 1765. He came of old Highland families on both sides. He went in 1780 to college at Aberdeen, where he made a friend of Robert Hall, afterwards the famous preacher. In 1784 he proceeded for the study of medicine to Edinburgh, where he participated to the full in the intellectual ferment, but did not quite neglect his medical studies, and took his degree in 1787.

In 1788 Mackintosh removed to London, then agitated by the trial of Warren Hastings and the king's first lapse into insanity. He was much more interested in these and other political events than in his professional prospects; and his attention was specially directed to the events and tendencies which caused or preceded the Revolution in France. In 1789 he married his first wife, Catherine Stuart, whose brother Daniel afterwards became editor of the *Morning Post.* His wife's prudence was a corrective to his own unpractical temperament, and his efforts in journalism became fairly profitable. Mackintosh was soon absorbed in the question of the time; and in April 1791, after long meditation, he published his *Vindiciae Gallicae*, a reply to Burke's *Reflections on the French Revolution.* It was the only worthy answer to Burke that appeared. It placed the author in the front rank of European publicists, and won him the friendship of some of the most distinguished men of the time, including Burke himself. The success of the *Vindiciae* finally decided him to give up the medical for the legal profession. He was called to the bar in 1795, and gained a considerable reputation there as well as a tolerable practice. In 1797 his wife died, and next year he married Catherine Allen, sister-in-law of Josiah and John Wedgwood, through whom he introduced Coleridge to the *Morning Post.* As a lawyer his greatest public efforts were his lectures (1799) at Lincoln's Inn on the law of nature and nations, of which the introductory discourse was published, and his eloquent defence (1803) of Jean Gabriel Peltier, a French refugee, tried at the instance of the French government for a libel against the first consul. In 1803 he was knighted, and received the post of recorder at Bombay. The spoilt child of London society was not at home in India, and he was glad to return to England, where he arrived in 1812.

He courteously declined the offer of Perceval to resume political life under the auspices of the dominant Tory party, though tempting prospects of office in connexion with India were opened up. He entered parliament in the Whig interest as member for Nairn. He sat for that county, and afterwards for Knaresborough, till his death. In London society, and in Paris during his occasional visits, he was a recognized favourite for his genial wisdom and his great conversational power. On Mme de Stael's visit to London he was the only Englishman capable of representing his country in talk with her. His parliamentary career was marked by the same wide and candid liberalism as his private life. He opposed the reactionary measures of the Tory government, supported and afterwards succeeded Romilly in his efforts for reforming the criminal code, and took a leading part both in Catholic emancipation and in the Reform Bill. But he was too little of a partisan, too widely sympathetic and candid, as well as too elaborate, to be a telling speaker in parliament, and was consequently surpassed by more practical men whose powers were incomparably inferior. From 1818 to 1824 he was professor of law and general politics in the East India Company's College at Haileybury.

In the midst of the attractions of London society and of his parliamentary avocations Mackintosh felt that the real work of his life was being neglected. His great ambition was to write a history of England. His studies both in English and foreign speculation led him to cherish the design also of making some worthy contribution to philosophy. It was not till 1828 that he set about the first task of his literary ambition. This was the *Dissertation on the Progress of Ethical Philosophy*, prefixed to the seventh edition of the *Encyclopaedia Britannica.* The dissertation, written mostly in ill-health and in snatches of time taken from his parliamentary engagements, was published in 1831. It was severely attacked in 1835 by James Mill in his *Fragment on Mackintosh.* About the same time he wrote for the *Cabinet Cyclopaedia* a "History of England from the Earliest Times to the Final Establishment of the Reformation." His more elaborate *History of the Revolution*, for which he had made great researches and collections, was not published till after his death. Already a privy councillor, Mackintosh was appointed commissioner for the affairs of India under the Whig administration of 1830. He died on the 30th of May 1832.

Mackintosh was undoubtedly one of the most cultured and catholic-minded men of his time. His studies and sympathies embraced almost every human interest, except pure science. But the width of his intellectual sympathies, joined to a constitutional indecision and *vis inertiae*, prevented him from doing more enduring work. *Vindiciae Gallicae* was the verdict of a philosophic Liberal on the development of the French Revolution up to the spring of 1791, and though the excesses of the revolutionists compelled him a few years after to express his entire agreement with the opinions of Burke, its defence of the "rights of man" is a valuable statement of the cultured Whig's point of view at the time. The *History of the Revolution in England*, breaking off at the point where William of Orange is preparing to intervene in the affairs of England, is chiefly interesting because of Macaulay's admiring essay on it and its author.

A *Life*, by his son R. J. Mackintosh, was published in 1836.

MACKLIN, CHARLES (*c.* 1699–1797), Irish actor and playwright, whose real name was McLaughlin, was born in Ireland, and had an adventurous youth before coming to Bristol, where he made his first appearance on the stage as Richmond in *Richard III.* He was at Lincoln's Inn Fields about 1725, and by 1733 was at Drury Lane, where the quarrel between the manager and the principal actors resulted in his getting better parts. When the trouble was over and these were taken from him, he went to the Haymarket, but he returned in 1734 to Drury Lane and acted there almost continuously until 1748. Then for two seasons he and his wife (d. *c.* 1758), an excellent actress, were in Dublin under Sheridan, then back in London at Covent Garden. He played a great number of characters, principally in comedy, although Shylock was his greatest part, and Iago and the Ghost in *Hamlet* were in his repertory. At the end of 1753 Macklin bade farewell to the stage to open a tavern, near the theatre, where he personally supervised the serving of dinner. He also delivered an evening lecture, followed by a debate, which was soon a hopeless subject of ridicule. The tavern failed, and Macklin returned to the stage, and played for a number of years in London and Dublin. His quick temper got him into constant trouble. In a foolish quarrel over a wig in 1735 he killed a fellow actor in the green-room at Drury Lane, and he was constantly at law over his various contracts and quarrels. The bitterest of these arose on account of his appearing as Macbeth at Covent Garden in 1772. The part was usually played there by William Smith, and the public would not brook a change. A few nights later the audience refused to hear Macklin as Shylock, and shouted their wish, in response to the manager's question, to have him discharged. This was done in order to quell the riot. His lawsuit, well conducted by himself, against the leaders of the disturbance resulted in an award of £600 and costs, but Macklin magnanimously elected instead that the defendants should take £100 in tickets at three benefits—for himself, his daughter and the management. He returned to Covent Garden, but his appearances thereafter were less frequent, ending in 1789, when as Shylock, at his benefit, he was only able to begin the play, apologize for his wandering memory, and retire. He lived until the 11th of July 1797, and his last years were provided for by a subscription edition of two of his best plays, *The Man of the World* and *Love in a Maze*. Macklin's daughter, Mary Macklin (*c.* 1734–1781), was a well-known actress in her day.

See Edward A. Parry, *Charles Macklin* (1891).

MACK VON LEIBERICH, KARL, FREIHERR (1752–1828), Austrian soldier, was born at Nenslingen, in Bavaria, on the 25th of August 1752. In 1770 he joined an Austrian cavalry regiment, in which his uncle, Leiberich, was a squadron commander, becoming an officer seven years later. During the brief war of the Bavarian Succession he was selected for service on the staff of Count Kinsky, under whom, and subsequently under the commander-in-chief Field Marshal Count Lacy, he did excellent work. He was promoted first lieutenant in 1778, and captain on the quartermaster-general's staff in 1783. Count Lacy, then the foremost soldier of the Austrian army, had the highest opinion of his young assistant. In 1785 Mack married Katherine Gabrieul, and was ennobled under the name of Mack von Leiberich. In the Turkish war he was employed on the headquarter staff, becoming in 1788 major and personal aide-de-camp to the emperor, and in 1789 lieutenant-colonel. He distinguished himself greatly in the storming of Belgrade. Shortly after this, disagreements between Mack and Loudon, now commander-in-chief, led to the former's demanding a court-martial and leaving the front. He was, however, given a colonelcy (1789) and the order of Maria Theresa, and in 1790 Loudon and Mack, having become reconciled, were again on the field together. During these campaigns Mack received a severe injury to his head, from which he never fully recovered. In 1793 he was made quartermaster-general (chief of staff) to Prince Josias of Saxe-Coburg, commanding in the Netherlands; and he enhanced his reputation by the ensuing campaign. The young Archduke Charles, who won his own first laurels in the action of the 1st of March 1793, wrote after the battle, "Above all we have to thank Colonel Mack for these successes." Mack distinguished himself again on the field of Neerwinden; and had a leading part in the negotiations between Coburg and Dumouriez. He continued to serve as quartermaster-general, and was now made titular chief (*Inhaber*) of a cuirassier regiment. He received a wound at Famars, but in 1794 was once more engaged, having at last been made a major-general. But the failure of the allies, due though it was to political and military factors and ideas, over which Mack had no control, was ascribed to him, as their successes of March–April 1793 had been, and he fell into disfavour in consequence. In 1797 he was promoted lieutenant field marshal, and in the following year he accepted, at the personal request of the emperor, the command of the Neapolitan army. But with the unpromising material of his new command he could do nothing against the French revolutionary troops, and before long, being in actual danger of being murdered by his men, he took refuge in the French camp. He was promised a free pass to his own country, but Napoleon ordered that he should be sent to France as a prisoner of war. Two years later he escaped from Paris in disguise. The allegation that he broke his parole is false. He was not employed for some years, but in 1804, when the war party in the Austrian court needed a general to oppose the peace policy of the Archduke Charles, Mack was made quartermaster-general of the army, with instructions to prepare for a war with France. He did all that was possible within the available time to reform the army, and on the opening of the war of 1805 he was made quartermaster-general to the titular commander-in-chief in Germany, the Archduke Ferdinand. He was the real responsible commander of the army which opposed Napoleon in Bavaria, but his position was ill-defined and his authority treated with slight respect by the other general officers. For the events of the Ulm campaign and an estimate of Mack's responsibility for the disaster, see NAPOLEONIC CAMPAIGNS. After Austerlitz, Mack was tried by a court-martial, sitting from February 1806 to June 1807, and sentenced to be deprived of his rank, his regiment, and the order of Maria Theresa, and to be imprisoned for two years. He was released in 1808, and in 1819, when the ultimate victory of the allies had obliterated the memory of earlier disasters, he was, at the request of Prince Schwarzenberg, reinstated in the army as lieutenant field marshal and a member of the order of Maria Theresa. He died on the 22nd of October 1828 at S. Pölten.

See Schweigerd, *Oesterreichs Helden* (Vienna, 1854); Würzbach, *Biogr. Lexikon d. Kaiserthums Oesterr.* (Vienna, 1867); Ritter von Rittersberg, *Biogr. d. ausgezeichneten Feldherren d. oest. Armee* (Prague, 1828); Raumer's *Hist. Taschenbuch* (1873) contains Mack's vindication. A short critical memoir will be found in *Streffleur* for January 1907.

McLANE, LOUIS (1786–1857), American political leader, was born in Smyrna, Delaware, on the 28th of May 1786, son of Allan McLane (1746–1829), a well-known Revolutionary soldier. He was admitted to the bar in 1807. He entered politics as a Democrat, and served in the Federal House of Representatives in 1817–1827 and in the Senate in 1827–1829. He was minister to England in 1829–1831, and secretary of the treasury in Jackson's cabinet from 1831 (when in his annual report he argued for the United States Bank) until May 1833, when he was transferred to the state department. He retired from the cabinet in June 1834. He was president of the Baltimore & Ohio railway in 1837–1847, minister to England in 1845–1846, and delegate to the Maryland constitutional convention of 1850–1851. He died in Baltimore, Maryland, on the 7th of October 1857.

His son, ROBERT MILLIGAN McLANE (1815–1898), graduated at West Point in 1837, resigned from the army in 1843, and practised law in Baltimore. He was a Democratic representative in Congress in 1847–1851 and again in 1879–1883, governor of Maryland in 1884–1885, U.S. commissioner to China in 1853–1854, and minister to Mexico in 1859–1860 and to France in 1885–1889.

See R. M. McLane's *Reminiscences*, 1827–1897 (privately printed, 1897).

MACLAREN, CHARLES (1782–1866), Scottish editor, was born at Ormiston, Haddingtonshire, on the 7th of October 1782, the son of a farmer and cattle-dealer. He was almost entirely self-educated, and when a young man became a clerk in Edinburgh. In 1817, with others, he established the *Scotsman* newspaper in Edinburgh and at first acted as its editor. Offered a post as clerk in the custom house, he resigned his editorial position, resuming it in 1820, and resigning it again in 1845. In 1820 Maclaren was made editor of the sixth edition of the *Encyclopaedia Britannica*. From 1864–1866 he was president of the Geological Society of Edinburgh, in which city he died on the 10th of September 1866.

MACLAREN, IAN, the pseudonym of John Watson (1850–1907), Scottish author and divine. The son of John Watson, a civil servant, he was born at Manningtree, Essex, on the 3rd of November 1850, and was educated at Stirling and at Edinburgh University, afterwards studying theology at New College, Edinburgh, and at Tübingen. In 1874 he entered the ministry of the Free Church of Scotland and became assistant minister of Barclay Church, Edinburgh. Subsequently he was minister at Logiealmond in Perthshire and at Glasgow, and in 1880 he became minister of Sefton Park Presbyterian church, Liverpool, from which he retired in 1905. In 1896 he was Lyman Beecher lecturer at Yale University, and in 1900 he was moderator of the synod of the English Presbyterian church. While travelling in America he died at Mount Pleasant, Iowa, on the 6th of May 1907. Ian Maclaren's first sketches of rural Scottish life, *Beside the Bonnie Briar Bush* (1894), achieved extraordinary popularity and were followed by other successful books, *The Days of Auld Lang Syne* (1895), *Kate Carnegie and those Ministers* (1896) and *Afterwards and other Stories* (1898). Under his own name Watson published several volumes of sermons, among them being *The Upper Room* (1895); *The Mind of the Master* (1896) and *The Potter's Wheel* (1897).

See Sir W. Robertson Nicoll, *Ian Maclaren* (1908).

MACLAURIN, COLIN (1698–1746), Scottish mathematician, was the son of a clergyman, and born at Kilmodan, Argyllshire. In 1709 he entered the university of Glasgow, where he exhibited a decided genius for mathematics, more especially for geometry; it is said that before the end of his sixteenth year he had discovered many of the theorems afterwards published in his *Geometria organica*. In 1717 he was elected professor of mathematics in Marischal College, Aberdeen, as the result of a competitive examination. Two years later he was admitted F.R.S. and made the acquaintance of Sir Isaac Newton. In 1719 he published his *Geometria organica, sive descriptio linearum curvarum universalis*. In it Maclaurin developed several theorems due to Newton, and introduced the method of generating conics which bears his name, and showed that many curves of the third and fourth degrees can be described by the intersection of two movable angles. In 1721 he wrote a supplement to the *Geometria organica*, which he afterwards published, with extensions, in the *Philosophical Transactions* for 1735. This paper is principally based on the following general theorem, which is a remarkable extension of Pascal's hexagram: "If a polygon move so that each of its sides passes through a fixed point, and if all its summits except one describe curves of the degrees m, n, p, &c., respectively, then the free summit moves on a curve of the degree $2mnp$ . . . . which reduces to mnp . . . . when the fixed points all lie on a right line." In 1722 Maclaurin travelled as tutor and companion to the eldest son of Lord Polwarth, and after a short stay in Paris resided for some time in Lorraine, where he wrote an essay on the percussion of bodies, which obtained the prize of the French Academy of Sciences for the year 1724. The following year he was elected professor of mathematics in the university of Edinburgh on the urgent recommendation of Newton. After the death of Newton, in 1728, his nephew, John Conduitt, applied to Maclaurin for his assistance in publishing an account of Newton's life and discoveries. This Maclaurin gladly undertook, but the death of Conduitt put a stop to the project.

In 1740 Maclaurin divided with Leonhard Euler and Daniel Bernoulli the prize offered by the French Academy of Sciences for an essay on tides. His *Treatise on Fluxions* was published at Edinburgh in 1742, in two volumes. In the preface he states that the work was undertaken in consequence of the attack on the method of fluxions made by George Berkeley in 1734. Maclaurin's object was to found the doctrine of fluxions on geometrical demonstration, and thus to answer all objections to its method as being founded on false reasoning and full of mystery. The most valuable part of the work is that devoted to physical applications, in which he embodied his essay on the tides. In this he showed that a homogeneous fluid mass revolving uniformly round an axis under the action of gravity ought to assume the form of an ellipsoid of revolution. The importance of this investigation in connexion with the theory of the tides, the figure of the earth, and other kindred questions, has always caused it to be regarded as one of the great problems of mathematical physics. Maclaurin was the first to introduce into mechanics, in this discussion, the important conception of *surfaces of level*; namely, surfaces at each of whose points the total force acts in the normal direction. He also gave in his *Fluxions*, for the first time, the correct theory for distinguishing between maxima and minima in general, and pointed out the importance of the distinction in the theory of the multiple points of curves. In 1745, when the rebels were marching on Edinburgh, Maclaurin took a most prominent part in preparing trenches and barricades for its defence. The anxiety, fatigue and cold to which he was thus exposed, affecting a constitution naturally weak, laid the foundation of the disease to which he afterwards succumbed. As soon as the rebel army got possession of Edinburgh Maclaurin fled to England, to avoid making submission to the Pretender. He accepted the invitation of T. Herring, then archbishop of York, with whom he remained until it was safe to return to Edinburgh. He died of dropsy on the 14th of June 1746, at Edinburgh. Maclaurin was married in 1733 to Anne, daughter of Walter Stewart, solicitor-general for Scotland. His eldest son John, born in 1734, was distinguished as an advocate, and appointed one of the judges of the Scottish court of session, with the title of Lord Dreghorn. He inherited an attachment to scientific discovery, and was one of the founders of the Royal Society of Edinburgh, in 1782.

After Maclaurin's death his account of Newton's philosophical discoveries was published by Patrick Murdoch, and also his algebra in 1748. As an appendix to the latter appeared his *De linearum geometricarum proprietatibus generalibus tractatus*, a treatise of remarkable elegance. Of the more immediate successors of Newton in Great Britain Maclaurin is probably the only one who can be placed in competition with the great mathematicians of the continent of Europe at the time. (B. W.)

M'LENNAN, JOHN FERGUSON (1827–1881), Scottish ethnologist, was born at Inverness on the 14th of October 1827. He studied at King's college, Aberdeen, where he graduated with distinction in 1849, thence proceeding to Cambridge, where he remained till 1855 without taking a degree. He was called to the Scottish bar in 1857, and in 1871 was appointed parliamentary draughtsman for Scotland. In 1865 he published *Primitive Marriage*, in which, arguing from the prevalence of the symbolical form of capture in the marriage ceremonies of primitive races, he developed an intelligible picture of the growth of the marriage relation and of systems of kinship (see Family) according to natural laws. In 1866 he wrote in the *Fortnightly Review* (April and May) an essay on "Kinship in Ancient Greece," in which he proposed to test by early Greek facts the theory of the history of kinship set forth in *Primitive Marriage*; and three years later appeared a series of essays on "Totemism" in the same periodical for 1869–1870 (the germ of which had been contained in the paper just named), which mark the second great step in his systematic study of early society. A reprint of *Primitive Marriage*, with "Kinship in Ancient Greece" and some other essays not previously published, appeared in 1876, under the title of *Studies in Ancient History*. The new essays in this volume were mostly critical, but one of them, in which perhaps his guessing talent is seen at its best, "The Divisions of the Irish Family," is an elaborate discussion of a problem which has long puzzled both Celtic scholars and jurists; and in another, "On the Classificatory System of Relationship," he propounded a new explanation of a series of facts which, he thought, might throw light upon the early history of society, at the same time putting to the test of those facts the theories he had set forth in *Primitive Marriage*. Papers on "The Levirate and Polyandry," following up the line of his previous investigations (*Fortnightly Review*, 1877), were the last work he was able to publish. He died of consumption on the 14th of June 1881 at Hayes Common, Kent.

Besides the works already cited, M'Lennan wrote a *Life of Thomas Drummond* (1867). The vast materials which he had accumulated on kinship were edited by his widow and A. Platt, under the title *Studies in Ancient History: Second Series* (1896).

MACLEOD, HENRY DUNNING (1821–1902), Scottish economist, was born in Edinburgh, and educated at Eton, Edinburgh University, and Trinity College, Cambridge, where he graduated in 1843. He travelled in Europe, and in 1849 was called to the English bar. He was employed in Scotland on the work of poor-law reform, and devoted himself to the study of economics. In 1856 he published his *Theory and Practice of Banking*, in 1858 *Elements of Political Economy*, and in 1859 *A Dictionary of Political Economy*. In 1873 appeared his *Principles of Economist Philosophy*, and other books on economics and banking were published later. Between 1868 and 1870 he was employed by the government in digesting and codifying the law of bills of exchange. He died on the 16th of July 1902. Macleod's principal contribution to the study of economics consists in his work on the theory of credit, to which he was the first to give due prominence.

For a judicious discussion of the value of Macleod's writings, see an article on "The Revolt against Orthodox Economics" in the *Quarterly Review* for October 1901 (No. 388).

MACLEOD, NORMAN (1812–1872), Scottish divine, son of Rev. Norman Macleod (1783–1862), and grandson of Rev. Norman Macleod, minister of Morven, Argyllshire, was born at Campbeltown on the 3rd of June 1812. In 1827 he became a student at Glasgow University, and in 1831 went to Edinburgh to study divinity under Dr Thomas Chalmers. On the 18th of March 1838 he became parish minister at Loudoun, Ayrshire. At this time the troubles in the Scottish Church were already gathering to a head (see FREE CHURCH OF SCOTLAND). Macleod, although he had no love for lay patronage, and wished the Church to be free to do its proper work, clung firmly to the idea of a national Established Church, and therefore remained in the Establishment when the disruption took place. He was one of those who took a middle course in the non-intrusion controversy, holding that the fitness of those who were presented to parishes should be judged by the presbyteries—the principle of Lord Aberdeen's Bill. On the secession of 1843 he was offered many different parishes, and having finally settled at Dalkeith, devoted himself to parish work and to questions affecting the Church as a whole. He was largely instrumental in the work of strengthening the Church. In 1847 he became one of the founders of the Evangelical Alliance, and from 1849 edited the *Christian Instructor* (Edinburgh). In 1851 he was called to the Barony church, Glasgow, in which city the rest of his days were passed. There the more liberal theology rapidly made way among a people who judged it more by its fruits than its arguments, and Macleod won many adherents by his practical schemes for the social improvement of the people. He instituted temperance refreshment rooms, a congregational penny savings bank, and held services specially for the poor. In 1860 Macleod was appointed editor of the new monthly magazine *Good Words*. Under his control the magazine, which was mainly of a religious character, became widely popular. His own literary work, nearly all of which originally appeared in its pages—sermons, stories, travels, poems—was only a by-product of a busy life. By far his best work was the spontaneous and delightful *Reminiscences of a Highland Parish* (1867). While *Good Words* made his name known, and helped the cause he had so deeply at heart, his relations with the queen and the royal family strengthened yet further his position in the country. Never since Principal Carstairs had any Scottish clergyman been on such terms with his sovereign. In 1865 he risked an encounter with Scottish Sabbatarian ideas. The presbytery of Glasgow issued a pastoral letter on the subject of Sunday trains and other infringements of the Sabbath. Macleod protested against the grounds on which its strictures were based. For a time, owing partly to a misleading report of his statement, he became "the man in all Scotland most profoundly distrusted." But four years later the Church accorded him the highest honour in her power by choosing him as moderator of her general assembly. In 1867, along with Dr Archibald Watson, he was sent to India, to inquire into the state of the missions. He undertook the journey in spite of failing health, and seems never to have recovered from its effects. He returned resolved to devote the rest of his days to rousing the Church to her duty in the sphere of foreign missions, but his health was now broken, and his old energy flagged. He died on the 16th of June 1872, and was buried at Campsie. He was one of the greatest of Scottish religious leaders, a man of wide sympathy and high ideals. His Glasgow church was named after him the "Macleod Parish Church," and the "Macleod Missionary Institute" was erected by the Barony church in Glasgow. Queen Victoria gave two memorial windows to Crathie church as a testimony of her admiration for his work.

See *Memoir of Norman Macleod*, by his brother, Donald Macleod (1876).

MACLISE, DANIEL (1806–1870), Irish painter, was born at Cork, the son of a Highland soldier. His education was of the plainest kind, but he was eager for culture, fond of reading, and anxious to become an artist. His father, however, placed him, in 1820, in Newenham's Bank, where he remained for two years, and then left to study in the Cork school of art. In 1825 it happened that Sir Walter Scott was travelling in Ireland, and young Maclise, having seen him in a bookseller's shop, made a surreptitious sketch of the great man, which he afterwards lithographed. It was exceedingly popular, and the artist became celebrated enough to receive many commissions for portraits, which he executed, in pencil, with very careful treatment of detail and accessory. Various influential friends perceived the genius and promise of the lad, and were anxious to furnish him with the means of studying in the metropolis; but with rare independence he refused all aid, and by careful economy saved a sufficient sum to enable him to leave for London. There he made a lucky hit by a sketch of the younger Kean, which, like his portrait of Scott, was lithographed and published. He entered the Academy schools in 1828, and carried off the highest prizes open to the students. In 1829 he exhibited for the first time in the Royal Academy. Gradually he began to confine himself more exclusively to subject and historical pictures, varied occasionally by portraits of Campbell, Miss Landon, Dickens, and other of his literary friends. In 1833 he exhibited two pictures which greatly increased his reputation, and in 1835 the "Chivalric Vow of the Ladies and the Peacock" procured his election as associate of the Academy, of which he became full member in 1840. The years that followed were occupied with a long series of figure pictures, deriving their subjects from history and tradition and from the works of Shakespeare, Goldsmith and Le Sage. He also designed illustrations for several of Dickens's Christmas books and other works. Between the years 1830 and 1836 he contributed to *Fraser's Magazine*, under the pseudonym of Alfred Croquis, a remarkable series of portraits of the literary and other celebrities of the time—character studies, etched or lithographed in outline, and touched more or less with the emphasis of the caricaturist, which were afterwards published as the *Maclise Portrait Gallery* (1871). In 1858 Maclise commenced one of the two great monumental works of his life, the "Meeting of Wellington and Blücher," on the walls of Westminster Palace. It was begun in fresco, a process which proved unmanageable. The artist wished to resign the task; but, encouraged by Prince Albert, he studied in Berlin the new method of "water-glass" painting, and carried out the subject and its companion, the "Death of Nelson," in that medium, completing the latter painting in 1864. The intense application which he gave to these great historic works, and various circumstances connected with the commission, had a serious effect on the artist's health. He began to shun the company in which he formerly delighted; his old buoyancy of spirits was gone; and when, in 1865, the presidentship of the Academy was offered to him he declined the honour. He died of acute pneumonia on the 25th of April 1870. His works are distinguished by powerful intellectual and imaginative qualities, but most of them are marred by harsh and dull colouring, by metallic hardness of surface and texture, and by frequent touches of the theatrical in the action and attitudes of the figures. His fame rests most securely on his two greatest works at Westminster.

A memoir of Maclise, by his friend W. J. O'Driscoll, was published in 1871.

MACLURE, WILLIAM (1763–1840), American geologist, was born at Ayr in Scotland in 1763. After a brief visit to New York in 1782 he began active life as a partner in a London firm of American merchants. In 1796 business affairs took him to Virginia, U.S.A., which he thereafter made his home. In 1803 he visited France as one of the commissioners appointed to settle the claims of American citizens on the French government; and during the few years then spent in Europe he applied himself with enthusiasm to the study of geology. On his return home in 1807 he commenced the self-imposed task of making a geological survey of the United States. Almost every state in the Union was traversed and mapped by him, the Alleghany Mountains being crossed and recrossed some fifty times. The results of his unaided labours were submitted to the American Philosophical Society in a memoir entitled *Observations on the Geology of the United States explanatory of a Geological Map*, and published in the Society's *Transactions* (vol. iv. 1809, p. 91) together with the first geological map of that country. This antedates William Smith's geological map of England by six years. In 1817 Maclure brought before the same society a revised edition of his map, and his great geological memoir was issued separately, with some additional matter, under the title *Observations on the Geology of the United States of America*. Subsequent survey has corroborated the general accuracy of Maclure's observations. In 1819 he visited Spain, and attempted, unsuccessfully, to establish an agricultural college near the city of Alicante. Returning to America in 1824, he settled for some years at New Harmony, Indiana, and sought to develop his scheme of the agricultural college. Failing health ultimately constrained him to relinquish the attempt, and to seek (in 1827) a more congenial climate in Mexico. There, at San Angel, he died on the 23rd of March 1840.

See S. G. Morton, "Memoir of William Maclure," *Amer. Journ. Sci.*, vol. xlvii. (1844), p. 1.

MACMAHON, MARIE EDMÉ PATRICE MAURICE DE, duke of Magenta (1808–1893), French marshal and president of the French republic, was born on the 13th of July 1808 at the château of Sully, near Autun. He was descended from an Irish family which went into exile with James II. Educated at the military school of St Cyr, in 1827 he entered the army, and soon saw active service in the first French campaign in Algeria, where his ability and bravery became conspicuous. Being recalled to France, he gained renewed distinction in the expedition to Antwerp in 1832. He became captain in 1833, and in that year returned to Algeria. He led daring cavalry raids across plains infested with Bedouin, and especially distinguished himself at the siege of Constantine in 1837. From then until 1855 he was almost constantly in Algeria, and rose to the rank of general of division. During the Crimean War MacMahon was given the command of a division, and in September 1855 he successfully conducted the assault upon the Malakoff works, which led to the fall of Sebastopol. After his return to France honours were showered upon him, and he was made a senator. Desiring a more active life, however, and declining the highest command in France, he was once more sent out, at his own request, to Algeria, where he completely defeated the Kabyles. After his return to France he voted as a senator against the unconstitutional law for general safety, which was brought forward in consequence of Orsini's abortive attempt on the emperor's life. MacMahon greatly distinguished himself in the Italian campaign of 1859. Partly by good luck and partly by his boldness and sagacity in pushing forward without orders at a critical moment at the battle of Magenta, he enabled the French to secure the victory. For his brilliant services MacMahon received his marshal's baton and was created duke of Magenta. In 1861 he represented France at the coronation of William I. of Prussia, and in 1864 he was nominated governor-general of Algeria. MacMahon's action in this capacity formed the least successful episode of his career. Although he did institute some reforms in the colonies, complaints were so numerous that twice in the early part of 1870 he sent in his resignation to the emperor. When the ill-fated Ollivier cabinet was formed the emperor abandoned his Algerian schemes and MacMahon was recalled.

War being declared between France and Prussia in July 1870, MacMahon was appointed to the command of the Alsace army detachment (see FRANCO-GERMAN WAR). On the 6th of August MacMahon fought the battle of Wörth (*q.v.*). His courage was always conspicuous on the field, but the two-to-one numerical superiority of the Germans triumphed. MacMahon was compelled to fall back upon Saverne, and thence to Toul. Though he suffered further losses in the course of his retreat, his movements were so ably conducted that the emperor confided to him the supreme command of the new levies which he was mustering at Châlons, and he was directed to effect a junction with Bazaine. This operation he undertook against his will. He had an army of 120,000 men, with 324 guns; but large numbers of the troops were disorganized and demoralized. Early on the 1st of September the decisive battle of Sedan began. MacMahon was dangerously wounded in the thigh, whereupon General Ducrot, and soon afterwards General de Wimpffen, took command. MacMahon shared the captivity of his comrades, and resided at Wiesbaden until the conclusion of peace.

In March 1871 MacMahon was appointed by Thiers commander-in-chief of the army of Versailles; and in that capacity he suppressed the Communist insurrection, and successfully conducted the second siege of Paris. In the following December he was invited to become a candidate for Paris in the elections to the National Assembly, but declined nomination. On the resignation of Thiers as president of the Republic, on the 24th of May 1873, MacMahon was elected to the vacant office by an almost unanimous vote, being supported by 390 members out of 392. The duc de Broglie was empowered to form a Conservative administration, but the president also took an early opportunity of showing that he intended to uphold the sovereignty of the National Assembly. On the 5th of November 1873 General Changarnier presented a motion in the Assembly to confirm MacMahon's powers for a period of ten years, and to provide for a commission of thirty to draw up a form of constitutional law. The president consented, but in a message to the Assembly he declared in favour of a confirmation of his own powers for seven years, and expressed his determination to use all his influence in the maintenance of Conservative principles. After prolonged debates the Septennate was adopted on the 19th of November by 378 votes to 310. There was no *coup d'état* in favour of "Henri V.," as had been expected, and the president resolved to abide by "existing institutions." One of his earliest acts was to receive the finding of the court-martial upon his old comrade in arms, Marshal Bazaine, whose death sentence he commuted to one of twenty years' imprisonment in a fortress. Though MacMahon's life as president of the Republic was of the simplest possible character, his term of office was marked by many brilliant displays, while his wife was a leader in all works of charity and benevolence.

The president was very popular in the rural districts of France, through which he made a successful tour shortly after the declaration of the Septennate. But in Paris and other large cities his policy soon caused great dissatisfaction, the Republican party especially being alienated by press prosecutions and the attempted suppression of Republican ideas. Matters were at a comparative deadlock in the National Assembly, until the accession of some Orleanists to the Moderate Republican party in 1875 made it possible to pass various constitutional laws. In May 1877, however, the constitutional crisis became once more acute. A peremptory letter of censure from MacMahon to Jules Simon caused the latter to resign with his colleagues. The duc de Broglie formed a ministry, but Gambetta carried a resolution in the Chamber of Deputies in favour of parliamentary government. The president declined to yield, and being supported by the Senate, he dissolved the Chamber, by decree, on the 25th of June. The prosecution of Gambetta followed for a speech at Lille, in which he had said "the marshal must, if the elections be against him, *se soumettre ou se démettre.*" In a manifesto respecting the elections, the president referred to his successful government and observed, "I cannot obey the injunctions of the demagogy; I can neither become the instrument of Radicalism nor abandon the post in which the constitution has placed me." His confidence in the result of the elections was misplaced. Notwithstanding the great pressure put upon the constituencies by the government, the elections in October resulted in the return of 335 Republicans and only 198 anti-Republicans, the latter including 30 MacMahonists, 89 Bonapartists, 41 Legitimists, and 38 Orleanists. The president endeavoured to ignore the significance of the elections, and continued his reactionary policy. As a last resort he called to power an extra-parliamentary cabinet under General Rochebouet, but the Republican majority refused to vote supplies, and after a brief interval the president was compelled to yield, and to accept a new Republican ministry under Dufaure. The prolonged crisis terminated on the 14th of December 1877, and no further constitutional difficulties arose in 1878. But as the senatorial elections, held early in 1879, gave the Republicans an effective working majority in the Upper Chamber, they now called for the removal of the most conspicuous anti-Republicans among the generals and officials. The president refused to supersede them, and declined to sanction the law brought in with this object. Perceiving further resistance to be useless, however, MacMahon resigned the presidency on the 30th of January 1879, and Jules Grévy was elected as his successor.

MacMahon now retired into private life. Relieved from the cares of state, his simple and unostentatious mode of existence enabled him to pass many years of dignified repose. He died at Paris on the 17th of October 1893, in his eighty-sixth year. A fine, tall, soldierly man, of a thoroughly Irish type, in private life MacMahon was universally esteemed as generous and honourable; as a soldier he was brave and able, without decided military genius; as a politician he was patriotic and well-intentioned, but devoid of any real capacity for statecraft. (G. B. S.)

McMASTER, JOHN BACH (1852–), American historian, was born in Brooklyn, New York, on the 29th of June 1852. He graduated from the college of the City of New York in 1872, worked as a civil engineer in 1873–1877, was instructor in civil engineering at Princeton University in 1877–1883, and in 1883 became professor of American history in the university of Pennsylvania. He is best known for his *History of the People of the United States from the Revolution to the Civil War* (1883 sqq.), a valuable supplement to the more purely political writings of Schouler, Von Holst and Henry Adams.

MACMILLAN, the name of a family of English publishers. The founders of the firm were two Scotsmen, Daniel Macmillan (1813–1857) and his younger brother Alexander (1818–1896). Daniel was a native of the Isle of Arran, and Alexander was born in Irvine on the 3rd of October 1818. Daniel was for some time assistant to the bookseller Johnson at Cambridge, but entered the employ of Messrs Seeley in London in 1837; in 1843 he began business in Aldersgate Street, and in the same year the two brothers purchased the business of Newby in Cambridge. They did not confine themselves to bookselling, but published educational works as early as 1844. In 1845 they became the proprietors of the more important business of Stevenson, in Cambridge, the firm being styled Macmillan, Barclay & Macmillan. In 1850 Barclay retired and the firm resumed the name of Macmillan & Co. Daniel Macmillan died at Cambridge on the 27th of June 1857. In that year an impetus was given to the business by the publication of Kingsley's *Two Years Ago.* A branch office was opened in 1858 in Henrietta Street, London, which led to a great extension of trade. These premises were surrendered for larger ones in Bedford Street, and in 1897 the buildings in St Martin's Street were opened. Alexander Macmillan died in January 1896. By his great energy and literary associations, and with the aid of his partners, there had been built up in little over half a century one of the most important publishing houses in the world. Besides the issue of many important series of educational and scientific works, they published the works of Kingsley, Huxley, Maurice, Tennyson, Lightfoot, Westcott, J. R. Green, Lord Roberts, Lewis Carroll, and of many other well-known authors. In 1898 they took over the old-established publishing house of R. Bentley & Son, and with it the works of Mrs Henry Wood, Miss Rhoda Broughton, *The Ingoldsby Legends*, and also *Temple Bar* and the *Argosy.* In 1893 the firm was converted into a limited liability company, its chairman being Frederick Macmillan (b. 1851), who was knighted in 1909. The American firm of the Macmillan Company, of which he was also a director, is a separate business.

See Thomas Hughes, *Memoir of Daniel Macmillan* (1882); *A Bibliographical Catalogue of Macmillan & Co's Publications from 1843 to 1889* (1891), with portraits of the brothers Daniel and Alexander after Lowes Dickinson and Hubert Herkomer; also articles in *Le Livre* (September 1886), *Publishers' Circular* (January 14, 1893), the *Bookman* (May 1901), &c.

MACMONNIES, FREDERICK WILLIAM (1863–), American sculptor and painter, was born at Brooklyn, New York, on the 20th of September 1863. His mother was a niece of Benjamin West. At the age of sixteen MacMonnies was received as an apprentice in the studio of Augustus St Gaudens, the sculptor, where he remained for five years. In 1884 he went to Paris and thence to Munich, where he painted for some months. Returning to Paris next year he became the most prominent pupil of Falguière. His "Diana" brought him a mention at the Salon of 1889. Three life-sized figures of angels for the church of St Paul, New York, were followed by his "Nathan Hale," in the City Hall Park, New York, and a portrait of James S. T. Stranahan, for Brooklyn. This last brought him a "second medal" in the Salon of 1891, the first time an American sculptor had been so honoured. In 1893 he was chosen to design and carry out the Columbian Fountain for the Chicago World's Fair, which placed him instantly in the front rank. His largest work is a decoration for the Memorial Arch to Soldiers and Sailors, in Prospect Park, Brooklyn, consisting of three enormous groups in bronze. In Prospect Park, Brooklyn, MacMonnies has also a large "Horse Tamer," a work of much distinction. A "Winged Victory" at the U.S. military academy at West Point, New York, is of importance; and his "Bacchante," an extraordinary combination of realism and imagination, rejected by the Boston Public Library, is now at the Metropolitan Museum of Art, New York. He also became well known as a painter, mainly of portraits. In 1888 he married Mary Fairchild, a figure painter of distinction, but in 1909 they were divorced and she married Will H. Low.

MACNAGHTEN, SIR WILLIAM HAY, BART. (1793–1841), Anglo-Indian diplomatist, was the second son of Sir Francis Macnaghten, Bart., judge of the supreme courts of Madras and Calcutta. He was born in August 1793, and educated at Charterhouse. He went out to Madras as a cadet in 1809, but was appointed in 1816 to the Bengal Civil Service. He early displayed a great talent for languages, and also published several treatises on Hindu and Mahommedan law. His political career began in 1830 as secretary to Lord William Bentinck; and in 1837 he became one of the most trusted advisers of the governor-general, Lord Auckland, with whose policy of supporting Shah Shuja against Dost Mahommed, the reigning amir of Kabul, Macnaghten was closely identified. As political agent at Kabul he came into conflict with the military authorities and subsequently with his subordinate Sir Alexander Burnes. Macnaghten attempted to placate the Afghan chiefs with heavy subsidies, but when the drain on the Indian exchequer became too great, and the allowances were reduced, this policy led to an outbreak. Burnes was murdered on the 2nd of November 1841; and owing to the incapacity of the aged General Elphinstone the British army in Kabul degenerated into a leaderless mob. Macnaghten tried to save the situation by negotiating with the Afghan chiefs and, independently of them, with Dost Mahommed's son, Akbar Khan, by whom he was assassinated on the 23rd of December 1841; the disastrous retreat from Kabul and the massacre of the British army in the Kurd Kabul pass followed. These events threw doubt on Macnaghten's capacity for dealing with the problems of Indian diplomacy, though his fearlessness and integrity were unquestioned. He had been created a baronet in 1840, and four months before his death was nominated to the governorship of Bombay.

MACNALLY, LEONARD (1752–1820), Irish informer, was born in Dublin, the son of a merchant. In 1776 he was called to the Irish, and in 1783 to the English bar. He supported himself for some time in London by writing plays and editing the *Public Ledger*. Returning to Dublin, he entered upon a systematic course of informing against the members of the revolutionary party, for whom his house had become the resort. He also betrayed to the government prosecutors political clients whom he defended eloquently in the courts. He made a fine defence for Robert Emmet and cheered him in his last hours, although before appearing in court he had sold, for £200, the contents of his brief to the lawyers for the Crown. After living a professed Protestant all his life, he received absolution on his deathbed from a Roman Catholic priest. He died on the 13th of February 1820.

MACNEE, SIR DANIEL (1806–1882), Scottish portrait painter, was born at Fintry in Stirlingshire. At the age of thirteen he was apprenticed, along with Horatio Macculloch and Leitch the water-colour painter, to John Knox, a landscapist of some repute. He afterwards worked for a year as a lithographer, was employed by the Smiths of Cumnock to paint the ornamental lids of their planewood snuff-boxes, and, having studied in Edinburgh at the "Trustees' Academy," supporting himself meanwhile by designing and colouring book illustrations for Lizars the engraver, he established himself as an artist in Glasgow, where he became a fashionable portrait painter. He was in 1829 admitted a member of the Royal Scottish Academy; and on the death of Sir George Harvey in 1876 he was elected president, and received the honour of knighthood. From this period till his death, on the 18th of January 1882, he resided in Edinburgh, where his genial social qualities and his inimitable powers as a teller of humorous Scottish anecdote rendered him popular.

MACNEIL, HERMON ATKINS (1866–), American sculptor, was born at Chelsea, Massachusetts. He was an instructor in industrial art at Cornell University in 1886–1889, and was then a pupil of Henri M. Chapu and Falguière in Paris. Returning to America, he aided Philip Martiny in the preparation of sketch models for the Columbian exposition, and in 1896 he won the Rinehart scholarship, passing four years (1896–1900) in Rome. In 1906 he became a National Academician. His first important work was "The Moqui Runner," which was followed by "A Primitive Chant," and "The Sun Vow," all figures of the North-American Indian. A "Fountain of Liberty," for the St Louis exposition, and other Indian themes came later; his "Agnese" and his "Beatrice," two fine busts of women, also deserve mention. His principal work is the sculpture for a large memorial arch, at Columbus, Ohio, in honour of President McKinley. In 1909 he won in competition a commission for a large soldiers' and sailors' monument in Albany, New York. His wife, Carol Brooks MacNeil, also a sculptor of distinction, was a pupil of F. W. MacMonnies.

McNEILE, HUGH (1795–1879), Anglican divine, younger son of Alexander McNeile (or McNeill), was born at Ballycastle, Co. Antrim, on the 15th of July 1795. He graduated at Trinity College, Dublin, in 1810. His handsome presence, and his promise of exceptional gifts of oratory, led a wealthy uncle, Major-General Daniel McNeill, to adopt him as his heir; and he was destined for a parliamentary career. During a stay at Florence, Hugh McNeile became temporarily intimate with Lord Byron and Madame de Staël. On returning home, he determined to abandon the prospect of political distinction for the clerical profession, and was disinherited. In 1820 he was ordained, and after holding the curacy of Stranorlar, Co. Donegal, for two years, was appointed to the living of Albury, Surrey, by Henry Drummond.

Edward Irving endeavoured, not without success at first, to draw McNeile into agreement with his doctrine and aims. Irving's increasing extravagance, however, soon alienated McNeile. His preaching now attracted much attention; in London he frequently was heard by large congregations. In 1834 he accepted the incumbency of St Jude's, Liverpool, where for the next thirty years he wielded great political as well as ecclesiastical influence. He repudiated the notion that a clergyman should be debarred from politics, maintaining at a public meeting that "God when He made the minister did not unmake the citizen." In 1835 McNeile entered upon a long contest, in which he was eventually successful, with the Liverpool corporation, which had been captured by the Whigs, after the passing of the Municipal Reform Act. A proposal was carried that the elementary schools under the control of the corporation should be secularized by the introduction of what was known as the Irish National System. The threatened withdrawal of the Bible as the basis of denominational religious teaching was met by a fierce agitation led by McNeile, who so successfully enlisted public support that before the new system could be introduced every child was provided for in new Church of England schools established by public subscriptions. At the same time he conducted a campaign which gradually reduced the Whig element in the council, till in 1841 it almost entirely disappeared. To his influence was also attributed the defeat of the Liberal parliamentary candidates in the general election of 1837, followed by a long period of Conservative predominance in Liverpool politics. McNeile had the Irish Protestant's horror of Romanism, which he constantly denounced in the pulpit and on the platform; and Macaulay, speaking in the House of Commons on the Maynooth endowment in April 1845, singled him out for attack as the most powerful representative of uncompromising Protestant opinion in the country. As the Tractarian movement in the Church of England developed, he became one of its most zealous opponents and the most conspicuous leader of the evangelical party. In 1840 he published a volume of *Lectures on the Church of England*, and in 1846 (the year after Newman's secession to Rome) *The Church and the Churches*, in which he maintained with much dialectical skill the evangelical doctrine of the "invisible Church" in opposition to the teaching of Newman and Pusey. Hugh McNeile was in close sympathy with the philanthropic work as well as the religious views of the 7th earl of Shaftesbury, who more than once tried to persuade Lord Palmerston to raise him to the episcopal bench. But although Palmerston usually followed the advice of Shaftesbury in the appointment of bishops, he would not consent to the elevation to the House of Lords of so powerful a political opponent as McNeile, whom Lord John Russell had accused of frustrating for thirty years the education policy of the Liberal party. In 1860 he was appointed a canon of Chester; and in 1868 Disraeli appointed him dean of Ripon. This preferment he resigned in 1875, and he lived in retirement at Bournemouth till his death on the 28th of January 1879. McNeile married, in 1822, Anne, daughter of William Magee, archbishop of Dublin, and aunt of William Connor Magee, archbishop of York, by whom he had a large family.

Although a vehement controversialist, Hugh McNeile was a man of simple and sincere piety of character. Sir Edward Russell, an opponent alike of his religious and his political opinions, bears witness to the deep spirituality of his teaching, and describes him as an absolutely unique personality. "He made himself leader of the Liverpool people, and always led with calm and majesty in the most excited times. His eloquence was grave, flowing, emphatic—had a dignity in delivery, a perfection of elocution, that only John Bright equalled in the latter half of the

19th century. Its fire was solemn force. McNeile's voice was probably the finest organ ever heard in public oratory. His action was as graceful as it was expressive. He ruled an audience."

See J. A. Picton, *Memorials of Liverpool*, vol. i. (1873); Sir Edward Russell, "The Religious Life of Liverpool," in the *Sunday Magazine* (June 1905); Charles Bullock, *Hugh McNeile and Reformation Truth*. (R. J. M.)

MACNEILL, HECTOR (1746–1818), Scottish poet, was born near Roslin, Midlothian, on the 22nd of October 1746, the son of an impoverished army captain. He went to Bristol as a clerk at the age of fourteen, and soon afterwards was despatched to the West Indies. From 1780 to 1786 he acted as assistant secretary on board the flagships of Admiral Geary and Sir Richard Bickerton (1727–1792). Most of his later life was spent in Scotland, and it was in the house of a friend at Stirling that he wrote most of his songs and his *Scotland's Skaith, or the History of Will and Jean* (1795), a narrative poem intended to show the deteriorating influences of whisky and pothouse politics. A sequel, *The Waes of War*, appeared next year. In 1800 he published *The Memoirs of Charles Macpherson, Esq.*, a novel understood to be a narrative of his own hardships and adventures. A complete edition of the poems he wished to own appeared in 1812. His songs "Mary of Castlecary," "Come under my plaidy," "My boy Tammy," "O tell me how for to woo," "I lo'ed ne'er a lassie but ane," "The plaid amang the hether," and "Jeanie's black e'e," are notable for their sweetness and simplicity. He died at Edinburgh on the 15th of March 1818.

MACOMB, a city and the county-seat of McDonough county, Illinois, U.S.A., in the W. part of the state, about 60 m. S.W. of Peoria. Pop. (1890), 4052; (1900), 5375 (232 foreign-born); (1910), 5774. Macomb is served by the Chicago, Burlington & Quincy, and the Macomb & Western Illinois railways. The city is the seat of the Western Illinois state normal school (opened in 1902), and has a Carnegie library and a city park. Clay is found in the vicinity, and there are manufactures of pottery, bricks, &c. The city was founded in 1830 as the county-seat of McDonough county, and was called Washington by the settlers, but the charter of incorporation, also granted in 1830, gave it the present name in honour of General Alexander Macomb. Macomb was first chartered as a city in 1856.

MACOMER, a village of Sardinia in the province of Cagliari, from which it is 95 m. N.N.W. by rail, and the same distance S.W. of Golfo degli Aranci. Pop. (1901), 3488. It is situated 1890 ft. above sea-level on the southern ascent to the central plateau (the Campeda) of this part of Sardinia; and it is the junction of narrow-gauge lines branching from the main line eastwards to Nuoro and westwards to Bosa. The old parish church of S. Pantaleone has three Roman mile-stones in front of it, belonging to the Roman high-road from Carales to Turris Libisonis. The modern high-road follows the ancient. The district, especially the Campeda, is well fitted for grazing and horse and cattle breeding, which is carried on to a considerable extent. It is perhaps richer in *nuraghi* than any other part of Sardinia.

MACON, NATHANIEL (1758–1837), American political leader, was born at Macon Manor, Warren county, North Carolina, on the 17th of December 1758. He studied at the college of New Jersey (now Princeton University) from 1774 to 1776, when the institution was closed on account of the outbreak of the War of Independence; served for a short time in a New Jersey militia company; studied law at Bute Court-house, North Carolina, in 1777–1780, at the same time managing his tobacco plantation; was a member of a Warren county militia company in 1780–1782, and served in the North Carolina Senate in 1781–1785. In 1786 he was elected to the Continental Congress, but declined to serve. In 1791–1815 he was a member of the national House of Representatives, and in 1815–1828 of the United States Senate. Macon's point of view was always local rather than national. He was essentially a North Carolinian first, and an American afterwards; and throughout his career he was an aggressive advocate of state sovereignty and an adherent of the doctrines of the "Old Republicans." He at first opposed the adoption of the Federal constitution of 1787, as a member of the faction led by Willie Jones (1731–1801) of Halifax, North Carolina, but later withdrew his opposition. In Congress he denounced Hamilton's financial policy, opposed the Jay Treaty (1795) and the Alien and Sedition Acts, and advocated a continuance of the French alliance of 1778. His party came into power in 1801, and he was Speaker of the house from December 1801 to October 1807. At first he was in accord with Jefferson's administration; he approved the Louisiana Purchase, and as early as 1803 advocated the purchase of Florida. For a number of years, however, he was politically allied with John Randolph.[1] As speaker, in spite of strong opposition, he kept Randolph at the head of the important committee on Ways and Means from 1801 to 1806; and in 1805–1808, with Randolph and Joseph H. Nicholson (1770–1817) of Maryland, he was a leader of the group of about ten independents, called the "Quids," who strongly criticized Jefferson and opposed the presidential candidature of Madison. By 1809, however, Macon was again in accord with his party, and during the next two years he was one of the most influential of its leaders. In December 1809 he introduced resolutions which combined the ideas of Peter Early (1773–1817) of Georgia, David R. Williams (1776–1830) of South Carolina, and Samuel W. Dana (1757–1830) of Connecticut with his own. The resolutions recommended the complete exclusion of foreign war vessels from United States ports and the suppression of illegal trade carried on by foreign merchants under the American flag. The substance of these resolutions was embodied in the "Macon Bill, No. 1," which passed the House but was defeated in the Senate. On the 7th of April 1810 Macon reported from committee the "Macon Bill, No. 2," which had been drawn by John Taylor (1770–1832) of South Carolina, and was not actively supported by him. This measure (amended) became law on the 1st of May, and provided for the repeal of the Non-Intercourse Act of 1809, authorized the president, "in case either Great Britain or France shall before the 3rd day of March next so revoke or modify her edicts as that they shall cease to violate the neutral commerce of the United States," to revive non-intercourse against the other, and prohibited British and French vessels of war from entering American waters. In 1812 Macon voted for the declaration of war against Great Britain, and later was chairman of the Congressional committee which made a report (July 1813) condemning Great Britain's conduct of the war. He opposed the Bank Act of 1816, the "internal improvements" policy of Calhoun (in the early part of his career) and Clay, and the Missouri Compromise, his speech against the last being especially able. In 1824 Macon received the electoral vote of Virginia for the vice-presidency, and in 1826–1828 was president pro tempore of the Senate. He was president of the North Carolina constitutional convention in 1835, and was an elector on the Van Buren ticket in 1836. He died at his home, Buck Springs, Warren county, North Carolina, on the 29th of June 1837.

See William E. Dodd, *The Life of Nathaniel Macon* (Raleigh, N.C., 1903); E. M. Wilson, *The Congressional Career of Nathaniel Macon* (Chapel Hill, N.C., 1900).

MÂCON, a town of east-central France, capital of the department of Saône-et-Loire, 45 m. N. of Lyons on the Paris-Lyon railway. Pop. (1906), 16,151. Mâcon is situated on the right bank of the Saône facing the plain of the Bresse; a bridge of twelve arches connects it with the suburb of St Laurent on the opposite bank. The most prominent building is the modern Romanesque church of St Pierre, a large three-naved basilica, with two fine spires. Of the old cathedral of St Vincent (12th and 13th centuries), destroyed at the Revolution, nothing remains but the Romanesque narthex, now used as a chapel, the façade and its two flanking towers. The hôtel de ville contains a library, a theatre and picture-gallery. Opposite to it stands a statue of the poet Alphonse Lamartine, a native of the town. Mâcon is the seat of a prefecture, and has tribunals of first instance and of commerce, and a chamber of commerce. There are lycées and training colleges. Copper-founding is an important industry; manufactures include casks, mats, rope and utensils for the wine-trade. The town has a large trade in wine of the district, known as Mâcon. It is a railway centre of considerable importance, being the point at which the line from Paris to Marseilles is joined by that from Mont Cenis and Geneva, as well as by a branch from Moulins.

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[1] Their names are associated in Randolph-Macon College, named in their honour in 1830.

Mâcon (*Matisco*) was an important town of the Aedui, but under the Romans it was supplanted by Autun and Lyons. It suffered a succession of disasters at the hands of the Germans, Burgundians, Vandals, Huns, Hungarians and even of the Carolingian kings. In the feudal period it was an important countship which in 1228 was sold to the king of France, but more than once afterwards passed into the possession of the dukes of Burgundy, until the ownership of the French crown was established in the time of Louis XI. In the 16th century Mâcon became a stronghold of the Huguenots, but afterwards fell into the hands of the League, and did not yield to Henry IV. until 1594. The bishopric, created by King Childebert, was suppressed in 1790.

MACON, a city and the county-seat of Bibb county, Georgia, U.S.A., in the central part of the state, on both sides of the Ocmulgee river (at the head of navigation), about 90 m. S.S.E. of Atlanta. Pop. (1900), 23,272, of whom 11,550 were negroes; (1910 census) 40,665. Macon is, next to Atlanta, the most important railway centre in the state, being served by the Southern, the Central of Georgia, the Georgia, the Georgia Southern & Florida, the Macon Dublin & Savannah, and the Macon & Birmingham railways. It was formerly an important river port, especially for the shipment of cotton, but lost this commercial advantage when railway bridges made the river impassable. It is, however, partially regaining the river trade in consequence of the compulsory substitution of drawbridges for the stationary railway bridges. The city is the seat of the Wesleyan female college (1836), which claims to be the first college in the world chartered to grant academic degrees to women; Mercer University (Baptist), which was established in 1833 as Mercer Institute at Penfield, became a university in 1837, was removed to Macon in 1871, and controls Hearn Academy (1839) at Cave Spring and Gibson Mercer Academy (1903) at Bowman; the state academy for the blind (1852), St Stanislaus' College (Jesuit), and Mt de Sales Academy (Roman Catholic) for women. There are four orphan asylums for whites and two for negroes, supported chiefly by the Protestant Episcopal and Methodist Churches, and a public hospital. Immediately east of Macon are two large Indian mounds, and there is a third mound 9 m. south of the city. Situated in the heart of the "Cotton Belt," Macon has a large and lucrative trade; it is one of the most important inland cotton markets of the United States, its annual receipts averaging about 250,000 bales. The city's factory products in 1905 were valued at $7,297,347 (33·8% more than in 1900). In the vicinity are large beds of kaolin, 30 m. wide, reaching nearly across the state, and frequently 35 to 70 ft. in depth. Macon is near the fruit-growing region of Georgia, and large quantities of peaches and of garden products are annually shipped from the city.

Macon (named in honour of Nathaniel Macon) was surveyed in 1823 by order of the Georgia legislature for the county-seat of Bibb county, and received its first charter in 1824. It soon became the centre of trade for Middle Georgia; in 1833 a steamboat line to Darien was opened, and in the following year 69,000 bales of cotton were shipped by this route. During the Civil War the city was a centre for Confederate commissary supplies and the seat of a Treasury depository. In July 1864 General George Stoneman (1822–1894) with 500 men was captured near the city by the Confederate general, Howell Cobb. Macon was finally occupied by Federal troops under General James H. Wilson (b. 1837) on the 20th of April 1865. In 1900–1910 the area of the city was increased by the annexation of several suburbs.

MACPHERSON, SIR DAVID LEWIS (1818–1896), Canadian financier and politician, was born at Castle Leathers, near Inverness, Scotland, on the 12th of September 1818. In 1835 he emigrated to Canada, settling in Montreal, where he built up a large fortune by "forwarding" merchandise. In 1853 he removed to Toronto, and in the same year obtained the contract for building a line of railway from Toronto to Sarnia, a project from which sprang the Grand Trunk railway, in the construction of which line he greatly increased his wealth. In 1864 he was elected to the Canadian parliament as member of the Legislative Council for Saugeen, and on the formation of the Dominion, in 1867, was nominated to the Senate. In the following years he published a number of pamphlets on economic subjects, of which the best-known is *Banking and Currency* (1869). In 1880 he was appointed Speaker of the Senate, and from October 1883 till 1885 was minister of the interior in the Conservative cabinet. In 1884 he was knighted by Queen Victoria. He died on the 16th of August 1896.

MACPHERSON, JAMES (1736–1796), Scottish "translator" of the Ossianic poems, was born at Ruthven in the parish of Kingussie, Inverness, on the 27th of October 1736. He was sent in 1753 to King's College, Aberdeen, removing two years later to Marischal College. He also studied at Edinburgh, but took no degree. He is said to have written over 4000 lines of verse while a student, but though some of this was published, notably *The Highlander* (1758), he afterwards tried to suppress it. On leaving college he taught in the school of his native place. At Moffat he met John Home, the author of *Douglas*, for whom he recited some Gaelic verses from memory. He also showed him MSS. of Gaelic poetry, supposed to have been picked up in the Highlands, and, encouraged by Home and others, he produced a number of pieces translated from the Gaelic, which he was induced to publish at Edinburgh in 1760 as *Fragments of Ancient Poetry collected in the Highlands of Scotland*. Dr Hugh Blair, who was a firm believer in the authenticity of the poems, got up a subscription to allow Macpherson to pursue his Gaelic researches. In the autumn he set out to visit western Inverness, the islands of Skye, North and South Uist and Benbecula. He obtained MSS. which he translated with the assistance of Captain Morrison and the Rev. A. Gallie. Later in the year he made an expedition to Mull, when he obtained other MSS. In 1761 he announced the discovery of an epic on the subject of Fingal, and in December he published *Fingal, an Ancient Epic Poem in Six Books, together with Several Other Poems composed by Ossian, the Son of Fingal, translated from the Gaelic Language*, written in the musical measured prose of which he had made use in his earlier volume. *Temora* followed in 1763, and a collected edition, *The Works of Ossian*, in 1765.

The genuineness of these so-called translations from the works of a 3rd-century bard was immediately challenged in England, and Dr Johnson, after some local investigation, asserted (*Journey to the Western Islands of Scotland*, 1775) that Macpherson had only found fragments of ancient poems and stories, which he had woven into a romance of his own composition. Macpherson is said to have sent Johnson a challenge, to which Johnson replied that he was not to be deterred from detecting what he thought a cheat by the menaces of a ruffian. Macpherson never produced his originals, which he refused to publish on the ground of the expense. In 1764 he was made secretary to General Johnstone at Pensacola, West Florida, and when he returned, two years later, to England, after a quarrel with Johnstone, he was allowed to retain his salary as a pension. He occupied himself with writing several historical works, the most important of which was *Original Papers, containing the Secret History of Great Britain from the Restoration to the Accession of the House of Hanover; to which are prefixed Extracts from the Life of James II., as written by himself* (1775). He enjoyed a salary for defending the policy of Lord North's government, and held the lucrative post of London agent to Mahommed Ali, nabob of Arcot. He entered parliament in 1780, and continued to sit until his death. In his later years he bought an estate, to which he gave the name of Belville, in his native county of Inverness, where he died on the 17th of February 1796.

After Macpherson's death, Malcolm Laing, in an appendix to his *History of Scotland* (1800), propounded the extreme view that the so-called Ossianic poems were altogether modern in origin, and that Macpherson's authorities were practically non-existent. For a discussion of this question see Celt: *Scottish Gaelic Literature.* Much of Macpherson's matter is clearly his own, and he confounds the stories belonging to different cycles. But apart from the doubtful morality of his transactions he must still be regarded as one of the great Scottish writers. The varied sources of his work and its worthlessness as a transcript of actual Celtic poems do not alter the fact that he produced a work of art which by its deep appreciation of natural beauty and the melancholy tenderness of its treatment of the ancient legend did more than any single work to bring about the romantic movement in European, and especially in German, literature. It was speedily translated into many European languages, and Herder and Goethe (in his earlier period) were among its profound admirers. Cesarotti's Italian translation was one of Napoleon's favourite books.

Authorities.—For Macpherson's life, see *The Life and Letters of James Macpherson . . .* (1894, new ed., 1906), by T. Bailey Saunders, who has laboured to redeem his character from the suspicions generally current with English readers. The antiquity of the Ossianic poems was defended in the introduction by Archibald Clerk to his edition of the *Poems of Ossian* (1870). Materials for arriving at a decision by comparison with undoubtedly genuine fragments of the Ossianic legend are available in *The Book of the Dean of Lismore*, Gaelic verses, collected by J. McGregor, dean of Lismore, in the early 16th century (ed. T. McLauchlan. 1862); the *Leabhar na Feinne* (1871) of F. J. Campbell, who also discusses the subject in *Popular Tales of the Western Highlands*, iv. (1893). See also L. C. Stern, "Die ossianische Heldenlieder" in *Zeitschrift für vergleichende Litteratur-geschichte* (1895; Eng. trans. by J. L. Robertson in *Trans. Gael. Soc. of Inverness*, xxii., 1897–1898); Sir J. Sinclair, *A Dissertation on the Authenticity of the Poems of Ossian* (1806); *Transactions of the Ossianic Society* (Dublin, 1854–1861); *Cours de littérature celtique*, by Arbois de Jubainville, editor of the *Revue celtique* (1883, &c.); A. Nutt, *Ossian and the Ossianic Literature* (1899), with a valuable bibliographical appendix; J. S. Smart, *James Macpherson: an Episode in Literature* (1905).

McPHERSON, JAMES BIRDSEYE (1828–1864), American soldier, was born at Sandusky, Ohio, on the 14th of November 1828. He entered West Point at the age of twenty-one, and graduated (1853) at the head of his class, which included Sheridan, Schofield and Hood. He was employed at the military academy as instructor of practical military engineering (1853). A year later he was sent to engineer duty at New York, and in 1857, after constructing Fort Delaware, he was sent as superintending engineer to San Francisco, becoming 1st lieutenant in 1858. He was promoted captain during the first year of the Civil War, and towards the close of 1861 became lieutenant-colonel and aide-de-camp to General Halleck, who in the spring of 1862 sent him to General Grant as chief engineer. He remained with Grant during the Shiloh campaign, and acted as engineer adviser to Halleck during the siege operations against Corinth in the summer of 1862. In October he distinguished himself in command of an infantry brigade at the battle of Corinth, and on the 8th of this month was made major-general of volunteers and commander of a division. In the second advance on Vicksburg (1863) McPherson commanded the XVII. corps, fought at Port Gibson, Raymond and Jackson, and after the fall of Vicksburg was strongly recommended by Grant for the rank of brigadier-general in the regular army, to which he was promoted on the 1st of August 1863. He commanded at Vicksburg until the following spring. He was about to go on leave of absence in order to be married in Baltimore when he received his nomination to the command of the Army of the Tennessee, Grant's and Sherman's old army, which was to take part under Sherman's supreme command in the campaign against Atlanta (1864). This nomination was made by Sherman and entirely approved by Grant, who had the highest opinion of McPherson's military and personal qualities. He was in command of his army at the actions of Resaca, Dallas, Kenesaw Mountain and the battles about Atlanta. On the 22nd of July, when the Confederates under his old classmate Hood made a sudden and violent attack on the lines held by the Army of the Tennessee, McPherson rode up, in the woods, to the enemy's firing line and was killed. He was one of the most heroic figures of the American Civil War, and Grant is reported to have said when he heard of McPherson's death, "The country has lost one of its best soldiers, and I have lost my best friend."

MACQUARIE, a British island in the South Pacific Ocean, in 54° 49′ S. and 159° 49′ E. It is about 20 m. long, and covered with a grassy vegetation, with some trees or shrubs in the sheltered places which afford food to a parrot of the genus *Cyanorhamphus*, allied to those of the Auckland Islands. Although it has no settled population, Macquarie is constantly visited by sailors in quest of the seals which abound in its waters.

MACRAUCHENIA, a long-necked and long-limbed, three-toed South American ungulate mammal, typifying the suborder *Litopterna* (*q.v.*).

MACREADY, WILLIAM CHARLES (1793–1873), English actor, was born in London on the 3rd of March 1793, and educated at Rugby. It was his intention to go up to Oxford, but in 1809 the embarrassed affairs of his father, the lessee of several provincial theatres, called him to share the responsibilities of theatrical management. On the 7th of June 1810 he made a successful first appearance as Romeo at Birmingham. Other Shakespearian parts followed, but a serious rupture between father and son resulted in the young man's departure for Bath in 1814. Here he remained for two years, with occasional professional visits to other provincial towns. On the 16th of September 1816, Macready made his first London appearance at Covent Garden as Orestes in *The Distressed Mother*, a translation of Racine's *Andromaque* by Ambrose Philips. Macready's choice of characters was at first confined chiefly to the romantic drama. In 1818 he won a permanent success in Isaac Pocock's (1782–1835) adaptation of Scott's *Rob Roy.* He showed his capacity for the highest tragedy when he played Richard III. at Covent Garden on the 25th of October 1819. Transferring his services to Drury Lane, he gradually rose in public favour, his most conspicuous success being in the title-rôle of Sheridan Knowles's *William Tell* (May 11, 1825). In 1826 he completed a successful engagement in America, and in 1828 his performances met with a very flattering reception in Paris. On the 15th of December 1830 he appeared at Drury Lane as Werner, one of his most powerful impersonations. In 1833 he played in *Antony and Cleopatra*, in Byron's *Sardanapalus*, and in *King Lear.* Already Macready had done something to encourage the creation of a modern English drama, and after entering on the management of Covent Garden in 1837 he introduced Robert Browning's *Strafford*, and in the following year Bulwer's *Lady of Lyons* and *Richelieu*, the principal characters in which were among his most effective parts. On the 10th of June 1838 he gave a memorable performance of *Henry V.*, for which Stanfield prepared sketches, and the mounting was superintended by Bulwer, Dickens, Forster, Maclise, W. J. Fox and other friends. The first production of Bulwer's *Money* took place under the artistic direction of Count d'Orsay on the 8th of December 1840, Macready winning unmistakable success in the character of Alfred Evelyn. Both in his management of Covent Garden, which he resigned in 1839, and of Drury Lane, which he held from 1841 to 1843, he found his designs for the elevation of the stage frustrated by the absence of adequate public support. In 1843–1844 he made a prosperous tour in the United States, but his last visit to that country, in 1849, was marred by a riot at the Astor Opera House, New York, arising from the jealousy of the actor Edwin Forrest, and resulting in the death of seventeen persons, who were shot by the military called out to quell the disturbance. Macready took leave of the stage in a farewell performance of Macbeth at Drury Lane on the 26th of February 1851. The remainder of his life was spent in happy retirement, and he died at Cheltenham on the 27th of April 1873. He had married, in 1823, Catherine Frances Atkins (d. 1852). Of a numerous family of children only one son and one daughter survived. In 1860 he married Cecile Louise Frederica Spencer (1827–1908), by whom he had a son.

Macready's performances always displayed fine artistic perceptions developed to a high degree of perfection by very comprehensive culture, and even his least successful personations had the interest resulting from thorough intellectual study. He belonged to the school of Kean rather than of Kemble; but, if his tastes were better disciplined and in some respects more refined than those of Kean, his natural temperament did not permit him to give proper effect to the great tragic parts of Shakespeare, *King Lear* perhaps excepted, which afforded scope for his pathos and tenderness, the qualities in which he specially excelled. With the exception of a voice of good compass and capable of very varied expression, Macready had no especial physical gifts for acting, but the defects of his face and figure cannot be said to have materially affected his success.

See *Macready's Reminiscences*, edited by Sir Frederick Pollock, 2 vols. (1875); *William Charles Macready*, by William Archer (1890).

MACROBIUS, AMBROSIUS THEODOSIUS, Roman grammarian and philosopher, flourished during the reigns of Honorius and Arcadius (395–423). He himself states that he was not a Roman, but there is no certain evidence whether he was of Greek or perhaps African descent. He is generally supposed to have been praetorian praefect in Spain (399), proconsul of Africa (410), and lord chamberlain (422). But the tenure of high office at that date was limited to Christians, and there is no evidence in the writings of Macrobius that he was a Christian. Hence the identification is more than doubtful, unless it be assumed that his conversion to Christianity was subsequent to the composition of his books. It is possible, but by no means certain, that he was the Theodosius to whom Avianus dedicates his fables.

The most important of his works is the *Saturnalia*, containing an account of the discussions held at the house of Vettius Praetextatus (*c.* 325–385) during the holiday of the Saturnalia. It was written by the author for the benefit of his son Eustathius (or Eustachius), and contains a great variety of curious historical, mythological, critical and grammatical disquisitions. There is but little attempt to give any dramatic character to the dialogue; in each book some one of the personages takes the leading part, and the remarks of the others serve only as occasions for calling forth fresh displays of erudition. The first book is devoted to an inquiry as to the origin of the Saturnalia and the festivals of Janus, which leads to a history and discussion of the Roman calendar, and to an attempt to derive all forms of worship from that of the sun. The second book begins with a collection of *bons mots*, to which all present make their contributions, many of them being ascribed to Cicero and Augustus; a discussion of various pleasures, especially of the senses, then seems to have taken place, but almost the whole of this is lost. The third, fourth, fifth and sixth books are devoted to Virgil, dwelling respectively on his learning in religious matters, his rhetorical skill, his debt to Homer (with a comparison of the art of the two) and to other Greek writers, and the nature and extent of his borrowings from the earlier Latin poets. The latter part of the third book is taken up with a dissertation upon luxury and the sumptuary laws intended to check it, which is probably a dislocated portion of the second book. The seventh book consists largely of the discussion of various physiological questions. The value of the work consists solely in the facts and opinions quoted from earlier writers, for it is purely a compilation, and has little in its literary form to recommend it. The form of the *Saturnalia* is copied from Plato's *Symposium* and Gellius's *Noctes atticae*; the chief authorities (whose names, however, are not quoted) are Gellius, Seneca the philosopher, Plutarch (*Quaestiones conviviales*), Athenaeus and the commentaries of Servius (excluded by some) and others on Virgil. We have also two books of a commentary on the *Somnium Scipionis* narrated by Cicero in his *De republica*. The nature of the dream, in which the elder Scipio appears to his (adopted) grandson, and describes the life of the good after death and the constitution of the universe from the Stoic point of view, gives occasion for Macrobius to discourse upon many points of physics in a series of essays interesting as showing the astronomical notions then current. The moral elevation of the fragment of Cicero thus preserved to us gave the work a popularity in the middle ages to which its own merits have little claim. Of a third work, *De differentiis et societatibus graeci latinique verbi*, we only possess an abstract by a certain Johannes, identified with Johannes Scotus Erigena (9th century).

See editions by L. von Jan (1848–1852, with bibliog. of previous editions, and commentary) and F. Eyssenhardt (1893, Teubner text); on the sources of the *Saturnalia* see H. Linke (1880) and G. Wissowa (1880). The grammatical treatise will be found in Jan's edition and H. Keil's *Grammatici latini*, v.; see also G. F. Schömann, *Commentatio macrobiana* (1871).

MACROOM, a market town in the western part of county Cork, Ireland, on the river Sullane, an affluent of the Lee, 24½ m. W. of Cork by the Cork & Macroom railway, of which it is the terminus. Pop. (1901), 3016. Besides a fine Roman Catholic church, a court house and barracks, Macroom possesses a modernized castle, which is said to have been founded by King John, though it is more probably attributable to Norman invaders. It was besieged more than once in the 17th century, and is said to have been the birthplace of Admiral Sir William Penn, whose more famous son founded Pennsylvania. Here some rebels of 1798 were executed and their heads exhibited on the spikes of the castle gate. Macroom has trade in corn-milling, leather-work and dairy produce, and is a good centre for salmon and trout fishing. It is governed by an urban district council.

MACUGNAGA, a village of Piedmont, Italy, in the province of Novara, 20 m. W.S.W. of Piedimulera, which is 7 m. S. of Domodossola by rail. Pop. (1901), 798. It is situated 4047 ft. above sea-level, and is 10 m. N.E. of the highest summit of Monte Rosa. It is frequented as a summer resort.

MacVEAGH, WAYNE (1833–), American lawyer and diplomatist, was born near Phoenixville, Chester county, Pa., on the 19th of April 1833. He graduated at Yale in 1853, was admitted to the bar in 1856, and was district attorney of Chester county in 1859–1864. He held commands in militia forces raised to meet threatened Confederate invasions of Pennsylvania (1862–63). He became a leader in the Republican party, and was a prominent opponent of his father-in-law, Simon Cameron, in the fight within the party in 1871. MacVeagh was minister to Turkey in 1870–1871; was a member of the state constitutional convention of 1872–1873; was chairman of the "MacVeagh Commission," sent in 1877 by President Hayes to Louisiana, which secured the settlement of the contest between the two existing state governments and thus made possible the withdrawal of Federal troops from the state; and was attorney-general of the United States in 1881 under President Garfield, but resigned immediately after Garfield's death. In 1892 he supported Grover Cleveland, the Democratic nominee for the presidency, and from 1893 to 1897 was ambassador to Italy. He returned to the Republican party in 1896. In 1903 he was chief counsel of the United States before the Hague tribunal in the case regarding the claims of Germany, Great Britain and Italy against the republic of Venezuela.

MADÁCH, IMRE (1829–1864), Hungarian dramatist, was born at Alsó-Sztregova. He took part in the great revolution of 1848–49 and was imprisoned; on his return to his small estate in the county of Nógrád, he found that his family life had meanwhile been completely wrecked. This only increased his natural tendency to melancholy, and he withdrew from public life till 1861, devoting his time mainly to the composition of his chief work, *Az ember tragoediája* ("The Tragedy of Man"). John Arany, then at the height of his fame as a poet, at once recognized the great merits of that peculiar drama, and Madách enjoyed a short spell of fame before his untimely death of heart-disease in 1864. In *The Tragedy of Man* Madách takes us from the hour when Adam and Eve were innocently walking in the Garden of Eden to the times of the Pharaohs; then to the Athens of Miltiades; to declining Rome; to the period of the crusades; into the study of the astronomer Kepler; thence into the horrors of the French Revolution; into greed-eaten and commerce-ridden modern London; nay, into the ultra-Socialist state of the future, when all the former ideals of man will by scientific formulae be shown up in their hollowness; still further, the poet shows the future of ice-clad earth, when man will be reduced to a degraded brute dragging on the misery of his existence in a cave. In all these scenes, or rather anticipatory dreams, Adam, Eve and the arch-fiend Lucifer are the chief and constantly recurring *personae dramatis.* In the end, Adam, despairing of his race, wants to commit suicide, when at the critical moment Eve tells him that she is going to be a mother. Adam then prostrates himself before God, who encourages him to hope and trust. The diction of the drama is elevated and pure, and although not meant for the stage, it has proved very effective at several public performances.

Concerning Madách there is an ample literature, consisting mostly of elaborate articles by Charles Szász (1862), Augustus Greguss (1872), B. Alexander (1871), M. Palágyi (1890), and others.

MADAGASCAR, an island in the Indian Ocean, and after New Guinea and Borneo the largest island in the world, about 260 m. distant, at the nearest point, from the S.E. coast of Africa, from which it is separated by the Mozambique Channel. Since 1896 Madagascar has been a French colony. It is 995 m. in length from N. to S., and about 250 m. in average breadth, although near the centre it is nearly 360 m. across; its area is about 228,000 sq. m., or not quite four times the extent of England and Wales. It lies mainly between 44° and 50° E. Its northernmost point, Cape Ambro, in 12° S., inclines 16° to the E. from the longitude of Cape St Mary, the southernmost point, in 25° 35′ S., so that the main axis of the island runs from N.N.E. to S.S.W. In its broad structure Madagascar consists of an elevated mountainous region, from 3000 to 5000 ft. in altitude, occupying from two-fifths to a half of the centre and the eastern side of the island, around which are extensive plains at a much less elevation above the sea, and most developed on the western and north-west sides. But this lower region is broken up by masses of hills, with several elevated plateaus, especially in the south-west and south.

Physical Features.—Madagascar has a very regular and compact form, with few indentations considering its great extent of shore-line. In general outline it has a strong resemblance to the impression of a human foot—the left side. Along two-thirds of its eastern side the coast is almost a straight line, without any inlet, Tamatave, the chief port on this side of the island, being only protected by coral reefs. North of this line, however, is Antongil Bay, a deep and wide inlet running northwards for about 50 m.; farther north is Port Louquez, and at almost the extreme point of the island is Diego-Suarez Bay, one of the finest harbours in the world. But the north-western side of Madagascar is broken up by a number of inlets, some of them land-locked and of considerable size. South of Cape St Andrew, the north-west angle of the island, the coast-line is unbroken until the estuary of the river Onilàhy, or St Augustine's Bay, is reached. Rounding the southern end of the island, there is no other inlet save the small bay north of Fort Dauphin, at the southern end of the straight line of coast already mentioned.

The islands around Madagascar are few and unimportant. The largest are Ste Marie, near the eastern coast, a narrow island about 35 m. long, and Nossi-bé (*q.v.*), larger and more compact in form, opposite Ampàsindàva Bay on the N.W. coast. Except the Minnow group, north of Nossi-bé, the rest are merely rocky islets, chiefly of coral.

The shores of the greater portion of the southern half of the island are low and flat, but in the northern half the coast is often bold and precipitous, the high land occasionally approaching the sea. On the eastern side the plains vary from 10 to 50 m. in breadth, but on the western side they exceed in some localities 100 m. From these coast-plains the ground rises by successive ranges of hills to the high interior land. This elevated region is broken in all directions by mountains, from which the crystalline rocks show most frequently as huge bosses, and in certain regions present very varied and picturesque outlines, resembling Titanic castles, cathedrals, domes, pyramids and spires. The highest mountain mass is centrally situated as regards the length of the island, but more to the eastern side. This is the ancient extinct volcano Ankàratra, three of the highest points varying in elevation from 7284 to 8635 ft. above the sea, and from 4000 to 5000 ft. above the general level of the surrounding country. The loftiest of these is named Tsi-àfa-jàvona, *i.e.* "That which the mists cannot climb." It had been supposed that Ankàratra was the highest point in the island, but in 1903 it was found that Ambòro, in the northern province of Antankàrana, is about 9490 ft. in altitude. Besides these highest points there are a considerable number of mountains in the central provinces of Imèrina and Bétsiléo and the intervening and surrounding districts; and in the Bàra country the Isàlo range has been compared to the "Church Buttes" and other striking features of the scenery of Utah. One of the finest of the Madagascar mountains is an isolated mass near the northern point of the island called Ambòhitra. This is 4460 ft. high, and rising from land little above the sea-level, is well seen far out to sea.

In the elevated region of Madagascar are many fertile plains and valleys, the former being the dried-up beds of ancient lakes. Among these are Bètsimitàtatra in Imèrina, and Tsiènimparìhy in Bétsiléo, supplying a large proportion of the rice required for the capitals of these two provinces. Still more spacious valleys are the Antsihànaka country and the Ankày district, between the two eastern lines of forest. The extensive coast plains on the western side of the island are chiefly in Ibòina (N.W.) and in Ménabé (S. of the Tsìribìhina River); those on the east are widest in the Taifàsy country (S.E.). The water-parting for six-sevenths of the whole length of the island is much nearer the eastern than the western side, averaging from 80 to 90 m. from the sea. There are no arid districts, except in the extreme south-west and towards the southern point of the island. The general surface of the interior highland consists of bare rolling moor-like country, with a great amount of red clay-like soil, while the valleys have a rich humus of bluish-black alluvium.

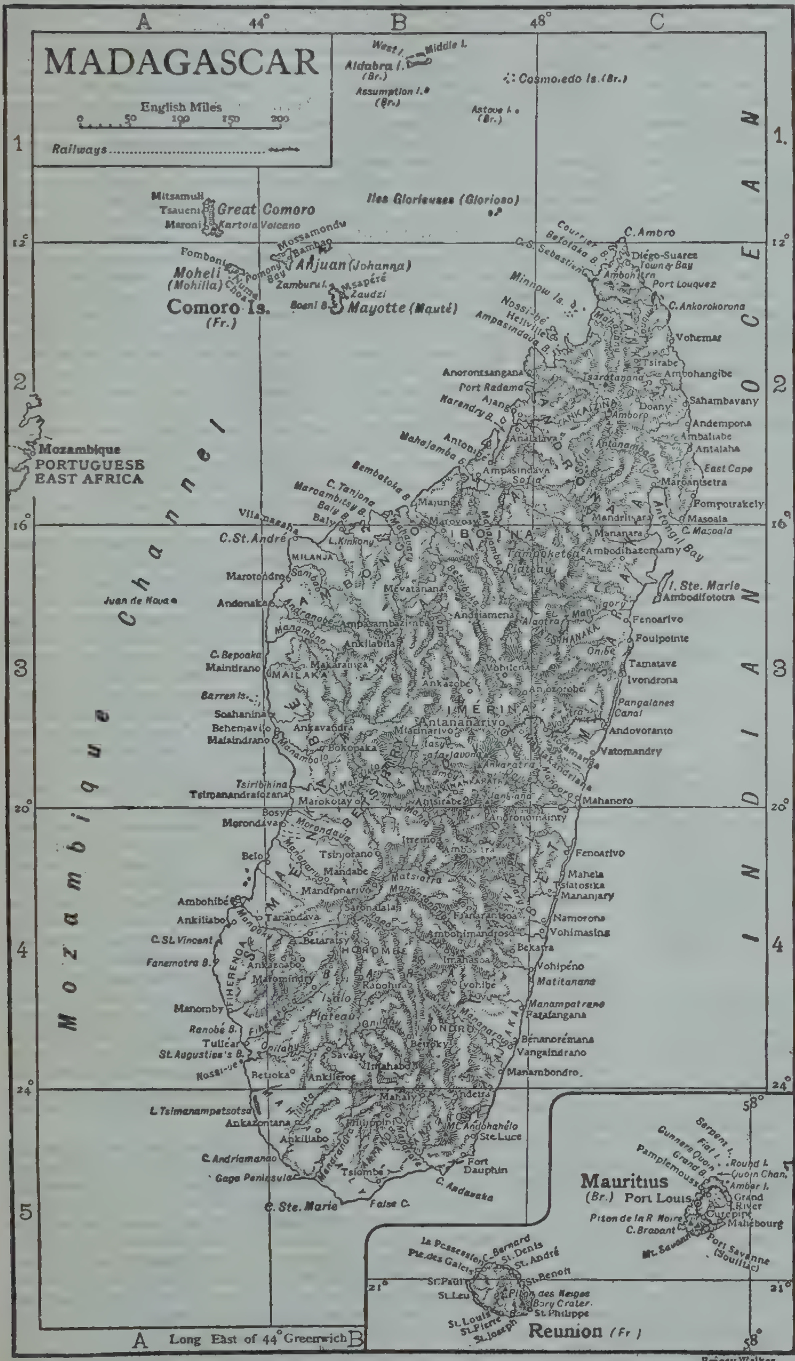
The chief rivers flow to the west and north-west sides of the island. The eastern streams are all less in size, except the Mangòro, which flows parallel with the coast. Few of them therefore are of much service for navigation, except for the light-draught native canoes; and all of them are more or less closed at their outlets by sand-bars. Beginning at the south-eastern point and going northwards, the principal rivers are the Mànanàra, Mànampàtrana, Màtitànana, Mànanjàry, Mangòro, with its great affluent Onivé, Vòhitra, Mànin-gòry, and the Antànambàlana at the head of Antongil Bay. On the N.W. coast, going southwards, are the Sofià and Màhajàmba, falling into Màhajàmba Bay, the Bétsiboka with the Ikòpa—the great drains of the northern central provinces, forming unitedly the second largest river of the island and falling into Bèmbatòka Bay—the Màhavàry, Mànambòlo, Tsìribìhina or Onimàinty, the third largest river, with its tributaries the Kìtsàmby, Màhajìlo and Manìa, the Mòrondàva, Mangòky, probably the largest river in the country, with its important tributaries the Matsìatra, Mànantànana and Rànomàitso, the Fiherènana and Onilàhy. On the south coast are four considerable streams, the largest of which is the Mènaràndra. Of the western rivers the Bètsibòka can be ascended by small steamers for about 100 m., and the Tsìribìhina is also navigable for a considerable distance. The former is about 300 m. long; the latter somewhat less, but by its affluents spreads over a greater extent of country, as also does the Mangòky. The rivers are all crossed frequently by rocky bars, which often form grand waterfalls. The eastern rivers cut their way through the ramparts of the high land by magnificent gorges amidst dense forest, and descend by a succession of rapids and cataracts. The Màtitànana, whose falls were first seen by the writer in 1876, descends at one plunge some 400 ft.; and on the Vòhitra River, whose valley is followed by the railway, there are also many fine waterfalls.

On the eastern side of Madagascar the contest between the fresh water of the rivers and the sea has caused the formation of a chain of lagoons for nearly 300 m. In many places these look like a river following the coast-line, but frequently they spread out into extensive sheets of water. By cutting about 30 m. of canal to connect them, a continuous waterway could be formed for 270 m. along the coast. This has already been done for about 55 m. between Ivòndrona and Andòvorànto, a service of small steamers forming part of the communication between the coast and the capital. Besides these lagoons, there are few lakes of any size in Madagascar, although there were some very extensive lakes in a recent geological epoch. Of the largest of these, the Alàotra Lake in the Antsihànaka plain is the relic; it is about 25 m. long. Next comes Kinkòny, near Maròambitsy Bay (N.W. coast), about 16 m. long, and then Itàsy, in western Imèrina, about half as large. There is also a salt lake, Tsimànampetsòtsa (S.W. coast), about as large as Alàotra.

There is now no active volcano in Madagascar, but a large number of extinct cones are found, some apparently of very recent formation. Some miles south of Diégo-Suarez is a huge volcanic mountain, Ambòhitra, with scores of subsidiary cones on its slopes and around its base. About 40 m. south-west of Antanànarìvo there is a still larger extinct volcano, Ankàratra, with an extensive lava field surrounding it; while near Lake Itàsy are some 200 volcanic cones. Another group of extinct volcanoes is in the Vàkinankàratra district, S.W. of Ankàratra. Many others exist in other parts of the island (see § *Geology*). Slight shocks of earthquake are felt every year, and hot springs occur at many places. Several of these are sulphurous and medicinal, and have been found efficacious in skin diseases and in internal complaints.

Geology.—Madagascar may be divided into two very distinct geological regions, viz. (I.) the Archean Region, which extends over the central and eastern portions of the island and occupies about two-thirds of its whole area, and is composed of crystalline schists; and (II.) the Western Region, of sedimentary rocks, including the remaining third of the island, in the centre of which, however, is an isolated patch of Archean rocks, near Cape St Andrew. There are also found in both regions numerous masses of igneous rocks, both plutonic and volcanic, in some places of considerable extent, which pierce through and overflow the earlier formations.

I. *The Archean Region.*[1]—This region, nearly coincident with the mountainous upper portion of the island, is chiefly composed of the following crystalline rocks: gneiss, which is the most common of them all, quartzite and quartz-schist, with occasional beds of crystalline limestone and mica-schist, although this latter rock is very rare. The gneiss is mostly grey, but occasionally pinkish, its essential constituents (felspar and quartz) being almost always associated with dark mica (biotite) and hornblende in variable quantity. The rock is therefore a hornblende-granitite-gneiss. Granite—more frequently granitite—occurs in several places, as well as pyroxene-granulite, serpentine, argillate, &c.; and gold is found widely disseminated, as well as other metals, but these latter, as far as at present known, except iron, are not abundant. The general strike of the rocks is the same as that of the trend of the island itself (N.N.E. to S.S.W.), but in its western portion the strike is frequently from N.N.W. to S.S.E. In both cases the strike of the rocks is coincident with the direction of several large valleys, which mark huge faults in the crystalline rocks. Almost the whole of this region is covered by a red soil, often of great thickness, which resembles and is often described as "clay," but is really decomposed rock, chiefly gneiss, reddened with oxidized magnetite.


MADAGASCAR
English Miles
0 50 100 150 200
Railways
A B C
44° 48°
1 2 3 4 5
12° 16° 20° 24°
West I. Middle I.
Aldabra I. (Br.)
Assumption I. (Br.)
Astove I. (Br.)
Cosmoledo Is. (Br.)
Iles Glorieuses (Glorioso)
Mitsamuli
Tsaueni
Maroni
Great Comoro
Kartola Volcano
Mossamondu
Fomboni
Moheli (Mohilla)
Pomony Bay
Anjuan (Johanna)
Zamburu I.
Msapéré
Zaudzi
Boeni B.
Mayotte (Mauté)
Comoro Is. (Fr.)
Mozambique
PORTUGUESE EAST AFRICA
Mozambique Channel
Juan de Nova
INDIAN OCEAN
Courier B.
Befotaka B.
C.S. Sebastian
C. Ambro
Diégo-Suarez Town & Bay
Ambohitra
Port Louquez
C. Ankorokorona
Minnow Is.
Nossi-bé
Helville
Ampasindava B.
Vohemar
Tsirabe
Ambohangibe
Anorontsangana
Port Radama
Ajangua
Narendry B.
Tsaratanana
Sahambavany
Doany
Amboro
Andempona
Ambatiabe
Antalaha
Analalava
Antonibe
Mahajamba B.
Ampasindava
Sofia
East Cape
Marantsetra
Bembatoka B.
C. Tanjona
Maroambitsy B.
Baly B.
Majunga
Pompotrakely
Masoala
C. Masoala
Mandritsara
Antongil Bay
Vilanasaha
C. St. André
L. Kinkony
Marovoay
IBOINA
Mananara
Ambodihazomamy
Tsiafaharafa
Plateau
MILANJA
Marotondro
Andonaka
Mevatanana
I. Ste. Marie
Ambodifototra
Andriamena
Alaotra
Mangoro
Fenoarivo
Foulpointe
Manambolo
Ankilahila
C. Bepoaka
Maintirano
MAILAKA
Makaranga
ANTSIHANAKA
Onibe
Tamatave
Ivondrona
Ankazobe
Barren Is.
Soahanina
Behemavilo
Maisindrano
IMERINA
Antananarivo
Miarinarivo
Itasy
Pangalanes Canal
Andovoranto
Vatomandry
Ankavandra
Bokopaka
Ankaratra
Tsiribihina
Tsimanandrafozana
Marokolay
Antsirabe
Mahanoro
Bosy
Morondava
Belo
Tsinjorano
Mandabe
Matsiatra
Mandronarivo
Fenoarivo
Mahela
Masiatosika
Mananjary
Ambohibé
Ankiliabo
Tanandava
Namorona
Vohimasina
C. St. Vincent
Fanemotra B.
Betaraisy
HOROMBE
Ambohimandroso
Bekatra
Vohipeno
Matitanana
Manomby
Isalo
Ranobé B.
Tuléar
St. Augustine's B.
Onilahy
Nosi-ve
Plateau
Manampatrana
Farafangana
Benanorémana
Vangaindrano
Betroky
Ihanabo
Ankileroe
Manambondro
Betioka
Mahaly
L. Tsimanampetsotsa
Ankazontana
Ankilabo
Anosy
Antanosy
Ste. Luce
C. Andriamanao
Gaga Peninsula
Tsiombe
Fort Dauphin
C. Andavaka
C. Ste. Marie
False C.
Long East of 44° Greenwich
58°
Mauritius (Br.)
Port Louis
Serpent I.
Gunners Quoin
Flat I.
Round I.
Quoin Chan.
Amber I.
Grand B.
Grand River
Pamplemousses
Piton de la R. Noire
C. Brabant
Mt. Savanne
Curepipe
Mahébourg
Port Savanne (Souillac)
La Possession
Pte. des Galets
C. Bernard
St. Denis
St. André
St. Benoît
St. Paul
St. Leu
Piton des Neiges
Bory Crater
St. Philippe
St. Louis
St. Pierre
St. Joseph
Reunion (Fr.)
21°

Emery Walker

II. *The Sedimentary Region.*—The sedimentary rocks extend continuously along the western side of Madagascar, following the coastline; in the north these series of strata are only from 20 to 30 m. across, but farther south they reach a breadth of nearly 100 m., while opposite the Bétsiléo province they extend nearly half across the island. A narrow band, of Cretaceous age, occurs also on the east coast, for about 120 m., between Vàtomàndry and Mànanjàry. The following formations are represented:—

1. *Primary.* It is thought that certain beds of slaty rocks, which have been recognized at different places, may belong to some of the Primary strata. Some siliceous schists of the Permian age were discovered in 1908 in the valley of the Sàkamèira, south of the Onilàhy, or Augustine river. (S.W. coast). These contain reptilian remains, and also clear imprints of leaves of the *Glossopteris indica*, as well as other indications of an ancient vegetation. In the same region conglomerates have been found containing enormous blocks, apparently brought by glacial action, and said to be identical in character with those described as existing in the Transvaal. True coal has also been obtained in the same district, the deposits varying from a third to half a metre in thickness.

2. *Secondary.* The lowest members of these rest directly upon the central mass of crystalline rocks, and consist of sandstones, conglomerates and shales, which have been supposed by some to belong to the Trias, without, however, the discovery of any fossil necessary to confirm this supposition, except some silicified trunks of trees. These beds are most probably lower members of the Jurassic series. Westward of and above these strata, the Middle and Upper Jurassic formations are found (Lias, Lower Oolite, Oxfordian, &c.), with well-marked and numerous fossils (*Ammonites, Nerinaea, Natica, Astarte, Rhynchonella, Echinodermata*, &c.); then the Cretaceous rocks, both these and the Jurassic series being largely developed, the Cretaceous fossils including *Nautilus, Belemnites, Ostrea, Gryphaea*, &c., and some very large Ammonites (*Pachydiscus*). The Secondary strata show generally a very slight dip westwards and are consequently almost horizontal. They do not seem to have been greatly disturbed, although faults occur here and there.

3. *Tertiary.* A small strip of coast of Eocene age is known near Tullear (S.W. coast), and rocks of the same period occur in Nòssi-bé, at Màhajamba Bay, and at Diégo-Suarez, with Nummulites and other foraminifera. Near the latter locality, beds of Oligocene age have been noticed, consisting of coarse limestones.

4. *Quaternary and Recent.* A narrow band of these deposits extends along the west coast, from north of Cape St Andrew nearly to the extreme southern point of the island. But the most noticeable of these are those in the ancient bed of the Alàotra Lake, which formerly extended far southwards along the valley of the Mangòro; also those in the marshes of Antsìrabè and of Ifànja, in the Ikòpa valley (the great rice plain west of the capital), and also in the plain of Tsiénimpàrìhy in Bétsiléo, and especially the recent deposits of Ampàsambazìmba, north-west of Lake Itàsy, discovered in 1902. These beds, rich in sub-fossil remains, have yielded important additions to our knowledge of the extinct fauna of the island. (See § *Palaeontology*.)

Igneous Rocks. (1) *Plutonic rocks.*—The ancient or plutonic igneous rocks (including granite, syenite, diorite, gabbro, porphyry, porphyrite, norite and retinite) appear at various points of the two previously described regions. In the Archean region the gneiss is very often found passing into granite, but certain granitic masses have a sufficiently distinct character. In the midst of the sedimentary region are two well-recognized masses of plutonic rocks, belonging to the syenites, sometimes quartziferous in structure. (2) *Volcanic rocks.*—Recent volcanic eruptive rocks (including rhyolite, trachyte, phonolite, andesite and basalt) have been examined at a number of points throughout both the geological regions of the island. In the Archean region these are very noticeable near Lake Itàsy, in the *massif* of Ankàratra (an ancient volcano) and in Vàkinankàratra (at Bètàfo, Antsìrabé, &c.); while there are numerous outflows of doleritic rocks, probably from faults, along the eastern side of the island and almost parallel with the coast line. In the sedimentary region volcanic rocks are very numerous; the most extensive of these is a tract of country, more than 80 m. long, on the west coast, where the basalt has overflowed the Cretaceous strata. It must be remembered that the geology of Madagascar is still only known in its broad features.[1]

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[1] In the apparent absence of any Cambrian formation above them, there is little doubt that these rocks are Archean, although this cannot be absolutely proved.

Minerals and Metals.—The country has considerable mineral wealth. Gold is found almost all over the region of crystalline rocks, except in and around the Antsihànaka province, the richest auriferous districts being a band of country parallel with the east coast and spreading at its southern end into the interior; and another tract, whose centre is about 100 m. N. of the capital (see § *Industries*, &c.). Silver has been detected in certain galenas, and also platinum; copper has been found in various localities, as well as zinc, lead, nickel, antimony and manganese, but none of these metals has yet been discovered in sufficient quantities for profitable working. Iron, on the contrary, especially magnetite, is found abundantly and has for long been worked by the Malagasy with the simple appliances brought by their ancestors from their original home in the Far East. The principal seats of the native industry are on the edge of the upper forest, where charcoal is easily procured. The following precious stones are reported: corundum (rubies and sapphires), beryl, topaz, zircon, garnet, amazon-stone, tourmaline, often in large crystals, and variously coloured quartz, also often found in crystals of great size. Bitumen and petroleum have been found; graphite is plentiful, and sulphur, salt, saltpetre and lime are also procured. On the north-west coast thin beds of lignite occur, and coal has been found in the valley of the Sàkameìra.

Palaeontology.—Researches in various parts of the island have revealed the existence, in a subfossil state, of the bones of numerous birds of the family *Struthidae*. These have been arranged in twelve species, belonging to two genera, *Aepyornis* and *Mullerornis*, which varied in size from that of a bustard to birds much exceeding an ostrich, and rivalling the recently extinct moa of New Zealand, the largest species being about 10 ft. in height. One species of these great wingless birds laid an egg which is the largest known, being 12½ in. by 9½ in. Associated with these remains there have been found those of many other birds, including a hawk, a duck, a darter, a spoonbill, a heron, a rail and a wild-goose, some of these being much larger than any now inhabiting Madagascar. In the same beds the remains of two, if not three, species of hippopotamus have been found, about two-thirds the size of the living South African species; also the bones and carapace, &c., of gigantic tortoises, and the bones of a crocodile, now extinct on the coast and rivers, but still living in the two chief lakes; also the remains of a river-hog, of a species of swine, and of a slender-legged form of zebu-ox. Near the south-west coast the skull of a large lemuroid animal was discovered in 1893, much longer than that of any living lemur, the animal being probably three times the size of any previously known Madagascar lemuroid. Later still, in 1899 and subsequently, the bones of two other creatures of the same suborder have been discovered, one of them indicating an animal much larger than a man. Many of these birds and animals were probably contemporaneous with the earliest human inhabitants of Madagascar. The remains of two species of Edentata have been found, as well as those of several species of small Rodents, also of a Carnivore (*Cryptoprocta*), a larger variety of the species still living in the island.

In the deposits of a much more remote era than those already spoken of—the Jurassic—the bones of some enormous terrestrial lizards have been brought to light, belonging to Sauropodous Dinosaurs of the genera *Bothriospondylus* and *Titanosaurus*, and to a Theropod of the genus *Megalosaurus*. In the beds of the Lower Oolite portions of the skull of a reptile resembling the gavial of the Ganges had been previously discovered, from which a new genus called *Steneosaurus* has been founded. Since the French occupation (1895) considerable additions have been made to our knowledge of the fossil fauna of Madagascar from researches made both on the west and south-west coast (at Bèlo and Ambòlisatrana) and in the interior (at Antsìrabè), especially in the rich deposits near Tsàrazàza (Ampàsambazimba), to the north-west of Lake Itàsy. From these various localities the subfossil remains of thirteen or fourteen extinct species of lemuroid animals (including the gigantic species already mentioned) have been obtained, and have been classified under five new genera: viz. *Megaladapis* (3 sp.), *Palaeopropithecus* (3 sp.), *Archaeolemur* (2 sp.), *Bradylemur* (1 sp.) and *Hadropithecus* (1 sp.), together with three new species of lemur. Of these, the *Archaeolemurs* seem to have combined the characteristics of lemuroid animals with those of the monkeys, while *Hadropithecus* is pronounced to be the nearest known link with them. A list of all the fossils of the island known in 1895, but omitting the vertebrates above mentioned, included 140 species,[2] belonging to the Mollusca, Foraminifera, Echinodermata, Actinozoa and Plantae; but the researches of French geologists made the total number of Madagascar fossils known in 1907 to be not fewer than 280 species.

Climate.—In the high interior the climate resembles that of the temperate zones, although six-sevenths of the island are within the tropics; there is no intense heat, and it is quite cold, occasionally touching freezing point, during the nights of the cool season. These parts of the country are tolerably healthy for Europeans. But the coasts are much hotter, especially on the western side, as is also the interior west of the highland region; and from the large amount of marsh and lagoon on the coasts, malarial fever is common and frequently fatal, both to Europeans and to natives from the interior. Epidemics of influenza and fever have been very prevalent of late years in the central provinces. The seasons are two—the hot and rainy season from November to April, and the cool and dry season during the rest of the year; this remark applies chiefly to the interior, for rain falls throughout the year on the eastern coast, which is exposed to the vapour-laden south-east trade winds. The rainfall diminishes as one goes westward and especially south-westward, there being very little rain in the south-west corner of the island. No snow is known, even on the loftiest mountains, but thin ice is occasionally seen; and hail-showers, often very destructive, are frequent in the rainy season. Terrific thunderstorms are also common at that period; waterspouts are sometimes seen; and as the Indian Ocean cyclone region touches the eastern coast, hurricanes occur every few years, at rare intervals ascending into the interior highland. The yearly rainfall of the Imèrina province (Antanànarivo) averages about 54½ in.; accurate statistics as to that of other parts of the island are not available; but on the east coast it appears to be about double that of the interior; in the south-east considerably more than that amount; while at Morondava (west coast) it is given as about 21 in. annually, and at Tullear (south-west coast) as only 10 in. At Tamatave (east coast) the mean annual temperature is given as 76·5°, while at the capital it is about 66°; the temperature of Antanànarivo resembles that of Naples or Palermo.[3] The following table gives the mean of two different sets of government returns of mean rainfall: Antanànarivo, 1369 mm.; Tamatave, E. coast, 1863 mm.; Fàrafangàna, S.E. coast, 2803 mm.; Diégo-Suarez, N. end of island, 1196 mm.; Morondava, W. coast, 543 mm.; Tullear, S.W. coast, 273 mm.; Màrovoày, W. interior, 1413 mm.

Fauna.—The fauna of Madagascar, while deficient in most of the characteristic tropical forms of life, is one of great interest to the naturalist from its remote affinities, much of its animal life having Asiatic rather than African relationships. The central portions of the island, from their generally bare and treeless character, are poor in living creatures; but the lower country, and especially the forests and coast plains, are fairly well stocked. But it is noticeable that many species have a very limited range. Although a continental island, it possesses no large quadrupeds—none of the larger carnivorous, ungulate, proboscoid or quadrumanous animals; but it is the headquarters of the *Lemuroidea*, no fewer than thirty-nine species of which are found in its forests and wooded plains. Some of these creatures are highly specialized, while the curious aye-aye (*Chiromys madagascariensis*), an allied form, is one of the most remarkable animals known, forming a genus and family by itself. Its whole structure is strangely modified to enable it to procure the wood-boring larvae which form its food. Other peculiar animals are twenty-three species of the *Centetidae*, a family of the Insectivora almost confined to Madagascar; while of the *Carnivora* there are several small creatures belonging to the civets (*Viverridae*). The largest of these ferocious animals, also forming a genus and family by itself, is the *Cryptoprocta ferox*; it is a plantigrade animal, 3 ft. long, but very like an enormous weasel, and attacks other animals with the greatest ferocity. The island contains twenty-five species of bats, mostly of African, but some of Indian, affinities. African humped cattle were introduced several hundred years ago and now exist in large herds all over the country. The fat-tailed sheep, goats and swine have also been naturalized, as well as all kinds of domestic poultry.

The avi-fauna is much richer than the mammalian, and, although wanting the largest birds as well as the most brilliantly coloured, comprises two hundred and sixty species, half of which are endemic. Many of the birds are remarkable not so much for their shape or colouring as for their distant relationships; many belong to peculiar genera, and some are so isolated that new families have had to be formed for their reception. There is a large variety of perching birds, including several species of brilliant plumage—sun-birds, kingfishers, rollers and flycatchers, &c.; kites, hawks and owls are numerous, and the lakes and marshes abound with water-fowl and herons, ibises, &c.

The island is free from deadly serpents, but contains two or three small species of boa; crocodiles abound in the rivers and lakes; and numerous species of lizard, chameleon and tree-frog inhabit the woods. Madagascar may be considered as one of the headquarters of the *Chamaeleonidae*, for of the fifty known species no fewer than twenty-five have already been described from the island. Many of these are of curious form, with remarkable developments of the plates of the head and projecting horns and spines. There are several peculiar tortoises, but the gigantic species are now found alive only on the little island of Aldabra, to the north. The insect life comprises many brilliantly-coloured beetles, butterflies (about eight hundred species of which are known), moths, locusts, spiders and flies, and also noxious spiders, with scorpions and centipedes. The river fishes belong chiefly to the family *Chromididae*; many of them are of brilliant and bizarre appearance, with strongly contrasted colours in bands and spots. Those found in the coast waters do not differ materially from the widely spread Indian Ocean species.

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[1] For most of the information here given on the geology the writer is indebted to Captain Mouneyres, chef de services des mines, and the Rev. R. Baron, F.G.S., F.L.S.

[2] See "On a Collection of Fossils from Madagascar," by R. B. Newton, *Quart. Journ. Geol. Soc.* (Feb. 1895).

[3] The following are figures of mean temperature, kindly supplied by the Rev. E. Colin, S. J., director of the observatory: Diégo-Suarez, N., 79°; Fàrafangàna, S.E. coast, 75°; Màrovoày, W. intr., 81°; Mòrondàva, W. coast, 77°; Tullēar, S.W. coast, 78°.

As a whole, the Madagascar fauna is marked by a strong individuality, which would appear to be the result of long isolation from the other zoological "regions." The Asiatic and Malayan affinities of many of its animals, as well as the physical conditions of the bed of the Indian Ocean, make it highly probable that Madagascar, while once forming part of Africa, is the chief relic of a considerable archipelago formerly connecting that continent with Asia, its other portions being shown by groups of small islands, and by coral atolls and shoals, which are gradually disappearing beneath the waves. These questions have been fully treated by Dr A. R. Wallace in his *Geographical Distribution of Animals* (vol. i. ch. ix., 1876) and *Island Life*, ch. xix. (1880).

Flora.—The flora of Madagascar is one of great interest. One of its most prominent features is the belt of forest round a large part of the island at no great distance from the sea, and generally following the coast-line. This forest is densest on the east side, and for about 120 m. forms a double line, the lower one being much the broader and averaging 30 m. across, but attaining a breadth of 60 or 70 m. on the north-east, near Antongil Bay. The vegetation on the western side of the island is much less dense, often appearing as scattered clumps of trees on savannah-like plains rather than continuous forest; while in the south-west, where the rainfall is very scanty, the vegetation is largely of fleshy-leaved and spiny plants—aloes and cacti (the latter introduced), with several species of Euphorbia, as well as numerous lianas, one of which (*Intisy*) yields india-rubber. It is estimated that there are about 30,000 sq. m. of forest-covered country in Madagascar, or about one-eighth of its whole surface. The vegetation of the forests, the abundant epiphytes, the tree-mosses, the filmy ferns and the viviparous character of many of the ferns, show clearly how abundant the rainfall is in the eastern forest region. This contains a large variety of hard-wooded and valuable timber trees, including species of *Weinmannia* (*Lalòna* [1]), *Elaeocarpus* (*Voànana*), *Dalbergia* (*Vòambòana*), *Nuxia* (*Vàlanìrana*), *Podocarpus*, a pine, the sole species in the island (*Hètatra*), *Tambourissa* (*Ambòra*), *Neobaronia* (*Hàrahàra*), *Ocotea* (*Varòngy*) and probably ebony, *Diospyros* sp., &c. The following trees are characteristic of Madagascar vegetation, some of them being endemic, and others very prominent features in the landscape: the traveller's-tree (*Urania speciosa*), with its graceful crown of plantain-like leaves growing like an enormous fan at the top of a tall trunk, and affording a supply of pure cool water, every part of the tree being of some service in building; the Raphia (rofia) palm (*Sagus ruffia*); the tall fir-like *Casuarina equisetifolia* or beefwood tree, very prominent on the eastern coast, as well as several species of screw-pine (*Pandanus*); the Madagascar spice (*Ravintsara madagascariensis*), a large forest tree, with fragrant fruit, leaves and bark; a beautiful-leaved species of *Calophyllum*; and the Tangèna (*Tanghinia veneniflua*), formerly employed as a poison ordeal. On the lagoons and lower reaches of the rivers the Vìha (*Typhonodorum lindleyanum*), an arum endemic to Madagascar, grows in great profusion to a height of 12 or 13 ft. and has a white spathe more than a foot in length; and on the western coast dense thickets of mangrove line the creeks and rivers. In the interior rivers is found the curious and beautiful lace-leaf plant (*Ouvirandra fenestralis*), with an edible tuberous root. On the western side of the island the baobab, the tamarind, the ròtra (*Eugenia* sp.), the rofia palm, and several species of fan-palm (*Hyphaene*) and of *Ficus* are prominent; and the mango (introduced) grows to a large tree. In the generally bare interior highlands, large trees, species of *Ficus* (*Amòntana*, *Avìdvy*, *Nònoka*, *Adàbo*, &c.), often mark the position of the old towns; and some of these, as Ambòhimànga, Vòhilèna, &c., are surrounded by remnants of the original forest, which formerly covered large portions of the interior. The most prominent tree in the central province is now the Cape-lilac (*Melia azederach*) introduced about 1825; and since the French conquest several species of eucalyptus have been planted in vast numbers by the road sides. These have given quite a new aspect to the vegetation, while bright colour is imparted by species of *Bougainvillea* and *Poinsettia*. In the eastern forests palms, bamboos, lianas and tree-ferns, as well as species of *Dracaena*, are found.

Although flowers growing on the ground or on shrubs are not conspicuous for number or beauty, there are many fine flowering trees, such as *Poinciana regia*, presenting a mass of scarlet flowers; *Colvillia racemosa*, with yellow flowers; *Astrapaea Wallichii*, striking attention from its abundant flowers; and species of *Cryptostegia*, a purple-flowered creeper, and *Strongylodon*, another creeper with cream-coloured blossoms. Among attractive plants are species of *Hibiscus*, *Euphorbia*, *Buddleia*, *Ixora*, *Kitchingia*, *Clematis*, &c. On the east coast two orchids, species of *Angraecum*, with large white waxy flowers, one with an extraordinarily long spur or nectary, attract the attention of every traveller during June and July by their abundance and beauty. Some 320 species of fern have been collected, and there are large numbers of spiny and prickly plants, as well as numerous grasses, reeds and rushes, many of them of great service in the native manufactures of mats, hats, baskets, &c.

The Rev R. Baron divides the flora into three distinctly marked "regions," which run in a longitudinal direction, following approximately the longer axis of the island, and are termed respectively eastern, western and central. The central includes the elevated highland of the interior, while the eastern and western include the forest belts and most of the wooded country and coast plains. Of the 4100 known plants—of which about three-fourths are endemic—composing the Madagascar flora, there are 3492 Dicotyledons, 248 Monocotyledons and 360 Acotyledons. Of these, the orders most largely represented (together with their species) are: Leguminosae, 346; Filices, 318; Compositae, 281; Euphorbiaceae, 228; Orchideae, 170; Cyperaceae, 160; Rubiaceae, 147; Acanthaceae, 131; Gramineae, 130. The number of endemic genera now known is 148. Of the 3178 species of plants whose localities have been determined, 35% are peculiar to the eastern region, 27·5% to the central, and 22% to the western. One natural order, Chlaenaceae, is strictly confined to Madagascar. "A small proportion of the species are Asian, but not African; and the flora of the mountains corresponds closely with that of the great ranges of the tropical zone of Africa." "The general plan of the flora follows thoroughly the same lines as that of the tropical regions of the Old World."

Among the food-giving plants are rice—the staff of life to the majority of the Malagasy—in many varieties, maize, millet, manioc, yams, sweet-potatoes, arrowroot, which is largely used by the western tribes—as well as numerous vegetables, many of them of foreign introduction. The fruits—the majority of which are introduced—are the banana, peach, loquat, pineapple, mango, melon, grape, quince, plum, apple, mulberry, orange, lemon, citron, guava, Chinese-guava, Cape-gooseberry, fig, raspberry, tomato, &c. Several spices are grown, including ginger, capsicum, &c.; sugar-cane, coffee, indigo, vanilla, tobacco, cotton, hemp, gourds, dye-woods, gums, mulberry and other trees and plants for silk-culture, are also among the vegetable productions; gum-copal was formerly, and india-rubber is still, an important article of export.

Provinces and Towns.—The island may be divided into districts or provinces, which in the main indicate tribal divisions. Of these tribal territories the following may be distinguished, taking them in three main divisions, from north to south: (1) *Eastern*: Antankàrana, occupying the northern peninsula; the country of the Bétsimisàraka, who inhabit a long extent of the coast plains, about 500 m. in length; parallel with this for about a third of it, and between the two lines of forest, is the Bézànozàno country. South again are the districts of the Taimbahòaka, the Taimòro, the Taifàsy and the Taisàka; and at the south-eastern corner are the Tanòsy. (2) *Central*: the districts of Tsimihèty and the Sihànaka; Imèrina, the Hova province; the Bétsiléo; the Tanàla or foresters; the Bàra; and the emigrant Tanòsy. (3) *Western*: the people from almost the northern to the southern extremities of the island are known as Sàkalàva, but consist of a number of distinct tribes—the Tibòina, the Màilaka, the Taménabé, and the Fiherènana, &c. South of these last are the Màhafàly, with the Tandròy at the extreme south. There are no distinctly marked boundaries between any of these tribal territories; and west of Imèrina and Bétsiléo there is a considerable extent of country with hardly any population, a kind of "no-man's-land." There are numerous subdivisions of most of the tribes.

The capital, Antanànarìvo (pop. 69,000), in the highlands of Imèrina, and Tamatàve (pop. 4600), on the east coast and the chief seaport, are separately described. Majunga (properly Mojangà, pop. 5300) on the north-west coast, just north of 16° S., and Diégo-Suarez, are important ports for foreign trade, the latter being also a fortified naval and military station. Other ports and towns are Màhanòro, Mànanjàry (S.E. coast, pop. 4500), Tullear (S.W. coast), and Fianàrantsòa (pop. 6200), the chief town of the Bétsiléo. There are very few places besides these with as many as 2000 people.

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[1] The words in parentheses are the native Malagasy names.

Inhabitants.—The population is somewhat under two and three-quarter millions,[1] including some 10,000 or 11,000 Europeans, and a smaller number of Indian, Arab, and other Asiatics, mostly small traders found in the seaports, the Chinese being found in every town of any size. The island, it will be seen, is very sparsely inhabited; the most densely peopled province is that of Imèrina with (1905) 388,000 inhabitants. The natives, collectively known as Malagasy, are divided into a considerable number of tribes, each having its distinct customs. Although geographically an African island, the majority of its inhabitants are derived, the lighter portion of them from the Malayo-Polynesian stock, and the darker races from the Melanesian. This is inferred from their similarity to the peoples of the Indian and Pacific archipelagoes in their physical appearance, mental habits, customs, and, above all, in their language. Their traditions also point in the same direction. There is, however, an undoubted African mixture in the western and some other tribes. There is also an Arab element both on the north-west and south-east coasts; and it appears that most of the families of the ruling classes in all parts of the island are descended from Arabs, who married native women. It is believed that there are traces of an aboriginal people (the Vazimba), who occupied portions of the interior before the advent of the present inhabitants, and these appear to have been a somewhat dwarfish race, and lighter-coloured than the Malagasy generally. The Hòva became the dominant tribe from the beginning of the 19th century; they appear to be the latest immigrants, and are the lightest in colour; and they are also the most intelligent and civilized of all the peoples inhabiting the island.

The most striking proof of the virtual unity of the inhabitants of Madagascar is that substantially but one language is spoken over the whole country. The Malay affinities of Malagasy were noted in the 16th century; indeed, the second and fifth books published upon the country (in 1603 and 1613) were comparative vocabularies of these two languages. Later investigations have confirmed the conclusions thus early arrived at; and Van der Tuuk, Marre de Marin and W. E. Cousins have shown conclusively the close relationships between the language of the Malagasy and those of the Malayo-Polynesian regions; similar connexions exist, especially in grammatical construction, between the Malagasy and Melanesian languages. The Malagasy had never invented for themselves a written character, and had consequently no manuscripts, inscriptions or books, until their language was reduced to writing, and its orthography settled by English missionaries. Their speech nevertheless is very full in many of its verbal and other forms, while it also exhibits some curious deficiencies. It is very soft and musical, full of vowels and liquids, and free from all harsh gutturals. Native oratory abounds in figures, metaphors and parables; and a large number of folk-tales, songs and legends, together with the very numerous proverbs, give ample evidence of the mental ability and imaginative powers of the Malagasy.

Native society in Imèrina among the Hòva was formerly divided into three great classes: the Andrìana, or nobles; the Hòva, freemen or commoners; and the Andèvo, or slaves; but these last became free by a proclamation issued in 1896. The Andrìana are, strictly speaking, royal clans, being descendants of petty kings who were conquered or otherwise lost their authority through the increasing power of the ancestors of the reigning family. Their descendants retained certain honours in virtue of their royal origin, such as special terms of salutation, the use of the smaller scarlet umbrella (the larger one was the mark of royal rank), the right to build a particular kind of tomb, &c.; they also enjoyed exemption from certain government service, and from some punishments for crime. The Hòva[2] or commoners form the mass of the population of Imèrina. They are composed of a large number of tribes, who usually intermarry strictly among themselves, as indeed do families, so that property and land may be kept together. The third great division was the slave population, which since 1896 has become merged in the mass of the people. The Mozambiques or African slaves, who had been brought from the African coast by Arab dhows, were in 1877 formally set free by an agreement with the British government.

Royalty and chieftainship in Madagascar had many peculiar customs. It had a semi-sacred character; the chief was, in heathen tribes, while living, the high priest for his people, and after death, was worshipped as a god; in its modern development among the Hòva sovereigns it gathered round it much state and ceremony. There were many curious examples of the taboo with regard to actions connected with royalty, and also in the words used which relate to Malagasy sovereigns and their surroundings. These were particularly seen in everything having to do with the burial of a monarch. While the foregoing description of native society applied chiefly to the people of the central province of Imèrina, it is applicable, with local modifications, to most of the Malagasy tribes. But on the island becoming a French colony, in 1896, royalty was formally abolished; and little regard is paid to native rank by French officials.

The chief employment of the Malagasy is agriculture. In the cultivation of rice they show very great ingenuity, the *kètsa* grounds, where the rice is sown before transplanting, being formed either on the margins of the streams or in the hollows of the hills in a series of terraces, to which water is often conducted from a considerable distance. In this agricultural engineering no people surpass the Bétsiléo. No plough is used, all work being done by a long-handled spade; and oxen are only employed to tread out the soft mud preparatory to transplanting. The rice is threshed by being beaten in bundles on stones set upright on the threshing-floor; and when beaten out the grain is stored by the Hòva in rice-pits dug in the hard red soil, but by the coast tribes in small timber houses raised on posts. In preparing the rice for use it is pounded in a wooden mortar to remove the husk, this work being almost always done by the women. The manioc root is also largely consumed, together with several other roots and vegetables; but little animal foods (save fish and freshwater *Crustacea*) is taken by the mass of the people except at festival times. Rice is used less by the western tribes than by those of the central and eastern provinces, and the former people are more nomadic in their habits than are the others. Large herds of fine humped cattle are found almost all over the island.

The central and eastern peoples have considerable manual dexterity. The women spin and weave, and with the rudest appliances manufacture a variety of strong and durable cloths of silk, cotton and hemp, and of ròfia palm, aloe and banana fibre, of elegant patterns, and often with much taste in colour. They also make from straw and papyrus peel strong and beautiful mats and baskets in great variety, some of much fineness and delicacy, and also hats resembling those of Panama. The people of the south and south-east make large use of soft rush matting for covering, and they also prepare a rough cloth of bark. Their non-employment of skins for clothing is a marked distinction between the Malagasy and the South African races, and their use of vegetable fibres an equally strong link between them and the Polynesian peoples. The men wear a loincloth or *salàka*, the women a *kitàmby* or apron folded round the body from waist to heel, to which a jacket or dress is usually added; both sexes use over these the *làmba*, a large square of cloth folded round the body something like the Roman toga, and which is the characteristic native dress. The Malagasy are skilful in metal-working; with a few rude-looking tools they manufacture silver chains of great fineness, and filagree ornaments both of gold and silver. Their iron-work is of excellent quality, and in copper and brass they can produce copies of anything made by Europeans. They display considerable inventive power, and they are exceedingly quick to adopt new ideas from Europeans.

There is a considerable variety in the houses of the different Malagasy tribes. The majority of Hòva houses were formerly built of layers of the hard red soil of the country, with high-pitched roofs thatched with grass or rush; while the chiefs and wealthy people had houses of framed timber, with massive upright planking, and lofty roofs covered with shingles or tiles. But the introduction of sun-dried and burnt bricks, and of roofing tiles in the central provinces has led to the general use of these materials in the building of houses, large numbers of which are made in two storeys and in European fashion. The forest and coast tribes make their dwellings chiefly of wood framing filled in with the leaf-stalks of the traveller's tree, with the leaves themselves forming the roof covering. The houses of the Bétsiléo and Sàkalàva are very small and dirty, but those of the coast peoples are more cleanly and roomy. Among the Hòva and Bétsiléo the old villages were always built for security on the summits of lofty hills, around which were dug several deep fosses, one within the other. In other districts the villages and homesteads are enclosed within formidable defences of prickly-pear or thorny mimosa.

Apart from the modern influence of religious teaching, the people are very immoral and untruthful, disregardful of human life and suffering, and cruel in war. Until lately polygamy has been common among all the Malagasy tribes, and divorce effected in an absurdly easy fashion. At the same time the position of woman is much higher in Madagascar than in most heathen countries; and, the fact that for nearly seventy years there were (with a few months' exception) only female sovereigns, helped to give women considerable influence in native society. The southern and western peoples still practise infanticide as regards children born on several unlucky days in each month. This was formerly the general practice all over the island. The old laws among the Hòva were very barbarous in their punishments, and death in various cruel forms was inflicted for very trifling offences. Drunkenness is very prevalent in many parts of the island; and it can hardly be said of many of the Malagasy that they are very industrious. But they are courageous and loyal to their chiefs and tribe, and for short periods are capable of much strenuous exertion. They are affectionate and firm in their friendships, kind to their children and their aged and infirm relatives, very respectful to old age, most courteous and polite and very hospitable to strangers. Slavery had a patriarchal and family character, and was seldom exercised in a cruel or oppressive way.

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[1] The census taken in 1905 gives 2,664,000 as the total population, but it is probably a little over that amount, as some localities are still imperfectly known.

[2] This is a special and restricted use of the word, Hòva in its widest sense being a tribal name, including all ranks of people in Imèrina.

The Malagasy have never had any organized religious system or forms of worship; there are no temples, images or stated seasons of devotion, nor is there a priesthood, properly so-called. Yet they have never been without some distinct recognition of a supreme being, whom they call *Andriamànitra*, "The Fragrant One," and *Zànahàry*, "The Creator"—words which are recognized all over the island. They have also retained many ancient sayings, proverbial in their style, which enforce many of the truths of natural religion as to the attributes of God. With all this, however, there has long existed a kind of idolatry, which in its origin is simply fetishism—the belief in charms—as having power to procure various benefits and protect from certain evils. Among the Hòva in modern times four or five of these charms had acquired special sanctity and were each honoured as a kind of national deity, being called "god," and brought out on all public occasions. Together with this idolatry there is also a firm belief in the power of witchcraft and sorcery, in divination, in lucky and unlucky days and times, in ancestor worship, especially that of the sovereign's predecessors, and in several curious ordeals for the detection of crime. The chief of these was the celebrated tangèna poison ordeal, in which there was implicit belief, and by which, until its prohibition by an article in the Anglo-Malagasy treaty of 1865, thousands of persons perished every year. Sacrifices of fowls and sheep are made at many places at sacred stones and altars, both in thanksgiving at times of harvest, &c., and as propitiatory offerings. Blood and fat are used to anoint many of these stones, as well as the tombs of ancestors, and especially those of the Vazìmba. In some of the southern districts it is said that human sacrifices were occasionally offered. The chief festival among the Hòva, and almost confined to them, was that of the New Year, at which time a kind of sacrificial killing of oxen took place, and a ceremonial bathing, from which the festival took its name of Fàndròana (the Bath). This festival is now merged in the French national fête of the 14th of July. Another great festival was at circumcision times. This rite was observed by royal command at intervals of a few years; these were occasions of great rejoicing, but also of much drunkenness and licentiousness. Since 1868 circumcision has been observed by each family at any time convenient to itself. It is practised by all the Malagasy tribes. Funerals were also times of much feasting, and at the death of people of rank and wealth numbers of bullocks were and are still killed. Although there was no proper priesthood, the idol-keepers, the diviners, the day-declarers and some others formed a class of people closely connected with heathen customs and interested in their continued observance.

Industries and Commerce.—The rearing of cattle and the dressing of hides, the collection of rubber and bee culture are important industries. The chief food crops grown have been indicated (see *Flora*), and the gold-mining is separately noticed below. Other industries undertaken or developed by Europeans are silk and cotton weaving and raphia-fibre preparation, and ostrich farming. Sugar, rice, soap and other factories have been established. In 1904 the exportation of straw and other fibre hats began; these resemble those of Panama and promise to become an important item. Tanning bark, coffee and guano are also recent exports.

Since 1862, when the country was thrown open to foreign trade, the growth of over-sea commerce has been comparatively slow. In the early days cattle were the chief export. About 1870 india-rubber began to be exported in considerable quantities, and cattle, rubber and hides continue staple products. Other important exports are raphia fibre and beeswax. Since 1900 gold has become a leading export, the value of the gold sent out of the country in the five years 1901–1906 being £1,384,493. The imports consist chiefly of tissues (mostly cotton goods), breadstuffs and rice, liquors, metal-ware and coal. Better means of internal transport and increased production in the island have greatly reduced the import of rice, which came mostly from Saigon.

Before the occupation of Madagascar by France the duty on imports and exports was 10% *ad valorem*, and the foreign trade was very largely in the hands of British and American merchants. In July 1897 the French tariff was applied and increased rates levied on foreign goods, notably cottons. This practically killed the American trade and reduced the British trade to a very small proportion. In 1897 the British imports were valued at £179,000; the next year, with the new tariff in force, they had dropped to £42,000. The only export duties are: cattle 2s. per head and rubber 2d. per lb.

In 1880–1885 the entire foreign trade of Madagascar, imports and exports, was estimated to be about £1,000,000; in 1900–1906 the volume of trade had increased to a little over £2,500,000 a year. But while from 1900 onwards imports had a tendency to decrease (they were £1,841,310 in 1901 and £1,247,936 in 1905), exports steadily increased, owing to the working of gold-mines. The total value of the exports rose from £359,019 in 1901 to £822,470 in 1906.[1] About 90% of the trade is with France or other French colonies. The remaining trade is nearly all British and German.

Banking business is in the hands of French companies. The legal currency is the French 5-franc piece and the smaller French coins. There was no native coinage, the French 5-franc piece or dollar being the standard, and all sums under that amount were obtained by cutting up those coins into all shapes and sizes, which were weighed with small weights and scales into halves, quarters, eighths, twelfths and twenty-fourths of a dollar, and even reckoned down to the seven hundred and twentieth fraction of the same amount.

Gold-mining.—Gold-mining has been carried on regularly since 1897, and by 1900 the value of the ore extracted exceeded £100,000. Reports of rich discoveries attracted considerable attention in South Africa and Europe during 1904–1906, but experts, sent from the Transvaal, came to the conclusion that Madagascar would not become one of the rich goldfields of the world. The chief mining districts have been already indicated (see under *Geology*). Rich finds were reported from the north of the island during 1907, in which year the export of gold was £320,000. The mines afford a lucrative occupation for some thousands of persons, and many of the claim-holders are British. Decrees of 1902 and 1905 regulate the conditions under which mining is carried on. By decree of the 23rd of May 1907, the radius of the circle within which claims may be pegged is 2 kilometres (1¼ m.), and a tax of 5% is levied on the value of the gold extracted.

Communications.—There is regular steamship communication between the chief ports and Marseilles, Zanzibar and India (via Mauritius and Ceylon); and a submarine cable to Mozambique places the island in telegraphic connexion with the rest of the world. The French have built carriage roads from the interior to the principal ports as well as to connect the principal towns. On these roads large use is made of bullock wagons, as well as carts drawn by men, and women also. Tamatave and Antanànarivo are joined by coast canals and lakes and by a railway service. Where other means are not available, goods are carried by canoes, or on the shoulders of bearers along the native footpaths.

There is a well-organized postal service, and all the towns of note are linked by a telegraph system, which has a length of over 4000 miles.

Government, Revenue, &c.—The colony is not represented in the French Chambers, nor has it self-government. At the head of the administration is a governor-general, who is assisted by a nominated council of administration which includes unofficial members. This council must be consulted on matters affecting the budget. In several towns there are *chambres consultatives*, composed of local merchants and planters. The island is divided into *circles*, placed under military officers, and *provinces*, presided over by a civilian. As far as possible in local affairs, each of the native races is granted autonomy, the dominion of the Hòva over the other tribes being abolished. Each province has its native governor and minor officials, the governor being generally selected by popular vote. Each village has an organization (the *Fòkon' òlona*) resembling that

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[1] *Exports:*	1901	1906	*Increase.*
Rubber	£26,679	£301,518	£274,839
Hides and skins	31,548	250,339	218,791
Gold	131,987	270,613	138,626

of a commune; at its head is a chief or *mpiadìdy*, who serves for three years.

For Europeans and in suits between Europeans and natives the French judicial code is applicable; suits between natives are tried by native tribunals (established 1898) presided over by a European assisted by two native assessors. These tribunals judge according to native law and usages, except when such customs (*e.g.* polygamy and slavery) have been expressly abolished. Arbitration councils are available everywhere for the settlement of disputes between native workmen and their employers. The native laws respecting land tenure have been improved by the adoption of a method of registration based on the Torrens system.

Revenue is derived from land, house and capitation taxes, from customs, posts and telegraphs, ferries, licences and other indirect imposts. The excess of expenditure over revenue is made good by subventions from France. A considerable portion of the revenue is expended on public works. Revenue and expenditure in 1905 were each just beneath £1,000,000. This is exclusive of the sums spent by France in the island on the army, and for the naval base at Diégo-Suarez. There is a public debt amounting (1907) to £4,055,600. As stated in the French senate (February 1909), everything is taxed in the island; and no sooner has any enterprise become fairly successful than it is so heavily taxed as to be no longer worth carrying on, and certain crops have therefore been destroyed by the colonists who had planted them. This has been the case with tobacco, sugar, rum, and also in butter-making, cattle-breeding and other things. Notwithstanding this taxation, from 1895 to 1908 £12,000,000 was required for Madagascar from the home government, and the demand is constantly increasing.

History.—From the earliest accounts given of the people of Madagascar by European travellers, as well as from what may be inferred from their present condition, they seem for many centuries to have been divided into a number of tribes, often separated from one another by a wide extent of uninhabited country. Each of these was under its own chief, and was often at war with its neighbours. No one tribe seems to have gained any great ascendancy over the rest until about the middle of the 17th century, when a small but warlike people called Sàkalàva, in the south-west of Madagascar, advanced northward, conquered all the inhabitants of the western half of the island, as well as some northern and central tribes, and eventually founded two kingdoms which retained their supremacy until the close of the 18th century. About that time, the Hòva in the central province of Imèrina began to assert their own position under two warlike and energetic chieftains, Andrianimpòina and his son Radàma; they threw off the Sàkalàva authority, and after several wars obtained a nominal allegiance from them; they also conquered the surrounding tribes, and so made themselves virtual kings of Madagascar. From that time until 1895 Hòva authority was retained over a large part of the central and eastern provinces, but it was only nominal over much of the western side of the island, while in the south-west the people were quite independent and governed by their own chiefs.

Arab Intercourse and Influence.

While European intercourse with Madagascar is comparatively recent, the connexion of the Arabs with the island dates from a very remote epoch; and in very early times settlements were formed both on the north-west and south-east coasts. In the latter locality there are still traces of their influence in the knowledge of Arabic possessed by a few of the people. But in these provinces they have become merged in the general mass of the people. It is different, however, in the north-west and west of the island. Here are several large Arab colonies, occupying the ports of Anòrontsànga, Mòjangà, Màrovoày and Mòrondàva, and retaining their distinct nationality. There is also in these districts a Hindu element in the population, for intercourse has also been maintained for some centuries between India and northern Madagascar, and in some towns the Banyan Indian element is as prominent as the Arab element. In the early times of their intercourse with Madagascar, the Arabs had a very powerful influence upon the Malagasy. This is seen in the number of words derived from the Arabic in the native language. Among these are the names of the months and the days of the week, those used in astrology and divination, some forms of salutation, words for dress and bedding, money, musical instruments, books and writings, together with a number of miscellaneous terms.

European Intercourse.

The island is mentioned by several of the early Arabic writers and geographers, but medieval maps show curious ignorance of its size and position. Marco Polo has a chapter upon it, and terms it "Madeigascar," but his accounts are confused with those of the mainland of Africa. The first European voyager who saw Madagascar was a Portuguese named Diogo Diaz, captain of one of the ships of a fleet commanded by Pedro Cabral and bound for India. Separated from his companions by a storm near the Cape, he sighted the eastern coast of the island on the 10th of August 1500. That day being the feast of St Lawrence, Madagascar was named the "Isle of St Lawrence," and retained that name on all maps and charts for a hundred years. The Portuguese gave names to most of the capes, but made no persistent attempts at colonization. After them the Dutch endeavoured, but with little success, to form colonies; and in the time of Charles I. proposals were made to form an English "plantation," but these were never carried into effect, although for a short time there was a settlement formed on the south-west coast. In the latter part of the 17th and during most of the 18th century the French attempted to establish military positions on the east coast. For some time they held the extreme south-east point of the island at Fort Dauphin; but several of their commandants were so incapable and tyrannical that they were frequently involved in war with the people, and more than once their stations were destroyed and the French were massacred. Early in the 19th century all their positions on the mainland were relinquished, and they retained nothing but the island of Ste Marie on the east coast. In 1811 Tamatave had been occupied by British troops, and the Treaty of Paris of 1814 recognized as British the "French settlements in Madagascar," but as a matter of fact France had then no settlements on the mainland. The then governor of Mauritius, Sir Robert Farquhar, endeavoured to prosecute British claims and obtained a cession of Diégo-Suarez Bay. These claims were not backed up by the home government, and a little later the policy was adopted by Great Britain of supporting the Hòva authority.

Radàma I.

Introduction of Christianity.

The political history of Madagascar as a whole may be said to date from the reign of Radàma I. (1810–1828). He was a man much in advance of his age—shrewd, enterprising, and undeterred by difficulty—a kind of Peter the Great of his time. He saw that it was necessary for his people to be educated and civilized if the country was to progress; and making a treaty with the governor of Mauritius to abolish the export of slaves, he received every year in compensation a subsidy of arms, ammunition, and uniforms, as well as English training for his troops. He was thus enabled to establish his authority over a large portion of the island. For some years a British agent, Mr Hastie, resided at Radàma's court, and exercised a powerful influence over the king, doing much for the material advance of the country. At the same period (1820) Christian teaching was commenced in the capital by the London Missionary Society, and by its missionaries the language was reduced to a systematic written form, and the art of printing introduced; books were prepared, the Scriptures were translated, numerous schools were formed, and several Christian congregations were gathered together. The knowledge of many of the useful arts was also imparted, and many valuable natural productions were discovered. The power of superstition was greatly broken, a result partly due to the keen good sense of the king, but chiefly to the spread of knowledge and religious teaching.

Rànavàlona I.

The bright prospects thus opening up were clouded by the death of Radàma at the age of thirty-six, and the seizure of the royal authority by one of his wives, the Princess Rànavàlona. She looked with much suspicion upon the ideas then gaining power among many of her people, and determined to strike a decisive blow at the new teaching. In 1835 the profession of the Christian religion was declared illegal; all worship was to cease, and all religious books were ordered to be given up. By the middle of 1836 all the English missionaries were obliged to leave the island, and for twenty-five years the most strenuous efforts were made by the queen and her government to suppress all opposition to her commands. This, however, only served to show in a very remarkable manner the courage and faith of the Christian Malagasy, of whom about two hundred suffered death in various cruel forms, while many hundreds were punished more or less severely by fine, degradation, imprisonment and slavery. During the queen's reign the political condition of the country was deplorable; there were frequent rebellions, many of the distant provinces were desolated by barbarous wars; and for some years all Europeans were excluded, and foreign commerce almost ceased. This last circumstance was partly owing to an ill-managed attack upon Tamatàve in 1846 by a combined British and French force, made to redress the wrongs inflicted upon the foreign traders of that port. But for the leaven of Christianity and education which had been introduced into the country it would have reverted to a state of barbarism.

Radama II.

This reign of terror was brought to a close in 1861 by the death of the queen and the accession of her son Radàma II. The island was reopened to European trade, and missionary efforts were recommenced. A determined attempt was made by some Frenchmen to gain for their country an overwhelming influence by means of a treaty which they induced the king to sign. But this act, as well as the vices and insane follies into which he was led by worthless foreign and native favourites, soon brought his reign and his life to an end. He was put to death in his palace (1863) and his wife was placed on the throne. The new sovereign and her government refused to ratify the agreement which had been illegally obtained, choosing rather to pay a million francs as compensation to the French company. During the five years' reign of Queen Rasohérina, quiet and steady advances were made in civilization and education, and treaties were concluded with the British, French and American governments.

Ranavalona II.

At the death of Rasohérina in 1868, she was succeeded by her cousin, Rànavàlona II. One of the first acts of the new queen was the public recognition of Christianity; and very soon afterwards she and her husband, the prime minister, were baptized, and the erection of a chapel royal was commenced in the palace yard. These acts were followed in the succeeding year by the burning of the royal idols, and immediately afterwards by the destruction of the idols throughout the central provinces, the people generally putting themselves under Christian instruction. From that time education and enlightenment made great progress, chiefly through the labours of missionaries of various societies.

Native Government.

The native Malagasy government, though theoretically despotic, was limited in various ways. Radàma I. and Rànavàlona I. were much more absolute sovereigns than those before or after them, but even they were largely restrained by public opinion. New laws were announced at large assemblies of the people, whose consent was asked, and always given through the headmen of the different divisions of native society; this custom was no doubt a survival from a time when the popular assent was not a merely formal act. The large disciplined army formed by Radàma I. aided much in changing what was formerly a somewhat limited monarchy into an absolute one. The Hòva queen's authority was maintained over the central and eastern portions of Madagascar, and at almost all the ports, by governors appointed by the queen, and supported by small garrisons of Hòva troops. At the same time the chiefs of the various tribes were left in possession of a good deal of their former honours and influence. Rànavàlona II., her predecessor and her successor were successively married to the prime minister, Ràinilaiàrivòny, a man of great ability and sagacity, who, by his position as husband and chief adviser of the sovereign, became virtual ruler of the country. Chiefly owing to his influence, many measures tending to improve the administration were introduced. The Hòva army was estimated at from 30,000 to 40,000 men, several English non-commissioned officers and, latterly, others of higher rank being engaged to train them in European methods. Revenue was derived from customs duties, firstfruits, fines and confiscation of offenders' property, and a money offering called *hàsina*, presented on a great variety of occasions both to the sovereign in person and to her representatives; and these were supplemented by "benevolences" (in the medieval sense of the word) levied upon the people for occasional state necessities. The government also claimed the unpaid service of all classes of the community for every kind of public work.

Foreign Relations.

The Hòva government aspired to have Madagascar recognized as an independent civilized state, and consuls appointed by the British, French and American governments were accredited to the Malagasy sovereign, the queen having a consul in England, and a consular agent at Mauritius. The treaty with Great Britain, concluded in 1865, gave the consuls of that nation jurisdiction over the British subjects in the island. At this period, on the initiative of the 4th earl of Clarendon, then foreign secretary, an understanding was come to between the British and French governments by which it was agreed that each power should respect the independence of Madagascar; and the future of the country appeared to be bound up in the gradual consolidation of the central Hòva authority over the whole island. While this prospect would have satisfied the British interests in the island, it was otherwise with the French. The tradition of their former settlements in and influence over the island was strong; in 1840 they had taken under their protection the Sàkalàva ruler of the small island of Nossi-bé, off the north-west coast, and in virtue of that act claimed a vague protectorate over the adjacent shores of the mainland. A treaty, concluded in 1868, while establishing French consular jurisdiction in Madagascar, recognized Rànavàlona II. as queen of Madagascar, and under the Second Empire attempts to establish French political influence were discouraged, and even as late as 1872 the subsidy enjoyed by the Jesuit missionaries was withdrawn. In 1878 the French consul, Laborde, died, and a dispute arose as to the disposal of his property. This dispute was the occasion of further intervention on the part of the French, for the Paris government supported the claims of Laborde's heirs, and revived their claim to a protectorate over the Sàkalàva of the north-west coast, as based on their agreement with them in 1840, ceding Nossi-bé to France. A policy of colonial expansion generally, and in Africa in particular at this time, was manifest in France, as in other European countries, and the French claims on the Hòva were pressed with vigour.

Franco-Malagasy War of 1883-85.

Towards the middle of 1882 the relations between the native government and that of France became much strained, and to settle, if possible, these causes of dispute, two Hòva officers of high rank were sent to France as ambassadors, but as they were not authorized to concede any territory, their visit accomplished very little. Treaties had been concluded with Great Britain, Germany and America, giving improved facilities for trade with Madagascar, but before the return of the envoys matters had come to a crisis in the island. In May 1883 an ultimatum was sent to the Malagasy queen, requiring immediate compliance with the demands of France; and as these were refused by the Hòva government, Tamatàve was bombarded by a French squadron and then occupied by the marines. The war continued in a desultory fashion for many months; but no serious attempt was made to invade the interior; and in 1885 terms of peace were agreed to. By a treaty signed on the 17th of December it was agreed that the foreign relations of Madagascar should be directed by France; that a resident should live at the capital, with a small guard of French soldiers; and that the Bay of Diégo-Suarez, together with surrounding territory, should be ceded to France. The word "protectorate" was carefully excluded from the treaty, although doubtless the French envoys intended that this should be its practical issue. It was at the same time agreed that there should be no foreign interference with the internal government of the country, and that the queen should retain her former position, with all its honours and dignity. It should be here noticed that the queen, Rànavàlona II., died just at the beginning of the war, on the

13th of July 1883, and was succeeded by her niece, Princess Razâfindrahèty, under the title of Rànavàlona III., who maintained the same policy as her predecessor, and was much beloved by her people and respected by all.

French Protectorate, 1885-1894.

Several French residents successively represented France at Antanànarivo; but these found themselves unable to obtain that influence which the home authorities thought they had a right to demand. Although the British government, in return for concessions in Zanzibar, had consented, in 1890, to recognize a French protectorate over Madagascar, the Malagasy prime minister, Rainilaiàrivòny, was not disposed to give any advantage to France and continued to arm and train, by the help of British officers, a large body of native soldiers. This state of tension and irritation could not last, and at length, towards the close of 1894, the French government sent an ultimatum to the Malagasy sovereign, demanding such powers as would have made French authority supreme in the island. These demands were refused by the native government, and other conditions were offered; but the French envoy, together with the resident's escort, left the capital, as also did the French traders and others, including the large Jesuit mission.

French Invasion and Conquest, 1895.

As soon as these had left the island, the chief ports were occupied by French troops, and an expeditionary force under General Duchesne was afterwards landed on the north-west coast at Mòjangà—commonly, but incorrectly, written Majunga—with the object of breaking the Hòva authority. Owing to the necessity of making a road for the passage of artillery and military stores, many months were spent on the march into the interior, and there was considerable loss of life by fever and other disease among the invading troops. But no effectual resistance was made by the Malagasy, and at length, on the 30th of September 1895, the French forces appeared on the heights north and east of Antanànarivo, bombarded the city, which surrendered in the afternoon, and on the evening of the same day the French entered the capital.

Rebellion of 1896, and Gradual Subjection of the Malagasy.

The result was that the protectorate of France was re-established in the central provinces, but the queen was allowed to retain her position. Early in 1896, however, a serious rebellion broke out in several parts of Imèrina. This movement was not only anti-French and anti-foreign, but also distinctly anti-Christian. The French troops gradually broke up the power of the rebellion in the central provinces, but as there appeared to be considerable unrest in many other parts of the island, General Gallieni, an officer with a reputation for vigour and ability in the Sudan and Tongking campaigns, was sent out to relieve the then resident-general.

Administration of General Gallieni.

General Gallieni had a difficult task in establishing the authority of France throughout the island among numbers of tribes who had never submitted to any control from others. Among the first steps he took were to put the country under martial law, to abolish royalty and all semblance of Hòva government, and to declare Madagascar to be henceforth a colony of France. Queen Rànavàlona III. was exiled to Réunion, and subsequently to Algeria. Meanwhile carriage roads were commenced to connect all the chief centres, and the military posts were gradually extended so as to consolidate French rule over all the outlying tribes. French residents and numerous other officials were placed at every important town, and various projects were started for the civilization of the Malagasy in accordance with French ideas. At the close of 1899, General Gallieni was able to report that only portions of the west and south-west remained to be brought into submission. Not long afterwards the authority of France was recognized throughout the island. General Gallieni, whose firm and vigorous administration, and desire to treat the Malagasy justly and kindly, made him liked by the people, retired in 1905, and was succeeded in that office by M. Victor Augagneur, late mayor of Lyons. Since the French occupation the Malagasy have conformed pretty readily to the new order of things, although many of the most intelligent Hòva deeply regret that their country did not retain its independence. Justice is administered, on the whole, with fairness and impartiality; but the taxation seems too heavy for the means of the people, indeed it is affirmed by trustworthy natives that the well-to-do classes are being gradually drained of their property. To an outsider it also appears that the staff of officials is very largely in excess of any real needs of administration; several monopolies, which interfere with the habits of the people, tend to produce discontent; and the taking of their land and houses for public works, roads, &c., while but a mere fraction of their real value is allowed as compensation, does not help to increase their acquiescence in foreign control. But the most serious cause for dislike to government action was the interference by the governor-general, in 1907, with their religious customs, by the suppression of hundreds of their congregational schools, and the closing of numbers of their churches. In July 1910 M. Augagneur was replaced as governor-general by N. Picquié, a prominent official of the Colonial Department, who had previously served with acceptance as deputy governor-general of French Indo-China, and who had a reputation for tact and impartiality.

Christian Missions and Education.—As already noticed, the Malagasy owe to missionaries of the London Missionary Society their first school system and their first literature, in 1820 and subsequent years;[1] and for fifteen years all educational work was carried on by them, some 10,000 to 12,000 children having been instructed in their schools. On the reopening of the country to Europeans in 1862, the L.M.S. mission was resumed and was carried on with vigour for several years, stations being formed in several parts of Imèrina, in the Bétsiléo and Antsihànaka provinces, and at the ports of Tamatave, Majunga and Fàrafangàna (south-east coast). In 1890 the number of their churches was 1220; adherents, 248,000; and scholars, 68,000; so that for long the greater part of the educational work was in their hands, carried on not only in primary schools, but also in high schools and colleges. In 1863 the Church of England began work in the island through the Society for the Propagation of the Gospel and the Church Missionary Society. After some time, however, the latter society withdrew, leaving the field to the S.P.G. A bishop is stationed in the capital, with a theological college in its neighbourhood, but the chief work of the Anglican mission is on the east coast. In 1866 the Norwegian Lutheran Society began work in Madagascar, and was joined in 1888 by an American Lutheran Society. With a representative church at the capital, the chief work of these missions is in the Vàkinankàratra district (south-west of Imèrina), in the Bétsiléo province, and on the south-east and south-west coasts; in these places they have a large number of converts and (until lately) schools. In 1867 a mission was begun by the Society of Friends, who gave great attention to education and literary work, and afterwards took up as their field of labour the western and south-western parts of Imèrina, where they have a large and well-organized mission. Immediately after the island became a French possession the French Protestant Churches began (in 1896) to take part in the evangelizing of their new colony, and about half the area for long occupied by the London Missionary Society was transferred to the Paris Society. The bulk of the Malagasy Christians are Protestants, probably three-fourths or four-fifths of those professing Christianity. A Roman Catholic (Jesuit) mission was begun in 1861, and a large force of priests with a bishop and lay brethren and sisters engaged in education, have been at work in the island since then, except during the two Franco-Malagasy wars.[2] Since the French conquest, the north of the island has been occupied by a mission of priests of the Saint Esprit, and the southern portion by the Lazarist mission, each with a bishop at its head. The following table gives the statistics of the various Protestant missions at the close of 1906:—

Mission	Missionaries	Churches	Adherents	Members	Scholars
Lond. Miss. Soc.	25	630	120,000	32,000	27,000
Soc. Prop. Gospel	15	121	13,000	4,094	7,655
Norweg. Luth.	60	892	84,000	71,500	38,000
Am. Luth.	14	?	?	?	?
Soc. of Friends	27	178	15,000	2,540	7,122
French Prot. Miss.	29	491	110,660	10,500	18,200

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[1] It is true that 200 years earlier than this, persistent efforts were made for nineteen years (1600–1619) by Portuguese Roman Catholic missionaries to propagate their faith among the south-east coast tribes. But although much zeal and self-denial were shown by these men, their efforts were abortive, and the mission was at length abandoned, leaving no fruit of their labours in a single church or convert. Half a dozen small books of devotion are all that remain to show their presence in Madagascar.

[2] The work of the "Frères chrétiens" was, however, almost broken up by the anti-clerical policy of the French government.

Since 1897 high schools, and medical and technical schools, and a few primary schools, have been formed by the French government; and all other schools have been placed under regulations issued by an educational department, the scholars being required to learn the French language; but until the end of 1906 the bulk of the educational work was carried on by the various missions. At that date the anti-clerical movement in France began to affect Madagascar. In all the missions the churches had, in the vast majority of cases, been used as school-houses, but in November 1906 it was strictly forbidden to use churches for educational purposes after two months from that date; and the effect of the decree, with other provisions, was to close hundreds of schools, probably three-fourths of the whole number.

For many years (1862–1896), all medical aid to the sick, the formation of hospitals and dispensaries, the training of native doctors, midwives and nurses, and the production of medical literature was entirely due to the Protestant missionaries, viz. the London Missionary Society, the Friends and the Norwegians. Numbers of young men received a full course of medical and surgical training, and were awarded diplomas after passing strict examinations. This work is now mostly in charge of a government department, and mission medical work is much restricted; but for thirty-five years the Malagasy owed all such help to the benevolence of European Christians. Besides care for the sick in ordinary diseases, asylums for lepers were for many years carried on; two by the London Missionary Society, one, a large one, with 800 or 900 inmates, by the Norwegian Society, and another by the Roman Catholic mission. This last, with one of those of the L.M.S., is now taken over by the government.

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MADAN, MARTIN (1726–1790), English writer, was educated at Westminster School, and at Christ Church, Oxford, where he graduated in 1746. In 1748 he was called to the bar, and for some time lived a very gay life, until he was persuaded to change his ways on hearing a sermon by John Wesley. He took holy orders, and was appointed chaplain to the Lock Hospital, London. He was closely connected with the Calvinistic Methodist movement supported by the countess of Huntingdon, and from time to time acted as an itinerant preacher. He was a first cousin of William Cowper, with whom he had some correspondence on religious matters. In 1767 much adverse comment was aroused by his support of his friend Thomas Haweis in a controversy arising out of the latter's possession of the living of Aldwinkle, Northamptonshire (see *Monthly Review*, xxxvii. 382, 390, 465). In 1780 Madan raised more serious storm of opposition by the publication of his *Thelyphthora, or A Treatise on Female Ruin*, in which he advocated polygamy as the remedy for the evils he deplored. The author was no doubt sincere in his arguments, which he based chiefly on scriptural authority; but his book called forth many angry replies. Nineteen attacks on it are catalogued by Falconer Madan in *Dict. Nat. Biog.* Madan resigned his chaplainship and retired to Epsom, where he produced, among other works, *A New and Literal Translation of Juvenal and Persius* (1789). He died on the 2nd of May 1790.

MADDALONI, a town of Campania, Italy, in the province of Caserta, about 3½ m. S.E. of Caserta, with stations on the railways from Caserta to Benevento and from Caserta to Avellino, 200 ft. above sea-level. Pop. (1901), 19,778 (town); 21,270 (commune). It is prettily situated at the base of one of the Tifata hills, the towers of its medieval castle and the church of San Michele crowning the heights above. The fine old palace of the Caraffa family, once dukes of Maddaloni, the old college now named after Giordano Bruno, and the institute for the sons of soldiers are the chief points of interest. About 2½ m. east of Valle di Maddaloni, the Ponte della Valle, an aqueduct built by the orders of Charles III. of Naples and his son to convey the water of the Tiburno to Caserta (19 m.), is carried across the valley between Monte Longano and Monte Gargano by a threefold series of noble arches rising to a height of 210 ft. The work was designed by Lodovico Vanvitelli, and constructed between 1753 and 1759.

MADDEN, SIR FREDERIC (1801–1873), English palaeographer, the son of an officer of Irish extraction, was born at Portsmouth on the 16th of February 1801. From his earliest years he displayed a strong bent to linguistic and antiquarian studies. In 1826 he was engaged by the British Museum to assist in the preparation of the classified catalogue of printed books then contemplated, and in 1828 he became assistant keeper of manuscripts. In 1833 he was knighted, and in 1837 succeeded Josiah Forshall as keeper of manuscripts. He was not entirely successful in this office, partly owing to want of harmony with his colleagues; he retired in 1866. He edited for the Roxburghe Club *Havelok the Dane* (1828), discovered by himself among the Laudian MSS. in the Bodleian, *William and the Werwolf* (1832) and the old English versions of the *Gesta Romanorum* (1838). In 1839 he edited the ancient metrical romances of *Syr Gawayne* for the Bannatyne Club, and in 1847 Layamon's *Brut*, with a prose translation, for the Society of Antiquaries. In 1850 the magnificent edition, in parallel columns, of what are known as the "Wycliffite" versions of the Bible, from the original MSS., upon which he and his coadjutor, Forshall, had been engaged for twenty years, was published by the university of Oxford. In 1866–1869 he edited the *Historia Minor* of Matthew Paris for the Rolls Series. In 1833 he wrote the text of Henry Shaw's *Illuminated Ornaments of the Middle Ages*; and in 1850 edited the English translation of Silvestre's *Paléographie universelle*. He died on the 8th of March 1873, bequeathing his journals and other private papers to the Bodleian Library, where they were to remain unopened until 1920.

Madden was perhaps the first palaeographer of his day. He was an acute as well as a laborious antiquary, but his ignorance of German prevented his ranking high as a philologist, although he paid much attention to the early dialectical forms of French and English. His minor contributions to antiquarian research were exceedingly numerous: the best known, perhaps, was his dissertation on the orthography of Shakespeare's name, which, mainly on the strength of the Florio autograph, he contended should be "Shakspere."

MADDER, or DYERS' MADDER, the root of *Rubia tinctorum* and perhaps also of *R. peregrina*, both European, *R. cordifolia*, a native of the hilly districts of India and of north-east Asia and Java, supplying the Indian madder or *manjit*. *Rubia* is a genus of about thirty-five species of the tribe *Galieae* of the order Rubiaceae, and much resembles the familiar *Galiums*, *e.g.* lady's bedstraw (*G. verum*) and the cleavers (*G. aparine*) of English hedges, having similarly whorled leaves, but the parts of the flowers are in fives and not fours, while the fruit is somewhat fleshy. The only British species is *R. peregrina*, which is found in Wales, the south and west of England, and in east and south Ireland. The use of madder appears to have been known from the earliest times, as cloth dyed with it has been found on the Egyptian mummies. It was the ἐρευθέδανον used for dyeing the cloaks of the Libyan women in the days of Herodotus (Herod. iv. 189). It is the ἐρυθρόδανον of Dioscorides, who speaks of its cultivation in Caria (iii. 160), and of Hippocrates (*De morb. mul.* i.), and the *Rubia* of Pliny (xix. 17). *R. tinctorum*, a native of western Europe, &c., has been extensively cultivated in south Europe, France, where it is called *garance*, and Holland, and to a small extent in the United States. Large quantities have been imported into England from Smyrna, Trieste, Leghorn, &c. The cultivation, however, decreased after alizarin, the red colouring principle of madder, was made artificially. Madder was employed medicinally by the ancients and in the middle ages. Gerard, in 1597, speaks of it as having been cultivated in many gardens in his day, and describes its supposed many virtues (*Herball*, p.960); but any pharmacological or therapeutic action which madder may possess is unrecognizable. Its most remarkable physiological effect is that of colouring red the bones of animals fed upon it, as also the claws and beaks of birds. This appears to be due to the chemical affinity of phosphate of lime for the colouring matter (Pereira, *Mat. med.*, vol. ii. pt. 2, p. 52). This property has been of much use in enabling physiologists to ascertain the manner in which bones develop, and the functions of the various types of cells found in growing bone. *R. chilensis* has been used for dyeing red from time immemorial. The chay-root, which furnishes a red dye in Coromandel and other parts of India, is the root-bark of *Oldenlandia umbellata*, a low-growing plant of the same family as madder.

MADEC, RENÉ-MARIE (1736–1784)—called Medoc in Anglo-Indian writings—French adventurer in India, was born at Quimper in Brittany on the 7th of February 1736, of poor parents. He went out to India and served under Dupleix and Lally, but being taken prisoner by the British he enlisted in the Bengal army. Deserting with some of his companions shortly before the battle of Buxar (1764), he became military instructor to various native princes, organizing successively the forces of Shuja-ud-Dowlah, nawab of Oudh, and of the Jats and Rohillas. He took service under the emperor Shah Alam in 1772, and when that prince was defeated at Delhi by the Mahrattas, Madec rejoined his own countrymen in Pondicherry, where he took an active part in the defence of the town (1778). After the capitulation of Pondicherry he returned to France with a considerable fortune, and died there in 1784. At one time he formed a scheme for a French alliance with the Mogul emperor against the British, but the project came to nothing.

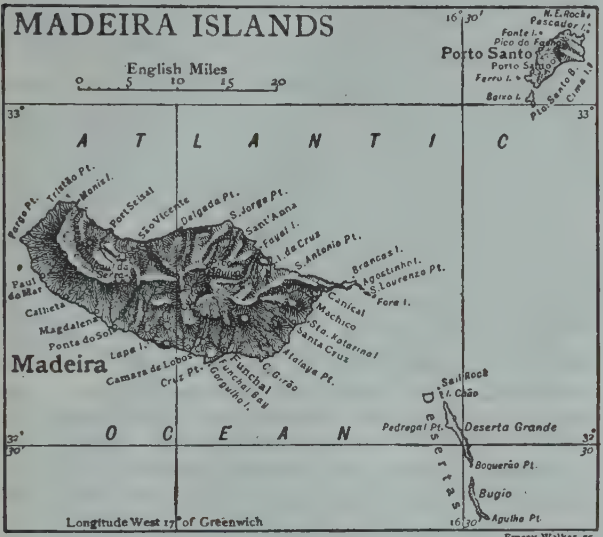
See Émile Barbé, *Le Nabab René Madec* (1894).

MADEIRA, or THE MADEIRAS, a group of islands in the North Atlantic Ocean, which belong to Portugal, and consist of two inhabited islands named Madeira and Porto Santo and two groups of uninhabited rocks named the Desertas and Selvagens. Pop. (1900), 150,574; area, 314 sq. m. Funchal, the capital of the archipelago, is on the south coast of Madeira Island, in 32° 37′ 45″ N. and 16° 54′ W. It is about 360 m. from the coast of Africa, 535 from Lisbon, 1215 from Plymouth, 240 from Teneriffe, and 480 from Santa Maria, the nearest of the Azores.

Madeira (pop. 1900, 148,263), the largest island of the group, has a length of 30 m., an extreme breadth of 12 m., and a coastline of 80 or 90 m. Its longer axis lies east and west, in which direction it is traversed by a mountain chain, the backbone of the island, having a mean altitude of 4000 ft., up to which many deep ravines penetrate from both coasts and render travel by land very difficult. Pico Ruivo, the highest summit, stands in the centre of the island, and has a height of 6056 ft., while some of the adjacent summits are very little lower. The depth and narrowness of the ravines, the loftiness of the rugged peaks, often covered with snow, that tower above them, the bold precipices of the coast, and the proximity of the sea, afford many scenes of picturesque beauty or striking grandeur. The greater part of the interior is uninhabited, though cultivated, for the towns, villages and scattered huts are usually built either at the mouths of ravines or upon the lower slopes that extend from the mountains to the coast. The ridges between the ravines usually terminate in lofty headlands, one of which, called Cabo Girão, has the height of 1920 ft., and much of the seaboard is bound by precipices of dark basalt. The north coast, having been more exposed to the erosion of the sea, is more precipitous than the south, and presents everywhere a wilder aspect. On the south there is left very little of the indigenous forest which once clothed the whole island and gave it the name it bears (from the Portuguese *madeira*, Lat. *materia*, wood), but on the north some of the valleys still contain native trees of fine growth. A long, narrow and comparatively low rocky promontory forms the eastern extremity of the island; and here is a tract of calcareous sand, known as the Fossil Bed, containing land shells and numerous bodies resembling the roots of trees, probably produced by infiltration.

Porto Santo is about 25 m. N.E. of Madeira. Pop. (1900), 2311. It has a length of 6⅓ m. and a width of 3 m. The capital is Porto Santo, called locally the *villa* or town. The island is very unproductive, water being scarce and wood wholly absent. Around the little town there is a considerable tract of pretty level ground covered by calcareous sand containing fossil land-shells. At each end of the island are hills, of which Pico do Facho, the highest, reaches the altitude of 1663 ft. Barley, but little else, is grown here, the limited requirements of the inhabitants being supplied from Funchal.

The Desertas lie about 11 m. S.E. of Madeira, and consist of three islands, Ilheo Chão, Bugio and Deserta Grande, together with Sail Rock off the north end of Ilheo Chão. They present lofty precipices to the sea on all sides. Rabbits and goats abound on them. The archil weed grows on the rocks, and is gathered for exportation. The largest islet (Deserta Grande) is 6½ m. long, and attains the height of 1610 ft. These rocks are conspicuous objects in the sea-views from Funchal.



Emery Walker sc.

The Selvagens or *Salvages* are a group of three islands, 156 m. from Madeira, and between Madeira and the Canary Islands. The largest island is the Great Piton, 3 m. long, and 1 m. broad. The inclusion of the Selvagens in the Madeira Archipelago is due to political rather than to geographical reasons.

Geology.—All the islands of the group are of volcanic origin. They are the summits of very lofty mountains which have their bases in an abyssal ocean. The greater part of what is now visible in Madeira is of subaerial formation, consisting of basaltic and trachytic lavas, beds of tuff and other ejectamenta, the result of a long and complicated series of eruptions from innumerable vents. Besides this building up by the emission of matter from craters and clefts, a certain amount of upheaval in mass has taken place, for at a spot about 1200 ft. above the sea in the northern valley of São Vicente, and again at about the same height in Porto Santo, there have been found fragments of limestone accompanied by tuffs containing marine shells and echinoderms of the Miocene Tertiary epoch. We have here proof that during or since that epoch portions at least of these islands have been bodily uplifted more than 1000 ft. The fossils are sufficiently well preserved to admit of their genera, and in many instances even their species, being made out.

There were pauses of considerable duration whilst the island of Madeira was being increased in height. The leaf bed and the accompanying carbonaceous matter, frequently termed lignite, although it displays no trace of structure, which lie under 1200 ft. of lavas in the valley of São Jorge, afford proof that there had been sufficient time for the growth of a vegetation of high order, many of the leaf impressions belonging to species of trees and shrubs which still exist on the island. Moreover, great alterations and dislocations had taken place in the rocks of various localities before other lavas and tuffs had been thrown upon them.

There are no data for determining when volcanic action began in this locality, but looking at the enormous depth of the surrounding sea it is clear that a vast period of time must have elapsed to allow of a great mountain reaching the surface and then rising several thousand feet. Again, considering the comparatively feeble agents for effecting the work of denudation (neither glaciers nor thick accumulations of alpine snow being found here), and then the enormous erosion that has actually taken place, the inference is inevitable that a very great lapse of time was required to excavate the deep and wide ravines that everywhere intersect the island. Nor is anything known as to the period of the cessation of volcanic action. At the present day there are no live craters or smoking crevices, as at the Canaries and Cape Verdes, nor any hot springs, as at the Azores.

In one of the northern ravines of Madeira by Porto da Cruz some masses of a coarsely crystalline Essexite are exposed to view; this rock is evidently the deep-seated representative of the Trachydoleritic and Nepheline basalt lavas. Fragments of a sodalite-syenite have also been found at Soca in the same neighbourhood.

In the eastern part of the island several small crater rings are to be seen; their rims are formed of spheroidal basalt, while within the craters themselves masses of bauxite are found accompanied by evidences of fumerolic action.

In the sections afforded by the ravines, which strike north and south from the central ridge of Madeira to the sea, the nucleus of the island is seen to consist of a confused mass of more or less stratified rock, upon which rest beds of tuff, scoriae and lava, in the shape of basalt, trap and trachyte, the whole traversed by dykes. These beds are thinnest near the central axis; as they approach the coast they become thicker and less intersected by dykes.

In various parts are elevated tracts of comparatively level ground. These are supposed to have been formed by the meeting of numerous streams of lava flowing from cones and points of eruption in close proximity, various ejectamenta assisting at the same time to fill up inequalities. Deep down in some of the lateral ravines may be seen ancient cones of eruption which have been overwhelmed by streams of melted matter issuing from the central region, and afterwards exposed to view by the same causes that excavated the ravines. These ravines may be regarded as having been formed at first by subterranean movements, both gradual and violent, which dislocated the rocks and cut clefts through which streams flowed to the sea. In course of time the waters, periodically swollen by melted snows and the copious rains of winter, would cut deeper and deeper into the heart of the mountains, and would undermine the lateral cliffs, until the valleys became as large as we now find them. Even the Curral, which from its rounded shape and its position in the centre of the island has been usually deemed the ruins of a crater, is thought to be nothing more than a valley scooped out in the way described. The rarity of crateriform cavities in Madeira is very remarkable. There exists, however, to the east of Funchal, on a tract 2000 ft. high, the Lagoa, a small but perfect crater, 500 ft. in diameter, and with a depth of 150 ft.; and there is another, which is a double one, in the district known as Fanal, in the north-west of Madeira, nearly 5000 ft. above the sea. The basalt, of which much of the outer part of the island is composed, is of a dark colour and a tough texture, with small disseminated crystals of olivine and augite. It is sometimes full of vesicular cavities, formed by the expansion of imprisoned gases. A rudely columnar structure is very often seen in the basalt, but there is nothing so perfect as the columns of Staffa or the Giant's Causeway. The trachytic rocks are small in quantity compared with those of the basaltic class. The tufa is soft and friable, and generally of a yellow colour; but where it has been overflowed by a hot stream of lava it has assumed a red colour. Black ashes and fragments of pumice are sometimes found in the tufaceous strata.

There are no metallic ores, nor has any sulphur been found; but a little iron pyrites and specular iron are occasionally met with. The basalt yields an excellent building-stone, various qualities of which are quarried near Camara de Lobos, five or six miles west of Funchal.

In Porto Santo the trachytic rocks bear a much greater proportion to the basaltic than in Madeira. An adjacent islet is formed of tuffs and calcareous rock, indicating a submarine origin, upon which supramarine lavas have been poured. The older series contains corals and shells (also of the Miocene Tertiary epoch), with water-worn pebbles, cemented together by carbonate of lime, the whole appearing to have been a coral reef near an ancient beach. The calcareous rock is taken in large quantities to Funchal, to be burnt into lime for building purposes.

Climate.—Observations taken at Funchal Observatory (80 ft. above sea-level) in the last twenty years of the 19th century showed that the mean annual temperature is about 65° F. The mean minimum for the coldest part of the year (October to May inclusive) does not fall below 55°, and the average daily variation of temperature in the same period does not exceed 10°. Madeira thus has a remarkably mild climate, though it lies only 10° north of the Tropic of Cancer. This mildness is due to the surrounding ocean, from which the atmosphere obtains a large supply of watery vapour. The mean humidity of the air is about 75 (saturation = 100). The prevalent winds are from the north or from a few points east or west of north, but these winds are much mitigated on the south coast by the central range of mountains. The west wind usually brings rain. That from the east is a dry wind. A hot and dry wind, the *leste* of the natives, occasionally blows from the east-south-east, the direction of the Sahara, and causes the hill region to be hotter than below; but even on the coast the thermometer under its influence sometimes indicates 93°. The *leste* is often accompanied by sandstorms. As the thermometer has never been known to fall as low as 46° at Funchal, frost and snow are there wholly unknown; but snow falls on the mountains once or twice during the winter, very seldom, however, below the altitude of 2000 ft. Thunderstorms are rare, and scarcely ever violent.

Madeira has long had a high reputation as a sanatory resort for persons suffering from diseases of the chest. Notwithstanding the ever-increasing competition of other winter resorts, a considerable number of invalids, especially English and German, winter at Funchal.

Fauna.—No species of land mammal is indigenous to the Madeiras. Some of the early voyagers indeed speak of wild goats and swine, but these animals must have escaped from confinement. The rabbit, black rat, brown rat and mouse have been introduced. The first comers encountered seals, and this amphibious mammal (*Monachus albiventer*) still lingers at the Desertas. Amongst the thirty species of birds which breed in these islands are the kestrel, buzzard and barn owl, the blackbird, robin, wagtail, goldfinch, ring sparrow, linnet, two swifts, three pigeons, the quail, red-legged partridge, woodcock, tern, herring gull, two petrels and three puffins. Only one species is endemic, and that is a wren (*Regulus madeirensis*), but five other species are known elsewhere only at the Canaries. These are the green canary (*Fringilla butyracea*, the parent of the domesticated yellow variety), a chaffinch (*Fringilla tintillon*), a swift (*Cypselus unicolor*), a wood pigeon (*Columba trocaz*) and a petrel (*Thalassidroma Bulwerii*). There is also a local variety of the blackcap, distinguishable from the common kind by the extension in the male of the cap to the shoulder. About seventy other species have been seen from time to time in Madeira, chiefly stragglers from the African coast, many of them coming with the *leste* wind.

The only land reptile is a small lizard (*Lacerta dugesii*), which is abundant and is very destructive to the grape crop. The loggerhead turtle (*Caouana caretta*, Gray) is frequently captured, and is cooked for the table, but the soup is much inferior to that made from the green turtle of the West Indies. A single variety of frog (*Rana esculenta*) has been introduced; there are no other batrachians.

About 250 species of marine fishes taken at Madeira have been scientifically determined, the largest families being *Scombridae* with 35 species, the sharks with 24, the *Sparidae* with 15, the rays with 14, the *Labridae* with 13, the *Gadidae* with 12, the eels with 12, the *Percidae* with 11, and the *Carangidae* with 10. Many kinds, such as the mackerel, horse mackerel, groper, mullet, braise, &c., are caught in abundance, and afford a cheap article of diet to the people. Several species of tunny are taken plentifully in spring and summer, one of them sometimes attaining the weight of 300 ℔. The only freshwater fish is the common eel, which is found in one or two of the streams.

According to T. V. Wollaston (*Testacea atlantica*, 1878), there have been found 158 species of mollusca on the land, 6 inhabiting fresh water, and 7 littoral species, making a total of 171. A large majority of the land shells are considered to be peculiar. Many of the species are variable in form or colour, and some have an extraordinary number of varieties. Of the land mollusca 91 species are assigned to the genus *Helix*, 31 to the genus *Pupa*, and 15 to the genus *Achatina* (or *Lovea*). About 43 species are found both living and fossil in superficial deposits of calcareous sand in Madeira or Porto Santo. These deposits were assigned by Lyell to the Newer Pliocene period. Some 12 or 13 species have not been hitherto discovered alive. More than 100 species of *Polyzoa* (*Bryozoa*) have been collected, among them are some highly interesting forms.

The only order of insects which has been thoroughly examined is that of the *Coleoptera*. By the persevering researches of T. V. Wollaston the astonishing number of 695 species of beetles has been brought to light at the Madeiras. The proportion of endemic kinds is very large, and it is remarkable that 200 of them are either wingless or their wings are so poorly developed that they cannot fly, while 23 of the endemic genera have all their species in this condition. With regard to the *Lepidoptera*, 11 or 12 species of butterflies have been seen, all of which belong to European genera. Some of the species are geographical varieties of well-known types. Upward of 100 moths have been collected, the majority of them being of a European stamp, but probably a fourth of the total number are peculiar to the Madeiran group. Thirty-seven species of *Neuroptera* have been observed in Madeira, 12 of them being so far as is known peculiar.

The bristle-footed worms of the coast have been studied by Professor P. Langerhans, who has met with about 200 species, of which a large number were new to science. There are no modern coral reefs, but several species of stony and flexible corals have been collected, though none are of commercial value. There is, however, a white stony coral allied to the red coral of the Mediterranean which would be valuable as an article of trade if it could be obtained in sufficient quantity. Specimens of a rare and handsome red *Paragorgia* are in the British Museum and Liverpool Museum.

Flora.—The vegetation is strongly impressed with a south-European character. Many of the plants in the lower region undoubtedly were introduced and naturalized after the Portuguese colonization. A large number of the remainder are found at the Canaries and the Azores, or in one of these groups, but nowhere else. Lastly, there are about a hundred plants which are peculiarly Madeiran, either as distinct species or as strongly marked varieties. The flowering plants found truly wild belong to about 363 genera and 717 species,—the monocotyledons numbering 70 genera and 128 species, the dicotyledons 293 genera and 589 species. The three largest orders are the *Compositae*, *Leguminosae* and *Graminaceae*. Forty-one species of ferns grow in Madeira, three of which are endemic species and six others belong to the peculiar flora of the North Atlantic islands. About 100 species of moss have been collected, and 47 species of *Hepaticae*. A connexion between the flora of Madeira and that of the West Indies and tropical America has been inferred from the presence in the former of six ferns found nowhere in Europe or North Africa, but existing on the islands of the east coast of America or on the Isthmus of Panama. A further relationship to that continent is to be traced by the presence in Madeira of the beautiful ericaceous tree *Clethra arborea*, belonging to a genus which is otherwise wholly American, and of a *Persea*, a tree laurel, also an American genus. The dragon tree (*Dracaena Draco*) is almost extinct. Amongst the trees most worthy of note are four of the laurel order belonging to separate genera, an *Ardisia*, *Pittosporum*, *Sideroxylon*, *Notelaea*, *Rhamnus* and *Myrica*,—a strange mixture of genera to be found on a small Atlantic island. Two heaths of arborescent growth and a whortleberry cover large tracts on the mountains. In some parts there is a belt of the Spanish chestnut about the height of 1500 ft. There is no indigenous pine tree as at the Canaries; but large tracts on the hills have been planted with *Pinus pinaster*, from which the fuel of the inhabitants is mainly derived. A European juniper (*J. Oxycedrus*), growing to the height of 40 or 50 ft., was formerly abundant, but has been almost exterminated, as its scented wood is prized by the cabinet-maker. Several of the native trees and shrubs now grow only in situations which are nearly inaccessible, and some of the indigenous plants are of the greatest rarity. But some plants of foreign origin have spread in a remarkable manner. Among these is the common cactus or prickly pear (*Opuntia Tuna*), which in many spots on the coast is sufficiently abundant to give a character to the landscape. As to *Algae*, the coast is too rocky and the sea too unquiet for a luxuriant marine vegetation, consequently the species are few and poor.

Inhabitants.—The inhabitants are of Portuguese descent, with probably some intermixture of Moorish and negro blood amongst the lower classes. The dress of the peasantry, without being picturesque, is peculiar. Both men and women in the outlying country districts wear the *carapuça*, a small cap made of blue cloth in shape something like a funnel, with the pipe standing upwards. The men have trousers of linen, drawn tight, and terminating at the knees; a coarse shirt enveloping the upper part of their person, covered by a short jacket, completes their attire, with the exception of a pair of rough yellow boots. The women's outer garments consist of a gaudily coloured gown, made from island material, with a small cape of coarse scarlet or blue woollen cloth.) The population tends to increase rapidly. In 1900 it amounted to 150,574, including 890 foreigners, of whom the majority were British. The number of females exceeds that of males by about 6000, partly because many of the able-bodied males emigrate to Brazil or the United States. The density of population (479·5 per sq. m.) is very great for a district containing no large town and chiefly dependent on agriculture and viticulture.

Agriculture.—A large portion of the land was formerly entailed in the families of the landlords (*morgados*), but entails have been abolished by the legislature, and the land is now absolutely free. The deficiency of water is a great obstacle to the proper cultivation of the land, and the rocky nature or steep inclination of the upper parts of the islands is an effectual bar to all tillage. An incredible amount of labour has been expended upon the soil, partly in the erection of walls intended to prevent its being washed away by the rains, and to build up the plots of ground in the form of terraces. Watercourses have been constructed for purposes of irrigation, without which at regular intervals the island would not produce a hundredth part of its present yield. These watercourses originate high up in the ravines, are built of masonry or driven through the rock, and wind about for miles until they reach the cultivated land. Some of them are brought by tunnels from the north side of the island through the central crest of hill. Each occupier takes his turn at the running stream for so many hours in the day or night at a time notified to him beforehand. In this climate flowing water has a saleable value as well as land, which is useless without irrigation.

The agricultural implements employed are of the rudest kind, and the system of cultivation is extremely primitive. Very few of the occupiers own the land they cultivate; but they almost invariably own the walls, cottages and trees standing thereon, the land alone belonging to the landlord. The tenant can sell his share of the property without the consent of the landlord, and if he does not so dispose of it that share passes to his heirs. In this way the tenant practically enjoys fixity of tenure, for the landlord is seldom in a position to pay the price at which the tenant's share is valued. Money rents are rare, the métayer system regulating almost universally the relations between landlord and tenant; that is, the tenant pays to the owner a certain portion of the produce, usually one half or one third. The holdings are as a rule rarely larger than one man can cultivate with a little occasional assistance. There are few meadows and pastures, the cattle being stall-fed when not feeding on the mountains. Horses are never employed for draught, all labour of that kind being done by oxen.

Wine.

The two staple productions of the soil are wine and sugar. The vine was introduced from Cyprus or Crete soon after the discovery of the island by the Portuguese (1420), but it was not actively cultivated until the early part of the 16th century. The vines, after having been totally destroyed by the oidium disease, which made its first appearance in the island in 1852, were replanted, and in a few years wine was again made. The phylloxera also made its way to the island, and every vineyard in Madeira was more or less affected by it. The wine usually termed Madeira is made from a mixture of black and white grapes, which are also made separately into wines called Tinta and Verdelho, after the names of the grapes. Other high-class wines, known as Bual, Sercial and Malmsey, are made from varieties of grapes bearing the same names. (See also WINE.)

Sugar.

The sugar cane is said to have been brought from Sicily about 1452, and in course of time its produce became the sole staple of the island. The cultivation languished, however, as the more abundant produce of tropical countries came into the European market, and sugar had long ceased to be made when the destruction of the vines compelled the peasants to turn their attention to other things. Its cultivation was resumed and sugar machinery imported. A considerable quantity of spirit is made by the distillation of the juice or of the molasses left after extracting the sugar, and this is consumed on the island. The cane does not flourish here as luxuriantly as within the tropics; but in localities below 1000 ft., where there is a good supply of water, it pays the cultivator well.

The grain produced on the island (principally wheat, barley and Indian corn) is not sufficient for the consumption of the people. The common potato, sweet potato and gourds of various kinds are extensively grown, as well as the *Colocasia esculenta*, the *kalo* of the Pacific islanders, the root of which yields an insipid food. Most of the common table vegetables of Europe are plentiful. Besides apples, pears and peaches, all of poor quality, oranges, lemons, guavas, mangoes, loquats, custard-apples, figs, bananas and pineapples are produced, the last two forming articles of export. The date palm is occasionally grown, but its fruit is scarcely edible. On the hills large quantities of the Spanish chestnut afford an item in the food of the common people. A little tobacco is grown, and is made into cigars of inferior quality.

The total foreign trade of Madeira was valued at £628,000 in 1900. The principal exports are wine, sugar, embroidery, vegetables, fruits and wicker goods. Coal is imported for the ships calling at Funchal, which is the headquarters of Madeiran commerce and industry. Spirits, beer, olive oil, soap, butter, linen and woollen goods, straw hats and leather, are manufactured for home consumption, and there are important fisheries.

Chief Towns and Communications.—Funchal (pop. 20,850) is described in a separate article. The other chief towns are Camara de Lobos (7150), Machico (6128), Santa Cruz (5876) Ponta do Sol (5665), São Vicente (4896), Calheta (3475), Sant' Anna (3011) and Porto Santo (2311). Each of these is the capital of a commune (*concelho*), to which it gives its name. Madeira is connected by regular lines of steamships with Great Britain, Germany, Portugal, Cape Colony, Brazil and the United States. There is no railway in the archipelago, and partly owing to the irregularities of the surface of the roads, of which there are some 580 m., are bad, except in the neighbourhood of Funchal. Wheel carriages are rare, and all heavy goods are transported either on the backs of mules or upon rude wooden sledges drawn by bullocks. When horses are not employed, locomotion is effected either by means of hammocks or by bullock cars. The hammock (*rêde*) is a piece of stout canvas gathered up and secured at each end to a long pole carried by a couple of bearers. In place of cabs, curtained cars on sledges, made to hold four persons, and drawn by a pair of bullocks, are employed. They are convenient, but the rate of progress is very slow.

Administration.—The archipelago is officially styled the district of Funchal; it returns members to the Portuguese Cortes, and is regarded as an integral part of the kingdom. The district is subdivided into the eight communes already enumerated, and is administered in accordance with the same laws that regulate local government on the mainland (see PORTUGAL). Funchal is a Roman Catholic bishopric in the archiepiscopal province of Lisbon. Education is compulsory in name only, for less than 2% of the population could read when the census of 1900 was taken. An infantry regiment and a battery of garrison artillery are permanently stationed in Madeira.

History.—It has been conjectured, but on insufficient evidence, that the Phoenicians discovered Madeira at a very early period. Pliny mentions certain Purple or Mauretanian Islands, the position of which with reference to the Fortunate Islands or Canaries might seem to indicate the Madeiras. There is a romantic story, to the effect that two lovers, Robert Machim, à Machin, or Macham, and Anna d'Arfet, fleeing from England to France (*c.* 1370) were driven out of their course by a violent storm and cast on the coast of Madeira at the place subsequently named Machico, in memory of one of them. Both perished here, but some of their crew escaped to the Barbary coast, and were made slaves. Among them was the pilot Pedro Morales of Seville, who is said to have been ransomed and to have communicated his knowledge of Madeira to João Gonçalvez Zarco (or Zargo). How far this story is true cannot now be ascertained. It is, however, certain that Zarco first sighted Porto Santo in 1418, having been driven thither by a storm while he was exploring the coast of West Africa. Madeira itself was discovered in 1420. It is probable that the whole archipelago had been explored at an earlier date by Genoese adventurers, and had been forgotten; for an Italian map dated 1351 (the Laurentian portolano) shows the Madeiras quite clearly, and there is some reason to believe that they were known to the Genoese before 1339. When Zarco visited Madeira in 1420 the islands were uninhabited, but Prince Henry the Navigator at once began their colonization, aided by the knights of the Order of Christ. Sanctioned by the pope and by two charters which the king of Portugal granted in 1430 and 1433, the work proceeded apace; much land was deforested and brought into cultivation, and the Madeiran sugar trade soon became important. For the sixty years 1580–1640 Madeira, with Portugal itself, was united with Spain. Slavery was abolished in Madeira in 1775, by order of Pombal. In 1801 British troops, commanded by General Beresford, occupied the island for a few months, and it was again under the British flag from 1807 to 1814. It shared in the civil disturbances brought about by the accession of Dom Miguel (see PORTUGAL: *History*), but after 1833 its history is a record of peaceful commercial development.

See A. S. Brown, *Madeira, the Canary Islands and the Azores* (1903), a comprehensive study of the three archipelagoes. *The Land of the Wine*, by A. J. D. Biddle (Philadelphia, 1901) is generally valuable, but its history cannot be trusted. See also P. Langerhaus, *Handbuch für Madeira* (1884) and Vahl, *Madeira's Vegetation* (Copenhagen, 1904).

MADELENIAN, a term derived from La Madeleine, a cave in the Vézère, about midway between Moustier and Les Eyzies, France, and given by the French anthropologist Gabriel de Mortillet to the third stage of his system of cave-chronology, synchronous with the fourth or most recent division of the Quaternary Age. The Madelenian epoch was a long one, represented by numerous stations, whose contents show progress in the arts and general culture. It was characterized by a cold and dry climate, the existence of man in association with the reindeer, and the extinction of the mammoth. The use of bone and ivory for various implements, already begun in the preceding Solutrian epoch, was much increased, and the period is essentially a Bone age. The bone instruments are very varied: spear-points, harpoon-heads, borers, hooks and needles. Most remarkable is the evidence La Madeleine affords of prehistoric art. Numbers of bones, reindeer antlers and animals' teeth were found, with rude pictures, carved or etched on them, of seals, fishes, reindeer, mammoths and other creatures. The best of these are a mammoth engraved on a fragment of its own ivory; a dagger of reindeer antler, with handle in form of a reindeer; a cave-bear cut on a flat piece of schist; a seal on a bear's tooth; a fish well drawn on a reindeer antler; and a complete picture, also on reindeer antler, showing horses, an aurochs, trees, and a snake biting a man's leg. The man is naked, and this and the snake suggest a warm climate, in spite of the presence of the reindeer. The fauna of the Madelenian epoch seems, indeed, to have included tigers and other tropical species side by side with reindeer, blue foxes, Arctic hares and other polar creatures. Madelenian man appears to have been of low stature, dolichocephalic, with low retreating forehead and prominent brow ridges. Besides La Madeleine the chief stations of the epoch are Les Eyzies, Laugerie Basse, and Gorge d'Enfer in Dordogne; Grotte du Placard in Charente and others in south-west France.

See G. de Mortillet, *Le Préhistorique* (1900); Edouard Lartet and Henry Christy, *Reliquiae Aquitanicae* (1865–1875); Edouard Dupont, *Le Temps préhistorique en Belgique* (1872); Lord Avebury, *Prehistoric Times* (1900).

MADELEY, a market town in the municipal borough of Wenlock, and the Wellington (Mid) parliamentary division of Shropshire, England, 159 m. N.W. from London, with stations on the London & North Western (Madeley Market) and Great Western railways (Madeley Court). Pop. of civil parish (1901), 8442. There are large ironworks, ironstone and coal are mined, and potter's clay is raised. The church of St Michael (1796) replaced a Norman building. The living was held from 1760 to 1783 by John William Fletcher or de la Flechêre, a close friend of the Wesleys. The parish includes a portion of Coalbrookdale (*q.v.*), and the towns of Ironbridge and Coalport. IRONBRIDGE, a town picturesquely situated on the steep left bank of the Severn, adjoins Madeley on the south-west. It takes its name from the iron bridge of one span crossing the river, erected in 1779. This bridge is a remarkable work considering its date; it was probably the first erected, at any rate on so large a scale, and attracted great attention. It is the work of Abraham Darby, the third of the name, one of the famous family of iron-workers in Coalbrookdale. Here are brick and tile works and lime-kilns. There is a station (Ironbridge and Broseley) on the Great Western railway, across the river. COALPORT lies also on the Severn, S. of Madeley and 2 m. S.E. of Ironbridge, with a station on the Great Western railway. It has large china works, founded at the close of the 18th century, which subsequently incorporated those of Caughley, across the Severn, and of Nantgarw in Glamorganshire.

MĀDHAVA ĀCHĀRYA (*fl. c.* 1380), Hindu statesman and philosopher, lived at the court of Vijayanagar (the modern Humpi in the district of Bellary), the vigorous Southern Hindu kingdom that so long withstood Mahommedan influence and aggression. His younger brother Sāyaṇa (d. 1387) was associated with him in the administration and was a famous commentator on the *Rigveda.* Sāyaṇa's commentaries were influenced by and dedicated to Mādhava, who is best known as the author of the *Sarvadarsana Samgraha* (*Compendium of Speculations*). With remarkable mental detachment he places himself in the position of an adherent of sixteen distinct systems. Mādhava also wrote a commentary on the Mīmāṃsā Sūtras. He died as abbot of the monastery of Sringeri.

MADI (A-MADI), a negro race of the Nile valley, occupying both banks of the Bahr-el-Jebel immediately north of Albert Nyanza. Tradition makes them immigrants from the north-west. They are remarkable for the consideration shown to their women, who choose their own husbands, are never ill-treated or hard-worked, and take part in tribal deliberations. The Madi build sepulchral monuments of an elaborate type, two huge narrow stones sloping towards each other with two smaller slabs covering the opening between them. They have been much harried by the Azandeh and Abarambo. They were visited by W. Junker in 1882–1883, and described by him in *Petermann's Mittheilungen* for May 1883.

MADISON, JAMES (1751–1836), fourth president of the United States, was born at Port Conway, in King George county, Virginia, on the 16th of March 1751. His first ancestor in America may possibly have been Captain Isaac Maddyson, a colonist of 1623 mentioned by John Smith as an excellent Indian fighter. His father, also named James Madison, was the owner of large estates in Orange county, Virginia. In 1769 the son entered the college of New Jersey (now Princeton University), where, in the same year, he founded the well-known literary club, "The American Whig Society." He graduated in 1771, but remained for another year at Princeton studying, apparently for the ministry, under the direction of John Witherspoon (1722–1794). In 1772 he returned to Virginia, where he pursued his reading and studies, especially theology and Hebrew, and acted as a tutor to the younger children of the family. In 1775 he became chairman of the committee of public safety for Orange county, and wrote its response to Patrick Henry's call for the arming of a colonial militia, and in the spring of 1776 he was chosen a delegate to the new Virginia convention, where he was on the committee which drafted the constitution for the state, and proposed an amendment (not adopted) which declared that "all men are equally entitled to the full and free exercise" of religion, and was more radical than the similar one offered by George Mason. In 1777, largely, it seems, because he refused to treat the electors with rum and punch, after the custom of the time, he was not re-elected, but in November of the same year he was chosen a member of the privy council or council of state, in which he acted as interpreter for a few months, as secretary prepared papers for the governor, and in general took a prominent part from the 14th of January 1778 until the end of 1779, when he was elected a delegate to the Continental Congress.

He was in Congress during the final stages of the War of Independence, and in 1780 drafted instructions to Jay, then representing the United States at Madrid, that in negotiations with Spain he should insist upon the free navigation of the Mississippi and upon the principle that the United States succeeded to British rights affirmed by the treaty of Paris of 1763. When the confederation was almost in a state of collapse because of the failure of the states to respond to requisitions of Congress for supplies for the federal treasury, Madison was among the first to advocate the granting of additional powers to Congress, and urged that congress should forbid the states to issue more paper money. In 1781 he favoured an amendment of the Articles of Confederation giving Congress power to enforce its requisitions, and in 1783, in spite of the open opposition of the Virginia legislature, which considered the Virginian delegates wholly subject to its instructions, he advocated that the states should grant to Congress for twenty-five years authority to levy an import duty, and suggested a scheme to provide for the interest on the debt not raised by the import duty—apportioning it among the states on the basis of population, counting three-fifths of the slaves, a ratio suggested by Madison himself. Accompanying this plan was an address to the states drawn up by Madison, and one of the ablest of his state papers. In the same year, with Oliver Ellsworth of Connecticut, Nathaniel Gorham of Massachusetts, Gunning Bedford of Delaware, and John Rutledge of South Carolina, he was a member of the committee which reported on the Virginia proposal as to the terms of cession to the Confederation of the "back lands," or unoccupied Western territory, held by several of the states; the report was a skilful compromise made by Madison, which secured the approval of the rather exigent Virginia legislature.

In November 1783 Madison's term in Congress expired, and he returned to Virginia and took up the study of the law. In the following year he was elected to the House of Delegates. As a member of its committee on religion, he opposed the giving of special privileges to the Episcopal (or any other) church, and contended against a general assessment for the support of the churches of the state. His petition of remonstrance against the proposed assessment, drawn up at the suggestion of George Nicholas (*c.* 1755–1799), was widely circulated and procured its defeat. On the 26th of December 1785 Jefferson's Bill for establishing religious freedom in Virginia, which had been introduced by Madison, was passed. In the Viginia House of Delegates, as in the Continental Congress, he opposed the further issue of paper money; and he tried to induce the legislature to repeal the law confiscating British debts, but he did not lose sight of the interests of the Confederacy. The boundary between Virginia and Maryland, according to the Baltimore grant, was the south shore of the Potomac, a line to which Virginia had agreed on condition of free navigation of the river and the Chesapeake Bay. Virginia now feared that too much had been given up, and desired joint regulation of the navigation and commerce of the river by Maryland and Virginia. On Madison's proposal commissioners from the two states met at Alexandria (*q.v.*) and at Mount Vernon in March 1785. The Maryland legislature approved the Mount Vernon agreement and proposed to invite Pennsylvania and Delaware to join in the arrangement. Madison, seeing an opportunity for more general concert in regard to commerce and trade (and possibly for the increase of the power of Congress), proposed that all the states should be invited to send commissioners to consider commercial questions, and a resolution to that effect was adopted (on Jan. 21, 1786) by the Virginia legislature. This led to the Annapolis convention of 1786, and that in turn led to the Philadelphia convention of 1787. In April 1787 Madison had written a paper, *The Vices of the Political System of the United States*, and from his study of confederacies, ancient and modern, later summed up in numbers 17, 18, and 19 of *The Federalist*, he had concluded that no confederacy could long endure if it acted upon states only and not directly upon individuals. As the time for the convention of 1787 approached he drew up an outline of a new system of government, the basis of the "Virginia plan" presented in the convention by Edmund Jennings Randolph. Madison's scheme, as expressed in a letter to Washington dated the 16th of April 1787, was that individual sovereignty of states was irreconcilable with aggregate sovereignty, but that the "consolidation of the whole into one simple republic would be as inexpedient as it is unattainable." He considered as a practical middle ground changing the basis of representation in Congress from states to population; giving the national government "positive and complete authority in all cases which require uniformity"; giving it a negative on all state laws, a power which might best be vested in the Senate, a comparatively permanent body; electing the lower house, and the more numerous, for a short term; providing for a national executive, for extending the national supremacy over the judiciary and the militia, for a council to revise all laws, and for an express statement of the right of coercion; and finally, obtaining the ratification of a new constitutional instrument from the people, and not merely from the legislatures. The "Virginia plan" was the basis of the convention's deliberations which resulted in the constitution favourably voted on by the convention on the 17th of September 1787. Among the features of the plan which were not embodied in the constitution were the following: proportionate representation in the Senate and the election of its members by the lower house "out of a proper number of persons nominated by the individual legislatures"; the vesting in the national Congress of power to negative state acts; and the establishment of a council of revision (the executive and a convenient number of national judges) with veto power over all laws passed by the national Congress. Madison, always an opponent of slavery, disapproved of the compromise (in Art. I. § 9 and Art.V.) postponing to 1808 (or later) the prohibition of the importation of slaves. He took a leading part in the debates of the convention, of which he kept full and careful notes, afterwards published by order of Congress (3 vols., Washington, 1843). Many minute and wise provisions are due to him, and he spoke before the convention more frequently than any delegate except James Wilson and Gouverneur Morris. In spite of the opposition to the constitution of the Virginia leaders George Mason and E. J. Randolph, Madison induced the state's delegation to stand by the constitution in the convention. His influence largely shaped the form of the final draft of the constitution, but the labour was not finished with this draft; that the constitution was accepted by the people was due in an eminent degree to the efforts of Madison, who, to place the new constitution before the public in its true light, and to meet the objections brought against it, joined Alexander Hamilton (*q.v.*) and John Jay in writing *The Federalist*, a series of eighty-five papers, out of which twenty certainly, and nine others probably, were written by him. In the Virginia convention for ratifying the constitution (June 1788), when eight states had ratified and it seemed that Virginia's vote would be needed to make the necessary nine (New Hampshire's favourable vote was cast only shortly before that of Virginia), and it appeared that New York would vote against the constitution if Virginia did not ratify it, Madison was called upon to defend that instrument again, and he appeared at his best against its opponents, Patrick Henry, George Mason, James Monroe, Benjamin Harrison, William Grayson and John Tyler. He answered their objections in detail, calmly and with an intellectual power and earnestness that carried the convention. The result was a victory against an originally adverse public opinion and against the eloquence of the opponents of the constitution, for Madison and for his lieutenants, Edmund Pendleton, John Marshall, George Nicholas, Harry Innes and Henry Lee. At the same time Madison's labours in behalf of the constitution alienated from him valuable political support in Virginia. He was defeated by Richard Henry Lee and William Grayson in his candidacy for the United States Senate, but in his own district he was chosen a representative to Congress, defeating James Monroe, who seems to have had the powerful support of Patrick Henry.

Madison took his seat in the House of Representatives in April 1789, and assumed a leading part in the legislation necessary to the organization of the new government. He drafted a Tariff Bill giving certain notable advantages to nations with which the United States had commercial treaties, hoping to force Great Britain into a similar treaty; but his policy of discrimination against England was rejected by Congress. It was his belief that such a system of retaliation would remove the possibility of war arising from commercial quarrels. He introduced resolutions calling for the establishment of three executive departments, foreign affairs, treasury and war, the head of each removable by the president. Most important of all, he proposed nine amendments to the constitution, embodying suggestions made by a number of the ratifying states, especially those made by Virginia at the instance of George Mason; and the essential principles of Madison's proposed amendments were included in a Bill of Rights, adopted by the states in the form of ten amendments. The absence of a Bill of Rights from the constitution as first adopted had been the point on which the opposition had made common cause, and the adoption of this now greatly weakened the same opposition. Although a staunch friend of the constitution, Madison believed, however, that the instrument should be interpreted conservatively and not be made the means of introducing radical innovations. The tide of strict construction was setting in strongly in his state, and he was borne along with the flood. It is very probable that Jefferson's influence over Madison, which was greater than Hamilton's, contributed to this result. Madison now opposed Hamilton's measures for the funding of the debt, the assumption of state debts, and the establishment of a National Bank, and on other questions he sided more and more with the opposition, gradually assuming its leadership in the House of Representatives and labouring to confine the powers of the national government within the narrowest possible limits; his most important argument against Hamilton's Bank was that the constitution did not provide for it explicitly, and could not properly be construed into permitting its creation. Madison, Jefferson and Randolph were consulted by Washington, and they advised him not to sign the bill providing for the Bank, but Hamilton's counter-argument was successful. On the same constitutional grounds Madison objected to the carrying out of the recommendations in Hamilton's famous report on manufactures (Dec. 5, 1791), which favoured a protective tariff. In the presidential campaign of 1792 Madison seems to have lent his influence to the determined efforts of the Jeffersonians to defeat John Adams by electing George Clinton vice-president. In 1793–1796 he strongly criticized the administration for maintaining a neutral position between Great Britain and France, writing for the public press five papers (signed "Helvidius"), attacking the "monarchical prerogative of the executive" as exercised in the proclamation of neutrality in 1793 and denying the president's right to recognize foreign states. He found in Washington's attitude—as in Hamilton's failure to pay an instalment of the moneys due France—an "Anglified complexion," in direct opposition to the popular sympathy with France and French Republicanism. In 1794 he tried again his commercial weapons, introducing in the House of Representatives resolutions based on Jefferson's report on commerce, advising retaliation against Great Britain and discrimination in commercial and navigation laws in favour of France; and he declared that the friends of Jay's treaty were "a British party systematically aiming at an exclusive connexion with the British government," and in 1796 strenuously but unsuccessfully opposed the appropriation of money to carry this treaty into effect. Still thinking that foreign nations could be coerced through their commercial interests, he scouted as visionary the idea that Great Britain would go to war on a refusal to carry Jay's treaty into effect, thinking it inconceivable that Great Britain "would wantonly make war" upon a country which was the best market she had in the world for her manufactures, and one with which her export trade was so much larger than her import.

In 1797 Madison retired from Congress, but not to a life of inactivity. In 1798 he joined Jefferson in opposing the Alien and Sedition Laws, and Madison himself wrote the resolutions of the Virginia legislature declaring that it viewed "the powers of the Federal government as resulting from the compact to which the states are parties, as limited by the plain sense and intention of the instrument constituting that compact; as no further valid than they are authorized by the grants enumerated in that compact; and that, in case of a deliberate, palpable and dangerous exercise of other powers, not granted by the said compact, the states, who are parties thereto, have the right and are in duty bound to interpose for arresting the progress of the evil, and for maintaining within their respective limits, the authorities, rights and liberties appertaining to them." The Virginia resolutions and the Kentucky resolutions (the latter having been drafted by Jefferson) were met by dissenting resolutions from the New England states, from New York, and from Delaware. In answer to these, Madison, who had become a member of the Virginia legislature in the autumn of 1799, wrote for the committee to which they were referred a report elaborating and sustaining in every point the phraseology of the Virginia resolutions.[1]

Upon the accession of the Republican party to power in 1801, Madison became secretary of state in Jefferson's cabinet, a position for which he was well fitted both because he possessed to a remarkable degree the gifts of careful thinking and discreet and able speaking, and of large constructive ability; and because he was well versed in constitutional and international law and practised a fairness in discussion essential to a diplomat. During the eight years that he held the portfolio of state, he had continually to defend the neutral rights of the United States against the encroachments of European belligerents; in 1806 he published *An Examination of the British Doctrine which subjects to Capture a Neutral Trade not open in Time of Peace*, a careful argument—with a minute examination of authorities on international law—against the rule of war of 1756 extended by Great Britain in 1793 and 1803.

During Jefferson's presidency and whilst Madison was secretary of state, by the purchase of Louisiana, Madison's campaign begun in 1780 for the free navigation of the Mississippi was brought to a successful close. The candidate in 1808 of the Republican party, although bitterly opposed in the party by John Randolph and George Clinton, Madison was elected president, defeating C. C. Pinckney, the Federalist candidate, by 122 votes to 47. Madison had no false hopes of placating the Federalist opposition, but as the preceding administration was one with which he was in harmony, his position was different from that of Jefferson in 1801, and he had less occasion for removing Federalists from office. Jefferson's peace policy—or, more correctly, Madison's peace policy—of commercial restrictions to coerce Great Britain and France he continued to follow until 1812, when he was forced to change these futile commercial weapons for a policy of war, which was very popular with the extreme French wing of his party. There is a charge, which has never been proved or disproved, that Madison's real desire was for peace, but that in order to secure the renomination he yielded to that wing of his party which was resolved on war with Great Britain. The only certain fact is that Madison, whatever were his personal feelings in this matter, acted according to the wishes of a majority of the Republicans; but whether in doing so he was influenced by the desire of another nomination is largely a matter of conjecture. Madison was renominated on the 18th of May 1812, issued his war message on the 1st of June, and in the November elections he was re-elected, defeating De Witt Clinton by 128 votes to 89. His administration during the war was pitiably weak. His cabinet in great part had been dictated to him in 1809 by a senatorial clique, and it was hopelessly discordant; for two years he was to all intents and purposes his own secretary of state, Robert Smith being a mere figure-head of whom he gladly got rid in 1811, giving Monroe the vacant place. Madison himself had attempted alternately to prevent war by his "commercial weapons" and to prepare the country for war, but he had met with no success, because of the tricky diplomacy of Great Britain and of France, and because of the general distrust of him coupled with the particular opposition to the war of the prosperous New England Federalists, who suggested with the utmost seriousness that his resignation should be demanded. In brief, Madison was too much the mere scholar to prove a strong leader in such a crisis. The supreme disgrace of the administration was the capture and partial destruction in August 1814 of the city of Washington—this was due, however, to incompetence of the military and not to any lack of prudence on the cabinet's part. In general, Congress was more blamable than either the president or his official family, or the army officers. With the declaration of peace the president again gained a momentary popularity much like that he had won in 1809 by his apparent willingness at that time to fight France.

Retiring from the presidency in 1817, Madison returned to his home, Montpelier (in Orange county, Virginia), which he left in no official capacity save in 1829, when he was a delegate to the state constitutional convention and served on several of its committees. Montpelier, like Jefferson's Monticello and Monroe's Oak-Hill, was an expensive bit of "gentleman farming," which with his generous Virginia hospitality nearly ruined its owner financially. Madison's home was peculiarly a centre for literary travellers in his last years; when he was eighty-three he was visited by Harriet Martineau, who reported her conversations with him in her *Retrospect of Western Travel* (1838). He took a great interest in education—his library was left to the university of Virginia, where it was burned in 1895—in emancipation, and in agricultural questions, to the very last. He died at Montpelier on the 28th of June 1836. Madison married, in 1794, Dorothy Payne Todd (1772–1849), widow of John Todd, a Philadelphia lawyer. She had great social charm, and upon Madison's entering Jefferson's cabinet became "first lady" in Washington society. Her plump beauty was often remarked—notably by Washington Irving—in contrast to her husband's delicate and feeble figure and wizened face—for even in his prime Madison was, as Henry Adams says, "a small man, quiet, somewhat precise in manner, pleasant, fond of conversation, with a certain mixture of ease and dignity in his address." Her son, spoiled by his mother and his step-father, became a wild young fellow, and added his debts to the heavy burden of Montpelier upon Madison.

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[1] Thirty years later Madison's arguments for the Virginia resolutions and the resolutions themselves were freely used by Calhoun and his followers in support of his doctrine of nullification. But Madison insisted that the Resolutions of 1798 did not involve the principles of nullification. Nearly all his arguments, especially where he attempts to interpret Jefferson's writings on the point, notably the Kentucky resolutions, are rather strained and specious, but it does seem that the Virginia resolutions were based on a different idea from Calhoun's doctrine of nullification. Madison's theory was that the legislature of Virginia, being one of the bodies which had chosen delegates to the constitutional convention, was legally capable of considering the question of the constitutionality of laws passed by the Federal government, and that the state of Virginia might invite other states to join her, but could not singly, as Calhoun argued, declare any law of the Federal legislature null and void. (It is to be noted the words "null and void" were in Madison's first draft of the Virginia resolutions, but that they were omitted by the Virginia legislature.) It is notable, besides, that Madison had always feared that the national congress would assume too great power, that he had approved of Supreme Court checks on the national legislature, and of veto power by a council of revision.

Madison's portrait was painted by Gilbert Stuart and by Charles Willson Peale; Giuseppe Ceracchi made a marble bust of him in 1792 and John H. J. Browere another in 1827, now in possession of the Virginia Historical Society at Richmond. Though commonly dignified and a little stiff he seems to have had a strong sense of humour and he was fond of telling a good story. Henry Clay, contrasting him with Jefferson, said that Jefferson had more genius, Madison more judgment and common sense; that Jefferson was a visionary and a theorist; Madison cool, dispassionate, practical, and safe.[1] The broadest and most accurate scholar among the "founders and fathers," he was particularly an expert in constitutional history and theory. In the great causes for which Madison fought in his earlier years—religious freedom and separation of church and state, the free navigation of the Mississippi, and the adoption of the constitution—he met with success. His greatest and truest fame is as the "father of the constitution." The "commercial weapons" with which he wished to prevent armed conflict proved less useful in his day than they have since been in international disputes.

AUTHORITIES.—Madison's personality is perplexingly vague; the biographies of him are little more than histories of the period, and the best history of the later period in which he was before the public, Henry Adams's *History of the United States from 1801 to 1817* (1889–1890), gives the clearest sketch and best criticism of him. The lives of Madison are: J. Q. Adams's (Boston, 1850); W. C. Rives's (Boston, 1859–1869, 3 vols.), covering the period previous to 1797; S. H. Gay's (Boston, 1884) in the "American Statesmen Series"; and Gaillard Hunt's (New York, 1902). Madison's *Writings* (7 vols., New York, 1900–1906) were edited by Hunt, who also edited *The Journal of the Debates in the Convention which framed the Constitution of the United States, as Recorded by James Madison* (2 vols., New York, 1908). See also Mrs Madison's *Memoirs and Letters* (Boston, 1887) and Maud Wilder Goodwin, *Dolly Madison* (New York, 1897).

MADISON, a city and the county-seat of Jefferson county, Indiana, U.S.A., on the N. bank of the Ohio river, about 90 m. below Cincinnati, and 44 m. above Louisville, Kentucky. Pop. (1870), 10,709; (1890), 8936; (1900), 7835 (554 foreign-born and 570 negroes); (1910), 6934. Madison is served by the Pittsburg, Cincinnati, Chicago & St Louis railroad and by river steamboats. The city is picturesquely situated on bluffs above the river and has two public parks. In Madison are a King's Daughters' Hospital, a children's home, and the Drusilla home for old ladies, and immediately north of the city are the buildings of the Indiana South-eastern Insane Hospital. Madison is a trading centre of the surrounding farming region, whose principal products are burley tobacco, grain and fruits (peaches, apples, pears, plums and small fruits). The municipality owns and operates the waterworks. Madison was settled about the beginning of the 19th century; was incorporated as a town in 1824, and was first chartered as a city in 1836.

MADISON, a borough of Morris county, New Jersey, U.S.A., 27 m. (by rail) W. of New York City and 4 m. S.E. of Morristown. Pop. (1890), 2469; (1900), 3754, of whom 975 were foreign-born and 300 were negroes; (1905), 4115; (1910), 4658. It is served by the Morris & Essex division of the Delaware, Lackawanna & Western railroad. The borough is attractively situated among the hills of Northern New Jersey, is primarily a residential suburb of New York and Newark, and contains many fine residences. There are a public library and a beautiful public park, both given to the borough by Daniel Willis James (1832–1907), a prominent metal manufacturer; the library is closely allied with the public schools. Madison is the seat of the well-known Drew theological seminary (Methodist Episcopal; founded in 1866 and opened in 1867), named in honour of Daniel Drew (1788–1879), who, having acquired great wealth from steamboat and railway enterprises, especially from trading in railway stocks, presented the large and beautiful grounds and most of the buildings. The seminary's course covers three years; no fee is charged. In connexion with the seminary the Drew settlement in New York City—officially the department of applied Christianity—has for its object the "practical study of present-day problems in city evangelism, church organization, and work among the poor." In 1907–1908 the seminary had 9 instructors, 175 students, and a library of more than 100,000 volumes, especially rich in works dealing with the history of Methodism and in Greek New Testament manuscripts. About 2 m. N.W. of Madison is Convent Station, the seat of a convent of the Sisters of Charity, who here conduct the college of St Elizabeth, for girls, founded in 1859; also conducted by the Sisters of Charity is St Joseph's preparatory school for boys, founded in 1862. The cultivation of roses and chrysanthemums is practically the only industry of Madison. Madison owns and operates its waterworks and electric-lighting plant. Before 1844 when it took its present name (in honour of President Madison), Madison was called Bottle Hill; it is one of the older places of the state, and its first church (Presbyterian) was built about 1748. The borough was incorporated in 1889.

MADISON, the capital of Wisconsin, U.S.A., and the county-seat of Dane County, situated between Lakes Mendota and Monona in the south central part of the state, about 82 m. W. of Milwaukee and about 131 m. N.W. of Chicago. Pop. (1890), 13,426; (1900) 19,164, of whom 3362 were foreign-born and 69 were negroes; (1910 census) 25,531. Madison is served by the Chicago & North-Western, the Chicago, Milwaukee & St Paul, and the Illinois Central railways (being the northern terminus of the last), and by interurban electric lines, connecting with Janesville, Beloit and Chicago. It has a picturesque situation in what is known as "the Four-Lakes region"; this region takes its name from a chain of lakes, Kegonsa, Waubesa, Monona and Mendota, which, lying in the order named and connected with one another by the Yahara or Catfish River, form the head-waters of Rock river flowing southward through Illinois into the Mississippi. The city occupies a hilly isthmus about a mile wide between Lakes Mendota and Monona, bodies of water of great clearness and beauty, with bottoms of white sand and granite.

The state capitol is in a wooded park at the summit of a hill 85 ft. high in the centre of the city. From this park the streets and avenues radiate in all directions. The capitol, built in 1860–1867 (with an addition in 1883) on the site of the original capitol building (1837–1838), was partially destroyed by fire in 1904, and in 1909–1910 was replaced by a larger edifice. The principal business portion of the city is built about the capitol park and the university. Among the public buildings on or near the park are the federal building, housing the post office and the United States courts, the city hall, the Dane county court-house, the public library, the Fuller opera-house, the county gaol, and the high school. Running directly west from the capitol is State Street, at the western end of which lie the grounds of the university of Wisconsin (*q.v.*), occupying a hilly wooded tract of 300 acres, and extending for a mile along the south shore of Lake Mendota. University Hill, on which the main building of the university stands, is 125 ft. above the lake; at its foot stands the magnificent library building of the State Historical Society. In it, in addition to the interesting and valuable historical museum and art gallery, are the Society's library of more than 350,000 books and pamphlets, the university library of 150,000 volumes, and the library of the Wisconsin academy of arts and sciences, 5000 volumes. Other libraries in the city include the state law library (45,000 volumes) in the capitol, the Madison public library (22,500 volumes), and the Woodman astronomical library (7500 volumes). The Madison public library houses also the state library school maintained by the Wisconsin library commission. Connected with the university is the Washburn observatory. On the margin of the city lies the extensive experimental farm of the state college of agriculture. In addition to the state university, Madison is the seat of several Roman Catholic and Lutheran parochial schools, two business schools, and the Wisconsin academy, a non-sectarian preparatory school of high grade. On the banks of Lake Monona are the beautiful grounds of the Monona Lake assembly, a summer assembly on the Chautauqua model. Near the city is one of the five fish-hatcheries maintained by the state; it is largely devoted to the propagation of trout and other small fish. North of the city, occupying a tract of 500 acres, on Lake Mendota, are the buildings and grounds of the state hospital for the insane, opened in 1860.

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[1] Clay's opinion is given in a report written by Mrs Samuel H. Smith of a conversation in 1829 between Clay and her husband, a prominent politician.

The city's streets are broad and heavily shaded with a profusion of elm, oak and maple trees. There are many fine stone residences dating from the middle of the 19th century. There are several parks of great beauty, and along the shores of Lake Mendota there is a broad boulevarded drive of 12 m. The municipality owns its waterworks, the water being obtained from eleven artesian wells, and being chemically similar to that of Waukesha Springs. The city and surrounding region are a summer resort, the lakes affording opportunities for fishing and for yachting and boating.

Madison is an important jobbing centre for central and south-western Wisconsin; it has an extensive trade in farm, garden and dairy products, poultry and tobacco; and there are various manufactures. In 1905 the value of the total factory product was $3,291,143, an increase of 22·4% over that in 1900.

At the time of the settlement by the whites the aboriginal inhabitants of the Four-Lakes region were the Winnebago. Prehistoric earthworks are to be seen in the neighbourhood, several animal-shaped mounds upon the shores of Lakes Mendota, Monona and Waubesa being among the best examples. A regular trading post is known to have been established on Lake Mendota as early as 1820. The title to the Indian lands was acquired by the United States by treaty in 1825. Colonel Ebenezer Brigham established himself at Blue Mounds, in the western part of Dane county, in 1827. In 1832 the "Four-Lakes" country was in the theatre of hostilities during the Black Hawk War; Colonel Henry Dodge held a conference with Winnebago chiefs on Lake Mendota, and there were several skirmishes in the neighbourhood between his troops and the followers of Black Hawk, one of which took place on the site of Madison. After Black Hawk's defeat on the Bad Axe he fled to the Wisconsin river Dalles, near the present Kilbourn, where he was betrayed by the Winnebago. In 1836 Stevens T. Mason, governor of Michigan, and James Duane Doty, then U.S. district judge, who had visited the region as early as 1829, recorded a tract of land, including most of the present site of Madison. Here they surveyed a "paper" city which they named in honour of James Madison. On the 3rd of December 1836 the territorial legislature in session at Belmont, after a protracted and acrimonious debate, determined, largely through Doty's influence, to make Madison the permanent capital. The construction of houses began in the early spring of 1837. The first constitutional convention met here in 1846, the second in 1847. Madison was chartered as a city in 1856. In 1862 a large number of Confederate prisoners were confined in Camp Randall, at Madison, and many of them died in hospital.

See D. S. Durrie, *History of Madison, Wisconsin* (Madison, 1874); Lyman C. Draper, *Madison the Capital of Wisconsin* (Madison, 1857); J. D. Butler, "The Four Lakes Country" in *Wisconsin Historical Society Collections*, vol. 10 (1888), and R. G. Thwaites, "Madison" in *Historic Towns of the Western States* (New York, 1900), and his "Story of Madison" in *The University of Wisconsin* (Madison, 1900).

MADOU, JEAN BAPTISTE (1796–1877), Belgian painter and lithographer, was born at Brussels on the 3rd of February 1796. He studied at the Brussels Academy of Fine Arts and was a pupil of François. While draughtsman to the topographical military division at Courtrai, he received a commission for lithographic work from a Brussels publisher. It was about 1820 that he began his artistic career. Between 1825 and 1827 he contributed to *Les Vues pittoresques de la Belgique*, to a *Life of Napoleon*, and to works on the costumes of the Netherlands, and later made a great reputation by his work in *La Physionomie de la société en Europe depuis 1400 jusqu' à nos jours* (1836) and *Les Scènes de la vie des peintres*. It was not until about 1840 that he began to paint in oils, and the success of his early efforts in this medium resulted in a long series of pictures representing scenes of village and city life, including "The Fiddler," "The Jewel Merchant," "The Police Court," "The Drunkard," "The Ill-regulated Household," and "The Village Politicians." Among his numerous works mention may also be made of "The Feast at the Château" (1851), "The Unwelcome Guests" (1852, Brussels Gallery), generally regarded as his masterpiece, "The Rat Hunt" (acquired by Leopold II., king of the Belgians), "The Arquebusier" (1860), and "The Stirrup Cup." At the age of sixty-eight he decorated a hall in his house with a series of large paintings representing scenes from La Fontaine's fables, and ten years later made for King Leopold a series of decorative paintings for the château of Ciergnon. Madou died at Brussels on the 31st of March 1877.

For a list of his paintings see the annual report of the Academy of Belgium for 1879. (F. K.*)

MADOZ, PASCUAL (1806–1870), Spanish statistician, was born at Pampeluna on the 7th of May 1806. In early life he was settled in Barcelona, as a writer and journalist. He joined the Progresista party formed during the first Carlist war, 1833–40. He saw some service against the Carlists; was elected deputy to the Cortes of 1836; took part for Espartero, and then against him; was imprisoned in 1843; went into exile and returned; was governor of Barcelona in 1854, and minister of finance in 1855; had a large share in secularizing the Church lands; and after the revolution of 1868 was governor of Madrid. He had, however, no great influence as a leader and soon went abroad, dying at Genoa in 1870. Madoz was distinguished from most of the politicians of his generation by the fact that in middle life he compiled what is still a book of value—a geographical, statistical and historical dictionary of Spain and its possessions oversea, *Diccionario geográfico, estadístico y historico de España, y sus posesiones de Ultramar* (Madrid, 1848–1850).

MADRAS, a presidency of British India—officially styled Fort St George—occupying, with its dependencies, the entire south of the Indian peninsula. The north boundary is extremely irregular. On the extreme N.E. is the Bengal province of Orissa; then the wild highlands of the Central Provinces; next the dominions of the nizam of Hyderabad; and lastly, on the N.W., the Bombay districts of Dharwar and North Kanara. Geographically Mysore and Coorg lie within the bounds of Madras, and politically it includes the Laccadive Islands, off the Malabar coast, in the Indian Ocean. Its total area, including native states, is 151,695 sq. m., and its population in 1901 was 42,397,522, showing an increase of 7·7% in the decade. The seat of government is at Madras city (*q.v.*).

Physical Aspect.—The Madras presidency may be roughly divided into three tracts: (1) the long and broad east coast, (2) the shorter and narrower west coast, and (3) the high interior table-land. These divisions are determined by the great mountain ranges of the Eastern and Western Ghats (*q.v.*). Between these two ranges lies the central table-land, with an elevation of 1000 to 3000 ft., which includes the whole of Mysore, and extends over about half a dozen districts of Madras. The Anaimudi mountain (8837 ft.) in Travancore is the highest in southern India. The Nilgiri hills, which join the Ghats, culminate in Dodabetta (8760 ft.). There are besides many outlying spurs and tangled masses of hills, of which the Shevaroys, Anamalais and Palnis are the most important. The Godavari, Kistna and Cauvery rivers, each having a large tributary system, all rise in the Western Ghats, and run across the peninsula in a south-east direction into the Bay of Bengal. In the upper parts of their course they drain rather than water the country through which they flow, and are comparatively valueless either for navigation or irrigation; but before reaching the sea they spread over alluvial deltas. Smaller rivers of the same character are the Pennar and South Pennar or Ponniar, Palar, Vaigai, Vellar and Tambraparni. The principal lake is that of Pulicat on the east coast, which is 37 m. long from north to south, and forms an important means of communication between Madras city and the northern districts. On the west coast are a remarkable series of backwaters or lagoons, fringing the seaboard of Kanara, Malabar and Travancore. The largest is the backwater of Cochin, which extends 120 m. from north to south.

Geology.—By far the greater part of Madras is occupied by granitic and gneissic rocks of very ancient date. Among them are the "charnockites," a series of associated eruptive rocks characterized by the presence of rhombic pyroxenes. In Bellary and Anantapur districts, as well as in Mysore and Hyderabad, several long narrow strips of a later formation, known as the Dharwar system, are folded or faulted into the gneissic floor. They run from N.N.W. to S.S.E., and consist of conglomerates, lavas and schists. All the quartz reefs which contain gold in paying quantities are found within these Dharwar bands, those of the Kolar goldfield in Mysore being the most important. The gneissic and Dharwar rocks are overlaid unconformably by the sandstones, limestones, shales, &c., of the Cuddapah and Kurnool series. It is in the sandstones and shales of the Kurnool group that most of the diamonds of southern India are found; but as these rocks are of sedimentary origin, it is probable that the diamonds were originally derived from some still unknown source. A strip of Gondwana beds follows approximately the course of the Godavari. In Hyderabad it includes the important Singareni coalfield, but in the Presidency no good coal seams have yet been found. Upper Gondwana beds also occur in small patches at several other places near the east coast. Marine cretaceous deposits are found in three detached areas, near Trichinopoly, Viruddhachalam and Pondicherry. Some of the coastal sandstones may be of late Tertiary age, but Tertiary fossils have not been found except in a few small patches on the west coast, the most southerly being near Quilon in Travancore.

Climate.—The climate varies in accordance with the height of the mountain chain on the western coast. Where this chain is lofty, as between Malabar and Coimbatore, the rainclouds are intercepted and give a rainfall of 150 in. on the side of the sea, and only 20 in. on the landward side. Where the range is lower, the rainclouds pass over the hills and carry their moisture to the interior districts. The Nilgiri hills enjoy the climate of the temperate zone, with a moderate rainfall. The Malabar coast has a rainfall of 150 in., and the clouds on the Western Ghats sometimes obscure the sun for months at a time. Along the eastern coasts and central table-lands the rainfall is low and the heat excessive. At Madras city the average rainfall is 50 in., but this is considerably above the mean of the east coast.

Minerals.—The mineral wealth of the province is undeveloped. Iron of excellent quality has been smelted by native smiths in many localities from time immemorial; but attempts to work the beds after European methods have proved unsuccessful. Carboniferous sandstone extends across the Godavari valley as far as Ellore, but the coal has been found to be of inferior quality. Among other minerals may be mentioned manganese in Vizagapatam, and mica in Nellore. Garnets are abundant in the sandstone of the Northern Circars, and diamonds of moderate value are found in the same region. Stone and gravel quarries are very numerous.

Forests.—The forest department of Madras was first organized in 1856, and it is estimated that forests cover a total area of more than 19,600 sq. m., the whole of which is under conservancy rules. An area of about 1500 sq. m. is strictly conserved. In the remaining forests, after supplying local wants, timber is either sold direct by the department or licences are granted to wood-cutters. The more valuable timber trees comprise teak, ebony, rosewood, sandal-wood and redwood. The trees artificially reared are teak, sandal-wood, *Casuarina* and eucalyptus. The finest teak plantation is near Beypur in Malabar. At Mudumalli there are plantations of both teak and sandal-wood; and the eucalyptus or Australian gum-tree grows on the Nilgiris in magnificent clumps.

Fauna.—The wild animals include the elephant, bison, sambur and ibex of the Western Ghats and the Nilgiris. Bison are found also in the hill tracts of the Northern Circars. In Travancore state the black leopard is not uncommon. The elephant is protected by law from indiscriminate destruction. The cattle are small, but in Nellore and along the Mysore frontier a superior breed is carefully kept up by the wealthier farmers. The best buffaloes are imported from the Bombay district of Dharwar.

Population.—The population in 1901 was divided into Hindus (37,026,471), Mahommedans (2,732,931), and Christians (1,934,480). The Hindus may be subdivided into Sivaites, Vishnuvites and Lingayats. The Sivaites are most numerous in the extreme south and on the west coast, while the Vishnuvites are chiefly found in the northern districts. The Lingayats, a sect of Sivaite puritans, derive their name from their practice of carrying about on their persons the *linga* or emblem of Siva. The Brahmans follow various pursuits, and some of them are recent immigrants, who came south in the train of the Mahratta armies. A peculiar caste of Brahmans, called Nambudri, is found in Malabar. The most numerous of the hill tribes are the Kondhs and Savaras, two cognate races who inhabit the mountainous tracts of the Eastern Ghats, attached to several of the large estates of Ganjam and Vizagapatam. On the Nilgiris the best known aboriginal tribe is the Todas (*q.v.*). The Mahommedans are subdivided into Labbai, Moplah, Arab, Sheikh, Sayad, Pathan and Mogul. The Labbais are the descendants of Hindu converts, and are traders by hereditary occupation, although many now employ themselves as sailors and fishermen. The Moplahs are the descendants of Malayalam converts to Islam—the head of the tribe, the raja of Cannanore, being descended from a fisher family in Malabar. They are a hard-working, frugal people, but quite uneducated and fanatical, and under the influence of religious excitement have often disturbed the public peace. Christians are more numerous in Madras than in any other part of India. In Travancore and Cochin states the native Christians constitute as much as one-fourth of the population. The Roman Catholics, whose number throughout southern India is estimated at upwards of 650,000, owe their establishment to St Francis Xavier and the famous Jesuit mission of Madura; they are partly under the authority of the archbishop of Goa, and partly under twelve Jesuit vicariates. Protestant missions date from the beginning of the 18th century. The Danes were the pioneers; but their work was taken up by the Society for Promoting Christian Knowledge, under whom laboured the great Lutherans of the 18th century—Schultz, Sartorius, Fabricius and Schwartz. The Church Missionary Society entered the field in 1814; and subsequently an American mission joined in the work.

Languages.—Broadly speaking, the entire population of Madras belongs to the five linguistic offshoots of the great Dravidian stock, dominant throughout southern India. At an early period, before the dawn of history, these races appear to have accepted some form of the Brahmanical or Buddhist faiths. Many storms of conquest have since swept over the land, and colonies of Mogul and Mahratta origin are to be found here and there. But the evidence of language proves that the ethnical character of the population has remained stable under all these influences, and that the Madras Hindu, Mahommedan, Jain and Christian are of the same stock. Of the five Dravidian languages in British territory Telugu is spoken by over 14,000,000 persons; Tamil by over 15,000,000 persons; Kanarese by over 1,500,000 persons; Malayalam by nearly 3,000,000 persons; and Tulu by about 500,000 persons. Oriya is the native tongue in the extreme north of Ganjam, bordering on Orissa; and various sub-dialects of Dravidian origin are used by the hill tribes of the Eastern Ghats, of whom the Kondhs may be taken as the type.

Agriculture.—Over the greater part of the area of Madras artificial irrigation is impossible, and cultivation is dependent upon the local rainfall, which rarely exceeds 40 in. a year, and is liable to fall irregularly. The Malabar coast is the only part where the rainfall brought by the south-west monsoon may be trusted both for its amount and regularity. Other districts, such as Bellary, are also dependent upon this monsoon; but in their case the rainclouds have spent themselves in passing over the Western Ghats, and cultivation becomes a matter of hazard. Over the greater part of the presidency the rainy season is caused by the south-east monsoon, which breaks about the end of September. The deltas of the Godavari, Kistna and Cauvery rivers are the only spots on the east coast which artificial irrigation is able to save from the risk of occasional scarcity. The principal food staples are rice, *cholam*, *cambu*, *ragi* and *varagu* (four kinds of millet). The most common oil-seed is gingelly (sesamum). Garden crops comprise tobacco, sugar-cane, chillies, betel-leaf and plantains. Sugar is chiefly derived from the sap of palms. The fruit trees are coco-nut, areca-nut, palmyra palm, jack, tamarind and mango. Special crops include cotton, indigo, coffee, tea, cinchona. The best cotton is grown in Tinnevelly. The principal coffee tract stretches along the slopes of the Western Ghats from the north of Mysore almost down to Cape Comorin. The larger portion of this area lies within Mysore, Coorg and Travancore states, but the Wynaad and the Nilgiri hills are within Madras. The first coffee plantation was opened in the Wynaad in 1840. Many of the early clearings proved unprofitable, and the enterprise made little progress till about 1855. Coffee, which is much cultivated on the Nilgiris, covers about 100 sq. m., though the area fluctuates. The tea plant was also introduced into the Nilgiri hills about 1840, but was not taken up as a commercial speculation till 1865, and is still unimportant. The cinchona plant was successfully introduced into the Nilgiri hills by the government in 1860, and there are now a few plantations belonging to private owners.

The greater part of the soil in Madras is held by the cultivators direct from the government under the tenure known as *ryotwari*. Besides these lands in the hands of the government, there are also proprietary or *zamindari* estates in all parts of the country. These estates are either the remains of ancient principalities, which the holder cannot sell or encumber beyond his own life interest, or they are creations of British rule and subject to the usual Hindu custom of partition. The total area of the *zamindari* estates is about 26 million acres, more than one-fourth of the whole presidency. The *peshkash* or tribute payable to government in perpetuity amounts to about £330,000 a year. *Ináms*, revenue-free or quit-rent grants of lands made for religious endowments or for services rendered to the state, occupy an aggregate area of nearly 8 million acres.

Manufactures.—Madras possesses few staple manufactures. The chief industries of the presidency are cotton-ginning, coffee-curing, fish-curing, indigo-pressing, oil-pressing, printing, rice-curing, rope-making, sugar-refining, tanning, tile and brick-making, and tobacco-curing. Up to the close of the 18th century cotton goods constituted the main article of export. Masulipatam, where the first English factory on the Coromandel coast was established in 1620, enjoyed a special reputation for its chintzes, which were valued for the freshness and permanency of their dyes. There is still a small demand for these articles in Burma, the Straits and the Persian Gulf; but Manchester goods have nearly beaten the Indian exporter out of the field. Native looms, however, still hold their own in the local market, in face of strenuous opposition. After weaving, working in metals appears to be the most widespread native industry. Among local specialities which have attracted European curiosity may be mentioned the jewelry of Trichinopoly, ornaments of ivory and horn worked at Vizagapatam, and sandal-wood carving in Kanara.

Commerce and Trade.—The continuous seaboard of the Madras presidency, without any natural harbours of the first rank, has tended to create a widely diffused trade. Madras city conducts nearly one-half of the total sea-borne commerce; next comes Malabar, containing the western railway terminus near Calicut; then Godavari, with its cluster of ports along the fringe of the delta; Tinnevelly, with the harbour at Tuticorin, which has opened large dealings with Ceylon and Burma; Tanjore, South Kanara, Ganjam and Vizagapatam. As compared with the other provinces, the trade of Madras is broadly marked by the larger proportion assigned to coasting trade with other Indian ports and with Ceylon. The chief staples of the export trade are hides and skins, coffee and raw cotton.

Railways and Irrigation.—The presidency is well supplied with railways, which naturally have their centre in Madras city, the chief seaport. The broad-gauge line of the Madras & Southern Mahratta railway connects with Bombay and Bangalore, and also crosses the peninsula to Calicut on the western coast. The South Indian (narrow-gauge) serves the extreme south, with its terminus at Tuticorin, and branches to Tinnevelly, Negapatam, Erade, Pondicherry and Nellore. The narrow-gauge line of the Madras & Southern Mahratta railway traverses the Deccan districts; and the East Coast line (broad-gauge), through the Northern Circars, has brought Madras into direct communication with Calcutta. The Madras system of irrigation has been most successful in the case of the three great eastern rivers, the Godavari, Kistna and Cauvery. Each of these is intercepted by an *anicut* or dam at the head of its delta, from which canals diverge on each side for navigation as well as irrigation. The scheme for diverting the waters of the Tungabhadra (a tributary of the Kistna) over the thirsty uplands of Kurnool proved a failure. The bold project of leading the Periyar river through a tunnel across the watershed of the Travancore hills on to the plain of Madura has been more successful.

Administration.—The Madras presidency is administered by a governor and a council, consisting of two members of the civil service, which number may be increased to four. There is also a board of revenue of three members. The number of districts is 24, each under the charge of a collector, with sub-collectors and assistants. The districts are not grouped into divisions or commissionerships, as in other provinces. For legislative purposes the council of the governor is augmented by additional members, numbering 45 in all, of whom not more than 17 may be nominated officials, while 19 are elected by various representative constituencies. Members of the legislative council enjoy the right of interpellation, of proposing resolutions on matters of public interest, and of discussing the annual financial statement. The principle of local devolution is carried somewhat further in Madras than in other provinces. At the bottom are union *panchayats* or village committees, whose chief duty is to attend to sanitation. Above them come *taluk* or subdivisional boards. At the head of all are district boards, a portion of whose members are elected by the *taluk* boards.

Education.—The chief educational institutions are the Madras University, the Presidency College, Madras Christian College, and Pachayyappa's College at Madras; the government arts colleges at Combaconum and Rajahmundry; the law college, medical college and engineering college at Madras; the college of agriculture at Coimbatore; the teachers' college at Saidapet; the school of arts at Madras; and the military ophanage at Ootacamund, in memory of Sir Henry Lawrence. In 1907, the total number of pupils at all institutions was 1,007,118, of whom 164,706 were females, and 132,857 were learning English.

History.—Until the British conquest the whole of southern India had never acknowledged a single ruler. The difficult nature of the hill passes and the warlike character of the highland tribes forbade the growth of great empires, such as succeeded one another on the plains of Hindustan. The Tamil country in the extreme south is traditionally divided between the three kingdoms of Pandya, Chola and Chera. The west coast supplied the nucleus of a monarchy which afterwards extended over the highlands of Mysore, and took its name from the Carnatic. On the north-east the kings of Kalinga at one time ruled over the entire line of seaboard from the Kistna to the Ganges. Hindu legend has preserved marvellous stories of these early dynasties, but our only authentic evidence consists in their inscriptions on stone and brass, and their noble architecture (see INDIA). The Mahommedan invader first established himself in the south in the beginning of the 14th century. Ala-ud-din, the second monarch of the Khilji dynasty at Delhi, and his general Malik Kafur conquered the Deccan, and overthrew the kingdoms of Karnataka and Telingana, which were then the most powerful in southern India. But after the withdrawal of the Mussulman armies the native monarchy of Vijayanagar arose out of the ruins. This dynasty gradually extended its dominions from sea to sea, and reached a pitch of prosperity before unknown. At last, in 1565, it was overwhelmed by a combination of the four Mahommedan principalities of the Deccan. At the close of the reign of Aurangzeb, although that emperor nominally extended his sovereignty as far as Cape Comorin, in reality South India had again fallen under a number of rulers who owned no regular allegiance. The nizam of the Deccan, himself an independent sovereign, represented the distant court of Delhi. The most powerful of his feudatories was the nawab of the Carnatic, with his capital at Arcot. In Tanjore, a descendant of Sivaji ruled; and on the central table-land a Hindu chieftain was gradually establishing his authority and founding the state of Mysore, destined soon to pass to a Mahommedan usurper.

Vasco da Gama cast anchor off Calicut on the 20th of May 1498, and for a century the Portuguese retained in their control the commerce of India. The Dutch began to establish themselves on the ruin of the Portuguese at the beginning of the 17th century, and were quickly followed by the English, who established themselves at Calicut and Cranganore in 1616. Tellicherry became the principal English emporium on the west coast of Madras. The Portuguese eventually retired to Goa, and the Dutch to the Spice Islands. The first English settlement on the east coast was in 1611, at Masulipatam, even then celebrated for its fabrics. Farther south a fort, the nucleus of Madras city, was erected in 1640. Pondicherry was purchased by the French in 1762. For many years the English and French traders lived peacefully side by side, and with no ambition for territorial aggrandisement. The war of the Austrian succession in Europe lit the first flame of hostility on the Coromandel coast. In 1746 Madras was forced to surrender to La Bourdonnais, and Fort St David remained the only English possession in southern India. By the peace of Aix-la-Chapelle Madras was restored to the English; but from this time the rivalry of the two nations was keen, and found its opportunities in the disputed successions which always fill a large place in Oriental politics. English influence was generally able to secure the favour of the rulers of the Carnatic and Tanjore, while the French succeeded in placing their own nominee on the throne at Hyderabad. At last Dupleix rose to be the temporary arbiter of the fate of southern

India, but he was overthrown by Clive, whose defence of Arcot in 1751 forms the turning point in Indian history. In 1760 the crowning victory of Wandewash was won by Colonel (afterwards Sir Eyre) Coote, over Lally, and in the following year, despite help from Mysore, Pondicherry was captured.

Though the English had no longer any European rival, they had yet to deal with Mahommedan fanaticism and the warlike population of the highlands of Mysore. The dynasty founded by Hyder Ali, and terminating in his son Tippoo Sultan, proved itself in four several wars, which terminated only in 1799, the most formidable antagonist which the English had ever encountered (see HYDER ALI and INDIA). Since the beginning of the 19th century Madras has known no regular war, but occasional disturbances have called for measures of repression. The *pálegárs* or local chieftains long clung to their independence after their country was ceded to the British. On the west coast, the feudal aristocracy of the Nairs, and the religious fanaticism of the Moplahs, have more than once led to rebellion and bloodshed. In the extreme north, the wild tribes occupying the hills of Ganjam and Vizagapatam have only lately learned the habit of subordination. In 1836 the *zamindári* of Gumsur in this remote tract was attached by government for the rebellious conduct of its chief. An inquiry then instituted revealed the wide prevalence among the tribe of Kondhs of human sacrifice, under the name of *meriah*. The practice has since been suppressed by a special agency. In 1879 the country round Rampa on the northern frontier was the scene of riots sufficiently serious to lead to the necessity of calling out troops. The same necessity arose three years later, when the Hindus and Mahommedans of Salem came into collision over a question of religious ceremonial. A more serious disturbance was that known as the "Anti-Shanar riots" of 1899. The Maravans of Tinnevelly and parts of Madura, resenting the pretensions of the Shanans, a toddy-drawing caste, to a higher social and religious status, organized attacks on Shanan villages. The town of Sivakasi was looted and burnt by five thousand Maravans. Quiet was restored by the military, and a punitive police force was stationed in the disturbed area.

The different territories comprising the Madras presidency were acquired by the British at various dates. In 1763 the tract encircling Madras city, then known as the Jagir now Chingleput district, was ceded by the nawab of Arcot. In 1765 the Northern Circars, out of which the French had recently been driven, were granted to the Company by the Mogul emperor, but at the price of an annual tribute of £90,000 to the nizam of Hyderabad. Full rights of dominion were not acquired till 1823, when the tribute was commuted for a lump payment. In 1792 Tippoo was compelled to cede the Baramahal (now part of Salem district), Malabar and Dindigul subdivision of Madura. In 1799, on the reconstruction of Mysore state after Tippoo's death, Coimbatore and Kanara were appropriated as the British share; and in the same year the Mahratta raja of Tanjore resigned the administration of his territory, though his descendant retained titular rank till 1855. In 1800 Bellary and Cuddapah were made over by the nizam of Hyderabad to defray the expense of an increased subsidiary force. In the following year the dominions of the nawab of the Carnatic, extending along the east coast almost continuously from Nellore to Tinnevelly, were resigned into the hands of the British by a puppet who had been put upon the throne for the purpose. The last titular nawab of the Carnatic died in 1855; but his representative still bears the title of prince of Arcot, and is recognized as the first native nobleman in Madras. In 1839 the nawab of Kurnool was deposed for misgovernment and suspicion of treason, and his territories annexed.

See *Madras Manual of Administration*, 3 vols. (Madras, 1885 and 1893); S. Ayyangar, *Forty Years' Progress in Madras* (Madras, 1893); J. P. Rees, *Madras* (Society of Arts, 1901); *Madras Provincial Gazetteer* (2 vols., Calcutta, 1908).

MADRAS, the capital of Madras presidency, and the chief seaport on the eastern coast of India, is situated in 13° 4′ N. and 80° 17′ E. The city, with its suburbs, extends nine miles along the sea and nearly four miles inland, intersected by the little river Cooum. Area, 27 sq. m.; pop. (1901), 509,346, showing an increase of 12·6% in the decade. Madras is the third city in India.

Although at first sight the city presents a disappointing appearance, and possesses not a single handsome street, it has several buildings of architectural pretensions, and many spots of historical interest. It is spread over a very wide area, and many parts of it are almost rural in character. Seen from the roadstead, the fort, a row of merchants' offices, a few spires and public buildings are all that strike the eye. Roughly speaking, the city consists of the following divisions: (1) George Town (formerly Black Town, but renamed after the visit of the Prince of Wales in 1906), an ill-built, densely-populated block, about a mile square, is the business part of the town, containing the banks, custom house, high court, and all the mercantile offices. The last, for the most part handsome structures, lie along the beach. On the sea-face of George Town are the pier and the new harbour. Immediately south of George Town there is (2) an open space which contains Fort St George, the Marina, or fashionable drive and promenade by the seashore, Government House, and several handsome public buildings on the sea-face. (3) West and south of this lung of the city are crowded quarters known by native names—Chintadrapet, Turuvaleswarampet, Pudupak, Royapet, Kistnampet and Mylapur, which bend to the sea again at the old town of Saint Thomé. (4) To the west of George Town are the quarters of Veperi and Pudupet, chiefly inhabited by Eurasians, and the suburbs of Egmore, Nangambakam, and Perambur, adorned with handsome European mansions and their spacious "compounds" or parks, which make Madras a city of magnificent distances. (5) South-west and south lie the European quarters of Tanampet and aristocratic Adyar. Among the most notable buildings are the cathedral, Scottish church, Government House, Pachayappa's Hall, senate house, Chepauk palace (now the revenue board), and the Central railway station.

Madras possesses no special industries. There are several cotton mills, large cement works, iron foundries and cigar factories. Large sums of money have from time to time been spent upon the harbour works, but without any great success. The port remains practically an open roadstead, protected by two breakwaters, and the P. & O. steamers ceased to call in 1898. Passengers or cargo are landed or embarked in flat-bottomed *masula* boats. The sea bottom is unusually flat, reaching a depth of ten fathoms only at a mile from the shore. The harbour is not safe during a cyclone, and vessels have to put out to sea. Madras conducts about 56% of the foreign trade of the presidency, but a much smaller share of the coasting trade. As the capital of southern India, Madras is the centre on which all the great military roads converge. It is also the terminal station of two lines of railway, the Madras & Southern Mahratta line and the Madras & Tanjore section of the South Indian railway. The Buckingham canal, which passes through an outlying part of the city, connects South Arcot district with Nellore and the Kistna and Godavari system of canal navigation. The municipal government of the city was framed by an act of the Madras legislature passed in 1884. The governing body consists of 32 commissioners, of whom 24 are elected by the ratepayers, together with a paid president. The Madras University was constituted in 1857, as an examining body, on the model of the university of London. The chief educational institutions in Madras city are the Presidency College; six missionary colleges and one native college; the medical college, the law college, the college of engineering, the teachers' college in the suburb of Saidapet, all maintained by government; and the government school of arts.

The foundation of Madras dates from 1640, when Francis Day, chief of the East India Company's settlement at Armagon, obtained a grant of the present site of the city from a native ruler. A fort—called Fort St George, presumably from having been finished on St George's Day (April 23)—was at once constructed, and a gradually increasing population settled around its walls. In 1653 Madras, which had previously been subordinate to the settlement of Bantam in Java, was raised to the rank of an independent presidency. In 1702 Daud Khan, Aurangzeb's general, blockaded the town for a few weeks, and in 1741 the Mahrattas unsuccessfully attacked the place. In 1746 La Bourdonnais bombarded and captured Madras. The settlement was restored to the English two years later by the Treaty of Aix-la-Chapelle, but the government of the presidency did not return to Madras till 1762. In 1758 the French under Lally occupied the Black Town and invested the fort. The siege was conducted on both sides with great skill and vigour. After two months the arrival of an English fleet relieved the garrison, and the besiegers retired with some precipitancy. With the exception of the threatening approach of Hyder Ali's horsemen in 1769, and again in 1780, Madras has since the French siege been free from external attack. The town of Saint Thomé, now part of Madras city, was founded and fortified by the Portuguese in 1504, and was held by the French from 1672 to 1674.

See Mrs F. Penny, *Fort St George* (1900); W. Foster, *Founding of Fort St George* (1902).

MADRAZO Y KUNT, DON FEDERICO DE (1815–1894), Spanish painter, was born in Rome on the 12th of February 1815. He was the son of the painter Madrazo y Agudo (1781–1859), and received his first instruction from his father. While still attending the classes at the Academy of San Fernando he painted his first picture, "The Resurrection of Christ" (1829), which was purchased by Queen Christina. Not long afterwards he painted "Achilles in his Tent," and subsequently presented to the Academy "The Continence of Scipio," which secured him admission as a member "for merit." While decorating the palace of Vista Alegre he took up portraiture. In 1852 he went to Paris, where he studied under Winterhalter, and painted portraits of Baron Taylor and of Ingres. In 1837 he was commissioned to produce a picture for the gallery at Versailles, and painted "Godfrey de Bouillon proclaimed King of Jerusalem." The artist then went to Rome, where he worked at various subjects, sacred and profane. Then he painted "Maria Christina in the Dress of a Nun by the bedside of Ferdinand III." (1843), "Queen Isabella," "The Duchess of Medina-Coeli," and "The Countess de Vilchès" (1845–1847), besides a number of portraits of the Spanish aristocracy, some of which were sent to the exhibition of 1855. He received the Legion of Honour in 1846. He was made a corresponding member of the Paris Academy of Fine Arts on the 10th of December 1853, and in 1873, on the death of Schnorr, the painter, he was chosen foreign member. After his father's death he succeeded him as director of the Prado Gallery and president of the Academy of San Fernando. He originated in Spain the production of art reviews and journals, such as *El Artista*, *El Renacimiento* and *El Semanario pintoresco*. He died at Madrid on the 11th of June 1894. His brother, Don Louis De Madrazo, was also known as a painter, chiefly by his "Burial of Saint Cecilia" (1855). Don Federico's best-known pupil was his son, Don Raimundo De Madrazo (b. 1841).

MADRID, a province of central Spain, formed in 1833 of districts previously included in New Castile, and bounded on the W. and N. by Ávila and Segovia, E. by Guadalajara, S.E. by Cuenca and S. by Toledo. Pop. (1900), 775,034, of whom 539,835 inhabit the city of Madrid; area, 3084 sq. m. Madrid belongs to the basin of the Tagus, being separated from that of the Douro by the Sierra de Guadarrama on the N.W. and N., and by the Sierra de Gredos on the S.W. The Tagus is the southern boundary for some distance, its chief tributary being the Jarama, which rises in the Somosierra in the north and terminates at Aranjuez. The Jarama, in turn, is joined by the Henares and Tajuña on the left, and by the Lozoya and Manzanares on the right. The Guadarrama, another tributary of the Tagus, has its upper course within the province. Like the rest of Castile, Madrid is chiefly of Tertiary formation; the soil is mostly clayey, but there are tracts of sandy soil. Agriculture is somewhat backward; the rainfall is deficient, and the rivers are not utilized as they might be for irrigation. The south-eastern districts are the best watered, and produce in abundance fruit, vegetables, wheat, olives, esparto grass and excellent wine. Gardening and viticulture are carried on to some extent near the capital, though the markets of Madrid receive their most liberal supply of fruits and vegetables from Valencia. Sheep, goats and horned cattle are reared, and fish are found in the Jarama and other rivers. Much timber is extracted from the forests of the northern and north-eastern parts of the province for building purposes and for firewood and charcoal. The royal domains of the Escorial, Aranjuez and El Pardo, and the preserves of the nobility, are all well wooded and contain much game. Efforts have also been made by the local authorities to cover the large stretches of waste ground and commons with pines and other trees.

The Sierra de Guadarrama has quarries of granite, lime and gypsum, and is known to contain iron, copper and argentiferous lead; but these resources are undeveloped. Other industries are chiefly confined to the capital; but cloth, leather, paper, earthenware, porcelain, glass, bricks and tiles, ironware, soap, candles, chocolate and lace are also manufactured on a small scale beyond its boundaries. There is very little commerce except for the supply of the capital with necessaries.

Besides the local lines, all the great railways in the kingdom converge in this province, and it contains in all 221 m. of line. Besides Madrid, the towns of Aranjuez (12,670) and Alcalá de Henares (11,206) and the Escorial are described in separate articles. The other towns with more than 5000 inhabitants are Vallecas (10,128), Colmenar de Oreja (6182), Colmenar Viejo (5255) and Carabanchel Bajo (5862).

MADRID, the capital of Spain and of the province of Madrid, on the left bank of the river Manzanares, a right-hand tributary of the Jarama, which flows south into the Tagus. Pop. (1877), 397,816; (1887), 472,228; (1897), 512,150; (1900), 539,835. Madrid was the largest city in Spain in 1900; it is the see of an archbishop, the focus of the principal Spanish railways, the headquarters of an army corps, the seat of a university, the meeting-place of parliament, and the chief residence of the king, the court, and the captain-general of New Castile. It is, however, surpassed in ecclesiastical importance by Toledo and in commerce by Barcelona.

Situation and Climate.—Madrid is built on an elevated and undulating plateau of sand and clay, which is bounded on the north by the Sierra Guadarrama and merges on all other sides into the barren and treeless table-land of New Castile. Numerous water-courses (*arroyos*), dry except at rare intervals, furrow the surface of the plateau; these as they pass through the city have in certain cases been converted into roads—*e.g.* the Paseo de Recoletos and Prado, which are still so liable to be flooded after prolonged rain that special channels have been constructed to carry away the water. The highest point in Madrid is 2372 ft. above sea-level. The city is close to the geographical centre of the peninsula, nearly equidistant from the Bay of Biscay, the Mediterranean and the Atlantic. Owing to its high altitude and open situation it is liable to sudden and frequent variations of climate, and the daily range of temperature sometimes exceeds 50° F. In summer the heat is rendered doubly oppressive by the fiery, dust-laden winds which sweep across the Castilian table-land; at this season a temperature of 109° has been registered in the shade. In winter the northerly gales from the Sierra Guadarrama bring intense cold; snow falls frequently, and skating is carried on in the Buen Retiro park. A Spanish proverb describes the wind of Madrid as so deadly and subtle that "it will kill a man when it will not blow out a candle"; but, though pulmonary diseases are not uncommon, the climate appears to be exceptionally healthy. In 1901 the death-rate was 22·07 per 1000, or lower than that of any other town on the Spanish mainland. The Sierra Guadarrama renders the atmosphere unusually dry and clear by intercepting the moisture of the north-western winds which prevail in summer; hence the average daily number of deaths decreases from 80 in winter to about 25 in summer. The sanitation of the older quarters is defective, and overcrowding is common, partly owing to the royal decrees which formerly prohibited the extension of the city; but much has been done in modern times to remove or mitigate these evils.

The Inner City.—The form of Madrid proper (exclusive of the modern suburbs) is almost that of a square with the corners rounded off; from east to west it measures rather less than from north to south. It was formerly surrounded by a poor wall, partly of brick, partly of earth, some 20 ft. in height, and pierced by five principal gates (*puertas*) and eleven doorways (*portillos*). Of these only three, the Puerta de Alcalá on the east, the Puerta de Toledo on the south and the Portillo de San Vicente on the west, actually exist; the first and the third were erected in the time of Charles III. (1759–1788), and the second in honour of the restoration of Ferdinand VII. (1827). The Manzanares—or rather its bed, for the stream is at most seasons of the year quite insignificant—is spanned by six bridges, the Puente de Toledo and Puente de Segovia being the chief.

The Puerta del Sol is the centre of Madrid, the largest of its many plazas, and the place of most traffic. It derived its name from the former east gate of the city, which stood here until 1570, and had on its front a representation of the sun. On its south side stands the Palacio de la Gobernacion, or ministry of the interior, a heavy square building by a French architect, J. Marquet, dating from 1768. From the Puerta del Sol diverge, immediately or mediately, ten of the principal streets of Madrid—eastward by north, the Calle de Alcalá, terminating beyond the Buen Retiro park; eastward, the Carrera de San Jeronimo, terminating by the Plaza de las Cortes in the Prado; southward, the Calle de Carretas; westward, the Calle Mayor, which leads to the council chamber and to the palace, and the Calle del Arenal, terminating in the Plaza de Isabel II. and the royal opera house; north-westward, the Calles de Preciados and Del Carmen; and northward, the Calle de la Montera, which afterwards divides into the Calle de Fuencarral to the left and the Calle de Hortaleza to the right. The contract for another wide street through central Madrid, to be called the Gran Via, was given to an English firm in 1905.

The Calle de Alcalá is bordered on both sides with acacias, and contains the Real Academia de Bellas Artes, founded in 1752 as an academy of art and music; its collection of paintings by Spanish masters includes some of the best-known works of Murillo. The handsome Bank of Spain (1884–1891) stands where the Calle de Alcalá meets the Prado; in the oval Plaza de Madrid, at the same point, is a fine 18th-century fountain with a marble group representing the goddess Cybele drawn in a chariot by two lions. The Calle de Alcalá is continued eastward past the Buen Retiro gardens and park, and through the Plaza de Independencia, in the middle of which is the Puerta de Alcalá. The Plaza de las Cortes is so called from the Congreso de los Diputados, or House of Commons, on its north side. The square contains a bronze statue of Cervantes, by Antonio Sola, erected in 1835. The Calle de Carretas, on the west side of which is the General Post Office, ranks with the Carrera de San Jeronimo and Calle de la Montera for the excellence of its shops. From the Calle Mayor is entered the Plaza Mayor, a rectangle of about 430 ft. by 330 ft., formerly the scene of tournaments, bull fights, autos de fé, acts of canonization (including that of Ignatius Loyola in 1622) and similar exhibitions, which used to be viewed by the royal family from the balcony of one of the houses called the Panaderia (belonging to the guild of bakers). The square, which was built under Philip III. in 1619, is surrounded by an arcade; the houses are uniform in height and decoration. In the centre stands a bronze equestrian statue of Philip III., designed by Giovanni da Bologna, after a painting by Pantoja de la Cruz, and finished by Pietro Tacca. From the southeast angle of the Plaza Mayor the Calle de Atocha, one of the principal thoroughfares of Madrid, leads to the outskirts of the inner city; it contains two large hospitals and part of the university buildings (faculty of medicine). The house occupied by Cervantes from 1606 until his death in 1616 stands at the point where it meets the Calle de Léon; in this street is the Real Academia de la Historia, with a valuable library and collections of MSS. and plate. From the southwest angle of the Plaza Mayor begins the Calle de Toledo, the chief mart for the various woollen and silken fabrics from which the picturesque costumes peculiar to the peninsula are made. In the Plaza de Isabel II., at the western extremity of the Calle del Arenal, stands the royal opera-house, the principal front of which faces the Plaza del Oriente and the royal palace. In the centre of the plaza is a fine bronze equestrian statue of Philip IV. (1621–1665); it was designed by Velazquez and cast by Tacca, while Galileo is said to have suggested the means by which the balance is preserved. The gift of the grand duke of Tuscany in 1640, it stood in the Buen Retiro gardens until 1844.

Modern Development of the City.—The north and east of the city—the new suburbs—have developed past the Retiro Park as far as the Bull-ring, and have covered all the vast space included between the Retiro, the Bull-ring, the long Castellana Drive to the race-course and the exhibition building. On the slopes of the other side of the Castellana, and along what were the northern limits of Madrid in 1875, the modern suburbs have extended to the vicinity of the fine cellular prison that was built at the close of the reign of King Alphonso XII. to replace the gloomy building known as El Saladero.

The new parts of the capital, with their broad streets and squares, and their villas sometimes surrounded with gardens, their boulevards lined by rather stunted trees, and their modern public buildings, all resemble the similar features of other European capitals, and contrast with the old Madrid that has preserved so many of its traits in architecture, popular life and habits. Some of the streets have been slightly widened, and in many thoroughfares new houses are being built among the ugly, irregular dwelling-places of the 18th and earlier centuries. This contrast is to be seen especially in and about the Calle Mayor, the Plaza Mayor, the Calle de Toledo, the Rastro, and the heart of the city.

Few capitals have more extensively developed their electric and horse tramways, gas and electric light installations and telephones. Much was done to improve the sanitary conditions of the city in the last twenty years of the 19th century. The streets are deluged three times a day with fire-hose, but even that has little effect upon the dust. Unfortunately the water supply, which used to be famed for its abundance and purity, became wholly insufficient owing to the growth of the city. The old reservoir of the Lozoya canal, a cutting 32 m. long, and the additional reservoir opened in 1883, are quite inadequate for the requirements of modern Madrid, and were formerly kept in such an unsatisfactory state that for several months in 1898 and 1899 the water not only was on the point of giving out, but at times was of such inferior quality that the people had recourse to the many wells and fountains available. The construction of new waterworks was delayed by a terrible accident, which occurred on the 8th of April 1905; the whole structure collapsed, and nearly 400 persons lost their lives in the flooded ruins. A decided improvement has been made in the burial customs of Madrid. No bodies are allowed to be interred in the churches and convents. Some of the older burial grounds in the northern suburbs have been closed altogether, and in those which remain open few coffins are placed in the niche vaults in the depth of the thick walls, as was once the practice. A large modern necropolis has been established a few miles to the north-east.

Principal Buildings.—As compared with other capitals Madrid has very few buildings of much architectural interest. The Basilica de Nuestra Señora de Atocha, on the Paseo de Atocha, a continuation of the Calle de Atocha, was originally founded in 1523. After being almost destroyed by the French, it was restored by Ferdinand VII., and rebuilt after 1896. The modern church is Romanesque in style; it contains a much venerated statue of the Virgin, attributed to St Luke. The collegiate church of San Isidro el Real, in the Calle de Toledo, dates from 1651; it has no architectural merit, but contains one or two valuable pictures and other works of art. It was originally owned by the Jesuits, but after their expulsion in 1769 it was reconsecrated, and dedicated to St Isidore the Labourer (d. 1170), the patron saint of Madrid, whose remains were entombed here. When the diocese of Madrid was separated from that of Toledo San Isidro was chosen as the cathedral. The modern Gothic church of San Jeronimo el Real occupies a conspicuous site eastward of the town. The church of San Francisco el Grande, which contains many interesting monuments, is also known as the National Pantheon. An act was passed in 1837 declaring that the remains of all the most distinguished Spaniards should be buried here; but no attempt to enforce the act systematically was made until 1869, and even then the attempt failed. Towards the close of the 19th century the church was splendidly restored at the expense of the state. Its interior was decorated with paintings and statuary by most of the leading Spanish artists of the time. Of secular buildings unquestionably the most important is the royal palace (Palacio Real), on the west side of the town, on rising ground overhanging the Manzanares. It occupies the site of the ancient Moorish alcázar (citadel), where a hunting seat was built by Henry IV.; this was enlarged and improved by Charles V. when he first made Madrid his residence in 1532; was further developed by Phillip II., but ultimately was destroyed by fire in 1734. The present edifice was begun under Philip V. in 1737 by Sacchetti of Turin, and was finished in 1764. It is in the Tuscan style, and is 470 ft. square and 100 ft. in height, the material being white Colmenar granite, resembling marble. To the north of the palace are the royal stables and coach-houses, remarkable for their extent; to the south is the armoury (Museo de la Real Armería), containing what is possibly the best collection of the kind in existence. After the Palacio Real may be mentioned the royal picture gallery (Real Museo de Pinturas), adjoining the Salon del Prado; it was built about 1785 for Charles III. by Juan de Villanueva as a museum of natural history and academy of sciences. It contains the collections of Charles V., Philip II. and Philip IV., and the pictures number upwards of two thousand. The specimens of Titian, Raphael, Tintoretto, Velazquez, Vandyck, Rubens and Teniers give it a claim to be considered the finest picture gallery in the world. The Biblioteca Nacional, in the Paseo de Recoletos, was founded in 1866, and completed in 1892. Not only the national library, with its important collections of MSS. and documents, but the archaeological museum, the museums of modern painting and sculpture, and the fine arts academy of San Fernando, are within its walls. The two houses of the Cortes meet in separate buildings. The deputies have a handsome building with a very valuable library in the Carrera San Jeronimo; the senators have an old Augustinian convent which contains some fine pictures. A large and handsome building near the Retiro Park contains the offices of the ministers of public works, agriculture and commerce, and of fine arts and education; nearly opposite stands the new station of the Southern Railway Company. The Great Northern and the Spain to Portugal Railway Companies have also replaced their old stations by very spacious, handsome structures, much resembling those of Paris. In 1896 the Royal Exchange was installed in a large monumental building with a fine colonnade facing the Dos de Mayo monument, not far from the museum of paintings.

Of the promenades and open places of public resort the most fashionable and most frequented is the Prado (Paseo del Prado, Salon del Prado) on the east side of the town, with its northward continuation—the Paseo de Recoletos. To the south of the town is the Paseo de las Delicias, and on the west, below the royal palace, and skirting the Manzanares, is the Paseo de la Virgen del Puerto, used chiefly by the poorer classes. Eastward from the Prado are the Buen Retiro Gardens, with ponds and pavilions, and a menagerie. The gardens were formerly the grounds surrounding a royal hunting seat, on the site of which a palace was built for Philip IV. in 1633; it was destroyed during the French occupation.

Education, Religion and Charity.—Madrid University developed gradually out of the college of Doña Maria de Aragon, established in 1590 by Alphonso Orozco. Schools of mathematics and natural science were added in the 16th and 17th centuries, and in 1786 the medical and surgical college of San Carlos was opened. In 1836–1837 the university of Alcalá de Henares (*q.v.*) was transferred to the capital and the older foundations incorporated with it. The university of Madrid thenceforth became the headquarters of education in central Spain. It has an observatory, and a library containing more than 2,000,000 printed books and about 5500 MSS. It gives instruction, chiefly in law and medicine, but also in literature, philosophy, mathematics and physics, to about 5000 students. Associated with the university is the preparatory school of San Isidro, founded by Philip IV. (1621–1665), and reorganized by Charles III. in 1770.

There are upwards of 100 official primary schools and a large number of private ones, among which the schools conducted by the Jesuits and the Scolapian fathers claim special mention. Madrid also has schools of agriculture, architecture, civil and mining engineering, the fine arts, veterinary science and music. The school of military engineering is at Guadalajara. Besides these special schools there are a self-supporting institute for preparing girls for the higher degrees and for certificates as primary teachers, and an institute for secondary education, conducted chiefly by ecclesiastics. Among the educational institutions may be reckoned the botanical garden, dating from 1781, the libraries of the palace, the university, and San Isidro, and the museum of natural science, exceedingly rich in the mineralogical department. The principal learned society is the royal Spanish Academy, founded in 1713 for the cultivation and improvement of the Spanish tongue. The Academy of History possesses a good library, rich in MSS. and incunabula, as well as a fine collection of coins and medals. In addition to the academies of fine arts, the exact sciences, moral and political science, medicine and surgery, and jurisprudence and legislation, all of which possess libraries, there are also anthropological, economic and geographical societies, and a scientific and literary athenaeum. Madrid has a British cemetery opened in 1853, when the older Protestant cemetery in the Paseo de Recoletos was closed. The town also contains a British embassy chapel, a German chapel, and several Spanish Protestant chapels, attended by over 1200 native Protestants, while the Protestant schools, chiefly supported by British, German and American contributions, are attended by more than 2500 children. The first Protestant bishop of Madrid was consecrated in 1895 by Archbishop Plunkett of Dublin. The charitable institutions were greatly improved between 1885 and 1905. The Princess Hospital was completely restored on modern methods, and can accommodate several hundred patients. The old contagious diseases hospital of San Juan de Dios was pulled down and a fine new hospital built in the suburbs beyond the Retiro Park, to hold 700 patients. The military hospital was demolished and a very good one built in the suburbs. There are in all twenty hospitals in Madrid, and a lunatic asylum on the outskirts of the capital, founded by one of the most eminent of Spanish surgeons, and admirably conducted. New buildings have been provided for the orphanages, and for the asylums for the blind, deaf and dumb, incurables and aged paupers. There are hospitals supported by the French, Italian and Belgian colonies; these are old and well-endowed foundations. Public charity generally is very active. In Madrid, as in the rest of Spain, there has been an unprecedented increase in convents, monasteries and religious institutions, societies and Roman Catholic workmen's clubs and classes.

Apart from private institutions for such purposes, the state maintains in the capital a savings bank for the poorer classes, and acts as pawnbroker for their benefit. The mercantile and industrial classes are organized in gilds, which themselves collect the lump sum of taxation exacted by the exchequer and the municipality from each *gremio* or class of taxpayers. The working classes also have commercial and industrial *circulos* or clubs that are obeyed by the gilds with great *esprit de corps*, a chamber of commerce and industries, and "associations of productions" for the defence of economic interests.

Industries.—The industries of the capital have developed extraordinarily since 1890. In the town, and within the municipal boundaries in the suburbs, many manufactories have been established, giving employment to more than 30,000 hands, besides the 4000 women and girls of the Tobacco Monopoly Company's factory. Among the most important factories are those which make every article in leather, especially cigar and card cases, purses and pocket-books. Next come the manufactures of fans, umbrellas, sunshades, chemicals, varnishes, buttons, wax candles, beds, cardboard, porcelain, coarse pottery, matches, baskets, sweets and preserves, gloves, guitars, biscuits, furniture, carpets, corks, cards, carriages, jewelry, drinks of all kinds, plate and plated goods. There are also tanneries, saw and flour mills, glass and porcelain works, soap works, brickfields, paper mills, zinc, bronze, copper and iron foundries. The working classes are strongly imbued with socialistic ideas. Strikes and May Day demonstrations have often been troublesome. Order is kept by a garrison of 12,500 men in the barracks of the town and cantonments around, and by a strong force of civil guards or gendarmes quartered in the town itself. The civil and municipal authorities can employ beside the gendarmes the police, about 1400 strong, and what is called the *guardias urbanos*, another police force whose special duty it is to regulate the street traffic and prevent breaches of the municipal regulations. There is not, on the average, more crime in Madrid than in the provinces.

History.—Spanish archaeologists have frequently claimed for Madrid a very high antiquity, but the earliest authentic historical mention of the town (Majrīt, Majoritum) occurs in the Arab chronicle, and does not take us farther back than to the first half of the 10th century. The place was finally taken from the Moors by Alphonso VI. (1083), and was made a hunting-seat by Henry IV., but first rose into importance when Charles V., benefiting by its keen air, made it his occasional residence. Philip II. created it his capital and "only court" (*única corte*) in 1560. It is, however, only classed as a town (*villa*), having never received the title of city (*ciudad*). Fruitless attempts were made by Philip III. and Charles III. respectively to transfer the seat of government to Valladolid and to Seville. (See also Spain: *History*).

See J. Amador de los Rios, *Historia de la villa y corte de Madrid* (Madrid, 1861-1864); Valverde y Alvarez, *La Capital de España* (Madrid, 1883); E. Sepúlvéda, *La Vida en Madrid en 1886* (Madrid, 1887); H. Peñasco, *Las Calles de Madrid* (Madrid, 1889); C. Perez Pastor, *Bibliografia madrileña, siglo XVI.* (Madrid, 1891); F. X. de Palacio y Garcia, count of las Almenas, *La Municipalidad de Madrid* (Madrid, 1896); E. Sepúlveda, *El Madrid de los recuerdos: colección de artículos* (Madrid, 1897); P. Hauser, *Madrid bajo el punto de vista medico-social* (Madrid, 1902); L. Williams, *Toledo and Madrid, their Records and Romances* (London, 1903).

MADRIGAL (Ital. *madrigale*), the name of a form of verse, the exact nature of which has never been decided in English, and of a form of vocal music.

(1) *In Verse.*—The definition given in the *New English Dictionary*, "a short lyrical poem of amatory character," offers no distinctive formula; some madrigals are long, and many have nothing whatever to do with love. The most important English collection of madrigals, not set to music, was published by William Drummond of Hawthornden (1585–1649) in his *Poems* of 1616. Perhaps the best way of ascertaining what was looked upon in the 17th century as a madrigal is to quote one of Drummond's:—

The beauty and the life
Of life's and beauty's fairest paragon,
O tears! O grief! hung at a feeble thread,
To which pale Atropos had set her knife;
The soul with many a groan
Had left each outward part,
And now did take his last leave of the heart;
Nought else did want, save death, even to be dead;
When the afflicted band about her bed,
Seeing so fair him come in lips, cheeks, eyes,
Cried ah! and can death enter Paradise?

This may be taken as a type of Drummond's madrigals, of which he has left us about eighty. They are serious, brief, irregular lyrics, in which neither the amatory nor the complimentary tone is by any means obligatory. Some of these pieces contain as few as six lines, one as many as fourteen, but they average from nine to eleven. In the majority of examples the little poem opens with a line of six syllables, and no line extends beyond ten syllables. The madrigal appears to be a short canzone of the Tuscan type, but less rigidly constructed. In French the madrigal has not this Italian character. It is simply a short piece of verse, ingenious in its turn and of a gallant tendency. The idea of compliment is essential. J. F. Guichard (1730–1811) writes:—

Orgon, poète marital,
  A Venus compare sa femme;
C'est pour la belle un madrigal,
  C'est pour Venus une épigramme.

This quatrain emphasizes the fact that in French a madrigal is a trifling piece of erotic compliment, neatly turned but not seriously meant. The credit of inventing the old French verse-form of madrigal belongs to Clément Marot, and one of his may be quoted in contrast to that of Drummond:—

Un doux nenni avec un doux sourire
  Est tant honneste, il le vous faut apprendre;
Quant est de oui, si veniez à le dire,
  D'avoir trop dit je voudrois vous reprendre;
  Non que je sois ennuyé d'entreprendre
D'avoir le fruit dont le désir me point;
  Mais je voudrois qu'en ne le laissant prendre,
  Vous me disiez: vous ne l'aurez point.

In English, when the word first occurred—it has not been traced farther back than 1588 (in the preface to Nicholas Yonge's *Musica transalpina*)—it was identified with the chief form of secular vocal music in the 16th century. In 1741 John Immyns (d. 1764) founded the Madrigal Society, which met in an ale-house in Bride Lane, Fleet Street; this association still exists, and is the oldest musical society in Europe.

The word "madrigal" is frequently also used to designate a sentimental or trifling expression in a half-contemptuous sense. (E. G.)

(2) *In Music.*—As a definite musical art-form, the madrigal was known in the Netherlands by the middle of the 15th century; like the motet, it obviously originated in the treatment of counterpoint on a canto fermo, some early examples even combining an ecclesiastical canto fermo in the tenor with secular counterpoint in the other parts. Thus Josquin's *Déploration de Jehan Okenheim* (see Music) might equally well be called a madrigal or motet, if the word "madrigal" were used for compositions to French texts at all. But by the middle of the 16th century the Italian supremacy in music had developed the madrigal into the greatest of secular musical forms, and made it independent of the form of the words; and thus when Lasso sets Marot's madrigals to appropriately witty and tuneful music he calls the result a "chanson"; while when Palestrina composes Petrarca's Sonnets to the Virgin in memory of Laura, the result appears as a volume of *Madrigali spirituali*. Elegiac madrigals, whether spiritual or secular, were thus as common as any other kind; so that when the *Musica transalpina* brought the word "madrigal" to England it brought a precedent for the poet Drummond's melancholy type of madrigal poetry.

Italian madrigals, however, are by no means always elegiac; but the term always means a highly organized and flowing polyphonic piece, often as developed as the motet, though, in the mature classical period, distinct in style. Yet masses were often founded on the themes of madrigals, just as they were on the themes of motets (see Mass; Motet); and it is interesting, in such beautiful cases as Palestrina's *Missa gia fu chi m'ebbe cara*, to detect the slight strain the mildly scandalous origin of the themes puts upon the ecclesiastical style.

The breaking strain was put on the madrigal style at the end of the 16th century, in one way by the new discords of Monteverde and (with more musical invention) Schütz; and in another way by the brilliant musical character-drawing of Vecchi, whose *Amfiparnasso* is a veritable comic opera in the form of a set of fourteen madrigals, all riotously witty in the purest and most masterly polyphonic style. It was probably meant, or at least made use of, to laugh down the earliest pioneers of opera (*q.v.*); but it is the beginning of the end for the madrigal as a living art. Long afterwards we occasionally meet with the word again, when a 17th or 18th century composer sets to some kind of accompanied singing a poem of madrigalesque character. But this does not indicate any continuation of the true musical history of the madrigal. The strict meaning of the word in its musical sense is, then, a musical setting of an Italian or English non-ecclesiastical poem (typically a canzone) for unaccompanied chorus, in a 16th-century style less ecclesiastical than the motet, but as like it in organization as the form and sentiment of the words admit. The greatest classics in the madrigal style are those of Italy; and but little, if at all, below them come the English. The form, though not the name, of course, exists in the 16th-century music of other languages whenever the poetry is not too light for it.

It is important but easy to distinguish the madrigal from the lighter 16th-century forms, such as the Italian *villanella* and the English ballet, these being very homophonic and distinguished by the strong lilt of their rhythm.

The madrigal has been very successfully revived in modern English music with a more or less strict adherence to the 16th century principles; the compositions of De Pearsall being of high artistic merit, while the *Madrigale spirituale* in Stanford's oratorio *Eden* is a movement of rare beauty. (D. F. T.)

MADURA (Dutch *Madoera*), an island of the Dutch East Indies, separated by the shallow Strait of Madura from the N.E. coast of Java. Pop. (1897), 1,652,580, of whom 1,646,071 were natives, 4252 Chinese and 558 Europeans. It extends from about 112° 32′ to 114° 7′ E., and is divided into two nearly equal portions by the parallel of 7° S.; the area is estimated at 1725 sq. m. It is a plateau-like prolongation of the limestone range of northern Java, with hills (1300 to 1600 ft. high) and dales. The formation of the coast and plains is Tertiary and recent alluvium. Hot springs are not infrequent; and in the valley between Gunong Geger and Banjar lies the mud volcano of

Banju Ening. The coasts are clothed with tropical vegetation; but the soil is better fitted for pastoral than agricultural purposes. Fishing and cattle-rearing are the chief means of subsistence. Besides rice and maize, Madura yields coco-nut oil and *jati*. The manufacture of salt for the government, abolished in other places, continues in Madura. Hence perhaps the name is derived (Sansk. *mandura*, salt). Petroleum is found in small quantities.

The principal town is Sumenep; and there are populous Malay, Arab and Chinese villages between the town and the European settlement of Maringan. On a hill in the neighbourhood lies Asta, the burial-place of the Sumenep princes. Pamekasan is the seat of government. Bangkalang is a large town with the old palace of the sultan of Madura and the residences of the princes of the blood; the mosque is adorned with the first three suras of the Koran, thus differing from nearly all the mosques in Java and Madura, though resembling those of western Islam. In the vicinity once stood the Erfprins fort. Arisbaya (less correctly Arosbaya) is the place where the first mosque was built in Madura, and where the Dutch sailors first made acquaintance with the natives. The once excellent harbour is now silted up. Sampang is the seat of an important market. The Kangean and Sapudi islands, belonging to Madura, yield timber, trepang, turtle, pisang and other products.

Madura formerly consisted of three native states—Madura or Bangkalang, Pamekasan and Sumenep. The whole island was considered part of the Java residency of Surabaya. The separate residency of Madura was constituted in 1857; it now consists of four "departments"—Pamekasan, Madura, Sumenep and Sampang.

See P. J. Veth, Java, vol. iii.; Kielstra, "Het Eiland Madoera," in *De Gids* (1890); H. van Lennep, "De Madoereezen," in *De Indische Gids* (1895), with detailed bibliography.

MADURA, a city and district of British India, in the Madras Presidency. The city is situated on the right bank of the river Vaigai, and has a station on the South Indian railway 345 m. S.E. of Madras. Pop. (1901), 105,984. The city was the capital of the old Pandyan dynasty, which ruled over this part of India from the 5th century B.C. to the end of the 11th century A.D. Its great temple forms a parallelogram about 847 ft. by 729 ft., and is surrounded by nine *gopuras*, of which the largest is 152 ft. high. These ornamental pyramids begin with door-posts of single stones 60 ft. in height, and rise course upon course, carved with rows of gods and goddesses, peacocks, bulls, elephants, horses, lions, and a bewildering entanglement of symbolical ornament all coloured and gilded, diminishing with distance until the stone *trisul* at the top looks like the finest jeweller's work. The temple, which contains some of the finest carving in southern India, is said to have been built in the reign of Viswanath, first ruler of the Nayak dynasty. Its chief feature is the sculptured "Hall of a Thousand Pillars." The palace of Tirumala Nayak is the most perfect relic of secular architecture in Madras. This palace, which covers a large area of ground, has been restored, and is utilized for public offices. The Vasanta, a hall 333 ft. long, probably dedicated to the god Sundareswara, and the Tamakam, a pleasure-palace, now the residence of the collector, are the other principal buildings of this period.

The last of the old Pandyan kings is said to have exterminated the Jains and conquered the neighbouring kingdom of Chola; but he was in his turn overthrown by an invader from the north, conjectured to have been a Mahommedan. In 1324 a Moslem army under Malik Kafur occupied Madura, and the Hindus were held in subjection for a period of fifty years. Subsequently Madura became a province of the Hindu Empire of Vijayanagar. In the middle of the 16th century the governor Viswanath established the Nayak dynasty, which lasted for a century. The greatest of the line was Tirumala Nayak (reigned 1623–1659), whose military exploits are recorded in the contemporary letters of the Jesuit missionaries. He adorned Madura with many public buildings, and extended his empire over the adjoining districts of Tinnevelly, Travancore, Coimbatore, Salem and Trichinopoly. His repudiation of the nominal allegiance paid to the raja of Vijayanagar brought him into collision with the sultan of Bijapur, and after a lapse of three centuries Mahommedans again invaded Madura and compelled him to pay them tribute. After the death of Tirumala the kingdom of Madura gradually fell to pieces, being invaded by both Mahommedans and Mahrattas. About 1736 the district fell into the hands of the nawab of the Carnatic, and the line of the Nayaks was extinguished. About 1764 British officers took charge of Madura in trust for Mahommed Ali (Wallah Jah), the last independent nawab of the Carnatic, whose son finally ceded his rights of sovereignty to the East India Company in 1801.

The District of Madura has an area of 8701 sq. m. Pop. (1901), 2,831,280, an increase of 8·5% in the decade. It consists of a section of the plain stretching from the mountains east to the sea, coinciding with the basin of the Vaigai river, and gradually sloping to the S.E. The plain is broken by the outlying spurs of the Ghats, and by a few isolated hills and masses of rock scattered over the country. The most important spur of the Ghats is known as the Palni hills, which project E.N.E. across the district for a distance of about 54 m. Their highest peaks are more than 8000 ft. above sea-level, and they enclose a plateau of about 100 sq. m., with an average height of 7000 ft. On this plateau is situated the sanatorium of Kodaikanal, and coffee-planting is successfully carried on. The other principal crops of the district are millets, rice, other food-grains, oil-seeds and cotton. Tobacco is grown chiefly in the neighbourhood of Dindigul, whence it is exported to Trichinopoly, to be made into cigars. There are several cigar factories and a number of saltpetre refineries. The only other large industry is that of coffee-cleaning. Madura is traversed by the main line of the South Indian railway. It has four small seaports, whose trade is chiefly carried on with Ceylon. The most important irrigation work, known as the Periyar project, consists of a tunnel through the Travancore hills, to convey the rainfall across the watershed.

See *Madura District Gazetteer* (Madras, 1906).

MADVIG, JOHAN NICOLAI (1804–1886), Danish philologist, was born on the island of Bornholm, on the 7th of August 1804. He was educated at the classical school of Frederiksborg and the university of Copenhagen. In 1828 he became reader, and in 1829 professor, of Latin language and literature at Copenhagen, and in 1832 was appointed university librarian. In 1848 Madvig entered parliament as a member of what was called the "Eider-Danish" party, because they desired the Eider to be the boundary of the country. When this party came into power Madvig became minister of education. In 1852 be became director of public instruction. Some years later, from 1856 to 1863, Madvig was president of the Danish parliament and leader of the National Liberal party. With these brief interruptions the greater part of his life was devoted to the study and teaching of Latin and the improvement of the classical schools, of which he was chief inspector. As a critic he was distinguished for learning and acumen. He devoted much attention to Cicero, and revolutionized the study of his philosophical writings by an edition of *De Finibus* (1839; 3rd ed., 1876). Perhaps his most widely known works are those on Latin grammar and Greek syntax, especially his Latin grammar for schools (Eng. trans. by G. Woods). In 1874 his sight began to fail, and he was forced to give up much of his work. He still, however, continued to lecture, and in 1879 he was chosen rector for the sixth time. In 1880 he resigned his professorship, but went on with his work on the Roman constitution, which was completed and published before his death. In this book Madvig takes a strongly conservative standpoint and attacks Mommsen's views on Caesar's programme of reforms. It is a clear exposition, though rather too dogmatic and without sufficient regard for the views of other scholars. His last work was his autobiography, *Livserindringer* (published 1887). Madvig died at Copenhagen on the 12th of December 1886.

See J. E. Sandys, *History of Classical Scholarship* (1908), iii., 319-324.

MAECENAS, GAIUS (Cilnius), Roman patron of letters, was probably born between 74 and 64 B.C., perhaps at Arretium. Expressions in Propertius (ii. 1, 25–30) seem to imply that he had taken some part in the campaigns of Mutina, Philippi and Perusia. He prided himself on his ancient Etruscan lineage, and claimed descent from the princely house of the Cilnii, who excited the jealousy of their townsmen by their preponderating wealth and influence at Arretium in the 4th century B.C. (Livy x. 3). The Gaius Maecenas mentioned in Cicero (*Pro Cluentio*, 56) as an influential member of the equestrian order in 91 B.C. may have been his grandfather, or even his father. The testimony of Horace (*Odes* iii. 8, 5) and Maecenas's own literary tastes imply that he had profited by the highest education of his time. His great wealth may have been in part hereditary, but he owed his position and influence to his close connexion with the emperor Augustus. He first appears in history in 40 B.C., when he was employed by Octavian in arranging his marriage with Scribonia, and afterwards in assisting to negotiate the peace of Brundusium and the reconciliation with Antony. It was in 39 B.C. that Horace was introduced to Maecenas, who had before this received Varius and Virgil into his intimacy. In the "Journey to Brundusium," (Horace, *Satires*, i. 5) in 37, Maecenas and Cocceius Nerva are described as having been sent on an important mission, and they were successful in patching up, by the Treaty of Tarentum, a reconciliation between the two claimants for supreme power. During the Sicilian war against Sextus Pompeius in 36, Maecenas was sent back to Rome, and was entrusted with supreme administrative control in the city and in Italy. He was vicegerent of Octavian during the campaign of Actium, when, with great promptness and secrecy, he crushed the conspiracy of the younger Lepidus; and during the subsequent absences of his chief in the provinces he again held the same position. During the latter years of his life he fell somewhat out of favour with his master. Suetonius (*Augustus*, 66) attributes the loss of the imperial favour to Maecenas having indiscreetly revealed to Terentia, his wife, the discovery of the conspiracy in which her brother Murena was implicated. But according to Dio Cassius (liv. 19) it was due to the emperor's relations with Terentia. Maecenas died in 8 B.C., leaving the emperor heir to his wealth.

Opinions were much divided in ancient times as to the personal character of Maecenas; but the testimony as to his administrative and diplomatic ability was unanimous. He enjoyed the credit of sharing largely in the establishment of the new order of things, of reconciling parties, and of carrying the new empire safely through many dangers. To his influence especially was attributed the humaner policy of Octavian after his first alliance with Antony and Lepidus. The best summary of his character as a man and a statesman is that of Velleius Paterculus (ii. 88), who describes him as "of sleepless vigilance in critical emergencies, far-seeing and knowing how to act, but in his relaxation from business more luxurious and effeminate than a woman."

Expressions in the *Odes* of Horace (ii. 17. 1) seem to imply that Maecenas was deficient in the robustness of fibre characteristic of the average Roman. His character as a munificent patron of literature—which has made his name a household word—is gratefully acknowledged by the recipients of it and attested by the regrets of the men of letters of a later age, expressed by Martial and Juvenal. His patronage was exercised, not from vanity or a mere dilettante love of letters, but with a view to the higher interest of the state. He recognized in the genius of the poets of that time, not only the truest ornament of the court, but a power of reconciling men's minds to the new order of things, and of investing the actual state of affairs with an ideal glory and majesty. The change in seriousness of purpose between the *Eclogues* and the *Georgics* of Virgil was in a great measure the result of the direction given by the statesman to the poet's genius. A similar change between the earlier odes of Horace, in which he declares his epicurean indifference to affairs of state, and the great national odes of the third book is to be ascribed to the same guidance. Maecenas endeavoured also to divert the less masculine genius of Propertius from harping continually on his love to themes of public interest. But if the motive of his patronage had been merely politic it never could have inspired the affection which it did in its recipients. The great charm of Maecenas in his relation to the men of genius who formed his circle was his simplicity, cordiality and sincerity. Although not particular in the choice of some of the associates of his pleasures, he admitted none but men of worth to his intimacy, and when once admitted they were treated like equals. Much of the wisdom of Maecenas probably lives in the *Satires* and *Epistles* of Horace. It has fallen to the lot of no other patron of literature to have his name associated with works of such lasting interest as the *Georgics* of Virgil, the first three books of Horace's *Odes*, and the first book of his *Epistles*.

Maecenas himself wrote in both prose and verse. The few fragments that remain show that he was less successful as an author than as a judge and patron of literature. His prose works on various subjects—*Prometheus*, *Symposium* (a banquet at which Virgil, Horace and Messalla were present), *De cultu suo* (on his manner of life)—were ridiculed by Augustus, Seneca and Quintilian for their strange style, the use of rare words and awkward transpositions. According to Dio Cassius, Maecenas was the inventor of a system of shorthand.

There is no good modern biography of Maecenas. The best known is that by P. S. Frandsen (1843). See "Horace et Mecène" by J. Girard, in *La Révue politique et littéraire* (Dec. 27, 1873); V. Gardthausen, *Augustus und seine Zeit*, i. 762 seq.; ii. 432 seq. The chief ancient authorities for his life are Horace (*Odes* with Scholia), Dio Cassius, Tacitus (*Annals*), Suetonius (*Augustus*). The fragments have been collected and edited by F. Harder (1889).

MAECIANUS, LUCIUS VOLUSIUS (2nd cent.) Roman jurist, was the tutor in law of the emperor Marcus Aurelius. When governor of Alexandria he was slain by the soldiers, as having participated in the rebellion of Avidius Cassius (175). Maecianus was the author of works on trusts (*Fideicommissa*), on the *Judicia publica*, and of a collection of the Rhodian laws relating to maritime affairs. His treatise on numerical divisions, weights and measures (*Distributio*) is extant, with the exception of the concluding portion.

See Capitolinus, *Antoninus*, 3; Vulcacius Gallicanus, *Avidius Cassius*, 7; edition of the metrological work by F. Hultsch in *Metrologicorum scriptorum reliquiae*, ii. (1866); Mommsen in *Abhandlungen der sächsischen Gesellschaft der Wissenschaften*, iii. (1853).

MAELDUIN (or MAELDUNE), **VOYAGE OF** (*Imram Maeleduin*), an early Irish romance. The text exists in an 11th-century redaction, by a certain Aed the Fair, described as the "chief sage of Ireland," but it may be gathered from internal evidence that the tale itself dates back to the 8th century. It belongs to the group of Irish romance, the *Navigations* (*Imrama*), the common type of which was probably imitated from the classical tales of the wanderings of Jason, of Ulysses and of Aeneas. Maelduin, the foster-son of an Irish queen, learnt on reaching manhood that he was the son of a nun, and that his father, Ailill of the edge of battle, had been slain by a marauder from Leix. He set sail to seek his father's murderer, taking with him, in accordance with the instructions of a sorcerer, seventeen men. His three foster-brothers swam after him, and were taken on board. This increase of the fateful number caused Maelduin's vengeance to be deferred for three years and seven months, until the last of the intruders had perished. The travellers visited many strange islands, and met with a long series of adventures, some of which are familiar from other sources. The *Voyage of St Brendan* (*q.v.*) has very close similarities with the *Maelduin*, of which it is possibly a clerical imitation, with the important addition of the whale-island episode, which it has in common with "Sindbad the Sailor."

Imram Curaig Mailduin is preserved, in each case imperfectly, in the *Lebor na h Uidre*, a MS. in the Royal Irish Academy, Dublin; and in the *Yellow Book of Lecan*, MS. H. 216 in the Trinity College Library, Dublin; fragments are in Harleian MS. 5280 and Egerton MS. 1782 in the British Museum. There are translations by Patrick Joyce, *Old Celtic Romances* (1879), by Whitley Stokes (a more critical version, printed together with the text) in *Revue celtique*, vols. ix. and x. (1888–1889). See H. Zimmer, "Brendan's Meerfahrt" in *Zeitschrift für deutsches Altertum*, vol. xxxiii. (1889). Tennyson's *Voyage of Maeldune*, suggested by the Irish romance, borrows little more than its framework.

MAELIUS, SPURIUS (d. 439 B.C.), a wealthy Roman plebeian, who during a severe famine bought up a large amount of corn and sold it at a low price to the people. Lucius (or Gaius) Minucius, the patrician *praefectus annonae* (president of the market), thereupon accused him of courting popularity with a view to making himself king. The cry was taken up. Maelius, summoned before the aged Cincinnatus (specially appointed dictator), refused to appear, and was slain by Gaius Servilius Ahala; his house was razed to the ground, his corn distributed amongst the people, and his property confiscated. The open space called Aequimaelium, on which his house had stood, preserved the memory of his death. Cicero calls Ahala's deed a glorious one, but, whether Maelius entertained any ambitious projects or not, his summary execution was an act of murder, since by the Valerio-Horatian laws the dictator was bound to allow the right of appeal.

See Niebuhr's *History of Rome*, ii. 418 (Eng. trans., 1851); G. Cornewall Lewis, *Credibility of early Roman History*, ii.; Livy, iv. 13; Cicero, *De senectute* 16, *De amicitia* 8, *De republica*, ii. 27; Florus, i. 26; Dion. Halic. xii. 1.

MAELSTROM (whirlpool), a term originally applied to a strong current running past the south end of the island of Moskenaes, a member of the group of Lofoten Islands on the west coast of Norway. It is known also as the Moskenstrom. Though dangerous in certain states of wind and tide, the tales of ships being swallowed in this whirlpool are fables. The word is probably of Dutch origin, from *malen*, to grind or whirl, and *strom* or *stroom*, a stream or current. It appears on Mercator's *Atlas* of 1595.

MAENADS (Gr. Μαινάδες, frenzied women), the female attendants of Dionysus. They are known by other names—Bacchae, Thyiades, Clodones and Mimallones (the last two probably of Thracian origin)—all more or less synonymous.

See the exhaustive articles by A. Legrand in Daremberg and Saglio's *Dictionnaire des antiquités* and A. Rapp in Roscher's *Lexikon der Mythologie*; also editions of Euripides, *Bacchae* (*e.g.* J. E. Sandys).

MAENIUS, GAIUS, Roman statesman and general. Having completed (when consul in 338 B.C.) the subjugation of Latium, which with Campania had revolted against Rome, he was honoured by a triumph, and a column was erected to him in the Forum. When censor in 318, in order that the spectators might have more room for seeing the games that were celebrated in the Forum, he provided the buildings in the neighbourhood with balconies, which were called after him *maeniana*.

See Festus, *s.v.* Maeniana; Livy viii. 13, ix. 34; Pliny, *Nat. Hist.* xxxiv. 11 (5).

MAERLANT, JACOB VAN (*c.* 1235–*c.* 1300), Flemish poet, was born in the Franc de Burges (tradition says at Damme) between 1230 and 1240. He was sacristan of Maerlant, in the island of Ost-Voorne, and afterwards clerk to the magistrates at Damme. His early works are translations of French romances. Maerlant's most serious work in the field of romance was his *Ystorien van Troyen* (*c.* 1264), a poem of some forty thousand lines, translated and amplified from the *Roman de Troie* of Benoît de Sainte-More. From this time Maerlant rejected romance as idle, and devoted himself to writing scientific and historical works for the education and enlightenment of the Flemish people. His *Heimelicheit der Heimelicheden* (*c.* 1266) is a translation of the *Secreta secretorum*, a manual for the education of princes, ascribed throughout the middle ages to Aristotle. *Van der Naturen Bloeme* is a free translation of *De natura rerum*, a natural history in twenty books by a native of Brabant, Thomas de Cantimpré; and his *Rijmbijbel* is taken, with many omissions and additions, from the *Historia scholastica* of Petrus Comestor. He supplemented this metrical paraphrase of Scripture history by *Die Wrake van Jherusalem* (1271) from Josephus. Although Maerlant was an orthodox Catholic, he is said to have been called to account by the priests for translating the Bible into the vulgar tongue. In 1284 he began his *magnum opus*, the *Spiegel historiael*, a history of the world, derived chiefly from the third part of the *Speculum majus* of Vincent de Beauvais. This work was completed by two other writers, Philipp Utenbroeke and Lodowijk van Velthem. Maerlant died in the closing years of the 13th century, his last poem, *Van den lande van oversee*, dating from 1291. The greater part of his work consists of translations, but he also produced poems which prove him to have had real original poetic faculty. Among these are *Die Clausule van der Bible*, *Der Kerken Clage*, imitated from the *Complaintes* of Rutebeuf, and the three dialogues entitled *Martijn*, in which the fundamental questions of theology and ethics were discussed. In spite of his orthodoxy, Maerlant was a keen satirist of the corruptions of the clergy. He was one of the most learned men of his age, and for two centuries was the most celebrated of Flemish poets.

See monographs by J. van Beers (Ghent, 1860); C. A. Serrure (Ghent, 1861); K. Versnaeyen (Ghent, 1861); J. te Winkel (Leiden, 1877, 2nd ed., Ghent, 1892); and editions of *Torec* (Leiden, 1875) by J. te Winkel; of *Naturen Bloeme*, by Eelco Verwijs; of *Alexanders Geesten* (Groningen, 1882), by J. Franck; *Merlijn* (Leiden, 1880–1882), by J. van Bloten; *Heimelicheit der Heimelicheden* (Dordrecht, 1838), by Clarisse; *Der Naturen Bloeme* (Groningen, 1878), by Verwijs; of *Rijmbijbel* (Brussels, 1858–1869), by David; *Spiegel historiael* (Leiden 1857–1863), by Verwijs and de Vries; selections from the *Ystorien van Troyen* (1873), by J. Verdam.

MAES, NICOLAS (1632–1693), Dutch painter, was born at Dordrecht, and went about 1650 to Amsterdam, where he entered Rembrandt's studio. Before his return to Dordrecht in 1654 Maes painted a few Rembrandtesque genre pictures, with life-size figures and in a deep glowing scheme of colour, like the "Reverie" at the Ryks Museum in Amsterdam, the "Card Players" at the National Gallery, and the "Children with a Goat Carriage," belonging to Baroness N. de Rothschild. So closely did his early style resemble that of Rembrandt, that the last-named picture, and other canvases in the Leipzig and Budapest galleries and in the collection of Lord Radnor, were or are still ascribed to Rembrandt. In his best period, from 1655 to 1665, Maes devoted himself to domestic genre on a smaller scale, retaining to a great extent the magic of colour he had learnt from Rembrandt. Only on rare occasions did he treat scriptural subjects, as in the earl of Denbigh's "Hagar's Departure," which has been ascribed to Rembrandt. His favourite subjects were women spinning, or reading the Bible, or preparing a meal. In 1665 he went to Antwerp, where he remained till 1678, in which year he probably returned to Amsterdam. His Antwerp period coincides with a complete change in style and subject. He devoted himself almost exclusively to portraiture, and abandoned the intimacy and glowing colour harmonies of his earlier work for a careless elegance which suggests the influence of Van Dyck. So great indeed was the change, that it gave rise to the theory of the existence of another Maes, of Brussels. Maes is well represented at the National Gallery by five paintings: "The Cradle," "The Dutch Housewife," "The Idle Servant," "The Card Players," and a man's portrait. At Amsterdam, besides the splendid examples to be found at the Ryks Museum, is the "Inquisitive Servant" of the Six collection. At Buckingham Palace is "The Listening Girl" (repetitions exist), and at Apsley House "Selling Milk" and "The Listener." Other notable examples are at the Berlin, Brussels, St Petersburg, the Hague, Frankfort, Hanover and Munich galleries.

MAESTRO, a north-westerly wind observed in the Adriatic and surrounding regions, chiefly during summer. The maestro is a "fine weather" wind, and is the counterpart of the sirocco.

MAETERLINCK, MAURICE (1862–), Belgian-French dramatist and poet, of Flemish extraction, was born at Ghent on the 29th of August 1862. He was educated at the Collège Sainte-Barbe, and then at the university of his native city, where, at the age of twenty-four, he was enrolled as a barrister. In 1887 he settled in Paris, where he immediately became acquainted with Villiers de l'Isle-Adam and the leaders of the symbolist school of French poetry. At the death of his father, Maeterlinck returned to Belgium, where he thenceforth mainly resided: in the winter at Ghent, in the summer on an estate at Oostacker. He had by this time determined to devote his whole life to poetry, a dedication which his fortune permitted. His career as an author began in 1889, when he published a volume of verse, *Serres chaudes*, and a play, *La Princesse Maleine*, the latter originally composed in metre, but afterwards carefully rewritten in prose, the vehicle which the author continued to use for his dramatic work. Maeterlinck was at this time totally unknown, but he became famous through an article by Octave Mirbeau, prominently published in the Paris *Figaro*, entitled "A Belgian Shakespeare." The enthusiasm of this review and the excellence of the passages quoted combined to make Maeterlinck the talk of the town. Maeterlinck, among his Belgian roses, continued to work with extreme deliberation. In 1890 he published, in Brussels, two more plays, *L'Intruse* and *Les Aveugles*; followed in 1891 by *Les Sept princesses.* His strong leaning to mysticism was now explained, or defined, by a translation of the Flemish medieval visionary, the Admirable Ruysbroeck, which Maeterlinck brought out in 1891. In 1892 appeared what has been perhaps the most successful of all his plays on the stage, *Pelléas et Mélisande*, followed in 1894 by those very curious and powerful little dramas written to be performed by marionettes: *Alladine et Palomides*, *Intérieur* and *La Mort de Tintagiles*. In 1895 Maeterlinck brought out, under the title of *Annabella*, a translation of Ford's *'Tis Pity She's a Whore*, with a preface. Two philosophical works followed, a study on Novalis (1895) and *Le Trésor des humbles* (1896). In 1896 he returned to drama with *Aglavaine et Sélysette* and to lyric verse with *Douze chansons*. A monograph on the ethics of mysticism, entitled *La Sagesse et la destinée*, was issued, as a kind of commentary on his own dramas, in 1898; and in 1901 Maeterlinck produced a fascinating volume of prose, founded upon observations made in his apiaries at Oostacker, in which philosophy, fancy and natural history were surprisingly mingled—*La Vie des abeilles*. In 1902 he published *Le Temple enseveli* and *Monna Vanna*; in 1903 *Joyzelle*. In 1901 he began to issue, in Brussels, an edition of his complete dramatic works.

The nature of Maeterlinck's writings, whether in prose or verse, has been strictly homogeneous. Few poets have kept so rigorously to a certain defined direction in the practice of their art. Whether in philosophy, or drama, or lyric, Maeterlinck is exclusively occupied in revealing, or indicating, the mystery which lies, only just out of sight, beneath the surface of ordinary life. In order to produce this effect of the mysterious he aims at an extreme simplicity of diction, and a symbolism so realistic as to be almost bare. He allows life itself to astonish us by its strangeness, by its inexplicable elements. Many of his plays are really highly pathetic records of unseen emotion; they are occupied with the spiritual adventures of souls, and the ordinary facts of time and space have no influence upon the movements of the characters. We know not who these orphan princesses, these blind persons, these pale Arthurian knights, these aged guardians of desolate castles, may be; we are not informed whence they come, nor whither they go; there is nothing concrete or circumstantial about them. Their life is intense and consistent, but it is wholly of a spiritual character; they are mysterious with the mystery of the movements of a soul. These characteristics, which make the dramatic work of Maeterlinck so curious and unique, are familiar to most readers in *Pelléas et Mélisande*, but are carried, perhaps, to their farthest intensity in *Aglavaine et Sélysette*, which seems to be written for a phantom stage and to be acted by disembodied spirits. In spite of the violence of his early admirers, and of the fact that the form of his dramas easily lent itself to the cheap ridicule of parodists, the talent of Maeterlinck has hardly met with opposition from the criticism of his time. It has been universally felt that his spirit is one of grave and disinterested attachment to the highest moral beauty, and his seriousness, his serenity and his extreme originality have impressed even those who are bewildered by his diaphanous graces and offended at his nebulous mysticism. While the crude enthusiasm which compared him with Shakespeare has been shown to be ridiculous, the best judges combine with Camille Mauclair when he says: "Maurice Maeterlinck est un homme de génie authentique, un très grand phénomène de puissance mentale à la fin du xix^e siècle." In spite of the shadowy action of Maeterlinck's plays, which indeed require some special conditions and contrivances for their performance, they are frequently produced with remarkable success before audiences who cannot be suspected of mysticism, in most of the countries of Europe. In his philosophical writings Maeterlinck shows himself a disciple of Novalis, of Emerson, of Hello, of the Flemish Catholic mystics, and he evolves from the teachings of those thinkers a system of aesthetics applicable to the theatre as he conceives it. (E. G.)

MAFEKING, a town in the British Bechuanaland division of the Cape, 870 m. N.E. of Cape Town and 492 m. S.S.W. of Bulawayo by rail, and 162 m. in a direct line W. by N. of Johannesburg. (Pop. 1904), 2713. It is built on the open veld, at an elevation of 4194 ft., by the banks of the Upper Molopo, is 9 m. W. of the western frontier of the Transvaal and 15 m. S. of the southern boundary of the Bechuanaland protectorate. The Madibi goldfields are some 10 m. south of the town. Mafeking is thus an important trading and distributing centre for Bechuanaland and the western Transvaal. Here are, too, the chief railway workshops between Kimberley and Bulawayo. The headquarters of the administration for the Bechuanaland protectorate are in the town. The chief buildings are the town-hall, Anglican church, Masonic temple, and hospital.

Mafeking was originally the headquarters of the Barolong tribe of Bechuana and is still their largest station, the native location (pop. 2860) being about a mile distant from the town. It was from Pitsani Pothlugo (or Potlogo), 24 m. north of Mafeking, that Dr Jameson started, on the 29th of December 1895, on his raid into the Transvaal. On the outbreak of the Anglo-Boer war in 1899 Mafeking was invested by a Boer force. Colonel R. S. S. Baden-Powell was in command of the defence, which was stubbornly maintained for 217 days (Oct. 12 to May 17), when a relief column arrived and the Boers dispersed (see TRANSVAAL: *History*). The fate of the town had excited the liveliest sympathy in England, and the exuberant rejoicings in London on the news of its relief led to the coining of the word *mafficking* to describe the behaviour of crowds on occasions of extravagant demonstrations of a national kind. In September 1904 Lord Roberts unveiled at Mafeking an obelisk bearing the names of those who fell in defence of the town.

R. S. S. Baden-Powell's *Sketches in Mafeking and East Africa* (1907) and Lady Sarah Wilson's *South African Memories* (1909) deal largely with the siege of Mafeking.

MAFFEI, FRANCESCO SCIPIONE, MARCHESE DI (1675–1755), Italian archaeologist and man of letters, was born at Verona on the 1st of June 1675. He studied for five years in Parma, at the Jesuit College, and afterwards from 1698 at Rome; and in 1703–1704 he took part as a volunteer in the war of succession, fighting on the Bavarian side at Donauwerth. In 1709 he began at Padua along with Apostolo Zeno and Valisnieri the *Giornale dei letterati d'Italia*, a literary periodical which had but a short career; and subsequently an acquaintance with the actor Riccoboni led him to exert himself for the improvement of dramatic art in Italy. His *Merope*, a tragedy, appeared in 1713; *Teatro italiano*, a small collection of works for presentation on the stage, in 1723–1725; and *Le Ceremonie*, an original comedy, in 1728. From 1718 he became specially interested in the archaeology of his native town, and his investigations resulted in the valuable *Verona illustrata* (1731–1732). Maffei afterwards devoted four years to travel in France, England, Holland and Germany. He died at Verona on the 11th of February 1755.

A complete edition of his works appeared at Venice (28 vols., 8vo) in 1790.

MAFIA (MAFFIA), a secret society of Sicily. Its organization and purposes much resemble those of the Camorra (*q.v.*).

Various derivations are found for the name. Some hold it to be a Tuscan synonym for *miseria*; others, a corruption of Fr. *mauvais* (bad). Others connect it with the name of an alleged Arab tribe, Mà-âfir, once settled at Palermo. Giuseppe Pitré asserts that the word is peculiar to western Sicily and that, with its derivatives, it formerly meant, in Il Borgo, a district of Palermo, beauty or excellence. Thus, a handsome woman showily dressed was said "to have *mafia*," or to be *mafiusa*. Often in Palermo the street merchants call *arance-mafiuse* (fine oranges). Thus, Pitré argues, *mafia*, applied to a man to express manly carriage and bravery, would naturally become the title of a society the members of which were all "bravos." A less credible explanation of the term is connected with Mazzini, who is said to have formed a secret society the members of which were called *Mafiusi*, from *Mafia*, a word composed of the initial letters of five Italian words, *Mazzini autorizza furti, incendi, avvelenamenti*, "Mazzini authorizes theft, arson and poisoning." This theory suggests that the word was unknown before 1859 or 1860.

The Mafia, however named, existed long before Mazzini's day. In its crudest form it was co-operative brigandage, blended with the Vendetta (*q.v.*). The more strictly organized Mafia was the result of the disorders consequent upon the expulsion of the king of Naples by Napoleon. When the Bourbon court took refuge in Sicily there were a large number of armed retainers in the service of the Sicilian feudal nobility. Ferdinand IV., at the bidding of England, granted a constitution to the island in 1812, and with the destruction of feudalism most of the feudal troops became brigands. Powerless to suppress them, Ferdinand organized the bandits into a rural *gendarmerie*, and they soon established a reign of terror. The abject poverty of the poorer classes, unable to eke out existence by work in the sulphur mines or on the fields, fostered the growth of two classes of *mafiusi*—the vast majority of the inhabitants who were glad to put themselves as passive members under the protection of the Mafia, while the active members shared in the plunder. The Mafia thus became a loosely organized society under an unwritten code of laws or ethics known as *Omertà*, *i.e.*, manliness (from Sicil. *omu*, Ital. *uomo*, a man), which embodied the rules of the Vendetta. Candidates were admitted after trial by duel, and were sworn to resist law and defeat justice. Like the Camorra, the Mafia was soon powerful in all classes, and even the commander of the royal troops acted in collusion with it. The real home of Mafia was in and around Palermo, where no traveller was safe from robbery and the knife. In an organized form the Mafia survives only in isolated districts. Generally speaking, it is to-day not a compact criminal association but a complex social phenomenon, the consequence of centuries of misgovernment. The Mafiuso is governed by a sentiment akin to arrogance which imposes a special line of conduct upon him. He considers it dishonourable to have recourse to lawful authority to obtain redress for a wrong or a crime committed against him. He therefore hides the identity of the offender from the police, reserving vengeance to himself or to his friends and dependants. This sentiment, still widely diffused among the lower classes of many districts, and not entirely unknown to the upper classes, renders difficult legal proof of culpability for acts of violence, and multiplies sanguinary private reprisals. In September 1892 about 150 Mafiusi were arrested at Catania, but all repressive measures proved useless. The only result was to drive some of the members abroad, with disastrous results to other countries. In October 1890 David Hennessy, chief of police in New Orleans, was murdered. Subsequent legal inquiry proved the crime to be the work of the Mafia, which had been introduced into the United States thirty years before. In May 1890 a band of Italians living in New Orleans had ambushed another gang of their fellow-countrymen belonging to a society called *Stoppaghera*. The severe police measures taken brought the vengeance of the society upon Hennessy. Eleven Italians were indicted on suspicion of being implicated in his murder; but the jury was terrorized and acquitted six. On the 14th of March 1891 a mob led by well-known New Orleans citizens broke into the gaol where nineteen Italians were imprisoned and lynched eleven of them.

See W. Agnew Paton, *Picturesque Sicily* (1898); C. W. Heckethorn, *Secret Societies of all Ages* (1897); Alongi, *La Maffia* (Turin, 1887); Le Faure, *La Maffia* (Paris, 1892).

MAFRA, a town of Portugal, in the district of Lisbon (formerly in the province of Estremadura); near the Atlantic coast and the right bank of the river Lizandro, and 20 m. N.W. of Lisbon. Pop. (1900), 4769. Mafra is remarkable for its monastery, church, and palace, built by John V. in 1717–1732, in consequence of a vow made during a dangerous illness to build a convent for the poorest friary of the kingdom—which proved to be a small Franciscan settlement here. The architects, Johann Friedrich Ludwig of Regensburg, and his son Johann Peter, took the Escurial for their model; but the imitation is less successful than the original, though the cost exceeded £4,000,000. The building is in the form of a parallelogram measuring upwards of 800 ft. from north to south and 700 ft. from east to west; it is said to contain 866 rooms, and to be lighted by no fewer than 5200 windows. The centre is occupied by the church, sumptuously built of marble, and richly adorned with statues and other objects of art. In each of the twin towers there is a chime of 57 bells. Part of the palace, originally designed as barracks, is used as a military academy. Adjoining the palace are fine gardens and a royal model farm.

MAGADHA, an ancient kingdom of India, mentioned in both the *Ramayana* and the *Mahābhārata*. It comprised that portion of Behar lying S. of the Ganges, with its capital at Pataliputra or Patna. As the scene of many incidents in the life of Gautama Buddha, it was a holy land. It was also the seat of the Maurya Empire, founded by Chandragupta, which extended over all India under Asoka; and, later, of the powerful Gupta dynasty.

MAGALDÁN, a town in the northern part of the province of Pangasinan, Luzon, Philippine Islands, about 2 m. from the shore of the Gulf of Lingayen. Pop. (1903), 15,841. In 1903 the adjacent municipality of Mapandan (pop. in 1903, 4198) was annexed to Magaldán. Most of its inhabitants are engaged in rice culture. The principal language is Pangasinan; Ilocano is also spoken.

MAGALLANES (Spanish form of *Magellan*), a territory of southern Chile extending from 47° S. to Cape Horn and including the mainland from the Argentine frontier to the Pacific coast, the islands extending along that coast, the Fuegian archipelago, and the western half of Tierra del Fuego. Area, about 71,127 sq. m.; pop. (1895), 5170. It is one of the most inhospitable regions of the world, being exposed to cold westerly storms for most of the year. The islands are barren, but the mainland is covered with forests, practically inaccessible to exploitation because of the inclement climate and the wet spongy soil. The coast is indented with bays and fjords and affords remarkable scenery. There is little animal life on land, but the coast is frequented by the seal and sea-otter and the sheltered waters by countless sea-fowl. The only permanent settlements are at Punta Arenas, the capital, on the Straits of Magellan, Palomares on Otway Water, Mina Marta on Skyring Water, and Ultima Esperanza (Last Hope) on the east shore of Worsley Sound. All are east of the Andean ranges and partially sheltered from the westerly storms. In this sheltered region there are open plains where sheep are grazed. A few sheep ranges have been established on Tierra del Fuego. Some nomadic tribes of Indians inhabit Tierra del Fuego and the extreme southern end of the mainland, but their numbers are small. Coal has been found in the vicinity of Punta Arenas, and gold occurs.

See *The Voyage of the Adventure and Beagle* (1839).

MAGAZINE, primarily a warehouse for goods or merchandise (Arab. *makhzan*, a storehouse, from *khazana*, to store up). In Morocco *makhzan* (or *maghzen*) has come to be used as the name of the government. The Spaniards adopted the Arabic in the form *magacen*, and the English form comes through the older French *magazin*, modern *magasin*. The meaning of a storehouse or large shop, common in French, is rare in English except in the military use of the term for a building for the storage of explosives and ammunition. It is applied to the chamber of a repeating rifle or machine-gun containing the supply of cartridges. The name as applied to a periodical publication containing articles on various subjects was first used in the *Gentleman's Magazine* (1731), described as "a monthly collection, to treasure up as in a magazine" articles on the subjects with which it was proposed to deal.

MAGDALA (more correctly Makdala), a natural stronghold in the country of the Wollo Gallas, Abyssinia, about 250 m. W. of Jibuti on the Gulf of Aden, in 11° 22′ N., 39° 25′ E. The basaltic plateau of which it consists rises 9110 ft. above the sea. It is about three-quarters of a mile in length by less than half a mile in breadth, and lies more than a thousand feet higher than the neighbouring plain of Arogié. Chosen about 1860 by the emperor Theodore of Abyssinia as his principal stronghold in the south, Magdala owes its celebrity to the fact that, as the place of imprisonment of the English captives, it became the goal of the great English Expedition of 1868. At the time of its capture it contained huts for a population of about three thousand. The whole rock was burned bare by order of the commander of the British force, Sir Robert Napier, who, on being raised to the peerage for his services on this occasion, took the title of Lord Napier of Magdala. The plateau was subsequently refortified by the Abyssinians.

See Clements Markham, *History of the Abyssinian Expedition* (1869); and H. Rassam, *British Mission to Theodore* (1869).

MAGDEBURG, a city of Germany, capital of the Prussian province of Saxony, a fortress of the first rank and one of the principal commercial towns of the German Empire. It lies in a broad and fertile plain, mainly on the left bank of the Elbe, 88 m. S.W. from Berlin and at the junction of main lines to Leipzig, Brunswick, Cassel and Hamburg. Pop. (1885), 159,520; (1890), 202,234; (1905), 240,661. It consists of the town proper, and of the five suburbs of Friedrichstadt, Wilhelmstadt, Neustadt, Sudenburg and Buckau; the last four are separated from the town by the ramparts and glacis, but are all included within the new line of advanced bastions, while Friedrichstadt lies on the right bank of the river. In the Elbe, between the old town and the Friedrichstadt, lies an island whereon stands the citadel; this is united with both banks by bridges. With the exception of the Breite Weg, a handsome thoroughfare running from north to south, the streets of the town proper are narrow and crooked. Along the Elbe, however, extend fine promenades, the Fürstenwall and the Fürsten Ufer. To the south of the inner town is the Friedrich Wilhelms Garten, a beautiful park laid out on the site of the celebrated convent of Berge, which was founded in 968 and suppressed in 1809. By far the most important building in Magdeburg is the cathedral, dedicated to SS Maurice and Catherine, a handsome and massive structure of the 14th century, exhibiting an interesting blending of Romanesque and Gothic architecture. The two fine western towers were completed about 1520. The interior contains the tombs of the emperor Otto the Great and his wife Edith, an English princess, and the fine monument of Archbishop Ernest (d. 1513), executed in 1495 by Peter Vischer of Nuremberg. The Liebfrauenkirche, the oldest church in Magdeburg, is an interesting Romanesque edifice of the 12th and 13th centuries, which was restored in 1890–1891. The chief secular buildings are the town-hall (Rathaus), built in 1691 and enlarged in 1866, the government offices, the palace of justice, the central railway station and the exchange. The Breite Weg and the old market contain numerous fine gable-ended private houses in the style of the Renaissance. In front of the town-hall stands an equestrian statue of Otto the Great, erected about 1290. The modern streets are spacious, and the houses well-built though monotonous. There are two theatres, an agricultural college, an art school, several gymnasia, a commercial and other schools, an observatory, and two fine hospitals. The first place amongst the industries is taken by the ironworks (one being a branch of the Krupp firm, the Grusonwerke, employing about 4000 hands), which produce naval armour and munitions of war. Of almost equal importance are the sugar refineries and chicory factories. Then come establishments for making tobacco, gloves, chocolate, artificial manure, cement, varnish, chemicals and pottery. There are also distilleries and breweries, and factories for the manufacture of cotton and silk goods. Magdeburg is the central market in Germany for sugar and chicory, but trades extensively also in cereals, fruit, vegetables, groceries, cattle, horses, wool, cloth, yarn, leather, coal and books. A new winter harbour, made at a cost of £400,000, facilitates the river traffic along the Elbe. Three million tons of merchandise pass Magdeburg, going upstream, and nearly 1 million tons, going downstream, annually. Magdeburg is the headquarters of the IV. corps of the German army and the seat of the provincial court of appeal and administrative offices, and of a Lutheran consistory.

History.—Magdeburg, which was in existence as a small trading settlement at the beginning of the 9th century, owes its early prosperity chiefly to the emperor Otto the Great, who established a convent here about 937. In 968 it became the seat of an archbishop, who exercised sway over an extensive territory. Although it was burnt down in 1188, Magdeburg became a flourishing commercial town during the 13th century, and was soon an important member of the Hanseatic League. Its bench of jurats (*Schöppenstuhl*) became celebrated, and "Magdeburg law" (*Magdeburger Recht*), securing the administrative independence of municipalities, was adopted in many parts of Germany, Poland and Bohemia. During the middle ages the citizens were almost constantly at variance with the archbishops, and by the end of the 15th century had become nearly independent of them. It should, however, be noted that Magdeburg never became a free city of the Empire. The town embraced the Reformation in 1524, and was thenceforth governed by Protestant titular archbishops (see Bishop). On the refusal of the citizens to accept the "Interim," issued by the emperor Charles V., Magdeburg was besieged by Maurice of Saxony in 1550, and capitulated on favourable terms in November 1551. During the Thirty Years' War it was twice besieged, and suffered terribly. It successfully resisted Wallenstein for seven months in 1629, but was stormed and sacked by Tilly in May 1631. The whole town, with the exception of the cathedral, and about 140 houses, was burned to the ground, and the greater part of its 36,000 inhabitants were butchered without regard to age or sex, but it recovered from this deadly blow with wonderful rapidity. By the peace of Westphalia (1648) the archbishopric was converted into a secular duchy, to fall to Brandenburg on the death of the last administrator, which happened in 1680. In 1806 Magdeburg was taken by the French and annexed to the kingdom of Westphalia, but it was restored to Prussia in 1814, on the downfall of Napoleon. Otto von Guericke (1602–1686), the inventor of the air-pump, was burgomaster of Magdeburg. Count Lazare Carnot died here in exile, and was buried in the cemetery, but his remains were exhumed in 1889 and conveyed to Paris. Luther was at school here, and sang in the streets for bread with other poor choristers.

See W. Kawerau, *Aus Magdeburgs Vergangenheit* (Halle, 1886) O. von Guericke, *Geschichte der Belagerung, Eroberung und Zerstörung von Magdeburg* (Magdeburg, 1887); M. Dittmar, *Beiträge zur Geschichte der Stadt Magdeburg* (Halle, 1885); F. W. Hoffmann, *Geschichte der Stadt Magdeburg* (Magdeburg, 1885–1886); F. Hülsse, *Die Einführung der Reformation in der Stadt Magdeburg* (Magdeburg, 1883); R. Volkholz, *Die Zerstörung Magdeburgs 1631* (Magdeburg, 1892); W. Leinung and R. Stumvoll, *Aus Magdeburgs Sage und Geschichte* (Magdeburg, 1894); and the *Urkundenbuch der Stadt Magdeburg* (1892).

The Archbishopric of Magdeburg was carved out of the bishopric of Halberstadt when it was founded in 968, and its history is largely bound up with that of the city and of the prelates who have ruled the see. The first archbishop was Adalbert, and he and his successors had six or seven suffragan bishops. Several of the archbishops took very prominent parts in German politics. Early in the 15th century their residence was fixed at Halle, and about the same time it became the custom to select them from one of the reigning families of Germany, most often from the house of Brandenburg. The doctrines of the reformers made their appearance in the diocese early in the 16th century, and soon Archbishop Sigismund, a son of Joachim II., elector of Brandenburg, openly avowed his adherence to Lutheranism. After the issue of the edict of restitution by the emperor Ferdinand II. in 1629, there were three rival candidates for the see, and their struggles added to the confusion caused by the Thirty Years' War. By the peace of Prague, however, in 1635, the archbishopric was given to Augustus, prince of Saxe-Weissenfels, who retained it until his death in 1680. In 1773 the area of the see was over 2000 sq. m. It included 29 towns and over 400 villages and contained about 250,000 inhabitants.

See the *Regesta archiepiscopatus magdeburgensis*, edited by G. A. von Mülverstedt (Magdeburg, 1876–1899); and K. Uhlirz, *Geschichte des Erzbistums Magdeburg unter den Kaisern aus sächsischem Hause* (Magdeburg, 1887).

Distinct both from the archbishopric and from the city was the BURGRAVIATE OF MAGDEBURG. The office of burgrave dates from the time of Charlemagne, although its holder was not at first called by this name, and it soon became one of great importance. The burgrave was the king's representative; he was charged with the administration of the royal estates in a given district, and in general with watching the royal interests therein. The burgraviate of Magdeburg was held by several countly families in turn until 1269, when it was purchased by Archbishop Conrad II., who, however, soon sold it. In 1294 it was again united with the archbishopric and the prelates retained it until 1538; then in 1579 Augustus, elector of Saxony, made an arrangement which again gave the office to the archbishops, who held it until the secularization of the see.

The MAGDEBURG CENTURIES (*Magdeburger Zenturien*) is the name given to the first general history of the Christian Church written from a Protestant point of view. It was compiled in Magdeburg, and the history is divided into periods of one hundred years each. It was written in Latin in 1562, its principal author being the reformer Matthias Flacius, who was assisted by other Lutheran theologians. The cost of the undertaking was borne by some of the German Protestant princes. As the *Historia ecclesiae Christi* it was first published at Basel in seven volumes (1559–1574). It deals with the history of the Church down to 1400, and considering the time at which it was written it is a remarkable monument to the scholarship of its authors. The earlier part of it has been translated into German (Jena, 1560–1565).

See E. Schaumkell, *Beitrag zur Entstehungsgeschichte der Magdeburger Zenturien* (Ludwigslust, 1898).

MAGEE, WILLIAM (1766–1831), archbishop of Dublin, was born at Enniskillen, Co. Fermanagh, and educated at Trinity College, Dublin, where he was elected fellow in 1788. He was ordained in 1790. Two sermons, preached in the college chapel in 1798 and 1799, form the basis of his *Discourses on the Scriptural Doctrines of Atonement and Sacrifice* (1801), a polemic against Unitarian theology which was answered by Lant Carpenter. Magee was appointed professor of mathematics and senior fellow of Trinity in 1800, but in 1812 he resigned, and undertook the charge of the livings of Cappagh, Co. Tyrone, and Killeleagh, Co. Down. Next year he became dean of Cork. He was well known as a preacher and promoter of the Irish reformation, and in 1819 he was consecrated bishop of Raphoe. In 1822 the archbishop of Dublin was translated to Armagh, and Magee succeeded him at Dublin. Though in most respects a tolerant man, he steadily opposed the movement for Catholic Emancipation. He died on the 18th of August 1831.

A memoir of his life is included with the *Works of the Most Reverend William Magee, D.D.* (1842), by A. H. Kenney.

MAGEE, WILLIAM CONNOR (1821–1891), Anglican divine, archbishop of York, was born at Cork in 1821. His father was curate of the parish attached to the Protestant cathedral in that city; his grandfather was archbishop of Dublin. Young Magee entered Trinity College, Dublin, with a scholarship at thirteen. He was ordained to the curacy of St Thomas's, Dublin, but, being threatened with consumption, went after two years to Malaga. On his return he took a curacy at Bath, and was speedily appointed to the Octagon Chapel, where his fame both as preacher and platform speaker continued to spread. Some years afterwards he was made prebendary of Wells Cathedral. In 1860 the delicate state of his health caused him to accept the living of Enniskillen. In 1864 he was made dean of Cork and chaplain to the lord lieutenant. Here he manifested those great gifts which ultimately raised him to high office; a powerful grasp of mental, moral and political problems, combined with eloquence of a high order, and illuminated with brilliant flashes of wit. In 1868 the question of the disestablishment of the Irish Church came to the front, and Magee threw himself into the task of its defence with his usual energy and vivacity. The success of his orations caused Disraeli to offer him the bishopric of Peterborough. He justified his appointment by his magnificent speech when the Disestablishment Bill reached the House of Lords in 1869, and then plunged into diocesan and general work in England. He preached three remarkable sermons on Christian Evidence in Norwich Cathedral in 1871. He took up the temperance question, and declared in the House of Lords that he would rather see "England free than England compulsorily sober," an utterance which the extreme advocates of total abstinence misquoted and attacked. He was also a supporter of the movement for abolishing the recitation of the Athanasian Creed in the public services of the Church of England, believing, as he said, that the "presence" of the damnatory clauses, "as they stand and where they stand, is a real peril to the Church and to Christianity itself," and that those clauses "are no essential part" of the creed. The project was laid aside in consequence of the hostility of a large body of the clergy, reinforced by the threat of Dr Pusey and Canon Liddon to abandon their offices if it were carried. Magee took a prominent part in the Ritual controversy, opposing what he conceived to be romanizing excess in ritual, as well as the endeavour of the opposite party to "put down Ritualism," as Disraeli expressed it, by the operation of the civil law. His incisive way of putting things earned for him the title of the "Militant Bishop," but, as he himself remarked in relation to this title, his efforts were ever for peace. Unfortunately for the Church, he was not elevated to the see of York until his energies were exhausted. He died on the 5th of May 1891, about four months after his appointment. Magee's manifold activities, his capability as an administrator, his sound judgment, and his remarkable insight into the ecclesiastical problems of his time, rank him among the most distinguished of English prelates.

See *Life and Letters*, by Canon MacDonnell (2 vols. 1896).

MAGELLAN, FERDINAND (in Sp. FERNANDO MAGALLANES, in Port. FERNÃO DE MAGALHÃES) (*c.* 1480–1521), the first circumnavigator of the globe, was born at Sabrosa in the Villa Real district of the Traz-os-Montes province of Portugal. He was a son of Pedro de Magalhães, and belonged to the fourth order of Portuguese nobility (*fidalgos de cota de armas*). He was brought up as one of the pages of Queen Leonor, consort of King John (João) II "the Perfect." In 1495 he entered the service of Manuel "the Fortunate," John's successor, and in 1504 enlisted as a volunteer for the Indian voyage of the first Portuguese viceroy in the East, Francisco d'Almeida. He sailed on the 25th of March 1505; was wounded at Cannanore on the 16th of March 1506; was then sent with Nuno Vaz Pereira to Sofala to build a Portuguese fortress at that place; returned to India early in 1508; and was again wounded at the battle of Diu on the 3rd of February 1509. At Cochin (Aug. 19, 1509) he joined Diogo Lopes de Sequeira on his famous voyage intended for the Spice Islands, when the Portuguese almost fell victims to Malay treachery at Malacca. In this crisis he fought bravely and skilfully (though it is not true, as often asserted, that he discovered the Malay plot); and before the 10th of October 1510 he had been rewarded for his many services with the rank of captain. He again distinguished himself at the taking of Malacca by Albuquerque (July-Aug., 1511), and was then sent on by the viceroy with Antonio d'Abreu to explore the Spice Islands (Moluccas). Leaving Malacca at the end of December 1511, this squadron sailed along the north of Java, passed between Java and Madura, left Celebes on their left, coasted by the Gunong Api volcano, touched at Bura, and so reached Amboyna and Banda. At the last-named they found such abundance of spices that they came straight back to Malacca without visiting Ternate, as had been intended.

Magellan returned to Portugal in 1512. On the 14th of July of that year he was raised to the rank of *fidalgo escudeiro*; and in 1513 he accompanied a Portuguese expedition against Azamor in Morocco. The city was taken on the 28th-29th of August 1513; but Magellan was subsequently wounded, and lamed for life, in a sortie; he was also accused of trading with the Moors. The accusation was subsequently dropped, but Magellan fell into disfavour with King Manuel, who let him understand that he would have no further employment in his country's service (after the 15th of May 1514). Magellan formally renounced his nationality, and went to offer his services to the court of Spain. He reached Seville on the 20th of October 1517, and thence went to Valladolid to see Charles V. With the help of Juan de Aranda, one of the three chief officials of the India House at Seville, and of other friends, especially Diogo Barbosa, a Portuguese like himself, naturalized as a Spaniard, who had acquired great influence in Seville, and whose daughter he now married, he gained the ear of Charles and of the powerful minister, Juan Rodriguez de Fonseca, bishop of Burgos, the persistent enemy of Columbus, the steady supporter of his great successor. Magellan proposed to reach the Spice Islands of the East Indies by the west; for that purpose he hoped to discover a strait at the extreme south of South America, and is said to have declared himself ready to sail southwards to 75° to realize his project. Ruy Faleiro the astronomer, another Portuguese exile, aided him in the working out of his plan, and he found an invaluable financial ally in Christopher de Haro, a member of a great Antwerp firm, who owed a grudge to the king of Portugal. On the 22nd of March 1518, Magellan and Faleiro, as joint captains-general, signed an agreement with Charles V., by which one-twentieth of the clear profits were to fall to them; further, the government of any lands discovered was vested in them and their heirs, with the title of *Adelantados*. On the 10th of August 1519, the fleet of five vessels, under Magellan's command, left Seville and dropped down the Guadalquivir to S. Lucar de Barrameda, at the mouth of the river, where they remained more than five weeks. On the 20th of September the armada put to sea. Of the vessels which composed it, the "Trinidad" was the flagship, and the "Vittoria" the only one which accomplished the circumnavigation. The crew, officers, volunteers, &c., numbered about 270–280, of whom the names of 268 are preserved; 237 of these received pay; at least 37 were Portuguese, 30 or more Italians (mostly Genoese), 19 French, 1 English, 1 German. Only 31 returned in the "Vittoria"; 4 survivors of the crew of the "Trinidad" reappeared later. Antonio Pigafetta of Vicenza, an Italian gentleman who has left the best history of the voyage, went as a volunteer in Magellan's suite. Faleiro stayed behind, having cast his horoscope and found that the venture would be fatal to him. The fleet was well armed, and the total cost of equipment was 8,751,000 maravedis, or £5032 (equal to over £50,000 in present value). Three-quarters were defrayed by the Spanish Crown, one-quarter by Christopher Haro and his friends. Before starting, Magellan made his will and addressed a memorandum to Charles V., assigning geographical positions connected with the controversy he was intending to settle: viz., the proper drawing of a demarcation-line between the spheres of Spain and Portugal in the East Indies, and the inclusion of the Moluccas within the Spanish sphere.

Steering south-west and calling at Teneriffe (Sept. 26–Oct. 3), Magellan sighted South America at Cape St Augustine, near Pernambuco on the 29th of November; thence he followed the east coast of the New World down to the La Plata estuary, which he examined in the hope of finding a passage at this point (Jan. 11–Feb. 6, 1520). On the 31st of March following, he arrived at Port St Julian (in 49° 20′ S.) where he wintered. Here he crushed a formidable mutiny (April 1-2), and made acquaintance with the natives, whom he called *Patagonians* ("Big Feet"), whose great size and lofty stature are magnified by Pigafetta to gigantic proportions. Leaving Port St Julian on the 24th of August 1520, he discovered on the 21st of October the cape of the Eleven Thousand Virgins, the eastern entrance of the long-sought passage. Through this strait, 360 m. long, often narrow and very tortuous, fringed by snow-clad mountains, he guided his armada for thirty-eight days, weakened by the desertion of one vessel (the "S. Antonio"). On the 21st of November a council of pilots and captains was held to consider the continuation of the voyage, and on the 28th of November the fleet rounded Cabo Deseado, the "desired" western terminus of the strait, variously called by the first discoverers, "Victoria Strait," "Strait of the Patagonians," "of all Saints," "of the Eleven Thousand Virgins," or "of Magellan," now only known by the last of these names. To the south of the passage lay the forbidding land "stark with eternal cold," which from the many fires here observed Magellan named "Tierra del Fuego." The expedition now entered the "Great South Sea," first sighted by Vasco Nuñez de Balboa (*q.v.*), which, from the steady and gentle winds that drove the fleet across the immeasurable expanse, was by Magellan called "Pacific." For ninety-eight days Magellan crossed this sea, almost beyond the grasp of man's mind for vastness (as Maximilian of Transylvania puts it), from Cabo Deseado to the Ladrones. On the whole transit he discovered only two islands, sterile and uninhabited, which he called "St Paul's" (Jan. 24, 1521) and "Shark Island" (Feb. 3). The first of these has been identified with Puka Puka in the Tuamotu Archipelago, the second with Flint Island in the Manihiki group; neither identification seems convincing. For most of these ninety-eight days the explorers had no fresh provisions, little water (and that bad), and putrid biscuit; the ravages of scurvy became terrible. The worst anticipations of Magellan ("he would push on, if they had to eat the leather of the rigging") were realized; ox-hides, sawdust, and rats became coveted food. At last, on the 6th of March 1521, the Ladrones (so named by Magellan from the thievish habits of the natives) came in sight, Guam being probably the first port of call. Here the fleet rested, watered, revictualled and refitted; on the 9th of March they started again westward; and on the 16th of March sighted the southern point of Samar Island in the archipelago, since 1542 called the Philippines, but named by Magellan, its first discoverer, after St Lazarus. On the 7th of April the squadron arrived at Cebu, south-west of Samar, in the heart of the Philippines; here Magellan contracted a close friendship and alliance with the treacherous native sovereign, who professed Christianity the better to please and utilize his Catholic friends. Undertaking an expedition to conquer, for the Catholic faith and the king of Cebu, the neighbouring island of Mactan, Magellan was killed there in a fight with the islanders (April 27, 1521). The king of Cebu after this got into his power several of the leading personages of the squadron, including Juan Serrano, one of the two admirals elected to replace Magellan, and murdered them. The survivors, burning one of the three remaining vessels, left the Philippines, and made their way to the Moluccas (Nov. 6), visiting Borneo on the way (July 9-Sept. 27, 1521). At Tidor a heavy cargo of cloves was taken in; the "Trinidad," becoming leaky, stayed behind with her crew; and the "Vittoria," under Juan Sebastian del Cano, proceeded to Europe alone (Dec. 21, 1521). To double the Cape of Good Hope the "Vittoria" reached between 40° and 41° S. (April 7-16, 1522) and suffered from contrary winds, heavy seas, scurvy and starvation. In the Cape Verde Islands (July 9-15, 1522) thirteen of the crew were detained prisoners by the Portuguese. Only thirty-one men returned with del Cano to Seville in the first vessel that had ever made the tour of the earth. Though Magellan had not quite reached the Spice Islands when he fell at Mactan, his task had then been accomplished. He had already reached and passed the longitude of the Moluccas, where he had already been; the way home from the Philippines by the Indian Ocean and the Cape of Good Hope was perfectly known to the Portuguese, himself included. Magellan's name has never received its due recognition in general history. It ranks with those of Columbus, Marco Polo, and Henry the Navigator. The circumnavigation of the globe is as great an event as the discovery of America. Magellan achieved what Columbus planned—the linking of west Europe with east Asia by direct transit over the western ocean. Had America not intervened, the project of 1492 must have failed; by 1519 European pioneers had formed a more adequate notion of the task and its magnitude.

Magellan's Straits, the Magellanic clouds (not first observed by him), and Magellan's Land—a name long given to Patagonia and that hypothetical southern continent of which Tierra del Fuego was considered only a portion, and now again bestowed by Chile on her territory in the extreme south—preserve the memory of the first circumnavigator. The largest of the oceans has also kept the flattering name given to it by the man who first crossed it.

No record of his exploits was left by Magellan himself; and contemporary accounts are less detailed and consistent than could be wished. The best is that of Antonio Pigafetta, a volunteer in the fleet. It is printed in Ramusio, and exists in four early MS. copies, one in Italian and three in French. The latter was perhaps the original language of this work, which was addressed by Pigafetta, as a knight of Rhodes, to the Frenchman Villiers de l'Isle Adam, grand master of the order of the Hospital of St John. But this view is rejected by J. A. Robertson (see below), who believes the Ambrosian MS. to be the ultimate text. See the *Primo viaggio intorno al mondo*, otherwise the *Navigation et descouvrement de la Indie supérieure faicte par moi Anthoyne Pigapheta, Vincentin, chevallier de Rhodes*, probably published in 1524 (in August of that year Pigafetta obtained leave to print his book in Venice). Of the three French MSS., two are in the Bibliothèque Nationale, Paris (5650 and 24,224 Fr.), the latter is wrongly supposed by Thomassy, followed by Lord Stanley of Alderley, to have been the copy presented by Pigafetta to the regent of France, Marie Louise of Savoy, mother of Francis I. The third French MS., often called the MS. of Nancy, first noticed by Thomassy in 1841, was bought by Sir Thomas Phillipps at Libri's sale, and became MS. Phillipps 16,405. The Italian MS. is in the Ambrosian library at Milan. From this Carlo Amoretti, prefect of the Ambrosiana. published his Italian edition of Pigafetta in 1800; a French translation of this, by Amoretti himself, was issued by H. J. Jansen, 1801. An English version of Pigafetta was made by Richard Eden in his *Decades of the Newe Worlde* (London, 1555). The earliest printed edition, apparently a summary of the Italian MS., was issued in French by Simon de Colines of Paris about 1525. The earliest Italian edition is of 1534 (or 1536).

Other authorities are: (1) The narrative of an unknown Portuguese in Ramusio's *Navigationi et viaggi*; (2) the *Derrotero* or Log-Book in the Seville Archives, supposed to be the work of Francisco Albo, *contramaestre* of Magellan's flagship, the "Trinidad": this consists mainly of nautical observations; (3) the narrative of the so-called Genoese pilot, written in excellent Portuguese, and printed in vol. iv. of the *Collecão de noticias* of the Lisbon Academy; (4) various *informaciones* and other papers in the Seville Archives, especially bearing on the mutiny; (5) the letter of Maximilian of Transylvania, under-secretary to Charles V., to the cardinal of Salzburg; (6) the references in Correa and Herrera, often based on good information, and adding points of interest to other records. Of these (1)–(3), (5), and an instance of (6) are translated in the Hakluyt Society's volume. Magellan's two wills (i) executed at Belem on the 17th of December 1504, on the eve of his departure with Almeida, (ii) executed at Seville on the 24th of August, 1519, just before starting on his voyage round the world, are both of some value for his life.

See also Lord Stanley of Alderley, *The First Voyage round the World by Magellan, translated from . . . Pigafetta, &c.*, Hakluyt Society (London, 1874); Diego de Barros Arana, *Vida e viagems de Fernão de Magalhães*, a trans. of the Spanish life by Fernando de Magalhães Villas Boas (Lisbon, 1881); F. H. H. Guillemard, *Life of Magellan* (London, 1890); *Magellan . . . the original text of the Ambrosian MS.* (of Pigafetta), with English translation, notes, bibliography, &c., by J. A. Robertson (Cleveland, U.S.A., 1906). Before the appearance of this indispensable work, the best edition of Pigafetta had been in vol. iii. part 5 of the *Raccolta di documenti e studi pubblicati nella r. commissione colombiana*, edited by Andrea da Mosto (Rome, Ministry of Public Instruction, 1894). (C. R. B.)

MAGELLANIC CLOUDS (named after Ferdinand Magellan), two cloud-like condensations of stars in the southern constellation of Mensa about 69° S. Dec. and between 5° and 5° 40′ of R. A. They are remarkable in the resemblance of their stars as regards spectra and physical constitution to the stars of the Milky Way, though entirely detached from that object.

MAGENTA, a town of Lombardy, Italy, in the province of Milan, 16 m. by rail W. of Milan city, 364 ft. about sea-level situated in the midst of rice-fields. Pop. (1901), 8012. It manufactures silks and matches, and is famous for the battle (1859) in which the allied French and Piedmontese defeated the Austrians (see ITALIAN WARS). A memorial chapel and a monument were erected on the battle-field in 1862. A crimson-purple aniline dye, discovered about the time of the battle, was given from it the name of "magenta,"

MAGGIORE, LAGO (*Lacus Verbanus* of the Romans; Fr. *Lac Majeur*; Ger. *Langensee*), the most extensive of the lakes that extend along the foot of the Alps in Lombardy, N. Italy. Its area is about 83 sq. m., its length 37 m., its greatest width 5½ m., and its greatest depth 1198 ft., while its surface is 646 ft. about sea-level. It is mainly formed by the Ticino (Tessin) River, flowing in at the north and out at the south end, on its way to join the Po, but on the west the lake receives a very important tributary, the Toce or Tosa River, which flows down through the Val d'Ossola from the mountains around the Simplon Pass. Other important affluents are the Maggia (N.W.) and the Tresa (E.). The upper end of the lake (about 16 sq. m.) is in the Swiss canton of Ticino (Tessin). Locarno, at the northern or Swiss end, is 14 m. by rail S.W. of Bellinzona on the St Gotthard line. There is a railway along the south-eastern shore, from Magadino (10½ m. S.W. of Bellinzona) to Sesto Calende (36½m.), at the southern end of the lake and 20 m. by rail from Novara. The east shore of the lake is reached at Luino by a steam tramway from Ponte Tresa on the lake of Lugano (8 m.), while the direct Simplon line runs along the west shore of the lake for 15½ m. from near Pallanza past Baveno and Stresa to Arona, which is 23 m. by rail from Novara. On the east shore are Luino (Ital. Luvino) and Laveno. On the west shore are (reckoning from N. to S.) Cannobio, Pallanza, Baveno, Stresa and Arona. Opposite (S.E.) Baveno are the famous Borromean Islands, on the largest of which (Isola Bella) are very remarkable gardens (formed about 1617), wherein many tropical plants flourish abundantly, while south-west of Baveno rises the glorious view-point of the Monte Mottarone (4892 ft.) between Lago Maggiore and the northern end of the Lake of Orta. In the morning the *tramontana* wind blows from the north down the lake, while in the afternoon the *inverna*, blowing from the south, prevails. The first steamer was placed on the lake in 1826. (W. A. B. C.)

MAGIC[1] (*i.e.* "art magic"; Lat. *ars magica*), the general term for the practice and power of wonder-working, as depending on the employment of supposed supernatural agencies. Etymologically the Gr. μαγεία meant the science and religion of the *magi*, or priests of Zoroaster, as known among the Greeks; in this sense it was opposed to γοητεία (? necromancy) and φαρμακεία (the use of drugs); but this distinction was not universally recognized, and γοητεία is often used as a synonym of μαγεία There is no general agreement as to the proper definition of "magic," which depends on the view taken of "religion."

I.—NATURE OF MAGIC

Theories of Magic.—Existing theories of magic may be classified as *objective* or *subjective.* The objective school regards magic as a thing by itself, entirely distinct from religion, recognizable by certain characteristics, and traceable to a definite psychological origin. Magic, on this view, is a system of savage science based on imaginary laws supposed to operate with the regularity ascribed to natural laws by the science of to-day. If practices prima facie magical form part of the recognized ritual of religion, it is because the older ideas have persisted and at most assumed a veneer of religion. For the subjective school, on the other hand, only those rites are magical which their practitioners qualify with the name of magic; there is no inherent quality which makes a rite magical; practices based on a belief in the law of sympathy may be religious as well as magical; rites may pass from the category of religion to that of magic when public recognition is withdrawn from them.

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[1] For what is often called "magic," but is really trick-performance, see CONJURING.

a. For E. B. Tylor the distinguishing characteristic of magic is its unreality; it is a confused mass of beliefs and practices, and their unity consists in the absence of the ordinary nexus of natural cause and effect. Under the general head of magic he distinguishes (i) a spiritual and (ii) a non-spiritual element. (i) The former is made up of such rites as involve the intervention of spiritual beings, ghosts of the dead, demons or gods; hence, in Tylor's view, this form of magic is merely an inferior branch of religion. (ii) The non-spiritual part, but for which the category of magic would be unnecessary, depends on imagined powers and correspondences in nature; it is merely imperfect reasoning, the mistaking of an ideal connexion for a real one. When the American Indian medicine man draws the picture of a deer on a piece of bark and expects that shooting at it will cause him to kill a real deer the next day, he mistakes a connexion which exists only in the mind of the sorcerer for a real bond independent of the human mind.

b. In J. G. Frazer's view all magic is based on the law of sympathy —*i.e.* the assumption that things act on one another at a distance through a secret link, due either to the fact that there is some similarity between them or to the fact that they have at one time been in contact, or that one has formed part of the other. These two branches of "sympathetic magic" Frazer denominates "homoeopathic magic" and "contagious magic." Homoeopathic or imitative (mimetic) magic may be practised by itself, but contagious magic generally involves the application of the imitative principle. (i) One of the most familiar applications of the former is the belief that an enemy may be destroyed or injured by destroying or injuring an image of him. (ii) Under the head of contagious magic are included such beliefs as that which causes the peasant to anoint the weapon with which he has been injured, which, according to Frazer, is founded on the supposition that the blood on the weapon continues to feel with the blood in the body. (iii) Implicitly Frazer seems to distinguish a third kind of magic; "the rain-charm," he says, "operates partly or wholly through the dead . . . in Halmahera there is a practice of throwing stones on a grave, in order that the ghost may fall into a passion and avenge the disturbance, as he imagines, by sending heavy rain." Here there is no assumption of an invariable course of nature set in motion by magical rites; save that it is coercive and not propitiatory, the practice does not differ from ordinary religious rites.

In his theory of the origin of magic Frazer follows the associationist school. But, as R. R. Marett has pointed out in a criticism of the associationist position, it is proved beyond question that even in the individual mind association by similarity, contiguity or contrast, is but the passive condition, the important element being interest and attention. Frazer assumes that magic has everywhere preceded religion: man tried to control nature by using what he conceived to be immutable laws; failing in this he came to believe in the existence of higher powers whom he could propitiate but not coerce; with this transformation religion appeared on the scene; the priest supplanted the magician, at least in part, and the first blows were struck in the perennial warfare of magic and religion. Frazer recognizes, however, that magical and religious rites are at the present day, and have been in historical times, frequently intermingled; it should be noted that for him religion means propitiation and that he does not recognize the existence of anything beyond magic among the aborigines of Australia. His theory is based on a selection of facts, and not on the whole body of beliefs and rites recognized as magical, among which are many wherein spirits figure. Frazer's position appears to be that such rites are relatively late and may be neglected in framing a definition of magic. It may be perfectly true that the idea of magic has been progressively extended; but belief in transformation is also for Dr Frazer magical; this belief is certainly primitive; yet sympathy will not explain it, as it should if Frazer's theory is correct.

c. L. Marillier distinguished three classes of magic: (i) the magic of the word or act; (ii) the magic of the human being, independent of rite or formula, &c.; (iii) the magic which demands at once a human being of special powers (or in a special state) and the use of certain forms. (i) Under the first head he included such rites as mimetic dances, rain-making, disease-making, and sympathetic magic generally. Some of these rites are conceived to affect the course of nature directly, as by influencing winds or the sun, others do so through the intermediary of a god or spirit, who controls the course of nature, and is himself coerced by man with magical acts and incantations. (ii) Other rites cannot be performed by all and sundry: ceremonial purity, initiation or other conditions may be needed to make the charm effective. (iii) Individuals are found who are invested with magical power (*mana*), whose will rules the universe, whose simple words bring rain or sunshine, and whose presence gives fertility to the fields. Sometimes this power is an attribute of the individual, sometimes it is bound up with the office which he fills. In many cases the magical powers of both men and other objects, animate and inanimate, are put down to the fact that a god resides in them.

d. Hubert and Mauss have made the most complete and systematic study of magic which has yet appeared. They hold that, implicitly at any rate, magic is everywhere distinguished from other systems of social facts; in order to be magical an act or belief must be common to the whole of a society; the acts which the whole of a group does not regard as efficacious are not, for this school of thought, magical: consequently the practices of gamesters, &c., do not come under the head of magic. Magic is essentially traditional; a distinguishing characteristic of primitive thought is that the individual mind is markedly unoriginal; and this feature is as prominent, if not more so, in magic as in technology or any other important element in human life. The correspondence between magic and technology can be traced far; for the gestures of the craftsman are as strictly prescribed as the ritual acts of the magician or priest: but in magic the results of the gestures are not of the same order as the results of the craftsman's movements, and herein lies the distinction between magic and technic. The distinction between magic and religion is to be sought not in the sympathetic character of the former, nor in any supposed necessary sequence of cause and effect, nor yet in its maleficent character. Religion is prescribed, official, an organized cult. Magic is prohibited, secret; at most it is permitted, without being prescribed. Three important laws may be traced in the machinery of magical operations—magical power flows along channels determined by the contiguity, similarity or contrast of the object of the act and the object to be affected; but these laws do not suffice to explain magic: equally insufficient are the demonological theory and the theory of properties inherent in the objects used in magical operations. The underlying idea of magic is dynamical; to this power may be given the name of *mana* (see below), of which sanctity is a special development. This *mana* operates in a *milieu* different from the ordinary material world; distance is no obstacle to contact; wishes are immediately realized; but law reigns in the milieu in question, necessary relations are conceived as existing. The notion of time as it is found in the world of magic is even more alien from European ideas; the notion of sanctity enters into it, but time in magic and religion is qualitative rather than quantitative. The homogeneity of periods of time not depending on their duration, conventional numbers are employed; successive periods of time apparently equal are not so for the primitive consciousness; and both in magic and religion periods are homogeneous by reason of occupying the same position in the calendar.

e. For A. Lehmann magic is the practice of superstitions, and his explanation of magic is purely psychological. Relying mainly on modern spiritualism for his examples, he traces magic back to illusions, prejudices and false precepts due to strained attention. This is ultimately also the view of Hubert and Mauss, who hold that "at the root of magic are states of consciousness which generate illusions; and that these states are not individual but collective and arise from the amalgamation of the ideas of a given person with those current in the society of which he forms a part." The reunion of a group supplies a soil in which illusions flourish readily, and it is important to note that in magic and religion attention is above all necessary for the success of a rite, witness the frequent rule imposing silence; but this concentration of attention is precisely calculated to favour illusions; it is indeed the ordinary condition of successful hypnotism; even in civilized countries collective hallucinations without verbal suggestion are not unknown.

f. R. R. Marett regards religion and magic as two forms of a social phenomenon originally one and indivisible; primitive man had an institution which dealt with the supernatural, and in this institution were the germs of both magic and religion, which were gradually differentiated; magic and religion differ in respectability; religion is always the higher, the accepted cult; but between what is definitely religious and what is definitely magical lies a mass of indeterminate elements, such as "white-magic," which do not attain to the public recognition of religion, nor suffer the condemnation meted out to the indisputably magical. For primitive man the abnormal was the supernormal, and the supernormal was the supernatural, the object of fear; this is especially evident when we consider the case of taboo; it may be regarded as a public scare for which no particular individual is responsible, which becomes traditional along fairly constant lines, growing as it goes. *Mana* was attributed to taboo objects, among which were men in any way abnormal, whether as geniuses or idiots; and such men were expected to exercise their powers for the good of society; hence came into existence the professional medicine man; man originally argued from cause to effect and not vice versa. Priest and magician were originally one; but the former, learning humility in the face of might greater than his own, discarded the spell for the prayer and prostrated himself before a higher power.

Definition of Magic.—To arrive at a definition of magic we may either follow the a priori road mapped out by Frazer and decline to recognize the distinction actually drawn by various societies between magical and religious practices; or we may ask what magic and corresponding terms actually connote. Frazer's method ignores the fact that magic, like religion, is an institution, *i.e.* a product of society, not of any single individual; there is no more reason to suppose that a child reared in isolation would develop any kind of magical practices than that it would invent for itself a religion; but if this is the case, the associationist account of magic cannot be true. It is therefore by an analysis of actually existing practices that we must define and limit the term magic. There is, however, a serious difficulty in the way of determining the attitude of non-European peoples towards religio-magical practices; general terms are things of slow growth; it is therefore prima facie improbable that peoples in the lower stages of culture will have anything corresponding to our terms "religion" and "magic"; moreover, if we are right in assuming the fundamental unity of the two, it is by no means certain that they have even the consciousness of any distinction. Even when this consciousness is present, it by no means follows that the whole of the field is mapped out according to our categories; there will be a large indeterminate area which is neither magical nor religious. This suggests that the consciousness of the educated Occidental, for which the spheres of magic and religion in civilized society are sharply defined and contrasted, should be the ultimate arbiter; but here again we are confronted by a difficulty, for, to the educated man, the characteristic of magic is its unreality, and this does not help us to distinguish primitive magic and religion.

We must, it appears, determine the relation of magic to religion by an analysis of the conceptions of those who believe in both; but in so doing we must consider that, like all other institutions, magic has a history. Even if we go back to the 16th century and take the view of magic then held by the average European, it is still a complex idea. When we ask what the most primitive races now on the earth regard as magic, we are applying to their ideas a touchstone made for a very different age and culture; as well might we ask what their theory of knowledge is. If, however, we reverse the process and ask what elements of primitive institutions correspond most nearly to later conceptions of magic, we can at once say that the forbidden and private arts are the prototypes of the magic of later times. Magic is therefore the practice of maleficent arts which involve the use of religio-magical power, with perhaps a secondary idea of the use of private arts, which are to benefit, not the community as a whole, but a single individual. Religion in the lower stages of culture is essentially the tribal creed which all practise and in which all believe; if therefore an individual has a cult of his own, even if otherwise indistinguishable from a public cult, it is for this very reason on a lower plane, and probably corresponds in a degree to what is later regarded as magic. But our information as to the attitude of the uncivilized towards magico-religious rites in general is seldom sufficiently clear; our terminology is influenced by the prepossession of alien observers whose accounts cannot be assumed to correspond to the native view of the case.

Magico-religious Force.—The mere fact that we cannot draw an exact line between magic and religion suggests that they may have some fundamental feature in common. Both terms have greatly changed their connotation in the course of their existence; *religio* seems to have meant originally καταδεσμός (magical spell), and Pliny says that μαγεια is a deceptive art compounded of medicine, religion and astrology. Among the Greeks, on the other hand, μαγεία occupied a respectable position. More important is the fact that taboo (*q.v.*) is both religious and magical. There is a universal tendency to regard as magical the religions of alien races, as well as national religions which have been superseded; Leland tells us that witchcraft in Italy is known as *la vecchia religione*. An examination of the ideas of primitive peoples shows that there is a widely found notion of a power which manifests itself both in religion and magic. Observers have often been content to describe ceremonies without attempting to penetrate to the fundamental ideas which underlie them; this is particularly the case with magic, and only recently have anthropologists realized that in many primitive societies exists a fairly well-defined idea of magico-religious power, to which the generic name of *mana*, from the Melanesian word, has been given.

a. *Mana* in Melanesia is a force, a being, an action, a quality, or a state; it is transmissible and contagious, and is hence associated with taboo; it may be regarded as material and seen in the form of flames or heard; it is the power which is inherent in certain spirits, among which are included such of the dead as are denominated *tindalos*; it may also be a force inherent in some inanimate object, such as a stone which causes the yams to grow, but it is a spiritual force and does not act mechanically; it is the power of the magician and of the rite; the magic formula is itself *mana*. There seem to be a variety of *manas*, but probably the underlying idea is essentially one, though it does not follow that the Melanesians have arrived at the consciousness of this unity. Hubert and Mauss go even further and regard all force as *mana*; it is a quality added to objects without prejudice to their other qualities, one which supplements without destroying their mechanical action.

b. Similar ideas are found in other areas. (i) The continental Malays have a word *Kramât* (*hrm*), which means sacred or magical; in Indo-China the Bahnars use the word *deng*; in Madagascar *hasina* seems to embody in part the same notion. (ii) In Africa the idea is less apparent; perhaps the *ngai* of the Tanganika tribes comes nearest to the notion of *mana*; on the Congo *nkici* has a similar but more restricted sense. (iii) In Australia there are two, or perhaps three, kinds of magical power distinguished by the aborigines; all over the continent we find the maleficent power, *boolya* in West Australia, *arungquiltha* in the central tribes, *koochie* in New South Wales; the central tribes have certain objects termed *churinga*, to which magical power (which we may term *churinga*) is attributed; the power of magicians is held to reside in certain stones, called *atnongara*, and in this we must, provisionally at any rate, see a third kind of magical power: *churinga* is beneficent and seems to originate with the mythical ancestors, whereas *arungquiltha* is of immediate origin, created by means of incantations or acquired by contact with certain objects; the power of the magicians seems to proceed from the ancestors in like manner. (iv) In America these ideas are widely found; the *orenda* of the Hurons has been elaborately described by J. N. B. Hewitt; everything in nature, and particularly all animate objects, have their *orenda*; so have gods and spirits; and natural phenomena are the product of the *orenda* of their spirits. *Orenda* is distinct from the things to which it is attached; the cry of birds, the rustle of the trees, the soughing of the wind, are expressions of their *orenda*; the voice of the magician is *orenda*, so are the prayer and the spell, and in fact all rites; *orenda* is above all the power of the medicine man. Among the Algonquins we find the word *manitu*, among the Sioux *wakanda*, *mahowa*, &c., among the Shoshones *pokunt*; all of which seem to carry, at least in part, the same signification. In Central America, according to Hubert and Mauss, *naual* or *nagual* is the corresponding term. (v) Traces of similar ideas may be found in more advanced nations; the Hindu *brahman* is identified by Hubert and Mauss as the correlative of *mana*; in Greece φύσις is possibly the echo of a similar idea; but we are yet far from having adequately fathomed the dynamical theories of pre-scientific days.

Origin of Magic.—The associationist theory of magic sets out with the assumption that primitive man began with general conceptions; he started with certain means at his disposal—the law of sympathy—by which he could, in his own belief, influence the outer world. But it is more probable that he argued from concrete instances and arrived little by little at abstract ideas of magical power.

a. Death and disease are universally regarded by uncivilized people as due to so-called "magic," *i.e.* to non-natural causes. Primitive man was familiar with the wounds and bruises caused by physical means; he would naturally attribute any pain not so caused to the operation of analogous but invisible weapons, and eventually attempt to discover how he himself could apply on his own behalf the forces thus used against him. Similarly he may have asked himself to what causes were to be attributed the superiority of one man over another; he may have decided the problem by referring it to the superior power of the one, and then inquired in what way this power could in individual instances be increased. In fact we may say generally that man probably explained the already existing and happening by reference to the supernormal, and then endeavoured to guide the supernormal for his own benefit, direct or indirect.

b. Ritual, however (the primitive magico-religious plasm), is negative as well as positive. The corpse is uncanny, and man's dread of the corpse may well have been an early development; this dread, become traditional, with accretions of various sorts, crystallized into *taboo*, the magico-religious prohibition. The notion of the uncanny, once arrived at, may have been exploited positively; psychical abnormalities are present among savage races in very different degrees; but if they were developed at an early stage in human history they doubtless suggested the possibility that man might exploit them for the collective advantage. But it by no means follows that beneficent rites were originally regarded as magical; and it should be noted that the initiator of the so-called magician in Australia is often the god of the tribe or nation. The limits of magic or its correlatives in the lower stages of culture are thus far undecided.

c. Magic as it represents itself to the Occidental mind of the present day, and perhaps to the great part of the inhabitants of the world, seems to be a thing of gradual growth. (i) In the earlier stages there was probably no animistic feature about magic; it was essentially "the prohibited." (ii) Then with the rise of animistic beliefs and practices came the association of the magician with demons—the spirits of the dead, or of animals, or unattached spirits—upon whose co-operation the powers of the magician are often now held to depend. These spirits were not in the position of gods; such recognition, worship, or cult as they received was often not a social institution, but the work of individuals, liable to fall into desuetude at the death of the individual, if not earlier. (iii) Again, the magical tends to be the less important and eventually the less respectable; therefore ancient cults which are conquered, like the religion of Rome by Christianity, come to be reckoned as within the sphere of magic and witchcraft. (iv) All non-animistic practices tend to become *ipso facto* magical; many ritual prohibitions fall under the head of negative magic. Religion is predominantly animistic, and with the rise of gods magic and religion become antagonistic. Thus rites of a neutral character, such as leechcraft, and perhaps agricultural ceremonies which are not absorbed by religion, tend to acquire the reputation of being magical, as also do all amulets and talismans, and, in fact, everything not directly associated with religion. We therefore arrive at a period when magic is distinguished as *white*, *i.e.* the laudable, or at least permitted form, and *black*, *i.e.* the prohibited form.

Magic and Demonology.—Primitive psychology tends to anthropomorphize and personify; it is in many of its stages inclined to an animistic philosophy. To this is due in part the difficulty of distinguishing magic from religion. In many rites there is no obvious indication that a spirit or personal being is concerned. A portion of the ceremonies in which the spirits of the dead are concerned falls under the head of religion (see ANCESTOR WORSHIP), but in the very name "necromancy" (νεκρος, corpse) lies an implication of magic; and dealings with the departed are viewed in this light in many parts of the world, sometimes concurrently with a cult of ancestors. Side by side with the human souls we find demons (see DEMONOLOGY); but on the whole only a small proportion of the world of spirits is recognized as powerful in magic; others, such as disease-spirits, are objects, not sources, of magical influence. Magic is sometimes made to depend upon the activity of demons and spirits, and it is true that the magician usually if not invariably has a spirit helper, often an animal; but there is no evidence that magical power had ever been confined to those who are thus aided. It is not easy to define the relation of fetishism (*q.v.*) to magic.

Magic and Science.—It is a commonplace that the sciences have developed from non-scientific beginnings; the root of astronomy is to be sought in astrology (*q.v.*), of chemistry in alchemy (*q.v.*), of leechcraft in the practices of the savage magician, who depends for much of his success on suggestion, conscious or unconscious, but also relies on a pharmacopeia of no mean extent. The dynamical theory of magic and religion brings primitive man from one point of view far nearer to the modern man of science than was previously suspected, we may fairly say that the Australians have an idea not unlike that of the transformation and conservation of energy, that this energy they store in accumulators, transmit by means of conductors, and so on. The discovery of these complicated ideas only serves to show how far the present-day peoples in the lower stages of culture have travelled from the primitive man who knew neither magic nor religion. But it is perhaps less in respect of abstract ideas than by its concrete investigations into properties, experiment and otherwise that magic has been the forerunner of science.

Magic and Divination.—Magic is an attempt to influence the course of events, divination (*q.v.*) to foresee them; but divination is frequently regarded as magical. It is certain that a large part of divination is religious, and the knowledge is explained as a message from the gods; but necromancy, the practice of discovering the future by consulting the dead, is in many respects essentially magical. Perhaps the magical character of divination may be in part explained, when we regard it as a group of practices in many varieties of which animism plays no part; for non-animistic ceremonies tend to be regarded as magical (cf. rain-making). Thus, heteroscopic divination seems to involve the idea of what may be termed a return current of magico-religious force; the event is not influenced, but itself determines the issue of the diviner's experiment.

II.—LAWS AND RITUAL OF MAGIC

The practice of magic involves the belief in the operation of certain laws, and demands certain conditions. The number of positive rites is not unlimited; a certain rite tends to become stable and is finally used for all sorts of purposes; and each magician tends to specialize in this respect. Just as there are well-marked schools of magic, and the rain-maker is not the same as the fetish-man, so within the school there are various groups, differentiated not by the purposes at which they aim nor by the powers they claim to possess, but by the ceremonies which they practise. Chief among the laws lying at the base of magical practice is that of sympathy.

Sympathy.—That the law of sympathy is an essential element of magic is admitted equally by the associationist school and by its critics. Under the head of sympathy are embraced the laws of contiguity or contagion, of similarity or homoeopathy, and of contrariety or antipathy.

a. In its simplest form the law of contiguity asserts that whatever has once formed part of a body continues to form part of it or to represent it for magical purposes; thus, by obtaining possession of the parings of a person's nails, or the clippings of his hair, and by working magic upon them, it is held to be possible to produce on the actual human body the effects which are in reality produced on the object of the magical rite. As is clear by the well-known case of the "life index," the current of magical power may pass in either direction; if the life of a man is supposed to be bound up with the life of a tree, so that any injury to the tree reacts on the man, it is equally believed that the death of the man will not fail to be manifest by the state of the tree. In particular this sympathetic relation is predicated of wizards or witches and their animal familiars; it is then known by the name of "repercussion." It is not only upon parts of the body that contagious magic can be worked; anything which has been in contact with the body, such as clothes, anything which has been in part assimilated by the body, such as the remains of food, and even representations of the body or of parts of it such as footprints, &c., may be used as objects of magical rites, in order to transmit to the human being some influence, maleficent or otherwise. The contact demanded may be actual, or mediate, for in Australia it suffices to connect the magician and his patient by a thread in order that the disease may be removed. (i) The use of clothes for magical purposes gives us perhaps the clue to the wide-spread custom of "rag-trees"; in nearly every part of the world it is the practice to suspend wool or rags to trees associated with some spirit, or, in Christian countries, with some saint, in order to reap a benefit; similarly nails are driven into trees or images; pins are dropped into wells, stones are cast upon cairns, and missiles aimed at various holy objects; but it cannot be assumed that the same explanation lies at the root of the whole group of practices. (ii) This law may perhaps be taken as the explanation of the "couvade"; in many parts of the world relatives, and in particular the father of a new-born child, are compelled to practise various abstinences, in order that the health of the child may not be affected, membership of the same family therefore establishes a sympathetic relation. (iii) In this direct transference of qualities is exemplified another magical process, which may also be referred to the operation of the law of sympathy; it is a world-wide belief that the assimilation of food involves the transference to the eater of the qualities, or of some of them, inherent in the source of the food; a South African warrior, for example, may not eat hedgehog, because the animal is held to be cowardly and the eater would himself become a coward; on the other hand, the flesh of lions is fit meat for brave men, because they at the same time transfer its courage to themselves.

b. The law of homoeopathy takes two forms. (i) The magician may proceed on the assumption that like produces like; he may, for example, take an image of wax or wood, and subject it to heat or other influences under the belief that it represents the human being against whom his malefice is directed, and that without any contact, real or pretended; so that any results produced on the image, which may be replaced by an animal or a portion of one, are equally produced in the human being. There need not even be any resemblance between the representation and the person or thing represented; a pot may serve to represent a village; hence step by step we pass from the representation to the symbol. (ii) The law of homoeopathy also manifests itself in the formula *similia similibus curantur*; the Brahman in India treated dropsy with ablutions, not in order to add to, but to subtract from, the quantity of liquid in the patient's body. So, too, the yellow turmeric was held to be a specific for jaundice.

c. Here we approach the third class of sympathetic rites; it is clear that a remedy produces the contrary, when it cures the like; conversely, like by producing like expels its contrary.

Some statements of the law of sympathy suggest that it is absolute in its application. It is true that the current of magical power is sometimes held to be transmitted along lines indicated by the law of sympathy, without the intervention of any volition, human or otherwise; thus, the crow which carries stray hairs away to weave them into the structure of its nest is nowhere supposed to be engaged in a magical process; but it is commonly held that the person whose hair is thus used will suffer from headache or other maladies; this seems to indicate that the law of sympathy operates mechanically in certain directions, though the belief may also be explained as a secondary growth. In general the operation of these laws is limited in the extreme. For example, the medieval doctrine known as the Law of Signatures asserted that the effects of remedies were correlated to their external qualities; bear's grease is good for baldness, because the bear is a hairy animal. But the transference was held to terminate with the acquisition by the man of this single quality; in some magical books powdered mummy is recommended as a means of prolonging life, but it is simply the age of the remedy which is to benefit the patient; the magician who removes a patient's pains or diseases does not transfer them to himself; the child whose parents eat forbidden foods is held to be affected by their transgression, while they themselves come off unharmed. The magical effects are limited by exclusive attention and abstraction; and this is true not only of the kind of effect produced but also as to the direction in which it is held to be produced.

The Magic of Names.—For primitive peoples the name is as much a part of the person as a limb; consequently the magical use of names is in some of its aspects assimilable to the processes dependent on the law of sympathy. In some cases the name must be withheld from any one who is likely to make a wrong use of it, and in some parts of the world people have secret names which are never used. Elsewhere the name must not be told by the bearer of it, but any other person may communicate it without giving an opening for the magical use of it. Not only human beings but also spirits can be coerced by the use of their names; hence the names of the dead are forbidden, lest the mention of them act as an evocation, unintentional though it be. Even among more advanced nations it has been the practice to conceal the real name of supreme gods; we may probably explain this as due to the fear that an enemy might by the use of them turn the gods away from those to whom they originally belonged. For the same reason ancient Rome had a secret name.

Magical Rites.—The magic of names leads us up to the magic of the spoken word in general. The spell or incantation and the magical act together make up the rite. (*a*) The manual acts are very frequently symbolic or sympathetic in their nature; sometimes they are mere reversals of a religious rite; such is the marching against the sun (known as *widdershins* or *deisul*); sometimes they are purificatory; and magic has its sacrifices just as much as religion. (*b*) There are many types of oral rites; some of the most curious consist in simply reciting the effect intended to be produced, describing the manual act, or, especially in Europe, telling a mythical narrative in which Christ or the apostles figure, and in which they are represented as producing a similar effect to the one desired; in other cases the "origin" of the disease or maleficent being is recited. Oral rites, which are termed spells or incantations, correspond in many cases to the oral rites of religion; they, like the manual rites, are a heterogeneous mass and hardly lend themselves to classification. Some formulae may be termed sympathetic; it suffices to name the result to be produced in order to produce it; but often an incantation is employed, not to produce a result directly, but to coerce a god or other being and compel him to fulfil the magician's will. The language of the incantations often differs from that of daily life; it may be a survival of archaic forms or may be a special creation for magical purposes. In many languages the word used to express the idea of magic means an act, a deed; and it may be assumed that few if any magical ceremonies consist of formulae only; on the other hand, it is certain that no manual act in magic stands absolutely alone without oral rite; if there is no spoken formula, there is at least an unspoken thought. It is in many cases difficult to discover the relative proportions and importance of manual and oral acts. Not only the words but also the tone are of importance in magic; in fact, the tone may be the more important. Rhythm and repetition are no less necessary in oral than in manual acts. (*c*) As preliminaries, more seldom as necessary sequels to the central feature of the rite, manual or oral, we usually find a certain number of accessory observances prescribed, which find their parallel in the sacrificial ritual. For example, it is laid down at what time of year, at what period of the month or week, at what hour of the day a rite must be performed; the waxing or waning of the moon must be noted; and certain days must be avoided altogether. Similarly, certain places may be prescribed for the performance of the ritual; often the altar of the god serves magical purposes also; but elsewhere it is precisely the impure sites which are devoted to magical operations—the cemeteries and the cross roads. The instruments of magic are in like manner often the remains of a sacrifice, or otherwise consecrated by religion; sometimes, especially when they belong to the animal or vegetable world, they must be sought at certain seasons, May Day, St George's Day, Midsummer Day, &c. The magician and his client must undergo rites of preparation and the exit may be marked by similar ceremonies.

Magicians.—Most peoples know the professional worker of magic, or what is regarded as magic. (*a*) In most if not all societies magic, or certain sorts of it, may be performed by any one, so far as we can see, who has mastered the necessary ritual; in other cases the magician is a specialist who owes his position to an accident of birth (seventh son of a seventh son); to simple inheritance (families of magicians in modern India, rain-makers in New Caledonia); to revelation from the gods or the spirits of the dead (Malays), showing itself in the phenomena of possession; or to initiation by other magicians. (*b*) From a psychical point of view it may probably be said that the initiation of a magician corresponds to the "development" of the modern spiritualistic medium; that is to say, that it resolves itself into exercises and rites which have for their object the creation or evolution of a secondary personality. From this point of view it is important to notice that certain things are forbidden to magicians under pain of loss of their powers; thus, hot tea is taboo to the Arunta medicine man; and if this seems unlikely to cause the secondary personality to disappear, it must be remembered that to the physiological effects, if any, must be added the effects of suggestion. Of this duplication of personality various explanations are given; in Siberia the soul of the *shaman* is said to wander into the other world, and this is a widely spread theory; where the magician is supposed to remain on earth, his soul is again believed to wander, but there is an alternative explanation which gives him two or more bodies. Here we reach a point at which the familiar makes its appearance; this is at times a secondary form of the magician, but more often is a sort of life index or animal helper (see LYCANTHROPY); in fact, the magician's power is sometimes held to depend on the presence—that is, the independence—of his animal auxiliary. Concurrent with this theory is the view that the magician must first enter into a trance before the animal makes its appearance, and this makes it a double of the magician, or, from the psychological point of view, a phase of secondary personality. (*c*) In many parts of the world magical powers are associated with the membership of secret societies, and elsewhere the magicians form a sort of corporation; in Siberia, for example, they are held to be united by a certain tie of kinship; where this is not the case, they are believed, as in Africa at the present day or in medieval Europe, to hold assemblies, so-called witches' Sabbaths; in Europe the meetings of heretics seem to be responsible for the prominence of the idea if not for its origin (see WITCHCRAFT). The magician is often regarded as possessed (see POSSESSION) either by an animal or by a human or super-human spirit. The relations of priest and magician are for various reasons complex; where the initiation of the magician is regarded as the work of the gods, the magician is for obvious reasons likely to develop into a priest, but he may at the same time remain a magician; where a religion has been superseded, the priests of the old cult are, for those who supersede them, one and all magicians; in the medieval church, priests were regarded as especially exposed to the assaults of demons, and were consequently often charged with working magic. The great magicians who are gods rather than men—*e.g.* kings of Fire and Water in Cambodia—enjoy a reverence and receive a cult which separates them from the common herd, and assimilates them to priests rather than to magicians. The function of the so-called magician is often said to be beneficent; in Africa the witch-doctor's business is to counteract evil magic; in Australia the magician has to protect his own tribe against the assaults of hostile magicians of other tribes; and in Europe "white magic" is the correlative of this beneficent power; but it may be questioned how far the beneficent virtue is regarded as magical outside Europe.

Talismans and Amulets.—Inanimate objects as well as living beings are credited with stores of magical force; when they are regarded as bringing good, *i.e.* are positive in their action, they may be termed "talismans"; "amulets" are protective or negative in their action, and their function is to avert evil; a single object may serve both purposes. Broadly speaking, the fetish, whose "magical" properties are due to association with a spirit, tends to become a talisman or amulet. The "medicine" of the Red Indian, originally carried as means of union between him and his *manito*, is perhaps the prototype of many European charms. In other cases it is some specific quality of the object or animal which is desired; the boar's tusk is worn on the Papuan Gulf as a means of imparting courage to the wearer; the Lukungen Indians of Vancouver Island rub the ashes of wasps on the faces of their warriors, in order that they may be pugnacious. Some Bechuanas wear a ferret as a charm, in the belief that it will make them difficult to kill, the animal being very tenacious of life. Among amulets may be mentioned horns and crescents, eyes or their representations, and grotesque figures, all of which are supposed to be powerful against the Evil Eye (*q.v.*).

Tylor has shown that the brass objects so often seen on harness were originally amuletic in purpose, and can be traced back to Roman times. Some amulets are supposed to protect from the evil eye simply by attracting the glance from the wearer to themselves, but, as a rule, magical power is ascribed to them.

Evil Magic.—The object of "black" magic is to inflict injury, disease, or death on an enemy, and the various methods employed illustrate the general principles dealt with above and emphasize the conclusion that magic is not simply a matter of sympathetic rites, but involves a conception of magical force. (*a*) It has been mentioned that contagious magic makes use of portions of a person's body; the Cherokee magician follows his victim till he spits on the ground; collecting the spittle mingled with dust on the end of a stick, the magician puts it into a tube made of a poisonous plant together with seven earth worms, beaten into a paste, and splinters of a tree blasted by lightning; the whole is buried with seven yellow stones at the foot of a tree struck by lightning, and a fire is built over the spot; the magician fasts till the ceremony is over. Probably the worms are supposed to feed on the victim's soul, which is said to become "blue" when the charm works; the yellow stones are the emblem of trouble, and lightning-struck trees are reputed powerful in magic. If the charm does not work, the victim survives the critical seven days, and the magician and his employer are themselves in danger, for a charm gone wrong returns upon the head of him who sent it forth. (*b*) In homoeopathic magic the victim is represented by an image or other object. In the Malay Peninsula the magician makes an image like a corpse, a footstep long. "If you want to cause sickness, you pierce the eye and blindness results; or you pierce the waist and the stomach gets sick. If you want to cause death, you transfix the head with a palm twig; then you enshroud the image as you would a corpse and you pray over it as if you were praying over the dead; then you bury it in the middle of the path which leads to the place of the person whom you wish to charm, so that he may step over it." Sometimes the wizard repeats a form of words signifying that not he but the Archangel Gabriel is burying the victim; sometimes he exclaims, "It is not wax I slay but the liver, heart and spleen of So-and-so." Finally, the image is buried in front of the victim's doors. (*c*) Very widespread is the idea that a magician can influence his victim by charming a bone, stick or other object, and then projecting the magical influence from it. It is perhaps the commonest form of evil magic in Australia; in the Arunta tribe a man desirous of using one of these pointing sticks or bones goes away by himself into the bush, puts the bone on the ground and crouches over it, muttering a charm: "May your heart be rent asunder." After a time he brings the *irna* back to the camp and hides it; then one evening after dark he takes it and creeps near enough to see the features of his victim; he stoops down with the *irna* in his hand and repeatedly jerks it over his shoulder, muttering curses all the time. The evil magic, *arungquiltha*, is said to go straight to the victim, who sickens and dies without apparent cause, unless some medicine-man can discover what is wrong and save him by removing the evil magic. The *irna* is concealed after the ceremony, for the magician would at once be killed if it were known that he had used it. (*d*) Magicians are often said to be able to assume animal form or to have an animal familiar. They are said to suck the victim's blood or send a messenger to do so; sometimes they are said to steal his soul, thus causing sickness and eventually death. These beliefs bring the magician into close relation with the werwolf (see LYCANTHROPY).

Rain-making.—In the lower stages of culture rain-making assumes rather the appearance of a religious ceremony, and even in higher stages the magical character is by no means invariably felt. It will, however, be well to notice some of the methods here. (*a*) Among the Dieri of Central Australia the whole tribe takes part in the ceremony; a hole is dug, and over this a hut is built, large enough for the old men; the women are called to look at it and then retire some five hundred yards. Two wizards have their arms bound at the shoulder, the old men huddle in the hut, and the principal wizard bleeds the two men selected by cutting them inside the arm below the elbow. The blood is made to flow on the old men, and the two men throw handfuls of down into the air. The blood symbolizes the rain; the down is the clouds. Then two large stones are placed in the middle of the hut; these two represent gathering clouds. The women are again summoned, and then the stones are placed high in a tree; other men pound gypsum and throw it into a water-hole; the ancestral spirits are supposed to see this and to send rain. Then the hut is knocked down, the men butting at it with their heads; this symbolizes the breaking of the clouds, and the fall of the hut is the rain. If no rain comes they say that another tribe has stopped their power or that the *Mura-mura* (ancestors) are angry with them. (*b*) Rain-making ceremonies are far from uncommon in Europe. Sometimes water is poured on a stone; a row of stepping-stones runs into one of the tarns on Snowdon, and it is said that water thrown upon the last one will cause rain to fall before night. Sometimes the images of saints are carried to a river or a fountain and ducked or sprinkled with water in the belief that rain will follow; sometimes rain is said to ensue when the water of certain springs is troubled; perhaps the idea is that the rain-god is disturbed in his haunts. But perhaps the commonest method is to duck or drench a human figure or puppet, who represents in many instances the vegetation demon. The gipsies of Transylvania celebrate the festival of "Green George" at Easter or on St George's Day; a boy dressed up in leaves and blossoms is the principal figure; he throws grass to the cattle of the tribe, and after various other ceremonies a pretence is made of throwing him into the water; but in fact only a puppet is ducked in the stream.

Negative Magic.—There is also a negative side to magic, which, together with ritual prohibitions of a religious nature, is often embraced under the name of taboo (*q.v.*); this extension of meaning is not justified, for taboo is only concerned with sacred things, and the mark of it is that its violation causes the taboo to be transmitted. All taboos are ritual prohibitions, but all ritual prohibitions are not taboos; they include also (*a*) interdictions of which the sanction is the wrath of a god; these may be termed religious interdictions; (*b*) interdictions, the violation of which will automatically cause some undesired magico-religious effect; to these the term negative magic should be restricted, and they might conveniently be called "bans"; they correspond in the main to positive rites and are largely based on the same principles.

(*a*) Certain prohibitions, such as those imposed on totem kins, seem to occupy an intermediate place; they depend on the sanctity of the totem animal without being taboos in the strict sense; to them no positive magical rites correspond, for the totemic prohibition is clearly religious, not magical.

(*b*) Among cases of negative magic may be mentioned (i.) the couvade, and prohibitions observed by parents and relatives generally; this is most common in the case of young children, but a sympathetic relation is held to exist in other cases also. In Madagascar a son may not eat fallen bananas, for the result would be to cause the death of his own father; the sympathy between father and son establishes a sympathy between the father and objects touched or eaten by the son, and, in addition, the fall of the bananas is equated with the death of a human being. Again, the wife of a Malagasy warrior may not be faithless to him when he is absent; if she is, he will be killed or wounded. Ownership, too, may create a sympathetic relation of this kind, for it is believed in parts of Europe that if a man kills a swallow his cows will give bloody milk. In some cases it is even harder to see how the sympathetic bond is established; some Indians of Brazil always hamstring animals before bringing them home, in the belief that by so doing they make it easier for themselves and their children to run down their enemies, who are then magically deprived of the use of their legs. These are all examples of negative magic with regard to persons, but things may be equally affected; thus in Borneo men who search for camphor abstain from washing their plates for fear the camphor, which is found crystallized in the crevices of trees, should dissolve and disappear. (ii.) Rules which regulate diet exist not only for the benefit of others but also for that of the eater. Some animals, such as the hare, are forbidden, just as others, like the lion, are prescribed; the one produces cowardice, while the other makes a man's heart bold. (iii.) Words may not be used; Scottish fishermen will not mention the pig at sea; the real names of certain animals, like the bear, may not be used; the names of the dead may not be mentioned; a sacred language must be used, *e.g.* camphor language in the Malay peninsula, or only words of good omen (cf. Gr. εὐφημεῖτε); or absolute silence must be preserved. Personal names are concealed; a man may not mention the names of certain relatives, &c. There are customs of avoidance not only as to (iv.) the names of relatives, but as to the persons themselves; the mother-in-law must avoid the son-in-law, and vice versa; sometimes they may converse at a distance, or in low tones, sometimes not at all, and sometimes they may not even meet. (v.) In addition to these few classes selected at random, we have prohibitions relating to numbers (cf. unlucky thirteen, which is, however, of recent date), the calendar (Friday as an unlucky day, May as an unlucky month for marriage), places, persons, orientation, &c; but it is impossible to enumerate even the main classes. The individual origin of such beliefs, which with us form the superstitions of daily life but in a savage or semi-civilized community play a large part in regulating conduct, is often shrouded in darkness; the meaning of the positive rite is easily forgotten; the negative rite persists, but it is observed merely to avoid some unknown misfortune. Sometimes we can, however, guess at the meaning of our civilized notions of ill luck; it is perhaps as a survival of the savage belief that stepping over a person is injurious to him that many people regard going under a ladder as unlucky; in the one case the luck is taken away by the person stepping over, in the other left behind by the person passing under.

History of Magic.—The subject is too vast and our data are too slight to make a general sketch of magic possible. Our knowledge of Assyrian magic, for example, hardly extends beyond the rites of exorcism; the magic of Africa is most inadequately known, and only in recent years have we well-analysed repertories of magical rituals from any part of the world. For certain departments of ancient magic, however, like the Pythagorean philosophy, there is no lack of illustrative material; it depended on mystical speculations based on numbers or analogous principles. The importance of numbers is recognized in the magic of America and other areas, but the science of the Mediterranean area, combined with the art of writing, was needed to develop such mystical ideas to their full extent. Among the neo-Platonists there was a strong tendency to magical speculation, and they sought to impress into their service the demons with which they peopled the universe. Alexandria was the home of many systems of theurgic magic, and gnostic gems afford evidence of the nature of their symbols. In the middle ages the respectable branches of magic, such as astrology and alchemy, included much of the real science of the period; the rise of Christianity introduced a new element, for the Church regarded all the religions of the heathen as dealings with demons and therefore magical (see WITCHCRAFT). In our own day the occult sciences still find devotees among the educated; certain elements have acquired a new interest, in so far as they are the subject matter of psychical research (*q.v.*) and spiritualism (*q.v.*). But it is only among what are regarded as the lower classes, and in England especially the rural population, that belief in its efficacy still prevails to any large extent.

Psychology of Magic.—The same causes which operated to produce a belief in witchcraft (*q.v.*) aided the creed of magic in general. Fortuitous coincidences attract attention; the failures are disregarded or explained away. Probably the magician is never wholly an impostor, and frequently has a whole-hearted belief in himself; in this connexion may be noted the fact that juggling tricks have in all ages been passed off as magical; the name of "conjuring" (*q.v.*) survives in our own day, though the conjurer no longer claims that his mysterious results are produced by demons. It is interesting to note that magical leechcraft depended for its success on the power of suggestion (*q.v.*), which is to-day a recognized element in medicine; perhaps other elements may have been instrumental in producing a cure, for there are cases on record in which European patients have been cured by the apparently meaningless performances of medicine-men, but an adequate study of savage medicine is still a desideratum.

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(N. W. T.)

MAGIC SQUARE, a square divided into equal squares, like a chess-board, in each of which is placed one of a series of consecutive numbers from 1 up to the square of the number of cells in a side, in such a manner that the sum of the numbers in each row or column and in each diagonal is constant.

From a very early period these squares engaged the attention of mathematicians, especially such as possessed a love of the marvellous, or sought to win for themselves a superstitious regard. They were then supposed to possess magical properties, and were worn, as in India at the present day, engraven in metal or stone, as amulets or talismans. According to the old astrologers, relations subsisted between these squares and the planets. In later times such squares ranked only as mathematical curiosities; till at last their mode of construction was systematically investigated. The earliest known writer on the subject was Emanuel Moscopulus, a Greek (4th or 5th century). Bernard Frenicle de Bessy constructed magic squares such that if one or more of the encircling bands of numbers be taken away the remaining central squares are still magical. Subsequently Poignard constructed squares with numbers in arithmetical progression, having the magical summations. The later researches of Phillipe de la Hire, recorded in the *Mémoires de l'Académie Royale* in 1705, are interesting as giving general methods of construction. He has there collected the results of the labours of earlier pioneers; but the subject has now been fully systematized, and extended to cubes.

200	217	232	249	8	25	40	57	72	89	104	121	136	153	168	185
58	39	26	7	250	231	218	199	186	167	154	135	122	103	90	71
198	219	230	251	6	27	38	59	70	91	102	123	134	155	166	187
60	37	28	5	252	229	220	197	188	165	156	133	124	101	92	69
201	216	233	248	9	24	41	56	73	88	105	120	137	152	169	184
55	42	23	10	247	234	215	202	183	170	151	138	119	106	87	74
203	214	235	246	11	22	43	54	75	86	107	118	139	150	171	182
53	44	21	12	245	236	213	204	181	172	149	140	117	108	85	76
205	212	237	244	13	20	45	52	77	84	109	116	141	148	173	180
51	46	19	14	243	238	211	206	179	174	147	142	115	110	83	78
207	210	239	242	15	18	47	50	79	82	111	114	143	146	175	178
49	48	17	16	241	240	209	208	177	176	145	144	113	112	81	80
196	221	228	253	4	29	36	61	68	93	100	125	132	157	164	189
62	35	30	3	254	227	222	195	190	163	158	131	126	99	94	67
194	223	226	255	2	31	34	63	66	95	98	127	130	159	162	191
64	33	32	1	256	225	224	193	192	161	160	129	128	97	96	65

FIG. 1.

Two interesting magical arrangements are said to have been given by Benjamin Franklin; these have been termed the "magic square of squares" and the "magic circle of circles." The first (fig. 1) is a square divided into 256 squares, *i.e.* 16 squares along a side, in which are placed the numbers from 1 to 256. The chief properties of this square are (1) the sum of the 16 numbers in any row or column is 2056; (2) the sum of the 8 numbers in half of any row or column is 1028, *i.e.* one half of 2056; (3) the sum of the numbers in two half-diagonals equals 2056; (4) the sum of the four corner numbers of the great square and the four central numbers equals 1028; (5) the sum of the numbers in any 16 cells of the large square which themselves are disposed in a square is 2056. This square has other curious

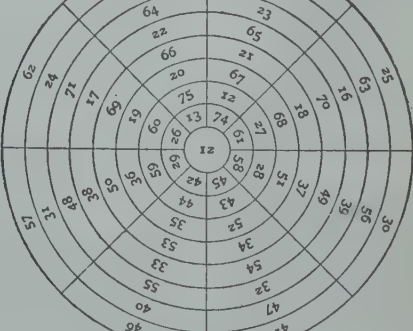

FIG. 2.

properties. The "magic circle of circles" (fig. 2) consists of eight annular rings and a central circle, each ring being divided into eight cells by radii drawn from the centre; there are therefore 65 cells. The number 12 is placed in the centre, and the consecutive numbers 13 to 75 are placed in the other cells. The properties of this figure include the following: (1) the sum of the eight numbers in any ring together with the central number 12 is 360, the number of degrees in a circle; (2) the sum of the eight numbers in any set of radial cells together with the central number is 360; (3) the sum of the numbers in any four adjoining cells, either annular, radial, or both radial and two annular, together with half the central number, is 180.

Construction of Magic Squares.—A square of 5 (fig. 3) has adjoining it one of the eight equal squares by which any square may be conceived to be surrounded, each of which has two sides resting on adjoining squares, while four have sides resting on the surrounded square, and four meet it only at its four angles. 1, 2, 3 are placed along the path of a knight in chess; 4, along the same path, would fall in a cell of the outer square, and is placed instead in the corresponding cell of the original square; 5 then falls within the square. a, b, c, d are placed diagonally in the square; but e enters the outer square, and is removed thence to the same cell of the square it had left. α, β, γ, δ, ϵ pursue another regular course; and the diagram shows how that course is recorded in the square they have twice left. Whichever of the eight surrounding squares may be entered, the corresponding cell of the central square is taken instead. The 1, 2, 3, ..., a, b, c, ..., α, β, γ, ... are said to lie in "paths."

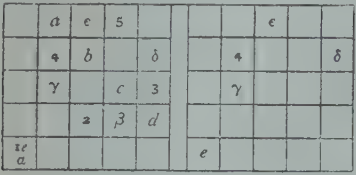

FIG. 3.

Squares whose Roots are Odd.—Figs 4, 5, and 6 exhibit one of the earliest methods of constructing magic squares. Here the 3's in fig. 4 and 2's in fig. 5 are placed in opposite diagonals to secure the two diagonal summations; then each number in fig. 5 is multiplied by 5 and added to that in the corresponding square in fig. 4, which gives the square of fig. 6. Figs. 7, 8 and 9 give De la Hire's method; the squares of figs. 7 and 8, being combined, give the magic square of fig. 9. C. G. Bachet arranged the numbers as in fig. 10, where there are three numbers in each of four surrounding squares; these being placed in the corresponding cells of the central square, the square of fig. 11 is formed. He also constructed squares such that if one or more outer bands of numbers are removed the remaining central squares are magical. His method of forming them may be understood from a square of 5. Here each summation is 5×13; if therefore 13 is subtracted from each number, the summations will be zero, and the twenty-five cells will contain the series ± 1, ± 2, ± 3, ... ± 12, the odd cell having 0. The central square of 3 is formed with four of the twelve numbers with + and − signs and zero in the middle; the band is filled up with the rest, as in fig. 12; then, 13 being added in each cell, the magic square of fig. 13 is obtained.

1	4	2	5	3
4	2	5	3	1
2	5	3	1	4
5	3	1	4	2
3	1	4	2	5

FIG. 4.

2	4	6	3	1
1	2	4	0	3
3	1	2	4	0
0	3	1	2	4
4	0	3	1	2

FIG. 5.

11	24	2	20	8
9	12	25	3	16
17	10	13	21	4
5	18	6	14	22
23	1	19	7	15

FIG. 6.

2	1	5	3	4
3	4	2	1	5
1	5	3	4	2
4	2	1	5	3
5	3	4	2	1

FIG. 7.

15	5	0	20	10
0	20	10	15	5
10	15	5	0	20
5	0	20	10	15
20	10	15	5	0

FIG. 8.

17	6	5	23	14
3	24	12	16	10
11	20	8	4	22
9	2	21	15	18
25	13	19	7	1

FIG. 9.

Squares whose Roots are Even.—These were constructed in various ways, similar to that of 4 in figs. 14, 15 and 16. The numbers in fig. 15 being multiplied by 4, and the squares of figs. 14 and 15 being superimposed, give fig. 16. The application of this method to squares the half of whose roots are odd requires a complicated adjustment. Squares whose half root is a multiple of 4, and in which there are summations along all the diagonal paths, may be formed, by observing, as when the root is 4, that the series 1 to 16 may be changed into the series 15, 13, ... 3, 1, −1, −3, ... , −13, −15, by multiplying each number by 2 and subtracting 17; and, vice versa, by adding 17 to each of the latter, and dividing by 2. The diagonal summations of a square, filled as in fig. 17, make zero; and, to obtain the same in the rows and columns, we must assign such values to the p's and q's as satisfy the equations $p_1 + p_2 + a_1 + a_2 = 0$, $p_3 + p_4 + a_3 + a_4 = 0$, $p_1 + p_3 - a_1 - a_3 = 0$, and $p_2 + p_4 - a_2 - a_4 = 0$,—a solution of which is readily obtained by inspection, as in fig. 18; this leads to the square, fig. 19. When the root is 8, the upper four subsidiary rows may at once be written, as in fig, 20; then, if 65 be added to each, and the sums halved, the square is completed. In such squares as these, the two opposite squares about the same diagonal (except that of 4) may be turned through any number of right angles, in the same direction, without altering the summations.

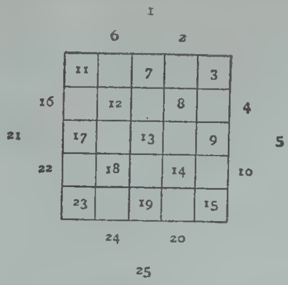

FIG. 10.

11	24	7	20	3
4	12	25	8	16
17	5	13	21	9
10	18	1	14	22
23	6	19	2	15

FIG. 11.

-9	12	5	-2	-6
1	7	-11	4	-1
-8	-3	0	3	8
10	-4	11	-7	-10
6	-12	-5	2	9

FIG. 12.

4	25	18	11	7
14	20	2	17	12
5	10	13	16	21
23	9	24	6	3
19	1	8	15	22

FIG. 13.

1	3	2	4
4	2	3	1
4	2	3	1
1	3	2	4

FIG. 14.

0	3	3	0
2	1	1	2
1	2	2	1
3	0	0	3

FIG. 15.

1	15	14	4
12	6	7	9
8	10	11	5
13	3	2	16

FIG. 16.

p_1	p_2	a_1	a_2
p_3	p_4	a_3	a_4
$-a_1$	$-a_2$	$-p_1$	$-p_2$
$-a_3$	$-a_4$	$-p_3$	$-p_4$

FIG. 17.

1	-3	11	-9
-5	7	-15	13
-11	9	-1	3
15	-13	5	-7

FIG. 18.

9	7	14	4
6	12	1	15
3	13	8	10
16	2	11	5

FIG. 19.

-1	3	5	-7	-33	35	37	-39
9	-11	-13	15	41	-43	-45	47
17	-19	-21	23	49	-51	-53	55
-25	27	29	-31	-57	59	61	-63

FIG. 20.

Nasik Squares.—Squares that have many more summations than in rows, columns and diagonals were investigated by A. H. Frost (*Cambridge Math. Jour.*, 1857), and called Nasik squares, from the town in India where he resided; and he extended the method to cubes, various sections of which have the same singular properties. In order to understand their construction it will be necessary to consider carefully fig. 21, which shows that, when the root is a prime, and not composite, number, as 7, eight letters *a*, *b*, . . . *h* may proceed from any, the same, cell, suppose that marked 0, each letter being repeated in the cells along different paths. These eight paths are called "normal paths," their number being one more than the root Observe here that, excepting the cells from which any two letters start, they do not occupy again the same cell, and that two letters, starting from any two different cells along different paths, will appear together in one and only one cell. Hence, if p_1 be placed in the cells of one of the $n+1$ normal paths, each of the remaining n normal paths will contain one, and only one, of these p_1's. If now we fill each row with $p_2, p_3, \dots p_n$ in the same order commencing from the p_1 in that row, the p_2's, p_3's and p_n's will lie each in a path similar to that of p_1, and each of the n normal paths will contain one, and only one, of the letters $p_1, p_2, \dots p_n$, whose sum will be Σp. Similarly, if q_1 be placed along any of the normal paths, different from that of the p's, and each row filled as above with the letters $q_2, q_3, \dots q_n$, the sum of the q's along any normal path different from that of the q_1 will be Σq. The n^2 cells of the square will now be found to contain all the combinations of the p's and q's; and if the q's be multiplied by n, the p's made equal to 1, 2, . . . n, and the q's to 0, 1, 2,. . .$(n-1)$ in any order, the Nasik square of n will be obtained, and the summations along all the normal paths, except those traversed by the p's and q's, will be the constant $\Sigma nq + \Sigma p$. When the root is an odd composite number, as 9, 15, &c., it will be found that in some paths, different from the two along which the p_1 and q_1 were placed, instead of having each of the p's and q's, some will be wanting, while some are repeated. Thus, in the case of 9, the triplets, $p_1p_4p_7$, $p_2p_5p_8$, $p_3p_6p_9$, and $q_1q_4q_7$, $q_2q_5q_8$, $q_3q_6q_9$ occur, each triplet thrice, along paths whose summation should be—Σp 45 and Σr 36. But if we make $p_1, p_2, \dots p_9, = 1, 3, 6, 5, 4, 7, 9, 8, 2$, and the $r_1, r_2, \dots r_9 = 0, 2, 5, 4, 3, 6, 8, 7, 1$, thrice each of the above sets of triplets will equal Σp and Σq respectively. If now the q's are multiplied by 9, and added to the p's in their several cells, we shall have a Nasik square, with a constant summation along eight of its ten normal paths. In fig. 22 the numbers are in the nonary scale; that in the centre is the middle one of 1 to 9^2, and the sum of pair of numbers equidistant from and opposite to the central 45 is twice 45; and the sum of any number and the 8 numbers 3 from it, diagonally, and in its row and column, is the constant Nasical summation, *e.g.* 72 and 32, 22, 76, 77, 26, 37, 36, 27. The numbers in fig. 22 being kept in the nonary scale, it is not necessary to add any nine of them together in order to test the Nasical summation; for, taking the first column, the figures in the place of units are seen at once to form the series, 1, 2, 3,. . . . 9, and those in the other place three triplets of 6, 1, 5. For the squares of 15 the p's and q's may be respectively 1, 2, 10, 8, 6, 14, 15, 11, 4, 13, 9, 7, 3, 12, 5, and 0, 1, 9, 7, 5, 13, 14, 10, 3, 12, 8, 6, 2, 11, 4, where five times the sum of every third number and three times the sum of every fifth number makes Σp and Σq; then, if the q's are multiplied by 15, and added to the p's, the Nasik square of 15 is obtained. When the root is the multiple of 4, the same process gives us, for the square of 4, fig. 23. Here the columns give Σp, but alternately $2q_1, 2q_3$, and $2q_2, 2q_4$; and the rows give Σq, but alternately $2p_1$, $2p_3$, and $2p_2$, $2p_4$; the diagonals giving Σp and Σq. If p_1, p_2, p_3, p_4 and q_1, q_2, q_3, q_4 be 1, 2, 4, 3, and 0, 1, 3, 2, we have the Nasik square of fig. 24. A square like this is engraved in the Sanskrit character on the gate of the fort of Gwalior, in India. The squares of higher multiples of 4 are readily obtained by a similar adjustment.

a	*g*	*f*	*e*	*d*	*c*	*b*
a	*d*	*g*	*c*	*f*	*b*	*e*
a	*c*	*e*	*g*	*b*	*d*	*f*
a	*f*	*d*	*b*	*g*	*e*	*c*
a	*e*	*b*	*f*	*c*	*g*	*d*
a	*b*	*c*	*d*	*e*	*f*	*g*
0	*h*	*h*	*h*	*h*	*h*	*h*

FIG. 21.

63	88	74	13	8	24	53	48	34
11	9	25	51	49	35	61	89	75
52	47	36	62	87	76	12	7	26
68	84	73	18	4	23	58	44	33
19	5	21	59	45	31	69	85	71
57	46	32	67	86	72	17	6	22
64	83	78	14	3	28	54	43	38
15	1	29	55	41	39	65	81	79
56	42	37	66	82	77	16	2	27

FIG. 22.

p_4q_3	p_2q_4	p_4q_1	p_2q_2
p_3q_1	p_1q_2	p_3q_3	p_1q_4
p_2q_3	p_4q_4	p_2q_1	p_4q_2
p_1q_1	p_3q_2	p_1q_3	p_3q_4

FIG. 23.

15	10	3	6
4	5	16	9
14	11	2	7
1	8	13	12

FIG. 24.

Nasik Cubes.—A Nasik cube is composed of n^3 small equal cubes, here called cubelets, in the centres of which the natural numbers from 1 to n^3 are so placed that every section of the cube by planes perpendicular to an edge has the properties of a Nasik square; also sections by planes perpendicular to a face, and passing through the cubelet centres of any path of Nasical summation in that face. Fig. 25 shows by dots the way in which these cubes are constructed. A dot is here placed on three faces of a cubelet at the corner, showing that this cubelet belongs to each of the faces AOB, BOC, COA, of the cube. Dots are placed on the cubelets of some path of AOB (here the knight's path), beginning from O, also on the cubelets of a knight's path in BOC. Dots are now placed in the cubelets of similar paths to that on BOC in the other six sections parallel to BOC, starting from their dots in AOB. Forty-nine of the three hundred and forty-three cubelets will now contain a dot; and it will be observed that the dots in sections perpendicular to BO have arranged themselves in similar paths. In this manner, p_1, q_1, r_1 being placed in the corner cubelet O, these letters are severally placed in the cubelets of three different paths of AOB, and again along any similar paths in the seven sections perpendicular to AO, starting from the letters' position in AOB Next, $p_2q_2r_2$, $p_3q_3r_3$, . . . $p_7q_7r_7$ are placed in the other cubelets of the edge AO, and dispersed in the same manner as $p_1q_1r_1$. Every cubelet will then be found to contain a different combination of the p's, q's and r's. If therefore the p's are made equal to 1, 2, . . . 7, and the q's and r's to 0, 1, 2,. . . 6, in any order, and the q's multiplied by 7, and the r's by 7^2, then, as in the case of the squares, the 7^3 cubelets will contain the numbers from 1 to 7^3, and the Nasical summations will be $\Sigma 7^2 r + \Sigma 7q + p$. If 2, 4, 5 be values of r, p, q, the number for that cubelet is written 245 in the septenary scale, and if all the cubelet numbers are kept thus, the paths along which summations are found can be seen without adding, as the seven numbers would contain 1, 2, 3,. . . 7 in the unit place, and 0, 1, 2, . . . 6 in each of the other places. In all Nasik cubes, if such values are given to the letters on the central cubelet that the number is the middle one of the series 1 to n^3, the sum of all the pairs of numbers opposite to and equidistant from the middle number is the double of it. Also, if around a Nasik cube the twenty-six surrounding equal cubes be placed with their cells filled with the same numbers, and their corresponding faces looking the same way,—and if the surrounding space be conceived thus filled with similar cubes, and a straight line of unlimited length be drawn through any two cubelet centres, one in each of any two cubes,—the numbers along that line will be found to recur in groups of seven, which (except in the three cases where the same p, q or r recur in the group) together make the Nasical summation of the cube. Further, if we take n similarly filled Nasik cubes of n, n new letters, $s_1, s_2, \dots s_n$, can be so placed, one in each of the n^4 cubelets of this group of n cubes, that each shall contain a different combination of the p's, q's, r's and s's. This is done by placing s_1 on each of the n^2 cubelets of the first cube that contain p_1, and on the n^2 cubelets of the 2d, 3d, . . . and nth cube that contain $p_2, p_3, \dots p_n$ respectively. This process is repeated with s_2, beginning with the cube at which we ended, and so on with the other s's; the n^4 cubelets, after multiplying the q's, r's, and s's by n, n^2, and n^3 respectively, will now be filled with the numbers from 1 to n^4, and the constant summation will be $\Sigma n^3 s + \Sigma n^2 r + \Sigma nq + \Sigma p$. This process may be carried on without limit; for, if the n cubes are placed in a row with their faces resting on each other, and the corresponding faces looking the same way, n such parallelepipeds might be put side by side, and the n^5 cubelets of this solid square be Nasically filled by the introduction of a new letter t; while, by introducing another letter, the n^6 cubelets of the compound cube of n^3 Nasik

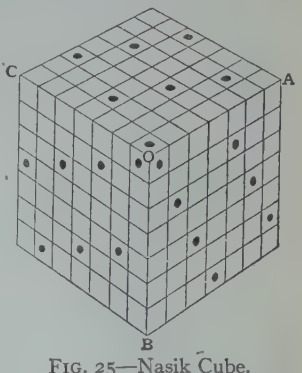

FIG. 25—Nasik Cube.

1	8	29	28
30	27	2	7
4	5	32	25
31	26	3	6

11	14	23	18
21	20	9	16
10	15	22	19
24	17	12	13

FIG. 26.

23	18	11	6	25
10	5	24	17	12
19	22	13	4	7
14	9	2	21	16
1	20	15	8	3

FIG. 27.

30	21	6	15	28	19
7	16	29	20	5	14
22	31	8	35	18	27
9	36	17	26	13	4
32	23	2	11	34	25
1	10	33	24	3	12

FIG. 28.

cubes might be filled by the numbers from 1 to n^6, and so *ad infinitum*. When the root is an odd composite number the values of the three groups of letters have to be adjusted as in squares, also in cubes of an even root. A similar process enables us to place successive numbers in the cells of several equal squares in which the Nasical summations are the same in each, as in fig. 26.

Among the many ingenious squares given by various writers, this article may justly close with two by L. Euler, in the *Histoire de l'académie royale des sciences* (Berlin, 1759). In fig. 27 the natural numbers show the path of a knight that moves within an odd square in such a manner that the sum of pairs of numbers opposite to and equidistant from the middle figure is its double. In fig. 28 the knight returns to its starting cell in a square of 6, and the difference between the pairs of numbers opposite to and equidistant from the middle point is 18.

A model consisting of seven Nasik cubes, constructed by A. H. Frost, is in the South Kensington Museum. The centres of the cubes are placed at equal distances in a straight line, the similar faces looking the same way in a plane parallel to that line. Each of the cubes has seven parallel glass plates, to which, on one side, the seven numbers in the septenary scale are fixed, and behind each, on the other side, its value in the common scale. 1201, the middle number from 1 to 7^4, occupies the central cubelet of the middle cube. Besides each cube having separately the same Nasical summation, this is also obtained by adding the numbers in any seven similarly situated cubelets, one in each cube. Also, the sum of all pairs of numbers, in a straight line, through the central cube of the system, equidistant from it, in whatever cubes they are, is twice 1201. (A. H. F.)

Fennell's Magic Ring.—It has been noticed that the numbers of magic squares, of which the extension by repeating the rows and columns of n numbers so as to form a square of $2n-1$ sides yields n^2 magic squares of n sides, are arranged as if they were all inscribed round a cylinder and also all inscribed on another cylinder at right angles to the first. C. A. M. Fennell explains this apparent anomaly by describing such magic squares as Mercator's projections, so to say, of "magic rings."

The surface of these magic rings is symmetrically divided into n^2 quadrangular compartments or cells by n equidistant zonal circles parallel to the circular axis of the ring and by n transverse circles which divide each of the n zones between any two neighbouring zonal circles into n equal quadrangular cells, while the zonal circles divide the sections between two neighbouring transverse circles into n unequal quadrangular cells. The diagonals of cells which follow each other passing once only through each zone and section, form similar and equal closed curves passing once quite round the circular axis of the ring and once quite round the centre of the ring. The position of each number is regarded as the intersection of two diagonals of its cell. The numbers are most easily seen if the smallest circle on the surface of the ring, which circle is concentric with the axis, be one of the zonal circles. In a perfect magic ring the sum of the numbers of the cells whose diagonals form any one of the $2n$ diagonal curves aforesaid is $\frac{1}{2}n(n^2 + 1)$ with or without increment, *i.e.* is the same sum as that of the numbers in each zone and each transverse section. But if n be 3 or a multiple of 3, only from 2 to n of the diagonal curves carry the sum in question, so that the magic rings are imperfect; and any set of numbers which can be arranged to make a perfect magic ring or magic square can also make an imperfect magic ring, *e.g.* the set 1 to 16 if the numbers 1, 6, 11, 16 lie thus on a diagonal curve instead of in the order 1, 6, 16 11. From a perfect magic ring of n^2 cells containing one number each, n^2 distinct magic squares can be read off; as the four numbers round each intersection of a zonal circle and a transverse circle constitute corner numbers of a magic square. The shape of a magic ring gives it the function of an indefinite extension in all directions of each of the aforesaid n^2 magic squares. (C. A. M. F.)

See F. E. A. Lucas, *Récréations mathématiques* (1891–1894); W. W. R. Ball, *Mathematical Recreations* (1892); W. E. M. G. Ahrens, *Mathematische Unterhaltungen und Spiele* (1901); H. C. H. Schubert, *Mathematische Mussestunden* (1900). A very detailed work is B. Violle, *Traité complet des carrés magiques* (3 vols., 1837–1838). The theory of "path nasiks" is dealt with in a pamphlet by C. Planck (1906).

MAGINN, WILLIAM (1793–1842), Irish poet and journalist, was born at Cork on the 10th of July 1793. The son of a schoolmaster, he graduated at Trinity College, Dublin, in 1811, and after his father's death in 1813 succeeded him in the school. In 1819 he began to contribute to the *Literary Gazette* and to *Blackwood's Magazine*, writing as "R. T. Scott" and "Morgan O'Doherty." He first made his mark as a parodist and a writer of humorous Latin verse. In 1821 he visited Edinburgh, where he made acquaintance with the Blackwood circle. He is credited with having originated the idea of the *Noctes ambrosianae*, of which some of the most brilliant chapters were his. His connexion with Blackwood lasted, with a short interval, almost to the end of his life. His best story was "Bob Burke's Duel with Ensign Brady." In 1823 he removed to London. He was employed by John Murray on the short-lived *Representative*, and was for a short time joint-editor of the *Standard*. But his intemperate habits and his imperfect journalistic morality prevented any permanent success. In connexion with Hugh Fraser he established *Fraser's Magazine* (1830), in which appeared his "Homeric Ballads." Maginn was the original of Captain Shandon in *Pendennis*. In spite of his inexhaustible wit and brilliant scholarship, most of his friends were eventually alienated by his obvious failings and his persistent insolvency. He died at Walton-on-Thames on the 21st of August 1842.

His *Miscellanies* were edited (5 vols., New York, 1855–1857) by R. Shelton Mackenzie and (2 vols., London, 1885) by R. W. Montagu [Johnson].

MAGISTRATE (Lat. *magistratus*, from *magister*, master, properly a public office, hence the person holding such an office), in general, one vested with authority to administer the law or one possessing large judicial or executive authority. In this broad sense the word is used in such phrases as "the first magistrate" of a king in a monarchy or "the chief magistrate" of the president of the United States. But it is more generally applied to minor or subordinate judicial officers, whether unpaid, as justices of the peace, or paid, as stipendiary magistrates. A stipendiary magistrate is appointed in London under the Metropolitan Police Courts Act 1839, in municipal boroughs under the Municipal Corporations Act 1882, and in particular districts under the Stipendiary Magistrates Act 1863 and special acts. In London and municipal boroughs a stipendiary magistrate must be a barrister of at least seven years' standing, while under the Stipendiary Magistrates Act 1863 he may be of five years' standing. A stipendiary magistrate may do alone all acts authorized to be done by two justices of the peace.

The term *magistratus* in ancient Rome originally implied the office of *magister* (master) of the Roman people, but was subsequently applied also to the holder of the office, thus becoming identical in sense with *magister*, and supplanting it in reference to any kind of public office. The fundamental conception of Roman magistracy is tenure of the *imperium*, the sovereignty which resides with the Roman people, but is by it conferred either upon a single ruler for life, as in the later monarchy, or upon a college of magistrates for a fixed term, as in the Republican period. The Roman theory of magistracy underwent little change when two consuls were substituted for the king; but the subdivision of magisterial powers which characterized the first centuries of the Republic, and resulted in the establishment of twenty annually elected magistrates of the people, implied some modification of this principle of the investiture of magistrates with supreme authority. For when the magistracies were multiplied a distinction was drawn between magistrates with *imperium*, namely consuls, praetors and occasionally dictators, and the remaining magistrates, who, although exercising independent magisterial authority and in no sense agents of the higher magistrates, were invested merely with an authority (*potestas*) to assist in the administration of the state. At the same time the actual authority of every magistrate was weakened not only by his colleagues' power of veto, but by the power possessed by any magistrate of quashing the act of an inferior, and by the tribune's right of putting his veto on the act of any magistrate except a dictator; and the subdivision of authority, which placed a great deal of business in the hands of young and inexperienced magistrates, further tended to increase the actual power as well as the influence of the senate at the expense of the magistracy.

In the developed Republic magistracies were divided into two classes: (*a*) magistrates of the whole people (*populi Romani*) and (*b*) magistrates of the *plebs*. The former class is again divided into two sections: (α) curule and (β) non-curule, a distinction which rests mainly on dignity rather than on actual power, for it cuts across the division of magistrates according to their tenure or non-tenure of *imperium*.

a. The magistrates of the people—also known as patrician magistrates, probably because the older and more important of these magistracies could originally be held only by patricians (*q.v.*)—were: (α) Dictator, master of the horse (see DICTATOR), consuls, praetors, curule, aediles and censors (curule); and (β) Quaestors, and the body of minor magistrates known as *xxvi. viri* (non-curule). The dictatorship and consulship were as old as the Republic. The first praetor was appointed in 366 B.C., a second was added in 242 B.C., and the number was gradually increased for provincial government until Sulla brought it up to eight, and under the early principate it grew to eighteen. Censors were first instituted in 443 B.C., and the office continued unchanged until its abolition by Sulla, after which, though restored, it rapidly fell into abeyance. Curule aediles were instituted at the same time as the praetorship, and continued throughout the Republic. The quaestorship was at least as old as the Republic, but the number rose during the Republic from two to twenty. All these offices except the censorship continued for administrative purposes during the principate, though shorn of all important powers.

b. The plebeian magistrates had their origin in the secession of the *plebs* to Mons Sacer in 494 B.C. (see ROME: *History*). In that year tribunes of the *plebs* were instituted, and two aediles were given them as subordinate officials, who were afterwards known as plebeian aediles, to distinguish them from the curule magistrates of the same name. Both these offices were abolished during the decemvirate, but were restored in 449 B.C., and survived into the principate.

The powers possessed by all magistrates alike were two:—that of enforcing their enactments (*coercitio*) by the exercise of any punishment short of capital, and that of veto(*intercessio*) of any act of a colleague or minor magistrate. The right of summoning and presiding over an assembly of that body of citizens with whose powers the magistrate was invested lay with the higher magistrates only in each class, with the consuls and praetors, and with the tribunes of the *plebs*. Civil jurisdiction was always a magisterial prerogative at Rome, and criminal jurisdiction also, except in capital cases, the decision of which was vested in the people at least as early as the first year of the Republic, was wielded by magistrates until the establishment of the various *quaestiones perpetuae* during the last century of the Republic. But in civil cases the magistrate, though controlling the trial and deciding matters of law, was quite distinct from the judge or body of judges who decided the question of fact; and the *quaestiones perpetuae*, which reduced the magistrate in criminal cases to a mere president of the court, gave him a position inferior to that of the praetor, who tried civil cases, only in so far as the praetor controlled the trial in some degree by his *formula*, under which the judges decided the question of fact.

Tenure of magistracy was always held to depend upon election by the body whose powers the magistrate wielded. Thus the magistrates of the *plebs* were elected by the plebeian council, those of the people in the Comitia (*q.v.*). In every case the outgoing magistrate, as presiding officer of the elective assembly, exercised the important right of nominating his successor for election.

See A. H. J. Greenidge, *Roman Public Life*, 152 seq., 363 seq. (London, 1901); T. Mommsen, *Römisches Staatsrecht*, I. II. i. (1887). (A. M. CL.)

MAGLIABECHI, ANTONIO DA MARCO (1633–1714), Italian bibliophile, was born at Florence on the 28th of October 1633. He followed the trade of a goldsmith until 1673, when he received the appointment of librarian to the grand-duke of Tuscany, a post for which he had qualified himself by his vast stores of self-acquired learning. He died on the 4th of July 1714, bequeathing his large private library to the grand-duke, who in turn handed it over to the city.

MAGLIANI, AGOSTINO (1824–1891), Italian financier, was a native of Lanzino, near Salerno. He studied at Naples, and a book on the philosophy of law based on Liberal principles won for him a post in the Neapolitan treasury. He entered the Italian Senate in 1871, and had already secured a reputation as a financial expert before his *Questione monetaria* appeared in 1874. In December 1877 he became minister of finance in the reconstructed Depretis ministry, and he subsequently held the same office in three other Liberal cabinets. In his second tenure he carried through (1880) the abolition of the grist tax, to take effect in 1884. Having to face an increased expenditure without offending the Radical electorate by unpopular taxes, he had recourse to unsound methods of finance, which seriously embarrassed Italian credit for some years after he finally laid down office in 1888. He died in Rome on the 22nd of February 1891. He was one of the founders of the anti-socialistic "Adam Smith Society" at Florence.

MAGNA CARTA, or the Great Charter, the name of the famous charter of liberties granted at Runnimede in June 1215 by King John to the English people. Although in later ages its importance was enormously magnified, it differs only in degree, not in kind, from other charters granted by the Norman and early Plantagenet kings. Its greater length, however, still more the exceptional circumstances attending its birth, gave to it a position absolutely unique in the minds of later generations of Englishmen. This feeling was fostered by its many confirmations, and in subsequent ages, especially during the time of the struggle between the Stuart kings and the parliament, it was regarded as something sacrosanct, embodying the very ideal of English liberties, which to some extent had been lost, but which must be regained. Its provisions, real and imaginary, formed the standard towards which Englishmen must strive.

The causes which led to the grant of Magna Carta are described in the article on *English History*. Briefly, they are to be found in the conditions of the time; the increasing insularity of the English barons, now no longer the holders of estates in Normandy; the substitution of an unpopular for a popular king, an active spur to the rising forces of discontent; and the unprecedented demands for money—demands followed, not by honour, but by dishonour, to the arms of England abroad. So much for the general causes. The actual crisis may be said to begin with the quarrel between John and Pope Innocent III. regarding the appointment of a new archbishop to the see of Canterbury. This was settled in May 1213, and in the new prelate, the papal nominee, Stephen Langton, who landed in England and absolved the king in the following July, the baronial party found an able and powerful ally. But before this event John had instituted a great inquiry, the inquest of service of June 1212, for the purpose of finding out how much he could exact from each of his vassals, a measure which naturally excited some alarm; and then, fearing a baronial rising, he had abandoned his proposed expedition into Wales, had taken hostages from the most prominent of his foes, and had sought safety in London.

His absolution followed, and then he took courage. Turning once more his attention to the recovery of Normandy, he asked the barons for assistance for this undertaking; in reply they, or a section of them, refused, and instead of crossing the seas the king marched northwards with the intention of taking vengeance on his disobedient vassals, who were chiefly barons of the north of England. Langton followed his sovereign to Northampton and persuaded him, at least for the present, to refrain from any serious measures of revenge. Before this interview a national council had met at St Albans at the beginning of August 1213, and this was followed by another council, held in St Paul's church, London, later in the same month; it was doubtless summoned by the archbishop, and was attended by many of the higher clergy and a certain number of the barons. Addressing the gathering, Langton referred to the laws of Edward the Confessor as "good laws," which the king ought to observe, and then mentioned the charter granted by Henry I. on his accession as a standard of good government. This event has such an important bearing on the issue of Magna Carta that it is not inappropriate to quote the actual words used by Matthew Paris in describing the incident. The chronicler represents the archbishop as saying "Inventa est quoque nunc carta quaedam Henrici primi regis Angliae per quam, si volueritis, libertates diu amissas poteritis ad statum pristinum revocare." Those present decided to contend to the death for their "long-lost liberties," and with this the meeting came to an end. Nothing, however, was done during the remainder of the year, and John, feeling his position had grown stronger, went abroad early in 1214, and remained for some months in France. With his mercenaries behind him he met with some small successes in his fight for Normandy, but on the 27th of July he and his ally, the emperor Otto IV., met with a crushing defeat at Bouvines at the hands of Philip Augustus, and even the king himself was compelled to recognise that his hopes of recovering Normandy were at an end.

Meanwhile in England, which was ruled by Peter des Roches as justiciar, the discontent had been increasing rather than diminishing, and its volume became much larger owing to an event of May 1214. Greatly needing money for his campaign, John ordered another scutage to be taken from his tenants; this, moreover, was to be at the unprecedented rate of three marks on the knight's fee, not as on previous occasions of two marks, although this latter sum had hitherto been regarded as a very high rate. The northern barons refused to pay, and the gathering forces of resistance received a powerful stimulus when a little later came the news of the king's humiliation at Bouvines. Then in October the beaten monarch returned to England, no course open to him but to bow before the storm. In November he met some of his nobles at Bury St Edmunds, but as they still refused to pay the scutage no agreement was reached. At once they took another step towards the goal. With due solemnity (*super majus altare*) they swore to withdraw their allegiance from the king and to make war upon him, unless within a stated time he restored to them their rightful laws and liberties. While they were collecting troops in order to enforce their threats, John on his part tried to divide his enemies by a concession to the clerical section. By a charter, dated the 21st of November 1214, he granted freedom of election to the church. However, this did not prevent the prelates from continuing to act to some extent with the barons, and early in January 1215 the malcontents asked the king to confirm the laws of Edward the Confessor and the other liberties of the kingdom. He evaded the request and secured a truce until Easter was passed. Energetically making use of this period of respite, he again issued the charter to the church, ordered his subjects to take a fresh oath of allegiance to him, and sent to the pope for aid; but neither these precautions, nor his expedient of taking the cross, deterred the barons from returning to the attack. In April they met in arms at Stamford, and as soon as the truce had expired they marched to Brackley, where they met the royal ministers and again presented their demands. These were carried to the king at Oxford, but angrily he refused to consider them. Then the storm burst. On the 5th of May the barons formally renounced their allegiance to John, and appointed Robert Fitzwalter as their leader. They marched towards London, while John made another attempt to delay the crisis, or to divide his foes, by granting a charter to the citizens of London (May 9, 1215), and then by offering to submit the quarrel to a court of arbitrators under the presidency of the pope. But neither the one nor the other expedient availed him. Arbitration under such conditions was contemptuously rejected, and after the king had ordered the sheriffs to seize the lands and goods of the revolting nobles, London opened its gates and peacefully welcomed the baronial army. Other towns showed also that their sympathies were with the insurgents, and John was forced to his knees. Promising to assent to their demands, he agreed to meet the barons, and the gathering was fixed for the 15th of June, and was to take place in a meadow between Staines and Windsor, called Runnimede.

At the famous conference, which lasted from Monday the 15th to Tuesday the 23rd of June, the hostile barons were present in large numbers; on the other hand John, who rode over each day from Windsor, was only attended by a few followers. At once the malcontents presented their demands in a document known popularly as the *Articles of the Barons*, more strictly as *Capitula quae barones petunt et dominus rex concedit.* Doubtless this had been drawn up beforehand, and was brought by the baronial leaders to Runnimede; possibly it was identical with the document presented to the royal ministers at Brackley a few weeks before. John accepted the Articles on the same day and at once the great seal was affixed to them. They are forty-eight in number, and on them Magna Carta was based, the work of converting them into a charter, which was regarded as a much more binding form of engagement, being taken in hand immediately. This duty occupied three days, negotiations between the two parties taking place over several disputed points, and it was completed by Friday the 19th, when several copies of the charter were sealed. All then took an oath to keep its terms, and orders were sent to the sheriffs to publish it, and to see that its provisions were observed, two or three days being taken up with making and sending out copies for this purpose. It should be mentioned that, although the charter was evidently not sealed until the 19th, the four existing copies of it are dated the 15th, the day on which John accepted the articles.

The days between Friday the 19th and the following Tuesday, when the conference came to an end, were occupied in providing, as far as possible, for the due execution of the reforms promised by the king in Magna Carta. The document itself provided for an elected committee of twenty-five barons, whose duty was to compel John, by force if necessary, to keep his promises; but this was evidently regarded as insufficient, and the matter was dealt with in a supplementary treaty (*Conventio facta inter regem Angliae et barones ejusdum regni*). As a guarantee of his good faith the king surrendered the city of London to his foes, while the Tower was entrusted to the neutral keeping of the archbishop of Canterbury. John then asked the barons for a charter that they on their part would keep the peace. This was refused, and although some of the bishops entered a mild protest, the question was allowed to drop. Regarding another matter also, the extent of the royal forests, the prelates made a protest. John and his friends feared lest the inquiry promised into the extent of the hated forest areas would be carried out too rigorously, and that these would be seriously curtailed, if not abolished altogether. Consequently, the two archbishops and their colleagues declared that the articles in the charter which provided for this inquiry, and for a remedy against abuses of the forest laws by the king, must not be interpreted in too harsh a spirit. The customs necessary for the preservation of the forests must remain in force.

No securities, however, could bind John. Even before Magna Carta was signed he had set to work to destroy it, and he now turned to this task with renewed vigour. He appealed to the pope, and hoped to crush his enemies by the aid of foreign troops, while the barons prepared for war, and the prelates strove to keep the peace. Help came first from the spiritual arm. On the 24th of August 1215 Innocent III. published a bull which declared Magna Carta null and void. It had been extorted from the king by force (*per vim et metum*), and in the words of the bull the pope said " compositionem hujusmodi reprobamus penitus et damnamus." He followed this up by excommunicating the barons who had obtained it, and in the autumn of 1215 the inevitable war began. Capturing Rochester castle, John met with some other successes, and the disheartened barons invited Louis, son of Philip Augustus of France and afterwards king as Louis VIII., to take the English crown. In spite of the veto of the pope Louis accepted the invitation, landed in England in May 1216, and occupied London and Winchester, the fortune of war having in the meantime turned against John. The " ablest and most ruthless of the Angevins," as J. R. Green calls this king, had not, however, given up the struggle, and he was still in the field when he was taken ill, dying in Newark castle on the 19th of October 1216.

In its original form the text of Magna Carta was not divided into chapters, but in later times a division of this kind was adopted. This has since been retained by all commentators, the number of chapters being 63.

The preamble states that the king has granted the charter on the advice of various prelates and barons, some of whom, including the archbishop of Canterbury, the papal legate Pandulf, and William Marshal, earl of Pembroke, are mentioned by name.

Chapter I. declares that the English church shall be free and shall enjoy freedom of election. This follows the precedent set in the accession charter of Henry I. and in other early charters, although it had no place in the Articles of the Barons. On the present occasion it was evidently regarded as quite a formal and introductory matter, and the same remark applies to the general grant of liberties to all freemen and their heirs, with which the chapter concludes.

Then follows a series of chapters intended to restrain the king from raising money by the harsh and arbitrary methods adopted in the past. These chapters, however, only afforded protection to the tenants-in-chief of the crown, and it is clear from their prominent position that the framers of the charter regarded them as of paramount importance.

Chapter II. fixes the amount of the relief to be paid to the king by the heir of any of his vassals. Previously John, disregarding the custom of the past, had taken as much as he could extort. Henceforward he who inherits a barony must pay £100, he who inherits a knight's fee 100 shillings or less, and for smaller holdings less "according to the ancient custom of fiefs."

Chapters III. to VI. deal with the abuses of the king's privilege of acting as guardian of minors and their lands. Money must not be extorted from a ward when he receives his inheritance. The guardian or his servant must not take from the ward's property more than a reasonable amount for his expenses and the like; on the contrary he must maintain the houses, estates and other belongings in a proper state of efficiency. A ward must be allowed a reasonable liberty in the matter of marriage. He or she must not, as had been so often the case in the past, be forced to marry some royal favourite, or some one who had paid a sum of money for the privilege.

Chapters VII. and VIII. are for the protection of the widows of tenants-in-chief. On the death of her husband a widow must receive her rightful inheritance, without delay or hindrance. Moreover she must not be compelled to marry, a proceeding sometimes adopted to get her lands into the possession of a royal minion.

Chapter IX. is intended to prevent the king from collecting the money owing to him in an oppressive manner.

Now for a short time the document leaves the great questions at issue between the king and the barons, and two chapters are devoted to protecting the people generally against the exactions of the Jews.

Chapter X. declares that money borrowed from the Jews shall not bear interest during a minority.

Chapter XI. provides for the repayment of borrowed money to the Jews, and also to other creditors. This, however, is only to be done after certain liabilities have been met out of the estate, including the services due to the lord of the land.

Having thus disposed of this matter, the grievances of the barons are again considered, the vexed question of scutage being dealt with.

Chapter XII. says that in future no scutage or aid, beyond the three recognized feudal aids, shall be levied except by the consent of the general council of the nation (*commune concilium regni nostri*), while the three recognized aids shall only be levied at a reasonable rate. In dealing with this matter the Articles of the Barons had declared that aids and tallages must not be taken from the citizens of London and of other places without the consent of the council. This provision was omitted from Magna Carta, except so far as it related to aids from the citizens of London. This chapter does not give the people the right to control taxation. It gives to the men interested a certain control over one form of taxation, and protects one class only from arbitrary exactions, and that class the most powerful and the most wealthy.

Chapter XIII. gives to the citizens of London all their ancient liberties and free customs.

Chapter XIV. provides for the assembly of the council when its consent is necessary for raising an aid or a scutage. Individual summonses must be sent to the prelates and greater barons, while the lesser barons will be called together through the sheriffs and bailiffs. At least forty days' notice of the meeting must be given, and the cause thereof specified. No chapter corresponding to this is found in the Articles and none was inserted in the reissues of Magna Carta. It is very interesting, but it does not constitute any marked advance in the history of parliament, as it merely expresses the customary method of summoning a council. It does not, as has been sometimes asserted, in any way establish a representative system, as this is understood to-day.

Chapter XV. extends the concessions obtained by the greater barons for themselves to the lesser landholders, the tenants of the tenants-in-chief.

Chapter XVI. declares that those who owe military service for their lands shall not be called upon to perform more than the due amount of such service.

We now come to an important series of articles which deal with abuses in the administration of justice. Henry II. made the royal courts of law a lucrative source of revenue, but he gave protection to suitors. Under his sons justice was equally, perhaps more, costly, while adequate protection was much harder to obtain. Here were many grievances, and the barons set to work to redress them.

Chapter XVII. declares that common pleas must henceforward be heard in a fixed place. This had already been to some extent the practice when this class of cases was heard; it was now made the rule. From this time suitors in this court were not put to the expense and inconvenience of following the king from place to place.

Chapters XVIII. and XIX. deal with the three petty assizes, three kinds of cases regarding disputes about the possession of land. These must be heard in the county courts before two visiting justices and four knights of the shire. The hardship of attendance at the county courts was to some extent obviated.

Chapters XX. to XXII. regulate the amount of fines imposed for offences against the law. Property necessary for one's livelihood must not be taken. The fines must only be imposed by the oath of honest men of the neighbourhood. In the same way earls and barons must only be fined by their peers, and a similar privilege is extended to the clergy, who, moreover, were not to be fined in accordance with the value of their benefices, but only of their other property. It should be noticed that trial by one's peers, as understood in Magna Carta, is not confined to the nobility; in every class of society an accused man is punished in accordance with the verdict of his peers, or equals.

Chapter XXIII. asserts that persons shall not be compelled to make bridges, unless they are bound to do so by ancient custom. John had oppressed his subjects in this way before he visited a district for purposes of sport, and the hardship was a real one.

Chapter XXIV. declared that the sheriffs and other officers of the king must not hold the pleas of the crown. This was intended to remove an old and serious evil, as the sheriffs had earned a very bad reputation by their methods of administering justice.

Chapter XXV. also concerns the sheriffs. It prevents the king from increasing by their agency the amount of money annually due to him from the various counties and hundreds. The custom was for the king to get a fixed sum from the sheriff of each county, this being called the *firma comitatus*, and for the sheriff to collect this as best he could. Henceforward this amount must not be raised.

Chapters XXVI. and XXVII. were intended to protect the property of deceased persons, and also to secure the full payment of debts due therefrom to the crown. Other creditors were also protected, and the property of an intestate must be distributed to his heirs under the supervision of the church.

Chapter XXVIII. strikes a blow at the custom of purveyance. Royal officials must pay for the corn and provisions which they take on behalf of the king.

Chapter XXIX. says knights must not be compelled to give money instead of performing castle-guard, if they are willing to perform this service. Castle-guard was the liability incumbent on the holders of some estates to serve in the garrison of the royal castles. The constables of these castles had adopted the custom of compelling these landholders to give money and not service, mercenaries being then hired to perform this.

Chapters XXX. and XXXI. forbid the royal officials to seize the horses or carts of freemen for transport duty, or to take wood for the king's buildings.

Chapter XXXII. says that the lands of convicted felons shall be handed over to the lords of such lands and not kept by the king beyond a year and a day. In cases of treason the king had a right to the forfeited lands, but he was not allowed to establish a similar right in cases of felony.

Chapter XXXIII. provided for the removal of kydells, or weirs, from all English rivers. This was intended to give greater freedom to inland navigation, the rivers being the main highways of trade.

Chapter XXXIV. limits the use of the writ known as *Praecipe*. This writ was one transferring cases concerning the ownership of property from the courts of the feudal lords to those of the king. This custom, which owes its origin to Henry II., meant a loss of revenue to the lords, whose victory in this matter, however, was a step backwards. It checked temporarily the process of centralizing the administration of justice.

Chapter XXXV. provides for the uniformity of weights and measures throughout the kingdom.

Chapter XXXVI. promises that in future writs of inquisition shall be granted freely without payment of any kind. This kind of writ allowed a man to refer the question of his guilt or innocence to the verdict of his neighbours instead of proving his innocence by the duel.

Chapter XXXVII. prevents the king from administering certain kinds of land when these fall into the possession of minors. In the past John had evidently stretched his authority and seized lands over which others had really the right of wardship.

Chapter XXXVIII. prevents a bailiff from compelling an accused man to submit to the ordeal without the approval of credible witnesses.

Chapter XXXIX. is more important and the English rendering of it may be given in full. "No freeman shall be arrested, or detained in prison, or deprived of his freehold, or outlawed, or banished, or in any way molested; and we will not set forth against him, nor send against him, unless by the lawful judgment of his peers and by the law of the land." The object of this was clearly to restrain John from arbitrary proceedings against his free subjects. The principle of judgment by one's peers is asserted, and is obviously the privilege of every class of freemen, not of the greater lords alone.

Chapter XL. simply says, "To no one will we sell, to no one will we refuse or delay, right or justice."

Chapters XLI. and XLII. give permission to merchants, both English and foreign, to enter and leave the kingdom, except in time of war. They are not to pay "evil tolls." The privilege is extended to all travellers, except the prisoner and the outlaw, and natives of a country with which England is at war.

Chapter XLIII. is intended to compel the king to refrain from exacting greater dues from an escheated barony than were previously due from such barony.

Chapter XLIV. deals with the hated and oppressive forest laws. In future attendance at the forest courts is only obligatory on those who have business thereat.

Chapter XLV. says that the royal officials must know something of the law and must be desirous of keeping it.

Chapter XLVI. gives to the founders of religious houses the right of acting as guardians of such houses when they are without heads.

Chapters XLVII. and XLVIII. deal again with the great grievance of the royal forests. John undertakes to disforest all forests which have been made in his time, and also to give up such river banks as he has seized for his own use when engaged in sport. Twelve knights in each county are to make a thorough inquiry into all evil customs connected with the forests, and these are to be utterly abolished.

Chapter XLIX. provides for the restoration of hostages. John had been in the habit of taking the children of powerful subjects as pledges for the good behaviour of their parents.

Chapter L. says that certain royal minions, who are mentioned by name, are to be removed from their offices.

Chapter LI. says that as soon as peace is made all foreign mercenaries are to be banished.

Chapters LII. and LIII. are those in which the king promises to make amends for the injuries he has done to his barons in the past. He will restore lands and castles to those who have been deprived of them without the judgment of their peers; he will do the same concerning property unlawfully seized by Henry II. or Richard I. and now in his hands. In the latter case, however, he was allowed a respite until he returned from the projected crusade. He promises also to do right concerning forests, abbeys and the wardship of lands which belong lawfully to others.

Chapter LIV. prevents any one from being arrested on the appeal of a woman, except on a charge of causing the death of her husband. As a woman could not prove her case in the judicial combat, it was felt that the earlier practice gave her an unfair advantage.

Chapter LV. provides for the remission of unjust fines. The decision on these matters is to rest with the archbishop of Canterbury and the twenty-five barons appointed to see that the terms of the charter are carried out.

Chapters LVI. and LVII. deal with the grievances of Welshmen. Restoration of property is promised to them practically in the same way as to Englishmen. Welsh law is to be used in Wales, and in the marches the law of the marches is to be employed.

Chapter LVIII. promises that his hostages and his charters shall be restored to Llewellyn, prince of Wales.

Chapter LIX. promises a restoration of hostages to Alexander I. king of Scotland. Right is also to be done to him concerning the lands which he holds in England.

Chapter LX. is a general statement that the aforesaid customs and liberties are to be observed by all classes.

Chapter LXI. provides for the execution of the royal promises. A committee is to be formed of twenty-five barons. Then if the king or any of his servants do wrong and complaint is made to four of the twenty-five, they are to ask for redress. In the event of this not being granted within forty days the matter is to be referred to the twenty-five, who are empowered to seize the lands and property of the king, or to obtain justice in any other way possible. They must, however, spare the persons of the king, the queen and their children. Vacancies in the committee are to be filled by the barons themselves. The twenty-five barons were duly appointed, their names being given by Matthew Paris. This chronicler also reports that another committee of thirty-eight members was appointed to assist and control the twenty-five. S. R. Gardiner calls the scheme "a permanent organization for making war against the king."

Chapter LXII. is an expression of general forgiveness.

Chapter LXIII. repeats the promise of freedom to the English church and of their rights and liberties to all.

Magna Carta is an elaboration of the accession charter of Henry I., and is based upon the Articles of the Barons. It is, however, very much longer than the former charter and somewhat longer than the Articles. Moreover, it differs in several particulars from the Articles, these differences being doubtless the outcome of deliberation and of compromise. For instance, the provisions in Magna Carta concerning the freedom of the church find no place in the Articles, while a comparison between the two documents suggests that in other ways also influences favourable to the church and the clergy were at work while the famous charter was being framed. When one reflects how active and prominent Langton and other prelates were at Runnimede the change is not surprising. Another difference between the two documents concerns the towns and the trading classes. Certain privileges granted to them in the Articles are not found in Magna Carta, although, it must be noted, this document bestows exceptionally favoured treatment on the citizens of London. The conclusion is that the friends of the towns and the traders were less in evidence at Runnimede than they were at the earlier meetings of the barons, but that the neighbouring Londoners were strong enough to secure a good price for their support.

Magna Carta throws much light on the condition of England in the early 13th century. By denouncing the evil deeds of John and the innovations practised by him, it shows what these were and how they were hated; how money had been raised, how forest areas had been extended, how minors and widows had been cheated and oppressed. By declaring, as it does, what were the laws and customs of a past age wherein justice prevailed, it shows what was the ideal of good government formed by John's prelates and barons. Magna Carta can hardly be said to have introduced any new ideas. As Pollock and Maitland (*History of English Law*) say "on the whole the charter contains little that is absolutely new. It is restorative." But although mature study has established the truth of this proposition it was not always so. Statesmen and commentators alike professed to find in Magna Carta a number of political ideas which belonged to a later age, and which had no place in the minds of its framers. It was regarded as having conferred upon the nation nothing less than the English constitution in its perfect and completed form. Sir Edward Coke finds in Magna Carta a full and proper legal answer to every exaction of the Stuart kings, and a remedy for every evil suffered at the time. Sir William Blackstone is almost equally admiring. Edmund Burke says "Magna Carta, if it did not give us originally the House of Commons, gave us at least a House of Commons of weight and consequence." Lord Chatham used words equally superlative. "Magna Carta, the Petition of Rights and the Bill of Rights form that code, which I call the Bible of the English Constitution." Modern historians, although less rhetorical, speak in the highest terms of the importance of Magna Carta, the view of most of them being summed up in the words of Dr Stubbs: "The whole of the constitutional history of England is a commentary on this charter."

Many regard Magna Carta as giving equal rights to all Englishmen. J. R. Green says "The rights which the barons claimed for themselves they claimed for the nation at large." As a matter of fact this statement is only true with large limitations. The villains, who formed the majority of the population, got very little from it; in fact the only clauses which protect them do so because they are property—the property of their lords—and therefore valuable. They get neither political nor civil rights under Magna Carta. The traders, too, get little, while preferential treatment is meted out to the clergy and the barons. Its benefits are confined to freemen, and of the benefits the lion's share fell to the larger landholders; the smaller landholders getting, it is true, some crumbs from the table. It did not establish freedom from arbitrary arrest, or the right of the representatives of the people to control taxation, or trial by jury, or other conceptions of a later generation.

The story of Magna Carta after the death of John is soon told. On the 12th of November 1216 the regent William Marshal, earl of Pembroke, reissued the charter in the name of the young king Henry III. But important alterations were made. War was being waged against Louis of France, and the executive must not be hampered in the work of raising money; moreover the personal equation had disappeared, the barons did not need to protect themselves against John. Consequently the chapter limiting the power of the crown to raise scutages and aids without the consent of the council vanished, and with it the complementary one which determined the method of calling a council. Other provisions, the object of which had been to restrain John from demanding more money from various classes of his subjects, were also deleted, and the same fate befell such chapters as dealt with mere temporary matters. The most important of these was Chapter LXI., which provided for the appointment of 25 executors to compel John to observe the charter. The next year peace was made at Lambeth (Sept. 11, 1217) between Henry III. and Louis and another reissue of the charter was promised. This promise was carried out, but two charters appeared, one being a revised issue of Magna Carta proper, and the other a separate charter dealing with the forests, all references to which were omitted from the more important document. The date of this issue appears to have been the 6th of November 1217. The issue of a separate forest charter at this time led subsequently to some confusion. Roger of Wendover asserts that John issued a separate charter of this kind when Magna Carta appeared. This statement was believed by subsequent writers until the time of Blackstone, who was the first to discover the mistake.

As issued in 1217 Magna Carta consists of 47 chapters only. It declares that henceforward scutages shall be taken according to the precedents of Henry II.'s reign. New provisions were introduced for the preservation of the peace—unlawful castles were to be destroyed—while others were directed towards making the administration of justice by the visiting justices less burdensome. With regard to the land and the services due therefrom a beginning was made of the policy which culminated in the statutes of Mortmain and of Quia Emptores. The sheriffs were ordered to publish the revised charter on the 22nd of February 1218. Then in February 1225 Henry III. again issued the two charters with only two slight alterations, and this is the final form taken by Magna Carta, this text being the one referred to by Coke and the other early commentators. Subsequently the charters were confirmed several times by Henry III. and by Edward I., the most important occasion being their confirmation by Edward at Ghent in November 1297. On this occasion some supplementary articles were added to the charter; these were intended to limit the taxing power of the crown.

There are at present in existence four copies of Magna Carta, sealed with the great seal of King John, and several unsealed copies. Of the four two are in the British Museum. Both came into the possession of the Museum with the valuable collection of papers which had belonged to Sir Robert Cotton, who had obtained possession of both. One was found in Dover castle about 1630. This was damaged by fire in 1731; the other is undamaged. The two other sealed copies belong to the cathedrals of Lincoln and of Salisbury. Both were written evidently in a less hurried fashion than those in the British Museum, and the one at Lincoln was regarded as the most perfect by the commissioners who were responsible for the appearance of the *Statutes of the Realm* in 1810. The British Museum also contains the original parchment of the Articles of the Barons. Magna Carta was first printed by Richard Pynson in 1499. This, however, was not the original text, which was neglected until the time of Blackstone, who printed the various issues of the charter in his book *The Great Charter and the Charter of the Forest* (1759). The earliest commentator of note was Sir Edward Coke, who published his *Second Institute*, which deals with Magna Carta, by order of the Long Parliament in 1642. Modern commentators, who also print the various texts of the charter, are Richard Thomson, *An Historical Essay on the Magna Carta of King John* (1829); C. Bémont, in his *Chartes des libertés anglaises* (1892); and W. Stubbs in his *Select Charters* (1895). A more recent book and one embodying the results of the latest research is W. S. McKechnie, *Magna Carta* (1905). The text of Magna Carta is also printed in the *Statutes of the Realm* (1810–1828), and in T. Rymer's *Foedera* (1816–1869). In addition to Blackstone, Coke and these later writers, the following works may also be consulted: John Reeves, *History of English Law* (1783–1784); L. O. Pike, *A Constitutional History of the House of Lords* (1894); W. Stubbs, *Constitutional History of England* (1897); Sir F. Pollock and F. W. Maitland, *The History of English Law* (1895); W. S. Holdsworth, *A History of English Law* (1903), and Kate Norgate, *John Lackland* (1902). (A. W. H.*)

MAGNA GRAECIA (ἡ μεγάλη Ἑλλάς), the name given (first, apparently, in the 6th century B.C.) to the group of Greek cities along the coast of the "toe" of South Italy (or more strictly those only from Tarentum to Locri, along the east coast), while the people were called Italiotes (Ἰταλιῶται). The interior, which the Greeks never subdued, continued to be in the hands of the Bruttii, the native mountaineers, from whom the district was named in Roman times (Βρεττία also in Greek writers). The Greek colonies were established first as trading stations, which grew into independent cities. At an early time a trade in copper was carried on between Greece and Temesa (Homer, *Od.* i. 181).[1] The trade for a long time was chiefly in the hands of the Euboeans; and Cyme (Cumae) in Campania was founded in the 8th century B.C., when the Euboean Cyme was still a great city. After this the energy of Chalcis went onward to Sicily, and the states of the Corinthian Gulf carried out the colonization of Italy, Rhegium having been founded, it is true, by Chalcis, but after Messana (Zancle), and at the request of the inhabitants of the latter. Sybaris (721) and Crotona (703) were Achaean settlements; Locri Epizephyrii (about 710) was settled by Ozolian Locrians, so that, had it not been for the Dorian colony of Tarentum, the southern coast of Italy would have been entirely occupied by a group of Achaean cities. Tarentum (whether or no founded by pre-Dorian Greeks—its founders bore the unexplained name of Partheniae) became a Laconian colony at some unknown date, whence a legend grew up connecting the Partheniae with Sparta, and 707 B.C. was assigned as its traditional date. Tarentum is remarkable as the only foreign settlement made by the Spartans. It was industrial, depending largely on the purple and pottery trade. Ionian Greeks fleeing from foreign invasion founded Siris about 650 B.C., and, much later, Elea (540).

The Italian colonies were planted among friendly, almost kindred, races, and grew much more rapidly than the Sicilian Greek states, which had to contend against the power of Carthage. After the Achaean cities had combined to destroy the Ionic Siris, and had founded Metapontum as a counterpoise to the Dorian Tarentum, there seems to have been little strife among the Italiotes. An amphictyonic league, meeting in common rites at the temple of Hera on the Lacinian promontory, fostered a feeling of unity among them. The Pythagorean and Eleatic systems of philosophy had their chief seat in Magna Graecia. Other departments of literature do not seem to have been so much cultivated among them. The poet Ibycus, though a native of Rhegium, led a very wandering life. They sent competitors to the Olympic games (among them the famous Milo of Croton); and the physicians of Croton early in the 6th century (especially in the person of Democedes) were reputed the best in Greece; but politically they appear to have generally kept themselves separate. One ship of Croton, however, fought at Salamis, though it is not recorded that Greece asked the Italiotes for help when it sent ambassadors to Gelon of Syracuse. Mutual discord first sapped the prosperity of Magna Graecia. In 510 Croton, having defeated the Sybarites in a great battle, totally destroyed their city. Croton maintained alone the leading position which had belonged jointly to the Achaean cities (Diod. xiv. 103); but from that time Magna Graecia steadily declined. In the war between Athens and Syracuse Magna Graecia took comparatively little part; Locri was strongly anti-Athenian, but Rhegium, though it was the headquarters of the Athenians in 427, remained neutral in 415. Foreign enemies pressed heavily on it. The Lucanians and Bruttians on the north captured one town after another. Dionysius of Syracuse attacked them from the south; and after he defeated the Crotoniate league and destroyed Caulonia (389 B.C.), Tarentum remained the only powerful city. Henceforth the history of Magna Graecia is only a record of the vicissitudes of Tarentum (*q.v.*). Repeated expeditions from Sparta and Epirus tried in vain to prop up the decaying Greek states against the Lucanians and Bruttians; and when in 282 the Romans appeared in the Tarentine Gulf the end was close at hand. The aid which Pyrrhus brought did little good to the Tarentines, and his final departure in 274 left them defenceless. During these constant wars the Greek cities had been steadily decaying; and in the second Punic war, when most of them seized the opportunity of revolting from Rome, their very existence was in some cases annihilated. Malaria increased in strength as the population diminished. We are told by Cicero (*De am.* 4), *Magna Graecia nunc quidem deleta est.* Many of the cities completely disappeared, and hardly any of them were of great importance under the Roman empire; some, like Tarentum, maintained their existence into modern times, and in these only (except at Locri) have archaeological investigations of any importance been carried on; so that there still remains a considerable field for investigation. (T. As.)

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[1] This passage should perhaps be referred to the 8th century B.C. It is the first mention of an Italian place in a literary record.

MAGNATE (Late Lat. *magnas*, a great man), a noble, a man in high position, by birth, wealth or other qualities. The term is specifically applied to the members of the Upper House in Hungary, the *Förendihaz* or House of Magnates (see Hungary).

MAGNES (*c.* 460 B.C.), Athenian writer of the Old Comedy, a native of the deme of Icaria in Attica. His death is alluded to by Aristophanes (*Equites*, 518–523, which was brought out in 424 B.C.), who states that in his old age Magnes had lost the popularity which he had formerly enjoyed. The few titles of his plays that remain, such as the *Frogs*, the *Birds*, the *Gall-flies*, indicate that he anticipated Aristophanes in introducing grotesque costumes for the chorus.

See T. Kock, *Comicorum atticorum fragmenta*, i. (1880); G. H. Bode, *Geschichte der hellenischen Dichtkunst*, iii. pt. 2 (1840).

MAGNESIA, in ancient geography the name of two cities in Asia Minor and of a district in eastern Thessaly, lying between the Vale of Tempe and the Pagasaean Gulf.

(1) Magnesia ad Maeandrum, a city of Ionia, situated on a small stream flowing into the Maeander, 15 Roman miles from Miletus and rather less from Ephesus. According to tradition, reinforced by the similarity of names, it was founded by colonists from the Thessalian tribe of the Magnetes, with whom were associated, according to Strabo, some Cretan settlers (Magnesia retained a connexion with Crete, as inscriptions found there attest). It was thus not properly an Ionic city, and for this reason, apparently, was not included in the Ionian league, though superior in wealth and prosperity to most of the members except Ephesus and Miletus. It was destroyed by the Cimmerii in their irruption into Asia Minor, but was soon after rebuilt, and gradually recovered its former prosperity. It was one of the towns assigned by Artaxerxes to Themistocles for support in his exile, and there the latter ended his days. His statue stood in its market-place. Thibron, the Spartan, persuaded the Magnesians to leave their indefensible and mutinous city in 399 B.C. and build afresh at Leucophrys, an hour distant, noted for its temple of Artemis Leucophryne, which, according to Strabo, surpassed that at Ephesus in the beauty of its architecture, though inferior in size and wealth. Its ruins were excavated by Dr K. Humann for the Constantinople Museum in 1891–1893; but most of the frieze of the temple of Artemis Leucophryne, representing an Amazon battle, had already been carried off by Texier (1843) to the Louvre. It was an octostyle, pseudo-dipteral temple of highly ornate Ionic order, built on older foundations by Hermogenes of Alabanda at the end of the 3rd century B.C. The platform has been greatly overgrown since the excavation, but many bases, capitals, and other architectural members are visible. In front of the west façade stood a great altar. An immense *peribolus* wall is still standing (20 ft. high), but its Doric colonnade has vanished. The railway runs right through the precinct, and much of Magnesia has gone into its bridges and embankments. South and west of the temple are many other remains of the Roman city, including a fairly perfect theatre excavated by Hiller von Gärtringen, and the shell of a large gymnasium. Part of the Agora was laid open to Humann, but his trenches have fallen in. The site is so unhealthy that even the Circassians who settled there twenty years ago have almost all died off or emigrated. Magnesia continued under the kings of Pergamum to be one of the most flourishing cities in this part of Asia; it resisted Mithradates in 87 B.C., and was rewarded with civic freedom by Sulla; but it appears to have greatly declined under the Roman empire, and its name disappears from history, though on coins of the time of Gordian it still claimed to be the seventh city of Asia.

See K. Haumann, *Magnesia am Maeander* (1904).

(2) Magnesia ad Sipylum (mod. *Manisa*, *q.v.*), a city of Lydia about 40 m. N.E. of Smyrna on the river Hermus at the foot of Mt Sipylus. No mention of the town is found till 190 B.C., when Antiochus the Great was defeated under its walls by the Roman consul L. Scipio Asiaticus. It became a city of importance under the Roman dominion and, though nearly destroyed by an earthquake in the reign of Tiberius, was restored by that emperor and flourished through the Roman empire. It was one of the few towns in this part of Asia Minor which remained prosperous under the Turkish rule. The most famous relic of antiquity is the "Niobe of Sipylus" (*Suratlu Tash*) on the lowest slopes of the mountain about 4 m. east of the town. This is a colossal seated image cut in a niche of the rock, of "Hittite" origin, and perhaps that called by Pausanias the "very ancient statue of the Mother of the Gods," carved by Broteas, son of Tantalus, and sung by Homer. Near it lie many remains of a primitive city, and about half a mile east is the rock-seat conjecturally identified with Pausanias' "Throne of Pelops." There are also hot springs and a sacred grotto of Apollo. The whole site seems to be that of the early "Tantalus" city. (D. G. H.)

MAGNESITE, a mineral consisting of magnesium carbonate, $MgCO_3$, and belonging to the calcite group of rhombohedral carbonates. It is rarely found in crystals or crystalline masses, being usually compact or earthy and intermixed with more or less hydrous magnesium silicate (meerschaum). The compact material has the appearance of unglazed porcelain, and the earthy that of chalk. In colour it is usually dead white, sometimes yellowish. The hardness of the crystallized mineral is 4; sp. gr. 3·1. The name magnesite as originally applied by J. C. Delamétherie in 1797 included several minerals containing magnesium, and at the present day it is used by French writers for meerschaum. The mineral has also been called baudisserite from the locality Baudissero near Ivrea in Piedmont. Breunnerite is a ferriferous variety.

Magnesite is a product of alteration of magnesium silicates, and occurs as veins and patches in serpentine, talc-schist or dolomite-rock. It is extensively mined in the island of Euboea in the Grecian Archipelago, near Salem in Madras, and in California, U.S.A. It is principally used for the manufacture of highly refractory fire-bricks for lining steel furnaces and electric furnaces; also for making plaster, tiles and artificial stone; for the preparation of magnesium salts (Epsom salts, &c.); for whitening paper-pulp and wool; and as a paint.

MAGNESIUM [symbol Mg, atomic weight 24·32 (O = 16)], a metallic chemical element. The sulphate or "Epsom salts" (*q.v.*) was isolated in 1695 by N. Grew, while in 1707 M. B. Valentin prepared *magnesia alba* from the mother liquors obtained in the manufacture of nitre. Magnesia was confounded with lime until 1755, when J. Black showed that the two substances were entirely different; and in 1808 Davy pointed out that it was the oxide of a metal, which, however, he was not able to isolate. Magnesium is found widely distributed in nature, chiefly in the forms of silicate, carbonate and chloride, and occurring in the minerals olivine, hornblende, talc, asbestos, meerschaum, augite, dolomite, magnesite, carnallite, kieserite and kainite. The metal was prepared (in a state approximating to purity) by A. A. B. Bussy (*Jour. de pharm.* 1829, 15, p. 30; 1830, 16, p. 142), who fused the anhydrous chloride with potassium; H. Sainte Claire Deville's process, which used to be employed commercially, was essentially the same, except that sodium was substituted for potassium (*Comptes rendus*, 1857, 44, p. 394), the product being further purified by redistillation. It may also be prepared by heating a mixture of carbon, oxide of iron and magnesite to bright redness; and by heating a mixture of magnesium ferrocyanide and sodium carbonate, the double cyanide formed being then decomposed by heating it with metallic zinc. Electrolytic methods have entirely superseded the older methods. The problem of magnesium reduction is in many respects similar to that of aluminium extraction, but the lightness of the metal as compared, bulk for bulk, with its fused salts, and the readiness with which it burns when exposed to air at high temperatures, render the problem somewhat more difficult.

Moissan found that the oxide resisted reduction by carbon in the electric furnace, so that electrolysis of a fusible salt of the metal must be resorted to. Bunsen, in 1852, electrolysed fused magnesium chloride in a porcelain crucible. In later processes, carnallite (a natural double chloride of magnesium and potassium) has commonly, after careful dehydration, been substituted for the single chloride. Graetzel's process, which was at one time employed, consisted in electrolysing the chloride in a metal crucible heated externally, the crucible itself forming the cathode, and the magnesium being deposited upon its inner surface. W. Borchers also used an externally heated metal vessel as the cathode; it is provided with a supporting collar or flange a little below the top, so that the upper part of the vessel is exposed to the cooling influence of the air, in order that a crust of solidified salt may there be formed, and so prevent the creeping of the electrolyte over the top. The carbon anode passes through the cover of a porcelain cylinder, open at the bottom, and provided with a side-tube at the top to remove the chlorine formed during electrolysis. The operation is conducted at a dull red heat (about 760° C. or 1400° F.), the current density being about 0·64 amperes per sq. in. of cathode surface, and the pressure about 7 volts. The fusing-point of the metal is about 730° C. (1350° F.), and the magnesium is therefore reduced in the form of melted globules which gradually accumulate. At intervals the current is interrupted, the cover removed, and the temperature of the vessel raised considerably above the melting-point of magnesium. The metal is then removed from the walls with the aid of an iron scraper, and the whole mass poured into a sheet-iron tray, where it solidifies. The solidified chloride is then broken up, the shots and fused masses of magnesium are picked out, run together in a plumbago crucible without flux, and poured into a suitable mould. Smaller pieces are thrown into a bath of melted carnallite and pressed together with an iron rod, the bath being then heated until the globules of metal float to the top, when they may be removed in perforated iron ladles, through the holes in which the fused chloride can drain away, but through which the melted magnesium cannot pass by reason of its high surface tension. The globules are then re-melted. F. Oettel (*Zeit. f. Elektrochem.*, 1895, 2, p. 394) recommends the electrolytic preparation from carnallite; the mineral should be freed from water and sulphates.

Magnesium is a silvery white metal possessing a high lustre. It is malleable and ductile. Sp. gr. 1·75. It preserves its lustre in dry air, but in moist air it becomes tarnished by the formation of a film of oxide. It melts at 632·7° C. (C. T. Heycock and F. H. Neville), and boils at about 1100°C. Magnesium and its salts are diamagnetic. It burns brilliantly when heated in air or oxygen, or even in carbon dioxide, emitting a brilliant white light and leaving a residue of magnesia, MgO. The light is rich in the violet and ultra-violet rays, and consequently is employed in photography. The metal is also used in pyrotechny. It also burns when heated in a current of steam, which it decomposes with the liberation of hydrogen and the formation of magnesia. At high temperatures it acts as a reducing agent, reducing silica to silicon, boric acid to boron, &c. (H. Moissan, *Comptes rendus*, 1892, 114, p. 392). It combines directly with nitrogen, when heated in the gas, to form the nitride Mg_3N_2 (see ARGON). It is rapidly dissolved by dilute acids, with the evolution of hydrogen and the formation of magnesium salts. It precipitates many metals from solutions of their salts.

Magnesium Oxide, magnesia, MgO, occurs native as the mineral periclase, and is formed when magnesium burns in air; it may also be prepared by the gentle ignition of the hydroxide or carbonate. It is a non-volatile and almost infusible white powder, which slowly absorbs moisture and carbon dioxide from air, and is readily soluble in dilute acids. On account of its refractory nature, it is employed in the manufacture of crucibles, furnace linings, &c. It is also used in making hydraulic cements. A crystalline form was obtained by M. Houdard (*Abst. J. C. S.*, 1907, ii. p. 621) by fusing the oxide and sulphide in the electric furnace. *Magnesium hydroxide* $Mg(OH)_2$, occurs native as the minerals brucite and némalite, and is prepared by precipitating solutions of magnesium salts by means of caustic soda or potash. An artificial brucite was prepared by A. de Schulten (*Comptes rendus*, 1885, 101, p. 72) by boiling magnesium chloride with caustic potash and allowing the solution to cool. Magnesium hydroxide is a white amorphous solid which is only slightly soluble in water; the solubility is, however, greatly increased by ammonium salts. It possesses an alkaline reaction and absorbs carbon dioxide. It is employed in the manufacture of cements.

When magnesium is heated in fluorine or chlorine or in the vapour of bromine or iodine there is a violent reaction, and the corresponding halide compounds are formed. With the exception of the fluoride, these substances are readily soluble in water and are deliquescent. The fluoride is found native as sellaïte, and the bromide and iodide occur in sea water and in many mineral springs. The most important of the halide salts is the *chloride* which, in the hydrated form, has the formula $MgCl_2 \cdot 6H_2O$. It may be prepared by dissolving the metal, its oxide, hydroxide, or carbonate in dilute hydrochloric acid, or by mixing concentrated solutions of magnesium sulphate and common salt, and cooling the mixture rapidly, when the less soluble sodium sulphate separates first. It is also formed as a by-product in the manufacture of potassium chloride from carnallite. The hydrated salt loses water on heating, and partially decomposes into hydrochloric acid and magnesium oxychlorides. To obtain the anhydrous salt, the double magnesium ammonium chloride, $MgCl_2 \cdot NH_4Cl \cdot 6H_2O$, is prepared by adding ammonium chloride to a solution of magnesium chloride. The solution is evaporated, and the residue strongly heated, when water and ammonium chloride are expelled, and anhydrous magnesium chloride remains. Magnesium chloride readily forms double salts with the alkaline chlorides. A strong solution of the chloride made into a thick paste with calcined magnesia sets in a few hours to a hard, stone-like mass, which contains an oxychloride of varying composition. Magnesium oxychloride when heated to redness in a current of air evolves a mixture of hydrochloric acid and chlorine and leaves a residue of magnesia, a reaction which is employed in the Weldon-Pechiney and Mond processes for the manufacture of chlorine.

Magnesium Carbonate, $MgCO_3$.—The normal salt is found native as the mineral magnesite, and in combination with calcium carbonate as dolomite, whilst hydromagnesite is a basic carbonate. It is not possible to prepare the normal carbonate by precipitating magnesium salts with sodium carbonate. C. Marignac has prepared it by the action of calcium carbonate on magnesium chloride. A salt $MgCO_3 \cdot 3H_2O$ or $Mg(CO_3H)(OH) \cdot 2H_2O$ may be prepared from the carbonate by dissolving it in water charged with carbon dioxide, and then reducing the pressure (W. A. Davis, *Jour. Soc. Chem. Ind.* 1906, 25, p. 788). The carbonate is not easily soluble in dilute acids, but is readily soluble in water containing carbon dioxide. *Magnesia alba*, a white bulky precipitate obtained by adding sodium carbonate to Epsom salts, is a mixture of $Mg(CO_3H)(OH) \cdot 2H_2O$, $Mg(CO_3H)(OH)$ and $Mg(OH)_2$. It is almost insoluble in water, but readily dissolves in ammonium salts.

Magnesium Phosphates.—By adding sodium phosphate to magnesium sulphate and allowing the mixture to stand, hexagonal needles of $MgHPO_4 \cdot 7H_2O$ are deposited. The *normal phosphate*, $Mg_3P_2O_8$, is found in some guanos, and as the mineral wagnerite. It may be prepared by adding normal sodium phosphate to a magnesium salt and boiling the precipitate with a solution of magnesium sulphate. It is a white amorphous powder, readily soluble in acids. *Magnesium ammonium phosphate*, $MgNH_4PO_4 \cdot 6H_2O$, is found as the mineral struvite and in some guanos; it occurs also in urinary calculi and is formed in the putrefaction of urine. It is prepared by adding sodium phosphate to magnesium sulphate in the presence of ammonia and ammonium chloride. When heated to 100° C., it loses five molecules of water of crystallization, and at a higher temperature loses the remainder of the water and also ammonia, leaving a residue of magnesium pyrophosphate, $Mg_2P_2O_7$. *Magnesium Nitrate*, $Mg(NO_3)_2 \cdot 6H_2O$, is a colourless, deliquescent, crystalline solid obtained by dissolving magnesium or its carbonate in nitric acid, and concentrating the solution. The crystals melt at 90° C. *Magnesium Nitride*, Mg_3N_2, is obtained as a greenish-yellow amorphous mass by passing a current of nitrogen or ammonia over heated magnesium (F. Briegleb and A. Geuther, *Ann.*, 1862, 123, p. 228; see also W. Eidmann and L. Moeser, *Ber.*, 1901, 34, p. 390). When heated in dry oxygen it becomes incandescent, forming magnesia. Water decomposes it with liberation of ammonia and formation of magnesium hydroxide. The chlorides of nickel, cobalt, chromium, iron and mercury are converted into nitrides when heated with it, whilst the chlorides of copper and platinum are reduced to the metals (A. Smits, *Rec. Pays Bas*, 1896, 15, p. 135). *Magnesium sulphide*, MgS, may be obtained, mixed with some unaltered metal and some magnesia, as a hard brown mass by heating magnesia, in sulphur vapour. It slowly decomposes in moist air. *Magnesium sulphate*, $MgSO_4$, occurs (with $1H_2O$) as Kieserite. A hexahydrate is also known. The salt may be obtained from Kieserite: formerly it was prepared by treating magnesite or dolomite with sulphuric acid.

Grignard Reagent.

Organic Compounds.—By heating magnesium filings with methyl and ethyl iodides A. Cahours (*Ann. chim. phys.*, 1860, 58, pp. 5, 19) obtained magnesium methyl, $Mg(CH_3)_2$, and magnesium ethyl, $Mg(C_2H_5)_2$, as colourless, strongly smelling, mobile liquids, which are spontaneously inflammable and are readily decomposed by water. The compounds formed by the action of magnesium on alkyl iodides in the cold have been largely used in synthetic organic chemistry since V. Grignard (*Comptes rendus*, 1900 et seq.) observed that magnesium and alkyl or aryl halides combined together in presence of anhydrous ether at ordinary temperatures (with the appearance of brisk boiling) to form compounds of the type RMgX(R = an alkyl or aryl group and X = halogen). These compounds are insoluble in ether, are non-inflammable and exceedingly reactive. A. V. Baeyer (*Ber.*, 1902, 35, p. 1201) regards them as oxonium salts containing tetravalent oxygen $(C_2H_5)_2{:}O{:}(MgR)\ (X)$, whilst W. Tschelinzeff (*Ber.*, 1906, 39, p. 773) considers that they contain two molecules of ether. In preparing the Grignard reagent the commencement of the reaction is accelerated by a trace of iodine. W. Tschelinzeff (*Ber.*, 1904, 37, p. 4534) showed that the ether may be replaced by benzene containing a small quantity of ether or anisole, or a few drops of a tertiary amine. With unsaturated alkyl halides the products are only slightly soluble in ether, and two molecules of the alkyl compound are brought into the reaction. They are very unstable, and do not react in the normal manner. (V. Grignard and L. Tissier, *Comptes rendus*, 1901, 132, p. 558).

The products formed by the action of the Grignard reagent with the various types of organic compounds are usually thrown out of solution in the form of crystalline precipitates or as thick oils, and are then decomposed by ice-cold dilute sulphuric or acetic acids, the magnesium being removed as a basic halide salt.

Applications.—For the formation of primary and secondary alcohols see ALDEHYDES and KETONES. Formaldehyde behaves abnormally with magnesium benzyl bromide (M. Tiffeneau, *Comptes rendus*, 1903, 137, p. 573), forming ortho-tolylcarbinol, $CH_3\cdot C_6H_4\cdot CH_2OH$, and not benzylcarbinol, $C_6H_5CH_2\cdot CH_2OH$ (cf. the reaction of formaldehyde on phenols: O. Manasse, *Ber.* 1894, 27, p. 2904). Acid esters yield carbinols, many of which are unstable and readily pass over into unsaturated compounds, especially when warmed with acetic anhydride: $R\cdot CO_2R'(R'')_2\cdot R:C\cdot OMgX \rightarrow (R'')_2R:C\cdot OH$.

Formic ester yields a secondary alcohol under similar conditions. Acid chlorides behave in an analogous manner to esters (Grignard and Tissier, *Comptes rendus*, 1901, 132, p. 683). Nitriles yield ketones (the nitrogen being eliminated as ammonia), the best yields being given by the aromatic nitriles (E. Blaise, ibid., 1901, 133, p. 1217): $R\cdot CN \rightarrow RR':C:NMgI \rightarrow R\cdot CO\cdot R'$. Acid amides also react to form ketones (C. Béis, ibid., 1903, 137, 575):

$$R\cdot CONH_2 \rightarrow RR':C(OMgX)\cdot NHMgX + R'H \rightarrow R\cdot CO\cdot R';$$

the yield increases with the complexity of the organic residue of the acid amide. On passing a current of dry carbon dioxide over the reagent, the gas is absorbed and the resulting compound, when decomposed by dilute acids, yields an organic acid, and similarly with carbon oxysulphide a thio-acid is obtained:

$$RMgX \rightarrow R\cdot CO_2MgX \rightarrow R\cdot CO_2H;\ COS \rightarrow CS(OMgX)\cdot R \rightarrow R\cdot CSOH.$$

A Klages (*Ber.*, 1902, 35, pp. 2633 et seq.) has shown that if one uses an excess of magnesium and of an alkyl halide with a ketone, an ethylene derivative is formed. The reaction appears to be perfectly general unless the ketone contains two ortho-substituent groups. Organo-metallic compounds can also be prepared, for example

$$SnBr_4 + 4MgBrC_6H_5 = 4MgBr_2 + Sn(C_6H_5)_4.$$

For a summary see A. McKenzie, *B. A. Rep.* 1907.

Detection.—The magnesium salts may be detected by the white precipitate formed by adding sodium phosphate (in the presence of ammonia and ammonium chloride) to their solutions. The same reaction is made use of in the quantitative determination of magnesium, the white precipitate of magnesium ammonium phosphate being converted by ignition into magnesium pyrophosphate and weighed as such. The atomic weight of magnesium has been determined by many observers. J. Berzelius (*Ann. chim. phys.*, 1820, 14, p. 375), by converting the oxide into the sulphate, obtained the value 12·62 for the equivalent. R. F. Marchand and T. Scheerer (*Jour. prakt. Chem.*, 1850, 50, p. 358), by ignition of the carbonate, obtained the value 24·00 for the atomic weight, whilst C. Marignac, by converting the oxide into the sulphate, obtained the value 24·37. T. W. Richards and H. G. Parker (*Zeit. anorg. Chem.*, 1897, 13, p. 81) have obtained the value 24·365 (O = 16).

Medicine.—These salts of magnesium may be regarded as the typical *saline purgatives.* Their aperient action is dependent upon the minimum of irritation of the bowel, and is exercised by their abstraction from the blood of water, which passes into the bowel to act as a diluent of the salt. The stronger the solution administered, the greater is the quantity of water that passes into the bowel, a fact to be borne in mind when the salt is administered for the purpose of draining superfluous fluid from the system, as in dropsy. The oxide and carbonate of magnesium are also invaluable as antidotes, since they form insoluble compounds with oxalic acid and salts of mercury, arsenic, and copper. The result is to prevent the local corrosive action of the poison and to prevent absorption of the metals. As alkaloids are insoluble in alkaline solutions, the oxide and carbonate—especially the former—may be given in alkaloidal poisoning. The compounds of magnesium are not absorbed into the blood in any appreciable quantity, and therefore exert no remote actions upon other functions. This is fortunate, as the result of injecting a solution of a magnesium salt into a vein is rapid poisoning. Hence it is of the utmost importance to avoid the use of salts of this metal whenever it is necessary—as in diabetic coma—to increase the alkalinity of the blood rapidly. The usual doses of the oxide and carbonate of magnesium are from half a drachm to a drachm.

MAGNETISM. The present article is a digest, mainly from an experimental standpoint, of the leading facts and principles of magnetic science. It is divided into the following sections:

1. General Phenomena.
2. Terminology and Elementary Principles.
3. Magnetic Measurements.
4. Magnetization in Strong Fields.
5. Magnetization in Weak Fields.
6. Changes of Dimensions attending Magnetization.
7. Effects of Mechanical Stress on Magnetization.
8. Effects of Temperature on Magnetism.
9. Magnetic Properties of Alloys and Compounds of Iron.
10. Miscellaneous Effects of Magnetization:—
    Electric Conductivity—Hall Effect—Electro-Thermal Relations—Thermoelectric Quality—Elasticity—Chemical and Voltaic Effects.
11. Feebly Susceptible Substances.
12. Molecular Theory of Magnetism.
13. Historical and Chronological Notes.

Of these thirteen sections, the first contains a simple description of the more prominent phenomena, without mathematical symbols or numerical data. The second includes definitions of technical terms in common use, together with so much of the elementary theory as is necessary for understanding the experimental work described in subsequent portions of the article; a number of formulae and results are given for purposes of reference, but the mathematical reasoning by which they are obtained is not generally detailed, authorities being cited whenever the demonstrations are not likely to be found in ordinary textbooks. The subjects discussed in the remaining sections are sufficiently indicated by their respective headings. (See also ELECTROMAGNETISM, TERRESTRIAL MAGNETISM, MAGNETO-OPTICS and UNITS.)

1. GENERAL PHENOMENA

Pieces of a certain highly esteemed iron ore, which consists mainly of the oxide Fe_3O_4, are sometimes found to possess the power of attracting small fragments of iron or steel. Ore endowed with this curious property was well known to the ancient Greeks and Romans, who, because it occurred plentifully in the district of Magnesia near the Aegean coast, gave it the name of *magnes*, or the *Magnesian stone.* In English-speaking countries the ore is commonly known as *magnetite*, and pieces which exhibit attraction as *magnets*; the cause to which the attractive property is attributed is called *magnetism*, a name also applied to the important branch of science which has been evolved from the study of phenomena associated with the magnet.

If a magnet is dipped into a mass of iron filings and withdrawn, filings cling to certain parts of the stone in moss-like tufts, other parts remaining bare. There are generally two regions where the tufts are thickest, and the attraction therefore greatest, and between them is a zone in which no attraction is evidenced. The regions of greatest attraction have received the name of *poles*, and the line joining them is called the *axis* of the magnet; the space around a magnet in which magnetic effects are exhibited is called the *field of magnetic force*, or the *magnetic field.*

Up to the end of the 15th century only two magnetic phenomena of importance, besides that of attraction, had been observed. Upon one of these is based the principle of the mariner's compass, which is said to have been known to the Chinese as early as 1100 B.C., though it was not introduced into Europe until more than 2000 years later; a magnet supported so that its axis is free to turn in a horizontal plane will come to rest with its poles pointing approximately north and south. The other phenomenon is mentioned by Greek and Roman writers of the 1st century: a piece of iron, when brought into contact with a magnet, or even held near one, itself becomes "inductively" magnetized, and acquires the power of lifting iron. If the iron is soft and fairly pure, it loses its attractive property when removed from the neighbourhood of the magnet; if it is hard, some of the induced magnetism is permanently retained, and the piece becomes an artificial magnet. Steel is much more retentive of magnetism than any ordinary iron, and some form of steel is now always used for making artificial magnets. Magnetism may be imparted to a bar of hardened steel by stroking it several times from end to end, always in the same direction, with one of the poles of a magnet. Until 1820 all the artificial magnets in practical use derived their virtue, directly or indirectly, from the natural magnets found in the earth: it is now recognized that the source of all magnetism, not excepting that of the magnetic ore itself, is electricity, and it is usual to have direct recourse to electricity for producing magnetization, without the intermediary of the magnetic ore. A wire carrying an electric current is surrounded by a magnetic field, and if the wire is bent into the form of an elongated coil or spiral, a field having certain very useful qualities is generated in the interior. A bar of soft iron introduced into the coil is at once magnetized, the magnetism, however, disappearing almost completely as soon as the current ceases to flow. Such a combination constitutes an *electromagnet*, a valuable device by means of which a magnet can be instantly made and unmade at will. With suitable arrangements of iron and coil and a sufficiently strong current, the intensity of the temporary magnetization may be very high, and electromagnets capable of lifting weights of several tons are in daily use in engineering works (see ELECTROMAGNETISM). If the bar inserted into the coil is of hardened steel instead of iron, the magnetism will be less intense, but a larger proportion of it will be retained after the current has been cut off. Steel magnets of great strength and of any convenient form may be prepared either in this manner or by treatment with an electromagnet; hence the natural magnet, or *lodestone* as it is commonly called, is no longer of any interest except as a scientific curiosity.

Some of the principal phenomena of magnetism may be demonstrated with very little apparatus; much may be done with a small bar-magnet, a pocket compass and a few ounces of iron filings. Steel articles, such as knitting or sewing needles and pieces of flat spring, may be readily magnetized by stroking them with the bar-magnet; after having produced magnetism in any number of other bodies, the magnet will have lost nothing of its own virtue. The compass needle is a little steel magnet balanced upon a pivot; one end of the needle, which always bears a distinguishing mark, points approximately, but not in general exactly, to the north,[1] the vertical plane through the direction of the needle being termed the *magnetic meridian*. The bar-magnet, if suspended horizontally in a paper stirrup by a thread of unspun silk, will also come to rest in the magnetic meridian with its marked end pointing northwards. The north-seeking end of a magnet is in English-speaking countries called the *north pole* and the other end the *south pole*; in France the names are interchanged. If one pole of the bar-magnet is brought near the compass, it will attract the opposite pole of the compass-needle; and the magnetic action will not be sensibly affected by the interposition between the bar and the compass of any substance whatever except iron or other magnetizable metal. The poles of a piece of magnetized steel may be at once distinguished if the two ends are successively presented to the compass; that end which attracts the south pole of the compass needle (and is therefore north) may be marked for easy identification.

Similar magnetic poles are not merely indifferent to each other, but exhibit actual repulsion. This can be more easily shown if the compass is replaced by a magnetized knitting needle, supported horizontally by a thread. The north pole of the bar-magnet will repel the north pole of the suspended needle, and there will likewise be repulsion between the two south poles. Such experiments as these demonstrate the fundamental law that *like poles repel each other; unlike poles attract.* It follows that between two neighbouring magnets, the poles of which are regarded as centres of force, there must always be four forces in action. Denoting the two pairs of magnetic poles by N, S and N′, S′, there is attraction between N and S′, and between S and N′; repulsion between N and N′, and between S and S′. Hence it is not very easy to determine experimentally the law of magnetic force between poles. The difficulty was overcome by C. A. Coulomb, who by using very long and thin magnets, so arranged that the action of their distant poles was negligible, succeeded in establishing the law, which has since been confirmed by more accurate methods, that *the force of attraction or repulsion exerted between two magnetic poles varies inversely as the square of the distance between them.* Since the poles of different magnets differ in strength, it is important to agree upon a definite unit or standard of reference in terms of which the strength of a pole may be numerically specified. According to the recognized convention, the unit pole is that which acts upon an equal pole at unit distance with unit force: a north pole is reckoned as positive (+) and a south pole as negative (−). Other conditions remaining unchanged, the force between two poles is proportional to the product of their strengths; it is repulsive or attractive according as the signs of the poles are like or unlike.

If a wire of soft iron is substituted for the suspended magnetic needle, either pole of the bar-magnet will attract either end of the wire indifferently. The wire will in fact become temporarily magnetized by induction, that end of it which is nearest to the pole of the magnet acquiring opposite polarity, and behaving as if it were the pole of a permanent magnet. Even a permanent magnet is susceptible of induction, its polarity becoming thereby strengthened, weakened, or possibly reversed. If one pole of a strong magnet is presented to the like pole of a weaker one, there will be repulsion so long as the two are separated by a certain minimum distance. At shorter distances the magnetism induced in the weaker magnet will be stronger than its permanent magnetism, and there will be attraction; two magnets with their like poles in actual contact will always cling together unless the like poles are of exactly equal strength. Induction is an effect of the field of force associated with a magnet. Magnetic force has not merely the property of acting upon magnetic poles, it has the additional property of producing a phenomenon known as *magnetic induction*, or *magnetic flux*, a physical condition which is of the nature of a flow continuously circulating through the magnet and the space outside it. Inside the magnet the course of the flow is from the south pole to the north pole; thence it diverges through the surrounding space, and again converging, re-enters the magnet at the south pole. When the magnetic induction flows through a piece of iron or other magnetizable substance placed near the magnet, a south pole is developed where the flux enters and a north pole where it leaves the substance. Outside the magnet the direction of the magnetic induction is generally the same as that of the magnetic force. A map indicating the direction of the force in different parts of the field due to a magnet may be constructed in a very simple manner. A sheet of cardboard is placed above the magnet, and some iron filings are sifted thinly and evenly over the surface: if the cardboard is gently tapped, the filings will arrange themselves in a series of curves, as shown in fig. 1. This experiment suggested to Faraday the conception of "lines of force," of which the curves formed by the filings afford a rough indication; Faraday's lines are however not confined to the plane of the cardboard, but occur in the whole of the space around the magnet. A *line of force* may be defined as an imaginary line so drawn that its direction at every point of its course coincides with the direction of the magnetic force at that point. Through any point in the field one such line can be drawn, but not more than one, for the force obviously cannot have more than one direction; the lines therefore never intersect. A line of force is regarded as proceeding from the north pole towards the south pole of the magnet, its direction being that in which an isolated north pole would be urged along

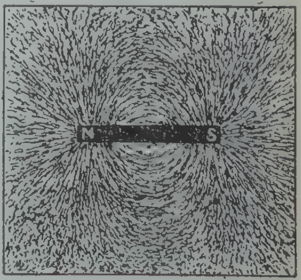

FIG. 1.

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[1] In London in 1910 the needle pointed about 16° W. of the geographical north. (See TERRESTRIAL MAGNETISM.)

it. A south pole would be urged oppositely to the conventional "direction" of the line; hence it follows that a very small magnetic needle, if placed in the field, would tend to set itself along or tangentially to the line of force passing through its centre, as may be approximately verified if the compass be placed among the filings on the cardboard. In the internal field of a long coil of wire carrying an electric current, the lines of force are, except near the ends, parallel to the axis of the coil, and it is chiefly for this reason that the field due to a coil is particularly well adapted for inductively magnetizing iron and steel. The older operation of magnetizing a steel bar by drawing a magnetic pole along it merely consists in exposing successive portions of the bar to the action of the strong field near the pole.

Faraday's lines not only show the direction of the magnetic force, but also serve to indicate its magnitude or strength in different parts of the field. Where the lines are crowded together, as in the neighbourhood of the poles, the force is greater (or the field is stronger) than where they are more widely separated; hence the strength of a field at any point can be accurately specified by reference to the concentration of the lines. The lines presented to the eye by the scattered filings are too vague and ill-defined to give a satisfactory indication of the field-strength (see Faraday, *Experimental Researches*, § 3237) though they show its direction clearly enough. It is however easy to demonstrate by means of the compass that the force is much greater in some parts of the field than in others. Lay the compass upon the cardboard, and observe the rate at which its needle vibrates after being displaced from its position of equilibrium; this will vary greatly in different regions. When the compass is far from the magnet, the vibrations will be comparatively slow; when it is near a pole, they will be exceedingly rapid, the frequency of the vibrations varying as the square root of the magnetic force at the spot. In a refined form this method is often employed for measuring the intensity of a magnetic field at a given place, just as the intensity of gravity at different parts of the earth is deduced from observations of the rate at which a pendulum of known length vibrates.

It is to the non-uniformity of the field surrounding a magnet that the apparent attraction between a magnet and a magnetizable body such as iron is ultimately due. This was pointed out by W. Thomson (afterwards Lord Kelvin) in 1847, as the result of a mathematical investigation undertaken to explain Faraday's experimental observations. If the inductively magnetized body lies in a part of the field which happens to be uniform there will be no resulting force tending to move the body, and it will not be "attracted." If however there is a small variation of the force in the space occupied by the body, it can be shown that the body will be urged, not necessarily towards a magnetic pole, but *towards places of stronger magnetic force*. It will not in general move along a line of force, as would an isolated pole, but will follow the direction in which the magnetic force increases most rapidly, and in so doing it may cross the lines of force obliquely or even at right angles.

If a magnetized needle were supported so that it could move freely about its centre of gravity it would not generally settle with its axis in a horizontal position, but would come to rest with its north-seeking pole either higher or lower than its centre. For the practical observation of this phenomenon it is usual to employ a needle which can turn freely in the plane of the magnetic meridian upon a horizontal axis passing through the centre of gravity of the needle. The angle which the magnetic axis makes with the plane of the horizon is called the *inclination* or *dip*. Along an irregular line encircling the earth in the neighbourhood of the geographical equator the needle takes up a horizontal position, and the dip is zero. At places north of this line, which is called the *magnetic equator*, the north end of the needle points downwards, the inclination generally becoming greater with increased distance from the equator. Within a certain small area in the Arctic Circle (about 97° W. long., 70° N. lat.) the north pole of the needle points vertically downwards, the dip being 90°. South of the magnetic equator the south end of the needle is always inclined downwards, and there is a spot within the Antarctic Circle (148° E. long., 74° S. lat.) where the needle again stands vertically, but with its north end directed upwards. All these observations may be accounted for by the fact first recognized by W. Gilbert in 1600, that the earth itself is a great magnet, having its poles at the two places where the dipping needle is vertical. To be consistent with the terminology adopted in Britain, it is necessary to regard the pole which is geographically north as being the south pole of the terrestrial magnet, and that which is geographically south as the north pole; in practice however the names assigned to the terrestrial magnetic poles correspond with their geographical situations. Within a limited space, such as that contained in a room, the field due to the earth's magnetism is sensibly uniform, the lines of force being parallel straight lines inclined to the horizon at the angle of dip, which at Greenwich in 1910 was about 67°. It is by the horizontal component of the earth's total force that the compass-needle is directed.

The magnets hitherto considered have been assumed to have each two poles, the one north and the other south. It is possible that there may be more than two. If, for example, a knitting needle is stroked with the south pole of a magnet, the strokes being directed from the middle of the needle towards the two extremities alternately, the needle will acquire a north pole at each end and a south pole in the middle. By suitably modifying the manipulation a further number of *consequent poles*, as they are called, may be developed. It is also possible that a magnet may have no poles at all. Let a magnetic pole be drawn several times around a uniform steel ring, so that every part of the ring may be successively subjected to the magnetic force. If the operation has been skilfully performed the ring will have no poles and will not attract iron filings. Yet it will be magnetized; for if it is cut through and the cut ends are drawn apart, each end will be found to exhibit polarity. Again, a steel wire through which an electric current has been passed will be magnetized, but so long as it is free from stress it will give no evidence of magnetization; if, however, the wire is twisted, poles will be developed at the two ends, for reasons which will be explained later. A wire or rod in this condition is said to be *circularly magnetized*; it may be regarded as consisting of an indefinite number of elementary ring-magnets, having their axes coincident with the axis of the wire and their planes at right angles to it. But no magnet can have a single pole; if there is one, there must also be at least a second, of the opposite sign and of exactly equal strength. Let a magnetized knitting needle, having north and south poles at the two ends respectively, be broken in the middle; each half will be found to possess a north and a south pole, the appropriate supplementary poles appearing at the broken ends. One of the fragments may again be broken, and again two bipolar magnets will be produced; and the operation may be repeated, at least in imagination, till we arrive at molecular magnitudes and can go no farther. This experiment proves that the condition of magnetization is not confined to those parts where polar phenomena are exhibited, but exists throughout the whole body of the magnet; it also suggests the idea of *molecular magnetism*, upon which the accepted theory of magnetization is based. According to this theory the molecules of any magnetizable substance are little permanent magnets the axes of which are, under ordinary conditions, disposed in all possible directions indifferently. The process of magnetization consists in turning round the molecules by the application of magnetic force, so that their north poles may all point more or less approximately in the direction of the force; thus the body as a whole becomes a magnet which is merely the resultant of an immense number of molecular magnets.

In every magnet the strength of the south pole is exactly equal to that of the north pole, the action of the same magnetic force upon the two poles being equal and oppositely directed. This may be shown by means of the uniform field of force due to the earth's magnetism. A magnet attached to a cork and floated upon water will set itself with its axis in the magnetic meridian, but it will be drawn neither northward nor southward; the forces acting upon the two poles have therefore no horizontal resultant. And again if a piece of steel is weighed in a delicate balance before and after magnetization, no change whatever in its weight can be detected; there is consequently no upward or downward resultant force due to magnetization; the contrary parallel forces acting upon the poles of the magnet are equal, constituting a couple, which may tend to turn the body, but not to propel it.

Iron and its alloys, including the various kinds of steel, though exhibiting magnetic phenomena in a pre-eminent degree, are not the only substances capable of magnetization. Nickel and cobalt are also strongly magnetic, and in 1903 the interesting discovery was made by F. Heusler that an alloy consisting of copper, aluminium and manganese (Heusler's alloy), possesses magnetic qualities comparable with those of iron. Practically the metals iron, nickel and cobalt, and some of their alloys and compounds constitute a class by themselves and are called *ferromagnetic* substances. But it was discovered by Faraday in 1845 that all substances, including even gases, are either attracted or repelled by a sufficiently powerful magnetic pole. Those substances which are attracted, or rather which tend, like iron, to move from weaker to stronger parts of the magnetic field, are termed *paramagnetic;* those which are repelled, or tend to move from stronger to weaker parts of the field, are termed diamagnetic. Between the ferromagnetics and the paramagnetics there is an enormous gap. The maximum magnetic susceptibility of iron is half a million times greater than that of liquid oxygen, one of the strongest paramagnetic substances known. Bismuth, the strongest of the diamagnetics, has a negative susceptibility which is numerically 20 times less than that of liquid oxygen.

Many of the physical properties of a metal are affected by magnetization. The dimensions of a piece of iron, for example, its elasticity, its thermo-electric power and its electric conductivity are all changed under the influence of magnetism. On the other hand, the magnetic properties of a substance are affected by such causes as mechanical stress and changes of temperature. An account of some of these effects will be found in another section.[1]

2. TERMINOLOGY AND ELEMENTARY PRINCIPLES

In what follows the C.G.S. electromagnetic system of units will be generally adopted, and, unless otherwise stated, magnetic substances will be assumed to be *isotropic*, or to have the same physical properties in all directions.

Vectors.—Physical quantities such as magnetic force, magnetic induction and magnetization, which have direction as well as magnitude, are termed *vectors*; they are compounded and resolved in the same manner as mechanical force, which is itself a vector. When the direction of any vector quantity denoted by a symbol is to be attended to, it is usual to employ for the symbol either a block letter, as H, I, B, or a German capital, as $\mathfrak{H}$, $\mathfrak{I}$, $\mathfrak{B}$.[2]

Magnetic Poles and Magnetic Axis.—A *unit magnetic pole* is that which acts on an equal pole at a distance of one centimetre with a force of one dyne. A pole which points north is reckoned positive, one which points south negative. The action between any two magnetic poles is mutual. If m_1 and m_2 are the strengths of two poles, d the distance between them expressed in centimetres, and f the force in dynes,

$$f = m_1 m_2 / d^2 \tag{1}$$

The force is one of attraction or repulsion, according as the sign of the product $m_1 m_2$ is negative or positive. The poles at the ends of an infinitely thin uniform magnet, or *magnetic filament*, would act as definite centres of force. An actual magnet may generally be regarded as a bundle of magnetic filaments, and those portions of the surface of the magnet where the filaments terminate, and so-called "free magnetism" appears, may be conveniently called poles or polar regions. A more precise definition is the following: When the magnet is placed in a uniform field, the parallel forces acting on the positive poles of the constituent filaments, whether the filaments terminate outside the magnet or inside, have a resultant, equal to the sum of the forces and parallel to their direction, acting at a certain point N. The point N, which is the centre of the parallel forces, is called the *north* or *positive pole* of the magnet. Similarly, the forces acting in the opposite direction on the negative poles of the filaments have a resultant at another point S, which is called the *south* or *negative pole.* The opposite and parallel forces acting on the poles are always equal, a fact which is sometimes expressed by the statement that the total magnetism of a magnet is zero. The line joining the two poles is called the *axis* of the magnet.

Magnetic Field.—Any space at every point of which there is a finite magnetic force is called a *field of magnetic force*, or a *magnetic field*. The *strength* or *intensity* of a magnetic field at any point is measured by the force in dynes which a unit pole will experience when placed at that point, the *direction* of the field being the direction in which a positive pole is urged. The field-strength at any point is also called the *magnetic force* at that point; it is denoted by H, or, when it is desired to draw attention to the fact that it is a vector quantity, by the block letter H, or the German character $\mathfrak{H}$. Magnetic force is sometimes, and perhaps more suitably, termed *magnetic intensity*; it corresponds to the intensity of gravity g in the theory of heavy bodies (see Maxwell, *Electricity and Magnetism*, § 12 and § 68, footnote). A *line of force* is a line drawn through a magnetic field in the direction of the force at each point through which it passes. A *uniform magnetic field* is one in which H has everywhere the same value and the same direction, the lines of force being, therefore, straight and parallel. A magnetic field is generally due either to a conductor carrying an electric current or to the poles of a magnet. The magnetic field due to a long straight wire in which a current of electricity is flowing is at every point at right angles to the plane passing through it and through the wire; its strength at any point distant r centimetres from the wire is

$$H = 2i/r, \tag{2}$$

i being the current in C.G.S. units.[3] The lines of force are evidently circles concentric with the wire and at right angles to it; their direction is related to that of the current in the same manner as the rotation of a corkscrew is related to its thrust. The field at the centre of a circular conductor of radius r through which current is passing is

$$H = 2\pi i/r, \tag{3}$$

the direction of the force being along the axis and related to the direction of the current as the thrust of a corkscrew to its rotation. The field strength in the interior of a long uniformly wound coil containing n turns of wire and having a length of l centimetres is (except near the ends)

$$H = 4\pi i n/l. \tag{4}$$

In the middle portion of the coil the strength of the field is very nearly uniform, but towards the end it diminishes, and at the ends is reduced to one-half. The direction of the force is parallel to the axis of the coil, and related to the direction of the current as the thrust of a corkscrew to its rotation. If the coil has the form of a ring of mean radius r, the length will be $2\pi r$, and the field inside the coil may be expressed as

$$H = 2ni/r. \tag{5}$$

The uniformity of the field is not in this case disturbed by the influence of ends, but its strength at any point varies inversely as the distance from the axis of the ring. When therefore sensible uniformity is desired, the radius of the ring should be large in relation to that of the convolutions, or the ring should have the form of a short cylinder with thin walls. The strongest magnetic fields employed for experimental purposes are obtained by the use of electromagnets. For many experiments the field due to the earth's magnetism is sufficient; this is practically quite uniform throughout considerable spaces, but its total intensity is less than half a unit.

Magnetic Moment and Magnetization.—The *moment*, M, M or $\mathfrak{M}$, of a uniformly and longitudinally magnetized bar-magnet is the product of its length into the strength of one of its poles; it is the moment of the couple acting on the magnet when placed in a field of unit intensity with its axis perpendicular to the direction of the field. If l is the length of the magnet, $M = ml$. The action of a magnet at a distance which is great compared with the length of the magnet depends solely upon its moment; so also does the action which the magnet experiences when placed in a uniform field. The moment of a small magnet may be resolved like a force. The *intensity of magnetization*, or, more shortly, the *magnetization* of a uniformly magnetized body is defined as the magnetic moment per unit of volume, and is denoted by I, I, or $\mathfrak{I}$. Hence

$$I = M/v = ml/v = m/a,$$

v being the volume and a the sectional area. If the magnet is not uniform, the magnetization at any point is the ratio of the moment of an element of volume at that point to the volume itself, or $I = m.ds/dv$. where ds is the length of the element. The direction of the magnetization is that of the magnetic axis of the element; in isotropic substances it coincides with the direction of the magnetic force at the point. If the direction of the magnetization at the surface of a magnet makes an angle ϵ with the normal, the normal component of the magnetization, I cos ϵ, is called the *surface density* of the magnetism, and is generally denoted by σ.

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[1] For the relations between magnetism and light see MAGNETO-OPTICS.

[2] Clerk Maxwell employed German capitals to denote vector quantities. J. A. Fleming first recommended the use of blockletters as being more convenient both to printers and readers.

[3] The C.G.S. unit of current = 10 amperes.

Potential and Magnetic Force.—The *magnetic potential* at any point in a magnetic field is the work which would be done against the magnetic forces in bringing a unit pole to that point from the boundary of the field. The line through the given point along which the potential decreases most rapidly is the direction of the resultant magnetic force, and the rate of decrease of the potential in any direction is equal to the component of the force in that direction. If V denote the potential, F the resultant force, X, Y, Z, its components parallel to the co-ordinate axes and n the line along which the force is directed, then

$$-\frac{\delta V}{\delta n}=F, -\frac{\delta V}{\delta x}=X, -\frac{\delta V}{\delta y}=Y, -\frac{\delta V}{\delta z}=Z. \qquad (6)$$

Surfaces for which the potential is constant are called *equipotential surfaces.* The resultant magnetic force at every point of such a surface is in the direction of the normal (n) to the surface; every line of force therefore cuts the equipotential surfaces at right angles. The potential due to a single pole of strength m at the distance r from the pole is

$$V=m/r, \qquad (7)$$

the equipotential surfaces being spheres of which the pole is the centre and the lines of force radii. The potential due to a thin magnet at a point whose distance from the two poles respectively is r and r' is

$$V=m(l/r=l/r'). \qquad (8)$$

When V is constant, this equation represents an equipotential surface.

The equipotential surfaces are two series of ovoids surrounding the two poles respectively, and separated by a plane at zero potential passing perpendicularly through the middle of the axis. If r and r' make angles θ and θ' with the axis, it is easily shown that the equation to a line of force is

$$\cos\theta-\cos\theta'=\text{constant}. \qquad (9)$$

At the point where a line of force intersects the perpendicular bisector of the axis $r=r'=r_0$, say, and $\cos\theta-\cos\theta'$ obviously $=l/r_0$, l being the distance between the poles; l/r_0 is therefore the value of the constant in (9) for the line in question. Fig. 2 shows the lines of force and the plane sections of the equipotential surfaces for a thin magnet with poles concentrated at its ends. The potential due to a small magnet of moment M, at a point whose distance from the centre of the magnet is r, is

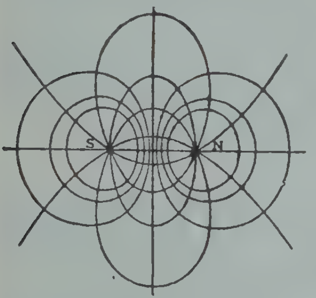

FIG. 2.

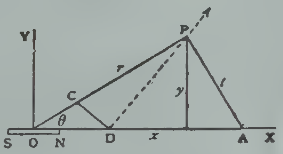

FIG. 3.

$$V=M\cos\theta/r^2, \qquad (10)$$

where θ is the angle between r and the axis of the magnet. Denoting the force at P (see fig. 3) by F, and its components parallel to the co-ordinate axes by X and Y, we have

$$\left.\begin{aligned}X&=-\frac{\delta V}{\delta x}=\frac{M}{r^3}(3\cos^2\theta-1),\\ Y&=-\frac{\delta V}{\delta y}=\frac{M}{r^3}(3\sin\theta\cos\theta.\end{aligned}\right\} \qquad (11)$$

If F_r is the force along r and F_t that along t at right angles to r,

$$F_r=X\cos\theta+Y\sin\theta=\frac{M}{r^3}\,2\cos\theta, \qquad (12)$$

$$F_t=-X\sin\theta+Y\cos\theta=\frac{M}{r^3}\sin\theta. \qquad (13)$$

For the resultant force at P,

$$F=\sqrt{F_r^2+F_t^2}=\frac{M}{r^3}\sqrt{3\cos^2\theta+1}. \qquad (14)$$

The direction of F is given by the following construction: Trisect OP at C, so that OC=OP/3; draw CD at right angles to OP, to cut the axis produced in D; then DP will be the direction of the force at P. For a point in the axis OX, $\theta=0$; therefore $\cos\theta=1$, and the point D coincides with C; the magnitude of the force is, from (14),

$$F_x=2M/r^3, \qquad (15)$$

its direction being along the axis OX. For a point in the line OY bisecting the magnet perpendicularly, $\theta=\pi/2$ therefore $\cos\theta=0$, and the point D is at an infinite distance. The magnitude of the force is in this case

$$F_y=M/r^3, \qquad (16)$$

and its direction is parallel to the axis of the magnet. Although the above useful formulae, (10) to (15), are true only for an infinitely small magnet, they may be practically applied whenever the distance r is considerable compared with the length of the magnet.

Couples and Forces between Magnets.—If a small magnet of moment M is placed in the sensibly uniform field H due to a distant magnet, the couple tending to turn the small magnet upon an axis at right angles to the magnet and to the force is

$$MH\sin\theta, \qquad (17)$$

where θ is the angle between the axis of the magnet and the direction of the force. In fig. 4 S′N′ is a small magnet of moment M′, and SN a distant fixed magnet of moment M; the axes of SN and S′N′ make angles of θ and ϕ respectively with the line through their middle points. It can be deduced from (17), (12) and (13) that the couple on S′N′ due to SN, and tending to increase ϕ, is

$$MM'(\sin\theta\cos\phi-2\sin\phi\cos\theta)/r^3. \qquad (18)$$

This vanishes if $\sin\theta\cos\phi=2\sin\phi\cos\theta$, *i.e.* if $\tan\phi=\frac{1}{2}\tan\theta$, S′N′ being then along a line of force, a result which explains the construction given above for finding the direction of the force F in (14). If the axis of SN produced passes through the centre of S′N′, $\theta=0$, and the couple becomes

$$2MM'\sin\phi/r^3, \qquad (19)$$

tending to diminish ϕ; this is called the "end on" position. If the centre of S′N′ is on the perpendicular bisector of SN, $\theta=\frac{1}{2}\pi$, and the couple will be

$$MM'\cos\phi/r^3, \qquad (20)$$

tending to increase ϕ; this is the "broadside on" position. These two positions are sometimes called the first and second (or A and B) principal positions of Gauss. The components X, Y, parallel and perpendicular to r, of the force between the two magnets SN and S′N′ are

$$X=3MM'(\sin\theta\sin\phi-2\cos\theta\cos\phi)/r^4, \qquad (21)$$
$$Y=3MM'(\sin\theta\cos\phi+\sin\phi\cos\theta)/r^4. \qquad (22)$$

It will be seen that, whereas the couple varies inversely as the cube of the distance, the force varies inversely as the fourth power.

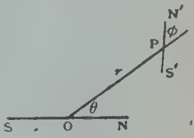

FIG. 4.

Distributions of Magnetism.—A magnet may be regarded as consisting of an infinite number of elementary magnets, each having a pair of poles and a definite magnetic moment. If a series of such elements, all equally and longitudinally magnetized, were placed end to end with their unlike poles in contact, the external action of the filament thus formed would be reduced to that of the two extreme poles. The same would be the case if the magnetization of the filament varied inversely as the area of its cross-section a in different parts. Such a filament is called a *simple magnetic solenoid*, and the product aI is called the *strength* of the solenoid. A magnet which consists entirely of such solenoids, having their ends either upon the surface or closed upon themselves, is called a *solenoidal magnet*, and the magnetism is said to be distributed solenoidally; there is no free magnetism in its interior. If the constituent solenoids are parallel and of equal strength, the magnet is also uniformly magnetized. A thin sheet of magnetic matter magnetized normally to its surface in such a manner that the magnetization at any place is inversely proportional to the thickness h of the sheet at that place is called a *magnetic shell;* the constant product hI is the *strength* of the shell and is generally denoted by Φ or ϕ. The potential at any point due to a magnetic shell is the product of its strength into the solid angle ω subtended by its edge at the given point, or $V=\Phi\omega$. For a given strength, therefore, the potential depends solely upon the boundary of the shell, and the potential outside a closed shell is everywhere zero. A magnet which can be divided into simple magnetic shells, either closed or having their edges on the surface of the magnet, is called a *lamellar magnet*, and the magnetism is said to be distributed lamellarly. A magnet consisting of a series of plane shells of equal strength arranged at right angles to the direction of magnetization will be uniformly magnetized.

It can be shown that uniform magnetization is possible only when the form of the body is ellipsoidal. (Maxwell, *Electricity and Magnetism*, II., § 437). The cases of greatest practical importance are those of a sphere (which is an ellipsoid with three equal axes) and an ovoid or prolate ellipsoid of revolution. The potential due to a uniformly magnetized sphere of radius a for an external point at a distance r from the centre is

$$V=\tfrac{4}{3}\pi a^3 I\cos\theta/r^2, \qquad (23)$$

θ being the inclination of r to the magnetic axis. Since $\frac{4}{3}\pi a^3 I$ is the moment of the sphere (=volume × magnetization), it appears from (10) that the magnetized sphere produces the same external effect as a very small magnet of equal moment placed at its centre and magnetized in the same direction; the resultant force therefore is the same as in (14). The force in the interior is uniform, opposite to the direction of magnetization, and equal to $\frac{4}{3}\pi I$. When it is desired to have a uniform magnet with definitely situated poles, it it usual to employ one having the form of an ovoid, or elongated ellipsoid of revolution, instead of a rectangular or cylindrical bar. If the magnetization is parallel to the major axis, and the lengths of the major and minor axes are $2a$ and $2c$, the poles are situated at a distance equal to $\frac{2}{3}a$ from the centre, and the magnet will behave externally like a simple solenoid of length $\frac{4}{3}a$. The internal force F is opposite to the direction of the magnetization, and equal to NI, where N is a coefficient depending only on the ratio of the axes. The moment $= \frac{4}{3}\pi ac^2 I = -\frac{4}{3}\pi ac^2 FN$.

The distribution of magnetism and the position of the poles in magnets of other shapes, such as cylindrical or rectangular bars, cannot be specified by any general statement, though approximate determinations may be obtained experimentally in individual cases.[1] According to F. W. G. Kohlrausch[2] the distance between the poles of a cylindrical magnet the length of which is from 10 to 30 times the diameter, is sensibly equal to five-sixths of the length of the bar. This statement, however, is only approximately correct, the distance between the poles depending upon the intensity of the magnetization.[3] In general, the greater the ratio of length to section, the more nearly will the poles approach the end of the bar, and the more nearly uniform will be the magnetization. For most practical purpose a knowledge of the exact position of the poles is of no importance; the magnetic moment, and therefore the mean magnetization, can always be determined with accuracy.

Magnetic Induction or Magnetic Flux.—When magnetic force acts on any medium, whether magnetic, diamagnetic or neutral, it produces within it a phenomenon of the nature of a flux or flow called *magnetic induction* (Maxwell, *loc. cit.*, § 428). Magnetic induction, like other fluxes such as electrical, thermal or fluid currents, is defined with reference to an area; it satisfies the same conditions of continuity as the electric current does, and in isotropic media it depends on the magnetic force just as the electric current depends on the electromotive force. The magnitude of the flux produced by a given magnetic force differs in different media. In a uniform magnetic field of unit intensity formed in empty space the induction or magnetic flux across an area of 1 square centimetre normal to the direction of the field is arbitrarily taken as the unit of induction. Hence if the induction per square centimetre at any point is denoted by B, then in empty space B is numerically equal to H; moreover in isotropic media both have the same direction, and for these reasons it is often said that in empty space (and practically in air and other non-magnetic substances) B and H are identical. Inside a magnetized body, B is the force that would be exerted on a unit pole if placed in a narrow crevasse cut in the body, the walls of the crevasse being perpendicular to the direction of the magnetization (Maxwell, §§ 399, 604); and its numerical value, being partly due to the free magnetism on the walls, is generally very different from that of H. In the case of a straight uniformly magnetized bar the direction of the magnetic force due to the poles of the magnet is from the north to the south pole outside the magnet, and from the south to the north inside. The magnetic flux per square centimetre at any point (B, B, or 𝔅) is briefly called the *induction*, or, especially by electrical engineers, the *flux-density*. The direction of magnetic induction may be indicated by *lines of induction*; a line of induction is always a closed curve, though it may possibly extend to and return from infinity. Lines of induction drawn through every point in the contour of a small surface form a re-entrant tube bounded by lines of induction; such a tube is called a *tube of induction*. The cross-section of a tube of induction may vary in different parts, but the total induction across any section is everywhere the same. A special meaning has been assigned to the term "lines of induction." Suppose the whole space in which induction exists to be divided up into *unit tubes*, such that the surface integral of the induction over any cross-section of a tube is equal to unity, and along the axis of each tube let a line of induction be drawn. These axial lines constitute the system of lines of induction which are so often referred to in the specification of a field. Where the induction is high the lines will be crowded together; where it is weak they will be widely separated, the number per square centimetre crossing a normal surface at any point being always equal to the numerical value of B. The induction may therefore be specified as B lines per square centimetre. The direction of the induction is also of course indicated by the direction of the lines, which thus serve to map out space in a convenient manner. Lines of induction are frequently but inaccurately spoken of as lines of force.

When induction or magnetic flux takes place in a ferromagnetic metal, the metal becomes magnetized, but the magnetization at any point is proportional not to B, but to B−H. The factor of proportionality will be $1 \cdot 4\pi$, so that

$$I = (B-H)/4\pi, \qquad (24)$$

or

$$B = H + 4\pi I. \qquad (25)$$

Unless the path of the induction is entirely inside the metal, free magnetic poles are developed at those parts of the metal where induction enters and leaves, the polarity being south at the entry and north at the exit of the flux. These free poles produce a magnetic field which is superposed upon that arising from other sources. The *resultant magnetic field*, therefore, is compounded of two fields, the one being due to the poles, and the other to the external causes which would be operative in the absence of the magnetized metal. The intensity (at any point) of the field due to the magnetization may be denoted by H_i, that of the external field by H_0, and that of the resultant field by H. In certain cases, as, for instance, in an iron ring wrapped uniformly round with a coil of wire through which a current is passing, the induction is entirely within the metal; there are, consequently, no free poles, and the ring, though magnetized, constitutes a poleless magnet. Magnetization is usually regarded as the direct effect of the resultant magnetic force, which is therefore often termed the *magnetizing force*.

Permeability and Susceptibility.—The ratio B/H is called the *permeability* of the medium in which the induction is taking place, and is denoted by μ. The ratio I/H is called the *susceptibility* of the magnetized substance, and is denoted by κ. Hence

$$B = \mu H \text{ and } I = \kappa H. \qquad (26)$$

Also

$$\mu = \frac{B}{H} = \frac{H + 4\pi I}{H} = 1 + 4\pi\kappa, \qquad (27)$$

and

$$\kappa = \frac{\mu - 1}{4\pi} \qquad (28)$$

Since in empty space B has been assumed to be numerically equal to H, it follows that the permeability of a vacuum is equal to 1. The permeability of most material substances differs very slightly from unity, being a little greater than 1 in paramagnetic and a little less in diamagnetic substances. In the case of the ferromagnetic metals and some of their alloys and compounds, the permeability has generally a much higher value. Moreover, it is not constant, being an apparently arbitrary function of H or of B; in the same specimen its value may, under different conditions, vary from less than 2 to upwards of 5000. The magnetic susceptibility κ expresses the numerical relation of the magnetization to the magnetizing force. From the equation $\kappa = (\mu - 1)/4\pi$, it follows that the magnetic susceptibility of a vacuum (where $\mu = 1$) is 0, that of a diamagnetic substance (where $\mu < 1$) has a negative value, while the susceptibility of paramagnetic and ferromagnetic substances (for which $\mu > 1$) is positive. No substance has yet been discovered having a negative susceptibility sufficiently great to render the permeability ($= 1 + 4\pi\kappa$) negative.

Magnetic Circuit.—The circulation of magnetic induction or flux through magnetic and non-magnetic substances, such as iron and air, is in many respects analogous to that of an electric current through good and bad conductors. Just as the lines of flow of an electric current all pass in closed curves through the battery or other generator, so do all the lines of induction pass in closed curves through the magnet or magnetizing coil. The total magnetic induction or flux corresponds to the current of electricity (practically measured in amperes); the induction or flux density B to the density of the current (number of amperes to the square centimetre of section); the magnetic permeability to the specific electric conductivity; and the line integral of the magnetic force, sometimes called the magneto-motive force, to the electro-motive force in the circuit. The principal points of difference are that (1) the magnetic permeability, unlike the electric conductivity, which is independent of the strength of the current, is not in general constant; (2) there is no perfect insulator for magnetic induction, which will pass more or less freely through all known substances. Nevertheless, many important problems relating to the distribution of magnetic induction may be solved by methods similar to those employed for the solution of analogous problems in electricity. For the elementary theory of the magnetic circuit see ELECTRO-MAGNETISM.

Hysteresis, Coercive Force, Retentiveness.—It is found that when a piece of ferromagnetic metal, such as iron, is subjected to a magnetic field of changing intensity, the changes which take place in the induced magnetization of the iron exhibit a tendency to lag behind those which occur in the intensity of the field—a phenomenon to which J. A. Ewing (*Phil. Trans.* clxxvi. 524) has given the name of *hysteresis* (Gr. ὑστερέω, to lag behind). Thus it happens that there is no definite relation between the magnetization of a piece of metal which has been previously magnetized and the strength of the field in which it is placed. Much depends upon its antecedent magnetic condition, and indeed upon its whole magnetic history. A well-known example of hysteresis is presented by the case of permanent magnets. If a bar of hard steel is placed in a strong magnetic field, a certain intensity of magnetization is induced in the bar; but when the strength of the field is afterwards reduced to zero, the magnetization does not entirely disappear. That portion which is permanently retained, and which may amount to considerably more than one-half, is called the *residual magnetization*. The ratio of the residual magnetization to its previous maximum value measures the *retentiveness*, or

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[1] The principal theoretical investigations are summarized in Mascart and Joubert's *Electricity and Magnetism*, i. 391–398 and ii. 646–657. The case of a long iron bar has been experimentally studied with great care by C. G. Lamb, *Proc. Phys. Soc.*, 1899, 16, 509.

[2] *Wied. Ann.*, 1884, 22, 411.

[3] See C. G. Lamb, *loc. cit.* p. 518.

retentivity, of the metal.[1] Steel, which is well suited for the construction of permanent magnets, is said to possess great "coercive force." To this term, which had long been used in a loose and indefinite manner, J. Hopkinson supplied a precise meaning (*Phil. Trans.* clxxvi. 460). The *coercive force*, or *coercivity*, of a material is that reversed magnetic force which, while it is acting, just suffices to reduce the residual induction to nothing after the material has been temporarily submitted to any great magnetizing force. A metal which has great retentiveness may at the same time have small coercive force, and it is the latter quality which is of chief importance in permanent magnets.

Demagnetizing Force.—It has already been mentioned that when a ferromagnetic body is placed in a magnetic field, the resultant magnetic force H, at a point within the body, is compounded of the force H_o, due to the external field, and of another force, H_i, arising from the induced magnetization of the body. Since H_i generally tends to oppose the external force, thus making H less than H_o, it may be called the *demagnetizing force*. Except in the few special cases when a uniform external field produces uniform magnetization, the value of the demagnetizing force cannot be calculated, and an exact determination of the actual magnetic force within the body is therefore impossible. An important instance in which the calculation can be made is that of an elongated *ellipsoid of revolution* placed in a uniform field H_o, with its axis of revolution parallel to the lines of force. The magnetization at any point inside the ellipsoid will then be

$$I = \frac{\kappa H_0}{1+\kappa N} \qquad (29)$$

where $$N = 4\pi\left(\frac{1}{e_2} - 1\right)\left(\frac{1}{2e}\log\frac{1+e}{1-e} - 1\right),$$

e being the eccentricity (see Maxwell's *Treatise*, § 438). Since $I = \kappa H$, we have

$$\kappa H + \kappa N I = \kappa H_0, \qquad (30)$$

or $$H = H_0 - NI,$$

NI being the demagnetizing force H_i. N may be called, after H. du Bois (*Magnetic Circuit*, p. 33), the *demagnetizing factor*, and the ratio of the length of the ellipsoid $2c$ to its equatorial diameter $2a$ $(=c/a)$, the *dimensional ratio*, denoted by the symbol $\mathfrak{m}$.

Since $$e = \sqrt{1 - \frac{a^2}{c^2}} = \sqrt{1 - \frac{1}{\mathfrak{m}^2}},$$

the above expression for N may be written

$$N = \frac{4\pi}{\mathfrak{m}^2 - 1}\left(\frac{\mathfrak{m}}{2\sqrt{\mathfrak{m}^2 - 1}}\log\frac{\mathfrak{m} + \sqrt{\mathfrak{m}^2 - 1}}{\mathfrak{m} - \sqrt{\mathfrak{m}^2 - 1}} - 1\right)$$
$$= \frac{4\pi}{\mathfrak{m}^2 - 1}\left\{\frac{\mathfrak{m}}{\sqrt{\mathfrak{m}^2 - 1}}\log\left(\mathfrak{m} + \sqrt{\mathfrak{m}^2 - 1}\right) - 1\right\},$$

from which the value of N for a given dimensional ratio can be calculated. When the ellipsoid is so much elongated that 1 is negligible in relation to $\mathfrak{m}^2$, the expression approximates to the simpler form

$$N = \frac{4\pi}{\mathfrak{m}^2}\left(\log 2\mathfrak{m} - 1\right). \qquad (31)$$

In the case of a *sphere*, $e = 0$ and $N = \frac{4}{3}\pi$; therefore from (29)

$$I = \kappa H = \frac{\kappa H_0}{1 + \frac{4}{3}\pi\kappa} = \frac{3\kappa}{3 + 4\pi\kappa}H_0, \qquad (32)$$

Whence $$H = \frac{3}{3 + 4\pi\kappa}H_0 = \frac{3}{\mu + 2}H_0, \qquad (33)$$

and $$B = \mu H = \frac{3\mu}{\mu + 2}H_0. \qquad (34)$$

Equations (33) and (34) show that when, as is generally the case with ferromagnetic substances, the value of μ is considerable, the resultant magnetic force is only a small fraction of the external force, while the numerical value of the induction is approximately three times that of the external force, and nearly independent of the permeability. The demagnetizing force inside a *cylindrical rod* placed longitudinally in a uniform field H_0 is not uniform, being greatest at the ends and least in the middle part. Denoting its mean value by $\bar{H}_i$, and that of the demagnetizing factor by $\bar{N}$, we have

$$H = H_0 - \bar{H}_i = H_0 - \bar{N}I. \qquad (35)$$

Du Bois has shown that when the dimensional ratio $\mathfrak{m}$ (=length/diameter) exceeds 100, $\bar{N}\mathfrak{m}^2 = \text{constant} = 45$, and hence for long thin rods

$$\bar{N} = 45/\mathfrak{m}^2. \qquad (36)$$

From an analysis of a number of experiments made with rods of different dimensions H. du Bois has deduced the corresponding mean demagnetizing factors. These, together with values of $\mathfrak{m}^2\bar{N}$ for cylindrical rods, and of N and $\mathfrak{m}^2$N for ellipsoids of revolution, are given in the following useful table (*loc. cit.* p. 41):—

Demagnetizing Factors.

$\mathfrak{m}$.	Cylinder.		Ellipsoid.	
	$\bar{N}$.	$\mathfrak{m}^2\bar{N}$.	N.	$\mathfrak{m}^2$N.
0	12·5664	0	12·5664	0
0·5	—	—	6·5864	—
1	—	—	4·1888	—
5	—	—	0·7015	—
10	0·2160	21·6	0·2549	25·5
15	0·1206	27·1	0·1350	30·5
20	0·0775	31·0	0·0848	34·0
25	0·0533	33·4	0·0579	36·2
30	0·0393	35·4	0·0432	38·8
40	0·0238	38·7	0·0266	42·5
50	0·0162	40·5	0·0181	45·3
60	0·0118	42·4	0·0132	47·5
70	0·0089	43·7	0·0101	49·5
80	0·0069	44·4	0·0080	51·2
90	0·0055	44·8	0·0065	52·5
100	0·0045	45·0	0·0054	54·0
150	0·0020	45·0	0·0026	58·3
200	0·0011	45·0	0.0016	64·0
300	0·00050	45·0	0·00075	67·5
400	0·00028	45·0	0·00045	72·0
500	0·00018	45·0	0·00030	75·0
1000	0·00005	45·0	0·00008	80·0

In the middle part of a rod which has a length of 400 or 500 diameters the effect of the ends is insensible; but for many experiments the condition of endlessness may be best secured by giving the metal the shape of a ring of uniform section, the magnetic field being produced by an electric current through a coil of wire evenly wound round the ring. In such cases $H_i = 0$ and $H = H_0$.

The residual magnetization I_r retained by a bar of ferromagnetic metal after it has been removed from the influence of an external field produces a demagnetizing force $\bar{N}I_r$, which is greater the smaller the dimensional ratio. Hence the difficulty of imparting any considerable permanent magnetization to a short thick bar not possessed of great coercive force. The magnetization retained by a long thin rod, even when its coercive force is small, is sometimes little less than that which was produced by the direct action of the field.

Demagnetization by Reversals.—In the course of an experiment it is often desired to eliminate the effects of previous magnetization, and, as far as possible, wipe out the magnetic history of a specimen. In order to attain this result it was formerly the practice to raise the metal to a bright red heat, and allow it to cool while carefully guarded from magnetic influence. This operation, besides being very troublesome, was open to the objection that it was almost sure to produce a material but uncertain change in the physical constitution of the metal, so that, in fact, the results of experiments made before and after the treatment were not comparable. Ewing introduced the method (*Phil. Trans.* clxxvi. 539) of demagnetizing a specimen by subjecting it to a succession of magnetic forces which alternated in direction and gradually diminished in strength from a high value to zero. By means of a simple arrangement, which will be described farther on, this process can be carried out in a few seconds, and the metal can be brought as often as desired to a definite condition, which, if not quite identical with the virgin state, at least closely approximates to it.

Forces acting on a Small Body in the Magnetic Field.—If a small magnet of length ds and pole-strength m is brought into a magnetic field such that the values of the magnetic potential at the negative and positive poles respectively are V_1 and V_2, the work done upon the magnet, and therefore its potential energy, will be

$$W = m(V_2 - V_1) = m\,dV,$$

which may be written

$$W = m\,ds\frac{dV}{ds} = M\frac{dV}{ds} = -MH_0 = -vIH_0,$$

where M is the moment of the magnet, v the volume, I the magnetization, and H_0 the magnetic force along ds. The small magnet may be a sphere rigidly magnetized in the direction of H_0; if this is replaced by an isotropic sphere inductively magnetized by the field, then, for a displacement so small that the magnetization of the sphere may be regarded as unchanged, we shall have

$$dW = -vI\,dH_0 = -v\frac{\kappa}{1 + \frac{4}{3}\pi\kappa}H_0\,dH_0;$$

whence

$$W = -\frac{v}{2}\,\frac{\kappa}{1 + \frac{4}{3}\pi\kappa}H^2_0. \qquad (37)$$

The mechanical force acting on the sphere in the direction of displacement x is

$$F = -\frac{dW}{dx} = v\frac{\kappa}{1 + \frac{4}{3}\pi\kappa}\,\frac{dH^2_0}{dx}. \qquad (38)$$

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[1] Hopkinson specified the retentiveness by the numerical value of the "residual induction" $(=4\pi I)$.

If H_0 is constant, the force will be zero; if H_0 is variable, the sphere will tend to move in the direction in which H_0 varies most rapidly. The coefficient $\kappa/(1+\frac{8}{3}\pi\kappa)$ is positive for ferromagnetic and paramagnetic substances, which will therefore tend to move from weaker to stronger parts of the field; for all known diamagnetic substances it is negative, and these will tend to move from stronger to weaker parts. For small bodies other than spheres the coefficient will be different, but its sign will always be negative for diamagnetic substances and positive for others;[1] hence the forces acting on any small body will be in the same directions as in the case of a sphere.[2]

Directing Couple acting on an Elongated Body.—In a non-uniform field every volume-element of the body tends to move towards regions of greater or less force according as the substance is paramagnetic or diamagnetic; and the behaviour of the whole mass will be determined chiefly by the tendency of its constituent elements. For this reason a thin bar suspended at its centre of gravity between a pair of magnetic poles will, if paramagnetic, set itself along the line joining the poles, where the field is strongest, and if diamagnetic, transversely to the line. These are the "axial" and "equatorial" positions of Faraday. It can be shown[3] that in a uniform field an elongated piece of any non-crystalline material is in stable equilibrium only when its length is parallel to the lines of force; for diamagnetic substances, however, the directing couple is exceedingly small, and it would hardly be possible to obtain a uniform field of sufficient strength to show the effect experimentally.

Relative Magnetization.—A substance of which the real susceptibility is κ will, when surrounded by a medium having the susceptibility k', behave towards a magnet as if its susceptibility were $\kappa_a=(\kappa-\kappa')/(1+4\pi\kappa')$. Since $1+4\pi\kappa'$ can never be negative, the apparent susceptibility κ_a will be positive or negative according as κ is greater or less than κ'. Thus, for example, a tube containing a weak solution of an iron salt will appear to be diamagnetic if it is immersed in a stronger solution of iron, though in air it is paramagnetic.[4]

Circular Magnetization.—An electric current i flowing uniformly through a cylindrical wire whose radius is a produces inside the wire a magnetic field of which the lines of force are concentric circles around the axis of the wire. At a point whose distance from the axis of the wire is r the tangential magnetic force is

$$H=2ir/a^2 \qquad (39)$$

it therefore varies directly as the distance from the axis, where it is zero.[5] If the wire consists of a ferromagnetic metal, it will become "circularly" magnetized by the field, the lines of magnetization being, like the lines of force, concentric circles. So long as the wire (supposed isotropic) is free from torsional stress, there will be no external evidence of magnetism.

Magnetic Shielding.—The action of a hollow magnetized shell on a point inside it is always opposed to that of the external magnetizing force,[6] the resultant interior field being therefore weaker than the field outside. Hence any apparatus, such as a galvanometer, may be partially shielded from extraneous magnetic action by enclosing it in an iron case. If a hollow sphere[7] of which the outer radius is R and the inner radius r is placed in a uniform field H_0, the field inside will also be uniform and in the same direction as H_0, and its value will be approximately

$$H_i=\frac{H_0}{1+\frac{2}{9}(\mu-2)\left(1-\frac{r^3}{R^3}\right)} \qquad (40)$$

For a cylinder placed with its axis at right angles to the lines of force,

$$H_i=\frac{H_0}{1+\frac{1}{4}(\mu-2)\left(1-\frac{r^2}{R^2}\right)} \qquad (41)$$

These expressions show that the thicker the screen and the greater its permeability μ, the more effectual will be the shielding action. Since μ can never be infinite, complete shielding is not possible.

Magneto-Crystallic Phenomenon.—In anisotropic bodies, such as crystals, the direction of the magnetization does not in general coincide with that of the magnetic force. There are, however, always three *principal axes* at right angles to one another along which the magnetization and the force have the same direction. If each of these axes successively is placed parallel to the lines of force in a uniform field H, we shall have

$$I_1=\kappa_1H,\ I_2=\kappa_2H,\ I_3=\kappa_3H,$$

the three susceptibilities κ being in general unequal, though in some cases two of them may have the same value. For crystalline bodies the value of κ (+ or −) is nearly always small and constant, the magnetization being therefore independent of the form of the body and proportional to the force. Hence, whatever the position of the body, if the field be resolved into three components parallel to the principal axes of the crystal, the actual magnetization will be the resultant of the three magnetizations along the axes. The body (or each element of it) will tend to set itself with its axis of greatest susceptibility parallel to the lines of force, while, if the field is not uniform, each volume-element will also tend to move towards places of greater or smaller force (according as the substance is paramagnetic or diamagnetic), the tendency being a maximum when the axis of greatest susceptibility is parallel to the field, and a minimum when it is perpendicular to it. The phenomena may therefore be exceedingly complicated.[8]

3. Magnetic Measurements

Magnetic Moment.—The moment M of a magnet may be determined in many ways,[9] the most accurate being that of C. F. Gauss, which gives the value not only of M, but also that of H, the horizontal component of the earth's force. The product MH is first determined by suspending the magnet horizontally, and causing it to vibrate in small arcs. If A is the moment of inertia of the magnet, and t the time of a complete vibration, $MH=4\pi^2A/t^2$ (torsion being neglected). The ratio M/H is then found by one of the magnetometric methods which in their simplest forms are described below. Equation (44) shows that as a first approximation.

$$M/H=(d^2-l^2)\tan\theta/2d,$$

where l is half the length of the magnet, which is placed in the "broadside-on" position as regards a small suspended magnetic needle, d the distance between the centre of the magnet and the needle, and θ the angle through which the needle is deflected by the magnet. We get therefore

$$M^2=MH\times M/H=2\pi^2A(d^2-l^2)^2\tan\theta/t^2d \qquad (42)$$

$$H^2=MH\times H/M=8\pi^2Ad/\{t^2(d^2-l^2)^2\tan\theta\} \qquad (43)$$

When a high degree of accuracy is required, the experiments and calculations are less simple, and various corrections are applied. The moment of a magnet may also be deduced from a measurement of the couple exerted on the magnet by a uniform field H. Thus if the magnet is suspended horizontally by a fine wire, which, when the magnetic axis points north and south, is free from torsion, and if θ is the angle through which the upper end of the wire must be twisted to make the magnet point east and west, then $MH=C\theta$, or $M=C\theta/H$, where C is the torsional couple for 1°. A bifilar suspension is sometimes used instead of a single wire. If P is the weight of the magnet, l the length of each of the two threads, $2a$ the distance between their upper points of attachment, and $2b$ that between the lower points, then, approximately, $MH=P(ab/l)\sin\theta$. It is often sufficient to find the ratio of the moment of one magnet to that of another. If two magnets having moments M, M′ are arranged at right angles to each other upon a horizontal support which is free to rotate, their resultant R will set itself in the magnetic meridian. Let θ be the angle which the standard magnet M makes with the meridian, then $M'/R=\sin\theta$, and $M/R=\cos\theta$, whence $M'=M\tan\theta$.

A convenient and rapid method of estimating a magnetic moment has been devised by H. Armagnat.[10] The magnet is laid on a table with its north pole pointing northwards, A compass having a very short needle is placed on the line which bisects the axis of the magnet at right angles, and is moved until a neutral point is found where the force due to the earth's field H is balanced by that due to the magnet. If $2l$ is the distance between the poles m and $-m$, d the distance from either pole to a point P on the line AB (fig. 5), we have for the resultant force at P

$$R=-2\cos\theta\times m/d^2=-2lm/d^3=-M/d^3.$$

When P is the neutral point, H is equal and opposite to R; therefore $M=Hd^3$, or the moment is numerically equal to the cube of the distance from the neutral point to a pole, multiplied by the

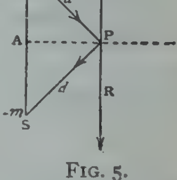

Fig. 5.

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[1] For all except ferromagnetic substances the coefficient is sensibly equal to κ.

[2] See W. Thomson's *Reprint*, §§ 615, 634–651.

[3] Ibid. §§ 646, 684.

[4] Faraday, *Exp. Res.* xxi.

[5] J. J. Thomson, *Electricity and Magnetism*, § 205.

[6] Maxwell, *Electricity and Magnetism*, § 431.

[7] H. du Bois, *Electrician*, 1898, 40, 317.

[8] M. Faraday, *Exp. Res.* xxii., xxiii.; W. Thomson, *Reprint*, § 604; J. C. Maxwell, *Treatise*, § 435; E. Mascart and J. Joubert, *Electricity and Magnetism*, §§ 384, 396, 1226; A. Winkelmann, *Physik*, v. 287.

[9] See A. Winkelmann, *Physik*, v. 69–94; Mascart and Joubert. *Electricity and Magnetism*, ii. 617.

[10] *Sci. Abs.* A, 1906, 9, 225.

horizontal intensity of the earth's force. The distance between the poles may with sufficient accuracy for a rough determination be assumed to be equal to five-sixths of the length of the magnet.

Measurement of Magnetization and Induction.—The magnetic condition assumed by a piece of ferromagnetic metal in different circumstances is determinable by various modes of experiment which may be classed as magnetometric, ballistic, and traction methods. When either the magnetization I or the induction B corresponding to a given magnetizing force H is known, the other may be found by means of the formula $B = 4\pi I + H$.

Magnetometric Methods.—Intensity of magnetization is most directly measured by observing the action which a magnetized body, generally a long straight rod, exerts upon a small magnetic needle placed near it. The magnetic needle may be cemented horizontally across the back of a little plane or concave mirror, about $\frac{1}{4}$ or $\frac{3}{8}$ in. in diameter, which is suspended by a single fibre of unspun silk; this arrangement, when enclosed in a case with a glazed front to protect it from currents of air, constitutes a simple but efficient magnetometer. Deflections of the suspended needle are indicated by the movement of a narrow beam of light which the mirror reflects from a lamp and focusses upon a graduated cardboard scale placed at a distance of a few feet; the angular deflection of the beam of light is, of course, twice that of the needle. The suspended needle is, in the absence of disturbing causes, directed solely by the horizontal component of the earth's field of magnetic force H_E, and therefore sets itself approximately north and south. The magnetized body which is to be tested should be placed in such a position that the force H_P due to its poles may, at the spot occupied by the suspended needle, act in a direction at right angles to that due to the earth—that is, east and west. The direction of the resultant field of force will then make, with that of H_E, an angle θ, such that $H_P/H_E = \tan\theta$, and the suspended needle will be deflected through the same angle. We have therefore

$$H_P = H_E \tan\theta.$$

The angle θ is indicated by the position of the spot of light upon the scale, and the horizontal intensity of the earth's field H_E is known; thus we can at once determine the value of H_P, from which the magnetization I of the body under test may be calculated.

In order to fulfil the requirement that the field which a magnetized rod produces at the magnetometer shall be at right angles to that of the earth, the rod may be conveniently placed in any one of three different positions with regard to the suspended needle.

(1) The rod is set in a horizontal position level with the suspended needle, its axis being in a line which is perpendicular to the magnetic meridian, and which passes through the centre of suspension of the needle. This is called the "end-on" position, and is indicated in fig. 6. AB is the rod and C the middle point of its axis; NS is the magnetometer needle; AM bisects the undeflected needle NS at right angles. Let $2l$ = the length of the rod (or, more accurately, the distance between its poles), v = its volume, m and $-m$ the strength of its poles, and let d = the distance CM. For most ordinary purposes the length of the needle may be assumed to be negligible in comparison with the distance between the needle and the rod. We then have approximately for the field at M due to the rod

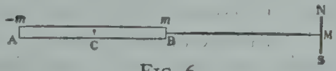

FIG. 6.

$$H_P = \frac{m}{(d-l)^2} - \frac{m}{(d+l)^2} = m\frac{4dl}{(d^2-l^2)^2}.$$

Therefore $$2ml = M = \frac{(d^2-l^2)^2 H_P}{2d} = \frac{(d^2-l^2)^2 H_E \tan\theta}{2d}. \quad (44)$$

And $$I = \frac{M}{v} = \frac{(d^2-l^2)^2 H_E}{2dv} \tan\theta, \quad (45)$$

whence we can find the values of I which correspond to different angles of deflection.

(2) The rod may be placed horizontally east and west in such a position that the direction of the undeflected suspended needle bisects it at right angles. This is known as the "broadside-on" position, and is represented in fig. 7. Let the distance of each pole of the rod AB from the centre of the magnetometer needle = d. Then, since H_P, the force at M due to m and $-m$, is the resultant of $\frac{m}{d^2}$ and $-\frac{m}{d^2}$, we have

$$\frac{H_P}{\frac{m}{d^2}} = \frac{2l}{d}$$

or $$H_P = \frac{2ml}{d^3},$$

the direction being parallel to AB.

And $$I = \frac{d^3 H_P}{v} = \frac{d^3 H_E}{v} \tan\theta. \quad (46)$$

(3) In the third position the test rod is placed vertically with one of its poles at the level of the magnetometer needle, and in the line drawn perpendicularly to the undeflected needle from its centre of suspension. The arrangement is shown in fig. 8, where AB is the vertical rod and M indicates the position of the magnetometer needle, which is supposed to be perpendicular to the plane of the paper. Denoting the distance AM by d_1, BM by d_2, and AB by l, we have for the force at M due to the magnetism of the rod

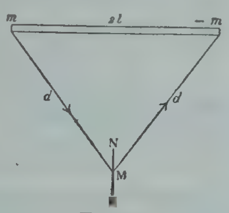

FIG. 7.

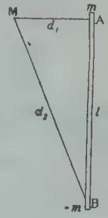

FIG. 8.

$$H_P = \frac{m}{d_1^2} - \text{horizontal component of } \frac{m}{d_2^2}$$
$$= m\left(\frac{1}{d_1^2} - \frac{d_1}{d_2^3}\right).$$

Therefore $$m = \frac{H_P}{\frac{1}{d_1^2} - \frac{d_1}{d_2^3}} = \frac{d_1^2 H_E}{1 - \left(\frac{d_1}{d_2}\right)^3} \tan\theta,$$

and $$I = \frac{l d_1^2 H_E}{v\left\{1 - \left(\frac{d_1}{d_2}\right)^3\right\}} \tan\theta. \quad (47)$$

This last method of arrangement is called by Ewing the "one-pole" method, because the magnetometer deflection is mainly caused by the upper pole of the rod (*Magnetic Induction*, p. 40). For experiments with long thin rods or wires it has an advantage over the other arrangements in that the position of the poles need not be known with great accuracy, a small upward or downward displacement having little effect upon the magnetometer deflection. On the other hand, a vertically placed rod is subject to the inconvenience that it is influenced by the earth's magnetic field, which is not the case when the rod is horizontal and at right angles to the magnetic meridian. This extraneous influence may, however, be eliminated by surrounding the rod with a coil of wire carrying a current such as will produce in the interior a magnetic field equal and opposite to the vertical component of the earth's field.

If the cardboard scale upon which the beam of light is reflected by the magnetometer mirror is a flat one, the deflections as indicated by the movement of the spot of light are related to the actual deflections of the needle in the ratio of $\tan 2\theta$ to θ. Since θ is always small, sufficiently accurate results may generally be obtained if we assume that $\tan 2\theta = 2 \tan\theta$. If the distance of the mirror from the scale is equal to n scale divisions, and if a deflection θ of the needle causes the reflected spot of light to move over s scale divisions, we shall have

$$s/n = \tan 2\theta \text{ exactly,}$$
$$s/2n = \tan\theta \text{ approximately.}$$

We may therefore generally substitute $s/2n$ for $\tan\theta$ in the various expressions which have been given for I.

Of the three methods which have been described, the first two are generally the most suitable for determining the moment or the magnetization of a permanent magnet, and the last for studying the changes which occur in the magnetization of a long rod or wire when subjected to various external magnetic forces, or, in other words, for determining the relation of I to H. A plan of the apparatus as arranged by Ewing for the latter purpose is shown diagrammatically in fig. 9. The cardboard scale SS is placed above a wooden screen, having in it a narrow vertical slit which permits a beam of light from the lamp L to reach the mirror of the magnetometer M, whence it is reflected upon the scale. A is the upper end of a glass tube, half a metre or so in length, which is clamped in a vertical position behind the magnetometer. The tube is wound over its whole length with two separate coils of insulated wire, the one being outside the other. The inner coil is supplied, through the intervening apparatus, with current from the battery of secondary cells B_1; this produces the desired magnetic field inside the tube. The outer coil derives current, through an adjustable resistance R, from a constant cell B_2; its object is to produce inside the tube a magnetic field equal and opposite to that due to the earth's magnetism. C is a "compensating coil" consisting of a few turns of wire through which the magnetizing current passes; it serves to neutralize the effect produced upon the magnetometer by the magnetizing coil, and its distance from the magnetometer is so adjusted that when the circuit is closed, no ferromagnetic metal being inside the magnetizing coil, the magnetometer needle undergoes no deflection. K is a commutator for reversing the direction of the magnetizing current, and G a galvanometer for measuring it. The strength of the magnetizing current is regulated by adjusting the position of the sliding contact E upon the resistance DF. The current increases to a maximum as E approaches F, and diminishes to almost nothing when E is brought up to D; it can be completely interrupted by means of the switch H.

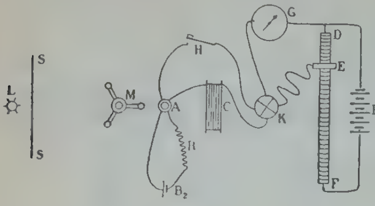

FIG. 9.

The specimen upon which an experiment is to be made generally consists of a wire having a "dimensional ratio" of at least 300 or 400; its length should be rather less than that of the magnetizing coil, in order that the field H_0, to which it is subjected, may be approximately uniform from end to end. The wire is supported inside the glass tube A with its upper pole at the same height as the magnetometer needle. Various currents are then passed through the magnetizing coil, the galvanometer readings and the simultaneous magnetometer deflections being noted. From the former we deduce H_0, and from the latter the corresponding value of I, using the formulae $H_0 = 4\pi in/l$ and

$$I = \frac{d_1{}^2 H_E}{2n\pi r^2 \left\{ 1 - \left(\frac{d_1}{d_2}\right)^3 \right\}} \times s, \tag{48}$$

where s is the deflection in scale-divisions, n the distance in scale-divisions between the scale and the mirror, and r the radius of the wire.

The curve, fig. 10, shows the result of a typical experiment made upon a piece of soft iron (Ewing, *Phil. Trans.* vol. clxxvi. Plate 59), the magnetizing field H_0 being first gradually increased and then diminished to zero. When the length of the wire exceeds 400 diameters, or thereabouts, H_0 may generally be considered as equivalent to H, the actual strength of the field as modified by the magnetization of the wire; but if greater accuracy is desired, the value of H_i ($=\overline{N}$I) may be found by the help of du Bois's table and subtracted from H_0. For a dimensional ratio of 400, $\overline{N}$ =0·00028, and therefore H=H_0 — 0·00028 I. This correction may be indicated in the diagram by a straight line drawn from 0 through the point at which the line of I = 1000 intersects that of H = 0·28 (Rayleigh, *Phil. Mag.* xxii. 175), the true value of H for any point on the curve being that measured from the sloping line instead of from the vertical axis. The effect of the ends of the wire is, as Ewing remarks, to *shear* the diagram in the horizontal direction through the angle which the sloping line makes with the vertical.

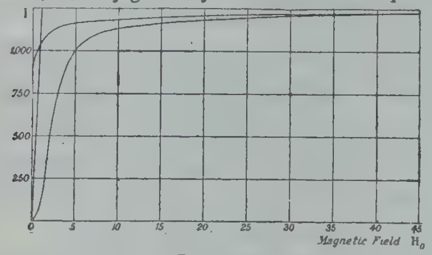

FIG. 10.

Since the induction B is equal to H + 4πI, it is easy from the results of experiments such as that just described to deduce the relation between B and H; a curve indicating such relation is called a curve of induction. The general character of curves of magnetization and of induction will be discussed later. A notable feature in both classes of curves is that, owing to hysteresis, the ascending and descending limbs do not coincide, but follow very different courses. If it is desired to annihilate the hysteretic effects of previous magnetization and restore the metal to its original condition, it may be demagnetized by reversals. This is effected by slowly moving the sliding contact E (fig. 9) from F to D, while at the same time the commutator K is rapidly worked, a series of alternating currents of gradually diminishing strength being thus caused to pass through the magnetizing coil.

The magnetometric method, except when employed in connexion with ellipsoids, for which the demagnetizing factors are accurately known, is generally less satisfactory for the exact determination of induction or magnetization than the ballistic method. But for much important experimental work it is better adapted than any other, and is indeed sometimes the only method possible.[1]

Ballistic Methods.—The so-called "ballistic" method of measuring induction is based upon the fact that a change of the induction through a closed linear conductor sets up in the conductor an electromotive force which is proportional to the rate of change. If the conductor consists of a coil of wire the ends of which are connected with a suitable galvanometer, the integral electromotive force due to a sudden increase or decrease of the induction through the coil displaces in the circuit a quantity of electricity $Q=\delta Bns$ R, where δB is the increment or decrement of induction per square centimetre, s is the area of the coil, n the number of turns of wire, and R the resistance of the circuit. Under the influence of the transient current, the galvanometer needle undergoes a momentary deflection, or "throw," which is proportional to Q, and therefore to δB, and thus, if we know the deflection produced by the discharge through the galvanometer of a given quantity of electricity, we have the means of determining the value of δB.

The galvanometer which is used for ballistic observations should have a somewhat heavy needle with a period of vibration of not less than five seconds, so that the transient current may have ceased before the swing has well begun; an instrument of the d'Arsonval form is recommended, not only because it is unaffected by outside magnetic influence, but also because the moving part can be instantly brought to rest by means of a short-circuit key, thus effecting a great saving of time when a series of observations is being made. In practice it is usual to standardize or "calibrate" the galvanometer by causing a known change of induction to take place within a standard coil connected with it, and noting the corresponding deflection on the galvanometer scale. Let s be the area of a single turn of the standard coil, n the number of its turns, and r the resistance of the circuit of which the coil forms part; and let S, N and R be the corresponding constants for a coil which is to be used in an experiment. Then if a known change of induction δB_a inside the standard coil is found to cause a throw of d scale-divisions, any change of induction δB through the experimental coil will be numerically equal to the corresponding throw D multiplied by $snRB_a/SNrd$. For a series of experiments made with the same coil this fraction is constant, and we may write $\delta B = k$D. Rowland and others have used an earth coil for calibrating the galvanometer, a known change of induction through the coil being produced by turning it over in the earth's magnetic field, but for several reasons it is preferable to employ an electric current as the source of a known induction. A primary coil of length l, having n turns, is wound upon a cylinder made of non-conducting and non-magnetic material, and upon the middle of the primary a secondary or induction coil is closely fitted. When a current of strength i is suddenly interrupted in the primary, the increment of induction through the secondary is sensibly equal to $4\pi in/l$ units. All the data required for standardizing the galvanometer can in this way be determined with accuracy.

The ballistic method is largely employed for determining the relation of induction to magnetizing force in samples of the iron and steel used in the manufacture of electrical machinery, and especially for the observation of hysteresis effects. The sample may have the form of a closed ring, upon which are wound the induction coil and another coil for taking the magnetizing current; or it may consist of a long straight rod or wire which can be slipped into a magnetizing coil such as is used in magnetometric experiments, the induction coil being wound upon the middle of the wire. With these arrangements there is no demagnetizing force to be considered, for the ring has not any ends to produce one, and the force due to the ends of a rod 400 or 500 diameters in length is quite insensible at the middle portion; H therefore is equal to H_0.

E. Grassot has devised a galvanometer, or "fluxmeter," which greatly alleviates the tedious operation of taking ballistic readings.[2] The instrument is of the d'Arsonval type; its coil turns in a strong uniform field, and is suspended in such a manner that torsion is practically negligible, the swings of the coil being limited by damping influences, chiefly electromagnetic. The index therefore remains almost stationary at the limit of its deflection, and the deflection is approximately the same whether the change of induction occurs suddenly or gradually.

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[1] See C. G. Lamb, *Proc. Phys. Soc.*, 1899, 16, 517.

[2] *Soc. Franc. Phys. Séances*, 1904, 1, 27.

Induction and Hysteresis Curves.—Some typical induction curves, copied from a paper by Ewing (*Proc. Inst. C.E.* vol. cxxvi.), are given in figs. 11, 12 and 13. Fig. 11 shows the relation of B to H in a specimen which has never before been magnetized. The experiment may be made in two different ways: (1) the magnetizing current is increased by a series of sudden steps, each of which produces a ballistic throw, the value of B after any one throw being proportional to the sum of that and all the previous throws; (2) the magnetizing current having been brought to any desired value, is suddenly reversed, and the observed throw taken as measuring twice the actual induction. Fig. 12 shows the nature of the course taken by the curve when the magnetizing current, after having been raised to the value corresponding to the point *a*, is diminished by steps until it is nothing, and then gradually increased in the reverse direction. The downward course of the curve is, owing to hysteresis, strikingly different from its upward course, and when the magnetizing force has been reduced to zero, there is still remaining an induction of 7500 units. If the operation is again reversed, the upward course will be nearly, but not exactly, of the form shown by the line *d e a*, fig. 13. After a few repetitions of the reversal, the process becomes strictly cyclic, the upward and downward curves always following with precision the paths indicated in the figure. In order to establish the cyclic condition, it is sufficient to apply alternately the greatest positive and negative forces employed in the test (greatest H = about ±5 C.G.S. units in the case illustrated in the figure), an operation which is performed by simply reversing the direction of the maximum magnetizing current a few times.

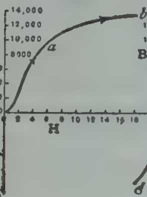

FIG. 11.

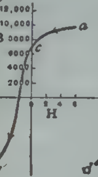

FIG. 12.

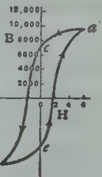

FIG. 13.

The closed figure *a c d e a* is variously called a *hysteresis curve* or *diagram* or *loop*. The area $\int \mathrm{H}d\mathrm{B}$ enclosed by it represents the work done in carrying a cubic centimetre of the iron through the corresponding magnetic cycle; expressed in ergs this work is $\frac{1}{4\pi}\int \mathrm{H}d\mathrm{B}$.[1] To quote an example given by J. A. Fleming, it requires about 18 foot-pounds of work to make a complete magnetic cycle in a cubic foot of wrought iron, strongly magnetized first one way and then the other, the work so expended taking the form of heat in the mass.

Fig. 14 shows diagrammatically a convenient arrangement described by Ewing (see *Proc. Inst. C.E.* vol. cxxvi., and *Phil. Trans.*, 1893A, p. 987) for carrying out ballistic tests by which either the simple B–H curve (fig. 11) or the hysteresis curve (figs. 12 and 13) can be determined. The sample under test is prepared in the form of a ring A, upon which are wound the induction and the magnetizing coils; the latter should be wound evenly over the whole ring, though for the sake of clearness only part of the winding is indicated in the diagram. The magnetizing current, which is derived from the storage battery B, is regulated by the adjustable resistance R and measured by the galvanometer G. The current passes through the rocking key K, which, when thrown over to the right, places *a* in contact with *c* and *b* with *d*, and when thrown over to the left, places *a* in contact with *e* and *b* with *f*. When the switch S is closed, K acts simply as a commutator or current-reverser, but if K is thrown over from right to left while S is opened, not only is the current reversed, but its strength is at the same time diminished by the interposition of the adjustable resistance R_2. The induction coil wound upon the ring is connected to the ballistic galvanometer G_2 in series with a large permanent resistance R_3. In the same circuit is also included the induction coil E, which is used for standardizing the galvanometer; this secondary coil is represented in the diagram by three turns of wire wound over a much longer primary coil. The short-circuit key F is kept closed except when an observation is about to be made; its object is to arrest the swing of the d'Arsonval galvanometer G_2. By means of the three-way switch C the battery current may be sent either into the primary of E, for the purpose of calibrating the galvanometer, or into the magnetizing coil of the ring under test. When it is desired to obtain a simple curve of induction, such as that in fig. 11, S is kept permanently closed, and corresponding values of H and B are determined by one of the two methods already described, the strength of the battery-current being varied by means of the adjustable resistance R. When a hysteresis curve is to be obtained, the procedure is as follows: The current is first adjusted by means of R to such a strength as will fit it to produce the greatest + and − values of the magnetizing force which it is intended to apply in the course of the cycle; then it is reversed several times, and when the range of the galvanometer throws has become constant, half the extent of an excursion indicates the induction corresponding to the extreme value of H, and gives the point *a* in the curve fig. 12. The reversing key K having been put over to the left side, the short-circuit key S is suddenly opened; this inserts the resistance R, which has been suitably adjusted beforehand, and thus reduces the current and therefore the magnetizing force to a known value. The galvanometer throw which results from the change of current measures the amount by which the induction is reduced, and thus a second point on the curve is found. In a similar manner, by giving different values to the resistance R, any desired number of points between *a* and *c* in the curve can be determined. To continue the process, the key K is turned over to the right-hand side, and then, while S is open, is turned back, thereby not only reversing the direction of the current, but diminishing its strength by an amount depending upon the previous adjustment of R_2. In this way points can be found lying anywhere between *c* and *d* of fig. 12, and the determination of the downward limb of the curve is therefore completed. As the return curve, shown in fig. 13, is merely an inverted copy of the other, no separate determination of it is necessary.

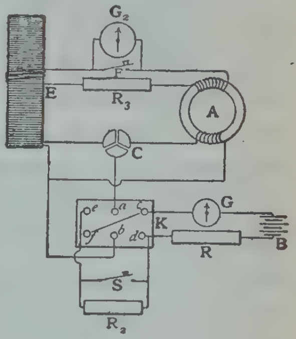

FIG. 14.

In fig. 15 (J. A. Fleming, *Magnets and Electric Currents*, p. 193) are shown three very different types of hysteresis curves, characteristic of the special qualities of the metals from which they were respectively obtained. The distinguishing feature of the first is the steepness of its outlines; this indicates that the induction increases rapidly in relation to the magnetic force, and hence the metal is well suited for the construction of dynamo magnets. The second has a very small area, showing that the work done in reversing the magnetization is small; the metal is therefore adapted for use in alternating current transformers. On the other hand, the form of the third curve, with its large intercepts on the axes of H and B, denotes that the specimen to which it relates possesses both retentiveness and coercive force in a high degree; such a metal would be chosen for making good permanent magnets.

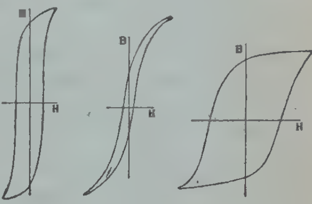

FIG. 15.

Several arrangements have been devised for determining hysteresis more easily and expeditiously than is possible by the ballistic method. The best known is J. A. Ewing's hysteresis-tester,[2] which is specially intended for testing the sheet iron used in transformers. The sample, arranged as a bundle of rectangular strips, is caused to rotate about a central horizontal axis between the poles of an upright C-shaped magnet, which is supported near its middle upon knife-edges in such a manner that it can oscillate about an axis in a line with that about which the specimen rotates; the lower side of the magnet is weighted, to give it some stability. When the specimen rotates, the magnet is deflected from its upright position by an amount which depends upon the work done in a single complete rotation, and therefore upon the hysteresis. The deflection is indicated by a pointer upon a graduated scale, the readings being interpreted by comparison with two standard specimens supplied with the instrument. G. F. Searle and T. G. Bedford[3] have introduced the method of measuring hysteresis by means of an electro-dynamometer used ballistically. The fixed and suspended coils of the dynamometer are respectively connected in series with the magnetizing solenoid and with a secondary wound upon the specimen. When the magnetizing current is twice reversed, so as to complete a cycle, the sum of the two deflections, multiplied by a factor depending upon the sectional area of the specimen and upon the constants of the apparatus, gives the hysteresis for a complete cycle in ergs per cubic centimetre. For specimens of large sectional area it is necessary to apply corrections in respect of the energy dissipated by eddy currents and in heating the secondary circuit. The method has been employed by the authors themselves in studying the effects of tension, torsion and circular magnetization, while R. L. Wills[1] has made successful use of it in a research on the effects of temperature, a matter of great industrial importance.

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[1] E. G. Warburg, *Wied. Ann.* 1881, 13, 141; Ewing, *Phil. Trans.*, 1885, 176, 549; Hopkinson, *Phil. Trans.* 1885, 176, 466. For a simple proof, see Ewing, *Magnetic Induction* (1900), p. 99. Hopkinson pointed out that the greatest dissipation of energy which can be caused by a to-and-fro reversal is approximately represented by *Coercive force × maximum induction /π*.

[2] *Magnetic Induction*, 1900, 378.

[3] *Phil. Trans.*, 1902, 198, 33.

C.P. Steinmetz (*Electrician*, 1891, 26, p. 261; 1892, 28, pp. 384, 408, 425) has called attention to a simple relation which appears to exist between the amount of energy dissipated in carrying a piece of iron or steel through a magnetic cycle and the limiting value of the induction reached in the cycle. Denoting by W the work in ergs done upon a cubic centimetre of the metal $\left(=\frac{1}{4\pi}\int HdB \text{ or} \int HdI\right)$, he finds $W=\eta B^{1\cdot 6}$ approximately, where η is a number, called the *hysteretic constant*, depending upon the metal, and B is the maximum induction. The value of the constant η ranges in different metals from about 0·001 to 0·04; in soft iron and steel it is said to be generally not far from 0·002. Steinmetz's formula may be tested by taking a series of hysteresis curves between different limits of B, measuring their areas by a planimeter, and plotting the logarithms of these divided by 4π as ordinates against logarithms of the corresponding maximum values of B as abscissae. The curve thus constructed should be a straight line inclined to the horizontal axis at an angle θ, the tangent of which is 1·6. Ewing and H. G. Klaassen (*Phil. Trans.*, 1893, 184, 1017) have in this manner examined how nearly and within what range a formula of the type $W=\eta B^{\epsilon}$ may be taken to represent the facts. The results of an example which they quote in detail may be briefly summarized as follows:—

Limits of B.	Hysteretic Constant. η	Index. $\epsilon(=\tan\theta)$	Degrees. θ
200 to 500	...	1·9	62·25
500 to 1,000	...	1·68	59·25
1,000 to 2,000	...	1·55	57·25
2,000 to 8,000	0.01	1·475	55·75
8,000 to 14,000	0·00134	1·70	59·50

It is remarked by the experimenters that the value of the index ϵ is by no means constant, but changes in correspondence with the successive well-marked stages in the process of magnetization. But though a formula of this type has no physical significance, and cannot be accepted as an equation to the actual curve of W and B, it is, nevertheless, the case that by making the index $\epsilon=1\cdot 6$, and assigning a suitable value to η, a formula may be obtained giving an approximation to the truth which is sufficiently close for the ordinary purposes of electrical engineers, especially when the limiting value of B is neither very great nor very small. Alexander Siemens (*Journ. Inst. Eng.*, 1894, 23, 229) states that in the hundreds of comparisons of test pieces which have been made at the works of his firm, Steinmetz's law has been found to be practically correct.[2] An interesting collection of W–B curves embodying the results of actual experiments by Ewing and Klaassen on different specimens of metal is given in fig. 16. It has been shown by Kennelly (*Electrician*, 1892, 28, 666) that Steinmetz's formula gives approximately correct results in the case of nickel. Working with two different specimens, he found that the hysteresis loss in ergs per cubic centimetre (W) was fairly represented by $0\cdot 00125B^{1\cdot 6}$ and $0\cdot 00101B^{1\cdot 6}$ respectively, the maximum induction ranging from about 300 to 3000. The applicability of the law to cobalt has been investigated by Fleming (*Phil. Mag.*, 1899, 48, 271), who used a ring of cast cobalt containing about 96% of the pure metal. The logarithmic curves which accompany his paper demonstrate that within wide ranges of maximum induction $W=0\cdot 01B^{1\cdot 6}=0\cdot 527I^{1\cdot 62}$ very nearly. Fleming rightly regards it as not a little curious that for materials differing so much as this cast cobalt and soft annealed iron the hysteretic exponent should in both cases be so near to 1·6. After pointing out that, since the magnetization of the metal is the quantity really concerned, W is more appropriately expressed in terms of I, the magnetic moment per unit of volume, than of B, he suggests an experiment to determine whether the mechanical work required to effect the complete magnetic reversal of a crowd of small compass needles (representative of magnetic molecules) is proportional to the 1·6th power of the aggregate maximum magnetic moment before or after completion of the cycle.

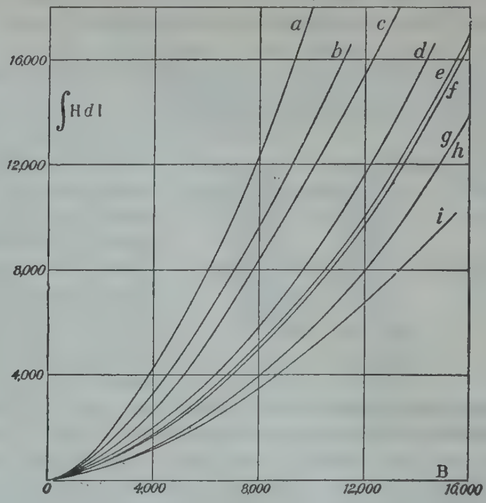

FIG. 16.

a, Fine steel wire 0·257 mm. diam.
b, Fine iron wire 0·34 mm. diam.
c, Fine iron wire 0·2475 mm. diam.
d, Thin sheet iron 0·47 mm. thick.
e, Iron wire 0·602 mm. diam.
f, Iron wire 0·975 mm. diam.
g, Sheet iron 1·95 mm. thick.
h, Thin sheet iron 0·367 mm. thick.
i, Very soft iron wire.

The experiments of K. Honda and S. Shimizu[3] indicate that Steinmetz's formula holds for nickel and annealed cobalt up to B=3000, for cast cobalt and tungsten steel up to B=8000, and for Swedish iron up to B=18,000, the range being in all cases extended at the temperature of liquid air.

The diagram, fig. 17, contains examples of ascending induction curves characteristic of wrought iron, cast iron, cobalt and nickel.

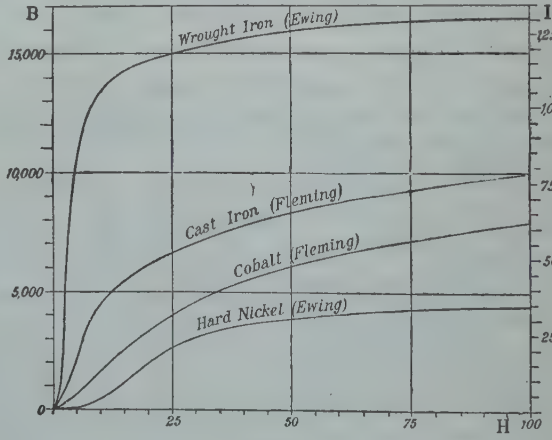

FIG. 17.

These are to be regarded merely as typical specimens, for the details of a curve depend largely upon the physical condition and purity of the material; but they show at a glance how far the several metals differ from and resemble one another as regards their magnetic properties. Curves of magnetization (which express the relation of I to H) have a close resemblance to those of induction; and, indeed, since $B=H+4\pi I$, and $4\pi I$ (except in extreme fields) greatly exceeds H in numerical value, we may generally, without serious error, put $I=B/4\pi$, and transform curves of induction into curves of magnetization by merely altering the scale to which the ordinates are referred. A scale for the approximate transformation for the curves in fig. 12 is given at the right-hand side of the diagram, the greatest error introduced by neglecting $H/4\pi$ not exceeding 0·6%. A study of such curves as these reveals the fact that there are three distinct stages in the process of magnetization. During the first stage, when the magnetizing force is small, the magnetization (or the induction) increases rather slowly with increasing force; this is well shown by the nickel curve in the diagram, but the effect would be no less conspicuous in the iron curve if the abscissae were plotted to a larger scale. During the second stage small increments of magnetizing force are attended by relatively large increments of magnetization, as is indicated by the steep ascent of the curve. Then the curve bends over, forming what is often called a "knee," and a third stage is entered upon, during which a considerable increase of magnetizing force has little further effect upon the magnetization. When in this condition the metal is popularly said to be "saturated." Under increasing magnetizing forces, greatly exceeding those comprised within the limits of the diagram, the magnetization does practically reach a limit, the maximum value being attained with a magnetizing force of less than 2000 for wrought iron and nickel, and less than 4000 for cast iron and cobalt. The induction, however, continues to increase indefinitely, though very slowly. These observations have an important bearing upon the molecular theory of magnetism, which will be referred to later.

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[1] *Phil. Mag.*, 1903, 5, 117.

[2] Some experiments by F. G. Baily showed that hysteresis ceased to increase when B was carried beyond 23,000. This value of B corresponds to I=1640, the saturation point for soft iron.—*Brit. Assoc. Rep.*, 1895, p. 636.

[3] *Tokyo Phys.-Math. Soc.*, 1904, 2, No. 14.

The magnetic quality of a sample of iron depends very largely upon the purity and physical condition of the metal. The presence of ordinary impurities usually tends to diminish the permeability, though, as will appear later, the addition of small quantities of certain other substances is sometimes advantageous. A very pure form of iron, which from the method of its manufacture is called "steel," is now extensively used for the construction of dynamo magnets; this metal sometimes contains not more than 0·3% of foreign substances, including carbon, and is magnetically superior to the best commercial wrought iron. The results of some comparative tests published by Ewing (*Proc. Inst. C.E.*, 1896) are given in the accompanying table. Those in the second column are quoted from a paper by F. Lydall and A. W. Pocklington (*Proc. Roy. Soc.*, 1892, 52, 228) and relate to an exceptional specimen containing nearly 99·9% of the pure metal.

Magnetic Force.	Magnetic Induction.			
	Pure Iron.	Low Moor Iron.	Steel Forging.	Steel Casting.
5	12,700	10,900	12,300	9,600
10	14,980	13,120	14,920	13,050
15	15,800	14,010	15,800	14,600
20	16,300	14,580	16,280	15,310
30	16,950	15,280	16,810	16,000
40	17,350	15,760	17,190	16,510
50	. .	16,060	17,500	16,900
60	. .	16,340	17,750	17,180
70	. .	16,580	17,970	17,400
80	. .	16,800	18,180	17,620
90	. .	17,000	18,390	17,830
100	. .	17,200	18,600	18,030

To secure the highest possible permeability it is essential that the iron should be softened by careful annealing. When it is mechanically hardened by hammering, rolling or wire-drawing its permeability may be greatly diminished, especially under a moderate magnetizing force. An experiment by Ewing showed that by the operation of stretching an annealed iron wire beyond the limits of elasticity the permeability under a magnetizing force of about 3 units was reduced by as much as 75%. Ewing has also studied the effect of vibration in conferring upon iron an apparent or spurious permeability of high value; this effort also is most conspicuous when the magnetizing force is weak. The permeability of a soft iron wire, which was tapped while subjected to a very small magnetizing force, rose to the enormous value of about 80,000 (*Magnetic Induction*, § 85). It follows that in testing iron for magnetic quality the greatest care must be exercised to guard the specimen against any accidental vibration.

Low hysteresis is the chief requisite for iron which is to be used for transformer cores, and it does not necessarily accompany high permeability. In response to the demand, manufacturers have succeeded in producing transformer plate in which the loss of energy due to hysteresis is exceedingly small. Tests of a sample supplied by Messrs. Sankey were found by Ewing to give the following results, which, however, are regarded as being unusually favourable. In a valuable collection of magnetic data (*Proc. Inst. C.E.*, cxxvi.) H. F. Parshall quotes tests of six samples of iron, described as of good quality, which showed an average hysteresis loss of 3070 ergs per c.cm. per cycle at an induction of 8000, being 1·6 times the loss shown by Ewing's specimen at the same induction.

Limits of Induction.	Ergs per c.cm. per cycle.	Watts per ℔. Frequency, 100.
2000	220	0·129
3000	410	0·242
4000	640	0·376
5000	910	0·535
6000	1200	0·710
7000	1520	0·890
8000	1900	1·120
9000	2310	1·360

The standard induction in reference to determinations of hysteresis is generally taken as 2500, while the loss is expressed in watts per ℔ at a frequency of 100 double reversals, or cycles, per second. In many experiments, however, different inductions and frequencies are employed, and the hysteresis-loss is often expressed as ergs per cubic centimetre per cycle and sometimes as horse-power per ton. In order to save arithmetical labour it is convenient to be provided with conversion factors for reducing variously expressed results to the standard form. The rate at which energy is lost being proportional to the frequency, it is obvious that the loss at frequency 100 may be deduced from that at any other frequency n by simply multiplying by $100\,n$. Taking the density of iron to be 7·7, the factor for reducing the loss in ergs per c.cm. to watts per ℔ with a frequency of 100 is 0·000589 (Ewing). Since 1 horse-power = 746 watts, and 1 ton = 2240 ℔, the factor for reducing horse-power per ton to watts per ℔ is 746/2240, or just 1/3. The loss for any induction B within the range for which Steinmetz's law holds may be converted into that for the standard induction 2500 by dividing it by $B^{1·6}/2500^{1·6}$. The values of this ratio for different values of B, as given by Fleming (*Phil. Mag.*, 1897), are contained in the second column of the annexed table. The third column shows the relative amount of hysteresis deduced by Ewing as a general mean from actual tests of many samples (*Journ. Inst. Elec. Eng.*, 1895). Incidentally, these two columns furnish an undesigned test of the accuracy of Steinmetz's law: the greatest difference is little more than 1%.

Induction B.	$\frac{B^{1·6}}{2500^{1·6}}$	Observed relative Hysteresis.
2000	0·700	0·702
2500	1·000	1·000
3000	1·338	1·340
4000	2·118	2·128
5000	3·031	3·000
6000	4·058	4·022
7000	5·193	5·129
8000	6·430	6·384

Curves of Permeability and Susceptibility.—The relations of μ ($=B/H$) to B, and of κ ($=I/H$) to I may be instructively exhibited by means of curves, a method first employed by H. A. Rowland.[1] The dotted curve for μ and B in fig. 18 is copied from Rowland's paper. The actual experiment to which it relates was carried only as the point marked X, corresponding to a magnetizing force of 65, and an induction of nearly 17,000. Rowland, believing that the curve would continue to fall in a straight line meeting the horizontal axis, inferred that the induction corresponding to the point B—about 17,500—was the highest that could be produced by any magnetizing force, however great. It has, however, been shown that, if the magnetizing force is carried far enough, the curve always becomes convex to the axis instead of meeting it. The full line shows the result of an experiment in which the magnetizing force was carried up to 585,[1] but though the force was thus increased ninefold, the induction only reached 19,800, and the ultimate value of the permeability was still as much as 33·9.

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[1] *Phil. Mag.*, 1873, 46, 140.

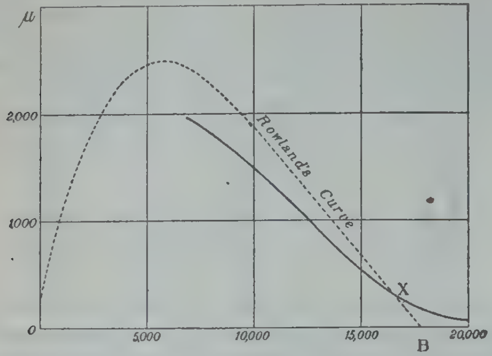

Fig. 18.

Ballistic Method with Yoke.—J. Hopkinson (*Phil. Trans.*, 1885, 176, 455) introduced a modification of the usual ballistic arrangement which presents the following advantages: (1) very considerable magnetizing forces can be applied with ordinary means; (2) the samples to be tested, having the form of cylindrical bars, are more easily prepared than rings or wires; (3) the actual induction at any time can be measured, and not only changes of induction. On the other hand, a very high degree of accuracy is not claimed for the results. Fig. 19 shows the apparatus by which the ends of the bar are prevented from exerting any material demagnetizing force, while the permeance of the magnetic circuit is at the same time increased. A A, called the "yoke," is a block of annealed wrought iron about 18 in. long, 6½ in. wide and 2 in. thick, through which is cut a rectangular opening to receive the two magnetizing coils B B. The test bar C C, which slides through holes bored in the yoke, is divided near the middle into two parts, the ends which come into contact being faced true and square. Between the magnetizing coils is a small induction coil D, which is connected with a ballistic galvanometer. The induction coil is carried upon the end of one portion of the test bar, and when this portion is suddenly drawn back the coil slips off and is pulled out of the field by an india-rubber spring. This causes a ballistic throw proportional to the induction through the bar at the moment when the two portions were separated. With such an arrangement it is possible to submit the sample to any series of magnetic forces, and to measure its magnetic state at the end. The uncertainty with which the results are affected depends chiefly upon the imperfect contact between the bar and the yoke and also between the ends of the divided bar. It is probable that Hopkinson did not attach sufficient importance to the demagnetizing action of the cut (cf. Ewing, *Phil. Mag.*, Sept. 1888, p. 274), and that the values which he assigned to H are consequently somewhat too high. He applied his method with good effect, however, in testing a large number of commercial specimens of iron and steel, the magnetic constants of which are given in a table accompanying his paper. When it is not required to determine the residual magnetization there is no necessity to divide the sample bar, and ballistic tests may be made in the ordinary way—by steps or by reversals—the source of error due to the transverse cut thus being avoided. Ewing (*Magnetic Induction*, § 194) has devised an arrangement in which two similar test bars are placed side by side; each bar is surrounded by a magnetizing coil, the two coils being connected to give opposite directions of magnetization, and each pair of ends is connected by a short massive block of soft iron having holes bored through it to fit the bars, which are clamped in position by set-screws. Induction coils are wound on the middle parts of both bars, and are connected in series. With this arrangement it is possible to find the actual value of the magnetizing force, corrected for the effects of joints and other sources of error. Two sets of observations are taken, one when the blocks are fixed at the ends of the bars, and another when they are nearer together, the clear length of the bars between them and of the magnetizing coils being reduced to one-half. If H_1 and H_2 be the values of $4\pi in/l$ and $4\pi i'\frac{n}{2}\Big/\frac{l}{2}$ for the same induction B, it can be shown that the true magnetizing force is $H = H_1 - (H_2 - H_1)$. The method, though tedious in operation, is very accurate, and is largely employed for determining the magnetic quality of bars intended to serve as standards.

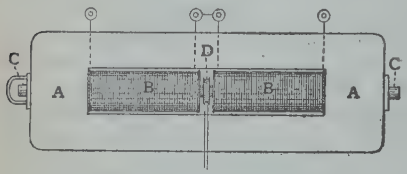

Fig. 19.

Traction Methods.—The induction of the magnetization may be measured by observing the force required to draw apart the two portions of a divided rod or ring when held together by their mutual attraction. If a transverse cut is made through a bar whose magnetization is I and the two ends are placed in contact, it can be shown that this force is $2\pi\ I^2$ dynes per unit of area (Mascart and Joubert, *Electricity and Magnetism*, § 322; and if the magnetization of the bar is due to an external field H produced by a magnetizing coil or otherwise, there is an additional force equal to HI. Thus the whole force, when the two portions of the bar are surrounded by a loosely-fitting magnetizing coil, is

$$F = 2\pi I^2 + HI$$

expressed as dynes per square centimetre. If each portion of the bar has an independent magnetizing coil wound tightly upon it, we have further to take into account the force due to the mutual action of the two magnetizing coils, which assists the forces already considered. This is equal to $H^2\ 8\pi$ per unit of sectional area. In the case supposed therefore the total force per square centimetre is

$$\begin{aligned} F &= 2\pi I^2 + HI + \frac{H^2}{8\pi} \\ &= \frac{(4\pi I + H)^2}{8\pi} \\ &= \frac{B^2}{8\pi}. \end{aligned}$$

The equation $F = B^2/8\pi$ is often said to express "Maxwell's law of magnetic traction" (Maxwell, *Electricity and Magnetism*, §§ 642–646). It is, of course, true for permanent magnets, where $H = 0$, since then $F = 2\pi I^2$; but if the magnetization is due to electric currents, the formula is only applicable in the special case when the mutual action of the two magnets upon one another is supplemented by the electromagnetic attraction between separate magnetizing coils rigidly attached to them.[2]

The traction method was first employed by S. Bidwell (*Proc. Roy. Soc.*, 1886, 40, 486), who in 1886 published an account of some experiments in which the relation of magnetization to magnetic field was deduced from observations of the force in grammes weight which just sufficed to tear asunder the two halves of a divided ring electro-magnet when known currents were passing through the coils. He made use of the expression

$$F = Wg = 2\pi I^2 + HI,$$

where W is the weight in grammes per square centimetre of sectional area, and g is the intensity of gravity which was taken as 981. The term for the attraction between the coils was omitted as negligibly small (see *Phil. Mag.*, 1890, 29, 440). The values assigned to H were calculated from $H = 2ni/r$, and ranged from 3·9 to 585, but inasmuch as no account was taken of any demagnetizing action which might be due to the two transverse cuts, it is probable that they are somewhat too high. The results, nevertheless, agree very well with those for annealed wrought iron obtained by other methods. Below is given a selection from Bidwell's tables, showing corresponding values of magnetizing force, weight supported, magnetization, induction, susceptibility and permeability:—

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[1] S. Bidwell, *Proc. Roy. Soc.*, 1886, 40, 495.

[2] Since in most practicable experiments H^2 is negligible in comparison with B^2, the force may be taken as $B^2/8\pi$ without sensible error.

H.	W.	I.	B.	κ.	μ.
3·9	2,210	587	7,390	151·0	1889·1
5·7	3,460	735	9,240	128·9	1621·3
10·3	5,400	918	11,550	89·1	1121·4
22·2	8,440	1147	14,450	51·7	650·9
40	9,680	1226	15,460	30·7	386·4
115	12,170	1370	17,330	11·9	150·7
208	13,810	1452	18,470	7·0	88·8
362	14,740	1489	19,080	4·1	52·7
465	15,275	1508	19,420	3·2	41·8
585	15,905	1530	19,820	2·6	33·9

A few months later R. H. M. Bosanquet (*Phil. Mag.*, 1886, 22, 535) experimented on the relation of tractive force to magnetic induction. Instead of a divided ring he employed a divided straight bar, each half of which was provided with a magnetizing coil. The joint was surrounded by an induction coil connected with a ballistic galvanometer, an arrangement which enabled him to make an independent measurement of the induction at the moment when the two portions of the bar were separated. He showed that there was, on the whole, a fair agreement between the values determined ballistically and those given by the formula $B=\sqrt{8\pi F}$. The greatest weight supported in the experiments was 14,600 grammes per square cm., and the corresponding induction 18,500 units. Taylor Jones subsequently found a good agreement between the theoretical and the observed values of the tractive force in fields ranging up to very high intensities (*Phil. Mag.*, 1895, 39, 254, and 1896, 41, 153).

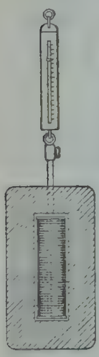

FIG. 20.

Permeameters.—Several instruments in which the traction method is applied have been devised for the rapid measurement of induction or of magnetization in commercial samples of iron and steel. The earliest of these is S. P. Thompson's *permeameter* (*Journ. Sci. Arts*, 1890, 38, 885), which consists of a rectangular block of iron shaped like Hopkinson's yoke, and slotted out in the same way to receive a magnetizing coil (fig. 20); the block is bored through at the upper end only, and its inner face opposite the hole is made quite flat and smooth. The sample has the form of a thin rod, one end of which is faced true; it is slipped into the magnetizing coil from above, and when the current is turned on its smooth end adheres tightly to the surface of the yoke. The force required to detach it is measured by a registering spring balance, which is clamped to the upper end of the rod, and thence the induction or the magnetization is deduced by applying the formula

$$(B-H)^2/8\pi=2\pi I^2=Pg/S,$$

where P is the pull in grammes weight, S the sectional area of the rod in square cm., and $g=981$. If the pull is measured in pounds and the area in square inches, the formula may be written $B=1317\times\sqrt{P/S}+H$. The instrument exhibited by Thompson would, without undue heating, take a current of 30 amperes, which was sufficient to produce a magnetizing force of 1000 units. A testing apparatus of a similar type devised by Gisbert Kapp (*Journ. Inst. Elec. Eng.* xxiii. 199) differs only in a few details from Thompson's permeameter. Ewing has described an arrangement in which the test bar has a soft-iron pole piece clamped to each of its ends; the pole pieces are joined by a long well-fitting block of iron, which is placed upon them (like the "keeper" of a magnet), and the induction is measured by the force required to detach the block. In all such measurements a correction should be made in respect of the demagnetizing force due to the joint, and unless the fit is very accurate the demagnetizing action will be variable. In the *magnetic balance* of du Bois (*Magnetic Circuit*, p. 346) the uncertainty arising from the presence of a joint is avoided, the force measured being that exerted between two pieces of iron separated from each other by a narrow air-gap of known width. The instrument is represented diagrammatically in fig. 21. The test-piece A, surrounded by a magnetizing coil, is clamped between two soft-iron blocks B, B′. Y Y′ is a soft iron yoke, which rocks upon knife-edges K and constitutes the beam of the balance. The yoke has two projecting pieces C, C′ at unequal distances from the knife-edges, and separated from the blocks B, B′ by narrow air-gaps. The play of the beam is limited by a stop S and a screw R, the latter being so adjusted that when the end Y of the beam is held down the two air-gaps are of equal width. W is a weight capable of sliding from end to end of the yoke along a graduated scale. When there is no magnetization, the yoke is in equilibrium; but as soon as the current is turned on the block C is drawn downwards as far as the screw R will allow, for, though the attractive forces F between B and C and between B′ and C′ are equal, the former has a greater moment. The weight W is moved along the scale until the yoke just tilts over upon the stop S; the distance of W from its zero position is then, as can easily be shown, proportional to F, and therefore to B^2, and approximately to I^2. The scale is graduated in such a manner that by multiplying the reading by a simple factor (generally 10 or 2) the absolute value of the magnetization is obtained. The actual magnetizing force H is of course less than that due to the coil; the corrections required are effected automatically by the use of a set of demagnetization lines drawn on a sheet of celluloid which is supplied with the instrument. The celluloid sheet is laid upon the squared paper, and in plotting a curve horizontal distances are reckoned from the proper demagnetization line instead of from the vertical axis. An improved but somewhat more complex form of the instrument is described in *Ann. d. Phys.*, 1900, 2, 317.

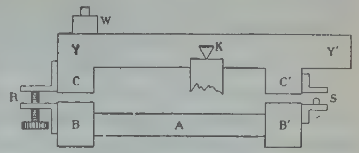

FIG. 21.

In Ewing's *magnetic balance* (*Journ. Inst. Elec. Eng.* 1898, 27, 526), the value of the magnetic induction corresponding to a single stated magnetizing force is directly read off on a divided scale. The specimen, which has the form of a turned rod, 4 in. long and ¼ in. in diameter, is laid across the poles of a horseshoe electromagnet, excited by a current of such strength as to produce in the rod a magnetizing force $H=20$. One pole has a V-shaped notch for the rod to rest in; the surface of the other is slightly rounded, forming a portion of a cylinder, the axis of which is perpendicular to the direction of the length of the rod. The rod touches this pole at a single point, and is pulled away from it by the action of a lever, the long arm of which is graduated and carries a sliding weight. The position of the weight at the moment when contact is broken indicates the induction in the rod. The standard force $H=20$ was selected as being sufficiently low to distinguish between good and bad specimens, and at the same time sufficiently high to make the order of merit the same as it would be under stronger forces.

Permeability Bridges.—Several pieces of apparatus have been invented for comparing the magnetic quality of a sample with that of a standard iron rod by a zero method, such as is employed in the comparison of electrical resistances by the Wheatstone bridge. An excellent instrument of the class is Ewing's *permeability bridge.* The standard rod and the test specimen, which must be of the same dimensions, are placed side by side within two magnetizing coils, and each pair of adjacent ends is joined by a short rectangular block or "yoke" of soft iron. An iron bar shaped like an inverted L projects upwards from each of the yokes, the horizontal portions of the bars being parallel to the rods, and nearly meeting at a height of about 8 in. above them (thus ┏ ┓). A compass needle placed in the gap serves to detect any flow of induction that may exist between the bent bars. For simplicity of calculation, the clear length of each rod between the yokes is made 12·56 ($=4\pi$) centimetres, while the coil surrounding the standard bar contains 100 turns; hence the magnetizing force due to a current of *n* amperes will be 10*n* C.G.S. units. The effective number of turns in the coil surrounding the test rod can be varied by means of three dial switches (for hundreds, tens and units), which also introduce compensating resistances as the number of effective turns in the coil is reduced, thus keeping the total resistance of the circuit constant. The two coils are connected in series, the same current passing through both. Suppose the switches to be adjusted so that the effective number of turns in the variable coil is 100; the magnetizing forces in the two coils will then be equal, and if the test rod is of the same quality as the standard, the flow of induction will be confined entirely to the iron circuit, the two yokes will be at the same magnetic potential, and the compass needle will not be affected. If, however, the permeability of the test rod differs from that of the standard, the number of lines of induction flowing in opposite directions through the two rods will differ, and the excess will flow from one yoke to the other, partly through the air, and partly along the path provided by the bent bars, deflecting the compass needle. But a balance may still be obtained by altering the effective number of turns in the test coil, and thus increasing or decreasing the magnetizing force acting on the test rod, till the induction in the two rods is the same, a condition which is fulfilled when reversal of the current has no effect on the compass needle. Let *m* be the number of turns in use, and H_1 and H_2 the magnetizing forces which produce the same induction B in the test and the standard rods respectively; then $H_1=H_2\times m/100$. The value of B which corresponds to $H_2m/100$ can be found from the

(B, H) curve for the standard, which is assumed to have been determined; and this same value corresponds to the force H in the case of the test bar. Thus any desired number of corresponding values of H and B can be easily and quickly found.

Measurement of Field Strength. Exploring Coil.—Since in air B = H, the ballistic method of measuring induction described above is also available for determining the strength of a magnetic field, and is more often employed than any other. A small coil of fine wire, connected in series with a ballistic galvanometer, is placed in the field, with its windings perpendicular to the lines of force, and then suddenly reversed or withdrawn from the field, the integral electromotive force being twice as great in the first case as in the second. The strength of the field is proportional to the swing of the galvanometer-needle, and, when the galvanometer is calibrated, can be expressed in C.G.S. units. Convenient arrangements have been introduced whereby the coil is reversed or withdrawn from the field by the action of a spring.

Bismuth Resistance.—The fact, which will be referred to later, that the electrical resistance of bismuth is very greatly affected by a magnetic field has been applied in the construction of apparatus for measuring field intensity. A little instrument, supplied by Hartmann and Braun, contains a short length of fine bismuth wire wound into a flat double spiral, half an inch or thereabouts in diameter, and attached to a long ebonite handle. Unfortunately the effects of magnetization upon the specific resistance of bismuth vary enormously with changes of temperature; it is therefore necessary to take two readings of the resistance, one when the spiral is in the magnetic field, the other when it is outside.

Electric Circuit.—If a coil of insulated wire is suspended so that it is in stable equilibrium when its plane is parallel to the direction of a magnetic field, the transmission of a known electric current through the coil will cause it to be deflected through an angle which is a function of the field intensity.

One of the neatest applications of this principle is that described by Edser and Stansfield (*Phil. Mag.*, 1893, 34, 186), and used by them to test the stray fields of dynamos. An oblong coil about an inch in length is suspended from each end by thin strips of rolled German silver wire, one of which is connected with a spiral spring for regulating the tension, the other being attached to a torsion-head. Inside the torsion-head is a commutator for automatically reversing the current, so that readings may be taken on each side of zero, and the arrangement is such that when the torsion-head is exactly at zero the current is interrupted. To take a reading the torsion-head is turned until an aluminium pointer attached to the coil is brought to the zero position on a small scale; the strength of the field is then proportional to the angular torsion. The small current required is supplied to the coil from a single dry cell. The advantages of portability, very considerable range (from H = 1 upwards), and fair accuracy are claimed for the instrument.

Polarized Light.—The intensity of a field may be measured by the rotation of the plane of polarization of light passing in the direction of the magnetic force through a transparent substance. If the field is uniform, $H = \theta/\omega d$, where θ is the rotation, d the thickness of the substance arranged as a plate at right angles to the direction of the field, and ω Verdet's constant for the substance.

For the practical measurement of field intensity du Bois has used plates of the densest Jena flint glass. These are preferably made slightly wedge-shape, to avoid the inconvenience resulting from multiple internal reflections, and they must necessarily be rather thin, so that double refractions due to internal strain may not exert a disturbing influence. Since Verdet's constant is somewhat uncertain for different batches of glass even of the same quality, each plate should be standardized in a field of known intensity. As the source of monochromatic light a bright sodium burner is used, and the rotation, which is exactly proportional to H, is measured by an accurate polarimeter. Such a plate about 1 mm. in thickness is said to be adapted for measuring fields of the order of 1000 units. A part of one surface of the plate may be silvered, so that the polarized ray, after having once traversed the glass, is reflected back again; the rotation is thus doubled, and moreover, the arrangement is, for certain experiments, more convenient than the other.

4. MAGNETIZATION IN STRONG FIELDS

Fields due to Coils.—The most generally convenient arrangement for producing such magnetic fields as are required for experimental purposes is undoubtedly a coil of wire through which an electric current can be caused to flow. The field due to a coil can be made as nearly uniform as we please throughout a considerable space; its intensity, when the constants of the coil are known, can be calculated with ease and certainty and may be varied at will through wide ranges, while the apparatus required is of the simplest character and can be readily constructed to suit special purposes. But when exceptionally strong fields are desired, the use of a coil is limited by the heating effect of the magnetizing current, the quantity of heat generated per unit of time in a coil of given dimensions increasing as the square of the magnetic field produced in its interior. In experiments on magnetic strains carried out by H. Nagaoka and K. Honda (*Phil. Mag.*, 1900, 49, 329) the intensity of the highest field reached in the interior of a coil was 2200 units; this is probably the strongest field produced by a coil which has hitherto been employed in experimental work. In 1890 some experiments in which a coil was used were made by du Bois (*Phil. Mag.*, 1890, 29, 253, 293) on the magnetization of iron, nickel, and cobalt under forces ranging from about 100 to 1250 units. Since the demagnetizing factor was 0·052, the strongest field due to the coil was about 1340; but though arrangements were provided for cooling the apparatus by means of ice, great difficulty was experienced owing to heating. Du Bois's results, which, as given in his papers, show the relation of H to the magnetic moment per unit of mass, have been reduced by Ewing to the usual form, and are indicated in fig. 22, the earlier portions of the curves being sketched in from other data.

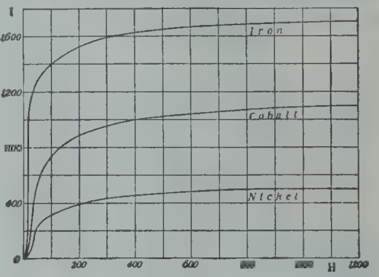

FIG. 22.

Fields due to Electromagnets.—The problem of determining the magnetization of iron and other metals in the strong fields formed between the poles of an electromagnet was first attacked by J. A. Ewing and W. Low. An account of their preliminary experiments by what they call the *isthmus method* was published in 1887 (*Proc. Roy. Soc.* 42, 200), and in the following year they described a more complete and perfect series (*Phil. Trans.*, 1889, 180, 221).

The sample to be inserted between the magnet poles was prepared in the form of a bobbin resembling an ordinary cotton reel, with a short narrow neck (constituting the "isthmus") and conical ends. Upon the central neck was wound a coil consisting of one or two layers of very fine wire, which was connected with a ballistic galvanometer for measuring the induction in the iron; outside this coil, and separated from it by a small and accurately determined distance, a second coil was wound, serving to measure the induction in the iron, together with that in a small space surrounding it. The difference of the ballistic throws taken with the two coils measured the intensity of the field in the space around the iron, and it also enabled a correction to be made for the non-ferrous space between the iron neck and the centre of the thickness of the inner coil. The pole pieces of the electromagnet (see fig. 23) were furnished with a pair of truncated cones *b b*, of soft iron forming an extension of the conical ends of the bobbin *c*. The most suitable form for the pole faces is investigated in the paper, and the conclusion arrived at is that to produce the greatest concentration of force upon the central neck, the cones should have a common vertex in the middle of the neck with a semi-vertical angle of 54° 44′, while the condition for a uniform field is satisfied when the cones have a semi-vertical angle of 39° 14′; in the latter case the magnetic force in the air just outside is sensibly equal to that within the neck. A pair of cones having a semi-vertical angle of 45° were considered to combine high concentrative power with a sufficient approximation to uniformity of field. In most of the experiments the measurements were made by suddenly withdrawing the bobbin from its place

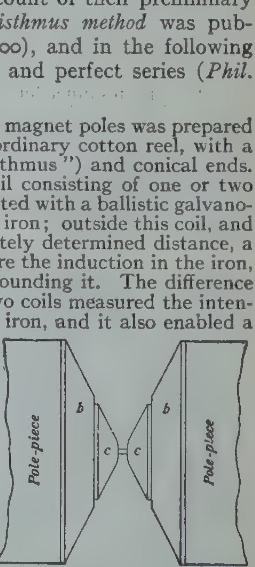

FIG. 23.

between the pole pieces. Two groups of observations were recorded, one giving the induction in the inner coil and the other that in the outer coil. The value of the residual induction which persisted when the bobbin was drawn out was added to that of the induction measured, and thus the total induction in the iron was determined. The highest induction reached in these experiments was 45,350 units, more than twice the value of any previously recorded. The corresponding intensity of the outside field was 24,500, but, owing to the wide angle of the cones used (about 2×63°), this was probably greater than the value of the magnetic force within the metal. The following table shows some results of other experiments in which H was believed to have sensibly the same value inside as outside the metal. Values of I are derived from $(B-H)/4\pi$ and of μ from B/H.

Metal.	H	B	I	μ
Swedish Iron	1,490	22,650	1680	15·20
	6,070	27,130	1680	4·47
	8,600	30,270	1720	3·52
	19,450	40,820	1700	2·10
	19,880	41,140	1700	2·07
Cast Iron	4,560	20,070	1230	4·40
	13,460	28,710	1210	2·13
	16,200	30,920	1170	1·91
	16,900	31,760	1180	1·88
Tool Steel	6,210	25,480	1530	4·10
	9,970	29,650	1570	2·97
	12,170	31,620	1550	2·60
	14,660	34,550	1580	2·36
	15,530	35,820	1610	2·31
Hard Nickel	2,220	7,100	390	3·20
	4,440	9,210	380	2·09
	7,940	12,970	400	1·63
	14,660	19,640	400	1·34
	16,000	21,070	400	1·32
Cobalt	1,350	16,000	1260	12·73
	4,040	18,870	1280	4·98
	8,930	23,890	1290	2·82
	14,990	30,210	1310	2·10

These results are of extreme interest, for they show that under sufficiently strong magnetizing forces the intensity of magnetization I reaches a maximum value, as required by W. E. Weber's theory of molecular magnetism. There appears to be no definite limit to the value to which the induction B may be raised, but the magnetization I attains a true saturation value under magnetizing forces which are in most cases comparatively moderate. Thus the magnetization which the sample of Swedish iron received in a field of 1490 was not increased (beyond the limits of experimental error) when the intensity of the field was multiplied more than thirteen-fold, though the induction was nearly doubled. When the saturation value of I has been reached, the relation of magnetic induction to magnetic force may be expressed by

$$B = H + \text{constant}.$$

The annexed table gives the saturation values of I for the particular metals examined by Ewing and Low:—

	Saturation Value of I
Wrought iron	1,700
Cast iron	1,240
Nickel (0·75% iron)	515
„ (0·56% „)	400
Cobalt (1·66% „)	1,300

It is shown in the paper that the greatest possible force which the isthmus method can apply at a point in the axis of the bobbin is

$$F = 11{\cdot}137\, I_s \log_{10} b/a,$$

I_s being the saturation value of the magnet poles, a the radius of the neck on which the cones converge, and b the radius of the bases of the cones.

Some experiments made by H. du Bois (*Phil. Mag.*, 1890, 29, 293) with an electromagnet specially designed for the production of strong fields, confirm Ewing's results for iron, nickel and cobalt. The method employed did not admit of the production of such high magnetizing forces, but was of special interest in that both B and I were measured optically—B by means of the rotation of a polarized ray inside a glass plate, as before described, and I by the rotation of a polarized ray reflected from the polished surface of the magnetized metal (see "Kerr's constant," MAGNETO-OPTICS). $H(=B-4\pi I)$ was calculated from corresponding values of I and B. Taylor Jones (*Wied. Ann.*, 1896, 57, 258, and *Phil. Mag.*, 1896, 41, 153), working with du Bois's electromagnet and using a modification of the isthmus method, succeeded in pushing the induction B up to 74,200 with H = 51,600, the corresponding value of I being 1798, and of μ only 1·44. The diameter of the isthmus was 0·241 mm., and the electromagnet was excited by a current of 40 amperes.

Tractive Force of a Magnet.—Closely connected with the results just discussed is the question what is the greatest tractive force that can be exerted by a magnet. In the year 1852 J. P. Joule (*Phil. Mag.*, 1852, 3, 32) expressed the opinion that no "force of current could give an attraction equal to 200 ℔ per sq. in.," or 14,000 grms. per square centimetre, and a similar view prevailed among high authorities more than twenty years later. For the greatest possible "lifting power" of permanent magnets this estimate is probably not very far from the truth, but it is now clearly understood that the force which can be exerted by an electromagnet, or by a pair of electromagnets with opposite poles in contact, is only limited by the greatest value to which it is practically possible to raise the magnetizing force H. This is at once evident when the tractive force due to magnetization is expressed as $2\pi I^2 + HI$. For fields of moderate intensity the first term of the expression is the more important, but when the value of H exceeds 12,000 or thereabouts, the second preponderates, and with the highest values that have been actually obtained, HI is several times greater than $2\pi I^2$. If H could be increased without limit, so also could the tractive force. The following table shows the greatest "lifting powers" experimentally reached at the dates mentioned:—

Observer.	Kilos per sq. cm.	℔ per sq. in.	Date.
Joule	12·3	175	1852
Bidwell	15·9	226	1886
Wilde	26·8	381	1891
T. Jones	114·9	1634	1896

5. MAGNETIZATION IN VERY WEAK FIELDS

Some interesting observations have been made of the effects produced by very small magnetic forces. It was first pointed out by C. Baur (*Wied. Ann.*, 1880, 11, 399) that in weak fields the relation of the magnetization I to the magnetizing force H is approximately expressed by an equation of the form

$$I = aH + bH^2,$$

or

$$\kappa = I/H = a + bH,$$

whence it appears that within the limits of Baur's experiments the magnetization curve is a parabola, and the susceptibility curve an inclined straight line, κ being therefore a known function of H. If these equations could be assumed to hold when H is indefinitely small, it would follow that κ has a finite initial value, from which there would be no appreciable deviation in fields so weak that bH was negligibly small in comparison with a. Such an assumption could not, however, without dangerous extrapolation, be founded upon the results of Baur's experiments, which did not go far enough to justify it. In some experiments carried out in 1887, Lord Rayleigh (*Phil. Mag.*, 1887, 23, 225) approached very much more nearly than Baur to the zero of magnetic force. Using an unannealed Swedish iron wire, he found that when H was gradually diminished from 0·04 to 0·00004 C.G.S. unit, the ratio of magnetization to magnetizing force remained sensibly constant at 6·4, wihch may therefore with great probability be assumed to represent the initial value of κ for the specimen in question. Experiments with annealed iron gave less satisfactory results, on account of the slowness with which the metal settled down into a new magnetic state, thus causing a "drift" of the magnetometer needle, which sometimes persisted for several seconds. Apart from this complication, it appeared that I was proportional to H when the value of H was less than 0·02.

The observations of Baur and Rayleigh have been confirmed and discussed by (amongst others) W. Schmidt (*Wied. Ann.*, 1895, 54, 655), who found the limiting values of κ to be 7·5 to 9·5 for iron, and 11·2 to 13·5 for steel, remaining constant up to $H=\cdot06$; by P. Culmann (*Elekt. Zeit.*, 1893, 14, 345; *Wied. Ann.*, 1895, 56, 602); and by L. Holborn (*Berl. Ber.*, 1897, p. 95, and *Wied. Ann.*, 1897, 61, 281). The latter gives values of the constants a and b for different samples of iron and steel, some of which are shown in the following table:—

$$\kappa=a+b\text{H}$$

Metal.	a	b
English tungsten steel	8·90	0·264
Tungsten steel, hardened	2·23	0·032
Silver steel	8·66	0·384
Tool steel	8·30	0·400
Refined steel	11·28	1·92
Cast iron	3·16	0·236
Soft iron	16·6	18·6
Hard drawn iron	5·88	1·76

For most samples of steel the straight-line law was found to hold approximately up to $H=3$; in the case of iron and of soft steel the approximation was less close.

The behaviour of nickel in weak fields has been observed by Ewing (*Phil. Trans.*, 1888, 179A, 325), who found that the initial value of κ was 1·7, and that it remained sensibly constant until H had reached a value of about five units. While therefore the initial susceptibility of nickel is less than that of iron and steel, the range of magnetic force within which it is approximately constant is about one hundred times greater. Ewing has also made a careful study (*Proc. Roy. Soc.*, 1889, 46, 269) of "magnetic viscosity" under small forces—the cause of the magnetometer "drift" referred to by Rayleigh. On the application of a small magnetizing force to a bar of soft annealed iron, a certain intensity of magnetization is instantly produced; this, however, does not remain constant, but slowly increases for some seconds or even minutes, and may ultimately attain a value nearly twice as great as that observed immediately after the force was applied.[1] When the magnetizing current is broken, the magnetization at once undergoes considerable diminution, then gradually falls to zero, and a similar sudden change followed by a slow one is observed when a feeble current is reversed. Ewing draws attention to a curious consequence of this time-lag. By the alternate application and withdrawal of a small magnetizing force a cyclic condition may be established in an iron rod. If now the alternations are performed so rapidly that time is not allowed for more than the first sudden change in the magnetization, there will be no hysteresis loss, the magnetization exactly following the magnetizing force. Further, if the alternations take place so slowly that the full maximum and minimum values of the magnetization are reached in the intervals between the reversals, there will again be no dissipation of energy. But at any intermediate frequency the ascending and descending curves of magnetization will enclose a space, and energy will be dissipated. It is remarkable that the phenomena of magnetic viscosity are much more evident in a thick rod than in a thin wire, or even in a large bundle of thin wires. In hardened iron and steel the effect can scarcely be detected, and in weak fields these metals exhibit no magnetic hysteresis of any kind.

6. Changes of Dimensions attending Magnetization

It is well known that the form of a piece of ferromagnetic metal is in general slightly changed by magnetization. The phenomenon was first noticed by J. P. Joule, who in 1842 and 1847 described some experiments which he had made upon bars of iron and steel. His observations were for the most part confirmed by a number of subsequent workers, notably by A. M. Mayer; but with the single exception of the discovery by W. F. Barrett in 1882 that a nickel bar contracts when magnetized, nothing of importance was added by Joule's results for nearly forty years. Later researches have however thrown much new light upon a class of phenomena which cannot fail to have an important bearing upon the complete theory of molecular magnetism.[2] According to Joule's observations, the length of a bar of iron or soft steel was increased by magnetization, the elongation being proportional up to a certain point to the square of the intensity of magnetization; but when the "saturation point" was approached the elongation was less than this law would require, and a stage was finally reached at which further increase of the magnetizing force produced little or no effect upon the length. From data contained in Joule's paper it may be calculated that the strongest external field H_0 produced by his coil was about 126 C.G.S. units, but since the dimensional ratio of his bars was comparatively small, the actual magnetizing force H must have been materially below that value. In 1885 it was shown by Bidwell, in the first of a series of papers on the subject, that if the magnetizing force is pushed beyond the point at which Joule discontinued his experiments, the extension of the bar does not remain unchanged, but becomes gradually less and less, until the bar, after first returning to its original length, ultimately becomes actually shorter than when in the unmagnetized condition. The elongation is generally found to reach a maximum under a magnetizing force of 50 to 120 units, and to vanish under a force of 200 to 400, retraction occurring when still higher forces are applied. In order to meet the objection that the phenomenon might be due to electromagnetic action between the coil and the rod, Bidwell made some experiments with iron rings, and found that the length of their diameters varied under magnetization in precisely the same manner as the length of a straight rod. Experiments were afterwards made with rods of iron, nickel, and cobalt, the external field being carried up to the high value of 1500 units. The results are indicated in Fig. 24. It appears that the contraction which followed the initial extension of the iron reached a limit in fields of 1000 or 1100. Nickel exhibited retraction from the very beginning (as observed by Barrett), its greatest change of length considerably exceeding that undergone by iron; in a field of 800 the original length was diminished by as much as 1/40,000 part, but stronger forces failed to produce any further effect. The curve for cobalt is a very remarkable one. Little or no change of length was observed until the strength of the field H_0 reached about 50; then the rod began to contract, and after passing a minimum at $H_0=400$, recovered its original length at $H_0=750$; beyond this point there was extension, the amount of which was still increasing fast when the experiment was stopped at $H_0=1400$. Similar results were obtained with three different samples of the metal. Roughly speaking, therefore, cobalt behaves oppositely to iron.

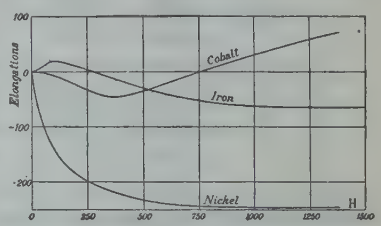

FIG. 24.

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[1] The same phenomenon is exhibited in a less marked degree when soft iron is magnetized in stronger fields (Ewing, *Phil. Trans.*, 1885, 176, 569).

[2] Principal publications: J. P. Joule, *Scientific Papers*, pp. 46, 235; A. M. Meyer, *Phil. Mag.*, 1873, 46, 177; W. F. Barrett, *Nature*, 1882, 26, 585; S. Bidwell, *Phil. Trans.*, 1888, 179A, 205; *Proc. Roy. Soc.*, 1886, 40, 109 and 257; 1888, 43, 406; 1890, 47, 469; 1892, 51, 495; 1894, 55, 228; 1894, 56, 94; 1904, 74, 60; *Nature*, 1899, 60, 222; M. Cantone, *Mem. d. Acc. d. Lincei*, 1889, 6, 487; *Rend. d. Acc. d. Lincei*, 1890, 6, 252; A. Berget, *C.R.*, 1892, 115, 722; S. J. Lochner, *Phil. Mag.*, 1893, 36, 498; H. Nagaoka, *Phil. Mag.*, 1894, 37, 131; *Wied. Ann.*, 1894, 53, 487; C. G. Knott, *Proc. Roy. Soc. Ed.*, 1891, 18, 315; *Phil. Mag.*, 1894, 37, 141; *Trans. Roy. Soc. Ed.*, 1896, 38, 527; 1898, 39, 457; C. G. Knott and A. Shand, *Proc. Roy. Soc. Ed.*, 1892, 19, 85 and 249; 1894, 20, 295; L. T. More, *Phil. Mag.*, 1895, 40, 345; G. Klingenberg, *Rostock Univ. Thesis*, Berlin, 1897; E. T. Jones, *Phil. Trans.*, 1897, 189A, 189; B. B. Brackett, *Phys. Rev.*, 1897, 5, 257; H. Nagaoka and K. Honda, *Phil. Mag.*, 1898, 46, 261; 1900, 49, 329; *Journ. Coll. Sci. Tokyo*, 1900, 13, 57; 1903, 19, art. 11; J. S. Stevens, *Phys. Rev.*, 1898, 7, 19; E. Rhoads, *Phys. Rev.*, 1898, 7, 5; *Phil. Mag.*, 1901, 2, 463; G. A. Shakespear, *Phil. Mag.*, 1899, 17, 539; K. Honda, *Journ. Coll. Sci. Tokyo*, 1900, 13, 77; L. W. Austin, *Phys. Rev.*, 1900, 10, 180; *Deutsch. Phys. Gesell. Verh.*, 1904, 6, 4, 211; K. Honda and S. Shimizu, *Phil. Mag.*, 1902, 4, 338; 1905, 10, 548.

Joule and others experimented with hardened steel, but failed to find a key to the results they obtained, which are rather complex, and have been thought to be inconsistent. The truth appears to be that a hardened steel rod generally behaves like one of iron or soft steel in first undergoing extension under increasing magnetizing force, and recovering its original length when the force has reached a certain critical value, beyond which there is contraction. But this "critical value" of the force is found to depend in an unexpected manner upon the hardness of the steel; the critical value diminishes as the hardness becomes greater *up to a certain point*, corresponding to a yellow temper, after which it increases and with the hardest steel becomes very high. For steel which has been made red-hot, suddenly cooled, and then let down to a yellow temper, the critical value of the magnetizing force is smaller than for steel which is either softer or harder; it is indeed so small that the metal contracts like nickel even under weak magnetizing forces, without undergoing any preliminary extension that can be detected.

Joule also made experiments upon iron wires under tension, and drew the erroneous inference (which has been often quoted as if it were a demonstrated fact) that under a certain critical tension (differing for different specimens of iron but independent of the magnetizing force) magnetization would produce no effect whatever upon the dimensions of the wire. What actually happens when an iron wire is loaded with various weights is clearly shown in Fig. 25. Increased tension merely has the effect of diminishing the maximum elongation and hastening the contraction; with the two greatest loads used in the experiment there was indeed no preliminary extension at all.[1] The effects of tension upon the behaviour of a nickel wire are of a less simple character. In weak fields the magnetic contraction is always diminished by pulling stress; in strong fields the contraction increases under a small load and diminishes under a heavy one. Cobalt, curiously enough, was found to be quite unaffected by tensile stress.

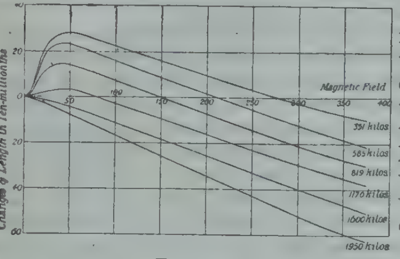

FIG. 25.

Certain experiments by C. G. Knott on magnetic twist, which will be referred to later, led him to form the conclusion that in an iron wire carrying an electric current the magnetic elongation would be increased. This forecast was shown by Bidwell to be well founded. The effect produced by a current is exactly opposite to that of tension, raising the elongation curve instead of depressing it. In the case of a wire 0·75 mm. in diameter the maximum elongation was nearly doubled when a current of two amperes was passing through the iron, while the "critical value" of the field was increased from 130 to 200. Yet notwithstanding this enormous effect in iron, the action of a current upon nickel and cobalt turned out to be almost inappreciable.

Some experiments were next undertaken with the view of ascertaining how far magnetic changes of length in iron were dependent upon the hardness of the metal, and the unexpected result was arrived at that softening produces the same effect as tensile stress; it depresses the elongation curve, diminishing the maximum extension, and reducing the "critical value" of the magnetizing force. A thoroughly well annealed ring of soft iron indeed showed no extension at all, beginning to contract, like nickel, under the smallest magnetizing forces. The experiments were not sufficiently numerous to indicate whether, as is possible, there is a critical degree of hardness for which the height of the elongation curve is a maximum.

Finally, experiments were made to ascertain the effect of magnetization upon the dimensions of iron rings in directions perpendicular to the magnetization, and upon the volume of the rings.[2] It was found that the curve showing the relation of transverse changes of dimensions to magnetizing force was similar in general character to the familiar elongation curves, but the signs were reversed; the curve was inverted, indicating at first retraction, which, after passing a maximum and vanishing in a critical field, was succeeded by elongation. The curve showing the circumferential (or longitudinal) changes was also plotted, and from the two curves thus obtained it was easy, on the assumption that the metal was isotropic in directions at right angles to the magnetization, to calculate changes of volume; for if circumferential elongation be denoted by l_1, and transverse elongation by l_2, then the cubical dilatation $(+ \text{ or } -) = l_1 + 2l_2$ approximately. If l_1 were exactly equal to $-2l_2$ for all values of the magnetizing force, it is clear that the volume of the ring would be unaffected by magnetization. In the case of the ring in question, the circumferential changes were in weak fields less than twice as great as the transverse ones, while in strong fields they were more than twice as great; under increasing magnetic force therefore the volume of the ring was first diminished, then it regained its original value (for $H=90$), and ultimately increased. It was also shown that annealing, which has such a large effect upon circumferential (or longitudinal) changes, has almost none upon transverse ones. Hence the changes of volume undergone by a given sample of wrought iron under increasing magnetization must depend largely upon the state of the metal as regards hardness; there may be always contraction, or always expansion, or first one and then the other.

Most of the experiments described above have been repeated and the results confirmed by other workers, some of whom have added fresh observations. The complicated hysteresis effects which attend magnetic elongation and retraction have been studied by H. Nagaoka, who also, in conjunction with K. Honda, measured the changes of length of various metals shaped in the form of ovoids instead of cylindrical rods, and determined the magnetization curves for the same specimens; a higher degree of accuracy was thus attained, and satisfactory data were provided for testing theories. Among other things, it was found that the behaviour of cast cobalt was entirely changed by annealing; the sinuous curve shown in Fig. 24 was converted into an almost perfectly straight line passing through the origin, and lying below the horizontal axis; while the permeability of the metal was greatly diminished by the operation. They also tested several varieties of nickel-steel in the form of both ovoids and wires. With a sample containing 25% of nickel no appreciable change was detected; others containing larger percentages, and tested in fields up to 2000, all exhibited elongation, which tended to an asymptotic value as the field was increased. The influence of temperature varying between wide limits has formed the subject of a research by K. Honda and S. Shimizu. For soft iron, tungsten-steel and nickel little difference appeared to result from lowering the temperature down to −186° C. (the temperature of liquid air); at sufficiently high temperatures, 600° to 1000° or more, it was remarked that the changes of length in iron, steel and cobalt tended in every case to become proportional to the magnetic force, the curves being nearly straight lines entirely above the axis. The retraction of nickel was diminished by rising temperature, and at 400° had almost vanished. The influence of high temperature on cobalt was very remarkable, completely altering the character of the change of length: the curves for annealed cobalt show that at 450° this metal behaves just like iron at ordinary temperatures, lengthening in fields up to about 300 and contracting in stronger ones. The same physicists have made some additional experiments upon the effect of tension on magnetic change of length. Bidwell's results for iron and nickel were confirmed, and it was further shown that the elongation of nickel-steel was very greatly diminished by tension; wher magnetized under very heavy loads, the wire was indeed found to undergo slight contraction. Honda subjected tubes of iron, steel and nickel to the simultaneous action of circular and longitudinal fields, and observed the changes of length when one of the fields was varied while the other remained constant at different successive values from zero upwards. The experimental results agreed in sign though not in magnitude with those calculated from the changes produced by simple longitudinal magnetization, discrepancies being partly accounted for by the fact that the metals employed were not actually isotropic. Heusler's alloy has been tested for change of length by L. Austin, who found continuous elongation with increasing fields, the curves obtained bearing some resemblance to curves of magnetization.

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[1] The loads were successively applied in decreasing order of magnitude. They are indicated in fig. 25 as kilos per sq. cm.

[2] Joule believed that the volume was unchanged.

As regards the effect of magnetization upon volume there are some discrepancies. Nagaoka and Honda, who employed a fluid dilatometer, found that the volume of several specimens of iron, steel and nickel was always slightly increased, no diminution being indicated in low fields; cobalt, on the other hand, was diminished in volume, and the amount of the change, though still very small, was greater than that shown by the other metals. Various nickel-steels all expanded under magnetization, the increase being generally considerable and proportional to the field; in the case of an alloy containing 29% of nickel the change was nearly 40 times greater than in soft iron. C. G. Knott, who made an exhaustive series of experiments upon various metals in the form of tubes, concluded that in iron there was always a slight increase of volume, and in nickel and cobalt a slight decrease. It is uncertain how far these various results are dependent upon the physical condition of the metals.

Attempts have been made to explain magnetic deformation by various theories of magnetic stress,[1] notably that elaborated by G. R. Kirchhoff (*Wied. Ann.*, 1885, 24, 52, and 1885, 25, 601), but so far with imperfect success. E. Taylor Jones showed in 1897 that only a small proportion of the contraction exhibited by a nickel wire when magnetized could be accounted for on Kirchhoff's theory from the observed effects of pulling stress upon magnetization; and in a more extended series of observations Nagaoka and Honda found wide quantitative divergences between the results of experiment and calculation, though in nearly all cases there was agreement as to quality. They consider, however, that Kirchhoff's theory, which assumes change of magnetization to be simply proportional to strain, is still in its infancy, the present stage of its evolution being perhaps comparable with that reached by the theory of magnetization at the time when the ratio I/H was supposed to be constant. In the light of future researches further development may reasonably be expected.

It has been suggested[2] that an iron rod under magnetization may be in the same condition as if under a mechanically applied longitudinal stress tending to shorten the iron. If a long magnetized rod is divided transversely and the cut ends placed nearly in contact, the magnetic force inside the narrow air gap will be $B=H+4\pi I$. The force acting on the magnetism of one of the faces, and urging this face towards the other, will be less than B by $2\pi I$, the part of the total force due to the first face itself; hence the force per unit of area with which the faces would press against each other if in contact is

$$P=(B-2\pi I)I=2\pi I^2+HI=(B^2-H^2)=/8\pi.$$

The width of the gap may be diminished until it is no greater than the distance between two neighbouring molecules, when it will cease to be distinguishable, but, assuming the molecular theory of magnetism to be true, the above statement will still hold good for the intermolecular gap. The same pressure P will be exerted across any imaginary section of a magnetized rod, the stress being sustained by the intermolecular springs, whatever their physical nature may be, to which the elasticity of the metal is due. The whole of the rod will therefore be subject to a compressive longitudinal stress P, the associated contraction R, expressed as a fraction of the original length, being

$$R=P/M=(B^2-H^2)/8\pi M,$$

where M is Young's modulus. This was found to be insufficient to account for the whole of the retraction exhibited by iron in strong fields, but it was pointed out by L. T. More[3] that R ought to be regarded as a "correction" to be applied to the results of experiments on magnetic change of length, the magnetic stress being no less an extraneous effect than a stress applied mechanically. Those who support this view generally speak of the stress as "Maxwell's stress," and assume its value to be $B^2/8\pi$. The stress in question seems, however, to be quite unconnected with the "stress in the medium" contemplated by Maxwell, and its value is not exactly $B^2/8\pi$ except in the particular case of a permanent ring magnet, when $H=0$. Further, Maxwell's stress is a tension along the lines of force, and is equal to $B^2/8\pi$ only when $B=H$, and there is no magnetization.[4] Some writers have indeed contended that the stress in magnetized iron is not compressive, but tensile, even when, as in the case of a ring-magnet, there are no free ends. The point at issue has an important bearing upon the possible correlation of magnetic phenomena, but, though it has given rise to much discussion, no accepted conclusion has yet been reached.[5]

7. Effects of Mechanical Stress upon Magnetization

The effects of traction, compression and torsion in relation to magnetism have formed the subject of much patient investigation, especially at the hands of J. A. Ewing, C. G. Knott and the indefatigable physicists of Tokyo University. The results of their experiments embrace a multiplicity of details of which it is impossible to give an adequate summary. Only a few of the most important can be mentioned here; the reader who wishes for fuller information should consult the original papers.[6]

It was first discovered by E. Villari in 1868 that the magnetic susceptibility of an iron wire was increased by stretching when the magnetization was below a certain value, but diminished when that value was exceeded; this phenomenon has been termed by Lord Kelvin, who discovered it independently, the "Villari reversal," the value of the magnetization for which stretching by a given load produces no effect being known as the "Villari critical point" for that load. The Villari critical point for a given sample of iron is reached with a smaller magnetizing force when the stretching load is great than when it is small; the reversal also occurs with smaller loads and with weaker fields when the iron is soft than when it is hard. The following table shows the values of I and H corresponding to the Villari critical point in some of Ewing's experiments:—

Soft Iron.			Hard Iron.		
Kilos per sq. mm.	I.	H.	Kilos per sq. mm.	I.	H.
2·15	1220	7·3	27·6	1180	34
4·3	1040	4·3	32·2	1150	32
8·6	840	3·4	37·3	1110	29
12·9	690	3·05	42·5	1020	25

The effects of pulling stress may be observed either when the wire is stretched by a constant load while the magnetizing force is varied, or when the magnetizing force is kept constant while the load is varied. In the latter case the first application of stress is always attended by an increase—often a very great one—of the magnetization, whether the field is weak or strong, but after a load has been put on and taken off several times the changes of magnetization become cyclic. From experiments of both classes it appears that for a given field there is a certain value of the load for which the magnetization is a maximum, the maximum occuring at a smaller load the stronger the field. In very strong fields the maximum may even disappear altogether, the effect of the smallest stress being to diminish the magnetization; on the other hand, with very weak fields the maximum may not have been reached with the greatest load that the wire can support without permanent deformation. When the load on a hardened wire is gradually increased, the maximum value of I is found to correspond with a greater stress than when the load is gradually diminished, this being an effect of hysteresis. Analogous changes are observed in the residual magnetization which remains after the wire has been subjected to fields of different strength. The effects of longitudinal pressure are opposite to those of traction; when the cyclic condition has been reached, pressure reduces the magnetization of iron in weak fields and increases it in strong fields (Ewing, *Magnetic Induction*, 1900, 223).

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[1] For a discussion of theories of magnetic stress, with copious references, see Nagaoka, *Rap. du Congrès International de Physique* (Paris, 1900), ii. 545. Also Nagaoka and Jones, *Phil. Mag.*, 1896, 41, 454.

[2] S. Bidwell, *Phil. Trans.*, 1888, 179a, 321.

[3] *Phil. Mag.*, 1895, 40, 345.

[4] J. C. Maxwell, *Treatise*, § 643.

[5] See correspondence in *Nature*, 1896, 53, pp. 269, 316, 365, 462, 533; 1906, 74, pp. 317, 539; B. B. Brackett, *loc. cit.*, quotes the opinion of H. A. Rowland in support of compressive stress.

[6] J. A. Ewing, *Phil. Trans.*, 1885, 176, 580; 1888, 179, 333; *Magnetic Induction*, 1900, ch. ix.; J. A. Ewing and G. C. Cowan, *Phil. Trans.*, 1888, 179a, 325; C. G. Knott, *Trans. Roy. Soc. Ed.*, 1882–1883, 32, 193; 1889, 35, 377; 1891, 36, 485; *Proc. Roy. Soc. Ed.*, 1899, 586; H. Nagaoka, *Phil. Mag.*, 1889, 27, 117; 1890, 29, 123; H. Nagaoka and K. Honda, *Journ. Coll. Sci. Tokyo*, 1900, 13, 263; 1902, 16, art. 8; *Phil. Mag.*, 1898, 46, 261; 1902, 4, 45; K. Honda and S. Shimizu, *Ann. d. Phys.*, 1904, 14, 791; *Tokyo Physico-Math. Soc. Rep.*, 1904, 2, No. 13; K. Honda and T. Terada, *Journ. Coll. Sci. Tokyo*, 1906, 21, art. 4.

The influence of traction in diminishing the susceptibility of nickel was first noticed by Kelvin (W. Thomson), and was subsequently investigated by Ewing and Cowan. The latter found the effect to be enormous, not only upon the induced magnetization, but in a still greater degree upon the residual. Even under so "moderate" a load as 33 kilogrammes per square mm., the induced magnetization of a hard-drawn nickel wire in a field of 60 fell from 386 to 72 units, while the residual was reduced from about 280 to 10. Ewing has also examined the effects produced by longitudinal compression upon the susceptibility and retentiveness of nickel, and found, as was to be expected, that both were greatly increased by pressure. The maximum susceptibility of one of his bars rose from 5·6 to 29 under a stress of 19·8 kilos per square mm. There were reasons for believing that no Villari reversal would be found in nickel. Ewing and Cowan looked carefully for it, especially in weak fields, but failed to discover anything of the kind.[1] Some experiments by A. Heydweiller,[2] which appeared to indicate a reversal in weak fields (corresponding to $I=5$, or thereabouts), have been shown by Honda and Shimizu to be vitiated by the fact that his specimen was not initially in a magnetically neutral state; they found that when the applied field had the same direction as that of the permanent magnetization, Heydweiller's fallacious results were easily obtained; but if the field were applied in the direction opposite to that of the permanent magnetization, or if, as should rightly be the case, there were no permanent magnetization at all, then there was no indication of any Villari reversal. Thus a very important question, which has given rise to some controversy, appears to be now definitely settled.

The effects of longitudinal pressure upon the magnetization of cast cobalt have been examined by C. Chree,[3] and also by J. A. Ewing.[4] Chree's experiments were undertaken at the suggestion of J. J. Thomson, who, from the results of Bidwell's observations on the magnetic deformation of cobalt, was led to expect that that metal would exhibit a reversal opposite in character to the effect observed in iron. The anticipated reversal was duly found by Chree, the critical point corresponding, under the moderate stress employed, to a field of about 120 units. Ewing's independent experiments showed that the magnetization curve for a cobalt rod under a load of 16·2 kilogrammes per square mm. crossed the curve for the same rod when not loaded at $H=53$. Both observers noticed analogous effects in the residual magnetization. The effect of tension was subsequently studied by Nagaoka and Honda, who in 1902 confirmed, *mutatis mutandis*, the results obtained by Chree and Ewing for cast cobalt, while for annealed cobalt it turned out that tension always caused diminution of magnetization, the diminution increasing with increasing fields. They also investigated the magnetic behaviour of various nickel-steels under tension, and found that there was always increase of magnetization. Thus it has been proved that in annealed cobalt and in nickel-steel there is no Villari reversal.

It has been pointed out by J. J. Thomson (*Applications of Dynamics to Physics and Chemistry*, 47) that on dynamical principles there must be a reciprocal relation between the changes of dimensions produced by magnetization and the changes of magnetization attending mechanical strain. Since, for example, stretching diminishes the magnetization of nickel, it follows from theory that the length of a nickel rod should be diminished by magnetization and conversely. So, too, the Villari reversals in iron and cobalt might have been predicted—as indeed that in cobalt actually was—from a knowledge of the changes of length which those metals exhibit when magnetized.

The complete reciprocity of the effects of magnetization upon length and of stretching upon magnetization is shown by the following parallel statements:—

Iron.	
Magnetization produces increase of length in weak fields, decrease in strong fields.	Tension produces increase of magnetization in weak fields, decrease in strong fields.
Cast Cobalt.	
Magnetization produces decrease of length in weak fields, increase in strong fields.	Tension produces decrease of magnetization in weak fields, increase in strong fields.
Nickel and Annealed Cobalt.	
Magnetization produces decrease of length in all fields.	Tension produces decrease of magnetization in all fields.
Nickel-Steel.	
Magnetization produces increase of length in all fields.	Tension produces increase of magnetization in all fields.

Nagaoka and Honda (*Phil. Mag.*, 1898, 46, 261) have investigated the effects of hydrostatic pressure upon magnetization, using the same pieces of iron and nickel as were employed in their experiments upon magnetic change of volume. In the iron cylinder and ovoid, which expanded when magnetized, compression caused a diminution of magnetization; in the nickel rod, which contracted when magnetized, pressure was attended by an increase of magnetization. The amount of the change was in both cases exceedingly small, that in iron being less than 0·1 C.G.S. unit with a pressure of 250 atmospheres and $H=54$. It would hardly be safe to generalize from these observations; the effects may possibly be dependent upon the physical condition of the metals. In the same paper Nagaoka and Honda describe an important experiment on the effect of transverse stress. An iron tube, having its ends closed by brass caps, was placed inside a compressing vessel into which water was forced until the pressure upon the outer surface of the tube reached 250 atmospheres. The experiment was the reverse of one made by Kelvin with a gun-barrel subjected to internal hydrostatic pressure (*Phil. Trans.*, 1878, 152, 64), and the results were also the reverse. Under increasing magnetizing force the magnetization first increased, reached a maximum, and then diminished until its value ultimately became less than when the iron was in the unstrained condition. Experiments on the effect of external hydrostatic pressure upon the magnetization of iron rings have also been made by F. Frisbie,[5] who found that for the magnetizing forces used by Nagaoka and Honda pressure produced a small *increase* of magnetization, a result which appears to be in accord with theory.

The relations of torsion to magnetization were first carefully studied by G. Wiedemann, whose researches are described in his *Elektricität*, iii. 671. The most interesting of his discoveries, now generally known as the "Wiedemann effect," is the following: If we magnetize longitudinally a straight wire which is fixed at one end and free at the other, and then pass an electric current through the wire (or first pass the current and then magnetize), the free end of the wire will twist in a certain direction depending upon circumstances: if the wire is of iron, and is magnetized (with a moderate force) so that its free end has north polarity, while the current through it passes from the fixed to the free end, then the free end as seen from the fixed end will twist in the direction of the hands of a watch; if either the magnetization or the current is reversed, the direction of the twist will be reversed. To this mechanical phenomenon there is a magnetic reciprocal. If we twist the free end of a ferromagnetic wire while a current is passing through it, the wire becomes longitudinally magnetized, the direction of the magnetization depending upon circumstances: if the wire is of iron and is twisted so that its free end as seen from the fixed end turns in the direction of the hands of a watch, while the current passes from the fixed to the free end, then the direction of the resulting magnetization will be such as to make the free end a north pole. The twist effect exhibited by iron under moderate longitudinal magnetization has been called by Knott a *positive* Wiedemann effect; if the twist were reversed, the other conditions remaining the same, the sign of the Wiedemann effect would be *negative.* An explanation of the twist has been given by Maxwell (*Electricity and Magnetism,* § 448). The wire is subject to two superposed magnetizations, the one longitudinal, the other circular, due to the current traversing the wire; the resultant magnetization is consequently in the direction of a screw or spiral round the wire, which will be right-handed or left-handed according as the relation between the two magnetizations is right-handed or left-handed; the magnetic expansion or contraction of the metal along the spiral lines of magnetization produces the Wiedemann twist. Iron (moderately magnetized) expands along the lines of magnetization, and therefore for a right-handed spiral exhibits a right-handed twist. This explanation was not accepted by Wiedemann,[1] who thought that the effect was accounted for by molecular friction. Now nickel contracts instead of lengthening when it is magnetized, and an experiment by Knott showed, as he expected, that *caeteris paribus* a nickel wire twists in a sense opposite to that in which iron twists. The Wiedemann effect being positive for iron is negative for nickel. Further, although iron lengthens in fields of moderate strength, it contracts in strong ones; and if the wire is stretched, contraction occurs with smaller magnetizing forces than if it is unstretched. Bidwell[2] accordingly found upon trial that the Wiedemann twist of an iron wire vanished when the magnetizing force reached a certain high value, and was reversed when that value was exceeded; he also found that the vanishing point was reached with lower values of the magnetizing force when the wire was stretched by a weight. These observations have been verified and extended by Knott, whose researches have brought to light a large number of additional facts, all of which are in perfect harmony with Maxwell's explanation of the twist.

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[1] H. Tomlinson found a critical point in the "temporary magnetization" of nickel (*Proc. Phys. Soc.*, 1890, 10, 367, 445), but this does not correspond to a Villari reversal. Its nature is made clear by Ewing and Cowan's curves (*Phil. Trans.*, 1888, 179, plates 15, 16).

[2] *Wied. Ann.*, 1894, 52, 462; *Electrician*, 1894, 34, 143.

[3] *Phil. Trans.*, 1890, 131, 329.

[4] *Magnetic Induction*, 1900, 222.

[5] *Phys. Rev.*, 1904, 18, 432.

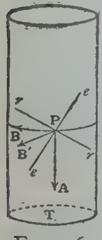

FIG. 26.

Maxwell has also given an explanation of the converse effect, namely, the production of longitudinal magnetization by twisting a wire when circularly magnetized by a current passing through it. When the wire is free from twist, the magnetization at any point P is in the tangential direction PB (see fig. 26). Suppose the wire to be fixed at the top and twisted at the bottom in the direction of the arrow-head T; then the element of the wire at P will be stretched in the direction P*e* and compressed in the direction P*r*. But tension and compression produce opposite changes in the magnetic susceptibility; if the metal is iron and its magnetization is below the Villari critical point, its susceptibility will be greater along P*e* than along P*r*; the direction of the magnetization therefore tends to approach P*e* and to recede from P*r*, changing, in consequence of the twist, from PB to some such direction as PB′, which has a vertical component downwards; hence the lower and upper ends will respectively acquire north and south polarity, which will disappear when the wire is untwisted. This effect has never been actually reversed in iron, probably, as suggested by Ewing, because the strongest practicable circular fields fail to raise the components of the magnetization along P*e* and P*r* up to the Villari critical value. Nagaoka and Honda have approached very closely to a reversal, and consider that it would occur if a sufficiently strong current could be applied without undue heating.

One other effect of torsion remains to be noticed. If a longitudinally magnetized wire is twisted, circular magnetization is developed; this is evidenced by the transient electromotive force induced in the iron, generating a current which will deflect a galvanometer connected with the two ends of the wire. The explanation given of the last described phenomenon will with the necessary modification apply also to this; it is a consequence of the aeolotropy produced by the twist. There are then three remarkable effects of torsion:

A A wire magnetized longitudinally and circularly becomes twisted.

B. Twisting a circularly magnetized wire produces longitudinal magnetization.

C. Twisting a longitudinally magnetized wire produces circular magnetization.

And it has been shown earlier that—

D. Magnetization produces change of length.

E. Longitudinal stress produces change of magnetization.

Each of these five effects may occur in two opposite senses. Thus in A the twist may be right-handed or left-handed; in B the polarity of a given end may become north or south; in C the circular magnetization may be clockwise or counter-clockwise; in D the length may be increased or diminished ; in E the magnetization may become stronger or weaker. And, other conditions remaining unchanged, the "sense" of any effect depends upon the nature of the metal under test, and (sometimes) upon the intensity of its magnetization. Let each of the effects A, B, C, D and E be called positive when it is such as is exhibited by moderately magnetized iron, and negative when its sense is opposite. Then the results of a large number of investigations may be briefly summarized as follows:

(W) = weakly magnetized. (S) = strongly magnetized.

Metal.	*Effects.*	*Sign.*
Iron (W)	A, B, C, D, E	+
Unannealed Cobalt (S)	A, D, E	+
Nickel-Steel (W)	A, D, E	+
Nickel	A, B, C, D, E	−
Annealed Cobalt	D, E	−
Iron (S)	A, C, D, E	−
Unannealed Cobalt	A, D, E	−

Several gaps remain to be filled, but the results so far recorded can leave no doubt that the five effects, varied as they may at first sight appear, are intimately connected with one another. For each of the metals tabulated in the first column all the effects hitherto observed have the same sign; there is no single instance in which some are positive and others negative. Until the mysteries of molecular constitution have been more fully explored, perhaps D may be most properly regarded as the fundamental phenomenon from which the others follow. Nagaoka and Honda have succeeded in showing that the observed relations between twist and magnetization are in qualitative agreement with an extension of Kirchhoff's theory of magnetostriction.

The effects of magnetization upon the torsion of a previously twisted wire, which were first noticed by Wiedemann, have been further studied by F. J. Smith[3] and by G. Moreau.[4] Nagaoka[5] has described the remarkable influence of combined torsion and tension upon the magnetic susceptibility of nickel, and has made the extraordinary observation that, under certain conditions of stress, the magnetization of a nickel wire may have a direction opposite to that of the magnetizing force.

8. EFFECTS OF TEMPERATURE UPON MAGNETISM

High Temperature.—It has long been known that iron, when raised to a certain "critical temperature" corresponding to dull red heat, loses its susceptibility and becomes magnetically indifferent, or, more accurately, is transformed from a ferromagnetic into a paramagnetic body. Recent researches have shown that other imporant changes in its properties occur at the same critical temperature. Abrupt alterations take place in its density, specific heat, thermo-electric quality, electrical conductivity, temperature-coefficient of electrical resistance, and in some at least of its mechanical properties. Ordinary magnetizable iron is in many respects an essentially different substance from the non-magnetizable metal into which it is transformed when its temperature is raised above a certain point (see *Brit. Assoc. Report*, 1890, 145). The first exact experiments demonstrating the changes which occur in the permeability of iron, steel and nickel when heated up to high temperatures were those of J. Hopkinson (*Phil. Trans.*, 1889, 180, 443; *Proc. Roy. Soc.*, 1888, 44, 317). The metal to be tested was prepared in the form of a ring, upon which were wound primary and secondary coils of copper wire insulated with asbestos. The primary coil carried the magnetizing current; the secondary, which was wound inside the other, could be connected either with a ballistic galvanometer for determining the induction, or with a Wheatstone's bridge for measuring the resistance, whence the temperature was calculated. The ring thus prepared was placed in a cast-iron box and heated in a gas furnace. The following are the chief results of Hopkinson's experiments: For small magnetizing forces the magnetization of iron steadily increases with rise of temperature till the critical temperature is approached, when the rate of increase becomes very high, the permeability in some cases attaining a value of about 11,000; the magnetization then with remarkable suddenness almost entirely disappears, the permeability falling to about 1·14. For strong magnetizing forces (which in these experiments did not exceed H = 48·9) the permeability remains almost constant at its initial value (about 400), until the temperature is within nearly 100° of the critical point; then the permeability diminishes more and more rapidly until the critical point is reached and the magnetization vanishes. Steel behaves in a similar manner, but the maximum permeability is not so high as in iron, and the fall, when the critical point is approached, is less abrupt. The critical temperature for various samples of iron and steel ranges from 690° C. to 870° C.; it is the temperature at which Barrett's "recalescence" occurs. The critical temperature for the specimen of nickel examined (which contained nearly 5% of impurities) was 310° C. F. Lydall and A. W. Pocklington found that the critical temperature of nearly pure iron was 874° C. (*Proc. Roy. Soc.*, 1893, 52, 228).

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[1] *Phil. Mag.*, 1886, 22, 50.

[2] *Ibid.* 251.

[3] *Phil. Mag.*, 1891, 32, 383.

[4] *C.R.*, 1896, 122, 1192; 1898, 126, 463.

[5] *Phil. Mag.*, 1889, 27, 117.

An exhaustive research into the effects of heating on the magnetic properties of iron has been carried out by D. K. Morris (*Proc. Phys. Soc.*, 1897, 15, 134; and *Phil. Mag.*, 1897, 44, 213), the results being embodied in a paper containing twelve pages of tables and upwards of 120 curves. As in Hopkinson's experiments, ring magnets were employed; these were wound with primary and secondary coils of insulated platinum wire, which would bear a much higher temperature than copper without oxidation or fusion. A third platinum coil, wound non-inductively between the primary and the secondary, served to carry the current by which the ring was heated; a current of 4·6 amperes, with 16 volts across the terminals, was found sufficient to maintain the ring at a temperature of 1150° C. In the ring itself was embedded a platinum-thermometer wire, from the resistance of which the temperature was determined. The whole was wrapped in several coverings of asbestos and placed in a glass vessel from which the air was partially exhausted, additional precautions being taken to guard against oxidation of the iron.

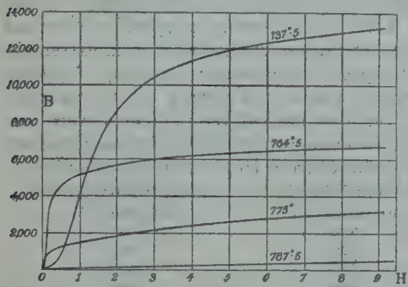

FIG. 27.

Some preliminary experiments showed the striking difference in the effects of annealing at a red heat (840° C.) and at a low white heat (1150° C.). After one of the rings had been annealed at 840°, its maximum permeability at ordinary temperatures was 4000 for H = 1·84; when it had been subsequently annealed at 1150°, the maximum permeability rose to 4680 for H = 1·48, while the hysteresis loss for B = ±4000 was under 500 ergs per c.cm. As regards the effects of temperature, Morris's results are in general agreement with those of Hopkinson, though no doubt they indicate details with greater clearness and accuracy. Specimens of curves showing the relation of induction to magnetic field at various temperatures, and of permeability to temperature with fields of different intensities, are given in figs. 27 and 28. The most striking feature presented by these is the enormous value, 12,660, which, with H = 0·153, is attained by the permeability at 765° C., followed by a drop so precipitous that when the temperature is only 15° higher, the value of the permeability has become quite insignificant. The critical temperatures for three different specimens of iron were 795°, 780°, and 770° respectively. Above these temperatures the little permeability that remained was found to be independent of the magnetizing force, but it appeared to vary a little with the temperature, one specimen showing a permeability of 100 at 820°, 2·3 at 950°, and 17 at 1050°. These last observations are, however, regarded as uncertain. The effects of temperature upon hysteresis were also carefully studied, and many hysteresis loops were plotted. The results of a typical experiment are given in the annexed table, which shows how greatly the hysteresis loss is diminished as the critical temperature is approached. The coercive force at 764°·5 is stated to have been little more than 0·1 C.G.S. unit; above the critical temperature no evidence of hysteresis could be obtained.

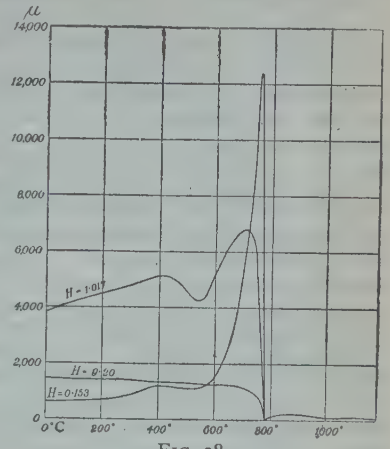

FIG. 28.

Hysteresis Loss in Ergs per c.cm. Max. H. = ±6·83.

Temp. C.°	Ergs.	Temp. C.°	Ergs
764·5	120	457	2025
748	328	352	2565
730	426	249	3130
695	797	137·5	3500
634	1010	24	3660
554	1345		

A paper by H. Nagaoka and S. Kusakabe[1] generally confirms Morris's results for iron, and gives some additional observations for steel, nickel and cobalt. The magnetometric method was employed, and the metals, in the form of ovoids, were heated by a specially designed burner, fed with gas and air under pressure, which directed 90 fine jets of flame upon the asbestos covering the ovoid. The temperature was determined by a platinum-rhodium and platinum thermo-junction in contact with the metal. Experiments were made at several constant temperatures with varying magnetic fields, and also at constant fields with rising and falling temperatures. For ordinary steel the critical temperature, at which magnetization practically disappeared, was found to be about 830°, and the curious fact was revealed that, on cooling, magnetization did not begin to reappear until the temperature had fallen 40° below the critical value. This retardation was still more pronounced in the case of tungsten-steel, which lost its magnetism at 910° and remained non-magnetic till it was cooled to 570°, a difference of 240°. For nearly pure nickel the corresponding temperature-difference was about 100°. This phenomenon is of the same nature as that first discovered by J. Hopkinson for nickel-steel. The paper contains tables and curves showing details of the magnetic changes, sometimes very complex, at different temperatures and with different fields. The behaviour of cobalt is particularly noticeable; its permeability increased with rising temperature up to a maximum at 500°, when it was about twice as great as at ordinary temperatures, while at 1600°, corresponding to white heat, there was still some magnetization remaining.

Further contributions to the subject have been made by K. Honda and S. Shimizu,[2] who experimented at temperatures ranging from −186° to 1200°. As regards the higher temperatures, the chief point of interest is the observation that the curve of magnetization for annealed cobalt shows a small depression at about 450°, the temperature at which they had found the sign of the length-change to be reversed for all fields. In the case of all the metals tested a small but measurable trace of magnetization remained after the so-called critical temperature had been exceeded; this decreased very slightly up to the highest temperature reached (1200°) without undergoing any such variation as had been suspected by Morris. When the curve after its steep descent has almost reached the axis, it bends aside sharply and becomes a nearly horizontal straight line; the authors suggest that the critical temperature should be defined as that corresponding to the point of maximum curvature. As thus defined the critical temperatures for iron, nickel and cobalt were found to be 780°, 360° and 1090° respectively, but these values are not quite independent of the magnetizing force.

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[1] *Journ. Coll. Sci. Tokyo*, 1904, 19, art. 9.

[2] *Phil. Mag.*, 1905, 10, 548; *Tokyo Phys.-Math. Soc. Rep.*, 1904, 2, No. 14; *Journ. Coll. Sci. Tokyo*, 1905, 20, art. 6.

Experiments on the effect of high temperatures have also been made by M. P. Ledeboer,[1] H. Tomlinson,[2] P. Curie,[3] and W. Kunz,[4] R. L. Wills,[5] J. R. Ashworth[6] and E. P. Harrison.[7]

Low Temperature.—J. A. Fleming and J. Dewar (*Proc. Roy. Soc.*, 1896, 60, 81) were the first to experiment on the permeability and hysteresis of iron at low temperatures down to that of liquid air (–186° C.). Induction curves of an annealed soft-iron ring were taken first at a temperature of 15° C., and afterwards when the ring was immersed in liquid air, the magnetizing force ranging from about 0·8 to 22. After this operation had been repeated a few times the iron was found to have acquired a stable condition, and the curves corresponding to the two temperatures became perfectly definite. They showed that the permeability of this sample of iron was considerably diminished at the lower temperature. The maximum permeability (for $H = 2$) was 3400 at 15° and only 2700 at –186°, a reduction of more than 20%; but the percentage reduction became less as the magnetizing force departed from the value corresponding to maximum permeability. Observations were also made of the changes of permeability which took place as the temperature of the sample slowly rose from –186° to 15°, the magnetizing force being kept constant throughout an experiment. The values of the permeability corresponding to the highest and lowest temperatures are given in the following table. Most of the permeability-temperature curves were more or less convex towards the axis of temperature, and in all the experiments, except those with annealed iron and steel wire, the permeability was greatest at the lowest temperature.[8] The hysteresis of the soft annealed iron turned out to be sensibly the same for equal values of the induction at –186° as at 15°, the loss in ergs per c.cm. per cycle being approximately represented by $0·002\ B^{1·56}$ when the maximum limits of B were $\pm$ 9000. Experiments with the sample of unannealed iron failed to give satisfactory results, owing to the fact that no constant magnetic condition could be obtained.

Sample of Iron.	H.	μ at 15°.	μ at—186°.
Annealed Swedish	1·77	2835	2332
Unannealed ,,	1·78	917	1272
,, ,,	9·79	1210	1293
Hardened ,,	2·66	56	132
,, ,,	4·92	106·5	502
,, ,,	11·16	447·5	823
,, ,,	127·7	109	124
Steel wire	7·50	86	64·5
,,	20·39	361	144

Honda and Shimizu have made similar experiments at the temperature of liquid air, employing a much wider range of magnetizing forces (up to about 700 C.G.S.) and testing a greater variety of metals. They found that the permeability of Swedish iron, tungsten-steel and nickel, when the metals were cooled to –186°, was diminished in weak fields but increased in strong ones, the field in which the effect of cooling changed its sign being 115 for iron and steel and 580 for nickel. The permeability of cobalt, both annealed and unannealed, was always diminished at the low temperature. The hysteresis-loss in Swedish iron was decreased for inductions below about 9000 and increased for higher inductions; in tungsten-steel, nickel and cobalt the hysteresis-loss was always increased by cooling. The range of $\pm$ B within which Steinmetz's formula is applicable becomes notably increased at low temperature. It may be remarked that, whereas Fleming and Dewar employed the ballistic method, their specimens having the form of rings, Honda and Shimizu worked magnetometrically with metals shaped as ovoids.

Permanent Magnets.—Fleming and Dewar (*loc. cit.* p. 57) also investigated the changes which occurred in permanently magnetized metals when cooled to the temperature of liquid air. The metals, which were prepared in the form of small rods, were magnetized between the poles of an electromagnet and tested with a magnetometer at temperatures of –186° and 15°. The first immersion into liquid air generally produced a permanent decrease of magnetic moment, and there was sometimes a further decrease when the metal was warmed up again; but after a few alternations of temperature the changes of moment became definite and cyclic. When the permanent magnetic condition had been thus established, it was found that in the case of all the metals, except the two alloys containing large percentages of nickel, the magnetic moment was temporarily increased by cooling to –186°. The following table shows the principal results. It is suggested that a permanent magnet might conveniently be "aged" (or brought into a constant condition) by dipping it several times into liquid air.

Metal.	Percentage Gain or Loss of Moment at —186° C.	
	First Effect.	Cyclic Effect.
Carbon steel, hard	–6	+12
,, ,, medium	Decrease	+22
,, ,, annealed	–33	+33
Chromium steels (four samples)	Increase	+12
Aluminium steels (three samples)	–2	+10
Nickel steels, up to 7·65%	Small	+10
,, ,, ,, 19·64%	–50	–25
,, ,, ,, 29%	–20	–10
Pure nickel	Decrease	+3
Silicon steel, 2·67%	,,	+4
Iron, soft	None	+2·5
,, hard	Decrease	+10
Tungsten steel, 15%	,,	+6
,, ,, 7·5%	,,	+10
,, ,, 1%	,,	+12

Other experiments relating to the effect of temperature upon permanent magnets have been carried out by J. R. Ashworth,[9] who showed that the temperature coefficient of permanent magnets might be reduced to zero (for moderate ranges of temperature) by suitable adjustment of temper and dimension ratio; also by R. Pictet,[10] A. Durward[11] and J. Trowbridge.[12]

Alloys of Nickel and Iron.—A most remarkable effect of temperature was discovered by Hopkinson (*Proc. Roy. Soc.*, 1890, 47, 23; 1891, 48, 1) in 1889. An alloy containing about 3 parts of iron and 1 of nickel—both strongly magnetic metals—is under ordinary conditions practically non-magnetizable ($\mu = 1·4$ for any value of H). If, however, this non-magnetic substance is cooled to a temperature a few degrees below freezing-point, it becomes as strongly magnetic as average cast-iron ($\mu = 62$ for $H = 40$), and retains its magnetic properties indefinitely at ordinary temperatures. But if the alloy is heated up to 580° C. it loses its susceptibility—rather suddenly when H is weak, more gradually when H is strong—and remains non-magnetizable till it is once more cooled down below the freezing-point. This material can therefore exist in either of two perfectly stable conditions, in one of which it is magnetizable, while in the other it is not. When magnetizable it is a hard steel, having a specific electrical resistance of 0·000052; when non-magnetizable it is an extremely soft, mild steel, and its specific resistance is 0·000072. Alloys containing different proportions of nickel were found to exhibit the phenomenon, but the two critical temperatures were less widely separated. The following approximate figures for small magnetizing forces are deduced from Hopkinson's curves:—

Percentage of Nickel.	Susceptibility lost at temp. C.	Susceptibility gained at temp. C.
0·97	890	—
4·7	820	660
4·7	780	600
24·5	680	–10
30·0	140	125
33·0	207	193
73·0	202	202

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[1] *C.R.*, 1888, 106, 129.
[2] *Proc. Phys. Soc.*, 1888, 9, 181.
[3] *C.R.*, 1892, 115, 805; 1894, 118, 796 and 859.
[4] *Elekt. Zeits.*, 1894, 15, 194.
[5] *Phil. Mag.*, 1900, 50, 1.
[6] *Phil. Trans.*, 1903, 201, 1.
[7] *Phil. Mag.*, 1904, 8, 179.
[8] A. M. Thiessen (*Phys.*, 1899, 8, 65) and G. Claude (*C. R.*, 1899, 129, 409) found that for considerable inductions ($B = 15,000$) the permeability and hysteresis-loss remained nearly constant down to –186°; for weak inductions both notably diminished with temperature.
[9] *Proc. Roy. Soc.*, 1898, 62, 210.
[10] *C.R.*, 1895, 120, 263.
[11] *Amer. Journ. Sci.*, 1898, 5, 245.
[12] *Phys. Rev.*, 1901, 14, 181.

Honda and Shimizu (*loc. cit.*) have determined the two critical temperatures for eleven nickel-steel ovoids, containing from 24·04 to 70·32 % of nickel, under a magnetizing force of 400, and illustrated by an interesting series of curves, the gradual transformation of the magnetic properties as the percentage of nickel was decreased. They found that the hysteresis-loss, which at ordinary temperatures is very small, was increased in liquid air, the increase for the alloys containing less than 30 % of nickel being enormous. Steinmetz's formula applies only for very weak inductions when the alloys are at the ordinary temperature, but at the temperature of liquid air it becomes applicable through a wide range of inductions. According to C. E. Guillaume[1] the temperature at which the magnetic susceptibility of nickel-steel is recovered is lowered by the presence of chromium; a certain alloy containing chromium was not rendered magnetic even by immersion in liquid air. Experiments on the subject have also been made by E. Dumont[2] and F. Osmond.[3]

9. Alloys and Compounds of Iron

In 1885 Hopkinson (*Phil. Trans.*, 1885, 176, 455) employed his yoke method to test the magnetic properties of thirty-five samples of iron and steel, among which were steels containing substantial proportions of manganese, silicon, chromium and tungsten. The results, together with the chemical analysis of each sample, are given in a table contained in this paper, some of them being also represented graphically. The most striking phenomenon which they bring into prominence is the effect of any considerable quantity of manganese in annihilating the magnetic property of iron. A sample of Hadfield's manufacture, containing 12·36 % of manganese, differed hardly at all from a non-magnetic substance, its permeability being only 1·27. According to Hopkinson's calculation, this sample behaved as if 91 % of the iron contained in it had completely lost its magnetic property.[4] Another point to which attention is directed is the exceptionally great effect which hardening has upon the magnetic properties of chrome steel; one specimen had a coercive force of 9 when annealed, and of no less than 38 when oil-hardened. The effect of the addition of tungsten in increasing the coercive force is very clearly shown; in two specimens containing respectively 3·44 and 2·35 % of tungsten the coercive force was 64·5 and 70·7. These high values render hardened tungsten-steel particularly suitable for the manufacture of permanent magnets. Hopkinson (*Proc. Roy. Soc.*, 1890, 48, 1) also noticed some peculiarities of an unexpected nature in the magnetic properties of the nickel-steel alloys already referred to. The permeability of the alloys containing from 1 to 4·7 % of nickel, though less than that of good soft iron for magnetizing forces up to about 20 or 30, was greater for higher forces, the induction reached in a field of 240 being nearly 21,700. The induction for considerable forces was found to be greater in a steel containing 73 % of nickel than in one with only 33 %, though the permeability of pure nickel is much less than that of iron.

The magnetic qualities of various alloys of iron have been submitted to a very complete examination by W. F. Barrett, W. Brown and R. A. Hadfield (*Trans. Roy. Dub. Soc.*, 1900, 7, 67; *Journ. Inst. Elec. Eng.*, 1902, 31, 674).[5] More than fifty different specimens were tested, most of which contained a known proportion of manganese, nickel, tungsten, aluminium, chromium, copper or silicon; in some samples two of the substances named were present. Of the very numerous results published, a few of the most characteristic are collected in the following table. The first column contains the symbols of the various elements which were added to the iron, and the second the percentage proportion in which each element was present; the sample containing 0·03 % of carbon was a specimen of the best commercial iron, the values obtained for it being given for comparison. All the metals were annealed.

A few among several interesting points should be specially noticed. The addition of 15·2 % of manganese produced an enormous effect upon the magnetism of iron, while the presence of only 2·25 % was comparatively unimportant. When nickel was added to the iron in increasing quantities the coercive force increased until the proportion of nickel reached 20 %; then it diminished, and when the proportion of nickel was 32 % the coercive force had fallen to the exceedingly low value of 0·5. In the case of iron containing 7·5 % of tungsten (W), the residual induction had a remarkably high value; the coercive force, however, was not very great. The addition of silicon in small quantities considerably diminished permeability and increased coercive force; but when the proportion amounted to 2·5 % the maximum permeability ($\mu = 5100$ for $H = 2$) was greater than that of the nearly pure iron used for comparison, while the coercive force was only 0·9.[6] A small percentage of aluminium produced still higher permeability ($\mu = 6000$ for $H = 2$), the induction in fields up to 60 being greater than in any other known substance, and the hysteresis-loss for moderate limits of B far less than in the purest commercial iron. Certain non-magnetizable alloys of nickel, chromium-nickel and chromium-manganese were rendered magnetizable by annealing.

Element.	Per cent.	B for H = 45.	B residual.	μ for H = 8.	Coercive Force.
C	0·03	16800	9770	1625	1·66
Cu	2·5	14300	10410	..	5·4
Mn	2·25	14720	10460	1080	6·0
Mn	15·2	0	..	..	..
Ni	3·82	16190	9320	1375	2·76
Ni	19·64	7770	4770	90	20·0
Ni	31·4	4460	1720	357	0·5
W	7·5	15230	13280	500	9·02
Al	2·25	16900	10500	1700	1·0
Cr	3·25	..	..	..	12·25
Si	2·5	16420	4080	1680	0·9
Si	5·5	15980	3430	1630	0·85

Later papers[7] give the results of a more minute examination of those specimens which were remarkable for very low and very high permeabilities, and were therefore likely to be of commercial importance. The following table gives the exact composition of some alloys which were found to be non-magnetizable, or nearly so, in a field of 320.

An. = Annealed. Un. = Unannealed.		
State.	Percentage Composition.	I, for H = 320.
Un.	Fe, 85·77; C, 1·23; Mn, 13.	0
An.	Fe, 84·64; C, 0·15; Mn, 15·2	0
An.	Fe, 80·16; C, 0·8; Mn, 5·04; Ni, 14·55.	3
Un.	Ditto	0
Un.	Fe, 75·36; C, 0·6; Mn, 5·04; Ni, 19.	3
An.	Fe, 86·61; C, 1·08; Mn, 10·2; W, 2·11.	5

A very small difference in the constitution often produces a remarkable effect upon the magnetic quality, and it unfortunately happens that those alloys which are hardest magnetically are generally also hardest mechanically and extremely difficult to work; they might however be used rolled or as castings. The specimens distinguished by unusually high permeability were constituted as follows:—

Silicon-iron.—Fe, 97·3; C, 0·2; Si, 2·5.
Aluminium-iron.—Fe, 97·33; C, 0·18; Al, 2·25.

The silicon-iron had, in fields up to about 10, a greater permeability than a sample of the best Swedish charcoal-iron, and its hysteresis-loss for max. B = 9000, at a frequency of 100 per second, was only 0·254 watt per pound, as compared with 0·382 for the Swedish iron. The aluminium-iron attained its greatest permeability in a field of 0·5, about that of the earth's force, when its value was 9000, this being more than twice the maximum permeability of the Swedish iron. Its hysteresis-loss for B = 9000 was 0·236 per pound. It was, however, found that the behaviour of this alloy was in part due to a layer of pure iron ("ferrite") averaging 0·1 mm. in thickness, which occurred on the outside of the specimen, and the exceptional magnetic quality which has been claimed for aluminium-iron cannot yet be regarded as established.

A number of iron alloys have been examined by Mme. Curie (*Bull. Soc. d'Encouragement*, 1898, pp. 36–76), chiefly with the object of determining their suitability for the construction of permanent magnets. Her tests appear to show that molybdenum is even more effective than tungsten in augmenting the coercive force, the highest values observed being 70 to 74 for tungsten-steel, and 80 to 85 for steel containing 3·5 to 4 % of molybdenum. For additional information regarding the composition and qualities of permanent magnet steels reference may be made to the publications cited below.[1] Useful instructions have been furnished by Carl Barus (*Terrestrial Magnetism*, 1897, 2, 11) for the preparation of magnets calculated to withstand the effects of time, percussion and ordinary temperature variations. The metal, having first been uniformly tempered glass-hard, should be annealed in steam at 100° C. for twenty or thirty hours; it should then be magnetized to saturation, and finally "aged" by a second immersion in steam for about five hours.

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[1] *C.R.*, 1897, 124, 176 and 1515; 1897, 125, 235; 1898, 126, 738.

[2] Ibid., 1898, 126, 741.

[3] Ibid., 1899, 128, 304 and 1395.

[4] See also J. Hopkinson, *Journ. Inst. Elect. Eng.*, 1890, 19, 20, and J. A. Ewing, *Phil. Trans.*, 1889, 180, 239.

[5] Many of the figures which, through an error, were inaccurately stated in the first paper are corrected in the second.

[6] The marked effect of silicon in increasing the permeability of cast iron has also been noticed by F. C. Caldwell, *Elect. World*, 1898, 32, 619.

[7] *Trans. Roy. Dub. Soc.*, 1902–4, 8, 1 and 123.

Magnetic Alloys of Non-Magnetic Metals.—The interesting discovery was made by F. Heusler[2] in 1903 that certain alloys of the non-magnetic metal manganese with other non-magnetic substances were strongly magnetizable, their susceptibility being in some cases equal to that of cast iron. The metals used in different combinations included tin, aluminium, arsenic, antimony, bismuth and boron; each of these, when united in certain proportions with manganese, together with a larger quantity of copper (which appears to serve merely as a menstruum), constituted a magnetizable alloy. So far, the best results have been attained with aluminium, and the permeability was greatest when the percentages of manganese and aluminium were approximately proportional to the atomic weights of the two metals. Thus in an alloy containing 26·5% of manganese and 14·6% of aluminium, the rest being copper, the induction for H=20 was 4500, and for H=150, 5550. When the proportion of aluminium to manganese was made a little greater or smaller, the permeability was diminished. Next to aluminium, tin was found to be the most effective of the metals enumerated above. In all such magnetizable alloys the presence of manganese appears to be essential, and there can be little doubt that the magnetic quality of the mixtures is derived solely from this component. Manganese, though belonging (with chromium) to the iron group of metals, is commonly classed as a paramagnetic, its susceptibility being very small in comparison with that of the recognized ferromagnetics; but it is remarkable that its atomic susceptibility in solutions of its salts is even greater than that of iron. Now iron, nickel and cobalt all lose their magnetic quality when heated above certain critical temperatures which vary greatly for the three metals, and it was suspected by Faraday[3] as early as 1845 that manganese might really be a ferromagnetic metal having a critical temperature much below the ordinary temperature of the air. He therefore cooled a piece of the metal to −105° C., the lowest temperature then attainable, but failed to produce any change in its magnetic quality. The critical temperature (if there is one) was not reached in Faraday's experiment; possibly even the temperature of −250° C., which by the use of liquid hydrogen has now become accessible, might still be too high.[4] But it has been shown that the critical temperatures of iron and nickel may be changed by the addition of certain other substances. Generally they are lowered, sometimes, however, they are raised[5]; and C. E. Guillaume[6] explains the ferromagnetism of Heusler's alloy by supposing that the naturally low critical temperature of the manganese contained in it is greatly raised by the admixture of another appropriate metal, such as aluminium or tin; thus the alloy as a whole becomes magnetizable at the ordinary temperature. If this view is correct, it may also be possible to prepare magnetic alloys of chromium, the only other paramagnetic metals of the iron group.

J. A. Fleming and R. A. Hadfield[7] have made very careful experiments on an alloy containing 22·42% of manganese, 11·65% of aluminium and 60·49% of copper. The magnetization curve was found to be of the same general form as that of a paramagnetic metal, and gave indications that with a sufficient force magnetic saturation would probably be attained. There was considerable hysteresis, the energy-loss per cycle being fairly represented by $W=0{\cdot}0005495B^{2{\cdot}238}$. The hysteretic exponent is therefore much higher than in the case of iron, nickel and cobalt, for which its value is approximately 1·6.

10. MISCELLANEOUS EFFECTS OF MAGNETIZATION

Electrical Conductivity.—The specific resistance of many electric conductors is known to be temporarily changed by the action of a magnetic field, but except in the case of bismuth the effect is very small.

A. Gray and E. Taylor Jones (*Proc. Roy. Soc.*, 1900, 67, 208) found that the resistance of a soft iron wire was increased by about 1/700 in a field of 320 C.G.S. units. The effect appeared to be closely connected with the intensity of magnetization, being approximately proportional to I. G. Barlow (*Proc. Roy. Soc.*, 1903, 71, 30), experimenting with wires of iron, steel and nickel, showed that in weak fields the change of resistance was proportional to a function $aI^2+bI^4+cI^6$, where a, b and c are constants for each specimen. W. E. Williams (*Phil. Mag.*, 1902, 4, 430) found that for nickel the curves showing changes of resistance in relation to magnetizing force were strikingly similar in form to those showing changes of length. H. Tomlinson (*Phil. Trans.*, 1883, Part I., 153) discovered in 1881 that the resistance of a bismuth rod was slightly increased when the rod was subjected to longitudinal magnetic force, and a year or two later A. Righi (*Atti R. A. Lincei*, 1883–1884, 19, 545) showed that a more considerable alteration was produced when the magnetic force was applied transversely to the bismuth conductor; he also noticed that the effect was largely dependent upon temperature (see also P. Lenard, *Wied. Ann.*, 1890, 39, 619). Among the most important experiments on the influence of magnetic force at different temperatures are those of J. B. Henderson and of Dewar and Fleming. Henderson (*Phil. Mag.*, 1894, 38, 488) used a little spiral of the pure electrolytic bismuth wire prepared by Hartmann and Braun; this was placed between the pole-pieces of an electromagnet and subjected to fields of various strengths up to nearly 39,000 units. At constant temperature the resistance increased with the field; the changes in the resistance of the spiral when the temperature was 18° C. are indicated in the annexed table, from which it will be seen that in the strongest transverse field reached the resistance was increased more than threefold. Other experiments showed the relation of resistance to temperature (from 0° to about 90°) in different constant fields.

H.	R.	H.	R.
0	1·000	27450	2·540
6310	1·253	32730	2·846
12500	1·630	38900	3·334
20450	2·160		

It appears that as the temperature rises the resistance decreases to a minimum and then increases, the minimum point occurring at a higher temperature the stronger the field. For H=11,500 the temperature of minimum resistance was about 50°; for much lower or higher values of H the actual minimum did not occur within the range of temperature dealt with. Dewar and Fleming (*Proc. Roy. Soc.*, 1897, 60, 425) worked with a similar specimen of bismuth, and their results for a constant temperature of 19° agree well with those of Henderson. They also experimented with constant temperatures of −79°, −185° and −203°, and found that at these low temperatures the effect of magnetization was enormously increased. The following table gives some of their results, the specific resistance of the bismuth being expressed in C.G.S. units.

Field Strength.	Temp. 19° C.		Temp.–185° C.	
	Spec. Res.	Comp. Res.	Spec. Res.	Comp. Res.
0	116200	1·000	41000	1·00
1375	118200	1·017	103300	2·52
2750	123000	1·059	191500	4·67
8800	149200	1·284	738000	18·0
14150	186200	1·602	1730000	42·2
21800	257000	2·212	6190000	151

At the temperature of liquid air (−185°) the application of a field of 21,800 multiplied the resistance of the bismuth no less than 150 times. Fig. 29 shows the variations of resistance in relation to temperature for fields of different constant values. It will be seen that for H=2450 and H=5500 the minimum resistance occurs at temperatures of about −80° and −7° respectively.

Hall Effect.—If an electric current is passed along a strip of thin metal, and the two points at opposite ends of an equipotential line are connected with a galvanometer, its needle will of course not be deflected. But the application of a magnetic field at right angles to the plane of the metal causes the equipotential lines to rotate through a small angle, and the points at which the galvanometer is connected being no longer at the same potential, a current is indicated by the galvanometer.[1]

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[1] J. Trowbridge and S. Sheldon, *Phil. Mag.*, 1890, 29, 136; W. H. Preece, *Journ. Inst. Elec. Eng.*, 1890, 19, 62; *Electrician*, 1890, 25, 546; I. Klemençiç, *Wien. Ber.*, 1896, 105, IIa, 635; B. O. Peirce, *Am. Journ. Sci.*, 1896, 2, 347; A. Abt, *Wied. Ann.*, 1898, 66, 116; F. Osmond, *C. R.*, 1899, 128, 1513.

[2] *Deutsch. phys. Gesell. Verh.*, 1903, 5, 220 and 224.

[3] *Exp. Res.*, iii. 440.

[4] No record can be found of experiments with manganese at the temperature of liquid air or hydrogen; probably, however, negative results would not be published.

[5] The critical temperature of iron, for instance, is raised more than 100° by the addition of a little carbon and tungsten.

[6] *Bull. Soc. Int. des Électriciens*, 1906, 6, 301.

[7] *Proc. Roy. Soc.*, 1905, 76A, 271.

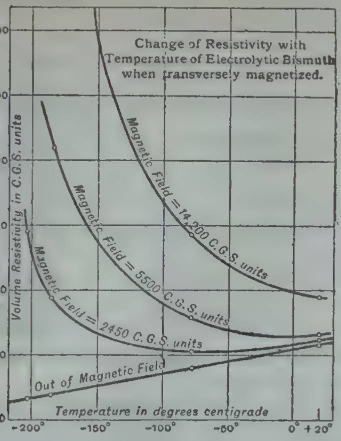


FIG. 29.

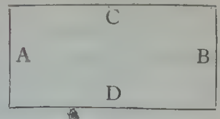
The tranverse electromotive force is equal to KCH/D, where C is the current, H the strength of the field, D the thickness of the metal, and K a constant which has been termed the *rotatory power* or *rotational coefficient*. (See Hopkinson, *Phil. Mag.*, 1880, 10, 430). The following values of K for different metals are given by E. H. Hall, the positive sign indicating that the electromotive force is in the same direction as the mechanical force acting upon the conductor. A. von Ettinghausen and W. Nernst (*Wien. Ber.*, 1886, 94, 560) have found that the rotational coefficient of tellurium is more than fifty times greater than that of bismuth, its sign being positive. Several experimenters have endeavoured to find a Hall effect in liquids, but such results as have been hitherto obtained are by no means free from doubt. E. A. Marx (*Ann. d. Phys.*, 1900, 2, 798) observed a well-defined Hall effect in incandescent gases. A large effect, proportional to the field, has been found by H. A. Wilson (*Cam. Phil. Soc. Proc.*, 1902, 11, pp. 249, 391) in oxygen, hydrogen and air at low pressures, and by C. D. Child (*Phys. Rev.*, 1904, 18, 370) in the electric arc.

Metal.	K×10^{15}	Metal.	K×10^{15}
Antimony	+114000	Copper	−520
Steel	+12060	Gold	−660
Iron	+7850	Nickel	−14740
Cobalt	+2460	Bismuth[2]	−8580000
Zinc	+820		

Electro-Thermal Relations.—The Hall electromotive force is only one of several so-called "galvano-magnetic effects" which are observed when a magnetic field acts normally upon a thin plate of metal traversed by an electric current. It is remarkable that if a flow of heat be substituted for a current of electricity a closely allied group of "thermo-magnetic effects" is presented. The two classes of phenomena have been collated by M. G. Lloyd (*Am. Journ. Sci.*, 1901, 12, 57), as follows:—

Galvano-Magnetic Effects.	*Thermo-Magnetic Effects.*
1. A transverse difference of electric potential (Hall effect).	i. A transverse difference of electric potential (Nernst effect).
2. A transverse difference of temperature (Ettinghausen effect).	ii. A transverse difference of temperature (Leduc effect).
3. Longitudinal change of electric conductivity.	iii. Longitudinal change of thermal conductivity.
4. Longitudinal difference of temperature.	iv. Longitudinal difference of electric potential.[3]

If in the annexed diagram ABCD represents the metallic plate through which the current of electricity or heat flows in the direction AB, then effects (1), (2), (i.) and (ii.) are exhibited at C and D, effects (4) and (iv.) at A and B, and effects (3) and (iii.) along AB. The transverse effects are reversed in direction when either the magnetic field or the primary current (electric or thermal) is reversed, but the longitudinal effects are independent of the direction of the field. It has been shown by G. Moreau (*C. R.*, 1900, 130, pp. 122, 412, 562) that if K is the coefficient of the Hall effect (1) and K′ the analogous coefficient of the Nernst effect (i.) (which is constant for small values of H), then $K' = K\sigma/\rho$, σ being the coefficient of the Thomson effect for the metal and ρ its specific resistance. He considers that Hall's is the fundamental phenomenon, and that the Nernst effect is essentially identical with it, the primary electromotive force in the case of the latter being that of the Thomson effect in the unequally heated metal, while in the Hall experiment it is derived from an external source.



Attempts have been made to explain these various effects by the electron theory.[4]

Thermo-electric Quality.—The earliest observations of the effect of magnetization upon thermo-electric power were those of W. Thomson (Lord Kelvin), who in 1856 announced that magnetization rendered iron and steel positive to the unmagnetized metals.[5] It has been found by Chassagny,[6] L. Houllevigue[7] and others that when the magnetizing force is increased, this effect passes a maximum, while J. A. Ewing[8] has shown that it is diminished and may even be reversed by tensile stress. Nickel was believed by Thomson to behave oppositely to iron, becoming negative when magnetized; but though his conclusion was accepted for nearly fifty years, it has recently been shown to be an erroneous one, based, no doubt, upon the result of an experiment with an impure specimen. Nickel when magnetized is always positive to the unmagnetized metal. So also is cobalt, as was found by H. Tomlinson.[9] The curves given by Houllevigue for the relation of thermo-electric force to magnetic field are of the same general form as those showing the relation of change of length to field. E. Rhoads [10] obtained a cyclic curve for iron which indicated thermo-electric hysteresis of the kind exhibited by Nagaoka's curves for magnetic strain. He also experimented with nickel and again found a resemblance to the strain curve. The subject was further investigated by S. Bidwell,[11] who, adopting special precautions against sources of error by which former work was probably affected, measured the changes of thermo-electric force for iron, steel, nickel and cobalt produced by magnetic fields up to 1500 units. In the case of iron and nickel it was found that, when correction was made for mechanical stress due to magnetization, magnetic change of thermo-electric force was, within the limits of experimental error, proportional to magnetic change of length. Further, it was shown that the thermo-electric curves were modified both by tensile stress and by annealing in the same manner as were the change-of-length curves, the modification being sometimes of a complex nature. Thus a close connexion between the two sets of phenomena seems to be established. In the case of cobalt no such relation could be traced; it appeared that the thermo-electric power of the unmagnetized with respect to the magnetized cobalt was proportional to the square of the magnetic induction or of the magnetization. Of nickel six different specimens were tested, all of which became, like iron, thermo-electrically positive to the unmagnetized metals.

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[1] E. H. Hall, *Phil. Mag.*, 1880, 9, 225; 1880, 10, 301; 1881, 12, 157; 1883, 15, 341; 1885, 19, 419.

[2] The large Hall effect in bismuth was discovered by Righi, *Journ. de Phys.*, 1884, 3, 127.

[3] REFERENCES.—(2) A. von Ettinghausen, *Wied. Ann.*, 1887, 31, 737.—(4) H. W. Nernst, ibid., 784.—(i.) and (iv.); A. von Ettinghausen and H. W. Nernst, *Wied. Ann.*, 1886, 29, 343.—(ii.) and (iii.); A. Righi, *Rend. Acc. Linc.*, 1887, 3 II, 6 and I, 481; and A. Leduc, *Journ. de Phys.*, 1887, 6, 78. Additional authorities are quoted by Lloyd, *loc. cit.*

[4] P. Drude, *Ann. d. Phys.*, 1900, 1, 566; 1900, 3, 369; 1902, 7, 687. See also E. van Everdingen, *Arch. Néerlandaises*, 1901, 4, 371; G. Barlow, *Ann. d. Phys.*, 1903, 12, 897; H. Zahn, ibid. 1904, 14, 886; 1905, 16, 148.

[5] *Phil. Trans.*, 1856, p. 722. According to the nomenclature adopted by the best modern authorities, a metal A is said to be thermo-electrically positive to another metal B when the thermo-current passes from A to B through the cold junction, and from B to A through the hot (see THERMO-ELECTRICITY).

[6] *C.R.*, 1893, 116, 997.

[7] *Journ. de Phys.*, 1896, 5, 53.

[8] *Phil. Trans.*, 1887, 177, 373.

[9] *Proc. Roy. Soc.*, 1885, 39, 513.

[10] *Phys. Rev.*, 1902, 15, 321. The sign of the thermo-electric effect for nickel, as given by Rhoads, is incorrect.

[11] *Proc. Roy. Soc.*, 1904, 73, 413.

As to what effect, if any, is produced upon the thermo-electric quality of bismuth by a magnetic field there is still some doubt. E. van Aubel[1] believes that in pure bismuth the thermo-electric force is increased by the field; impurities may neutralize this effect, and in sufficient quantities reverse it.

Elasticity.—The results of experiments as to the effect of magnetization were for long discordant and inconclusive, sufficient care not having been taken to avoid sources of error, while the effects of hysteresis were altogether disregarded. The subject, which is of importance in connexion with theories of magnetostriction, has been investigated by K. Honda and T. Terada in a research remarkable for its completeness and the ingenuity of the experimental methods employed.[2] The results are too numerous to discuss in detail; some of those to which special attention is directed are the following: In Swedish iron and tungsten-steel the change of elastic constants (Young's modulus and rigidity) is generally positive, but its amount is less than 0·5%; changes of Young's modulus and of rigidity are almost identical. In nickel the maximum change of the elastic constants is remarkably large, amounting to about 15% for Young's modulus and 7% for rigidity; with increasing fields the elastic constants first decrease and then increase. In nickel-steels containing about 50 and 70% of nickel the maximum increase of the constants is as much as 7 or 8%. In a 29% nickel-steel, magnetization increases the constants by a small amount. Changes of elasticity are in all cases dependent, not only upon the field, but also upon the tension applied; and, owing to hysteresis, the results are not in general the same when the magnetization follows as when it precedes the application of stress; the latter is held to be the right order.

Chemical and Voltaic Effects.—If two iron plates, one of which is magnetized, are immersed in an electrolyte, a current will generally be indicated by a galvanometer connected with the plates.

As to whether the magnetized plate becomes positive or negative to the other, different experimenters are not in agreement. It has, however, been shown by Dragomir Hurmuzescu (*Rap. du Congrès Int. de Phys.*, Paris, 1900, p. 561) that the true effect of magnetization is liable to be disguised by secondary or parasitic phenomena, arising chiefly from polarization of the electrodes and from local variations in the concentration and magnetic condition of the electrolyte; these may be avoided by working with weak solutions, exposing only a small surface in a non-polar region of the metal, and substituting a capillary electrometer for the galvanometer generally used. When such precautions are adopted it is found that the "electromotive force of magnetization" is, for a given specimen, perfectly definite both in direction and in magnitude; it is independent of the nature of the corrosive solution, and is a function of the field-strength alone, the curves showing the relation of electromotive force to field-intensity bearing a rough resemblance to the familiar I–H curves. The value of the E.M.F. when H = 2000 is of the order of 1/100 volt for iron, 1/1000 volt for nickel and 1/10,000 for bismuth. When the two electrodes are ferro-magnetic, the direction of the current through the liquid is from the unmagnetized to the magnetized electrode, the latter being least attacked; with diamagnetic electrodes the reverse is the case. Hurmuzescu shows that these results are in accord with theory. Applying the principle of the conservation of internal energy, he demonstrates that for iron in a field of 1000 units and upwards the E.M.F. of magnetization is

$$E = \frac{l}{\delta} \cdot \frac{I^2}{2\kappa} \qquad \text{approximately,}$$

l being the electrochemical equivalent and δ the density of the metal. Owing to the difficulty of determining the magnetization I and the susceptibility κ with accuracy, it has not yet been possible to submit this formula to a quantitative test, but it is said to afford an indication of the results given by actual experiment. It has been discovered by E. L. Nichols and W. S. Franklin (*Am. Journ. Sci.*, 1887, 34, 419; 1888, 35, 290) that the transition from the "passive" to the active state of iron immersed in strong nitric acid is facilitated by magnetization, the temperature of transition being lowered. This is attributed to the action of local currents set up between unequally magnetized portions of the iron. Similar results have been obtained by T. Andrews (*Proc. Roy. Soc.*, 1890, 48, 116).

11. Feebly Susceptible Substances

Water.—The following are recent determinations of the magnetic susceptibility of water:—

Observer.	$\kappa \times 10^6$.	Publication.
G. Quincke	$-0{\cdot}797$ at 18° C.	*Wied. Ann.*, 1885, 24, 387.
H. du Bois	$-0{\cdot}837\,(1-0{\cdot}0025\,t-15°)$	*Wied. Ann.*, 1888, 35, 137.
P. Curie	$-0{\cdot}790$ at 4° C.	*C. R.*, 1893, 116, 136.
J. Townsend	$-0{\cdot}77$	*Phil. Trans.*, 1896, 187, 544.
J. A. Fleming and J. Dewar	$-0{\cdot}74$	*Proc. Roy. Soc.*, 1898, 63, 311.
G. Jäger and S. Meyer	$-0{\cdot}689\,(1-0{\cdot}0016t)$	*Wied. Ann.*, 1899, 67, 707.
J. Koenigsberger	$-0{\cdot}781$ at 22° C.	*Ann. d. Phys.*, 1901, 6, 506.
H. D. Stearns	$-0{\cdot}733$ at 22° C.	*Phys. Rev.*, 1903, 16, 1.
A. P. Wills	$-0{\cdot}720$ at 18° C.	*Phys. Rev.*, 1905, 20, 188.

Wills found that the suceptibility was constant in fields ranging from 4200 to 15,000.

Oxygen and Air.—The best modern determinations of the value of κ for gaseous oxygen agree very fairly well with that given by Faraday in 1853 (*Exp. Res.* III, 502). Assuming that for water $\kappa = -0{\cdot}8 \times 10^{-6}$, his value of κ for oxygen at 15° C. reduces to $0{\cdot}15 \times 10^{-6}$. Important experiments on the susceptibility of oxygen at different pressures and temperatures were carried out by P. Curie (*C.R.* 1892, 115, 805; 1893, 116, 136). *Journ. de Phys.*, 1895, 4, 204. He found that the susceptibility for unit of mass, K, was independent of both pressure and magnetizing force, but varied inversely as the absolute temperature, θ, so that $10^6 K = 33700/\theta$. Since the mass of 1 cub. cm. of oxygen at 0° C. and 760 mm. pressure is 0·00141 grm., the mass at any absolute temperature θ is by Charles's law $0{\cdot}00141 \times 273\theta = 0{\cdot}3849/\theta$ grm.; hence the susceptibility per unit of volume at 760 mm. will be

$$\begin{aligned}\kappa &= 10^{-6} \times 0{\cdot}3849 \times 33700/\theta^2 \\ &= 10^{-6} \times 12970/\theta^2.\end{aligned}$$

At 15° C. $\theta = 273 + 15 = 288$, and therefore $\kappa = 0{\cdot}156 \times 10^{-6}$, nearly the same as the value found by Faraday. At 0° C., $\kappa = 0{\cdot}174 \times 10^{-6}$. For air Curie calculated that the susceptibility per unit mass was $10^6 K = 7830/\theta$; or, taking the mass of 1 c.c. of air at 0° C. and 760 mm. as 0·001291 grm., $\kappa = 10^{-6} \times 2760/\theta^2$ for air at standard atmospheric pressure. It is pointed out that this formula may be used as a temperature correction in magnetic determinations carried out in air.

Fleming and Dewar determined the susceptibility of liquid oxygen (*Proc. Roy. Soc.*, 1896, 60, 283; 1898, 63, 311) by two different methods. In the first experiments it was calculated from observations of the mutual induction of two conducting circuits in air and in the liquid; the results for oxygen at—182° C. were

$$\mu = 1{\cdot}00287,\ \kappa = 228 \times 10^{-6}.$$

In the second series, to which greater importance is attached, measurements were made of the force exerted in a divergent field upon small balls of copper, silver and other substances, first when the balls were in air and afterwards when they were immersed in liquid oxygen. If V is the volume of a ball, H the strength of the field at its centre, and κ' its apparent susceptibility, the force in the direction x is $f = \kappa' \mathrm{VH} \times d\mathrm{H}/dx$; and if κ'_a and κ'^o are the apparent susceptibilities of the same ball in air and in liquid oxygen, $\kappa'_a - \kappa'_o$ is equal to the difference between the susceptibilities of the two media. The susceptibility of air being known—practically it was negligible in these experiments—that of liquid oxygen can at once be found. The mean of 36 experiments with 7 balls gave

$$\mu = 1{\cdot}00407,\ \kappa = 324 \times 10^{-6}.$$

A small but decided tendency to a decrease of susceptibility in very strong fields was observed. It appears, therefore, that liquid oxygen is by far the most strongly paramagnetic liquid known, its susceptibility being more than four times greater than that of a saturated solution of ferric chloride. On the other hand, its susceptibility is about fifty times less than that of Hadfield's 12% manganese steel, which is commonly spoken of as non-magnetizable.

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[1] *C.R.*, 1903, 136, 1131.

[2] *Journ. Coll. Sci. Tokyo*, 1906, 21, art. 4. The paper contains 40 tables and 85 figures.

Bismuth.—Bismuth is of special interest, as being the most strongly diamagnetic substance known, the mean value of the best determinations of its susceptibility being about -14×10^{-6} (see G. Meslin, *C. R.*, 1905, 140, 449). The magnetic properties of the metal at different temperatures and in fields up to 1350 units have been studied by P. Curie (*loc. cit.*), who found that its "specific susceptibility" (K) was independent of the strength of the field, but decreased with rise of temperature up to the melting-point, 273° C. His results appear to show the relation

$$-K\times10^6=1{\cdot}381-0{\cdot}00155t^\circ.$$

Assuming the density of Bi to be 9·8, and neglecting corrections for heat dilatation, his value for the susceptibility at 20° C. is equivalent to $\kappa=-13{\cdot}23\times10^{-6}$. As the temperature was raised up to 273°, κ gradually fell to $-9{\cdot}38\times10^{-6}$, rising suddenly when fusion occurred to $-0{\cdot}37\times10^{-6}$, at which value it remained constant when the fluid metal was further heated. Fleming and Dewar give for the susceptibility the values $-13{\cdot}7\times10^{-6}$ at 15° C. and $-15{\cdot}9\times10^{-6}$ at $-182°$, the latter being approximately equivalent to $K\times10^6=-1{\cdot}62$. Putting $t^\circ=-182$ in the equation given above for Curie's results, we get $K\times10^6=-1{\cdot}66$, a value sufficiently near that obtained by Fleming and Dewar to suggest the probability that the diamagnetic susceptibility varies inversely as the temperature between $-182°$ and the melting-point.

Other Diamagnetics.—The following table gives Curie's determinations (*Journn. de Phys.*, 1895, 4, 204) of the specific susceptibility K of other diamagnetic substances at different temperatures. It should be noted that $K=\kappa$/density.

Substance.	Temp. °C.	$-K\times10^6$.
Water	15–189	0·790
Rock salt	16–455	0·580
Potassium chloride	18–465	0·550
,, sulphate	17–460	0·430
,, nitrate (fusion 350°)	18–420	0·330
Quartz	18–430	0·441
Sulphur, solid or fused	18–225	0·510
Selenium, solid or fused	20–200	0·320
,, fused	240–415	0·307
Tellurium	20–305	0·311
Bromine	20	0·410
Iodine, solid or fused	18–164	0·385
Phosphorus, solid or fused	19–71	0·920
,, amorphous	20–275	0·730
Antimony, electrolytic	20	0·680
,,	540	0·470
Bismuth, solid	20	1·350
,, ,,	273	0·957
,, fused	273–405	0·038

For all diamagnetic substances, except antimony and bismuth, the value of K was found to be independent of the temperature.

Paramagnetic Substances.—Experiments by J. S. Townsend (*Phil. Trans.*, 1896, 187, 533) show that the susceptibility of solutions of salts of iron is independent of the magnetizing force, and depends only on the quantity of iron contained in unit volume of the liquid. If W is the weight of iron present per c.c. at about 10° C., then for ferric salts

$$10^6\kappa=266W-0{\cdot}77$$

and for ferrous salts

$$10^6\kappa=206W-0{\cdot}77,$$

the quantity $-0{\cdot}77$ arising from the diamagnetism of the water of solution. Annexed are values of $10^6\kappa$ for the different salts examined, w being the weight of the salt per c.c. of the solution.

Salt.	$10^6\kappa+0{\cdot}77$	Salt.	$10^6\kappa+0{\cdot}77$
Fe_2Cl_6	$91{\cdot}6w$	$FeCl_2$	$90{\cdot}8w$
$Fe_2(SO_4)_3$	$74{\cdot}5w$	$FeSO_4$	$74{\cdot}9w$
$Fe_2(NO_3)_6$	$61{\cdot}5w$		

Susceptibility was found to diminish greatly with rise of temperature. According to G. Jäger and S. Meyer (*Wien. Akad. Sitz.*, 1897, 106, II.*a*, p. 623, and 1898, 107, II.*a*, p. 5) the atomic susceptibilities k of the metals nickel, chromium, iron, cobalt and manganese in solutions of their salts are as follows:—

Metal.	$k\times10^6$.	Metal.	$k\times10^6$.
Ni	$4{\cdot}95=2{\cdot}5\times2$	Co	$10{\cdot}0=2{\cdot}5\times4$
Cr	$6{\cdot}25=2{\cdot}5\times2{\cdot}5$	Fe(2)	$12{\cdot}5=2{\cdot}5\times5$
Fe(1)	$7{\cdot}5=2{\cdot}5\times3$	Mn.	$15{\cdot}0=2{\cdot}5\times6$

Fe(1) is iron contained in $FeCl_2$ and Fe(2) iron contained in $Fe_2(NO_3)_6$.

Curie has shown, for many paramagnetic bodies, that the specific susceptibility K is inversely proportional to the absolute temperature θ. Du Bois believes this to be an important general law, applicable to the case of every paramagnetic substance, and suggests that the product $K\theta$ should be known as "Curie's constant" for the substance.

Elementary Bodies and Atomic Susceptibility.—Among a large number of substances the susceptibilities of which have been determined by J. Koenigsberger (*Wied. Ann.*, 1898, 66, 698) are the following elements:—

Element.	$\kappa\times10^6$.	Element.	$\kappa\times10^6$.
Copper	−0·82	Tellurium	−2·10
Silver	−1·51	Graphite	+2
Gold	−3·07	Aluminium	+1·80
Zinc	−0·96	Platinum	+22
Tin	+0·46	Palladium	+50 to 60
Lead	−1·10	Tungsten	+14
Thallium	−4·61	Magnesium	+4
Sulphur	−0·86	Sodium	+2·2
Selenium (red)	−0·50	Potassium	+3·6

In a table accompanying Koenigsberger's paper the elements are arranged upon the periodic system and the atomic susceptibility (product of specific susceptibility into atomic weight) is given for each. It appears that the elements at about the middle of each row are the most strongly paramagnetic; towards the ends of a row the susceptibility decreases, and ultimately becomes negative. Thus a relation between susceptibility and atomic weight is clearly indicated. Tables similarly arranged, but much more complete, have been published by S. Meyer (*Wied. Ann.*, 1899, 68, 325 and 1899, 69, 236), whose researches have filled up many previously existing gaps. The values assigned to the atomic susceptibilities of most of the known elements are appended. According to the notation adopted by Meyer the atomic susceptibility $k=\kappa\times$ atomic-weight/ (density $\times$ 1000).

Meyer thinks that the susceptibilities of the metals praseodymium, neodymium, ytterbium, samarium, gadolinium, and erbium, when obtained in a pure form, will be found to equal or even exceed those of the well-known ferromagnetic metals. Many of their compounds are very strongly magnetic erbium, for example, in Er_2O_3 being four times as strong as iron in the familiar magnetite or lodestone, Fe_3O_4. The susceptibilities of some hundreds of inorganic compounds have also been determined by the same investigator (*loc. cit.*). Among other researches relating to atomic and molecular magnetism are those of O. Liebknecht and A. P. Wills (*Ann. d. Phys.*, 1900, 1, 178), H. du Bois and O. Liebknecht (ibid. p. 189), and Meyer (ibid. p. 668). An excellent summary regarding the magnetic properties of matter, with many tables and references, has been compiled by du Bois (*Report to the Congrès Int. de Phys.*, Paris, 1900, ii. 460).

Element	10^6k	*Element*	10^6k	*Element*	10^6k
Be	+0·72	Cu	−0·006	Cs	− 0·03[1]
B	+0·05	Zn	−0·010	Ba	− 0·02[1]
C	−0·05	Ga	—	La	+13·0
N	?	Ge	—	Ce	+34·0
O	+	As	?	Pr	+
F	−0·01[1]	Se	−0·025	Nd	+ Strong
		Br	−0·033	Sa	+
Na	−0·005[1]			Gd	+
Mg	+0·014	Rb	−0·02[1]		
Al	+	Sr	−0·02[1]	Er	+41·8(?)
Si	+0·002	Y	+3·2(?)		
P	−0·007	Zr	−0·014	Yb	+ (?)
S	−0·011	Nb	+0·49(?)	Ta	+ 1·02(?)
Cl	−0·02[1]	Mo	+0·024	W	+ 0·1
		Ru	+	Os	+ 0·074
K	−0·001[1]	Rh	+	Ir	+
Ca	−0·003[1]	Pd	+0·55	Pt	+ 0·227
Sc	?	Ag	−0·016	Au	− 0·031
Ti	+0·09	Cd	−0·015	Hg	− 0·030
V	+0·17	In	−0·01[1]	Tl	− 0·93
Cr	+	Sn	+0·004[1]	Pb	− 0·025
Mn	+	Sb	−0·069	Bi	− 0·023
Fe	+ Strong	Te	−0·039		
Co	+	I	−0·040	Th	+16·0(?)
Ni	+			U	+ 0·21

[1] Calculated.

12. Molecular Theory of Magnetism

According to W. E. Weber's theory, the molecules of a ferromagnetic metal are small permanent magnets, the axes of which under ordinary conditions are turned indifferently in every direction, so that no magnetic polarity is exhibited by the metal as a whole; a magnetic force acting upon the metal tends to turn the axes of the little magnets in one direction, and thus the entire piece acquires the properties of a magnet. If, however, the molecules could turn with perfect freedom, it is clear that the smallest magnetizing force would be sufficient to develop the highest possible degree of magnetization, which is of course not the case. Weber therefore supposed each molecule to be acted on by a force tending to preserve it in its original direction, the position actually assumed by the axis being in the direction of the resultant of this hypothetical force and the applied magnetizing force. Maxwell (*Electricity and Magnetism*, § 444), recognizing that the theory in this form gave no account of residual magnetization, made the further assumption that if the deflection of the axis of the molecule exceeded a certain angle, the axis would not return to its original position when the deflecting force was removed, but would retain a permanent set. Although the amended theory as worked out by Maxwell is in rough agreement with certain leading phenomena of magnetization, it fails to account for many others, and is in some cases at variance with observed facts.

J. A. Ewing (*Proc. Roy. Soc.*, 1890, 48, 342) has demonstrated that it is quite unnecessary to assume either the directive force of Weber, the permanent set of Maxwell, or any kind of frictional resistance, the forces by which the molecular magnets are constrained being simply those due to their own mutual attractions and repulsions. The effect of these is beautifully illustrated by a model consisting of a number of little compass needles pivoted on sharp points and grouped near to one another upon a board, which is placed inside a large magnetizing coil. When no current is passing through the coil and the magnetic field is of zero strength, the needles arrange themselves in positions of stable equilibrium under their mutual forces, pointing in many different directions, so that there is no resultant magnetic moment. This represents the condition of the molecules in unmagnetized iron. If now a gradually increasing magnetizing force is applied, the needles at first undergo a stable deflection, giving to the group a small resultant moment which increases uniformly with the force; and if the current is interrupted while the force is still weak, the needles merely return to their initial positions. This illustrates the first stage in the process of magnetization, when the moment is proportional to the field and there is no hysteresis or residual magnetism (see *ante*). A somewhat stronger field will deflect many of the needles beyond the limits of stability, causing them to turn round and form new stable combinations, in which the direction assumed by most of them approximates to that of the field. The rearrangement is completed within a comparatively small range of magnetizing force, a rapid increase of the resultant moment being thus brought about. When the field is removed, many of the newly formed combinations are but slightly disturbed, and the group may consequently retain a considerable resultant moment. This corresponds to the second stage of magnetization, in which the susceptibility is large and permanent magnetization is set up. A still stronger magnetizing force has little effect except in causing the direction of the needles to approach still more nearly to that of the field; if the force were infinite, every member of the group would have exactly the same direction and the greatest possible resultant moment would be reached; this illustrates "magnetic saturation"—the condition approached in the third stage of magnetization. When the strong magnetizing field is gradually diminished to zero and then reversed, the needles pass from one stable position of rest to another through a condition of instability; and if the field is once more reversed, so that the cycle is completed, the needles again pass through a condition of instability before a position of stable equilibrium is regained. Now the unstable movements of the needles are of a mechanically irreversible character; the energy expended in dissociating the members of a combination and placing them in unstable positions assumes the kinetic form when the needles turn over, and is ultimately frittered down into heat. Hence in performing a cycle there is a waste of energy corresponding to what has been termed hysteresis-loss.

Supposing Ewing's hypothesis to be correct, it is clear that if the magnetization of a piece of iron were reversed by a strong rotating field instead of by a field alternating through zero, the loss of energy by hysteresis should be little or nothing, for the molecules would rotate with the field and no unstable movements would be possible.[1] Some experiments by F. G. Baily (*Phil. Trans.*, 1896, 187, 715) show that this is actually the case. With small magnetizing forces the hysteresis was indeed somewhat larger than that obtained in an alternating field, probably on account of the molecular changes being forced to take place in one direction only; but at an induction of about 16,000 units in soft iron and 15,000 in hard steel the hysteresis reached a maximum and afterwards rapidly diminished. In one case the hysteresis loss per cubic centimetre per cycle was 16,100 ergs for $B=15,900$, and only 1200 ergs for $B=20,200$, the highest induction obtained in the experiment; possibly it would have vanished before B had reached 21,000.[2] These experiments prove that actual friction must be almost entirely absent, and, as Baily remarks, the agreement of the results with the previously suggested deduction affords a strong verification of Ewing's form of the molecular theory. Ewing has himself also shown how satisfactorily this theory accords with many other obscure and complicated phenomena, such as those presented by coercive force, differences of magnetic quality, and the effects of vibration, temperature and stress; while as regards simplicity and freedom from arbitrary assumptions it leaves little to be desired.

The fact being established that magnetism is essentially a molecular phenomenon, the next step is to inquire what is the constitution of a magnetic molecule, and why it is that some molecules are ferromagnetic, others paramagnetic, and others again diamagnetic. The best known of the explanations that have been proposed depend upon the magnetic action of an electric current. It can be shown that if a current i circulates in a small plane circuit of area S, the magnetic action of the circuit for distant points is equivalent to that of a short magnet whose axis is perpendicular to the plane of the circuit and whose moment is iS, the direction of the magnetization being related to that of the circulating current as the thrust of a right-handed screw to its rotation. Ferromagnetism was explained by Ampère on the hypothesis that the magnetization of the molecule is due to an electric current constantly circulating within it. The theory now most in favour is merely a development of Ampère's hypothesis, and applies not only to ferromagnetics, but to paramagnetics as well. To account for diamagnetism, Weber supposed that there exist within the molecules of diamagnetic substances certain channels around which an electric current can circulate without any resistance. The creation of an external magnetic field H will, in accordance with Lenz's law, induce in the molecule an electric current so directed that the magnetization of the equivalent magnet is opposed to the direction of the field. The strength of the induced current is $-HS\cos\theta/L$, where θ is the inclination of the axis of the circuit to the direction of the field, and L the coefficient of self-induction; the resolved part of the magnetic moment in the direction of the field is equal to $-HS^2\cos^2\theta/L$, and if there are n molecules in a unit of volume, their axes being distributed indifferently in all directions, the magnetization of the substance will be $-\frac{1}{3}nHS^2/L$, and its susceptibility $-\frac{1}{3}S^2/L$ (Maxwell, *Electricity and Magnetism*, § 838). The susceptibility is therefore constant and independent of the field, while its negative sign indicates that the substance is diamagnetic. There being no resistance, the induced current will continue to circulate round the molecule until the field is withdrawn, when it will be stopped by the action of an electro-motive force tending to induce an exactly equal current in the opposite direction. The principle of Weber's theory, with the modification necessitated by lately acquired knowledge, is the basis of the best modern explanation of diamagnetic phenomena.

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[1] This deduction from Ewing's theory appears to have been first suggested by J. Swinburne. See *Industries*, 1890, 289.

[2] R. Beattie (*Phil. Mag.*, 1901, 1, 642) has found similar effects in nickel and cobalt.

There are strong reasons for believing that magnetism is a phenomenon involving rotation, and as early as 1876 Rowland, carrying out an experiment which had been proposed by Maxwell, showed that a revolving electric charge produced the same magnetic effects as a current. Since that date it has more than once been suggested that the molecular currents producing magnetism might be due to the revolution of one or more of the charged atoms or "ions" constituting the molecule. None of the detailed hypotheses which were based on this idea stood the test of criticism, but towards the end of the 19th century the researches of J. J. Thomson and others once more brought the conception of moving electric charges into prominence. Thomson has demonstrated the existence under many different conditions of particles more minute than anything previously known to science. The mass of each is about $\frac{1}{1700}$th part of that of a hydrogen atom, and with each is indissolubly associated a charge of negative electricity equal to about $3\cdot1\times10^{-10}$ C.G.S. electrostatic unit. These particles, which were termed by their discoverer *corpuscles*, are more commonly spoken of as *electrons*,[1] the particle thus being identified with the charge which it carries. An electrically neutral atom is believed to be constituted in part, or perhaps entirely, of a definite number of electrons in rapid motion within a "sphere of uniform positive electrification" not yet explained. One or more of the electrons may be detached from the system by a finite force, the number so detachable depending on the valency of the atom; if the atom loses an electron, it becomes positively electrified; if it receives additional electrons, it is negatively electrified. The process of electric conduction in metals consists in the movement of detached electrons, and many other phenomena, both electrical and thermal, can be more or less completely explained by their agency. It has been supposed that certain electrons revolve like satellites in orbits around the atoms with which they are associated, a view which receives strong support from the phenomena of the Zeeman effect, and on this assumption a theory has been worked out by P. Langevin,[2] which accounts for many of the observed facts of magnetism. As a consequence of the structure of the molecule, which is an aggregation of atoms, the planes of the orbits around the latter may be oriented in various positions, and the direction of revolution may be right-handed or left-handed with respect to the direction of any applied magnetic field. For those orbits whose projection upon a plane perpendicular to the field is right-handed, the period of revolution will be accelerated by the field (since the electron current is negative), and the magnetic moment consequently increased; for those which are left-handed, the period will be retarded and the moment diminished. The effect of the field upon the speed of the revolving electrons, and therefore upon the moments of the equivalent magnets, is necessarily a very small one. If S is the area of the orbit described in time τ by an electron of charge e, the moment of the equivalent magnet is $M=eS\tau$; and the change in the value of M due to an external field H is shown to be $\Delta M=-He^2S/4\pi m$, m being the mass of the electron. Whence

$$\frac{\Delta M}{M}=-\frac{H\tau}{4\pi}\frac{e}{m}.$$

According to the best determinations the value of e/m does not exceed $1\cdot8\times10^7$, and τ is of the order of 10^{-15} second, the period of luminous vibrations; hence $\Delta M/M$ must always be less than $10^{-9}H$, and therefore the strongest fields yet reached experimentally, which fall considerably short of 10^5, could not change the magnetic moment M by as much as a ten-thousandth part. If the structure of the molecule is so perfectly symmetrical that, in the absence of any external field, the resultant magnetic moment of the circulating electrons is zero, then the application of a field, by accelerating the right-handed (negative) revolutions, and retarding those which are left-handed, will induce in the substance a resultant magnetization opposite in direction to the field itself; a body composed of such symmetrical molecules is therefore diamagnetic. If however the structure of the molecule is such that the electrons revolving around its atoms do not exactly cancel one another's effects, the molecule constitutes a little magnet, which under the influence of an external field will tend to set itself with its axis parallel to the field. Ordinarily a substance composed of asymmetrical molecules is paramagnetic, but if the elementary magnets are so conditioned by their strength and concentration that mutual action between them is possible, then the substance is ferromagnetic. In all cases however it is the diamagnetic condition that is initially set up—even iron is diamagnetic—though the diamagnetism may be completely masked by the superposed paramagnetic or ferromagnetic condition. Diamagnetism, in short, is an atomic phenomenon; paramagnetism and ferromagnetism are molecular phenomena. Hence may be deduced an explanation of the fact that, while the susceptibility of all known diamagnetics (except bismuth and antimony) is independent of the temperature, that of paramagnetics varies inversely as the absolute temperature, in accordance with the law of Curie.

13. HISTORICAL AND CHRONOLOGICAL NOTES

The most conspicuous property of the lodestone, its attraction for iron, appears to have been familiar to the Greeks at least as early as 800 B.C., and is mentioned by Homer, Plato, Aristotle, Theophrastus and others. A passage in *De rerum natura* (vi. 910–915) by the Roman poet, Lucretius (96–55 B.C.), in which it is stated that the stone can support a chain of little rings, each adhering to the one above it, indicates that in his time the phenomenon of magnetization by induction had also been observed. The property of orientation, in virtue of which a freely suspended magnet points approximately to the geographical north and south, is not referred to by any European writer before the 12th century, though it is said to have been known to the Chinese at a much earlier period. The application of this property to the construction of the mariner's compass is obvious, and it is in connexion with navigation that the first references to it occur (see COMPASS). The needles of the primitive compasses, being made of iron, would require frequent re-magnetization, and a "stone" for the purpose of "touching the needle" was therefore generally included in the navigator's outfit. With the constant practice of this operation it is hardly possible that the repulsion acting between like poles should have entirely escaped recognition; but though it appears to have been noticed that the lodestone sometimes repelled iron instead of attracting it, no clear statement of the fundamental law that unlike poles attract while like poles repel was recorded before the publication in 1581 of the *New Attractive* by Robert Norman, a pioneer in accurate magnetic work. The same book contains an account of Norman's discovery and correct measurement of the dip (1576). The downward tendency of the north pole of a magnet pivoted in the usual way had been observed by G. Hartmann of Nüremberg in 1544, but his observation was not published till much later.

The foundations of the modern science of magnetism were laid by William Gilbert (*q.v.*). His *De magnete magneticisque corporibus et de magno magnete tellure physiologia nova* (1600), contains many references to the expositions of earlier writers from Plato down to those of the author's own age. These show that the very few facts known with certainty were freely supplemented by a number of ill-founded conjectures, and sometimes even by "figments and falsehoods, which in the earliest times, no less than nowadays, used to be put forth by raw smatterers and copyists to be swallowed of men."[1] Thus it was taught that "if a lodestone be anointed with garlic, or if a diamond be near, it does not attract iron," and that "if pickled in the salt of a sucking fish, there is power to pick up gold which has fallen into the deepest wells." There were said to be "various kinds of magnets, some of which attract gold, others silver, brass, lead; even some which attract flesh, water, fishes;" and stories were told about "mountains in the north of such great powers of attraction that ships are built with wooden pegs, lest the iron nails should be drawn from the timber." Certain occult powers were also attributed to the stone. It was "of use to thieves by its fume and sheen, being a stone born, as it were, to aid theft," and even opening bars and locks; it was effective as a love potion, and possessed "the power to reconcile husbands to their wives, and to recall brides to their husbands." And much more of the same kind, which, as Gilbert says, had come down "even to [his] own day through the writings of a host of men, who, to fill out their volumes to a proper bulk, write and copy out pages upon pages on this, that and the other subject, of which they know almost nothing for certain of their own experience." Gilbert himself absolutely disregarded authority, and accepted nothing at second-hand. His title to be honoured as the "Father of Magnetic Philosophy" is based even more largely upon the scientific method which he was the first to inculcate and practise than upon the importance of his actual discoveries. Careful experiment and observation, not the inner consciousness, are, he insists, the only foundations of true science. Nothing has been set down in his book "which hath not been explored and many times performed and repeated" by himself. "It is very easy for men of acute intellect, apart from experiment and practice, to slip and err." The greatest of Gilbert's discoveries was that the globe of the earth was magnetic and a magnet; the evidence by which he supported this view was derived chiefly from ingenious experiments made with a spherical lodestone or *terrella*, as he termed it, and from his original observation that an iron bar could be magnetized by the earth's force. He also carried out some new experiments on the effects of heat, and of screening by magnetic substances, and investigated the influence of shape upon the magnetization of iron. But the bulk of his work consisted in imparting scientific definiteness to what was already vaguely known, and in demolishing the errors of his predecessors.

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[1] The charge associated with a corpuscle is the same as that carried by a hydrogen atom. G. J. Stoney in 1881 (*Phil. Mag.*, 1881, 11, 387) pointed out that this latter constituted the indivisible "atom of electricity" or natural unit charge. Later he proposed (*Trans. Roy. Dub. Soc.*, 1891, 4, 583) that such unit charge should be called an "electron." The application of this term to Thomson's corpuscle implies, rightly or wrongly, that notwithstanding its apparent mass, the corpuscle is in fact nothing more than an atom of electricity. The question whether a corpuscle actually has a material gravitating nucleus is undecided, but there are strong reasons for believing that its mass is entirely due to the electric charge.

[2] *Jour. de Phys.*, 1905, 4, 678; translated in *Electrician*, 1905, 56, 108 and 141.

No material advance upon the knowledge recorded in Gilbert's book was made until the establishment by Coulomb in 1785 of the law of magnetic action. The difficulties attending the experimental investigation of the forces acting between magnetic poles have already been referred to, and indeed a rigorously exact determination of the mutual action could only be made under conditions which are in practice unattainable. Coulomb,[2] however, by using long and thin steel rods, symmetrically magnetized, and so arranged that disturbing influences became negligibly small, was enabled to deduce from his experiments with reasonable certainty the law that the force of attraction or repulsion between two poles varies inversely as the square of the distance between them. Several previous attempts had been made to discover the law of force, with various results, some of which correctly indicated the inverse square; in particular the German astronomer, J. Tobias Mayer (*Gött. Anzeiger*, 1760), and the Alsatian mathematician, J. Heinrich Lambert (*Hist. de l'Acad. Roy. Berlin*, 1766, p. 22), may fairly be credited with having anticipated the law which was afterwards more satisfactorily established by Coulomb. The accuracy of this law was in 1832 confirmed by Gauss,[3] who employed an indirect but more perfect method than that of Coulomb, and also, as Maxwell remarks, by all observers in magnetic observatories, who are every day making measurements of magnetic quantities, and who obtain results which would be inconsistent with each other if the law of force had been erroneously assumed.

Coulomb's researches provided data for the development of a mathematical theory of magnetism, which was indeed initiated by himself, but was first treated in a complete form by Poisson in a series of memoirs published in 1821 and later.[4] Poisson assumed the existence of two dissimilar magnetic fluids, any element of which acted upon any other distant element in accordance with Coulomb's law of the inverse square, like repelling and unlike attracting one another. A magnetizable substance was supposed to consist of an indefinite number of spherical particles, each containing equivalent quantities of the two fluids, which could move freely within a particle, but could never pass from one particle to another. When the fluids inside a particle were mixed together, the particle was neutral; when they were more or less completely separated, the particle became magnetized to an intensity depending upon the magnetic force applied; the whole body therefore consisted of a number of little spheres having north and south poles, each of which exerted an elementary action at a distance. On this hypothesis Poisson investigated the forces due to bodies magnetized in any manner, and also originated the mathematical theory of magnetic induction. The general confirmation by experiment of Poisson's theoretical results created a tendency to regard his hypothetical magnetic fluids as having a real existence; but it was pointed out by W. Thomson (afterwards Lord Kelvin) in 1849 that while no physical evidence could be adduced in support of the hypothesis, certain discoveries, especially in electromagnetism, rendered it extremely improbable (*Reprint*, p. 344). Regarding it as important that all reasoning with reference to magnetism should be conducted without any uncertain assumptions, he worked out a mathematical theory upon the sole foundation of a few well-known facts and principles. The results were substantially the same as those given by Poisson's theory, so far as the latter went, the principal additions including a fuller investigation of magnetic distribution, and the theory of magnetic induction in aeolotropic or crystalline substances. The mathematical theory which was constructed by Poisson, and extended and freed from doubtful hypotheses by Kelvin, has been elaborated by other investigators, notably F. E. Neumann, G. R. Kirchhoff, and Maxwell. The valuable work of Gauss on magnetic theory and measurements, especially in relation to terrestrial magnetism, was published in his *Intensitas vis magneticae terrestris*, 1833, and in memoirs communicated to the *Resultate aus den Beobachtungen des magnetischen Vereins*, 1838 and 1839, which, with others, are contained in vol. 5 of the collected *Werke*. Weber's molecular theory, which has already been referred to, appeared in 1852.[5]

An event of the first importance was the discovery made in 1819 by H. C. Oersted[6] that a magnet placed near a wire carrying an electric current tended to set itself at right angles to the wire, a phenomenon which indicated that the current was surrounded by a magnetic field. This discovery constituted the foundation of electromagnetism, and its publication in 1820 was immediately followed by A. M. Ampère's experimental and theoretical investigation of the mutual action of electric currents,[7] and of the equivalence of a closed circuit to a polar magnet, the latter suggesting his celebrated hypothesis that molecular currents were the cause of magnetism. In the same year D. F. Arago[8] succeeded in magnetizing a piece of iron by the electric current, and in 1825 W. Sturgeon[9] publicly exhibited an apparatus "acting on the principle of powerful magnetism and feeble galvanism" which is believed to have constituted the first actual electromagnet. Michael Faraday's researches were begun in 1831 and continued for more than twenty years. Among the most splendid of his achievements was the discovery of the phenomena and laws of magneto-electric induction, the subject of two papers communicated to the Royal Society in 1831 and 1832. Another was the magnetic rotation of the plane of polarization of light, which was effected in 1845, and for the first time established a relation between light and magnetism. This was followed at the close of the same year by the discovery of the magnetic condition of all matter, a discovery which initiated a prolonged and fruitful study of paramagnetic and diamagnetic phenomena, including magnecrystallic action and "magnetic conducting power," now known as permeability. Throughout his researches Faraday paid special regard to the medium as the true seat of magnetic action, being to a large extent guided by his pregnant conception of "lines of force," or of induction, which he considered to be "closed curves passing in one part of the course through the magnet to which they belong, and in the other part through space," always tending to shorten themselves, and repelling one another when they were side by side (*Exp. Res.* §§ 3266–8, 3271). In 1873 James Clerk Maxwell published his classical *Treatise on Electricity and Magnetism*, in which Faraday's ideas were translated into a mathematical form. Maxwell explained electric and magnetic forces, not by the action at a distance assumed by the earlier mathematicians, but by stresses in a medium filling all space, and possessing qualities like those attributed to the old luminiferous ether. In particular, he found that the calculated velocity with which it transmitted electromagnetic disturbances was equal to the observed velocity of light; hence he was led to believe, not only that his medium and the ether were one and the same, but, further, that light itself was an electromagnetic phenomenon. Since the experimental confirmation of Maxwell's views by H. R. Hertz in 1888 (*Weid. Ann.*, 1888, 34, 155, 551, 609; and later vols.) they have commanded universal assent, and his methods are adopted in all modern work on electricity and magnetism.

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[1] The quotations are from the translation published by the Gilbert Club, London, 1900.

[2] C. A. Coulomb, *Mem. Acad. Roy. Paris*, 1785, p. 578.

[3] *Intensitas vis magneticae*, § 21, C. F. Gauss's *Werke*, 5, 79. See also J. J. Thomson, *Electricity and Magnetism*, § 132.

[4] S. D. Poisson, *Mém. de l'Institut*, 1821 and 1822, 5, 247, 488; 1823, 6, 441; 1838, 16, 479.

[5] For outlines of the mathematical theory of magnetism and references see H. du Bois, *Magnetic Circuit*, chs. iii. and iv.

[6] Gilbert's *Ann. d. phys.*, 1820, 6, 295.

[7] *Ann. de chim. et de phys.*, 1820, 15, 59, 170; *Recueil d'observations électrodynamiques*, 1822; *Théories des phénomènes électrodynamiques*, 1826.

[8] *Ann. de chim. et de phys.*, 1820, 15, 93.

[9] *Trans. Soc. Arts*, 1825, 43, 38.

The practice of measuring magnetic induction and permeability with scientific accuracy was introduced in 1873 by H. A. Rowland,[1] whose careful experiments led to general recognition of the fact previously ignored by nearly all investigators, that magnetic susceptibility and permeability are by no means constants (at least in the case of the ferromagnetic metals) but functions of the magnetizing force. New light was thrown upon many important details of magnetic science by J. A. Ewing's *Experimental Researches* of 1885; throughout the whole of his work special attention was directed to that curious lagging action to which the author applied the now familiar term "hysteresis."[2] His well-known modification[3] of Weber's molecular theory, published in 1890, presented for the first time a simple and sufficient explanation of hysteresis and many other complexities of magnetic quality. The amazing discoveries made by J. J. Thomson in 1897 and 1898[4] resulted in the establishment of the electron theory, which has already effected developments of an almost revolutionary character in more than one branch of science. The application of the theory by P. Langevin to the case of molecular magnetism has been noticed above, and there can be little doubt that in the near future it will contribute to the solution of other problems which are still obscure.

See W. Gilbert, *De magnete* (London, 1600; trans. by P. F. Mottelay, New York, 1893, and for the Gilbert Club, London, 1900); M. Faraday, *Experimental Researches in Electricity*, 3 vols. (London, 1839, 1844 and 1855); W. Thomson (Lord Kelvin), *Reprint of Papers on Electrostatics and Magnetism* (London, 1884, containing papers on magnetic theory originally published between 1844 and 1855, with additions); J. C. Maxwell, *Treatise on Electricity and Magnetism* (3rd ed., Oxford, 1892); E. Mascart and J. Joubert, *Leçons sur l'électricité et le magnétisme* (2nd ed., Paris, 1896–1897; trans., not free from errors, by E. Atkinson, London, 1883); J. A. Ewing, *Magnetic Induction in Iron and other Metals* (3rd ed., London, 1900); J. J. Thomson, *Recent Researches in Electricity and Magnetism* (Oxford, 1893); *Elements of Mathematical Theory of Electricity and Magnetism* 3rd ed., Cambridge, 1904); H. du Bois, *The Magnetic Circuit* (trans. by E. Atkinson, London, 1896); A. Gray, *Treatise on Magnetism and Electricity*, vol. i. (London, 1898); J. A. Fleming, *Magnets and Electric Currents* (London, 1898); C. Maurain, *Le magnétisme du fer* (Paris, 1899; a lucid summary of the principal facts and laws, with special regard to their practical application); *Rapports présentés au Congrès international de physique*, vol. ii. (Paris, 1900); G. C. Foster and A. W. Porter, *Treatise on Electricity and Magnetism* (London, 1903); A. Winkelmann, *Handbuch der Physik*, vol. v. part i. (2nd ed., Leipzig, 1905; the most exhaustive compendium of magnetic science yet published, containing references to all important works and papers on every branch of the subject). (S. Bi.)

MAGNETISM, TERRESTRIAL, the science which has for its province the study of the magnetic phenomena of the earth.

Historical.

§ 1. Terrestrial magnetism has a long history. Its early growth was slow, and considerable uncertainty prevails as to its earliest developments. The properties of the magnet (see MAGNETISM) were to some small extent known to the Greeks and Romans before the Christian era, and compasses (see COMPASS) of an elementary character seem to have been employed in Europe at least as early as the 12th century. In China and Japan compasses of a kind seem to have existed at a much earlier date, and it is even claimed that the Chinese were aware of the declination of the compass needle from the true north before the end of the 11th century. Early scientific knowledge was usually, however, a mixture of facts, very imperfectly ascertained, with philosophical imaginings. When an early writer makes a statement which to a modern reader suggests a knowledge of the declination of the compass, he may have had no such definite idea in his mind. So far as Western civilization is concerned, Columbus is usually credited with the discovery—in 1492 during his first voyage to America—that the pointing of the compass needle to the true north represents an exceptional state of matters, and that a *declination* in general exists, varying from place to place. The credit of these discoveries is not, however, universally conceded to Columbus. G. Hellmann[6] * considers it almost certain that the departure of the needle from the true north was known in Europe before the time of Columbus. There is indirect evidence that the declination of the compass was not known in Europe in the early part of the 15th century, through the peculiarities shown by early maps believed to have been drawn solely by regard to the compass. Whether Columbus was the first to observe the declination or not, his date is at least approximately that of its discovery.

The next fundamental discovery is usually ascribed to Robert Norman, an English instrument maker. In *The Newe Attractive* (1581) Norman describes his discovery made some years before of the *inclination* or *dip*. The discovery was made more or less by accident, through Norman's noticing that compass needles which were truly balanced so as to be horizontal when unmagnetized, ceased to be so after being stroked with a magnet. Norman devised a form of dip-circle, and found a value for the inclination in London which was at least not very wide of the mark.

Another fundamental discovery, that of the secular change of the declination, was made in England by Henry Gellibrand, professor of mathematics at Gresham College, who described it in his *Discourse Mathematical on the Variation of the Magneticall Needle together with its Admirable Diminution lately discovered* (1635). The history of this discovery affords a curious example of knowledge long delayed. William Borough, in his *Discourse on the Variation of the Compas or Magneticall Needle* (1581), gave for the declination at Limehouse in October 1580 the value 11°¼ E. approximately. Observations were repeated at Limehouse, Gellibrand tells us, in 1622 by his colleague Edmund Gunter, professor of astronomy at Gresham College, who found the much smaller value 6° 13′. The difference seems to have been ascribed at first to error on Borough's part, and no suspicion of the truth seems to have been felt until 1633, when some rough observations gave a value still lower than that found by Gunter.

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[1] *Phil. Mag.*, 1873, 46, 140; 1874, 48, 321.

[2] *Phil. Trans.*, 1885, 176, 523; *Magnetic Induction*, 1900.

[3] *Proc. Roy. Soc.*, 1890, 48, 342.

[4] *Phil. Mag.*, 1897, 44, 293; 1898, 46, 528.

* For explanation of these numbers, see end of article.

It was not until midsummer 1634 that Gellibrand felt sure of his facts, and yet the change of declination since 1580 exceeded 7°. The delay probably arose from the strength of the preconceived idea, apparently universally held, that the declination was absolutely fixed. This idea, it would appear, derived some of its strength from the positive assertion made on the point by Gilbert of Colchester in his *De magnete* (1600).

A third fundamental discovery, that of the diurnal change in the declination, is usually credited to George Graham (1675–1751), a London instrument maker. Previous observers, *e.g.* Gellibrand, had obtained slightly different values for the declination at different hours of the day, but it was natural to assign them to instrumental uncertainties. In those days the usual declination instrument was the compass with pivoted needles, and Graham himself at first assigned the differences he observed to friction. The observations on which he based his conclusions were made in 1722; an account of them was communicated to the Royal Society and published in the *Philosophical Transactions* for 1724.

The movements of the compass needle throughout the average day represent partly a regular diurnal variation, and partly irregular changes in the declination. The distinction, however, was not at first very clearly realized. Between 1756 and 1759 J. Canton observed the declination-changes on some 600 days, and was thus able to deduce their general character. He found that the most prominent part of the regular diurnal change in England consisted of a westerly movement of the north-pointing pole from 8 or 9 a.m. to 1 or 2 p.m., followed by a more leisurely return movement to the east. He also found that the amplitude of the movement was considerably larger in summer than in winter. Canton further observed that in a few days the movements were conspicuously irregular, and that aurora was then visible. This association of magnetic disturbance and aurora had, however, been observed somewhat before this time, a description of one conspicuous instance being contributed to the Royal Society in 1750 by Pehr Vilhelm Wargentin (1717–1783), a Swede.

Another landmark in the history of terrestrial magnetism was the discovery towards the end of the 18th century that the intensity of the resultant magnetic force varies at different parts of the earth. The first observations clearly showing this seem to be those of a Frenchman, Paul de Lamanon, who observed in 1785–1787 at Teneriffe and Macao, but his results were not published at the time. The first published observations seem to be those made by the great traveller Humboldt in tropical America between 1798 and 1803. The delay in this discovery may again be attributed to instrumental imperfections. The method first devised for comparing the force at different places consisted in taking the time of oscillation of the dipping needle, and even with modern circles this is hardly a method of high precision. Another discovery worth chronicling was made by Arago in 1827. From observations made at Paris he found that the inclination of the dipping needle and the intensity of the horizontal component of the magnetic force both possessed a diurnal variation.

§ 2. Whilst Italy, England and France claim most of the early observational discoveries, Germany deserves a large share of credit for the great improvement in instruments and methods during the first half of the 19th century. Measurements of the intensity of the magnetic force were somewhat crude until Gauss showed how absolute results could be obtained, and not merely relative data based on observations with some particular needle. Gauss also devised the bifilar magnetometer, which is still largely represented in instruments measuring changes of the horizontal force; but much of the practical success attending the application of his ideas to instruments seems due to Johann von Lamont (1805–1879), a Jesuit of Scottish origin resident in Germany.

The institution of special observatories for magnetic work is largely due to Humboldt and Gauss. The latter's observatory at Göttingen, where regular observations began in 1834, was the centre of the Magnetic Union founded by Gauss and Weber for the carrying out of simultaneous magnetic observations and it was long customary to employ Göttingen time in schemes of international co-operation.

In the next decade, mainly through the influence of Sir Edward Sabine (1788–1883), afterwards president of the Royal Society, several magnetic observatories were established in the British colonies, at St Helena, Cape of Good Hope, Hobarton (now Hobart) and Toronto. These, with the exception of Toronto, continued in full action for only a few years; but their records—from their widely distributed positions—threw much fresh light on the differences between magnetic phenomena in different regions of the globe. The introduction of regular magnetic observatories led ere long to the discovery that there are notable differences between the amplitudes of the regular daily changes and the frequency of magnetic disturbances in different years. The discovery that magnetic phenomena have a period closely similar to, if not absolutely identical with, the "eleven year" period in sunspots, was made independently and nearly simultaneously about the middle of the 19th century by Lamont, Sabine and R. Wolf.

The last half of the 19th century showed a large increase in the number of observatories taking magnetic observations. After 1890 there was an increased interest in magnetic work. One of the contributory causes was the magnetic survey of the British Isles made by Sir A. Rücker and Sir T. E. Thorpe, which served as a stimulus to similar work elsewhere; another was the institution by L. A. Bauer of a magazine, *Terrestrial Magnetism*, specially devoted to the subject. This increased activity added largely to the stock of information, sometimes in forms of marked practical utility; it was also manifested in the publication of a number of papers of a speculative character. For historical details the writer is largely indebted to the works of E. Walker[1] and L. A. Bauer.[3]

Observational Methods and Records.

§ 3. All the more important magnetic observatories are provided with instruments of two kinds. Those of the first kind give the absolute value of the magnetic elements at the time of observation. The unifilar magnetometer (*q.v.*), for instance, gives the absolute values of the declination and horizontal force, whilst the inclinometer (*q.v.*) or dip circle gives the inclination of the dipping needle. Instruments of the second kind, termed magnetographs (*q.v.*), are differential and self-recording, and show the changes constantly taking place in the magnetic elements. The ordinary form of magnetograph records photographically. Light reflected from a fixed mirror gives a base line answering to a constant value of the element in question; the light is cut off every hour or second hour so that the base line also serves to make the time. Light reflected from a mirror carried by a magnet gives a curved line answering to the changes in position of the magnet. The length of the ordinate or perpendicular drawn from any point of the curved line on to the base line is proportional to the extent of departure of the magnet from a standard position. If then we know the absolute value of the element which corresponds to the base line, and the equivalent of 1 cm. of ordinate, we can deduce the absolute value of the element answering to any given instant of time. In the case of the declination the value of 1 cm. of ordinate is usually dependent almost entirely on the distance of the mirror carried by the magnet from the photographic paper, and so remains invariable or very nearly so. In the case of the horizontal force and vertical force magnetographs—these being the two force components usually recorded—the value of 1 cm. of ordinate alters with the strength of the magnet. It has thus to be determined from time to time by observing the deflection shown on the photographic paper when an auxiliary magnet of known moment, at a measured distance, deflects the magnetograph magnet. Means are provided for altering the sensitiveness, for instance, by changing the effective distance in the bifilar suspension of the horizontal force magnet, and by altering the height of a small weight carried by the vertical force magnet. It is customary to aim at keeping the sensitiveness as constant as possible. A very common standard is to have 1 cm. of ordinate corresponding to 10′ of arc in the declination and to 50γ ($1\gamma \equiv 0{\cdot}00001$ C.G.S.) in the horizontal and vertical force magnetographs.

As an example of how the curves are standardized, suppose that absolute observations of declination are taken four times a month, and that in a given month the mean of the observed values is 16° 34′·6 W. The curves are measured at the places which correspond to the times of the four observations, and the mean length of the four ordinates is, let us say, 2·52 cms. If 1 cm. answers to 10′, then 2·52 cms. represents 25′·2, and thus the value of the base line—*i.e.* the value which the declination would have if the curve came down to the base line—is for the month in question 16° 34′·6 less 25′·2 or

16° 9′ 4. If now we wish to know the declination at any instant in this particular month all we have to do is to measure the corresponding ordinate and add its value, at the rate of 10′ per cm., to the base value 16° 9′·4 just found. Matters are a little more complicated in the case of the horizontal and vertical force magnetographs. Both instruments usually possess a sensible temperature coefficient, *i.e.* the position of the magnet is dependent to some extent on the temperature it happens to possess, and allowance has thus to be made for the difference from a standard temperature. In the case of the vertical force an "observed" value is derived by combining the observed value of the inclination with the simultaneous value of the horizontal force derived from the horizontal force magnetograph after the base value of the latter has been determined. In themselves the results of the absolute observations are of minor interest. Their main importance is that they provide the means of fixing the value of the base line in the curves. Unless they are made carefully and sufficiently often the information derivable from the curves suffers in accuracy, especially that relating to the secular change. It is from the curves that information is derived as to the regular diurnal variation and irregular changes. In some observatories it is customary to publish a complete record of the values of the magnetic elements at every hour for each day of the year. A useful and not unusual addition to this is a statement of the absolutely largest and smallest values of each element recorded during each day, with the precise times of their occurrence. On days of large disturbance even hourly readings give but a very imperfect idea of the phenomena, and it is customary at some observatories, *e.g.* Greenwich, to reproduce the more disturbed curves in the annual volume. In calculating the regular diurnal variation it is usual to consider each month separately. So far as is known at present, it is entirely or almost entirely a matter of accident at what precise hours specially high or low values of an element may present themselves during an individual highly disturbed day; whilst the range of the element on such a day may be 5, 10 or even 20 times as large as on the average undisturbed day of the month. It is thus customary when calculating diurnal inequalities to omit the days of largest disturbance, as their inclusion would introduce too large an element of uncertainty. Highly disturbed days are more than usually common in some years, and in some months of the year, thus their omission may produce effects other than that intended. Even on days of lesser disturbance difficulties present themselves. There may be to and fro movements of considerable amplitude occupying under an hour, and the hour may come exactly at the crest or at the very lowest part of the trough. Thus, if the reading represents in every case the ordinate at the precise hour a considerable element of chance may be introduced. If one is dealing with a mean from several hundred days such "accidents" can be trusted to practically neutralize one another, but this is much less fully the case when the period is as short as a month. To meet this difficulty it is customary at some observatories to derive hourly values from a freehand curve of continuous curvature, drawn so as to smooth out the apparently irregular movements. Instead of drawing a freehand curve it has been proposed to use a planimeter, and to accept as the hourly value of the ordinate the mean derived from a consideration of the area included between the curve, the base line and ordinates at the thirty minutes before and after each hour.

§ 4. Partly on account of the uncertainties due to disturbances, and partly with a view to economy of labour, it has been the practice at some observatories to derive diurnal inequalities from a comparatively small number of undisturbed or *quiet* days. Beginning with 1890, five days a month were selected at Greenwich by the astronomer royal as conspicuously quiet. In the selection regard was paid to the desirability that the arithmetic mean of the five dates should answer to near the middle of the month. In some of the other English observatories the routine measurement of the curves was limited to these selected quiet days. At Greenwich itself diurnal inequalities were derived regularly from the quiet days alone and also from all the days of the month, excluding those of large disturbance. If a quiet day differed from an ordinary day only in that the diurnal variation in the latter was partly obscured by irregular disturbances, then supposing enough days taken to smooth out irregularities, one would get the same diurnal inequality from ordinary and from quiet days. It was found, however, that this was hardly ever the case (see §§ 29 and 30). The quiet day scheme thus failed to secure exactly what was originally aimed at; on the other hand, it led to the discovery of a number of interesting results calculated to throw valuable sidelights on the phenomena of terrestrial magnetism.

The idea of selecting quiet days seems due originally to H. Wild. His selected quiet days for St Petersburg and Pavlovsk were very few in number, in some months not even a single day reaching his standard of freedom from disturbance. In later years the International Magnetic Committee requested the authorities of each observatory to arrange the days of each month in three groups representing the quiet, the moderately disturbed and the highly disturbed. The statistics are collected and published on behalf of the committee, the first to undertake the duty being M. Snellen. The days are in all cases counted from Greenwich midnight, so that the results are strictly synchronous. The results promise to be of much interest.

§ 5. The intensity and direction of the resultant magnetic force at a spot—*i.e.* the force experienced by a unit magnetic pole—are known if we know the three components of force parallel to any set of orthogonal axes. It is usual to take for these axes the vertical at the spot and two perpendicular axes in the horizontal plane; the latter are usually taken in and perpendicular to the geographical meridian. The usual notation in mathematical work is X to the north, Y to the west or east, and Z vertically downwards. The international magnetic committee have recommended that Y be taken positive to the east, but the fact that the declination is westerly over most of Europe has often led to the opposite procedure, and writers are not always as careful as they should be in stating their choice. Apart from mathematical calculations, the more usual course is to define the force by its horizontal and vertical components—usually termed H and V—and by the declination or angle which the horizontal component makes with the astronomical meridian. The declination is sometimes counted from 0° to 360°, 0° answering to the case when the so-called north pole (or north seeking pole) is directed towards geographical north, 90° to the case when it is directed to the east, and so on. It is more usual, however, to reckon declination only from 0° to 180°, characterizing it as easterly or westerly according as the north pole points to the east or to the west of the geographical meridian. The force is also completely defined by H *or* V, together with D the declination, and I the inclination to the horizon of the dipping needle. Instead of H and D some writers make use of N the northerly component, and W the westerly (or E the easterly). The resultant force itself is denoted sometimes by R, sometimes by T (total force). The following relationships exist between the symbols

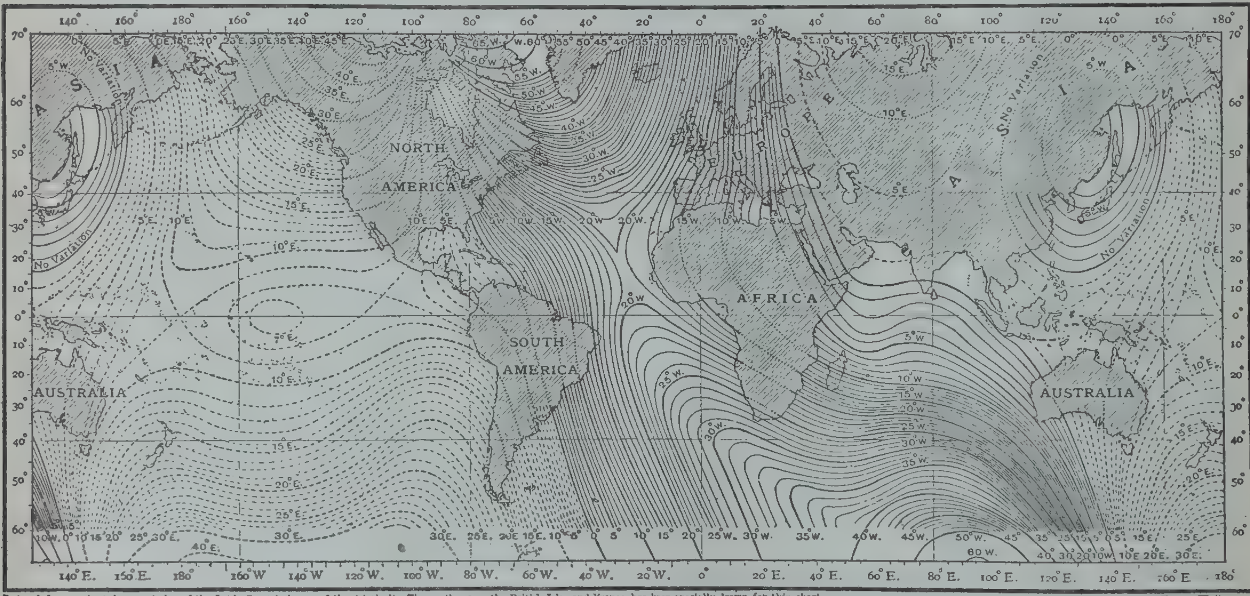
$$X \equiv N,\ Y \equiv W \text{ or } E,\ Z \equiv V,\ R \equiv T,$$
$$H \equiv \sqrt{(X^2+Y^2)},\ R \equiv \sqrt{(X^2+Y^2+Z^2)},$$
$$\tan D = Y/X,\ \tan I = V/H.$$

The term *magnetic element* is applied to R or any of the components, and even to the angles D and I.

Charts.

§ 6. Declination is the element concerning which our knowledge is most complete and most reliable. With a good unifilar magnetometer, at a fixed observatory distant from the magnetic poles, having a fixed mark of known azimuth, the observational uncertainty in a single observation should not exceed 0′·5 or at most 1′·0. It cannot be taken for granted that different unifilars, even by the best makers, will give absolutely identical values for the declination, but as a matter of fact the differences observed are usually very trifling. The chief source of uncertainty in the observation lies in the torsion of the suspension fibre, usually of silk or more rarely of phosphor bronze or other metal. A very stout suspension must be avoided at all cost, but the fibre must not be so thin as to have a considerable risk of breaking even in skilled hands. Near a magnetic pole the directive force on the declination magnet is reduced, and the effects of torsion are correspondingly increased. On the other hand, the regular and irregular changes of declination are much enhanced. If an observation consisting of four readings of declination occupies twelve minutes, the chances are that in this time the range at an English station will not exceed 1′, whereas at an arctic or antarctic station it will frequently exceed 10′. Much greater uncertainty thus attaches to declination results in the Arctic and Antarctic than to those in temperate latitudes. In the case of secular change data one important consideration is that the observations should be taken at an absolutely fixed spot, free from any artificial source of disturbance. In the case of many of the older observations of which records exist, the precise spot cannot be very exactly fixed, and not infrequently the site has become unsuitable through the erection of buildings not free from iron. Apart from buildings, much depends on whether the neighbourhood is free from basaltic and other magnetic rocks. If there are no local disturbances of this sort, a few yards difference is usually without appreciable influence, and even a few miles difference is of minor importance when one is calculating the mean secular change for a long period of years. When, however, local disturbances exist, even a few feet difference in the site may be important, and in the absence of positive knowledge to the contrary it is only prudent to act as if the site were disturbed. Near a magnetic pole the declination naturally changes very rapidly when one travels in the direction perpendicular to the lines of equal declination, so that the exact position of the site of observation is there of special importance.

The usual method of conveying information as to the value of the declination at different parts of the earth's surface is to draw curves on a map—the so-called *isogonals*—such that at all points on any one curve the declination at a given specified epoch has the same value. The information being of special use to sailors, the preparation of magnetic charts has been largely the work of naval authorities—more especially of the hydrographic department of the British admiralty. The object of the admiralty world charts—four of which are reproduced here, on a reduced scale, by the kind permission of the Hydrographer—is rather to show the general features boldly than to indicate minute details. Apart from the immediate necessities of the case, this is a counsel of prudence. The observations used have mostly been taken at dates considerably anterior to that to which the chart is intended to apply. What the sailor wants is the declination now or for the next few years, not what it was five, ten or twenty years ago. Reliable secular change data, for reasons already indicated, are mainly obtainable from fixed observatories, and there are enormous areas outside of Europe where no such observatories exist. Again, as we shall see presently, the rate of the secular change sometimes alters greatly in the course of a comparatively few years. Thus, even when the observations themselves are thoroughly reliable, the prognostication made for a future date by even the most experienced of chart makers may be occasionally somewhat wide of the mark. Fig. 1 is a reduced copy of the British admiralty declination chart for the epoch 1907. It shows the isogonals between 70° N. and 65° S. latitude. Beyond the limits of this chart, the number of exact measurements of declination is somewhat limited, but the general nature of the phenomena is easily inferred. The geographical and the magnetic poles—where the dipping needle is vertical—are fundamental points. The north magnetic pole is situated in North America near the edge of the chart. We have no reason to suppose that the magnetic pole is really a fixed point, but for our present purpose we may regard it as such. Let us draw an imaginary circle round it, and let us travel round the circle in the direction, west, north, east, south, starting from a point where the north pole of a magnet (*i.e.* the pole which in Europe or the United States points to the north) is directed exactly towards the astronomical north. The point we start from is to the geographical south of the magnetic pole. As we go round the circle the needle keeps directed to the magnetic pole, and so points first slightly to the east of geographical north, then more and more to the east, then directly east, then to south of east, then to due south, to west of south, to west, to north-west, and finally when we get round to our original position due north once more. Thus, during our course round the circle the needle will have pointed in all possible directions. In other words, isogonals answering to all possible values of the declination have their origin in the north magnetic pole. The same remark applies of course to the south magnetic pole.



Reduced from a chart, by permission of the Lords Commissioners of the Admiralty The portion over the British Isles and France has been specially drawn for this chart

Emery Walker sc.

FIG. 1.—Isogonals, or lines of equal magnetic declination.

Now, suppose ourselves at the north geographical pole of the earth. Neglecting as before diurnal variation and similar temporary changes, and assuming no abnormal local disturbance, the compass needle at and very close to this pole will occupy a fixed direction relative to the ground underneath. Let us draw on the ground through the pole a straight line parallel to the direction taken there by the compass needle, and let us carry a compass needle round a *small* circle whose centre is the pole. At all points on the circle the positions of the needle will be parallel; but whereas the north pole of the magnet will point exactly towards the centre of the circle at one of the points where the straight line drawn on the ground cuts the circumference, it will at the opposite end of the diameter point exactly away from the centre. The former part is clearly on the isogonal where the declination is 0°, the latter on the isogonal where it is 180°. Isogonals will thus radiate out from the north geographical pole (and similarly of course from the south geographical pole) in all directions. If we travel along an isogonal, starting from the north magnetic pole, our course will generally take us, often very circuitously, to the north geographical pole. If, for example, we select the isogonal of 10° E., we at first travel nearly south, but then more and more westerly, then north-westerly across the north-east of Asia; the direction then gets less northerly, and makes a dip to the south before finally making for the north geographical pole. It is possible, however, according to the chart, to travel direct from the north magnetic to the south geographical pole, provided we select an isogonal answering to a small westerly or easterly declination (from about 19° W. to 7° E.).

Special interest attaches to the isogonals answering to declination 0°. These are termed *agonic lines*, but sailors often call them *lines of no variation*, the term *variation* having at one time been in common use in the sense of declination. If we start from the north magnetic pole the agonic line takes us across Canada, the United States and South America in a fairly straight course to the south geographical pole. A curve continuous with this can be drawn from the south geographical to the south magnetic pole at every point of which the needle points in the geographical meridian; but here the north pole of the needle is pointing south, not north, so that this portion of curve is really an isogonal of 180°. In continuation of this there emanates from the south magnetic pole a second isogonal of 0°, or agonic line, which traverses Australia, Arabia and Russia, and takes us to the north geographical pole. Finally, we have an isogonal of 180°, continuous with this second isogonal of 0° which takes us to the north magnetic pole, from which we started. Throughout the whole area included within these isogonals of 0° and 180°—excluding locally disturbed areas—the declination is westerly; outside this area the declination is in general easterly. There is, however, as shown in the chart, an isogonal of 0° enclosing an area in eastern Asia inside which the declination is westerly though small.

§ 7. Fig. 2 is a reduced copy of the admiralty chart of inclination or dip for the epoch 1907. The places where the dip has the same value lie on curves called *isoclinals*. The dip is northerly (north pole dips) or southerly (south pole dips) according as the place is north or south of the isoclinal of 0°. At places actually on this isoclinal the dipping needle is horizontal. The isoclinal of 0° is nowhere very far from the geographical equator, but lies to the north of it in Asia and Africa, and to the south of it in South America. As we travel north from the isoclinal of 0° along the meridian containing the magnetic pole the dipping needle's north pole dips more and more, until when we reach the magnetic pole the needle is vertical. Going still farther north, we have the dip diminishing. The northerly inclination is considerably less in Europe than in the same latitudes of North America; and correspondingly the southerly inclination is less in South America than in the same latitudes of Africa.

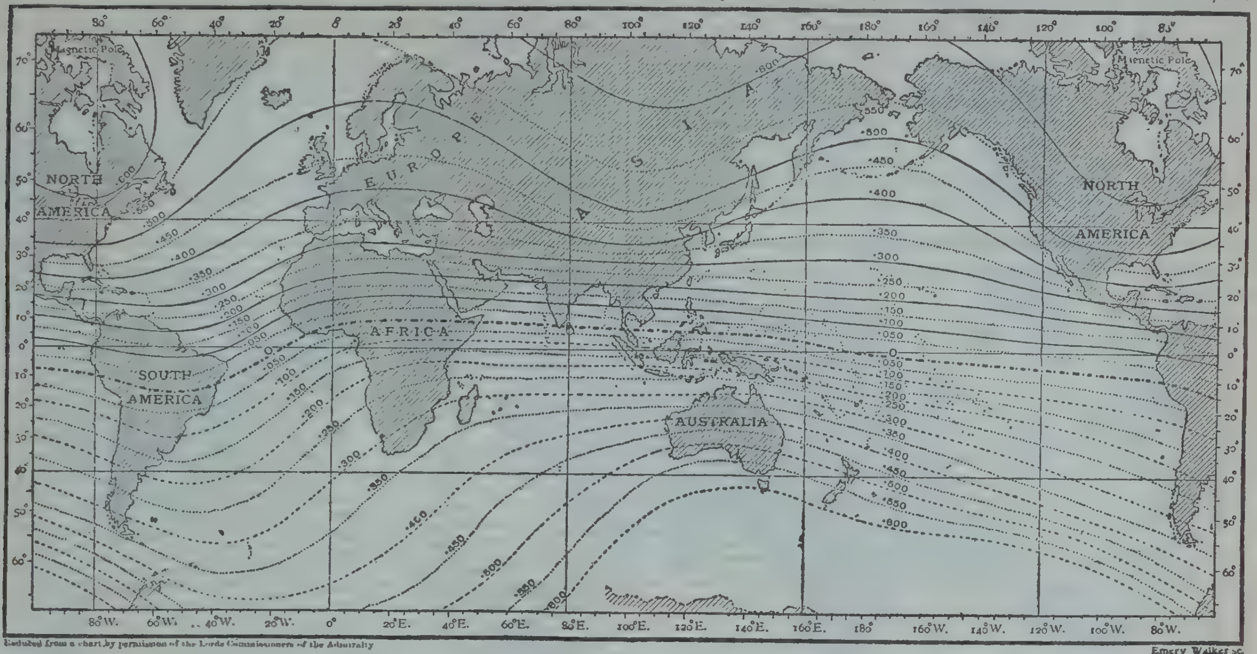

Magnetic Pole
Magnetic Pole
NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
AUSTRALIA
NORTH AMERICA
80°W.
60°W.
40°W.
20°W.
0°
20°E.
40°E.
60°E.
80°E.
100°E.
120°E.
140°E.
160°E.
180°
160°W.
140°W.
120°W.
100°W.
80°W.
70°
60°
50°
40°
30°
20°
10°
0°
10°
20°
30°
40°
50°
60°
·600
·550
·500
·450
·400
·350
·300
·250
·200
·150
·100
·050
0
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FIG. 2—Isoclinals, or lines of equal magnetic dip.

Fig. 3 is a reduced copy of the admiralty horizontal force chart for 1907. The curves, called *isomagnetics*, connect the places where the horizontal force has the same value; the force is expressed in C.G.S. units. The horizontal force vanishes of course at the magnetic poles. The chart shows a maximum value of between 0·39 and 0·40 in an oval including the south of Siam and the China Sea. The horizontal force is smaller in North America than in corresponding latitudes in Europe.

Charts are sometimes drawn for other magnetic elements, especially vertical force (fig. 4) and total force. The isomagnetic of zero vertical force coincides necessarily with that of zero dip, and there is in general considerable resemblance between the forms of lines of equal vertical force and those of equal dip. The highest values of the vertical force occur in areas surrounding the magnetic poles, and are fully 50% larger than the largest values of the horizontal force. The total force is least in equatorial regions, where values slightly under 0·4 C.G.S. are encountered. In the northern hemisphere there are two distinct maxima of total force. One of these so-called *foci* is in Canada, the other in the north-east of Siberia, the former having the higher value of the force. There are, however, higher values of the total force than at either of these *foci* throughout a considerable area to the south of Australia. In the northern hemisphere the lines of equal total force—called *isodynamic* lines—form two sets more or less distinct, consisting of closed ovals, one set surrounding the Canadian the other the Siberian focus.

§ 8. As already explained, magnetic charts for the world or for large areas give only a general idea of the values of the elements. If the region is undisturbed, very fairly approximate values are derivable from the charts, but when the highest accuracy is necessary the only thing to do is to observe at the precise spot. In disturbed areas local values often depart somewhat widely from what one would infer from the chart, and occasionally there are large differences

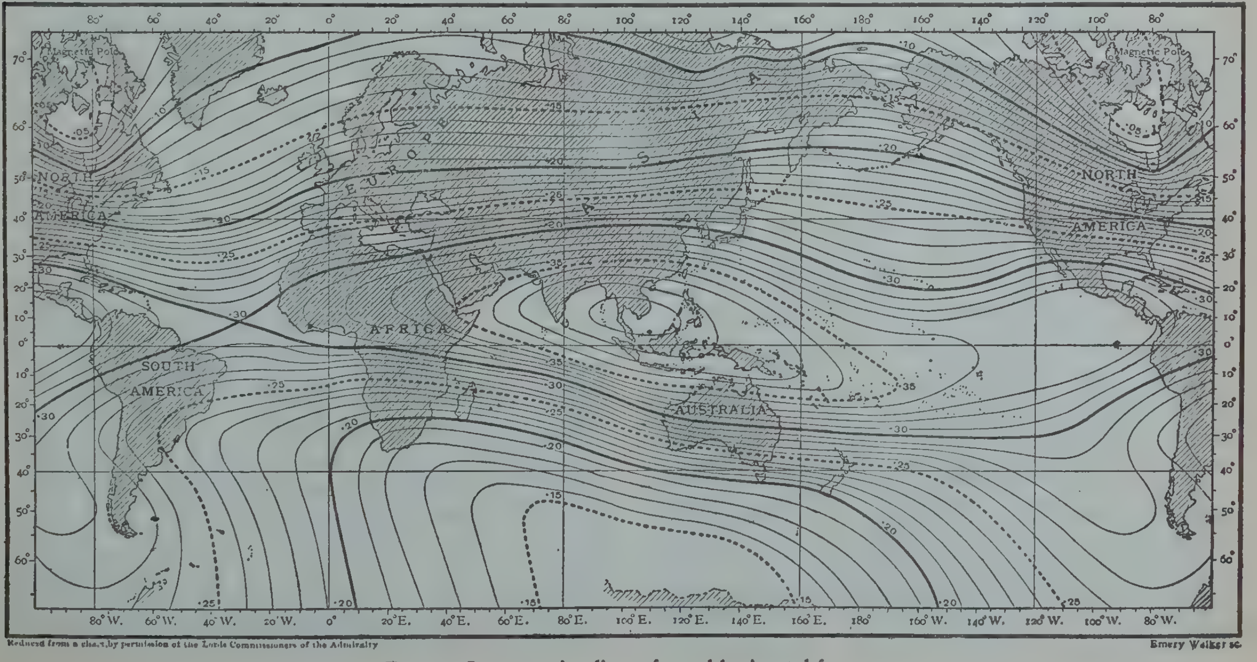
Magnetic Pole
Magnetic Pole
NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
AUSTRALIA
NORTH AMERICA
80°W.
60°W.
40°W.
20°W.
0°
20°E.
40°E.
60°E.
80°E.
100°E.
120°E.
140°E.
160°E.
180°
160°W.
140°W.
120°W.
100°W.
80°W.
·05
·10
·15
·20
·25
·30
·35
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FIG. 3.—Isomagnetics, lines of equal horizontal force.

Magnetic Elements and their Secular Change.

between places only a few miles apart. Magnetic observatories usually publish the mean value for the year of their magnetic elements. It has been customary for many years to collect and publish these results in the annual report of the Kew Observatory (Observatory Department of the National Physical Laboratory). The data in Tables I. and II. are mainly derived from this source. The observatories are arranged in order of latitude, and their geographical co-ordinates are given in Table II., longitude being reckoned from Greenwich. Table I. gives the mean values of the declination, inclination and horizontal force for January 1, 1901; they are in the main arithmetic means of the mean annual values for the two years 1900 and 1901. The mean annual secular changes given in this table are derived from a short period of years—usually 1898 to 1903—the centre of which fell at the beginning of 1901. Table II. is similar to Table I., but includes vertical force results; it is more extensive and contains more recent data. In it the number of years is specified from which the mean secular change is derived; in all cases the last year of the period employed was that to which the absolute values assigned to the element belong. The great majority of the stations have declination west and inclination north; it has thus been convenient to attach the + sign to increasing westerly (or decreasing easterly) declination and to increasing northerly (or decreasing southerly) inclination. In other words, in the case of the declination + means that the north end of the needle is moving to the west, while in the case of the inclination + means that the north end (whether the dipping end or not) is moving towards the nadir. In the case, however, of the vertical force + means simply *numerical* increase, irrespective of whether the north or the south pole dips. The unit employed in the horizontal and vertical force secular changes is 1γ, *i.e.* 0·00001 C.G.S. Even in the declination, at the very best observatories, it is hardly safe to assume that the apparent change from one year to the next is absolutely truthful to nature. This is especially the case if there has been any change of instrument or observer, or if any alteration has been made to buildings in the immediate vicinity. A change of instrument is a much greater source of uncertainty in the case of horizontal force or dip than in the case of declination, and dip circles and needles are more liable to deterioration than magnetometers. Thus, secular change data for inclination and vertical force are the least reliable. The uncertainties, of course, are much less, from a purely mathematical standpoint, for secular changes representing a mean from five or ten years than for those derived from successive years' values of the elements. The longer, however, the period of years, the greater is the chance that one of the elements may in the course of it have passed through a maximum or minimum value. This possibility should always be borne in mind in cases where a mean secular change appears exceptionally small.

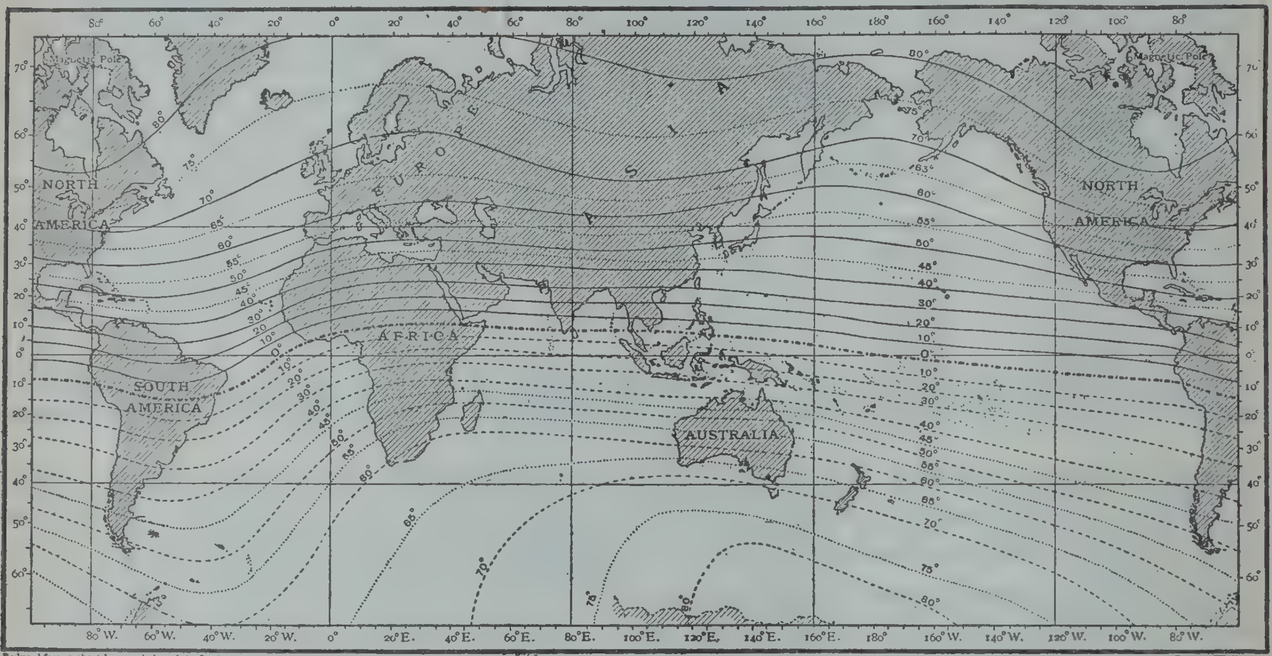

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FIG. 4.—Isomagnetics, lines of equal vertical force.

As Tables I. and II. show, the declination needle is moving to the east all over Europe, and the rate at which it is moving seems not to vary much throughout the continent. The needle is also moving to the east throughout the western parts of Asia, the north and east of Africa, and the east of North America. It is moving to the west in the west of North America, in South America, and in the south and east of Asia, including Japan, south-east Siberia, eastern China and most of India.

§ 9. The information in figs. 1, 2, 3 and 4 and in Tables I. and II. applies only to recent years. Owing to secular change, recent charts differ widely from the earliest ones constructed. The first charts believed to have been constructed were those of Edmund Halley the astronomer. According to L. A. Bauer,[7] who has made a special study of the subject, Halley issued two declination charts for the epoch 1700; one, published in 1701, was practically confined to the Atlantic Ocean, whilst the second, published in 1702, contained also data for the Indian Ocean and part of the Pacific. These charts showed the isogonic lines, but only over the ocean areas. Though the charts for 1700 were the first published, there are others which apply to earlier epochs. W. van Bemmelen[8] has published charts for the epochs 1500, 1550, 1600, 1650 and 1700, whilst H. Fritsche[9] has more recently published charts of declination, inclination and horizontal force for 1600, 1700, 1780, 1842 and 1915. A number of early declination charts were given in Hansteen's *Atlas* and in G. Hellmann's reprints, *Die Altesten Karten der Isogonen, Isoklinen, Isodynamen* (Berlin, 1895). The data for the earlier epochs, especially those prior to 1700, are meagre, and in many cases probably of indifferent accuracy, so that the reliability of the charts for these epochs is somewhat open to doubt.

If we take either Hansteen's or Fritsche's declination chart for 1600 we notice a profound difference from fig. 1. In 1600 the agonic line starting from the north magnetic pole, after finding its way south to the Gulf of Mexico, doubled back to the north-east, and passed across or near Iceland. After getting well to the north of Iceland it doubled again to the south, passing to the east of the Baltic. The second agonic line which now lies to the west of St Petersburg appears in 1600 to have continued, after traversing Australia, in a nearly northerly direction through the extreme east of China. The nature of the changes in declination in western Europe will be understood from Table III., the data from which, though derived from a variety of places in the south-east of England,[10] may be regarded as approximately true of London. The earliest result is that obtained by Borough at Limehouse. Those made in the 16th century are due to Gunter, Gellibrand, Henry Bond and Halley. The observations from 1787 to 1805 were due to George Gilpin, who published particulars of his own and the earlier observations in the *Phil. Trans.* for 1806. The data for 1817 and 1820 were obtained by Col. Mark Beaufoy, at Bushey, Herts. They seem to come precisely at the time when the needle, which had been continuously moving to the west since the earliest observations, began to retrace its steps. The data from 1860 onwards apply to Kew.

TABLE I.—Magnetic Elements and their Rate of Secular Change for January 1, 1901.

Place.	Absolute values			Secular change.		
	D.	I.	H.	D.	I.	H.
	° ′	° ′		′	′	γ
Pavlovsk	0 39·8E	70 36·8N	·16553	− 4·1	−0·8	+ 7
Ekatarinburg	10 6·3E	70 40·5N	·17783	− 4·6	+0·5	−13
Copenhagen	10 10·4W	68 38·5N	·17525			
Stonyhurst	18 10·3W	68 48·0N	·17330	− 4·0		+22
Wilhelmshaven	12 26·0W	67 39·7N	·18108	− 4·1	−2·1	+20
Potsdam	9 54·2W	66 24·5N	·18852	− 4·2	−1·6	+16
Irkutsk	2 1·0E	70 15·8N	·20122	+ 0·5	+1·6	−14
de Bilt	13 48·3W	66 55·5N	·18516	− 4·4	−2·2	+14
Kew	16 50·8W	67 10·6N	·18440	− 4·2	−2·2	+25
Greenwich	16 27·5W	67 7·3N	·18465	− 4·0	−2·2	+23
Uccle	14 11·0W	66 8·8N	·18954	− 4·2	−2·1	+23
Falmouth	18 27·3W	66 44·0N	·18705	− 3·8	−2·7	+26
Prague	9 4·4W		·19956	− 4·4		+20
St Helier	16 58·1W	65 44·1N		− 3·5	−2·7	
Parc St Maur	14 43·4W	64 52·3N	·19755	− 4·0	−2·2	+23
Val Joyeux	15 13·7W	65 0·0N	·19670			
Munich	10 25·8W	63 18·1N	·20629	− 4·8	−2·7	+21
O'Gyalla	7 26·1W		·21164	− 4·8		+13
Pola	9 22·7W	60 14·5N	·22216	− 4·0		+23
Toulouse	14 16·4W	60 55·9N	·21945	− 3·9	−2·5	+25
Perpignan	13 34·7W	59 57·6N	·22453			
Capo di Monte	9 8·0W	56 22·3N		− 5·2	−2·3	
Madrid	15 39·0W					
Coimbra	17 18·1W	59 22·0N	·22786	− 3·7	−4·3	+34
Lisbon	17 15·7W	57 53·0N	·23548			
Athens	5 38·2W	52 7·5N	·26076			
San Fernando	15 57·5W	55 8·8N	·24648			
Tokyo	4 34·9W	49 0·3N	·29932			
Zi-ka-wei	2 23·5W	45 43·5N	·32875	+ 1·5	−1·5	+37
Helwan	3 39·7W	40 30·8N	·30136	− 7·0	−0·4	− 7
Hong-Kong	0 17·5E	31 22·8N	·36753	+ 1·8	−4·3	+45
Kolaba	0 23·2E	21 26·5N	·37436	+ 2·2	+7·0	− 9
Manila	0 52·2E	16 13·5N	·38064	+ 0·1	−5·3	+47
Batavia	1 7·3E	30 35·5S	·36724	+ 3·0	−7·3	−11
Mauritius	9 25·2W	54 9·4S	·23820	− 4·7	+4·6	−39
Rio de Janeiro	8 2·9W	13 20·1S	·2501	+10·4	−2·3	
Melbourne	8 25·6E	67 24·6S	·23295			

The rate of movement of the needle to the east at London—and throughout Europe generally—fell off markedly subsequent to 1880. The change of declination in fact between 1880 and 1895 was only about 75% of that between 1865 and 1880, and the mean annual change from 1895 to 1900 was less than 75% of the mean annual change of the preceding fifteen years. Thus in 1902 it was at least open to doubt whether a change in the sign of the secular change were not in immediate prospect. Subsequent, however, to that date there was little further decline in the rate of secular change, and since 1905 there has been very distinct acceleration. Thus, if we derive a mean value from the eighteen European stations for which declination secular changes are given in Tables I. and II. we find

mean value from table I. −4·18
„ „ „ „ II. −5·21

The epoch to which the data in Table II. refer is somewhat variable, but is in all cases more recent than the epoch, January 1, 1901, for Table I., the mean difference being about 5 years.

§ 10. At Paris there seems to have been a maximum of easterly declination (about 9°) about 1580; the needle pointed to true north about 1662, and reached its extreme westerly position between 1812 and 1814. The phenomena at Rome resembled those at Paris and London, but the extreme westerly position is believed to have been attained earlier. The rate of change near the turning point seems to have been very slow, and as no fixed observatories existed in those days, the precise time of its occurrence is open to some doubt.

Perhaps the most complete observations extant as to the declination phenomena near a turning point relate to Kolaba observatory at Bombay; they were given originally by N. A. F. Moos,[11] the director of the observatory. Some of the more interesting details are given in Table IV.; here W denotes movement to be west, and so answers to a numerical diminution in the declination, which is easterly.

Prior to 1880 the secular change at Kolaba was unmistakably to the east, and subsequent to 1883 it was clearly to the west; but between these dates opinions will probably differ as to what actually happened. The fluctuations then apparent in the sign of the annual change may be real, but it is at least conceivable that they are of instrumental origin. From 1870 to 1875 the mean annual change was −1′·2; from 1885 to 1890 it was +1′·5; from 1890 to 1895 it was +2′·0, while from 1895 to 1905 it was +2′·35, the + sign denoting movement to the west. Thus, in this case the rate of secular change has increased fairly steadily since the turning point was reached.

Table V. contains some data for St Helena and the Cape of Good Hope,[12] both places having a long magnetic history. The remarkable feature at St Helena is the uniformity in the rate of secular change. The figures for the Cape show a reversal in the direction of the secular change about 1840, but after a few years the arrested movement to the west again became visible. According, however, to J. C. Beattie's *Magnetic Survey of South Africa* the movement to the west ceased shortly after 1870. A persistent movement to the east then set in, the mean annual change increasing from 1′·8 between 1873 and 1890 to 3′·8 between 1890 and 1900.

§ 11. Secular changes of declination have been particularly interesting in the United States, an area about which information is unusually complete, thanks to the labours and publications of the United States Coast and Geodetic Survey.[13] At present the agonic line passes in a south-easterly direction from Lake Superior to South Carolina. To the east of the agonic line the declination is westerly, and to the west it is easterly. In 1905 the declination varied from about 21° W. in the extreme north-east to about 24° E. in the extreme north-west. At present the motion of the agonic line seems to be towards the west, but it is very slow. To the east of the agonic line westerly declination is increasing, and to the west of the line, with the exception of a narrow strip immediately adjacent to it, easterly declination is increasing. The phenomena in short suggest a motion southwards in the north magnetic pole. Since 1750 declination has always been westerly in the extreme east of the States, and always easterly in the extreme west, but the position of the agonic line has altered a good deal. It was to the west of Richmond, Virginia, from 1750 to about 1772, then to the east of it until about 1838 when it once more passed to the west; since that time it has travelled farther to the west. Table VI. is intended to show the nature of the secular change throughout the whole country. As before, + denotes that the north pole of the magnet is moving to the west, − that it is moving to the east.

The data in Table VI. represent the mean change of declination per annum, derived from the period (ten years, except for 1900–1905) which ended in the year put at the top of the column. The stations are arranged in four groups, the first group representing the extreme eastern, the last group the extreme western states, the other two groups being intermediate. In each group the stations are arranged, at least approximately, in order of latitude. The data are derived from the values of the declination given in the Geodetic Survey's *Report* for 1906, appendix 4, and *Magnetic Tables and Magnetic Charts* by L. A. Bauer, 1908. The values seem, in most cases, based to some extent on calculation, and very probably the secular change was not in reality quite so regular as the figures suggest. For the Western States the earliest data are comparatively recent, but for some of the eastern states data earlier than any in the table appear in the *Report of the Coast and Geodetic Survey* for 1902. These data indicate that the easterly movement of the magnet, visible in all the earlier figures for the Eastern States in Table VI., existed in all of them at least as far back as 1700. There is not very much evidence as to the secular change between 1700 and 1650, the earliest date to which the Coast and Geodetic Survey's figures refer. The figures show a maximum of westerly declination about 1670 in New Jersey and about 1675 in Maryland. They suggest that this maximum was experienced all along the Atlantic border some time in the 17th century, but earlier in the extreme north-east than in New York or Maryland.

Examination of Table VI. shows that the needle continued to move to the east for some time after 1750 even in the Eastern States. But the rate of movement was clearly diminishing, and about 1765 the extreme easterly position was reached in Eastport, Maine, the needle then beginning to retrace its steps to the west. The phenomena visible at Maine are seen repeating themselves at places more and more to the west, in Boston about 1785, in Albany about 1800, in Washington, D.C., about 1805, in Columbus (Ohio) about 1815, in Montgomery (Alabama) about 1825, in Bloomington (Ill.) about 1830, in Des Moines (Iowa) about 1840, in Santa Rosa (New Mexico) about 1860 and in Salt Lake about 1870. In 1885 the needle was moving to the west over the whole United States with the exception of a comparatively narrow strip along the Pacific coast. Even an acute observer would have been tempted to prophesy in 1885 that at no distant date the secular change would be pronouncedly westerly right up to the Pacific. But in a few years a complete change took place. The movement to the east, which had become exceedingly small, if existent, in the Pacific states, began to accelerate; the movement to the west continued in the central, as in the eastern states, but perceptibly slackened. In 1905 the area throughout which the movement to the west still continued had greatly contracted and lay to the east of a line drawn from the west end of Lake Superior to the west of Georgia. If we take a station like Little Rock (Arkansas), we have the secular change to the

TABLE II.—Recent Values of the Magnetic Elements and their Rate of Secular Change.

Place.	Geographical position.		Absolute Values of Elements.					Secular change (mean per annum).				
	Latitude.	Longitude.	Year.	D.	I.	H.	V.	Interval in years.	D.	I.	H.	V.
	° ′	° ′		° ′	° ′				′	′		
Pavlovsk	59 41N	30 29E	1906	1 4·2E	70 36·6N	·16528	·46963	5	−4·5	+0·1	− 6	−14
Sitka (Alaska)	57 3N	135 20W	1906	30 3·3E	74 41·7N	·15502	·56646	4	−3·0	−1·6	+18	−38
Ekatarinburg	56 49N	60 38E	1906	10 31·0E	70 49·5N	·17664	·50796	5	−4·5	+1·7	−23	+18
Rude Skov (Copenhagen)	55 51N	12 27E	1908	9 43·3W	68 45N	·17406	·44759					
Stonyhurst	53 51N	2 28W	1909	17 28·6W	68 42·8N	·17424	·44722	5	−5·9	−1·1	+ 6	−25
Hamburg	53 33N	9 59E	1903	11 10·2W	67 23·5N	·18126	·43527					
Wilhelmshaven	53 32N	8 9E	1909	11 46·8W		·18129		5	−5·2		− 7	
Potsdam	52 23N	13 4E	1909	9 10·6W	66 20·0N	·18834	·42971	5	−5·8	+0·1	− 9	−19
Irkutsk	52 16N	104 16E	1905	1 58·1E	70 25·0N	·20011	·56250	5	+0·6	+2·0	−24	+39
de Bilt	52 5N	5 11E	1907	13 19·0W	66 49·9N	·18559	·43368	5	−4·7	−0·6	+ 2	−16
Valencia	51 56N	10 15W	1909	20 50·3W	68 15·1N	·17877	·44812	5	−5·0	−1·2	+ 7	−25
Kew	51 28N	0 19W	1909	16 10·8W	66 59·7N	·18506	·43588	5	−5·4	−1·1	+ 2	−35
Greenwich	51 28N	0 0	1909	15 47·6W	66 53·9N	·18526	·43432	5	−5·5	−0·7	+ 1	−20
Uccle	50 48N	4 21E	1908	13 36·7W	66 1·6N	·19061	·42867	4	−5·3	−0·8	− 3	−35
Falmouth	50 9N	5 5W	1909	17 48·4W	66 30·6N	·18802	·43266	5	−4·7	−1·4	+ 9	−30
Prague	50 5N	14 25E	1908	8 20·9W				5	−6·5			
Cracow	50 4N	19 58E	1909	5 35·1W	64 18N			3	−7·3			
St Helier	49 12N	2 5W	1907	16 27·4W	65 34·5N			5	−5·3	−1·2		
Val Joyeux	48 49N	2 1E	1909	14 32·9W	64 43·9N	·19727	·41792	5	−5·4	−1·7	+ 1	−51
Vienna	48 15N	16 21E	1898	8 24·1W								
Munich	48 9N	11 37E	1906	9 59·5W	63 10·0N	·20657	·40835	5	−4·8	−1·3	+ 4	−31
O'Gyalla	47 53N	18 12E	1909	6 43·9W		·21094		5	−5·0		−10	
Odessa	46 26N	30 46E	1899	4 36·7W	62 18·2N	·21869	·41660					
Pola	44 52N	15 51E	1908	8 43·2W	60 6·8N	·22207	·38640	5	−5·5	−0·6	− 4	−23
Agincourt (Toronto)	43 47N	79 16W	1906	5 45·3W	74 35·6N	·16397	·59502	4	+3·4	+0·9	−23	−24
Nice	43 43N	7 16E	1899	12 4·0W	60 11·7N	·22390	·39087					
Toulouse	43 37N	1 28E	1905	13 56·3W	60 49·1N	·22025	·39439	5	−4·5	−1·5	+ 2	− 2
Perpignan	42 42N	2 53E	1907	13 4·4W				7	−4·7			
Tiflis	41 43N	44 48E	1905	2 41·6E	56 2·8N	·25451	·37799	7	−5·2	+1·7	−26	+ 2
Capo di Monte	40 52N	14 15E	1906	8 40·3W	56 13·5N			5	−5·1	−1·5		
Madrid	40 25N	3 40W	1901	15 35·6W								
Coimbra	40 12N	8 25W	1908	16 46·2W	58 57·3N	·22946	·38120	5	−4·6	−2·9	+17	−45
Baldwin (Kansas)	38 47N	95 10W	1906	8 30·1E	68 45·1N	·21807	·56081	4	−1·7	+1·8	−36	− 8
Cheltenham (Maryland)	38 44N	76 50W	1906	5 22·0W	70 27·3N	·20035	·56436	4	+3·8	+1·2	−38	−45
Lisbon	38 43N	9 9W	1900	17 18·0W	57 54·8N	·23516	·37484					
Athens	37 58N	21 23E	1908	4 52·9W	52 11·7N	·26197	·33613	5	−5·5			
San Fernando	36 28N	6 12W	1908	15 25·6W	54 48·4N	·24829	·35206	5	−4·6	−2·8	+26	−24
Tokyo	35 41N	139 45E	1901	4 36·1W	49 0·0N	·29954	·34459					
Zi-ka-wei	31 12N	121 26E	1906	2 32·0W	45 35·3N	·33040	·33726	5	+1·5	−1·3	+30	+ 6
Dehra Dun	30 19N	78 3E	1907	2 38·3E	43 36·1N	·33324	·31736	4	+0·8	+5·5	−26	+77
Helwan	29 52N	31 21E	1909	2 49·2W	40 40·4N	·30031	·25804	5	−5·7	+1·2	− 6	+13
Havana	23 8N	82 25W	1905	2 25·0E	52 57·4N	·30531	·40452					
Barrackpore	22 46N	88 22E	1907	1 9·9E	30 30·2N	·37288	·21967	3	+4·2	+3·4	+21	+62
Hong-Kong	22 18N	114 10E	1908	0 3·9E	31 2·5N	·37047	·22292	5	+1·9	−1·8	+43	− 1
Honolulu	21 19N	158 4W	1906	9 21·7E	40 1·8N	·29220	·24545	4	−0·9	−3·2	−19	−62
Kolaba	18 54N	72 49E	1905	0 14·0E	21 58·5N	·37382	·15084	5	+2·1	+7·2	−11	+86
Alibagh	18 39N	72 52E	1909	1 0·3E	23 29·0N	·36845	·16008	3	+1·7	+6·8	−10	+82
Vieques (Porto Ricc)	18 9N	65 26W	1906	1 33·2W	49 47·7N	·28927	·34224	2	+7·2	+6·8	−49	+66
Manila	14 35N	120 59E	1904	0 51·4E	16 0·2N	·38215	·10960	5	+0·1	−3·9	+47	−34
Kodaikanal	10 14N	77 28E	1907	0 40·7W	3 27·2N	·37431	·02259	4	+4·3	+5·5	+16	+61
Batavia	6 11S	106 49E	1906	0 54·1E	30 48·5S	·36708	·21889	4	+2·1	−7·7	− 2	+110
Dar es Salaam	6 49S	39 18E	1903	7 35·2W								
Mauritius	20 6S	57 33E	1908	9 14·3W	53 44·9S	·23415	·31932	5	−0·3	+2·9	−53	−131
Rio de Janeiro	22 55S	43 11W	1906	8 55·3W	13 57·1S	·24772	·06164	5	+9·1	−6·8	−42	+44
Santiago (Chilĕ)	33 27S	70 42W	1906	14 18·7E	30 11·8S			3	+6·1	+9·9		
Melbourne	37 50S	144 58E	1901	8 26·7E	67 25·0S	·23305	·56024					
Christchurch, N.Z.	43 32S	172 37E	1903	16 18·4E	67 42·3S	·22657	·55259					

west lasting for about sixty years. Further west the period shortens. At Pueblo (Colorado) it is about forty years, at Salt Lake under thirty years, at Prescott (Arizona) about twenty years. Considering how fast the area throughout which the secular change is easterly has extended to the east since 1885, one would be tempted to infer that at no distant date it will include the whole of the United States. In the extreme north-east, however, the movement of the needle to the west, which had slackened perceptibly after 1860 or 1870, is once more accelerating. Thus the auspices do not all point one way, and the future is as uncertain as it is interesting.

§ 12. Table VII. gives particulars of the secular change of horizontal force and northerly inclination at London. Prior to the middle of the 19th century information as to the value of H is of uncertain value. The earlier inclination data[14] are due to Norman, Gilbert, Bond, Graham, Heberden and Gilpin. The data from 1857 onwards, both for H and I, refer to Kew. "London" is rather a vague term, but the differences between the values of H and I at Kew and Greenwich—in the extreme west and east—are almost nil. For some time after its discovery by Robert Norman inclination at London increased. The earlier observations are not sufficient to admit of the date of the maximum inclination or its absolute value being determined with precision. Probably the date was near 1723. This view is supported by the fact that at Paris the inclination fell from 72° 15′ in 1754 to 71° 48′ in 1780. The

TABLE III.—Declination at London.

Date.	Declination.	Date.	Declination.	Date.	Declination.
	° ′		° ′		° ′
1580	11 15E	1773	21 9W	1860	21 38·9W
1622	6 0	1787	23 19	1865	20 58·7
1634	4 6	1795	23 57	1870	20 18·3
1657	0 0	1802	24 6	1875	19 35·6
1665	1 22W	1805	24 8	1880	18 52·1
1672	2 30	1817	24 36	1885	18 19·2
1692	6 0	1818	24 38	1890	17 50·6
1723	14 17	1819	24 36	1895	17 16·8
1748	17 40	1820	24 34	1900	16 52·7
				1905	16 32·9

earlier observations in London were probably of no very high accuracy, and the rates of secular change deducible from them are correspondingly uncertain. It is not improbable that the average annual change 0′·8 derived from the thirteen years 1773–1786 is too small, and the value 6′·2 derived from the fifteen years 1786–1801 too large. There is, however, other evidence of unusually rapid secular change of inclination towards the end of the 18th century in western Europe; for observations in Paris show a fall of 56′ between 1780 and 1791, and of 90′ between 1791 and 1806. Between 1801 and 1901 inclination in London diminished by 3° 26′·5, or on the average by 2′·1 per annum, while between 1857 and 1900 H increased on the average by 22γ a year. These values differ but little from the secular changes given in Table I. as applying at Kew for the epoch Jan. 1, 1901. Since the beginning, however, of the 20th century a notable change has set in, which seems shared by the whole of western Europe. This is shown in a striking fashion by contrasting the data from European stations in Tables I. and II. There are fifteen of these stations which give secular change data for H in both tables, while thirteen give secular data for I. The mean values of the secular changes derived from these stations are as follows:—

TABLE IV.—Declination at Kolaba (Bombay).

Year.	Declination East.	Change since previous year.	Year.	Declination East.	Change since previous year.
	° ′ ″	′ ″		° ′ ″	′ ″
1876	0 55 58	0 37 E	1881	0 57 12	0 3 E
1877	56 39	0 41 E	1882	0 56 50	0 22 W
1878	57 6	0 27 E	1883	57 2	0 12 E
1879	57 30	0 24 E	1884	55 39	1 23 W
1880	57 9	0 21 W	1885	55 3	0 36 W

	I	H
From Table I.	−2′·35	+21·0γ
From Table II.	−1·12	+1·6γ

The difference in epoch between the two sets of results is only about 5 years, and yet in that short time the mean rate of annual increase in H fell to a thirteenth of its original value. During 1908–1909 H diminished throughout all Europe except in the extreme west. Whether we have to do with merely a temporary phase, or whether a general and persistent diminution in the value of H is about to set in over Europe it is yet hardly possible to say.

§ 13. It is often convenient to obtain a formula to express the mean annual change of an element during a given period throughout an area of some size. The usual method is to assume that the change at a place whose latitude is l and longitude λ is given by an expression of the type $c+a(l-l_0)+b(\lambda-\lambda_0)$, where a, b, c are constants, l_0 and λ_0 denoting some fixed latitude and longitude which it is convenient to take as point of departure. Supposing observational data available from a series of stations throughout the area, a, b and c can be determined by least squares. As an example, we may take the following slightly modified formula given by Ad. Schmidt [15] as applicable to Northern Europe for the period 1890 to 1900. ΔD, ΔI and ΔH represent the mean annual changes during this period in westerly declination, in inclination and in horizontal force:—

$$\begin{aligned}\Delta D &= -5{\cdot}24' - 0{\cdot}071'(l-50) + 0{\cdot}033'(\lambda-10),\\ \Delta I &= -1{\cdot}58 + 0{\cdot}010(l-50) + 0{\cdot}036(\lambda-10),\\ \Delta H &= +23{\cdot}5 - 0{\cdot}59\ (l-50) - 0{\cdot}35\ (\lambda-10).\end{aligned}$$

Longitude λ is here counted positive to the east. The central position assumed here (lat. 50°, long. 10° E.) falls in the north of Bavaria. In the case of the horizontal force unity represents 1γ. Schmidt found the above formulae to give results in very close agreement with the data at the eight stations which he had employed in determining the constants. These stations ranged from Pavlovsk to Perpignan, and from Stonyhurst to Ekaterinburg in Siberia. Formulae involving the second as well as the first powers of $l-l_0$ and $\lambda-\lambda_0$ have also been used, *e.g.*, by A. Tanakadate in the Magnetic Survey of Japan.

TABLE V.—Declination at St Helena and Cape of Good Hope.

St Helena.		Cape of Good Hope.	
Date.	Declination.	Date.	Declination.
	° ′		° ′
1610	7 13 E	1605	0 30 E
1677	0 40	1609	0 12 W
1691	1 0 W	1675	8 14
1724	7 30	1691	11 0
1775	12 18	1775	21 14
1789	15 30	1792	24 31
1796	15 48	1818	26 31
1806	17 18	1839	29 9
1839	22 17	1842	29 6
1840	22 53	1846	29 9
1846	23 11	1850	29 19
1890	23 57	1857	29 34
		1874	30 4
		1890	29 32
		1903	28 44

TABLE VI.—Secular Change of Declination in the United States (+ to the West).

Place.	Epoch	1760	70	80	90	1800	10	20	30	40	50	60	70	80	90	1900	50
		′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
Eastport, Maine		−1·2	0·0	+1·2	+2·1	+3·2	+4·0	+4·5	+4·9	+5·0	+5·6	+4·5	+3·0	+2·1	+1·0	+1·8	+2·4
Boston, Mass.		−2·7	−1·9	−1·0	0·0	+1·1	+1·9	+2·7	+3·5	+4·2	+4·4	+4·0	+3·3	+3·1	+3·0	+3·2	+3·4
Albany, New York		−4·2	−3·6	−2·7	−1·6	−0·6	+0·6	+1·6	+2·7	+3·6	+4·6	+4·6	+3·9	+4·7	+2·3	+3·4	+3·6
Philadelphia, Penn.		−4·6	−4·2	−3·5	−2·3	−1·3	+0·1	+1·3	+2·5	+3·4	+4·3	+4·2	+4·6	+4·4	+3·4	+3·5	+3·4
Baltimore, Maryland		−3·9	−3·4	−2·7	−2·0	−0·9	0·0	+0·9	+2·0	+2·7	+3·4	+3·9	+4·0	+3·9	+3·6	+3·5	+3·2
Richmond, Virginia		−3·6	−3·2	−2·5	−1·8	−0·9	0·0	+0·9	+1·8	+2·5	+3·1	+3·6	+3·9	+3·8	+3·7	+3·4	+3·2
Columbia, S. Carolina		−3·7	−3·4	−2·9	−2·2	−1·3	−0·5	+0·5	+1·3	+2·2	+2·9	+3·4	+3·8	+3·8	+3·8	+3·6	+1·8
Macon, Georgia		−3·7	−3·6	−3·2	−2·5	−1·8	−0·9	0·0	+0·9	+1·8	+2·5	+3·2	+3·6	+3·9	+3·5	+3·1	+1·2
Tampa, Florida		−3·0	−2·5	−2·0	−1·1	−0·4	+0·4	+1·1	+2·0	+2·5	+3·0	+3·2	+3·5	+3·7	+2·8	+2·9	+1·6
Marquette, Michigan									0·0	+1·4	+2·6	+3·7	+4·7	+5·1	+4·9	+3·8	+2·4
Columbus, Ohio							−0·9	0·0	+0·9	+2·0	+2·9	+3·4	+3·6	+3·7	+3·9	+4·0	+2·4
Bloomington, Illinois							−2·4	−1·5	−0·4	+0·4	+1·5	+2·4	+2·8	+4·2	+3·9	+2·9	+1·0
Lexington, Kentucky							−0·9	0·0	+0·9	+1·8	+2·5	+3·2	+3·6	+3·8	+3·8	+3·4	+1·8
Chattanooga, Tennessee							−0·9	0·0	+0·9	+1·8	+2·5	+3·2	+3·6	+4·0	+3·5	+3·1	+1·6
Little Rock, Arkansas							−2·3	−1·5	−0·9	+0·1	+0·8	+1·7	+2·0	+3·6	+3·7	+2·3	−1·2
Montgomery, Alabama		−3·6	−3·5	−3·1	−2·8	−2·2	−1·5	−0·8	+0·1	+0·8	+1·6	+2·2	+2·8	+3·8	+3·9	+2·6	+0·2
Alexandria, Louisiana							−2·1	−1·6	−0·8	+0·1	+0·8	+1·6	+2·2	+3·6	+3·3	+2·0	−1·4
Northome, Minnesota									−1·7	−0·6	+0·6	+1·7	+2·8	+4·2	+4·4	+3·5	0·0
Jamestown, N. Dakota												+1·0	+1·9	+3·1	+4·8	+1·9	−2·2
Des Moines, Iowa									−1·5	−0·6	+0·6	+1·5	+2·5	+3·8	+4·5	+2·7	−0·6
Douglas, Wyoming												−0·8	0·0	+1·2	+2·3	+0·5	−1·6
Emporia, Kansas												+0·6	+1·6	+2·7	+3·8	+1·7	−1·8
Pueblo, Colorado												−0·3	+0·4	+1·5	+3·1	+0·7	−2·2
Okmulgee, Oklahoma												+0·9	+1·5	+2·7	+3·9	+1·4	−2·4
Santa Rosa, New Mexico												−0·4	+0·4	+1·4	+2·6	+0·4	−2·4
San Antonio, Texas										−1·1	−0·5	−0·5	+1·1	+1·8	+2·7	+0·9	−2·4
Seattle, Washington					−3·3	−3·5	−3·7	−3·7	−3·5	−3·3	−3·0	−2·6	−2·1	−1·3	−1·9	−2·0	−3·2
Wilson Creek, Washington												−2·1	−1·5	−0·4	−1·0	−1·6	−3·2
Detroit, Oregon							−3·8	−3·9	−3·9	−3·7	−3·4	−2·9	−2·5	−1·8	−0·8	−1·8	−3·8
Salt Lake, Utah												−1·1	−0·4	+1·0	+1·0	−0·8	−2·8
Prescott, Arizona												−1·4	−0·7	+0·4	+0·4	−1·2	−3·2
San José, California					−2·6	−2·9	−2·9	−2·9	−2·7	−2·5	−2·3	−2·0	−1·5	−0·8	−0·4	−1·9	−3·8
Los Angeles, ,,					−3·4	−3·4	−3·5	−3·2	−3·0	−2·7	−2·1	−1·6	−1·1	−0·9	−0·3	−1·6	−3·6

Formulae are also wanted to show how the value of an element, or the rate of change of an element, at a particular place has varied throughout a long period. For comparatively short periods it is best to use formulae of the type $E=a+bt+ct^2$, where E denotes the value of an element t years subsequent to some convenient epoch; a, b, c are constants to be determined from the observational data. For longer periods formulae of the type $E=a+b\sin(mt+n)$, where a, b, m and n are constants, have been used by Schott [16] and others with considerable success. The following examples, due to G. W. Littlehales, [17] for the Cape of Good Hope, will suffice for illustration:

$$\text{Declination (West)}=14^\circ{\cdot}63+15^\circ{\cdot}00\sin\{0{\cdot}61(t-1850)+77^\circ{\cdot}8\}$$

$$\text{Inclination (South)}=49^\circ{\cdot}11+8^\circ{\cdot}75\sin\{0{\cdot}8\ (t-1850)+34^\circ{\cdot}3\}.$$

Here t denotes the date. It is perhaps hardly necessary to point out that the extension of any of these empirical formulae—whether to places outside the surveyed area, or to times not included in the period of observation—is fraught with danger, which increases rapidly the further the extra-polation is pushed.

Table VII.—Inclination (northerly) and Horizontal Force at London.

Date.	I.	Date.	I.	Date.	I.	H.	Date.	I.	H.
	° ′		° ′		° ′			° ′	
1576	71 50	1801	70 36·0	1857	68 24·9	·17474	1891	67 33·2	·18193
1600	72 0	1821	70 3·4	1860	69 19·8	·17550	1895	67 25·4	·18278
1676	73 30	1830	69 38·0	1865	68 8·7	·17662	1900	67 11·8	·18428
1723	74 42	1838	69 17·3	1870	67 58·6	·17791	1905	67 3·8	·18510
1773	72 19	1854	68 31·1	1874	67 50·0	·17903	1908	67 0·9	·18515
1786	72 9								

Bauer has employed a convenient graphical method of illustrating secular change. Radii are drawn from the centre of a sphere parallel to the direction of the freely dipping needle, and are produced to intersect the tangent plane drawn at the point which answers to the mean position of the needle during the epoch under consideration. The curve formed by the points of intersection shows the character of the secular change. Fig. 5 (slightly modified from *Nature*, vol. 57, p. 181) applies to London. The curve is being described in the clockwise direction. This, according to Bauer's [18] own investigation, is the normal mode of description. Schott and Littlehales have found, however, a considerable number of cases where it is difficult to say whether the motion is clockwise or not, while in some stations on both the east and west shores of the Pacific it was clearly anti-clockwise. Fritsche [19] dealing with the secular changes from 1600 to 1885—as given by his calculated values of the magnetic elements—at 204 points of intersection of equidistant lines of latitude and longitude, found only sixty-three cases in which the motion was unmistakably clockwise, while in twenty-one cases it was clearly the opposite.

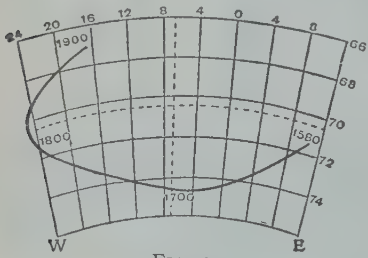


FIG. 5.

Diurnal Variations.

§ 14. All the magnetic elements at any ordinary station show a regular variation in the solar day. To separate this from the irregular changes, means of the hourly readings must be formed making use of a number of days. The amplitude of the diurnal change usually varies considerably with the season of the year. Thus a diurnal inequality derived from all the days of the year combined, or from a smaller number of days selected equally from all the months of the year, can give only the average effect throughout the year. Also unless the hours of maxima and minima at a given station are but slightly variable with the season, the result obtained by combining data from all the months of the year may be a hybrid which does not very closely resemble the phenomena in the majority of individual months. This remark applies in particular to the declination at places within the tropics. One consequence is obviously to make the range of a diurnal inequality which answers to the year as a whole less than the arithmetic mean of the twelve ranges obtained for the constituent months. At stations in temperate latitudes, whilst minor differences of type do exist between the diurnal inequalities for different months of the year, the difference is mainly one of amplitude, and the mean diurnal inequality from all the months of the year gives a very fair idea of the nature of the phenomena in any individual month.

Tables VIII. to XI. give mean diurnal inequalities derived from all the months of the year combined, the figures representing the algebraic excess of the hourly value over the mean for the twenty-four hours. The + sign denotes in Table VIII. that the north end of the needle is to the west of its mean position for the day; in Tables IX. to XI. it denotes that the element—the dip being the north or south as indicated—is numerically in excess of the twenty-four hour mean. The letter "a" denotes that all days have been included except, as a rule, those characterized by specially large disturbances. The letter "q" denotes that the results are derived from a limited number of days selected as being specially quiet,

Table VIII.—Diurnal Inequality of Declination, mean from whole year (+ to West).

Station.	Jan Mayen.		St Petersburg and Pavlovsk.		Greenwich.	Kew.		Parc St Maur.	Tiflis.	Kolaba.	Batavia.	Mauritius.	South Victoria Land.	
Latitude. Longitude.	71° 0′ N. 8° 28′ W.		59° 41′ N. 30° 29′ E.		51° 28′ N. 0° 0′.	51° 28′ N. 0° 19′W.		48° 49′ N. 2° 29′ E.	41° 43′ N. 44° 48′E.	18° 54′ N. 72° 49′ E.	6° 11′S. 106° 49′E.	20° 6′ S. 57° 33′ E.	77° 51′ S. 166° 45′ E.	
Period.	1882-1883.		1873-1885.		1890-1900.	1890-1900.		1883-1897.	1888-1898.	1894-1901.	1883-1894.	1876-1890.	1902-1903.	
	a.	q.	a.	q.	a.	a.	q.	a.	a.	q.	a.	a.	a.	q.
Hour.	′	′	′	′	′	′	′	′	′	′	′	′	′	′
1	−6·6	−4·2	−1·3	−0·7	−1·4	−1·5	−0·9	−1·4	−0·7	−0·2	+0·1	+0·1	+2·0	+0·9
2	−10·5	−6·4	−1·2	−0·8	−1·3	−1·4	−0·9	−1·2	−0·6	−0·1	−0·1	+0·1	−2·1	−1·8
3	−15·2	−7·8	−1·2	−1·0	−1·3	−1·5	−1·0	−1·2	−0·6	−0·1	−0·1	+0·1	−5·2	−4·5
4	−16·9	−8·4	−1·4	−1·3	−1·4	−1·7	−1·3	−1·2	−0·5	−0·1	0·0	+0·2	−9·4	−6·8
5	−17·0	−8·1	−1·7	−1·8	−1·7	−2·1	−1·8	−1·6	−0·7	−0·1	0·0	+0·3	−12·2	−9·0
6	−13·7	−7·0	−1·9	−2·3	−2·1	−2·4	−2·3	−1·9	−1·2	−0·6	+0·1	+0·4	−15·3	−11·7
7	−9·3	−5·1	−2·2	−2·8	−2·4	−2·7	−2·8	−2·4	−1·9	−1·0	+0·5	+0·6	−17·2	−15·0
8	−6·8	−3·2	−2·5	−3·2	−2·5	−2·8	−3·1	−2·7	−2·4	−1·2	+1·3	+1·1	−21·5	−17·3
9	−3·7	−0·6	−2·3	−3·0	−1·9	−2·1	−2·5	−2·3	−2·3	−0·7	+1·7	+1·8	−23·5	−18·1
10	−2·4	+2·1	−1·0	−1·7	−0·2	−0·3	−0·7	−0·5	−0·9	0·0	+1·5	+1·9	−21·2	−15·8
11	−0·5	+4·6	+1·0	+0·4	+2·1	+2·2	+1·7	+2·0	+1·0	+0·9	+0·9	+1·3	−15·3	−9·2
Noon	+2·5	+6·5	+3·1	+2·7	+4·2	+4·3	+3·9	+4·2	+2·6	+1·4	+0·1	0·0	−9·8	−4·9
1	+3·7	+7·3	+4·6	+4·3	+5·1	+5·3	+4·8	+5·3	+3·3	+1·2	−0·6	−1·1	−3·2	−0·1
2	+6·4	+7·1	+4·9	+4·5	+4·7	+4·9	+4·4	+4·9	+3·1	+0·6	−1·1	−2·0	+3·8	+5·9
3	+7·4	+5·9	+4·1	+3·6	+3·6	+3·7	+3·1	+3·7	+2·3	+0·1	−1·3	−2·3	+11·1	+9·5
4	+8·5	+4·3	+2·7	+2·3	+2·2	+2·4	+1·8	+2·3	+1·3	+0·2	−1·2	−1·8	+16·6	+12·9
5	+10·6	+3·0	+1·5	+1·3	+1·1	+1·2	+0·7	+1·1	+0·6	−0·1	−0·9	−0·9	+19·9	+14·6
6	+14·2	+2·3	+0·6	+0·7	+0·3	+0·4	+0·2	+0·2	+0·2	0·0	−0·6	−0·1	+22·0	+15·5
7	+15·2	+2·2	0·0	+0·4	−0·3	−0·2	−0·1	−0·4	+0·1	+0·1	−0·4	+0·1	+22·0	+15·9
8	+15·8	+2·6	−0·4	+0·2	−0·9	−0·6	−0·3	−0·9	−0·1	+0·2	−0·2	+0·1	+19·9	+14·6
9	+13·2	+2·6	−1·0	0·0	−1·2	−1·0	−0·5	−1·3	−0·4	+0·1	0·0	+0·1	+16·0	+10·6
10	+7·4	+2·0	−1·4	−0·2	−1·5	−1·3	−0·7	−1·5	−0·6	0·0	+0·1	+0·1	+11·6	+7·2
11	+1·1	+0·5	−1·6	−0·4	−1·6	−1·4	−0·8	−1·6	−0·7	0·0	+0·1	+0·1	+7·6	+4·2
12	−3·6	−1·8	−1·5	−0·6	−1·6	−1·5	−0·9	−1·6	−0·8	−0·1	+0·1	+0·1	+3·3	+1·9
Range	32·8	15·7	7·4	7·7	7·6	8·1	7·9	8·0	5·7	2·6	3·0	4·2	45·5	34·0

TABLE IX.—Diurnal Inequality of Horizontal Force, mean from whole year (Unit 1γ ≡ ·00001 C.G.S.)

Station.	Jan Mayen.		St Petersburg and Pavlovsk.		Greenwich.	Kew.	Parc St Maur.	Tiflis.	Kolaba.	Batavia.	Mauritius.	S. Victoria Land.
Period.	1882–1883.		1873–1885.		1890–1900.	1890–1900.	1883–1897.	1888–1898.	1894–1901.	1883–1894.	1883–1890.	1902–1903.
	a.	q.	a.	q.	a.	q.	a.	a.	q.	a.	a.	a.
Hour.												
1	−57	−22	+4	+5	+4	+4	+5	+3	−10	−11	−3	−12
2	−64	−24	+4	+4	+3	+4	+5	+3	−9	−10	−1	−13
3	**−74**	**−25**	+4	+4	+3	+4	+5	+3	−9	−8	+1	−14
4	−69	−24	+4	+4	+3	+4	+5	+4	−9	−7	+2	−15
5	−60	−22	+5	+4	+3	+4	+6	+4	−9	−5	+3	**−15**
6	−37	−19	+4	+4	+1	+2	+4	+4	−7	−1	+4	−12
7	−15	−15	+2	+2	−3	−1	+1	+2	−1	+5	+7	−9
8	−1	−13	−3	−4	−9	−7	−5	−3	+8	+14	+9	−7
9	+8	−12	−10	−10	−16	−13	−12	−8	+19	+24	+9	−3
10	+17	−12	−16	−16	**−20**	**−18**	**−17**	**−10**	+26	+31	**+9**	+3
11	+32	−10	**−19**	**−20**	−19	−18	−16	−7	**+30**	**+35**	+9	+7
Noon	+49	−4	−17	−18	−13	−12	−12	−1	+26	+31	+8	+12
1	+65	+8	−12	−13	−7	−7	−7	+4	+19	+22	+7	+18
2	+78	+22	−6	−6	−1	−2	−4	**+5**	+10	+10	+2	**+20**
3	**+89**	+37	0	0	+2	+1	−1	+3	+2	−1	−2	+19
4	+83	+43	+3	+3	+5	+3	0	−1	−3	−9	−6	+18
5	+68	**+49**	+5	+5	+7	+5	+2	−4	−7	−13	−7	+15
6	+37	+43	+6	+6	+9	+7	+4	−6	−8	−14	−7	+11
7	+13	+30	+7	+7	**+10**	**+8**	+6	−4	−9	−15	−7	+5
8	−11	+15	+8	+8	+10	+8	**+7**	−1	−10	−16	−8	+0
9	−33	+1	**+9**	**+9**	+8	+7	+7	+1	**−11**	**−16**	**−8**	−4
10	−36	−10	+8	+9	+7	+6	+6	+2	−11	−16	−8	−7
11	−40	−16	+7	+8	+6	+6	+6	+3	−10	−15	−7	−9
12	−51	−20	+6	+6	+5	+5	+6	+3	−10	−13	−5	−11
Range	163	74	28	29	30	26	24	15	41	51	17	35

i.e. free from disturbance. In all cases the aperiodic or non-cyclic element—indicated by a difference between the values found for the first and second midnights of the day—has been eliminated in the usual way, *i.e.* by treating it as accumulating at a uniform rate throughout the twenty-four hours. The years from which the data were derived are indicated. The algebraically greatest and least of the hourly values are printed in heavy type; the range thence derived is given at the foot of the tables.

When comparing results from different stations, it must be remembered that the disturbing forces required to cause a change of 1′ in declination and in dip vary directly, the former as the horizontal force, the latter as the total force. Near a magnetic pole the horizontal force is relatively very small, and this accounts, at least partly, for the difference between the declination phenomena at Jan Mayen and South Victoria Land on the one hand and at Kolaba, Batavia and Mauritius on the other. There is, however, another cause, already alluded to, viz. the variability in the type of the diurnal inequality in tropical stations. With a view to illustrating this point Table XII. gives diurnal inequalities of declination for June and December for a number of stations lying between 45° N. and 45° S. latitude. Some of the results are represented graphically in fig. 6, plus ordinates representing westerly deflection. At the northmost station, Toronto, the difference between the two months is mainly a matter of amplitude, the range being much larger at midsummer than at midwinter. The conspicuous phenomenon at both seasons is the rapid swing to the west from 8 or 9 a.m. to

TABLE X.—Diurnal Inequality of Vertical Force, mean from whole year (Unit 1γ).

Station.	Jan Mayen.		St Petersburg and Pavlovsk.		Greenwich.	Kew.	Parc St Maur.	Tiflis.	Kolaba.	Batavia.	Mauritius.	South Victoria Land.
Period.	1882–1883.		1873–1885.		1890–1900.	1891–1900.	1883–1897.	1888–1898.	1894–1901.	1883–1894.	1884–1890.	1902–1903.
	a.	q.	a.	q.	a.	q.	a.	a.	q.	a.	a.	a.
Hour												
1	**+65**	+3	−7	−1	−3	+1	0	+2	+4	+7	+2	**+13**
2	**+65**	+2	**−7**	−1	−4	+1	0	+2	+4	+5	+2	+12
3	+56	−1	−7	−1	−4	0	−1	+1	+3	+4	+2	+10
4	+37	−5	−6	0	−3	0	0	+1	+3	+3	+2	+8
5	+16	−7	−5	0	−2	+1	0	+2	+5	+2	+2	+3
6	−7	−8	−4	0	−1	+1	+1	+3	**+7**	+1	+2	0
7	−17	−6	−3	0	0	0	+1	+3	+6	0	+3	0
8	−14	−4	−2	0	0	−1	0	+3	0	−3	+4	−2
9	−9	0	−3	−1	−3	−4	−4	−1	−8	−11	**+5**	−6
10	−6	+5	−2	−2	−6	−8	−8	−7	−14	−20	+3	−13
11	−6	+10	−3	−4	−9	−11	−12	−11	**−15**	−26	0	−17
Noon	−10	+16	−3	**−5**	**−10**	**−11**	**−12**	**−11**	−10	**−27**	−4	**−20**
1	−13	+21	−1	−4	−6	−8	−9	−9	−3	−21	−7	−20
2	−24	**+23**	+2	−1	0	−3	−3	−5	+1	−13	**−9**	−16
3	−31	+20	+8	+2	+5	+2	+2	−1	+4	−4	−8	−12
4	−40	+13	+9	+3	+8	+5	+6	+1	+3	+4	−5	−6
5	−48	+2	**+10**	+3	+9	+6	+7	+3	0	+10	−3	−1
6	**−53**	−9	+10	+3	**+10**	**+7**	**+8**	**+4**	0	+13	0	+3
7	−47	−18	+9	+3	+9	+6	+7	+3	0	+14	0	+6
8	−36	**−20**	+8	+3	+7	+5	+6	+3	+1	**+14**	+1	+9
9	−7	−19	+6	+2	+5	+5	+5	+3	+2	+14	+2	+11
10	+18	−13	+3	+2	+3	+4	+3	+3	+3	+13	+2	+12
11	+42	−5	−2	0	0	+3	+2	+3	+3	+11	+2	+12
12	+54	0	−5	−1	−2	+2	+1	+2	+3	+9	+2	+13
Range	118	43	17	8	20	18	20	15	22	41	14	33

TABLE XI.—Diurnal Inequality of Inclination mean from whole year.

Station.	Jan Mayen.		St. Petersburg and Pavlovsk.		Greenwich.	Kew.	Parc St Maur.	Tiflis.	Kolaba.	Batavia.	Mauritius.	South Victoria Land.
End Dipping.	North.		North.		North.	North.	North.	North.	North.	South.	South.	South.
Period.	1882–1883.		1873–1885.		1890–1900.	1891–1900.	1883–1897.	1888–1898.	1894–1901.	1883–1894.	1884–1890.	1902–1903.
	a.	q.	a.	q.	a.	q.	a.	a.	q.	a.	a.	a.
Hour	′	′	′	′	′	′	′	′	′	′	′	′
1	+4·6	+1·5	**−0·5**	−0·3	−0·4	−0·3	−0·3	−0·1	+0·6	+0·9	+0·3	+0·6
2	+5·0	**+1·6**	−0·5	−0·3	−0·3	−0·2	−0·3	−0·1	+0·6	+0·8	+0·2	+0·7
3	**+5·6**	+1·6	−0·5	−0·3	−0·3	−0·2	−0·3	−0·1	+0·5	+0·6	0·0	+0·7
4	+5·0	+1·5	−0·4	−0·3	−0·3	−0·2	**−0·4**	−0·2	+0·5	+0·5	0·0	**+0·7**
5	+4·2	+1·4	−0·5	−0·3	−0·2	−0·2	−0·4	−0·2	+0·7	+0·3	−0·1	+0·7
6	+2·4	+1·2	−0·4	−0·3	−0·1	−0·1	−0·3	−0·1	**+0·8**	+0·1	−0·2	+0·5
7	+0·7	+0·9	−0·2	−0·1	+0·2	+0·1	0·0	0·0	+0·5	−0·2	−0·3	+0·4
8	−0·1	+0·8	+0·1	+0·3	+0·6	+0·4	+0·4	+0·3	−0·2	−0·8	−0·4	+0·3
9	−0·7	+0·8	+0·6	+0·6	+1·0	+0·8	+0·7	+0·5	−1·2	−1·7	−0·4	+0·1
10	−1·2	+0·9	+1·0	+1·0	**+1·1**	**+1·0**	**+0·9**	+0·3	−1·9	−2·7	−0·5	−0·2
11	−2·2	+0·8	**+1·2**	**+1·2**	+1·0	+0·9	+0·7	0·0	**−2·1**	**−3·3**	−0·6	−0·4
Noon	−3·4	+0·4	+1·1	+1·1	+0·6	+0·6	+0·4	−0·5	−1·6	−3·1	−0·7	−0·7
1	−4·5	−0·2	+0·7	+0·7	+0·3	+0·2	+0·2	**−0·6**	−0·8	−2·4	**−0·8**	−0·9
2	−5·6	−1·2	+0·4	+0·4	+0·1	+0·1	+0·2	−0·5	−0·2	−1·3	−0·6	**−1·0**
3	**−6·3**	−2·2	+0·2	+0·1	0·0	0·0	+0·2	−0·3	+0·3	−0·2	−0·3	−1·0
4	−6·1	−2·9	0·0	−0·1	−0·1	−0·1	+0·2	+0·1	+0·3	+0·7	+0·1	−0·9
5	−5·1	**−3·2**	−0·1	−0·3	−0·2	−0·2	+0·1	+0·4	+0·2	+1·3	+0·4	−0·7
6	−3·1	−2·9	−0·2	−0·3	−0·3	−0·3	0·0	**+0·5**	+0·2	+1·5	+0·5	−0·5
7	−1·7	−2·2	−0·3	−0·4	−0·4	**−0·4**	−0·2	+0·4	+0·3	+1·6	+0·5	−0·2
8	+0·3	−1·3	−0·3	−0·5	**−0·4**	−0·4	−0·3	+0·2	+0·4	**+1·6**	+0·6	0·0
9	+2·0	−0·3	−0·4	−0·6	−0·4	−0·4	−0·3	+0·1	+0·5	+1·6	**+0·6**	+0·2
10	+2·5	+0·5	−0·5	**−0·6**	−0·4	−0·3	−0·3	0·0	+0·6	+1·5	+0·6	+0·4
11	+3·0	+1·0	−0·5	−0·6	−0·4	−0·3	−0·3	0·0	+0·6	+1·4	+0·5	+0·5
12	+4·0	+1·3	−0·5	−0·4	−0·4	−0·3	−0·3	−0·1	+0·6	+1·2	+0·4	+0·6
Range	11·9	4·8	1·7	1·8	1·5	1·4	1·3	1·1	2·9	4·9	1·4	1·7

1 or 2 p.m. At the extreme southern station, Hobart—at nearly equal latitude—the rapid diurnal movement is to the east, and so in the opposite direction to that in the northern hemisphere, but it again takes place at nearly the same hours in June (midwinter) as in December. If, however, we take a tropical station such as Trivandrum or Kolaba, the phenomena in June and December are widely different in type. At Trivandrum—situated near the magnetic equator in India—we have in June the conspicuous forenoon swing to the west seen at Toronto, occurring it is true slightly earlier in the day; but in December at the corresponding hours the needle is actually swinging to the east, just as it is doing at Hobart. In June the diurnal inequality of declination at tropical stations—whether to the north of the equator like Trivandrum, or to the south of it like Batavia—is on the whole of the general type characteristic of temperate regions in the northern hemisphere; whereas in December the inequality at these stations resembles that of temperate regions in the southern hemisphere. Comparing the inequalities for June in Table XII. amongst themselves, and those for December amongst themselves, one can trace a gradual transformation from the phenomena seen at Toronto to those seen at Hobart. At a tropical station the change from the June to the December type is probably in all cases more or less gradual, but at some stations the transition seems pretty rapid.

§ 15. In the case of the horizontal force there are, as Table IX. shows, two markedly different types of diurnal inequality. In the one type, exemplified by Pavlovsk or Greenwich, the force is below its mean value in the middle of the day; it has a principal minimum about 10 or 11 a.m., and morning and evening maxima, the latter usually the largest. In the other type, exemplified by Kolaba or Batavia, the horizontal force is above its mean in the middle of the

TABLE XII.—Diurnal Inequality of Declination (+ to West).

Station.	Toronto.		Kolaba.		Trivandrum.		Batavia.		St Helena.		Mauritius.		Cape.		Hobart.	
Month.	June.	Dec.	June.	Dec.	June.	Dec.	June.	Dec.	June.	Dec.	June.	Dec.	June.	Dec.	June.	Dec.
Hour	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
1	−0·4	−0·1	−0·3	0·0	−0·3	−0·1	+0·1	+0·1	−0·1	−0·4	0·0	+0·1	−0·4	−0·7	+0·8	+1·1
2	−0·2	+0·4	−0·3	+0·1	−0·4	+0·1	−0·1	+0·1	−0·2	−0·1	−0·2	+0·2	−0·5	−0·4	+0·3	+1·1
3	−0·2	−0·1	−0·3	+0·1	−0·4	+0·3	−0·2	+0·2	−0·2	+0·1	−0·2	+0·4	−0·7	−0·1	−0·1	+1·0
4	−1·2	−0·4	−0·3	+0·3	−0·5	+0·5	−0·3	+0·3	−0·3	+0·3	−0·2	+0·7	−0·6	+0·3	−0·1	+1·1
5	−2·9	−0·6	−0·7	+0·4	−0·7	+0·7	−0·3	+0·5	−0·5	+0·6	−0·3	+1·0	−0·7	+1·0	0·0	+1·7
6	−5·2	−0·6	−1·6	+0·5	−1·6	+1·1	−0·5	+1·2	−1·0	+0·9	−0·4	+1·7	−1·0	+2·2	0·0	+2·7
7	**−6·2**	−0·9	**−2·2**	**+0·7**	**−1·7**	**+1·4**	**−1·1**	+2·0	**−2·2**	+1·9	−1·1	**+2·6**	**−1·6**	+3·3	−0·1	+4·4
8	−6·0	−1·2	−2·1	+0·2	−1·1	+0·9	−0·4	**+2·3**	−1·5	**+2·2**	−1·0	+2·4	−0·8	**+3·6**	+0·1	**+5·6**
9	−4·4	**−1·8**	−1·1	−0·1	−0·2	+0·5	+0·5	+2·0	−0·3	+1·3	+0·2	+2·0	+0·7	+3·1	+0·6	+5·6
10	−1·5	−1·1	0·0	−0·2	+0·6	+0·3	+0·9	+1·3	+0·3	+0·2	+1·2	+1·1	**+1·6**	+1·6	+1·2	+3·6
11	+2·1	+0·6	+1·2	0·0	+1·2	+0·1	**+1·0**	+0·4	+0·5	−1·0	**+1·4**	0·0	+1·5	+0·1	+1·0	+0·7
Noon	+4·8	+2·2	**+2·1**	0·0	**+1·4**	−0·4	+0·7	−0·6	+0·3	**−1·4**	+1·0	−1·4	+0·8	−1·0	−0·1	−2·6
1	+6·1	+3·2	+2·0	−0·2	+1·1	−0·8	+0·3	−1·4	+0·3	−1·2	+0·1	−2·2	+0·3	−1·8	−1·4	−5·1
2	**+6·1**	**+3·2**	+1·6	−0·3	+0·7	**−0·9**	−0·2	−1·8	+0·2	−0·4	−0·9	**−2·5**	−0·3	**−1·9**	−2·2	**−6·2**
3	+5·2	+2·4	+0·9	−0·3	+0·3	−0·9	−0·7	**−1·9**	+0·2	+0·4	**−1·5**	−2·2	−0·3	−1·4	**−2·4**	−5·8
4	+3·6	+1·5	+0·2	**−0·3**	+0·1	−0·8	−0·8	−1·6	+0·7	+0·6	−1·3	−1·6	+0·2	−0·8	−1·6	−4·8
5	+1·8	+0·5	0·0	−0·2	0·0	−0·4	−0·5	−1·2	**+1·1**	+0·4	−0·3	−1·0	+0·5	−0·8	−0·7	−3·3
6	+0·7	−0·1	+0·1	−0·2	+0·2	−0·4	−0·1	−0·7	+1·0	+0·1	+0·5	−0·5	+0·5	−0·6	−0·4	−1·9
7	0·0	−0·8	+0·3	−0·2	+0·5	−0·4	+0·1	−0·6	+0·6	−0·4	+0·7	−0·3	+0·4	−0·8	0·0	−1·0
8	0·0	−1·2	+0·4	−0·1	+0·5	−0·3	+0·2	−0·5	+0·5	−0·7	+0·7	−0·3	+0·3	−0·9	+0·5	−0·3
9	−0·5	−1·4	+0·3	−0·1	+0·4	−0·2	+0·4	−0·3	+0·4	−0·9	+0·6	−0·2	+0·2	−0·9	+1·1	0·0
10	−0·5	−1·7	+0·1	0·0	+0·2	−0·1	+0·4	−0·1	+0·2	−1·0	+0·4	−0·1	+0·1	−1·0	+1·3	+0·6
11	−0·7	−1·1	−0·1	−0·1	0·0	−0·1	+0·3	0·0	+0·1	−0·8	+0·3	0·0	0·0	−1·0	**+1·3**	+0·9
12	−0·6	−0·7	−0·2	−0·1	−0·2	−0·1	+0·2	+0·1	−0·1	−0·6	+0·1	+0·1	−0·2	−1·0	+1·1	+1·2
Range	12·3	5·0	4·3	1·0	3·1	2·3	2·1	4·2	3·3	3·6	2·9	5·1	3·2	5·5	3·7	11·8

day, and has a maximum about 11 a.m. The second type may be regarded as the tropical type. At tropical stations, such as Kolaba, Batavia, Manila and St Helena, the type is practically the same in summer as in winter, and is the same whether the station is north or south of the equator. Similarly, what we may call the temperate type is seen—with comparatively slight modifications—both in summer and winter at stations such as Greenwich or Pavlovsk. In winter, it is true, the pronounced daily minimum is a little later and the early morning maximum is relatively more important than in summer. There is not, as in the case of the declination, any essential difference between the phenomena at temperate stations in the northern and southern hemispheres.

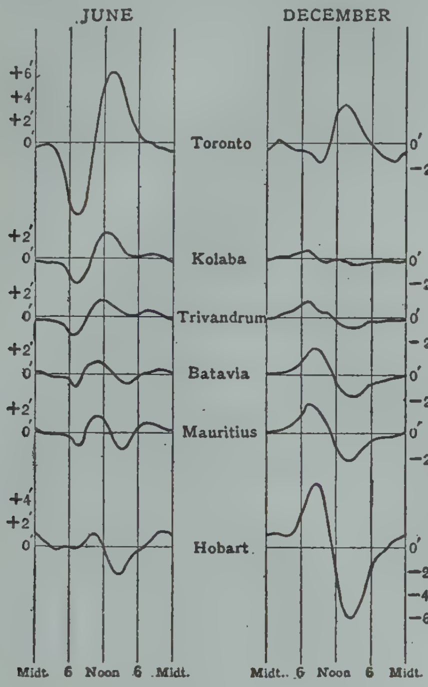


FIG. 6.

With diminishing latitude, there is a gradual transition from the temperate to the tropical type of horizontal force diurnal variation, and at stations whose latitude is under 45° there is a very appreciable variation in type with the season. The mean diurnal variation for the year at Tiflis in Table IX. really represents a struggle between the two types, in which on the whole the temperate type prevails. If we take the diurnal variations at Tiflis for midsummer and midwinter, we find the former essentially of the temperate, the latter essentially of the tropical type. A similar conflict may be seen in the mean diurnal inequality for the year at the Cape of Good Hope, but there the tropical type on the whole predominates, and it prevails more at midwinter than at midsummer. Toronto and Hobart, though similar in latitude to Tiflis, show a closer approach to the temperate type. Still at both stations the hours during which the force is below its mean value tend to extend back towards midnight, especially at midsummer. The amplitude of the horizontal force range appears less at intermediate stations, such as Tiflis, than at stations in either higher or lower latitudes. There is a very great difference in this respect between the north and the south of India.

§ 16. In the case of the vertical force in higher temperate latitudes —at Pavlovsk for instance—the diurnal inequalities from "all" and from "quiet" days differ somewhat widely in amplitude and slightly even in type. In mean latitudes, *e.g.* at Tiflis, there is often a well marked double period in the mean diurnal inequality for the whole year; but even at Tiflis this is hardly, if at all, apparent in the winter months. In the summer months the double period is distinctly seen at Kew and Greenwich, though the evening maximum is always pre-eminent. Speaking generally, the time of the minimum, or principal minimum, varies much less with the season than that of the maximum. At Kew, for instance, on quiet days the minimum falls between 11 a.m. and noon in almost all the months of the year, but the time of the maximum varies from about 4 p.m. in December to 7 p.m. in June. At Kolaba the time of the minimum is nearly independent of the season; but the changes from positive to negative in the forenoon and from negative to positive in the afternoon are some hours later in winter than in summer. At Batavia the diurnal inequality varies very little in type with the season, and there is little evidence of more than one maximum and minimum in the day. At Batavia, as at Kolaba, negative values occur near noon; but it must be remembered that while at Kolaba and more northern stations vertical force urges the north pole of a magnet downwards, the reverse is true of Batavia, as the dip is southerly. At St Helena vertical force is below its mean value in the forenoon, but the change from − to + occurs at noon, or but little later, both in winter and summer. At the Cape of Good Hope the phenomena at midsummer are similar to those at Kolaba, the force being below its mean value from about 9 a.m. to 3 p.m. and above it throughout the rest of the day; but at midwinter there is a conspicuous double period, the force being below its mean from 1 a.m. to 7 a.m. as well as from 11 a.m. to 3 p.m., and thus resembling the all-day annual results at Greenwich. At Hobart vertical force is below its mean value from 1 a.m. to 9 a.m. at midsummer, and from 4 a.m. to noon at midwinter; while the force is above its mean persistently throughout the afternoon both in summer and winter, there is at midwinter a well marked secondary minimum about 6 p.m., almost the same hour as that at which the maximum for the day is observed in summer.

§ 17. Variations of inclination are connected with those of horizontal and vertical force by the relation

$$\delta I = \tfrac{1}{2} \sin 2I\{V^{-1}\,\delta V - H^{-1}\,\delta H\}.$$

Thus in temperate latitudes where V is considerably in excess of H, whilst diurnal changes in V are usually less than those in H, it is the latter which chiefly dominate the diurnal changes in inclination. When the H influence prevails, I has its highest values at hours when H is least. This explains why the dip is above its mean value near midday at stations in Table XI. from Pavlovsk to Parc St Maur. Near the magnetic equator the vertical force has the greater influence. This alone would tend to make a minimum dip in the late forenoon, and this minimum is accentuated owing to the altered type of the horizontal force diurnal variation, whose maximum now coincides closely with the minimum in the vertical force. This accounts for the prominence of the minimum in the diurnal variation of the inclination at Kolaba and Batavia, and the large amplitude of the range. Tiflis shows an intermediate type of diurnal variation; there is a minimum near noon, as in tropical stations, but inclination is also below its mean for some hours near midnight. The type really varies at Tiflis according to the season of the year. In June—as in the mean equality from the whole year—there is a well marked double period; there is a principal minimum at 2 p.m. and a secondary one about 4 a.m.; a principal maximum about 9 a.m. and a secondary one about 6 p.m. In December, however, only a single period is recognizable, with a minimum about 8 a.m. and a maximum about 7 p.m. The type of diurnal inequality seen

TABLE XIII.—Range of the Diurnal Inequality of Declination.

Place.	Period.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
		′	′	′	′	′	′	′	′	′	′	′	′
Pavlovsk . . .	1890–1900 a	4·93	6·15	8·58	10·93	12·18	12·27	11·82	11·38	8·70	6·87	5·54	4·63
,, . .	,, q	2·96	4·20	8·73	11·28	12·89	13·28	12·31	11·70	9·37	6·91	3·95	2·66
Ekatarinburg .	1890–1900 a	3·33	4·32	7·63	11·19	11·82	11·58	11·09	10·45	8·13	5·60	3·73	3·14
Greenwich . .	1865–1896 a	5·87	7·07	9·40	11·42	10·55	10·90	10·82	10·93	9·66	8·15	6·41	5·15
Kew	1890–1900 a	4·92	6·06	9·08	10·95	10·66	10·92	10·59	11·01	9·49	7·73	5·37	4·46
,, ...	,, q	4·07	4·76	8·82	10·57	10·92	10·62	10·18	11·01	9·76	7·51	4·75	3·34
Toronto . . .	1842–1848 a	5·96	6·05	9·18	9·94	11·55	12·34	12·21	13·14	10·76	6·96	6·32	4·97
Manila . . .	1890–1900 a	1·79	1·09	2·13	3·02	3·84	3·94	4·21	4·89	4·53	1·83	0·85	1·33
Trivandrum . .	1853–1864 a	2·06	1·48	0·79	1·67	2·90	3·06	3·06	3·64	3·31	1·27	2·14	2·33
Batavia . . .	1884–1899 a	4·18	4·64	3·57	2·93	2·38	2·03	2·31	3·16	3·80	4·51	4·50	4·19
St Helena . .	1842–1847 a	3·72	5·19	4·93	3·30	2·64	3·24	3·42	3·59	2·40	4·43	4·05	3·54
Mauritius . .	1876–1890 a	5·2	6·1	6·3	4·7	4·1	2·9	3·4	4·9	5·0	5·5	5·6	5·1
Cape	1841–1846 a	5·14	8·21	7·27	5·00	3·91	3·21	3·54	4·98	4·33	5·96	6·36	5·47
Hobart . . .	1841–1848 a	11·66	11·80	9·50	7·26	4·56	3·70	4·61	5·89	8·24	11·01	12·05	11·81

at the Cape of Good Hope does not differ much from that seen at Batavia. Only a single period is clearly shown. The maximum occurs about 8 or 9 p.m. throughout the year. The time of the minimum is more variable; at midsummer it occurs about 11 a.m., but at midwinter three or four hours later. At Hobart the type varies considerably with the season. In June (midwinter) a double period is visible. The principal minimum occurs about 8 a.m., as at the Cape. But, corresponding to the evening maximum seen at the Cape, there is now only a secondary maximum, the principal maximum occurring about 1 p.m. At midsummer the principal maximum is found—as at Kew or Greenwich—about 10 or 11 a.m., the principal minimum about 4 p.m.

§ 18. Even at tropical stations a considerable seasonal change is usually seen in the amplitude of the diurnal inequality in at least one of the magnetic elements. At stations in Europe, and generally in temperate latitudes, the amplitude varies notably in all the elements. Table XIII. gives particulars of the inequality range of declination derived from hourly readings at selected stations, arranged in order of latitude from north to south. The letters "a" and "q" are used in the same sense as before. At temperate stations in either hemisphere—*e.g.* Pavlovsk, Greenwich or Hobart—the range is conspicuously larger in summer than in winter. In northern temperate stations a decided minimum is usually apparent in December. There is, on the other hand, comparatively little variation in the range from April to August. Sometimes, as at Kew and Greenwich, there is at least a suggestion of a secondary minimum at midsummer. Manila and Trivandrum show a transition from the December minimum, characteristic of the northern stations, to the June minimum characteristic of the southern, there being two conspicuous minima in February or March and in November or October. At St Helena there are two similar minima in May and September, while a third apparently exists in December. It will be noticed that at both Pavlovsk and Kew the annual variation in the range is specially prominent in the quiet day results.

Table XIV. gives a smaller number of data analogous to those of Table XIII., comprising inequality ranges for horizontal force, vertical force and inclination. In some cases the number of years from which the data were derived seems hardly sufficient to give a smooth annual variation. It should also be noticed that unless the same group of years is employed the data from two stations are not strictly comparable. The difference between the all and quiet day vertical force data at Pavlovsk is remarkably pronounced. The general tendency in all the elements is to show a reduced range at midwinter; but in some cases there is also a distinct reduction in the range at midsummer. This double annual period is particularly well marked at Batavia.

§ 19. When discussing diurnal inequalities it is sometimes convenient to consider the components of the horizontal force in and perpendicular to the astronomical meridian, rather than the horizontal force and declination. If N and W be the components of H to astronomical north and west, and D the westerly declination, $N = H\cos D$, $W = H\sin D$. Thus corresponding small variations in N, W, H and D are connected by the relations:—

$$\delta N = \cos D\delta H - H\sin D\delta D,\quad \delta W = \sin D\delta H + H\cos D\delta D.$$

If δH and δD denote the departures of H and D at any hour of the day from their mean values, then δN and δW represent the corresponding departures of N and W from their mean values. In this way diurnal inequalities may be calculated for N and W when those for H and D are known. The formulae suppose δD to be expressed in absolute measure, *i.e.* 1′ of arc has to be replaced by 0·0002909. If we take as an example a station at which H is ·185 then $H\delta D = {\cdot}0000538$(number of minutes in δD). In other words, employing 1γ as unit of force, one replaces $H\delta D$ by $5{\cdot}38\delta D$, where δD represents declination change expressed as usual in minutes of arc. In calculating diurnal inequalities for N and W, one ought, strictly speaking, to assign to H and D the exact mean values belonging to these elements for the month or the year being dealt with. For practical purposes, however, a slight departure from the true mean values is immaterial, and one can make use of a constant value for several successive years without sensible error. As an example, Table XV. gives the mean diurnal inequality for the whole year in N and W at Falmouth, as calculated from the 12 years 1891 to 1902. The unit employed is 1γ.

The data in Table XV. are closely similar to corresponding Kew data, and are presumably fairly applicable to the whole south of England for the epoch considered. At Falmouth there is comparatively little seasonal variation in the type of the diurnal variation in either N or W. The amplitude of the diurnal range varies, however, largely with the season, as will appear from Table XVI., which is based on the same 12 years as Table XV.

Diurnal inequalities in N and W lend themselves readily to the construction of what are known as *vector diagrams.* These are curves showing the direction and intensity at each hour of the day of the horizontal component of the disturbing force to which the diurnal inequality may be regarded as due. Figs. 7 and 8, taken from the *Phil. Trans.* vol. 204A, will serve as examples. They refer to the mean diurnal inequalities for the months stated at Kew (1890 to 1900) and Falmouth (1891 to 1902), thick lines relating to Kew, thin to Falmouth. NS and EW represent the geographical north-south and east-west directions; their intersection answers to the origin (thick lines for Kew, thin for Falmouth). The line from the origin to M represents the magnetic meridian. The line from the origin to any cross—the number indicating the corresponding hour counted from midnight as 0—represents the magnitude and direction at that hour of the horizontal component of the disturbing force to which the diurnal inequality may be assigned. The cross marks the point whose rectangular co-ordinates are the values of δN and δW derived from the diurnal inequalities of these elements. In figs. 7 and 8 the distances of the points N, E, S, W from their corresponding origin represents 10γ. The tendency to form a loop near midnight, seen in the November and December

TABLE XIV.—Ranges in the Diurnal Inequalities.

			Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
H (unit 1γ)														
Pavlovsk	1890–1900	a	12	20	32	46	47	49	49	44	39	32	17	11
,,	,,	q	12	17	31	42	45	45	42	40	37	31	17	10
Ekatarinburg	,,	a	11	15	29	37	40	40	39	36	33	27	13	9
Kew	,,	q	15	17	26	36	38	39	38	38	35	27	20	11
Toronto	1843–1848	a	23	21	24	28	29	29	26	28	41	25	21	20
Batavia	1883–1898	a	49	47	54	60	51	48	50	53	58	52	43	40
St Helena	1843–1847	a	43	41	48	53	46	40	40	45	41	40	40	32
Mauritius	1883–1890	a	21	15	21	23	20	21	20	22	20	21	21	20
Cape of Good Hope	1841–1846	a	13	10	13	13	15	16	14	18	21	14	17	20
Hobart	1842–1848	a	42	43	34	28	19	17	22	23	23	35	39	42
V (unit 1γ)														
Pavlovsk	1890–1900	a	15	27	29	24	26	20	23	19	23	20	18	14
,,	,,	q	4	5	9	13	13	12	13	10	9	7	5	4
Ekatarinburg	,,	a	10	15	17	21	22	19	20	16	14	13	11	9
Kew	1891–1900	q	7	10	20	25	31	27	28	23	20	15	9	6
Toronto	1843–1848	a	12	14	17	23	26	14	27	32	34	25	19	18
Batavia	1883–1898	a	42	48	48	45	31	31	32	29	41	50	40	33
St Helena	1843–1847	a	16	13	12	14	13	11	17	11	17	11	15	18
Mauritius	1884–1890	a	12	16	18	15	14	13	15	21	20	16	13	11
Cape of Good Hope	1841–1846	a	29	47	41	38	21	12	14	19	19	35	33	28
Hobart	1842–1848	a	25	27	22	23	24	21	22	28	26	22	23	27
Inclination			′	′	′	′	′	′	′	′	′	′	′	′
Pavlovsk	1890–1900	a	0·97	1·24	2·07	2·79	2·72	2·88	2·85	2·64	2·52	2·18	1·20	0·89
Ekatarinburg	,,	a	0·79	0·94	1·70	2·08	2·25	2·19	2·18	2·08	2·00	1·70	0·88	0·69
Kew	,,	q	0·98	1·01	1·38	1·86	2·05	2·02	2·05	2·15	1·98	1·57	1·27	0·63
Toronto	1843–1848	a	1·15	0·94	1·19	1·23	1·31	1·37	1·13	1·26	1·87	1·16	1·09	1·05
Batavia	1883–1898	a	4·88	5·22	5·56	5·62	4·21	4·05	4·24	4·17	5·13	5·58	4·51	3·85
Cape of Good Hope	1842–1846	a	1·55	2·29	2·23	2·23	1·60	1·41	1·54	1·70	1·86	2·03	1·55	2·04
Hobart	1842–1848	a	1·95	2·16	1·72	1·62	1·23	1·16	1·28	1·42	1·39	1·75	2·04	2·10

Table XV.—Diurnal Inequalities in N. and W. at Falmouth (unit 1γ).

Hour.		1	2	3	4	5	6	7	8	9	10	11	12
N.	a.m.	+ 6	+ 5	+ 5	+ 5	+ 6	+ 6	+ 5	+ 1	− 6	−14	−20	−20
	p.m.	−17	−12	− 6	− 1	+ 3	+ 6	+ 9	+ 9	+ 9	+ 8	+ 7	+ 7
W.	a.m.	− 2	− 2	− 3	− 4	− 6	− 9	−13	−17	−19	−13	− 3	+11
	p.m.	+20	+22	+17	+11	+ 6	+ 4	+ 2	+ 1	0	− 1	− 2	− 2

curves, is characteristic of the winter months at Kew and Falmouth. The shape is less variable in summer than in winter; but even in summer the portion answering to the hours 6 p.m. to 6 a.m. varies a good deal. The object of presenting the Kew and Falmouth curves side by side is to emphasize the close resemblance between the magnetic phenomena at places in similar latitudes, though over 200 miles apart and exhibiting widely different ranges for their meteorological elements. With considerable change of latitude however the shape of vector diagrams changes largely.

Fourier Series.

§ 20. Any diurnal inequality can be analysed into a series of harmonic terms whose periods are 24 hours and submultiples thereof. The series may be expressed in either of the equivalent forms:—

$$a_1 \cos t + b_1 \sin t + a_2 \cos 2t + b_2 \sin 2t + \ldots \qquad \text{(i)}$$

$$c_1 \sin (t + \alpha_1) + c_2 \sin (2t + \alpha_2) + \ldots \qquad \text{(ii)}$$

Table XVI.—Ranges in Diurnal Inequalities at Falmouth (unit 1γ).

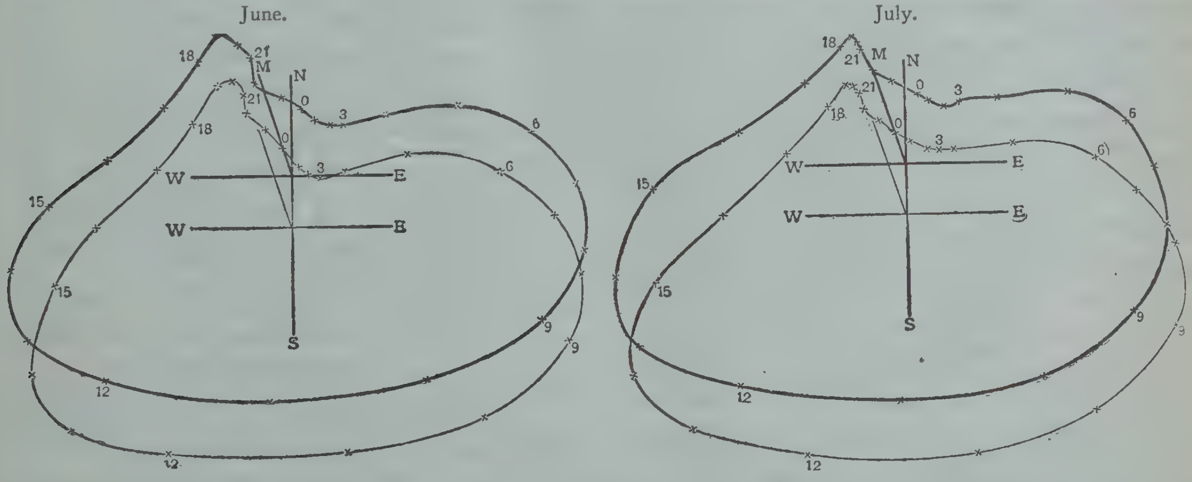
	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
N.	21	23	30	39	39	37	37	39	36	32	24	15
W.	20	24	46	54	55	55	54	56	51	39	24	15

In both forms t denotes time, counted usually from midnight, one hour of time being interpreted as 15° of angle. Form (i) is that utilized in actually calculating the constants $a, b, \ldots$ Once the $a, b, \ldots$ constants are known, the $c, \alpha, \ldots$ constants are at once derivable from the formulae:—

$$\tan \alpha_n = a_n/b_n; \; c_n = a_n/\sin \alpha_n = b_n/\cos \alpha_n = \sqrt{(a_n^2 + b_n^2)}.$$

The a, b, c, α constants are called sometimes Fourier, sometimes Bessel coefficients.

By taking a sufficient number of terms a series can always be obtained which will represent any set of diurnal inequality figures; but unless one can obtain a close approach to the observational figures from the terms possessing the periods 24, 12, 8 and 6 hours the physical significance and general utility of the analysis is somewhat problematical. In the case of the magnetic elements, the 24 and 12 hour terms are usually much the more important; the 24-hour term is generally, but by no means always, the larger of the two. The c constants give the amplitudes of the harmonic terms or waves, the α constants the phase angles. An advance of 1 hour in the time of occurrence of the first (and subsequent, if any) maximum and minimum answers to an *increase* of 15° in α_1 of 30° in α_2, of 45° in α_3, of 60° in α_4 and so on. In the case of magnetic elements the phase angles not infrequently possess a somewhat large annual variation. It is thus essential for a minute study of the phenomena at any station to carry out the analysis for the different seasons of the year, and preferably for the individual months. If the a and b constants are known for all the individual months of one year, or for all the Januarys of a series of years, we have only to take their arithmetic means to obtain the corresponding constants for the mean diurnal inequality of the year, or for the diurnal inequality of the average January of the series of years. This, however, is obviously not true of the c or α constants, unless the phase angle is absolutely unchanged throughout the contributory months or years. This is a point requiring careful attention, because when giving values of c and α for the whole year some authorities give the arithmetic mean of the c's and α's calculated from the diurnal inequalities of the individual months of the year, others give the values obtained for c and α from the mean diurnal inequality of the whole year. The former method inevitably supplies a larger value for c than the latter, supposing α to vary with the season. At some observatories, *e.g.* Greenwich and Batavia, it has long been customary to publish every year values of the Fourier coefficients for each month, and to include other elements besides the declination. For a thoroughly satisfactory comparison of different stations, it is necessary to have data from one and the same epoch; and preferably that epoch should include at least one 11-year period. There are, however, few stations which can supply the data required for such a comparison and we have to make the best of what is available. Information is naturally most copious for the declination. For this element E. Engelenburg[20] gives values of c_1, c_2, c_3, c_4, and of α_1, α_2, α_3, α_4 for each month of the year for about 50 stations, ranging from Fort Rae (62° 6′ N. lat.) to Cape Horn (55° 5′ S. lat.). From the results for individual stations, Engelenburg derives a series of means which he regards as representative of 11 different zones of latitude. His data for individual stations refer to different epochs, and some are based on only one year's observations. The original observations also differ in reliability; thus the results are of somewhat unequal value. The mean results for Engelenburg's zones must naturally have some of the sources of uncertainty reduced; but then the fundamental idea represented by the arrangement in zones is open to question. The majority of the data in Table XVII. are taken from Engelenburg, but the phase angles have been altered so as to apply to westerly declination. The stations are arranged in order of latitude from north to south; in a few instances results are given for quiet days. The figures represent in all cases arithmetic means derived from the 12 monthly values. In the table, so far as is known, the local mean time of the observatory has been employed. This is a point requiring attention, because most observatories employ Greenwich time, or time based on Greenwich or some other national observatory, and any departure from local time enters into the values of the constants. The data for Victoria Land refer to the "Discovery's" 1902–1903 winter quarters, where the declination, taken westerly, was about 207°·5.



(From *Phil. Trans.*)

FIG. 7.

As an example of the significance of the phase angles in Table XVII., take the ordinary day data for Kew. The times of occurrence of the maxima are given by $t + 234° = 450°$ for the 24-hour term, $2t + 39°·7 = 90°$ or $= 450°$ for the 12-hour term, and so on, taking an hour in t as equivalent to 15°.

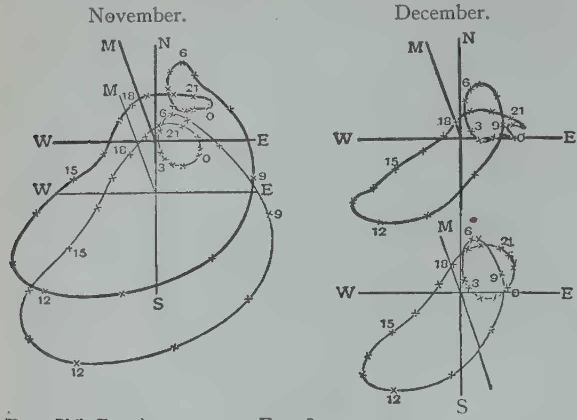
Thus the times of the maxima are:—

24-hour term, 2 h. 24 m. p.m.; 12-hour term, 1 h. 41 m. a.m. and p.m.

8-hour term, 4 h. 41 m. a.m., 0 h. 41 m. p.m., and 8 h. 41 m. p.m.

6-hour term, 0 h. 33 m. a.m. and p.m., and 6 h. 33 m. a.m. and p.m.

The minima, or extreme easterly positions in the waves, lie midway between successive maxima. All four terms, it will be seen, have maxima at some hour between 0h. 30m. and 2h. 30m. p.m. They thus reinforce one another strongly from 1 to 2 p.m., accounting for the prominence of the maximum in the early afternoon.



(From *Phil. Trans.*) FIG. 8.

The utility of a Fourier analysis depends largely on whether the several terms have a definite physical significance. If the 24-hour and 12-hour terms, for instance, represent the action of forces whose distribution over the earth or whose seasonal variation is essentially different, then the analysis helps to distinguish these forces, and may assist in their being tracked to their ultimate source. Suppose, for example, one had reason to think the magnetic diurnal variation due to some meteorological phenomenon, *e.g.* heating of the earth's atmosphere, then a comparison of Fourier coefficients, if such existed, for the two sets of phenomena would be a powerful method of investigation.

TABLE XVII.—Amplitudes and Phase Angles for Diurnal Inequality of Declination.

Place.	Epoch.	c_1.	c_2.	c_3.	c_4.	a_1.	a_2.	a_3.	a_4.
		′	′	′	′	°	°	°	°
Fort Rae (all) . .	1882–1883	18·49	8·22	1·99	2·07	156·5	41·9	308	104
,, (quiet) .	,,	9·09	4·51	1·32	0·73	166·5	37·5	225	350
Ekatarinburg .	1841–1862	2·57	1·81	0·73	0·22	223·3	7·4	204	351
Potsdam . . .	1890–1899	2·81	1·90	0·83	0·31	239·9	32·6	237	49
Kew (ordinary) . .	1890–1900	2·91	1·79	0·79	0·27	234·0	39·7	239	57
Kew (quiet) . .	,,	2·37	1·82	0·90	0·30	227·3	42·1	240	55
Falmouth (quiet) .	1891–1902	2·18	1·82	0·91	0·29	226·2	40·5	238	56
Parc St Maur . .	1883–1899	2·70	1·87	0·85	0·30	238·6	32·5	235	95
Toronto . . .	1842–1848	2·65	2·34	1·00	0·33	213·7	34·9	238	350
Washington . .	1840–1842	2·38	1·86	0·65	0·33	223·0	26·6	223	53
Manila	1890–1900	0·53	0·58	0·43	0·17	266·3	50·7	226	89
Trivandrum . .	1853–1864	0·54	0·46	0·29	0·10	289·0	49·6		114
Batavia	1883–1899	0·80	0·88	0·43	0·13	332·0	163·2	5	236
St. Helena . . .	1842–1847	0·68	0·61	0·63	0·34	275·8	171·4	27	244
Mauritius . . .	1876–1890	0·86	1·11	0·76	0·22	21·6	172·7	350	161
C. of G. Hope . .	1841–1846	1·15	1·13	0·80	0·35	287·7	156·0	351	193
Melbourne . . .	1858–1863	2·52	2·45	1·23	0·35	27·4	176·7	9	193
Hobart	1841–1848	2·29	2·15	0·87	0·32	33·6	170·8	349	185
S. Georgia . . .	1882–1883	2·13	1·28	0·75	0·31	30·3	185·3	7	180
Victoria Land (all).	1902–1903	20·51	4·81	1·21	1·32	158·7	306·9	292	303
,, (quieter).	,,	15·34	4·05	1·24	1·18	163·8	312·9	261	

§ 21. Fourier coefficients of course often vary much with the season of the year. In the case of the declination this is especially true of the phase angles at tropical stations. To enter on details for a number of stations would unduly occupy space. A fair idea of the variability in the case of declination in temperate latitudes may be derived from Table XVIII., which gives monthly values for Kew derived from ordinary days of an 11-year period 1890–1900.

Fourier analysis has been applied to the diurnal inequalities of the other magnetic elements, but more sparingly. Such results are illustrated by Table XIX., which contains data derived from quiet days at Kew from 1890 to 1900. *Winter* includes November to February, *Summer* May to August, and *Equinox* the remaining four months. In this case the data are derived from mean diurnal inequalities for the season specified. In the case of the *c* or amplitude coefficients the unit is 1′ for I (inclination), and 1γ for H and V (horizontal and vertical force). At Kew the seasonal variation in the amplitude is fairly similar for all the elements. The 24-hour and 12-hour terms tend to be largest near midsummer, and least near midwinter; but the 8-hour and 6-hour terms have two well-marked maxima near the equinoxes, and a clearly marked minimum near midsummer, in addition to one near midwinter. On the other hand, the phase angle phenomena vary much for the different elements. The 24-hour term, for instance, has its maximum earlier in winter than in summer in the case of the declination and vertical force, but the exact reverse holds for the inclination and the horizontal force.

TABLE XVIII.—Kew Declination: Amplitudes and Phase Angles (local mean time).

Month.	c_1.	c_2.	c_3.	c_4.	a_1.	a_2.	a_3.	a_4.
′		′	′	′	°	°	°	°
January . .	1·79	0·86	0·41	0·27	251·2	29·8	254	64
February .	2·41	1·11	0·57	0·30	242·0	27·7	235	39
March . .	3·05	1·98	1·11	0·45	233·2	36·1	223	49
April . . .	3·35	2·48	1·17	0·39	224·8	39·2	228	61
May . . .	3·57	2·38	0·87	0·17	221·3	50·8	245	89
June . . .	3·83	2·39	0·74	0·05	212·6	46·7	239	72
July . . .	3·72	2·30	0·77	0·11	214·6	48·1	233	8
August . .	3·64	2·43	1·05	0·18	228·2	57·2	244	51
September .	3·35	2·02	1·04	0·35	236·9	55·3	245	70
October . .	2·69	1·69	0·92	0·48	240·1	35·6	235	65
November .	1·94	1·06	0·51	0·32	248·3	28·3	247	61
December .	1·61	0·81	0·35	0·20	255·1	22·0	243	56

Annual Inequality.

§ 22. If secular change proceeded uniformly throughout the year, the value E_n of any element at the middle of the nth month of the year would be connected with $\bar{E}$, the mean value for the whole year, by the formula $E_n=\bar{E}+(2n-13)s/24$, where s is the secular change per annum. For the present purpose, difference in the lengths of the months may be neglected. If one applies to $E_n-\bar{E}$ the correction $-(2n-13)s/24$ one eliminates a regularly progressive secular change; what remains is known as the *annual inequality*. If only a short period of years is dealt with, irregularities in the secular change from year to year, or errors of observation, may obviously simulate the effect of a real annual inequality. Even when a long series of years is included, there is always a possibility of a spurious inequality arising from annual variation in the instruments, or from annual change in the conditions of observation. J. Liznar,[21] from a study of data from a number of stations, arrived at certain mean results for the annual inequalities in declination and inclination in the northern and southern hemispheres, and J. Hann[22] has more recently dealt with Liznar's and newer results. Table XX. gives a variety of data, including the mean results given by Liznar and Hann. In the case of declination + denotes westerly position; in the case of inclination it denotes a larger dip (whether the inclination be north or south). According to Liznar declination in summer is to the west of the normal position in both hemispheres. The phenomena, however, at Parc St Maur are, it will be seen, the exact opposite of what Liznar regards as normal; and whilst the Potsdam results resemble his mean in type, the range of the inequality there, as at Parc St Maur, is relatively small. Of the three sets of data given for Kew the first two are derived in a similar way to those for other stations; the first set are based on quiet days only, the second on all but highly disturbed days. Both these sets of results are fairly similar in type to the Parc St Maur results, but give larger ranges; they are thus even more opposed to Liznar's normal type. The last set of data for Kew is of a special kind. During the 11 years 1890 to 1900 the Kew declination magnetograph showed to within 1′ the exact secular change as derived from the absolute observations; also, if any annual variation existed in the position of the base lines of the curves it was exceedingly small. Thus the accumulation of the daily non-cyclic changes shown by the curves should closely represent the combined

TABLE XIX.—Kew Diurnal Inequality: Amplitudes and Phase Angles (local mean time).

		c_1.	c_2.	c_3.	c_4.	a_1.	a_2.	a_3.	a_4.
						°	°	°	°
I	Winter .	0·240	0·222	0·104	0·076	250·0	91·8	344	194
	Equinox	0·601	0·290	0·213	0·127	290·3	135·5	4	207
	Summer	0·801	0·322	0·172	0·070	312·5	155·5	39	238
H	Winter .	3·62	3·86	1·81	1·13	82·9	277·3	154	6
	Equinox	10·97	5·87	3·32	1·84	109·6	303·5	167	16
	Summer	14·85	6·23	2·35	0·95	130·3	316·5	199	41
V	Winter .	2·46	1·67	0·86	0·42	153·9	300·8	108	280
	Equinox	6·15	4·70	2·51	0·94	117·2	272·3	99	289
	Summer	8·63	6·45	2·24	0·55	122·0	272·4	100	285

effects of secular change and annual inequality. Eliminating the secular change, we arrive at an annual inequality, based on all days of the year including the highly disturbed. It is this annual inequality which appears under the heading *s*. It is certainly very unlike the annual inequality derived in the usual way. Whether the difference is to be wholly assigned to the fact that highly disturbed days contribute in the one case, but not in the other, is a question for future research.

In the case of the inclination, Liznar found that in both hemispheres the dip (north in the northern, south in the southern hemisphere) was larger than the normal when the sun was in perihelion, corresponding to an enhanced value of the horizontal force in summer in the northern hemisphere.

TABLE XX.—Annual Inequality.

	Declination.								Inclination.			
	Liznar, N. Hemisphere.	Potsdam, 1891–1906.	Parc St Maur, 1888-1897.	Kew (1890–1900).			Batavia, 1883-1893.	Mauritius.	Liznar & Hann's mean.	Potsdam.	Parc St. Maur.	Kew.
				q.	*o.*	*s.*						
	′	′	′	′	′	′	′	′	′	′	′	′
January	−0·25	+0·04	+0·01	+0·08	+0·03	+0·32	+0·23	+0·06	+0·49	+0·32	+0·44	−0·03
February	−0·54	−0·11	0·00	+0·48	+0·25	−0·20	+0·19	+0·29	+0·39	+0·56	+0·29	−0·07
March	−0·27	+0·04	+0·17	+0·03	+0·05	−1·02	−0·12	+0·27	+0·20	+0·38	+0·13	+0·53
April	−0·03	+0·10	+0·12	−0·31	−0·14	−0·90	−0·11	+0·30	−0·08	−0·02	−0·13	+0·18
May	+0·19	+0·07	−0·11	−0·39	−0·28	+0·29	−0·30	+0·08	−0·43	−0·29	−0·37	−0·15
June	+0·46	+0·13	−0·14	−0·47	−0·39	+0·78	−0·13	−0·19	−0·70	−0·77	−0·59	−0·35
July	+0·48	+0·14	−0·17	−0·30	−0·13	+0·44	−0·08	−0·44	−0·72	−0·67	−0·27	−0·13
August	+0·47	+0·11	+0·01	+0·08	+0·05	+0·52	−0·18	−0·38	−0·47	−0·23	−0·05	−0·19
September	+0·31	+0·01	0·00	+0·29	+0·24	−0·02	+0·06	−0·06	−0·06	+0·16	+0·01	+0·20
October	−0·07	−0·11	+0·09	+0·06	+0·01	−0·26	+0·03	−0·04	+0·31	+0·27	+0·19	0·00
November	−0·30	−0·28	−0·05	+0·17	+0·11	−0·02	+0·08	−0·01	+0·51	+0·30	+0·43	+0·18
December	−0·36	−0·14	+0·05	+0·26	+0·23	+0·05	+0·35	+0·06	+0·55	+0·19	+0·24	−0·29
Range	1·02	0·42	0·34	0·95	0·64	1·80	0·65	0·74	1·27	1·33	1·03	0·88

In the case of annual inequalities, at least that of the declination, it is a somewhat suggestive fact that the range seems to become less as we pass from older to more recent results, or from shorter to longer periods of years. Thus for Paris from 1821 to 1830 Arago deduced a range of 2′ 9″. Quiet days at Kew from 1890 to 1894 gave a range of 1′·2, while at Potsdam Ludeling got a range 30% larger than that in Table XX. when considering the shorter period 1891–1899. Up to the present, few individual results, if any, can claim a very high degree of certainty. With improved instruments and methods it may be different in the future.

Annual Variation Fourier Coefficients.

§ 23. The inequalities in Table XX. may be analysed—as has in fact been done by Hann—in a series of Fourier terms, whose periods are the year and its submultiples. Fourier series can also be formed representing the annual variation in the amplitudes of the regular diurnal inequality, and its component 24-hour, 12-hour, &c. waves, or of the amplitude of the absolute daily range (§ 24). To secure the highest theoretical accuracy, it would be necessary in calculating the Fourier coefficients to allow for the fact that the "months" from which the observational data are derived are not of uniform length. The mid-times, however, of most months of the year are but slightly displaced from the position they would occupy if the 12 months were exactly equal, and these displacements are usually neglected. The loss of accuracy cannot be but trifling, and the simplification is considerable.

The Fourier series may be represented by

$$P_1 \sin(t+\theta_1)+P_2 \sin(2t+\theta_2)+\ldots,$$

where t is time counted from the beginning of the year, one month being taken as the equivalent of 30°, P_1, P_2 represent the amplitudes, and θ_1, θ_2 the phase angles of the first two terms, whose periods are respectively 12 and 6 months. Table XXI. gives the values of these coefficients in the case of the range of the regular diurnal inequality for certain specified elements and periods at Kew[23] and Falmouth.[23a] In the case of P_1 and P_2 the unit is 1′ for D and I, and 1γ for H and V. M denotes the mean value of the range for the 12 months. The letters *q* and *o* represent quiet and ordinary day results. S max. means the years 1892–1895, with a mean sun spot frequency of 75·0. S min. for Kew means the years 1890, 1899 and 1900 with a mean sun spot frequency of 9·6; for Falmouth it means the years 1899–1902 with a mean sun spot frequency of 7·25.

Increase in θ_1 or θ_2 means an earlier occurrence of the maximum or maxima, 1° answering roughly to one day in the case of the 12-month term, and to half a day in the case of the 6-month term. P_1/M and P_2/M both increase decidedly as we pass from years of many to years of few sun spots; i.e. *relatively* considered the range of the regular diurnal inequality is more variable throughout the year when sun spots are few than when they are many.

The tendency to an earlier occurrence of the maximum as we pass from quiet days to ordinary days, or from years of sun spot minimum to years of sun spot maximum, which appears in the table, appears also in the case of the horizontal force—at least in the case of the annual term—both at Kew and Falmouth. The phenomena at the two stations show a remarkably close parallelism. At both, and this is true also of the absolute ranges, the maximum of the annual term falls in all cases near midsummer, the minimum near midwinter. The maxima of the 6-month terms fall near the equinoxes.

Absolute Range.

§ 24. Allusion has already been made in § 14 to one point which requires fuller discussion. If we take a European station such as Kew, the general character of, say, the declination does not vary very much with the season, but still it does vary. The principal minimum of the day, for instance, occurs from one to two hours earlier in summer than in winter. Let us suppose for a moment that all the days of a month are exactly alike, the difference in type between successive months coming in *per saltum*. Suppose further that having formed twelve diurnal inequalities from the days of the individual months of the year, we deduce a mean diurnal inequality for the whole year by combining these twelve inequalities and taking the mean. The hours of maximum and minimum being different for the twelve constituents, it is obvious that the resulting maximum will normally be less than the arithmetic mean of the twelve maxima, and the resulting minimum (arithmetically) less than the arithmetic mean of the twelve minima. The range—or algebraic excess of the maximum over the minimum—in the mean diurnal inequality for the year is thus normally less than the arithmetic mean of the twelve ranges from diurnal inequalities for the individual months. Further, as we shall see later, there are differences in type not merely between the different months of the year, but even between the same months in different years. Thus the range of the mean diurnal inequality for, say, January based on the combined observations of, say, eleven Januarys may be and generally will be slightly less than the arithmetic mean of the ranges obtained from the Januarys separately. At Kew, for instance, taking the ordinary days of the 11 years 1890–1900, the arithmetic mean of the diurnal inequality ranges of declination from the 132 months treated independently was 8′·52, the mean range from the 12 months of the year (the eleven Januarys being combined into one, and so on) was 8′·44, but the mean range from the whole 4,000 odd days superposed was only 8′·03. Another consideration is this: a diurnal inequality is usually based on hourly readings, and the range deduced is thus an under-estimate unless the absolute maximum and minimum both happen to come exactly at an hour. These considerations would alone suffice to show that the *absolute range* in individual days, *i.e.* the difference between the algebraically largest and least values of the element found any time during the 24 hours, must on the average exceed the

TABLE XXI.—Annual Variation of Diurnal Inequality Range. Fourier Coefficients.

		P_1.	P_2.	θ_1.	θ_2.	P_1/M	P_2/M.
Kew 1890–1900	D_o	3·36	0·94	279°	280°	0·40	0·11
	D_q	3·81	1·22	275°	273°	0·47	0·15
	I_q	0·67	0·16	264°	269°	0·42	0·10
	H_q	13·6	3·0	269°	261°	0·48	0·11
	V_q	11·7	2·2	282°	242°	0·63	0·12
S max.	Kew	4·50	1·26	277°	282°	0·47	0·13
D_q	Falmouth	4·10	1·40	277°	286°	0·43	0·15
S min.	Kew	3·35	1·10	274°	269°	0·49	0·16
D_q	Falmouth	3·19	1·14	275°	277°	0·49	0·17

range in the mean diurnal inequality for the year, however this latter is formed. Other causes, moreover, are at work tending in the same direction. Even in central Europe, the magnetic curves for individual days of an ordinary month often differ widely amongst themselves, and show maxima and minima at different times of the day. In high latitudes, the variation from day to day is sometimes so great that mere eye inspection of magnetograph curves may leave one with but little idea as to the probable shape of the resultant diurnal curve for the month. Table XXII. gives the arithmetic mean of the absolute daily ranges from a few stations. The values which it assigns to the year are the arithmetic means of the 12 monthly values. The Mauritius data are for different periods, viz. declination 1875, 1880 and 1883 to 1890, horizontal force 1883 to 1890, vertical force 1884 to 1890. The other data are all for the period 1890 to 1900.

TABLE XXII.—Mean Absolute Daily Ranges (Units 1′ for Declination, 1γ for H and V).

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Declination.													
Pavlovsk	13·42	17·20	18·22	17·25	17·76	15·91	16·89	16·57	16·75	15·70	13 87	12·37	15·99
Ekatarinburg	7·33	9·54	11·90	12·89	13·63	13·03	12·78	12·21	11·23	9·44	7·86	6·85	10·72
Kew. All days	11·16	13·69	15·93	15·00	14·90	13·65	14·13	14·22	14·57	14·07	11·71	9·80	13·57
„ Ordinary days	10·14	11·87	14·19	14·24	13·85	13·26	13·47	13·67	13·71	13·10	10·40	9·00	12·58
„ Quiet „	6·12	7·57	10·59	11·84	12·09	11·95	11·60	11·93	10·86	9·16	6·54	5·08	9·61
Zi-ka-wei	3·88	3·25	6·22	7·04	7·15	7·40	7·77	8·06	6·73	4·68	2·91	2·52	5·63
Mauritius	6·93	7·79	7·11	5·75	4·87	4·03	4·36	6·00	6·28	6·71	6·99	6·78	6·13
Horizontal force.													
Pavlovsk	52·4	74·5	79·1	80·1	86·2	79·0	86·7	77·6	76·7	67·3	55·7	45·9	71·8
Ekatarinburg	33·2	43·1	48·4	51·7	56·2	54·1	56·7	51·7	49·3	44·1	34·1	29·3	46·0
Mauritius	37·9	35·0	36·2	37·6	35·0	34·1	33·8	34·5	36·6	37·4	37·8	35·3	35·9
Vertical force.													
Pavlovsk	27·0	50·4	54·7	43·2	45·3	34·8	42·1	35·5	42·5	37·5	33·5	25·5	39·3
Ekatarinburg	17·4	26·6	29·2	30·1	29·6	27·6	29·6	26·1	25·2	22·1	19·6	16·4	24·9
Mauritius	17·1	19·5	20·1	17·3	16·5	15·5	17·1	22·0	22·7	19·4	16·7	15·2	18·2

A comparison of the absolute ranges in Table XXII. with the inequality ranges for the same stations derivable from Tables VIII. to X. is most instructive. At Mauritius the ratio of the absolute to the inequality range is for D 1·38, for H 1·76, and for V 1·19. At Pavlovsk the corresponding ratios are much larger, viz. 2·16 for D, 2·43 for H, and 2·05 for V. The declination data for Kew in Table XXII. illustrate other points. The first set of data are derived from all days of the year. The second omit the highly disturbed days. The third answer to the 5 days a month selected as typically quiet. The yearly mean absolute range from ordinary days at Kew in Table XXII. is 1·49 times the mean inequality range in Table VIII.; comparing individual months the ratio of the absolute to the inequality range varies from 2·06 in January to 1·21 in June. Even confining ourselves to the quiet days at Kew, which are free from any but the most trifling disturbances, we find that the mean absolute range for the year is 1·20 times the arithmetic mean of the inequality ranges for the individual months of the year, and 1·22 times the range from the mean diurnal inequality for the year. In this case the ratio of the absolute to the inequality range varies from 1·55 in December to only 1·09 in May.

§ 25. The variability of the absolute daily range of declination is illustrated by Table XXIII., which contains data for Kew[24] derived from all days of the 11-year period 1890–1900. It gives the total number of times during the 11 years when the absolute range lay within the limits specified at the heads of the first nine columns of figures. The two remaining columns give the arithmetic means of the five largest and the five least absolute ranges encountered each month. The mean of the twelve monthly diurnal inequality ranges from ordinary days was only 8′·44, but the absolute range during the 11 years exceeded 20′ on 492 days, 15′ on 1196 days, and 10′ on 2784 days, *i.e.* on 69 days out of every 100.

TABLE XXIII.—Absolute Daily Range of Declination at Kew.

	Number of occasions during 11 years when absolute range was:—									Means from the 5 largest and 5 least ranges of the month on the average of 11 years.	
	0′ to 5′.	5′ to 10′.	10′ to 15′.	15′ to 20′.	20′ to 25′.	25′ to 30′.	30′ to 35′.	35′ to 40′.	over 40′.	5 largest.	5 least.
										′	′
January	51	145	69	37	24	7	4	3	1	22·90	5·07
February	26	99	84	51	26	10	4	2	8	27·21	6·55
March	1	72	138	61	32	21	8	1	7	29·87	8·93
April	0	43	167	73	27	10	6	3	1	23·69	10·31
May	0	57	157	85	20	12	3	0	7	25·36	9·50
June	0	56	185	67	15	1	3	1	2	19·92	9·89
July	0	59	185	70	14	5	2	2	4	22·49	9·96
August	0	37	202	75	22	1	2	0	2	21·27	10·05
September	1	68	153	71	19	5	4	5	4	24·55	9·52
October	3	103	111	67	34	10	11	2	0	23·92	8·01
November	42	140	81	28	14	9	8	5	3	23·58	5·64
December	64	166	56	29	14	7	1	1	3	20·43	4·36
Totals	188	1045	1588	714	261	98	56	25	42		

Relations to Sun-spot Frequency.

§ 26. Magnetic phenomena, both regular and irregular, at any station vary from year to year. The extent of this variation is illustrated in Tables XXIV. and XXV., both relating to the period 1890 to 1900.[25] Table XXIV. gives the amplitudes of the regular diurnal inequality in the elements stated at the head of the columns. The ordinary day declination data (D_o) for Kew represent arithmetic means from the twelve months of the year; the other data all answer to the mean diurnal inequality for the whole year. Table XXV. gives the arithmetic means for each year of the absolute daily range, of the monthly range (or difference between the highest and lowest values in the month), and of the yearly range (or difference between the highest and lowest values of the year). The numerals attached to the years in these tables indicate their order as regards sun-spot frequency according to Wolf and Wolfer (see AURORA POLARIS), 1893 being the year of largest frequency, and 1890 that of least. The difference in sun-spot frequency between 1897 and 1898 was microscopic; the differences between 1890, 1900 and 1899 were small, and those between 1893, 1894 and 1892 were not very large.

The years 1892–1895 represent high sun-spot frequency, while 1890, 1899 and 1900 represent low frequency. Table XXIV. shows that 1892 to 1895 were in all cases distinguished by the large size of the inequality ranges, and 1890, 1899 and 1900 by the small size. The range in 1893 is usually the largest, and though the H and V ranges at Ekaterinburg are larger in 1892 than in 1893, the excess is trifling. The phenomena apparent in Table XXIV. are fairly representative; other stations and other periods associate large inequality ranges with high sun-spot frequency. The diurnal inequality range it should be noticed is comparatively little influenced by irregular disturbances. Coming to Table XXV., we have ranges of a different character. The absolute range at Kew on quiet days is almost as little influenced by irregularities as is the range of the diurnal inequality, and in its case the phenomena are very similar to those observed in Table XXIV. As we pass from left to right in Table XXV., the influence of disturbance increases. Simultaneously with this, the parallelism with sun-spot frequency is less close. The entries relating to 1892 and 1894 become more and more prominent compared to those for 1893. The yearly range may depend on but a single magnetic storm, the largest disturbance of the year possibly far outstripping any other. But taking even the monthly ranges the values for 1893 are, speaking roughly, only half those for 1892 and 1894, and very similar to those of 1898, though the sun-spot frequency in the latter year was less than a third of that in 1893. Ekatarinburg data exactly analogous to those for Pavlovsk show a similar prominence in 1892 and 1894 as compared to 1893. The retirement of 1893 from first place, seen in the absolute ranges at Kew, Pavlovsk and Ekatarinburg, is not confined to the northern hemisphere. It is visible, for instance, in the amplitudes of the Batavia disturbance results. Thus though the variation from year to year in the amplitude of the absolute ranges is relatively not less but greater than that of the inequality ranges, and though the general tendency is for all ranges to be larger in years of many than in years of few sun-spots, still the parallelism between the changes in sun-spot frequency and in magnetic range is not so close for the absolute ranges and for disturbances as for the inequality ranges.

TABLE XXIV.—Ranges of Diurnal Inequalities.

	Pavlovsk.			Ekatarinburg.				Kew.			
	D.	I.	H.	D.	I.	H.	V.	D_q.	I_q.	H_q.	D_o.
	′	′	γ	′	′	γ	γ	′	′	γ	′
1890_{11}	6·32	1·33	22	5·83	1·05	18	9	6·90		20	7·32
1891_{6}	7·31	1·79	30	6·85	1·38	25	14	8·04	1·52	28	8·48
1892_{3}	8·75	2·21	37	7·74	1·72	32	19	9·50	1·66	31	9·85
1893_{1}	9·64	2·24	38	8·83	1·80	31	17	10·06	1·96	35	10·74
1894_{2}	8·58	2·17	38	7·80	1·73	30	17	9·32	1·94	34	9·80
1895_{4}	8·22	2·08	33	7·29	1·64	28	15	8·59	1·66	30	9·54
1896_{5}	7·39	1·77	29	6·50	1·38	25	15	7·77	1·31	25	8·50
1897_{8}	6·79	1·59	26	6·01	1·16	21	12	6·71	1·14	22	7·76
1898_{7}	6·25	1·56	26	5·76	1·19	21	11	6·85	1·07	21	7·59
1899_{9}	6·02	1·44	24	5·33	1·12	20	11	6·69	1·01	21	7·30
1900_{10}	6·20	1·28	22	5·88	0·93	17	8	6·52	1·06	21	6·83

TABLE XXV.—Absolute Ranges.

	Kew Declination, Daily.			Pavlovsk.								
				Daily.			Monthly.			Yearly.		
	q.	*o*.	*a*.	D.	H.	V.	D.	H.	V.	D.	H.	V.
	′	′	′	′	γ	γ	′	γ	γ	′	γ	γ
1890_{11}	8·3	10·5	10·7	12·1	49	21	28·2	118	80	42·1	169	179
1891_{6}	10·0	12·8	13·7	16·0	70	39	46·3	218	233	92·3	550	614
1892_{3}	12·3	15·4	17·7	21·0	111	73	93·6	698	575	194·0	2416	1385
1893_{1}	11·8	15·2	15·6	17·8	79	41	48·3	241	210	87·1	514	457
1894_{2}	11·3	14·7	16·5	20·4	97	62	84·1	493	493	145·6	1227	878
1895_{4}	10·6	14·8	15·6	18·1	80	46	47·4	220	223	73·9	395	534
1896_{5}	9·5	12·9	14·5	17·5	74	43	52·4	232	236	88·7	574	608
1897_{8}	8·2	11·5	12·1	14·6	61	30	43·8	201	170	101·1	449	480
1898_{7}	8·2	11·2	12·3	14·7	67	35	46·6	276	242	118·9	1136	888
1899_{9}	7·9	10·5	11·3	13·1	58	27	38·3	178	150	63·8	382	527
1900_{10}	7·4	8·9	9·2	10·5	44	16	32·8	134	89	94·2	457	365
Means	9·6	12·6	13·6	16·0	72	39	51·1	274	246	100·2	752	629

§ 27. The relationship between magnetic ranges and sun-spot frequency has been investigated in several ways. W. Ellis[26] has employed a graphical method which has advantages, especially for tracing the general features of the resemblance, and is besides independent of any theoretical hypothesis. Taking time for the axis of abscissae, Ellis drew two curves, one having for its ordinates the sun-spot frequency, the other the inequality range of declination or of horizontal force at Greenwich. The value assigned in the magnetic curve to the ordinate for any particular month represents a mean from 12 months of which it forms a central month, the object being to eliminate the regular annual variation in the diurnal inequality. The sun-spot data derived from Wolf and Wolfer were similarly treated. Ellis originally dealt with the period 1841 to 1877, but subsequently with the period 1878 to 1896, and his second paper gives curves representing the phenomena over the whole 56 years. This period covered five complete sun-spot periods, and the approximate synchronism of the maxima and minima, and the general parallelism of the magnetic and sun-spot changes is patent to the eye. Ellis[27] has also applied an analogous method to investigate the relationship between sun-spot frequency and the number of days of magnetic disturbance at Greenwich. A decline in the number of the larger magnetic storms near sun-spot minimum is recognizable, but the application of the method is less successful than in the case of the inequality range. Another method, initiated by Professor Wolf of Zurich, lends itself more readily to the investigation of numerical relationships. He started by supposing an exact proportionality between corresponding changes in sun-spot frequency and magnetic range. This is expressed mathematically by the formula

$$R = a + bS \equiv a\{1 + (b/a)S\},$$

where R denotes the magnetic range, S the corresponding sun-spot frequency, while a and b are constants. The constant a represents the range for zero sun-spot frequency, while b/a is the proportional increase in the range accompanying unit rise in sun-spot frequency. Assuming the formula to be true, one obtains from the observed values of R and S numerical values for a and b, and can thus investigate whether or not the sun-spot influence is the same for the different magnetic elements and for different places. Of course, the usefulness of Wolf's formula depends largely on the accuracy with which it represents the facts. That it must be at least a rough approximation to the truth in the case of the diurnal inequality at Greenwich might be inferred from Ellis's curves. Several possibilities should be noticed. The formula may apply with high accuracy, a and b having assigned values, for one or two sun-spot cycles, and yet not be applicable to more remote periods. There are only three or four stations which have continuous magnetic records extending even 50 years back, and, owing to temperature correction uncertainties, there is perhaps no single one of these whose earlier records of horizontal and vertical force are above criticism. Declination is less exposed to uncertainty, and there are results of eye observations of declination before the era of photographic curves. A change, however, of 1′ in declination has a significance which alters with the intensity of the horizontal force. During the period 1850–1900 horizontal force in England increased about 5%, so that the force requisite to produce a declination change of 19′ in 1900 would in 1850 have produced a deflection of 20′. It must also be remembered that secular changes of declination must alter the angle between the needle and any disturbing force acting in a fixed direction. Thus secular alteration in a and b is rather to be anticipated, especially in the case of the declination. Wolf's formula has been applied by Rajna[28] to the yearly mean diurnal declination ranges at Milan based on readings taken twice daily from 1836 to 1894, treating the whole period together, and then the period 1871 to 1894 separately. During two sub-periods, 1837–1850 and 1854–1867, Rajna's calculated values for the range differ very persistently in one direction from those observed; Wolf's formula was applied by C. Chree[25] to these two periods separately. He also applied it to Greenwich inequality ranges for the years 1841 to 1896 as published by Ellis, treating the whole period and the last 32 years of it separately, and finally to all (a) and quiet (q) day Greenwich ranges from 1889 to 1896. The results of these applications of Wolf's formula appear in Table XXVI.

The Milan results are suggestive rather of heterogeneity in the material than of any decided secular change in a or b. The Greenwich data are suggestive of a gradual fall in a, and rise in b, at least in the case of the declination.

Table XXVII. gives values of a, b and b/a in Wolf's formula calculated by Chree[25] for a number of stations. There are two sets of data, the first set relating to the range from the mean diurnal inequality for the year, the second to the arithmetic mean of the ranges in the mean diurnal inequalities for the twelve months. It is specified whether the results were derived from all or from quiet days.

TABLE XXVI.—Values of a and b in Wolf's Formula.

Milan.			Greenwich.				
Epoch.	Declination (unit 1′).		Epoch.	Declination (unit 1′).		Horizontal Force (unit 1γ).	
	a.	*b*.		*a*.	*b*.	*a*.	*b*.
1836–94	5·31	·047	1841–96	7·29	·0377	26·4	·190
1871–94	5·39	·047	1865–96	7·07	·0396	23·6	·215
1837–50	6·43	·041	1889–96(*a*)	6·71	·0418	23·7	·218
1854–67	4·62	·047	1889–96(*q*)	6·36	·0415	25·0	·213

As explained above, a would represent the range in a year of no sun-spots, while 100 b would represent the excess over this shown by the range in a year when Wolfer's sun-spot frequency is 100. Thus

TABLE XXVII.—Values of *a* and *b* in Wolf's Formula.

		Declination (unit 1′).			Inclination (unit 1′).			Horizontal Force (unit 1γ).			Vertical Force (unit 1γ).		
Diurnal Inequality for the Year.		*a.*	*b.*	100 *b*/*a.*	*a.*	*b.*	100 *b*/*a.*	*a.*	*b.*	100 *b*/*a.*	*a.*	*b.*	100 *b*/*a.*
Pavlovsk, 1890–1900	all	5·74	·0400	·70	1·24	·0126	1·01	20·7	·211	1·02	8·1	·265	3·26
Pavlovsk, 1890–1900	quiet	6·17	·0424	·69	..	..	..	20·6	·195	0·95	5·9	·027	0·46
Ekatarinburg, 1890–1900	all	5·29	·0342	·65	0·93	·0105	1·13	16·8	·182	1·09	8·6	·117	1·37
Irkutsk „ „	all	4·82	·0358	·74	0·97	·0087	0·90	18·2	·190	1·04	6·5	·071	1·09
Kew „ „	quiet	6·10	·0433	·71	0·87	·0125	1·45	18·1	·194	1·07	14·3	·081	0·56
Falmouth, 1891–1902	quiet	5·90	·0451	·76	..	..	..	20·1	·233	1·16	..	..	..
Kolaba, 1894–1901	quiet	2·37	·0066	·28	..	..	..	31·6	·281	0·89	19·4	·072	0·37
Batavia, 1887–1898	all	2·47	·0179	·72	3·60	·0218	0·61	38·7	·274	0·71	30·1	·156	0·52
Mauritius {1875–1880 1883–1890}	all	4·06	·0164	·40	..	..	..	15·0	·096	0·64	11·9	·069	0·58
Mean from individual months:—													
Pavlovsk, 1890–1900	all	6·81	·0446	·66	1·44	·0151	1·05	22·8	·243	1·07	9·7	·287	2·97
„ „	quiet	6·52	·0442	·68	..	..	..	22·2	·208	0·94	7·0	·044	0·63
Ekatarinburg, 1890–1900	all	6·18	·0355	·58	1·12	·0120	1·06	19·2	·195	1·01	9·2	·156	1·70
Greenwich, 1865–1896	all	7·07	·0396	·56	..	..	..	23·6	·215	0·91	..	..	..
Kew, 1890–1900	all	6·65	·0428	·64	..	..	..	..	..	..	..	..	..
„ „ „	quiet	6·49	·0410	·63	1·17	·0130	1·11	21·5	·191	0·89	16·0	·072	0·45
Falmouth, 1891–1902	quiet	6·16	·0450	·73	..	..	..	20·9	·236	1·13	..	..	..

b/*a* seems the most natural measure of sun-spot influence. Accepting it, we see that sun-spot influence appears larger at most places for inclination and horizontal force than for declination. In the case of vertical force there is at Pavlovsk, and probably in a less measure at other northern stations, a large difference between all and quiet days, which is not shown in the other elements. The difference between the values of *b*/*a* at different stations is also exceptionally large for vertical force. Whether this last result is wholly free from observational uncertainties is, however, open to some doubt, as the agreement between Wolf's formula and observation is in general somewhat inferior for vertical force. In the case of the declination, the mean numerical difference between the observed values and those derived from Wolf's formula, employing the values of *a* and *b* given in Table XXVII., represented on the average about 4% of the mean value of the element for the period considered, the probable error representing about 6% of the difference between the highest and lowest values observed. The agreement was nearly, if not quite, as good as this for inclination and horizontal force, but for vertical force the corresponding percentages were nearly twice as large.

Applying Wolf's formula to the diurnal ranges for different months of the year, Chree found, as was to be anticipated, that the constant *a* had an annual period, with a conspicuous minimum at midwinter; but whilst *b* also varied, it did so to a much less extent, the consequence being that *b*/*a* showed a minimum at midsummer. The annual variation in *b*/*a* alters with the place, with the element, and with the type of day from which the magnetic data are derived. Thus, in the case of Pavlovsk declination, whilst the mean value of 100 *b*/*a* for the 12 months is, as shown in Table XXVII., 0·66 for all and 0·68 for quiet days—values practically identical—if we take the four midwinter and the four midsummer months separately, we have 100 *b*/*a*, varying from 0·81 in winter to 0·52 in summer on all days, but from 1·39 in winter to 0·52 in summer on quiet days. In the case of horizontal force at Pavlovsk the corresponding figures to these are for all days—winter 1·77, summer 0·98, but for quiet days—winter 1·83, summer 0·71.

Wolf's formula has also been applied to the absolute daily ranges, to monthly ranges, and to various measures of disturbance. In these cases the values found for *b*/*a* are usually larger than those found for diurnal inequality ranges, but the accordance between observed values and those calculated from Wolf's formula is less good. If instead of the range of the diurnal inequality we take the sum of the 24-hourly differences from the mean for the day—or, what comes to the same thing, the average departure throughout the 24 hours from the mean value for the day—we find that the resulting Wolf's formula gives at least as good an agreement with observation as in the case of the inequality range itself. The formulae obtained in the case of the 24 differences, at places as wide apart as Kew and Batavia, agreed in giving a decidedly larger value for *b*/*a* than that obtained from the ranges. This indicates that the inequality curve is relatively less peaked in years of many than in years of few sun-spots.

§ 28. The applications of Ellis's and Wolf's methods relate directly only to the amplitude of the diurnal changes. There is, however, a change not merely in amplitude but in type. This is clearly seen when we compare the values found in years of many and of few sun-spots for the Fourier coefficients in the diurnal inequality. Such a comparison is carried out in Table XXVIII. for the declination on ordinary days at Kew. Local mean time is used. The heading S max. (sun-spot maximum) denotes mean average results from the four years 1892–1895, having a mean sun-spot frequency of 75·0, whilst S min. (sun-spot minimum) applies similarly to the years 1890, 1899 and 1900, having a mean sun-spot frequency of only 9·6. The data relate to the mean diurnal inequality for the whole year or for the season stated. It will be seen that the difference between the *c*, or amplitude, coefficients in the S max. and S min. years is greater for the 24-hour term than for the 12-hour term, greater for the 12-hour than for the 8-hour term, and hardly apparent in the 6-hour term. Also, *relatively considered*, the difference between the amplitudes in S max. and S min. years is greatest in winter and least in summer. Except in the case of the 6-hour term, where the differences are uncertain, the phase angle is larger, *i.e.* maxima and minima occur earlier in the day, in years of S min. than in years of S max. Taking the results for the whole year in Table XXVIII., this advance of phase in the S min. years represents in time 15·6 minutes for the 24-hour term, 9·4 minutes for the 12-hour term, and 14·7 minutes for the 8-hour term. The difference in the phase angles, as in the amplitudes, is greatest in winter. Similar phenomena are shown by the horizontal force, and at Falmouth [24] as well as Kew.

TABLE XXVIII.—Fourier Coefficients in Years of many and few Sun-spots.

	Year.		Winter.		Equinox.		Summer.	
	S max.	S min.	S max.	S min.	S max.	S min.	S max.	S min.
	′	′	′	′	′	′	′	′
c_1	3·47	2·21	2·41	1·43	3·76	2·41	4·38	2·98
c_2	2·04	1·51	1·15	0·78	2·33	1·71	2·73	2·06
c_3	0·89	0·72	0·55	0·42	1·16	0·97	0·97	0·77
c_4	0·28	0·27	0·30	0·27	0·42	0·42	0·11	0·11
	°	°	°	°	°	°	°	°
α_1	228·5	232·4	243·0	256·0	231·3	233·7	218·2	220·3
α_2	41·7	46·6	23·5	36·9	40·6	43·9	50·6	52·5
α_3	232·6	243·6	234·0	257·6	228·4	236·2	236·8	245·4
α_4	58·0	57·3	52·3	60·8	62·0	58·2	57·4	45·2

Quiet Day Phenomena.

§ 29. There have already been references to *quiet* days, for instance in the tables of diurnal inequalities. It seems to have been originally supposed that quiet days differed from other days only in the absence of irregular disturbances, and that mean annual values, or secular change data, or diurnal inequalities, derived from them might be regarded as truly normal or representative of the station. It was found, however, by P. A. Müller [29] that mean annual values of the magnetic elements at St Petersburg and Pavlovsk from 1873 to 1885 derived from quiet days alone differed in a systematic fashion from those derived from all days, and analogous results were obtained by Ellis [30] at Greenwich for the period 1889–1896. The average excesses for the quiet-day over the all-day means in these two cases were as follows:—

	Westerly Declination.	Inclination.	Horizontal Force.	Vertical Force.
St Petersburg	+0·24	−0·23	+3·2γ	−0·8γ
Greenwich	+0·08		+3·3γ	−0·9γ

The sign of the difference in the case of D, I and H was the same in each year examined by Müller, and the same was true of H at Greenwich. In the case of V, and of D at Greenwich, the differences are small and might be accidental. In the case of D at Greenwich 1891 differed from the other years, and of two more recent years examined by Ellis[31] one, 1904, agreed with 1891. At Kew, on the average of the 11 years 1890 to 1900, the quiet-day mean annual value of declination exceeded the ordinary day value, but the apparent excess 0′·02 is too small to possess much significance.

Another property more recently discovered in quiet days is the non-cyclic change. The nature of this phenomenon will be readily understood from the following data from the 11-year period 1890 to 1900 at Kew[32]. The mean daily change for all days is calculated from the observed annual change.

Non-cyclic Change.

	D.	I.	H.	V.
	′	′		
Mean annual change	−5·79	−2·38	+25·9γ	−22·6γ
Mean daily change, all days	−0·016	−0·007	+0·07γ	−0·06γ
Mean daily change, quiet days	+0·044	−0·245	+3·34γ	−0·84γ

Thus the changes during the representative quiet day differed from those of the average day. Before accepting such a phenomenon as natural, instrumental peculiarities must be carefully considered. The secular change is really based on the absolute instruments, the diurnal changes on the magnetographs, and the first idea likely to occur to a critical mind is that the apparent abnormal change on quiet days represents in reality change of zero in the magnetographs. If, however, the phenomenon were instrumental, it should appear equally on days other than quiet days, and we should thus have a shift of zero amounting in a year to over 1,200γ in H, and to about 90′ in I. Under such circumstances the curve would be continually drifting off the sheet. In the case of the Kew magnetographs, a careful investigation showed that if any instrumental change occurred in the declination magnetograph during the 11 years it did not exceed a few tenths of a minute. In the case of the H and V magnetographs at Kew there is a slight drift, of instrumental origin, due to weakening of the magnets, but it is exceedingly small, and in the case of H is in the opposite direction to the non-cyclic change on quiet days. It only remains to add that the hypothesis of instrumental origin was positively disproved by measurement of the curves on ordinary days.

It must not be supposed that every quiet day agrees with the average quiet day in the order of magnitude, or even in the sign, of the non-cyclic change. In fact, in not a few months the sign of the non-cyclic change on the mean of the quiet days differs from that obtained for the average quiet day of a period of years. At Kew, between 1890 and 1900, the number of months during which the mean non-cyclic change for the five quiet days selected by the astronomer royal (Sir W. H. M. Christie) was plus, zero, or minus, was as follows:—

Element.	D.	I.	H.	V.
Number +	63	13	112	47
,, 0	14	16	11	9
,, −	55	101	9	74

The + sign denotes westerly movement in the declination, and increasing dip of the north end of the needle. In the case of I and H the excess in the number of months showing the normal sign is overwhelming. The following mean non-cyclic changes on quiet days are from other sources:—

Element.	Greenwich (1890–1895).	Falmouth (1898–1902).	Kolaba (1894–1901).
	′	′	′
D	+ 0·03	+ 0·05	+ 0·07
H	+ 4·3γ	+ 3·0γ	+ 3·9γ

The results are in the same direction as at Kew, + meaning in the case of D movement to the west. At Falmouth[32], as at Kew, the non-cyclic change showed a tendency to be small in years of few sun-spots.

§ 30. In calculating diurnal inequalities from quiet days the non-cyclic effect must be eliminated, otherwise the result would depend on the hour at which the "day" is supposed to commence. If the value recorded at the second midnight of the average day exceeds that at the first midnight by N, the elimination is effected by applying to each hourly value the correction $N(12-n)/24$, where n is the hour counted from the first midnight (0 hours). This assumes the change to progress uniformly throughout the 24 hours. Unless this is practically the case—a matter difficult either to prove or disprove—the correction may not secure exactly what is aimed at. This method has been employed in the previous tables. The fact that differences do exist between diurnal inequalities derived from quiet days and all ordinary days was stated explicitly in § 4, and is obvious in Tables VIII. to XI. An extreme case is represented by the data for Jan Mayen in these tables. Figs. 9 and 10 are vector diagrams for this station, for all and for quiet days during May, June and July 1883, according to data got out by Lüdeling. As shown by the arrows, fig. 10 (quiet days) is in the main described in the normal or clockwise direction, but fig. 9 (all days) is described in the opposite direction. Lüdeling found this peculiar difference between all and quiet days at all the north polar stations occupied in 1882–1883 except Kingua Fjord, where both diagrams were described clockwise.

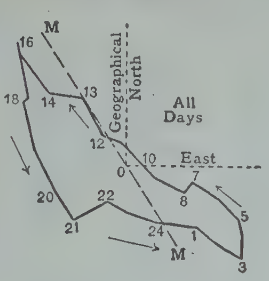


FIG. 9.

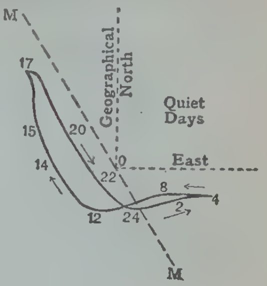


FIG. 10.

In temperate latitudes the differences of type are much less, but still they exist. A good idea of their ordinary size and character in the case of declination may be derived from Table XXIX., containing data for Kew, Greenwich and Parc St Maur.

The data for Greenwich are due to W. Ellis[30], those for Parc St Maur to T. Moureaux[33]. The quantity tabulated is the algebraic excess of the all or ordinary day mean hourly value over the corresponding quiet day value in the mean diurnal inequality for the year. At Greenwich and Kew days of extreme disturbance have been excluded from the ordinary days, but apparently not at Parc St Maur. The number of highly disturbed days at the three stations is, however, small, and their influence is not great. The differences disclosed by Table XXIX. are obviously of a systematic character, which would not tend to disappear however long a period was utilized. In short, while the diurnal inequality from quiet days may be that most truly representative of undisturbed conditions, it does not represent the average state of conditions at the station. To go into full details respecting the differences between all and quiet days would occupy undue space, so the following brief summary of the differences observed in declination at Kew must suffice. While the inequality range is but little different for the two types of days, the mean of the hourly differences from the mean for the day is considerably reduced in the quiet days. The 24-hour term in the Fourier analysis is of smaller amplitude in the quiet days, and its phase angle is on the average about 6°·75 smaller than on ordinary days, implying a retardation of about 27 minutes in the time of maximum. The diurnal inequality range is more variable throughout the year in quiet days than on ordinary days, and the same is true of the absolute ranges. The tendency to a secondary minimum in the range at midsummer is considerably more decided on ordinary than on quiet days. When the variation throughout the year in the diurnal inequality range is expressed in Fourier series, whose periods are the year and its submultiples, the 6-month term is notably larger for ordinary than for quiet days. Also the date of the maximum in the 12-month term is about three days earlier for ordinary than for quiet days. The exact size of the differences between ordinary and quiet day phenomena must depend to some extent on the criteria employed in selecting quiet days and in excluding disturbed days. This raises difficulties when it comes to comparing results at different stations. For stations near together the difficulty is trifling. The astronomer royal's quiet days have been used for instance at Parc St. Maur, Val Joyeux, Falmouth and Kew, as well as at Greenwich. But when stations are wide apart there are two obvious difficulties: first, the difference of local time; secondly, the fact that a day may be typically quiet at one station but appreciably disturbed at the other.

If the typical quiet day were simply the antithesis of a disturbed day, it would be natural to regard the non-cyclic change on quiet days as a species of recoil from some effect of disturbance. This view derives support from the fact, pointed out long ago by Sabine[34], that the horizontal force usually, though by no means always, is lowered by magnetic disturbances. Dr van Bemmelen[35] who has examined non-cyclic phenomena at a number of stations, seems disposed to regard this as a sufficient explanation. There are, however, difficulties in accepting this view. Thus, whilst the non-cyclic effect in horizontal force and inclination at Kew and Falmouth appeared on the whole enhanced in years of sun-spot maximum, the difference between years such as 1892 and 1894 on the one hand, and 1890 and 1900 on the other, was by no means proportional to the excess of disturbance in the former years. Again, when the average non-cyclic change of declination was calculated at Kew for 207 days, selected as those of most marked irregular disturbance between 1890 and 1900, the sign actually proved to be the same as fot the average quiet day of the period.

Table XXIX.—All or Ordinary, less Quiet Day Hourly Values (+ to the West).

Hour.	Forenoon.			Afternoon.		
	Kew 1890–1900.	Greenwich 1890–1894.	Parc St Maur 1883–1897.	Kew 1890–1900.	Greenwich 1890–1894.	Parc St Maur 1893–1897.
	′	′	′	′	′	′
1	−0·58	−0·59	−0·63	+0·42	+0·44	+0·40
2	−0·54	−0·47	−0·47	+0·52	+0·45	+0·50
3	−0·51	−0·31	−0·32	+0·57	+0·52	+0·59
4	−0·41	−0·23	−0·16	+0·60	+0·51	+0·55
5	−0·28	−0·10	−0·01	+0·46	+0·34	+0·38
6	−0·08	+0·12	+0·18	+0·21	+0·04	+0·07
7	+0·13	+0·30	+0·34	−0·06	−0·24	−0·25
8	+0·29	+0·48	+0·47	−0·27	−0·50	−0·54
9	+0·40	+0·56	+0·53	−0·47	−0·68	−0·74
10	+0·44	+0·58	+0·51	−0·61	−0·78	−0·79
11	+0·48	+0·50	+0·44	−0·62	−0·77	−0·79
12	+0·45	+0·44	+0·38	−0·54	−0·61	−0·67

Magnetic Disturbances.

§ 31. A satisfactory definition of magnetic disturbance is about as difficult to lay down as one of heterodoxy. The idea in its generality seems to present no difficulty, but it is a very different matter when one comes to details. Amongst the chief disturbances recorded since 1890 are those of February 13–14 and August 12, 1892; July 20 and August 20, 1894; March 15–16, and September 9, 1898; October 31, 1903; February 9–10, 1907; September 11–12, 1908 and September 25, 1909. On such days as these the oscillations shown by the magnetic curves are large and rapid, aurora is nearly always visible in temperate latitudes, earth currents are prominent, and there is interruption—sometimes very serious—in the transmission of telegraph messages both in overhead and underground wires. At the other end of the scale are days on which the magnetic curves show practically no movement beyond the slow regular progression of the regular diurnal inequality. But between these two extremes there are an infinite variety of intermediate cases. The first serious attempt at a precise definition of disturbance seems due to General Sabine [35a]. His method had once an extensive vogue, and still continues to be applied at some important observatories. Sabine regarded a particular observation as disturbed when it differed from the mean of the observations at that hour for the whole month by not less than a certain limiting value. His definition takes account only of the extent of the departure from the mean, whether the curve is smooth at the time or violently oscillating makes no difference. In dealing with a particular station Sabine laid down separate limiting values for each element. These limits were the same, irrespective of the season of the year or of the sun-spot frequency. A departure, for example, of 3′·3 at Kew from the mean value of declination for the hour constituted a disturbance, whether it occurred in December in a year of sun-spot minimum, or in June in a year of sun-spot maximum, though the regular diurnal inequality range might be four times as large in the second case as in the first. The limiting values varied from station to station, the size depending apparently on several considerations not very clearly defined. Sabine subdivided the disturbances in each element into two classes: the one tending to increase the element, the other tending to diminish it. He investigated how the numbers of the two classes varied throughout the day and from month to month. He also took account of the aggregate value of the disturbances of one sign, and traced the diurnal and annual variations in these aggregate values. He thus got two sets of diurnal variations and two sets of annual variations of disturbance, the one set depending only on the number of the disturbed hours, the other set considering only the aggregate value of the disturbances. Generally the two species of disturbance variations were on the whole fairly similar. The aggregates of the + and − disturbances for a particular hour of the day were seldom equal, and thus after the removal of the disturbed values the mean value of the element for that hour was generally altered. Sabine's complete scheme supposed that after the criterion was first applied, the hourly means would be recalculated from the undisturbed values and the criterion applied again, and that this process would be repeated until the disturbed observations all differed by not less than the accepted limiting value from the final mean based on undisturbed values alone. If the disturbance limit were so small that the disturbed readings formed a considerable fraction of the whole number, the complete execution of Sabine's scheme would be exceedingly laborious. As a matter of fact, his disturbed readings were usually of the order of 5% of the total number, and unless in the case of exceptionally large magnetic storms it is of little consequence whether the first choice of disturbed readings is accepted as final or is reconsidered in the light of the recalculated hourly means.

Sabine applied his method to the data obtained during the decade 1840 to 1850 at Toronto, St Helena, Cape of Good Hope and Hobart, also to data for Pekin, Nertchinsk, Point Barrow, Port Kennedy and Kew. C. Chambers [36] applied it to data from Bombay. The yearly publication of the Batavia observatory gives corresponding results for that station, and Th. Moureaux [33] has published similar data for Parc St Maur. Tables XXX. to XXXII. are based on a selection of these data. Tables XXX. and XXXI. show the annual variation in Sabine's disturbances, the monthly values being expressed as percentages of the arithmetic mean value for the 12 months. The Parc St Maur and Batavia data, owing to the long periods included, are especially noteworthy. Table XXX. deals with the east (E) and west (W) disturbances of declination separately. Table XXXI., dealing with disturbances in horizontal and vertical force, combines the + and − disturbances, treated numerically. At Parc St Maur the limits required to qualify for disturbance were 3′·0 in D, 20γ in H, and 12γ in V; the corresponding limits for Batavia were 1′·3, 11γ and 11γ. The limits for D at Toronto, Bombay and Hobart were respectively 3′·6, 1′·4 and 2′·4.

At Parc St Maur the disturbance data from all three elements give distinct maxima near the equinoxes; a minimum at midwinter is clearly shown, and also one at midsummer, at least in D and H. A decline in disturbance at midwinter is visible at all the stations, but at Batavia the equinoctial values for D and V are inferior to those at midsummer.

Table XXXII. shows in some cases a most conspicuous diurnal variation in Sabine's disturbances. The data are percentages of the totals for the whole 24 hours. But whilst at Batavia the easterly and westerly disturbances in D vary similarly, at Parc St Maur they follow opposite laws, the easterly showing a prominent maximum near noon, the westerly a still more prominent maximum near midnight. The figures in the second last line of the table, if divided by 0·24, will give the percentage of hours which show the species of disturbance indicated. For instance, at Parc St Maur, out of 100 hours, 3 show disturbances to the west and 3·7 to the east; or in all 6·7 show disturbances of declination. The last line gives the average size of a disturbance of each type, the unit being 1′ in D and 1γ in H and V.

At Batavia disturbances increasing and decreasing the element are about equally numerous, but this is exceptional. Easterly disturbances of declination predominated at Toronto, Point Barrow, Fort Kennedy, Kew, Parc St Maur, Bombay and the Falkland Islands whilst the reverse was true of St Helena, Cape of Good Hope, Pekin and Hobart. At Kew and Parc St Maur the ratios borne by the

Table XXX.—Annual Variation of Disturbances (Sabine's numbers).

	Parc St Maur 1883–97.		Toronto 1841–48.		Bombay 1859–65.		Batavia 1883–99.		Hobart 1843–48.	
Month.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.
January	78	60	55	66	89	89	180	223	165	182
February	116	92	75	86	94	67	138	144	121	116
March	126	107	92	94	129	97	102	87	114	104
April	105	113	115	114	106	129	67	73	110	102
May	101	118	101	101	63	99	72	71	62	53
June	77	89	95	72	78	81	45	27	32	37
July	82	104	140	126	121	173	62	46	50	49
August	88	113	137	133	154	131	69	69	86	78
September	134	137	163	139	111	108	135	144	135	114
October	119	115	101	111	140	128	95	88	124	123
November	99	94	73	85	43	43	106	91	79	111
December	75	58	51	72	72	55	124	137	123	130

Table XXXI.—Annual Variation of Disturbances.

	Parc St Maur.		Toronto.		Batavia.			
Month.	Numbers.		Aggregates.		Numbers.		Aggregates.	
	H.	V.	H.	V.	H.	V.	H.	V.
January	81	51	58	56	96	151	89	154
February	96	133	94	74	105	123	110	125
March	126	118	94	108	116	105	117	103
April	94	111	150	149	104	76	105	73
May	108	133	90	112	101	92	105	95
June	90	85	36	50	82	69	79	66
July	99	128	61	71	90	83	95	81
August	113	92	75	108	91	91	98	91
September	119	122	171	160	113	111	114	115
October	101	94	148	129	114	89	104	86
November	104	81	98	75	99	102	100	101
December	70	51	128	100	89	108	84	110

TABLE XXXII.—Diurnal Variation of Disturbances (Sabine's numbers).

Hour.	Parc St Maur.						Batavia.					
	D.		H.		V.		D.		H.		V.	
	E.	W.	+	−	+	−	E.	W.	+	−	+	−
0−3	10·1	20·3	9·0	8·3	5·7	9·2	1·1	5·8	13·1	6·6	4·0	7·4
3−6	12·3	8·2	8·4	8·0	6·4	10·4	7·6	7·3	14·2	4·8	6·3	10·0
6−9	15·7	3·8	14·1	12·5	7·2	9·0	24·9	16·8	12·1	9·9	21·2	21·7
9−noon	16·2	5·1	18·0	15·6	12·9	15·4	38·5	33·0	8·6	15·8	19·8	16·4
noon−3	19·3	6·7	15·3	16·5	18·2	18·3	18·8	24·7	16·8	21·1	23·5	22·1
3−6	14·8	9·7	12·5	15·4	22·9	21·8	6·4	5·4	13·3	16·9	12·6	12·7
6−9	5·7	21·2	11·4	13·2	18·9	11·2	2·3	3·4	9·9	13·6	7·1	4·1
9−12	5·9	25·0	11·2	10·5	7·8	4·7	0·4	3·8	12·0	11·1	5·6	5·4
Mean number per day .	0·88	0·72	1·15	1·56	1·04	0·96	0·46	0·44	1·62	1·61	1·19	1·13
Mean size .	..	...	...	..	..	...	1·72	1·69	18·0	19·5	16·7	15·5

eastern to the western disturbances were 1·19 and 1·23 respectively, and so not much in excess of unity; but the preponderance of easterly disturbances at the North American [37] stations was considerably larger than this.

§ 32. From the point of view of the surveyor there is a good deal to be said for Sabine's definition of disturbance, but it is less satisfactory from other standpoints. One objection has been already indicated, viz. the arbitrariness of applying the same limiting value at a station irrespective of the size of the normal diurnal range at the time. Similarly it is arbitrary to apply the same limit between 10 a.m. and noon, when the regular diurnal variation is most rapid, as between 10 p.m. and midnight, when it is hardly appreciable. There seems a distinct difference of phase between the diurnal inequalities on different types of days at the same season; also the phase angles in the Fourier terms vary continuously throughout the year, and much more rapidly at some stations and at some seasons than at others. Thus there may be a variety of phenomena which one would hesitate to regard as disturbances which contribute to the annual and diurnal variations in Tables XXX. to XXXII.

Sabine, as we have seen, confined his attention to the departure of the hourly reading from the mean for that hour. Another and equally natural criterion is the apparent character of the magnetograph curve. At Potsdam curves are regarded as "1" quiet, "2" moderately disturbed, or "3" highly disturbed. Any hourly value to which the numeral 3 is attached is treated as disturbed, and the annual Potsdam publication contains tables giving the annual and diurnal variations in the number of such disturbed hours for D, H and V. According to this point of view, the extent to which the hourly value departs from the mean for that hour is immaterial to the results. It is the greater or less sinuosity and irregularity of the curve that counts. Tables XXXIII. and XXXIV. give an abstract of the mean Potsdam results from 1892 to 1901. The data are percentages: in Table XXXIII. of the mean monthly total, in Table XXXIV. of the total for the day. So far as the annual variation is concerned, the results in Table XXXIII. are fairly similar to those in Table XXX. for Parc St Maur. There are pronounced maxima near the equinoxes, especially the spring equinox. The diurnal variations, however, in Tables XXXII. and XXXIV. are dissimilar. Thus in the case of H the largest disturbance numbers at Parc St Maur occurred between 6 a.m. and 6 p.m., whereas in Table XXXIV. they occur between 4 p.m. and midnight. Considering the comparative proximity of Parc St Maur and Potsdam, one must conclude that the apparent differences between the results for these two stations are due almost entirely to the difference in the definition of disturbance.

TABLE XXXIII.—Annual Variation of Potsdam Disturbances.

Element.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
D	129	170	149	90	86	57	62	64	99	118	94	82
H	109	133	131	102	109	82	94	91	89	101	75	84
V	106	171	170	108	121	56	64	74	93	87	78	70
Mean	115	158	150	100	105	65	73	76	94	102	82	79

TABLE XXXIV.—Diurnal Variation of Potsdam Disturbances.

Hours.	1–3.	4–6.	7–9.	10–noon.	1–3.	4–6.	7–9.	10–12.
D	14·9	11·1	8·0	5·2	5·7	13·1	22·5	19·5
H	10·5	8·4	8·0	8·5	11·3	17·6	19·2	16·5
V	13·5	9·7	5·7	4·7	8·5	17·2	21·5	19·2
Mean	13·0	9·7	7·2	6·1	8·5	16·0	21·1	18·4

TABLE XXXV.—Disturbed Day less ordinary Day Inequality (Unit 1′, + to West).

Hour.	1	2	3	4	5	6	7	8	9	10	11	12
a.m.	−3·4	−2·6	−2·0	−0·3	+1·6	+1·9	+2·3	+2·0	+2·1	+2·0	+1·6	+1·8
p.m.	+1·8	+2·2	+2·1	+1·7	+1·4	0·0	−1·3	−2·8	−3·5	−2·6	−3·5	−2·4

One difficulty in the Potsdam procedure is the maintenance of a uniform standard. Unless very frequent reference is made to the curves of some standard year there must be a tendency to enter under "3" in quiet years a number of hours which would be entered under "2" in a highly disturbed year. Still, such a source of uncertainty is unlikely to have much influence on the diurnal, or even on the annual, variation.

§ 33. A third method of investigating a diurnal period in disturbances is to form a diurnal inequality from disturbed days alone, and compare it with the corresponding inequalities from ordinary or from quiet days. Table XXXV. gives some declination data for Kew, the quantity tabulated being the algebraic excess of the disturbed day hourly value over that for the ordinary day in the mean diurnal inequality for the year, as based on the 11 years 1890 to 1900.

The disturbed day inequality was corrected for non-cyclic change in the usual way. Fig. 11 shows the results of Table XXXV. graphically. The irregularities are presumably due to the limited number, 209, of disturbed days employed; to get a smooth curve would require probably a considerably longer period of years. The differences between disturbed and ordinary days at Kew are of the same general character as those between ordinary and quiet days in Table XXIX.; they are, however, very much larger, the range in Table XXXV. being fully 5½ times that in Table XXIX. If quiet days had replaced ordinary days in Table XXXV., the algebraic excess of the disturbed day would have varied from +2′·7 at 2 p.m. to −4′·1 at 11 p. m., or a range of 6′·8.

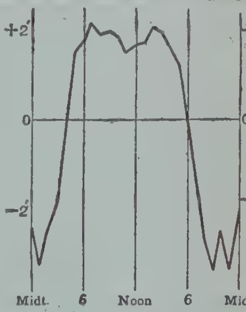


FIG. 11.

§ 34. When the mean diurnal inequality in declination for the year at Kew is analysed into Fourier waves, the chief difference, it will be remembered, between ordinary and quiet days was that the amplitude of the 24-hour term was enhanced in the ordinary days, whilst its phase angle indicated an earlier occurrence of the maximum. Similarly, the chief difference between the Fourier waves for the disturbed and ordinary day inequalities at Kew is the increase in the amplitude of the 24-hour term in the former by over 70 %, and the earlier occurrence of its maximum by about 1 hour 50 minutes. It is clear from these results for Kew, and it is also a necessary inference from the differences obtained by Sabine's method between east and west or + and − disturbances, that there is present during disturbances some influence which affects the diurnal inequality in a regular systematic way, tending to make the value of the element higher during some hours and lower during others than it is on days relatively free from disturbance. At Kew the consequence is a notable increase in the range of the regular diurnal inequality on disturbed days; but whether this is the general rule or merely a local peculiarity is a subject for further research.

§ 35. There are still other ways of attacking the problem of disturbances. W. Ellis [27] made a complete list of disturbed days at Greenwich from 1848 onwards, arranging them in classes according to the amplitude of the disturbance shown on the curves. Of the 18,000 days which he considered, Ellis regarded 2,119, or only about 12 %, as undisturbed. On 11,898 days, or 66 %, the disturbance movement in declination was under 10′; on 3614, or 20 %, the disturbance, though exceeding 10′, was under 30′; on 294 days it lay between 30′ and 60′; while on 75 days it exceeded 60′. Taking each class of disturbances separately, Ellis found, except in the case of his "minor" disturbances—those under 10′—a distinct double annual period, with maxima towards the equinoxes. Subsequently C. W. Maunder,[38] making use of these same data, and of subsequent data up to 1902, put at his disposal by Ellis, came to similar conclusions. Taking all the days with disturbances of declination over 10′, and dealing with 15-day periods, he found the maxima of frequency to occur the one a little before the spring equinox, the other apparently after the autumnal equinox; the two minima were found to occur early in June and in January. When the year is divided into three seasons—winter (November to February), summer (May to August), and equinox—Maunder's figures lead to the results assigned to Greenwich disturbed days in Table XXXVI. The frequency in winter, it will be noticed, though less than at equinox, is considerably greater than in summer. This greater frequency in winter is only slightly apparent in the disturbances over 60′, but their number is so small that this may be accidental. The next figures in Table XXXVI. relate to highly disturbed days at Kew. The larger relative frequency at Kew in winter as compared to summer probably indicates no real difference from Greenwich, but is simply a matter of definition. The chief criterion at Kew for classifying the days was not so much the mere amplitude of the largest movement, as the general character of the day's curve and its departure from the normal form. The data in Table XXXVI. as to magnetic storms at Greenwich are based on the lists given by Maunder[39] in the *Monthly Notices*, R.A.S. A storm may last for any time from a few hours to several days, and during part of its duration the disturbance may not be very large; thus it does not necessarily follow that the frequencies of magnetic storms and of disturbed days will follow the same laws. The table shows, however, that so far as Greenwich is concerned the annual variations in the two cases are closely alike. In addition to mean data for the whole 56 years, 1848 to 1903, Table XXXVI. contains separate data for the 14 years of that period which represented the highest sun-spot frequency, and the 15 years which represented lowest sun-spot frequency. It will be seen that relatively considered the seasonal frequencies of disturbance are more nearly equal in the years of many than in those of few sun-spots. Storms are more numerous as a whole in the years of many sun-spots, and this preponderance is especially true of storms of the largest size. This requires to be borne in mind in any comparisons between larger and smaller storms selected promiscuously from a long period. An unduly large proportion of the larger storms will probably come from years of large sun-spot frequency, and there is thus a risk of assigning to differences between the laws obeyed by large and small storms phenomena that are due in whole or in part to differences between the laws followed in years of many and of few sun-spots. The last data in Table XXXVI. are based on statistics for Batavia given by W. van Bemmelen,[40] who considers separately the storms which commence suddenly and those which do not. These sudden movements are recorded over large areas, sometimes probably all over the earth, if not absolutely simultaneously, at least too nearly so for differences in the time of occurrence to be shown by ordinary magnetographs. It is ordinarily supposed that these sudden movements, and the storms to which they serve as precursors, arise from some source extraneous to the earth, and that the commencement of the movement intimates the arrival, probably in the upper atmosphere, of some form of energy transmitted through space. In the storms which commence gradually the existence of a source external to the earth is not so prominently suggested, and it has been sometimes supposed that there is a fundamental difference between the two classes of storms. Table XXXVI. shows, however, no certain difference in the annual variation at Batavia. At the same time, this possesses much less significance than it would have if Batavia were a station like Greenwich, where the annual variation in magnetic storms is conspicuous.

Besides the annual period, there seems to be also a well-marked diurnal period in magnetic disturbances. This is apparent in Tables XXXVII. and XXXVIII., which contain some statistics for Batavia due to van Bemmelen, and some for Greenwich derived from the data in Maunder's papers referred to above. Table XXXVII. gives the relative frequency of occurrence for two hour intervals, starting with midnight, treating separately the storms of gradual (g) and sudden (s) commencement. In Table XXXVIII. the day is subdivided into three equal parts. Batavia and Greenwich agree in showing maximum frequency of beginnings about the time of minimum frequency of endings and conversely; but the hours at which the respective maxima and minima occur at the two places differ rather notably.

TABLE XXXVI.—Disturbances, and their Annual Distribution.

	Total Number.	Percentages.		
		Winter.	Equinox.	Summer.
Greenwich disturbed days, all, 1848–1902	4,214	33·9	39·2	26·9
Greenwich disturbed days, range 10′ to 30′, 1848–1902	3,830	33·9	39·0	27·1
Greenwich disturbed days, range 30′ to 60′, 1848–1902	307	34·5	41·0	24·4
Greenwich disturbed days, range over 60′, 1848–1902	77	29·9	41·6	28·6
Kew highly disturbed days, 1890–1900	209	38·3	41·6	20·1
Greenwich magnetic storms, all, 1848–1903	726	32·1	42·3	25·6
Greenwich magnetic storms, range 20′ to 30′, 1848–1903	392	30·1	43·6	26·3
Greenwich magnetic storms, range over 30′, 1848–1903	334	34·4	40·7	24·9
Greenwich magnetic storms, all, 14 years of S. max.	258	35·3	38·0	26·7
Greenwich magnetic storms, all, 15 years of S. min.	127	28·4	48·0	23·6
Batavia magnetic storms, all, 1883–1899	1,008	32·9	34·9	32·2
Batavia magnetic storms of gradual commencement	679	32·4	34·8	32·8
Batavia magnetic storms of sudden commencement	329	33·7	35·3	31·0

§ 36. There are peculiarities in the sudden movements ushering in magnetic storms which deserve fuller mention. According to van Bemmelen the impulse consists usually at some stations of a sudden slight jerk of the magnet in one direction, followed by a larger decided movement in the opposite direction, the former being often indistinctly shown. Often we have at the very commencement but a faint outline, and thereafter a continuous movement which is only sometimes distinctly indicated, resulting after some minutes in the displacement of the trace by a finite amount from the position it occupied on the paper before the disturbance began. This may mean, as van Bemmelen supposes, a small preliminary movement in the opposite direction to the clearly shown displacement; but it may only mean that the magnet is initially set in vibration, swinging on both sides of the position of equilibrium, the real displacement of the equilibrium position being all the time in the direction of the displacement apparent after a few minutes. To prevent misconception, the direction of the displacement apparent after a few minutes has been termed the direction of the first *decided* movement in Table XXXIX., which contains some data as to the direction given by Ellis[41] and van Bemmelen.[40] The + sign means an increase, the − sign a decrease of the element. The sign is not invariably the same, it will be understood, but there are in all cases a marked preponderance of changes in the direction shown in the table. The fact that all the stations indicated an increase in horizontal force is of special significance.

TABLE XXXVII.—Batavia Magnetic Storms, Diurnal Distribution (percentages).

Hour.		0	2	4	6	8	10	12	14	16	18	20	22
Beginning	g	5	5	5	6	20	16	7	5	6	9	8	8
	s	7	5	7	10	10	11	10	8	8	9	8	7
Maximum	g	12	10	6	5	4	9	9	6	6	6	12	15
	s	14	7	5	2	2	9	9	5	8	10	13	16
End	all	15	16	19	13	5	3	6	5	4	5	4	5

TABLE XXXVIII.—Greenwich Magnetic Storms, Diurnal Distribution.

Epoch.		Class.	Total Number.	Percentages.		
				1–8 p.m.	9 p. m.–4 a.m.	5 a.m.–noon.
Beginning	1848–1903	all	721	60·1	21·9	18·0
	1882–1903	,,	276	58·0	18·8	23·2
	,, ,,	sudden	77	45·4	27·3	27·3
End	1848–1903	all	720	9·4	44·6	46·0
	1882–1903	,,	276	7·2	41·7	51·1
	,, ,,	sudden	77	11·7	35·1	53·2

§ 37. That large magnetic disturbances occur simultaneously over large areas was known in the time of Gauss, on whose initiative observations were taken at 5-minute intervals at a number of stations on prearranged *term days.* During March 1879 and August 1880 some large magnetic storms occurred, and the magnetic curves showing these at a number of stations fitted with Kew pattern magnetographs were compared by W. G. Adams.[42] He found the more characteristic movements to be, so far as could be judged, simultaneous at all the stations. At comparatively near stations such as Stonyhurst and Kew, or Coimbra and Lisbon, the curves were in general almost duplicates. At Kew and St Petersburg there were usually considerable differences in detail, and the movements were occasionally in opposite directions. The differences between Toronto, Melbourne or Zi-ka-wei and the European stations were still more pronounced. In 1896, on the initiative of M. Eschenhagen,[43] eye observations of declination and horizontal force were taken at 5-second intervals during prearranged hours at Batavia, Manila, Melbourne and nine European stations. The data from one of these occasions when appreciable disturbance prevailed were published by Eschenhagen, and were subsequently analysed by Ad. Schmidt.[44] Taking the stations in western Europe, Schmidt drew several series of lines, each series representing the disturbing forces at one instant of time as deduced from the departure of the elements at the several stations from their undisturbed value. The lines answering to any one instant had a general sameness of direction with more or less divergence or convergence, but their general trend varied in a way which suggested to Schmidt the passage of a species of vortex with large but finite velocity.

TABLE XXXIX.—Direction of First Decided Movement.

Place.	Declination.	Horizontal Force.	Vertical Force.
Pavlovsk	West	+	+
Potsdam	West	+	−
Greenwich	West	+	+
Zi-ka-wei	East	+	−
Kolaba	East	+	−
Batavia	West	+	−
Mauritius	East	+	+
Cape Horn	West	+	−

The conclusion that magnetic disturbances tend to follow one another at nearly equal intervals of time has been reached by several independent observers. J. A. Broun[45] pronounced for a period of about 26 days, and expressed a belief that a certain zone, or zones, of the sun's surface might exert a prepotent influence on the earth's magnetism during several solar rotations. Very similar views were advanced in 1904 by E. W. Maunder,[39] who was wholly unaware of Broun's work. Maunder concluded that the period was 27·28 days, coinciding with the sun's rotation period relative to an observer on the earth. Taking magnetic storms at Greenwich from 1882 to 1903, he found the interval between the commencement of successive storms to approach closely to the above period in a considerably larger number of instances than one would have expected from mere chance. He found several successions of three or four storms, and in one instance of as many as six storms, showing his interval. In a later paper Maunder reached similar results for magnetic storms at Greenwich from 1848 to 1881. Somewhat earlier than Maunder, Arthur Harvey[46] deduced a period of 27·246 days from a consideration of magnetic disturbances at Toronto. A. Schuster,[47] examining Maunder's data mathematically, concluded that they afforded rather strong evidence of a period of about $\frac{1}{2}$ (27·28) or 13·6 days. Maunder regarded his results as *demonstrating* that magnetic disturbances originate in the sun. He regarded the solar action as arising from active areas of limited extent on the sun's surface, and as propagated along narrow, well defined streams. The active areas he believed to be also the seats of the formation of sun-spots, but believed that their activity might precede and outlive the visible existence of the sun-spot.

Maunder did not discuss the physical nature of the phenomenon, but his views are at least analogous to those propounded somewhat earlier by Svante Arrhenius,[48] who suggested that small negatively charged particles are driven from the sun by the repulsion of light and reach the earth's atmosphere, setting up electrical currents, manifest in aurora and magnetic disturbances. Arrhenius's calculations, for the size of particle which he regarded as most probable, make the time of transmission to the earth slightly under two days. Amongst other theories which ascribe magnetic storms to direct solar action may be mentioned that of Kr. Birkeland,[49] who believes the vehicle to be cathode rays. Ch. Nordmann[50] similarly has suggested Röntgen rays. Supposing the sun the ultimate source, it would be easier to discriminate between the theories if the exact time of the originating occurrence could be fixed. For instance, a disturbance that is propagated with the velocity of light may be due to Röntgen rays, but not to Arrhenius's particles. In support of his theory, Nordmann mentions several cases when conspicuous visual phenomena on the sun have synchronized with magnetic movements on the earth—the best known instance being the apparent coincidence in time of a magnetic disturbance at Kew on the 1st of September 1859 with a remarkable solar outburst seen by R. C. Carrington. Presumably any electrical phenomenon on the sun will set up waves in the aether, so transmission of electric and magnetic disturbances from the sun to the earth with the velocity of light is a certainty rather than a hypothesis; but it by no means follows that the energy thus transmitted can give rise to sensible magnetic disturbances. Also, when considering Nordmann's coincidences, it must be remembered that magnetic movements are so numerous that it would be singular if no apparent coincidences had been noticed. Another consideration is that the movements shown by ordinary magnetographs are seldom very rapid. During some storms, especially those accompanied by unusually bright and rapidly varying auroral displays, large to and fro movements follow one another in close succession, the changes being sometimes too quick to be registered distinctly on the photographic paper. This, however, is exceptional, even in polar regions where disturbances are largest and most numerous. As a rule, even when the change in the direction of movement in the declination needle seems quite sudden, the movement in one direction usually lasts for several minutes, often for 10, 15 or 30 minutes. Thus the cause to which magnetic disturbances are due seems in many cases to be persistent in one direction for a considerable time.

§ 38. Attempts have been made to discriminate between the theories as to magnetic storms by a critical examination of the phenomena. A general connexion between sun-spot frequency and the amplitude of magnetic movements, regular and irregular, is generally admitted. If it is a case of cause and effect, and the interval between the solar and terrestrial phenomena does not exceed a few hours, then there should be a sensible connexion between corresponding daily values of the sun-spot frequency and the magnetic range. Even if only some sun-spots are effective, we should expect when we select from a series of years two groups of days, the one containing the days of most sun-spots, the other the days of least, that a prominent difference will exist between the mean values of the absolute daily magnetic ranges for the two groups. Conversely, if we take out the days of small and the days of large magnetic range, or the days that are conspicuously quiet and those that are highly disturbed, we should expect a prominent difference between the corresponding mean sun-spot areas. An application of this principle was made by Chree[23] to the five quiet days a month selected by the astronomer royal between 1890 and 1900. These days are very quiet relative to the average day and possess a much smaller absolute range. One would thus have expected on Birkeland's or Nordmann's theory the mean sun-spot frequency derived from Wolfer's provisional values for these days to be much below his mean value, 41·22, for the eleven years. It proved, however, to be 41·28. This practical identity was as visible in 1892 to 1895, the years of sun-spot maximum, as it was in the years of sun-spot minimum. Use was next made of the Greenwich *projected* sun-spot areas, which are the result of exact measurement. The days of each month were divided into three groups, the first and third—each normally of ten days—containing respectively the days of largest and the days of least sun-spot area. The mean sun-spot area from group 1 was on the average about five times that for group 3. It was then investigated how the astronomer royal's quiet days from 1890 to 1900, and how the most disturbed days of the period selected from the Kew[24] magnetic records, distributed themselves among the three groups of days. Nineteen months were excluded, as containing more than ten days with no sun-spots. The remaining 113 months contained 565 quiet and 191 highly disturbed days, whose distribution was as follows:

	Group 1.	Group 2.	Group 3.
Quiet days	179	195	191
Disturbed days	68	65	58

The group of days of largest sun-spot area thus contained slightly under their share of quiet days and slightly over their share of disturbed days. The differences, however, are not large, and in three years, viz. 1895, 1897 and 1899, the largest number of disturbed days actually occurred in group 3, while in 1895, 1896 and 1899 there were fewer quiet days in group 3 than in group 1. Taking the same distribution of days, the mean value of the absolute daily range of declination at Kew was calculated for the group 1 and the group 3 days of each month. The mean range from the group 1 days was the larger in 57% of the individual months as against 43% in which it was the smaller. When the days of each month were divided into groups according to the absolute declination range at Kew, the mean sun-spot area for the group 1 days (those of largest range) exceeded that for the group 3 days (those of least range) in 55% of the individual months, as against 45% of cases in which it was the smaller.

Taking next the five days of largest and the five days of least range in each month, sun-spot areas were got out not merely for these days themselves, but also for the next subsequent day and the four immediately preceding days in each case. On Arrhenius's theory we should expect the magnetic range to vary with the sun-spot area, not on the actual day but two days previously. The following figures give the percentage excess or deficiency of the mean sun-spot area for the respective groups of days, relative to the average value for the whole epoch dealt with. n denotes the day to which the magnetic range belongs, $n+1$ the day after, $n-1$ the day before, and so on. Results are given for 1894 and 1895, the years which were on the whole the most favourable and the least favourable for Arrhenius's hypothesis, as well as for the whole eleven years.

TABLE XL.

Day.		$n-4$	$n-3$	$n-2$	$n-1$	n	$n+1$
Five days of largest range	1894	+12	+ 9	+11	+12	+11	+6
	1895	−16	−17	−15	−12	−11	−10
	11 yrs.	+ 9	+ 8	+ 8	+ 7	+ 5	+ 0·5
Five days of least range	1894	−15	−17	−19	−21	−21	−19
	1895	+17	+10	+ 1	− 2	− 2	− 4
	11 yrs.	− 4	− 4	− 7	− 7	− 7	− 6

Taking the 11-year-means we have the sun-spot area practically normal on the day subsequent to the representative day of large magnetic range, but sensibly above its mean on that day and still more so on the four previous days. This suggests an emission from the sun taking a highly variable time to travel to the earth. The 11-year mean data for the five days of least range seem at first sight to point to the same conclusion, but the fact that the deficiency in sun-spot area is practically as prominent on the day after the representative day of small magnetic range as on that day itself, or the previous days, shows that the phenomenon is probably a secondary one. On the whole, taking into account the extraordinary differences between the results from individual years, we seem unable to come to any very positive conclusion, except that in the present state of our knowledge little if any clue is afforded by the extent of the sun's spotted area on any particular day as to the magnetic conditions on the earth on that or any individual subsequent day. Possibly some more definite information might be extracted by considering the extent of spotted area on different zones of the sun. On theories such as those of Arrhenius or Maunder, effective bombardment of the earth would be more or less confined to spotted areas in the zones nearest the centre of the visible hemisphere, whilst all spots on this hemisphere contribute to the total spotted area. Still the *projected* area of a spot rapidly diminishes as it approaches the edge of the visible hemisphere, *i.e.* as it recedes from the most effective position, so that the method employed above gives a preponderating weight to the central zones. One rather noteworthy feature in Table XL. is the tendency to a sequence in the figures in any one row. This seems to be due, at least in large part, to the fact that days of large and days of small sun-spot area tend to occur in groups. The same is true to a certain extent of days of large and days of small magnetic range, but it is unusual for the range to be much above the average for more than 3 or 4 successive days.

§ 39. The records from ordinary magnetographs, even when run at the usual rate and with normal sensitiveness, not infrequently show **Pulsations.** a repetition of regular or nearly regular small rhythmic movements, lasting sometimes for hours. The amplitude and period on different occasions both vary widely. Periods of 2 to 4 minutes are the most common. W. van Bemmelen[61] has made a minute examination of these movements from several years' traces at Batavia, comparing the results with corresponding statistics sent him from Zi-ka-wei and Kew. Table XLI. shows the diurnal variation in the frequency of occurrence of these small movements—called *pulsations* by van Bemmelen—at these three stations. The Batavia results are from the years 1885 and 1892 to 1898. Of the two sets of data for Zi-ka-wei (i) answers to the years 1897, 1898 and 1900, as given by van Bemmelen, while (ii) answers to the period 1900–1905, as given in the Zi-ka-wei *Bulletin* for 1905. The Kew data are for 1897. The results are expressed as percentages of the total for the 24 hours. There is a remarkable contrast between Batavia and Zi-ka-wei on the one hand and Kew on the other, pulsations being much more numerous by night than by day at the two former stations, whereas at Kew the exact reverse holds. Van Bemmelen decided that almost all the occasions of pulsation at Zi-ka-wei were also occasions of pulsations at Batavia. The hours of commencement at the two places usually differed a little, occasionally by as much as 20 minutes; but this he ascribed to the fact that the earliest oscillations were too small at one or other of the stations to be visible on the trace. Remarkable coincidence between pulsations at Potsdam and in the north of Norway has been noted by Kr. Birkeland.[49]

With magnetographs of greater sensitiveness and more open time scales, waves of shorter period become visible. In 1882 F. Kohlrausch[52] detected waves with a period of about 12 seconds. Eschenhagen[53] observed a great variety of short period waves, 30 seconds being amongst the most common. Some of the records he obtained suggest the superposition of regular sine waves of different periods. Employing a very sensitive galvanometer to record changes of magnetic induction through a coil traversed by the earth's lines of force, H. Ebert[54] has observed vibrations whose periods are but a small fraction of a second. The observations of Kohlrausch and Eschenhagen preceded the recent great development of applications of electrical power, while longer period waves are shown in the Kew curves of 50 years ago, so that the existence of natural waves with periods of from a few seconds up to several minutes can hardly be doubted. Whether the much shorter period waves of Ebert are also natural is more open to doubt, as it is becoming exceedingly difficult in civilized countries to escape artificial disturbances.

TABLE XLI.—Diurnal Distribution of Pulsations.

Hours.	0–3.	3–6.	6–9.	9–Noon.	Noon–3.	3–6.	6–9.	9–12.
Batavia .	28	9	2	6	8	6	13	28
Zi-ka-wei (i)	33	5	2	7	4	4	10	35
" (ii)	23	6	8	11	7	5	14	26
Kew .	4	8	19	14	22	18	11	4

§ 40. The fact that the moon exerts a small but sensible effect on the earth's magnetism seems to have been first discovered in 1841 by C. Kreil. Subsequently Sabine[55] investigated **Lunar Influence.** the nature of the lunar diurnal variation in declination at Kew, Toronto, Pekin, St Helena, Cape of Good Hope and Hobart. The data in Table XLII. are mostly due to Sabine. They represent the mean lunar diurnal inequality in declination for the whole year. The unit employed is 0′·001, and as in our previous tables + denotes movement to the *west*. By "mean departure" is meant the arithmetic mean of the 24 hourly departures from the mean value for the lunar day; the range is the difference between the algebraically greatest and least of the hourly values. Not infrequently the mean departure gives the better idea of the importance of an inequality, especially when as in the present case two maxima and minima occur in the day. This double daily period is unusually prominent in the case of the lunar diurnal inequality, and is seen in the other elements as well as in the declination.

Lunar action has been specially studied in connexion with observations from India and Java. Broun[56] at Trivandrum and C. Chambers[57] at Kolaba investigated lunar action from a variety of aspects. At Batavia van der Stok[58] and more recently S. Figee[59] have carried out investigations involving an enormous amount of computation. Table XLIII. gives a summary of Figee's results for the mean lunar diurnal inequality at Batavia, for the two half-yearly periods April to September (Winter or W.), and October to March (S.). The + sign denotes movement to the west in the case of declination, but numerical increase in the case of the other elements. In the case of H and T (total force) the results for the two seasons present comparatively small differences, but in the case of D, I and V the amplitude and phase both differ widely. Consequently a mean lunar diurnal variation derived from all the months of the year gives at Batavia, and presumably at other

TABLE XLII.—Lunar Diurnal Inequality of Declination (unit 0′·001).

Lunar Hour.	Kew. 1858–1862.	Toronto. 1843–1848.	Batavia. 1883–1899.	St Helena. 1843–1847.	Cape. 1842–1846.	Hobart. 1841–1848.
0	+103	+315	−70	− 43	−148	− 98
1	+160	+275	−63	− 5	−107	−138
2	+140	+158	−39	+ 37	− 35	−142
3	+ 33	+ 2	− 8	+ 70	+ 43	−107
4	+ 10	−153	+38	+ 85	+108	− 45
5	− 67	−265	+63	+ 77	+140	+ 27
6	−150	−302	+87	+ 48	+132	+ 88
7	−188	−255	+77	+ 5	+ 82	+122
8	−160	−137	+40	− 43	+ 5	+120
9	− 78	+ 7	− 4	− 82	− 78	+ 82
10	+ 2	+178	−45	−102	−143	+ 17
11	+ 92	+288	−80	− 98	−177	− 57
12	+160	+323	−87	− 73	−165	−120
13	+188	+272	−68	− 32	−112	−152
14	+158	+148	−43	+ 13	− 30	−147
15	+ 90	− 17	− 8	+ 52	+ 58	−105
16	+ 10	−180	+30	+ 73	+132	− 35
17	− 85	−297	+62	+ 73	+172	+ 45
18	−142	−337	+72	+ 52	+168	+112
19	−163	−290	+68	+ 17	+122	+152
20	−147	−170	+52	− 25	+ 45	+152
21	−123	− 7	+ 8	− 58	− 40	+113
22	− 40	+155	−28	− 73	−112	+ 47
23	+ 27	+265	−56	− 68	−153	− 30
Mean Departure	105	200	50	54	104	93
Range .	376	660	174	187	349	304

Table XLIII.—Lunar Diurnal Inequality at Batavia in Winter and Summer.

	Declination (unit 0′·001).		Inclination, S. (unit 0′·001).		H. (unit 0·01γ).		V. (unit 0·01γ).		T. (unit 0·01γ).	
Lunar Hour.	W.	S.	W.	S.	W.	S.	W.	S.	W.	S.
0	+30	−170	− 1	+25	−15	− 56	− 9	+ 4	− 17	−47
1	+21	−147	−23	+49	−40	− 87	−54	+20	− 61	−67
2	+ 5	− 83	−49	+69	−25	−107	−82	+37	− 62	−76
3	− 5	− 12	−51	+47	−21	− 76	−83	+24	− 59	−55
4	+ 1	+ 76	−37	+43	−13	− 59	−58	+18	− 39	−38
5	− 8	+134	−23	+12	+10	− 9	−27	+11	− 4	− 3
6	− 7	+181	− 2	−21	+21	+ 43	+ 9	− 6	+ 23	+35
7	−10	+164	+30	−12	+23	+ 45	+55	+ 8	+ 47	+43
8	− 7	+ 86	+36	−21	+38	+ 52	+71	− 1	+ 68	+45
9	− 8	0	+28	−23	+46	+ 30	+64	−16	+ 71	+19
10	− 5	− 85	+34	−20	+13	+ 13	+54	−21	+ 38	+ 1
11	−15	−144	+27	−11	−12	− 6	+31	−19	+ 5	−15
12	− 9	−164	+19	− 5	−47	− 23	0	−19	− 41	−29
13	+ 1	−136	− 3	+17	−59	− 46	−36	− 2	− 69	−41
14	− 7	− 79	−13	+27	−66	− 44	−55	+14	− 84	−32
15	− 8	− 8	−32	+25	−53	− 37	−74	+14	− 82	−26
16	−12	+ 72	−37	+25	−34	− 17	−70	+26	− 64	− 2
17	−13	+137	−33	+ 4	− 1	+ 28	−47	+21	− 24	+35
18	−21	+165	− 2	−10	+20	+ 47	+ 8	+12	+ 21	+47
19	−12	+147	+21	−42	+44	+ 81	+53	−14	+ 64	+64
20	+10	+ 95	+21	−62	+75	+107	+71	−28	+100	+80
21	+13	+ 4	+26	−70	+65	+ 98	+72	−44	+ 92	+65
22	+25	− 82	+35	−41	+35	+ 35	+68	−38	+ 64	+12
23	+36	−147	+34	− 4	− 7	− 14	+44	−13	+ 15	−19
Mean Departure	12	150	26	29	33	48	50	18	51	37
Range	57	351	87	139	141	214	155	81	184	156

tropical stations, an inadequate idea of the importance of the lunar influence. In January Figee finds for the range of the lunar diurnal inequality 0′·62 in D, 3·1γ in H and 3·5γ in V, whereas the corresponding ranges in June are only 0′·13, 1·1γ and 2·2γ respectively. The difference between summer and winter is essentially due to solar action, thus the lunar influence on terrestrial magnetism is clearly a somewhat complex phenomenon. From a study of Trivandrum data, Broun concluded that the action of the moon is largely dependent on the solar hour at the time, being on the average about twice as great for a day hour as for a night hour. Figee's investigations at Batavia point to a similar conclusion. Following a method suggested by Van der Stok, Figee arrives at a numerical estimate of the "lunar activity" for each hour of the solar day, expressed in terms of that at noon taken as 100. In summer, for instance, in the case of D he finds the "activity" varying from 114 at 10 a.m. to only 8 at 9 p.m.; the corresponding extremes in the case of H are 139 at 10 a.m. and 54 at 6 a.m.

The question whether lunar influence increases with sun-spot frequency is obviously of considerable theoretical interest. Balfour Stewart in the 9th edition of this encyclopaedia gave some data indicating an appreciably enhanced lunar influence at Trivandrum during years of sun-spot maximum, but he hesitated to accept the result as finally proved. Figee recently investigated this point at Batavia, but with inconclusive results. Attempts have also been made to ascertain how lunar influence depends on the moon's declination and phase, and on her distance from the earth. The difficulty in these investigations is that we are dealing with a small effect, and a very long series of data would be required satisfactorily to eliminate other periodic influences.

Planetary Influence. § 41. From an analysis of seventeen years data at St Petersburg and Pavlovsk, Leyst[60] concluded that all the principal planets sensibly influence the earth's magnetism. According to his figures, all the planets except Mercury—whose influence he found opposite to that of the others—when nearest the earth tended to deflect the declination magnet at St Petersburg to the west, and also increased the range of the diurnal inequality of declination, the latter effect being the more conspicuous. Schuster,[61] who has considered the evidence advanced by Leyst from the mathematical standpoint, considers it to be inconclusive.

Magnetic Surveys. § 42. The best way of carrying out a magnetic survey depends on where it has to be made and on the object in view. The object that probably still comes first in importance is a knowledge of the declination, of sufficient accuracy for navigation in all navigable waters. One might thus infer that magnetic surveys consist mainly of observations at sea. This cannot however be said to be true of the past, whatever it may be of the future, and this for several reasons. Observations at sea entail the use of a ship, specially constructed so as to be free from disturbing influence, and so are inherently costly; they are also apt to be of inferior accuracy. It might be possible in quiet weather, in a large vessel free from vibration, to observe with instruments of the highest precision such as a unifilar magnetometer, but in the ordinary surveying ship apparatus of less sensitiveness has to be employed. The declination is usually determined with some form of compass. The other elements most usually found directly at sea are the inclination and the total force, the instrument employed being a special form of inclinometer, such as the Fox circle, which was largely used by Ross in the Antarctic, or in recent years the Lloyd-Creak. This latter instrument differs from the ordinary dip-circle fitted for total force observations after H. Lloyd's method mainly in that the needles rest in pivots instead of on agate edges. To overcome friction a projecting pin on the framework is scratched with a roughened ivory plate.

The most notable recent example of observations at sea is afforded by the cruises of the surveying ships "Galilee" and "Carnegie" under the auspices of the Carnegie Institution of Washington, which includes in its magnetic programme a general survey. To see where the ordinary land survey assists navigation, let us take the case of a country with a long sea-board. If observations were taken every few miles along the coast results might be obtained adequate for the ordinary wants of coasting steamers, but it would be difficult to infer what the declination would be 50 or even 20 miles off shore at any particular place. If, however, the land area itself is carefully surveyed, one knows the trend of the lines of equal declination, and can usually extend them with considerable accuracy many miles out to sea. One also can tell what places if any on the coast suffer from local disturbances, and thus decide on the necessity of special observations. This is by no means the only immediately useful purpose which is or may be served by magnetic surveys on land. In Scandinavia use has been made of magnetic observations in prospecting for iron ore. There are also various geological and geodetic problems to whose solution magnetic surveys may afford valuable guidance. Among the most important recent surveys may be mentioned those of the British Isles by A. Rücker and T. E. Thorpe,[62] of France and Algeria by Moureaux,[63] of Italy by Chistoni and Palazzo,[64] of the Netherlands by Van Ryckevorsel,[65] of South Sweden by Carlheim Gyllensköld,[66] of Austria-Hungary by Liznar,[67] of Japan by Tanakadate,[68] of the East Indies by Van Bemmelen, and South Africa by J. C. Beattie. A survey of the United States has been proceeding for a good many years, and many results have appeared in the publications of the U.S. Coast and Geodetic Survey, especially Bauer's *Magnetic Tables and Magnetic Charts*, 1908. Additions to our knowledge may also be expected from surveys of India, Egypt and New Zealand.

For the satisfactory execution of a land survey, the observers must have absolute instruments such as the unifilar magnetometer and dip circle, suitable for the accurate determination of the magnetic elements, and they must be able to fix the exact positions of the spots where observations are taken. If, as usual, the survey occupies several years, what is wanted is the value of the elements not at the actual time of observation, but at some fixed epoch, possibly some years earlier or later. At a magnetic observatory, with standardized records, the difference between the values of a magnetic element at any two specified instants can be derived from the magnetic curves. But at an ordinary survey station, at a distance from an observatory, the information is not immediately available. Ordinarily the reduction to a fixed epoch is done in at least two stages, a correction being applied for secular change, and a second for the departure from the mean value for the day due to the regular diurnal inequality and to disturbance.

The reduction to a fixed epoch is at once more easy and more accurate if the area surveyed contains, or has close to its borders, a well distributed series of magnetic observatories, whose records are comparable and trustworthy. Throughout an area of the size of France or Germany, the secular change between any two specified dates can ordinarily be expressed with sufficient accuracy by a formula of the type

$$\delta=\delta_0+a(l-l_0)+b(\lambda-\lambda_0) \quad . \quad . \quad \text{(i)},$$

where δ denotes secular change, l latitude and λ longitude, the letters with suffix o relating to some convenient central position. The constants δ_0, a, b are to be determined from the observed secular changes at the fixed observatories whose geographical co-ordinates are accurately known. Unfortunately, as a rule, fixed observatories are few in number and not well distributed for survey purposes; thus the secular change over part at least of the area has usually to be found by repeating the observations after some years at several of the field stations. The success attending this depends on the exactitude with which the sites can be recovered, on the accuracy of the observations, and on the success with which allowance is made for diurnal changes, regular and irregular. It is thus desirable that the observations at repeat stations should be taken at hours when the regular diurnal changes are slow, and that they should not be accepted unless taken on days that prove to be magnetically quiet. Unless the secular change is exceptionally rapid, it will usually be most convenient in practice to calculate it from or to the middle of the month, and then to allow for the difference between the mean value for the month and the value at the actual hour of observation. There is here a difficulty, inasmuch as the latter part of the correction depends on the diurnal inequality, and so on the local time of the station. No altogether satisfactory method of surmounting this difficulty has yet been proposed. Rücker and Thorpe in their British survey assumed that the divergence from the mean value at any hour at any station might be regarded as made up of a regular diurnal inequality, identical with that at Kew when both were referred to *local* time, and of a disturbance element identical with that existing at the same absolute time at Kew. Suppose, for instance, that at hour h G.M.T. the departure at Kew from the mean value for the month is d, then the corresponding departure from the mean at a station λ degrees west of Kew is $d-e$, where e is the increase in the element at Kew due to the regular diurnal inequality between hour $h-\lambda/15$ and hour h. This procedure is simple, but is exposed to various criticisms. If we define a diurnal inequality as the result obtained by combining hourly readings from all the days of a month, we can assign a definite meaning to the diurnal inequality for a particular month of a particular year, and after the curves have been measured we can give exact numerical figures answering to this definition. But the diurnal inequality thus obtained differs, as has been pointed out, from that derived from a limited number of the quietest days of the month, not merely in amplitude but in phase, and the view that the diurnal changes on any individual day can be regarded as made up of a regular diurnal inequality of definite character and of a disturbance element is an hypothesis which is likely at times to be considerably wide of the mark. The extent of the error involved in assuming the regular diurnal inequality the same in the north of Scotland, or the west of Ireland, as in the south-east of England remains to be ascertained. As to the disturbance element, even if the disturbing force were of given magnitude and direction all over the British Isles—which we now know is often very far from the case—its effects would necessarily vary very sensibly owing to the considerable variation in the direction and intensity of the local undisturbed force. If observations were confined to hours at which the regular diurnal changes are slow, and only those taken on days of little or no disturbance were utilized, corrections combining the effects of regular and irregular diurnal changes could be derived from the records of fixed observations, supposed suitably situated, combined in formulae of the same type as (1).

§ 43. The field results having been reduced to a fixed epoch, it remains to combine them in ways likely to be useful. In most cases the results are embodied in charts, usually of at least two kinds, one set showing only general features, the other the chief local peculiarities. Charts of the first kind resemble the world charts (figs. 1 to 4) in being free from sharp twistings and convolutions. In these the declination for instance at a fixed geographical position on a particular isogonal is to be regarded as really a mean from a considerable surrounding area.

Various ways have been utilized for arriving at these *terrestrial isomagnetics*—as Rücker and Thorpe call them—of which an elaborate discussion has been made by E. Mathias.[69] From a theoretical standpoint the simplest method is perhaps that employed by Liznar for Austria-Hungary. Let l and λ represent latitude and longitude relative to a certain central station in the area. Then assume that throughout the area the value E of any particular magnetic element is given by a formula

$$E = E_0 + al + b\lambda + cl^2 + d\lambda^2 + el\lambda,$$

where E_0, a, b, c, d, e are absolute constants to be determined from the observations. When determining the constants, we write for E in the equation the observed value of the element (corrected for secular change, &c.) at each station, and for l and λ the latitude and longitude of the station relative to the central station. Thus each station contributes an equation to assist in determining the six constants. They can thus be found by least squares or some simpler method. In Liznar's case there were 195 stations, so that the labour of applying least squares would be considerable. This is one objection to the method. A second is that it may allow undesirably large weight to a few highly disturbed stations. In the case of the British Isles, Rücker and Thorpe employed a different method. The area was split up into *districts*. For each district a mean was formed of the observed values of each element, and the mean was assigned to an imaginary central station, whose geographical co-ordinates represented the mean of the geographical co-ordinates of the actual stations. Want of uniformity in the distribution of the stations may be allowed for by weighting the results. Supposing E_0 the value of the element found for the central station of a district, it was assumed that the value E at any actual station whose latitude and longitude exceeded those of the central station by l and λ was given by $E = E_0 + al + b\lambda$, with a and b constants throughout the district. Having found E_0, a and b, Rücker and Thorpe calculated values of the element for points defined by whole degrees of longitude (from Greenwich) and half degrees of latitude. Near the common border of two districts there would be two calculated values, of which the arithmetic mean was accepted.

The next step was to determine by interpolation where isogonals —or other isomagnetic lines—cut successive lines of latitude. The curves formed by joining these successive points of intersection were called *district* lines or curves. Rücker and Thorpe's next step was to obtain formulae by trial, giving smooth curves of continuous curvature—terrestrial isomagnetics—approximating as closely as possible to the district lines. The curves thus obtained had somewhat complicated formulae. For instance, the isogonals south of 54°·5 latitude were given for the epoch Jan. 1, 1891 by

$$\begin{aligned} D = {} & 18^\circ\ 37' + 18'{\cdot}5(l-49{\cdot}5) - 3'{\cdot}5 \cos\{45^\circ(l-49{\cdot}5)\} \\ & + \{26'{\cdot}3 + 1'{\cdot}5(l-49{\cdot}5)\}(\lambda-4) + 0'{\cdot}01(\lambda-4)^2(l-54{\cdot}5)^2, \end{aligned}$$

where D denotes the westerly declination. Supposing, what is at least approximately true, that the secular change in Great Britain since 1891 has been uniform south of lat. 54°·5, corresponding formulae for the epochs Jan. 1, 1901, and Jan. 1, 1906, could be obtained by substituting for 18° 37′ the values 17° 44′ and 17° 24′ respectively. In their very laborious and important memoir E. Mathias and B. Baillaud[69] have applied to Rücker and Thorpe's observations a method which is a combination of Rücker and Thorpe's and of Liznar's. Taking Rücker and Thorpe's nine districts, and the magnetic data found for the nine imaginary central stations, they employed these to determine the six constants of Liznar's formula. This is an immense simplification in arithmetic. The declination formula thus obtained for the epoch Jan. 1, 1891, was

$$\begin{aligned} D = 20^\circ\ 45'{\cdot}89 + {\cdot}53474\lambda + {\cdot}34716l + {\cdot}000021\lambda^2 \\ + {\cdot}000343l\lambda - {\cdot}000239l^2, \end{aligned}$$

where $l+(53^\circ\ 30'{\cdot}5)$ represents the latitude, and $(\lambda+5^\circ\ 35'{\cdot}2)$ the west longitude of the station. From this and the corresponding formulae for the other elements, values were calculated for each of Rücker and Thorpe's 882 stations, and these were compared with the observed values. A complete record is given of the differences between the observed and calculated values, and of the corresponding differences obtained by Rücker and Thorpe from their own formulae. The mean numerical (calculated ∼ observed) differences from the two different methods are almost exactly the same—being approximately 10′ for declination, $5'\frac{1}{2}$ for inclination, and 70γ for horizontal force. The applications by Mathias[69] of his method to the survey data of France obtained by Moureaux, and those of the Netherlands obtained by van Rijckevorsel, appear equally successful. The method dispenses entirely with district curves, and the parabolic formulae are perfectly straightforward both to calculate and to apply; they thus appear to possess marked advantages. Whether the method could be applied equally satisfactorily to an area of the size of India or the United States actual trial alone would show.

Local Disturbances.

§ 44. Rücker and Thorpe regarded their terrestrial isomagnetics and the corresponding formulae as representing the normal field that would exist in the absence of disturbances peculiar to the neighbourhood. Subtracting the forces derived from the formulae from those observed, we obtain forces which may be ascribed to regional disturbance.

When the vertical disturbing force is downwards, or the observed vertical component larger than the calculated, Rücker and Thorpe regard it as positive, and the loci where the largest positive values occur they termed *ridge lines*. The corresponding loci where the largest negative values occur were called *valley lines*. In the British Isles Rücker and Thorpe found that almost without exception, in the neighbourhood of a ridge line, the horizontal component of the disturbing force pointed towards it, throughout a considerable area on both sides. The phenomena are similar to what would occur if ridge lines indicated the position of the summits of underground masses of magnetic material, magnetized so as to attract the north-seeking pole of a magnet. Rücker and Thorpe were inclined to believe in the real existence of these subterranean magnetic mountains, and inferred that they must be of considerable extent, as theory and observation alike indicate that thin basaltic sheets or dykes, or limited masses of trap rock, produce no measurable magnetic effect except in their immediate vicinity. In support of their conclusions, Rücker and Thorpe dwell on the fact that in the United Kingdom large masses of basalt such as occur in Skye, Mull, Antrim, North Wales or the Scottish coalfield, are according to their survey invariably centres of attraction for the north-seeking pole of a magnet. Various cases of repulsion have, however, been described by other observers in the northern hemisphere.

§ 45. Rücker and Thorpe did not make a very minute examination of disturbed areas, so that purely local disturbances larger than any noticed by them may exist in the United Kingdom. But any that exist are unlikely to rival some that have been observed elsewhere, notably those in the province of Kursk in Russia described by Moureaux[70] and by E. Leyst.[71] In Kursk Leyst observed declinations varying from 0° to 360°, inclinations varying from 39°·1 to 90°; he obtained values of the horizontal force varying from 0 to 0·856 C.G.S., and values of the vertical force varying from 0·371 to 1·836. Another highly disturbed Russian district Krivoi Rog

(48° N. lat. 33° E. long.) was elaborately surveyed by Paul Passalsky.[72] The extreme values observed by him differed, the declination by 282° 40′, the inclination by 41° 53′, horizontal force by 0·658, and vertical force by 1·358. At one spot a difference of 116°½ was observed between the declinations at two positions only 42 metres apart. In cases such as the last mentioned, the source of disturbance comes presumably very near the surface. It is improbable that any such enormously rapid changes of declination can be experienced anywhere at the surface of a deep ocean. But in shallow water disturbances of a not very inferior order of magnitude have been met with. Possibly the most outstanding case known is that of an area, about 3 m. long by 1¼ m. at its widest, near Port Walcott, off the N.W. Australian coast. The results of a minute survey made here by H.M.S. "Penguin" have been discussed by Captain E. W. Creak.[73] Within the narrow area specified, declination varied from 26° W. to 56° E., and inclination from 50° to nearly 80°, the observations being taken some 80 ft. above sea bottom. Another noteworthy case, though hardly comparable with the above, is that of East Loch Roag at Lewis in the Hebrides. A survey by H.M.S. "Research" in water about 100 ft. deep—discussed by Admiral A. M. Field[74]—showed a range of 11° in declination. The largest observed disturbances in horizontal and vertical force were of the order 0·02 and 0·05 C.G.S. respectively. An interesting feature in this case was that vertical force was reduced, there being a well-marked valley line.

In some instances regional magnetic disturbances have been found to be associated with geodetic anomalies. This is true of an elongated area including Moscow, where observations were taken by Fritsche.[75] Again, Eschenhagen [76] detected magnetic anomalies in an area including the Harz Mountains in Germany, where deflections of the plumb line from the normal had been observed. He found a magnetic ridge line running approximately parallel to the line of no deflection of the plumb line.

§ 46. A question of interest, about which however not very much is known, is the effect of local disturbance on secular change and on the diurnal inequality. The determination of secular change in a highly disturbed locality is difficult, because an unintentional slight change in the spot where the observations are made may wholly falsify the conclusions drawn. When the disturbed area is very limited in extent, the magnetic field may reasonably be regarded as composed of the normal field that would have existed in the absence of local disturbance, plus a disturbance field arising from magnetic material which approaches nearly if not quite to the surface. Even if no sensible change takes place in the disturbance field, one would hardly expect the secular change to be wholly normal. The changes in the rectangular components of the force may possibly be the same as at a neighbouring undisturbed station, but this will not give the same change in declination and inclination. In the case of the diurnal inequality, the presumption is that at least the declination and inclination changes will be influenced by local disturbance. If, for example, we suppose the diurnal inequality to be due to the direct influence of electric currents in the upper atmosphere, the declination change will represent the action of the component of a force of given magnitude which is perpendicular to the position of the compass needle. But when local disturbance exists, the direction of the needle and the intensity of the controlling field are both altered by the local disturbance, so it would appear natural for the declination changes to be influenced also. This conclusion seems borne out by observations made by Passalsky[72] at Krivoi Rog, which showed diurnal inequalities differing notably from those experienced at the same time at Odessa, the nearest magnetic observatory. One station where the horizontal force was abnormally low gave a diurnal range of declination four times that at Odessa; on the other hand, the range of the horizontal force was apparently reduced. It would be unsafe to draw general conclusions from observations at two or three stations, and much completer information is wanted, but it is obviously desirable to avoid local disturbance when selecting a site for a magnetic observatory, assuming one's object is to obtain data reasonably applicable to a large area. In the case of the older observatories this consideration seems sometimes to have been lost sight of. At Mauritius, for instance, inside of a circle of only 56 ft. radius, having for centre the declination pillar of the absolute magnetic hut of the Royal Alfred Observatory, T. F. Claxton[77] found that the declination varied from 4° 56′ to 13° 45′ W., the inclination from 50° 21′ to 58° 34′ S., and the horizontal force from 0·197 to 0·244 C.G.S. At one spot he found an alteration of 1°⅓ in the declination when the magnet was lowered from 4 ft. above the ground to 2. Disturbances of this order could hardly escape even a rough investigation of the site.

Gaussian Potential and Constants.

§ 47. If we assume the magnetic force on the earth's surface derivable from a potential V, we can express V as the sum of two series of solid spherical harmonics, one containing negative, the other positive integral powers of the radius vector r from the earth's centre. Let λ denote east longitude from Greenwich, and let $\mu=\cos(\tfrac{1}{2}\pi-l)$, where l is latitude; and also let

$$\mathrm{H}_n^m=(1-\mu^2)^{\frac{1}{2}m}\left[\mu^{n-m}-\frac{(n-m)(n-m-1)}{2(2n-1)}\mu^{n-m-2}+\ldots\right],$$

where n and m denote any positive integers, m being not greater than n. Then denoting the earth's radius by R, we have

$$\begin{aligned}\mathrm{V/R}&=\Sigma(\mathrm{R}/r)^{n+1}[\mathrm{H}_n^m(g_n^m\cos m\lambda+h_n^m\sin m\lambda)]\\&+\Sigma(r/\mathrm{R})^n[\mathrm{H}_n^m(g_{-n}^m\cos m\lambda+h_{-n}^m\sin m\lambda)],\end{aligned}$$

where Σ denotes summation of m from 0 to n, followed by summation of n from 0 to ∞. In this equation g_n^m, &c. are constants, those with positive suffixes being what are generally termed *Gaussian constants*. The series with negative powers of r answers to forces with a source internal to the earth, the series with positive powers to forces with an external source. Gauss found that forces of the latter class, if existent, were very small, and they are usually left out of account. There are three Gaussian constants of the first order, $g_1{}^\circ$, $g_1{}^1$, $h_1{}^1$, five of the second order, seven of the third, and so on. The coefficient of a Gaussian constant of the n^{th} order is a spherical harmonic of the n^{th} degree. If R be taken as unit length, as is not infrequent, the first order terms are given by

$$\mathrm{V}_1=r^{-2}[g_1{}^\circ\sin l+(g_1{}^1\cos\lambda+h_1{}^1\sin\lambda)\cos l].$$

The earth is in reality a spheroid, and in his elaborate work on the subject J. C. Adams [78] develops the treatment appropriate to this case. Here we shall as usual treat it as spherical. We then have for the components of the force at the surface

$\mathrm{X}=-\mathrm{R}^{-1}(1-\mu^2)^{\frac{1}{2}}(d\mathrm{V}/d\mu)$ towards the astronomical north,
$\mathrm{Y}=-\mathrm{R}^{-1}(1-\mu^2)^{-\frac{1}{2}}(d\mathrm{V}/d\lambda)$ " " " west,
$\mathrm{Z}=-d\mathrm{V}/dr$ vertically downwards.

Supposing the Gaussian constants known, the above formulae would give the force all over the earth's surface. To determine the Gaussian constants we proceed of course in the reverse direction, equating the observed values of the force components to the theoretical values involving g_n^m, &c. If we knew the values of the component forces at regularly distributed stations all over the earth's surface, we could determine each Gaussian constant independently of the others. Our knowledge however of large regions, especially in the Arctic and Antarctic, is very scanty, and in practice recourse is had to methods in which the constants are not determined independently. The consequence is unfortunately that the values found for some of the constants, even amongst the lower orders, depend very sensibly on how large a portion of the polar regions is omitted from the calculations, and on the number of the constants of the higher orders which are retained.

TABLE XLIV.—Gaussian Constants of the First Order.

	1829 Erman-Petersen.	1830 Gauss.	1845 Adams.	1880 Adams.	1885 Neumayer.	1885 Schmidt.	1885 Fritsche.
$g_1{}^\circ$	+·32007	+·32348	+·32187	+·31684	+·31572	+·31735	+·31635
$g_1{}^1$	+·02835	+·03111	+·02778	+·02427	+·02481	+·02356	+·02414
$h_1{}^1$	−·06011	−·06246	−·05783	−·06030	−·06026	−·05984	−·05914

Table XLIV. gives the values obtained for the Gaussian constants of the first order in some of the best-known computations, as collected by W. G. Adams.[79]

§ 48. Allowance must be made for the difference in the epochs, and for the fact that the number of constants assumed to be worth retaining was different in each case. Gauss, for instance, assumed 24 constants sufficient, whilst in obtaining the results given in the table J. C. Adams retained 48. Some idea of the uncertainty thus arising may be derived from the fact that when Adams assumed 24 constants sufficient, he got instead of the values in the table the following:—

	$g_1{}^\circ$	$g_1{}^1$	$h_1{}^1$
1842–1845	+·32173	+·02833	−·05820
1880	+·31611	+·02470	−·06071

Some of the higher constants were relatively much more affected. Thus, on the hypotheses of 48 and of 24 constants respectively, the values obtained for $g_2{}^\circ$ in 1842–1845 were −·00127 and −·00057, and those obtained for $h_3{}^1$ in 1880 were +·00748 and +·00573. It must also be remembered that these values assume that the series in positive powers of r, with coefficients having negative suffixes, is absolutely non-existent. If this be not assumed, then in any equation determining X or Y, g_n^m must be replaced by $g_n^m+g_{-n}^m$, and in any equation determining Z by $g_n^m-\{n/(n+1)\}\,g_n^m$; similar remarks apply to h_n^m and h_{-n}^m. It is thus theoretically possible to check the truth of the assumption that the positive power series is non-existent by comparing the values obtained for g_n^m and h_n^m from the X and Y or from the Z equations, when g_{-n}^m and h_{-n}^m are assumed zero. If the values so found differ, values can be found for g_{-n}^m and h_{-n}^m which will harmonize the two sets of equations. Adams gives the values obtained from the X, Y and the Z equations separately for the

Gaussian constants. The following are examples of the values thence deducible for the coefficients of the positive power series:—

	g_{-1}°	g_{-1}^{1}	h_{-1}^{1}	g_{-4}°	g_{-5}°	g_{-6}°
1842–1845	+·0018	−·0002	−·0014	+·0064	+·0072	+·0124
1880	−·0002	−·0012	+·0015	−·0043	−·0021	−·0013

Compared to g_4°, g_5° and g_6° the values here found for g_{-4}°, g_{-5}° and g_{-6}° are far from insignificant, and there would be no excuse for neglecting them if the observational data were sufficient and reliable. But two outstanding features claim attention, first the smallness of g_{-1}°, g_{-1}^{1} and h_{-1}^{1}, the coefficients least likely to be affected by observational deficiencies, and secondly the striking dissimilarity between the values obtained for the two epochs. The conclusion to which these and other facts point is that observational deficiencies, even up to the present date, are such that no certain conclusion can be drawn as to the existence or non-existence of the positive power series. It is also to be feared that considerable uncertainties enter into the values of most of the Gaussian constants, at least those of the higher orders. The introduction of the positive power series necessarily improves the agreement between observed and calculated values of the force, but it is more likely than not to be disadvantageous physically, if the differences between observed values and those calculated from the negative power series alone arise in large measure from observational deficiencies.

TABLE XLV.—Axis and Moment of First Order Gaussian Coefficients.

Epoch.	Authority for Constants.	North Latitude.	West Longitude.	M/R^3 in G.C.S. units.
		° ′	° ′	
1650	H. Fritsche . . .	82 50	42 55	·3260
1836	,,	78 27	63 35	·3262
1845	J. C. Adams	78 44	64 20	·3282
1880	,,	78 24	68 4	·3234
1885	Neumayer-Petersen and Bauer	78 3	67 3	·3224
1885	Neumayer, Schmidt	78 34	68 31	·3230

§ 49. The first order Gaussian constants have a simple physical meaning. The terms containing them represent the potential arising from the uniform magnetization of a sphere parallel to a fixed axis, the moment M of the spherical magnet being given by

$$M = R^3\{(g_1^{\circ})^2 + (g_1^1)^2 + (h_1^1)^2\}^{\frac{1}{2}},$$

where R is the earth's radius. The position of the north end of the axis of this uniform magnetization and the values of M/R^3, derived from the more important determinations of the Gaussian constants, are given in Table XLV. The data for 1650 are of somewhat doubtful value. If they were as reliable as the others, one would feel greater confidence in the reality of the apparent movement of the north end of the axis from east to west. The table also suggests a slight diminution in M since 1845, but it is open to doubt whether the apparent change exceeds the probable error in the calculated values. It should be carefully noticed that the data in the table apply only to the first order Gaussian terms, and so only to a portion of the earth's magnetization, and that the Gaussian constants have been calculated on the assumption that the negative power series alone exists. The field answering to the first order terms—or what Bauer has called the *normal* field—constitutes much the most important part of the whole magnetization. Still what remains is very far from negligible, save for rough calculations. It is in fact one of the weak points in the Gaussian analysis that when one wishes to represent the observed facts with high accuracy one is obliged to retain so many terms that calculation becomes burdensome.

Earth-air Currents.

§ 50. The possible existence of a positive power series is not the only theoretical uncertainty in the Gaussian analysis. There is the further possibility that part of the earth's magnetic field may not answer to a potential at all. Schmidt[80] in his calculation of Gaussian constants regarded this as a possible contingency, and the results he reached implied that as much as 2 or 3 % of the entire field had no potential. If the magnetic force F on the earth's surface comes from a potential, then the line integral $\int F ds$ taken round any closed circuit *s* should vanish. If the integral does not vanish, it equals $4\pi I$, where I is the total electric current traversing the area bounded by *s*. A + sign in the result of the integration means that the current is downwards (*i.e.* from air to earth) or upwards, according as the direction of integration round the circuit, as viewed by an observer above ground, has been clockwise or anti-clockwise. In applications of the formula by W. von Bezold [81] and Bauer [82] the integral has been taken along parallels of latitude in the direction west to east. In this case a + sign indicates a resultant upward current over the area between the parallel of latitude traversed and the north geographical pole. The difference between the results of integration round two parallels of latitude gives the total vertical current over the zone between them. Schmidt's final estimate of the average intensity of the earth-air current, irrespective of sign, for the epoch 1885 was 0·17 ampere per square kilometre. Bauer employing the same observational data as Schmidt, reached somewhat similar conclusions from the differences between integrals taken round parallels of latitude at 5° intervals from 60° N. to 60° S. H. Fritsche [83] treating the problem similarly, but for two epochs, 1842 and 1885, got conspicuously different results for the two epochs, Bauer [84] has more recently repeated his calculations, and for three epochs, 1842–1845 (Sabine's charts), 1880 (Creak's charts), and 1885 (Neumayer's charts), obtaining the mean value of the current per sq. km. for 5° zones. Table XLVI. is based on Bauer's figures, the unit being 0·001 ampere, and + denoting an *upwardly* directed current.

TABLE XLVI.—Earth-air Currents, after Bauer.

Latitude.	Northern Hemisphere.			Southern Hemisphere.		
	1842–5.	1880.	1885.	1842–5.	1880.	1885.
0° to 15°	− 1	−32	−34	+66	+ 30	+ 36
15° ,, 30°	−70	−59	−68	+ 2	− 62	− 63
30° ,, 45°	+ 3	+14	−22	+26	− 11	− 14
45° ,, 60°	−31	−21	+78	+ 5	+276	+213

In considering the significance of the data in Table XLVI., it should be remembered that the currents must be regarded as mean values derived from all hours of the day, and all months of the year. Currents which were upwards during certain hours of the day, and downwards during others, would affect the diurnal inequality; while currents which were upwards during certain months, and downwards during others, would cause an annual inequality in the absolute values. Thus, if the figures be accepted as real, we must suppose that between 15° N. and 30° N. there are preponderatingly downward currents, and between 0° S. and 15° S. preponderatingly upward currents. Such currents might arise from meteorological conditions characteristic of particular latitudes, or be due to the relative distribution of land and sea; but, whatever their cause, any considerable real change in their values between 1842 and 1885 seems very improbable. The most natural cause to which to attribute the difference between the results for different epochs in Table XLVI. is unquestionably observational deficiencies. Bauer himself regards the results for latitudes higher than 45° as very uncertain, but he seems inclined to accept the reality of currents of the average intensity of 1/30 ampere per sq. km. between 45° N. and 45° S.

Currents of the size originally deduced by Schmidt, or even those of Bauer's latest calculations, seem difficult to reconcile with the results of atmospheric electricity (*q.v.*).

§ 51. There is no single parallel of latitude along the whole of which magnetic elements are known with high precision. Thus results of greater certainty might be hoped for from the application of the line integral to well surveyed countries. Such applications have been made, *e.g.* to Great Britain by Rücker,[85] and to Austria by Liznar,[86] but with negative results. The question has also been considered in detail by Tanakadate[68] in discussing the magnetic survey of Japan. He makes the criticism that the taking of a line integral round the *boundary* of a surveyed area amounts to utilizing the values of the magnetic elements where least accurately known, and he thus considers it preferable to replace the line integral by the surface integral.

$$4\pi I = \iint (dY/dx - dX/dy)dxdy.$$

He applied this formula not merely to his own data for Japan, but also to British and Austrian data of Rücker and Thorpe and of Liznar. The values he ascribes to X and Y are those given by the formulae calculated to fit the observations. The result reached was "a line of no current through the middle of the country; in Japan the current is upward on the Pacific side and downward on the Siberian side; in Austria it is upward in the north and downward in the south; in Great Britain upward in the east and downward in the west." The results obtained for Great Britain differed considerably according as use was made of Rücker and Thorpe's own district equations or of a series of general equations of the type subsequently utilized by Mathias. Tanakadate points out that the fact that his investigations give in each case a line of no current passing through the middle of the surveyed area, is calculated to throw doubt on the reality of the supposed earth-air currents, and he recommends a suspension of judgment.

§ 52. A question of interest, and bearing a relationship to the Gaussian analysis, is the law of variation of the magnetic elements with height above sea-level. If F represent the value at sea-level, and $F+\delta F$ that at height *h*, of any component of force answering to Gaussian constants of the n^{th} order, then $1+\delta F/F = (1+h/R)^{-n-2}$, where R is the earth's radius. Thus at heights of only a few miles we have very approximately $\delta F/F = -(n+2)h/R$. As we have seen, the constants of the first order are much the most important, thus we should expect as a first approximation $\delta X/X = \delta Y/Y = \delta Z/Z = -3h/R$. This equation gives the same rate of decrease in all three components, and so no change in declination or inclination. Liznar [86] ([a]) compared this equation with the observed results of his Austrian survey, subdividing his stations into three groups according to altitude. He considered the agreement not satisfactory. It must be remembered that the Gaussian analysis, especially when only lower order terms are retained, applies only to the earth's field freed from local disturbances. Now observations at individual high level stations may be seriously influenced not merely by regional disturbances common to low level stations, but by magnetic material in the mountain itself. A method of arriving at the vertical change in the elements, which theoretically seems less open to criticism, has been employed by A. Tanakadate.[68] If we assume that a potential exists, or if admitting the possibility of earth-air currents we assume their effort negligible, we have $dX/dz=dZ/dx$, $dY/dz=dZ/dy$. Thus from the observed rates of change of the vertical component of force along the parallels of latitude and longitude, we can deduce the rate of change in the vertical direction of the two rectangular components of horizontal force, and thence the rates of change of the horizontal force and the declination. Also we have $dZ/dz=4\pi\rho-(dX/dx+dY/dy)$, where ρ represents the density of free magnetism at the spot. The spot being above ground we may neglect ρ, and thus deduce the variation in the vertical direction of the vertical component from the observed variations of the two horizontal components in their own directions. Tanakadate makes a comparison of the vertical variations of the magnetic elements calculated in the two ways, not merely for Japan, but also for Austria-Hungary and Great Britain. In each country he took five representative points, those for Great Britain being the central stations of five of Rücker and Thorpe's districts. Table XLVII. gives the mean of the five values obtained. By method (i.) is meant the formula involving $3h/R$, by method (ii.) Tanakadate's method as explained above. H, V, D, and I are used as defined in § 5. In the case of H and V unity represents 1γ.

TABLE XLVII.—Change per Kilometre of Height.

	Great Britain.		Austria-Hungary.		Japan.	
Method.	(i.)	(ii.)	(i.)	(ii.)	(i.)	(ii.)
H . .	− 8·1	− 6·7	−10·1	− 8·7	−13·9	−14·0
V . .	−21·2	−19·4	−19·0	−18·1	−17·1	−17·4
D (west)	. .	− 0′·04	. .	+ 0′·10	. .	− 0′·27
I . .	. .	− 0′·05	. .	− 0′·06	. .	− 0′·01

The − sign in Table XLVII. denotes a decrease in the numerical values of H, V and I, and a diminution in westerly declination. If we except the case of the westerly component of force—not shown in the table—the accordance between the results from the two methods in the case of Japan is extraordinarily close, and there is no very marked tendency for the one method to give larger values than the other. In the case of Great Britain and Austria the differences between the two sets of calculated values though not large are systematic, the $3h/R$ formula invariably showing the larger reduction with altitude in both H and V. Tanakadate was so satisfied with the accordance of the two methods in Japan, that he employed his method to reduce all observed Japanese values to sea-level. At a few of the highest Japanese stations the correction thus introduced into the value of H was of some importance, but at the great majority of the stations the corrections were all insignificant.

Schuster's Diurnal Variation Potential.

§ 53. Schuster [87] has calculated a potential analogous to the Gaussian potential, from which the regular diurnal changes of the magnetic elements all over the earth may be derived. From the mean summer and winter diurnal variations of the northerly and easterly components of force during 1870 at St Petersburg, Greenwich, Lisbon and Bombay, he found the values of 8 constants analogous to Gaussian constants; and from considerations as to the hours of occurrence of the maxima and minima of vertical force, he concluded that the potential, unlike the Gaussian, must proceed in positive powers of r, and so answer to forces external to the earth. Schuster found, however, that the calculated amplitudes of the diurnal vertical force inequality did not accord well with observation; and his conclusion was that while the original cause of the diurnal variation is external, and consists probably of electric currents in the atmosphere, there are induced currents inside the earth, which increase the horizontal components of the diurnal inequality while diminishing the vertical. The problem has also been dealt with by H. Fritsche,[88] who concludes, in opposition to Schuster, that the forces are partly internal and partly external, the two sets being of fairly similar magnitude. Fritsche repeats the criticism (already made in the last edition of this encyclopaedia) that Schuster's four stations were too few, and contrasts their number with the 27 from which his own data were derived. On the other hand, Schuster's data referred to one and the same year, whereas Fritsche's are from epochs varying from 1841 to 1896, and represent in some cases a single year's observations, in other cases means from several years. It is clearly desirable that a fresh calculation should be made, using synchronous data from a considerable number of well distributed stations; and it should be done for at least two epochs, one representing large, the other small sun-spot frequency. The year 1870 selected by Schuster had, as it happened, a sun-spot frequency which has been exceeded only once since 1750; so that the magnetic data which he employed were far from representative of average conditions.

Magnetization of Vases, &c.

§ 54. It was discovered by Folgheraiter [89] that old vases from Etruscan and other sources are magnetic, and from combined observation and experiment he concluded that they acquired their magnetization when cooling after being baked, and retained it unaltered. From experiments, he derived formulae connecting the magnetization shown by new clay vases with their orientation when cooling in a magnetic field, and applying these formulae to the phenomena observed in the old vases he calculated the magnetic dip at the time and place of manufacture. His observations led him to infer that in Central Italy inclination was actually southerly for some centuries prior to 600 B.C., when it changed sign. In 400 B.C. it was about 20° N.; since 100 B.C. the change has been relatively small. L. Mercanton [90] similarly investigated the magnetization of baked clay vases from the lake dwellings of Neuchatel, whose epoch is supposed to be from 600 to 800 B.C. The results he obtained were, however, closely similar to those observed in recent vases made where the inclination was about 63°N., and he concluded in direct opposition to Folgheraiter that inclination in southern Europe has not undergone any very large change during the last 2500 years. Folgheraiter's methods have been extended to natural rocks. Thus B. Brunhes [91] found several cases of clay metamorphosed by adjacent lava flows and transformed into a species of natural brick. In these cases the clay has a determinate direction of magnetization agreeing with that of the volcanic rock, so it is natural to assume that this direction coincided with that of the dip when the lava flow occurred. In drawing inferences, allowance must of course be made for any tilting of the strata since the volcanic outburst. From one case in France in the district of St Flour, where the volcanic action is assigned to the Miocene Age, Brunhes inferred a southerly dip of some 75°. Until a variety of cases have been critically dealt with, a suspension of judgment is advisable, but if the method should establish its claims to reliability it obviously may prove of importance to geology as well as to terrestrial magnetism.

Polar Phenomena.

§ 55. Magnetic phenomena in the polar regions have received considerable attention of late years, and the observed results are of so exceptional a character as to merit separate consideration. One feature, the large amplitude of the regular diurnal inequality, is already illustrated by the data for Jan Mayen and South Victoria Land in Tables VIII. to XI. In the case, however, of declination allowance must be made for the small size of H. If a force F perpendicular to the magnetic meridian causes a change ΔD in D then $\Delta D=F/H$. Thus at the "Discovery's" winter quarters in South Victoria Land, where the value of H is only about 0·36 of that at Kew, a change of 45′ in D would be produced by a force which at Kew would produce a change of only 16′. Another feature, which, however, may not be equally general, is illustrated by the data for Fort Rae and South Victoria Land in Table XVII. It will be noticed that it is the 24-hour term in the Fourier analysis of the regular diurnal inequality which is specially enhanced. The station in South Victoria Land—the winter quarters of the "Discovery" in 1902–1904—was at 77° 51′ S. lat.; thus the sun did not set from November to February (midsummer), nor rise from May to July (midwinter). It might not thus have been surprising if there had been an outstandingly large seasonal variation in the type of the diurnal inequality. As a matter of fact, however, the type of the inequality showed exceptionally small variation with the season, and the amplitude remained large throughout the whole year. Thus, forming diurnal inequalities for the three midsummer months and for the three midwinter months, we obtain the following amplitudes for the range of the several elements[92]:—

	D.	H.	V.	I.
Midsummer	64′·1	57γ	58γ	2′·87
Midwinter	26′·8	25γ	18γ	1′·23

The most outstanding phenomenon in high latitudes is the frequency and large size of the disturbances. At Kew, as we saw in § 25, the absolute range in D exceeds 20′ on only 12% of the total number of days. But at the "Discovery's" winter quarters, about sun-spot minimum, the range exceeded 1° on 70%, 2° on 37%, and 3° on fully 15% of the total number of days. One day in 25 had a range exceeding 4°. During the three midsummer months, only one day out of 111 had a range under 1°, and even at midwinter only one day in eight had a range as small as 30′. The H range at the "Discovery's" station exceeded 100γ on 40% of the days, and the V range exceeded 100γ on 32% of the days.

The special tendency to disturbance seen in equinoctial months in temperate latitudes did not appear in the "Discovery's" records in the Antarctic. D ranges exceeding 3° occurred on 11% of equinoctial days, but on 40% of midsummer days. The preponderance of large movements at midsummer was equally apparent in the other elements. Thus the percentage of days having a V range over 200γ was 21 at midsummer, as against 3 in the four equinoctial months.

At the "Discovery's" station small oscillations of a few minutes' duration were hardly ever absent, but the character of the larger disturbances showed a marked variation throughout the 24 hours.

Those of a very rapid oscillatory character were especially numerous in the morning between 4 and 9 a.m. In the late afternoon and evening disturbances of a more regular type became prominent, especially in the winter months. In particular there were numerous occurrences of a remarkably regular type of disturbance, half the total number of cases taking place between 7 and 9 p.m. This "special type of disturbance" was divisible into two phases, each lasting on the average about 20 minutes. During the first phase all the elements diminished in value, during the second phase they increased. In the case of D and H the rise and fall were about equal, but the rise in V was about 3½ times the preceding fall. The disturbing force—on the north pole—to which the first phase might be attributed was inclined on the average about 5°½ below the horizon, the horizontal projection of its line of action being inclined about 41°½ to the north of east. The amplitude and duration of the disturbances of the "special type" varied a good deal; in several cases the disturbing force considerably exceeded 200γ. A somewhat similar type of disturbance was observed by Kr. Birkeland[93] at Arctic stations also in 1902–1903, and was called by him the "polar elementary" storm. Birkeland's record of disturbances extends only from October 1902 to March 1903, so it is uncertain whether "polar elementary" storms occur during the Arctic summer. Their usual time of occurrence seems to be the evening. During their occurrence Birkeland found that there was often a great difference in amplitude and character between the disturbances observed at places so comparatively near together as Iceland, Nova Zembla and Spitzbergen. This led him to assign the cause to electric currents in the Arctic, at heights not exceeding a few hundred kilometres, and he inferred from the way in which the phenomena developed that the seat of the disturbances often moved westward, as if related in some way to the sun's position. Contemporaneously with the "elementary polar" storms in the Arctic Birkeland found smaller but distinct movements at stations all over Europe; these could generally be traced as far as Bombay and Batavia, and sometimes as far as Christchurch, New Zealand. Chree,[92] on the other hand, working up the 1902–1904 Antarctic records, discovered that during the larger disturbances of the "special type" corresponding but much smaller movements were visible at Christchurch, Mauritius, Kolaba, and even at Kew. He also found that in the great majority of cases the Antarctic curves were specially disturbed during the times of Birkeland's "elementary polar" storms, the disturbances in the Arctic and Antarctic being of the same order of magnitude, though apparently of considerably different type.

Examining the more prominent of the sudden commencements of magnetic disturbances in 1902–1903 visible simultaneously in the curves from Kew, Kolaba, Mauritius and Christchurch, Chree found that these were all represented in the Antarctic curves by movements of a considerably larger size and of an oscillatory character. In a number of cases Birkeland observed small simultaneous movements in the curves of his co-operating stations, which appeared to be at least sometimes decidedly larger in the equatorial than the northern temperate stations. These he described as "equatorial" perturbations, ascribing them to electric currents in or near the plane of the earth's magnetic equator, at heights of the order of the earth's radius. It was found, however, by Chree that in many, if not all, of these cases there were synchronous movements in the Antarctic, similar in type to those which occurred simultaneously with the sudden commencements of magnetic storms, and that these Antarctic movements were considerably larger than those described by Birkeland at the equatorial stations. This result tends of course to suggest a somewhat different explanation from Birkeland's. But until our knowledge of facts has received considerable additions all explanations must be of a somewhat hypothetical character.

Magnetic Poles.

In 1831 Sir James Ross[94] observed a dip of 89° 59′ at 70° 5′ N., 96° 46′ W., and this has been accepted as practically the position of the north magnetic pole at the time. The position of the south magnetic pole in 1840 as deduced from the Antarctic observations made by the "Erebus" and "Terror" expedition is shown in Sabine's chart as about 73° 30′ S., 147° 30′ E. In the more recent chart in J. C. Adams's *Collected Papers*, vol. 2, the position is shown as about 73° 40′ S., 147° 7′ E. Of late years positions have been obtained for the south magnetic pole by the "Southern Cross" expedition of 1898–1900 (A), by the "Discovery" in 1902–1904 (B), and by Sir E. Shackleton's expedition 1908–1909 (C). These are as follow:

(A)	72° 40′ S., 152° 30′ E.
(B)	72° 51′ S., 156° 25′ E.
(C)	72° 25′ S., 155° 16′ E.

Unless the diurnal inequality vanishes in its neighbourhood, a somewhat improbable contingency considering the large range at the "Discovery's" winter quarters, the position of the south magnetic pole has probably a diurnal oscillation, with an average amplitude of several miles, and there is not unlikely a larger annual oscillation. Thus even apart from secular change, no single spot of the earth's surface can probably claim to be a magnetic pole in the sense popularly ascribed to the term. If the diurnal motion were absolutely regular, and carried the point where the needle is vertical round a closed curve, the centroid of that curve—though a spot where the needle is never absolutely vertical—would seem to have the best claim to the title. It should also be remembered that when the dip is nearly 90° there are special observational difficulties. There are thus various reasons for allowing a considerable uncertainty in positions assigned to the magnetic poles. Conclusions as to change of position of the south magnetic pole during the last ten years based on the more recent results (A), (B) and (C) would, for instance, possess a very doubtful value. The difference, however, between these recent positions and that deduced from the observations of 1840–1841 is more substantial, and there is at least a moderate probability that a considerable movement towards the north-east has taken place during the last seventy years.

See publications of individual magnetic observatories, more especially the Russian (*Annales de l'Observatoire Physique Central*), the French (*Annales du Bureau Central Météorologique de France*), and those of Kew, Greenwich, Falmouth, Stonyhurst, Potsdam, Wilhelmshaven, de Bilt, Uccle, O'Gyalla, Prague, Pola, Coimbra, San Fernando, Capo di Monte, Tiflis, Kolaba, Zi-ka-wei, Hong-Kong, Manila, Batavia, Mauritius, Agincourt (Toronto), the observatories of the U.S. Coast and Geodetic Survey, Rio de Janeiro, Melbourne.

In the references below the following abbreviations are used: B.A. = *British Association Reports*; Batavia = *Observations made at the Royal . . . Observatory at Batavia*; M.Z. = *Meteorologische Zeitschrift*, edited by J. Hann and G. Hellman; P.R.S. = *Proceedings of the Royal Society of London*; P.T. = *Philosophical Transactions*; R. = *Repertorium für Meteorologie*, St Petersburg; T.M. = *Terrestrial Magnetism*, edited by L. A. Bauer; R.A.S. Notices = *Monthly Notices of the Royal Astronomical Society*. Treatises are referred to by the numbers attached to them; *e.g.* (1) p. 100 means p. 100 of Walker's *Terrestrial Magnetism*.

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1899), p. 103. [84] *T.M.* 9, p. 113. [85] *T.M.* 1, p. 77, and *Nature*, 57, pp. 160 and 180. [86] *M.Z.* 15, p. 175. [86a] *Sitz. der k. k. Akad. der Wiss. Wien, math. nat. Classe*, 1898, Bd. cvii., Abth. ii. [87] *P.T.* (A) 180, p. 467. [88] *Die Tägliche Periode der erdmagnetischen Elemente* (St Petersburg, 1902). [89] *R. Accad. Lincei Atti*, viii. 1899, pp. 69, 121, 176, 269 and previous volumes, see also *Séances de la Soc. Franç. de Physique*, 1899, p. 118. [90] *Bull. Soc. Vaud., Sc. Nat.* 1906, 42, p. 225. [91] *Comptes rendus*, 1905, 141, p. 567. [92] *National Antarctic Expedition 1901–1904*, "Magnetic Observations." [93] *The Norwegian Aurora Polaris Expedition 1902–1903*, vol. i. [94] (1) p. 163. (C. Ch.)

MAGNETITE, a mineral forming the natural magnet (see Magnetism), and important also as an iron-ore. It is an iron-black, opaque mineral, with metallic lustre; hardness about 6, sp. gr. 4·9 to 5·2. When scratched, it yields a black streak. It is an oxide of iron having the formula Fe_3O_4, corresponding with 72·4% of metal, whence its great value as an ore. It may be regarded as a ferroso-ferric oxide, $FeO.Fe_2O_3$, or as iron ferrate, $Fe''Fe_2'''O_4$. Titanium is often present, and occasionally the mineral contains magnesium, nickel, &c. It is always strongly magnetic. Magnetite crystallizes in the cubic system, usually in octahedra, less commonly in rhombic dodecahedra, and not infrequently in twins of the "spinel type" (fig. 1). The rhombic faces of the dodecahedron are often striated parallel to the longer diagonal. There is no distinct cleavage, but imperfect parting may be obtained along octahedral planes.

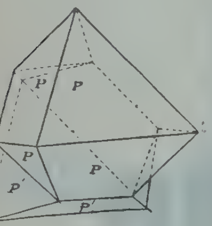

Fig. 1.

Magnetite is a mineral of wide distribution, occurring as grains in many massive and volcanic rocks, like granite, diorite and dolerite. It appears to have crystallized from the magma at a very early period of consolidation. Its presence contributes to the dark colour of many basalts and other basic rocks, and may cause them to disturb the compass. Large ore-bodies of granular and compact magnetite occur as beds and lenticular masses in Archean gneiss and crystalline schists, in various parts of Norway, Sweden, Finland and the Urals; as also in the states of New York, New Jersey, Pennsylvania and Michigan, as well as in Canada. In some cases it appears to have segregated from a basic eruptive magma, and in other cases to have resulted from metamorphic action. Certain deposits appear to have been formed, directly or indirectly, by wet processes. Iron rust sometimes contains magnetite. An interesting deposit of oolitic magnetic ore occurs in the Dogger (Inferior Oolite) of Rosedale Abbey, in Yorkshire; and a somewhat similar pisolitic ore, of Jurassic age, is known on the continent as chamoisite, having been named from Chamoison (or Chamoson) in the Valais, Switzerland. Grains of magnetite occur in serpentine, as an alteration-product of the olivine. In emery, magnetite in a granular form is largely associated with the corundum; and in certain kinds of mica magnetite occurs as thin dendritic enclosures. Haematite is sometimes magnetic, and A. Liversidge has shown that magnetite is probably present. By deoxidation, haematite may be converted into magnetite, as proved by certain pseudomorphs; but on the other hand magnetite is sometimes altered to haematite. On weathering, magnetite commonly passes into limonite, the ferrous oxide having probably been removed by carbonated waters. Closely related to magnetite is the rare volcanic mineral from Vesuvius, called magnoferrite, or magnesioferrite, with the formula $MgFe_2O_4$; and with this may be mentioned a mineral from Jakobsberg, in Vermland, Sweden, called jakobsite, containing $MnFe_2O_4$. (F. W. R.*)

MAGNETOGRAPH, an instrument for continuously recording the values of the magnetic elements, the three universally chosen being the declination, the horizontal component and the vertical component (see Terrestrial Magnetism). In each case the magnetograph only records the variation of the element, the absolute values being determined by making observations in the neighbourhood with the unifilar magnetometer (*q.v.*) and inclinometer (*q.v.*).

Declination.—The changes in declination are obtained by means of a magnet which is suspended by a long fibre and carries a mirror, immediately below which a fixed mirror is attached to the base of the instrument. Both mirrors are usually concave; if plane, a concave lens is placed immediately before them. Light passing through a vertical slit falls upon the mirrors, from which it is reflected, and two images of the slit are produced, one by the movable mirror attached to the magnet and the other by the fixed mirror. These images would be short lines of light; but a plano-cylindrical lens is placed with its axis horizontal just in front of the recording surface. In this way a spot of light is obtained from each mirror. The recording surface is a sheet of photographic paper wrapped round a drum which is rotated at a constant speed by clockwork about a horizontal axis. The light reflected from the fixed mirror traces a straight line on the paper, serving as a base line from which the variations in declination are measured. As the declination changes the spot of light reflected from the magnet mirror moves parallel to the axis of the recording drum, and hence the distance between the line traced by this spot and the base line gives, for any instant, on an arbitrary scale the difference between the declination and a constant angle, namely, the declination corresponding to the base line. The value of this constant angle is obtained by comparing the record with the value for the declination as measured with a magnetometer. The value in terms of arc of the scale of the record can be obtained by measuring the distance between the magnet mirror and the recording drum, and in most observations it is such that a millimetre on the record represents one minute of arc. The time scale ordinarily employed is 15 mm. per hour, but in modern instruments provision is generally made for the time scale to be increased at will to 180 mm. per hour, so that the more rapid variations of the declination can be followed. The advantages of using small magnets, so that their moment of inertia may be small and hence they may be able to respond to rapid changes in the earth's field, were first insisted upon by E. Mascart,[1] while M. Eschenhagen[2] first designed a set of magnetographs in which this idea of small moment of inertia was carried to its useful limit, the magnets only weighing 1·5 gram each, and the suspension consisting of a very fine quartz fibre.

Horizontal Force.—The variation of the horizontal force is obtained by the motion of a magnet which is carried either by a bifilar suspension or by a fairly stiff metal wire or quartz fibre. The upper end of the suspension is turned till the axis of the magnet is at right angles to the magnetic meridian. In this position the magnet is in equilibrium under the action of the torsion of the suspension and the couple exerted by the horizontal component, H, of the earth's field, this couple depending on the product of H into the magnetic moment, M, of the magnet. Hence if H varies the magnet will rotate in such a way that the couple due to torsion is equal to the new value of H multiplied by M. Since the movements of the magnet are always small, the rotation of the magnet is proportional to the change in H, so long as M and the couple, θ, corresponding to unit twist of the suspension system remain constant. When the temperature changes, however, both M and θ in general change. With rise of temperature M decreases, and this alone will produce the same effect as would a decrease in H. To allow for this effect of temperature a compensating system of metal bars is attached to the upper end of the bifilar suspension, so arranged that with rise of temperature the fibres are brought nearer together and hence the value of θ decreases. Since such a decrease in θ would by itself cause the magnet to turn in the same direction as if H had increased, it is possible in a great measure to neutralize the effects of temperature on the reading of the instrument. In the case of the unifilar suspension, the provision of a temperature compensation is not so easy, so that what is generally done is to protect the instrument from temperature variation as much as possible and then to correct the indications so as to allow for the residual changes, a continuous record of the temperature being kept by a recording thermograph attached to the instrument. In the Eschenhagen pattern instrument, in which a single quartz fibre is used for the suspension, two magnets are placed in the vicinity of the suspended magnet and are so arranged that their field partly neutralizes the earth's field; thus the torsion required to hold the magnet with its axis perpendicular to the earth's field is reduced, and the arrangement permits of the sensitiveness being altered by changing the position of the deflecting magnets. Further, by suitably choosing the positions of the deflectors and the coefficient of torsion of the fibre, it is possible to make the temperature coefficient vanish. (See Adolf Schmidt, *Zeits. für Instrumentenkunde*, 1907, 27, 145.) The method of recording the variations in H is exactly the same as that adopted in the case of the declination, and the sensitiveness generally adopted is such that 1 mm. on the record represents a change in H of ·00005 C.G.S., the time scale being the same as that employed in the case of the declination.

Vertical Component.—To record the variations of the vertical component use is made of a magnet mounted on knife edges so that it can turn freely about a horizontal axis at right angles to its length (H. Lloyd, *Proc. Roy. Irish Acad.*, 1839, 1, 334). The magnet is so weighted that its axis is approximately horizontal, and any change in the inclination of the axis is observed by means of an attached mirror, a second mirror fixed to the stand serving to give a base line for the records, which are obtained in the same way as in the case of the declination. The magnet is in equilibrium under the influence of the couple VM due to the vertical component V, and the couple due to the fact that the centre of gravity is slightly on one side of the knife-edge. Hence when, say, V decreases the couple VM decreases, and hence the north end of the balanced magnet rises, and vice versa. The chief difficulty with this form of instrument is that it is very sensitive to changes of temperature, for such changes not only alter M but also in general cause the centre of gravity of the system to be displaced with reference to the knife-edge. To reduce these effects the magnet is fitted with compensating bars, generally of zinc, so adjusted by trial that as far as possible they neutralize the effect of changes of temperature. In the Eschenhagen form of vertical force balance two deflecting magnets are used to partly neutralize the vertical component, so that the centre of gravity is almost exactly over the support. By varying the positions of these deflecting magnets it is possible to compensate for the effects of changes of temperature (A. Schmidt, *loc. cit.*). In order to eliminate the irregularity which is apt to be introduced by dust, &c., interfering with the working of the knife-edge, W. Watson (*Phil. Mag.*, 1904 [6], 7, 393) designed a form of vertical force balance in which the magnet with its mirror is attached to the mid point of a horizontal stretched quartz fibre. The temperature compensation is obtained by attaching a small weight to the magnet, and then bringing it back to the horizontal position by twisting the fibre.

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[1] *Report British Association*, Bristol, 1898, p. 741.

[2] *Verhandlungen der deutschen physikalischen Gesellschaft*, 1899, 1, 147; or *Terrestrial Magnetism*, 1900, 5, 59.

The scale values of the records given by the horizontal and vertical force magnetographs are determined by deflecting the respective needles, either by means of a magnet placed at a known distance or by passing an electric current through circular coils of large diameter surrounding the instruments.

The width of the photographic sheet which receives the spot of light reflected from the mirrors in the above instruments is generally so great that in the case of ordinary changes the curve does not go off the paper. Occasionally, however, during a disturbance such is not the case, and hence a portion of the trace would be lost. To overcome this difficulty Eschenhagen in his earlier type of instruments attached to each magnet two mirrors, their planes being inclined at a small angle so that when the spot reflected from one mirror goes off the paper, that corresponding to the other comes on. In the later pattern a third mirror is added of which the plane is inclined at about 30° to the horizontal. The light from the slit is reflected on to this mirror by an inclined fixed mirror, and after reflection at the movable mirror is again reflected at the fixed mirror and so reaches the recording drum. By this arrangement the angular rotation of the reflected beam is less than that of the magnet, and hence the spot of light reflected from this mirror yields a trace on a much smaller scale than that given by the ordinary mirror and serves to give a complete record of even the most energetic disturbance.

See also Balfour Stewart, *Report of the British Association*, Aberdeen, 1859, 200, a description of the type of instrument used in the older observatories; E. Mascart, *Traité de magnétisme terrestre*, p. 191; W. Watson, *Terrestrial Magnetism*, 1901, 6, 187, describing magnetographs used in India; M. Eschenhagen, *Verhandlungen der deutschen physikalischen Gesellschaft*, 1899, 1, 147; *Terrestrial Magnetism*, 1900, 5, 59; and 1901, 6, 59; *Zeits. für Instrumentenkunde*, 1907, 27, 137; W. G. Cady, *Terrestrial Magnetism*, 1904, 9, 69, describing a declination magnetograph in which the record is obtained by means of a pen acting on a moving strip of paper, so that the curve can be consulted at all times to see whether a disturbance is in progress.

The effects of temperature being so marked on the readings of the horizontal and vertical force magnetographs, it is usual to place the instruments either in an underground room or in a room which, by means of double walls and similar devices, is protected as much as possible from temperature changes. For descriptions of the arrangements adopted in some observatories see the following: U.S. observatories, *Terrestrial Magnetism*, 1903, 8, 11; Utrecht, *Terrestrial Magnetism*, 1900, 5, 49; St Maur, *Terrestrial Magnetism*, 1898, 3, 1; Potsdam, *Veröffentlichungen des k. preuss. meteorol. Instituts*, "Ergebnisse der magnetischen Beobachtungen in Potsdam in den Jahren 1890 und 1891;" Pavlovsk, "Das Konstantinow'sche meteorologische und magnetische Observatorium in Pavlovsk," *Ausgabe der kaiserl. Akad. der Wissenschaften zu St Petersburg*, 1895. (W. Wn.)

MAGNETOMETER, a name, in its most general sense, for any instrument used to measure the strength of any magnetic field; it is, however, often used in the restricted sense of an instrument for measuring a particular magnetic field, namely, that due to the earth's magnetism, and in this article the instruments used for measuring the value of the earth's magnetic field will alone be considered.

The elements which are actually measured when determining the value of the earth's field are usually the declination, the dip and the horizontal component (see MAGNETISM, TERRESTRIAL). For the instruments and methods used in measuring the dip see INCLINOMETER. It remains to consider the measurement of the declination and the horizontal component, these two elements being generally measured with the same instrument, which is called a unifilar magnetometer.

Measurement of Declination.—The measurement of the declination involves two separate observations, namely, the determination of (*a*) the magnetic meridian and (*b*) the geographical meridian, the angle between the two being the declination. In order to determine the magnetic meridian the orientation of the magnetic axis of a freely suspended magnet is observed; while, in the absence of a distant mark of which the azimuth is known, the geographical meridian is obtained from observations of the transit of the sun or a star. The geometrical axis of the magnet is sometimes defined by means of a mirror rigidly attached to the magnet and having the normal to the mirror as nearly as may be parallel to the magnetic axis. This arrangement is not very convenient, as it is difficult to protect the mirror from accidental displacement, so that the angle between the geometrical and magnetic axes may vary. For this reason the end of the magnet is sometimes polished and acts as the mirror, in which case no displacement of the reflecting surface with reference to the magnet is possible. A different arrangement, used in the instrument described below, consists in having the magnet hollow, with a small scale engraved on glass firmly attached at one end, while to the other end is attached a lens, so chosen that the scale is at its principal focus. In this case the geometrical axis is the line joining the central division of the scale to the optical centre of the lens. The position of the magnet is observed by means of a small telescope, and since the scale is at the principal focus of the lens, the scale will be in focus when the telescope is adjusted to observe a distant object. Thus no alteration in the focus of the telescope is necessary whether we are observing the magnet, a distant fixed mark, or the sun.

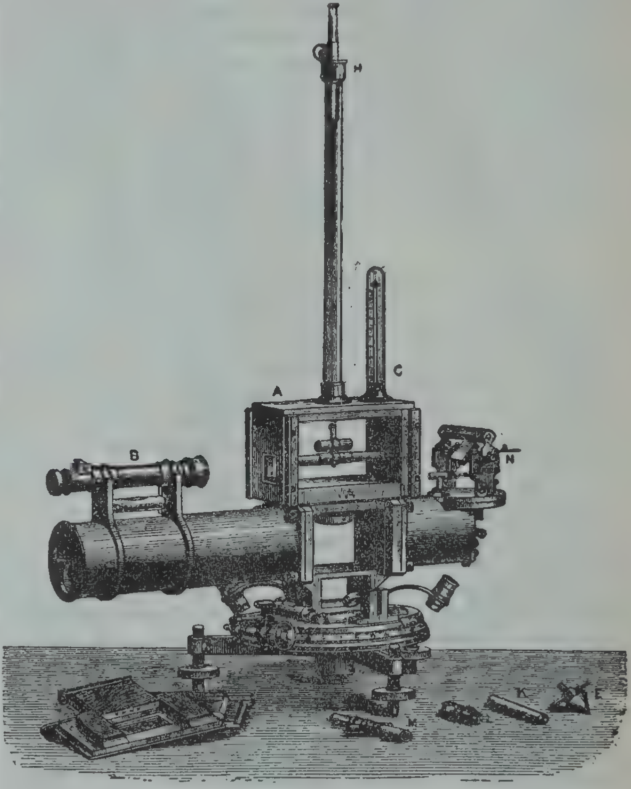

FIG. 1.—Unifilar Magnetometer, arranged to indicate declination.

The Kew Observatory pattern unifilar magnetometer is shown in figs. 1 and 2. The magnet consists of a hollow steel cylinder fitted with a scale and lens as described above, and is suspended by a long thread of unspun silk, which is attached at the upper end to the torsion head H. The magnet is protected from draughts by the box A, which is closed at the sides by two shutters when an observation is being taken. The telescope B serves to observe the scale attached to the magnet when determining the magnetic meridian, and to observe the sun or star when determining the geographical meridian.

When making a determination of declination a brass plummet having the same weight as the magnet is first suspended in its place, and the torsion of the fibre is taken out. The magnet having been attached, the instrument is rotated about its vertical axis till the centre division of the scale appears to coincide with the vertical cross-wire of the telescope. The two verniers on the azimuth circle having been read, the magnet is then inverted, *i.e.* turned through 180° about its axis, and the setting is repeated. A second setting with the magnet inverted is generally made, and then another setting with the magnet in its original position. The mean of all the readings of the verniers gives the reading on the azimuth circle corresponding to the magnetic meridian. To obtain the geographical meridian the box A is removed, and an image of the sun or a star is reflected into the telescope B by means of a small transit mirror N. This mirror can rotate about a horizontal axis which is at right angles to the line of collimation of the telescope, and is parallel to the surface of the mirror. The time of transit of the sun or star across the vertical wire of the telescope having been observed by means of a chronometer of which the error is known, it is possible to calculate the azimuth of the sun or star, if the latitude and longitude of the place of observation are given. Hence if the readings of the verniers on the azimuth circle are made when the transit is observed we can deduce the reading corresponding to the geographical meridian.

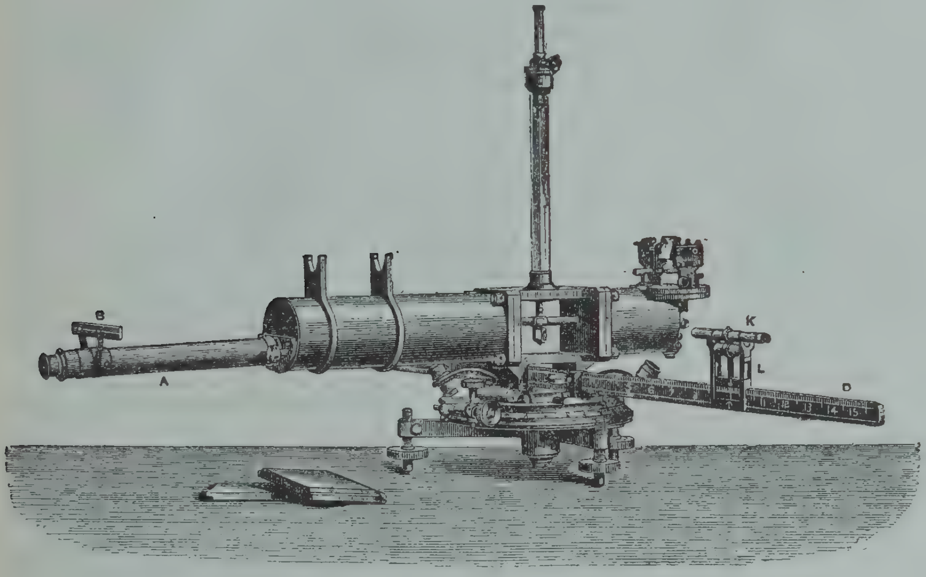

FIG 2.—Unifilar Magnetometer, arranged to show deflexion.

The above method of determining the geographical meridian has the serious objection that it is necessary to know the error of the chronometer with very considerable accuracy, a matter of some difficulty when observing at any distance from a fixed observatory. If, however, a theodolite, fitted with a telescope which can rotate about a horizontal axis and having an altitude circle, is employed, so that when observing a transit the altitude of the sun or star can be read off, then the time need only be known to within a minute or so. Hence in more recent patterns of magnetometer it is usual to do away with the transit mirror method of observing and either to use a separate theodolite to observe the azimuth of some distant object, which will then act as a fixed mark when making the declination observations, or to attach to the magnetometer an altitude telescope and circle for use when determining the geographical meridian.

The chief uncertainty in declination observations, at any rate at a fixed observatory, lies in the variable torsion of the silk suspension, as it is found that, although the fibre may be entirely freed from torsion before beginning the declination observations, yet at the conclusion of these observations a considerable amount of torsion may have appeared. Soaking the fibre with glycerine, so that the moisture it absorbs does not change so much with the hygrometric state of the air, is of some advantage, but does not entirely remove the difficulty. For this reason some observers use a thin strip of phosphor bronze to suspend the magnet, considering that the absence of a variable torsion more than compensates for the increased difficulty in handling the more fragile metallic suspension.

Measurement of the Horizontal Component of the Earth's Field.—The method of measuring the horizontal component which is almost exclusively used, both in fixed observatories and in the field, consists in observing the period of a freely suspended magnet, and then obtaining the angle through which an auxiliary suspended magnet is deflected by the magnet used in the first part of the experiment. By the vibration experiment we obtain the value of the product of the magnetic moment (M) of the magnet into the horizontal component (H), while by the deflexion experiment we can deduce the value of the ratio of M to H, and hence the two combined give both M and H.

In the case of the Kew pattern unifilar the same magnet that is used for the declination is usually employed for determining H, and for the purposes of the vibration experiment it is mounted as for the observation of the magnetic meridian. The time of vibration is obtained by means of a chronometer, using the eye-and-ear method. The temperature of the magnet must also be observed, for which purpose a thermometer C (fig. 1) is attached to the box A.

When making the deflection experiment the magnetometer is arranged as shown in fig. 2. The auxiliary magnet has a plane mirror attached, the plane of which is at right angles to the axis of the magnet. An image of the ivory scale B is observed after reflection in the magnet mirror by the telescope A. The magnet K used in the vibration experiment is supported on a carriage L which can slide along the graduated bar D. The axis of the magnet is horizontal and at the same level as the mirror magnet, while when the central division of the scale B appears to coincide with the vertical cross-wire of the telescope the axes of the two magnets are at right angles. During the experiment the mirror magnet is protected from draughts by two wooden doors which slide in grooves. What is known as the method of sines is used, for since the axes of the two magnets are always at right angles when the mirror magnet is in its zero position, the ratio M/H is proportional to the sine of the angle between the magnetic axis of the mirror magnet and the magnetic meridian. When conducting a deflexion experiment the deflecting magnet K is placed with its centre at 30 cm. from the mirror magnet and to the east of the latter, and the whole instrument is turned till the centre division of the scale B coincides with the cross-wire of the telescope, when the readings of the verniers on the azimuth circle are noted. The magnet K is then reversed in the support, and a new setting taken. The difference between the two sets of readings gives twice the angle which the magnetic axis of the mirror magnet makes with the magnetic meridian. In order to eliminate any error due to the zero of the scale D not being exactly below the mirror magnet, the support L is then removed to the west side of the instrument, and the settings are repeated. Further, to allow of a correction being applied for the finite length of the magnets the whole series of settings is repeated with the centre of the deflecting magnet at 40 cm. from the mirror magnet.

Omitting correction terms depending on the temperature and on the inductive effect of the earth's magnetism on the moment of the deflecting magnet, if θ is the angle which the axis of the deflected magnet makes with the meridian when the centre of the deflecting magnet is at a distance r, then

$$\frac{r^3 H}{2M}\sin\theta = 1 + \frac{P}{r} + \frac{Q}{r^2} + \&c.,$$

in which P and Q are constants depending on the dimensions and magnetic states of the two magnets. The value of the constants P and Q can be obtained by making deflexion experiments at three distances. It is, however, possible by suitably choosing the proportions of the two magnets to cause either P or Q to be very small. Thus it is usual, if the magnets are of similar shape, to make the deflected magnet 0·467 of the length of the deflecting magnet, in which case Q is negligible, and thus by means of deflexion experiments at two distances the value of P can be obtained. (See C. Börgen, *Terrestrial Magnetism*, 1896, i. p. 176, and C. Chree, *Phil. Mag.*, 1904 [6], 7, p. 113.)

In the case of the vibration experiment correction terms have to be introduced to allow for the temperature of the magnet, for the inductive effect of the earth's field, which slightly increases the magnetic moment of the magnet, and for the torsion of the suspension fibre, as well as the rate of the chronometer. If the temperature of the magnet were always exactly the same in both the vibration and deflexion experiment, then no correction on account of the effect of temperature in the magnetic moment would be necessary in either experiment. The fact that the moment of inertia of the magnet varies with the temperature must, however, be taken into account. In the deflexion experiment, in addition to the induction correction, and that for the effect of temperature on the magnetic moment, a correction has to be applied for the effect of temperature on the length of the bar which supports the deflexion magnet.

See also Stewart and Gee, *Practical Physics*, vol. 2, containing a description of the Kew pattern unifilar magnetometer and detailed instructions for performing the experiments; C. Chree, *Phil. Mag.*, 1901 (6), 2, p. 613, and *Proc. Roy. Soc.*, 1899, 65, p. 375, containing a discussion of the errors to which the Kew unifilar instrument is subject; E. Mascart, *Traité de magnetisme terrestre*, containing a description of the instruments used in the French magnetic survey, which are interesting on account of their small size and consequent easy portability; H. E. D. Fraser, *Terrestrial Magnetism*, 1901, 6, p. 65, containing a description of a modified Kew pattern unifilar as used in the Indian survey; H. Wild, *Mém. Acad. imp. sc. St Pétersbourg*, 1896 (viii.), vol. 3, No. 7, containing a description of a most elaborate unifilar magnetometer with which it is claimed results can be obtained of a very high order of accuracy; K. Haufsmann, *Zeits. für Instrumentenkunde*, 1906, 26, p. 2, containing a description of a magnetometer for field use, designed by M. Eschenhagen, which has many advantages.

Measurements of the Magnetic Elements at Sea.—Owing to the fact that the proportion of the earth's surface covered by sea is so much greater than the dry land, the determinaton of the magnetic elements on board ship is a matter of very considerable importance. The movements of a ship entirely preclude the employment of any instrument in which a magnet suspended by a fibre has any part, so that the unifilar is unsuited for such observations. In order to obtain the declination a pivoted magnet is used to obtain the magnetic meridian, the geographical meridian being obtained by observations on the sun or stars. A carefully made ship's compass is usually employed, though in some cases the compass card, with its attached magnets, is made reversible, so that the inclination to the zero of the card of the magnetic axis of the system of magnets attached to the card can be eliminated by reversal. In the absence of such a reversible card the index correction must be determined by comparison with a unifilar magnetometer, simultaneous observations being made on shore, and these observations repeated as often as occasion permits. To determine the dip a Fox's dip circle[1] is used. This consists of an ordinary dip circle (see INCLINOMETER) in which the ends of the axle of the needle are pointed and rest in jewelled holes, so that the movements of the ship do not displace the needle. The instrument is, of course, supported on a gimballed table, while the ship during the observations is kept on a fixed course. To obtain the *strength* of the field the method usually adopted is that known as Lloyd's method.[2] To carry out a determination of the total force by this method the Fox dip circle has been slightly modified by E. W. Creak, and has been found to give satisfactory results on board ship. The circle is provided with two needles in addition to those used for determining the dip, one (*a*) an ordinary dip needle, and the other (*b*) a needle which has been loaded at one end by means of a small peg which fits into one of two symmetrically placed holes in the needle. The magnetism of these two needles is never reversed, and they are as much as possible protected from shock and from approach to other magnets, so that their magnetic state may remain as constant as possible. Attached to the cross-arm which carries the microscopes used to observe the ends of the dipping needle is a clamp, which will hold the needle *b* in such a way that its plane is parallel to the vertical circle and its axis is at right angles to the line joining the two microscopes. Hence, when the microscopes are adjusted so as to coincide with the points of the dipping needle *a*, the axes of the two needles must be at right angles. The needle *a* being suspended between the jewels, and the needle *b* being held in the clamp, the cross-arm carrying the reading microscopes and the needle *b* is rotated till the ends of the needle *a* coincide with the cross-wires of the microscopes. The verniers having been read, the cross-arm is rotated so as to deflect the needle *a* in the opposite direction, and a new setting is taken. Half the difference between the two readings gives the angle through which the needle *a* has been deflected under the action of the needle *b*. This angle depends on the ratio of the magnetic moment of the needle *b* to the total force of the earth's field. It also involves, of course, the distance between the needles and the distribution of the magnetism of the needles; but this factor is determined by comparing the value given by the instrument, at a shore station, with that given by an ordinary magnetometer. Hence the above observation gives us a means of obtaining the *ratio* of the magnetic moment of the needle *b* to the value of the earth's total force. The needle *b* is then substituted for *a*, there being now no needle in the clamp attached to the microscope arm, and the difference between the reading now obtained and the dip, together with the weight added to the needle, gives the product of the moment of the needle *b* into the earth's total force. Hence, from the two observations the value of the earth's total force can be deduced. In an actual observation the deflecting needle would be reversed, as well as the deflected one, while different weights would be used to deflect the needle *b*.

For a description of the method of using the Fox circle for observations at sea consult the *Admiralty Manual of Scientific Inquiry*, p. 116, while a description of the most recent form of the circle, known as the Lloyd-Creak pattern, will be found in *Terrestrial Magnetism*, 1901, 6, p. 119. An attachment to the ordinary ship's compass, by means of which satisfactory measurements of the horizontal component have been made on board ship, is described by L. A. Bauer in *Terrestrial Magnetism*, 1906, 11, p. 78. The principle of the method consists in deflecting the compass needle by means of a horizontal magnet supported vertically over the compass card, the axis of the deflecting magnet being always perpendicular to the axis of the magnet attached to the card. The method is not strictly an absolute one, since it presupposes a knowledge of the magnetic moment of the deflecting magnet. In practice it is found that a magnet can be prepared which, when suitably protected from shock, &c., retains its magnetic moment sufficiently constant to enable observations of H to be made comparable in accuracy with that of the other elements obtained by the instruments ordinarily employed at sea. (W. WN.)

MAGNETO-OPTICS. The first relation between magnetism and light was discovered by Faraday,[1] who proved that the plane of polarization of a ray of light was rotated when the ray travelled through certain substances parallel to the lines of magnetic force. This power of rotating the plane of polarization in a magnetic field has been shown to be possessed by all refracting substances, whether they are in the solid, liquid or gaseous state. The rotation by gases was established independently by H. Becquerel,[2] and Kundt and Röntgen,[3] while Kundt[4] found that films of the magnetic metals, iron, cobalt, nickel, thin enough to be transparent, produced enormous rotations, these being in iron and cobalt magnetized to saturation at the rate of 200,000° per cm. of thickness, and in nickel about 89,000°. The direction of rotation is not the same in all bodies. If we call the rotation positive when it is related to the direction of the magnetic force, like rotation and translation in a right-handed screw, or, what is equivalent, when it is in the direction of the electric currents which would produce a magnetic field in the same direction as that which produces the rotation, then most substances produce positive rotation. Among those that produce negative rotation are ferrous and ferric salts, ferricyanide of potassium, the salts of lanthanum, cerium and didymium, and chloride of titanium.[5]

The magnetic metals iron, nickel, cobalt, the salts of nickel and cobalt, and oxygen (the most magnetic gas) produce positive rotation.

For slightly magnetizable substances the amount of rotation in a space PQ is proportional to the difference between the magnetic potential at P and Q; or if θ is the rotation in PQ, Ω_P, Ω_Q, the magnetic potential at P and Q, then $\theta = R(\Omega_P - \Omega_Q)$, where R is a constant, called Verdet's constant, which depends upon the refracting substance, the wave length of the light, and the temperature. The following are the values of R (when the rotation is expressed in circular measure) for the D line and a temperature of 18° C.:—

Substance.	$R \times 10^5$.	Observer.
Carbon bisulphide	1·222	Lord Rayleigh[6] and Köpsel.[7]
	1·225	Rodger and Watson.[8]
Water	·377	Arons.[9]
	·3808	Rodger and Watson.[8]
Alcohol	·330	Du Bois.[10]
Ether	·315	Du Bois.[10]
Oxygen (at 1 atmosphere)	·000179	Kundt and Röntgen (*loc. cit.*)
Faraday's heavy glass	1·738	

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[1] *Annals of Electricity*, 1839, 3, p. 288.

[2] Humphrey Lloyd, *Proc. Roy. Irish Acad.*, 1848, 4, p. 57.

The variation of Verdet's constant with temperature has been determined for carbon bisulphide and water by Rodger and Watson (*loc. cit.*). They find if R_t, R_0 are the values of Verdet's constant at t°C. and 0°C. respectively, then for carbon bisulphide $R_t = R_0 (1 - \cdot 0016961)$, and for water $R_t = R_0 (1 - \cdot 0000305t - \cdot 00000305t^2)$.

For the magnetic metals Kundt found that the rotation did not increase so rapidly as the magnetic force, but that as this force was increased the rotation reached a maximum value. This suggests that the rotation is proportional to the intensity of magnetization, and not to the magnetic force.

The amount of rotation in a given field depends greatly upon the wave length of the light; the shorter the wave length the greater the rotation, the rotation varying a little more rapidly than the inverse square of the wave length. Verdet[11] has compared in the cases of carbon bisulphide and creosote the rotation given by the formula

$$\theta = mc\gamma\frac{c^2}{\lambda^2}\left(c - \lambda\frac{di}{d\lambda}\right)$$

with those actually observed; in this formula θ is the angular rotation of the plane of polarization, m a constant depending on the medium, λ the wave length of the light in air, and i its index of refraction in the medium. Verdet found that, though the agreement is fair, the differences are greater than can be explained by errors of experiment.

Verdet[12] has shown that the rotation of a salt solution is the sum of the rotations due to the salt and the solvent; thus, by mixing a salt which produces negative rotation with water which produces positive rotation, it is possible to get a solution which does not exhibit any rotation. Such solutions are not in general magnetically neutral. By mixing diamagnetic and paramagnetic substances we can get magnetically neutral solutions, which, however, produce a finite rotation of the plane of polarization. The relation of the magnetic rotation to chemical consitution has been studied in great detail by Perkin,[3] Wachsmuth,[4] Jahn[5] and Schönrock.[6]

The rotation of the plane of polarization may conveniently be regarded as denoting that the velocity of propagation of circular-polarized light travelling along the lines of magnetic force depends upon the direction of rotation of the ray, the velocity when the rotation is related to the direction of the magnetic force, like rotation and translation on a right-handed screw being different from that for a left-handed rotation. A plane-polarized ray may be regarded as compounded of two oppositely circularly-polarized rays, and as these travel along the lines of magnetic force with different velocities, the one will gain or lose in phase on the other, so that when they are again compounded they will correspond to a plane-polarized ray, but in consequence of the change of phase the plane of polarization will not coincide with its original position.

Reflection from a Magnet.—Kerr[17] in 1877 found that when plane-polarized light is incident on the pole of an electromagnet, polished so as to act like a mirror, the plane of polarization of the reflected light is rotated by the magnet. Further experiments on this phenomenon have been made by Righi,[18] Kundt,[19] Du Bois,[20] Sissingh,[21] Hall,[22] Hurion,[23] Kaz[24] and Zeeman.[25] The simplest case is when the incident plane-polarized light falls normally on the pole of an electromagnet. When the magnet is not excited the reflected ray is plane-polarized; when the magnet is excited the plane of polarization is rotated through a small angle, the direction of rotation being opposite to that of the currents exciting the pole. Righi found that the reflected light was slightly elliptically polarized, the axes of the ellipse being of very unequal magnitude. A piece of gold-leaf placed over the pole entirely stops the rotation, showing that it is not produced in the air near the pole. Rotation takes place from magnetized nickel and cobalt as well as from iron, and is in the same direction (Hall). Righi has shown that the rotation at reflection is greater for long waves than for short, whereas, as we have seen, the Faraday rotation is greater for short waves than for long. The rotation for different coloured light from iron, nickel, cobalt and magnetite has been measured by Du Bois; in magnetite the direction of rotation is opposite to that of the other metals. When the light is incident obliquely and not normally on the polished pole of an electromagnet, it is elliptically polarized after reflection, even when the plane of polarization is parallel or at right angles to the plane of incidence. According to Righi, the amount of rotation when the plane of polarization of the incident light is perpendicular to the plane of incidence reaches a maximum when the angle of incidence is between 44° and 68°, while when the light is polarized in the plane of incidence the rotation steadily decreases as the angle of incidence is increased. The rotation when the light is polarized in the plane of incidence is always less than when it is polarized at right angles to that plane, except when the incidence is normal, when the two rotations are of course equal.

Reflection from Tangentially Magnetized Iron.—In this case Kerr[26] found: (1) When the plane of incidence is perpendicular to the lines of magnetic force, no rotation of the reflected light is produced by magnetization: (2) no rotation is produced when the light is incident normally; (3) when the incidence is oblique, the lines of magnetic force being in the plane of incidence, the reflected light is elliptically polarized after reflection, and the axes of the ellipse are not in and at right angles to the plane of incidence. When the light is polarized in the plane of incidence, the rotation is at all angles of incidence in the opposite direction to that of the currents which would produce a magnetic field of the same sign as the magnet. When the light is polarized at right angles to the plane of incidence, the rotation is in the same direction as these currents when the angle of incidence is between 0° and 75° according to Kerr, between 0° and 80° according to Kundt, and between 0° and 78° 54′ according to Righi. When the incidence is more oblique than this, the rotation of the plane of polarization is in the opposite direction to the electric currents which would produce a magnetic field of the same sign.

The theory of the phenomena just described has been dealt with by Airy,[27] C. Neumann,[28] Maxwell,[29] Fitzgerald,[30] Rowland,[31] H. A. Lorentz,[32] Voight,[33] Ketteler,[34] van Loghem,[35] Potier,[36] Basset,[37] Goldhammer,[38] Drude,[39] J. J. Thomson,[40] and Leatham;[41] for a critical discussion of many of these theories we refer the reader to Larmor's[42] British Association Report. Most of these theories have proceeded on the plan of adding to the expression for the electromotive force terms indicating a force similar in character to that discovered by Hall (see MAGNETISM) in metallic conductors carrying a current in a magnetic field, *i.e.* an electromotive force at right angles to the plane containing the magnetic force and the electric current, and proportional to the sine of the angle between these vectors. The introduction of a term of this kind gives rotation of the plane of polarization by transmission through all refracting substance, and by reflection from magnetized metals, and shows a fair agreement between the theoretical and experimental results. The simplest way of treating the questions seems, however, to be to go to the equations which represent the propagation of a wave travelling through a medium containing ions. A moving ion in a magnetic field will be acted upon by a mechanical force which is at right angles to its direction of motion, and also to the magnetic force, and is equal per unit charge to the product of these two vectors and the sine of the angle between them. For the sake of brevity we will take the special case of a wave travelling parallel to the magnetic force in the direction of the axis of z.

Then supposing that all the ions are of the same kind, and that there are n of these each with mass m and charge e per unit volume, the equations representing the field are (see ELECTRIC WAVES):—

$$K_0\frac{dX_0}{dt} + 4\pi ne\frac{d\xi}{dt} = \frac{d\beta}{dz};$$

$$\frac{dX_0}{dz} = \frac{d\beta}{dt};$$

$$K_0\frac{dY_0}{dt} + 4\pi ne\frac{d\eta}{dt} = -\frac{d\alpha}{dz}$$

$$\frac{dY_0}{dz} = -\frac{d\alpha}{dt};$$

$$m\frac{d^2\xi}{dt^2} + R_1\frac{d\xi}{dt} + a\xi = \left(X_0 + \frac{4\pi}{3}ne\xi\right)e + He\frac{d\eta}{dt}$$

$$m\frac{d^2\eta}{dt^2} + R_1\frac{d\eta}{dt} + a\eta = \left(Y_0 + \frac{4\pi}{3}ne\eta\right)e - He\frac{d\xi}{dt};$$

where H is the external magnetic field, X_0, Y_0 the components of the part of the electric force in the wave not due to the charges on the atoms, α and β the components of the magnetic force, ξ and η

the co-ordinates of an ion, R_1 the coefficient of resistance to the motion of the ions, and α the force at unit distance tending to bring the ion back to its position of equilibrium, K_0 the specific inductive capacity of a vacuum. If the variables are proportional to $\epsilon^{\iota(pt-qz)}$ we find by substitution that q is given by the equation

$$q^2-K_0p^2-\frac{4\pi ne^2p^2P}{P^2-H^2e^2p^2}=\pm\frac{4\pi ne^3Hp^3}{P^2-H^2e^2p^2},$$

where $$P=(a-\tfrac{4}{3}\pi ne^2)+R_1\iota p-mp^2,$$

or, by neglecting R, $P=m(s^2-p^2)$, where s is the period of the free ions. If, q_1^2, q_2^2 are the roots of this equation, then corresponding to q_1 we have $X_0=\iota Y_0$ and to q_2 $X_0= -\iota Y_0$. We thus get two oppositely circular-polarized rays travelling with the velocities p/q_1 and p/q_2 respectively. Hence if v_1, v_2 are these velocities, and v the velocity when there is no magnetic field, we obtain, if we neglect terms in H^2,

$$\frac{1}{v_1^2}=\frac{1}{v^2}+\frac{4\pi ne^3Hp}{m^2(s^2-p^2)^2},$$
$$\frac{1}{v_2^2}=\frac{1}{v^2}-\frac{4\pi ne^3Hp}{m^2(s^2-p^2)^2}.$$

The rotation r of the plane of polarization per unit length

$$=\tfrac{1}{2}p\left(\frac{1}{v_1}-\frac{1}{v_2}\right)=\frac{2\pi ne^3Hp^2v}{m^2(s^2-p^2)^2}.$$

Since $1/v^2=K_0+4\pi ne^2/m(s^2-p^2)$, we have if μ is the refractive index for light of frequency p, and v_0 the velocity of light in vacuo.

$$\mu^2-1=4\pi ne^2v^2{}_0/m(s^2-p^2) \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

So that we may put

$$r=(\mu^2-1)^2p^2H/s\pi\mu nev_0^3 \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Becquerel (*Comptes rendus*, 125, p. 683) gives for r the expression

$$\frac{1}{2}\frac{e}{m}\frac{H}{v_0}\frac{d\mu}{d\lambda},$$

where λ is the wave length. This is equivalent to (2) if μ is given by (1). He has shown that this expression is in good agreement with experiment. The sign of r depends on the sign of e, hence the rotation due to negative ions would be opposite to that for positive. For the great majority of substances the direction of rotation is that corresponding to the negation ion. We see from the equations that the rotation is very large for such a value of p as makes $P=0$: this value corresponds to a free period of the ions, so that the rotation ought to be very large in the neighbourhood of an absorption band. This has been verified for sodium vapour by Macaluso and Corbino.[43]

If plane-polarized light falls normally on a plane face of the medium containing the ions, then if the electric force in the incident wave is parallel to x and is equal to the real part of $A\epsilon^{\iota(pt-qz)}$, if the reflected beam in which the electric force is parallel to x is represented by $B\epsilon^{\iota(pt+qz)}$ and the reflected beam in which the electric force is parallel to the axis of y by $C\epsilon^{\iota(pt+qz)}$, then the conditions that the magnetic force parallel to the surface is continuous, and that the electric forces parallel to the surface in the air are continuous with Y_0, X_0 in the medium, give

$$\frac{A}{(q+q_1)\,(q+q_2)}=\frac{B}{(q^2-q_1q_2)}=\frac{\iota C}{q(q_2-q_1)}$$

or approximately, since q_1 and q_2 are nearly equal,

$$\frac{\iota C}{B}=\frac{q(q_2-q_1)}{q^2-q_1^2}=\frac{(\mu^2-1)pH}{4\pi\mu neV_0^2}.$$

Thus in transparent bodies for which μ is real, C and B differ in phase by $\pi/2$, and the reflected light is elliptically polarized, the major axis of the ellipse being in the plane of polarization of the incident light, so that in this case there is no rotation, but only elliptic polarization; when there is strong absorption so that μ contains an imaginary term, C/B will contain a real part so that the reflected light will be elliptically polarized, but the major axis is no longer in the plane of polarization of the incident light; we should thus have a rotation of the plane of polarization superposed on the elliptic polarization.

Zeeman's Effect.—Faraday, after discovering the effect of a magnetic field on the plane of polarization of light, made numerous experiments to see if such a field influenced the nature of the light emitted by a luminous body, but without success. In 1885 Fievez,[44] a Belgian physicist, noticed that the spectrum of a sodium flame was changed slightly in appearance by a magnetic field; but his observation does not seem to have attracted much attention, and was probably ascribed to secondary effects. In 1896 Zeeman[45] saw a distinct broadening of the lines of lithium and sodium when the flames containing salts of these metals were between the poles of a powerful electromagnet; following up this observation, he obtained some exceedingly remarkable and interesting results, of which those observed with the blue-green cadmium line may be taken as typical. He found that in a strong magnetic field, when the lines of force are parallel to the direction of propagation of the light, the line is split up into a doublet, the constituents of which are on opposite sides of the undisturbed position of the line, and that the light in the constituents of this doublet is circularly polarized, the rotation in the two lines being in opposite directions. When the magnetic force is at right angles to the direction of propagation of the light, the line is resolved into a triplet, of which the middle line occupies the same position as the undisturbed line; all the constituents of this triplet are plane-polarized, the plane of polarization of the middle line being at right angles to the magnetic force, while the outside lines are polarized on a plane parallel to the lines of magnetic force. A great deal of light is thrown on this phenomenon by the following considerations due to H. A. Lorentz.[46]

Let us consider an ion attracted to a centre of force by a force proportional to the distance, and acted on by a magnetic force parallel to the axis of z: then if m is the mass of the particle and e its charge, the equations of motion are

$$m\frac{d^2x}{dt^2}+\alpha x=-He\frac{dy}{dt};$$
$$m\frac{d^2y}{dt^2}+\alpha y=He\frac{dx}{dt};$$
$$m\frac{d^2z}{dt^2}+\alpha z=0.$$

The solution of these equations is

$$x = A\cos(p_1t+\beta)+B\cos(p_2t+\beta_1)$$
$$y = A\sin(p_1t+\beta)-B\sin(p_2t+\beta_1)$$
$$z = C\cos(pt+\gamma)$$

where
$$\alpha - mp_1^2= -Hep_1$$
$$\alpha - mp_2^2= Hep_2$$
$$p^2=\alpha/m,$$

or approximately $p_1=p+\tfrac{1}{2}\frac{He}{m},\ p_2=p-\tfrac{1}{2}\frac{He}{m}.$

Thus the motion of the ion on the xy plane may be regarded as made up of two circular motions in opposite directions described with frequencies p_1 and p_2 respectively, while the motion along z has the period p, which is the frequency for all the vibrations when $H=0$. Now suppose that the cadmium line is due to the motion of such an ion; then if the magnetic force is along the direction of propagation, the vibration in this direction has its period unaltered, but since the direction of vibration is perpendicular to the wave front, it does not give rise to light. Thus we are left with the two circular motions in the wave front with frequencies p_1 and p_2 giving the circularly polarized constituents of the doublet. Now suppose the magnetic force is at right angles to the direction of propagation of the light; then the vibration parallel to the magnetic force being in the wave front produces luminous effects and gives rise to a plane-polarized ray of undisturbed period (the middle line of the triplet), the plane of polarization being at right angles to the magnetic force. The components in the wave-front of the circular orbits at right angles to the magnetic force will be rectilinear motions of frequency p_1 and p_2 at right angles to the magnetic force—so that they will produce plane-polarized light, the plane of polarization being parallel to the magnetic force; these are the outer lines of the triplet.

If Zeeman's observations are interpreted from this point of view, the directions of rotation of the circularly-polarized light in the doublet observed along the lines of magnetic force show that the ions which produce the luminous vibrations are *negatively* electrified, while the measurement of the charge of frequency due to the magnetic field shows that e/m is of the order 10^7. This result is of great interest, as this is the order of the value of e/m in the negatively electrified particles which constitute the Cathode Rays (see CONDUCTION, ELECTRIC III. *Through Gases*). Thus we infer that the "cathode particles" are found in bodies, even where not subject to the action of intense electrical fields, and are in fact an ordinary constituent of the molecule. Similar particles are found near an incandescent wire, and also near a metal plate illuminated by ultra-violet light. The value of e/m deduced from the Zeeman effect ranges from 10^7 to $3{\cdot}4 \times 10^7$, the value of e/m for the particle in the cathode rays is $1{\cdot}7 \times 10^7$. The majority of the determinations of e/m from the Zeeman effect give numbers larger than this, the maximum being about twice this value.

A more extended study of the behaviour of the spectroscopic lines has afforded examples in which the effects produced by a magnet are more complicated than those we have described, indeed the simple cases are much less numerous than the more complex. Thus Preston[47] and Cornu[48] have shown that under the action of a transverse magnetic field one of the D lines splits up into four, and the other into six lines; Preston has given many other examples of these quartets and sextets, and has shown that the change in the frequency, which, according to the simple theory indicated, should be the same for all lines, actually varies considerably from one line to another, many lines showing no appreciable displacement. The splitting up of a single line into a quartet or sextet indicates, from the point of view of the ion theory, that the line must have its origin in a system consisting of more than one ion. A single ion having only three degrees of freedom can only have three periods. When there is no magnetic force acting on the ion these periods are equal, but though under the action of a magnetic force they are separated, their number cannot be increased. When therefore we get four or more lines, the inference is that the system giving the lines must have at least four degrees of freedom, and therefore must consist of more than one ion. The theory of a system of ions mutually influencing each other shows, as we should expect, that the effects are more complex than in the case of a single ion, and that the change in the frequency is not necessarily the same for all systems (see J. J. Thomson, *Proc. Camb. Phil. Soc.* 13, p. 39). Preston[49] and Runge and Paschen have proved that, in some cases at any rate, the change in the frequency of the different lines is of such a character that they can be grouped into series such that each line in the series has the same change in frequency for the same magnetic force, and, moreover, that homologous lines in the spectra of different metals belonging to the same group have the same change in frequency.

A very remarkable case of the Zeeman effect has been discovered by H. Becquerel and Deslandres (*Comptes rendus*, 127, p. 18). They found lines in iron when the most deflected components are those polarized in the plane at right angles to the magnetic force. On the simple theory the light polarized in this way is not affected. Thus the behaviour of the spectrum in the magnetic field promises to throw great light on the nature of radiation, and perhaps on the constitution of the elements. The study of these effects has been greatly facilitated by the invention by Michelson[50] of the echelon spectroscope.

There are some interesting phenomena connected with the Zeeman effect which are more easily observed than the effect itself. Thus Cotton[51] found that if we have two Bunsen flames, A and B, coloured by the same salt, the absorption of the light of one by the other is diminished if either is placed between the poles of a magnet: this is at once explained by the Zeeman effect, for the times of vibration of the molecules of the flame in the magnetic field are not the same as those of the other flame, and thus the absorption is diminished. Similar considerations explain the phenomenon observed by Egoroff and Georgiewsky,[52] that the light emitted from a flame in a transverse field is partially polarized in a plane parallel to the magnetic force; and also Righi's[53] observation that if a sodium flame is placed in a longitudinal field between two crossed Nicols, and a ray of white light sent through one of the Nicols, then through the flame, and then through the second Nicol, the amount of light passing through the second Nicol is greater when the field is on than when it is off. Voight and Wiechert (*Wied. Ann.* 67, p. 345) detected the double refraction produced when light travels through a substance exposed to a magnetic field at right angles to the path of the light; this result had been predicted by Voight from theoretical considerations. Jean Becquerel has made some very interesting experiments on the effect of a magnetic field on the fine absorption bands produced by xenotime, a phosphate of yttrium and erbium, and tysonite, a fluoride of cerium, lanthanum and didymium, and has obtained effects which he ascribes to the presence of positive electrons. A very complete account of magneto- and electro-optics is contained in Voight's *Magneto- and Elektro-optik.*

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[4] *Wied. Ann.* 23, p. 228; 27, p. 191.
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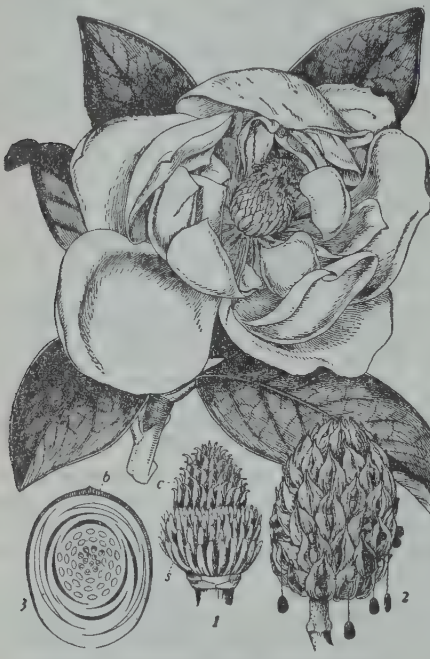
(J. J. T.)

MAGNOLIA, the typical genus of the botanical order Magnoliaceae, named after Pierre Magnol (1638–1715), professor of medicine and botany at Montpellier. It contains about twenty species, distributed in Japan, China and the Himalayas, as well as in North America.

Magnolias are trees or shrubs with deciduous or rarely evergreen foliage. They bear conspicuous and often large, fragrant, white, rose or purple flowers. The sepals are three in number, the petals six to twelve, in two to four series of three in each, the stamens and carpels being numerous. The fruit consists of a number of follicles which are borne on a more or less conical receptacle, and dehisce along the outer edge to allow the scarlet or brown seeds to escape; the seeds however remain suspended by a long slender thread (the funicle). Of the old-world species, the earliest in cultivation appears to have been *M. Yulan* (or *M. conspicua*) of China, of which the buds were preserved, as well as used medicinally and to season rice; together with the greenhouse species, *M. fuscata*, it was transported to Europe in 1789, and thence to North America, and is now cultivated in the Middle States. There are many fine forms of *M. conspicua*, the best being *Soulangeana*, white tinted with purple, *Lenné* and *stricta*. Of the Japanese magnolias, *M. Kobus* and the purple-flowered *M. obovata* were met with by Kaempfer in 1690, and were introduced into England in 1709 and 1804 respectively. *M. pumila*, the dwarf magnolia, from the mountains of Amboyna, is nearly evergreen, and bears deliciously scented flowers; it was introduced in 1786. The Indian species are three in number, *M. globosa*, allied to *M. conspicua* of Japan, *M. sphenocarpa*, and, the most magnificent of all magnolias, *M. Campbellii*, which forms a conspicuous feature in the scenery and vegetation of Darjeeling. It was discovered by Dr Griffith in Bhutan, and is a large forest tree, abounding on the outer ranges of Sikkim, 80 to 150 ft. high, and from 6 to 12 ft. in girth. The flowers are 6 to 10 in. across, appearing before the leaves, and vary from white to a deep rose colour.

The first of the American species brought to Europe (in 1688 by John Banister) was *M. glauca*, a beautiful evergreen species about 15 ft. high with obtuse leathery leaves, blue-green above, silvery underneath, and globular flowers varying from creamy white to pale yellow with age. It is found in low situations near the sea from Massachusetts to Louisiana—more especially in New Jersey and the Carolinas. *M. acuminata*, the so-called "cucumber tree," from the resemblance of the young fruits to small cucumbers, ranges from Pennsylvania to Carolina. The wood is yellow, and used for bowls; the flowers, 3 to 4 in. across, are glaucous green tinted with yellow. It was introduced into England from Virginia about 1736. *M. tripetala* (or *M. umbrella*), is known as the " umbrella tree " from the arrangement of the leaves at the ends of the branches resembling somewhat that of the ribs of an umbrella. The flowers, 5 to 8 in. across, are white and have a strong but not disagreeable scent. It was brought to England in 1752. *M. Fraseri* (or *M. auriculata*), discovered by John Bartram in 1773, is a native of the western parts of the Carolinas and Georgia, extending southward to western Florida and southern Alabama. It grows 30 to 50 ft. high, has leaves a foot or more long, heart-shaped and bluntly auricled at the base, and fragrant pale yellowish-white flowers, 3 to 4 in. across. The most beautiful species of North America is *M. grandiflora*, the "laurel magnolia," a native of the south-eastern States, and introduced into England in 1734. It grows a straight trunk, 2 ft. in diameter and upwards of 70 ft. high, bearing a profusion of large, powerfully lemon-scented creamy-white flowers. It is an evergreen tree, easily recognized by its glossy green oval oblong leaves with a rusty-brown under surface. In England it is customary to train it against a wall in the colder parts, but it does well as a bush tree; and the original species is surpassed by the Exmouth varieties, which originated as seedlings at Exeter from the tree first raised in England by Sir John Colliton, and which flower much more freely than the parent plant. Other fine magnolias now to be met with in gardens are *M. cordata*, a North American deciduous tree 40 to 50 ft. high, with heart-shaped leaves, woolly beneath, and yellow flowers lined with purple; *M. hypoleuca*, a fine Japanese tree 60 ft. high or more, with leaves a foot or more long, 6 to 7 in. broad, the under surface covered with hairs; *M. macrophylla*, a handsome deciduous North American tree, with smooth whitish bark, and very large beautiful green leaves, 1 to 3 ft. long, 8 to 10 in. broad, oblong-obovate and heart-shaped at the base; the open sweet-scented bell-shaped flowers 8 to 10 in. across, are white with a purple blotch at the base of the petals; *M. stellata* or *Halleana*, a charming deciduous Japanese shrub remarkable for producing its pure white starry flowers as early as February and March on the leafless stems; and *M. Watsoni*, another fine deciduous Japanese bush or small tree with very fragrant pure white flowers 5 to 6 in. across.



Magnolia grandiflora, shoot with flower; rather less than ½ nat. size.

1. Flower after removal of the sepals and petals, showing the indefinite stamens, *s*, and carpels, *c*.
2. Fruit—the ripe carpels are splitting, exposing the seeds, some of which are suspended by the long funicle.
3. Floral diagram, *b*, bract.

The tulip tree, *Liriodendron tulipifera*, a native of North America, frequently cultivated in England, is also a member of the same family. It reaches a height of over 100 ft. in a native condition, and as much as 60 to 80 ft. in England. It resembles the plane tree somewhat in appearance, but is readily recognized by lobed leaves having the apical lobe truncated, and by its soft green and yellow tulip-like flowers—which however are rarely borne on trees under twenty years of age.

For a description of the principal species of magnolia under cultivation see J. Weathers, *Practical Guide to Garden Plants*, pp. 174 seq., and for a detailed account of the American species see C. S. Sargent, *Silva of North America*, vol. i.

MAGNUS, HEINRICH GUSTAV (1802–1870), German chemist and physicist, was born at Berlin on the 2nd of May 1802. His father was a wealthy merchant; and of his five brothers one, Eduard (1799–1872), became a celebrated painter. After studying at Berlin, he went to Stockholm to work under Berzelius, and later to Paris, where he studied for a while under Gay-Lussac and Thénard. In 1831 he returned to Berlin as lecturer on technology and physics at the university. As a teacher his success was rapid and extraordinary. His lucid style and the perfection of his experimental demonstrations drew to his lectures a crowd of enthusiastic scholars, on whom he impressed the importance of applied science by conducting them round the factories and workshops of the city; and he further found time to hold weekly " colloquies " on physical questions at his house with a small circle of young students. From 1827 to 1833 he was occupied mainly with chemical researches, which resulted in the discovery of the first of the platino-ammonium compounds (" Magnus's green salt " is $Ptll_2, 2NH_3$), of sulphovinic, ethionic and isethionic acids and their salts, and, in conjunction with C. F. Ammermüller, of periodic acid. Among other subjects at which he subsequently worked were the absorption of gases in blood (1837–1845), the expansion of gases by heat (1841–1844), the vapour pressures of water and various solutions (1844–1854), thermo-electricity (1851), electrolysis (1856), induction of currents (1858–1861), conduction of heat in gases (1860), and polarization of heat (1866–1868). From 1861 onwards he devoted much attention to the question of diathermancy in gases and vapours, especially to the behaviour in this respect of dry and moist air, and to the thermal effects produced by the condensation of moisture on solid surfaces.

In 1834 Magnus was elected extraordinary, and in 1845 ordinary professor at Berlin. He was three times elected dean of the faculty, in 1847, 1858 and 1863; and in 1861, rector magnificus. His great reputation led to his being entrusted by the government with several missions; in 1865 he represented Prussia in the conference called at Frankfort to introduce a uniform metric system of weights and measures into Germany. For forty-five years his labour was incessant; his first memoir was published in 1825 when he was yet a student; his last appeared shortly after his death on the 4th of April 1870. He married in 1840 Bertha Humblot, of a French Huguenot family settled in Berlin, by whom he left a son and two daughters.

See *Allgemeine deutsche Biog.* The Royal Society's *Catalogue* enumerates 84 papers by Magnus, most of which originally appeared in *Poggendorff's Annalen.*

MAGNY, CLAUDE DRIGON, Marquis de (1797–1879), French heraldic writer, was born in Paris. After being employed for some time in the postal service, he devoted himself to the study of heraldry and genealogy, his work in this direction being rewarded by Pope Gregory XVI. with a marquisate. He founded a French college of heraldry, and wrote several works on heraldry and genealogy, of which the most important were *Archives nobiliaires universelles* (1843) and *Livre d'or de la noblesse de France* (1844–1852). His two sons, Edouard Drigon and Achille Ludovice Drigon, respectively comte and vicomte de Magny, also wrote several works on heraldry.

MAGO, the name of several Carthaginians. (1) The reputed founder of the military power of Carthage, fl. 550–500 B.C. (Justin xviii. 7, xix. 1). (2) The youngest of the three sons of Hamilcar Barca. He accompanied Hannibal into Italy, and held important commands in the great victories of the first three years. After the battle of Cannae (216 B.C.) he sailed to Carthage to report the successes gained. He was about to return to Italy with strong reinforcements for Hannibal, when the government ordered him to go to the aid of his other brother, Hasdrubal, who was hard pressed in Spain. He carried on the war there with varying success in concert with the two Hasdrubals until, in 209, his brother marched into Italy to help Hannibal. Mago remained in Spain with Hasdrubal, the son of Gisco. In 207 he was defeated by M. Junius Silanus, and in 206 the combined forces of Mago and Hasdrubal were scattered by Scipio Africanus in the decisive battle of Silpia. Mago maintained himself for some time in Gades, but afterwards received orders to carry the war into Liguria. He wintered in the Balearic Isles, where the harbour Portus Magonis (Port Mahon) still bears his name. Early in 204 he landed in Liguria, where he maintained a desultory warfare till in 203 he was defeated in Cisalpine Gaul by the Roman forces. Shortly afterwards he was ordered to return to Carthage, but on the voyage home he died of wounds received in battle.

See Polybius iii.; Livy xxi.–xxiii.; xxviii., chs. 23–37; xxix., xxx.; Appian, *Hispanica*, 25–37; T. Friedrich, *Biographie des Barkiden Mago*; H. Lehmann, *Der Angriff der drei Barkiden auf Italien* (Leipzig, 1905); and further J. P. Mahaffy, in *Hermathena*, vii. 29–36 (1890).

(3) The name of Mago is also attached to a great work on agriculture which was brought to Rome and translated by order of the senate after the destruction of Carthage. The book was regarded as a standard authority, and is often referred to by later writers.

See Pliny, *Nat. Hist.* xviii. 5; Columella, i. 1; Cicero, *De oratore*, i. 58.

MAGPIE, or simply PIE (Fr. *pie*), the prefix being the abbreviated form of a human name (Margaret[1]), a bird once common throughout Great Britain, though now nearly everywhere scarce. Its pilfering habits have led to this result, yet the injuries it causes are exaggerated by common report; and in many countries of Europe it is still the tolerated or even the cherished neighbour of every farmer, as it formerly was in England if not in Scotland also. It did not exist in Ireland in 1617, when Fynes Morison wrote his *Itinerary*, but it had appeared there within a hundred years later, when Swift mentions its occurrences in his *Journal to Stella*, 9th July 1711. It is now common enough in that country, and there is a widespread but unfounded belief that it was introduced by the English out of spite. It is a species that when not molested is extending its range, as J. Wolley ascertained in Lapland, where within the last century it has been gradually pushing its way along the coast and into the interior from one fishing-station or settler's house to the next, as the country has been peopled.

Since the persecution to which the pie has been subjected in Great Britain, its habits have altered greatly. It is no longer the merry, saucy hanger-on of the homestead, but is become the suspicious thief, shunning the gaze of man, and knowing that danger may lurk in every bush. Hence opportunities of observing it fall to the lot of few, and most persons know it only as a curtailed captive in a wicker cage, where its vivacity and natural beauty are lessened or wholly lost. At large few European birds possess greater beauty, the pure white of its scapulars and inner web of the flight-feathers contrasting vividly with the deep glossy black on the rest of its body and wings, while its long tail is lustrous with green, bronze, and purple reflections. The pie's nest is a wonderfully ingenious structure, placed either in high trees or low bushes, and so massively built that it will stand for years. Its foundation consists of stout sticks, turf and clay, wrought into a deep, hollow cup, plastered with earth, and lined with fibres; but around this is erected a firmly interwoven, basket-like outwork of thorny sticks, forming a dome over the nest, and leaving but a single hole in the side for entrance and exit, so that the whole structure is rendered almost impregnable. Herein are laid from six to nine eggs, of a pale bluish-green freckled with brown and blotched with ash-colour. Superstition as to the appearance of the pie still survives even among many educated persons, and there are several versions of a rhyming adage as to the various turns of luck which its presenting itself, either alone or in company with others, is supposed to betoken, though all agree that the sight of a single pie presages sorrow.

The pie belongs to the same family of birds as the crow, and is the *Corvus pica* of Linnaeus, the *Pica caudata*, *P. melanoleuca*, or *P. rustica* of modern ornithologists, who have recognized it as forming a distinct genus, but the number of species thereto belonging has been a fruitful source of discussion. Examples from the south of Spain differ slightly from those inhabiting the rest of Europe, and in some points more resemble the *P. mauritanica* of north-western Africa; but that species has a patch of bare skin of a fine blue colour behind the eye, and much shorter wings. No fewer than five species have been discriminated from various parts of Asia, extending to Japan; but only one of them, the *P. leucoptera* of Turkestan and Tibet, has of late been admitted as valid. In the west of North America, and in some of its islands, a pie is found which extends to the upper valleys of the Missouri and the Yellowstone, and has long been thought entitled to specific distinction as *P. hudsonia*; but its claim thereto is now disallowed by some of the best ornithologists of the United States, and it can hardly be deemed even a geographical variety of the Old-World form. In California, however, there is a permanent race if not a good species, *P. nuttalli*, easily distinguishable by its yellow bill and the bare yellow skin round its eyes; on two occasions in the year 1867 a bird apparently similar was observed in Great Britain (*Zoologist*, ser. 2, pp. 706, 1016. (A. N.)

MAGWE, a district in the Minbu division of Upper Burma. Area, 2913 sq. m.; pop. (1901), 246,708, showing an increase of 12·38% in the decade. Magwe may be divided into two portions: the low, flat country in the Taungdwingyi subdivision, and the undulating high ground extending over the rest of the district. In Taungdwingyi the soil is rich, loamy, and extremely fertile. The plain is about 45 m. from north to south. At its southern extremity it is about 30 m. wide, and lessens in width to the north till it ends in a point at Natmauk. On the east are the Pegu Yomas, which at some points reach a height of 1500 ft. A number of streams run westwards to the Irrawaddy, of which the Yin and the Pin, which form the northern boundary, are the chief. The only perennial stream is the Yanpè. Rice is the staple product, and considerable quantities are exported. Sesamum of very high quality, maize, and millet are also cultivated, as well as cotton in patches here and there over the whole district.

In this district are included the well-known Yenangyaung petroleum wells. The state wells have been leased to the Burma Oil Company. The amount of oil-bearing lands is estimated at 80 sq. m. and the portion not leased to the company has been demarcated into blocks of 1 sq. m. and offered on lease. The remaining land belongs to hereditary Burmese owners called *twinsa*, who dig wells and extract their oil by the rope and pulley system as they have always done. Lacquered wood trays, bowls and platters, and cart-wheels, are the only manufactures of any note in the district.

The annual rainfall averages about 27 inches. The maximum temperature rises to a little over 100° in the hot season, and falls to an average minimum of 53° and 54° in the cold season.

The town of MAGWE is the headquarters of the district; pop. (1901), 6232. It is diagonally opposite Minbu, the headquarters of the division, on the right bank of the Irrawaddy.

MAGYARS, the name of the dominant race in Hungary, or Hungarians proper. Though they have become physically assimilated to the western peoples, they belong in origin and language to the Finno-Ugrian (*q.v.*) division of the Ural-Altaic race. They form barely half of the population of Hungary, but are by far the largest and most compact of all its racial groups.

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[1] "Magot" and "Madge," with the same origin, are names frequently given in England to the pie; while in France it is commonly known as *Margot*, if not termed, as it is in some districts, *Jaquette*.

Magyar is the official language of Hungary, the official name of which (*Magyarorzág*, or "country of the Magyars") enshrines the Magyar claim to predominance. While all Magyars are properly Hungarians, all Hungarians are not necessarily Magyars. "Hungarian" may be used as a generic term covering all the various races of Hungary, while "Magyar" is strictly specific to a single group. The Magyars themselves, indeed, sometimes apply the name *Magyarorzág* to Hungary "proper," excluding Croatia-Slavonia, the whole kingdom being called *Magyarbirodalom*, the Magyar monarchy or realm. See HUNGARY.

MAHABALESHWAR, or MALCOLMPETH, a hill station in Satara district, and the principal sanatorium in the Bombay presidency, India. Pop. (1901), 5299. It is reached by carriage from Wathar railway station (39 m.) or by motor car from Poona (119 m.). Mahabaleshwar occupies the summit of a ridge of the Western Ghats, with a general elevation of 4500 ft. above sea-level. It was established in 1828 by Sir John Malcolm, governor of Bombay, who obtained the site from the raja of Satara in exchange for another patch of territory. The superior elevation of Mahabaleshwar renders it much cooler than Matheran (2460 ft.), a sanatorium about 50 m. E. of Bombay, but its heavy rainfall (292 in. annual average) makes it almost uninhabitable during the rainy season. The mean annual temperature is 67° F. In the hottest season (March–April) an extreme of a little over 90° is reached during the day. Mahabaleshwar forms the retreat usually during spring, and occasionally in autumn, of the governor of Bombay, and the chief officers of his establishment, and has the usual public buildings of a first-class sanatorium.

MAHAFFY, JOHN PENTLAND (1839–), Irish classical scholar, was born in Switzerland on the 12th of July 1839. He received his early education in Switzerland and Germany, and later at Trinity College, Dublin, where he held the professorship of ancient history. Mahaffy, a man of great versatility, published numerous works, some of which, especially those dealing with what may be called the Silver age of Greece, became standard authorities. The following deserve mention: *History of Classical Greek Literature* (4th ed., 1903 seq.); *Social Life in Greece from Homer to Menander* (4th ed., 1903); *The Silver Age of the Greek World* (1906); *The Empire of the Ptolemies* (1896); *Greek Life and Thought from Alexander to the Roman Conquest* (2nd ed., 1896); *The Greek World under Roman Sway from Polybius to Plutarch* (1890). His translation of Kuno Fischer's *Commentary on Kant* (1866) and his own exhaustive analysis, with elucidations, of Kant's critical philosophy are of great value. He also edited the Petrie papyri in the *Cunningham Memoirs* (3 vols. 1891–1905).

MAHALLAT, a province of central Persia, situated between Kashan and Irak. Pop. about 20,000; yearly revenue about £2500. Until 1890 it was one of the five "central provinces" (the other four being Irak, Ferahan, Kezzaz, and Savah), which were under a governor appointed by the shah; since then it has formed part of the Isfahan government. It is traversed by the Anarbar or Kum River, and comprises the city of Mahallat, divided into upper and lower, or Rivkan and Zanjirvan, and twenty-two flourishing villages. It was known in former times as Anar, the Anarus of Peutinger's tables. The city, capital of the province, is situated at an elevation of 5850 ft. in 33° 51′ N., 50° 30′ E.; pop. about 9000.

MAHAN, ALFRED THAYER (1840–), American naval officer and historian, was born on the 27th of September 1840 at West Point, New York. His father, Dennis Hart Mahan (1802–1871) was a professor in the military academy, and the author of textbooks on civil and military engineering. The son graduated at the naval academy in 1859, became lieutenant in 1861, served on the "Congress," and on the "Pocahontas," "Seminole," and "James Adger" during the Civil War, and was instructor at the naval academy for a year. In 1865 he was made lieut.-commander, commander in 1872, captain in 1885. Meanwhile he saw service in the Gulf of Mexico, the South Atlantic, the Pacific, and Asia, and did shore duty at Boston, New York and Annapolis. In 1886–89 he was president of the naval war college at Newport, Rhode Island. Between 1889 and 1892 he was engaged in special service for the bureau of navigation, and in 1893 was made commander of the "Chicago," of the European squadron. In 1896 he retired from active service, but was a member of the naval board of strategy during the war between the United States and Spain. He was a member of the peace congress at the Hague in 1899. This long and varied service gave him extensive opportunities for observation, which he supplemented by constant study of naval authorities and reflection on the interpretation of the problems of maritime history. His first book was a modest and compact story of the affairs in *The Gulf and Inland Waters* (1883), in a series of volumes by various writers, entitled *The Navy in the Civil War*; in 1890 he suddenly acquired fame by the appearance of his masterly work entitled *The Influence of Sea Power upon History, 1660–1783*. Having been impressed by the failure of historians to allow for the influence of sea power in struggles between nations, he was led to make prolonged investigations of this general theme (see SEA POWER). The reception accorded the volume was instant and hearty; in England, in particular, it was deemed almost an epoch-making work, and was studied by naval specialists, cabinet ministers and journalists, as well as by a large part of the general public. It was followed by *The Influence of Sea Power upon the French Revolution and Empire* (2 vols. 1892); *The Life of Nelson, the Embodiment of the Sea Power of Great Britain* (1897); and *Sea Power in its Relations to the War of 1812* (1905). The author's general aim in these works—some of which have been translated into French, German and Japanese—was to make the consideration of maritime matters paramount to that of military, political or economic movements, without, however, as he himself says "divorcing them from their surroundings of cause and effect in general history, but seeking to show how they modified the latter, and were modified by them." He selected the year 1660 as the beginning of his narrative, as being the date when the "sailing-ship era, with its distinctive features, had fairly begun." The series as a whole has been accepted as finally authoritative, supplanting its predecessors of similar aim, and almost—in the words of Theodore Roosevelt—founding a new school of naval historical writing.

Other works by Mahan are a *Life of Admiral Farragut* (1892); *The Interest of America in Sea Power* (1897); *Lessons of the War with Spain* (1899); *The Story of the War with South Africa* and *The Problem of Asia* (1900); *Types of Naval Officers drawn from the History of the British Navy* (1901); *Retrospect and Prospect*, studies of international relations (1902).

MAHANADI, or MAHANUDDY ("The Great River"), a river of India. It rises in 20° 10′ N., 82° E., 25 m. S. of Raipur town, in the wild mountains of Bastar in the Central Provinces. At first an insignificant stream, taking a northerly direction, it drains the eastern portion of the Chhattisgarh plain, then a little above Seorinarayan it receives the waters which its first great affluent, the Seonath, has collected from the western portion of the plain; thence flowing for some distance due E., its stream is augmented by the drainage of the hills of Uprora, Korba, and the ranges that separate Sambalpur from Chota Nagpur. At Padampur it turns towards the south, and struggling through masses of rock, flows past the town of Sambalpur to Sonpur. From Sonpur it pursues a tortuous course among ridges and rocky crags towards the range of the Eastern Ghats. This mountain line it pierces by a gorge about 40 m. in length, overlooked by forest-clad hills. Since the opening of the Bengal-Nagpur railway, the Mahanadi is little used for navigation. It pours down upon the Orissa delta at Naraj, about 7 m. west of Cuttack town; and after traversing Cuttack district from west to east, and throwing off numerous branches (the Katjori, Paika, Biropa, Chitartala, &c.) it falls into the Bay of Bengal at False Point by several channels.

The Mahanadi has an estimated drainage area of 43,800 sq. m., and its rapid flow renders its maximum discharge in time of flood second to that of no other river in India. During unusually high floods 1,500,000 cub. ft. of water pour every second through the Naraj gorge, one-half of which, uncontrolled by the elaborate embankments, and heavily laden with silt, pours over the delta, filling the swamps, inundating the rice-fields, and converting the plains into a sea. In the dry weather the discharge of the Mahanadi dwindles to 1125 cub. ft. per second. Efforts have been made to husband and utilize the vast water supply thrown upon the Orissa delta during seasons of flood. Each of the three branches into which the parent stream splits at the delta head is regulated by a weir. Of the four canals which form the Orissa irrigation system, two take off from the Biropa weir, and one, with its branch, from the Mahanadi weir. On the 31st of December 1868 the government took over the whole canal works from the East Indian Irrigation Company, at a cost of £941,368. The canals thus taken over and since completed, are the high-level canal, the Kendrapara canal, the Taldanda canal and the Machgaon canal, irrigating 275,000 acres.

MAHANOY CITY, a borough of Schuylkill county, Pennsylvania, U.S.A., 56 m. N.E. of Harrisburg. Pop. (1890), 11,286; (1900), 13,504, of whom 3877 were foreign-born, mostly Slavs; (1910 census) 15,936. It is served by branches of the Lehigh Valley and the Philadelphia & Reading railways. The borough is situated in the valley of Mahanoy Creek, and has an elevation of 1240 ft. above the sea; Broad Mountain (1795 ft.), a ridge extending through Schuylkill county, overlooks it on the S.E. The valley is a part of the anthracite coal region of Pennsylvania, fire clay abounds in the vicinity, and the borough's principal industries are the mining and shipping of coal, and the manufacture of shirts and foundry products. Mahanoy City, originally a part of Mahanoy township (pop. in 1910, 6256), was incorporated as a borough in 1863.

MAHAR, the name of a servile caste in the Deccan, India. Their special function, apart from that of scavenger, is to act as village watchman, as guardian of the village boundaries, and as public messenger. In some parts they are also weavers of coarse cotton cloth. In 1901 their total number in all India was just under three millions.

MAHARAJPUR, a village in Gwalior state, Central India. Pop. (1901), 366. It was the scene of a battle (Dec. 29, 1843) in which Sir Hugh Gough, accompanied by the governor-general, Lord Ellenborough, defeated the insurgent army of the Gwalior state.

MAHĀVAṂSA, the *Great Chronicle*, a history of Ceylon from the 5th century B.C. to the middle of the 5th century A.D., written in Pali verse by Mahānāma of the Dīghasanda Hermitage, shortly after the close of the period with which it deals. In point of historical value it compares well with early European chronicles. In India proper the decipherment of early Indian inscriptions was facilitated to a very great extent by the data found only in the Mahāvaṃsa. It was composed on the basis of earlier works written in Sinhalese, which are now lost, having been supplanted by the chronicles and commentaries in which their contents were restated in Pali in the course of the 5th century. The particular one on which our Mahāvaṃsa was mainly based was also called the Mahāvaṃsa, and was written in Sinhalese prose with Pali memorial verse interspersed. The extant Pali work gives legends of the Buddha and the genealogy of his family; a sketch of the history of India down to Asoka; an account of Buddhism in India down to the same date; a description of the sending out of missionaries after Asoka's council, and especially of the mission of Mahinda to Ceylon; a sketch of the previous history of Ceylon; a long account of the reign of Devānam-piya Tissa, the king of Ceylon who received Mahinda, and established Buddhism in the island; short accounts of the kings succeeding him down to Duṭṭha Gāmīin (Dadagamana or Dutegemunu); then a long account, amounting to an epic poem, of the adventures and reign of that prince, a popular hero, born in adversity, who roused the people, and drove the Tamil invaders out of the island. Finally we have short notices of the subsequent kings down to the author's time. The Mahāvaṃsa was the first Pali book made known to Europe. It was edited in 1837, with English translation and an elaborate introduction, by George Turnour, then colonial secretary in Ceylon. Its vocabulary was an important part of the material utilized in Childer's *Pali Dictionary*. Its relation to the sources from which it drew has been carefully discussed by various scholars and in especial detail by Geiger. It is agreed that it gives a reasonably fair and correct presentation of the tradition preserved in the lost Sinhalese Mahāvaṃsa; that, except in the earliest period, its list of kings, with the years of each reign, is complete and trustworthy; and that it gives throughout the view, as to events in Ceylon, of a resident in the Great Minster at Anurādhapura.

See *The Mahāvaṃsa*, ed. by Geo. Turnour (Colombo, 1837); ed. by W. Geiger (London, 1908); H. Oldenberg, in the introduction to his edition of the *Dīpavamsa* (London, 1879); O. Franke, in *Wiener Zeitschrift für die Kunde des Morgenlandes* (1907); W Geiger, *Dīpavamsa und Mahāvamsa* (Leipzig, 1905, trans. by Ethel M. Coomaraswamy, Colombo, 1908). (T. W. R. D.)

MAHAYANA ("Great Vehicle"), the name given to the later Buddhism, the popular religion which embraced all the people and had its pantheon of Buddhas and Bodhisatvas, with attendant deities and demons, spacious temples and images, pompous ceremonial and noisy festivals. It was thus contrasted with the Hinayana ("Little Vehicle") of the primitive Buddhism which had been only for the select few. (See BUDDHISM.)

MAHDI (Arab. "he who is guided aright"), a title assumed by the third Abbasid caliph (see CALIPHATE: *Abbasids*, § 3). According to Moslem traditionists Mahomet declared that one of his descendants, the imam of God, who would fill the earth with equity and justice, would bear the name of al-mahdi. The Sunnis hold that this mahdi has not yet appeared. The name of mahdi is also given by the Shiʽite Mahommedans to the last of the imams of the house of ʽAli. It was under the name of al-mahdi that Mokhtar proclaimed ʽAli's son Mahommed as the opponent of the caliph Abdalmalik, and, according to Shahrastani, the doctrine of the mahdi, the hidden deliverer who is one day to appear and fill the oppressed world with righteousness, first arose in connexion with a belief that this Mahommed had not died but lived concealed at Mount Radwā, near Mecca, guarded by a lion and a panther. The hidden imam of the common Shiʽites is, however, the twelfth imam, Mahommed Abuʽl-Qasim, who disappeared mysteriously in 879. The belief in the appearance of the mahdi readily lent itself to imposture. Of the many pretenders to this dignity known in all periods of Moslem history the most famous was the first caliph of the Fatimite dynasty in North Africa, ʽObaidallah al-Mahdi, who reigned 909–933. After him was named the first capital of the dynasty, the once important city of Mahdia (*q.v.*). Another great historical movement, headed by a leader who proclaimed himself the mahdi (Mahommed ibn Abdallah ibn Tumart), was that of the Almohades (*q.v.*). In 1881 Mahommed Ahmed ibn Seyyid Abdullah (*q.v.*), a Dongolese, proclaimed himself al-mahdi and founded in the eastern Sudan the short-lived empire overthrown by an Anglo-Egyptian force at the battle of Omdurman in 1898. Concurrently with the claim of Mahommed Ahmed to be the mahdi the same title was claimed by, or for, the head of the Senussites, a confraternity powerful in many regions of North Africa.

MAHDIA (also spelt *Mehdia*, *Mehedia*, &c.), a town of Tunisia, on the coast between the gulfs of Hammamet and Gabes, 47 m. by rail S.S.E. of Susa. Pop. about 8000. Mahdia is built on a rocky peninsula which projects eastward about a mile beyond the normal coast line, and is not more than a quarter of a mile wide. The extremity of the peninsula is called Ras Mahdia or Cape Africa—Africa being the name by which Mahdia was designated by Froissart and other European historians during the middle ages and the Renaissance. In the centre of the peninsula and occupying its highest point is a citadel (16th century); another castle farther west is now used as a prison and is in the centre of the native town. The European quarter and the new port are on the south-west side of the peninsula. The port is available for small boats only; steamers anchor in the roadstead about a quarter of a mile from the shore. On the south-east, cut out of the rock, is the ancient harbour, or *cothon*, measuring about 480 ft by 240 ft., the entrance being 42 ft. wide. There are manufactories of olive oil, but the chief industry is sardine fishing, largely in the hands of Italians.

Mahdia occupies the site of a Phoenician settlement and by some authorities is identified with the town called Turris Hannibalis by the Romans. Hannibal is said to have embarked here on his exile from Carthage. After the Arab conquest of North Africa the town fell into decay. It was refounded in 912 by the first Fatimite caliph, 'Obaidallah-al-Mahdi, after whom it was named. It became the port of Kairawan and was for centuries a city of considerable importance, largely owing to its great natural strength, and its position on the Mediterranean. It carried on an active trade with Egypt, Syria and Spain. The town was occupied by the Normans of Sicily in the 12th century, but after holding it for about twelve years they were driven out in 1159 by the Almohades. In 1390 a joint English and French force vainly besieged Mahdia for sixty-one days. In the early part of the 16th century the corsair Dragut seized the town and made it his capital, but in 1550 the place was captured by the Spaniards, who held it until 1574. Before evacuating the town the Spaniards dismantled the fortifications. Under the rule of the Turks and, later, the beys of Tunis Mahdia became a place of little importance. It was occupied by the French in 1881 without opposition, and regained some of its former commercial importance.

During 1908 numbers of bronzes and other works of art were recovered from a vessel wrecked off Mahdia in the 5th century A.D. (see *Classical Review*, June 1909).

MAHÉ, a French settlement in the Malabar district of Madras, India, situated in 11° 43′ N. and 75° 33′ E., at the mouth of a river of the same name. Area, 26 sq. m.; pop. (1901), 10,298. It is the only French possession on the west coast of India, and is in charge of a *chef de service*, subordinate to the governor-general at Pondicherry. It is now a decaying place.

MAHESHWAR, a town in Indore state, Central India, on the N. bank of the Narbada (Nerbudda). Pop. (1901), 7042. Though of great antiquity and also of religious sanctity, it is chiefly noted as the residence of Ahalya Bai, the reigning queen of the Holkar dynasty during the last half of the 18th century, whose ability and munificence are famous throughout India. Close by her cenotaph stands the family temple of the Holkars.

MAHI, a river of western India, which rises in Central India and, after flowing through south Rajputana, enters Gujarat and falls into the sea by a wide estuary near Cambay; total length, 300 m.; estimated drainage area, 16,000 sq. m. It has given its name to the Mahi Kantha agency of Bombay, and also to the *mehwasis*, marauding highlanders often mentioned in Mahommedan chronicles.

MAHI KANTHA, a political agency or collection of native states in India, within the Gujarat division of Bombay. Over half the territory is covered by the native state of Idar. There are eleven other chiefships, and a large number of estates belonging to Rajput or Koli thakurs, formerly feudatories of Baroda. Several of the states are under British administration. Total area, 3125 sq. m.; pop. (1901), 361,545, showing a decrease of 38% in the decade, due to famine; estimated revenue, £76,000; tribute (mostly to the gaekwar of Baroda), £9000. Many of the inhabitants belong to the wild tribes of Bhils and Kolis. In 1897 a metre-gauge railway was opened from Ahmedabad through Parantij to Ahmednagar. At Sadra is the Scott College for the education of the sons of chiefs on the lines of an English public school. There are also Anglo-vernacular schools at Sadra, Idar and Mansa. The famine of 1899–1900 was severely felt in this tract.

MAHMUD I. (1696–1754), sultan of Turkey, was the son of Mustafa II., and succeeded his uncle Ahmed III. in 1730. After the suppression of a military revolt the war with Persia was continued with varying success, and terminated in 1736 by a treaty of peace restoring the *status quo ante bellum*. The next enemy whom Turkey was called upon to face was Russia, later joined by Austria. War went on for four years; the successes gained by Russia were outweighed by Austria's various reverses, terminating by the defeat of Wallis at Krotzka, and the peace concluded at Belgrade was a triumph for Turkish diplomacy. The sultan, throughout desirous for peace, is said to have been much under the influence of the chief eunuch, Haji Beshir Aga. In 1754 Mahmud died of heart-disease when returning from the Friday service at the mosque. He had a passion for building, to which are due numberless kiosques, where nocturnal orgies were carried on by him and his boon companions. In this reign the system of appointing Phanariote Greeks to the principalities of Moldavia and Wallachia was instituted. (See PHANARIOTES.)

MAHMUD II. (1785–1839), sultan of Turkey, was the son of Abu-ul-Hamid I., and succeeded his brother, Mustafa IV., in 1808. He had shared the captivity of his ill-fated cousin, the ex-sultan, Selim III., whose efforts at reform had ended in his deposition by the janissaries. Mahmud was thus early impressed with the necessity for dissembling his intention to institute reforms until he should be powerful enough to carry them through. The reforming efforts of the grand vizier Bairakdar, to whom he had owed his life and his accession, broke on the opposition of the janissaries; and Mahmud had to wait for more favourable times. Meanwhile the empire seemed in danger of breaking up. Not till 1812 was the war with Russia closed by the treaty of Bucharest, which restored Moldavia and the greater part of Wallachia to the Ottoman government. But though the war was ended, the terms of the treaty left a number of burning questions, both internal and external, unsettled. This was notably the case with the claim of Russia to Poti and the valley of the Rion (Phasis), which was still outstanding at the time of the congress of Vienna (1814–1815) and prevented the question of a European guarantee of the integrity of Turkey from being considered.

Meanwhile, within the empire, ambitious valis were one by one attempting to carve out dominions for themselves at the expense of the central power. The ambitions of Mehemet Ali of Egypt were not yet fully revealed; but Ali (*q.v.*) of Jannina, who had marched to the aid of the sultan against the rebellious pasha Pasvan Oglu of Widdin, soon began to show his hand, and it needed the concentration of all the forces of the Turkish empire to effect his overthrow and death (1822). The preoccupation of the sultan with Ali gave their opportunity to the Greeks whose disaffection had long been organized in the great secret society of the *Hetaeria Philike*, against which Metternich had in vain warned the Ottoman government. In 1821 occurred the abortive raid of Alexander Ypsilanti into the Danubian principalities, and in May of the same year the revolt of the Greeks of the Morea began the war of Greek Independence (see GREECE: *History*). The rising in the north was easily crushed; but in the south the Ottoman power was hampered by the defection of the sea-faring Greeks, by whom the Turkish navy had hitherto been manned. After three abortive campaigns Mahmud was compelled, infinitely against his will, to summon to his assistance the already too powerful pasha of Egypt, Mehemet Ali, whom he had already employed to suppress the rebellious Wahhabis in Arabia. The disciplined Egyptian army, supported by a well organized fleet, rapidly accomplished what the Turks had failed to do; and by 1826 the Greeks were practically subdued on land, and Ibrahim was preparing to turn his attention to the islands. But for the intervention of the powers and the battle of Navarino Mahmud's authority would have been restored in Greece. The news of Navarino betrayed Mahmud into one of those paroxysms of rage to which he was liable, and which on critical occasions were apt fatally to cloud his usual good sense. After in vain attempting to obtain an apology for "the unparalleled outrage against a friendly power" he issued on the 20th of December a solemn *hatti sheriff* summoning the faithful to a holy war. This, together with certain outstanding grievances and the pretext of enforcing the settlement of the Greek Question approved by the powers, gave Russia the excuse for declaring war against Turkey. After two hardly fought campaigns

(1828, 1829) Mahmud was at length, on the 14th of September 1829, compelled to sign the peace of Adrianople. From this moment until his death Mahmud was, to all intents and purposes, the "vassal of Russia," though not without occasional desperate efforts to break his chains. (For the political events of the period between the first revolt of Mehemet Ali (Sept. 1832) and the death of Mahmud see MEHEMET ALI.) The personal attitude of the sultan, which alone concerns us here, was determined throughout by his overmastering hatred of the upstart pasha, of whom he had stooped to ask aid, and who now defied his will; and the importance of this attitude lies in the fact that, as the result of the success of his centralizing policy, and notably of the destruction of the janissaries (*q.v.*), the supreme authority, hitherto limited by the practical power of the ministers of the Porte and by the turbulence of the privileged military caste, had become concentrated in his own person. It was no longer the Porte that decided, but the Seraglio, and the sultan's private secretary had more influence on the policy of the Ottoman empire than the grand vizier.

This omnipotence of the sultan in deciding the policy of the government was in striking contrast with his impotence in enforcing his views on his subjects and in his relations with foreign powers. Mahmud, in spite of—or rather because of—his well-meant efforts at reform, was hated by his Mussulman subjects and stigmatized as an "infidel" and a traitor to Islam. He was, in fact, a victim to those "half-measures" which Machiavelli condemns as fatal to success. Ibrahim, the conqueror of Syria, scoffed at the sultan's idea "that reform consisted in putting his soldiers into tight trousers and epaulettes." The criticism is not entirely unjust. Mahmud's policy was the converse of that recommended by Machiavelli, viz. in making a revolution to change the substance while preserving the semblance of the old order. Metternich's advice to Mahmud to "remain a Turk" was sound enough. His failure to do so—in externals—left him isolated in his empire: *rayahs* and true believers alike distrusted and hated him. Of this hatred he was fully conscious; he knew that his subjects, even many of his own ministers, regarded Mehemet Ali as the champion of Islam against the "infidel sultan;" he suspected the pasha, already master of the sacred cities, of an intention to proclaim himself caliph in his stead. This, together with the weakness due to military reforms but recently begun, drove him to rely on foreign aid; which, in the actual conditions of Europe, meant the aid of Russia. The long tradition of French friendship for Turkey had been broken, in 1830, by the conquest of Algiers. Austria was, for the time, but the faithful ally of the tsar. On the 9th of August 1832 Mahmud made, through Stratford Canning, a formal proposal for an alliance with Great Britain, which Palmerston refused to consider for fear of offending France. Mahmud bitterly contrasted the fair professions of England with the offers of effective help from Russia. His old ally having deserted him, he accepted the aid of his hereditary foe. The Russian expedition to the Bosporus, the convention of Kutaiah, and the treaty of Unkiar Skelessi (July 8, 1833) followed. Mahmud was under no illusion as to the position in which the latter placed him towards Russia; but his fear of Mehemet Ali and his desire to be revenged upon him outweighed all other considerations. He resented the action of France and England in forcing the settlement of Kutaiah upon him, and remained shut up in his palace, inaccessible to all save his favourites and the representative of Russia. With his single aim in view he busied himself with the creation of a national militia, with the aid of Moltke and other German officers. In 1834 the revolt of Syria against Ibrahim seemed to give him his opportunity. He pleaded the duty of a sultan to go to the aid of his subjects when oppressed by one of his servants; but the powers were obdurate, even Russia, much occupied in affairs nearer home, leaving him in the lurch. He was astute enough to take advantage of the offence given to the powers by Mehemet Ali's system of monopolies, and in 1838 signed with Great Britain, and afterwards with others, a commercial treaty which cut at the root of the pasha's system. A few months later his passionate impatience overcame his policy and his fears. The hand of death was upon him, and he felt that he must strike now or never. In vain the powers, now united in their views, warned him of the probable consequences of any aggressive action on his part. He would rather die, he exclaimed, or become the slave of Russia, than not destroy his rebellious vassal. On his sole initiative, without consulting his ministers or the council of the empire, he sent instructions to Hafiz Pasha, commanding the Ottoman troops concentrated at Bir on the Euphrates, to advance into Syria. The fatal outcome of the campaign that followed he did not live to hear. When the news of Ibrahim's overwhelming victory at Nessib (June 24, 1839) reached Constantinople, Mahmud lay dying and unconscious. Early in the morning of the 1st of July his proud and passionate spirit passed away.

Mahmud II. cannot be reckoned among the great sultans, neither had he any of the calculating statecraft which characterized Abd-ul-Hamid II.; but his qualities of mind and heart, none the less, raised him far above the mass of his predecessors and successors. He was well versed in state affairs and loyal to those who advised and served him, personally brave, humane and kindly when not maddened by passion, active and energetic, and always a man of his word. Unhappily, however, the taint of the immemorial corruption of Byzantium had fallen upon him too, and the avenue to his favour and to political power lay too often through unspeakable paths. In view of the vast difficulty of the task before him at his succession it is less surprising that he failed to carry out his ideas than that he accomplished so much. When he came to the throne the empire was breaking up from within; one by one he freed the provinces from the tyrannical rulers who, like Ali of Jannina, were carving out independent, or quasi-independent, empires within the empire. If he failed in his wider schemes of reform, this was only one more illustration of a truth of which other "enlightened" sovereigns besides himself had experienced the force, namely, that it is impossible to impose any system, however admirable, from above on a people whose deepest convictions and prejudices it offends.

There is a great deal of valuable material for the history of Mahmud and his policy in the unpublished F.O. records (1832–1839), volumes of correspondence marked *Turkey.—From Sir Stratford Canning.—From Mr. Mandeville.—From Lord Ponsonby.* See further works mentioned under TURKEY: *History*; and MEHEMET ALI. (W. A. P.)

MAHMUD NEDIM PASHA (*c.* 1818–1883), Turkish statesman, was the son of Nejib Pasha, ex-governor-general of Bagdad. After occupying various subordinate posts at the Porte he became successively under-secretary of state for foreign affairs, governor-general of Syria and Smyrna, minister of commerce, and governor-general of Tripoli; minister successively of justice and of marine (1869); grand vizier from 1871 to 1872 and from 1875 to 1876. He was high in favour with Sultan Abd-ul-Aziz and fell much under the influence of General Ignatiev, the forceful Russian ambassador before the war of 1877–78, his subserviency to Russia earning for him the nickname of "Mahmudoff." His administration was most unsuccessful from every point of view, and he was largely responsible for the issue of the decree suspending the interest on the Turkish funds. He was minister of the interior from 1879 to 1883.

MAHMUD[1] **OF GHAZNI** (971–1030), son of Sabuktagīn, Afghan conqueror, was born on the 2nd of October 971. His fame rests chiefly on his successful wars, in particular his numerous invasions of India. His military capacity, inherited from his father, Nasir-ud-din Sabuktagīn, was strengthened by youthful experience in the field. Sabuktagīn, a Turki slave of Alptagīn, governor of Khorasan under Abdalmalik I, b. Nuḥ of the Samanid dynasty of Bokhara, early brought himself to notice (see SAMANIDS). He was raised to high office in the state by Alptagīn's successor, Abū Ishāk, and in A.H. 366 (A.D. 977), by the choice of the nobles of Ghazni, he became their ruler. He soon began to make conquests in the neighbouring countries, and in these wars he was accompanied by his young son Mahmud. Before he had reached the age of fourteen he encountered in two expeditions under his father the Indian forces of Jaipal, raja of Lahore, whom Sabuktagīn defeated on the Punjab frontier.

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[1] The name is strictly Maḥmūd.

In 994 Mahmud was made governor of Khorasan, with the title of Saif addaula (ud-daula) ("Sword of the State") by the Sāmānīd Nūh II. Two years later, his father Sabuktagīn died in the neighbourhood of Balkh, having declared his second son, Ismail, who was then with him, to be his successor. As soon as Ismail had assumed the sovereignty at Balkh, Mahmud, who was at Nishapur, addressed him in friendly terms, proposing a division of the territories held by their father at his death. Ismail rejected the proposal, and was immediately attacked by Mahmud and defeated. Retreating to Ghazni, he there yielded, and was imprisoned, and Mahmud obtained undisputed power as sovereign of Khorasan and Ghazni (997).

The Ghaznevid dynasty is sometimes reckoned by native historians to commence with Sabuktagīn's conquest of Bost and Kosdār (978). But Sabuktagīn, throughout his reign at Ghazni, continued to acknowledge the Sāmānid suzerainty, as did Mahmud also, until the time, soon after succeeding to his father's dominions, when he received from Qādir, caliph of Bagdad (see CALIPHATE, C. § 25), a *khilat* (robe of honour), with a letter recognizing his sovereignty, and conferring on him the titles *Yamīn-addaula* ("Right hand of the State"), and *Amīn-ul-Millat* ("Guardian of the Faith"). From this time it is the name of the caliph that is inscribed on Mahmud's coins, together with his own new titles. Previously the name of the Sāmānid sovereign, Mansūr II. b. Nūh is given along with his own former title, Saif addaula Mahmūd. The earliest of those of the new form gives his name Mahmūd bin Sabuktagīn. Thereafter his father's name does not appear on his coins, but it is inscribed again on his tomb.

The new honours received from the caliph gave fresh impulse to Mahmud's zeal on behalf of Islam, and he resolved on an annual expedition against the idolaters of India. He could not quite carry out this intention, but a great part of his reign was occupied with his Indian campaigns. In 1000 he started on the first of these expeditions, but it does not appear that he went farther than the hill country near Peshawar. The hostile attitude of Khalaf ibn Ahmad, governor of Seistan, called Mahmud to that province for a short time. He was appeased by Khalaf's speedy submission, together with the gift of a large sum of money, and further, it is said, by his subdued opponent addressing him as *sultān*, a title new at that time, and by which Mahmud continued to be called, though he did not formally adopt it, or stamp it on his coins. Four years later Khalaf, incurring Mahmud's displeasure again, was imprisoned, and his property confiscated.

Mahmud's army first crossed the Indus in 1001, opposed by Jaipāl, raja of Lahore. Jaipāl was defeated, and Mahmud, after his return from this expedition, is said to have taken the distinctive appellation of *Ghāzi* ("Valiant for the Faith"), but he is rarely so-called. On the next occasion (1005) Mahmud advanced, as far as Bhera on the Jhelum, when his adversary Anang-pāl, son and successor of Jaipāl, fled to Kashmir. The following year saw Mahmud at Multan. When he was in the Punjab at this time, he heard of the invasion of Khorāsan by the Ilek Khan Nasr I. ruler of Transoxiana whose daughter Mahmud had married. After a rapid march back from India, Mahmud repelled the invaders. The Ilek Khan, having retreated across the Oxus, returned with reinforcements, and took up a position a few miles from Balkh, where he was signally defeated by Mahmud.

Mahmud again entered the Punjab in 1008, this time for the express purpose of chastising Sēwah Pāl, who, having become a Mussulman, and been left by Mahmud in charge of Multan, had relapsed to Hinduism. The Indian campaign of 1009 was notable. Near the Indus Mahmud was opposed again by Anang-pāl, supported by powerful rajas from other parts of India. After a severe fight, Anang-pāl's elephants were so terror-struck by the fire-missiles flung amongst them by the invaders that they turned and fled, the whole army retreating in confusion and leaving Mahmud master of the field. Mahmud, after this victory, pushed on through the Punjab to Nagar-kōt (Kangra), and carried off much spoil from the Hindu temples to enrich his treasury at Ghazni. In 1011 Mahmud, after a short campaign against the Afghans under Mahommed ibn Sūr in the hill country of Ghur, marched again into the Punjab. The next time (1014) he advanced to Thanēsar, another noted stronghold of Hinduism, between the Sutlej and the Jumna. Having now found his way across all the Punjab rivers, he was induced on two subsequent occasions to go still farther. But first he designed an invasion of Kashmir (1015), which was not carried out, as his progress was checked at Lōh-kōt, a strong hill fort in the north-west of the Punjab. Then before undertaking his longer inroad into Hindustan he had to march north into Khwārizm (Khiva) against his brother-in-law Mamūn, who had refused to acknowledge Mahmud's supremacy. The result was as usual, and Mahmud, having committed Khwārizm to a new ruler, one of Mamūn's chief officers, returned to his capital. Then in 1018, with a very large force, he proceeded to India again, extending his inroad this time to the great Hindu cities of Mathra on the Jumna and Kanauj on the Ganges. He reduced the one, received the submission of the other, and carried back great stores of plunder. Three years later he went into India again, marching over nearly the same ground, to the support, this time, of the raja of Kanauj, who, having made friendship with the Mahommedan invader on his last visit, had been attacked by the raja of Kalinjar. But Mahmud found he had not yet sufficiently subdued the idolaters nearer his own border, between Kabul and the Indus, and the campaign of 1022 was directed against them, and reached no farther than Peshawar. Another march into India the following year was made direct to Gwalior.

The next expedition (1025) is the most famous of all. The point to which it was directed was the temple of Somnath on the coast of the Gujarāt peninsula. After an arduous journey by Multan, and through part of Rajputana, he reached Somnath, and met with a very vigorous but fruitless resistance on the part of the Hindus of Gujarāt. Moslem feet soon trod the courts of the great temple. The chief object of worship it contained was broken up, and the fragments kept to be carried off to Ghazni. The story is often told of the hollow figure, cleft by Mahmud's battle-axe, pouring out great store of costly jewels and gold. But the idol in this Sivite temple was only a tall block or pillar of hewn stone, of a familiar kind. The popular legend is a very natural one. Mahmud, it was well known, made Hindu temples yield up their most precious things. He was a determined idol-breaker. And the stone block in this temple was enriched with a crown of jewels, the gifts of wealthy worshippers. These data readily give the Somnath exploit its more dramatic form. For the more recent story of the Somnath gates see SOMNATH.

After the successes at Somnath, Mahmud remained some months in India before returning to Ghazni. Then in 1026 he crossed the Indus once more into the Punjab. His brilliant military career closed with an expedition to Persia, in the third year after this, his last, visit to India. The Indian campaigns of Mahmud and his father were almost, but not altogether, unvarying successes. The Moslem historians touch lightly on reverses. And, although the annals of Rajputana tell how Sabuktagīn was defeated by one raja of Ajmere and Mahmud by his successor, the course of events which followed shows how little these and other reverses affected the invader's progress. Mahmud's failure at Ajmere, when the brave raja Bisal-deo obliged him to raise the siege but was himself slain, was when the Moslem army was on its way to Somnath. Yet Mahmud's Indian conquests, striking and important in themselves, were, after all, in great measure barren, except to the Ghazni treasury. Mahmud retained no possessions in India under his own direct rule. But after the repeated defeats, by his father and himself, of two successive rajas of Lahore, the conqueror assumed the right of nominating the governors of the Punjab as a dependency of Ghazni, a right which continued to be exercised by seven of his successors. And for a time, in the reign of Masʽud II.

(1098–1114), Lahore was the place of residence of the Ghaznevid sovereign.

Mahmud died at Ghazni in 1030, the year following his expedition to Persia. He is conspicuous for his military ardour, his ambition, strong will, perseverance, watchfulness and energy, combined with great courage and unbounded self-reliance. But his tastes were not exclusively military. His love of literature brought men of learning to Ghazni, and his acquaintance with Moslem theology was recognized by the learned doctors.

The principal histories of Mahmud's reign are—*Kitāb-i-Yamīnī* (Utbi); *Tarīkh-us-Subuktigīn* (Baihaki); *Tabakāt i Nasiri* (Minhāj el-Sirāj); *Rauzat-us-Safa* (Mir Khond); *Habīb-us-Sivar* (Khondamir). See Elliot, *History of India;* Elphinstone, *History of India;* and Roos-Keppel's translation of the *Tarīkh-i-Sultan Mahmūd-i-Ghaznavi* (1901).

MAHOBA, an ancient town in India, in Hamirpur district of the United Provinces. Pop. (1901), 10,074. As the capital of the Chandel dynasty, who ruled over Bundelkhand from the 9th to the 13th century, the neighbourhood is covered with architectural antiquities, prominent among which are artificial lakes, formed by banking up valleys with masonry dams. The largest of these is more than 4 m. in circuit.

MAHOGANY, a dark-coloured wood largely used for household furniture, the product of a large tree indigenous to Central America and the West Indies. It was originally received from Jamaica; 521,300 ft. were exported from that island in 1753. It is known botanically as *Swietenia Mahogani*, and is a member of the order *Meliaceae*. It bears compound leaves, resembling those of the ash, and clusters of small flowers, with five sepals and petals and ten stamens which are united into a tube. The fruit is a pear-shaped woody capsule, and contains many winged seeds. The dark-coloured bark has been considered a febrifuge, and the seeds were used by the ancient Aztecs with oil for a cosmetic, but the most valuable product is the timber, first noticed by the carpenter on board Sir Walter Raleigh's ship in 1595 for its great beauty, hardness and durability. Dr Gibbons brought it into notice as well adapted for furniture in the early part of the 18th century, and its use as a cabinet wood was first practically established by a cabinet-maker named Wollaston, who was employed by Gibbons to work up some mahogany brought to England by his brother. It was introduced into India in 1795, and is now cultivated in Bengal and as far north as Saharunpur.

The timber of species of *Cedrela* and *Melia*, other members of the order *Meliaceae*, are used as Mahogany, and the product of the West African *Khaya senegalensis* is known as African mahogany. There is some confusion between the product of these various trees. Herbert Stone (*The Timbers of Commerce*, 1904) says: "The various species of mahogany and cedar are so confusing that it is difficult to make precise statements as to their structure or origin. I know of no convincing proof that any of the American kinds met with on the English market are the wood of *Swietenia Mahogani*, nor that those shipped from Africa are the wood of *Khaya senegalensis*. These two genera are very nearly allied to *Cedrela* and *Melia*, and it is difficult to separate any of the four from the rest by the characters of the wood. After giving the most careful attention to every detail, I lean to the view that most if not all of the mahoganies commonly met with are Cedrelas."

Kiggelaria Dregeana (natural order *Bixineae*), a native of South Africa, is known as Natal mahogany.

MAHOMET (strictly MUḤAMMAD, commonly also MOHAMMED), founder of the religious system called in Europe after him Mahommedanism, and by himself Islam or Ḥanifism. He died, according to the ordinary synchronism, on the 7th of June 632 (12 Rabia, A.H. 11), and his birthday was exactly sixty-three or sixty-five years earlier, the latter number being evidently an interpretation in lunar years of a number thought to refer to solar years. The lunar system was introduced into Arabia by Mahomet himself quite at the close of his career; that which existed before was certainly solar, as it involved a process of intercalation—which, however, seems to have been arbitrarily manipulated by priests, whence certain synchronisms cannot be got for the events in the Prophet's career. The number 63 for the years of his life may rest on tradition, though it is unlikely that such matters were accurately noted; it can also be accounted for by a priori combination. A Meccan, it is said, became a full citizen at the age of 40; this then would be the age at which the mission might be started. The Medina period (of which count was kept) lasted ten to eleven years; for the Meccan period ten years would seem a likely length. Finally it was known that for some years—about three—the mission had been conducted secretly. The only event in contemporary history to which the Koran alludes in its earlier parts is the Persian conquest of Palestine in 616. Clearly Mahomet had begun to prophesy at that date.

His Country.

Before the rise of Islam, Mahomet's native place, Mecca, appears to figure nowhere in historical records, unless there be a reference to it in the "valley of Baca" (Psalm lxxxiv. 6). Its sacred, and therefore archaic, name is *Bakkah*; hence the identification of the name with that of the sanctuary Makoraba, known to the Greek geographers, is not philologically tenable; although so eminent a linguist as Dozy evolved a theory of the origin of the city from this name, which appears to be South Arabian for "sanctuary," and has no connexion with Hebrew (as Dozy supposed). In the 3rd century of Islam the mythology of Mecca was collected and published in book form, but we learn little more from it than names of tribes and places; it is clear that there was no record of the mode in which the community inhabiting the place had got there, and that little was remembered with accuracy of the events which preceded the rise of its prophet. The city had a sanctuary, called the *Cube* (*kaʿba*), of which the nucleus was the "Black Stone," probably to be identified with Allah, the god of the community; both still exist, or rather their legitimate substitutes, as the Kaʿba has been repeatedly reconstructed, and the original Black Stone was stolen by the Carmathians in the 4th century of Islam; they afterwards returned one, but it may or may not have been the same as that which they removed. At some time in the 6th century—said to have been the birth-year of the Prophet, but really much earlier—an Abyssinian invader raided Mecca with the view of abolishing this sanctuary; but for some reason had to desist. This expedition, known as the "Raid of the Elephant," one of these animals being employed in it, seems to be of great importance for explaining the rise of Islam; for a sanctuary which can repel an invader acquires tremendous reputation. Some verses in the Koran which are perhaps not genuine, record the miracle whereby Allah repelled the "People of the Elephant." The sanctuary was apparently in the possession of the tribe Koreish (Quraish), the origin of whose name is unknown, said to have come originally from Cutha in Mesopotamia. They were known (we are told) as the people of Allah, and, by wearing a badge, were sacrosanct throughout Arabia. If this be true, it was probably a privilege earned by the miraculous defence of the Kaʿba, and is sufficient to account for the rise of Meccan commerce of which we hear much in the biography of the Prophet, and to which some verses of the earliest part of the Koran allude; for merchants who were safe from attacks by bandits would have an enormous advantage. The records seem, however, to be inconsistent with this assertion; and the growth of the Meccan commerce is sufficiently accounted for by the fact that after the Abyssinian invasion pilgrimage to the Kaʿba became the practice of numerous Arab tribes, and for four months in the year (selected by Meccan priests) raiding was forbidden, in order to enable the pilgrimage to be safely made. In addition to this it would seem that all Mecca counted as sanctuary—*i.e.* no blood might under any circumstances be shed there. The community lived by purveying to pilgrims and the carrying trade; and both these operations led to the immigration of strangers.

Mahomet's Family.

There seems to be no doubt that Mahomet was himself a member of the tribe Koreish, and indeed too many of his relatives figure in history to permit of his parentage being questioned. His cousin ʿAli, fourth caliph, was the son of Abū Ṭālib, whose name attests the historical character of the kindred name ʿAbd al-Moṭṭalib, Mahomet's grandfather: for the fact that this name is in part enigmatical is certainly no argument against its genuineness. In the 3rd century of Islam a document was shown in which a man of San'a in Yemen acknowledged that he had borrowed from 'Abd al-Moṭṭalib 1000 silver dirhems of the Hudaida standard, and Allāh with the two "angels" (probably a euphemism for the goddesses Al-lāt and al-'Uzzā) served as witness; it is difficult to see why such a document should have been forged. The name Hāshim (for 'Abd al-Moṭṭalib's father) may or may not be historical; here, as in the ascending line throughout, we have subjects without predicates. The name of 'Abd al-Moṭṭalib's son, who was Mahomet's father, is given as 'Abdallāh; the correctness of this has been questioned, because "Servant of Allah" would seem to be too appropriate, and the name was often given by the Prophet to converts as a substitute for some pagan appellation. This, however, is hypercritical, as the name of the father could not easily be altered, when relatives abounded, and it would seem that at one time the Prophet made no theological use of the name Allah, for which he intended to substitute Raḥmān. The name of his mother is given as Āminah, and with this one of his own titles, Amīn, agrees; although the Arabs do not appear to bring the two into connexion. Her father's name is given as Wahb, and she is brought into relation with a Medinese tribe called the Banū 'Adī b. al-Najjār, to whom she is said to have brought her son in his early infancy. The circumstances may have been suggested by his later connexion with that place; yet in what seems a historical narrative her grave is mentioned as known to be at Abwa, midway between the two cities, whence this early bond between the Prophet and his future home may have really existed.

His own name is given in the Koran in the forms Aḥmad and the familiar Muḥammad; in contemporary poetry we also find the form Maḥmūd. Similar variation between derivatives from the same root is found in proper names which occur in early poetry; the meaning of all would be "the praised," if the root be given its Arabic signification—"the desired" if interpreted from the Hebrew.

The form Muḥammad (ordinarily transliterated Mohammed; Mahomet, Mehmet, &c., represent the Turkish pronunciation) is found in a pre-Islamic inscription, and appears to have been fairly common in Arabia. In Hag. ii. 7 a derivative of the Hebrew equivalent root occurs in the prophecy "and the desired of all nations shall come," and this passage has suggested the idea that the name may have been taken by the Prophet as the equivalent of "Messiah," while the Moslems themselves find its equivalent in the *Paraclete* of the Fourth Gospel, though this identification requires more ingenuity. His *kunyah* (*i.e.* the Arab title of respect, in which a man is called after his son) is Abu'l-Qāsim; other names by which he is called are titles of honour, *e.g.* Muṣṭafā "chosen." (See further the genealogical table, *ad fin.*)

Early Life.

In the Koran, Allah says that He found the Prophet an orphan, poor and astray; it is possible that all these expressions should be understood figuratively, like the "poor, naked, blind" of Christian hymns; the Arabs, however, take them literally, and Mahomet is said to have been a posthumous child, whose mother died a few months or years after his birth, and who was brought up first by his grandfather, and then by his uncle Abū Ṭālib, one of the poorer members of the family; in the controversy between the Alid and Abbasid pretenders of the 2nd century of Islam the Abbasid Manṣūr claims that his ancestor fed the ancestor of 'Ali, *i.e.* Abū Ṭālib, otherwise he would have had to beg. There was evidently an apparent inconsistency between Mahomet's being a poor orphan and the favourite grandchild of the eminent and wealthy 'Abd al-Moṭṭalib; and it was solved in this way. There was a tradition that in his early years he was sent into the desert to acquire the habits and the language of the Bedouins; and this seems to have been attested by the Prophet himself. In a tribal fight he is said to have acted as armour-bearer to one of his uncles, Zubair. There seems no doubt that he often accompanied Meccan caravans to the countries with which the Meccans had trade relations; such especially were Syria and south Arabia, and perhaps Egypt and Mesopotamia. It is conceivable that he may have visited Abyssinia by sea. For though accurate knowledge is nowhere to be found in the Koran, it exhibits a large amount of miscellaneous information, such as a trader might well pick up. His career as a caravan-conductor appears to have terminated with his marriage to Khadīja, daughter of Khuwailid, represented by the tradition as a wealthy widow, fifteen years his senior and forty years of age at the time of the union. As she became the mother of a numerous family, a special rule was discovered by Moslem physiologists extending the child-bearing period of Korashite women beyond that of others. Since it is claimed for Mahomet that he first gave Arab women the right to inherit property, the difficulty noticed is not the only one connected with this marriage; and Robertson Smith has called attention to some others, unconnected with his theory of "marriage and kinship in early Arabia." After his marriage Mahomet appears to have been partner in a shop in Mecca; where he apparently sold agricultural produce. His style is strongly marked by phrases and metaphors drawn from trade, though as a statesman he never displayed any financial ability.

Education.

Writing in the monumental script of South Arabia had been known for centuries in the peninsula; and shortly before the rise of Islam a cursive script—the parent of the ordinary Arabic character—had been started in the Christian state of Hira, with which the beginnings of modern Arabic literature are connected. A modification of this had been introduced into Mecca, and was probably used for contracts and similar documents. The word *ummī*, literally "popular" or "plebeian" (according to one etymology), applied to Mahomet in the Koran, is said to mean "one who can neither read nor write," and the most generally accepted view is that he could do neither, a supposition which enters into the doctrine of the miraculous nature of the Koran. According to another interpretation the word means "Meccan," *i.e.* native of "the Mother of the Villages" (*Umm al-Qura*); and the most probable theory is that he could do both, but unskilfully. Indeed on one historic occasion he erased certain words in a document; and where in the Koran he rebuts the charge of "taking notes," he does not employ the obvious retort that he could not write, but gives a far less convincing answer. For poetry, which seems to have been cultivated in Arabia long before his time, he possessed no ear; but we have little reason for supposing that either writing or versification had yet entered into Arabian education. The former would be acquired by those who needed it, the latter was regarded as a natural gift. There is reason for thinking the language of the Koran incorrect and ungrammatical in parts, but as it afterwards became the ultimate standard of classical Arabic, this point is not easy to prove. On the whole then his early life seems to have been such as was normal in the case of a man belonging to one of the more important families in a community which had not long been started on a career of prosperity.

Social System.

Of the organization of that community we unfortunately know very little, though we hear of a council-chamber, and, as has been seen, of an age-qualification for admission to it. It is, however, certain that the theory of decision by majority was absolutely unknown to Mahomet's second successor, whence we learn little from this tradition (even if it be authentic) of the mode whereby the tribes who together formed the Meccan population managed their common concerns, whether commercial or political. The form of government seems to have been a rudimentary oligarchy, directed by some masterful individual; before the Flight we read of various prominent personages, after the Flight and the battle of Badr (A.H. 2) one chieftain, Abū Sofiān (see CALIPHATE, *ad init.*), appears to take the lead whether in war or in policy. It would seem, however, that the right of independent action belonged to the individual tribes, even to the extent of refusing to take part in a campaign. For the settlement of ordinary disputes recourse was had (it appears) rather to soothsayers, near or distant, than to any regularly constituted authority or tribunal. On the other hand we are furnished with a list of officials who were concerned with different parts of the festal performances and the ordinary worship. Of these we may mention the Custodian of the Ka'ba, and the official whose duty was *siqāyah* ("watering"), said to mean furnishing the pilgrims with water, but more ingeniously interpreted in recent times as "rain-bringing," a function which even in the 2nd century of Islam the governor in some places was supposed to exercise.

Beginnings of the Mission.

Of Arabian paganism we possess no trustworthy or complete account; since we hear of no theological literature belonging to it, probably no such account could have been given. There were doubtless a variety of practices, many of which have been continued to this day in the ceremonies of the pilgrimage, and offerings of different sorts to various deities, interpreted variously by the worshippers in accordance with their spiritual, intellectual and moral levels; *e.g.* as actual stones, or as men (or more often women) residing in the stones or otherwise connected with them, or bearing a similar relation to trees, or stars, &c. In general every tribe had its patron of the kind, and where there were aggregations of tribes, connexions were established between these deities, and affiliation-theories excogitated; hence the theory attributed in the Koran to the Meccans that the goddesses al-'Uzzā, &c. were the daughters of Allah, may well represent the outcome of such speculation. These, however, were known to few, whereas the practices were familiar to all. Some of these were harmless, others barbarous; many offensive, but not very reprehensible, superstitions.

External Influences.

Before Mahomet's time Arabian paganism had already been attacked both from the outside and from the inside. On the one hand the northern tribes had gradually been christianized, owing to the influence of the Byzantine empire; on the other hand south Arabia had fallen successively under Jewish, Abyssinian and Persian influence; and the last, though little is known of Persian rule, is unlikely to have favoured pagan cults. Christianity had also some important representation in Najran far south of Mecca, while Jewish settlements were prospering north of Mecca in the Prophet's future home Yathrib and its neighbourhood. Power, civilization and learning were thus associated with monotheism (Judaism), dualism (Mazdaism) and tritheism (as the Arabs interpreted Christianity); paganism was the religion of ignorance (*jāhiliyyah*, interpreted by Goldziher as "barbarism," but the difference is not very considerable). Mecca itself and the neighbouring and allied Ṭāif are said to have produced some monotheists or Christians, who identified the *Allah* of Mecca with the *Allāhā* or God of the Syrian Christians, called by the Abyssinian Christians "Lord of the Regions," and by the Jews "the Merciful" (*Raḥmānā*); one such is said to have been a cousin of Khadija, Mahomet's wife; his name is given as Waraqah, son of Naufal, and he is credited with copying or translating a Gospel. We even hear of flagellant monks and persons vowed to total abstinence among the precursors of Islam.

With these persons Mahomet had little in common, since they do not appear to have claimed to enforce their views upon others, or to have interfered with politics. He appears mainly to have been struck by the personality of the founders of the systems dominant in the civilized world, and to have aspired from the first to occupy the place of legislator or mouthpiece of the Deity; and that he was this was and is the main proposition of the Mahommedan creed. The "Prophet" or "Apostle" (at different times he employed both the Jewish and the Christian phrase) was the divinely appointed dictator of his community; if he were not obeyed, divine vengeance would overtake the disobedient. At this proposition Mahomet arrived by induction from the records of the Biblical prophets, as well as others who seem to have figured in Arabian mythology, *e.g.* the destruction of the tribe Thamūd (mentioned by Pliny, and therefore historical) for their disobedience to their prophet Ṣāliḥ, and of 'Ad (probably mythical) for their similar treatment of Hūd. The character of the message did not affect the necessity for obedience; at times it was condemnation of some moral offence, at others a trivial order. Divine vengeance overtook those who disobeyed either.

The Prophet's Call.

This is the theory of the prophetic office which pervades the Koran, wherein the doctrine is formulated that every nation had its divine guide and that Mecca before Mahomet's time had none. This place, then, Mahomet felt a divine call to fill. But we are never likely to ascertain what first put the idea into his mind. The fables which his biographers tell on this subject are not worth repeating; his own system, in which he is brought into direct communication with the Deity, though at a later period the angel Gabriel appears to have acted as intermediary, naturally leaves no room for such speculations; and since his dispensation was thought to be absolutely new, and to make a *tabula rasa* of the pagan past, his first followers, having broken with that past, left no intelligible account of the state of affairs which preceded their master's call. Some generations therefore elapsed before that past was studied with any sort of sympathy, and details could not then be recovered, any more than they can now be supplied by conjecture.

So far as Mahomet may be said from the first to have formulated a definite notion of his work, we should probably be right in thinking it to be the restoration of the religion of Abraham, or (as the Koran calls him) Ibrahim. Though we have no reason for supposing the name of Abraham or Ishmael to have been known in Mecca generally before Mahomet's time, the Biblical ethnology was not apparently questioned by those who were told of it, and there are stories, not necessarily apocryphal, of precursors of Mahomet going abroad in search of the "religion of Abraham." One feature of that system, associated in the Bible with the name of Ishmael as well, was circumcision, which was actually observed by the Meccan tribes, though it would appear with technical differences from the Jewish method; the association of monotheism with it would seem reasonable enough, in view of Jewish traditions, such as Mahomet may have heard on his travels; why the doctrine of the future life should be coupled with it is less obvious. That the Meccan temple and its rites had been founded by these two patriarchs appears to have been deduced by Mahomet himself, but perhaps at a later stage of his career. That these rites, so far as they were idolatrous, were in flagrant defiance of the religion of Abraham must have struck any one who accepted the accounts of it which were current among Jews and Christians. The precursors, however, appear to have felt no call to reform their fellow-citizens; whereas it is evident that Mahomet regarded himself as charged with a message, which he was bound to deliver, and which his God would in some way render effective.

As it was obvious that the claim to be God's mouthpiece was to claim autocracy, Mahomet employed the utmost caution in his mode of asserting this claim; on the question of his sincerity there have been different opinions held, and it is not necessary to take any view on this matter. For three years his followers were a secret society; and this period appears to have been preceded by one of private preparation, the first revelation being received when the Prophet was in religious retirement—a ceremony called *taḥannuth*, of which the meaning is uncertain, but which can have no connexion with the Hebrew *teḥinnōth* ("supplications")—on Mount Ḥirā, near Mecca.

The Koran.

If the traditional dates assigned to the *suras* (chapters) of the Koran (*q.v.*) are correct, the earliest revelations took the form of pages or rolls which the Prophet was to read by the "grace of God," as Joseph Smith, the founder of the Mormon community, said of the power given him to read the "Egyptian" characters on the gold plates which he had found. The command to read is accompanied by the statement that "his most generous Lord had taught man by the pen (*calamus*) that which he did not know." Waraqah, to whom the event is said to have been communicated by Khadija, called these communications "the Greater Law (*nomos*)." The Prophet was directed to communicate his mission at the first only to his nearest relatives. The utterances were from the first in a sort of rhyme, such as is said to have been employed for solemn matter in general, *e.g.* oracles or prayers. At an early period the production of a written communication was abandoned for oral communications, delivered by the Prophet in trance; their delivery was preceded by copious perspiration, for which the Prophet prepared (in accordance with instructions found in the Koran) by wrapping himself in a blanket. Trusty followers were instructed to take these utterances down, but the phenomena which accompanied their delivery at least in one case suggested imposture to the scribe, who apostatized in consequence. It is extraordinary that there is no reason to suppose that any official record was ever kept of these revelations; the Prophet treated them somewhat as the Sibyl did her leaves. This carelessness is equally astounding whether the Prophet was sincere or insincere.

If the matter afterwards collected in the Koran be genuine, the early revelations must have been miscellaneous in content, magical, historical and homiletic. To some strange oaths are prefixed. Apparently the purpose to be compassed was to convince the audience of their miraculous origin. The formulation of doctrines belongs to a later period and that of jurisprudence to the latest of all. In that last period also, when Mahomet was despot of Medina, the Koran served as an official chronicle, well compared by Sprenger to the leading articles on current events in a ministerial organ. Where the continuous paragraph is substituted for the ejaculation, the divine author apologizes for the style.

Certain doctrines and practices (*e.g.* washing of the person and the garments) must have been enjoined from the first, but our authorities scarcely give us any clear notion what they were. The doctrines to which the Prophet himself throughout assigned most value seem to have been the unity of God and the future life, or resurrection of the body. The former necessitated the abandonment of the idolatrous worship which formed part of the daily life of Mecca, and in which Mahomet and Khadija had been accustomed to take their part. Yet it seems to have been due to the initiative of the proselytes themselves rather than to the Prophet's orders that the Meccan worship was actually flouted by them; for the anecdote which represents the Prophet and his young cousin attempting to pull down the images in or about the Kaʿba appears to be apocryphal. The first Moslem ceremony would appear to have been the religious meeting for the purpose of hearing the delivery of revelations, of which after the Prophet's death the sermon (*khuṭbah*) took the place. After various provisional meeting-places, the house of one al-Arqam on Mt. Safa was adopted for this purpose; and here proselytes were initiated.

Growth of the Early Community.

The names which the new community received from its founder are both philological puzzles; for the natural sense of Moslem (*Muslim*) appear to be "traitors," and to this a contemporary war-song of Mahomet's enemies alludes; while *Ḥanīf* (especially applied in the Koran to Abraham) seems to be the Hebrew word for "hypocrite." The former is explained in the Koran to mean "one who hands over his face or person to God," and is said to have been invented by Abraham; of the latter no explanation is given, but it seems to signify from the context "devotee." Since the divine name *Raḥmān* was at one time favoured by Mahomet, and this was connected with one Maslama of the tribe Ḥanīfa, who figures in politics at the end of Mahomet's career but must have been a religious leader far earlier, it has been suggested that the names originally belonged to Maslama's community. The honour of having been Mahomet's first convert is claimed for three persons: his wife Khadīja, his cousin Ali, who must have been a lad at the commencement of the mission, and Abū Bekr, son of Abū Quḥāfah, afterwards Mahomet's first successor. This last person became Mahomet's *alter ego*, and is usually known as the *Ṣiddiq* (Heb. word signifying "the saint," but to the Arabs meaning "faithful friend)". His loyalty from first to last was absolutely unswerving; he was selected to accompany Mahomet on the most critical occasion of his life, the Flight from Mecca; Mahomet is said to have declared that had he ever made a confidant of any one, that person would have been Abū Bekr; implying that there were things which were not confided even to him. The success of the Prophet's enterprise seems to have been very largely due to the part played by this adherent, who possessed a variety of attainments which he put at Mahomet's service; who when an intermediary was required was always ready to represent him, and who placed the commendation of the Prophet above every other consideration, private or public. The two appear to have regularly laid siege to those persons in Mecca whose adherence was desirable; and the ability which many of the earlier converts afterwards displayed, whether as statesmen or generals, is a remarkable testimony to their power of gauging men. It seems clear that the growth of wealth in Mecca had led to the accentuation of the difference between persons of different station, and that many were discontented with the oligarchy which governed the city. Converts could, therefore, be won without serious difficulty among the aliens and in general those who suffered under various disqualifications. Some members of the Jewish community seem also to have joined; and some relics of the Abyssinian expedition (*i.e.* descendants of the invaders). Among the most important converts of the Meccan period were Mahomet's uncle Ḥamza, afterwards for his valour called "the Lion of God"; ʿAbd al-Raḥman (Abdarraḥman) son of ʿAuf; Othman, son of ʿAffān, who married two of the Prophet's daughters successively, and was Mahomet's third successor; and, more important than any save Abū Bekr, Omar, son of al-Khattāb, a man of extraordinary force of character, to whom siege seems to have been laid with extraordinary skill. At some time he received the honourable title *Fārūq* ("Deliverer"); he is represented as regularly favouring force, where Abū Bekr favoured gentle methods; unlike Abū Bekr, his loyalty was not always above suspicion. His adherence is ascribed to the period of publicity.

The secrecy which marked its early years was of the greatest value for the eventual success of the mission; for when Mahomet came forward publicly he was already the head of a band of united followers. His own family appear to have been either firm adherents, or violent enemies, or lukewarm and temporizing—this is the best which can be said for ʿAbbās, eponymus of the Abbasid dynasty; or finally espousers of his cause, on family grounds, but not as believers.

First Period of Publicity.

Rejecting accounts of Mahomet's first appearance as a public preacher, which are evidently comments on a text of the Koran, we have reason for supposing that his hand was forced by ardent followers, who many times in his career compelled him to advance. The astute rulers of the community perceived that the claim made by Mahomet was to be dictator or autocrat; and while this was naturally ridiculed by them, some appear to have been devoted adherents of the gods or goddesses whom he attacked. The absence of dated documents for the period between this open proclamation (which in any case commenced before 616) and the Flight to Medina in 622 renders the course of events somewhat conjectural, though certain details appear to be well established. Apparently there was a war of words, followed by a resort to diplomacy and then to force; and then a period in which Mahomet's attention was directed to foreign conversions, resulting in his being offered and accepting the dictatorship of Yathrib.

Of the war of words we have an imperfect record in the Meccan suras of the Koran, which occasionally state the objections urged by the opponents. In the course of the debate the theological position of both parties seems to have shifted, and the knowledge of both was probably increased in various ways. The miracle of the Koran, which at first consisted in its mode of production, was transformed into a marvel connected with its contents; first by Mahomet's claiming to tell historical narratives which had previously been unknown to him; afterwards by the assertion that the united efforts of mankind and Jinn would be unable to match the smallest passage of the Koran in sublimity. Probably the first of these claims could not be long maintained, though A. J. Davis, "the Seer of Poughkeepsie," in our own time brought a similar one in regard to his *Principles of Nature*. Indeed both parties evidently resorted to external aid. To those who undertook to name the man who dictated stories of the ancients to Mahomet day and night, he replied that the individual whom they had in mind was a foreigner, whereas the Koran was in pure Arabic. This was obviously a quibble, for it was scarcely asserted that he delivered the matter dictated to him without alteration. The purity of the Arabic also appears to have been very questionable; for several expressions appear to be Ethiopic rather than Arabic, and the person whom the Meccans had in mind is likely to have been an Abyssinian Christian, since the Christian technicalities of the Koran are mainly derived from the Ethiopic Gospels and Acts. On one occasion when some questions suggested by learned foreigners had been propounded to the Prophet he required a fortnight's delay before the revelation which solved them came; the matter contained in his reply was certainly such as required research. His sources of information seem at all times to have been legendary rather than canonical; and the community which seemed to his opponents to agree best with his views was that of the Sabians or Mandaeans (*qq.v.*).

It has been suggested that Mahomet first threatened the Meccans with temporal punishment, and only when this threat failed to take effect resorted to the terrors of the Day of Judgment and the tortures of Hell; it seems however a mistake to distinguish between the two. These threats provided the Prophet with his most powerful sermons. The boasts of incomparable eloquence which the Koran contains are evidence that his oratorical power was effective with his audiences, since the more successful among the Arabic poets talk of their compositions somewhat in the same way. These discourses certainly led to occasional conversions, perhaps more frequently among women than men.

The Exiles in Axum.

The diplomatic war seems to have been due to the Prophet's increasing success, which led to serious persecution of Mahomet's less influential followers, though, as has been seen, no blood could be shed in Mecca. Abū Ṭālib, moreover, prevented him from being exiled, though he probably had to endure many personal insults. Something however had to be done for the persecuted Moslems, and (perhaps at the suggestion of his Abyssinian helper) Mahomet endeavoured to find a refuge for them in the realm of Axum. Abyssinia was doubtless connected in every Meccan mind with the "Expedition of the Elephant"; and such an alliance secured by Mahomet was a menace to the existence of the Meccan community. A deputation was therefore sent by the Meccan leaders to demand extradition of the exiles; and as chief of this expedition the future conqueror of Egypt, ʽAmr b. al-ʽĀṣ (see ʽAMR IBN EL-ASS), first figures in history. To frustrate his efforts Mahomet sent his cousin Jaʽfar armed with an exposition of the Prophet's beliefs and doctrines afterwards embodied in the Koran as the Sura of Mary (No. XIX.; though with the addition of some anti-Christian matter). The original document contained an account of the Nativity of Christ with various miracles not known to either the canonical or even the apocryphal gospels which have been preserved, but which would be found edifying rather than unorthodox by a church one of whose most popular books is *The Miracles of the Virgin Mary*. To this there were added certain notices of Old Testament prophets. The Abyssinian king and his ecclesiastical advisers took the side of Mahomet and his followers, whom they appear to have regarded as persecuted Christians; and an attempt made probably by the astute ʽAmr to embroil them with the Abyssinians on the difficult question of the Natures of Christ failed completely. There seems reason for thinking that the Abyssinian king contemplated bringing back the exiles by force, but was diverted from this purpose by frontier wars; meanwhile they were safely harboured, though they seem to have suffered from extreme poverty. The want of an Abyssinian chronicle for this period is a serious disadvantage for the study of Islamic origins. The sequel shows that regular correspondence went on between the exiles and those who remained in Mecca, whence the former were retained within the fold of Islam, with occasional though rare apostasies to Christianity.

Mahomet's diplomatic victory roused the Meccan leaders to fury, and they decided on the most vigorous measures to which they could rise; Abū Ṭālib, Mahomet's protector, and the clan which acknowledged him as *sheikh*, including the Prophet and his family, were blockaded in the quarter which they occupied; as in other sanctuaries, though blood might not be shed, a culprit might be starved to death. That this did not occur, though the siege appears to have lasted some months at least, was due to the weak good nature of the Meccans, but doubtless also to the fact that there were enlisted on Mahomet's side many men of great physical strength and courage (as their subsequent careers proved), who could with impunity defy the Meccan embargo. After a time however the besieged found the situation intolerable, and any assistance which they might have expected from the king of Axum failed to come. The course adopted by Mahomet was retractation of those of his utterances which had most offended the Meccans, involving something like a return to paganism. A revelation came acknowledging the effectiveness of the Meccan goddesses as well as Allah, and the Meccans raised the siege. News of the reconciliation reached the Abyssinian exiles and they proceeded to return.

By the time they reached the Arabian coast the dispute had recommenced. The revelation was discovered to be a fabrication of the Devil, who, it appears, regularly interpolates in prophetic revelations; such at least is the apology preserved in the Koran, whence the fabricated verses have been expunged. Since our knowledge of this episode (regarded as the most disgraceful in the Prophet's career) is fragmentary, we can only guess that the Prophet's hand had once more been forced by the more earnest of his followers, for whom any compromise with paganism was impossible. The exiles went back to Abyssinia; and about this time both Abū Ṭālib and Khadīja died, leaving the Prophet unprotected.

He fled to the neighbouring oasis of Ṭāif, where wealthy Meccans had possessions, and where the goddess al-ʽUzza was worshipped with special zeal—where she is said still to exist in the form of a block of stone. He had but little success there in proselytizing, and indeed had to cease preaching; but he opened negotiations with various Meccan magnates for a promise of protection in case of his return. This was at last obtained with difficulty from one Moṭʽim b. ʽAdi. It would appear that his efforts were now confined to preaching to the strangers who assembled at or near Mecca for the ceremonies connected with the feasts. He received in consequence some invitations to come and expound his views away from Mecca, but had to wait some time before one came of a sort which he could wisely accept.

The Flight to Yathrib.

The situation which led to Mahomet's Flight (*hijra*, anglicized incorrectly *hejira*, *q.v.*) was singularly favourable to Mahomet's enterprise, and utilized by him with extraordinary caution and skill. At the palm plantation called Yathrib, afterwards known as *al-Medina*, Medina, "the City" (*i.e.* of the Prophet), there were various tribes, the two most important, called Aus and Khazraj, being pagan, and engaged in an internecine feud, while under their protection there were certain Jewish tribes, whose names have come down to us as Qainuqā, Naḍīr and Quraiẓa—implying that the Israelites, as might be expected, imitated the totem nomenclature of their neighbours. The memory of these Israelites is exclusively preserved by the Moslem records; the main stream of Jewish history flowed elsewhere. In the series of combats between the Aus and Khazraj the former had generally been worsted; the Jews, as usual, had avoided taking any active part in the fray. Finally, owing to an act of gross perfidy, they were compelled to fight in aid of the Aus; and in the so-called battle of Buʽāth the Aus aided by the Jews had won a victory, doubtless attributed to the God of the Jews. As has been seen, the divine name employed by Mahomet (*Raḥmān*) was one familiar to the Jews; and the Yathribites who visited Mecca at feast-time were naturally attracted by a professed representative of al-Raḥmān. The first Yathribite converts appear to have been Khazrajites, and one Asʽad, son of Zurarah, is the most prominent figure. Their idea may have been in the first place to secure the aid of the Israelitish Deity in their next battle with the Aus, and indeed the primary object of their visit to Mecca is said to have been to request assistance for their war. For this the plan was substituted of inviting the Prophet to come to Mecca as dictator, to heal the feud and restore order, a procedure to which Greek antiquity offers parallels. The new converts were told to carry on secret propaganda in Yathrib with this end in view. At the next feast some of the rival faction embraced Islam. A trusty follower of Mahomet, Mus'ab b.'Umair, who resembled Mahomet in personal appearance, was sent to Yathrib to assist in the work. The correspondence between this person and the Prophet would, if we possessed it, be of the greatest value for the study of Islamic antiquity. We first hear at this time of *the conditions of Islam*, *i.e.* a series of undertakings into which the convert entered: namely, to abstain from adultery, theft, infanticide and lying, and to obey Mahomet *in licitis et honestis*. The wholesale conversion of Yathrib was determined by that of two chieftains, Usaid b. Ḥuraith and Sa'd b. Mu'adh, both Ausites. The example of these was quickly followed, and iconoclasm became rife in the place. At the next Meccan feast a deputation of seventy Yathribites brought Mahomet a formal invitation, which he accepted, after imposing certain conditions. The interviews between Mahomet and the Yathribites are known as the *'Aqabah* (probably with reference to a text of the Koran). The attitude of the Jews towards the project appears to have been favourable.

The Refugees.

Among the conditions imposed by Mahomet on his new adherents appears to have been the protection and harbouring of the older proselytes, whom Mahomet most wisely determined to send before him to Yathrib, where, in the event of the Yathribite loyalty wavering, they could be counted on with certainty. The welcome given these refugees (*muhājirūn*), as they were from this time known in contradistinction to the helpers (*anṣār*) or allies from Yathrib, is said to have been of the warmest; a Helper with two wives would hand one over to a wifeless Refugee. A yet more important condition which preceded the Flight was readiness to fight men of all colours in defence of the faith.

Although the transactions with the people of Yathrib had been carried on with profound secrecy, the nature of Mahomet's contract with his new adherents was somewhat divulged to the Meccan magnates, and the danger of allowing an implacable enemy to establish himself on the high-road of their north-bound caravans flashed upon them. The rule which forbade bloodshed in the sacred city had at last to be suspended; but elaborate precautions were to be taken whereby every tribe (except Mahomet's own clan) should have their share in the guilt, which would thus be spread over the whole community fairly. When the committee appointed to perpetrate the crime reached Mahomet's house, they found that it was too late; Mahomet had already departed, leaving Ali in his bed.

The actual Flight from Mecca to Yathrib has naturally been a favourite subject for romance, and indeed appears to have been executed with the greatest cunning. Accompanied by Abū Bekr only, Mahomet took refuge in a cave of Mt Thaur, in the opposite direction to that which he intended to take finally, and there remained for three days; provision had been made of every requisite, food, powerful camels, a trusty and competent guide. The date at which he reached Kuba, on the outskirts of Yathrib, where there was already some sort of Moslem oratory, is given as 8 Rabia I., of the year A.H. 1; the fact that he arrived there on the Jewish Day of Atonement gives us the date September 20, 622. The Meccans, who had employed professional trackers to hunt down the fugitives, proceeded to confiscate the houses and goods of Mahomet and of his followers who had fled.

Mahomet as Despot of Yathrib.

The safe arrival of Mahomet at his destination marks the turning-point in his career, which now became one of almost unbroken success; his intellectual superiority over both friends and enemies enabling him to profit by defeat little less than by victory. His policy appears to have been to bind his followers to himself and them to each other by every possible tie; he instituted brotherhoods between the Refugees and Helpers, which were to count as relationships for legal purposes, and having himself no sons, he contracted numerous marriages partly with the same end in view; *e.g.* with the infant daughter of Abū Bekr, Ayesha ('A'ishah), whose ability he appears to have discerned; and the unamiable Ḥafṣa, daughter of Omar. Of his own daughters three were given to faithful allies, the one by whom his line is supposed to have been continued to our time, Fāṭima, was reserved for his cousin Ali. Owing to his efforts the alliance between the Refugees and Helpers resisted numerous attempts on the part of enemies to break it up, and only towards the end of the Prophet's life, when he appeared to favour Meccans unduly, do we hear of any bitterness between the two communities.

The Medina Community.

The population of Yathrib, or, as it may now be called, Medina, soon divided into three groups: Mahomet's united followers; the Jews; and a party known as the "Hypocrites," *i.e.* professing Moslems, who were lukewarm, or disaffected, among whom the most prominent is 'Abdallah b. Ubayy, a Khazrajite chieftain, who is said to have himself aspired to be despot of Yathrib, and who till nearly the end of Mahomet's career figures somewhat as a leader of the opposition; of his importance there is no question, but the reason for it and the mode whereby he made it felt are often obscure. It would seem that the pagans remaining in Yathrib speedily adopted Islam after the Prophet's arrival, whence we hear little of serious opposition on their part. Coming in the capacity of prophet of the Israelitish God, Mahomet at first seems to have courted alliance with the Jews, and to have been ready to adopt their system with very slight modifications—similar to those which, according to his opinion, Jesus had come to introduce. The Jews met these advances by submitting him to examination in the intricacies of the *Torah*, and, finding him very poorly equipped, proceeded to denounce him as an imposter; one of his examiners is said to have even translated the *Torah* into Arabic with a view of convicting him of ignorance and imposture. They are further charged with exercising their magical arts on the Prophet and his followers, and to have succeeded thereby in producing barrenness among the Moslem women. Their conduct must not of course be judged by the statement of their enemies; it is however clear that Mahomet soon found that there was no possibility of compromising with them on religious questions, or of obtaining their loyal support; meanwhile he discovered that they were incapable of united and persistent action, and useless as warriors except against each other. He therefore resolved on their extermination. His ruthlessness in their case compared with his patience and forbearance in the case of the "Hypocrites" was consistent with his principle (always faithfully observed) that no inquiry was permissible into the motives of conversion, and with his division of mankind into the two antagonistic factions Believers and Unbelievers. The latter principle, as will be seen, was somewhat modified before the end of his life.

Development of Islam.

Mahomet's failure to effect a compromise with the Jews caused a reaction in his mind towards paganism, and after about a year's residence at Medina the direction of prayer, which had till then been towards Jerusalem, was turned southward to the pagan temple at Mecca. With this change we may perhaps couple the adoption of the name *Allah* for the Diety; in the Moslem formula "in the Name of Allah the Raḥmān the Merciful," the translation attached to the word *Raḥmān*, and the prefixing to it of the name *Allah* furnish clear evidence of theological transition, though the stages are not recorded; we know, however, that the Meccans approved of the name *Allah*, but objected to the name *Raḥmān*. Prayer (*ṣalāt*), said to have been prescribed on the occasion of the Prophet's ascent into heaven after a miraculous journey from Mecca to Jerusalem, began to assume a stereotyped form in the place of assembly built by Mahomet immediately after his arrival; the attitudes of prayer in use among many communities (*e.g.* the Jewish standing, the prostration of some Christian sects) were combined. In general it was Mahomet's principle, while taking over a practice from some other sect, to modify it so as to render the Moslem method absolutely distinct; thus when a summons to prayer became requisite, a new mode (by the voice of a crier called *muaddhin* or *muezzin*) was preferred to the Christian hammer; a new sacred day was adopted, in lieu of the Jewish Saturday and the Christian Sunday, in the weekday on which he had safely reached Kuba, Friday; but the sanctity was reduced to the actual time occupied by public worship. On the subject of food he was satisfied with the regulations of the Council of

Jerusalem, recorded in Acts xv.; which were observed by few if any Christian sects. The prohibition of wine, which was enacted in A.H. 3, is said to have been occasioned by the riotous conduct of one of his followers when under the influence of liquor; Palgrave saw in it (perhaps with justice) a deliberate attempt to prevent harmony between Moslems and Christians, in whose most sacred rite wine is used. The Fast of Ramaḍān, in which food both liquid and solid is forbidden from sunrise to sunset, is said to be a pagan or semi-pagan institution; its importance for military training and discipline is not likely to have been overlooked by the Prophet. When the direction of prayer was altered, it is probable that Mahomet already intended to introduce into his system the whole of the pagan pilgrimage with its antique ceremonial (with, of course, a new interpretation); before this he is supposed to have aimed at the abolition of the Ka'ba and all that appertained to it.

The difference between religious and civil law has never been recognized by Islamic jurists, whose manuals deal equally with the law of contract and the amount of the body to be washed before prayer; the Prophet's ordinances on both subjects were suggested by the occasion in each case, and it would seem that the opinions of trusted advisers were regularly heard before a revelation was issued. Even when this had been done the ordinance might be cancelled by an abrogating revelation; it being "easy for Allah" to substitute for a text already revealed another that was better or at least as good.

As Islam began to spread outside the limits of Medina both conversion to Islam and persistence therein were reduced to simple tests; the pronunciation of the double formula of belief in Allah and Mahomet was sufficient to indicate conversion, whilst payment of an income-tax, called by the Jewish names for alms (*zakāt* and *ṣadaqah*), was evidence of loyalty. This income-tax, of which the definite assessment perhaps belongs to a later period, was for the support of necessitous converts—an element in the community whose presence accounts for the mode in which the development of the Islamic state proceeded.

First Campaigns of Mahomet.

The industries in which the Meccan Refugees had been engaged were not of a sort which they could exercise at Medina, where the palm took the place of the camel as the basis of society. Moreover the Prophet seems to have given some disastrous advice on the subject of palmiculture, and thereby to have accentuated the poverty of the place. He had, therefore, to find some fresh source of revenue in order to deal with this difficulty, and one of the Helpers is said to have suggested the plan which he adopted, viz. of attacking the Meccan caravans. With this view he organized a series of expeditions, taking the lead himself sometimes, while at others he gave it to one of his veteran followers; and at first only Refugees took part in them. The leaders of the caravans, however, were expert in evading attacks of this sort, which were doubtless regularly attempted by the desert tribes; and in the first year of his despotism Mahomet did not score a single success of the kind intended. The attempts were not wholly fruitless; for while on the one hand he accustomed his followers to campaigning, on the other he made a series of agreements with the chieftains of the tribes through whose territory the caravans ordinarily passed. Finding continued failure intolerable, he resolved to take advantage of his power to bind and to loose by sending an expedition of seven men under his cousin 'Abdallah b. Jaḥsh to attack a caravan at the beginning of the sacred month Rajab, when, as raiding during such a season was unknown, success was practically certain. The commander on this, the Nakhlah raid, was given sealed orders, to be opened after two days' march; the men were then to be given the option of retiring, if they disapproved. Of this no one seems definitely to have availed himself, and the raid ended successfully, for considerable booty was captured, while of the four persons who escorted the caravan two were made prisoners, one escaped, and one, 'Amr b. al-Ḥaḍrami, was killed; he was the first person slain fighting against an Islamic force. The violation of the sacred month seems to have caused considerable scandal in Arabia, but led to no serious consequence; on the other hand the shedding of blood created a feud between the people of Mecca and the Refugees, with whom the Meccans long declined to identify the people of Medina. The fact that the man who had been killed was a client, not a citizen, made no difference. The circumstance that booty had been actually acquired appears to have helped the Prophet's cause very considerably.

Attack on Meccan Caravan.

Both these consequences, the Meccan desire to avenge the blood that had been shed and the anxiety of the Medinese to take part in a successful raid, manifested themselves a few months later, when an expedition was organized by Mahomet to attack a caravan returning from Syria, which had escaped him the previous year. Many desired to take part in the raid, and finally some 300 persons were selected, including a large number of "Helpers." The leader of the caravan learned somehow that an attack was being organized by Mahomet on a large scale, and sent to Mecca for aid, while hurrying home by forced marches. This is the first historical appearance of Abū Sofiān (the leader of the caravan), who now for some years played the part of president in the Meccan opposition to Mahomet, and whose son was destined to found the second Mahommedan dynasty (see CALIPHATE, B). The day before the battle to be fought at Badr, near the point where the northern road leaves the coast to turn eastwards to Mecca, the Moslem army learned that the Meccan succour (some 1000 strong) was near, but that the caravan had escaped. The Meccans, it is asserted, would have returned home now that their object was secured, but the patrons of the man who had been killed in the former raid were compelled to strike for vengeance.

The battle (Ramaḍān 19, A.H. 2, usually made to synchronize with March 17, 624) ended in a complete victory for Mahomet, whose followers killed seventy of the enemy and took seventy prisoners—if we may trust what seem to be round numbers; it was attributed by him to divine co-operation, taking the form of an illusion wrought on the enemy, and the despatch of a regiment of angels to the assistance of the Believers, while on the other hand the treachery of the Devil did mischief to the Meccans. The popular tradition attributed it to the prowess of some of Mahomet's followers, especially his uncle Ḥamza and his cousin Ali. In the narratives which have come down and which seem to be authentic the result is amply accounted for by the excellence of the Moslem discipline and the complete absence of any on the Meccan side. Mahomet himself is said to have fainted at the first sight of blood, and to have remained during the battle in a hut built for him to which swift camels were tied, to be used in case of a defeat; yet these accounts make him responsible for the tactics, whilst assigning the credit for the strategy to one Ḥobab b. al-Mondhir. Several of Mahomet's old enemies and friends of Meccan days perished on this occasion; notably one Abu Jahl, his uncle, but represented as an implacable enemy; another hostile uncle, Abu Lahab, who is cursed in the Koran, was not present but died shortly after the battle.

The day is called in the Koran by a Syriac expression the "Day of Deliverance," and both for internal and external politics it was of incalculable advantage to Islam. The booty and the ransoms of the prisoners provided the means for dealing with distress; the story of supernatural aid soothed the feelings of the defeated Meccans and had a tendency to disarm resistance elsewhere; whilst Mahomet in the popularity acquired by his victory was able to strike forcibly at his enemies in Medina. One of the sequels to the victory was a series of assassinations whereby critics of his actions were removed.

The Taking of Mecca.

The defeat at Badr naturally led to efforts on the part of the Meccans to avenge their dead and besides to secure the commerce, by which they lived, from an enemy who was gradually getting all the seaboard that lay between Jeddah and Yanbo within his sphere of influence; and the year after Badr (A.H. 3) Abū Sofiān was able to lead a force said to be three times as great as that which had been defeated, and so numbering some 3000 men, against Medina itself; part of it was under Khālid b. al-Walid, one of the greatest of Arab captains, afterwards conqueror of Syria. It is said that Mahomet's plan was to remain in Medina itself, and leave it to the

Meccan commander to discover some way of taking the place; but that his hand was forced by his more ardent followers. Others, however, assign this advice to Abdallah b. Ubayy, and make the Prophet anxious to fight from the first. A battle was in consequence fought under Mt Uḥud (or Ohod), north-west of Medina, wherein Khālid succeeded in inflicting a severe defeat on Mahomet's forces; his uncle Ḥamza, hero of Badr, was killed on this occasion. Fortunately for the Moslems, the Meccans considered that they had finished their task when they discovered that they had killed a number of the former equal to those who had fallen at Badr on their own side; instead therefore of pursuing their victory they went home. The immediate effect on Arabia appears to have been to dissipate the illusion that the Prophet could count on supernatural assistance in his wars; and we hear of some blows being dealt him from outside. Meanwhile his relations towards the Medinese Jews had grown more and more hostile, and these are credited with doing their best to rouse the Meccans to a sense of the danger which threatened them in the continuance of the Prophet's power, and in general to stir up hostility against him in Arabia. Whether this part was played by them or not, in the fifth year of the Prophet's stay at Medina a fresh invasion of the territory took place by a vast confederate force of Meccans with their allies, the tribes Fazarah, Asad, Murrah, &c., to the number, it is said, of 10,000. This time the intention of the leaders was undoubtedly to stamp out Islam. For the first time in Arab warfare Mahomet resorted to the expedient of defending his city by a trench, called by a Persian name, and suggested by a Persian convert. But he also employed agents to sow dissension among the confederates, and succeeded with this no less than with the other expedient. After a brief stay, and scarcely striking a blow, the confederacy dispersed, leaving the Jews who still remained in Medina to the summary vengeance of the Prophet. The want of records written from the Meccan standpoint renders the abortiveness of this last attempt at storming the Prophet's stronghold scarcely intelligible.

From this time, however, the road towards the eventual taking of Mecca became easy, and we are told that such was the importance attached to that city throughout Arabia that its acquisition meant for the Prophet the acquisition of the whole peninsula. The next year (A.H. 6) he deemed it advisable to make a truce with the Meccans (the Truce of Ḥodaibiyah), whereby he secured for his followers the right of performing the pilgrimage in the following year; on this occasion he even consented to forgo his title "Prophet of Allah," when the Meccans refused to sign a deed in which it was employed, greatly to the scandal of his more earnest followers, including Omar; they were however too deeply committed to Islam to be able to defy the Prophet. When the pilgrimage was performed (A.H. 7), Mahomet not only won important converts in the persons of Khālid and the no less able ʿAmr b. al-ʿAṣ, but in general impressed the population with the idea that his was the winning side. An excuse was easily found for invading Mecca itself in the following year, when Abū Sofiān took the opportunity of embracing Islam before it was too late. Very little resistance was now made by the Meccans, whose chiefs were already in Mahomet's camp, and Mahomet used his victory with great moderation; his proscription list was finally reduced to two. The theory that all offences were cancelled by conversion was loyally observed. Moreover the Prophet incurred the displeasure of his Medinese friends by the anxiety which he displayed to soothe the feelings of his former enemies and antagonists. The Medinese, however, prevailed upon him to maintain their city as his political capital, while making Mecca the religious centre of his system; and this arrangement accounts perhaps more than anything else for the persistence of the system amid so many dynastic changes.

In the main he appears to have introduced little alteration into the government of Mecca, and it is said that he even declined to retaliate on those who had confiscated the possessions of the Refugees. Even the Kaʿba was left in the keeping of its former custodian, though of course its interior as well as its precincts were cleansed of all that could offend monotheists. In the following year the pilgrimage was for the first time conducted by a Moslem official, Abū Bekr. A proclamation was made on that occasion, forbidding idolaters in future to take part in the pilgrimage, and giving all Arabs who were not as yet converted four months' grace before force was to be brought to bear upon them. In the following year Mahomet conducted the Pilgrimage himself. This solemn occasion (the "Farewell Pilgrimage") was also employed for the delivery of an important proclamation, wherein the Prophet declared that God had completed their religion. The principle whereon he specially insisted was the brotherhood of Islam; but there is some difficulty in enucleating the original sermon from later additions.

Conquest of Arabia.

It would seem that Mahomet's enterprise originally comprised the conversion of Mecca only, and that he thought of himself as sent to his fellow-citizens only, as had been the case with earlier prophets, whose message was for their "brethren." His views took a somewhat different direction after his brief exile to Ṭāif, and the conquest of Arabia was in a way forced upon him in the course of his struggle with the Meccans. It is not indeed perfectly clear by what process he arrived at the resolution to exclude paganism from Arabia; at first he appears to have tolerated it at Medina, and in some of his earlier contracts with neighbouring tribes he is represented as allowing it, though some of our texts make him reserve to himself the right of enforcing Islam if he chose; only the Meccans were at first, according to the most authentic documents, excluded from all truce or treaty. At the battle of Badr he appears to have formulated the rule that no one might fight on his side who had not embraced Islam; and when once he had won fame as a successful campaigner, those who wished to share his adventures had to pass the Islamic test. After the battle of Uhud (Ohod) we hear of a tribe demanding missionaries to instruct them in Islamic principles; and though in the case recorded the demand was treacherous, the idea of sending missionaries appears not to have been unfamiliar even then, albeit the number sent (70), if rightly recorded, implies that the Prophet suspected the good faith of the applicants. After the taking of Mecca, whereby the chief sanctuary at any rate of north Arabia had been cleared of all idolatrous associations, and consecrated to monotheism, paganism in general was conscious of being attacked; and the city had scarcely been brought under the new régime before the Prophet had to face a confederation of tribes called Hawāzin and Thaqīf. The battle which ensued, known as the Day of Honain, was near ending disastrously for Islam; some of Mahomet's sturdiest followers fled; but the terrible danger of a defeat in the neighbourhood of recently conquered Mecca roused the Prophet and Ali to heroism, and they saved the day. Emissaries were now sent far and wide demanding the destruction of idols, and only Ṭāif appears to have made any considerable resistance; against this place for the first time the Prophet made use of siege artillery, such as was employed by the Byzantines; though compelled by the bravery of the inhabitants to raise the siege, he was afterwards able to take the city by capitulation. It has been observed that here only do we read of much attachment to the old deities; in most places they were discarded with few regrets when once their impotence had been found out. After the taking of Mecca and the victory of Honain there appears to have been a general desire, extending even to the extreme south of Arabia, to make the best terms with the conqueror so soon as possible; iconoclasm became general. Flatterers of various kinds, including poets, came to seek the favour of the sovereign; and a mock war of words appears to have been substituted by some tribes for more serious fighting, to terminate in surrender. For warfare of his sort Mahomet had a powerful helper in the poet Ḥāssan b. Thābit, for whose effusions a pulpit was erected in the Medina mosque, and whose verses were said to be inspired by the Holy Spirit; though, as has been seen, Mahomet was not himself able to judge of their artistic merit. It was not, however, found easy to enforce the payment of the alms on these new converts; and this taxation caused an almost general revolt so soon as Mahomet's death had been ascertained.

Plan of World-conquest.

Although the central portions of the peninsula in Mahomet's time were practically independent, large portions of the north-west and south-east were provinces of the Byzantine and Persian empires respectively, whence any scheme for the conquest of Arabia would necessarily involve the conqueror in war with these great powers. The conquest of Persia is said to have been contemplated by the Prophet as early as A.H. 5, when the famous Trench was being dug; but it was not till the year A.H. 7, on the eve of the taking of Mecca, that the Prophet conceived the idea of sending missives to all known sovereigns and potentates, promising them safety if, but only if, they embraced Islam. The text of these letters, which only varied in the name of the person addressed, is preserved (doubtless faithfully) by the Moslem Oral Tradition; in the middle of the last century a French explorer professed to discover in Egypt the original of one of them—addressed to the mysterious personage called the Muqauqis(Muḳauḳis)of Egypt—and this,it appears, is still preserved amid other supposed relics of the Prophet in Constantinople, though there is little reason for believing it to be genuine. The anecdotes dealing with the reception of these letters by their addressees are all fabulous in character. Two appear to have sent favourable replies: the king of Axum, who now could send the exiles whom he had so long harboured to their successful master; and the Egyptian governor, who sent Mahomet a valuable present, including two Coptic women for his harem. The emperor Heraclius is claimed as a secret convert to Islam, on whom pressure had to be put by his advisers to conceal his convictions. The Persian king is said to have sent orders to have Mahomet arrested; his messengers arrived in Medina, but were unable to carry out the commands of their master, who died while they were there. Two of the letters are said to have had important results. One was addressed to the Himyarite chiefs (called by the south Arabian appellation *qail*) in Yemen, and effected their conversion; another to the governor of Bostra in Roman Arabia, who put the bearer of this insolent message to death; a force was despatched by Mahomet immediately afterwards (beginning of A.H. 8) to avenge this outrage; and though the Moslems were defeated in their first encounter with the Byzantine forces at Muṭah, they appear to have given a good account of themselves; it was here that Jaʿfar, cousin of the Prophet, met his death. In A. H. 9 a successful expedition was led by the Prophet himself northward, in which, though no Byzantine force was encountered, a considerable region was withdrawn from the Byzantine sphere of influence, and made either Islamic or tributary to Islam. At the time of his death (of fever, after a short illness) he was organizing an expedition for the conquest of Syria.

Jewish and Christian Communities.

The Prophet claimed throughout that his revelation confirmed the Jewish and Christian Scriptures, and this claim is on the whole reasonable, though his acquaintance with both was in the highest degree vague and inaccurate. Still he reproduced the Old Testament as faithfully as he could, and though he patriotically endeavours to shed some lustre on his supposed ancestor Ishmael, he does not appear to have questioned the Biblical theory according to which the founder of the north Arabian nations was the son of a slave girl. On neither the truth of the Biblical history and miracles nor the validity of the Mosaic legislation does he appear to have cast any doubt. He even allows that Israel was the chosen people. The Gospel was known to him chiefly through apocryphal and heretical sources, which cannot certainly be identified; but he accepted the doctrine of the Virgin-birth, the miracles of healing the sick and raising the dead, and the ascension; the crucifixion and resurrection were clearly denied by the sect from whom he had received his information, and rejected by him, though certainly not because of any miracle which the latter involved. His quarrel with the Jews at Medina appears to have been by no means of his own seeking, but to have arisen unavoidably, owing to his particular view of his office being such as they could not accept; and his attempt to discredit, not the Mosaic Law, but the form in which they presented it, was an expedient to which he resorted in self-defence. An attempt was made shortly after his arrival at Medina to settle the relations between the two communities by a treaty, according to which, while their equality was guaranteed there should be little interference between the two; this, however, was found unworkable, and each victory of Mahomet over the Meccans was followed by violent measures against the Medinese Israelites. When experience had shown him their military incompetence he appears to have been unable to resist the temptation to appropriate their goods for the benefit of his followers; and his attack on the flourishing Jewish settlement of Khaibar, after the affair of Ḥodaibiyah, appears to have been practically unprovoked, and designed to satisfy his discontented adherents by an accession of plunder. Yet the consciousness that this process was economically wasteful suggested to him an idea which Islamic states are only now abandoning, viz. that of a tolerated caste, who should till the soil and provide sustenance for the Believers who were to be the fighting caste. Whereas then his former plan in dealing with Israelites had been to banish or massacre, he now left the former owners of Khaibar (who had survived the capture of the place) in possession of the soil, of whose produce they were to pay a fixed proportion to the Islamic state. The same principle was adopted in the case of later conquests of Jewish settlements.

Disputes with Christians occur somewhat later in the Prophet's career than those with Jews, for neither at Mecca nor Medina were the former to be found in any numbers; individuals are likely to have been found in both cities, and we hear of one Medinese "Abu ʿAmir the Monk," who after Mahomet's arrival at Medina branded him as an impostor, and, going himself into exile, made many an abortive attempt to discredit and injure Mahomet's cause. The notices of him are meagre and obscure. Mahomet's manifesto to the world, about the time of the taking of Khaibar, appears to represent his definite breach with Christianity; and when in the "year of the embassies" the Christians of Najran sent a deputation to him, they found that the breach between the two systems was not to be healed. Of the three alternatives open to them—conversion, internecine war, and tribute, they chose the last. The Christian tribes of north Arabia showed greater inclination towards the first. The Prophet's policy was to give Christians lighter terms than Jews, and though the Koran reflects the gradual adoption by the Prophet of an attitude of extreme hostility to both systems, its tone is on the whole far more friendly to the former than to the latter. Some other communities are mentioned in the Koran, but merely in casual allusions: thus we know that Mahomet's sympathy was with the Byzantines in their struggle with Persia, but in his most tolerant utterance the Magians or Mazdians as well as the Sabians (with whom his followers were identified by the Meccans) are mentioned with respect.

Mahomet's Administration.

The financial requirements of Mahomet's state were of the simplest kind, for there is no trace of any form of governmental department having been instituted by him, even when he was master of the peninsula; nor can we name any permanent officials in his employ except his *muaddhin* Bilal, and perhaps his court-poet Hassān. A staff of scribes was finally required both to take down his revelations and to conduct correspondence; but although he encouraged the acquisition of penmanship (indeed some of the prisoners at Badr are said to have been allowed to ransom themselves by teaching it to the Medinese), we know of no regular secretaries in his employ. As despot of Medina he combined the functions of legislator, administrator, general and judge; his duties in the last three capacities were occasionally delegated to others, as when he appointed a governor of Medina during his absence, or leaders for expeditions, with provision for successors in case of their falling, but we hear of no permanent or regular delegation of them. Till near the end of his career at Medina he maintained the principle that migration to that city was a condition of conversion; but when, owing to the extension of his power, this was no longer practicable, his plan was in the main to leave the newly converted communities to manage their internal affairs as before, only sending occasional envoys to discharge special duties, especially instruction in the Koran and the principles of Islam, and to collect the Alms; quite towards the end of his life he appears to have sent persons to the provinces to act as judges, with instructions to judge according to the Koran, and where that failed, *the practice* (*sunna*), *i.e.* the practice of the community, for which a later generation substituted the practice of the Prophet. There were, therefore, no regular payments to permanent officials; and the taxation called *Alms*, which developed into an income-tax, but was at first a demand for voluntary contributions, was wholly for the support of the poor Moslems; it might not be used for the maintenance of the state, *i.e.* Mahomet and his family. For them, and for public business, *e.g.* the purchase of war material and gratuities to visitors, provision was made out of the booty, of which Mahomet claimed one-fifth (the chieftain's share had previously, we are told, been one-fourth), while the remainder—or at least the bulk of it—was distributed among the fighting men; the Prophet appears to have prided himself on the justice of his distribution on these occasions, and doubtless won popularity thereby, though we hear occasionally of grumbling; for difficulties occurred when a defeated tribe embraced Islam, and so could claim equality with their conquerors, or when portions of the spoil were irregularly employed by Mahomet to allay resentment: the persons whose allegiance was thus purchased were euphemistically termed "those whose hearts were united." What afterwards proved the main source of revenue in Islamic states dates from the taking of Khaibar; for the rent paid to the state by tolerated communities for the right to work their land developed long after Mahomet's time into a poll-tax for Unbelievers (see CALIPHATE, *e.g.* B. § 8 and MAHOMMEDAN INSTITUTIONS), and a land-tax for all owners of land. Immediately after the taking of Khaibar certain communities, of which the most notable was Fadak, sent tribute before they had been attacked and reduced; their land was regarded by Mahomet as his private domain, but after his death it was withdrawn from his heirs by his successor Abū Bekr, in virtue of a maxim that Prophets left no inheritance, which in the opinion of Fāṭima was contrary to Koranic doctrine, and invented by Ayesha's father expressly for the purpose of excluding her and her husband from their rights; and this is likely to have been the case.

As a military organizer Mahomet, as has been seen, was anxious to adopt the most advanced of contemporary methods, and more than once is said to have scandalized the Arabs by foreign innovations, as at a later time the Moslem chiefs who first used gunpowder scandalized their co-religionists. The unit in his armies seems to have been, as of old, the tribe, under its natural leader; that he introduced no more scientific division, and nothing like a hierarchy of officers was perhaps due to the difficulty of reconciling such a system with the equality of all Moslems.

As has been seen, the Koran only assumed the character of a civil code as the need for one arose; and for some time after Mahomet's arrival at Medina old-fashioned methods of settling disputes continued in use, and doubtless in accordance with precedent where such was known. For difficult cases, even in Arab opinion, divine inspiration was required; and since Mahomet naturally claimed to be in sole enjoyment of this, his utterances soon became the unique source of law, though he did not at first think of organizing a code. Such a plan is said to have occurred to him, and he even wished to dictate a code upon his deathbed; but his friends supposed or professed to suppose him to be delirious. A table regulating the "Alms" was left by him, it is said, in the possession of Abū Bekr; but other traditions assign another origin to this document.

Just as there were no regular officials for the arrangement of business, so there were none for its execution; when punishment was to be administered, any follower of Mahomet might be called upon to administer it. In the case of the massacre of the Banū Quraiẓah care was taken to see that some of the heads were struck off by their former allies, in order that the latter might be unable at any time to bring a demand for vengeance. The Prophet hoped by the mere terror of his name to make complete security reign throughout Arabia, and there is no evidence that any system of policing either it or even Medina occurred to him.

Domestic Life.

Until the death of Khadija the Prophet's private life seems to have been normal and happy, for though the loss of his sons in infancy is said to have earned him a contemptuous epithet, he was fortunate in his adoption of Zaid b. Ḥarithah, apparently a prisoner ransomed by Khadija or one of her relatives, who appears as dutiful almost to excess and competent in affairs. The marriages of his daughters seem all to have been happy, with, curiously, the exception of that between Fāṭima and Ali. His domestic troubles, to which an unreasonable amount of space seems to be devoted, even in the Koran, began after the Migration, when, probably in the main for political reasons, he instituted a royal harem. One of these political motives was the principle which long survived, that the conquest of a state was consummated by possession of the former monarch's wife, or daughter; another, as has been seen, the desire to obtain the securest possible hold on his ministers. In his marriage with the daughter of his arch-enemy Abū Sofiān, before the latter's conversion, we can see a combination of the two. Few, therefore, of these marriages occasioned scandal; yet public morality seemed to be violated when the Prophet took to himself the wife of his adopted son Zaid, whose name has in consequence the honour of mention in the Koran in the revelation which was delivered in defence of this act. Its purpose was, according to this, to establish the difference between adoptive and real filiation. Serious trouble was occasioned by a charge of adultery brought against the youthful favourite Ayesha, and this had to be refuted by a special revelation; the charge, which was backed up apparently by Ali, seems to have been connected with some deeper scheme for causing dissension between the Prophet and his friends. Yet another revelation is concerned with a mutiny in the harem organized by Omar's daughter Hafsa, owing to undue favour shown to a Coptic concubine (Mary, mother of a son called Ibrahim, who died in infancy; his death was marked by an eclipse, January 27, 632); and various details of factions within the harem are told us by Mahomet's biographers.

Of the members of this harem the only prominent one is Ayesha, married to the Prophet shortly after the Flight, when she had scarcely passed the period of infancy, but who appears to have been gifted with astuteness and ambition that were quite beyond her years, and who maintained her ascendancy over the Prophet in spite of the fact that many carping criticisms of his revelations are attributed to her. Some of this may have been due to the obligations (including pecuniary obligations) under which her father had laid Mahomet; but her reputation seems to have been greatly enhanced by the sending down of a revelation to exonerate her (A.H. 6), for which she thanked God and not the Prophet. Each accession to the harem rendered the building of a house or room necessary for the newcomer's accommodation; a fact in which Robertson Smith perhaps rightly saw a relic of the older system whereby the tent was the property of women. The trouble noticed above seems to have arisen from the want of a similar arrangement in the case of slave girls, with whom Mahomet's system permits cohabitation. When Mahomet, whether in consequence of the fatigue incurred by the "Farewell Pilgrimage," or, as others thought, by the working of some poison put into his food some years before by a Jewess of Khaibar, was attacked by the illness which proved fatal, it was to the house of Ayesha that he was transferred (from that of another wife) to be nursed; and he apparently died in the arms of the favourite, on whose statements we have to rely for what we know of his last hours.

General Characteristics.

The traditional description of Mahomet is "of middle height, greyish, with hair that was neither straight nor curly; with a large head, large eyes, heavy eyelashes, reddish tint in the eyes, thick-bearded, broad-shouldered, with thick hands and feet"; he was in the habit of giving violent expression to the emotions of anger and mirth. The supposition that he at any time suffered from physical weakness seems absolutely refuted by his career as a leader of difficult, dangerous and wearisome expeditions, from his migration to Medina until his death; indeed, during his last years he exhibited a capacity for both physical and intellectual activity which implies a high degree of both health and strength; and without these the previous struggle at Mecca could scarcely have been carried on. The supposition that he was liable to fits (epileptic or cataleptic) was intended to account for certain of the phenomena supposed to accompany the delivery of revelations; some of these however rest on very questionable authority: and the greater number of the revelations give evidence of careful preparation rather than spontaneity.

The literary matter ascribed to the Prophet consists of (1) the Koran (*q.v.*); (2) certain contracts, letters and rescripts preserved by his biographers; (3) a number of sayings on a vast variety of topics, collected by traditionalists. The references in the Koran to a form of literature called "Wisdom" (*ḥikmah*) suggest that even in the Prophet's time some attempts had been made to collect or at least preserve some of the last; the general uncertainty of oral tradition and the length of time which elapsed before any critical treatment of it was attempted, and the variety of causes, creditable and discreditable, which led to the wilful fabrication of prophetic utterances, render the use to which No. 3 can be put very limited. Thus the lengthy description of the journey to heaven which Sprenger was inclined to accept as genuine is regarded by most critics as a later fabrication. It is very much to be regretted that the number of *pièces justificatives* (No. 2) quoted by the biographers is so small, and that for these oral tradition was preferred to a search for the actual documents, some of which may well have been in existence when the earliest biographies were written. Their style appears to have been plain and straightforward, though the allusions which they contain are not always intelligible.

In his personal relations with men Mahomet appears to have been able to charm and impress in an extraordinary degree, whence we find him able to control persons like Omar and Khalid, who appear to have been self-willed and masterful, and a single interview seems to have been sufficient to turn many an enemy into a devoted adherent. Cases (perhaps legendary) are quoted of his being able by a look or a word to disarm intending assassins.

Although the titles which he took were religious in character, and his office might not be described as sovereignty, his interests appear to have lain far more in the building up and maintenance of empire than in ecclesiastical matters. Thus only can we account for the violent and sudden changes which he introduced into his system, for his temporary lapse into paganism, and for his ultimate adoption of the cult of the Black Stone, which, it is said, gave offence to some of his sincere adherents (*e.g.* Omar), and seems hard to reconcile with his tirades against fetish-worship. The same is indicated by his remarkable doctrine that the utterance of the creed constituted a Moslem and not its cordial acceptance, and his practice of at times buying adhesion. Even an historian so favourable to the Prophet as Prince Caetani recognizes that ultimately what he regarded as most important was that his subjects should pay their taxes. And in general his system was not favourable to fanaticism (*al-ghulū fi'l-dīn*); he repeatedly gave permission for concealment of faith when the profession of it was dangerous; he took care to avoid institutions which, like the Jewish Sabbath, interfered seriously with military expeditions and the conduct of business, and permitted considerable irregularity in the matters of prayer and fasting when circumstances rendered it desirable. In his theory that Koranic texts could be abrogated he made wise provision against the danger of hasty legislation, though some of its usefulness was frustrated by his failure to provide for such abrogation after his death.

Mahomet's Reforms.

As has been seen, Mahomet claimed to introduce a wholly new dispensation, and a maxim of his law is that Islam cancels all that preceded it, except, indeed, pecuniary debts; it is not certain that even this exception always held good. Hence his system swept away a number of practices (chiefly connected with the camel) that were associated with pagan superstitions. The most celebrated of these is the arrow-game, a form of gambling for shares in slaughtered camels, to which poetic allusions are very frequent. More important than this was his attitude towards the blood-feud, or system of tribal responsibility for homicide (whether intentional or accidental), whereby one death regularly led to protracted wars, it being considered dishonourable to take blood-money (usually in the form of camels) or to be satisfied with one death in exchange. This system he endeavoured to break down, chiefly by sinking all earlier tribal distinctions in the new brotherhood of Islam; but also by limiting the vengeance to be demanded to such as was no more than the equivalent of the offence committed, and by urging the acceptance of money-compensation instead, or complete forgiveness of the offence. The remembrance of pre-Islamic quarrels was visited by him with condign punishment on those who had embraced Islam; and though it was long before the tribal system quite broke down, even in the great cities which rose in the new provinces, and the old state of things seems to have quickly been resumed in the desert, his legislation on this subject rendered orderly government among Arabs possible.

Next in importance to this is the abolition of infanticide, which is condemned even in early Suras of the Koran. The scanty notices which we have of the practice are not altogether consistent; at times we are told that it was confined to certain tribes, and consisted in the burying alive of infant daughters; at other times it is extended to a wider area, and said to have been carried out on males as well as females. After the taking of Mecca this prohibition was included among the conditions of Islam.

In the laws relating to women it seems likely that he regulated current practice rather than introduced much that was actually new, though, as has been seen, he is credited with giving them the right to inherit property; the most precise legislation in the Koran deals with this subject, of which the main principle is that the share of the male equals that of two females. Our ignorance of the precise nature of the marriage customs prevalent in Arabia at the rise of Islam renders it difficult to estimate the extent to which his laws on this subject were an improvement on what had been before. The pre-Islamic family, unless our records are wholly misleading, did not differ materially from the Islamic; in both polygamy and concubinage were recognized and normal; and it is uncertain that the text which is supposed to limit the number of wives to four was intended to have that meaning. The "condition of Islam" whereby adultery was forbidden is said to have been ridiculed at the time, on the ground that this practice had never been approved. Yet it would seem that certain forms of promiscuity had been tolerated, though the subject is obscure. Against these services we must set the abrogation of some valuable practices. His unfortunate essay in astronomy, whereby a calendar of twelve lunar months, bearing no relation to the seasons, was introduced, was in any case a retrograde step; but it appears to have been connected with the abrogation of the sanctity of the four months during which raiding had been forbidden in Arabia, which, as has been seen, he was the first to violate. He also, as has been noticed, permitted himself a slight amount of bloodshed in Mecca itself, and that city perhaps never quite recovered its sacrosanct character. Of more serious consequences for the development of the community was his encouragement of the shedding of kindred blood in the cause of Islam; the consequences of the abrogation of this taboo seem to have been felt for a great length of time. His assassinations of enemies were afterwards quoted as precedents in books of Tradition. No less unfortunate was the recognition of the principle whereby atonement could be made for oaths. On the question how far the seclusion of women was enjoined or countenanced by him different views have been held.

Sources.

Besides the contemporary documents enumerated above (Koranic texts, rescripts and authentic traditions) many of the events were celebrated by poets, whose verses were ostensibly incorporated in the standard biography of Ibn Isḥāq; in the abridgment of that biography which we possess many of these are obelized as spurious, and, indeed, what we know of the procedure of those who professed to collect early poetry gives us little confidence in the genuineness of such odes. A few, however, seem to stand criticism, and the *diwan* (or collection of poems) attributed to Ḥassan b. Thābit is ordinarily regarded as his. Though they rarely give detailed descriptions of events, their attestation is at times of value, *e. g.* for the story that the bodies of the slain at Badr were cast by the Prophet into a pit. Besides this, the narratives of eyewitnesses of important events, or of those who had actually taken part in them, were eagerly sought by the second generation, and some of these were committed to writing well before the end of the 1st century. The practice instituted by the second Caliph, of assigning pensions proportioned to the length of time in which the recipient had been a member of the Islamic community, led to the compilation of certain rolls, and to the accurate preservation of the main sequence of events from the commencement of the mission, and for the detailed sequence after the Flight, which presently became an era (beginning with the first month of the year in which the Flight took place). The procedure whereby the original dates of the events (so far as they were remembered) were translated into the Moslem calendar—for something of this sort must have been done—is unknown, and is unlikely to have been scientific.

Mahomet's conduct being made the standard of right and wrong, there was little temptation to "whitewash" him, although the original biography by Ibn Isḥāq appears to have contained details which the author of the abridgment omitted as scandalous. The preservation of so much that was historical left little room for the introduction of miraculous narrations; these therefore either belong to the obscure period of his life or can be easily eliminated; thus the narratives of the Meccan council at which the assassination of Mahomet was decided, of the battles of Badr, Uḥud and Ḥonain, and the death of Sa'd b. Mu 'adh, would lose nothing by the omission of the angels and the devil, though a certain part is assigned the one or the other on all these occasions. We should have expected biographies which were published when the 'Abbasids were reigning to have falsified history for the purpose of glorifying 'Abbās, their progenitor; the very small extent to which this expectation is justified is a remarkable testimony to their general trustworthiness.

RELATIVES OF THE PROPHET[1]

1. *Family of 'Abd al-Moṭṭalib*, Mahomet's maternal grandfather:—*'Abbās (d. A.H. 32 or 34), *Ḥamza (d. A.H. 3), 'Abdallāh, father of the

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[1] * is prefixed to names which figure on occasions which seem to be historical. Female names are in italics.

Prophet, *Abū Ṭālib (said to be named ʿAbd Manāf), ? *Zubair, Ḥārith, Ḥajal, Moqawwam, Ḍirār, *Abū Lahab (said to be named ʿAbd al-ʿUzzā, d. A.H. 2), **Ṣafiyyah* (d. A.H. 20), *Umm Ḥakīm, al-Baiḍā, ʿĀtikah, Umaimah, Arwā, Barrah.*

2. *Family of Abū Ṭālib*:—*ʿAqīl (d. after A.H. 40), *Jaʿfar (d. A.H. 8), Ṭālib, Ṭulaiq, ʿAlī, the caliph, *Umm Hānī', Jumānah, Raiṭah.*

3. *Family of Mahomet. Wives:*—**Khadīja* (Children:—Qāsim; ? ʿAbd Manāf (Ṭāhir, Tayyib); **Zainab* m. Abu'l-ʿĀṣ b. Rabīʿ, d. A.H. 7; **Ruqayyah*, m. ʿOthmān b. ʿAffān, d. A.H. 2; **Umm Kulthūm* m. ʿOthmān b. ʿAffān, d. A.H. 9; **Fāṭimah*, m. ʿAlī, d. A.H. 11): **Saudah bint Zamʿah*, ? d. A.H. 54, **ʿA'ishah (Ayesha) bint Abī Bekr* (d. A.H. 56), **Ḥafṣa bint ʿOmar* (d. A.H. 45 or 47), **Zainab bint Khuzaimah*, d. before A.H. 11, **Zainab bint Jaḥsh*, d. A.H. 20, **Umm Salimah*, d. A.H. 59, **Maimūnah*, d. A.H. 38, **Juwairiyah*, d. A.H. 56, **Umm Ḥabībah Ramlah bint Abī Sofiān*, d. A.H. 44.

Concubines:—**Ṣafiyyah bint Ḥuyyay*, d. A.H. 36, **Raiḥānah bint Zaid*, **Māriyah the Copt*, d. A.H. 15 or 16, mother of Ibrāhim. (Other names given by Ibn Saʿd, vol. viii.)

Chronological Table of Chief Events in the Life of Mahomet.[1]

? 570 Birth.
? 595 Marriage with Khadīja.
? 610 Commencement of call.
? 613 Public appearance.
616 Persian conquest of the nearer East.
? 617 Flight of his followers to Abyssinia.
? 618–619 Siege in Mecca. Retractation and subsequent repudiation. Death of Abū Talīb and Khadija.
? 620 Flight to Ṭāif.
622 July 16. Beginning of the Moslem era.
Sept. 20. Arrival at Kuba after the Flight.
632 Jan. 27. Death of his son Ibrāhīm.
632 June 7. Death of Mahomet.

The following dates are given by the Arabic historians according to their own calendar. For the reasons which have been seen it is impossible to obtain certain synchronisms.

A.H. 2. Rajab 1. Raid of ʿAbdallah b. Jaḥsh to Nakhlah.
Ramaḍān 19. Battle of Badr.
Shawwāl 15. Attack on the Banū Qainuqā.
3. Rabīa I. 14. Assassination of Kaʿb b. al-Ashraf.
Shawwāl 7. Battle of Uḥud.
4. Ṣaphar. Massacre of Mahomet's 70 missionaries at Bi'r Maʿūnah.
Rabīa I. Attack on the Banu Naḍīr.
Dhu'l-Qaʿda. Abortive raid called "the lesser Badr."
5. Shaabān 2. Attack on the Banu'l-Muṣṭaliq (according to Wāqidī).
Dhu'l-Qaʿda. Battle of the Trench.
Massacre of the Banū Quraiẓah.
6. Jomādā i. Capture of a caravan by Zaid b. Ḥārithah.
Futile attempt to assassinate Abū Sofiān.
Dhu'l-Qaʿda. Affair of Ḥodaibiyah.
7. Jomādā i. Taking of Khaibar. Mission extended to the world.
Dhu'l-Qaʿda. Pilgrimage to Mecca (called *ʿumrat al-qaḍiyyah*)
8 Jomādā i. Expedition to Mūtah.
Ramaḍān 20. Taking of Mecca.
Shawwāl. Battle of Ḥonain.
Attack on Ṭāʿif.
9. Muḥarram. Tax-gatherers sent over Arabia.
Rajab. Expedition to Tabūk.
Rival Mosque built at Kubā, destroyed on Mahomet's return to Medina.
Dhu'l-Ḥijja. Pilgrimage conducted by Abu Bekr.
Abolition of idolatry in Arabia.
10. Ramaḍān. Expedition of ʿAlī to Yemen.
Dhu'l-Qaʿda. "Farewell Pilgrimage."
11. Ṣaphar. Expedition ordered against the Byzantines.

Companions of the Prophet.

The *saḥābah*, as they are called, are the subject of a vast literature, and the biographical dictionaries devoted to them, of which the best known are the *Usd ul-ghāba* of the historian Ibn Athīr and the *Iṣābah* of Ibn Ḥajar al-'Asqalāni, enumerate many thousands. The following two lists are of special groups.

(*a*) *Naqībs, i.e.* leaders selected by Mahomet from the Medinese tribes: i. *Khazrajites*:—Asʿad b. Zurārah, Saʿd b. al-Rabīʿ, ʿAbdallah b. Rawāḥah, al-Barā' b. Maʿrūr, ʿAbdallah b. ʿAmr b. Ḥarām, ʿUbādah b. al-Ṣāmit, Saʿd b. ʿUbādah, al-Mondhir b. ʿAmr; ii. *Ausites*: Usaid b. Ḥuḍair, Saʿd b. Khaithamah, Rifāʿah b. ʿAbd al-Mondhir.

(*b*) *Commanders of Expeditions*: names occurring in (*a*) are not repeated: ʿAbdallāh b. Jaḥsh, ʿAbd ar-Raḥmān b. ʿAuf, Abū Bekr, Abū Qatādah, Abū ʿUbaidah b. al-Jarrāḥ, ʿAli, ʿAlqamah b. Mujazziz, ʿAmr b. al-ʿĀṣ (ibn el-Ass), Bashīr b. Saʿd, Ḍaḥḥāk b. Sofiān, Ghālib b. ʿAbdallāh, Ibn Abi'l-Aujā, Kaʿb b. ʿUmair, Khālid b. al-Walīd, Kurz b. Jābir, Marthad b. Abī Marthad, Muḥammad b. Maslamah, Quṭbah b. ʿĀmir, Saʿd b. Abī Waqqāṣ, Saʿd d. Zaid, Salama b. ʿAbd al-Asad, Shujāʿ b. Wahb, ʿUbaidah b. al-Ḥārith, ʿUkkāshah b. Miḥṣan, ʿUmar b. al-Khaṭṭāb, Usamah b. Zaid, ʿUyainah b. Ḥiṣn, Zaid b. Ḥārithah.

AUTHORITIES.—The biography of Ibn Isḥāq was before the world long before the two chief causes for the falsification of tradition had begun to have serious effects; these were the need for legal precedents, and the concept of saintliness, combining those of asceticism and thaumaturgy. These gave rise to the classical works on the *Evidences of Mohammed's Mission* by Abū Nuʿaim (d. A.D. 1012–1013) and Baihaqī (d. A.D. 1066).

Lives of the Prophet († indicates that the work is lost); †ʿUrwah b. Zubair (d. 712–713); †Musa b. ʿUkbah (d. 758–759); †Mohammed b. Isḥāq (d. 768); Mohammed b. Hishām (d. 828–829), ed. Wüstenfeld (Göttingen, 1860); reprinted in Egypt by Zubair Pasha, a series of excerpts from the last; Mohammed b. Omar al-Wāqidī (d. 823), portion published by Kremer (Calcutta, 1855), abridged trans. of a fuller copy by Wellhausen, *Muhammad in Medina* (Berlin, 1882); Mohammed b. Saʿd (d. 844–845), an encyclopaedic work on the history of Mahomet and his followers, called *Ṭabaqat*, ed. Sachau and others (Berlin, foll.); Mohammed b. Jarīr al-Ṭabarī (see TABARI). Many more writers on this subject are enumerated in the *Fihrist*, cf. Sprenger's *Leben Muhammads*, iii. 54–76.

Among the most popular compilers of later times are: Ibn al-Athir (*q.v.*) al Jazarī, the historian (d. 1233); Aḥmad b. Ali al Kasṭalānī (d. A.D. 1517), whose *al-Mawāhib al-Laduniyyah* was published with commentary (Cairo, 1278); Ḥosain b. Mohammed al Diyarbakrī (d. 1574) whose work *Ta'rikh al-Khamīs* was published in Cairo, A.H. 1382; ʿAli b. Burhān al-dīn al-Ḥalabī (d. A.D. 1634), whose biography called *Insān al-ʿuyūn* was published in Cairo, A.H. 1292. To these must be added all the collections of Tradition.

Modern Authorities.—The critical study of the Life of Mahomet begins in Europe with the publication by Th. Gagnier in 1723 of the Life by Abulfeda (*q.v.*). Presently there appeared an apologetic biography by Henri Cmte. de Boulainvilliers (2nd ed., Amsterdam, 1731), to which Gagnier replied in 1732 (*La Vie de Mahomet, traduite*, &c. ibid.). The next considerable advance in the treatment of the subject is marked by the biography of G. Weil (*Muhammed der Prophet*, Stuttgart, 1843), which is wholly without religious bias; the popular life by Washington Irving (London, 1849) is based on this. That by J. L. Merrick (the *Life and Religion of Mohammed*, Boston, U.S.A., 1850) rests on Shiʿite sources. The search for MSS. in India conducted by A. Sprenger led to the discovery of fresh material, which was utilized by Sprenger himself in his unfinished *Life of Mohammad* (Pt. 1, Allahabad, 1851), and his more elaborate *Das Leben und die Lehre des Mohammad* (Berlin, 1861–1865), and by Sir William Muir in his *Life of Mahomet*, London, 1858–1861) 4 vols.: afterwards abridged in one volume and reprinted. These are still the standard treatises on the subject; the pro-Christian bias of Muir is very marked, while Sprenger has hazarded numerous conjectures on subjects with which he had little familiarity. The biography by S. W. Koelle, *Mohammed and Mohammedanism* (London, 1889), is pro-Christian, the popular work of Syed Ameer Ali *The Spirit of Islam*, (London, 1896) an apology for Mahommedanism. Later treatises, resting on original authorities, are those by H. Grimme *Mohamed*, (Münster, 1892, and Munich, 1904), F. Buhl, *Mohameds Liv* (Copenhagen, 1903—Danish: since translated into German), D. S. Margoliouth *Mohammed and the Rise of Islam* (N.Y., 1905, &c.), and Prince Caetani *Annali del Islam*, i. ii. (Milan, 1905–1907). For the direction of public opinion in Mahomet's favour the Lecture on *The Hero as Prophet* in Carlyle's *Heroes and Hero-worship* (London, 1846) was singularly effective; his views were enforced by R. Bosworth Smith *Mohammed and Mohammedanism*, (London, 1873, &c.). A somewhat similar line was taken in France by J. Barthélémy Saint-Hilaire, *Mahomet et le Coran*, (Paris, 1865), while the *Vie de Mahomet d'après la Tradition* of E. Lamairesse and G. Dujarric (Paris, 1897) is written entirely from the Moslem standpoint.

See further CALIPHATE, *ad init.*; MAHOMMEDAN INSTITUTIONS; MAHOMMEDAN LAW; MAHOMMEDAN RELIGION. (D. S. M.*)

MAHOMMED AHMED IBN SEYYID ABDULLAH (1848–1885), Sudanese tyrant, known as "the Mahdi," was born in Dongola. His family, known as excellent boat-builders, claimed to be *Ashraf* (or *Sherifs*), *i.e.* descendants of Mahomet. His father was a *fiki* or religious teacher, and Mahommed Ahmed devoted himself early to religious studies. When about twenty years old he went to live on Abba Island on the White Nile about 150 m. above Khartum. He first acquired fame by a quarrel with the head of the brotherhood which he had joined, Mahommed asserting that his master condoned transgression of the divine law. After this incident many dervishes (religious mendicants) gathered round the young sheikh, whose reputation for sanctity speedily grew. He travelled secretly through Kordofan, where (with ample justification) he denounced to the villagers the extortion of the tax-gatherer and told of the coming of the mahdi who should deliver them from the oppressor. He also wrote a pamphlet summoning true believers to purify their religion from the defilements of the "Turks" *i.e.* the Egyptian officials and all non-native inhabitants of the Sudan. The influence he gained at length aroused the anxiety of the authorities, and in May 1881 a certain Abu Saud, a notorious scoundrel, was sent to Abba Island to bring the sheikh to Khartum. Abu Saud's mission failed, and Mahommed Ahmed no longer hesitated to call himself al-Mahdi al Montasir, "The Expected Guide." In August he defeated another force sent to Abba Island to arrest him, but thereafter deemed it prudent to retire to Jebel Gedir, in the Nuba country south of Kordofan, where he was soon at the head of a powerful force; and 6000 Egyptian troops under Yusef Pasha, advancing from Fashoda, were nearly annihilated in June 1882. By the end of 1882 the whole of the Sudan south of Khartum was in rebellion, with the exception of the Bahr-el-Ghazal and the Equatorial Provinces. In January 1883 El Obeid, the capital of Kordofan, was captured. In the November following Hicks Pasha's force of 10,000 men was destroyed at Kashgil, and in the same year the mahdi's lieutenant, Osman Digna, raised the tribes in the eastern Sudan, and besieged Sinkat and Tokar, near Suakin, routing General Valentine Baker's force of 2500 men at El Teb in February 1884. The operations undertaken by Great Britain in face of this state of affairs are narrated under Egypt: *Military Operations.* It need only be added that General Gordon (*q.v.*) was besieged at Khartum by the mahdi and was killed there when the town was captured by the mahdists on the 25th–26th of January 1885. The mahdi himself died at Omdurman a few months later (June 22, 1885), and was succeeded in power by his khalifa Abdullah.

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[1] Dates are given A.D.

When he announced his divine mission Mahommed Ahmed adopted the Shi'ite traditions concerning the mahdi, and thus put himself in opposition to the sultan of Turkey as the only true commander of the faithful. To emphasize his position the mahdi struck coins in his own name and set himself to suppress all customs introduced by the "Turks." His social and religious reforms are contained in various proclamations, one of which is drawn up in the form of ten commandments. They concern, chiefly, such matters as ritual, prayers, soberness in food and raiment, the cost of marriage and the behaviour of women. How far the mahdi was the controller of the movement which he started cannot be known, but from the outset of his public career his right-hand man was a Baggara tribesman named Abdullah (the khalifa), who became his successor, and after his flight to Jebel Gedir the mahdi was largely dependent for his support on Baggara sheikhs, who gratified one of his leading tastes by giving him numbers of their young women. In the few months between the fall of Khartum and his death the mahdi, relieved from the incessant strain of toil, copied in his private life all the vices of Oriental despots while maintaining in public the austerity he demanded of his followers. His death is variously attributed to disease and to poisoning by a woman of his harem. On the occupation of Omdurman by the British (Sept. 1898) the mahdi's tomb was destroyed, his body burnt and the ashes thrown into the Nile (see Sudan: *Anglo-Egyptian*).

See *Mahdiism and the Egyptian Sudan* by F. R. Wingate (1891); *Ten Years' Captivity in the Mahdi's Camp* (1882–1892) from the MS. of Father Joseph Ohrwalder by F. R. Wingate (1892) and *Fire and Sword in the Sudan* (1879–1895) by Slatin Pasha (trans. F. R. Wingate, 1896). Both Ohrwalder and Slatin were personally acquainted with the mahdi, and their narratives contain much first-hand information. Wingate prints many translations of the proclamations and correspondence of the mahdi.

MAHOMMEDAN INSTITUTIONS. Of all the institutions of Islam the caliphate is the oldest, the most fundamental, and in essence the most enduring. For its history see Caliphate; the present subject is its origin and nature. Mahomet enjoyed absolute rule over his people as a divinely inspired and guided prophet. He led the public prayers; he acted as judge; he ruled. If he consulted with others or paid attention to public feeling or local usage, it was as a matter of policy; the ultimate decision lay with himself. He was the state. On his death a leader was put in his place of similar authority, though without the divine prophetic guidance. He was called the "successor" (*khalīfa*, caliph) of the Prophet, later also the *amīr-al-mu'minīn*, commander of the faithful, and was elected by the Moslems, just as the Arab tribes had always elected their chiefs. He was thus an absolute ruler, but was democratically elected; and such is the essence of the caliphate among Sunnite Moslems to this day. For them it has been a matter of agreement (see Mahommedan Law) from the earliest times that the Moslem community must appoint such a leader (see Imām). The Shi'ites, on the other hand, hold that the appointment lies with God, and that God always has appointed, though his appointment may not always have been known and accepted. Their position may be called a legitimist one. Some few heretical sects have held that the necessity of a leader was based on reason, not on the agreement of the community. But, for all, the rule of the leader thus appointed is absolute, and all authority is delegated from him and, in theory, can be resumed by him at any time. Just as God can require unreasoning obedience from his creatures (his "slaves" in Arabic), so can the caliph, his representative on earth.

The Caliphate.

But Abu Bekr, the first caliph, nominated his successor, Omar, and that nomination was accepted and confirmed by the people. So a second precedent was fixed, which was again carried a step farther, when Moawiya I., the first Omayyad caliph, nominated his son, Yazīd I., as his successor, and caused an oath of allegiance to be taken to him. The hereditary principle was thus introduced, though some relics of the form of election persisted and still persist. The true election possible in the early days of the small community at Medina became first a formal acceptance by the populace of the capital; then an assertion, by the palace guard, of their power; and now, in the investiture of the sultans of the Ottoman Turks, who claim the caliphate, a formal ceremony by the 'ulemā (*q.v.*) of Constantinople. The Ottoman claim is based on an asserted nomination by the last Abbasid, who died in exile in Egypt in 1538, of the Ottoman sultan, Suleiman the Great, as his successor. Such a nomination in itself was a perfectly legal act, but in this case had a fatal flaw. It is an absolute condition, laid down in tradition, that the caliph must be of the tribe of Koreish (Quraish), that of the Prophet.

The duties of this democratically elected autocrat are, in theory, generally stated as follows. He shall enforce legal decisions and maintain the divinely revealed restrictive ordinances; guard the frontiers and equip armies; receive the alms; put down robberies, thieving, highwaymen; maintain the Friday services and the festivals; decide disputes and receive evidence bearing on legal claims; marry minors, male and female, who have no guardians; divide booty. He must be a free, male, adult Moslem; must have administrative ability; must be an effective governor and do justice to the wronged. So long as he fulfils these conditions he is to be absolutely obeyed; private immorality or even tyranny are not grounds for deposing him. This is a position reached by Islam practically. But a caliph who openly denied the faith would be as impossible as an unbelieving pope. The caliph, therefore, is the highest executive officer of a system assumed to be definite and fixed. He, in a word, administers Islam; and the content of Islam is determined by the agreement of the Moslem people, expressed immediately through the 'ulemā, and ultimately, if indirectly and half-consciously, by the people. To depose him a *fatwā* (see Mufti) would be required—in Turkey from the Sheikh-ul-Islām—that he had violated some essential of the Moslem faith, and no longer fulfilled the conditions of a caliph.

The Dīwāns.

But it was impossible for the caliph personally to administer the affairs of the empire, and by degrees the supreme office was gradually put into commission, until the caliph himself became a mere figurehead, and vanished into the sacred seclusion of his palace. The history of the creation of government bureaus (*dīwāns;* see Divan) must therefore now be sketched. The first need which appeared was that of a means of regulating and administering the system of taxation and the revenues of the state. Immense sums flowed into Medina from the Arab conquests; the surplus, after the requirements of the state were met, was distributed among the believers.

All Moslems had a right to a certain share of this, which was regarded as booty. Omar, the second caliph, regulated this distribution and also the system of taxation, and the result was the first divan and the constitution of Omar, looked back to now by all Sunnite Moslems as an ideal. The sources of revenue were (i) the poor-rate (*zakāt*), a tithe paid by every Moslem; (ii) the fifth of all booty; (iii) the poll-tax (*jizya*) on non-Moslems; and (iv) the land-tax (*kharāj*) also on non-Moslems. Thus the constitution determined the position of all non-Moslems in a Moslem state. The ideal was that the Moslems should be kept apart as a superior, fighting caste, and that the non-Moslems should support them (cf. CALIPHATE, B. § 8, on the reign of Omar II.). The Moslems, therefore, were forbidden to acquire land in conquered countries. The non-Moslems must retain their lands, cultivate them and pay the land-tax (the Arabic word is also used of revenue from the work of a slave) and the poll-tax (the Arabic word means also "ransom"), and give contributions in kind to support the local Moslem garrisons which were massed in great camp-cities at strategic points. If a non-Moslem embraced Islam he entered the ruling caste; his land was distributed among his non-Moslem fellows, and he no longer paid the land-tax but rather received support from the public funds. The amount of these pensions varied with the standing of the pensioner from 10,000 dirhems (a dirhem equalled about a franc) to the widows and relations of the Prophet down to 300. This bureau had, therefore, not only to keep the books of the state, but also to maintain a list of all Moslems, classified genealogically and socially. Its registers were kept by Greeks, Copts and Persians; the Arabs, it may be said in general, adopted the method of administration which they found in the captured countries and drew upon the trained services of their inhabitants.

Such a system led naturally to wholesale conversions to Islam; and the consequent decline in revenue, combined with large donations of lands by Othman, the third caliph, to his own family, gradually broke it down. The first patriarchal period of conquest, unearned wealth and the simple life—called by Moslems the period of the "four rightly guided caliphs," and very happily by Sachau, *ein mönchisches Imperium*—passed rapidly into the genuinely Arab empire of the Omayyads, with whom came an immediate development of organization in the state. The constructive genius in this was Moawiya, the first Omayyad caliph. Under him the old simplicity vanished. A splendid and ceremonious court was maintained at Damascus. A chamberlain kept the door; a bodyguard surrounded the caliph, and even in the mosque the caliph, warned by the murder of Othman and of Ali, prayed in a railed-off enclosure. The beginning of the seclusion of the caliph had come, and he no longer walked familiarly among his fellow Moslems. This seclusion increased still further when the administration of the state passed by delegation into other hands, and the caliph himself became a sacrosanct figure-head, as in the case of the later Abbasids; when theories of semi-divine nature and of theocratic rule appeared, as in the case of the Fatimites; and finally when all the elaborate court ritual of Byzantium was inherited by the Ottoman sultans.

But Moawiya I. was still a very direct and personal ruler. He developed a post-system for the carrying of government despatches by relays, and thus received secret information from and kept control of the most distant provinces. He established a sealing-bureau by which state papers were secured against change. He dealt arbitrarily with the revenues of the state and the pensions of the Moslems. Governors of provinces were given a much freer hand, and were required to turn over to the central treasury their surplus revenue only. As they were either conquerors or direct successors of conquerors they had an essentially military government, and were really semi-independent rulers, unhampered except by direct action of the caliph, acting on information sent by the postmaster, who was his local spy. Being thus the heads of armies of occupation, they were not necessarily charged with the control of religious ritual and of justice. These, like every other function, inhered in the office of the caliph and he generally appointed in each province independent cadis over the courts and imāms to be in charge of religious services. Yet the governor was sometimes permitted to hold these two other offices (see CADI; IMĀM).

The Vizierate.

Further administrative developments came with the Abbasids. They created a new city, Bagdad, between the Tigris and the Euphrates, where the three races, Syrian, Arab and Persian, met and sought with Bagdad as a capital to consolidate the empire. The Arab empire, it is true, had passed away with the Omayyads; yet there might be a chance to create a world-empire of all the Moslem peoples. But not even the genius and administrative skill of the early Abbasids could hold together that unwieldy mass. The semi-independent provinces soon became fully independent, or at most acknowledged the caliph as a spiritual head and paid a nominal tribute. His name might stand on the coinage and prayers be offered for him in the Friday service, the two signs of sovereignty to this day in Islam. With this crumbling of the empire went a more elaborate organization; bureaus took the place of principles and of the energy of individual rulers. As the system of Moslem law was built on that of the Roman codes, so was the machinery of administration on that of Persia. And with the Abbasids the chance of the Persians had come. Abū 'l-Abbās, the first Abbasid caliph, was the first to appoint a vizier (*wazīr*, "helper," so Aaron is *wazīr* to Moses in the Koran), a confidential minister to advise him and come between him and the people. Advisers the caliphs had had before; but not a definite adviser with this name. He must, we are told, have a strain of the ruler in him and a strain of the people to be able to work with both. He must know how to be acceptable; fidelity and truthfulness are his capital; sagacity, firmness, generosity, clemency, dignity, effectiveness of speech are essential. It is plain that the vizier became as important as the caliph. But Abū 'l-Abbās was fortunate in early securing as his vizier the grandfather of the house of the Barmecides (*q.v.*). On this Persian family the fortunes of the Abbasids hung, and it secured for them and for Islam a short golden age, like that of the Antonines, until the jealous madness of Hārūn al-Rashīd cast them down. Thereafter the vizierate had many vicissitudes. Technically a vizier could be either limited or unlimited. The limited vizier had no initiative; he carried out the commands of the caliph. The unlimited vizier, often afterwards called the grand vizier, exercised full authority and was the *alter ego* of the caliph, to whom he was required only to report. Naturally the formal distinction is a later theorizing of history; for a weak ruler his vizier became absolute, for a strong ruler his vizier remained subordinate. Here, as with regard to all Moslem institutions, a marked distinction must be made between the historic facts and the speculative edifices raised by constitutional theorizers. Compare especially MAHOMMEDAN LAW. Until the time of Rāḍī (934–940) the vizierate thus fluctuated in importance. In that caliphate the vizier lost all authority, and in his place came the *amīr al-omarā*—equivalent to the *major domus* of the Franks—the head of the Turkish bodyguard, in terror of whom the caliph now stood. When in 945 the Būyids captured Bagdad and the caliph became a purely spiritual sovereign, they took the title "vizier" for their own chief minister, and the caliphs retained only a secretary (see CALIPHATE, C. § 22). Under the Seljuks, however, they regained their viziers and some real authority. Elsewhere, also the vizierate had its vicissitudes. Under the Mamelukes the vizier fell to be merely the court purveyor. Under the Omayyads of Spain the title was given to several responsible officers of the state, but their chief was called *ḥājib*, chamberlain. Under the Almohades the chamberlain was called vizier. In the modern Turkish empire the grand vizier (called generally *ṣadr A'ẓam*) is the sultan's representative in secular matters, and nominally stands between the sovereign and all the other officials. He is the president of the council of ministers, but Abd-ul Hamid II. deprived the office of almost all its importance.

Other Ministers.

Under the early Abbasids the four most important ministers were the chief cadi, the chief of police or head of the life guards, the minister of finance and the postmaster, who was the head of the system of information and espionage which covered the empire. But at different times the different bureaus varied greatly. Under Motawakkil we find the bureau of taxes and finance; bureau of the crown estates; bureau of state book-keeping; bureau of war, *i.e.* of hired troops; bureau which kept reckoning and control of the pensions of the clients and slaves of the ruling family; bureau of the post system; bureau of expenditures. But in spite of this elaborate system, no Moslem government has, except sporadically, been highly centralized. Provided the taxes are paid, a large measure of local autonomy has always been enjoyed by the country districts. Under the Abbasids almost the only exception was the necessarily centralized control of the irrigation system of the Tigris and Euphrates. And similarly elsewhere.

In the case of all these offices, we have delegation by the caliph, under necessity, of his too heavy burdens. But one duty of an Oriental ruler he could not so easily lay aside. It had always to be possible for the oppressed to come into his presence and claim justice; he must sit in the gate and judge. Therefore, when the caliph found it necessary to delegate the ordinary administration of justice, he found it also necessary to set up a special court of oppressions, which developed, to a certain extent, into a court of appeals. The first to establish such a separate court was Abdal-malik the Omayyad

(685–705), and his example was followed by the more vigorous of the caliphs up to the time of Mohtadī the Abbasid (869–870). If any other than the caliph presided over this court it had to be a man whose dignity, independence and authority commanded respect. He was not bound by strict rules of evidence, method and literal application of law as was the cadi. Rather, he applied a system of equity suited to the absolute source of authority which he represented.

As the chief of police, mentioned above, was rather the head of the caliph's bodyguard, there was also a police system after our ideas, but more thoroughgoing. The *muhtasib* had charge in the broadest sense of public order and morals in the streets, and had oversight as to weights, measures and adulterations; but had no right to interfere privately or enter houses save in the clearest and most necessary cases. He had a summary jurisdiction in all minor cases where no trial was necessary; but where witnesses and oaths entered the case must go to the cadi. Slaves and beasts of burden were under his guardianship; he prevented public scandals, such as the sale of wine; he regulated the public conduct of Jews and Christians. In the interest of public morals he had to find suitable husbands for widows and see that they did not marry before the legal time; questions of paternity also he had to investigate. The outdoor costume of the people he could regulate. It should, of course, be remembered that the canon law of Islam covers minutely all sides of life (see MAHOMMEDAN LAW).

It is impossible in Islam to separate logically from the mass of institutions those which we should call religious, as Islam on all sides is for the Moslem equally religious. But perhaps the following may practically be separated under that rubric. Islam, runs a tradition, is built on five things: testimony that there is no god save Allah, and that Mahomet is the apostle of Allah; prayer; the poor-rate; pilgrimage; fasting. For these see MAHOMMEDAN RELIGION.

The law and usage of religious foundations in perpetuity (*waqf*, mortmain) became as important in Islam as monastic endowments in medieval Europe, and such foundations tended similarly to absorb the greater part of the national wealth. It was the only safe way of providing for posterity. A pious foundation could be erected in such a way that either so much from its funds would be paid yearly in perpetuity to the descendants of the erector, or those descendants would be employed as officials of the foundation.

The Imām.

When it became impossible for the caliph to lead the people personally in prayer in the mosque, he delegated that part of his duties to another, hence called imām (*q.v.*). Naturally, then, the appointment of the imām would lie with the supreme ruler. This holds of the daily prayers in the principal mosque (*al-masjid al-jāmi'*) supported by the ruler where the Friday service is held, but in the separate smaller mosques built by each community the community chooses its own imām. With regard to the Friday service, the schools of law disagree as to the necessity of the presence of an imām appointed by the chief ruler. But the imām should certainly make mention of the ruler in his sermon and pray for him. At the occasional prayers, such as those for rain, &c., the presence of an imām appointed by the ruler is not necessary. The imām appoints the *muaddhin*, the announcer of the hour of prayer from the minaret, and both have a claim on the state treasury.

Another office exercised when possible by the caliph, but very frequently delegated to some high dignitary, such as the heir to the caliphate or a prince, was the leadership of the pilgrimage caravan to Mecca and back. Sometimes this official, called *amīr-al-hajj*, was appointed imām as well. He then led all the pilgrimage ceremonies at Mecca. When outside of towns where there was a cadi he exercised also over the caravan the rights of a judge.

The Cadi.

Mahommedan law (*q.v.*) is treated separately. Here, again, as judging is a duty of the caliph, a cadi is the delegate, or, when appointed by a vizier or governor, a delegate of his delegate. He examines into disputes brought before him and enforces his judgments, he names administrators of the estates of minors, the insane, &c.; he supervises the *waqf* property of mosques and schools in his district and inspects highways and public buildings; he watches over the execution of wills; he inflicts the due legal penalties for apostasy, neglect of religious duties, refusal to pay taxes, theft, adultery, outrages, murder; he can inflict the penalties of imprisonment, fine, corporal punishment, death; if there is no imām, he can perform his duty, as in fact can anyone who has the requisite knowledge. But it should be noticed that all this holds only of the un-europeanized Moslem state.

The Army.

For the existence of an army in Islam, there are two grounds, the holy war (*jihād*, *q.v.*) against unbelievers without the state and the suppression of rebellion within. Under the ordinance of Omar the entire community was preserved and used as a weapon for the subduing of the world to Islam, and every able-bodied male Moslem was theoretically a fighting man, part of the national militia. This army was divided into corps situated in the conquered lands, as armies of occupation, where they eventually came to form military colonies in great camp-cities. The occupied countries had to support them, and they were bound to render military service at any time. But as the ideal of Omar broke down before facts the use of mercenary and slave troops finally increased; although there has always continued in Moslem armies acting against unbelievers a proportion of volunteers not paid a fixed wage but subsidized by the state from the poor-rate and alms funds. The generals were appointed by the caliph, and had either unlimited authority to act as his representatives, concluding peace, acting as cadi and imām, distributing booty; or were restricted within limits, *e.g.* to simple leading of the troops and carrying on military operations. They, in turn, appointed their subordinates; this principle of giving a head full powers and full responsibility was very generally applied in Islam. It was controlled of course by the espionage of the postal system. As war by a Moslem power is essentially sacred war, the regulations of *jihad* must be considered here. Unbelievers must first be invited to embrace Islam and, if they follow a sacred book and are not idol-worshippers, are given a choice between (*a*) becoming Moslems; or (*b*) submitting to the Moslems and entering on a treaty with them of protection and tribute; or (*c*) fighting. If they accept Islam, their lives, families and property are secure, and they form henceforth part of the Moslem community. The ability of Islam to create a common feeling between highly different races is one of its most striking features. If they submit and enter on treaty relations, they pay a poll-tax, for which their personal safety is assured, and assume a definitely inferior status, having no technical citizenship in the state, only the condition of protected clients (*dhimmīs*). If they elect to fight, the door of repentance is open, even when the armies are face to face. But after defeat their lives are forfeit, their families are liable to slavery, and all their goods to seizure. It is open to the sovereign either to put them to death; or to enslave them; or to give them their liberty; or to exchange them for ransom or against Moslem prisoners. The sovereign will choose that which is best for Islam. As for their families and wealth, the sovereign can release them only with consent of the army that has captured them. Apostates must be put to death. Four-fifths of the booty after a battle goes to the conquering army.

The technical art of war seems to have been little studied among Moslems; they have treatises on archery but very little upon tactics. Their writers recognize, however, the essential difference between the European and Persian methods of charging in solid lines and holding the ground stubbornly, and the Arab and Berber method of flying attacks and retreats by clouds of cavalry. Therefore, one explained, the custom grew of using a mass of European mercenaries as a fixed nucleus and rallying-point. The early Moslem armies, too, had used the solid, unyielding charge, which may have been the secret of their success. For one of the greatest puzzles of history is the cause which changed the erratic, untrustworthy swarms of Arab horsemen with their childish strategy into the ever-victorious legions of the first caliphs. They certainly learned rapidly. Byzantium and Persia taught them the use of military engines and the entrenched camp. Before that they had been, at the best, single knights with mail-shirt, helmet, sword and lance. Bowmen, too, they used, but the principal use of the bow seems to have come with the Turks.

Education.

The glory of Moslem education was its university system, which fed the higher learning and did not serve every-day needs. Its primary system was very poor, almost non-existent; and technical education has never been recognized in Islam. Primary teachers were despised as ignorant and foolish. Apparently, if we may trust the many stories of how ignorant men set up for themselves, there was no control of them by the state. Their pupils were young only; they taught the rudiments of reading, Koran, catechism, prayer, writing and arithmetic, but very little of the latter. Technical education was given by the gilds through their apprentice system, teaching mechanical arts and crafts. This was genuine instruction, but was not so regarded; it was looked upon rather as are the mysteries and secrets of operative masonry. It produced artisans of independent character, but not artists. Thus there was no distinction between architect and builder; there was no sculpture; and painting, so far as it went, was like carving, a craft. All Moslem university education, like all Moslem science, revolved round theology. There were, apparently, only two outstanding exceptions to this rule, the academy of Mamun (813–833) at Bagdad, and the hall of wisdom of the Fatimites at Cairo (1004–1171); both of these are explained by their environment. From the earliest times, independent scholars instructed classes in mosques—the common places of meeting for the community—and gave their pupils personal certificates. Their subjects were the reading and interpretation of the Koran; the body of traditions from the Prophet; the thence deduced system of theology; the canon law. But the interpretation of the Koran involved grammatical and lexicographical studies of early Arabic, and hence of the early Arabic literature. Theology came to involve metaphysical and logical studies. Canon law required arithmetic and mensuration, practical astronomy, &c. But these last were strictly ancillary; the object of the instruction was primarily to give knowledge of value for the life of the next world, and, secondarily, to turn out theologians and lawyers. Medicine was in Jewish and Christian hands; engineering, architecture, &c., with their mathematical bases, were crafts. Then this instruction was gradually subsidized and organized by the state, or endowed by individuals. How early this took place is uncertain. But the individual teacher, with his certificate, remained the object of the student; there was nothing corresponding to our general degrees. Thirdly, educational institutions came to be equipped with scholarships of money or in kind for the students. The first instance of this is generally ascribed to Nishapur (Naisābūr) in 1066; but it soon became general in the system and afforded a means of control and centralization. A final, and most important, characteristic was the wide journeying of the students "in search of knowledge." Aided by Arabic as the universal language of learning, students journeyed from teacher to teacher, and from Samarkand to the Atlantic, gathering on their way hundreds of personal certificates. Scholars were thus kept in touch all over the Moslem world, and intellectual unity was maintained.

The Sayyids.

To the democratic equality of Islam, in which the slave of to-day may be the prime minister of to-morrow, there is one outstanding exception. The descendants of the Prophet and of his relatives (the family of Hāshim) formed and form a special class, held in social reverence, and guarded from contamination and injury. These are the *sayyids* (lords), and genealogical registers of them are carefully preserved. They are of all degrees of wealth and poverty, but are guarded legally from *mésalliances* with persons of ignoble origin or equivocal occupation. Their influence is very great, and in some parts of the Moslem world they have the standing and reverence of saints.

See Von Kremer, *Culturgeschichte des Orients*, based largely on Māwardī's *Aḥkām*, trans. in part by Ostrorog; McG. de Slane's trans. of Ibn Khaldūn, *Prolégomènes*; Lane, *Manners and Customs of the Modern Egyptians*; R. F. Burton, *Pilgrimage to Mekka*; Snouck Hurgronje, *Mekka*; Hughes, *Dictionary of Islam*; Juynboll, *De Mohammedaansche Wet*; Macdonald, *Development of Muslim Theology*, &c. For women in Islam, see HAREM. (D. B. MA.)

MAHOMMEDAN LAW. The legal situation in the Moslem world is of the highest complexity, and can be made intelligible only by tracing its historical development. First came the system (*fiqh, sharī'a*) which takes the place in Islam of canon law in Roman Christendom. It begins with Mahomet sitting as judge over the primitive Moslem community at Medina. He was the Prophet of God, and judged, as he ruled, absolutely; any decision of his was valid. But he found it, in general, advisable and fitting to follow the local law or usage of Medina when the new faith did not require a change. It thus came about that his decisions followed, at one time, the usage of the Arab tribes of Medina; at another, the law respected by the Jewish tribes there—a rabbinic development of the law of Moses, deeply affected by Roman law; at another, the more developed commercial law of Mecca, known to his followers who had fled thence with him; or, finally, his own personal judgment, stated it might be as his own sense of right or as the decision of Allah and even incorporated in the Koran. In his use of these he was an eclectic opportunist, and evidently, except as regards such frequently recurring subjects as inheritance, marriage, &c., had no thought of building up a system or code. At his death he left behind only a few specific prescriptions in the Koran and a mass of recorded decisions of cases that had come before him. He had used himself, in our terms, common law, equity, legislation; to guide his followers he left his legislative enactments and the record of his use of common law. Since his death there has been no new legislation in orthodox Islam.

With the death of Mahomet began the development and codification of Moslem law. It was at first entirely practical. Cases had to be decided, and to decide them there was, first, the Koran; secondly, if nothing *ad rem* was found in the Koran, there were the decisions of the Prophet; thirdly, if these failed, there was the common law of Medina; and, fourthly, if it, in turn, failed, the common sense of the judge, or equity. A knowledge of the decisions of Mahomet came thus to be of great importance, and records of such decisions were eagerly sought and preserved. But this was simply a part of a much wider movement and tendency. As among primitive peoples in general, custom and usage have always been potent among the Arabs. The ways of the fathers, the old paths, they love to tread. Very early there arose a special reverence for the path and usage (*sunna*) of Mahomet. Whatever he did or said, or left unsaid or undone, and how he did it, has become of the first importance to the pious Moslem, who would act in every way as did the Prophet. There is evidence that for this purpose the immediate companions of Mahomet took notes, either in memory or in writing, of his table talk and wise sayings, just as they took down or learned by heart for their private use the separate fragments of the Koran. His sayings and doings, manners and customs, his answers to questions on religious life and faith, above all his decisions in legal disputes, came to be recorded on odd sheets in private notebooks. This was the beginning of the enormous literature of traditions (*ḥadīth*) in Islam. The collecting and preserving of these, which was at first private, for personal guidance and edification, finally became one of the most powerful weapons of political and theological propaganda, and coloured the whole method and fabric of Moslem thought. All knowledge tended to be expressed in that form, and each element of it to be traced back to, and given in the words of, some master or other through a chain of transmitters. Above all there grew up an enormous mass of evidently forged sayings put into the mouth of Mahomet. At every important political or theological crisis each party would invent and put into circulation a tradition from him, supporting its view. By a study of these flatly opposed "sayings" it is possible to reconstruct the different controversies of Islam in the past, and to discover what each party regarded as the essence of its position.

The first collecting of traditions was for private purposes, and the first publication dealing with them was legal. This was the *Muwaṭṭa'* of Malik ibn Anas (d. 795), a *corpus juris* based partly on traditions, and a protest in its methods against the too speculative character of the books of canon law which preceded it. Thereafter came collections of two different types. The earlier kind was arranged according to the companions of Mahomet, on whose authority the traditions were transmitted; after each companion came the traditions going back to him. The best known example of this kind is the *Musnad* of Aḥmad ibn Ḥanbal. The other kind, called *Muṣannaf* (classified), contains traditions arranged in chapters according to their subject matter. That of Bukhārī is the most famous, and is arranged to give a traditional basis for a complete system of canon law; its rubrics are those of such a system. Another is that of Muslim ibn al-Ḥajjāj, who paid less attention to legal aspects and more to minute accuracy. There are many others of more or less acceptance and canonicity. Bukhārī's book enjoys a reverence only second to that of the Koran. But in all these publications the primary object was to purify the mass of traditions of forged accretions and to give to the believer a sound basis for his knowledge of the usages of the Prophet, whether for his personal or for public use. These two kinds were a natural development. In the Moslem community there were from the first students of tradition proper whose interest lay in collecting, testing and transmitting, not in combining, systematizing and elucidating; whose preference was to take a single statement from the Prophet and apply it to a case, without reasonings or questionings. And there were students of canon law who were interested rather in the system and results, and who, while they used traditions, used them only to an end and insisted on the free application of speculative principles. The conflict of the future was to be between these traditionalists, on the one hand, and rationalists, on the other; and the result was to be a compromise.

With the wide sweep of Moslem conquest another element came into the development. This was Roman law, which the Moslem jurist found at work in the conquered Roman provinces and in the law courts of which they went to school. It is to be remembered that the Arab armies were not devastating hordes; they recognized the need of law and order wherever they went, and it was the policy of their leaders to take over the administrative systems of the countries which they seized. Even the Arabic legal nomenclature shows evident signs of literal translation from Latin, and many Moslem principles can be traced to the Roman codes. One important development was plainly influenced by the liberty involved in the *Responsa prudentium* of Roman lawyers, and by the broad conception of the law of nature in the Edict of the Praetor. In its earliest stages Moslem law recognized in the judge a liberty of opinion (*ra'y*) which went beyond even that of the *Responsa* and became plain equity, in the English sense, and one school (the Hanifite) established as a basis the right of preference (*istiḥsān*) even when the analogy of the code dictated otherwise; while another (the Malikite) used the term *istiṣlāḥ*, "a seeking of (general) benefit" to the community, in a similar situation. But these developments were bitterly contested, and the liberty of opinion was in the end narrowed down to a principle of analogy (*qiyās*), the nearest approach to which in Western law is legal fiction.

It is necessary now to return to the first successors of Mahomet. "For thirty years after my death," he is said to have declared, "my people will tread in my path (*sunna*); thereafter will come kings and princes." This tradition crystallizes the later feeling of Islam. The first thirty years were a golden age; the centre of the state was the Prophet's own city of Medina; the conditions of the state continued in close conformity to those of his own time. The study of tradition, *i.e.* of his usage, went hand in hand with the study of law. They were vital functions of the state, and it encouraged both.

Then came the great *débâcle*. The *ancien régime*, a semi-monkish, theocratic empire, went down, and the Omayyad dynasty, kings and princes of the old Arab type, took its place (see CALIPHATE, B). The public life of the state was no longer deeply religious; the pious said that it was godless. Under these conditions law was indeed still needed; but it had to be opportunist. Its development went on, but became speculative. The study of tradition was now private, and its students were more and more the personally pious. There were, thus, two results. On the one hand, the framers of systems of canon law—as it now was—no longer lived in contact with reality; hypothetical and ideal structures were reared which could never stand the touch of the practical law-court. And on another, traditions and law, even this hypothetical law, came to take separate roads. The interest of the students of tradition became the gathering of traditions for their own sake, going no farther than a striving to regulate each detail of life by some specific, concrete, prophetic dictum. They had no use for systems that went beyond the mere registering of these dicta. The feeling also became widespread that any system of government which did not simply reproduce the patriarchal form of Medina was of the world and the devil—a thing with which no religious man could have aught to do. At every turn he would have to peril his soul.

Here we must place the transition of this law with which we have hitherto dealt from being the law of the land to being in essence a variety of canon law. It was always broader than any western secular law. It regulated all the aspects of life—duty to God, to one's neighbour, to one's self. It was really a system of duties, ethical, legal, religious. It did not limit itself to defining the forbidden (*ḥarām*); but designated actions also as required (*farḍ*, *wājib*), recommended (*mandūb*, *mustaḥabb*), indifferent (*jā'iz*, *mubāḥ*), disliked (*makrūh*). It played the part of, or rendered necessary, a religious director quite as much as a lawyer. And for a time at Medina it was really the law of the land. But from the Omayyad period on it has held the position of the canon law of the Roman Church in countries that will not recognize it and yet dare not utterly reject it. It governs, in one or other of its four schools, the private lives of all pious Moslems, it regulates some semi-public relationships—*e.g.* marriage, divorce, inheritance; it compels respect, if not acceptance, from the state; and by its ideal standard the world, filled with righteousness by the Mahdi, will be ruled in the Moslem millennium.

The rise of the Abbasids brought a change, but not a great one. They had promised a return to the old religious attitudes, and the promise was formally kept. But in substance they were as much as the Omayyads, and though the state was outwardly on a pious footing, and the religious sentiment of the people was respected, the old, absolute canon law was not restored. It was made possible for more theologians and lawyers to work with the state, but an irreconcilable party still remained, and the situation was fixed as it is to this day. It is true that the struggle to adapt such a single and detailed system to all the varying conditions, climates and times of the great empire was impossible; but the failure marked the great rent in the supposed unity of Islam between the church and the world, religion and law.

Yet the Abbasids did, in their way, encourage legal studies, and under them processes and results, long pursued in private, became public. Almost within the first century of their dynasty the four legal schools, or rites, were formed and the principles established which survive to this day.

The first school to take definite form was the Hanifite, founded by Abū Ḥanīfa (d. 767), who left behind him a definite system and many enthusiastic pupils. He was a man of means, in touch with commercial, but not with practical legal life, a speculative or philosophical jurist. Being of non-Arab origin, the usage of Medina had small interest for him. He therefore used few traditions, and preferred to go back to the Koran, and extract from it by reasoning the rulings which fitted his ideas. This he called the use of analogy (*qiyās*); but, in his hands, it became practically legal fiction, the application of a law in some sense undreamed by its first imposer. But he had another, and still freer instrument. The effect of differences in local conditions had been early observed and admitted in general terms. Abū Ḥanīfa reduced it to a subjective formula. Under such conditions he claimed the right of preference (*istiḥsān*) of a ruling suited to the local needs, even when the strict analogy indicated otherwise. This met and meets with vehement protest when formally stated, but the usage of Islam has practically accepted it. His system, finally, was not developed through the exigencies of actual cases, but was worked out as a system of casuistry, though in a good sense. He tried, that is, to construct a system of rules to answer any conceivable question. After his death his pupils elaborated it still further, and accepted public office. The 'Abbāsids adopted his school, and threw their influence on its side; its philosophic breadth and casuistic possibilities evidently commended it to them. Later, the Ottoman Turks also adopted it, and it may be said to hold now a leadership among the four legal rites. Its influence has undoubtedly tended to broaden and humanize Moslem law.

Twenty-eight years after Abū Ḥanīfa, Malik ibn Anas, the founder of the Malikite school, died at Medina. In many points his situation was precisely opposite to that of Abū Ḥanīfa, and yet his results were very similar. He was a working jurist, in practical touch with actual life; he was in the centre of the tradition of the usage of the Prophet, in the line, one might say, of the apostolic succession. He, therefore, used traditions much more generally than did Abū Ḥanīfa, and when he, under pressure, took refuge in opinion, he certainly felt that he, under his conditions, had a better right to do so than any outsider. But two of his principles marked a distinct advance and showed that he was no mere traditionalist. For one, he laid down the conception of public advantage (*istiṣlāḥ*); when a rule founded on even a valid analogy would work a general injury it was to be set aside; justice must not be overcome by logic. And, for the other, he laid stress on the conception of the agreement (*ijmā'*), an idea which was to have indefinite importance in the future. When the surviving companions of the Prophet, after his death, agreed upon any point as belonging to their store of tradition and experience, their agreement was accepted as final. In the first instance they agreed that such had been the statement of the Prophet. That easily passed over into an agreement that such was the true Moslem view, and finally into an acceptance of the principle that the Moslem Church, when unanimous, could formulate truth—practically as in the canon of Vincent of Lérins, *Quod semper, quod ubique, quod ab omnibus*. But such a broadly catholic position was still in the future, and for Malik, juristic agreement meant the agreement of Medina, though there are signs that he permitted the same latitude to other places also. It was a way of allowing for local conditions rather than of reaching the voice of the Church. His law book, the *Muwaṭṭa'*, the earliest in our possession written by the founder of a school, has already been mentioned. It is a collection of about seventeen hundred traditions of juristic importance, arranged according to subject, with appended remarks on the usage of Medina and on his own view of each matter.

So far opinion and local usage had fully held their own, and the philosophical jurist had been free to work out his system. The difference between the *istiḥsān* of Abū Ḥanīfa and the *istiṣlāḥ* of

Malik was not great; students attended the lectures of both and combined their systems. But a reaction now began, and the traditionalist party finally made itself felt. We have the inevitable rivalry between the historical-empirical and the speculative-philosophical schools of jurisprudence, rendered all the more bitter in that the historical lawyers believed, in this case, that they were defending a divine institution. There resulted, first, one of the most important schools, the Shāfiʿite; secondly, an extremely literal school for which ash-Shāfiʿī did not go far enough, and which has now vanished; and thirdly, the Ḥanbalite school, still surviving in small numbers, more moderately traditional than the last.

The school founded by ash-Shāfiʿī (d. 820), a pupil of Malik, came first in order of time. The others were really revolts against the mildness of his compromise. His characteristics were a broad-minded, steady grasp of means and ends, a perception of what could and what could not be done, a willingness to admit all the tried principles in due balance, and, at one point especially, the insight of genius as to the possibilities of these principles. He laid great stress on tradition; a clear, authentic tradition he regarded as no less valid than the Koran itself. If the tradition was chronologically later than a Koranic passage and corrected that passage, he followed the tradition. But in this he was only regulating a fixed tendency. The Koran may be regarded theoretically as the first of all the sources of law and theology; practically its clear statements have been over-ridden in many cases. Most important of all, the principle of agreement (*ijmāʿ*) came finally with him to its full rights. The agreement of the Moslem peoples was to be the voice of God. "My people," said a tradition from Mahomet, "will never agree in an error." And so, over traditions and over the Koran itself, the agreement tacitly or explicitly ruled and rules. It stamps as authoritative that which the other principles lay down. At the head of each section of a Shāfiʿite law book we read, "The basis of this, before the agreement, is such and such." But with the aid of a principle of this breadth it was easy to reject the opinion which was so objectionable to the traditionalist party. In its place he took analogy (*qiyās*), which, discreetly used, could serve almost the same purpose. The Koranic passage or the tradition with which an analogy was suggested should, he taught, be examined to see if there was a reason clearly stated for the command. If so, that reason would give a basis for the analogy. Analogy based on the mechanical or external could not hold.

The four bases thus laid down by ash-Shāfiʿī—Koran; prophetic usage as expressed in traditions; analogy; agreement—have come to be accepted by all existing schools. This applies to all spheres of life, ethical, social, theological, legal, and it should never be forgotten that the Koran is only one of the sources for Moslem faith and conduct.

Few words are needed for the other, reactionary schools. One, now long extinct, was founded by a certain Dāʿūd uẓ-Ẓāhirī, "David the Literalist," born three or four years before the death of ash-Shāfiʿī, and so called because he insisted upon an absolutely literal interpretation of his texts—Koran or tradition—without account of context or metaphor. In consequence he had to reject analogy, and limited agreement to that of the companions of Mahomet; the Church of Islam was to have no constructive authority. In one point he showed great sanity of judgment, namely in his rejection of the principle *jurare in verba magistri*, otherwise regnant in Islam. His school had long and interesting consequences, mostly theological, but is now extinct, and never took rank with the others. The Moslem world found his positions too impossible, and now no one swears to his words. The other, the Ḥanbalite school, was founded by the scholars of Aḥmad ibn Ḥanbal after his death in 885. He himself would never have revolted against his master, ash-Shāfiʿī, but it was soon felt that his system, so far as he had any, was in essential opposition. He had been no lawyer, but a theologian and a collector and student of traditions. All his life had been a protest against speculation in divine things. Where the Koran and traditions were silent, he, too, had been silent. For this agnostic principle he had witnessed and suffered, and his standing with the people was that of a saint. Naturally, then, the last still existent school of traditionalist protest was launched in his name. It minimizes agreement and analogy, is literal in its interpretations, and is now by far the smallest of the four surviving schools. Its external history is that of a testifying and violent minority.

Other men, such as Ṭabarī, the historian and commentator, have had dreams that they, too, might join the Four Imāms (see Imām) as founders of legal rites, but none has succeeded. The Four remain the ultimate exponents of this canon law, and under the banner of one or other of them every Moslem must range himself. As there is a principle of unity in Islam, expressed in the alleged prophetic saying, "My people will never agree in an error," so there is a principle of variety, also expressed in an alleged prophetic saying, "The disagreement of my people is a mercy from God." The four rites may differ upon many points, yet the adherents of one never dream of regarding the adherents of the others as outside the Church of Islam; they are not "dissenters" in the English sense. God is merciful to his creatures, and gives them so much liberty of choice. Yet in practice this liberty is not great. The principle of swearing to the words of the master is a dead hand laid upon Islam. A man's legal rite is generally settled by the place and other conditions of his birth, and after he has once accepted a rite, he must, if good and pious, follow it in all its details. Only the avowed sceptic or the recognized eccentric can be an eclectic.

The geographical distribution of the rites is roughly as follows: Moslems in Central Asia and northern India and the Turks everywhere are Hanifites; in Lower Egypt, Syria, southern India and the Malay Archipelago they are Shāfiʿites; in Upper Egypt and in north Africa, west of Egypt, they are Malikites; only the Wahhābis (*q.v.*) in central Arabia are Ḥanbalites. But the will of the sovereign has also had a powerful influence and has frequently dictated the legal, as well as the theological, affiliations of his subjects. The Turks, for example, have thrown their weight almost everywhere on the Hanifite side. Their policy is to appoint only Hanifite judges (see Cadi), although for private and personal questions they appoint and pay Muftis (*q.v.*) of the other rites. In other cases, with a population of mixed legal adherence, the government has been known to appoint judges of different rites.

The Shīʿite canon law is dealt with separately, but some mention of two outstanding sects is here in place. The Ibāḍites (see Mahommedan Religion: *Sects*) have a system of canon law which in essentials is of older codification than that of any of the orthodox schools, going back to Abdallah ibn Ibāḍ himself, of the first century of the Hijra (Hejira). Its basis is above all the Koran, then a sparing use of traditions, natural to their early origin, and finally the agreement of their own learned men, again natural to an extreme dissenting sect, and it still rules the Ibāḍite communities at Oman, Zanzibar and the Mzab in southern Algeria. At all these places they, the last descendants of the Khārijites, hold severely apart, while the other Moslems shrink from them as heretics of the worst. Not nearly so far from ordinary Islam, but still of an extreme self-conscious Puritanism are the Wahhābis. They are really Ḥanbalites, but apply the rules of that school with uncompromising, reforming energy. The doctrine of the agreement of the Church of Islam they reject; only that of the immediate companions of Mahomet is valid. The people of Mahomet can err and has erred; each man must, on his own responsibility, draw his doctrine from the Koran and the traditions. Here they follow the Ẓāhirites.

All these schools of law administer a scheme of duties, which, as has already been remarked, comes nearest to the canon law of the Roman Church, and which for centuries has had only a partial connexion with the real legal systems of the Moslem peoples. Among the Wahhābis and Ibāḍites alone is it the whole of law. Elsewhere, since the Omayyad period, its courts have been in great part pushed aside by others, and its scheme has come to be regarded as an expression of impossible theory, to be realized at best with the coming of the millennium. The causes and methods of this change call now for detailed notice.

As Islam spread beyond the desert and the conditions in which the life of Mahomet and his companions had been cast, it came to regions, climates, customs, where the Arabian usages no longer held. Not only were the prescripts of Medina ill adapted to the new conditions; the new people had legal usages of their own to which they clung and which nothing could make them abandon. It was rather the Moslem leaders who were compelled to abandon their ideas and for the sake of the spread of Islam to accept and incorporate much that was diametrically opposed to the original legislation either of the Koran or of Mahomet's recorded decisons. As in religion the faiths of the conquered peoples were thinly veneered with Moslem phrases, so in law there grew up a customary code (*ʿādāt*) for each country, differing from every other, which often completely obscured and annulled the prescriptions of the canon law. The one was an ideal system, studied and praised by the pious, learned; the other was the actual working of law in the courts.

But besides the obstinate adherence of various peoples to their old paths, the will of individual rulers was a determining factor. When these ceased to be saints and students of divine things, and came to be worldly statesmen and opportunists, followers of their own objects and pleasures, no system could hold which set a limit to their authority. The Oriental ruler must rule and judge on his own initiative, and the schools of canon law tended to reduce everything to an academic fixedness. There thus arose a new and specific statute law, emanating from the sovereign. At first he judged in the gate as seemed good in his eyes and as was his right and duty (cf. "court of oppressions"; see Mahommedan Institutions); later, his will was codified as in the Turkish statute law (*qawānīn*) derived from various European codes. Thus there has grown up in almost every Moslem country at least two systems of courts, the one administering this canon law, and taking cognisance of private and family affairs, such as marriage, divorce, inheritance, its officials also giving rulings on purely personal religious questions, such as details of the ritual law, the law of oaths and vows, &c.; the other, the true law courts of the land, administering codes based on local custom and the decrees of the local rulers.

A rift almost as important entered the legal life of the Moslem lands on another side. Non-Moslem communities, settled in Moslem territory, have been uniformly permitted to administer and judge themselves according to their own customs and laws. Save when they come into direct contact and conflict with Moslems, they are left to themselves with a contemptuous tolerance. The origin of this attitude in Islam appears to be threefold: (i) The Islam of theory cannot conceive of a mixed state; it takes account, only, of a state containing none but Moslems, and its ideal is that the whole world will, in the end, form such a state. In practice, then, Moslems try to shut their eyes to the existence of non-Moslems in their midst and make no provision for them until compelled. That a non-Moslem should have the same civil position as a Moslem is unthinkable. (ii) This, of course, produces an attitude of extreme contempt. The only citizens are Moslems and all others are to be looked down upon and left to themselves. What they do or think among themselves does not matter; they are outside the ring-fence of Islam. (iii) A different, but equally important, cause is the Moslem indolence. When the Arabs conquered, they knew that they must administer the conquered lands, and they, very wisely, sought help from the machinery which they found in operation. But besides the ordinary organization of the state, they found also various ecclesiastical organizations, Christian and Jewish, and to these they gave over the administration of the non-Moslem sections of the community, making their rabbis and bishops their responsible heads and the links of contact with the Moslem rulers. They, unquestionably, found the same method in use by the Byzantine government; but in Moslem hands it went so far as to make a number of little states (*millet*, *milal*) within the state and effectually to preclude the possibility of ever welding all the inhabitants of the land into one corporate life.

But this indolence, when applied to resident aliens, had consequences still more serious, because external as well as internal. Following the same method of leaving the unbeliever to settle his affairs for himself, the European merchant, living and trading in the East, was put first by usage and finally by treaty under the jurisdiction and control of his own consul. Thus there grew up the extra-territorial law of the capitulations and conventions, by which the sanctity of the person and household of an ambassador is extended to every European. And this in turn, has reacted on the status of the non-Moslem subject races, and has come to be the indirect but chief support on which they lean. Through it, an element has developed which makes it practically impossible for a Moslem state to introduce legal changes even remotely affecting its non-Moslem population, alien or subject, without the consent of the European embassies. Any change may be upset by their refusal to accept it as incompatible with the capitulations and conventions. The embassies have thus, as interpreters of a part, at least, of the constitution, come to hold a position remarkably, if absurdly, like that of the Supreme Court of the United States (see Young, *Corps de droit Ottoman*, *passim*).

There may be said, then, in short, to be three elements in the legal life of a Moslem state: the sacred and fixed canon law of Islam; the civil law, based on the usages of the different peoples, Moslem and non-Moslem, and on statutes going back to the will of rulers; the international law of the capitulations, with a contractual sanction of its own. The hope for the future in Islam, there can be little doubt, lies in the principle of the agreement of the Moslem people, with its conception of catholic unity, and its ability, through that unity, to make and abrogate laws. As the Moslem peoples advance, their law can, thus, advance with them, and the grasp of the dead hand of the canon law be gradually and legally released.

See I. Goldziher, *Muhammedanische Studien*, I. and II. (Halle a.S., 1889–1890); *Zahiriten* (Leipzig, 1884); E. Sachau, *Zur ältesten Geschichte des muhammedanischen Rechts* (Vienna Akad., 1870) and *Muhammedanisches Recht* (Stuttgart and Berlin, 1897); Snouck Hurgronje, review of preceding in *Z.D.M.G.* liii. 125 seq. and "Le droit musulman" (*Rev. de l'hist. des religions*, xxxvii. 1 seq. and 174 seq.); Juynboll, *Handleiding tot de Kennis von de mohammedaansche Wet* (Leiden, 1903); Von Kremer, *Culturgeschichte des Orients unter den Chalifen*, i. 470 seq. (Vienna, 1875–1877); Hughes, *Dictionary of Islam*, pp. 285 seq. (London, 1896); D. B. Macdonald, *Development of Muslim Theology*, &c., pp. 65 seq. (New York, 1903); Bukhari, *Les Traditions islamiques traduites . . . par O. Houdas et W. Marcel* (Paris, 1906); N. B. E. Bailie, *Digest of Moohummadan Law* (2 vols., London, 1875–1887). A good bibliography appeared in the *Bulletin of the New York Public Library* for January 1907. (D. B. Ma.)

MAHOMMEDAN RELIGION. The Mahommedan religion is generally known as *Islam*—the name given to it by Mahomet himself—and meaning the resigning or submitting oneself to God. The participle of the same Arabic verb, *Muslim* (in English usually spelt Moslem), is used for one who professes this religion. The expression "Mahommedan religion" has arisen in the West probably from analogy with "Christian religion," but is not recognized as a proper one by Moslem writers. Islam claims to be a divinely revealed religion given to the world by Mahomet, who was the last of a succession of inspired prophets. Its *doctrine* and *practices* are to be found in (1) the Book of God—the Koran—which was sent down from the highest heaven to Gabriel in the lowest, who in turn revealed it in sections to Mahomet; (2) the collections of tradition (*ḥadīth*) containing the sayings and manner of life (*sunna*) of the Prophet; (3) the use of analogy (*qiyās*) as applied to (1) and (2); and (4) the universal consent (*ijmāʿ*) of the believers. The *worship* of Islam consists in (1) the recital of the creed; (2) the recital of the ordained prayers; (3) the fast during the month of Ramadhān; (4) almsgiving; (5) the *hajj*, the pilgrimage to Mecca. The *theology* of Islam finds its first public expression among the orthodox in the teaching of al-Ashʿarī (d. after 932), but had its real beginning among the sects that arose soon after the death of Mahomet.

Islam is the latest of the so-called world-religions, and as several of the others were practised in Arabia at the time of Mahomet, and the Prophet undoubtedly borrowed some of his doctrines and some of his practices from these, it is necessary to enumerate them and to indicate the extent to which they prevailed in the Arabian world.

Relations with Other Religions.—The religions practised in Arabia at the time of Mahomet were heathenism, Judaism, Christianity, and Zoroastrianism.

1. *Heathenism* was the religion of the majority of the Arabs. In the cities of south Arabia it was a survival from the forms represented in the Sabaean, Minaean and Himyaritic inscriptions of south Arabia (see Arabia: *Antiquities*). The more popular form current among the nomads is known very imperfectly from the remains of pre-Islamic poetry and such works as the *Kitāb ul-Aṣnām* contained in Yaqūt's geography, from Shahrastānī's work on the sects, and from the few references in classical writers. From these we have mostly names of local deities (cf. J. Wellhausen, *Reste arabischen Heidentums*, 2nd ed., Berlin, 1897) and ancient religious customs, which remained in part after the introduction of Islam (cf. W. Robertson Smith, *The Religion of the Semites*, Edinburgh, 1889, and *Kinship and Marriage in Early Arabia*, Cambridge, 1885). From these sources we learn that Arabian religion was a nature-worship associated with fetishism. Sun, moon and stars were worshipped, some tribes being devoted to the worship of special constellations. Certain stones, wells and trees were regarded as sacred and as containing a deity. Many (perhaps most) tribes had their own idols. Hobal was the chief god of the Kaʿba in Mecca with its sacred stone, but round him were grouped a number of other tribal idols. It was against this association (*shirk*) of gods that Mahomet inveighed in his attempt to unify the religion and polity of the Arabs. But there were features in this heathenism favourable to unity, and these Mahomet either simply took over into Islam or adapted for his purpose. The popularity of the Kaʿba in Mecca as a place of resort for worshippers from all parts of Arabia led Mahomet not only to institute the *hajj* as a duty, but also to take over the customs connected with the heathen worship of these visits, and later to make Mecca the *qibla*, *i.e.* the place to which his followers turned when they prayed. The name of Allah, who seems to have been the god of the Koreish (cf. D. S. Margoliouth, *Mohammed*, p. 19, London, 1905), was accepted by Mahomet as the name of the one God, though he abandoned the corresponding female deity Al-lāt.

2. *Judaism* had long been known in Arabia at the time of the Prophet. Whether Hebrews settled in Arabia as early as the time of David (cf. R. Dozy, *Die Israeliten zu Mecca*, Leipzig, 1864), or not, is of little importance here as Judaism cannot be said to have existed until the end of the 5th century B.C. The Seleucid persecutions and the political troubles that ended with the fall of Jerusalem (A.D. 70) probably sent many Jews to Arabia. In the 5th and 6th centuries the history of south Arabia and of Nejrān is largely that of the strife between Jews and Christians. In the north-west the Jews possessed Temā, Khaibar, Yathrib (Medina), Fadak, and other smaller settlements. In these they lived as self-contained communities, not seeking to proselytize but working at their trades, especially concerned with money and jewelry. Mahomet seems to have expected their help in his proclamation of monotheism, and his first *qibla* was Jerusalem. It was only when they refused to accept him as prophet that he turned in anger against them. They had, however, supplied him with much material from the Old Testament, and the stories of creation, the patriarchs and early kings and prophets occur continually in the Koran, told evidently as they were recited by the common people and with many mistakes caused by his own misunderstanding.

3. *Christianity*, though later than Judaism, had a sure footing in Arabia. It had suffered persecution in Nejrān and had been supported in the south by the Abyssinian invasions. The kingdom of Hira was largely Christian; the same is true of the north Arabian tribes of Bakr and Taghlib, and east of the Jordan and on the Syrian boundary as well as in Yemāma Christianity had made progress. Pre-Islamic literature contains many allusions to the teaching and practices of Christianity. Of the time of its introduction little is known; little also of the form in which it was taught, save that it came from the Eastern Church and probably to a large extent through Monophysite and Nestorian sects. Tradition says that Mahomet heard Christian preaching at the fair of Ukaz, and he probably heard more when he conducted the caravans of Khadija. Gospel stories derived apparently from uncanonical works, such as the Gospel of the Nativity, occur in the Koran. The asceticism of the monks attracted his admiration. A mistaken notion of the Trinity was sharply attacked by him. It is curious that his followers in the earliest times were called by the heathen Arabs, Sabians (*q.v.*), this being the name of a semi-Christian sect. In the time of the Omayyads Christianity led to some of the earliest theological sects of Islam (see below).

4. *Zoroastrianism* was known to the Arab tribes in the north-east, but does not seem to have exercised any influence in Mecca or Medina except indirectly through Judaism in its angelology. As soon, however, as the armies of Islam conquered Mesopotamia it began to penetrate the thought and practices of Islam (see below).

Sources of Authority.—Islam, as we have said, is founded on: (1) the Koran; (2) the tradition or rather the *sunna* (manner of life of Mahomet) contained in the tradition (*Ḥadith*); (3) *ijmā'*; the universal agreement; (4) *qiyās* (analogy).

1. The *Koran*[1] (properly *Qur'ān* from *qara'a* to collect, or to read, recite) is the copy of an uncreated original preserved by God (see below), sent down from the seventh heaven to Gabriel in the first heaven, and revealed to Mahomet in sections as occasion required. These revelations were recited by the Prophet and in many cases written down at once, though from ii. 100 it would seem that this was not always the case. God is the speaker throughout the revelations. It seems probable that the whole Koran was written in Mahomet's lifetime, but not brought together as a whole or arranged in order.

As it exists now the Koran consists of 114 chapters called *suras* (from *sura*, a row of bricks in a wall, a degree or step). The first is the *Fātiḥa* (opening), which occupies the place of the Lord's Prayer in Christianity. The others are arranged generally in order of length, the longest coming first, the shortest (often the earliest in date) coming at the end. Certain groups, however, indicated by initial unvowelled letters, seem to have been kept together from the time of the Prophet. At the head of each *sura* is a title, the place of its origin (Mecca or Medina) and the number of its verses (*āyāt*) together with the formula, "In the name of God the Merciful, the Compassionate" (except in *sura* 9). For liturgical purposes the whole book is divided into 60 sections (*aḥzāb*) or into 30 divisions (*ajzā*), each subdivided into a number of prostrations (*ruk'a* or *sajda*). The origin of the collected and written Koran is due to Omar, who in the caliphate of Abū Bekr pointed out that many possessors of *suras* were being slain in the battles of Islam and their property lost, that there was a danger in this way that much of the revelation might disappear, and that men were uncertain what was to be accepted as genuine revelation. Accordingly Zaid ibn Thābit who had been secretary to Mahomet, was commissioned to collect all he could find of the revelation. His work seems to have been simply that of a collector. He seems to have done his work thoroughly and made a copy of the whole for Abū Bekr. The collection was thus chiefly a private matter, and this copy passed after Abū Bekr's death into the hands of Omar, and after his death to Ḥafṣa, daughter of Omar, a widow of Mahomet. In the caliphate of Othman it was discovered that there were serious differences between the readings of the Koran possessed by the Syrian troops and those of the Eastern soldiers, and Othman was urged to have a copy prepared which should be authoritative for the Moslem world. He appointed Zaid ibn Thābit and three members of the tribe of Koreish (Quraish) to do the work. Each of these made a copy of Abū Bekr's collection, carefully preserving Koreishite forms of words. How far the text was amended by the help of other copies is doubtful; in any case the mode of procedure was undoubtedly very conservative. The four similar manuscripts were sent, one each to Medina, Cufa (Kufa), Basra and Damascus, and an order was issued that all differing copies should be destroyed. In spite of the personal unpopularity of Othman this recension was adopted by the Moslem world and remains the only standard text. A few variant readings and differences of order of the *suras* in the collections of Ubay ibn Ka'b and of Ibn Mas'ūd were, however, known to later commentators. The only variants after the time of Othman were owing to different possible ways of pronouncing the consonantal text. These are usually of little importance for the meaning. As the text is now always vowelled, variations are found in the vowels of different copies, and the opinions of seven leading "readers" are regarded as worthy of respect by commentators (see Th. Nöldeke, *Geschichte des Qorāns*, pp. 279 seq., Göttingen, 1860). Various characteristics enable one to establish with more or less certainty the relative chronological order of the *suras* in the Koran, at any rate so far as to place them in the first or second Meccan period or that of Medina. The form of the sentences is a guide, for the earliest parts are usually written in the *saj'* form (see ARABIA: *Literature*). The expressions used also help; thus the "O ye people" of the Meccan period is replaced in the Medina *suras* by "O ye who believe." The oaths in the first Meccan period are longer, in the second shorter, and are absent in the Medinan. In the earliest period the style is more elevated and passionate. Occasionally the time of origin is determined by reference to historical events. In accordance with such principles of criticism two leading scholars, Nöldeke (*loc. cit.*) and H. Grimme (in his *Mohammed Zweiter Teil. Einleitung in den Koran. System der koranischen Theologie*, Münster, 1895), have arranged the *suras* as follows:—

Order of Suras in Koran.

NÖLDEKE.	
Mecca.	
1st to 5th yr. (*a*).	96. 74. 111. 106. 108. 104. 107. 102. 105. 92. 90. 94. 93. 97. 86. 91. 80. 68. 87. 95. 103. 85. 73. 101. 99. 82. 81. 53. 84. 100. 79. 77. 78. 88. 89. 75. 83. 69. 51. 52. 56. 70. 55. 112. 109. 113. 114. 1.
5th and 6th yr. (*b*).	54. 37. 71. 76. 44. 50. 20. 26. 15. 19. 38. 36. 43. 72. 67. 23. 21. 25. 17. 27. 18.
7th yr. to Flight (*c*).	32. 41. 45. 16. 30. 11. 14. 12. 40. 28. 39. 29. 31. 42. 10. 34. 35. 7. 46. 6. 13.
Medina.	2. 98. 64. 62. 8. 47. 3. 61. 57. 4. 65. 59. 33. 63. 24. 58. 22. 48. 66. 60. 110. 49. 9. 5.
GRIMME.	
Mecca. (1).	[1] In old *saj'* form: 111. 107. 106. 105. 104. $\underline{103}$. 102. 101. 100. 99. 108. 96. 95. 94. 93. 92. 91. 90. 89. 88. $\underline{87}$. 86. $\underline{85}$. $\underline{84}$. 83. 82. $\underline{81}$. 80. 79. $\underline{78}$. 77. $\underline{76}$. 75. $\underline{74}$. $\underline{73}$. 70. 69. 68. 114. 113. 56. 55. 54. $\underline{53}$. 52. 51. 50. 15. $\underline{22}$. $\underline{14}$.
(2).	In loosened *saj'* form: 46. 72. 45. 44. 41. 97. 40. 39. 38. 37. 36. 35. 34. 32. 31. 67. 30. $\underline{29}$. 28. 27. 26. 71. 25. 20. 23. 43. 21. 19. 1. 42. $\underline{18}$. 17. $\underline{16}$. 13. 12. 11. 10. $\underline{7}$. 6. 98. (112. 109).
Medina.	
From the Flight to Badr.	$\underline{2}$. 62. $5_{15-88 \cdot 108-120}$. 47 and some interpolations in Meccan *suras*.
From Badr to Ohod	8. 24. 59.
From Ohod to capture of Mecca.	3. 29_{1-12}. 4. 57. 64. 61. 60. 58. 65. 33. 63. 49. 110. 48. 5_{1-14}. 66. 9_{1-24}.
After capture of Mecca.	9_{25-124}.

Theology.

On the supposition that the arrangements given above are at any rate approximately correct, it is possible to trace a certain development in the teaching of the Koran on some of the chief dogmas. It must, however, be borne in mind that orthodox Islam recognizes the Koran as the work not of Mahomet but of God. Yet Moslem theologians recognize that some revelations are inconsistent with others, and so have developed the doctrine of *nāsikh* and *mansūkh* ("abrogating" and "abrogated"), whereby it is taught that in certain definite cases a later revelation supersedes an earlier. A critical study of the Koran shows in the earlier revelations the marks of a reflective mind trained under the influence of Arabian education and stirred by an acquaintance (somewhat imperfect) with Judaism and Christianity. The later revelations seem to be influenced by the now dominant position of the Prophet and a desire after the capture of Mecca to incorporate such heathen religious ceremonies as are national. God is one and universal from the beginning. His unity is emphasized as against the mistaken conception of the Christian Trinity. At first his might is taught by the name *Rabb* (Lord) which is generally used with an attribute as "the highest Lord," "Lord of the worlds," "Lord of men," "Lord of heaven and earth," "Lord of the East and West," or "our Lord." Then he is identified with the god Allah (see above) and the first part of the later Moslem creed is announced—*la ilaha illa-llaha*, "there is no god but Allah." But every act of creation is a proof not only of God's power but also of his beneficence (xiv. 37), and so he becomes known as *ar-Raḥmān*, "the Compassionate." The attributes of God may all be arranged in the three classes of his power, unity and goodness. They are expressed by the ninety-nine "beautiful names" applied to him in the Koran (see E. H. Palmer, *The Quran* in "Sacred Books of the East," vol. vi., Introd. pp. 67–68, Oxford, 1880). In the Medina period of Mahomet's life the nature of God is not so clear, and the description of it varies according to the moods of the Prophet.

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[1] See also KORAN.

[1] Underlined = with interpolations.

Spirits.

Beside God are two other uncreated beings: (1) the original of the Koran, the "mother of the Book" (xliii. 3) on a "preserved tablet" (*lauḥ maḥfūẓ*) (lxxxv. 22), in accordance with which God acts, and (2) the throne (*kursī*) (ii. 256). When the heavens are created, God sits on his throne in the seventh heaven; around him are angels, pure, sexless beings, some of whom bear the throne, while some are engaged in praising him continually. They are also his messengers and are sent to fight with the believers against the heathen. Some are the guardian angels of men, others are the watchmen of hell. Mediate beings between God and man are the "word" (*amr*) and from it the "spirit" (*rūḥ*) or "holy spirit" (*rūḥ ul-qudus*). Another manifestation of God to the believers only is the "glory" (*sakīna*).

Cosmology.

God created the world in six days according to the plan of the Book. Each new life was created by God's breathing into it a soul. The duality of soul and body is maintained. In each man is a good and a bad impulse. The bad impulse which was latent in Adam was roused to action by Satan (*Iblīs*). Adam by his fall lost the grace of God, which was restored to him solely by the gracious choice of God. Between men and angels in their nature are the genii (*jinn*) male and female, inhabitants of desert places, created from smokeless fire. They had been accustomed to spy round heaven, but in Mahomet's time could learn no more of its secrets. Some of them were converted by the Prophet's teaching. Lowest of creation in his estate is Satan (*Shaiṭān*), who was an angel but was expelled from heaven because he refused to worship Adam at his Lord's command. God has revealed himself to man by (1) writing (*kitāb*), and (2) prophets. As he had given to the Jews the Law (*Taurāt*) and to the Christians the Gospel (*Injīl*) so he revealed to Mahomet the Koran (Qur'ān, known also by other names, *e.g. al-Furqān*, *at-Tafṣīl*, &c.), each single revelation being called an *aya*. With his revelation God has also sent an apostle or prophet to each people. Several of these are mentioned in the Koran, Moses the prophet of the Jews, Jesus (*Īsā*) that of the Christians. Mahomet is not only the apostle of the Moslems but the "seal of the prophets," *i.e.* the final member of the class. His mission at first was to warn men of imminent judgment. Later he became more of a teacher. At first he seems to have relied for the salvation of men on his natural faculties, but later announced the doctrine of God's election.

Ethics.

The ethics of the Koran are based on belief (*imān*) and good works, the latter alone occurring in the early Meccan *suras*. Fear of the judgment of God was a motive of action; this is followed by repentance and turning to God. A complete surrender to God's will (*islām*) is the necessary condition of religious life and is expressed in the phrase so common in everyday speech among the Moslems—*inshallah*, "if God will." God has full power to overlook evil deeds if he will. Unbelievers can acquire no merit, however moral their actions. A short account of the chief ethical requirements of the Koran is given in xvii. 23–40:—

> "Put not God with other gods, or thou wilt sit despised and forsaken. Thy Lord has decreed that ye shall not serve other than Him; and kindness to one's parents, whether one or both of them reach old age with thee, and say not to them, 'Fie,' and do not grumble at them, but speak to them a generous speech. And lower to them the wing of humility out of compassion, and say, 'O Lord! have compassion on them as they brought me up when I was little!' Your Lord knows best what is in your souls if ye be righteous, and, verily, He is forgiving unto those who come back penitent.
>
> "And give thy kinsman his due and the poor and the son of the road; and waste not wastefully, for the wasteful were ever the devil's brothers, and the devil is ever ungrateful to his Lord.
>
> "But if thou dost turn away from them to seek after mercy from thy Lord, which thou hopest for, then speak to them an easy speech.
>
> "Make not thy hand fettered to thy neck, nor yet spread it out quite open, lest thou shouldest have to sit down blamed and straightened in means. Verily, thy Lord spreads out provision to whomsoever He will or He doles it out. Verily, He is ever well aware of and sees His servants.
>
> "And slay not your children for fear of poverty; we will provide for them; beware! for to slay them is ever a great sin.
>
> "And draw not near to fornication; verily, it is ever an abomination, and evil is the way thereof.
>
> "And slay not the soul that God has forbidden you, except for just cause; for he who is slain unjustly we have given his next of kin authority; yet let him not exceed in slaying; verily, he is ever helped.
>
> "And draw not near to the wealth of the orphan, save to improve it, until he reaches the age of puberty, and fulfil your compacts; verily, a compact is ever enquired of.
>
> "And give full measure when ye measure out, and weigh with a right balance; that is better and a fairer determination.
>
> "And do not pursue that of which thou hast no knowledge; verily, the hearing, the sight and the heart, all of these shall be enquired of.
>
> "And walk not on the earth proudly; verily, thou canst not cleave the earth, and thou shalt not reach the mountains in height.
>
> "All this is ever evil in the sight of your Lord and abhorred."
>
> (E. H. Palmer's translation.)

Eschatology.

The eschatology of the Koran is especially prominent in its earlier parts. The resurrection, last judgment, paradise and hell are all described. At death the body again becomes earth, while the soul sinks into a state of sleep or unconsciousness. At a time decreed, known as "the hour" (*as-Sa'a*), "the day of resurrection" (*yaum ul-qiyyāma*), "day of judgment" (*yaum-ud-dīn*), &c., an angel will call or will sound a trumpet, the earth will be broken up, and the soul will rejoin the body. God will appear on his throne with angels. The great book will be opened, and a list of his deeds will be given to every man, to the good in his right hand, to the evil in his left (*sura* 69). A balance will be used to weigh the deeds. The *jinn* will testify against the idolaters. The righteous will then obtain eternal peace and joy in the garden (*al-janna*) and the wicked will be cast into the fiery ditch (*Jahannam*), where pains of body and of soul are united.

2. The *Tradition.*—The revelation of God is twofold—in a writing and by a prophet. The former was contained in the Koran, the latter was known from the actions of Mahomet in the different circumstances of life. The manner of life of the Prophet (*sunna*) was contained in the tradition (*al-ḥadith*). The information required was at first naturally obtained by word of mouth from the companions and helpers of Mahomet. These in turn bequeathed their information to their younger companions, who quoted traditions and gave decisions in their names.

For long these traditions circulated orally, the authority of each depending on the person who first gave it and the reliability of the chain (*isnād*) of men who had passed it on from him. At first this tradition was regarded as explanatory of, or at the most supplementary to, the teaching of the Koran. Early Moslem teachers pointed to the Jews as having two law-books—the *Taurāt* and the *Mishna*—while Islam had only one—the Koran. But opinion changed, the value of tradition as an independent revelation came to be more highly esteemed until at last it was seriously discussed whether a tradition might not abrogate a passage of the Koran with which it was at variance. The writing of traditions was at first strongly discouraged, and for more than a century the stories of the Prophet's conduct passed from mouth to mouth. Had all the narrators been pious men, this might have been tolerable, but this was not the case. The Omayyad dynasty was not a pious one. Men who were not religious but wished to appear so invented traditions to justify their manner of life. The sectarians did not hesitate to adopt the same means of spreading their own teaching. Many Moslem writers testify to the fact that forged traditions were circulated, and that religious opinion was confused thereby. The need for some sort of authoritative collection seems to have been felt by the one pious Omayyad caliph, Omar II. (717–720), who is said to have ordered Ibn Shihāb uz-Zuhrī to make such a collection. Of this work, if it was carried out, we know nothing further. It was, however, by a man born during this reign that the first systematic collection of traditions was made—the *Muwatta*ʽ of Mālik ibn Anas (*q.v.*). Yet this work is not a book of tradition in the religious sense. It is really a *corpus juris* and not a complete one. The object of Mālik was simply to record every tradition that had been used to give effect to a legal decision. The work of sifting the vast mass of traditions and arranging them according to their relation to the different parts of religious life and practice was first undertaken in the 3rd century of Islam (A.D. 815–912). In this century all the six collections afterwards regarded as canonical by the Sunnites (orthodox) were made. By this time an immense number of traditions was in circulation. Bukhārī in the course of sixteen years' journeying through Moslem lands collected 600,000, and of these included 7275 (or, allowing for repetitions, 4000) in his work. The six collections of tradition received by the Sunnites as authoritative are: (i) The *Kitāb ul-jāmiʽ uṣ-Ṣaḥīḥ* of Bukhārī (*q.v.*) (810–870). This is the most respected throughout the Moslem world and most carefully compiled (ed. L. Krehl and T. W. Juynboll, Leiden, 1862—and frequently in the East; also with many commentaries. French translation by O. Houdas and W. Marcais, Paris, 1903 sqq.). (ii) The *Ṣaḥīḥ* of Muslim (817–875) with an introduction on the science of tradition (ed. Calcutta, 1849, &c.). (iii) The *Kitāb uṣ-Sunan* of Abū Dāʽūd (817–888) (ed. Cairo, 1863, Lucknow, 1888, Delhi, 1890). (iv) The *Jāmiʽ uṣ-Ṣaḥīḥ* of Tirmidhī (*q.v.*). (v) The *Kitāb uṣ-Sunan* of Nasāʽī (830–915) (ed. Cairo, 1894). (vi) The *Kitāb uṣ-Sunan* of Ibn Māja (824–866) (ed. Delhi, 1865 and 1889). The last four are not held in the same repute as the first two.

3. *Ijmā*ʽ is the universal consent which is held to justify practices or beliefs, although they are not warranted by the Koran or tradition, and may be inconsistent with the apparent teaching of one or both of these. These beliefs and practices, which had often come from the pre-Islamic customs of those who had become believers, seem to have escaped notice until the Abbasid period. They were too deeply rooted in the lives of men to be abolished. It became necessary either to find a tradition to abrogate the earlier forbidding one, or to acknowledge that *ijmā*ʽ is higher than the tradition. The former expedient was resorted to by some later theologians (*e.g.* Nawāwī) by a fiction that such a tradition existed though it was not found now in writing. But in earlier times some (as Ibn Qutaiba) had adopted the latter alternative, saying that the truth can be derived much earlier from the *ijmā*ʽ than from the tradition, because it is not open to the same chances of corruption in its transmission as the latter. Tradition itself was found to confirm this view, for the Prophet is related to have said, "My people does not agree to an error."

But *ijmā*ʽ itself has been used in different senses: (i) The *ijmā*ʽ of Medina was used to indicate the authority coming from the practices of the people of Medina (see below). (ii) The *ijmā*ʽ of the whole community of Moslems is that most commonly recognized. It was used to support fealty to the Abbasid dynasty. By it the six books of tradition mentioned above are recognized as authoritative, and it is the justification of the conception of Mahomet as superhuman. (iii) Some of the more thoughtful theologians recognize only the *ijmā*ʽ of the doctors or the teachers of Islam (the *mujtahidūn*), these being restricted by the orthodox to the first few generations after Mahomet, while the Shiʽites allow the existence of such up to the present time.

4. The fourth basis of Islam is *qiyās*, *i.e.* analogy. It is that process by which a belief or practice is justified on the ground of something similar but not identical in the Koran, the tradition or *ijmā*ʽ. Originally it seems to have been instituted as a check upon the use of private opinion (*ra'y*) in the teaching of doctrine. The extent to which it may be used is a subject of much discussion among theologians. Some would apply it only to a "material similarity," others to similarity of motive or cause as well.

Worship and Ritual.—The acts of worship required by Islam are five in number: (i) the recital of the creed; (ii.) observance of the five daily prayers; (iii) the fast in the month of Ramadhān; (iv) giving of the legal alms; (v) the pilgrimage to Mecca.

Creed.

i. The creed is belief—"la ilaha illa-llahu, Muḥammad rasūl allahi," "there is no god but God (Allah), Mahomet is the apostle of God." It is required that this shall be recited at least once in a lifetime aloud, correctly, with full understanding of its meaning and with heartfelt belief in its truth. It is to be professed without hesitation at any time until death.

Prayer.

ii. Every man who professes Islam is required in ordinary life to pray five times in each day. In the Koran these prayers are commanded, though four only are mentioned. "Wherefore glorify God, when the evening overtaketh you, and when ye rise in the morning, and unto Him be praise in Heaven and earth; and in the evening and when ye rest at noon" (xxx. 16–17), but commentators say the "evening" includes the sunset and after sunset. The five times therefore are: (1) Dawn or just before sunrise, (2) just after noon, (3) before sunset, (4) just after sunset, and (5) just after the day has closed. Tradition decides within what limits the recitals may be delayed without impairing their validity. Prayer is preceded by the lesser ablution (*wadū*) consisting in the washing of face, hands (to the elbows) and feet in prescribed manner. Complete washing of the body (*ghusl*) is required only after legal pollution. In prayer the worshipper faces the *qibla* (direction of prayer), which was at first Jerusalem, but was changed by the Prophet to Mecca. In a mosque the *qibla* is indicated by a niche (*miḥrab*) in one of the walls. The prayers consist of prescribed ejaculations, petitions, and the recital of parts of the Koran, always including the first *sura*, accompanied by prostrations of the body. Detailed physical positions are prescribed for each part of the worship; these vary slightly in the four orthodox schools (see below). On a journey, in time of war or in other special circumstances, the set form of prayers may be modified in accordance with appointed rules. Besides these private prayers, there is the prayer of the assembly, which is observed on a Friday (*yaum ul-jamʽa*, "the day of assembly") in a mosque, and is usually accompanied by an address or declamation (*khutba*) delivered from a step of the pulpit (*minbar*). Special prayers are also prescribed for certain occasions, as on the eclipse of the sun or the moon, &c. Among the Sūfis special attention is given to informal prayer, consisting chiefly in the continual repetition of the name of God (*dhikr*) (see SUFIʽISM). This is still a characteristic of some of the dervish (*q.v.*) communities.

Fasting.

iii. The command to fast begins with the words, "O ye who believe! There is prescribed for you the fast, as it was prescribed for those before you." The expression "those before you" has been taken to refer to the Jews, who fasted on the day of atonement, but more probably refers to the long fast of thirty-six days observed by the Eastern Christians. In the passage of the Koran referred to (ii. 179–181) Moslems are required to fast during the month of Ramadhān, "wherein the Koran was revealed," but if one is on a journey or sick he may fast "another number of days," and if he is able to fast and does not, "he may redeem it by feeding a poor man," but "if ye fast, it is better for you." This fast was probably instituted in the second year at Medina. At that time the corrected lunar year was in use and Ramadhān, the ninth month, was always in the winter. A few years later Mahomet decreed the use of the uncorrected lunar year, which remains the standard of time for the Moslem world, so that the month of fasting now occurs at all seasons of the year in turn. The fast is severe, and means entire abstinence from food and drink from sunrise to sunset each day of the month. The fast is associated with the statement that in this month God sent down the Koran from the seventh heaven to Gabriel in the lowest that it might be revealed to the Prophet.

Alms.

iv. Alms are of two kinds: (1) the legal and determined (*zakāt*), and (2) voluntary (*ṣadaqāt*). The former were given in cattle, grain, fruit, merchandise and money once a year after a year's possession. For cattle a somewhat elaborate scale is adopted. Of grain and fruit a tenth is given if watered by rain, a twentieth if the result of irrigation. Of the value of merchandise and of money a fortieth is prescribed. In the early days of Islam the alms were collected by officials and used for the building of mosques and similar religious purposes. At the present time the carrying of these prescriptions is left to the conscience of the believers, who pay the alms to any needy fellow-Moslem. A good example of a *ṣadaqā* is found in a gift to an unbeliever (see C. M. Doughty, *Arabia deserta*, i. 446, ii. 278, Cambridge, 1888).

Pilgrimage.

v. The fifth religious duty of the Moslem is the pilgrimage (*hajj*) to Mecca, which should be performed once by every Moslem "if he is able," that is if he can provide or obtain the means to support himself on pilgrimage and his family during his absence, and if he is physically capable. The pilgrimage is made at one time of the (Moslem) year, namely, from the 7th to the 10th of the month Dhu'l-Hijja. For the arrangements for the journey from various countries to Mecca see CARAVAN. When the pilgrim arrives within five or six miles of the holy city he puts off his ordinary dress after ablution and prayer, and puts on the two seamless wrappers which form the dress of the pilgrim (the *ihrām*), who goes without head-covering or boots or shoes. He must not shave at all, or trim the nails or anoint the head during the ceremonial period. The chief parts of the ceremonial are the visit to the sacred mosque *masjīd ul-ḥarām*), the kissing of the black stone, the compassing of the Ka'ba (the *Ṭawāf*) seven times, three times running, four times slowly, the visit to the Maqām Ibrahīm, the ascent of Mount Ṣafā and running from it to Mount Marwa seven times, the run to Mount 'Arafāt, hearing a sermon, and going to Muzdalifa, where he stays the night, the throwing of stones at the three pillars in Minā on the great feast day, and the offering of sacrifice there (for the localities see MECCA). After the accomplishment of these ceremonies the ordinary dress is resumed, the pilgrimage is finished, but the pilgrim usually remains another three days in Mecca, then visits Medina to pay his respects to the tomb of Mahomet. Beside the *hajj* (great pilgrimage) Islam also recognizes the merit of the *'umra* (or lesser pilgrimage), *i.e.* a religious visit to Mecca at any time accompanied by most of the ceremonies of the *hajj*.

The ceremonies of the *hajj* have been described by several European travellers who have witnessed them, such as J. L. Burckhardt in 1814, Sir Richard Burton in 1853 (see bibliography to MECCA). A concise account of them is given in T. P. Hughes, *Notes on Muhammadanism* (3rd ed., London, 1894). Details in vol. i. of Bukhārī's traditions (Houdas and Marcais's French translation, i. 493–567).

The Development of Islam.—The battle of Siffīn (657) between 'Ali and Moawiya was the occasion of the first breach in the unity of Islam, and the results remain to this day. The occasion was in the first case political, but politics were at that time too intimately connected with religion to be considered apart from it. After the battle (see CALIPHATE) 'Alī was practically compelled to submit his claims to arbitration, whereupon a number of his supporters broke away from him, saying that there should have been no appeal save to the Book of God. These men were for the most part country Arabs, and, inspired by the free spirit of the desert, were democratic, claiming that the caliph should be elected by the whole community from any family (and not from the Koreish alone), and that the caliph might be deposed for sin. A few extremists were republicans and would do without a caliph altogether. The whole party was known as the Khārijites (Khārijiyya or Khawārij). The Moslems who disagreed with them were regarded by them as renegades and were to be put to death. They were soon divided into extremists and moderates. The former put to death the children of unbelievers and refused to hold intercourse in daily life with unbelievers. The moderates, who came to be known as Ibadites (from their leader 'Abdallah ibn 'Ibād), would allow the children of unbelievers to grow up, and would then deal with them according to their choice. In ordinary life they would mix with all men, but marriage with other Moslems outside their own ranks was forbidden. These still remain in Oman, parts of Algeria and East Africa.

Another party, consisting mainly of city Arabs infected with Persian ideas as to the divinity of the ruler, clung to 'Alī with inconvenient affection. They regarded 'Alī and his descendants as the only legitimate caliphs, and came to be known as Shi'ites (*q.v.*). They remain to-day the largest part of Islam outside orthodoxy. During the Omayyad caliphate (661–750) there were three centres of religious thought and influence; students and teachers often passed from one to the other, thus making universal the teachings which in their origin were due to local circumstances. These centres were Damascus (the seat of the caliphate), Medina and the East (Irak, &c.). In Damascus the court was worldly and indifferent to the interests of Islam. The early Omayyads were distinguished for their striving after dominion (*mulk*). Instead of attempting to propagate Islam, they tolerated other religions and favoured Christians who were distinguished as poets (*e.g.* Akhtal) or officials (John of Damascus), or men likely to be of use to them in any way. The doctrines of Christianity began to influence even serious Moslems and to affect their way of stating Moslem belief. John of Damascus (d. before 767), the Greek theologian, and his pupil, Theodorus Abucara (d. 826), have written controversial works on Islam, from which it seems probable that disputations on subjects pertaining to religion were held between Christians and Moslems. Two schools of heretical Moslem sects arose under these influences—that of the Murjiites and that of the Qadarites. The Murjiites (" postponers ") were so called because they postponed the judgment of human actions until the Day of Judgment. In politics they accepted the Omayyads as *de facto* rulers, since they were Moslems, and left the judgment of their actions to God. As theologians they taught that religion consists in belief (*imān*) in the unity of God and in his apostle, and in that alone, consequently no one who held this faith would perish eternally, though he had been a sinner. This was opposed to the Khārijite doctrine that the unrepentant sinner would perish eternally, even though he had professed Islam.

The Qadarites were concerned with the doctrine of predestination and free-will. So long as Moslems were fighting the battles of Islam they naturally paid most attention to those revelations which laid stress on the absolute determination of a man's destiny by God. They fought with great bravery because they believed that God had foreordained their death or life and they could not escape His will. In the quieter realm of town and court life and in their disputations with Christians they were called upon to reconcile this belief with the appeals made in the Koran to man's own self-determination to good, to courage, &c. Mahomet was not a systematic theologian and had done nothing to help them. The Qadarites declared that man had power over his own actions. But the teaching of predestination had gained too great a hold on Moslems to be thus displaced. The teaching of the Qadarites was held to be heresy, and one of its first professors, Ma'bad ul-Juhānī, was put to death in 699.[1] During this period Medina was the home of tradition. Those who had been in closest relation with the Prophet dwelt there. The very people of the city derived a certain splendour and authority from the fact that Mahomet had lived and was buried there. Free thought in religion had little chance of arising, less of expressing itself, in the holy city. But the Koran was diligently studied, traditions were collected (and invented) though not yet written in books, and innovation (*bid'a*) was resolutely avoided. At the same time it really did contribute a new element to religious practice, for the custom (*ijmā'*, see above) of Medina gained a certain authority even in Syria and the East.

In the East, on the other hand, there was more mental activity, and the religious teachers who came from Medina had to be prepared to meet with many questions. The wits of the Moslems were sharpened by daily contact with Christians, Buddhists, Manichaeans and Zoroastrians. Ḥasan ul-Baṣrī (*q.v.*), who has been claimed as one of the first mystics, also as one of the first systematic theologians of Islam, was remarkable alike for his personal piety and his orthodoxy. Yet it was among his pupils that the great rationalist movement originated. Its founder was Wāṣil ibn 'Atā, who separated himself (whence his followers were called Motazilites, strictly Mu'tazilites, " Separatists ") from his teacher and founded a school which became numerous and influential. The Mu'tazilites objected to the attributes of God being considered in any way as entities beside God; they explained away the anthropomorphisms used in speaking of the deity; they regarded the Koran as created and as a product of Mahomet writing under the divine influence. Briefly, they asserted the supremacy of reason (*'aql*) as distinct from faith received by tradition (*naql*). They also called themselves " the people of justice and unity " (*Ahl ul-'adl wat-tauḥīd*). Such a faith as this naturally found favour rather with the thinking classes than with the uneducated multitude, and so went through many vicissitudes. At the time of its appearance and until the reign of Ma'mūn its adherents were persecuted as heretics. After discussions among the theologians Ma'mūn took the decided step of proclaiming that the Koran was created, and that a belief in this dogma was necessary. Other Mu'tazilite doctrines were proclaimed later. Mu'tazilites were appointed to official posts, and an inquisition (*miḥna*) was appointed to enforce belief in their doctrines. This movement was strongly opposed by the orthodox and especially by Aḥmad ibn Hanbal (*q.v.*). By him the founding of theology on reason was rejected, and he suffered persecution for his faith (see W. N. Patton, *Aḥmed ibn Hanbal and the Miḥna*, Leiden, 1897). Mu'tazilism retained its sway until 849, when the caliph Motawakkil again declared the Koran uncreate and restored orthodoxy. It was during the early years of the Abbasid rule that the four legal schools of Abū Hanīfa (d. 767), Mālik ibn Anas (d. 795), ash-Shāfiʿī (d. 819) and Ibn Hanbal (d. 855) came into existence (see Mahommedan Law). As the bases of religion and law were the same, so the methods applied in the treatment of the one affected the other. Abū Hanīfa depended little on tradition, but referred back to the Koran, making use of individual opinion (*raʿy*) as controlled by analogy (*qīyās*) with a written ordinance. Mālik Ibn Anas supplemented the Koran and Sunna by customary law founded largely on the custom (*ijmāʿ*) of Medina, and by what he conceived to be for the public good (*istiṣlāḥ*). Shafiʿi recognized tradition as equal to the Koran, and even as being able to supersede its ordinances, while he also recognized the universal custom (*ijmāʿ*) of the Moslem world as divine and binding. His four bases of religion—Koran, sunna, qiyās and ijmāʿ—have been generally accepted in Islam (see above). Ibn Hanbal's position has been already mentioned. All these four schools are reckoned orthodox, and all orthodox Moslems belong to one or another of them. Another teacher of this time, who founded a school which did not succeed in being recognized as orthodox, was Dāʿūd uz-Ẓāhirī. Trained as a Shafiʿite, he became too strict for this school, rejected analogy, restricted *ijmāʿ* to the agreement or custom of the companions of Mahomet, and accepted the whole of the Koran and tradition in the most literal and external sense. His followers were called Ẓāhirites (*i.e.* externalists). After Ashʿarī's time these principles were applied to theology by Ibn Hazm (*q.v.*) see I. Goldziher, *Die Zahiriten, ihr Lehrsystem und ihre Geschichte* (Leipzig, 1884).

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[1] For the doctrines of these two sects see Shahrastānī's *Book of Sects*, and for the Qadarites, A. de Vlieger's *Kitāb ul-Qadr, matériaux pour servir à l'étude de la doctrine de la prédestination dans la théologie musulmane* (Leiden, 1903).

Before turning to the reform of Ashʿarī and the introduction into orthodox theology of scholastic philosophy it is necessary to notice another phase of religious life which became the common property of orthodox and heretics. This was the introduction of asceticism in religious practice and of mysticism in religious thought. Sufiʿism (*q.v.*), which combined these two, is rightly not counted among the sects of Islam. Asceticism seems to have won a certain amount of approval from Mahomet himself, who much respected the Christian monks. The attention paid in early Islam to the joys and punishments of the future life led to self-denial and simple living in this world. An Arabian writer, speaking of the simplicity of manners of the first four caliphs, says that their affairs were conducted with more consideration of the future life than of this world. Many Moslems went even farther than these caliphs, and gave up all concern as far as possible with the affairs of this world and lived in poverty, in wanderings or in retirement (see Dervish). For the historical development of this movement, with its accompanying mysticism, see Sufiʿism. Ashʿarī (d. before 942) was for forty years a Muʿtazilite, then became orthodox (see Ashʿarī), and at once applied rational methods for the support and interpretation of the orthodox faith. Before him, reason had not been allowed any scope in orthodox theology. He was not the first to use it; some teachers (as al-Junaid) had employed it in teaching, but only in secret and for the few. The methods of scholastic philosophy were now introduced into Moslem theology. The chief characteristic of his religious teaching was the adoption of the *via media* between materialistic grossness and the ideas of pure speculative philosophy. Thus he taught, as to the attributes of God, that they exist, but are not to be compared with human attributes; as to His visibility, that He can be seen but without the limitations of human sight. As to the great question of free will, he denied man's power but asserted his responsibility. So he passed in review the doctrines of God, faith, the Koran, sin, intercession, &c., and for the first time in the history of Islam produced a systematic theology. The teaching of Ashʿarī was taken up and propagated by the Buyids soon after his death, and was developed and perfected by Abū Bekr ul-Bāqilānī, the Cadi (d. 1012), but up to the middle of the 5th century of Islam (*c.* A.D. 1058) was suspected elsewhere and confounded with Muʿtazilism. The Ashʿarīte al-Juwainī (known as Imām ul-Haramain) was persecuted under Toghrul Beg (*c.* 1053) and exiled, but was restored under Alp Arslan by the vizier Niẓām ul-Mulk, who founded an Ashʿarite college (the Niẓāmiyya). In the West, Ibn Hazm (*q.v.*) fiercely opposed the system, but Ghazālī established its orthodoxy in the East, and it spread from Persia to Syria and Egypt under the Ayyūbites and Mamelukes and thence to the Almohades in Africa under Ibn Tumart (1130). It remains the predominating influence to the present day, its only serious rival being the theological system of al-Matāridī, a Hanifite (d. 945), whose creed as represented in that of an-Nasafī is still used largely by the Turks. Since the 12th century no great theological movement has been made in Islam. The quiet of religious life has twice been broken, once by Wahhābism (*q.v.*) in Arabia, once by Bābism (*q.v.*) in Persia.

The Sects

According to an early tradition Mahomet said that Islam would be divided into seventy-three parties (sects),[1] of which seventy-two would perish and one would be saved. The orthodox Arabian writers on heretical sects of Islam feel compelled by this tradition to make up their number to seventy-two, and, as different writers adopt different divisions or are familiar with different parties, the names of sects amount to some hundreds. Each writer, however, adopts certain main classes under which he attempts to group the others. Abū Mutīʿ Makhūl at the beginning of the 10th century in his "Refutation" (MS. in Bodleian Library) has six such chief classes: Ḥarūrites (*i.e.* Khārijites), Rāfiḍites (*i.e.* Shiʿites), Qadarites, Jabarites, Jahmites and Murjiites. Ibn Hazm (*q.v.*) adopts four classes: Muʿtazilites (Motazilites), Murjiites, Shiʿites and Khārijites. Shahrastānī (*q.v.*) complains of the want of system in earlier writers, and suggests as bases of classification the position of parties with regard to the doctrines as to (1) the divine attributes, (2) predestination and free-will (3) promises and threats, faith and error, (4) revelation, reason, the imāmate. In one part of his preface he gives as the chief parties the Qadarites, Ṣifātites, Khārijites and Shiʿites, proposing to divide these classes according to leaders who agreed with the main doctrines of their class but differed in some points. In another place he mentions four opposite pairs of sects: (1) the Qadarites with their doctrine of free-will, and the Jabarites, who are necessitarians; (2) the Ṣifātites, who maintain the eternal nature of the attributes of God, and the Muʿtazilites, who deny it; (3) the Murjiites, who postpone judgment of actions until the Last Day, and the Wāʿidites, who condemn in this life; (4) the Khārijites, who consider the caliphate a human institution, and the Shiʿites, who deify their ruler. In his detailed treatment of the sects Shahrastānī arranged them under the headings: Muʿtazilites, Jabarites, Ṣifātites, Khārijites, Murjiites and Shiʿites. About the same time as Shahrastānī two other Arabian writers wrote on the sects —Ṭāhir ul-Isfarainī (d. 1078), whose MS. is in the Berlin library, and ʿAbd ul-Qādir ul-Jīlānī (1078–1166) in his *Kitāb ul-Ghanīyya li-Tālibī Tarīq il-Haqqi* (Cairo, 1871). Both adopt as main classes Rāfiḍites (or Shiʿites), Qadarites (or Muʿtazilites), Khārijites, Murjiites, Najjārites, Dirārites, Jahmites, Mushabbiha, to which Ṭāhir adds Bakrites, Karrāmites, and a class including those sects which are not reckoned as Moslem though they have sprung from Islam. Jīlānī adds to the eight the Kilābites.

The following list is not a complete list of names of sects but is founded on that of Shahrastānī.[2]

Afṭahites.—Shiʿites of the Imāmite class, who ascribe the imāmate to ʿAbdallah ul-Afṭahi, the son of Ṣādiq.

Ajārida.—Khārijites, followers of Ibn ʿAjarrad, who agreed for the most part with the Najadāt (below), considered grave sins as equivalent to unbelief, but remained friendly with those who professed Islam but did not fight for it. They rejected *sura* 7 as a fable. Shahrastānī enumerates seven divisions of this sect.

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[1] For the origin and significance of this number see M. Steinschneider, "Die kanonische Zahl der muhammedanischen Secten und die Symbolik der Zahl, 70–73," in *Zeitschr. d. deutschen morgenl. Gesellschaft*, iv., 145–170 (1850); and I. Goldziher, "Le Denombrement des sectes mohamétanes" in *Revue de l'hist. des religions*, xxvi. 129–137 (1892).

[2] The names are given throughout in the anglicized form on the analogy of Shiʿites, which is recognized in common usage. The strict termination according to the scheme of transliteration adopted in this work is *iyya*, or *iya*, *e.g.* Hishāmiyya for Hishāmites. For information regarding the important sects see separate articles and the preceding portion of this article.

Akhnasites.—A section of the Tha‘āliba not so strict in treatment of those who fear to fight for Islam.

Ash‘arites.—Followers of Ash‘arī (*q.v.*) who are counted by Shahrastānī among the Ṣifātites.

Aṭrāfites.—A division of the ‘Ajārida who agree with the Ḥamzites except that they excuse the lower classes for inaction when they are ignorant of the law.

Azraqites.—Khārijites who followed al-Azraq in the days of Ibn Zubair. They held ‘Ali to be an unbeliever; those who did not fight were unbelievers; the children of unbelievers were to be put to death and went to hell. Sin is unbelief.

Bahshamites.—Mu‘tazilites akin to the Jubbā‘ites.

Baihasites.—Khārijites, followers of Abu Baihas ul-Haitham, who was put to death by the caliph Walīd. They asserted the necessity of knowledge for religion.

Bāqirites.—Shi‘ites who followed Abū Ja‘far ul-Bāqir, the fifth imām, and looked for his return.

Bāṭinites.—Isma‘ilites, so called because they believe that every external has an internal (*bātin*), and every passage in the Koran has an allegoric meaning.

Bishrites.—Mu‘tazilites, followers of Bishr ibn Mu‘tamir, one of the most learned men of his party. His teaching was philosophical and was distinguished by his doctrine of "origination" (*tawallud*).

Bunānites.—Kaisānites, followers of Bunān ibn Sim‘ān un-Nahdī, who claimed that the imāmate passed from Abū Hāshim to himself and that he had also acquired the divine element of ‘Alī.

Butrites.—Zaidites, followers of Kathīr un-Nawā ul-Abtar, who agreed with the Suleimanites (Sulaimānites) except that he suspended judgment as to whether Othmān was a believer or not.

Ḍirārites.—Jabarites who empty God of his attributes, and assert that man has a sixth sense by which he will see God on the day of resurrection. The actions of man are "created" and acquired by him. A caliph need not be chosen from the Koreish.

Ghāliites (Ghulā) are the extreme Shi‘ites (*q.v.*) in ascribing deity to the imāms. Their heresies are said to be four in number: (1) Making God resemble man, (2) ascribing change of mind to God, (3) looking for the return of the imām, (4) metempsychosis. They are divided by Shahrastānī into ten classes.

Ghassānites.—Murjiites, followers of Ghassān ibn ul-Kufī, who say that faith consists of knowledge of God, his apostle, and the Koran *in general* not in detail, and that faith increases but is not diminished.

Ḥabitites = Ḥāyitites (below).

Ḥadathites (Ḥudabites) are Mu‘tazilites, followers of Faḍl ibn ul-Ḥadathī, who agreed with the Ḥāyitites (below).

Ḥafṣites.—Ibāḍites, followers of Ḥafṣ ibn abī-l-Miqdām, who distinguished between idolatry (*shirk*) and unbelief (*kufr*).

Ḥamzites.—‘Ajārida, followers of Hamza ibn Adrak in Sijistān. They agree with the Maimūnites, but condemn the children of unbelievers to hell.

Ḥārithites.—Ibāḍites who differ from others in holding the Mu‘tazilite doctrine of free-will.

Ḥarūrites.—A name given to the first Khārijites, who rebelled against ‘Āli, and met in Ḥarūra near Kufa.

Hāshimites.—Shi‘ites who supported Abū Hāshim, son of Mahommed ibn ul-Ḥanafiyya, although they held that his father had gone astray.

Hashwiites.—A party who asserted the eternity even of the letters of the Koran. They are not mentioned as a separate sect by Shahrastānī; cf. van Vloten, "*Les Hachwia et Nabita,*" in the *Acts of the 11th Oriental Congress* (Paris, 1899), pt. iii., pp. 99 sqq.

Ḥāyiṭites.—Mu‘tazilites who agreed with the Naẓẓāmites, but added three heresies of their own: (1) the divinity of the Messiah, (2) metempsychosis, (3) the interpretation of all references to the vision of God as referring to the "first Reason" or "creative Reason."

Hishāmites.—A name given to two sects: (1) Mu‘tazilites, strong in their assertion of man's free-will, even opposing the statement of the Koran. (2) Shi‘ites of the extreme kind, who attributed to God a body with quantities (measurements) and qualities.

Ḥudabites.—See Ḥadathites.

Hudhailites (Hodhailites).—Mu‘tazilites, followers of Abū-l Hudhail Ḥamdān, who was a leading teacher of his party and developed the philosophical side of its teaching. Ten of his main doctrines are given by Shahrastānī.

Ibaḍites.—Khārijites of moderate tendencies (see above).

Ilbāites.—Ghāliites who put ‘Alī above Mahomet and blamed the latter because he called men to himself instead of to ‘Alī.

Imāmites.—One of the chief divisions of the Shi‘ites (*q.v.*).

Isḥāqites.—Ghāliites agreeing with the Nuṣairites except that they incline to speak of the imams' participation in the prophetic office rather than of their divinity.

Isma‘īlites.—This name is applied to all who consider Isma‘īl ibn Ja‘far the last imām, some believing that he did not die but will return, others, that at his death his son Mahommed became imām (see ASSASSINS); it is also used as equivalent to the Bāṭinites.

Ithna‘asharites.—Imāmites who accept the twelve imāms (see SHI‘ITES).

Jabarites.—Those who deny all actions and power to act to man and ascribe all to God (see above).

Ja‘farites.—Imāmites who carry the imāmate no farther than Ja‘far uṣ-Ṣadīq.

Jāhizites.—Mu‘tazilites, followers of the celebrated writer Jāhiẓ (*q.v.*), who indulged in philosophical speculations, believed in the eternity of matter, and was regarded as a naturalist (*ṭaba‘ī*) rather than a theist (*allahī*).

Jahmites.—Jabarites, followers of Jahm ibn Ṣafwān, who was put to death at Merv toward the close of the Omayyad period. He was extreme in his denial of the attributes of God.

Jārūdites.—Zaidites who held that Mahomet designated ‘Alī as imām, not by name but by his attributes, and that the Moslem sinned by not taking sufficient trouble to recognize these attributes.

Jubbā‘ites.—Mu‘tazilites who followed the philosophical teaching of Abu ‘Alī Mahommed ul-Jubbā‘i of Basra.

Kaisānites.—A main class of the Shi‘ites (*q.v.*).

Kāmilites.—Ghāliites, followers of Abū Kāmil, who condemned the companions (*Anṣār*) because they did not do allegiance to ‘Alī, and ‘Alī because he surrendered his claims.

Karrāmites.—Ṣifātites, followers of Ibn Karrām, who went so far as to ascribe a body to God, and assimilated his nature to human nature.

Kayyālites.—Ghāliites, followers of Ahmad ibn Kayyāl, who, after supporting a propaganda for an Aliite, claimed to be the imām himself on the ground of his power over the spheres.

Khalafites.—‘Ajārida of Kermān and Multān, who believed that God wills good and evil, but condemned the children of unbelievers to hell.

Khārijites.—One of the earliest sects of Islam (see above).

Khārimites.—‘Ajārida, agreeing mostly with the Shu‘aibites and teaching that the relation of God to a man depends on what he professes at the end of his life.

Khaṭṭābites.—Ghāliites, followers of Abū-l Khaṭṭāb, who was put to death by Ibn Mūsā at Kufa. He was a violent supporter of Ja‘far uṣ-Ṣādiq, who however disowned him.

Khayyātites.—Mu‘tazilites, followers of Abū-l Ḥosain ul-Khayyāt, a teacher in Bagdad, part of whose philosophical teaching was that the non-existent is a thing.

Ma‘badites.—Tha‘labites who differed from the Akhnasites on the question of the marriage of believing women and from Tha‘lab on the question of taking alms from slaves.

Maimūnites.—‘Ajārida, followers of Maimūn ibn Khālid, who believed that God wills good only and that man determines his actions.

Majhūlites.—Tha‘labites, agreeing generally with the Khārimites, but teaching that he who knows some names and attributes of God and is ignorant of some knows God.

Ma‘lūmites.—Tha‘labites agreeing generally with the Khārimites but alleging that a believer must know all the names and attributes of God.

Manṣūrites.—Ghāliites, followers of Abū Manṣūr ul-‘Ijlī, who at first supported al-Bāqir, but, rejected by him, claimed the imāmate for himself. He was crucified by the caliph Hishām ibn ‘Abd ul-Mālik (Abdalmalik).

Mu‘ammarites.[1]—Mu‘tazilites who strongly denied the predestination of God, and affirmed that God created bodies only, and that the accidents spring naturally from them.

Mufaḍḍalites.[1]—The same as the Mūsāites (*q.v.*).

Mughīrites.[1]—Ghāliites, followers of Mughīra ibn Sa‘īd ul-‘Ijlī, who claimed the imāmate and prophetic office and held extremely gross views of God.

Muhakkima[1] (the first).—Another name for the Ḥarūrites (above).

Mukarramites.[1]—Tha‘labites who taught that sin consists in ignorance of God.

Mukhtārites.[1]—Kaisānites, followers of al-Mukhtār ibn ‘Ubaid, who held to Mahommed ibn ul-Ḥanafīyya but was disowned by him. He allowed the possibility of change of mind on the part of God.

Murjiites.—Those who postponed judgment of actions until the Day of Judgment. See above.

Mūṣāites.—Imāmites who held to the imāmate of Mūsā ibn Ja‘far, who was imprisoned by Harun al-Rashid and poisoned.

Mushabbiha.[1]—Ṣifātites who compared God's actions with human actions. They said that the Koran was eternal with all its letters, accents and written signs.

Mu‘tazilites.[1]—The rationalists of Islam. See above, cf. also H. Steiner, *Die Mu‘taziliten oder die Freidenker im Islām* (Leipzig, 1865).

Muzdārites.[1]—Mu‘tazilites, followers of al-Muzdār, a pupil of Bishr (cf. Bishrites) whose teaching he developed further. He taught that God has power to do evil, but, if he acted thus, would be an evil God; also that man can produce the equal of the Koran.

Najadat (also known as *‘Adhirites*).—Kharijites, who followed Najda ibn ‘Āmir of Yemāma as he went to join the Azraqites but withdrew from these, being more orthodox than they. He held that fear of fighting was not sin.

Nāwisites take their name from a person or a place. They are Ja‘farites who believe in Ṣādiq as the mahdi.

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[1] All these names are alternatively spelt *Mo-* instead of *Mu-*.

Nazzāmites.—Mu‘tazilites, followers of Ibrahīm ibn Sayyār un-Nazzām, who was an extremist in his teaching of man's free-will and other philosophical doctrines.

Nu‘mānites.[1]—Ghāliites agreeing in some points with Hishāmites, but holding that God is a light in the form of a man, yet not a body.

Nuṣairites.[1]—Ghāliites who agree with the Isḥāqites except that they lay more stress on the incorporation of the deity.

Qadarites.—The upholders of free-will (see above).

Qata‘ites.—Mūsāites who regard the rank of the imāms as closed with the death of Mūsā.

Rāfiḍites.—A term used by some writers to denote the Shi‘ites as a whole; by others given to a class of the Shi‘ites who forsook Zaid ibn ‘Alī because he forbade them to abuse the Companions.

Rashīdites.—Tha‘labites, followers of Rashīd ut-Tūsī, sometimes called ‘Ushrites ("tithers") because they differed from others on the question of tithing the produce of land watered by rivers and canals.

Rizāmites.—Kaisānites of Khorasān at the time of Abū Muslim, to whom they ascribed the imāmate and the Spirit of God. They also believed in metempsychosis.

Saba‘ites.—Ghāliites, who followed ‘Abdallah ibn Sabā (see SHI‘ITES).

Ṣāliḥites.—(*a*) Zaidites, followers of al-Hasan ibn Ṣāliḥ, who agreed with the teachings of the Butrites (above); (*b*) Murjiites, followers of Ṣāliḥ ibn Amr, who united with the doctrines of their own party those of the Qadarites.

Ṣaltites.—‘Ajārida who had nothing to do with the children of believers until they had grown up and professed Islam.

Shaibānites.—Tha‘labites, followers of Shaibān ibn Salama, who was killed in the time of Abū Muslim (Moslem). They arose chiefly in Jorjān and Armenia and agreed in doctrine with the Jahmites.

Shamīṭites.—Ja‘farites, followers of Yaḥyā ibn Abū Shamīṭ.

Shi‘ites.—See separate article.

Shu‘aibites.—‘Ajārida who said that God creates the actions of men, and men appropriate them.

Ṣifātites are those who ascribe eternity to all the attributes of God, whether they denote essence or action, or are of the class called descriptive attributes.

Ṣifrites, the same as Ziyādites (below).

Sulaimānites (Suleimanites).—Zaidites, followers of Suleimān ibn Jarīr, who held that the appointment to the imāmate was a matter of consultation and that the imāmates of Abū Bekr and Omar were legal although ‘Alī had a better claim.

Tha‘labites.—A party of the Khārijites, followers of Tha‘lab ibn Amir, who agreed with the ‘Ajārida except that he was friendly with children until they actually denied the faith. He also took alms from slaves when they were rich, and gave alms to poor slaves.

Thaubānites.—Murjiites who said that faith consists in the knowledge and confession of God and His apostle, and what the intellect is not capable of doing. What the intellect can do (or leave) is not of faith.

Thumāmites.—Mu‘tazilites, followers of Thumāma ibn Ashras in the days of Mamūn, who taught that all non-Moslems would become dust on the day of resurrection.

Tūmanites.—Murjiites who taught that faith depends on obedience rather to the principles than to the commands of Islam.

‘Ubaidites.—Murjiites who believed that anything but idolatry might be forgiven, and that if a man died professing the unity of God his sins would not hurt him.

Wa‘īdites.—Those who, opposed to the Murjiites, pronounced judgment in this life; they are not counted as a separate sect by Shahrastānī (see above).

Wāṣilites.—A name given to those who followed Wāṣil ibn ‘Atā, the founder of Mu‘tazilitism, who denied the attributes of God, asserted the power of man over his own actions, taught the existence of a middle place between heaven and hell, and despised the parties of Othman and ‘Alī alike.

Yazīdites.—Ibāḍites who said that they followed the religion of the Sabians in the Koran, and believed that God would send an apostle from the Persians.

Yūnusites.—Murjiites who taught that faith consists in knowledge of God, subjection to Him, abandonment of pride before Him, and love in the heart. Obedience apart from knowledge is not of faith.

Zaidites.—The moderate Shi‘ites (see SHI‘ITES).

Ziyādites.—Khārijites, followers of Ziyād ibn ul-Aṣfar, who did not regard those who abstained from fighting for Islam as unbelievers, and did not kill the children of idolaters or condemn them to hell.

AUTHORITIES.—For the philosophy and theology of Ash‘arī see M. A. F. Mehren, *Exposé de la réforme de l'Islamisme par Abou-'l Hasan Ali el-Ash‘arī* (Leiden, 1878); W. Spitta, *Zur Geschichte Abu-l Hasan al-Ash‘arīs* (Leipzig, 1876); M. Schreiner, *Zur Geschichte des Ash‘aritenthums* (Leiden, 1891); D. B. Macdonald, *Development of Muslim Theology, Jurisprudence and Constitutional Theory* (London, 1903). The last work contains translations of the creeds of Ash‘arī and Nasafī (Matāridite). A further bibliography of works on the faith and outlook of Islam will be found in D. B. Macdonald's *Muslim Theology*.

The text of the Koran has been edited by G. Flügel, Leipzig, various dates; and by G. M. Redslob, Paris, 1868 and 1880. There are also hundreds of Eastern editions. Concordances have been published by G. Flügel, Leipzig, 1842 (several times reprinted), also in Egypt, Palestine and India. A dictionary and glossary were published by J. Penrice, London, 1873. English translations have been made by G. Sale, London, 1734 (the fullest edition is that with notes by E. M. Wherry, 4 vols., London, 1882–1886); by J. M. Rodwell with notes, London, 1861 and 1876; and by E. H. Palmer in vols. vi. and ix. of the "Sacred Books of the East," Oxford, 1880–1882. Among the best or best-known Arabic commentaries are those of Ṭabarī (*q.v.*), Zamakhsharī (*q.v.*), Baidhawī (*q.v.*), the Jalalain (see SUYUTI), and such later ones as the Mafātiḥ ul-Ghaib of ar-Rāzī (d. 1210). The composition and theology of the Koran are treated in the works of Nöldeke and Grimme referred to above.

On the eschatology of Islam see M. Wolff, *Muhammedanische Eschatologie* (Leipzig, 1872); and on the doctrine of revelation, Otto Pautz, *Muhammeds Lehre von der Offenbarung* (Leipzig, 1898). (G. W. T.)

MAHONY, FRANCIS SYLVESTER (1804–1866), known as "Father Prout," Irish priest and author, son of a woollen manufacturer, was born in Cork in 1804. His classical education was chiefly obtained at a Jesuit college at Amiens, and after studying in Paris he entered the Jesuit college at Rome and was admitted into the Society of Jesus. He served in Switzerland and at Clongoweswood, Ireland, where he was prefect of studies and subsequently master of rhetoric. Here he was involved in scandals that led to his resignation. On going to Italy he was told at Florence that he was expelled from the Society. He succeeded, however, in obtaining priest's orders at Rome in 1832, and returned to Ireland, but subsequently went to London, officiating for some time in the chapel of the Bavarian Legation. While there he fell in with William Maginn, and about 1834 began to contribute his celebrated "Prout Papers" to *Fraser's Magazine*. These consist of episodes in the life of the parish priest "Father Prout," and dialogues after the model of "Christopher North," varied by translations of well-known English songs into Latin, Greek, French and Italian verse, which he humorously represents as being the true originals from which the English authors had merely plagiarized them. Mahony's translations have been universally admired for the extraordinary command which they display of the various languages into which his renderings are made, and for their spirit and freedom both of thought and expression. His original verse tends chiefly to show that with all his sarcastic and cynical wit his genius had also its tender, serious and sentimental side. His "Bells of Shandon" has always been greatly admired. In 1846 Mahony became correspondent at Rome to the *Daily News*, and his letters from that capital gave very vivid pictures of the first years of the reign of Pius IX. The last twelve or fifteen years of his life were spent in Paris, whence he supplied the *Globe* with a series of piquant letters on the incidents of the day. He died in Paris on the 18th of May 1866.

The *Reliques of Father Prout* were collected from *Fraser's Magazine* and published in two volumes in 1836; *The Final Reliques of Father Prout*, chiefly extracted from the *Daily News* and the *Globe*, were edited by Blanchard Jerrold in 1876, and an edition of his works, edited by Charles Kent, was published in 1881.

MAHOUT (Hind. *mahāwat*), an elephant-driver. The mahout sits on the elephant's neck and directs him by voice and by the use of a goad called *ankus*.

MAHRATTAS, a people of India, inhabiting the district known by the ancient name of Maharashtra (Sans. "great kingdom or region"). This large tract, extending from the Arabian Sea on the west to the Sātpura mountains in the north, comprises a good part of western and central India, including the modern provinces of the Konkan, Khandesh, Berar, the British Deccan, part of Nagpur, and about half the nizam's Deccan.

The etymology of the word Mahratta (*Marāthā*) is uncertain. The name does not indicate a social caste, or a religious sect; it is not even tribal. Strictly, it is confined to the upper class from whom Sivaji's generals were mostly drawn, and who sometimes claim a Rajput origin. In a wider sense it may be extended to include all who inhabit Maharashtra and speak Mahratti as their mother-tongue. In 1901 the total number of speakers of Mahratti in all India exceeded 18 millions.

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[1] These names are alternatively spelt *No-* instead of *Nu-*.

The Mahrattas have always been a separate nation or people, and still regard themselves as such, though nowadays they are almost all under British or Mahommedan jurisdiction; that is, they belong either to British India or to the nizam's dominions. There are indeed still three large native states nominally Mahratta: that of Sindhia near the borders of Hindustan in the north, that of Holkar in Malwa in the heart of the Indian continent, and that of the gaekwar in Gujarat on the western coast. But in these states the prince, his relatives and some of his ministers or officials only are Mahrattas; the mass of the people belong to other sections of the Hindu race. These states then are not to be included in the Mahratta nation, though they have a share in Mahratta history.

In general terms the Mahrattas, in the wider sense, may be described under two main heads: first the Brahmans, and secondly the low-caste men. The Mahratta Brahmans possess, in an intense degree, the qualities of that famous caste, physical, intellectual and moral. They have generally the lofty brow, the regular features, the spare upright figure, and the calm aspect which might be expected in a race maintained in great purity yet upon a broad basis. In modern times they have proved themselves the most able and ambitious of all the Brahmans in the Indian Empire. They are notably divided into two sections: the Konkanast, coming from the Konkan or littoral tract on the west coast below the Western Ghāt mountains; and the Deshast, coming from the uplands or Deccan, on the east of the mountains. Though there have been many distinguished Deshasts, yet the most remarkable of all have been Konkanasts. For instance, the pēshwas, or heads of the Mahratta confederation which at one time dominated nearly all India, were Konkanast Brahmans. The birthplaces of these persons are still known, and to this day there are sequestered villages, nestling near the western base of the Ghāts, which are pointed to as being the ancestral homes of men who two centuries ago had political control over half India.

Apart from the Brahmans, the Mahrattas may be generally designated as Sūdras, the humblest of the four great castes into which the Hindu race is theoretically divided. But the upper classes claim to be Kshattriyas or Rajputs. They probably are aborigines fundamentally, with a mixture of what are now called the Scythian tribes, which at a very early time overran India. The ordinary Mahrattas, who form the backbone of the nation, have plain features, an uncouth manner, short stature, a small but wiry frame. Though not powerful physically as compared with the northern races of the Punjab and Oudh, they have much activity and an unsurpassed endurance. Born and bred in or near the Western Ghāt mountains and the numerous tributary ranges, they have all the qualities of mountaineers. In recent times they enter military service less and less, betaking themselves mainly to cultivation and to the carrying business connected with agriculture. As husbandmen they are not remarkable; but as graziers, as cartmen, as labourers, they are excellent. As artisans they have seldom signalized themselves, save as armourers and clothweavers.

In the Konkan there are some superior proprietors termed Khots. With this and perhaps some other exceptions, there are not in the Mahratta country many large landlords, nor many of the superior tenure-holders whose position relatively to that of the peasantry has caused much discussion in other parts of India. There are indeed many Mahratta chiefs still resident in the country, members of the aristocracy which formerly enjoyed much wealth and power. They are sometimes in the position of landlords, but often they are the assignees of the land revenue, which they are entitled under special grants to collect for themselves instead of for government, paying merely a small sum to Government by way of quit-rent. Under them the cultivators are by British arrangements placed in the position of peasant proprietors. The village community has always existed as the social unit in the Mahratta territories, though with less cohesion among its members than in the village communities of Hindustan and the Punjab. The ancient offices pertaining to the village, as those of the headmen (*patel*), the village accountant, &c., are in working order throughout the Mahratta country.

The Mahratta peasantry possess manly fortitude under suffering and misfortune. Though patient and good-tempered in the main, they have a latent warmth of temper, and if oppressed beyond a certain limit they would fiercely turn upon their tormentors. As a rule they are orderly and law-abiding, but traditions of plunder have been handed down to them from early times, and many of them retain the predatory instincts of their forefathers. The neighbourhood of dense forests, steep hill-sides, and fastnesses hard of access offers extraordinary facilities to plunderers for screening themselves and their booty. Thus gang robbery is apt to break out, gains head with rapidity, and is suppressed with difficulty. In times of peace it is kept under, but during war, or whenever the bands of civil order are loosened, it becomes a cause of anxiety and a source of danger. The women have frankness and strength of character; they work hard in the fields, and as a rule evince domestic virtue.

The peasantry preserve a grave and quiet demeanour, but they have their humble ideas of gaiety, and hold their gatherings on occasions of births or marriages. They frequently beguile their toil with carols. They like the gossiping and bartering at the rural markets and in the larger fairs, which are sometimes held in strikingly picturesque localities. They are superstitious, and worship with hearty veneration any being or thing whose destructive agency they fear. They even speak of the tiger with honorific titles. They are Hindus, but their Hinduism is held to be of a non-Aryan type. They are sincerely devout in religion, and feel an awe regarding "the holy Brahmans," holding the life and the person of a Brahman sacred, even though he be a criminal of the deepest dye. They of course regard the cow as equally sacred. There are two principal sects among modern Hindus—those who follow Vishnu, and those who follow Siva. The Mahrattas generally follow Siva and his wife, a dread goddess known under many names. The Mahratta war-cry, "Har, Har, Mahadeo," referred to Siva. All classes high and low are fond of the religious festivals, the principal of which, the Dasahra, occurs in October, when the first harvest of the year has been secured and the second crops sown. This has always been held with the utmost pomp and magnificence at every centre of Mahratta wealth and power. The people frequently assemble in bowers and arbours constructed of leafy boughs to hear *kathas* recited. These recitations are partly religious, partly also romantic and quasi-historical. After them national resolves of just resistance or of aggressive ambition have often been formed.

Apart from the Mahratta Brahmans, as already mentioned, the Mahratta nobles and princes are not generally fine-looking men. There is general truth in what was once said by a high authority to the effect that, while there will be something dignified in the humblest Rājpūt, there will be something mean in the highest Mahratta. Bluff good-nature, a certain jocoseness, a humour pungent and ready, though somewhat coarse, a hot or even violent disposition, are characteristics of Mahratta chieftains. They usually show little aptitude for business or for sedentary pursuits; but, on the other hand, they are born equestrians and sportsmen. Mahratta ladies and princesses have often taken a prominent part, for good or evil, in public affairs and dynastic intrigues.

Though they have produced some poetry, the Mahrattas have never done much for literature. Nor have they been distinguished in industrial art. Their architecture in wood, however, was excellent; and the teak forests of their country afforded the finest timber for building and for carving. They had also much skill in the construction of works for the supply of drinking water on a large scale and for irrigation.

The range of the Western Ghāts enabled the Mahrattas to rise against their Mahommedan conquerors, to reassert their Hindu nationality against the whole power of the Mogul Empire, and to establish in its place an empire of their own. It is often stated that in India British conquest or annexation succeeded Mahommedan rule; and to a considerable extent this was the case. But, on the other hand, the principal power, the widest sovereignty, which the British overthrew in India was that of the Mahrattas.

During the earlier Moslem invasions in 1100 and in subsequent years, the Mahrattas do not seem to have made much resistance. They submitted to several Mahommedan kings under the changing circumstances of those times. It was against the Mahommedan king of Bijapur in the Deccan that Sivaji, the hero of Mahratta history, first rebelled in 1657. Sivaji and his fighting officers were Mahrattas of humble caste, but his ministers were Brahmans. When the Mogul Empire absorbed the Bijapur kingdom he defied the emperor. He imparted a self-reliant enthusiasm to his countrymen, formed them into an army, and organized them as a political community; his mountaineer infantry, though limited in numbers, proved desperately courageous; his cavalry was daring and ubiquitous. The Moslems, having once overcome the Hindus in almost all parts of India, had not for centuries met with any noteworthy uprising. Sivaji, however, planned their expulsion, and before the end of his restless life made much progress in the execution of that design. The new state which he founded was maintained under various vicissitudes after his death. Mahratta resistance, once aroused by him, was never extinguished, and the imperial resources were worn out by ceaseless though vain efforts to quell it. The great Mogul emperor's impoverished and enfeebled successor was fain to recognize the Mahratta state by a formal instrument. The Mahratta king, a descendant of Sivaji, had become a *roi fainéant*, and the arrangement was negotiated by his Brahman minister, whose official designation was the pēshwa. The office of pēshwa then became hereditary in the minister's family, and grew in importance as the Mahratta kingdom rose, while the king sunk into the condition of a puppet. Thus the Mahratta power was consolidated throughout nearly the whole of Maharashtra under the Brahman pēshwa as virtual sovereign, with his capital at Poona, while the titular Mahratta raja or king had his court at the neighbouring city of Satara. Despite his political importance, however, the raja was still venerated as the descendant of Sivaji.

Then several chiefs carved out principalities of their own from among the ruins of the Mogul Empire. Thus Raghoji Bhonsla established himself in the tracts lying underneath the southern base of the Satpura range (namely, Nagpur and Berar), overran Orissa and entered Bengal. Damaji Gaekwar descended from the Western Ghāts upon the alluvial plains of Gujarat around Baroda; Tukoji Holkar subdued the uplands of Malwa beyond the Vindhya range on the north bank of the Nerbudda; and Mahadji Sindhia obtained possession of large tracts immediately south of Agra and Delhi, marched into Hindustan and became virtually the master of the Mogul emperor himself (see Gwalior). Sivaji's own father had founded a dominion at Tanjore in the extreme south, which, however, never had relations with the central power at Poona. The same may be said of the state of Kolhapur, allotted to a younger branch of Sivaji's family.

But these principalities, though independent respecting internal administration, and making war or peace with their neighbours according to opportunity, owned allegiance to the pēshwa at Poona as the head of the Mahratta race. On state occasions heads of principalities would visit Poona by way of acknowledging the superior position of the pēshwa. On the other hand, the pēshwa was careful to obtain the sanction of his nominal sovereign at Satara to every important act of state. Thus a confederation was formed of which the Brahman pēshwa or head was at Poona, governing the adjacent territories, while the members, belonging to the lower castes, were scattered throughout the continent of India. Such was the Mahratta Empire which supplanted the Mogul Empire. The Mahratta power grew and prospered till it embraced all western and most of central India. Its culminating point was reached about 1750, or about a century after Sivaji first rebelled against his Mahommedan sovereign.

Its armies drew soldiers from all parts of India. The infantry was not of good quality; but its cavalry was really an enormous force, numbering fully a hundred thousand in all. The horsemen were splendidly audacious in riding for long distances into the heart of a hostile country, without support, striking some terrific blows, and then returning rapidly beyond reach of pursuit. They could truly boast of having watered their horses in every Indian river from the Cauvery to the Indus. If attacked, however, in a competent manner, they would not stand; and afterwards, in conflict with the British, whole masses of them behaved in a dastardly manner. As their ambition grew the chiefs began to organize their troops after the system learnt from the English and French. In this way several Frenchmen—Benoit de Boigne, Perron and others—rose in the Mahratta service to a position dangerous to the British. But the new system was unsuited to the Mahratta genius; it hampered the meteoric movements of the cavalry, which was obliged to manœuvre in combination with the new artillery and the disciplined battalions. Mahratta elders hence uttered predictions of military disaster which were in the end more than fulfilled.

The rapid and amazing success of the Mahratta confederation rendered it the largest Hindu power that ever existed in India. But it lacked the elements of true greatness. It was founded by plundering expeditions, and its subsequent existence was tainted by the baseness of this predatory origin. With the exception of the pēshwas, its chiefs were little more than freebooting warriors, for the most part rude, violent and unlettered. Their custom was to offer their neighbours or victims the alternative of paying *chouth*, that is, one-fourth of the revenue, or being plundered and ravaged. Thus the Mahratta *chouth* came to have an ominous significance in Indian history. Desultory efforts were made to establish a civil government, but in the main there was no administration formed on statesmanlike principles. The pēshwas, on the other hand, as Brahmans, were men of the highest education then possible in India. But they were absorbed by the direction of military and political combinations, and by intrigues for the preservation of their own power; and, even allowing for all this, they failed to evince the civil capacity which might have been anticipated. While several displayed commanding abilities, and some possessed many virtues, one alone attempted to conduct an administration in an enlightened manner, and he died prematurely.

There were at the same time powers existing in India to keep the Mahrattas in check, and some parts of India were excepted from their depredations. The English power was rising at Calcutta, Madras and Bombay. The nascent Sikh power prevented Mahratta incursions from being permanently successful in the Punjab. As the Mogul Empire broke up, some separate Mahommedan powers rose upon its ruins. The nizam of the Deccan established himself at Hyderabad, comparatively near the headquarters of the pēshwa. Hyder Ali was proclaimed sultan of Mysore in the south. Ahmed Shah Abdali burst upon India from Afghanistan. The Mahrattas bravely encountered him at Panipat near Delhi in 1761, and were decisively defeated. The defeat, however, did not essentially shake the Mahratta confederation. It was collision with the English that broke that wonderful fabric to pieces.

The first collision with the English occurred in 1775, arising from a disputed succession to the pēshwaship. The English government at Bombay supported one of the claimants, and the affair became critical for the English as well as for the Mahrattas. It was at this conjuncture that Warren Hastings displayed his political genius and rendered signal service to his country, by succouring from Bengal the defeated Bombay army and negotiating a peace (in 1782) that restored the *status quo*.

The next collision happened in 1803. The pēshwa had fallen into grave difficulties with some of the principal members of the Mahratta confederation. He therefore placed himself under British protection, and this led to the great Mahratta War, in which the Marquis Wellesley displayed those talents for military and political combination which rendered him illustrious. It was during the campaigns which ensued that General Arthur Wellesley defeated Sindhia and the Bhonsla raja at Assaye, and General Lake won the victories of Farrukhabad, Dīg and Laswari over Sindhia and Holkar. The three confederates, Sindhia, Holkar and the Bhonsla, concluded peace with the British government, after making large sacrifices of territory in favour of the victor, and submitting to British control politically. It was during these events that the British won the province of Orissa, the old Hindustan afterwards part of the North-Western Provinces, and a part of the western coast in Gujarat.

The third collision came to pass between 1816 and 1818, through the conduct, not only of the confederates, but also of the pēshwa (Baji Bao) himself. During the previous war the pēshwa had been the protégé and ally of the British; and since the war he had fallen more completely than before under British protection—British political officers and British troops being stationed at his capital. He apparently felt encouraged by circumstances to rebel. Holkar and the Bhonsla committed hostile acts. The predatory Pindaris offered a formidable resistance to the British troops. So the pēshwa ventured to take part in the combination against the British power, which even yet the Mahrattas did not despair of overthrowing. After long-protracted menaces, he attacked the British at Kirkee, but failed utterly, and fled a ruined man. Ultimately he surrendered to Sir John Malcolm, and was sent as a state pensioner to Bithūr, near Cawnpore. The British, however, released the raja of Satara from the captivity in which he had been kept during the pēshwa's time, and reinstated him on the throne, with a limited territory. Owing to these events the British government became possessed of the Konkan and of the greater part of the Deccan.

It remains to mention briefly the fortunes of each remaining member of the once imperial confederation. The principality of Satara was held to have lapsed in 1848 by the death of the raja without lineal heirs, and was annexed by the British government. The Bhonsla raja of Nagpur died without lineal heirs in 1853, and his territory was likewise annexed. The house of Holkar remained faithful to its engagements with the British government, and its position as a feudatory of the empire was maintained. In Sindhia's territory, by reason of internal feuds, the British had to undertake measures which were successfully terminated after the battles of Maharajpur and Panniar in 1843. But on the whole the house of Sindhia remained faithful. Sindhia himself was actively loyal during the Mutiny. The gaekwar gradually fell under British control towards the close of the 18th century, and his house never engaged in hostilities with the British government. The ex-pēshwa lived to old age at Bithur, and died in 1857. His adopted son grew up to be the Nana Sahib, of infamous memory, who took a leading part in the Mutiny.

See J. Grant Duff, *History of the Mahrattas* (3 vols., 1826); T. D. Broughton, *Letters written in a Mahratta Camp* (1813); M. G. Ranade, *Rise of the Maratha Power* (Bombay, 1900).
(R. T.; J. S. Co.)

MAHSEER, or MAHASEER (*Barbus mosal*), a kind of barbel, abundant in the rivers of India, especially in pools of the upper and more rapid streams where they issue from the mountainous part of the country. It is one of the largest species of the Cyprinid family, attaining to a length of 3 to 5 ft., and sometimes exceeding a weight of 70 ℔. Its body is well-proportioned, rather elongate, and somewhat like that of the European barbel, but covered with very large scales, of which there are only twenty-five or twenty-seven placed along the lateral line; the dorsal fin is armed with a long and strong spine, and the mouth provided with four slender and short barbels. The lips are sometimes produced into fleshy lobes. To the fisherman in India the mahseer affords the same kind of sport as the salmon in the British Isles, and it rivals that fish as regards size, strength and activity. Its flesh is likewise much esteemed.

MAI, ANGELO (1782–1854), Italian cardinal and philologist, was born of humble parents at Schilpario in the province of Bergamo, Lombardy, on the 7th of March 1782. In 1799 he entered the Society of Jesus, and in 1804 he became a teacher of classics in the college of Naples. After completing his studies at the Collegium Romanum, he lived for some time at Orvieto, where he was engaged in teaching and palaeographical studies. The political events of 1808 necessitated his withdrawal from Rome (to which he had meanwhile returned) to Milan, where in 1813 he was made custodian of the Ambrosian library. He now threw himself with characteristic energy and zeal into the task of examining the numerous MSS. committed to his charge, and in the course of the next six years was able to restore to the world a considerable number of long-lost works. Having withdrawn from the Society of Jesus, he was invited to Rome in 1819 as chief keeper of the Vatican library. In 1833 he was transferred to the office of secretary of the congregation of the Propaganda; on the 12th of February 1838 he was raised to the dignity of cardinal. He died at Castelgandolfo, near Albano, on the 8th of September 1854.

It is on his skill as a reader of palimpsests that Mai's fame chiefly rests. To the period of his residence at Milan belong: Fragments of Cicero's *Pro Scauro*, *Pro Tullio*, *Pro Flacco*, *In Clodium et Curionem*, *De aere alieno Milonis*, *De rege* (*Alexandrino* (1814); *M. Corn. Frontonis opera inedita, cum epistolis item ineditis, Antonini Pii, Marci Aurelii, Lucii Veri et Appiani* (1815; new ed., 1823, with more than 100 additional letters found in the Vatican library); portions of eight speeches of Quintus Aurelius Symmachus; fragments of Plautus; the oration of Isaeus *De hereditate Cleonymi*; the last nine books of the *Antiquities* of Dionysius of Halicarnassus, and a number of other works. *M. Tullii Ciceronis de republica quae supersunt* appeared at Rome in 1822; *Scriptorum veterum nova collectio, e vaticanis codicibus edita* in 1825–1838; *Classici scriptores e vaticanis codicibus editi* in 1828–1838; *Spicilegium romanum* in 1839–1844; and *Patrum nova bibliotheca* in 1845–1853. His edition of the celebrated *Codex vaticanus*, completed in 1838, but not published (ostensibly on the ground of inaccuracies) till four years after his death (1858), is the least satisfactory of his labours and was superseded by the edition of Vercellone and Cozza (1868), which itself leaves much to be desired. Although Mai was not as successful in textual criticism as in the decipherment of manuscripts, he will always be remembered as a laborious and persevering pioneer, by whose efforts many ancient writings have been rescued from oblivion.

See B. Prina, *Biografia del cardinale Angelo Mai* (Bergamo, 1882), a scientific work, which gives a full and, at the same time, a just appreciation of his work; Cozza-Luzi, *Epistolario del card. Angelo Mai* (Bergamo, 1883); life by G. Poletto (Siena, 1887).

MAIA, in Greek mythology, the eldest of the Pleiades, the seven daughters of Atlas and the Oceanid Pleïone. She and her sisters, born on Mt Cyllene in Arcadia, are sometimes called mountain goddesses. In a cave of Cyllene Maia became by Zeus the mother of the god Hermes. The story is told in the *Hymn to Hermes* attributed to Homer. She was identified by the Romans with Maia Majesta, an old Italian goddess of spring, to whom a sacrifice was offered on the 1st of May by the priest of Vulcan.

MAIDA, a town of Calabria, Italy, in the province of Catanzaro, from which it is 30 m. W.S.W. direct, and 12 m. N.N.E. of Pizzo by rail (the station is 8 m. W. of the town). Pop. (1901), 5190. The town gives its name to the plain of Maida, where in 1806 British troops under Sir John Stuart defeated the French under Regnier. The names Maida Hill and Maida Vale in London are derived from this battle.

MAIDAN, an Indian term for any open plain. The Maidan is the name of the park in Calcutta, surrounding Fort William, where society people drive in the afternoon. The name is also applied to one of the valleys in the Afridi country of Tirah, and to the plateau portion of the state of Mysore.

MAIDEN, or MAID, a young unmarried girl. "Maid" is a shortened form of "maiden," O. Eng. *maegden*, which represents a diminutive of a Teutonic word meaning "young person," of either sex. An old English word "may," meaning a kinsman or kinswoman, and also a virgin or girl, represents the original. In early usage "maiden" as meaning "virgin" is frequently applied to the male sex, thus, in Malory's *Morte d'Arthur*, Sir Percyvale is called a "parfyte clene megden." Apart from the direct applications of the word to the unmarried state, such as "maiden name," "maiden lady," &c., the word is used adjectivally, implying the preservation of the first state of an object, or indicating a first effort of any kind. Probably a "maiden" fortress is one which has never fallen, though the *New English Dictionary* suggests that the various "maiden castles" in England, usually ancient earthworks, may have been so called from being so strong that they could be defended by maidens, and points out that Edinburgh Castle, called "maiden-castle" by William Drummond of Hawthornden (*Speech for Edinburgh to the King*), is styled *Castrum puellarum*, the "castle of the maidens," in Geoffrey of Monmouth. A "maiden" assize, circuit or session is one at which there are no prisoners for trial; a "maiden over" or "maiden" in cricket is an over from which no runs are scored. A "maiden speech" is the first speech made by a member of parliament in the house. In the *Annual Register* for 1794 (quoted in *N.E.D.*) the expression, with reference to Canning's first speech, is said to be "according to the technical language of the house." "Maiden" is applied to several objects, to a movable framework or horse for drying and airing of linen, to a washerwoman's "dolly" or wooden beater, to the "kirnbaby" formed of the last sheaf of corn reaped which formerly figured in the Scottish harvest homes, and to the beheading instrument, known as the "Scottish maiden" (see below). "Maid," apart from its primary sense of an unmarried woman, is chiefly used for a domestic female servant, usually with a qualifying word prefixed, such as "housemaid," "parlourmaid," &c.

The title of "MAID OF HONOUR" is given to an unmarried lady attached to the personal suite of a queen. The custom of sending young girls of noble or good birth to the court of a prince or feudal superior, for the purpose, primarily, of education, goes back to early feudal times, and is parallel with the sending of boys to act as pages and squires to the feudal castles. The regular establishment of maids of honour (*filles d'honneur*) appears first in the royal court of France. This has usually been attributed to Anne of Brittany, wife of Charles VIII.; she had a group of unmarried girls of high rank at her court as part of her household, in whom she took a lively and parental interest, educating them and bestowing a dowry upon them on their marriage. A slightly earlier instance, however, has been found. When the young Margaret of Austria came to France on her espousal to Charles VIII., broken by his marriage to Anne of Brittany, there were in her train several *filles d'honneur*, whose names appear in the *Comptes d'argenterie de la reine Marguerite d'Autriche*, from 1484–1485 and 1488–1489 (*Archives de l'empire K.K. 80 and 81* quoted by A. Jal, *Dictionnaire critique de biographie et d'histoire*). It is from the days of Francis I. that the *chroniques scandaleuses* begin which circle round the maids of honour of the French court. The maids of Catherine de Medici, celebrated as the "flying squadron," *l'escadron volant*, are familiar from the pages of Pierre de l'Estoile (1574–1611) and Brantôme. Among those whose beauty Catherine used in her political intrigues, the most famous were Isabelle de Limeuil, Mlle de Montmorency-Fosseux, known as *la belle Fosseuse*, and Charlotte de Baune. The *filles d' honneur*, as an institution, were suppressed in the reign of Louis XIV., at the instigation of Mme de Montespan—who had been one of them—and their place was taken by the *dames de palais*. In the English court, this custom of attaching "maids of honour" to the queen's person was no doubt adopted from France. At the present day a queen regnant has eight maids of honour, a queen consort four. They take precedence next after the daughters of barons, and where they have not by right or courtesy a title of their own, they are styled "Honourable."

The Scottish Maiden was an instrument of capital punishment formerly in use in Scotland. It is said to have been invented by the earl of Morton, who is also said to have been its first victim. This, however, could not have been the case, as the maiden was first used at the execution of the inferior agents in the assassination of Rizzio (1561) and Morton was not beheaded till 1581. The maiden was practically an early form of guillotine. A loaded blade or axe moving in grooves was fixed in a frame about ten feet high. The axe was raised to the full height of the frame and then released, severing the victim's head from his body. At least 120 suffered death by the maiden, including the regent Morton, Sir John Gordon of Haddo, President Spottiswood, the marquis and earl of Argyll. In 1710 it ceased to be used; it is now preserved in the museum of the Society of Antiquaries of Scotland, in Edinburgh.

MAIDENHAIR, in botany, the common name for a fern, *Adiantum Capillus-Veneris*, characterized by the spreading hair-like branches of the frond, the ultimate pinnules of which are ½ to 1 in. long with a rounded crenate outer edge and repeatedly forked veins; the sori (or masses of spore-capsules) are in the crenatures of the pinnules, and are protected by a kidney-shaped involucre. The plant is widely distributed in temperate and tropical regions, and is occasionally found in the western counties of England, the Isle of Man, and west Ireland, growing on damp rocks or walls especially near the sea. The genus *Adiantum* is a large one containing many handsome species both tropical and temperate, well known in greenhouse and hothouse cultivation.

Maidenhair-tree is a popular name for *Ginkgo biloba*, a remarkable and handsome gymnospermous tree, the fan-shaped leaves of which with their forked veins recall those of the maidenhair (see Gymnosperms).

MAIDENHEAD, a market town and municipal borough in the Wokingham parliamentary division of Berkshire, England; 24½ m. W. of London by the Great Western railway. Pop. (1901), 12,980. Area, 2125 acres. It is pleasantly situated on and above the west (right) bank of the Thames, and is much in favour as a residential town and a resort of boating parties. Though of high antiquity it is wholly modern in appearance, and a large number of handsome houses have been built in its vicinity. A beautiful timbered house of the 15th century, however, survives in Ockwells, a short distance south of the town. The stone bridge carrying the London road over the Thames dates from 1772; but the crossing is of ancient importance. Maidenhead has trade in malt and grain. The borough is under a mayor, 4 aldermen and 12 councillors.

The history of Maidenhead (Maydenhutt, Maydenhith) is bound up with that of the ancient bridge. It is not mentioned in Domesday. Edward I. (1297) gave a grant of pontage in aid of the bridge, which was almost broken down; similar grants to the "bailiffs and good men of Maydenhithe" were made by succeeding sovereigns. In 1451 Henry VI. incorporated the gild of the Brethren and Sisters of Maydenhith to provide certain necessaries for the celebration of Mass and to keep the bridge in order: the gild, dissolved at the Reformation, was revived by Elizabeth, who, however, later (1581) substituted for it a corporation consisting of a warden, bridgemaster, burgesses and commonalty: the governing charter until the 19th century was that of James I. (1685) incorporating the town under the title of the mayor, bridgemaster and burgesses. In 1400 Thomas Holand, earl of Kent, held the bridge in the interests of the deposed Richard II., but was eventually forced to retire. In 1643 a meeting took place in the town between Charles I. and three of his children. In the 18th century a considerable trade was done in carrying malt, meal and timber in barges to London: at that time three fairs were held which have now practically disappeared. The Wednesday market is held under a charter of Elizabeth (1582).

MAID MARIAN, a personage incorporated in the English legend of Robin Hood. There is no evidence that she had originally any connexion with the Robin Hood cycle. She seems to have been an essential feature of the morris dance, and in the may-game was paired sometimes with Robin-Hood, but oftener with Friar Tuck. The well-known pastoral play of Adam de la Hale, *Jeu de Robin et Marion*, and the many French songs on the subject, account for the association of the names. In the ballads on Robin Hood her name is twice casually mentioned, but there is a late ballad, by a certain S. G. (F. J. Child, *English and Scottish Ballads*, i. 219), which tells how Maid Marian sought Robin in the forest disguised as a page, and fought with him for an hour before she recognized him by his voice. S. G. was perhaps acquainted with the two plays, written in 1598, of *The Downfall* and *The Death of Robert Earl of Huntingdon*, by Anthony Munday and Harry Chettle. In *The Downfall* Matilda Fitz Walter escapes from the persecution of King John by following her lover to Sherwood Forest, where they took the names of Robin Hood and Maid Marian, and lived apart until they could be legally united. Perhaps this tale has some connexion with the romance of the outlaw Fulk Fitz Warin. Matilda or Mahaud, widow of Theobald Walter, escaped from John's solicitations by marrying the outlawed Fulk and following him to the forest. There were in semi-historical legends three Matildas pursued by King John, of whom particulars are given by H. L. D. Ward in his *Catalogue of Romances* (i. 502). Their several histories were fused by the Elizabethan dramatists, and associated with the Maid Marian of the morris dance, who up to that time had probably only a vague connexion with Robin Hood.

MAIDSTONE, a market town and municipal and parliamentary borough, and the county town of Kent, England, 41 m. E.S.E. of London by the South Eastern & Chatham railway. Pop. (1901), 33,516; area, 4008 acres. It lies principally on the eastern bank of the river Medway, the modern part spreading over the western slopes of a picturesque valley, which is intersected and environed by orchards and hop gardens, this being the richest agricultural district of Kent. The hop grounds form the so-called middle growth of Kent, and the town has the principal grain market in the county. Archbishop Boniface in 1260 established a hospital here (Newark hospital) for poor pilgrims, the chapel of which, with modern additions, is now St Peter's Church. The parish church of St Mary, which had existed from Norman times, was demolished in 1395 by Archbishop Courtenay, who erected on the site the present church of All

Saints. This fine Perpendicular building contains, besides many excellent monuments, the richly carved sedilia and the twenty-eight oak seats used by the collegiate priests. Courtenay also founded a college of secular canons, the ruins of which are an interesting specimen of 14th-century architecture. From the reign of John until the Reformation the archbishops had a residence here, at which Stafford and Courtenay died. This Perpendicular building, with its Elizabethan east front, was acquired by the corporation as a memorial of Queen Victoria's Jubilee in 1887, and houses the school of science and art. The rectory, with the manor, passed into lay hands at the Reformation; and, having been a perpetual curacy for three hundred and twenty years, the living became a vicarage in 1866. The grammar school was founded in 1549, and endowed with the estates of the local Corpus Christi fraternity, then dissolved; the hall in which the gild assembled remains, but the school is established in modern buildings on a new site. There are oil-mills, rope, sacking and twine factories, and cement, lime, and brick works. There is a considerable carrying trade on the Medway. A museum, with public library, was opened in 1858, in an interesting building of the early part of the 16th century. This is the headquarters of the Kent Archaeological Society, founded by the Rev. L. B. Larking in 1858. In 1890 an art gallery was added. The West Kent and General hospital, the county ophthalmic hospital, county gaol and barracks may be mentioned among other institutions. From Saxon times down to 1830 condemned malefactors were executed, and all the great county meetings were held, on Penenden Heath, a common situated about a mile north-east of the town, and enclosed by the corporation as a public recreation ground. The parliamentary borough of Maidstone returns one member. The town is governed by a mayor, 6 aldermen and 18 councillors.

There is evidence of a Roman settlement at Maidstone. The name Maidstone (Medwegestun, Meddestane, Maydestan), probably meaning Medway Town, is presumably of Saxon origin. At the time of the Domesday Survey it belonged to the archbishop of Canterbury, and from the reign of John the archbishops had a residence there. Its position in the centre of Kent gave it an early importance; the shire-moot was held on Penenden Heath in the 11th century, and Maidstone was an assize town in the reign of Edward I. In 1537 Cranmer exchanged the manor of Maidstone with the king, and it was granted by Edward VI. to Sir Thomas Wyatt. Edward also incorporated the town by the title of the mayor, jurats and commonalty; it had formerly been governed by a portreve and 12 "brethren." This charter was forfeited through Wyatt's rebellion; a second charter was granted by Elizabeth in 1559 and confirmed by subsequent sovereigns. A new charter constituting a governing body of a mayor, 12 jurats and 40 common councilmen was given at the petition of the inhabitants by George II. in 1747, and remained the governing charter until 1835. Four fairs were granted by the charter of 1559; these are now held on the 13th of February, the 12th of May, the 20th of June and the 17th of October. A Thursday market was granted by Henry III. to Archbishop Boniface, and a market every second Tuesday in the month by charter of George II. A corn market on Tuesday and a cattle market on Thursday are still held. The manufacture of linen and woollen goods was introduced by Walloons, who settled here in 1567. This was succeeded by paper-making, now the chief industry of the town. The cultivation of hops has been carried on since the 17th century.

Maidstone has been associated with various incidents of general history. Wat Tyler broke into the prison, liberated John Ball the rebel preacher, and committed various depredations. Several of the leading inhabitants joined Jack Cade's rising. The rising of the Kentish Royalists in 1648 collapsed at Maidstone, where on the 1st of June Fairfax, after five hours' obstinate fighting, captured the town at midnight.

See *Victoria County History, Kent*; I. M. Russell, *History of Maidstone* (1881).

MAIHAR, a native state of Central India, in the Baghelkhand agency. Area, 407 sq. m.; pop. (1901), 63,702; estimated revenue, £4700. The state, which is watered by the Tons river, consists mainly of alluvial soil covering sandstone, and is fertile except in the hilly district of the south. A large area is under forest, the produce of which provides a small export trade. The chief, whose title is raja, claims descent from the Kachwaha Rajput clan. The state suffered severely from famine in 1896–1897. The town of Maihar (pop. 6802) is on the East Indian railway, 97 m. N. of Jubbulpore. Extensive ruins of shrines and other buildings in its neighbourhood indicate a former much greater extent of the place.

MAIL. (1) (Through Fr. *maille*, from Lat. *macula*, a spot or hole, the mesh of a net), properly a metal ring or link which, joined closely with other links, formed the fabric of body and other armour in the middle ages, till it was superseded by plate-armour. The word "mail," properly applied to this form of chain-armour, is also used of armour generally, whether plate or chain, and is also transferred to the horny defensive coverings of animals, such as the tortoise, crab, &c. (see ARMS AND ARMOUR). (2) (O. Eng. *mâl*, speech; probably the same as O. Saxon *mahal*, assembly; in meaning connected with O.Norse *mâle*, stipulation), a Scots law term meaning rent, tax. "Mails and duties" are the rents, whether in kind or money, of an estate. In English the word only survives in "blackmail" (*q.v.*). (3) (Through O. Fr. *male*, mod. *malle*, a Teutonic word surviving in Dutch *maal*), properly a bag, especially one used in travelling; this word, which appears in Chaucer, is now applied chiefly to the despatch and delivery of postal matter. In this sense "mail" is properly the bag in which such matter is conveyed, and hence is applied to the contents of the mail, postal matter collectively, and to the train, carts, or other means used in the despatch and delivery of the same. In general usage "mail" is confined to the "foreign" as opposed to the "inland" despatch of letters, &c., and to which the word "post" is chiefly applied; in official language, the word refers to the inland despatch. The word appears also in "mail-coach," a coach used for conveying the mails, and in "mail-cart," a cart similarly employed. This word is also applied to a light low vehicle propelled or drawn by hand, suitable for young children. The "mail phaeton" is a type of phaeton with high seat for two persons and drawn by a pair of horses.

MAILLY, LOUISE JULIE, COMTESSE DE (1710–1751), mistress of Louis XV. of France, was the daughter of Louis, marquis de Nesle. She was the eldest of three sisters who succeeded one another as favourites of the king. In 1726 she married her cousin, Louis Alexandre de Mailly. Although Louis XV. had paid her attentions from 1732, she did not become titular mistress until 1738. She did not use her position either to enrich herself or to interfere in politics. She was supplanted by her sister, the duchess of Châteauroux, and obliged to leave court in 1742.

See E. and J. de Goncourt, *La Duchesse de Châteauroux et ses sœurs* (1879); Toussaint, *Anecdotes curieuses de [illegible] Louis XV.* (2 vols., 1905); J. B. H. R. Capefigue, *Mesdemoiselles de Nesle et la jeunesse de Louis XV.* (1864).

MAIMANA, a town and khanate of Afghan Turkestan. The town is situated 100 m. S.W. of Balkh, and only some 25 m. from the frontier of Russian Turkestan. It is about two-thirds the size of Herat, square built and surrounded by a ruined wall and moat. The khanate was for long in dispute between Bokhara and Kabul, but in 1868 Abdur Rahman laid siege to the town, and it was compelled to come to terms. Its political status as an Afghan province was definitely fixed by the Russo-Afghan boundary commission of 1885. The inhabitants are chiefly Uzbegs.

MAIMAND, a town in the province of Fars, Persia, a few miles east of Firuzabad and about 70 m. from Shiraz. It has a population of about 5000, almost wholly occupied with the manufacture and sale of rose-water, which is largely exported to many parts of Persia as well as to Arabia, India and Java. The district also produces great quantities of almonds. The rose gardens cover several square miles. In 1349 a great part of Maimand and of three little villages belonging to it became *wakf* (pious endowment) of the shrine at Shiraz of Mīr Ahmed, surnamed Shah Chiragh, a son of Musa Kazim, the seventh imām of the Shiahs, and the remainder of the Maimand grounds was given to the shrine by Mīr Habbib Ullah Sharifi and by Shah Ismail in 1504; the administration of the Maimand property as well as the guardianship of the shrine is still with the descendants of Mīr Habbib Ullah.

MAIMBOURG, LOUIS (1610–1686), French Jesuit and historian, was born at Nancy. He entered the Society of Jesus at the age of sixteen, and after studying at Rome became a classical master in the Jesuit college at Rouen. He afterwards devoted himself to preaching, but with only moderate success. After having taken some part in minor controversies he threw himself with energy into the dispute which had arisen as to the Gallican liberties; for his *Traité historique sur les prérogatives de l'Église de Rome* (1682) he was by command of Innocent XI. expelled from the Society, but rewarded by Louis XIV. with a residence at the abbey of St Victor, Paris, and a pension. He died on the 13th of August 1686. His numerous works include histories of Arianism, the iconoclastic controversy, the Greek schism, Lutheranism, Calvinism, and of the pontificates of Leo I. and Gregory I.; they are mere compilations, written indeed in a very lively and attractive style, but inaccurate and untrustworthy.

The History of Arianism was published in English (1728–1729) by William Webster, with an appendix on the English writers in the Socinian and Arian controversies.

MAIMING, mutilation, a physical injury which involves the loss of, or incapacity to use, a bodily member. The verb "to maim," in M. E. *maynhe, mahayme, mayme*, &c. was adopted from O. Fr. *mahaignier*: cf. It. *magagnars*, Med. Lat. *mahemiare, mahennare*, &c. (see Du Cange, *Gloss.*, *s.v.* "Mahamium"). Maiming or mutilation is and has been practised by many races with various ethnical and religious significances, and was a customary form of punishment on the principle of an "eye for an eye" (see Mutilation). In law "maiming" is a criminal offence; the old law term for a special case of maiming of persons was "mayhem" (*q.v.*), an Anglo-French variant form of the word. Maiming of animals by others than their owners is a particular form of the offences generally grouped as "malicious damage." For the purpose of the law as to this offence animals are divided into cattle, which includes horses, pigs and asses, and other animals which are either subjects of larceny at common law or are usually kept in confinement or for domestic purposes. The punishment for maiming of cattle is three to fourteen years' penal servitude. Malicious injury to other animals is a misdemeanour punishable on summary conviction. For a second offence the penalty is imprisonment with hard labour for over twelve months. (Malicious Damage Act 1861.) Maiming of animals by their owner falls under the Cruelty to Animals Acts.

MAIMON, SALOMON (1754–1800), German philosopher, was born of Jewish parentage in Polish Lithuania, and died at Nieder-Siegersdorf on the 22nd of November 1800. He married at the age of twelve, and studied medicine in Berlin. In 1770 he severed his connexion with his orthodox co-religionists by his critical commentary on the *Moreh Nebuḥim* of Maimonides, and devoted himself to the study of philosophy on the lines of Wolff and Moses Mendelssohn. After many vicissitudes he found a peaceful residence in the house of Count Kalkreuth at Nieder-Siegersdorf in 1790. During the ensuing ten years he published the works which have made his reputation as a critical philosopher. Hitherto his life had been a long struggle against difficulties of all kinds. From his autobiography, it is clear that his keen critical faculty was developed in great measure by the slender means of culture at his disposal. It was not till 1788 that he made the acquaintance of the Kantian philosophy, which was to form the basis of his lifework, and as early as 1790 he published the *Versuch über die Transcendentalphilosophie*, in which he formulates his objections to the system. He seizes upon the fundamental incompatibility of a consciousness which can apprehend, and yet is separated from, the "thing-in-itself." That which is object of thought cannot be outside consciousness; just as in mathematics $\sqrt{-1}$ is an unreal quantity, so "things-in-themselves" are *ex hypothesi* outside consciousness, *i.e.* are unthinkable. The Kantian paradox he explains as the result of an attempt to explain the origin of the "given" in consciousness. The *form* of things is admittedly subjective; the mind endeavours to explain the *material* of the given in the same terms, an attempt which is not only impossible but involves a denial of the elementary laws of thought. Knowledge of the given is, therefore, essentially incomplete. Complete or perfect knowledge is confined to the domain of pure thought, to logic and mathematics. Thus the problem of the "thing-in-itself" is dismissed from the inquiry, and philosophy is limited to the sphere of pure thought. The Kantian categories are, indeed, demonstrable and true, but their application to the given is meaningless and unthinkable. By this critical scepticism Maimon takes up a position intermediate between Kant and Hume. Hume's attitude to the empirical is entirely supported by Maimon. The casual concept, as given by experience, expresses not a necessary objective order of things, but an ordered scheme of perception; it is subjective and cannot be postulated as a concrete law apart from consciousness. The main argument of the *Transcendentalphilosophie* not only drew from Kant, who saw it in MS., the remark that Maimon alone of his all critics had mastered the true meaning of his philosophy, but also directed the path of most subsequent criticism.

Maimon's chief works, in addition to the above quoted, are *Philos. Wörterbuch* (1791); *Streifereien im Gebiete der Philos.* (1793); *Über die Progresse der Philos.* (1793); *Die Kategorien des Aristoteles mit Anmerkungen erläutert* (1794); *Versuch einer neuen Logik* (1794 and 1798); *Kritische Untersuchungen über den menschl. Geist* (1797). See *S. Maimons Lebensgeschichte von ihm selbst beschrieben* (1792, ed. K. P. Moritz; Eng. trans. by J. C. Murray, 1888); Wolff, *Maimoniana* (1813); Witte, *S. Maimon* (1876).

MAIMONIDES, the common name of Rabbi Moses ben Maimon (1135–1204), also known from the initials of these last words as Rambam, Jewish philosopher. His life falls into three epochs, which may be typified by the towns in which they were passed, viz. Cordova, Fez and Cairo. He was born in Cordova on the 20th of March 1135, the eve of Passover; he had a brother, David, and one sister. His early years were spent in his native town, which had then just passed the zenith of its glory. The Arab rulers had fostered the development of science, art, medicine, philosophy, literature and learning. All these influences played their part in the education of Maimonides, whose father, besides training him in all branches of Hebrew and Jewish scholarship, implanted in the youth a sound knowledge of these secular studies as well. In 1148 Cordova was taken from the last Fatimite caliph by the victorious Almohades, who had spread over Spain from N. Africa. These militant revivalists strove to re-establish Islam in what they considered its primitive simplicity. They laid great stress on the unity of God, and tolerated neither schism within the faith nor dissent without. The position of the orthodox Spanish Jews became intolerable, and Maimon, after ten years of hardships, wanderings and escapes, decided to take his family out of the country. He settled in Fez. The years which Maimonides spent there (1160–1165) were memorable for his friendship with Abdul Arab Ibn Muisha—a Moslem poet and theologian—and for the commencement of his literary activity. His energies were diverted towards stimulating the religious feelings of his brethren and combating assimilation. In consequence he became alarmed for his own safety, and in 1165 left for Egypt, where he settled after a passing visit to the Holy Land. Cordova taught him the humanities; Fez humanity. Cairo, besides giving him prominence at court and in the Jewish community, was the centre of the almost world-wide influence which he exercised over Jewry by his monumental writings and dominant personality. By 1177 Maimonides was the recognized chief of the Cairene congregation and consulted on important matters by communities far and wide. Here he was joined by his most famous disciple, Joseph Aknin. But his early life in Egypt was fraught with deep sorrow. His father died soon after their arrival, and Maimonides himself suffered severely from prostration and sickness. His brother David, jointly with whom he carried on a trade in gems, was shipwrecked in the Indian Ocean. With him perished the entire fortune of the family. Forced to earn a livelihood, Maimonides turned to medicine. The fame of his skill eventually brought him the appointment of body physician to Saladin, to whom, it is said, he was so attached that when Richard I. wrote from Ascalon, offering him a similar post at the English court, Maimonides refused. He married the sister of Ibn al Māli, one of the royal secretaries. In 1186, his son Abraham was born. His remaining years were spent in ceaseless activity and in controversy, which he sought to avoid. He died amidst universal sorrow and veneration.

The works of Maimonides fall into three periods: (*a*) To the Spanish period belong his commentary on the whole Talmud (not fully carried out), a treatise on the calendar (*Maamar ha-ibbur*), a treatise on logic (*Milloth Higgayon*), and his commentary on the *Mishnah* (this was called *Siraj* or *Maor*, *i.e.* "Light": begun 1158, completed 1168 in Egypt). (*b*) While he was in Fez, he wrote an essay on the Sanctification of the Name of God (*Maamar Kiddush Hashem, Iggereth Hashemad*). (*c*) The works written in Egypt were: Letter to the Yemenites (*Iggereth Teman* or *Pethaḥ Tiqvah*); *Responsa* on questions of law; Biblical and Rabbinical Code (*Misnheh Torah* or *Yad Hahazaka*, completed 1180); *Sepher hamitzvoth*, an abbreviated handbook of the preceding; and his great philosophical work *Moreh Nebuḥim* or "the guide of the perplexed" (1190). To these must be added certain portions of the *Mishnah* commentary, such as the "Eight Chapters," the discussion on reward and punishment and immortality, the Jewish Creed, which have acquired fame as independent works.

The influence of Moses ben Maimon is incalculable. "From Moses unto Moses there arose not one like Moses," is the verdict of posterity. Maimonides was the great exponent of reason in faith and toleration in theology. One of the main services to European thought of the "Guide" was its independent criticism of some of Aristotle's principles. His codification of the Talmud was equally appreciated in the study of the scholar and in practical life. Christian Europe owed much to Maimonides. Not only did his "Guide" influence scholasticism in general, but it was from his Code that the Church derived its medieval knowledge of the Synagogue.

A complete bibliography will be found in *Maimonides*, by David Yellin and Israel Abrahams (London, 1903); the final chapter of that work gives a summary of the influence of Maimonides on Christian philosophers such as Aquinas, and Jewish such as Spinoza. The "Guide" has been translated into English by M. Friedlander (1881–1885; new ed., 1905). See also *Jewish Encyclopedia*, articles *s.v.*, and the volumes edited by Guttmann, *Moses ben Maimon* (Leipzig, 1908, &c.). (H. Le.)

MAIN (Lat. *Moenus*), a river of Germany, and the most important right-bank tributary of the Rhine. It has two sources, the Weisse Main (White Main), which rises in the Fichtelgebirge on the east side of the Ochsenkopf, and the Rote Main (Red Main), which, rising on the eastern slope of the Frankish Jura, flows past Bayreuth. They unite 3 m. below Kulmbach, 920 ft. above the sea. Hence the river, already of considerable size, pursues a north-westerly direction, skirting the spurs of the Frankish Jura in a pleasant valley. At Lichtenfels the river takes a south-westerly course, which it retains until entering the fertile basin of Bamberg. Here it receives from the south-east the waters of its chief tributary, the Regnitz, and enters upon its middle course. Its direction is now again north-west, and meandering through pleasant vales and pastures it passes Hassfurt and reaches Schweinfurt. Its course is now almost due south to Ochsenfurt, when it again proceeds north-west. Continuing in this direction amid vine-clad hills, it washes the walls of the university city of Würzburg, and thence, dividing the forest-clad ranges of the Spessart and the Odenwald, reaches Gemünden. Here it is joined from the right by the Frankish Saale and, turning abruptly south, receives at Wertheim the beautiful Tauber. Feudal castles and medieval towns now crown its banks, notably, Freudenberg and Miltenberg. From the latter it proceeds due north to Aschaffenburg, whence passing Frankfort it pours its yellow waters into the green waters of the Rhine just above Mainz. The Main has a total length of 310 m. and drains a basin of approximately 11,000 sq. m. It is navigable from the confluence of the Regnitz, 240 m. from its mouth, for barges and other small craft, and through the Ludwig Canal is connected with the Danube.

See Ulrici, *Das Maingebiet in seiner natürlichen Beschaffenheit* (Kassel, 1885); E. Faber, *Zur Hydrographie des Maingebiets* (Munich, 1895), and Lill, *Mainthal, Main und Mainschiffahrt* (Berlin, 1904).

MAIN (from the Aryan root which appears in "may" and "might," and Lat. *magnus*, great), a word meaning properly power or strength, especially physical. This use chiefly survives in the expression "with might and main." The word is more common as a substantival elliptical use of the adjective, which usually has the sense of principal or chief in size, strength, importance, &c. Thus "the main," the high open sea, is for "main sea," cf. "mainland," the principal part of a territory excluding islands and sometimes far-projecting peninsulas. The expression "the Spanish main" properly meant that part of the main land of the N.E. coast of South America stretching from the Orinoco to the Isthmus of Panama, and the former Spanish possessions in Central America bordering on the Caribbean Sea, but it is often loosely used, especially in connexion with the buccaneers, of the Caribbean Sea itself. The term "main" is also thus used of a principal pipe or cable for conducting gas, water, electricity, &c. The elliptical use does not appear, however, in such expressions as main road, line, stream. Another use of the word "main" has a somewhat obscure history. It appears as a term in the game of hazard, and also in cock-fighting. In the last it is used for a match, and for the cocks engaged in a match. In hazard it is the number called by the "caster" before the dice are thrown; this may be any number from five to nine inclusive. The usual derivation is from the French *main*, a hand, but according to the *New English Dictionary* there is no evidence for this, and the more probable explanation is that it is an adaptation of "main" meaning principal or chief. From this use of the word in hazard the expression "main chance" is derived. "Main," a shortened form of domain or demesne, only now survives in Scotland, usually in the plural "mains" for a home farm.

MAINA (or Mani) and **MAINOTES**, a district and people of the Peloponnesus, the modern Morea. Maina is the country occupied by the mountain range of Taygetus from Sparta to Cape Matapan, the ancient Taenarum. It is now divided between the modern districts Oetylos and Gythion. Before the organization of the present kingdom of Greece, Maina was subdivided into Ἔξω Μάνη, Outer Maina, from the frontier of Kalamata, on the Gulf of Messenia, to Vitylo (Oetylos) and inland to the summit of Taygetus; Κάτω Μάνη, Lower Maina, from Vitylo to Cape Matapan; and Μέσα Μάνη, or Inner Maina, on the east, and on the Gulf of Laconia as far as the plain of Elos. It contained over a hundred villages. The country is mountainous and inaccessible, a formation to which it owes its historical importance. The Mainotes claim to descend from the Spartans, and probably represent the Eleuthero, or free, Laconians who were delivered by Rome from the power of Sparta, as is suggested by the traces of ancient Greek in their dialect and by their physical type. Their country being a natural fortress, they were able to defend themselves against the Byzantine emperors, the barbarians who broke into the empire, the Latin princes of Achaea of the house of Villehardouin, and the Turks. As their country is also poor and maritime, they were early tempted to take to piratical adventure. Gibbon says that "in the time of Constantine Porphyrogenitus they had acquired the name of Mainotes, under which they dishonour the claim of liberty by the inhuman pillage of all that is shipwrecked on their rocky shore." Their neighbours gave their country the name of "Kakaboulia"—the land of wicked counsels. The passes of their mountains were elaborately fortified and their villages were full of fortified towers (*pyrgoi*) from which they formed their own favourite epithet, Maina Polypyrgos—many-towered Maina. On the western side it also contains the remains of feudal keeps, erected by William II. de Villehardouin (1245–1278) and other Latin princes of Achaea. The Mainotes did not become Christians till the 9th century. From the 15th till the 17th century they recognized a family which claimed to belong to the Comneni of Trebizond as head chiefs. But the real power was in the hands of the chiefs of the different families and villages, who formed a turbulent and martial aristocracy. Enduring and ferocious feuds were common among them. In the course of the 18th century the family of Mavromicheli (Black Michael), which belonged to lower Maina, established a general headship over the Mainotes after much strife and many murders. When Russia endeavoured to promote a rising against the Turks in the Morea in 1770 the Mainotes acted with her, and the strength of their country enabled them to escape the vengeance of the Turks when the Christians were cynically deserted by the Russians. In 1777 their practical independence was recognized by the sultan's officers. During the Greek war of independence the Mainotes were chiefly led by Petros (Petro Bey) Mavromicheli, known to his countrymen as the king of Maina, who undoubtedly cherished the hope of establishing a principality for himself. The freedom of Greece, for which he had fought in his own way, proved the ruin of his ambition. He found the new order less compatible with his schemes than the Turkish dominion. Petro Bey was imprisoned by the Greek president Capodistrias (see CAPO D'ISTRIA, COUNT), who was in revenge murdered by the Mavromichelis. The family were finally content to become courtiers and officials in the reign of King Otto I. In the 19th century Maina was but little affected by civilization, except in so far as the efficiency of modern navies debarred the Mainotes from their old resource of piracy.

See W. Martin Leake, *Travels in the Morea* (1830); M. E. Yemeniz, "La Maina," in *Revue des deux mondes* (March 1, 1865); and Philipson, "Zur Ethnographie des Peloponnes," in *Petermanns Mittheilungen*, vol. 36 (Gotha).

MAINE, ANNE LOUISE BÉNÉDICTE DE BOURBON, DUCHESSE DU (1676–1753), daughter of Henri Jules de Bourbon, prince de Condé and Anne of Bavaria, was born on the 8th of November 1676. On the 19th of March 1692 she married Louis Auguste de Bourbon, duc du Maine, son of Louis XIV. and Mme de Montespan. The duchesse du Maine held a little court at Sceaux, where she gave brilliant entertainments and immersed herself in political intrigues. Displeased with the action of the regent Orleans in degrading the illegitimate children of Louis XIV. from their precedence above the peers of France, she induced her husband to join in the Cellamare conspiracy for the transference of the regency to the king of Spain. The plot, however, was discovered, and she was imprisoned in 1719. The following year she returned to Sceaux, where she resumed her salon and gathered round her a brilliant company of wits and poets. She died in Paris on the 23rd of January 1753.

See Général de Piépape, *La Duchesse du Maine* (1910).

MAINE, SIR HENRY JAMES SUMNER (1822–1888), English comparative jurist and historian, son of Dr James Maine, of Kelso, Roxburghshire, was born on the 15th of August 1822. He was at school at Christ's Hospital, and thence went up to Pembroke College, Cambridge, in 1840. At Cambridge he was one of the most brilliant classical scholars of his time. He won a Craven scholarship and graduated as senior classic in 1844, being also senior chancellor's medallist in classics. Shortly afterwards he accepted a tutorship at Trinity Hall. In 1847 he was appointed regius professor of civil law, and he was called to the bar three years later; he held this chair till 1854. Even the rudiments of Roman law were not then included in the ordinary training of English lawyers; it was assumed at the universities that any good Latin scholar could qualify himself at short notice for keeping up such tradition of civilian studies as survived. Maine cannot have known much Roman law in 1847, but in 1856 he contributed to the *Cambridge Essays* the essay on Roman law and legal education, republished in the later editions of *Village Communities*, which was the first characteristic evidence of his genius. Meanwhile he had become one of the readers appointed by the Inns of Court, in the first of their many half-hearted attempts at legal education, in 1852. Lectures delivered by Maine in this capacity were the groundwork of *Ancient Law* (1861), the book by which his reputation was made at one stroke. Its object, as modestly stated in the preface, was "to indicate some of the earliest ideas of mankind, as they are reflected in ancient law, and to point out the relation of those ideas to modern thought." Within a year of its publication the post of legal member of council in India was offered to Maine, then a junior member of the bar with little practice, few advantages of connexion, and no political or official claims. He declined once, on grounds of health; the very next year the office was again vacant. This time Maine was persuaded to accept, not that his health had improved, but that he thought India might not make it much worse. It turned out that India suited him much better than Cambridge or London. His work, like most of the work done by Englishmen in India in time of peace, was not of a showy kind—its value is shown by the fact that he was asked to prolong his services beyond the regular term of five years, and returned to England only in 1869. The subjects on which it was his duty to advise the government of India were as much political as legal. They ranged from such problems as the land settlement of the Punjab, or the introduction of civil marriage to provide for the needs of unorthodox Hindus, to the question how far the study of Persian should be required or encouraged among European civil servants. On the civil marriage question in particular, and some years earlier on the still more troublesome one of allowing the remarriage of native converts to Christianity, his guidance, being not only learned but statesmanlike, was of the greatest value. Plans of codification, moreover, were prepared, and largely shaped, under Maine's direction, which were carried into effect by his successors, Sir J. Fitzjames Stephen and Dr Whitley Stokes. The results are open to criticism in details, but form on the whole a remarkable achievement in the conversion of unwritten and highly technical law into a body of written law sufficiently clear to be administered by officers to many of whom its ideas and language are foreign. All this was in addition to the routine of legislative and consulting work and the establishment of the legislative department of the government of India on substantially its present footing.

Maine's power of swiftly assimilating new ideas and appreciating modes of thought and conduct remote from modern Western life came into contact with the facts of Indian society at exactly the right time, and his colleagues and other competent observers expressed the highest opinion of his work. In return Maine brought back from his Indian office a store of knowledge which enriched all his later writings, though he took India by name for his theme only once. This essay on India was his contribution to the composite work entitled *The Reign of Queen Victoria* (ed. T. H. Ward, 1887). Not having been separately published, it is perhaps the least known of Maine's writings; but its combination of just perception and large grasp with command of detail is not easily matched outside W. Stubbs's prefaces to some of the chronicles in the Rolls series, and (more lately) F. W. Maitland's monographs. As vice-chancellor of the university of Calcutta, Maine commented, with his usual pregnant ingenuity, on the results produced by the contact of Eastern and Western thought. Three of these addresses were published, wholly or in part, in the later editions of *Village Communities*; the substance of others is understood to be embodied in the Cambridge Rede lecture of 1875, which is to be found in the same volume. The practical side of Maine's experience was not long lost to India; he became a member of the secretary of state's council in 1871, and remained so for the rest of his life. In the same year he was gazetted a K.C.S.I. In 1869 Maine was appointed to the chair of historical and comparative jurisprudence newly founded in the university of Oxford by Corpus Christi College. Residence at Oxford was not required, and the election amounted to an invitation to the new professor to resume and continue in his own way the work he had begun in *Ancient Law*. During the succeeding years he published the principal matters of his lectures in a carefully revised literary form: *Village Communities in the East and the West* (1871); *Early History of Institutions* (1875); *Early Law and Custom* (1883). In all these works the phenomena of societies in an archaic stage, whether still capable of observation or surviving in a fragmentary manner among more modern surroundings or preserved in contemporary records, are brought into line, often with singular felicity, to establish and illustrate the normal process of development in legal and political ideas.

In 1877 the mastership of Trinity Hall, Cambridge, where Maine had formerly been tutor, became vacant. There were two strong candidates whose claims were so nearly equal that it was difficult to elect either; the difficulty was solved by a unanimous invitation to Maine to accept the post. His acceptance entailed the resignation of the Oxford chair, though not continuous residence at Cambridge. Ten years later considerations of a somewhat similar kind led to his election to succeed Sir William Harcourt as Whewell professor of international law at Cambridge. His all too short performance in this office is represented by a posthumous volume which had not received his own final revision, *International Law* (1888).

Meanwhile Maine had published in 1885 his one work of speculative politics, a volume of essays on *Popular Government*, designed to show that democracy is not in itself more stable than any other form of government, and that there is no necessary connexion between democracy and progress. The book was deliberately unpopular in tone; it excited much controversial comment and some serious and useful discussion.

In 1886 there appeared in the *Quarterly Review* (clxii. 181) an article on the posthumous work of J. F. M'Lennan, edited and completed by his brother, entitled "The Patriarchal Theory." The article, though necessarily unsigned (in accordance with the rule of the *Quarterly* as it then stood), was Maine's reply to the M'Lennan brothers' attack on the historical reconstruction of the Indo-European family system put forward in *Ancient Law* and supplemented in *Early Law and Custom*. Maine was generally averse from controversy, but showed on this occasion that it was not for want of controversial power. He carried the war back into the invader's country, and charged J. F. M'Lennan's theory of primitive society with owing its plausible appearance of universal validity to general neglect of the Indo-European evidence and misapprehension of such portions of it as M'Lennan did attempt to handle.

Maine's health, which had never been strong, gave way towards the end of 1887. He went to the Riviera under medical advice, and died at Cannes on the 3rd of February 1888. He left a wife and two sons, of whom the elder died soon afterwards.

An excellent summary of Maine's principal writings may be seen in Sir Mountstuart Grant Duff's memoir. The prompt and full recognition of Maine's genius by continental publicists must not pass unmentioned even in the briefest notice. France, Germany, Italy, Russia have all contributed to do him honour; this is the more remarkable as one or two English publicists of an older school signally failed to appreciate him. Maine warned his countrymen against the insularity which results from ignorance of all law and institutions save one's own; his example has shown the benefit of the contrary habit. His prominent use of Roman law and the wide range of his observation have made his works as intelligible abroad as at home, and thereby much valuable information—for example, concerning the nature of British supremacy in India, and the position of native institutions there—has been made the property of the world of letters instead of the peculiar and obscure possession of a limited class of British public servants. Foreign readers of Maine have perhaps understood even better than English ones that he is not the propounder of a system but the pioneer of a method, and that detailed criticism, profitable as it may be and necessary as in time it must be, will not leave the method itself less valid or diminish the worth of the master's lessons in its use. The rather small bulk of Maine's published and avowed work may be explained partly by a fine literary sense which would let nothing go out under his name unfinished, partly by the drawbacks incident to precarious health. Maine's temperament was averse from the labour of minute criticism, and his avoidance of it was no less a matter of prudence. But it has to be remembered that Maine also wrote much which was never publicly acknowledged. Before he went to India he was one of the original contributors to the *Saturday Review*, founded in 1855, and the inventor of its name. Like his intimate friend Fitzjames Stephen, he was an accomplished journalist, enjoyed occasional article-writing as a diversion from official duties, and never quite abandoned it. The practice of such writing probably counted for something in the freedom and clearness of Maine's style and the effectiveness of his dialectic. His books are a model of scientific exposition which never ceases to be literature.

See Sir A. Lyall and others, in *Law Quart. Rev.* iv. 129 seq. (1888); Sir F. Pollock, "Sir Henry Maine and his Work," in *Oxford Lectures, &c.* (1890); "Sir H. Maine as a Jurist," *Edin. Rev.* (July 1893); Introduction and Notes to new ed. of *Ancient Law* (1906); Sir M. E. Grant Duff, *Sir Henry Maine: a brief Memoir of his Life, &c.* (1892); *Notes from a Diary, passim*; L. Stephen, "Maine" in *Dict. Nat. Biog.* (1893); Paul Vinogradoff, *The Teaching of Sir Henry Maine* (1904). (F. Po.)

MAINE, an old French province, bounded N. by Normandy, E. by Orléanais, S. by Touraine and Anjou, and W. by Brittany. Before the Roman Conquest the region occupied by this province was inhabited by the Aulerci Cenomanni and the Aulerci Diablintes; under the Roman empire it consisted of two *civitates* comprised in the Provincia Lugdunensis Tertia—the Civitas Cenomannorum and the Civitas Diablintum, whose chief towns were Le Mans and Jublains. These two *civitates* were united during the barbarian period and formed a single bishopric, that of Le Mans, suffragan to the metropolitan see of Tours. Under the Merovingians and Carolingians the diocese of Le Mans corresponded to the Pagus Cenomanensis, and in the feudal period to the county of Maine. In the 16th century the county of Maine, with the addition of Perche, formed a military government—the province of Maine. Since 1790 this province has been represented approximately by the departments of Sarthe and Mayenne, the respective capitals of which are Le Mans and Laval. In 1855 the bishopric of Laval was separated from that of Le Mans. Maine was evangelized in the 3rd century by St Julian. After forming part of the kingdom of Syagrius, it was conquered by Clovis at the end of the 5th century. Owing to the scarcity of documents the history of Maine until the end of the 9th century is merged in the history of the bishops of Le Mans, which has come down to us in the *Actus pontificum Cenomannis in urbe degentium* (ed. Busson-Ledru, Le Mans, 1901), composed under the direction of Bishop Aldric (832–857). Roger (*c.* 892–*c.* 898) was perhaps the first hereditary count of Maine; the counts whose existence is certain are Hugh I. (*c.* 939–before 992), Hugh II. (before 992–1015), Herbert I. (1015–1032 to 1036), Hugh III. (1032 to 1036–1051), Herbert II. (1051–1062), William the Bastard (1063–1087), Robert Curthose (1087–1091), Hugh IV. (1091–1092) and Helias (1092–1110). Maine, which was in the vassalage of Anjou as early as the 9th century, was united to Anjou in 1110 by the marriage of Count Helias's daughter to Fulk V., count of Anjou, and passed to the English crown in 1154, when Henry Plantagenet (who was born at Le Mans) became king of England. In 1204, after the confiscation of the estates of John of England, Maine was united to France; in 1246 it was separated from France by Louis IX., who handed it over to his brother Charles, count of Provence. Again united to France in 1328, it was given in 1356 as an apanage to Louis, second son of King John II., and did not definitely return to the French crown until 1481, after the death of Charles II., count of Maine. During the Hundred Years' War Maine was taken in 1425 by the English, who lost it in 1448.

See *Histoire de l'église du Mans*, by Dom Piolin (Paris, 1851–1858), which is useful but out of date; *Revue historique et archéologique du Maine* (1876); *La Province du Maine* (1893); B. Hauréau, *Histoire littéraire du Maine* (1870–1877).

MAINE, a North Atlantic state of the United States of America, the most north-easterly state in the Union, and the largest of the New England group. It lies between 43° 4′ and 47° 27′ 33″ N., and between 66° 56′ 48″ and 71° 6′ 41″ W. It is bounded N.W. by the Canadian province of Quebec; N. and E. by the Canadian province of New Brunswick, from which it is separated in part by the natural barriers of the Saint John River, the Grand (or Schoodic) Lakes, the Saint Croix River, and Passamaquoddy Bay; S.S.E. by the Atlantic Ocean; and W. by New Hampshire, the Piscataqua and Salmon Falls rivers being the natural boundary lines at the S.W. The area of the state is 33,040 sq. m., 3145 sq. m. being water surface.

Maine attracts more summer visitors than any other state in the Union. This is due to the cool and refreshing summer climate; the picturesque coast and its many islands, which are favourite grounds for camps and summer cottages; the mountains, and the beautiful lakes and rivers, many of which afford opportunities for good fishing and canoeing. Among the more widely known resorts are Mount Desert Island, on which is Bar Harbor, a fashionable summer place of great beauty; Long Island, Orr's and other islands in Casco Bay; Old Orchard, with a gently sloping white sand sea-beach 9 m. long, Rangeley and Moosehead Lakes, favourite resorts of fishermen and hunters; Mt Katahdin, in the heart of the moose country; and Poland Springs (38 m. by rail from Portland) in Androscoggin county, near lake Anasigunticook. About 1870, camps, summer cottages, summer hotels and boarding houses began to multiply throughout the state. The needs of this summer population gave a new impulse and a new turn to agriculture; and the demand for souvenirs revived among the Indians basket-weaving, moccasin-making, and such crafts.

Physical Features.—The surface is a gently rolling upland, forming a part of the "New England uplands," above which rise isolated mountain peaks and clusters of peaks, and below which are cut numerous river valleys.[1] The highest peak is Mt Katahdin (5200 ft.), a little N.E. of the centre of the state in Piscataquis county, which rises from a comparatively level upland. South-west of Katahdin, in Franklin county, are most of the other high peaks of the state: Saddleback Mountain (4000 ft.), Mt Abraham (3388 ft.), Mt Bigelow (3600 ft.), and Mt Blue (3200 ft.). A little N. of this line of mountain peaks is the water-parting which divides the state into a north slope and a south slope. The north slope descends gently both to the N. and to the E.; although quite hilly in the middle and western portions it is so poorly drained that swamps abound in all sections. The south slope which contains nearly all the mountains and is generally more hilly, has a mean descent toward the sea of about 7 ft. to the mile, the fall being greater in the W., where the mountains are high at the N. and the shore low at the S., and less to the E., where the water-parting is lower and the shore high and rocky.

After the uplift which caused the rivers to cut below the general "uplands," and develop well marked valleys for themselves, came the period of the great continental glaciation. The glacier or ice sheet overran all Maine, irregularly scouring out the bed rock to produce rock basins, damming up many river valleys with glacial deposits and completely disarranging the drainage lines. When the ice melted, the rock basins and the dammed-up valleys filled with water to produce lakes. This is the origin of the numerous lakes of Maine, which give it some of its most beautiful scenery, and help to make it a holiday resort in summer. These lakes are about 1600 in number, are scattered in all parts of the state, are especially numerous at high elevations, and have an aggregate area of more than 2000 sq. m. Few other regions have so many large lakes so variously situated, and with such beauty of aspect and surroundings. They contribute largely to a constant supply of water power for which the course of the rivers of S.W. Maine are exceptionally well adapted, many of them abound in trout, salmon, togue, black bass and pickerel; and near them there is still much game. Moosehead Lake (about 120 sq. m.; 35 m. long and from 2 m. to 10 m. wide), on the boundary between Piscataquis and Somerset counties, is the largest in Maine and the largest inland body of water wholly in New England; the Kennebec River is its principal outlet and Mt Kineo rises abruptly to about 1760 ft. above the sea (about 700 ft. above the lake) on its eastern shore. Other lakes, such as the Rangeley Lakes,[2] Chesuncook and Twin Lakes on the Penobscot, and the Grand or Schoodic Lakes, in the western boundary at the head waters of the Saint Croix River, equal or surpass Moosehead in picturesqueness. The glacier or ice sheet, above referred to, deposited till or boulder clay, which was compacted under the enormous pressure of the ice sheet to form the "hard-pan" referred to later. The glaciation is also responsible for the poor soil of most of the state, for, although the rocks are the same crystallines which give good soils further south in unglaciated regions, all the decayed portions of the Maine rocks have been removed by glacial erosion, revealing fresh, barren rock over great areas, or depositing the rather sterile hard-pan as a thin coating in other places.

After the uplift came a period of subsidence, during which this region sank one or more thousand feet, allowing the sea to encroach on the land and run far inland into the previously made river valleys. This depression probably occurred during the glacial period, perhaps toward its close, and is responsible for the second most important feature of Maine physiography, the embayed coast. To this subsidence are due the picturesque coastal scenery, the numerous islands and bays, the good harbours and the peculiar coast-line.

The shortest distance between the N.E. and the S.W. extremities of the coast is only 225 m.; but, on account of projections and indentations, the coast-line measures not less than 2500 m. The headlands, the deep indentations and the numerous islands in the bays and beyond produce a beautiful mingling of land and sea and give to the whole ocean front the appearance of a fringed and tasselled border; west of the mouth of the Kennebec River are a marshy shore and many low grassy islands; but east of this river the shore becomes more and more bold, rising in the precipitous cliffs and rounded summits of Mt Desert and Quoddy Head, 1527 and 1000 ft. high respectively. All along the coast-line there are capacious and well-protected harbours, Casco, Penobscot, Frenchman's, Machias and Passamaquoddy bays being especially noteworthy.

After the subsidence came another period of uplift, possibly still in progress. This uplift has brought up submarine deposits of sand, &c., to form little coastal plains at some points along the coast, providing good land for settlement and clay for brick and pottery. Further evidence of this uplift is found in old beach lines now well above sea-level.

The principal river systems of Maine are the Saint John on the north slope, and the Penobscot, the Kennebec, the Androscoggin, and the Saco on the south slope. The mean height of the basin of the St John is exceeded only by that of the Androscoggin, but the fall of the St John River through the greater part of its course in Maine is only sufficient to give a sluggish or a gentle current. The Penobscot, Kennebec, Androscoggin and Saco have numerous falls and rapids.

Fauna.—The animal life of Maine shows a mixture of northern and southern forms, and very little that is peculiar as compared with surrounding regions. The state has moose, caribou and deer, especially in the northern part. The black bear, wolf, catamount, wolverine, wild cat, fox, beaver, racoon, marten, sable, woodchuck, skunk, otter, mink, rabbit and squirrel are also found. Geese, ducks and other water fowl frequent the lakes and bays in the migratory season, and eagles, gulls, hawks, kingfishers, owls, plover, woodcock, "partridge" (ruffed grouse), robins, orioles, bobolinks, blue birds, swallows, sparrows, and many other insectivorous birds are common. In the inland waters salmon, trout, togue (*Salvelinus namaycush*), pickerel and bass abound; along the shore there are lobsters, clams and scallops (*Pecten irradians*); and off the shore are herring, alewives, mackerel, cod, halibut, haddock, smelts, hake, menhaden, porgies and porpoises. The game in the North Woods attracts large numbers of sportsmen during the autumn season.

Flora.—Maine was formerly covered with forests, principally of white pine and spruce, but mixed with these were some hemlock, tamarack, cedar, and, on the south slope, birch, poplar, oak, maple and beech. Chestnut and walnut are rare and are found only near

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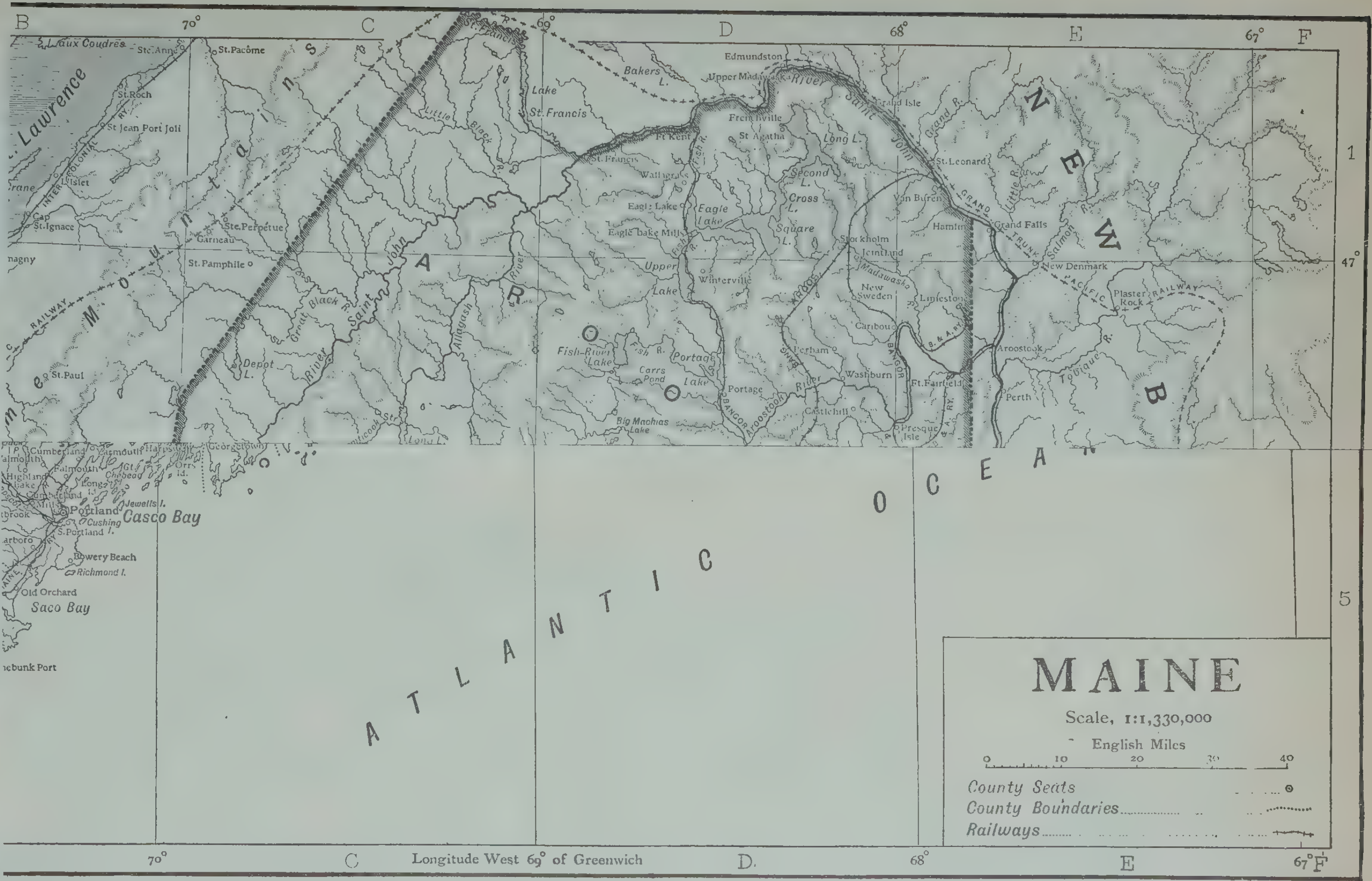
[1] This condition results from the fact that Maine and the adjacent region were worn down nearly to sea-level by stream erosion, except certain peaks and ridges inland; then the region was elevated and numerous river valleys were cut down below the general erosion surface formed before. Thus we have a general "upland surface," above which the mountain remnants tower, and below which the rivers have been entrenched.

[2] This name is applied to a chain of lakes (the Rangeley, or Oquossoc, the Cupsuptic, the Mooselookmeguntic, the Molechunkamunk or Upper Richardson, the Welokenebacook or Lower Richardson, and the Umbagog) in Franklin and Oxford counties, in the western part of the state; the Umbagog extends into New Hampshire and its outlet helps to form the Androscoggin River. These lakes are connected by straits, have a total area of between 80 and 90 sq. m., and are from 1200 to 1500 ft. above the sea. They are sometimes called the Androscoggin Lakes.


MAINE
Scale, 1:1,330,000
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County Seats
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ATLANTIC OCEAN
AROOSTOOK
NEW B
Mountains
Lawrence
St. Paul
St. Ignace
St. Pamphile
Ste. Perpetue
Garneau
St. Pacôme
St. Anne
St. Roch
St Jean Port Joli
Islet
Cap St. Ignace
INTERCOLONIAL RY.
RAILWAY
Saint John River
Great Black R.
Little Black R.
Depot L.
Allagash River
Lake St. Francis
Bakers L.
Edmundston
Upper Madawaska River
Grand Isle
Grand R.
St. Leonard
Little R.
Grand Falls
Salmon R.
New Denmark
Plaster Rock
PACIFIC RAILWAY
GRAND TRUNK
Tobique R.
Perth
Aroostook
Ft. Fairfield
Presque Isle
Castlehill
Washburn
Perham
Caribou
Limestone
New Sweden
Madawaska
Jemtland
Stockholm
Van Buren
Hamlin
B. & A. RY.
BANGOR
Aroostook River
Portage
Portage Lake
Carrs Pond
Big Machias Lake
Fish River Lake
Fish R.
Upper Lake
Winterville
Eagle Lake
Eagle Lake Mills
Wallagrass
Ft. Kent
St. Francis
Frenchville
St. Agatha
Long L.
Second L.
Cross L.
Square L.
Cumberland
Falmouth
Yarmouth
Harpswell
Georgetown
Orrs Id.
Gt. Chebeag
Long I.
Jewells I.
Portland
Cushing I.
S. Portland
Casco Bay
Bowery Beach
Richmond I.
Old Orchard
Saco Bay
Highland Lake
Mills
Scarboro
Kennebunk Port

Emery Walker sc.

the south-west border. In 1900 about 21 % of the state's area was cleared, and much besides had once been cleared, but not being suited to agriculture had become reforested. Of fruit trees the chief is the apple. The plum, cherry and pear also thrive. The peach grows well only in the south-west near the border. Species of grape, gooseberry and currant are native, and others are cultivated with advantage. The blackberry, raspberry, blueberry and strawberry grow wild in profusion throughout the state.

Climate.—The climate of the state is moist and, for its latitude, cold. Extremes of temperature are not so great as farther inland in the same latitude; for the summer heats are tempered by the sea and the cool north winds, and the winter cold is so constant as to be less severely felt than the changing temperature of more southern districts. The summers are short, there being only about 4½ months between frosts even in the southern sections, and the mean summer temperature is about 62° F. The mean winter temperature is approximately 20° F., and the mean annual temperature for the entire state is 42° F., that for the north slope being about 5° F. less than that for the south slope. Although the temperature remains pretty steadily below the freezing point for at least three months of the year, many of the harbours remain unobstructed; for the tides and the prevailing off-shore winds break up and drive off the ice. The precipitation is about 42 in. annually, and is distributed very evenly throughout the year, 10–11 in. of rain or its equivalent in snow falling each season. During 4½ months about 44 % of the precipitation is in the form of snow; but the snow-fall varies from about 60 in. on the coast to more than 100 in. on the north slope. The winds are variable; at no season of the year is it usual for them to blow from the same direction for many days in succession. But, with the exception of those from the west, they are maritime and consequently moisture-bearing. In summer, especially in the latter part of it, the cool and moist N. or N.E. winds often cause a considerable part of the state to be enveloped in fog for several days in succession.

Agriculture.—The soil is for the most part glacial drift, containing a large mixture of clay with sand or gravel, and the sub-soil is mostly "hard-pan," *i.e.* mingled clay and boulders which have been so much compressed by glacial action as to make the mixture hard and ledge-like. Except in the valley of the Aroostook and along the Kennebec, the Penobscot, and some other rivers, the soil is generally unfit for cultivation, there being too little alluvium mixed with it to make it fertile. In the Arroostook valley, however, is the largest undivided area of good arable land in all New England, the soil being a deep, porous, yellow loam well adapted to the growth of cereals and to market gardening. The most sterile regions are on the mountains and along the coast. Because of the cold climate, the large areas in which there is little or no good arable land, the growing demand for timber land, and the large and constant supply of water-power afforded by the principal rivers, agriculture in Maine, as in all the other New England states except Vermont, is a smaller industry than manufacturing; in 1900 there were 87,932 people engaged in manufacturing and only 76,932 engaged in agriculture. Only 32·9 % of the state's land area was in that year included in farms, only 37·9 % of this farm land was improved, and only 16·3 % of the improved land was in crops other than hay and forage. Nevertheless, as indicated by the unusually large proportion of farmers who either own their farms or pay cash rent for them, farming usually is profitable. The number of farms in 1900 was 59,299; of these 18,644 contained between 50 and 100 acres and 17,191 contained between 100 and 175 acres, the average size being 106·2 acres; 54,263 (or 91·5 %) were operated by their owners, 775 were operated by part owners, 2030 by cash tenants, and only 745 by share tenants. Beginning with the middle of the 19th century, the increasing competition of the more productive soils of the West, the growth of urban population in the state, and the number of summer visitors effected the reforesting of much poor land and the more intensive cultivation of the better arable land. The cultivation of cereals, for example, has given way to a marked extent in nearly all the farming districts except in Aroostook county to market gardening, dairying, and egg and poultry production. The number of dairy cows increased from 157,240 in 1890 to 183,000 in 1908, and the annual production of milk increased from 57,969,791 gallons in 1890 to 99,586,188 gallons in 1900. The number of other neat cattle (180,878 in 1900; 151,000 in 1908) decreased during every decade from 1860 to 1900; the number of sheep in 1900 was 427,209 (31·9 % less than in 1890), and in 1908 it was 267,000; but the number of horses in 1890 and 1900 was about the same (140,310 in 1900, but only 116,000 in 1908). Hay is still by far the largest crop, the acreage of it and of forage in 1899 being 1,270,254 acres, or 76·5 % of that of all crops, and the yield was 1,133,932 tons; in 1907 the acreage was 1,400,000 acres, and the crop was 2,100,000 tons. The acreage of cereals decreased from 187,013 in 1880, when agriculture in Aroostook county was little developed, to 166,896 in 1899, when the cereal acreage in Aroostook county alone was 82,069. Maine potatoes are of a superior quality, and the acreage of this crop increased from 49,617 in 1889 to 118,000 in 1907. Sweet Indian corn, cabbages, turnips, cucumbers and tomatoes are grown in large quantities. The fruit crop consists very largely of apples and strawberries (1,421,773 bushels of apples and 1,066,860 quarts of strawberries in 1899). The output of eggs increased from 9,369,534 dozen in 1889 to 13,304,150 dozen in 1899. The most productive dairy section of the state is a belt extending from the south-west corner N.E. entirely across the state and embracing the whole or parts of the counties of York, Oxford, Cumberland, Androscoggin, Kennebec, Penobscot and Aroostook.

Lumber Industry.—Except in the remote parts, the valuable white pine, for which Maine was long noted, has been cut; but the woodland of the state was estimated in 1900 at 23,700 sq. m. or 79 % of its area. The tendency is for this area to increase, for the establishment between 1890 and 1900 of large paper and pulp mills on some of the principal rivers of the south slope greatly increased the value of forests, especially those of spruce and poplar. The state makes large appropriations for preventing and extinguishing forest fires, and in 1903 established a department of forestry in the university of Maine. Good spruce, which is by far the most valuable timber in the state and is used most largely for the manufacture of paper and pulp, stands in large quantities in the St John, Penobscot, Androscoggin and Kennebec basins. Poplar, also used for the manufacture of paper, abounds in several sections of the south slope, but is most abundant in the basin of the Kennebec. White birch, used largely for the manufacture of spools, is found throughout a wide belt extending across the middle of the state. There is much cedar on the north slope. Oak, maple and beech are rather scarce. A new growth of white pine and other timber is gradually becoming valuable. The value of the timber product increased from $11,849,654 in 1890 to $13,489,401 in 1900, and to $17,937,683 in 1905.

Fisheries.—Fishing has always been an important industry in Maine. From 1901 to 1904 inclusive, the average annual catch amounted to 195,335,646 ℔, and its average value was $5,557,083. In 1908, according to state reports, the catch was 185,476,343 ℔, valued at $3,849,900. Herrings are caught in largest quantities (in 1908, according to state reports, 68,210,800 ℔, valued at $450,665), and Maine is noted for the canning of the smaller herrings under the name of "sardines." In 1908, according to state reports, the take of lobsters was 17,635,980 ℔, valued at $1,558,252. Maine markets more clams than any other state in the Union, and the catches of cod, hake, haddock, smelt, mackerel, swordfish, shad, pollock, cusk, salmon, alewives, eels and halibut are of importance. The scallop fishery is becoming more and more valuable. For the protection and promotion of the lobster fishery the United States government has established a lobster hatchery at Boothbay Harbor; and the state legislature enacted a law in 1895 prohibiting the taking of lobsters less than 10½ in. in length (one effect of this law being to drive the lobster-canning industry from the state) and another law in 1903 for the protection of lobsters with eggs attached. This latter law directs the state fish commissioner to purchase such lobsters whenever caught and either to liberate them or to sell them to the United States for keeping in a fish hatchery.

Minerals.—The principal mineral products are granite, limestone, slate, clay products and mineral waters. In 1905 Maine held first rank among the states of the Union as a producer of granite, the value of the output being $2,713,795. In 1907 Maine's granite was valued at $2,146,420, that of Massachusetts at $2,328,777, and that of Vermont at $2,693,889. The stone is of superior quality, and the largest part of it is used for building purposes; much of it is used as paving blocks and some for monuments. It abounds all along the coast east of the Kennebec and on the adjacent islands, and is found farther inland, especially about the Rangeley lakes in Franklin and Oxford counties, and, near Mt Katahdin, in Penobscot and Piscataquis counties. The principal quarries, however, are situated in positions most convenient for shipment by water, in the vicinity of Penobscot bay and in Kennebec county, and these have supplied the bulk of the material used in the construction of many prominent buildings and monuments in the United States. The Fox Island granite comes from the quarries on Vinalhaven Island and the surrounding islands, and on Vinalhaven were quarried monolithic columns 51·5 to 54 ft. long and 6 ft. in diameter for the Cathedral of St John the Divine in New York City. Black granite was quarried in 1907 at 12 quarries, in York, Lincoln, Waldo, Penobscot and Washington counties. Limestone abounds, especially in the south-east part of the state, but it is quarried chiefly in Knox county. As its colour —blue and blue-black streaked with white—renders it undesirable for building purposes, nearly all of it is burned into lime, which has become a very important article of manufacture in the city of Rockland; the industry dates back to 1733 in Knox county. In 1907 the quantity of lime burned in Maine was 159,494 tons and its value was $747,947. Slate is quarried chiefly in Piscataquis county, most of it being used for roofing, but some for blackboards; in 1907 the amount quarried in Maine was valued at $236,106. About 1896 some remarkably white and pure feldspar began to be quarried in Androscoggin, Oxford and Sagadahoc counties, but afterwards the spar mined in Maine was of less excellent quality; in 1907 the production in Maine was valued at $157,334, the total for the entire country being $499,069. Clay is obtained in various places, and in 1905 the total value of the clay products was $619,294. In Oxford county tourmaline, spodumene (or kunzite) and beryl occur, the tourmaline crystals being notably large and beautiful. Mineral water occurs in many localities, particularly in Androscoggin, York, Cumberland and Oxford counties; the most famous springs are the Poland Springs in Androscoggin county. Most of the mineral waters bottled in the state are chalybeate and slightly alkaline—saline; their average temperature is about 43°. In 1908 27 springs were reported, their aggregate sales amounting to 1,182,322 gallons. Copper, gold alloyed with platinum, iron ore, barytes, graphite and lead occur in small quantities in the state. In 1908 the total mineral product of the state was valued at $7,044,678.

Manufactures.—Although Maine has no coal and only a very small amount of iron ore within her borders for the encouragement of manufacturing, yet the abundance of fine timber and the numerous coves, bays and navigable streams along or near the coast promoted ship-building from the first, and this was the leading industry of the state until about the middle of the 19th century, when wooden ships began to be supplanted by those of iron and steel. Until about the same time, when the Maine liquor law was passed, the manufacture of rum from molasses, received in exchange for lumber and fish in the West Indies, was also an important industry. It was not until early in the 19th century that the large and constant supply of water power afforded by the rivers began to be used to any considerable extent. The first cotton mill was built at Brunswick on the Androscoggin about 1809, and from 1830 the development of cotton manufacturing was rapid; woollen mills followed, and late in the 19th century were erected some of the largest paper and pulp mills in the country, which are run by water power from the rivers, and use the spruce and poplar timber in the river basins. The total value of the manufactures of the state increased from $95,689,500 in 1890 to $127,361,485 in 1900; and in 1905 the value of factory-made products alone was $144,020,197, or 27·5 % greater than their value in 1900.[1] Measured by the value of the output, paper and wood pulp rose from fifth among the state's manufactures in 1890 to third in 1900 and to first in 1905; from $3,281,051 in 1890 to $13,223,275 in 1900, an increase of 303 % within the decade, and to $22,951,124 in 1905, a further increase of 73·6 % in this period. Lumber and timber products ranked second (1905)—$11,849,654 in 1890, $13,489,401 in 1900, and $17,937,683 in 1905. Cotton goods ranked third (1905) in value—$15,316,909 in 1890, $14,631,086 in 1900, and $15,404,823 in 1905. Woollen goods ranked fourth (1905)—$8,737,653 in 1890, $13,744,126 in 1900, an increase of 57·3 % within the decade; and the value of the factory-made product alone in 1905 was $13,969,600, or 20·1 % greater than in 1900. Boots and shoes ranked fifth (1905)—$12,295,847 in 1900, and $12,351,293 in 1905. Fish, canned and preserved, followed next, $1,660,881 in 1890 and $4,779,773 in 1900, an increase within the decade of 187·8 %, most of which was in one branch—the canning of small herring under the name "sardines"; from 1900 to 1905 the increase was slight, only $275,358, or 5·8 %. In the value of its manufactures as compared with those of the other states of the Union, in wooden ships and boats, Maine in 1900 and in 1905 was outranked by New York only; in canned and preserved fish by Washington only (the value of fish canned and preserved in Maine in 1900 was 21·7 % of the total for the United States, and in 1905 19·2 %); in the output of woollen mills by Massachusetts and Pennsylvania only; in the output of paper mills by New York and Massachusetts only. It ranked ninth in 1900 and tenth in 1905 in the value of its cotton goods. Portland, Lewiston, Biddeford, and Auburn are the leading manufacturing cities, and in 1905 the total value of their manufactures was 21·5 % of those of the entire state. But from 1900 to 1905 the value of manufactures grew most rapidly in Rockland (especially noted for lime), the increase being from $1,243,881 to $1,822,591 (46·5 %), and in Waterville, where the increase was from $2,283,536 to $3,069,309 (34·4 %). Among the largest paper mills are those at Millinocket, in Penobscot county, at Madison on the Kennebec river, and at Rumford Falls on the Androscoggin river. Lewiston leads in the manufacture of cotton goods; Auburn, Bangor and Augusta, in the manufacture of boots and shoes; Bath, in ship and boat building; Eastport and Lubec, in canning "sardines."

Transportation and Commerce.—The south-western part of the state, including the manufacturing, the quarrying, and much of the older agricultural district, early had fairly satisfactory means of transportation either by water or by rail; for the coast has many excellent harbours, the Kennebec river is navigable for coast vessels to Augusta, the Penobscot to Bangor, and railway service was soon supplied for the villages of the south-west, but it was not until the last decade of the 19th century that the forests, the farming lands, and the summer resorts of Aroostook county were reached by a railway, the Bangor & Aroostook. The first railway in the state, from Bangor to Old Town, was completed in 1836, and the state's railway mileage increased from 12 m. in that year to 245 m. in 1850, to 1377·47 m. in 1890, and to 2210·79 in January 1909. The principal railway systems are the Maine Central, which enters every county but one, the Boston & Maine, the Bangor & Aroostook, the Grand Trunk and the Canadian Pacific. Lines of steamboats ply regularly between the largest cities of the state and Boston, between Portland and New York, and between Portland and several Canadian ports.

The foreign trade, especially that with the West Indies and with Great Britain, decreased after 1875, and yet much trade from the West that goes to Montreal during the warmer months passes through Portland during the winter season. The chief exports to foreign countries are textile fabrics, Indian corn, meat, dairy products, apples, paraffin, boards and shooks; the chief imports from foreign countries are sugar, molasses and wool. Fish, canned goods, potatoes, granite, lime, paper, and boots and shoes are also exported to foreign countries to some extent, but they are shipped in larger quantities to other states of the Union, from which Maine receives in return cotton, coal, iron, oil, &c. The ports of entry in Maine are Bangor, Bath, Belfast, Castine, Eastport, Ellsworth, Houlton, Kennebunk, Machias, Portland, Wiscasset and York.

Population.—The population in 1880 was 648,936; in 1890, 661,086; in 1900, 694,466; and in 1910, 742,371.[2] From 1880 to 1900 there was an increase of only 7 %, a percentage which was exceeded in every other state in the Union except Nevada and Vermont. Of the total population of 1900, 599,291, or 86·3 %, were native whites, 93,330 were foreign-born, 1,319 were negroes, 798 were Indians, 119 were Chinese, and 4 were Japanese. Of the inhabitants born in the United States, 588,211, or 97·8 %, were natives of New England and 560,506 were natives of Maine, and of the foreign-born 67,077, or 71·8 %, were natives of Canada (36,169 English and 30,908 French), and 10,159, or 10·8 %, were natives of Ireland. Of the total population, 199,734 were of foreign parentage—*i.e.* either one or both parents were foreign-born—and 89,857 were of Canadian parentage, both on the father's and on the mother's side (41,355 English and 48,502 French). The French-speaking inhabitants probably number considerably more than 50,000. They are of two quite distinct classes. One, numbering about 15,000, includes those who became citizens by the establishment of the northern boundary in 1842 and their descendants. They are largely of Acadian stock. The state has established among them a well-appointed training school for teachers, conducted in the English language, the graduates of which render excellent service in the common schools. The other class is of French-Canadian immigrants, who find profitable employment in the manufacturing centres. The colony of Swedes established by the state near its north-eastern border in 1870 has proved in every way successful. The Indians are remnants of the Penobscot and Passamaquoddy tribes, the Passamaquoddies being a little the more numerous. The Penobscots' chief gathering places are on the islands of the Penobscot river north of Old Town; the Passamaquoddies', on the shores of Passamaquoddy Bay and the banks of the Saint Croix river.

Roman Catholics are more numerous than all the Protestant sects taken together, having in 1906 a membership of 113,419 out of a total of 212,988 in all denominations. In the last decade of the 19th century the urban population (*i.e.* population of places having 4,000 inhabitants or more) increased from 226,268 to 251,685, or 11·2 %; the semi-urban population (*i.e.* population of incorporated places, or the approximate equivalent, having less than 4,000 inhabitants) increased from 14,221 to 26,674, or 87·5 %; while the rural population (*i.e.* population outside of incorporated places) decreased from 420,597 to 416,134, or 1 %. The principal cities of the state are: Portland, pop. (1910), 58,571; Lewiston, 26,247; Bangor, 24,803; Biddeford, 17,079; Auburn, 15,064; Augusta (the capital), 13,211; Waterville, 11,458; Bath, 9,396; Westbrook, 8,281; and Rockland, 8,174.

Administration.—Maine has had but one state constitution; this was ratified in December 1819, about three months before the admission of the state into the Union. It admits of amendment by a two-thirds vote of both houses of the legislature followed by a majority vote of the electorate at the next

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[1] The census of 1905 was taken under the direction of the United States census bureau, but the statistics for hand trades were omitted.

[2] According to previous censuses the population was as follows: (1790) 96,540; (1800) 151,719; (1810) 228,705; (1820) 298,335; (1830) 399,455; (1840) 501,793; (1850) 583,169; (1860) 628,279; (1870) 626,915.

September election; or, as provided by an amendment adopted in 1875, the legislature may by a two-thirds vote of each house summon a constitutional convention. From 1819 to 1875 twelve amendments were adopted; in 1875, after nine more were added, the twenty-one were incorporated in the text; and between 1875 and 1899 nine more were adopted. Suffrage is conferred by the constitution on all male citizens of the United States who are at least twenty-one years of age and have, for some other reason than because of being in the military, naval or marine service of the United States, or of being students at college, lived in the state for three months next preceding any election; the following classes, however, are excepted: paupers, persons under guardianship, Indians not taxed, and, as provided by an amendment adopted in 1892, persons intellectually incapable of reading the state constitution in the English language or of writing their names. State elections were annual until 1897 when they were made biennial; they are held on the second Monday in September in even numbered years, Maine being one of the few states in the Union in which they are not held in November.

The governor is the only executive officer of the state elected by popular vote. There is no lieutenant-governor, the president of the Senate succeeding to the office of governor in case of a vacancy, but there is a council of seven members elected by the legislature (not more than one from any one senatorial district), whose sole function is to advise the governor. The governor's term of office is two years (before 1879 it was one year); and the constitution further directs that he shall be at least thirty years of age at the beginning of his term, that he shall be a native-born citizen of the United States, that when elected he shall have been a resident of the state for five years, and that he shall reside in the state while in office. His power of appointment is unusually extensive and the advice and consent of the council (instead of that of the Senate as in other states) are required for his appointments. He appoints all judges, coroners and notaries public, besides all other civil and military officers for whose appointment neither the constitution nor the laws provide otherwise. The governor is commander-in-chief of the state militia. Any bill of which he disapproves he can within five days after its passage prevent from becoming a law unless it is passed over his veto by a two-thirds vote of each house of the legislature. He and the council examine and pass upon election returns; he may summon extra sessions of the legislature, and he may grant pardons, reprieves, and commutations in all cases except impeachment, but the manner of hearing applications for pardon is in a measure prescribed by statute, and he must present to the legislature an account of each case in which he grants a pardon. His salary is $2,000 a year. The seven members of the council, the secretary of state, the treasurer, the attorney general and the commissioner of agriculture are elected biennially by a joint ballot of the two houses of the legislature, which also elects, one every two years, the three state assessors, whose term is six years.

The legislature meets biennially at Augusta, the capital, and is composed of a Senate of thirty-one members and a House of Representatives of one hundred and fifty-one members. Members of each house are elected for a term of two years: one senator from each senatorial district and one to seven representatives (one for a population of 1,500, and seven for a population of 26,250) from each township, or, where the township or plantation has less than 1,500 inhabitants, from each representative district, according to its population. There is a new reapportionment every ten years, counting from 1821. Every senator and every representative must at the beginning of his term have been for five years a citizen of the United States, for one year a resident of the state, and for three months next preceding his election, as well as during his term of office, a resident of the township or district which he represents; and every senator must be at least twenty-five years of age. All revenue bills must originate in the House of Representatives, but to such bills the Senate may propose amendments provided they relate solely to raising revenue. Other bills may originate in either house. In September 1908 a constitutional amendment was adopted providing for referendum and initiative by the people. Any bill proposed in the legislature or passed by it must be referred to popular vote before becoming law, if there is a referendum petition therefor signed by 10,000 voters; and a petition signed by 12,000 voters initiates new legislation.

At the head of the department of justice is the supreme judicial court, which consists of a chief justice and seven associate justices appointed by the governor and council for a term of seven years. When it sits as a law court, at least five of its justices must be present, and it holds three such sessions annually: one at Augusta, one at Bangor, and one at Portland. But only one of its justices is required for a trial court, and trial courts are held two or three times a year in each county for the trial of both civil and criminal cases which come before it in the first instance or upon appeal. In Cumberland and Kennebec counties there is a superior court presided over by one justice and having extensive civil and criminal jurisdiction; and in each of the counties there are a probate court for the settlement of the estates of deceased persons and courts of the trial justice and the justice of the peace for the trial of petty offences and of civil cases in which the debt or damage involved does not exceed $20.

The principal forms of local government are the town (or township), the plantation, the county and the city. As in other parts of New England, the town is the most important of these. At the regular town meeting held in March the electorate of the town assembles, decides what shall be done for the town during the ensuing year, elects officers to execute its decisions with limited discretion, and votes money to meet the expenses. The principal officers are the selectmen (usually three), town clerk, assessors, collector, treasurer, school committee and road commissioner. A populous section of a town, in order to promote certain financial ends, is commonly incorporated as a village without however becoming a governing organization distinct from the town. Maine is the only state in the Union that retains what is known as the organized plantation. This is a governmental unit organized from an unincorporated township having at least 200 inhabitants,[1] and its principal officers are the moderator, clerk, three assessors, treasurer, collector, constable and school committee. The county is a sort of intermediate organization between the state and the towns to assist chiefly in the administration of justice, especially in the custody of offenders, and in the making and care of roads. Its officers are three commissioners, a treasurer, a register of deeds, a judge and a register of probate, and a sheriff. They are all elected: the commissioners for a term of six years, one retiring every two years, the register of deeds and the judge and the register of probate for a term of four years, and the others for two years. Among other duties the commissioners care for county property, manage county business and take charge of county roads. Maine has no general law under which cities are chartered, and does not even set a minimum population. A town may, therefore, be incorporated as a city whenever it can obtain from the legislature a city charter which a majority of its electorate prefers to a continuance under its town government; consequently there is much variety in the government of the various cities of the state.

By the laws of Maine the property rights of a wife are approximately equal to those of a husband. A woman does not lose nor a man acquire right to property by marriage, and a wife may manage, sell, or will her property without the assent of her husband. She may even receive as her own the wages of her personal labour which was not performed for her own family. In the absence of a will, bar or release, there is no legal distinction between the rights of a widower in the estate of his deceased wife and those of a widow in the estate of her deceased husband. The grounds for divorce in the state are adultery, impotence, extreme cruelty, desertion for three consecutive years next preceding the application, gross and confirmed habits of intoxication, cruel and abusive treatment, or a husband's gross or wanton refusal or neglect to provide a suitable maintenance for his wife.

Under the laws of Maine a householder owning and occupying a house and lot may hold the same, or such part of it as does not exceed $500 in value, as a homestead exempt from attachment, except for the satisfaction of liens for labour or material, by filing in the registry of deeds a certificate stating his desire for such an exemption, provided he is not the owner of an exempted lot purchased from the state; and the exemption may be continued during the widowhood of his widow or the minority of his children. A considerable amount of personal property, including apparel, household furniture not exceeding $100 in value, a library not exceeding $150 in value, interest in a pew in a meeting-house, and a specified amount of fuel, provisions, tools or farming implements, and domestic animals, and one fishing boat, is also exempt from attachment.

Maine was the first state in the Union to enact a law for prohibiting the sale of intoxicating liquors. An act for restricting the sale of such liquors was passed in 1846; the first prohibitory act was passed, largely through the influence of Neal Dow, in 1851; this was frequently amended; and in 1884 an amendment to the constitution was adopted which declares the manufacture of intoxicating liquors and their sale, except "for medicinal and mechanical purposes and the arts," forever prohibited. By the law enacted for enforcing this prohibition the governor and council appoint a state liquor commissioner from whom alone the selectmen of a town, the mayor or aldermen of a city, are authorized to receive the liquors which may be sold within the exceptions named in the amendment, and the selectmen, mayor or aldermen appoint an agent who alone is authorized to sell any of these liquors within their jurisdiction and who is forbidden to sell any whatever to minors, Indians, soldiers and drunkards. But the law labours under the disadvantage of all laws not vigorously sustained by general public sentiment, and is grossly violated. For the most part it is executed to the degree demanded by local sentiment in the several municipalities, thus operating in practice much the same as a "local option" law. The law looks to checking the demand by preventing the supply; and since habitual reliance on the stringency of law tends to the neglect of other influences for the removal of evils from the community, the citizens seem to absolve themselves from personal responsibility, both for the execution of the law and for the existence of the evil itself. There has been a strong movement for the repeal of the law, and the question of prohibition has long been an important one in state politics.

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[1] An unincorporated township containing less than 200 inhabitants may, on the application of three resident voters, be organized as a plantation, but does not pay state or county taxes unless by special legislative order. Other unincorporated districts, especially islands along the coast, are called "grants," "surpluses," "gores" or "tracts."

The death penalty was abolished in Maine in 1876, restored in 1883, and again abolished in 1887.

Penal and Charitable Institutions.—The state penal and reformatory institutions consist of the state prison at Thomaston, the state (reform) school for boys at South Portland, and a state industrial school for girls at Hallowell, established in 1875 and taken over by the state in 1899. The two schools are not places of punishment, but reformatory schools for delinquent boys (from 8 to 16 years of age) and girls (from 6 to 16 years), who have been committed by the courts for violations of law, and, in the case of girls, who, by force of circumstances or associations, are "in manifest danger of becoming outcasts of society." The prison is in charge of a board of three inspectors and a warden, and each of the other two institutions is in charge of a board of trustees; the inspectors, warden, and trustees are all appointed by the governor and council. Convicts in the prison are usually employed in the manufacture of articles that are not extensively made elsewhere in the state, such as carriages, harness, furniture and brooms. The inmates of the state school for boys receive instruction in farming, carpentry, tailoring, laundry work, and various other trades and occupations; and the girls in the state industrial school are trained in housework, laundering, dressmaking, &c. Paupers are cared for chiefly by the towns and cities, those wholly dependent being placed in almshouses and those only partially dependent receiving aid at their homes. The charitable institutions maintained by the state are: the military and naval orphan asylum at Bath, the Maine institution for the blind at Portland, the Maine school for the deaf (established in 1876, and taken over by the state in 1897) at Portland, the Maine insane hospital at Augusta, the Eastern Maine insane hospital at Bangor, and a school for the feeble-minded (established in 1907) at West Pownal, each of which is governed by trustees appointed by the governor and council, with the exception of a part of those of the orphan asylum, who are appointed by the corporation. Besides the strictly state institutions, there are a number of private charitable institutions which are assisted by state funds; among these are the eye and ear infirmary at Portland, the Maine state sanatorium at Hebron for the treatment of tuberculosis, and various hospitals, orphanages, &c. The national government has a branch of the national home for disabled volunteer soldiers at Togus, and a marine hospital at Portland.

Education.—The school-district system was established in 1800 while Maine was still a part of Massachusetts and was maintained by the first school law passed, in 1821, by the state legislature; but, beginning in the next year, one town after another received the privilege of abolishing its districts, and in 1893 the system was abolished by act of the legislature. A state board of education, composed of one member from each county, was established in 1846, but for this was substituted, in 1852, a commissioner of schools for each county, appointed by the governor, and two years later a state superintendent of schools was substituted for the county commissioners. County supervision by county supervisors was tried in 1869–1872. Since these several changes the common school system has been administered by towns and cities subject to an increasing amount of control through enactments of the state legislature and the general supervision of the state superintendent. The town officers are a superintending school committee of three members and a superintendent. The members of the committee are elected for a term of three years, one retiring every year, and women as well as men are eligible for the office. The superintendent may be elected by the town or appointed by the committee, or towns having not less than twenty or more than fifty schools may unite in employing a superintendent. In cities the committee is usually larger than in towns and is commonly elected by wards. Since 1889 each town and city has been required to furnish textbooks, apparatus and supplies, without cost to the pupils. The minimum length of the school year is fixed by a statute of 1893 at twenty weeks; the average length is about twenty-eight weeks. A compulsory education law, enacted in 1901, requires the attendance at some public or approved private school of each child between the ages of seven and fifteen during all the time that school is in session, except that necessary absences may be excused. For the maintenance of the common schools each town is required (since 1905) to raise annually at least fifty-five cents *per capita*, exclusive of what may be received from other sources, and to this is added the proceeds of a state tax of one and a half mills on a dollar, one-half the proceeds of the tax on savings banks, a 6% income from the permanent school fund (derived mainly from the sale of school lands), and state appropriations for the payment in part of the superintendence in towns that have united for that purpose. Any section of a town may establish and maintain a high school provided there be not more than two such schools in one town, and the state makes appropriations for the support of such schools equal to one-half the cost of instruction, but the maximum grant to any one such school is $250.

The state maintains five normal schools: that at Farmington (established 1864), that at Castine (1866), that at Gorham (1879); that at Presque Isle (the Aroostook state normal school, 1903), and the Madawaska training school at Fort Kent, each of which is under the direction of a board of trustees consisting of the governor, the state superintendent of schools, and five other members appointed by the governor and council for not more than three years. At the head of the public school system is the university of Maine, near the village of Orono in Orono township (pop. in 1900, 3257), Penobscot county. This institution was founded in 1865 as the state college of agriculture and the mechanic arts; in 1897 the present name was adopted. It embraces a college of arts and sciences, a college of agriculture, a college of technology (including a department of forestry), a college of law (at Bangor), and a college of pharmacy. The most conspicuous of its twenty-five buildings is the library, built with funds contributed by Andrew Carnegie. In 1908–1909 the university had 104 instructors and 884 students, of whom 113 were in the college of law at Bangor and 420 in the college of technology. The university is maintained with the proceeds of an endowment fund derived chiefly from public lands given by the national government in accordance with the land grant, or Morrill, Act of 1862 (see MORRILL, JUSTIN S.) and from the bequest ($100,000) of Abner Coburn (1803–1885); by appropriations of Congress under the second Morrill Act (1890), and under the Nelson Amendment of 1907, by appropriations of the state legislature, and by fees paid by the students. Connected with the university is an agricultural experiment station, established and maintained under the Hatch Act (1887) and the Adams Act (1906) of the national Congress. The government of the university is entrusted, subject to inspection of the governor and council, to a board of eight trustees. Among the important institutions of learning which have no official connexion with the state are Bowdoin College (opened in 1802), at Brunswick; Colby College (Baptist, opened in 1818), at Waterville; and Bates College (originally Free Baptist but now unsectarian; opened in 1863), at Lewiston. In 1900 5·1% of the state's inhabitants ten years of age and over were illiterate (*i.e.* could neither read nor write, or could read but not write); of the native whites within this age limit 2·4% were illiterate, of the foreign whites, 19·4%. Of the foreign-born whites 15·7% were unable to speak English.

Finance.—The chief sources of the state's revenue are a general property tax and taxes on the franchises of corporations, especially those of railway and insurance companies and savings banks; among the smaller sources are licences or fees, a poll tax, and a collateral inheritance tax. The general property tax for state and local purposes is assessed by local assessors, but their work is reviewed for the purpose of equalization among the several towns and counties by a board of state assessors, which also assesses the corporations. This board of three members (not more than two of whom may be of the same political party) is elected by a joint ballot of the two houses of the legislature for a term of six years, one member retiring every two years. The state is prohibited by the constitution from creating a debt exceeding $300,000 except for the suppression of a rebellion, for repelling an invasion, or for war purposes; and every city and town is forbidden by an amendment adopted in 1877 from creating one exceeding 5% of the assessed value of its property. But the state was authorized by an amendment adopted in 1868 to issue bonds for the reimbursement of the expenses incurred by its cities, towns, and plantations on account of the Civil War, and these bonds, with those issued by the state itself during the Civil War, constituted the largest part of the state's bonded indebtedness. The bonded debt, however, is rapidly being paid; in January 1901 it was $2,103,000, and in January 1909 only $698,000.

History.—During the 16th century and the early part of the 17th, the coast of Maine attracted various explorers, among them Giovanni da Verrazano (1524), Estéban Gomez (1525), Bartholomew Gosnold (1602), Martin Pring (1603), Pierre du Guast, Sieur De Monts (1604), George Weymouth (1605), and John Smith (1614), who explored and mapped the coast and gave to the country the name New England; but no permanent English settlement was established within what are now the borders of the state until some time between 1623 and 1629. In 1603 De Monts received from Henry IV. of France a charter for all the region between 40° and 46° N. under the name of Acadie, or Acadia, and in 1604 he built a fort on Neutral Island at the mouth of the Saint Croix river. This he abandoned in 1605, but some of his followers were in the vicinity a few years later. In the same year George Weymouth explored the south-west coast, kidnapped five Indians, and carried them to England, where three of them lived for a time in the family of Sir Ferdinando Gorges, who soon became the leader in founding Maine. In 1607 the Plymouth Company, of which he was an influential member and which had received a grant of this region from James I. of England in the preceding year, sent out a colony numbering 120 under George Popham (*c.* 1550–1608), brother of Sir John Popham, and Raleigh Gilbert, son of Sir Humphrey Gilbert. The colony established itself at the mouth of the Kennebec river in August, but, finding its supplies insufficient, about three-fifths of its number returned to England in December; a severe winter followed and Popham died; then Gilbert, who succeeded to the presidency of the council for the colony, became especially interested in his claim to the territory under his father's charter,[1] and in 1608 the colony was abandoned. In 1609 the French Jesuits Biard and Masse established a fortified mission station on the island of Mount Desert, and although this as well as the remnant of De Monts' settlement at the mouth of the Saint Croix was taken in 1613 by Sir Samuel Argall (d. 1626), acting under the instructions of the English at Jamestown, Virginia, some of these colonists returned later. In 1620 the Council for New England, the successor of the Plymouth Company, obtained a grant of the country between latitude 40° and 48° N. extending from sea to sea, and two years later Gorges and John Mason (1586–1635) received from the Council a grant of the territory between the Merrimac and the Kennebec rivers for 60 m. inland under the name of the Province of Maine. In 1629 they divided their possession, Gorges taking the portion between the Piscataqua and the Kennebec. Numerous grants of land in this vicinity followed within a few years; and in the meantime permanent settlements at York, Saco, Biddeford, Port Elizabeth, Falmouth (now Portland) and Scarborough were established in rapid succession. The Council for New England surrendered its charter in 1635. In the division of its territory Gorges retained the portion previously granted to him, and the region between the Kennebec and the Saint Croix north to the Saint Lawrence, though still claimed by the French as part of Acadia, was conveyed to Sir William Alexander (1567?–1640); later, in 1664, this was conveyed to the duke of York, afterwards James II. of England.

Gorges named his tract the County of New Somersetshire, and immediately began the administration of government, setting up in 1635 or 1636 a court at Saco under the direction of his kinsman William Gorges. In 1639 he procured for his province a royal charter modelled after that of Maryland, which invested him with the feudal tenure of a county palatine and vice-regal powers of government. He called into existence a formidably large number of officers to govern it, but his charter was in conflict with the other (mutually conflicting) grants of the Council for New England, east of the Piscataqua; and Gorges and his agents met with a determined opposition under the leadership of George Cleeve, the deputy-president of the Lygonia, or "Plough" Patent, which extended along the coast from Cape Porpoise to Casco, and in issuing which the Council for New England had granted governmental as well as territorial rights. Moreover, Puritan Massachusetts, which was naturally hostile to the Anglicanism of Gorges and his followers, interpreted her charter so as to make her northern boundary run east and west from a point 3 m. north of the source of the Merrimac river, and on this basis laid claim to practically the whole of Maine then settled. The factional quarrels there, together with the Commonwealth government in England, made it easy for Massachusetts to enforce this claim at the time, and between 1652 and 1658 Maine was gradually annexed to Massachusetts. In 1672 Massachusetts extended her boundary eastward as far as Penobscot Bay. Ferdinando Gorges, a grandson of the original proprietor, brought before parliament his claim to Maine and in 1664 a committee of that body decided in his favour; but Massachusetts successfully resisted until 1677, when the king in council decided against her. She then quietly purchased the Gorges claim for £1,250 and held the province as a proprietor until 1691, when by the new Massachusetts charter Maine was extended to the Saint Croix river, and was made an integral part of Massachusetts.

The French still claimed all territory east of the Penobscot, and not only was Maine an exposed frontier and battleground during the long struggle of the English against the Indians and the French, but its citizens bore a conspicuous part in the expeditions beyond its borders. Port Royal was taken in May 1690 by Sir William Phipps and Louisburg in June 1745 by Sir William Pepperell, both these commanders being from Maine. These expeditions were such a drain on Maine's population that Massachusetts was called upon to send men to garrison the little forts that protected the homes left defenceless by men who had gone to the front. During the War of Independence, the town of Falmouth (now Portland), which had ardently resisted the claims of the British, was bombarded and burned, in 1775; in the same year Benedict Arnold followed the course of the Kennebec and Dead rivers on his expedition to Quebec; and from 1779 to 1783 a British force was established at Castine. The embargo and non-intercourse laws from 1807 to 1812 were a severe blow to Maine's shipping, and in the War of 1812 Eastport, Castine, Hampden, Bangor and Machias fell into the hands of the British.

Maine was in general well governed as a part of Massachusetts, but a geographical separation, a desire to be rid of the burden of a large state debt, and a difference of economic interests as well as of politics (Maine was largely Democratic and Massachusetts was largely Federalist) created a desire for an independent commonwealth. This was felt before the close of the War of Independence and in 1785–1787 conventions were held at Falmouth (Portland) to consider the matter, but the opposition prevailed. The want of protection during the War of 1812 revived the question, and in 1816 the General Court in response to a great number of petitions submitted to a vote in the towns and plantations of the District the question: "Shall the legislature be requested to give its consent to the separation of the District of Maine from Massachusetts, and the erection of said District into a separate state?" The returns showed 10,393 yeas to 6501 nays, but they also showed that less than one-half the full vote had been cast. Acting upon these returns the legislature passed a bill prescribing the terms of separation, and directed another vote of the towns and plantations upon the question of separation and the election of delegates to a convention at Brunswick which should proceed to frame a constitution in case the second popular vote gave a majority of five to four for separation; but as that vote was only 11,969 yeas to 10,347 nays the advocates of separation were unsuccessful. But a large source of opposition to separation was removed in 1819 when Congress, dividing the east coast of the United States into two great districts, did away with the regulation which, making each state a district for entering and clearing vessels, would have required coasting vessels from the ports of Maine as a separate state to enter and clear on every trip to or from Boston; as a consequence, the separation measures were carried by large majorities this year, a constitution was framed by a convention which met at Portland in October, this was ratified by town meetings in December, and Maine applied for admission into the Union. Owing to the peculiar situation at the time in Congress, arising from the contest over the admission of Missouri, the question of the admission of Maine became an important one in national politics. By an Act of the 3rd of March 1820, however, Maine was finally admitted into the Union as a separate state, her admission being a part of the Missouri compromise (*q.v.*).

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[1] By this charter, issued in 1578, Sir Humphrey Gilbert was entitled to all territory lying within two hundred leagues of any colony that he might plant within six years; although it had long since lapsed, Raleigh Gilbert seems not to have been aware of it.

The boundary on the north had not yet been ascertained, and it had long been a subject of dispute between the United States and Great Britain. The treaty of 1783 (Article II.) had defined the north-east boundary of the United States as extending along the middle of the river St Croix "from its mouth in the bay of Fundy to its source" and "due north from the source of St Croix river to the highlands; along the said highlands which divide those rivers that empty themselves into the river St Lawrence from those which fall into the Atlantic Ocean, to the north-westernmost head of Connecticut river; thence down along the middle of that river to the forty-fifth degree of north latitude." Great Britain claimed that the due north line was 40 m. long and ran to Mars Hill in Aroostook county, and that the highlands ran thence westerly 115 m. to the source of the Chaudière; the United States, on the other hand, claimed that the northerly line was 140 m. long, running to highlands dividing the Ristigouche and the tributaries of the Metis; and there was a further disagreement with regard to the side of the highlands on which the boundary should be, and as to what stream was the "north-westernmost head of Connecticut river." The fifth article of the Jay treaty of 1794 provided for a commission to decide what the St Croix river actually was, and this commission in 1798 defined the St Croix, saying that its mouth was in Passamaquoddy bay and that the boundary ran up this river and the Cheputnatecook to a marked monument. The treaty of Ghent in 1814 (Article IV.) referred the question of the ownership of the islands in Passamaquoddy bay to a commission which gave Moose, Dudley and Frederick islands to the United States; and the same treaty by Article V. provided for the survey (which was made in 1817–1818) of a part of the disputed territory, and for a general commission. The general commissioners met at St Andrews, N.B., in 1816, and in New York City in 1822, only to disagree; and when the king of the Netherlands, chosen as arbitrator in 1829 (under the Convention of 1827) rendered in 1831 a decision against which the state of Maine protested, the Federal Senate withheld its assent to his decision. In 1838–1839 the territory in dispute between New Brunswick and Maine became the scene of a border "war," known as the "Aroostook disturbance"; Maine erected forts along the line she claimed, Congress authorized the president to resist any attempt of Great Britain to enforce exclusive jurisdiction over the disputed territory, and an armed conflict seemed imminent. General Winfield Scott was sent to take command on the Maine frontier, and on the 21st of March 1839 he arranged a truce and a joint occupancy of the territory in dispute until a satisfactory settlement should be reached by the United States and Great Britain. The Webster-Ashburton treaty of 1842 was a compromise, which allowed Maine about 5500 sq. m. less than she had claimed and allowed Great Britain about as much less than her claim; all grants of land previously made by either party within the limits of the territory which by this treaty fell within the dominions of the other party were to be "held valid, ratified and confirmed to the persons in possession under such grants, to the same extent as if such territory had . . . fallen within the dominions of the party by whom such grants were made"; and the government of the United States agreed to pay to Maine and Massachusetts[1] "in equal moieties" the sum of $300,000 as compensation for the lands which they had claimed and which under the treaty they were called upon to surrender. The long controversy, which is known in American history as "The North-East boundary dispute," was not finally settled however until 1910.

It was the Democratic majority in the district of Maine that effected the separation from Massachusetts, and from the date of that separation until 1853 Maine was classed as a Democratic state, although it elected a Whig governor in 1838 and in 1840, and cast its electoral vote for John Quincy Adams in 1824 and 1828 and for W. H. Harrison in 1840. As a result of the slavery question, there was a party disintegration between 1850 and 1855, followed by the supremacy of the Republican party from 1856 to 1878. In 1878, of the 126,169 votes cast in the election for governor, Selden Connor (b. 1839), re-nominated by the Republicans, received 56,554; Joseph L. Smith ("National" or "Greenback"), 41,371; Alonzo Garcelon (1813–1906) (Democratic), 28,218; as no candidate received a majority of the votes, the election was left to the legislature.[2] The vote of the House eliminated Connor, and Garcelon was chosen in the Senate by a Democratic-National fusion. Again there was no election by popular vote in 1879, and Garcelon and his council, to secure the election of a fusion government, counted-in a fusion majority in the legislature by evident falsification of the returns. On the 3rd of January 1880 the Supreme Court declared the governor and council in error in counting in a fusion majority, but on the 7th the governor swore in a legislature with 78 fusion and only two Republican members, and, the governor's term having expired, the president of the Senate, James D. Lamson, became governor, ex-officio. On the 12th the legislative chambers were seized by the Republicans, whose organized legislature was declared legal by the Supreme Court, and who chose as governor Daniel Franklin Davis (1843–1897); whereupon, on the 17th, Joshua L. Chamberlain, to whom the peaceful solution of the difficulty had largely been due, retired from the task assigned him by Garcelon on the 5th of January "to protect the public property and institutions of the state" until Garcelon's successor should be duly qualified. In 1880 the Democrats and Greenbacks united and elected their candidate, but after 1883 Maine was strongly Republican until 1910.

The governors of the state have been as follows:—

William King	Democrat	1820
William Durkee Williamson (acting)	„	1821
Benjamin Ames (acting)	„	1821
Albion Keith Parris	„	1822
Enoch Lincoln	„	1827
Nathan Cutler (acting)	„	1829
Jonathan G. Hunton	„	1830
Samuel Emerson Smith	„	1831
Robert Pinckney Dunlap	„	1834
Edward Kent	Whig	1838
John Fairfield	Democrat	1839
Edward Kent	Whig	1841
John Fairfield	Democrat	1842
Edward Kavanagh (acting)	„	1843
Hugh J. Anderson	„	1844
John Winchester Dana	„	1847
John Hubbard	„	1850
William George Crosby	Whig and Free Soil	1853
Anson Peaslee Morrill	Republican	1855
Samuel Wells	Democrat	1856
Hannibal Hamlin	Republican	1857
Joseph H. Williams (acting)	„	1857
Lot Myrick Morrill	„	1858
Israel Washburn	„	1861
Abner Coburn	„	1863

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[1] An article in the Act relating to the separation of Maine from Massachusetts stipulated that the lands within the District of Maine which prior to the separation had belonged to Massachusetts should after the separation belong one-half to Maine and one-half to Massachusetts. In 1826 the wild lands of Maine were surveyed and divided between the two states; and in 1853 Maine acquired from Massachusetts, for $362,500, all of this land still remaining in possession of the latter state.

[2] According to Art. V. of the constitution a majority of the total number of votes cast was required for election; in case no candidate should receive a majority, it was prescribed that the "House of Representatives shall, by ballot, from the persons having the four highest numbers of votes on the lists, if so many there be, elect two persons and make returns of their names to the Senate, of whom the Senate shall, by ballot, elect one, who shall be declared the governor." An amendment, which became a part of the constitution on the 9th of November 1880, provided that a plurality of the total number of votes cast should be sufficient for election.

Samuel Cony	Republican	1864
Joshua Lawrence Chamberlain	„	1867
Sidney Perham	„	1871
Nelson Dingley	„	1874
Selden Connor	„	1876
Alonzo Garcelon	Democrat	1879
Daniel F. Davis	Republican	1880
Harris Merrill Plaisted	Democrat-Greenback	1881
Frederick Robie	Republican	1883
Joseph R. Bodwell	„	1887
Sebastian S. Marble (acting)	„	1887
Edwin C. Burleigh	„	1889
Henry B. Cleaves	„	1893
Llewellyn Powers	„	1897
John Fremont Hill	„	1901
William T. Cobb	„	1905
Bert M. Fernald	„	1909
Frederick W. Plaisted	Democrat	1911

See S. L. Boardman, *Climate, &c., of Maine* (Washington, 1884); Walton Wells, *The Water Power of Maine* (Augusta, 1869); G. H. Hitchcock, *General Report on the Geology of Maine* (Augusta, 1861); G. H. Stone, *The Glacial Gravels of Maine and their Associated Deposits* (Washington, 1899); T. Nelson Dale, *The Granites of Maine* (Washington, 1907), being Bulletin 313 of the U. S. Geological Survey; B. F. De Costa, *Sketches of the Coast of Maine and Isle of Shoals* (New York, 1869); H. D. Thoreau, *The Maine Woods* (Boston, 1881); L. L. Hubbard, *Woods and Lakes of Maine* (Boston, 1883); T. S. Steele, *Canoe and Camera, a Two Hundred Mile Tour through the Maine Forests* (New York, 1882); William MacDonald, *The Government of Maine, Its History and Administration* (New York, 1902); *Maine Historical Society Collections* (Portland, 1831–); W. D. Williamson, *History of the State of Maine* (Hallowell, 1832); J. P. Baxter, *Sir Ferdinando Gorges and his Province of Maine* (Boston, 1890) and *George Cleeve of Casco Bay* (Portland, 1885); George Folsom, *History of Saco and Biddeford, with notices of other Early Settlements and of the Proprietary Governments in Maine* (Saco, 1830); J. L. Chamberlain, *Maine, Her Place in History* (Augusta, 1877); E. S. Whitin, *Factory Legislation in Maine* (New York, 1908).

MAINE DE BIRAN, FRANÇOIS-PIERRE-GONTHIER (1766–1824), French philosopher, was born at Bergerac, on the 29th of November, 1766. The name Maine he assumed (some time before 1787) from an estate called Le Maine, near Mouleydier. After studying with distinction under the *doctrinaires* of Périgueux, he entered the life-guards of Louis XVI., and was present at Versailles on the memorable 5th and 6th of October 1789. On the breaking up of the *gardes du corps* Biran retired to his patrimonial inheritance of Grateloup, near Bergerac, where his retired life preserved him from the horrors of the Revolution. It was at this period that, to use his own words, he "passed *per saltum* from frivolity to philosophy." He began with psychology, which he made the study of his life. After the Reign of Terror Maine de Biran took part in political affairs. Having been excluded from the council of the Five Hundred on suspicion of royalism, he took part with his friend Lainé in the commission of 1813, which gave expression for the first time to direct opposition to the will of the emperor. After the Restoration he held the office of treasurer to the chamber of deputies, and habitually retired during the autumn recess to his native district to pursue his favourite study. He died on the 20th (16th, or 23rd, according to others) of July 1824.

Maine de Biran's philosophical reputation has suffered from two causes—his obscure and laboured style, and the fact that only a few, and these the least characteristic, of his writings appeared during his lifetime. These consisted of the essay on habit (*Sur l'influence de l'habitude*, 1803), a critical review of P. Laromiguière's lectures (1817), and the philosophical portion of the article "Leibnitz" in the *Biographie universelle* (1819). A treatise on the analysis of thought (*Sur la décomposition de la pensée*), although sent to press, was never printed. In 1834 these writings, together with the essay entitled *Nouvelles considérations sur les rapports du physique et du moral de l'homme*, were published by Victor Cousin, who in 1841 added three volumes, under the title *Œuvres philosophiques de Maine de Biran*. But the publication (in 1859) by E. Naville (from MSS. placed at his father's disposal by Biran's son) of the *Œuvres inédites de Maine de Biran*, in three volumes, first rendered possible a connected view of his philosophical development. At first a sensualist, like Condillac and Locke, next an intellectualist, he finally shows himself a mystical theosophist. The *Essai sur les fondements de la psychologie* represents the second or completest stage of his philosophy, the fragments of the *Nouveaux essais d'anthropologie* the third.

Maine de Biran's first essays in philosophy were written avowedly from the point of view of Locke and Condillac, but even in them he was brought to signalize the essential fact on which his later speculation turns. Dealing with the formation of habits, he is compelled to note that passive impressions, however transformed, do not furnish a complete or adequate explanation. With Laromiguière he distinguishes attention as an active effort, of no less importance than the passive receptivity of sense, and with Butler distinguishes passively formed customs from active habits. He finally arrived at the conclusion that Condillac's notion of passive receptivity as the one source of conscious experience was not only an error in fact but an error of method—in short, that the mechanical mode of viewing consciousness as formed by external influence was fallacious and deceptive. For it he proposed to substitute the genetic method, whereby human conscious experience might be exhibited as growing or developing from its essential basis in connexion with external conditions. The essential basis he finds in the real consciousness of self as an active striving power, and the stages of its development, corresponding to what one may call the relative importance of the external conditions and the reflective clearness of self-consciousness he designates as the affective, the perceptive and the reflective. In connexion with this Biran treats most of the obscure problems which arise in dealing with conscious experience, such as the mode by which the organism is cognized, the mode by which the organism is distinguished from extra-organic things, and the nature of those general ideas by which the relations of things are known to us—cause, power, force, &c.

In the latest stage of his speculation Biran distinguishes the animal existence from the human, under which the three forms above noted are classed, and both from the life of the spirit, in which human thought is brought into relation with the supersensible, divine system of things. This stage is left imperfect. Altogether Biran's work presents a very remarkable specimen of deep metaphysical thinking directed by preference to the psychological aspect of experience.

The *Œuvres inédites* of Maine de Biran by E. Naville contain an introductory study; in 1887 appeared *Science et psychologie: nouvelles œuvres inédites*, with introduction by A. Bertrand. See also O. Merton, *Étude critique sur Maine de Biran* (1865); E. Naville, *Maine de Biran, sa vie et ses pensées* (1874); J. Gérard, *Maine de Biran, essai sur sa philosophie* (1876); Mayonade, *Pensées et pages inédites de Maine de Biran* (Périgueux, 1896); G. Allievo, "Maine de Biran e la sua dottrina antropologica" (Turin, 1896, in *Memorie dell' accademia delle scienze*, 2nd ser., xlv, pt. 2); A. Lang, *Maine de Biran und die neuere Philosophie* (Cologne, 1901); monographs by A. Kühtmann (Bremen, 1901) and M. Couailhac (1905); N. E. Truman in *Cornell Studies in Philosophy*, No. 5 (1904) on Maine de Biran's Philosophy of Will.

MAINE-ET-LOIRE, a department of western France, formed in 1790 for the most part out of the southern portion of the former province of Anjou, and bounded N. by the departments of Mayenne and Sarthe, E. by Indre-et-Loire, S.E. by Vienne, S. by Deux-Sèvres and Vendée, W. by Loire-Inférieure, and N.W. by Ille-et-Vilaine. Area, 2786 sq. m. Pop. (1906), 513,490. Maine-et-Loire is made up of two distinct regions, the line of demarcation running roughly from north to south along the valley of the Sarthe, then turning south-west and passing Brissac and Doué; that to the west consists of granites, felspars, and a continuation of the geological formations of Brittany and Vendée; to the east, schists, limestone and chalk prevail. The department is traversed from east to west by the majestic valley of the Loire, with its rich orchards, nurseries and market-gardens. The highest altitudes are found in the south-west, where north-east of Cholet one eminence reaches 689 ft. Elsewhere the surface is low and undulating in character. The department belongs entirely to the basin of the Loire, the bed of which is wide but shallow, and full of islands, the depth of the water in summer being at some places little more than 2 ft. Floods are sudden and destructive. The chief affluent of the Loire within the department is the Maine, formed a little above Angers by the junction of the Mayenne and the Sarthe, the latter having previously received the waters of the Loire. All three are navigable. Other tributaries of the Loire are the Thouet (with its tributary the Dive), the Layon, the Evre, and the Divatte on the left, and the Authion on the right. The Mayenne is joined on the right by the Oudon, which can be navigated below Segré. The Erdre, which joins the Loire at Nantes, and the Moine, a tributary of the Sèvre-Nantaise, both rise within this department. The climate is very mild. The mean annual temperature of Angers is about 53°, slightly exceeding that of Paris; the rainfall (between 23 and 24 in. annually) is distinctly lower than that of the rest of France. Notwithstanding this deficiency, the frequent fogs, combined with the peculiar nature of the soil in the south-east of the department, produce a degree of moisture which is highly favourable to meadow growths. The winter colds are never severe, and readily permit the cultivation of certain trees which cannot be reared in the adjoining departments.

The agriculture of the department is very prosperous. The produce of cereals, chiefly wheat, oats and barley, is in excess of its needs, and potatoes and mangels also give good returns. Extensive areas in the valley of the Loire are under hemp, and the vegetables, melons and other fruits of that region are of the finest quality. Good wine is produced at Serrant and other places near Angers, and on the right bank of the Layon and near Saumur, the sparkling white wine of which is a rival of the cheaper brands of champagne. Cider is also produced, and the cultivation of fruit is general. Forests and woodland in which oak and beech are the chief trees cover large tracts. The fattening of cattle is an important industry round Cholet, and horses much used for light cavalry are reared. Several thousand workmen are employed in the slate quarries in the vicinity of Angers, tufa is worked in the river valleys, and freestone and other stone, mispickel, iron and coal are also found. Cholet, the chief industrial town, and its district manufacture pocket-handkerchiefs, as well as linen cloths, flannels, cotton goods, and hempen and other coarse fabrics, and similar industries are carried on at Angers, which also manufactures liqueurs, rope, boots and shoes and parasols. Saumur, besides its production of wine, makes beads and enamels. The commerce of Maine-et-Loire comprises the exportation of live stock and of the various products of its soil and industries, and the importation of hemp, cotton, and other raw materials. The department is served by the railways of the state and the Orléans and Western companies. The Mayenne, the Sarthe and the Loir, together with some of the lesser rivers, provide about 130 m. of navigable waterway. In the south-east the canal of the Dive covers some 10 m. in the department.

There are five arrondissements—Angers, Baugé, Cholet, Saumur and Segré, with 34 cantons and 381 communes. Maine-et-Loire belongs to the académie (educational division) of Rennes, to the region of the VIII. army corps, and to the ecclesiastical province of Tours. Angers (*q.v.*), the capital, is the seat of a bishopric and of a court of appeal. Other principal places are Cholet, Saumur, and Fontevrault, which receive separate treatment. For architectural interest there may also be mentioned the châteaux of Brissac (17th century), Serrant (15th and 16th centuries), Montreuil-Bellay (14th and 15th centuries), and Ecuillé (15th century), and the churches of Puy-Notre-Dame (13th century) and St Florent-le-Vieil (13th, 17th, and 19th centuries), the last containing the fine monument to Charles Bonchamps, the Vendean leader, by David d'Angers. Gennes has remains of a theatre and other ruins of the Roman period, as well as two churches dating in part from the 10th century. Ponts-de-Cé, an interesting old town built partly on islands in the Loire, is historically important, because till the Revolution its bridges formed the only way across the Loire between Saumur and Nantes.

MAINPURI, or MYNPOOREE, a town and district of British India, in the Agra division of the United Provinces. The town has a station on a branch of the East Indian railway recently opened from Shikohabad. Pop. (1901), 19,000. It consists of two separate portions, Mainpuri proper and Mukhamganj. Holkar plundered and burned part of the town in 1804, but was repulsed by the local militia. Since the British occupation the population has rapidly increased and many improvements have been carried out. The Agra branch of the Grand Trunk road runs through the town, forming a wide street lined on both sides by shops, which constitute the principal bazaar. Mainpuri has a speciality in the production of carved wooden articles inlaid with brass wire. The American Presbyterian mission manages a high school.

The DISTRICT OF MAINPURI lies in the central Doab. Area, 1675 sq. m. Pop. (1901), 829,357, an increase of 8·8% in the decade. It consists of an almost unbroken plain, intersected by small rivers, with a few undulating sand ridges. It is wooded throughout with mango groves, and isolated clumps of *bâbul* trees occasionally relieve the bareness of its saline *usar* plains. On the south-western boundary the Jumna flows in a deep alluvial bed, sometimes sweeping close to the high banks which overhang its valley, and elsewhere leaving room for a narrow strip of fertile soil between the river and the upland plain. From the low-lying lands thus formed a belt of ravines stretches inland for some 2 m., often covered with jungle, but affording good pasturage for cattle. The district is watered by two branches of the Ganges canal, and is traversed by the main line of the East Indian railway.

Mainpuri anciently formed part of the great kingdom of Kanauj, and after the fall of that famous state it was divided into a number of petty principalities, of which Rapri and Bhongaon were the chief. In 1194 Rapri was made the seat of a Moslem governor. Mainpuri fell to the Moguls on Baber's invasion in 1526, and, although temporarily wrested from them by the short-lived Afghan dynasty of Shere Shah, was again occupied by them on the reinstatement of Humayun after the victory of Panipat. Like the rest of the lower Doab, Mainpuri passed, towards the end of the 18th century, into the power of the Mahrattas, and finally became a portion of the province of Oudh. When this part of the country was ceded to the British, in 1801, Mainpuri town became the headquarters of the extensive district of Etawah, which was in 1856 reduced by the formation of Etah and Mainpuri into separate collectorates. On the outbreak of the Mutiny in 1857 the regiment stationed at Mainpuri revolted and attacked the town, which was successfully defended by the few Europeans of the station for a week, until the arrival of the Jhansi mutineers made it necessary to abandon the district.

MAINTENANCE (Fr. *maintenance*, from *maintenir*, to maintain, support, Lat. *manu tenere*, to hold in the hand). The action of giving support, supplying means of subsistence, keeping efficient or in working order. In English law maintenance is an officious intermeddling in an action that in no way belongs to one by maintaining or assisting either party, with money or otherwise, to prosecute or defend it. It is an indictable offence, both at common law and by statute, and punishable by fine and imprisonment. It invalidates all contracts involving it. It is also actionable. There are, however, certain cases in which maintenance is justifiable, *e.g.* any one who has an interest, even if it be only contingent, in the matter at variance can maintain another in an action concerning the matter; or several parties who have a common interest in the same thing may maintain one another in a suit concerning the same. Neither is it reckoned maintenance to assist another in his suit on charitable grounds, or for a master to assist his servant, or a parent his son, or a husband his wife. The law with regard to the subject is considered at length in *Bradlaugh* v. *Newdegate*, 1883, 11 Q.B.D. 1. See also CHAMPERTY. For the practice of "livery and maintenance" see ENGLISH HISTORY, §§ v. and vi.

A CAP OF MAINTENANCE, *i.e.* a cap of crimson velvet turned up with ermine, is borne, as one of the insignia of the British sovereign, immediately before him at his coronation or on such state occasions as the opening of parliament. It is carried by the hereditary bearer, the marquess of Winchester, upon a white wand. A similar cap is also borne before the lord mayor of London. The origin of this symbol of dignity is obscure. It is stated in the *New English Dictionary* that it was granted by the pope to Henry VII. and Henry VIII. It is probably connected with the "cap of estate" or "dignity," sometimes also styled "cap of maintenance," similar to the royal symbol with two peaks or horns behind, which is borne as a heraldic charge by certain families. It seems originally to have been a privilege of dukes. Where it is used the crest is placed upon it, instead of on the usual wreath.

MAINTENON, FRANÇOISE D'AUBIGNÉ, MARQUISE DE (1635–1719), the second wife of Louis XIV., was born in a prison at Niort, on the 27th of November 1635. Her father, Constant d'Aubigné, was the son of Agrippa d'Aubigné, the famous friend and general of Henry IV., and had been imprisoned as a Huguenot malcontent, but her mother, a fervent Catholic, had the child baptized in her religion, her sponsors being the duc de la Rochefoucauld, father of the author of the *Maxims*, and the comtesse de Neuillant. In 1639 Constant d'Aubigné was released from prison and took all his family with him to Martinique, where he died in 1645, after having lost what fortune remained to him at cards. Mme d'Aubigné returned to France, and from sheer poverty unwillingly yielded her daughter to her sister-in-law, Mme de Villette, who made the child very happy, but converted or pretended to convert her to Protestantism. When this was known an order of state was issued that she should be entrusted to Mme de Neuillant, her godmother. Every means was now used to convert her back to Catholicism, but at the last she only yielded on the condition that she need not believe that the soul of Mme de Villette was lost. Once reconverted, she was neglected and sent home to live with her mother, who had only a small pension of 200 livres a year, which ceased on her death in 1650. The chevalier de Meré, a man of some literary distinction, who had made her acquaintance at Mme de Neuillant's, discovered her penniless condition, and introduced his "young Indian," as he called her, to Scarron, the famous wit and comic writer, at whose house all the literary society of the day assembled. Scarron took a fancy to the friendless girl, and offered either to pay for her admission to a convent, or, though he was deformed and an invalid, to marry her himself. She accepted his offer of marriage, and became Mme Scarron in 1651. For nine years she was not only his most faithful nurse, but an attraction to his house, where she tried to bridle the licence of the conversation of the time. On the death of Scarron, in 1660, Anne of Austria continued his pension to his widow, and even increased it to 2000 livres a year, which enabled her to entertain and frequent the literary society her husband had made her acquainted with; but on the queen-mother's death in 1666 the king refused to continue her pension, and she prepared to leave Paris for Lisbon as lady attendant to the queen of Portugal. But before she started she met Mme de Montespan, who was already, though not avowedly, the king's mistress, and who took such a fancy to her that she obtained the continuance of her pension, which put off for ever the question of going to Portugal. Mme de Montespan did yet more for her, for when, in 1669, her first child by the king was born, Mme Scarron was established with a large income and a large staff of servants at Vaugirard to bring up the king's children in secrecy as they were born. In 1674 the king determined to have his children at court, and their governess, who had now made sufficient fortune to buy the estate of Maintenon, accompanied them. The king had now many opportunities of seeing Mme Scarron, and, though at first he was prejudiced against her, her even temper contrasted so advantageously with the storms of passion and jealousy exhibited by Mme de Montespan, that she grew steadily in his favour, and had in 1678 the gratification of having her estate at Maintenon raised to a marquisate and herself entitled Mme de Maintenon by the king. Such favours brought down the fury of Mme de Montespan's jealousy, and Mme de Maintenon's position was almost unendurable, until, in 1680, the king severed their connexion by making the latter second lady in waiting to the dauphiness, and soon after Mme de Montespan left the court. The new *amie* used her influence on the side of decency, and the queen openly declared she had never been so well treated as at this time, and eventually died in Mme de Maintenon's arms in 1683. The queen's death opened the way to yet greater advancement; in 1684 Mme de Maintenon was made first lady in waiting to the dauphiness, and in the winter of 1685–1686 she was privately married to the king by Harlay, archbishop of Paris, in the presence, it is believed, of Père la Chaise, the king's confessor, the marquis de Montchevreuil, the chevalier de Forbin, and Bontemps. No written proof of the marriage is extant, but that it took place is nevertheless certain. Her life during the next thirty years can be fully studied in her letters, of which many authentic examples are extant. As a wife she was wholly admirable; she had to entertain a man who would not be amused, and had to submit to that terribly strict court etiquette of absolute obedience to the king's inclination, which Saint-Simon so vividly describes, and yet be always cheerful and never complain of weariness or ill-health. Her political influence has probably been exaggerated, but it was supreme in matters of detail. The ministers of the day used to discuss and arrange all the business to be done with the king beforehand with her, and it was all done in her cabinet and in her presence, but the king in more important matters often chose not to consult her. Such mistakes as, for instance, the replacing of Catinat by Villeroi may be attributed to her, but not whole policies—notably, according to Saint-Simon, not the policy with regard to the Spanish succession. Even the revocation of the edict of Nantes and the dragonnades have been laid to her charge, but recent investigations have tended to show that in spite of ardent Catholicism, she at least opposed, if not very vigorously, the cruelties of the dragonnades, although she was pleased with the conversions they procured. She was apparently afraid to imperil her great reputation for devotion, which had in 1692 obtained for her from Innocent XII. the right of visitation over all the convents in France. Where she deserves blame is in her use of her power for personal patronage, as in compassing the promotions of Chamillart and Villeroi, and the frequent assistance given to her brother Comte Charles d'Aubigné. Her influence was on the whole a moderating and prudent force. Her social influence was not as great as it might have been, owing to her holding no recognized position at court, but it was always exercised on the side of decency and morality, and it must not be forgotten that from her former life she was intimate with the literary people of the day. Side by side with this public life, which wearied her with its shadowy power, occasionally crossed by a desire to be recognised as queen, she passed a nobler and sweeter private existence as the foundress of St Cyr. Mme de Maintenon was a born teacher; she had so won the hearts of her first pupils that they preferred her to their own mother, and was similarly successful later with the young and impetuous duchess of Burgundy, and she had always wished to establish a home for poor girls of good family placed in such straits as she herself had experienced. As soon as her fortunes began to mend she started a small home for poor girls at Ruel, which she afterwards moved to Noisy, and which was the nucleus of the splendid institution of St Cyr, which the king endowed in 1686, at her request, out of the funds of the Abbey of St Denis. She was in her element there. She herself drew up the rules of the institution; she examined every minute detail; she befriended her pupils in every way; and her heart often turned from the weariness of Versailles or of Marly to her "little girls" at St Cyr. It was for them that Racine wrote his *Esther* and his *Athalie*, and it was because he managed the affairs of St Cyr well that Michel Chamillart became controller-general of the finances. The later years of her power were marked by the promotion of her old pupils, the children of the king and Mme de Montespan, to high dignity between the blood royal and the peers of the realm, and it was doubtless under the influence of her dislike for the duke of Orleans that the king drew up his will, leaving the personal care of his successor to the duke of Maine, and hampering the duke of Orleans by a council of regency. On or even before her husband's death she retired to St Cyr, and had the chagrin of seeing all her plans for the advancement of the duke of Maine overthrown by means of the parliament of Paris. However, the regent Orleans in no way molested her, but, on the contrary, visited her at St Cyr and continued her pension of 48,000 livres. She spent her last years at St Cyr in perfect seclusion, but an object of great interest to all visitors to France, who, however, with the exception of Peter the Great, found it impossible to get an audience with her. On the 15th of April 1719 she died, and was buried in the choir at St Cyr, bequeathing her estate at Maintenon to her niece, the only daughter of her brother Charles and wife of the maréchal de Noailles, to whose family it still belongs.

L. A. la Beaumelle published the *Lettres de Madame de Maintenon*, but much garbled, in 2 vols. in 1752, and on a larger scale in 9 vols. in 1756. He also, in 1755, published *Mémoires de Madame de Maintenon*, in 6 vols., which caused him to be imprisoned in the Bastille. All earlier biographies were superseded by Théophile Lavallée's *Histoire de St Cyr*, reviewed in *Causeries du lundi*, vol. viii., and by his edition of her *Lettres historiques et édifiantes*, &c., in 7 vols.

and of her *Correspondance générale*, in 4 vols. (1888), which latter must, however, be read with the knowledge of many forged letters, noticed in P. Grimblot's *Faux autographes de Madame de Maintenon.* Saint-Simon's fine but biased account of the court in her day and of her career is contained in the twelfth volume of Chéruel and Regnier's edition of his *Mémoires.* See also Mademoiselle d'Aumale's *Souvenirs sur Madame de Maintenon*, published by the Comte d'Haussonville and G. Hanotaux (Paris, 3 vols., 1902–1904); an excellent account by A. Geffroy, *Madame de Maintenon d'après sa correspondance authentique* (Paris, 2 vols., 1887); P. de Noailles, *Histoire de Madame de Maintenon et des principaux évènements du règne de Louis XIV.* (4 vols., 1848–1858); A. de Boislisle, *Paul Scarron et Françoise d'Aubigné d'après des documents nouveaux* (1894); É. Pilastre, *Vie et caractère de Madame de Maintenon d'après les œuvres du duc de Saint-Simon et des documents anciens ou récents* (1907); A. Rosset, *Madame de Maintenon et la révocation de l'édit de Nantes* (1897). (H. M. S.)

MAINZ (Fr. Mayence) a city, episcopal see and fortress of Germany, situated on the left bank of the Rhine, almost opposite the influx of the Main, at the junction of the important main lines of railway from Cologne to Mannheim and Frankfort-on-Main, 25 m. W. of the latter. Pop. (1905), 91,124 (including a garrison of 7500 men), of whom two-thirds are Roman Catholic. The Rhine, which here attains the greatest breadth of its upper course, is crossed by a magnificent bridge of five arches, leading to the opposite town of Castel and by two railway bridges. The old fortifications have recently been pushed farther back, and their place occupied by pleasant boulevards. The river front has been converted into a fine promenade, commanding extensive views of the Taunus range of mountains, and the "Rheingau," the most favoured wine district of Germany. Alongside the quay are the landing-places of the steamboats navigating the Rhine. The railway, which formerly incommoded the bank, has been diverted, and now, following the ceinture of the new line of inner fortifications, runs into a central station lying to the south of the city. The interior of the old town consists chiefly of narrow and irregular streets, with many quaint and picturesque houses. The principal street of the new town is the Kaiserstrasse, leading from the railway station to the river.

The first object of historical and architectural interest in Mainz is the grand old cathedral, an imposing Romanesque edifice with numerous Gothic additions and details (for plan, &c. see ARCHITECTURE: *Romanesque and Gothic in Germany*). It was originally erected between 975 and 1009, but has since been repeatedly burned down and rebuilt, and in its present form dates chiefly from the 12th, 13th and 14th centuries. The largest of its six towers is 300 ft. high. The whole building was restored by order of Napoleon in 1814, and another thorough renovation was made more recently. The interior contains the tombs of Boniface, the first archbishop of Mainz, of Frauenlob, the Minnesinger, and of many of the electors. Mainz possesses nine other Roman Catholic churches, the most noteworthy of which are those of St Ignatius, with a finely painted ceiling, of St Stephen, built 1257–1328, and restored after an explosion in 1857, and of St Peter. The old electoral palace (1627–1678), a large building of red sandstone, now contains a valuable collection of Roman and Germanic antiquities, a picture gallery, a natural history museum, the Gutenberg Museum, and a library of 220,000 volumes. Among the other principal buildings are the palace of the grand duke of Hesse, built in 1731–1739 as a lodge of the Teutonic order, the theatre, the arsenal, and the government buildings. A handsome statue of Gutenberg, by Thorwaldsen, was erected at Mainz in 1837. Mainz still retains many relics of the Roman period, the most important of which is the Eigelstein, a monument believed to have been erected by the Roman legions in honour of Drusus. It stands within the citadel, which occupies the site of the Roman castrum. A little to the south-west of the town are the remains of a large Roman aqueduct, of which upwards of sixty pillars are still standing. The educational and scientific institutions of Mainz include an episcopal seminary, two gymnasia and other schools, a society for literature and art, a musical society, and an antiquarian society. The university, founded in 1477, was suppressed by the French in 1798.

The site of Mainz would seem to mark it out naturally as a great centre of trade, but the illiberal rule of the archbishops and its military importance seriously hampered its commercial and industrial development, and prevented it from rivalling its neighbour Frankfort. It is now, however, the chief emporium of the Rhenish wine traffic, and also carries on an extensive transit trade in grain, timber, flour, petroleum, paper and vegetables. The natural facilities for carriage by water are supplemented by the extensive railway system. Large new harbours to the north of the city were opened in 1887. The principal manufactures are leather goods, furniture, carriages, chemicals, musical instruments and carpets, for the first two of which the city has attained a wide reputation. Other industries include brewing and printing. Mainz is the seat of the administrative and judicial authorities of the province of Rhein-Hessen, and also of a Roman Catholic bishop.

History.—Mainz, one of the oldest cities in Germany, was originally a Celtic settlement. Its strategic importance was early recognized by the Romans, and about 13 B.C. Drusus, the son-in-law of Augustus, erected a fortified camp here, to which the *castellum Mattiacorum* (the modern Castel) on the opposite bank was afterwards added, the two being connected with a bridge at the opening of the Christian era. The Celtic name became latinized as *Maguntiacum*, or *Moguntiacum*, and a town gradually arose around the camp, which became the capital of Germania Superior. During the Völkerwanderung Mainz suffered severely, being destroyed on different occasions by the Alamanni, the Vandals and the Huns. Christianity seems to have been introduced into the town at a very early period, and in the 6th century a new Mainz was founded by Bishop Sidonius. In the middle of the 8th century under Boniface it became an archbishopric, and to this the primacy of Germany was soon annexed. Charlemagne, who had a palace in the neighbourhood, gave privileges to Mainz, which rose rapidly in wealth and importance, becoming a free city in 1118. During the later middle ages it was the seat of several diets, that of 1184 being of unusual size and splendour. In 1160 the citizens revolted against Archbishop Arnold, and in 1163 the walls of the city were pulled down by order of the emperor Frederick I. But these events did not retard its progress. In 1244 certain rights of self-government were given to the citizens; and in 1254 Mainz was the centre and mainspring of a powerful league of Rhenish towns. Owing to its commercial prosperity it was known as *goldene* Mainz, and its population is believed to have been as great as it is at the present day. But soon a decline set in. In 1462 there was warfare between two rival archbishops, Diether or Dietrich II. of Isenburg (d. 1463) and Adolph II. of Nassau (d. 1475). The citizens espoused the cause of Diether, but their city was captured by Adolph; it was then deprived of its privileges and was made subject to the archbishop. Many of the inhabitants were driven into exile, and these carried into other lands a knowledge of the art of printing, which had been invented at Mainz by Johann Gutenberg in 1450. During the Thirty Years' War Mainz was occupied by the Swedes in 1631 and by the French in 1644, the fortifications being strengthened by the former under Gustavus Adolphus; in 1688 it was captured again by the French, but they were driven out in the following year. In 1792 the citizens welcomed the ideas of the French Revolution; they expelled their archbishop, Friedrich Karl Joseph d'Erthal, and opened their gates to the French troops. Taken and retaken several times during the next few years, Mainz was ceded to France by the treaty of Campo Formio in 1797, and again by the Treaty of Lunéville in 1801. In 1814 it was restored to Germany and in 1816 it was handed over to the grand duke of Hesse; it remained, however, a fortress of the German confederation and was garrisoned by Prussian and Austrian troops. Since 1871 it has been a fortress of the German Empire. There were disturbances in the city in 1848.

See Brühl, *Mainz, geschichtlich, topographisch und malerisch* (Mainz, 1829); C. A. Schaab, *Geschichte der Stadt Mainz* (Mainz, 1841–1845); K. Klein, *Mainz und seine Umgebungen* (1868); C. G. Bockenheimer, *Beiträge zur Geschichte der Stadt Mainz* (1874); Neeb, *Führer durch Mainz und Umgebung* (Stuttgart, 1903); and O. Beck, *Mainz und sein Handel* (Mainz, 1881).

The ARCHBISHOPRIC OF MAINZ, one of the seven electorates of the Holy Roman Empire, became a powerful state during the middle ages and retained some of its importance until the dissolution of the empire in 1806. Its archbishop was president of the electoral college, arch-chancellor of the empire and primate of Germany. Its origin dates back to 747, when the city of Mainz was made the seat of an archbishop, and a succession of able and ambitious prelates, obtaining lands and privileges from emperors and others, made of the district under their rule a strong and vigorous state. Among these men were Hatto I. (d. 913), Siegfried III. of Eppstein (d. 1249), Gerhard of Eppstein (d. 1305), and Albert of Brandenburg (d. 1545), all of whom played important parts in the history of Germany. There were several violent contests between rivals anxious to secure so splendid a position as the electorate, and the pretensions of the archbishops occasionally moved the citizens of Mainz to revolt. The lands of the electorate lay around Mainz, and were on both banks of the Rhine; their area at the time of the French Revolution was about 3200 sq. m. The last elector was Karl Theodor von Dalberg. The archbishopric was secularized in 1803, two years after the lands on the left bank of the Rhine had been seized by France. Some of those on the right bank of the river were given to Prussia and to Hesse; others were formed into a grand duchy for Dalberg. The archbishopric itself was transferred to Regensburg.

For the history of the electorate see the *Scriptores rerum moguntiacarum*, edited by G. C. Joannis (Frankfort, 1722–1727); Schunk, *Beiträge zur Mainzer Geschichte* (Frankfort, 1788–1791); Hennes, *Die Erzbischöfe von Mainz* (Mainz, 1879); Ph. Jaffé, *Monumenta moguntina* (Berlin, 1866), and J. F. Böhmer and C. Will, *Regesta archiepiscoporum moguntinensium* (Innsbruck, 1877–1886).

MAIRET, JEAN DE (1604–1686), French dramatist, was born at Besançon, and baptized on the 10th of May 1604. His own statement that he was born in 1610 has been disproved. He went to Paris to study at the Collège des Grassins about 1625, in which year he produced his first piece *Chriséide et Arimand*, followed in 1626 by *Sylvie*, a "pastoral tragi-comedy." In 1634 appeared his masterpiece, *Sophonisbe*, which marks, in its observance of the rules, the beginning of the "regular" tragedies. Mairet was one of the bitterest assailants of Corneille in the controversy over *The Cid*. It was perhaps his jealousy of Corneille that made him give up writing for the stage. He was appointed in 1648 official representative of the Franche-Comté in Paris, but in 1653 he was banished by Mazarin. He was subsequently allowed to return, but in 1668 he retired to Besançon, where he died on the 31st of January 1686. His other plays include *Silvanire ou la Morte-vive*, published in 1631 with an elaborate preface on the observance of the unities, *Les Galanteries du duc d'Orsonne* (1632), *Virginie* (1633), *Marc-Antoine* (1635), and *Le Grand et dernier Solyman* (1637).

See G. Bizos, *Étude sur la vie et les œuvres de Jean de Mairet* (1877). *Sophonisbe* was edited by K. Vollmöller (Heilbronn, 1888), and *Silvanire* by R. Otto (Bamberg, 1890).

MAISTRE, JOSEPH DE (1754–1821), French diplomatist and polemical writer, was born at Chambéry on the 1st of April 1754. His family was an ancient and noble one, enjoying the title of count, and is said to have been of Languedocian extraction. The father of Joseph was president of the senate of Savoy, and held other important offices. Joseph himself, after studying at Turin, received various appointments in the civil service of Savoy, finally becoming a member of the senate. In 1786 he married Françoise de Morand. The invasion and annexation of Savoy by the French Republicans made him an exile. He did not take refuge in that part of the king of Sardinia's domains which was for the time spared, but betook himself to the as yet neutral territory of Lausanne. There, in 1796, he published his first important work (he had previously written certain discourses, pamphlets, letters, &c.), *Considérations sur la France*. In this he developed his views, which were those of a Legitimist, but a Legitimist entirely from the religious and Roman Catholic point of view. The philosophism of the 18th century was Joseph de Maistre's lifelong object of assault.

After the still further losses which, in the year of the publication of this book, the French Revolution inflicted on Sardinia, Charles Emmanuel summoned Joseph de Maistre to Turin, and he remained there for the brief space during which the king retained a remnant of territory on the mainland. Then he went to the island of Sardinia, and held office at Cagliari. In 1802 he was appointed envoy extraordinary and minister plenipotentiary at St Petersburg, and journeyed thither the next year. Although his post was no sinecure, its duties were naturally less engrossing than the official life, with intervals of uneasy exile and travelling, which he had hitherto known, and his literary activity was great. He only published a single treatise, on the *Principe générateur des Constitutions*; but he wrote his best and most famous works, *Du Pape*, *De L'église gallicane* and the *Soirées de St Pétersbourg*, the last of which was never finished. *Du Pape*, which the second-named book completes, is a treatise in regular form, dealing with the relations of the sovereign pontiff to the Church, to temporal sovereigns, to civilization generally, and to schismatics, especially Anglicans and the Greek Church. It is written from the highest possible standpoint of papal absolutism. The *Soirées de St Pétersbourg*, so far as it is anything (for the arrangement is somewhat desultory), is a kind of *théodicée*, dealing with the fortunes of virtue and vice in this world. It contains two of De Maistre's most famous pieces, his panegyric on the executioner as the foundation of social order, and his acrimonious, and in part unfair, but also in part very damaging, attack on Locke. The *Du Pape* is dated May 1817; on the *Soirées* the author was still engaged at his death. Besides these works he wrote an examination of the philosophy of Bacon, some letters on the Inquisition (an institution which, as may be guessed from the remarks just noticed about the executioner, was no stumbling-block to him), and, earlier than any of these, a translation of Plutarch's "Essay on the Delay of Divine Justice," with somewhat copious notes. After 1815 he returned to Savoy, and was appointed to high office, while his *Du Pape* made a great sensation. But the world to which he had returned was not altogether in accordance with his desires. He had domestic troubles; and chagrin of one sort and another is said to have had not a little to do with his death by paralysis on the 26th of February 1821 at Turin. Most of the works mentioned were not published till after his death, and it was not till 1851 that a collection of *Lettres et opuscules* appeared, while even since that time fresh matter has been published.

Joseph de Maistre was one of the most powerful, and by far the ablest, of the leaders of the neo-Catholic and anti-revolutionary movement. The most remarkable thing about his standpoint is that, layman as he was, it was entirely ecclesiastical. Unlike his contemporary Bonald, Joseph de Maistre regarded the temporal monarchy as an institution of altogether inferior importance to the spiritual primacy of the pope. He was by no means a political absolutist, except in so far as he regarded obedience as the first of political virtues, and he seldom loses an opportunity of stipulating for a tempered monarchy. But the pope's power is not to be tempered at all, either by councils or by the temporal power or by national churches, least of all by private judgment. The peculiarity of Joseph de Maistre is that he supports his conclusions, or if it be preferred his paradoxes, by the hardest and heaviest argument. Although a great master of rhetoric, he never makes rhetoric do duty for logic. Every now and then it is possible to detect fallacies in him, but for the most part he has succeeded in carrying matters back to those fundamental differences of opinion which hardly admit of argument, and on which men take sides in consequence chiefly of natural bent, and of predilection for one state of things rather than for another. The absolute necessity of order may be said to have been the first principle of this thinker, who, in more ways than one, will invite comparison with Hobbes. He could not conceive such order without a single visible authority, reference to which should settle all dispute. He saw that there could be no such temporal head, and in the pope he thought that he saw a spiritual substitute. The anarchic tendencies of the Revolution in politics and religion were what offended him. It ought to be added that he was profoundly and accurately learned in history and philosophy, and that the superficial blunders of the 18th-century *philosophes* irritated him as much as their doctrines. To Voltaire in particular he shows no mercy.

Of the two works named as his masterpieces, *Du Pape* and the *Soirées de St Pétersbourg*, editions are extremely numerous. No complete edition of his works appeared till 1884–1887, when one was published at Lyons in 14 volumes. This had been preceded, and has been followed, by numerous biographies and discussions: C. Barthélemy, *L'Esprit de Joseph de Maistre* (1859); R. de Sézeval, *Joseph de Maistre* (1865), and J. C. Glaser, *Graf Joseph Maistre* (same year); L. I. Moreau, *Joseph de Maistre* (1879); F. Paulhan, *Joseph de Maistre et sa philosophie* (1893); L. Cogordan, "Joseph de Maistre" in the *Grands écrivains français* (1894); F. Descostes, *Joseph de Maistre avant la révolution* (1896), and other works by the same writer; J. Mandoul, *Un Homme d'état italien: Joseph de Maistre et la politique de la maison de Savoie* (1900); and E. Grasset, *Joseph de Maistre* (1901). (G. Sa.)

MAISTRE, XAVIER DE (1763–1852), younger brother of Joseph de Maistre, was born at Chambéry in October 1763. He served when young in the Piedmontese army, and wrote his delightful fantasy, *Voyage autour de ma chambre* (published 1794) when he was under arrest at Turin in consequence of a duel. Xavier shared the politics and the loyalty of his brother, and on the annexation of Savoy to France, he left the service, and took a commission in the Russian army. He served under Suvarov in his victorious Austro-Russian campaign and accompanied the marshal to Russia. He shared the disgrace of his general, and supported himself for some time in St Petersburg by miniature painting. But on his brother's arrival in St Petersburg he was introduced to the minister of marine. He was appointed to several posts in the capital, but also saw active service, was wounded in the Caucasus, and attained the rank of major-general. He married a Russian lady and established himself in his adopted country, even after the overthrow of Napoleon, and the consequent restoration of the Piedmontese dynasty. For a time, however, he lived at Naples, but he returned to St Petersburg and died there on the 12th of June 1852. He was only once in Paris (in 1839), when Sainte-Beuve, who has left some pleasant reminiscences of him, met him. Besides the *Voyage* already mentioned, Xavier de Maistre's works (all of which are of very modest dimensions) are *Le Lépreux de la cité d'Aoste* (1811), a touching little story of human misfortune; *Les Prisonniers du Caucase*, a powerful sketch of Russian character, *La Jeune Sibérienne*, and the *Expédition nocturne*, a sequel to the *Voyage autour de ma chambre* (1825). His style is of remarkable ease and purity.

His works, with the exception of some brief chemical tractates, are included in the collections of Charpentier, Garnier, &c. See Sainte-Beuve's *Portraits contemporains*, vol. iii.

MAITLAND, EDWARD (1824–1897), English humanitarian writer, was born at Ipswich on the 27th of October 1824, and was educated at Caius College, Cambridge. The son of Charles David Maitland, perpetual curate of St James's Chapel, Brighton, he was intended for the Church, but his religious views did not permit him to take holy orders. For some years he lived abroad, first in California and then as a commissioner of Crown-lands in Australia. After his return to England in 1857 he took up an advanced humanitarian position, and claimed to have acquired a new sense by which he was able to discern the spiritual condition of other people. He was associated with Mrs Anna Kingsford (1846–1888), the lady-doctor and supporter of vegetarianism and anti-vivisectionism, who, besides being one of the pioneers of higher education for women, had become a devotee of mystical theosophy; with her he brought out *Keys of the Creeds* (1875), *The Perfect Way: or the Finding of Christ* (1882), and founded the Hermetic Society in 1884. After her death he founded the Esoteric Christian Union in 1891, and wrote her *Life and Letters* (1896). He died on the 2nd of October 1897.

MAITLAND, FREDERIC WILLIAM (1850–1906), English jurist and historian, son of John Gorham Maitland, was born on the 28th of May 1850, and educated at Eton and Trinity, Cambridge, being bracketed at the head of the moral sciences tripos of 1872, and winning a Whewell scholarship for international law. He was called to the bar (Lincoln's Inn) in 1876, and made himself a thoroughly competent equity lawyer and conveyancer, but finally devoted himself to comparative jurisprudence and especially the history of English law. In 1884 he was appointed reader in English law at Cambridge, and in 1888 became Downing professor of the laws of England. Though handicapped in his later years by delicate health, his intellectual grasp and wide knowledge and research gradually made him famous as a jurist and historian. He edited numerous volumes for the Selden Society, including *Select Pleas for the Crown, 1200–1225*, *Select Pleas in Manorial Courts* and *The Court Baron*; and among his principal works were *Gloucester Pleas* (1884), *Justice and Police* (1885), *Bracton's Note-Book* (1887), *History of English Law* (with Sir F. Pollock, 1895; new ed. 1898; see also his article ENGLISH LAW in this encyclopaedia), *Domesday Book and Beyond* (1897), *Township and Borough* (1898), *Canon Law in England* (1898), *English Law and the Renaissance* (1901), the *Life of Leslie Stephen* (1906), besides important contributions to the *Cambridge Modern History*, the *English Historical Review*, the *Law Quarterly Review*, *Harvard Law Review* and other publications. His writings are marked by vigour and vitality of style, as well as by the highest qualities of the historian who recreates the past from the original sources; he had no sympathy with either legal or historical pedantry; and his death at Grand Canary on the 19th of December 1906 deprived English law and letters of one of their most scholarly and most inspiring representatives, notable alike for sweetness of character, acuteness in criticism, and wisdom in counsel.

See P. Vinogradoff's article on Maitland in the *English Historical Review* (1907); Sir F. Pollock's in the *Quarterly Review* (1907); G. T. Lapsley's in *The Green Bag* (Boston, Mass., 1907); A. L. Smith, *F. W. Maitland* (1908); H. A. L. Fisher, *F. W. Maitland* (1910).

MAITLAND, SIR RICHARD (LORD LETHINGTON) (1496–1586), Scottish lawyer, poet, and collector of Scottish verse, was born in 1496. His father, Sir William Maitland of Lethington and Thirlestane, fell at Flodden; his mother was a daughter of George, Lord Seton. He studied law at the university of St Andrews, and afterwards in Paris. His castle at Lethington was burnt by the English in 1549. He was in 1552 one of the commissioners to settle matters with the English about the debateable lands. About 1561 he seems to have lost his sight, but this did not render him incapable of attending to public business, as he was the same year admitted an ordinary lord of session with the title of Lord Lethington, and a member of the privy council; and in 1562 he was appointed keeper of the Great Seal. He resigned this last office in 1567, in favour of John, prior of Coldingham, his second son, but he sat on the bench till he attained his eighty-eighth year. He died on the 20th of March 1586. His eldest son, by his wife Mary Cranstoun of Crosbie, was William Maitland (*q.v.*): his second son, John (*c.* 1545–1595), was a lord of session, and was made a lord of parliament in 1590, with the title of Lord Maitland of Thirlestane, in which he was succeeded by his son John, also for some time a lord of session, who was created earl of Lauderdale in 1624. One of Sir Richard's daughters, Margaret, assisted her father in preparing his collection of old Scots verse.

The poems of Sir Richard Maitland, none of them lengthy, are for the most part satirical, and are principally directed against the social and political abuses of his time. He is chiefly remembered as the industrial collector and preserver of many pieces of Scots poetry. These were copied into two large volumes, one in folio and another in quarto, the former written by himself, and the latter by his daughter. After being in the possession of his descendant the duke of Lauderdale, these volumes were purchased at the sale of the duke's library by Samuel Pepys, and have since been preserved in the Pepysian Library, Magdalene College, Cambridge. They lay there unnoticed for many years till Bishop Percy published one of the poems in his *Reliques of English Poetry*. Several of the prices were then transcribed by John Pinkerton, who afterwards published them under the title of *Ancient Scottish Poems* (2 vols., 1786.)

For an account of the Maitland Folio MS. see Gregory Smith's *Specimens of Middle Scots*, 1902 (p. lxxiii.). The Scottish Text Society has undertaken an edition of the entire manuscript. Maitland's own poems were reprinted by Sibbald in his *Chronicle of Scottish Poetry* (1802), and in 1830 by the Maitland Club, named after him, and founded for the purpose of continuing his efforts to preserve the remains of early Scots literature. Sir Richard left in manuscript a history of the family of Seton, and a volume of legal decisions collected by him between the years 1550 and 1565. Both are preserved in the Advocates' Library, Edinburgh; the former was published by the Maitland Club, in 1829.

MAITLAND (MAITLAND OF LETHINGTON), **WILLIAM** (*c.* 1528–1573), Scottish statesman, eldest son of the preceding, was educated at St Andrews. At an early age he entered public life and began in various ways to serve the regent, Mary of Lorraine, becoming her secretary of state in 1558. In 1559, however, he deserted her and threw in his lot with the lords of the congregation, to whom his knowledge of foreign, and especially of English, politics and his general ability were assets of the highest value. The lords sent him to England to ask for assistance from Elizabeth, and his constant aim throughout his political career was to bring about a union between the two crowns. He appears to have feared the return of Mary Queen of Scots to Scotland, but after her arrival in 1561 he was appointed secretary of state, and for about six years he directed the policy of Scotland and enjoyed the confidence of the queen. His principal antagonist was John Knox; there were several tussles between them, the most famous, perhaps, being the one in the general assembly of 1564, and on the whole Maitland held his own against the preachers. He was doubtless concerned in the conspiracy against David Rizzio, and after the favourite's murder he was obliged to leave the court and was himself in danger of assassination. In 1567, however, he was again at Mary's side. He was a consenting party to the murder of Darnley, although he had favoured his marriage with Mary, but the enmity between Bothwell and himself was one of the reasons which drove him into the arms of the queen's enemies, among whom he figured at Langside. He was one of the Scots who met Elizabeth's representatives at York in 1568; here he showed a desire to exculpate Mary and to marry her to the duke of Norfolk, a course of action probably dictated by a desire to avoid all revelations about the Darnley murder. But this did not prevent him from being arrested in September 1569 on account of his share in the crime. He was, however, delivered from his captors by a ruse on the part of his friend, Sir William Kirkcaldy of Grange, and was brought into Edinburgh Castle, while his trial was put off because the city was thronged with his adherents. Maitland now became the leader of the remnant which stood by the cause of the imprisoned queen. Already a physical wreck, he was borne into Edinburgh Castle in April 1571 and with Kirkcaldy he held this fortress against the regent Morton and his English auxiliaries. The castle surrendered in May 1573 and on the 7th or the 9th of June following Maitland died at Leith, there being very little evidence for the theory that he poisoned himself. "Secretary Maitland" was a man of great learning with a ready wit and a caustic tongue. He was reputed to be the most versatile and accomplished statesman of his age, and almost alone among his Scottish contemporaries he placed his country above the claims of either the Roman Catholic or the Protestant religions. Among the testimonies to his great abilities are those of Queen Elizabeth, of William Cecil and of Knox. By his second wife, Mary Fleming, one of Queen Mary's ladies, whom he married in 1567, he had a son and daughter. His son James died without issue about 1620.

See John Skelton, *Maitland of Lethington* (1894); A. Lang, *History of Scotland*, vol. ii. (1902).

MAITLAND, EAST and **WEST,** adjoining municipalities in Northumberland county, New South Wales, Australia, 120 m. by rail N. of Sydney. Pop. (1901), West Maitland, 6798; East Maitland, 3287. These towns are situated in a valley on the Hunter River, which is liable to sudden floods, to guard against which the river is protected by stone embankments at West Maitland, while there are flood-gates at East Maitland. Maitland is the centre of the rich agricultural district of the Hunter valley, which produces maize, wheat and other cereals, lucerne, tobacco, fruit and wine; excellent coal also is worked in the vicinity. East Maitland is the see of a Roman Catholic bishop, whose cathedral (St John's), however, is situated in the larger town. Besides this, West Maitland contains several handsome public and commercial buildings.

MAITREYA, the name of the future Buddha. In one of the works included in the Pali canon, the *Dīgha Nikāya*, a prophecy is put into the Buddha's mouth that after the decay of the religion another Buddha, named Metteyya, will arise who will have thousands of followers instead of the hundreds that the historical Buddha had. This is the only mention of the future Buddha in the canon. For some centuries we hear nothing more about him. But when, in the period just before and after the Christian era, some Buddhists began to write in Sanskrit instead of Pali, they composed new works in which Maitreya (the Sanskrit form of Metteyya) is more often mentioned, and details are given as to his birthplace and history. These are entirely devised in imitation of the details of the life of the historical Buddha, and have no independent value. Only the names differ. The document in which the original prophecy occurs was put together at some date during the 1st century after the Buddha's death (see NIKĀYA). It is impossible to say whether tradition was, at that time, correct in attributing it to the Buddha. But whoever chose the name (it is a patronymic or family, not a personal name), had no doubt regard to the etymological connexion with the word for "love," which is Mettā in Pali. This would only be one of those punning allusions so frequent in Indian literature.

Long afterwards, probably in the 6th or 7th century, a reformer in south India, at a time when the incoming flood of ritualism and superstition threatened to overwhelm the simple teaching of the earlier Buddhism, wrote a Pali poem, entitled the *Anāgata Vaṃsa.* In this he described the golden age of the future when, in the time of Metteyya, kings, ministers and people would vie one with the other in the maintenance of the original simple doctrine, and in the restoration of the good times of old. The other side also claimed the authority of the future Buddha for their innovations. Statues of Maitreya are found in Buddhist temples, of all sects, at the present day; and the belief in his future advent is universal among Buddhists.

AUTHORITIES.—*Dīgha Nikāya*, vol. iii., edited by J. E. Carpenter, (London, 1908); "*Anāgata Vaṃsa*," edited by J. Minayeff in *Journal of the Pali Text Society* (1886); *Watters on Yuan Chwang*, edited by Rhys Davids and S. W. Bushell (London, 1904–1905).

(T. W. R. D.)

MAIWAND, a village of Afghanistan, 50 m. N.W. of Kandahar. It is chiefly notable for the defeat inflicted on a British brigade under General Burrows by Ayub Khan on the 27th of July 1880 during the second Afghan War (see AFGHANISTAN). Ayub Khan, Shere Ali's younger son, who had been holding Herat during the British operations at Kabul and Kandahar, set out towards Kandahar with a small army in June 1880, and a brigade under General Burrows was detached from Kandahar to oppose him. Burrows advanced to the Helmund, opposite Girishk, to oppose Ayub Khan, but was there deserted by the troops of Shere Ali, the wali of Kandahar, and forced to retreat to Kushk-i-Nakhud, half way to Kandahar. In order to prevent Ayub passing to Ghazni, Burrows advanced to Maiwand on the 27th of July, and attacked Ayub, who had already seized that place. The Afghans, who numbered 25,000, outflanked the British, the artillery expended their ammunition, and the native portion of the Brigade got out of hand and pressed back on the few British infantry. The British were completely routed, and had to thank the apathy of the Afghans for escaping total annihilation. Of the 2476 British troops engaged, 934 were killed and 175 wounded or missing. This defeat necessitated Sir Frederick Roberts' famous march from Kabul to Kandahar.

See Lord Roberts, *Forty-one Years in India* (1896).

MAIZE, or INDIAN CORN, *Zea Mays* (from ζεά or ζειά, which appears to have been "spelt," *Triticum spelta*, according to the description of Theophrastus), a plant of the tribe Maydeae of the order Gramineae or grasses (see fig. 1). It is unknown in the native state, but is most probably indigenous to tropical America. Small grains of an unknown variety have been found in the ancient tombs of Peru, and Darwin found heads of maize embedded on the shore in Peru at 85 ft. above the present sea-level. Bonafous, however (*Histoire naturelle du maïs*), quotes authorities (Bock, 1532, Ruel and Fuchs) as believing that it came from Asia, and maize was said by Santa Rosa de Viterbo to have been brought by the Arabs into Spain in the 13th century. A drawing of maize is also given by Bonafous from a Chinese work on natural history, *Li-chi-tchin*, dated 1562, a little over sixty years after the discovery of the New World. It is not figured on Egyptian monuments, nor was any mention made of it by Eastern travellers in Africa or Asia prior to the 16th century. Humboldt, Alphonse de Candolle and others, however, do not hesitate to say that it originated solely in America, where it had been long and extensively cultivated at the period of the discovery of the New World; and that is the generally accepted modern view. Some hold the view that maize originated from a common Mexican fodder grass, *Euchlaena mexicana*, known as Teosinte, a closely allied plant which when crossed with maize yields a maize-like hybrid.

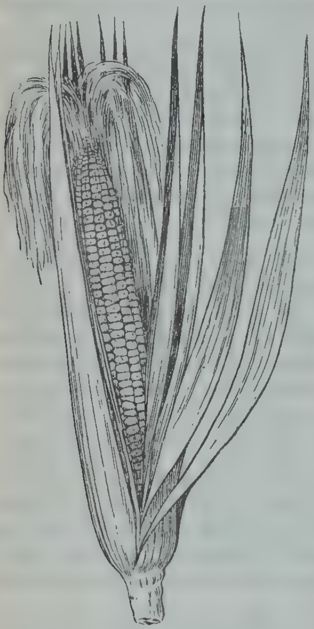

FIG. 1.

Maize—*Zea Mays*—unripe cob. The membranous spathes have been cut and drawn aside, revealing the spike of fruit which bears the long silky styles. One-third nat. size.

The plant is monoecious, producing the staminate (male) flowers in a large feathery panicle at the summit, and the (female) dense spikes of flowers, or "cobs," in the axils of the leaves below, the long pink styles hanging out like a silken tassel. They are invested by the sheaths of leaves, much used in packing oranges in south Europe, and the more delicate ones for cigarettes in South America. Fig. 2 shows a branch of the terminal male inflorescence. Fig. 3 is a single spikelet of the same, containing two florets, with the three stamens of one only protruded. Fig. 4 is a spike of the female inflorescence, protected by the sheaths of leaves—the blades being also present. Usually the sheaths terminate in a point, the blades being arrested. Fig. 5 is a spikelet of the female inflorescence, consisting of two outer glumes, the lower one ciliated, which enclose two florets—one (*a*) barren (sometimes fertile), consisting of a flowering glume and pale only, and the other (*b*) fertile, containing the pistil with elongated style. The mass of styles from the whole spike is pendulous from the summit of the sheaths, as in fig. 4. Fig. 6 shows the fruit or grain. More than three hundred varieties are known, which differ more among themselves than those of any other cereal. Some come to maturity in two months, others require seven months; some are as many feet high as others are inches; some have kernels eleven times larger than others. They vary similarly in shape and size of ears, colour of the grain, which may be white, yellow, purple, striped, &c., and also in physical characters and chemical composition. Dr E. Lewis Sturtevant, who has made an extended study of the forms and varieties, classes into seven groups those grown primarily for the grain, the distinguishing characters of which are based on the grains or kernels; there are, in addition, forms of horticultural interest grown for ornament. Pod corn (var. *tunicata*) is characterized by having each kernel enclosed in a husk. Pop corn (var. *everta*) has a very large proportion of the "endosperm"—the nutritious matter which with the small embryo makes up the grain—of a horny consistency, which causes the grain to pop when heated, that is to say, the kernel becomes turned inside out by the explosion of the contained moisture. It is also characterized by the small size of the grain and ear. Flint corn (var. *indurata*) has a starchy endosperm enclosed in a horny layer of varying thickness in the different varieties. The colour of the grain is white, yellow, red, blue or variegated. It is commonly cultivated in Canada and northern United States, where the seasons are too short for Dent corn, and has been grown as far north as 50° N. lat. Dent or field corn (var. *indentata*) has the starchy endosperm extending to the summit of the grain, with horny endosperm at the sides. The top of the grain becomes indented, owing to the drying and shrinkage of the starchy matter; the character of the indented surface varies with the height and thickness of the horny endosperm. This is the form commonly grown in the United States; the varieties differ widely in the size of the plants and the appearance of the ear.

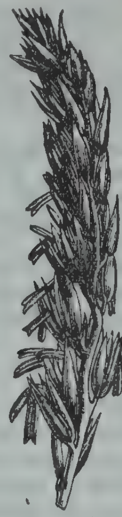

FIG. 2.—Spike of Male Flowers.

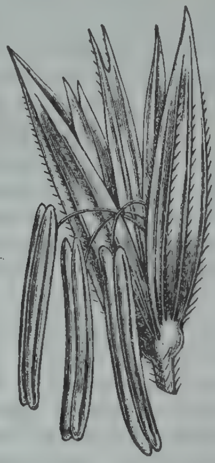

FIG. 3.—Male Spikelet.

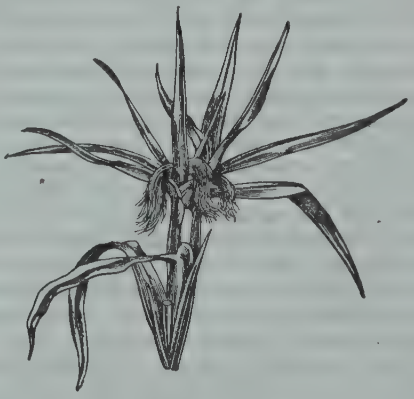

FIG. 4.—Female Spike.

The colour of the grain varies greatly, being generally white, yellow, mottled red, or less commonly red. Soft corn (var. *amylacea*) has no horny endosperm, and hence the grains shrink uniformly. It is cultivated only to a limited extent in the United States, but seems to have been commonly grown by the Indians in many localities in North and South America. Sweet corn (var. *saccharata*) is characterized by the translucent horny appearance of the grains and their more or less wrinkled condition. It is pre-eminently a garden vegetable, the ear being used before the grain hardens, when it is well filled but soft and milky. It is often cooked and served in the cob; when canned it is cut from the cob. Canned sweet corn is an important article of domestic commerce in Canada and the United States. In starchy sweet corn (var. *amylea-saccharata*) the grain has the external appearance of sweet corn, but examination shows the lower half to be starchy, the upper horny and translucent. A form of flint corn, with variegated leaves, is grown for ornament under the name *Zea japonica* or Japanese striped corn.

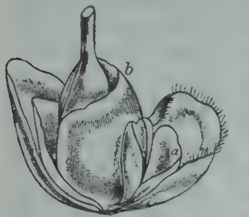

FIG. 5.—Female Spikelet.

Chemical analysis, like common experience, shows that Indian corn is a very nutritious article of food, being richer in albuminoids than any other cereals when ripe (calculated in the dry weight). It can be grown in the tropics from the level of the sea to a height equal to that of the Pyrenees and in the south and middle of Europe, but it cannot be grown in England with any chance of profit, except perhaps as fodder. Frost kills the plant in all its stages and all its varieties; and the crop does not flourish well if the nights are cool, no matter how favourable the other conditions. Consequently it is the first crop to disappear as one ascends into the mountain regions, and comparatively little is grown west of the great plains of North America. In Brittany, where it scarcely ripens the grain, it furnishes a strong crop in the autumn upon sandy soil where clover and lucerne will yield but a poor produce. It prefers a deep, rich, warm, dry and mellow soil, and hence the rich bottoms and fertile prairies of the Mississippi basin constitute the region of its greatest production. It is extensively grown throughout India, both for the ripe grain and for use of the unripe cob as a green vegetable. It is the most common crop throughout South Africa, where it is known as mealies, being the staple food of the natives. It is also largely used for fodder and is an important article of export.

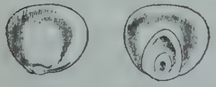

FIG. 6.—Grain.

As an article of food maize is one of the most extensively used grains in the world. Although rich in nitrogenous matter and fat, it does not make good bread. A mixture of rye and corn meal, however, makes an excellent coarse bread, formerly much used in the Atlantic states, and a similar bread is now the chief coarse bread of Portugal and some parts of Spain. It is either baked into cakes, called *tortilla* by the Indians of Yucatan, or made into a kind of porridge, as in Ireland. When deprived of the gluten it constitutes oswego, maizena or corn flour. Maize contains more oil than any other cereal, ranging from 3·5 to 9·5% in the commercial grain. This is one of the factors in its value for fattening purposes. In distilling and some other processes this oil is separated and forms an article of commerce. When maize is sown broadcast or closely planted in drills the ears may not develop at all, but the stalk is richer in sugar and sweeter; and this is the basis of growing "corn-fodder." The amount of forage that may be produced in this way is enormous; 50,000 to 80,000 ℔ of green fodder are grown per acre, which makes 8000 to 12,000 ℔ as field-cured. Sugar and molasses have from time to time been manufactured from the corn stalks.

See articles on corn and *Zea Mays* in L. H. Bailey's *Cyclopaedia of American Horticulture* (1900–1902); and for cultivation in India, Watt's *Dictionary of the Economic Products of India*, vi. (1893).

MAJESTY (Fr. *majesté*; Lat. *majestas*, grandeur, greatness, from the base *mag-*, as in *magnus*, great, *major*, greater, &c.), dignity, greatness, a term especially used to express the dignity and power of a sovereign. This application is to be traced to the use of *majestas* in Latin to express the supreme sovereign dignity of the Roman state, the *majestas reipublicae* or *populi Romani*, hence *majestatem laedere* or *minuere*, was to commit high treason, *crimen majestatis*. (For the modern law and usage of *laesa majestas*, *lèse majesté*, *Majestätsbeleidigung*, see Treason.) From the republic *majestas* was transferred to the emperors, and the *majestas populi Romani* became the *majestas imperii*, and *augustalis majestas* is used as a term to express the sovereign person of the emperor. Honorius and Theodosius speak of themselves in the first person as *nostra majestas*. The term "majesty" was strictly confined in the middle ages to the successors of the Roman emperors in the West, and at the treaty of Cambrai (1529) it is reserved for the emperor Charles V. Later the word is used of kings also, and the distinction is made between imperial majesty (*caesareana majestas*) and kingly or royal majesty. From the 16th century dates the application of "Most Christian and Catholic Majesty" to the kings of France, of "Catholic Majesty" to the kings of Spain, of "Most Faithful Majesty" to the kings of Portugal, and "Apostolic Majesty" to the kings of Hungary. In England the use is generally assigned to the reign of Henry VIII., but it is found, though not in general usage, earlier; thus the *New English Dictionary* quotes from an *Address of the Kings Clerks to Henry II.* in 1171 (Materials for the History of Archbishop Becket, vii. 471, Rolls Series, 1885), where the king is styled *vestra majestas*, and Selden (*Titles of Honour*, part i. ch. 7, p. 98, ed. 1672) finds many early uses in letters to Edward I., in charters of creation of peers, &c. The fullest form in English usage is "His Most Gracious Majesty"; another form is "The King's Most Excellent Majesty," as in the English Prayer-book. "His Sacred Majesty" was common in the 17th century; and of this form Selden says: "It is true, I think, that in our memory or the memory of our fathers, the use of it first began in England." "His Majesty," abbreviated H.M., is now the universal European use in speaking of any reigning king, and "His Imperial Majesty," H.I.M., of any reigning emperor.

From the particular and very early use of "majesty" for the glory and splendour of God, the term has been used in ecclesiastical art of the representation of God the Father enthroned in glory, sometimes with the other persons of the Trinity, and of the Saviour alone, enthroned with an aureole.

MAJLÁTH, JÁNOS, or John, Count (1786–1855), Hungarian historian and poet, was born at Pest on the 5th of October 1786. First educated at home, he subsequently studied philosophy at Eger (Erlau) and law at Györ (Raab), his father, Count Joseph Majláth, an Austrian minister of state, eventually obtaining for him an appointment in the public service. Majláth devoted himself to historical research and the translation into German of Magyar folk-tales, and of selections from the works of the best of his country's native poets. Moreover, as an original lyrical writer, and as an editor and adapter of old German poems, Majláth showed considerable talent. During the greater part of his life he resided either at Pest or Vienna, but a few years before his death he removed to Munich, where he fell into a state of destitution and extreme despondency. Seized at last by a terrible infatuation, he and his daughter Henriette, who had long been his constant companion and amanuensis, drowned themselves in the Lake of Starnberg, a few miles south-west of Munich, on the 3rd of January 1855.

Of his historical works the most important are the *Geschichte der Magyaren* (Vienna, 1828–1831, 5 vols.; 2nd ed., Ratisbon, 1852–1853) and his *Geschichte des österreichischen Kaiserstaats* (Hamburg, 1834–1850, 5 vols.). Specially noteworthy among his metrical translations from the Hungarian are the *Magyarische Gedichte* (Stuttgart and Tübingen, 1825); and *Himfy's auserlesene Liebeslieder* (Pest, 1829; 2nd ed., 1831). A valuable contribution to folk-lore appeared in the *Magyarische Sagen, Märchen und Erzählungen* (Brünn, 1825; 2nd ed., Stuttgart and Tübingen, 1837, 2 vols.).

MAJOLICA, a name properly applied to a species of Italian ware in which the body is coated with a tin-enamel, on which is laid and fired a painted decoration. It is also applied to similar wares made in imitation of the Italian ware in other countries. The word in Italian is *maiolica*. Du Cange (*Gloss. s.v.* "Majorica") quotes from a chronicle of Verona of 1368, in which the form *majolica* occurs for the more usual Latin form *majorica*. It has usually been supposed that this type of pottery was first made in the island of Majorca, but it is more probable that the name was given by the Italians to the lustred Spanish ware imported by ships hailing from the Balearic Islands. (See Ceramics: *Medieval and Later Italian.*)

MAJOR (or Mair), **JOHN** (1470–1550), Scottish theological and historical writer, was born at the village of Gleghornie, near North Berwick, Scotland, in the year 1470. He was educated at the school of Haddington, where John Knox was later a pupil. After a short period spent at Cambridge (at God's House, afterwards Christ's College) he entered the university of Paris in 1493, studying successively at the colleges of St Barbe, Montaigu and Navarre, and graduating as master of arts in 1496. Promoted to the doctorate in 1505, he lectured on philosophy at Montaigu College and on theology at Navarre. He visited Scotland in 1515 and returned in 1518, when he was appointed principal regent in the university of Glasgow, John Knox being among the number of those who attended his lectures there. In 1522 he removed to St Andrew's University, where in 1525 George Buchanan was one of his pupils. He returned to the college of Montaigu in 1525, but was once more at St Andrew's in 1531, where he was head of St Salvator's College from 1534 until his death.

Major's voluminous writings may be grouped under (*a*) logic and philosophy, (*b*) Scripture commentary, and (*c*) history. All are in Latin, all appeared between 1503 and 1530, and all were printed at Paris. The first group includes his *Exponabilia* (1503), his commentary on Petrus Hispanus (1505–1506), his *Inclitarum artium libri* (1506, &c.), his commentary on Joannes Dorp (1504, &c.), his *Insolubilia* (1516, &c.), his introduction to Aristotle's logic (1521, &c.), his commentary on the ethics (1530), and, chief of all, his commentary on Peter Lombard's *Sentences* (1509, &c.); the second consists of a commentary on Matthew (1518) and another on the Four Gospels (1529); the last is represented by his famous *Historia Majoris Britanniae tam Angliae quam Scotiae per J. M.* (1521). In political philosophy he maintained the Scotist position, that civil authority was derived from the popular will, but in theology he was a scholastic conservative, though he never failed to show his approbation of Gallicanism and its plea for the reform of ecclesiastical abuses. He has left on record that it was his aim and hope to reconcile realism and nominalism in the interests of theological peace. He had a world-wide reputation as a teacher and writer. Buchanan's severe epigram, perhaps the only unfriendly words in the flood of contemporary praise, may be explained as a protest against the compromise which Major appeared to offer rather than as a personal attack on his teacher. Major takes a more independent attitude in his *History*, which is a remarkable example of historical accuracy and insight. He claims that the historian's chief duty is to write truthfully, and he is careful to show that a theologian may fulfil this condition.

The *History*, on which his fame now rests, was reprinted by Freebairn (Edinburgh, 1740), and was translated in 1892 by Archibald Constable for the Scottish History Society. The latter volume contains a full account of the author by Aeneas J. G. Mackay and a bibliography by Thomas Graves Law.

MAJOR (Lat. for "greater"), a word used, both as a substantive and adjective, for that which is greater than another in size, quality, degree, importance, &c., often opposed correlatively to that to which "minor" is applied in the same connotation. In the categorical syllogism in logic, the major term is the term which forms the predicate of the conclusion, the major premise is that which contains the major term. (For the distinction between major and minor intervals, and other applications in music, see Music and Harmony.)

The use of *Major* as part of an official title in Med. Lat. has given the Span. *mayor*, Fr. *maire*, and Eng. "mayor" (*q.v.*). In English the unadapted form "major" is the title of a military officer now ranking between a captain and a lieutenant-colonel. Originally the word was used adjectivally in the title "sergeant-major," an officer of high rank (third in command of an army) who performed the same duties of administration, drill and encampments on the staff of the chief commander as the sergeant in a company performs as assistant to the captain. This was in the latter half of the 16th century, and very soon afterwards the "sergeant-major" became known as the "sergeant-major-general"—hence the modern title of major-general. By the time of the English Civil War "majors" had been introduced in each regiment of foot, who corresponded in a lesser sphere to the "major-general" of the whole army. The major's sphere of duties, precedence and title have since varied but little, though he has, in the British service, taken the place of the lieutenant-colonel as second in command—the latter officer exercising the command of the cavalry regiment, infantry battalion or artillery brigade, and the colonel being, save for certain administrative functions, little more than the titular chief of his regiment. Junior majors command companies of infantry; squadrons of cavalry and batteries of artillery are also commanded by majors. In most European armies, however, and of late years in the army of the United States also, the major has become a battalion commander under the orders of a regimental commander (colonel or lieutenant-colonel). The word appears also in the British service in "brigade-major" (the adjutant or staff officer of a brigade). "Town-majors" (garrison staff officers) are now no longer appointed. In the French service up to 1871 the "major-general" was the chief of the general staff of a field army, and thus preserved the tradition of the former "sergeant-major" or "sergeant-major-general."

MAJORCA (*Mallorca*), the largest of the group of Spanish islands in the Mediterranean Sea known as the Balearic Islands (*q.v.*). Pop. (1900), 248,191; area, 430 sq. m. Majorca has the shape of a trapezoid, with the angles directed to the cardinal points; and its diagonal, from Cape Grozer in the west to Cape Pera in the east, is about 60 m. On the north-west the coast is precipitous, but on the other sides it is low and sloping. On the north-east there are several considerable bays, of which the chief are those of Alcudia and Pollensa; while on the south-west is the still more important bay of Palma. No fewer than twelve ports or harbours are enumerated round the island, of which may be mentioned Andraitx and Sóller. In the north-west Majorca is traversed by a chain of mountains running parallel with the coast, and attaining its highest elevation in Silla de Torrellas (5154 ft.). Towards the south and east the surface is comparatively level, though broken by isolated peaks of considerable height. The northern mountains afford great protection to the rest of the island from the violent gales to which it would otherwise be exposed, and render the climate remarkably mild and pleasant. The scenery of Majorca has all the picturesqueness of outline that usually belongs to a limestone formation. Some of the valleys, such as those of Valdemosa and Sóller, with their luxuriant vegetation, are delightful resorts. There are quarries of marble of various grains and colours—those near Santañy, in the district of Manacor, being especially celebrated; while lead, iron and cinnabar have also been obtained. Coal of a jet-like character is found at Benisalem, where it was first worked in 1836; at Selva, where it has been mined since 1851; near Santa Maria and elsewhere. It is used in the industrial establishments of Palma, and in the manufacture of lime, plaster and bricks near the mines. A considerable quantity is also exported to Barcelona.

The inhabitants are principally devoted to agriculture, and most of the arable land is cultivated. The mountains are terraced; and the old pine woods have in many places given way to the olive, the vine and the almond tree, to fields of wheat and flax, or to orchards of figs and oranges. For the last-mentioned fruits the valley of Sóller is one of the most important districts the produce being largely transmitted to France. The yield of oil is very considerable, and Inca is the centre of the oil district. The wines are light but excellent, especially the Muscadel and Montona. During the summer there is often great scarcity of water; but, according to a system handed down by the Moors, the rains of autumn and winter are collected in enormous reservoirs, which contain sufficient water to last through the dry season; and on the payment of a certain rate, each landholder has his fields flooded at certain intervals. Mules are used in the agriculture and traffic of the island. The cattle are small, but the sheep are large and well fleeced. Pigs are reared for export to Barcelona, and there is abundance of poultry and small game. Brandy is made and exported in large quantities. Excellent woollen and linen cloths are woven; the silkworm is reared and its produce manufactured; and canvas, rope and cord are largely made, from both native and foreign materials.

The roads are excellent, the four principal being those from Alcudia, Manacor, Sóller and Andraitx to the capital. Forty-eight miles of railway were open at the beginning of the 20th century. The main line runs from Palma to Manacor and Alcudia. The telegraphic system is fairly complete, and there is regular steam communication with Barcelona and Alicante. The principal towns include—besides Palma (63,937), Felanitx (11,294) and Manacor (12,408), which are described in separate articles—Andraitx (6516), Inca (7579), Llummayor (8859), Pollensa (8308), Santañy (6692) and Sóller (8026).

MAJORIAN (Julius Valerius Majorianus), emperor of the West from 457 to 461. He had distinguished himself as a general by victories over the Franks and Alemanni, and six months after the deposition of Avitus he was declared emperor by the regent Ricimer. After repelling an attack by the Vandals upon Campania (458) he prepared a large force, composed chiefly of barbarians, to invade Africa, which he previously visited in disguise. Having during his stay in Gaul defeated and concluded an alliance with Theodoric the Visigoth, at the beginning of 460 he crossed the Pyrenees for the purpose of joining the powerful fleet which he had collected at Carthagena. The Vandal king Genseric, however, after all overtures of peace had been rejected, succeeded through the treachery of certain officers in surprising the Roman fleet, most of the ships being either taken or destroyed. Majorian thereupon made peace with Genseric. But his ill-success had destroyed his military reputation; his efforts to put down abuses and improve the condition of the people had roused the hatred of the officials; and Ricimer, jealous of his fame and influence, stirred up the foreign troops against him. A mutiny broke out in Lombardy, and on the 2nd of August 461 Majorian was forced to resign. He died five days afterwards, either of dysentery or by violence. Majorian was the author of a number of remarkable laws, contained in the Theodosian Code. He remitted all arrears of taxes, the collection of which was for the future placed in the hands of the local officials. He revived the institution of *defensores*, defenders of cities, whose duty it was to protect the poor and inform the emperor of abuses committed in his name. The practice of pulling down the ancient monuments to be used as building material, which was connived at by venal officials, was strictly prohibited. He also passed laws against compulsory ordination and premature vows of celibacy.

See Sidonius Apollinaris, *Panegyric of Majorian*; Gibbon, *Decline and Fall*, ch. xxxvi. (where an outline of the "novels" of Majorian is given); J. B. Bury, *Later Roman Empire*, bk. iii.

MAJORITY (Fr. *majorité*; Med. Lat. *majoritas*; Lat. *major*, greater), a term signifying the greater number. In legislative and deliberative assemblies it is usual to decide questions by a majority of those present at a meeting and voting. In law, majority is the state of being of full age, which in the United Kingdom is twenty-one years of age. A person attains his majority at twelve o'clock at night of the day preceding his twenty-first birthday (see Infant; Age)

MAJUBA (properly Amajuba, Zulu for "the hill of doves"), a mountain in northern Natal, part of the Drakensberg range, rising about 7000 ft. above the sea and over 2000 ft. above the level of the surrounding country. It overlooks the pass through the Drakensberg known as Laing's Nek, is 8 m. S. of the Transvaal border and 18 m. N. of the town of Newcastle. The railway from Durban to Johannesburg skirts the base of the mountain. During the Boer War of 1880–81 Majuba was occupied on the night of the 26th of February 1881 by some 600 British troops under Sir George Pomeroy Colley. On the following morning the hill was stormed by the Boers under Piet Joubert and the British routed, Colley being among the slain.

MAKALAKA, a general designation used by the Bechuana, Matabele and kindred peoples, for conquered or slave tribes. Thus many of the tribes subjugated by the Makololo chief, Sebituane, about 1830 were called Makalaka (see David Livingstone's *Missionary Travels and Researches in South Africa*, London, 1857). By early writers on south-central Africa certain of the inhabitants of Barotseland were styled Makalaka; the name is more frequently used to designate the Makalanga, one of the tribes now classed as Mashonas (*q.v.*), who were brought into subjection by the Matabele.

MAKARAKA, or Iddio ("Cannibals"), a negroid people of Central Africa, closely related to the powerful Azandeh or Niam-Niam race, occupying the Bahr-el-Ghazal west of Lado. They came originally from the country of the Kibas, north of the Welle. Dr W. Junker described them as among the most trustworthy, industrious and intelligent people of the Bahr-el-Ghazal. They are a reddish-black, with nose less flat and cheek-bones less prominent than the ordinary negroes, and, unlike the latter, do not extract the incisors. Their long silky hair is built up in the most fantastic form by means of vegetable substances. They are well-known for strength and staying power.

See W. Junker, *Travels in Africa* (1890–1892).

MAKART, HANS (1840–1884), Austrian painter, born at Salzburg, was the son of an inspector of the imperial castle. He has been aptly called the first German *painter* of the 19th century. When he, as a youth, entered the Vienna Academy German art was under the rule of Cornelius's cold classicism. It was entirely intellectual and academic. Clear and precise drawing, sculpturesque modelling, and pictorial erudition were the qualities most esteemed; and it is not surprising that Makart, poor draughtsman to the very last, with a passionate and sensual love of colour, and ever impatient to escape the routine of art-school drawing, was found to be "devoid of all talent" and forced to leave the Vienna Academy. He went to Munich, and after two years of independent study attracted the attention of Piloty, under whose guidance he made rapid and astonishing progress. The first picture he painted under Piloty, "Lavoisier in Prison," though timid and conventional, attracted attention by its sense of colour. In the next, "The Knight and the Water Nymphs," he first displayed the decorative qualities to which he afterwards sacrificed everything else in his work. With the "Cupids" and "The Plague in Florence" of the next year his fame became firmly established. "Romeo and Juliet" was soon after bought by the Austrian emperor for the Vienna Museum, and Makart was invited to come to Vienna, where a large studio was placed at his disposal. In Vienna Makart became the acknowledged leader of the artistic life of the city, which in the 'seventies passed through a period of feverish activity, the chief results of which are the sumptuously decorated public buildings of the Ringstrasse.

The enthusiasm of the time, the splendour of the fêtes over which Makart presided, and the very obvious appeal of his huge compositions in their glowing richness of colour, in which he tried to emulate Rubens, made him appear a very giant to his contemporaries in Vienna, and indeed in all Austria and Germany. The appearance of each of his ambitious historical and allegorical paintings was hailed with enthusiasm—the "Catherina Cornaro," "Diana's Hunt," "The Entry of Charles V. into Antwerp," "Abundantia," "Spring," "Summer," "The Death of Cleopatra" and the "Five Senses." He reached the zenith of his fame when, in 1879, he designed, single-handed, the costumes, scenic setting, and triumphal cars of the grand pageant with which the citizens of Vienna celebrated the silver wedding of their rulers. Some 15,000 people participated in the pageant, all dressed in the costumes of the Rubens and Rembrandt period. Makart died in Vienna in October 1884.

Unfortunately Makart was in the habit of using such villainous pigments and mediums that in the few decades which have passed since his death, the vast majority of his large paintings have practically perished. The blues have turned into green; the bitumen has eaten away the rich glow of the colour harmonies; the thickly applied paint has cracked and in some instances crumbled away. And this loss of their chief quality has accentuated the weaknesses of these pictures—the faulty drawing, careless and hasty execution, lack of deeper significance and prevalence of glaring anachronisms. Important examples of his work are to be found at the galleries of Vienna, Berlin, Hamburg and Stuttgart. For the Vienna Museum he also executed a series of decorative lunettes.

MAKING-UP PRICE, a term used in the London and other British Stock Exchanges, to denote the price at which speculative bargains are carried over from one account to the next. The carrying over of a "bull" position in Eries, for example, implies a sale for cash and a simultaneous repurchase for the new account, both bargains being done at the making-up price. This is fixed at noon on carry-over day, in accordance with the market price then current (see ACCOUNT; STOCK EXCHANGE). The term is also used in New York, where the making-up prices are fixed at the end of a day's business, in accordance with the American system of daily settlements.

MAKÓ, a town of Hungary, capital of the county of Csanád 135 m. S.E. of Budapest by rail. Pop. (1900), 33,701. It is situated near the right bank of the Maros, and is a typical Hungarian town of the Alföld. The most noteworthy building is the palace of the bishop of Csanád, whose usual residence is in Temesvár. The town possesses numerous mills, and the surrounding country is fertile. The communal lands are extensive; they afford excellent pasturage for horses and sheep and also for large herds of horned cattle, for the size and quality of which Makó has obtained a high repute.

MAKRAN, or MEKRAN, a province of Baluchistan, fringing the Arabian Sea from Persia almost to Sind for about 200 m. It is subject to the khan of Kalat under British political supervision. Estimated area, 26,000 sq. m.; estimated pop. (1903), 78,000. The long lateral valley of Kej is usually associated with Makran in early geographical records. The Kej-Macoran of Marco Polo is the Makran of to-day.

The long stretch of sandy foreshore is broken on the coastline by the magnificent cliffs of Malan, the hammer-shaped headlands of Ormarah and Gwadar, and the precipitous cliffs of Jebel Zarain, near Pasni. Within them lies the usual frontier band of parallel ridges, alternating with narrow valleys. Amongst them the ranges called Talana and Talur are conspicuous by their height and regular configuration. The normal conformation of the Baluchistan frontier is somewhat emphasized in Makran. Here the volcanic action, which preceded the general upheaval of recent strata and the folding of the edges of the interior highlands, is still in evidence in occasional boiling mud volcanoes on the coast-line. It is repeated in the blazing summit of the Kuh-i-taftan (the burning mountain of the Persian frontier) which is the highest active volcano in Asia (13,000 ft.), and probably the farthest inland. Evidence of extinct mud volcanoes exists through a very wide area in Baluchistan and Seistan. Probably the *miri*, or fort, at Quetta represents one of them. The coast is indented by several harbours. Ormarah, Khor Kalmat, Pasni and Gwadar are all somewhat difficult of approach by reason of a sand-bar which appears to extend along the whole coastline, and which is very possibly the last evidence of a submerged ridge; and they are all subject to a very lively surf under certain conditions of wind. Of these the port of Gwadar (which belongs to Muscat and is therefore foreign territory) is the most important. They all are (or were) stations of the Indo-Persian telegraph system which unites Karachi with Bushire. With the exception of the Kej valley, and that of the Bolida, which is an affluent of the Kej, there are no considerable spaces of cultivation in Makran. These two valleys seem to concentrate the whole agricultural wealth of the country. They are picturesque, with thick groves of date palms at intervals, and are filled with crops and orchards. They are indeed exceedingly beautiful; and yet the surrounding waste of hills is chiefly a barren repetition of sun-cracked crags and ridges with parched and withered valleys intersecting them, where a trickle of salt water leaves a white and leprous streak amongst the faded tamarisk or the yellow stalks of last season's grass. Makran is the home of remnants of an innumerable company of mixed people gathered from the four corners of Asia and eastern Africa. The ancient Dravidians, of whom the Brahui is typical, still exist in many of the districts which are assigned to them in Herodotus. Amongst them there is always a prominent Arab element, for the Arabs held Makran even before they conquered Sind and made the Kej valley their trade highway to India. There are negroes on the coast, bred from imported slaves. The Meds of the Indus valley still form the greater part of the fishing population, representing the Ichthyophagi of Arrian. The old Tajik element of Persia is not so evident in Makran as it is farther north; and the Karak pirates whose depredations led to the invasion of India and the conquest of Sind, seem to have disappeared altogether. The fourth section includes the valleys formed by the Rakshān and Mashkel, which, sweeping downwards from the Kalat highlands and the Persian border east and west, unite to break through the intervening chain of hills northward to form the Mashkel swamps, and define the northern limits of Makran. In these valleys are narrow strips of very advanced cultivation, the dates of Panjgur being generally reckoned superior even to those of the Euphrates. The great Mashkel swamp and the Kharan desert to the east of it, mark the flat phase of southern Baluchistan topography. It is geologically part of an ancient inland lake or sea which included the present swamp regions of the Helmund, but not the central depression of the Lora. The latter is buttressed against hills at a much higher elevation than the Kharan desert, which is separated from the great expanse of the Helmund desert within the borders of Afghanistan by a transverse band of serrated hills forming a distinct watershed from Nushki to Seistan. Here and there these jagged peaks appear as if half overwhelmed by an advancing sea of sand. They are treeless and barren, and water is but rarely found at the edges of their foot-hills. The Koh-i-Sultan, at the western extremity of the northern group of these irregular hills, is over 6000 ft. above sea-level, but the general level of the surrounding deserts is only about 2000 ft., sinking to 1500 ft. in the Mashkel Hamun and the Gaod-i-Zirreh.

The whole of this country has been surveyed by Indian surveyors and the boundary between Persian and British Baluchistan was demarcated by a commission in 1895–1896. In 1898 a column of British troops under Colonel Mayne was despatched to Makran by sea, owing to a rebellion against the authority of the khan of Kalat, and an attack made by some Makran chiefs on a British survey party. The campaign was short and terminated with the capture of the Kej citadel. Another similar expedition was required in 1901 to storm the fort at Nodiz. The headquarters of the native governor, under the khan of Kalat, are at Turbat, with deputies at Tump, Kolwa, Pasni and Panjgur. A levy corps, with two British officers, is stationed along the western frontier. The port of Gwadur forms an enclave belonging to the sultan of Muscat.

Baluchistan District Gazetteer, vol. vii. (Bombay, 1907).

(T. H. H.*)

MAKSOORA, the term in Mahommedan architecture given to the sanctuary or praying-chamber in a mosque, which was sometimes enclosed with a screen of lattice-work; the word is occasionally used for a similar enclosure round a tomb.

MALABAR, a district of British India, in the Madras Presidency. Geographically the name is sometimes extended to the entire western coast of the peninsula. Properly it should apply to the strip below the Ghāts, which is inhabited by people speaking the Malayalam language, a branch of the Dravidian stock, who form a peculiar race, with castes, customs and traditions of their own. It would thus be coextensive with the old kingdom of Chera, including the modern states of

Travancore and Cochin, and part of Kanara. In 1901 the total number of persons speaking Malayalam in all India was 6,029,304.

The district of Malabar extends for 145 m. along the coast, running inland to the Ghāts with a breadth varying from 70 to 25 m. The administrative headquarters are at Calicut. Area, 5795 sq. m. Malabar is singularly diversified in its configuration; from the eastward, the great range of the Western Ghāts, only interrupted by the Palghāt gap, looks down on a country broken by long spurs, extensive ravines, dense forests and tangled jungle. To the westward, gentler slopes and downs, and gradually widening valleys closely cultivated, succeed the forest uplands, till, nearer the seaboard, the low laterite tablelands shelve into rice plains and backwaters fringed with coconut palms. The coast runs in a south-easterly direction, and forms a few headlands and small bays, with a natural harbour in the south at Cochin. In the south there is considerable extent of table-land. The mountains of the Western Ghāts run almost parallel to the coast, and vary from 3000 to 7000 ft. in height. One of the most characteristic features of Malabar is an all but continuous chain of lagoons or backwaters lying parallel to the coast, which have been formed by the action of the waves and shore currents in obstructing the waters of the rivers. Connected by artificial canals, they form a cheap means of transit; and a large local trade is carried on by inland navigation. Fishing and fishcuring is an important industry. The forests are extensive and of great value, but they are almost entirely private property. The few tracts which are conserved have come into government hands by escheat or by contract. Wild animals include the elephant, tiger, panther, bison, *sambhar*, spotted deer, Nīlgiri ibex, and bear. The population in 1901 was 2,800,555, showing an increase of 5·6% in the decade.

The staple crop is rice, the next most important product being coco-nuts. Coffee is grown chiefly in the upland tract known as the Wynaad, where there are also a few acres under tea. The Madras railway crosses the district and has been extended from Calicut to Cannanore along the coast. There are eleven seaports, of which the principal are Calicut, Tellicherry, Cannanore and Cochin. The principal exports are coffee, coco-nut products and timber. There are factories for cleaning coffee, pressing coir and making matting, making tiles, sawing timber and weaving cotton.

See *Malabar District Gazetteer* (Madras, 1908).

MALABARI, BEHRAMJI (1853–   ), Indian journalist and social reformer, was born in 1853 at Baroda, the son of a poor Parsi in the employment of the state, who died shortly after his birth. His mother took him to Surat, where he was educated in a mission school, but he never succeeded in gaining an academical degree. Coming to Bombay, he fell under the influence of Dr John Wilson, principal of the Scottish College. As early as 1875 he published a volume of poems in Gujarati, followed in 1877 by *The Indian Muse in English Garb*, which attracted attention in England, notably from Tennyson, Max Müller, and Florence Nightingale. His life work began in 1880 when he acquired the *Indian Spectator*, which he edited for twenty years until it was merged in the *Voice of India*. In 1901 he became editor of *East and West*. Always holding aloof from politics, he was an ardent and indefatigable advocate of social reform in India, especially as regards child marriage and the remarriage of widows. It was largely by his efforts, both in the press and in tours through the country, that the Age of Consent Act was passed in 1891. His account of his visits to England, entitled *The Indian Eye on English Life* (1893), passed through three editions, and an earlier book of a somewhat satirical nature, *Gujarat and the Gujaratis* (1883), was equally popular.

See R. P. Karkaria, *India, Forty Years of Progress and Reform*, (London, 1896).

MALABON, a town of the province of Rizal, Luzon, Philippine Islands, 1 m. inland from the shore of Manila Bay and 3 m. N. of the city of Manila, with which it is connected by an electric tramway. Pop. (1903), 20,136. The leading industries are the refining of sugar, fishing, trade, the weaving of jusi cloth, the making of cigars, and the cultivation of ilang-ilang-trees (*Cananga odorata*) for their flowers, from which a fine perfume is distilled; ilang-ilang is one of the principal exports, mostly to France. Tagalog and Spanish are the principal languages. Malabon was formerly known as Tambóbong.

MALACCA, a town on the west coast of the Malay Peninsula, in 2° 14′ N., 102° 12′ E., which, with the territory lying immediately around and behind it forms one of the Straits Settlements, and gives its name to the Straits which divide Sumatra from the Malay Peninsula. Its name, which is more correctly transliterated *mĕlāka*, is that of a species of jungle fruit, and is also borne by the small river on the right bank of which the old Dutch town stands. The Dutch town is connected by a bridge with the business quarter on the left bank, which is inhabited almost exclusively by Chinese, Eurasians and Malays.

Malacca, now a somnolent little town, a favourite resort of rich Chinese who have retired from business, is visited by few ships and is the least important of the three British settlements on the Straits which give their name to the colony. It has, however, a remarkable history. The precise date of its foundation cannot be ascertained, but there is strong reason to believe that this event took place at the earliest in the 14th century. The Roman youth Ludovigo Barthema is believed to have been the first European to visit it, some time before 1503; and in 1509 Diogo Lopez de Siqueira sailed from Portugal for the express purpose of exploiting Malacca. At first he was hospitably received, but disagreements with the natives ensued and word was brought to Siqueira by Magellan, who was one of his company, that a treacherous attack was about to be made upon his ships. Siqueira then sent a native man and woman ashore "with an arrow passed through their skulls" to the sultan, "who was thus informed," says de Barros, "through his subjects that unless he kept a good watch the treason which he had perpetrated would be punished with fire and sword." The sultan retaliated by arresting Ruy de Araujo, the factor, and twenty other men who were ashore with him collecting cargo for the ships. Siqueira immediately burned one of his vessels and sailed direct for Portugal. In 1510 Mendez de Vasconcellos with a fleet of four ships set out from Portugal "to go and conquer Malacca," but d'Alboquerque detained him at Goa, and it was not until 1511 that d'Alboquerque himself found time to visit Malacca and seek to rescue the Portuguese prisoners who all this time had remained in the hands of the sultan. An attack was delivered by d'Alboquerque on the 25th of July 1511, but it was only partially successful, and it was not until the 4th of August, when the assault was repeated, that the place finally fell. Since that time Malacca has continued to be the possession of one or another of the European Powers. It was a Portuguese possession for 130 years, and was the headquarters of their trade and the base of their commercial explorations in south-eastern Asia while they enjoyed, and later while they sought to hold, their monopoly in the East. It was from Malacca, immediately after its conquest, that d'Alboquerque sent d'Abreu on his voyage of discovery to the Moluccas, or Spice Islands, which later were the objective of Magellan's voyage of circumnavigation. During the Portuguese tenure of Malacca the place was attacked at least twice by the Achinese; its shipping was harried by Lancaster in 1592, when the first British fleet made its way into these seas; it was besieged by the Dutch in 1606, and finally fell to a joint attack of the Dutch and the Achinese in 1641. It was under the Portuguese government that St Francis Xavier started a mission in Malacca, the first Christian mission in Malayan lands.

The Dutch held Malacca till 1795, when it was taken from them by Great Britain, and the Dutch system of monopoly in the straits was forthwith abolished. The colony was restored to the Dutch, however, in 1818, but six years later it came finally into the hands of Great Britain, being exchanged by a treaty with Holland for the East India Company's settlement of Benkulen and a few other unimportant places on the western coast of Sumatra. By this treaty the Dutch were precluded from interference in the affairs of the Malay Peninsula, and Great Britain from similar action in regard to the States of Sumatra, with the sole exception of Achin, the right to protect that state being maintained by Great Britain until 1872 when it was finally abandoned by a treaty concluded with Holland in that year. The Dutch took advantage of this immediately to invade Achin, and the strife begun in 1873 still continues and is now a mere war of extermination. It was not until 1833 that the whole territory lying at the back of Malacca was finally brought under British control, and as late as 1887 the Negri Sembilan, or Nine States, which adjoin Malacca territory on the east and north-east, were completely independent. They to-day form part of the Federated Malay States, which are under the protection of Great Britain, and are governed with the assistance and by the advice of British officers.

Malacca, in common with the rest of the Straits Settlements, was administered by the government of India until 1867, when it became a crown colony under the control of the Colonial Office. It is to-day administered by a resident councillor, who is responsible to the governor of the Straits Settlements, and by a number of district officers and other officials under his direction. The population of the town and territory of Malacca in 1901 was 94,487, of whom 74 were Europeans and Americans, 1598 were Eurasians, the rest being Asiatics (chiefly Malays with a considerable sprinkling of Chinese). The population in 1891 was 92,170, and the estimated population for 1905 was 97,000. The birth-rate is about 35 per thousand, and the death-rate about 29 per thousand. The trade of this once flourishing port has declined, most of the vessels being merely coasting craft, and no large line of steamers holding any communication with the place. This is due partly to the shallowness of the harbour, and partly to the fact that the ports of Penang and Singapore, at either entrance to the straits, draw all the trade and shipping to themselves. The total area of the settlement is about 700 sq. m. The colony is wholly agricultural, and the land is almost entirely in the hands of the natives. About 50,000 acres are under tapioca, and about 9000 acres are under rubber (*hevea*). This cultivation is rapidly extending. There are still considerable areas unoccupied which are suitable for rubber and for coco-nuts. The settlement is well opened up by roads; and a railway, which is part of the Federated Malay States railway system, has been constructed from the town of Malacca to Tampin in the Negri Sembilan. There is a good rest-house at Malacca and a comfortable seaside bungalow at Tanjong Kling, seven miles from the town. Malacca is 118 m. by sea from Singapore and 50 m. by rail from Seremban, the capital of the Negri Sembilan. There is excellent snipe-shooting to be had in the vicinity of Malacca.

See *The Commentaries of d'Alboquerque* (Hakluyt Society); *The Voyages and Adventures of Fernand Mendez Pinto* (London, 1653); *An Account of the East Indies*, by Captain Alexander Hamilton (Edinburgh, 1727); Valentyn's *History of Malacca*, translated by Dudley Hervey; *Journal of the Straits Branch of the Royal Asiatic Society*; "Our Tropical Possessions in Malayan India," by the same author, *ibid.*; *Further India*, by Hugh Clifford (London, 1904); *British Malaya*, by Sir Frank Swettenham (London, 1906).

(H. Cl.)

MALACHI, the name assigned to the last book of the Old Testament in English (the last of the "prophets" in the Hebrew Bible), which according to the title (Mal. i. 1) contains the "word of Yahweh to Israel by the hand of Malachi." In form the word means "my messenger." It could be explained as a contraction of Malachiah, "messenger of Yahweh"; but the Septuagint is probably right in not regarding it as a proper name ("by the hand of His messenger"). Not only do we know nothing from internal or external evidence of the existence of a prophet of this name,[1] but the occurrence of the word in the title is naturally explained as derived from iii. 1: "Behold, I send my messenger" (cf. ii. 7). The prophecy must, therefore, be regarded as anonymous; the title was added by the compiler who wrote similar editorial titles to the anonymous prophecies beginning Zech. ix. 1, xii. 1.

The contents of the prophecy fall into a series of clearly marked sections, as in the paragraph division of the Revised Version. These apply, in various ways, the truth emphasized at the outset: Yahweh's love for Israel in contrast with his treatment of Edom (i. 2–5). Israel's response should be a proper regard for the ritual of His worship; yet any offering, however imperfect, is thought good enough for Yahweh's altar (i. 6–14). Let the priests, who are responsible, take warning, and return to their ancient ideals (ii. 1–9). Again, the common Fatherhood of God should inspire a right relation among fellow Israelites, not such conduct as the divorce of Israelite wives in order to marry non-Israelite women (ii. 10–16).[2] The prevalence of wrong-doing has provoked scepticism as to righteous judgment; but the messenger of Yahweh is at hand to purge away indifferentism from worship and immorality from conduct (ii. 17–iii. 6). The payment of tithes now withheld will be followed by the return of prosperity (iii. 7–12). Religion may seem useless, but Yahweh remembers His own, and will soon in open judgment distinguish them from the irreligious (iii. 13–iv. 3). The book closes with an appeal to observe the law of Moses, and with a promise that Elijah shall come before the threatened judgment.[3]

The topics noticed clearly relate the prophecy to the period of Ezra and Nehemiah, when the Temple had been rebuilt (i. 10; iii. 1, 10), the province of Judah was under a Persian governor (i. 8), and there had been time enough for the loss of earlier enthusiasm. The majority of modern scholars are agreed that the prophet prepares for the work of those reformers (Ezra, 458; Nehemiah, 444, 432 B.C.). The abuses of which he particularly complains are such as were found rampant by Ezra and Nehemiah—marriage with foreign women (ii. 11; cf. Ezra ix.; Neh. xiii. 23 seq.; Deut. vii. 3) and failure in payment of sacred dues (iii. 8 seq.; cf. Neh. x. 34 seq.; xiii. 10 seq.; Deut. xxvi. 12 seq.). The priests have fallen into contempt (ii. 9) and have neglected what is still one of their chief trusts, the oral law (ii. 6 seq.). The priestly code of written law was not promulgated until 444 B.C. (Neh. viii.–x.); "Malachi" writes under the influence of the earlier Code of Deuteronomy only,[4] and must therefore belong to a date prior to 444. The independent character of the attack on current abuses also suggests priority to the work of Ezra in 458. The prophecy affords an interesting and valuable glimpse of the post-exilic community, with its various currents of thought and life. The completion of the second Temple (516 B.C.) has been followed by disillusionment as to the anticipated prosperity, by indifference to worship, scepticism as to providence, and moral laxity.[5] In view of these conditions, the prophet's message is to reassert the true relation of Israel to Yahweh, and to call for a corresponding holiness, especially in regard to questions of ritual and of marriage. He saw that "the disobedience of his time was the outcome of a lowered morality, not of a clearer spiritual vision."[1] A strong sense of the unique privileges of the children of Jacob, the objects of electing love (i. 2), the children of the Divine Father (ii. 10), is combined with an equally strong assurance of Yahweh's righteousness notwithstanding the many miseries that pressed on the unhappy inhabitants of Judaea. At an earlier date the prophet Haggai had taught that the people could not expect Yahweh's blessing while the Temple lay in ruins. In Malachi's time the Temple was built (i. 10) and the priests waited in their office, but still a curse seemed to rest on the nation's labours (iii. 9). To Malachi the reason of this is plain. The "law of Moses" was forgotten (iv. 4 [iii. 22]); let the people return to Yahweh, and He will return to them. It was in vain to complain, saying, "Every one that doeth evil is good in the eyes of Yahweh," or "Where is the God of judgment?"—vain to ask "Wherein shall we return?" Obedience to the law is the sure path to blessing (ii. 17-iii. 12).

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[1] A Hebrew tradition given in the Targum of Jonathan, and approved by Jerome, identifies Malachi with Ezra the priest and scribe.

[2] Torrey (*Ency. Bib.* c. 2908) holds that the reference here is purely figurative; "Judah has dealt falsely with the wife of his youth, the covenant religion, and is wedding a strange cult." But he assigns the book to the 4th century.

[3] This closing prophecy may possibly be a later addition (so Marti) rounding off the prophetic canon by reference to the two great names of Moses and Elijah, and their characteristic activities. In this case, "Elijah" will represent an early interpretation (cf. Ecclus. xlviii. 10) of the "messenger," originally conceived as a purely ideal figure. The only other passage in the book whose originality is not generally accepted is that referring to mixed marriages (ii. 11, 12).

[4] It is the Deuteronomic law that is most familiar to him, as appears from his use of the name Horeb for the mountain of the law, and the Deuteronomic phrase "statutes and judgments" (iv. 4), from his language as to tithes and offerings (iii. 8, 10; cf. Deut. xii. 11; xxvi. 12), and especially from his conception of the priesthood as resting on a covenant with Levi (ii. 4 seq.). Malachi indeed assumes that the "whole tithe"—the Deuteronomic phrase for the tithe in which the Levites shared—is not stored in each township, but brought into the treasury at the Temple. But this was a modification of the Deuteronomic law naturally called for under the circumstances of the return from Babylon, and Neh. x. and xiii. produce the impression that it was not introduced for the first time by Ezra and Nehemiah, though the collection of the tithe was enforced by them. See further, W.R.S. in *O.T.J.C.* ii. 425–427.

[5] Cf. Stade's reconstruction, *G.V.I.* ii. 128–138.

He calls the people to repentance, and he enforces the call by proclaiming the approach of Yahweh in judgment against the sorcerers, the adulterers, the false swearers, the oppressors of the poor, the orphan and the stranger. Then it shall be seen that He is indeed a God of righteous judgment, distinguishing between those that serve Him and those that serve Him not. The Sun of Righteousness shall shine forth on those that fear Yahweh's name; they shall go forth with joy, and tread the wicked under foot. The conception of the day of final decision, when Yahweh shall come suddenly to His temple (iii. 1) and confound those who think the presumptuous godless happy (iii. 15), is taken from earlier prophets, but is applied wholly within the Jewish nation. The day of Yahweh would be a curse, not a blessing, if it found the nation in its present state: the priests listlessly performing a fraudulent service (i. 7–ii. 9), the people bound by marriage to heathen women, while the tears of the daughters of Israel, thrust aside to make way for strangers, cover the altar (ii. 11–16), all faith in divine justice gone (ii. 17; iii. 14 seq.), sorcery, uncleanness, falsehood and oppression rampant (iii. 5), the house of God deprived of its dues (iii. 8), and the true fearers of God a little flock gathered together in private exercises of religion (perhaps the germ of the later synagogue) in the midst of a godless nation (iii. 16). That the day of Yahweh is delayed in such a state of things is but a new proof of His unchanging love (iii. 6), which refuses to consume the sons of Jacob. Meantime He is about to send His messenger to prepare His way before Him. The prophet Elijah must reappear to bring back the hearts of fathers and children before the great and terrible day of Yahweh come. Elijah was the advocate of national decision in the great concerns of Israel's religion; and it is such decision, a clear recognition of what the service of Yahweh means, a purging of His professed worshippers from hypocritical and half-hearted service (iii. 3) that Malachi with his intense religious earnestness sees to be the only salvation of the nation. In thus looking to the return of the ancient prophet to do the work for which later prophecy is too weak, Malachi unconsciously signalizes the decay of the order of which he was one of the last representatives; and the somewhat mechanical measure which he applies to the people's sins, as for example when he teaches that if the sacred dues were rightly paid prosperous seasons would at once return (iii. 10), heralds the advent of that system of formal legalism which thought that all religious duty could be reduced to a system of set rules. Yet Malachi himself is no mere formalist. To him, as to the Deuteronomic legislation, the forms of legal observance are of value only as the fitting expression of Israel's peculiar sonship and service, and he shows himself a true prophet when he contrasts the worthless ministry of unwilling priests with the pure offering of prayer and praise that rises from the implicit monotheism of even Gentile worship[2] (i. 11), or when he asserts the brotherhood of all Israelites under their one Father (ii. 10), not merely as a ground of separation from the heathen, but as inconsistent with the selfish and cruel freedom of divorce current in his time.[3] The book is a significant landmark in the religious history of Israel. Its emphasis on the observance of ritual finds fullest development in the Priestly Code, subsequently promulgated; its protest against foreign marriages is made effective through the reforms of Ezra and Nehemiah;[4] the influence of its closing words on later expectation is familiar to every reader of the new Testament.[5]

The style of Malachi, like his argument, corresponds in its generally prosaic character to that transformation or decay of prophecy which began with Ezekiel; and Ewald rightly called attention to the fact that the conduct of the argument already shows traces of the dialectic manner of the schools. Yet there is a simple dignity in the manner not unworthy of a prophet, and rising from time to time to poetical rhythm.

LITERATURE.—Nowack, *Die kleinen Propheten* (1897; 2nd ed., 1904); Wellhausen, id. (iii. 1898); G. A Smith, *The Book of the Twelve* (ii. 1898); A. C. Welch, art. "Malachi" in Hastings's *Dict. of the Bible*, iii. 218–222 (1900); C. C. Torrey, id. in *Ency. Bib.* iii. c. 2907–2910 (1902); Marti, *Dodekapropheton* (1904); Stade, *Biblische Theologie des Alten Test.* § 141 (1905); Driver, *The Minor Prophets*, ii. (Century Bible, 1906). (W. R. S.; H. W. R.*)

MALACHITE, a copper-ore of fine green colour, sometimes polished as an ornamental stone. The name is derived from Gr. *μαλάχη*, the mallow, in allusion to the colour of the mineral being rather like that of the mallow-leaf. Malachite was perhaps one of the green minerals described by Theophrastus under the general name of *σμάραγδος*; and according to the late Rev. C. W. King it was probably the *smaragdus medicus* of Pliny, whilst his *molochites* seems to have been a different stone from our malachite and may have been a green jasper. It is suggested by J. L. Myres (*Ency. Bib.*) that malachite may have been the Heb. *soham*, of the high priest's breastplate.

Malachite is a basic cupric carbonate, represented by the formula $CuCO_3Cu(HO)_2$, and has usually been formed by the action of meteoric agencies on other copper-minerals; hence it is found in the upper part of ore-deposits, often as an incrustation, and occasionally as a pseudomorph after cuprite, chalcocite, &c. When formed, as commonly happens, by the alteration of copper-pyrites the iron of this mineral usually takes the form of limonite, which may remain associated with the malachite. Occasionally, though but rarely, malachite occurs in small dark-green prismatic crystals of the monoclinic system. Its usual mode of occurrence is in nodular or stalagmitic forms, with a mammillated, reniform or botryoidal surface, whilst in other cases it forms fibrous, compact or even earthy masses. The nodules, though commonly dull on the outside, may display on fracture a beautiful zonary structure, the successive layers often succeeding each other as curved deposits of light and dark tints. The colours include various shades of apple-green, grass-green, emerald-green and verdigris-green. Certain varieties exhibit a finely fibrous structure, producing on the fractured surface a soft silky sheen.

Whilst malachite is found in greater or less quantity in most copper-mines, the finer varieties useful for ornamental purposes are of very limited occurrence, and the lapidary has generally drawn his supply from Russia and Australia. The principal source in recent years has been the Medno-Rudiansk mine near Nizhne Tagilsk, on the Siberian side of the Urals, but it was formerly obtained from mines near Bogoslovsk to the north and Gumishev to the south of this locality. A mass from Gumishev, preserved in the museum of the Mining Institute of St Petersburg weighs 3240 ℔, and still larger masses have been found near Nizhne Tagilsk. The mineral is prized in

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[1] Welch in *D.B.* iii. 220.

[2] This remarkable utterance is sometimes (as by W.R.S.) interpreted of the worship of Jews scattered in the Dispersion: reasons for the above view are given by Driver.

[3] In ii. 16 the Targum renders "If thou hatest her put her away." It is characteristic of later Judaism that an arbitrary exegesis transformed the above anticipation of the doctrine of marriage laid down in the gospel into an express sanction of the right of the husband to put away his wife at will.

[4] "The permanence of Judaism depended on the religious separateness of the Jews" (Ryle, *Ezra and Nehemiah*, p. 143).

[5] Matt. xvii. 3, 4, 10–13; xxvii. 47, 49; John i. 21, 25.

Russia for use in mosaic-work, and for the manufacture of vases, snuff-boxes and various ornamental objects. Even folding doors, mantelpieces, table-tops and other articles of furniture have been executed in malachite, the objects being veneered with thin slabs cleverly fitted together so as to preserve the pattern, and having the interspaces filled up with fragments and powder of malachite applied with a cement. The malachite is sawn into slabs, ground with emery and polished with tripoli. Its hardness is less than 4, but it takes a good polish like marble: it is rather denser than marble, having a specific gravity of 3·7 to 4, but it is more difficult to work, in consequence of a tendency to break along the curved planes of deposition. Exceptionally fine examples of the application of malachite are seen in some of the columns of St Isaac's Cathedral in St Petersburg, which are hollow iron columns encrusted with malachite. Large masses of ornamental malachite have been found in Australia, especially at the old Burra Burra copper-mine in South Australia. The Copper Queen and other mines in Arizona have yielded fine specimens of malachite associated with azurite, and polished slabs of the mixed minerals sometimes show the vivid green and the deep blue carbonate in very striking contrast. This natural association, cut as an ornamental stone, has been named, by Dr G. F. Kunz, azur-malachite. Malachite is occasionally used for cameo-work, and some fine antique examples are known. It was formerly worn as an amulet to preserve the wearer from lightning, contagion and witchcraft.

The mineral, when ground, has been used as a pigment under the name of "mountain green." The coarser masses are extensively used, with other minerals, as ores of copper, malachite containing about 57% of metal. "Blue malachite" is a name sometimes given to azurite (*q.v.*), whilst "siliceous malachite" is a term inappropriately applied to chrysocolla (*q.v.*). (F. W. R.*)

MALACHOWSKI, STANISLAW (1736–1809), Polish statesman, the younger son of Stanislaw Malachowski, palatine of Posen, the companion in arms of Sobieski. From his youth Malachowski laboured zealously for the good of his country, and as president of the royal court of justice won the honourable title of the "Polish Aristides." He was first elected a deputy to the Coronation Diet of 1764, and the great Four Years' Diet unanimously elected him its speaker at the beginning of its session in 1788. Accurately gauging the situation, Malachowski speedily gathered round him all those who were striving to uphold the falling republic and warmly supported every promising project of reform. He was one of the framers of the constitution of the 3rd of May 1791, exceeding in liberality all his colleagues and advocating the extension of the franchise to the towns and the emancipation of the serfs. He was the first to enter his name as a citizen of Warsaw in the civic register and to open negotiations with his own peasantry for their complete liberation. Disappointed in his hopes by the overthrow of the constitution, he resigned office and left the country in 1792, going first to Italy and subsequently to his estates in Galicia, where he was imprisoned for a time on a false suspicion of conspiracy. In 1807 Malachowski was placed at the head of the executive committee appointed at Warsaw after its evacuation by the Prussians, and when the grand duchy of Warsaw was created Malachowski became president of the senate under King Frederick Augustus of Saxony. In the negotiations with the Austrian government concerning the Galician salt-mines Malachowski came to the assistance of the depleted treasury by hypothecating all his estates as an additional guarantee. In 1809 he died at Warsaw. His death was regarded as a public calamity, and multitudes followed his remains to their last resting-place in the Church of the Holy Cross. In all the other towns of the grand duchy funeral services were held simultaneously as a tribute of the respect and gratitude of the Polish nation.

See August Sokolowski, *Illustrated History of Poland* (Pol.), vol. iv. (Vienna, 1900); *Life and Memoirs of S. Malachowski*, edited by Lucyan Siemienski (Pol; Cracow, 1853). (R. N. B.)

MALACHY, ST (*c.* 1094–1148), otherwise known as Maol-Maodhog (or Maelmaedhog) Ua Morgair, archbishop of Armagh and papal legate in Ireland, was born at Armagh. His father, an Irish clergyman, the *Fearleighlinn*, or *lector*, at the university, was said to have been of noble family. Having been ordained to the priesthood, he for some time acted as vicar of Archbishop Celsus or Ceallach of Armagh, and carried out many reforms tending to increase conformity with the usage of the Church of Rome. In order to improve his knowledge of the Roman ritual he spent four years with Malchus, bishop of Lismore (in Munster), a strong advocate of Romanism. Here he became acquainted with Cormac MacCarthy, king of Desmond, who had sought refuge with Malchus, and, when he subsequently regained his kingdom, rendered great services to Malachy. On his return from Lismore, Malachy undertook the government of the decayed monastery of Bangor (in Co. Down), but very soon afterwards he was elected bishop of Connor (now a small village near Ballymena). After the sack of that place by the king of Ulster he withdrew into Munster; here he was kindly received by Cormac MacCarthy, with whose assistance he built the monastery of Ibrach (in Kerry). Meanwhile he had been designated by Celsus (in whose family the see of Armagh had been hereditary for many years) to succeed him in the archbishopric; in the interests of reform he reluctantly accepted the dignity, and thus became involved for some years in a struggle with the so-called heirs. Having finally settled the diocese, he was permitted, as had been previously stipulated by himself, to return to his former diocese, or rather to the smaller and poorer portion of it, the bishopric of Down. Although the Roman party had by this time obtained a firm hold in the north of Ireland, the organization of the Church had not yet received the sanction of the pope. Accordingly, in 1139, Malachy set out from Ireland with the purpose of soliciting from the pope the pallium (the token of archiepiscopal subjection to Rome) for the archbishop of Armagh. On his way to Rome he visited Clairvaux, and thus began a lifelong friendship with St Bernard. Malachy was received by Innocent II. with great honour, and made papal legate in Ireland, though the pope refused to grant the pallium until it had been unanimously applied for "by a general council of the bishops, clergy and nobles." On his way home Malachy revisited Clairvaux, and took with him from there four members of the Cistercian order, by whom the abbey of Mellifont (in the county of Louth) was afterwards founded in 1141. For the next eight years after his return from Rome Malachy was active in the discharge of his legatine duties, and in 1148, at a synod of bishops and clergy held at Inis-Patrick (St Patrick's Island, near Skerries, Co. Dublin), he was commissioned to return to Rome and make fresh application for the pallium; he did not, however, get beyond Clairvaux, where he died in the arms of St Bernard on the 2nd of November 1148. The object of his life was realized four years afterwards, in 1152, during the legateship of his successor. Malachy was canonized by Clement III. in 1190.

The influence of Malachy in Irish ecclesiastical affairs has been compared with that of Boniface in Germany. He reformed and reorganized the Irish Church and brought it into subjection to Rome; like Boniface, he was a zealous reformer and a promoter of monasticism. But perhaps his chief claim to distinction is that of having opened the first Cistercian monastery in Ireland, five more being soon afterwards established. Several works are attributed to him, but are all probably spurious. The most curious of these is a *Prophecy concerning the Future Roman Pontiffs*, which has produced an extensive literature. It is now generally attributed to the year 1590, and is supposed to have been forged to support the election of Cardinal Simoncelli to the papal chair.

St Bernard's *Life* of Malachy, and two sermons on his death will be found in J. P. Migne, *Patrologia Latina*, clxxxii., clxxxiii.; see also *Annals of the Kingdom of Ireland by the Four Masters*, ed. J. O'Donovan (Dublin, 1851); G. Germano, *Vita, gesti e predittioni del padre san Malachia* (Naples, 1670); the ecclesiastical histories of Ireland by J. Lanigan (1829) and W. D. Killen (1875); A. Bellesheim, *Geschichte der katholischen Kirche in Irland*, Bd. I. (Mainz, 1890); G. T. Stokes, *Ireland and the Celtic Church* (6th ed., 1907); J. O'Hanlon, *Life of Saint Malachy* (Dublin, 1859); articles in *Dictionary of National Biography* and Herzog-Hauck's *Realencyklopädie für protestantische Theologie*. On the *Prophecy*, see the treatise by C. F. Menêtrier (Paris, 1689); Marquis of Bute in *Dublin Review* (1885); A. Harnack in *Zeitschrift für Kirchengeschichte*, Bd. III.

MALACOSTRACA. Under this zoological title are included several groups of Crustacea (*q.v.*), united by characters which attest their common origin, though some, and probably all of them, were already separated in distant geological ages, and some have now attained a peculiar isolation. Throughout the whole, the researches made since 1860 have not only added a great throng of new species, genera and families, but have thrown a flood of light upon questions of their phylogeny, systematic arrangement, horizontal and bathymetric distribution, organization, habits of life and economic importance. There are at least seven orders: the stalk-eyed Brachyura, Macrura, Schizopoda, Stomatopoda, and the sessile-eyed Sympoda, Isopoda, Amphipoda. An ocular segment claimed by the former division is not present or in no case demonstrable in the latter. In neither does the terminal segment or telson, whether large or obsolescent, whether articulated or coalescent, carry appendages, unless occasionally in fusion with itself. Between the eyes and the tail-piece in all the orders nineteen segments are counted, the proof of a segment's existence depending on its separateness, complete or partial, or on a sutural indication, or else on the pair of appendages known to belong to it. All these marks may fail, and then the species must be proved to be Malacostracan by other evidence than the number of its segments; but if some exceptions exhibit fewer, none of the Malacostraca exhibits more than 19 (+ 1 or + 2) segments, unless the Nebaliidae be included. Of the corresponding pairs of appendages thirteen belong to the head and trunk, two pairs of antennae, one pair of mandibles, two pairs of maxillae, followed by three which may be all maxillipeds or may help to swell the number of trunk-legs to which the next five pairs belong. The abdomen or pleon carries the remaining six pairs, of which from three to five are called pleopods and the remainder uropods. Underlying the diversity of names and functions and countless varieties of shape, there is a common standard to which the appendages in general can be referred. In the maxillipeds and the trunk-legs it is common to find or otherwise easy to trace a seven-jointed stem, the endopod, from which may spring two branches, the epipod from the first joint, the exopod from the second.[1] The first antennae are exceptional in branching, if at all, at the third joint. In the mandibles and maxillae some of the terminal joints of the stem are invariably wanting. In the rest of the appendages they may either be wanting or indistinguishable. The latter obscurity results either from coalescence, to which all joints and segments are liable, or from subdivision, which occasionally affects joints even in the trunk-legs. The carapace, formerly referred only to the antennar-mandibular segments, may perhaps in fact contain elements from any number of other segments of head and trunk, Huxley, Alcock, Bouvier giving support to this opinion by the sutural or other divisional lines in *Potamobius*, *Nephrops*, *Thalassina*, and various fossil genera. Not all questions of classification internal to this division are yet finally settled. Between the Brachyura and Macrura some authors uphold an order Anomura, though in a much restricted sense, the labours of Huxley, Boas, Alcock and conjointly Alphonse Milne-Edwards and Bouvier, having resulted in restoring the Dromiidea and Raninidae to the Brachyura, among which de Haan long ago placed them. The French authors argue that from the macruran lobsters (*Nephropsidae*) anciently diverged two lines: one leading through the Dromiidea to the genuine Brachyura; or crabs, the other independently to the Anomura proper, which may conveniently be named and classed as *Macrura anomala*. Spence Bate maintained that the Schizopoda ought not to form a separate order, but to be ranged as a macruran tribe, "more nearly allied to the degraded forms of the Penaeidea than to those of any other group" ("*Challenger*" *Reports*, "Macrura," p. 472, 1888). According to Sars, the Sympoda (or Cumaceans), in spite of their sessile eyes, have closer affinities with the stalk-eyed orders. H. J. Hansen and others form a distinct order Tanaidea for the decidedly anomalous group called by Sars *Isopoda chelifera*.

1. Brachyura.—For the present, as of old, the true Brachyura are divided into four tribes: *Cyclometopa*, with arched front as in the common eatable crab; *Catometopa*, with front bent down as in the land-crabs and the little oyster-crab; *Oxyrhyncha*, with sharpened beak-like front as in the various spider-crabs; *Oxystomata*, including the Raninidæ, and named not from the character of the front but from that of the buccal frame which is usually narrowed forwards. In these tribes the bold and active habits, the striking colours, or the fantastic diversities of structure, have so long attracted remark that recent investigations, while adding a multitude of new species and supplying the specialist with an infinity of new details, have not materially altered the scientific standpoint. New light, however, has been thrown upon the "intellectual" capacity of Crustacea by the proof that the spider-crabs deliberately use changes of raiment to harmonize with their surroundings, donning and doffing various natural objects as we do our manufactured clothes. Others have the power of producing sounds, one use to which they put this faculty being apparently to signal from their burrow in the sand that they are "not at home" to an inopportune visitor. Deep-sea exploration has shown that some species have an immensely extended range, and still more, that species of the same genus, and genera of the same family, though separated by great intervals of space, may be closely allied in character. A curious effect of parasitism, well illustrated in crabs, though not confined to them, has been expounded by Professor Giard, namely, that it tends to obliterate the secondary sexual characters. Modern research has discovered no crab to surpass *Macrocheira kämpferi*, De Haan, that can span between three and four yards with the tips of its toes, but at the other end of the scale it has yielded *Collodes malabaricus*, Alcock, "of which the carapace, in an adult and egg-laden female, is less than one-sixth of an inch in its greatest diameter." The most abyssal of all crabs yet known is *Ethusina abyssicola*, Smith, or what is perhaps only a variety of it, *E. challengeri*, Miers. Of the latter the "Albatross" obtained a specimen from a depth of 2232 fathoms (Faxon, 1895), of the former from 2221 fathoms, and of this S. I. Smith remarks that it has "distinctly faceted black eyes," although in them "there are only a very few visual elements at the tips of the immobile eye-stalks."

The *Brachyura anomala*, or Dromiidea, "have preserved the external characters and probably also the organization of the Brachyura of the Secondary epoch" (Milne-Edwards and Bouvier, 1901). They agree with the true crabs in not having appendages (uropods) to the sixth segment of the pleon, the atrophy being complete in the Homolidae and Homolodromiidae, whereas in the Dromiidae and Dynomenidae a pair of small plates appear to be vestiges of these organs. In the family Homolidae stands the strange genus *Latreillia*, Roux, with long slender limbs and triangular carapace after the fashion of oxyrhynch spider-crabs. In *Homola* the carapace is quadrilateral. Between these two a very interesting link was discovered by the "Challenger" in the species *Latreillopsis bispinosa*. Henderson. Bouvier (1896) has shown that *Palaeinachus longipes*, Woodward, from the Forest Marble of Wiltshire, is in close relationship, not to the oxyrhynch Inachidae, but to the genera *Homolodromia* and *Dicranodromia* of the Homolodromiidae, and that the Jurassic crabs in general, of the family Prosoponidae (Meyer), are Dromiidea.

2. Macrura.—The *Macrura anomala*, or Anomura in restricted sense, are popularly known through the hermit-crabs alone. These only partially represent one of the three main divisions, Paguridea, Galatheidea, Hippidea. The first of these is subdivided into *Pagurinea*, *Lithodinea*, *Lomisinea*, each with a literature of its own. Among the Pagurinea is the *Birgus latro*, or robber-crab, whose expertness in climbing the coco-nut palm need no longer be doubted, since in recent years it has been noted and photographed by trustworthy naturalists in the very act. Alcock "observed one of these crabs drinking from a runnel of rain-water, by dipping the fingers of one of its chelipeds into the water and then carrying the wet fingers to its mouth." Hermits of the genus *Coenobita* he found feeding voraciously on nestling sea-terns. That pagurids must have the usually soft pleon or abdomen protected by the shell of a mollusc is now known to be subject to a multitude of exceptions. *Birgus* dispenses with a covering; *Coenobita* can make shift with half the shell of a coco-nut; *Chlaenopagurus* wraps itself up in a blanket of colonial polyps; *Cancellus tanneri*, Faxon, was found in a piece of dead coral rock; *Xylopagurus rectus*, A. Milne-Edwards, lodges in tubes of timber or bits of hollow reed. The last-named species has a straight symmetrical abdomen, with the penultimate segment expanded and strongly calcified to form a back-door to the very unconventional habitation. This it enters head-foremost from the rear, while "hermits" in general are forced to go backwards into their spiral or tapering shelters by the front. Some of the species can live in the ocean at a depth of two or three miles. Some can range inland up to a considerable height on mountains. The advantage that this group has derived from the adoption of mollusc

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[1] In Huxley's terminology the first two or three joints of the stem constitute a "protopodite," from which spring the "endopodite" and "exopodite."

shells as houses or fortresses, ready built and light enough for easy transport, is obviously discounted by a twofold inconvenience. There is nothing to ensure that the supply will be equal to the demand, and Nature has not arranged that the borrowed tenement shall continue to grow with the growth of its new tenant. To meet these defects it is found that numerous species encourage or demand the companionship of various zoophytes, simple or colonial. These sometimes completely absorb the shell on which they are settled, but then act as a substitute for it, and in any case by their outgrowth they extend the limits of the dwelling, so that the inmate can grow in comfort without having to hunt or fight for a larger abode. Among the *Lithodinea*, or stone crabs, besides important readjustments of classification (Bouvier, 1895, 1896), should be noticed the evidence of their cosmopolitan range, and the species *Neolithodes agassizii* (Smith) and *N. grimaldii*, Milne-Edwards and Bouvier, which carry to an extreme the spinosity characteristic of the group (fig. 1). S. I. Smith's investigations on the early stages of *Hippa talpoida*, Say, were published in 1877.

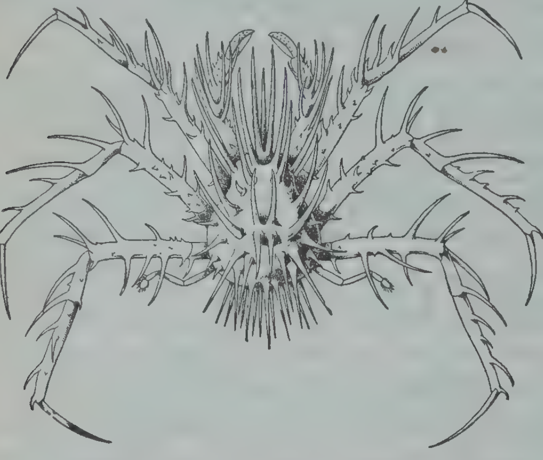
FIG. 1.—*Neolithodes grimaldii*, A. Milne-Edwards and Bouvier.

With regard to the accessions to knowledge in the enormous group of the genuine Macrura, reference need only be made to the extensive reports in which Spence Bate, S. I. Smith, Faxon, Wood-Mason, Alcock, and others have made known the results of celebrated explorations. Various larval stages have been successfully investigated by Sars. Alcock (1901) describes from his own observation the newly hatched *Phyllosoma* larva of *Thenus orientalis*, Fabricius. An admirable discrimination of the larval and adult characters of the genus *Sergestes* has been given by H. J. Hansen (*Proc. Zool. Soc.*, London, 1896). Singularity excites our wonder in *Thaumastocheles zaleucus*, v. Willemoes Suhm, which makes up for its vanished eyes by its extraordinarily elongate and dentated claws; in *Psalidopus huxleyi*, Wood-Mason and Alcock (1892), bristling with spikes from head to tail; in the Nematocarcinidae, with their long thread-like limbs and longer antennae; in species of *Aristaeopsis* reported by Chun from deep water off the east coast of Africa, bright red prawns nearly a foot long, with antennae about five times the length of the body. That certain species, particularly many from deep water, have disproportionately large eggs, is explained by the supposition that the young derive the advantage of being hatched in an advanced stage of development.

3. SCHIZOPODA.—This order of animals for the most part delicately beautiful, has for the moment five families—Lophogastridae, Eucopiidae, Euphausiidae, Mysidae and Anaspididae. In the Euphausiidae the digitiform-arborescent branchiae, as if conscious of their own extreme elegance, remain wholly uncovered. In the two preceding families they are partially covered. In the Mysidae the branchiae are wanting, and some would form this family into a separate order, Mysidacea. In *Anaspides*, a peculiar fresh-water genus discovered in 1892 by G. M. Thomson on Mount Wellington, in Tasmania, the gills are not arborescent, and there are seven segments of the trunk free of the carapace (fig. 2). A membranaceous carapace separates the Eucopiidae from the more solidly invested Lophogastridae. Among many papers that the student will find it necessary to consult may be mentioned the "*Challenger*" *Report* on Schizopoda, by Sars, 1885, dealing with the order at large; "British Schizopoda," by Norman *Ann. Nat. Hist*, (1892); "Decapoden und Schizopoden," *Plankton-Expedition* (Ortmann, 1893); "Euphausiidae," by Stebbing, *Proc. Zool. Soc.* (London, 1900); *Mysidae of the Russian Empire*, by Czerniavski (1882–1883); and *Mysidae of the Caspian*, by Sars (1893–1895–1897).

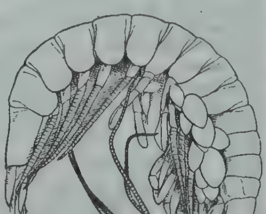
FIG. 2.—*Anaspides tasmaniae*, Thomson.

4. STOMATOPODA.—This order, at one time a medley of heterogeneous forms, is now confined to the singularly compact group of the Squillidae. Here the articulation of the ocular segment is unusually distinct, and here two characters quite foreign to all the preceding groups come into view. The second maxillipeds are developed into powerful prehensile organs, and the branchiae, instead of being connected with the appendages of head and trunk, are developed on the pleopods, appendages of the abdomen. At least three segments of the trunk are left uncovered by the carapace. The developing eggs are not carried about by the mother, but deposited in her subaqueous burrow, "where they are aerated by the currents of water produced by the abdominal feet of the parent." An excellent synopsis of the genera and species is provided by R. P. Bigelow (*Proc. U.S. Mus.* vol. xvii., 1894). For the habits and peculiarities of these and many other Crustaceans, A. E. Verrill and S. I. Smith on the *Invertebrates of Vineyard Sound* should be consulted (1874). The general subject has been illuminated by the labours of Claus, Miers, Brooks ("*Challenger*" *Report*, 1886), and the latest word on the relationship between the various larvae and their respective genera has been spoken by H. J. Hansen (*Plankton-Expedition Report*, 1895). The striking forms of *Alima* and *Erichthus*, at one time regarded as distinct genera, are now with more or less certainty affiliated to their several squillid parents.

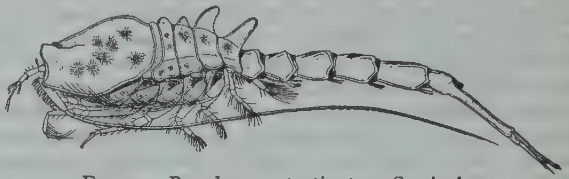
FIG. 3.—*Pseudocuma pectinatum*, Sowinsky.

5. SYMPODA.—This order of sessile-eyed decapods was absolutely unknown to science till 1779. A species certainly belonging to it was described by Lepekhin in 1780, but the obscure *Gammarus esca*, "food Gammarus" beloved of herrings, described by J. C. Fabricius in the preceding year, may also be one of its members. Nutritious possibilities are implied in *Diastylis rathkii*, Kröyer, one of the largest forms, which, though slender and rarely an inch long, in its favourite Arctic waters is found "in incalculable masses, in thousands of specimens" (Stuxberg, 1880). Far on in the 19th century eminent naturalists were still debating whether in this group there were eyes or no eyes, whether the eyes were stalked or sessile, whether the animals observed were larval or adult. The American T. Say in 1818 gave a good description of a new species and founded the premier genus *Diastylis*, but other investigators derived little credit from the subject till more than sixty years after its introduction by the Russian Lepekhin. Then Goodsir, Kröyer, Lilljeborg, Spence Bate and one or two others made considerable advances, and in 1865 a memorable paper by G. O. Sars led the way to the great series of researches which he has continued to the present day. The name *Cumacea*, however, which he uses cannot be retained, being founded on the preoccupied name *Cuma* (Milne-Edwards, 1828). The more recent name *Sympoda* (see Willey, *Results*, pt. v. p. 609, 1900) alludes to the huddling together of the legs, which is conspicuous in most of the species. Ten families are now distinguished—Diastylidae, Lampropidae, Platyaspidae, Pseudocumidae, all with an articulated telson; without one, the Bodotriidae (formerly called *Cumidae*), Vaunthompsoniidae, Leuconidae, Nannastacidae, Campylaspidae, Procampylaspidae. All the Leuconidae and Procampylaspidae are blind, and some species in most of the other families. Usually the sides of the carapace are strangely produced into a mock rostrum in front of the ocular lobe, be it oculiferous or not. The last four or five segments of the trunk are free from the carapace. The slender pleon has always six distinct segments, the sixth carrying two-branched uropods, the preceding five armed with no pleopods in the female, whereas in the male the number of pairs varies from five to none. The resemblance of these creatures to miniature Macrura is alluded to in the generic name *Nannastacus*, meaning dwarf-lobster. In this genus alone of the known Sympoda the eyes sometimes form a pair, in accordance with the custom of all other malacostracan orders except this and of this order itself in the embryo (Sars, 1900). The most but not the only remarkable character lies in the first maxillipeds. These, with the main stem more or less pediform, have the epipod and exopod modified for respiratory purposes. The backward-directed epipods usually carry branchial vesicles. The forward-directed exopods either act as valves or form a tube (rarely two tubes), protensile and retractile, for regulating egress of water from the branchial regions. This mechanism as a whole is unique, although, as Sars observes, the epipod of the first maxillipeds has a respiratory function also in the Lophogastridae and Mysidae and in the cheliferous isopods. As a rule armature of

the carapace is much more developed in the comparatively sedentary female than in the usually more active male. Only in the male do the second antennae attain considerable length, with strong resemblance to what is found in some of the Amphipoda. About 150 species distributed among thirty-four genera are now known, many from shallow water and from between tide-marks, some from very great depths. H. J. Hansen concludes that "they are all typically ground animals, and as yet no species has been taken under such conditions that it could be reckoned to the pelagic plankton." As they have been found in all zones and chiefly by a very few observers, it is probable that a great many more species remain to be discovered. In recent years thirteen species, all belonging to the same genus *Pseudocuma* (fig. 3), have been recorded by Sars from the Caspian Sea. A bibliography of the order is given in that author's *Crustacea of Norway*, vol. iii. (1899–1900).

6. Isopoda.—This vast and populous order can be traced far back in geological time. It is now represented in all seas and lands, in fresh-water lakes and streams, and even in warm springs. It adapts itself to parasitic life not only in fishes, but in its own class Crustacea, and that in species of every order, its own included. In this process changes of structure are apt to occur, and sometimes unimaginable sacrifices of the normal appearance. The order has been divided into seven tribes, of which a fuller summary than can here be given will be found in Stebbing, *History of Crustacea* (1893). The first tribe, called Chelifera, from the usually chelate or claw-bearing first limbs, may be regarded as *Isopoda anomala*, of which some authors would form a separate order, Tanaidea. Like the genuine isopods, they have seven pairs of trunk-legs, but instead of having seven segments of the middle body (or peraeon) normally free, they have the first one or two of its segments coalesced with the head. Instead of the breathing organs being furnished by the appendages of the pleon with the heart in their vicinity, the respiration is controlled by the maxillipeds, with the heart in the peraeon (see Delage, *Arch. Zool. expér. et gén.*, vol. ix., 1881). There are two families, Tanaidae and Apseudidae. Occasionally the ocular lobes are articulated.

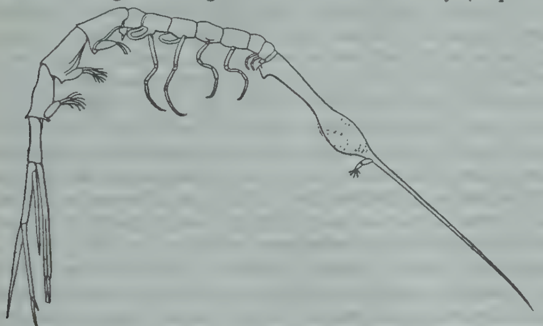

Fig. 4.—*Rhabdosoma piratum*, Stebbing.

The genuine Isopoda are divided among the *Flabellifera*, in which the terminal segment and uropods form a flabellum or swimming fan; the *Epicaridea*, parasitic on Crustaceans; the *Valvifera*, in which the uropods fold valve-like over the branchial pleopods; the *Asellota*, in which the first pair of pleopods of the female are usually transformed into a single opercular plate; the *Phreatoicidea*, a fresh-water tribe, known as yet only from subterranean waters in New Zealand and an Australian swamp nearly 6000 ft. above sea-level; and lastly, the *Oniscidea*, which are terrestrial. Only the last of these, under the contemptuous designation of wood-lice, has established a feeble claim to popular recognition. Few persons hear without surprise that England itself possesses more than a score of species in this air-breathing tribe. Those known from the world at large number hundreds of species, distributed among dozens of genera in six families. That a wood-louse and a land-crab are alike Malacostracans, and that they have by different paths alike become adapted to terrestrial life, are facts which even a philosopher might condescend to notice. Of the other tribes which are aquatic there is not space to give even the barest outline. Their swarming multitudes are of enormous importance in the economy of the sea. If in their relation to fish it must be admitted that many of them plague the living and devour the dead, in return the fish feed rapaciously upon them. Among the most curious of recent discoveries is that relating to some of the parasitic *Cymothoidae*, as to which Bullar has shown that the same individual can be developed first as a male and then as a female. Of lately discovered species the most striking is one of the deep-sea Cirolanidae, *Bathynomus giganteus*, A. M. Edwards (1879), which is unique in having supplementary ramified branchiae developed at the bases of the pleopods. Its eyes are said to contain nearly 4000 facets. The animal attains, what in this order is the monstrous size of 9 in. by 4. A general uniformity of the trunk-limbs in Isopoda justifies the ordinal name, but the valviferous Astacillidae, and among the Asellota the Munnopsidae, offer some remarkable exceptions to this characteristic. Among many essential works on this group may be named the *Monogr. Cymothoarum* of Schiödte and Meinert (1879–1883); "*Challenger*" *Report*, Beddard (1884–1886); *Cirolanidae*, H. J. Hansen (1890); *Isopoda Terrestria*, Budde-Lund (1885); *Bopyridae*, Bonnier (1900); *Crustacea of Norway*, vol. ii. (Isopoda), Sars (1896–1899), while their multitude precludes specification of important contributions by Benedict, Bovallius, Chilton, Dohrn, Dollfus, Fraisse, Giard and Bonnier, Harger, Haswell, Kossmann, Miers, M'Murrich, Norman, Harriet Richardson, Ohlin, Studer, G. M. Thomson, A. O. Walker, Max Weber and many others.

7. Amphipoda.—As in the genuine Isopoda, the eyes of Amphipoda are always sessile, and generally paired, and, in contrast to crabs and lobsters, these two groups have only four pairs of mouth-organs instead of six, but seven pairs of trunk-legs instead of five. From the above-named isopods the present order is strongly differentiated by having heart and breathing organs not in the pleon, but in the peraeon, or middle body, the more or less simple branchial vesicles being attached to some or all of the last six pairs of trunk-legs. Normally the pleon carries six pairs of two-branched appendages, of which the first three are much articulated flexible swimming feet, the last three few-jointed comparatively indurated uropods. There are three tribes, *Gammaridea*, *Caprellidea*, *Hyperiidea*. The middle one contains but two families, the cylindrical and often thread-like skeleton shrimps, Caprellidae, and their near cousins, the broad, flattened, so-called whale-lice, Cyamidae. This tribe has the pleon dwindled into insignificance, whereas in the other two tribes it is powerfully developed. The Hyperiidea are distinguished by having their maxillipeds never more than three-jointed. In the companion tribes these appendages have normally seven joints, and always more than three. The order thus sharply divided is united by an intimate interlacing of characters, and forms a compact whole at present defying intrusion from any other crustacean group. Since 1775, when J. C. Fabricius instituted the genus *Gammarus* for five species, of which only three were amphipods, while he left five other amphipods in the genus *Oniscus*, from this total of eight science has developed the order, at first very slowly, but of late by great leaps and bounds, so that now the *Gammaridea* alone comprise more than 1300 species, distributed among some 300 genera and 39 families. They burrow in the sands of every shore; they throng the weeds between tide-marks; they ascend all streams; they are found in deep wells, in caverns, in lakes; in Arctic waters they swarm in numbers beyond computation; they find lodgings on crabs, on turtles, on weed-grown buoys; they descend into depths of the ocean down to hundreds or thousands of fathoms; they are found in mountain streams as far above sea-level as some of their congeners live below it. The Talitridae, better known as sandhoppers, can forgo the briny shore and content themselves with the damp foliage of inland forests or casual humidity in the crater of an extinct volcano. Over the ocean surface, as well as at various depths, float and swim innumerable *Hyperiidea*—the wonderful *Phronima*, glass-like in its glassy barrel hollowed out of some Tunicate; the *Cystisoma*, 4 or 5 in. long, with its eye-covered head; the *Rhabdosoma*, like a thin rod of glass, with needle-like head and tail, large eyes, but limbs and mouth-organs all in miniature, and the second antennae of the male folding up like a carpenter's rule (fig. 4). On jelly-fishes are to be found species of *Hyperia* and their kindred, so fat and wholesome that they have been commended to shipwrecked men in open boats as an easily procurable resource against starvation. Many of the Amphipoda are extremely voracious. Some of them are even cannibals. The Cyamidæ afflict the giant whale by nibbling away its skin; the *Chelura terebrans* is destructive to submerged timber. But, on the other hand, they largely help to clear the sea and other waters of refuse and carrion, and for fishes, seals and whales they are food desirable and often astoundingly copious. From the little flea-like species, scarcely a tenth of an inch long, up to the great and rare but cosmopolitan *Eurythenes gryllus*, Lichtenstein, and the still larger *Alicella gigantea*, Chevreux, nearly half a foot long, captured by the prince of Monaco from a depth of 2936 fathoms, not one of these ubiquitous, uncountable hordes has ever been accused of assailing man. For the naturalist they have the recommendation that many are easy to obtain, that most, apart from the very minute, are easy to handle, and that all, except as to the fleeting colours, are easy to preserve.

A nearly complete bibliography of the order down to 1888 will be found in the "*Challenger*" *Reports*, vol. xxviii., and supplementary notices in Della Valle's *Monograph of the Gammarini* (1893), the scope of his work, however, not covering the Hyperiidea and Oxycephalidae of Bovallius (1889, 1890); but since these dates very numerous additions to the literature have been made by Birula, Bonnier, Norman, Walker and others, especially the *Crustacea of Norway*, vol. i. (*Amphipoda*), Sars (1890–1895), demanding attention, and the quite recent *Amphipoda of the Hirondelle*, Chevreux (1900), and *Hyperiidea of the Plankton-Expedition*, Vosseler (1901). (T. R. R. S.)

MALAGA, a maritime province of southern Spain, one of the eight modern subdivisions of Andalusia; bounded on the W. by Cadiz, N. by Seville and Cordova, E. by Granada, and S. by the Mediterranean Sea. Pop. (1900), 511,989; area, 2812 sq. m. The northern half of Malaga belongs to the great

Andalusian plain watered by the Guadalquivir, the southern is mountainous, and rises steeply from the coast. Of the numerous sierras may be mentioned that of Alhama, separating the province from Granada, and at one point rising above 7000 ft.; its westward continuation in the Sierra de Abdalajis and the Axarquia between Antequera and Malaga; and not far from the Cadiz boundary the Sierras de Ronda, de Mijas, de Tolox and Bermeja, converging and culminating in a summit of nearly 6500 ft. The rivers which rise in the watershed formed by all these ranges reach the sea after a short and precipitous descent, and in rainy seasons are very liable to overflow their banks. In 1907 great loss of life and destruction of property were caused in this manner. The principal river is the Guadalhorce, which rises in the Sierra de Alhama, and, after a westerly course past the vicinity of Antequera, bends southward through the wild defile of Peñarrubia and the beautiful *vega* or vale of Malaga, falling into the sea near that city. The only other considerable stream is the Guadiaro, which has the greater part of its course within the province and flows past Ronda. There is an extensive salt lagoon near the northern boundary. The mountains are rich in minerals, lead, and (in the neighbourhood of Marbella) iron, being obtained in large quantities. There are warm sulphurous springs and baths at Carratraca. Though the methods of agriculture are for the most part rude, the yield of wheat in good seasons is considerably in excess of the local demand; and large quantities of grapes and raisins, oranges and lemons, figs and almonds, are annually exported. The oil and wines of Malaga are also highly esteemed, and after 1870 the manufacture of beet and cane sugar developed into an important industry. In 1905 there were about 500 flour mills and 230 oil factories beside 95 stills and 100 wine-presses in the province. Malaga has suffered severely from the agricultural depression prevalent throughout southern Spain, but its manufacturing industries tend to expand. The fisheries are important; a fleet of about 300 boats brings in 18,000,000 ℔ annually, of which 25% is exported. The internal communications are in many parts defective, owing to the broken nature of the surface; but the province is traversed from north to south by the Cordova-Malaga railway, which sends off branches from Bobadilla to Granada and Algeciras. A branch line along the coast from Malaga to Vélez Malaga was opened in 1908.

Malaga, the capital (pop. 130,109), Antequera (31,609), Vélez Malaga (23,586), Ronda (20,995), Coín (12,326), and Alora (10,325), are described in separate articles. Other towns with more than 7000 inhabitants are Marbella (9629), Estepona (9310), Archidona (8880) and Nerja (7112). The population of the province tends gradually to decrease, as many families emigrate to South America, Algeria and Hawaii.

MALAGA, the capital of the province of Malaga, an episcopal see, and, next to Barcelona, the most important seaport of Spain, finely situated on the Mediterranean coast, at the southern base of the Axarquia hills and at the eastern extremity of the fertile *vega* (plain) of Malaga in 36° 43′ N. and 4° 25′ W. Pop. (1900), 130,109. From the clearness of its sky, and the beautiful sweep of its bay, Malaga has sometimes been compared with Naples. The climate is one of the mildest and most equable in Europe, the mean annual temperature being 66·7° Fahr. The principal railway inland gives access through Bobadilla to all parts of Spain, and a branch line along the coast to Vélez-Malaga was opened in 1908. Malaga lies principally on the left bank of a mountain torrent, the Guadalmedina (" river of the city "); the streets near the sea are spacious and comparatively modern, but those in the older part of the town, where the buildings are huddled around the ancient citadel, are narrow, winding and often dilapidated. Well-built suburbs have also spread on all sides into the rich and pleasant country which surrounds Malaga, and several acres of land reclaimed from the sea have been converted into a public park. There are various squares or plazas and public promenades; of the former the most important are the Plaza de Riego (containing the monument to General José Maria Torrijos, who, with forty-eight others, was executed in Malaga on the 11th of December 1831, for promoting an insurrection in favour of the constitution) and the Plaza de la Constitucion; adjoining the quays is the fine Paseo de la Alameda. The city has no public buildings of commanding architectural or historical importance. The cathedral, on the site of an ancient mosque, was begun about 1528; after its construction had been twice interrupted, it was completed to its present state in the 18th century, and is in consequence an obtrusive record of the degeneration of Spanish architecture. The woodwork of the choir, however, is worthy of attention. The church of El Cristo de la Victoria contains some relics of the siege of 1487. There are an English church and an English cemetery, which dates from 1830; up to that year all Protestants who died in Malaga were buried on the foreshore, where their bodies were frequently exposed by the action of wind and sea. Of the old Moorish arsenal only a single horse-shoe gateway remains, the rest of the site being chiefly occupied by an iron structure used as a market; the Alcazába, or citadel, has almost disappeared. The castle of Gibralfaro, on a bold eminence to the north-east dates from the 13th century, and is still in fairly good preservation.

During the 19th century so much silt accumulated in the harbour that vessels were obliged to lie in the roads outside, and receive and discharge cargo by means of lighters; but new harbour works were undertaken in 1880, and large ships can now again load or discharge at the quays, which are connected with the main railway system by a branch line. About 2150 ships of 1,750,000 tons enter at Malaga every year. Iron, lead, wine, olive oil, almonds, fresh and dried fruit, palmetto hats and canary seed are exported in large quantities, while the imports include grain, codfish, fuel, chemicals, iron and steel, machinery, manures and staves for casks. Although trade was impeded during the early years of the 20th century by a succession of bad harvests and by the disastrous floods of September 1907, the number of industries carried on in and near Malaga tends steadily to increase. There are large cotton mills, iron foundries, smelting works and engineering works. Pottery, mosaic, artificial stone and tiles are produced chiefly for the home market, though smaller quantities are sent abroad. There is a chromo-lithographic establishment, and the other industries include tanning, distilling and the manufacture of sugar, chocolate, soap, candles, artificial ice, chemical products, white lead and pianos. Foreign capital has played a prominent part in the development of Malaga; a French syndicate owns the gas-works, and the electric lighting of the streets is controlled by British and German companies.

Malaga is the Μάλακα of Strabo (iii. 156) and Ptolemy (ii. 4, 7) and the *Malaca foederatorum* of Pliny (iii. 3). The place seems to have been of some importance even during the Carthaginian period; under the Romans it became a municipium, and under the Visigoths an episcopal see. In 711 it passed into the possession of the Moors, and soon came to be regarded as one of the most important cities of Andalusia. It was attached to the caliphate of Cordova, but on the fall of the Omayyad dynasty it became for a short time the capital of an independent kingdom; afterwards it was dependent on Granada. In 1487 it was taken and treated with great harshness by Ferdinand and Isabella after a protracted siege. In 1810 it was sacked by the French under General Sebastiani. The citizens of Malaga are noted for their opposition to the Madrid government; they took a prominent part in the movements against Espartero (1843), against Queen Isabella (1868) and in favour of a republic (1873).

MALAKAND PASS, a mountain pass in the North-West Province of India, connecting the British district of Peshawar with the Swat Valley. It is now a military post and the headquarters of a political agency. It came into prominence for the first time in 1895 during the Chitral campaign, when 7000 Pathans held it against Sir Robert Low's advance, but were easily routed. After the campaign was over a fortified camp was formed on the Malakand to guard the road to Chitral. During the frontier risings of 1897 the Swatis made a determined attack on the Malakand, where 700 were killed, and on the adjacent post of Chakdara, where 2000 were killed. This was the origin of the Malakand Expedition of the same year. (See SWAT.)

MALALAS (or MALELAS) (Syriac for "orator"), **JOHN** (*c.* 491–578), Byzantine chronicler, was born at Antioch. He wrote a Χρονογραφία in 18 books, the beginning and the end of which are lost. In its present state it begins with the mythical history of Egypt and ends with the expedition to Africa under Marcianus, the nephew of Justinian. Except for the history of Justinian and his immediate predecessors, it possesses little historical value; it is written without any idea of proportion and contains astonishing blunders. The writer is a supporter of Church and State, an upholder of monarchical principles. The work is rather a chronicle written round Antioch, which he regarded as the centre of the world, and (in the later books) round Constantinople. It is, however, important as the first specimen of a chronicle written not for the learned but for the instruction of the monks and the common people, in the language of the vulgar, with an admixture of Latin and Oriental words. It obtained great popularity, and was conscientiously exploited by various writers until the 11th century, being translated even into the Slavonic languages. It is preserved in an abridged form in a single MS. now at Oxford.

For the authorities consulted by Malalas, the influence of his work on Slavonic and Oriental literature, the state of the text, the original form and extent of the work, the date of its composition, the relation of the concluding part to the whole, and the literature of the subject, see C. Krumbacher's *Geschichte der byzantinischen Litteratur* (1897). See also the *editio princeps*, by E. Chilmead (Oxford, 1691), containing an essay by Humphrey Hody and Bentley's well-known letter to Mill; other editions in the Bonn *Corpus scriptorum hist. byz.*, by L. Dindorf (1831), and in J. P. Migne *Patrologia graeca*, xcvii.

MALAN, SOLOMON CAESAR (1812–1894), British divine and orientalist, was by birth a Swiss descended from an exiled French family, and was born at Geneva on the 22nd of April 1812, where his father, Dr Henry Abraham Caesar Malan (1787–1864) enjoyed a great reputation as a Protestant divine. From his earliest youth he manifested a remarkable faculty for the study of languages, and when he came to Scotland as tutor in the marquis of Tweeddale's family at the age of 18 he had already made progress in Sanskrit, Arabic and Hebrew. In 1833 he matriculated at St Edmund Hall, Oxford; and English being almost an unknown tongue to him, he petitioned the examiners to allow him to do his paper work of the examination in French, German, Spanish, Italian, Latin or Greek, rather than in English. But his request was not granted. After gaining the Boden and the Pusey and Ellerton scholarships, he graduated 2nd class in *Lit. hum.* in 1837. He then proceeded to India as classical lecturer at Bishop's College, Calcutta, to which post he added the duties of secretary to the Bengal branch of the Royal Asiatic Society; and although compelled by illness to return in 1840, laid the foundation of a knowledge of Tibetan and Chinese. After serving various curacies, he was presented in 1845 to the living of Broadwindsor, Dorset, which he held until 1886. During this entire period he continued to augment his linguistic knowledge, which he carried so far as to be able to preach in that most difficult language, Georgian, on a visit which he paid to Nineveh in 1872. His translations from the Armenian, Georgian and Coptic were numerous. He applied his Chinese learning to the determination of important points connected with Chinese religion, and published a vast number of parallel passages illustrative of the Book of Proverbs. In 1880 the university of Edinburgh conferred upon him the honorary degree of D.D. No modern scholar, perhaps, has so nearly approached the linguistic omniscience of Mezzofanti; but, like Mezzofanti, Dr Malan was more of a linguist than a critic. He made himself conspicuous by the vehemence of his opposition to Westcott and Hort's text of the New Testament, and to the transliteration of Oriental languages, on neither of which points did he in general obtain the suffrages of scholars. His extensive and valuable library, some special collections excepted, was presented by him in his lifetime to the Indian Institute at Oxford. He died at Bournemouth on the 25th of November 1894. His life has been written by his son.

MÄLAR, a lake of Sweden, extending 73 m. westward from Stockholm, which lies at its junction with the Saltsjö, an arm of the Baltic Sea. The height of the lake is normally only from 11 in. to 2 ft. above sea-level, and its outflow is sometimes reversed. The area is 449 sq. m. The bottom consists of a series of basins separate by ridges from which rise numerous islands. The deepest sounding is 210 ft. The outline is very irregular, the mean breadth being about 15 m., but an arm extends northward for 30 m. nearly to the city of Upsala with many ramifications. The area of the drainage basin is 8789 sq. m., of which 1124 are occupied by lakes. The navigable connexions with the lake are—(1) with lake Hjelmar to the south-west by the Arboga river and the Hjelmar canal; and by the Eskilstuna river and the Thorshälla canal; (2) with the Baltic southward through the Södertelge canal, the route followed by the Göta canal steamers; (3) with the Baltic by two channels at Stockholm. The more important towns, besides Stockholm, are Vesterås on the north, Södertelge and Eskilstuna near the south shore. The lake offers a field for recreation fully appreciated by the inhabitants of the capital, and many of those whose business lies at Stockholm have their residences on the shores of Mälar. On Drottningholm (Queen's Island, named from Catherine, wife of John III.) is a palace with a fine park and formal gardens. John III. built a palace at the close of the 16th century, but the existing building, by Nicodemus Tessin and his son Nicodemus, dates from the second half of the 17th century. At Mariefred on the south shore there is the castle of Gripsholm (1537), built by Gustavus Vasa, a picturesque erection with four towers, richly adorned within, and containing a large collection of portraits. Strengnäs, on the same shore, became an episcopal see in 1291, when the fine cathedral, much altered since, was consecrated. In the episcopal palace, a building of the 15th century now used as a school, Gustavus Vasa was elected to the throne of Sweden in 1523. On the northward arm of the lake is the palace of Rosenberg, used as a school of gunnery, in a well-wooded park. On a branch of the same arm is Sigtuna, a village whose ruined churches are a memorial of its rank among the principal towns of Sweden after its foundation in the 11th century. Remains prove that on Björkö, an island in the eastern part of the lake, there was a large settlement of earlier importance than Sigtuna. Here a cross commemorates the preaching of Christianity by St Ansgar in 829. Finally, on the northern arm about 10 m. south of Upsala, there is the château of Skokloster, occupying the site of a monastery, and presented by Gustavus Adolphus to Marshal Herman Wrangel, whose son Charles Gustavus Wrangel stored it with a remarkable collection of trophies from Germany, taken during the Thirty Years' War; including a library, an armoury, and a great accumulation of curios.

MALARIA, an Italian colloquial word (from *mala*, bad, and *aria*, air), introduced into English medical literature by Macculloch (1827) as a substitute for the more restricted terms "marsh miasm" or "paludal poison." It is generally applied to the definite unhealthy condition of body known by a variety of names, such as ague, intermittent (and remittent) fever, marsh fever, jungle fever, hill fever, "fever of the country" and "fever and ague." A single paroxysm of simple ague may come upon the patient in the midst of good health or it may be preceded by some malaise. The ague-fit begins with chills proceeding as if from the lower part of the back, and gradually extending until the coldness overtakes the whole body. Tremors of the muscles more or less violent accompany the cold sensations, beginning with the muscles of the lower jaw (chattering of the teeth), and extending to the extremities and trunk. The expression has meanwhile changed: the face is pale or livid; there are dark rings under the eyes; the features are pinched and sharp, and the whole skin shrunken; the fingers are dead white, the nails blue.

All those symptoms are referable to spasmodic constriction of the small surface arteries, the pulse at the wrist being itself small, hard and quick. In the interior organs there are indications of a compensating accumulation of blood, such as swelling of the spleen, engorgement (very rarely rupture) of the heart, with a feeling of oppression in the chest, and a copious flow of clear and watery urine from the congested kidneys. The body temperature will have risen suddenly from the normal to 103° or higher. This first or cold stage of the paroxysm varies much in length; in temperate climates it lasts from one to two hours, while in tropical and subtropical countries it may be shortened. It is followed by the stage of dry heat, which will be prolonged in proportion as the previous stage is curtailed. The feeling of heat is at first an internal one, but it spreads outwards to the surface and to the extremities; the skin becomes warm and red, but remains dry; the pulse becomes softer and more full, but still quick; and the throbbings occur in exposed arteries, such as the temporal. The spleen continues to enlarge; the urine is now scanty and high-coloured; the body temperature is high, but the highest temperatures occur during the chill; there is considerable thirst; and there is the usual intellectual unfitness, and it may be confusion, of the feverish state. This period of dry heat, having lasted three or four hours or longer, comes to an end in perspiration, at first a mere moistness of the skin, passing into sweating that may be profuse and even drenching. Sleep may overtake the patient in the midst of the sweating stage, and he awakes, not without some feeling of what he has passed through, but on the whole well, with the temperature fallen almost or altogether to the normal, or it may be even below the normal; the pulse moderate and full; the spleen again of its ordinary size; the urine that is passed after the paroxysm deposits a thick brick-red sediment of urates. The three stages together will probably have lasted six to twelve hours. The paroxysm is followed by a definite interval in which there is not only no fever, but even a fair degree of bodily comfort and fitness; this is the intermission of the fever. Another paroxysm begins at or near the same hour next day (quotidian ague), which results from a double tertian infection, or the interval may be forty-eight hours (tertian ague), or seventy-two hours (quartan ague). It is the general rule, with frequent exceptions, that the quotidian paroxysm comes on in the morning, the tertian about noon, and the quartan in the afternoon. Another rule is that the quartan has the longest cold stage, while its paroxysm is shortest as a whole; the quotidian has the shortest cold stage and a long hot stage, while its paroxysm is longest as a whole. The point common to the various forms of ague is that the paroxysm ceases about midnight or early morning. Quotidian intermittent is on the whole more common than tertian in hot countries; elsewhere the tertian is the usual type, and quartan is only occasional.

If the first paroxysm should not cease within the twenty-four hours, the fever is not reckoned as an intermittent, but as a remittent.

Remittent is a not unusual form of the malarial process in tropical and subtropical countries, and in some localities or in some seasons it is more common than intermittent. It may be said to arise out of that type of intermittent in which the cold stage is shortened while the hot stage tends to be prolonged. A certain abatement or remission of the fever takes place, with or without sweating, but there is no true intermission or interval of absolute apyrexia. The periodicity shows itself in the form of an exacerbation of the still continuing fever, and that exacerbation may take place twenty-four hours after the first onset, or the interval may be only half that period, or it may be double. A fever that is to be remittent will usually declare itself from the outset: it begins with chills, but without the shivering and shaking fit of the intermittent; the hot stage soon follows, presenting the same characters as the prolonged hot stage of the quotidian, with the frequent addition of bilious symptoms, and it may be even of jaundice and of tenderness over the stomach and liver. Towards morning the fever abates; the pulse falls in frequency, but does not come down to the normal; headache and aching in the loins and limbs become less, but do not cease altogether; the body temperature falls, but does not touch the level of apyrexia. The remission or abatement lasts generally throughout the morning; and about noon there is an exacerbation, seldom ushered in by chills, which continues till the early morning following, when it remits or abates as before. A patient with remittent may get well in a week under treatment, but the fever may go on for several weeks; the return to health is often announced by the fever assuming the intermittent type, or, in other words, by the remissions touching the level of absolute apyrexia. Remittent fevers (as well as intermittents) vary considerably in intensity; some cases are intense from the outset, or pernicious, with aggravation of all the symptoms—leading to stupor, delirium, collapse, intense jaundice, blood in the stools, blood and albumen in the urine, and, it may be, suppression of urine followed by convulsions. The severe forms of intermittent are most apt to occur in the very young, or in the aged, or in debilitated persons generally. Milder cases of malarial fever are apt to become dangerous from the complications of dysentery, bronchitis or pneumonia. Severe remittents (pernicious or bilious remittents) approximate to the type of yellow fever (*q.v.*), which is conventionally limited to epidemic outbreaks in western longitudes and on the west coast of Africa.

Of the mortality due to malarial disease a small part only is referable to the direct attack of intermittent, and chiefly to the fever in its pernicious form. Remittent fever is much more fatal in its direct attack. But probably the greater part of the enormous total of deaths set down to malaria is due to the *malarial cachexia*. The dwellers in a malarious region like the Terai (at the foot of the Himalayas) are miserable, listless and ugly, with large heads and particularly prominent ears, flat noses, tumid bellies, slender limbs and sallow complexions; the children are impregnated with malaria from their birth, and their growth is attended with aberrations from the normal which practically amount to the disease of rickets. The malarial cachexia that follows definite attacks of ague consists in a state of ill-defined suffering, associated with a sallow skin, enlarged spleen and liver, and sometimes with dropsy.

Causation.—From the time of Hippocrates onwards the malarial or periodical fevers have engaged the attention of innumerable observers, who have suggested various theories of causation, and have sometimes anticipated—vaguely, indeed, but with surprising accuracy—the results of modern research; but the true nature of the disease remained in doubt until the closing years of the 19th century. It has now been demonstrated by a series of accurate investigations, contributed by many workers, that malaria is caused by a microscopic parasite in the blood, into which it is introduced by the bites of certain species of mosquito. (See PARASITIC DISEASES and MOSQUITOES.)

History of Discovery.

The successive steps by which the present position has been reached form an interesting chapter in the history of scientific progress. The first substantial link in the actual chain of discovery was contributed in 1880 by Laveran, a French army surgeon serving in Algeria. On the 6th of November in that year he plainly saw the living parasites under the microscope in the blood of a malarial patient, and he shortly afterwards communicated his observations to the Paris Académie de Médecine. They were confirmed, but met with little acceptance in the scientific world, which was preoccupied with the claims of a subsequently discredited *Bacillus malariae*. In 1885 the Italian pathologists came round to Laveran's views, and began to work out the life history of his parasites. The subject has a special interest for Italy, which is devastated by malaria, and Italian science has contributed materially to the solution of the problem. The labours of Golgi, Marchiafava, Celli and others established the nature of the parasite and its behaviour in the blood; they proved the fact, guessed by Rasori so far back as 1846, that the periodical febrile paroxysm corresponds with the development of the organisms; and they showed that the different forms of malarial fever have their distinct parasites, and consequently fall into distinct groups, defined on an etiological as well as a clinical basis—namely, the mild or spring group, which includes tertian and quartan ague, and the malignant or "aestivo-autumnal" group, which includes a tertian or a semi-tertian and the true quotidian type. Three distinct parasites, corresponding with the tertian, quartan and malignant types of fever, have been described by Italian observers, and the classification is generally accepted; intermediate types are ascribed to mixed and multiple infections. So far, however, only half the problem, and from the practical point of view the less important half, had been solved. The origin of the parasite and its mode of introduction into the blood remained to be discovered. An old popular belief current in different countries, and derived from common observation, connected mosquitoes with malaria, and from time to time this theory found support in more scientific quarters on general grounds, but it lacked demonstration and attracted little attention. In 1894, however, Sir Patrick Manson, arguing with greater precision by analogy from his own discovery of the cause of filariasis and the part played by mosquitoes, suggested that the malarial parasite had a similar intermediate host outside the human body, and that a suctorial insect, which would probably be found to be a particular mosquito, was required for its development. Following up this line of investigation, Major Ronald Ross in 1895 found that if a mosquito sucked blood containing the parasites they soon began to throw out flagellae, which broke away and became free; and in 1897 he discovered peculiar pigmented cells, which afterwards turned out to be the parasites of aestivo-autumnal malaria in an early stage of development, within the stomach-wall of mosquitoes which had been fed on malarial blood. He further found that only mosquitoes of the genus *Anopheles* had these cells, and that they did not get them when fed on healthy blood. Then, turning his attention to the malaria of birds, he worked out the life-history of these cells within the body of the mosquito. "He saw that they increased in size, divided, and became full of filiform spores, then ruptured and poured out their multitudinous progeny into the body-cavity of their insect host. Finally, he saw the spores accumulate within the cells of the salivary glands, and discovered that they actually passed down the salivary ducts and along the grooved hypopharynx into the seat of puncture, thus causing infection in a fresh vertebrate host" (Sambon). To apply these discoveries to the malaria of man was an obvious step. In working out the details the Italian school have again taken a prominent part.

Experiment.

Thus we get a complete scientific demonstration of the causation of malaria in three stages: (1) the discovery of the parasite by Laveran; (2) its life-history in the human host and connexion with the fever demonstrated by the Italian observers; (3) its life-history in the alternate host, and the identification of the latter with a particular species of mosquito by Ross and Manson. The conclusions derived from the microscopical laboratory were confirmed by actual experiment. In 1898 it was conclusively shown in Italy that if a mosquito of the *Anopheles* variety bites a person suffering from malaria, and is kept long enough for the parasite to develop in the salivary gland, and is then allowed to bite a healthy person, the latter will in due time develop malaria. The converse proposition, that persons efficiently protected from mosquito bites escape malaria, has been made the subject of several remarkable experiments. One of the most interesting was carried out in 1900 for the London School of Tropical Medicine by Dr Sambon and Dr Low, who went to reside in one of the most malarious districts in the Roman Campagna during the most dangerous season. Together with Signor Terzi and two Italian servants, they lived from the beginning of July until the 19th of October in a specially protected hut, erected near Ostia. The sole precaution taken was to confine themselves between sunset and sunrise to their mosquito-proof dwelling. All escaped malaria, which was rife in the immediate neighbourhood. Mosquitoes caught by the experimenters, and sent to London, produced malaria in persons who submitted themselves to the bites of these insects at the London School of Tropical Medicine. Experiments in protection on a larger scale, and under more ordinary conditions, have been carried out with equal success by Professor Celli and other Italian authorities. The first of these was in 1899, and the subjects were the railwaymen employed on certain lines running through highly malarious districts. Of 24 protected persons, all escaped but four, and these had to be out at night or otherwise neglected precautions; of 38 unprotected persons, all contracted malaria except two, who had apparently acquired immunity. In 1900 further experiments gave still better results. Of 52 protected persons on one line, all escaped except two, who were careless; of 52 protected on another line, all escaped; while of 51 unprotected persons, living in alternate houses, all suffered except seven. Out of a total of 207 persons protected in these railway experiments, 197 escaped. In two peasants' cottages in the Campagna, protected with wire netting by Professor Celli, all the inmates—10 in number—escaped, while the neighbours suffered severely; and three out of four persons living in a third hut, from which protection was removed owing to the indifference of the inmates, contracted malaria. In the malarious islet of Asinara a pond of stagnant water was treated with petroleum and all windows were protected with gauze. The result was that the houses were free from mosquitoes and no malaria occurred throughout the entire season, though there had been 40 cases in the previous year. Eight Red Cross ambulances, each with a doctor and attendant, were sent into the most malarious parts of the Campagna in 1900. By living in protected houses and wearing gloves and veils at night all the staff escaped malaria except one or two attendants. These and other experiments, described by Dr Manson in the *Practitioner* for March 1900, confirming the laboratory evidence as they do, leave no doubt whatever of the correctness of the mosquito-parasitic theory of malaria.

It is possible, though not probable, that malaria may also be contracted in some other way than by mosquito bite, but there are no well-authenticated facts which require any other theory for their explanation. The alleged occurrence of the disease in localities free from mosquitoes or without their agency is not well attested; its absence from other localities where they abound is accounted for by their being of an innocent species, or—as in England—free from the parasite. The old theory of paludism or of a noxious miasma exhaled from the ground is no longer necessary. The broad facts on which it is based are sufficiently accounted for by the habits of mosquitoes. For instance, the swampy character of malarial areas is explained by their breeding in stagnant water; the effect of drainage, and the general immunity of high-lying, dry localities, by the lack of breeding facilities; the danger of the night air, by their nocturnal habits; the comparative immunity of the upper storeys of houses, by the fact that they fly low; the confinement of malaria to well-marked areas and the diminution of danger with distance, by their habit of clinging to the breeding-grounds and not flying far. Similarly, the subsidence of malaria during cold weather and its seasonal prevalence find an adequate explanation in the conditions governing insect life. At the same time it should be remembered that many points await elucidation, and it is unwise to assume conclusions in advance of the evidence.

Parasites.

With regard to the parasites, which are the actual cause of malaria in man, an account of them is given under the heading of Parasitic Diseases, and little need be said about them here. They belong to the group of Protozoa, and, as already explained, have a double cycle of existence: (1) a sexual cycle in the body of the mosquito, (2) an asexual cycle in the blood of human beings. They occupy and destroy the red corpuscles, converting the haemoglobin into melanin; they multiply in the blood by sporulation, and produce accessions of fever by the liberation of a toxin at the time of sporulation (Ross). The number in the blood in an acute attack is reckoned by Ross to be not less than 250 millions. A more general and practical interest attaches to the insects which act as their intermediate hosts. These mosquitoes or gnats—the terms are synonymous—belong to the family *Culicidae* and the genus *Anopheles*, which was first classified by Meigen in 1818. It has a wide geographical distribution, being found in Europe (including England), Asia Minor, Burma, Straits Settlements, Java, China, Formosa, Egypt; west, south and Central Africa; Australia, South America, West Indies, United States and Canada, but is generally confined to local centres in those countries. About fifty species are recognized at present. It is believed that all of them may serve as hosts of the parasite. The species best known in connexion with malaria are *A. maculipennis* (Europe and America), *A. funestus* and *A. costales* (Africa). In colour *Anopheles* is usually brownish or slaty, but sometimes buff, and the thorax frequently has a dark stripe on each side. The wings in nearly all species have a dappled or speckled appearance, owing to the occurrence of blotches on the front margin and to the arrangement of the scales covering the veins in alternating light and dark patches (Austen). The genus with which *Anopheles* is most likely to be confounded is *Culex*, which is the commonest of all mosquitoes, has a world-wide distribution, and is generally a greedy blood-sucker. A distinctive feature is the position assumed in resting; *Culex* has a humpbacked attitude, while in *Anopheles* the proboscis, head and body are in a straight line, and in many species inclined at an angle to the wall, the tail sticking outwards. In the female of *Culex* the palpi are much shorter than the proboscis; in *Anopheles* they are of the same length. The wings in *Culex* have not the same dappled appearance. *Anopheles* is also a more slender insect, with a smaller head, narrower body and thinner legs. There are further differences in the other stages of life. Mosquitoes go through four phases: (1) ovum, (2) larva, (3) nympha, (4) complete insect. The ova of *Anopheles* are tiny black rod-shaped objects, which are deposited on the water of natural puddles, ponds, or slowly moving streams, by preference those which are well supplied with vegetation; they float, singly or attached to other objects or clustered together in patterns. They can live in brackish and even in sea water. The larva has no breathing-tube, and floats horizontally at the surface, except when feeding; it does not frequent sewage or foul water. The ova of *Culex*, on the other hand, are deposited in any stagnant water, including cesspools, drains, cisterns, or water collected in any vessel; they float in boat-shaped masses on the surface. The larva has a breathing-tube, and floats head downwards; when disturbed it wriggles to the bottom (Christy). Some observers maintain that *Anopheles* does not "sing," like the common mosquito, and its bite is much less irritating. Only the females suck blood; the act is believed to be necessary for fertilization and reproduction. *Anopheles* rarely bites by day, and then only in dark places. In the daytime "the gorged females rest motionless on the walls and ceilings of rooms, choosing always the darkest situations for this purpose" (Austen). In temperate climates the impregnated females hibernate during the winter in houses, cellars, stables, the trunks of trees, &c., coming out to lay their eggs in the spring. The four phases are passed in thirty days in a favourable season, and consequently there are ordinarily four or five generations from April to September (Celli).

The most important question raised by the mosquito-parasitic theory of malaria is that of prevention. This may be considered under two heads: (1) individual prophylaxis; (2) administrative prevention on a large scale.

Prophylaxis.

(1) In the first place, common sense suggests the avoidance, in malarious countries, of unhealthy situations, and particularly the neighbourhood of stagnant water. Among elements of unhealthiness is next to be reckoned the proximity of native villages, the inhabitants of which are infected. In the tropics "no European house should be located nearer to a native village than half a mile" (Manson), and, since children are almost universally infected, "the presence of young natives in the house should be absolutely interdicted" (Manson). When unhealthy situations cannot be avoided, they may be rendered more healthy by destroying the breeding-grounds of mosquitoes in the neighbourhood. All puddles and collections of water should be filled in or drained; as a temporary expedient they may be treated with petroleum, which prevents the development of the larvae. When a place cannot be kept free from mosquitoes the house may be protected, as in the experiments in Italy, by wire gauze at the doors and windows. The arrangement used for the entrance is a wire cage with double doors. Failing such protection mosquito curtains should be used. Mosquitoes in the house may be destroyed by the fumes of burning sulphur or tobacco smoke. According to the experiments of Celli and Casagrandi, these are the most effective culicides; when used in sufficient quantity they kill mosquitoes in one minute. The same authorities recommend a powder, composed of larvicide (an aniline substance), chrysanthemum flowers, and valerian root, to be burnt in bedrooms. Anointing the skin with strong-smelling substances is of little use in the open air, but more effective in the house; turpentine appears to be the best. Exposure at night should be avoided. All these prophylactic measures are directed against mosquitoes. There remains the question of protection against the parasite. Chills are recognized as predisposing both to primary infection and to relapses, and malnutrition is also believed to increase susceptibility; both should therefore be avoided. Then a certain amount of immunity may be acquired by the systematic use of quinine. Manson recommends five to ten grains once or twice a week; Ross recommends the same quantity every day before breakfast. There is some evidence that arsenic has a prophylactic effect. An experiment made on the railway staff at Bovino, a highly malarious district on the Adriatic, gave a striking result. The number of persons was 78, and they were divided into two equal groups of 39 each. One group was treated with arsenic, and of these 36 escaped altogether, while three had mild attacks; the remaining 39 who were not treated, all had fever. In a more extended experiment on 657 railway-men 402 escaped. This was in 1889; but in spite of the encouraging results the use of arsenic does not appear to have made any further progress. Experiments in immunizing by sero-therapeutic methods have not as yet met with success.

Administrative Measures.

(2) Much attention has been directed in scientific circles to the possibility of "stamping out" epidemic malaria by administrative measures. The problem is one of great practical importance, especially to the British Empire. There are no data for estimating the damage inflicted by malaria in the British colonies. It is, indeed, quite incalculable. In Italy the annual mortality from this cause averages 15,000, which is estimated to represent two million cases of sickness and a consequent loss of several million francs. In British tropical possessions the bill is incomparably heavier. There is not only the heavy toll in life and health exacted from Europeans, but the virtual closing of enormous tracts of productive country which would otherwise afford scope for British enterprise. The "deadly" climates, to which so much dread attaches, generally mean malaria, and the mastery of this disease would be equivalent to the addition of vast and valuable areas to the empire. The problem, therefore, is eminently one for the statesman and administrator. A solution may be sought in several directions, suggested by the facts already explained. The existence of the parasite is maintained by a vicious interchange between its alternate hosts, mosquitoes and man, each infecting the other. If the cycle be broken at any point the parasite must die out, assuming that it has no other origin or mode of existence. The most effective step would obviously be the extermination of the *Anopheles* mosquito. A great deal may be done towards this end by suppressing their breeding-places, which means the drying of the ground. It is a question for the engineer, and may require different methods in different circumstances. Put comprehensively, it involves the control of the subsoil and surface waters by drainage, the regulation of rivers and floods, suitable agriculture, the clearing of forests or jungles, which tend to increase the rainfall and keep the ground swampy.

The city of Rome is an example of what can be done by drainage; situated in the midst of malaria, it is itself quite healthy. Recent reports also show us how much may be done in infected districts. At Ismailia malaria was reduced from 1551 cases in 1902 to 37 cases in 1905. The cost of operations amounted to an initial expenditure of 6·25 francs, and an annual expenditure of about 2·3 francs per head of the population. "The results are due to mosquito reduction together with cinchonization." The following is a tabulated list of the cases. The population of Ismailia is about 6000.

Year	1900	1901	1902[1]	1903	1904	1905
Cases of Malaria . .	2250	1990	1548	214	90	37[2]

Klang and Port Swettenham are contiguous towns in the Federated Malay States, having a population of 4000 and a rainfall of 100 in. a year. At Klang the expenditure has been £3100, with an annual expenditure of £270, devoted to clearing and draining 332 acres. At Port Swettenham £7000, with an annual upkeep of £240, has been devoted to treating 110 acres. In Hong-Kong similar measures were carried out, with the result that the hospital admissions for malaria diminished from 1294 in 1901, the year when operations were begun, to 419 in 1905.

Klang and Port Swettenham.

Year	1900	1901[1]	1902	1903	1904	1905
Cases of Malaria . .	510	610	199	69	32	23

A systematic campaign for the destruction of breeding-places has been inaugurated in the British West African colonies, with encouraging results. The planting of eucalyptus trees is out of favour at present, but it appears to have been successful in Portugal, not from any prophylactic virtues in the plant, but through the great absorption of moisture by its deep roots, which tends to dry the subsoil. Treating the breeding-ponds with petroleum or similar preparations seems to be hardly applicable on a large scale, and in any case can only be a temporary expedient. H. Ziemann advocates the destruction of mosquito larvae by the growing of such plants as the water-pest (*Anacharis alsinatrum*) which covers the surface of the water and suffocates larvae and nymphae. Short of suppressing mosquitoes, the parasitic cycle may theoretically be broken by preventing them from giving the infection to man or taking it from him. The means of accomplishing the former have been already pointed out, but they are obviously difficult to carry out on a large scale, particularly in native communities. It is one thing to protect individuals from mosquito bites, another to prevent the propagation of the parasite in a whole community. Perhaps the converse is more feasible in some circumstances—that is to say, preventing mosquitoes from having access to malarial persons, and so propagating the parasite in themselves. It could be carried out where the infected persons are few, by isolating and protecting them, but not where many are infected, as in native villages. Koch has suggested that the disinfection of malarial persons by quinine would have the desired effect, but other authorities of greater experience do not consider it practicable. In spite of the difficulties, however, there is no doubt that a great deal can be done to reduce, if not stamp out, malaria by the methods indicated, which should be applied according to circumstances. An encouraging example is afforded by the remarkable fact that malaria, which was once rife in certain districts of England, has now died out, although the *Anopheles maculipennis* mosquito still exists there. The parasitic cycle has been broken, and the insect is no longer infected. The suggested causes are (1) reduction of insects by drainage, (2) reduced population, (3) the use of quinine. Sir Patrick Manson has suggested that the problem of stamping out malaria may be assisted by the discovery of some at present unknown factors. He has pointed out that certain areas and certain islands are entirely free from the disease, while neighbouring areas and islands are devastated. This immunity is apparently not due to the absence of favourable conditions, but rather to the presence of some inimical factor which prevents the development of the parasite. If this factor could be discovered it might be applied to the suppression of the disease in malarious localities.

A few other points may be noted. The pathological changes in malaria are due to the deposition of melanin and the detritus of red corpuscles and haemoglobin, and to the congregation of parasites in certain sites (Ross). In chronic cases the eventual effects are anaemia, melanosis, enlargement of the spleen and liver, and general cachexia. Apparently the parasites may remain quiescent in the blood for years and may cause relapses by fresh sporulation. Recent discoveries have done little or nothing for treatment. Quinine still remains the one specific. In serious cases it should not be given in solid form, but in solution by the stomach, rectum, or—better—hypodermically (Manson). According to Ross, it should be given promptly, in sufficient doses (up to 30 grains), and should be continued for months. Euquinine is by some preferred to quinine, but it is more expensive. Nucleogen and Aristochin have also been recommended instead of quinine. The nature of immunity is not known. Some persons are naturally absolutely immune (Celli), but this is rare; immunity is also sometimes acquired by infection, but as a rule persons once infected are more predisposed than others. Races inhabiting malarious districts acquire a certain degree of resistance, no doubt through natural selection. Children are much more susceptible than adults.

Malaria in the Lower Vertebrates.—Birds are subject to malaria, which is caused by blood parasites akin to those in man and having a similar life-history. Two species, affecting different kinds of birds, have been identified. Their alternate hosts are mosquitoes of the *Culex* genus. Oxen, sheep, dogs, monkeys, bats, and probably horses also suffer from similar parasitic diseases. In the case of oxen the alternate host of the parasite is a special tick (Smith and Kilborne). In the other animals several parasites have been described by different observers, but the alternate hosts are not known.

AUTHORITIES.—Celli, *Malaria*; Christy, *Mosquitoes and Malaria*; Manson, *Tropical Diseases*; Allbutt's *System of Medicine*; Ross, "Malaria," Quain's *Dictionary of Medicine*, 3rd ed.; *The Practitioner*, March, 1901 (Malaria Number); *Lancet* (Sept. 29, 1907); *British Medical Journal* (Oct. 19, 1907); *Indian Medical Gazette* (February 1908). (A. SL.; H. L. H.)

MALATIA (MALATIEH or ASPUZU) the chief town of a sanjak of the same name in the Mamuret el-Aziz vilayet of Asia Minor, and a military station on the Samsun-Sivas-Diarbekr road, altitude 2900 ft., situated about 10 m. S.W. of the junction of the Tokhma Su (med. Kubakīb) with the Euphrates, near the south end of a fertile plain, and at the northern foot of the Taurus. Pop. about 30,000, including, besides many Armenian Christians, bodies of Kurds and "Kizilbash." It is a wholly modern place, rebuilt since the earthquake of 1893, contains fine public buildings, and is noted for its fruit orchards. There are Protestant (American) and Roman Catholic missions, and an Armenian Catholic archbishop has his seat here. Eski-shehr or Old Malatia (*Melitene*), 5 m. N.E. and 3 m. from the great medieval bridge (Kirkgeuz) over the Tokhma Su, is said to owe its present desolation largely to its occupation by Hafiz Pasha as his headquarters in 1838 before his advance to fight the disastrous battle of Nizib with the Egyptian, Ibrahim. But it has still many inhabitants and large gardens and many ruinous mosques, baths, &c., relics of Mansur's city. It was the residence of von Moltke for some months, while attached to Hafiz's army. The earliest site was possibly Arslan Tepe about 2 m. south of Eskishehr were two "Hittite" stelae, representing hunting scenes, now in the Constantinople and Paris museums, were found in 1894.

In the time of Strabo (xii. 537) there was no town in the district of Melitene, which was reckoned part of Cappadocia. Under Titus the place became the permanent station of the 12th ("Thundering") legion; Trajan raised it to a city. Lying in a very fertile country at the crossing point of important routes, including the Persian "Royal Road," and two imperial military highways from Caesarea and along the Euphrates bank, it grew in size and importance, and was the capital of Armenia Minor or Secunda. Justinian, who completed the walls commenced by Anastasius, made it the capital of Armenia Tertia; it was then a very great place (Procop., *De aed.*, iii. 4). The town was burnt by Chosroes on his retreat after his great defeat there in 577. Taken by the Saracens, retaken and destroyed by Constantine Copronymus, it was presently recovered to Islam, and rebuilt under Mansur (A.D. 756). It again changed hands more than once, being reckoned among the frontier towns of Syria (Istakhry, pp. 55, 62). At length the Greeks recovered it in 934, and Nicephorus II., finding the district much wasted, encouraged the Jacobites to settle in it, which they did in great numbers. A convent of the Virgin, and the great church which bears his name, were erected by the bishop Ignatius (Isaac the Runner). From this time Malatia continued to be a great seat of the Jacobites, and it was the birthplace of their famous maphrian Barhebraeus (or Abulfaragius). At the commencement of the 11th century the population was said to number 60,000 fighting men (Assem., *Bib. Or.*, ii. 149; cf. Barheb., *Chr. Eccl.*, i. 411, 423). At the time of the first crusade, the city, being hard pressed by the Turks under Ibn Danishmend, was relieved by Baldwin, after Bohemund had failed and lost his liberty in the attempt. But the Jacobites had no cause to love Byzantium, and the Greek governor Gabriel was so cruel and faithless that the townsmen were soon glad to open their gates to Ibn Danishmend (1102), and the city subsequently became part of the realm of Kilij Arslan, sultan of Iconium.

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[1] Drainage works begun.

[2] Nearly all were relapses of previous infection.

See H. C. B. v. Moltke, *Briefe über Zustände, &c. in der Türkei* (1835–1839). (D. G. H.)

MALAYALAM, a language of the Dravidian family, spoken on the west coast of southern India. It is believed to have developed out of Tamil as recently as the 9th century. It possesses a large literature, in which words borrowed from Sanskrit are conspicuous. In 1901 the total number of speakers of Malayalam in all India was just about six millions.

MALAY ARCHIPELAGO[1] (variously called *Malaysia*, the *Indian Archipelago*, the *East Indies*, *Indonesia*, *Insulinde*), the largest group of islands in the world, lying south-east of Asia and north and north-west of Australia. It includes the Sunda Islands, the Moluccas, New Guinea, and the Philippine Islands, but excludes the Andaman-Nicobar group. The equator passes through the middle of the archipelago; it successively cuts Sumatra, Borneo, Celebes and Halmahera, four of the most important islands. A. R. Wallace (who includes the Solomon Islands as well as New Guinea in the group) points out that the archipelago "includes two islands larger than Great Britain; and in one of them, Borneo, the whole of the British Isles might be set down, and would be surrounded by a sea of forests. Sumatra is about equal in extent to Great Britain; Java, Luzon, and Celebes are each about the size of Ireland. Eighteen more islands are on the average as large as Jamaica; and more than a hundred are as large as the Isle of Wight."

	Area.	Estimated Population.
Sunda Islands	459,578	32,632,400
Moluccas, with Celebes	115,334	3,000,000
New Guinea	312,329	800,000
Philippine Islands	115,026	7,635,400

The islands of the archipelago nearly all present bold and picturesque profiles against the horizon, and at the same time the character of the scenery varies from island to island and even from district to district. The mountains are arranged for the most part in lines running either from north-west to south-east or from west to east. In Sumatra and in the islands between Sumatra and Borneo the former direction is distinctly marked, and the latter is equally noticeable in Java and the other southern islands. The mountains of Borneo, however, rise rather in short ridges and clusters. Nothing in the general physiognomy of the islands is more remarkable than the number and distribution of the volcanoes, active or extinct. Running south-east through Sumatra, east through Java and the southern islands to Timor, curving north through the Moluccas, and again north, from the end of Celebes through the whole line of the Philippines, they follow a line roughly resembling a horseshoe narrowed towards the point. The loftiest mountain in the archipelago would appear to be Kinabalu in Borneo (13,698 ft.). An important fact in the physical geography of the archipelago is that Java, Bali, Sumatra and Borneo, and the lesser islands between them and the Asiatic mainland, all rest on a great submerged bank, nowhere more than 100 fathoms below sea-level, which may be considered a continuation of the continent; while to the east the depth of the sea has been found at various places to be from 1000 to 2500 fathoms. As the value of this fact was particularly emphasized by Wallace, the limit of the shallow water, which is found in the narrow but deep channel between Bali and Lombok, and strikes north to the east of Borneo, has received the name of "Wallace's Line." The Philippines on the other hand, "are almost surrounded by deep sea, but are connected with Borneo by means of two narrow submarine banks" (A. R. Wallace, *Island Life*). The archipelago, in effect, is divided between two great regions, the Asiatic and the Australian, and the fact is evident in various branches of its geography—zoological, botanical, and even human. It is believed that there was a land-connexion between Asia and Australia in the later part of the Secondary epoch, and that the Australian continent, when separated, became divided into islands before the south-eastern part of the Asiatic did so.

The most notable fact in the geological history of the archipelago is the discovery in Java of the fossil remains of *Pithecanthropus erectus*, a form intermediate between the higher apes and man. In its structure and cranial capacity it is entitled to a higher place in the zoological scale than any anthropoid, for it almost certainly walked erect; and, on the other hand, in its intellectual powers it must have been much below the lowest of the human race at present known. The strata in which it was found belong to the Miocene or Upper Pliocene. Among the rocks of economic importance may be mentioned granite of numerous kinds, syenite, serpentine, porphyry, marble, sandstones and marls. Coal is worked in Sumatra, Borneo and Labuan. Diamonds are obtained in Borneo, garnets in Sumatra, Bachian and Timor, and topazes in Bachian, antimony in Borneo and the Philippines; lead in Sumatra, Borneo and the Philippines; copper and malachite in the Philippines, Timor, Borneo and Sumatra; and, most important of all, tin in Banka, Billiton and Singkep. Iron is pretty frequent in various forms. Gold is not uncommon in the older ranges of Sumatra, Banka, Celebes, Bachian, Timor and Borneo. Manganese could be readily worked in Timor, where it lies in the Carboniferous Limestone. Platinum is found in Landak and other parts of Borneo. Petroleum is a valuable product of Sumatra and Java, and is also found in Borneo.

Climate, Flora, Fauna.—The most striking general fact as regards climate in the archipelago is that wherever that part of the south-east monsoon which has passed over Australia strikes, the climate is comparatively dry, and the vegetation is less luxuriant. The east end of Java, *e.g.* has a less rainfall than the west; the distribution of the rain on the north coast is quite different from that on the south, and a similar difference is observed between the east and the west of Celebes. The north-west monsoon, beginning in October and lasting till March, brings the principal rainy season in the archipelago.

Most of the islands of the archipelago belong to the great equatorial forest-belt. In its economical aspect the vegetation, whether natural or cultivated, is of prime interest. The list of fruits is very extensive, though few of them are widely known. These, however, include the orange, mango, mangosteen, shaddock, guava and the durian. The variety of food-plants is equally notable. Not only are rice and maize, sugar and coffee, among the widely cultivated crops, but the coco-nut, the bread-fruit, the banana and plantain, the sugar-palm, the tea-plant, the sago-palm, the coco-tree, the ground-nut, the yam, the cassava, and others besides, are of practical importance. The cultivation of sugar and coffee owes its development mainly to the Dutch; and to them also is due the introduction of tea. They have greatly encouraged the cultivation of the coco-nut among the natives, and it flourishes, especially in the coast districts, in almost every island in their territory. The oil is largely employed in native cookery. Pepper, nutmegs and cloves were long the objects of the most important branch of Dutch commerce; and gutta-percha, camphor, dammar, benzoin and other forest products have a place among the exports.

To the naturalist the Malay Archipelago is a region of the highest interest; and from an early period it has attracted the attention of explorers of the first rank. The physical division between the Asiatic and Australian regions is clearly reflected in the botany and zoology. The flora of the Asiatic islands (thus distinguished) "is a special development of that prevailing from the Himalayas to the Malay Peninsula and south China. Farther east this flora intermingles with that of Australia" (F. H. H. Guillemard, *Australasia*). Similarly, in the Asiatic islands are found the great mammals of the continent—the elephant, tiger, rhinoceros,

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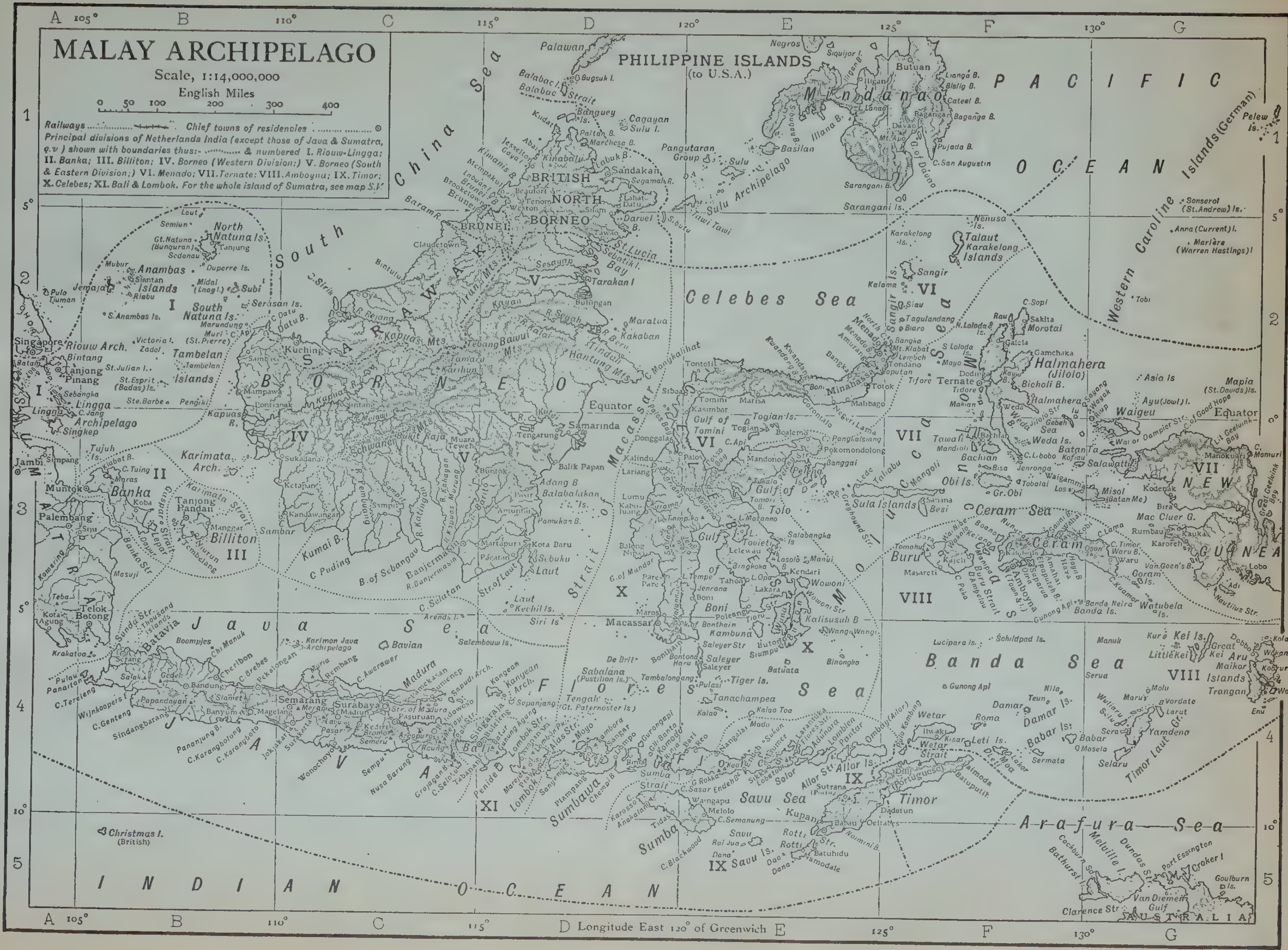
[1] For more detailed information respecting the several islands and groups of the archipelago, see the separate articles BORNEO; JAVA; PHILIPPINE ISLANDS; SUMATRA, &c.



MALAY ARCHIPELAGO

Scale, 1:14,000,000

English Miles

Railways .... Chief towns of residencies .... ⊙

Principal divisions of Netherlands India (except those of Java & Sumatra, q.v) shown with boundaries thus:- .... & numbered I. Riouw-Lingga; II. Banka; III. Billiton; IV. Borneo (Western Division;) V. Borneo (South & Eastern Division;) VI. Menado; VII. Ternate; VIII. Amboyna; IX. Timor; X. Celebes; XI. Bali & Lombok. For the whole island of Sumatra, see map S.V.

0 50 100 200 300 400
A 105° B 110° C 115° D 120° E 125° F 130° G
1
2
3
4
5
5°
0°
10°
D Longitude East 120° of Greenwich E
PHILIPPINE ISLANDS
(to U.S.A.)
Palawan
Negros
Siquijor I.
Butuan
Mindanao
Lianga B.
Bislig B.
Cateel B.
Baganga B.
Pujada B.
C. San Augustin
Davao
G. of Davao
Mt. Apo
Illana B.
Sindangan B.
Lanao
Iligan
Basilan
Sarangani B.
Sarangani Is.
Balabac I.
Balabac Strait
Bugsuk I.
Banguey Is.
Cagayan Sulu I.
Pangutaran Group
Sulu
Sulu Archipelago
Tawi Tawi
Sibutu
PACIFIC OCEAN
Western Caroline Islands (German)
Pelew Is.
Sonsorol (St. Andrew) Is.
Anna (Current) I.
Mariere (Warren Hastings) I.
Tobi
China Sea
South China Sea
Kudat
Abai
Jesselton
Gaya I.
Kinabalu
Marchesa B.
Paitan B.
Labuk B.
Sandakan
Segamah R.
BRITISH NORTH BORNEO
Lahat Datu
Darvel B.
Tawao
St. Lucia
Sebatik I.
Bay
Tarakan I.
Kimanis B.
Mempakul
Labuan I.
Brunei B.
Brooketown
Brunei
Beaufort
Tenom
Weston
BRUNEI
Baram R.
Claudetown
Bintulu
C. Sirik
SARAWAK
Oya
R. Rejang
Kuching
Sambas
Datu B.
C. Datu
Iran Mts.
Kapuas Mts.
Tebang
Bawui Mts.
Kayan
Sesayap
Bulungan
R. Segah
R. Berau
Maratua
Kakaban
Tindah Hantung Mts.
C. Mangkalihat
BORNEO
Mampawa
Pontianak
Kapuas R.
Tamiang
Karihun
Melawi
Sintang
Schwaner Mts.
Bukit Raja
Muara Tewe
R. Kutei
Tengarung
Samarinda
Equator
Balik Papan
Adang B.
Balabalakan Is.
Pamukan B.
Kota Baru
Sebuku
Laut
Str. of Laut
Laut
Kechil Is.
Siri Is.
Martapura
Pleihari
Banjermasin
R. Banjermasin
R. Barito
R. Kahayan
R. Katingan
R. Pembuang
Sampit
Pembuang
Kumai B.
C. Puding
B. of Sebangau
C. Selatan
Ketapang
Sukadana
Kandawangan
IV
V
Sambar
Karimata Arch.
Karimata Strait
Billiton
III
Tanjong Pandan
Manggar
Nurun
Tembelang
Lepar
Gaspar Strait
Dapur
Banka
Koba
Maras
II
Klabat B.
C. Tuing
Banka Str.
Muntok
Masuji
Palembang
Jambi
Simpang
Komering
SUMATRA
Teba
Telok Betong
Kota Agung
Krakatoa
Sunda Str.
Thousand Islands
Batavia
Pulau Panaitan
C. Tereleng
Wijnkoopers B.
C. Genteng
Sindangbarang
Salak
Gede
Bandung
Papandayan
Cheribon
Chi Manuk
C. Brebes
Pekalongan
Slamet
Banyumas
Magelang
Semarang
Merapi
Muria
Rembang
JAVA
Pananjung B.
C. Karangbolong
C. Karangkoto
Jokjakarta
Surakarta
Wonochoyo
Madiun
Kelud
Pasar
Surabaya
Str. of Madura
Madura
Pasuruan
Bromo
Semeru
Sempu
Nusa Barung
Argopuro
Raung
C. Awarawer
Kangean
Sapudi Arch.
Sumenep
Grajagan B.
C. Selokan
Bali
Tabanan
Singaraja
Buleleng
Batur
Gunung Agung
Lombok Str.
Penida
Maredjo
Lombok
Praya
Alas Str.
Sumbawa
Sanjang
Moyo
Sumbawa
Tambora
Sangar
Dompo
Bima
Sape Str.
Komodo
Gili Banta
Rinca
Sumba Strait
C. Karosso
Anakalang
Tidas
Sumba
C. Blackwood
Waingapu
Melolo
C. Semanung
XI
Bawean
Karimon Java Archipelago
Boompjes
Salembouw Is.
Arends I.
JAVA SEA
Jemaja
Anambas
Islands
Siantan
Riabu
Mubur
S. Anambas Is.
Pulo Tiuman
Johore
Singapore
Batam
Riouw Arch.
Bintang
Tanjong Pinang
Sebangka
Lingga
Archipelago
Singkep
C. Jang
Tujuh Is.
I
Victoria I.
Zadel
St. Julian I.
St. Esprit (Badas) Is.
Ste. Barbe
Pengiki
Tambelan Islands
Tambelan
Serasan Is.
South Natuna Is.
Marundung
Muri (St. Pierre)
C. Api
Subi
Midai (Laagt)
Duperre Is.
Lout
Semiun
North Natuna Is.
Gt. Natuna (Bunguran)
Sedanau
Tanjung
INDIAN OCEAN
Christmas I.
(British)
Celebes Sea
Strait of Macassar
Kwandang
Kwandang B.
Tontoli
Sibogo
Tomini
Kasimbar
Gulf of Tomini
Togian Is.
Togian
Boalemo
Gorontalo
Negeri Lama
Panglaisiang
Pokomondolong
Marisa
C. Api
VI
Menado
Menado B.
North C.
Minahassa
Mt. Klabat
Lembeh
Tondano
Amurang
Kotabunan
Bangka
Bolaang
Totok
Malibago
Bangka Str.
Sangir Is.
Sangir
Siau
Tagulandang
Biaro
Kalama
Karakelong Is.
Talaut
Karakelong Islands
Nenusa Is.
Donggala
Palos
Palos Bay
Kalindu
Lariang
Mandono
Peling
Banggai
Gulf of Tolo
Tomori B.
Tolo
Lakara
Salabangka
Lasolo
Mani
Kendari
Wowoni
Wowoni Str.
Kalisusuh B.
Wangi Wangi
Buton
Butong
Binongko
Gulf of Boni
Boni
Tioro
Poleang
Kambuna
Bonthain
Macassar
Maros
Pare Pare
Balong Nipa
G. of Mandar
Lumu
Kabu Iuang
Tempe
Tahon
Jenrana
Saleyer
Saleyer Str.
Siumpu
Batuata
Bontonda
Haru
Tambalongang
Pulasi
Tiger Is.
Tanachampea
Kalao
Kalao Toa
Madu
De Bril
Sabalana
(Postilion Is.)
Tengah
(Gt. Paternoster Is.)
Sepanjang
Flores Sea
Flores
X
Sula Islands
Sanana
Besi
Taliabu
Mangoli
C. Mangoli
Greyhound Str.
Molucca Sea
VII
Tawali
Mandioli
Bachian
Obi Is.
Gr. Obi
Bisa
Jenronga
Tobalai
Waigamma
Los
Misol
(Batan Me)
Halmahera
(Jilolo)
Halmahera Sea
Gamchaka
Galela
Morotai
Sakita
Rau
C. Sopi
N. Loloda
S. Loloda Is.
Mayo
Dodinga
Ternate
Tidore
Makian
Tifore
Bicholi B.
Weda
Weda B.
Weda Is.
Gebeh
Jilolo Str.
C. Lobobo
Kofiau
Batanta
Salawatti
Sagewin
Waigeu
Wai or Dampier Str.
Asia Is.
Ayu (Joul) I.
Mapia (St. Davids) Is.
C. of Good Hope
Equator
Lit. Geelvink Bay
Manokwari
C. Momuri
Geelvink Bay
Kodepak
Mac Cluer G.
Rumbau
Kaukas
Karoreh
Bira
NEW GUINEA
Van Goon's B.
Goram Is.
Lobo
Adi
Nautilus Str.
Kuamar
Watubela Is.
Banda Neira
Banda Is.
Gunong Api
Ceram
Ceram Sea
Boano
Kelang
Manipa
Buru Strait
Ambelau
Amboyna (Town & I.)
Saparua
Oma
Elpaputeh B.
Amahai
Haya
Hayu B.
Wahai
Sauti B.
C. Lama
C. Timor
Waru B.
Waru
Oson
Buru
Tomahu
Kajeli
Masarete
C. Peko
VIII
Banda Sea
Lucipara Is.
Schildpad Is.
Gunong Api
Manuk
Serua
Nila
Teun
Damar
Damar Is.
Roma
Wetar
Wetar Strait
Kisar
Leti Is.
Moa
Lakor
Babar Is.
Babar
Mosela
Sermata
Kei Is.
Kuro
Great Kei
Little Kei
Aru
Maikor
Kobror
Wokan
Kola
Dobbo
Trangan
Islands
Eno
Workai
VIII
Molu
Vordate
Larat
Yamdena
Timor Laut Gr.
Serua
Selaru
Maru
Wuliaru
Sulu
Arafura Sea
Savu Sea
Savu
Savu Is.
Raijua
Dana
Dao
Rotti
Rotti Str.
Kupang
Babau
Oeltaflis
Normini B.
Batuhidu
Amodale
Timor
Dili
(Portuguese)
Dadatun
Jaimoda
Batuputih
Alor Str.
Allor Is.
Sutrana
Ombay (Allor)
Pulo Kambing
Ilwaki
Pantar
Lomblen
Adinara
Solor
Solor Str.
Flores Str.
Larantuka
Sikka
Ende
Endeh B.
Sukun
Sumba
C. Sasar
C. Rokka
Reo
Bari
Ngada
IX
AUSTRALIA
Melville I.
Bathurst I.
Cockburn Sd.
Dundas Str.
Van Diemen Gulf
Clarence Str.
Port Essington
Croker I.
Goulburn Is.

Emery Walker sc.

anthropoid ape, &c., which are wanting in the Australian region, with which the eastern part of the archipelago is associated. (For details concerning flora and fauna, see separate articles, especially JAVA.)

Inhabitants.—The majority of the native inhabitants of the Malay Archipelago belong to two races, the Malays and the Melanesians (Papuans). As regards the present racial distribution, the view accepted by many anthropologists, following A. H. Keane, is that the Negritos, still found in the Philippines, are the true aborigines of Indo-China and western Malaysia, while the Melanesians, probably their kinsmen, were the earliest occupants of eastern Malaysia and western Polynesia. At some date long anterior to history it is supposed that Indo-China was occupied first by a fair Caucasian people and later by a yellow Mongolian race. From these two have come all the peoples—other than Negrito or Papuan—found to-day from the Malay Peninsula to the farthest islands of Polynesia. The Malay Archipelago was thus first invaded by the Caucasians, who eventually passed eastward and are to-day represented in the Malay Archipelago only by the Mentawi islanders. They were followed by an immigration of Mongol-Caucasic peoples with a preponderance of Caucasic blood—the Indonesians of some, the pre-Malays of other writers—who are to-day represented in the archipelago by such peoples as the Dyaks of Borneo and the Battas of Sumatra. At a far later date, probably almost within historic times, the true Malay race, a combination of Mongol and Caucasic elements, came into existence and overran the archipelago, in time becoming the dominant race. A Hindu strain is evident in Java and others of the western islands; Moors and Arabs (that is, as the names are used in the archipelago, Mahommedans from various countries between Arabia and India) are found more or less amalgamated with many of the Malay peoples; and the Chinese form, from an economical point of view, one of the most important sections of the community in many of the more civilized districts. Chinese have been established in the archipelago from a very early date: the first Dutch invaders found them settled at Jacatra; and many of them, as, for instance, the colony of Ternate, have taken so kindly to their new home that they have acquired Malay to the disuse of their native tongue. Chinese tombs are among the objects that strike the traveller's attention at Amboyna and other ancient settlements.

There is a vast field for philological explorations in the archipelago. Of the great number of distinct languages known to exist, few have been studied scientifically. The most widely distributed is the Malay, which has not only been diffused by the Malays themselves throughout the coast regions of the various islands, but, owing partly to the readiness with which it can be learned, has become the common medium between the Europeans and the natives. The most cultivated of the native tongues is the Javanese, and it is spoken by a greater number of people than any of the others. To it Sundanese stands in the relation that Low German holds to High German, and the Madurese in the relation of a strongly individualized dialect. Among the other languages which have been reduced to writing and grammatically analysed are the Balinese, closely connected with the Javanese, the Batta (with its dialect the Toba), the Dyak and the Macassarese. Alfurese, a vague term meaning in the mouths of the natives little else than non-Mahommedan, has been more particularly applied by Dutch philologists to the native speech of certain tribes in Celebes. The commercial activity of the Buginese causes their language to be fairly widely spoken—little, however, by Europeans.

Political Division.—Politically the whole of the archipelago, except British North Borneo, &c. (see BORNEO), part of Timor (Portuguese), New Guinea east of the 141st meridian (British and German), and the Philippine Islands, belongs to the Netherlands. The Philippine Islands which had been for several centuries a Spanish possession, passed in 1898 by conquest to the United States of America. For these several political units see the separate articles; a general view, however, is here given of the government, economic conditions, &c., of the Dutch possessions, which the Dutch call *Nederlandsch-Indië*.

NETHERLANDS INDIA

Administration.—The Dutch possessions in Asia lie between 6° N. and 11° S. and 95° E. and 141° E. Politically they are divided into lands under the direct government of the Netherlands vassal lands and confederated lands. Administratively they are further divided into residencies, divisions, regencies, districts, and *dessas* or villages. In the principal towns and villages there are parish councils, and in some provinces county councils have been established. Natives, Chinese and Arabs, are given seats, and in certain instances some of the members are elected, but more generally they are appointed by government. The islands are often described as of two groups, Java and Madura forming one, and the other consisting of Sumatra, Borneo, Riouw-Lingga Archipelago, Banka, Billiton, Celebes, Molucca Archipelago, the small Sunda Islands, and a part of New Guinea—the Outposts as they are collectively named. The Outposts are divided into 20 provinces. A governor-general holds the superior administrative and executive authority, and is assisted by a council of five members, partly of a legislative and partly of an advisory character, but with no share in the executive work of the government. In 1907 a Bill was introduced to add four extraordinary members to the council, but no immediate action was taken. The governor-general not only has supreme executive authority, but can of his own accord pass laws and regulations, except in so far as these, from their nature, belong of right to the home government, and as he is bound by the constitutional principles on which, according to the *Regulations for the Government of Netherlands India*, passed by the king and States-General in 1854, the Dutch East Indies must be governed. There are nine departments, each under a director: namely, justice; interior; instruction, public worship and industry; agriculture (created in 1905); civil public works; government works (created in 1908); finance; war; marine. The administration of the larger territorial divisions (*gouvernement, residentie*) is in the hands of Dutch governors, residents, assistant residents and *contrôleurs*. In local government a wide use is made of natives, in the appointment of whom a primary consideration is that if possible the people should be under their own chieftains. In Surakarta and Jokjakarta in Java, and in many parts of the Outposts, native princes preserve their positions as vassals; they have limited power, and act generally under the supervision of a Dutch official. In concluding treaties with the vassal princes since 1905, the Dutch have kept in view the necessity of compelling them properly to administer the revenues of their states, which some of them formerly squandered in their personal uses. Provincial banks have been established which defray the cost of public works.

Population.—The following table gives the area and population of Java (including Madura) and of the Outposts:—

		Area: English sq. m.	Pop.	
			1900.	1905.
Java and Madura		50,970	28,746,688	30,098,008
Sumatra	Sumatra, West Coast	31,649	1,527,297	4,029,505
	Sumatra, East Coast	35,312	421,090	
	Benkulen	9,399	162,396	
	Lampong Districts	11,284	142,426	
	Palembang	53,497	804,299	
	Achin	20,471	110,804	
Riouw-Lingga Archipelago		16,301	86,186	112,216
Banka		4,446	106,305	115,189
Billiton		1,863	43,386	36,858
Borneo, West Coast		55,825	413,067	1,233,655
Borneo, South and East Districts		156,912	716,822	
Celebes	Celebes	49,390	454,368	415,499
	Menado	22,080	429,773	436,406
Molucca Islands		43,864	410,190	407,419
Timor Archipelago		17,698	119,239	308,600
Bali and Lombok		4,065	1,041,696	523,535
New Guinea to 141° E.		151,789	200,000	...
Total		736,815	36,000,000	37,717,377[1]

In no case are the above figures for population more than fairly accurate, and in some instances they are purely conjectural. The population is legally divided into Europeans and persons assimilated to them, and natives and persons assimilated to them. The first class includes half-castes (who are numerous, for the Dutch are in closer relationship with the natives than is the case with most colonizing peoples), and also Armenians, Japanese, &c. The total number of this class in 1900 was 75,833; 72,019 of these were called Dutch, but 61,022 of them were born in Netherlands India; there were also 1382 Germans, 441 British and 350 Belgians. Among the natives and persons assimilated to them were about 537,000 Chinese and 27,000 Arabs. In the decade 1890–1900 the increase of the European population was 30·9%, of the Arabs 26·6%, and of the Chinese 16·5%. A large proportion of the Europeans are government officials, or retired officials, for many of the Dutch, once established in the colonies, settle there for life. The remaining Europeans are mostly planters and heads of industrial establishments; the Arabs are nearly all traders, as are some of the Chinese, but a large number of the latter are labourers in the Sumatra tobacco plantations and the tin mines of Banka, Billiton, &c. The bulk of the natives are agriculturists.

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[1] Including 487 in Merauke, the capital of Dutch New Guinea.

Religion and Instruction.—Entire liberty is granted to the members of all religious confessions. The Reformed Church has about 40 ministers and 30 assistants, the Roman Catholic 35 curates and 20 priests, not salaried out of the public funds. There are about 170 Christian missionaries, and the progress of their work may be illustrated by showing that the number of Christians among the natives and foreign Orientals was:—

	In 1873.	In 1896.	In 1903.
In Java and Madura	5,673	19,193	About 34,000
In the Outposts	148,672	290,065	„ 390,000

About 10,000 natives go annually to Mecca on pilgrimage.

Both the government and private enterprise maintain vernacular schools. Large sums have been voted in Holland for the establishment of primary and secondary schools, and the government has undertaken to assist in the establishment of parochial schools, the object being that every village, at least in Java, should possess one. There are schools for higher education at Batavia, Surabaya and Semarang; at the first two of these towns are government schools for mechanical engineering, and at Batavia a crafts school and a medical school for natives. There are five colleges for native schoolmasters and four for sons of native officials. Government schools for the European education of Chinese children are established in the principal towns. Private mechanical and crafts schools are established at Jokjakarta, Surabaya and Semarang, and there is an agricultural school at Buitenzorg.

Justice.—As regards the administration of justice, the distinction is maintained between (1) Europeans and persons assimilated with them (who include Christians and Japanese), and (2) natives, together with Chinese, Arabs, &c. The former are subject to laws closely resembling those of the mother country, while the customs and institutions of natives are respected in connexion with the administration of justice to the latter. In 1906 a bill was passed somewhat modifying the existing status of the classes above mentioned, and especially directing new ordinances with regard to the judicial treatment of Christian natives. A general judicial revision being also in contemplation, this bill did not immediately come into force. Justice for Europeans is administered by European judges, but, as with administration at large so in judicial matters, native chiefs have extensive powers in native affairs. For European justice the High Court of Justice is established at Batavia; there are councils of justice at Batavia, Semarang and Surabaya, with authority not only over Java but over parts of the Outposts; there is a resident court of justice in each residency. For native justice there are courts in the districts and regencies; residents act as police judges; provincial councils have judicial powers, and there are councils of priests with powers in matrimonial disputes, questions of succession, &c.

As regards pauperism, the government subsidizes Protestant and Catholic orphan houses.

Finance.—The revenue of Netherlands India has been derived mainly from customs, excise, ground-tax, licences, poll-tax, &c., from monopolies—opium, salt and pawn-shops (the management of which began to be taken over by the government in 1903, in place of the previous system of farming-out), coffee, &c., railways, tin mines and forests, and from agricultural and other concessions. But attempts have been made, and have been largely successful, to make the revenue dependent to a less extent on monopolies and the products (especially agricultural) of the land; and to abolish licences and substitute direct taxes. There is a progressive income-tax for Europeans, and the system has also been applied in the case of natives.

The following table affords comparisons in the revenue and expenditure:—

Year.	Revenue.	Expenditure.
1880	£12,236,500	£12,244,666
1890	11,482,457	10,644,728
1900	11,832,417	12,313,854
1905	12,951,497	13,844,173

The monetary system is similar to that of Holland (the unit being the *guilder*), but there are also certain silver and copper coins of small value bearing Malay or Javanese inscriptions. The Java Bank, established in 1828, with headquarters at Batavia, is the only bank issuing notes, two-fifths of the amount of which must be covered by specie or bullion. The government has a control over the administration of this bank.

Defence.—The army is purely colonial, *i.e.* distinct from that of the Netherlands. Its strength is a little under 40,000, about one-third being Europeans of various nationalities and two-thirds natives of various races. No portion of the regular army of the Netherlands is allowed to be sent on colonial service, but individual soldiers are at liberty to enlist, by permission of their commanding officers, in the army of Netherlands India, and they form its nucleus. Native and European soldiers are generally mixed together in the same battalions, though in separate companies. The officers were all Dutch till 1908, when a trial was made of native officers from noble Javanese families. The artillery is composed of European gunners, with native riders, while the cavalry are Europeans and natives. A military academy is established at Meester Cornelis, near Batavia. Schools for soldiers are attached to every battalion. There are certain local forces outside the regular army—militia in some of the large towns, native infantry in Madura, and guards of some of the vassal princes. Unlike the army, which is purely colonial, the navy in Netherlands India is partly colonial, partly belonging to the royal navy of the Netherlands, and its expenses are therefore borne partly by the mother country and partly by the colony. About six ironclads and twenty smaller vessels of the royal navy are stationed in colonial waters; the vessels of the colonial marine number about twenty-four, and undertake police supervision, prevention of slave trading, &c.

Trade and Industries.—The principal articles of export are sugar, tobacco, copra, forest products (various gums, &c.), coffee, petroleum, tea, cinchona, tin, rice, pepper, spices and gambier. The average annual value of exports during 1900–1905 was £22,496,468, and of imports £17,050,338. A great proportion of the exports goes to the mother country, though a considerable quantity of rice is exported to China. An indication of the mineral products has already been given; as regards the export trade, tin is the most important of these, but the Ombilin coalfields of Sumatra, connected by a railway with the coast, call for mention here also. Agricultural labour is very carefully regulated by law, in the enforcement of which the residents and lower officials have wide powers. One day's gratuitous labour out of seven or more can be demanded of labourers either on private or on government estates; but in 1882 this form of labour was for the most part abolished as far as government estates were concerned, each labourer so exempted paying one guilder per year. The principal private agricultural estates are in the west of Java, in which island the greater part of the soil is government property. Such estates have increased greatly in number and extent, not only in Java but elsewhere, since the agrarian law of 1870, under which it became possible for settlers to obtain waste lands on hereditary lease for 75 years. In 1899 the total acreage of land ceded was 1,002,766 acres; in 1903 it was 1,077,295. The government ceased to cultivate sugar in 1891, but coffee, and to some extent cinchona, are cultivated on government plantations, though not in equal quantity to that grown on land held on emphyteusis. The average annual yield of sugar in 1900–1905 was 852,400 tons, but it increased steadily during that period. The average annual yield of coffee during the same period was 101,971,132 lb; it fluctuates greatly. The average annual production of tobacco is about fifty million pounds from each of the islands of Java and Sumatra. The total annual yield of the tin mines is about 15,000 tons, and of the coal mines 240,000 tons. The average output of petroleum annually in 1900–1905 was 120,000,000 gallons; this, again, has fluctuated greatly. There are upwards of 3000 miles of railways and steam tramways in Netherlands India, but these are almost entirely in Java; elsewhere only Sumatra has a few short lines. The principal steamship company in the archipelago is the Royal Packet (*Koninklyke Paketvaart*) Company.

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History

Portuguese and Spanish Ascendancy, 1511–1595.—Ptolemy and other ancient geographers describe the Malay Archipelago, or part of it, in vague and inaccurate terms, and the traditions they preserved were supplemented in the middle ages by the narratives of a few famous travellers, such as Ibn Batuta, Marco Polo, Odoric of Pordenone and Niccolò Conti. Malay and Chinese records also furnish material for the early history of individual islands, but the known history of the archipelago as a whole begins in the 16th century. At this period a civilization, largely of Hindu origin, had flourished and decayed in Java, where, as in all the more important islands, Mahommedanism had afterwards become the dominant creed. But the smaller islands and the remoter districts, even of Java and Sumatra, remained in a condition of complete savagery.

The Portuguese were the first Europeans to colonize any part of the archipelago. A Portuguese squadron under Diogo Lopes de Sequeira arrived off Sumatra in 1509, explored the north coast for some distance, and noted that the inhabitants of the interior were cannibals, while those of the littoral were civilized and possessed a gold coinage. The main object of the Portuguese was to obtain a share in the lucrative spice trade carried on by the Malays, Chinese and Japanese; the trade-routes of the archipelago converged upon Malacca, which was the point of departure for spice merchants trading with every country on the shores of the Indian Ocean and Arabian Sea. In 1511 the Portuguese under Alphonso d'Albuquerque occupied Malacca, and in November of that year an expedition under Antonio de Abreu was despatched to find a route to the Moluccas and Banda Islands, then famous for their cloves and nutmegs. The explorers reached Amboyna and Ternate, after gaining some knowledge of Java, Madura, Sumbawa and other islands, possibly including New Guinea. During the return voyage the second-in-command, Francisco Serrão, was shipwrecked, but succeeded in making his way in a native boat to Mindanao. Thus the Philippines were discovered. In 1514 a second Portuguese fleet arrived at Ternate, which during the next five years became the centre of Portuguese enterprise in the archipelago; regular traffic with Malacca and Cochin was established, and the native raja became a vassal of Portugal.

Meanwhile the Spanish government was considering whether the Moluccas did not fall within the Spanish sphere of influence as defined by the Treaty of Tordesillas in 1494; and in August 1519 an expedition commanded by Ferdinand Magellan (*q.v.*) sailed from Seville to seek a westward passage to the archipelago. After losing the commander in the Philippines and discovering Borneo, the two surviving ships reached the Moluccas late in 1520. One vessel returned to Seville by the Cape route, thus completing the first voyage round the world; the other attempted to return by the Pacific, but was driven back to Tidore and there welcomed by the natives as a useful ally against the Portuguese. Reinforcements from Spain arrived in 1525 and 1528; but in 1529 a treaty was concluded between the emperor Charles V. and John III. of Portugal, by which, in return for 350,000 gold ducats, the Spanish claim to the Moluccas was withdrawn. The boundary between the Spanish and Portuguese spheres was fixed at 17° E. of the Moluccas, but by a geographical fiction the Philippines were included within the Spanish sphere. Further disputes occurred from time to time, and in 1542 a Spanish fleet came into conflict with the Portuguese off Amboyna; but after 1529 the supremacy of each power in its own sphere was never seriously endangered.

Though the Portuguese traders frequented the coast of Java, they annexed no territory either there or in Sumatra; but farther east they founded numerous forts and factories, notably in Amboyna, the Banda Island, Celebes and Halmahera. Ternate remained the seat of the governor of the Moluccas, who was the highest official in the archipelago, though subordinate to the viceroy or governor of Portuguese India. The first attempt to enter into relations with the states of Borneo was made by D. Jorge de Menezes, who visited Brunci in 1526, and in 1528 sent an envoy to its raja. The embassy failed in a curious manner. Among the gifts sent by Menezes was a piece of tapestry representing the marriage of Catherine of Aragon to Arthur, prince of Wales. The raja was persuaded that these mysterious figures were demons under a spell, which might come to life and kill him as he slept. The envoy was therefore dismissed.

In 1536, after a period of war and anarchy caused by the tyrannical rule of Menezes, Antonio Galvão, the historian, was appointed governor of the Moluccas. He crushed the rebellion and won the affection of the natives by his just and enlightened administration, which had no parallel in the annals of Portuguese rule in the archipelago. He returned to Europe in 1540 (see Portugal: *Literature*), after inaugurating an active missionary movement, which was revived in 1546–1547 by Francis Xavier (*q.v.*). At this period the Portuguese power in the East was already beginning to wane; in the archipelago it was weakened by administrative corruption and by incessant war with native states, notably Bintang and Achin; bitter hostility was aroused by the attempts which the Portuguese made to establish a commercial monopoly and to force Christianity upon their native subjects and allies (see Portugal: *History*). From 1580 to 1640 Portugal was itself united to Spain—a union which differed from annexation in little but name.

The English and Dutch, 1595–1674.—Pirates from Dieppe visited the archipelago between 1527 and 1539. It is possible that they reached Australia[1]—more than sixty years before the first voyage thither of which there is any clear record; but their cruise had no political significance, and the Spaniards and Portuguese remained without European competitors until the appearance of Sir Francis Drake in 1579. An English squadron under Sir James Lancaster came into conflict with the Portuguese in 1591, and an expedition under Sir Henry Middleton traded in the archipelago in 1604. But the English were simple traders or explorers; far more formidable were the Dutch, who came to the East partly to avenge the injuries inflicted on their country by the Spaniards, partly to break the commercial monopoly of the peninsular states. As middlemen they already possessed a large interest in the spice trade, for the Portuguese, having no direct access to the principal European markets, had made a practice of sending cargo to the Netherlands for distribution by way of the Scheldt and Rhine. The Dutch now sought to monopolize not only the distribution but the production of spices—an enterprise facilitated by the co-operation of many exiled Portuguese Jews who had settled in Holland.

The first Dutch fleet sailed from Texel, under the command of Cornelis Houtman, on the 2nd of April 1595 and reached Sumatra on the 1st of January 1596. It visited Madura, and came into conflict with the Portuguese at Bantam in Java, returning to Holland in 1597. Though not a commercial success, the expedition had demonstrated the weakness of the Portuguese. In 1602 the Dutch East India Company (*q.v.*) was incorporated, and for nearly two centuries this organization played the chief part in the history of the archipelago. By 1604 the Dutch could already claim to be the stronger power at sea. They had attacked the Portuguese in Ceylon (1601), established friendly relations with Achin (1602), and defeated a powerful fleet off Banda (1602). In 1606 they concluded a treaty of alliance with the sultan of Johor, and in 1608 they forced the Portuguese to assent to an armistice for twelve years. On the 29th of November 1609 Pieter Both was chosen by the states-general, on the nomination of the Dutch East India Company, as first governor-general of Netherlands India. In 1611 the headquarters of the Dutch was changed from Bantam to Jakatra, which in 1619 was renamed Batavia, and was thenceforward the Dutch capital. Meanwhile the English East India Company, chartered in 1600, had also extended its operations to the archipelago. After 1611 the commercial rivalry between the Dutch and British became acute, and in 1613, 1615 and 1618 commissioners met in London to discuss the matters in dispute. The result of their deliberations was the Treaty of Defence, signed on the 2nd of June 1619 and modified on the 24th of January 1620, which arranged for co-operation between the Dutch and British companies, and especially for the maintenance of a joint fleet. But neither company could restrain its agents in the East from aggressive action, and many fresh causes of dispute arose, the chief being the failure of the British to provide the naval forces required for service against the Portuguese, and the so-called "massacre of Amboyna" (*q.v.*) in 1623. The Treaty of Defence lapsed in 1637, but as early as 1634 the British made peace with Portugal. Even without allies, however, the Dutch continued to extend their trade and to annex fresh territory, for the British were weakened by civil war at home, while, after 1640, the Portuguese were struggling to maintain their independence against Spain. The Dutch company opened up a profitable trade with Japan and China, and prosecuted the war against Portugal with great vigour, invading Portuguese India and capturing Point de Galle in 1640, Malacca in 1641, Cochin and Cannanore in 1663. The war with England in 1652–54 and the renewal of the Anglo-Portuguese alliance by the marriage of Charles II. to Catherine of Braganza in 1661 were unable to check the growth of Dutch power; more serious was the resistance offered by some of the native states. Rebellions in Java (1629) and the Moluccas (1650) were suppressed with great severity, but in 1662 the company suffered a heavy reverse in Formosa, all its colonists being expelled from the island. A new war between Great Britain and Holland broke out in 1672 and was terminated by the Treaty of Westminster (February 17, 1674), by which the points at issue between the two companies were referred first to commissioners and finally to an arbitrator. The full details of the settlement are unknown, but thenceforward the British company devoted its energies chiefly to the development of its Indian possessions, while the Dutch were left supreme in the archipelago. In 1684 the British even evacuated Bantam, their chief settlement, and retired to Benkulen in Sumatra, which remained for more than a century their sole territorial possession in the archipelago.

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[1] See *The Geographical Journal*, ix. 80 seq. (London, 1897).

Dutch Ascendancy, 1674–1749.—The weakness of Spain and Portugal and the withdrawal of the British left the Dutch company free to develop its vast colonial and commercial interests. In 1627 the so-called Dutch "colonial system" had been inaugurated by the fourth governor-general, Jan Pieterszoon Coen (*q.v.*). Under this system, which was intended to provide Netherlands India with a fixed population of European descent, Dutch girls were sent to the archipelago to be married to white settlers, and subsequently marriages between Dutchmen and captive native women were encouraged. As early as 1624 vast fortunes had been acquired by trade: two members of the company who died in that year were stated to possess seven and eight tons of gold respectively, an amount approximately equivalent, in the aggregate, to £2,000,000. The use of slave labour, and the application of the *corvée* system to natives who were nominally free, enabled the company to lower the cost of production, while the absence of competition enabled it to raise prices. The hardship inflicted on the native races provoked an insurrection throughout Java, in which the Chinese settlers participated; but the Dutch maintained naval and military forces strong enough to crush all resistance, and a treaty between the company and the Susuhunan in November 1749 made them practically supreme throughout the island.

Decline of Dutch Power, 1749–1811.—In the second half of the 17th century the monopoly system and the employment of slaves and forced labour gave rise to many abuses, and there was a rapid decline in the revenue from sugar, coffee and opium, while the competition of the British East India Company, which now exported spices, indigo, &c. from India to Europe, was severely felt. The administration was corrupt, largely because of the vast powers given to officials, who were invariably underpaid; and the financial methods of the company precipitated its ruin, large dividends being paid out of borrowed money. The burden of defence could no longer be sustained; piracy and smuggling became so common that the company was compelled to appeal to the states-general for aid. In 1798 it was abolished and its authority vested in a "Council of the Asiatic Possessions." In 1803 a commission met to consider the state of the Dutch colonies, and advocated drastic administrative and commercial reforms, notably freedom of trade in all commodities except firearms, opium, rice and wood—with coffee, pepper and spices, which were state monopolies. Some of these reforms were carried out by H. W. Daendels (1808–1811), who was sent out as governor-general by Louis Bonaparte, after the French conquest of Holland. Daendels, however, maintained the existing restrictions upon trade and even made rice a state monopoly. His harsh rule aroused great antagonism; in 1811 he was recalled and J. W. Janssens became governor-general.

British Occupation, 1811–1816.—Netherlands India was at this time regarded as a part of the Napoleonic Empire, with which Great Britain was at war. A British naval squadron arrived in the Moluccas in February 1810 and captured Amboyna, Banda, Ternate and other islands. In 1811 a strong fleet was equipped by Lord Minto, then governor-general of India, for the conquest of Java; a British force was landed on the 4th of August; Batavia was captured on the 26th, and on the 18th of September Janssens and the remnant of his army surrendered. Lord Minto had issued a proclamation establishing British rule on the 11th of September, and Thomas (afterwards Sir Thomas) Stamford Raffles was appointed lieutenant-governor. Raffles (*q.v.*) held office until March 1816, and introduced many important changes in the departments of revenue, commerce and judicature. He was succeeded by John Fendall, who in 1816 carried out the retrocession of Netherlands India to the Dutch, in accordance with the Treaty of Vienna (1814).

Restoration and Reform of Dutch Power, 1816–1910.—Various disputes between Great Britain and the Netherlands, arising chiefly out of the transfer of power in Java and the British occupation of Singapore (1819), were settled by treaty between the two powers in 1824. By this treaty the Dutch were given almost entire freedom of action in Sumatra, while the Malay Peninsula was recognized as within the British sphere of influence. In 1825–30 a serious rebellion in Java involved the despatch of a large military force from the Netherlands, and was with difficulty suppressed. An outbreak of Mahommedan fanaticism in Sumatra also gave much trouble.

The reform movement inaugurated by the commission of 1803 was resumed in 1830, when Governor-General Johannes van den Bosch endeavoured to improve the conditions of land-tenure and agriculture by introducing the so-called "culture system." The native cultivators were to be exempted from the ground-tax, but were to cultivate one-fifth of their land as the government might direct, the government taking the produce. This culture-system worked fairly during Van den Bosch's tenure of office, but gave rise to many abuses between 1833 and 1844, involving, as it did, a combination of the *métayer* and *corvée* systems.

In 1848 the *Grondwet*, or fundamental law of the Netherlands, recognized for the first time the responsibility of the Dutch nation for its colonial dependencies. The *Grondwet* involved certain important changes, which were embodied in an act passed in 1854 and commonly known as the *Regulations for the Government of Netherlands India.* The *Regulations* substituted statute law for administrative and military despotism, and made the governor-general in council responsible to the minister of the colonies at the Hague. They reformed the judicature, introduced elementary education for the natives, and abolished slavery in Java as from the 1st of January 1860. They also prepared the way for further legislation tending towards the gradual emancipation of the natives from the culture system, and from semi-feudal servitude to their native rulers. That servitude existed in many forms all over the archipelago, but among the most curious must be reckoned the *pandelingschap* or "pledgedom," which originated in Borneo, and according to which a man had the power to make his debtors his serfs until their debts were paid.

The reform movement was aided by the publication in 1860 of *Max Havelaar*, a romance by E. Douwes Dekker (*q.v.*), which contained a scathing indictment of the colonial system. Many important financial and agrarian measures were carried between 1860 and 1890. In 1863 Fransen van de Putte, minister for the colonies, introduced the first of the annual colonial budgets for which the *Regulations* had provided, thus enabling the states-general to control the revenue and expenditure of Netherlands India; in 1865 he reduced and in 1872 abolished the differentiation of customs dues in favour of goods imported from Holland, substituting a uniform import duty of 6% and establishing a number of free ports throughout the archipelago. The import duty was considered so moderate that an increase required for revenue purposes was readily conceded in 1886. In 1876 the practice of paying a yearly surplus (*batig slot*) from the revenues of Netherlands India to the treasury at the Hague was discontinued. The chief reforms in the land system were those introduced by De Waal, then minister for the colonies, in 1870. The cultivation of pepper, cochineal, cinnamon and indigo for the government had already ceased; De Waal restricted the area of the sugar plantations (carried on by forced native labour) as from 1878, and provided for their abolition after 1890. He also enabled natives to secure proprietary rights over the land they cultivated, and legalized the leasing of Crown forest-lands to Europeans.

The extension of Dutch political power—notably in Java, Sumatra, Celebes, the Moluccas, Borneo, the Sunda Islands and New Guinea—proceeded simultaneously with the reform movement, and from time to time involved war with various native states. A large expedition was sent to Lombok in 1894, and almost the whole of that island was incorporated in the Dutch dominions. The long and costly war with Achin (*q.v.*) began in 1873 and reached its climax in the military occupation of the country after 1905, when the native sultan surrendered and was deported. A guerrilla war was still carried on by his subjects, but their principal leader, the chief Panglima Polim, was captured in 1907; in 1908–1910 the condition of Achin under the military rule of General Swart was one of almost unbroken peace, and taxes were regularly paid.

While the Dutch were thus consolidating their authority, other countries were acquiring new commercial or colonial interests in the archipelago. Immigration from China and Japan steadily increased, especially towards the end of the period 1816–1910. The enterprise of Sir James Brooke (*q.v.*) led, after 1838, to the establishment of British sovereignty in North Borneo; in 1895 New Guinea was divided between Great Britain, Germany and the Netherlands; and the Spanish-American War of 1898 resulted in the cession of the Philippines, Sulu Island and the largest of the Mariana Islands to the United States, and the sale of the Caroline group to Germany. Australian and Japanese trade in the archipelago was stimulated by the establishment of the Australian Commonwealth (1901) and the Russo-Japanese War (1904–5). In 1910 the nations most directly interested in the future of the archipelago were the Netherlands, Great Britain, the United States, Germany, Japan, China and Portugal.

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(K. G. J.)

MALĀYIR, a small province of Persia, situated between Hamadan and Burujird. It has a population of about 70,000, and, together with the district Tusirkhan, pays a yearly revenue of about £13,000. It produces much corn and fruit; a great quantity of the latter, dried, is exported. Its capital and seat of government is Doletabad (Dowletabad), a thriving little city, with a population of about 5000, situated at an elevation of 5680 ft., 38 m. from Hamadan and 32 m. from Burujird. It has post and telegraph offices.

MALAY PENINSULA (called by the Malays *Tanah Malayu*, *i.e.* the Malay Land), a lozenge-shaped strip of land projecting into the China Sea, and forming the most southerly portion of the continent of Asia. Geographically, the peninsula begins at the isthmus of Kra, 10° N., at which point it is only between 60 and 70 m. in width, and the distance from sea to sea is further diminished by a large irregular salt-water inlet. Politically and anthropologically, however, this upper portion must be regarded as a continuation of the kingdom of Siam rather than as a section of Malaya. From the isthmus of Kra the peninsula extends south with a general inclination towards the east, the most southerly point being Tanjong Bulus in 1° 16½′ N. A line drawn diagonally down the centre from the isthmus of Kra to Cape Romania (Ramunya) gives the extreme length at about 750 miles. The breadth at the widest point, from Tanjong Pen-unjut in Trengganu to Tanjong Hantu in the Dindings territory, is about 200 m. The area is estimated at about 70,000 sq. m. The peninsula is bounded on the N. by Siam, on the S. by the island and strait of Singapore, on the E. by the China Sea, and on the W. by the Strait of Malacca.

Physical Characteristics.—A range of granite mountains forms a backbone which divides the peninsula into two unequal portions, the larger of which lies to the east and the smaller to the west of the chain. Smaller ranges run parallel to the main mountain chain in many places, and there are numerous isolated spurs which have no connexion with either. The country is covered with limestone in many parts, and large isolated bluffs of this formation stand up in the plains both on the eastern and the western slopes. The descent from the summits of the range into the plain is somewhat less abrupt on the western than it is on the eastern side, and between the foot of the mountains and the Strait of Malacca the largest known alluvial deposits of tin are situated. On the eastern side of the range, after a steep descent, the granite formation speedily gives place to slates of vast depth, intersected here and there by fissures of quartz containing gold, and in many places covered by limestone which has been superimposed upon the slates. The highest known peak in the main range is that of Gunong Korbu, 7217 ft. above sea-level. The highest mountain is believed to be Gunong Tahan, which forms part of an isolated range on the eastern side, between Pahang and Kelantan, and is estimated at about 8000 ft. The west coast throughout its whole length is covered to a depth of some miles with mangrove swamps, with only a few isolated stretches of sandy beach, the dim foliage of the mangroves and the hideous mud flats presenting a depressing spectacle. On the east coast the force of the north-east monsoon, which beats upon the shores of the China Sea annually from November to February, has kept the land for the most part free from mangroves, and the sands, broken here and there by rocky headlands thickly wooded, and fringed by *casuarina* trees, stretch for miles without interruption. The islands on each coast present the features of the shore to which they are adjacent. On both the east and the west coast the islands are thickly wooded, but whereas the former are surrounded by beautiful sands and beaches, the latter are fringed by mangrove-swamps. The whole peninsula may be described as one vast forest, intersected in every direction by countless streams and rivers which together form the most lavish water-system in the world. Only an insignificant fraction of these forests has ever been visited by human beings, the Malays and even the aboriginal tribe having their homes on the banks of the rivers, and never, even when travelling from one part of the country to another, leaving the banks of a stream except for a short time when passing from one river-system to another. The bulk of the jungle, therefore, which lies between stream and stream, has never been trodden by the foot of man. The principal rivers on the west coast are the Perak, the Bernam and the Muar. The first-named is far finer than its fellows, and is navigable for steamers for about 40 m. from its mouth, and for native craft for over 250 m. It is exceedingly shallow, however, and is not of much importance as a waterway. The Bernam runs through flat swampy country for the greater part of its course, and steam-launches can penetrate to a distance of over 100 m. from its mouth, and it is therefore probably the deepest river. The country which it waters, however, is not of any value, and it is not much used. The Muar waters a very fertile valley, and is navigable for native boats for over 150 m. On the east coast the principal streams are the Petani, Telubin, Kelantan, Besut, Trengganu, Dungun, Kmamun, Kuantan, Pahang, Rompin, Endau and Sedeli, all guarded by difficult bars at their mouths, and dangerous during the continuance of the north-east monsoon. The deepest rivers are the Kuantan and Rompin; the largest are the Kelantan and the Pahang, both of which are navigable for native boats for a distance of over 250 m. The Trengganu river is obstructed by impassable rapids at a distance of about 30 m. from its mouth. The rivers on the east coast are practically the only highways, the Malays always travelling by boat in preference to walking, but they serve their purpose very indifferently, and their great beauty is their chief claim to distinction. Magnificent caves are found on both slopes of the peninsula, those at Batu in Selangor being the finest on the west coast, while those of Chadu and Koto Glanggi in Pahang are the most extensive yet visited by Europeans on the east coast. They are all of limestone formation. So far as is known, the Malay Peninsula consists of an axial zone of crystalline rocks, flanked on each side by an incomplete band of sedimentary deposits. Granite is the most widely spread of the crystalline rocks; but dikes of various kinds occur, and gneiss, schist and marble are also met with. These rocks form the greater part of the central range, and they are often—especially the granite—decomposed and rotten to a considerable depth. The sedimentary deposits include slate, limestone and sandstone. Impure coal has also been recorded. The limestone has yielded *Proetus*, *Chonetes* and other fossils, and is believed to be of Carboniferous age. In the sandstone Myophoria and other Triassic fossils have been found, and it appears to belong to the Rhaetic or Upper Trias.[1] The minerals produced are tin, gold, iron, galena and others, in insignificant quantities.

The tin occurs in the form of cassiterite, and is found chiefly in or near the crystalline rocks, especially the granite. As stream tin it occurs abundantly in some of the alluvial deposits derived from the crystalline area, especially on the west coast. Only two tin lodes are worked, however, and both are situated on the east coast, the one at Kuantan in Pahang, the other at Bandi in Trengganu territory. On the west coast no true lode has yet been discovered, though the vast alluvial deposits of tin found there seem to make such a discovery probable in the future. Since 1890 the tin produced from these alluvial beds has supplied between 50% and 75% of the tin of the world. Gold is worked with success in Pahang, and has been exploited from time immemorial by the natives of that state and of Kelantan. Small quantities have also been found on the western slope in Perak.

Climate, &c.—It was formerly the custom to speak of the Malay Peninsula as an unhealthy climate, and even to compare it with the west coast of Africa. It is now generally admitted, however, that, though hot, it compares favourably with that of Burma. The chief complaint which Europeans make concerning it is the extreme humidity, which causes the heat to be more oppressive than is the case where the air is dry. On the other hand, the thermometer, even at Singapore on the southern coast, which is the hottest portion of the peninsula, seldom rises above 98° in the shade, whereas the mean for the year at that place is generally below 80°. On the mainland, and more especially on the eastern slope, the temperature is cooler, the thermometer seldom rising above 93° in the shade, and falling at night below 70°. On an average day in this part of the peninsula the temperature in a European house ranged from 88° to 68°. The number of rainy days throughout the peninsula varies from 160 to over 200 in each year, but violent gusts of wind, called "Sumatras," accompanied by a heavy downpour of short duration, are more common than persistent rain. The rainfall on the west coast varies from 75 to 120 in. per annum, and that of the east coast, where the north-east monsoon breaks with all its fury, is usually about 155 in. per annum. Malarial fevers make their appearance in places where the forest has been recently felled, or where the surface earth has been disturbed. It is noticed that labourers employed in deep mines worked by shafts suffer less from fever than do those who are engaged in stripping the alluvial deposits. This, of course, means that a new station, where clearing, digging, and building are in progress, is often unhealthy for a time, and to this must be attributed the evil reputation which the peninsula formerly enjoyed. To Europeans the climate is found to be relaxing and enervating, but if, in spite of some disinclination for exertion, regular exercise is taken from the beginning, and ordinary precautions against chills, more especially to the stomach, are adopted, a European has almost as good a chance of remaining in good health in the peninsula as in Europe. A change of climate, however, is imperatively necessary every five or six years, and the children of European parents should not be kept in the peninsula after they have attained the age of four or five years. The Chinese immigrants suffer chiefly from fever of a malarial type, from beri-beri, a species of tropical dropsy, and from dysentery. The Malays formerly suffered severely from smallpox epidemics, but in the portion of the peninsula under British rule vaccination has been introduced, and the ravages of the disease no longer assume serious dimensions. Occasional outbreaks of cholera occur from time to time, and in the independent states these cause terrible loss of life, as the natives fly from the disease and spread the infection in every direction. As a whole, the Malays are, however, a remarkably healthy people, and deformity and hereditary diseases are rare among them. There is little leprosy in the peninsula, but there is a leper hospital near Penang on Pula Deraja and another on an island on the west coast for the reception of lepers from the Federated Malay States.

Flora and Fauna.—The soil of the peninsula is remarkably fertile both in the plains and on the mountain slopes. In the vast forests the decay of vegetable matter during countless ages has enriched the soil to the depth of many feet, and from it springs the most marvellous tangle of huge trees, shrubs, bushes, underwood, creepers, climbing plants and trailing vines, the whole hung with ferns, mosses, and parasitic growths, and bound together by rattans and huge rope-like trailers. In most places the jungle is so dense that it is impossible to force a way through it without the aid of a wood-knife, and even the wild beasts use well-worn game-tracks through the forest. In the interior brakes of bamboos are found, many of which spread for miles along the river banks. Good hard-wood timber is found in plenty, the best being the *merabau*, *penak*, *rasok* and *chengal*. Orchids of countless varieties abound. The principal fruit trees are the *duri-an*, mangosteen, custard-apple, pomegranate, *rambut-an*, *pulas-an*, *langsat*, *rambai*, jack-fruit, coco-nut, areca-nut, sugar-palm, and banana. Coffee, tobacco, sugar-cane, rice, pepper, gambier, cotton and sago are cultivated with success. Great developments have been made of recent years in the cultivation of rubber in British Malaya. The principal jungle products are gutta and rubber of several varieties, and many kinds of rattan. The mangrove grows on the shores of the west coast in profusion. Agila-wood, the camphor tree, and ebony are also found in smaller quantities.

The fauna of the peninsula is varied and no less profuse than is the vegetable life. The Asiatic elephant; the *seladang*, a bison of a larger type than the Indian gaur; two varieties of rhinoceros; the honey bear (*bruang*), the tapir, the sambhur (*rusa*); the speckled deer (*kijang*), three varieties of mouse-deer (*napoh*, *plandok* and *kanchil*); the gibbon (*ungka* or *wawa'*), the *siamang*, another species of anthropoid ape, the *brok* or coco-nut monkey, so called because it is trained by the Malays to gather the nuts from the coco-nut trees, the *lotong*, *kra*, and at least twenty other kinds of monkey; the *binturong* (*arctictis binturong*), the lemur; the Asiatic tiger, the black panther, the leopard, the large wild cat (*harimau akar*), several varieties of jungle cat; the wild boar, the wild dog; the flying squirrel, the flying fox; the python, the cobra, and many other varieties of snake, including the hamadryad; the alligator, the otter and the gavial, as well as countless kinds of squirrel, rat, &c., are found throughout the jungles of the peninsula in great numbers. On the east coast peafowl are found, and throughout the interior the argus pheasant, the firebacked pheasant, the blue partridge, the adjutant-bird, several kinds of heron and crane, duck, teal, cotton-teal, snipe, wood-pigeon, green-pigeon of several varieties, swifts, swallows pied-robins, hornbills, parakeets, fly-catchers, nightjars, and many other kinds of bird are met with frequently. A few specimens of solitary goose have been procured, but the bird is rarely met with. The forests literally swarm with insects of all kinds, from *cicadae* to beautiful butterflies, and from stick- and leaf-insects to endless varieties of ants. The scorpion and the centipede are both common. The study of the insect life of the peninsula opens a splendid field for scientific research, and the profusion and variety of insects found in these forests probably surpass those to be met with anywhere else in the world.

Political Divisions and Population.—Politically the Malay Peninsula is divided into four sections: the colony of the Straits Settlements and the Federated Malay States; the independent Malay State of Johor, which is within the British sphere of influence; the non-federated states under British protection; and the groups of states to the north of Perak and Pahang which are now recognized as lying within the sphere of influence of Siam. The colony of the Straits Settlements consists of the islands of Singapore, Penang and the Dindings, the territory of Province Wellesley, on the mainland opposite to Penang, the insignificant territory of the Dindings, and the town and territory of Malacca. The Federated Malay States under British protection consist of the sultanates of Perak, Selangor and the Negri Sambilan on the west coast, and the sultanate of Pahang on the east coast. Johor is the only Malay state in the southern portion of the peninsula, the whole of which is within the British sphere, which has been suffered to remain under native rule. The non-federated states under British protection (since 1909) are Kelantan, Trengganu, Kedah and Perlis (Palit). The population of the peninsula numbers about 2,000,000, of whom about 600,000 inhabit the colony of the Straits Settlements, about 900,000 the Federated Malay States, about 200,000 the Malay State of Johor, and about 250,000 to 300,000 the remainder of the peninsula. The population of the peninsula includes about 850,000 Chinese, mostly immigrants or descendants of immigrants from the southern provinces of China, of whom about 300,000 reside in the colony of the Straits Settlements, 365,000 in the Federated Malay States, 150,000 in Johor, and the remainder in smaller communities or as isolated traders scattered throughout the villages and small towns of the peninsula. The Malay population of the peninsula, including immigrants from the eastern archipelago, number some 750,000 to 800,000, while the Tamils and other natives of India number about 100,000, the aboriginal natives of the peninsula perhaps 20,000, Europeans and Americans about 6500, and Eurasians about 9000. The colony of the Straits Settlements, and to a lesser extent the towns of the Federated Malay States, carry a considerable heterogenous population, in which most of the races of Asia find their representatives.

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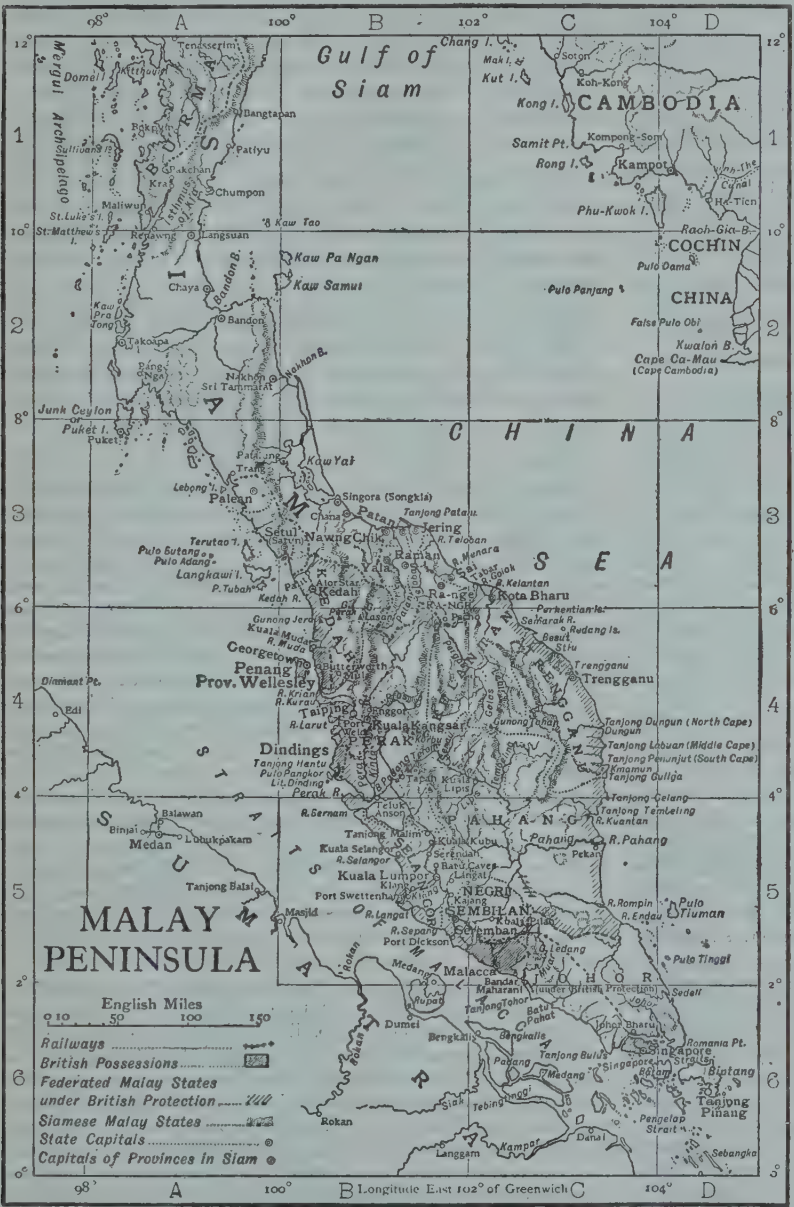
[1] See R. B. Newton, "Notes on Literature bearing upon the Geology of the Malay Peninsula; with an Account of a Neolithic Implement from that Country" (*Geol. Mag.*, 1901, pp. 128–134). See also the various reports by J. B. Scrivenor in *Suppl. Perak Gov. Gazette*, 1905.


MALAY PENINSULA
Gulf of Siam
CHINA SEA
CAMBODIA
COCHIN CHINA
SIAM
MALAY
Mergui Archipelago
English Miles
0 10 50 100 150
Railways
British Possessions
Federated Malay States under British Protection
Siamese Malay States
State Capitals
Capitals of Provinces in Siam
Longitude East 102° of Greenwich
98° A 100° B 102° C 104° D
Tenasserim
Bangtapan
Patiyu
Chumpon
Isthmus of Kra
Langsuan
Kaw Tao
Kaw Pa Ngan
Kaw Samui
Chaya
Bandon
Takoapa
Nakhon Sri Tammarat
Junk Ceylon
Puket I.
Kaw Yai
Singora (Songkla)
Patani
Tanjong Patani
Jering
Setul (Satun)
Nawng Chik
Raman
Langkawi I.
Kedah
Alor Star
Kelantan
Kota Bharu
Perhentian Is.
Redang Is.
Besut
Trengganu
Penang
Georgetown
Butterworth
Prov. Wellesley
Taiping
Kuala Kangsar
PERAK
Dindings
Tanjong Dungun (North Cape)
Tanjong Lobuan (Middle Cape)
Tanjong Penunjut (South Cape)
PAHANG
R. Pahang
Pekan
Kuantan
Teluk Anson
R. Selangor
Kuala Selangor
Kuala Lumpur
Klang
Port Swettenham
NEGRI SEMBILAN
Seremban
Port Dickson
Malacca
R. Rompin
R. Endau
Pulo Tiuman
Pulo Tinggi
JOHOR (under British Protection)
Johor Bharu
Singapore
Singapore Strait
Romania Pt.
Bintang
Tanjong Pinang
Bengkalis
Rokan
Kampar
Medan
Tanjong Balai
Diamant Pt.
Chang I.
Kong I.
Kampot
Kompong-Som
Samit Pt.
Rong I.
Phu-Kwok I.
Ha-Tien
Pulo Obi
Pulo Panjang
Cape Ca-Mau (Cape Cambodia)
Kwalon B.
STRAITS OF MALACCA
SUMATRA

Emery Walker sc.

Races of the Peninsula.—Excluding the Tai, or Siamese, who are undoubtedly recent intruders from the north, there are three races which for an extended period of time have had their home in the Malay Peninsula. These are the Semang or Pangan, the Sakai or Jakun, and the Malays. The Semang, as they are most usually called by the Malays, are Negritos—a small, very dark people, with features of the negroid type, very prognathous, and with short, woolly hair clinging to the scalp in tiny crisp curls. These people belong to the race which would seem to be the true aboriginal stock of southern Asia. Representatives of it are found scattered about the islands from the Andaman group southwards. The state of civilization to which they have attained is very low. They neither plant nor have they any manufactures except their rude bamboo and rattan vessels, the fish and game traps which they set with much skill, and the bows, blow-pipes and bamboo spears with which they are armed. They are skilful hunters, however, catch fish by ingeniously constructed traps, and live almost entirely on jungle-roots and the produce of their hunting and fishing. The most civilized of these people is found in Upper Perak, and the members of this clan have acquired some knowledge of the art of planting, &c. They cannot, however, be taken as typical of their race, and other specimens of this people are seldom seen even by the Sakai. From time to time they have been raided by the latter, and many Negritos are to be found in captivity in some of the Malayan villages on the eastern side of the peninsula. The mistake of speaking of the Sakai tribes as practically identical with the Semang or Pangan has very frequently been made, but as a matter of fact the two races are absolutely distinct from one another. It has also been customary to include the Sakai in the category of Malayan races, but this too is undoubtedly incorrect. The Sakai still inhabit in greatest numbers the country which forms the interior of Pahang, the Plus and Kinta districts of Perak, and the valley of Nenggiri in Kelantan. Representatives of their race are also found scattered among the Malayan villages throughout the country, and also along the coast, but these have intermixed so much with the Malays, and have acquired so many customs, &c., from their more civilized neighbours, that they can no longer be regarded as typical of the race to which they belong. The pure Sakai in the interior have a good knowledge of planting rice, tapioca, &c., fashion pretty vessels from bamboos, which they decorate with patterns traced by the aid of fire, make loin-cloths (their only garment) from the bark of the *trap* and *ipoh* trees; are very musical, using a rude lute of bamboo, and a nose-flute of a very sweet tone, and singing in chorus very melodiously; and altogether have attained in their primitive state to a higher degree of civilization than have the Semang. They are about as tall as the average Malay, are slimly built, light of colour, and have wavy fine hair. In their own language they usually have only three numerals, viz. *na-nun*, one; *nar*, two; and *ne'*, three, or variants of these; all higher arithmetical ideas being expressed by the word *kerpn*, which means "many." A few cases have been recorded, however, of tribes who can count in their own tongue up to four and five. Among the more civilized, however, the Malay numerals up to ten are adopted by the Sakai. An examination of their language seems to indicate that it belongs to the Mon-Khmer group of languages, and the anthropological information forthcoming concerning the Sakai points to the conclusion that they show a greater affinity to the people of the Mon-Khmer races than to the Malayan stock. Though they now use metal tools imported by the Malays, it is noticeable that the names which they give to those weapons which most closely resemble in character the stone implements found in such numbers all over the peninsula are native names wholly unconnected with their Malay equivalents. On account of this, it has been suggested that in a forgotten past the Sakai were themselves the fashioners of the stone implements, and certain it is that all tools which have no representatives among the stone kelts are known to the Sakai by obvious corruptions of their Malayan names. The presence of the Sakai, a people of the Mon-Khmer stock, in the interior of the peninsula has also been considered as one of many proofs that the Malays intruded from the south and approached the peninsula by means of a sea-route, since had they swept down from the north, being driven thence by the people of a stronger breed, it might be expected that the fringe of country dividing the two contending races would be inhabited by men of the more feeble stock. Instead, we find the Sakai occupying this position, thus indicating that they have been driven northward by the Malays, and that the latter people has not been expelled by the Mon-Khmer races from the countries now represented by Burma, Siam and French Indo-China. The Sakai population is dying out, and must eventually disappear. (With regard to the Malay, see MALAYS.)

Archaeology.—The only ancient remains found in the peninsula are the stone implements, of which mention has already been made, and some remarkable ancient mines, which are situated in the Jelai valley in Pahang. The stone implements are generally of one or two types: a long rectangular adze or wedge rudely pointed at one end, and used in conjunction with a mallet or flat stone, and a roughly triangular axe-head, which has evidently been fixed in the cleft of a split stick. A few stones, which might perhaps be arrowheads, have been found, but they are very rare. The mines, which have been constructed for the purpose of working quartz lodes containing gold, are very extensive, and argue a high stage of civilization possessed by the ancient miners. They consist of a number of circular or rectangular pits sunk from the cap of a hill, and going down to a depth of in some cases as much as 120 ft., until in fact the miners have been stopped by being unable to cope with the quantity of water made when the level of the valley was reached. The shafts are placed so close together that in many instances they are divided by only a couple of feet of solid ground, but at their bases a considerable amount of gallery work has been excavated, though it is possible that this was done by miners who came after the people who originally sank the shafts. Native tradition attributes these mines to the Siamese, but no importance can be attached to this, as it is very general for the Malays to give this explanation for anything which is obviously not the work of their own ancestors. A theory, which seems to have some probability in its favour, is that these mines were worked by the Khmer people during the period of power, energy and prosperity which found its most lofty expression in the now ruined and deserted city of Angkor Thom; while another attributes these works to the natives of India whose Hindu remains are found in Java and elsewhere, whose influence was at one time widespread throughout Malayan lands, and of whose religious teaching remnants still linger in the superstitions of the Malays and are preserved in some purity in Lombok and Bali. In the absence, however, of any relics of a kind which might lead to the identification of the ancient miners, their nationality and origin are matters which must continue to be mere questions of speculation and conjecture.

History.—The first hint to reach Europe concerning the existence of habitable lands to the eastward of the Ganges is to be found in the writings of Pomponius Mela (A.D. 43) which speak of Chryse, or the Golden Isle, as lying off Cape Tamus—supposed to be the most easterly point in Asia—and over against the estuary of the Ganges. Thereafter there occur vague references to Chryse in the *Periplus of the Erythrean Sea*, &c., but the earliest trace of anything resembling first-hand knowledge concerning the peninsula of Indo-China and Malaya is revealed in the writings of Ptolemy, whose views were mainly derived from those of his predecessor Marinus of Tyre, who in his turn drew his deductions from information supplied to him by the mariner Alexander who, there is every reason to think, had himself voyaged to the Malay Peninsula and beyond. In the light of present knowledge concerning the trade-routes of Asia, which had been in existence for thousands of years ere ever Europeans attempted to make use of them, it is safe to identify Ptolemy's Sinus Perimulicus with the Gulf of Siam, the Sinus Sabaricus with the Straits of Malacca from their southern portals to the Gulf of Martaban, the Aurea Chersonesus with the Malay Peninsula, and the island of Iabadius or Sabadius—the reading of the name is doubtful—with Sumatra, not as has often been mistakenly attempted with Java. Although the first definite endeavour to locate the Golden Chersonese thus dates from the middle of the 2nd century of our era, the name was apparently well known to the learned of Europe at a somewhat earlier period, and in his *Antiquities of the Jews*, written during the latter half of the 1st century, Josephus says that Solomon gave to the pilots furnished to him by Hiram of Tyre commands "that they should go along with his stewards to the land that of old was called Ophir, but now the Aurea Chersonesus, which belongs to India, to fetch gold." After the time of Ptolemy no advance in knowledge concerning the geography of south-eastern Asia was made until Cosmas Indicopleustes, a monk and an Alexandrian Greek, wrote from personal knowledge between A.D. 530 and 550. His primary object was to prove that the world was built after the same shape and fashion as the Ark made by the Children of Israel in the desert; but he was able to show that the Malay Peninsula had to be rounded and thereafter a course steered in a northerly direction if China was to be reached. Meanwhile inter-Asiatic intercourse by means of sea-routes had been steadily on the increase since the discovery of the way to utilize the monsoons and to sail directly to and fro across the Indian Ocean (attributed to the Greek pilot Hippalus) had been made. After the decline of the power of Rome, the dominant force in Asiatic commerce and navigation was Persia, and from that time onward, until the arrival of the Portuguese upon the scene early in the 16th century the spice trade, whose chief emporia were in or near the Malay Peninsula, was in Persian or Arab hands. There is considerable reason to think, however, that the more frequent ports of call in the Straits of Malacca were situated in Sumatra, rather than on the shores of the Malay Peninsula, and two famous medieval travellers, Marco Polo and Ibn Batuta, both called and wintered at the former, and make scant mention of the latter.

The importance of the Malay Peninsula, as has been noted, consisted in the privilege which its locality conferred upon it of being the distributing centre of the spices brought thither from the Moluccas *en route* for India and Europe. As early as the 3rd century B.C. Megasthenes makes mention of spices brought to the shores of the Ganges from "the southern parts of India," and the trade in question was probably one of the most ancient in the world. So long, however, as India held the monopoly of the clove, the Malay Peninsula was ignored, the Hindus spreading their influence through the islands of the archipelago and leaving traces thereof even to this day. The Mahommedan traders from Persia and Arabia, following the routes which had been prepared for them by their forebears, broke down the Hindu monopoly and ousted the earlier exploiters so effectually that by the beginning of the 16th century the spice trade was almost exclusively in their hands. These traders were also missionaries of their religion, as indeed is every Mahommedan, and to them is due the conversion of the Malays from rude pantheism, somewhat tinctured by Hindu mythology, to the Mahommedan creed. The desire to obtain the monopoly of the spice trade has been a potent force in the fashioning of Asiatic history. The Moluccas were, from the first, the objective of the Portuguese invaders, and no sooner had the white men found their way round the Cape of Good Hope and established themselves successively upon the coast of East Africa, in the neighbourhood of the Gulf of Aden and the Malabar coast, than Malacca, then the chief trading centre of the Malayan Archipelago, became the object of their desire. The first Portuguese expedition sent out to capture Malacca was under the command of Diogo Lopez de Siqueira and sailed from Portugal in 1508. At Cochin Siqueira took on board certain adherents of Alphonso d'Alboquerque who were in bad odour with his rival d'Almeida, among them being Magellan, the future circumnavigator of the world, and Francisco Serrão, the first European who ever lived in the Spice Islands. Siqueira's expedition ended in failure, owing partly to the aggressive attitude of the Portuguese, partly to the very justifiable suspicions of the Malays, and he was presently forced to destroy one of his vessels, to leave a number of his men in captivity, and to sail direct for Portugal. In 1510 a second expedition against Malacca was sent out from Portugal under the command of Diogo Mendez de Vasconcellos, but d'Alboquerque retained it at Cochin to aid him in the retaking of Goa, and it was not until 1511 that the great viceroy could spare time to turn his attention to the scene of Siqueira's failure. After some futile negotiations, which had for their object the recovery of the Portuguese captives before hostilities should begin, an assault was delivered upon Malacca, and though the first attempt to take the city failed after some hard fighting, a second assault made some days later succeeded, and Malacca passed for ever into European hands. The Portuguese were satisfied with the possession of Malacca itself and did not seek further to extend their empire in Malaya. Instead they used every endeavour to establish friendly relations with the rulers of all the neighbouring kingdoms, and before d'Alboquerque returned to India he despatched embassies to China, Siam, and several kingdoms of Sumatra, and sent a small fleet, with orders to assume a highly conciliatory attitude toward all natives, in search of the Moluccas. Very soon the spice trade had become a Portuguese monopoly, and Malacca was the great headquarters of the trade. It should moreover be noted that Magellan's famous expedition had for its object not the barren feat of circumnavigation but the breaking down of this monopoly, without violating the terms of the papal bull which gave to Spain the conquest of the West, to Portugal the possession of the East. In 1528 a French expedition sailed from Dieppe, penetrated as far as Achin in Sumatra, but returned without reaching the Malay Peninsula. It was, however, the first attempt ever made to defy the papal bull. In 1591, three years after the defeat of the Armada, Raymond and Lancaster rounded the Cape, and after cruising off Penang, decided to winter in Achin. They subsequently hid among the Pulau Sambilan near the mouth of the Perak river, and thence captured a large Portuguese vessel which was sailing from Malacca in company with two Burmese ships. In 1595 the first Dutch expedition sailed from the Texel, but it took a more southerly course than its predecessors and confined its operations to Java and the neighbouring islands. During this period Achin developed a determined enmity to the Portuguese, and more than one attempt was made to drive the strangers from Malacca. Eventually, in 1641, a joint attack was made by the Achinese and the Dutch, but the latter, not the people of the sturdy little Sumatran kingdom, became the owners of the coveted port. Malacca was taken from the Dutch by the British in 1795; was restored to the latter in 1818; but in 1824 was exchanged for Benkulen and a few more unimportant places in Sumatra. The first British factory in the peninsula was established in the native state of Patani on the east coast in 1613, the place having been used by the Portuguese in the 16th century for a similar purpose; but the enterprise came to an untimely end in 1620 when Captain Jourdain, the first president, was killed in a naval engagement in Patani Roads by the Dutch. Penang was purchased from Kedah in 1786, and Singapore from the then sultan of Johor in 1819. The Straits Settlements—Singapore, Malacca and Penang—were ruled from India until 1867, when they were erected into a crown colony under the charge of the Colonial Office. In 1874 the Malay state of Perak was placed under British protection by a treaty entered into with its sultan; and this eventually led to the inclusion in a British protectorate of the neighbouring Malay States of Selangor, Sungei Ujong, the cluster of small states called the Negri Sembilan and Pahang, which now form the Federated Malay States. By a treaty made between Great Britain and Siam in 1902 the northern Malay states of the peninsula were admitted to lie within the Siamese sphere of influence, but by a treaty of 1909 Siam ceded her suzerain rights over the states of Kelantan, Trengganu, Kedah and Perlis to Britain.

Singapore is the political, commercial and administrative headquarters of the colony of the Straits Settlements, and the governor for the time being is *ex officio* high commissioner of the Federated Malay States, British North Borneo, Sarawak, the Cocos-Keeling and Christmas Islands, and governor of Labuan.

See Sir F. Swettenham, *British Malaya* (1906); H. Clifford, *Further India* (1904); *Journal of the Malay Archipelago*, Logan (Singapore); *Journal of the Straits Branch of the Royal Asiatic Society* (Singapore); Weld, Maxwell, Swettenham and Clifford in the *Journal of the Royal Colonial Institute* (London); Clifford in the *Journal of the Royal Geographical Society* (London). (H. Cl.)

MALAYS, the name given by Europeans to the people calling themselves *Orang Malayu*, *i.e.* Malayan folk, who are the dominant race of the Malay Peninsula and of the Malay Archipelago. Broadly speaking, all the brown races which inhabit the portion of Asia south of Siam and Indo-China, and the islands from the Philippines to Java, and from Sumatra to Timor, may be described as belonging to the Malayan family, if the aboriginal tribes, such as the Sakai and Semang in the Malay Peninsula, the Bataks in Sumatra, and the Muruts in Borneo, be excepted. For the purposes of this article, however, only those among these races which bear the name of Orang Malayu, speak the Malayan language, and represent the dominant people of the land, can be included under the title of Malays. These people inhabit the whole of the Malayan Peninsula to the borders of lower Siam, the islands in the vicinity of the mainland, the shores of Sumatra and some portions of the interior of that island, Sarawak and Brunei in Borneo, and some parts of Dutch Borneo, Batavia and certain districts in Java, and some of the smaller islands of the archipelago. Though in these lands they have for not less than a thousand years enjoyed the position of the dominant race, they all possess a tradition that they are not indigenous, and that their first rulers "came out of the sea," with a large band of Malayan warriors in their train. In the peninsula especially, where the presence of the Malays is more recent than elsewhere, many traditions exist which point to a comparatively recent occupation of the country. It has been remarked that there is evidence that the Malays had attained to a certain stage of civilization before ever they set foot in Malaya. For instance, the names which they give to certain fruits, such as the *duri-an*, the *rambut-an* and the *pulas-an*, which are indigenous in the Malayan countries, and are not found elsewhere, are all compound words meaning respectively the thorny, the hairy and the twisted fruit. These words are formed by the addition of the substantial affix "*-an*," the use of which is one of the recognized methods by which the Malays turn primitive words into terms of more complex meaning. This may be taken to indicate that when first the Malays became acquainted with the fruits which are indigenous in Malayan lands they already possessed a language in which most primary words were represented, and also that their tongue had attained to a stage of development which provided for the formation of compound words by a system sanctioned by custom and the same linguistic instinct which causes a Malay to-day to form similar compounds from European and other foreign roots. For any aboriginal race inhabiting these countries, such important articles of diet as the *duri-an*, &c., could not fail to be among the first natural objects to receive a name, and thus we find primary terms in use among the Sakai and Semang, the aborigines of the Peninsula, to describe these fruits. The use by the Malays of artificially constructed terms to denote these things may certainly be taken to strengthen the opinion that the Malays arrived in the lands they now inhabit at a comparatively late period in their history, and at a time when they had developed considerably from the original state of primitive man.

In the Malay Peninsula itself there is abundant evidence, ethnological and philological, of at least two distinct immigrations of people of the Malayan stock, the earlier incursions, it is probable, taking place from the eastern archipelago to the south, the later invasion spreading across the Straits of Malacca from Sumatra at a comparatively recent date. The fact that the semi-wild tribes, which are ethnologically Malayan and distinct from the aboriginal Semang and Sakai, are met with almost invariably in the neighbourhood of the coast would seem to indicate that they reached the peninsula by a sea, not by a land route, a supposition which is strengthened by their almost amphibious habits. Many of these tribes have retained their pristine paganism, but many others it is certain have adopted the Mahommedan religion and have been assimilated by the subsequent and stronger wave of Sumatran immigrants. A study of the local dialects to be met with in some of the districts of the far interior, *e.g.* the Tembeling valley in Pahang, whose people are now Mahommedans and in many respects indistinguishable from the ordinary Malays of the peninsula, reveals the fact that words, current in the archipelago to the south but incomprehensible to the average peninsula Malays, by whom these more ancient populations are now completely surrounded, have been preserved as local words, whereas they really belong to an older dialect once spoken widely in the peninsula, as to-day it is spoken in the Malayan islands. This would seem to show that in some instances the earlier Malay immigrants fell or were driven by the later invaders back from the coast and sought refuge in the far interior.

Theories of Origin.

Until recently many eminent scientists held the theory that the Malayan peoples were merely an offspring of the Mongol stock, and that their advance into the lands they now inhabit had taken place from the cradle of the Mongolian race—that is to say, from the north. In the fifth edition of his *Malay Archipelago*, A. R. Wallace notes the resemblance which he traced between the Malays and the Mongolians, and others have recorded similar observations as to the physical appearance of the two races. To-day, however, fuller data are available than when Wallace wrote, and the more generally accepted theory is that the Malayan race is distinct, and came from the south, until it was stayed by the Mongolian races living on the mainland of southern Asia. The cranial measurements of the Malays and an examination of their hair sections seem to bear out the theory that they are distinct from the Mongolian races. Their language, which is neither monosyllabic nor tonic, has nothing in common with that of the Mon-Annam group. It has, moreover, been pointed out that had the Malays been driven southwards by the stronger races of the mainland of Asia, it might be expected that the people inhabiting the country nearest to the border between Siam and Malaya would belong to the Malayan and not to the Mon-Annam or Mon-Khmer stock. As a matter of fact the Sâkai of the interior of the peninsula belong to the latter race. It might also be anticipated, were the theory of a southward immigration to be sustained, that the Malays would be new-comers in the islands of the archipelago, and have their oldest settlements on the Malayan Peninsula. The facts, however, are in exact contradiction to this; and accordingly the theory now most generally held by those who have studied the question is that the Malays form a distinct race, and had their original home in the south. Where this home lay it is not easy to say, but the facts recorded by many writers as to the resemblance between the Polynesian and the Malayan races, and the strong Malayan element found in the languages of the former (see Tregear's *Maori and Comparative Polynesian Dictionary*, London, 1891), have led some students to think that the two races may have had a common origin. John Crawfurd, in the Dissertation to his *Dictionary of the Malay Language*, published in 1840, noted the prevalence of Malayan terms in the Polynesian languages, and attributed the fact to the casting away of ships manned by Malays upon the islands of the Polynesian Archipelago. The appearance of the same Malayan words in localities so widely separated from each other, however, cannot be satisfactorily accounted for by any such explanation, and the theory is now more generally held that the two races are probably allied and may at some remote period of history have shared a common home. It has been suggested that their separation did not take place until after the continent which once existed in the north Pacific had become submerged, and that the Malays wandered northward, while the Polynesian race spread itself over the islands of the southern archipelago. All this, however, must necessarily be of the nature of the purest speculation, and the only facts which we are able to deduce in the present state of our knowledge of the subject may be summed up as follows: (*a*) That the Malays ethnologically belong to a race which is allied to the Polynesians; (*b*) that the theory formerly current to the effect that the Sakai and other similar races of the peninsula and archipelago belonged to the Malayan stock cannot be maintained, since recent investigations tend to identify them with the Mon-Annam or Mon-Khmer family of races; (*c*) that the Malays are, comparatively speaking, new-comers in the lands which they now inhabit; (*d*) that it is almost certain that their emigration took place from the south; (*e*) and that, at some remote period of their history, they came into close contact with the Polynesian race, probably before its dispersion over the extensive area which it now occupies.

Religion and Superstitions.

The Malays to-day are Sunni Mahommedans of the school of Shafi'i, and they habitually use the terms *Orang Malayu*, *i.e.* a Malay, and *Orang Islam*, *i.e.* a Mahommedan, as synonymous expressions. Their conversion from paganism took place during the 13th, 14th and 15th centuries of our era. The raja of Achin, in northern Sumatra, is said to have been converted as early as 1206, while the Bugis people in Celebes are supposed not to have become Mahommedans until 1495. Mahommedanism undoubtedly spread to the Malays of the peninsula from Sumatra, but their conversion was slow and gradual, and may even now in some respects be regarded as imperfect. Upon the bulk of the Malayan peoples their religion sits but lightly. Few are found to observe the law concerning the Five Hours of Prayer, and many fail to put in an appearance at the Friday congregational services in the mosques. The Fast of Ramadhān, however, is generally observed with some faithfulness. Compared with other Mahommedan peoples, the Malays are not fanatical, though occasionally an outbreak against those of a different creed is glorified by them into a holy war. The reason of such outbreaks, however, is usually to be found in political and social rather than in religious grievances. Prior to their conversion to Mahommedanism the Malays were subjected to a considerable Hindu influence, which reached them by means of the traders who visited the archipelago from India. In the islands of Bali and Lombok the people still profess a form of Hinduism, and Hindu remains are to be found in many other parts of the archipelago, though their traces do not extend to the peninsula. Throughout, however, the superstitions of the Malays show indications of this Hindu influence, and many of the demons whom their medicine-men invoke in their magic practices are clearly borrowed from the pantheon of India. For the rest, a substratum of superstitious beliefs, which survives from the days when the Malays professed only their natural religion, is to be found firmly rooted in the minds of the people, and the influence of Mahommedanism, which regards such things with horror, has been powerless to eradicate this. Mr W. W. Skeat's *Malay Magic* (London, 1900) is a compilation of all the writings on the subject of Malay superstitions by the best authorities and contains considerable original matter.

Mode of Life, &c.

The Malays of the coast are a maritime people, and were long famous for the daring character of their acts of piracy. They are now peaceable fisher-folk, who show considerable ingenuity in their calling. Inland the Malays live by preference on the banks of rivers, building houses on piles some feet from the ground, and planting groves of coco-nut, betel-nut, sugar-palm and fruit-trees around their dwellings. Behind their villages the rice-fields usually spread, and rice, which is the staple food of the people, is the principal article of agriculture among them. Sugar-cane, maize, tapioca and other similar products are grown, however, in smaller quantities. In planting rice three methods are in use: the cultivation of swamp-rice in irrigated fields; the planting of ploughed areas; and the planting of hill-rice by sowing each grain separately in holes bored for the purpose. In the irrigated fields the rice plants are first grown in nurseries, and are subsequently transplanted when they have reached a certain stage of development. The Malays also work jungle produce, of which the most important are gutta, rattans, agila wood, camphor wood, and the beautiful *kamuning* wood which is used by the natives for the hilts of their weapons. The principal manufactures of the Malays are cotton and silk cloths, earthenware and silver vessels, mats and native weapons. The best cotton cloths are those manufactured by the Bugis people in Celebes, and the *batek* cloths which come from Java and are stamped with patterns. The best silks are produced by the natives of Pahang, Kĕlantan and Johor in the Malay Peninsula. Lord Leighton pronounced the silver ware from Malaya to be the most artistic of any exhibited at the Colonial Exhibition held in London in 1886. The pottery of the Malays is rude but curious. When the first Europeans visited the Malay Archipelago the Malays had already acquired the art of manufacturing gunpowder and forging canon. The art of writing also appears to have been independently invented by the Malayan races, since numerous alphabets are in use among the peoples of the archipelago, although for the writing of Malay itself the Arabic character has been adopted for some hundreds of years. The Malays are excellent boat-builders.

Character, &c.

While the Malays were famous almost exclusively for their piratical expeditions they naturally bore an evil reputation among Europeans, but now that we have come into closer contact with them, and have learned to understand them better, the old opinions concerning them have been greatly modified. They used to be described as the most cruel and treacherous people in the world, and they certainly are callous of the pain suffered by others, and regard any strategy of which their enemies are the victims with open admiration. In ordinary circumstances, however, the Malay is not treacherous, and there are many instances recorded in which men of this race have risked their own lives on behalf of Europeans who chanced to be their friends. As a race they are exceedingly courteous and self-respecting. Their own code of manners is minute and strict, and they observe its provisions faithfully. Unlike many Orientals, the Malays can be treated with a friendly familiarity without such treatment breeding lack of respect or leading to liberties being taken with the superior. The Malays are indolent, pleasure-loving, improvident beyond belief, fond of bright clothing, of comfort, of ease, and they dislike toil exceedingly. They have no idea of the value of money, and little notion of honesty where money is concerned. They would always borrow rather than earn money, and they feel no shame in adopting the former course. They will frequently refuse to work for a wage when they most stand in need of cash, and yet at the invitation of one who is their friend they will toil unremittingly without any thought of reward. They are much addicted to gambling, and formerly were much given to fighting, though they never display that passion for war in the abstract which is characteristic of some of the white races, and their courage on the whole is not high if judged by European standards. It is notorious, however, on the coasts that a Malay gang on board a ship invariably gets the better of any fight which may arise between it and the Chinese crew. The sexual morality of the Malays is very lax, but prostitution is not common in consequence. Polygamy, though allowed by their religion, is practised for the most part among the wealthy classes only. The Malays are an intensely aristocratic people, and show a marvellous loyalty to their rajas and chiefs. Their respect for rank is not marred by any vulgarity or snobbery. The ruling classes among them display all the vices of the lower classes, and few of the virtues except that of courtesy. They are for the most part, when left to their own resources, cruel, unjust, selfish and improvident.

Much has been written concerning the acts of homicidal mania called amuck (*amok*), which word in the vernacular means to attack. It was formerly believed that these outbursts were to be attributed to madness *pur et simple*, and some cases of *amok* can certainly be traced to this source. These are not, however, in any sense typical, and might equally have been perpetrated by men of another race. The typical *amok* is usually the result of circumstances which render a Malay desperate. The motive is often inadequate from the point of view of a European, but to the Malay it is sufficient to make him weary of life and anxious to court death. Briefly, where a man of another race might not improbably commit suicide, a Malay runs *amok*, killing all whom he may meet until he himself is slain.

The nervous affliction called *latah*, to which many Malays are subject, is also a curious trait of the people. The victims of this affliction lose for the time all self-control and all sense of their own identity, imitating the actions of any person who chances to rivet their attention. Accounts of these manifestations will be found in Swettenham's *Malay Sketches* (London, 1895) and Clifford's *Studies in Brown Humanity* (London, 1897).

Costume, Weapons, &c.

The Malays wear a loose coat and trousers, and a cap or head-kerchief, but the characteristic item of their costume is the *sarong*, a silk or cotton cloth about two yards long by a yard and a quarter wide, the ends of which are sewn together, forming a kind of skirt. This is worn round the waist folded in a knot, the women allowing it to fall to the ankle, the men, when properly dressed in accordance with ancient custom, folding it over the hilt of their waist-weapon, and draping it around them so that it reaches nearly to the knee. In the hall of a raja on state occasions a head-kerchief twisted into a peak is worn, and the coat is furnished with a high collar extending round the back of the neck only. This coat is open in front, leaving the chest bare. The trousers are short and of a peculiar cut and material, being coloured many hues in parallel horizontal lines. The *sarong* is of Celebes manufacture and made of cotton, to the surface of which a high polish is imparted by friction with a shell. The typical fighting costume of the Malay is a sleeveless jacket with texts from the Koran written upon it, short tight drawers reaching to the middle of the thigh, and the *sarong* is then bound tightly around the waist, leaving the hilt of the dagger worn in the girdle exposed to view. The principal weapon of the Malays is the *kris*, a short dagger with a small wooden or ivory handle, of which there are many varieties. The blade of a *kris* may either be wavy or straight, but if wavy the number of waves must always be uneven in number. The *kris* most prized by the Malays are those of Bugis (Celebes) manufacture, and of these the kind called *tuasek* are of the greatest value. Besides the short *kris*, the Malays use long straight *kris* with very narrow blades, shorter straight *kris* of the same form, short broad swords called *sundang*, long swords of ordinary pattern called *pedang*, somewhat shorter swords curved like scimitars with curiously carved handles called *chenangkas*, and short stabbing daggers called *tumbok lada*. The principal tools of the Malays are the *parang* or *gôlok*, a heavy knife used in the jungle, without which no peasant ever stirs abroad from his house, the *beliong* or native axe, and the *pisau raut*, which is used for scraping rattan. Their implements are very primitive, consisting of a plough fashioned from a fork of a tree, and a rude harrow. Reaping is usually performed by the aid of a curious little knife which severs each ear of grain separately. The fisherfolk use many kinds of nets, which they manufacture themselves. Sails, paddles, oars and punting-poles are all in use.

MALAY LANGUAGE AND LITERATURE

The Malay language is a member of the Malayan section of the Malayo-Polynesian class of languages, but it is by no means a representative type of the section which has taken its name from it. The area over which it is spoken comprises the peninsula of Malacca with the adjacent islands (the Rhio-Lingga Archipelago), the greater part of the coast districts of Sumatra and Borneo, the seaports of Java, the Sunda and Banda Islands. It is the general medium of communication throughout the archipelago from Sumatra to the Philippine Islands, and it was so upwards of three hundred and fifty years ago when the Portuguese first appeared in those parts.

There are no Malay manuscripts extant, no monumental records with inscriptions in Malay, dating from before the spreading of Islam in the archipelago, about the end of the 13th century. By some it has been argued from this fact that the Malays possessed no kind of writing prior to the introduction of the Arabic alphabet (W. Robinson, J. J. de Hollander); whereas others have maintained, with greater show of probability, that the Malays were in possession of an ancient alphabet, and that it was the same as the Rechang (Marsden, Friederich), as the Kawi (Van der Tuuk), or most like the Lampong (Kern)—all of which alphabets, with the Battak, Bugi and Macassar, are ultimately traceable to the ancient Cambojan characters. With the Mahommedan conquest the Perso-Arabic alphabet was introduced among the Malays; it has continued ever since to be in use for literary, religious and business purposes. Where Javanese is the principal language, Malay is sometimes found written with Javanese characters; and in Palembang, in the Mĕnangkabo country of Middle Sumatra, the Rechang or Renchong characters are in general use, so called from the sharp and pointed knife with which they are cut on the smooth side of bamboo staves. It is only since the Dutch have established their supremacy in the archipelago that the Roman character has come to be largely used in writing and printing Malay. This is also the case in the Straits Settlements.

By the simplicity of its phonetic elements, the regularity of its grammatical structure, and the copiousness of its nautical vocabulary, the Malay language is singularly well fitted to be the *lingua franca* throughout the Indian archipelago. It possesses the five vowels *a*, *i*, *u*, *e*, *o*, both short and long, and one pure diphthong, *au*. Its consonants are *k*, *g*, *ng*, *ch*, *j*, *ñ*, *t*, *d*, *n*, *p*, *b*, *m*, *y*, *r*, *l*, *w*, *s*, *h*. Long vowels can only occur in open syllables. The only possible consonantal nexus in purely Malay words is that of a nasal and mute, a liquid and mute and vice versa, and a liquid and nasal. Final *k* and *h* are all but suppressed in the utterance. Purely Arabic letters are only used in Arabic words, a great number of which have been received into the Malay vocabulary. But the Arabic character is even less suited to Malay than to the other Eastern languages on which it has been foisted. As the short vowels are not marked, one would, in seeing, *e.g.* the word *bntng*, think first of *bintang*, a star; but the word might also mean a large scar, to throw down, to spread, rigid, mutilated, enceinte, a kind of cucumber, a redoubt, according as it is pronounced, *bantang*, *banting*, *bentang*, *buntang*, *buntung*, *bunting*, *bonteng*, *benteng*.

Malay is essentially, with few exceptions, a dissyllabic language, and the syllabic accent rests on the penultimate unless that syllable is open and short; *e.g.* dātang, namáña, bĕsár, diumpatkanñálah. Nothing in the form of a root word indicates the grammatical category to which it belongs; thus, *kāsih*, kindness, affectionate, to love; *ganti*, a proxy, to exchange, instead of. It is only in derivative words that this vagueness is avoided. Derivation is effected by infixes, prefixes, affixes and reduplication. Infixes occur more rarely in Malay than in the cognate tongues. Examples are—*gūruh*, a rumbling noise, *gumūruh*, to make such a noise; *tunjuḳ*, to point, *telunjuḳ*, the forefinger; *chūchuk*, to pierce, *cherūchuḳ*, a stockade. The import of the prefixes—mĕ (mĕng, mĕñ, mĕn, mĕm), pĕ (pĕng, pĕñ, pĕn, pĕm), bĕr (bĕl), pĕr, pĕl, ka, di, tĕr,—and affixes—an, kan, i, lah—will best appear from the following examples—root word *ājar*, to teach, to learn; *mĕngājar*, to instruct (expresses an action); *bĕlājar*, to study (state or condition); *mĕngajāri*, to instruct (some one, trans.); *mĕngājarkan*, to instruct (in something, causative); *pĕngājar*, the instructor; *pĕlājar*, the learner; *pĕngajāran*, the lesson taught, also the school; *pĕlajāran*, the lesson learnt; *diājar*, to be learnt; *tĕrājar*, learnt; *tĕrājarkan*, taught; *tĕrajāri*, instructed; [*pĕrāja* (from *rāja*, prince), to recognize as prince; *pĕrajākan*, to crown as prince; *karajāan*, royalty]; *ājarkanlah*, teach! Examples of reduplication are—*ājar-ājar*, a sainted person; *ājar-bĕrājar* (or *bĕlājar*), to be learning and teaching by turns; similarly there are forms like *ājar-mĕngājar*, *bĕrājār-ajāran*, *ājar-ajāri*, *mĕmpĕrājar*, *mĕmpĕrājarkan*, *mĕmpĕrajāri*, *tĕrbĕlājarkan*, *pĕrbĕlājarkan*, &c. Altogether there are upwards of a hundred possible derivative forms, in the idiomatic use of which the Malays exhibit much skill. See especially H. von Dewall, *De vormveranderingen der Maleische taal* (Batavia, 1864) and J. Pijnappel, *Maleisch-Hollandsch Woordenboek* (Amsterdam, 1875), "Inleiding." In every other respect the language is characterized by great simplicity and indefiniteness. There is no inflexion to distinguish number, gender or case. Number is never indicated when the sense is obvious or can be gathered from the context; otherwise plurality is expressed by adjectives such as *sagāla*, all, and *bāñak*, many; more rarely by the repetition of the noun, and the indefinite singular by *sa* or *sātu*, one, with a class-word. Gender may, if necessary, be distinguished by the words *laki-lāki*, male, and *pĕrampūan*, female, in the case of persons, and of *jantan* and *bĕtīna* in the case of animals. The genitive case is generally indicated by the position of the word after its governing noun. Also adjectives and demonstrative pronouns have their places after the noun. Comparison is effected by the use of particles. Instead of the personal pronouns, both in their full and abbreviated forms, conventional nouns are in frequent use to indicate the social position or relation of the respective interlocutors, as, *e.g. hamba tuan*, the master's slave, *i.e.* I. These nouns vary according to the different localities. Another peculiarity of Malay (and likewise of Chinese, Shan, Talaing, Burmese and Siamese) is the use of certain class-words or coefficients with numerals, such as *orang* (man), when speaking of persons, *ekor* (tail) of animals, *kĕping* (piece) of flat things, *bīji* (seed) of roundish things; *e.g. līma bīji, tĕlor*, five eggs. The number of these class-words is considerable. Malay verbs have neither person or number nor mood or tense. The last two are sometimes indicated by particles or auxiliary verbs; but these are generally dispensed with if the meaning is sufficiently plain without them. The Malays avoid the building up of long sentences. The two main rules by which the order of the words in a sentence is regulated are—subject, verb, object; and qualifying words follow those which they qualify. This is quite the reverse of what is the rule in Burmese.

The history of the Malays amply accounts for the number and variety of foreign ingredients in their language. Hindus appear to have settled in Sumatra and Java as early as the 4th century of our era, and to have continued to exercise sway over the native populations for many centuries. These received from them into their language a very large number of Sanskrit terms, from which we can infer the nature of the civilizing influence imparted by the Hindu rulers. Not only in words concerning commerce and agriculture, but also in terms connected with social, religious and administrative matters that influence is traceable in Malay. See W. E. Maxwell, *Manual of the Malay Language* (1882), pp. 5–34, where this subject is treated more fully than by previous writers. This Sanskrit element forms such an integral part of the Malay vocabulary that in spite of the subsequent infusion of Arabic and Persian words adopted in the usual course of Mahommedan conquest it has retained its ancient citizenship in the language. The number of Portuguese, English, Dutch and Chinese words in Malay is not considerable; their presence is easily accounted for by political or commercial contact.

The Malay language abounds in idiomatic expressions, which constitute the chief difficulty in its acquisition. It is sparing in the use of personal pronouns, and prefers impersonal and elliptical diction. As it is rich in specific expressions for the various aspects of certain ideas, it is requisite to employ always the most appropriate term suited to the particular aspect. In Maxwell's *Manual*, pp. 120 seq., no less than sixteen terms are given to express the different kinds of striking, as many for the different kinds of speaking, eighteen for the various modes of carrying, &c. An unnecessary distinction has been made between *High Malay* and *Low Malay*. The latter is no separate dialect at all, but a mere brogue or jargon, the medium of intercourse between illiterate natives and Europeans too indolent to apply themselves to the acquisition of the language of the people; its vocabulary is made up of Malay words, with a conventional admixture of words from other languages; and it varies, not only in different localities, but also in proportion to the individual speaker's acquaintance with Malay proper. A few words are used, however, only in speaking with persons of royal rank—*e.g. santap*, to eat (of a raja) instead of *mākan*; *bĕrādu*, to sleep, instead of *tīdor; gring*, unwell, instead of *sākit; mangkat*, to die, instead of *māti*, &c. The use is different as regards the term *Jāwī* as applied to the Malay language. This has its origin in the names Great Java and Lesser Java, by which the medieval Java and Sumatra were called, and it accordingly means the language spoken along the coasts of the two great islands.

The Malays cannot, strictly speaking, be said to possess a literature, for none of their writings can boast any literary beauty or value.

Literature. Their most characteristic literature is to be found, not in their writings, but in the folk-tales which are transmitted orally from generation to generation, and repeated by the wandering minstrels called by the people *Pĕng-līpor Lāra*, *i.e.* "Soothers of Care." Some specimens of these are to be found in the *Journal of the Straits Branch of the Asiatic Society* (Singapore). The collections of *Malay Proberbs* made by Klinkert, Maxwell and Clifford also give a good idea of the literary methods of the Malays. Their verse is of a very primitive description, and is chiefly used for purposes of love-making. There are numerous rhymed fairy tales, which are much liked by the people, but they are of no literary merit. The best Malay books are the *Hikāyat Hang Tūak*, *Bĕstāmam* and the *Hikāyat Abdullah*. The latter is a diary of events kept during Sir Stamford Raffle's administration by his Malay scribe.

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MALAY STATES (British). The native states of the Malay Peninsula under British protection are divided into two groups: (1) federated, and (2) non-federated.

I.—Federated States

The federated states, under the protection of Great Britain, but not British possessions, are Perak, Selangor and the confederation of small states known as the Negri Sembilan (*i.e.* Nine States) on the west coast, and the state of Pahang on the east coast. Each state is under the rule of a sultan, who is assisted in his legislative duties by a state council, upon which the resident, and in some cases the secretary to the resident, has a seat, and which is composed of native chiefs and one or more Chinese members nominated by the sultan with the advice and consent of the resident. The council, in addition to legislative and other duties, revises all sentences of capital punishment. The administrative work of each state is carried on by the resident and his staff of European officials, whose ranks are recruited by successful candidates in the competitive examinations held annually by the Civil Service commissioners. The sultan of each state is bound by treaty with the British government to accept the advice of the resident, who is thus practically paramount; but great deference is paid to the opinions and wishes of the sultans and their chiefs, and the British officials are pledged not to interfere with the religious affairs of the Mahommedan community. In the actual administration of the Malay population great use is made of the native aristocratic system, the peasants being governed largely by their own chiefs, headmen and village elders, under the close supervision of British district officers. The result is a benevolent autocracy admirably adapted to local conditions and to the character and traditions of the people. A recognition of the fact that the welfare of the Malays, who are the people of the land and whose sultans have never ceded their territories to the British, must be regarded as the first consideration has been the guiding principle of the administration of the Malay States, and this has resulted in an extraordinary amelioration of the condition of the natives, which has proceeded concurrently with a notable development of the country and its resources, mineral and agricultural. To the work of development, however, the Malays have themselves contributed little, sound administration having been secured by the British officials, enterprise and capital having been supplied mainly by the Chinese, and the labour employed being almost entirely Chinese or Tamil. Meanwhile the Malays have improved their ancestral holdings, have enjoyed a peace and a security to which their past history furnishes no parallel, have obtained easy access to new and important markets for their agricultural produce, and for the rest have been suffered to lead the lives best suited to their characters and their desires. Each principal department of the administration has its federal head, and all the residents correspond with and are controlled by the resident-general, who, in his turn, is responsible to the high commissioner, the governor of the Straits Settlements for the time being.

The estimated aggregate area of the Federated Malay States is 28,000 sq. m., and the estimated population in 1905 was 860,000, as against 678,595 in 1901. Of these only about 230,000 are Malays. The revenue of the federation in 1905 was $23,964,593 (about £2,795,000), and the expenditure was $20,750,395 (about £2,460,000). The imports for the same year were valued at $50,575,455 (about £5,900,000), and the exports at $80,057,654 (about £9,340,000), making a total trade of nearly $15\frac{1}{4}$ millions sterling. The principal sources of revenue are an export duty on tin, the rents paid for the revenue farms of the right to collect import duties on opium, wine and spirits, and to keep licensed gambling-houses for the exclusive use of the Chinese population, railway receipts, land and forest revenue and postal revenue. The tin is won from large alluvial deposits found in the states of the western seaboard, and the mines are worked almost exclusively by Chinese capital and labour. Since 1889 the Federated Malay States have produced considerably more than half the tin of the world. Recently there has been a great development in agricultural enterprise, especially with regard to rubber, which is now grown in large quantities, the estates being mainly in the hands of Europeans, and the labour mostly Tamil. The states are opened up by over 2500 m. of some of the best metalled cart-roads in the world, and by a railway system, 350 m. of which, extending from the mainland opposite Penang to the ancient town of Malacca, are open to traffic. Another 150 m. of railway is under construction. The government offices at Kuala Lumpor, the federal capital of the states, are among the finest buildings of the kind in Asia. The whole of this extraordinary development, it should be noted, has been effected by careful, sound and wise administration coupled with a courageous and energetic policy of expenditure upon public works. Throughout, not one penny of debt has been incurred, the roads, railways, &c., being constructed entirely from current balances. This of course has only been rendered possible by the extraordinary mineral wealth which the states on the western seaboard have developed in the hands of Chinese miners amid the peace and security which British rule has brought to these once lawless lands. The value of the tin output for the year 1905 amounted to $69,460,993 (£8,104,199). Although agricultural enterprise in the Malay States is assuming considerable proportions and a growing importance, the total value of the principal agricultural products, including timber, for the year 1905 only aggregated $2,435,513 (£289,143).

The whole of the Malay Peninsula is one vast forest, through which flow countless streams that form one of the most lavish water-systems in the world. The rivers, though many of them are of imposing appearance and of considerable length, are uniformly shallow, only a few on the west coast being navigable by ships for a distance of some 40 m. from their mouths. In spite of the notable development above referred to, only a very small fraction of the entire area of the states has as yet been touched either by mining or agricultural enterprise. It is not too much to assert that the larger half of the forest-lands has never been trodden by the foot of man. (For information concerning the botany, geology, &c., of the Malay States see MALAY PENINSULA. For the ethnology see MALAYS.)

PERAK is situated between the parallels 3° 37′ and 6° 5′ N. and 100° 3′ to 101° 51′ E. on the western side of the Malay Peninsula. It is bounded on the N. by the British possession of Province Wellesley and the Malay state of Kedah; on the S. by the protected native state of Selangor; on the E. by the protected native state of Pahang and the independent states of Kelantan and Petani; and on the W. by the Straits of Malacca. The coast-line is about 90 m. in length. The extreme distance from the most northerly to the most southerly portions of the state is about 172 m., and the greatest breadth from east to west is about 100 m. The total area of the country is estimated at about 10,000 sq. m.

The Perak river, which runs in a southerly direction almost parallel with the coast for nearly 150 m. of its course, is navigable for small steamers for about 40 m. from its mouth, and by native trading boats for nearly 200 m. The Plus, Batang, Padang and Kinta rivers are its principal tributaries, all of them falling into the Perak on its left bank. The other principal rivers of the state are the Krian, Kurau, Larut and Bruas to the north of the mouth of the Perak, and the Bernam to the south. None of these rivers is of any great importance as a waterway, although the Bernam River is navigable for small steamers for nearly 100 m. of its course. The mountain ranges, which cover a considerable area, run from the north-east to the south-west. The highest altitudes attained by them do not exceed 7500 ft., but they average about 2500 ft. They are all thickly covered with jungle. The ranges are two, running parallel to one another, with the valley of the Perak between them. The larger is a portion of the main chain, which runs down the peninsula from north to south. The lesser is situated in the district of Larut. There are several hill sanatoria in the state at heights which vary from 2500 to 4700 ft. above sea-level, but the extreme humidity of the atmosphere renders the coolness thus obtainable the reverse of enjoyable.

Geology.

Mr Leonard Wray, curator of the Perak museum, writes as follows on the subject of the geological formation of the state: "There are really only four formations represented—firstly, the granitic rocks; secondly, a large series of beds of gneiss, quartzite, schist and sandstone, overlaid in many places by thick beds of crystalline limestone; thirdly, small sheets of trap rock; and fourthly, river-gravels and other Quaternary deposits. The granites are of many varieties, and also, in all probability, of several different geological periods. The series of quartzites, schists, and limestone are of great age, but as no fossils have ever been found in any of them, nothing definite can be stated as to their exact chronological position. Their lithological characteristics and the total absence of all organic remains point to the Archaean period. The failure to discover signs of life in them is, of course, merely negative evidence, and the finding of a single fossil would at once upset it. However, until this happens they may be conveniently classed as Laurentian. It is at present impossible to form anything approaching an accurate estimate of the thickness of this extensive series, but it is probable that it is somewhere between 4000 and 5000 ft. Unconformability has been noticed between the limestones and the beds beneath, but whether this is sufficient to separate them or not is a matter for future investigation. . . . The taller hills are exclusively composed of granite, as also are some of the lower ones. . . . The ores of the following metals have been found in the formations named: Granite—tin, lead, iron, arsenic, tungsten and titanium; Laurentian—tin, gold, lead, silver, iron, arsenic, copper, zinc, tungsten, manganese and bismuth; Quaternary—tin, gold, copper, tungsten, iron and titanium. This is not to be considered a complete list, as small quantities of other metals have also been found."

History.

The early history of Perak is obscure, the only information on the subject being obtained from native traditions, which are altogether untrustworthy. According to these authorities, however, a settlement was first made by Malays in Perak at Bruas, and the capital was later moved to the banks of the Perak River, the site chosen being a little village called Temong, which lies some miles up stream from Kuala Kangsar, the present residence of the sultan. When the Malacca sultanate fell, owing to the invasion of the Portuguese in 1511, a member of that royal house is said to have migrated to Perak, and the present dynasty claims to have been descended from him. As this boast is also made by almost every ruling family in the peninsula, the tradition is not worthy of any special attention. What is more certain is the tradition that Perak was twice invaded by the Achinese, and its rulers carried off into captivity, one of them, Sultan Mansur Shah, subsequently becoming the ruler of Achin. The first European settlement in Perak was made by the Dutch in 1650, under a treaty entered into with the Achinese, but the natives of the country rose against the Dutch again and again, and it was abandoned in 1783, though it was afterwards reoccupied, the Dutch being finally ejected by the British in 1795. In 1818 the Siamese conquered Perak, but its independence was secured by a treaty between the British and Siamese governments in 1824. From that date until 1874 Perak was ruled by its own sultans, but in that year, owing to internal strife, Sultan Abdullah applied to the then governor of the Straits Settlements, Sir Andrew Clarke, for the assistance of a British Resident. The treaty of Pangkor was concluded on the 20th of January 1874, and the first resident, Mr J. W. W. Birch, was murdered on the 2nd of November 1875. A punitive expedition became necessary; sultan Abdullah and the other chiefs concerned in the murder were banished, the actual murderers were hanged, and Raja Muda Jusuf was declared regent. He died in 1888, and was succeeded by the sultan Raja Idris, K.C.M.G., a most enlightened ruler, who was from the first a strong and intelligent advocate of British methods of administration. Sir Hugh Low was appointed resident, a position which he held until 1889, when he was succeeded by Sir Frank Swettenham. Since then the history of Perak has been one of continuous peace and growing prosperity and wealth. Although the federal capital is Kuala Lumpor in Selangor, Perak still enjoys the honour of being the senior and leading state of the federation.

Population.

By the census taken on the 5th of April 1891 the population of Perak was shown to be as follows: Europeans, 366; Eurasians, Jews and Armenians, 293; Malays, 96,719; Chinese, 94,345; Tamils, 13,086; aborigines, 5779; other nationalities, 3666; thus making a grand total of 214,254, of whom 156,408 were males and 57,846 were females. The estimated population in 1905 was 400,000, of whom 200,000 were Chinese and 160,000 were Malays, but owing to the disparity of the proportions between the sexes the deaths in each year largely outnumber the births, and the increase in the population is accounted for solely by the number of immigrants, chiefly from the mainland of China, and to a lesser extent from India also.

The revenue of Perak in 1874 amounted to $226,333. That for 1905 amounted to $12,242,897. Of this latter sum $4,876,400 was derived from duty on exported tin, $2,489,300 from railway receipts, $505,300 from land revenue and $142,800 from postal and telegraphic revenue. The remainder is mainly derived from the revenue farms, which are leased to Chinese capitalists for a short term of years, conveying to the lessee the right to collect import duties upon opium, wine and spirits, to keep pawnbroking shops, and to keep public licensed gambling-houses for the use of Chinese only. The expenditure for 1905 amounted to $10,141,980. Of this sum $4,236,000 was expended upon railway upkeep and construction and $2,176,100 upon public works. The value of the imports into Perak during 1905 was over $20,000,000, and that of the exports exceeded $40,000,000, making a total of over $60,000,000, equivalent to about seven million sterling. The output of tin from Perak ranged between 18,960 tons, valued at $23,099,506 in 1899, and 26,600 tons, valued at $35,500,000, in 1905. The fluctuating character of the output is due, not to any exhaustion of the mineral deposits of the state—that is not to be anticipated for many years yet to come—but to the uncertainty of the labour supply. The mining population is recruited exclusively from the districts of southern China, and during certain years an increased demand for labourers in China itself, in French Indo-China, in the Dutch colonies, and in South Africa temporarily and adversely affected immigration to the Straits of Malacca. The output has, moreover, been affected from time to time by the price of tin, which was $32.20 per pikul in 1896, rose to $42.96 in 1898, to $74.15 in 1900, and averaged $80.60 in 1905. Exclusive of tin, the principal exports were $108,000 worth of Para rubber, $181,000 of copra, $54,000 of hides, $48,000 of patchouli, and considerable quantities of timber, rattans and other jungle produce. The agricultural development of the state is still in its infancy, but rubber is cultivated in rapidly increasing areas, and the known fertility of the soil, the steady and regular rainfall, the excellent means of communication, and the natural and artificial conditions of the country, justify the expectation that the future of Perak as an agricultural country will be prosperous.

Although so much has been done to develop the resources of Perak, by far the greater portion of the state is still covered by dense and virgin forest. In 1898 it was calculated that only 330,249 acres of land were occupied or cultivated out of a total acreage of 6,400,000.

General.

The area of agricultural holdings has notably increased, but a considerable period must yet elapse before it will amount to even one-tenth of the whole. A line of railway connects the port of Teluk Anson with the great mining district of Kinta, whence the line runs, crossing the Perak River at Enggor, to Kuala Kangsar, the residence of the sultan, thence to Taiping, the administrative capital of the state, and via Krian to a point opposite to the island of Penang. A second line runs south from Perak and connects with the railway system of Selangor, which in its turn connects with the Negri Sembilan and Malacca line, thus giving through railway communication between the last-named town and Penang. Perak also possesses some 600 miles of excellent metalled cart-road, and the length of completed road is annually increasing.

For administrative purposes the state is divided into six districts: Upper Perak, Kuala Kangsar and Lower Perak, on the Perak River; Kinta; Batany Padang and Larut and Krian. Of these, Larut and Kinta are the principal mining centres, while Krian is the most prosperous agricultural district. The districts on the Perak River are mostly peopled by Malays. The administrative capital is Taiping, the chief town of Larut. Kuala Kangsar is chiefly memorable as having been the scene of the first federal meeting of native chiefs, who, with the British Residents from each state, met together in 1897 for friendly discussion of their common interests for the first time in history, under the auspices of the high commissioner, Sir Charles H. B. Mitchell. This, in the eyes of those who are acquainted with the character of the Malays and of the relations which formerly subsisted between the rulers of the various states, is perhaps the most signal token of the changes which British influence has wrought in the peninsula.

SELANGOR is situated between the parallels 2° 32′ and 3° 37′ N. and 100° 38′ and 102° E., on the western side of the Malay Peninsula. It is bounded on the N. by the protected native state of Perak, on the S. by the protected states of the Negri Sembilan, on the E. by Pahang and the Negri Sembilan, and on the W. by the Straits of Malacca. The coast-line is about 100 m. in length, greatest length about 104 m., and greatest breadth about 48 m., total area estimated at about 3000 sq. m.

The state consists of a narrow strip of land between the mountain range which forms the backbone of the peninsula and the Straits of Malacca. Compared with other states in the peninsula, Selangor is poorly watered. The principal rivers are the Selangor, the Klang and the Langat. The principal port of the state is Port Swettenham, situated at the mouth of the Klang River, and is connected with the capital, Kuala Lumpor, by a railway. The geology of the state closely resembles that of Perak. The state is possessed of most valuable deposits of alluvial tin, and mining for this metal is the chief industry of the population. Kuala Lumpor is also the federal capital of the Malay States.

History.

According to native tradition, the ruling house of Selangor is descended from a Bugis raja, who, with two of his brothers, settled in the state in 1718, the son of the youngest brother eventually becoming ruler of the country. In 1783 the then sultan of Selangor joined with the Iang-di-per-Tuan Muda of Riau in an unsuccessful attack upon the Dutch who then held Malacca. In retaliation the Dutch, under Admiral Van Braam, invaded Selangor and drove the sultan out of his country. In 1785, aided by the Bendahara of Pahang, Sultan Ibrahim of Selangor reconquered his state; but the Dutch blockaded his ports, and eventually forced him to enter into a treaty whereby he consented to acknowledge their sovereignty. The earliest British political communication with Selangor began in 1818, when a commercial treaty was concluded with the governor of Penang. In 1867 Sultan Abdul Samad of Selangor appointed his son-in-law, Tungku Dia Udin, to be viceroy; and this gave rise to a civil war which lasted almost without intermission till 1873, when the enemies of Tungku Dia Udin were finally vanquished, largely by the agency of the Bendahara of Pahang, who, at the invitation of the governor of the Straits Settlements, sent a warlike expedition to the assistance of the viceroy. In 1874 the occurrence of an atrocious act of piracy off the mouth of the Langat River led to the governor, Sir Andrew Clarke, appointing, at the request of the sultan, a British Resident to aid him in the administration of his kingdom. Since that date there has been no further breach of the peace, and the prosperity of Selangor has increased annually.

By the census taken on the 5th of April 1891 the population of Selangor was given at 81,592 souls, of whom 67,051 were males and only 14,541 were females. The census taken on the 5th of April 1901 gave a total population of 168,789 souls, of whom 136,823 were males and 31,966 females. Of these 108,768 were Chinese, 33,997 were Malays, 16,748 were Tamils, and only 487 were Europeans. The returns deal with nearly a score of different nationalities. Since 1901 the population has been much increased and now certainly exceeds 200,000 souls. Now, however, that instead of a single port of entry there exist easy means of access to the state by rail both from the north and the south, it is no longer possible to estimate the annual increase by immigration with any approach to accuracy. It will be noted that the inhabitants of this erstwhile Malayan state were, even at the time of the census of 1901, over 64% Chinese, while the Malays were little more than 20% of the population. In Selangor, as elsewhere in the Malay Peninsula, the deaths annually far outnumber the births recorded (*e.g.* in 1905 births 8293, deaths 12,500). The disproportion of the female to the male sections of the population is greater in Selangor than in any other part of the colony or Malay States. The development of planting enterprise in Selangor, and more especially the cultivation of rubber, has led during recent years to the immigration of a considerable number of Tamil coolies, but the Tamil population is still insignificant as compared with the Chinese.

Finance, Trade, &c.

The revenue of Selangor in 1875 amounted to only $115,656; in 1905 it had increased to $8,857,793. Of this latter sum $3,195,318 was derived from duty on tin exported, $1,972,628 from federal receipts, and $340,360 from land revenue. The balance is chiefly derived from the revenue farms, which include the right to collect import duty on opium and spirits. The expenditure for 1905 amounted to $7,186,146, of which sum $3,717,238 was on account of federal charges and $1,850,711 for public works. The value of the imports in 1905 was $24,643,619 and that of the exports was $26,683,316, making a total of $51,326,935, equivalent to £5,988,000. Tin is the principal export. The amount exported in 1905 was 17,254 tons. The total area of alienated mining land at the end of 1905 amounted to 65,573 acres, and it was estimated that over 60,000 Chinese were employed in the mines.

The main trunk line of the Federated Malay States railways passes through Selangor. It enters the state at Tanjong Malim on the Perak boundary, runs southward through Kuala Lumpor and so into the Negri Sembilan. It runs for 81 m. in Selangor territory. A branch line 27 m. long connects Kuala Lumpor with Port Swettenham on the Klang Straits where extensive wharves, capable of accommodating ocean-going vessels, have been constructed. A second branch line, measuring rather more than 4 m. in length, has been opened to traffic. It connects the caves at Batu with Kuala Lumpor. Frequent communication is maintained by steamer between Port Swettenham and Singapore, and by coasting vessels between the former port and those on the shores of the Straits of Malacca. All the principal places in the state are connected with one another by telegraph.

For administrative purposes Selangor is divided into six districts: Kuala Lumpor, in which the capital and the principal tin-fields are situated; Ulu Selangor, which is also a prosperous mining district; Kuala Selangor, which is agricultural, and poorly populated by Malays; Ulu Langat, mining and agricultural; Kuala Langat, the residence of the late sultan Abdul Samad, agricultural; and Klang, the only prosperous port of the state. Much money has been expended upon the capital, Kuala Lumpor, which possesses some fine public buildings, waterworks, &c., and where the principal residence of the Resident-General is situated. In some sort Kuala Lumpor is the capital not only of Selangor, but also of the whole federation. Its scenery is very attractive.

NEGRI SEMBILAN (the Nine States) is a federation of small native states which is now treated as a single entity, being under the control of a British Resident, and is situated between parallels 2° 28′ and 3° 18′ N. and 101° 45′ and 102° 45′ E., on the western side of the Malay Peninsula. It is bounded on the N. by the protected state of Pahang, on the S. by the territory of Malacca, on the E. by Pahang and the independent state of Johor, and on the W. by the Straits of Malacca. The coast-line is about 28 m. in length, and the extreme distance from north to south is 55 m., and that from east to west about 65 m. The estimated area is about 3000 sq. m. Port Dickson, or Arang-Arang, is the only port on the coast. It is connected with the capital, Seremban, by a railway 24 m. in length. Most of the states comprising the federation depend largely for their prosperity upon agriculture, but in some of the districts tin is being worked in considerable quantities, with good results.

History.

As is the case with the history of most Malayan states, much rests upon no surer ground than tradition, in so far as the records of the Negri Sembilan are concerned. At the same time the native story that the states which now form the federation of the Negri Sembilan were originally peopled by tribes of Sakai, or aborigines of the peninsula, who descended from the mountains of the interior and peopled the valleys, is supported by much corroborative evidence. Not only does the Malay's contempt for the Sakai make it exceedingly unlikely that the tradition, which is hardly a matter for pride, should have been preserved if it were not true, but also many of the laws and customs in force in these states are wholly foreign to those of the Malays, and can plainly be traced to the aborigines. As an instance, the custom of inheriting rank and property through the mother instead of through the father may be mentioned. Tradition further relates that towards the end of the

18th century a raja of the royal house of Menangkabu came from Sumatra to rule over the federation of small states, each of which continued to be governed in all its local affairs by its own chief and by the village and other councils sanctioned by ancient custom. The Sumatran raja took the title of Iang-di-per-Tuan of Sri Menanti. Although they bore the name of the "Nine States," only six seem to have belonged to the federation during the time of which history speaks. These are Sri Menanti, Johol, Tampin, Rembau, Jelebu, and Sungei Ujong. Later the two latter separated themselves from the confederation. Ancient tradition says that the names of the nine states were originally Klang, Jelebu, Sungei Ujong, Johol, Segamat, Pasir Besar, Naning, Rembau and Jelai. Of these Klang was annexed by Selangor, Segamat and Pasir Besar by Johor, and Naning by Malacca. During the last years of the 18th century the Iang-di-per-Tuan appointed an Iang-di-per-Tuan Muda to rule Rembau, and the state of Tampin was created to provide for the family of the new chief. In 1887 the governor of the Straits Settlements sent Mr Martin Lister to the Negri Sembilan, which had become disintegrated, and by his influence the ancient federal system was revived under the control of a Resident appointed by the governor. The states which formed this new confederation were Johol, Ulu Muar, Jempol, Terachi, Inas, Gunong Pasir, Rembau, Tampin and Gemencheh. Prior to this, in 1873, owing to a civil war in Sungei Ujong, Sir Andrew Clarke sent a military force to that state, put an end to the disturbances, and placed the country under the control of a British Resident. Jelebu was taken under British protection in 1886, and was thenceforth managed by a magistrate under the orders of the Resident of Sungei Ujong. In 1896, when the federation of all the Malayan states under British control was effected, Sungei Ujong and Jelebu were reunited to the confederation of small states from which they had so long been separated and the whole, under the old name of the Negri Sembilan, or Nine States, was placed under one Resident.

The population of the Negri Sembilan, which according to the census taken in April 1891 was only 70,730, had increased to 96,028 by 1901, and was estimated at 119,454 in 1905. Of these 46,500 are Chinese, 65,000 Malays, 6700 Tamils, and 900 Europeans and Eurasians. The births registered slightly exceed the deaths in number, there being a large Malay population in the Negri Sembilan among whom the proportion of women to men is fair, a condition of things not found in localities where the inhabitants are mostly Chinese immigrants.

Finance and Trade.

The revenue of the Negri Sembilan amounted to only $223,435 in 1888. In 1898 it had increased to $701,334, in 1900 to $1,251,366, and in 1905 to $2,335,534. The revenue for 1905 was derived mainly as follows:—customs $1,268,602, land revenue $145,475, land sales $21,407, while the revenue farms contributed $584,459. The expenditure in 1905 amounted to $2,214,093, of which $1,125,355 was expended upon public works. The trade returns for 1905, which are not, however, complete, show an aggregate value of about $13,000,000. The value of the tin exported during 1905 exceeded $6,900,000, and the value of the agricultural produce, of which gambier represented $211,000 and damar $80,000, amounted to $407,990.

General.

Seremban, the administrative capital of the Negri Sembilan, is connected with Port Dickson by a railway line, owned by the Sungei Ujong Railway Company, which is 24½ m. in length. It is also situated on the trunk line of the Federated Malay States, and is thus joined by rail to Selangor on the north and to Malacca on the south. Frequent steam communication is maintained between Port Dickson and the ports on the Straits of Malacca and with Singapore.

For administrative purposes the Negri Sembilan is divided into five districts, viz. the Seremban District, the Coast District, Jelebu, Kuala Pilah and Tampin. Each of these is under the charge of a European district officer, who is responsible to the Resident. The Iang-di-per-Tuan lives at Kuala Pilah, but the capital of the federation is at Seremban in Sungei Ujong, where the Resident is stationed. The hereditary chiefs of the various states aid in the government of their districts, and have seats upon the state council, over which the Iang-di-per-Tuan presides. The watering-place of Magnolia Bay, where excellent sea-bathing is obtainable, is one of the pleasure resorts of this part of the peninsula.

PAHANG, on the east coast of the peninsula, is situated between parallels 2° 28′ and 3° 45′ N. and 101° 30′ and 103° 30′ E. It is bounded on the N. by the independent native states of Kelantan and Trengganu; on the S. by the Negri Sembilan and Johor; on the E. by the China Sea; and on the W. by the protected states of Perak and Selangor. The coast-line is about 112 m. in length; the greatest length is about 210 m., and greatest breadth about 130 m. The state is the largest in the peninsula, its area being estimated at 15,000 sq. m. The ports on the coast are the mouths of the Endau, Rompin, Pahang and Kuantan rivers, but during the north-east monsoon the coast is not easy of approach, and the rivers, all of which are guarded by difficult bars, are impossible of access except at high tides.

The principal river of the state is the Pahang, from which it takes its name. At a distance of 180 m. from the coast this river is formed by two others named respectively the Jelai and the Tembeling. The former is joined 20 m. farther up stream by the Lipis, which has its rise in the mountains which form the boundary with Perak. The Jelai itself has its rise also in a more northerly portion of this range, while its two principal tributaries above the mouth of the Lipis, the Telom and the Serau, rise, the one in the plateau which divides Perak from Pahang, the other in the hills which separate Pahang from Kelantan. The Tembeling has its rise in the hills which divide Pahang from Kelantan, but some of its tributaries rise on the Trengganu frontier, while the largest of its confluents comes from the hills in which the Kuantan River takes its rise. The Pahang is navigable for large boats as far as Kuala Lipis, 200 m. from the mouth, and light-draught launches can also get up to that point. Smaller boats can be taken some 80 m. higher up the Jelai and Telom. The river, however, as a waterway is of little use, since it is uniformly shallow. The Rompin and Kuantan rivers are somewhat more easily navigated for the first 30 m. of their course, but taken as a whole the waterways of Pahang are of little value. The interior of Pahang is chiefly noted for its auriferous deposits. Gunong Tahan is situated on the boundary between Pahang and Kelantan. Its height is estimated at 8000 ft. above sea-level, but it has never yet been ascended. Pahang, like the states on the west coast, is covered almost entirely by one vast forest, but in the Lipis valley, which formerly was thickly populated, there is a considerable expanse of open grass plain unlike anything to be seen on the western sea-board. The coast is for the most part a sandy beach fringed with *casuarina* trees and there are only a few patches of mangrove-swamp throughout its entire length.

History.

The ancient name of Pahang was Indrapura. It is mentioned in the history of *Hang Tuah*, the great Malacca brave, who flourished in the 16th century, and succeeded in abducting a daughter of the then ruling house of Pahang for his master, the sultan of Malacca. Prior to this, Pahang had been ruled by the Siamese. When Malacca fell into the hands of the Portuguese in 1511 the sultan, Muhammad Shah, fled to Pahang, and the present ruling house claims to have been descended from him. The title of the ruler of Pahang was Bendahara until 1882, when the present (1902) ruler, Wan Ahmad, assumed the title of sultan, taking the name of Sultan Ahmad Maatham Shah. Up to that time the Bendahara had been installed on his accession by the sultan of Riau, and held his office by virtue of that chief's letter of authority. About 1855 the father of the present sultan died at Pekan, and his son Bendahara Korish, who succeeded him, drove Wan Ahmad from the country. After making three unsuccessful attempts to conquer the land and to dethrone his elder brother, Wan Ahmad at last succeeded in 1865 in invading the state and wresting the throne from his nephew, who had succeeded his father some years earlier. From that time, in spite of two attempts to shake his power by invasions from Selangor which were undertaken by his nephews Wan Aman and Wan Da, Bendahara Ahmad ruled his country with a rod of iron. In 1887 he consented to enter into a treaty with the governor of the Straits by which he accepted a consular agent at his court. This treaty was finally signed on the 8th of October 1887. In February of the following year a Chinese British subject was murdered at Pekan in circumstances which pointed to the responsibility of the sultan for the crime, and in October 1888 a Resident was appointed to assist the sultan in the administration of his country, that being, in the opinion of the British government, the only guarantee for the safety of the life and property of British subjects which it could accept. In December 1891 disturbances broke out in Pahang, the nominal leaders of which were certain of the sultan's most trusted chiefs. The sultan himself took no part in the outbreak, but it undoubtedly had his sympathy, even if it was not caused by his direct commands. The rebels were driven to seek safety in flight in November 1892, but in June 1894 they gathered strength for a second disturbance, and raided Pahang from Kelantan, in which state they had been given shelter by the Mahommedan rulers. This event, added to the occurrence of other raids from across the border, led to an irregular expedition being led into Trengganu and Kelantan by the Resident of Pahang (Mr Hugh Clifford) in 1895, and this had the desired result. The rebel chiefs were banished to Siam, and no further breach of the peace has troubled the tranquillity of Pahang since that time. Pahang joined the Federated Malay States by a treaty signed in 1895, and the sultan and his principal chiefs were present at the federal durbar held at Kuala Kangsar in Perak in 1897.

Population.

The census taken in April 1901 gave the total population of Pahang at 84,113, of whom 73,462 were Malays, 8695 Chinese, 1227 Tamils and other natives of India, 180 Europeans and Eurasians, and 549 people of other nationalities. The population in 1905 was estimated at 100,000, the increase being due to immigration mainly from the states on the western seaboard. In former days Pahang was far more thickly populated than in modern times, but the long succession of civil wars which racked the land after the death of Bendahara Ali caused thousands of Pahang Malays to fly the country. To-day the valley of the Lebir River in Kelantan and the upper portions of several rivers near the Perak and Selangor boundaries are inhabited by Pahang Malays, the descendants of these fugitives. The Pahang natives are almost all engaged in agriculture. The work of the mines, &c., is performed by Chinese and foreign Malays. In the Lipis valley the descendants of the Rawa Malays, who at one time possessed the whole of the interior in defiance of the Pahang rajas, still outnumber the people of the land.

Finance and Trade.

The revenue of Pahang in 1899 amounted to only $62,077; in 1900 to $419,150. In 1905 it was $528,368. The expenditure in 1905 amounted to $1,208,176. Of this sum $736,886 was expended on public works. Pahang is still a source of expense to the federation, its progress having been retarded by the disturbances which lasted from December 1891 until 1895, with short intervals of peace, but the revenue is now steadily increasing, and the ultimate financial success of the state is considered to be secure. Pahang owes something over $3,966,500 to Selangor and $1,175,000 to Perak, which have financed it now for some years out of surplus revenue. The value of the imports in 1905 was $1,344,346, that of the exports was $3,838,928, thus making a total trade value of $5,183,274. The most valuable export is tin, the value of which in 1905 amounted to $2,820,745. The value of the gutta exported exceeded $140,000, that of dried and salted fish amounted to nearly $70,000, and that of timber to $325,000.

General.

The geological formation of the states lying to the eastward of the main range of mountains which splits the peninsula in twain differs materially from that of the western states. At a distance of about a dozen miles from the summits of the mountains the granite formation is replaced by slates, which in many places are intersected by fissures of quartz, and in others are overlaid by vast thicknesses of limestone. Those of the quartz fissures which have been exploited are found to be auriferous, and several mining companies have attempted to work the deposits. Their efforts, however, have not hitherto been successful. A magnificent road over the mountains, with a ruling grade of 1 in 30, joins Kuala Lipis, the administrative capital of Pahang, to Kuala Kubu, the nearest railway station in Selangor. The road measures 82 m. in length. Pekan, where the sultan has his residence, was the capital of Pahang until the middle of 1898, when the administrative headquarters were transferred to the interior as being more central. None of these towns is of any size or importance. In the Kuantan valley, which lies parallel to the Pahang River, a European company is working tin lodes with considerable success. These lodes are the only mines of the kind being worked in the Federated Malay States. Pahang is fertile and well suited for agriculture of many kinds. The rainfall is heavy and regular. The climate is cooler than that of the west coast, and the full force of the monsoon is felt from October to February in each year. For administrative purposes Pahang is divided into four districts—Ulu Pahang, in which the present capital is situated; Temerloh, which includes 80 odd miles of the Pahang valley and the Semantan River; Pekan, which includes the coast rivers down to Endau; and Kuantan. Each of these is under the charge of a district officer, who is responsible to the resident. The boundary with Johor and the Negri Sembilan was rectified by a commission which sat in London in 1897–1898.

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II.—NON-FEDERATED STATES

In 1909 a treaty was made between Great Britain and Siam, one provision of which was the cession to the former of the suzerain rights enjoyed by the latter over certain territories in the Malay Peninsula. These territories consisted of the four Siamese Malay States: Kelantan, Trengganu, Kedah and Perlis, very ancient dependencies of Siam, all of which except Trengganu, were in a flourishing condition and had been administered by British officers in the service of Siam for some years prior to their transference. Though the four states were loyal to Siam and wished to retain their former allegiance, the change was effected without disturbance of any kind, the British government on assuming the rights of suzerainty placing an adviser at the court of each raja and guaranteeing the continuance of the administration on the lines already laid down by Siam so far as might be compatible with justice and fair treatment for all. The four states lie to the north of the Federated Malay States, two on the east and two on the west side of the peninsula.

KELANTAN.—This state on the east coast, bounded N. and N.E. by the China Sea, E. by Trengganu, S. by Pahang and W. by Perak and Ra-nge, lies between 4° 48′ and 6° 20′ N. and 101° 33′ and 102° 45′ E. The greatest length from north to south is 115 m. and the greatest breadth from east to west 60 m. The area is about 5000 sq. m. The northern part of the state is flat and fertile, but the southern district which comprises more than half the total area, is mountainous and uncultivated.

Next to the Pahang, the Kelantan River is the largest on the east coast. It is 120 miles long and is navigable for shallow-draft launches and big country boats for about 80 miles, and for vessels of 8 ft. draft for about six miles. Its principal tributaries are the Galas, Pergau and Lebir. The Golok and Semarak rivers water the west and east parts of the state, falling into the sea a few miles on either side of the mouth of the Kelantan River. The climate of Kelantan is mild and singularly healthy in the open cultivated regions. The population is about 300,000 of which 10,000 are aboriginal tribes (Sakeis and Jakuns), 10,000 Siamese and Chinese and the rest Malays. The Chinese are increasing and natives of different parts of India are resorting to the state for purposes of trade. Kota Bharu (pop. 10,000) is the only town in the state. It lies on the right bank of the river, about six miles from the sea. Since 1904 it has been laid out with metalled roads and many public and private buildings have been erected. The town is the commercial as well as the administrative centre of the state. Tumpat and Tabar on the coast, with population 4000 and 3000 respectively, are the places next in importance after Kota Bharu. A network of creeks render communication easy in the northern districts, the river and its tributaries afford means of access to all parts of the south; 20 miles of road have been made in the neighbourhood of Kota Bharu. Kelantan is connected by telegraph with Bangkok and Singapore, and maintains regular postal communication with those places. Rice cultivation is the principal industry and is increasing rapidly. Coco-nut and betel-nut growing are also largely practised. Much livestock is raised. About 400,000 acres of land are under cultivation. Though reputed rich in minerals, past misrule prevented mining enterprise in Kelantan until, in 1900, a large concession was given to an Englishman and the country was opened to foreigners. In 1909 three mining syndicates were at work, and several others were in process of formation. Gold, tin and galena have been found in several localities and during the years 1906–1909 28,000 ounces of gold were dredged from the Kelantan River. The Kelantanese are expert fishermen, some 30,000 finding employment in fishing and fish-drying. Silk-weaving is a growing industry. Foreign trade, which in 1909 reached the value of two and a half million dollars, is chiefly with Singapore. Principal exports are copra, rice, fish, cattle and gold; chief imports are cotton goods, hardware and specie. The currency is the Straits Settlements dollar and small silver coin, supplemented by a locally made tin coin of low value.

By virtue of a mutual agreement made in 1902 Siam appointed a resident commissioner to Kelantan and consented, so long as the advice of that officer should be followed, to leave internal affairs to be conducted locally. Under this arrangement a council of state was appointed, departments of government were organized, penal, civil and revenue laws were passed and enforced, courts were established and a police force was raised. Though formerly of an evil reputation, the people were found to be naturally peaceful and law-abiding, and serious crime is rare. The state revenue, which was practically nothing in 1902, amounted to $320,000 in 1907. Islamism was adopted about 300 years ago but the old animistic superstitions are still strong. The state is divided into *mukim* or parishes, but the *imam* no longer exercise temporal authority. There are three schools at Kota Bharu, education in the interior being in the hands of the imam assisted with government grants.

No historical records of Kelantan exist, and the state was not noticed by the European merchants of the 16th and 17th centuries. Consequently little is known of its early history beyond what is to be gathered from brief references in the Malay annals and the old chronicles of Siam. The sites of ancient towns and the remains of former gold diggings are visible here and there, but all knowledge of the men who made these marks has been lost. The present ruling family dates from about 1790. Siam was frequently called upon to maintain internal peace and in 1892 a royal prince was sent to reside in Kelantan as commissioner. Complications brought about by the incapacity of the ruler led to the making of the agreement of 1902 above mentioned, to the fixing of a regular tribute in money to Siam, and ultimately to the merging of the state from chaotic lawlessness into the path of reform. On the 15th of July 1909 the state came under British suzerainty and the commissioner of Siam was replaced by a British adviser, from which date the liability to payment of tribute ceased, though in all other respects the administrative arrangements of Siam remained unaltered.

TRENGGANU.—This state on the east coast, bounded N. and N.E. by the China Sea, S. by Pahang and W. by Pahang and

Kelantan, lies between parallels 4° 4′ and 4° 46′ N. and 102° 30′ and 103° 26′ E. The greatest length from north to south is 120 m., and the greatest breadth from east to west 50 m. It has a coast-line of 130 m. and an estimated area of about 5000 sq. m. There are several islands off the coast, some of which are inhabited. The surface is generally mountainous.

Principal rivers are the Besut, Stiu, Trengganu, Dungun and Kmamun, none of which is navigable for any distance. The climate is mild and fairly healthy. The population numbers about 180,000, almost all Malays, and mostly clusters round the mouths and lower reaches of the rivers. The capital, which is situated at the mouth of the Trengganu River, contains, with its suburbs, not less than 30,000 people. Difficulty of access by river and by land render the interior districts almost uninhabitable. Communication is maintained by boat along the coast. There are no roads and no postal or telegraphic communications.

The majority of the people are sailors and fishermen. Rice is grown, but not in sufficient quantities to supply local needs. Much pepper and gambier were at one time grown and exported, but about the year 1903 agriculture began to fall off owing to prevailing insecurity of life and property. Not much livestock is raised, the few head of cattle exported from Besut being mostly stolen from across the neighbouring Kelantan border. A successful tin mine under European control exists in the Kmamun district, but as everything possible was done in the past to discourage all foreign enterprise, the probable mineral wealth of the country is still practically untouched. Silk-weaving, carried on entirely by the women, is a considerable industry. The silk is imported raw and is re-exported in the form of Malay clothing (*sarongs*) of patterns and quality which are widely celebrated. The manufacture of native weapons and of brassware was at one time brisk but is declining. The trade of Trengganu is not increasing. It is valued roughly at about one and a half million dollars a year, is chiefly with Singapore, and is to a great extent carried in Trengganu-built ships, which latter also do some carrying trade for other states on the east coast.

The Trengganu sultanate is one of the most ancient in the peninsula and ranks with that of Riau. The state was feudatory to Malacca in the 13th century and during the 14th, 15th and 16th centuries its possession was frequently disputed between Malacca and Siam. The present sultan is the descendant of an ancient family, the members of which have quarrelled and fought with each other for the succession from time immemorial. The last serious disturbance was in 1837 when the grandfather of the present sultan stole the throne from his nephew. Until the acquisition of the state by Great Britain a triennial tribute of gold flowers was paid to Siam, and this with occasional letters of instructions and advice, constituted almost the only tangible evidence of Siamese suzerainty. Of government there was practically none. The sultan, having alienated most of his powers and prerogatives to his relatives, passed his life in religious seclusion and was ruler in no more than name. The revenues were devoured by the relatives, a small part of those accruing from the capital sufficing for the sultan's needs. There were no written laws, no courts and no police. All manner of crime was rampant, the peasantry was mercilessly downtrodden, but the land was full of holy men and the cries of the miserable were drowned in the noise of ostentatious prayer. In fine, Trengganu presented in the beginning of the year 1909 the type of untrammelled Malay rule which had fortunately disappeared from every other state in the peninsula. In July of that year, however, the first British adviser or agent arrived in the state, which was shortly afterwards visited by the governor of the Straits Settlements, who discussed with the sultan the changed conditions consequent upon the Anglo-Siamese treaty and laid the foundations of future reform.

Kedah.—This state, on the west coast of the peninsula, lies between parallels 5° 20′ and 6° 42′ N., and is bounded, N. by Palit and Songkla, E. by Songkla and Raman, S. by Province Wellesley and Perak, and W. by the sea. The coast-line is 65 m. long, the greatest distance from north to south is 115 m. and the greatest breadth 46 m. Off the coast lies a group of islands, the largest of which is Langkawi, well peopled and forming a district of the state.

The total area of Kedah is about 4000 sq. m. The land is low-lying and swampy near the coast except towards the south where the height known as Kedah Hill rises from the shore opposite Penang, flat and fertile farther inland, and mountainous towards the eastern border. The rivers are small, the Sungei Kedah, navigable for a few miles for vessels of 50 tons, and the S. Muda, which forms the boundary with Province Wellesley, being the only streams worthy of notice. The plains are formed of marine deposit, and in the mountains limestone and granite preponderate. The population is estimated at 220,000, of whom about 100,000 are Malays, 50,000 Siamese and Samsams and 70,000 Chinese and Madrassis (Klings). There are three towns of importance. Alor Star, the capital, on the Kedah river, 10 miles from the sea, in a flat, unhealthy, but fertile locality, is a well laid out town with good streets, many handsome public and private buildings, and good wharfage for small vessels. The population is about 20,000, of whom more than half are Chinese and the remainder government servants and retainers of the local aristocracy. Kuala Muda (pop. 10,000) and Kulim (pop. 8000) situated in the south, are unimposing collections of small birch houses and thatched bamboo huts; the latter is the centre of the Kedah tin mining industry. The bulk of the population is scattered over the plains in small villages. A good road runs north from Alor Star to the border of the state, a distance of 40 miles, and other roads are being constructed. The state has 185 miles of telegraph line and 75 miles of telephone line. Mails are closed daily at Alor Star for Penang and there is a good internal postal service. The chief industry is rice cultivation. Coco-nut, betel-nut and fruit plantations are many, and the cultivation of rubber has recently been taken up with prospects of success. The estimated area under cultivation is about 300,000 acres. There are rice-mills at Alor Star and at Kuala Muda. The principal exports are rice, cattle and tin. The chief imports are cotton goods, provisions, hardware and raw silk. Accurate trade statistics are not available. The ruler holds the rank of sultan and is assisted in the government by a council and by the British adviser who since the state passed from Siamese to British protection in 1909, has replaced the officer formerly appointed by Siam. The sultan comes of a family long recognized by Siam as having hereditary right to the rulership. The penal and civil laws are administered in accordance with the precepts of Islamism, the official religion of the state. Though much has been done to improve the courts, justice is not easily obtainable. A land registration system is in force but is in a state of confusion, though a land law passed in 1905 gives security of tenure over lands newly acquired. The mining laws are similar to those of Siam. In 1905 the Siamese government advanced two and a half million dollars to Kedah, to pay the debts of the state, which sum was refunded by the British Government on assuming the position of protector. The annual revenue is $1,000,000 and the expenditure about the same. Chief heads of revenue are opium and land tax. Many revenue monopolies, created in the past, have not yet expired; but for this the revenue would be greater than it is. There is no army. In 1906 the police service was reorganized under British officers, resulting in great improvement to this department. The state is divided into a number of administrative districts under Malay officials. Each district comprises several *mukim* or parishes, the *imam* of which exercise both spiritual and temporal control. There are schools in the chief towns, but education has not yet been seriously undertaken.

Kedah was founded by colonists from India in A.D. 1200, about which time the Siamese had subdued Nakhon Sri Tammarat and claimed the whole Malay Peninsula. When the rise of Malacca shook Siamese authority in the peninsula, Kedah oscillated between them, and on the conquest of Malacca by the Portuguese, fell to Siam, though the capital was raided and burnt by the Europeans. The ruler and his people were converted to Islam in the 15th century. In 1768, the Siamese kingdom being disorganized, the sultan of Kedah entered into direct political relations with the Hon. East India Company, leasing the island of Penang to the latter. Further treaties followed in 1791 and 1802, but in 1821 Siam reasserted her control, expelling the rebellious sultan after a sanguinary war. The sultan made several fruitless efforts to recover the state, and at length made full submission, when he was reinstated. In 1868 an agreement between Great Britain and Siam was substituted for the treaties of the East India Company with the sultan. The present sultan succeeded in 1881, and for 14 years governed well, but in 1895 he began to contract debts and to leave the government to his minions. The result was chaos, and in 1905 the Siamese government had to intervene to avert a condition of bankruptcy, adjusting the finances and reorganizing the general administration to such effect that when, four years later, the state became a British dependency, a government was found established on a sound basis and requiring nothing but the presence of a firm and experienced officer as adviser to maintain its efficiency and assist its further advance.

Perlis (*Palit*).—This small state, consisting of the left bank drainage area of the Perlis River, lies between Setul and Kedah, which bound it on the N. and W. and on the E. respectively. It touches the sea only round the mouth of the river.

The population is about 10,000, Malays and Chinese. The chief town, Perlis, is situated about 12 m. up the river. A good deal of tin is worked, and rice and pepper are grown and exported. In the early part of the 19th century Perlis was a district of Kedah, but during a period of disturbance in the latter state it established itself as a separate chiefdom. In 1897 Siam restored the nominal authority of Kedah, but the measure was not productive of good. In 1905 the Siamese government advanced a loan of $200,000 to Perlis, and appointed an English adviser to assist in the general administration. This money was refunded to Siam and the adviser relieved by a British officer when the state became British in July 1909. The condition of the state has improved, but the revenue, $80,000, is not sufficient for the immediate needs of government.

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(W. A. G.)

MALAY STATES (Siamese). The authority of Siam, which at one time covered the whole of the Malay peninsula, now extends southward to an irregular line drawn across the Peninsula at about 6° 30′ N. Between that line and the Isthmus of Kra, usually accepted as the northernmost point of the Malay Peninsula, there lie some 20,000 sq. m. of territory inhabited by a mixed population of Siamese and Malays with here and there a few remnants of the aboriginal inhabitants clinging to the wilder districts, and with a few Chinese settlers engaged in commerce. Formerly this tract was divided into a number of states, each of which was ruled by a chief (Siamese, *Chao Muang*; Malay, *raja*), who held his title from the king of Siam, but, subject to a few restrictions, conducted the affairs of his state in accordance with his own desires; the office of chief, moreover, was hereditary, subject always to the approval of the suzerain. The states formed two groups: a northern, including Langsuan, Chaya, Nakhon Sri Tammarat, Songkla, Renawng, Takoapa, Pang Nga, Tongka and Trang, in which the Siamese element predominated and of which the chiefs were usually Siamese or Chinese; and a southern, including Palean, Satun (Setul), Patani, Raman, Jering, Sai (Teloban), Re Nge (Legeh), Yala (Jalor) and Nong Chik, in which the population was principally Malay and the ruler also Malay. Four other states of the southern group, Kelantan, Trengganu, Kedah and Perlis, of which the population is entirely Malay, passed from Siamese to British protection in 1909.

With the gradual consolidation of the Siamese kingdom all the states of the northern group have been incorporated as ordinary provinces of Siam (*q.v.*), the hereditary *Chao Muang* having died or been pensioned and replaced by officials of the Siamese Civil Service, while the states themselves now constitute provinces of the administrative divisions of Chumpon, Nakhon Sri Tammarat and Puket. The states of the southern group, however, retain their hereditary rulers, each of whom presides over a council and governs with the aid of a Siamese assistant commissioner and with a staff of Siamese district officials, subject to the general control of high commissioners under whom the states are grouped. This southern group, with a total area of about 7000 sq. m. and a population of 375,000, constitutes the Siamese Malay States. A British consul with headquarters at Puket, and a vice-consul who resides at Songkla, watch over the interests of British subjects in the states of the west and east sides of the peninsula respectively. Other foreign powers are unrepresented.

Palean.—This small state on the west coast, bounded N. by the province of Trang, E. by the Songkla division, S. by the state of Setul, and W. by the sea, is about 900 sq. m. in area, and has a population of about 20,000. It is attached for administrative purposes to the province of Trang, and its people are chiefly engaged in the cultivation of pepper, of which about 150 tons are annually exported. A few tin mines are also worked.

Satun (*Setul*).—This small state, bounded N. by Palean, E. by Songkla, S. by Perlis, and W. by the sea, contains about 1000 sq. m. area with a population of about 25,000, Malays, Siamese and a few Chinese. The principal production is pepper, which is exported in junks and in the small Penang steamers which ply on the west coast of the peninsula. In 1897 Setul was placed under the control of Kedah, then a Siamese dependency, but the arrangement was not a success, and in 1907 the Siamese government was forced, owing to prevailing corruption and misrule, to restrict the powers of the chief and, cancelling the authority of Kedah, to place him to some extent under the orders of the high commissioner of Songkla. By the terms of the Anglo-Siamese treaty of 1909 about half of the state of Perlis was added to Satun, an arrangement by which the importance of the latter was considerably increased.

Patani.—The seven Malay states of Nawng Chik, Patani, Jering, Yala (Jalor), Sai (Teloban), Raman and Ra-ngé (Legeh) were constituted from the old state of Patani at the beginning of the 19th century. In 1906 they were reunited to form the Patani administrative division of Siam, but each state retains its Malay ruler, who governs jointly with a Siamese officer under the direction of the Siamese high commissioner, and many of the ancient privileges and customs of Malay government are preserved. The group of states is situated between 5° 34′ and 6° 52′ N. and 100° 54′ and 101° 58′ E. It is bounded N. by the China Sea, E. by the China Sea and Kelantan, S. by Perak, and W. by Kedah. The total area is about 5000 sq. m. The country is mountainous except close to the coast. The principal rivers are the Patani and the Teloban, long, winding and shallow, and navigable for small boats only. The population is about 335,000, of whom the great majority are Malays. Each state has its capital, but Patani (the headquarters of the high commissioner) is the only town of importance. Communications are poor and are chiefly by river, but roads are under construction. Patani and Sai are in telegraphic communication with Bangkok and Singapore, and regular weekly mails are despatched to those places. The area under cultivation is small except round about Patani and in Nawng Chik, where much rice is grown. Tin mining is a growing industry; many Chinese own mines and several European syndicates are at work in Raman, Ra-ngé and Patani, prospecting for, or mining, this metal. Fishing and salt-evaporation occupy a large proportion of the population. The annual export of tin is about 400 tons, and dried fish, salt, cattle and elephants are other exports. Steamers up to 300 tons maintain frequent communication with Bangkok and Singapore, and the Patani roads afford good anchorage at all seasons.

Mahommedan law is followed in the settlement of inherited property disputes and of matrimonial affairs; otherwise the laws of Siam obtain. Efficient law courts have been established in each state, and there is a serviceable force of gendarmerie recruited from amongst Malays and Siamese alike. The revenue amounts to about 600,000 ticals, or £45,000 a year, one-third being payable to the rulers as private income for themselves and their relatives, one-third expended on the administration, and one-third reserved for special purposes, but it is usually found necessary to devote the last-mentioned third to the expenses of administration. Patani has been subject to Siam from the remotest times. It is said that the old state adopted Islamism in the 16th century, the chief, a relative of the kings of Siam, embracing that religion and at the same time revolting to Malacca. It has several times been necessary to send punitive expeditions to recall the state to its allegiance. The present rulers are mostly descended from the ruling families of the neighbouring state of Kelantan, but the chief of Patani itself is a member of the family which ruled there in the days of its greatness. Throughout the 17th century Patani was resorted to by Portuguese, Dutch and English merchants, who had factories ashore and used the place as an emporium for trade with Siam. In 1621 an engagement took place in the Patani roads between three Dutch and two British ships, the latter being taken after the president of the British merchants, John Jourdain, had been killed. In 1899 the border between the state of Perak and Raman was fixed by an agreement between England and Siam, a dispute of old standing being thereby settled, but the question was reopened in the negotiations which preceded the Anglo-Siamese treaty of 1909, when a new border line was fixed between British and Siamese possessions in the Peninsula.

(W. A. G.)

MALCHIN, a town of Germany, in the grand-duchy of Mecklenburg-Schwerin, on the river Peene, between lakes Malchin and Kummerow, 28 m. by rail N.W. of Neu-Brandenburg. Pop. (1900), 7449. It is, alternately with Sternberg, the place of assembly of the Diet of Mecklenburg. Here are the châteaux of Remplin, Basedow and Schlitz; a church dating from the 14th century, and a fine town-hall. The well-wooded and undulating country, environing the shores of Lake Malchin, is known as the "Mecklenburg Switzerland," and is increasing in favour as a summer resort. A canal unites Lake Kummerow with the Peene. The industries of the town include the manufacture of sugar and bricks, and brewing and malting. Malchin became a town in 1236.

MALCOLM, the name of four kings of the Scots, two of whom, Malcolm I., king from 943 to 954, and Malcolm II., king from 1005 to 1034, are shadowy and unimportant personages.

Malcolm III. (d. 1093), called Canmore or the "large-headed," was a son of King Duncan I., and became king after the defeat of the usurper Macbeth in July 1054, being crowned at Scone in April 1057. Having married as his second wife, (St) Margaret (*q.v.*), a sister of Edgar Ætheling, who was a fugitive at his court, he invaded England in 1070 to support the claim of Edgar to the English throne, returning to Scotland with many captives after harrying Northumbria. William the Conqueror answered this attack by marching into Scotland in 1072, whereupon Malcolm made peace with the English king at Abernethy and "was his man." However, in spite of this promise he ravaged the north of England again and again, until in 1091 William Rufus invaded Scotland and received his submission. Then in 1092 a fresh dispute arose between the two kings, and William summoned Malcolm to his court at Gloucester. The

Scot obeyed, and calling at Durham on his southward journey was present at the foundation of Durham Cathedral. When he reached Gloucester Rufus refused to receive him unless he did homage for his kingdom; he declined and returned home in high dudgeon. Almost at once he invaded Northumbria, and was killed at a place afterwards called Malcolm's Cross, near Alnwick, on the 13th of November 1093. Four of Malcolm's sons, Duncan II., Edgar, Alexander I., and David I., became kings of Scotland; and one of his daughters, Matilda, became the wife of Henry I. of England, a marriage which united the Saxon and the Norman royal houses.

MALCOLM IV. (*c.* 1141–1165) was the eldest son of Henry, earl of Huntingdon (d. 1152), son of King David I., and succeeded his grandfather David as king of Scotland in 1153. He is called the "Maiden," and died unmarried on the 9th of December 1165.

See E. A. Freeman, *The Norman Conquest*, vols. iv. and v. (1867–1879), and *The Reign of William Rufus* (1882); W. F. Skene, *Celtic Scotland* (1876–1880); E. W. Robertson, *Scotland under her Early Kings* (1862); and A. Lang, *History of Scotland*, vol. i. (1900).

MALCOLM, SIR JOHN (1769–1833), Anglo-Indian soldier, diplomatist, administrator and author, was born at Burnfoot on the Esk, near Langholm, Dumfriesshire, Scotland, on the 2nd of May 1769. His father was a humble farmer, but three of his sons attained the honour of knighthood. At the age of twelve he received a cadetship in the Indian army, and in April 1783 he landed at Madras, shortly afterwards joining his regiment at Vellore. In 1792, having for some time devoted himself to the study of Persian, he was appointed to the staff of Lord Cornwallis as Persian interpreter, but two years afterwards was compelled by ill health to leave for England. On his return to India in 1796 he became military secretary to Sir Alured Clarke, commander-in-chief at Madras, and afterwards to his successor General Harris; and in 1798 he was appointed by Lord Wellesley assistant to the resident at Hyderabad. In the last-mentioned capacity he highly distinguished himself by the manner in which he gave effect to the difficult measure of disbanding the French corps in the pay of the nizam. In 1799, under the walls of Seringapatam, began his intimacy with Colonel Arthur Wellesley, which in a short time ripened into a life-long friendship. In the course of the same year he acted as first secretary to the commission appointed to settle the Mysore government, and before its close he was appointed by Lord Wellesley to proceed as envoy to the court of Persia for the purpose of counteracting the policy of the French by inducing that country to form a British alliance. Arriving at Teheran in December 1800, he was successful in negotiating favourable treaties, both political and commercial, and returned to Bombay by way of Bagdad in May 1801. He now for some time held the interim post of private secretary to Lord Wellesley, and in 1803 was appointed to the Mysore residency. At the close of the Mahratta War, in 1804, and again in 1805, he negotiated important treaties with Sindhia and Holkar, and in 1806, besides seeing the arrangements arising out of these alliances carried out, he directed the difficult work of reducing the immense body of irregular native troops. In 1808 he was again sent on a mission to Persia, but circumstances prevented him from getting beyond Bushire; on his reappointment in 1810, he was successful indeed in procuring a favourable reception at court, but otherwise his embassy, if the information which he afterwards incorporated in his works on Persia be left out of account, was (through no fault of his) without any substantial result. He sailed for England in 1811, and shortly after his arrival in the following year was knighted. His intervals of leisure he devoted to literary work, and especially to the composition of a *History of Persia*, which was published in two quarto volumes in 1815. On his return to India in 1817 he was appointed by Lord Moira his political agent in the Deccan, with eligibility for military command; as brigadier-general under Sir T. Hislop he took a distinguished part in the victory of Mehidpur (December 21, 1817), as also in the subsequent work of following up the fugitives, determining the conditions of peace and settling the country. In 1821 he returned once more to England, where he remained until 1827, when he was appointed governor of Bombay. His influence in this office was directed to the promotion of various economical reforms and useful administrative measures. Leaving India for the last time in 1830, he shortly after his arrival in England entered parliament as member for Launceston, and was an active opponent of the Reform Bill. He died of paralysis on the 30th of May 1833.

Besides the work mentioned above, Sir John Malcolm published *Sketch of the Political History of India since . . . . 1784* (in 1811 and 1826); *Sketch of the Sikhs* (1812); *Observations on the Disturbances in the Madras Army in 1809* (1812); *Persia, a Poem*, anonymous (1814); *A Memoir of Central India* (2 vols., 1823); and *Sketches of Persia*, anonymous (1827). A posthumous work, *Life of Robert, Lord Clive*, appeared in 1836. See *Life and Correspondence of Sir John Malcolm*, by J. W. Kaye (2 vols., 1856).

MALDA, a district of British India, in the Rajshahi division of Eastern Bengal and Assam. Area, 1899 sq. m.; pop. (1901), 884,030, showing an increase of 8·5 in the decade. The administrative headquarters are at English Bazar (pop. 13,667) near the town of Old Malda. The district is divided into two almost equal parts by the Mahananda river, flowing from north to south. The western tract between the Mahananda and the main stream of the Ganges is an alluvial plain of sandy soil and great fertility. The eastern half is an elevated region broken by the deep valleys of the Tangan and Purnabhaba rivers and their small tributary streams. The soil here is a hard red clay; and the whole is overgrown with thorny tree jungle known as the *kātāl*. Agricultural prosperity centres on the Mahananda, where mango orchards and high raised plots of mulberry land extend continuously along both banks of the river. The Ganges nowhere intersects the district, but skirts it from its north-western corner to the extreme south. The Mahananda flows in a deep well-defined channel through the centre, and joins the Ganges at the southern corner. Its tributaries are the Kalindri on the right, and the Tangan and Purnabhaba on the left bank. The two principal industries are the production of indigo and silk. The first has declined, and so has the second as far as concerns the weaving of piece goods, but the rearing of silkworms and the export of raw silk and silk thread are carried on upon a large scale. No railway touches the district, but the communications by water are good.

Malda supplied two great capitals to the early Mahommedan kings of Bengal; and the sites of Gaur and Pandua exhibit the most interesting remains to be found in the lower valley of the Ganges. (See GAUR.) The connexion of the East India Company with Malda dates from a very early period. As far back as 1676 there was a factory there. In 1770 English Bazar was fixed upon for a commercial residency, the buildings of which at the present day form both the public offices and private residence of the collector.

MALDEN, a city, including several villages, of Middlesex county, Massachusetts, U.S.A., on the Malden river, about 5 m. N. of Boston. Pop. (1890), 23,031, (1900), 33,664, of whom 9513 were foreign-born, 3673 being English Canadians, 870 English, and 617 Swedes; (1910 census) 44,404. Malden had in 1906 a land area of 4·78 sq. m. It is served by the Boston & Maine railroad, and by inter-urban electric railways. Although it is largely a residential suburb of Boston—its post office is a Boston sub-station—it has important manufacturing industries. The most valuable manufactured product is rubber boots and shoes. The capital invested in manufacturing in 1905 was $5,553,432; and the value of the factory product, $11,235,635, was 70.2% greater than the value of the factory product in 1900. Among Malden's institutions are the public library (endowed by Elisha S. Converse), the Malden hospital, the Malden day nursery, a Young Men's Christian Association, and a home for the aged. A fine system of parks is maintained; the best known is possibly Pine Banks. To the north and west is the Middlesex Fells, a state reservation; about 60 acres of this and about 20 acres of the Middlesex Fells Parkway lie within Malden. Malden, when first settled about 1640, was part of Charlestown, and was known for some years as Mystic Side. It was incorporated as a town under the name of "Mauldon" in 1649, and was chartered as a city in 1881. The north part of Malden was set off in 1850 to form Melrose, and the south part in 1870 to form the town of Everett. Malden was the birthplace of Adoniram Judson, the "apostle to Burma." Michael Wigglesworth was pastor here from 1656 until 1705.

See D. P. Corey, *History of Malden* (Malden, 1899); and *Malden, Past and Present* (Malden, 1899).

MALDIVE ISLANDS, an archipelago of coral islets in the Indian Ocean, forming a chain between 7° 6′ N. and 0° 42′ S. It consists of seventeen atolls with an immense number of islands, of which some three hundred are inhabited. In the extreme south are the isolated atolls of Addu and Fua-Mulaku, separated from Suvadiva by the Equatorial Channel, which is itself separated from the main chain of atolls by One-and-a-half-degree Channel.[1] Following the chain northward from this channel we have Haddumati and Kolumadulu, after which the chain becomes double: to the east the chief atolls are Mulaku, Felidu, South Malé, North Malé, Kardiva (where the channel of the same name, 35 m. broad, partly breaks the chain), and Fadiffolu. To the west are South Nilandu, North Nilandu, Ari, South Mahlos, North Mahlos and Miladumadulu. To the north again are Tiladumati and Ihavandifulu. Finally, to the north of Eight-degree Channel is Minikoi, 71 m. from the nearest point of the Maldives, and 110 m. from that of the Laccadives to the north. The main part of the archipelago, north of One-and-a-half-degree Channel, consists of a series of banks either surrounded or studded all over with reefs (see J. S. Gardiner, "Formation of the Maldives," in *Geographical Journ.* xix. 277 seq.). Mr Gardiner regarded these banks as plateaus rising to different elevations beneath the surface of the sea from a main plateau rising steeply from the great depths of the Indian Ocean.

After the Portuguese, from about 1518 onwards, had attempted many times to establish themselves on the islands by force, and after the Maldivians had endured frequent raids by the Mopla pirates of the Malabar coast, they began to send tokens of homage and claims of protection (the first recorded being in 1645) to the rulers of Ceylon, and their association with this island has continued practically ever since. The hereditary sultan of the archipelago is tributary to the British government of Ceylon. The population of the Maldives is estimated at 30,000. All are Mahommedans. By Messrs. Gardiner and Cooper they are classed in four ethnological divisions. (1) Those of the atolls north of the Kardiva Channel. Here the reefs are generally less perfect than elsewhere, seldom forming complete central lagoons, and as they were formerly exposed to the constant attacks of the Mopla pirates from India, the people are hardier and more vigorous than their less warlike southern neighbours. They annually visited the coasts of India or Ceylon, and often married Indian wives, thus acquiring distinct racial characters of an approximately Dravidian type. (2) Those of the central division, comprising the atolls between North Malé and Haddumati, who are under the direct rule of the sultan, and have been more exposed to Arab influences. They formerly traded with Arabia and Malaysia, and many Arabs settled amongst them, so that they betray a strong strain of Semitic blood in their features. (3 and 4) The natives of Suvadiva, Addu, Mulaku and the other southern clusters, who have had little communication with the Central Malé people, and probably preserve more of the primitive type, approximating in appearance to the Sinhalese villagers of Ceylon. They are an intelligent and industrious people, growing their own crops, manufacturing their own cloth and mats, and building their own boats, while many read Arabic more or less fluently, although still believers in magic and witchcraft. The language is a dialect of Sinhalese, but indicating a separation of ancient date and more or less mahommedanized.

The sultan's residence and the capital of the archipelago is the island of Malé. From the earliest notices the production of coir, the collection of cowries, and the weaving of excellent textures on these islands have been noted. The chief exports of the islands besides coir and cowries (a decreasing trade) are coco-nuts, copra, tortoise-shell and dried bonito-fish.

Minikoi atoll, with the numerous wrecks on its reefs, its lighthouse, and its position on the track of all eastward-bound vessels, is a familiar sight to seafarers in these waters. The atoll, which is pear-shaped and disposed in the direction from S.W. to N.E. is 5 m. long, with an extreme breadth of nearly 3 m., with a large but shallow lagoon approached from the north by a passage two fathoms deep. The atoll is growing outwards on every side, and at one place rises 19 ft. above sea-level. The population, which numbers about 3000, is sharply divided into five castes, of which the three highest are pure Maldivians, the lower two the same as in the Laccadives. All are centred in a small village opposite Mou Rambu Point on the west or lagoon side; but most of the men are generally absent, many being employed with the Lascar crews on board the large liners plying in the eastern seas.

In 1899–1900 Messrs. J. Stanley Gardiner and C. Forster Cooper carried out an expedition to the Maldives and Laccadives, for the important results of which see *The Fauna and Geography of the Maldive and Laccadive Archipelagoes*, ed. J. S. Gardiner (Cambridge, 1901–1905), also *Proceedings of the Cambridge Philosophical Society*, vol. xi. pt. 1 (1900), and the *Geographical Journ.*, *loc. cit.*, &c. A French adventurer, François Pyrard de la Val, was wrecked in the Maldives in 1602 and detained there five years; he wrote an interesting account of the archipelago, *Voyage de F. P. de la Val* (Paris, 1679; previous editions 1611, &c.). See also A. Agassiz, "An Expedition to the Maldives" in *Amer. Journ. Science*, vol. xiii. (1902).

MALDON, a market town, municipal borough and port, in the Maldon parliamentary borough of Essex, England, on an acclivity rising from the south side of the Blackwater, 43 m. E.N.E. from London by a branch from Witham of the Great Eastern railway. Pop. (1901), 5565. There are east and west railway stations. The church of All Saints, dating from 1056, but, as it stands, Early English and later, consists of chancel, nave and aisles, with a triangular Early English tower (a unique form) at the west end surmounted by a hexagonal spire. The tower of St Mary's Church shows Norman work with Roman materials. The other public buildings are the grammar school, founded in 1547; the town-hall, formerly D'Arcy's tower, built in the reign of Henry VI.; and the public hall. There are manufactures of crystallized salt, breweries, an oyster fishery and some shipping. On Osea Island, in the Blackwater estuary, there is a farm colony for the unemployed. A mile west of Maldon are remains of Beeleigh Abbey, a Premonstratensian foundation of the 12th century. They consist of the chapter-house and another chamber, and are of fine Early English work. The borough is under a mayor, 4 aldermen and 12 councillors. Area, 3028 acres.

At Maldon (*Maelduna*, *Melduna*, *Mealdon* or *Meaudon*) palaeolithic, neolithic and Roman remains that have been found seem to indicate an early settlement. It is not, however, an important Roman site. An earthwork, of which traces exist, may be Saxon or Danish. The Anglo-Saxon Chronicle relates that Edward the Elder established a "burh" there about 921, and that Ealdorman Brihtnoth was killed there by the Danes in 991. The position of Maldon may have given it some commercial importance, but the fortress is the point emphasized by the Chronicle. Maldon remained a royal town up to the reign of Henry I., and thus is entered as on *terra regis* in Domesday. Henry II. granted the burgesses their first charter, probably in 1155, giving them the land of the borough and suburb with sac and soc and other judicial rights, also freedom from county and forest jurisdiction, danegeld, scutage, tallage and all tolls, by the service of one ship a year for forty days. This charter was confirmed by Edward I. in 1290, by Edward III. in 1344, and by Richard II. in 1378. In 1403 the bishop of London granted further judicial and financial rights, and Henry V. confirmed the charters in 1417, Henry VI. in 1443, and Henry VIII. in 1525. Maldon was incorporated by Philip and Mary in 1554, and received confirmatory charters from Elizabeth in 1563 and 1592, from Charles I. in 1631, Charles II. and James II. In 1768 the incorporation charter was regranted, with modifications in 1810.

MALEBRANCHE, NICOLAS (1638–1715), French philosopher of the Cartesian school, the youngest child of Nicolas

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[1] These and other channels in the locality are named from their position under parallels of latitude.

Malebranche, secretary to Louis XIII., and Catherine de Lauzon, sister of a viceroy of Canada, was born at Paris on the 6th of August 1638. Deformed and constitutionally feeble, he received his elementary education from a tutor, and left home only when sufficiently advanced to enter upon a course of philosophy at the Collège de la Marche, and subsequently to study theology at the Sorbonne. He had resolved to take holy orders, but his studious disposition led him to decline a stall in Notre Dame, and in 1660 he joined the congregation of the Oratory. He was first advised by Père Lecointe to devote himself to ecclesiastical history, and laboriously studied Eusebius, Socrates, Sozomen and Theodoret, but "the facts refused to arrange themselves in his mind, and mutually effaced one another." Richard Simon undertook to teach him Hebrew and Biblical criticism with no better success. At last in 1664 he chanced to read Descartes's *Traité de l' homme* (*de homine*), which moved him so deeply that (it is said) he was repeatedly compelled by palpitations of the heart to lay aside his reading. Malebranche was from that hour consecrated to philosophy, and after ten years' study of the works of Descartes he produced the famous *De la recherche de la vérité*, followed at intervals by other works, both speculative and controversial. Like most of the great metaphysicians of the 17th century, Malebranche interested himself also in questions of mathematics and natural philosophy, and in 1699 was admitted an honorary member of the Academy of Sciences. During his later years his society was much courted, and he received many visits from foreigners of distinction. He died on the 13th of October 1715; his end was said to have been hastened by a metaphysical argument into which he had been drawn in the course of an interview with Bishop Berkeley. For a critical account of Malebranche's place in the history of philosophy, see CARTESIANISM.

WORKS.—*De La recherche de la vérité* (1674; 6th ed., 1712; ed. Bouillier, 1880; Latin trans. by J. Lenfant at Geneva in 1685; English trans. by R. Sault, 1694; and T. Taylor, 1694, 1712); *Conversations chrétiennes* (1677, and frequently; Eng. trans., London, 1695); *Traité de la nature et de la grâce* (1680; Eng. trans., London, 1695); *Méditations chrétiennes et métaphysiques* (1683); *Traité de morale* (1684; separate ed. by H. Joly, 1882; Eng. trans. by Sir J. Shipton, 1699); several polemical works against Arnauld from 1684 to 1688; *Entretiens sur la métaphysique et sur la religion* (1688); *Traité de l'amour de Dieu* (1697); *Entretiens d'un philosophe chrétien et d'un philosophe chinois sur l'existence et la nature de Dieu* (1708); *Réflexions sur la prémotion physique* (1715).

A convenient edition of his works in two volumes, with an introduction, was published by Jules Simon in 1842. A full account by Mrs Norman Smith of his theory of vision, in which he unquestionably anticipated and in some respects surpassed the subsequent work of Berkeley, will be found in the *British Journal of Psychology* (Jan. 1905). For recent criticism see H. Joly, in the series *Les Grands philosophes* (Paris, 1901); L. Ollé-Laprune, *La Philosophie de Malebranche* (1870); M. Novaro, *Die Philosophie des Nicolaus Malebranche* (1893).

MALER KOTLA, a native state of India, within the Punjab. It ranks as one of the Cis-Sutlej states, which came under British influence in 1809. The territory lies south of Ludhiana. Area, 167 sq. m. Pop. (1901), 77,506, showing an increase of 2% in the decade. Estimated gross revenue, £30,100. The military force numbers 280 men; and there is no tribute. The town Maler Kotla is 30 m. S. of Ludhiana; pop. (1901), 21,122. The nawab or chief is of Afghan descent; his family originally came from Kabul, and occupied positions of trust in Sirhind under the Mogul emperors. They gradually became independent as the Mogul Empire sank into decay in the course of the 18th century. In General Lake's campaign against Holkar in 1805 the nawab of Maler Kotla sided with the British. After the subjugation and flight of Holkar, the English government succeeded to the power of the Mahrattas in the districts between the Sutlej and the Jumna; and in 1809 its protection was formally extended to Maler Kotla, as to the other Cis-Sutlej states, against the formidable encroachments of Ranjit Singh. In the campaigns of 1806, 1807 and 1808 Ranjit Singh had made considerable conquests across the Sutlej; in 1808 he marched on Maler Kotla and demanded a ransom of £10,000 from the nawab. This led to the interference of the British, who addressed an ultimatum to Ranjit Singh, declaring the Cis-Sutlej states to be under British protection. Finally the raja of Lahore submitted, and the nawab was reinstated in February 1809. Owing to the mental incapacity of nawab Ibrahim Ali Khan, the state was administered in recent years for some time by the chief of Loharu; but his son, Ahmed Ali Khan, was made regent in February 1905.

See *Maler Kotla State Gazetteer* (Lahore, 1908).

MALESHERBES, CHRÉTIEN GUILLAUME DE LAMOIGNON DE (1721–1794), commonly known as Lamoignon-Malesherbes, French statesman, minister, and afterwards counsel for the defence of Louis XVI., came of a famous legal family. He was born at Paris on the 6th of December 1721, and was educated for the legal profession. The young lawyer soon proved his intellectual capacity, when he was appointed president of the *cour des aides* in the parlement of Paris in 1750 on the promotion of his father, Guillaume de Lamoignon, to be chancellor. One of the chancellor's duties was to control the press, and this duty was entrusted to Malesherbes by his father during his eighteen years of office, and brought him into connexion with the public far more than his judicial functions. To carry it out efficiently he kept in communication with the literary leaders of Paris, and especially with Diderot, and Grimm even goes so far as to say that "without the assistance of Malesherbes the *Encyclopédie* would probably never have been published." In 1771 he was called upon to mix in politics; the parlements of France had been dissolved, and a new method of administering justice devised by Maupeou, which was in itself commendable as tending to the better and quicker administration of justice, but pernicious as exhibiting a tendency to over-centralization, and as abolishing the hereditary "nobility of the robe," which, with all its faults, had from its nature preserved some independence, and been a check on the royal power. Malesherbes presented a strong remonstrance against the new system, and was at once banished to his country seat at St Lucie, to be recalled, however, with the old parlement on the accession of Louis XVI., and to be made minister of the *maison du roi* in 1775. He only held office nine months, during which, however, he directed his attention to the police of the kingdom, which came under his department, and did much to check the odious practice of issuing *lettres de cachet*. The protest of the *cour des aides* in 1775 is one of the most important documents of the old régime in France. It gives a complete survey of the corrupt and inefficient administration, and presented the king with most outspoken criticism. On retiring from the ministry with Turgot in 1776, he betook himself entirely to a happy country and domestic life and travelled through Switzerland, Germany and Holland. An essay on Protestant marriages (1787) did much to procure for them the civil recognition in France. He had always been an enthusiastic botanist; his avenue at St Lucie was world famous; he had written against Buffon on behalf of the botanists whom Buffon had attacked, and had been elected a member of the *Académie des sciences* as far back as 1750. He was now elected a member of the *Académie française*, and everything seemed to promise a quiet and peaceful old age spent in the bosom of his family and occupied with scientific and literary pursuits, when the king in his difficulties wished for the support of his name, and summoned him back to the ministry in 1787. Lamoignon-Malesherbes held office but a short time, but returned to his country life this time with a feeling of insecurity and disquiet, and, as the troubles increased, retired to Switzerland. Nevertheless, in December 1792, in spite of the fair excuse his old age and long retirement would have given him, he voluntarily left his asylum and undertook with Tronchet and Desèze the defence of the king before the Convention, and it was his painful task to break the news of his condemnation to the king. After this effort he returned once more to the country, but in December 1793 he was arrested with his daughter, his son-in-law M. de Rosambô, and his grandchildren, and on the 23rd of April 1794 he was guillotined, after having seen all whom he loved in the world executed before his eyes for their relationship to him. Malesherbes is one of the sweetest characters of the 18th century; though no man of action, hardly a man of the world, by his charity and unfeigned goodness he became one of the most popular men in France, and it was an act of truest self-devotion in him to sacrifice himself for a king who had done little or nothing for him.

There are in print several scientific works of Malesherbes of varying value, of which the most interesting is his *Observations sur Buffon et Daubenton*, written when he was very young, and published with a notice by Abeille in 1798. There exist also his *Mémoire pour Louis XVI.*, his *Mémoire sur la liberté de la presse* (published 1809) and extracts from his remonstrances, published as *Œuvres choisies de Malesherbes* in 1809. For his life should be read the *Notice historique* (3rd ed., 1806) of Dubois, the *Éloge historique* (1805) of Gaillard, and the interesting *Essai sur la vie, les écrits et les opinions de M. de Malesherbes* (in 2 vols., 1818), of F. A. de Boissy d'Anglas. There are also many *éloges* on him in print, of which the best-known is that of M. Dupin, which was delivered at the Academy in 1841, and was reviewed with much light on Malesherbes's control of the press by Sainte-Beuve in the 2nd volume of the *Causeries du lundi.* The protest of the *cour des aides* has been published with translation by G. Robinson in the *Translations and Reprints of the University of Pennsylvania* (1900). For his defence of Louis XVI. see Marquis de Beaucourt, *Captivité et derniers moments de Louis XVI.* (2 vols., 1892, Soc. d'hist. contemp.), and A. Tuetey, *Répertoire général des sources manuscrites de l'hist. de Paris pendant la Rev. fr.*, vol. viii. (1908).

MALET, LUCAS, the pen-name of Mary St Leger Harrison (1852–), English novelist. She was the eldest daughter of Charles Kingsley, and was born at Eversley on the 4th of June 1852. She studied at the Slade school and at University College, London, and married in 1876 William Harrison, rector of Clovelly. After her husband's death in 1897 she eventually settled in London. She had already written several books—*Mrs Lorimer* (1882), *Colonel Enderby's Wife* (1885), *Little Peter* (1887), *A Counsel of Perfection* (1888)—when she published her powerful story, *The Wages of Sin* (1891), which attracted great attention. Her *History of Sir Richard Calmady* (1901) had an even greater success. Her other novels include *The Carissima* (1896), *The Gateless Barrier* (1900), *On the Far Horizon* (1906).

MALHERBE, FRANÇOIS DE (1555–1628), French poet, critic and translator, was born at Caen in 1555. His family was of some position, though it seems not to have been able to establish to the satisfaction of heralds the claims which it made to nobility older than the 16th century. The poet was the eldest son of another François de Malherbe, *conseiller du roi* in the magistracy of Caen. He himself was elaborately educated at Caen, at Paris, at Heidelberg and at Basel. At the age of twenty-one, preferring arms to the gown, he entered the household of Henri d'Angoulême, grand prior of France, the natural son of Henry II. He served this prince as secretary in Provence, and married there in 1581. It seems that he wrote verses at this period, but, to judge from a quotation of Tallemant des Réaux, they must have been very bad ones. His patron died when Malherbe was on a visit in his native province, and for a time he had no particular employment, though by some servile verses he obtained a considerable gift of money from Henry III., whom he afterwards libelled. He lived partly in Provence and partly in Normandy for many years after this event; but very little is known of his life during this period. His *Larmes de Saint Pierre*, imitated from Luigi Tansillo, appeared in 1587.

It was in the year parting the two centuries (1600) that he presented to Marie de' Medici an ode of welcome, the first of his remarkable poems. But four or five years more passed before his fortune, which had hitherto been indifferent, turned. He was presented by his countryman, the Cardinal Du Perron, to Henry IV.; and, though that economical prince did not at first show any great eagerness to entertain the poet, he was at last summoned to court and endowed after one fashion or another. It is said that the pension promised him was not paid till the next reign. His father died in 1606, and he came into his inheritance. From this time forward he lived at court, corresponding affectionately with his wife, but seeing her only twice in some twenty years. His old age was saddened by a great misfortune. His son, Marc Antoine, a young man of promise, fell in a duel in 1626. His father used his utmost influence to have the guilty parties (for more than one were concerned, and there are grounds for thinking that it was not a fair duel) brought to justice. But he died before the suit was decided (it is said in consequence of disease caught at the camp of La Rochelle, whither he had gone to petition the king), in Paris, on the 16th of October, 1628, at the age of seventy-three.

The personal character of Malherbe was far from amiable, but he exercised, or at least indicated the exercise of, a great and enduring effect upon French literature, though by no means a wholly beneficial one. The lines of Boileau beginning *Enfin Malherbe vint* are rendered only partially applicable by the extraordinary ignorance of older French poetry which distinguished that peremptory critic. But the good as well as bad side of Malherbe's theory and practice is excellently described by his contemporary and superior Regnier, who was animated against him, not merely by reason of his own devotion to Ronsard but because of Malherbe's discourtesy towards Regnier's uncle P. Desportes, whom the Norman poet had at first distinctly copied. These are the lines:—

"Cependant leur savoir ne s'étend nullement
Qu'à régratter un mot douteuse au jugement,
Prendre garde qu'un *qui* ne heurte une diphthongue,
Epier si des vers la rime est brève ou longue,
Ou bien si la voyelle à l'autre s'unissant
Ne rend point à l'oreille un vers trop languissant.

. . . .

C'est proser de la rime et rimer de la prose."

This is perfectly true, and from the time of Malherbe dates that great and deplorable falling off of French poetry in its more poetic qualities, which was not made good till 1830. Nevertheless the critical and restraining tendency of Malherbe was not ill in place after the luxuriant importation and innovation of the *Pléiade*; and if he had confined himself to preaching greater technical perfection, and especially greater simplicity and purity in vocabulary and versification, instead of superciliously striking his pen through the great works of his predecessors, he would have deserved wholly well. As it was, his reforms helped to elaborate the kind of verse necessary for the classical tragedy, and that is the most that can be said for him. His own poetical work is scanty in amount, and for the most part frigid and devoid of inspiration. The beautiful *Consolation à Duperier*, in which occurs the famous line—

Et, rose, elle a vécu ce que vivent les roses—

the odes to Marie de' Medici and to Louis XIII., and a few other pieces comprise all that is really worth remembering of him. His prose work is much more abundant, not less remarkable for care as to style and expression, and of greater positive value. It consists of some translations of Livy and Seneca, and of a very large number of interesting and admirably written letters, many of which are addressed to Peiresc, the man of science of whom Gassendi has left a delightful Latin life. It contains also a most curious commentary on Desportes, in which Malherbe's minute and carping style of verbal criticism is displayed on the great scale.

The chief authorities for the biography of Malherbe are the *Vie de Malherbe* by his friend and pupil Racan, and the long *Historiette* which Tallemant des Réaux has devoted to him. The standard edition is the admirable one of Ludovic Lalanne (5 vols., Paris, 1862–1869). Of the poems only, there is an excellent and handsome little issue in the *Nouvelle collection Jannet* (Paris, 1874). Of modern works devoted to him, *La Doctrine de Malherbe*, by G. Brunot (1891), is not only the most important but a work altogether capital in regard to the study of French language and literature. Others are A. Gasté, *La Jeunesse de Malherbe* (1890); V. Bourrienne, *Points obscurs dans la vie normande de Malherbe* (1895); and the duc de Broglie's "Malherbe" in *Les Grands écrivains français.* On his position in French and general critical history, G. Saintsbury's *History of Criticism*, vol. ii., may be consulted. (G. Sa.)

MALIBRAN, MARIE FÉLICITÉ (1808–1836), operatic singer, daughter of Manoel Garcia, was born in Paris on the 24th of March 1808. Her father was then a member of the company of the Théâtre des Italiens, and she accompanied him to Italy and London. She possessed a soprano voice of unusual beauty and phenomenal compass, which was carefully cultivated by her father. She was only seventeen when, in consequence of an indisposition of Madame Pasta, she was suddenly asked to take her place in *The Barber of Seville* at Covent Garden. She was forthwith engaged for the remaining six weeks of the season, and then followed her father to New York, where she appeared in *Othello, The Barber of Seville, Don Juan, Romeo and Juliet, Tancred.* Her gifts as an actress were on a par with her magnificent voice, and her gaiety made her irresistible in light opera, although her great triumphs were obtained chiefly in tragic parts. She married a French banker of New York, named Malibran, who was much older than herself. The marriage was an unhappy one, and Mme Malibran returned alone to Europe in 1828, when she began the series of representations at the Théâtre des Italiens, which excited an enthusiasm in Paris only exceeded by the reception she received in the principal towns of Italy. She was formally divorced from Malibran in 1835, and married the Belgian violinist, Charles de Beriot; but she died of fever on the 23rd of September 1836.

See *Memoirs of Mme Malibran by the comtesse de Merlin and other intimate friends, with a selection from her correspondence* (2 vols., 1840); and M. Teneo, *La Malibran, d'après des documents inédits*, in *Sammelbände der internationalen Musik-Gesellschaft* (Leipzig, 1906).

MALIC ACID (Hydroxyethylene Succinic Acid), $C_4H_6O_5$, an organic acid found abundantly in the juices of many plants, particularly in mountain-ash berries, in unripe apples and in grapes. The acid potassium salt is also found in the leaves and stalks of rhubarb. Since the acid contains an asymmetric carbon atom, it can exist in three forms, a dextro-rotatory, a laevo-rotatory and an inactive form; the acid obtained in the various synthetical processes is the inactive form. It may be prepared by heating racemic acid (see Tartaric Acid) with fuming hydriodic acid; by heating fumaric acid (*q.v.*) with water at 150–200° C.; by the action of nitrous acid on inactive aspartic acid; and by the action of moist silver oxide on monobromsuccinic acid. It forms deliquescent crystals, which are readily soluble in alcohol and melt at 100° C. When heated for some time at 130° C. it yields fumaric acid (*q.v.*), and on rapid heating at 180° C. gives maleic anhydride and fumaric acid. It yields coumarins when warmed with sulphuric acid and phenols (H. v. Pechmann, *Ber.*, 1884, 17, 929, 1649 et seq.). Potassium bichromate oxidizes it to malonic acid; nitric acid oxidizes it to oxalic acid; and hydriodic acid reduces it to succinic acid. The inactive variety may be split into the component active forms by means of its cinchonine salt (G. J. W. Bremer, *Ber.*, 1880, 13, 352).

MALIGNANT (Lat. *malignus*, evil-disposed, from *maligenus*), wicked, of a malicious or wilfully evil disposition. The word was early applied by the Protestants to the Romanists, with an allusion to the "congregation of evil doers" (Vulgate *Ecclesiam malignantium*) of Psalm xxvi. 5. In English history, during the Great Rebellion, the name was given to the Royalists by the Parliamentary party. In the Great Remonstrance of 1641 occur the words "the malignant partie, wherof the Archbishop (Laud) and the earl of Strafford being heads." The name throughout the period had special reference to the religious differences between the parties. In medical science, the term "malignant" is applied to a particularly virulent or dangerous form which a disease may take, or to a tumour or growth of rapid growth, extension to the lymphatic glands, and recurrence after operation.

MALIK IBN ANAS (*c.* 718–795), the founder of the Malikite school of canon law, was born at Medina about A.D. 718: the precise date is not certain. He studied and passed his life there, and came to be regarded as the greatest local authority in theology and law. (For his legal system and its history see Mahommedan Law.) His life was one of extreme honour and dignity, but uneventful, being given to study, lecturing on law and acting as muftī and judge. Only two episodes stand out in his biography. When Mahommed ibn ʿAbdallāh, the ʿAlid, rose in A.D. 762 at Medina against the ʿAbbāsids, Malik gave a *fatwā*, or legal opinion, that the oath of allegiance to the ʿAbbāsids was invalid, as extorted by force. For this independence he was severely scourged by the ʿAbbāsid governor, who, apparently, did not dare to go beyond scourging with a man of his standing with the people. The second episode gave equal proof of independence. In 795 Hārūn al-Rashīd made the pilgrimage, came with two of his sons to Medina, and sat at the feet of Malik as he lectured in the mosque. The story, legendary or historical, adds that Malik had refused to go to the caliph, saying that it was for the student to come to his teacher. Late in life he seems to have turned to asceticism and contemplation. It is said that he retired from all active, public life and even neglected plain, public duties, replying to reproaches, "Not every one can speak in his own excuse" (Ibn Qutaiba, *Maʿārif*, 250). He is also entered among the early ascetic Sūfīs (cf. *Fihrist*, 183). He died in Medina, A.D. 795.

For a description of his principal book, the *Muwaṭṭa'*, see Goldziher's *Muhammedanische Studien*, ii. 213 sqq. He wrote also a Koran commentary, now apparently lost, and a hortatory epistle to Hārūn al-Rashīd. See further, de Slane's trans. of Ibn Khallikān, ii. 545 sqq.; von Kremer, *Culturgeschichte*, i. 477 sqq.; Brockelmann, *Gesch. der arab. Litt.*, i. 175 sqq.; Macdonald, *Muslim Theology, &c.*, 99 sqq. and index; *Fihrist*, 198 seq.; Nawawi, 530 sqq. (D. B. Ma.)

MALINES (Flemish, *Mechelen*, called in the middle ages by the Latin name Mechlinia, whence the spelling Mechlin), an ancient and important city of Belgium, and the seat since 1559 of the only archbishopric in that country. Pop. (1904), 58,101. The name is supposed to be derived from *maris linea*, and to indicate that originally the sea came up to it. It is now situated on the Dyle, and is in the province of Antwerp, lying about half-way between Antwerp and Brussels. The chief importance of Malines is derived from the fact that it is in a sense the religious capital of Belgium—the archbishop being the primate of the Catholic Church in that country. The archbishop's palace is in a picturesque situation, and dates from the creation of the dignity. The principal building in the city is the exceedingly fine cathedral dedicated to St Rombaut. This cathedral was begun in the 12th and finished early in the 14th century, and although modified in the 15th after a fire, it remains one of the most remarkable specimens of Gothic architecture in Europe. The massive tower of over 300 ft., which is described as unfinished because the original intention was to carry it to 500 ft., is its most striking external feature. The people of Malines gained in the old distich—"gaudet Mechlinia stultis"—the reputation of being "fools," because one of the citizens on seeing the moon through the dormer windows of St Rombaut called out that the place was on fire, and his fellow-citizens, following his example, endeavoured to put out the conflagration until they realized the truth. The cathedral contains a fine altar-piece by Van Dyck, and the pulpit is in carved oak of the 17th century. Another old palace is that of Margaret of Austria, regent for Charles V., which has been carefully preserved and is now used as a court of justice. In the church of Notre Dame (16th century) is Rubens' masterpiece "the miraculous draught of fishes," and in that of St John is a fine triptych by the same master. Malines, although no longer famous for its lace, carries on a large trade in linen, needles, furniture and oil, while as a junction for the line from Ghent to Louvain and Liége, as well as for that from Antwerp to Brussels and the south, its station is one of the busiest in Belgium, and this fact has contributed to the general prosperity of the city.

The lordship of Malines was conferred as a separate fief by Pippin the Short on his kinsman Count Adon in 754. In the 9th century Charles the Bald bestowed the fief on the bishop of Liége, and after being shared between Brabant and Flanders it passed into the hands of Philip the Bold, founder of the house of Burgundy, in 1384. During the religious troubles of the 16th century Malines suffered greatly, and in 1572 it was sacked by Alva's troops during three days. In the wars of the 17th and 18th centuries it was besieged many times and captured by the French, Dutch and English on several occasions. The French finally removed the fortifications in 1804, since which year it has been an open town.

MALLANWAN, a town in Hardoi district, the United Provinces, India. Pop. (1901), 11,158. Under native rule the town possessed considerable political importance, and upon the British annexation of Oudh it was selected as the headquarters of the district, but was abandoned in favour of Hardoi after the Mutiny. Saltpetre and brass utensils are manufactured.

MALLARMÉ, FRANÇOIS RENÉ AUGUSTE (1755–1835), French Revolutionist, the son of a lawyer, was born at Nancy on the 25th of February 1755. He was brought up in his father's profession, and was appointed *procureur-syndic* of the district of Pont-à-Mousson. During the Revolution he was elected by the department of Meurthe deputy to the Legislative Assembly and the Convention, where he attached himself to the Mountain and voted for the death of Louis XVI. He was elected president of the Convention on the 30th of May 1793, and by his weakness during the crisis of the following day contributed much to the success of the insurrection against the Girondists. He took an active part in the *levée-en-masse,* and in November 1793 was given the task of establishing the revolutionary government in the departments of Meuse and Moselle, where he gained an unenviable notoriety by ordering the execution of the sentence of death decreed by the revolutionary tribunal on some young girls at Verdun who had offered flowers to the Prussians when they entered the town. After the fall of Robespierre he joined the group of "Thermidorians" and was sent on mission to the south of France, where he closed the Jacobin club at Toulouse and set free a number of imprisoned "suspects." On the 1st of June 1795 he was denounced and arrested, but was soon set at liberty. In 1796 he was appointed by the Directory commissioner for the organization of the departments of Dyle and Mont-Tonnerre. Under the empire he was receiver of the *droits réunis* at Nancy, and lost his money in 1814 in raising a levy of volunteers. Appointed sub-prefect of Avesnes during the Hundred Days, he was imprisoned by the Prussians in revenge for the death of the maidens of Verdun, and lived in exile during the Restoration. He returned to France after the revolution of 1830, and died at Richemont (Seine-Inférieure) on the 25th of July 1835.

MALLARMÉ, STÉPHANE (1842–1898), French poet and theorist, was born at Paris, on the 18th of March 1842. His life was simple and without event. His small income as professor of English in a French college was sufficient for his needs, and, with his wife and daughter, he divided the year between a fourth-floor flat in Paris and a cottage on the banks of the Seine. His Tuesday evening receptions, which did so much to form the thought of the more interesting of the younger French men of letters, were almost as important a part of his career as the few carefully elaborated books which he produced at long intervals. *L'Après-midi d'un faune* (1876) and other fragments of his verse and prose had been known to a few people long before the publication of the *Poésies complètes* of 1887, in a facsimile of his clear and elegant handwriting, and of the *Pages* of 1891 and the *Vers et prose* of 1893. His remarkable translation of poems of Poe appeared in 1888, "The Raven" having been published as early as 1875, with illustrations by Manet. *Divagations,* his own final edition of his prose, was published in 1897, and a more or less complete edition of the *Poésies*, posthumously, in 1899. He died at Valvins, Fontainebleau, on the 9th of September 1898. All his life Mallarmé was in search of a new aesthetics, and his discoveries by the way were often admirable. But he was too critical ever to create freely, and too limited ever to create abundantly. His great achievement remains unfinished, and all that he left towards it is not of equal value. There are a few poems and a few pieces of imaginative prose which have the haunting quality of Gustave Moreau's pictures, with the same jewelled magnificence, mysterious and yet definite. His later work became more and more obscure, as he seemed to himself to have abolished limit after limit which holds back speech from the expression of the absolute. Finally, he abandoned punctuation in verse, and invented a new punctuation, along with a new construction, for prose. Patience in the study of so difficult an author has its reward. No one in our time has vindicated with more pride the self-sufficiency of the artist in his struggle with the material world. To those who knew him only by his writings his conversation was startling in its clearness; it was always, like all his work, at the service of a few dignified and misunderstood ideas.

See also Paul Verlaine, *Les Poètes maudits* (1884); J. Lemaître, *Les Contemporains* (5th series, 1891); Albert Moekel, *Stéphane Mallarmé, un héros* (1899); E. W. Gosse, *French Profiles* (1905) and A. Symons, *The Symbolist Movement in Literature* (1900). A complete bibliography is given in the *Poètes d'aujourd'hui* (1880–1900, 11th ed., 1905) of MM. A. van Bever and P. Léautaud. (A. Sy.)

MALLECO, a province of southern Chile, once a part of the Indian territory of Araucania (*q.v.*), lying between the provinces of Bio-Bio on the N. and E., Cautin on the S. and Arauco on the W. Area, 2973 sq. m. Pop. (1895), 98,032. It belongs to the rainy, forested region of southern Chile, and is thinly populated, a considerable part of its population being Araucanian Indians, who occupy districts in the Andean foothills. Gold placer mining has attracted some attention, but the output is small. The principal industries are cattle and wheat raising and timber-cutting. The capital is Angol (pop., 7056 in 1895; estimated at 7638 in 1902), a small town in the northern part of the province, on the Malleco river, and a station on the Traiguen branch of the state railway. Traiguen (pop., 5732 in 1895; estimated at 7099 in 1902) in the southern part of the province is the second town in importance, and Victoria (pop., 6989 in 1895; estimated at 10,002 in 1902), about 20 m. E. of the last-named town, was for a time the terminal station of the main line of the railway.

MALLEMUCK, from the German rendering of the Dutch *Mallemugge* (which originally meant small flies or midges that madly whirl round a light), a name given by the early Dutch Arctic voyagers to the Fulmar (*q.v.*), of which the English form is nowadays most commonly applied by our sailors to the smaller albatrosses, of about the size of a goose, met with in the Southern Ocean—corrupted into "molly mawk," or "mollymauk." A number of species have been identified. *Diomedea irrorata* of West Peru is sooty-brown with white mottlings and a white head; *D. migripes* of the North Pacific is similar in colour but with white only near the eye and at the base of the tail and bill; *D. immutabilis* of Japan is darker but has a white head. *D. melanophrys* of the southern oceans has been found in summer both in California, in England, and as far north as the Faeroes, According to J. Gould the latter is the commonest species of albatross inhabiting the Southern Ocean, and its gregarious habits and familiar disposition make it well known to every voyager to or from Australia, for it is equally common in the Atlantic as well as the Pacific. The back, wings and tail are of a blackish-grey, but all the rest of the plumage is white, except a dusky superciliary streak, whence its name of black-browed albatross, as also its scientific epithet, are taken. The bill of the adult is of an ochreous-yellow, while that of the young is dark. This species breeds on the Falkland Islands. *D. bulleri* of the New Zealand seas is greyish-brown, with white underparts and rump and ashy head. *Diomedea* (or *Thalassogeron*) *culminata* and *chlororhyncha* of the southern seas, *D.* (or *T.*) *cauta* of Tasmania, *salvini* of New Zealand and *layardi* of the Cape resemble *D. bulleri*, but have a strip of naked skin between the plates of the maxilla towards its base. H. N. Moseley (*Notes of a Naturalist,* 130) describes *D. culminata* as making a cylindrical nest of grass, sedge and clay, with a shallow basin atop and an overhanging rim—the whole being about 14 in. in diameter and 10 in height. The bird lays a single white egg, which is held in a sort of pouch, formed by the skin of the abdomen, while she is incubating. The feet of *D. bulleri* are red, of *D. chlororhyncha* flesh-coloured, of the others yellow. (A. N.)

MALLESON, GEORGE BRUCE (1825–1898), Indian officer and author, was born at Wimbledon, on the 8th of May 1825. Educated at Winchester, he obtained a cadetship in the Bengal infantry in 1842, and served through the second Burmese War. His subsequent appointments were in the civil line, the last being that of guardian to the young maharaja of Mysore. He retired with the rank of colonel in 1877, having been created C.S.I. in 1872. He died at Kensington, on the 1st of March 1898. He was a voluminous writer, his first work to attract attention being the famous “ Red Pamphlet,” published at Calcutta in 1857, when the Mutiny was at its height. He continued, and considerably rewrote the *History of the Indian Mutiny* (6 vols., 1878–1880), which was begun but left unfinished by Sir John Kaye. Among his other books the most valuable are *History of the French in India* (2nd ed., 1893) and *The Decisive Battles of India* (3rd ed., 1888).

MALLET (or MALLOCH), **DAVID** (?1705–1765), Scottish poet and dramatist, the son of a Perthshire farmer, was born in that county, probably in 1705. In 1717 he went to the high school at Edinburgh, and some three years later to the university, where he made the friendship of James Thomson, author of *The Seasons*. As early as 1720 he began to publish short poems in the manner of the period, a number of which appeared during the next few years in collections such as the *Edinburgh Miscellany* and Allan Ramsay's *Tea Table Miscellany*, in which his ballad “ William and Margaret ” was published in 1724. For some years from 1723 he was private tutor to the duke of Montrose's sons, with whom he travelled on the Continent in 1727. His real name was Malloch; but this he changed to Mallet in 1724. In 1735 he took the M.A. degree at Oxford. He had already made the friendship of Pope, whose vanity he flattered in a poem on *Verbal Criticism*, in 1733; and through Pope he became acquainted with Bolingbroke and other Tory politicians, especially those attached to the party of the prince of Wales, who in 1742 appointed Mallet to be his paid secretary. After Pope's death, in 1744, Mallet, at the instigation of Bolingbroke and forgetful of past favours and friendship, vilified the poet's memory, thereby incurring the resentment of Pope's friends. For his services as a party pamphleteer, in which character he published an attack on Admiral Byng, Mallet received from Lord Bute a lucrative sinecure in 1760. He died on the 21st of April 1765. Mallet was a small man, in his younger days something of a dandy and inordinately vain. He was twice married; by his first wife he had a daughter, Dorothy, who married Pietro Paolo Celesia, a Genoese gentleman, and was the author of several poems and plays, notably *Almida*, produced by Garrick at Drury Lane in 1771.

Mallet's own works included several plays, some of which were produced by Garrick, who was Mallet's personal friend. *Eurydice*, a tragedy, with prologue and epilogue by Aaron Hill, was produced at Drury Lane in 1731; *Mustapha*, also a tragedy, had considerable success at the same theatre in 1739; in 1740, in collaboration with Thomson, he produced the masque *Alfred*, of which he published a new version in 1751, after Thomson's death, claiming it to be almost entirely his own work. This masque is notable as containing the well-known patriotic song, “ Rule Britannia,” the authorship of which has been attributed to Mallet, although he allowed it to appear without protest in his lifetime with Thomson's name attached. His other writings include *Poems on Several Occasions* (1743); *Amyntor and Theodora, or the Hermit* (1747); another volume of *Poems* (1762).

In 1759 a collected edition of Mallet's *Works* was published in three volumes; and in 1857 his *Ballads and Songs* were edited by F. Dinsdale with notes, and a biographical memoir of the author.

MALLET, PAUL HENRI (1730–1807), Swiss writer, was born on the 20th of August 1730, in Geneva. After having been educated there, he became tutor in the family of the count of Calenberg in Saxony. In 1752 he was appointed professor of *belles lettres* to the academy at Copenhagen. He was naturally attracted to the study of the ancient literature and history of his adopted country, and in 1755 he published the first fruits of his researches, under the title *Introduction à l'histoire du Danemarck où l'on traite de la religion, des mœurs, des lois, et des usages des anciens Danois*. A second part, more particularly relating to the ancient literature of the country, *Monuments de la mythologie et de la poesie des Celtes, et particulièrement des anciens Scandinaves*, was issued in 1756, and was also translated into Danish. A translation into English, with notes and preface, by Bishop Percy, was issued in 1770 under the title of *Northern Antiquities* (republished with additions in 1847). The book had a wide circulation, and attracted much attention on account of its being the first (though a very defective) translation into French of the *Edda*. The king of Denmark showed his appreciation by choosing Mallet to be preceptor of the crown prince. In 1760 he returned to Geneva, and became professor of history in his native city. While there he was requested by the czarina to undertake the education of the heir-apparent of Russia (afterwards the czar Paul I.), but declined the honour. An invitation more congenial to his tastes led to his accompanying Lord Mountstuart in his travels through Italy and thence to England, where he was presented at court and commissioned to write the history of the house of Brunswick. He had previously received a similar commission from the landgrave of Hesse-Cassel for the preparation of a history of the house of Hesse, and both works were completed in 1785. The quietude of a literary life was rudely broken by the shock of the Revolution, to which he was openly hostile. His leanings to the unpopular side were so obnoxious to his fellow-citizens that he was obliged to quit his native country in 1792, and remained in exile till 1801. He died at Geneva, on the 8th of February 1807.

A memoir of his life and writings, by Sismondi, was published at Geneva in 1807. Besides the *Introduction to the History of Denmark*, his principal works are: *Histoire du Danemarck* (3 vols., Copenhagen, 1758–1777); *Histoire de la maison de Hesse* (4 vols., 1767–1785); *Histoire de la maison de Brunswick* (4 vols., 1767–1785); *Histoire de la maison et des états du Mecklenbourg* (1796); *Histoire des Suisses ou Helvétiens* (4 vols., Geneva, 1803) (mainly an abridgment of J. von Müller's great history); *Histoire de la ligue hanséatique* (1805).

MALLET, ROBERT (1810–1881), Irish engineer, physicist and geologist, was born in Dublin, on the 3rd of June 1810. He was educated at Trinity College in that city, and graduated B.A. in 1830. Trained as an engineer, he was elected M.Inst.C.E. in 1842; he built in 1848–1849 the Fastnet Rock lighthouse, south-west of Cape Clear, and was engaged in other important works. Devoting much attention to pure science, he became especially distinguished for his researches on earthquakes, and from 1852–1858 he was engaged (with his son John William Mallet) in the preparation of his great work, *The Earthquake Catalogue of the British Association* (1858). In 1862 he published two volumes, dealing with the *Great Neapolitan Earthquake of 1857* and *The First Principles of Observational Seismology*. He then brought forward evidence to show that the depth below the earth's surface, whence came the impulse of the Neapolitan earthquake, was about 8 or 9 geographical miles. One of his most important essays was that communicated to the Royal Society (*Phil. Trans.* clxiii. 147; 1874), entitled *Volcanic Energy: an Attempt to develop its True Origin and Cosmical Relations*. He sought to show that volcanic heat may be attributed to the effects of crushing, contortion and other disturbances in the crust of the earth; the disturbances leading to the formation of lines of fracture, more or less vertical, down which water would find its way, and if the temperature generated be sufficient volcanic eruptions of steam or lava would follow. He was elected F.R.S. in 1854, and he was awarded the Wollaston medal by the Geological Society of London in 1877. He died at Clapham, London, on the 5th of November 1881.

MALLET DU PAN, JACQUES (1749–1800), French journalist, of an old Huguenot family, was born near Geneva in 1749, the son of a Protestant minister. He was educated at Geneva, and through the influence of Voltaire obtained a professorship at Cassel. He soon, however, resigned this post, and going to London joined H. S. N. Linguet in the production of his *Annales politiques* (1778–1780). During Linguet's imprisonment in the Bastille Mallet du Pan continued the *Annales* by himself (1781–1783); but Linguet resented this on his release, and Mallet du Pan changed the title of his own publication to *Mémoires historiques* (1783). From 1783 he incoporated this work with the *Mercure de France* in Paris, the political direction of which had been placed in his hands. On the outbreak of the French Revolution he sided with the Royalists, and was sent on a mission (1791–1792) by Louis XVI. to Frankfort to try and secure the sympathy and intervention of the German princes. From Germany he travelled to Switzerland and from Switzerland to Brussels in the Royalist interest. He published a number of anti-revolutionary pamphlets, and a violent attack on Bonaparte and the Directory resulted in his being exiled in 1797 to Berne. In 1798 he came to London, where he founded the *Mercure britannique*. He died at Richmond, Surrey, on the 10th of May 1800, his widow being pensioned by the English government. Mallet du Pan has a place in history as a pioneer of modern political journalism. His son JOHN LEWIS MALLET (1775–1861) spent a useful life in the English civil service, becoming secretary of the Board of Audit; and J. L. Mallet's second son, SIR LOUIS MALLET (1823–1890) also entered the civil service in the Board of Trade and rose to be a distinguished economist and a member of the Council of India.

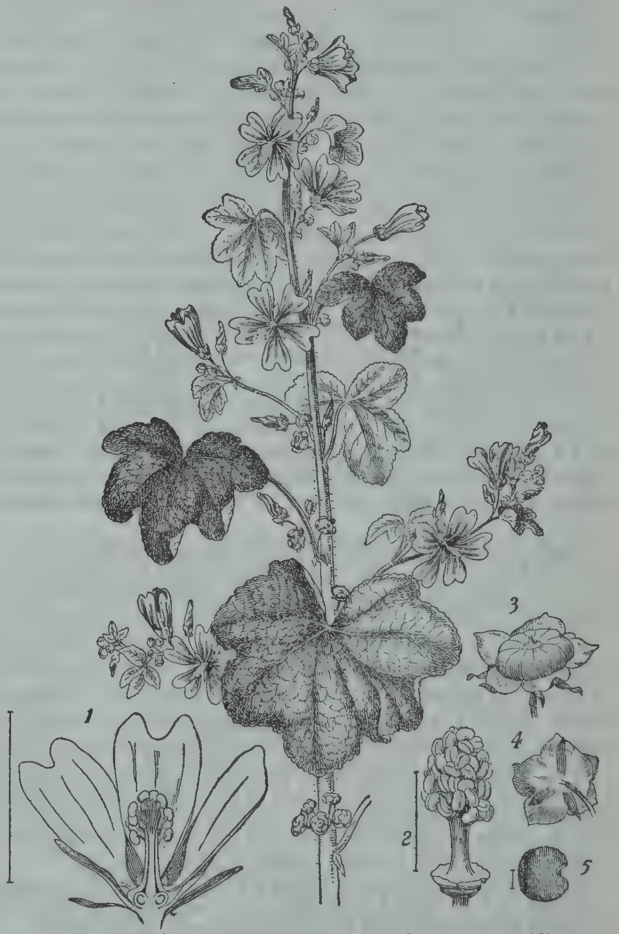
Mallet du Pan's *Mémoires et correspondance* was edited by A. Sayous (Paris, 1851). See *Mallet du Pan and the French Revolution* (1902), by Bernard Mallet, son of Sir Louis Mallet, author also of a biography of his father (1900).

MALLING, EAST and **WEST,** two populous villages in the Medway parliamentary division of Kent, England, respectively 5 and 6 m. W. by N. of Maidstone, with a station on the South-Eastern and Chatham railway. Pop. (1901), East Malling, 2391; West Malling, 2312. They are situated in a rich agricultural district on the western slope of the valley of the Medway, and East Malling has large paper mills. At West Malling are remains of Malling Abbey, a Benedictine nunnery founded in 1090 by Gundulf, bishop of Rochester. The remains, which are partly incorporated in a modern building, include the Norman west front of the church, the Early English cloisters, the chapter-house, gate-house (the chapel of which is restored to use), and other portions. About Addington near West Malling are considerable prehistoric remains, including mounds, single stones, stone circles and pits in the chalk hills; while at Leybourne are the gateway and other fragments of the castle held by the Leybourne family from the 12th to the 14th century.

MALLOCK, WILLIAM HURRELL (1849–), English author, was born at Cockington Court, Devonshire. He was educated privately, and at Balliol College, Oxford. He won the Newdigate prize in 1872, and took a second class in the final classical schools in 1874. He attracted considerable attention by his satirical story *The New Republic* (2 vols., 1877), in which he introduced characters easily recognized as prominent living men, Mark Pattison, Matthew Arnold, W.K. Clifford and others. His keen logic and gift for acute exposition and criticism were displayed in later years both in fiction and in controversial works. In a series of books dealing with religious questions he insisted on dogma as the basis of religion and on the impossibility of founding religion on purely scientific data. In *Is Life Worth Living?* (1879) and *The New Paul and Virginia* (1878) he attacked Positivist theories, and in a volume on the intellectual position of the Church of England, *Doctrine and Doctrinal Disruption* (1900), he advocated the necessity of a strictly defined creed. Later volumes on similar topics were *Religion as a Credible Doctrine* (1903) and *The Reconstruction of Belief* (1905). He published several brilliant works on economics, directed against Radical and Socialist theories: *Social Equality* (1882), *Property and Progress* (1884), *Labour and the Popular Welfare* (1893), *Classes and Masses* (1896) and *Aristocracy and Evolution* (1898); and among his anti-socialist works should be classed his novel, *The Old Order Changes* (1886). His other novels include *A Romance of the Nineteenth Century* (1881), *A Human Document* (1892), *The Heart of Life* (1895) and *The Veil of the Temple* (1904). He published a volume of *Poems* in 1880, and in 1900 *Lucretius on Life and Death* in verse.

MALLOW, a market town and watering place of Co. Cork, Ireland, on the Blackwater, 144½ m. S.W. from Dublin, and 21 N. from Cork by the Great Southern and Western railway. Pop. (1901), 4542. It is a junction for lines westward to Killarney and Co. Kerry, and eastward to Lismore and Co. Waterford. The town owes its prosperity to its beautiful situation in a fine valley surrounded by mountains, and possesses a tepid mineral spring, considered efficacious in cases of general debility and for scorbutic and consumptive complaints. A spa-house with pump-room and baths was erected in 1828. The parish church dates from 1818, but there are remains of an earlier building adjoining it. There are manufactures of mineral water and condensed milk, corn-mills and tanneries. Mallow received a charter of incorporation from James I. Its name was originally Magh Allo, that is, Plain of the Allo (the old name used by Spenser for this part of the river), and the ford was defended by a castle, built by the Desmonds, the ruins of which remain. A bridge connects the town with the suburb of Ballydaheen. Mallow is a centre for the fine salmon fishing on the Blackwater. The climate is very mild. The town was a parliamentary borough till 1885. It is governed by an urban district council.

MALLOW, botanically *Malva*, the typical genus of the natural order Malvaceae, embracing about sixteen species of annual and perennial herbaceous plants, widely distributed throughout the northern hemisphere. The mallows possess the reniform one-celled anthers which specially characterize the *Malvaceae* (*q.v.*). The petals also are united by their base to the tube formed by the coalesced filaments of the stamens. The special characters which separate the genus *Malva* from others most nearly allied to it are the involucre, consisting of a row of three separate bracts attached to the lower part of the true calyx, and the numerous single-seeded carpels disposed in a circle around a central axis, from which they become detached when ripe. The flowers are



Mallow (*Malva sylvestris*).

1. Flower in section.
2. Stamens showing the union of the filaments into a common tube (monadelphous).
3. Fruit with persistent calyx.

1, 2 and 5 enlarged.

4. Same seen from the back showing the 3-leaved epicalyx.
5. Seed.

mostly white or pinkish, never yellow, the leaves radiate-veined, and more or less lobed or cut. Three species are natives of Britain. The musk mallow (*Malva moschata*) is a perennial herb with five-partite, deeply-cut leaves, and large rose-coloured flowers clustered together at the ends of the branched stems, and is found growing along hedges and borders of fields, blossoming in July and August. It owes its name to a slight musky odour diffused by the plant in warm dry weather when it is kept in a confined situation. The round-leaved dwarf mallow (*Malva rotundifolia*) is a creeping perennial, growing in waste sandy places, with roundish serrate leaves and small pinkish-white flowers produced in the axils of the leaves from June to September. It is common throughout Europe and the north of Africa, extending to western and northern Asia. The common mallow (*Malva sylvestris*), the *mauve* of the French, is an erect biennial or perennial plant with long-stalked roundish-angular serrate leaves, and conspicuous axillary reddish-purple flowers, blossoming from May to September. Like most plants of the order it abounds in mucilage, and hence forms a favourite domestic remedy for colds and sore throats. The aniline dye called mauve derives its name from its resemblance to the colour of this plant.

The marsh mallow (*Althaea officinalis*), the *guimauve* of the French, belongs to another genus having an involucre of numerous bracts. It is a native of marshy ground near the sea or in the neighbourhood of saline springs. It is an erect perennial herb, with somewhat woody stems, velvety, ovate, acute, unequally serrate leaves, and delicate pink showy flowers blooming from July to September. The flowers are said to yield a good deal of honey to bees. The marsh mallow is remarkable for containing asparagin, $C_4H_8N_2O_3,H_2O$, which, if the root be long kept in a damp place, disappears, butyric acid being developed. The root also contains about 25 % of starch and the same quantity of mucilage, which differs from that of gum arabic in containing one molecule less of water and in being precipitated by neutral acetate of lead. It is used in *pâte de guimauve* lozenges. *Althaea rosea* is the hollyhock (*q.v.*).

The mallow of Scripture, Job xxx. 4, has been sometimes identified with Jew's mallow (*Corchorus olitorius*), a member of the closely allied order Tiliaceae, but more plausibly (the word מלוח implying a saline plant) with *Atriplex Halimus*, or sea orache. In Syria the *Halimus* was still known by the name *Mallūh* in the time of Ibn Beitar. See Bochart, *Hieroz.* iii. 16.

MALMEDY, a town of Germany, in the Prussian Rhine Province, lying in a wild and deep basin, on the Warche, 20 m. S. of Aix-la-Chapelle by rail via Eupen. It contains two Roman Catholic churches, a modern town-hall and a classical school. Its industries include tanning, dyeing and paper-making. Pop. (1900), 4680. Malmedy was famous for its Benedictine abbey, founded about 675, which was united with that of Stablo, the abbot of the joint house being a prince of the empire. In 1802 the lands of the abbey passed to France, and in 1815 they were divided between Prussia and Netherlands.

See Kellen, *Malmedy und die preussische Wallonie* (Essen, 1897).

MALMESBURY, JAMES HARRIS, 1ST EARL OF (1746–1820), English diplomatist, was born at Salisbury on the 21st of April 1746, being the son of James Harris (*q.v.*), the author of *Hermes*. Educated at Winchester, Oxford and Leiden, young Harris became secretary in 1768 to the British embassy at Madrid, and was left as *chargé d'affaires* at that court on the departure of Sir James Grey until the arrival of George Pitt, afterwards Lord Rivers. This interval gave him his opportunity; he discovered the intention of Spain to attack the Falkland Islands, and was instrumental in thwarting it by putting on a bold countenance. As a reward he was appointed minister *ad interim* at Madrid, and in January 1772 minister plenipotentiary to the court of Prussia. His success was marked, and in 1777 he was transferred to the court of Russia. At St Petersburg he made his reputation, for he managed to get on with Catherine in spite of her predilections for France, and steered adroitly through the accumulated difficulties of the first Armed Neutrality. He was made a knight of the Bath at the end of 1778, but in 1782 he returned home owing to ill-health, and was appointed by his friend Fox to be minister at the Hague, an appointment confirmed after some delay by Pitt (1784). He did very great service in furthering Pitt's policy of maintaining England's influence on the Continent by the arms of her allies, and held the threads of the diplomacy which ended in the king of Prussia's overthrowing the republican party in Holland, which was inclined to France, and re-establishing the prince of Orange. In recognition of his services he was created Baron Malmesbury of Malmesbury (Sept. 1788), and permitted by the king of Prussia to bear the Prussian eagle on his arms, and by the prince of Orange to use his motto "Je maintiendrai." He returned to England, and took an anxious interest in politics, which ended in his seceding from the Whig party with the duke of Portland in 1793; and in that year he was sent by Pitt, but in vain, to try to keep Prussia true to the first coalition against France. In 1794 he was sent to Brunswick to solicit the hand of the unfortunate Princess Caroline for the prince of Wales, to marry her as proxy, and conduct her to her husband in England. In 1796 and 1797 he was at Paris and Lille vainly negotiating with the French Directory. After 1797 he became partially deaf, and quitted diplomacy altogether; but for his long and eminent services he was in 1800 created earl of Malmesbury, and Viscount Fitzharris, of Heron Court in the county of Hants. He now became a sort of political Nestor, consulted on foreign policy by successive foreign ministers, trusted by men of the most different ideas in political crises, and above all the confidant, and for a short time after Pitt's death almost the political director, of Canning. Younger men were also wont to go to him for advice, and Lord Palmerston particularly, who was his ward, was tenderly attached to him, and owed many of his ideas on foreign policy directly to his teaching. His later years were free from politics, and till his death on the 21st of November 1820 he lived very quietly and almost forgotten. As a statesman, Malmesbury had an influence among his contemporaries which is scarcely to be understood from his writings, but which must have owed much to personal charm of manner and persuasiveness of tongue; as a diplomatist, he seems to have deserved his reputation, and shares with Macartney, Auckland and Whitworth the credit of raising diplomacy from a profession in which only great nobles won the prizes to a career opening the path of honour to ability. He was succeeded as 2nd earl by his son James Edward (1778–1841), under-secretary for foreign affairs under Canning; from whom the title passed to James Howard, 3rd earl of Malmesbury (*q.v.*).

Malmesbury did not publish anything himself, except an account of the Dutch revolution, and an edition of his father's works, but his important *Diaries* (1844) and *Letters* (1870) were edited by his grandson.

MALMESBURY, JAMES HOWARD HARRIS, 3RD EARL OF (1807–1889), English statesman, son of the 2nd earl, was born on the 25th of March 1807, and educated at Eton and Oriel College, Oxford. He led a life of travel for several years, making acquaintance with famous people; and in 1841 he had only just been elected to the House of Commons as a Conservative, when his father died and he succeeded to the peerage. His political career, though not one which made any permanent impression on history, attracted a good deal of contemporary attention, partly from his being foreign secretary in 1852 and again in 1858–1859 (he was also lord privy seal in 1866–1868 and in 1874–1876), and partly from his influential position as an active Tory of the old school in the House of Lords at a time when Lord Derby and Mr Disraeli were, in their different ways, moulding the Conservatism of the period. Moreover his long life—he survived till the 17th of May 1889—and the publication of his *Memoirs of an Ex-Minister* in 1884, contributed to the reputation he enjoyed. These *Memoirs*, charmingly written, full of anecdote, and containing much interesting material for the history of the time, remain his chief title to remembrance. Lord Malmesbury also edited his grandfather's *Diaries and Correspondence* (1844), and in 1870 published *The First Lord Malmesbury and His Friends: Letters from 1745 to 1820*. He was succeeded as 4th earl by his nephew, Edward James (1842–1899), whose son, James Edward (b. 1872) became the 5th earl in 1899.

MALMESBURY, a market town and municipal borough in the Chippenham parliamentary division of Wiltshire, England, 94½ m. W. of London by the Great Western railway. Pop. (1901),

2854. It lies on a ridge surrounded on all sides except the north-west by the river Avon and a small tributary. The church of St Mary and St Aldhelm, standing high, is a majestic fragment consisting of the greater part of the nave (with aisles) of a Benedictine abbey church. The ruined skeleton of the great tower arches now terminates the building eastward. The nave is transitional Norman, with a Decorated superstructure including the clerestory. The south porch is one of the finest Norman examples extant, both the outer and the inner doorways (especially the first) exhibiting the typical ornament of the period in remarkable exuberance. With the exception of a crypt, the monastic buildings have disappeared. In the market square stands a fine market cross of the 16th century, borne upon an octagonal battlemented basement. Early English fragments of a hospital of St John of Jerusalem appear in the corporation almshouse. Malmesbury has an agricultural trade, with breweries, tanneries and manufactures of silk and pillow lace. It is governed by a mayor, 4 aldermen and 12 councillors. Area, 178 acres.

Maildulphus, a Scottish or Irish monk, who came into England about 635, built a hermitage near the site of the modern Malmesbury (*Maildulphi-urbs*, *Maldelmesburh*, *Malmesbiri*) and gathered disciples round him, thus forming the nucleus of the later abbey of which Aldhelm his pupil became the first abbot. Æthelstan, who was buried here (though his tomb in the church only dates from the 16th century), rebuilt and endowed the monastery. Round the abbey the town of Malmesbury grew up, and by the time of the Domesday Survey it had become one of the only two Wiltshire boroughs. The first charter, said to be a forgery, purports to have been given by Æthelstan. It granted to the burgesses all privileges and free customs such as they held in the time of Edward the Elder, with many additional exemptions, in return for help rendered against the Danes. The castle built at Malmesbury during the reign of Henry I. gave a further impetus to the growth of the town during the 12th and 13th centuries. It was not incorporated, however, until 1645, when it was made a free borough under the title of "aldermen and burgesses of the borough of Malmesbury, County Wilts." By this charter it was governed until 1885. The borough returned two members to parliament from 1295 to 1832 when the number was reduced to one. Finally in 1885 its representation was merged in that of the county. A grant of a yearly fair on the 31st of March, the feast of St Aldhelm, was obtained from William II., and another for three days from the 25th of July from John. In 1792 fairs were held on the 28th of March, the 28th of April and the 29th of June, but in 1891 they had ceased entirely. John also granted a weekly market on Thursday. In the 16th and 18th centuries it was held on Saturday, and in 1891 on the third Wednesday in each month. In the middle ages Malmesbury possessed a considerable cloth manufacture, and at the Dissolution the abbey was bought by a rich clothier and fitted with looms for weaving. The trade in wool still flourished in 1751.

See *Victoria County History: Wiltshire*; and *Registrum malmesburiense* (1879–1880).

MALMÖ, a seaport of Sweden, chief town of the district (*län*) of Malmöhus, on a small bay of the Sound, 384 m. S.S.W. of Stockholm by rail. Pop. (1800), 38,054; (1900), 60,857. It is connected with Copenhagen, 17¼ m. W. by N., by steam-ferry, the Sound being kept open in winter by an ice-breaker. It is also the first important station in Sweden on the Berlin-Stockholm route, which crosses the sea between Sassnitz in Rügen and Trelleborg, 20 m. S.E. of Malmö. The town, which stands upon a level plain, formerly had strong fortifications, of which only the citadel (Malmöhus) remains; in it the earl of Bothwell was imprisoned by Frederick II. of Denmark for some time after his departure from Scotland in 1567. The town-hall (1546, largely restored in 1864) contains a handsome chamber, the Knutssal, formerly used by the council of the gild of Canute. The hall fronts the central square (*Stortorg*) which is planted with trees and contains a colossal statue of Charles X. by Johan Helenus Börjeson (b. 1835) erected in 1896. The most notable church is that of St. Peter (*Peterkyrka*), dating in part from 1319. Malmö is second to Stockholm as an industrial centre. There are breweries and large works for the manufacture of machinery, among which may be mentioned the Kockum mechanical works, with yards for the construction of vessels of war, and others; of cotton and woollen goods, gloves, chocolate, sweetmeats and tobacco. A large export trade is carried on in butter and other agricultural produce, and matches. Coal is the chief import. The harborage includes an outer harbour of 22 ft. depth, and two inner basins admitting vessels of 21 ft. draught, with dry dock and patent slip. Malmö returns four members to the second chamber of the Riksdag (parliament).

Malmö (Malmhauge, Malmey, Malmöye, Malmoughe), sometimes called *Ancona Scanorum* or *Ellenbogen*, first appears in history about the middle of the 13th century. During the Hanseatic period it was the most important commercial town on the Sound, but in the 16th and 17th centuries greatly lost ground owing to the decay of its herring fisheries and the rise of its rival, Copenhagen. Its modern prosperity is largely due to the enterprise of Frans Snell, one of its merchants in the second half of the 18th century, who first constructed the harbour.

MALMSEY, a strong sweet wine, originally made at Monemvasia (Gr. Μονεμβασία), Napoli di Malvasia, in the Morea, Greece. The name of the place was corrupted in Med. Lat. into *malmasia*, whence the English form of the word. The corruption malvasia gives the O. Fr. *malvesie*, from which comes the alternative English form "malvoisie." The wine is now made not only in Greece but also in Spain, Madeira and the Azores.

MALOCELLO, LANCILOTO ("LANZAROTE, the 'Lancelot Maloisiel' of the French"), leader of the first of modern European oceanic enterprises. This was a Genoese expedition, which about 1270 seems to have sailed into the Alantic, re-discovered the "Fortunate Islands" or Canaries, and made something of a conquest and settlement in one of the most northerly isles of this archipelago, still known (after the Italian captain) as Lanzarote. According to a Spanish authority of about 1345, the anonymous Franciscan's *Conosçimiento de todos los reinos*, "Lancarote" was killed by the Canarian natives; but the castle built by him was standing in 1402–1404, when it was utilized for the storage of grain by the French conquerors under Gadifer de la Salle. To Malocello's enterprise, moreover, it is probable that Petrarch (born 1304) alludes when he tells how, within the memory of his parents, an armed fleet of Genoese penetrated to the "Fortunatae"; this passage some would refer, without sufficient authority, to the expedition of 1291. Malocello's name and nationality are certainly preserved by those early *Portolani* or scientific charts (such as the "Dulcert" of 1339 and the "Laurentian Portolano" of 1351), in which the African islands appear, for the first time in history, in clear and recognizable form. Thus Dulcert reads *Insula de Lanzarotus* and *Marocelus*, the Laurentian map *I. de Lanzarote*, against Lanzarote Island, which is well depicted on both designs, and marked with the cross of Genoa. The *Conosçimiento* (as noticed above) explicitly derives the island-name from the Genoese commander who perished here. Malocello's enterprise not only marks the beginning of the oversea expansion of western Europe in exploration, conquest and colonization (after the age of Scandinavian world-roving had passed); it is also probably not unconnected with the great Genoese venture of 1291 (in search of a waterway to India, which soon follows), with which this attempt at Canarian discovery and dominion has been by some unjustifiably identified.

See the *Conosçimiento*, p. 100, as edited by Marcos Jimenez de la Espada in the *Boletin de la sociedad geográfica de Madrid*, February 1877); *Le Canarien* in P. Margry, *Conquête des . . . Canaries*, p. 177; M. A. P. d'Avezac in vol. vi., part ii., of *L'Univers*, pp. 1–41 (*Îles africaines de l'océan atlantique*); C. R. Beazley, *Dawn of Modern Geography*, iii. 411–413, 449, 451.

MALOLOS, a town and the capital of the province of Bulacán, island of Luzon, Philippine Islands, on a branch of the Pampanga

Grande river. Pop. (1903), after the annexation of Barasoain and Santa Isabel, 27,025. There are thirty-eight villages, or barrios, of which eight had, in 1903, 1000 inhabitants or more. The principal language is Tagalog, but Spanish is spoken to some extent. Malolos is served by the Manila & Dagupan railway, and is a trade centre of considerable importance. The cultivation of rice is an important industry. In 1898–99, during the Filipino revolt, Malolos was the seat of the rebel government, but it was captured and reduced to desolation in March 1899. In 1904 a new municipal school building, a municipal market and a provincial building were erected.

MALONE, EDMOND (1741–1812), Irish Shakespearian scholar and editor, was born in Dublin, on the 4th of October 1741, the son of a barrister and a member of the Irish House of Commons. He was educated at Trinity College, Dublin, and was called to the Irish bar in 1767. The death of his father in 1774 assured him a competency, and he went to London, where he frequented literary and artistic circles. He frequently visited Dr Johnson and was of great assistance to Boswell in revising and proof-reading his *Life*, four of the later editions of which he annotated. He was intimate with Sir Joshua Reynolds, to whom he sat for a portrait now in the National Portrait Gallery. He was one of Reynolds' executors, and published a posthumous collection of his works (1798) with a memoir. Horace Walpole, Burke, Canning, Lord Charlemont, and, at first, George Steevens, were among Malone's friends. Encouraged by the two last he devoted himself to the study of Shakespearian chronology, and the results of his "Attempt to ascertain the Order in which the Plays of Shakespeare were written" (1778) are still largely accepted. This was followed in 1780 by two supplementary volumes to Steevens's version of Dr Johnson's *Shakespeare*, partly consisting of observations on the history of the Elizabethan stage, and of the text of doubtful plays; and this again, in 1783, by an appendix volume. His refusal to alter some of his notes to Isaac Reed's edition of 1785, which disagreed with Steevens's, resulted in a quarrel with the latter. The next seven years were devoted to Malone's own edition of Shakespeare in eleven volumes, of which his essays on the history of the stage, his biography of Shakespeare, and his attack on the genuineness of the three parts of Henry VI., were especially valuable. His editorial work was lauded by Burke, criticized by Walpole and damned by Joseph Ritson. It certainly showed indefatigable research and proper respect for the text of the earlier editions. Malone published a denial of the claim to antiquity of the Rowley poems (see CHATTERTON), and in this (1782) as in his branding (1796) of the Ireland MSS. (see IRELAND, WILLIAM HENRY) as forgeries, he was among the first to guess and state the truth. His elaborate edition of Dryden's works (1800), with a memoir, was another monument to his industry, accuracy and scholarly care. In 1801 the university of Dublin made him an LL.D. At the time of his death, on the 25th of April 1812, Malone was at work on a new octavo edition of Shakespeare, and he left his material to James Boswell the younger; the result was the edition of 1821—generally known as the Third Variorum edition—in twenty-one volumes. Lord Sunderlin (1738–1816), his elder brother and executor, presented the larger part of Malone's splendid collection of books, including dramatic varieties, to the Bodleian Library, which afterwards bought many of his MS. notes and his literary correspondence. The British Museum also owns some of his letters and his annotated copy of Johnson's *Dictionary*.

A memoir of Malone by James Boswell is included in the *Prolegomena* to the edition of 1821. See also Sir J. Prior's *Life of Edmond Malone* (1860).

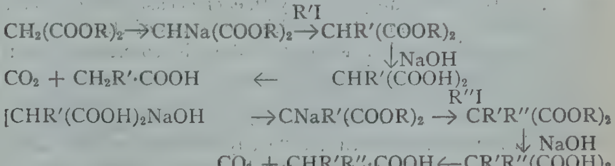
MALONE, a village and the county-seat of Franklin county, in the township of Malone, in the N.E. part of New York, U.S.A., about 60 m. E.N.E. of Ogdensburg. Pop. (1890), 4986; (1900), 5935 (910 foreign-born); (1905, state census), 6478; (1910), 6467. It is served by the New York Central & Hudson River and the Rutland (N.Y. Central Lines) railways. The village has a Memorial Park, Arsenal Green, on the site of an arsenal and parade-ground sold by the state in 1850, a state armoury, the Northern New York Institute for Deaf Mutes, Franklin Academy, St Joseph's Ursuline Academy, and a detention-house for Chinamen entering the state from Canada. From Malone tourists visit the Great North Woods, in the Adirondack foothills, about 15 m. distant. Iron ore and Potsdam sandstone are found near Malone. In the surrounding region hops, potatoes, &c., are grown, and there are dairying and livestock interests. The village is a centre for the collection of hides and pelts. It manufactures woollen goods, paper and pulp, &c., and has foundry and machine shops and car repair shops. Malone, being on the line of communication between lakes Champlain and Ontario, was of strategic importance in the war of 1812, and later was twice the rendezvous of Fenians for attacks on Canada. The township of Malone was settled and erected from Chateaugay in 1805. The village was first known as Harison, was named Ezraville, in honour of Ezra L'Hommedieu in 1808, received its present name in 1812, and was incorporated in 1853.

MALONIC ACID, $C_3H_4O_4$ or $CH_2(COOH)_2$, occurs in the form of its calcium salt in the sugar beet. It was first prepared in 1858 by V. Dessaignes, who obtained it by oxidizing malic acid (*Ann.*, 1858, 107, p. 251). It may also be obtained by oxidizing allylene and propylene with cold potassium permanganate solution, by the hydrolysis of barbituric acid (malonyl urea) with alkalis (A. Baeyer, *Ann.*, 1864, 130, p. 143); by the hydrolysis of cyanacetic acid (H. Kolbe, *Ann.*, 1864, 131, p. 349; H. Muller, *Ann.*, 1864, 131, p. 352), and by the action of silver oxide on β-di-chloracrylic ester at 125° C. (O. Wallach, *Ann.*, 1878, 193, p. 25)

$$CCl_2{:}CH{\cdot}COOC_2H_5 + Ag_2O + H_2O = 2AgCl + HOOC{\cdot}CH_2{\cdot}COOC_2H_5.$$

It crystallizes in monoclinic tables, and is readily soluble in water, alcohol and ether. The acid melts at 132° C., and at a higher temperature it rapidly decomposes into acetic acid and carbon dioxide. When heated with bromine and water to 100° C. it forms tribromacetic acid, some bromoform being produced at the same time. Malonic acid, as well as its esters, is characterized by the large number of condensation products it can form. In the presence of a dehydrating agent (such as acetic anhydride), it combines with aldehydes to form compounds of the type $R\cdot CH{:}\,C(COOH)_2$, or their decomposition products (formed by loss of CO_2) $R\cdot CH:CH\cdot COOH$.

Many salts of the acid are known and, with the exception of those of the alkali metals, they are difficultly soluble in water. Many esters of malonic acid have been prepared, the most important being the *diethyl ester* (*malonic ester*), $CH_2(COOC_2H_5)_2$, which is obtained by dissolving monochloracetic acid in water, neutralizing the solution with potassium carbonate, and then adding potassium cyanide and warming the mixture until the reaction begins. When the reaction has finished, the whole is evaporated and heated to about 130°–140° C. and then allowed to cool. The mass is then covered with two-thirds of its weight of alcohol, and saturated with hydrochloric acid gas. The whole is then poured into ice-cold water, extracted by ether and the ethereal solution distilled (L. Claisen, *Ann.*, 1883, 218, p. 131). It is a colourless liquid boiling at 197°·7–198°·2 C. (W. H. Perkin). It is a most important synthetic reagent; with sodium or sodium ethylate it forms sodio-malonic ester, which reacts readily with alkyl halides, forming alkyl malonic esters, which are again capable of forming sodium derivatives, that by further treatment with alkyl halides yield the di-alkyl malonic esters. These esters are readily hydrolysed and yield the mono- and di-alkyl malonic acids which, on heating, are readily decomposed, with evolution of carbon dioxide and the formation of mono- and di-alkyl acetic acids. The scheme of reactions is shown thus:



$$\begin{tikzcd}
CH_2(COOR)_2 \arrow[r] & CHNa(COOR)_2 \arrow[r, "R'I"] & CHR'(COOR)_2 \arrow[d, "NaOH"] \\
CO_2 + CH_2R'{\cdot}COOH & & CHR'(COOH)_2 \arrow[ll] \\
{[}CHR'(COOH)_2NaOH \arrow[r] & CNaR'(COOR)_2 \arrow[r, "R''I"] & CR'R''(COOR)_2 \arrow[d, "NaOH"] \\
& CO_2 + CHR'R''{\cdot}COOH & CR'R''(COOH)_2 \arrow[l]
\end{tikzcd}$$

When sodio-malonic ester is heated to 145° C., it undergoes condensation, with elimination of alcohol and formation of the benzene derivative, *phloroglucin tricarboxylic ester*. The addition of urea to an alcoholic solution of sodio-malonic ester results in the formation of barbituric acid (A. Michael, *Jour. pr. Chem.*, 1887 [2], 35, p. 456)

The half nitrile of malonic acid is *cyanacetic acid*, $CN\cdot CH_2\, COOH$, which, in the form of its ester, may be obtained by the action of a solution of potassium cyanide on monochloracetic acid. The solution obtained is neutralized, concentrated on the water-bath, acidified by sulphuric acid and extracted with ether. It is then converted into the lead salt, which is decomposed by sulphuretted hydrogen and the solution is carefully concentrated (Th. Meves, *Ann.*, 1867, 143, p. 201). It melts at 70° C. and at higher temperatures decomposes, with evolution of carbon dioxide and formation of aceto-nitrile, $CH_3\cdot CN$. The true nitrile of malonic acid is *methylene cyanide*, $CH_2\,(CN)_2$, which is obtained by distilling a mixture of cyanacetamide and phosphorus pentoxide. It is a crystalline solid, which melts at 29°–30° C. and boils at 218°–219° C., and is readily soluble in alcohol and ether.

MALORY, SIR THOMAS, translator and compiler of the famous English classic, the *Morte d'Arthur.* Previous to the publication of Professor Kittredge's monograph, *Who was Sir Thomas Malory?* the identity of this writer remained an unsolved problem. Mr. Sidney Lee, in the *Dictionary of National Biography*, was compelled to admit that he could find no one of that name fulfilling the necessary conditions. Of direct evidence we have very little; in the concluding passage of the book the author asks the prayers of the reader for "Syr Thomas Maleore knyght," and states that the book was ended "the ix. yere of the reygne of Kyng Edward the fourth." Caxton, in his preface, says that he printed the book "after a copye unto me delivered whyche copye Syr Thomas Malorye dyd take oute of certeyn bookes of frensshe and reduced it in to Englysshe"; in his colophon he repeats this statement, adding that he himself is responsible for the division of the work into books and chapters, and that it was printed in 1485. It will be noted that Caxton does not say that he received the book from Malory, only that he had received a copy made by Malory; from this Professor Kittredge draws the conclusion that the compiler was no longer living. The problem then is to find a Thomas Malory who was (*a*) a knight, (*b*) alive in the ninth year of King Edward IV. (Mar. 4, 1469–Mar. 3, 1470), and (*c*) who was no longer living in July (or June) 1485.

All these conditions Professor Kittredge finds fulfilled in the life of Sir Thomas Malory, knight, of Newbold Revell (or Fenny Newbold), M.P. for Warwickshire in 1445. The date of Sir Thomas's birth is uncertain, but he succeeded his father, Sir John, in 1433 or 1434. Previously to this he had served in France, in the retinue of the earl of Warwick, most probably during the time that that nobleman held the office of captain of Calais. It seems probable that he is also to be identified with a "Thomas Malorie, miles," who in 1468 was, on account of the part played by him in the Wars of the Roses, excluded with several others from the operation of a pardon issued by Edward IV. As, however, on the death of Sir Thomas on the 14th of March 1470, there was no difficulty as to inheritance, his estates passing to his grandson, he must, if this identification be correct, have come under the general amnesty of 1469. It will be seen, therefore, that so far as it is in our power to state the question this Sir Thomas Malory fulfils all the necessary conditions.

It is interesting to note that the career of the earl of Warwick in France was marked by certain picturesque and chivalric features which might well impress the imagination of a young retainer. John Rous, in his *Life of Richard Earl of Warwick*, tells us that at a certain tourney held near Calais at Christmastide, Earl Richard appeared three days running in different armour, overthrowing his adversary on each occasion—an exploit obviously imitated from the chivalric romances of the period.

The work with which Malory's name is connected is an abridged compilation of the great body of Arthurian romance in its latest form. The *Merlin* (Vulgate and Suite), *Tristan*, *Lancelot*, *Queste* and *Mort Artus* are all represented, the only branch omitted is that dealing with the "early history" of the Grail, the *Joseph of Arimathea* and *Grand S. Graal*. Thanks mainly to the labours of Dr Oskar Sommer, we can now assign the majority of the books to their separate sources, although certain stories, such as the adventures of Sir Gareth under the pseudonym of Beaumains, the handling of Sir Urre of Hungary, and the details of the abduction of Guenevere by Meleagaunt, still remain unidentified. But we do not yet know whether Malory himself was responsible for this selection, or whether he found it ready to hand in a MS., the "Frensshe Booke" to which he often refers. To make such a compilation at first hand, considering the extent of the ground covered, would involve an enormous amount of study and selection, and the access to a very large library—conditions which scarcely seem to fit in with the social position and activities of Sir Thomas. On the other hand it is undeniable that the medieval copyists, at the instance of their patrons, did make compilations from the various romances within their reach, such as *e.g.* the enormous codex 112 (*fonds Franç.*) of the Bibliothèque Nationale, which includes large sections of the *Tristan*, the *Lancelot*, and the *Merlin* Suite. Taking into consideration alike what Malory retains and what he omits, it seems most probable that he was in possession, not of complete copies of the romances, but of one or more volumes of compilations from these sources.

From the point of view of matter it must be admitted that the *Morte d' Arthur* does not represent the Arthurian cycle at its best, but rather in the period of its decadence; nor does Malory in any way endeavour to overcome the difficulties caused by the juxtaposition of a number of independent (and often contradictory) versions. This is especially noticeable in his treatment of Gawain; in the section derived from the *Lancelot* and *Mort Artus* he is a good and valiant knight, "a ful noble knyghte as ever was borne," in those derived from the *Tristan* and the *Queste*, he is treacherous, dissolute, and a murderer of good knights.

The great charm of Malory's work lies in his style; stately, earnest and dignified, it has lent to the relations between Lancelot and Guenevere a character of truth and vitality in which the French original is wholly lacking. Malory achieved a remarkable feat—he took the Arthurian story in its worst and weakest form and he imparted to it a moral force and elevation which the cycle, even in its earlier and finer stage, had, save in the unique case of Von Eschenbach's *Parzival*, never possessed. While genuine lovers of the Arthurian cycle must regret that the romances should only be known to the great majority of English readers through the versions of Malory and Tennyson, it is impossible to withhold from the *Morte d' Arthur* the admiration due to an imperishable monument of English language and literature.

See *Who was Sir Thomas Malory?* G. L. Kittredge (*Harvard Studies and Notes*, vol. v., 1896); *Morte d'Arthur*, ed. by Dr Oskar Sommer (an exact reproduction of the original text in 2 vols.) —vol. iii. a study on "*The Sources of Malory.*" The sections on *Lancelot* and *Queste* are unfortunately very inadequate; for these cf. *The Legend of Sir Lancelot*, Grimm Library, vol. xii. (J. L. W.)

MALOT, HECTOR HENRI (1830–1907), French novelist and man of letters, the son of a notary, was born at La Bouille (Seine Inférieure) on the 20th of May 1830. He studied law at Rouen and Paris, but literature early absorbed his attention. He collaborated in the *Biographie générale* of Didot, became literary critic of *L'Opinion Nationale*, and dramatic critic of the *Lloyd français*. He is the author of a long series of popular novels dealing with contemporary life, including: a trilogy of domestic novels entitled *Victimes d'amour* (1859, 1865, 1866); *Un Beau frère* (1869); *Madame Obernin* (1870); *Le Docteur Claude* (1879); *Justice* (1889). *Les Aventures de Romain Kalbris* (1869) and *Sans famille* (1888) are excellent stories for children. A complete edition of Hector Malot's works appeared in 1894–1897. He died at Vincennes in July 1907.

MALOU, JULES ÉDOUARD XAVIER (1810–1886), Belgian statesman, one of the leaders of the clerical party, was born at Ypres on the 19th of October 1810. He was a civil servant in the department of justice when he was elected to the Chamber of Deputies by his native constituency in 1841, and was for some time governor of the province of Antwerp. He was minister of finance in the coalition ministry of J. B. Nothomb in 1844, and formed with B. T. de Theux a Catholic cabinet in 1846, which was overthrown in the Liberal victory of 1847. Malou then became a member of the senate, and his party only regained ascendancy in 1870. The extreme clerical ministry of Baron d'Anethan retired in December 1871 after serious rioting in Brussels, and Malou was the real, though not the nominal, head of the more moderate clerical administrations of de Theux and Aspremont-Lynden (1870–1878). He was wise enough to disavow the noisy sympathy of Belgian Ultramontane politicians with the German victims of the *Kulturkampf*, and, retaining in his own hands the portfolio of finance, he subordinated his clerical policy to a useful administration in commercial matters, including a development of the railway system. It was only after the fall of the ministry in 1878 that he adopted a frankly clerical policy, and when he became chief of a new government in June 1884 he proceeded to undo the educational compromise of his predecessors in the Frère-Orban ministry. His legislation in favour of the Catholic schools caused rioting in Brussels, and in October the king demanded the retirement of MM. Jacobs and Woeste, the members of the cabinet against whom popular indignation was chiefly directed. Malou followed them into retirement, and died at Woluwe Saint Lambert, in Brabant, on the 11th of July 1886. He was a financier of great knowledge and experience, and his works (of which a long list is given in Koninck's *Bibliographie nationale de Belgique*) include three series (1874–1880) of memoirs on financial questions, edited by him for the Chamber of Deputies, besides pamphlets on railroad proposals, mining and other practical questions. His brother Jean Baptiste Malou (1809–1864) was a well-known divine.

MALOUET, PIERRE VICTOR, BARON (1740–1814), French publicist and politician, was born at Riom (Puy-de-Dôme) on the 11th of February 1740, the son of a lawyer. He entered the civil service and was employed successively at the French embassy in Lisbon, in the administrative department of the duc de Broglie's army, as commissary in San Domingo from 1767–1774, and, after his return to France, as commissary-general of the marine. In 1776 he was entrusted to carry out plans of colonization in French Guiana, but was superseded in 1779. On his return to France he was well received at court, and the execution of his plans in Guiana was assured. He became intendant of the port of Toulon, and in 1789 was returned to the states-general, where he soon became well known as a defender of the monarchical principle. He emigrated to England in September, 1792, but shortly afterwards sought in vain permission to return to assist in the defence of Louis XVI. His name was erased from the list of emigrants in 1801 by Napoleon, who restored him to his position in the service and sent him to Antwerp as commissioner-general and maritime prefect to superintend the erection of defence works, and the creation of a fleet. He entered the council of state in 1810, but, having offended the emperor by his plainness of speech, he was disgraced in 1812. At the Restoration, Louis XVIII. made him minister of marine; and he died on the 7th of September 1814.

The most important documents for his domestic and colonial policy are a *Collection de ses opinions à l'Assemblée Nationale* (3 vols., 1791–1792); and *Collection de mémoires et correspondances officielles sur l'administration des colonies et notamment sur la Guiane française et hollandaise* (5 vols. 1802).

MALPIGHI, MARCELLO (1628–1694), Italian physiologist, was born at Crevalcuore near Bologna, on the 10th of March 1628. At the age of seventeen he began the study of philosophy; it appears that he was also in the habit of amusing himself with the microscope. In 1649 he started to study medicine; after four years at Bologna he graduated there as doctor. He at once applied to be admitted to lecture in the university, but it was not till after three years (1656) that his request was granted. A few months later he was appointed to the chair of theoretical medicine at Pisa, where he enjoyed the friendship and countenance of G. A. Borelli. At the end of four years he left Pisa, on the ground of ill-health, and returned to Bologna. A call to be professor primarius at Messina (procured for him through Borelli, who had in the meantime become professor there) induced him to leave Bologna in 1662. His engagement at Messina was for a term of four years, at an annual stipend of 1000 scudi. An attempt was made to retain him at Messina beyond that period, but his services were secured for his native university, and he spent the next twenty-five years there. In 1691, being then in his sixty-fourth year, and in failing health, he removed to Rome to become private physician to Pope Innocent XII., and he died there of apoplexy three years later, on the 30th of November 1694. Shortly before his death, he drew up a long account of his academical and scientific labours, correspondence and controversies, and committed it to the charge of the Royal Society of London, a body with which he had been in intimate relations for more than twenty years. The autobiography, along with some other posthumous writings, was published in London in 1696, at the cost of the Society. The personal details left by Malpighi are few and dry. His narrative is mainly occupied with a summary of his scientific contributions and an account of his relations to contemporary anatomists, and is entirely without graces of style or elements of ordinary human interest.

Malpighi was one of the first to apply the microscope to the study of animal and vegetable structure; and his discoveries were so important that he may be considered to be the founder of microscopic anatomy. It was his practice to open animals alive, and some of his most striking discoveries were made in those circumstances. Although Harvey had correctly inferred the existence of the capillary circulation, he had never seen it; it was reserved for Malpighi in 1661 (four years after Harvey's death) to see for the first time the marvellous spectacle of the blood coursing through a network of small tubes on the surface of the lung and of the distended urinary bladder of the frog. We are enabled to measure the difficulties of microscopic observation at the time by the fact that it took Malpighi four years longer to reach a clear understanding of the corpuscles in the frog's blood, although they are the parts of the blood by which its movement in the capillaries is made visible. His discovery of the capillary circulation was given to the world in the form of two letters *De Pulmonibus*, addressed to Borelli, published at Bologna in 1661 and reprinted at Leiden and other places in the years following; these letters contained also the first account of the vesicular structure of the human lung, and they made a theory of respiration for the first time possible. The achievement that comes next both in importance and in order of time was a demonstration of the plan of structure of secreting glands; against the current opinion (revived by F. Ruysch forty years later) that the glandular structure was essentially that of a closed vascular coil from which the secretion exuded, he maintained that the secretion was formed in terminal acini standing in open communication with the ducts. The name of Malpighi is still associated with his discovery of the soft or mucous character of the lower stratum of the epidermis, of the vascular coils in the cortex of the kidney, and of the follicular bodies in the spleen. He was the first to attempt the finer anatomy of the brain, and his descriptions of the distribution of grey matter and of the fibre-tracts in the cord, with their extensions to the cerebrum and cerebellum, are distinguished by accuracy; but his microscopic study of the grey matter conducted him to the opinion that it was of glandular structure and that it secreted the "vital spirits." At an early period he applied himself to vegetable histology as an introduction to the more difficult study of the animal tissues, and he was acquainted with the spiral vessels of plants in 1662. It was not till 1671 that he wrote his *Anatome plantarum* and sent it to the Royal Society, who published it in the following year. An English work under a similar title (*Anatomy of Vegetables*) had been published in London a few months earlier, by Nehemiah Grew; so that Malpighi's priority as a vegetable histologist is not so incontestable as it is in animal histology. The *Anatome plantarum* contained an appendix, *Observations de ovo incubato*, which gave an account (with good plates) of the development of the chick (especially of the later stages) in many points more complete than that of Harvey, although the observations were needlessly lessened in value by being joined to the metaphysical notion of "praedelineation" in the undeveloped ovum.

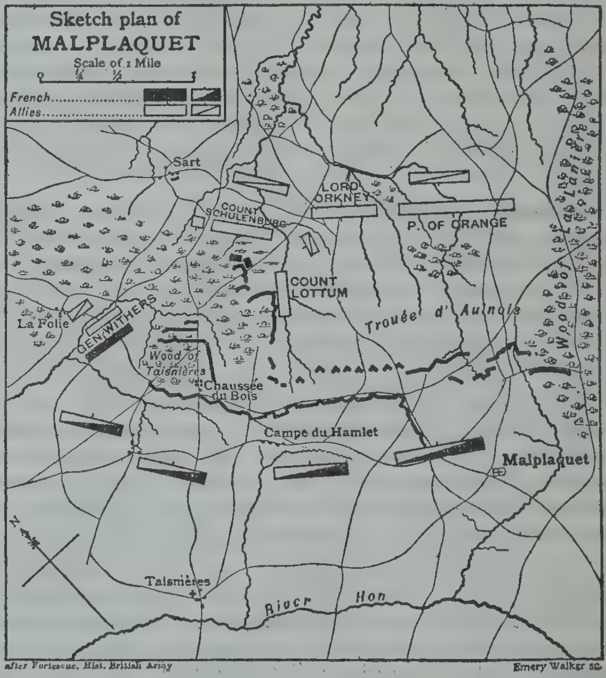
He also wrote *Epistolae anatomicae Marc. Malpighii et Car. Fracassati* (Amsterdam, 1662) (on the tongue, brain, skin, omentum, &c.); *De viscerum structura: exercitatio anatomica* (London, 1669); *De structura glandularum conglobatarum* (London, 1689); *Opera posthuma, et vita a seipso scripta* (London, 1697; another edition, with preface and additions, was published at Amsterdam in 1700.) An edition containing all his works except the last two was published in London in 1687, in 2 vols. folio, with portrait and plates.

MALPLAQUET, a village of France in the department of the Nord, close to the Belgian frontier and about 10 miles S. by E. of Mons, famous as the scene of the battle, September 1709, between the Allies under the duke of Marlborough and Prince

Eugène and the French commanded by Marshal Villars, in which the former were victorious. The country to the west and south of Mons is enclosed by a semicircular wall of woods and broken ground, through which there are only two important gaps—that of Jemappes (famous in 1792) to the west, and that of Aulnois, in which stands the village of Malplaquet, to the south. In the latter gap and the woods on either side Villars took up his position facing north-eastwards, on August 29/September 9. The forces in presence, over 90,000 on each side, were exceptionally large, and the French army in particular represented the spirit of its nation to a degree unusual in the armies of that time. Villars was the best general in the service of Louis XIV. and the veteran Marshal Boufflers, though senior to him, had volunteered to serve as his second in command. Marlborough and Eugène lay with their army between Mons and the French camps, which were almost within cannon shot. Marlborough's own wish was for an immediate battle, but he was opposed by the Dutch deputies at his headquarters, and even by Eugène, so that it was only on August 31/September 11 that the attack actually took place. Villars had made full use of his respite. The French right stood at the fringe of the wood of Lanière, the left was strongly posted in the midst of the wood of Taisnière, and across the two and a half miles of open ground between the woods the position was entrenched with several successive lines of works. The troops were almost equally distributed along the whole line as usual, and the cavalry was massed in rear of the infantry. In the Allied army the mounted troops were also kept back, but for the most part distributed to the various infantry commands.

The intention of Marlborough and Eugène, when on the morning of the battle they examined this formidable position, was to deliver the main attack upon the French left wing, combining the assaults of several columns on its front and flanks. In this quarter the French not only held the interior of the wood but also were thrown forward so as to occupy the edges of its north-eastern salient, and upon the two faces of this salient Count Lottum (1650–1719) with the Prussians, and Count von der Schulenburg (1661–1747) with the Austrian infantry were to deliver a double attack, while farther to the Allied right a column under the English General Withers was detached to make a wide turning movement through the woods. Marlborough took command on the right, Eugène on the left. The centre, which was intended only to observe the enemy until the decision had been forced at the wood of Taisnière, consisted of Lord Orkney's British corps and the prince of Orange's Dutch contingent. These extended across the Trouée d'Aulnois as soon as the combined attack of Lottum and Schulenburg opened. The general advance was covered by a heavy cannonade, and the salient of the Taisnière wood was duly attacked on its two faces by the Prussians and Austrians about 9 a.m. They encountered a sterner resistance than in any of the battles and combats of the past seven campaigns, for on this field the defenders were fighting, not as hitherto for the interests of their king, but to defend their country, and the regiments of Picardie and Champagne which held the salient were the oldest and most famous of the French line. Lottum attacked the works on the eastern edge, again and again without success, until three British battalions had to be sent to reinforce him, and Marlborough placed himself with a corps of cavalry in close support. At last the entrenchments were stormed. Schulenburg, with the Austrians, had by this time fought his way through the woods and undergrowth, and the united force pressed back the French farther and farther into the wood. Still, so stubborn was the defence and so dense the wood that the impetus of the assault died away and the troops on both sides broke up into small disconnected bodies, fighting too fiercely to be amenable to superior control.

But the French were not reinforced from their right wing as Villars expected. The prince of Orange, far from merely observing the hostile right as he had been ordered to do, committed his corps, very early in the battle, to a serious assault upon it, which Boufflers repulsed with enormous loss. The Dutch infantry never recovered from its casualties on this day, and the memory of Malplaquet was strong even at Fontenoy nearly forty years afterwards. Some Hanoverian troops which took part in this futile attack suffered equally heavily. The only advantage to the Allies—an advantage which, as it happened, counted for much—was that Boufflers did not dare to send reinforcements to the hard-pressed left wing. Thanks to this the Austrians and Prussians, with the English detached to their aid, made steady progress in the wood of Taisnière. Villars launched the "Irish brigade" to check the advance of the Allies, and this famous corps charged into the forest. Villars, Eugène and Marlborough personally led their troops in the encounter which followed. Eugène was wounded, but refused to quit the field. Villars was more seriously hurt, and after trying in vain to direct the fighting from a chair was carried insensible from the field. At this crisis General Withers, who commanded the force that had been ordered to turn the French extreme left, and had fought his way through the forest, appeared on the scene. The British 18th regiment (Royal Irish), encountering the French *Royal Irlandais*, put it to the rout, and Villars's counterstroke was at an end. The French maintained themselves on this side only by the aid of troops drawn from the centre and right, and this gave the Allied centre the opportunity which the prince of Orange had so rashly anticipated. The great attack over the open was carried out, in spite of the previous repulse, with the greatest determination. Preceded by forty guns, the corps of the prince of Orange and Lord Orkney swiftly carried the first line of works. The Allied cavalry then pushed out to the front, and horse, foot and artillery were combined in the last advance. Boufflers's cavalry masses, coming into play for the first time, fought hard, and the struggle fluctuated with the arrival of successive reserves on either side, but in the end, shortly before 3 p.m., Boufflers (who had been in command since Villars's fall) decided to retreat. The Allies had no troops left intact for the pursuit, and those engaged had expended their last efforts. Moreover Boufflers, experienced soldier as he was, drew off his men before they had lost their order and discipline.



After Hon. J. W. Fortescue, *History of the British Army*, by permission of Macmillan & Co., Ltd.

Thus this "very murdering battle" as Marlborough called it—the last and greatest pitched battle of the war—was almost barren of results. The Allies lost not less than twenty thousand men, or nearly a quarter of the whole force, the thirty battalions of the Dutch infantry losing half their numbers. On the French side there were some twelve thousand casualties. If further evidence were necessary to prove that the French fought their hardest, it could be found in the fact that whereas in almost every other battle, from 1660 to 1792, there were deserters and prisoners by the thousand, at Malplaquet only 500 of the French fell into the hands of the victors unwounded.

MALSTATT-BURBACH, a town of Germany, in the Prussian Rhine province on the right bank of the Saar (Sarre), which separates it from Saarbrücken. Pop. (1900), 31,195. It lies in the midst of an important coal-mining and industrial district, and is itself little more than a long and narrow row of manufactories and workmen's houses. The largest factories are engaged in the production of iron, steel and cement. There is a large wharf on the river for the export of coal.

Malstatt received municipal rights in 1321. These, however, were afterwards resigned to the newer town of Saarbrücken, and in 1818 Malstatt and Burbach were two small villages with a joint population of only about 800. About the middle of the century the population began to increase rapidly, in consequence of the development of the mining industry of the district and the extension of the railway system, and in 1874 the two villages were united to form a town.

MALT (O. Eng., *mealt*; O. Sax., *malt*; O. Teut., *maltos*; Mod. Ger., *Malz*; Scand., *malt*; probably derived from the Sanskrit *mrdu*, soft, thus having reference to the fact that malt is raw grain rendered soft or tender), the name given to grain in which germination has been caused to proceed to a certain stage and has then been arrested by the removal of water and the application of heat. During this limited germination enzymes are developed (see FERMENTATION), and the constituents of the grain modified so that the finished malt, when ground and submitted to the mashing process (see BREWING), differs from the original raw grain in that the greater portion dissolves. This solubility is, however, a direct one to a slight extent only; it is due for the most part to the action of the malt enzymes, diastase, &c. on the constituents of the grain, the main portion of which are of themselves insoluble. Thus starch, the main constituent of all graminaceous seeds, probably exists in the same condition in raw grain and in malt. When however the malt is mashed, the starch is attacked by the enzyme diastase, and converted by the process of hydrolysis into a mixture of soluble compounds, *e.g.* the crystalline sugar, maltose, and a number of gummy substances known as maltodextrins. But to a certain extent starch and other carbohydrate substances are rendered directly soluble and diffusible during the malting process, some of the products serving the respiratory needs of the growing germ, others being assimilated by the plantlet and reconverted into reserve carbohydrates in the tissues of the germ and rootlets, whilst the remaining portions are retained as such in the finished malt. Similarly certain of the nitrogenous constituents of the grain, the proteïns, are broken down and rendered soluble by proteolytic enzymes, the products being assimilated to a certain extent by the germ and rootlets, by the cells of which they are again built up into complex proteïns, whilst others remain in their simplified form. It is now known that proteolytic enzymes exist in finished malt, and that, when the mashing process is conducted under certain conditions, these are able to degrade and render soluble some of the higher proteïns present in the malt. When germination is allowed to proceed as it does when the grain is planted in the soil, the whole of the contents are rendered soluble by degrees and in turn assimilated by the growing plantlet. By the limited germination which constitutes the malting process, however, the balance of soluble compounds left in the finished malt is from 15 to 25% of the total weight of the corn.

Although other seeds of the natural order Gramineae are occasionally malted, the greater portion of malt is made from the various species of *Hordeum*, known by the name of barley (*q.v.*), bigg, or bere. Indeed ordinary beer derives its characteristic flavour to the greatest extent from barley malt. A small proportion of malted oats or malted wheat is sometimes used in conjunction with barley malt for certain kinds of beer, whilst rye, maize, and even rice are occasionally malted. Barley is, however, the grain best adapted for making malt intended for brewing beer, and accordingly some space will be devoted to a description of those varieties of this grain which are used by the brewer.

Barley belongs to the genus Hordeum, of which there are numerous species and varieties. Linnaeus and the earlier botanists recognized six species of cultivated barleys, but modern botanists usually consider all cultivated barleys as belonging to one species to which the name *H. sativum* has been given. Körnicke regards *H. spontaneum*, a very long thin-grained two-rowed barley (see below) which grows in the East, as being the parent form; but E. S. Beaven inclines to the view that wild species of more than one form were originally used as food and subsequently cultivated. The last-named author has drawn up a scheme of classification for the varieties and races of cultivated barleys.

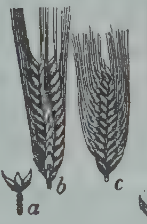


FIG. 1.

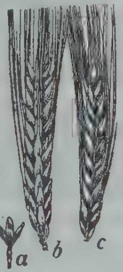


FIG. 2.

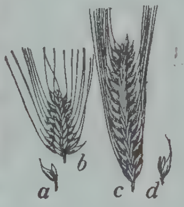


FIG. 3.

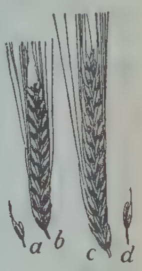


FIG. 4.

Six-rowed barleys.

FIG. 1.—*H. hexastichum.*

a. Three spikelets *in situ* on the rachis, showing short internodes.

b. Spike. Median spikelets uppermost, and with lower awns removed.

c. Spike. Lateral spikelets uppermost, and with lower awns removed.

FIG. 2.—*H. vulgare.*

a. Three spikelets *in situ* on the rachis, showing long internodes.

b. Spike. Median spikelets uppermost.

c. Spike. Lateral spikelets uppermost.

Two-rowed barleys.

FIG. 3.—*H. zeocriton.*

a, d. Spikelets. Rachis edgewise, showing short internodes.

b. Var. *zeocrithum* (fan barley). Spike converging.

c. Var. *erectum* (Goldthorpe). Spike parallel.

FIG. 4.—*H. distichum.*

a, d. Spikelets. Rachis edgewise, showing long internodes.

b. Var. *nutans* (Chevallier).

c. Ouchak barley.

Figures 1–4 redrawn from a paper by E. S. Beaven in *Journ. Fed. Inst. Brewing* (1902), **8**. 542.

In an ear of barley the primary axis or rachis is divided into internodes of which there may be any number up to forty. Each internode bears three single-flowered spikelets arranged alternately on either side of the rachis. In the six-rowed varieties the whole of these spikelets attain maturity, whilst in the two-rowed varieties only one on each side of the rachis, viz. the median, develops. British beer is brewed principally from the malt made from home-grown two-rowed barleys. Of late years, however, it has been found advantageous to employ a proportion of malt made from the thinner and more husky foreign barleys, mostly six-rowed varieties. The corns of two-rowed barleys are as a rule plumper than those of six-rowed barleys.

The most favourite barley for malting purposes grown in the United Kingdom is the narrow-eared two-rowed *H. distichum*, commonly known as Chevallier, from the name of the original cultivator, the Rev. John Chevallier. Of late years the quantity of barley of the so-called Goldthorpe type (*H. zeocriton*), used for malting, has increased. The paleae or outer coverings of the corns of this variety are somewhat "greasy" in appearance, and do not adhere so closely to the corn as in the Chevallier. The corns of Goldthorpe barley possess a small dimple or transverse furrow near the basal end. Further the basal bristle or rachilla (the prolongation of the axis or point from which the corn was originally developed) is invariably covered with long hairs, whilst in the case of Chevallier it has generally very short hairs. In the variety of Chevallier known as Archer, however, the rachilla has somewhat long hairs. Further the corns of Chevallier barley lie nearly vertical, that is almost parallel to the rachis, whereas in Goldthorpe they are spread out at a greater angle, hence the name fan or peacock barley given to that variety commonly known as sprat. It is believed by some brewers that Goldthorpe barleys never yield malt of so high a quality as do Chevallier barleys. On the other hand, when well matured. Goldthorpes work evenly and freely on the malting floors; and from an agricultural point of view they have the advantage of standing up better against unfavourable weather conditions on account of their stouter straws. Numerous fresh varieties of barley are continually being introduced as a result of artificial cross-fertilization, but cross-fertilization rarely if ever occurs naturally.

Hungarian two-rowed barleys are excellent as regards quality, and command a high price. The so-called Californian Chevallier and Chilean Chevallier contain a certain admixture of the six-rowed *H. vulgare*.

Of the imported thin barleys may be mentioned Brewing Californian, Brewing Chilean, Danubian and Smyrna (Yerli), all for the most part six-rowed varieties; also Ouchak, consisting principally of a two-rowed variety. For the manufacture of grain spirit a malt of high diastatic activity is required, and this is largely made from a very thin barley shipped from Odessa.

In the common six-rowed English barley or Scottish bere (*H. vulgare*), the two lateral rows of spikelets springing from one side of the rachis, either partially or entirely intersect and overlap the alternate lateral spikelets which spring from the opposite side of the rachis. This has given rise to the term "four-rowed barley." Figs. 1–4 show some typical barleys in the ear.

The production of new varieties by cross-fertilization has of late years attained a degree of almost mathematical precision by the application of the law of inheritance first discovered by Gregor Mendel in 1865, and brought to light in 1901 independently by de Vries, Correns and Tschermak.

Constitution of Barley.—A grain of barley is shuttle-shaped; the end containing the germ which was originally attached to the rachis is known as the proximal end, whilst the opposite end of the corn is called the distal end. A deep furrow runs down the more convex side, which is accordingly denoted the ventral side, the opposite side being distinguished as the dorsal side. Within the ventral furrow at the proximal end is the rachilla already referred to. The skin or husk of a barleycorn consists of two paleae, one adhering to the dorsal side (the palea inferior) and the other to the ventral side (the palea superior); the former overlaps the edges of the latter. The awn or beard is merely an elongation of the palea inferior. If the two paleae are removed from a barleycorn after soaking it in water, it will be seen that there are other skins completely enveloping the embryo and endosperm. These are the true skins, and are known as the pericarp and the testa respectively. It may here be mentioned that A. J. Brown has shown recently that the embryo and endosperm of a barleycorn are enclosed in a semi-permeable membrane, *i.e.* one which allows the passage of water to the interior of the corn, but not of certain salts and acids. This property appears to be associated with one of the layers of the testa. Next to these skins will be seen the triple layer of thick-walled square-shaped aleurone cells.

The histology of the barleycorn is best studied by the examination of sections under the microscope. The grain consists of two main portions, the embryo or germ, and the endosperm, the storehouse of reserve materials for the growing plant.

The accompanying illustrations show portions of longitudinal sections of a barleycorn magnified to different degrees.

On examining fig. 5, which represents a section of the germ end of a grain of barley cut through the ventral furrow, it will be noticed that the rudimentary leaves, stem and roots are distinguishable. The embryo lies embedded in a mass of cells, the part dividing it from the endosperm being known as the scutellum. Special note should be taken of the elongated cells known as the absorptive epithelial layer, which has certain very important functions to fulfil during the process of germination, notably in feeding the embryo when it begins to develop into a young plant. Next to this, actually between the scutellum and the endosperm, will be seen a layer of empty cells. These at one time in the history and the development of the corn contained starch granules, but this starch was absorbed during its later development by the embryo. It will be observed further that the endosperm is filled with a network of thin-walled cells closely packed with starch granules, and smaller granules of proteïn matter (fig. 6). Nearest the skin will be seen the triple layer of aleurone cells already referred to (fig. 7).

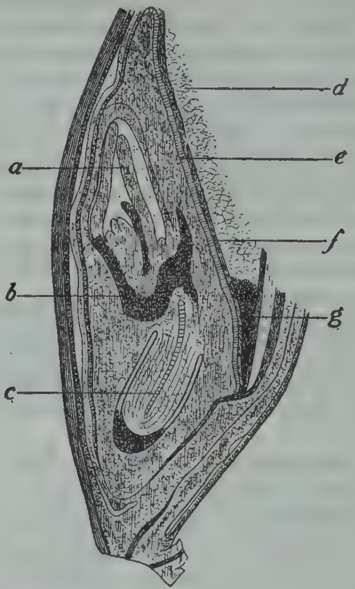


Fig. 5.—Median longitudinal section of a barleycorn showing the germ and its appendages.

a, Rudimentary leaves or plumules;
b, Rudimentary stem;
c, Rudimentary root;
d, Empty starch cells of the endosperm;
e, Absorptive epithelial layer;
f, Compressed layer of empty cells;
g, Starch cells (filled).

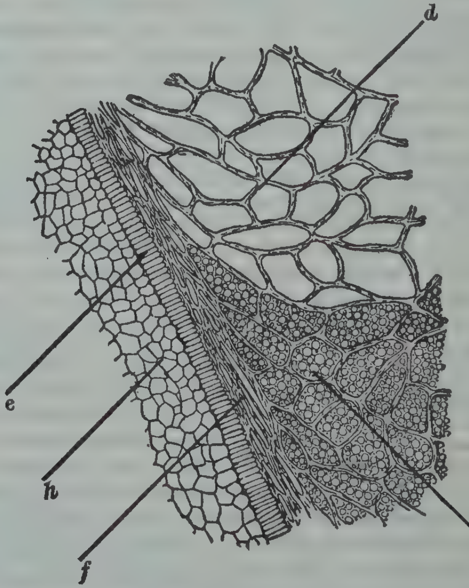


Fig. 6.—Section showing absorptive epithelial layer more highly magnified.

d, Walls of starch cells;
e, Epithelial layer;
f, Compressed layer of empty cells;
g, Cells filled with starch granules;
h, Cells of the scutellum.

Germination.—The barleycorn in its resting stage is in a state which may be described as one of dormant vitality; it respires very slowly and thus loses weight during storage. The best and driest barleys are said to lose 1·3% of their weight in the first year, 0·9% in the second, and 0·5% in the third. The loss is considerably more with coarse and damp samples. When the grain is steeped this dormant vitality gives place to that complicated series of processes comprised under the general term germination. When germination begins, enzymes are secreted, and these act on the reserve materials, starch and proteïns of the endosperm, converting them into simpler compounds, capable of diffusing to various parts of the growing germ. Following this, starch and proteïns are re-formed, the former being deposited in the tissues of the germ and in the cells of the scutellum, which previously were almost free from starch; the proteïn matter deposited in the latter disappears to a considerable extent, and the protoplasmic content of the cells assumes a very granular appearance. The pointed mass of cells constituting the root-sheath is pushed forward by the root which protrudes through the base of the grain. It is at this stage that the barley is said by the maltster to "chit." After the first rootlet has broken through the ends of the sheath, it is followed by others. The cotyledonary sheath begins to elongate on the third or fourth day of germination and ruptures the true covering of the seed; it then grows upwards between this and the husk and forms the acrospire or "spire" of the maltster.

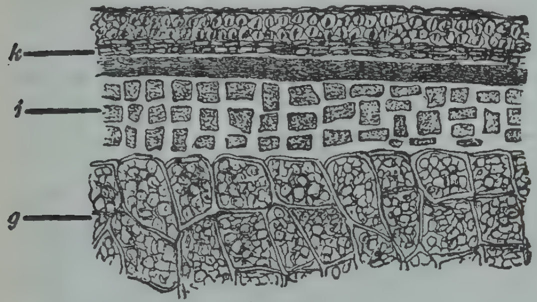


FIG. 7.—Section showing the aleurone layer.

g, Starch cells; k, Layers which collectively constitute the husk.
j, Aleurone layer;

[Figs. 5–7 from Sykes & Ling, *Principles and Practice of Brewing* (1907), Charles Griffin & Co., Ltd.]

According to Brown and Morris, when the first rootlet is breaking through the sheath, starch begins to appear in the tissues of the grain, also in the protoplasm of those cells which are nearest the epithelial layer, and it gradually invades the deeper-seated cells. Further the cellulose walls of the endosperm, situated immediately above the secretory layer, are partially dissolved, the dissolved matter passing into the scutellum, there to be transformed into starch. Brown and Morris state that this process gradually extends to the cellulose walls of the endosperm, and until these are affected there is no evidence of any solvent action on the starch granules themselves. Thus according to these authors the first enzyme to be formed is one which dissolves cell walls, and it was consequently termed by them a "cytohydrolyst." They assert further that the so-called mealy or modified condition, which the maltster desires to bring about to the fullest degree, depends on the extent to which the cell walls have been affected, and they enter into a minute description of the entire disappearance of these during the malting process. On the other hand, J. Grüss has pointed out that the action which takes place on the cell walls of the endosperm during germination does not consist in their complete solution. Schulze has shown that these cell walls consist of two carbohydrates, an araban and a xylan. Grüss states that the araban is completely dissolved, whilst the xylan is more or less unattacked. The cell walls become, however, transparent so that they can only be seen in sections which have been stained; Brown and Morris examined unstained sections. The writer (A. R. Ling) has proved that the cell wall is present in the most friable and well modified finished malt.

Condition.—Barley is bought in the open market solely on the evidence of certain external signs, and judgment can only be acquired by long experience. The corns should be plump, even in size, and the colour should be uniform from end to end. The sample should have a sweet odour, and it should be dry to the touch. The presence of light or weevilled corns may be detected by the fact that they float in water. Careless threshing or dressing is responsible for much damage done to barley. In this way many of the corns may be broken, have the paleae partly stripped off or portions removed along with the awn. All broken and dead corns are prone to become mouldy on the malting floors, the contagion thus presented becoming general. E. R. Moritz drew attention in 1895 to the ill effects of close dressing, and more recently (1905) the matter has been brought before the Highland and Agricultural Society, chiefly through Montagu Baird, who with C. H. Babington was instrumental in inducing the Board of Agriculture to publish a leaflet recommending more careful methods of threshing barley. Close dressing was at one time practised as a means of raising the bushel weight, and thus giving a fictitious value to the barley. Immature barley feels cold to the hand, has a greenish-yellow colour, and, when dry, a starved wrinkled appearance. Over-ripeness in barley is distinguished by a white dead appearance of the corn. Mature or dry grains slip through the fingers more readily than unripe or damp ones. The contents of the endosperm should present a white friable or mealy appearance when the corns are bitten or cut in two with a penknife. The condition of the grain may be determined by means of a mechanical cutter, which cuts a certain number of corns (fifty or more) at one time. Some cutters are constructed to cut the corns transversely, others to cut them longitudinally. The so-called transparency test may be used for the same purpose. It is carried out in an apparatus known as the diaphanoscope, which consists of a box fitted with a sliding tray, furnished with a certain number of shuttle-shaped holes (usually 500), each of such a size as just to hold a barleycorn longitudinally. Into the portion of the box below this tray an electric lamp is placed, and the corns are looked at from above. Thoroughly mealy corns are opaque, whilst steely corns are transparent. When certain portions of a corn are steely, these present the appearance of lakes. By this means the percentage of mealy, steely, or half steely corns in a sample may readily be estimated.

E. Prior points out that steeliness of barley is of two kinds, one of which disappears after the grain has been steeped and dried, and therefore does not necessarily influence the malting value of the sample, and the other which is permanent, and therefore retards the modification of the corn. He proposed to determine what he called the coefficient of mellowness of a sample of barley by means of the formula:—

$$A = \frac{(M_1 - M)\,100}{100 - M} + M,$$

in which A is the degree of mellowness, M is the percentage of mealy corns in the original barley, and M_1 is the percentage of mealy corns after steeping and drying the barley. Prior points out that, generally speaking, the degree of mellowness varies inversely as the proteïn content.

The physical differences between steely and mealy grains were first investigated by Johansen, who arrived at the conclusion that mealiness is always accompanied by the presence of air spaces in the endosperm. Munro and Beaven confirmed and extended this. Their conclusions are as follow: "Mealy grains have a lower specific gravity than steely grains, and contain a larger amount of interstitial air. The total nitrogen content of mealy grains is less than that of steely grains. Steely grains contain a relatively high proportion of nitrogenous substances soluble (*a*) in 5% salt solution, and (*b*) in alcohol of specific gravity 0·9. Mealy barley modifies better than steely during germination. The process of drying damp and under-matured barley intact at 100° F. produced an apparent mellowing or maturation. Other things being equal, maturation, which is physiologically a post-ripening process, is correlated with the mealy appearance of the endosperm." H. T. Brown and his collaborators point out that thin sections of steely corns when examined under the microscope no longer exhibit a translucent appearance, but show the mealy properties as completely as if they had been cut from a mealy grain, and they suggest that in a steely corn the whole of the endosperm is under a state of tensile stress which cannot be maintained in the thin sections. If, however, a thin section of a steely barley be cemented to a slide with Canada balsam and then pared away with a razor, steeliness and translucency may be preserved even in the thinnest sections. The mealy appearance in the endosperm of barley is assumed to be a direct consequence of the formation of interspaces around the cell-contents and within the cell walls. Under ordinary conditions it is conjectured that these interspaces are filled with air, but it is pointed out that they can also be produced under circumstances which suggest that they are at times vacuous or partly so. According to the last-mentioned authors they appear to originate from a system of stresses and strains induced within the endosperm by its gradual loss of water, a break of continuity taking place which gives rise to these interspaces when the cohesive power of the heterogeneous cell-contents falls below a certain point. It is further suggested by them that the most important factor in producing the stresses and strains is probably the shrinkage of the starch granules as their water content is reduced from, say, 40 to about 15%. It is pointed out, however, that actual discontinuity in the cell-contents can only take place when the tensile strength of the protoplasmic matrix in which the starch granules are embedded has been surpassed, and this being so it might be anticipated that those cells which contain the larger amount of proteïn material would probably best resist the internal stresses and strains, a deduction in close agreement with observed facts, steely grains being as a rule richer in proteïn than mealy grains. Brown and his co-workers determine the coefficient of mealiness of a barley as follows: Five hundred corns are cut transversely in a corn cutter and the percentage of mealy, half mealy and steely corns is noted. The number 100 is taken to represent complete mealiness, 1 complete steeliness, and 50 the intermediate class. If the percentage of each class be multiplied by its special value, and the sum of the products divided by 100, the result is the coefficient of mealiness. By steeping and drying a very steely Scottish barley, the coefficient of mealiness was raised from 29·7 to 87·1, whilst concurrently the specific gravity fell from 1·417 to 1·289.

Barley even of the same kind varies widely in its chemical composition, but on an average the proximate constituents of British malting barleys lie within the following limits:—

Moisture	18 —12	per cent.
Nitrogenous matters expressed as proteïns	8 —15	"
Fat	2 — 2·5	"
Starch	60 —65	"
Sugars	1·5— 2·0	"
Gums	1·7— 2·0	"
Fibre (cellulose)	5 — 7	"
Ash	2 — 2·5	"

Any sample of barley which contains more than 20% of moisture would be considered damp. The late Professor Lintner expressed the view several years ago that a good malting barley should not contain more than 10% of proteïn, but R. Wahl asserts that in America six-rowed barleys containing a far higher percentage of proteïn are used successfully, indeed preferably, for malting purposes. The only precise knowledge we possess of the proteïn compounds of barley is due to the researches of T. B. Osborne. According to this observer, barley contains the under-mentioned compounds of this class in the following proportions:—

Soluble in water	Leucosin (albumin) Proteose	0·30	per cent.
Soluble in salt solution:	Edestin (globulin)	1·95	"
Soluble in 75% alcohol	Hordeïn	4·00	"
	Insoluble proteïn	4·50	"
Total		10·75	"

It should be pointed out here that the above are only average values for the particular samples of barley investigated. Undoubtedly the nitrogenous constituents of different barleys vary widely in nature as well as in amount.

Raw barley contains enzymes, thus diastase of translocation, so called by Horace T. Brown and G. H. Morris, and catalase (H. van Laer). Proteolytic enzymes appear only to arise with the beginning of germination; but it has been asserted that raw barley contains proenzymes (zymogens), which can be rendered active by treatment with dilute lactic acid at an appropriate temperature. The action of the diastase of raw barley on starch has been studied by Julian L. Baker.

Barley should not be cut until it is properly ripe, but over-ripeness is much more to be guarded against by the maltster than premature cutting, as it is accompanied by a loss in germinative power. Moreover, unripe corn may to a certain extent be matured in stack, whilst a great improvement in germinative capacity is frequently produced by sweating. Very wet seasons are prejudicial to the ripening of the grain, and when the latter is stacked in too moist a condition it is apt to become what is known as mow burnt. Especially is this the case with barleys containing large percentages of nitrogen and of high enzymatic activities. Such barleys are denoted "warm" by M. Delbrück from their tendency to heat when stored in a moist condition. The effect of this heating is exhibited in the corns becoming black and discoloured at the tips; they are then said to be magpied. Even in an otherwise dry season a large amount of rain during harvest causes the corns to become "weathered," whilst some of them begin germinating and rot. At the same time heavy dews at night whilst the barley lies cut in the field, or even a sprinkling of rain, assists in mellowing the grain, which often in consequence works the more freely on the malting floors. Properly harvested barley is all the better for remaining in stack for two or three months, as was the practice in former years; if, however, it has been stacked too wet the sooner it is broken down the better.

It is difficult to give any specific test for ripeness, but a series of observations has been made by H. T. Brown and F. Escombe. Samples of barley were taken from the field on the 20th, 24th and 29th of July, and on the 2nd, 6th and 10th of August, and preserved in spirit so that they remained in the same state as when they were gathered. Sections were then cut of these corns, when it was found that the progress of maturation is attended by deformation and ultimate disintegration of the cell nuclei. The change which is denoted by the term nuclear senescence is said to begin in the starch-containing cells, near the periphery of the corn, immediately underlying the layer next to the aleurone layer. This deformation is followed by complete disintegration of the nucleus, and at the end of seven or eight days nearly the whole of the endosperm has been involved. Brown and Escombe state that when this nuclear test is properly applied it stamps as immature those corns in a sample which are manifestly unripe owing to premature desiccation as well as those in which the ratio of nitrogen to carbohydrate is unduly high, owing to an excess of nitrogenous manure in the soil, or to sparser sowing with its consequent reduction of root competition. This method, interesting though it be, is not fitted for practical use, and the agriculturist must rely as heretofore upon empirical methods for deciding whether or not the grain has attained ripeness or maturity.

The bushel weight is a useful criterion in arriving at an opinion regarding the value of a sample of barley; but in basing judgment upon this factor regard must be paid to the fact already mentioned that if the grains be dressed closely the bushel weight is increased. The reason of this is that with the removal of the awns the corns pack more closely together. The best British malting barleys should weigh 52–56 ℔ per bushel, the standard weight for malting barleys being 56 ℔.

During the storage of barley access of air is necessary, otherwise the grain dies from asphyxiation. Sound barley after being kiln-dried retains its vitality for a number of years; but the statement that the corns found in the Egyptian mummy cases, in which they had remained for several thousands of years, were still capable of germination, is contrary to modern experience. Moisture must also be carefully excluded, as it initiates germination in a few cells only of the endosperm and causes heating. A constant repetition of wetting such as may take place on account of alterations of the atmospheric temperature, which causes moisture to be deposited, in the form of dew, may ultimately destroy the vitality and foster the growth and development of mould fungi which usually grow on broken and damaged corns. In this connexion the advantage of screening and sweating of barley before storing it will be apparent (see below).

An immense amount of damage is caused to the grain, during storage, by various insects, one of the most destructive of these being the common weevil (*Calandra granaria*). When fully developed this insect measures $\frac{1}{6}$th to $\frac{1}{8}$th of an inch in length, and is of a bright chestnut colour. The larvae are fleshy legless grubs, shorter than the perfect insect, with a series of tubercles along each side of the body; the head is round with strong jaws. The pupa is white, clear and transparent, showing the form of the future weevil. The female bores a hole in the grain with her snout and deposits an egg. The larva when hatched lives on the contents of the grain and undergoes its changes therein. Windisch asserts that only barley which has ripened in the granary is attacked by weevil. Grain which is only slightly attacked should be kilned at a temperature of 122° F., which destroys the weevil in all stages of development. To detect weevil in a sample of barley, the grain should be spread out on a sheet of white paper in bright sunlight. If weevils are present they soon appear, and betake themselves to a position outside the sunlight, to which they are averse. Treatment of the grain with carbon bisulphide has been suggested as a means of destroying weevil; even if efficacious, however, such a process could not be recommended on account of its danger, carbon bisulphide being highly inflammable. The only practical means of ridding a granary or shop of weevil is to clear out all the grain and leave it empty for a year or more.

The vitality of barley may be determined by causing a sample to germinate in any of the well-known forms of apparatus devised for that purpose, and counting the percentage of germinating and idle corns. The germinative capacity of a sample of barley may frequently be raised by sweating (see below), which, as already mentioned, brings about a kind of artificial maturation.

Malting.—There are two systems of malting used in England: floor malting and pneumatic or drum malting. These systems will be described separately.

A floor malting consists of a rectangular building of several storeys, having the cisterns at one end and the kilns at the other. The uppermost floor is devoted to barley.

The capacity of a malting is described by the number of quarters which are put through it every four days. A fifty quarter malting does not merely mean that the cisterns have a capacity of fifty quarters, but that this quantity of barley goes through the house every four days. The average time the germinating barley is on the floors is twelve days, and, as a rule, kilning occupies four days. If, as sometimes happens, the malt has to be kept on the floors thirteen, fourteen, fifteen days, or even longer, the malting is not being worked at the capacity under which it is described, and the kilns may remain unused for a day or more. Conversely, when the malt is loaded at less than twelve days, a day or two has to be missed in steeping. In the former case when the kilns are not being used for drying and curing malt, advantage may be taken to utilize them for sweating barley.

Steeping cisterns were formerly rectangular vessels, of slate, brick or cement, from which the barley had to be discharged by shovelling it out. The forms approved most at the present day are conical and constructed of iron; they have arrangements at the apex of the cone, the lower portion, for discharging the grain by gravitation. The steeping period ranges from 48 to 70 hours; it varies according to the kind of barley, and the time of the year. In some of the older maltings there are no arrangements for heating the steep water, and in the winter steeping has occasionally to be performed with water at a temperature near its freezing-point. Steeping should be carried out at a temperature as near as possible to 55° and not higher than 60° F. The usual practice is to fill the cistern up to a certain height with water and throw the barley into it, stirring it until it is about level; the heavy corns will then sink directly to the bottom, whilst the light corns and refuse float on the surface and may be skimmed off. During the time the barley remains in the cistern it is usual to change the steep water two or three times, generally at intervals of twelve hours or tides. The advantage of this is not merely to keep the grain fresh and sweet, but to bring it into contact with the air during the time it is taking up water. Aëration of the steep has long been recognized in Germany as promoting germination, and several arrangements are on the market enabling air to be passed through the grain while it is in the cistern. It has been recommended by Graham, Stopes, Moritz and Morris, and experimental evidence as to its beneficial effects has been published by Windisch, Bleisch, Will, and Baker and Dick. When the corn is steep ripe it contains some 60% of water. Steeping does not consist, however, merely in the

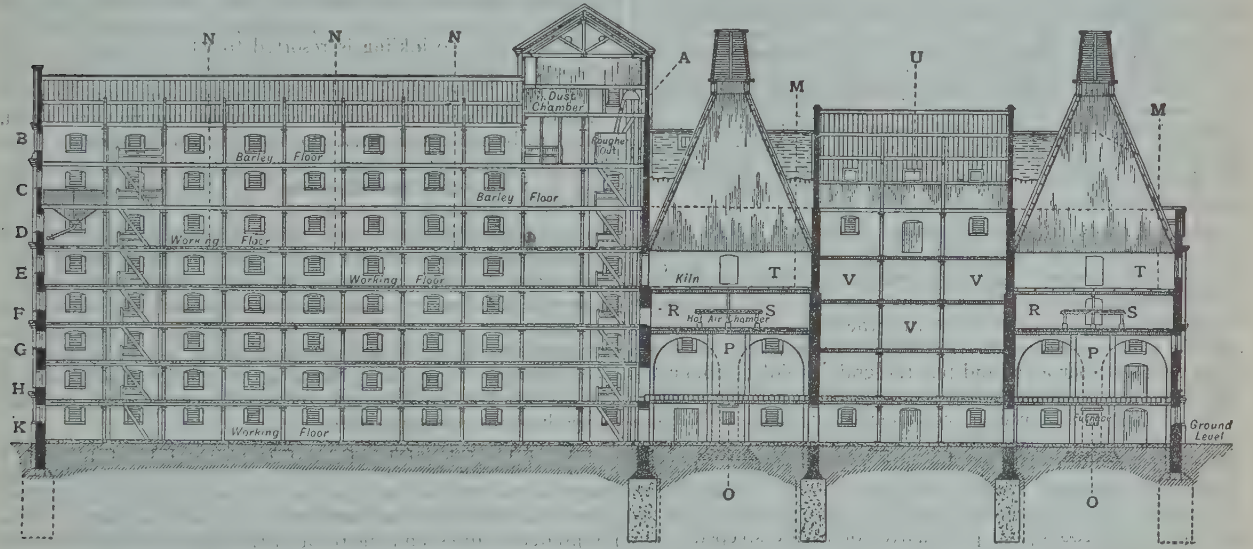


FIG. 8.—Longitudinal section of 200 quarter malting at Mortlake. (Julian L. Baker, architect.)

Figure 8 shows a longitudinal section of Messrs Watney, Combe, Reid & Co.'s 200 quarter malting at Mortlake. The barley is carried to the top of the building by the elevator A, where the screening and dressing machinery is situated. After leaving these machines the grain is conveyed on bands to the barley floors B and C. The floor C contains also the steeping cisterns. The six working floors are D, E, F, G, H, K. The floors are ventilated by louvres, N, N, N. The cisterns are connected to the floors by means of plugs. The "pieces," as they are termed, of germinating barley are gradually worked along the floors to the kilns M, M, on to which they are loaded by rotary bands. The fire-places O, O, are arranged so that the draught may be easily controlled. The hot air and products of combustion pass up the shafts P, P, to the hot-air chamber R, R, where they strike the baffle plates S, S. These plates disperse the hot air and gases evenly beneath the kiln floors T, T, through the green malt. After drying and curing, the malt is allowed to cool and is then carried by bands to the floor U, where by suitable machinery the coombs or rootlets are removed. The finished malt is stored in the bins V, V, V.

On arrival at the malting the barley has to be put through the following operations seriatim: receiving, hoisting and weighing, rough screening, drying and sweating, storing until required for use, screening, grading and removing broken corns, steeping, couching, flooring, withering, drying and curing, dressing and polishing, storing, weighing, sacking and discharging the finished malt.

In sweating barley the temperature should not be allowed to rise above 120° F.; it is usually conducted at 100° F.; and subsequently the barley should be stored for some weeks before it is steeped.

imbibition of a certain amount of water; in order to bring about germination this water must remain within the corn a certain length of time. Thus, although it is quite possible to force the necessary amount of water into the grain in less than the 48–70 hours usually taken up by the steeping process, the grain is not steep-ripe until certain changes initiated by the water have taken place, and these require time for their completion. The following average data are useful to remember in connexion with the steeping process:—

Amount of water in steep-ripe barley (about) 60%.
Matter removed from barley during steeping (about) 1·5 %.
Increase in volume of barley due to water absorption (about) 18–20 %.

There has been much discussion as to the influence of saline matters in water on the steeping process. The late Professor Lintner stated that common salt in water tended to extract the nitrogenous constituents of the grain, but impeded its germination. Mills and Pettigrew found that waters containing calcium salts extracted a minimum of nitrogenous compounds from the barley; they also came to the conclusion that the esteem in which the Lichfield water is held for steeping purposes is due to the presence of nitrates which, they assert, have a stimulating effect on the subsequent germination of the grain. The writer has added lime-water to the extent of one-third of the total volume of water at the first change, believing it to promote regularity of germination. Bearing in mind, however, the observations of Adrian J. Brown, that the barleycorn is enclosed in a membrane permeable to water but impermeable to most salts, it is difficult to see how the saline constituents of water can have any effect except in removing matter from the external portions of the grain and on those corns which are broken. The apparent beneficial effect of lime-water in the steep is probably entirely due to the removal of matters from the husks or paleae.

Malting floors may be constructed of cement, tiles or slate, the two former being preferable to the latter. Ford, in 1849, recommended 200 sq. ft. per quarter of barley steeped as the area of the working floors, and he was quite convinced of the necessity of allowing ample floor room, so that the grain could be worked on the slow, cool system. Subsequently, however, maltsters reduced their floor area, and put the grain rapidly through the malting, thus producing what is termed "forced" malt. This kind of malt was, however, condemned by practical brewers, and a chemical test whereby forcing could be detected having been devised by E. R. Moritz and G. H. Morris, maltsters have been compelled again to increase the area of their working floors. At the present time the approved area may be placed at 175–200 sq. ft. per quarter of barley steeped. The area is, however, largely ruled by the kind of barley to be malted.

After the barley has been thrown out of the cistern it is made up in a rectangular heap 16–20 in. deep, called the "couch"; the object of this is to enable it to gather heat and so start germinating. It usually remains in couch for 12–24 hours, until in fact the interior portion of the heap registers a temperature of about 60° F. During the days of the malt tax the exciseman gauged the quantity of the barley while it was in the couch. After couching the barley is spread thinly and evenly on the floor, forming what is known as the young floor or No. 1 piece. The first visible sign of germination is the sprouting of the rootlet, termed "chitting," and this occurs either while the grain is on the couch or on the young floor. As already mentioned, it may be quickened by aerating the grain in the cistern. From the time the barley is first cast out of the cistern up to the stage of the young floor, or No. 1 piece, it has a pleasant ethereal odour resembling apples. Drs Thomson, Hope and Coventry stated in the earlier part of the 19th century that they distilled "spirits" from germinating barley at this stage. In the light of our present knowledge it would not be surprising if alcoholic fermentation were proved to occur within the grain at this stage, since intramolecular or anaerobic respiration in certain vegetables has been found to be due to alcoholic fermentation.

The thickness at which the young floor is spread depends upon the outside temperature and the nature of the barley. If the weather be warm, or if there be a tendency for the barley to heat, the piece must be spread all the thinner. At this stage the grain loses its external wet appearance. When spread too thickly the grain will begin to sweat, and the rootlets will be thrown out suddenly and unevenly. As a rule, under these circumstances, the rootlets will be long and thin, when they are said to be "wild." A piece which has been allowed to get into this condition must at once be spread thinner. If the sweating has not continued long, the harm done may be confined to increased loss by respiration. The young floor is usually turned with a plough twice during twelve hours, and it may be forked between whiles, but no hard and fast rule can be laid down as to when this is necessary; it must be left to the maltster's judgment, as it depends entirely on what is going on within the grain. The object of turning is in the first place to aerate the grain and freshen it, secondly to check excessive rise of temperature, and thirdly to promote evenness of growth. Too frequent turning is not to be advised. After remaining four days on the young floor three or four rootlets should have appeared, and the acrospire should have begun to grow up the back of the corn. The apple-like odour of the piece then gives place to one resembling that of the common rush, and this should continue the whole time that the malt remains on the floor. On the fifth day the piece is next moved to No. 2 position, a stage nearer the kiln. It is here that sprinkling is resorted to when necessary. The amount of sprinkling and the time it is given cannot be exactly prescribed. The amount may vary from two to five gallons per quarter, and it should only be given when the rootlets, which ought to be short and curly, and five or more in number, show signs of losing their freshness. If an excessive amount of sprinkling be given forced growth ensues. It is preferable not to add the whole of the water at one time, but to divide it over two lots; and immediately after the piece has been sprinkled it should be thoroughly and carefully mixed, otherwise some of the grain will receive an undue proportion of water. When all the sprinkling water has been given to the piece, which as a rule should not be done later than at the sixth or seventh day of flooring, the temperature should be kept down to about 55° F. by turning. Too frequent turning may, however, detach the rootlet, and it may cause the grain to lose its vitality prematurely, so that growth of the acrospire stops.

By about the eighth day of flooring the acrospire should be about three-quarters up the corn. After this the germinating corn is moved forward to No. 3 piece, which is at first spread as thinly on the floors as in the previous pieces. Here it gradually dries and incipient withering of the rootlets sets in. The only treatment which is now given to the grain is to heap it up thicker and thicker by degrees until it is ready for loading on the kiln. This increase in thickness of the piece (now called the old piece) should not be too sudden, especially if the grain be fresh in appearance and contain a large quantity of water. When the piece is thickened up to say 10 in. in depth, while it is in a very moist condition, heating and sweating take place, with additional growth of acrospire and rootlet. Under such forcing conditions a large production of sugar and degradation of the proteïns will take place. When, however, the moisture has been gradually reduced before thickening up, the rootlet dies off; and although increase of temperature may occur, this is accompanied by little or no further growth of the acrospire, action being confined to the mellowing of the grain by the enzymes. When the malt is ready for loading on the kiln it should be possible to break down the contents of each corn between the thumb and finger. Opinions differ as to what the final temperature on the withering floor should be. If the moisture content of the malt be about 50 %, the piece must be kept thin to avoid sweating. But under these conditions mellowing does not occur, hence the necessity of reducing the moisture content gradually after the last sprinkling water has been given. When the process has been conducted properly the temperature of the old piece may be allowed to rise as high as 70° F. during the six hours previous to loading. The moisture content of the green malt when loaded should not be much above 40 %.

The endosperm of green malt which is ready for the kiln should be soft and mealy, and should not exude moisture when pressed between the thumb-nails, but should crumble and disintegrate to a chalky mass having little or no adhesiveness.

The foregoing observations are not to be regarded as hard and fast rules, but they are simply intended to give some indications of the malting process when it proceeds on normal lines; it may be that on account of the presence of damaged corns the piece begins to develop mould by about the tenth day, and it then has to be kept thin and sometimes even loaded on kiln prematurely.

The malt made for grain distillers, in which a high diastatic activity is required, is manufactured on quite different lines from those above indicated. It is often sprinkled late, and loaded on kiln often in a sodden condition. In some cases sprinkling on kiln is resorted to, but it is doubtful if this leads to the desired object. Other things being equal, the smaller the corns—*i.e* the greater number of embryos in a given weight—the higher the diastatic activity of the malt. In selecting a barley for the production of highly diastatic malt, the diastatic power of the original raw grain is a factor of great importance.

Kilning.—When loaded on kiln, malt intended for brewing ale and stout is, if properly withered, in a moribund condition; nevertheless, during the first stages of the kilning process a certain amount of vital activity is manifested, and the malt undergoes mellowing by the action of enzymes on the contents of the endosperm. If the malt be loaded while the rootlets appear fresh on account of the presence of too much moisture, rapid growth of the acrospire ensues, giving rise to overshot corns, known in Germany as "hussars." To check this the moisture must be rapidly removed by the passage of large volumes of air through the malt. But under such circumstances mellowing does not occur. The ideal conditions of kilning are when the malt has been properly withered on the floors before loading, and, assuming that drying and curing occupy four days, that 25–30 % of the moisture be removed very gradually, this occupying the first three days, at the end of which the malt is said to be hand-dry. The thickness at which the malt is spread on the kiln should not exceed 7–8 in., and until hand-dry (that is to say, reduced to a moisture content of 12–15%) it should not be turned; if moved at all (and that only is necessary when reek occurs), it should only be lightly forked. The rate at which the temperature is raised depends largely on the kind of malt to be made and the construction of the kiln. If high flavour and colour are required, these are produced by keeping the malt for several hours near a temperature of 160° F. while it still contains 12–15% of moisture. If more than this amount of moisture be present when the temperature reaches the limit just mentioned, the conditions known as stewing would obtain, with the result that "forced" malt would be produced. A certain amount of colour is produced at the final temperature to which the malt is raised; but when such means are relied upon for the production of the greater part of the colour, reduction of extract and deficiency of flavour follow, the colour being then almost exclusively the result of caramelization of the carbohydrates.

The so-called curing stage constitutes the last part of the kilning process, and the malt must then be turned frequently to ensure uniformity of action. Mechanical turners are exceedingly useful for this purpose. Curing in a drum, as in the so-called pneumatic malting process (see below), also effects satisfactory curing.

The following table will give an idea of the kilning temperatures usually employed for the three kinds of malt mentioned, but it must be remembered that these temperatures are largely regulated by the construction of the kiln and the amount of draught available. In this connexion it may be mentioned that the final curing temperature is not necessarily a criterion of the tint of the malt. A malt may have been finished off at a very high temperature and still be a pale malt, provided the moisture percentage has been sufficiently reduced in the initial stages of kilning.

	Pale Malt.	Running Ale Malt.	Amber Malt.
1st day temp.	90–100° F.	90–100° F.	90–100° F.
2nd ,, ,,	100–120	100–120	100–130
3rd ,, ,,	120–130(10 hrs.)	120–130(6 hrs.)	130–150(6 hrs.)
3rd ,, ,,	130–180(8 ,,)	130–150(12 ,,)	150–160(12 ,,)
3rd ,, ,,	180–190(6 ,,)	150–180(6 ,,)	160–180(6 ,,)
4th ,, ,,	drop to 170(12 ,,)	180–190(12 ,,)	180–200(12 ,,)
4th ,, ,,		190–200(6 ,,)	200–220(6 ,,)
4th ,, ,,		drop to 180(6 ,,)	drop to 190(6 ,,)

The average laboratory values obtained from malts of the descriptions after about two months' storage should be as follows:—

	Pale Malt.	Running Ale Malt.	Amber Malt.
Extract per standard quarter of 336 ℔	95–98 ℔	94–96 ℔	94–96 ℔
Moisture	about 2·0 % in each case		
Diastatic activity (Lintner) . . .	30–35	20–30	8–10
Tint (Lovibond 52 series neutral) .	3–5	6–8	20–25

Metabolic Changes.—All through the malting process metabolic changes are proceeding, in which both carbohydrates and proteïns are concerned. In its resting stage the embryo of a barleycorn is generally free from starch; as soon as germination sets in, however, starch appears in the scutellum, while the amount of sucrose there present increases, these being apparently formed from maltose originating from the action of diastase on the starch of the endosperm. Sucrose also augments in the aleurone layer, but starch is never formed in the aleurone cells. These changes occur when the malt is first loaded on kiln; indeed, at no part of the malting process is there greater physiological activity.

Kilning has been specially studied by J. Grüss, who divides the process into four stages, the first being that at which the temperature limit is 113° F. It is characterized by a continuation of the living processes, especially growth of the acrospire, which, as already stated, proceeds too far if the malt be loaded too wet. In any case the rootlet dies away. The metabolism of the carbohydrates already mentioned is accompanied by that of the nitrogenous constituents, the reserve proteïn of the sub-aleurone layer being attacked by proteolytic enzymes and broken down into simpler compounds. This is a most important matter from the point of view of the brewing value of barley, for the degradation products of the proteïns are necessary constituents of wort as yeast food. Moreover, unless proper modification of these proteïn bodies occurs it is impossible to produce tender malt. A barley which contains a high percentage of reserve proteïn is as a rule unfitted for malting purposes, and indeed, the higher the proteïn content the greater the difficulty the maltster experiences in dealing with it. Proteïn hydrolysis requires the presence of a certain amount of moisture, and if this be removed too rapidly by a forced draught at the early stages of kilning the proteolytic enzymes cannot perform their function. If, on the other hand, the grain be loaded in too moist a condition, and the temperature be raised too quickly, the proteolytic enzymes lose their activity and the proteïns remain for the most part unattacked. When germination is allowed to proceed on the kiln too great degradation of the proteïn occurs, and the malt is liable to produce fretty beers, on account of the presence of an excessive amount of nitrogenous nutritive matter, which leads to the development of disease organisms.

The second stage of the kilning process, according to Grüss, is that at which the temperatures range from 113° to 167° F. The life of the corn is now suspended, but enzymatic processes continue. The starch is further saccharified, and the dividing line of the aleurone layer at the furrow is attacked, as are also the cell walls of the endosperm, which are still intact, these being partially converted into gummy substances. This change, however, also requires the presence of a certain amount of moisture. If too much air be passed through the malt at this stage the above-named dividing partition of the cell walls is not attacked. The air may expand the grain to some extent and produce malt of a low bushel weight, which, however, is not properly modified and cannot give satisfactory results in practice.

During the third stage of kilning, an enzyme, which Grüss claims to have recognized, and which he denotes spermoxidase, is said to exert its activity.

Schönfeld has confirmed the discoveries of Grüss by practical experiments.

Fuel.—The fuel used for drying and curing malt is either anthracite or coke, and the greatest care is necessary in selecting it on account of its liability to contain arsenic, which is to a greater or less extent an invariable constituent of all coal. The fuel used for malting purposes should not contain more arsenic than $\frac{1}{100}$th grain per ℔. Gas coke should on no account be used, unless it has been proved to be sufficiently free from arsenic; but the best oven coke frequently contains so little arsenic that it may be employed with perfect safety, especially if it be mixed with a proportion (*e.g.* 5%) of milk of lime, which retains the arsenic as calcium arsenate. In Germany malt is, as a rule, dried and cured with hot air, whilst in Great Britain the products of combustion are passed through the malt, as it is believed that they exert a beneficial influence on the flavour. The proportion of fuel used for drying and curing malt varies according to the quality of the fuel and the construction of the kiln, but on an average it may be placed at 50–80 ℔ per quarter.

Storing.—After the malt has passed through the curing stage it is generally heaped up for a few hours. This is believed to increase its flavour. The malt is then stripped from the kiln, and the rootlets, technically known as the coombs, are removed. Formerly this was effected by workmen treading the malt, who wore heavy boots for the purpose. At the present time, however, the rootlets are usually removed by machinery, special forms of which have been devised for this as well as for dressing and polishing the malt. It is the custom of some maltsters to store malt with the rootlets still attached; but this is an objectionable practice, since malt coombs attract moisture, and the presence of more than 3% of moisture in malt produces the condition known as "slackness." When the malt is packed in bin it is often covered with a layer of coombs, which then prevent access of atmospheric moisture. Malt, to preserve its good qualities intact, should be stored in bins made as nearly as possible air-tight, and it should never be placed in bin until it is quite cool. It is probably wrong to store malt in bins adjacent to the kilns, where it is kept at a higher temperature than that of the surrounding atmosphere. During storage of the malt a kind of mellowing occurs, the mechanism of which is not understood. It is, however, known by practical brewers that the best results cannot be obtained when new malt is used.

Premature Malting.—Several years ago Galland suggested germinating barley in a drum, his idea being to do away with handling of the grain, and also to be independent of changes of atmospheric temperature. The latest development of this system, the so-called Galland-Henning process of pneumatic malting, has been improved by Mr R. Blair Robertson, and a diagrammatic view of the interior of one of these maltings, showing the drums and conical steeping cisterns, is shown in fig. 9.

The drums are provided with a perforated channel for the passage of air through the malt, which is packed in the annular space between this channel and outside wall of the drum. Each drum is capable of revolving on its axis, and there are arrangements for passing either moist, saturated or dry air through the malt. The system as now improved is capable of producing some of the best malt, especially if, after germination has been completed in the drums, the green malt is loaded on an ordinary kiln and the initial stages of kilning (see above) conducted in the usual way; the curing, however, may be carried out successfully in a special form of drum.

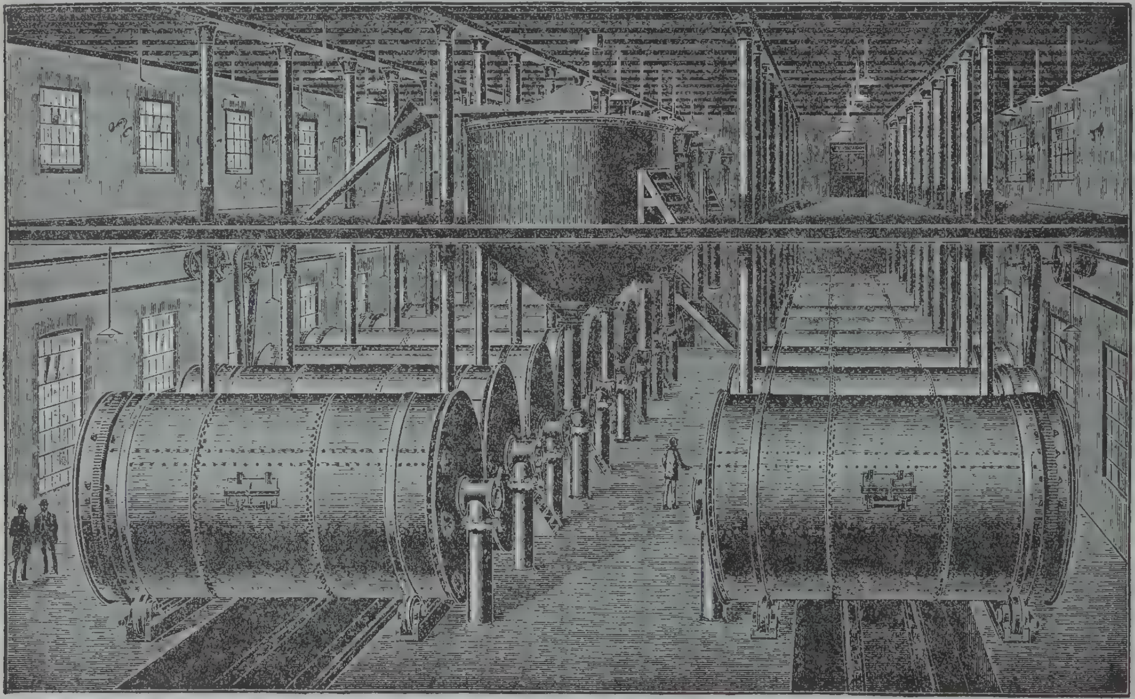
Yield and Weight.—The malting process is attended with a certain amount of loss of dry substance of the barley, as follows:—

In the steep	1·5 to 2·0%
By respiration on floors and on kilns . .	3·0 ,, 5·0%
Coombs	3·0 ,, 4·0%
Total	7·5 ,, 11·0%

In addition to this, barley, as already mentioned, contains from 15 to 20% of moisture, whereas finished malt contains 1 to 2%. The total loss in weight which barley undergoes in the malting process may be put down at from 17 to 28%. Since, however, malt is lighter than barley (and the quantity of both was in former years measured exclusively by volume), it frequently happens that a given number of quarters of barley yields a larger number of quarters of finished malt. When this happens it is usual to speak of an increase having been obtained. At the present time weight replaces measure for both barley and malt, and although it is usual to speak of the quantity of grain in terms of quarters, what is meant is not the measured quarter, but so many weighed standard quarters. The standard quarter for English malting barley is 448 ℔ and for malt 336 ℔. From this it will be seen that when a given number of weighed quarters of barley yields the same number of quarters of finished malt, the actual yield is 75%, and there is then said to be neither increase nor decrease. As a rule, in practical working the yield of malt varies from a 4% decrease to a 10% increase, corresponding to an actual yield on the original barley of 72 to 82·5%.

J. Baverstock, an old writer, says that finished malt should weigh one-fifth less than the barley from which it is produced. This corresponds to a malting increase of about 7%, which is a high yield. As a rule, foreign barley will give a greater malting increase than English barley, because, on the one hand, the former usually contains less moisture than the latter, and, further, because there is less loss on the floors by respiration and rootlet growth.

The yield of malt from barley may be determined in the laboratory in an extremely simple manner. Since every grain of barley must yield a grain of malt, if we know the respective weights of a definite number of barley and malt grains, provided that this number is large enough to represent the average, then obviously this gives the data requisite for calculating the yield of malt from barley. The number of corns the weight of which is determined for this purpose is usually 1000, and if the weight of this number be determined on several different 1000 corns, the average will closely approximate



[From Sykes & Ling, *Principles and Practice of Brewing* (1907), Charles Griffin & Co., Ltd.]

FIG. 9.—Diagrammatic view of pneumatic malting, showing pneumatic washing and steeping cisterns.

to the truth. Instead of counting the corns by hand, an instrument may be used for this purpose.

If 1000 corns of a barley were found to weigh 42 grammes, and 1000 corns of a finished malt from the same barley 32 grammes, then the yield of malt is $\frac{32 \times 100}{42} = 76{\cdot}1$, this corresponding to a 1% increase. Assuming that the moisture content of the barley was 15% and that of the finished malt 2%, 100 grammes of malt will contain 2 grammes of moisture, and 76·1 grammes will contain $\frac{76{\cdot}1 \times 2}{100} = 1{\cdot}5$ grammes moisture; therefore 76·1 grammes of malt contain $76{\cdot}1 - 1{\cdot}5 = 74{\cdot}6$ grammes of dry matter. This was obtained from $100 - 15 = 85$ grammes of barley dry substance. Hence 100 parts of barley dry substance will yield $\frac{74{\cdot}6 \times 100}{85} = 87{\cdot}7$ corresponding with a loss of dry substance equal to 12·5% of the dry substance of the barley, or with a loss of 10·7% on the barley containing 15% of moisture.

The results obtained by this method of laboratory control when it is accurately carried out agree very closely with those deduced from the practical results of weighing the barley, malt and coombs in the malting.

Special Malts.—In addition to the kinds of malt considered in what precedes, there are others mostly used for imparting specific flavours and colour to beers and stout. These are crystal malt, imperial malt, brown or blown malt, and black or roasted malt. Crystal malt is grown for a shortened period on the floors, and then placed in a wire cylinder, which is rotated over a fire so that it is dried at a very high temperature. The weight per quarter is from 250 to 280 ℔. Imperial malt is dried off on an ordinary kiln at a final temperature of 240–270° F., but it is not allowed the usual length of time on the withering floor. It is placed on the drying kiln in a layer not exceeding one inch and a half in thickness. A moderate heat from burnt wood is first applied until the bulk of the moisture has been driven off, when the temperature is suddenly raised so that the grains swell some 25% and the malt takes up a strong empyreumatic flavour from the products of combustion. This kind of malt weighs 270–300 ℔ per quarter. Black or roasted malt is prepared by roasting malt in a cylinder. Ford states that perfectly malted corn gives a colour of less intensity and permanence than does partially malted corn, and this has been confirmed by other observers. A certain quantity of the so-called black malt is actually made from raw barley, but this gives a product of inferior flavour. The weight per quarter of black malt varies as much as from 215 to 290 ℔.

Valuation.—For the valuation of malt the following determinations are usually carried out: Extract per standard quarter, moisture, diastatic activity by the Lintner process, tint, and matters soluble in cold water. The physical examination of malt is also a matter of importance, inasmuch as direct evidence is obtained thereby of the modification of the malt. Among the methods adopted for this purpose may be mentioned counting the percentage of corns in which the aerospire has grown up to one-half, two-thirds and three-fourths the entire length of the corn. In properly made malt the modification of the endosperm should proceed *pari passu* with the growth of the acrospire. The sinker test is also useful when carried out in an intelligent manner. Those corns which sink in water and lie flat are improperly modified. Normal malt has a specific gravity less than water and the corns have equal density throughout; consequently they float horizontally in water. In forced samples the proximal ends are frequently lighter than the distal ends, and the corns float horizontally in water, with the germ directed upwards. The latter, however, may in some cases fill with water, and the corns lie flat or sink. This is a characteristic of over-modified malt. It will be seen from these remarks that it is essential to carry out the sinker test under standard conditions. The modification of the malt may also be determined by means of the diaphanoscope already referred to under Barley.

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MALTA, the largest of the Maltese Islands, situated between Europe and Africa, in the central channel which connects the eastern and western basins of the Mediterranean Sea. The group belongs to the British Empire. It extends over 29 m., and consists of Malta, 91 sq. m., Gozo (*q.v.*) 20 sq. m., Comino (set apart as a quarantine station) 1 sq. m., and the uninhabited rocks called Cominotto and Filfla. Malta (lat. of Valletta Observatory 35° 53′ 55″ N., long. 14° 30′ 45″ W.) is about 60 m. from the nearest point of Sicily, 140 m. from the mainland of Europe and 180 from Africa; it has a magnificent natural harbour. From the dawn of maritime trade its possession has been important to the strongest nations on the sea for the time being.

Malta is about 17½ m. long by 8¼ broad; Gozo is 8¾ by 4½ m. This chain of islands stretches from N.E. to S.E. On the S.W. the declivities towards the sea are steep, and in places rise abruptly some 400 ft. from deep water. The general slope of these ridges is towards the N.W., facing Sicily and snow-capped Etna, the source of cool evening breezes. The Bingemma range, rising 726 ft., is nearly at right angles to the axis of the main island. The geological "Great Fault" stretches from sea to sea at the foot of these hills. There are good anchorages in the channels between Gozo and Comino, and between Comino and Malta. In addition to the harbours of Valletta, there are in Malta, facing N.W., the bays called Mellieha and St Paul's, the inlets of the Salina, of Madalena, of St Julian and St Thomas; on the S.E. there is the large bay of Marsa Scirocco. There are landing places on the S.W. at Fomh-il-rih and Miggiarro. Mount Sceberras (on which Valletta is built) is a precipitous promontory about 1 m. long, pointing N.E. It rises out of deep water; well-sheltered creeks indent the opposite shores on both sides. The waters on the S.E. form the "Grand Harbour," having a narrow entrance between Ricasoli Point and Fort St Elmo. The series of bays to the N.W., approached between the points of Tigne and St Elmo, is known as the Marsamuscetto (or Quarantine) Harbour.

Mighty fortifications and harbour works have assisted to make this ideal situation an emporium of Mediterranean trade. During the Napoleonic wars and the Crimean campaign the Grand Harbour was frequently overcrowded with shipping. The gradual supplanting of sail by steamships has made Malta a coaling station of primary importance. But the tendency to great length and size in modern vessels caused those responsible for the civil administration towards the end of the 19th century to realize that the harbour accommodation was becoming inadequate for modern fleets and first-class liners. A breakwater was therefore planned on the Monarch shoal, to double the available anchorage area and increase the frontage of deep-water wharves available in all weathers.

Geology and Wate Supply.

The Maltese Islands consist largely of Tertiary Limestone, with somewhat variable beds of Crystalline Sandstone, Greensand and Marl or Blue Clay. The series appears to be in line with similar formations at Tripoli in Africa, Cagliari in Sardinia, and to the east of Marseilles. To the south-east of the Great Fault (already mentioned) the beds are more regular, comprising, in descending order, (*a*) Upper Coralline Limestone; (*b*) Yellow, Black or Greensand; (*c*) Marl or Blue Clay; (*d*) White, Grey and Pale Yellow Sandstone; (*e*) Chocolate-coloured nodules with shells, &c.; (*f*) Yellow Sandstone; (*g*) Lower Crystalline Limestone. The Lower Limestone probably belongs to the Tongarian stage of the Oligocene series, and the Upper Coralline Limestone to the Tortonian stage of the Miocene. The beds are not folded. The general dip of the strata is from W.S.W. to E.N.E. North of the Great Fault and at Comino the level of the beds is about 400 ft. lower, bringing (*c*), the Marl, in juxtaposition with (*g*), the semi-crystalline Limestone. There is a system of lesser faults, parallel to the Great Fault, dividing the area into a number of blocks, some of which have fallen more than others. There are also indications of another series of faults roughly parallel to the south-east coast, which point to the islands being fragments of a former extensive plateau. The mammalian remains found in Pleistocene deposits are of exceptional interest. Among the more remarkable forms are a species of hippopotamus, the elephant (including a pigmy variety), and a gigantic dormouse.

In the Coralline Limestone the following fossils have been noted:—*Spondylus*, *Ostrea*, *Pecten*, *Cytherea*, *Arca*, *Terebratula*, *Orthis*, *Clavagella*, *Echinus*, *Cidaris*, *Nucleolites*, *Brissus*, *Spatangus*; in the Marl the *Nautilus zigzag*; in the Yellow, Black and Greensand shells of *Lenticulites complanatus*, teeth and vertebrae of *Squalidae* and *Cetacea*; in the Sandstone *Vaginula depressa*, *Crystallaria*, *Nodosaria*, *Brissus*, *Nucleolites*, *Pecten burdigallensis*, *Scalaria*, *Scutella subrotunda*, *Spatangus*, *Nautilus*, *Ostrea navicularis* and *Pecten cristatus* (see Captain Spratt's work and papers by Lord Ducie and Dr Adams).

The Blue Clay forms, at the higher levels, a stratum impervious to water, and holds up the rainfall, which soaks through the spongy mass of the superimposed coralline formations. Hence arise the springs which run perennially, several of which have been collected into the gravitation water supplies of the Vignacourt and Fawara aqueducts. The larger part of the water supply, however, is now derived by pumping from strata at about sea-level. These strata are generally impregnated with salt water, and are practically impenetrable to the rain-water of less weight. The honeycomb of rock, and capillary action, retard the lighter fresh-water from sinking to the sea; the soakage from rain has therefore to move horizontally, over the strata about sea-level, seeking outlets. At this stage the rain-water is intercepted by wells, and by galleries hewn for miles in the water-bearing rock. Large reservoirs assist to store this water after it is raised, and to equalize its distribution.

Climate and Hygiene.

The climate is, for the greater part of the year, temperate and healthy; the thermometer records an annual mean of 67° F. Between June and September the temperature ranges from 75° to 90°; the mean for December, January and February is 56°; March, May and November are mild. Pleasant north-east winds blow for an average of 150 days a year, cool northerly winds for 31 days, east winds 70 days, west for 34 days. The north-west "Gregale" (Euroclydon of Acts xxvii. 14) blows about the equinox, and occasionally, in the winter months, with almost hurricane force for three days together; it is recorded to have caused the drowning of 600 persons in the harbour in 1555. This wind has been a constant menace to shipping at anchor; the new breakwater on the Monarch Shoal was designed to resist its ravages. The regular tides are hardly perceptible, but, under the influence of barometric pressure and wind, the sea-level occasionally varies as much as 2 ft. The average rainfall is 21 in.; it is, however, uncertain; periods of drought have extended over three years. Snow is seen once or twice in a generation; violent hailstorms occur. On the 19th of October 1898, exceptionally large hailstones fell—one, over 4 in. in length, being brought to the governor, Sir Arthur Fremantle, for inspection. Mediterranean (sometimes called "Malta") fever has been traced by Colonel David Bruce to a *Micrococcus melitensis*. The supply of water under pressure is widely distributed and excellent. There is a modern system of drainage for the towns, and all sewerage has been intercepted from the Grand Harbour. There are efficient hospitals and asylums, a system of sanitary inspection, and modernized quarantine stations.

Flora.

It is hardly possible to differentiate between imported and indigenous plants. Among the marine flora may be mentioned *Porphyra laciniata*, the edible laver; *Codium tomentosum*, a coarse species; *Padina pavonia*, common in shallow water; *Ulva latissima*; *Haliseris polypodioides*; *Sargassum bacciferum*; the well-known gulf weed, probably transported from the Atlantic; *Zostera marina*, forming dense beds in muddy bays; the roots are cast up by storms and are valuable to dress the fields. Among the land plants may be noted the blue anemone; the ranunculus along the road-sides, with a strong perfume of violets; the Malta heath, which flowers at all seasons; *Cynomorium coccineum*, the curious "Malta fungus," formerly so valued for medicinal purposes that a guard was set for its preservation under the rule of the Knights; the pheasant's-eye; three species of mallow and geranium; *Oxalis cernua*, a very troublesome imported weed; *Lotus edulis*; *Scorpiurus subvillosa*, wild and cultivated as forage; two species of the horseshoe-vetch; the opium poppy; the yellow and claret-coloured poppy; wild rose; *Crataegus azarolus*, of which the fruit is delicious preserved; the ice-plant; squirting cucumber; many species of *Umbelliferae*; *Labiatae*, to which the spicy flavour of the honey (equal to that of Mt Hymettus) is ascribed; snapdragons; broom-rape; glass-wort; *Salsola soda*, which produces when burnt a considerable amount of alkali; there are fifteen species of orchids; the *gladiolus* and *iris* are also found; *Urginia scilla*, the medicinal squill, abounds with its large bulbous roots near the sea; seventeen species of sedges and seventy-seven grasses have been recorded.

Fauna.

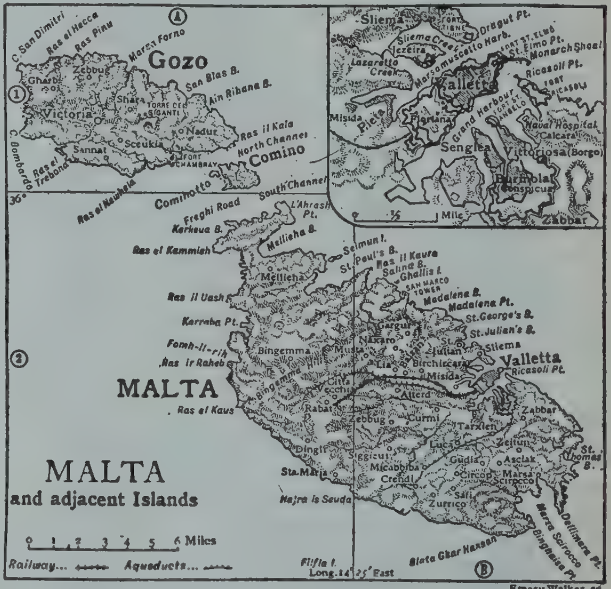
There are four species of lizard and three snakes, none of which is venomous; a land tortoise, a turtle and a frog. Of birds very few are indigenous; the jackdaw, blue solitary thrush, spectacled warbler, the robin, kestrel and the herring-gull. A bird known locally as *Hangi*, not met elsewhere in Europe, nests at Filfla. Flights of quail and turtle doves, as well as teal and ducks, stay long enough to afford sport. Of migratory birds over two hundred species have been enumerated. The only wild mammalia in the island are the hedgehogs, two species of weasel, the Norway rat, and the domestic mouse. The Maltese dog was never wild and has ceased to exist as a breed.

Malta has several species of zoophytes, sponges, mollusca and crustacea. Insect life is represented by plant-bugs, locusts, crickets, grasshoppers, cockroaches, dragon-flies, butterflies, numerous varieties of moths, bees and mosquitoes.

Among the fish may be mentioned the tunny, dolphin, mackerel, sardine, sea-bream, dentice and pagnell; wrasse, of exquisite rainbow hue and good for food; members of the herring family, sardines, anchovies, flying-fish, sea-pike; a few representatives of the cod family, and some flat fish; soles (very rare); *Cernus* which grows to large size; several species of grey and red mullet; eleven species of *Triglidae*, including the beautiful flying gurnard whose colours rival the angel-fish of the West Indies; and eighteen species of mackerel, all migratory.

Population and Language.

The real population of Malta, viz. of the country districts, is to be differentiated from the cosmopolitan fringe of the cities. There is continuous historical evidence that Malta remains to-day what Diodorus Siculus described it in the 1st century, "a colony of the Phoenicians"; this branch of the Caucasian race came down the great rivers to the Persian Gulf and thence to Palestine. It carried the art of navigation through the Mediterranean, along the Atlantic seaboard as far as Great Britain, leaving colonies along its path. In prehistoric times one of these colonies displaced previous inhabitants of Libyan origin. The similarity of the megalithic temples of Malta and of Stonehenge connect along the shores of western Europe the earliest evidence of Phoenician civilization. Philology proves that, though called "Canaanites" from having sojourned in that land, the Phoenicians have no racial connexion with the African descendants of Ham. No subsequent invader of Malta attempted to displace the Phoenician race in the country districts. The Carthaginians governed settlements of kindred races with a light hand; the Romans took over the Maltese as "dedititii," not as a conquered race. Their conversion by St Paul added difference of religion to the causes which prevented mixture of race. The Arabs from Sicily came to eject the Byzantine garrison; they treated the Maltese as friends, and were not sufficiently numerous to colonize. The Normans came as fellow-Christians and deliverers; they found very few Arabs in Malta. The fallacy that Maltese is a dialect of Arabia has been luminously disproved by A. E. Caruana, *Sull' origine della lingua Maltese*.


MALTA
and adjacent Islands
Gozo
C. San Dimitri
Ras el Hecca
Ras Pinu
Marsa Forno
Zebbug
Gharb
Victoria
Shara
Torre dei Giganti
San Blas B.
Ain Ribana B.
Nadur
Sceukia
Sannat
C. Bombarda
Ras el Trebona
Fort Chambray
Ras il Kala
North Channel
Comino
Cominotto
South Channel
Ras el Nawhela
Sliema
Fort Tigne
Dragut Pt.
Sliema Creek
Jezeira
Marsamuscetto Harb.
Fort St. Elmo
St. Elmo Pt.
Monarch Shoal
Lazaretto Creek
Valletta
Ricasoli Pt.
Fort Ricasoli
Misida
Pieta
Floriana
Grand Harbour
Fort St. Angelo
Naval Hospital
Calcara
Senglea
Vittoriosa (Borgo)
Burmola (Conspicua)
Zabbar
½ Mile
36°
Freghi Road
L'Ahrash Pt.
Kerkeua B.
Mellieha B.
Ras el Kammieh
Selmun I.
St. Paul's B.
Ras il Kaura
Salina B.
Ghallis I.
San Marco Tower
Mellieha
Ras il Uash
Madalena B.
Madalena Pt.
St. George's B.
St. Julian's B.
Karraba Pt.
Gargur
Naxaro
St. Julian
Sliema
Fomh-il-rih
Ras ir Raheb
Bingemma
Musta
Lia
Birchircara
Misida
Valletta
Ricasoli Pt.
MALTA
Bingemma Hill
Citta Vecchia
Attard
Ras el Kaus
Rabat
Zebbug
Curmi
Zabbar
Tarxien
Dingli
Siggieui
Luca
Zeitun
St. Thomas B.
Sta. Maria
Micabbiba
Gudia
Asclak
Crendi
Circop
Marsa Scirocco
Hajra is Seuda
Safi
Zurrico
Marsa Scirocco
Dellimara Pt.
Binghaisa Pt.
Blata Ghar Hansan
Filfla I.
Long. 14° 25' East
0 1 2 3 4 5 6 Miles
Railway...
Aqueducts...
Ⓐ
①
②
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Emery Walker sc.

The upper classes have Norman, Spanish and Italian origin. The knights of St John of Jerusalem, commonly called "of Malta," were drawn from the nobility of Catholic Europe. They took vows of celibacy, but they frequently gave refuge in Malta to relatives driven to seek asylum from feudal wars and disturbances in their own lands. At the British occupation there were about two dozen families bearing titles of nobility granted, or recognized, by the Grand Masters, and descending by primogeniture. These "privileges" were guaranteed, together with the rights and religion of the islanders, when they became British subjects, but no government has ever recognized papal titles in Malta. High and low, all speak among themselves the Phoenician Maltese, altogether different from the Italian language; Italian was only spoken by 13·24 % in 1901. Such Italian as is spoken by the lingering minority has marked divergences of pronunciation and inflexion from the language of Rome and Florence. In 1901, in addition to visitors and the naval and military forces, 18,922 Maltese spoke English, and the number has been rapidly increasing.

In appearance the Maltese are a handsome, well-formed race, about the middle height, and well set up; they have escaped the negroid contamination noticeable in Sicily, and their features are less dark than the southern Italians. The women are generally smaller than the men, with black eyes, fine hair and graceful carriage. They are a thrifty and industrious people, prolific and devoted to their offspring, good-humoured, quick-tempered and impressionable. The food of the working classes is principally bread, with oil, olives, cheese and fruit, sometimes fish, but seldom meat; common wine is largely imported from southern Europe. The Maltese are strict adherents to the Roman Catholic religion, and enthusiastic observers of festivals, fasts and ceremonials.

In 1906 the birth-rate was 40·68 per thousand, and the excess of births over deaths 2637. In April 1907 the estimated population was 206,690 of whom 21,911 were in Gozo. This phenomenal congestion of population gives interest to records of its growth; in the 10th century there were 16,767 inhabitants in Malta and 4514 in Gozo; the total population in 1514 was 22,000. Estimates made at the arrival of the knights (1530) varied from 15,000 to 25,000: it was then necessary to import annually 10,000 quarters of grain from Sicily. The population in 1551 was, Malta 24,000, Gozo 7000. In 1582, 20,000 quarters of imported grain were required to avert famine. A census of 1590 makes the population 30,500; in that year 3000 died of want. The numbers rose in 1601 to 33,000; in 1614 to 41,084; in 1632 to 50,113; in 1667 to 55,155; in 1667 11,000 are said to have died of plague out of the total population. At the end of the rule of the knights (1798) the population was estimated at 100,000; sickness, famine and emigration during the blockade of the French in Valletta probably reduced the inhabitants to 80,000. In 1829 the population was 114,236; in 1836, 119,878 (inclusive of the garrison); in 1873, 145,605; at the census in 1901 the civil population was 184,742. Sanitation decreases the death-rate, religion keeps up the birth-rate. Nothing is done to promote emigration or to introduce manufactures.

Towns and Villages.—The capital is named after its founder, the Grand Master de la Valette, but from its foundation it has been called Valletta (pop. 1901, 24,685); it contains the palace of the Grand Masters, the magnificent Auberges of the several "Langues" of the Order, the unique cathedral of St John with the tombs of the Knights and magnificent tapestries and marble work; a fine opera house and hospital are conspicuous. Between the inner fortifications of Valletta and the outer works, across the neck of the peninsula, is the suburb of Floriana (pop. 7278). To the south-east of Valletta, at the other side of the Grand Harbour, are the cities of Senglea (pop. 8093), Vittoriosa (pop. 8993); and Cospicua (pop. 12,184); this group is often spoken of as "The Three Cities." The old capital, near the centre of the island is variously called Notabile, Città Vecchia (*q.v.*), and Medina, with its suburb Rabat, its population in 1901 was 7515; here are the catacombs and the ancient cathedral of Malta. Across the Marsamuscetto Harbour of Valletta is a considerable modern town called Sliema. The villages of Malta are Mellieha, StPaul's Bay, Musta, Birchircara, Lia, Atterd, Balzan, Naxaro, Gargur, Misida, S. Julian's, S. Giuseppe, Dingli, Zebbug, Siggieui, Curmi, Luca, Tarxein, Zurrico, Crendi, Micabbiba, Circop, Zabbar, Asciak, Zeitun, Gudia and Marsa Scirocco. The chief town of Gozo is called Victoria, and there are several small villages.

Industry and Trade.—The area under cultivation in 1906 was 41,534 acres. As a rule the tillers of the soil live away from their lands, in some neighbouring village. The fields are small and composed of terraces by which the soil has been walled up along the contours of the hills, with enormous labour, to save it from being washed away. Viewed from the sea, the top of one wall just appearing above the next produces a barren effect; but the aspect of the land from a hill in early spring is a beautiful contrast of luxuriant verdure. It is estimated that there are about 10,000 small holdings averaging about four acres and intensely cultivated. The grain crops are maize, wheat and barley; the two latter are frequently sown together. In 1906, 13,000 acres produced 17,975 quarters of wheat and 12,000 quarters of barley. The principal fodder crops are green barley and a tall clover called "sulla" (*Hedysarum coronarum*), having a beautiful purple blossom. Vegetables of all sorts are easily grown, and a rotation of these is raised on land irrigated from wells and springs. Potatoes and onions are grown for exportation at seasons when they are scarce in northern Europe. The rent of average land is about £2 an acre, of very good land over £3; favoured spots, irrigated from running springs, are worth up to £12 an acre. Two, and often three, crops are raised in the year; on irrigated land more than twice as many croppings are possible. The presence of phosphates accounts for the fertility of a shallow soil. There is a considerable area under vines, but it is generally more profitable to sell the fruit as grapes than to convert it into wine. Some of the best oranges in the world are grown, and exported; but sufficient care is not taken to keep down insect pests, and to replace old trees. Figs, apricots, nectarines and peaches grow to perfection. Some cotton is raised as a rotation crop, but no care is taken to improve the quality. The caroub tree and the prickly pear are extensively cultivated. There are exceptionally fine breeds of cattle, asses and goats; cows of a large and very powerful build are used for ploughing. The supply of butchers' meat has to be kept up by constant importations. More than two-thirds of the wheat comes from abroad; fish, vegetables and fruit are also imported from Sicily in considerable quantities. Excellent honey is produced in Malta; at certain seasons tunny-fish and young dolphin (lampuca) are abundant; other varieties of fish are caught all the year round.

About 5000 women and children are engaged in producing Maltese lace. The weaving of cotton by hand-looms survives as a languishing industry. Pottery is manufactured on a small scale; ornamental carvings are made in Maltese stone and exported to a limited extent. The principal resources of Malta are derived from its being an important military station and the headquarters of the Mediterranean fleet. There are great naval docks, refitting yards, magazines and stores on the south-east side of the Grand Harbour; small vessels of war have also been built here. Steamers of several lines call regularly, and there is a daily mail to Syracuse. The shipping cleared in 1905–1906 was 3524 vessels of 3,718,168 tons. Internal communications include a railway about eight miles long from Valletta to Notabile; there are electric tramways and motor omnibus services in several directions. The currency is English. Local weights and measures include the cantar, 175 ℔; salm, one imperial quarter; cafiso, 4½ gallons; canna, 6 ft. 10½ in.; the tumolo (256 sq. ca.), about a third of an acre.

The principal exports of local produce are potatoes, cumin seed, vegetables, oranges, goats and sheep, cotton goods and stone.

To keep alive, in a fair standard of comfort, the population of 206,690, food supplies have to be imported for nine and a half months in the year. The annual value of exports would be set off against imported food for about one month and a half. The Maltese have to pay for food imports by imperial wages, earned in connexion with naval and military services, by commercial services to passing steamers and visitors, by earnings which emigrants send home from northern Africa and elsewhere, and by interest on investments of Maltese capital abroad. A long absence of the Mediterranean fleet, and withdrawals of imperial forces, produce immediate distress.

Finance.—The financial position in 1906–1907 is indicated by the following: Public revenue £513,594 (including £51,039 carried to revenue from capital); expenditure £446,849; imports (actual), £1,219,819; imports in transit, £5,876,981; exports (actual), £123,510; exports in transit £6,127,277; imports from the United Kingdom (actual), £218,461. In March 1907 there were 8159 depositors in the government savings bank, with £569,731 to their credit.

Government.—Malta is a crown colony, within the jurisdiction of a high commissioner and a commander-in-chief, to whom important questions of policy are reserved; in other matters the administration is under a military governor (£3000), assisted by a civil lieutenant-governor or chief secretary. There is an executive council, now comprising eleven members with the governor as president. The legislative council, under letters patent of the 3rd of June 1903, is composed of the governor (president), ten official members, and eight elected members. There are eight electoral districts with a total of about 10,000 electors. A voter is qualified on an income from property of £6, or by paying rent to the same amount, or having the qualifications required to serve as a common juror. There are no municipal institutions. Letters patent, orders in council, and local ordinances have the force of law. The laws of Justinian are still the basis of the common law, the Code of Rohan is not altogether abrogated, and considerable weight is still given to the Roman Canon Law. The principal provisions of the Napoleonic Code and some English enactments have been copied in a series of ordinances forming the Statute Law. Latin was the language of the courts till 1784, and was not completely supplanted by Italian till 1815. The partial use of English (with illogical limitations to the detriment of the Maltese-born British subjects who speak English) was introduced by local ordinances and orders in council at the end of the 19th century. The Maltese, of whom 86% cannot understand Italian, are still liable to be tried, even for their lives, in Italian, to them a foreign language. The endeavour to restrict juries to those who understand Italian reveals glaring incongruities.

Education.—There were, in 1906, 98 elementary day schools, and 33 night schools. The attendance on the 1st of September 1905 was 16,530, the percentage on those enrolled 84·6; the total enrolment was 18,719. The average cost per pupil in these schools was 35s. 11d. a year on daily attendance. There is a secondary school for girls in Valletta, and one for boys in Gozo. A lyceum in Malta had an average attendance of 464. The number of students at the university was about 150. The average cost per student in the lyceum was £8, 0s. 11d.; in the university £26, 10s. 1d. The fees in these institutions are almost nominal, the middle-classes are thus educated at the expense of the masses. In the 18th century the government of the Knights and of the Inquisition did not favour the education of the people, after 1800 British governors were slow to make any substantial change. About the middle of the 19th century it began to be recognized that the education of the people was more conducive to the safety of the fortress than to leave in ignorance congested masses of southern race liable to be swayed spasmodically by prejudice. At first an attempt was made to make Maltese a literary language by adapting the Arabic characters to record it in print. This failed for several reasons, the foremost being that the language was not Arabic but Phoenician, and because professors and teachers, whose personal ascendancy was based on the official prominence of Italian, did not realize that educational institutions existed for the rising generation rather than to provide salaries for alien teachers and men behind the times. Various educational schemes were proposed, but they were easier to propose than to carry into effect: no one, except Mr Savona, had the ability to urge English as the basis of instruction, and he agitated and was installed as director of education and made a member of the Executive. The obstruction which he encountered alarmed him, and he compromised by adopting a mixed system of both English and Italian, *pari passu*, as the basis of Maltese education; he resigned after a brief effort. Mr Savona's attempt to teach the Maltese children simultaneously two foreign languages (of which they were quite ignorant, and their teachers only partially conversant) without first teaching how to read and write the native Maltese systematically was continued for some years under an eminent archaeologist, Dr A. A. Caruana, who became Director of Education. He began to give some preference to English indirectly. On his resignation Sir G. Strickland established a new system of education based on the principle of beginning from the bottom, by teaching to read and write in Maltese as the medium for assimilating, at a further stage, either English or Italian, one at a time, and aiming at imparting general knowledge in colloquial English. A series of school books, in the Maltese language printed in Roman characters, with translations in English interlined in different type, was produced at the government printing office and sold at cost price. The parents and guardians were called upon to select whether each child should learn English or Italian next after learning reading, writing and arithmetic in Maltese. About 89% recorded their preference in favour of English at the outset; then, as a result of violent political agitation, this percentage was considerably lowered, but soon crept up again. Teachers and professors who were weak in English, lawyers, newspaper men and others, combined to deprive these reforms of their legitimate consequence, viz. that after a number of years English should be the language of the courts as well as of education, and to protect those belonging to the old order of knowledge from the competition of young Maltese better educated than themselves, whose rapid rise everywhere would be assured by knowing English thoroughly. An order in council was enacted in 1899 providing that no Maltese (except students of theology) should thenceforth suffer any detriment through inability to pass examinations in Italian, in either the schools or university, but the fraction of the Maltese who claim to speak Italian (13·24%) still command sufficient influence to hamper the full enjoyment of this emancipation by the majority. In the university most of the textbooks used are English, nevertheless many of the lectures are still delivered in Italian—for the convenience of some professors or to please the politicians, rather than for the benefit of the students. The number of students who enter the university without passing any examination in Italian is rapidly increasing; the longer the period of transition, the greater the detriment to the rising generation.

History and Antiquities.—The earliest inhabitants of Malta (Melita) and Gozo (Gaulos) belonged to a culture-circle which included the whole of the western Mediterranean, and to a race which perhaps originated from North Africa; and it is they, and not the Phoenicians, who were the builders of the remarkable megalithic monuments which these islands contain, the Gigantia in Gozo, Hagiar Kim and Mnaidra near Crendi, the rock-cut hypogeum of Halsaflieni,[1] and the megalithic buildings on the hill of Corradino in Malta, being the most noteworthy. The contemporaneity of these structures has been demonstrated by the identity of the pottery and other objects discovered in them, including some remarkable steatopygic figures in stone, and it is clear that they belong to the neolithic period, numerous flints, but no metal, having been found. Those that have been mentioned seem to have been sanctuaries (some of them in part dwelling-places), but Halsaflieni was an enormous ossuary, of which others may have existed in other parts of the island; for the numerous rock-cut tombs which are everywhere to be seen belong to the Phoenician and Roman periods. In these buildings there is a great preference for apsidal terminations to the internal chambers, and the façades are as a rule slightly curved. The numerous niches, generally containing sacrificial (?) tables,[2] are often approached by window-like openings hewn out of one of the flat slabs by which they are enclosed. The surface of the stones in the interior is often pitted, as a form of ornamentation. Even the barren islet of Comino, between Malta and Gozo, was inhabited in prehistoric times.

To the Phoenician period, besides the tombs already mentioned, belong some remains of houses and cisterns, and (probably) a few round towers which are scattered about the island, while the important Roman house at Cittavecchia is the finest monument of this period in the islands.

The Carthaginians came to Malta in the 6th century B.C., not as conquerors, but as friends of a sister Phoenician colony (Freeman, *Hist. Sicily*, i. 255): Carthage in her struggle with Rome was at last driven to levy oppressive tribute, whereupon the Maltese gave up the Punic garrison to Titus Sempronius under circumstances described by Livy (xxi. 51). The Romans did not treat the Maltese as conquered enemies, and at once gave them the privileges of a *municipium*; Cicero (*in Verrem*) refers to the Maltese as "Socii." Nothing was to be gained by displacing the Phoenician inhabitants in a country from which any race less thrifty would find life impossible by agriculture. On the strength of a monument bearing his name, it has been surmised that Hannibal was born in Malta, while his father was governor-general of Sicily; he certainly did not die in Malta. There is evidence from Cicero (*in Verrem*) that a very high stage of manufacturing and commercial prosperity, attained in

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[1] See T. Zammit, *The Halsaflieni prehistoric hypogeum at Casal Paula, Malta* (Malta, 1910).

[2] Sometimes the pillar which represents the *baetylus*, which seems to have been the object of worship (see A. J. Evans in *Journal of Hellenic Studies*, xxi., 1901) stands free sometimes it serves as support to the table stone which covers the niche, and sometimes again monolithic tables occur. Conical stones (possibly themselves *baetyli*) are also found.

Carthaginian times, continued in Malta under the Romans. The Phoenician temple of Juno, which stood on the site of Fort St Angelo, is also mentioned by Valerius Maximus. An inscription records the restoration of the temple of Proserpine by Cheriston, a freed-man of Augustus and procurator of Malta. Diodorus Siculus (L. V., c. 4) speaks of the importance and ornamentation of Maltese dwellings, and to this day remains of palaces and dwellings of the Roman period indicate a high degree of civilization and wealth. When forced to select a place of exile, Cicero was at first (*ad Att.* III. 4, X. i. 8, 9) attracted to Malta, over which he had ruled as quaestor 75 B.C. Among his Maltese friends were Aulus Licinius and Diodorus. Lucius Castricius is mentioned as a Roman governor under Augustus. Publius was "chief of the island" when St Paul was shipwrecked (Acts xxvii. 7); and is said to have become the first Christian bishop of Malta. The site where the cathedral at Notabile now stands is reputed to have been the residence of Publius and to have been converted by him into the first Christian place of worship, which was rebuilt in 1090 by Count Roger, the Norman conqueror of Malta. The Maltese catacombs are strikingly similar to those of Rome, and were likewise used as places of burial and of refuge in time of persecution. They contain clear indication of the interment of martyrs. St Paul's Bay was the site of shipwreck of the apostle in A.D. 58; the "topon diathalasson" referred to in Acts is the strait between Malta and the islet of Selmun. The claim that St Paul was shipwrecked at Meleda off the Dalmatian coast, and not at Malta, has been clearly set at rest, on nautical grounds, by Mr Smith of Jordanhill (*Voyage and Shipwreck of St Paul*, London, 1848). According to tradition and to St Chrysostom (*Hom.* 54) the stay of the apostle resulted in the conversion of the Maltese to Christianity. The description of the islanders in Acts as "barbaroi" confirms the testimony of Diodorus Siculus that they were Phoenicians, neither hellenized nor romanized. The bishopric of Malta is referred to by Rocco Pirro (*Sicilia sacra*), and by Gregory the Great (*Epist.* 2, 44; 9, 63; 10, 1). It appears that Malta was not materially affected by the Greek schism, and remained subject to Rome.

On the final division of the Roman dominions in A.D. 395 Malta was assigned to the empire of Constantinople. On the third Arab invasion, A.D. 870, the Maltese joined forces against the Byzantine garrison, and 3000 Greeks were massacred. Unable to garrison the island with a large force, the Arabs cleared a zone between the central stronghold, Medina, and the suburb called Rabat, to restrict the fortified area. Many Arab coins, some Kufic inscriptions and several burial-places were left by the Arabs; but they did not establish their religion or leave a permanent impression on the Phoenician inhabitants, or deprive the Maltese language of the characteristics which differentiate it from Arabic. There is no historical evidence that the domination of the Goths and Vandals in the Mediterranean ever extended to Malta: there are fine Gothic arches in two old palaces at Notabile, but these were built after the Norman conquest of Malta. In 1090 Count Roger the Norman (son of Tancred de Hauteville), then master of Sicily, came to Malta with a small retinue; the Arab garrison was unable to offer effective opposition, and the Maltese were willing and able to welcome the Normans as deliverers and to hold the island after the immediate withdrawal of Count Roger. A bishop of Malta was witness to a document in 1090. The Phoenician population had continued Christian during the mild Arab rule. Under the Normans the power of the Roman Church quickly augmented, tithes were granted, and ecclesiastical buildings erected and endowed. The Normans, like the Arabs, were not numerically strong; the rule of both, in Sicily as well as Malta, was based on a recognition of municipal institutions under local officials; the Normans, however, exterminated the Mahommedans. Gradually feudal customs asserted themselves. In 1193 Margarito Brundusio received Malta as a fief with the title of count; he was Grand Admiral of Sicily. Constance, wife of the emperor Henry IV. of Germany became, in 1194, heiress of Sicily and Malta; she was the last of the Norman dynasty. The Grand Admiral of Sicily in 1223 was Henry, count of Malta. He had led 300 Maltese at the capture of two forts in Tripoli by the Genoese. In 1265 Pope Alexander IV. conferred the crown of Sicily on Charles of Anjou to the detriment of Manfred, from whom the French won the kingdom at the battle of Benevento. Under the will of Corradino a representative of the blood of Roger the Norman, Peter of Aragon claimed the succession, and it came to him by the revolution known as "the Sicilian Vespers" when 28,000 French were exterminated in Sicily. Charles held Malta for two years longer, when the Aragonese fleet met the French off Malta, and finally crushed them in the Grand Harbour. In 1427 the Turks raided Malta and Gozo, they carried many of the inhabitants into captivity, but gained no foothold. The Maltese joined the Spaniards in a disastrous raid against Gerbi on the African coast in 1432. In 1492 the Aragonese expelled the Jews. Dissatisfaction arose under Aragonese rule from the periodical grants of Malta, as a marquisate or countship, to great officers of state or illegitimate descendants of the sovereign. Exemption was obtained from these incidences of feudalism by large payments to the Crown in return for charters covenanting that Malta should for ever be administered under the royal exchequer without the intervention of intermediary feudal lords. This compact was twice broken, and in 1428 the Maltese paid King Alfonso 30,000 florins for a confirmation of privileges, with a proviso that entitled them to resist by force of arms any intermediate lord that his successors might attempt to impose. Under the Aragonese, Malta, as regards local affairs, was administered by a *Università* or municipal commonwealth with wide and indefinite powers, including the election of its officers, Capitan di Verga, Jurats, &c. The minutes of the "Consiglio Popolare" of this period are preserved, showing it had no legislative power; this was vested in the king, and was exercised despotically in the interests of the Crown. The knights of St John having been driven from Rhodes by the Turks, obtained the grant of Malta, Gozo and Tripoli in 1530 from the emperor Charles V., subject to a reversion in favour of the emperor's successor in the kingdom of Aragon should the knights leave Malta, and to the annual tribute of a falcon in acknowledgment that Malta was under the suzerainty of Spain. The Maltese, at first, challenged the grant as a breach of the charter of King Alfonso, but eventually welcomed the knights. The Grand Master de l'Isle Adam, on entering the ancient capital of Notabile, swore for himself and his successors to maintain the rights and liberties of the Maltese. The Order of St John took up its abode on the promontory guarded by the castle of St Angelo on the southern shore of the Grand Harbour, and, in expectation of attacks from the Turks, commenced to fortify the neighbouring town called the Borgo. The knights lived apart from the Maltese, and derived their principal revenues from estates of the Order in the richest countries of Europe. They accumulated wealth by war, or by privateering against the Turks and their allies. The African Arabs under Selim Pasha in 1551 ravaged Gozo, after an unsuccessful attempt on Malta, repulsed by cavalry under Upton, an English knight. The Order of St John and the Christian Maltese now realized that an attempt to exterminate them would soon be made by Soliman II., and careful preparations were made to meet the attack.

The great siege of Malta which made the island and its knights famous, and checked the advance of Mahommedan power in southern and western Europe, began in May 1565. The fighting men of the defenders are variously recorded between 6100 and 9121; the roll comprises one English knight, Oliver Starkey. The Mahommedan forces were estimated from 29,000 to 38,500. Jehan Parisot de la Valette had participated in the defence of Rhodes, and in many naval engagements. He had been taken prisoner by Dragut, who made him row for a year as a galley slave till ransomed. This Grand Master had gained the confidence of Philip of Spain, the friendship of the viceroy of Sicily, of the pope and of the Genoese admiral, Doria. The Sultan placed his troops under the veteran Mustapha, and his galleys under his youthful relative Piali, he hesitated to make either supreme and ordered them to await the arrival of Dragut with his Algerian allies, before deciding on their final plans. Meanwhile, against Mustapha's better judgment, Piali induced the council of war to attack St Elmo, in order to open the way for his fleet to an anchorage, safe in all weathers, in Marsamuscetto harbour. This strategical blunder was turned to the best advantage by La Valette, who so prolonged the most heroic defence of St Elmo that the Turks lost 7000 killed and as many wounded before exterminating the 1200 defenders, who fell at their post. In the interval Dragut was mortally wounded, the attack on Notabile was neglected, valuable time lost, and the main objective (the Borgo) and St Angelo left intact. The subsequent siege of St Angelo, and its supporting fortifications, was marked by the greatest bravery on both sides. The knights and their Maltese troops fought for death or victory, without asking or giving quarter. The Grand Master proved as wise a leader as he was brave. By September food and ammunition were getting scarce, a large relieving force was expected from Sicily, and Piali became restive, on the approach of the equinox, for the safety of his galleys. At last the viceroy of Sicily, who had the Spanish and allied fleets at his disposal, was spurred to action by his council. He timidly landed about 6000 or 8000 troops at the north-west of Malta and withdrew. The Turks began a hurried embarcation and allowed the Christians to join forces at Notabile; then, hearing less alarming particulars of the relieving force, Mustapha relanded his reluctant troops, faced his enemies in the open, and was driven in confusion to his ships on the 8th of September.

The Order thus reached the highest pinnacle of its fame, and new knights flocked to be enrolled therein from the flower of the nobility of Europe; La Valette refused a cardinal's hat, determined not to impair his independence. He made his name immortal by founding on Mt Sceberras " a city built by gentlemen for gentlemen " and making Valletta a magnificent example of fortification, unrivalled in the world. The pope and other sovereigns donated vast sums for this new bulwark of Christianity, but, as its ramparts grew in strength, the knights were slow to seek the enemy in his own waters, and became false to their traditional strategy as a naval power. Nevertheless, they harassed Turkish commerce and made booty in minor engagements throughout the 16th and 18th centuries, and they took part as an allied Christian power in the great victory of Lepanto. With the growth of wealth and security the martial spirit of the Order began to wane, and so also did its friendly relations with the Maltese. The field for recruiting its members, as well as its landed estates, became restricted by the Reformation in England and Germany, and the French knights gradually gained a preponderance which upset the international equilibrium of the Order. The election of elderly Grand Masters became prevalent, the turmoil and chances of frequent elections being acceptable to younger members. The civil government became neglected and disorganized, licentiousness increased, and riots began to be threatening. Expenditure on costly buildings was almost ceaseless, and kept the people alive. In 1614 the Vignacourt aqueduct was constructed. The Jesuits established a university, but they were expelled and their property confiscated in 1768. British ships of war visited Malta in 1675, and in 1688 a fleet under the duke of Grafton came to Valletta. The fortifications of the " Three Cities " were greatly strengthened under the Grand Master Cotoner.

In 1722 the Turkish prisoners and slaves, then very numerous, formed a conspiracy to rise and seize the island. Premature discovery was followed by prompt suppression. Castle St Angelo and the fort of St James were, in 1775, surprised by rebels, clamouring against bad government; this rising is known as the Rebellion of the Priests, from its leader, Mannarino. The last but one of the Grand Masters who reigned in Malta, de Rohan, restored good government, abated abuses and promulgated a code of laws; but the ascendancy acquired by the Inquisition over the Order, the confiscation of the property of the knights in France on the outbreak of the Revolution, and the intrigues of the French made the task of regenerating the Order evidently hopeless in the changed conditions of Christendom. On the death of Rohan the French knights disagreed as to the selection of his successor, and a minority were able to elect, in 1797, a German of weak character, Ferdinand Hompesch, as the last Grand Master to rule in Malta. Bonaparte had arranged to obtain Malta by treachery, and he took possession without resistance in June 1798; after a stay of six days he proceeded with the bulk of his forces to Egypt, leaving General Vaubois with 6000 troops to hold Valletta. The exiled knights made an attempt to reconstruct themselves under the emperor Paul of Russia, but finally the Catholic parent stem of the Order settled in Rome and continues there under papal auspices. It still comprises members who take vows of celibacy and prove the requisite number of quarterings.

Towards the close of the rule of the knights in Malta feudal institutions had been shaken to their foundations, but the transition to republican rule was too sudden and extreme for the people to accept it. The French plundered the churches, abolished monks, nuns and nobles, and set up forthwith the ways and doings of the French Revolution. Among other laws Bonaparte enacted that French should at once be the official language, that 30 young men should every year be sent to France for their education; that all foreign monks be expelled, that no new priests be ordained before employment could be found for those existing; that ecclesiastical jurisdiction should cease; that neither the bishop nor the priests could charge fees for sacramental ministrations, &c. Stoppage of trade, absence of work (in a population of which more than half had been living on foreign revenues of the knights), and famine, followed the defeat of Bonaparte at the Nile, and the failure of his plans to make Malta a centre of French trade. An attempt to seize church valuables at Notabile was forcibly resisted by the Maltese, and general discontent broke out into open rebellion on the 2nd of September 1798. The French soon discovered to their dismay that, from behind the rubble walls of every field, the agile Maltese were unassailable. The prospect of an English blockade of Malta encouraged the revolt, of which Canon Caruana became the leader. Nelson was appealed to, and with the aid of Portuguese allies he established a blockade and deputed Captain Ball, R.N. (afterwards the first governor) to assume, on the 9th of February 1799, the provisional administration of Malta and to superintend operations on land. Nelson recognized the movement in Malta as a successful revolution against the French, and upheld the contention that the king of Sicily (as successor to Charles V. in that part of the former kingdom of Aragon) was the legitimate sovereign of Malta. British troops were landed to assist in the siege; few lives were lost in actual combat, nevertheless famine and sickness killed thousands of the inhabitants, and finally forced the French to surrender to the allies. Canon Caruana and other leaders of the Maltese aspired to obtain for Malta the freedom of the Roman Catholic religion guaranteed by England in Canada and other dependencies, and promoted a petition in order that Malta should come under the strong power of England rather than revert to the kingdom of the two Sicilies.

The Treaty of Amiens (1802) provided for the restoration of the island to the Order of St John; against this the Maltese strongly protested, realizing that it would be followed by the re-establishment of French influence. The English flag was flown side by side with the Neapolitan, and England actually renewed war with France sooner than give up Malta. The Treaty of Paris (1814), with the acclamations of the Maltese, confirmed Great Britain in the aggregation of Malta to the empire.

A period elapsed before the government of Malta again became self-supporting, during which over £600,000 was contributed by the British exchequer in aid of revenue, and for the importation of food-stuffs. The restoration of Church property, the re-establishment of law and administration on lines to which the people were accustomed before the French invasion, and the claiming for the Crown of the vast landed property of the knights, were the first cares of British civil rule. As successor to the Order, the Crown claimed and eventually established (by the negotiations in Rome of Sir Frederick Hankey, Sir Gerald Strickland and

Sir Lintorn Simmons) with regard to the presentation of the bishopric (worth about £4000 a year) the right to veto the appointment of distasteful candidates. This right was exercised to secure the nomination of Canon Caruana and later of Monsignor Pace. When the pledge, given by the Treaty of Amiens, to restore the Order of St John with a national Maltese "langue," could not be fulfilled, political leaders began demanding instead the re-establishment of the " Consiglio Popolare " of Norman times (without reflecting that it never had legislative power); but by degrees popular aspirations developed in favour of a free constitution on English lines. The British authorities steadily maintained that, at least until the mass of the people became educated, representative institutions would merely screen irresponsible oligarchies. After the Treaty of Paris stability of government developed, and many important reforms were introduced under the strong government of the masterful Sir Thomas Maitland; he acted promptly, without seeking popularity or fearing the reverse, and he ultimately gained more real respect than any other governor, not excepting the marquess of Hastings, who was a brilliant and sympathetic administrator. Trial by jury for criminal cases was established in 1829. A council of government, of which the members were nominated, was constituted by letters patent in 1835, but this measure only increased the agitation for a representative legislature. Freedom of the press and many salutary innovations were brought about on a report of John Austin and G. C. Lewis, royal commissioners, appointed in 1836. The basis of taxation was widened, sinecures abolished, schools opened in the country districts, legal procedure simplified, and Police established on an English footing. Queen Adelaide vistied Malta in 1838 and founded the Anglican collegiate church of St Paul. Sir F. Hankey as chief secretary was for many years the principal official of the civil administration. In 1847 Mr R. Moore O'Ferrall was appointed civil governor. In June 1849 the constitution of the council was altered to comprise ten nominated and eight elected members.

The revolutions in Italy caused about this time many, including Crispi and some of the most intellectual Italians, to take refuge in Malta. These foreigners introduced new life into politics and the press, and made it fashionable for educated Maltese to delude themselves with the idea that the Maltese were Italians, because a few of them could speak the language of the peninsula. A clerical reaction followed against new progressive ideas and English methods of development. After much unreasoning vituperation the Irish Catholic civil governor, who had arrived amidst the acclamations of all, left his post in disgust. His successor as civil governor was Sir W. Reid, who had formerly held military command. His determined attempts to promote education met with intense opposition and little success. At this period the Crimean War brought great wealth and commercial prosperity to Malta. Under Sir G. Le Marchant, in 1858, the nominal rule of military governors was re-established, but the civil administration was largely confided to Sir Victor Houlton as chief secretary, whilst the real power began to be concentrated in the hands of Sir A. Dingli, the Crown advocate, who was the interpreter of the law, and largely its maker, as well as the principal depository of local knowledge, able to prevent the preferment of rivals, and to countenance the barrier which difference of language created between governors and governed. The civil service gravitated into the hands of a clique. At this period much money was spent on the Marsa extension of the Grand Harbour, but the rapid increase in the size of steamships made the scheme inadequate, and limited its value prematurely. The military defences were entirely remodelled under Sir G. Le Marchant, and considerable municipal improvements and embellishments were completed. But this governor was obstructed and misrepresented by local politicians as vehemently as his predecessors and his successors. Ministers at home have often appeared to be inclined to the policy of pleasing by avoiding the reforming of what might be left as it was found. Sir A. Dingli adapted a considerable portion of the Napoleonic Code in a series of Malta Ordinances, but stopped short at points likely to cause agitation. Sir P. Julyan was appointed royal commissioner on the civil establishments, and Sir P. Keenan on education; their work revived the reform movement in 1881. Mr Savona led an agitation for a more sincere system of education on English lines. Fierce opposition ensued, and the *pari passu* compromise was adopted to which reference is made in the section on *Education* above; Mr Savona was an able organizer, and began the real emancipation of the Maltese masses from educational ignorance; but he succumbed to agitation before accomplishing substantial results.

An executive council was established in 1881, and the franchise was extended in 1883. A quarter of a century of Sir Victor Houlton's policy of *laissez-faire* was changed in 1883 by the appointment of Sir Walter Hely-Hutchinson as chief secretary. An attempt was made to utilize fully the abilities of this eminent administrator by creating him civil lieutenant-governor, in whom to concentrate both the real and the nominal power of detailed administration; but the military authorities objected to his corresponding directly with the Colonial Office; and a political deadlock began to develop. Sir A. Dingli was transferred from an administrative office to that of chief justice. With the continuance of military power over details, the public could not understand where responsibility really rested. The elected members under the leadership of Dr Mizzi clamoured for more power, opposed reforms and protested against the carrying of government measures by the casting vote of a military governor as president of the council. To force a crisis, abstention of elected members from the council was resorted to, together with the election of notoriously unfit candidates. Under these circumstances a constitution of a more severe type was recommended by those responsible for the government of Malta and was about to be adopted, as the only alternative to a deadlock, by the imperial authorities.

A regulation excluding Maltese from the navy (because of their speaking on board a language that their officers did not understand) provoked from Trinity College, Cambridge, the Strickland correspondence in *The Times* on the constitutional rights of the Maltese, and a leading article induced the Colonial Office to try an experiment known as the Strickland-Mizzi Constitution of 1887. This constitution (abolished in 1903) ended a period of government by presidential casting votes and official ascendancy. For the first time the elected members were placed in a majority; they were given three seats in the executive council; in local questions the government had to make every effort to carry the majority by persuasion. When persuasion failed and imperial interests, or the rights of unrepresented minorities, were involved the power of the Crown to legislate by order in council could be (and was) freely used. This system had the merit of counteracting any abuse of power by the bureaucracy. It brought to bear on officials effective criticism, which made them alert and hard-working. Governor Simmons eventually gave his support to the new constitution, which was received with acclamation. Strickland, who had been elected while an undergraduate on the cry of equality of rights for Maltese and English, and Mizzi, the leader of the anti-English agitation, were, as soon as elected, given seats in the executive council to co-operate with the government; but their aims were irreconcilable. Mizzi wanted to undo the educational forms of Mr Savona, to ensure the predominance of the Italian language and to work the council as a caucus. Strickland desired to replace bureaucratic government by a system more in touch with the independent gentlemen of the country, and to introduce English ideas and precedents. Friction soon arose. Mizzi cared little for a constitution that did not make him complete master of the situation, and resigned his post in the government.

Sir Walter Hely-Hutchinson left Malta in March 1889, and was succeeded by Sir Gerald Strickland (Count Della Catena), who lost no time in pushing, and carrying with a rapidity that was considered hasty, reforms that had been retarded for years. The majorities behind the government began to dwindle and agitation to grow. Meanwhile the Royal Malta Militia was established as a link between the Maltese and the garrison. The police were reorganized with proper pay, criminal laws were rigorously enforced. A naval officer was placed over the police to diminish difficulties with the naval authorities and sailors. A marine force was raised to stop smuggling; and the subtraction of coal during coaling operations was stopped by drastic legislation. The civil service was reorganized so as to reward merit and work by promotion. Tenders were strictly enforced in letting government property and contracts; a largely increased revenue was applied on water supply, drainage and other works. Lepers were segregated by law.

The Malta marriage question evoked widespread agitation; Sir A. Dingli had refrained from making any provision in his code as to marrying. The Maltese relied on the Roman Canon Law, the English on the common law of England, Scots or Irish had nothing but the English law to fall back upon. Maltese authorities were ignorant of the disabilities of British Nonconformists at common law, and they had not perceived that persons with a British domicile could not evade their own laws by marrying in Malta, *e.g.* that an English girl up to the age of 21 required the father's or guardian's consent from which a Maltese was legally exempt at 18. Sir G. Strickland preferred legislation to the covering up of difficulties by governors' licences and appeals to incongruous precedents. Sir Lintorn Simmons was appointed envoy to the Holy See, to ascertain how far legislation might be pushed in the direction of civil marriage without justifying clerical agitation and obstruction in the council. He succeeded in coming to an agreement with Rome. Nevertheless Sir A. Dingli and ecclesiastics of all denominations, for conflicting reasons, swelled the opposition against the liberal concessions obtained from Leo XIII. The legal necessity for legislation in accordance with the agreement was, nevertheless, on a special reference, submitted to the privy council, whose decision affirmed the advisibility of legislation and the need for validating retrospectively marriages not supported by either Maltese or English common law. Agitation in the imperial parliament stopped government action, but the publicity of the finding of the privy council warned all concerned against the risk of neglecting the common law of the empire whenever they were not prepared to follow the *lex loci contractus.*

Since the British occupation it was disputed whether the military authorities had the right to alienate for the benefit of the imperial exchequer fortress sites no longer required for defence. The reversion of such property was claimed for the local civil government, and the principles governing these rights were ultimately laid down by an order in council, which also determined military rights to restrict buildings within the range of forts. The co-operation of naval and military authorities was obtained for the construction, at imperial expense, of the breakwater designed to save Malta from being abandoned by long and deep draft modern vessels. British-born subjects were given the right to be tried in English. The new system of education (already described) was set up, and many new schools were built with funds provided by order in council against the wishes of the elected majority.

An order in council (1899) making English the language of the courts after fifteen years (by which the Maltese would have obtained the right to be tried in English) was promulgated at a time when the system of taxation was also being revised; henceforth agitation in favour of Italian and against taxation attained proportions unpleasant for those who preferred popularity to reform and progress. The elected members demanded the recall of Sir G. Strickland on his refusing to change his policy. The military governor gave way, as regards making English the language of the courts on a fixed date, but educational reforms and the imposition of new taxes (those in Malta being 27s. 6d. per head, against 93s. in England) were enacted by an order in council notwithstanding the agitation. Mr Mereweather was appointed chief secretary and civil lieutenant-governor in 1902, and Sir Gerald Strickland became governor and commander-in-chief of the Leeward Islands. Governor Sir F. Grenfell was created a peer. Strenuous efforts were made to placate the Italian party in the administration of the educational reforms; but, as these were not repealed, elected members refused supply, and kept away from the council. Persistence in this course led to the repeal by letters-patent of 1903 of the Strickland-Mizzi Constitution of 1887. In place of occasional orders in council for important matters in urgent cases, bureaucratic government with an official majority was again, with its drawbacks, fully re-established for all local affairs great and small. The representatives of the people were repeatedly re-elected, only to resign again and again as a protest against a restricted constitution.

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MALTA (or MEDITERRANEAN) **FEVER,** a disease long prevalent of Malta and formerly at Gibraltar, as well as other Mediterranean centres, characterized by prolonged high temperature, with anaemia, pain and swelling in the joints, and neuritis, lasting on an average four months but extending even to two or three years. Its pathology was long obscure, but owing to conclusive research on the part of Colonel (afterwards Sir) David Bruce, to which contributions were made by various officers of the R.A.M.C. and others, this problem had now been solved. A specific microorganism, the *Micrococcus melitensis*, was discovered in 1887, and it was traced to the milk of the Maltese goats. A commission was sent out to Malta in 1904 to investigate the question, and after three years' work its conclusions were embodied in a report by Colonel Bruce in 1907. It was shown that the disappearance of the disease from Gibraltar had synchronized with the non-importation of goats from Malta; and preventive measures adopted in Malta in 1906, by banishing goats' milk from the military and naval dietary, put a stop to the occurrence of cases. In the treatment of Malta fever a vaccine has been used with considerable success.

MALTE-BRUN, CONRAD (1755–1826), French geographer, was born on the 12th of August 1755 at Thisted in Denmark, and died at Paris on the 14th of December 1826. His original name was Malte Conrad Bruun. While a student at Copenhagen he made himself famous partly by his verses, but more by the violence of his political pamphleteering; and at length, in 1800, the legal actions which the government authorities had from time to time instituted against him culminated in a sentence of banishment. The principles which he had advocated were those of the French Revolution, and after first seeking asylum in Sweden he found his way to Paris. There he looked forward to a political career; but, when Napoleon's personal ambition began to unfold itself, Malte-Brun was bold enough to protest, and to turn elsewhere for employment and advancement. He was associated with Edme Mentelle (1730–1815) in the compilation of the *Géographie mathématique . . . de toutes les parties du monde* (Paris, 1803–1807, 16 vols.), and he became recognized as one of the best geographers of France. He is remembered, not only as the author of six volumes of the learned *Précis de la géographie universelle* (Paris, 1810–1829), continued by other hands after his death, but also as the originator of the *Annales des voyages* (1808), and one of the founders of the Geographical Society of Paris. His second son, VICTOR ADOLPHE MALTE-BRUN (1816–1889), followed his father's career of geographer, and was a voluminous author.

MALTHUS, THOMAS ROBERT (1766–1834), English economist, was born in 1766 at the Rookery, near Guildford, Surrey, a small estate owned by his father, Daniel Malthus, a gentleman of good family and independent fortune, of considerable culture, the friend and correspondent of Rousseau and one of his executors. Young Malthus was never sent to a public school, but received his education from private tutors. In 1784 he was sent to Cambridge, where he was ninth wrangler, and became fellow of his college (Jesus) in 1797. The same year he received orders, and undertook the charge of a small parish in Surrey. In the following year he published the first edition of his great work, *An Essay on the Principle of Population as it affects the Future Improvement of Society, with Remarks on the Speculations of Mr Godwin, M. Condorcet, and other Writers.* The work excited a good deal of surprise as well as attention; and with characteristic thoroughness and love of truth the author went abroad to collect materials for the verification and more exhaustive treatment of his views. As Britain was then at war with France, only the northern countries of Europe were quite open to his research at that time; but during the brief Peace of Amiens Malthus continued his investigations in France and Switzerland. The result of these labours appeared in the greatly enlarged and more mature edition of his work published in 1803. In 1805 Malthus married happily, and not long after was appointed professor of modern history and political economy in the East India Company's College at Haileybury. This post he retained till his death suddenly from heart disease on the 23rd of December 1834. Malthus was one of the most amiable, candid and cultured of men. In all his private relations he was not only without reproach, but distinguished for the beauty of his character. He bore popular abuse and misrepresentation without the slightest murmur or sourness of temper. The aim of his inquiries was to promote the happiness of mankind, which could be better accomplished by pointing out the real possibilities of progress than by indulging in vague dreams of perfectibility apart from the actual facts which condition human life.

Malthus's *Essay on Population* grew out of some discussions which he had with his father respecting the perfectibility of society. His father shared the theories on that subject of Condorcet and Godwin; and his son combated them on the ground that the realization of a happy society will always be hindered by the miseries consequent on the tendency of population to increase faster than the means of subsistence. His father was struck by the weight and originality of his views, asked him to put them in writing, and then recommended the publication of the manuscript. It was in this way the *Essay* saw the light. Thus it will be seen that both historically and philosophically the doctrine of Malthus was a corrective reaction against the superficial optimism diffused by the school of Rousseau. It was the same optimism, with its easy methods of regenerating society and its fatal blindness to the real conditions that circumscribe human life, that was responsible for the wild theories of the French Revolution and many of its consequent excesses.

The project of a formal and detailed treatise on population was an afterthought of Malthus. The essay in which he had studied a hypothetic future led him to examine the effects of the principle he had put forward on the past and present state of society; and he undertook an historical examination of these effects, and sought to draw such inferences in relation to the actual state of things as experience seemed to warrant. In its original form he had spoken of no checks to population but those which came under the head either of vice or of misery. In the 1803 edition he introduced the new element of the preventive check supplied by what he calls "moral restraint," and is thus enabled to "soften some of the harshest conclusions" at which he had before arrived. The treatise passed through six editions in his lifetime, and in all of them he introduced various additions and corrections. That of 1816 is the last he revised, and supplies the final text from which it has since been reprinted.

Notwithstanding the great development which he gave to his work and the almost unprecedented amount of discussion to which it gave rise, it remains a matter of some difficulty to discover what solid contribution he has made to our knowledge, nor is it easy to ascertain precisely what practical precepts, not already familiar, he founded on his theoretic principles. This twofold vagueness is well brought out in his celebrated correspondence with Nassau Senior, in the course of which it seems to be made apparent that his doctrine is new not so much in its essence as in the phraseology in which it is couched. He himself tells us that when, after the publication of the original essay, the main argument of which he had deduced from David Hume, Robert Wallace, Adam Smith and Richard Price, he began to inquire more closely into the subject, he found that "much more had been done" upon it "than he had been aware of." It had "been treated in such a manner by some of the French economists, occasionally by Montesquieu, and, among English writers, by Dr Franklin, Sir James Steuart, Arthur Young and Rev. J. Townsend, as to create a natural surprise that it had not excited more of the public attention." "Much, however," he thought, "remained yet to be done. The comparison between the increase of population and food had not, perhaps, been stated with sufficient force and precision," and "few inquiries had been made into the various modes by which the level" between population and the means of subsistence "is effected." The first desideratum here mentioned—the want, namely, of an accurate statement of the relation between the increase of population and food—Malthus doubtless supposed to have been supplied by the celebrated proposition that "population increases in a geometrical, food in an arithmetical ratio." This proposition, however, has been conclusively shown to be erroneous, there being no such difference of law between the increase of man and that of the organic beings which form his food. When the formula cited is not used, other somewhat nebulous expressions are sometimes employed, as, for example, that "population has a tendency to increase faster than food," a sentence in which both are treated as if they were spontaneous growths, and which, on account of the ambiguity of the word "tendency," is admittedly consistent with the fact asserted by Senior, that food tends to increase faster than population. It must always have been perfectly well known that population will probably (though not necessarily) increase with every augmentation of the supply of subsistence, and may, in some instances, inconveniently press upon, or even for a certain time exceed, the number properly corresponding to that supply. Nor could it ever have been doubted that war, disease, poverty—

the last two often the consequences of vice—are causes which keep population down. In fact, the way in which abundance, increase of numbers, want, increase of deaths, succeed each other in the natural economy, when reason does not intervene, had been fully explained by Joseph Townsend in his *Dissertation on the Poor Laws* (1786) which was known to Malthus. Again, it is surely plain enough that the apprehension by individuals of the evils of poverty, or a sense of duty to their possible offspring, may retard the increase of population, and has in all civilized communities operated to a certain extent in that way. It is only when such obvious truths are clothed in the technical terminology of "positive" and "preventive checks" that they appear novel and profound; and yet they appear to contain the whole message of Malthus to mankind. The laborious apparatus of historical and statistical facts respecting the several countries of the globe, adduced in the altered form of the essay, though it contains a good deal that is curious and interesting, establishes no general result which was not previously well known.

It would seem, then, that what has been ambitiously called Malthus's theory of population, instead of being a great discovery as some have represented it, or a poisonous novelty, as others have considered it, is no more than a formal enunciation of obvious, though sometimes neglected, facts. The pretentious language often applied to it by economists is objectionable, as being apt to make us forget that the whole subject with which it deals is as yet very imperfectly understood—the causes which modify the force of the sexual instinct, and those which lead to variations in fecundity, still awaiting a complete investigation.

It is the law of diminishing returns from land, involving as it does—though only hypothetically—the prospect of a continuously increasing difficulty in obtaining the necessary sustenance for all the members of a society, that gives the principal importance to population as an economic factor. It is, in fact, the confluence of the Malthusian ideas with the theories of Ricardo, especially with the corollaries which the latter deduced from the doctrine of rent (though these were not accepted by Malthus), that has led to the introduction of population as an element in the discussion of so many economic questions in modern times.

Malthus had undoubtedly the great merit of having called public attention in a striking and impressive way to a subject which had neither theoretically nor practically been sufficiently considered. But he and his followers appear to have greatly exaggerated both the magnitude and the urgency of the dangers to which they pointed.[1] In their conceptions a single social imperfection assumed such portentous dimensions that it seemed to overcloud the whole heaven and threaten the world with ruin. This doubtless arose from his having at first omitted altogether from his view of the question the great counteracting agency of moral restraint. Because a force exists, capable, if unchecked, of producing certain results, it does not follow that those results are imminent or even possible in the sphere of experience. A body thrown from the hand would, under the single impulse of projection, move for ever in a straight line; but it would not be reasonable to take special action for the prevention of this result, ignoring the fact that it will be sufficiently counteracted by the other forces which will come into play. And such other forces exist in the case we are considering. If the inherent energy of the principle of population (supposed everywhere the same) is measured by the rate at which numbers increase under the most favourable circumstances, surely the force of less favourable circumstances, acting through prudential or altruistic motives, is measured by the great difference between this maximum rate and those which are observed to prevail in most European countries. Under a rational system of institutions, the adaptation of numbers to the means available for their support is effected by the felt or anticipated pressure of circumstances and the fear of social degradation, within a tolerable degree of approximation to what is desirable. To bring the result nearer to the just standard, a higher measure of popular enlightenment and more serious habits of moral reflection ought indeed to be encouraged. But it is the duty of the individual to his possible offspring, and not any vague notions as to the pressure of the national population on subsistence, that will be adequate to influence conduct.

It can scarcely be doubted that the favour which was at once accorded to the views of Malthus in certain circles was due in part to an impression, very welcome to the higher ranks of society, that they tended to relieve the rich and powerful of responsibility for the condition of the working classes, by showing that the latter had chiefly themselves to blame, and not either the negligence of their superiors or the institutions of the country. The application of his doctrines, too, made by some of his successors had the effect of discouraging all active effort for social improvement. Thus Chalmers "reviews *seriatim* and gravely sets aside all the schemes usually proposed for the amelioration of the economic condition of the people" on the ground that an increase of comfort will lead to an increase of numbers, and so the last state of things will be worse than the first.

Malthus has in more modern times derived a certain degree of reflected lustre from the rise and wide acceptance of the Darwinian hypothesis. Its author himself, in tracing its filiation, points to the phrase "struggle for existence" used by Malthus in relation to the social competition. Darwin believed that man advanced to his present high condition through such a struggle, consequent on his rapid multiplication. He regarded, it is true, the agency of this cause for the improvement of the race as largely superseded by moral influences in the more advanced social stages. Yet he considered it, even in these stages, of so much importance towards that end that, notwithstanding the individual suffering arising from the struggle for life, he deprecated any great reduction in the natural, by which he seems to mean the ordinary, rate of increase.

Besides his great work, Malthus wrote *Observations on the Effect of the Corn Laws*; *An Inquiry into the Nature and Progress of Rent*; *Principles of Political Economy*; and *Definitions in Political Economy*. His views on rent were of real importance.

For his life see *Memoir* by his friend Dr Otter, bishop of Chichester (prefixed to 2nd ed., 1836, of the *Principles of Political Economy*), and *Malthus and his Work*, by J. Bonar (London, 1885). Practically every treatise on economics deals with Malthus and his essay, but the following special works may be referred to: Soetbeer, *Die Stellung der Sozialisten zur Malthusschen Bevölkerungslehre* (Berlin, 1886); G. de Molinari, *Malthus, essai sur le principe de population* (Paris, 1889); Cossa, *Il Principio di popolazione di T. R. Malthus* (Milan, 1895); and Ricardo, *Letters to Malthus*, ed. J. Bonar (1887).

MALTON, a market town in the Thirsk and Malton parliamentary division of Yorkshire, England, 21 m. N.E. of York by a branch of the North Eastern railway. The town comprises Old Malton and New Malton in the North Riding, and Norton on the opposite side of the river Derwent, in the East Riding. Pop. of urban district of Malton (1901), 4758; of urban district of Norton 3842. The situation, on the wooded hills rising from the narrow valley, is very picturesque. The church of St Michael is a fine late Norman building with perpendicular tower; the church of St Leonard, of mixed architecture, with square tower and spire, has three Norman arches and a Norman font. The church of St Mary at Old Malton was attached to a Gilbertine priory founded in 1150; it is transitional Norman and Early English, with later insertions. Remains of the priory are scanty, but include a crypt under a modern house. In the neighbourhood of Malton are the slight but beautiful fragments of Kirkham Abbey, an Early English Augustinian foundation of Walter l'Espec (1131); and the fine mansion of Castle Howard, a massive building by Vanbrugh, the seat of the earls of Carlisle, containing a noteworthy collection of pictures. Malton possesses a townhall, a corn exchange, a museum, and a grammar-school founded in 1547. There are iron and brass foundries, agricultural implement works, corn mills, tanneries and breweries. In the neighbourhood are lime and whinstone quarries.

Traces of a Romano-British village exist on the east side of the town, but there appears to be no history of Malton before the Norman Conquest. The greater part of Malton belonged to the crown in 1086 and was evidently retained until Henry I.

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[1] Malthus himself said, "It is probable that, having found the bow bent too much one way, I was induced to bend it too much the other in order to make it straight."

gave the castle and its appurtenances to Eustace son of John, whose descendants took the name of Vescy. Eustace meditated the deliverance of Malton Castle to King David of Scotland in 1138, but his plans were altered owing to the battle of the Standard. The "burgh" of Malton is mentioned in 1187, and in 1295 the town returned two members to parliament. It was not represented again, however, until 1640, when an act was passed to restore its ancient privileges. In 1867 the number of members was reduced to one, and in 1885 the town was disfranchised. Until the 17th century the burgesses had all the privileges of a borough by prescriptive right, and were governed by two bailiffs and two under-bailiffs, but these liberties were taken from them in 1684 and have never been revived. From that time a bailiff and two constables were appointed at the court leet of the lord of the manor until a local board was formed in 1854. In the 13th century Agnes de Vescy, then lady of the manor, held a market in Malton by prescription, and Camden writing about 1586 says that the lord of the manor then held two weekly markets, on Tuesday and Saturday, the last being the best cattle market in the county. The markets are now held on Saturdays and alternate Tuesdays, and still belong to the lord of the manor.

MALTZAN, HEINRICH VON, BARON ZU WARTENBURG UND PENZLIN (1826–1874), German traveller, was born on the 6th of September 1826 near Dresden. He studied law at Heidelberg, but on account of ill health spent much of his time from 1850 in travel. Succeeding to his father's property in 1852, he extended the range of his journeys to Morocco and other parts of Barbary, and before his return home in 1854 had also visited Egypt, Palestine and other countries of the Levant. In 1856–1857 he was again in Algeria; in 1858 he reached the city of Morocco; and in 1860 he succeeded in performing the pilgrimage to Mecca, which he afterwards described in *Meine Wallfahrt nach Mecca* (Leipzig, 1865), but had to flee for his life to Jidda without visiting Medina. He then visited Aden and Bombay, and after some two years of study in Europe again began to wander through the coasts and islands of the Mediterranean, repeatedly visiting Algeria. His first book of travel, *Drei Jahre im Nordwesten von Afrika* (Leipzig), appeared in 1863, and was followed by a variety of works and essays, popular and scientific. Maltzan's last book, *Reise nach Südarabien* (Brunswick, 1873), is chiefly valuable as a digest of much information about little-known parts of south Arabia collected from natives during a residence at Aden in 1870–1871. Among his other services to science must be noticed his collection of Punic inscriptions (*Reise in Tunis und Tripolis*, Leipzig, 1870), and the editing of Adolph von Wrede's remarkable journey in Hadramut (*Reise in Hadramaut*, &c., Brunswick, 1870). After long suffering from neuralgia, Maltzan died by his own hand at Pisa on the 23rd of February 1874.

MALUS, ÉTIENNE LOUIS (1775–1812), French physicist, was born at Paris on the 23rd of June 1775. He entered the military engineering school at Mezières; but, being regarded as a suspected person, he was dismissed without receiving a commission, and obliged to enter the army as a private soldier. Being employed upon the fortifications of Dunkirk, he attracted the notice of the director of the works, and was selected as a member of the École polytechnique then to be established under G. Monge. After three years at the École he was admitted into the corps of engineers, and served in the army of the Sambre and Meuse; he was present at the passage of the Rhine in 1797, and at the affairs of Ukratz and Altenkirch. In 1798 he joined the Egyptian expedition and remained in the East till 1801. On his return he held official posts successively at Antwerp, Strassburg and Paris, and devoted himself to optical research. A paper published in 1809 ("Sur une propriété de la lumière réfléchie par les corps diaphanes") contained the discovery of the polarization of light by reflection, which is specially associated with his name, and in the following year he won a prize from the Institute with his memoir, "Théorie de la double refraction de la lumière dans les substances cristallines." He died of phthisis in Paris on the 23rd of February 1812.

MALVACEAE, in botany, an order of Dicotyledons belonging to the series Columniferae, to which belong also the orders Tiliaceae (containing *Tilia*, the lime-tree), Bombaceae (containing *Adansonia*, the baobab), Sterculiaceae (containing *Theobroma*, cocoa, and *Colo*, cola-nut). It contains 39 genera with about 300 species, and occurs in all regions except the coldest, the number of species increasing as we approach the tropics. It is represented in Britain by three genera: *Malva*, mallow; *Althaea*, marsh-mallow; and *Lavatera*, tree-mallow. The plants are herbs, as in the British mallows, or, in the warmer parts of the earth, shrubs or trees. The leaves are alternate and often palmately lobed or divided; the stipules generally fall early. The leaves and young shoots often bear stellate hairs and the tissues contain mucilage-sacs. The regular, hermaphrodite, often showy flowers are borne in the leaf-axils, solitary or in fasicles, or form more or less complicated cymose arrangements. An epicalyx (see MALLOW, figs. 3, 4), formed by a whorl of three or more bracteoles is generally present just beneath the calyx; sometimes, as in *Abutilon*, it is absent. The parts of the flowers are typically in fives (fig. 1); the five sepals, which have a valvate aestivation, are succeeded by five often large showy petals which are twisted in the bud; they are free to the base, where they are attached to the staminal tube and fall with it when the flower withers. The very numerous stamens are regarded as arising from the branching of a whorl of five opposite the petals; they are united into a tube at the base, and bear kidney-shaped one-celled anthers which open by a slit across the top (fig. 2). The large spherical pollen-grains are covered with spines. The carpels are one to numerous; when five in number, as in *Abutilon*, they are opposite the petals, or, as in *Hibiscus*, opposite the sepals. In the British genera and many others they are numerous, forming a whorl round the top of the axis in the centre of the flower, the united styles rising from the centre and bearing a corresponding number of stigmatic branches. In *Malope* the numerous carpels are arranged one above the other in vertical rows. One or more anatropous ovules are attached to the inner angle of each carpel; they are generally ascending but sometimes pendulous or horizontal; the position may vary, as in *Abutilon*, in one and the same carpel.

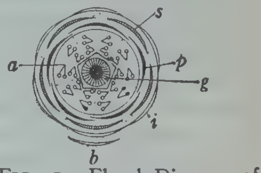


FIG. 1.—Floral Diagram of Hollyhock (*Althaea rosea*).

a, Stamens. b, Bract.
g, Pistil of carpels.
i, Epicalyx, formed from an involucre of bracteoles.
p, Petals. s, Sepals.

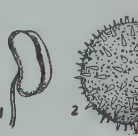


FIG. 2.

1, Anther.
2, Pollen grain of Hollyhock (*Althaea rosea*) enlarged. The pollen grain bears numerous spines, the dark spots indicate thin places in the extine.

The flowers are proterandrous; when the flower opens the unripe stigmas are hidden in the staminal tube and the anthers occupy the centre of the flower; as the anthers dehisce the filaments bend backwards and finally the ripe stigmas spread in the centre. Pollination is effected by insects which visit the flower for the honey, which is secreted in pits one between the base of each petal and is protected from rain by hairs on the lower margin of the petals. In small pale-flowered forms, like *Malva rotundifolia*, which attract few insects, self-pollination has been observed, the style-arms twisting to bring the stigmatic surfaces into contact with the anthers.

Except in *Malvaviscus* which has a berry, the fruits are dry. In *Malva* (see MALLOW) and allied genera they form one-seeded schizocarps separating from the persistent central column and from each other. In *Hibiscus* and *Gossypium* (cotton-plant, *q.v.*), the fruit is a capsule splitting loculicidally. Distribution of the seeds is sometimes aided by hooked outgrowths on the wall of the schizocarp, or by a hairy covering on the seed, an extreme case of which is the cotton-plant where the seed is buried in a mass of long tangled hairs—the cotton. The embryo is generally large with much-folded cotyledons and a small amount of endosperm.

The largest genus, *Hibiscus*, contains 150 species, which are widely distributed chiefly in the tropics; *H, rosasinensis* is a well-known greenhouse plant. *Abutilon* (*q.v.*) contains 80 species, mainly tropical; *Lavatera*, with 20 species, is chiefly Mediterranean; *Althaea* has about 15 species in temperate and warm regions, *A. rosea* being the hollyhock (*q.v.*); *Malva* has about 30 species in the north-temperate zone. Several genera are largely or exclusively American.

MALVASIA (Gr. *Monemvasia*, *i.e.* the "city of the single approach or entrance"; Ital. *Napoli di Malvasia;* Turk. *Mengeshe* or *Beneshe*), one of the principal fortresses and commercial centres of the Levant during the middle ages, still represented by a considerable mass of ruins and a town of about 550 inhabitants. It stood on the east coast of the Morea, contiguous to the site of the ancient Epidaurus Limera, of which it took the place. So extensive was its trade in wine that the name of the place became familiar throughout Europe as the distinctive appellation of a special kind—Ital. *Malvasia;* Span. *Malvagia;* Fr. *Malvoisie;* Eng. *Malvesie* or *Malmsey*. The wine was not of local growth, but came for the most part from Tenos and others of the Cyclades.

As a fortress Malvasia played an important part in the struggles between Byzantium, Venice and Turkey. The Byzantine emperors considered it one of their most valuable posts in the Morea, and rewarded its inhabitants for their fidelity by unusual privileges. Phrantzes (Lib. IV. cap. xvi.) tells how the emperor Maurice made the city (previously dependent in ecclesiastical matters on Corinth) a metropolis or archbishop's see, and how Alexius Comnenus, and more especially Andronicus II. (Palaeologus) gave the Monembasiotes freedom from all sorts of exactions throughout the empire. It was captured after a three years' siege by Guillaume de Villehardouin in 1248, but the citizens retained their liberties and privileges, and the town was restored to the Byzantine emperors in 1262. After many changes, it placed itself under Venice from 1463 to 1540, when it was ceded to the Turks. In 1689 it was the only town of the Morea which held out against Morosini, and Cornaro his successor only succeeded in reducing it by famine. In 1715 it capitulated to the Turks, and on the failure of the insurrection of 1770 the leading families were scattered abroad. As the first fortress which fell into the hands of the Greeks in 1821, it became in the following year the seat of the first national assembly.

See Curtius, *Peloponnesos*, ii. 293 and 328; Castellan, *Lettres sur la Morée* (1808), for a plan; Valiero, *Hist. della guerra di Candia* (Venice, 1679), for details as to the fortress; W. Miller in *Journal of Hellenic Studies* (1907).

MALVERN, an inland watering-place in the Bewdley parliamentary division of Worcestershire, England, 128 m. W.N.W. from London by the Great Western railway, served also by a branch of the Midland railway from Ashchurch on the Bristol-Birmingham line. Pop. of urban district (1901), 16,449. It is beautifully situated on the eastern slopes of the Malvern Hills, which rise abruptly from the flat valley of the Severn to a height of 1395 ft. in the Worcestershire Beacon. The district still bears the name of Malvern Chase, originally a Crown-land and forest, though it was granted to the earldom of Gloucester by Edward I. A ditch along the summit of the hills determined the ancient boundary. Becoming a notorious haunt of criminals, the tract was disafforested by Charles I., with the exception of a portion known as the King's Chase, part of which is included in the present common-land formed under the Malvern Hills Act of 1884.

Malvern was in early times an important ecclesiastical settlement, but its modern fame rests on its fine situation, pure air, and chalybeate and bituminous springs. The open-air cure for consumptive patients is here extensively practised.

The name Malvern is collectively applied to a line of small towns and villages, extending along the foot of the hills for 5 m. The principal is Great Malvern, lying beneath the Worcestershire Beacon. It has a joint station of the Great Western and Midland railways. Here was the Benedictine priory which arose in 1083 out of a hermitage endowed by Edward the Confessor. The priory church of SS. Mary and Michael is a fine cruciform Perpendicular building, with an ornate central tower, embodying the original Norman nave, and containing much early glass and carved choir-stalls. The abbey gate and the refectory also remain. There are here several hydropathic establishments, and beautiful pleasure gardens. Malvern College, founded in 1862, is an important English public school. A museum is attached to it. Mineral waters are manufactured. At Malvern Wells, 2½ m. S., are the principal medicinal springs, also the celebrated Holy Well, the water of which is of perfect purity. There are extensive fishponds and hatcheries; and golf-links. The Great Western railway has a station, and the Midland one at Hanley Road. Little Malvern lies at the foot of the Herefordshire Beacon, which is crowned by a British camp, 1½ m. S. of Malvern Wells. There was a Benedictine priory here, of which traces remain in the church. Malvern Link, 1 m. N.E. of Great Malvern, of which it forms a suburb, has a station on the Great Western railway. West Malvern and North Malvern, named from their position relative to Great Malvern, are pleasant residential quarters on the higher slopes of the hills.

MALWA, an historic province of India, which has given its name to one of the political agencies into which Central India is divided. Strictly, the name is confined to the hilly table-land, bounded S. by the Vindhyan range, which drains N. into the river Chambal; but it has been extended to include the Nerbudda valley farther south. Its derivation is from the ancient tribe of Malavas about whom very little is known, except that they founded the Vikrama Samvat, an era dating from 57 B.C., which is popularly associated with a mythical king Vikramaditya. The earliest name of the tract seems to have been Avanti, from its capital the modern Ujjain. The position of the Malwa or Moholo mentioned by Hsuan Tsang (7th century) is plausibly assigned to Gujarat. The first records of a local dynasty are those of the Paramaras, a famous Rajput clan, who ruled for about four centuries (800–1200), with their capital at Ujjain and afterwards at Dhar. The Mahommedans invaded Malwa in 1235; and in 1401 Dilawar Khan Ghori founded an independent kingdom, which lasted till 1531. The greatest ruler of this dynasty was Hoshang Shah (1405–1435), who made Mandu (*q.v.*) his capital and embellished it with magnificent buildings. In 1562 Malwa was annexed to the Mogul empire by Akbar. On the break-up of that empire, Malwa was one of the first provinces to be conquered by the Mahrattas. About 1743 the Mahratta peshwa obtained from Delhi the title of governor, and deputed his authority to three of his generals—Sindhia of Gwalior, Holkar of Indore, and the Ponwar of Dhar who claims descent from the ancient Paramaras. At the end of the 18th century Malwa became a cockpit for fighting between the rival Mahratta powers, and the headquarters of the Pindaris or irregular plunderers. The Pindaris were extirpated by the campaign of Lord Hastings in 1817, and the country was reduced to order by the energetic rule of Sir John Malcolm. Malwa is traditionally the land of plenty, in which sufferers from famine in the neighbouring tracts always take refuge. But in 1899-1900 it was itself visited by a severe drought, which seriously diminished the population, and has since been followed by plague. The most valuable product is opium.

The Malwa agency has an area of 8919 sq. m. with a population (1901) of 1,054,753. It comprises the states of Dewas (senior and junior branch), Jaora, Ratlam, Sitamau and Sailana, together with a large portion of Gwalior, parts of Indore and Tonk, and about 35 petty estates and holdings. The headquarters of the political agent are at Nimach.

Malwa is also the name of a large tract in the Punjab, south of the river Sutlej, which is one of the two chief homes of the Sikhs, the other being known as Manjha. It includes the British districts of Ferozpore and Ludhiana, together with the native states of Patiala, Jind, Nabha and Maler Kotla.

See J. Malcolm, *Central India* (1823); C. E. Luard, *Bibliography of Central India* (1908), and *The Paramars of Dhar and Malwa* (1908).

MAMARONECK, a township of Westchester county, New York, U.S.A., on Long Island Sound, about 20 m. N.E. of New York City and a short distance N.E. of New Rochelle. Pop. (1890), 2385; (1900) 3849; (1905) 5655; (1910)

5602. Mamaroneck is served by the New York, New Haven & Hartford railway. The township includes the village of Larchmont (pop. in 1910, 1958), incorporated in 1891, and part of the village of Mamaroneck (pop. in 1910, including the part in Rye township, 5699), incorporated in 1895. Larchmont is the headquarters of the Larchmont Yacht Club. The site of Mamaroneck township was bought in 1660 from the Indians by John Richbell, an Englishman, who obtained an English patent to the tract in 1668. The first settlement was made by relatives of his on the site of Mamaroneck village in 1676, and the township was erected in 1788. On the 28th of August 1776, near Mamaroneck, a force of American militiamen under Capt. John Flood attacked a body of Loyalist recruits under William Lounsbury, killing the latter and taking several prisoners. Soon afterwards Mamaroneck was occupied by the Queen's Rangers under Colonel Robert Rogers. On the night of the 21st of October an attempt of a force of Americans under Colonel John Haslet to surprise the Rangers failed, and the Americans, after a hand-to-hand fight, withdrew with 36 prisoners. Mamaroneck was the home of John Peter DeLancey (1753–1828), a Loyalist soldier in the War of Independence, and was the birthplace of his son William Heathcote DeLancey (1797–1865), a well-known Protestant Episcopal clergyman, provost of the University of Pennsylvania in 1827–1832 and bishop of western New York from 1839 until his death. James Fenimore Cooper, the novelist, married (1811) a daughter of John Peter DeLancey; lived in Mamaroneck for several years, and here wrote his first novel, *Precaution*, and planned *The Spy*.

MAMELI, GOFFREDO (1827–1849), Italian poet and patriot, was born at Genoa of a noble Sardinian family. He received a sound classical education at the Scolopi College, and later studied law and philosophy at the university of Genoa. When nineteen years old he corresponded with Mazzini, to whom he became whole-heartedly devoted; among other patriotic poems he wrote a hymn to the Bandiera brothers, and in the autumn of 1847 a song called "Fratelli d'Italia," which as Carducci wrote, "resounded through every district and on every battlefield of the peninsula in 1848 and 1849." Mameli served in the National Guard at Genoa, and then joined the volunteers in the Lombard campaign of 1848, but after the collapse of the movement in Lombardy he went to Rome, where the republic was proclaimed and whence he sent the famous despatch to Mazzini: "Roma! Repubblica! Venite!" At first he wrote political articles in the newspapers, but when the French army approached the city with hostile intentions he joined the fighting ranks and soon won Garibaldi's esteem by his bravery. Although wounded in the engagement of the 30th of April, he at once resumed his place in the ranks, but on the 3rd of June he was again wounded much more severely, and died in the Pellegrini hospital on the 6th of July 1849. Besides the poems mentioned above, he wrote hymns to Dante, to the Apostles, "Dio e popolo," &c. The chief merit of his work lies in the spontaneity and enthusiasm for the Italian cause which rendered it famous, in spite of certain technical imperfections, and he well deserved the epithet of "The Tyrtaeus of the Italian revolution."

See A. G. Barrili, "G. Mameli nella vita e nell' arte," in *Nuova Antologia* (June 1, 1902); the same writer's edition of the *Scritti editi ed inediti di G. Mameli* (Genoa, 1902); Countess Martinengo Cesaresco, *Italian Characters* (London, 1901); A. Luzio, *Profili Biografici* (Milan, 1906); G. Trevelyan, *Garibaldi's Defence of the Roman Republic* (London, 1907).

MAMELUKE (anglicized through the French, from the Arabic *mamlūk*, a slave), the name given to a series of Egyptian sultans, originating (1250) in the usurpation of supreme power by the bodyguard of Turkish slaves first formed in Egypt under the successors of Saladin. See Egypt: *History* (Moslem period).

MAMERTINI, or "children of Mars," the name taken by a band of Campanian (or Samnite) freebooters who about 289 B.C. seized the Greek colony of Messana at the north-east corner of Sicily, after having been hired by Agathocles to defend it (Polyb. I. 7. 2). The adventure is explained by tradition (*e.g.* Festus 158, Müller) as the outcome of a *ver sacrum*; the members of the expedition are said to have been the male children born in a particular spring of which the produce had been vowed to Apollo (cf. Samnites), and to have settled first in Sicily near Tauromenium. An inscription survives (R. S. Conway, *Italic Dialects*, 1) which shows that they took with them the Oscan language as it was spoken in Capua or Nola at that date, and the constitution usual in Italic towns of a free community (*touta*=) governed by two annual magistrates (*meddices*). The inscription dedicated some large building (possibly a fortification) to Apollo, which so far confirms the tradition just noticed. Though in the Oscan language, the inscription is written in the Greek alphabet common to south Italy from the 4th century B.C. onwards, viz. the Tarentine Ionic, and so are the legends of two coins of much the same date as the inscription (Conway, ib. 4). From 282 onwards (B. V. Head, *Historia numorum*, 136) the legend itself is Graecized (ΜΑΜΕΡΤΙΝΩΝ, instead of ΜΑΑΜΕΡΤΙΝΟΥΜ) which shows how quickly here, as everywhere, "Graecia capta ferum victorem cepit." On the Roman conquest of Sicily the town secured an independence under treaty (Cicero, *Verr*. 3. 6. 13). The inhabitants were still called Mamertines in the time of Strabo (vi. 2. 3).

See further Mommsen, *C.I.L.* x. sub loc., and the references already given. (R. S. C.)

MĀMERTINUS, CLAUDIUS (4th century A.D.), one of the Latin panegyrists. After the death of Julian, by whom he was evidently regarded with special favour, he was praefect of Italy (365) under Valens and Valentinian, but was subsequently (368) deprived of his office for embezzlement. He was the author of an extant speech of thanks to Julian for raising him to the consulship, delivered on the 1st of January 362 at Constantinople. Two panegyrical addresses (also extant) to Maximian (emperor A.D. 286–305) are attributed to an older *magister* Mamertinus, but it is probable that the corrupt MS. superscription contains the word *memoriae*, and that they are by an unknown *magister memoriae* (an official whose duty consisted in communicating imperial rescripts and decisions to the public). The first of these was delivered on the birthday of Rome (April 21, 289), probably at Maximian's palace at Augusta Trevirorum (Trèves), the second in 290 or 291, on the birthday of the emperor. By some they are attributed to Eumenius (*q.v.*) who was a *magister memoriae* and the author of at least one (if not more) panegyrics.

The three speeches will be found in E. Bährens, *Panegyrici latini* (1874); see also Teuffel-Schwabe, *Hist. of Roman Literature* (Eng trans.), § 417, 7.

MAMIANI DELLA ROVERE, TERENZIO, Count (1802–1885), Italian writer and statesman, was born at Pesaro in 1799. Taking part in the outbreaks at Bologna arising out of the accession of Pope Gregory XVI., he was elected deputy for Pesaro to the assembly, and subsequently appointed minister of the interior; but on the collapse of the revolutionary movement he was exiled. He returned to Italy after the amnesty of 1846, and in 1848 he was entrusted with the task of forming a ministry. He remained prime minister, however, only for a few months, his political views being anything but in harmony with those of the pope. He subsequently retired to Genoa where he worked for Italian unity, was elected deputy in 1856, and in 1860 became minister of education under Cavour. In 1863 he was made minister to Greece, and in 1865 to Switzerland, and later senator and councillor of state. Meanwhile, he had founded at Genoa in 1849 the Academy of Philosophy, and in 1855 had been appointed professor of the history of philosophy at Turin; and he published several volumes, not only on philosophical and social subjects, but of poetry, among them *Rinnovamento della filosofia antica italiana* (1836), *Teoria della Religione e dello stato* (1869), *Kant e l'ontologia* (1879), *Religione dell' avenire* (1880), *Di un nuovo diritto europeo* (1843, 1857). He died at Rome on the 21st of May, 1885.

See *Indice delle opere di Terenzio Mamiani* (Pesaro, 1887); Gaspare, *Vita di Terenzio Mamiani* (Ancona, 1887); Barzellotti, *Studii e ritratti* (Bologna, 1893).

MAMMALIA (from Lat. *mamma*, a teat or breast), the name proposed by the Swedish naturalist Linnaeus for one of the classes, or primary divisions, of vertebrated animals, the members of which are collectively characterized by the presence in the females of special glands secreting milk for the nourishment of the young. With the exception of the lowest group, such glands always communicate with the exterior by means of the teats, nipples or mammae, from which the class derives its name. The class-name (modified by the French into *Mammifères*, and replaced in German by the practically equivalent term *Säugethiere*) has been anglicized into "Mammals" (mammal, in the singular). Of recent years, and more especially in America, it has become a custom to designate the study of mammals by the term "mammalogy." Etymologically, however, that designation cannot be justified; for it is of hybrid (Latin and Greek) origin, and is equivalent to "mastology," the science which deals with the mammary gland (Gr. μαστός, woman's breast), a totally different signification. As regards existing forms of life, the limitations of the class are perfectly well defined and easy of recognition; for although certain groups (not, by the way, whales, which, although excluded in popular estimation from the class, are in all essential respects typical mammals) are exceedingly aberrant, and present structural features connecting them with the lower vertebrate classes, yet they are by common consent retained in the class to which they are obviously most nearly affiliated by their preponderating characteristics. There is thus at the present day a great interval, unbridged by any connecting links, between mammals and the other classes of vertebrates.

Not so, however, when the extinct forms of vertebrate life are taken into consideration, for there is a group of reptiles from the early part of the Secondary, or Mesozoic period, some of whose members must have been so intimately related to mammals that, were the whole group fully known, it would clearly be impossible to draw a distinction between Mammalia on the one hand and Reptilia on the other. Indeed, as it is, we are already partially acquainted with one of these early intermediate creatures (*Tritylodon*), which forms a kind of zoological shuttlecock, being, so to speak, hit from one group to another, and back again, by the various zoologists by whom its scanty remains have been studied. Considered collectively, mammals, which did not make their appearance on the earth for some time after reptiles had existed, are certainly the highest group of the whole vertebrate sub-kingdom. This expression must not, however, be considered in too restricted a sense. In mammals, as in other classes, there are low as well as high forms; but by any tests that can be applied, especially those based on the state of development of the central nervous system, it will be seen that the average exceeds that of any other class, that many species of this class far excel those of any other in perfection of structure, and that it contains one form which is unquestionably the culminating point amongst organized beings.

Mammals, then, are vertebrated animals, possessing the normal characteristics of the members of that primary division of the animal kingdom. They are separated from fishes and batrachians (Pisces and Batrachians) on the one hand, and agree with reptiles, and birds (Reptilia and Aves) on the other, in the possession during intra-uterine life of the membranous vascular structures respectively known as the amnion and the allantois, and likewise in the absence at this or any other period of external gills. A four-chambered heart, with a complete double circulation, and warm blood (less markedly so in the lowest group than in the rest of the class), distinguish mammals from existing reptiles, although not from birds. From both birds and reptiles the class is distinguished, so far at any rate as existing forms are concerned, by the following features: the absence of a nucleus in the red corpuscles of the blood, which are nearly always circular in outline; the free suspension of the lungs in a thoracic cavity, separated from the abdominal cavity by a muscular partition, or diaphragm, which is the chief agent in inflating the lungs in respiration; the aorta, or main artery, forming but a single arch after leaving the heart, which curves over the left terminal division of the windpipe, or bronchus; the presence of more or fewer hairs on the skin and the absence of feathers; the greater development of the bridge, or commissure, connecting the two halves of the brain, which usually forms a complete corpus callosum, or displays an unusually large size of its anterior portion; the presence of a fully developed larynx at the upper end of the trachea or windpipe, accompanied by the absence of a syrinx, or expansion, near the lower end of the same; the circumstance that each half of the lower jaw (except perhaps at a very early stage of development) consists of a single piece articulating posteriorly with the squamosal element of the skull without the intervention of a separate quadrate bone; the absence of prefrontal bones in the skull; the presence of a pair of lateral knobs, or condyles (in place of a single median one), on the occipital aspect of the skull for articulation with the first vertebra; and, lastly, the very obvious character of the female being provided with milk-glands, by the secretion of which the young (produced, except in the very lowest group, alive and not by means of externally hatched eggs) are nourished for some time after birth.

In the majority of mammals both pairs of limbs are well developed and adapted for walking or running. The fore-limbs may, however, be modified, as in moles, for burrowing, or, as in bats, for flight, or finally, as in whales and dolphins, for swimming, with the assumption in this latter instance of a flipper-like form and the complete disappearance of the hind-limbs. Special adaptations for climbing are exhibited by both pairs of limbs in opossums, and for hanging to boughs in sloths. In no instance are the fore-limbs wanting.

In the great majority of mammals the hind extremity of the axis of the body is prolonged into a tail. Very generally the tail has distinctly the appearance of an appendage, but in some of the lower mammals, such as the thylacine among marsupials, and the aard-vark or ant-bear among the edentates, it is much thickened at the root, and passes insensibly into the body, after the fashion common among reptiles. As regards function, the tail may be a mere pendent appendage, or may be adapted to grasp boughs in climbing, or even to collect food or materials for a nest or sleeping place, as in the spider-monkeys, opossums and rat-kangaroos. Among jumping animals it may serve as a balance, as in the case of jerboas and kangaroos, while in the latter it is also used as a support when resting; among many hoofed mammals it is used as a fly-whisk; and in whales and dolphins, as well as in the African *Potamogale* and the North American musquash, it plays an important part in swimming. Its supposed use as a trowel by the beaver is, however, not supported by the actual facts of the case.

As already indicated, the limbs of different mammals are specially modified for various modes of life; and in many cases analogous modifications occur, in greater or less degree, throughout the entire body. Those modifications most noticeable in the case of cursorial types may be briefly mentioned as examples. In this case, as might be expected, the greatest modifications occur in the limbs, but correlated with this is also an elongation of the head and neck in long-legged types. Adaptation for speed is further exhibited in the moulding of the shape of the body so as to present the minimum amount of resistance to the air, as well as in increase in heart and lung capacity to meet the extra expenditure of energy. Finally, in the jumping forms we meet with an increase in the length and weight of the tail, which has to act as a counterpoise. As regards the feet, a reduction in the number of digits from the typical five is a frequent feature, more especially among the hoofed mammals, where the culmination in this respect is attained by the existing members of the horse tribe and certain representatives of the extinct South American *Proterotheriidae*, both of which are monodactyle. Brief reference may also be made to the morphological importance of extraordinary length or shortness in the skulls of mammals—dolichocephalism and brachycephalism; both these features being apparently characteristic of specialized types, the former condition being (as in the horse) often, although not invariably, connected with length of limb and neck, and adaptation to speed, while brachycephalism may be correlated with short limbs and an abbreviated neck. Exceptions to this rule, as exemplified by the cats, are due to special adaptive causes. In point of bodily size mammals present a greater range of variation than is exhibited by any other living terrestrial animals, the extremes in this respect being displayed by the African elephant on the one hand and certain species of shrew-mice (whose head and body scarcely exceed an inch and a half in length) on the other. When the aquatic members of the class are taken into consideration, the maximum dimensions are vastly greater, Sibbald's rorqual attaining a length of fully 80 ft., and being probably the bulkiest and heaviest animal that has ever existed. Within the limits of individual groups, it may be accepted as a general rule that increase in bulk or stature implies increased specialization; and, further, that the largest representatives of any particular group are also approximately the latest. The latter dictum must not, however, be pushed to an extreme, since the African elephant, which is the largest living land mammal, attaining in exceptional cases a height approaching 12 ft., was largely exceeded in this respect by an extinct Indian species, whose height has been estimated at between 15 and 16 ft.

In regard to sense-organs, ophthalmoscopic observations on the eyes of living mammals (other than man) have revealed the existence of great variation in the arrangement of the blood-vessels, as well as in the colour of the retina; blue and violet seem to be unknown, while red, yellow and green form the predominating shades. In the main, the various types of minute ocular structure correspond very closely to the different groups into which mammals are divided, this correspondence affording important testimony in the favour of the general correctness of the classification. Among the exceptions are the South American squirrel-monkeys, whose eyes approximate in structure to those of the lemurs. Man and monkeys alone possess parallel and convergent vision of the two eyes, while a divergent, and consequently a very widely extended, vision is a prerogative of the lower mammals; squirrels, for instance, and probably also hares and rabbits, being able to see an object approaching them directly from behind without turning their heads.

An osteological question which has been much discussed is the fate of the reptilian quadrate bone in the mammalian skull. In the opinion of F. W. Thyng, who has carefully reviewed all the other theories, the balance of evidence tends to show that the quadrate has been taken up into the inner ear, where it is represented among the auditory ossicles by the incus.

Although the present article does not discuss mammalian osteology in general (for which see VERTEBRATA), it is interesting to notice in this connexion that the primitive condition of the mammalian tympanum apparently consisted merely of a small and incomplete bony ring, with, at most, an imperfect ventral wall to the tympanic cavity, and that a close approximation to this original condition still persists in the monotremes, especially *Ornithorhynchus*. The tympano-hyal is the characteristic mammalian element in this region; but the entotympanic likewise appears to be peculiar to the class, and to be unrepresented among the lower vertebrates. The tympanum itself has been regarded as representing one of the elements—probably the supra-angular—of the compound reptilian lower jaw. The presence of only seven vertebrae in the neck is a very constant feature among mammals; the exceptions being very few.

Two other points in connexion with mammalian osteology may be noticed. A large number of mammals possess a perforation, or foramen, on the inner side of the lower end of the humerus, and also a projection on the shaft of the femur known as the third trochanter. From its occurrence in so many of the lower vertebrates, the entepicondylar foramen of the humerus, as it is called, is regarded by Dr E. Stromer as a primitive structure, of which the original object was to protect certain nerves and bloodvessels. It is remarkable that it should persist in the spectacled bear of the Andes, although it has disappeared in all other living members of the group. The third trochanter of the femur, on the other hand, can scarcely be regarded as primitive, seeing that it is absent in several of the lower groups of mammals. Neither can its presence be attributed, as Professor A. Gaudry suggests, to the reduction in the number of the toes, as otherwise it should not be found in the rhinoceros. Its general absence in man forbids the idea of its having any connexion with the upright posture.

Hair.—In the greater number of mammals the skin is more or less densely clothed with a peculiarly modified form of epidermis known as hair. This consists of hard, elongated, slender, cylindrical or tapering, thread-like masses of epidermic tissue, each of which grows, without branching, from a short prominence, or papilla, sunk at the bottom of a pit, or follicle, in the true skin, or dermis. Such hairs, either upon different parts of the skin of the same species, or in different species, assume very diverse forms and are of various sizes and degrees of rigidity—as seen in the fur of the mole, the bristles of the pig, and the spines of the hedgehog and porcupine, which are all modifications of the same structures. These differences arise mainly from the different arrangement of the constituent elements into which the epidermal cells are modified. Each hair is composed usually of a cellular pithy internal portion, containing much air, and a denser or more horny external or cortical part. In some mammals, as deer, the substance of the hair is almost entirely composed of the central medullary or cellular substance, and is consequently very easily broken; in others the horny part prevails almost exclusively, as in the bristles of the wild boar. In the three-toed sloth (*Bradypus*) the hairs have a central horny axis and a pithy exterior. Though generally nearly smooth, or but slightly scaly, the surface of some hairs is imbricated; that is to say, shows projecting scale-like processes, as in some bats, while in the two-toed sloth (*Choloepus*) they are longitudinally grooved or fluted. Though usually more or less cylindrical or circular in section, hairs are often elliptical or flattened, as in the curly-haired races of men, the terminal portion of the hair of moles and shrews, and conspicuously in the spines of the spiny squirrels of the genus *Xerus* and those of the mouse-like *Platacanthomys*. Hair having a property of mutual cohesion or "felting," which depends upon a roughened scaly surface and a tendency to curl, as in domestic sheep, is called "wool."

It has been shown by J. C. H. de Meijere that the insertion of the individual hairs in the skin displays a definite arrangement, constant for each species, but varying in different groups. In jerboas, for example, a bunch of twelve or thirteen hairs springs from the same point, while in the polar bear a single stout hair and several slender ones arise together, and in the marmosets three equal-sized hairs form regular groups. These tufts or groups likewise display an orderly and definite grouping in different mammals, which suggests the origin of such groups from the existence in primitive mammals of a scaly coat comparable to that of reptiles, and indeed directly inherited therefrom.

In a large proportion of mammals there exist hairs of two distinct types: the one long, stiff, and alone appearing on the surface, and the other shorter, finer and softer, constituting the under-fur, which may be compared to the down of birds. A well-known example is furnished by the fur-bearing seals, in which the outer fur is removed in the manufacture of commercial "seal-skin," leaving only the soft and fine under-fur.

Remarkable differences in the direction or slope of the hair are noticeable on different parts of the body and limbs of many mammals, especially in certain apes, where the hair of the fore-limbs is inclined towards the elbow from above and from below. More remarkable still is the fact that the direction of the slope often differs in closely allied groups, as, for instance, in African and Asiatic buffaloes, in which the hair of the middle line of the back has opposite directions. Whorls of hair, as on the face of the horse and the South American deer known as brockets, occur where the different hair-slopes meet. In this connexion reference may be made to patches or lines of long and generally white hairs situated on the back of certain ruminants, which are capable of erection during periods of excitement, and serve, apparently, as "flags" to guide the members of a herd in flight. Such are the white chrysanthemum-like patches on the rump of the Japanese deer and of the American prong-buck (*Antilocapra*), and the line of hairs situated in a groove on the loins of the African spring-buck. The white under-side of the tail of the rabbit and the yellow rump-patch of many deer are analogous.

The eye-lashes, or *ciliae*, are familiar examples of a special local development of hair. Special tufts of stout stiff hairs, sometimes termed *vibrissae*, and connected with nerves, and in certain cases with glands, occur in various regions. They are most common on the head, while they constitute the "whiskers," or "feelers," of the cats and many rodents. In other instances, notably in the lemurs, but also in certain carnivora, rodents and marsupials, they occupy a position on the fore-arm near the wrist, in connexion with glands, and receive sensory powers from the radial nerve. In some mammals the hairy covering is partial and limited to particular regions; in others, as the hippopotamus and the sea-cows, or Sirenia, though scattered over the whole surface, it is extremely short and scanty;

but in none is it reduced to so great an extent as in the Cetacea, in which it is limited to a few small bristles confined to the neighbourhood of the lips and nostrils, and often present only in the young, or even the foetal condition.

Some kinds of hairs, as those of the mane and tail of the horse, persist throughout life, but more generally, as in the case of the body-hair of the same animal, they are shed and renewed periodically, generally annually. Many mammals have a longer hairy coat in winter, which is shed as summer comes on; and some few, which inhabit countries covered in winter with snow, as the Arctic fox, variable hare and ermine, undergo a complete change of colour in the two seasons, being white in winter and grey or brown in summer. There has been much discussion as to whether this winter whitening is due to a change in the colour of the individual hairs or to a change of coat. It has, however, been demonstrated that the senile whitening of human hair is due to the presence of phagocytes, which devour the pigment-bodies; and from microscopic observations recently made by the French naturalist Dr E. Trouessart, it appears that much the same kind of action takes place in the hairs of mammals that turn white in winter. Cold, by some means or other, causes the pigment-bodies to shift from the normal positions, and to transfer themselves to other layers of the hair, where they are attacked and devoured by phagocytes. The winter whitening of mammals is, therefore, precisely similar to the senile bleaching of human hair, no shift of the coat taking place. Under the influence of exposure to intense cold a small mammal has been observed to turn white in a single night, just as the human hair has been known to blanch suddenly under the influence of intense emotion, and in both cases extreme activity of the phagocytes is apparently the inducing cause. The African golden-moles (*Chrysochloris*), the desmans or water-moles (*Myogale*), and the West African *Potamogale velox*, are remarkable as being the only mammals whose hair reflects those iridescent tints so common in the feathers of tropical birds.

The principal and most obvious purpose of the hairy covering is to protect the skin. Its function in the hairless Cetacea is discharged by the specially modified and thickened layer of fatty tissue beneath the skin known as "blubber."

Scales, &c.—True scales, or flat imbricated plates of horny material, covering the greater part of the body, are found in one family only of mammals, the pangolins or *Manidae*; but these are also associated with hairs growing from the intervals between the scales or on the parts of the skin not covered by them. Similarly imbricated epidermic productions form the covering of the under-surface of the tail of the African flying rodents of the family *Anomaluridae*; and flat scutes, with the edges in apposition, and not overlaid, clothe both surfaces of the tail of the beaver, rats and certain other members of the rodent order, and also of some insectivora and marsupials. Armadillos alone possess an external bony skeleton, composed of plates of bony tissue, developed in the skin and covered with scutes of horny epidermis. Other epidermic appendages are the horns of ruminants and rhinoceroses—the former being elongated, tapering, hollow caps of hardened epidermis of fibrous structure, fitting on and growing from conical projections of the frontal bones and always arranged in pairs, while the latter are of similar structure, but without any internal bony support, and situated in the middle line. Callosities, or bare patches covered with hardened and thickened epidermis, are found on the buttocks of many apes, the breast of camels, the inner side of the limbs of *Equidae*, the grasping under-surface of the tail of prehensile-tailed monkeys, opossums, &c. The greater part of the skin of the one-horned Asiatic rhinoceros is immensely thickened and stiffened by an increase of the tissue of both the skin and epidermis, constituting the well-known jointed "armour-plated" hide of those animals.

Nails, Claws and Hoofs.—With few exceptions, the terminal extremities of the digits of both limbs of mammals are more or less protected or armed by epidermic plates or sheaths, constituting the various forms of nails, claws or hoofs. These are absent in the Cetacea alone. A perforated spur, with a special secreting gland in connexion with it, is found attached to each hind-leg of the males of the existing species of Monotremata.

Scent-glands, &c.—Besides the universally distributed sweat-glands connected with the hair-system, most mammals have special glands in modified portions of the skin, often involuted to form a shallow recess or a deep sac with a narrow opening, situated in various parts of the surface of the body, and secreting odorous substances, by the aid of which individuals recognize one another. These probably afford the principal means by which wild animals are able to become aware of the presence of other members of the species, even at great distances.

To this group of structures belong the suborbital face-gland, "larmier," or "crumen," of antelopes and deer, the frontal gland of the muntjak and of bats of the genus *Phyllorhina*, the chin-gland of the chevrotains and of *Taphozous* and certain other bats, the glandular patch behind the ear of the chamois and the reed-buck, the glands on the lower parts of the legs of most deer and a few antelopes (the position of which is indicated by tufts of long and often specially coloured hair), the interdigital foot-glands of goats, sheep, and many other ruminants, the temporal gland of elephants, the lateral glands of the musk-shrew, the gland on the back of the hyrax and the peccary (from the presence of which the latter animal takes the name *Dicotyles*), the gland on the tails of the members of the dog-tribe, the preputial glands of the musk-deer and beaver (both well known for the use made of their powerfully odorous secretion in perfumery), and also of the swine and hare, the anal glands of Carnivora, the perineal gland of the civet (also of commercial value), the caudal glands of the fox and goat, the gland on the wing-membrane of bats of the genus *Saccopteryx*, the post-digital gland of the rhinoceros, &c. Very generally these glands are common to both sexes, and it is in such cases that their function as a means of mutual recognition is most evident. It has been suggested that the above-mentioned callosities or "chestnuts" on the limbs of horses are vestigial scent-glands; and it is noteworthy that scrapings or shavings from their surface have a powerful attraction for other horses, and are also used by poachers and burglars to keep dogs silent. The position of such glands on the lower portions of the limbs is plainly favourable to a recognition-taint being left in the tracks of terrestrial animals; and antelopes have been observed deliberately to rub the secretion from their face-glands on tree-trunks. When glands are confined to the male, their function is no doubt sexual; the secretion forming part of the attraction, or stimulus, to the other sex.

Dentition.—In the great majority of mammals the teeth form a definite series, of which the hinder elements are of a more or less complex type, while those in front are simpler. With the exception of the marsupials, a set of deciduous, or milk, teeth is developed in most mammals with a complicated type of dentition; these milk-teeth being shed at a comparatively early period (occasionally even *in utero*), when they are succeeded by the larger permanent series, which is the only other ever developed. This double series of teeth thus forms a very characteristic feature of mammals generally. Both the milk and the permanent dentition display the aforesaid complexity of the hinder teeth as compared with those in front, and since the number of milk-teeth is always considerably less than that of the permanent set, it follows that the hinder milk-teeth are usually more complex than the teeth of which they are the predecessors in the permanent series, and represent functionally, not their immediate successors, but those more posterior permanent teeth which have no direct predecessors. This character is clearly seen in those animals in which the various members of the lateral or cheek series are well differentiated from each other in form, as the Carnivora, and also in man.

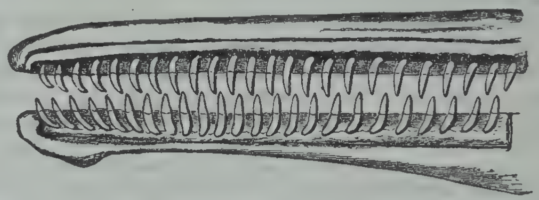


FIG. 1.—Upper and Lower Teeth of one side of the Mouth of a Dolphin (*Lagenorhynchus*), as an example of the homoeodont type of dentition. The bone covering the outer side of the roots of the teeth has been removed to show their simple character.

In mammals with two sets of teeth the number of those of the permanent series preceded by milk-teeth varies greatly, being sometimes, as in marsupials and some rodents, as few as one on each side of each jaw, and in other cases including the larger portion of the series. As a rule, the teeth of the two sides of the jaws are alike in number and character, except in cases of accidental or abnormal variation, and in the tusks of the narwhal, in which the left is of immense size, and the right rudimentary. In mammals, such as dolphins and some armadillos, which have a large series of similar teeth, not always constant in number in different individuals, there may indeed be differences in the two sides; but, apart from these in describing the dentition of any mammal, it is generally sufficient to give the number and characters of the teeth of one side only. As the teeth of the upper and the lower jaws work against each other in masticating, there is a general correspondence or harmony between them, the projections of one series, when the mouth is closed, fitting into corresponding depressions of the other. There is also a general resemblance in the number, characters and mode of succession of both series; so that, although individual teeth of the upper and lower jaws may not be in the strict sense of the term homologous parts, there is a great convenience in applying the same descriptive terms to the one which are used for the other.

The simplest dentition is that of many species of dolphin (fig. 1), in which the crowns are single-pointed, slightly curved cones, and the roots also single and tapering; so that all the teeth are alike in form from the anterior to the posterior end of the series, though it may be with some slight difference in size, those at the two extremities being rather smaller than the others. Such a dentition is called "homoeodont" (Gr. ὅμοιος, like, ὀδούς, tooth), and in the case cited, as the teeth are never changed, it is also monophyodont (Gr. μόνος, alone, single, φύειν, to generate, ὀδούς, tooth). Such teeth are adapted only for catching slippery living prey, like fish.

In a very large number of mammals the teeth of different parts of the series are more or less differentiated in character; and, accordingly, have different functions to perform. The front teeth are simple and one-rooted, and are adapted for cutting and seizing. They are called "incisors." The back, lateral or cheek teeth, on the other hand, have broader and more complex crowns, tuberculated or ridged, and supported on two or more roots. They crush or grind the food, and are hence called "molars." Many mammals have, between these two sets, a tooth at each corner of the mouth, longer and more pointed than the others, adapted for tearing or stabbing, or for fixing struggling prey. From the conspicuous development of such teeth in the Carnivora, especially the dogs, they have received the name of "canines." A dentition with its component parts so differently formed that these distinctive terms are applicable to them is called heterodont (Gr. ἕτερος, different). In most cases, though by no means invariably, mammals with a heterodont dentition are also diphyodont (Gr. διφυής, of double form).

This general arrangement is obvious in a considerable number of mammals; and examination shows that, under great modifications in detail, there is a remarkable uniformity of essential characters in the dentition of a large number of members of the class belonging to different orders and not otherwise closely allied, so much that it is possible to formulate a common plan of dentition from which the others have been derived by the alteration of some and the suppression of other members of the series, and occasionally, but very rarely, by addition. In this generalized form of mammalian dentition the total number of teeth present is 44, or 11 above and 11 below on each side. Those of each jaw are placed in continuous series without intervals between them; and, although the anterior teeth are simple and single-rooted, and the posterior teeth complex and with several roots, the transition between the two kinds is gradual.

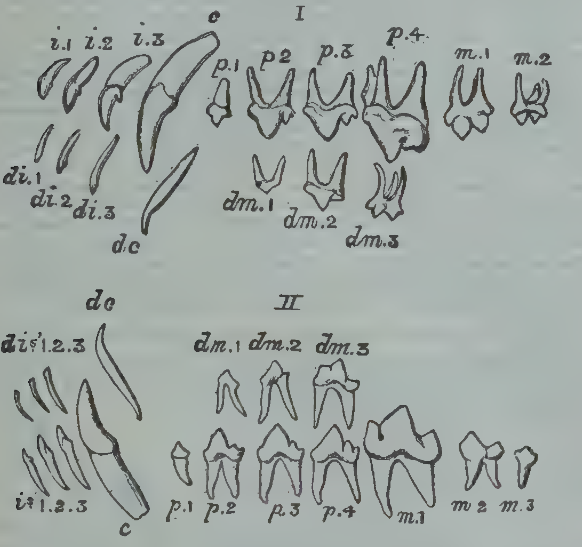


FIG. 2.—Milk and Permanent Dentitions of Upper (I.) and Lower (II.) Jaws of the Dog (*Canis*), with the symbols by which the different teeth are designated. The third upper molar (*m* 3) is the only tooth wanting to complete the typical heterodont mammalian dentition.

In dividing and grouping such teeth for the purpose of description and comparison more definite characters are required than those derived merely from form or function. The first step towards a classification rests on the fact that the upper jaw is composed of two bones, the premaxilla and the maxilla, and that the division or suture between these bones separates the three front teeth from the rest. These three teeth, which are implanted in the premaxilla, form a distinct group, to which the name of "incisor" is applied. This distinction is, however, not so important as it appears at first sight, for their connexion with the bone is only of a secondary nature, and, although it happens conveniently that in the great majority of cases the division between the bones coincides with the interspace between the third and fourth tooth of the series, still, when it does not, as in the mole, too much weight must not be given to this fact, if it contravenes other reasons for determining the homologies of the teeth. The eight remaining teeth of the upper jaw offer a natural division, inasmuch as the three hindmost never have milk-predecessors; and, although some of the anterior teeth may be in the same case, the particular one preceding these three always has such a predecessor. These three, then, are grouped as the "molars." Of the five teeth between the incisors and molars the most anterior, or the one usually situated close behind the premaxillary suture, very generally assumes a lengthened and pointed form, and constitutes the "canine" of the Carnivora, the tusk of the boar, &c. It is customary, therefore, to call this tooth, whatever its size or form, the "canine." The remaining four are the "premolars." This system has been objected to as artificial, and in many cases not descriptive, the distinction between premolars and canine especially being sometimes not obvious; but the terms are now in such general use, and also so convenient, that it is not likely they will be superseded. It is frequently convenient to refer to all the teeth behind the canine as the "cheek-teeth."

With regard to the lower teeth the difficulties are greater, owing to the absence of any suture corresponding to that which defines the incisors above; but since the number of the teeth is the same, since the corresponding teeth are preceded by milk-teeth, and since in the large majority of cases it is the fourth tooth of the series which is modified in the same way as the canine (or fourth tooth) of the upper jaw, it is reasonable to adopt the same divisions as with the upper series, and to call the first three, which are implanted in the part of the mandible opposite to the premaxilla, the incisors, the next the canine, the next four the premolars, and the last three the molars.

It may be observed that when the mouth is closed, especially when the opposed surfaces of the teeth present an irregular outline, the corresponding upper and lower teeth are not exactly opposite, otherwise the two series could not fit into one another, but as a rule the points of the lower teeth shut into the interspaces in front of the corresponding teeth of the upper jaw. This is very distinct in the canine teeth of the Carnivora, and is a useful guide in determining the homologies of the teeth of the two jaws.

For the sake of brevity the complete dentition is described by the following formula, the numbers above the line representing the teeth of the upper, those below the line those of the lower jaw: incisors $\frac{3-3}{3-3}$, canines $\frac{1-1}{1-1}$, premolars $\frac{4-4}{4-4}$, molars, $\frac{3-3}{3-3}=\frac{11-11}{11-11}$; total 44. As, however, initial letters may be substituted for the names of each group, and it is unnecessary to give more than the numbers of the teeth on one side of the mouth, the formula may be abbreviated into:

$$i\,\tfrac{3}{3},\ c\,\tfrac{1}{1},\ p\,\tfrac{4}{4},\ m\,\tfrac{3}{3};\ \text{total } 44.$$

The individual teeth of each group are enumerated from before backwards, and by such a formula as the following:—

$$\frac{i\,1,\ i\,2,\ i\,3,\ c,\ p\,1,\ p\,2,\ p\,3,\ p\,4,\ m\,1,\ m\,2,\ m\,3}{i\,1,\ i\,2,\ i\,3,\ c,\ p\,1,\ p\,2,\ p\,3,\ p\,4,\ m\,1,\ m\,2,\ m\,3}$$

a special numerical designation is given by which each one can be indicated. In mentioning any single tooth, such a sign as $\underline{m1}$ will mean the first upper molar, $\overline{m1}$ the first lower molar, and so on.

When, as is the case among nearly all existing mammals with the exception of the members of the genera *Sus* (pigs), *Gymnura* (rat-shrew), *Talpa* (moles) and *Myogale* (desmans) the number of teeth is reduced below the typical forty-four, it appears to be an almost universal rule that if one of the incisors is missing it is the second, or middle one, while the premolars commence to disappear from the front end of the series and the molars from the hinder end.

The milk-dentition is expressed by a similar formula, *d* for deciduous, being added before the letter expressive of the nature of the tooth. As the three molars and (almost invariably) the first premolar of the permanent series have no predecessors, the typical milk-dentition would be expressed as follows: $di\,\frac{3}{3}$, $dc\,\frac{1}{1}$, $dm\,\frac{3}{3}=28$. The teeth which precede the premolars of the permanent series are called either milk-molar or milk-premolar. When there is a marked difference between the premolars and molars of the permanent dentition, the first milk-molar resembles a premolar, while the last has the characters of the posterior molar. It is sometimes convenient to refer to all the seven cheek-teeth as members of a single continuous series (which they undoubtedly are), and for this purpose the following nomenclature has been proposed:—

	Upper Jaw.	Lower Jaw.
Cheek-tooth 1	Protus.	Protid.
" 2	Deuterus.	Deuterid.
" 3	Tritus.	Tritid.
" 4	Tetartus.	Tetartid.
" 5	Pemptus.	Pemptid.
" 6	Hectus.	Hectid.
" 7	Hebdomus.	Hebdomid.

With the exception of the Cetacea, most of the Edentata, and the Sirenia, in which the teeth, when present, have been specialized in a retrograde or aberrant manner, the placental mammals as a whole have a dentition conforming more or less closely to the foregoing type.

With the marsupials the case is, however, somewhat different; the whole number not being limited to 44, owing largely to the fact that the number of upper incisors may exceed three pairs, reaching indeed in some instances to as many as five. Moreover, with the exception of the wombats, the number of pairs of incisors in the upper always exceeds those in the lower. When fully developed, the number of cheek-teeth is, however, seven; and it is probable that, as in placentals, the first four of these are premolars and the remaining three molars, although it was long held that these numbers should be transposed. The most remarkable feature about the marsupial dentition is that, at most, only a single pair of teeth is replaced in each jaw; this pair, on the assumption that there are four premolars, representing the third of that series. With the exception of this replacing pair of teeth in each jaw, it is considered by many authorities that the marsupial dentition corresponds to the deciduous, or milk, dentition of placentals. If this be really the case, the rudiments of an earlier set of teeth which have been detected in the jaws of some members of the order, represent, not the milk-series, but a prelacteal dentition. On the assumption that these functional teeth correspond to the milk-series of placentals, marsupials in this respect agree exactly with modern elephants, in which the same peculiarity exists.

In very few mammals are teeth entirely absent. Even in the whalebone whales their germs are formed in the same manner and at the same period of life as in other mammals, and even become partially calcified, although they never rise above the gums, and completely disappear before birth. In the American anteaters and the pangolins among the Edentata no traces of teeth have been found at any age. Adult monotremes are in like case, although the duck-billed platypus (*Ornithorhynchus*) has teeth when young on the sides of the jaws. The northern sea-cow (*Rhytina*), now extinct, appears to have been toothless throughout life.

In different groups of mammals the dentition is variously specialized in accordance with the nature of the food on which the members of these groups subsist. From this point of view the various adaptive modifications of mammalian dentition may be roughly grouped under the headings of piscivorous, carnivorous, insectivorous, omnivorous and herbivorous.

The fish-eating, or piscivorous, type of dentition is exemplified under two phases in the dolphins and in the seals (being in the latter instance a kind of retrograde modification from the carnivorous type). In the dolphins, and in a somewhat less marked degree among the seals, this type of dentition consists of an extensive series of conical, nearly equal-sized, sharp-pointed teeth, implanted in an elongated and rather narrow mouth (fig. 1), and adapted to seize slippery prey without either tearing or masticating. In the dolphins the teeth form simple cones, but in the seals they are often trident-like; while in the otters the dentition differs but little from the ordinary carnivorous type.

This carnivorous adaptation, in which the function is to hold and kill struggling animals, often of large size, attains its highest development in the cats (*Felidae*). The canines are in consequence greatly developed, of a cutting and piercing type, and from their wide separation in the mouth give a firm hold; the jaws being as short as is consistent with the free action of the canines, or tusks, so that no power is lost. The incisors are small, so as not to interfere with the penetrating action of the tusks; and the crowns of some of the teeth of the cheek-series are modified into scissor-like blades, in order to rasp off the flesh from the bones, or to crack the bones themselves, while the later teeth of this series tend to disappear.

In the insectivorous type, as exemplified in moles and shrew-mice, the middle pair of incisors in each jaw are long and pointed so as to have a forceps-like action for seizing insects, the hard coats of which are broken up by the numerous sharp cusps surmounting the cheek-teeth.

In the omnivorous type, as exemplified in man and monkeys, and to a less specialized degree in swine, the incisors are of moderate and nearly equal size; the canines, if enlarged, serve for other purposes than holding prey, and such enlargement is usually confined to those of the males; while the cheek-teeth have broad flattened crowns surmounted by rounded bosses, or tubercles.

In the herbivorous modification, as seen in three distinct phases in the horse, the kangaroo, and in ruminants, the incisors are generally well developed in one or both jaws, and have a nipping action, either against one another or against a toothless hard pad in the upper jaw; while the canines are usually small or absent, at least in the upper jaw, but in the lower jaw may be approximated and assimilated to the incisors. The cheek-teeth are large, with broad flattened crowns surmounted either by simple transverse ridges, or complicated by elevations and infoldings. In the specialized forms the premolars tend to become more or less completely like the molars; and, contrary to what obtains among the Carnivora, the whole series of cheek-teeth (with the occasional exception of the first) is very strongly developed.

Opinions differ as to the mode in which the more complicated cheek-teeth of mammals have been evolved from a simpler type of tooth. According to one theory, this has been brought about by the fusion of two or more teeth of a simple conical type to form a compound tooth. A more generally accepted view—especially among palaeontologists—is the tritubercular theory, according to which the most generalized type of tooth consists of three cusps arranged in a triangle, with the apex pointing inwards in the teeth of the upper jaw. Additions of extra cusps form teeth of a more complicated type. Each cusp of the primitive triangle has received a separate name, both in the teeth of the upper and of the lower jaw, while names have also been assigned to super-added cusps. Molar teeth of the simple tritubercular type persist in the golden moles (*Chrysochloris*) among the Insectivora and also in the marsupial mole (*Notoryctes*) among the marsupials. The type is, moreover, common among the mammals of the early Eocene, and still more so in those of the Jurassic epoch; this forming one of the strongest arguments in favour of the tritubercular theory. (See Professor H. F. Osborn, "Palaeontological Evidence for the Original Tritubercular Theory," in vol. xvii. (new series) of the *American Journal of Science*, 1904.)

Digestive System.—As already mentioned, mammals are specially characterized by the division of the body-cavity into two main chambers, by means of the horizontal muscular partition known as the diaphragm, which is perforated by the great blood-vessels and the alimentary tube. The mouth of the great majority of mammals is peculiar for being guarded by thick fleshy lips, which are, however, absent in the Cetacea; their principal function being to seize the food, for which purpose they are endowed, as a rule, with more or less strongly marked prehensile power. The roof of the mouth is formed by the palate, terminating behind by a muscular, contractile arch, having in man and a few other species a median projection called the uvula, beneath which the mouth communicates with the pharynx. The anterior part of the palate is composed of mucous membrane tightly stretched over the flat or slightly concave bony layer which separates the mouth from the nasal passages, and is generally raised into a series of transverse ridges, which sometimes, as in ruminants, attain a considerable development. In the floor of the mouth, between the two branches of the lower jaw, and supported behind by the hyoid apparatus, lies the tongue, an organ the free surface of which, especially in its posterior part, is devoted to the sense of taste, but which by reason of its great mobility (being composed almost entirely of muscular fibres) performs important mechanical functions connected with masticating and procuring food. Its modifications of form in different mammals are numerous. Between the long, extensile, worm-like tongue of the anteaters, essential to the peculiar mode of feeding of those animals, and the short, immovable and almost functionless tongue of the porpoise, every intermediate condition is found. Whatever the form, the upper surface is, however, covered with numerous fine papillae, in which the terminal filaments of the taste-nerve are distributed. In some mammals, notably lemurs, occurs a hard structure known as the sublingua, which may terminate in a free horny tip. If, as has been suggested, this organ represents the tongue of reptiles, the mammalian tongue will obviously be a superadded organ distinctive of the class.

Salivary glands, of which the most constant are the parotid and the submaxillary, are always present in terrestrial mammals. Next in constancy are the "sublingual," closely associated with the last-named, at all events in the locality in which the secretion is poured out; and the "zygomatic," found only in some mammals in the cheek, just under cover of the anterior part of the zygomatic arch, the duct entering the mouth-cavity near that of the parotid.

The alimentary, or intestinal, canal varies greatly in relative length and capacity in different mammals, and also offers manifold peculiarities of form, being sometimes a simple cylindrical tube of nearly uniform calibre throughout, but more often subject to alterations of form and capacity in different portions of its course—the most characteristic and constant being the division into an upper and narrower and a lower and wider portion, called respectively the small and the large intestine; the former being arbitrarily divided into duodenum, jejunum and ileum, and the latter into colon and rectum. One of the most striking peculiarities of this part of the canal is the frequent presence of a blind pouch, "caecum," situated at the junction of the large and the small intestine. Their structure presents an immense variety of development, from the smallest bulging of a portion of the side-wall of the tube to a huge and complex sac, greatly exceeding in capacity the remainder of the alimentary canal. It is only in herbivorous mammals that the caecum is developed to this great extent, and among these there is a complementary relationship between the size and complexity of the organ and that of the stomach. Where the latter is simple the caecum is generally the largest, and vice versa. In vol. xvii. (1905) of the *Transactions* of the Zoological Society of London, Dr P. Chalmers Mitchell has identified the paired caeca, or blind appendages, of the intestine of birds with the usually single caecum of mammals. These caeca occur in birds (as in mammals) at the junction of the small with the large intestine; and while in ordinary perching-birds they are reduced to small nipple-like buds of no functional importance, in many other birds—owls for instance—they form quite long receptacles. Among mammals,

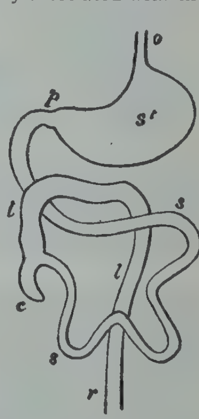


Fig. 3.—Diagrammatic Plan of the general arrangement of the Alimentary Canal in a typical Mammal.

o, oesophagus;
st, stomach;
p, pylorus;
ss, small intestine (abbreviated);
c, caecum;
ll, large intestine or colon, ending in
r, the rectum.

the horse and the dog may be cited as instances where the single caecum is of large size, this being especially the case of the former, where it is of enormous dimensions; in human beings, on the other hand, the caecum is rudimentary, and best known in connexion with "appendicitis." The existence of paired caeca was previously known in a few armadillos and anteaters, but Dr Mitchell has shown that they are common in these groups, while he has also recorded their occurrence in the hyrax and the manati. With the aid of these instances of paired caeca, coupled with the frequent existence of a rudiment of its missing fellow when only one is functional, the author has been enabled to demonstrate conclusively that these double organs in birds correspond in relations with their normally single representative in mammals.

In mammals both caecum and colon are often sacculated, a disposition caused by the arrangement of the longitudinal bands of muscular tissue in their walls; but the small intestine is always smooth and simple-walled externally, though its lining membrane often exhibits contrivances for increasing the absorbing surface without adding to the general bulk of the organ, such as the numerous small tags, or "villi," by which it is everywhere beset, and the more obvious transverse, longitudinal, or reticulating folds projecting into the interior, met with in many animals, of which the "valvulae conniventes" of man form well-known examples. Besides the crypts of Lieberkühn found throughout the intestinal canal, and the glands of Brunner confined to the duodenum, there are other structures in the mucous membrane, about the nature of which there is still much uncertainty, called "solitary" and "agminated" glands, the latter more commonly known by the name of "Peyer's patches." Of the liver little need be said, except that in all living mammals it has been divided into a number of distinct lobes, which have received separate names. It has, indeed, been suggested that in the earlier mammals the liver was a simple undivided organ. This, however, is denied by G. Ruge (vol. xxix. of Gegenbaur's *Morphologisches Jahrbuch*).

Origin of Mammals.—That mammals have become differentiated from a lower type of vertebrates at least as early as the commencement of the Jurassic period is abundantly testified by the occurrence of the remains of small species in strata of that epoch, some of which are mentioned in the articles MARSUPIALIA and MONOTREMATA (*q.v.*). Possibly mammalian remains also occur in the antecedent Triassic epoch, some palaeontologists regarding the South African *Tritylodon* as a mammal, while others consider that it was probably a reptile. Whatever may be the true state of the case with regard to that animal probably also holds good in the case of the approximately contemporaneous European *Microlestes*. Of the European Jurassic (or Oolitic) mammals our knowledge is unfortunately very imperfect; and from the scarcity of their remains it is quite probable that they are merely stragglers from the region (possibly Africa) where the class was first differentiated. It is not till the early Eocene that mammals become a dominant type in the northern hemisphere.

It is now practically certain that mammals are descended from reptiles. Dr H. Gadow, in a paper on the origin of mammals contributed to the *Zeitschrift für Morphologie*, sums up as follows: "Mammals are descendants of reptiles as surely as they [the latter] have been evolved from Amphibia. This does not mean that any of the living groups of reptiles can claim their honour of ancestry, but it means that the mammals have branched where the principal reptilian groups meet, and that is a long way back. The Theromorpha, especially small Theriodontia, alone show us what these creatures were like." It may be explained that the Theromorpha, or Anomodontia, are those extinct reptiles so common in the early Secondary (Triassic) deposits of South Africa, some of which present a remarkable resemblance in their dentition and skeleton to mammals, while others come equally near amphibians. A difficulty naturally arises with regard to the fact that in reptiles the occipital condyle by which the skull articulates with the vertebral column is single, although composed of three elements, whereas in amphibians and mammals the articulation is formed by a pair of condyles. Nevertheless, according to Professor H. F. Osborn, the tripartite reptilian condyle, by the loss of its median element, has given rise to the paired mammalian condyles; so that this difficulty disappears. The fate of the reptilian quadrate bone (which is reduced to very small dimensions in the Anomodontia) has been referred to in an earlier section of the present article, where some mention has also been made of the disappearance in mammals of the hinder elements of the reptilian lower jaw, so as to leave the single bone (dentary) of each half of this part of the skeleton in mammals.

Most of the earliest known mammals appear to be related to the Marsupialia and Insectivora. Others however (inclusive of *Tritylodon* and *Microlestes*, if they be really mammals), seem nearer to the Monotremata; and the question has yet to be decided whether placentals and marsupials on the one hand, and monotremes on the other are not independently derived from reptilian ancestors.

With regard to the evolution of marsupials and placentals, it has been pointed out that the majority of modern marsupials exhibit in the structure of their feet traces of the former opposability of the thumb and great toe to the other digits; and it has accordingly been argued that all marsupials are descended from arboreal ancestors. This doctrine is now receiving widespread acceptation among anatomical naturalists; and in the *American Naturalist* for 1904, Dr W. D. Matthew, an American palaeontologist, considers himself provisionally justified in so extending it as to include all mammals. That is to say, he believes that, with the exception of the duckbill and the echidna, the mammalian class as a whole can lay claim to descent from small arboreal forms. This view is, of course, almost entirely based upon palaeontological considerations; and these, in the author's opinion, admit of the conclusion that all modern placental and marsupial mammals are descended from a common ancestral stock, of which the members were small in bodily size. These ancestral mammals, in addition to their small size, were characterized by the presence of five toes to each foot, of which the first was more or less completely opposable to the other four. The evidence in favour of this primitive opposability is considerable. In all the groups which are at present arboreal, the palaeontological evidence goes to show that their ancestors were likewise so; while since, in the case of modern terrestrial forms, the structure of the wrist and ankle joints tends to approximate to the arboreal type, as we recede in time, the available evidence, so far as it goes, is in favour of Dr Matthew's contention.

The same author also discusses the proposition from another standpoint, namely, the condition of the earth's surface in Cretaceous times. His theory is that in the early Cretaceous epoch the animals of the world were mostly aerial, amphibious, aquatic or arboreal; the flora of the land being undeveloped as compared with its present state. On the other hand, towards the close of the Cretaceous epoch (when the Chalk was in course of deposition), the spread of a great upland flora vastly extended the territory available for mammalian life. Accordingly, it was at this epoch that the small ancestral insectivorous mammals first forsook their arboreal habitat to try a life on the open plains, where their descendants developed on the one hand into the carnivorous and other groups, in which the toes are armed with nails or claws, and on the other into the hoofed group, inclusive of such monsters as the elephant and the giraffe. The hypothesis is not free from certain difficulties, one of which will be noticed later.

Classification.—Existing mammals may be primarily divided into three main groups, or subclasses, of which the second and third are much more closely related to one another than is either of them to the first. These three classes are the Monotremata (or Prototheria), the Marsupialia (Didelphia, or Metatheria), and the Placentalia (Monodelphia, or Eutheria); the distinctive characters of each being given in separate articles (see MONOTREMATA, MARSUPIALIA and MONODELPHIA.)

The existing monotremes and marsupials are each represented only by a single order; but the placentals are divided into the following ordinal and subordinal groups, those which are extinct being marked with an asterisk (*):—

1. Insectivora (Moles, Hedgehogs, &c.).
2. Chiroptera (Bats).
3. Dermoptera (Colugo, or Flying Lemur).
4. Edentata:—
    - *a.* Xenarthra (Anteaters, Sloths and Armadillos).
    - *b.* Pholidota (Pangolins).
    - *c.* Tubulidentata (Ant-bears, or Aard-varks).

5. Rodentia (Gnawing Mammals):—
   a. Duplicidentata (Hares and Picas).
   b. Simplicidentata (Rats, Beavers, &c.).
6. *Tillodontia (*Tillotherium*).
7. Carnivora:—
   a. Fissipedia (Cats, Dogs, Bears, &c.).
   b. Pinnipedia (Seals and Walruses).
   c.*Creodonta (*Hyaenodon*, &c.).
8. Cetacea (Whales and Dolphins):—
   a.*Archaeoceti (*Zeuglodon*, &c.).
   b. Odontoceti (Spermwhales and Dolphins).
   c. Mystacoceti (Whalebone Whales).
9. Sirenia (Dugongs and Manatis).
10. Ungulata (Hoofed Mammals):—
   a. Proboscidea (Elephants and Mastodons).
   b. Hyracoidea (Hyraxes).
   c.*Barypoda (*Arsinöitherium*).
   d.*Toxodontia (*Toxodon*, &c.).
   e.*Amblypoda (*Uintatherium*, &c.).
   f.*Litopterna (*Macrauchenia*, &c.).
   g.*Ancylopoda (*Chalicotherium*, &c.).
   h.*Condylarthra (*Phenacodus*, &c.).
   i. Perissodactyla (Tapirs, Horses, &c.).
   j. Artiodactyla (Ruminants, Swine, &c.).
11. Primates:—
   a. Prosimiae (Lemurs and Galagos).
   b. Anthropoidea (Monkeys, Apes and Man).

Separate articles are devoted to each of these orders, where references will be found to other articles dealing with some of the minor groups and a number of the more representative species.

Relationships of the Groups.—As we recede in time we find the extinct representatives of many of these orders approximating more and more closely to a common generalized type, so that in a large number of early Eocene forms it is often difficult to decide to which group they should be assigned.

The Insectivora are certainly the lowest group of existing placental mammals, and exhibit many signs of affinity with marsupials; they may even be a more generalized group than the latter. From the Insectivora the bats, or Chiroptera, are evidently a specialized lateral offshoot; while the Dermoptera may be another branch from the same stock. As to the Edentata, it is still a matter of uncertainty whether the pangolins (Pholidota) and the ant-bears (Tubulidentata) are rightly referred to an order typically represented by the sloths, anteaters, and armadillos of South and Central America, or whether the two first-named groups have any close relationship with one another. Much uncertainty prevails with regard to the ancestry of the group as a whole, although some of the earlier South American forms have a comparatively full series of teeth, which are also of a less degenerate type than those of their modern representatives.

An almost equal degree of doubt obtains with regard to the ancestry of that very compact and well-defined group the Rodentia. If, however, the so-called Proglires of the lower Eocene are really ancestral rodents, the order is brought into comparatively close connexion with the early generalized types of clawed, or unguiculate mammals. Whether the extinct Tillodontia are most nearly allied to the Rodentia, the Carnivora or the Ungulata, and whether they are really entitled to constitute an ordinal group by themselves, must remain for the present open questions.

The Carnivora, as represented by the (mainly) Eocene Creodonta, are evidently an ancient and generalized type. As regards the number and form of their permanent teeth, at any rate, creodonts present such a marked similarity to carnivorous marsupials, that it is difficult to believe the two groups are not allied, although the nature of the relationship is not yet understood, and the minute internal structure of the teeth is unlike that of marsupials and similar to that of modern Carnivora. There is the further possibility that creodonts may be directly descended from the carnivorous reptiles; a descent which if proved might introduce some difficulty with regard to the above-mentioned theory as to the arboreal ancestry of mammals generally. Be this as it may, there can be little doubt that the creodonts are related to the Insectivora, which, as stated above, show decided signs of kinship with the marsupials.

A much more interesting relationship of the creodont carnivora has, however, been established on the evidence of recent discoveries in Egypt. From remains of Eocene age in that country Dr E. Fraas, of Stuttgart, has demonstrated the derivation of the whale-like *Zeuglodon* from the creodonts. Dr C. E. Andrews has, moreover, not only brought forward additional evidence in favour of this most remarkable line of descent, but is confident—which Professor Fraas was not—that *Zeuglodon* itself is an ancestral cetacean, and consequently that whales are the highly modified descendants of creodonts. It must be admitted, however, that the links between *Zeuglodon* and typical cetaceans are at present unknown; but it may be hoped that these will be eventually brought to light from the deposits of the Mokattam Range, near Cairo. Whales and dolphins being thus demonstrated to be nothing more than highly modified Carnivora, might almost be included in the same ordinal group.

An analogous statement may be made with regard to the sea-cows, or Sirenia, which appear to be derivates from the great herbivorous order of Ungulata, and might consequently be included in that group, as indeed has been already done in Dr Max Weber's classification. It is with the proboscidean suborder of the Ungulata to which the Sirenia are most nearly related; the nature of this relationship being described by Dr Andrews as follows:—

"In the first place, the occurrence of the most primitive Sirenians with which we are acquainted in the same region as the most generalized proboscidean, *Moeritherium*, is in favour of such a view, and this is further supported by the similarity of the brain-structure and, to some extent, of the pelvis in the earliest-known members of the two groups. Moreover, in the anatomy of the soft-parts of the recent forms there are a number of remarkable points of resemblance. Among the common characters may be noted the possession of: (1) pectoral mammae; (2) abdominal testes; (3) a bifid apex of the heart; (4) bilophodont molars with a tendency to the formation of an additional lobe from the posterior part of the cingulum. The peculiar mode of displacement of the teeth from behind forwards in some members of both groups may perhaps indicate a relationship, although in the case of the Sirenia the replacement takes place by means of a succession of similar molars, while in the Proboscidea the molars remain the same numerically, but increase greatly in size and number of transverse ridges."

These and certain other facts referred to by the same author point to the conclusion that not only are the Sirenia and the Proboscidea derived from a single ancestral stock, but that the Hyracoidea—and so *Arsinöitherium*—are also derivatives from the same stock, which must necessarily have been Ethiopian.

Of the other suborders of ungulates, the Toxodontia and Litopterna are exclusively South American, and while the former may possibly be related to the Hyracoidea and Barypoda, the latter is perhaps more nearly akin to the Perissodactyla. The Amblypoda, on the other hand, are perhaps not far removed from the ancestral Proboscidea, which depart comparatively little from the generalized ungulate type. The latter is represented by the Eocene Condylarthra, which undoubtedly gave rise to the Perissodactyla and Artiodactyla, and probably to most, if not all, of the other groups. The Condylarthra, in their turn, approximate closely to the ancestral Carnivora, as they also do in some degree to the ancestral Primates. As regards the latter order, although we are at present unacquainted with all the connecting links between the lemurs and the monkeys, there is little doubt that the ancestors of the former represent the stock from which the latter have originated. C. D. Earle, in the *American Naturalist* for 1897, observes that "so far as the palaeontological evidence goes it is decidedly in favour of the view that apes and lemurs are closely related. Beginning with the earliest known lemur, *Anaptomorphus*, this genus shows tendencies towards the anthropoids, and, when we pass up into the Oligocene of the Old World, *Adapis* is a decidedly mixed type, and probably not far from the common stem-form which gave origin to both suborders of the Primates. In regard to *Tarsius*, it is evidently a type nearly between the lemurs and apes, but with many essential characters belonging to the former group."

Distribution.—For an account of the "realms" and "regions" into which the surface of the globe has been divided by those who have made a special study of the geographical distribution of animals, see ZOOLOGICAL DISTRIBUTION. For the purposes of such zoo-geographical divisions, mammals are much better adapted than birds, owing to their much more limited powers of dispersal; most of them (exclusive of the purely aquatic forms, such as seals, whales, dolphins and sea-cows) being unable to cross anything more than a very narrow arm of the sea. Consequently, the presence of nearly allied groups of mammals in areas now separated by considerable stretches of sea proves that at no very distant date such tracts must have had a land-connexion. In the case of the southern continents the difficulty is, however, to determine whether allied groups of mammals (and other animals) have reached their present isolated habitats by dispersal from the north along widely sundered longitudinal lines, or whether such a distribution implies the former existence of equatorial land connexions. It may be added that even bats are unable to cross large tracts of sea; and the fact that fruit-bats of the genus *Pteropus* are found in Madagascar and the Seychelles, as well as in India, while they are absent from Africa, is held to be an important link in the chain of evidence demonstrating a former land-connexion between Madagascar and India.

There is another point of view from which mammals are of especial importance in regard to geographical distribution, namely their comparatively late rise and dispersal, or "radiation," as compared with reptiles.

As regards terrestrial mammals (with which alone we are at present concerned), one of the most striking features in their distribution is their practical absence from oceanic islands; the only species found in such localities being either small forms which might have been carried on floating timber, or such as have been introduced by human agency. This absence of mammalian life in oceanic islands extends even to New Zealand, where the indigenous mammals comprise only two peculiar species of bats, the so-called Maori rat having been introduced by man.

One of the leading features in mammalian distribution is the fact that the Monotremata, or egg-laying mammals, are exclusively confined to Australia and Papua, with the adjacent islands. The marsupials also attain their maximum development in Australia ("Notogaea" of the distributionists), extending, however, as far west as Celebes and the Moluccas, although in these islands they form an insignificant minority among an extensive placental fauna, being represented only by the cuscuses (*Phalanger*), a group unknown in either Papua or Australia. Very different, on the other hand, is the condition of things in Australia and Papua, where marsupials (and monotremes) are the dominant forms of mammalian life, the placentals being represented (apart from bats, which are mainly of an Asiatic type) only by a number of more or less aberrant rodents belonging to the mouse-tribe, and in Australia by the dingo, or native dog, and in New Guinea by a wild pig. The dingo was, however, almost certainly brought from Asia by the ancestors of the modern natives; while the Papuan pig is also in all probability a human introduction, very likely of much later date. The origin of the Australasian fauna is a question pertaining to the article ZOOLOGICAL DISTRIBUTION. The remaining marsupials (namely the families *Didelphyidae* and *Epanorthidae*) are American, and mainly South and Central American at the present day; although during the early part of the Tertiary period representatives of the first-named family ranged all over the northern hemisphere.

The Insectivora (except a few shrews which have entered from the north) are absent from South America, and appear to have been mainly an Old World group, the only forms which have entered North America being the shrew-mice (*Soricidae*) and moles (*Talpidae*). The occurrence of one aberrant group (*Solenodon*) in the West Indies is, however, noteworthy. The family with the widest distribution is the *Soricidae*, the *Talpidae* being unknown in Africa. The tree-shrews (*Tupaiidae*) are exclusively Asiatic, whereas the jumping-shrews (*Macroscelididae*) are equally characteristic of the African continent. Madagascar is the sole habitat of the tenrecs (*Centetidae*), as is Southern Africa of the golden moles (*Chrysochloridae*). It is, however, important to mention that an extinct South American insectivore, *Necrolestes*, has been referred to the family last mentioned; and even if this reference should not be confirmed in the future, the occurrence of a representative of the order in Patagonia is a fact of considerable importance in distribution.

The Rodentia have a wider geographical range than any other order of terrestrial mammals, being, as already mentioned, represented by numerous members of the mouse-tribe (*Muridae*) even in Australasia. With the remarkable exception of Madagascar, where it is represented by the *Nesomyidae*, that family has thus a cosmopolitan distribution. Very noteworthy is the fact that, with the exception of Madagascar (and of course Australia) the squirrel family (*Sciuridae*) is also found in all parts of the world. Precisely the same may be said of the hares, which, however, become scarce in South America. On the other hand, the scaly-tailed squirrels (*Anomaluridae*), the jumping-hares (*Pedetidae*), and the strand-moles (*Bathyergidae*) are exclusively African; while the sewellels (*Haplodontidae*) and the pocket-gophers (*Geomyidae*) are as characteristically North American, although a few members of the latter have reached Central America. The beavers (*Castoridae*) are restricted to the northern hemisphere, whereas the dormice (*Gliridae*) and the mole-rats (*Spalacidae*) are exclusively Old World forms, the latter only entering the north of Africa, in which continent the former are largely developed. The jerboa group (*Dipodidae*, or *Jaculidae*) is also mainly an Old World type, although its aberrant representatives the jumping-mice (*Zapus*) have effected an entrance into Arctic North America. Porcupines enjoy a very wide range, being represented throughout the warmer parts of the Old World, with the exception of Madagascar (and of course Australasia), by the *Hystricidae*, and in the New World by the *Erethizontidae*. Of the remaining families of the Simplicidentata, all are southern, the cavies (*Caviidae*), chinchillas (*Chinchillidae*), and degus (*Octodontidae*) being Central and South American, while the *Capromyidae* are common to southern America and Africa, and the *Ctenodactylidae* are exclusively African. The near alliance of all these southern families, and the absence of so many Old World families from Madagascar form two of the most striking features in the distribution of the order. Lastly, among the Duplicidentata, the picas (*Ochotonidae* or *Lagomyidae*) form a group confined to the colder or mountainous regions of the northern hemisphere.

Among the existing land Carnivora (of which no representatives except the introduced dingo are found in Australasia) the cat-tribe (*Felidae*) has now an almost cosmopolitan range, although it only reached South America at a comparatively recent date. Its original home was probably in the northern hemisphere; and it has no representatives in Madagascar. The civet-tribe (*Viverridae*), on the other hand, which is exclusively an Old World group, is abundant in Madagascar, where it is represented by peculiar and aberrant types. The hyenas (*Hyaenidae*), at any rate at the present day, to which consideration is mainly limited, are likewise Old World. The dog-tribe (*Canidae*), on the other hand, are, with the exception of Madagascar, an almost cosmopolitan group. Their place of origin was, however, almost entirely in the northern hemisphere, and not improbably in some part of the Old World, where they gave rise to the bears (*Ursidae*). The latter are abundant throughout the northern hemisphere, and have even succeeded in penetrating into South America, but, with the exception of the Mediterranean zone, have never succeeded in entering Africa, and are therefore of course unknown in Madagascar. The raccoon group (*Procyonidae*) is mainly American, being represented in the Old World only by the pandas (*Aelurus* and *Aeluropus*), of which the latter apparently exhibits some affinity to the bears. The birthplace of the group was evidently in the northern hemisphere—possibly in east Central Asia. The weasel-tribe (*Mustelidae*) is clearly a northern group, which has, however, succeeded in penetrating into South America and Africa, although it has never reached Madagascar.

The extinct creodonts, especially if they be the direct descendants of the anomodont reptiles, may have originated in Africa, although they are at present known in that continent only from the Fayum district. Elsewhere they occur in South America and throughout a large part of the northern hemisphere, where they appear to have survived in India to the later Oligocene or Miocene.

In the case of the great order, or assemblage, of Ungulata it is necessary to pay somewhat more attention to fossil forms, since a considerable number of groups are either altogether extinct or largely on the wane.

So far as is at present known, the earliest and most primitive group, the Condylarthra, is a northern one, but whether first developed in the eastern or the western hemisphere there is no sufficient evidence. The more or less specialized Litopterna and Toxodontia, as severally typified by the macrauchenia and the toxodon, are, on the other hand, exclusively South American. With the primitive five-toed Amblypoda, as represented by the coryphodon, we again reach a northern group, common to the two hemispheres; but there is not improbably some connexion between this group and the much more specialized Barypoda, as represented by *Arsinöitherium*, of Africa. The Ancylopoda, again, typified by *Chalicotherium*, and characterized by the claw-like character of the digits, are probably another northern group, common to the eastern and western hemispheres.

Recent discoveries have demonstrated the African origin of the elephants (Proboscidea) and hyraxes (Hyracoidea), the latter group being still indeed mainly African, and in past times also limited to Africa and the Mediterranean countries. As regards the elephants (now restricted to Africa and tropical Asia), there appears to be evidence that the ancestral mastodons, after having developed from African forms probably not very far removed from the Amblypoda, migrated into Asia, where they gave rise to the true elephants. Thence both elephants and mastodons reached North America by the Bering Sea route; while the former, which arrived earlier than the latter, eventually penetrated into South America.

The now waning group of Perissodactyla would appear to have originally been a northern one, as all the three existing families, rhinoceroses (*Rhinocerotidae*), tapirs (*Tapiridae*), and horses (*Equidae*), are well represented in the Tertiaries of both halves of the northern hemisphere. If eastern Central Asia were tentatively given as the centre of radiation of the group, this might perhaps best accord with the nature of the case. Rhinoceroses disappeared comparatively early from the New World, and never reached South America. In Siberia and northern Europe species of an African type survived till a comparatively late epoch, so that the present relegation of the group to tropical Asia and Africa may be regarded as a modern feature in distribution. Horses, now unknown in a wild state in the New World, although still widely spread in the Old, attained a more extensive range in past times, having successfully invaded South America. On the other hand, in common with the rest of the Perissodactyla, they never reached Madagascar. In addition to the occurrence of their fossil remains almost throughout the world, the former wide range of the tapirs is attested by the fact of their living representatives being confined to such widely sundered areas as Malaysia and tropical America.

The Artiodactyla are the only group of ungulates known to have been represented in Madagascar; but since both these Malagasy forms—namely two hippopotamuses (now extinct) and a river-hog—are capable of swimming, it is most probable that they reached the island by crossing the Mozambique Channel. As regards the deer-family (*Cervidae*), which is unknown in Africa south of the Sahara, it is quite evident that it originated in the northern half of the Old World, whence it reached North America by the Bering Sea route, and eventually travelled into South America. More light is required with regard to the past history of the giraffe-family (*Giraffidae*), which includes the African okapi and the extinct Indian *Sivatherium*, and is unknown in the New World. Possibly, however, its birthplace may prove to be Africa; if so, we shall have a case analogous to that of the African elephant, namely that while giraffes flourished during the Pliocene in Asia (where they may have originated), they survive only in Africa. An African origin has also been suggested for the hollow-horned ruminants (*Bovidae*); and if this were substantiated it would explain the abundance of that family in Africa and the absence from the heart of that continent of the deer-tribe. Some confirmation of this theory is afforded by the fact that whereas we can recognize ancestral deer in the Tertiaries of Europe we cannot point with certainty to the forerunners of the *Bovidae*. Whether its birthplace was in Africa or to the north, it is, however, clear that the hollow-horned ruminants are essentially an Old World group, which only effected an entrance into North America at a comparatively recent date, and never succeeded in reaching South America. So far as it goes, this fact is also in favour of the African ancestry of the group.

The *Antilocapridae* (prongbuck), whose relationships appear to be rather with the *Cervidae* than with the *Bovidae*, are on the other hand apparently a North American group. The chevrotains (*Tragulidae*), now surviving only in West and Central Africa and tropical Asia, are conversely a purely Old World group.

The camels (*Tylopoda*) certainly originated in the northern hemisphere, but although their birthplace has been confidently claimed for North America, an equal, if not stronger, claim may be made on the part of Central Asia. From the latter area, where wild camels still exist, the group may be assumed to have made its way at an early period into North America; whence, at a much later date, it finally penetrated into South America. In the Old World it seems to have reached the fringe of the African continent, where its wanderings in a wild state were stayed.

The pigs (*Suidae*) and the hippopotamuses (*Hippopotamidae*) are essentially Old World groups, the former of which has alone succeeded in reaching America, where it is represented by the collateral branch of the peccaries (*Dicotylinae*). An African origin would well explain the present distribution of both groups, but further evidence on this point is required before anything decisive can be affirmed, although it is noteworthy that the earliest known pig (*Geniohyus*) is African. The *Suinae* are at present spread all over the Old World, although the African forms (other than the one from the north) are markedly distinct from those inhabiting Europe and Asia. Hippopotamuses, on the contrary, are now exclusively African, although they were represented in tropical Asia during the Pliocene and over the greater part of Europe at a later epoch.

A brief notice with regard to the distribution of the Primates must suffice, as their past history is too imperfectly known to admit of generalizations being drawn. The main facts at the present day are, firstly, the restriction of the Prosimiae, or lemurs, to the warmer parts of the Old World, and their special abundance in Madagascar (where other Primates are wanting); and, secondly, the wide structural distinction between the monkeys of tropical America (Platyrrhina), and the Old World monkeys and apes, or Catarrhina. It is, however, noteworthy that extinct lemurs occur in the Tertiary deposits of both halves of the northern hemisphere—a fact which has induced Dr J. L. Wortman to suggest a polar origin for the entire group—a view we are not yet prepared to endorse. For the distribution of the various families and genera the reader may be referred to the article PRIMATES; and it will suffice to mention here that while chimpanzees and baboons are now restricted to Africa and (in the case of the latter group) Arabia, they formerly occurred in India.

As regards aquatic mammals, the greater number of the Cetacea, or whales and dolphins, have, as might be expected, a very wide distribution in the ocean. A few, on the other hand, have a very restricted range, the Greenland right whale (*Balaena mysticetus*) being, for instance, limited to the zone of the northern circumpolar ice, while no corresponding species occurs in the southern hemisphere. In this case, not only temperature, but also the peculiar mode of feeding, may be the cause. The narwhal and the beluga have a very similar distribution, though the latter occasionally ranges farther south. The bottle-noses (*Hyperöodon*) are restricted to the North Atlantic, never entering, so far as known, the tropical seas. Other species are exclusively tropical or austral in their range. The pigmy whale (*Neobalaena marginata*), for instance, has only been met with in the seas round Australia, New Zealand and South America, while a beaked whale (*Berardius arnouxi*) appears to be confined to the New Zealand seas.

The Cetacea, however, are by no means limited to the ocean, or even to salt water, some entering large rivers for considerable distances, and others being exclusively fluviatile. The susu (*Platanista*) is, for instance, extensively distributed throughout nearly the whole of the river systems of the Ganges, Brahmaputra and Indus, ascending as high as there is water enough to swim in, but apparently never passing out to sea. The individuals inhabiting the Indus and the Ganges must therefore have been for long ages isolated without developing any distinctive anatomical characters, those by which *P. indi* was separated from *P. gangetica* having been shown to be of no constant value. *Orcella fluminalis*, again, appears to be limited to the Irrawaddy; and at least two distinct species of dolphin, belonging to different genera, are found in the Amazon. It is remarkable that none of the great lakes or inland seas of the world is inhabited by cetaceans.

The great difference in the manner of life of the sea-cows, or Sirenia, as compared with that of the Cetacea, causes a corresponding difference in their geographical distribution. Slow in their movements, and feeding on vegetable substances, they are confined to the neighbourhood of rivers, estuaries or coasts, although there is a possibility of accidental transport by currents across considerable distances. Of the three genera existing within historic times, one (*Manatus*) is exclusively confined to the shores of the tropical Atlantic and the rivers entering into it, individuals scarcely specifically distinguishable being found both on the American and the African. The dugong (*Halicore*) is distributed in different colonies, at present isolated, throughout the Indian Ocean from Arabia to North Australia; while the *Rhytina* or northern sea-cow was, for some time before its extinction, limited to a single island in the extreme north of the Pacific Ocean.

The seals (*Pinnipedia*) although capable of traversing long reaches of ocean, are less truly aquatic than the last two groups, always resorting to the land or to ice-floes for breeding. The geographical range of each species is generally more or less restricted, usually according to climate, as they are mostly inhabitants either of the Arctic or Antarctic seas and adjacent temperate regions, few being found within the tropics. For this reason the northern and the southern species are for the most part quite distinct. In fact, the only known exception is the case of a colony of elephant-seals (*Macrorhinus leoninus*), whose general range is in the southern hemisphere, inhabiting the coast of California. In this case a different specific name has been given to the northern form, but the characters by which it is distinguished are of little importance, and probably, except for the abnormal geographical distribution, would never have been discovered. The most remarkable circumstance connected with the distribution of seals is the presence of members of the order in the three isolated great lakes or inland seas of Central Asia—the Caspian, Aral and Baikal—which, notwithstanding their long isolation, have varied but slightly from species now inhabiting the Polar Ocean.

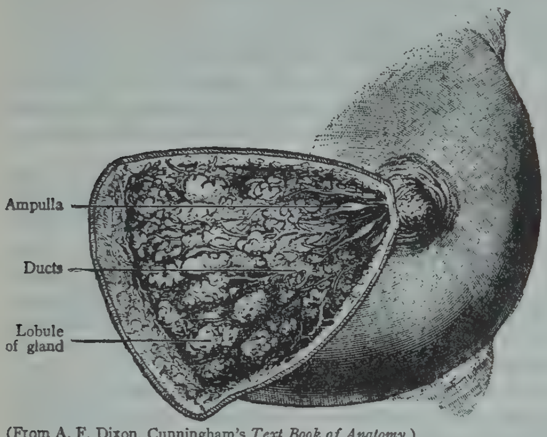
AUTHORITIES.—The above article is partly based on that of Sir W. H. Flower in the 9th edition of this work. The literature connected with mammals is so extensive that all that can be attempted here is to refer the reader to a few textbooks, with the aid of which, combined with that of the annual volumes of the *Zoological Record*, he may obtain such information on the subject as he may require: F. E. Beddard, "Mammals," *The Cambridge Natural History*, vol. x. (1902); W. H. Flower and R. Lydekker, *The Study of Mammals* (London, 1891); Max Weber, *Die Säugethiere* (Jena, 1904); W. T. Blanford, *The Fauna of British India—Mammalia* (1888–1891); D. G. Elliot, *Synopsis of the Mammals of North America* (Chicago, 1901) and *The Mammals of Middle America and the West Indies* (Chicago, 1904); W. L. Sclater, *The Fauna of South Africa—Mammals* (Cape Town, 1901–1902); W. K. Parker, *Mammalian Descent* (London, 1885); E. Trouessart, *Catalogus mammalium, tam viventium quam fossilium* (Paris, 1898–1899); and supplement, 1904–1905; T. S. Palmer, *Index generum mammalium* (Washington, 1904); W. L. and P. L. Sclater, *The Geography of Mammals* (London, 1899); R. Lydekker, *A Geographical History of Mammals* (Cambridge, 1896). (W. H. F.; R. L.)

MAMMARY GLAND (Lat. *mamma*), or female breast, the organ by means of which the young are suckled, and the possession of which, in some region of the trunk, entitles the animal bearing it to a place in the order of Mammalia.

Anatomy.—In the human female the gland extends vertically from the second to the sixth rib, and transversely from the edge of the sternum to the mid axillary line; it is embedded in the fat superficial to the pectoralis major muscle, and a process which extends toward the armpit is sometimes called the axillary tail. A little below the centre of the glandular swelling is the *nipple*, surrounding which is a pigmented circular patch called the areola; this is studded with slight nodules, which are the openings of areolar glands secreting an oily fluid to protect the skin during suckling. During the second or third month of pregnancy the areola becomes more or less deeply pigmented, but this to a large extent passes off after lactation ceases. In structure the gland consists of some fifteen to twenty lobules, each of which has a *lactiferous duct* opening at the summit of the nipple, and branching in the substance of the gland to form secondary lobules, the walls of which are lined by cubical epithelium in which the milk is secreted. These secondary lobules project into the surrounding fat, so that it is difficult to dissect out the gland cleanly. Before opening at the nipple each lactiferous duct has a fusiform dilatation called the *ampulla*.

After the child-bearing period of life the breasts atrophy and tend to become pendulous, while in some African races they are pendulous throughout life. Variations in the mammary glands are common; often the left breast is larger than the right, and in those rare cases in which one breast is suppressed it is usually the right, though suppression of the breast does not necessarily include absence of the nipple.

Supernumerary nipples and glands are not uncommon, and, when they occur, are usually situated in the mammary line which extends from the anterior axillary fold to the spine of the pubis; hence, when an extra nipple appears above the normal one, it is external to it, but, when below, it is nearer the middle line. The condition of extra breasts is known as *polymasty*, that of extra nipples as *polythely*, and it is interesting to notice that the latter is commoner in males than in females. O. Ammon (quoted by Wiedersheim) records the case of a German soldier who had four nipples on each side. These nipples in the human subject are seldom found below the costal margin. In normal males the breast structure is present, but rudimentary, though it is not very rare to find instances of boys about puberty in whom a small amount of milk is secreted, and one case at least is recorded of a man who suckled a child. A functional condition of the mammary glands in men is known as *gynaekomasty*. (For further details see *The Structure of Man*, by R. Wiedersheim, translated by H. and M. Bernard, and edited by G. B. Howes, London, 1895.)



(From A. F. Dixon, Cunningham's *Text Book of Anatomy*.)

FIG. 1.—Dissection of the Mammary Gland.

Embryology.—There is every probability that the mammary glands are modified and hypertrophied sebaceous glands, and transitional stages are seen in the areolar glands, which sometimes secrete milk. At an early stage of foetal life a raised patch of ectoderm is seen, which later on becomes a saucer-like depression; from the bottom of this fifteen or twenty solid processes of cells, each presumably representing a sebaceous gland, grow into the mesoderm which forms the connective-tissue stroma of the mamma. Later on these processes branch. The last stage is that the centre of the *mammary pit* or saucer-like depression once more grows up to form the nipple, and at birth the processes become tubular, thus forming lactiferous ducts. The glands grow little until the age of puberty, but their full development is not reached until the birth of the first child.

Comparative Anatomy.—In the lower Mammals the mammary line, already mentioned, appears in the embryo as a ridge, and in those which have many young at a birth patches of this develop in the thoracic and abdominal regions to form the mammae, while the intervening parts of the ridge disappear. The number of mammae is not constant in animals of the same species; as an instance of this it will be found that in the dog the number of nipples varies from seven to ten, though animals with many nipples are more liable to variation than those with few. When only a few young are produced at a time the mammae are few, and it seems to depend on the convenience of suckling in which part of the mammary line the glands are developed. In the pouched Mammals (Monotremes and Marsupials) inguinal mammae are found, and so they are in most Ungulates as well as in the Cetacea. In the elephants, Sirenia, Chiroptera and most of the Primates, on the other hand, they are confined to the pectoral region, and this is also the case in some Rodents, *e.g.* the jumping hare (*Pedetes caffer*). In the monotremes the mammary pit remains throughout life, and the milk is conducted along the hairs to the young, but in other Mammals nipples are formed in one of two ways. One is that already described in Man, which is common to the Marsupials and Primates, while in the other the margin or *vallum* of the mammary pit grows up, and so forms a nipple with a very deep pit, into the bottom of which the lactiferous ducts open. The latter is regarded as the primary arrangement. In the monotremes the mammae are looked upon, not as modified sebaceous glands, as in other Mammals, but as altered sweat glands. It is further of interest to notice that in these primitive Mammals the glands are equally developed in both sexes, and it is thought that among the bats the male often assists in suckling the young (see G. Dobson, *Brit. Museum Cat. of the Chiroptera*, London, 1878). These facts, together with the occasional occurrence of gynaekomasty in man, make it probable that the ancestral Mammal was an animal in which both sexes helped in the process of lactation.

For further details and literature up to 1906 see *Comparative Anatomy of Vertebrates*, by R. Wiedersheim, adapted by W. N. Parker (1907), and Bronn's *Classen und Ordnungen des Thierreichs*. (F. G. P.)

Diseases of the Mammary Gland.—Inflammation of the breast (*mastitis*) is apt to occur in a woman who is suckling, and is due to the presence of septic micro-organisms, which, as a rule, have found their way into the milk-ducts, the lymphatics or the veins, through a crack, or other wound, in a nipple which has been made sore by the infant's vigorous attempts to obtain food. Especially is this septic inflammation apt to occur if the nipple is depressed, or so badly formed that the infant has difficulty in feeding from it. The inflamed breast is enlarged, tender and painful, and the skin over it is hot, and perhaps too reddened. The woman feels ill and feverish, and she may shiver, or have a definite rigor—which suggests that the inflammation is running on to the formation of an abscess. The abscess may be superficial to, or beneath, the breast, but it is usually within the breast itself. The infant should at once be weaned, the milk-tension being relieved by the breast-pump. Fomentations should be applied under waterproof jaconette, and the breast should be evenly supported by a bandage or by the corsets. Belladonna and glycerine should be smeared over the breast, with the view of checking the secretion of milk, as well as of easing pain. But before this is done six or eight leeches may be applied. On the first indication that matter is collecting, an incision should be made, for if the matter is allowed to remain locked up in the breast tissue the abscess will rapidly increase in size, and the whole of the breast may become infected and destroyed. Supposing that, in making the incision, no pus is discovered, the relief to the vascular tension thus afforded will be nevertheless highly beneficial. The operation had better be done under a general anaesthetic, so that the surgeon can introduce a probe, or his finger, into the wound, breaking down the partitions which are likely to exist between separate abscesses, and thus enable them to be drained through the one opening. As the discharge begins to cease, the tenderness subsides, and gentle massage, or firm strapping of the breast, will prove useful. The general treatment will consist in the administration of an aperient, and, the tongue being clean, in prescribing such drugs as quinine, strychnia and iron. The diet should be liberal, but not carried to such excess that the power of digestion and absorption is overtaxed. During the early acute stage of the disease small doses of morphia may be necessary. When the tongue has cleaned, a little wine may be given with advantage.

Chronic Eczema around the nipple of a woman late in life, with, perhaps, localized ulceration, is known as *Paget's Disease*. The importance of it is that cancerous infiltration is apt to pass from it along the milk-ducts and to involve the breast in malignant disease. Hence, when eczema about the nipple refuses to clear up under the influence of soothing treatment, it is well to insist on the removal of the entire breast. Sometimes this eczema is malignant from the beginning, being associated with the active prolification of the epithelial cells of the milk-ducts, and with their escape into the surrounding tissues. The nipple is retracted in most of these cases, which, however, are not often met with.

Chronic Mastitis is of frequent occurrence in women who are past middle age. The part of the breast involved is enlarged, hard, and more or less tender and painful. It is sometimes impossible clinically to distinguish this disease from cancer. True, the tumour is not so definite or so hard as a cancer, nor is it attached to the skin, nor to the muscles of the chest wall, and if there are any glands secondarily enlarged in the arm-pit they are not so hard as they may be in cancer. But all these are questions of degree. It is, of course, highly inadvisable to leave it to time to clear up the diagnosis, for a chronic mastitis, innocent at first, may eventually become cancerous. If in any case the difficulty of distinguishing a chronic mastitis from a malignant tumour of the breast is insuperable, the safest course is to remove the breast and have it examined by the microscope. The suggestion, sometimes made, as to the preliminary removal of a small piece of the tumour for examination is not to be recommended.

A simple glandular tumour, *fibro-adenoma*, is apt to be found in the breasts of youngish women, who may possibly give an account of some blow or other injury; there may, however, be no history of injury. The tumour is smooth, rounded or oval, and lies loose in the midst of the breast; as a rule it is not tender. It is not associated with enlarged glands in the arm-pit. The tumour had best be removed, though there is no urgency about the operation, as the growth is absolutely innocent. There is, however, no telling as to what course an innocent tumour of the breast may take as middle age comes on.

Cysts of the Breast.—A *galactocele* is a tumour due to the locking up of milk in a greatly dilated duct. Other forms of cystic disease may be due to serous or hydatid fluid, or to thin pus, being surrounded by fibrous walls. Such cysts are best treated by free incision, and by passing a gauze dressing into their depths. If the tissue is occupied by many cysts, the whole breast had better be removed.

Cancer of the Breast may be met with in men as well as in women; in men, however, it is very rare. It is commonest in women between the ages of forty and fifty. It is sometimes met with in women of twenty; and the younger the individual the more malignant is the disease. Married life seems to have no effect as regards the incidence of the disease, but it often happens that a breast which gave trouble during the period of suckling becomes later the subject of cancer; in other cases there is a clear history of the attack having followed an injury. It is, thus, as if inflammatory changes in the breast were the direct cause of a later cancerous invasion. Though it is impossible to affirm that heredity has a great influence in the incidence of cancer, it is, nevertheless, remarkable that the members of certain families are unusually prone to the disease.

The chief feature of a cancerous tumour of the breast is its great hardness. The technical name for the growth is *scirrhus* (Gr. *σκίρος*, or *σκὶρρος*, any hard coat or covering, *stucco*), from its stony hardness. The tumour consists of a dense framework of fibrous tissue, with groups of cancer-cells in the spaces. The malignancy of the disease depends upon the cells, not upon the fibrous tissue. In young subjects the cells predominate, but in old ones the contraction of the fibrous tissue throughout the breast compresses and destroys the cells, and this sometimes to such an extent that there is at last nothing left at the site but contracted fibrous tissue, all trace of malignancy having disappeared. This variety of the disease is found in old people, and is called *atrophic cancer*.

The cells of a cancerous breast are apt to be carried by the lymphatics to the lymphatic glands in the arm-pit, and by the blood-stream to the spinal column and to other parts of the skeleton, and sometimes to the liver, which thus becomes large and hard, or to the other breast.

As the fibrous tissue around the tumour becomes invaded by the new growth it undergoes contraction (much as a string becomes shorter when it is wetted), and as this shortening of the fibrous bands increases the nipple may be retracted, and the breast may be closely bound down to the chest-wall; and, further, the skin overlying the tumour may be drawn in towards the tumour so as to form a conspicuous dimple. Later, the nutrition of this patch of skin may be so interfered with that it mortifies or breaks down, and thus a cancerous ulcer is produced. This ulcer slowly spreads, and its floor is covered with a discharge in which septic micro-organisms undergo cultivation; in this way the ulcer becomes highly offensive. By the use of antiseptic lotions and a frequent change of dressings, however, all unpleasant smell can be checked or prevented. As the ulcer extends it is apt to implicate large blood-vessels, so that serious, and sometimes alarming, haemorrhages take place. And if the breast had previously been in pain, the bleeding is likely to give great relief. But repeated haemorrhages bring on increasing exhaustion, and thus materially hasten the end.

There is at present only one trustworthy treatment for cancer, and that is its free removal by operation. The entire breast and the nipple must be sacrificed. At the present day the operation itself is not a "dreadful" one. To be successful it must be very thorough, and it must be done *early*. The patient, being under an anaesthetic, feels nothing, and the subsequent dressings of the wound are attended with scarcely any pain. There need be but a couple of days of confinement to bed, and when the wound has soundly healed the patient may be encouraged to use her arm. Should there be recurrence of cancerous nodules in or about the wound, their removal should be promptly and widely effected. The writer has records of one case in which between the first operation and the last report there was a space of over twenty-nine years, and another of fifteen years. Each of these patients had one extensive operation, and four or five smaller operations for dealing with recurrences. Each of them, however, might be considered unlikely subjects for further return.

For a *superficial cancer* the X-rays may be of service, but many applications of the rays are likely to be needed, and the case may possibly refuse to yield to their influence, and, after loss of valuable time, the disease may have eventually to be removed by the knife. The great advantage which the treatment by the knife offers over every other method is that the growth can be cleanly, efficiently and promptly removed, and, with it, all the affected lymph-spaces, and the lymphatic glands which are secondarily implicated.

As regards the value of radium in the treatment of cancer of the breast, the high expectations which were somewhat widely associated with this newly-found element early in 1909 must be said to have been unjustified by any precise results. Injections of radium salts have been made into the substance of a cancer, and tubes of aluminium containing the salt have been introduced into the growth, but no deep cancer has thereby been cured. Radium has also been exposed again and again on the surface of the affected breast, but similarly with no great result. Unfortunately, whilst one is experimenting in the treatment of an operable cancer, the epithelial cells of the growth may be making their way towards distant parts, where no rays or emanations could possibly reach them. Whatever may be the future of radium as a therapeutic agent in the treatment of cancer of the breast, it is certain that, on the facts as known at the beginning of 1910, the only safe course is to remove the breast by direct operation, together with the associated lymph-spaces and lymphatic glands. And if this is done promptly and thoroughly cancer of the breast will come more and more into the class of curable diseases. (E. O.*)

MAMMEE APPLE, South American or St Domingo Apricot, the fruit of *Mammea americana* (natural order Clusiaceae), a large tree with opposite leathery gland-dotted leaves, white, sweet-scented, short-stalked, solitary or clustered axillary flowers and yellow fruit 3 to 6 in. in diameter. The bitter rind encloses a sweet aromatic flesh, which is eaten raw or steeped in wine or with sugar, and is also used for preserves. There are one to four large rough seeds, which are bitter and resinous, and used as anthelmintics. An aromatic liqueur distilled from the flowers is known as *eau de créole* in the West Indies, and the acrid resinous gum is used to destroy the chigoes which attack the naked feet of the negroes. The wood is durable and well adapted for building purposes; it is beautifully grained and used for fancy work.

MAMMON, a word of Aramaic origin meaning "riches." The etymology is doubtful; connexions with a word meaning "entrusted," or with the Hebrew *matmon*, treasure, have been suggested. "Mammon," Gr. *μαμωνᾶς* (see Professor Eb. Nestle in *Ency. Bib., s.v.*), occurs in the Sermon on the Mount (Matt. vi. 24) and the parable of the Unjust Steward (Luke xvi. 9–13). The Authorized Version keeps the Syriac word. Wycliffe uses "richessis." The *New English Dictionary* quotes *Piers Plowman* as containing the earliest personification of the name. Nicholaus de Lyra (commenting on the passage in Luke) says that *Mammon est nomen daemonis*. There is no trace, however, of any Syriac god of such a name, and the common identification of the name with a god of covetousness or avarice is chiefly due to Milton (*Paradise Lost*, i. 678).

MAMMOTH (O. Russ. *mammot*, mod. *mamant*; the Tatar word *mama*, earth, from which it is supposed to be derived, is not known to exist), a name given to an extinct elephant, *Elephas primigenius* of Blumenbach. Probably no extinct animal has left such abundant evidence of its former existence; immense numbers of bones, teeth, and more or less entire carcases, or "mummies," as they may be called, having been discovered, with the flesh, skin and hair *in situ*, in the frozen soil of the tundra of northern Siberia.

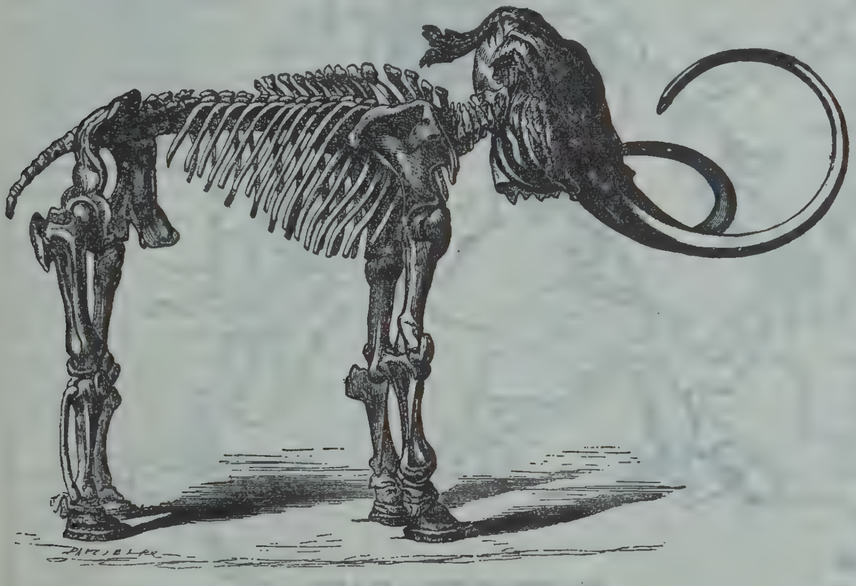
The general characteristics of the order Proboscidea, to which the mammoth belongs, are given under that heading. The mammoth pertains to the most highly specialized section of the group of elephants, which also contains the modern Asiatic species. Of the whole group it is in many respects, as in the size and form of the tusks and the characters of the molar teeth, the farthest removed from the mastodon type, while its nearest surviving relative, the Asiatic elephant (*E. maximus*), has retained the slightly more generalized characters of the mammoth's contemporaries of more southern climes, *E. columbi* of America and *E. armeniacus* of the Old World. The tusks, or upper incisor teeth, which were probably smaller in the female, in the adult males attained the length of from 9 to 10 ft. measured along the outer curve. Upon leaving the head they were directed at first downwards, and outwards, then upwards and finally inwards at the tips, and generally with a tendency to a spiral form not seen in other elephants.

It is chiefly by the characters of the molar teeth that the various extinct modifications of the elephant type are distinguished. Those of the mammoth (fig. 2) differ from the corresponding organs of allied species in great breadth of the crown as compared with the length, the narrowness and crowding or close approximation of the ridges, the thinness of the enamel, and its straightness, parallelism and absence of "crimping," as seen on the worn surface or in a horizontal section of the tooth. The molars, as in other elephants, are six in number on each side above and below, succeeding each other from before backwards. Of these Dr Falconer gave the prevailing "ridge-formula" (or number of complete ridges in each tooth) as 4, 8, 12, 12, 16, 24, as in *E. maximus*. Dr Leith-Adams, working from more abundant materials, has shown that the number of ridges of each tooth, especially those at the posterior end of the series, is subject to individual variation, ranging in each tooth of the series within the following limits: 3 to 4, 6 to 9, 9 to 12, 9 to 15, 14 to 16, 18 to 27—excluding the small plates, called "talons," at each end. Besides these variations in the number of ridges or plates of which each tooth is composed, the thickness of the enamel varies so much as to have given rise to a distinction between a "thick-plated" and a "thin-plated" variety—the latter being most prevalent among specimens from the Arctic regions. From the specimens with thick enamel plates the transition to the other species mentioned above, including *E. maximus*, is almost imperceptible.

The bones of the skeleton generally more resemble those of the Indian elephant than of any other species, but the skull differs in the narrower summit, narrower temporal fossae, and more prolonged incisive sheaths, supporting the roots of the enormous tusks. Among the external characters by which the mammoth was distinguished from either of the existing species of elephant was the dense clothing, not only of long, coarse outer hair, but also of close under woolly hair of a reddish-brown colour, evidently in adaptation to the cold climate it inhabited. This character is represented in rude but graphic drawings of prehistoric age found in caverns in the south of France. It should be added that young Asiatic elephants often show considerable traces of the woolly coat of the mammoth. The average height does not appear to have exceeded that of either of the existing species of elephant.

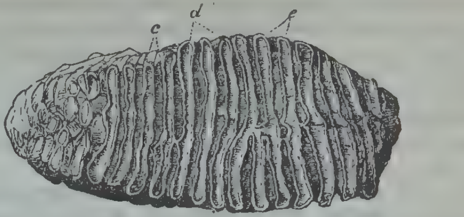
The geographical range of the mammoth was very extensive. There is scarcely a county in England in which its remains have not been found in alluvial gravel or in caverns, and numbers of its teeth are dredged in the North Sea. In Scotland and Ireland its remains are less abundant, and in Scandinavia and Finland they appear to be unknown; but they have been found in vast numbers at various localities throughout the greater part of central Europe (as far south as Santander and Rome), northern Asia, and the northern part of the American continent.

The mammoth belongs to the post-Tertiary or Pleistocene epoch and was contemporaneous with man. There is evidence to show that it existed in Britain before, during and after the glacial period. It is in northern Siberia that its remains have been found in the greatest abundance and in exceptional preservation. For a long period there has been from that region an export of mammoth-ivory, fit for commercial purposes, to China and to Europe. In the middle of the 10th century trade was carried on at Khiva in fossil ivory. Middendorff estimated the number of tusks which have yearly come into the market during the last two centuries at at least a hundred pairs, but Nordenskiöld considers this estimate too low. Tusks are found along the whole shore-line between the mouth of the Obi and Bering Strait, and the farther north the more numerous they become, the islands of New Siberia being one of the favourite collecting localities. The remains are found not only round the mouths of the great rivers, but embedded in the frozen soil in such circumstances as to indicate that the animals lived not far from the localities in which they are found; and they are exposed either by the melting of the ice in warm summers or the washing away of the sea-cliffs or river-banks. In this way the bodies of more or less nearly perfect animals, often standing in the erect position, with the soft parts and hairy covering entire, have been brought to light.



(From Tilesius.)

FIG. 1.—Skeleton of Mammoth (*Elephas primigenius*), with portions of the skin.



(From Owen.)

FIG. 2.—Grinding surface of Upper Molar Tooth of the Mammoth (*Elephas primigenius*). *c*, cement; *d*, dentine; *e*, enamel.

For geographical distribution and anatomical characters see Falconer's *Palaeontological Memoirs*, vol. ii. (1868); B. Dawkins, "*Elephas Primigenius*, its Range in Space and Time," *Quart. Journ. Geol. Soc.*, xxxv. 138 (1879); and A. Leith Adams, "Monograph of British Fossil Elephants," part ii., *Palaeontographical Society* (1879). (W. H. F.; R. L.*)

MAMMOTH CAVE, a cave in Edmondson county, Kentucky, U.S.A., 37° 14′ N. lat. and 86° 12′ W. long., by rail 85 m. S.S.W. of Louisville. Steamboats run from the mouth of the Green river, near Evansville, Indiana, to the Mammoth Cave landing. The cave is usually said to have been discovered, in 1809, by a hunter named Hutchins; but the county records, as early as 1797, fixed its entrance as the landmark for a piece of real estate. Its mouth is in a forest ravine, 194 ft. above Green river and 600 ft. above the sea. This aperture is not the original mouth, the latter being a chasm a quarter of a mile north of it, and leading into what is known as Dixon's cave. The two portions are not now connected, though persons in one can make themselves heard by those in the other.

The cavernous limestone of Kentucky covers an area of 8000 sq. m., is massive and homogeneous, and belongs to the Subcarboniferous period. It shows few traces of dynamic disturbance, but has been carved, mainly by erosion since the Miocene epoch, into many caverns, of which the Mammoth Cave is the largest.

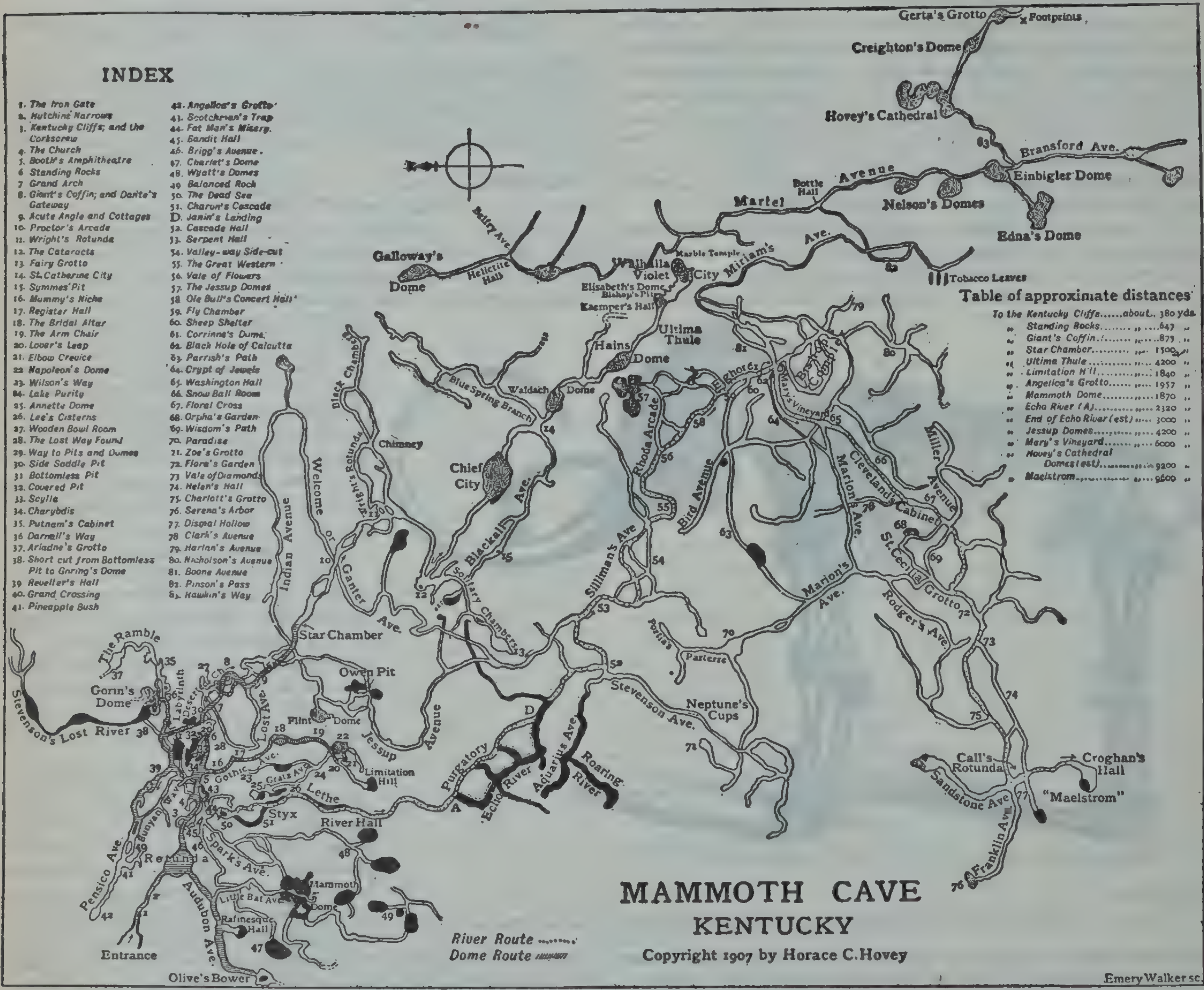
The natural arch that admits one to Mammoth Cave has a span of 70 ft., and from a ledge above it a cascade leaps 59 ft. to the rocks below, where it disappears. A flight of stone steps leads the way down to a narrow passage, through which the air rushes with violence, outward in summer and inward in winter. The temperature of the cave is uniformly 54° F. throughout the year, and the atmosphere is both chemically and optically of singular purity. While the lower levels are moist from the large pools and rivers that have secret connexion with Green river, the upper galleries are extremely dry. These conditions led at one time to the erection of thirteen cottages at a point about 1 m. underground, for the use of invalids, especially consumptives. The experiment failed, and only two cottages now remain as curiosities.

The Main Cave, from 40 to 300 ft. wide and from 35 to 125 ft. high, has several vast rooms, *e.g.* the Rotunda, where are the ruins of the old saltpetre works; the Star Chamber, where the protrusion of white crystals through a coating of the black oxide of manganese creates an optical illusion of great beauty; the Chief City, where an area of 2 acres is covered by a vault 125 ft. high, and the floor is strewn with rocky fragments, among which are found numerous half-burnt torches made of canes, and other signs of prehistoric occupancy. Two skeletons were exhumed near the

Rotunda; but few other bones of any description have been found. The so-called Mammoth Cave "mummies" (*i.e.* bodies kept by being inhumed in nitrous earth), with accompanying utensils, ornaments, braided sandals and other relics, were found in Short and Salt Caves near by, and removed to Mammoth Cave for exhibition. The Main Cave, which abruptly ends 4 m. from the entrance, is joined by winding passages, with spacious galleries on different levels; and, although the diameter of the area of the whole cavern is less than 10 m., the conbined length of all accessible avenues is supposed to be about 150 m.

The chief points of interest are arranged along two lines of exploration, besides which there are certain side excursions. The "short route" requires about four hours, and the "long route" nine. Audubon's Avenue, the one nearest the entrance, is occupied in winter by myriads of bats, that hang from the walls in clusters like swarms of bees. The Gothic Avenue contains numerous large stalactites and stalagmites, and an interesting place called the Chapel, and ends in a double dome and cascade. Among the most surprising features of cave scenery are the vertical shafts that pierce through all levels, from the uppermost galleries, or even from the sink-holes, down to the lowest floor. These are styled pits or domes, according to the position occupied by the observer. A crevice behind a block of stone, 40 ft. long by 20 ft. wide, called the Giant's Coffin, admits the explorer to a place where six pits, varying in depth from 65 ft. to 200 ft., exist in an area of 600 yds. This includes Gorin's Dome, which is viewed from a point midway in its side, and also from its top, and was formerly regarded as the finest room in the cavern. Others admire more the Mammoth Dome, at the termination of Spark's Avenue, where a cataract falls from a height of 150 ft. amid walls wonderfully draped with stalactitic tapestry. The Egyptian Temple, which is a continuation of the Mammoth Dome, contains six massive columns, two of them quite perfect and 80 ft. high and 25 ft. in diameter. The combined length of these contiguous chambers is 400 ft. By a crevice above they are connected with an arm of Audubon's Avenue. Lucy's Dome, one of the group of Jessup Domes, is supposed to be the loftiest of all these vertical shafts. A pit called the "Maelstrom," in Croghan's Hall, is the spot most remote from the mouth of the cave. There are some fine stalactites near this pit, and others in the Fairy Grotto and in Pensico Avenue; but, considering the magnitude of Mammoth Cave, its poverty of stalactitic ornamentation is remarkable. The wealth of crystals is, however, surprising, and these are of endless variety and fantastic beauty.

Cleveland's Cabinet and Marion's Avenue, each a mile long, are adorned by myriads of gypsum rosettes and curiously twisted crystals, called "oulopholites." These cave flowers are unfolded by pressure, as if a sheaf were forced through a tight binding, or the crystal fibres curl outward from the centre of the group. Thus spotless arches of 50 ft. span are embellished by floral clusters and garlands, hiding nearly every foot of the grey limestone. The botryoidal formations hanging by thousands in Mary's Vineyard resemble mimic clusters of grapes,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Dome Route
Table of approximate distances
To the Kentucky Cliffs......about.. 380 yds.
" Standing Rocks........ " ....647 "
" Giant's Coffin......... " .....873 "
" Star Chamber.......... " .. 1500 "
" Ultima Thule............ " ... 4200 "
" Limitation Hill........... " ... 1840 "
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" Mary's Vineyard....... " .... 6000 "
" Hovey's Cathedral Domes (est.).......... " .... 9200 "
" Maelstrom................... " .... 9600 "
Emery Walker sc.

MAMMOTH CAVE
KENTUCKY
Copyright 1907 by Horace C. Hovey

as the oulophollites resemble roses. Again, there are chambers with drifts of snowy crystals of the sulphate of magnesia, the ceilings so thickly covered with their efflorescence that a loud concussion will cause them to fall like flakes of snow.

Many small rooms and tortuous paths, where nothing of special interest can be found, are avoided as much as possible on the regular routes; but certain disagreeable experiences are inevitable. There is peril also in the vicinity of the deep pits. The one known as the Bottomless Pit was for many years a barrier to all further exploration, but it is now crossed by a wooden bridge. Long before the shaft had been cut as deep as now the water flowed away by a channel gradually contracting to a serpentine way, so extremely narrow as to be called the Fat Man's Misery. The walls, only 18 in. apart, change direction eight times in 105 yds., while the distance from the sandy path to the ledge overhead is but 5 ft. The rocky sides are finely marked with waves and ripples, as if running water had suddenly been petrified. This winding way conducts one to River Hall, beyond which lie the crystalline gardens that have been described. It used to be said that, if this narrow passage were blocked up, escape would be impossible; but an intricate web of fissures, called the Corkscrew, has been discovered, by means of which a good climber, ascending only a few hundred feet, lands 1000 yds. from the mouth of the cave, and cuts off one or two miles.

The waters, entering through numerous domes and pits, and falling, during the rainy season, in cascades of great volume, are finally collected in River Hall, where they form several extensive lakes, or rivers, whose connexion with Green River is known to be in deep springs appearing under arches on its margin. Whenever there is a freshet in Green River the streams in the cave are joined in a continuous body of water, the rise sometimes being 60 ft. above the low-water mark. The subsidence within is less rapid than the rise; and the streams are impassable for about seven months in each year. They are navigable from May to October, and furnish interesting features of cave scenery. The first approach is called the Dead Sea, embraced by cliffs 60 ft. high and 100 ft. long, above which a path has been made, whence a stairway leads down to the banks of the river Styx, a body of water 40 ft. long, crossed by a natural bridge. Lake Lethe comes next—a broad basin enclosed by walls 90 ft. high, below which a narrow path leads to a pontoon at the neck of the lake. A beach of the finest yellow sand extends for 500 yds. to Echo River, the largest of all being from 20 to 200 ft. wide, 10 to 40 ft. deep and about three-quarters of a mile long. It is crossed by boats. The arched passage-way is very symmetrical, varying in height from 19 to 35 ft., and famous for its musical reverberations—not a distinct echo, but an harmonious prolongation of sound for from 10 to 30 seconds after the original tone is produced. The long vault has a certain keynote of its own, which, when firmly struck, excites harmonics, including tones of incredible depth and sweetness.

There are several other streams here besides those in River Hall. On one of them F. J. Stevenson of London is said to have floated for seven hours without finding its end. A glance at the accompanying map will show that there is a labyrinth of avenues and chasms seldom visited and never fully explored. New discoveries are frequently made. An exploring party in 1904 found a curious complex of upper and lower galleries accessible from the most eastern portion of the cave; beyond which another party, in 1905, discovered several large domes previously unknown. H. C. Hovey, in 1907, was led by expert guides into still wilder recesses, where a series of five domes were found, that opened into each other by tall gateways; each dome being 60 ft. in diameter and 175 ft. high. This magnificent group has since been named "Hovey's Cathedral Domes." No instrumental survey of the Mammoth Cave has ever been allowed by the management. The best map possible is therefore only the result of estimates and partial measurements. The depths of the most noted pits have easily been ascertained by line and plummet and the height of several large domes has been found by the use of small balloons. While making a survey exclusively for the cave-owners in 1908, Max Kaemper of Berlin, Germany, forced an opening from the main cave into a remarkable region to which the general name of "Violet City" was given, in honour of Mrs Violet Blair Janin, who owned a third of the Mammoth Cave estate. Special features are Kaemper Hall, Blair Castle, the Marble Temple and Walhalla. There are eleven enormous pits, many large fine stalactites and stalagmites and surprisingly beautiful mural decorations. Dr Hovey made and published (1909) a new handbook embodying all known discoveries of importance, with four sketch-maps of the routes of usual exhibition.

The fauna of Mammoth Cave has been classified by F. W. Putnam, A. S. Packard and E. D. Cope, who have catalogued twenty-eight species truly subterraneous, besides those that may be regarded as stragglers from the surface. They are distributed thus: *Vertebrata*, 8 species; *Insecta*, 17; *Arachnida*, 12; *Myriapoda*, 2; *Crustacea*, 5; *Vermes*, 3; *Mollusca*, 1. Ehrenberg adds a list of 8 Polygastric *Infusoria*, 1 fossil infusorian, 5 *Phytolitharia* and several microscopic fungi. A bed of *Agaricus* was found by the writer near the river Styx; and upon this hint an attempt has been made to propagate edible fungi in this locality. All the known forms of plant-life are either fungi or allied to them, and many are only microscopic. The most interesting inhabitants of Mammoth Cave are the blind, wingless grasshoppers, with extremely long antennae; blind, colourless crayfish (*Cambarus pellucidus*, Telk.); and the blind fish, *Amblyopsis spelaeus*, colourless and viviparous, from 1 in. to 6 in. long. The *Cambarus* and *Amblyopsis* have wide distribution, being found in many other caves, and also in deep wells, in Kentucky and Indiana. Fish not blind are occasionally caught, which are apparently identical with species existing in streams outside. The true subterranean fauna may be regarded as chiefly of Pleistocene origin; yet certain forms are possibly remnants of Tertiary life.

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MAMORÉ, a large river of Bolivia which unites with the Beni in 10° 20′ S. to form the Madeira, one of the largest tributaries of the Amazon. It rises on the northern slope of the Sierra de Cochabamba east of the city of Cochabamba, and is known as the Chimoré down to its junction with the Chapare, or Chapari. Its larger tributaries are the Chapare, Sécure, Apere and Yacuma from the west, and the Ichila, Guapay or Grande, Ivari and Guaporé from the east. Taking into account its length only, the Guapay should be considered the upper part of the Mamoré; but it is shallow and obstructed, and carries a much smaller volume of water. The Guaporé, or Itenez, also rivals the Mamoré in length and volume, having its source in the Serra dos Parecis, Matto Grosso, Brazil, a few miles from streams flowing northward to the Tapajos and Amazon, and southward to the Paraguay and Paraná. The Mamoré is interrupted by rapids a few miles above its junction with the Beni, but a railway 180 m. long has been undertaken from below the rapids of the Madeira. Above the rapids the river is navigable to Chimoré, at the foot of the *sierra*, and most of its tributaries are navigable for long distances. Franz Keller (in *The Amazon and Madeira Rivers*; New York, 1874) gives the outflow of the Mamoré at mean water level, and not including the Guaporé, as 2530 cub. in. per second, and the area of its drainage basin, also not including the Guaporé, as 9382 sq. m.

See Edward D. Mathews, *Up the Amazon and Madeira Rivers* (London, 1879).

MAMUN (*c.* 786–833), originally ABDALLAH, surnamed AL-MA'MŪN (" in whom men trust "), the seventh of the Abbasid caliphs of Bagdad, was born about A.D. 786, and was the second son of Harun al-Rashīd. By Harun's will he was successor-designate to his brother Amin, during whose reign he was to be governor of the eastern part of the empire. On Harun's death (809) Amin succeeded and Mamun acquiesced. Irritated, however, by the treatment he received from Amin, and supported by a portion of the army, Mamun speedily rebelled. A five years' struggle between the two brothers ended in the death of Amin and the proclamation of Mamun as caliph at Bagdad (Sept. 813). Various factions and revolts, which disturbed the first years of his reign, were readily quelled by his prudent and energetic measures. But a much more serious rebellion, stirred up by his countenancing the heretical sect of Ali and adopting their colours, soon after threatened his throne. His crown was actually on the head of his uncle Ibrahim b. Mahdi (surnamed Mobarek) for a short time (Barbier de Meynard, in *Journal Asiatique*, March–April 1869). This inaugurated a period of tranquillity, which Mamun employed in fostering literature and science. He had already, while governor of Khorasan, founded a college there, and attracted to it the most eminent men of the day, and Bagdad became the seat of academical instruction. At his own expense he caused to be translated into Arabic many valuable books from the Greek, Persian, Chaldean and Coptic languages; and he was himself an ardent student of mathematics and astronomy. The first Arabic translation of Euclid was dedicated to him in 813. Mamun founded observatories at Bagdad and Kassiun (near Damascus), and succeeded in determining the inclination of the ecliptic. He also caused a degree of the meridian to be measured on the plain of Shinar; and he constructed astronomical tables, which are said to be wonderfully accurate.

In 827 he was converted to the heterodox faith of the Moʻtazilites, who asserted the free-will of man and denied the eternity of the Koran. The later years (829–830) of his reign were distracted by hostilities with the Greek emperor Theophilus, while a series of revolts in different parts of the Arabian empire betokened the decline of the military glory of the caliphs. Spain and part of Africa had already asserted their independence, and Egypt and Syria were now inclined to follow. In 833, after quelling Egypt, at least nominally, Mamun marched into Cilicia to prosecute the war with the Greeks, but died near Tarsus, leaving his crown to a younger brother, Motasim. The death of Mamun ended an important epoch in the history of science and letters and the period of Arabian prosperity which his father's reign had begun.

See further under CALIPHATE, sect. C., §§ 5, 6, 7.

MAMUND, a Pathan tribe and valley on the Peshawar border of the North-West Frontier Province of India. The Mamunds live partly in Bajour and partly in Afghan territory, due north of the Mohmands, a much larger tribe, with whom they must not be confounded. They are one of the clans of the Tarkanis (*q.v.*), and number 6000 fighting men; they gave much trouble during the Chitral Campaign in 1895, and again during the Mohmand Expedition in 1897 they inflicted severe losses upon General Jeffrey's brigade. (See MOHMAND.)

MAN, the word common to Teutonic languages for a single person of the human race, of either sex, the Lat. *homo*, and Gr. ἄνθρωπος; also for the human race collectively, and for a full-grown adult male human being. Teutonic languages, other than English, have usually adopted a derivative in the first sense, *e.g.* German *Mensch*. Philologists are not in agreement as to whether the Sanskrit *manu* is the direct source, or whether both are to be traced to a common root. Doubt also is thrown on the theory that the word is to be referred to the Indo-Germanic root, *men*, meaning "to think," seen in "mind," man being essentially the thinking or intelligent animal. (See ANTHROPOLOGY.)

MAN, ISLE OF (anc. *Mona*), a dominion of the crown of England, in the Irish Sea. (For map, see ENGLAND, section I.) It is about 33 m. long by about 12 broad in the broadest part. Its general form resembles that of an heraldic lozenge, though its outline is very irregular, being indented with numerous bays and narrow creeks. Its chief physical characteristic is the close juxtaposition of mountain, glen and sea, which has produced a variety and beauty of scenery unsurpassed in any area of equal size elsewhere.

The greater part of its surface is hilly. The hills, which reach their culminating point in Snaefell (2034 ft.), have a definite tendency to trend in the direction of the longer axis, but throw out many radiating spurs, which frequently extend to the coast-line. They are, for the most part, smooth and rounded in outline, the rocks being such as do not favour the formation of crags, though, owing to the rapidity of their descent, streams have frequently rent steep-walled craggy gulleys in their sides. The strength of the prevalent westerly winds has caused them to be treeless, except in some of the lower slopes, but they are clad with verdure to their summits. Rising almost directly from the sea, they appear higher than they really are, and therefore present a much more imposing appearance than many hills of greater altitude. On the south-west, where they descend precipitously into the sea, they unite with the cliffs to the north and south of them to produce the most striking part of the coast scenery for which the isle is remarkable. But, indeed, the whole coast from Peel round by the Calf, past Castletown and Douglas to Maughold Head, near Ramsey, is distinguished by rugged grandeur. From Ramsey round by the Point of Ayre to within a few miles of Peel extend low sandy cliffs, bordered by flat sandy shores, which surround the northern plain. This plain is relieved only by a low range of hills, the highest of which attains an elevation of 270 ft. The drainage of the island radiates from the neighbourhood of Snaefell, from which mountain and its spurs streams have on all sides found their way to the sea. The most important of these are the Sulby, falling into the sea at Ramsey; the *Awin-glass* (bright river) and the *Awin-dhoo* (dark river), which unite their waters near Douglas; the *Neb*, at the mouth of which Peel is situated; and the *Awin-argid* (silver river, now called the Silverburn), which joins the sea at Castletown. There are no lakes. The narrow, winding glens thus formed, which are studded with clumps of fir, sycamore and mountain ash, interspersed with patches of gorse, heather and fern, afford a striking and beautiful contrast to the bare mountain tops. Traces of an older system of drainage than that which now exists are noticeable in many places, the most remarkable being the central depression between Douglas and Peel. The chief bays are, on the east coast, Ramsey, with an excellent anchorage, Laxey, Douglas, Derbyhaven, Castletown and Port St Mary; and, on the west coast, Port Erin and Peel.

Geology.—The predominant feature in the stratigraphy of the Isle of Man is, in the words of G. W. Lamplough,[1] "the central ridge of slate and greywacke, which seems to have constituted an insulated tract at as early a date as the beginning of the Carboniferous period. This prototype of the present island appears afterwards to have been enfolded and obliterated by the sediments of later times; but with the progress of denudation the old ridge has once more emerged from beneath this mantle." This mass of ancient rocks, the Manx Slate Series, has been divided locally into the Barrule slates, the Agneesh and other grit beds; and the Lonan and Niarbyl Flags. The whole series strikes N.E.–S.W., while structurally the strata form part of a synclinorium, the higher beds being on the N.W. and S.E. sides of the islands, the lower beds in the interior; although the subordinate dips appear to indicate an anticlinal structure. These rocks have been greatly crumpled; and in places, notably in Sully Glen, thrusting has developed a well-marked crush-breccia. So much has this folding and compression toughened the soft argillaceous rocks that the Barrule Slate, for example, is almost everywhere found occupying the highest points, while the hard but more joined grits and flags occupy the lower ground on the mountain flanks. The Manx Series is penetrated and altered by large masses of granite at Dhoon, Foxdale and one or two other spots; and dykes, more or less directly associated with these masses, are numerous. No satisfactory fossils have yet been obtained from these rocks, but they are regarded, provisionally, as of Upper Cambrian age. Carboniferous rocks, including a basal conglomerate, white limestone with abundant fossils, and the black "Posidonomya Beds" (some of which are polished as a black marble) occur about Castletown, Poolvash Bay and Langness; and the basement beds appear again on the west coast at Peel. The cliffs and foreshore at Scarlet Point exhibit contemporaneous Carboniferous tuffs, agglomerates and basalts, as well as later dolerite dykes, in a most striking manner. Here too may be seen some curious effects of thrusting in the limestones. At the northern end of the island the Manx Slates end abruptly in an ancient sea-cliff which crosses between Ramsey and Ballaugh. The low-lying country beyond is formed of a thick mass of glacial sands, gravels and boulder clay. In the Bride Hills are to be seen glacial mounds rising 150 ft. above the level of the plain. The depressions known as the Curragh, now drained but still peaty in places, probably represent the sites of late glacial lakes. Glacial deposits are found also in all parts of the island. Beneath the thick drift of the plain, Carboniferous, Permian and Trassic rocks have been proved to lie at some depth below the present sea-level. On the coast near the Point of Ayr is a raised beach. Silver-bearing lead ore, zinc and copper are the principal minerals found in the Isle of Man; the most important mining centres being at Foxdale and Laxey.

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[1] G. W. Lamplough, *The Geology of the Isle of Man*, Mem. Geol. Survey (1903).

Climate.—The island is liable to heavy gales from the south-west. Of this the trend of the branches of the trees to the north-east is a striking testimony. But it is equally subject to the influence of the warm drift from the Atlantic, so that its winters are mild, and, influenced by the less changeable temperature of the sea, its summers cool. The mean annual temperature is 49°·0 F., the temperature of the coldest month (January) being 41°·5, and the warmest (August) 58°·5, giving an extreme annual range of temperature of 17°·1 only, while the average temperature in spring is 46°·0, in summer 57°·2, in autumn 50°·9 and in winter 42°·0. Further evidence of the mildness of the climate is afforded by the fact that fuchsias, hydrangeas, myrtles and escallonias grow luxuriantly in the open air. Its rainfall, placed as it is between mountain districts in England, Ireland, Scotland and Wales, is naturally rather wet than dry. Statistics, however, reveal remarkable divergencies in the amounts of rain in the different parts of the island, varying from 61 in. at Snaefell to 25 in. at the Calf of Man. In the more populous districts it varies from 46 in. at Ramsey, and 45 in. at Douglas, to 38 in. at Peel and 34 in. at Castletown. Of sunshine the Isle of Man has a larger share than any portion of the United Kingdom except the south and south-east coasts and the Channel Islands. Briefly, then, the climate of the island may be pronounced to be equable and sunny, and, though humid, decidedly invigorating; its rainfall, though it varies greatly, is excessive in the populous districts; and its winds are strong and frequent, and usually mild and damp.

Fauna.—Like Ireland, the Isle of Man is exempt from snakes and toads, a circumstance traditionally attributed to the agency of St Patrick, the patron saint of both islands. Frogs, however, have been introduced from Ireland, and both the sand lizard and the common lizard are found. Badgers, moles, squirrels and voles are absent and foxes are extinct. Fossil bones of the Irish elk are frequently found, and a complete skeleton of this animal is to be seen at Castle Rushen. The red deer, which is referred to in the ancient laws and pictured on the runic crosses, became extinct by the beginning of the 18th century. Hares are less plentiful than formerly, and rabbits are not very numerous. Snipe are fairly common, and there are a few partridges and grouse. The latter, which had become extinct, were reintroduced in 1880. Woodcock, wild geese, wild ducks, plover, widgeon, teal, heron, bittern, kingfishers and the Manx shearwater (*Puffinus anglorum*) visit the island, but do not breed there. The puffin (*Fratercula artica*) is still numerous on the Calf islet in the summer time. The peregrine falcon, which breeds on the rocky coast, and the chough have become very scarce. The legal protection of sea-birds (local act of 1867) has led to an enormous increase in the number of gulls. A variety of the domestic cat, remarkable for the absence or stunted condition of the tail, is peculiar to the island.

Flora.—Like the fauna, the flora is chiefly remarkable for its meagreness. It contains at most 450 species as compared with 690 in Jersey. Alpine forms are absent. But what it lacks in variety it makes up in beauty and quantity. For the profusion of the gorse-bloom and the abundance of spring flowers, especially of primroses, and of ferns, the Isle of Man is probably unrivalled.

People.—The Manx people of the present day are mainly of Scandio-Celtic origin, with some slight traces of earlier races. They have large and broad heads, usually broader than those of their brother Celts (*Goidels*) in Ireland and Scotland, with very broad, but not specially prominent cheek-bones. Their faces are usually either scutiform, like those of the Northmen, or oval, which is the usual Celtic type, and their noses are almost always of good length, and straighter than is general among Celtic races. Light eyes and fair complexion, with rather dark hair, are the more usual combinations. They are usually rather tall and heavily built, their average height (males) being 5 ft. 7½ in., and average weight (naked) 155 lb. The tendency of the population to increase is balanced by emigration. It reached its maximum in 1891. Since then it has slightly declined. A noticeable feature is its greater proportionate growth in the towns, especially in Douglas, than in the country. The country population reached its maximum in 1851. Since then it has been shrinking rapidly, especially in the northern district.

Sheadings, Parishes and Towns.		1726.	1821.	1871.	1901.
Rushen.	Malew (P.)	890	2,649	2,466	2,113
	Castletown (T.)	785	2,036	2,318	1,963
	Arbory (P.)	661	1,455	1,350	802
	Rushen (P.)	813	2,568	3,665	3,277
Middle.	Santon (P.)	376	800	628	468
	Braddan (P.)	780	1,754	2,215	2,177
	Douglas (T.)	810	6,054	13,846	19,149
	Onchan (P.)	370	1,457	1,620	3,942
Glen-falea.	Marown (P.)	499	1,201	1,121	973
	German (P.)	510	1,849	1,762	1,230
	Peel (T.)	475	1,909	3,496	3,306
	Patrick (P.)	745	2,031	2,888	1,925
Garff.	Lonan (P.)	547	1,846	3,741	2,513
	Maughold (P.)	529	1,514	1,433	887
	Ramsey (T.)	460	1,523	3,861	4,672
Ayre.	Lezayre (P.)	1,309	2,209	1,620	1,389
	Bride (P.)	612	1,001	880	539
	Andreas (P.)	967	2,229	1,757	1,144
Mi-chael.	Jurby (P.)	483	1,108	788	504
	Ballaugh (P.)	806	1,467	1,077	712
	Michael (P.)	643	1,427	1,231	928
Total		14,070	40,087	53,763	54,613

Chief Political Divisions and Towns.—The island is divided into six sheadings (so named from the Scandinavian *skeða-þing*, or ship-district), called Glenfaba, Middle, Rushen, Garff, Ayre and Michael, each of which has its officer, the coroner, whose functions are similar to those of a sheriff; and there are seventeen parishes. For the towns see CASTLETOWN, DOUGLAS, PEEL and RAMSEY. The principal villages are Ballasalla, Ballaugh, Foxdale, Laxey, Michael, Onchan, Port Erin and Port St Mary.

Communications.—There is communication by steamer with Liverpool, Glasgow, Greenock, Belfast, Silloth, Whitehaven, Belfast and Dublin throughout the year and, during the summer season, there are also steamers plying to Ardrossan, Heysham, Fleetwood and Blackpool. A daily mail was established in 1879. The internal communications are excellent. The roads are under the management of a board appointed by the Tynwald Court, a surveyor-general, and parochial surveyors. They are maintained by a system of licences on public-houses, carriages, carts and dogs, and a rate on real property. There are railways between Douglas, Ramsey, Peel, Castletown, Port Erin and Port St Mary, the line between Douglas and Ramsey being via St John's and Michael. Electric tramways run from Douglas to Ramsey via Laxey, from Douglas to Port Soderick, and from Laxey to the summit of Snaefell.

Industries. (*a*) *Agriculture.*—The position of the Manx farmers, though they generally pay higher rents than their compeers in those countries do, is, except in the remote parts of the island, more favourable than that of the English or Scottish farmers. The best land is in the north and south. The farms are principally held on lease and small holdings have almost entirely disappeared. The cultivated area is about 93,000 acres, or 65% of the whole. The commons and uncultivated lands on the mountains are also utilized for pasturage. Oats occupy about three-fourths of the area under corn crops, barley about one-sixth. The amount of wheat and other corn crops is very trifling. Neither Manx wheat nor barley is as good on an average as English; but oats is, on the whole, fully equal to what is grown on the mainland. Turnips, which are an excellent crop, are largely exported, and the dry and sandy soil of the north of the island is very favourable for the growth of potatoes. The white and red clover and the common grasses grow luxuriantly, and the pasturage is, generally speaking, good. Some of the low-lying land, especially in the north, is much in need of systematic drainage. The livestock, largely in consequence of the premiums given by the insular government and the local agricultural society to bulls, heavy and light stallions and cart mares, now approximates very closely in quality to the stock in the north of England. Dairying, owing to the large number of summer visitors, is the most profitable department of agricultural industry. Apples, pears and wall fruit do not succeed very well, but the soil is favourable for the cultivation of strawberries, raspberries, gooseberries, currants and vegetables. Both agricultural and market-garden produce are quite insufficient to supply the demand in the summer.

(*b*) *Fishing.*—The important place which the fishing industry anciently held in the social organization of the Isle of Man is quaintly reflected in the wording of the oath formerly taken by the deemsters, who promised to execute the laws between the sovereign and his subjects, and "betwixt party and party, as indifferently as the herring backbone doth lie in the midst of the fish." The statutes and records abound in evidence of the great extent to which both the people and their rulers were dependent on the produce of the sea. The most numerous fish are herrings, cod, mackerel, ling, haddock, plaice, sole, fluke, turbot and brett. The industry is, however, in a decaying condition, especially the herring fishery, which, for reasons which have not been satisfactorily ascertained, fails periodically. The amount of fish caught, except herrings, is not sufficient to supply the local demand in the summer, though some of the fish named are exported during the rest of the year. About 250 vessels, aggregating 4260 tons, with crews numbering 4250, are employed in this industry. A fish hatchery has been established at Port Erin by the insular government.

(*c*) *Mining.*—There is no doubt that, in proportion to its area, the metalliferous wealth of the Isle of Man has been very considerable. Two of its mines, Laxey and Foxdale, have stood for a long series of years in the first rank in the British Islands for productiveness of zinc and silver lead respectively. These metals have constituted its principal riches, but copper pyrites and hematite iron have also been raised in marketable quantities, while only very small amounts of the ores of nickel and antimony have been found. The mines are rented from the Crown as lord of the manor. The value of the ore produced is about £40,000 annually. Other economic products are clay, granite, limestone, sandstone, slate (of an inferior quality) and salt, which has been discovered near the Point of Ayre.

(*d*) *Textiles, &c.*—Since labour has become scarcer and dearer textile industries have been declining, being unable to compete with larger and more completely organized manufactories elsewhere. The principal manufactured articles are woollen cloths and blankets, hemp ropes and cotton, and herring nets. A few fishing vessels are built, and brewing is a prosperous industry. But, apart from agriculture, the most important industry (for so it may be called) is that of the provision for summer visitors, nearly half a million of whom come to the island annually.

Commerce.—The chief exports are lead, zinc, turnips, ropes, cotton nets and salt. The imports consist chiefly of timber, provisions, live-stock, poultry, flour, fruit, vegetables and eggs. In 1906 the tonnage of vessels (other than fishing or wind-bound vessels) cleared for traffic was 720,790. The number of vessels (other than fishing vessels) registered as belonging to the island in 1906 was 79.

Government.—The government of the island is vested in a lieutenant-governor, appointed by the Crown; in a Council, which is the upper branch of the legislature; in the House of Keys, which is the lower branch; and in the Tynwald Court. The Council and Keys sit separately as legislative bodies, but they sit in the Tynwald Court as distinct bodies with co-ordinate powers to transact executive business and to sign Bills. The Tynwald Court controls the surplus revenue, after the payment of the cost of government and of a fixed contribution of £10,000 to the imperial exchequer, subject to the supervision of the Treasury and the veto of the lieutenant-governor, and it appoints boards to manage the harbours, highways, education, local government, and lunatic and poor asylums. The Imperial government, after intimating its intention to Tynwald, fixes the rates of the customs duties, but Tynwald can by resolution "impose, abolish or vary" the customs duties subject to the approval of parliament or the Treasury, such change to take effect immediately and to continue for six months, and, if parliament be then sitting, to the end of the session, provided that the same be not in the meantime annulled by the passing of an act of parliament, or a Treasury minute. The approval of the sovereign of the United Kingdom in Council is essential to every legislative enactment. Acts of the imperial parliament do not affect the island except it be specially named in them. The lieutenant-governor, who is the representative of the sovereign, presides in the Council, in the Tynwald Court, in the High Court of Justice (Staff of Government division) and in the Court of General Gaol Delivery. He is the supreme executive authority, and he shares the control of the legislative and administrative functions, including the management of the revenue and the control of its surplus, with the Tynwald Court; he has also the power of veto as regards the disposal of surplus revenue and the nature of proposed harbour works, and his signature is necessary to the validity of all acts. It has been the practice for him to act as chancellor of the exchequer and to initiate all questions concerning the raising or expenditure of public funds. The Council consists of the lieutenant-governor, the lord-bishop of the diocese, the clerk of the rolls, the two deemsters, the attorney-general, the archdeacon (all of whom are appointed by the Crown) and the vicar-general, who is appointed by the bishop. No act of the governor and Council is valid unless it is the act of the governor and at least two members of the Council. The House of Keys (for origin of the name see KEY) is one of the most ancient legislative assemblies in the world. It consists of twenty-four members, elected by male and female owners or occupiers of property. Each of the six sheadings elects three members; the towns of Castletown, Peel and Ramsey one each, and Douglas five. There is no property qualification required of the members, and the house sits for five years unless previously dissolved by the lieutenant-governor.

Law.—The High Court of Justice, of which the lieutenant-governor is president, contains three divisions: viz. the Chancery Division, in which the clerk of the rolls sits as judge, the Common Law Division, of which the deemsters are the judges, the Staff of Government Division, in which the governor and three judges sit together. The jurisdiction of the Chancery and Common Law Division is in the main similar to that of the corresponding divisions in the English Courts. The Staff of Government exercises appellate jurisdiction, similar to that of the Appeal Courts in England. The Common Law Courts for the southern division of the island are held at Douglas and Castletown alternately and those for the northern division at Ramsey, once in three months. Actions in these courts are heard by a deemster and a special or common jury. The Chancery Court sits once a fortnight at Douglas. The deemsters also have summary jurisdiction in matters of debt, actions for liquidated damages under £50, suits for possession of real or personal property, petitions for probate, &c. These courts, called Deemsters' Courts, are held weekly, alternately at Douglas and Castletown, by the deemster for the southern division of the island, and at Ramsey and Peel by the deemster for the northern division. Criminal cases are heard by the magistrates or a high-bailiff and are (with the exception of minor cases which may be dealt with summarily) sent on by them for trial by a deemster and a jury of six, who hear the evidence and determine whether there is sufficient ground for sending the case for trial before the Court of General Gaol Delivery, thus discharging the functions of the Grand Jury in England. The Court of General Gaol Delivery is the Supreme Criminal Court and is presided over by the lieutenant-governor, who is assisted by the clerk of the rolls and the two deemsters. The high-bailiffs hold weekly courts in the four towns for the recovery of debts under forty shillings and for the trial of cases usually brought before a stipendiary magistrate in England. The magistrates (J.P.'s) also hold regular courts in the towns for the trial of breaches of the peace and minor offences. There is a coroner in each of the six sheadings. These officers are appointed annually by the lieutenant-governor and perform duties similar to those of a sheriff's officer in England. Inquests of death are held by a high-bailiff and jury. The Manx Bar is distinct from that of England. Its members, called "Advocates," combine the functions of barrister and solicitor. The laws relating to real property still retain much of their ancient peculiarity, but other branches of law have of late years by various acts of Tynwald been made practically identical with English law.

As regards real property the general tenure is a customary freehold devolving from each possessor to his next heir-at-law. The descent of land follows the same rules as the descent of the crown of England. The right of primogeniture extends to females in default of males in the direct line. The interest of a widow or widower, being the first wife or husband of a person deceased, is a life estate in one-half of the lands which have descended hereditarily, and is forfeited by a second marriage; a second husband or second wife is only entitled to a life interest in one-fourth, if there be issue of the first marriage. Of the land purchased by the husband the wife surviving him is entitled to a life interest in one moiety. By a statute of the year 1777 proprietors of land are empowered to grant leases for any term not exceeding twenty-one years in possession without the consent of the wife.

Church.—It is not known by whom Christianity was introduced into Man, but from the large proportion of names of Irish ecclesiastics surviving in the appellations of the old Manx *keeills*, or cells, which are of similar type to the Irish oratories of the 6th and 7th centuries, and in the dedications of the parish churches, which are usually on ancient sites, it may be reasonably conjectured that Manxmen were, for the most part, Christianized by Irish missionaries. During the incursions of the pagan Vikings Christianity was almost certainly extirpated and it was probably not reintroduced before the beginning of the 11th century. The two most important events in the history of the medieval Manx Church were the formation of the diocese of *Sodor* (*q.v.*) and the foundation of the abbey of Rushen, a branch of the Cistercian abbey of Furness, in 1134. This latter event was important because the Cistercians were exempted from all episcopal visitation and control, by charter granted by the pope, and were, therefore, only subject to his rule and that of the abbots of their own order. From this time till the Reformation we find that there was an almost continuous struggle between the laity and the spiritual barons and monks, who had obtained great power and much property in the island. In 1458 the diocese was placed under York. The dissolution of the religious houses in Man was not brought about by the English Act of 1539, which did not apply to the island, but by the arbitrary action of Henry VIII. From such evidence as is available it would seem that the Reformation was a very slow process. When Isaac Barrow (uncle of his well-known namesake) became bishop in 1663 the condition of the Church was deplorable, but under him and his able and saintly successors, Thomas

Wilson (1698–1755) and Mark Hildesley (1755–1773), it attained to a very much higher level than the English Church during the same period. After Hildesley's time it was again neglected, and successful missions by John Wesley and others resulted in the establishment and rapid increase of Nonconformity. It was not till the second decade of the 19th century that the condition of the Church began to improve again, and this improvement has steadily continued. In 1878 a Sodor and Man theological school was established for the training of candidates for holy orders. This school has been affiliated to Durham University. In 1880 four rural deaneries were established, and commissioners were constituted as trustees of endowments for Church purposes. In 1895 a cathedral chapter, with four canons, was constituted under the name of the "Dean and Chapter of Man," the bishop being the dean of the cathedral church. A Church Sustentation Fund was established by Bishop Straton in 1894, with a view to supplementing the incomes of the clergy, which had been greatly reduced on account of the low price of corn. There have been several acts giving Nonconformists equal rights with Churchmen. Among these are the Burials Acts of 1881 and 1895, which permit burials to take place in churchyards without the rites of the Church of England, and allow any burial service, provided it be Christian, in mortuary chapels. At the present day Nonconformists, chiefly Wesleyan Methodists, probably outnumber Churchmen, and there is a small number of Roman Catholics and Presbyterians. The bishop, who has a seat, but not a vote, in the House of Lords, is assisted by an archdeacon, a vicar-general, a registrar and a sumner-general. The jurisdiction of the only remaining ecclesiastical court, which is presided over by the vicar-general, as representing the bishop, is mainly in connexion with affiliation questions, the swearing-in of churchwardens and the granting of faculties. The power of the Manx Convocation to make canons, though not exercised since 1704, has never been abrogated, and so far affords a token that the Manx Church is a separate national Church governed by its own laws, which, however, must be approved by the insular Legislature.

Education.—It was not till 1872, when the insular Legislature passed the Public Elementary Education Act, that the Manx State undertook any direct responsibility for education. This act differed from the English Act of 1870 in three important particulars: (1) it at once constituted every town and parish a school district under a school board; (2) the attendance of children was made compulsory; and (3) every elementary school, those in connexion with the Church of Rome excepted, was obliged to provide for non-sectarian instruction in religious subjects, and for the reading of the Bible accompanied by suitable explanation. Since the date of this act education has made extraordinary strides. It became free in 1892, and a higher-grade school was established in Douglas in 1894. The public elementary schools, which are nearly all managed by School Boards, are subject to the control of a local "Council of Education" appointed by the Tynwald Court; but, as the Manx Act of 1872 requires that, in order to obtain a government grant, the schools shall fulfil the conditions contained in the minutes of the education department at Whitehall, they are examined by English inspectors and compelled to attain the same standard of efficiency as the English and Welsh schools. In 1907 an act establishing a system of secondary education was passed by the Legislature. The total number of public elementary schools in 1906 was 47, 42 being board and 5 denominational. Besides King William's College, opened in 1833, which provided a similar education to that obtainable at the English public schools, there are grammar schools in Douglas, Ramsey and Castletown.

The Manx language (see CELT: *Language*) still lingers, the census of 1901 showing that there were about 4400 people who understood something of it. There is now no one who does not speak English.

Economics.—Municipal government was established in 1860, and in 1876 vaccination was made compulsory, as also was the registration of births, marriages and deaths in 1878. It was not till 1884 that the sanitation of the towns was seriously taken in hand; but ten years more elapsed before the sanitary condition of the island was dealt with by the passing of an act which constituted parish and village districts, with commissioners elected by the people, who had, in conjunction with a board elected by the Tynwald Court and an inspector appointed by it, to attend to all questions relating to sanitation and infectious diseases. As a result of these measures the death-rate has been greatly reduced. In 1888 a permissive poor law was established; it has been adopted by all the towns except Peel and by seven of the seventeen country parishes. Before this date the poor had been dependent on voluntary relief, which broke down owing to the growth of a temporarily employed class occupied in administering to the wants of the summer visitors. The total number of persons in receipt of poor relief averages about 920, and that of lunatics about 212. The average number of births during the five years 1902–1906 was 21·6, of marriages 6·1, and of deaths 17·6 per thousand. The rateable annual value of the parishes, towns and villages is about £400,000. The revenue for the year ending the 31st of March 1907 was £86,365, and the expenditure £75,728. The largest revenue raised was £91,193 in 1901, and the debt reached its maximum amount, £219,531, in 1894.

History.—The history of the Isle of Man falls naturally into three periods. In the first of these the island was inhabited by a Celtic people. The next is marked by the Viking invasions and the establishment of Scandinavian rule. The third period is that of the English dominion. The secular history of the Isle of Man during the Celtic period is an absolute blank, there being no trustworthy record of any event whatever before the incursions of the Northmen, since the exploits attributed to Baetan MacCairill, king of Ulster, at the end of the 6th century, which were formally supposed to have been performed in the Isle of Man, really occurred in the country between the Firths of Clyde and Forth. And it is clear that, even if the supposed conquest of the Menavian islands—Man and Anglesey—by Edwin of Northumbria, in 616, did take place, it could not have led to any permanent results; for, when the English were driven from the coasts of Cumberland and Lancashire soon afterwards, they could not well have retained their hold on the island to the west of these coasts. It is, however, possible that in 684, when Ecfrid laid Ireland waste from Dublin to Drogheda, he temporarily occupied Man. During the period of Scandinavian domination there are two main epochs—one before the conquest of Man by Godred Crovan in 1079, and the other after it. The earlier epoch is characterized by warfare and unsettled rule, the later is comparatively peaceful. Between about A.D. 800 and 815 the Vikings came to Man chiefly for plunder; between about 850 and 990, when they settled in it, the island fell under the rule of the Scandinavian kings of Dublin; and between 990 and 1079, it was subject to the powerful earls of Orkney. The conqueror Godred Crovan was evidently a remarkable man, though little information about him is attainable. According to the *Chronicon Manniae* he "subdued Dublin, and a great part of Leinster, and held the Scots in such subjection that no one who built a vessel dared to insert more than three bolts." The memory of such a ruler would be likely to survive in tradition, and it seems probable therefore that he is the person commemorated in Manx legend under the name of King Gorse or Orry. The islands which were under his rule were called the *Suðr-eyjar* (Sudreys or the south isles, in contradistinction to the *norðr-eyjar*, or the north isles, *i.e.* the Orkneys and Shetlands, and they consisted of the Hebrides, and of all the smaller western islands of Scotland, with Man. At a later date his successors took the title of *Rex Manniae et Insularum*. Olaf, Godred's son, was a powerful monarch, who, according to the Chronicle, maintained "such close alliance with the kings of Ireland and Scotland that no one ventured to disturb the Isles during his time" (1113–1152). His son, Godred, who for a short period ruled over Dublin also, as a result of a quarrel with Somerled, the ruler of Argyll, in 1156, lost the smaller islands off the coast of Argyll. An independent sovereignty was thus interposed between the two divisions of his kingdom. Early in the 13th century, when Reginald of Man did homage to King John, we hear for the first time of English intervention in the affairs of Man. But it was into the hands of Scotland that the islands were ultimately to fall. During the whole of the Scandinavian period the isles were nominally under the suzerainty of the kings of Norway, but they only occasionally asserted it with any vigour. The first to do so was Harold Haarfager about 885, then came Magnus Barfod about 1100, both of whom conquered the isles. From the middle of the 12th century till 1217 the suzerainty, owing to the fact that Norway was a prey to civil dissensions, had been of a very shadowy character. But after that date it became a reality and Norway consequently came into collision with the growing power of Scotland. Finally, in 1261, Alexander III. of Scotland sent envoys to Norway to negotiate for the cession of the isles, but their efforts led to no result. He therefore initiated hostilities which terminated in the complete defeat of the Norwegian fleet at Largs in 1263. Magnus, king of Man and the Isles, who had fought on the Norwegian side, was compelled to surrender all the islands over which he had ruled, except Man, for which he did homage. Two years later Magnus died and in 1266 the king of Norway, in consideration of the sum of 4000 marks, ceded the islands, including Man, to Scotland. But Scotland's rule over Man was not firmly established till 1275, when the Manx were defeated in a decisive battle at Ronaldsway, near Castletown. In 1290 we find Edward I. of England in possession of Man, and it remained in English hands till 1313, when it was taken by Robert Bruce after besieging Castle Rushen for five weeks. Then, till 1346, when the battle of Neville's Cross decided the long struggle between England and Scotland in England's favour, there followed a confused period when Man was sometimes under English and sometimes under Scottish rule. About 1333 it had been granted by King Edward III. to William de Montacute, 1st earl of Salisbury, as his absolute possession, without reserving any service to be rendered to him. In 1392 his son sold the island "with the crowne" to Sir William Le Scroope. In 1399 Henry IV. caused Le Scroope, who had taken Richard's side, to be beheaded. The island then came into the possession of the crown and was granted to Henry de Percy, earl of Northumberland, but, he having been attainted, Henry IV., in 1406, made a grant of it, with the patronage of the bishopric, to Sir John Stanley, his heirs and assigns, on the service of rendering two falcons on paying homage and two falcons to all future kings of England on their coronation.

With the accession of the Stanleys to the throne there begins a better epoch in Manx history. Though the island's new rulers rarely visited its shores they placed it under responsible governors, who, in the main, seem to have treated it with justice. Of the thirteen members of the family who ruled in Man, the second Sir John Stanley (1414–1432), James, the 7th earl (1627–1651), and the 10th earl of the same name (1702–1736) had the most important influence on it. The first curbed the power of the spiritual barons, introduced trial by jury, instead of trial by battle, and ordered the laws to be written. The second, known as the Great Stanley, and his wife, Charlotte de la Tremoille (or Tremouille), are probably the most striking figures in Manx history. In 1643 Charles I. ordered him to go to Man, where the people, who were no doubt influenced by what was taking place in England, threatened to revolt. But his arrival, with English soldiers, soon put a stop to anything of this kind. He conciliated the people by his affability, brought in Englishmen to teach various handicrafts and tried to help the farmers by improving the breed of Manx horses, and, at the same time, he restricted the exactions of the Church. But the Manx people never had less liberty than under his rule. They were heavily taxed; troops were quartered upon them; and they also had the more lasting grievance of being compelled to accept leases for three lives instead of holding their land by the "straw" tenure which they considered to be equivalent to a customary inheritance. Six months after the death of the king Stanley received a summons from General Ireton to surrender the island, which he haughtily declined. In August 1651 he went to England with some of his troops, among whom were 300 Manxmen, to join King Charles II., and he and they shared in the decisive defeat of the Royalists at Worcester. He was captured and confined in Chester Castle, and, after being tried by court martial, was executed at Wigan. Soon after his death the Manx Militia, under the command of William Christian, rose against the Countess and captured all the insular forts except Rushen and Peel. They were then joined by a parliamentary force under Colonel Duckenfield, to whom the Countess surrendered after a brief resistance. Fairfax had been appointed "Lord of Man and the Isles" in September, so that Man continued under a monarchical government and remained in the same relation to England as before. The restoration of Stanley government in 1660 therefore caused as little friction and alteration as its temporary cessation had. One of the first acts of the new lord, Charles (the 8th earl), was to order Christian to be tried. He was found guilty and executed. Of the other persons implicated in the rebellion only three were excepted from the general amnesty. But by order in Council they were pardoned, and the judges responsible for the sentence on Christian were punished. His next act was to dispute the permanency of the tenants' holdings, which they had not at first regarded as being affected by the acceptance of leases, a proceeding which led to an almost open rebellion against his authority and to the neglect of agriculture. In lieu of it the people devoted themselves to the fisheries and to contraband trade. The agrarian question was not settled till 1704, when James, Charles's brother and successor, largely through the influence of Bishop Wilson, entered into a compact with his tenants, which was embodied in an act, called the "Act of Settlement." Their compact secured the tenants in the possession of their estates in perpetuity on condition of a fixed rent, and a small fine on succession or alienation. From the great importance of this act to the Manx people it has been called their *Magna Carta*. As time went on, and the value of the estates increased, the rent payable to the lord became so small in proportion as to be almost nominal. James died in 1736 and the sovereignty of the isle passed to James Murray, 2nd duke of Atholl. In 1764 he was succeeded by his only surviving child Charlotte, Baroness Strange, and her husband, John Murray, who, in right of his wife, became Lord of Man. About 1720 the contraband trade greatly increased. In 1726 it was, for a time, somewhat checked by the interposition of parliament, but during the last ten years of the Atholl régime (1756–1765) it assumed such proportions that, in the interests of the imperial revenue, it became necessary to suppress it. With a view to so doing an Act of Parliament, called the "Revesting Act," was passed in 1765, under which the sovereign rights of the Atholls and the customs revenues of the island were purchased for the sum of £70,000, and an annuity of £2000 was granted to the duke and duchess. The Atholls still retained their manorial rights, the patronage of the See, and certain other perquisites, which were finally purchased for the excessive sum of £417,144 in 1828. Up to the time of the Revestment the Tynwald Court passed laws concerning the government of the island in all respects and had control over its finances, subject to the approval of the lord. After the Revestment, or rather after the passage of the "Mischief Act" in the same year, Imperial Parliament legislated with respect to customs, harbours and merchant shipping, and, in measures of a general character, it occasionally inserted clauses by which penalties in contravention of the acts of which they formed part might be enforced in the island. It also assumed the control of the insular customs duties. Such were the changes which, rather than the transference of the sovereignty from the lord to the king of Great Britain and Ireland, modified the Constitution of the Isle of Man. Its ancient laws and tenures were not interfered with, but in many ways the Revestment adversely affected it. The hereditary lords were far from being model rulers, but most of them had taken some personal share in its government, and had interested themselves in the well-being of its inhabitants. But now the whole direction of its affairs was handed over to officials, who regarded the island as a pestilent nest of smugglers, from which it was their duty to extract as much revenue as possible. Some alleviation of this state of things was experienced between 1793 and 1826 when the 4th duke of Atholl was appointed governor, since, though he quarrelled with the Keys and was unduly solicitous for his pecuniary interests, he did occasionally exert himself to promote the welfare of the island. After his departure the English officials resumed their sway. But they were more considerate than before. Moreover, since smuggling, which had only been checked, not suppressed, by the Revesting Act, had by that time almost disappeared, and the Manx revenue was producing a large and increasing surplus, the Isle of Man came to be regarded more favourably, and, thanks to this fact and to the representations of the Manx people to English ministers in 1837, 1844 and 1853, it obtained a somewhat less stringent customs tariff and an occasional dole towards erecting its much neglected public works. Since 1866, when the Isle of Man obtained a measure of at least nominal "Home Rule," the Manx people have made remarkable progress, and at the present day form a prosperous community.

Monuments.—The prehistoric monuments in Man are numerous. There are earth entrenchments, seemingly of the earliest period; fragments of stone circles and alignments; burial cairns with stone cists of several successive periods; urn mounds and *crannoges* or lake dwellings. The monuments belonging to the historic period begin with the round tower on Peel islet, the humble Celtic *keeills* and the sculptured crosses in which the island is especially rich. Of these crosses about one-fourth have inscriptions in the old Norse language. The origin and history of the early buildings remaining on the island are obscure. The castles of Rushen and Peel are the only important buildings of a military character which survive, but the remains of ecclesiastical buildings are numerous and interesting, though, with the exception of St German's Cathedral on Peel islet, now in ruins, they are only small and simple structures.

Arms.—There has been much controversy about the origin of the arms of the island—the "three-legs" found on a beautiful pillar cross near Maughhold churchyard belonging to the latter part of the 14th century. It was probably originally a sun symbol and was brought from Sicily by the Vikings. The motto *quocunque jeceris stabit* is of comparatively recent origin.

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Hall Caine's novels, *The Deemster*, *The Manxman*, &c., have no doubt tended to popularize the island. The most truthful description of the social life of the people is to be found in a novel entitled *The Captain of the Parish*, by John Quine. *Bibliotheca Monensis* (*Manx Society*, vol. xxiv.) contains a good list of MSS. and books relating to the island up to 1876, and A. W. Moore's *History of the Isle of Man* has a list of the most important MSS. and books up to 1900. (A. W. M.)

MANAAR, GULF OF, a portion of the Indian Ocean lying between the coast of Madras and Ceylon. Its northern limit is the line of rocks and islands called Adam's Bridge. Its extreme width from Cape Comorin to Point de Galle is about 200 miles.

MANACOR, a town of Spain in the island of Majorca, 40 m. by rail E. of Palma. Pop. (1900), 12,408. Manacor has a small trade in grain, fruit, wine, oil and live stock. In the neighbourhood are the cave of Drach, containing several underground lakes, and the caves of Artá, one of the largest and finest groups of stalactite caverns in western Europe.

MANAGE, to control, direct, or be in a position or have the capacity to do anything (from Ital. *maneggiare*, to train horses, literally to handle; Lat. *manus*, hand). The word was first used of the "management" of a horse. Its meanings have been much influenced by the French *ménager*, to direct a household or *ménage* (from late Lat. *mansio*, house); hence to economize, to husband resources, &c. The French *menage*, act of guiding or leading, from *mener*, to lead, seems also to have influenced the meaning.

MANAGUA, the capital of Nicaragua, and of the department of Managua; on the southern shore of Lake Managua, and on the railway from Diriamba to El Viejo, 65 m. by rail S.E. of the Pacific port of Corinto. Pop. (1905), about 30,000. Managua is a modern city, with many flourishing industries and a rapidly growing population. Its chief buildings are those erected after 1855, when it was chosen as the capital to put an end to the rivalry between the then more important cities of Leon and Granada. They include the Palacio Nacional or government buildings, Corinthian in style, the national library and museum, an ornate Renaissance structure, the barracks and the general post office. Owing to its position on the lake, and its excellent communications by rail and steamer, Managua obtained after 1855 an important export trade in coffee, sugar, cocoa and cotton, although in 1876 it was temporarily ruined by a great inundation.

MANAKIN, from the Dutch word *Manneken*, applied to certain small birds, a name apparently introduced into English by G. Edwards (*Nat. Hist. Birds*, i. 21) in or about 1743, since which time it has been accepted generally, and is now used for those which form the family *Pipridae*. The manakins are peculiar to the Neotropical Region and have many of the habits of the titmouse family (*Paridae*), living in deep forests, associating in small bands, and keeping continually in motion, but feeding almost wholly on the large soft berries of the different kinds of *Melastoma*. The *Pipridae*, however, have no close affinity with the *Paridae*,[1] but belong to another great division of the order *Passeres*, the *Clamatores* group of the *Anisomyodae*. The manakins are nearly all birds of gay appearance, generally exhibiting rich tints of blue, crimson, scarlet, orange or yellow in combination with chestnut, deep black, black and white, or olive green; and among their most obvious characteristics are their short bill and feeble feet, of which the outer toe is united to the middle toe for a good part of its length. The tail, in most species very short, has in others the middle feathers much elongated, and in one of the outer rectrices are attenuated and produced into threads. They have been divided (Brit. Mus. *Cat. Birds*, vol. xiv.) into nineteen genera with about seventy species, of which eighteen are included under *Pipra* itself. *P. leucilla*, one of the best known, has a wide distribution from the isthmus of Panama to Guiana and the valley of the Amazon; but it is one of the most plainly coloured of the family, being black with a white head. The genus *Machaeropterus*, consisting of four species, is very remarkable for the extraordinary form of some of the secondary wing-feathers in the males, in which the shaft is thickened and the webs changed in shape, as described and illustrated by P. L. Sclater (*Proc. Zool. Society*, 1860, p. 90; *Ibis*, 1862, p. 175[2]) in the case of the beautiful *M. deliciosus*, and it has been observed that the wing-bones of these birds are also much thickened, no doubt in correlation with this abnormal structure. A like deviation from the ordinary character is found in the allied genus *Chiromachaeris*, comprehending seven species, and Sclater is of the opinion that it enables them to make the singular noise for which they have long been noted, described by O. Salvin (*Ibis*, 1860, p. 37) in the case of one of them, *M. candaei*, as beginning "with a sharp note not unlike the crack of a whip," which is "followed by a rattling sound not unlike the call of a landrail"; and it is a similar habit that has obtained for another species, *M. edwardsi*, the name in Cayenne, according to Buffon (*Hist. Nat. Oiseaux*, iv. 413), of *Cassenoisette*. (A. N.)

MANAOAG, a town in the north central part of the province of Pangasinán, Luzon, Philippine Islands, on the Angalacan river, 21 m. N.E. of Lingayen. Pop. (1903), 16,793. The inhabitants devote themselves especially to rice-culture, though tobacco, Indian corn, sugar-cane, fruit and vegetables are also raised. A statue of the Virgin Mary here is visited annually (especially during May) by thousands from Pangasinán and adjoining provinces. The inhabitants are mostly Ilocanos. Manaoag includes the town proper and eighteen barrios.

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[1] Though Edwards called the species he figured (*ut supra*) a titmouse, he properly remarked that there was no genus of European birds to which he could liken it.

[2] The figures are repeated by Darwin (*Descent of Man*, &c., ii. 66).

MANÁOS, a city and port of Brazil and capital of the state of Amazonas, on the left bank of the Rio Negro 12 m. above its junction with the Solimões, or Amazon, and 908 m. (Wappäus) above the mouth of the latter, in lat. 3° 8′ 4″ S., long. 60° W. Pop. (1908), about 40,000, including a large percentage of Indians, negroes and mixed-bloods; the city is growing rapidly. Manáos stands on a slight eminence overlooking the river, 106 ft. above sea-level, traversed by several "igarapés" (canoe-paths) or side channels, and beautified by the luxuriant vegetation of the Amazon valley. The climate is agreeable and healthful, the average temperature for the year (1902) being 84°, the number of rainy days 130, and the total rainfall 66·4 in. Up to the beginning of the 20th century the only noteworthy public edifices were the church of N.S. da Conceição, the St Sebastião asylum and, possibly, a Misericordia hospital; but a government building, a custom-house, a municipal hall, courts of justice, a market-place and a handsome theatre were subsequently erected, and a modern water-supply system, electric light and electric tramways were provided. The "igarapés" are spanned by a number of bridges. Higher education is provided by a lyceum or high school, besides which there is a noteworthy school (bearing the name of Benjamin Constant) for poor orphan girls. Manáos has a famous botanical garden, an interesting museum, a public library, and a meteorological observatory. The port of Manáos, which is the commercial centre of the whole upper Amazon region, was nothing but a river anchorage before 1902. In that year a foreign corporation began improvements, which include a stone river-wall or quay, storehouses for merchandise, and floating wharves or landing stages connected with the quay by floating bridges or roadways. The floating wharves and bridges are made necessary by the rise and fall of the river, the difference between the maximum and minimum levels being about 33 ft.

The principal exports are rubber, nuts, cacao, dried fish, hides and piassava fibre. The markets of Manáos receive their supplies of beef from the national stock ranges on the Rio Branco, and it is from this region that hides and horns are received for export. The shipping movement of the port has become large and important, the total arrivals in 1907, including small trading boats, being 1589, of which 133 were ocean-going steamers from Europe and the United States, 75 from south Brazilian ports, and 227 river steamers from Pará. This rapid growth in its direct trade is due to a provincial law of 1878 which authorized an abatement of 3% in the export duties on direct shipments, and a state law of 1900 which made it compulsory to land and ship all products of the state from the Manáos custom-house.

The first European settlement on the site of Manáos was made in 1660, when a small fort was built here by Francisco da Motta Falcão, and was named São José de Rio Negro. The mission and village which followed was called Villa de Barra, or Barra do Rio Negro (the name "Barra" being derived from the "bar" in the current of the river, occasioned by the set-back caused by its encounter with the Amazon). It succeeded Barcellos as the capital of the old *capitania* of Rio Negro in 1809, and became the capital of Amazonas when that province was created in 1850, its name being then changed to Manáos, the name of the principal tribe of Indians living on the Rio Negro at the time of its discovery. In 1892 Manáos became the see of the new bishopric of Amazonas.

MANASSAS, a district of Prince William county, Virginia, and a town of the district, about 30 m. W.S.W. of Washington, D.C. Pop. (1910) of the district, 3381; of the town, 1217. The village of Manassas (in the town), known also as Manassas Junction, is served by the Chesapeake & Ohio and the Southern railways. North of the junction is Bull Run, a small stream which empties into the Occoquan, an arm of the Potomac. In this neighbourhood two important battles of the American Civil War, the first and second battles of Bull Run, were fought on the 21st of July 1861 and on the 29th-30th of August 1862 respectively; by Southern historians these battles are called the battles of Manassas. At Manassas is the Manassas Industrial School for Coloured Youth (non-sectarian; privately supported), which was founded in 1892 and opened in 1894; in 1908–1909 it had nine teachers (all negroes) and 121 pupils, all in elementary grades.

MANASSEH (7th cent. B.C.), son of Hezekiah, and king of Judah (2 Kings xxi. 1–18). His reign of fifty-five years was marked by a reaction against the reforming policy of his father, and his persistent idolatry and bloodshed were subsequently regarded as the cause of the destruction of Jerusalem and of the dispersion of the people (2 Kings xxiii. 26 seq.; Jer. xv. 4). As a vassal of Assyria he was contemporary with Sennacherib, Esar-haddon (681–668 B.C.) and Assur-bani-pal (668–626 B.C.), and his name (*Me-na-si-e*) appears among the tributaries of the two latter. Little is known of his history. The chronicler, however, relates that the Assyrian army took him in chains to Babylon, and that after his repentance he returned, and distinguished himself by his piety, by building operations in Jerusalem and by military organization (2 Chron, xxxiii. 10 sqq.). The story of his penitence referred to in xxxiii. 22, is untrustworthy, but the historical foundation may have been some share in the revolt of the Babylonian Samas-sum-ukin (648 B.C.), on which occasion he may have been summoned before Assur-bani-pal with other rebels and subsequently reinstated. See further Driver, in Hogarth, *Authority and Archaeology*, pp. 114 sqq. Manasseh was succeeded by his son Amon, who after a brief reign of two years perished in a conspiracy, his place being taken by Amon's son (or brother) Josiah (*q.v.*). A lament formerly ascribed to Manasseh (cf. 2 Chron. xxxiii. 18) is preserved in the Apocrypha (see Manasses, Prayer of; and Apocryphal Literature). On Judg. xviii. 30 (marg.), see Jonathan.

MANASSEH (apparently Hebrew for "he who causes to forget," but see H. W. Hogg, *Encyc. Bib.*, *s.v.*); in the Bible, a tribe of Israel, the elder but less important of the "sons" of Joseph. Its seat lay to the north of Ephraim, but its boundaries can scarcely be defined. It merged itself with its "brother" in the south and with Issachar, Zebulun and other tribes in the north (Josh. xvii. 7 sqq.). From the latter it was separated for a time by a line of Canaanite cities extending from Dor to Bethshean, which apparently were not all subdued till the days of David or Solomon (Judg. i. 27; 1 Sam. xxxi. 10; 1 Kings ix. 15). Besides its western settlement in the fertile glades of northern Samaria, running out into the great plain, there were territories east of the Jordan reckoned to Manasseh. Gilead and Bashan were said to have been taken by Machir, and a number of places of uncertain identification were occupied by Nobah and Jair (Num. xxxii. 41; Judg. x. 3–5). It seems most natural to suppose that these districts were held before the Israelites crossed over to the west (cf. the tradition Num. xxi., Deut. iii.). On the other hand, in Judg. v. 14, Machir may conceivably belong to the west, and it is possible that, according to another tradition, these movements were the result of the complaint of the Joseph tribes that their original territory was too restricted.[1] In the genealogical lists, Machir, perhaps originally an independent branch, is the eldest son of Manasseh (Josh. xvii. 1 *b*, 2); but according to later schemes he is Manasseh's only son (Num. xxvi. 28–34). Intermixture with Aramaeans is indicated in the view that he was the son of Manasseh and an Aramean concubine (1 Chron. vii. 14), and this is supported by the statement that the Arameans of Geshur and Maacah (cf. 2 Sam. x. 6; Gen. xxii. 24) dwelt among the Israelites of eastern Jordan (Josh. xiii. 13). Subsequently, at an unknown period of history, sixty cities were lost (1 Chron. ii. 23). The story of the daughters of the Manassite Zelophehad is of interest for the Hebrew law of inheritance (Num. xxvii. 1–11, xxxvi.).

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[1] So Budde (*Richter u. Samuel*), who recovers certain old fragments and arranges Josh. xvii. 14–18 (*v.* 18 read "hill-country of Gilead"); Num. xxxii. 39, 41 seq.; Josh. xiii. 13.

Some details of the history of this twofold branch of the Israelites are contained in the stories of Gideon (W. Manasseh) and Jephthah (E. Manasseh). The relations between Saul and Jabesh-Gilead point to the close bond uniting the two districts, but the details have been variously interpreted: Winckler, for example, suggesting that Saul himself was originally from E. Manasseh and that he followed in the steps of Jephthah (*Keilinschr. u. d. alte Test.*, pp. 216 seq. 227). Generally speaking, its position in the west made it share the fortunes of Ephraim, whilst on the east the proximity of Ammonites and Moabites controlled its history; see also the articles on its southern neighbours, GAD and REUBEN, and the articles GENEALOGY (Biblical); and JEWS: *History*. (S. A. C.)

MANASSES, CONSTANTINE, Byzantine chronicler, flourished in the 12th century during the reign of Manuel I. (Comnenus) (1143–1180). He was the author of a *Chronicle* or historical synopsis of events from the creation of the world to the end of the reign of Nicephorus Botaniates (1081), written by direction of Irene, the emperor's sister-in-law. It consists of about 7000 lines in the so-called "political" metre.[1] There is little to be said of it, except that it is rather more poetical than the iambic chronicle of Ephraim (about 150 years later). It obtained great popularity and appeared in a free prose translation; it was also translated into Slavonic. The poetical romance of the *Loves of Aristander and Callithea*, also in "political" verse, is only known from the fragments preserved in the Ῥοδωνία (rose-garden) of Macarius Chrysocephalus (14th century). Manasses also wrote a short biography of Oppian, and some descriptive pieces (all except one unpublished) on artistic and other subjects.

EDITIONS.—*Chronicle* in Bonn, *Corpus scriptorum hist. Byz.*, 1st ed. Bekker (1837) and in J. P. Migne, *Patrologia graeca*, cxxvii.; *Aristander and Callithea* in R. Hercher's *Scriptores erotici graeci*, ii. (1859); "Life of Oppian" in A. Westermann, *Vitarum scriptores graeci minores* (1845). A long didactic poem in "political" verse (edited by E. Miller in *Annuaire de l'assoc. pour l'encouragement des études grecques en France*, ix. 1875) is attributed to Manasses or one of his imitators. See also F. Hirsch, *Byzantinische Studien* (1876); C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897).

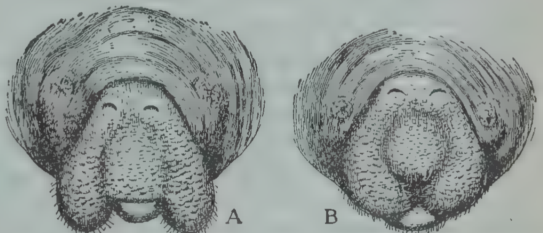
MANASSES, PRAYER OF, an apocryphal book of the Old Testament. This writing, which since the Council of Trent has been relegated by the Church of Rome to the position of an appendix to the Vulgate, was placed by Luther and the translators of the English Bible among the apocryphal books. In some MSS. of the Septuagint it is the eighth among the canticles appended to the Psalter, though in many Greek psalters, which include the canticles, it is not found at all. In Swete's Old Testament in Greek, iii. 802 sqq., A is printed with the variants of T (*Psalterium turicense*).[2] From the statements in 2 Chron. xxxiii. 12, 13, 18, 19, it follows that the Old Testament chronicler found a prayer attributed to Manasseh in his Hebrew sources, *The History of the Kings of Israel* and *The History of the Seers*. Naturally the question arose, had the existing Prayer of Manasses any direct connexion with the prayer referred to by the chronicler? Ewald was of opinion that the Greek was an actual translation of the lost Hebrew; but Ball more wisely takes it as a free rendering of a lost Haggadic narrative founded on the older document from which the chronicler drew his information. This view he supports by showing that there was once a considerable literature in circulation regarding Manasseh's later history. On the other hand most scholars take the Prayer to have been written in Greek, *e.g.* Fritzsche, Schürer and Ryssel (Kautzsch, *Apok. u. Pseud.* i. 165–168).

This fine penitential prayer seems to have been modelled after the penitential psalms. It exhibits considerable unity of thought, and the style is, in the main, dignified and simple.

As regards the date, Fritzsche, Ball and Ryssel agree in assigning this psalm to the Maccabean period. Its eschatology and doctrine of "divine forgiveness" may point to an earlier date.

The best short account of the book is given by Ball (*Speaker's Apocrypha*, ii. 361–371); see also Porter in Hastings's *Dict. Bible*, iii. 232–233. (R. H. C.)

MANATI (often anglicized as "manatee"), the name, adapted from the Carib *manattouï*, given by the Spanish colonists of the West Indies to the American representative of a small group of herbivorous aquatic mammals, constituting, with their allies the dugong and the now extinct *Rhytina*, the order Sirenia. The name, though possibly of Mandingo origin (see MANDINGO), was latinized as *manatus*, furnished with hands, thus referring the etymology to the somewhat hand-like form, or hand-like use, of the fore-flippers, which alone serve these creatures for limbs. Manatis, as shown in the illustration in the article SIRENIA, are somewhat whale-like in shape, having a similar horizontally expanded tail-fin; but here the resemblance to the Cetacea ceases, the whole organization of these animals being constructed on entirely different lines. The American manati, *Manatus* (or, as some would have it, *Trichechus latirostris*), inhabits the rivers of Florida, Mexico, Central America and the West Indies, and measures from 9 to 13 feet in length. The body is somewhat fish-like, but depressed and ending posteriorly in a broad, flat, shovel-like horizontal tail, with rounded edges. The head is of moderate size, oblong, with a blunt, truncated muzzle, and divided from the body by a slight constriction or neck. The fore limbs are flattened oval paddles, placed rather low on the sides of the body, and showing externally no signs of division into fingers, but with three diminutive flat nails near their extremities. No traces of hind limbs are discernible either externally or internally; and there is no dorsal fin. The mouth is peculiar, the tumid upper lip being cleft in the middle line into two lobes, each of which is separately movable. The nostrils are two semilunar valve-like slits at the apex of the muzzle. The eyes are very minute, placed at the sides of the head, and with a nearly circular aperture with wrinkled margins; and external ears are wanting. The skin generally is of a dark greyish colour, not smooth or glistening like that of whale or dolphin, but finely wrinkled. At a little distance it appears naked, but close inspection, at all events in young animals, shows a scanty covering of delicate hairs, and both upper and under lips are supplied with short, stiff bristles.



(From Murie.)

Front view of head of American Manati, showing the eyes, nostrils, and mouth. A, with the lobes of the upper lip divaricated; B, with the lip contracted.

Manatis have a number—as many as 20 pairs in each jaw—of two-ridged teeth, of which, however, but comparatively few are in use at once. They lack the large tusks of the male dugong, and the fore part of the skull is not so much bent down as in that animal. In life the palate has a horny plate, with a similar one in the lower jaw. The skeleton is described under SIRENIA.

Manatis pass their life in the water, inhabiting bays, lagoons, estuaries and large rivers, but the open sea is unsuited to their peculiar mode of life. As a rule they prefer shallow water, in which, when not feeding, they lie near the bottom. In deeper water they often float, with the body much arched, the rounded back close to the surface, and the head, limbs and tail hanging downwards. The air in the lungs assists them to maintain this position. Their food consists exclusively of aquatic plants, on which they feed beneath the water. They are slow in their movements, and perfectly harmless, but are subject to persecution for the sake of their oil, skin and flesh. Frequent attempts have been made to keep specimens alive in captivity, and sometimes with considerable success, one having lived in the Brighton Aquarium for upwards of sixteen months. From such captive specimens certain observations on the mode of life of these animals have been made. We learn, for instance, that from the shoulder-joint the flippers can be moved in all directions, and the elbow and wrist permit of free extension and flexion. In feeding, manatis push the food towards their mouths by means of one of the hands, or both used simultaneously, and any one who has seen these members thus employed can believe the stories of their carrying their young under their arms. Still more interesting is the action of the peculiar lateral pads formed by the divided upper lip, thus described by Professor A. Garrod: "These pads have the power of transversely approaching towards and receding from one another simultaneously (see fig.). When the animal is on the point of seizing (say) a leaf of lettuce, the pads are diverged transversely in such a way as to make a median gap of considerable breadth. Directly the leaf is within grasp the lip pads are approximated, the leaf is firmly seized between their contiguous bristly surfaces, and then drawn inwards by a backward movement of the lower margin of the lip as a whole." The animal is thus enabled by the unaided means of the upper lip to introduce food placed before it without the assistance of the comparatively insignificant lower lip, the action recalling that of the mouth of the silkworm and other caterpillars in which the mandibles diverge and converge laterally during mastication. All trustworthy observations indicate that the manati has not the power of voluntarily leaving the water. None of the specimens in confinement has been observed to emit any sound.

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[1] "Political" verse or metre is the name given to a kind of verse found as early as the 6th century in proverbs, and characteristic of Byzantine and modern Greek poetry. It takes no account of the quantity of syllables; the scansion depends on accent, and there is always an accent on the last syllable but one. It is specially used of an iambic verse with fifteen syllables, *i.e.* seven feet and an unaccented syllable over. Byron compares ("A captain bold of Halifax who lived in country quarters." Such facile metres are called "political," in the sense of "commonplace," "of the city." Cf. Gibbon's *Decline and Fall* (ed. Bury, 1898), vi. 108; Du Cange, *Gloss. med. et infin. lat.* (vi. 395), who has an interesting quotation from Leo Allatius. Leo explains "political" as implying that the verses are "scorta et meretrices, quod omnibus sunt obsequiosae et peculiares, et servitutem publicam serviunt."

[2] Nestle (*Septuaginta Studien III.*) contends that the text of A and T is derived from the *Apost. Const.* ii. 22, or from its original, and not from a MS. of the Septuagint.

The Amazonian manati (*M. inunguis*) is a much smaller species, not exceeding 7 or 8 ft. in length, and without nails to the flippers. It ascends most of the tributaries of the Amazon until stopped by rapids. From a specimen which lived a short time in London it appears that the lip-pads are less developed than in the northern species. The third species is the West African *M. senegalensis*, which extends a distance of about ten degrees south and sixteen north of the equator, and ranges into the heart of the continent as far as Lake Tchad. From 8 to 10 ft. appears to be the normal length; the weight of a specimen was 590 ℔. The colour is bluish black, with a tinge of olive-green above and yellow below. (R. L.*)

MANBHUM, a district of British India, in the Chota Nagpur division of Bengal. The administrative headquarters are at Purulia. Area, 4147 sq. m.; pop. (1901), 1,301,364, showing an increase of 9·1% since 1891. Manbhum district forms the first step of a gradual descent from the table-land of Chota Nagpur to the delta of lower Bengal. In the northern and eastern portions the country is open, and consists of a series of rolling downs dotted here and there with isolated conical hills. In the western and southern tracts the country is more broken and the scenery much more picturesque. The principal hills are Dalma (3407 ft.), the crowning peak of a range of the same name; Gangabari or Gajboro (2220 ft.), the highest peak of the Baghmundi range, about 20 m. south-west of Purulia; and Panchkot or Panchet (1600 ft.), on which stands the old fort of the rajas of Panchet. The hills are covered with dense jungle. The chief river is the Kasai, which flows through the district from north-west to south-east into Midnapore, and on which a considerable floating trade in *sal* timber is carried on. The most numerous aboriginal tribe are the Sontals; but the Bhumij Kols are the characteristic race. In Manbhum they inhabit the country lying on both sides of the Subanrekha. They are pure Mundas, but their compatriots to the east have dropped the title of Munda and the use of their distinctive language, have adopted Hindu customs, and are fast becoming Hindus in religion. The Bhumij Kols of the Jungle Mahals were once the terror of the surrounding districts; they are now more peaceful.

Three principal crops of rice are grown, one sown broadcast early in May on table-lands and the tops of ridges, an autumn crop, and a winter crop, the last forming the chief harvest of the district. Other crops are wheat, barley, Indian corn, pulses, oilseeds, linseeds, jute, hemp, sugar-cane, indigo, pan and tobacco. Owing to the completeness of the natural drainage, floods are unknown, but the country is liable to droughts caused by deficient rainfall. The principal articles of export are oilseeds, pulses, *ghi*, lac, indigo, tussur silk (manufactured near Raghunathpur), timber, resin, coal, and (in good seasons) rice. The chief imports are salt, piece goods, brass utensils and unwrought iron. Cotton hand-loom weaving is carried on all over the district. Manbhum contains the Jherria coalfield, in the Damodar valley, where a large number of mines have been opened since 1894. The United Free Church of Scotland has a mission at Pakheria, with a printing press that issues a monthly journal in Sonthali; and a German Lutheran mission has been established since 1864. The district is traversed by the Bengal–Nagpur railway, while two branches of the East Indian railway serve the coalfield.

MANCHA, LA (Arabic, *Al Mansha*, "the dry land" or "wilderness"), a name which when employed in its widest sense denotes the bare and monotonous elevated plateau of central Spain that stretches between the mountains of Toledo and the western spurs of the hills of Cuenca, being bounded on the S. by the Sierra Morena and on the N. by the Alcarria region. It thus comprises portions of the modern provinces of Toledo, Albacete and Cuenca, and the greater part of Ciudad Real. Down to the 16th century the eastern portion was known as La Mancha de Montearagon or de Aragon, and the western simply as La Mancha; afterwards the north-eastern and south-western sections respectively were distinguished by the epithets *Alta* and *Baja* (upper and lower). La Mancha is famous as the scene of Cervantes' novel *Don Quixote*; in appearance, with its multitude of windmills and vast tracts of arid land, it remains almost exactly as Cervantes described it. Many villages, such as El Toboso and Argamasilla de Alba, both near Alcázar de San Juan, are connected by tradition with episodes in *Don Quixote*.

MANCHE, a department of north-western France, made up chiefly of the Cotentin and the Avranchin districts of Normandy, and bounded W., N. and N.E. by the English Channel (Fr. *La Manche*), from which it derives its name, E. by the department of Calvados, S.E. by Orne, S. by Mayenne and Ille-et-Vilaine. Pop. (1906), 487,443. Area, 2475 sq. m.

The department is traversed from south to north by a range of hills, in many parts picturesque, and connected in the south with those of Maine and Brittany. In the country round Mortain, which has been called the Switzerland of Normandy, they rise to a height of 1200 ft. The coast-line, running northward along the bay of the Seine from the rocks of Grand Camp to Cape Barfleur, thence westward to Cape la Hague, and finally southward to the Bay of Mont St Michel, has a length of 200 miles. The Vire and the Taute (which near the small port of Carentan receives the Ouve as a tributary on the left) fall into the sea at the Calvados border, and are united by a canal some miles above their mouths. From the mouth of the Taute a low beach runs to the port of St Vaast-la-Hougue, where the coast becomes rocky, with sandbanks. Off St Vaast lies the fortified island of Tatihow, with the laboratory of marine zoology of the Natural History Museum of Paris. Between Cape Barfleur and Cape la Hague lie the roads of Cherbourg, protected by the famous breakwater. The whole western coast is inhospitable; its small havens, lying behind formidable barriers and reefs, are almost dry at low tide. Great cliffs, such as the points of Jobourg (420 ft. high) and Flamanville, alternate with long strands, such as that which extends for 30 m. from Cape Carteret to Granville. Between this coast and the Channel Islands the tide, pent up between numerous sandbanks, flows with a terrific force that has given these passages such ill-omened names as *Passage de la Déroute* and the like. The only important harbours are Granville and the haven of refuge of Diélette between Granville and Cherbourg. Carteret carries on a passenger traffic with the Channel Islands. The chief stream is the Sienne, with its tributary the Soulle flowing by Coutances. South of Granville the samds of St Pair are the commencement of the great bay of Mont Saint Michel, whose area of 60,000 acres was covered with forest till the terrible tide of the year 709. The equinoctial tides reach a vertical height of nearly 50 ft. In the bay the picturesque walls of the abbey rise from the summit of a rock 400 ft. high. The Sée, which waters Avranches, and the Couesnon (separating Manche from Ille-et-Vilaine) disembogue in the bay.

The climate of Manche is mild and humid, from its propinquity to the sea. Frosts are never severe; myrtles and fuchsias flourish in the open air. Excessive heat is also unusual; the predominant winds are south-west.

The characteristic industry of the department is the rearing of horses and cattle, carried on especially in the rich meadow of the eastern Cotentin; sheep are raised in the western arrondissement of Coutances. Wheat, buckwheat, barley and oats are the chief cereals cultivated. Manche is one of the foremost departments for the production of cider-apples and pears; plums and figs are also largely grown. Butter is an important source of profit, as also are poultry and eggs. Flourishing market-gardens are found in the west. The department contains valuable granite quarries in the Cherbourg arrondissement and the Chausey islands; building and other stone is quarried.

Villedieu manufactures copper-ware and Sourdeval iron and other metal-ware; and there are wool-spinning mills, paper-works and leather-works, but the department as a whole is industrially unimportant. There are oyster-beds on the coast (St Vaast, &c.), and the maritime population, besides fishing for herring, mackerel, lobsters or sole, collect seaweed for agricultural use. Coutances is the seat of a bishopric of the province of Rouen. The department forms part of the region of the X. army corps and of the circumscriptions of the académie (educational division) and appeal-court of Caen. Cherbourg (*q.v.*), with its important port, arsenal and shipbuilding yards, is the chief centre of population. St Lô (*q.v.*) is the capital; there are six arrondissements (St Lô, Avranches, Cherbourg, Coutances, Mortain, Valognes), with 48 cantons and 647 communes. Avranches, Mortain, Coutances, Granville and Mont Saint Michel receive separate treatment. At Lessay and St Sauveur-le-Vicomte there are the remains of ancient Benedictine abbeys, and Torigni-sur-Vire and Tourlaville (close to Cherbourg) have interesting châteaux of the 16th century. Valognes, which in the 17th and 18th centuries posed as a provincial centre of culture, has a church (15th, 16th and 17th centuries) remarkable for its dome, the only one of Gothic architecture in France.

MANCHESTER, EARLS AND DUKES OF. The Manchester title, in the English peerage, belongs to a branch of the family of Montagu (*q.v.*). The first earl was SIR HENRY MONTAGU (*c.* 1563–1642), grandson of Sir Edward Montagu, chief justice of the king's bench 1539–1545, who was named by King Henry VIII. one of the executors of his will, and governor to his son, Edward VI. Sir Henry Montagu, who was born at Boughton, Northamptonshire, about 1563, was educated at Christ's College, Cambridge, and, having been called to the bar, was elected recorder of London in 1603, and in 1616 was made chief justice of the king's bench, in which office it fell to him to pass sentence on Sir Walter Raleigh in October 1618. In 1620 he was appointed lord high treasurer, being raised to the peerage as Baron Montagu of Kimbolton, Huntingdonshire, and Viscount Mandeville. He became president of the council in 1621, in which office he was continued by Charles I., who created him earl of Manchester[1] in 1626. In 1628 he became lord privy seal, and in 1635 a commissioner of the treasury. Although from the beginning of his public life in 1601, when he first entered parliament, Manchester had inclined to the popular side in politics, he managed to retain to the end the favour of the king. He was a judge of the Star Chamber, and one of the most trusted councillors of Charles I. His loyalty, ability and honesty were warmly praised by Clarendon. In conjunction with Coventry, the lord keeper, he pronounced an opinion in favour of the legality of ship-money in 1634. He died on the 7th of November 1642. Manchester was married three times. One of his sons by his third wife was father of Charles Montagu, created earl of Halifax in 1699.

EDWARD MONTAGU, 2nd earl of Manchester (1602–1671), eldest son of the 1st earl by his first wife, Catherine Spencer, granddaughter of Sir John Spencer of Althorpe, was born in 1602, and was educated at Sidney Sussex College, Cambridge. He was member of parliament for Huntingdonshire 1623–1626, and in the latter year was raised to the peerage in his father's lifetime as Baron Montagu of Kimbolton, but was known generally by his courtesy title of Viscount Mandeville. His first wife, who was related to the duke of Buckingham, having died in 1625 after two years of marriage, Mandeville married in 1626 Anne, daughter of the 2nd earl of Warwick. The influence of his father-in-law, who was afterwards admiral on the side of the parliament, drew Mandeville to the popular side in the questions in dispute with the crown, and at the beginning of the Long Parliament he was one of the recognized leaders of the popular party in the upper House, his name being joined with those of the five members of the House of Commons impeached by the king in 1642. At the outbreak of the Civil War, having succeeded his father in the earldom in November 1642, Manchester commanded a regiment in the army of the earl of Essex, and in August 1643 he was appointed major-general of the parliamentary forces in the eastern counties, with Cromwell as his second in command. Having become a member of the "committee of both kingdoms" in 1644, he was in supreme command at Marston Moor (July 1, 1644); but in the subsequent operations his lack of energy brought him into disagreement with Cromwell, and in November 1644 he strongly expressed his disapproval of continuing the war (see CROMWELL, OLIVER). Cromwell brought the shortcomings of Manchester before parliament in the autumn of 1644; and early in the following year, anticipating the self-denying ordinance, Manchester resigned his command. He took a leading part in the frequent negotiations for an arrangement with Charles, was custodian with Lenthall of the great seal 1646–1648, and frequently presided in the House of Lords. He opposed the trial of the king, and retired from public life during the Commonwealth; but after the Restoration, which he actively assisted, he was loaded with honours by Charles II. In 1667 he was made a general, and he died on the 5th of May 1671. Manchester was made a K.G. in 1661, and became F.R.S. in 1667. Men of such divergent sympathies as Baxter, Burnet and Clarendon agreed in describing Manchester as a lovable and virtuous man, who loved peace and moderation both in politics and religion. He was five times married, leaving children by two of his wives, and was succeeded in the title by his eldest son, Robert, 3rd earl of Manchester (1634–1683).

See Lord Clarendon, *History of the Rebellion and Civil Wars in England* (7 vols., Oxford, 1839) and *Life of Clarendon* (Oxford, 1827); S. R. Gardiner, *History of the Great Civil War, 1642–1649*. (4 vols., London, 1886–1891); *The Quarrel between Manchester and Cromwell*, Camden Soc., N.S. 12 (London, 1875); Sir Philip Warwick, *Memoirs of the Reign of Charles I.* (London, 1701).

CHARLES MONTAGU, 1st duke of Manchester (*c.* 1656–1722), son of Robert, 3rd earl of Manchester, was educated at Trinity College, Cambridge, and succeeded to his father's earldom in 1683. Warmly sympathizing with the Whig revolution of 1688, he attended William and Mary at their coronation, fought under William at the Boyne, became a privy councillor in 1698, and held various important diplomatic posts between that date and 1714, when he received an appointment in the household of George I., by whom on the 28th of April 1719 he was created duke of Manchester. He died on the 20th of January 1722, and was succeeded successively in the dukedom by his two sons, William 2nd duke of Manchester (1700–1739), and Robert 3rd duke (*c.* 1710–1762), who was vice-chamberlain to Queen Caroline, wife of George II.

GEORGE MONTAGU, 4th duke of Manchester (1737–1788), was the son of Robert, the 3rd duke. He was a supporter of Lord Rockingham, and an active opponent in the House of Lords of Lord North's American policy. In the Rockingham ministry of 1782 Manchester became lord chamberlain. He died in September 1788.

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[1] The title was derived, not from Manchester in Lancashire, but from Manchester (or Godmanchester) in Huntingdonshire, where the Montagu family estates were.

William Montagu, 5th duke of Manchester (1768–1843), second son of the preceding, was educated at Harrow, and having become a colonel in the army in 1794, was appointed governor of Jamaica in 1808. Here he remained, except for a visit to England (1811–1813) till 1827, administering the colony with ability in a period of considerable difficulty, and doing much to prepare the way for emancipation of the slaves. From 1827 to 1830 he was postmaster-general in the cabinet of the duke of Wellington, and died in Rome on the 18th of March 1843. His wife was Susan, daughter of the 4th duke of Gordon. He was succeeded by his son George, 6th duke (1799–1855), a captain in the navy; whose son William Drogo, 7th duke (1823–1890), married Louise, daughter of the Comte d'Alten of Hanover, who after his death married Spencer Cavendish, 8th duke of Devonshire. William was succeeded by his son George Victor Drogo, 8th duke of Manchester (1853–1892), on whose death the title devolved on his son, William Angus Drogo, 9th duke of Manchester (b.1877). (R. J. M.)

MANCHESTER, a township of Hartford county, Connecticut, U.S.A., about 9 m. E. of Hartford. Pop.(1890), 8222; (1900), 10,601, of whom 3771 were foreign-born; (1910 census) 13,641. Manchester is served by the New York, New Haven & Hartford railway and by electric line connecting with Hartford, Rockville and Stafford Springs. The township covers an area of about 28 sq. m., and includes the villages of Manchester, South Manchester, Buckland, Manchester Green and Highland Park. The Hockanum River provides a good water power, and Manchester has various manufactures. At South Manchester, an attractive industrial village, a silk mill was built in 1838; the silk mills of one firm (Cheney Brothers) here cover about 12 acres; the company has done much for its employees, whose homes are almost all detached cottages in attractive grounds. Manchester was originally a part of the township of Hartford, and later a part of the township of East Hartford. The first settlement within its present limits was made about 1672; the land was bought from the Indians in 1676; and the township was separated from East Hartford and incorporated in 1823.

See also Meakin's *Model Factories and Villages* (1905).

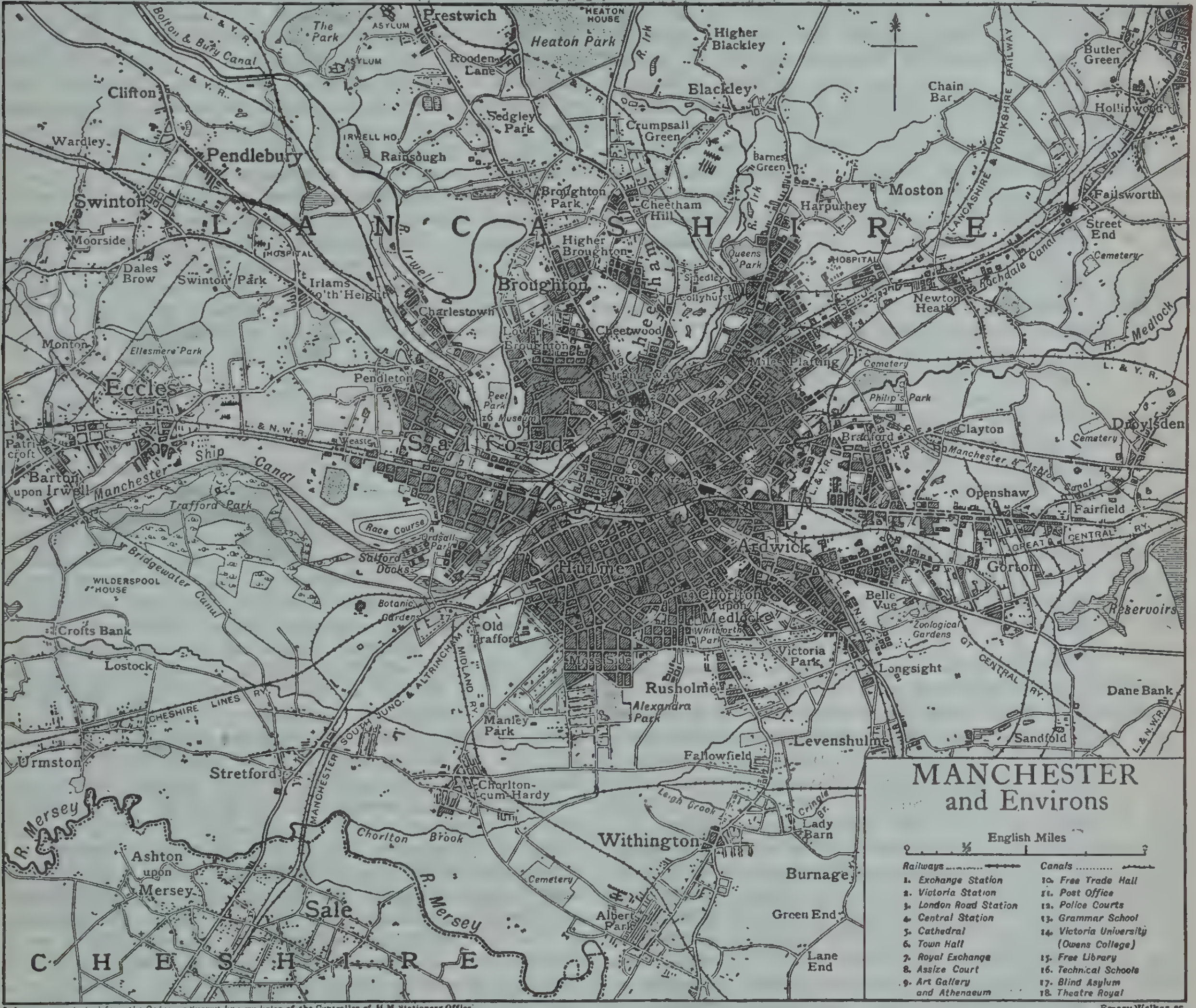
MANCHESTER, a city and county of a city, municipal, county and parliamentary borough of Lancashire, England, 189 m. N.W. by N. of London, and 31 m. E. by N. of Liverpool. It stands for the most part on a level plain, the rising ground being chiefly on the north side. The rivers are the Irwell, the Medlock, the Irk, and the Tib, the last entirely overarched and covered by streets and warehouses. The Irwell, which separates Manchester from Salford, is crossed by a series of bridges and discharges itself into the Mersey, which is about 10 m. distant. The chief part of the district, before it was covered with the superficial drift of sand, gravel and clay, consisted of upper New Red Sandstone with slight portions of lower New Red Sandstone, magnesian marls and upper red marls, hard sandstone and limestone rock, and cold clays and shales of contiguous coal-fields. The city, as its thousands of brick-built houses show, has been for the most part dug out of its own clay-fields. The parliamentary and municipal boroughs of Manchester are not conterminous. The city boundaries, which in 1841 enclosed 4293 acres, have been successively enlarged and now enclose 19,914 acres.

There are four large stations for the Lancashire & Yorkshire, London & North-Western, the Midland, Cheshire lines, Great Northern, and Great Central railways, and many subsidiary stations for local traffic. Tramways, as well as railways, run from Manchester to Oldham, Ashton, Eccles, Stockport, &c., with which places the city is connected by continuous lines of street. The length of the streets in the city of Manchester is 758 m. (exclusive of those in the district of Withington, which joined the city in 1905). The tramway lines within the city boundaries extend to 111 m., and in addition there are 58 m. leased to the corporation by adjacent local authorities. As a matter of fact, the whole of south-east Lancashire and some portions of Cheshire are linked to Manchester by railways and tramways so as to form one great urban area, and the traveller passes from one town to another by lines of street which, for the most part, are continuous. Facility of communication is essential to the commercial prosperity of Manchester, and its need was recognized by the duke of Bridgewater, whose canal, constructed in 1761, has now been absorbed by the Manchester Ship Canal (*q.v.*). The making of this early waterway was an event only less important than the opening of the Manchester & Liverpool railway in 1830.

The township of Manchester, which forms the nucleus of the city, is comparatively small, and outlying hamlets having been added, its size has increased without regularity of plan. Roughly speaking, the city forms a square, with Market Street as its central thoroughfare. The tendency of recent development is to reduce the irregularities so that the other main streets may either run parallel to or intersect Market Street. Deansgate, which formerly ended in a narrow tangle of buildings, is now a broad road with many handsome buildings, and the same process of widening, enlarging and rebuilding is going on, more or less, all over Manchester. Market Street, which has not been widened since 1820, has been termed, and with some reason, "the most congested street in Europe"; but relief is anticipated from some of the other street improvements. The centre of the city is occupied by business premises; the factories and workshops are mainly on the eastern side. The most important of the public buildings are in the centre and the south. The latter is also the most favoured residential district, and at its extremity is semi-rural in character. Large masses of the population live beyond the city boundary and come to their daily avocations by train and tram. Such a population is rarely homogeneous and Manchester attracts citizens from every part of the globe; there are considerable numbers of German, Armenian and Jewish residents. The houses are for the most part of brick, the public buildings of stone, which is speedily blackened by the smoky atmosphere. Many of the warehouses are of considerable architectural merit, and in recent years the use of terra-cotta has become more common. It is only in the suburbs that gardens are possible; the air is laden with black dust, and the rivers, in spite of all efforts, are in the central part of the city mere dirty ditches. It is impossible to describe Manchester in general terms, for within the city boundaries the conditions vary from the most squalid of slums to suburban and almost rural beauty.

Churches.—Manchester is the seat of an Anglican bishopric, and the chief ecclesiastical building is the cathedral, which, however, was built simply as a parish church, and, although a fine specimen of the Perpendicular period, is by no means what might be expected as the cathedral of an important and wealthy diocese. In the course of restoration a piece of Saxon sculpture came to light. This "Angel stone" represents a winged figure with a scroll inscribed *In manus tuas Domine* in characters of the 8th century. The bulk of the building belongs to the early part of the 15th century. The first warden was John Huntington, rector of Ashton, who built the choir. The building, which was noticed for its hard stone by Leland when he visited the town, did not stand time and weather well, and by 1845 some portions of it were rapidly decaying. This led to its restoration by James P. Holden. By 1868 the tower was almost completely renovated in a more durable stone. Further restoration was carried out by J. S. Crowther, and the addition of a porch and vestries was executed by Basil Champneys. The total length is 220 ft. and the breadth 112 ft. There are several stained-glass windows, including one to the memory of "Chinese Gordon." The recumbent statues of Bishop James Fraser and of Hugh Birley, M.P., should also be named. In the Ely chapel is the altar tomb of Bishop James Stanley. In the stalls there are some curious *miserere* carvings. The tower is 139 ft. high, and contains a peal of ten bells, chiefly from the foundry of the Rudhalls. There are two organs, one by Father Smith, and a modern one in an oak case designed by Sir G. Scott. The parish church was made collegiate in 1422, and when in 1847 the bishopric of

Manchester was created the warden and fellows became dean and canons and the parish church became the cathedral. The first bishop was James Prince Lee, who died in 1869; the second was James Fraser, who died in 1885; the third was James Moorhouse, who resigned in 1903 and was succeeded by Edmund Arbuthnott Knox. The church endowments are considerable and have been the subject of a special act of parliament, known as the Manchester Rectory Division Act of 1845, which provides £1500 per annum for the dean and £600 to each of the four canons, and divides the residue among the incumbents of the new churches formed out of the old parish.


MANCHESTER
and Environs
English Miles
Railways
Canals
1. Exchange Station
2. Victoria Station
3. London Road Station
4. Central Station
5. Cathedral
6. Town Hall
7. Royal Exchange
8. Assize Court
9. Art Gallery and Athenaeum
10. Free Trade Hall
11. Post Office
12. Police Courts
13. Grammar School
14. Victoria University (Owens College)
15. Free Library
16. Technical Schools
17. Blind Asylum
18. Theatre Royal
L A N C A S H I R E
C H E S H I R E
Prestwich
Heaton Park
Higher Blackley
Blackley
Crumpsall Green
Cheetham Hill
Harpurhey
Moston
Failsworth
Newton Heath
Miles Platting
Broughton
Salford
Pendleton
Eccles
Swinton
Pendlebury
Clifton
Manchester Ship Canal
Trafford Park
Hulme
Ardwick
Openshaw
Gorton
Chorlton upon Medlock
Moss Side
Rusholme
Levenshulme
Old Trafford
Stretford
Urmston
Chorlton-cum-Hardy
Withington
Burnage
Sale
Ashton upon Mersey
R. Mersey
R. Irwell
R. Medlock
Information embodied from the Ordnance Survey, by permission of the Controller of H.M. Stationery Office.
Emery Walker sc.

Of the Roman Catholic churches that of the Holy Name, which belongs to the Jesuits, is remarkable for its costly decoration. The Greek Church and most of the Nonconformist bodies have places of worship. There are twelve Jewish synagogues. The meeting-house of the Society of Friends is said to be the largest of the kind in the kingdom and will seat 1200 persons.

Public Buildings.—The Royal Infirmary, founded in 1752, having become inadequate for its purposes, a new building has been erected on the south side of the city near the university, from designs by Edwin T. Hall and John Brooke; it was opened in 1909 by king Edward VII. The central site in Piccadilly thus became available for other purposes, and the corporation gave instructions for plans to be made for a new library and art gallery. The art gallery already existing in 1909 was founded as the Royal Institution, but in 1882 passed under the control of the city council. The building was designed by Sir Charles Barry. The collection contains some fine paintings by Etty, Millais, Leighton and other artists. The sculpture includes casts of the Elgin marbles and a statue of Dr John Dalton by Chantrey. The most striking of the public buildings is the town hall, probably the largest municipal building in the country, but no longer entirely adequate to the increasing business of the city council. It was completed in 1877 from designs by Alfred Waterhouse, who selected as the style of architecture a form of Gothic, but treated it very freely as purposes of utility required. The edifice covers 8000 sq. yds., and includes more than two hundred and fifty rooms. The building consists of continuous lines of corridors surrounding a central courtyard and connected by bridges. The principal tower is 286 ft. high to the top of the ball, and affords a view which extends over a large part of south Lancashire and Cheshire and is bounded only by the hills of Derbyshire. The tower contains a remarkable peal of bells by Taylor of Loughborough, forming an almost perfect chromatic scale of twenty-one bells; each bell has on it a line from canto 105 of Tennyson's *In Memoriam.* The great hall is 100 ft. long and 50 ft. wide and contains a magnificent organ built by Cavaillé-Coll of Paris. The twelve panels of this room are filled with paintings by Ford Madox Brown, illustrating the history and progress of the city. The royal exchange is a fine specimen of Italian architecture and was erected in 1869; the great meeting-hall is one of the largest rooms in England, the ceiling having a clear area, without supports, of 120 ft. in width. The exchange is seen at its best on market days (Tuesday and Friday). The assize courts were built in 1864 from designs by Waterhouse. The style is a mixture of Early English and Decorative, and a large amount of decorative art has been expended on the building. The branch Bank of England is a Doric building designed by C. R. Cockerell. There are separate town-halls for the townships of Ardwick, Chorlton, Hulme, Cheetham, Broughton and Pendleton. The Free Trade hall is a fine structure in the Lombardo-Venetian style, and its great hall will accommodate about five thousand people. It is used for public meetings, concerts, &c., and was built by Edward Walters. The Athenaeum, designed by Barry, was founded by Richard Cobden and others associated with him for "the advancement and diffusion of knowledge." The institution has, perhaps, not developed exactly on the lines contemplated by its promoters, but it has been very useful. The advantages enjoyed by members of social clubs, with the addition of facilities for educational classes and the use of an excellent news-room and a well-selected library, are offered in return for a payment which does not amount to a penny a day. The mechanics' institution has developed into the school of Technology, which now forms a part of the university. The Portico is a good specimen of the older proprietary libraries and news-rooms. It dates from 1806, and has a library. The Memorial Hall was built to commemorate the memory of the ejected ministers of 1662; it is used for meetings, scientific, educational, musical and religious. The Whitworth Institute is governed by a corporate body originating from the liberal bequests of Sir Joseph Whitworth. The Institute contains a valuable collection of works of art and stands in the centre of a woodland park. In the park, which has been transferred to the corporation, is a sculpture group of "Christ and the Children," executed by George Tinworth from the designs of R. D. Darbishire, by whom it was presented. The assize courts, built from designs by Waterhouse (1864), the post office (1887), and the police courts (1871) should also be named. Many fine structures suffer from being hemmed in by streets which prevent the proportions from being seen to advantage.

Monuments.—In Piccadilly are bronze statues of Wellington, Watt, Dalton, Peel and Queen Victoria. Another statue of the Queen, by the Princess Louise, is placed on the new porch of the cathedral. A bronze statue of Cobden occupies a prominent position in St Ann's Square. There also is the South African War Memorial of the Manchester Regiment. The marble statue of the Prince Consort, covered by a Gothic canopy of stone, is in front of the town hall, which dwarfs what would otherwise be a striking monument. In Albert Square there are also statues of Bishop Fraser, John Bright, Oliver Heywood and W. E. Gladstone. A statue of J. P. Joule is in the town hall, which also contains memorials of other worthies. The Queen's Park has a statue of Benjamin Brierley, a well-known writer in the Lancashire dialect. The most picturesque is Matthew Noble's bronze statue of Cromwell, placed on a huge block of rough granite as pedestal. It stands at the junction of Deansgate and Victoria Street, near the cathedral, and was presented to the town by Mrs E. S. Heywood.

Education.—There are many educational facilities. The oldest institution is the grammar school, which was founded in 1519 by Hugh Oldham, bishop of Exeter, a native of the town. The master and usher appointed by the bishop were to teach freely every child and scholar coming to the school, "without any money or reward taken"; and the bishop forbade the appointment of any member of the religious orders as head master. Some corn mills were devised for the maintenance of the school, which was further endowed at both the universities by Sarah, duchess of Somerset, in 1692. The school has now two hundred and fifty free scholars, whilst other pupils are received on payment of fees. Among those educated at the grammar school were Thomas De Quincey, Harrison Ainsworth and Samuel Bamford the Radical. After the grammar school the oldest educational foundation is that of Humphrey Chetham, whose bluecoat school, founded in 1653, is housed in the building formerly occupied by the college of clergy. This also contains the public library founded by Chetham, and is the most interesting relic of antiquity in the city. The educational charity of William Hulme (1631–1691) is administered under a scheme drawn up in 1881. Its income is nearly £10,000 a year, and it supports a grammar school and aids education in other ways. There are three high schools for girls. The Nicholls hospital was founded in 1881 for the education of orphan boys. Manchester was one of the first places to adopt the powers given by Forster's Act of 1870, and on the abolition of school boards the educational supervision was transferred to a committee of the corporation strengthened by co-opted members. In addition to the elementary schools, the municipality provides a large and well-equipped school of technology, and a school of art to which is attached an arts and crafts museum. There are a pupil teachers' college, a school of domestic economy, special schools for feeble-minded children, and a Royal College of Music. The schools for the deaf and dumb are situated at Old Trafford, in a contiguous building of the same Gothic design as the blind asylum, to which Thomas Henshaw left a bequest of £20,000. There is also an adult deaf and dumb institution, containing a news-room, lecture hall, chapel, &c., for the use of deaf mutes.

The Victoria University of Manchester has developed from the college founded by John Owens, who in 1846 bequeathed nearly £100,000 to trustees for an institution in which should be taught "such branches of learning and science as were then or might be hereafter usually taught in English universities." It was opened in 1851 in a house which had formerly been the residence of Cobden. In 1872 a new college building was erected on the south side of the town from designs by Waterhouse. In 1880 a university charter was granted, excluding the faculties of theology and medicine, and providing for the incorporation of University College, Liverpool, and the College of Science, Leeds. The federal institution thus created lasted until 1903, when the desire of Liverpool for a separate university of its own led to a reconstruction. Manchester University consists of one college—Owens College—in its greatly enlarged form. The buildings include the Whitworth Hall (the gift of the legatees of Sir Joseph Whitworth), the Manchester Museum and the Christie Library, which is a building for the university library given by R. C. Christie, who also bequeathed his own collection. Dr Lee, the first bishop of Manchester, left his library to Owens College, and the legatees of Sir Joseph Whitworth bought and presented E. A. Freeman's books. The library has received other important special collections. The benefactions to the university of Thomas Ashton are estimated at £80,000. There are in Manchester a number of denominational colleges, Wesleyan, Primitive Methodist, Unitarian, Baptist, &c., and many of the students preparing for the ministry receive their arts training at the university, the theological degrees of which are open to students irrespective of creed.

Libraries, Museums and Societies.—Manchester is well provided with libraries. The Chetham library, already named, contains some rare manuscripts, the gem of the collection being a copy of the historical compilation of Matthew Paris, with corrections in the author's handwriting. There is a large collection of matter relating to the history and archaeology of Lancashire and Cheshire, including the transcripts of Lancashire MSS. bequeathed by Canon F. R. Raines. The collections of broadsides formed by Mr J. O. Halliwell-Phillipps, and the library of John Byrom, rich in mystics and shorthand writers, should also be named. The Manchester Free Libraries were founded by Sir John Potter in 1852. There is now a reference library containing about 170,000 volumes, including an extensive series of English historical works, a remarkable collection of books of political economy and trade, and special collections relating to local history, Dr Thomas Fuller, shorthand and the gipsies. The

Henry Watson Music Library, and the Thomas Greenwood Library for librarians were presented to the reference library, and the Foreign Library was purchased. Affiliated to the reference library there are nineteen libraries, each of which includes a lending department and reading rooms. The municipal libraries contain in the aggregate over 366,000 vols. There are also libraries in connexion with the Athenaeum, the School of Technology, the Portico, and many other institutions. The most remarkable of the Manchester libraries is that founded by Mrs Enriqueta Rylands, and named the John Rylands Library in memory of her husband. The beautiful building was designed by Basil Champneys; the library includes the famous Althorp collection, which was bought from Earl Spencer. Mrs Rylands died in 1908, and by her will increased the endowment of the library so that it has an income of £13,000 yearly. She also bequeathed her own library.

Manchester possesses numerous literary and scientific associations. The oldest of these, the Literary and Philosophical Society, founded in 1781, has a high reputation, and has numbered among its working members John Dalton, Eaton Hodgkinson, William Fairbairn, J. P. Joule, H. E. Roscoe and many other famous men of science. It has published a series of memoirs and proceedings. The Manchester Statistical Society was the first society of the kind established in the kingdom, and has issued *Transactions* containing many important papers. The Field Naturalists' and Archaeologists' Society, the Microscopical Society, the Botanists' Association, and the Geological Society may also be named. Manchester is the headquarters of the Lancashire and Cheshire Antiquarian Society and of several printing clubs, the Chetham, the Record, the Lancashire Parish Registers societies. Seven daily papers are published, and various weekly and other periodicals. The journalism of Manchester takes high rank, the *Manchester Guardian* (Liberal) being one of the best newspapers in the country, while the *Manchester Courier* (Unionist) has an important local influence. The *Manchester Quarterly* is issued by the Manchester Literary Club, which was founded in 1862. The success of the Art Treasures Exhibition in 1857 was repeated in the Jubilee Exhibition of 1887. The Manchester Academy of Fine Arts is a society of artists, and holds an annual exhibition in the city art gallery.

Parks and Open Spaces.—There are fifty-three parks and open spaces. The Queen's Park, at Harpurhey, is pleasantly situated, though surrounded by cottages and manufactories. Philips Park is also attractive, in spite of its close proximity to some of the most densely populated portions of the town. The Alexandra Park has very good ornamental grounds and a fine cactus house with a remarkable collection presented by Charles Darrah. Some of the open spaces are small; Boggart Hole Clough, where great efforts have been made to preserve the natural features, is 76 acres in extent, and was the largest until 1902, when Heaton Park, containing 692 acres, was purchased. It was formerly the seat of the earls of Wilton, and includes Heaton House, one of Wyatt's structures. In the Queen's Park there is a museum, and periodical exhibitions of works of art are held. The total area of the city parks is 1146 acres. The corporation are also responsible for four cemeteries, having a total area of 228 acres.

Recreation.—There are nine theatres, mostly large, and eight music halls. The Theatre Royal was established as a patent theatre. When the bill for it was before the House of Lords in 1775 it was advocated as an antidote to Methodism. The Bellevue Zoological Gardens is a favourite holiday place for working people. The Ancoats Recreation Committee have since 1882 had Sunday lectures, and occasional exhibitions of pictures, window gardening, &c. The Ancoats Art Museum was founded to carry out the educational influences of art and culture generally. In addition to works of art, there are concerts, lectures, reading circles, &c. The museum is worked in connexion with a university settlement. The German element in the population has largely influenced the taste for music by which Manchester is distinguished, and the orchestral concerts (notably under Charles Hallé) are famous.

Population.—From a census taken in 1773 it appears that there were then in the township of Manchester and its out-townships 36,267 persons. The first decennial census, 1801, showed the population to be 75,275; in 1851 it was 303,382; in 1901, 606,824. It is not easy to make an exact comparison between different periods, because there have been successive enlargements of the boundaries. The population has overflowed into the surrounding districts, and if all that belongs to the urban area, of which it is the centre, were included, greater Manchester would probably rival London in the number of its inhabitants.

Manufactures and Commerce.—Manchester is the centre of the English cotton industry (for details see COTTON and COTTON MANUFACTURE), but owing to the enhanced value of land many mills and workshops have been removed to the outskirts and to neighbouring villages and towns, so that the centre of Manchester and an ever-widening circle around are now chiefly devoted not so much to production as to the various offices of distribution. It would be a mistake, however, to regard Manchester as solely dependent upon the industries connected with cotton. There are other important manufactures which in another community would be described as gigantic. Wool and silk are manufactured on a considerable scale, though the latter industry has for some years been on the decline. The miscellaneous articles grouped under the designation of small-wares occupy many hands. Machinery and tools are made in vast quantities; the chemical industries of the city are also on a large scale. In short, there are but few important manufactures that are wholly unrepresented. The proximity of Manchester to the rich coal-fields of Lancashire has had a marked influence upon its prosperity; but for this, indeed, the rapid expansion of its industries would have been impossible.

The Manchester Bankers' Clearing House returns show an almost unbroken yearly increase. The amount in 1872 was £72,805,510; in 1907 it was £320,296,332; by the severe depression of 1908 it was reduced to £288,555,307. Another test of prosperity is the increase in rateable value. In 1839 it was £669,994; in 1871, £1,703,627; in 1881, £2,301,225; in 1891, £2,798,005; in 1901, £3,394,879; in 1907, £4,191,039; in 1909, £4,234,129.

The commercial institutions of Manchester are too numerous for detailed description; its chamber of commerce has for more than sixty years exercised much influence on the trade of the district and of the nation. Manchester is the headquarters of the Co-operative Wholesale Society, and indeed of the co-operative movement generally.

The most important event in the modern history of the district is the creation of the Manchester Ship Canal (*q.v.*), by which Manchester and Salford have a direct communication with the sea at Eastham, near Liverpool. The canal was opened for traffic in January 1894. The official opening ceremony was on the 21st of May 1894, when Queen Victoria visited Manchester. The total expenditure on capital account has been £16,567,881. The original share capital of £8,000,000 and £1,812,000, raised by debentures, having been exhausted, the corporation of Manchester advanced on loan a further sum of £5,000,000.

Municipality.—Manchester received a municipal charter in 1838, received the title of city in 1853, and became a county borough in 1889. The city is divided into 30 wards, and the corporation consists of 31 aldermen and 93 councillors. The mayor received the title of lord mayor in 1893. Unlike some of the municipalities, that of Manchester makes no pecuniary allowance to its lord mayor, and the office is a costly one.

The water supply is controlled by the corporation. The works at Longdendale, begun in 1848, were completed, with extensions in 1884, at a cost of £3,147,893. The area supplied by Manchester waterworks was about 85 square miles, inhabited by a million people. The increase of trade and population led to the obtaining of a further supply from Lake Thirlmere, at the foot of Helvellyn and 96 miles from Manchester. The watershed is about 11,000 acres. The daily consumption is over 38 million gallons. Manchester supplies in bulk to many local authorities in the district between Thirlmere and the city. The corporation have also established works for the supply of hydraulic and electric power.

The gas lighting of Manchester has been in the hands of the corporation for many years, as also the supply of electricity both for lighting and energy. When the works are complete the electricity committee will supply an area of 45 sq. m.

Sanitary Condition.—Dr John Tatham constructed a Manchester life-table based on the vital statistics of the decennium 1881–1890, from which it appeared that, while in England and Wales of 1000 men aged 25 nearly 800 survived to be 45 and of 1000 aged 45, 569 survived to be 65, in Manchester the survivors were only 732 and 414 respectively. The expectation of life, at 25, was, for England and Wales 36·12 years, and for Manchester 30·69 years. But the death-rate has since rapidly decreased; in 1891 it was 26·0 per thousand living; in 1901 it was 21·6; in 1906 it was 19·0; in 1907 it was 17·9. The deaths of infants under one year old amounted to 169 per 1000

The reports of the medical officer show that whilst the density of the population, the impurity of the atmosphere, and the pollution of the streams are difficult elements in the sanitary problem, great efforts have been made towards improving the health of the people. The birth-rate in 1907 was 28·4, but the population is augmented by immigration as well as by natural increase. The number of persons to the acre is 33.

Administration of Justice.—The city has a stipendiary magistrate who, in conjunction with lay magistrates, tries cases of summary jurisdiction in the police courts. There are also quarter sessions, presided over by a recorder. Separate sessions are held for the Salford hundred. Certain sittings of the Court of Chancery for the duchy of Lancaster are held in Manchester. In addition to the county court, there is an ancient civil court known as the Salford Hundred Court of Record. Assizes have been held since 1866.

Parliamentary Representation.—By the first Reform Bill Manchester received in 1832 two representatives. In 1868 this was increased to three, but each voter had only two votes. In 1885 the city was divided into six divisions, each returning one member. Owing to the extension of the city boundaries there are Manchester voters in the Stretford, Prestwich and Gorton parliamentary divisions.

History.—Very little is known with certainty of the early history of Manchester.[1] A Roman station of some importance existed at Castlefield, and a fragment of the wall still exists. Another, perhaps earlier, was at Hunt's Bank. In the 18th century considerable evidences of Roman occupation were still visible; and from time to time, in the course of excavation (especially during the making of the Bridgewater Canal), Roman remains have been found. The coins were chiefly those of Vespasian, Antoninus Pius, Trajan, Hadrian, Nero, Domitian, Vitellius and Constantine. Investigations by the Lancashire and Cheshire Antiquarian Society and the Classical Association have brought to light many relics, chiefly of pottery. The period succeeding the Roman occupation is for some time legendary. As late as the 17th century there was a tradition that Tarquin, an enemy of King Arthur, kept the castle of Manchester, and was killed by Lancelot of the Lake. The references to the town in authentic annals are very few. It was probably one of the scenes of the missionary preaching of Paulinus; and it is said (though by a chronicler of comparatively late date) to have been the residence of Ina, king of Wessex, and his queen Ethelberga, after he had defeated Ivor, somewhere about the year 689. Almost the only point of certainty in its history before the Conquest is that it suffered greatly from the devastations of the Danes, and that in 923 Edward, who was then at Thelwall, near Warrington, sent a number of his Mercian troops to repair and garrison it. In Domesday Book Manchester, Salford, Rochdale and Radcliffe are the only places named in south-east Lancashire, a district now covered by populous towns. Large portions of it were then forest, wood and waste lands. Twenty-one thanes held the manor or hundred of Salford among them. The church of St Mary and the church of St Michael in Manchester are both named in Domesday, and some difficulty has arisen as to their proper identification. Some antiquaries consider that the passage refers to the town only, whilst others think it relates to the parish, and that, while St Mary's is the present cathedral, St Michael's would be the present parish church of Ashton-under-Lyne. In 1301 Manchester received a charter of manorial liberties and privileges from its baron, Thomas Gresley, a descendant of one to whom the manor had been given by Roger of Poictou, who was created by William the Conqueror lord of all the land between the rivers Mersey and Ribble. The Gresleys were succeeded by the De la Warrs, the last of whom was educated for the priesthood, and became rector of the town. To avoid the evil of a non-resident clergy, he made considerable additions to the lands of the church, in order that it might be endowed as a collegiate institution. A college of clergy was thus formed, whose fellows were bound to perform the necessary services at the parish church, and to whom the old baronial hall was granted as a place of residence. The manorial rights passed to Sir Reginald West, a descendant of Joan Gresley, who was summoned to parliament as Baron de la Warre. The West family, in 1579, sold the manorial rights for £3000 to John Lacy, who, in 1596, resold them to Sir Nicholas Mosley, whose descendants enjoyed the emoluments derived from them until 1845, when they were purchased by the municipality of Manchester for a sum of £200,000. The lord of the manor had the right to tax and toll all articles brought for sale into the market of the town. But, though the inhabitants were thus to a large extent taxed for the benefit of one individual, they had a far greater amount of local self-government than might have been supposed, and the court leet, which was then the governing body of the town, had, though in a rudimentary form, nearly all the powers now possessed by municipal corporations. This court had not only control over the watching and warding of the town, the regulation of the water supply, and the cleaning of the streets, but also had power, which at times was used freely, of interfering with the private liberty of their fellow-citizens. Thus, no single woman was allowed to be a householder; no person might employ other than the town musicians; and the amount to be spent at wedding feasts and other festivities was carefully settled. Under the protection of the barons the town appears to have steadily increased in prosperity, and it early became an important seat of the textile manufactures. Fulling mills were at work in the district in the 13th century; and documentary evidence exists to show that woollen manufactures were carried on in Ancoats at that period. In 1538 Leland described it as "the fairest, best-builded, quickest, and most populous town in Lancashire." The right of sanctuary granted to the town in 1540 was found so detrimental to its industrial pursuits that after very brief experience the privilege was taken away. The college of Manchester was dissolved in 1547, but was refounded in Mary's reign. Under her successor the town became the headquarters of the commission for establishing the Reformed religion. In 1641 we hear of the Manchester people purchasing linen yarn from the Irish, weaving it, and returning it for sale in a finished state. They also brought cotton wool from Smyrna to work into fustians and dimities. An act passed in the reign of Edward VI. regulates the length of cottons called Manchester, Lancashire and Cheshire cottons. These, notwithstanding their name, were probably all woollen textures. It is thought that some of the Flemish weavers who were introduced into England by Queen Philippa of Hainault were settled at Manchester; and Fuller has given an exceedingly quaint and picturesque description of the manner in which these artisans were welcomed by the inhabitants of the country they were about to enrich with a new industry. The Flemish weavers were in all probability reinforced by religious refugees from the Low Countries.

In the civil wars, the town was besieged by the Royalists under Lord Strange (better known as earl of Derby—"the great Stanley"); but was successfully defended by the inhabitants under the command of a German soldier of fortune, Colonel Rosworm, who complained with some bitterness of their ingratitude to him. An earlier affray between the Puritans and some of Lord Strange's followers is said to have occasioned the shedding of the first blood in the struggle between the king and parliament. The year 1694 witnessed the trial of those concerned in the so-called Lancashire plot, which ended in the triumphant acquittal of the supposed Jacobites. That the district really contained many ardent sympathizers with the Stuarts was, however, shown in the rising of 1715, when the clergy ranged themselves to a large extent on the side of the Pretender; and was still more clearly shown in the rebellion of 1745, when the town was occupied by Prince Charles Edward Stuart, and a regiment, known afterwards as the Manchester regiment, was formed and placed under the command of Colonel Francis Townley. In the fatal retreat of the Stuart troops the Manchester contingent was left to garrison Carlisle, and surrendered to the duke of Cumberland. The officers were taken to London, where they were tried for high treason and beheaded on Kennington Common.

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[1] In the *Antonine Itinerary* the name Mancunium (*q.v.*) or Mamucium is given. This is the origin of the modern name, and has supplied the adjective "Mancunian" (cf. "Old Mancunians" applied to old boys of Manchester Grammar School).

The variations of political action in Manchester had been exceedingly marked. In the 16th century, although it produced both Roman Catholic and Protestant martyrs, it was earnestly in favour of the Reformed faith, and in the succeeding century it became indeed a stronghold of Puritanism. Yet the successors of the Roundheads who defeated the army of Charles I. were Jacobite in their sympathies, and by the latter half of the 18th century had become imbued with the aggressive form of patriotic sentiment known as anti-Jacobinism, which showed itself chiefly in dislike of reform and reformers of every description. A change, however, was imminent. The distress caused by war and taxation, towards the end of the 18th and the beginning of the 19th century, led to bitter discontent, and the anomalies existing in the parliamentary system of representation afforded only too fair an object of attack. While single individuals in some portions of the country had the power to return members of parliament for their pocket boroughs, great towns like Manchester were entirely without representation. The popular discontent was met by a policy of repression, culminating in the affair of Peterloo, which may be regarded as the starting-point of the modern reform agitation. This was in 1819, when an immense crowd assembled on St Peter's Fields (now covered by the Free Trade Hall and warehouses) to petition parliament for a redress of their grievances. The Riot Act was read by a clerical magistrate; but in such a manner as to be quite unheard by the mass of the people; and drunken yeomanry cavalry were then turned loose upon the unresisting mass of spectators. The yeomanry appear to have used their sabres freely; several people killed and many more injured; and, although the magistrates received the thanks of the prince regent and the ministry, their conduct excited the deepest indignation throughout the entire country. Those who had organized the meeting, including "Orator" Hunt with Samuel Bamford and other working men, were imprisoned.

Naturally enough, the Manchester politicians took an important part in the Reform agitation; when the Act of 1832 was passed, the town sent as its representatives the Right Hon. C. P. Thomson, vice-president of the board of trade, and Mark Philips. With one notable exception, this was the first time that Manchester had been represented in parliament since its barons had seats in the House of Peers in the earlier centuries. In 1654 Charles Worsley and R. Radcliffe were nominated to represent it in Cromwell's parliament. Worsley was a man of great ability, and has a place in history as the man who carried out the injunction of the Protector to "remove that bauble," the mace of the House of Commons. The agitation for the repeal of the corn laws had its headquarters at Manchester, and the success which attended it, not less than the active interest taken by its inhabitants in public questions, has made the city the home of other projects of reform. The "United Kingdom Alliance for the Suppression of the Liquor Traffic" was founded there in 1853, and during the continuance of the American War the adherents both of the North and of the South deemed it desirable to have organizations in Manchester to influence public opinion in favour of their respective causes. A charter of incorporation was granted in 1838; a bishop was appointed in 1847; and the town became a city in 1853. The Lancashire cotton famine, caused by the Civil War in America, produced much distress in the Manchester district, and led to a national movement to help the starving operatives. The more recent annals of Manchester are a record of industrial and commercial developments, and of increase in educational opportunities of all kinds. Politically Manchester was Liberal, of one or other shade, under the first Reform Act; a Conservative member was first elected in 1868, and in 1874 two. Under household suffrage in 1885 that party secured five out of six members; in 1886 and 1892, three out of six. In 1895 and 1900 five Unionists were elected, but in 1906 six Liberals were returned, one of whom (Mr Winston Churchill) was defeated at a by-election in 1908. In 1910 three Liberals, two Labour members and one Conservative were elected.

Authorities.—Although several excellent books have been written on subjects connected with the town, there is no adequate modern history. The *History of Manchester*, by the Rev. John Whitaker, appeared in 1771; it is a mere fragment, and, though containing much important matter, requires to be very discreetly used. The following may be recommended: John Reilly, *History of Manchester*, (1861); R. W. Procter, *Manchester in Holiday Dress* (1866), *Memorials of Manchester Streets* (1874), *Memorials of Byegone Manchester* (1880); Richard Buxton, *Botanical Guide to Manchester, &c.* (2nd ed., 1859); Leo Grindon, *Manchester Flora* (1859); Edward Baines, *History of Lancashire*, edited by Croston (1886–1893), 5 vols.; W. A. Shaw, *Manchester, Old and New* (1894); W. E. A. Axon, *Annals of Manchester* (1885), *Cobden as a Citizen* (1906); Harry Rawson, *Historical Record of some Recent Enterprises of the Corporation of Manchester* (1894); *Official Manual of Manchester and Salford* (1909); J. P. Earwaker, *Court Leet Records of Manchester, 1552–1686, 1731–1846* (1884–1890), 12 vols.; *Constable's Accounts, 1612–1647, 1743–1776* (1891–1892), 3 vols.; *Manchester Municipal Code* (1894–1899), 5 vols.; George Saintsbury, *Manchester* (1887); Thomas Swindells, *Manchester Streets and Manchester Men* (1906–1907), 3 vols.; James Tait, *Medieval Manchester* (1904); Charles Roeder, *Roman Manchester* (1900); Sir Bosdin Leech, *History of the Manchester Ship Canal* (1907), 2 vols. (W. E. A. A.)

MANCHESTER (popularly Manchester-by-the-Sea), a township of Essex county, Massachusetts, U.S.A., about 25 m. N.E. of Boston, on Massachusetts Bay. Pop. (1900), 2522; (1905, state census), 2618; (1910), 2673. Area, 7·64 sq. m. It is served by the Boston & Maine railroad, and is connected with neighbouring towns and cities by electric lines. The township, heavily wooded in parts, and with picturesque shores alternating between rocky headlands and sandy beaches, stretches for several miles along the coast between Beverly on the west and Gloucester on the east. It is one of the most beautiful watering-places in America, and is the favourite summer residence of many of the foreign diplomats at Washington. The "singing beach" is a stretch of white sand, which, when trodden upon, emits a curious musical sound. Manchester, originally a part of Salem, was settled about 1630 and was at first known as Jeffrey's Creek. It was incorporated separately under its present name in 1645.

See *Manchester Town Records* (2 vols., Salem, 1889–1891), and D. F. Lamson, *History of the Town of Manchester, 1645–1895* (Manchester, 1895).

MANCHESTER, the largest city of New Hampshire, U.S.A., and one of the county-seats of Hillsboro county, on the Merrimac river, at the mouth of the Piscataquog river, (by rail) 18 m. S. of Concord and 57 m. N.N.W. of Boston. Pop. (1890), 44,126; (1900), 56,987; (1910 U.S. census) 70,063. Of the total population in 1900, 24,257 were foreign-born, including 13,429 French-Canadians; and 37,530 were of foreign parentage (both parents foreign-born), including 18,839 of French-Canadian parentage. Manchester is served by the Southern, the Western, the White Mountains, and the Worcester Nashua & Portland divisions of the Boston & Maine railroad, and by inter-urban electric lines. It is situated on a plain about 90 ft. above the Merrimac river (which is spanned here by three bridges), commands extensive views of the beautiful Merrimac valley, and covers a land area of about 33 sq. m. On the east side of the city are two connected lakes known as Lake Massabesic (30 m. in circumference). Manchester is known for the attractive appearance of the residence districts in which the factory operatives live, detached homes and "corporation boarding-houses," instead of tenement houses, being the rule. The Institute of Arts and Sciences (incorporated in 1898) provides lecture courses and classes in science, art and music. Among the other public buildings and institutions are the United States Government building, the city-hall, the county-court-house, the city library (1854; the outgrowth of the Manchester Athenaeum, established in 1844), St Anselm's College (R.C.), a Roman Catholic cathedral, four Roman Catholic convents, the Elliot hospital, the Sacred Heart hospital and the hospital of Notre Dame de Lourdes, the State industrial school, the State house of correction, the Gale home for aged women, an old ladies' home (R.C.), St Martha's home for working girls, the Manchester children's home and four orphan asylums. In the largest of five public squares is a soldiers' monument, consisting of a granite column 50 ft. high, surmounted by a statue of Victory. The city has two parks, and in one of them, overlooking the Merrimac, is a monument to the memory of General John Stark, who was born and was buried here. The water-supply is obtained from Lake Massabesic. Amoskeag Falls in the Merrimac are 55 ft. in height, and by means of hydraulic canals Manchester is provided with a fine water-power. Steam power is also used, and the city is by far the most important manufacturing centre in the state. It is extensively engaged in the manufacture of cotton goods, boots and shoes, worsted goods, hosiery and other knit goods, and locomotives; among the other manufactures are linen goods, steam fire-engines, paper, edge tools, soap, leather, carriages and beer. The value of the city's factory products increased from $24,628,345 in 1900 to $30,696,926 in 1905, or 24·6%. In 1905 Manchester produced 24·8% of the total factory product of the state. Manchester ranks fifth among the cities of the United States in cotton manufacturing, and ninth among the cities of the country in the manufacture of boots and shoes.

On account of the abundance of fish in the river here, Amoskeag Falls and vicinity were a favourite resort of the Penacook Indians, and it is said that John Eliot, the "Apostle to the Indians," preached to them here in the summer of 1651. The first white settlement within the present limits of Manchester was made in 1722 by Scottish-Irish immigrants at Goffe's Falls, 5 m. below Amoskeag Falls. In 1723 a cabin was built by some of these immigrants at the greater falls, and gradually a small settlement grew up there. In 1735 Massachusetts granted to a body of men known as "Tyng's Snow-Shoe Scouts" and their descendants a tract of land 3 m. wide along the east bank of the Merrimac, designated as "Tyng's Township." The Scottish-Irish claimed this tract as part of their grant from New Hampshire, and there arose between the rival claimants a bitter controversy which lasted until May 1741, when the courts decided against the Massachusetts claimants. In 1751 the territory formerly known as "Tyng's Township," and sometimes called "Harrytown," with portions of Chester and Londonderry, was incorporated as a township under the name Derryfield; in 1810 the name was changed to Manchester, the change having been suggested by the town's manufacturing possibilities; and in 1846 Manchester was chartered as a city. The first sawmill was erected as early as 1736, and during the years from 1794 to 1807 a canal was constructed around the Amoskeag Falls through which to carry lumber. As late as 1830 the town had a population of only 877, but in 1831 the Amoskeag Manufacturing Company was incorporated, the construction of hydraulic canals and the erection of cotton mills followed, the villages of Piscataquog and Amoskeag were annexed in 1853, and the population increased to 3235 in 1840, to 8841 in 1860, and to 33,592 in 1880.

Consult M. D. Clarke, *Manchester, A Brief Record of its Past and a Picture of its Present* (Manchester, 1875).

MANCHESTER, a former city of Chesterfield county, Virginia, U.S.A., (on the S. side of the James river), since 1910 a part of Richmond. Pop. (1900), 9715, of whom 3338 were negroes; (1906 estimate), 9997. It is served by the Atlantic Coast Line, the Seaboard Air Line, and the Southern railways, by electric lines to Richmond and Petersburg, and by numerous river boats. It is finely situated in a bend of the river, with about 2 m. of water front; on the heights above is Forest Hill park, a pleasure resort, and adjacent to it Woodland Heights, a beautiful residential district. From the surrounding country come much agricultural produce, coal, lumber, bricks and granite. There is a good harbour and excellent water power. Among the manufactures are paper, flour, cotton goods, leather, brick, railway supplies, &c. The value of the city's factory products increased from $1,621,358 in 1900 to $3,226,268 in 1905, or 99%.

MANCHESTER SHIP CANAL. The advantage of a waterway for the conveyance of goods between eastern Lancashire and the sea is so obvious that so far back as the year 1721 Thomas Steers designed a plan for continuing to Manchester the barge navigation which then existed between Liverpool and Warrington. Parliamentary powers were then obtained to improve the rivers Mersey and Irwell from Warrington to Manchester by means of locks and weirs. This work was successfully carried out, and proved of great benefit to the trade of the district. The duke of Bridgewater, who had made a canal from his collieries at Worsley to Manchester, afterwards continued the canal to the Mersey at Runcorn; this extension was opened in 1722 and competed with the Mersey and Irwell navigation, both routes being navigated by barges carrying about fifty tons of cargo. The Liverpool & Manchester railway at a later date afforded further facilities for conveyance of goods, but the high rates of carriage, added to heavy charges at the Liverpool docks, prejudiced trade, and the question was mooted of a ship canal to bring cotton, timber, grain and other goods direct to Manchester without transshipment. The first plan was made by William Chapman in 1825, and was followed by one designed by Henry Palmer in 1840, but it was not until the year 1882 that the movement was originated that culminated in the opening of the Manchester Ship Canal by Queen Victoria on the 21st of May 1894.

In determining the plan of the canal the main point which arose was whether it should be made with locks or whether it should be on the sea-level throughout, and therefore tidal. The advantage of a still waterway in navigating large steamers, and the facilities afforded by one constant water-level for works on the banks and the quick discharge of goods at the terminal docks at Manchester, secured the adoption of the plans for a canal with locks as designed by Sir E. Leader Williams. The fresh-water portion of the canal extended between Manchester and Runcorn, while from the latter place to Garston it was proposed to improve the upper Mersey estuary by constructing training walls and dredging to form a deep central channel. Parliamentary powers to construct the canal were sought in the session of 1883, when the bill passed the committee of the House of Commons but was rejected by the committee of the House of Lords. Brought forward again the next year, it was passed by the Lords but thrown out by the Commons. The opposition from Liverpool and the railway companies was very strong; to meet to some extent that of the former, a continuation of the canal was proposed from Runcorn to Eastham along the Cheshire side of the Mersey, instead of a trained channel in the estuary, and in this form the bill was again introduced in the session of 1885, and, notwithstanding strong opposition, was passed by both houses of parliament. The cost of this contest to promoters and opponents exceeded £400,000, the various committees on the bill having sat over 175 days. Owing to difficulties in raising the capital the works were not begun until November 1887.

The total length of the canal is 35½ m. and it may be regarded as divided into three sections. From Eastham to Runcorn it is near or through the Mersey estuary for 12¾ m., and thence to Latchford near Warrington, 8¼ m., it is inland; both these sections have the same water-level, which is raised by high tides. At Latchford the locks stop tidal action, and the canal is fed by the waters of the rivers Mersey and Irwell from that point to Manchester, 14½ m. from Latchford. The canal begins on the Cheshire side of the Mersey at Eastham, about 6 m. above Liverpool. The entrance is well sheltered and adjoins a good low-water channel communicating with the Sloyne deep at Liverpool. Three entrance locks have been provided close to and parallel with each other, their length and width being 600 by 80, 350 by 50, and 150 by 30 ft. These locks maintain the water-level in the canal nearly to mean high-water level (14 ft. 2 in. above the Liverpool datum); when the tide rises above that height the lock gates are opened and the tide flows up to Latchford, giving on high spring tides an additional depth of water of about 7 ft. On the ebb tide this water is returned to the Mersey through large sluices at Randles Creek and at the junction of the river Weaver with the canal, the level of the canal thus being reduced to its normal height. The canal throughout to Manchester has a minimum depth of 28 ft.; the depth originally was 26 ft., but the lock sills were placed 2 ft. lower to allow of the channel being dredged to 28 ft. when necessary. The minimum width at bottom is 120 ft., allowing large vessels to pass each other at any point on the canal; this width is considerably increased at the locks and other parts. The slopes are generally about 1½ to 1, but are flatter through some portions; in rock-cutting the sides are nearly vertical. From Eastham to Runcorn the canal is alternately inland and on the foreshore of the estuary, on which embankments were constructed to act as dams and keep out the tide during the excavation of the canal, and afterwards to maintain the water-level at low water in the estuary; both sides are faced with heavy coursed stone. The material for the embankments was principally clay excavated from the cuttings. In some places, where the foundation was of a porous nature, sheeting piles of timber had to be used. At Ellesmere Port, where the embankment is 6200 ft. long on sand, 13,000 whole timber sheeting piles 35 ft. long were driven, to secure the base of the embankment on each side; water jets under pressure through 1½ in. wrought-iron pipes were used at the foot of each pile to assist the sinking, which was found most difficult by ordinary means. At the river Weaver ten Stoney roller sluices are built, each 30 ft. span, with heavy stone and concrete piers and foundations; at Runcorn, where the river Mersey is narrow, a concrete sea-wall 4300 ft. long was substituted for the embankment. At various points under the canal cast-iron siphon pipes were laid to carry off any land drainage which was at a lower level than the canal; the largest of these siphons were constructed to allow the tidal and fresh water of the river Gowy to pass under the canal at Stanlow Point, between Eastham and Ellesmere Port. Two 12-ft. siphons are there placed close together, built of cast-iron segments; they are each 400 ft. long, and were laid on concrete 4 ft. below the bottom of the canal. From Runcorn to Latchford the canal is nearly straight, the depth of cutting varying from 35 to 70 ft., partly in rock, but generally in alluvial deposit. The whole length of the canal passes through the New Red Sandstone formation, with its overlying beds of gravel, clay, sand and silt, which gave much trouble during the progress of the work; retaining walls of stone and brickwork had to be built in these places to maintain the sides of the canal from slips and injury from the wash of steamers.

The canal from Latchford to Manchester is in heavy cutting through the valleys of the rivers Mersey and Irwell. As these rivers are circuitous in course, only very small portions could be utilized in forming the canal; a line as nearly straight as possible was therefore adopted, and involved many crossings of the river channels. During the whole progress of the work these had to be kept open for the discharge of floods and land water, and in some places temporary cuts of considerable length had to be made for the same object. In November 1890 and December 1891 high winter floods covered the whole of the river valleys, filling many miles of the unfinished canal and causing great damage to the slopes. Altogether 23 m. of canal had to be pumped out to enable the work to be completed. After the cuttings between the river channels were finished, the end dams were removed, and the rivers Irwell and Mersey were turned into the new channel now forming the upper portion of the ship canal. The total rise to the level of the docks at Manchester from the ordinary level of the water in the tidal portion of the canal below Latchford locks is 60 ft. 6 in.; this is obtained by an average rise of about 15 ft. at each of the sets of locks at Latchford, Irlam (7½ m. nearer Manchester), Barton (2 m. farther) and Mode Wheel (3½ m. above Barton locks at the entrance to the Manchester docks). For the greater part of this last length the canal is widened at bottom from 120 ft., its normal width, to 170 ft., to enable vessels to lie at timber and other wharves without interfering with the passage of large vessels to or from the docks. The locks are in duplicate, one being 600 ft. long by 65 ft. wide, the other 350 ft. long by 45 ft. wide, with Stoney's sluices adjacent. They are filled or emptied in five minutes by large culverts on each side with side openings into the lock. Concrete with facings of blue Staffordshire brick is largely used, and the copings, sills, hollow quoins and fender courses are of Cornish granite. The lock gates are constructed of greenheart timber. The sluices near the locks take the place of the weirs used in the old Mersey and Irwell navigation; they are 30 ft. span each, four being generally used at each set of locks. In ordinary seasons any water not used for lockage purposes passes over the tops of the sluices, which are kept closed; in flood times the sluices are raised to a height which will pass off floods with a comparatively small rise in the canal. There are eight hydraulic installations on the canal, each having duplicate steam-engines and boilers; the mains exceed 7 m. in length, the pressure being 700 ℔ to the inch. They work the cranes, lifts and capstans at the docks, lock gates and culvert sluices, coal tips, swing bridges and aqueduct.

At Barton, near Manchester, the Bridgewater canal crosses the river Irwell on the first navigable aqueduct constructed in England. It was the work of James Brindley, and since it was built at only sufficient height to allow of barges passing under it, means had to be found to allow of this important canal being maintained, and yet to permit steamers to use the ship canal below it. Brindley's canal is on one level throughout its whole length, and as its water supply is only sufficient for the flight of locks by which it descends at Runcorn to the Mersey, locks down to the ship canal would have involved the waste of a lock of water on each side and caused serious delay to the traffic. Sir E. Leader Williams surmounted the difficulty by means of a swing aqueduct for the Bridgewater canal, which when closed enables the traffic to pass as before, while it is opened to allow of ships crossing it on the lower level of the ship canal. The water in the swing portions of the aqueduct when opened is retained by closing gates at each end, similar gates being shut at the same time across the fixed portion of the aqueduct. The swing portion is a large steel trough carried by side girders, 234 ft. long and 33 ft. high in the centre, tapering 4 ft. to the ends; the waterway is 19 ft. wide and 6 ft. deep. The whole works on a central pier with similar arrangements to the largest swing bridges on the canal; it has two spans over the ship canal of 90 ft. each. It is somewhat singular that the first fixed canal aqueduct in England should, after the lapse of 136 years, be replaced by the first swing aqueduct ever constructed. The swing aqueduct is moved by hydraulic power, and has never given any trouble in working, even in times of severe frost. The weight of the movable portion, including the water, is 1600 tons.

The manner of dealing with the five lines of railways that were cut through by the canal was one of importance, both in the interests of the travelling public and the trade on the canal; they are all lines with a heavy traffic, including the main line of the London & North Western railway near Warrington, with its important route to Scotland. Swing bridges, although in use on some lines to cross navigations, are dangerous and inconvenient, and high-level deviation lines were adopted for each railway crossing the canal. No such alteration of a railway had been previously sanctioned by parliament, and it was only the importance of a ship canal to Manchester that secured the requisite powers against the strong opposition of the railway companies. Embankments were made close to and parallel with the old lines, beginning about a mile and a quarter from the canal on each side, the canal itself being crossed by viaducts which give a clear headway of 75 ft. at ordinary water-level. Vessels with high masts trading on the canal are provided with telescopic or sliding top-masts. The gradients on the railways rising up to the viaducts are 1 in 135. The span of the viaducts is so arranged as to maintain the full width of the canal for navigation; and as the railways generally cross the canal on the skew, this necessitated girders in some cases of 300 ft. span. There are nine main roads requiring swing bridges across the canal; all below Barton have a span giving a clear water-way of 120 ft. The width of these bridges varies with the importance of the roads from 20 to 36 ft., and they are constructed of steel, their weight ranging from 500 to 1000 tons each. They work on a live ring of conical cast-iron rollers and are moved by hydraulic power supplied by steam, gas or oil engines. The Trafford Road bridge at the docks at Manchester is the heaviest swing bridge on the canal; being of extra width, it weighs 1800 tons.

The canal being virtually one long dock, wharves at various points have been erected to enable chemical or manufacturing works to be carried on, widenings being provided where necessary. At Ellesmere Port coal tips and sheds have been erected, and the canal is in direct communication with the docks there as well as at Weston Point and Runcorn, where a large trade is carried on with the Staffordshire Potteries and the Cheshire salt districts. At Partington branches from the railways connect the canal with the Yorkshire and Lancashire coal-fields, and the canal is widened out 65 ft. on each side for six hydraulic coal tips. At Mode Wheel there are extensive abattoirs and lairages, erected by the Manchester Corporation; also large petroleum oil tanks, graving dock and pontoons, cold-air meat stores and other accommodation for traffic. At Manchester the area of the docks is 104 acres, with 152 acres of quay space, having over 5 m. of frontage to the docks, which are provided with a number of three-storey transit sheds, thirteen seven-storey and seven four-storey warehouses, and a large grain silo. The London & North Western and Lancashire & Yorkshire railway companies and the Cheshire Lines Committee have made branch lines to the docks, the railways and sidings at which are over 30 miles in length. Much traffic is also carted, or dealt with by inland canals in direct communication with the docks. The substitution of a wide and deep canal, nearly straight, for comparatively shallow and narrow winding rivers, and the use of large sluices in place of fixed weirs to carry off the river water, have been of great advantage to the district in greatly reducing the height of floods.

The total amount of excavation in the canal, docks and subsidiary work amounted to over 54 million cub. yds., nearly one-fourth of which was sandstone rock; the excavated material was used in forming the railway deviation embankments, filling up the old beds of the rivers and raising low lands near the canal. As many men were employed on the works as could be obtained, but the number never exceeded 17,000, and the greater part of the excavation was done by about eighty steam navvies and land dredgers. For the conveyance of excavation and materials, 228 miles of temporary railway lines were laid, and 173 locomotives, 6300 wagons and trucks, and 316 fixed and portable steam-engines and cranes were employed, the total cost of the plant being nearly £1,000,000. The expenditure on the works, including plant and equipment, to the 1st of January 1900, was £10,327,666. The purchase of the Mersey and Irwell and Bridgewater navigations (£1,786,651), land and compensation (£1,223,809), interest on capital during constructions (£1,170,733), and parliamentary, superintendence and general expenses brought up the total amount to £15,248,437.

The traffic on the canal gradually increased from 925,659 tons in 1894 to 2,778,108 tons in 1899 and 5,210,759 tons in 1907. After its opening considerable reductions were made in the railway rates of carriage and the charges at the Liverpool docks in order to meet the lower cost of conveyance by shipping passing up it. The result has been of great advantage to the trade of Lancashire and the surrounding districts, and the saving in the cost of carriage, estimated at £700,000 a year, assists manufacturers to meet the competition of their foreign opponents who have the advantage of low rates of carriage on the improved waterways of America, Germany, France and Belgium. Before the construction of the canal, large manufacturers had left Manchester to establish their works at ports like Glasgow, where they could save the cost of inland carriage. Since its opening, new industries have been started at Manchester and along its banks, warehouses and mills that were formerly empty are now occupied; while nearly 10,000 new houses have been built for the accommodation of the workpeople required to meet the enlarged trade of the city.

For further details see Sir Bosdin Leech, *History of the Manchester Ship Canal* (Manchester, 1907). (E. L. W.)

MANCHURIA, the name by which the territory in the east of Asia occupied by the Manchus is known in Europe. By the Chinese it is called the country of the Manchus, an epithet meaning "pure," chosen by the founder of the dynasty which now rules over Manchuria and China as an appropriate designation for his family. Manchuria lies in a north-westerly and south-easterly direction between 39° and 53° N. and between 116° and 134° E., and is wedged in between China and Mongolia on the west and north-west, and Korea and the Russian territory on the Amur on the east and north. More definitely, it is bounded N. by the Amur, E. by the Usuri, S. by the Gulf of Liao-tung, the Yellow Sea and Korea, and W. by Chih-li and Mongolia. The territory thus defined is about 800 m. in length and 500 m. in width, and contains about 390,000 sq. m. It is divided into three provinces, viz. Hei-lung-kiang or Northern Manchuria, Kirin or Central Manchuria, and Shēng-king or Southern Manchuria. Physically the country is divided into two regions, the one a series of mountain ranges occupying the northern and eastern portions of the kingdom, and the other a plain which stretches southwards from Mukden, the capital, to the Gulf of Liao-tung.

A system of parallel ranges of mountains, culminating in the Chinese Chʻang pai Shan, "the long white mountains," on the Korean frontier, runs in a north-easterly direction from the shores of the Gulf of Liao-tung. In its course through Eastern Manchuria it forms the watershed of the Sungari, Usuri and other rivers, and in the south that of the Ya-lu and many smaller streams. It also forms the eastern boundary of the great plain of Liao-tung. The mountains of this system reach their greatest height on the south-east of Kirin, where their snow-capped peaks rise to the elevation of 8000 ft. The scenery among them is justly celebrated, more especially in the neighbourhood of Haichʻēng, Siu-yen and the Korean Gate.

The three principal rivers of Manchuria are the Sungari, Mutan-kiang and Usuri already mentioned. Of these the Sungari, which is the largest, rises on the northern slopes of the Chʻang pai Shan range, and runs in a north-westerly direction to its junction with the Nonni, from which point it turns north-east until it empties itself into the Amur. It is navigable by native junks above Kirin, which city may also be reached by steamer. In its long course it varies greatly both in depth and width, in some parts being only a few feet deep and spreading out to a width of more than a mile, while in other and mountainous portions of its course its channel is narrowed to 300 or 400 ft., and its depth is increased in inverse ratio. The Usuri rises in about 44° N. and 131° E., and after running a north-easterly course for nearly 500 m. it also joins the Amur. The Mutan-kiang takes its rise, like the Sungari, on the northern slopes of the Chʻang pai Shan range, and not far from the sources of that river. It takes a north-easterly course as far as the city of Ninguta, at which point it turns northward, and so continues until it joins the Sungari at San-sing. It is navigable by junks between that city and Ninguta, though the torrents in its course make the voyage backwards and forwards one of considerable difficulty. Next in importance to these rivers are the Liao and Ya-lu, the former of which rises in Mongolia, and after running in an easterly direction for about 400 m. enters Manchuria in about 43° N., and turning southward empties itself into the Gulf of Liao-tung. The Ya-lu rises in Korea, and is the frontier river of that country.

Provinces and Towns.—Mukden, or as it is called by the Chinese Shēng-king, the capital city of Manchuria, is situated in the province of Shēng-king, occupies a fine position on the river Hun-ho, an affluent of the Liao, and is a city of considerable pretensions. Liao-yang, which was once the capital of the country, is also in the province of Shēng-king. The other cities in the province are Kin-chow-fu on the west of the Gulf of Liao-tung; Kin-chow, on the western extremity of the Liao-tung peninsula; Kai-ping, on the north-western shore of the same peninsula; Hai-chēng, on the road from Niu-chwang to Mukden; Ki-yuen, a populous and prosperous city in the north of the province; and Sing-king, east of Mukden, the original seat of the founders of the present dynasty. The most important commercial place, however, is the treaty port of Niu-chwang, at the head of the Gulf of Liao-tung. According to the custom-house returns the value of the foreign imports and exports in the year 1880 was £691,954 and £1,117,790 respectively, besides a large native trade carried on in junks. In 1904 the value of foreign imports had risen to £2,757,962, but the exports amounted to £1,742,859 only, the comparatively low figure being accounted for by the Russo-Japanese war.

The province of Kirin, or Central Manchuria, is bounded on the N. and N.W. by the Sungari, on the S. by Shēng-king and Korea, on the W. by Mongolia, and on the E. by the Usuri and the maritime Russian province. It contains an area of about 90,000 sq. m., and is entirely mountainous with the exception of a stretch of plain country in its north-western corner. This plain produces large quantities of indigo and opium, and is physically remarkable for the number of isolated conical hills which dot its surface. These sometimes occur in a direct line at intervals of 15 or 20 m., and elsewhere are scattered about "like dish-covers on a table." Kirin, the capital of the province, occupies a magnificent position, being surrounded on the north, west and south by a semicircular range of mountains with the broad stream of the Sungari flowing across the front. The local trade is considerable. A-She-ho, on the Ashe, with a population of 60,000; Petuna (Chinese, Sing-chung), on the Sungari, population 30,000; San-sing, near the junction of the Sungari and Mutan-kiang; La-lin, 120 m. to the north of Kirin, population 20,000; Harbin or Kharbin and Ninguta are the other principal cities in the province.

Hei-lung-kiang, or Northern Manchuria, which contains about 195,000 sq. m., is bounded on the N. and N.E. by the Amur, on the S. by the Sungari, and on the W. by the Nonni and Mongolia. It is traversed by the Great and Lesser Khingan mountains and their offshoots. This province is thinly populated, and is cultivated only along the lines of its rivers. The only towns of any importance are Tsitsihar and Mergen, both situated on the Nonni and Khailar in the west.

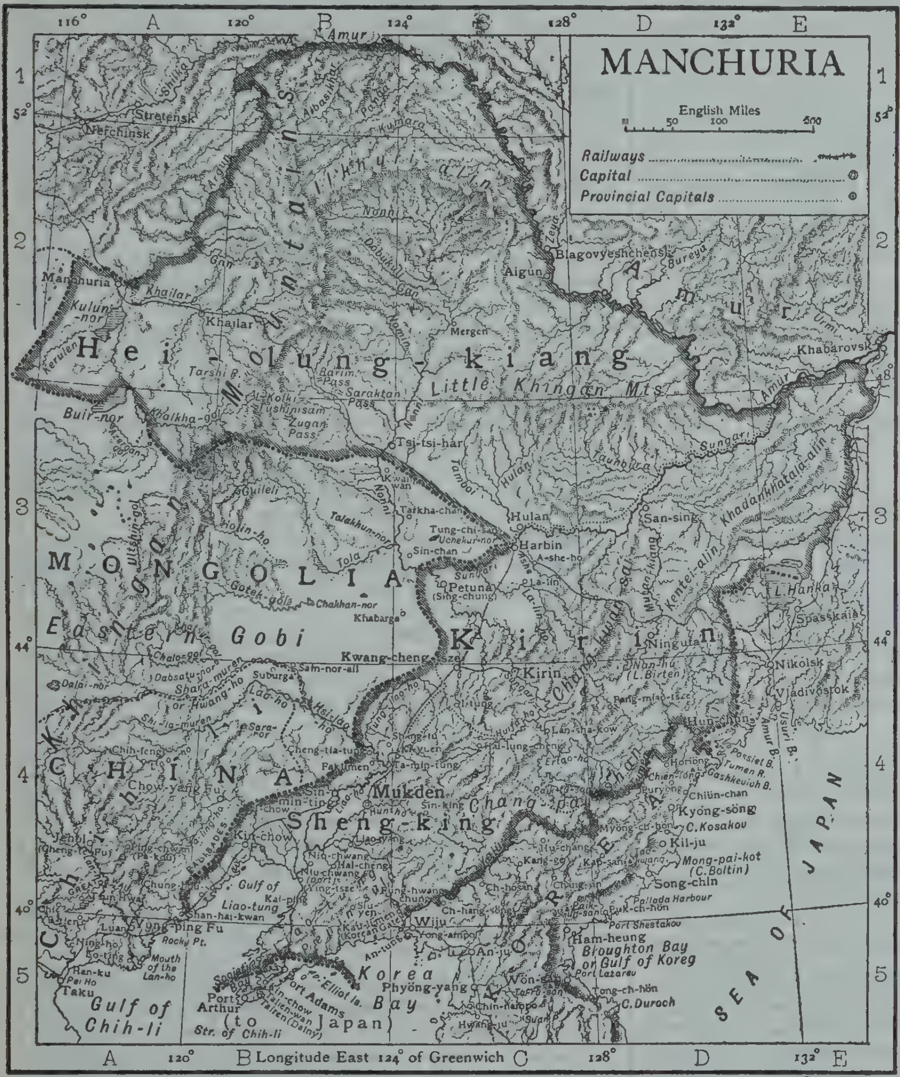
Climate, Flora, Fauna.—The climate over the greater part of the country varies between extremes of heat and cold, the thermometer ranging between 90° F. in the summer and 10° below zero in the winter. As in the north of China, the rivers are frozen up during the four winter months. After a short spring the heat of summer succeeds, which in its turn is followed by an autumn of six weeks' duration. The great plain in Shēng-king is in many parts swampy, and in the neighbourhood of the sea, where the soil emits a saline exudation such as is also common in the north of China, it is perfectly sterile. In other parts fine crops of millet and various kinds of grain are grown, and on it trees flourish abundantly. The trees and plants are much the same as those common in England, and severe as the weather is in winter the less elevated mountains are covered to their summits with trees. The wild animals also are those known in Europe, with the addition of tigers and panthers. Bears, wild boars, hares, wolves, foxes and wild cats are very common, and in the north sables are found in great numbers. One of the most noticeable of the birds is the Mongolian lark (*Melanocorypha mongolica*), which is found in a wild state both in Manchuria and in the desert of Mongolia. This bird is exported in large numbers to northern China, where it is much prized on account of its extraordinary power of imitation. The Manchurian crane is common, as also are eagles, cuckoos, laughing doves, &c. Insects abound, owing to the swampy nature of much of the country. The rivers are well stocked with fish, especially with salmon, which forms a common article of food. In such immense shoals do these fish appear in some of the smaller streams that numbers are squeezed out on to the banks and there perish.

Products and Industries.—In minerals Manchuria is very rich: coal, gold, iron (as well as magnetic iron ore), and precious stones are found in large quantities. Gold mines are worked at several places in the northern part of Manchuria, of which the principal are on the Muho river, an affluent of the Amur, and near the Russian frontier. Mines are also worked at Kwanyin-shan, opposite the Russian frontier town of Radevska, and at Chia-pi-kou, on an affluent of the upper Sungari. Indigo and opium are the most lucrative crops. The indigo plant is grown in large quantities in the plain country to the north of Mukden, and is transported thence to the coast in carts, each of which carries rather more than a ton weight of the dye. The poppy is cultivated wherever it will grow, the crop being far more profitable than that of any other product. Cotton, tobacco, pulse, millet, wheat and barley are also grown.

Population.—The population is estimated as follows for each of the three divisions:—

Province of Shēng-king (Fēng T'ien)	4,000,000
„ „ Kirin	6,500,000
„ „ Hei-lung-kiang	2,000,000
Total	12,500,000

Communications.—Four principal highways traverse Manchuria. The first runs from Peking to Kirin via Mukden, where it sends off a branch to Korea. At Kirin it bifurcates, one branch going to San-sing, the extreme north-eastern town of the province of Kirin, and the other to Possiet Bay on the coast via Ninguta. The second road runs from the treaty port of Niu-chwang through Mukden to Petuna in the north-western corner of the Kirin province, and thence to Tsitsihar, Mergen and the Amur. The third also starts from Niu-chwang, and strikes southward to Kin-chow at the extremity of the Liao-tung peninsula. The fourth connects Niu-chwang with the Gate of Korea.



Manchurian Railways. The original Manchurian railway was constructed under an agreement made in 1896 between the Chinese government and the Russo-Chinese bank, an institution founded in 1895 to develop Russian interests in the East. The Chinese Eastern Railway Company was formed by the bank under this agreement, to construct and work the line, and surveys were made in 1897, the town of Harbin being founded as headquarters for the work. The line, which affords through communication from Europe by way of the Trans-Siberian system, enters Manchuria near a station of that name in the north-west corner of the country, passes Khailar, and runs south-east, near Tsitsihar, to Harbin. Thence the main line continues in the same general direction to the eastern frontier of Manchuria, and so to Vladivostok. In 1898 Russia obtained a lease of the Liao-tung peninsula, and a clause of this contract empowered her to connect Port Arthur and Dalny (now Tairen) with the main Manchurian railway by a branch southward from Harbin. In spite of interruption caused by the Boxer outbreak, through communication was established in 1901. Under the Russo-Japanese treaty of August 1905, after the war, supplemented by a convention between Japan and China concluded in December of the same year, Japan took over the line from Port Arthur as far as Kwang-chēng-tsze, now known as the Southern Manchurian railway (508 m.). Branches were promoted (*a*) from Mukden to Antung on the Yalu, to connect with the Korean system, and (*b*) from Kwang-chēng-tsze to Kirin. The rest of the original Manchurian system (1088 miles) remains under Russian control. In the south-west of Manchuria a line of the imperial railways of Northern China gives connexion from Peking, and branches at Kou-pang-tsze to Sin-min-ting and to Niu-chwang, and the link between Sin-min-ting and Mukden is also under Chinese control. The lines now under Russian control were laid down, and remain, on the 5 ft. gauge which is the Russian standard; but after the Russian control of the southern lines was lost the gauge was altered from that standard.

History.—Manchu, as has been said, is not the name of the country but of the people who inhabit it. The name was adopted by a ruler who rose to power in the beginning of the 13th century. Before that time the Manchus were more or less a shifting population, and, being broken up into a number of tribes, they went mainly under the distinctive name of those clans which exercised lordship over them. Thus under the Chow dynasty (1122–225 B.C.) they were known as Sewshin, and at subsequent periods as Yih-low, Wuh-keih, Moh-hoh, Pohai, Nüchih and according to the Chinese historians also as Khitan. Throughout their history they appear as a rude people, the tribute they brought to the Chinese court consisting of stone arrow-heads, hawks, gold, and latterly ginseng. Assuming that, as the Chinese say, the Khitans were Manchus, the first appearance of the Manchus, as a people, in China dates from the beginning of the 10th century, when the Khitans, having first conquered the kingdom of Pohai, crossed the frontier into China and established the Liao or Iron dynasty in the northern portion of the empire. These invaders were in their turn overthrown two centuries later by another invasion from Manchuria. These new conquerors were Nüchihs, and therefore direct ancestors of the Manchus. On assuming the imperial yellow in China their chief adopted the title of Kin or "Golden" for his dynasty. "Iron" (Liao), he said, "rusts, but gold always keeps its purity and colour, therefore my dynasty shall be called Kin." In a little more than a century, however, the Kins were driven out of China by the Mongols under Jenghiz Khan. But before the close of their rule a miraculous event occurred on the Chang-pai-Shan mountains which is popularly believed to have laid the seeds of the greatness of the present rulers of the empire. Three heaven-born maidens, so runs the legend, were bathing one day in a lake under the Chang-pai-Shan mountains when a passing magpie dropped a ripe red fruit into the lap of one of them. The maiden ate the fruit, and in due course a child was born to her, whom she named Aisin Gioro, or the Golden. When quite a lad Aisin Gioro was elected chief over three contending clans, and established his capital at Otoli near the Chang-pai-Shan mountains. His reign, however, was brief, for his subjects rose and murdered him, with all his sons except the youngest, Fancha, who, like the infant Haitu in Mongolian history, was miraculously saved. Nothing is recorded of the facts of Aisin Gioro's reign except that he named the people over whom he reigned Manchu, or "Pure." His descendants, through the rescued Fancha, fell into complete obscurity until about the middle of the 16th century, when one of them, Nurhachu by name, a chieftain of a small tribe, rose to power. Nurhachu played with skill and daring the rôle which had been played by Jenghiz Khan more than three centuries before in Mongolia. With even greater success than his Mongolian counterpart, Nurhachu drew tribe after tribe under his sway, and after numerous wars with Korea and Mongolia he established his rule over the whole of Manchuria. Being thus the sovereign of an empire, he, again like Jenghiz Khan, adopted for himself the title of Ying-ming, "Brave and Illustrious," and took for his reign the title of T'ien-ming. Thirteen years later, in 1617, after numerous border fights with the Chinese, Nurhachu drew up a list of "seven hates," or indictments, against his southern neighbours, and, not getting the satisfaction he demanded, declared war against them. The progress of this war, the peace hastily patched up, the equally hasty alliance and its consequences, being matters of Chinese history, are treated in the article CHINA.

Manchuria was claimed by Russia as her particular sphere of interest towards the close of the 19th century, and in the course of the disturbances of 1900 Russian troops occupied various parts of the country. Eventually a Manchurian convention was arranged between China and Russia, by which Russia was to evacuate the province; but no actual ratification of this convention was made by Russia. The Anglo-German agreement of October 1900, to which Japan also became a party, and by which it was agreed to "maintain undiminished the territorial condition of the Chinese empire," was considered by Great Britain and Japan not to exclude Manchuria; but Germany, on the other hand, declared that Manchuria was of no interest to her. The Anglo-Japanese treaty of 1902, however, was ostensibly directed towards the preservation of Manchuria in Chinese hands. British capital has been invested in the extension of the Chinese Northern railway to Niu-chwang, and the fact was officially recognized by an agreement between Great Britain and Russia in 1899. One result of the Russo-Japanese War was the evacuation of Manchuria by the Russians, which, after the conclusion of peace in 1905, was handed over by Japan to China.

See H. E. M. James, *The Long White Mountain* (London, 1888); D. Christie, *Ten Years in Manchuria* (Paisley, 1895); F. E. Younghusband, *The Heart of a Continent: a Narrative of Travels in Manchuria* (London, 1896); P. H. Kent, *Railway Enterprise in China* (London, 1907). (R. K. D.)

MANCINI, PASQUALE STANISLAO (1817–1888), Italian jurist and statesman, was born at Castel Baronia, in the province of Avellino, on the 17th of March 1817. At Naples, where he studied law and displayed great literary activity, he rapidly acquired a prominent position, and in 1848 was instrumental in persuading Ferdinand II. to participate in the war against Austria. Twice he declined the offer of a portfolio in the Neapolitan cabinet, and upon the triumph of the reactionary party undertook the defence of the Liberal political prisoners. Threatened with imprisonment in his turn, he fled to Piedmont, where he obtained a university professorship and became preceptor of the crown prince Humbert. In 1860 he prepared the legislative unification of Italy, opposed the idea of an alliance between Piedmont and Naples, and, after the fall of the Bourbons, was sent to Naples as administrator of justice, in which capacity he suppressed the religious orders, revoked the Concordat, proclaimed the right of the state to Church property, and unified civil and commercial jurisprudence. In 1862 he became minister of public instruction in the Rattazzi cabinet, and induced the Chamber to abolish capital punishment. Thereafter, for fourteen years, he devoted himself chiefly to questions of international law and arbitration, but in 1876, upon the advent of the Left to power, became minister of justice in the Depretis cabinet. His Liberalism found expression in the extension of press freedom, the repeal of imprisonment for debt, and the abolition of ecclesiastical tithes. During the Conclave of 1878 he succeeded, by negotiations with Cardinal Pecci (afterwards Leo XIII.), in inducing the Sacred College to remain in Rome, and, after the election of the new pope, arranged for his temporary absence from the Vatican for the purpose of settling private business. Resigning office in March 1878, he resumed the practice of law, and secured the annulment of Garibaldi's marriage. The fall of Cairoli led to Mancini's appointment (1881) to the ministry of foreign affairs in the Depretis administration. The growing desire in Italy for alliance with Austria and Germany did not at first secure his approval; nevertheless he accompanied King Humbert to Vienna and conducted the negotiations which led to the informal acceptance of the Triple Alliance. His desire to retain French confidence was the chief motive of his refusal in July 1882 to share in the British expedition to Egypt, but, finding his efforts fruitless when the existence of the Triple Alliance came to be known, he veered to the English interest and obtained assent in London to the Italian expedition to Massawa. An indiscreet announcement of the limitations of the Triple Alliance contributed to his fall in June 1885, when he was succeeded by Count di Robilant. He died in Rome on the 26th of December 1888.

MANCIPLE, the official title of the caterer at a college, an inn of court, or other institution. Sometimes also the chief cook. The medieval Latin *manceps*, formed from *mancipium*, acquisition by purchase (see ROMAN LAW), meant a purchaser of stores, and *mancipium* became used of his office. It is from the latter word that the O. Fr. *manciple* is taken.

MANCUNIUM, the name often (though perhaps incorrectly) given as the Romano-British name of Manchester. Here, close to the Medlock, in the district still called Castlefield near Knott Mill, stood in Roman days a fort garrisoned by a cohort of Roman auxiliary soldiers. The site is now obscured by houses, railways and the Rochdale canal, but vestiges of Roman ramparts can still be seen, and other remains were found in 1907 and previous years. Traces of Romano-British inhabitation have been noted elsewhere in Manchester, especially near the cathedral. But there was no town here; we can trace nothing more than a fort guarding the roads running north through Lancashire and east into Yorkshire, and the dwellings of women-folk and traders which would naturally spring up outside such a fort. The ancient name is unknown. Our Roman authorities give both Mancunium and Mamucium, but it is not clear that either form is correct.

See W. T. Watkin's *Roman Lancashire*; C. Roeder's *Roman Manchester*, and the account edited by F. Bruton of the excavations in 1907. (F. J. H.)

MANDAEANS, also known as Sabians, Nasoraeans, or St John's Christians,[1] an Oriental sect of great antiquity, interesting to the theologian as almost the only surviving example of a religion compounded of Christian, heathen and Jewish elements on a type which is essentially that of ancient Gnosticism.

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[1] The first of these names (not Mendaeans or Mandaites) is that given by themselves, and means *γνωστικοί*, followers of Gnosis (מאנדאייא, from מאנדא, Hebr. מַדָּע). The Gnosis of which they profess themselves adherents is a *personification*, the æon and mediator "knowledge of life" (see below). The title Nasoraeans (Nāṣōrāyē), according to Petermann, they give only to those among themselves who are most distinguished for knowledge and character. Like the Arabic Naṣāra, it is originally identical with the name of the half heathen half Jewish-Christian Ναζωραῖοι, and indicates an early connexion with that sect. The inappropriate designation of St John's Christians arises from the early and imperfect acquaintance of Christian missionaries, who had regard merely to the reverence in which the name of the Baptist is held among them, and their frequent baptisms. In their dealings with members of other communions the designation they take is Sabians, in Arabic Ṣābi'ūna, from צבע=צְבָא, to baptize, thus claiming the toleration extended by the Koran (Sur. 5, 73; 22, 17; 2, 59) to those of that name.

The Mandaeans are found in the marshy lands of South Babylonia (al-baṭāiḥ), particularly in the neighbourhood of Basra (or Bussorah), and in Khūzistān (Disful, Shuster).[1] They speak the languages of the localities in which they are settled (Arabic or Persian), but the language of their sacred books is an Aramaic dialect, which has its closest affinities with that of the Babylonian Talmud, written in a peculiar character suggestive of the old Palmyrene.[2] The existence of the Mandaeans has been known since the middle of the 17th century, when the first Christian missionaries, Ignatius a Jesu[3] and Angelus a Sancto, began to labour among them at Basra; further information was gathered at a somewhat later date by Pietro della Valle[4] and Jean de Thévenot[5] (1633–1667), and in the following century by Engelbrecht Kaempfer (1651–1716), Jean Chardin (1643–1713) and Carsten Niebuhr. In recent times they have been visited by A. H. Petermann[6] and Albrecht Socin, and Siouffi[7] published in 1880 a full and accurate account of their manners and customs, taken from the lips of a converted Mandaean. For our knowledge of their doctrinal system, however, we still depend chiefly upon the sacred books already mentioned, consisting of fragments of very various antiquity derived from an older literature.[8] Of these the largest and most important is the *Sidrā rabbā* ("Great Book"), known also as *Ginzā* ("Treasure"), consisting of two unequal parts, of which the larger is called *yamīnā* (to the right hand) and the smaller *s'mala* (to the left hand), because of the manner in which they are bound together. The former is intended for the living; the latter consists chiefly of prayers to be read at the burial of priests. As regards doctrine, the work is exhaustive; but it is diffuse, obscure, and occasionally self-contradictory, as might be expected in a work which consists of a number of unconnected paragraphs of various authorship and date. The last section of the "right-hand" part (the "Book of Kings") is one of the older portions, and from its allusion to "the Persian and Arabian kings" may be dated somewhere between A.D. 700 and 900. Many of the doctrinal portions may in substance well be still older, and date from the time of the Sassanids. None of the MSS., however, is older than the 16th century.[9]

The following sketch represents, as far as can be gathered from these heterogeneous sources, the principal features of the Mandaean system. The ground and origin of all things is *Pīrā*, or more correctly *Pērā rabbā* ("the great abyss," or from פער, "to split," cf. the Gnostic *βυθός*, or more probably cf. Heb. *perī*, "the great fruit"), associated with whom, and forming a triad with him, are the primal aeons *Ayar zīvā rabbā*, "the great shining aether," and *Mānā rabbā d'eḳārā*, "the great spirit of glory," usually called simply *Mānā rabbā*. The last-named, the most prominent of the three, is the king of light properly so called, from whom the development of all things begins. From him emanates *Yardĕnā rabbā*, "the great Jordan," which, as the higher-world soul, permeates the whole aether, the domain of Ayar. Alongside of *Mānā rabbā* frequent mention is made of *D'mūthā*, his "image," as a female power; the name "image of the father" arises out of the same conception as that which gives rise to the name of *ἔννοια* among the Greek Gnostics. *Mānā rabbā* called into being the highest of the aeons properly so called, *Hayyē Ḳadmāyē*, "Primal Life," and then withdrew into deepest secrecy, visible indeed to the highest but not to the lowest aeons (cf. *Σοφία* and *Προπάτωρ*), yet manifesting himself also to the souls of the more pious of the Mandaeans after their separation from the body. Primal Life, who is properly speaking the Mandaean god, has the same predicates as the primal spirit, and every prayer, as well as every section of the sacred books, begins by invoking him.[10] The extremely fantastic delineation of the world of light by which *Hayyē Ḳadmāyē* is surrounded (see for example the beginning of *Sidrā rabbā*) corresponds very closely with the Manichaean description of the abode of the "king of the paradise of light." The king of light "sits in the far north in might and glory." The Primal Light unfolds himself by five great branches, viz. "the highest purest light, the gentle wind, the harmony of sounds, the voice of all the aeons, and the beauty of their forms," all these being treated as abstractions and personified. Out of the further development and combination of these primary manifestations arise numerous aeons (*'Uthrē*, "splendours," from עתר, "is rich"), of which the number is often stated to be three hundred and sixty. They are divided into a number of classes (kings, hypostases, forms, &c.); the proper names by which they are invoked are many, and for the most part obscure, borrowed doubtless, to some extent, from the Parsee angelology. From the First Life proceeds as a principal emanation the "Second Life," *Hayyē Tinyānē*, generally called *Yōshamīn*. This last name is evidently meant to be Hebrew, "Yahweh of the heavens," the God of the Jews being of a secondary rank in the usual Gnostic style. The next emanation after *Yōshamīn* is "the messenger of life" (*Mandā d'hayyē*, literally *γνῶσις τῆς ζωῆς*), the most important figure in the entire system, the mediator and redeemer, the *λόγος* and the Christ of the Mandaeans, from whom, as already stated, they take their name. He belongs to the heathen Gnosis, and is in his essence the same as the Babylonian Marduk. *Yōshamīn* desired to raise himself above the Primal Light, but failed in the attempt, and was punished by removal out of the pure aetherial world into that of inferior light. Mandā, on the other hand, continues with the First Life and *Mānā rabbā*, and is called his "beloved son," the "first born," "high priest" and "word of life." The "Life" calls into existence in the visible world a series of three great Helpers, Hibil, Shithil and Anōsh (late Judaeo-Babylonian transformations of the well-known names of the book of Genesis), the guardians of souls. The last son of the Second Life is *Hayyē t'līthayē*, the "Third Life," usually called father of the Uthrē (*Abā d' 'Uthrē*, *Abāthūr*). His usual epithet is "the Ancient" (*'Aṭīqā*), and he is also called "the deeply hidden and guarded." He stands on the borderland between the here and the hereafter, like the mysterious *πρεσβύτης τρίτος* or *senex tertius* of Mani, whose becoming visible will betoken the end of the world. Abāthūr sits on the farthest verge of the world of light that lies towards the lower regions, and weighs in his balance the deeds of the departed spirits who ascend to him. Beneath him was originally nothing but a huge void with muddy black water at the bottom, in which his image was reflected, becoming ultimately solidified into P'tāhīl, his son, who now partakes of the nature of matter. The demiurge of the Mandaeans, and corresponding to the Ialdabaoth of the Ophites, he at the instance of his father frames the earth and men—according to some passages in conjunction with the seven bad planetary spirits. He created Adam and Eve, but was unable to make them stand upright, whereupon Hibil, Shithil and Anōsh were sent by the First Life to infuse into their forms spirit from *Mānā rabbā* himself. Hibil, at the instance of the supreme God, also taught men about the world of light and the aeons, and especially gave them to know that not P'tāhīl but another was their creator and supreme God, who as "the great king of light, without number, without limit," stands far above him. At the same time he enjoined the pair to marry and people the world. P'tāhīl had now lost his power over men, and was driven by his father out of the world of light into a place beneath it, whence he shall at the day of judgment be raised, and after receiving baptism be made king of the 'Uthrē with divine honours.

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[1] In 1882 they were said to have shrunk to 200 families, and to be seeking a new settlement on the Tigris, to escape the persecutions to which they are exposed.

[2] See T. Nöldeke's admirable *Mandäische Grammatik* (Halle, 1875).

[3] *Narratio originis, rituum, et errorum Christianorum S. Joannis* (Rome, 1652).

[4] *Reisebeschreibung*, part iv. (Geneva, 1674).

[5] *Voyage au Levant* (Paris, 1664).

[6] *Reisen im Orient*, ii. 447 seq.

[7] M. M. Siouffi, *Études sur la religion . . . des Soubbas* (Paris, 1880).

[8] Mandaean MSS. occur in the British Museum, the Bodleian Library, the Bibliothèque Nationale of France, and also in Rome, Weimar and Berlin. A number of Mandaean inscriptions relating to popular beliefs and superstitions have been published by H. Pognon, *Inscriptions mandaites* (2 vols., Paris, 1898–1899), also by M. Lidzbarski in his *Ephemeris* (Giessen, 1900 seq.).

[9] The first printed edition and translation of the *Sidra rabba*, by Matth. Norberg (*Codex Nazaraeus, liber Adami appellatus*, 3 vols., Copenhagen, 1815–1816, followed by a lexicon in 1816, and an onomasticon in 1817), is so defective as to be quite useless; even the name Book of Adam is unknown to the Mandaeans. Petermann's *Thesaurus s. Liber magnus, vulgo "Liber Adami" appellatus, opus Mandaeorum summi ponderis* (2 vols., Berlin and Leipzig, 1867), is an excellent metallographic reproduction of the Paris MS. A German translation of about a quarter of this work has been published in W. Brandt's *Mandaische Schriften*, with notes (Göttingen, 1893). A critical edition still remains a desideratum. Next in importance to the *Sidrā rābbā* is the *Sidrā d'Yahyā*, or "Book of John," otherwise known as the *D'rāschē d'Malkē*, "Discourses of the Kings," which has not as yet been printed as a whole, although portions have been published by Lorsbach and Tychsen (see *Museum f. bibl. u. orient. Lit.* (1807), and Stäudlin's *Beitr. z. Phil. u. Gesch. d. Relig. u. Sittenlehre* 1796 seq.). The *Kolāstā* (Ar. *Khulāṣa*, "Quintessence"), or according to its fuller title *'Enyānē uderāshē d'maṣbūthā umassekthā* ("Songs and Discourses of Baptism and the Ascent," viz. of the soul after death), has been admirably lithographed by Euting (Stuttgart, 1867). It is also known as *Sidrā d'neshmātha*, "Book of Souls," and besides hymns and doctrinal discourses contains prayers to be offered by the priests at sacrifice and at meals, as well as other liturgical matter. The Mandaean marriage service occurs both in Paris and in Oxford as an independent MS. The *Dīwān*, hitherto unpublished, contains the ritual for atonement. The *Asfar malwāshē*, or "Book of the Zodiac," is astrological. Of smaller pieces many are magical and used as amulets.

[10] The use of the word "life" in a personal sense is usual in Gnosticism; compare the Ζωή of Valentin and *el-ḥayāt el-muallama*, "the dark life," of Mani in the *Fihrist*.

The underworld is made up of four vestibules and three hells properly so called. The vestibules have each two rulers, Zārtay and Zartanay, Hag and Mag, Gaf and Gafan, Anatan and Kin. In the highest hell rules alone the grisly king Sh'dūm, "the warrior"; in the storey immediately beneath is Giv, "the great"; and in the lowest is Krūn or Karkūm, the oldest and most powerful of all, commonly called "the great mountain of flesh" (*Tūrā rabbā d'besrā*), but also "the first-born of darkness." In the vestibules dirty water is still to be met with, but the hells are full of scorching consuming fire, except Krūn's domain, where is nought but dust, ashes and vacancy. Into these regions descended Hibil the brilliant, in the power of *Mānā rabbā*, just as in the Manichaean mythology the "primal man," armed with the elements of the king of light, descends to a contest with the primal devil. Hibil lingers, gradually unfolding his power, in each of the vestibules, and finally passing from hell to hell reaches Karkūm. Hibil allows himself to be half swallowed by the monster, but is unhurt, and compels his antagonist to recognize the superiority of *Mānā rabbā*, the God of light, and to divulge his profoundest secret, the hidden name of darkness. Armed with this he returns through the successive hells, compelling the disclosure of every secret, depriving the rulers of their power, and barring the doors of the several regions. From the fourth vestibule he brought the female devil Rūhā, daughter of Kin, and set her over the whole four. This Rūhā, the mother of falsehood and lies, of poisoning and fornication is an anti-Christian parody of the Rūhā d'Qudshā (Holy Spirit) of the Syriac Church. She is the mother of Ur, the personified fire of hell, who in anger and pride made a violent onset on the world of light (compare the similar occurrence in the Manichaean mythology), but was mastered by Hibil and thrown in chains down to the "black water," and imprisoned within seven iron and seven golden walls. By Ur, Rūhā, while P'tāhīl was engaged in his work of creation, became mother of three sets of seven, twelve and five sons respectively; all were translated by P'tāhīl to the heavenly firmament (like the Archons of Mani), the first group forming the planets and the next the signs of the zodiac, while the third is as yet undetermined. Of the names of the planets Estera (Ishtar Venus, also called Rūhā d'Qudshā, "holy spirit"), Enba (Nebo, Mercury), Sīn (moon), Kēwān (Saturn), Bīl (Jupiter), and Nirīg (Nirgal, Mars) reveal their Babylonian origin; Il or Il Il, the sun, is also known as Ḳādūsh and Adūnay (the Adonai of the Old Testament); as lord of the planetary spirits his place is in the midst of them; they are the source of all temptation and evil amongst men. The houses of the planets, as well as the earth and a second world immediately to the north of it, rest upon anvils laid by Hibil on the belly of Ur.

In the Mandaean representation the sky is an ocean of water, pure and clear, but of more than adamantine solidity, upon which the stars and planets sail. Its transparency allows us to see even to the pole star, who is the central sun around whom all the heavenly bodies move. Wearing a jewelled crown, he stands before Abāthūr's door at the gate of the world of light; the Mandaeans accordingly invariably pray with their faces turned northward. The earth is conceived of as a round disk, slightly sloping towards the south, surrounded on three sides by the sea, but on the north by a high mountain of turquoises; behind this is the abode of the blest, a sort of inferior paradise, inhabited by the Egyptians who were saved from drowning with Pharaoh in the Red Sea, and whom the Mandaeans look upon as their ancestors, Pharaoh himself having been their first high priest and king. The total duration of the earth they fix at four hundred and eighty thousand years, divided into seven epochs, in each of which one of the planets rules. The *Sidrā Rabbā* knows of three total destructions of the human race by fire and water, pestilence and sword, a single pair alone surviving in each case. In the Mandaean view the Old Testament saints are false prophets; such as Abraham, who arose six thousand years after Nū (Noah) during the reign of the sun, Mīshā (Moses), in whose time the true religion was professed by the Egyptians, and Shlīmūn (Solomon) bar Davith, the lord of the demons. Another false prophet and magician was Yishu M'shīhā, who was in fact a manifestation of the planet Mercury. Forty-two years before his day, under King Pontius Pilate, there had appeared the true prophet Yahyā or John son of Zechariah, an incarnation of Hibil, of whose birth and childhood fantastic stories are told. Yahyā by a mistake gave baptism to the false Messiah, who had feigned humility; on the completion of his mission, after undergoing a seeming execution, he returned clothed with light into the kingdom of light. As a contemporary of Yahyā and the false Messiah Hibil's younger brother Anōsh 'Uthrā came down from heaven, caused himself to be baptized by Yahyā, wrought miracles of healing and of raising the dead, and brought about the crucifixion of the false Messiah. He preached the true religion, destroyed Jerusalem ("Urashlam," *i.e.* "the devil finished it"), which had been built by Adūnay, dispersed over the world the Jews who had put Yahyā to death, and previous to his return into the worlds of light sent forth three hundred and sixty prophets for the diffusion of the true religion. All this speaks of intense hatred alike of Jews and Christians; the fasts, celibacy and monastic and anchoret life of the latter are peculiarly objectionable to the Mandaeans. Two hundred and forty years after the appearing of the false Messiah there came to the world sixty thousand saints out of Pharaoh's world to take the place of the Mandaeans, who had been completely extirpated; their high priest had his residence in Damascus. The last false prophet was M'hammad or Ahmat bar Bisbat (Mahomet), but Anōsh, who remained close beside him and his immediate successors, prevented hostilities against the true believers, who claim to have had in Babylonia, under the Abbasids, four hundred places of worship. Subsequent persecutions compelled their withdrawal to 'Ammāra in the neighbourhood of Wāsit, and ultimately to Khūzistān. At the end of the world the devil Ur will swallow up the earth and the other intermediate higher worlds, and thereupon will burst and fall into the abyss of darkness where, along with all the worlds and powers of darkness, he will ultimately cease to be, so that thenceforward the universe will consist of but one everlasting world of light.

The chief depositaries of these Mandaean mysteries are the priests, who enjoy a high degree of power and social regard. The priesthood has three grades: (1) the *Sh'kandā* or deacon is generally chosen from episcopal or priestly families, and must be without bodily blemish. The candidate for orders must be at least nineteen years old and have undergone twelve years' preparation; he is then qualified to assist the priesthood in the ceremonies of religion. (2) The *Tarmīdā* (*i.e.* "Talmīdā," "initiated") or priest is ordained by a bishop and two priests or by four priests after a long and extremely painful period of preparation. (3) The *Ganzivrā* ("treasurer") or bishop, the highest dignitary, is chosen from the whole body of the Tarmīdās after a variety of tests, and possesses unlimited authority over the clergy. A supreme priestly rank, that of *Rish 'ammā*, or "head of the people," is recognized, but only in theory; since the time of Pharaoh this sovereign pontificate has only once been filled. Women are admitted to priestly offices as well as men. The priestly dress, which is all white, consists of drawers, an upper garment, and a girdle with the so-called *tāgā* ("crown"); in all ceremonies the celebrants must be barefoot. By far the most frequent and important of the religious ceremonies is that of baptism (*masbūthā*), which is called for in a great variety of cases, not only for children but for adults, where consecration or purification is required, as for example on all Sundays and feast days, after contact with a dead body, after return from abroad, after neglect of any formality on the part of a priest in the discharge of his functions. In all these cases baptism is performed by total immersion in running water, but during the five days' baptismal festival the rite is observed wholesale by mere sprinkling of large masses of the faithful at once. The Mandaeans observe also with the elements of bread (*pehtā*) and wine (*mambūhā*, lit. "fountain") a sort of eucharist, which has a special sanctifying efficacy, and is usually dispensed at festivals, but only to baptized persons of good repute who have never willingly denied the Mandaean faith. In receiving it the communicant must not touch the host with his finger; otherwise it loses its virtue. The hosts are made by the priests from unleavened fine flour. The Mandaean places of worship, being designed only for the priests and their assistants (the worshippers remaining in the forecourt), are excessively small, and very simply furnished; two windows, a door that opens towards the south so that those who enter have their faces turned towards the pole star, a few boards in the corner, and a gabled roof complete the whole structure; there is neither altar nor decoration of any kind. The neighbourhood of running water (for baptisms) is essential. At the consecration of a church the sacrifice of a dove (the bird of Ishtar) has place among the ceremonies. Besides Sundays there are six great feasts: (1) that of the New Year (*Naurūz rabbā*), on the first day of the first month of winter; (2) *Dehwā h' nīnā*, the anniversary of the happy return of *Hibil Zīvā* from the kingdom of darkness into that of light, lasting five days, beginning with the 18th of the first month of spring; (3) the *Marwānā*, in commemoration of the drowned Egyptians, on the first day of the second month of spring; (4) the great five days' baptismal festival (*pantshā*), the chief feast, kept on the five intercalary days at the end of the second month of summer—during its continuance every Mandaean, male and female, must dress in white and bathe thrice daily; (5) *Dehwā d'daimānā*, in honour of one of the three hundred and sixty 'Uthras, on the first day of the second month of autumn; (6) *Kanshe Zahlā*, the preparation feast, held on the last day of the year. There are also fast days called m'battal (Arab.), on which it is forbidden to kill any living thing or eat flesh. These, however, are really "rest-days," as fasting is forbidden in Mandaeism. The year is solar, and has twelve months of thirty days each, with five intercalary days between the eighth and the ninth month. Of the seven days of the week, next to Sunday (habshaba) Thursday has a special sacredness as the day of *Hibil Zīvā*. As regards secular occupation, the present Mandaeans are goldsmiths, ironworkers, and house and ship carpenters. The *Sidrā Rabbā* lays great stress upon the duty of procreation, and marriage is a duty. In the 17th century, according to the old travellers, they numbered about 20,000 families, but at the present day they hardly number more than 1200 souls. In external appearance the Mandaean is distinguished from the Moslem only by a brown coat and a parti-coloured headcloth with a cord twisted round it. They have some peculiar deathbed rites: a deacon with some attendants waits upon the dying, and as death approaches administers a bath first of warm and afterwards of cold water; a holy dress, consisting of seven pieces (rastā), is then put on; the feet are directed towards the north and the head turned to the south, so that the body faces the pole star. After the burial a funeral feast is held in the house of mourning.

The Mandaeans are strictly reticent about their theological dogmas in the presence of strangers; and the knowledge they actually possess of these is extremely small. The foundation of the system is obviously to be sought in Gnosticism, and more particularly in the older type of that doctrine (known from the serpent symbol as Ophite or Naassene) which obtained in Mesopotamia and Further Asia generally. But it is equally plain that the Ophite nucleus has from time to time received very numerous and often curiously perverted accretions from Babylonian Judaism, Oriental Christianity and Parsism, exhibiting a striking example of religious syncretism. In the Gnostic basis itself it is not difficult to recognize the general features of the religion of ancient Babylonia, and thus we are brought nearer a solution of the problem as to the origin of Gnosticism in general. It is certain that Babylonia, the seat of the present Mandaeans, must be regarded also as the cradle in which their system was reared; it is impossible to think of them as coming from Palestine, or to attribute to their doctrines a Jewish or Christian origin. They do not spring historically from the disciples of John the Baptist (Acts xviii. 25; xix. 3 seq.; *Recog. Clem.* i. 54); the tradition in which he and the Jordan figure so largely is not original, and is therefore worthless; at the same time it is true that their baptismal praxis and its interpretation place them in the same religious group with the Hemerobaptists of Eusebius (*H. E.* iv. 22) and Epiphanius (*Haer.*, xvii.), or with the sect of disciples of John who remained apart from Christianity. Their reverence for John is of a piece with their whole syncretizing attitude towards the New Testament. Indeed, as has been seen, they appropriate the entire personale of the Bible from Adam, Seth, Abel, Enos and Pharaoh to Jesus and John, a phenomenon which bears witness to the close relations of the Mandaean doctrine both with Judaism and Christianity—not the less close because they were relations of hostility. The history of religion presents other examples of the degradation of holy to demonic figures on occasion of religious schism. The use of the word "Jordan," even in the plural, for "sacred water," is precisely similar to that by the Naassenes described in the *Philosophumena* (v. 7); there ὁ μέγας Ἰορδάνης denotes the spiritualizing sanctifying fluid which pervades the world of light. The notions of the Egyptians and the Red Sea, according to the same work (v. 16), are used by the Peratae much as by the Mandaeans. And the position assigned by the Sethians (Σηθιανοί) to Seth is precisely similar to that given by the Mandaeans to Abel. Both alike are merely old Babylonian divinities in a new Biblical garb. The genesis of Mandaeism and the older gnosis from the old and elaborate Babylonio-Chaldaean religion is clearly seen also in the fact that the names of the old pantheon (as for example those of the planetary divinities) are retained, but their holders degraded to the position of demons—a conclusion confirmed by the fact that the Mandaeans, like the allied Ophites, Peratae and Manichaeans, certainly have their original seat in Mesopotamia and Babylonia. It seems clear that the trinity of Anu, Bel, and Ea in the old Babylonian religion has its counterpart in the Mandaean Pīrā, Ayar, and Mānā rabbā. The D'mūthā of Mānā is the Damkina, the wife of Ea, mentioned by Damascius as Δαύκη, wife of Ἀός. Mandā d'hayyē and his image Hibil Zīvā with his incarnations clearly correspond to the old Babylonian Marduk, Merodach, the "first-born" son of Ea, with his incarnations, the chief divinity of the city of Babylon, the mediator and redeemer in the old religion. Hibil's contest with darkness has its prototype in Marduk's battle with chaos, the dragon Tiamat, which (another striking parallel) partially swallows Marduk, just as is related of Hibil and the Manichaean primal man. Other features are borrowed by the Mandaean mythology under this head from the well-known epos of Istar's *descensus ad inferos*. The sanctity with which water is invested by the Mandaeans is to be explained by the fact that Ea has his seat "in the depths of the world sea."

Cf. K. Kessler's article, "Mandäer," in Herzog-Hauck's *Realencyklopädie*, and the same author's paper, "Ueber Gnosis u. altbabylonische Religion," in the *Abhandh. d. fünften internationalen Orientalisten-congresses zu Berlin* (Berlin, 1882); also W. Brandt's *Mandäische Religion* (Leipzig, 1889), and M. N. Siouffi's *Études sur la religion des Soubbas* (Paris, 1880). (K. K.; G. W. T.)

MANDALAY, formerly the capital of independent Burma, now the headquarters of the Mandalay division and district, as well as the chief town in Upper Burma, stands on the left bank of the Irrawaddy, in 21° 59′ N. and 96° 8′ E. Its height above mean sea-level is 315 ft. Mandalay was built in 1856–1857 by King Mindōn. It is now divided into the municipal area and the cantonment. The town covers an area of 6 m. from north to south and 3 from east to west, and has well-metalled roads lined with avenues of trees and regularly lighted and watered. The cantonment consists of the area inside the old city walls, and is now called Fort Dufferin. In the centre stands the palace, a group of wooden buildings, many of them highly carved and gilt, resting on a brick platform 900 ft. by 500 ft., and 6 ft. high. The greater part of it is now utilized for military and other offices. The garrison consists of a brigade belonging to the Burma command of the Indian army. There are many fine pagodas and monastic buildings in the town. The population in 1901 was 183,816, showing a decrease of 3% in the decade. The population is very mixed. Besides Burmese there are Zerbadis (the offspring of a Mahommedan with a Burman wife), Mahommedans, Hindus, Jews, Chinese, Shans and Manipuris (called Kathe), Kachins and Palaungs. Trains run from Mandalay to Rangoon, Myit-kyina, and up the Mandalay–Kunlong railway. The steamers of the Irrawaddy Flotilla Company also ply in all directions. There are twenty bazaars, the chief of which, the Zegyo, was burnt in 1897, and again in 1906, but rebuilt.

The MANDALAY DISTRICT has an area of 2117 sq. m. and a population (1901) of 366,507, giving a density of 177 inhabitants to the square mile. About 600 sq. m. along the Irrawaddy river are flat land, nearly all cultivated. In the north and east there are some 1500 sq m. of high hills and table-lands, forming geographically a portion of the Shan table-land. Here the fall to the plains averages 3000 to 4000 ft. in a distance of 10 m. This part of the district is well wooded and watered. The Maymyo subdivision has very fine plateaus of 3000 to 3600 ft. in height. The highest peaks are between 4000 and 5000 ft. above sea-level. The Irrawaddy, the Myit-ngè and the Madaya are the chief rivers. The last two come from the Shan States, and are navigable for between 20 and 30 m. There are many canals, most of which have fallen greatly into disrepair, and the Aungbinle, Nanda and Shwepyi lakes also supply water for cultivation. A systematic irrigation scheme has been undertaken by the government. The Sagyin hills near Madaya are noted for their alabaster; rubies are also found in small quantities. There are 335 sq. m. of forest reserves in the district, but there is little teak. The climate is dry and healthy. During May and June and till August strong winds prevail. The thermometer rises to about 107° in the shade in the hot weather, and the minimum in the month of December is about 55°. The rainfall is light, the average being under 30 in.

The Division includes the districts of Mandalay, Bhamo, Myitkyina, Katha and Ruby Mines, with a total area of 29,373 sq. m., and a population (1901) of 777,338, giving an average density of 30 inhabitants to the square mile. (J. G. Sc.)

MANDAMUS, WRIT OF, in English law, a high prerogative writ issuing from the High Court of Justice (named from the first word in the Latin form of the writ) containing a command in the name of the king, directed to inferior courts, corporations, or individuals, ordering them to do a specific act within the duty of their office, or which they are bound by statute to do, and performance whereof the applicant for the writ has a specific legal right to enforce. Direct orders from the sovereign to subjects commanding the performance of particular acts were common in early times, and to this class of orders *mandamus* originally belonged. It became customary for the court of king's bench, in cases where a legal duty was established but no sufficient means existed for enforcing it, to order performance by this writ. Under the Judicature Acts and the *Crown Office Rules*, 1906 (r. 49), the powers of the court of king's bench as to the grant of the prerogative writ of mandamus are exercisable only in the king's bench division of the High Court.

The writ though of right is not of course: *i.e.* the applicant cannot have it merely for the asking, but must satisfy the High Court that circumstances exist calling for its issue. The procedure regulating the grant and enforcement of the writ is determined by the *Crown Office Rules*, 1906 (rr. 49–68, 125).

Mandamus has always been regarded as an exceptional remedy to supplement the deficiencies of the common law, or defects of justice. Where another legal or equitable remedy exists, equally appropriate, convenient, speedy, beneficial and effectual, the writ will as a rule be refused. It is occasionally granted even when a remedy by indictment is available: but is not issued unless the existence of the duty and refusal to perform it are clearly established, nor where performance in fact has become impossible. The writ is used to compel inferior courts to hear and determine according to law cases within their jurisdiction, *e.g.* where a county court or justices in petty or quarter sessions refuse to assume a jurisdiction which they possess to deal with a matter brought before them. It has in recent years been employed to compel municipal bodies to discharge their duties as to providing proper sewerage for their districts and to compel anti-vaccinationist guardians of the poor to appoint officers for the execution of the Vaccination Acts; and it is also employed to compel the promoters of railway and similar undertakings to discharge duties imposed upon them towards the public by their special acts, *e.g.* with reference to highways, &c., affected by their railways or other undertakings. The courts do not prescribe the specific manner in which the duty is to be discharged, but do not stay their hands until substantial compliance is established.

Besides the prerogative common-law writ there are a number of orders, made by the High Court under statutory authority, and described as or as being in the nature of mandamus, *e.g.* mandamus to proceed to the election of a corporate officer of a municipal corporation (Municipal Corporations Act 1882, s. 225); orders in the nature of mandamus to justices to hear and determine a matter within their jurisdiction, or to state and sign a case under the enactments relating to special cases.

At common law mandamus lies only for the performance of acts of a public or official character. The enforcement of merely private obligations, such as those arising from contracts, is not within its scope. By s. 68 of the Common Law Procedure Act 1854, the plaintiff in any action other than replevin and ejectment was empowered to claim a writ of mandamus to compel the defendant to fulfil any duty in the fulfilment of which the plaintiff was personally interested. By s. 25 (8) of the Judicature Act 1873 a mandamus may be granted by an interlocutory order of the High Court in all cases in which it shall appear to the court just or convenient that such an order should be made. This enactment does not deal with the prerogative mandamus but empowers the king's bench and the chancery divisions to grant an interlocutory mandamus in any pending cause or matter by an order other than the final judgment and even by an order made after the judgment. S. 68 of the act of 1854 has been repealed and replaced by Order LIII. of the *Rules of the Supreme Court*. The remedy thus created is an attempt to engraft upon the old common law remedy by damages a right in the nature of specific performance of the duty in question. It is not limited to cases in which the prerogative writ would be granted; but mandamus is not granted when the result desired can be obtained by some remedy equally convenient, beneficial and effective, or a particular and different remedy is provided by statute. An action for mandamus does not lie against judicial officers such as justices. The mandamus issued in the action is no longer a writ of mandamus, but a judgment or order having effect equivalent to the writ formerly used.

Mandatory Injunction.—The High Court has a jurisdiction derived from the court of chancery to grant injunctions at the suit of the attorney-general or of private persons. Ordinarily these injunctions are in the form of prohibition or restraint and not of command. But occasionally mandatory injunctions are granted in the form of a direct command by the court.

Specific Performance.—The jurisdiction of the High Court, derived from the court of chancery, to decree specific performance of contracts has some resemblance to mandamus in the domains of public or quasi-public law.

Ireland.—The law of Ireland as to mandamus is derived from that of England, and differs therefrom only in minor details.

British Possessions.—In a British possession the power to issue the prerogative writ is usually vested in the Supreme Court by its charter or by local legislation.

United States.—The writ has passed into the law of the United States. "There is in the federal judiciary an employment of the writ substantially as the old prerogative writ in the king's bench practice, also as a mode of exercising appellate jurisdiction, also as a proceeding ancillary to a judgment previously rendered, in exercise of original jurisdiction, as when a circuit court having rendered a judgment against a county issues a mandamus requiring its officers to levy a tax to provide for the payment of the judgment." And in the various states mandamus is used under varying regulations, mandate being in some cases substituted as the name of the proceeding.

MANDAN, a tribe of North American Indians of Siouan stock. When first met they were living on the Missouri at the mouth of the Heart river. At the beginning of the 19th century they were driven up the Missouri by the Sioux. In 1845 they joined the Gros Ventres and later the Arikaras, and settled in their present position at Fort Berthold reservation, North Dakota. The Mandans have always been agricultural; they are noted for their ceremonies, and from the tattooing on face and breast were described in the sign language as "the tattooed people."

MANDARIN, the common name for all public officials in China, the Chinese name for whom is *kwan* or *kwūn*. The word comes through the Portuguese from Malay *mantri*, a counsellor or minister of state. The ultimate origin of this word is the Sanskrit root *man-*, meaning to "think," seen in "man," "mind," &c. The term "mandarin" is not, in its western usage, applied indiscriminately to all civil and military officials, but only to those who are entitled to wear a "button," which is a spherical knob, about an inch in diameter, affixed to the top of the official cap or hat. These officials, civil and military alike, are divided into nine grades or classes, each grade being distinguished by a button of a particular colour. The grade to which an official belongs is not necessarily related to the office he holds. The button which distinguishes the first grade is a transparent red stone; the second grade, a red coral button; the third, a sapphire; the fourth, a blue opaque stone; the fifth, a crystal button; the sixth, an opaque white shell button; the seventh, a plain gold button; the eighth, a worked gold button; and the ninth, a worked silver button. The mandarins also wear certain insignia embroidered on their official robes, and have girdle clasps of different material. The first grade have, for civilians an embroidered Manchurian crane on the breast and back, for the military an embroidered unicorn with a girdle clasp of jade set in rubies. The second grade, for civilians an embroidered golden pheasant, for the military a lion with a girdle clasp of gold set in rubies. The third grade, for civilians a peacock, for the military a leopard with a clasp of worked gold. The fourth grade, for civilians a wild goose, for the military a tiger, and a clasp of worked gold with a silver button. The fifth grade, for civilians a silver pheasant, for the military a bear and a clasp of plain gold with a silver button. The sixth grade, for civilians an egret, for the military a tiger-cat with a mother-of-pearl clasp. The seventh grade, for civilians a mandarin duck, for the military a mottled bear with a silver clasp. The eighth grade, for civilians a quail, for the military a seal with a clear horn clasp. The ninth grade, for civilians a long-tailed jay, for the military a rhinoceros with a buffalo-horn clasp.

The "mandarin language" is the Chinese, which is spoken in official and legal circles; it is also spoken over a considerable portion of the country, particularly the northern and central parts, though not perhaps with the same purity. Mandarin duck (*anas galericulata*) and Mandarin orange (*citrus nobilis*) possibly derive their names, by analogy, from the sense of superiority implied in the title "mandarin."

See *Society in China*, by Sir R. K. Douglas; *L'Empire du milieu*, by E. and O. Reclus.

MANDASOR, or MANDSAUR, a town of Central India, in the native state of Gwalior, on the Rajputana railway, 31 m. S. of Neemuch. Pop. (1901), 20,936. It gave its name to the treaty with Holkar, which concluded the Mahratta-Pindari War in 1818. It is a centre of the Malwa opium trade.

Mandasor and its neighbourhood are full of archaeological interest. An inscription discovered near the town indicated the erection of a temple of the sun in 437, and at Sondani are two great monolith pillars recording a victory of Yasodharma, king of Malwa, in 528. The fort dates from the 14th and 15th centuries. Hindu and Jain remains are numerous, though the town is now entirely Mahommedan.

MANDATE (*Mandatum*), a contract in Roman law constituted by one person (the *mandatarius*) promising to do something gratuitously at the request of another (the *mandator*), who undertakes to indemnify him against loss. The jurist distinguished the different cases of mandatum according as the object of the contract was the benefit of the mandator or a third person singly, or the mandator and a third person, the mandator and the mandatarius, or the mandatarius and a third person together. When the benefit was that of the mandatarius alone, the obligations of the contract were held not to arise, although the form of the contract might exist, the commission being held to be merely advice tendered to the mandatarius, and acted on by him at his own risk. Mandatum was classified as one of the contracts established by consent of the parties alone; but, as there was really no obligation of any kind until the mandatarius had acted on the mandate, it has with more propriety been referred to the contracts created by the supply of some fact (*re*). The obligations of the mandatarius under the contract were, briefly, to do what he had promised according to his instructions, observing ordinary diligence in taking care of any property entrusted to him, and handing over to his principal the results of his action, including the right to sue in his name. On the other hand, the principal was bound to recoup him his expenses and indemnify him against loss through obligations he might have incurred.

The essentials and the terminology of the contract are preserved in most modern systems of law. But in English law mandate, under that name, can hardly be said to exist as a separate form of contract. To some extent the law of mandatum corresponds partly to the law of principal and agent, partly to that of principal and surety. "Mandate" is retained to signify the contract more generally known as gratuitous bailment. It is restricted to personal property, and it implies the delivery of something to the bailee, both of which conditions are unknown in the mandatum of the civil law (see BAILMENT).

MANDAUE, a town of the province of Cebú, island of Cebú, Philippine Islands, on the E. coast and E. coast road, about 4 m. N.E. of the town of Cebú, the capital. Pop. (1903), 11,078; in the same year the town of Consolación (pop. 5511) was merged with Mandaue. Its climate is very hot, but healthy. The principal industries are the raising of Indian corn and sugar-cane and the manufacture of salt from sea-water. Cebú-Visayan is the language.

MANDELIC ACID (Phenylglycollic Acid), $C_8H_8O_3$ or $C_6H_5{\cdot}CH(OH){\cdot}COOH$, an isomer of the cresotinic and the oxymethylbenzoic acids. Since the molecule contains an asymmetric carbon atom, the acid exists in three forms, one being an inactive "racemic" mixture, and the other two being optically active forms. The inactive variety is known as *paramandelic acid*. It may be prepared by the action of hydrochloric acid on the addition compound of benzaldehyde and hydrocyanic acid:—

$$C_6H_5CHO + HCN + HCl + 2H_2O = C_6H_5{\cdot}CHOH{\cdot}COOH + NH_4Cl,$$

(F. L. Winckler, *Ann.*, 1836, 18, 310), by boiling phenylchloracetic acid with alkalis (A. Spiegel, *Ber.*, 1881, 14, 239), by heating benzoylformaldehyde with alkalis (H. v. Pechmann, *Ber.*, 1887, 20, 2905), and by the action of dilute alkalies on ω-dibromacetophenone (C. Engler, *Ber.*, 1887, 20, 2202):—

$$C_6H_5COCHBr_2 + 3KHO = 2KBr + H_2O + C_6H_5{\cdot}CHOH{\cdot}CO_2K.$$

It crystallizes from water in large rhombic crystals, which melt at 118° C. Oxidizing agents convert it into benzaldehyde. When heated with hydriodic acid and phosphorus it forms phenylacetic acid; whilst concentrated hydrobromic acid and hydrochloric acid at moderate temperatures convert it into phenylbrom- and phenylchlor-acetic acids. The inactive mixture may be resolved into its active components by fractional crystallization of the cinchonine salt, when the salt of the *dextro* modification separates first; or the ammonium salt may be fermented by *Penicillium glaucum*, when the *laevo* form is destroyed and the *dextro* form remains untouched; on the other hand, *Saccharomyces ellipsoïdeus* destroys the *dextro* form, but does not touch the *laevo* form. A mixture of the two forms in equivalent quantities produces the inactive variety, which is also obtained when either form is heated for some hours to 160° C.

MANDER, CAREL VAN (1548–1606), Dutch painter, poet and biographer, was born of a noble family at Meulebeke. He studied under Lucas de Heere at Ghent, and in 1568–1569 under Pieter Vlerick at Kortryck. The next five years he devoted to the writing of religious plays for which he also painted the scenery. Then followed three years in Rome (1574–1577), where he is said to have been the first to discover the catacombs. On his return journey he passed through Vienna, where, together with the sculptor Hans Mont, he made the triumphal arch for the entry of the emperor Rudolph. After many vicissitudes caused by war, loss of fortune and plague, he settled at Haarlem where, in conjunction with Goltzius and Cornelisz, he founded a successful academy of painting. His fame is, however, principally based upon a voluminous biographical work on the paintings of various epochs—a book that has become for the northern countries what Vasari's *Lives of the Painters* became for Italy. It was completed in 1603 and published in 1604, in which year Van Mander removed to Amsterdam, where he died in 1606.

MANDEVILLE, BERNARD DE (1670–1733), English philosopher and satirist, was born at Dordrecht, where his father practised as a physician. On leaving the Erasmus school at Rotterdam he gave proof of his ability by an *Oratio scholastica de medicina* (1685), and at Leiden University in 1689 he maintained a thesis *De brutorum operationibus*, in which he advocated the Cartesian theory of automatism among animals. In 1691 he took his medical degree, pronouncing an "inaugural disputation," *De chylosi viliata*. Afterwards he came to England "to learn the language," and succeeded so remarkably that many refused to believe he was a foreigner. As a physician he seems to have done little, and lived poorly on a pension given him by some Dutch merchants and money which he earned from distillers for advocating the use of spirits. His conversational abilities won him the friendship of Lord Macclesfield (chief justice 1710–1718) who introduced him to Addison, described by Mandeville as "a parson in a tye-wig." He died in January (19th or 21st) 1733/4 at Hackney.

The work by which he is known is the *Fable of the Bees*, published first in 1705 under the title of *The Grumbling Hive, or Knaves Turn'd Honest* (two hundred doggerel couplets). In 1714 it was republished anonymously with *Remarks* and *An Enquiry into the Origin of Moral Virtue*. In 1723 a later edition appeared, including *An Essay on Charity and Charity Schools*, and *A Search into the Nature of Society*. The book was primarily written as a political satire on the state of England in 1705, when the Tories were accusing Marlborough and the ministry of advocating the French War for personal reasons. The edition of 1723 was presented as a nuisance by the Grand Jury of Middlesex, was denounced in the *London Journal* by "Theophilus Philo-Britannus," and attacked by many writers, notably by Archibald Campbell (1691–1756) in his *Aretelogia* (published as his own by Alexander Innes in 1728; afterwards by Campbell, under his own name, in 1733, as *Enquiry into the Original of Moral Virtue*). The *Fable* was reprinted in 1729, a ninth edition appeared in 1755, and it has often been reprinted in more recent times. Berkeley attacked it in the second dialogue of the *Alciphron* (1732) and John Brown criticized him in his *Essay upon Shaftesbury's Characteristics* (1751).

Mandeville's philosophy gave great offence at the time, and has always been stigmatized as false, cynical and degrading. His main thesis is that the actions of men cannot be divided into lower and higher. The higher life of man is merely a fiction introduced by philosophers and rulers to simplify government and the relations of society. In fact, virtue (which he defined as "every performance by which man, contrary to the impulse of nature, should endeavour the benefit of others, or the conquest of his own passions, out of a rational ambition of being good") is actually detrimental to the state in its commercial and intellectual progress, for it is the vices (*i.e.* the self-regarding actions of men) which alone, by means of inventions and the circulation of capital in connexion with luxurious living, stimulate society into action and progress. In the *Fable* he shows a society possessed of all the virtues "blest with content and honesty," falling into apathy and utterly paralyzed. The absence of self-love (cf. Hobbes) is the death of progress. The so-called higher virtues are mere hypocrisy, and arise from the selfish desire to be superior to the brutes. "The moral virtues are the political offspring which flattery begot upon pride." Similarly he arrives at the great paradox that "private vices are public benefits." But his best work and that in which he approximates most nearly to modern views is his account of the origin of society. His *a priori* theories should be compared with Maine's historical inquiries (*Ancient Law*, c. V.). He endeavours to show that all social laws are the crystallized results of selfish aggrandizement and protective alliances among the weak. Denying any form of moral sense or conscience, he regards all the social virtues as evolved from the instinct for self-preservation, the give-and-take arrangements between the partners in a defensive and offensive alliance, and the feelings of pride and vanity artificially fed by politicians, as an antidote to dissension and chaos. Mandeville's ironical paradoxes are interesting mainly as a criticism of the "amiable" idealism of Shaftesbury, and in comparison with the serious egoistic systems of Hobbes and Helvetius. It is mere prejudice to deny that Mandeville had considerable philosophic insight; at the same time he was mainly negative or critical, and, as he himself said, he was writing for "the entertainment of people of knowledge and education." He may be said to have cleared the ground for the coming utilitarianism.

WORKS.—*Typhon: a Burlesque Poem* (1704); *Aesop Dress'd, or a Collection of Fables writ in Familiar Verse* (1704); *The Planter's Charity* (1704); *The Virgin Unmasked* (1709, 1724, 1731, 1742), a work in which the coarser side of his nature is prominent; *Treatise of the Hypochondriack and Hysterick Passions* (1711, 1715, 1730) admired by Johnson (Mandeville here protests against merely speculative therapeutics, and advances fanciful theories of his own about animal spirits in connexion with "stomachic ferment"; he shows a knowledge of Locke's methods, and an admiration for Sydenham); *Free Thoughts on Religion* (1720); *A Conference about Whoring* (1725); *An Enquiry into the Causes of the Frequent Executions at Tyburn* (1725); *The Origin of Honour and the Usefulness of Christianity in War* (1732). Other works attributed, wrongly, to him are *A Modest Defence of Public Stews* (1724); *The World Unmasked* (1736) and *Zoologia medicinalis hibernica* (1744).

See Hill's *Boswell*, iii. 291–293; L. Stephen's *English Thought in the Eighteenth Century*; A. Bain's *Moral Science* (593–598); Windelband's *History of Ethics* (Eng. trans. Tufts); J. M. Robertson, *Pioneer Humanists* (1907); P. Sakmann, *Bernard de Mandeville und die Bienenfabel-Controverse* (Freiburg i/Br., 1897), and compare articles ETHICS, SHAFTESBURY, HOBBES. (J. M. M.).

MANDEVILLE, GEOFFREY DE (d. 1144), earl of Essex, succeeded his father, William, as constable of the Tower of London in or shortly before 1130. Though a great Essex landowner, he played no conspicuous part in history till 1140, when Stephen created him earl of Essex in reward for his services against the empress Matilda. After the defeat and capture of Stephen at Lincoln (1141) the earl deserted to Matilda, but before the end of the year, learning that Stephen's release was imminent, returned to his original allegiance. In 1142 he was again intriguing with the empress; but before he could openly join her cause he was detected and deprived of his castles by the king. In 1143–1144 Geoffrey maintained himself as a rebel and a bandit in the fen-country, using the Isle of Ely and Ramsey Abbey as his headquarters. He was besieged by Stephen in the fens, and met his death in September 1144 in consequence of a wound received in a skirmish. His career is interesting for two reasons. The charters which he extorted from Stephen and Matilda illustrate the peculiar form taken by the ambitions of English feudatories. The most important concessions are grants of offices and jurisdictions which had the effect of making Mandeville a viceroy with full powers in Essex, Middlesex and London, and Hertfordshire. His career as an outlaw exemplifies the worst excesses of the anarchy which prevailed in some parts of England during the civil wars of 1140–1147, and it is probable that the deeds of Mandeville inspired the rhetorical description, in the Peterborough Chronicle of this period, when "men said openly that Christ and his saints were asleep."

See J. H. Round, *Geoffrey de Mandeville, a Study of the Anarchy* (London, 1892). (H. W. C. D.)

MANDEVILLE, JEHAN DE ("Sir John Mandeville"), the name claimed by the compiler of a singular book of travels, written in French, and published between 1357 and 1371. By aid of translations into many other languages it acquired extraordinary popularity, while a few interpolated words in a particular edition of an English version gained for Mandeville in modern times the spurious credit of being "the father of English prose."

In his preface the compiler calls himself a knight, and states that he was born and bred in England, of the town of St Albans; had crossed the sea on Michaelmas Day 1322; had travelled by way of Turkey (Asia Minor), Armenia the little (Cilicia) and the great, Tartary, Persia, Syria, Arabia, Egypt upper and lower, Libya, great part of Ethiopia, Chaldaea, Amazonia, India the less, the greater and the middle, and many countries about India; had often been to Jerusalem, and had written in Romance as more generally understood than Latin. In the body of the work we hear that he had been at Paris and Constantinople; had served the sultan of Egypt a long time in his wars against the Bedawin, had been vainly offered by him a princely marriage and a great estate on condition of renouncing Christianity, and had left Egypt under sultan Melech Madabron, *i.e.* Muzaffar or Mudhaffar[1] (who reigned in 1346–1347); had been at Mount Sinai, and had visited the Holy Land with letters under the great seal of the sultan, which gave him extraordinary facilities; had been in Russia, Livonia, Cracow, Lithuania, "en roialme daresten" (? de Daresten or Silistria), and many other parts near Tartary, but not in Tartary itself; had drunk of the well of youth at Polombe (Quilon on the Malabar coast), and still seemed to feel the better; had taken astronomical observations on the way to Lamory (Sumatra), as well as in Brabant, Germany, Bohemia and still farther north; had been at an isle called Pathen in the Indian Ocean; had been at Cansay (Hangchow-fu) in China, and had served the emperor of China fifteen months against the king of Manzi; had been among rocks of adamant in the Indian Ocean; had been through a haunted valley, which he places near "Milstorak" (*i.e.* Malasgird in Armenia); had been driven home against his will in 1357 by arthritic gout; and had written his book as a consolation for his "wretched rest." The paragraph which states that he had had his book confirmed at Rome by the pope is an interpolation of the English version.

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[1] The *on* in Madabron apparently represents the Arabic nunation, though its use in such a case is very odd.

Part at least of the personal history of Mandeville is mere invention. Nor is any contemporary corroboration of the existence of such a Jehan de Mandeville known. Some French MSS., not contemporary, give a Latin letter of presentation from him to Edward III., but so vague that it might have been penned by any writer on any subject. It is in fact beyond reasonable doubt that the travels were in large part compiled by a Liége physician, known as Johains à le Barbe or Jehan à la Barbe, otherwise Jehan de Bourgogne.

The evidence of this is in a modernized extract quoted by the Liége herald, Louis Abry[1] (1643–1720), from the lost fourth book of the *Myreur des Hystors* of Johans des Preis, styled d'Oultremouse. In this "Jean de Bourgogne, dit à la Barbe," is said to have revealed himself on his deathbed to d'Oultremouse, whom he made his executor, and to have described himself in his will as "messire Jean de Mandeville, chevalier, comte de Montfort en Angleterre et seigneur de l'isle de Campdi et du château Pérouse." It is added that, having had the misfortune to kill an unnamed count in his own country, he engaged himself to travel through the three parts of the world, arrived at Liége in 1343, was a great naturalist, profound philosopher and astrologer, and had a remarkable knowledge of physic. And the identification is confirmed by the fact that in the now destroyed church of the Guillelmins was a tombstone of Mandeville, with a Latin inscription stating that he was otherwise named "ad Barbam," was a professor of medicine, and died at Liége on the 17th of November 1372: this inscription is quoted as far back as 1462.

Even before his death the Liége physician seems to have confessed to a share in the composition of the work. In the common Latin abridged version of it, at the end of c. vii., the author says that when stopping in the sultan's court at Cairo he met a venerable and expert physician of "our" parts, that they rarely came into conversation because their duties were of a different kind, but that long afterwards at Liége he composed this treatise at the exhortation and with the help (*hortatu et adiutorio*) of the same venerable man, as he will narrate at the end of it. And in the last chapter he says that in 1355, in returning home, he came to Liége, and being laid up with old age and arthritic gout in the street called Bassesauenyr, *i.e.* Basse Savenir, consulted the physicians. That one came in who was more venerable than the others by reason of his age and white hairs, was evidently expert in his art, and was commonly called Magister Iohannes ad Barbam. That a chance remark of the latter caused the renewal of their old Cairo acquaintance, and that Ad Barbam, after showing his medical skill on Mandeville, urgently begged him to write his travels; "and so at length, by his advice and help, *monitu et adiutorio,* was composed this treatise, of which I had certainly proposed to write nothing until at least I had reached my own parts in England." He goes on to speak of himself as being now lodged in Liége, "which is only two days distant from the sea of England"; and it is stated in the colophon (and in the MSS.) that the book was first published in French by Mandeville, its author, in 1355, at Liége, and soon after in the same city translated into "the said" Latin form. Moreover, a MS. of the French text extant at Liége about 1860[2] contained a similar statement, and added that the author lodged at a hostel called "al hoste Henkin Levo": this MS. gave the physician's name as "Johains de Bourgogne dit ale barbe," which doubtless conveys its local form.

There is no contemporary English mention of any English knight named Jehan de Mandeville, nor are the arms said to have been on the Liége tomb like any known Mandeville arms. But Dr G. F. Warner has ingeniously suggested that de Bourgogne may be a certain Johan de Bourgoyne, who was pardoned by parliament on the 20th of August 1321 for having taken part in the attack on the Despensers, but whose pardon was revoked in May 1322, the year in which "Mandeville" professes to have left England. And it should now be added that among the persons similarly pardoned *on the recommendation of the same nobleman* was a Johan Mangevilayn, whose name appears closely related to that of "de Mandeville"[3]—which is merely a later form of "de Magneville."

Mangeuilain occurs in Yorkshire as early as 16 Hen. I. (*Pipe Roll Soc.*, xv. 40), but is very rare, and (failing evidence of any place named Mangeville) seems to be merely a variant spelling of Magnevillain. The meaning may be simply "of Magneville," *de* Magneville; but the family of a 14th century bishop of Nevers were called both "Mandevilain" and "de Mandevilain"—where Mandevilain seems a derivative place-name, meaning the Magneville or Mandeville district. In any case it is clear that the name "de Mandeville" might be suggested to de Bourgogne by that of his fellow-culprit Mangevilayn, and it is even possible that the two fled to England together, were in Egypt together, met again at Liége, and shared in the compilation of the *Travels.*

Whether after the appearance of the *Travels* either de Bourgogne or "Mangevilayn" visited England is very doubtful. St Albans Abbey had a sapphire ring, and Canterbury a crystal orb, said to have been given by Mandeville; but these might have been sent from Liége, and it will appear later that the Liége physician possessed and wrote about precious stones. St Albans also had a legend that a ruined marble tomb of Mandeville (represented cross-legged and in armour, with sword and shield) once stood in the abbey; this may be true of "Mangevilayn" or it may be a mere myth.

It is a little curious that the name preceding Mangevilayn in the list of persons pardoned is "Johan le Barber." Did this suggest to de Bourgogne the *alias* "à le Barbe," or was that only a Liége nickname? Note also that the arms on Mandeville's tomb were borne by the Tyrrells of Hertfordshire (the county in which St Albans lies); for of course the crescent on the lion's breast is only the "difference" indicating a second son.

Leaving this question, there remains the equally complex one whether the book contains any facts and knowledge acquired by actual travels and residence in the East. Possibly it may, but only as a small portion of the section which treats of the Holy Land and the ways of getting thither, of Egypt, and in general of the Levant. The prologue, indeed, points almost exclusively to the Holy Land as the subject of the work. The mention of more distant regions comes in only towards the end of this prologue, and (in a manner) as an afterthought.

By far the greater part of these more distant travels, extending in fact from Trebizond to Hormuz, India, the Malay Archipelago, and China, and back again to western Asia, has been appropriated from the narrative of Friar Odoric (written in 1330). These passages, as served up by Mandeville, are almost always, indeed, swollen with interpolated particulars, usually of an extravagant kind, whilst in no few cases the writer has failed to understand the passages which he adopts from Odoric and professes to give as his own experiences. Thus (p. 209),[4] where Odoric has given a most curious and veracious account of the Chinese custom of employing tame cormorants to catch fish, the cormorants are converted by Mandeville into "little beasts called *loyres* (*layre*, B), which are taught to go into the water" (the word *loyre* being apparently used here for "otter," *lutra*, for which the Provençal is *luria* or *loiria*).

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[1] Quoted again from him by the contemporary Liége herald, Lefort, and from Lefort in 1866 by Dr S. Bormans. Dr J. Vogels communicated it in 1884 to Mr E. W. B. Nicholson, who wrote on it in the *Academy* of April 12, 1884.

[2] See Dr G. F. Warner's edition (Roxburghe Club), p. 38. In the *Bull. de l'Institut archéologique Liégeois*, iv. (1860), p. 171, M. Ferd. Henaux quotes the passage from "MSS. de la Bibliothèque publique de Liége, à l'Université, no. 360, fol. 118," but the MS. is not in the 1875 printed catalogue of the University Library, which has no Old French MS. of Mandeville at present. It was probably lent out and not returned.

[3] The de Mandevilles, earls of Essex, were originally styled de Magneville, and Leland, in his *Comm. de Script. Britt.* (CDV), calls our Mandeville himself "Joannes Magnovillanus, alias Mandeville."

[4] Page indications like this refer to passages in the 1866 reissue of Halliwell's edition, as being probably the most ready of access.

At a very early date the coincidence of Mandeville's stories with those of Odoric was recognized, insomuch that a MS. of Odoric which is or was in the chapter library at Mainz begins with the words: *Incipit Itinerarius fidelis fratris Odorici socii Militis Mendavil per Indian; licet hic* [read *ille*] *prius et alter posterius peregrinationem suam descripsit.* At a later day Sir T. Herbert calls Odoric "travelling companion of our Sir John"; and Purchas, with most perverse injustice, whilst calling Mandeville, next to Polo, "if next . . . the greatest Asian traveller that ever the world had," insinuates that Odoric's story was stolen from Mandeville's. Mandeville himself is crafty enough, at least in one passage, to anticipate criticism by suggesting the probability of his having travelled with Odoric (see p. 282 and below).

Much, again, of Mandeville's matter, particularly in Asiatic geography and history, is taken bodily from the *Historiae Orientis* of Hetoum, an Armenian of princely family, who became a monk of the Praemonstrant order, and in 1307 dictated this work on the East, in the French tongue at Poitiers, out of his own extraordinary acquaintance with Asia and its history in his own time.

It is curious that no passage in Mandeville can be plausibly traced to Marco Polo, with one exception. This is (p. 163) where he states that at Hormuz the people during the great heat lie in water—a circumstance mentioned by Polo, though not by Odoric. We should suppose it most likely that this fact had been interpolated in the copy of Odoric used by Mandeville; for if he had borrowed it direct from Polo he would have borrowed more.

A good deal about the manners and customs of the Tatars is demonstrably derived from the famous work of the Franciscan Ioannes de Plano Carpini, who went as the pope's ambassador to the Tatars in 1245–1247; but Dr Warner considers that the immediate source for Mandeville was the *Speculum historiale* of Vincent de Beauvais. Though the passages in question are all to be found in Plano Carpini more or less exactly, the expression is condensed and the order changed. For examples compare Mandeville, p. 250, on the tasks done by Tatar women, with Plano Carpini, p. 643;[1] Mandeville, p. 250, on Tatar habits of eating, with Plano Carpini, pp. 639–640; Mandeville, p. 231, on the titles borne on the seals of the Great Khan, with Plano Carpini, p. 715, &c.

The account of Prester John is taken from the famous *Epistle* of that imaginary potentate, which was so widely diffused in the 13th century, and created that renown which made it incumbent on every traveller in Asia to find some new tale to tell of him. Many fabulous stories, again, of monsters, such as cyclopes, sciapodes, hippopodes, monoscelides, anthropophagi, and men whose heads did grow beneath their shoulders, of the phoenix and the weeping crocodile, such as Pliny has collected, are introduced here and there, derived no doubt from him, Solinus, the bestiaries, or the *Speculum naturale* of Vincent de Beauvais. And interspersed, especially in the chapters about the Levant, are the stories and legends that were retailed to every pilgrim, such as the legend of Seth and the grains of paradise from which grew the wood of the cross, that of the shooting of old Cain by Lamech, that of the castle of the sparrow-hawk (which appears in the tale of Melusina), those of the origin of the balsam plants at Maṭarīya, of the dragon of Cos, of the river Sabbation, &c.

But all these passages have also been verified as substantially occurring in Barrois's French MS. Nouv. Acq. Franç. 4515 in the Bibliothèque Nationale, Paris, mentioned below (of A.D. 1371), cited B, and in that numbered xxxix. of the Grenville collection (British Museum), which dates probably from the early part of the 15th century, cited G.

Even in that part of the book which might be supposed to represent some genuine experience there are the plainest traces that another work has been made use of, more or less—we might almost say as a framework to fill up. This is the itinerary of the German knight Wilhelm von Boldensele, written in 1336 at the desire of Cardinal Talleyrand de Perigord.[2] A cursory comparison of this with Mandeville leaves no doubt that the latter has followed its thread, though digressing on every side, and too often eliminating the singular good sense of the German traveller. We may indicate as examples Boldensele's account of Cyprus (Mandeville, p. 28 and p. 10), of Tyre and the coast of Palestine (Mandeville, 29, 30, 33, 34), of the journey from Gaza to Egypt (34), passages about Babylon of Egypt (40), about Mecca (42), the general account of Egypt (45), the pyramids (52), some of the wonders of Cairo, such as the slave-market, the chicken-hatching stoves, and the apples of paradise, *i.e.* plantains (49), the Red Sea (57), the convent on Sinai (58, 60), the account of the church of the Holy Sepulchre (74–76), &c. There is, indeed, only a small residuum of the book to which genuine character, as containing the experiences of the author, can possibly be attributed. Yet, as has been intimated, the borrowed stories are frequently claimed as such experiences. In addition to those already mentioned, he alleges that he had witnessed the curious exhibition of the garden of transmigrated souls (described by Odoric) at Cansay, *i.e.* Hangchow-fu (211). He and his fellows with their valets had remained fifteen months in service with the emperor of Cathay in his wars against the king of Manzi—Manzi, or Southern China, having ceased to be a separate kingdom some seventy years before the time referred to. But the most notable of these false statements occurs in his adoption from Odoric of the story of the Valley Perilous (282). This is, in its original form, apparently founded on real experiences of Odoric viewed through a haze of excitement and superstition. Mandeville, whilst swelling the wonders of the tale with a variety of extravagant touches, appears to safeguard himself from the reader's possible discovery that it was stolen by the interpolation: "And some of our fellows accorded to enter, and some not. So there were with us two worthy men, Friars Minor, that were of Lombardy, who said that if any man would enter they would go in with us. And when they had said so, upon the gracious trust of God and of them, we caused mass to be sung, and made every man to be shriven and houselled; and then we entered, fourteen persons; but at our going out we were but nine," &c.

In referring to this passage it is only fair to recognize that the description (though the suggestion of the greatest part exists in Odoric) displays a good deal of imaginative power; and there is much in the account of Christian's passage through the Valley of the Shadow of Death, in Bunyan's famous allegory, which indicates a possibility that John Bunyan may have read and remembered this episode either in Mandeville or in Hakluyt's Odoric.

Nor does it follow that the whole work is borrowed or fictitious. Even the great Moorish traveller Ibn Batuta, accurate and veracious in the main, seems—in one part at least of his narrative—to invent experiences; and in such works as those of Jan van Hees and Arnold von Harff we have examples of pilgrims to the Holy Land whose narratives begin apparently in sober truth, and gradually pass into flourishes of fiction and extravagance. So in Mandeville also we find particulars not yet traced to other writers, and which may therefore be provisionally assigned either to the writer's own experience or to knowledge acquired by colloquial intercourse in the East.

It is difficult to decide on the character of his statements as to recent Egyptian history. In his account of that country (pp. 37, 38) though the series of the Comanian (*i.e.* of the Bahri Mameluke) sultans is borrowed from Hetoum down to the accession of *Melechnasser*, *i.e.* Malik al-Nāṣir (Nāṣir ud-din Mahommed), who came first to the throne in 1293, Mandeville appears to speak from his own knowledge when he adds that this "*Melechnasser* reigned long and governed wisely." In fact, though twice displaced in the early part of his life, Malik Nāṣir reigned till 1341, a duration unparalleled in Mahommedan Egypt, whilst we are told that during the last thirty years of his reign Egypt rose to a high pitch of wealth and prosperity. Mandeville, however, then goes on to say that his eldest son, *Melechemader*, was chosen to succeed; but this prince was caused privily to be slain by his brother, who took the kingdom under the name of *Melechmadabron*. "And he was Soldan when I departed from those countries." Now Malik Nāṣir Mahommed was followed in succession by no less than eight of his sons in thirteen years, the first three of whom reigned in aggregate only a few months. The names mentioned by Mandeville appear to represent those of the fourth and sixth of the eight, viz. Ṣaliḥ ʿImād ud-din Ismāʿīl, and Moẓaffar (Saif ud-din Ḥajjī); and these the statements of Mandeville do not fit.

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[1] Viz. in D'Avezac's ed. in tom. iv. of *Rec. de voyages et de mémoires* pub. by the Soc. de Géog., 1839.

[2] It is found in the *Thesaurus* of Canisius (1604), v. pt. ii. p. 95, and in the ed. of the same by Basnage (1725), iv. 337.

On several occasions Arabic words are given, but are not always recognizable, owing perhaps to the carelessness of copyists in such matters. Thus, we find (p. 50) the names (not satisfactorily identified) of the wood, fruit and sap of the balsam plant; (p. 99) of bitumen, "alkatran" (*al-Kāṭrān*); (p. 168) of the three different kinds of pepper (long pepper, black pepper and white pepper) as *sorbotin*, *fulful* and *bano* or *bauo* (*fulful* is the common Arabic word for pepper; the others have not been satisfactorily explained). But these, and the particulars of his narrative for which no literary sources have yet been found, are too few to constitute a proof of personal experience.

Mandeville, again, in some passages shows a correct idea of the form of the earth, and of position in latitude ascertained by observation of the pole star; he knows that there are antipodes, and that if ships were sent on voyages of discovery they might sail round the world. And he tells a curious story, which he had heard in his youth, how a worthy man did travel ever eastward until he came to his own country again (p. 183). But he repeatedly asserts the old belief that Jerusalem was in the centre of the world (79, 183), and maintains in proof of this that at the equinox a spear planted erect in Jerusalem casts no shadow at noon, which, if true, would equally consist with the sphericity of the earth, provided that the city were on the equator.

The sources of the book, which include various authors besides those whom we have specified, have been laboriously investigated by Dr Albert Bovenschen[1] and Dr G. F. Warner,[2] and to them the reader must be referred for more detailed information on the subject.

The oldest known MS. of the original—once Barrois's, afterwards the earl of Ashburnham's, now Nouv. Acq. Franç. 4515 in the Bibliothèque Nationale, Paris—is dated 1371, but is nevertheless very inaccurate in proper names. An early printed Latin translation made from the French has been already quoted, but four others, unprinted, have been discovered by Dr J. Vogels.[3] They exist in eight MSS., of which seven are in Great Britain, while the eighth was copied by a monk of Abingdon; probably, therefore, all these unprinted translations were executed in this country. From one of them, according to Dr Vogels,[4] an English version was made which has never been printed and is now extant only in free abbreviations, contained in two 15th century MSS. in the Bodleian Library, Oxford—MS. e Museo 116, and MS. Rawlinson D. 99: the former, which is the better, is in Midland dialect, and may possibly have belonged to the Augustinian priory of St Osyth in Essex, while the latter is in Southern dialect.

The first English translation direct from the French was made (at least as early as the beginning of the 15th century) from a MS. of which many pages were lost.[5] Writing of the name Califfes (Khalif), the author says (*Roxburghe Club ed.*, p. 18) that it is *tant a dire come roi (s). Il y soleit auoir v. soudans*—"as much as to say king. There used to be 5 sultans." In the defective French MS. a page ended with *Il y so*; then came a gap, and the next page went on with part of the description of Mount Sinai, *Et est celle vallee mult froide* (ibid. p. 32). Consequently the corresponding English version has "That ys to say amonge hem *Roys Ils* and this vale ys ful colde"! All English printed texts before 1725, and Ashton's 1887 edition, follow these defective copies, and in only two known MSS. has the lacuna been detected and filled up.

One of them is the British Museum MS. Egerton 1982 (Northern dialect, about 1410–1420?), in which, according to Dr Vogels, the corresponding portion has been borrowed from that English version which had already been made from the Latin. The other is in the British Museum MS. Cotton Titus C. xvi. (Midland dialect, about 1410–1420?), representing a text completed, and revised throughout, from the French, though not by a competent hand. The Egerton text, edited by Dr G. F. Warner, has been printed by the Roxburghe Club, while the Cotton text, first printed in 1725 and 1727, is in modern reprints the current English version.

That none of the forms of the English version can be from the same hand which wrote the original is made patent by their glaring errors of translation, but the Cotton text asserts in the preface that it was made by Mandeville himself, and this assertion was till lately taken on trust by almost all modern historians of English literature. The words of the original "je eusse cest livret mis en latin . . . mais . . . je l'ay mis en rōmant" were mistranslated as if "je eusse" meant "I had" instead of "I should have," and then (whether of fraudulent intent or by the error of a copyist thinking to supply an accidental omission) the words were added "and translated it aȝen out of Frensche into Englyssche." Mätzner (*Altenglische Sprachproben*, I., ii., 154–155) seems to have been the first to show that the current English text cannot possibly have been made by Mandeville himself. Of the original French there is no satisfactory edition, but Dr Vogels has undertaken a critical text, and Dr Warner has added to his Egerton English text the French of a British Museum MS. with variants from three others.

It remains to mention certain other works bearing the name of Mandeville or de Bourgogne.

MS. Add. C. 280 in the Bodleian appends to the "Travels" a short French life of St Alban of *Germany*, the author of which calls himself John Mandivill[e], knight, formerly of the town of St Alban, and says he writes to correct an impression prevalent among his countrymen that there was no other saint of the name: this life is followed by part of a French herbal.

To Mandeville (by whom de Bourgogne is clearly meant) d'Oultremouse [6] ascribes a Latin "lappidaire selon l'oppinion des Indois," from which he quotes twelve passages, stating that the author (whom he calls knight, lord of Montfort, of Castelperouse, and of the isle of Campdi) had been "baillez en Alexandrie" seven years, and had been presented by a Saracen friend with some fine jewels which had passed into d'Oultremouse's own possession: of this *Lapidaire*, a French version, which seems to have been completed after 1479, has been several times printed.[7] A MS. of Mandeville's travels offered for sale in 1862 [8] is said to have been divided into five books: (1) the travels, (2) *de là forme de la terre et comment et par quelle manière elle fut faite*, (3) *de la forme del ciel*, (4) *des herbes selon les yndois et les philosophes par de là*, and (5) *ly lapidaire*—while the cataloguer supposed Mandeville to have been the author of a concluding piece entitled *La Venianche de nostre Signeur Ihesu-Crist fayte par Vespasian fil del empereur de Romme et comment Iozeph daramathye fu deliures de la prizon*. From the treatise on herbs a passage is quoted asserting it to have been composed in 1357 in honour of the author's natural lord, Edward, king of England. This date is corroborated by the title of king of Scotland given to Edward, who had received from Baliol the surrender of the crown and kingly dignity on the 20th of January 1356, but on the 3rd of October 1357 released King David and made peace with Scotland: unfortunately we are not told whether the treatise contains the author's name, and, if so, *what* name. Tanner (*Bibliotheca*) alleges that Mandeville wrote several books on medicine, and among the Ashmolean MSS. in the Bodleian are a medical receipt by John de Magna Villa (No. 1479), an alchemical receipt by him (No. 1407), and another alchemical receipt by Johannes de Villa Magna (No. 1441).

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[1] *Die Quellen für die Reisebeschreibung des Johann von Mandeville, Inaugural-Dissertation . . . Leipzig* (Berlin, 1888). This was revised and enlarged as "Untersuchungen über Johann von Mandeville und die Quellen seiner Reisebeschreibung," in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, Bd. 23, Heft 3 u. 4 (No. 135, 136).

[2] In his edition (Roxburghe Club).

[3] *Die ungedruckten lateinischen Versionen Mandeville's* (Crefeld, 1886).

[4] *Handschriftliche Untersuchungen über die englische Version Mandeville's* (Crefeld, 1891), p. 46.

[5] Dr Vogels controverts these positions, arguing that the first English version from the French was the complete Cotton text, and that the defective English copies were made from a defective *English* MS. His supposed evidences of the priority of the Cotton text equally consist with its being a later revision, and for *Roys Ils* in the defective English MSS. he has only offered a laboured and improbable explanation.

[6] Stanislas Bormans, Introduction to d'Oultremouse's Chronicle, pp. lxxxix., xc.; see also Warner's edition of the Travels, p. xxxv. The ascription is on ff. 5 and 6 of *Le Tresorier de philosophie naturele des pierres precieuses*, an unprinted work by d'Oultremouse in *MS. Fonds français* 12326 of the Bibliothèque Nationale, Paris. The passage about Alexandria is on f. 81.

[7] See L. Pannier, *Les Lapidaires français*, pp. 189–204: not knowing d'Oultremouse's evidence, he has discredited the attribution to Mandeville and doubted the existence of a Latin original.

[8] *Description . . . d'une collection . . . d'anciens manuscrits . . . réunis par les soins de M. J. Techener*, pt. i. (Paris, 1862), p. 159 (referred to by Pannier, pp. 193–194).

Finally, de Bourgogne wrote under his own name a treatise on the plague,[1] extant in Latin, French and English texts, and in Latin and English abridgments. Herein he describes himself as Johannes de Burgundia, otherwise called *cum Barba*, citizen of Liége and professor of the art of medicine; says that he had practised forty years and had been in Liége in the plague of 1365; and adds that he had previously written a treatise on the cause of the plague, according to the indications of astrology (beginning *Deus deorum*), and another on distinguishing pestilential diseases (beginning *Cum nimium propter instans tempus epidimiale*). "Burgundia" is sometimes corrupted into "Burdegalia," and in English translations of the abridgment almost always appears as "Burdews" (Bordeaux) or the like. MS. Rawlinson D. 251 (15th century) in the Bodleian also contains a large number of English medical receipts, headed "Practica phisicalia M*agist*ri Joh*ann*is de Burg*u*ndia."

See further Dr G. F. Warner's article in the *Dictionary of National Biography* for a comprehensive account, and for bibliographical references; Ulysse Chevalier's *Répertoire des sources historiques du moyen age* for references generally; and the *Zeitschr. f. celt. Philologie* II., i. 126, for an edition and translation, by Dr Whitley Stokes, of Fingin O'Mahony's Irish version of the *Travels*.

(E. W. B. N.; H. Y.)

MANDHATA, a village with temples in India, in Nimar district of the Central Provinces, on the south bank of the Narbada. Pop. (1901), 832. It is a famous place of Hindu pilgrimage, as containing one of the twelve great *lingas* of Siva; and as late as the beginning of the 19th century it was the scene of the self-immolation of devotees who threw themselves from the cliffs into the river.

MANDI, a native state of India, within the Punjab. It ranks as the most important of the hill states to which British influence extended in 1846 after the first Sikh War. The territory lies among the lower ranges of the Himalaya, between Kangra and Kulu. The country is mountainous, being intersected by two great parallel ranges, reaching to an average height of 5000 to 7000 ft. above sea-level. The valleys between the hill ranges are fertile, and produce all the ordinary grains, besides more valuable crops of rice, maize, sugar-cane, poppy and tobacco. Iron is found in places, and also gold in small quantities. Area, 1200 sq. m.; pop. (1901), 174,045; estimated revenue, £28,000; tribute, £6666. The chief, whose title is raja, is a Rajput of old family. Considerable sums have been expended on roads and bridges. An important product of the state is salt, which is mined in two places.

The town of Mandi is on the Beas, which is here a mountain torrent, crossed by a fine iron bridge; 2991 ft. above sea-level; 88 m. from Simla. Pop. (1901), 8144. It was founded in 1527, and contains a palace of the 17th century and other buildings of interest. It is a mart for transfrontier trade with Tibet and Yarkand.

See *Mandi State Gazetteer* (Lahore, 1908).

MANDINGO, the name currently given to a very important division of negro peoples in West Africa. It is seemingly a corruption of a term applied to an important section of this group, the Mande-nka or Mande-nga. The present writer has usually heard this word pronounced by the Mandingo themselves "Mandiña," or even "Madiña." It seems to be derived from the racial name *Mande*, coupled with the suffix *nka* or *nke*, meaning "people," the people of Mande. Then again this word *Mande* seems to take the varying forms of *Male*, *Meli*, *Mane*, *Madi*, and, according to such authorities as Binger, Delafosse and Desplagnes, it is connected with a word *Mali*, which means "hippopotamus" or else "manati"—probably the latter. According to Desplagnes, the word is further divisible into *ma*, which would have meant "fish," and *nde*, a syllable to which he ascribes the meaning of "father." In no Mandingo dialect known to the present writer (or in any other known African language) does the vocable *ma* apply to "fish," and in only one very doubtful far eastern Mandingo dialect is the root *nde* or any other similar sound applied to "father." This etymology must be abandoned, probably in favour of *Mani*, *Mali*, *Madi*, *Mande*, meaning "hippopotamus," and in some cases the other big water mammal, the manati.[2]

The West African tribes speaking Mandingo languages vary very much in outward appearance. Some of them may be West African negroes of the forest type with little or no intermixture with the Caucasian; others, such as the typical Mandingos or the Susus, obviously contain a non-negro element in their physique. This last type resembles very strongly the Swahilis of the Zanzibar littoral or other crosses between the Arab and the negro; and though nearly always black-skinned, often has a well-shaped nose and a fairly full beard. The tribes dwelling in the West African forest, but speaking languages of Mandingo type, do not perhaps exhibit the very prognathous, short-limbed, "ugly" development of West African negro, but are of rather a refined type, and some of them are lighter in skin colour than the more Arab-looking Mandingos of the north. But in these forest Mandingos the beard is scanty. Occasionally the Mandingo physical type appears in eastern Liberia and on the Ivory Coast amongst people speaking Kru languages. In other cases it is associated with the Senufo speech-family.

Delafosse divides the Mandingo group linguistically into three main sections: (1) the *Mande-tamu*, (2) the *Mande-fu*, and (3) the *Mande-tã*, according as they use for the numeral 10 the root *tamu*, *tã* or *fu*. Of the first group are the important tribes of the Soni-nké (called Sarakulle by the Fula, and Sarakolé by the French); the Swaninki people of Azer, and the oases of Tishitt, Wadan and Walata in the south-west Sahara; and the Bozo, who are the fishermen along the banks of the Upper Niger and the Bani from Jenné to Timbuktu. The Soni-nké are also known as Marka, and they include (according to Binger) the Samogho and even the Kurtei along the banks of the Niger east of Timbuktu as far as Say.

The group of Mande-tã would include the Bamana (incorrectly called Bambara) of the upper Senegal and of Segu on the Upper Niger, the Toronke, the Mandenga, the Numu of the district west of the Black Volta, the Vai of south-western Liberia, and the Dyula or Gyula of the region at the back of the Ivory Coast.

The group of the Mande-fu includes a great many different languages and dialects, chiefly in the forest region of Sierra Leone and Liberia, and also the dialects of the celebrated Susu or Soso tribe, and the Mandingo tribes of Futa Jallon, of the Grand Scarcies River and of the interior of the Ivory Coast, and of the regions between the eastern affluents of the Upper Niger and the Black Volta. To this group Delafosse joins the Boko dialect spoken by people dwelling to the west of the Lower Niger at Bussa—between Bussa and Borgu. If this hypothesis be correct it gives a curious eastern extension to the range of the Mandingo family at the present day; or it may be a vestige left by the Mandingo invasion which, according to legend, came in prehistoric times from the Hausa countries across the Niger to Senegambia. It is remarkable that this Boko dialect as recorded by the missionary Koelle most resembles certain dialects in central Liberia and in the Ivory Coast hinterland.

The Mandingos, coming from the East and riding on horses (according to tradition), seem to have invaded western Nigeria about A.D. 1000 (if not earlier), and to have gradually displaced and absorbed the Songhai or Fula (in other words, Negroid, "White") rulers of the countries in the basin of the Upper Niger or along its navigable course as far as the Bussa Rapids and the forest region. On the ruins of these Songhai, Berber, or Fula kingdoms rose the empire of Mali (Melle). Considerable sections of the Mandingo invaders had adopted Mahommedanism, and extended a great Mahommedan empire of western Nigeria far northwards into the Sahara Desert. In the 16th century the Songhai regained supreme power. See *infra*, § *The Melle Empire*.

Although the Mandingos, and especially the Susu section, may have come as conquerors, they devoted themselves through the succeeding centuries more and more to commerce. They became to the extreme west of Africa what the Hausa are in the west-central regions. Some of the Mandingo invasions, especially in the forest region, left little more than the imposition of their language; but where there was any element of Caucasian blood (for the original Mandingo invaders were evidently dashed with the Caucasian by intermingling with some of the negroid races of north-central Africa), they imposed a degree of civilization which excluded cannibalism (still rampant in much of the forest region of West Africa), introduced working in leather and in metals, and was everywhere signalized by a passionate love of music, a characteristic of all true Mandingo tribes at the present day. It is noteworthy that many of the instruments affected by the Mandingos are found again in the more civilized regions of Bantu Africa, as well as in the central Sudan. Many of these types of musical instruments can also be traced originally to ancient Egypt. The Mandingos also seem to have brought with them in their westward march the Egyptian type of ox, with the long, erect horns. It would almost seem as if this breed had been preceded by the zebu or humped ox; though these two types are evidently of common origin so far as derivation from one wild species is concerned. The Mandingos maintain the system of totems or clans, and each section or tribe identifies itself with a symbol, which is usually an animal or a plant. The Mandenga are supposed to have either the manati or the hippopotamus as *tanna* (totem). (Binger states that the manati was the totem of the Mande group, to which perhaps belonged originally the Susu and the Dyula.) The Bamana are the people of the crocodile; the Samanke are the people of the elephant; the Samokho of the snake. Other totems or symbols of special families or castes are the dog, the calabash or gourd, the lion, the green monkey, the leopard, the monitor lizard, a certain spice called bandugu, certain rats, the python, the puff-adder, &c.

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[1] Respecting this, see David Murray, *The Black Book of Paisley*, &c. (1885), and *John de Burdeus*, &c. (1891).

[2] Indeed it is possible that the European name for this Sirenian—manati—derived from the West Indies, is the corruption of a West African word *manti*, applied very naturally to the animal by the West African slaves, who at once recognized it as similar to the creature found on the West African coast in their own rivers, and also on the Upper Niger.

AUTHORITIES.—The bibliography dealing with the Mandingo peoples is very extensive, but only the following works need be cited: Captain L. G. Binger, *Du Niger au Golfe de Guinée*, &c. (1892); Maurice Delafosse, *Vocabulaires comparatifs de plus de 60 langues et dialectes parlés à la Côte d'Ivoire*, &c. (1904); Lieut. Desplagnes, *Le Plateau central nigérien* (1907); Lady Lugard, *A Tropical Dependency* (1905); Sir Harry Johnston, *Liberia* (1906). Most of these works contain extensive bibliographies. (H. H. J.)

The Melle Empire.—The tradition which ascribes the arrival of the Mandingo in the western Sudan to the 10th or 11th century is referred to in the previous section. It is not known by whom the Melle (Mali) state was founded. Neither is there certainty as to the site of the capital, also called Melle. Idrisi in the 12th century describes the Wangara (a Hausa name for the Mandingo) as a powerful people, and El Bakri writes in similar terms. But the first king whose name is preserved was Baramindana, believed to have reigned from 1213 to 1235. His territory lay south of that of Jenné, partly within the bend of the Niger and partly west of that river. The people were already Moslem, and the capital was a rendezvous for merchants from all parts of the western Sudan and the Barbary States. Mari Jatah (or Diara), Baramindana's successor, about the middle of the 13th century conquered the Susu, then masters of Ghanata (Ghana). Early in the 14th century Mansa, *i.e.* Sultan, Kunkur Musa, extended the empire, known as the Mellistine, to its greatest limits, making himself master of Timbuktu, Gao and all the Songhoi dominions. His authority extended northward over the Sahara to the Tuat oases. Mansa Suleiman was on the throne when in 1352–1353 Melle was visited by Ibn Batuta. By this monarch the empire was divided into three great provinces, ruled by viceroys. For a century afterwards Melle appears to have been the dominant Sudan state west of the Lower Niger, but it had to meet the hostility of the growing power of the pagan Mossi, of the Tuareg in the north and of the Songhoi, who under Sunni Ali (*c.* 1325) had already regained a measure of independence. Cadamosto nevertheless describes Melle in 1454 as being still the most powerful of the negro-land kingdoms and the most important for its traffic in gold and slaves. The Songhoi sovereign Askia is said to have completed the conquest of Melle at the beginning of the 16th century. It nevertheless retained some sort of national existence—though with the advent of the Moors in the Niger countries (end of the 16th century) native civilization suffered a blow from which it never recovered. Civil war is said to have finally wrought the ruin of Melle about the middle of the 17th century.[1] The Portuguese, from their first appearance on the Senegal and Gambia, entered into friendly relations with the rulers of Melle. Barros relates (*Da Asia*, Decade I.) that John II. of Portugal sent embassies to the court of Melle by way of the Gambia (end of the 15th century). At that time the authority of Melle was said to extend westward to the coast. The king, pressed by the Mossi, the Songhoi and the Fula, solicited the help of his "friends and allies" the Portuguese —with what result does not appear; but in 1534 Barros himself despatched an ambassador to the king of Melle concerning the trade of the Gambia. By way of that river the Portuguese themselves penetrated as far as Bambuk, a country conquered by the Mandingo in the 12th century. By Barros the name of the Melle ruler is given as Mandi Mansa, which may be the native form for "Sultan of the Mandi" (Mandingo).

See further TIMBUKTU and the authorities there cited; cf. also L. Marc, *Le Pays Mossi* (Paris, 1909). Lists of Mandingo sovereigns are given in Stokvis, *Manuel d'histoire*, vol. i. (Leiden, 1888). (F. R. C.)

MANDLA, a town and district of British India, in the Jubbulpore division of the Central Provinces. The town is on the river Nerbudda, 1787 ft. above the sea. It has a manufacture of bell-metal vessels. Pop. (1901), 5054. The district of Mandla, among the Satpura hills, has an area of 5054 sq. m. It consists of a wild highland region, broken up by the valleys of numerous rivers and streams. The Nerbudda flows through the centre of the district, receiving several tributaries which take their rise in the Maikal hills, a range densely clothed with *sāl* forest, and forming part of the great watershed between eastern and western India. The loftiest mountain is Chauradadar, about 3400 ft. high. Tigers abound, and the proportion of deaths caused by wild animals is greater than in any other district of the Central Provinces. The magnificent *sāl* forests which formerly clothed the highlands have suffered greatly from the nomadic system of cultivation practised by the hill tribes, who burned the wood and sowed their crops in the ashes; but measures have been taken to prevent further damage. The population in 1901 was 318,400, showing a decrease of 6·5% in the decade, due to famine. The aboriginal or hill tribes are more numerous in Mandla than in any other district of the Central Provinces, particularly the Gonds. The principal crops are rice, wheat, other food grains, pulse and oil-seeds. There is a little manufacture of country cloth. A branch of the Bengal-Nagpur railway touches the south-western border of the district. Mandla suffered most severely from the famine of 1896–1897, partly owing to its inaccessibility, and partly from the shy habits of the aboriginal tribes. The registered death-rate in 1907 was as high as 96 per thousand.

MANDOLINE (Fr. *mandoline*; Ger. *Mandoline*; It. *mandolina*), the treble member of the lute family, and therefore a stringed instrument of great antiquity. The mandoline is classified amongst the stringed instruments having a vaulted back, which is more accentuated than even that of the lute. The mandoline is strung with steel and brass wire strings. There are two varieties of mandolines, both Italian: (1) the *Neapolitan*, 2 ft. long, which is the best known, and has four courses of pairs of unisons tuned like the violin in fifths; (2) the *Milanese*, which is slightly larger and has five or six courses of pairs of unisons. The neck is covered by a finger-board, on which are distributed the twelve or more frets which form nuts at the correct points under the strings on which the fingers must press to obtain the chromatic semitones of the scale. The strings are twanged by means of a plectrum or pick, held between the thumb and first finger of the right hand. In order to strike a string the pick is given a gliding motion over the string combined with a *down* or an *up* movement, respectively indicated by signs over the notes. In order to sustain notes on the mandoline the effect known as *tremolo* is employed; it is produced by means of a double movement of the pick up and down over a pair of strings.

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[1] On the ruins of the old Melle dominions arose five smaller kingdoms, representing different sections of the Mandingo peoples.

The mandoline is a derivative of the mandola or mandore, which was smaller than the lute but larger than either of the mandolines described above. It had from four to eight courses of strings, the *chanterelle* or melody string being single and the others in pairs of unisons. The mandore is mentioned in Robert de Calenson (12th cent.), and elsewhere; it may be identified with the pandura.

The Neapolitan mandoline was scored for by Mozart as an accompaniment to the celebrated serenade in *Don Juan.* Beethoven wrote for it a *Sonatina per il mandolino*, dedicated to his friend Krumpholz. Grétry and Paisiello also introduced it into their operas as an accompaniment to serenades.

The earliest method for the mandoline was published by Fouchette in Paris in 1770. The earliest mention of the instrument in England, in 1707, is quoted in Ashton's *Social Life in the Reign of Queen Anne*: "Signior Conti will play . . . . on the mandoline, an instrument not known yet." (K. S.)

MANDRAKE (*Mandragora officinarum*), a plant of the potato family, order Solanaceae, a native of the Mediterranean region. It has a short stem bearing a tuft of ovate leaves, with a thick fleshy and often forked root. The flowers are solitary, with a purple bell-shaped corolla; the fruit is a fleshy orange-coloured berry. The mandrake has been long known for its poisonous properties and supposed virtues. It acts as an emetic, purgative and narcotic, and was much esteemed in old times; but, except in Africa and the East, where it is used as a narcotic and antispasmodic, it has fallen into well-earned disrepute. In ancient times, according to Isidorus and Serapion, it was used as a narcotic to diminish sensibility under surgical operations, and the same use is mentioned by Ḳazwīnī, i. 297, *s.v.* "Luffāḥ." Shakespeare more than once alludes to this plant, as in *Antony and Cleopatra*: "Give me to drink mandragora." The notion that the plant shrieked when touched is alluded to in *Romeo and Juliet*: "And shrieks like mandrakes torn out of the earth, that living mortals, hearing them, run mad." The mandrake, often growing like the lower limbs of a man, was supposed to have other virtues, and was much used for love philtres, while the fruit was supposed, and in the East is still supposed, to facilitate pregnancy (Aug., *C. Faust.* xxii. 56; cf. Gen. xxx. 14, where the Hebrew דודאים is undoubtedly the mandrake). Like the mallow, the mandrake was potent in all kinds of enchantment (see Maimonides in Chwolson, *Ssabier*, ii. 459). Dioscorides identifies it with the *κιρκαία*, the root named after the enchantress Circe. To it appears to apply the fable of the magical herb Baaras, which cured demoniacs, and was procured at great risk or by the death of a dog employed to drag it up, in Josephus (*B. J.* vii. 6, § 3). The German name of the plant (*Alraune*; O. H. G. *Alrûna*) indicates the prophetic power supposed to be in little images (homunculi, Goldmännchen, Galgenmännchen) made of this root which were cherished as oracles. The possession of such roots was thought to ensure prosperity. (See Du Cange, *s.vv.* "Mandragora" and Littré.)

Gerard in 1597 (*Herball*, p. 280) described male and female mandrakes, and Dioscorides also recognizes two such plants corresponding to the spring and autumn species (*M. vernalis* and *M. officinarum* respectively), differing in the colour of the foliage and shape of fruit.

MANDRILL (a name formed by the prefix "man" to the word "drill," which was used in ancient literature to denote an ape, and is probably of West African origin), the common title of the most hideous and most brilliantly coloured of all the African monkeys collectively denominated baboons and constituting the genus *Papio*. Together with the *drill* (*q.v.*), the mandrill, *Papio maimon*, constitutes the subgenus *Maimon*, which is exclusively West African in distribution, and characterized, among other peculiarities, by the extreme shortness of the tail, and the great development of the longitudinal bony swellings, covered during life with naked skin, on the sides of the muzzle. As a whole, the mandrill is characterized by heaviness of body, stoutness and strength of limb, and exceeding shortness of tail, which is a mere stump, not 2 in. long, and usually carried erect. It is, moreover, remarkable for the prominence of its brow-ridges, beneath which the small and closely approximated eyes are deeply sunk; the immense size of the canine teeth; and more especially for the extraordinarily vivid colouring of some parts of the skin. The body generally is covered with soft hair—light olive-brown above and silvery grey beneath—and the chin is furnished underneath with a small pointed yellow beard. The hair of the forehead and temples is directed upwards so as to meet in a point on the crown, which gives the head a triangular appearance. The ears are naked, and bluish black. The hands and feet are naked, and black. A large space around the greatly developed callosities on the buttocks, as well as the upper part of the insides of the thighs, is naked and of a crimson colour, shading off on the sides to lilac or blue, which, depending upon injection of the superficial blood-vessels, varies in intensity according to the condition of the animal—increasing under excitement, fading during sickness, and disappearing after death. It is, however, in the face that the most remarkable disposition of vivid hues occurs, more resembling those of a brilliantly coloured flower than what might be expected in a mammal. The cheek-prominences are of an intense blue, the effect of which is heightened by deeply sunk longitudinal furrows of a darker tint, while the central line and termination of the nose are bright scarlet. It is only to fully adult males that this description applies. The female is of much smaller size, and more slender; and, though the general tone of the hairy parts of the body is the same, the prominences, furrows, and colouring of the face are much less marked. The young males have black faces.

Old males are remarkable for the ferocity of their disposition, as well as for other disagreeable qualities; but when young they can easily be tamed. Like baboons, mandrills appear to be indiscriminate eaters, feeding on fruit, roots, reptiles, insects, scorpions, &c., and inhabit open rocky ground rather than forests. Not much is known of the mandrill's habits in the wild state, nor of the exact limits of its geographical distribution; the specimens brought to Europe coming from the west coast of tropical Africa, from Guinea to the Gaboon. (See also PRIMATES.) (W. H. F.; R. L.*)

MANDU, or MANDOGARH, a ruined city in the Dhar state of Central India, the ancient capital of the Mahommedan kingdom of Malwa. The city is situated at an elevation of 2079 ft. and extends for 8 m. along the crest of the Vindhyan mountains. It reached its greatest splendour in the 15th century under Hoshang Shah (1405–1434). The circuit of the battlemented wall is nearly 23 m., enclosing a large number of palaces, mosques and other buildings. The oldest mosque dates from 1405; the finest is the Jama Masjid or great mosque, a notable example of Pathan architecture, founded by Hoshang Shah. The marble-domed tomb of this ruler is also magnificent.

For a description and history of Mandu, see Sir James Campbell's *Gazetteer of Bombay*, vol. i. part ii. (1896), and *Journal of the Bombay Asiatic Society* (vol. xxi.).

MANDURIA, a city of Apulia, Italy, in the province of Lecce, from which it is 27 m. W. by road (22 m. E. of Taranto), 270 ft. above sea-level, and 8 m. N. of the coast. Pop. (1901), 12,199 (town); 13,190 (commune). It is close to the site of the ancient Manduria, considerable remains of the defences of which can still be seen; they consisted of a double line of wall built of rectangular blocks of stone, without mortar, and with a broad ditch in front. Some tombs with gold ornaments were found in 1886 (L. Viola in *Notizie degli Scavi*, 1886, 100). It was an important stronghold of the Messapii against Tarentum, and Archidamus III., king of Sparta, fell beneath its walls in 338 B.C., while leading the army of the latter (Plut., *Agis*, 3, calls the place Mandonion: see *s.v.* ARCHIDAMUS). It revolted to Hannibal, but was stormed by the Romans in 209 B.C. Pliny mentions a spring here which never changed its level, and may still be seen. The town was destroyed by the Saracens in the 10th century; the inhabitants settled themselves on the site of the present town, at first called Casalnuovo, which resumed the old name in 1700. (T. As.)

MANDVI, a seaport of India, in the native state of Cutch, within the Gujarat province of Bombay, 36 m. from Bhuj, and 182 m. by sea from Karachi. Pop. (1901), 24,683. It is a weekly port of call for steamers of the British India line, vessels of 70 tons cannot come nearer than 500 yards. The pilots and sailors of Mandvi have a high reputation.

MANES, in Roman mythology, the disembodied and immortal spirits of the dead. The word is an old adjective—*manis*, *manus*, meaning "good," the opposite of which is *immanis*; hence the Manes, clearly a euphemistic term, are the "good people." They were looked upon as gods; hence the dedication, of great antiquity and frequent occurrence, *Divis* or *Dis Manibus* in sepulchral inscriptions, used even in Christian times. When a body was consumed on the funeral pyre, relations and friends invoked the deceased as a divinity, and the law of the Twelve Tables prescribed that the rights of the divine Manes should be respected, and that each man should regard the dead members of his family as gods. Their home was in the bowels of the earth, from which they only emerged at certain times. It was an old Italian custom—especially at the foundation of cities—to dig a pit in the form of an inverted sky (hence called *mundus*), the lower part of which was supposed to be sacred to the gods of the underworld, including the Manes. Such a pit existed on the Palatine at Rome. It was covered by a stone called *lapis manalis*, representing the entrance to the lower world, which was removed three times in the year (Aug. 24, Oct. 5, Nov. 8). The Manes were then believed to issue forth, and these days were regarded as *religiosi*—that is, all important business in public and private life was suspended. Offerings were made to propitiate the dead: libations of water, wine, warm milk, honey, oil, and the blood of sacrificial victims—black sheep, pigs and oxen (*suovetaurilia*)—was poured upon the graves; ointment and incense were offered, lamps were lighted, and the grave was adorned with garlands of flowers, especially roses and violets. Beans, eggs, lentils, salt, bread and wine, placed on the grave, formed the chief part of a meal partaken of by the mourners. There was also a public state festival in honour of the dead, called Parentalia, held from the 13th to the 21st of February, the last month of the old Roman year, the last day of the festival being called Feralia. During its continuance all the temples were shut, marriages were forbidden, and the magistrates had to appear without the insignia of their office.

There was considerable analogy between the Manes and the received idea of "souls"—and there was a corresponding idea that they could be conjured up and appear as ghosts. They were also supposed to have the power of sending dreams. It is to be noticed that, unlike the Lares, the Manes are never spoken of singly.

For authorities, see LARES and PENATES.

MANET, ÉDOUARD (1832–1883), French painter, regarded as the most important master of Impressionism (*q.v.*), was born in Paris on the 23rd of January 1832. After spending some time under the tuition of the Abbé Poiloup, he entered the Collège Rollin, where his passion for drawing led him to neglect all his other lessons. His studies finished in 1848, he was placed on board the ship *Guadeloupe*, voyaging to Rio de Janeiro. On his return he first studied in Couture's studio (1851), where his independence often infuriated his master. For six years he was an intermittent visitor to the studio, constantly taking leave to travel, and going first to Cassel, Dresden, Vienna and Munich, and afterwards to Florence, Rome and Venice, where he made some stay. Some important drawings date from this period, and one picture, "A Nymph Surprised." Then, after imitating Couture, more or less, in "The Absinthe-drinker" (1866), and Courbet in "The Old Musician," he devoted himself almost exclusively to the study of the Spanish masters in the Louvre. A group was already gathering round him—Whistler, Legros, and Fantin-Latour haunted his studio in the Rue Guyot. His "Spaniard playing the Guitar," in the Salon of 1861, excited much animadversion. Delacroix alone defended Manet, but, this notwithstanding, his "Fifer of the Guard" and "Breakfast on the Grass" were refused by the jury. Then the "Exhibition of the Rejected" was opened, and round Manet a group was formed, including Bracquemond, Legros, Jongkind, Whistler, Harpignies and Fantin-Latour, the writers Zola, Duranty and Duret, and Astruc the sculptor. In 1863, when an amateur, M. Martinet, lent an exhibition-room to Manet, the painter exhibited fourteen pictures; and then, in 1864, contributed again to the Salon "The Angels at the Tomb" and "A Bull-fight." Of this picture he afterwards kept nothing but the toreador in the foreground, and it is now known as "The Dead Man." In 1865 he sent to the Salon "Christ reviled by the Soldiers" and the famous "Olympia," which was hailed with mockery and laughter. It represents a nude woman reclining on a couch, behind which is seen the head of a negress who carries a bunch of flowers. A black cat at her feet emphasizes the whiteness of the sheet on which the woman lies. This work (now in the Louvre) was presented to the Luxembourg by a subscription started by Claude Monet (1890). It was hung in 1897 among the Caillebotte collection, which included the "Balcony," and a study of a female head called "Angelina." This production, of a highly independent individuality, secured Manet's exclusion from the Salon of 1866, so that he determined to exhibit his pictures in a place apart during the Great Exhibition of 1867. In a large gallery in the Avenue de l'Alma, half of which was occupied by Courbet, he hung no fewer than fifty paintings. Only one important picture was absent, "The Execution of the Emperor Maximilian"; its exhibition was prohibited by the authorities. From that time, in spite of the fierce hostility of some adversaries, Manet's energy and that of his supporters began to gain the day. His "Young Girl" (Salon of 1868) was justly appreciated, as well as the portrait of Lola; but the "Balcony" and the "Breakfast" (1869) were as severely handled as the "Olympia" had been. In 1870 he exhibited "The Music Lesson" and a portrait of Mlle E. Gonzales. Not long before the Franco-Prussian War, Manet, finding himself in the country with a friend, for the first time discovered the true value of open air to the effects of painting in his picture "The Garden," which gave rise to the "open air" or *plein air* school. After fighting as a gunner, he returned to his family in the Pyrenees, where he painted "The Battle of the *Kearsarge* and the *Alabama*." His "Bon Bock" (1873) created a *furore*. But in 1875, as in 1869, there was a fresh outburst of abuse, this time of the "Railroad," "Polichinelle," and "Argenteuil," and the jury excluded the artist, who for the second time arranged an exhibition in his studio. In 1877 his "Hamlet" was admitted to the Salon, but "Nana" was rejected. The following works were exhibited at the Salon of 1881: "In the Conservatory," "In a Boat," and the portraits of Rochefort and Proust; and the Cross of the Legion of Honour was conferred on the painter on the 31st of December in that year. Manet died in Paris on the 20th of April 1883. He left, besides his pictures, a number of pastels and engravings. He illustrated *Les Chats* by Champfleury, and Edgar Allan Poe's *The Raven*.

See Zola, *Manet* (Paris, 1867); E. Bazire, *Manet* (Paris, 1884); G. Geffroy, *La Vie artistique* (1893). (H. Fr.)

MANETENERIS, a tribe of South American Indians of the upper Purus river, and between it and the Jurua, north-western Brazil. They manufacture cotton cloth, and have iron axes and fish hooks. The men wear long ponchos, the women sacks open at the bottom. The Maneteneris are essentially a waterside people. Their cedarwood canoes are very long and beautifully made.

MANETHO (Μανέθων in an inscription of Carthage; Μανεθῶς in a papyrus), Egyptian priest and annalist, was a native of Sebennytus in the Delta. The name which he bears has a good Egyptian appearance, and has been found on a contemporary papyrus probably referring to the man himself. The evidence of Plutarch and other indications connect him with the reigns of Ptolemy I. and II. His most important work was an Egyptian history in Greek, for which he translated the native records. It is now only known by some fragments of narrative in Josephus's treatise *Against Apion*, and by tables of dynasties and kings with lengths of reigns, divided into three books, in the works of Christian chronographers. The earliest and best of the latter is Julius Africanus, besides whom Eusebius and some falsifying apologists offer the same materials; the chief text is that preserved in the *Chronographia* of Georgius Syncellus. It is difficult to judge the value of the original from these extracts: it is clear from the different versions of the lists that they have been corrupted. Manetho's work was probably based on native lists like that of the Turin Papyrus of Kings: even his division into dynasties may have been derived from such. The fragments of narrative give a very confused idea of Egyptian history in the time of the Hyksos and the XVIIIth Dynasty. The royal lists, too, are crowded with errors of detail, both in the names and order of the kings, and in the lengths attributed to the reigns. The brief notes attached to some of the names may be derived from Manetho's narrative, but they are chiefly references to kings mentioned by Herodotus or to marvels that were supposed to have occurred: they certainly possess little historical value. A puzzling annotation to the name of Bocchoris, "in whose time a lamb spake 990 years," has been well explained by Krall's reading of a demotic story written in the twenty-third year of Augustus. According to this a lamb prophesied that after Bocchoris's reign Egypt should be in the hands of the oppressor 900 years; in Africanus's day it was necessary to lengthen the period in order to keep up the spirits of the patriots after the stated term had expired. This is evidently not from the pure text of Manetho. Notwithstanding all their defects, the fragments of Manetho have provided the accepted scheme of Egyptian dynasties and have been of great service to scholars ever since the first months of Champollion's decipherment.

See C. Müller, *Fragmenta historicorum graecorum*, ii. 511–616; A. Wiedemann, *Aegyptische Geschichte* (Gotha, 1884), pp. 121 et sqq.; J. Krall in *Festgaben für Büdinger* (Innsbruck, 1898); Grenfell and Hunt, *El Hibeh Papyri*, i, 223; also the section on chronology in EGYPT, and generally books on Egyptian history and chronology. (F. Ll. G.)

MANFRED (*c.* 1232–1266), king of Sicily, was a natural son of the emperor Frederick II. by Bianca Lancia, or Lanzia, who is reported on somewhat slender evidence to have been married to the emperor just before his death. Frederick himself appears to have regarded Manfred as legitimate, and by his will named him as prince of Tarentum and appointed him as the representative in Italy of his half-brother, the German king, Conrad IV. Although only about eighteen years of age Manfred acted loyally and with vigour in the execution of his trust, and when Conrad appeared in southern Italy in 1252 his authority was quickly and generally acknowledged. When in May 1254 the German king died, Manfred, after refusing to surrender Sicily to Pope Innocent IV., accepted the regency on behalf of Conradin, the infant son of Conrad. But the strength of the papal party in the Sicilian kingdom rendered the position of the regent so precarious that he decided to open negotiations with Innocent. By a treaty made in September 1254, Apulia passed under the authority of the pope, who was personally conducted by Manfred into his new possession. But Manfred's suspicions being aroused by the demeanour of the papal retinue, he fled to the Saracens at Lucera. Aided by Saracen allies, he defeated the papal troops at Foggia on the 2nd of December 1254, and soon established his authority over Sicily and the Sicilian possessions on the mainland.

Taking advantage in 1258 of a rumour that Conradin was dead, Manfred was crowned king of Sicily at Palermo on the 10th of August in that year. The falsehood of this report was soon manifest; but the new king, supported by the popular voice, declined to abdicate, and pointed out to Conradin's envoys the necessity for a strong native ruler. But the pope, to whom the Saracen alliance was a serious offence, declared Manfred's coronation void and pronounced sentence of excommunication. Undeterred by this sentence Manfred sought to obtain power in central and northern Italy, and in conjunction with the Ghibellines his forces defeated the Guelphs at Monte Aperto on the 4th of September 1260. He was then recognized as protector of Tuscany by the citizens of Florence, who did homage to his representative, and he was chosen senator of the Romans by a faction in the city. Terrified by these proceedings, Pope Urban IV. implored aid from France, and persuaded Charles count of Anjou, a brother of King Louis IX., to accept the investiture of the kingdom of Sicily at his hands. Hearing of the approach of Charles, Manfred issued a manifesto to the Romans, in which he not only defended his rule over Italy but even claimed the imperial crown. The rival armies met near Benevento on the 26th of February 1266, where, although the Germans fought with undaunted courage, the cowardice of the Italians quickly brought destruction on Manfred's army. The king himself, refusing to fly, rushed into the midst of his enemies and was killed. Over his body, which was buried on the battlefield, a huge heap of stones was placed, but afterwards with the consent of the pope the remains were unearthed, cast out of the papal territory, and interred on the banks of the Liris. Manfred was twice married. His first wife was Beatrice, daughter of Amadeus IV. count of Savoy, by whom he had a daughter, Constance, who became the wife of Peter III. king of Aragon; and his second wife, who died in prison in 1271, was Helena, daughter of Michael II. despot of Epirus. Contemporaries praise the noble and magnanimous character of Manfred, who was renowned for his physical beauty and intellectual attainments.

Manfred forms the subject of dramas by E. B. S. Raupach, O. Marbach and F. W. Roggee. Three letters written by Manfred are published by J. B. Carusius in *Bibliotheca historica regni Siciliae* (Palermo, 1732). See Cesare, *Storia di Manfredi* (Naples, 1837); Münch, *König Manfred* (Stuttgart, 1840); Riccio, *Alcuni studii storici intorno a Manfredi e Conradino* (Naples, 1850); F. W. Schirrmacher, *Die letzten Hohenstaufen* (Göttingen, 1871); Capesso, *Historia diplomatica regni Siciliae* (Naples, 1874); A. Karst, *Geschichte Manfreds vom Tode Friedrichs II. bis zu seiner Krönung* (Berlin, 1897); and K. Hampe, *Urban IV. und Manfred* (Heidelberg, 1905).

MANFREDONIA, a town and archiepiscopal see (with Viesti) of Apulia, Italy, in the province of Foggia, from which it is 22½ m. N.E. by rail, situated on the coast, facing E., 13 ft. above sea-level, to the south of Monte Gargano, and giving its name to the gulf to the east of it. Pop. (1901), 11,549. It was founded by Manfred in 1263, and destroyed by the Turks in 1620; but the medieval castle of the Angevins and parts of the town walls are well preserved. In the church of S. Domenico, the chapel of the Maddalena contains old paintings of the 14th century. Two miles to the south-west is the fine cathedral of S. Maria Maggiore di Siponto, built in 1117 in the Romanesque style, with a dome and crypt. S. Leonardo, nearer Foggia, belonging to the Teutonic order, is of the same date. This marks the site of the ancient Sipontum, the harbour of Arpi, which became a Roman colony in 194 B.C., and was not deserted in favour of Manfredonia until the 13th century, having become unhealthy owing to the stagnation of the water in the lagoons.

See A. Beltramelli, *Il Gargano* (Bergamo, 1907). (T. As.)

MANGABEY, a name (probably of French origin) applied to the West African monkeys of the genus *Cercocebus*, the more typical representatives of which are characterized by their bare, flesh-coloured upper eye-lids, and the uniformly coloured hairs of the fur. (See PRIMATES.)

MANGALIA, a town in the department of Constantza Rumania, situated on the Black Sea, and at the mouth of a small stream, the Mangalia, 10 m. N. of the Bulgarian frontier. Pop. (1900), 1459. The inhabitants, among whom are many Turks and Bulgarians, are mostly fisherfolk. Mangalia is to be identified with the Thracian Kallatis or Acervetis, a colony of Miletus which continued to be a flourishing place to the close of the Roman period. In the 14th century it had 30,000 inhabitants, and a large trade with Genoa.

MANGALORE, a seaport of British India, administrative headquarters of the South Kanara district of Madras, and terminus of the west coast line of the Madras railway. Pop. (1901), 44,108. The harbour is formed by the backwater of two small rivers. Vessels ride in 24 to 30 ft. of water, and load from and unload into lighters. The chief exports are coffee, coco-nut products, timber, rice and spices. Mangalore clears and exports all the coffee of Coorg, and trades directly with Arabia and the

Persian Gulf. There is a small shipbuilding industry. The town has a large Roman Catholic population, with a European bishop, several churches, a convent and a college. It is the headquarters of the Basel Lutheran mission, which possesses one of the most active printing presses in southern India, and has also successfully introduced the industries of weaving and the manufacture of tiles. Two colleges (Government and St Aloysius) are situated here. Mangalore was gallantly defended by Colonel John Campbell of the 42nd regiment from May 6, 1783, to January 30, 1784, with a garrison of 1850 men, of whom 412 were English, against Tippoo Sultan's whole army.

MANGAN, JAMES CLARENCE (1803–1849), Irish poet, was born in Dublin on the 1st of May 1803. His baptismal name was James, the "Clarence" being his own addition. His father, a grocer, who boasted of the terror with which he inspired his children, had ruined himself by imprudent speculation and extravagant hospitality. The burden of supporting the family fell on James, who entered a scrivener's office, at the age of fifteen, and drudged as a copying clerk for ten years. He was employed for some time in the library of Trinity College, and in 1833 he found a place in the Irish Ordnance Survey. He suffered a disappointment in love, and continued ill health drove him to the use of opium. He was habitually the victim of hallucinations which at times threatened his reason. For Charles Maturin, the eccentric author of *Melmoth*, he cherished a deep admiration, the results of which are evident in his prose stories. He belonged to the Comet Club, a group of youthful enthusiasts who carried on war in their paper, the *Comet*, against the levying of tithes on behalf of the Protestant clergy. Contributions to the *Dublin Penny Journal* followed; and to the *Dublin University Magazine* he sent translations from the German poets. The mystical tendency of German poetry had a special appeal for him. He chose poems that were attuned to his own melancholy temperament, and did much that was excellent in this field. He also wrote versions of old Irish poems, though his knowledge of the language, at any rate at the beginning of his career, was but slight. Some of his best-known Irish poems, however, *O'Hussey's Ode to the Maguire*, for instance, follow the originals very closely. Besides these were "translations" from Arabic, Turkish and Persian. How much of these languages he knew is uncertain, but he had read widely in Oriental subjects, and some of the poems are exquisite though the original authors whom he cites are frequently mythical. He took a mischievous pleasure in mystifying his readers, and in practising extraordinary metres. For the *Nation* he wrote from the beginning (1842) of its career, and much of his best work appeared in it. He afterwards contributed to the *United Irishman*. On the 20th of June 1849 he died at Meath Hospital, Dublin, of cholera. It was alleged at the time that starvation was the real cause. This statement was untrue, but there is no doubt that his wretched poverty made him ill able to withstand disease.

Mangan holds a high place among Irish poets, but his fame was deferred by the inequality and mass of his work, much of which lay buried in inaccessible newspaper files under his many pseudonyms, "Vacuus," "Terrae Filius," "Clarence," &c. Of his genius, morbid though it sometimes is, as in his tragic autobiographical ballad of *The Nameless One*, there can be no question. He expressed with rare sincerity the tragedy of Irish hopes and aspirations, and he furnished abundant proof of his versatility in his excellent nonsense verses, which are in strange contrast with the general trend of his work.

An autobiography which appeared in the *Irish Monthly* (1882) does not reproduce the real facts of his career with any fidelity. For some time after his death there was no adequate edition of his works, but *German Anthology* (1845), and *The Poets and Poetry of Munster* (1849) had appeared during his lifetime. In 1850 Hercules Ellis included thirty of his ballads in his *Romances and Ballads of Ireland*. Other selections appeared subsequently, notably one (1897), by Miss L. I. Guiney. *The Poems of James Clarence Magan* (1903), and the *Prose Writings* (1904), were both edited by D. J. O'Donoghue, who wrote in 1897 a complete account of the *Life and Writings* of the poet.

MANGANESE [symbol Mn; atomic weight, 54·93 (O=16)], a metallic chemical element. Its dioxide (pyrolusite) has been known from very early times, and was at first mistaken for a magnetic oxide of iron. In 1740 J. H. Pott showed that it did not contain iron and that it yielded a definite series of salts, whilst in 1774 C. Scheele proved that it was the oxide of a distinctive metal. Manganese is found widely distributed in nature, being generally found to a greater or less extent associated with the carbonates and silicates of iron, calcium and magnesium, and also as the minerals braunite, hausmannite, psilomelane, manganite, manganese spar and hauerite. It has also been recognized in the atmosphere of the sun (A. Cornu, *Comptes rendus*, 1878, 86, pp. 315, 530), in sea water, and in many mineral waters.

The metal was isolated by J. G. Gahn in 1774, and in 1807 J. F. John (*Gehlen's Jour. chem. phys.*, 1807, 3, p. 452) obtained an impure metal by reducing the carbonate at a high temperature with charcoal, mixed with a small quantity of oil. R. Bunsen prepared the metal by electrolysing manganese chloride in a porous cell surrounded by a carbon crucible containing hydrochloric acid. Various reduction methods have been employed for the isolation of the metal. C. Brunner (*Pogg. Ann.*, 1857, 101, p. 264) reduced the fluoride by metallic sodium, and E. Glatzel (*Ber.*, 1889, 22, p. 2857) the chloride by magnesium, H. Moissan (*Ann. Chim. Phys.*, 1896 (7) 9, p. 286) reduced the oxide with carbon in the electric furnace; and H. Goldschmidt has prepared the metal from the oxide by means of his "thermite" process (see CHROMIUM). W. H. Green and W. H. Wahl [German patent 70773 (1893)] prepare a 97% manganese from pyrolusite by heating it with 30% sulphuric acid, the product being then converted into manganous oxide by heating in a current of reducing gas at a dull red heat, cooled in a reducing atmosphere, and finally reduced by heating with granulated aluminium in a magnesia crucible with lime and fluorspar as a flux. A purer metal is obtained by reducing manganese amalgam by hydrogen (O. Prelinger, *Monats.*, 1894, 14, p. 353).

Prelinger's manganese has a specific gravity of 7·42, and the variety obtained by distilling pure manganese amalgam *in vacuo* is pyrophoric (A. Guntz, *Bull. Soc.* [3], 7, 275), and burns when heated in a current of sulphur dioxide. The pure metal readily evolves hydrogen when acted upon by sulphuric and hydrochloric acids, and is readily attacked by dilute nitric acid. It precipitates many metals from solutions of their salts. It is employed commercially in the manufacture of special steels. (See IRON AND STEEL.)

COMPOUNDS

Manganese forms several oxides, the most important of which are manganous oxide, MnO, trimanganese tetroxide, Mn_3O_4, manganese sesquioxide, Mn_2O_3, manganese dioxide, MnO_2, manganese trioxide, MnO_3, and manganese heptoxide, Mn_2O_7.

Manganous oxide, MnO, is obtained by heating a mixture of anhydrous manganese chloride and sodium carbonate with a small quantity of ammonium chloride (J. v. Liebig and F. Wöhler, *Pogg. Ann.*, 1830, 21, p. 584); or by reducing the higher oxides with hydrogen or carbon monoxide. It is a dark coloured powder of specific gravity 5·09. *Manganous hydroxide*, $Mn(OH)_2$, is obtained as a white precipitate on adding a solution of a caustic alkali to a manganous salt. For the preparation of the crystalline variety identical with the mineral pyrochroite (see A. de Schulten, *Comptes rendus*, 1887, 105, p. 1265). It rapidly oxidizes on exposure to air and turns brown, going ultimately to the sesquioxide. *Trimanganese tetroxide*, Mn_3O_4, is produced more or less pure when the other oxides are heated. It may be obtained crystalline by heating manganese sulphate and potassium sulphate to a bright red heat (H. Debray, *Comptes rendus*, 1861, 52, p. 985). It is a reddish-brown powder, which when heated with hydrochloric acid yields chlorine. *Manganese sesquioxide*, Mn_2O_3, found native as the mineral braunite, may be obtained by igniting the other oxides in a mixture of nitrogen and oxygen, containing not more than 26% of the latter gas (W. Dittmar, *Jour. Chem. Soc.*, 1864, 17, p. 294). The hydrated form, found native as the mineral manganite, is produced by the spontaneous oxidation of manganous hydroxide. In the hydrated condition it is a dark brown powder which readily loses water at above 100° C., it dissolves in hot nitric acid, giving manganous nitrate and manganese dioxide: $2MnO(OH) + 2HNO_3 = Mn(NO_3)_2 + MnO_2 + 2H_2O$. *Manganese dioxide*, or pyrolusite (*q.v.*), MnO_2, the most important oxide, may be prepared by heating crystallized manganous nitrate until red fumes are given off, decanting the clear liquid, and heating to 150° to 160° C. for 40 to 60 hours (A. Gorgen, *Bull. Soc.*, 1890 [3], 4, p. 16), or by heating manganese carbonate to 260° C. in the presence of air and washing the residue with very dilute cold hydrochloric acid. It is a hard black solid which readily loses oxygen when strongly heated, leaving a residue of Mn_3O_4. When heated with concentrated hydrochloric acid it yields chlorine, and with concentrated sulphuric acid it yields oxygen. It is reduced to the monoxide when heated in a current of hydrogen. It is a strong oxidizing agent. It dissolves in cold concentrated hydrochloric acid, forming a dark brown solution which probably contains manganic chloride (see R. J. Meyer, *Zeit. anorg. Chem.*, 1899, 22, p. 169; G. Neumann, *Monats.*, 1894, 15, p. 489). It is almost impossible to prepare a pure hydrated manganese dioxide owing to the readiness with which it loses oxygen, leaving residues of the type $x\mathrm{MnO}\cdot y\mathrm{MnO_2}$. Such mixtures are obtained by the action of alkaline hypochlorites on manganous salts, or by suspending manganous carbonate in water and passing chlorine through the mixture. The solid matter is filtered off, washed with water, and warmed with 10% nitric acid (A. Gorgen). It is a dark brown powder, which reddens litmus. Manganese dioxide combines with other basic oxides to form *manganites*, and on this property is based the Weldon process for the recovery of manganese from the waste liquors of the chlorine stills (see CHLORINE). The manganites are amorphous brown solids, insoluble in water, and decomposed by hydrochloric acid with the evolution of chlorine. *Manganese trioxide*, MnO_3, is obtained in small quantity as an unstable deliquescent red solid by dropping a solution of potassium permanganate in sulphuric acid on to dry sodium carbonate (B. Franke, *Jour. prak. Chem.*, 1887 [2], 36, p. 31). Above 50° C. it decomposes into the dioxide and oxygen. It dissolves in water forming manganic acid, H_2MnO_4. *Manganese heptoxide*, Mn_2O_7, prepared by adding pure potassium permanganate to well cooled, concentrated sulphuric acid, when the oxide separates as a dark oil (H. Aschoff, *Pogg. Ann.*, 1860, 111, p. 217), is very unstable, continually giving off oxygen. It decomposes violently on heating, and explodes in contact with hydrogen, sulphur, phosphorus, &c. It dissolves in water to form a deep red solution which contains *permanganic acid*, $HMnO_4$. This acid is also formed by decomposing barium or lead permanganate with dilute sulphuric acid. It is only known in aqueous solution. This solution is of a deep violet-red colour, and is somewhat fluorescent; it decomposes on exposure to light, or when heated. It is a monobasic acid, and a very powerful oxidizing agent (M. M. P. Muir, *Jour. Chem. Soc.*, 1907, 91, p. 1485).

Manganous Salts.—The anhydrous *chloride*, $MnCl_2$, is obtained as a rose-red crystalline solid by passing hydrochloric acid gas over manganese carbonate, first in the cold and afterwards at a moderate red heat. The hydrated chloride, $MnCl_2\cdot 4H_2O$, is obtained in rose-red crystals by dissolving the metal or its carbonate in aqueous hydrochloric acid and concentrating the solution. It may be obtained in at least two different forms, one isomorphous with $NaCl\cdot 2H_2O$, by concentrating the solution between 15° C. and 20° C.; the other, isomorphous with $FeCl_2\cdot 4H_2O$, by slow evaporation of the mother liquors from the former. It forms double salts with the chlorides of the alkali metals. The *bromide* $MnBr_2\cdot 4H_2O$, *iodide*, MnI_2, and *fluoride*, MnF_2, are known.

Manganous Sulphate, $MnSO_4$, is prepared by strongly heating a paste of pyrolusite and concentrated sulphuric acid until acid fumes cease to be evolved. The ferric and aluminium sulphates present are thus converted into insoluble basic salts, and the residue yields manganous sulphate when extracted with water. The salt crystallizes with varying quantities of water, according to the temperature at which crystallization is effected: between −4° C. and +6° C. with $7H_2O$, between 15° C. and 20° C. with $5H_2O$, and between 25° C. and 31° C. with $4H_2O$. It crystallizes in large pink crystals, the colour of which is probably due to the presence of a small quantity of manganic sulphate or of a cobalt sulphate. It combines with the sulphates of the alkali metals to form double salts.

Manganous Nitrate, $Mn(NO_3)_2\cdot 6H_2O$, obtained by dissolving the carbonate in nitric acid and concentrating the solution, crystallizes from nitric acid solutions in long colourless needles, which melt at 25·8° C. and boil at 129·5° C. with some decomposition.

Manganous Carbonate, $MnCO_3$, found native as manganese spar, may be prepared as an amorphous powder by heating manganese chloride with sodium carbonate in a sealed tube to 150° C., or in the hydrated form as a white flocculent precipitate by adding sodium carbonate to a manganous salt. In the moist condition it rapidly turns brown on exposure to air.

Manganous Sulphide, MnS, found native as manganese glance, may be obtained by heating the monoxide or carbonate in a porcelain tube in a current of carbon bisulphide vapour. R. Schneider (*Pogg. Ann.*, 1874, 151, 449) obtained a crystalline variety by melting sulphur with anhydrous manganous sulphate and dry potassium carbonate, extracting the residue and drying it in a current of hydrogen. Four sulphides are known; the red and green are anhydrous, a grey variety contains much water, whilst the pink is a mixture of the grey and red (J. C. Olsen and W. S. Rapalje, *Jour. Amer. Chem. Soc.*, 1904, 26, p. 1615). Ammonium sulphide alone gives incomplete precipitation of the sulphide. In the presence of ammonium salts the precipitate is dirty white in colour, whilst in the presence of free ammonia it is a buff colour. This form of the sulphide is readily oxidized when exposed in the moist condition, and is easily decomposed by dilute mineral acids.

Manganese Disulphide, MnS_2, found native as hauerite, is formed as a red coloured powder by heating manganous sulphate with potassium polysulphide in a sealed tube at 160°–170° C. (H. v. Senarmont, *Jour. prak. Chem.*, 1850, 51, p. 385).

Manganic Salts.—The sulphate, $Mn_2(SO_4)_3$, is prepared by gradually heating at 138° C. a mixture of concentrated sulphuric and manganese dioxide until the whole becomes of a dark green colour. The excess of acid is removed by spreading the mass on a porous plate, the residue stirred for some hours with nitric acid, again spread on a porous plate, and finally dried quickly at about 130° C. It is a dark green deliquescent powder which decomposes on heating or on exposure to moist air. It is readily decomposed by dilute acids. With potassium sulphate in the presence of sulphuric acid it forms potassium manganese alum, $K_2SO_4\cdot Mn_2(SO_4)_3\cdot 24H_2O$. A. Piccini (*Zeit. anorg. Chem.* 1898, 17, p. 355) has also obtained a manganese caesium alum. *Manganic Fluoride*, MnF_3, a solid obtained by the action of fluorine on manganous chloride, is decomposed by heat into manganous fluoride and fluorine. By suspending the dioxide in carbon tetrachloride and passing in hydrochloric acid gas, W. B. Holmes (*Abst. J.C.S.*, 1907, ii., p. 873) obtained a black trichloride and a reddish-brown tetrachloride.

Manganese Carbide, Mn_3C, is prepared by heating manganous oxide with sugar charcoal in an electric furnace, or by fusing manganese chloride and calcium carbide. Water decomposes it, giving methane and hydrogen (H. Moissan); $Mn_3C+6H_2O=3Mn(OH)_2+CH_4+H_2$.

Manganates.—These salts are derived from manganic acid H_2MnO_4. Those of the alkali metals are prepared by fusing manganese dioxide with sodium or potassium hydroxide in the presence of air or of some oxidizing agent (nitre, potassium chlorate, &c.); $MnO_2+2KHO+O=K_2MnO_4+H_2O$. In the absence of air the reaction proceeds slightly differently, some manganese sesquioxide being formed; $3MnO_2+2KHO=K_2MnO_4+Mn_2O_3+H_2O$. The fused mass has a dark olive-green colour, and dissolves in a small quantity of cold water to a green solution, which is, however, only stable in the presence of an excess of alkali. The green solution is readily converted into a pink one of permanganate by a large dilution with water, or by passing carbon dioxide through it: $3K_2MnO_4+2CO_2=2K_2CO_3+2KMnO_4+MnO_2$.

Permanganates are the salts of permanganic acid, $HMnO_4$. The *potassium* salt, $KMnO_4$, may be prepared by passing chlorine or carbon dioxide through an aqueous solution of potassium manganate, or by the electrolytic oxidation of the manganate at the anode [German patent 101710 (1898)]. It crystallizes in dark purple-red prisms, isomorphous with potassium perchlorate. It acts as a powerful oxidizing agent, both in acid and alkaline solution; in the first case two molecules yield five atoms of available oxygen and in the second, three atoms:

$$2KMnO_4+3H_2SO_4=K_2SO_4+2MnSO_4+3H_2O+5O;$$
$$2KMnO_4+3H_2O=2MnO_2\cdot H_2O+2KHO+3O.$$

It completely decomposes hydrogen peroxide in sulphuric acid solution—

$$2KMnO_4+5H_2O_2+3H_2SO_4=K_2SO_4+2MnSO_4+8H_2O+5O_2.$$

It decomposes when heated to

$$200°–240°\text{C.}: 2KMnO_4=K_2MnO_4+MnO_2+O_2;$$

and when warmed with hydrochloric acid it yields chlorine:

$$2KMnO_4+16HCl=2KCl+2MnCl_2+8H_2O+5Cl_2.$$

Sodium Permanganate, $NaMnO_4\cdot 3H_2O$ (?), may be prepared in a similar manner, or by precipitating the silver salt with sodium chloride. It crystallizes with great difficulty. A solution of the crude salt is used as a disinfectant under the name of "Condy's fluid."

Ammonium Permanganate, $NH_4\cdot MnO_4$, explodes violently on rubbing, and its aqueous solution decomposes on boiling (W. Muthmann, *Ber.*, 1893, 26, p. 1018); $NH_4\cdot MnO_4=MnO_2+N_2+2H_2O$.

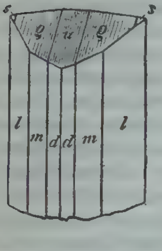
Barium Permanganate, $BaMn_2O_8$, crystallizes in almost black needles, and is formed by passing carbon dioxide through water containing suspended barium manganate.

Detection.—Manganese salts can be detected by the amethyst colour they impart to a borax-bead when heated in the Bunsen flame, and by the green mass formed when they are fused with a mixture of sodium carbonate and potassium nitrate. Manganese may be estimated quantitatively by precipitation as carbonate, this salt being then converted into the oxide, Mn_3O_4 by ignition; or by precipitation as hydrated dioxide by means of ammonia and bromine water, followed by ignition to Mn_3O_4. The valuation of pyrolusite is generally carried out by means of a distillation with hydrochloric acid, the liberated chlorine passing through a solution of potassium iodide, and the amount of iodine liberated being ascertained by means of a standard solution of sodium thiosulphate.

The atomic weight of manganese has been frequently determined. J. Berzelius, by analysis of the chloride, obtained the value 54·86; K. v. Hauer (*Sitzb. Akad. Wien.*, 1857, 25, p. 132), by conversion of the sulphate into sulphide, obtained the value 54·78; J. Dewar and A. Scott (*Chem. News*, 1883, 47, p. 98), by analysis of silver permanganate, obtained the value 55·038; J. M. Weeren (*Stahl. u.*

Eisen, 1893, 13, p. 559), by conversion of manganous oxide into the sulphate obtained the value 54·883, and of the sulphate into sulphide the value 54·876 (H = 1), and finally G. P. Baxter and Hines (*Jour. Amer. Chem. Soc.*, 1906, 28, p. 1360), by analyses of the chloride and bromide, obtained 54·96 (O = 16).

MANGANITE, a mineral consisting of hydrated manganese sesquioxide, $Mn_2O_3 \cdot H_2O$, crystallizing in the orthorhombic system and isomorphous with diaspore and göthite. Crystals are prismatic and deeply striated parallel to their length; they are often grouped together in bundles. The colour is dark steel-grey to iron-black, and the lustre brilliant and submetallic: the streak is dark reddish-brown. The hardness is 4, and the specific gravity 4·3. There is a perfect cleavage parallel to the brachypinacoid, and less perfect cleavage parallel to the prism faces *m*. Twinned crystals are not infrequent. The mineral contains 89·7% of manganese sesquioxide; it dissolves in hydrochloric acid with evolution of chlorine. The best crystallized specimens are those from Ilfeld in the Harz, where the mineral occurs with calcite and barytes in veins traversing porphyry. Crystals have also been found at Ilmenau in Thuringia, Neukirch near Schlettstadt in Alsace ("newkirkite"), Granam near Towie in Aberdeenshire, Upton Pyne near Exeter and Negaunee in Michigan. As an ore of manganese it is much less abundant than pyrolusite or psilomelane. The name manganite was given by W. Haidinger in 1827: French authors adopt F. S. Beudant's name "acerdèse," (Gr. ἀκερδής, unprofitable) because the mineral is of little value for bleaching purposes as compared with pyrolusite. (L. J. S.)



MANGBETTU (*Monbuttu*), a negroid people of Central Africa living to the south of the Niam-Niam in the Welle district of Belgian Congo. They number about a million. Their country is a table-land at an altitude of 2500 to 2800 ft. Despite its abundant animal life, luxuriant vegetation and rich crops of plantain and oil-palm, the Mangbettu have been some of the most inveterate cannibals in Africa; but since the Congo State established posts in the country (*c.* 1895) considerable efforts have been made to stamp out cannibalism. Physically the Mangbettu differ greatly from their negro neighbours. They are not so black and their faces are less negroid, many having quite aquiline noses. The beard, too, is fuller than in most negroes. They appear to have imposed their language and customs on the surrounding tribes, the Mundu, Abisanga, &c. Once a considerable power, they have practically disappeared as far as the original stock is concerned; their language and culture, however, remain, maintained by their subjects, with whom they have to a large extent intermixed. The men wear bark cloth, the art of weaving being unknown, the women a simple loin cloth, often not that. Both sexes paint the body in elaborate designs. As potters, sculptors, boatbuilders and masons the Mangbettu have had few rivals in Africa. Their huts, with pointed roofs, were not only larger and better built, but were cleaner than those of their neighbours, and some of their more important buildings were of great size and exhibited some skill in architecture.

See G. A. Schweinfurth, *Heart of Africa* (1874); W. Junker, *Travels in Africa* (1890); G. Casati, *Ten Years in Equatoria* (1891).

MANGEL-WURZEL, or field-beet, a variety of the common beet, known botanically as *Beta vulgaris*, var. *macrorhiza*. The name is German and means literally "root of scarcity." R. C. A. Prior (*Popular Names of British Plants*) says it was originally mangold, a word of doubtful meaning. The so-called root consists of the much thickened primary root together with the "hypocotyl," *i.e.* the original stem between the root and the seed-leaves. A transverse section of the root shows a similar structure to the beet, namely a series of concentric rings of firmer "woody" tissue alternating with rings of soft thin-walled parenchymatous "bast-tissue" which often has a crimson or yellowish tint. The root is a store of carbohydrate food-stuff in the form of sugar, which is formed in the first year of growth when the stem remains short and bears a rosette of large leaves. If the plant be allowed to remain in the ground till the following year strong leafy angular aerial stems are developed, 3 ft. or more in height, which branch and bear the inflorescences. The flowers are arranged in dense sessile clusters subtended by a small bract, and resemble those of the true beet. The so-called seeds are clusters of spurious fruits. After fertilization the fleshy receptacle and the base of the perianth of each flower enlarge and the flowers in a cluster become united; the fleshy parts with the ovaries, each of which contains one seed, become hard and woody. Hence several seeds are present in one "seed" of commerce, which necessitates the careful thinning of a young crop, as several seedlings may spring from one "seed."

This plant is very susceptible of injury from frost, and hence in the short summer of Scotland it can neither be sown so early nor left in the ground so late as would be requisite for its mature growth. But it is peculiarly adapted for those southern parts of England where the climate is too hot and dry for the successful cultivation of the turnip. In feeding quality it rivals the swede; it is much relished by livestock—pigs especially doing remarkably well upon it; and it keeps in good condition till midsummer if required. The valuable constituent of mangel is dry matter which averages about 12% as against 11% in swedes. Of this two-thirds may be sugar, which only develops fully during storage. Indeed, it is only after it has been some months in the store heap that mangel becomes a palatable and safe food for cattle. It is, moreover, exempt from the attacks of the turnip beetle. On all these accounts, therefore, it is peculiarly valuable in those parts of Great Britain where the summer is usually hot and dry.

Up to the act of depositing the seed, the processes of preparation for mangel are similar to those described for the turnip; winter dunging being even more appropriate for the former than for the latter. The common drilling machines are easily fitted for sowing its large rough seeds, which should be sown from the beginning of April to the middle of May and may be deposited either on ridges or on the flat. The after culture is like that of the turnip. The plants are thinned out at distances of not less than 15 in. apart. Transplanting can be used for filling up of gaps with more certainty of success than in the case of swedes, but it is much more economical to avoid such gaps by sowing a little swede seed along with the mangel. Several varieties of the plant are cultivated—those in best repute being the long red, the yellow globe and the tankard, intermediate in shape. This crop requires a heavier dressing of manure than the turnip to grow it in perfection, and is much benefited by having salt mixed with the manure at the rate of 2 or 3 cwt. per acre. Nitrogenous manures are of more marked value than phosphatic manures. The crop requires to be secured in store heaps as early in autumn as possible, as it is easily injured by frost.

MANGLE. (1) A machine for pressing and smoothing clothes after washing (see LAUNDRY). The word was adopted from the Dutch; *mangel-stok* means a rolling pin, and *linnen mangelen*, to press linen by rolling; similarly in O. Ital. *mangano* meant, according to Florio, "a presse to press buckrom," &c. The origin of the word is to be found in the medieval Latin name, *manganum*, *mangonus* or *mangana*, for an engine of war, the "mangonel," for hurling stones and other missiles (see CATAPULT). The Latin word was adapted from the Greek μάγγανον, a trick or device, cognate with μηχανή, a machine. (2) To cut in pieces, to damage or disfigure, to mutilate. This word is of obscure origin. According to the *New English Dictionary* it presents an Anglo-French *mahangler*, a form of *mahaigner* from which the English "maim" is derived, cf. the old form "mayhem," surviving in legal phraseology. Skeat connects the word with the Latin *mancus*, maimed, with which "maim" is not cognate.

MANG LÖN, a state in the northern Shan states of Burma. It is the chief state of the Wa or Vü tribes, some of whom are head-hunters, and Mang Lön is the only one which as yet has direct relations with the British government. Estimated area, 3000 sq. m.; estimated population, 40,000. The state extends from about 21° 30′ to 23° N., or for 100 m. along the river

Salween. Its width varies greatly, from a mile or even less on either side of the river to perhaps 40 m. at its broadest part near Taküt, the capital. It is divided into East and West Mang Lön, the boundary being the Salween. There are no Wa in West Mang Lön. Shans form the chief population, but there are Palaungs, Chinese and Yanglam, besides Lahu. The bulk of the population in East Mang Lön is Wa, but there are many Shans and Lahu. Both portions are very hilly; the only flat land is along the banks of streams in the valleys, and here the Shans are settled. There are prosperous settlements and bazaars at Nawng Hkam and Möng Kao in West Mang Lön. The Wa of Mang Lön have given up head-hunting, and many profess Buddhism. The capital, Taküt, is perched on a hill-top 6000 ft. above sea-level. The sawbwa is a Wa, and has control over two sub-states, Mōt Hai to the north and Maw Hpa to the south.

MANGNALL, RICHMAL (1769–1820), English schoolmistress, was born, probably at Manchester, on the 7th of March 1769. She was a pupil and finally mistress of a school at Crofton Hall, near Wakefield, Yorkshire, which she conducted most successfully until her death there on the 1st of May 1820. She was the author of *Historical and Miscellaneous Questions for the Use of Young People* (1800), generally known as "Mangnall's Questions," which was prominent in the education of English girls in the first half of the 19th century.

MANGO. The mango-tree (*Mangifera indica*, natural order Anacardiaceae) is a native of tropical Asia, but is now extensively cultivated in the tropical and subtropical regions of the New as well as the Old World. It is indigenous in India at the base of the Himalayas, and in Further India and the Andaman Islands (see A. de Candolle, *Origin of Cultivated Plants*). The cultivation of the fruit must have spread at an early age over the Indian Peninsula, and it now grows everywhere in the plains. It grows rapidly to a height of 30 to 40 ft., and its dense, spreading and glossy foliage would secure its cultivation for the sake of its shade and beauty alone. Its fruit, a drupe, though in the wild variety (not to be confused with that of *Spondias mangifera*, belonging to the same order, also called wild mango in India) stringy and sour, from its containing much gallic acid, and with a disagreeable flavour of turpentine, has become sweet and luscious through culture and selection, to which we owe many varieties, differing not only in flavour but also in size, from that of a plum to that of an apple. When unripe, they are used to make pickles, tarts and preserves; ripe, they form a wholesome and very agreeable dessert. In times of scarcity the kernels also are eaten. The timber, although soft and liable to decay, serves for common purposes, and, mixed with sandal-wood, is employed in cremation by the Hindus. It is usually propagated by grafts, or by layering or inarching, rather than by seed.

See G. Watt, *Dictionary of the Economic Products of India* (1891).

MANGOSTEEN (*Garcinia Mangostana*), a tree belonging to the order Guttiferae. It is a native of the Malay Peninsula, and is extensively cultivated in southern Tenasserim, and in some places in the Madras presidency. Poor results have followed the attempt to introduce it to other countries; and A. de Candolle refers to it as one of the most local among cultivated plants both in its origin, habitation and cultivation. It belongs to a family in which the mean area of the species is very restricted. It is an evergreen about 20 ft. high, and is somewhat fir-like in general form, but the leaves are large, oval, entire, leathery and glistening. Its fruit, the much-valued mangosteen, is about the size and shape of an orange, and is somewhat similarly partitioned, but is of a reddish-brown to chestnut colour. Its thick rind yields a very astringent juice, rich in tannin, and containing a gamboge-like resin. The soft and juicy pulp is snow-white or rose-coloured, and of delicious flavour and perfume. It is wholesome, and may be administered in fever.

The genus *Garcinia* is a genus of trees containing about fifty species in the tropics of the Old World, and usually yielding a yellow gum-resin (gamboge). *G. Morella*, a native of India, yields the true gamboge.

MANGROVE. The remarkable "mangrove forests" which fringe tidal estuaries, overrun salt marshes, and line muddy coasts in the tropics of both Old and New Worlds, are composed of trees and shrubs belonging mainly to the Rhizophoraceae, but including, especially in the eastern mangrove formations of Further India and the Malay Archipelago, members of other orders of Dicotyledons, such as Lythraceae (*Sonneratia*), Verbenaceae (*Avicennia*), and the acaulescent Nipa-palm. Their trunks and branches constantly emit adventitious roots, which, descending in arched fashion, strike at some distance from the parent stem, and send up new trunks, the forest thus spreading like a banyan grove. An advantage in dispersal, very characteristic of the order, is afforded by the seeds, which have a striking peculiarity of germination. While the fruit is still attached to the parent branch the long radicle emerges from the seed and descends rapidly towards the mud, where it may even establish itself before falling off. Owing to its clubbed shape, this is always in the right position; the plumule then makes its appearance. An interesting feature of the mangrove is the air-roots, erect or kneed branches of the roots, which project above the mud, and are provided with minute openings (stomata or lenticels), into which the air passes and is then carried by means of passages in the soft spongy tissue to the roots which spread beneath the mud. The wood of some species is hard and durable, and the astringent bark is used in tanning. The fruit of the common mangrove, *Rhizophora Mangle*, is sweet and wholesome, and yields a light wine.

MANICHAEISM. Towards the close of the 3rd century two great religions stood opposed to one another in western Europe, one wholly Iranian, namely Mithraism, the other of Jewish origin, but not without Iranian elements, part and parcel probably of the Judaism which gave it birth, namely Christianity. Professor Franz Cumont has traced the progress of Mithraism all over the Balkan Peninsula, Italy, the Rhine-lands, Britain, Spain and Latin Africa. It was peculiarly the religion of the Roman garrisons, and was carried by the legionaries wherever they went. It was an austere religion, inculcating self-restraint, courage and honesty; it secured peace of conscience through forgiveness of sins, and abated for those who were initiated in its mysteries the superstitious terrors of death and the world to come. In these respects it resembled Christianity. Soldiers may have espoused it rather than the rival faith, because in the primitive age Christian discipline denied them the sacraments, on the ground that they were professional shedders of blood. The cumbrous mythology and cosmogony of Mithraism at last weakened its hold upon men's minds, and it disappeared during the 4th century before a victorious Catholicism, yet not until another faith, equally Iranian in its mythology and cosmological beliefs, had taken its place. This new faith was that of Mani, which spread with a rapidity only to be explained by supposing that Mithraism had prepared men's minds for its reception.

Mani professed to blend the teachings of Christ with the old Persian Magism. Kessler, the latest historian of Manichaeism, opines that Mani's own declaration on this point is not to be relied upon, and has tried to prove that it was rather of Semitic or Chaldaic origin. He certainly shows that the old Assyrian mythology influenced Mani, but not that this element did not reach him through Persian channels. In genuine Manichaean documents we only find the name Mani, but Manes, Μάνης, Manichaeus, meet us in 4th-century Greek and Latin documents. In the *Acta Archelai* his first name is said to have been Cubricus, which Kessler explains as a corruption of Shuravik, a name common among the Arabs of the Syrian desert.

Life of Mani.—According to the Mahommedan tradition, which is more trustworthy than the account contained in these *Acta*, Mani was a high-born Persian of Ecbatana. The year of his birth is uncertain, but Kessler accepts as reliable the statement made by Biruni, that Mani was born in the year 527 of the astronomers of Babylon (A.D. 215–216). He received a careful education at Ctesiphon from his father Fatak, Babak or Patak (Πατέκιος). As the father connected himself at a later period with the confession of the *Moghtasilah*, or "Baptists," in southern Babylonia, the son also was brought up in the religious doctrines and exercises of this sect. These Baptists (see the *Fihrist*) were apparently connected with the Elkesaites and the Hemerobaptists, and certainly with the Mandaeans. It is probable that this Babylonian sect had absorbed Christian elements. Thus the boy early became acquainted with very different forms of religion. If even a small part of the stories about his father is founded on fact, it was he who first introduced Mani to that medley of religions out of which his system arose. Manichaean tradition relates that Mani received revelations while yet a boy, and assumed a critical attitude towards the religious instruction that was being imparted to him. This is the more incredible since the same tradition informs us that the boy was as yet prohibited from making public use of his new religious views. It was only when Mani had reached the age of twenty-five or thirty years that he began to proclaim his new religion. This he did at the court of the Persian king, Shāpūr I., and, according to the story, on the coronation day of that monarch (241/2). A Persian tradition says that he had previously been a Christian presbyter, but this is certainly incorrect. Mani did not remain long in Persia, but undertook long journeys for the purpose of spreading his religion, and also sent forth disciples. According to the *Acta Archelai*, his missionary activity extended westwards into the territory of the Christian church; but from Oriental sources it is certain that Mani rather went into Transoxiana, western China, and southwards as far as India. His labours there as well as in Persia were not without result. Like Mahomet after him and the founder of the Elkesaites before him, he gave himself out for the last and highest prophet, who was to surpass all previous divine revelation, which only possessed a relative value, and to set up the perfect religion. In the closing years of the reign of Shāpūr I. (*c.* 270) Mani returned to the Persian capital, and gained adherents even at court. But the dominant priestly caste of the Magians, on whose support the king was dependent, were naturally hostile to him, and after some successes Mani was made a prisoner, and had then to flee. The successor of Shāpūr, Hōrmizd (272–273), appears to have been favourably disposed towards him, but Bahrām I. abandoned him to the fanaticism of the Magians, and caused him to be crucified in the capital in the year 276/7. The corpse was flayed, and Mani's adherents were cruelly persecuted by the king.

Mani's Writings.—Mani himself composed a large number of works and epistles, which were in great part still known to the Mahommedan historians, but are now mostly lost. The later heads of the Manichaean churches also wrote religious treatises, so that the ancient Manichaean literature must have been very extensive. According to the *Fihrist*, Mani made use of the Persian and Syriac languages; but, like the Oriental Marcionites before him, he invented an alphabet of his own, which the *Fihrist* has handed down to us. In this alphabet the sacred books of the Manichaeans were written, even at a later period. The *Fihrist* reckons seven principal works of Mani, six being in the Syriac and one in the Persian language; regarding some of these we also have information in Epiphanius, Augustine, Titus of Bostra, and Photius, as well as in the formula of abjuration (Cotelerius, *PP. Apost. Opp.* i. 543) and in the *Acta Archelai*. They are (1) *The Book of Secrets* (see *Acta Archel.*), containing discussions bearing on the Christian sects spread throughout the East, especially the Marcionites and Bardesanites, and dealing also with their conception of the Old and New Testaments; (2) *The Book of the Giants* (Demons?); (3) *The Book of Precepts for Hearers* (probably identical with the *Epistola Fundamenti* of Augustine and with the *Book of Chapters* of Epiphanius and the *Acta Archelaï*; this was the most widely spread and most popular Manichaean work, having been translated into Greek and Latin; it contained a short summary of all the doctrines of fundamental authority); (4) *The Book Shāhpūrakān* (Flügel was unable to explain this name; according to Kessler it signifies "epistle to King Shāpūr"; the treatise was of an eschatological character); (5) *The Book of Quickening* (Kessler identifies this work with the "Thesaurus [vitae]" of the *Acta Archelai*, Epiphanius, Photius and Augustine, and if this be correct it also must have been in use among the Latin Manichaeans); (6) *The Book πραγματεία* (of unknown contents); (7) a book in the Persian language, the title of which is not given in our present text of the *Fihrist*, but which is in all probability identical with the "holy gospel" of the Manichaeans (mentioned in the *Acta Archel.* and many other authorities). It was this work which the Manichaeans set up in opposition to the Gospels. Besides these principal works, Mani also wrote a large number of smaller treatises and epistles. The practice of writing epistles was continued by his successors. These Manichaean dissertations also became known in the Graeco-Roman Empire, and existed in collections.[1] There also existed a Manichaean book of memorabilia, and of prayers, in Greek, as well as many others,[2] all of which were destroyed by the Christian bishops acting in conjunction with the authorities. A Manichaean epistle, addressed to one Marcellus, has, however, been preserved for us in the *Acta Archelai.*[3]

Manichaean System.—Though the leading features of Manichaean doctrine can be exhibited clearly even at the present day, and though it is undoubted that Mani himself drew up a complete system, many details are nevertheless uncertain, since they are differently described in different sources, and it often remains doubtful which of the accounts that have been transmitted to us represents the original teaching of the founder.

The Manichaean system is one of consistent, uncompromising dualism, in the form of a fantastic philosophy of nature. The physical and the ethical are not distinguished, and in this respect the character of the system is thoroughly materialistic; for when Mani co-ordinates good with light, and evil with darkness, this is no mere figure of speech, but light is actually good and darkness evil. From this it follows that religious knowledge involves the knowledge of nature and her elements, and that redemption consists in a physical process of freeing the element of light from the darkness. Under such circumstances ethics becomes a doctrine of abstinence in regard to all elements which have their source within the sphere of darkness.

The self-contradictory character of the present world forms the point of departure for Mani's speculations. This contradiction presents itself to his mind primarily as elemental, and only in the second instance as ethical, inasmuch as he considers the sensual nature of man to be the outflow of the evil elements in nature. From the contradictory character of the world he concludes the existence of two beings, originally quite separate from each other—light and darkness. Each is to be thought of according to the analogy of a kingdom. Light presents itself to us as the good primal spirit (God, radiant with the ten [twelve] virtues of love, faith, fidelity, high-mindedness, wisdom, meekness, knowledge, understanding, mystery and insight), and then further as the heavens of light and the earth of light, with their guardians the glorious aeons. Darkness is likewise a spiritual kingdom (more correctly, it also is conceived of as a spiritual and feminine personification), but it has no "God" at its head. It embraces an "earth of darkness." As the earth of light has five tokens (the mild zephyr, cooling wind, bright light, quickening fire, and clear water), so has the earth of darkness also five (mist, heat, the sirocco, darkness and vapour). Satan with his demons was born from the kingdom of darkness. These two kingdoms stood opposed to each other from all eternity, touching each other on one side, but remaining unmingled. Then Satan began to rage, and made an incursion into the kingdom of light, into the earth of light. The God of light, with his *syzygy*, "the spirit of his right hand," now begot the primal man, and sent him, equipped with the five pure elements, to fight against Satan. But the latter proved himself the stronger, and the primal man was for a moment vanquished. And although the God of light himself now took to the field, and with the help of new aeons (the spirit of life, &c.) inflicted total defeat upon Satan, and set the primal man free; the latter had already been robbed of part of his light by the darkness, and the five dark elements had already mingled themselves with the generations of light. It only remained now for the primal man to descend into the abyss and prevent the further increase of the generations of darkness by cutting off their roots; but he could not immediately separate again the elements that had once mingled. These mixed elements are the elements of the present visible world, which was formed from them at the command of the God of light. The forming of the world is in itself the beginning of the deliverance of the imprisoned elements of light. The world is represented as an orderly structure of various heavens and various earths, which is borne and supported by the aeons, the angels of light. It possesses in the sun and moon, which are in their nature almost quite pure, large reservoirs, in which the portions of light that have been rescued are stored up. In the sun dwells the primal man himself, as well as the glorious spirits which carry on the work of redemption; in the moon the mother of life is enthroned. The twelve constellations of the zodiac form an ingenious machine, a great wheel with buckets, which pour into the sun and moon, those shining ships that sail continually through space, the portions of light set free from the world. Here they are purified anew, and attain finally to the kingdom of pure light and to God Himself. The later Western Manichaeans termed those portions of light which are scattered throughout the world—in its elements and organisms—awaiting their deliverance, the *Jesus patibilis*.

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[1] A *βιβλιον ἐπιστολῶν* is spoken of in the formula of abjuration, and an *Epistola ad virginem Menoch* by Augustine. Fabricius has collected the "Greek Fragments of Manichaean Epistles" in his *Bibliotheca Graeca* (vii. 311 seq.).

[2] The *Canticum amatorium* is cited by Augustine.

[3] Zittwitz assumes that this epistle was in its original form of much larger extent, and that the author of the *Acts* took out of it the matter for the speeches which he makes Mani deliver during his disputation with Bishop Archelaus. The same scholar traces back the account by Turbo in the *Acts*, and the historical data given in the fourth section, to the writings of Turbo, a Mesopotamian, who is assumed to have been a Manichaean renegade and a Christian. But as to this difference of opinion is at least allowable.

It is significant of the materialistic and pessimistic character of the system that, while the formation of the world is considered as a work of the good spirits, the creation of man is referred to the princes of darkness. The first man, Adam, was engendered by Satan in conjunction with "sin," "cupidity," "desire." But the spirit of darkness drove into him all the portions of light he had stolen, in order to be able to dominate them the more securely. Hence Adam is a discordant being, created in the image of Satan, but carrying within him the stronger spark of light. Eve is given him by Satan as his companion. She is seductive sensuousness, though also having in her a small spark of light. But if the first human beings thus stood entirely under the dominion of the devil, the glorious spirits took them under their care from the very outset, sending aeons down to them (including Jesus), who instructed them regarding their nature, and in particular warned Adam against sensuality. But this first man fell under the temptation of sexual desire. Cain and Abel indeed are not sons of Adam, but of Satan and Eve; Seth, however, who is full of light, is the offspring of Adam by Eve. Thus did mankind come into existence, its various members possessing very different shares of light, but the men having uniformly a larger measure of it than the women. In the course of history the demons sought to bind men to themselves by means of sensuality, error and false religions (among which is to be reckoned above all the religion of Moses and the prophets), while the spirits of light carried on their process of distillation with the view of gaining the pure light which exists in the world. But these good spirits can only save men by imparting to them the true *gnosis* concerning nature and her forces, and by calling them away from the service of darkness and sensuality. To this end prophets, preachers of true knowledge, have been sent into the world. Mani, following the example of the gnostic Jewish Christians, appears to have held Adam, Noah, Abraham (perhaps Zoroaster and Buddha) to be such prophets. Probably Jesus was also accounted a prophet who had descended from the world of light—not, however, the historical Jesus, the devilish Messiah of the Jews, but a contemporaneous phantom Jesus, who neither suffered nor died (*Jesus impatibilis*). According to the teaching of some Manichaeans, it was the primal man who disseminated the true gnosis in the character of Christ. But at all events Mani himself, on his own claim, is to be reckoned the last and greatest prophet, who took up the work of Jesus impatibilis and of Paul (for he too finds recognition), and first brought full knowledge. He is the "leader," the "ambassador of the light," the "Paraclete." It is only through his agency and that of his imitators, "the elect," that the separation of the light from the darkness can be completed. The system contains very fantastic descriptions of the processes by which the portions of light when once set free finally ascend even to the God of light. He who during his lifetime did not become one of the elect, who did not completely redeem himself, has to go through a severe process of purification on the other side of the grave, till he too is gathered to the blessedness of the light. It is erroneous, however, to ascribe, as has been done, a doctrine of transmigration to the Manichaeans. Of course men's bodies as well as the souls of the unsaved, who according to the oldest conception have in them no light whatever, fall under the sway of the powers of darkness. A later view, adapted to the Christian one, represents the portions of light in the unsaved as actually becoming lost. When the elements of light have at last been completely, or as far as possible, delivered from the world, the end of all things comes. All glorious spirits assemble, the God of light himself appears, accompanied by the aeons and the perfected just ones. The angels supporting the world withdraw themselves from their burden, and everything falls in ruins. A tremendous conflagration consumes the world; the perfect separation of the two powers takes place once more; high above is the kingdom of light, again brought into a condition of completeness, and deep below is the (? now powerless) darkness.

Ethics, Social Polity and Worship of the Manichaeans.—On the basis of such a cosmical philosophy, ethics can only have a dualistic ascetic character. Manichaean ethics is not merely negative, however, since it is necessary to cherish, strengthen and purify the elements of light, as well as free oneself from the elements of darkness. The aim is not self-destruction, but self-preservation; and yet the ethics of Manichaeism appears in point of fact as thoroughly ascetic. The Manichaean had, above all, to refrain from sensual enjoyment, shutting himself up against it by three seals—the *signaculum oris*, *manus* and *sinus*. The *signaculum oris* forbids all eating of unclean food (which included all bodies of animals, wine, &c.—vegetable diet being allowed because plants contained more light, though the killing of plants, or even plucking their fruit and breaking their twigs, was not permitted), as well as all impure speech. The *signaculum manus* prohibits all traffic with things generally, in so far as they carry in them elements of darkness. Finally, by the *signaculum sinus* every gratification of sexual desire, and hence also marriage, are forbidden. Besides all this, life was further regulated by an exceedingly rigorous system of fasts. Certain astronomical conjunctions determined the selection of the fast-days, which in their total number amounted to nearly a quarter of the year. Sunday was regularly solemnized as one, and the practice was also generally observed on Monday. Hours of prayer were determined with equal exactness. The Manichaean had to pray four times a day, each prayer being preceded by ablutions. The worshipper turned towards the sun, or the moon, or the north, as the seat of light; but it is erroneous to conclude from this, as has been done, that in Manichaeism the sun and moon were themselves objects of worship. Forms of prayer used by the Manichaeans have been preserved to us in the *Fihrist*. The prayers are addressed to the God of light, to the whole kingdom of light, to the glorious angels, and to Mani himself, who is apostrophized in them as "the great tree, which is all salvation." According to Kessler, these prayers are closely related to the Mandaean and the ancient Babylonian hymns. An asceticism so strict and painful as that demanded by Manichaeism could only be practised by few; hence the religion must have abandoned all attempts at an extensive propaganda had it not conceded the principle of a twofold morality. A distinction was made in the community between the *electi* (*perfecti*), the perfect Manichaeans, and the *catechumeni* (*auditores*), the secular Manichaeans. Only the former submitted themselves to all the demands made by their religion; for the latter the stringency of the precepts was relaxed. They had to avoid idolatry, sorcery, avarice, falsehood, fornication, &c.; above all, they were not allowed to kill any living being (the ten commandments of Mani). They had also to free themselves as much as possible from the world; but in truth they lived very much as their non-Manichaean fellow-citizens. We have here essentially the same condition of things as in the Catholic Church, where a twofold morality was also in force, that of the religious orders and that of secular Christians—only that the position of the electi in Manichaeism was a more distinguished one than that of the monks in Catholicism. For, after all, the Christian monks never quite forgot that salvation is given by God through Christ, whereas the Manichaean *electi* were actually themselves redeemers. Hence it was the duty of the *auditores* to pay the greatest respect and most assiduous attention to the *electi*. These "perfect ones," wasting away under their asceticism, were objects of admiration and of the most elaborate solicitude.[1] Food was presented to them in abundance, and by their eating it the *electi* set free the portions of light from the vegetables. They prayed for the *auditores*, they blessed them and interceded for them, thereby shortening the process of purification the latter had to pass through after death. It was only the *electi*, too, who possessed full knowledge of religious truths, a point of distinction from Catholicism.

The distinction between *electi* and *auditores*, however, does not exhaust the conception of the Manichaean Church; on the contrary, the latter possessed a hierarchy of three ranks, so that there were altogether five gradations in the community. These were regarded as a copy of the ranks of the kingdom of light. At the head stood the *teachers* ("the sons of meekness," Mani himself and his successors); then follow the *administrators* ("the sons of knowledge," the bishops); then the *elders* ("the sons of understanding," the presbyters); the *electi* ("the sons of mystery"); and finally the *auditores* ("the sons of insight"). The number of the *electi* must always have been small. According to Augustine the teachers were twelve and the bishops seventy-two in number. One of the teachers appears to have occupied the position of superior at the head of the whole Manichaean Church. At least Augustine speaks of such a personage, and the *Fihrist* also has knowledge of a chief of all Manichaeans. The constitution, therefore, had a monarchic head.

The worship of the Manichaeans must have been very simple, and must have essentially consisted of prayers, hymns and ceremonies of adoration. This simple service promoted the secret dissemination of their doctrines. The Manichaeans too, at least in the West, appear to have adapted themselves to the Church's system of festivals. The *electi* celebrated special feasts; but the principal festival with all classes was the *Bema* (βῆμα), the feast of the "teacher's chair," held in commemoration of the death of Mani in the month of March. The faithful prostrated themselves before an adorned but empty chair, which was raised upon a podium of five steps. Long fasts accompanied the feasts. The Christian and Mahommedan historians could learn little of the Manichaean mysteries and "sacraments," and hence the former charged them with obscene rites and abominable usages. It may be held as undoubted that the later Manichaeans celebrated mysteries analogous to Christian baptism and the Lord's Supper, which may have rested upon ancient consecration rites and other ceremonies instituted by Mani himself and having their origin in nature worship.

Recent Discoveries.—F. Cumont (*Revue d'histoire et de littérature religieuse*, t. xii., 1907, No. 2) showed that one at least of the fundamental myths of Mani was borrowed from the Avesta, namely, that which recounts how through the manifestation of the virgin of light and of the messenger of salvation to the libidinous princes of darkness the vital substance or light held captive in their limbs was liberated and recovered for the realm of light. The legend of the *Omophorus* and *Splenditeneus*, rival giants who sustain earth and luminous heavens on their respective shoulders, even if it already figures in the cuneiform texts of Assyria, is yet to be traced in Mithraic bas-reliefs. It also may therefore have come to Mani through Magian channels.

When, however, we turn to the numerous fragments of authentic Manichaean liturgies and hymns lately discovered in Turfan in East Turkestan, Mani's direct indebtedness to the cycle of Magian legends rather than to Chaldaic sources (as Kessler argued) is clearly exhibited.

In fr. 472, taken from the Shāpūrakān, as part of a description of the sun-god in his ship or reservoir the sun, we have a mention of Āz and Ahriman and the devas (demons), the Pairikas. Āz in the Avestan mythology was the demon serpent who murders Gayomert in the old Persian legend, and an ally of Ahriman, as also are the *Pairikas* or Peris. In the same fragment we read of the ruin of *Aźidahāka Māzainya*, which name Darmesteter interprets in the Persian sources as the demon serpent, the sorcerer (*Ormazd et Ahriman*, Paris, 1877, p. 157). In fr. 470, descriptive of the conflagration of the world, we read of how, after Āz and the demons have been struck down, the pious man is purified and led up to sun and moon and to the being of Ahura Mazda, the Divine.

In another fragment (388) of a hymn Mani describes himself as "the first stranger" (cf. Matt. xxv. 43), the son of the god Zarvān, the Ruler-Child. In the orthodox literature of fire-worship Zarvān was Time or Destiny. Later on Zarvān was elevated to the position of supreme principle, creator of Ormazd and Ahriman, and, long before Mani, Zarvān accompanied Mithras in all his westward migrations.

In fr. 20, in an enumeration of angels, we hear of Narsus, who may be the Nēryōsang (Armenian Nerses or Narsai) of the Avesta. The other angels are Jacob, the mighty angel and leader of angels, the Lord Bar Simūs, Qaftinus the mighty, Raphael, Gabriel, Michael, Sarael and Nastikus—a truly Catholic list.

In fr. 4 a rubric enjoins the recital of the hymn of the *Frašēgērd*. Here we recognize a technical term of the Avesta—namely, the "Frashō-kereti," that is the reanimation of the world or resurrection of the dead (Darmesteter, *op. cit.*, p. 239). In this hymn we read how the gods shall release us from this sinful time, from the oppression of this world. In fr. 4, under the rubric Bar Simūs, we find the god Mihir (Mīḥryazd), the liberator, the compassionate, invoked along with Frēdōn, the good; and later on we read as follows: "with his mighty glance may the god of pure name, Prēdōn, the king and Jacob Narēman, protect religion and us the sons." Mihr or Mithras and Fēridoun or Thraētaona, the slayer of Ajis (or Azi) Dahāka, also Narīmān, spelled Nairimanau, are familiar figures in the old Persian pantheon. In the same prayer the votary begs that "new blessing may come, new victory from the god Zarvān over the glories and angels, the spirits of this world, to the end that he accept our holy religion, become a watcher within and without, helper and protector," and the prayer ends thus: "I invoke the angels, the strong ones, the mighty, Raphael, Michael, Gabriel, Sarael, who shall protect us from all adversity, and free us from the wicked Ahriman."

In fr. 176 Jesus is invoked: "Jesus, of the gods first new moon, thou art God. . . . Jesus, O Lord, of waxing fame full moon, O Jesus. Lord . . . light, our hearts' prayer. Jesus, God and Vahman. Sheen God! We will praise the God Narēsaf. Mār Mānī will we bless. O new moon and spring. Lord, we will bless. The angels, the gods . . . New sun, Mihr."

In the above Vahman is Vohu Manō, the good thought or inspiration of the Zoroastrian religion. Mihr is Mithras. The god Narēsaf is also invoked in other fragments.

In fr. 74 is invoked, together with Jesus and Mani, the "strong mighty Zrōsch, the redeemer of souls." In the Avesta Sraosha is the angel that guards the world at night from demons, and is styled "the righteous" or "the strong."

Fr. 38 is as follows: "Mithras (MS. Mītrā) great . . . messenger of the gods, mediator (or interpreter) of religion, of the elect one Jesus—virgin of light. Mār Mānī, Jesus—virgin of light, Mār Mānī. Do thou in me make peace, O light-bringer, mayest thou redeem my soul from this born-dead (existence)."

Fr. 543 runs thus: ". . . and ladder of the Mazdean faith. Thou, new teacher of Chorasan (of the East), and promoter of those that have the good faith. For thou wast born under a glittering star in the family of the rulers. Elect are these—Jesus and Vahman."

The above examples bear out Mani's own declaration, as reported by the *Fihrist*, that his faith was a blend of the old Magian cult with Christianity. Whether the Hebrew names of angels came to him direct from the Jews or not we cannot tell, but they were, as the Greek magical papyri prove, widely diffused among the Gentiles long before his age. The Armenian writer Eznik (*c.* 425) also attests that Mani's teaching was merely that of the Magi, *plus* an ascetic morality, for which they hated and slew him.

Just as the background of Christianity was formed by the Hebrew scriptures, and just as the Hebrew legends of the creation became the basis of its scheme of human redemption from evil, so the Avesta, with its quaint cosmogony and myths, formed the background of Mani's new faith. He seems to have quarrelled with the later Magism because it was not dualistic enough, for in fr. 28 we have such a passage as the following: "They also that adore the fire, the burning, by this they themselves recognize that their end shall be in fire. And they say that Ormuzd and Ahriman are brothers, and in consequence of this saying they shall come to annihilation." In the same fragment the Christians are condemned as worshippers of idols, unless indeed the writer has genuine pagans in view. There is a mention of Marcion in the same context, but it is unintelligible. There can be no doubt that in the form in which Mani became acquainted with it Christianity had been disengaged and liberated from the womb of Judaism which gave it birth. This presentation of it as an ethical system of universal import was the joint work of Paul and Marcion.

It remains to add that in these newly found fragments Mani styles himself "the apostle (*lit.* the sent forth) of Jesus the friend in the love of the Father, of God." He uses the formula:

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[1] Analogous to this is the veneration in which the Catholic monks and the Neoplatonic "philosophers" were held; but the prestige of the Manichaean *electi* was greater than that of the monks and the philosophers.

"Praise and laud to the Father and the Son and the Holy Spirit." In fr. 4 he attests that he was sprung from the land Babel; in fr. 566 that he was a physician from the land Babel. Fr. 3 recounts his interview with King Shāpūr I. The Gospel of Peter seems to have been in use, for one lengthy citation is taken from it in fr. 18. The Manichaeans of Chinese Turkestan also used a version of the *Shepherd* of Hermas. Several of the hymns (*e.g.* in fr. 7 and 32) reproduce the ideas and almost the phases of the Syriac "Hymn of the Soul," so confirming the hypothesis that Mani was influenced by Bardesanes.

With the exception of a few fragments written in a Pehlevi dialect, all this recovered Manichaean literature is in the Ouigour or Vigur dialect of Tatar. The alphabet used is the one adapted by Mani himself from the Syriac estrangelo. The fragments are 800 in number, both on paper and vellum, written and adorned with the pious care and good taste which the Manichaeans are known to have bestowed on their manuscripts. They were brought back by Professor Grünwedel and Dr Huth from Turfan in East Turkestan, and were partly translated by Dr F. W. K. Müller in the *Abhandlungen der k. preuss. Akademie der Wissenschaften* (Berlin, 1904). Much of this literature is still left in Turfan, where the natives use the sheets of Vigur and Chinese vellum MSS. as window-panes in their huts. The Russian and German governments have sent out fresh expeditions to rescue what is left before it is too late. We may thus hope to recover some priceless monuments of early Christianity, hymns and treatises perhaps of Marcion and Bardesanes, the Gospel of Peter, and even the Diatessaron. Müller's translations includes a long extract of Mani's book called *Schāpūrakān*, parts of his *Evangelium*, and epistles, with liturgies, hymns and prayers, for Tatar Khāns who espoused the faith in Khorasan.

Manichaeism and Christianity.—It is very difficult to determine what was the extent of Mani's knowledge of Christianity, how much he himself borrowed from it, and through what channels it reached him. It is certain that Manichaeism, in those districts where it was brought much into contact with Christianity, became additionally influenced by the latter at a very early period. The Western Manichaeans of the 4th and 5th centuries are much more like Christians than their Eastern brethren. In this respect Manichaeism experienced the same kind of development as Neo-Platonism. As regards Mani himself, it is safest to assume that he held both Judaism and Catholic Christianity to be entirely false religions. It is indeed true that he not only described himself as the promised Paraclete—for this designation probably originated with himself—but also conceded a high place in his system to "Jesus"; we can only conclude from this, however, that he distinguished between Christianity and Christianity. The religion which had proceeded from the historical Jesus he repudiated together with its founder, and Catholicism as well as Judaism he looked upon as a religion of the devil. But he distinguished between the Jesus of darkness and the Jesus of light who had lived and acted contemporaneously with the former. This distinction agrees with that made by the gnostic Basilides no less strikingly than the Manichaean criticism of the Old Testament does with that propounded by the Marcionites (see the *Acta Archelai*, in which Mani is made to utter the antitheses of Marcion). Finally, the Manichaean doctrines exhibit points of similarity to those of the Christian Elkesaites. The historical relation of Mani to Christianity is then as follows. From Catholicism, which he very probably had no detailed knowledge of, he borrowed nothing, rejecting it as devilish error. On the other hand, he looked upon what he considered to be Christianity proper—that is, Christianity as it had been developed among the sects of Basilidians, Marcionites, and perhaps Bardesanites, as a comparatively valuable and sound religion. He took from it the moral teaching of the Sermon on the Mount, and a criticism of the Old Testament and of Judaism so far as he required it. Indications of the influence of Marcionitism are found in the high estimation in which Mani held the apostle Paul, and in the fact that he explicitly rejects the Book of Acts. Mani appears to have given recognition to a portion of the historical matter of the Gospels, and to have interpreted it in accordance with his own doctrine.

Manichaeism and Buddhism.—It remains to be asked whether Buddhistic elements can also be detected in Manichaeism. Most modern scholars since F. C. Baur have answered this question in the affirmative. According to Kessler, Mani made use of the teaching of Buddha, at least as far as ethics was concerned. It cannot be doubted that Mani, who undertook long journeys as far as India, knew of Buddhism. The name Buddha (Buddas) which occurs in the legendary account of Mani, and perhaps in the latter's own writings, indicates further that he had occupied his attention with Buddhism when engaged in the work of founding his new religion. But his borrowings from this source must have been quite insignificant. A detailed comparison shows the difference between Buddhism and Manichaeism in all their principal doctrines to be very great, while it becomes evident that the points of resemblance are almost everywhere accidental. This is also true of the ethics and the asceticism of the two systems. There is not a single point in Manichaeism which demands for its explanation an appeal to Buddhism. Such being the case, the relationship between the two religions remains a mere possibility, a possibility which the inquiry of Geyler (*Das System des Manichaeismus und sein Verhältniss zum Buddhismus*, Jena, 1875) has not been able to elevate into a probability.

The Secret of Manichaeism.—How are we to explain the rapid spread of Manichaeism, and the fact that it really became one of the great religions? What gave it strength was that it united an ancient mythology and a thorough-going materialistic dualism with an exceedingly simple spiritual worship and a strict morality. On comparing it with the Semitic religions of nature we perceive that it was free from their sensuous *cultus*, substituting instead a spiritual worship as well as a strict morality. Manichaeism was thus able to satisfy the new wants of an old world. It offered revelation, redemption, moral virtue and immortality, spiritual benefits on the basis of the religion of nature. A further source of strength lay in the simple yet firm social organization which was given by Mani himself to his new institution. The wise man and the ignorant, the enthusiast and the man of the world, could all find acceptance here, and there was laid on no one more than he was able and willing to bear. Each one, however, was attached and led onward by the prospect of a higher rank to be attained, while the intellectually gifted had an additional inducement in the assurance that they did not require to submit themselves to any authority, but would be led to God by pure reason. Thus adapted from the first to individual requirements, this religion also showed itself able to appropriate from time to time foreign elements. Originally furnished from fragments of various religions, it could increase or diminish this possession without rupturing its own elastic framework. And, after all, great adaptability is just as necessary for a universal religion as a divine founder in whom the highest revelation of God may be seen and reverenced. Manichaeism indeed, though it applies the title "redeemer" to Mani, has really no knowledge of a redeemer, but only of a physical and gnostic process of redemption; on the other hand, it possesses in Mani the supreme prophet of God. If we consider in conclusion that Manichaeism gave a simple, apparently profound, and yet convenient solution of the problem of good and evil, a problem that had become peculiarly oppressive to the human race in the 2nd and 3rd centuries, we shall have named the most important factors which account for the rapid spread of the system.

Sketch of the History of Manichaeism.—Manichaeism first gained a firm footing in the East, *i.e.* in Persia, Mesopotamia and Transoxiana. The persecutions it had to endure did not hinder its extension. The seat of the Manichaean pope was for centuries in Babylon, at a later period in Samarkand. Even after the conquests of Islam the Manichaean Church continued to maintain itself, indeed it seems to have become still more widely diffused by the victorious campaigns of the Mahommedans, and it frequently gained secret adherents among the latter themselves. Its doctrine and discipline underwent little change in the East; in particular, it drew no nearer to the Christian religion. More than once, however, Manichaeism experienced attempts at reformation; for of course the *auditores* very easily became worldly in character, and movements of reformation led temporarily to divisions and the formation of sects. Towards the close of the 10th century, at the time the *Fihirst* was written, the Manichaeans in Mesopotamia and Persia had already been in large measure ousted from the towns, and had withdrawn to the villages. But in Turkestan, and as far as the Chinese frontier, there existed numerous Manichaean communities and even whole tribes that had adopted the name of Mani. Probably it was the great migrations of the Mongolian race that first put an end to Manichaeism in Central Asia. But even in the 15th century there were Manichaeans living beside the Thomas-Christians on the coast of Malabar in India (see Germann, *Die Thomas-Christen*, 1875). Manichaeism first penetrated the Greek-Roman Empire about the year 280, in the time of the emperor Probus (see the *Chronicon* of Eusebius). If we may take the edict of Diocletian against the Manichaeans as genuine, the system must have gained a firm footing in the West by the beginning of the 4th century, but we know that as late as about the year 325 Eusebius had not any accurate knowledge of the sect. It was only subsequent to about 330 that Manichaeism spread rapidly in the Roman Empire. Its adherents were recruited on the one hand from the old gnostic sects (especially from the Marcionites—Manichaeism exerted besides this a strong influence on the development of the Marcionite churches of the 4th century), on the other hand from the large number of the "cultured," who were striving after a "rational" and yet in some manner Christian religion. Its polemics and its criticism of the Catholic Church now became the strong side of Manichaeism, especially in the West. It admitted the stumbling-blocks which the Old Testament offers to every intelligent reader, and gave itself out as a Christianity without the Old Testament. Instead of the subtle Catholic theories concerning divine predestination and human freedom, and instead of a difficult theodicaea, it offered an exceedingly simple conception of sin and goodness. The doctrine of the incarnation of God, which was especially objectionable to those who were going over to the new universal religion from the old cults, was not proclaimed by Manichaeism. In its rejection of this doctrine Manichaeism agreed with Neo-Platonism; but, while the latter, notwithstanding all its attempts to conform itself to Christianity, could find no formula by which to inaugurate within its own limits the special veneration of Christ, the Western Manichaeans succeeded in giving their teaching a Christian tinge. The only part of the Manichaean mythology that became popular was the crude, physical dualism. The barbaric elements were judiciously screened from view as a "mystery"; they were, indeed, here and there explicitly disavowed even by the initiated. The farther Manichaeism advanced into the West the more Christian and philosophic did it become. In Syria it maintained itself in comparative purity. In North Africa it found its most numerous adherents, gaining secret support even among the clergy. Augustine was an *auditor* for nine years, while Faustus was at that time the most esteemed Manichaean teacher in the West. Augustine in his later writings against the Manichaeans deals chiefly with the following problems: (1) the relation between knowledge and faith, and between reason and authority; (2) the nature of good and evil, and the origin of the latter; (3) the existence of free will, and its relation to the divine omnipotence; (4) the relation of the evil in the world to the divine government.

The Christian Byzantine and Roman emperors, from Valens onwards, enacted strict laws against the Manichaeans. But at first these bore little fruit. The *auditores* were difficult to trace out, and besides they really gave little occasion for persecution. In Rome itself between 370 and 440 Manichaeism gained a large amount of support, especially among the scholars and public teachers. It also made its way into the life of the people by means of a popular literature in which the apostles were made to play a prominent part (*Apocryphal Acts of the Apostles*). Manichaeism in the West had also some experience of attempts at reformation from the ascetic side, but of these we know little. In Rome Leo the Great was the first who took energetic measures, along with the state authorities, against the system. Valentinian III. decreed banishment against its adherents, Justinian the punishment of death. In North Africa Manichaeism appears to have been extinguished by the persecution of the Vandals. But it still continued to exist elsewhere, both in the Byzantine Empire and in the West, and in the earlier part of the middle ages it gave an impulse to the formation of new sects, which remained related to it. And if it has not been quite proved that so early as the 4th century the Priscillianists of Spain were influenced by Manichaeism, it is at least undoubted that the Paulicians and Bogomiles, as well as the Catharists and the Albigenses, are to be traced back to Manichaeism (and Marcionitism). Thus the system, not indeed of Mani the Persian, but of Manichaeism as modified by Christian influences, accompanied the Catholic Church until the 13th century.

Sources.—(*a*) Oriental. Among the sources for a history of Manichaeism the most important are the Oriental. Of these the Mahommedan, though of comparatively late date, are distinguished by the excellent manner in which they have been transmitted to us, as well as by their impartiality. They must be named first, because ancient Manichaean writings have been used in their construction. At the head of all stands En-Nedīm, '*Fihrist* (*c.* 980), ed. by Flügel (1871–1872); cf. the latter's work *Mani, seine Lehre u. seine Schriften* (1862). See also Shahrastānī, *Kitab al-milal wan-nuḥal* (12th cent.), ed. by Cureton (1846) and translated into German by Haarbrücker (1851), and individual notes and excerpts by Tabarī (10th cent.), Al-Bīrūnī (11th cent.), and other Arabian and Persian historians. Next come the Turfan fragments described in the body of this article. See also W. Brandt, *Schriften aus der Genza oder Sidvā Rabba* (Göttingen, 1893).

Of the Christian Orientals those that afford most information are Ephraem Syrus (d. 373), in various writings; the Armenian Esnik (German translation by J. M. Schmid, Vienna, 1900, see also *Zeitsch. f. hist. Theol.*, 1840, ii.; Langlois, *Collection*, ii. 375 seq.), who wrote in the 5th century against Marcion and Mani; and the Alexandrian patriarch Eutychius d. 916), *Annales*, ed. Pococke (1628). There are, besides, scattered pieces of information in Aphraates (4th cent.), Barhebraeus (13th cent.) and others. The newly found Syriac *Book of Scholia* of Theodor bar Khouni (see Pognon, *Les Coupes de Kouabir*, Paris, 1898) gives many details about Mani's teaching (also ed. without translation by Dr M. Lewin, Berlin, 1905).

(*b*) Greek and Latin. The earliest mention of the Manichaeans in the Graeco-Roman Empire is to be found in an edict of Diocletian (see Hänel, *Cod. Gregor.*, tit. xv.), which is held by some to be spurious, while others assign it to one or other of the years 287, 290, 296, 308 (so Mason, *The Persec. of Diocl.*, pp. 275 seq.). Eusebius gives a short account of the sect (*H. E.*, vii. 31). It was the *Acta Archelai*, however, that became the principal source on the subject of Manichaeism for Greek and Roman writers. These *Acta* are not indeed what they give themselves out for, viz. an account of a disputation held between Mani and the bishop Archelaus of Cascar, in Mesopotamia; but they nevertheless contain much that is trustworthy, especially regarding the doctrine of Mani, and they also include Manichaean documents. They consist of various distinct pieces, and originated in the beginning of the 4th century, probably at Edessa. They were translated as early as the first half of the same century from the Syriac (as is maintained by Jerome, *De vir. illust.*, 72; though this is doubted by modern scholars) into Greek, and soon afterwards into Latin. It is only this secondary Latin version that we possess (ed. by C. H. Beeson, Leipzig, 1906, under title *Hegemonius acta Archelai*); earlier editions, Zacagni (1698); Routh, *Reliquiae sac.*, vol. v. (1848); translated in Clark's *Ante-Nicene Library*, vol. xx.); small fragments of the Greek version have been preserved. Regarding the *Acta Archelai*, see Zittwitz in *Zeitschr. f. d. histor. Theol.* (1873) and Oblasinski, *Acta disp. Arch. et Manetis* (1874). In the form in which we now possess them, they are a compilation after the pattern of the *Clementine Homilies*, and have been subjected to manifold redactions. These *Acta* were used by Cyril of Jerusalem (*Catech.* 6), Epiphanius (*Haer.* 66), and a great number of other writers. All the Greek and Latin heresiologists have included the Manichaeans in their catalogues; but they seldom adduce any independent information regarding them (see Theodoret, *Haer. fab.* i. 26). Important matter is to be found in the resolutions of the councils from the 4th century onwards (see Mansi, *Acta concil.*, and Hefele, *Conciliengeschichte*, vols. i.-iii.), and also in the controversial writings of Titus of Bostra (6th century), Πρὸς Μανιχαίους (ed. Lagarde, 1859), and of Alexander of Lycopolis Λόγος πρὸς τὰς Μανιχαίου δόξας (ed. Combefis; transl. in *Ante-Nic. Lib.*, vol. xiv.). Of the Byzantines, the most worthy of mention are John of Damascus (*De haeres.* and *Dialog.*) and Photius (*cod.* 179 *Biblioth.*). The struggle with the Paulicians and the Bogomiles, who were often simply identified with the Manichaeans, again directed attention to the latter. In the West the works of Augustine are the great repertory for information on the subject of Manichaeism (*Contra epistolam Manichaei, quam vocant fundamenti*; *Contra Faustum Manichaeum*; *Contra Fortunatum*; *Contra Adimantum*; *Contra Secundinum*; *De actis cum Felice Manichaeo*; *De genesi c. Manichaeos*; *De natura boni*; *De duabus animabus*; *De utilitate credendi*; *De moribus eccl. cathol. et de moribus Manichaeorum*; *De haeres.*). The more complete the picture, however, which may here be obtained of Manichaeism, the more cautious must we be in making generalizations from it, for it is beyond doubt that Western Manichaeism adopted Christian elements which are wanting in the original and in the Oriental Manichaeism. The "Dispute of Paul the Persian with a Manichaean" in Migne *P.G.*, 88, col. 529–578 (first ed. by A. Mai) is shown by G. Mercati, *Studi e testi* (Rome, 1901) to be the *procès verbal* of an actual discussion held under Justinian at Constantinople in 527.

LITERATURE.—The most important works on Manichaeism are Beausobre, *Hist. critique de Manichée et du Manichéisme* (2 vols., 1734 seq.; the Christian elements in Manichaeism are here strongly, indeed too strongly, emphasized); Baur, *Das manich. Religionssystem* (1831; in this work Manichaean speculation is exhibited from a speculative standpoint); Flügel, *Mani* (1862; a very careful investigation on the basis of the *Fihrist*); Kessler, *Untersuchung zur Genesis des manich. Religionssystems* (1876); and the article "Mani, Manichäer," by the same writer in Herzog-Hauck's *R.E.*, xii. 193–228; Kessler, *Mani* (2 vols., Berlin, 1889, 1903); Ernest Rochat, *Essai sur Mani et sa doctrine* (Geneva, 1897); *Recherches sur le manichéisme: I. La cosmogonie manichéisme d'après Théodore Bar Khôui*, by Franz Cumont (Brussels, 1908); *II. Fragments syriaques d'ouvrages manichéens*, by Kugener and F. Cumont. *III. Les Formules grecques d'abjuration imposées aux manichéens*, by F. Cumont. The accounts of Mosheim, Lardner, Walch and Schröckh, as well as the monograph by Trechsel, *Ueber Kanon, Kritik und Exegese der Manichäer* (1832), may also be mentioned as still useful. The various researches which have been made regarding Parsism, the ancient Semitic religions, Gnosticism, &c., are of the greatest importance for the investigation of Manichaeism. (A. Ha.; F. C. C.)

MANIFEST (Lat. *manifestus*, clear, open to view), in commercial law, a document delivered to the officer of customs by the captain of a ship before leaving port, giving a description of the shipped goods of every kind, and setting forth the marks, numbers and descriptions of the packages and the names of the consignors thereof. In England, by the Revenue Act 1884, s. 3, where goods are exported for which no bond is required, a manifest must be delivered to the officer of customs by the master or owner of the ship within six days after the final clearance, or a declaration in lieu thereof, the penalty in default being a sum not exceeding five pounds.

MANIHIKI (MANAHIKI, MONAHIKI), a scattered archipelago in the central Pacific Ocean, between 4° and 11° S., and 150° and 162° W., seldom visited, and producing only a little copra and guano. It may be taken to include the Caroline or Thornton Islands, Vostok and Flint to the east; Suvarov, Manihiki or Humphrey, and Tongareva or Penrhyn to the west, and Starbuck and Malden to the north, the whole thus roughly forming the three corners of a triangle. There are pearl and pearl-shell fisheries at Tongareva and Suvarov. The natives (about 1000) are Polynesians and nominally Christian. There are ancient stone buildings of former inhabitants on Malden Island. The islands were mostly discovered early in the 19th century, and were annexed by Great Britain mainly in 1888–1889.

MANIKIALA, a village of India, in Rawalpindi district of the Punjab. Pop. (1901), 734. It contains one of the largest *stupas* or Buddhist memorial shrines in N. India, and the one first known to Europeans, who early detected traces of Greek influence in the sculpture. The *stupa* was excavated by General Court in 1834, and has been identified by Sir A. Cunningham with the scene of Buddha's "body-offering."

MANILA, the capital city and principal port of the Philippine Islands, situated on the W. coast of the island of Luzon, on the E. shore of Manila Bay, at the mouth of the Pasig river, in lat. 14° 35′ 31″ N., and in long. 120° 58′ 8″ E. It is about 4890 m. W.S.W. of Honolulu, 6990 m. W.S.W. of San Francisco, 628 m. S.E. of Hong-Kong, and 1630 m. S. by W. of Yokohama. Pop. (1876), 93,595; (1887), 176,777; (1903), 219,928. Of the total population in 1903, 185,351 were of the brown race, 21,838 were of the yellow race, 7943 were of the white race, and 232 were of the black race (230 of those of this race were foreign-born), and 4564 were of mixed races; of the same total 131,659, or nearly 60% were males. The foreign-born in 1903 numbered 29,491, comprising 21,083 natives of China, 4300 natives of the United States of America, 2065 natives of Spain, and 721 natives of Japan. Nearly all of the brown race were native-born, and 80·6% of them were Tagalogs.

The city covers an area of about 20 sq. m. of low ground, through which flow the Pasig river and several *esteros*, or tide-water creeks. To the west is the broad expanse of Manila Bay, beyond which are the rugged Mariveles Mountains; to the eastward the city extends about half-way to Laguna de Bay, a lake nearly as large as Manila Bay and surrounded on three sides by mountains. On the south bank of the Pasig and fronting the bay for nearly a mile is the "Ancient City," or Intramuros, enclosed by walls 2½ m. long, with a maximum height of 25 ft., built about 1590. Formerly a moat flanked the city on the land sides, and a drawbridge at each of six gates was raised every night. But this practice was discontinued in 1852 and the moat was filled with earth in 1905. In the north-west angle of the walled enclosure stands Fort Santiago, which was built at the same time as the walls to defend the entrance to the river; the remaining space is occupied largely by a fine cathedral, churches, convents, schools, and government buildings. Outside the walls the modern city has been formed by the union of several towns whose names are still retained as the names of districts. The Pasig river is crossed by two modern steel cantilever bridges. Near the north-east angle of Intramuros is the Bridge of Spain, a stone structure across the Pasig, leading to Binondo, the principal shopping and financial district; here is the Escolta, the most busy thoroughfare of the city, and the Rosario, noted for its Chinese shops. Between Binondo and the bay is San Nicholas, with the United States custom-house and large shipping interests. North of San Nicholas is Tondo, the most densely populated district; in the suburbs, outside the fire limits, the greater part of the inhabitants live in native houses of bamboo frames roofed and sided with nipa palm, and the thoroughfares consist of narrow streets and navigable streams. Paco, south-west of Intramuros, has some large cigar factories, and a large cemetery where the dead are buried in niches in two concentric circular walls. Ermita and Malate along the bay in the south part of the city, San Miguel on the north bank of the river above Intramuros, and Sampaloc farther north, are the more attractive residential districts.

Most of the white inhabitants live in Ermita and Malate, or in San Miguel, where there are several handsome villas along the river front, among them that of the governor-general of the Philippines. The better sort of houses in Manila have two storeys, the lower one built of brick or stone and the upper one of wood, roofed with red Spanish tile or with corrugated iron; the upper storey contains the living-rooms, and the lower has servants' rooms, store-houses, stables, carriage-houses and poultry yards. On account of the warm climate the cornices are wide, the upper storey projects over the lower, and the outer walls are fitted with sliding frames. Translucent oyster shells are a common substitute for glass; and the walls are whitewashed, but on account of the frequency of earthquakes are not plastered. More than one half of the dwellings in the city are mere shacks or nipa huts. Few of the public buildings are attractive or imposing. There are, however, some churches with graceful towers and beautiful façades and a few attractive monuments; among the latter are one standing on the Magellan Plaza (Plaza or Paseo de Magellanes) beside the Pasig, to the memory of Ferdinand Magellan, the discoverer of the islands; and another by A. Querol on the shore of the bay, to the memory of Don Miguel de Legaspi (d. 1572), the founder of the Spanish city, and of Andres de Urdaneta (1498–1568), the Augustinian friar who accompanied Legaspi to Cebu (but not to what is now Manila).

Many improvements have been made in and about the city since the American occupation in 1898. The small tram-cars drawn by native ponies have been replaced by a modern American electric street-railway service, and the railway service to and from other towns on the island of Luzon has been extended; in 1908, 267 m. were open to traffic and 400 m. were under construction. Connected with Manila by electric railway is Fort William McKinley, a U.S. army post in the hills five miles away, quartering about 3000 men. The scheme for dredging some of the *esteros* in order to make them more navigable and for filling in others has been in part executed. But the greatest improvement affecting transportation is the construction of a safe and deep harbour. Although Manila Bay is nearly landlocked, it is so large that in times of strong winds it becomes nearly as turbulent as the open sea, and it was formerly so shallow that vessels drawing more than 16 ft. could approach no nearer than two miles to the shore, where typhoons of the south-west monsoon not infrequently obliged them to lie several days before they could be unloaded. Two long jetties or breakwaters have now been constructed, about 350 acres of harbour area have been dredged to a depth of 30 ft., and two wharves of steel and concrete, one 600 ft. long and 70 ft. wide, and the other 650 ft. long and 110 ft. wide, were in process of construction in 1909. The Pasig river has been dredged up to the Bridge of Spain to a depth of 18 ft. and from the Bridge of Spain to Laguna de Bay to a depth of 6 ft. The construction of the harbour was begun about 1880 by the Spanish government, but the work was less than one-third completed when the Americans took possession. Among other American improvements were: an efficient fire department, a sewer system whereby the sewage by means of pumps is discharged into the bay more than a mile from the shore; a system of gravity waterworks (1908) whereby the city's water supply is taken from the Mariquina river about 23 m. from the city into a storage reservoir which has a capacity of 2,000,000,000 gallons and is 212 ft. above the sea; the extension of the Luneta, the principal pleasure-ground; a boulevard for several miles along the bay; a botanical garden; and new market buildings.

Climate.—Manila has a spring and summer hot season, an autumn and winter cooler season, a summer and autumn rainy season, and a winter and spring dry season. For the twenty years 1883–1902 the annual average of mean monthly temperatures was 26·8° C., the maximum being 27·4° in 1889 and 1897, and the minimum 26·2° in 1884. From May until October the prevailing wind is south-east, from November to January it is north, and from February to April it is east. July and August are the cloudiest months of the year; the average number of rainy days in each of those months being 21, and in February or March only 3. The annual average of rainy days is 138: 94 in the wet season (average precipitation for the six months, 1556·3 mm.) and 44 in the dry season (average precipitation for the six dry months, 382 mm.). Thunderstorms are frequent and occasionally very severe, between May and September; the annual average of thunderstorms for the decennium 1888–1897 was 505, the greatest frequency was in May (average 100·3) and in June (average 90·7); the severity of these storms may be imagined from the fact that in a half-hour between 5 and 6 p.m. on the 21st of May 1892 the fall (probably the maximum) was 60 mm. The air is very damp: for the period 1883–1902 the annual average of humidity was 79·4%, the lowest average for any one month was 66·6% in April 1896 (the average for the twenty Aprils was 70·7), and the highest average for any one month was 89·9% for September 1897 (the average for the twenty Septembers was 85·5). The city is so situated as to be affected by shocks from all the various seismological centres of Luzon, especially those from the active volcano Taal, 35 m. south of the city. At the Manila observatory, about 1 m. south-east of the walled city, the number of perceptible earthquakes registered by seismograph between 1880 and 1897 inclusive was 221; the greatest numbers for any one year were 26 in 1882 and 23 in 1892, and the least, 5 in 1896 and 6 in 1889 and in 1894; the average number in each May was 1·44, in each July, 1·33, and in January and in February 0·72; the frequency is much greater in each of the spring summer months (except June, average 0·78) than in the months of autumn and winter.

Public Institutions.—The public school system of Manila includes, besides the common schools and Manila high school, the American school, the Philippine normal school (1901), the Philippine school of arts and trades (1901), the Philippine medical school (1907) and the Philippine school of commerce (1908). The Philippine government also maintains here a bureau of science which publishes the monthly *Philippine Journal of Science*, and co-operates with the Jesuits in maintaining, in Ermita, the Manila observatory (meteorological, seismological and astronomical), which is one of the best equipped institutions of the kind in the East. The royal and pontifical university of St Thomas Aquinas (generally known as the university of Santo Tomas) was founded in 1857 with faculties of theology, law, philosophy, science, medicine and pharmacy, and grew out of a seminary, for the foundation of which Philip II. of Spain gave a grant in 1585, and which opened in 1601; and of the Dominican college of St Thomas, dating from 1611. Other educational institutions are the (Dominican) San José medical and pharmaceutical college, San Juan de Letrán (Dominican), which is a primary and secondary school, the ateneo municipal, a corresponding secondary and primary school under the charge of the Jesuits, and the college of St Isabel, a girls' school. In 1908 there were thirty-four newspapers and periodicals published in the city, of which thirteen were Spanish, fourteen were English, two were Chinese, and five were Tagalog; the principal dailies were the *Manila Times*, *Cablenews American*, *El Comercio*, *El Libertas*, *El Mercantil*, *El Renacimiento* and *La Democracia*. There are several Spanish hospitals in Manila, in two of which the city's indigent sick are cared for at its expense; in connexion with another a reform school is maintained; and there are a general hospital, built by the government, a government hospital for contagious diseases, a government hospital for government employees, a government hospital for lepers, an army hospital, a free dispensary and hospital supported by American philanthropists, St Paul's hospital (Roman Catholic), University hospital (Protestant Episcopal), and the Mary Johnson hospital (Methodist Episcopal). There are several American Protestant churches in the city, notably a Protestant Episcopal cathedral and training schools for native teachers. In Bibilid prison, in the Santa Cruz district, nearly 80% of the prisoners of the archipelago are confined; it is under the control of the department of public instruction and its inmates are given an opportunity to learn one or more useful trades.

Trade and Industry.—Manila is important chiefly for its commerce, and to make it the chief distributing point for American goods consigned to Eastern markets the American government undertook the harbour improvements, and abolished the tonnage dues levied under Spanish rule. Manila is the greatest hemp market in the world; 110,399 tons, valued at $19,444,769, were exported from the archipelago in 1906, almost all being shipped from Manila. Other important exports are sugar, copra and tobacco. The imports represent a great variety of food stuffs and manufactured articles. In 1906 the the total value of the exports was $23,902,986 and the total value of the imports was $21,868,257. The coastwise trade is large. The principal manufactures are tobacco, cigars, cigarettes, malt liquors, distilled liquors, cotton fabrics, clothing, ice, lumber, foundry and machine shop products, carriages, waggons, furniture and boots and shoes. There is some ship and boat building. Lumber is sawed by steam power, and cotton mills in the Tondo district are operated by steam. In the foundries and machine shops small engines, boilers and church bells are made, and the government maintains an ice and cold-storage plant. With these exceptions manufacturing is in a rather primitive state. Another industry of importance, especially in the district of Tondo, is fishing, and the city's markets are well supplied with many varieties of choice fish.

Administration.—Manila is governed under a charter enacted in 1901 by the Philippine commission, and amended in 1903. This vests the legislative and administrative authority mainly in a municipal board of five members, of whom three are appointed by the governor of the Philippines by the advice and with the consent of the Philippine commission, and the others are the president of the advisory board and the city engineer. The administration is divided into eight departments: engineering and public works; sewer and waterworks construction; sanitation and transportation; assessments and collections; police, fire, law and schools. There are no elective offices, but there is an advisory board, appointed by the governor and consisting of one member from each of eleven districts; its recommendations the municipal board must seek on all important matters. The administration of justice is vested in a municipal court and in one court under justices of the peace and auxiliary justices; the administration of school affairs is vested in a special board of six members; and matters pertaining to health are administered by the insular bureau of health.

History.—The Spanish city of Manila (named from "nilad," a weed or bush which grew in the locality) was founded by Legaspi in 1571. The site had been previously occupied by a town under a Mahommedan chieftain, but this town had been burned before Legaspi gained possession, although a native settlement still remained, within the present district of Tondo. In 1572, while its fortifications were still slight, the Spanish city was attacked and was nearly captured by a force of Chinese pirates who greatly outnumbered the Spaniards. About 1590 the construction of the present walls and other defences was begun. At the beginning of the 17th century Manila had become the commercial metropolis of the Far East. To it came fleets from China, Japan, India, Malacca and other places in the Far East for an exchange of wares, and from it rich cargoes were sent by way of Mexico to the mother country in exchange for much cheaper goods. Before the close of the century, however, a decline began, from which there was but little recovery under Spanish rule. Several causes contributed to this, among them the waning of the power of Spain, an exclusive commercial policy, dishonest administration, hostilities with the Chinese, ravages of the Malay pirates, and the growth of Dutch commerce. On several occasions the city has been visited with destructive earthquakes; those of 1645 and 1863 were especially disastrous. In 1762, during war between England and Spain, an English force under Vice-Admiral Sir Samuel Cornish (d. 1770) and Lieut.-General Sir William Draper (1721–1787) breached the walls and captured the city, but by the Treaty of Paris (1763) it was returned to Spain. In 1837 the port of Manila was opened to foreign trade, and there was a steady but slow increase in prosperity up to about 1890. During this period, however, progress was hampered by vested interests, and the spirit of rebellion among the natives became increasingly threatening. About 1892 a large number of Filipinos in and near Manila formed a secret association whose object was independence and separation from Spain. In August 1896 members of this association began an attack; and late in December the movement was reinforced as a result of the execution in Manila of Dr José Rizal y Mercado (1861–1896), a Filipino patriot. It spread to the provinces, and was only in part suppressed when, in April 1898, the United States declared war against Spain. On the 1st of May an American fleet under Commodore George Dewey destroyed the Spanish fleet stationed in Manila Bay (see SPANISH-AMERICAN WAR). The smouldering Filipino revolt then broke out afresh and an American army under General Wesley Merritt (1836–) was sent from San Francisco to assist in capturing the city. The Spaniards, after making a rather weak defence, surrendered it on the 13th of August 1898. Trouble now arose between the Americans and the Filipinos under the leadership of Emilio Aguinaldo, for the latter wished to establish a government of their own. On the night of the 4th of February 1899 the Filipinos attacked the American army which was defending the city, but were repulsed after suffering a heavy loss. A military government, however, was maintained in the city until August 1901.

MANILA HEMP, the most valuable of all fibres for cordage, the produce of the leaf-stalks of *Musa textilis*, a native of the Philippine Islands. The plant, called *abacá* by the islanders, throws up a spurious stem from its underground rootstocks, consisting of a cluster of sheathing leaf-stalks, which rise to a height of from 15 to 25 ft. and spread out into a crown of huge undivided leaves characteristic of the various species of *Musa* (plantain, banana, &c.). From 12 to 20 clusters are developed on each rhizome. In its native regions the plant is rudely cultivated solely as a source of fibre; it requires little attention, and when about three years old develops flowers on a central stem, at which stage it is in the most favourable condition for yielding fibre. The stock is then cut down, and the sheathing stalks are torn asunder and reduced to small strips. These strips in their fresh succulent condition are drawn between a knife-edged instrument and a hard wooden block to which it is fixed. The knife is kept in contact with the block except when lifted to introduce the ribbons. Sufficient weight is suspended to the end of the knife to keep back all pith when the operator is drawing forward the ribbon between the block and knife. By repeated scraping in this way the soft cellular matter which surrounds the fibre is removed, and the fibre so cleaned has only to be hung up to dry in the open air, when, without further treatment, it is ready for use. Each stock yields, on an average, a little under 1 ℔ of fibre; and two natives cutting down plants and separating fibre will prepare not more than 25 ℔ per day. The fibre yielded by the outer layer of leaf-stalks is hard, fully developed and strong, and used for cordage, but the produce of the inner stalks is increasingly thin, fine and weak. The finer fibre is used by the natives, without spinning or twisting (the ends of the single fibres being knotted or gummed together), for making exceedingly fine, light and transparent yet comparatively strong textures, which they use as articles of dress and ornament. According to Warden, "muslin and grass-cloth are made from the finest fibres of Manila hemp, and some of them are so fine that a garment made of them may, it is said, be enclosed in the hollow of the hand." In Europe, especially in France, articles of clothing, such as shirts, veils, neckerchiefs and women's hats, are made from *abacá*. It is also used for matting and twines. It is of a light colour, very lustrous, and possesses great strength, being thus exceptionally suitable for the best class of ropes. It is extensively used for marine and other cordage. The hemp exported for cordage purposes is a somewhat woody fibre, of a bright brownish-white colour, and possessing great durability and strain-resisting power. The strength of Manila hemp compared with English hemp is indicated by the fact that a Manila rope $3\frac{1}{4}$ in. in circumference and 2 fathoms long stood a strain of 4669 ℔ before giving way, while a similar rope of English hemp broke with 3885 ℔. The fibre contains a very considerable amount of adherent pectinous matter, and in its so-called dry condition an unusually large proportion, as much as 12% of water. In a damp atmosphere the fibre absorbs moisture so freely that it has been found to contain not less than 40% of water, a circumstance which dealers in the raw fibre should bear in mind. From the old and disintegrated ropes is made the well-known manila paper. The plant has been introduced into tropical lands—the West Indies, India, Borneo, &c.—but only in the Philippines has the fibre been successfully produced as an article of commerce. It is distributed throughout the greater part of the Philippine Archipelago. The area of successful cultivation lies approximately between 6° and 15° N. and 121° and 126° E.; it may be successfully cultivated up to about 4000 ft. above sea-level. The provinces, or islands, where cultivation is most successful are those with a heavy and evenly distributed rainfall. H. T. Edwards, fibre expert to the Philippine bureau of agriculture, wrote in 1904:—

> "The opportunities for increasing the production of *abacá* in the Philippines are almost unlimited. Enormous areas of good *abacá* land are as yet untouched, while the greater part of land already under cultivation might yield a greatly increased product if more careful attention were given to the various details of cultivation. The introduction of irrigation will make possible the planting of *abacá* in many districts where it is now unknown. The *perfection* of a machine for the extraction of the fibre will increase the entire output by nearly one-third, as this amount is now lost by the wasteful hand-stripping process."

Hitherto, while numerous attempts have been made to extract the fibre with machinery, some obstacle has always prevented the general use of the process. The exports have increased with great rapidity, as shown by the following table:—

1870	31,426	tons.
1880	50,482	,,
1890	67,864	,,
1900	89,438	,,
1904	121,637	,,

In 1901 the value of the export was $14,453,410, or 62·3% of the total exports from the Philippines. The fibre is now so valuable that Manila hemp cordage is freely adulterated by manufacturers, chiefly by admixture of phormium (New Zealand flax) and Russian hemp.

MANILIUS, a Roman poet, author of a poem in five books called *Astronomica*. The author is neither quoted nor mentioned by any ancient writer. Even his name is uncertain, but it was probably Marcus Manilius; in the earlier MSS. the author is anonymous, the later give Manilius, Manlius, Mallius. The poem itself implies that the writer lived under Augustus or Tiberius, and that he was a citizen of and resident in Rome. According to R. Bentley he was an Asiatic Greek; according to F. Jacob an African. His work is one of great learning; he had studied his subject in the best writers, and generally represents the most advanced views of the ancients on astronomy (or rather astrology). He frequently imitates Lucretius, whom he resembles in earnestness and originality and in the power of enlivening the dry bones of his subject. Although his diction presents some peculiarities, the style is metrically correct. Firmicus, who wrote in the time of Constantine, exhibits so many points of resemblance with the work of Manilius that he must either have used him or have followed some work that Manilius also followed. As Firmicus says that hardly any Roman except Caesar, Cicero and Fronto had treated the subject, it is probable that he did not know the work of Manilius. The latest event referred to in the poem (i. 898) is the great defeat of Varus by Arminius in the Teutoburgiensis Saltus (A.D. 9). The fifth book was not written till the reign of Tiberius; the work appears to be incomplete, and was probably never published.

See editions by J. Scaliger (1579); R. Bentley (1739); F. Jacob (1846); A. G. Pingré (1786); and T. Breiter (Leipzig, 1907; and commentary 1909); of book i. by A. E. Housman (1903). On the subject generally see M. Bechert, *De emendandi Manilii Ratione* (1878) and *De M. M. Astronomicorum Poeta* (1891); B. Freier, *De M. Astronom. Aetate* (1880); A. Cramer, *De Manilii Elocutione* (very full; 1882); G. Lanson, *De Manilio Poeta*, with select bibliog. (1887); P. Monceaux, *Les Africains* (a study of the Latin literature of Africa; 1894); R. Ellis, *Noctes Manilianae* (1891); J. P. Postgate, *Silva Maniliana* (1897), chiefly on textual questions; P. Thomas, *Lucubrationes Manilianae* (1888), a collation of the Gemblacensis (Gembloux)MS.; F. Plessis, *La Poesie latine* (1909), pp. 477–483.

MANILIUS, GAIUS, Roman tribune of the people in 66 B.C. At the beginning of his year of office (Dec. 67) he succeeded in getting a law passed (*de libertinorum suffragiis*), which gave freedmen the privilege of voting together with those who had manumitted them, that is, in the same tribe as their patroni; this law, however, was almost immediately declared null and void by the senate. Both parties in the state were offended by the law, and Manilius endeavoured to secure the support of Pompey by proposing to confer upon him the command of the war against Mithradates with unlimited power (see POMPEY). The proposal was supported by Cicero in his speech, *Pro lege Manilia*, and carried almost unanimously. Manilius was later accused by the aristocratical party on some unknown charge and defended by Cicero. He was probably convicted, but nothing further is heard of him.

See Cicero's speech; Dio Cassius xxxvi. 25–27; Plutarch, *Pompey*, 30; Vell. Pat. ii. 33; art. ROME: *History*, § II.

MANIN, DANIELE (1804–1857), Venetian patriot and statesman, was born in Venice, on the 13th of May 1804. He was the son of a converted Jew, who took the name of Manin because that patrician family stood sponsors to him, as the custom then was. He studied law at Padua, and then practised at the bar of his native city. A man of great learning and a profound jurist, he was inspired from an early age with a deep hatred for Austria. The heroic but foolhardy attempt of the brothers Bandiera, Venetians who had served in the Austrian navy against the Neapolitan Bourbons in 1844, was the first event to cause an awakening of Venetian patriotism, and in 1847 Manin presented a petition to the Venetian congregation, a shadowy consultative assembly tolerated by Austria but without any power, informing the emperor of the wants of the nation. He was arrested on a charge of high treason (Jan. 18, 1848), but this only served to increase the agitation of the Venetians, who were beginning to know and love Manin. Two months later, when all Italy and half the rest of Europe were in the throes of revolution, the people forced Count Palffy, the Austrian governor, to release him (March 17). The Austrians soon lost all control of the city, the arsenal was seized by the revolutionists, and under the direction of Manin a civic guard and a provisional government were instituted. The Austrians evacuated Venice on the 26th of March, and Manin became president of the Venetian republic. He was already in favour of Italian unity, and though not anxious for annexation to Piedmont (he would have preferred to invoke French aid), he gave way to the will of the majority, and resigned his powers to the Piedmontese commissioners on the 7th of August. But after the Piedmontese defeats in Lombardy, and the armistice by which King Charles Albert abandoned Lombardy and Venetia to Austria, the Venetians attempted to lynch the royal commissioners, whose lives Manin saved with difficulty; an assembly was summoned, and a triumvirate formed with Manin at its head. Towards the end of 1848 the Austrians, having been heavily reinforced, reoccupied all the Venetian mainland; but the citizens, hard-pressed and threatened with a siege, showed the greatest devotion to the cause of freedom, all sharing in the dangers and hardships and all giving what they could afford to the state treasury. Early in 1849 Manin was again chosen president of the republic, and conducted the defence of the city with great ability. After the defeat of Charles Albert's forlorn hope at Novara in March the Venetian assembly voted "Resistance at all costs!" and granted Manin unlimited powers. Meanwhile the Austrian forces closed round the city; but Manin showed an astonishing power of organization, in which he was ably seconded by the Neapolitan general, Guglielmo Pepe. But on the 26th of May the Venetians were forced to abandon Fort Malghera, half-way between the city and the mainland; food was becoming scarce, on the 19th of June the powder magazine blew up, and in July cholera broke out. Then the Austrian batteries began to bombard Venice itself, and when the Sardinian fleet withdrew from the Adriatic the city was also attacked by sea, while certain demagogues caused internal trouble. At last, on the 24th of August 1849, when all provisions and ammunition were exhausted, Manin, who had courted death in vain, succeeded in negotiating an honourable capitulation, on terms of amnesty to all save Manin himself, Pepe and some others, who were to go into exile. On the 27th Manin left Venice for ever on board a French ship. His wife died at Marseilles, and he himself reached Paris broken in health and almost destitute, having spent all his fortune for Venice. In Paris he maintained himself by teaching and became a leader among the Italian exiles. There he became a convert from republicanism to monarchism, being convinced that only under the auspices of King Victor Emmanuel could Italy be freed, and together with Giorgio Pallavicini and Giuseppe La Farina he founded the *Società Nazionale Italiana* with the object of propagating the idea of unity under the Piedmontese monarchy. His last years were embittered by the terrible sufferings of his daughter, who died in 1854, and he himself died on the 22nd of September 1857, and was buried in Ary Scheffer's family tomb. In 1868, two years after the Austrians finally departed from Venice, his remains were brought to his native city and honoured with a public funeral. Manin was a man of the greatest honesty, and possessed genuinely statesmanlike qualities. He believed in Italian unity when most men, even Cavour, regarded it as a vain thing, and his work of propaganda by means of the National Society greatly contributed to the success of the cause.

See A. Errera, *Vita di D. Manin* (Venice, 1872); P. de la Farge, *Documents, &c., de D. Manin* (Paris, 1860); Henri Martin, *D. Manin* (Paris, 1859); V. Marchesi, *Settant' anni della storia di Venezia* (Turin) and an excellent monograph in Countess Martinengo Cesaresco's *Italian Characters* (London, 1901).

MANING, FREDERICK EDWARD (1812–1883), New Zealand judge and author, son of Frederick Maning, of Johnville, county Dublin, was born on the 5th of July 1812. His father emigrated to Tasmania in the ship "Ardent" in 1824 and took up a grant of land there. Young Maning served in the fatuous expedition which attempted to drive in the Tasmanian blacks by sweeping with an unbroken line of armed men across the island. Soon afterwards he decided to try the life of a trader among the wild tribes of New Zealand, and, landing in the beautiful inlet of Hokianga in 1833, took up his abode among the Ngapuhi. With them the tall Irish lad—he stood 6 ft. 3 in.—full of daring and good-humour and as fond of fun as of fighting, quickly became a prime favourite, was adopted into the tribe, married a chief's daughter, and became a "Pakeha-Maori" (foreigner turned Maori). With the profits of his trading he bought a farm of 200 acres on the Hokianga, for which, unlike most white adventurers of the time, he paid full value. When New Zealand was peacefully annexed in 1840, Maning's advice to the Maori was against the arrangement, but from the moment of annexation he became a loyal friend to the government, and in the wars of 1845–46 his influence was exerted with effect in the settlers' favour. Again, in 1860, he persuaded the Ngapuhi to volunteer to put down the insurrection in Taranaki. Finally, at the end of 1865, he entered the public service as a judge of the native lands court, where his unequalled knowledge of the Maori language, customs, traditions and prejudices was of solid value.

In this office he served until 1881, when ill-health drove him to resign, and two years later to seek surgical aid in London, where, however, he died of cancer on the 25th of July 1883. At his wish, his body was taken back to New Zealand and buried there. A bust of him is placed in the public library at Auckland. Maning is chiefly remembered as the author of two short books, *Old New Zealand* and *History of the War in the North of New Zealand against the Chief Heke.* Both books were reprinted in London in 1876 and 1884, with an introduction by the earl of Pembroke.

MANIPLE (Lat. *manipulus*, from *manus*, hand, and *plere*, to fill), a liturgical vestment of the Catholic Church, proper to all orders from the subdeacon upwards. It is a narrow strip of material, silk or half-silk, about a yard long, worn on the left fore-arm in such a way that the ends hang down to an equal length on either side. In order to secure it, it is sometimes tied on with strings attached underneath, sometimes provided with a hole in the lining through which the arm is passed. It is ornamented with three crosses, one in the centre and one at each end, that in the centre being obligatory, and is often elaborately embroidered. It is the special ensign of the office of subdeacon, and at the ordination is placed on the arm of the new subdeacon by the bishop with the words: "Take the maniple, the symbol of the fruit of good works."[1] It is strictly a "mass vestment," being worn, with certain exceptions (*e.g.* by a subdeacon singing the Gospel at the service of blessing the palms), only at Mass, by the celebrant and the ministers assisting.

The most common name for the maniple up to the beginning of the 11th century in the Latin Church was *mappula* (dim. of *mappa*, cloth), the Roman name for the vestment until the time of Innocent III. The designation *manipulus* did not come into general use until the 15th century. Father Braun (*Liturg. Gewandung*, p. 517) gives other early medieval names: *sudanum, fano, mantile*, all of them meaning "cloth" or "handkerchief." He traces the vestment ultimately to a white linen cloth of ceremony (*pallium linostinum*) worn in the 4th century by the Roman clergy over the left arm, and peculiar at that time to them. Its ultimate origin is obscure, but is probably traceable to some ceremonial handkerchiefs commonly carried by Roman dignitaries, *e.g.* those with which the magistrates were wont to signal the opening of the games of the circus. As late as the 9th century, indeed, the maniple was still a handkerchief, held folded in the left hand. By what process it became changed into a narrow strip is not known; the earliest extant specimen of the band-like maniple is that found in the grave of St Cuthbert (9th century); by the 11th century (except in the case of subdeacons, whose maniples would seem to have continued for a while to be cloths in practical use) the maniple had universally assumed its present general form and purely ceremonial character.

The maniple was originally carried in the left hand. In pictures of the 9th, 10th and 11th centuries it is represented as either so carried or as hung over the left fore-arm. By the 12th century the rule according to which it is worn over the left arm had been universally accepted. According to present usage the maniple is put on by priests after the alb and girdle; by deacons and subdeacons after the dalmatic or tunicle; by bishops at the altar after the *Confiteor*, except at masses for the dead, when it is assumed before the stole.[2]

In the East the maniple in its Western form is known only to the Armenians, where it is peculiar to subdeacons. This vestment is not derived from the Roman rite, but is properly a stole, which the subdeacons used to carry in the left hand. It is now laid over the subdeacon's left arm at ordination. The true equivalent of the maniple (in the Greek and Armenian rites only) is not, as has been assumed, the *epimanikion*, a sort of loose, embroidered cuff (see VESTMENTS), but the *epigonation*. This is a square of silk, stiffened with cardboard, surrounded by an embroidered border, and usually decorated in the middle with a cross or a sword (the "sword of the Spirit," which it is supposed to symbolize); sometimes, however, the space within the border is embroidered with pictures. It is worn only by bishops and the higher clergy, and derives its name from the fact that it hangs down over the knee (γόνυ). It is worn on the right side, under the *phelonion*, but when the *sakkos* is worn instead of the *phelonion*, by metropolitans, &c., it is attached to this. The *epigonation*, like the maniple, was originally a cloth held in the hand; a fact sufficiently proved by the ancient name ἐγχείριον (χείρ, hand), which it retained until the 12th century. For convenience' sake this cloth came to be suspended from the girdle on the right side, and is thus represented in the earliest extant paintings (see Braun, p. 552). The name *epigonation*, which appears in the latter half of the 12th century, probably marks the date of the complete conventionalizing of the original cloth into the present stiff embroidered square; but the earliest representations of the vestment in its actual form date from the 14th century, *e.g.* the mosaic of St Athanasius in the chapel of St Zeno in St Mark's at Venice.

See J. Braun, S. J., *Die liturgische Gewandung* (Freiburg im Breisgau, 1907), pp. 515–561, and the bibliography to VESTMENTS.

MANIPUR, a native state on the north-east frontier of India, in political subordination to the lieutenant-governor of Eastern Bengal and Assam. Area, 8456 sq. m. Pop. (1901), 284,465. It is bounded on the N. by the Naga country and the hills overlooking the Assam valley, on the W. by Cachar district, on the E. by Upper Burma, and on the S. by the Lushai hills. The state consists of a wide valley, estimated at about 650 sq. m., and a large surrounding tract of mountainous country. The hill ranges generally run north and south, with occasional connecting spurs and ridges of lower elevation between. Their greatest altitude is in the north, where they reach to upwards of 8000 ft. above sea-level. The principal geographical feature in the valley is the Logtak lake, an irregular sheet of water of considerable size, but said to be yearly growing smaller. The valley is watered by numerous rivers, the Barak being the most important. The hills are densely clothed with tree jungle and large forest timber. Some silk is produced and there are a few primitive manufacturing industries, *e.g.* of pottery. Rice and forest produce, however, are the principal exports. The road from Manipur to the Assam-Bengal railway at Dimapur is the principal trade route.

The kingdom of Manipur, or, as the Burmans call it, Kasse or Kathe, first emerges from obscurity as a neighbour and ally of the Shan kingdom of Pong, which had its capital at Mogaung. The valley appears to have been originally occupied by several tribes which came from different directions. Although their general facial characteristics are Mongolian, there is a great diversity of feature among the Manipuris, some of them showing a regularity approaching the Aryan type. In the valley the people are chiefly Hindus, that religion being of recent introduction. Their own name for themselves is Meithei, and their language is a branch of the Kuki-Chin family, spoken by 273,000 persons in all India in 1901. One of their peculiarities is the high position enjoyed by women, who conduct most of the trade of the valley. They have a caste system of their own, different from that of India, and chiefly founded on the system of *lallup*, or forced labour, which has been abolished by the British. Every male between the ages of seventeen and sixty was formerly obliged to place his services at the disposal of the state for a certain number of days each year, and to different classes of the people different employments were assigned. About four hundred Mahommedan families, descendants of settlers from Bengal, reside to the east of the capital. The aboriginal hillmen belong to one of the two great divisions of Nagas and Kukis, and are subdivided into innumerable clans and sections with slight differences in language, customs or dress. The state is noted for the excellence of its breed of ponies. The English game of polo was introduced from Manipur, where it forms a great national pastime.

The first relations of the British with Manipur date from 1762, when the raja solicited British aid to repel a Burmese invasion, and a treaty was entered into. The force was recalled, and little communication between the two countries took place until 1824, on the outbreak of the first Burmese War. British assistance was again invoked by the raja, and the Burmese were finally expelled from both the Assam and the Manipur valleys. Disputed successions have always been a cause of trouble. The raja, Chandra Kirtti Singh, died in 1886, and was succeeded by his eldest son, Sur Chandra Singh, who appointed his next brother, Kula Chandra Dhuya Singh, *jubraj*, or heir-apparent. In 1890 another brother, the *senapati*, or commander-in-chief, Tikendrajit Singh, dethroned the raja, and installed the *jubraj* as regent, the ex-raja retiring to Calcutta. In March 1891 the chief commissioner of Assam (Quinton) marched to Manipur with 400 Gurkhas, in order to settle the question of succession. His purpose was to recognize the new ruler, but to remove the *senapati*. After some futile negotiations, Quinton sent an ultimatum, requiring the surrender of the *senapati*, by the hands of the political resident, F. Grimwood, but no result followed. An attempt was then made to arrest the *senapati*, but after some sharp fighting, in which Lieut. Brackenbury was killed, he escaped; and the Manipuris then attacked the British residency with an overwhelming force. Quinton was compelled to ask for a parley, and he, Colonel Skene, Grimwood, Cossins and Lieut. Simpson, unarmed, went to the fort to negotiate. They were all there treacherously murdered, and when the news arrived the Gurkhas retreated to Cachar, Mrs Grimwood and the wounded being with them. This led to a military expedition, which did not encounter much resistance. The various columns, converging on Manipur, found it deserted; and the regent, *senapati*, and others were captured during May. After a formal trial the *senapati* and one of the generals of the rebellion were hanged and the regent was transported to the Andaman Islands. But it was decided to preserve the existence of the state, and a child of the ruling family, named Chura Chand, of the age of five, was nominated raja. He was sent to be educated in the Mayo College at Ajmere, and he afterwards served for two years in the imperial cadet corps. Meanwhile the administration was conducted under British supervision. The opportunity was seized for abolishing slavery and unpaid forced labour, a land revenue of Rs. 2 per acre being substituted in the valley and a house-tax in the hills. The boundaries of the state were demarcated, disarmament was carried out, and the construction of roads was pushed forward. In 1901 Manipur was visited by Lord Curzon, on his way from Cachar to Burma. In May 1907 the government of the state was handed over to Chura Chand, who was to be assisted by a council of six Manipuris, with a member of the Indian civil service as vice-president. At the same time it was announced that the government of India would support the raja with all its powers and suppress summarily all attempts to displace him. The revenue is £26,000. The capital is Imphal, which is really an overgrown village; pop. (1901), 67,093.

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[1] According to Father Braun this custom cannot be traced earlier than the 9th century. It forms no essential part of the ordination ceremony (*Liturg. Gewandung*, p. 548).

[2] For the evolution of these rules see Braun, *op. cit.* pp. 546 seq.

See Mrs Ethel St Clair Grimwood, *My Three Years in Manipur* (1891); *Manipur State Gazetteer* (Calcutta, 1905); T. C. Hodson, *The Meitheis* (1908).

MANISA (anc. *Magnesia ad Sipylum*), the chief town of the Saru-khan sanjak of the Aidin (Smyrna) vilayet of Asia Minor, situated in the valley of the Gediz Chai (Hermus), at the foot of Mt Sipylus, and connected by railway with Smyrna and Afium Kara-Hissar. Pop. about 35,000, half being Mussulman. Manisa is an important commercial centre, and contains interesting buildings dating from the times of the Seljuk and early Osmanli sultans, including mosques built by Murad II. and III. and a Mevlevi *Tekke* second only to that at Konia. It is the seat of a flourishing American mission. In 1204 Manisa was occupied by John Ducas, who when he became emperor made it the Byzantine seat of government. In 1305, after the inhabitants had massacred the Catalan garrison, Roger de Flor besieged it unsuccessfully. In 1313 the town was taken by Saru Khan and became the capital of the Turcoman emirate of that name. In 1398 it submitted to the Osmanli sultan Bayezid I., and in 1402 was made a treasure city by Timur. In 1419 it was the scene of the insurrection of the liberal reformer, Bedr ed-Din, which was crushed by Prince Murad, whose residence in the town as Murad II., after twice abdicating the throne, is one of the most romantic stories in Turkish history. In the 17th century Manisa became the residence of the greatest of the Dere Bey families, Kara Osman Oglu, Turcoman by origin, and possibly connected with the former emirs of Sarukhan, which seems to have risen to power by farming the taxes of a province which princes of the house of Othman had often governed and regarded with especial affection. The *liva* of Sarukhan was one of the twenty-two in the Ottoman Empire leased on a life tenure up to the time of Mahmud II. In the 18th century the family of Kara Osman Oglu (or Karasman) ruled *de facto* all west central Anatolia, one member being lord of Bergama and another of Aidin, while the head of the house held Manisa with all the Hermus valley and had greater power in Smyrna than the representative of the capitan pasha in whose province that city nominally lay. Outside their own fiefs the family had so much property that it was commonly said they could sleep in a house of their own at any stage from Smyrna to Baghdad. The last of its great beys was Haji Hussein Zadē, who was frequently called in to Smyrna on the petition of his friends, the European merchants, to assure tranquillity in the troublous times consequent on Napoleon's invasion of Egypt, and the British and Russian attacks on the Porte early in the 19th century. He always acquitted himself well, but having refused to bring his contingent to the grand vizier when on the march to Egypt in 1798, and awakened the jealousy of the capitan pasha, he was in continual danger. Exiled in 1812, he was subsequently restored to Manisa, and died there in 1821. His son succeeded after sanguinary tumults; but Mahmud II., who had long marked the family for destruction, was so hostile towards it, after he had got rid of the janissaries, that it had lost all but the shadow of power by 1830. Descendants survived in Manisa who retained a special right of granting title-deeds within the district, independent of the local administration. (D. G. H.)

MANISTEE, a city and the county-seat of Manistee county, Michigan, U.S.A., on the Manistee river (which here broadens into a small lake) near its entrance into Lake Michigan, about 114 m. W.N.W. of Grand Rapids. Pop. (1890), 12,812; (1900), 14,260 (4966 foreign-born); (1904, state census), 12,708; (1910), 12,381. It is served by the Père Marquette, the Manistee & Grand Rapids, the Manistee & North-Eastern, and the Manistee & Luther railways, and by steamboat lines to Chicago, Milwaukee and other lake ports. The channel between Lake Manistee and Lake Michigan has been considerably improved since 1867 by the Federal government. There is a United States life-saving station at the harbour entrance. The city has a county normal school, a school for the deaf and dumb, a domestic science and manual training school, a business college, and a Carnegie library. Manistee is a summer resort, with good trout streams and well-known brine-baths. One mile from the city limits, on Lake Michigan, is Orchard Beach, a bathing resort, connected with the city by electric railway; and about 9 m. north of Manistee is Portage Lake (about 2 m. long and 1 m. wide), a fishing resort and harbour of refuge (with a good channel from Lake Michigan), connected with the city by steamboat and railway. Manistee has large lumber interests, is the centre of an extensive fruit-growing region, and has various manufactures, including lumber and salt.[1] The total value of the factory product in 1904 was $3,256,601. The municipality owns and operates its waterworks. Manistee (the name being taken from a former Ottawa Indian village, probably on Little Traverse Bay, Mich.) was settled about 1849, and was chartered as a city in 1869, the charter of that year being revised in 1890.

MANITOBA, a lake of Manitoba province, Canada, situated between 50° 11′ and 51° 48′ N. and 97° 56′ and 99° 35′ W. It has an area of 1711 sq. m., a length of shore line of 535 m., and is at an altitude of 810 ft. above the sea. It has a total length of 119 m., a maximum width of 29 m., discharge of 14,833 cub. ft.

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[1] There is a very large salt block at Eastlake, 1 m. east of Manistee, and Filer City, a few miles south-east, is another source of supply.

per second, and has an average depth of 12 ft. Its shores are low, and for the most part swampy. The Waterhen river, which carries the discharge of Lake Winnipegosis, is the only considerable stream entering the lake. It is drained by the Little Saskatchewan river into Lake Winnipeg. It was discovered by De la Verendrye in 1739.

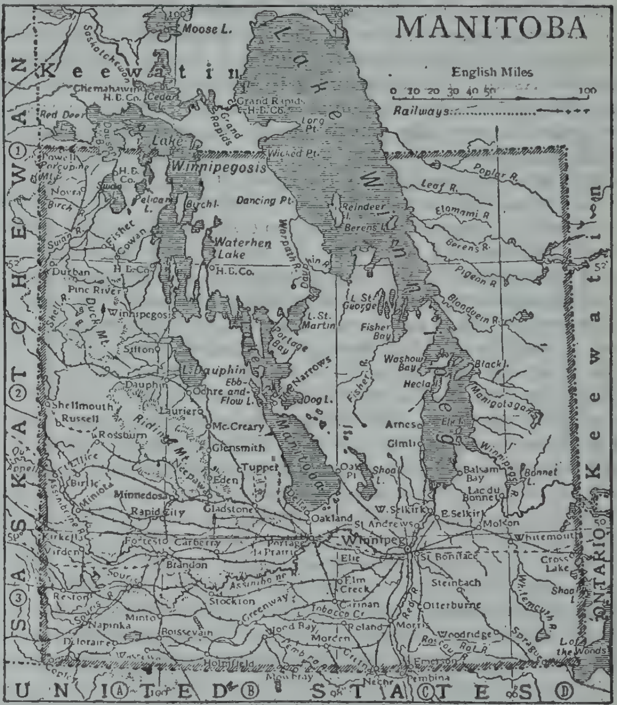
MANITOBA, one of the western provinces of the Dominion of Canada, situated midway between the Atlantic and the Pacific coasts of the Dominion, about 1090 m. due west of Quebec. It is bounded S. by the parallel 49° N., which divides it from the United States; W. by 101° 20′ W.; N. by 52° 50′ N.; and E. by the western boundary of Ontario. Manitoba formerly belonged to the Hudson's Bay Company, and after the transfer of its territory to Canada was admitted in 1870 as the fifth province of the Dominion. At that time the infant province had an area of 13,500 sq. m., and some 12,000 people, chiefly Indian half-breeds. In 1881 the limits were increased as above, and the province now contains upwards of 73,956 sq. m., extending 264 m. from north to south and upwards of 300 from east to west. The old district of Assiniboia, the result of the efforts in colonization by the earl of Selkirk in 1811 and succeeding years, was the nucleus of the province.

The name Manitoba sprang from the union of two Indian words, *Manito* (the Great Spirit), and *Waba* (the "narrows" of the lake, which may readily be seen on the map). This well-known strait was a sacred place to the Crees and Saulteaux, who, impressed by the weird sound made by the wind as it rushed through the narrows, as simple children of the prairies called them *Manito-Waba*, or the "Great Spirit's narrows." The name, arising from this unusual sound, has been by metonymy translated into "God's Voice." The word was afterwards contracted into its present form. As there is no accent in Indian words, the natural pronunciation of this name would be Mān-ī-tō-bā. On this account, the custom of both the French and English people of the country was for years before and for several years after 1870 to pronounce it Mān-ĭ-tŏ-bā, and even in some cases to spell it "Manitobah." After the formation of the province and the familiar use of the provincial name in the Dominion parliament, where it has occupied much attention for a generation, the pronunciation has changed, so that the province is universally known from ocean to ocean as Mān-ĭ-tō-bă.

Physical Features.—The drainage of Manitoba is entirely north-eastward to Hudson Bay. The three lakes—whose greatest lengths are 260, 122 and 119 m. respectively—are Winnipeg, Winnipegosis and Manitoba. They are all of irregular shape, but average respectively 30, 18 and 10 m. in width. They are fresh, shallow and tideless. Winnipegosis and Manitoba at high water, in spring-time, discharge their overflow through small streams into Winnipeg. The chief rivers emptying into Lake Winnipeg are the Winnipeg, the Red and the Saskatchewan. The Assiniboine river enters the Red river 45 m. from Lake Winnipeg, and at the confluence of the rivers ("The Forks") is situated the city of Winnipeg. The Winnipeg, which flows from the territory lying south-east of Lake Winnipeg, is a noble river some 200 m. long, which after leaving Lake of the Woods dashes with its clear water over many cascades, and traverses very beautiful scenery. At its falls from Lake of the Woods is one of the greatest and most easily utilized water-powers in the world, and from falls lower down the river electric power for the city of Winnipeg is obtained. The Red river is at intervals subject to freshets. In a century's experience of the Selkirk colonists there have been four "floods." The highest level of the site of the city of Winnipeg is said to have been under 5 ft. of water for several weeks in May and June in 1826, and 2½ ft. in 1852, not covered in 1861; only the lowest levels were under water in 1882. The extent of overflow has thus on each occasion been less. The loose soil on the banks of the river is every year carried away in great masses, and the channel has so widened as to render the recurrence of an overflow unlikely. The Saskatchewan, though not in the province, empties into Lake Winnipeg less than half a degree from the northern boundary. It is a mighty river, rising in the Rocky Mountains, and crossing eighteen degrees of longitude. Near its mouth are the Grand Rapids. Above these steamers ply to Fort Edmonton, a point upwards of 800 m. north-west of the city of Winnipeg. Steamers run from Grand Rapids, through Lake Winnipeg, up Red river to the city of Winnipeg, important locks having been constructed on the river at St Andrews.

The surface of Manitoba is somewhat level and monotonous. It is chiefly a prairie region, with treeless plains of from 5 to 40 m. extent, covered in summer with an exuberant vegetable growth, which dies every year. The river banks, however, are fringed with trees, and in the more undulating lands the timber belts vary from a few hundreds of yards to 5 or 10 m. in width, forming at times forests of no inconsiderable size. The chief trees of the country are the aspen (*Populus tremuloides*), the ash-leaved maple (*Negundo aceroides*), oak (*Quercus alba*), elm (*Ulmus Americana*), and many varieties of willow. The strawberry, raspberry, currant, plum, cherry and grape are indigenous.

Climate.—The climate of Manitoba, being that of a region of wide extent and of similar conditions, is not subject to frequent variations. Winter, with cold but clear and bracing weather, usually sets in about the middle of November, and ends with March. In April and May the rivers have opened, the snow has disappeared, and the opportunity has been afforded the farmer of sowing his grain. June is often wet, but most favourable for the springing crops; July and August are warm, but, excepting two or three days at a time, not uncomfortably so; while the autumn weeks of late August and September are very pleasant. Harvest generally extends from the middle of August to near the end of September. The chief crops of the farmer are wheat (which from its flinty hardness and full kernel is the specialty of the Canadian north-west), oats, barley and pease. Hay is made of the native prairie grasses, which grow luxuriantly. From the richness and mellowness of the soil potatoes and all tap-roots reach a great size. Heavy dews in summer give the needed moisture after the rains of June have ceased. The traveller and farmer are at times annoyed by the mosquito.


MANITOBA
English Miles
0 10 20 30 40 50 100
Railways
Keewatin
SASKATCHEWAN
ONTARIO
UNITED STATES
Moose L.
Chemahawin H.B.Co.
Cedar
Grand Rapids H.B.Co.
Long Pt.
Red Deer
Lake Winnipegosis
Wicked Pt.
Poplar R.
Leaf R.
Elomami R.
Berens R.
Pigeon R.
Bloodvein R.
Dancing Pt.
Reindeer I.
Berens I.
Waterhen Lake
H.B.Co.
Swan R.
Durban
Pine River
Winnipegosis
Sifton
L. Dauphin
Dauphin
Ochre
Ebb-and-Flow L.
The Narrows
Dog L.
Portage Bay
L. St. Martin
L. St. George
Fisher Bay
Fisher R.
Washow Bay
Hecla I.
Black I.
Manigotagan
Arnes
Gimli
Balsam Bay
Lac du Bonnet
Bonnet L.
Shellmouth
Russell
Rossburn
Riding Mt.
Laurier
McCreary
Glensmith
Tupper
Eden
Neepawa
Minnedosa
Rapid City
Gladstone
Birtle
Minota
Oakland
W. Selkirk
E. Selkirk
St Andrews
Molson
Whitemouth
Winnipeg
St Boniface
Kirkella
Virden
Fortescue
Carberry
Portage la Prairie
Elie
Brandon
Souris
Assiniboine R.
Elm Creek
Carman
Steinbach
Cross Lake
Shoal L.
Otterburne
Reston
Stockton
Greenway
Tobacco Cr.
Minto
Napinka
Boissevain
Roland
Morris
Woodridge
Red R.
Deloraine
Morden
Emerson
Pembina
Holmfield
Lake of the Woods
Whitemouth R.
Sprague

Emery Walker sc.

Area and Population.—The area is 73,956 sq. m., of which 64,066 are land and 9890 water. Pop. (1871), 18,995; (1881), 62,260; (1891), 152,506; (1901), 254,947 (138,332 males, 116,615 females); (1906), 365,688 (205,183 males and 160,505 females). The principal cities and towns are: Winnipeg (90,153), Brandon (10,408), Portage la Prairie (5106), St Boniface (5119), West Selkirk (2701), and Morden (1437). In 1901, 49,102 families inhabited 48,415 houses, and the proportion of the urban population to the rural was 27·5 to 72·5. Classified according to place of birth, the principal nationalities were as follows in 1901: Canada, 180,853; England, 20,392; Scotland, 8099; Ireland, 4537; other British possessions, 490; Germany, 2291; Iceland, 5403; Austria, 11,570; Russia and Poland, 8854; Scandinavia, 1772; United States, 6922; other countries, 4028. In 1901 the Indians numbered 5827; half-breeds, 10,372. Of the Indian half-breeds, one half are of English-speaking parentage, and chiefly of Orkney origin; the remainder are known as Metis or Bois-brûlés, and are descended from French-Canadian voyageurs. In 1875 a number of Russian Mennonites (descendants of the Anabaptists of the Reformation) came to the country. They originally emigrated from Germany to the plains of southern Russia, but came over to Manitoba to escape the conscription. They number upwards of 15,000. About 4000 French Canadians, who had emigrated from Quebec to the United States, have also made the province their home, as well as Icelanders now numbering 20,000. During the decade ending 1907 large reserves were settled with Ruthenians often known as Galicians, Poles and other peoples from central and northern Europe. Some 30,000 of these are found in the province. The remainder of the population is chiefly made up of English-speaking people from the other provinces of the Dominion, from the United States, from England and Scotland and the north of Ireland.

Religion.—Classified according to religion, the various denominations were, in 1901, as follows: Presbyterians, 65,310; Episcopalians, 44,874; Methodists, 49,909; Roman Catholics, 35,622; Baptists, 9098; Lutherans, 16,473; Mennonites, 15,222; Greek Catholics, 7898; other denominations, 9903; not specified, 638.

Government.—The province is under a lieutenant-governor, appointed for a term of five years, with an executive council of six members, responsible to the local legislature, which consists of forty-two members. It has four members in the Canadian Senate and ten in the House of Commons.

Education.—The dual system of education, established in 1871, was abolished in 1890, and the administrative machinery consolidated under a minister of the Crown and an advisory board. This act was amended in 1897 to meet the wishes of the Roman Catholic minority, but separate schools were not re-established; nor was the council divided into denominational committees. There are collegiate institutes for more advanced education at Winnipeg, Brandon and Portage la Prairie, with a total of 1094 pupils enrolled. There is also a normal school at Winnipeg for the training of teachers. Higher education is represented by the provincial university, which teaches science and mathematics, holds examinations, distributes scholarships, and grants degrees in all subjects. It has affiliated to it colleges of the Roman Catholic, Episcopalian, Presbyterian and Methodist denominations, with medical and pharmaceutical colleges. The arts colleges of the churches carry on the several courses required by the university, and send their students to the examinations of the university. A well-equipped agricultural college near Winnipeg is provided for sons and daughters of farmers.

Agriculture is the prevailing industry of Manitoba. Dairy-farming is rapidly increasing in importance, and creameries for the manufacture of butter and cheese are established in almost all parts of the province. Large numbers of horses, cattle, swine and poultry are reared. The growth of cereals is the largest department of agriculture followed.

The following statistics are interesting:—

	1883.	1890.	1894.	1901.
	Bushels.	Bushels.	Bushels.	Bushels.
Wheat	5,686,355	14,665,769	17,172,883	50,502,085
Oats	9,478,965	9,513,443	11,907,854	27,796,588
Barley	1,898,430	2,069,415	2,981,716	6,536,155
Flax	No statistics collected.		366,000	266,420
Rye	,,	,,	59,924	62,261
Peas	,,	,,	18,434	16,349
Potatoes	,,	,,	2,035,336	4,797,433
Other roots	,,	,,	1,841,942	2,925,362

The enormous development of the wheat-growing industry is shown by these and the following statistics:—

Wheat inspected in Winnipeg.

1902	51,833,000 bushels
1903	40,396,650 ,,
1904	39,784,900 ,,
1905	55,849,840 ,,
1906	66,636,390 ,,

These figures do not include the wheat ground into flour and sent by way of British Columbia to Asia and Australia, nor the wheat retained by the farmers for seed. The Dominion government maintains an experimental farm of 670 acres at Brandon. The fisheries are all fresh-water, principally white-fish, pickerel and pike. Large quantities of fresh fish caught in lakes Winnipeg and Manitoba are exported to all parts of the United States.

Communications.—The region of the Red River and Assiniboine valleys was opened up by the fur traders, who came by the waterways from Lake Superior, and afterwards by the water communication with Hudson Bay. While these early traders used the canoe and the York boat,[1] yet the steam-boat played an important part in the early history of the region from 1868 till 1885, when access from the United States was gained by steamers down the Red River. The completion of the St Andrew's Rapids canal on Red River, and the Grand Rapids canal on the Saskatchewan river will again give an impetus to inland navigation on the tributaries of Lake Winnipeg. Lake Manitoba also affords opportunity for inland shipping.

The broad expanse of prairie-land in the western provinces of Canada is well suited for the cheap and expeditious building of railways. The first connexion with the United States was by two railways coming down the Red River valley. But the desire for Canadian unity led the Dominion to assist a transcontinental line connecting Manitoba with eastern Canada. The building of the Canadian Pacific railway through almost continuous rocks for 800 miles was one of the greatest engineering feats of modern times. Immediately on the formation of the Canadian Pacific railway company branch lines were begun at Winnipeg and there are eight radial lines running from this centre to all parts of the country. Winnipeg is thus connected with Montreal on the east, and Vancouver on the west, and is the central point of the Canadian Pacific system, having railway yards and equipment equalled by few places in America. In opposition to the Canadian Pacific railway a southern line was built from Winnipeg to the American boundary. This fell into the hands of the Northern Pacific railway, but was purchased by the promoters of the Canadian Northern railway. This railway has six radiating lines leaving the city of Winnipeg, and its main line connects Port Arthur on Lake Superior with Edmonton in the west. The Canadian Northern railway has a remarkable network of railways connecting Winnipeg with every corner of Manitoba. The Great Northern railway has also three branch lines in Manitoba and one of these has Winnipeg as its terminus. The grand Trunk Pacific railway, the great transcontinental line promoted by the Laurier government, passes through Manitoba north of the Canadian Pacific, coming from the east deflects southward to pass through Winnipeg, and then strikes northward in a direct line of easy gradients to find its way through the Rocky Mountains to its terminus of Prince Rupert on the north coast of British Columbia.

History.—The first white settlement in Manitoba was made by Pierre Gaultier de Varennes, Sieur de la Verendrye (d. 1749), who, gradually pushing westward from Lake Superior, reached Lake Winnipeg in 1733, and in the following year built a fort not far from the present Fort Alexander. In October 1738 he built another at Fort Rouge, at the junction of the Red and Assiniboine rivers, where is now the city of Winnipeg. After the British conquest of 1763 the west became the scene of a rapidly increasing fur trade, and for many years there was keen rivalry between the Hudson's Bay Company, with its headquarters in England, and the North-West Company of Montreal. French and Scottish farmers and fur-traders gradually settled along the Red River, and by their frequent marriages with the Indians produced a race of metis or half-breeds. From 1811 to 1818 Lord Selkirk's attempted colonization greatly increased the population; from the time of his failure till 1869 the settlers lived quietly under the mild rule of the Hudson's Bay Company. In that year the newly formed Dominion of Canada bought from the company its territorial and political rights. A too hasty occupation by Canadian officials and settlers led to the rebellion of the Metis under Louis Riel, a native leader. The rebellion was quieted and Sir Garnet Wolseley (now Lord Wolseley) was sent from Canada by the lake route, with several regiments of troops—regulars and volunteers. The Manitoba Act constituting the province was passed by the Canadian parliament in 1870. (See RED RIVER SETTLEMENT; and RIEL, LOUIS.)

The admixture of races and religions, and its position as the key to the great West, have ever since made Manitoba the storm centre of Canadian politics. In the charter granted by the Canadian parliament to the Canadian Pacific railway a clause giving it for twenty years control over the railway construction of the province led to a fierce agitation, till the clause was repealed in 1888. Till 1884 an equally fierce agitation was carried on against Ontario with regard to the eastern boundary of Manitoba. (See ONTARIO.) In both these disputes the provincial leader was the Hon. John Norquay, in whose veins ran a large admixture of Indian blood. In 1890 changes in the school system unfavourable to the Roman Catholic Church led to a constitutional struggle, to which was due the defeat of the Federal ministry in 1896. Since 1896 its rapid material progress has produced numerous economic problems and disputes, many of which are still unsolved.

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[1] A round-bottomed, strongly built boat, 30 to 36 ft. long, propelled by 8 men. It was devised by the Hudson's Bay Company for carrying freight, as a substitute for the less serviceable canoe, and was named after their York factory, the centre to which the traders brought down the furs for shipment to England and from which they took back merchandise and supplies to the interior of Rupert's Land.

(G. BR.; W. L. G.)

MANITOU or MANITO (Algonquian Indian, "mystery," "supernatural"), among certain American Indian tribes, a spirit or genius of good or evil. The manitou is almost always an animal, each individual having one assigned him, generally by dream-inspiration, at the greatest religious act of his life—his first fast. This animal then becomes his fetish; its skin is carried as a charm, and representations of it are tattooed and painted on the body or engraved on the weapons.

MANITOWOC (Indian, "Spirit-land"), a city and the county-seat of Manitowoc county, Wisconsin, on the W. shore of Lake Michigan, 75 m. N. of Milwaukee. Pop. (1890), 7710; (1900), 11,786, of whom 2998 were foreign-born; (1910 census), 13,027. It is served by the Chicago & North-Western, and the Wisconsin Central railways; by ferry across the lake to Frankfort, Mich., and Ludington, Mich.; by the Ann Arbor and the Père Marquette railways; and by the Goodrich line of lake steamers. The city is finely situated on high ground above the lake at the mouth of the Manitowoc river. At Manitowoc are the county insane asylum and a Polish orphan asylum. The city has a training school for county teachers, a business college, two hospitals and a Carnegie library. There are ship-yards for the construction of both steel and wooden vessels, and several grain elevators. The value of the factory products increased from $1,935,442 in 1900 to $4,427,816 in 1905, or 128·8 per cent.—a greater increase than that of any other city in the state during this period. There is a good harbour, and the city has a considerable lake commerce in grain, flour, and dairy products. Jacques Vieau established here a post for the North-west Company of fur traders in 1795. The first permanent settlement was made about 1836, and Manitowoc was chartered as a city in 1870. In Manitowoc county, 18 m. south-west of the city of Manitowoc, is St Nazianz, an unorganized village near which in 1854 a colony or community of German Roman Catholics was established under the leadership of Father Ambrose Oswald, the primary object being to enable poor people by combination and co-operation to supply themselves with the comforts of life at minimum expense and have as much time as possible left for religious thought and worship. The title of the colony's land was vested in Father Oswald after the panic of 1857 until his death in 1874, when he devised the lands to "the colony founded by me." The colony had no legal existence at the time, but was then incorporated as the "Roman Catholic Religious Society of St Nazianz," and as such sued successfully for the bequest. Financially the colony was successful, but as there were some desertions and no new recruits after Father Oswald's death, there were few members by 1909. There are no longer any traces of communism, and the colony's property is actually held by an organization of the local Roman Catholic church.

MANIZALES, a city of Colombia and capital of the department of Cáldas (up to 1905 the northern part of Antioquia, 75 m. S. of Medellin, on the old trade route across the Cordillera between Honda, on the Magdalena, and the Cauca Valley. Pop. (1906, estimate), 20,000. The city is situated on a plateau of the western slope of the Cordillera, 6988 ft. above the sea. It is surrounded by rich mineral and agricultural districts.

MANKATO, a city and the county-seat of Blue Earth county, Minnesota, U.S.A., at the southern bend of the Minnesota river, where it is joined by the Blue Earth about 86 m. S.W. of Minneapolis. Pop. (1890), 8838; (1900), 10,599, of whom 2578 were foreign-born; (1910 census), 10,365. Mankato is served by the Chicago, St. Paul, Minneapolis & Omaha, the Chicago & North-Western (both "North-Western Lines"), the Chicago, Milwaukee & St Paul, and the Chicago Great-Western railways. The city has two fine parks, a Carnegie library, a Federal building, the Immanuel and St Joseph hospitals, two commercial colleges, and a state normal school (1868). The numerous lakes in the neighbourhood, particularly Lake Madison and Lake Washington, are widely known as summer resorts. Four miles west of the city is Minneopa state park (area, 60 acres), in which are Minneopa Falls (60 ft.) and a fine gorge; the park was established by the state in 1905–1906. Mankato has an extensive trade in dairy and agricultural products (especially grain), stone (a pinkish buff limestone is quarried in the vicinity), and forest products. The value of its factory products increased from $1,887,315 in 1900 to $3,422,117 in 1905, or 81·3%.

Mankato was settled about 1853, and was first chartered as a city in 1868. On or near the site of the city stood a village of the Mankato ("blue earth") band of the Mdewakanton Sioux, who derived their name from one of their chiefs, "Old Mankato." In this region occurred the Sioux uprising of 1862, and from this point operations were carried on which eventually resulted in the subjugation of the Indians and the hanging, at Mankato, in December 1862, of 38 leaders of the revolt. In the uprising the Mankato band was led by another chief named Mankato, who took part in the attack on Ft Ridgeley, Minn., in August, in the engagement on the 3rd of September at Birch Coolie, Minn., and in that on the 23rd of September at Wood Lake, where he was killed.

MANLEY, MARY DE LA RIVIERE (*c.* 1663–1724), English writer, daughter of Sir Roger Manley, governor of the Channel Islands, was born on the 7th of April 1663 in Jersey. She wrote her own biography under the title of *The Adventures of Rivella, or the History of the Author of the Atalantis* by "Sir Charles Lovemore" (1714). According to her own account she was left an orphan at the age of sixteen, and beguiled into a mock marriage with a kinsman who deserted her basely three years afterwards. She was patronized for a short time by the duchess of Cleveland, and wrote an unsuccessful comedy, *The Lost Lover* (1696); in freedom of speech she equalled the most licentious writers of comedy in that generation. Her tragedy, *The Royal Mischief* (1696) was more successful. From 1696 Mrs Manley was a favourite member of witty and fashionable society. In 1705 appeared *The Secret History of Queen Zarah and the Zarazians*, a satire on Sarah, duchess of Marlborough, in the guise of romance. This was probably by Mrs Manley, who, four years later, achieved her principal triumph as a writer by her *Secret Memoirs . . . . of Several Persons of Quality* (1709), a scandalous chronicle "from the New Atalantis, an island in the Mediterranean." She was arrested in the autumn of 1709 as the author of a libellous publication, but was discharged by the court of queen's bench on the 13th of February 1710. Mrs Manley sought in this scandalous narrative to expose the private vices of the ministers whom Swift, Bolingbroke and Harley combined to drive from office. During the keen political campaign in 1711 she wrote several pamphlets, and many numbers of the *Examiner*, criticizing persons and policy with equal vivacity. Later were published her tragedy *Lucius* (1717); *The Power of Love, in Seven Novels* (1720), and *A Stage Coach Journey to Exeter* (1725).

MANLIUS, the name of a Roman gens, chiefly patrician, but containing plebeian families also.

1. MARCUS MANLIUS CAPITOLINUS, a patrician, consul 392 B.C. According to tradition, when in 390 B.C. the besieging Gauls were attempting to scale the Capitol, he was roused by the cackling of the sacred geese, rushed to the spot and threw down the foremost assailants (Livy v. 47; Plutarch, *Camillus*, 27).

Several years after, seeing a centurion led to prison for debt, he freed him with his own money, and even sold his estate to relieve other poor debtors, while he accused the senate of embezzling public money. He was charged with aspiring to kingly power, and condemned by the comitia, but not until the assembly had adjourned to a place without the walls, where they could no longer see the Capitol which he had saved. His house on the Capitol (the origin of his surname) was razed, and the Manlii resolved that henceforth no patrician Manlius should bear the name of Marcus. According to Mommsen, the story of the saving of the Capitol was a later invention to explain his surname, and his attempt to relieve the debtors a fiction of the times of Cinna.

Livy vi. 14–20; Plutarch, *Camillus*, 36; Cicero, *De domo*, 38.

2. Titus Manlius Imperiosus Torquatus, twice dictator (353, 349 B.C.) and three times consul (347, 344, 340). When his father, L. Manlius Imperiosus (dictator 363), was brought to trial by the tribune M. Pomponius for abusing his office of dictator, he forced Pomponius to drop the accusation by threatening his life (Livy vii. 3–5). In 360, during a war with the Gauls, he slew one of the enemy, a man of gigantic stature, in single combat, and took from him a *torques* (neck-ornament), whence his surname. When the Latins demanded an equal share in the government of the confederacy, Manlius vowed to kill with his own hand the first Latin he saw in the senate-house. The Latins and Campanians revolted, and Manlius, consul for the third time, marched into Campania and gained two great victories, near Vesuvius, where P. Decius Mus (*q.v.*), his colleague, "devoted" himself in order to gain the day, and at Trifanum. In this campaign Manlius executed his own son, who had killed an enemy in single combat, and thus disobeyed the express command of the consuls.

Livy vii. 4, 10, 27, viii. 3; Cicero, *De off.* iii. 31.

3. Titus Manlius Torquatus, consul 235 B.C. and 224, censor 231, dictator 208. In his first consulship he subjugated Sardinia, recently acquired from the Carthaginians, when the temple of Janus was shut for the second time in Roman history (Livy i. 19). In 216 he opposed the ransoming of the Romans taken prisoners at Cannae; and in 215 he was sent to Sardinia and defeated a Carthaginian attempt to regain possession of the island.

Livy xxiii. 34; Polybius ii. 31.

4. Gnaeus Manlius Vulso, praetor 195, consul 189. He was sent to Asia to conclude peace with Antiochus III., king of Syria. He marched into Pamphylia, defeated the Celts of Galatia on Mt Olympus and drove them back across the Halys. In the winter, assisted by ten delegates sent from Rome, he settled the terms of peace with Antiochus, and in 187 received the honour of a triumph.

Polybius xxii. 16–25; Livy xxxviii. 12–28, 37–50; xxxix. 6.

MANN, HORACE (1796–1859), American educationist, was born in Franklin, Massachusetts, on the 4th of May 1796. His childhood and youth were passed in poverty, and his health was early impaired by hard manual labour. His only means for gratifying his eager desire for books was the small library founded in his native town by Benjamin Franklin and consisting principally of histories and treatises on theology. At the age of twenty he was fitted, in six months, for college, and in 1819, graduated with highest honours, from the Brown University at Providence, Rhode Island, having devoted himself so unremittingly to his studies as to weaken further his naturally feeble constitution. He then studied law for a short time at Wrentham, Massachusetts; was tutor in Latin and Greek (1820–1822) and librarian (1821–1823) at Brown University; studied during 1821–1823 in the famous law school conducted by Judge James Gould at Litchfield, Connecticut; and in 1823 was admitted to the Norfolk (Mass.) bar. For fourteen years, first at Dedham, Massachusetts, and after 1833 at Boston, he devoted himself, with great success, to his profession. Meanwhile he served, with conspicuous ailbity, in the Massachusetts House of Representatives from 1827 to 1833 and in the Massachusetts Senate from 1833 to 1837, for the last two years as president. It was not until he became secretary (1837) of the newly created board of education of Massachusetts, that be began the work which was soon to place him in the foremost rank of American educationists. He held this position till 1848, and worked with a remarkable intensity—holding teachers' conventions, delivering numerous lectures and addresses, carrying on an extensive correspondence, introducing numerous reforms, planning and inaugurating the Massachusetts normal school system, founding and editing *The Common School Journal* (1838), and preparing a series of *Annual Reports*, which had a wide circulation and are still considered as being "among the best expositions, if, indeed, they are not the very best ones, of the practical benefits of a common school education both to the individual and to the state" (Hinsdale). The practical result of his work was the virtual revolutionizing of the common school system of Massachusetts, and indirectly of the common school systems of other states. In carrying out his work he met with bitter opposition, being attacked particularly by certain school-masters of Boston who strongly disapproved of his pedagogical theories and innovations, and by various religious sectaries, who contended against the exclusion of all sectarian instruction from the schools. He answered these attacks in kind, sometimes perhaps with unnecessary vehemence and rancour, but he never faltered in his work, and, an optimist by nature, a disciple of his friend George Combe (*q.v.*), and a believer in the indefinite improvability of mankind, he was sustained throughout by his conviction that nothing could so much benefit the race, morally, intellectually and materially, as education. Resigning the secretaryship in 1848, he was elected to the national House of Representatives as an anti-slavery Whig to succeed John Quincy Adams, and was re-elected in 1849, and, as an independent candidate, in 1850, serving until March 1853. In 1852 he was the candidate of the Free-soilers for the governorship of Massachusetts, but was defeated. In Congress he was one of the ablest opponents of slavery, contending particularly against the Compromise Measures of 1850, but he was never technically an Abolitionist and he disapproved of the Radicalism of Garrison and his followers. From 1853 until his death, on the second of August 1859, he was president of the newly established Antioch College at Yellow Springs, Ohio, where he taught political economy, intellectual and moral philosophy, and natural theology. The college received insufficient financial support and suffered from the attacks of religious sectaries—he himself was charged with insincerity because, previously a Unitarian, he joined the Christian Connexion, by which the college was founded—but he earned the love of his students, and by his many addresses exerted a beneficial influence upon education in the Middle West.

A collected edition of Mann's writings, together with a memoir (1 vol.) by his second wife, Mary Peabody Mann, a sister of Miss E. P. Peabody, was published (in 5 vols. at Boston in 1867–1891) as the *Life and Works of Horace Mann*. Of subsequent biographies the best is probably Burke A. Hinsdale's *Horace Mann and the Common School Revival in the United States* (New York, 1898), in "The Great Educators" series. Among other biographies O. H. Lang's *Horace Mann, his Life and Work* (New York, 1893), Albert E. Winship's *Horace Mann, the Educator* (Boston, 1896), and George A. Hubbell's *Life of Horace Mann, Educator, Patriot and Reformer* (Philadelphia, 1910), may be mentioned. In vol. I. of the *Report* for 1895–1896 of the United States commissioner of education there is a detailed "Bibliography of Horace Mann," containing more than 700 titles.

MANNA, a concrete saccharine exudation obtained by making incisions on the trunk of the flowering or manna ash tree, *Fraxinus Ornus*. The manna ash is a small tree found in Italy, and extending to Switzerland, South Tirol, Hungary, Greece, Turkey and Asia Minor. It also grows in the islands of Sicily, Corsica and Sardinia. It blossoms early in summer, producing numerous clusters of whitish flowers. At the present day the manna of commerce is collected exclusively in Sicily from cultivated trees, chiefly in the districts around Capaci, Carini, Cinisi and Favarota, small towns 20 to 25 m. W. of Palermo, and in the townships of Geraci, Castelbuono, and other places in the district of Cefalù, 50 to 70 m. E. of Palermo. In the *frassinetti* or plantations the trees are placed about 7 ft. apart, and after they are eight years old, and the trunk at least 3 in. in diameter, the collection of manna is begun. This operation is performed in July or August during the dry weather, by making transverse incisions 1½ to 2 in. long, and about 1 in. apart, through the bark, one cut being made each day, the first at the bottom of the tree, another directly above the first, and so on. In succeeding years the process is repeated on the untouched sides of the trunk, until the tree has been cut all round and exhausted. It is then cut down, and a young plant arising from the same root takes its place. The finest or flaky manna appears to have been allowed to harden on the stem. A very superior kind, obtained by allowing the juice to encrust pieces of wood or straws inserted in the cuts, is called *manna a cannolo*. The fragments adhering to the stem, after the finest flakes have been removed are scraped off, and form the small or Tolfa manna of commerce. That which flows from the lower incisions is often collected on tiles or on a concave piece of the prickly pear (*Opuntia*), but is less crystalline and more glutinous, and is less esteemed.

Manna of good quality dissolves at ordinary temperatures in about 6 parts of water, forming a clear liquid. Its chief constituent is mannite or manna sugar, a hexatomic alcohol, $C_6H_8(OH)_6$, which likewise occurs, in much smaller quantity, in certain species of the brown seaweed, *Fucus*, and in plants of several widely separated natural orders. Mannite is obtained by extracting manna with alcohol and crystallizing the solution. The best manna contains 70 to 80%. It crystallizes in shining rhombic prisms from its aqueous solution and as delicate needles from alcohol. Manna possesses mildly laxative properties, and on account of its sweet taste is employed as a mild aperient for children. It is less used in England now than formerly, but is still largely consumed in South America. In Italy mannite is prepared for sale in the shape of small cones resembling loaf sugar in shape, and is frequently prescribed in medicine instead of manna.

The manna of the present day appears to have been unknown before the 15th century, although a mountain in Sicily with the Arabic name Gibelman, *i.e.* "manna mountain," appears to point to its collection there during the period that the island was held by the Saracens, 827–1070. In the 16th century it was collected in Calabria, and until recently was produced in the Tuscan Maremma, but none is now brought into commerce from Italy, although the name of Tolfa, a town near Civita Vecchia, is still applied to an inferior variety of the drug.

Various other kinds of manna are known, but none of these has been found to contain mannite. Alhagi manna (Persian and Arabic *tar-angubīn*, also known as terendschabin) is the produce of *Alhagi maurorum*, a small, spiny, leguminous plant, growing in Arabia, Asia Minor, Persia, Afghanistan, Baluchistan and northern India. This manna occurs in the form of small, roundish, hard, dry tears, varying from the size of a mustard seed to that of a coriander, of a light-brown colour, sweet taste, and senna-like odour. The spines and pods of the plant are often mixed with it. It is collected near Kandahar and Herat, and imported into India from Cabul and Kandahar. Tamarisk manna (Persian *gaz-angubīn*, tamarisk honey) exudes in June and July from the slender branches of *Tamarix gallica*, var. *mannifera*, in the form of honey-like drops, which, in the cold temperature of the early morning, are found in the solid state. This secretion is caused by the puncture of an insect, *Coccus manniparus*. In the valleys of the peninsula of Sinai, especially in the Wādy el-Sheikh, this manna (Arabic *man*) is collected by the Arabs and sold to the monks of St Catherine, who supply it to the pilgrims visiting the convent. It is found also in Persia and the Punjab, but does not appear to be collected in any quantity. This kind of manna seems to be alluded to by Herodotus (vii. 31). Under the same name of *gaz-angubīn* there are sold commonly in the Persian bazaars round cakes, of which a chief ingredient is a manna obtained to the south-west of Ispahan, in the month of August, by shaking the branches or scraping the stems of *Astragalus florulentus* and *A. adscendens*.[1] *Shir Khist*, a manna known to writers on materia medica in the 16th century, is imported into India from Afghanistan and Turkestan to a limited extent; it is the produce of *Cotoneaster nummularia* (*Rosaceae*), and to a less extent of *Atraphaxis spinosa* (*Polygonaceae*); it is brought chiefly from Herat.

Oak manna or *Gueze-elefi*, according to Haussknecht, is collected from the twigs of *Quercus Vallonia* and *Q. persica*, on which it is produced by the puncture of an insect during the month of August. This manna occurs in the state of agglutinated tears, and forms an object of some industry among the wandering tribes of Kurdistan. It is collected before sunrise, by shaking the grains of manna on to linen cloths spread out beneath the trees, or by dipping the small branches in hot water and evaporating the solution thus obtained. A substance collected by the inhabitants of Laristan from *Pyrus glabra* strongly resembles oak manna in appearance.

Australian or Eucalyptus manna is found on the leaves of *Eucalyptus viminalis*, *E. Gunnii*, var. *rubida*, *E. pulverulenta*, &c. The Lerp manna of Australia is of animal origin.

Briançon manna is met with on the leaves of the common Larch (*q.v.*), and *bide-khecht* on those of the willow, *Salix fragilis*; and a kind of manna was at one time obtained from the cedar.

The manna of the Biblical narrative, notwithstanding the miraculous circumstances which distinguish it from anything now known, answers in its description very closely to the tamarisk manna.

See Bentley and Trimen, *Medicinal Plants* (1880); Watt, *Dictionary of Economic Products of India*, under "Manna" (1891). For analyses see A. Ebert, *Abst. J.C.S.*, 1909, 96, p. 176.

MANNERS, CHARLES (1857–), English musician, whose real name was Southcote Mansergh, was born in London, son of Colonel Mansergh, an Irishman. He had a fine bass voice, and was educated for the musical profession in Dublin and at the Royal Academy of Music in London. He began singing in opera in 1881, and in 1882 had great success as the sentry in *Iolanthe* at the Savoy, following this with numerous engagements in opera both in England and America. He married the singer Fanny Moody, already a leading soprano on the operatic stage, in 1890; and in 1897 they formed the Moody-Manners opera company, which had a great success in the provinces and undertook seasons in London in 1902. Manners and his wife were assisted by some other excellent artists, and their enterprise had considerable influence on contemporary English music.

MANNERS-SUTTON, CHARLES (1755–1828), archbishop of Canterbury, was educated at Charterhouse and Cambridge. In 1785 he was appointed to the family living at Averham-with-Kelham, in Nottinghamshire, and in 1791 became dean of Peterborough. He was consecrated bishop of Norwich in 1792, and two years later received the appointment of dean of Windsor *in commendam*. In 1805 he was chosen to succeed Archbishop Moore in the see of Canterbury. During his primacy the old archiepiscopal palace at Croydon was sold and the country palace of Addington bought with the proceeds. He presided over the first meeting which issued in the foundation of the National Society, and subsequently lent the scheme his strong support. He also exerted himself to promote the establishment of the Indian episcopate. His only published works are two sermons, one preached before the Lords (London, 1794), the other before the Society for the Propagation of the Gospel (London, 1797). His brother, THOMAS MANNERS-SUTTON, 1st BARON MANNERS (1756–1842), was lord chancellor of Ireland. For his son Charles see CANTERBURY, 1st VISCOUNT.

MANNHEIM, a town of Germany, in the grand-duchy of Baden, lying on the right bank of the Rhine, at its confluence with the Neckar, 39 m. by rail N. of Karlsruhe, 10 m. W. of Heidelberg and 55 m. S. of Frankfort-on-Main. Pop. (1900), 141,131; (1905), 162,607 (of whom about 70,000 are Roman Catholics and 6000 Jews). It is perhaps the most regularly built town in Germany, consisting of twelve parallel streets intersected at right angles by others, which cut it up into 136 square sections of equal size. These blocks are distinguished, after the American fashion, by letters and numerals. Except on the south side all the streets debouch on the promenade, which forms a circle round the town on the site of the old ramparts. Outside this ring are the suburbs Schwetzinger-Vorstadt to the south and Neckar-Vorstadt to the north, others being Lindenhof, Mühlau, Neckarau and Käferthal. Mannheim is connected by a handsome bridge with Ludwigshafen, a rapidly growing commercial and manufacturing town on the left bank of the Rhine, in Bavarian territory. The Neckar is spanned by two bridges.

Nearly the whole of the south-west side of the town is occupied by the palace (1720–1729), formerly the residence of the elector palatine of the Rhine. It is one of the largest buildings of the kind in Germany, covering an area of 15 acres, and having a frontage of about 600 yards. It has 1500 windows. The left wing was totally destroyed by the bombardment of 1795, but has since been restored. The palace contains a picture gallery and collections of natural history and antiquities, and in front of it are two monumental fountains and a monument to the emperor William I. The large and beautiful gardens at the back form the public park of the town. Among the other prominent buildings are the theatre, the arsenal, the synagogue, the "Kaufhaus," the town-hall (*Rathaus*, 1771) and the observatory. A newer building is the fine municipal Festhalle with magnificent rooms. The only noteworthy churches are the Jesuit church (1737–1760), the interior of which is lavishly decorated with marble and painting; the Koncordienkirche and the Schlosskirche. In front of the theatre are statues of Schiller, August Wilhelm Iffland the actor, and Wolfgang Heribert von Dalberg (1750–1806), intendant of the theatre in the time of Schiller. Mannheim is the chief commercial town on the upper Rhine, and yields in importance to Cologne alone among the lower Rhenish towns. It stands at the head of the effective navigation on the Rhine, and is not only the largest port on the upper course of that stream, but is the principal emporium for south Germany for such commodities as cereals, coal, petroleum, timber, sugar and tobacco, with a large trade in hops, wine and other south German produce. Owing to the rapid increase in the traffic, a new harbour at the mouth of the Neckar was opened in 1898. The industries are equal in importance to the transit trade, and embrace metal-working, ironfounding and machine building, the manufacture of electric plant, celluloid, automobiles, furniture, cables and chemicals, sugar refining, cigar and tobacco making, and brewing.

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[1] See *Bombay Lit. Tr.*, vol. i. art. 16, for details as to the *gazangubīn*. A common Persian sweetmeat consists of wheat-flour kneaded with manna into a thick paste.

Mannheim is the seat of the central board for the navigation of the Rhine, of a high court of justice, and of the grand ducal commissioner for north Baden.

History.—The name of Mannheim was connected with its present site in the 8th century, when a small village belonging to the abbey of Lorsch lay in the marshy district between the Neckar and the Rhine. To the south of this village, on the Rhine, was the castle of Eicholzheim, which acquired some celebrity as the place of confinement assigned to Pope John XXIII. by the council of Constance. The history of modern Mannheim begins, however, with the opening of the 17th century, when the elector palatine Frederick IV. founded a town here, which was peopled chiefly with Protestant refugees from Holland. The strongly fortified castle which he erected at the same time had the unfortunate result of making the infant town an object of contention in the Thirty Years' War, during which it was five times taken and retaken. In 1688 Mannheim, which had in the meantime recovered from its former disasters, was captured by the French, and in 1689 it was burned down. Ten years later it was rebuilt on an extended scale, and provided with fortifications by the elector John William. For its subsequent importance it was indebted to the elector Charles Philip, who, owing to ecclesiastical disputes, transferred his residence from Heidelberg to Mannheim in 1720. It remained the capital of the Palatinate for nearly sixty years, being especially flourishing under the elector Charles Theodore. In 1794 Mannheim fell into the hands of the French, and in the following year it was retaken by the Austrians after a severe bombardment, which left scarcely a single building uninjured. In 1803 it was assigned to the grand duke of Baden, who caused the fortifications to be razed. Towards the end of the 18th century Mannheim attained great celebrity in the literary world as the place where Schiller's early plays were performed for the first time. It was at Mannheim that Kotzebue was assassinated in 1819. During the revolution in Baden in 1849 the town was for a time in the hands of the insurgents, and was afterwards occupied by the Prussians.

See Feder, *Geschichte der Stadt Mannheim* (1875–1877, 2 vols., new ed. 1903); Pichler, *Chronik des Hof-und National Theaters in Mannheim* (Mannheim, 1879); Landgraf, *Mannheim und Ludwigshafen* (Zürich, 1890); *Die wirthschaftliche Bedeutung Mannheims*, published by the Mannheim Chamber of Commerce (Mannheim, 1905); the *Forschungen zur Geschichte Mannheims und der Pfalz*, published by the *Mannheimer Altertumsverein* (Leipzig, 1898); and the annual *Chronik der Hauptstadt Mannheim* (1901 seq.).

MANNING, HENRY EDWARD (1808–1892), English Roman Catholic cardinal, was born at Totteridge, Hertfordshire, on the 15th of July 1808,[1] being the third and youngest son of William Manning, a West India merchant, who was a director of the Bank of England and governor, 1812–1813, and who sat in Parliament for some thirty years, representing in the Tory interest Plympton Earle, Lymington, Evesham, and Penryn consecutively. His mother, Mary, daughter of Henry Leroy Hunter, of Beech Hill, Reading, was of a family said to be of French extraction. Manning's boyhood was mainly spent at Coombe Bank, Sundridge, Kent, where he had for companions Charles and Christopher Wordsworth, afterwards bishops of St Andrews and of Lincoln. He was educated at Harrow, 1822–1827, Dr G. Butler being then the head master, but obtained no distinction beyond being in the cricket eleven in 1825. He matriculated at Balliol College, Oxford, in 1827, and soon made his mark as a debater at the Union, where Gladstone succeeded him as president in 1830. At this date he was ambitious of a political career, but his father had sustained severe losses in business, and in these circumstances Manning, having graduated with first-class honours in 1830, obtained the year following, through Viscount Goderich, a post as supernumerary clerk in the colonial office. This, however, he resigned in 1832, his thoughts having been turned towards a clerical career under Evangelical influences, which affected him deeply throughout life. Returning to Oxford, he was elected a fellow of Merton College, and was ordained; and in 1833 he was presented to the rectory of Lavington-with-Graffham in Sussex by Mrs Sargent, whose granddaughter Caroline he married on the 7th of November 1833, the ceremony being performed by the bride's brother-in-law, Samuel Wilberforce, afterwards bishop of Oxford and of Winchester. Manning's married life was of brief duration. His young and beautiful wife was of a consumptive family, and died childless (July 24, 1837). The lasting sadness that thus early overshadowed him tended to facilitate his acceptance of the austere teaching of the Oxford Tracts; and though he was never an acknowledged disciple of Newman, it was due to the latter's influence that from this date his theology assumed an increasingly High Church character, and his printed sermon on the "Rule of Faith" was taken as a public profession of his alliance with the Tractarians. In 1838 he took a leading part in the Church education movement, by which diocesan boards were established throughout the country; and he wrote an open letter to his bishop in criticism of the recent appointment of the ecclesiastical commission. In December of that year he paid his first visit to Rome, and called on Dr Wiseman in company with W. E. Gladstone. In January 1841 Shuttleworth, bishop of Chichester, appointed him archdeacon, whereupon he began a personal visitation of each parish within his district, completing the task in 1843. In 1842 he published a treatise on *The Unity of the Church*, and his reputation as an eloquent and earnest preacher being by this time considerable, he was in the same year appointed select preacher by his university, thus being called upon to fill from time to time the pulpit which Newman, as vicar of St Mary's, was just ceasing to occupy. Four volumes of his sermons appeared between the years 1842 and 1850, and these had reached the 7th, 4th, 3rd and 2nd editions respectively in 1850, but were not afterwards reprinted. In 1844 his portrait was painted by Richmond, and the same year he published a volume of university sermons, in which, however, was not included the one on the Gunpowder Plot. This sermon had much annoyed Newman and his more advanced disciples, but it was a proof that at that date Manning was loyal to the Church of England as Protestant. Newman's secession in 1845 placed Manning in a position of greater responsibility, as one of the High Church leaders, along with Pusey and Keble and Marriott; but it was with Gladstone and James Hope (afterwards Hope-Scott) that he was at this time most closely associated. In the spring of 1847 he was seriously ill, and that autumn and the following winter he spent abroad, chiefly in Rome, where he saw Newman "wearing the Oratorian habit and dead to the world." He had public and private audiences with the pope on the 9th of April and the 11th of May 1848, but recorded next to nothing in his diary concerning them, though numerous other entries show an eager interest in everything connected with the Roman Church, and private papers also indicate that he recognized at this time grave defects in the Church of England and a mysterious attractiveness in Roman Catholicism, going so far as to question whether he might not one day be a Roman Catholic himself. Returning to England, he protested, but with moderation, against the appointment of Hampden as bishop of Hereford, and continued to take an active part in the religious education controversy. Through the influence of Samuel Wilberforce, he was offered the post of sub-almoner to Queen Victoria, always recognized as a stepping-stone to the episcopal bench, and his refusal of it was honourably consonant with all else in his career as an Anglican dignitary, in which he united pastoral diligence with an asceticism that was then quite exceptional. In 1850 the decision of the privy council, that the bishop of Exeter was bound to institute the Rev. G. C. Gorham to the benefice of Brampford Speke in spite of the latter's acknowledged disbelief in the doctrine of baptismal regeneration, brought to a crisis the position within the Church of England of those who believed in that Church as a legitimate part of the infallible *Ecclesia docens*. Manning made it clear that he regarded the matter as vital, though he did not act on this conviction until no hope remained of the decision being set aside or practically annulled by joint action of the bishops. In July he addressed to his bishop an open letter on "The Appellate Jurisdiction of the Crown in Matters Spiritual," and he also took part in a meeting in London which protested against the decision. In the autumn of this year (1850) was the great popular outcry against the "Papal aggression" (see WISEMAN), and Manning, feeling himself unable to take part in this protest, resigned, early in December his benefice and his archdeaconry; and writing to Hope-Scott, who a little later became a Roman Catholic with him, stated his conviction that the alternative was "either Rome or licence of thought and will." He was received into the Roman Catholic Church by Father Brownbill, S.J., at the church in Farm Street, on Passion Sunday, the 6th of April 1851. On the following Sunday he was confirmed and received to communion by Cardinal Wiseman, who also, within ten weeks of his reception, ordained him priest. Manning thereupon proceeded to Rome to pursue his theological studies, residing at the college known as the "Academy for Noble Ecclesiastics," and attending lectures by Perrone and Passaglia among others. The pope frequently received him in private audience, and in 1854 conferred on him the degree of D.D. During his visits to England he was at the disposal of Cardinal Wiseman, who through him, at the time of the Crimean War, was enabled to obtain from the government the concession that for the future Roman Catholic army chaplains should not be regarded as part of the staff of the Protestant chaplain-general. In 1857 the pope, *proprio motu*, appointed him provost (or head of the chapter) of Westminster, and the same year he took up his residence in Bayswater as superior of a community known as the "Oblates of St Charles," an association of secular priests on the same lines as the institute of the Oratory, but with this difference, that they are by their constitution at the beck and call of the bishop in whose diocese they live. The community was thus of the greatest service to Cardinal Wiseman, whose right-hand man Manning thenceforward became. During the eight years of his life at Bayswater he was most active in all the duties of the priesthood, preaching, hearing confessions, and receiving converts; and he was notably zealous to promote in England all that was specially Roman and papal, thus giving offence to old-fashioned Catholics, both clerical and lay, many of whom were largely influenced by Gallican ideas, and had with difficulty accepted the restoration of the hierarchy in 1850. In 1860 he delivered a course of lectures on the pope's temporal power, at that date seriously threatened, and shortly afterwards he was appointed a papal domestic prelate, thus becoming a "Monsignor," to be addressed as "Right Reverend." He was now generally recognized as the able and effective leader of the Ultramontane party among English Roman Catholics, acting always, however, in subordination to Cardinal Wiseman; and on the latter's death (Feb. 15, 1865) it was felt that, if Manning should succeed to the vacant archbishopric, the triumph of Ultramontanism would be secured. Such a consummation not being desired by the Westminster chapter, they submitted to the pope three names, and Manning's was not one of them. Great efforts were made to secure the succession for the titular archbishop Errington, who at one time had been Wiseman's coadjutor with that right reserved to him, but who had been ousted from that position by the pope acting under Manning's influence. In such circumstances Pius IX. could hardly do otherwise than ignore Errington's nomination, as he also ignored the nomination of Clifford, bishop of Clifton, and of Grant, bishop of Southwark; and, by what he humorously described as "the Lord's own *coup d'état*," he appointed Manning to the archiepiscopal see. Consecrated at the pro-cathedral at Moorfields (since destroyed) by Dr Ullathorne, bishop of Birmingham (June 8, 1865), and enthroned there (Nov. 6), after receiving the *pallium* in Rome, Manning began his work as archbishop by devoting himself especially to the religious education of the poor and to the establishment of Catholic industrial and reformatory schools. He steadily opposed whatever might encourage the admission of Catholics to the national universities, and so put his foot down on Newman's project to open a branch house of the Oratory at Oxford with himself as superior. He made an unsuccessful and costly effort to establish a Catholic university at Kensington, and he also made provision for a diocesan seminary of strictly ecclesiastical type. Jealous of the exclusive claims of the Roman Church, he procured a further condemnation at Rome of the "Association for the Promotion of the Unity of Christendom," which advocated prayers for the accomplishment of a kind of federal union between the Roman, Greek and Anglican Churches, and in a pastoral letter he insisted on the heretical assumption implied in such an undertaking. He also worked for the due recognition of the dignity of the secular or pastoral clergy, whose position seemed to be threatened by the growing ascendancy of the regulars, and especially of the Jesuits, whom, as a practically distinct organization within the Church, he steadily opposed. In addition to his diocesan synods, he presided in 1873 over the fourth provincial synod of Westminster, which legislated on "acatholic" universities, church music, mixed marriages, and the order of a priest's household, having previously taken part, as theologian, in the provincial synods of 1853 and 1859, with a hand in the preparation of their decrees. But it was chiefly through his strenuous advocacy of the policy of defining papal infallibility at the Vatican council (1869–1870) that Manning's name obtained world-wide renown. In this he was instant in season and out of season. He brought to Rome a petition in its favour from his chapter at Westminster, and during the progress of the council he laboured incessantly to overcome the opposition of the "inopportunists." And he never ceased to regard it as one of the chief privileges of his life that he had been able to take an active part in securing the definition, and in having heard with his own ears that doctrine proclaimed as a part of divine revelation. In 1875 he published a reply to Gladstone's attack on the Vatican decrees; and on the 15th of March in that year he was created cardinal, with the title of SS. Andrew and Gregory on the Coelian. He was present at the death of Pius IX. (Feb. 7, 1878); and in the subsequent conclave, while some Italian cardinals were prepared to vote for his election to fill the vacant chair, he himself supported Cardinal Pecci, afterwards known as Leo XIII. With him, however, Manning found less sympathy than with his predecessor, though Manning's advocacy of the claims of labour attracted Leo's attention, and influenced the encyclical which he issued on the subject. After the Vatican council, and more especially after the death of Pius IX., Manning devoted his attention mainly to social questions, and with these his name was popularly associated during the last fifteen years of his life. From 1872 onwards he was a strict teetotaller, not touching alcohol even as a medicine, and there was some murmuring among his clergy that his teaching on this subject verged on heresy. But his example and his zeal profoundly influenced for good the Irish poor forming the majority of his flock; and the "League of the Cross" which he founded, and which held annual demonstrations at the Crystal Palace, numbered nearly 30,000 members in London alone in 1874. He sat on two royal commissions, the one on the housing of the working classes (1884), and the other on primary education (1886); and in each case the report showed evident marks of his influence, which his fellow-commissioners recognized as that of a wise and competent social reformer. In the cause of labour he was active for many years, and in 1872 he set an example to the clergy of all the churches by taking a prominent part in a meeting held in Exeter Hall on behalf of the newly established Agricultural Labourers' Union, Joseph Arch and Charles Bradlaugh being among those who sat with him on the platform. In later years his strenuous advocacy of the claims of the working classes, and his declaration that "every man has a right to work or to bread" led to his being denounced as a Socialist. That he was such he denied more than once (Lemire, *Le Cardinal Manning et son action sociale*, Paris, 1893, p. 210), nor was he ever a Socialist in principle; but he favoured some of the methods of Socialism, because they alone seemed to him practically to meet the case of that pressing poverty which appealed to his heart. He took a leading part in the settlement of the dockers' strike in the autumn of 1889, and his patient and effectual action on this and on similar occasions secured for him the esteem and affection of great numbers of working men, so that his death on the 14th of January 1892, and his funeral a week later, were the occasion for a remarkable demonstration of popular veneration. The Roman Catholic Cathedral at Westminster is his joint memorial with his predecessor, Cardinal Wiseman.

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[1] Purcell's assertion that the year of his birth was 1807 rests on no trustworthy evidence.

Whatever may have been the value of Manning's services to the Roman Catholic Church in England in bringing it, as he did, up to a high level of what in earlier years was commonly denounced as Ultramontanism, it is certain that by his social action, as well as by the earnestness and holiness of his life, he greatly advanced, in the minds of his countrymen generally, their estimate of the character and value of Catholicism. Preeminently he was a devout ecclesiastic, a "great priest"; and his sermons, both Anglican and Catholic, are marked by fervour and dignity, by a conviction of his own authoritative mission as preacher, and by an eloquent insistence on considerations such as warm the heart and bend the will rather than on such as force the intellect to assent. But many of his instincts were those of a statesman, a diplomatist, a man of the world, even of a business man; and herein lay, at least in part, the secret of his influence and success. Intellectually he did not stand in the front rank. He was neither a philosopher nor a literary genius. Among his many publications, written, it is only fair to admit, amidst the urgent pressure of practical work, there is barely a page or even a sentence that bears the stamp of immortality. But within a somewhat narrower field he worked with patience, industry, and self-denying zeal; his ambition, which seemed to many personal, was rather the outcome of his devotion to the cause of the Church; and in the later years of his life especially he showed that he loved righteousness and hated iniquity, and that he realized as clearly as any one that the service of God was incomplete without the service of man.

The publication in 1896 of Manning's *Life*, by Purcell, was the occasion for some controversy on the ethics of biography. Edward Purcell was an obscure Catholic journalist, to whom Manning, late in life, had entrusted, rather by way of charitable bequest, his private diaries and other confidential papers. It thus came to pass that in Purcell's voluminous biography much that was obviously never intended for the public eye was, perhaps inadvertently, printed, together with a good deal of ungenerous comment. The facts disclosed which mainly attracted attention were: (1) that Manning, while yet formally an Anglican, and while publicly and privately dissuading others from joining the Roman Catholic Church, was yet within a little convinced that it was his own duty and destiny to take that step himself; (2) that he was continually intriguing at the back-stairs of the Vatican for the furtherance of his own views as to what was desirable in matters ecclesiastical; (3) that his relations with Newman were very unfriendly; and (4) that, while for the most part he exhibited towards his own clergy a frigid and masterful demeanour, he held privately very cordial relations with men of diverse religions or of no theological beliefs at all. And certainly Manning does betray in these autobiographical fragments an unheroic sensitiveness to the verdict of posterity on his career. But independent critics (among whom may specially be named François de Pressensé) held that Manning came well through the ordeal, and that Purcell's *Life* had great value as an unintentionally frank revelation of character. (A. W. Hu.)

MANNY, SIR WALTER DE MANNY, Baron de (d. 1372), soldier of fortune and founder of the Charterhouse, younger son of Jean de Mauny, known as Le Borgne de Mauny, by his wife Jeanne de Jenlain, was a native of Hainaut, from whose counts he claimed descent. Manny—the name is thus spelt by most English writers—was a patron and friend of Froissart, in whose chronicles his exploits have a conspicuous and probably an exaggerated place. He appears to have first come to England as an esquire of Queen Philippa in 1327, and he took a distinguished part in the Scottish wars of Edward III. In 1337 he was placed in command of an English fleet, and in the following year accompanied Edward to the continent, where in the campaigns of the next few years he proved himself one of the boldest and ablest of the English king's military commanders. He was summoned to parliament as a baron by writ from the 12th of November 1347 to the 8th of January 1371. In 1359 he was made a knight of the Garter; and at various times he received extensive grants of land both in England and in France. He was frequently employed by King Edward in the conduct of diplomatic negotiations as well as in military commands. He was one of those charged with the safe custody of the French king John when a prisoner at Calais in 1360; in 1369 he was second in command under John of Gaunt in his invasion of France.

But Manny is chiefly remembered for his share in the foundation of the Charterhouse in London. In 1349 he bought some acres of land near Smithfield, which were consecrated as a burying-place where large numbers of the victims of the Black Death were interred; and here he built a chapel, from which the place obtained the name of "Newchurchhaw." The chapel and ground were bought from Manny by the bishop of London, Michael de Northburgh, who died in 1361 and by his will bequeathed a large sum of money to found there a Carthusian convent. It is not clear whether this direction was ever carried out; for in 1371 Manny obtained letters patent from King Edward III. permitting him to found, apparently on the same site, a Carthusian monastery called "La Salutation Mère Dieu," where the monks were to pray for the soul of Northburgh as well as for the soul of Manny himself. The bishop's bequest may have contributed to the building and endowment of the house; or possibly, as seems to be implied by a bull granted by Urban VI, in 1378, there were originally two kindred establishments owing their foundation to Northburgh and Manny respectively. At all events Manny, who died early in 1372, left instructions that he was to be buried in the church of the Carthusian monastery founded by himself. About 1335 he married Margaret, daughter and heiress of Thomas Plantagenet, earl of Norfolk, son of King Edward I., whose first husband had been John, Lord Segrave. This lady, who outlived Manny by many years, was countess of Norfolk in her own right, and she was created duchess of Norfolk in 1397. Manny left no surviving son. His daughter Anne, Baroness de Manny in her own right, married John Hastings, 2nd earl of Pembroke; and on the death of her only son unmarried in 1389, the barony of Manny became extinct.

See *Œuvres de Froissart, I. Chroniques*, edited by Baron Kervyn de Lettenhove (Brussels, 1867–1877), and the Globe edition of *Froissart's Chronicles* (Eng. trans., London, 1895); G. F. Beltz, *Memorials of the Most Noble Order of the Garter* (London, 1841); *Chronicon Angliae 1323–1388*, edited by E. Maunde Thompson (Rolls series 64, London, 1874); Philip Bearcroft, *An Historical Account of Thomas Sutton and of his Foundation in Charterhouse* (London, 1737).

MANNYNG, ROBERT (Robert of Brunne) (*c.* 1264–1340?), English poet, was a native of Brunne, now Bourne, in

Lincolnshire. About 6 m. from Bourne was the Gilbertine monastery of Sempringham, founded by Sir Gilbert de Sempringham in 1139. The foundation provided for seven to thirteen canons, with a number of lay brothers and a community of nuns. No books were allowed to the lay brothers and nothing could be written in the monastery without the prior's consent. Mannyng entered this house in 1288, when, according to the rules, he must have been at least 24 years of age, if, as is supposed, he was a lay brother. He says he was at Cambridge with Robert de Bruce and his two brothers, Thomas and Alexander, but this does not necessarily imply that he was a fellow-student. There was a Gilbertine monastery at Cambridge, and Mannyng may have been there on business connected with his order. When he wrote *Handlyng Synne* he had been (ll. 63–76) fifteen years in the priory, beginning to write in "englysch rime in 1303." Thirty-five years later he began his *Story of Inglande*, and had removed (ll. 139, &c.) to the monastery of Sixille (now Sixhills), near Market Rasen, in north Lincolnshire.

Handlyng Synne, a poem of nearly 13,000 lines, is a free translation, with many additions and amplifications, from William of Waddington's *Manuel des Pechiez*. It is a series of metrical homilies on the Ten Commandments, the Seven Deadly Sins and the Seven Sacraments, illustrated by a number of amusing stories from various sources. The *Cursor Mundi* had turned religious history into something not very different from a romance of chivalry, and in the stories of *Handlyng Synne* the influence of the *fabliaux* is not far to seek. Mannyng wrote in the English tongue not for learned but for "lewd" men, "that talys and ryme wyl blethly here," to occupy the leisure hours during which they might otherwise fall into "vylanye, dedly synne or other folye." Each of his twenty-four topics has its complement of stories. He tells of the English observance of Saturday afternoon as holy to the Virgin, and has much to say of popular amusements, which become sins when they keep people away from church. Tournaments in particular are fertile occasions of all the deadly sins; and mystery plays, except those of the birth and resurrection of Christ performed in the churches, also lead men into transgression. He inveighs against the oppression of the poor by the rich, reproves those who, weary of matins or mass, spend their time in church "jangling," telling tales, and wondering where they will get the best ale, and revives the legend of the dancers at the church door during mass who were cursed by the priest and went on dancing for a twelvemonth without cessation. He loved music himself, and justified this profane pleasure by the example of Bishop Grosseteste, who lodged his harper in the chamber next his own; but he holds up as a warning to gleemen the fate of the minstrel who sang loud while the bishop said grace, and was miserably killed by a falling stone in consequence. The old monk's keen observation makes the book a far more valuable contribution to history than his professed chronicle. It is a storehouse of quaint stories and out-of-the-way information on manners and customs.

His chronicle, *The Story of Inglande*, was also written for the solace and amusement of the unlearned when they sit together in fellowship (ll. 6–10). The earlier half is written in octosyllabic verse, and begins with the story of the Deluge. The genealogy of Locrine, king of Britain, is traced back to Noah, through Aeneas, and the chronicler relates the incidents of the Trojan war as told by Dares the Phrygian. From this point he follows closely the *Brut* of Wace. He loved stories for their own sake, and found fault with Wace for questioning the miraculous elements in the legend of Arthur. In the second half of his chronicle, which is less simple in style, he translates from the French of Pierre de Langtoft. He writes in rhyming alexandrines, and in the latter part of the work uses middle rhymes. Mannyng's *Chronicle* marks a change in national sentiment. Though he regards the Norman domination as a "bondage," he is loud in his praises of Edward I., "Edward of Inglond."

The linguistic importance of Mannyng's work is very great. He used very few of those Teutonic words which, though still in use, were eventually to drop out of the language, and he introduced a great number of French words destined to be permanently adopted in English. Moreover, he employed comparatively few obsolete inflexions, and his work no doubt furthered the adoption of the Midland dialect as the acknowledged literary instrument. T. L. Kington-Oliphant (*Old and Middle English*, 1878) regards his work as the definite starting point of the New English which with slight changes was to form the language of the Book of Common Prayer.

A third work, usually ascribed to Mannyng, chiefly on the ground of its existing side by side with the *Handlyng Synne* in the Harleian and Bodleian MSS., is the *Medytacyuns of the Soper of oure lorde Jhesu, And also of hys passyun And eke of the peynes of hys swete modyr, Mayden marye*, a free translation of St Bonaventura's *De coena et passione Domini*. . . .

Robert of Brunne's *Chronicle* exists in two MSS.: Petyt MS. 511, written in the Northern dialect, in the Inner Temple library; and Lambeth MS. 131 in a Midland dialect. The first part was edited *The Story of England* . . . (1887) for the Rolls Series, with an introductory essay by F. J. Furnivall; the second part was published by Thomas Hearne as *Peter Langtoft's Chronicle* . . . (1725). Peter Langtoft's French version was edited by Thomas Wright for the "Rolls Series" in 1866. Of *Handlyng Synne* there are complete MSS. in the Bodleian library (MS. 415) and in the British Museum (Harleian MS. 1701), and a fragment in the library of Dulwich College (MS. 24). It was edited, with Waddington's text in parallel columns, by F. J. Furnivall for the Roxburghe Club (1862), and for the Early English Text Society (1901–1903). The *Meditacyun* was edited from the Bodleian and Harleian MSS. by J. Meadow Cooper for the same society (1875). See also Gerhard Hellmers, *Ueber die Sprache Robert Mannyngs of Brunne und über die Autorschaft der ihm zugeschriebenen Meditations* . . . (Göttingen, 1885), which contains an analysis of the dialectic peculiarities of Mannyng's work; O. Boerner, "Die Sprache Robert Mannyngs" . . . in *Studien zur engl. Philologie* (vol. xii., Halle, 1904) and Oskar Preussner, *Robert Mannyng of Brunne's Übersetzung von Pierre de Langtofts Chronicle* (Breslau, 1891). All accounts of his life are based on his own work. For the Sempringham priory see Dugdale, *Monasticon* vi. 947 seq., and Miss Rose Graham's *S. Gilbert of Sempringham and the Gilbertines* (1901).

MANŒUVRES, MILITARY. Manœuvres may be defined as the higher training for war of troops of all arms in large bodies, and have been carried out in most countries ever since the first formation of standing armies. In England no manœuvres or camps of exercise appear to have been held till the beginning of the 19th century, when Sir John Moore trained the famous Light Brigade at Shorncliffe camp. In France, however, under Louis XIV., large camps of instruction were frequently held, the earliest recorded being that of 18,000 troops at Compiègne in 1666; and these were continued at intervals under his successor. At these French camps much time was devoted to ceremonial, and the manœuvres performed were of an elementary description. Still their effect upon the training of the army for war was far-reaching, and bore fruit in the numerous wars in the first half of the 18th century. Moreover, experiments were made with proposed tactical systems and technical improvements, as in the case of the contest between *l'ordre mince* and *l'ordre profonde* (see INFANTRY) between 1785 and 1790. Other countries followed suit, but it was reserved for Frederick the Great to inaugurate a system of real manœuvres and to develop on the training-ground the system of tactics which bore such good fruit in his various campaigns. The numbers of troops assembled were large; for example, at Spandau in 1753, when 36,000 men carried out manœuvres for twelve days. The king laid the greatest stress on these exercises, and took immense pains to turn to account the experience gained in his campaigns. Great secrecy was observed, and before the Seven Years' War no stranger was allowed to be present. The result of all this careful training was shown in the Seven Years' War, and after it the Prussian manœuvres gained a reputation which they have maintained to this day. But with the passing away of the great king they became more and more pedantic, and the fatal results were shown in 1806. After the Napoleonic wars yearly manœuvres became the custom in every large Continental army. Great Britain alone thought she could dispense with them, perhaps because of the constant practical training her troops and officers received in the various Indian and colonial wars:

and it was not till 1853 that, by the advice of the Prince Consort, a body of troops were gathered together for a camp of exercise on Chobham Common, and that eventually a standing camp of exercise was evolved out of the temporary camp formed during the Crimean War at Aldershot.

Most continental armies have, since the great successes of the Germans in 1870, copied more or less their system of military training; hence it is appropriate to consider their methods first. The whole training of the army is based on a yearly programme of gradual progression, from the joining of the recruits in October to the training by squads, companies, battalions and regiments, the latter finishing their field training about the middle of August, when the manœuvre period begins. First of all, the brigades go through five working days of drills on flat ground, to get them under the hand of their commanders and prepare them for manœuvres. Then follow ten working days of manœuvres in new and varied ground, of which four are "brigade," four "divisional" and two "corps" manœuvres, in each case the unit named being divided into two portions of all arms, which manœuvre against one another. Each year two or more army corps carry out manœuvres before the emperor, working against one another. The chief feature of the German manœuvres is the free hand allowed to leaders of sides. Of course, for reasons of supply and transport, it is necessary to keep the troops within a certain area, but the general and special ideas[1] are so framed that, while retaining their own initiative, the leaders of sides have to give such orders as will suit the arrangements made by the director of manœuvres for supply. The faculty of quartering troops on private individuals to any extent, and the fact of the troops being provided with portable tent equipment, give great latitude to the German leaders in their choice of quarters for troops, and so increase the similitude of manœuvres to war. The Austrian and Italian manœuvres are a close copy of the German, but those of the French present the peculiarity of a certain amount of prearrangement, especially at grand manœuvres, when it is frequently laid down beforehand which side is to be victorious. Thus a series of pictures of war is presented, but the manœuvres are hardly a test of the skill of the rival leaders. But, just as in recent years in France this practice has been modified, so also the entire liberty given to commanders in the German manœuvres in 1906–7 had to be curtailed in the following years owing to the strain of forced marches which it entailed on the troops.

In Russia the climatic and social conditions, and the distribution of the army, necessitate a quite peculiar system. The troops leave their barracks and move into standing camps, generally in May, and in these for about three months their training up to that in battalions is carried out on the drill ground. Camps of mixed units are then formed for a month, and from them, but always over the same ground, the manœuvres of regiments, brigades and divisions are performed. Then follow the so-called mobile manœuvres, which last for ten days or a fortnight. Of all European manœuvres these are perhaps the nearest approach to war, for the sides start a great distance apart, and ample time is allowed for cavalry reconnaissance. Besides, the Russian soldier does not require elaborate arrangements for supply; hence the director is not so tied down by consideration of this matter as in other armies. A political colour is sometimes given to such large assemblages of troops, especially when the manœuvres take place in frontier districts.

In England the military authorities have long been hampered in the organization of manœuvres by the necessity of carrying them out on very limited portions of government land or on areas lent as a favour by, or hired from, private individuals. There has been no want of recognition by the military authorities of the necessity for, and value of, manœuvres, and the training at the camps of instruction has been supplemented as far as possible by small manœuvres on such portions of country as could be made available. But, with the exception of spasmodic efforts in 1871 and 1872, it was not until 1897 that the government allowed itself to be convinced by its military advisers, and passed a Military Manœuvres Act, by which certain districts could be "proclaimed" for purposes of manœuvres, and troops in consequence could traverse all ground. In 1898 the first manœuvres under this Act were held in Wilts and Dorset, and were intended to be repeated at fixed intervals in future years. In addition, every effort was made to add to the existing permanent training grounds for troops, and ground was acquired on Salisbury Plain with the intention of developing it into a second Aldershot. But the training on those well-known grounds, excellent as it is in itself as a preparation, is not "manœuvres," and never can do away with the necessity for them, with a more or less free hand given to the leaders over fresh country.

Much misconception prevails as to the nature and limitation of the military instruction to be imparted at manœuvres. Manœuvres are a school for the leaders, in a less degree for the led, and consequently the minor details of instruction must be completed, and the troops fully trained as units, before they can take part in them with advantage. The time during which large bodies of troops can be kept together for manœuvres is too short, and the expense too great, to justify time being spent on exercises which might as well be carried out in the ordinary stations or at the great training camps. Therefore it may be laid down as a principle that manœuvres, properly so-called, should be begun with units not smaller than a brigade of infantry on each side, with a due proportion of the other arms attached. It is useful if these can precede the manœuvres of larger bodies, as the training is then progressive and the result more satisfactory.[2]

The choice of ground is of great importance. Its extent should be proportionate to the force to be employed and the nature of the instruction to be imparted. It should not be too hilly nor yet too flat, but both descriptions should be judiciously combined; and regard must be had to the water supply and the road and railway net for the convenience of the supply service. Once the ground has been selected, the general and special ideas must be so framed that the troops are thereby confined to the chosen ground without seeming to tie the hands of the leaders of sides. It is of great advantage if the same idea can be maintained throughout each series of operations, as thereby the interest of all concerned and the likeness to actual warfare are increased; and, if possible, the "state of war" should be continuous also. Within the limits of the special idea, the utmost latitude should be left to leaders; but if the orders of one or both sides seem to render a collision unlikely, the director should so modify the special idea as to compel one or other to re-cast his orders in such a way that contact is brought about. Such interference will scarcely be necessary after the first issues of orders in each series. In war the number of marching days vastly outnumbers those of fighting, but in manœuvres this must not be allowed; tactical instruction is what is desired, and a manœuvre day in which none is imparted is not fully utilized. It is not necessary that all the troops should be engaged, but at least the advanced bodies must come into contact, and the rest must carry out marches as on active service. Each action should be fought to its end, "Cease firing" being sounded when the crisis has been reached; and on a decision being given by the director, one side should retire and the fight be broken off in a proper military manner. The troops should place outposts each day, and act in all respects as if on active service.

The quartering and supply of troops are the chief difficulties in the arrangement of manœuvres, and afford ample opportunity for the practising of the officers and departments responsible for these matters. In England, where in peace it is not possible to billet troops on private individuals, quartering must be replaced by encampments or bivouacs, and the selection of ground for them affords invaluable practice. If possible, their position should be selected to conform to the military situation; but if it is found necessary, for reasons of water or food supply, to withdraw troops to positions other than such as they would occupy in real warfare, time should be allowed them on the following day to regain the positions they would otherwise have occupied. It is next to impossible, for various reasons, financial and other, to organize the food supply in manœuvres as it would be in war. Sufficient transport *cadres* cannot be kept up in peace, and consequently recourse must be had to hired transport, which cannot be treated as a military body. Again, food cannot be requisitioned, and local purchase at the time cannot be trusted to; so dépôts of supplies must be formed beforehand in the manœuvres area, which more or less tie the hands of the supply service. Still, with a judicious choice of the points at which these are formed, much may be done to approximate to service conditions, and the more nearly these are realized the more instructive for the supply will the manœuvres become.

Finally, a word must be said as to the umpire staff, which represents the bullets. The most careful selection of officers for this important duty is necessary, and they must have sufficient authority and be in sufficient number to make their influence everywhere felt. Their principal object should be to come to a decision quickly, so as to prevent the occurrence of unreal situations; and by constant intercommunication they must ensure uniformity in their decisions, and so maintain continuity of the action all over the manœuvres battlefield. (J. M. Gr.)

MANOMETER (Gr. μανός, thin or loose; μέτρον, a measure), an instrument for measuring the pressures exerted by gases or vapours. An alternative name is pressure gauge, but this term may conveniently be restricted to manometers used in connexion with steam-boilers, &c. The principle of hydrostatics suggest the most common forms. Suppose we have a U tube (fig. 1), containing a liquid: if the pressures on the surfaces of the liquid be equal, then the surfaces will be at the same height. If, on the other hand, the pressure in one limb be greater than the pressure in the other, the surfaces will be at different heights, the difference being directly proportional to the difference of pressures and inversely as the specific gravity of the liquid used.

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[1] The "general idea" is a document, communicated to both sides, containing such general information of the war—the supposed frontiers, previous battles, &c.—as would be matters of common knowledge. The "special idea" of each side comprises the instructions upon which it is acting.

[2] Manœuvres incidentally afford an excellent opportunity of testing new patterns of equipment, transport or other matériel under conditions approximating to those of active service.

Two forms are in use: (1) the "open-tube," in which the pressure in one limb is equal to the atmospheric pressure, and (2) the "closed-tube," in which the experimental pressure is balanced against the liquid column and the air compressed into the upper part of a closed limb of the tube. In the "open tube" form (fig. 1) the pressure on the surface a is equal to the pressure on the surface at b (one atmosphere) *plus* the hydrostatic pressure exerted by the liquid column of height $a\ b$. The liquid commonly used is mercury. If a scale be placed behind the limbs of the tube, so that the difference $a\ b$ can be directly determined, then the pressure in a is at once expressible as $P + a\ b$ in millimetres or inches of mercury, where P is the atmospheric pressure, known from an ordinary barometric observation. In the "closed tube" form (fig. 2) the calculation is not so simple, for the variation of pressure on the mercury surface in the closed limb has to be taken into account. Suppose the length of the air column in the closed limb be h when the mercury is at the same height in both tubes. Applying the experimental pressure to the open end, if this be greater than atmospheric pressure the mercury column will rise and the air column diminish in the closed limb. Let the length of the air column be h', then its pressure is h/h' atmospheres. The difference in height of the mercury columns in the two limbs is $2(h-h')$, and the pressure in the open limb is obviously equal to that of a column of mercury of length $2(h-h')$, *plus* h/h' atmospheres. These instruments are equally serviceable for determining pressures less than one atmosphere. In laboratory practice, *e.g.* when it is required to determine the degree of exhaust of a water pump, a common form consists of a vertical glass tube having its lower end immersed in a basin of mercury, and its upper end connected by means of an intermediate vessel to the exhaust. The mercury rises in the tube, and the difference between the barometric height and the length of the mercury column gives the pressure attained.

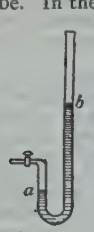

FIG. 1.

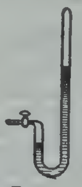

FIG. 2.

MANOR. Any definition of a manor, in land tenure, must take note of two elements—economic and political. The manor has an estate for its basis, although it need not coincide with an estate, but may be wider. It is also a political unit, a district formed for purposes of government, although the political functions made over to it may greatly vary. As a lordship based on land tenure, the manor necessarily comprises a ruler and a population dependent on him, and the characteristic trait of such dependence consists not in ownership extending over persons, as in slave-holding communities, nor in contractual arrangements, as in a modern economic organization, but in various forms and degrees of subjection, chiefly regulated by custom. In the sense mentioned the manor is by no means a peculiarly English institution; it occurs in every country where feudalism got a hold. Under other names we find it not only in France, Germany, Italy, Spain, but also, to a certain extent, in the Byzantine Empire, Russia, Japan, &c. It is especially representative of an aristocratic stage in the development of European nations. When tribal notions and arrangements ceased to be sufficient for upholding their commonwealths, when social and political life had to be built up on the basis of land-tenure, the type of manorial organization came forward in natural course. It was closely connected with natural economy, and was suited to a narrow horizon of economic wants and political requirements. At the same time it provided links for a kind of national federation of military estates. We shall only speak of the course of manorial evolution in France and Germany, because this presents the clearest expression of the fundamental principles of manorial life and the best material for comparison with English facts.

One problem common to the entire European world has to be considered from the very beginning. Does the manor date from the Roman Empire, or not? Can its chief features be traced in Roman institutions? There can be no doubt that at the end of the Roman period certain traits are noticeable which might, under favourable conditions, develop into a manorial combination. Great estates with political functions, populations subjected to the political lordship of landowners, appear in the closing centuries of the empire, and have to be reckoned with as precursors of medieval manorial life. The original organization of the ancient world was built up on the self-government of cities and on the sharp distinction between citizens and slaves. Both features were gradually modified by the Roman Empire. Self-government was atrophied by bureaucratic interference; the economy based on the exploitation of slaves began to give way before relations in which the elements of freedom and serfdom were oddly mixed. During the last centuries of its existence the Western Empire became more and more a conglomerate of barbaric and half-civilized populations, and it is not strange that the characteristic germs of feudalism began to show themselves within its territory as well as outside it. As far as political institutions are concerned, we notice that the central power, after claiming an absolute sway over its subjects, is obliged more and more to lean on private forces in order to maintain itself. One of its favourite resources in the 4th and 5th centuries consists in making great landowners responsible for the good behaviour of their tenants and even of their less important neighbours. The *saltus*, the great domain, is occasionally recognized as a separate district exempt from the ordinary administration of the city, subordinated to its owner in respect of taxes and police. Even in ordinary estates (*fundi*) there is a tendency to make the landowner responsible for military conscription, for the presentation of criminals to justice. On the other hand the incumbents of ecclesiastical offices are nominated in accordance with the wishes of patrons among the landowners; in the administration of justice the influence of this same class makes itself felt more and more. Nor are signs of a convergent evolution wanting on the economic side. Slaves are used more and more as small householders provided with rural tenements and burdened with rents and services. Free peasant farmers holding by free agreement get more and more reduced to a status of half-free settlers occupying their tenancies on the strength of custom and traditional ascription to the glebe. Eventually this status is recognized as a distinct class by imperial legislation. Ominous symptoms of growing political disruption and of an aristocratic transformation of society were visible everywhere at the close of the empire. Yet there could be no talk of a manorial system as long as the empire and the commercial intercourse protected by it continued to exist.

The fall of the empire hastened the course of evolution. It brought into prominence barbaric tribes who were unable to uphold either the political power or the economic system of the Romans. The Germans had from old certain manorial features in the constitution of their government and husbandry. The owner of a house had always been possessed of a certain political power within its precincts, as well as within the fenced area surrounding it; the peace of the dwelling and the peace of the hedged-in yard were recognized by the legal customs of all the German tribes. The aristocratic superiority of warriors over all classes engaged in base peaceful work was also deeply engraved in the minds of the fighting and conquering tribes. On the other hand the downfall of complicated forms of civilization and civil intercourse rendered necessary a kind of subjection in which tributary labourers were left to a certain extent to manage their own affairs. The Germanic conqueror was unable to move slaves about like draughts: he had no scope for a complicated administration of capital and work. The natural outcome was to have recourse to serfdom with its convenient system of tribute and services.

But, as in the case of the Roman Empire, the formation of regular manors was held back for a time in the early Germanic monarchies by the lingering influence of tribal organization. In the second period of medieval development in continental Europe, in the Carolingian epoch, the features of the estate as a political unit are more sharply marked. Notwithstanding the immense efforts of Charles Martel, Pippin and Charlemagne to strengthen the tottering edifice of the Frankish Empire, public authority had to compromise with aristocratic forces in order to ensure regular government. As regards military organization this is expressed in the recognition of the power of *seniores*, called upon to lead their vassals in the host; as regards jurisdiction, in the increase of the numbers of commended freemen who seek to interpose the powerful patronage of lay and secular magnates between themselves and the Crown. Great estates arose not only on the lands belonging to the king, but on that of churches and of lay potentates, and the constitution of these estates, as described for instance in the Polyptique of St Germain des Près or in the "Brevium exempla ad describendas res ecclesiasticas et fiscales" (*Capitularia*, ed. Boretius, i. 250), reminds us forcibly of that of later feudal estates. They contain a home-farm, with a court and a *casa indominicata*, or manor-house, some holdings (*mansi*) of free men (*ingenuiles*), of serfs (*serviles*), and perhaps of half-free people (*lidiles*). The rents and services of this dependent population are stated in detail, as in later custumals, and there is information about the agricultural implements, the stores and stock on the home-farm. Thus the economic basis of the manor exists in more or less complete order, but it cannot be said as yet to form the prevailing type of land tenure in the country. Holdings of independent free men and village organizations of ancient type still surround the great estates, and in the case of ecclesiastical possessions we are often in a position to watch their gradual extension at the expense of the neighbouring free settlers, by way of direct encroachment, and by that of surrender and commendation on the part of the weaker citizens. Another factor which plays a great part in the gradual process of infeudation is the rise of private jurisdictions, which falls chiefly into the 10th and 11th centuries. The struggle against Northmen, Magyars and Slavs gave a crowning touch to the process of localization of political life and of the aristocratic constitution of society.

In order to describe the full-grown continental manor of the 11th century it is better to take French examples than German, Italian or Spanish. Feudalism in France attained the greatest extension and utmost regularity, while in other European countries it was hampered and intermixed with other institutional features. The expression best corresponding to the English "manor," in the sense of an organized district, was *seigneurie*. *Manoir* is in use, and is, of course, a French word corresponding to *manerium*, but it meant strictly "mansion" or chief homestead in France. *Baronie* is another term which might be employed in some instances as an equivalent of the English manor, but, in a sense, it designates only one species of a larger genus, the estate of a full baron in contrast to a mere knight's fee, as well as to a principality. Some of the attributes of a baron are, however, typical, as the purest expression of manorial rights, and may be used in a general characterization of the latter.

The *seigneurie* may be considered from three points of view—as a unit of administration, as an economic unit, and as a union of social classes.

(*a*) In principle the disruption of political life brought about by feudalism ought to have resulted in the complete administrative independence of the manor. *Chaque baron est souverain dans sa baronie* is a proverb meant to express this radical view of manorial separatism. As a matter of fact this separatism was never completely realized, and even at the time of the greatest prevalence of feudalism the little sovereigns of France were combined into a loose federation of independent fiefs. Still, the proverb was not a mere play of words, and it took a long time for the kings of France to break in potentates, like the little Sire de Coucy in the immediate vicinity of Paris, who sported in his crest the self-complacent motto: *Je ne suis ni comte, ni marquis, je suis le sire de Coucy.* The institutional expression of this aspect of feudalism in the life of the *seigneurie* was the jurisdiction combined with the latter. The principal origin of this jurisdiction was the dismemberment of royal justice, the acquisition by certain landowners of the right of holding royal pleas. The assumption of authority over public tribunals of any kind was naturally considered as equivalent to such a transmission of royal right. But other sources may be noticed also. It was assumed by French feudal law that in all cases when land was granted by a *seigneur* in subinfeudation the recipients would be bound to appear as members of a court of tenants for the settlement of conflicts in regard to land. A third source may be traced in the extension of the patrimonial justice of a person over his serfs and personal dependents to the classes of free and half-free population connected with the *seigneurie* in one way or another. There arose in consequence of these assumptions of jurisdiction a most bewildering confusion of tribunals and judicial rights. It happened sometimes that the question as to who should be the judge in some particular contest was decided by matter-of-fact seizure—the holder of pleas who was the first on the spot to proclaim himself judge in a case was deemed entitled to jurisdiction. In other cases one *seigneur* held the pleas in a certain place for six days in the week, while some competitor of his possessed jurisdiction during the seventh. A certain order was brought into this feudal chaos by the classification of judiciary functions according to the four categories of high, middle, low and tenurial justice. The scope of the first three subdivisions is sufficiently explained by their names; the fourth concerned cases arising from subinfeudation. As a rule the baron or *seigneur* sat in justice with a court of assessors or peers, but the constitution of such courts varied a great deal. They represented partly the succession of the old popular courts with their *scabini*, partly courts of vassals and tenants. In strict feudal law an appeal was allowed from a lower to a higher court only in a case of a denial of justice (*dénie de justice*), not in error or revision of sentence. This rule was, however, very often infringed, and gave way ultimately before the restoration of royal justice.

(*b*) The economic fabric of the French *seigneurie* varied greatly, according to localities. In the north of France it was not unlike that of the English manor. The capital messuage, or castle, and the home-farm of the lord, were surrounded by dependent holdings, *censives*, paying rent, and villein tenements burdened with services. Between these tenancies there were various ties of neighbourhood and economic solidarity recalling the open-field cultivation in England and Germany. When the harvest was removed from the open strips they returned to a state of undivided pasture in which the householders of the village exercised rights of common with their cattle. Wild pasture and woods were used more or less in the same fashion as in England (*droit de pacage de vaine pâture*). The inhabitants often formed courts and held meetings in order to settle the by-laws, and to adjudicate as to trespasses and encroachments (*courts colongères*). In the south, individual property was more prevalent and the villagers were not so closely united by ties of neighbourhood. Yet even there the dependent households were arranged into *mansi* or *colonicae*, subjected to approximately equal impositions in respect of rents and services. In any case the characteristic dualism of manorial life, the combined working of a central home-farm, and of its economic satellites providing necessary help in the way of services, and contributing towards the formation of manorial stores, is quite as much a feature of French as of English medieval husbandry.

(*c*) The social relations between the manorial lord and his subjects are marked by various forms of the exploitation of the latter by the former. Apart from jurisdictional profits, rents and agricultural services, dues of all kinds are exacted from the rural population. Some of these dues have to be traced to servile origins, although they were evidently gradually extended to groups of people who were not descended from downright serfs but had lapsed into a state of considerable subjection. The *main morte* of rustic tenants meant that they had no goods of their own, but held movable property on sufferance without the right of passing it on to their successors. As a matter of fact, sons were admitted to inheritance after their fathers, and sometimes succession was extended to other relatives, but the person taking inheritance paid a heavy fine for entering into possession, or gave up a horse, an ox, or some other especially valuable piece of property. The *formariage* corresponded to the English *merchetum*, and was exacted from rustics on the marriage of their daughters. Although this payment assumed very different shapes, and sometimes only appeared in case consorts belonged to different lords, it was considered a badge of serfdom. *Chevage* (*capitagium*) might be exacted as a poll-tax from all the unfree inhabitants of a *seigneurie*, or, more especially, from those who left it to look for sustenance abroad. The power of the lord as a landowner was more particularly expressed in his right of pre-emption (*retrait seigneurial*), and in taxes on alienation (*lods et ventes*). As a person wielding political authority, a kind of sovereignty, the lord enjoyed divers rights which are commonly attributed to the state—the right of coining money, of levying direct taxes and toll (*tallagium*, *tolneta*) and of instituting monopolies. These latter were of common occurrence, and might take the shape, for instance, of forcing the inhabitants to make use of the lord's mill (*moulin banal*), or of his oven (*four banal*), or of his bull (*taureau banal*).

In Germany the history of the manorial system is bound up with the evolution of the *Grundherrschaft* (landlordship), as opposed to *Gutsherrschaft* (estate-ownership). The latter need not include any elements of public authority and aristocratic supremacy: the former is necessarily connected with public functions and aristocratic standing. The centre of the *Grundherrschaft* was the *Hof*, the court or hall of the lord, from which the political and economic rights of the lord radiated.

The struggle of the military aristocracy and of ecclesiastical institutions with common freedom was more protracted than in France or England; the lordships very often took the shape of disparate rights over holdings and groups of population scattered over wide tracts of country and intermixed with estates and inhabitants subjected to entirely different authority. Therefore the aspect of German manorialism is more confused and heterogeneous than that of the French or English systems. One remarkable feature of it is the consistent separation of criminal justice from other kinds of jurisdiction on Church property. Episcopal sees and abbeys delegated their share of criminal justice to lay magnates in the neighbourhood (*Vogtei*), and this division of power became a source of various conflicts and of many entangled relations. The main lines of German manorialism are not radically different from those of France and England. The communal element, the *Dorfverband*, is usually more strongly developed than in France, and assumes a form more akin to the English township. But there were regions, *e.g.* Westphalia, where the population had settled in separate farms (*Hofsystem*), and where the communal solidarity was reduced to a union for administrative purposes and for the use of pasture.

It need hardly be added that every step in the direction of more active economic intercourse and more efficient public authority tended to lessen the influence of the manorial system in so far as the latter was based on the localization of government, natural husbandry and aristocratic authority.

See Fustel de Coulanges, *Histoire des institutions de la France*, especially the volumes "L' Alleu et le domaine rural" and "L'Invasion germanique"; Beaudouin, Les Grands domaines dans l'empire romain" (*Nouvelle revue de droit français et étranger*, 1898); J. Flach, *Les Origines de l'ancienne France*, I., II., III. (1886); Paul Viollet, *Histoire des institutions de la France*, I., II. (1890, 1898); A. Luchaire, *Manuel des institutions françaises* (1892); G. Waitz, *Deutsche Verfassungsgeschichte*, I.–VIII. (1865–1883); K. T. von Inama-Sternegg, *Deutsche Wirtschaftsgeschichte*, I., II. (1879–1891); K. Lamprecht, *Deutsches Wirthschaftsleben*, I.–IV. (1885); A. Meitzen, *Ansiedelungen, Wanderungen und Agrarwesen der Völker Europas*, I.–IV. (1895 ff.); W. Wittich, *Die Grundherrschaft in Nordwestdeutschland* (1896); G. F. von Maurer, *Geschichte der Mark-, Dorf- und Hofverfassung in Deutschland*; and F. Seebohm, *The English Village Community* (1883). (P. Vi.)

Rights of Lord and Tenants.

Rights of Villeins.

Cotters.

The Manor in England.—It will be most convenient to describe a typical English manor in its best known period, the 13th century, and to indicate briefly the modifications of the type which varying conditions may produce. Topographically such a manor consisted partly of the houses of the inhabitants more or less closely clustered together, and surrounded by arable land divided into large fields, two or three in number. Each of these fields was divided again into shots or furlongs, and each of the shots was broken up into cultivated strips a pole wide, each containing an acre, separated by narrow balks of turf. There were also certain meadows for supplying hay; and beyond the cultivated land lay the wood and waste of the manor. Portions of arable or meadow land might be found apart from the organization of the remainder; the lord of the manor might have a park, and each householder a garden, but the land of the manor was the open fields, the meadows and the wastes or common. The condition of the inhabitants of such a manor is as complex as its geography. At the head of the society came the lord of the manor, with his hall, court, or manor-house, and the land immediately about it, and his demesne both in the fields and in the meadow land. The arable demesne consisted of certain of the acre strips lying scattered over the various furlongs; his meadow was a portion assigned to him each year by the custom of the manor. He had also rights over the surrounding waste paramount to those enjoyed by the other inhabitants. Part of his demesne land would be granted out to free tenants to hold at a rent or by military or other service; part would be in the lord's own hands, and cultivated by him. Each part so granted out will carry with it a share in the meadow land and in the profits of the waste. These rights of the free tenants over the waste limited the lord's power over it. He could not by enclosure diminish their interest in it. The statute of Merton in 1236 and the second statute of Westminster in 1285 marked the utmost limit of enclosure allowed in the 13th century. Below the lord and the free tenants came the villeins, natives, bondmen, or holders of *virgates* or yard-lands, each holding a house, a fixed number of acre strips, a share of the meadow and of the profits of the waste. The number of strips so held was usually about thirty; but virgates of fifteen acres or even eighty are not unknown. In any one manor, however, the holdings of all the villeins were equal. Normally the holder of a virgate was unfree; he had no rights in the eye of the law against his lord, who was protected from all suits by the *exceptio villenagii*; he could not without leave quit the manor, and could be reclaimed by process of law if he did; the strict contention of law deprived him of all right to hold property; and in many cases he was subject to certain degrading incidents, such as *merchet* (*merchetum*), a payment due to the lord upon the marriage of a daughter, which was regarded as a special mark of unfree condition. But there are certain limitations to be made. Firstly, all these incidents of tenure, even merchet, might not affect the personal status of the tenant; he might still be free, though holding by an unfree tenure; secondly, even if unfree, he was not exposed to the arbitrary will of his lord but was protected by the custom of the manor as interpreted by the manor court. Moreover, he was not a slave, he was not bought and sold apart from his holding. The hardship of his condition lay in the services due from him. As a rule a villein paid for his holding in money, in labour and in kind. In money he paid, firstly, a small fixed rent called rent of assize; and, secondly, dues under various names, partly in lieu of services commuted into money payments, and partly for the privileges and profits enjoyed by him on the waste of the manor. In labour he paid more heavily. Week by week he had to come with his own plough and oxen to plough the lord's demesne; when ploughing was done he had to harrow, to reap the crops, to thresh and carry them, or do whatever might be required of him, until his allotted number of days' labour in the year was done. Beyond this his lord might request of him extra days in harvest or other seasons of emergency, and these requests could not be denied. Further, all the carriage of the manor was provided by the villeins, even to places as much as a hundred miles away from the manor. The mending of the ploughs, hedging, ditching, sheepshearing and other miscellaneous work also fell upon him, and it is sometimes hard to see what time remained to him to work upon his own holding. In kind he usually rendered honey, eggs, chickens and perhaps a ploughshare, but these payments were almost always small in value. Another class of inhabitants remains to be mentioned —the cotters. These are the poor of the manor, who hold a cottage and garden, or perhaps one acre or half an acre in the fields. They were unfree in condition, and in most manors their services were modelled upon those of the villeins. From their ranks were usually drawn the shepherd of the manor, the bee-keeper and other minor officials of the manor.

Staff.

A complicated organization necessarily involves administrators. Just as the services of the tenants and even their names vary from manor to manor, so does the nature of the staff. Highest in rank came the steward; he was attached to no manor in particular, but controlled a group, travelling from one to another to take accounts, to hold the courts, and generally represent the lord. Under him are the officers of the several manors. First came the bailiff or beadle, the representative of the lord in the manor; his duty was to collect the rents and services, to gather in the lord's crops and account for the receipts and expenditure of the manor. Closely connected with him was the "messor" or reaper; in many cases, indeed, "reaper" seems to have been only another name for the bailiff. But the villeins were not without their own officer, the provost or reeve. His duty was to arrange the distribution of the services due from the tenants, and, as their representative, to assist the bailiff in the management of the manor. Sometimes the same man appears to have united both offices, and we find the reeve accounting to the lord for the issues of the manor.

To these important officials may be added a number of smaller ones, the shepherd, the swineherd, the beekeeper, the cowherd, the ploughman and so on, mostly selected from the cotters, and occupying their small holdings by the services expressed in their titles. The number varies with the constitution and needs of each estate, and they are often replaced by hired labour.

Manor Court.

The most complicated structure in the system is the manor court. The complication is, indeed, partly the work of lawyers interpreting institutions they did not understand by formulae not adapted to describe them. But beyond this there remain the facts that the court was the meeting-point of the lord and the tenants both free and unfree, that any question touching on the power and constitution of the court was bound to affect the interests of the lord and the tenants, and that there was no external power capable of settling such questions as did arise. Amid this maze a few clear lines can be laid down. In the first place, so far as the 13th century goes, all the discussion that has collected about the terms court leet, court baron and court customary may be put aside; it relates to questions which in the 13th century were only just emerging. The manor court at that date exercised its criminal, civil, or manorial jurisdiction as one court; its names may differ, the parties before it may be free or unfree, but the court is the same. Its president was the lord's steward; the bailiff was the lord's representative and the public prosecutor; and the tenants of the manor, both free and unfree, attended at the court and gave judgment in the cases brought before it. To modern ears the constitution sounds unfamiliar. The president of the court settled the procedure of the court, carried it out, and gave the final sentence, but over the law of the court he had no power. All that is comprised in the word "judgment" was settled by the body of tenants present at the court. This attendance was, indeed, compulsory, and absence subjected to a fine any tenant owing and refusing the service known as "suit of court." It may be asked who in these courts settled questions of fact. The answer must be that disputed questions of fact could only be settled in one way, by ordeal; and that in most manorial courts the method employed was the wager of law. The business of the court may be divided into criminal, manorial and civil. Its powers under the first head depended on the franchises enjoyed by the lord in the particular manor; for the most part only petty offences were triable, such as small thefts, breaches of the assize of bread and ale, assaults, and the like; except under special conditions, the justice of great offences remained in the king. But offences against the custom of the manor, such as bad ploughing, improper taking of wood from the lord's woods, and the like, were of course the staple criminal business of the court. Under the head of manorial business the court dealt with the choice of the manorial officers, and had some power of making regulations for the management of the manor; but its most important function was the recording of the surrenders and admittances of the villein tenants. Into the history and meaning of this form of land transfer it is not necessary to enter here. But it must be noted that the conveyance of a villein's holding was effected by the vendor surrendering his land to the lord, who thereupon admitted the purchaser to the holding. The same procedure was employed in all cases of transfer of land, and the transaction was regularly recorded upon the rolls of the court among the records of all the other business transacted there. Finally, the court dealt with all suits as to land within the manor, questions of dower and inheritance, and with civil suits not connected with land. But it need hardly be said that in an ordinary rural manor very few of these would occur.

It will be clear on consideration that the manor court as here described consisted of conflicting elements of very different origin and history. Founded partly on express grants of franchises, partly on the inherent right of a feudal lord to hold a court for his free tenants, partly on the obscure community traceable among the unfree inhabitants of the manor, it is incapable of strict legal definition. All these elements, moreover, contain in themselves reasons for the decay which gradually came over the system. The history of the decay of the manorial jurisdictions in England has not yet been written. On the one hand were the king's courts, with new and improved processes of law; on the other hand the gradual disintegration which marks the history of the manor during the 14th and 15th centuries. The criminal jurisdiction was the first to disappear, and was closely followed by the civil jurisdiction over the free tenants; and in modern times all that is left is the jurisdiction over the customary tenants and their holdings, and that in an attenuated form.

A few words must be given to the legal theories of the 15th century on the manor court. It would seem to have become the law that to the existence of the manor two courts were necessary—a court customary for customary tenants, and a court baron for free tenants. In the court customary the lord's steward is the judge; in the court baron the freeholders are the judges. If the freeholders in the manor diminish to less than two in number the court baron cannot be held, and the manor perishes. Nor can it be revived by the grant of new freehold tenures, because under the statute of *Quia Emptores* such new freeholders would hold not of the lord of the manor, but of his lord. The customary tenants and the court customary may survive, but the manor is only a reputed manor. Of the 13th century all this is untrue, but even at that date the existence of free tenants was in a measure essential to the existence of the manor court. If there were none the jurisdiction of the court over free tenants of course collapsed; but in addition to this the lord also lost his power of exercising the highest criminal franchises, even if he otherwise possessed them; he could, for instance, no longer hang a murderer on his own gallows. Perhaps it may be said that to the exercise of the feudal power and of the royal franchises the presence of free tenants was necessary. But it is clear that no such condition was necessary to the existence of the manor.

Apart from the change in the court of the manor, the most important thread in its history is the process which converted the villein into the copyholder. Here again the subject is imperfectly explored, and part of it is still subject to controversy. In the strict view of contemporary lawyers the holding of the villein tenant of the 13th century was at the will of the lord, and the king's courts of law would not protect him in his possession. If, however, the villein were a tenant on the king's ancient demesne his condition was improved. The writs of *monstraverunt* and the little writ of right close protected him from the improper exaction of services and from ejection by the lord. But in ordinary manors there was no such immunity. That ejection was common cannot be believed, but it was legally possible; and it was not until the well-known decision of Danby, C.J., and Bryan, C.J., in 7 Edw. IV., that the courts of law would entertain an action of trespass brought against his lord by a customary tenant. From that date the courts, both of law and equity, begin to intervene; and the records of the Courts of Star Chamber and Requests show that in the Tudor period equitable suits brought by tenants against their lords are not infrequent. Side by side with the alteration in the legal condition of the manor there went on an economic change. The labour rents and other services slowly disappeared, and were replaced by money payments. The field divisions gave way before inclosures, effected sometimes by the lords and sometimes by the tenants. Change in legal and agricultural practice went on side by side, and finally the manor ceased to be an important social form, and became only a peculiar form of land tenure and the abode of antiquarian curiosities.

See G. L. von Maurer, *Einleitung in die Geschichte der Hof-, Mark-, Dorf- und Stadtverfassung in Deutschland* (Erlangen, 1856); G. Nasse, *Zur Geschichte der mittelälterlichen Feldgemeinschaft in England* (Bonn, 1869); H. S. Maine, *Village Communities in the East and West* (Cambridge, 1872); F. Seebohm, *The English Village Community* (1883); W. J. Ashley, *English Economic History*, pts. i. ii. (1888–1893); F. W. Maitland, *Select Pleas in Manorial Courts* (London, Selden Society, 1888); P. Vinogradoff, *Villainage in England* (Cambridge, 1892); *The Growth of the Manor* (1905) and *English Society in the 11th Century* (1908); A. Meitzen, *Siedelung und Agrarwesen der Westgermanen und Ostgermanen* (Berlin, 1896); W. Cunningham, *Growth of English Industry and Commerce* (Cambridge, 1896); F. Pollock and F. W. Maitland, *History of English Law* (Cambridge, 1896); F. W. Maitland, *Doomsday Book and Beyond* (Cambridge, 1897); and C. M. Andrews, *The Old English Manor* (1892). (C. G. Cr.)

MANOR-HOUSE (Lat. *manerium*; Fr. *manoir*), in architecture, the name given to the dwelling-house of the lord of the manor. The manor-house was generally arranged for defence against robbers and thieves and was often surrounded by a moat with drawbridge, but was not provided with a keep or with towers or lofty curtain walls so as to stand a siege. The early buildings were comparatively small, square in plan, comprising a hall with one or two adjacent chambers; at a later period wings were added, thus forming three sides of a quadrangle, like the house designed by John Thorpe as his residence, the plan of which is among his drawings in the Soane Museum. One of the most ancient examples is the manor-house built by Richard Cœur de Lion at Southampton as a rendezvous when he was about to cross into France. This consisted of a hall and chapel on the first floor, with cellars on the ground floor; the walls of this structure, with the chimney-piece, are still in existence. The distinction between the "manor-house" and "castle" is not always very clearly defined; in France such buildings as the castles of Aydon (Northumberland) and of Stokesay (Shropshire) would be regarded as manor-houses in that they were built as country houses and not as fortresses, like Coucy and Pierrefonds; some of the smaller castles in France were, in the 16th century, transformed into manor-houses by the introduction of windows on the second floors of their towers and the partial destruction of their curtain walls, as in the manor-houses of Sedières (Corrèze), Nantouillet and Compiègne; and in the same century, as at Chenonceaux, Blois and Chambord, though angle towers and machicolated parapets still formed part of the design, they were considered to be purely decorative features. The same is found in England; thus in Thornbury and Hurstmonceaux castles, and in Cowdray House, the fortifications were more for show than for use. There is an interesting example of a French manor-house near Dieppe, known as the Manoir-d'Ango, built in 1525, of which a great portion still exists, where the proprietor Ango received François I., so that it must have been of considerable size.

In England the principal examples of which remains exist are the manor-houses of Appleton, Berkshire, with a moat; King John's house at Warnford (Hampshire); Boothby Ragnell, Lincolnshire, with traces of moat; Godmersham, Kent; Little Wenham Hall, Suffolk, built partly in brick and flint, and one of the earliest in which the bricks, probably imported from Flanders, are found; Charney Hall, Berkshire (T-shaped in plan in two storeys); Longthorpe House, near Peterborough; Stokesay, Shropshire, already referred to; Cottesford, Oxfordshire; Woodcroft, Northamptonshire; Acton Burnell, Shropshire; Old Soar, Plaxtol, Kent, in two storeys, the ground storey vaulted and used as cellar and storehouse, and the upper floor with hall, solar and chapel. The foundation of all these dates from the 13th century. Ightham Mote, Kent, portions of which, with the moat, date from the 14th century, is one of the best preserved manor-houses; then follow Norborough Hall, Northamptonshire; Creslow manor-house, Bucks, with moat; Sutton Courtenay, Berkshire; the Court Lodge, Great Chart, Kent; Stanton St Quentin, Great Chalfield, and South Wraxhall, all in Wilts; Meare manor-house, Somerset; Ockwell, Berks; Kingfield manor-house, Derbyshire; Kirby Muxloe, Leicestershire; Stoke Albany, Northamptonshire; and, in the 16th century, Large Marney Hall, Essex (1520); Sutton Place, Surrey (1530); the Vyne, Hampshire, already influenced by the first Renaissance. In the 17th and 18th centuries the manor-house is generally rectangular in plan, and, though well and solidly built, would seem to have been erected more with a view to internal comfort than to exterior embellishments. There is one other type of manor-house, which partakes of the character of the castle in its design, and takes the form of a tower, rectangular or square, with angle turrets and in several storeys; in France it is represented by the manor-houses of St Medard near Bordeaux and Camarsae (Dordogne), and in England by Tattershall Castle, Lincolnshire and Middleton Tower, Norfolk, both being in brick. (R. P. S.)

MANRESA, a town of north-eastern Spain, in the province of Barcelona, on the river Cardoner and the Barcelona-Lérida railway. Pop. (1900), 23,252. Manresa is the chief town of the highlands watered by the Cardoner and upper Llobregat, which meet below the town, and are also connected by a canal 18 m. long. Two bridges, one built of stone and dating from the Roman period, the other constructed of iron in 1804, unite the older and larger part of Manresa with the modern suburbs on the right bank of the river. The principal buildings are the collegiate church of Santa Maria de la Séo, the Dominican monastery, and the church of San Ignazio, built over the cavern (*cueva santa*) where Ignatius de Loyola spent most of the year 1522 in penitentiary exercises and the composition of his *Exercitia spiritualia*. Santa Maria is a fine example of Spanish Gothic, and consists, like many Catalan churches, of nave and chancel, aisles and ambulatory, without transepts. One of its chief treasures is an exquisite 15th-century Florentine altar-frontal, preserved in the sacristy. The Dominican monastery, adjoining the *cueva santa*, commands a magnificent view of the Montserrat (*q.v.*), and is used for the accommodation of the pilgrims who yearly visit the cavern in thousands. Manresa has important iron-foundries and manufactures of woollen, cotton and linen goods, ribbons, hats, paper, soap, chemicals, spirits and flour. Building-stone is quarried near the town.

Manresa is probably the *Munorisa* of the Romans, which was the capital of the Jacetani or Jaccetani, an important tribe of the south-eastern Pyrenees. A large portion of the town was burned by the French in 1811.

MANRIQUE, GÓMEZ (1412?–1490?), Spanish poet, soldier, politician and dramatist, was born at Amusco. The fifth son of Pedro Manrique, *adelantado mayor* of León, and nephew of Santillana (*q.v.*), Gómez Manrique was introduced into public life at an early age, took a prominent part against the constable Álvaro de Luna during the reign of John II., went into opposition against Miguel Lucas de Iranzo in the reign of Henry IV., and declared in favour of the infanta Isabel, whose marriage with Ferdinand he promoted. Besides being a distinguished soldier, he acted as a moderating political influence and, when appointed *corregidor* of Toledo, was active in protecting the converted Jews from popular resentment. His will was signed on the 31st of May 1490, and he is known to have died before the 16th of February 1491. He inherited the literary taste of his uncle Santillana, and was greatly esteemed in his own age; but his reputation was afterwards eclipsed by that of his nephew Jorge Manrique (*q.v.*), whose *Coplas* were continually reproduced. Gómez Manrique's poems were not printed till 1885, when they were edited by Antonio Paz y Melia. They at once revealed him to be a poet of eminent merit, and it seems certain that his *Consejos*, addressed to Diego Arias de Avila, inspired the more famous *Coplas* of his nephew. His didactic verses are modelled upon those of Santillana, and his satires are somewhat coarse in thought and expression; but his place in the history of Spanish literature is secure as the earliest Spanish dramatist whose name has reached posterity. He wrote the *Representación del nascimiento de Nuestro Señor*, a play on the Passion, and two *momos*, or interludes, played at court.

MANRIQUE, JORGE (1440?–1478), Spanish poet and soldier, was born probably at Paredes de Nava. The fourth son of Rodrigo Manrique, count de Paredes, he became like the rest of his family a fervent partisan of Queen Isabel, served with great distinction in many engagements, and was made *comendador* of Montizón in the order of Santiago. He was killed in a skirmish near the fortress of Garci-Muñoz in 1478, and was buried in the church attached to the convent of Uclés. His love-songs, satires, and acrostic verses are merely ingenious compositions in the taste of his age; he owes his imperishable renown to a single poem, the *Coplas por la muerte de su padre*, an elegy of forty stanzas on the death of his father, which was apparently first printed in the *Cancionero llamado de Fray Inigo de Mendoza* about the year 1482. There is no foundation for the theory that Manrique drew his inspiration from an Arabic poem by Abu 'l-Bakā Sālih ar-Rundi; the form of the *Coplas* is influenced by the *Consejos* of his uncle, Gómez Manrique, and the matter derives from the Bible, from Boethius and from other sources readily accessible. The great sonorous commonplaces on death are vitalized by the intensely personal grief of the poet, who lent a new solemnity and significance to thoughts which had been for centuries the common property of mankind. It was given to Jorge Manrique to have one single moment of sublime expression, and this isolated achievement has won him a fame undimmed by any change of taste during four centuries.

The best edition of the *Coplas* is that issued by R. Foulché-Delbosc in the *Bibliotheca hispanica*; the poem has been admirably translated by Longfellow. Manrique's other verses were mostly printed in Hernando del Castillo's *Cancionero general* (1511).

MANSE (Med. Lat. *mansa*, *mansus* or *mansum*, from *manere*, to dwell, remain), originally a dwelling-house together with a portion of land sufficient for the support of a family. It is defined by Du Cange (*Glossarium*, *s.v. Mansus*) as . . . *certam agri portionem quae coleretur et in qua coloni aedes esset.* The term was particularly applied, in ecclesiastical law, to the house and glebe to which every church was entitled by common right, the rule of canon law being *sancitum est ut unicuique ecclesiae unus mansus integer absque ullo servitio tribuatur* (Phillimore, *Eccles. Law*, 1895, ii. 1125). The word is now chiefly used for the residence of a minister of the Established Church of Scotland; to this every minister of a rural parish is entitled, and the landed proprietors must build and keep it up. "Manse" is also loosely used for the residence of a minister of various Free Church denominations (see GLEBE).

MANSEL, HENRY LONGUEVILLE (1820–1871), English philosopher, was born at Cosgrove, Northamptonshire (where his father, also Henry Longueville Mansel, fourth son of General John Mansel, was rector), on the 6th of October 1820. He was educated at Merchant Taylors' School and St John's College, Oxford. He took a double first in 1843, and became tutor of his college. He was appointed reader in moral and metaphysical philosophy at Magdalen College in 1855, and Waynflete professor in 1859. He was a great opponent of university reform and of the Hegelianism which was then beginning to take root in Oxford. In 1867 he succeeded A. P. Stanley as professor of ecclesiastical history, and in 1868 he was appointed dean of St Paul's. He died on the 31st of July 1871.

The philosophy of Mansel, like that of Sir William Hamilton, was mainly due to Aristotle, Kant and Reid. Like Hamilton, Mansel maintained the purely formal character of logic, the duality of consciousness as testifying to both self and the external world, and the limitation of knowledge to the finite and "conditioned." His doctrines were developed in his edition of Aldrich's *Artis logicae rudimenta* (1849)—his chief contribution to the reviving study of Aristotle—and in his *Prolegomena logica: an Inquiry into the Psychological Character of Logical Processes* (1851, 2nd ed. enlarged 1862), in which the limits of logic as the "science of formal thinking" are rigorously determined. In his Bampton lectures on *The Limits of Religious Thought* (1858, 5th ed. 1867; Danish trans. 1888) he applied to Christian theology the metaphysical agnosticism which seemed to result from Kant's criticism, and which had been developed in Hamilton's *Philosophy of the Unconditioned*. While denying all knowledge of the supersensuous, Mansel deviated from Kant in contending that cognition of the ego as it really is is itself a fact of experience. Consciousness, he held—agreeing thus with the doctrine of "natural realism" which Hamilton developed from Reid—implies knowledge both of self and of the external world. The latter Mansel's psychology reduces to consciousness of our organism as extended; with the former is given consciousness of free will and moral obligation. A summary of his philosophy is contained in his article "Metaphysics" in the 8th edition of the *Encyclopaedia Britannica* (separately published, 1860). Mansel wrote also *The Philosophy of the Conditioned* (1866) in reply to Mill's criticism of Hamilton; *Letters, Lectures, and Reviews* (ed. Chandler, 1873), and *The Gnostic Heresies* (ed. J. B. Lightfoot, 1875, with a biographical sketch by Lord Carnarvon). He wrote a commentary on the first two gospels in the *Speaker's Commentary*.

See J. W. Burgon, *Lives of Twelve Good Men* (1888–1889); James Martineau, *Essays, Reviews and Addresses* (London, 1891), iii. 117 seq.; A. W. Benn, *History of Rationalism* (1906), ii. 100–112; Masson, *Recent British Philosophy* (3rd ed., London, 1877), pp. 252 seq.; Sir Leslie Stephen in *Dict. Nat. Biog.*

MANSFELD, the name of an old and illustrious German family which took its name from Mansfeld in Saxony, where it was seated from the 11th to the 18th century. One of its earliest members was Hoyer von Mansfeld (d. 1115), a partisan of the emperor Henry V. during his struggles with the Saxons; he fought for Henry at Warnstädt and was killed in his service at Welfesholz. Still more famous was Albert, count of Mansfeld (1480–1560), an intimate friend of Luther and one of the earliest and staunchest supporters of the Reformation. He helped to crush the rising of the peasants under Thomas Munzer in Thuringia in 1525; he was a member of the league of Schmalkalden, and took part in all the movements of the Protestants against Charles V. With Albert was associated his brother Gebhard, and another member of the family was Johann Gebhard, elector of Cologne from 1558 to 1562. A scion of another branch of the Mansfelds was Peter Ernst, Fürst von Mansfeld (1517–1604), governor of Luxemburg, who unlike his kinsmen was loyal to Charles V. He went with the emperor to Tunis and fought for him in France. He was equally loyal to his son, Philip II. of Spain, whom he served at St Quentin and in the Netherlands. He distinguished himself in the field and found time to lead a body of troops to aid the king of France against the Huguenots. In this capacity he was present in 1569 at the battle of Moncontour, where another member of his family, Count Wolrad of Mansfeld (d. 1578) was among the Huguenot leaders. The Mansfeld family became extinct in 1780 on the death of Josef Wenzel Nepomuk, prince of Fondi, the lands being divided between Saxony and Prussia.

See L. F. Niemann, *Geschichte der Grafen von Mansfeld* (Aschersleben, 1834).

MANSFELD, ERNST, GRAF VON (*c.* 1580–1626), German soldier, was an illegitimate son of Peter Ernst, Fürst von Mansfeld, and passed his early years in his father's palace at Luxemburg. He gained his earliest military experiences in Hungary, where his half-brother Charles (1543–1595,) also a soldier of renown, held a high command in the imperial army. Later he served under the Archduke Leopold, until that prince's ingratitude, real or fancied, drove him into the arms of the enemies of the house of Habsburg. Although remaining a Roman Catholic he allied himself with the Protestant princes, and during the earlier part of the Thirty Years' War he was one of their foremost champions. He was despatched by Charles Emmanuel, duke of Savoy, at the head of about 2000 men to aid the revolting Bohemians when war broke out in 1618. He took Pilsen, but in the summer of 1619 he was defeated at Zablat; after this he offered his services to the emperor Ferdinand II. and remained inactive while the titular king of Bohemia, Frederick V., elector palatine of the Rhine, was driven in headlong rout from Prague. Mansfeld, however, was soon appointed by Frederick to command his army in Bohemia, and in 1621 he took up his position in the Upper Palatinate, successfully resisting the efforts made by Tilly to dislodge him. From the Upper he passed into the Rhenish Palatinate. Here he relieved Frankenthal and took Hagenau; then, joined by his master, the elector Frederick, he defeated Tilly at Wiesloch in April 1622 and plundered Alsace and Hesse. But Mansfeld's ravages were not confined to the lands of his enemies; they were ruinous to the districts he was commissioned to defend. At length Frederick was obliged to dismiss Mansfeld's troops from his service. Then joining Christian of Brunswick the count led his army through Lorraine, devastating the country as he went, and in August 1622 defeating the Spaniards at Fleurus. He next entered the service of the United Provinces and took up his quarters in East Friesland, capturing fortresses and inflicting great hardships upon the inhabitants. A mercenary and a leader of mercenaries, Mansfeld often interrupted his campaigns by journeys made for the purpose of raising money, or in other words of selling his services to the highest bidder, and in these diplomatic matters he showed considerable skill. About 1624 he paid three visits to London, where he was hailed as a hero by the populace, and at least one to Paris. James I. was anxious to furnish him with men and money for the recovery of the palatinate, but it was not until January 1625 that Mansfeld and his army of "raw and poor rascals" sailed from Dover to the Netherlands. Later in the year, the Thirty Years' War having been renewed under the leadership of Christian IV., king of Denmark, he re-entered Germany to take part therein. But on the 25th of April 1626 Wallenstein inflicted a severe defeat upon him at the bridge of Dessau. Mansfeld, however, quickly raised another army, with which he intended to attack the hereditary lands of the house of Austria, and pursued by Wallenstein he pressed forward towards Hungary, where he hoped to accomplish his purpose by the aid of Bethlem Gabor, prince of Transylvania. But when Gabor changed his policy and made peace with the emperor, Mansfeld was compelled to disband his troops. He set out for Venice, but when he reached Rakowitza he was taken ill, and here he died on the 29th of November 1626. He was buried at Spalato.

See F. Stieve, *Ernst von Mansfeld* (Munich, 1890); R. Reuss, *Graf Ernst von Mansfeld im böhmischen Kriege* (Brunswick, 1865); A. C. de Villermont, *Ernest de Mansfeldt* (Brussels, 1866); L. Graf Uetterodt zu Schaffenberg, *Ernst Graf zu Mansfeld* (Gotha, 1867); J. Grossmann, *Des Grafen Ernst von Mansfeld letzte Pläne und Thaten* (Breslau, 1870); E. Fischer, *Des Mansfelders Tod* (Berlin, 1873); S. R. Gardiner, *History of England*, vols. iv. and v. (1901); J. L. Motley, *Life and Death of John of Barneveld* (ed. 1904; vol. ii.).

MANSFIELD, RICHARD (1857–1907), American actor, was born on the 24th of May 1857, in Berlin, his mother being Madame [Erminia] Rudersdorff (1822–1882), the singer, and his father, Maurice Mansfield (d. 1861), a London wine merchant. He first appeared on the stage at St George's Hall, London, and then drifted into light opera, playing the Major-General in *The Pirates of Penzance*, and the Lord High Executioner in *The Mikado*, both in the English provinces and in America. In 1883 he joined A.M. Palmer's Union Square theatre company in New York, and made a great hit as Baron Chevrial in *A Parisian Romance*. He appeared successfully in several plays adapted from well-known stories, and his rendering (1887) of the doubled title-parts in R. L. Stevenson's *Strange Case of Dr Jekyll and Mr Hyde* created a profound impression. It was with this play that he made his London reputation during a season (1888) at the Lyceum theatre, by invitation of Henry Irving. He produced Richard III. the next year at the Globe. Among his other chief successes were *Prince Karl*, *Cyrano de Bergerac* and *Monsieur Beaucaire*. He was one of the earliest to produce G. Bernard Shaw's plays in America, appearing in 1894 as Bluntschli in *Arms and the Man*, and as Dick Dudgeon in *The Devil's Disciple* in 1897. As a manager and producer of plays Mansfield was remarkable for his lavish staging. He died in New London, Connecticut, on the 30th of August 1907.

See the lives by Paul Wilstach (1908) and William Winter (1910).

MANSFIELD, WILLIAM MURRAY, 1st Earl of (1705–1793), English judge, was born at Scone in Perthshire, on the 2nd of March 1705. He was a younger son of David Murray, 5th Viscount Stormont (*c.* 1665–1731), the dignity having been granted in 1621 by James I. to his friend and helper, Sir David Murray (d. 1631), a Scottish politician of some note. Lord Stormont's family was Jacobite in its politics, and his second son James (*c.* 1690–1728), being apparently mixed up in some of the plots of the time, joined the court of the exiled Stuarts and in 1721 was created earl of Dunbar by James Edward, the Old Pretender.

William Murray was educated at Perth grammar school and Westminster School, of which he was a king's scholar. Entering Christ Church, Oxford, he graduated in 1727. A friend of the family, Lord Foley, provided the funds for his legal training, and he became a member of Lincoln's Inn on his departure from Oxford, being called to the bar in 1730. He was a good scholar and mixed with the best literary society, being an intimate friend of Alexander Pope. His appearance in some important Scottish appeal cases brought him into notice, and in Scotland at least he acquired an immense reputation by his appearance for the city of Edinburgh when it was threatened with disfranchisement for the affair of the Porteous mob. His English practice had as yet been scanty, but in 1737 a single speech in a jury trial of note placed him at the head of the bar, and from this time he had all he could attend to. In 1738 he married Lady Elizabeth Finch, daughter of the earl of Winchelsea. His political career began in 1742 with his appointment as solicitor-general. During the next fourteen years he was one of the most conspicuous figures in the parliamentary history of the time. By birth a Jacobite, by association a Tory, he was nevertheless a Moderate, and his politics were really dominated by his legal interests. Although holding an office of subordinate rank, he was the chief defender of the government in the House of Commons, and during the time that Pitt was in opposition had to bear the brunt of his attacks. In 1754 he became attorney-general, and for the next two years acted as leader of the House of Commons under the administration of the duke of Newcastle. But in 1756, when the government was evidently approaching its fall, an unexpected vacancy occurred in the chief justiceship of the king's bench, and he claimed the office, being at the same time raised to the peerage as Baron Mansfield.

From this time the chief interest of his career lies in his judicial work, but he did not wholly dissever himself from politics. He became by a singular arrangement, only repeated in the case of Lord Ellenborough, a member of the cabinet, and remained in that position through various changes of administration for nearly fifteen years, and, although he persistently refused the chancellorship, he acted as Speaker of the House of Lords while the Great Seal was in commission. During the time of Pitt's ascendancy he took but little part in politics, but while Lord Bute was in power his influence was very considerable, and seems mostly to have been exerted in favour of a more moderate line of policy. He was on the whole a supporter of the prerogative, but within definite limits. Macaulay terms him, justly enough, "the father of modern Toryism, of Toryism modified to suit an order of things in which the House of Commons is the most powerful body in the state." During the stormy session of 1770 he came into violent collision with Chatham and Camden in the questions that arose out of the Middlesex election and the trials for political libel; and in the subsequent years he was made the subject of the bitter attacks of Junius, in which his early Jacobite connexions, and his apparent leanings to arbitrary power, were used against him with extraordinary ability and virulence. In 1776 he was created earl of Mansfield. In 1783, although he declined to re-enter the cabinet, he acted as Speaker of the House of Lords during the coalition ministry, and with this his political career may be said to have closed. He continued to act as chief justice until his resignation in June 1788, and after five years spent in retirement died on the 20th of March 1793. He left no family, but his title had been re-granted in 1792 with a direct remainder to his nephew David Murray, 7th Viscount Stormont (1727–1796). The 2nd earl was ambassador to Vienna and then to Paris; he was secretary of state for the southern department from 1779 to 1782, and lord president of the council in 1783, and again from 1794 until his death. In 1906 his descendant Alan David Murray (b. 1864) became 6th earl of Mansfield.

Lord Mansfield's great reputation rests chiefly on his judicial career. The political trials over which he presided, although they gave rise to numerous accusations against him, were conducted with singular fairness and propriety. He was accused with especial bitterness of favouring arbitrary power by the law which he laid down in the trials for libel which arose out of the publications of Junius and Horne Tooke, and which at a later time he reaffirmed in the case of the dean of St Asaph (see Libel). But we must remember that his view of the law was concurred in by the great majority of the judges and lawyers of that time, and was supported by undoubted precedents. In other instances, when the government was equally concerned, he was wholly free from suspicion. He supported Lord Camden's decision against general warrants, and reversed the outlawry of Wilkes. He was always ready to protect the rights of conscience, whether they were claimed by Dissenters or Catholics, and the popular fury which led to the destruction of his house during the Gordon riots was mainly due to the fact that a Catholic priest, who was accused of saying Mass, had escaped the penal laws by his charge to the jury. His chief celebrity, however, is founded upon the consummate ability with which he discharged the civil duties of his office. He has always been recognized as the founder of English mercantile law. The common law as it existed before his time was wholly inadequate to cope with the new cases and customs which arose with the increasing development of commerce. The facts were left to the jury to decide as best they might, and no principle was ever extracted from them which might serve as a guide in subsequent cases. Mansfield found the law in this chaotic state, and left it in a form that was almost equivalent to a code. He defined almost every principle that governed commercial transactions in such a manner that his successors had only to apply the rules he had laid down. His knowledge of Roman and foreign law, and the general width of his education, freed him from the danger of relying too exclusively upon narrow precedents, and afforded him a storehouse of principles and illustrations, while the grasp and acuteness of his intellect enabled him to put his judgments in a form which almost always commanded assent. A similar influence was exerted by him in other branches of the common law; and although, after his retirement, a reaction took place, and he was regarded for a while as one who had corrupted the ancient principles of English law, these prejudices passed rapidly away, and the value of his work in bringing the older law into harmony with the needs of modern society has long been fully recognized.

See Holliday's *Life* (1797); Campbell's *Chief Justices*; Foss's *Judges*; Greville's *Memoirs*, *passim*; Horace Walpole's *Letters*; and other memoirs and works on the period.

MANSFIELD, a market town and municipal borough in the Mansfield parliamentary division of Nottinghamshire, England, on the small river Mann or Maun; the junction of several branches of the Midland railway, by which it is 142 m. N.N.W. from London. Pop. (1891), 13,094; (1901), 15,250. Area, 7068 acres. The church of St Peter is partly Early Norman, and partly Perpendicular. There is a grammar school founded by Queen Elizabeth in 1561, occupying modern buildings. Twelve almshouses were founded by Elizabeth Heath in 1693, and to these six were afterwards added. There are a number of other charities. The industries are the manufacture of lace, thread, boots and machinery, iron-founding and brewing. In the neighbourhood, as at Mansfield Woodhouse to the north, there are quarries of limestone, sandstone and freestone. The town is governed by a mayor, 6 aldermen and 18 councillors. During the heptarchy Mansfield was occasionally the residence of the Mercian kings, and it was afterwards a favourite resort of Norman sovereigns, lying as it does on the western outskirts of Sherwood Forest. By Henry VIII. the manor was granted to the earl of Surrey. Afterwards it went by exchange to the duke of Newcastle, and thence to the Portland family. The town obtained a fair from Richard II. in 1377. It became a municipal borough in 1891.

MANSFIELD, a city and the county-seat of Richland county, Ohio, U.S.A., about 65 m. S.W. of Cleveland. Pop. (1890), 13,473; (1900), 17,640, of whom 1781 were foreign-born; (1910 census), 20,768. It is served by the Pennsylvania (Pittsburg, Ft Wayne & Chicago division), the Erie, and the Baltimore & Ohio railways. It is built on an eminence (1150 ft.), and has two public parks, a substantial court-house, a soldiers' and sailors' memorial building, a public library, a hospital and many fine residences. It is the seat of the Ohio state reformatory. Mansfield has an extensive trade with the surrounding agricultural country, but its largest interests are in manufactures. The total factory product in 1905 was valued at $7,353,578. There are natural gas wells in the vicinity. The waterworks and the sewage disposal plant are owned and operated by the municipality. Mansfield was laid out in 1808, and was named in honour of Lieut.-Colonel Jared Mansfield (1759–1830), United States surveyor of Ohio and the North-west Territory in 1803–1812, and professor of natural and experimental philosophy at West Point from 1812 to 1828. Mansfield was incorporated as a village in 1828 and was first chartered as a city in 1857. It was the home of John Sherman from 1840 until his death.

MANSION (through O. Fr. *mansion*, mod. *maison*, from Lat. *mansio*, dwelling-place, stage on a journey; *manere*, to remain), a term applied in early English use to the principal house of the lord of a manor. By the Settled Land Act 1890, § 10, subsec. 2, repealing § 15 of the act of 1882, "the principal mansion house . . . on any settled land shall not be sold or exchanged or leased by the tenant for life without the consent of the trustees of the settlement or an order of the court." The principles guiding an English court of law for making or refusing such an order are laid down in *In re the Marquess of Ailesbury's Settled Estate* (1892), 1 Ch. 506, 546; A.C. 356. In general usage, the term "mansion" is given to any large and important house in town or country; and "mansion house" to the official residence, when provided, of the mayor of a borough, particularly to that of the lord mayors of London and Dublin. From the general meaning of a conspicuously large dwelling-place comes the modern employment of the term "mansions," in London and elsewhere, for large buildings composed of "flats."

MANSLAUGHTER (O. Eng., *mannslacht*, from *mann*, man, and *slaeht*, act of slaying, *slean*, to slay, properly to smite; cf. Ger. *schlagen*, *Schlacht*, battle), a term in English law signifying "unlawful homicide without malice aforethought" (Stephen, *Digest of the Criminal Law*, Art. 223). The distinction between manslaughter and murder and other forms of homicide is treated under Homicide.

MANSON, GEORGE (1850–1876), Scottish water-colour painter, was born in Edinburgh on the 3rd of December 1850. When about fifteen he was apprenticed as a woodcutter with W. & R. Chambers, with whom he remained for over five years, diligently employing all his spare time in the study and practice of art, and producing in his morning and evening hours water-colours of much delicacy and beauty. In 1871 he devoted himself exclusively to painting. His subjects were derived from humble Scottish life—especially child-life, varied occasionally by portraiture, by landscape, and by views of picturesque architecture. In 1873 he visited Normandy, Belgium and Holland; in the following year he spent several months in Sark; and in 1875 he resided at St Lô, and in Paris, where he mastered the processes of etching. Meanwhile in his water-colour work he had been adding more of breadth and power to the tenderness and richness of colour which distinguished his early pictures, and he was planning more complex and important subjects. But his health had been gradually failing, and he was ordered to Lympstone in Devonshire, where he died on the 27th of February 1876.

A volume of photographs from his water-colours and sketches, with a memoir by J. M. Gray, was published in 1880. For an account of Manson's technical method as a wood engraver see P. G. Hamerton's *Graphic Arts*, p. 311.

MANṢŪR (Arab. "victorious"), a surname (*laqab*) assumed by a large number of Mahommedan princes. The best known are: (1) Abū Ja'far ibn Mahommed, second caliph of the Abbasid house, who reigned A.D. 754–775 (see Caliphate: § C, §2); (2) Abū Ṭāhir Isma'il ibn al-Qāim, the third Fatimite caliph of Africa (946–953) (see Fatimites); (3) Abū Yūsuf Ya 'qūb ibn Yūsuf, often described as Jacob Almanzor, of the Moorish dynasty of the Almohades, conqueror of Alfonso III. in the battle of Alarcos (1195); (4) Ibn Abī 'Āmir Mahommed, commonly called Almanzor by European writers, of an ancient but not illustrious Arab family, which had its seat at Torrox near Algeciras. The last-named was born A.D. 939, and began life as a lawyer at Cordova. In 967 he obtained a place at the court of Ḥakam II., the Andalusian caliph, and by an unusual combination of the talents of a courtier with administrative ability rapidly rose to distinction, enjoying the powerful support of Ṣubḥ, the favourite of the caliph and mother of his heir Hishām. The death of Ḥakam (976) and the accession of a minor gave fresh scope to his genius, and in 978 he became chief minister. The weak young caliph was absorbed in exercises of piety, but at first Manṣūr had to share the power with his father-in-law Ghālib, the best general of Andalusia, and with the mother of Hishām. At last a rupture took place between the two ministers. Ghālib professed himself the champion of the caliph and called in the aid of the Christians of Leon; but Manṣūr, anticipating the struggle, had long before remodelled the army and secured its support. Ghālib fell in battle (981); a victorious campaign chastised the Leonese; and on his return to Cordova the victor assumed his regal surname of *al-Manṣūr billah*, and became practically sovereign of Andalusia. The caliph was a mere prisoner of state, and Manṣūr ultimately assumed the title as well as the prerogatives of king (996). Unscrupulous in the means by which he rose to power, he wielded the sovereignty nobly. His strict justice and enlightened administration were not less notable than the military prowess by which he is best known. His arms were the terror of the Christians, and raised the Moslem power in Spain to a pitch it had never before attained. In Africa his armies were for a time hard pressed by the revolt of Zīrī, viceroy of Mauretania, but before his death this enemy had also fallen. Mansūr died at Medinaceli on the 10th of August 1002, and was succeeded by his son Mozaffar.

MANSURA, the capital of the province of Dakahlia, Lower Egypt, near the west side of Lake Menzala, and on the Cairo-Damietta railway. Pop. (1907), 40,279. It dates from 1221, and is famous as the scene of the battle of Mansura, fought on the 8th of February 1250, between the crusaders commanded by the king of France, St Louis, and the Egyptians. The battle was drawn, but it led to the retreat of the crusaders on Damietta, and to the surrender of St Louis. Mansura has several cotton-ginning, cotton, linen and sail-cloth factories.

MANT, RICHARD (1776–1848), English divine, was born at Southampton on the 12th of February 1776, and was educated at Winchester and Trinity College, Oxford. He was elected fellow of Oriel in 1798, and after taking orders held a curacy at Southampton (1802), and then the vicarage of Coggeshall, Essex (1810). In 1811 he was Bampton lecturer, in 1816 was made rector of St Botolph's, and in 1820 bishop of Killaloe and Kilfenoragh (Ireland). In 1823 he was translated to Down and Connor, to which Dromore was added in 1842. In connexion with the Rev. George D'Oyly he wrote a commentary on the whole Bible. Other works by him were the *Psalms in an English Metrical Version* (1842) and a *History of the Church of Ireland* (1839–1841; 2 vols.).

MANTEGAZZA, PAOLO (1831–1910), Italian physiologist and anthropologist, was born at Monza on the 31st of October 1831. After spending his student-days at the universities of Pisa and Milan, he gained his M.D. degree at Pavia in 1854. After travelling in Europe, India and America, he practised as a doctor in the Argentine Republic and Paraguay. Returning to Italy in 1858 he was appointed surgeon at Milan Hospital and professor of general pathology at Pavia. In 1870 he was nominated professor of anthropology at the Instituto di Studii Superiori, Florence. Here he founded the first Museum of Anthropology and Ethnology in Italy, and later the Italian Anthropological Society. From 1865 to 1876 he was deputy for Monza in the Italian parliament, subsequently being elected to the senate. He became the object of bitter attacks on the ground of the extent to which he carried the practice of vivisection. His published works include *Fisiologia del dolore* (1880); *Fisiologia dell' amore* (1896); *Elementi d' igiene* (1875); *Fisonomia e mimica* (1883); *Le Estasi umane* (1887).

MANTEGNA, ANDREA (1431–1506), one of the chief heroes in the advance of painting in Italy, was born in Vicenza, of very humble parentage. It is said that in his earliest boyhood Andrea was, like Giotto, put to shepherding or cattle-herding; this is not likely, and can at any rate have lasted only a very short while, as his natural genius for art developed with singular precocity, and excited the attention of Francesco Squarcione, who entered him in the gild of painters before he had completed his eleventh year.

Squarcione, whose original vocation was tailoring, appears to have had a remarkable enthusiasm for ancient art, and a proportionate faculty for acting, with profit to himself and others, as a sort of artistic middleman; his own performances as a painter were merely mediocre. He travelled in Italy, and perhaps in Greece also, collecting antique statues, reliefs, vases, &c., forming the largest collection then extant of such works, making drawings from them himself, and throwing open his stores for others to study from, and then undertaking works on commission for which his pupils no less than himself were made available. As many as one hundred and thirty-seven painters and pictorial students passed through his school, established towards 1440, which became famous all over Italy. Mantegna was, as he deserved to be, Squarcione's favourite pupil. Squarcione adopted him as his son, and purposed making him the heir of his fortune. Andrea was only seventeen when he painted, in the church of S. Sofia in Padua, a Madonna picture of exceptional and recognized excellence. He was no doubt fully aware of having achieved no common feat, as he marked the work with his name and the date, and the years of his age. This painting was destroyed in the 17th century.

As the youth progressed in his studies, he came under the influence of Jacopo Bellini, a painter considerably superior to Squarcione, father of the celebrated painters Giovanni and Gentile, and of a daughter Nicolosia; and in 1454 Jacopo gave Nicolosia to Andrea in marriage. This connexion of Andrea with the pictorial rival of Squarcione is generally assigned as the reason why the latter became alienated from the son of his adoption, and always afterwards hostile to him. Another suggestion, which rests, however, merely on its own internal probability, is that Squarcione had at the outset used his pupil Andrea as the unavowed executant of certain commissions, but that after a while Andrea began painting on his own account, thus injuring the professional interests of his chief. The remarkably definite and original style formed by Mantegna may be traced out as founded on the study of the antique in Squarcione's atelier, followed by a diligent application of principles of work exemplified by Paolo Uccello and Donatello, with the practical guidance and example of Jacopo Bellini in the sequel.

Among the other early works of Mantegna are the fresco of two saints over the entrance porch of the church of S. Antonio in Padua, 1452, and an altar-piece of St Luke and other saints for the church of S. Giustina, now in the Brera Gallery in Milan, 1453. It is probable, however, that before this time some of the pupils of Squarcione, including Mantegna, had already begun that series of frescoes in the chapel of S. Cristoforo, in the church of S. Agostino degli Eremitani, by which the great painter's reputation was fully confirmed, and which remain to this day conspicuous among his finest achievements.[1] The now censorious Squarcione found much to carp at in the earlier works of this series, illustrating the life of St James; he said the figures were like men of stone, and had better have been coloured stone-colour at once. Andrea, conscious as he was of his own great faculty and mastery, seems nevertheless to have felt that there was something in his old preceptor's strictures; and the later subjects, from the legend of St Christopher, combine with his other excellences more of natural character and vivacity. Trained as he had been to the study of marbles and the severity of the antique, and openly avowing that he considered the antique superior to nature as being more eclectic in form, he now and always affected precision of outline, dignity of idea and of figure, and he thus tended towards rigidity, and to an austere wholeness rather than gracious sensitiveness of expression. His draperies are tight and closely folded, being studied (as it is said) from models draped in paper and woven fabrics gummed. Figures slim, muscular and bony, action impetuous but of arrested energy, tawny landscape, gritty with littering pebbles, mark the athletic hauteur of his style. He never changed, though he developed and perfected, the manner which he had adopted in Padua; his colouring, at first rather neutral and undecided, strengthened and matured. There is throughout his works more balancing of colour than fineness of tone. One of his great aims was optical illusion, carried out by a mastery of perspective which, though not always impeccably correct, nor absolutely superior in principle to the highest contemporary point of attainment, was worked out by himself with strenuous labour, and an effect of actuality astonishing in those times.

Successful and admired though he was in Padua, Mantegna left his native city at an early age, and never afterwards resettled there; the hostility of Squarcione has been assigned as the cause. The rest of his life was passed in Verona, Mantua and Rome—chiefly Mantua; Venice and Florence have also been named, but without confirmation.

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[1] His fellow-workers were Bono of Ferrara, Ansuino of Forlì, and Niccolò Pizzolo, to whom considerable sections of the fresco-paintings are to be assigned. The acts of St James and St Christopher are the leading subjects of the series. St James Exorcizing may have been commenced by Pizzolo, and completed by Mantegna. The Calling of St James to the Apostleship appears to be Mantegna's design, partially carried out by Pizzolo; the subjects of St James baptizing, his appearing before the judge, and going to execution, and most of the legend of St Christopher, are entirely by Mantegna.

It may have been in 1459 that he went to Verona; and he painted, though not on the spot, a grand altar-piece for the church of S. Zeno, a Madonna and angels, with four saints on each side. The Marquis Lodovico Gonzaga of Mantua had for some time been pressing Mantegna to enter his service; and the following year, 1460, was perhaps the one in which he actually established himself at the Mantuan court, residing at first from time to time at Goito, but, from December 1466 onwards, with his family in Mantua itself. His engagement was for a salary of 75 lire (about £30) a month, a sum so large for that period as to mark conspicuously the high regard in which his art was held. He was in fact the first painter of any eminence ever domiciled in Mantua. He built a stately house in the city, and adorned it with a multitude of paintings. The house remains, but the pictures have perished. Some of his early Mantuan works are in that apartment of the Castello which is termed the Camera degli Sposi—full compositions in fresco, including various portraits of the Gonzaga family, and some figures of genii, &c. In 1488 he went to Rome at the request of Pope Innocent VIII., to paint the frescoes in the chapel of the Belvedere in the Vatican; the marquis of Mantua (Federigo) created him a cavaliere before his departure. This series of frescoes, including a noted "Baptism of Christ," was ruthlessly destroyed by Pius VI. in laying out the Museo Pio-Clementino. The pope treated Mantegna with less liberality than he had been used to at the Mantuan court; but on the whole their connexion, which ceased in 1490, was not unsatisfactory to either party. Mantegna then returned to Mantua, and went on with a series of works—the nine tempera-pictures, each of them 9 ft. square, of the "Triumph of Caesar"—which he had probably begun before his leaving for Rome, and which are now in Hampton Court. These superbly invented and designed compositions, gorgeous with all splendour of subject-matter and accessory, and with the classical learning and enthusiasm of one of the master-spirits of the age, have always been accounted of the first rank among Mantegna's works. They were sold in 1628 along with the bulk of the Mantuan art treasures, and were not, as is commonly said, plundered in the sack of Mantua in 1630. They are now greatly damaged by patchy repaintings. Another work of Mantegna's later years was the so-called "Madonna della Vittoria," now in the Louvre. It was painted in tempera about 1495, in commemoration of the battle of Fornovo, which Ginfrancesco Gonzaga found it convenient to represent to his lieges as an Italian victory, though in fact it had been a French victory; the church which originally housed the picture was built from Mantegna's own design. The Madonna is here depicted with various saints, the archangel Michael and St Maurice holding her mantle, which is extended over the kneeling Gianfrancesco Gonzaga, amid a profusion of rich festooning and other accessory. Though not in all respects of his highest order of execution, this counts among the most obviously beautiful and attractive of Mantegna's works—from which the qualities of beauty and attraction are often excluded, in the stringent pursuit of those other excellences more germane to his severe genius, tense energy passing into haggard passion.

Vasari eulogizes Mantegna for his courteous, distinguished and praiseworthy deportment, although there are indications of his having been not a little litigious in disposition. With his fellow-pupils at Padua he had been affectionate; and for two of them, Dario da Trevigi and Marco Zoppo, he retained a steady friendship. That he had a high opinion of himself was natural, for no artist of his epoch could produce more manifest vouchers of marked and progressive attainment. He became very expensive in his habits, fell at times into difficulties, and had to urge his valid claims upon the marquis's attention. After his return to Mantua from Rome his prosperity was at its height, until the death of his wife. He then formed some other connexion, and became at an advanced age the father of a natural son, Giovanni Andrea; and at the last, although he continued launching out into various expenses and schemes, he had serious tribulations, such as the banishment from Mantua of his son Francesco, who had incurred the marquis's displeasure. Perhaps the aged master and connoisseur regarded as barely less trying the hard necessity of parting with a beloved antique bust of Faustina. Very soon after this transaction he died in Mantua, on the 13th of September 1506. In 1517 a handsome monument was set up to him by his sons in the church of S. Andrea, where he had painted the altar-piece of the mortuary chapel.

Mantegna was no less eminent as an engraver, though his history in that respect is somewhat obscure, partly because he never signed or dated any of his plates, unless in one single disputed instance, 1472. The account which has come down to us is that Mantegna began engraving in Rome, prompted by the engravings produced by Baccio Baldini of Florence after Sandro Botticelli; nor is there anything positive to invalidate this account, except the consideration that it would consign all the numerous and elaborate engravings made by Mantegna to the last sixteen or seventeen years of his life, which seems a scanty space for them, and besides the earlier engravings indicate an earlier period of his artistic style. It has been suggested that he began engraving while still in Padua, under the tuition of a distinguished goldsmith, Niccolò. He engraved about fifty plates, according to the usual reckoning; some thirty of them are mostly accounted indisputable—often large, full of figures, and highly studied. Some recent connoisseurs, however, ask us to restrict to seven the number of his genuine extant engravings—which appears unreasonable. Among the principal examples are "Roman Triumphs" (not the same compositions as the Hampton Court pictures), "A Bacchanal Festival," "Hercules and Antaeus," "Marine Gods," "Judith with the Head of Holophernes," the "Deposition from the Cross," the "Entombment," the "Resurrection," the "Man of Sorrows," the "Virgin in a Grotto." Mantegna has sometimes been credited with the important invention of engraving with the burin on copper. This claim cannot be sustained on a comparison of dates, but at any rate he introduced the art into upper Italy. Several of his engravings are supposed to be executed on some metal less hard than copper. The technique of himself and his followers is characterized by the strongly marked forms of the design, and by the oblique formal hatchings of the shadows. The prints are frequently to be found in two states, or editions. In the first state the prints have been taken off with the roller, or even by hand-pressing, and they are weak in tint; in the second state the printing press has been used, and the ink is stronger.

The influence of Mantegna on the style and tendency of his age was very marked, and extended not only to his own flourishing Mantuan school, but over Italian art generally. His vigorous perspectives and trenchant foreshortenings pioneered the way to other artists: in solid antique taste, and the power of reviving the aspect of a remote age with some approach to system and consistency, he distanced all contemporary competition. He did not, however, leave behind him many scholars of superior faculty. His two legitimate sons were painters of only ordinary ability. His favourite pupil was known as Carlo del Mantegna; Caroto of Verona was another pupil, Bonsignori an imitator. Giovanni Bellini, in his earlier works, obviously followed the lead of his brother-in-law Andrea.

The works painted by Mantegna, apart from his frescoes, are not numerous; some thirty-five to forty are regarded as fully authenticated. We may name, besides those already specified—in the Naples Museum, "St Euphemia," a fine early work; in Casa Melzi, Milan, the "Madonna and Child with Chanting Angels" (1461); in the Tribune of the Uffizi, Florence, three pictures remarkable for scrupulous finish; in the Berlin Museum, the "Dead Christ with two Angels"; in the Louvre, the two celebrated pictures of mythic allegory—"Parnassus" and "Minerva Triumphing over the Vices"; in the National Gallery, London, the "Agony in the Garden," the "Virgin and Child Enthroned, with the Baptist and the Magdalen," a late example; the monochrome of "Vestals," brought from Hamilton Palace; the "Triumph of Scipio" (or Phrygian Mother of the Gods received by the Roman Commonwealth), a tempera in chiaroscuro, painted only a few months before the master's death; in the Brera, Milan, the "Dead Christ, with the two Maries weeping," a remarkable *tour de force* in the way of foreshortening, which, though it has a stunted appearance, is in correct technical perspective as seen from all points of view. With all its exceptional merit, this is an eminently ugly picture. It remained in Mantegna's studio unsold at his death, and was disposed of to liquidate debts.

Not to speak of earlier periods, a great deal has been written concerning Mantegna of late years. See the works by Maud Crutwell (1901), Paul Kristeller (1901), H. Thode (1897), Paul Yriarte (1901), Julia Cartwright, *Mantegna and Francia* (1881). (W. M. R.)

MANTELL, GIDEON ALGERNON (1790–1852), English geologist and palaeontologist, was born in 1790 at Lewes, Sussex. Educated for the medical profession, he first practised in his native town, afterwards in 1835 in Brighton, and finally at Clapham, near London. He found time to prosecute researches on the palaeontology of the Secondary rocks, particularly in Sussex—a region which he made classical in the history of discovery. While he was still a country doctor at Lewes his eminence as a geological investigator was fully recognized on the publication of his work on *The Fossils of the South Downs* (1822). His most remarkable discoveries were made in the Wealden formations. He demonstrated the fresh-water origin of the strata, and from them he brought to light and described the remarkable Dinosaurian reptiles known as *Iguanodon*, *Hylaeosaurus*, *Pelorosaurus* and *Regnosaurus*. For these researches he was awarded the Wollaston medal by the Geological Society and a Royal medal by the Royal Society. He was elected F.R.S. in 1825. Among his other contributions to the literature of palaeontology was his description of the Triassic reptile *Telerpeton elginense*. Towards the end of his life Dr Mantell retired to London, where he died on the 10th of November 1852. His eldest son, WALTER BALDOCK DURRANT MANTELL (1820–1895), settled in New Zealand, and there attained high public positions, eventually being secretary for Crown-lands. He obtained remains of the *Notornis*, a recently extinct bird, and also brought forward evidence to show that the moas were contemporaries of man.

In addition to the works above mentioned Dr Mantell was author of *Illustrations of the Geology of Sussex* (4to, 1827); *Geology of the South-east of England* (1833); *The Wonders of Geology*, 2 vols. (1838; ed. 7, 1857); *Geological Excursions round the Isle of Wight, and along the Adjacent Coast of Dorsetshire* (1847; ed. 3, 1854); *Petrifactions and their Teachings* (1851); *The Medals of Creation* (2 vols., 1854).

MANTES-SUR-SEINE, a town of northern France, capital of an arrondissement in the department of Seine-et-Oise on the left bank of the Seine, 34 m. W.N.W. of Paris by rail. Pop. (1906), 8113. The chief building in Mantes is the celebrated church of Notre-Dame which dates in the main from the end of the 12th century. A previous edifice was burnt down by William the Conqueror together with the rest of the town, at the capture of which he lost his life in 1087; he is said to have bequeathed a large sum for the rebuilding of the church. The plan, which bears a marked resemblance to that of Notre-Dame at Paris, includes a nave, aisles and choir, but no transepts. Three portals open into the church on the west, the two northernmost, which date from the 12th century, being decorated with fine carving; that to the south is of the 14th century and still more ornate. A fine rose-window and an open gallery, above which rise the summits of the western towers, occupy the upper part of the façade. In the interior, chapels dating from the 13th and 14th centuries are of interest. The tower of St Maclou (14th century), relic of an old church and the hôtel de ville (15th to 17th centuries), are among the older buildings of the town, and there is a fountain of the Renaissance period. Modern bridges and a medieval bridge unite Mantes with the opposite bank of the Seine on which the town of Limay is built. The town has a sub-prefecture and a tribunal of first instance. Mantes was occupied by the English from 1346 to 1364, and from 1416 to 1449.

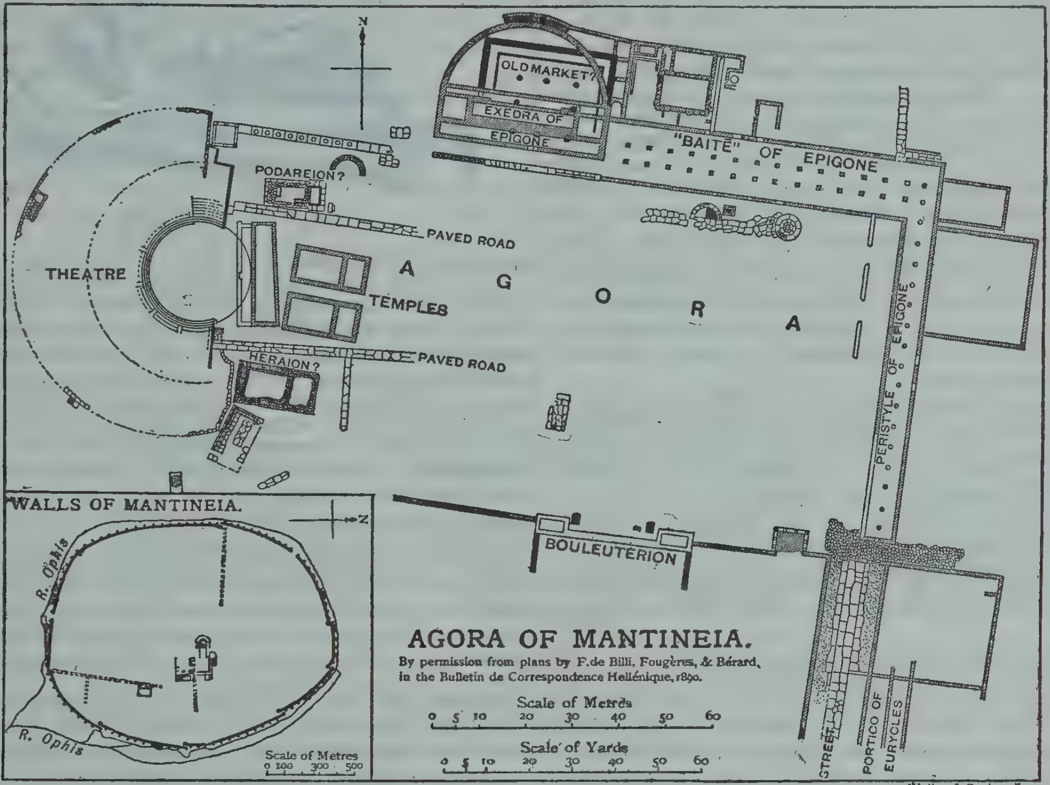
MANTEUFFEL, EDWIN, FREIHERR VON (1809–1885), Prussian general field marshal, son of the president of the superior court of Magdeburg, was born at Dresden on the 24th of February 1809. He was brought up with his cousin, Otto von Manteuffel (1805–1882), the Prussian statesman, entered the guard cavalry at Berlin in 1827, and became an officer in 1828. After attending the War Academy for two years, and serving successively as aide-de-camp to General von Müffling and to Prince Albert of Prussia, he was promoted captain in 1843 and major in 1848, when he became aide-de-camp to Frederick William IV., whose confidence he had gained during the revolutionary movement in Berlin. Promoted lieutenant-colonel in 1852, and colonel to command the 5th Uhlans in 1853, he was sent on important diplomatic missions to Vienna and St Petersburg. In 1857 he became major-general and chief of the military cabinet. He gave hearty support to the prince regent's plans for the reorganization of the army. In 1861 he was violently attacked in a pamphlet by Karl Twesten (1820–1870), a Liberal leader, whom he wounded in a duel. He served as lieutenant-general (to which rank he was promoted on the coronation of William I., Oct. 18, 1861) in the Danish war of 1864, and at its conclusion was appointed civil and military governor of Schleswig. In the Austrian War of 1866 he first occupied Holstein and afterwards commanded a division under Vogel von Falkenstein in the Hanoverian campaign, and succeeded him, in July, in command of the Army of the Main (see SEVEN WEEKS' WAR). His successful operations ended with the occupation of Würzburg, and he received the order *pour le mérite*. He was, however, on account of his monarchist political views and almost bigoted Roman Catholicism, regarded by the parliament as a reactionary, and, unlike the other army commanders, he was not granted a money reward for his services. He then went on a diplomatic mission to St Petersburg, where he was *persona grata*, and succeeded in gaining Russia's assent to the new position in north Germany. On returning he was gazetted to the colonelcy of the 5th Dragoons. He was appointed to the command of the IX. (Schleswig-Holstein) army corps in 1866. But having formerly exercised both civil and military control in the Elbe duchies he was unwilling to be a purely military commander under one of his late civil subordinates, and retired from the army for a year. In 1868, however, he returned to active service. In the Franco-German War of 1870–71 he commanded the I. corps under Steinmetz, distinguishing himself in the battle of Colombey-Neuilly, and in the repulse of Bazaine at Noisseville (see FRANCO-GERMAN WAR; and METZ). He succeeded Steinmetz in October in the command of the I. army, won the battle of Amiens against General Farre, and occupied Rouen, but was less fortunate against Faidherbe at Pont Noyelles and Bapaume. In January 1871 he commanded the newly formed Army of the South, which he led, in spite of hard frost, through the Côte d'Or and over the plateau of Langres, cut off Bourbaki's army of the east (80,000 men), and, after the action of Pontarlier, compelled it to cross the Swiss frontier, where it was disarmed. His immediate reward was the Grand Cross of the order of the Iron Cross, and at the conclusion of peace he received the Black Eagle. When the Southern Army was disbanded Manteuffel commanded first the II. army, and, from June 1871 until 1873, the army of occupation left in France, showing great tact in a difficult position. On leaving France at the close of the occupation, the emperor promoted Manteuffel to the rank of general field marshal and awarded him a large grant in money, and about the same time Alexander II. of Russia gave him the order of St Andrew. After this he was employed on several diplomatic missions, was for a time governor of Berlin, and in 1879, perhaps, as was commonly reported, because he was considered by Bismarck as a formidable rival, he was appointed governor-general of Alsace-Lorraine; and this office he exercised—more in the spirit, some said, of a Prussian than of a German official—until his death at Carlsbad, Bohemia, on the 17th of June 1885.

See lives by v. Collas (Berlin, 1874), and K. H. Keck (Bielefeld and Leipzig, 1890).

MANTINEIA, or MANTINEA, an ancient city of Arcadia, Greece, situated in the long narrow plain running north and south, which is now called after the chief town Tripolitsa. Tegea was in the same valley, about 10 m. S. of Mantineia, and the two cities continually disputed the supremacy of the district. In every great war we find them ranged on opposite sides, except when superior force constrained both. The worship and mysteries of Cora at Mantineia were famous. The valley in which the city lies has no opening to the coast, and the water finds its way, often only with much care and artificial aid, through underground passages (*katavothra*) to the sea. It is bounded on the west by Mount Maenalus, on the east by Mount Artemision.

Mantineia is mentioned in the Homeric catalogue of ships, but in early Greek times existed only as a cluster of villages inhabited by a purely agricultural community. In the 6th century it was still insignificant as compared with the neighbouring city of Tegea, and submitted more readily to Spartan overlordship. The political history of Mantineia begins soon after the Persian wars, when its five constituent villages, at the suggestion of Argos, were merged into one city, whose military strength forthwith secured it a leading position in the Peloponnesus. Its policy was henceforth guided by three main considerations. Its democratic constitution, which seems to have been entirely congenial to the population of small freeholders, and its ambition to gain control over the Alpheus watershed and both the Arcadian high roads to the isthmus, frequently estranged Mantineia from Sparta and threw it into the arms of Argos. But the chronic frontier disputes with Tegea, which turned the two cities into bitter enemies, contributed most of all to determine their several policies. About 469 B.C. Mantineia alone of Arcadian townships refused to join the league of Tegea and Argos against Sparta. Though formally enrolled on the same side during the Peloponnesian War the two cities used the truce of 423 to wage a fierce but indecisive war with each other. In the time following the peace of Nicias the Mantineians, whose attempts at expansion beyond Mount Maenalus were being foiled by Sparta, formed a powerful alliance with Argos, Elis and Athens (420), which the Spartans, assisted by Tegea, broke up after a pitched battle in the city's territory (418). In the subsequent years Mantineia still found opportunity to give the Athenians covert help, and during the Corinthian War (394–387) scarcely disguised its sympathy with the anti-Spartan league. In 385 the Spartans seized a pretext to besiege and dismantle Mantineia and to scatter its inhabitants among four villages. The city was reconstituted after the battle of Leuctra and under its statesman Lycomedes played a prominent part in organizing the Arcadian League (370). But the long-standing jealousy against Tegea, and a recent one against the new foundation of Megalopolis, created dissensions which resulted in Mantineia passing over to the Spartan side. In the following campaign of 362 Mantineia, after narrowly escaping capture by the Theban general Epaminondas, became the scene of a decisive conflict in which the latter achieved a notable victory but lost his own life. After the withdrawal of the Thebans from Arcadia Mantineia failed to recover its pre-eminence from Megalopolis, with which city it had frequent disputes. In contrast with the Macedonian sympathies of Megalopolis Mantineia joined the leagues against Antipater (322) and Antigonus Gonatas (266). A change of constitution, imposed perhaps by the Macedonians, was nullified (about 250) by a revolution through which democracy was restored. About 235 B.C. Mantineia entered the Achaean League, from which it had obtained protection against Spartan encroachments, but soon passed in turn to the Aetolians and to Cleomenes III. of Sparta. A renewed defection, inspired apparently by aversion to the aristocratic government of the Achaeans and jealousy of Megalopolis, was punished in 222 by a thorough devastation of the city, which was now reconstituted as a dependency of Argos and renamed Antigoneia in honour of the Achaeans' ally Antigonus Doson. Mantineia regained its autonomous position in the Achaean League in 192, and its original name during a visit of the emperor Hadrian in A.D. 133. Under the later Roman Empire the city dwindled into a mere village, which since the 6th century bore the Slavonic name of Goritza. It finally became a prey to the malaria which arose when the plain fell out of cultivation, and under Turkish rule disappeared altogether.

(M. O. B. C.)



AGORA OF MANTINEIA.

By permission from plans by F. de Billi, Fougères, & Bérard, in the Bulletin de Correspondence Hellénique, 1890.

Walker & Cockerell sc.

The site was excavated by M. Fougères, of the French School at Athens, in 1888. The plan of the agora and adjacent buildings has been recovered, and the walls have been completely investigated. The town was situated in an unusual position for a Greek city, on a flat marshy plain, and its walls form a regular ellipse about 2½ m. in circumference. When the town was first formed in 470 B.C. by the "synoecism" of the neighbouring villages, the river Ophis flowed through the midst of it, and the Spartan king Agesipolis dammed it up below the town and so flooded out the Mantineians and sapped their walls, which were of unbaked brick. Accordingly, when the city was rebuilt in 370 B.C., the river Ophis was divided into two branches, which between them encircled the walls; and the walls themselves were constructed to a height of about 3 to 6 feet of stone, the rest being of unbaked brick. These are the walls of which the remains are still extant. There are towers about every 80 ft.; and the gates are so arranged that the passage inwards usually runs from right to left, and so an attacking force would have to expose its right or shieldless side. Within the walls the most conspicuous landmark is the theatre, which, unlike the majority of Greek theatres, consists entirely of an artificial mound standing up from the level plain. Only about a quarter of its original height remains. Its *scena* is of rather irregular shape, and borders one of the narrow ends of the agora. Close to it are the foundations of several temples, one of them sacred to the hero Podaros. The agora is of unsymmetrical form; its sides are bordered by porticoes, interrupted by streets, like the primitive agora of Elis as described by Pausanias, and unlike the regular agoras of Ionic type. Most of these porticoes were of Roman period —the finest of them were erected, as we learn from inscriptions, by a lady named Epigone: one, which faced south, had a double colonnade, and was called the *Βαίτη*: close to it was a large exedra. The foundations of a square market-hall of earlier date were found beneath this. On the opposite side of the agora was an extensive Bouleuterion or senate-house. Traces remain of paved roads both within the agora and leading out of it; but the whole site is now a deserted and feverish swamp. The site is interesting for comparison with Megalopolis; the nature of its plan seems to imply that its main features must survive from the earlier "synoecism" a century before the time of Epaminondas.

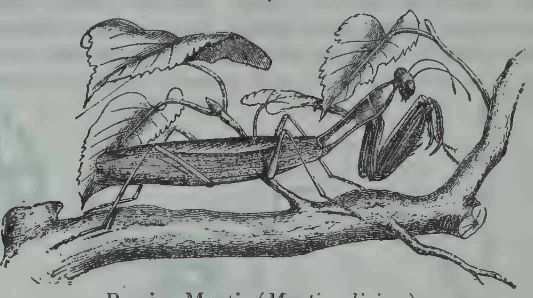
See Strabo viii. 337; Pausanias viii. 8; Thucyd. iv. 134, v.; Xenophon, *Hellenica*, iv.-vii.; Diodorus xv. 85–87; Polybius ii. 57 sqq., vi. 43; D. Worenka, *Mantineia* (1905); B. V. Head, *Historia numorum* (Oxford, 1887), pp. 376–377; G. Fougères in *Bulletin de correspondance hellénique* (1890), id. *Mantinée et l'Arcadie orientale* (Paris, 1898). Consult also TEGEA; ARCADIA.

Five battles are recorded to have been fought near Mantineia; 418, 362 (see above), 295 (Demetrius Poliorcetes defeats Archidamus of Sparta), 242 (Aratus beats Agis of Sparta), 207 (Philopoemen beats Machanidas of Sparta). The battles of 362 and 207 are discussed at length by J. Kromayer, *Antike Schlachtfelder in Griechenland* (Berlin, 1903), 27–123, 281–314; *Wiener Studien* (1905), pp. 1–16. (E. GR.)

MANTIS, an insect belonging to the order *Orthoptera*. Probably no other insect has been the subject of so many and widespread legends and superstitions as the common "praying mantis," *Mantis religiosa*, L. The ancient Greeks endowed it with supernatural powers (*μάντις*, a diviner); the Turks and Arabs hold that it prays constantly with its face turned towards Mecca; the Provençals call it *Prega-Diou* (*Prie-Dieu*); and numerous more or less similar names—preacher, saint, nun, mendicant, soothsayer, &c.—are widely diffused throughout southern Europe. In Nubia it is held in great esteem, and the Hottentots, if not indeed worshipping the local species (*M. fausta*), as one traveller has alleged, at least appear to regard its alighting upon any person both as a token of saintliness and an omen of good fortune.

Yet these are "not the saints but the tigers of the insect world." The front pair of limbs are very peculiarly modified—the coxa being greatly elongated, while the strong third joint or femur bears on its curved underside a channel armed on each edge by strong movable spines. Into this groove the stout tibia is capable of closing like the blade of a penknife, its sharp, serrated edge being adapted to cut and hold. Thus armed, with head raised upon the much-elongated and semi-erect prothorax, and with the half-opened fore-limbs held outwards in the characteristic devotional attitude, it rests motionless upon the four posterior limbs waiting for prey, or occasionally stalks it with slow and silent movements, finally seizing it with its knife-blades and devouring it. Although apparently not daring to attack ants, these insects destroy great numbers of flies, grasshoppers and caterpillars, and the larger South-American species even attack small frogs, lizards and birds. They are very pugnacious, fencing with their sword-like limbs "like hussars with sabres," the larger frequently devouring the smaller, and the females the males. The Chinese keep them in bamboo cages, and match them like fighting-cocks.

The common species fixes its somewhat nut-like egg capsules on the stems of plants in September. The young are hatched in early summer, and resemble the adults, but are without wings.


Praying Mantis (*Mantis religiosa*).

The green coloration and shape of the typical mantis are procryptic, serving to conceal the insect alike from its enemies and prey. The passage from leaf to flower simulation is but a step which, without interfering with the protective value of the coloration so far as insectivorous foes are concerned, carries with it the additional advantage of attracting flower-feeding insects within reach of the raptorial limbs. This method of allurement has been perfected in certain tropical species of *Mantidae* by the development on the prothorax and raptorial limbs of laminate expansions so coloured on the under side as to resemble papilionaceous or other blossoms, to which the likeness is enhanced by a gentle swaying kept up by the insect in imitation of the effect of a lightly blowing breeze. As instances of this may be cited *Idalum diabolicum*, an African insect, and *Gongylus gongyloides*, which comes from India. Examples of another species (*Empusa eugena*) when standing upon the ground deceptively imitate in shape and hue a greenish white anemone tinted at the edges with rose; and Bates records what appears to be a true case of aggressive mimicry practised by a Brazilian species which exactly resembles the white ants it preys upon.

MANTIS-FLY, the name given to neuropterous insects of the family *Mantispidae*, related to the ant-lions, lace-wing flies, &c., and named from their superficial resemblance to a *Mantis* owing to the length of the prothorax and the shape and prehensorial nature of the anterior legs. The larva, at first campodeiform, makes its way into the egg-case of a spider or the nest of a wasp to feed upon the eggs or young. Subsequently it changes into a fat grub with short legs. When full grown it spins a silken cocoon in which the transformation into the pupa is effected. The latter escapes from its double case before moulting into the mature insect.

MANTLE, a long flowing cloak without sleeves, worn by either sex. Particularly applied to the long robe worn over the armour by the men-at-arms of the middle ages, the name is still given to the robes of state of kings, peers, and the members of an order of knights. Thus the "electoral mantle" was a robe of office worn by the imperial electors, and the Teutonic knights were known as the *orde alborum mantellorum* from their white mantles. As an article of women's dress a mantle now means a loose cloak or cape, of any length, and made of silk, velvet, or other rich material. The word is derived from the Latin *mantellum* or *mantelum*, a cloak, and is probably the same as, or another form of, *mantelium* or *mantele*, a table-napkin or table-cloth, from *manus*, hand, and *tela*, a cloth. A late Latin *mantum*, from which several Romance languages have taken words (cf. Ital. *manto*, and Fr. *mante*), must, as the *New English Dictionary* points out, be a "back-formation," and this will explain the diminutive form of the Spanish *mantilla*. From the old French *mantel* came the English compounds "mantel-piece," "mantel-shelf," for the stone or wood beam which serves as a support for the structure above a fire-place, together with the whole framework, whether of wood, stone, &c., that acts as an ornament of the same (see CHIMNEYPIECE). The modern French form *manteau* is used in English chiefly as a dressmaker's term for a woman's mantle. "Mantua," much used in the 18th century for a similar garment, is probably a corruption of *manteau*, due to silk or other materials coming from the Italian town of that name, and known by the trade name of "mantuas." The Spanish *mantilla* is a covering for the head and shoulders of white or black lace or other material, the characteristic head-dress of women in southern and central Spain. It is occasionally seen in the other parts of Spain and Spanish countries, and also in Portugal.

"Mantle" is used in many transferred senses, all with the meaning of "covering," as in zoology, for an enclosing sac or integument; thus it is applied to the "tunic" or layer of connective-tissue forming the body-wall of ascidians enclosing muscle-fibres, blood-sinuses and nerves (see TUNICATA). The term is also used for a meshed cap of refractory oxides employed in systems of incandescent lighting (see LIGHTING). The verb is used for the creaming or frothing of liquids and of the suffusing of the skin with blood. In heraldry "mantling," also known as "panache," "lambrequin" or "contoise," is an ornamental appendage to an escutcheon, of flowing drapery, forming a background (see HERALDRY).

MANTON, THOMAS (1620–1677), English Nonconformist divine, was born at Laurence Lydiard, Somerset, in 1620, and was educated at Hart Hall, Oxford. Joseph Hall, bishop of Norwich, ordained him deacon: he never took priest's orders, holding that "he was properly ordained to the ministerial office." He was one of the clerks at the Westminster Assembly, one of Cromwell's chaplains and a "trier," and held livings at Stoke Newington (1645) and St Paul's, Covent Garden (1656). He disapproved of the execution of Charles I. In 1658 he assisted Baxter to draw up the "Fundamentals of Religion." He helped to restore Charles II. and became one of his chaplains, refusing the deanery of Rochester. In 1662 he lost his living under the Act of Uniformity and preached in his own rooms and in other parts of London. For this he was arrested in 1670.

His works are best known in the collected edition by J. C. Ryle (22 vols. 1870–1875).

MAN-TRAPS, mechanical devices for catching poachers and trespassers. They have taken many forms, the most usual being like a large rat-trap, the steel springs being armed with teeth which met in the victim's leg. Since 1827 they have been illegal in England, except in houses between sunset and sunrise as a defence against burglars.

MANTUA (Ital. *Mantova*), a fortified city of Lombardy, Italy, the capital of the province of Mantua, the see of a bishop, and the centre of a military district, 25 m. S.S.W. of Verona and 100 m. E.S.E. of Milan by rail. Pop. (1906), 31,783. It is situated 88 ft. above the level of the Adriatic on an almost insular site in the midst of the swampy lagoons of the Mincio. As the belt of marshy ground along the south side can be laid under water at pleasure, the site of the city proper, exclusive of the considerable suburbs of Borgo di Fortezza to the north and Borgo di San Giorgio to the east, may still be said to consist, as it formerly did more distinctly, of two islands separated by a narrow channel and united by a number of bridges. On the west side lies Lago Superiore, on the east side Lago Inferiore—the boundary between the two being marked by the *Argine del Mulino*, a long mole stretching northward from the north-west angle of the city to the citadel.

On the highest ground in the city rises the cathedral, the interior of which was built after his death according to the plans of Giulio Romano; it has double aisles, a fine fretted ceiling, a dome-covered transept, a bad baroque façade, and a large unfinished Romanesque tower. Much more important architecturally is the church of St Andrea, built towards the close of the 15th century, after plans by Leon Battista Alberti, and consisting of a single, barrel-vaulted nave 350 ft. long by 62 ft. wide. It has a noble façade with a deeply recessed portico, and a brick campanile of 1414. The interior is decorated with 18th-century frescoes, to which period the dome also belongs. Mantegna is buried in one of the side chapels. S. Sebastiano is another work of Alberti's. The old ducal palace—one of the largest buildings of its kind in Europe—was begun in 1302 for Guido Bonaccolsi, and probably completed in 1328 for Ludovico Gonzaga; but many of the accessory apartments are of much later date, and the internal decorations are for the most part the work of Giulio Romano and his pupils. There are also some fine rooms of the early 19th century. Close by are the Piazza dell' Erbe and the Piazza Sordello, with Gothic palaces. The Castello di Corte here, the old castle of the Gonzagas (1395–1406), erected by Bartolino da Novara, the architect of the castle of Ferrara, now contains the archives, and has some fine frescoes by Mantegna with scenes from the life of Ludovico Gonzaga. Outside of the city, to the south of Porta Pusterla, stands the Palazzo del Te, Giulio's architectural masterpiece, erected for Frederick Gonzaga in 1523–1535; of the numerous fresco-covered chambers which it contains, perhaps the most celebrated is the Sala dei Giganti, where, by a combination of mechanical with artistic devices, the rout of the Titans still contending with artillery of uptorn rocks against the pursuit and thunderbolts of Jove appears to rush downwards on the spectator. The architecture of Giulio's own house in the town is also good.

Mantua has an academy of arts and sciences (*Accademia Vergiliana*), occupying a fine building erected by Piermarini, a public library founded in 1780 by Maria Theresa, a museum of antiquities dating from 1779, many of which have been brought from Sabbioneta, a small residence town of the Gonzagas in the late 16th century, a mineralogical museum, a good botanical garden, and an observatory. There are ironworks, tanneries, breweries, oil-mills and flour-mills in the town, which also has printing, furriery, doll-making and playing-card industries. As a fortress Mantua was long one of the most formidable in Europe, a force of thirty to forty thousand men finding accommodation within its walls; but it had two serious defects—the marshy climate told heavily on the health of the garrison, and effective sorties were almost impossible. It lies on the main line of railway between Verona and Modena; and is also connected by rail with Cremona and with Monselice, on the line from Padua to Bologna, and by steam tramway with Brescia and other places.

S. Maria delle Grazie, standing some 5 m. outside the town, was consecrated in 1399 as an act of thanksgiving for the cessation of the plague, and has a curious collection of *ex voto* pictures (wax figures), and also the tombs of the Gonzaga family.

Mantua had still a strong Etruscan element in its population during the Roman period. It became a Roman municipium, with the rest of Gallia Transpadana; but Martial calls it little Mantua, and had it not been for Virgil's interest in his native place, and in the expulsion of a number of the Mantuans (and among them the poet himself) from their lands in favour of Octavian's soldiers, we should probably have heard almost nothing of its existence. In 568 the Lombards found Mantua a walled town of some strength; recovered from their grasp in 590 by the exarch of Ravenna, it was again captured by Agilulf in 601. The 9th century was the period of episcopal supremacy, and in the 11th the city formed part of the vast possessions of Bonifacio, marquis of Canossa. From him it passed to Geoffrey, duke of Lorraine, and afterwards to the countess Matilda, whose support of the pope led to the conquest of Mantua by the emperor Henry IV. in 1090. Reduced to obedience by Matilda in 1113, the city obtained its liberty on her death, and instituted a communal government of its own, *salva imperiali justitia*. It afterwards joined the Lombard League; and the unsuccessful attack made by Frederick II. in 1236 brought it a confirmation of its privileges. But after a period of internal discord Ludovico Gonzaga attained to power (1328), and was recognized as imperial vicar (1329);

and from that time till the death of Ferdinando Carbo in 1708 the Gonzagas were masters of Mantua (see GONZAGA). Under Gian Francesco II., the first marquis, Ludovico III., Gian Francesco III. (whose wife was Isabella d'Este), and Federico II., the first duke of Mantua, the city rose rapidly into importance as a seat of industry and culture. It was stormed and sacked by the Austrians in 1630, and never quite recovered. Claimed in 1708 as a fief of the empire by Joseph I., it was governed for the greater part of the century by the Austrians. In June 1796 it was besieged by Napoleon; but in spite of terrific bombardments it held out till February 1797. A three days' bombardment in 1799 again placed Mantua in the hands of the Austrians; and, though restored to the French by the peace of Lunéville (1801), it became Austrian once more from 1814 till 1866. Between 1849 and 1859, when the whole of Lombardy except Mantua was, by the peace of Villafranca, ceded to Italy, the city was the scene of violent political persecution.

See Gaet. Susani, *Nuovo prospetto delle pitture, &c., di Mantova* (Mantua, 1830); Carlo d'Arco, *Delle arti e degli artefici di Mantova* (Mantua, 1857); and *Storia di Mantova* (Mantua, 1874).

MANU (Sanskrit, "man"), in Hindu mythology, the first man, ancestor of the world. In the Satapatha-Brahmana he is represented as a holy man, the chief figure in a flood-myth. Warned by a fish of the impending disaster he built a ship, and when the waters rose was dragged by the fish, which he harnessed to his craft, beyond the northern mountains. When the deluge ceased, a daughter was miraculously born to him and this pair became the ancestors of the human race. In the later scriptures the fish is declared an incarnation of Brahma. See SANSKRIT LITERATURE; INDIAN LAW (*Hindu*).

MANUAL, *i.e.* belonging to the hand (Lat. *manus*), a word chiefly used to describe an occupation which employs the hands, as opposed to that which chiefly or entirely employs the mind. Particular uses of the word are: "sign-manual," a signature or autograph, especially one affixed to a state document; "manual-exercise," in military usage, drill in the handling of the rifle; "manual alphabet," the formation of the letters of the alphabet by the fingers of one or both hands for communication with the deaf and dumb; and "manual acts," the breaking of the bread, and the taking of the cup in the hands by the officiating priest in consecrating the elements during the celebration of the Eucharist. The use of the word for tools and implements to be used by the hand, as distinct from machinery, only survives in the "manual fire-engine." From the late Latin use of *manuale* as a substantive, meaning "handbook," comes the use of the word for a book treating a subject in a concise way, but more particularly of a book of offices, containing the forms to be used in the administration of the sacraments other than the Mass, but including communion out of the Mass, also the forms for churching, burials, &c. In the Roman Church such a book is usually called a *rituale*, "manual" being the name given to it in the English Church before the Reformation. The keyboard of an organ, as played by the hands, is called the "manual," in distinction from the "pedal" keys played by the feet.

MANUCODE, from the French, an abbreviation of *Manucodiata*, and the Latinized form of the Malay *Manukdewata*, meaning, says Crawfurd (*Malay and Engl. Dictionary*, p. 97), the "bird of the gods," and a name applied for more than two hundred years apparently to birds-of-paradise in general. In the original sense of its inventor, Montbeillard (*Hist. nat. oiseaux*, iii. 163), *Manucode* was restricted to the king bird-of-paradise and three allied species; but in English it has curiously been transferred[1] to a small group of species whose relationship to the *Paradiseidae* has been frequently doubted, and must be considered uncertain. These manucodes have a glossy steel-blue plumage of much beauty, but are distinguished from other birds of similar coloration by the outer and middle toes being united for some distance, and by the extraordinary convolution of the trachea, in the males at least, with which is correlated the loud and clear voice of the birds. The convoluted portion of the trachea lies on the breast, between the skin and the muscles, much as is found in the females of the painted snipes (*Rostratula*), in the males of the curassows (*Cracidae*), and in a few other birds, but wholly unknown elsewhere among the *Passeres*. The manucodes are peculiar to the Papuan sub-region (including therein the peninsula of Cape York), and comprehend, according to R. B. Sharpe (*Cat. B. Brit. Museum*, iii. 164), two genera, for the first of which, distinguished by the elongated tufts on the head, he adopts R. P. Lesson's name *Phonygama*, and for the second, having no tufts, but the feathers of the head crisped, that of *Manucodia*; and W. A. Forbes (*Proc. Zool. Soc.* 1882, p. 349) observed that the validity of the separation was confirmed by their tracheal formation. Of *Phonygama* Sharpe recognizes three species, *P. keraudreni* (the type) and *P. jamesi*, both from New Guinea, and *P. gouldi*, the Australian representative species; but the first two are considered by D. G. Elliot (*Ibis*. 1878, p. 56) and Count Salvadori (*Ornitol. della Papuasia*, ii. 510) to be inseparable. There is a greater unanimity in regard to the species of the so-called genus *Manucodia* proper, of which four are admitted—*M. chalybeata* or *chalybea* from north-western New Guinea, *M. comriei* from the south-eastern part of the same country, *M. atra* of wide distribution within the Papuan area, and *M. jobiensis* peculiar to the island which gives it a name. Little is known of the habits of these birds, except that they are, as already mentioned, remarkable for their vocal powers, which, in *P. keraudreni*, Lesson describes (*Voy. de la Coquille*, "Zoologie," i. 638) as enabling them to pass through every note of the gamut. (A. N.)

MANUEL I., COMNENUS (*c.* 1120–1180), Byzantine emperor (1143–1180), the fourth son of John II., was born about 1120. Having distinguished himself in his father's Turkish war, he was nominated emperor in preference to his elder surviving brother. Endowed with a fine physique and great personal courage, he devoted himself whole-heartedly to a military career. He endeavoured to restore by force of arms the predominance of the Byzantine empire in the Mediterranean countries, and so was involved in conflict with his neighbours on all sides. In 1144 he brought back Raymond of Antioch to his allegiance, and in the following year drove the Turks out of Isauria. In 1147 he granted a passage through his dominions to two armies of crusaders under Conrad III. of Germany and Louis VII. of France; but the numerous outbreaks of overt or secret hostility between the Franks and the Greeks on their line of march, for which both sides were to blame, nearly precipitated a conflict between Manuel and his guests. In the same year the emperor made war upon Roger of Sicily, whose fleet captured Corfu and plundered the Greek towns, but in 1148 was defeated with the help of the Venetians. In 1149 Manuel recovered Corfu and prepared to take the offensive against the Normans. With an army mainly composed of mercenary Italians he invaded Sicily and Apulia, and although the progress of both these expeditions was arrested by defeats on land and sea, Manuel maintained a foothold in southern Italy, which was secured to him by a peace in 1155, and continued to interfere in Italian politics. In his endeavour to weaken the control of Venice over the trade of his empire he made treaties with Pisa and Genoa; to check the aspirations of Frederic I. of Germany he supported the free Italian cities with his gold and negotiated with pope Alexander III. In spite of his friendliness towards the Roman church Manuel was refused the title of "Augustus" by Alexander, and he nowhere succeeded in attaching the Italians permanently to his interests. None the less in a war with the Venetians (1172–74), he not only held his ground in Italy but drove his enemies out of the Aegean Sea. On his northern frontier Manuel reduced the rebellious Serbs to vassalage (1150–52) and made repeated attacks upon the Hungarians with a view to annexing their territory along the Save. In the wars of 1151–53 and 1163–68 he led his troops into Hungary but failed to maintain himself there; in 1168, however, a decisive victory near Semlin enabled him to conclude a peace by which Dalmatia and other frontier strips were ceded to him. In 1169 he sent a joint expedition with King Amalric of Jerusalem to Egypt, which retired after an ineffectual attempt to capture Damietta. In 1158–59 he fought with success against Raymond of Antioch and the Turks of Iconium, but in later wars against the latter he made no headway. In 1176 he was decisively beaten by them in the pass of Myriokephalon, where he allowed himself to be surprised in line of march. This disaster, though partly retrieved in the campaign of the following year, had a serious effect upon his vitality; henceforth he declined in health and in 1180 succumbed to a slow fever.

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[1] *Manucodiata* was used by M. J. Brisson (*Ornithologie*, ii. 130) as a generic term equivalent to the Linnaean *Paradisea*. In 1783 Boddaert, when assigning scientific names to the birds figured by Daubenton, called the subject of one of them (*Pl. enlum.* 634) *Manucodia chalybea*, the first word being apparently an accidental curtailment of the name of Brisson's genus to which he referred it. Nevertheless some writers have taken it as evidence of an intention to found a new genus by that name, and hence the importation of *Manucodia* into scientific nomenclature, and the English form to correspond.

In spite of his military prowess Manuel achieved but in a slight degree his object of restoring the East Roman empire. His victories were counterbalanced by numerous defeats, sustained by his subordinates, and his lack of statesmanlike talent prevented his securing the loyalty of his subjects. The expense of keeping up his mercenary establishment and the sumptuous magnificence of his court put a severe strain upon the financial resources of the state. The subsequent rapid collapse of the Byzantine empire was largely due to his brilliant but unproductive reign. Manuel married, firstly, a sister-in-law of Conrad III. of Germany; and secondly, a daughter of Raymond of Antioch. His successor, Alexis II., was a son of the latter.

See John Cinnamus, *History of John and Manuel* (ed. 1836, Bonn); E. Gibbon, *The Decline and Fall of the Roman Empire* (ed. Bury, London, 1896), v. 229 sqq., vi. 214 sqq.; G. Finlay, *History of Greece* (ed. 1877, Oxford), iii. 143–197; H. v. Kap-Herr, *Die abendländische Politik Kaiser Manuels* (Strassburg, 1881). (M. O. B. C.)

MANUEL II. PALAEOLOGUS (1350–1425), Byzantine emperor from 1391 to 1425, was born in 1350. At the time of his father's death he was a hostage at the court of Bayezid at Brusa, but succeeded in making his escape; he was forthwith besieged in Constantinople by the sultan, whose victory over the Christians at Nicopolis, however (Sept. 28, 1396), did not secure for him the capital. Manuel subsequently set out in person to seek help from the West, and for this purpose visited Italy, France, Germany and England, but without material success; the victory of Timur in 1402, and the death of Bayezid in the following year were the first events to give him a genuine respite from Ottoman oppression. He stood on friendly terms with Mahommed I., but was again besieged in his capital by Murad II. in 1422. Shortly before his death he was forced to sign an agreement whereby the Byzantine empire undertook to pay tribute to the sultan.

Manuel was the author of numerous works of varied character—theological, rhetorical, poetical and letters. Most of these are printed in Migne, *Patrologia graeca*, clvi.; the letters have been edited by E. Legrand (1893). There is a special monograph, by B. de Xivrey (in *Mémoires de l'Institut de France*, xix. (1853), highly commended by C. Krumbacher, whose *Geschichte der byzantinischen Litteratur* (1897) should also be consulted.

MANUEL I. (d. 1263), emperor of Trebizond, surnamed the Great Captain (*ὁ στρατηγικώτατος*), was the second son of Alexius I., first emperor of Trebizond, and ruled from 1228 to 1263. He was unable to deliver his empire from vassalage, first to the Seljuks and afterwards to the Mongols. He vainly negotiated for a dynastic alliance with the Franks, by which he hoped to secure the help of Crusaders.

Manuel II., the descendant of Manuel I., reigned only a few months in 1332–1333. Manuel III. reigned from 1390 to 1417, but the only interest attaching to his name arises from his connexion with Timur, whose vassal he became without resistance.

See G. Finlay, *History of Greece* (ed. 1877, Oxford), iv. 338–340, 340–341, 386; Ph. Fallmerayer, *Geschichte des Kaisertums Trapezunt* (Munich, 1827), i. chs. 8, 14, ii. chs. 4, 5; T. E. Evangelides, *Ἱστορία τῆς Τραπεζοῦντος* (Odessa, 1898), 71–73, 87–88, 126–132.

MANUEL, EUGENE (1823–1901), French poet and man of letters, was born in Paris, the son of a Jewish doctor, on the 13th of July 1823. He was educated at the École Normale, and taught rhetoric for some years in provincial schools and then in Paris. In 1870 he entered the department of public instruction, and in 1878 became inspector-general. His works include: *Pages intimes* (1866), which received a prize from the Academy; *Poèmes populaires* (1874); *Pendant la guerre* (1871), patriotic poems, which were forbidden in Alsace-Lorraine by the German authorities; *En voyage* (1881), poems; *La France* (4 vols., 1854–1858); a school-book written in collaboration with his brother-in-law, Lévi Alavarès; *Les Ouvriers* (1870), a drama dealing with social questions, which was crowned by the Academy; *L'Absent* (1873), a comedy; *Poésies du foyer et de l'école* (1889), and editions of the works of J. B. Rousseau (1852) and André Chénier (1884). He died in Paris in 1901.

His *Poésies complètes* (2 vols., 1899) contained some fresh poems; to his *Mélanges en prose* (Paris, 1905) is prefixed an introductory note by A. Cahen.

MANUEL, JACQUES ANTOINE (1775–1827), French politician and orator, was born on the 10th of December 1775. When seventeen years old he entered the army, which he left in 1797 to become a lawyer. In 1814 he was chosen a member of the chamber of representatives, and in 1815 he urged the claim of Napoleon's son to the French throne and protested against the restoration of the Bourbons. After this event he actively opposed the government, his eloquence making him the foremost orator among the members of the Left. In February 1823 his opposition to the proposed expedition into Spain to help Ferdinand VII. against his rebellious subjects produced a tumult in the Assembly. Manuel was expelled, but he refused to accept this sentence, and force was employed to remove him. He died on the 20th of August 1827.

MANUEL, LOUIS PIERRE (1751–1793), French writer and Revolutionist, was born at Montargis (Loiret). He entered the Congregation of the Christian Doctrine, and became tutor to the son of a Paris banker. In 1783 he published a pamphlet, called *Essais historiques, critiques, littéraires, et philosophiques*, for which he was imprisoned in the Bastille. He embraced the revolutionary ideas, and after the taking of the Bastille became a member of the provisional municipality of Paris. He was one of the leaders of the *émeutes* of the 20th of June and the 10th of August 1792, played an important part in the formation of the revolutionary commune which assured the success of the latter *coup*, and was made *procureur* of the commune. He was present at the September massacres and saved several prisoners, and on the 7th of September 1792 was elected one of the deputies from Paris to the convention, where he was one of the promoters of the proclamation of the republic. He suppressed the decoration of the Cross of St Louis, which he called a stain on a man's coat, and demanded the sale of the palace of Versailles. His missions to the king, however, changed his sentiments; he became reconciled to Louis, courageously refused to vote for the death of the sovereign, and had to tender his resignation as deputy. He retired to Montargis, where he was arrested, and was guillotined in Paris on the 17th of November 1793. Besides the work cited above and his political pamphlets, he was the author of *Coup d'œil philosophique sur le règne de St Louis* (1786); *L'Année française* (1788); *La Bastille dévoilée* (1789); *La Police de Paris dévoilée* (1791); and *Lettres sur la Révolution* (1792). In 1792 he was prosecuted for publishing an edition of the *Lettres de Mirabeau à Sophie*, but was acquitted.

MANUEL DE MELLO, DOM FRANCISCO (? 1611–1666), Portuguese writer, a connexion on his father's side of the royal house of Braganza, was a native of Lisbon. He studied the Humanities at the Jesuit College of S. Antão, where he showed a precocious talent, and tradition says that at the age of fourteen he composed a poem in *ottava rima* to celebrate the recovery of Bahia from the Dutch, while at seventeen he wrote a scientific work, *Concordancias mathematicas*. The death of his father, Dom Luiz de Mello, drove him early to soldiering, and having joined a contingent for the Flanders war, he found himself in the historic storm of January 1627, when the pick of the Portuguese fleet suffered shipwreck in the Bay of Biscay. He spent much of the next ten years of his life in military routine work in the Peninsula, varied by visits to the court of Madrid, where he contracted a friendship with the Spanish poet Quevedo and earned the favour of the powerful minister Olivares. In 1637 the latter despatched him in company with the conde de Linhares on a mission to pacify the revolted city of Evora, and on the same occasion the duke of Braganza, afterwards King John IV. (for whom he acted as confidential agent at Madrid), employed him to satisfy King Philip of his loyalty to the Spanish crown. In the following year he suffered a short imprisonment in Lisbon. In 1639 he was appointed colonel of one of the regiments raised for service in Flanders, and in June that year he took a leading part in defending Corunna against a French fleet commanded by the archbishop of Bordeaux, while in the following August he directed the embarcation of an expeditionary force of 10,000 men when Admiral Oquendo sailed with seventy ships to meet the French and Dutch. He came safely through the naval defeat in the channel suffered by the Spaniards at the hands of Van Tromp, and on the outbreak of the Catalonian rebellion became chief of the staff to the commander-in-chief of the royal forces, and was selected to write an account of the campaign, the *Historia de la guerra de Cataluña*, which became a Spanish classic. On the proclamation of Portuguese independence in 1640 he was imprisoned by order of Olivares, and when released hastened to offer his sword to John IV. He travelled to England, where he spent some time at the court of Charles I., and thence passing over to Holland assisted the Portuguese ambassador to equip a fleet in aid of Portugal, and himself brought it safely to Lisbon in October 1641. For the next three years he was employed in various important military commissions and further busied himself in defending by his pen the king's title to his newly acquired throne. An intrigue with the beautiful countess of Villa Nova, and her husband's jealousy, led to his arrest on the 19th of November 1644 on a false charge of assassination, and he lay in prison about nine years. Though his innocence was clear, the court of his Order, that of Christ, influenced by his enemies, deprived him of his *commenda* and sentenced him to perpetual banishment in India with a heavy money fine, and the king would not intervene to save him. Owing perhaps to the intercession of the queen regent of France and other powerful friends, his sentence was finally commuted into one of exile to Brazil. During his long imprisonment he finished and printed his history of the Catalonian War, and also wrote and published a volume of Spanish verses and some religious treatises, and composed in Portuguese a volume of homely philosophy, the *Carta de Guia de Casados* and a *Memorial* in his own defence to the king, which Herculano considered "perhaps the most eloquent piece of reasoning in the language." During his exile in Brazil, whither he sailed on the 17th of April 1655, he lived at Bahia, where he wrote one of his *Epanaphoras de varia historia* and two parts of his masterpiece, the *Apologos dialogaes*. He returned home in 1659, and from then until 1663 we find him on and off in Lisbon, frequenting the celebrated *Academia dos Generosos*, of which he was five times elected president. In the last year he proceeded to Parma and Rome, by way of England, and France, and Alphonso VI. charged him to negotiate with the Curia about the provision of bishops for Portuguese sees and to report on suitable marriages for the king and his brother. During his stay in Rome he published his *Obras morales*, dedicated to Queen Catherine, wife of Charles II. of England, and his *Cartas familiares*. On his way back to Portugal he printed his *Obras metricas* at Lyons in May 1665, and he died in Lisbon the following year.

Manuel de Mello's early Spanish verses are tainted with Gongorism, but his Portuguese sonnets and *cartas* on moral subjects are notable for their power, sincerity and perfection of form. He strove successfully to emancipate himself from foreign faults of style, and by virtue of his native genius, and his knowledge of the traditional poetry of the people, and the best Quinhentista models, he became Portugal's leading lyric poet and prose writer of the 17th century. As with Camoens, imprisonments and exile contributed to make Manuel de Mello a great writer. His *Letters*, addressed to the leading nobles, ecclesiastics, diplomats and literati of the time, are written in a conversational style, lighted up by flashes of wit and enriched with apposite illustrations and quotations. His commerce with the best authors appears in the *Hospital das lettras*, a brilliant chapter of criticism forming part of the *Apologos dialogaes*. His comedy in *redondilhas*, the *Auto do Fidalgo Aprendiz*, is one of the last and quite the worthiest production of the school of Gil Vicente, and may be considered an anticipation of Molière's *Le Bourgeois gentilhomme*.

There is no uniform edition of his works, but a list of them will be found in his *Obras morales*, and the various editions are set out in Innocencio da Silva's *Diccionario bibliographico portuguez*. See *Dom Francisco Manuel de Mello, his Life and Writings*, by Edgar Prestage (Manchester, 1905), "D. Francisco Manuel de Mello, documentos biographicos" and "D. Francisco Manuel de Mello, obras autographas e ineditas," by the same writer, in the *Archivo historico portuguez* for 1909. Manuel de Mello's prose style is considered at length by G. Cirot in *Mariana historien* (Bordeaux, 1905), pp. 378 seq. (E. Pr.)

MANUL (*Felis manul*), a long-haired small wild cat from the deserts of Central Asia, ranging from Tibet to Siberia. The coat is long and soft, pale silvery grey or light buff in hue, marked with black on the chest and upper parts of the limbs, with transverse stripes on the loins and rings on the tail of the same hue. The Manul preys upon small mammals and birds. A separate generic name, *Trichaelurus*, has been proposed for this species by Dr K. Satunin.

MANURES AND MANURING. The term "manure" originally meant that which was "worked by hand" (Fr. *manœuvre*), but gradually came to apply to any process by which the soil could be improved. Prominent among such processes was that of directly applying "manure" to the land, manure in this sense being what we now call "farmyard manure" or "dung," the excreta of farm animals mixed with straw or other litter. Gradually, however, the use of the term spread to other materials, some of home origin, some imported, some manufactured by artificial processes, but all useful as a means of improving the fertility of the soil. Hence we have two main classes of manures: (*a*) what may be termed "natural manures," and (*b*) "artificial manures." Manures, again, may be divided according to the materials from which they are made—*e.g.* "bone manure," "fish manure," "wool manure," &c.; or according to the constituents which they mainly supply—*e.g.* "phosphatic manures," "potash manures," "nitrogenous manures," or there may be numerous combinations of these to form mixed or "compound" manures. Whatever it be, the word "manure" is now generally applied to anything which is used for fertilizing the soil. In America the term "fertilizers" is more generally adopted, and in Great Britain the introduction of the "Fertilizers and Feeding Stuffs Act" has effected a certain amount of change in the same direction. The modern tendency to turn attention less to the consideration of manurial applications given to land and more to the physical and mechanical changes introduced thereby in the soil itself, would seem to be carrying the word "manure" back more to its original meaning.

The subject of manures and their application involves a prior consideration of plant life and its requirements. The plant, growing in the soil, and surrounded by the atmosphere, derives from these two sources its nourishment and means of growth through the various stages of its development.

Chemical analysis has shown that plants are composed of water, organic or combustible matters, and inorganic or mineral matters. Water constitutes by far the greater part of a living plant; a grass crop will contain about 75% of water, a turnip crop 89 or 90%. The organic or combustible matters are those which are lost, along with the water, when the plant is burnt; the inorganic or mineral matters are those which are left behind as an "ash" after the burning. The combustible matter is composed of six elements: carbon, hydrogen, oxygen, nitrogen, sulphur and a little phosphorus. About one-half of the combustible matter of plants is carbon. Along with hydrogen and oxygen the carbon forms the cellulose, starch, sugar, &c., which plants contain, and with these same elements and sulphur the carbon forms the albuminoids of plants. The inorganic or mineral matters comprise a comparatively small part of the plant, but they contain, as essential constituents of plant life, the following elements: potassium, calcium, magnesium, iron, phosphorus and sulphur. In addition, other, but not essential, elements are found in the ash *e.g.* sodium, silicon and chlorine, together with small quantities of manganese and other rarer elements.

The above constituents that have been classed as "essential," are necessary for the growth of the plant, and absence of any one will involve failure. This has been shown by growing plants in water dissolved in which are salts of the elements present in plants. By omitting in turn one or other of the elements aforesaid it is found that the plants will not grow after they have used up the materials contained in the seed itself. These elements are accordingly termed "essential," and it therefore becomes necessary to inquire how they are to be supplied.

The atmosphere is the great storehouse of organic plant food. The leaves take up, through their stomata, the carbonic acid and other gases of the atmosphere. The carbonic acid, under the influence of light, is decomposed in the chlorophyll cells, oxygen is given off and carbon is assimilated, being subsequently built up into the various organic bodies forming the plant's structure. It would seem, too, that plants can take up a small quantity of ammonia by their leaves, and also water to some extent, but the free or uncombined nitrogen of the air cannot be directly assimilated by the leaves of plants.

From the soil, on the other hand, the plant obtains, by means of its roots, its mineral requirements, also sulphur and phosphorus, and nearly all its nitrogen and water. Carbon, too, in the case of fungi, is obtained from the decayed vegetable matter in the soil. The roots are able not only to take up soluble salts that are presented to them, but they can attack and render soluble the solid constituents of the soil, thus transforming them into available plant food. In this way important substances, such as phosphoric acid and potash, are supplied to the plant, as also lime. Roots can further supply themselves with nitrogen in the form of nitrates, the ammonia and other nitrogenous bodies undergoing ready conversion into nitrates in the soil. These various mineral constituents, being now transferred to the plant, go to form new tissue, and ultimately seed, or else accumulate in the sap and are deposited on the older tissue.

Whether the nitrogen of the air can be utilized by plants or not has been long and strenuously discussed, Boussingault first, and then Lawes, Gilbert and Pugh, maintaining that there was no evidence of this utilization. But it was always recognized that certain plants, clover for example, enriched the land with nitrogen to an extent greater than could be accounted for by the mere supply to them of nitrates in the soil. Ultimately Hellriegel supplied the explanation by showing that, at all events, certain of the Leguminosae, by the medium of swellings or "nodules" on their roots, were able to fix the atmospheric nitrogen in the soil, and to convert it into nitrates for the use of the plant. This was found to be the result of the action of certain organisms within the nodules themselves, which in turn fed upon the carbohydrates of the plant and were thus living in a state of "symbiosis" with it. So far, however, this has not been shown to be the case with any other plants than the Leguminosae, and, though it is asserted by some that many other plants can take up the nitrogen of the air directly through their leaves, there is no clear evidence as yet of this.

We must now consider how the different requirements of the plant in regard to the elements necessary to maintain its life and to build up its structure affect the question of manuring.

Under conditions of natural growth and decay, when no crops are gathered in, or consumed on the land by live stock, the herbage, on dying down and decaying, returns to the atmosphere and the soil the elements taken from them during life; but, under cultivation, a succession of crops deprives the land of the constituents which are essential to healthy and luxuriant growth. Without an adequate return to the land of the matters removed in the produce, its fertility cannot be maintained for many years. In newly opened countries, where old forests have been cleared and the land brought under cultivation, the virgin soil often possesses at first a high degree of fertility, but gradually its productive power decreases from year to year. Where land is plentiful and easy to be obtained it is more convenient to clear fresh forest land than to improve more or less exhausted land by the application of manure, labour and skill. But in all densely peopled countries, and where the former mode of cultivation cannot be followed, it is necessary to resort to artificial means to restore the natural fertility of the land and to maintain and increase its productiveness. That continuous cropping without return of manure ends in deterioration of the soil is well seen in the case of the wheat-growing areas in America. Crops of wheat were taken one after another, the straw was burned and nothing was returned to the land; the produce began to fall off and the cultivators moved on to fresh lands, there to meet, in time, with the same experience; and now that the available land has been more or less intensely occupied, or that new land is too far removed for ready transport of the produce, it has been found necessary to introduce the system of manuring, and America now manufactures and uses for herself large quantities of artificial and other manures.

That the same exhaustion of soil would go on in Great Britain, if unchecked by manuring, is known to every practical farmer, and, if evidence were needed, it is supplied by the renowned Rothamsted experiments of Lawes and Gilbert, on a heavy land, and also by the more recent Woburn experiments of the Royal Agricultural Society of England, conducted on a light sandy soil. The following table will illustrate this point, and show also how under a system of manuring the fertility is maintained:—

TABLE I.—Showing Exhaustion of Land by continuous Cropping without Manure, and the maintenance of fertility through manuring. (Rothamsted 50 years; Woburn 30 years.)

1. Rothamsted (heavy land).

Crop.	Plot.	Treatment.	Average yield of corn per acre. 8 years, 1844–1851.	10 years, 1852–1861.	10 years, 1862–1871.	10 years, 1872–1881.	10 years, 1882–1891.	10 years, 1892–1901.	Average of 50 years, 1852–1901.
			Bush.	Bush.	Bush.	Bush.	Bush.	Bush.	Bush.
Wheat	3	Unmanured continuously	17·2	15·9	14·5	10·4	12·6	12·3	13·1
	2	Farm-yard manure yearly	28·0	34·2	37·5	28·7	38·2	39·2	35·6
Barley	7–2	Unmanured continuously	—	22·4	17·5	13·7	12·7	10·0	15·3
	1–0	Farm-yard manure yearly	—	45·0	51·5	50·2	47·6	44·3	47·7

2. Woburn (light land).

Crop.	Plot	Treatment.	Average yield of corn per acre. 10 years, 1877–1886.	10 years, 1887–1896.	10 years, 1897–1906.	Average of 30 years, 1877–1906.
			Bush.	Bush.	Bush.	Bush.
Wheat	7	Unmanured continuously	17·4	14·5	10·8	14·2
	11b	Farm-yard manure yearly	26·7	27·8	24·0	26·2
Barley	7	Unmanured continuously	23·0	18·1	13·3	18·1
	11b	Farm-yard manure yearly	40·0	39·9	36·6	38·8

Whereas on the heavier and richer land of Rothamsted the produce of unmanured wheat has fallen in 58 years from 17·2 bushels to 12·3 bushels, on the lighter and poorer soil of Woburn it has fallen in 30 years from 17·4 bushels to 10·8 bushels; barley has in 50 years at Rothamsted gone from 22·4 bushels to 10 bushels, whilst at Woburn (which is better suited for barley) it has fallen in 30 years from 23 bushels to 13·3 bushels. At both Rothamsted and Woburn the application of farm-yard manure has kept the produce of wheat and barley practically up to what it was at the beginning, or even increased it. Similar conclusions can be drawn from the use of artificial manures at each of the experimental stations named, exemplifying the fact that with suitable manuring crops of wheat or barley can be grown years after year without the land undergoing deterioration, whereas if left unmanured it gradually declines in fertility. Practical proof has further been given of this in the well-known "continuous corn-growing" system pursued, in his regular farming, by Mr John Prout of Sawbridgeworth, Herts, and subsequently by his son, Mr W. A. Prout, since the year 1862. By supplying, in the form of artificial manures, the necessary constituents for his crops, Mr Prout was enabled to grow year after year, with only an occasional interval for a clover crop and to allow of cleaning the land, excellent crops of wheat, barley and oats, and without, it may be added, the use of farm-yard manure at all.

In considering the economical use of manures on the land regard must be had to the following points: (1) the requirements of the crops intended to be cultivated; (2) the physical condition of the soil; (3) the chemical composition of the soil; and (4) the composition of the manure. Briefly stated, the guiding principle of manuring economically and profitably is to meet the requirements of the crops intended to be cultivated, by incorporating with the soil, in the most efficacious states of combination, the materials in which it is deficient, or which the various crops usually grown on the farm do not find in the land in a sufficiently available condition to ensure an abundant harvest. Soils vary greatly in composition, and hence it will be readily understood that in one locality or on one particular field a certain manure may be used with great benefit, while in another field the same manure has little or no effect upon the produce.

For plant life to thrive certain elements are necessary, viz. carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, among the organic or combustible matters, and among the inorganic or mineral matters, potassium, calcium, magnesium, iron, phosphorus and sulphur. We must now examine the extent to which these necessary elements occur in either of the two great storehouses, the atmosphere and the soil, and how their removal in the form of crops may be made up for by the use of manures, so that the soil may be maintained in a state of fertility. Further, we must consider what functions these elements perform in regard to plant life, and, lastly, the forms in which they can best be applied for the use of crops.

Of carbon, hydrogen and oxygen there is no lack, the atmosphere providing carbonic acid in abundance, and rain giving the elements hydrogen and oxygen, so that these are supplied from natural sources. Iron, magnesium and sulphur also are seldom or never deficient in soils, and do not require to be supplemented by manuring. Accordingly, the elements for which there is the greatest demand by plants, and which the soil does not provide in sufficiency, are nitrogen, phosphorus, potassium, and, possibly, calcium. Manuring, apart from the physical and mechanical advantages which it confers upon soils, practically resolves itself, therefore, into the supply of nitrogen, phosphorus and potassium, and it is with the supply of these that we shall accordingly deal in particular.

1. *Nitrogen.*—Though we are still far from knowing what are the exact functions which nitrogen fulfils in plant life, there is no doubt as to the important part which it plays in the vegetable growth of the plant and in the formation of stem and leaf. Without a sufficiency of nitrogen the plant would be stunted in growth. Its growth, indeed, may be said to be measured by the supply of nitrogen, for while mineral constituents like phosphoric acid and potash are only taken up to the extent that the plant can use them *i.e.* according to its rate of growth, this actual growth itself would seem to be determined by the extent of the nitrogen supply. This it is which causes the ready response given to a crop by the application of some quickly-acting nitrogenous material like nitrate of soda, and which is marked by the dark-green colour produced and the pushing-on of the growth. Similarly, this use of nitrogen, by prolonging growth, defers maturity, while over-use of nitrogen tends to produce increase of leaf and lateness of ripening. Along with this growth of the vegetative portions, and seen, in the case of corn crops, mainly in the straw, there is a corresponding decrease, from the use of nitrogen in excess, in the quality of the grain. In corn a smaller grain and lesser weight per bushel are the result of over-nitrogen manuring. The composition of the grain is likewise affected, becoming more nitrogenous. With crops, however, where rapid green growth is required, nitrogen effects the purpose well, though here, too, over-manuring with nitrogen will tend to produce rankness and coarseness of growth. Experiments at Rothamsted and elsewhere, as well as everyday practice of the farm, bear testimony to the paramount importance of nitrogen-supply, and to the crops it is capable of raising. This applies not only to corn crops of all kinds, but to root crops, grass, potatoes, &c. Leguminous crops alone seem to have no need of it. In view of this practical experience, Liebig's "mineral theory"—according to which he laid down that plants only needed to have mineral constituents, such as phosphoric acid, potash and lime, supplied to them—reads strangely nowadays. The use of mineral manures without nitrogen other than that already present in the soil or supplied in rain has been shown, alike at Rothamsted and Woburn, to produce crops of wheat and barley little better than those from unmanured land. The lack of nitrogen in ordinary cultivated soils is much more marked than is that of mineral constituents, and consequently even with the application of nitrogen alone (as by the use of nitrate of soda or sulphate of ammonia), good crops have been grown for a large number of years. This has been shown both at Rothamsted and at Woburn. On the other hand, experiments at these stations have demonstrated that better and more lasting results are obtained by the judicious use of nitrogenous materials in conjunction with phosphates and potash.

The form in which nitrogen is taken up by plants is mainly, if not wholly, that of nitrates, which are readily-soluble salts. Ammonia and other nitrogenous bodies undergo in the soil, through the agency of nitrifying organisms present in it (*Bacterium nitrificans*, &c.), rapid conversion into nitrates, and as such are easily assimilable by the plant. Similarly, they are the constituents which are most readily removed in drainage, and hence the adequate supply of nitrogen for the plant's use is a constant problem in agriculture. Experiments on the rate of removal of nitrates from the soil by drainage showed that every inch of rain passing through the drains caused a loss of 2½ lb of nitrogen per acre (Voelcker and Frankland). At the same time, soils, as Way showed, have the power of absorbing, in different degrees, ammonia from its solution in water, and when salts of ammonia are passed through soils the ammonia alone is absorbed, the acids passing, generally in combination with lime, into the drainage.

Other experiments at Rothamsted on drainage showed that, though large quantities of ammonia salts were applied to the land, the drainage water contained merely traces of ammonia, but, on the other hand, nitrates in quantity, thus proving that it is as nitrates, and not as ammonia, that plants mainly, if not entirely, take up their nitrogenous food.

From these investigations it follows that much more nitrogen must be added to the land than would be needed to produce a given increase in the crop. Nitrogen, then, being so all-important, the question is, where is it to come from? We have seen that the leaves take up only minute quantities of ammonia, comparatively small amounts are supplied in the rain, dew, snow, &c.,[1] and in the case of Leguminosae alone have we any evidence of plants being able to provide themselves with nitrogen from atmospheric sources. Some few organisms present in fertile soils, *e.g. Azotobacter chroococcum*, have also the power, under certain conditions, of fixing the free nitrogen of the atmosphere without the intervention of a "host," but all these sources would be very inadequate to meet the demands of an intensive cultivation. An ordinary fertile arable soil will not show, on analysis, much more than ·15% of nitrogen, and it is evident that the great source of supply of the needed nitrogen must be the direct manuring of the soil with materials containing nitrogen. These materials will be considered in detail later.

2. *Phosphorus.*—This is the most important mineral element which has to be supplied to the soil by the agency of manuring. It occurs in ordinary fertile soils to the extent of only about ·15%, reckoned as phosphoric acid, and though its absence in sufficiency is not so marked or so soon shown under prolonged cultivation as is that of nitrogen, yet the fact that it is needed by all classes of crops, and that its application in manurial form is attended with great benefits, makes its supply one of great importance. From the time that Liebig, in 1840, suggested the treatment of bones with sulphuric acid in order to make them more readily available for the use of crops, and that

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[1] The amount of nitrogen thus deposited annually was found at Rothamsted to be 7·21 lb per acre.

the late Sir John Lawes (in 1843) began the dissolving of mineral phosphates for the purpose of manufacturing superphosphate, the "artificial manure" trade took its rise, and ever since then the whole globe has been exploited for the purpose of obtaining the raw phosphatic materials which form the base of the artificial manures of the past and of the present day. The functions which phosphoric acid fulfils in plant life would appear to be connected rather with the maturing of the plant than with the actual growth of the structure. Phosphates are found concentrated in those parts of the plant where cell growth and reproduction are most active. More especially is this the case with the seed in which phosphates are present in greatest quantity. While nitrogen delays maturity, phosphoric acid has just the opposite effect, and cereal crops not sufficiently supplied with it ripen much more tardily than do others. Moreover, the grain is formed more early when phosphatic manures have been given than when they are withheld. Phosphates increase the proportion of corn to straw, and, as regards the grain itself, they render it less nitrogenous, richer in phosphates, and altogether improve its quality.

While these are the principal functions of phosphates, they also exercise an influence on the young plant in its early stages. This is well seen in the almost universal practice of applying superphosphate to the young turnip or swede crop in order to push it beyond the attack of "fly." Undoubtedly phosphates in readily available form stimulate the young seedling, enabling it to develop root growth, and, later on, causing the plant to "tiller out" well. Phosphoric acid occurs in the soil bound up with the oxides of iron and alumina, or, it may be, with lime, and the extent to which it may become useful to plants will depend largely upon the readiness with which it becomes available. For the purpose of ascertaining this different analytical methods have been suggested, the best known one being that of B. Dyer, in which a 1 % solution of citric acid is used as a solvent. As a result of experimenting with Rothamsted soils of known capability it has been put forward that if a soil shows, by this treatment, less than ·01 % of phosphoric acid it is in need of phosphatic manuring.

Experiments carried on for many years at Rothamsted and Woburn have clearly established the beneficial effects of phosphatic manuring on corn crops, for though no material increase marks the application of mineral manures in the absence of nitrogen, yet the results when phosphates and nitrogen are used together are very much greater than when nitrogen alone has been applied; and this is true as regards not only the better ripening and quality of the grain, but also as regards the actual crop increase.

With root crops phosphates are almost indispensable; and, owing to the limited power which these crops have of utilizing the phosphoric acid in the soil, the supply of a readily available phosphatic manure like superphosphate is of the highest importance.

The assimilation of phosphoric acid goes on in a cereal crop after the time of flowering and to a later date than does that of nitrogen and potash, and it is ultimately stored in the seed. Soils possess a retentive power for phosphoric acid which enables the latter to be conserved and not removed to any extent by drainage. This function is exercised mainly by the presence of oxide of iron. Alumina acts in a similar way. In the case of soils that contain clay only traces of phosphoric acid are found in the drainage water.

3. *Potassium.*—The element third in importance, which requires to be supplied by manuring, is potassium, or, as it is generally expressed, potash. This in its functions resembles phosphoric acid somewhat, being concerned rather with the mature development of the plant than with its actual increase of growth. Like phosphoric acid, potash is found concentrated throughout the plant in the early stages of its growth, but, unlike it, is in the case of a cereal crop all taken up by the time of full bloom, whereas with phosphoric acid the assimilation continues later. Potash would appear to have an intimate connexion with the quality of crops, and to be favourable to the production of seed and fruit rather than to stem and leaf development. Certain crops, such as vegetables, fruit, hops, as well as root crops generally, make special demands upon potash supply, and, as checking the tendency to over-development of leaf, &c., induced by nitrogenous manures when used alone, potash has great practical importance. Potash appears to be bound up in a special way with the process of assimilation, for it has been clearly shown that whenever potash is deficient the formation of the carbohydrates, such as sugar, starch and cellulose, does not go on properly. Hellriegel and Wilfarth showed by experiment the dependence of starch formation on an adequate supply of potash. Cereal grains remained small and undeveloped when potash was withheld, because the formation of starch did not go on. The same effect has been strikingly shown in the Rothamsted experiments with mangels, a plot receiving potash salts as manure giving a crop of roots nearly 2½ times as heavy as that grown on a plot which has received no potash. In this case the increase is due almost entirely to the sugar and other carbohydrates elaborated in the leaves, and not to any increase of mineral constituents.

The effect of potash on maturity is somewhat uncertain, inasmuch as in the case of grain crops it would appear to delay maturity and to hasten it in that of root crops.

The influence of potash on particular crops is very marked. On clovers and other leguminous crops it is highly beneficial, while on grass land it is of particular importance as inducing the spread of clovers and other leguminous herbage. This is well seen in the Rothamsted grass experiments, where with a mineral manure containing potash one-half of the herbage is leguminous in nature, whereas the same manure without potash gives only 15 % of leguminous plants. Similarly, where nitrogen is used by itself and no potash given there are no leguminous plants at all to be found. Potash occurs in an ordinary fertile soil to the extent of about ·20 %; a sandy soil will have less, a clay soil may have considerably more. Potash, however, is mostly bound up in the soil in the form of insoluble silicates, and these are often in a far from available form, but require cultivation, the use of lime and other means for getting them acted on by the air and moisture, and so liberating the potash. According to B. Dyer's method of ascertaining the availability of potash in soils, the amount of potash soluble in a 1 % citric acid solution should be about ·005 %, otherwise the addition of potash manures will be a requisite. In the case of soils containing much lime a larger quantity would, no doubt, be needed.

Potash, like phosphoric acid, is readily retained by soils, and so is not subject to any considerable losses by drainage. This retention is exercised by the ferric-oxide and alumina in soils, but still more so by the double silicates, and to some extent also by the humus of the soil. Potash will be liberated from its salts by the action of lime in the soil, the lime taking the place of the potash. Lime is, therefore, of much importance in setting free fresh stores of potash. Soda salts also, when in considerable excess, are able to liberate potash from its compounds, and to this is probably due, in many cases, the beneficial action attending the use of common salt.

4. *Calcium.*—Though calcium, or lime, is found in sufficiency in most cultivated soils, there are, nevertheless, soils in which lime is clearly deficient and where that deficiency has shown itself in practice. Moreover, so comparatively easy is the removal of lime from the soil by drainage, and so important is the part which lime plays in liberating potash from its compounds, and in helping to retain bases in the soil so that they are not lost in drainage, that the significance of lime cannot be ignored. Further, the availability of both potash and phosphoric acid in the soil has been found to be much increased by the presence of lime. Lime, as carbonate of calcium, is also necessary for the process of nitrification to go on in the soil. Some sandy soils, and even some clays, contain so little lime as to call for the direct supply of lime as an addition to the soil. When this is the case nothing can adequately take the place of lime, and in this sense lime may be called a "manure." In the majority of cases, however, the practice of liming or chalking, which was a common one in former times, was resorted to mainly because of the ameliorating effects it produced on the land, both in a mechanical and in a physical direction. Thus, on clay soil it flocculates the particles, rendering the soil less tenacious of moisture, improving the drainage and making the soil warmer. Nor must the directly chemical results be overlooked, for in addition to those already mentioned, of liberating plant food (chiefly potash and phosphoric acid), retaining bases, and aiding nitrification, lime acts in a special way as regards the sourness or "acidity" which is sometimes produced in land when lime is deficient. In soils that are acid through the accumulation of humic acid nitrification does not go on, and bacterial life is repressed. The addition of lime has the effect of "sweetening" the land, and of restoring its bacterial activity. This acidity is also seen in the occurrence of the disease known as "finger and toe" in turnips, the fungus producing this being one that thrives in an acid soil. It is only found in soils poor in lime, and the only remedy for it is liming. The growth of weeds like spurry, marigold, sorrel, &c., is also a sign of land being wanting in lime. The most striking instance of this "soil acidity" is that afforded by the Woburn experiments, where, on a soil originally poor in lime, the soil has, through the continuous use of ammonia salts, been impoverished of its lime to such an extent that it has become quite sterile and is distinctly acid in character. The application of lime, however, to such a soil has had the effect of quite restoring its fertility.

The amount of lime which soils contain is a very variable one, chalk soils being very rich in lime, whereas sandy and peaty soils are generally very poor in it. If the amount of lime in a soil falls below 1 % of carbonate of lime on the dried soil, the soil will sooner or later require liming.

5. *Magnesium.*—This is not known to be deficient in soils, although an essential element in them, and it is seldom directly applied as a manurial ingredient. Some natural potash salts, such as kainit, contain magnesia salts in considerable quantity; but their influence is not known to be of beneficial nature, though, like common salt, magnesia salts will, doubtless, render some of the potash in the soil available. At the same time magnesia salts are not without their influence on crops, and experiments have been undertaken at the Woburn experimental farm and elsewhere to determine the nature of this influence. Carbonate of magnesia has been tried in connexion with potato-growing, and, it is said, with good results.

6. *Iron.*—Iron is another essential ingredient of soil that is found in abundance and does not call for special application in manurial

form. Iron is essential for the formation of chlorophyll in the leaves, and its presence is believed also to be beneficial for the development of colour in flowers, and for producing flavour in fruits and in vines especially. Ferrous sulphate has, partly with this view, and partly for its fungus-resisting properties, been suggested as a desirable constituent of manures. The function performed by ferric oxide in the soil of retaining phosphoric acid, potash and ammonia has been already alluded to.

7. *Sulphur.*—This, the last of the "essential" elements, is seldom specially employed in manurial form. There would appear to be no lack of it for the plant's supply, and it is little required except for the building-up, with carbon, hydrogen, oxygen and nitrogen, of the albuminoids. There are few artificial manures which do not contain considerable amounts of sulphur, notably superphosphate. Sulphate of lime (gypsum) is sometimes applied to the land direct as a way of giving lime; this is employed in the case of clover and hops principally.

Having thus dealt with the essential ingredients which plants must have, and which may require to be supplied to them in the form of additional manures, we may briefly pass over the other constituents found in plants, which may, or may not, be given as manures.

8. *Sodium.*—This is a widely distributed element. The influence of common salt (chloride of sodium) in liberating, when used in large excess, potash from the silicates in which it is combined in the soil has been already referred to, and in this way common salt and also nitrate of soda (the two forms in which soda salts are used as manures) may have some benefit. The principal purpose for which common salt, however, is used, is that of retaining moisture in the land. It is specially useful in a dry season, or for succulent crops such as cabbage, kale, &c., or again for plants of maritime origin (such as mangels), which thrive near the sea shore.

9. *Silicon.*—All soils contain silica in abundance. Though silica forms so large a part of the ash of plants and is especially abundant in the straw of cereals, there is no evidence that it is required in plant life. Popularly, it is believed to "stiffen" the stems of cereals and grasses, but plants grown without it will do perfectly well. It would, however, appear that soluble silica does play some part in enabling phosphoric acid to be better assimilated by the plant. Silicates, however, have not justified their use as direct fertilizers.

10. *Chlorine.*—A certain amount of chlorine is brought down in the rain, and chlorides are also used in the form of common salt, with the effect, as aforesaid, of liberating potash from silicates, when given in excess, but there is no evidence as to any particular part which the chlorine itself plays.

11. *Manganese,* &c.—Manganese occurs in minute quantities in most plants, and it, along with lithium (found largely in the tobacco-plant), caesium, titanium, uranium and other rare elements, may be found in soils. Experiments at the Woburn pot-culture station and elsewhere, point to stimulating effects on vegetation produced by the action of minute doses of salts of these elements, but, so far, their use as manurial ingredients need not be considered in practice.

12. *Humus.*—Though not an element, or itself essential, this body, which may be described as decayed vegetable matter, is not without importance in plant life. Of it, farmyard manure is to a large extent composed, and many "organic manures," as they are termed, contain it in quantity. Dead leaves, decayed vegetation, the stubble of cereal crops and many waste materials add humus to the land, and this humus, by exposure to the air, is always undergoing further changes in the soil, opening it out, distributing carbonic acid through it, and supplying it, in its further decomposition, with nitrogen. The principal effects of humus on the soil are of a physical character, and it exercises particular benefit through its power of retaining moisture. Humus, however, has a distinct chemical action, in that it forms combinations with iron, calcium and ammonia. It thus becomes one of the principal sources of supply of the nitrogenous food of plants, and a soil rich in humus is one rich in nitrogen. The nitrogen in humus is not directly available as a food for plants, but many kinds of fungi and bacteria are capable of converting it into ammonia, from which, by the agency of nitrifying organisms, it is turned into nitrates and made available for the use of plants. Humus is able to retain phosphoric acid, potash, ammonia and other bases. So important were the functions of humus considered at one time that on this Thaer built his "humus theory," which was, in effect, that, if humus was supplied to the soil, plants required nothing more. This was based, however, on the erroneous belief that the carbon, of which the bulk of the plant consists, was derived from the humus of the soil, and not, as we now know it to be, from the carbonic acid of the atmosphere. This theory was in turn replaced by the "mineral theory" of Liebig, and then both of them by the "nitrogen theory" of Lawes and Gilbert.

We pass next to review, in the light of the foregoing, the manures in common use at the present day.

Manures, as already stated, may be variously classified according to the materials they are made from, the constituents which they chiefly supply, or the uses to which they are put. But, except with certain few manures, such as nitrate of soda, sulphate of ammonia and potash salts, which are used purely for one particular purpose, it is impossible to make any definite classification of manures, owing to the fact that the majority of them serve more than one purpose, and contain more than one fertilizing constituent of value. It is only on broad lines, therefore, that any division can be framed. Between so-called "natural" manures like farm-yard manure, seaweed, wool waste, shoddy, bones, &c., which undergo no particular artificial preparation, and maufactured manures like superphosphate, dissolved bones, and other artificially prepared materials, there may, however, be a distinction drawn, as also between these and such materials as are imported and used without further preparation, *e.g.* nitrate of soda, kainit, &c. On the whole, the best classification to attempt is that according to the fertilizing constituents which each principally supplies, and this will be adopted here, with the necessary qualifications.

I.—NITROGENOUS (WHOLLY OR MAINLY) MANURES

These divided themselves into: (*a*) Natural nitrogenous manures; (*b*) imported or manufactured manures.

a. NATURAL NITROGENOUS MANURES

Under this heading come—farm-yard manure; seaweed; refuse cakes and meals; wool dust and shoddy; hoofs and horns; blood; soot; sewage sludge.

Farm-yard Manure.—This is the most important, as well as the most generally used, of all natural manures. It consists of the solid and liquid excreta of animals that are fed at the homestead, together with the material used as litter. The composition of farm-yard manure will vary greatly according to the conditions under which it is produced. The principal determining factors are (1) the nature and age of the animals producing it, (2) the food that is given them, (3) the kind and quantity of litter used, (4) whether it be made in feeding-boxes, covered yards or open yards, (5) the length of time and the way in which it has been stored. The following analysis represents the general composition of well-made farm-yard manure, in which the litter used is straw:—

Water	75·42
*Organic matter	16·52
Oxide of iron and alumina	·36
Lime	2·28
Magnesia	·14
Potash	·48
Soda	·08
†Phosphoric acid	·44
Sulphuric acid	·12
Chlorine	·02
Carbonic acid, &c.	1·38
Silica	2·76
	100·00

*Containing nitrogen = ·59 %, which is equal to ammonia . . . . . ·72 %

†Equal to phosphate of lime . . . . . ·96

Put broadly, farm-yard manure will contain from 65 to 80% of water, from ·45 to ·65% of nitrogen, from ·4 to ·8% of potash, and from ·2 to ·5% of phosphoric acid.

This analysis shows that farm-yard manure contains all the constituents, without exception, which are required by cultivated crops in order to bring them to perfection, and hence it may be called a "perfect" manure. Dung, it may be observed, contains a great variety of organic and inorganic compounds of various degrees of solubility, and this complexity of composition—difficult, if not impossible, to imitate by art—is one of the circumstances which render farm-yard manure a perfect as well as a universal manure.

The excrements of different kinds of animals vary in composition, and those of the same animal will vary according to the nature and quantity of the food given, the age of the animal, and the way it is generally treated. Thus, a young animal which is growing, needs food to produce bone and muscle, and voids poorer dung than one which is fully grown and only has to keep up its condition. Similarly, a milking-cow will produce poorer dung than a fattening bullock. Again, cake-feeding will produce a richer manure than feeding without cake. Straw is the most general litter used, but peat-moss litter, sawdust, &c., may be used, and they will affect the quality of the manure to some extent. Peat-moss is the best absorbent and has a higher manurial value than straw. Box-fed manure, and that made in covered yards will suffer much less loss than that made in an open yard. Lastly, manure kept in a heap covered with earth will be much richer than that left in an uncovered heap. The solid and liquid excrements differ much in composition, for, while the former contain principally phosphoric acid, lime, magnesia, and silica and comparatively little nitrogen, the urine is almost destitute of phosphoric acid, and abounds in alkaline salts (including salts of potash) and in nitrogenous organic matters, among which are urea and uric acid, and which on decomposition yield ammonia. Unless, therefore, the two kinds of excrements are mixed, a perfect manure supplying all the needs of the plant is not obtained; care must accordingly be taken to absorb all the urine by the litter. Farm-yard manure, it is well known, is much affected by the length of time and the way in which it has been kept. Fresh dung is soluble in water only to a limited extent, and, in consequence, it acts more slowly on vegetation, and the action lasts longer than when dung is used which has been kept some time; fresh dung is therefore generally used in autumn or winter, and thoroughly rotten dung in spring, when an immediate forcing effect is required.

The changes which farm-yard manure undergoes on keeping, have been made the subject of much inquiry. In Germany, Maercker and Schneidewind; in France, Muntz and Girard; and in England, Voelcker, Wood, Russell and others, have investigated these losses, coming to very similar conclusions concerning them. Perhaps the most complete set of experiments is one conducted at the Woburn experimental station and extending over three years (1899–1901). The dung was cake-fed manure made in feeding-boxes from which no drainage issued, and, after removal, it was kept in a heap, covered with earth. Hence it was made under as good conditions as possible; but, even then, the losses—after deduction for live-weight increase of the animals—were found to be 15% of the total nitrogen of the food, during the making, and 34% (or a further 19%) during storing and by the time the manure came to be put on the land. Accordingly, under ordinary farm conditions it is quite clear that only about 50% of the nitrogen of the food given is recovered in the dung that goes on the land. This is the figure which Lawes and Gilbert suggested in the practical application of their Tables of Compensation for Unexhausted Manure Value.

During the fermentation of dung a large proportion of the non-nitrogenous organic matters disappear in the forms of carbonic acid and water, while another portion is converted into humic acids which fix the ammonia gradually produced from the nitrogenous constituents of the solid and liquid excreta. The mineral matters remain behind entirely in the rotten dung, if care be taken to prevent loss by drainage. For proper decomposition, both air and moisture are requisite, while extreme dryness or too much water will arrest the due fermentation of the mass.

Well-fermented dung is more concentrated and consequently more efficacious than fresh farm-yard manure. Neither fresh nor rotten dung contains any appreciable quantity of volatile ammonia, and there is no advantage from applying gypsum, dilute acid, superphosphate, kainit, or other substances recommended as fixers of ammonia. If dung is carted into the field and spread out at once in thin layers it will suffer comparatively little loss. But if dung be kept for a length of time in shallow heaps, or in open straw-yards and exposed to rain, it loses by drainage a considerable proportion of its most valuable soluble fertilizing constituents. Experiments with farm-yard manure kept in an open yard showed that, after twelve months' exposure to the weather, nearly all the soluble nitrogen and 78·2% of the soluble mineral matters were lost by drainage (A. Voelcker). To prevent this loss, farmyard manure, as had been pointed out, should, whenever possible, be carted into the field, spread out at once, and ploughed in at the convenience of the farmer. It is, however, not always practicable to apply farm-yard manure just at the time it is made, and, as the manure heap cannot be altogether dispensed with, it is necessary to see how the manure may best be kept. The best dung is that made in regular pits or feeding-boxes. In them the urine is thoroughly absorbed, and, the manure being more compact through the constant treading, air enters less freely and the decomposition goes on less rapidly, the volatile matters, in consequence, not being so readily lost. External agents, such as rain, wind, sun, &c., do not affect the manure as they would in the case of open yards. Next best to box-fed manure is that made in covered yards, then that in sheds, and lastly that in open yards. When removed from the box or yard, the manure should be put in a heap upon a floor of clay or well-beaten-down earth, and then be covered with earth. When kept in an open yard, care should be taken not to let spoutings of buildings lead on to it, and if there be a liquid-manure tank, this might be pumped out over the manure again when the latter is too dry.

The advantages of farm-yard manure consist, not only in its supplying all the constituents of plant food, but also in the improved physical condition of the soil which results from its application, inasmuch as the land is thereby kept porous, and air is allowed free access. While, however, farm-yard manure has these advantages, experience has shown that artificial manures, properly selected so as to meet the requirements of the crops intended to be grown on the particular land, may be employed to greater advantage. In farm-yard manure about two-thirds of the weight is water and one-third dry matter; a large bulk thus contains only a small proportion of fertilizing substances, and expense is incurred for carriage of much useless matter when dung has to be carted to distant fields. When a plentiful supply of good farm-yard manure can be produced on the farm or bought at a moderate price in the immediate neighbourhood, it is economy to use it either alone or in conjunction with artificial manures; but when food is dear and fattening does not pay, or farm-yard manure is expensive to buy, it will be found more economical to use artificial manures. This has obtained confirmation from the experience of Mr Prout, at Sawbridgeworth, Herts, where since 1866, successive crops of corn have been grown, and entirely with the use of artificial manures.

The real difficulty with farm-yard manure is to get enough of it, and, if it were available in sufficiency, it would be safe to say that farmers generally would not require to go farther in regard to the manuring of any of the crops of the farm. Moreover, experiments at Rothamsted and Woburn have shown of how "lasting" a character farm-yard manure is, its influence having told for some 15 to 20 years after its application had ceased.

Light land is benefited by farm-yard manure through its supplying to the soil organic matter, and imparting to it "substance" whereby it becomes more consolidated and is better able to retain the manurial ingredients given to it. By improving the soil's moisture-holding capacity, moreover, "burning" of the land is prevented.

With heavy clay soils the advantages are that these are kept more open in texture, drainage is improved, and the soil rendered easier of working. On light land, well-rotted manure is best to apply; and in spring, whereas on heavy land freshly-made, "long," manure is best, and should be put on in autumn or winter.

Farm-yard manure, where the supply is limited, is mostly saved for the root-crop, which, however, generally needs a little superphosphate to start it, as farm-yard manure is not sufficiently rich in this constituent. It serves a great purpose in retaining the needed moisture in the soil for the root crop.

For potato-growing, for vegetables, and in market-gardening, farm-yard manure is almost indispensable. On grass-land and on clover-ley it is also very useful, and in the neighbourhood of large towns is employed greatly for the production of hay.

For corn crops also, and especially for wheat on heavy land, farm-yard manure is much used, and, in a dry season in particular, shows excellent results, though experiments at Rothamsted and Woburn have shown that, on heavy and light land alike, heavier crops of wheat and barley can be produced in average seasons by artificial manures.

Seaweed.—Along the sea-coast seaweed is collected, put in heaps and allowed to rot, being subsequently used on the land, just as farm-yard manure is. According to the nature of the weed and its water-contents, it may have from ·3 to 1% of nitrogen, or more, with potash in some quantity.

Green-manuring.—Though properly belonging to cultivation rather than to manuring, and acting chiefly as a means of improving the condition of the soil, the practice of green-manuring carries with it manurial benefits also, in that it supplies humus and nitrogen to the soil, and provides a substitute for farm-yard manure. The ploughing-in of a leguminous green-crop which has collected nitrogen from the atmosphere should result in a greater accumulation of nitrogen for a succeeding corn-crop, and thus supply the cheapest form of manuring. Green-manuring is most beneficial on light land, poor in vegetable matter.

Manure Cakes, Malt Dust, Spent Hops, &c.—Many waste materials of this kind are used because of their supplying, in the form of nitrogenous organic matter, nitrogen for crop uses. The nitrogen in these is of somewhat slow-acting, but lasting, nature. In addition to nitrogen, some of these materials, *e.g.* rape cake, cotton cake and castor cake, contain appreciable amounts of phosphoric acid and potash. Rape cake, or "land cake," as it is called in Norfolk, is used considerably for wheat. It is also believed to be a preventive of wireworm, and so is often employed for potatoes and root-crops. Rape-seed from which the oil has been extracted by chemical means, and which is called "rape refuse," is made use of in hop-gardens as a slowly acting supplier of nitrogen. It will contain 4 to 5% of nitrogen with 3 to 4% of phosphates. Damaged cotton and other feeding-cakes, no longer fit for feeding, are ground into meal and put on the land. Castor cake is directly imported for manurial purposes, and will have up to 5% of nitrogen with 4 to 5% of phosphates. Spent hops, malt dust and other waste materials are similarly used. The principal use of these materials is on light land, and to give bulk to the soil while supplying nitrogen in suitable form.

Wool-dust, Shoddy, &c.—The clippings from wool, the refuse from cloth factories, silk, fur and hair waste, carpet clippings and similar waste materials are comprised in this category. They are valuable purely for their nitrogen, and should be purchased according to their nitrogen-contents. They are favourite materials with hop-growers and fruit-farmers, whose experience leads them to prefer a manure which supplies its nitrogen in organic form, and which acts continuously, if not too readily. It is the custom in hop-lands to manure the soil annually with large quantities of these waste materials till it has much fertility stored up in it for succeeding crops. According to its nature, wool-dust or shoddy may contain anything from 3% of nitrogen up to 14%.

Leather is another waste material of the same class, but the process of tanning it has undergone makes its nitrogen but very slowly available and it is avoided, in consequence, as a manure.

There have been several processes started with the object of rendering leather more useful as a manure.

Hoofs and Horns.—The clippings and shavings from horn factories are largely used by some hop-growers, and, though very slow in their action, they will contain 14 to 15% of nitrogen. They are sometimes very finely ground and sold as "keronikon," chiefly for use in compound artificial manures.

Dried Blood is another purely nitrogenous material, which however seldom finds its way to the farmer, being used up eagerly by the artificial manure maker. It will contain from 12 to 14% of nitrogen. It is obtained by simply evaporating down the blood obtained from slaughter-houses. It is the most rapidly acting of the organic nitrogenous materials enumerated, and, when obtainable, is a favourite manure with fruit-growers, being also used for root and vegetable growing.

Soot is an article of very variable nature. It owes its manurial value mainly to the ammonia salts it contains, and a good sample will have about 4% of ammonia. It is frequently adulterated, being mixed with ashes, earth, &c. Flue sweepings of factory chimneys are sometimes sold as soot, but possess little value. Besides the ammonia that soot contains, there would undoubtedly seem to be a value attaching to the carbonaceous matter. Soot is a favourite top-dressing for wheat on heavy land, and is efficacious in keeping off slugs, &c. Speaking generally, the lighter a sample of soot is the more likely is it to be genuine.

Sewage Manure.—Where methods of dealing with the solid matters of sewage are in operation, it frequently happens that these matters are dried, generally with the aid of lime, and sold locally. Occasionally they are prepared with the addition of other fertilizing materials and made up as special manures. It may be taken for granted that sewage refuse by itself is not worth transporting to any distance. When made up with lime, the "sludge," as it is generally termed, is often useful because of the lime it contains. But, on the whole, the value of such preparations has been greatly exaggerated. Where land is in need of organic matter, or where it is desirable to consolidate light land by the addition of material of this class, sludge may, however, have decided value on mechanical and physical grounds, but such land requires to be near at hand.

b. Imported or Manufactured Nitrogenous Manures.

These are nitrate of soda; sulphate of ammonia; calcium cyanamide; calcium nitrate.

Nitrate of Soda.—This is the best known and most generally used of purely nitrogenous manures. It comes from the rainless districts of Chile and Peru, from which it was first shipped about the year 1830. By 1899 the export had reached to 1,344,550 tons. It is uncertain what its origin is, but it is generally believed to be the deposit from an ancient sea which was raised by volcanic eruption and its waters evaporated. Another theory puts it as the deposit from the saline residues of fresh-water streams. The crude deposit is termed *caliche*, and from this (which contains common salt and sulphates of soda, potash and lime) the nitrate is crystallized out and obtained as a salt containing 95 to 96% pure nitrate of soda. It is sold on a basis of 95% pure, and is but little subject to adulteration.

As a quickly acting nitrogenous manure nitrate of soda has no equal, and it is in great demand as a top-dressing for corn crops, also for roots. On grass-land, if used alone, it tends to produce grass but to exterminate leguminous herbage. Its tendency with corn crops is to produce, if used in quantity, inferiority of quality in grain. It can be employed in conjunction with superphosphate and other artificial manures, though it should not be mixed with them long before the mixture is to be put on. It is a very soluble salt, and the nitrogen being in the form of nitrates, it can be readily taken up by plants. On the other hand, it is readily removed from the soil by drainage, and its effects last only for a single season. Owing to its solubility, it requires to be used in much larger amount than the crop actually will take up. On a heavy soil it has a bad influence if used repeatedly and in quantity, causing the land to "run," and making the tilth bad. Though, doubtless, exhaustive to the soil, when used alone, there is no evidence yet of nitrate of soda causing land to "run out," as has been shown to be the case with sulphate of ammonia. One cwt. to the acre is a common dressing for corn crops, but for mangels it has been used to advantage up to 4 cwt. per acre. As a top-dressing for corn crops it differs little in its crop-results from its rival sulphate of ammonia, but in a dry season it answers better, owing to its more ready solubility and quicker action, whereas in a wet season sulphate of ammonia does better.

Sulphate of Ammonia.—This is the great competitor with nitrate of soda, and, like the latter, is useful purely as a nitrogenous manure. It is obtained in the manufacture of gas and as a by-product in the distillation of shale, &c., as also from coke ovens. By adding sulphuric acid to the ammoniacal liquor distilled over from the coal, &c., the salt is crystallized out. It is seldom adulterated, and, as sold in commerce, generally contains 24 to 25% of ammonia. It is not quite so readily soluble as nitrate of soda; it does not act quite so quickly on crops, but is less easily removed from the soil by drainage, leaving also a slight amount of residue for a second crop. It is nearly as efficacious as a top-dressing for corn crops as is nitrate of soda, and for some crops, *e.g.* potatoes, it is considered superior. It may also be used like nitrate of soda for root crops. On grass-land its effect in increasing gramineous but reducing leguminous herbage is similar to that of nitrate of soda, but with corn crops it has not the same deteriorating influence on the quality of grain. It can be mixed quite well with superphosphate and other artificial manures, and is therefore a common form in which nitrogen is supplied in compound manures. It does not produce the bad effect on the tilth of certain soils that nitrate of soda does, but it is open to the objection that, if used continually on soil poor in lime, it will gradually exhaust the soil and leave it in an acid condition, so that the soil is unable to bear crops again until fertility is restored by the addition of lime. A usual dressing of sulphate of ammonia is 1 cwt. per acre.

Calcium Cyanamide.—This is a new product which represents the earliest result of the utilization, in a commercial form, of atmospheric nitrogen as a manurial substance. It is obtained by passing nitrogen gas over the heated calcium carbide obtained in the electric furnace, the nitrogen then uniting with the carbide to form calcium cyanamide. The product contains from 19 to 20% of nitrogen, and, though still under trial as a nitrogenous manure, it bids fair to form a valuable source of supply, especially should the natural deposits of nitrate of soda become exhausted. The cost of production limits its manufacture to places where electrical power can be cheaply generated. In its action it would seem to resemble most closely sulphate of ammonia.

Calcium Nitrate.—This is another product of the utilization of atmospheric nitrogen as a manurial agent. Nitrogen and oxygen are made to combine within the electric arc and the nitric acid produced is then combined with lime, forming nitrate of lime. Nitrate of lime contains, as put on the market, about 13% of nitrogen. In its action it should be very similar to nitrate of soda, with, possibly, some added benefit to certain soils by reason of the lime it contains. Like cyanamide, it is still in the experimental stage as regards its agricultural use, and can only be produced where electric power is cheaply obtainable.

Neither material is altogether free from objection, the cyanamide heating when mixed with other manures and even with soil, and being liable to give off acetylene gas owing to the presence of calcium carbide, whereas the calcium nitrate is a salt which on exposure to a moist atmosphere readily deliquesces.

II.—PHOSPHATIC MANURES

Under the heading of manures that are used purely for their phosphatic benefit to the soil are superphosphate and basic slag.

Superphosphate.—This is the typical phosphatic manure, and is the base of the numerous artificial manures used on the farm. Superphosphate is made by dissolving raw phosphatic minerals in sulphuric acid (oil of vitriol), the tribasic phosphate of lime which these contain being converted into the so-called "soluble phosphate," sulphate of lime being formed at the same time. The first impetus to the manufacture of superphosphate was given by Liebig, when he suggested, in 1840, the treatment of bones with oil of vitriol in order to make them act more quickly in the soil. Lawes subsequently, in 1843, applied this to mineral phosphates, using phosphorite, first of all, and the great manufacture of mineral superphosphate then began. Coprolites, as found in Cambridgeshire, Suffolk, Bedfordshire and elsewhere were the raw materials at first employed in the United Kingdom. But gradually the demand for the new manure became so great that distant parts of the world were searched to bring in the raw material for conversion into superphosphate. Many new sources of supply have been worked, and many worked out or abandoned in favour of better and richer phosphates. Among these were the crystalline apatites of Canada and Norway, French, Spanish and German (Lahn) phosphates, and, at a later period, Carolina (land and river), Florida, Tennessee, Somme, Belgian, Algerian and Tunisian phosphates. In addition to these came other materials which, in their origin, were really of the nature of guano, being bird deposits the ammoniacal matters of which were gradually washed out. The mineral matters remained and altered the composition of the original rock on which the guano was deposited, thus forming rich deposits of phosphate of lime. Such were the phosphates obtained from many of the islands of the West Indies and South Pacific, and known under such various names as Sombrero, Curaçao, Aruba, Malden Island, Megillones, Baker Island, Fanning Islands, Lacepedes Islands, &c. guanos. Few of these are now worked, but their place has been largely taken by the rich deposits of Ocean Island and Christmas Island, which are of similar origin. The principal supplies of phosphatic minerals at the present time come from Florida, Algeria, Tunis, Ocean Island and Christmas Island. Other phosphates imported are Redonda and Alta Vela phosphates, but these consist mainly of phosphate of alumina, and are not used for superphosphate manufacture but for phosphorus production.

Coprolites, as formerly used, contained from 50 to 60% of phosphate of lime, but they are not worked now, the richer sources, which are also better adapted for superphosphate manufacture, having taken their place. The amount of oxide of iron and alumina in raw phosphates is of great importance, as phosphates containing these bodies are liable to cause superphosphate to "go back" or form what is called "reverted" phosphate, the percentage of "soluble phosphate" being reduced thereby. For this reason many of the older supplies have been replaced by newer and better ones. Florida rock phosphate of high grade contains 75 to 78% of phosphate of lime, and Florida land pebble phosphate about 70%. Algerian and Tunisian phosphates have from 55 to 65% of phosphate of lime, and are very free from iron and alumina, this fitting them especially for superphosphate making. Tennessee phosphate has about 70% of phosphate, Somme and Belgian phosphates 40 to 50%, while Ocean Island and Christmas Island phosphates are of very high grade and yield over 80 and up to 86% of phosphate of lime. Superphosphate is made by finely grinding the raw phosphate and mixing it with oil of vitriol (chamber acid); what actual product is formed is a matter of some uncertainty, but it is a phosphate soluble in water, and believed to be mono-calcic phosphate. This is the true "soluble phosphate," but in commercial transactions it is universal to express the amount in terms of the original tribasic phosphate which has been rendered soluble. Ordinary grades of mineral superphosphate give from 25 to 27% of soluble phosphate and higher grades 30 to 35%. On reaching the soil, the soluble phosphate becomes precipitated by the calcium and iron compounds in the soil. But it is precipitated in a very fine form of division, in which it is readily attacked by the plant roots. Superphosphate is used practically for all crops, including cereals, clover and other leguminous crops. Its use tends to early maturity in a crop. Its value for giving a start to root crops is particularly recognized, and root crops generally are dependent on it, as they have little power of utilizing the phosphoric acid in the soil itself. On land poor in lime superphosphate must be used with caution owing to its acid nature, and in such cases an undissolved phosphate is preferable. The quantity in which it is applied ranges from 2 and 3 cwt. per acre to 5 cwt. It suffers but little loss through drainage, and will exercise an influence on crops beyond the year of application.

Basic Slag.—This other principal phosphatic manure is of more recent origin, and is an undissolved phosphate. It is the waste product of steel-making where the Thomas-Gilchrist or "basic" process of manufacture has been employed. This process is used with ores containing much phosphorus, the removal of which is necessary in steel-manufacture. The "converters" which hold the molten iron are lined with lime and magnesia, and the impurities of the iron form a "slag" with these materials. For a long time the slag was regarded as a waste product, but ultimately it was found that, by grinding it very finely, it had distinct agricultural value, and now its use is universal. Basic slag is of various grades, containing 12 to 20% of phosphoric acid, which is believed to exist in the form of a tetracalcic phosphate. This phosphate is found to be readily attacked by a weak solution of citric acid, and this probably accounts for the comparative ease with which plants can utilize the phosphate. With it is also a good deal of lime, and the presence of this undoubtedly, in many cases, accounts partly for the benefits that follow the use of basic slag. It should be very finely ground; a common standard is that 80 to 90% should pass through a sieve having 10,000 meshes to the square inch.

The principal use of basic slag is on grass-land, especially where the soil is heavy or clayey. Its effect on such land in causing white clover to appear is in many cases most remarkable, and without doubt, much poor, cold grass-land has been immensely benefited by its use. It is also employed for root crops; but its effect on these, as on cereals, is not so marked as on grass-land. On light land its benefit is not nearly so great or universal as on heavier land.

III.—Manures containing Nitrogen and Phosphates

These may be classified as follows: (*a*) Natural manures—bones, fish and meat guanos, Peruvian guano, bats' guano; (*b*) Manufactured manures—dissolved bones, compound manures.

a. Natural Manures

Bones.—The value and use of these in agriculture has long been known, as also the comparative slowness of their action, which latter induced Liebig to suggest their treatment with sulphuric acid. Natural bones will contain from 45 to 50% of phosphate of lime with 4 to 4½% of nitrogen. It is usual to boil bones lightly after collection, in order to remove the adhering particles of flesh and the fat. If steamed under pressure the nitrogenous matter is to a great extent extracted, yielding glue, size, gelatine, &c., and the bones—known then in agriculture as "steamed bones"—will contain from 55 to 60% of phosphate of lime with 1 to 1½% of nitrogen. Bones are also imported from India, and these are of a very hard and dry nature. Bones are principally used for root crops, and to some extent on grass-land. The more finely they are ground the quicker is their action, but they are a slow-acting manure, which remains some years in the land. Mixed with superphosphate, bone meal forms an excellent manure for roots, and obviates the difficulty of using superphosphate on land poor in lime. Steamed bones, sometimes ground into flour, are much used in dairy pastures.

Fish and Meat Guanos.—The term "guano," though generally applied to these manures, is wrongly so used, for they are in no sense guano (meaning thereby the droppings of sea birds). They are really fish or meat refuse, being generally the dried fish-offal or the residue from meat-extract manufacture. They vary much in composition, according to their origin, some being highly nitrogenous (11 to 12% nitrogen) and comparatively low in phosphate of lime, and others being more highly phosphatic (30 to 40% phosphate of lime) with lower nitrogen. These materials are to some extent used for root and vegetable crops, and chiefly for hop-growing, but they go largely also to the artificial manure maker.

Peruvian Guano.—This material, though once a name to conjure with, has now not much more than an academic interest, owing to the rapid exhaustion of the supplies. It is true guano, *i.e.* the deposit of sea birds, and was originally found on islands off the coast of Peru. Peruvian guano was first discovered in 1804 by A. von Humboldt, and the wonderful results attending its use gave an enormous impulse to its exportation. The Chincha Islands yielded the finest qualities of guano, this giving up to 14 and 15% of nitrogen. Gradually the Chincha Islands deposits became worked out, and other sources, such as the Pabellon de Pica, Lobos, Guanape and Huanillos deposits were worked in turn. In many instances the guano had suffered from washing by rain or by decomposition, or in other cases the bare rock was reached and the shipments contained some considerable quantity of this rocky matter, so that the highly nitrogenous guanos were no longer forthcoming and deposits more phosphatic in character took their place. Gradually the shipments fell off, and with them the great reputation of the guano as a manure. On some of the islands the birds, after having been driven off, have returned and fresh deposits are being formed. On the west coast of Africa also some new deposits have been found, and a certain amount of guano comes from Ichaboe Island; but the trade will never be what it once was. Occasional shipments come from the Ballista Islands, giving from 10 to 11% of nitrogen with 11 to 12% of phosphoric acid, and lower-grade guanos (7% of nitrogen and 16% of phosphoric acid) are arriving from Guanape, while from Lobos de Tierra comes a still lower grade.

The particular feature that marked guano was that it contained both its nitrogenous and phosphatic ingredients in forms in which they could be very readily assimilated by plants. Moreover, the occurrence of the nitrogenous and phosphatic matters in different forms of combination gave to them a special value, and one that could not be exactly imitated in artificial manures. The nitrogenous matters, *e.g.*, exist as urates, carbonates, oxalates and phosphates of ammonia, and a particular nitrogenous body termed "guanine" is also found. Guano contains much alkaline salts, and is, from its containing alike phosphates, nitrogen and potash in suitable forms and quantity, an exceedingly well balanced manure. In agriculture it is used for corn crops, and also for root crops, potatoes and hops. It is esteemed for barley, as tending to produce good quality. For vegetable and market-garden crops that require forcing guano is also still in demand. The more phosphatic kinds are sometimes treated with sulphuric acid, and constitute "Dissolved Peruvian Guano."

Bats' Guano.—In caves in New Zealand, parts of America, South Africa and elsewhere, are found deposits formed by bats, and these are used to some extent as a manure, though they have no great commercial value.

b. Manufactured Manures

Dissolved Bones.—These are bones treated with oil of vitriol, as in superphosphate manufacture. By this treatment bones become much more readily available, and are used to a considerable extent, more especially for root crops. Their composition varies with the method of manufacture and the extent to which they are dissolved. Speaking generally, they will have from 11 to 19% of soluble phosphate, with 20 to 24% of insoluble phosphates, and if pure should contain 3% of nitrogen. When mixed with superphosphate in varying amount, or if made with steamed and not raw bone, they are generally known under the indefinite name of "bone manure."

Compound Manures.—To this class belong the manures of every description which it is the aim of the artificial manure manufacturer to compound for particular purposes or to suit particular soils or crops. The base of all these is, as a rule, mineral superphosphate or else dissolved bones, or the two together, and with these are mixed numerous different manurial substances calculated to supply definite amounts of nitrogen, potash, &c. Such manures, the trade in which is a very large one, are variously known as "corn manure," "turnip manure," "grass manure" and the like, and much care is bestowed on their compounding and on their preparation in good condition to allow of their ready distribution over the land.

IV.—Potash Manures

These, with few exceptions, are natural products from the potash mines of Stassfurt (Prussia). Until the discovery of these deposits, in 1861, the use of potash as a fertilizing constituent was very limited, being confined practically to the employment of wood ashes. At the present time a small quantity of potash salts—principally carbonate of potash—is obtained from sugar refinery and other manufacturing processes, but the great bulk of the potash supply comes from the German mines. In these the different natural salts occur in different layers and in conjunction with layers of rock-salt, carbonate of lime and other minerals, from which they have to be separated out and undergo subsequently a partial purification by re-crystallization.

The principal potash salts used in agriculture are—(1) sulphate of potash, which is about 90% pure; (2) kainit, an impure form of sulphate of potash, and containing much common salt and magnesia salts, and giving about 12% of potash (K_2O); (3) muriate of potash, which is used to a great extent in agriculture, and contains 75 to 90% of muriate of potash; and (4) potash manure salts, a mixture of different salts and containing from 20 to 30% of potash.

Potash is much esteemed in agriculture, more especially on light land (which is frequently deficient in it) and on peaty soils, and for use with root crops and potatoes in particular. For fruit and vegetable growing and for flowers potash manures are in constant request. Clay land, as a rule, is not benefited by their use, these oils containing generally an abundance of potash. Along with basic slag, potash salts have been frequently used for grass on light land with advantage.

V.—Miscellaneous Manures

There are, in addition to the foregoing, certain materials which in a limited sense only can be called "manures," but the influences of which are mostly seen in the mechanical and physical improvements which they effect in soil. Such are salt, and also lime in its different forms.

Salt.—The action of salt in liberating potash from the soil has been explained. As a manure it is sometimes used along with nitrate of soda as a top-dressing for corn crops, in the belief that it stiffens the straw. For root crops also, and mangels in particular, it is employed; also for cabbage and other vegetables.

Lime.—The use of this is almost solely to be considered as a soil improvement, and not as that of a manure. Sulphate of lime (gypsum) is, however, occasionally used as a dressing for clover, and also for hops. The fact that superphosphate itself contains a considerable amount of sulphate of lime renders the special application of gypsum unnecessary, as a rule.

As compared with "natural" manures, like farm-yard manure, artificial manures have the disadvantage that they, unlike it, do not improve the physical condition of the soil. Artificial manures have, however, the advantage over farm-yard manure that they can supply in a small compass, and even if used in small quantity, the needed nitrogen, phosphoric acid and potash, &c., which crops require, and which farm-yard manure has but in small proportion. They, further, present the expensive fertilizing matters in a concentrated form, and by their application save expense in labour.

(J. A. V.*)

MANUSCRIPT, a term applied to any document written by the human hand (Lat. *manû scriptum*) with the aid of pen, pencil or other instrument which can be used with cursive facility, as distinguished from an inscription engraved with chisel or graver, worked laboriously. By usage the word has come to be employed in a special sense to indicate a written work of the ancient world or of the middle ages; collections of such "ancient manuscripts" being highly prized and being stored for preservation in public libraries. Down to the time of the invention of printing, and until the printed book had driven it out of the field, the manuscript was the vehicle for the conservation and dissemination of literature, and discharged all the functions of the modern book. In the present article a description is given of the development of the ancient manuscript, particularly among the Greeks and Romans, leading on to the medieval manuscripts of Europe, and bringing down the history of the latter to the invention of printing; the history of the printed volume is dealt with in the article Book (*q.v.*).

Materials.—The handbooks on palaeography describe in full the different materials which have been employed from remote time to receive writing, and may be referred to for minuter details. To dispose, in the first place, of the harder materials that have been put under requisition, we find metals both referred to by writers and actually represented by surviving examples. Thin leaves of gold or silver were recommended for the inscription of charms in particular. Leaden plates were in common use for incantations; the material was cheap and was supposed to be durable. On such plates were scratched the *dirae* or solemn devotions of obnoxious persons to the infernal deities; many examples have survived. As an instance of the use of soft substance afterwards hardened may be cited the practice by the Babylonians and Assyrians of writing, or rather of puncturing, their cuneiform characters on clay tablets while moist, which were afterwards dried in the heat of the sun or baked in the oven. Potsherds, or *ostraka*, were employed for all kinds of temporary purposes. Thousands of them have been found in Egypt inscribed with tax receipts and ephemeral drafts and memoranda, children's dictation lessons, &c. Analogous to the clay documents of western Asia are the tablets coated with wax in vogue among the Greeks and Romans, offering a surface not to be inscribed with the pen but to be scratched with the sharp pointed *stilus*. These will be described more fully below. With them we class the wooden boards, generally whitened with a coating of paint or composition and adapted for the pen, which were common in Egypt, and were specially used for educational purposes. Such boards were also employed for official notices in Athens in the 4th century B.C.

Of the more pliant, and therefore generally more convenient, substances there were many, such as animal skins and vegetable growths. Practically we might confine our attention to three of them: papyrus, parchment or vellum, and paper, the employment of which, each in turn, as a writing material became almost universal. But there are also others which must be mentioned.

In a primitive state of society leaves of plants and trees strong enough for the purpose might be taken as a ready-made material to receive writing. Palm leaves are used for this purpose to the present day in parts of India; and the references in classical authors to leaves as early writing material among the Greeks and Romans cannot be dismissed as entirely fanciful.

The bark of trees, and particularly the inner bark of the lime-tree, φιλύρα, *tilia*, was employed. The fact that the Latin word *liber*, bark, eventually meant also a book, would be sufficient proof that that material was once in common literary use, even if it were not referred to by writers.

Linen, too, was a writing material among the early Romans, as it was also among the Etruscans, and as it had been to some extent among the Egyptians.

Skins of animals, tanned, have doubtless served as a writing material from the very earliest period of the use of letters. The Egyptians occasionally employed this material. Instances of the use of leather in western Asia are recorded by ancient authors, and from Herodotus we learn that the Ionian Greeks applied to the rolls of the later-imported papyrus the title διφθέραι, skins, by which they had designated their writing material of leather. The Jews, also, to the present day hold to the ancient Eastern custom and inscribe the law upon skin rolls.

But generally these materials were superseded in the old world by the famous Egyptian writing material manufactured from the papyrus plant, which gradually passed beyond the boundaries of its native land and was imported at a remote period into other countries. Into Greece and into Rome it was introduced at so early a time that practically it was the vehicle for classical literature throughout its course. A description of the manufacture and use of this material will be found under Papyrus. Here it need only be noted that papyrus is associated in Greek and Roman literature with the roll form of the ancient manuscript, as will be more fully explained below, and that it was the supersession of this material by parchment or vellum which led to the change of shape to the book form.

The introduction of the new material, parchment or vellum, was not a revival of the use of animal skins as followed by the old world. The skins were now not tanned into leather, but were prepared by a new process to provide a material, thin, strong, flexible, and smooth of surface on both faces. This improved process was the secret of the success of the new material in ousting the time-honoured papyrus from its high position. The common story, as told by Pliny, that Eumenes II. of Pergamum (197–158 B.C.), seeking to extend the library of his capital, was opposed by the jealousy of the Ptolemies, who forbade the export of papyrus, hoping thus to check the growth of a rival library, and that he was thus compelled to have recourse to skins as a writing material, at all events points to Pergamum as the chief centre of trade in the material, περγαμηνή, *charta pergamena*. The old terms διφθέραι, *membranae*, applied originally to the older leather, were transferred to the newly improved substance. In describing MSS. written on this material, by common consent the term parchment has in modern times given place to that of vellum, properly applicable only to calfskin, but now generally used in reference to a medieval skin-book of any kind. Parchment is a title now usually reserved for the hard sheepskin or other skin material on which law deeds are engrossed. (See Parchment.)

Vellum had a long career as a writing material for the literature of the early centuries of our era and of the middle ages. But in its turn it eventually gave place to paper (*q.v.*). As early as the 13th century paper, an Asiatic invention, was making its way into Europe and was adopted in the Eastern Empire as a material for Greek literature side by side with vellum. It soon afterwards began to appear in the countries of southern Europe. In the course of the 14th century the use of it became fairly established, and in the middle of the century a number of paper manuscripts were produced along with those on vellum, particularly in Italy. Finally, in the 15th century paper became the common material for the manuscript book. The new paper, however, made no further change in the form of the manuscript. It possessed exactly the same qualities, as a writing material, as vellum: it could be inscribed on both sides; it could be made up into quires and bound in the codex form; and it had the further advantage of being easily manufactured in large quantities, and therefore of being comparatively cheap.

The Forms of the Manuscript Book.—In describing the development of the manuscript book in the ancient world, and subsequently in the middle ages, we have to deal with it in two forms. The common form of the book of the ancient world was the *roll*, composed of one continuous sheet of material and inscribed only on one side. This form had a long career. In Egyptian literature it can be traced back for thousands of years. In Greek literature it may be assumed to have been in vogue from the earliest times; actual examples have survived of the latter part of the 4th and beginning of the 3rd centuries B.C. As to its early use in Latin literature we cannot speak so definitely; but Rome followed the example of Greece in letters, and therefore no doubt also in the material shape of literary productions. Both in Greek and Latin literature the roll lasted down to the early centuries of the Christian era. It was superseded by the *codex*, the manuscript in book form (in the modern sense of the word book), composed of separate leaves stitched together into quires and made available to receive writing on both sides of the material. This form is still in vogue as the modern printed book, and probably will never be superseded. But the codex in this developed shape was only an evolution from the early waxen tablets of the Greeks and Romans, two or more of which, hinged together, formed the primitive codex which suggested the later form. Therefore it will be necessary to include the description of the tablets with that of the later codex.

The Roll.

The ordinary terms in use among the Greeks for a book (that is, a roll) were *βίβλος* (another form of *βύβλος*, papyrus) and its diminutive *βιβλίον*, which included the idea of a written book. The corresponding Latin terms were *liber* and *libellus*; *volumen* was a rolled-up roll. A roll of material uninscribed was *χάρτης*, *charta*, or *τόμος* (originally a *cutting* of papyrus), applicable also to a roll containing a portion or division of a large work which extended to more than one roll. A work contained within the compass of a single roll was a *μονόβιβλος*, or *μονόβιβλον*. The term *τεῦχος* seems also to have meant a single roll, but it was also applied at a later time to indicate a work contained in several rolls.

In writing the text of a work, the scribe might choose to make use of separate sheets of papyrus, *κολλήματα*, *schedae*, and then join them to one another consecutively so as to make up the roll; or he might purchase from the stationers a *scapus*, or ready-made roll of twenty sheets at most; and if this length were not sufficient, he might add other sheets or *scapi*, and thus make a roll of indefinite length. But proverbially a great book was a great evil, and, considering the inconvenience of unrolling a long roll, not only for perusal, but, still more so, for occasional reference, the practice of subdividing lengthy works into divisions of convenient size, adapted to the capacity of moderate-sized rolls, must have come into vogue at a very early period.

It was the practice to write on one side only of the papyrus; to write on both front and back of a roll would obviously be a clumsy and irritating method. Works intended for the market were never *opisthograph*. Of course the blank backs of written rolls which had become obsolete might be turned to account for personal or temporary purposes, as we learn not only from references in classical authors but also from actual examples. The most interesting extant case of an opisthograph papyrus is the copy of Aristotle's *Constitution of Athens* in the British Museum, which is written on the back of a farmer's accounts, of the end of the 1st century—but only for private use. It being the rule, then, to confine the writing to one side of the material, that is, to the inner surface of the made-up roll, that surface was more carefully prepared and smoothed than the other; and, further, the joints of the several sheets were so well made that they offered no obstacle to the action of the pen. Still further, care was taken that this, the *recto* surface of the material, should be that in which the shreds of papyrus of which it was composed lay horizontally, so that the pen might move freely along the fibres; the shreds of the *verso* side, on the other hand, being in vertical position. This point is of some importance, as, in cases where two different handwritings are found on the two sides of a papyrus, it may be usually assumed that the one on the *recto* surface is the earlier.

The text was written in columns, *σελίδες*, *paginae*, the width of which seems not to have been prescribed, but which for calligraphic effect were by preference made narrow, sufficient margins being left at head and foot. The average width of the columns in the best extant papyri ranges from two to three-and-a-half inches. The written lines were parallel with the length of the roll, so that the columns stood, so to say, with the height of the rolled-up roll, and were disclosed consecutively as the roll was unwound. Ruling with lead to guide the writing is mentioned by writers, but it does not appear that the practice was generally followed. The number of lines in the several columns of extant papyri is not constant, nor is the marginal boundary of the beginnings of the lines, for the accuracy of which a ruled vertical line would have proved useful, ordinarily kept even. No doubt in practice the horizontal fibres of the material were found to afford a sufficient guide for the lines of writing.

If the title of the work was to be given, the scribe appears to have written it ordinarily at the end of the text. But something more was needed. To be obliged to unroll a text to the end, in order to ascertain the name of the author, would be the height of inconvenience. Its title was therefore sometimes written at the head of the text. It appears also that at an early period it was inscribed on the outside of the roll, so as to be visible as the roll lay in a chest or on the shelf. But a more general practice was to attach to the top edge of the roll a label or ticket, *σίλλυβος*, or *σίττυβος*, *titulus*, *index*, which hung down if the roll lay on the shelf, or was conveniently read if the roll stood along with others in the ordinary cylindrical roll-box, *κίστη*, *κιβωτός*, *cista*, *capsa*. One such label made of papyrus has survived and is in the British Museum.

The scribe would not commence his text at the very beginning, nor would he carry it quite down to the end, of the roll. He would leave blank a sufficient length of material at either extremity, where the roll would naturally be most exposed to wear and tear by handling in unrolling and re-rolling; and, further, the extreme vertical edges might each be strengthened by the addition of a strip of papyrus so as to form a double thickness of material.

According to the particulars given by classical authors, the roll would be finished off somewhat elaborately; but the details described by them must be taken to apply to the more expensive productions of the book trade, corresponding with the full-bound volumes of our days. In practice, a large proportion of working copies and ordinary editions must have been dealt with more simply. Firstly, the roll should be rolled up round a central stick, of wood or bone, called the *ὀμφαλός*, *umbilicus*, to which the last sheet of the papyrus may or may not have been attached. But as a matter of fact no rolling-sticks have been found in company with extant papyri, and it has therefore been suggested that they were not attached to the material but were rolled in loose, and were therefore liable to drop out. In some instances, as in the rolls found at Herculaneum, a central core of papyrus instead of a stick was thought sufficient. The edges, *frontes*, of the roll, after it had been rolled up, were shorn and were rubbed smooth with pumice, and they were sometimes coloured. A valuable roll might be protected with a vellum wrapper, *φαινόλης*, *paenula*, stained with colour; and, further, it might be secured with ornamental thongs. The central stick might also be adorned with knobs or "horns," plain or coloured. This seems to be the natural explanation of the *κέρατα*, or *cornua*, mentioned by the ancient writers. Finally, the title-label described above was attached to the completed roll, now ready for the book-market.

In the perusal of a work the reader held the roll upright and unrolled it gradually with the right hand; with the left hand he rolled up in the reverse direction what he had read. Thus, when he had finished, the roll had become reversed, the beginning of the text being now in the centre of the roll and the end of it being outside. The roll was "explicitus ad umbilicum," or "ad sua cornua." It had therefore now to be unrolled afresh and to be re-rolled into its normal shape—a troublesome process which the lazy man shirked, and which the careful man accomplished by making the revolutions with his two hands while he held the revolving material steady under his chin.

Although the codex or manuscript in book-form began to make its way in Greek and Roman literature as early as the 1st century of our era, the roll maintained its position as the recognized type of literary document down to the 3rd, and even into the 4th, century, when it was altogether superseded. We shall proceed to describe the codex after giving some account of the waxen, or, to speak more correctly, the waxed, tablet, its precursor in the book-form.

The Waxen Tablet.

The ordinary waxen tablet in use among the Greeks and Romans was a small oblong slab of wood, beech, fir, and especially box, the surface of which on one or both sides, with the exception of the surrounding margins which were left intact in order to form a frame, was sunk to a slight depth and was therein coated with a thin layer of wax, usually black. The tablet thus presented the appearance of a child's school-slate of the present day. Such tablets were single, double, triple, or of several pieces or leaves. In Greek they were called πίναξ, πινακίς, δέλτος, δελτίον: in Latin *cera*, *tabula*, *tabella*, &c. Two or more put together and held together by rings or thongs acting as hinges formed a *caudex* or *codex*, literally a stock of wood, which a set of tablets might resemble, and from which they might actually be made by cleaving the wood. A codex of two leaves was called δίθυροι, δίπτυχα, *diptycha*; of three, τρίπτυχα, *triptycha*: and so on. The triptych appears to have been most generally used. A general term was also *libellus*.

Tablets served for the ordinary minor affairs of life; for memoranda, literary and other notes and drafts, school exercises, accounts, &c. The writing incised with the stilus could be easily obliterated by smoothing the wax, and the *tabula rasa* was thus rendered available for a fresh inscription. But tablets were also employed for official purposes, when documents had to be protected from unauthorized scrutiny or from injury. Thus they were the receptacles for wills, conveyances, and other legal transactions; and in such cases they were closed against inspection by being bound round with threads which were covered by the witnesses' seals.

Small tablets, *codicilli*, *pugillares*, often of more valuable material, such as ivory, served for correspondence among other purposes; very small specimens are mentioned as *vitelliani*, for the exchange of love-letters.

A certain number of Greek waxen tablets have been recovered, chiefly from Egypt, but none of them is very early. They are generally of the 3rd century, and are mostly inscribed with school exercises. The largest and most perfect extant codex is one in the British Museum (Add. MS. 33,270), perhaps of the 3rd century, being made up of nine leaves, measuring nearly 9 by 7 in., and inscribed with documents in shorthand.

Of Latin tablets we are fortunate in having a fairly large number of examples. Exclusive of a few isolated specimens, they are the result of two important finds. Twenty-four tablets containing the records of a burial club, A.D. 131–167, were recovered between 1786 and 1855 from some ancient mining works in Dacia. In 1875 as many as 127 tablets, containing deeds connected with sales by auction and payment of taxes, A.D. 15–62, were found in the ruins of Pompeii. These specimens have afforded the means of ascertaining the mechanical arrangement of waxen tablets when adopted for legal instruments among the Romans. Most of them are triptychs, severally cloven from single blocks of wood. Subject to some variations, the triptych was usually arranged as follows. Of the six sides or pages of the codex, pages 1 and 6 (the outside pages) were of plain wood; pages 2, 3, 5 were waxed; and page 4, which had a groove cut across the middle was sometimes of plain wood, sometimes waxed. The authentic deed was inscribed with the stilus on the waxed pages 2 and 3; and the first two leaves were then bound round with three twisted threads which passed down the groove so as to close the deed from inspection. On page 4 the witnesses' names were then inscribed (in ink if the page was plain; with the stilus if waxed), and their seals were impressed in the groove, thus securing the threads. In addition to the protection afforded to the seals from casual injury by their position in the groove, the third leaf acted as a cover to them. On page 5 an abstract or duplicate of the deed, as required by law, was inscribed. The arrangement of the Dacian tablets differed in this respect, that page 4 was waxed, and that the duplicate copy was begun on that page in the space on the left of the groove, that on the right being reserved for the names of the witnesses. In the case of one of the Pompeian tablets the threads and seals still remain.

The survival of the use of tablets to a late time should be noted. St Augustine refers to his tablets, and St Hilary of Arles also mentions their employment for the purpose of correspondence; there is a record of a letter written *in tabellâ* as late as A.D. 1148. They were very commonly used throughout the middle ages in all the west of Europe. Specimens inscribed with money accounts of the 13th and 14th centuries have survived in France, and similar documents of the 14th and 15th centuries are to be found in several of the municipal archives of Germany. Reference to their use in England occurs in literature, and specimens of the 14th or 15th century are said to have been dug up in Ireland. In Italy their employment is both recorded and proved by actual examples of the 13th and 14th centuries. With the beginning of the 16th century they seem to have practically come to an end, although a few survivals of the custom of writing on wax have lingered to modern times.

The Codex.

As already stated, the *codex*, or MS. in book-form, owed its existence to the substitution of vellum for papyrus as the common writing material for Greek and Roman literature. The fact that vellum was a tough material capable of being inscribed on both sides, that writing, particularly if freshly written, could be easily washed off or erased from it, and that the material could thus be made available for second use, no doubt contributed largely to its ready adoption. In Rome in the 1st century B.C. it was used, like the waxen tablets for notes, drafts, memoranda, &c.; and vellum tablets began to take the place of the *cerae*. References are not wanting in the classical writers to its employment for such temporary purposes. To what extent it was at first pressed into the service of literature and used in the preparation of books for the market must remain uncertain. But in the first three centuries of our era it may be assumed that vellum codices were not numerous. The papyrus roll still held its position as the *liber* or book of literature. Yet we learn from the poems of Martial that in his day the works of some of the best classical authors were to be had on vellum. From the way in which, in his *Apophoreta*, he has contrasted as exchangeable gifts certain works written respectively on papyrus and on vellum, it has been argued that vellum at that time was a cheap material, inferior to papyrus, and only used for roughly written copies. Up to a certain point this may be true, but the fact that the earliest great vellum Greek codices of the Bible and of Latin classical authors, dating back to the 4th century, are composed of very finely prepared material would indicate a perfection of manufacture of long standing.

But, apart from the references of writers, we have the results of recent excavations in Egypt to enable us to form a more correct judgment on the early history of the vellum codex. There have been found a certain number of inscribed leaves and fragments of vellum of early date which without doubt originally formed part of codices or MSS. in book-form. It is true that they are not numerous, but from the character of the writing certain of them can be individually assigned to the 3rd, to the 2nd, and even to the 1st century. We may then take it for an established fact that the codex form of MS. was gradually thrusting its way into use in the first centuries of our era.

The convenience of the codex form for easy reference was also a special recommendation in its favour. There can be little doubt that such compilations as public registers must at once have been drawn up in the new form. The jurists also were quick to adopt it, and the very title "codex" has been attached to great legal compilations, such as those of Theodosius and Justinian. Again, the book-form was favoured by the early Christians. The Bible, the book which before all others became the great work of reference in their hands, could only be consulted with convenience and despatch in the new form. A single codex could hold the contents of a work which formerly must have been distributed through many volumes in roll-form. The term *σωμάτιον*, which was one of the names given to a codex, was expressive of its capacity. Turning again to discoveries in Egypt, it appears that in the early centuries the codex-form had become so usual among the Christians in that land that even the native material, papyrus, the recognized material for the roll, was now also made up by them into leaved books. The greater number of papyri of the 3rd century containing Christian writings, fragments of the Scriptures, the "Sayings of Our Lord," and the like, are in book-form. On the other hand, the large majority of the non-Christian papyri of the same period keep to the old roll-form. Thus the codex becomes at once identified with the new religion, while the papyrus roll to the last is the chosen vehicle of pagan literature.

In the 4th century the struggle between the roll and the codex for supremacy in the literary field was finished, and the victory of the codex was achieved. Henceforward the roll-form remained in use for records and legal documents, and in certain instances for liturgies; and for such purposes it survives to the present day. But so completely was it superseded in literature by the codex that even when papyrus, the material once identified with the roll-form, was used as it sometimes was down to the 6th and 7th centuries and later, it was made up into the leaved codex, not only in Egypt but also in western Europe.

Quires.

The shape which the codex usually assumed in the early centuries of the middle ages was the broad quarto. The quires or gatherings of which the book was formed generally consisted, in the earliest examples, of four sheets folded to make eight leaves (*τετράς* or *τετράδιον*, *quaternio*), although occasionally quinterns, or quires of five sheets (ten leaves), were adopted. Sexterns, or quires of six sheets (twelve leaves), came into use at a later period. In making up the quires, care was generally taken to lay the sheets of vellum in such a way that hair-side faced hair-side, and flesh-side faced flesh-side; so that, when the book was opened, the two pages before the reader had the same appearance, either the yellow tinge of the hair-side, or the fresh whiteness of the flesh-side. In Greek MSS. the arrangement of the sheets was afterwards reduced to a system; the first sheet was laid with the flesh-side downwards, so that that side began the quire; yet in so early an example as the Codex Alexandrinus the first page of a quire is the hair-side. In Latin MSS. also the hair-side appears generally to have formed the first page. When paper came into general use for codices in the 15th century, it was not an uncommon practice to give the paper quires additional strength by an admixture of vellum, a sheet of the latter material forming the outer leaves, and sometimes the middle leaves also, of the quire. The quire mark, or "signature," was usually written at the foot of the last page, but in some early instances (*e.g.* the Codex Alexandrinus) it appears at the head of the first page of each quire. The numbering of the separate leaves in a quire, in the fashion followed by early printers, came in in the 14th century. Catch-words to connect the quires appear first in the 11th century and are not uncommon in the 12th century.

Ruling.

No exact system was followed in ruling the guiding lines on the pages of the codex. In the case of papyri it was enough to mark with the pencil the vertical marginal lines to bound the text, if indeed even this was considered needful (see above); the fibres of the papyrus were a sufficient guide for the lines of writing. On vellum it became necessary to rule lines to keep the writing even. These lines were at first drawn with a blunt point, almost invariably on the hair (or outer) side of the skin, and strongly enough to be in relief on the flesh (or inner) side. Marginal lines were drawn to bound the text laterally; but the ruled lines which guided the writing were not infrequently drawn right across the sheet. Each sheet should be ruled separately; but two or more sheets were often laid and ruled together, the lines being drawn with so much force that the lower sheets also received the impressions. In rare instances lines are found ruled on both sides of the leaf, as in some parts of the Codex Alexandrinus. In this same MS. and in other early codices the ruling was not always drawn for every line of writing, but was occasionally spaced so that the writing ran between the ruled lines as well as on them. The lines were evenly spaced by means of guiding pricks made at measured intervals with a compass or rotary instrument down the margins; in some early MSS. these pricks run down the middle of the page. Ruling with the plummet or lead-point is found in the 11th century and came into ordinary use in the 12th century; coloured inks, *e.g.* red and violet, were used for ornamental ruling in the 15th century.

Columns.

Mechanical Arrangement of Writing in MSS.—It has already been stated above that in the papyrus rolls the text was written in columns. They stood with convenient intervals between them and with fair margins at top and bottom. The length of the lines was to some extent governed by the nature of the text. If it was a poetical work, the metrical line was naturally the line of the column, unless, as sometimes was the case, the verse was written continuously as prose. For prose works a narrow column was preferred. It is noticeable that the columns in papyri have a tendency to lean to the right instead of being perpendicular—an indication that it was not the practice to rule marginal lines. In codices the columnar arrangement was also largely followed, and the number of columns in a page was commonly two. There are instances, however, of a larger number. The Codex Sinaiticus of the Bible has four columns to the page; and the Codex Vaticanus, three columns. And the tricolumnar arrangement occurs every now and then in later MSS.

Text without separation of Words.

In both Greek and Latin literary MSS. of early date the writing runs on continuously without separation of words. This practice however, may be regarded as rather artificial, as in papyri written in non-literary hands and in Latin deeds also, contemporary with these early literary MSS., there is a tendency to separation. In a text thus continuously written occasional ambiguities necessarily occurred, and then a dot or apostrophe might be inserted between words to aid the reader. Following the system of separation of words which appears in ancient inscriptions, wherein the several words are marked off by single, double, or treble dots or points, the words of the fragmentary poem on the battle of Actium found at Herculaneum are separated by single points, probably to facilitate reading aloud; monosyllables or short prepositions and conjunctions, however, being left unseparated from the words immediately following them—a system which is found in practice at a later time. But such marks of separation are not to be confounded with similar marks of punctuation whereby sentences are marked off and the sense of the text is made clear. Throughout the career of the uncial codices down to the 6th century, continuity of text was maintained. In the 7th century there is some evidence of separation of words, but without system. In early Latin minuscule codices partial separation in an uncertain and hesitating manner went on to the time of the Carolingian reform. In early Irish and English MSS., however, separation is more consistently practised. In the 9th and 10th centuries long words tend to separation, but short words, prepositions and conjunctions, still cling to the following word. It was not till the 11th century that the smaller words at length stood apart, and systematic separation of words was established. In Greek minuscule codices of the 10th century a certain degree of separation takes place; yet a large proportion of words remain linked together, and they are even incorrectly divided. Indeed a correct system of distinct separation of words in Greek texts was never thoroughly established even as late as the 15th century.

Paragraphs.

But while distinction of words was disregarded in early literary texts, distinction of important pauses in the sense was recognized from the first. The papyrus of the *Persae* of Timotheus of Miletus, the oldest MS. of a Greek classic in existence, of the end of the 4th century B.C., is written in independent paragraphs. This is a natural system, the simplicity of which has caused it to be the system of modern times. But, in addition, the Greek scribe also separated paragraphs by inserting a short horizontal stroke, *παράγραφος*, between them at the commencement of the lines of writing. It should be noted that this stroke indicated the close of a passage, and therefore belonged to the paragraph just concluded, and did not stand for an initial sign for the new paragraph which followed. The dividing stroke was also used to mark off the different speeches of a play. Besides the stroke, a wedge-shaped sign or tick might be used. But to make every paragraph stand distinctly by itself would have entailed a certain loss of space. If the concluding line were short, there would remain a long space unfilled. Therefore, when this occurred, it became customary to leave only a short space blank to mark the termination of the paragraph, and then to proceed with the new paragraph in the same line, the *παράγραφος* at the same time preventing possible ambiguity. The next step was to project the first letter of the first full line of the new paragraph slightly into the margin, as a still further distinction; and lastly to enlarge it. The enlargement of the letter gave it so much prominence that the dividing stroke could then be dispensed with, and in this form the new paragraph was henceforward indicated in Greek MSS., it being immaterial whether the enlarged letter was the initial or a medial letter of a word. As early as the 5th century there is evidence that the *παράγραφος* was losing its meaning with the scribes, for in the Codex Alexandrinus of the Bible it is not infrequently found in anomalous positions, particularly above the initial letters of different books, as if it were a mere ornament.

In Latin MSS. there was no such fixed system of marking off paragraphs as that just described. A new paragraph began with a new line, or a brief space in a line separated the conclusion of a paragraph from the beginning of the next one. It was only by the ultimate introduction of large letters, as the initial letters of the several sentences and paragraphs, and by the establishment of a system of punctuation, in the modern sense of the word, that a complete arrangement of the text was possible into sentences and paragraphs in accordance with its sense.

Punctuation.

From the earliest times an elementary system of punctuation by points is found in papyri. Thus the papyrus of the *Curse of Artemisia*, at Vienna, which is at least as early as the 3rd century B.C., and in one or two other ancient examples, a double point, resembling the modern colon, separates sentences. But more commonly a single point, placed high in the line of writing, is employed. This single punctuation was reduced to a system by the Alexandrian grammarians, its invention being ascribed to Aristophanes of Byzantium, 260 B.C. The point placed high on a level with the top of the letters had the value of a full-stop; in the middle of the line of writing, of a comma; and low down on the line, of a semicolon. But these distinctions were not observed in the MSS. In the early vellum codices both the high and the middle point are found. In medieval MSS. other signs, coming nearer to our modern system, make their appearance. In Latin MSS. by the 7th century the high point has the value of the modern comma, the semicolon appears with its present value, and a point emphasized with additional signs, such as a second point or point and dash, marks a full-stop. In the Carolingian period the comma appears, as well as the inverted semicolon holding a position between our comma and semicolon.

Division of Words at the End of a Line.

Another detail which required the scribe's attention in writing his text was the division of the last word in a line, when for want of room a portion of it had to be carried over into the next line. It was preferable, indeed, to avoid such division, and in the papyri as well as in the codices letters might be reduced in size and huddled together at the end of the line with this view. In the early codices too it was a common practice to link letters together in monogrammatic form, such as the common verbal terminations *ur*, *unt*, and thus save space. But when the division of a word was necessary, it was subject to certain rules. According to the Greek practice the division was ordinarily made after a vowel, as *ἔτυ|χον* (even monosyllables might be so treated, as *οὐ|κ*). But in the case of double consonants the division fell after the first of them, as *ἵπ|πος*: and, when the first of two or more consonants was a liquid or nasal the division followed it, as *ὀφθαλ|μός*, *μαν|θάνω*. When a word was compounded with a preposition, the division usually followed the preposition, as *προς|εῖπον*, but not infrequently the normal practice of dividing after a vowel prevailed, as *προ|σεῖπον*. In Latin the true syllabic division was followed, but occasionally the scribes adopted the Greek system and divided after a vowel.

Colometry.

A modification of the practice of writing the text continuously was allowed in the case of certain works. Rhetorical texts, such as the orations of Demosthenes and Cicero, and the text of the Bible, might be broken up into short clauses or sense-lines, apparently with the view of assisting reading aloud. Instances of MSS. so written are still extant. This system, to which the name of "colometry" has been given, is the arrangement by *cola* and *commata* referred to by St Jerome in his preface to Isaiah. It will be found more fully explained under the heading of STICHOMETRY; where also is described the mechanical computation of the length of a text by measured lines, for the purpose or calculating the pay of the scribe.

Titles and Colophons.

Quotations.

The title of a MS., both in roll-form and in codex-form, was frequently written at the end of the text, but even at an early date it stood in some instances at the beginning; and the latter practice in course of time prevailed, although even in the 15th century the title was sometimes reserved for the close of the MS. In this latter position it might stand alone or be accompanied by other particulars concerning the MS., such as the length of the work, the date of writing, the name of the scribe, &c., all combined in a final paragraph called the colophon. For distinction, title and colophon might be written in red, as might also the first few lines of the text. This method of rubrication was a very early practice, appearing even in ancient Egyptian papyri. Such rubrics and titles and colophons were at first written in the same character as the text; afterwards, when the admixture of different kinds of writing was allowed, capitals and uncials were used at discretion. Running titles or head-lines are found in some of the earliest Latin MSS. in the same characters as the text, but of a small size. Quotations were usually indicated by ticks or arrow-heads in the margin, serving the purpose of the modern inverted commas. Sometimes the quoted words were arranged as a sub-paragraph or indented passage. In commentaries of later date, the quotations from the work commented upon were often written in a different style from the text of the commentary itself.

Accentuation, &c.—Accentuation was not systematically applied to Greek MSS. before the 7th century, but even in the literary papyri it appears occasionally. In the latter instances accents were applied specially to assist the reader, and they seem to have been used more frequently in texts which may have presented greater difficulties than usual. For example, they are found fairly plentifully in the papyrus of Bacchylides of the 1st century B.C. In the less well-written papyri they are fewer in number; and papyri written in non-literary hands are practically devoid of them. Accents have been frequently added to the ancient texts of Homer, as in the Harris and Bankes papyri, but apparently long after the date of the writing. They were not used in the early uncial MSS. Breathings also appear occasionally in the papyri. The rough and the smooth breathings are found in the form of the two halves of the H (H) in the Bacchylides papyrus; in other papyri they are in rectangular form, never rounded like an apostrophe; in fact rounded breathings do not come into general use until the 12th century. Other signs resembling accents are used occasionally in Greek MSS. For example, a short accent or horizontal stroke was employed to indicate a single-letter word, and an apostrophe was sometimes used to separate words in order to prevent ambiguity and was placed after words ending in *κ*, *χ*, *ξ*, *ρ*, and after proper names not having a Greek termination.

Accents were seldom employed by Latin scribes. In early Irish and English MSS., in particular, an acute accent is occasionally found over a monosyllabic word or one consisting of a single letter. In the 9th and 10th centuries a curious occasional practice obtained among the correctors of the texts of expressing the aspirate by the Greek half-eta symbol ⊢, instead of writing the letter *h* in the ordinary way—perhaps only an affectation.

Corrections.—For obliteration or removing pen strokes from the surface of the material the sponge was used in ancient times. While the writing was still fresh, the scribe could easily wash off the ink by this means; and for a fragile material, such as papyrus, he could well use no other. On vellum he might use sponge or knife. But after a MS. had left his hands it would undergo revision at the hands of a corrector, who had to deal with the text in a different manner. He could no longer conveniently apply the sponge. On hard material he might still use the knife to erase letters or words or sentences. But he could also use his pen for such purposes. Thus we find that a very early system of indicating erasure was the placing of dots or minute strokes above the letters to be thus "expunged." The same marks were also (and generally at later periods) placed under the letters; in rare instances they stood inside them. It need scarcely be said that letters were also struck out with strokes of the pen or altered into others, and that letters and words were interlined. A long sentence, however, which could not be admitted between the lines, was entered in the margin, and its place in the text indicated by corresponding reference marks, such as *hd.*, *hs.* = *hic deest, hoc supra* or *hic scribas*, &c.

Abbreviations and Contractions.—The practice of shortening words in writing has played an important part in the history of the ancient and the medieval manuscript. Two reasons have disposed men to follow this practice: firstly, the desire to avoid the labour of writing over and over again words or portions of words of common occurrence which can be readily understood in a shortened form as when written in full; and, secondly, the necessity of saving space at a time when it was an object to make the most of the writing material to hand. To meet the former requirement, a simple and limited method alone was needed; to satisfy the second, a more elaborate system was necessary. The most natural method of reducing the length of a word is to suppress as much as possible of its termination, consistently with intelligibility, that is, by simple *abbreviation.* But if space of any appreciable value is to be saved in a page of writing, a system is necessary for eliminating letters from the body of the word as well as curtailing the termination, that is, a system of *contraction* as well as abbreviation; and, in addition, the employment of arbitrary signs, analogous to shorthand, will serve still further to condense the text. An elaborate system of contraction of this nature was naturally only fully developed after very long practice. Both in Greek and in Latin MSS. from the 9th to the 15th century such a system was in full force.

Different kinds of literature were, according to their nature, more or less abbreviated and contracted. From early times such curtailment was more freely employed in works written in technical language, such as works on law or grammar or mathematics, wherein particular words are more liable to repetition, than in MSS. of general literature. The oldest system of abbreviation is that in which a single letter (nearly always the initial letter) or at most two or three letters represent the whole word. This system we know was in common use among both Greek and Latin writers, and ancient inscriptions afford plentiful examples. It is well adapted for the brief expression of the common words and phrases in works of a technical nature (as for example such a phrase as C D E R N E = *cujus de ea re notio est*); but for general literature it is of little use, and practically has been restricted to express proper names and numerals.

Abbreviation in Greek MSS.

When abbreviations were employed only with the view of speed in writing, it is obvious that they would occur more frequently in the ephemeral documents of daily life than in carefully written literary works intended for the book-market. Hence they are not to be found in Greek papyri of the latter class. On the other hand in literary papyri written in non-literary script they naturally occur just as they would in contemporary common documents. As early as the 3rd and 2nd centuries B.C. the ordinary method of abbreviation was to omit the termination or latter portion of the word and to mark the omission by a short horizontal stroke or dash; or the letter which immediately preceded the omission was written above the line as a key to the reading, as $\tau\epsilon^{\lambda}$ for *τέλος*. Such a system obviously might be extended indefinitely at the discretion of the writer. But in addition, at quite an early period, symbols and monogrammatic forms for particular words must have been developed, for they are found in common use in cursive papyri. A notable instance of their employment in a full degree occurs in the papyrus of Aristotle's *Constitution of Athens*, of the 1st century.

Like the well-written literary papyri, the early vellum uncial codices of the Bible, being inscribed with calligraphic formality, avoided in principle the use of abbreviations. But by the 4th to the 6th century, the period when they were chiefly produced, the contraction or abbreviation of certain words and terminations had, it seems, become so fixed by usage that the contracted forms were adopted in the texts. They are $\overline{\Theta\mathrm{C}}$ = *θεός*, $\overline{\mathrm{IC}}$ = *ἰησοῦς*, $\overline{\mathrm{XC}}$ = *χριστός*, $\overline{\Pi\mathrm{NA}}$ = *πνεῦμα*, $\overline{\mathrm{CHP}}$ = *σωτήρ*, $\overline{\mathrm{KC}}$ = *κύριος*, $\overline{\mathrm{CTPOC}}$ = *σταυρός*, $\overline{\Pi\mathrm{HP}}$ = *πατήρ*, $\overline{\mathrm{MHP}}$ = *μήτηρ*, $\overline{\mathrm{YC}}$ = *υἱός*, $\overline{\mathrm{ANOC}}$ = *ἄνθρωπος*, $\overline{\mathrm{OYNOC}}$ = *οὐρανός*, K = *καί*, T = *ται*, M̊ = *μου, μοι*, &c. Final N, especially at the end of a line, was dropped, and its place occupied by the horizontal stroke, as TO̅.

But while this limited system was used in biblical, and also in liturgical MSS., in profane literature a greater licence was recognized. For example, in a fragment of a mathematical work at Milan, of the 7th century, we find instances of abbreviation by dropping terminations, just as in the earlier papyri, and, in addition, contracted particles and prepositions are numerous. Technical works, in fact, inherited the system instituted in the early papyri written in non-literary or cursive hands; and this system, undergoing continual development, had a larger scope when the cursive writing was cast into a literary form and became the literary minuscule script of the middle ages. From the 9th century onwards a fully developed system of abbreviation and contraction was practised in Greek MSS., comprising the early system of the papyri, the special contractions of the early biblical MSS., and also a large number of special symbols, derived in great measure from tachygraphical signs.

In the early Greek minuscule MSS. contractions are not very frequent in the texts; but in the marginal glosses, where it was an object to save space, they are found in great numbers as early as the 10th century. The MS. of Nonnus, of A.D. 972, in the British Museum (Wattenb. and Von Vels., *Exempla*, 7) is an instance of a text contracted to a degree that almost amounts to tachygraphy. In the 12th, 13th and 14th centuries texts were fully contracted; and as the writing became more cursive contraction-marks were more carelessly applied, until, in the 15th century, they degenerated into mere flourishes.

Abbreviations in Latin MSS.

As far back as material is available for comparison, it appears that abbreviations and contractions in Latin MSS. followed the same lines as those in Greek MSS. We have no very early papyri written in Latin as we have in Greek to show us what the practice of Roman writers was in the 3rd and 2nd and early 1st centuries B.C.; but there can be little doubt that in that remote time there was followed in Latin writing a system of abbreviation similar to that in Greek, that is, by curtailment of terminations, and that in ephemeral documents written in cursive characters such abbreviation was allowed more freely than in carefully written literary works. The early system of representing words by their initial letters has already been referred to. It was in common use, as we know, in the inscriptions on coins and monuments, and to some extent in the texts of Roman writers. But the ambiguity which must have always accompanied such a system of single-letter abbreviations, or *sigla*, naturally induced an improvement by expressing a word by two or more of its letters. Hence was developed the more regular syllabic system of the Romans, by which the leading letters of the several syllables were written, as EG = *ergo*, $\mathrm{H\overline{R}}$ = *heres*, $\overline{\mathrm{ST}}$ = *satis*. At a later time Christian writers secured greater exactness by expressing the final letter of a contracted word, as $d\bar{s}$ = *deus*, $d\bar{o}$ = *deo*, *scs* = *sanctus*. Further, certain marks and signs, many derived from shorthand symbols, came into use to indicate inflections and terminations; or the terminating letter or a leading letter to indicate the termination might be written above the line, as Q° = *quo*, V^{m} = *verum*, N° = *noster*, S^{i} = *sint*. This practice became capable of greater development later on. Among the special signs are c̄ = *est*, ƚ = *vel*, n̄ = *non*, p' = *pre*, ꝑ = *per*, ꝓ = *pro*, ꝰ = termination *us*. The letter *q* with distinctive strokes applied in different positions represented the often recurring relative and other short words, as *quod*, *quia*.

In Latin Biblical uncial MSS. the same restrictions on abbreviations were exercised as in the Greek. The sacred names and titles $\overline{\mathrm{DS}}$ = *deus*, $\overline{\mathrm{DMS}}$, $\mathrm{D\overline{N}S}$ = *dominus*, $\mathrm{S\overline{C}S}$ = *sanctus*, $\overline{\mathrm{SPS}}$ = *spiritus*, and others appear in the oldest codices. The contracted terminations Q· = *que*, B· = *bus*, and the omission of final *m*, or (more rarely) final *n*, are common to all Latin MSS. of the earliest period. There is a peculiarity about the contracted form of our Saviour's name that it is always written by the Latin scribes in letters imitating the Greek $\overline{\mathrm{IHC}}$, $\overline{\mathrm{XPC}}$, $\overline{ihc}$, $\overline{xpo}$, and $\overline{ihs}$, $\overline{xps}$.

The full development of the medieval system of abbreviation and contraction was effected at the time when the Carolingian schools were compelling the reform of the handwriting of western Europe. Then came a freer practice of abbreviation by suppression of terminations and the latter portions of words, the omission of which was indicated by the ordinary signs, the horizontal or oblique stroke or the apostrophe; then came also a freer practice of contraction by omitting letters and syllables from the middle as well as the end of words, as $\overline{\mathrm{oio}}$, *omnino*, $\mathrm{pr\bar{b}}$, *presbyter*; and then from the practice of writing above the line a leading letter of an omitted syllable, as $\mathrm{int}^{\mathrm{a}}$ = *intra*, t^{r} = *tur*, conventional signs, with special significations, were also gradually developed. Such growths are well illustrated in the change undergone by the semicolon, which was attached to the end of a word to indicate the omission of the termination, as b; = *bus*, q; = *que*, deb; = *debet*, and which in course of time became converted into a *z*, a form which survives in our ordinary abbreviation, viz. (*i.e.* vi; = *videlicet*). The different forms of contraction were common to all the nations of western Europe. The Spanish scribes, however, attached different values to certain of them. For example, in Visigothic MSS., $\overline{qm}$, which elsewhere represented *quoniam*, may be read as *quum*; and ꝓ, which elsewhere = *pro*, is here = *per*. Nor must the use of arbitrary symbols for special words be forgotten. These are generally adaptations of the shorthand signs known as Tironian notes. Such are K = *autem*, ÷ = *est*, Ə = *ejus*, Ħ = *enim*, ⁊ = *et*, v̇ and u̇ = *ut*, which were employed particularly in early MSS. of English and Irish origin.

By the 11th century the system of Latin contractions had been reduced to exact rules; and from this time onwards it was universally practised. It reached its culminating point in the 13th century, the period of increasing demand for MSS., when it became more than ever necessary to economize space. After this date the exact formation of the signs of contractions was less strictly observed, and the system deteriorated together with the decline of handwriting. In conclusion, it may be noticed that in MSS. written in the vernacular tongues contractions are more rarely used than in Latin texts. A system suited to the inflexions and terminations of this language could not be readily adapted to other languages so different in grammatical structure.

Palimpsests, &c.—Palimpsest MSS., that is, MSS. written upon material from which older writing has been previously removed by washing or scraping, are described in a separate article (Palimpsest). The ornamentation of MSS. is fully dealt with under the headings Illuminated MSS., and Miniatures.

Writing Implements.—In conclusion, a few words may be added respecting the writing implements employed in the production of MSS. The reed, *κάλαμος*, *calamus*, was adapted for tracing characters either on papyrus or vellum. By the ancient Egyptians, and also probably by the early Greek scribes in Egypt, it was used with a soft brush-like point, rather as a paint-brush than as a pen. The Greek and Roman scribes used the reed cut to a point and slit like the quill-pen; and it survived as a writing implement into the middle ages. For scratching letters on the waxen tablet the sharp pointed bodkin, *στῦλος*, *γραφεῖον*, *stilus*, *graphium*, was necessary, made of iron, bronze, ivory, or other suitable material, with a knobbed or flattened butt-end wherewith corrections could be made by smoothening the wax surface (hence *vertere stilum*, to correct). Although there is no very early record of the use of quills as pens, it is obvious that, well adapted as they are for the purpose and to be had everywhere, they must have been in request even in ancient times as they afterwards were in the middle ages. Bronze pens, fashioned exactly on the model of the quill-pen, that is in form of a tube ending in a slit nib (sometimes even with a nib at each end), of late Roman manufacture, are still in existence. A score of them are to be found scattered among public and private museums. The ruler for guiding ruled lines was the *κανών*, *canon*, *regula*; the pencil was the *μόλυβδος*, *plumbum*, the plummet; the pricker for marking the spacing out of the ruled lines was the *διαβάτης*, *circinus*, *punctorium*; the pen-knife, *γλύφανον*, *σμίλη*, *scalprum*; the erasing-knife, *rasorium*, *novacula*.

Inks.—Inks of various colours were employed from early times. The ink of the early papyri is a deep glossy black; in the Byzantine period it deteriorates. In the middle ages black ink is generally of excellent quality; it tends to deteriorate from the 14th century. But its quality varies in different countries at different periods. Red ink, besides being used for titles and colophons, also served for contrast, as, for example, in glosses. In the Carolingian period entire MSS. were occasionally written in red ink. Other coloured inks—green, violet and yellow—are also found, at an early date. Gold and silver writing fluids were used in the texts of the ancient purple vellum MSS., and writing in gold was reintroduced under Charlemagne for codices of ordinary white vellum. It was introduced into English MSS. in the 10th century.

Authorities.—H. Geraud, *Essai sur les livres dans l'antiquité* (1840); E. Egger, *Histoire du livre depuis ses origines jusqu'à nos jours* (1880); T. Birt, *Das antike Buchwesen* (1882) and *Die Buchrolle in der Kunst* (1907); W. Wattenbach, *Das Schriftwesen im Mittelalter* (1896); K. Dziatzko, *Untersuchungen über ausgewählte Kapitel des antiken Buchwesens* (1900); J. W. Clark, *The Care of Books* (1901); W. Schubart, *Das Buch bei den Griechen und Römern* (1907); and generally the authorities quoted in the article Palaeography. See also Textual Criticism. (E. M. T.)

MANUTIUS, the Latin name of an Italian family (Mannucci, Manuzio), famous in the history of printing as organizers of the Aldine press.

1. Aldus Manutius (1450–1515). Teobaldo Mannucci, better known as Aldo Manuzio, the founder of the Aldine press, was born in 1450 at Sermoneta in the Papal States. He received a scholar's training, studying Latin at Rome under Gasparino da Verona, and Greek at Ferrara under Guarino da Verona. In 1482 he went to reside at Mirandola with his old friend and fellow-student, the illustrious Giovanni Pico. There he stayed two years, prosecuting his studies in Greek literature. Before Pico removed to Florence, he procured for Aldo the post of tutor to his nephews Alberto and Lionello Pio, princes of Carpi. Alberto Pio supplied Aldo with funds for starting his printing press, and gave him lands at Carpi. It was Aldo's ambition to secure the literature of Greece from further accident by committing its chief masterpieces to type. Before his time four Italian towns had won the honours of Greek publications: Milan, with the grammar of Lascaris, Aesop, Theocritus, a Greek Psalter, and Isocrates, between 1476 and 1493; Venice, with the *Erotemata* of Chrysoloras in 1484; Vicenza, with reprints of Lascaris's grammar and the *Erotemata*, in 1488 and 1490; Florence, with Alopa's Homer, in 1488. Of these works, only three, the Milanese Theocritus and Isocrates and the Florentine Homer, were classics. Aldo selected Venice as the most appropriate station for his labours. He settled there in 1490, and soon afterwards gave to the world editions of the *Hero and Leander* of Musaeus, the *Galeomyomachia*, and the Greek Psalter. These have no date; but they are the earliest tracts issued from his press, and are called by him "Precursors of the Greek Library."

At Venice Aldo gathered an army of Greek scholars and compositors around him. His trade was carried on by Greeks, and Greek was the language of his household. Instructions to type-setters and binders were given in Greek. The prefaces to his editions were written in Greek. Greeks from Crete collated MSS., read proofs, and gave models of calligraphy for casts of Greek type. Not counting the craftsmen employed in merely manual labour, Aldo entertained as many as thirty of these Greek assistants in his family. His own industry and energy were unremitting. In 1495 he issued the first volume of his Aristotle. Four more volumes completed the work in 1497–1498. Nine comedies of Aristophanes appeared in 1498. Thucydides, Sophocles and Herodotus followed in 1502; Xenophon's *Hellenics* and Euripides in 1503; Demosthenes in 1504. The troubles of Italy, which pressed heavily on Venice at this epoch, suspended Aldo's labours for a while. But in 1508 he resumed his series with an edition of the minor Greek orators; and in 1509 appeared the lesser works of Plutarch. Then came another stoppage. The league of Cambray had driven Venice back to her lagoons, and all the forces of the republic were concentrated on a struggle to the death with the allied powers of Europe. In 1513 Aldo reappeared with Plato, which he dedicated to Leo X. in a preface eloquently and earnestly comparing the miseries of warfare and the woes of Italy with the sublime and tranquil objects of the student's life. Pindar, Hesychius, and Athenaeus followed in 1514.

These complete the list of Aldo's prime services to Greek literature. But it may be well in this place to observe that his successors continued his work by giving Pausanias, Strabo, Aeschylus, Galen, Hippocrates and Longinus to the world in first editions. Omission has been made of Aldo's reprints, in order that the attention of the reader might be concentrated on his labours in editing Greek classics from MSS. Other presses were at work in Italy; and, as the classics issued from Florence, Rome or Milan, Aldo took them up, bestowing in each case fresh industry upon the collation of codices and the correction of texts. Nor was the Aldine press idle in regard to Latin and Italian classics. The *Asolani* of Bembo, the collected writings of Poliziano, the *Hypnerotomachia Poliphili*, Dante's *Divine Comedy*, Petrarch's poems, a collection of early Latin poets of the Christian era, the letters of the younger Pliny, the poems of Pontanus, Sannazzaro's *Arcadia*, Quintilian, Valerius Maximus, and the *Adagia* of Erasmus were printed, either in first editions, or with a beauty of type and paper never reached before, between the years 1495 and 1514. For these Italian and Latin editions Aldo had the elegant type struck which bears his name. It is said to have been copied from Petrarch's handwriting, and was cast under the direction of Francesco da Bologna, who has been identified by Panizzi with Francia the painter.

Aldo's enthusiasm for Greek literature was not confined to the printing-room. Whatever the students of this century may think of his scholarship, they must allow that only vast erudition and thorough familiarity with the Greek language could have enabled him to accomplish what he did. In his own days Aldo's learning won the hearty acknowledgment of ripe scholars. To his fellow workers he was uniformly generous, free from jealousy, and prodigal of praise. While aiming at that excellence of typography which renders his editions the treasures of the book-collector, he strove at the same time to make them cheap. We may perhaps roughly estimate the current price of his pocket series of Greek, Latin and Italian classics, begun in 1501, at 2s. per volume of our present money. The five volumes of the Aristotle cost about £8. His great undertaking was carried on under continual difficulties, arising from strikes among his workmen, the piracies of rivals, and the interruptions of war. When he died, bequeathing Greek literature as an inalienable possession to the world, he was a poor man. In order to promote Greek studies, Aldo founded an academy of Hellenists in 1500 under the title of the New Academy. Its rules were written in Greek. Its members were obliged to speak Greek. Their names were Hellenized, and their official titles were Greek. The biographies of all the famous men who were enrolled in this academy must be sought in the pages of Didot's *Alde Manuce*. It is enough here to mention that they included Erasmus and the English Linacre.

In 1499 Aldo married Maria, daughter of Andrea Torresano of Asola. Andrea had already bought the press established by Nicholas Jenson at Venice. Therefore Aldo's marriage combined two important publishing firms. Henceforth the names Aldus and Asolanus were associated on the title pages of the Aldine publications; and after Aldo's death in 1515, Andrea and his two sons carried on the business during the minority of Aldo's children. The device of the dolphin and the anchor, and the motto *festina lente*, which indicated quickness combined with firmness in the execution of a great scheme, were never wholly abandoned by the Aldines until the expiration of their firm in the third generation.

2. Paulus Manutius (1512–1574). By his marriage with Maria Torresano, Aldo had three sons, the youngest of whom, Paolo, was born in 1512. He had the misfortune to lose his father at the age of two. After this event his grandfather and two uncles, the three Asolani, carried on the Aldine press, while Paolo prosecuted his early studies at Venice. Excessive application hurt his health, which remained weak during the rest of his life. At the age of twenty-one he had acquired a solid reputation for scholarship and learning. In 1533 Paolo undertook the conduct of his father's business, which had latterly been much neglected by his uncles. In the interregnum between Aldo's death and Paolo's succession (1514–1533) the Asolani continued to issue books, the best of which were Latin classics. But, though their publications count a large number of first editions, and some are works of considerable magnitude, they were not brought out with the scholarly perfection at which Aldo aimed. The Asolani attempted to perform the whole duties of editing, and to reserve all its honours for themselves, dispensing with the service of competent collaborators. The result was that some of their editions, especially their Aeschylus of 1518, are singularly bad. Paolo determined to restore the glories of the house, and in 1540 he separated from his uncles. The field of Greek literature having been well-nigh exhausted, he devoted himself principally to the Latin classics. He was a passionate Ciceronian, and perhaps his chief contributions to scholarship are the corrected editions of Cicero's letters and orations, his own epistles in a Ciceronian style, and his Latin version of Demosthenes. Throughout his life he combined the occupations of a student and a printer, winning an even higher celebrity in the former field than his father had done. Four treatises from his pen on Roman antiquities deserve to be commemorated for their erudition no less than for the elegance of their Latinity. Several Italian cities contended for the possession of so rare a man; and he received tempting offers from the Spanish court. Yet his life was a long struggle with pecuniary difficulties. To prepare correct editions of the classics, and to print them in a splendid style, has always been a costly undertaking. And, though Paolo's publications were highly esteemed, their sale was slow. In 1556 he received for a time external support from the Venetian Academy, founded by Federigo Badoaro. But Badoaro failed disgracefully in 1559, and the academy was extinct in 1562. Meanwhile Paolo had established his brother, Antonio, a man of good parts but indifferent conduct, in a printing office and book shop at Bologna. Antonio died in 1559, having been a source of trouble and expense to Paolo during the last four years of his life. Other pecuniary embarrassments arose from a contract for supplying fish to Venice, into which Paolo had somewhat strangely entered with the government. In 1561 pope Pius IV. invited him to Rome, offering him a yearly stipend of 500 ducats, and undertaking to establish and maintain his press there. The profits on publications were to be divided between Paolo Manuzio and the Apostolic camera. Paolo accepted the invitation, and spent the larger portion of his life, under three papacies, with varying fortunes, in the city of Rome. Ill-health, the commercial interests he had left behind at Venice, and the coldness shown him by pope Pius V., induced him at various times and for several reasons to leave Rome. As was natural, his editions after his removal to Rome were mostly Latin works of theology and Biblical or patristic literature.

Paolo married Caterina Odoni in 1546. She brought him three sons and one daughter. His eldest son, the younger Aldus, succeeded him in the management of the Venetian printing house when his father settled at Rome in 1561. Paolo had never been a strong man, and his health was overtaxed with studies and commercial worries. Yet he lived into his sixty-second year, and died at Rome in 1574.

3. Aldus Manutius, Junior (1547–1597). The younger Aldo born in the year after his father Paolo's marriage, proved what is called an infant prodigy. When he was nine years old his name was placed upon the title page of the famous *Eleganze della lingua Toscana e Latina*. The *Eleganze* was probably a book made for his instruction and in his company by his father. In 1561, at the age of fourteen, he produced a work upon Latin spelling, called *Orthographiae ratio*. During a visit to his father at Rome in the next year he was able to improve this treatise by the study of inscriptions, and in 1575 he completed his labours in the same field by the publication of an *Epitome orthographiae*. Whether Aldo was the sole composer of the work on spelling, in its first edition, may be doubted; but he appropriated the subject and made it his own. Probably his greatest service to scholarship is this analysis of the principles of orthography in Latin.

Aldo remained at Venice, studying literature and superintending the Aldine press. In 1572 he married Francesca Lucrezia daughter of Bartolommeo Giunta, and great-grandchild of the first Giunta, who founded the famous printing house in Venice. This was an alliance which augured well of the Giunta for the future of the Aldines, especially as Aldo had recently found time to publish a new revised edition of Velleius Paterculus. Two years later the death of his father at Rome placed Aldo at the head of the firm. In concert with the Giunta, he now edited an extensive collection of Italian letters, and in 1576 he published his commentary upon the *Ars poetica* of Horace. About the same time, that is to say, about the year 1576, he was appointed professor of literature to the Cancelleria at Venice. The Aldine press continued through this period to issue books, but none of signal merit; and in 1585 Aldo determined to quit his native city for Bologna, where he occupied the chair of eloquence for a few months. In 1587 he left Bologna for Pisa, and there, in his quality of professor, he made the curious mistake of printing Alberti's comedy *Philodoxius* as a work of the classic Lepidus. Sixtus V. drew him in 1588 from Tuscany to Rome; and at Rome he hoped to make a permanent settlement as lecturer. But his public lessons were ill attended, and he soon fell back upon his old vocation of publisher under the patronage of a new pope, Clement VIII. In 1597 he died, leaving children, but none who cared or had capacity to carry on the Aldine press. Aldo himself, though a precocious student, a scholar of no mean ability, and a publisher of some distinction, was the least remarkable of the three men who gave books to the public under the old Aldine ensign. This does not of necessity mean that we should adopt Scaliger's critique of the younger Aldo without reservation. Scaliger called him "a poverty-stricken talent, slow in operation; his work is very commonplace; he aped his father." What is true in this remark lies partly in the fact that scholarship in Aldo's days had flown beyond the Alps, where a new growth of erudition, on a basis different from that of the Italian Renaissance, had begun.

See Renouard's *Annales de l'imprimerie des Aldes* (Paris, 1834); Didot's *Alde Manuce* (Paris, 1873); Omont's *Catalogue* of Aldine publications (Paris, 1892). (J. A. S.)

MANWARING, ROBERT, English 18th-century furniture designer and cabinet maker. The dates of his birth and death are unknown. He was a contemporary and imitator of Chippendale, and not the least considerable of his rivals. He prided himself upon work which he described as "genteel," and his speciality was chairs. He manifests the same surprising variations of quality that are noticed in the work of nearly all the English cabinet-makers of the second half of the 18th century, and while his best had an undeniable elegance his worst was exceedingly bad—squat, ill-proportioned and confused. Some of his chairbacks are so nearly identical with Chippendale's that it is difficult to suppose that the one did not copy from the other, and most of the designs of the greater man enjoyed priority of date. During a portion of his career Manwaring was a devotee of the Chinese taste; he likewise practised in the Gothic manner. He appears to have introduced the small bracket between the front rail of the seat and the top of the chair leg, or at all events to have made such constant use of it that it has come to be regarded as characteristic of his work. Manwaring described certain of his own work as "elegant and superb," and as possessing "grandeur and magnificence." He did not confine himself to furniture but produced many designs for rustic gates and railings, often very extravagant. One of his most absurd rural chairs has rock-work with a waterfall in the back.

Among Manwaring's writings were *The Cabinet and Chair Makers' Real Friend and Companion, or the Whole System of Chairmaking Made Plain and Easy* (1765); *The Carpenters' Compleat Guide to Gothic Railing* (1765); and *The Chair-makers' Guide* (1766).

MANYCH, a river and depression in S. Russia, stretching between the lower river Don and the Caspian Sea, through the Don Cossacks territory and between the government of Astrakhan on the N. and that of Stavropol on the S. During the greater part of the year it is either dry or occupied in part by a string of saline lakes (*limans* or *ilmens*); but in spring when the streams swell which empty into it, the water flows in two opposite directions from the highest point (near Shara-Khulusun). The western stream flows westwards, with an inclination northwards, until it reaches the Don, though when the latter river is running high, its water penetrates some 60 miles up the Manych. The eastern stream dies away in the sandy steppe about 25 miles from the Caspian, though it is said sometimes to reach the Kuma through the Huiduk, a tributary of the Kuma. Total length of the depression, 330 m. For its significance as a former (geologic) connexion between the Sea of Azov and the Caspian Sea, see CASPIAN SEA. By some authorities the Manych depression is taken as part of the boundary between Europe and Asia.

MANYEMA (*Una-Ma-Nyema*, eaters of flesh), a powerful and warlike Bantu-Negroid people in the south-east of the Congo basin. Physically they are of a light colour, with well formed noses and not over-full lips, the women being described as singularly pretty and graceful. Manyemaland was for the greater part of the 19th century an Eldorado of the Arab slave raiders.

MANZANARES, a town of Spain, in the province of Ciudad Real, on the river Azuer, a large sub-tributary of the Záncara, and on the railways from Madrid to Ciudad Real and Linares. Pop. (1900), 11,229. Manzanares is one of the chief towns of La Mancha, and thus in the centre of the district described by Cervantes in *Don Quixote*. Its citadel was founded as a Christian fortress after the defeat of the Moors at Las Navas de Tolosa (1212). Bull-fights were formerly held in the main *plaza*, where galleries to accommodate spectators were built between the buttresses of an ancient parish church. Manzanares has manufactures of soap, bricks and pottery, and an active trade in wheat, wine, spirits, aniseed and saffron.

MANZANILLO, a town and port on the Pacific coast of Mexico, in the state of Colima, 52 m. by rail W.S.W. of the city of that name. It is situated on a large harbour partly formed and sheltered by a long island extending southwards parallel with the coast. Southward also, and in the vicinity of the town, is the large stagnant, shallow lagoon of Cayutlán which renders the town unhealthy. Manzanillo is a commercial town of comparatively recent creation. Its new harbour works, the construction of which was begun in 1899, and its railway connexion with central Mexico, promise to make it one of the chief Pacific ports of the republic. These works include a breakwater 1300 ft. long, with a depth of 12 to 70 ft. and a maximum breadth of 320 ft. at the base and 25 ft. on top, and all the necessary berthing and mechanical facilities for the handling of cargoes. A narrow-gauge railway was built between Colima and Manzanillo toward the end of the nineteenth century, but the traffic was only sufficient for a tri-weekly service up to 1908, when the gauge was widened and the railway became part of the Mexican Central branch, completed in that year from Irapuato through Guadalajara to Colima. The exports include hides and skins, palm leaf hats, Indian corn, coffee, palm oil, fruit, lumber and minerals.

MANZANILLO, an important commercial city of Cuba, in Santiago province, on the gulf of Guacanabo, about 17 m. S. of the mouth of the Rio Cauto, on the shore of Manzanillo Bay. Pop. (1907), 15,819. It is shut off to the east and south by the Sierra Maestra. Besides the Cauto, the rivers Yara and Buey are near the city. Manzanillo is the only coast town of importance between Trinidad and Santiago. It exports large quantities of sugar, hides, tobacco, and bees-wax; also some cedar and mahogany. The history of the settlement begins in 1784, but the port was already important at that time for a trade in woods and fruits; French and English corsairs resorted thither for ship-building woods. The settlement was sacked by the French in 1792, and in the following year a fort was built for its protection. In 1833 it received an *ayuntamiento* (council) and in 1837, for its "loyalty" in not following the lead of Santiago in proclaiming the Spanish Constitution, received from the crown the title of *Fiel*. In 1827 the port was opened to commerce, national and foreign.

MANZOLLI, PIER ANGELO, Italian author, was born about the end of the fifteenth century at La Stellata, near Ferrara. He wrote a poem entitled *Zodiacus vitae*, published at Basel in 1543, and dedicated to Hercules II. of Ferrara. The poem is full of didactic writing on the subject of human happiness in connexion with scientific knowledge, and combines metaphysical speculation with satirical attacks on ecclesiastical hypocrisy, and especially on the Pope and on Luther. It was translated into several languages, but fell under the ban of the Inquisition on the ground of its rationalizing tendencies.

MANZONI, ALESSANDRO FRANCESCO TOMMASO ANTONIO (1785–1873), Italian poet and novelist, was born at Milan on the 7th of March 1785. Don Pietro, his father, then about fifty, represented an old family settled near Lecco, but originally feudal lords of Barzio, in the Valsassina, where the memory of their violence is still perpetuated in a local proverb, comparing it to that of the mountain torrent. The poet's maternal grandfather, Cesare Beccaria, was a well-known author, and his mother Giulia a woman of some literary ability. Manzoni's intellect was slow in maturing, and at the various colleges where his school days were passed he ranked among the dunces. At fifteen, however, he developed a passion for poetry, and wrote two sonnets of considerable merit. On the death of his father in 1805, he joined his mother at Auteuil, and spent two years there, mixing in the literary set of the so-called "ideologues," philosophers of the 18th century school, among whom he made many friends, notably Claude Fauriel. There too he imbibed the negative creed of Voltairianism, and only after his marriage, and under the influence of his wife, did he exchange it for that fervent Catholicism which coloured his later life. In 1806–1807, while at Auteuil, he first appeared before the public as a poet, with two pieces, one entitled *Urania*, in the classical style, of which he became later the most conspicuous adversary, the other an elegy in blank verse, on the death of Count Carlo Imbonati, from whom, through his mother, he inherited considerable property, including the villa of Brusuglio, thenceforward his principal residence.

Manzoni's marriage in 1808 to Henriette Blondel, daughter of a Genevese banker, proved a most happy one, and he led for many years a retired domestic life, divided between literature and the picturesque husbandry of Lombardy. His intellectual energy at this period was devoted to the composition of the *Inni sacri*, a series of sacred lyrics, and a treatise on Catholic morality, forming a task undertaken under religious guidance, in reparation for his early lapse from faith. In 1818 he had to sell his paternal inheritance, as his affairs had gone to ruin in the hands of a dishonest agent. His characteristic generosity was shown on this occasion in his dealings with his peasants, who were heavily indebted to him. He not only cancelled on the spot the record of all sums owing to him, but bade them keep for themselves the whole of the coming maize harvest.

In 1819 Manzoni published his first tragedy, *Il Conte di Carmagnola*, which, boldly violating all classical conventionalisms, excited a lively controversy. It was severely criticized in the *Quarterly Review*, in an article to which Goethe replied in its defence, "one genius," as Count de Gubernatis remarks, "having divined the other." The death of Napoleon in 1821 inspired Manzoni's powerful stanzas *Il Cinque maggio*, the most popular lyric in the Italian language. The political events of that year, and the imprisonment of many of his friends, weighed much on Manzoni's mind, and the historical studies in which he sought distraction during his subsequent retirement at Brusuglio suggested his great work. Round the episode of the *Innominato*, historically identified with Bernardino Visconti, the novel *I Promessi sposi* began to grow into shape, and was completed in September 1822. The work when published, after revision by friends in 1825–1827, at the rate of a volume a year, at once raised its author to the first rank of literary fame. In 1822, Manzoni published his second tragedy *Adelchi*, turning on the overthrow by Charlemagne of the Lombard domination in Italy, and containing many veiled allusions to the existing Austrian rule. With these works Manzoni's literary career was practically closed. But he laboriously revised *I Promessi sposi* in the Tuscan idiom, and in 1840 republished it in that form, with a sort of sequel, *La Storia della Colonna infame*, of very inferior interest. He also wrote a small treatise on the Italian language.

The end of the poet's long life was saddened by domestic sorrows. The loss of his wife in 1833 was followed by that of several of his children, and of his mother. In 1837 he married his second wife, Teresa Borri, widow of Count Stampa, whom he also survived, while of nine children born to him in his two marriages all but two preceded him to the grave. The death of his eldest son, Pier Luigi, on the 28th of April 1873, was the final blow which hastened his end; he fell ill immediately, and died of cerebral meningitis, on the 22nd of May. His country mourned him with almost royal pomp, and his remains, after lying in state for some days, were followed to the cemetery of Milan by a vast cortège, including the royal princes and all the great officers of state. But his noblest monument was Verdi's *Requiem*, specially written to honour his memory.

Biographical sketches of Manzoni have been published by Cesare Cantù (1885), Angelo de Gubernatis (1879), Arturo Graf (1898). Some of his letters have been published by Giovanni Sforza (1882).

MAORI (pronounced "Mowri"; a Polynesian word meaning "native," "indigenous"; the word occurs in distinction from *pakeha*, "stranger," in other parts of Polynesia in the forms *Maoi* and *Maoli*), the name of the race inhabiting New Zealand when first visited by Tasman in 1642.

That they were not indigenous, but had displaced an earlier Melanesian or Papuan race, the true aborigines, is certain. The Maoris are Polynesians, and, in common with the majority of their kinsfolk throughout the Pacific, they have traditions which point to Savaii, originally Savaiki, the largest island of the Samoan group, as their cradleland. They say they came to New Zealand from "Hawaiki," and they appear to distinguish between a large and small, or a nearer and farther, "Hawaiki." "The seed of our coming is from Hawaiki; the seed of our nourishing, the seed of mankind." Their great chief, Te Kupe, first landed, they say, on Aotearoa, as they called the north island, and, pleased with his discovery, returned to Hawaiki to tell his fellow-countrymen. Thereafter he returned with seven war canoes, each holding a hundred warriors, priests, stone idols and sacred weapons, as well as native plants and animals. Hawaiki, the name of Te Kupe's traditional home, is identical with several other Polynesian place-names, *e.g.* Hawaii, Apai in the Tonga Islands, Evava in the Marquesas, all of which are held to be derived from Savii or Savaiki. Dr Thomson, in his *Story of New Zealand*, quotes a Maori tradition, published by Sir George Grey, that certain islands, among which it names Rarotonga, Parima and Manono, are islands near Hawaiki. The Rarotongas call themselves Maori, and state that their ancestors came from Hawaiki, and Pirima and Manono are the native names of two islands in the Samoan group. The almost identical languages of the Rarotongas and the Maoris strengthen the theory that the two peoples are descended from Polynesians migrating, possibly at widely different dates, from Samoa. The distance from Rarotonga to New Zealand is about 2000 m., and, with the aid of the trade wind, large canoes could traverse the distance within a month. Moreover the fauna and flora of New Zealand in many ways resemble those of Samoa. Thus it would seem certain that the Maoris, starting from "further Hawaiki," or Samoa, first touched at Rarotonga, "nearer Hawaiki," whence, after forming a settlement, they journeyed on to New Zealand. Maori tradition is explicit as to the cause of the exodus from Samoa, gives the names of the canoes in which the journey was made and the time of year at which the coast of New Zealand was sighted. On the question of the date a comparison of genealogies of Maori chiefs shows that, up to the beginning of the 20th century, about eighteen generations or probably not much more than five centuries had passed since the first Maori arrivals. There is some evidence that the "tradition of the six canoes" does not represent the first contact of the Polynesian race with New Zealand. If earlier immigrants from Samoa or other eastern Pacific islands arrived they must have become absorbed into the native Papuan population—arguing from the absence of any distinct tradition earlier than that "of the six canoes." Some have sought to find in the Morioris of Chatham Island the remnants of this Papuan-Polynesian population, expelled by Te Kupe and his followers. The extraordinary ruined fortifications found, and the knowledge of the higher art of war displayed by the Maoris, suggest (what is no doubt the fact) that there was a hard fight for them when they first arrived, but the greatest resistance must have been from the purer Papuan inhabitants, and not from the half-castes who were probably easily overwhelmed. The shell heaps found on the coasts and elsewhere dispose of the theory that New Zealand was uninhabited or practically so six centuries back.

Any description of the Maoris, who in recent years have come more and more under the influence of white civilization, must necessarily refer rather to what they have been than what they are. Physically the Maoris are true Polynesians, tall, well-built, with straight or slightly curved noses, high foreheads and oval faces. Their colour is usually a darker brown than that of their kinsfolk of the eastern Pacific, but light-complexioned Maoris, almost European in features, are met with. Their hair is black and straight or wavy, scarcely ever curly. They have long been celebrated for their tattooing, the designs being most elaborate.

Among the most industrious of Polynesian races, they have always been famed for wood-carving; and in building, weaving and dyeing they had made great advances before the whites arrived. They are also good farmers and bold seamen. In the Maori wars they showed much strategic skill, and their knowledge of fortification was very remarkable. Politically the

Maoris have always been democratic. No approach to a monarchy ever existed. Each tribe under its chief was autonomous. Tribal lands were held in common and each man was entitled to a share in the products. They had slaves, but so few as not to alter the social conditions. Every Maori was a soldier, and war was the chief business and joy of his life. Tribal wars were incessant. The weapons were wooden spears, clubs and stone tomahawks. Cannibalism, which earned them in earlier years a terrible name, was generally restricted to the bloodthirsty banquets which always followed a victory. The Maoris ate their enemies' hearts to gain their courage, but to whatever degree animistic beliefs may have once contributed to their cannibalism, it is certain that long before Captain Cook's visit religious sanction for the custom had long given place to mere gluttonous enjoyment.

The Maoris had no regular marriage ceremony. Polygamy was universal, and even to-day they are not strictly monogamous. The power of the husband over the wife was absolute, but women took their meals with the men, were allowed a voice in the tribe's affairs, and sometimes accompanied the men into battle. Some tribes were endogamic, and there matriarchy was the rule, descent being traced through the female line. Ferocious as they were in war, the Maoris are generally hospitable and affectionate in their home-life, and a pleasant characteristic, noticed by Captain Cook, is their respect and care of the old. The Maoris buried their dead, the cemeteries being ornamented with carved posts. Their religion was a nature-worship intimately connected with the veneration of ancestors. There was a belief in the soul, which was supposed to dwell in the left eye. They had no doubt as to a future state, but no definite idea of a supreme being. They had no places of worship, nor, though they had sacred wooden figures, is there any reason to consider that they were idolaters in the strict sense of the word. The custom of taboo was very fully developed. Nowadays they are all nominally Christians. While they had no written language, a considerable oral literature of songs, legends and traditions existed. Their priesthood was a highly trained profession, and they had schools which taught a knowledge of the stars and constellations, for many of which they had names. All Maoris are natural orators and poets, and a chief was expected to add these accomplishments to his prowess as a warrior or his skill as a seaman. The Maoris of to-day are law-abiding, peaceable and indolent. They have been called the Britons of the south, and their courage in defending their country and their intelligence amply justify the compliment. By the New Zealanders they are cordially liked. At the census of 1906 they numbered 47,731, as against 45,470 in 1874; and there were 6516 half-castes. See also POLYNESIA and SAMOA.

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MAP (or MAPES), **WALTER** (d. *c.* 1208/9), medieval ecclesiastic, author and wit, to whose authority the main body of prose Arthurian literature has, at one time or another, been assigned, flourished in the latter part of the 12th and early years of the 13th centuries. Concerning the date of his birth and his parentage nothing definite is known, but as he ascribes his position at court to the merits of his parents they were probably people of some importance. He studied at Paris under Girard la Pucelle, who began to teach in or about 1160, but as he states in his book *De nugis curialium* that he was at the court of Henry II. before 1162, his residence at Paris must have been practically comprised in the decade 1150–1160.

Map's career was an active and varied one; he was clerk of the royal household and justice itinerant; in 1179 he was present at the Lateran council at Rome, on his way thither being entertained by the count of Champagne; at this time he apparently held a plurality of ecclesiastical benefices, being a prebend of St Paul's, canon and precentor of Lincoln and parson of Westbury, Gloucestershire. There seems to be no record of his ordination, but as he was a candidate for the see of Hereford in 1199 it is most probable that he was in priest's orders. The last reference to him, as living, is in 1208, when an order for payment to him is on record, but Giraldus Cambrensis, in the second edition of his *Hibernica*, redacted in 1210, utters a prayer for his soul, "cujus animae propitietur Deus," a proof that he was no longer alive.

The special interest of Map lies in the perplexing question of his relation to the Arthurian legend and literature. He is invariably cited as the author of the *Lancelot* proper (consisting of two parts), the *Queste* and the *Mort Artus*, all three of which are now generally found in one manuscript under the title of *Lancelot*. The *Mort Artus*, however, we know to be the prose working over of an earlier and independent poem. Sundry manuscripts of the yet more extensive compilation which begins with the *Grand Saint Graal* also refer to Map as having composed the cycle in conjunction with Robert de Borron, to whom, as a rule, the *Grand Saint Graal* and *Merlin* are exclusively assigned. The curious *Merlin* text, Bibl. Nat. 337 (fonds Français), refers throughout to Map as authority; and the enormous *Lancelot* codex, B. N. 112, a combination of the *Lancelot* and the *Tristan*, also couples his name with that of Robert de Borron. In fact it may safely be said that, with the exception of the prose *Tristan*, always attributed either to Luces de Gast, or Hélie de Borron, the authority of Map has been invoked for the entire vast mass of Arthurian prose romantic literature. Now it is practically impossible that one man, and that one an occupier of court and public offices, constantly employed in royal and public business, very frequently travelling abroad (*e.g.* we know he was at Limoges in 1173; at Rome in 1179; in Anjou in 1183; and at Angers in 1199), could have found the necessary leisure. On this point we have the testimony of his one undoubted work, *De nugis curialium*, which he tells us he composed "by snatches" during his residence at court. *De nugis* is a comparatively small book; if it were difficult to find leisure for that, much more would it have been difficult to find the time requisite for the composition of one only of the many long-winded romances which have been fathered on Map. Giraldus Cambrensis, with whom he was on most friendly terms, and who frequently refers to and quotes him, records a speech in which Map contrasted Giraldus' labours with his own, apparently to the disadvantage of the latter, "vos scripta dedistis, et nos verba"—a phrase which has been interpreted as meaning that Map himself had produced no literary work. But inasmuch as the *De nugis* is undoubtedly, and certain satirical poems directed against the loose life of the clergy of the day most probably, his work, the speech must not be taken too literally. It seems difficult also to believe that Map's name should be so constantly connected with our Arthurian tradition without any ground whatever; though it must be admitted that he himself never makes any such claim—the references in the romances are all couched in the third person, and bear no sign of being other than the record by the copyist of a traditional attribution.

A different and very interesting piece of evidence is afforded by the *Ipomedon* of Hue de Rotelande; in relating how his hero appeared at a tournament three days running, in three different suits of armour, red, black and white, the author remarks,

Sul ne sai pas de mentir l'art
Walter Map reset ben sa part.

This apparently indicated that Map, also, had made himself responsible for a similar story. Now this incident of the "Three Days' Tournament" is found alike in the prose *Lancelot* and in the German *Lanzelet*, this latter translated from a French poem which, in 1194, was in the possession of Hugo de Morville. The *Ipomedon* was written somewhere in the decade 1180–1190, and there is no evidence of the prose romance having then been in existence. We have no manuscript of any prose Arthurian romance earlier than the 13th century, to which period Gaston

Paris assigned them; they are certainly posterior to the verse romances. Chrétien de Troyes, in his *Cligés* (the date of which falls somewhere in the decade 1160–1170), knew and utilized the story of the "Three Days' Tournament," and moreover makes Lancelot take part in it. Map was, as we have seen, frequently in France; Chrétien had for patroness Marie, countess of Champagne, step-daughter to Henry II., Map's patron; Map's position was distinctly superior to that of Chrétien. Taking all the evidence into consideration it seems more probable that Map had, at a comparatively early date, before he became so important an official, composed a poem on the subject of Lancelot, which was the direct source of the German version, and which Chrétien also knew and followed.

The form in which certain of the references to him are couched favours the above view; the compiler of *Guiron le Cortois* says in his prologue that "*maistre Gautier Map qui fu clers au roi Henry—devisa cil l'estoire de monseigneur Lancelot du Lac, que d'autre chose ne parla il mie gramment en son livre*"; and in another place he refers to Map, "*qui fit lou propre livre de monsoingnour Lancelot dou Lac.*" Now only during the early part of his career could Map fairly be referred to as simple "*clers au roi Henry,*" and both extracts emphasize the fact that his work dealt, almost exclusively, with Lancelot. Neither of these passages would fit the prose romance, as we know it, but both might well suit the lost French source of the *Lanzelet*; where we are in a position to compare the German versions of French romances with their originals we find, as a rule, that the translators have followed their source faithfully.

One of the references to Map's works in the *Merlin* manuscript above referred to (B.N. 337) has an interesting touch not found elsewhere. After saying how Map translated the romance from the Latin at the bidding of King Henry, the usual statement, the scribe adds "*qui riche loier l'en dona.*" It is of course possible that Map's rise at court may have been due to his having hit the literary taste of the monarch, who, we know, was interested in the Arthurian tradition, but it must be admitted that direct evidence on the subject is practically nil, and that in the present condition of our knowledge we can only advance possible hypotheses.

See art. "Map" in *Dict. Nat. Biog.* *De nugis curialium* and the *Latin Poems attributed to Map* have been edited for the Camden Society by T. Wright (1841). For discussion of his authorship of the *Lancelot* cf. *The Three Days' Tournament*, Grimm Library XV. See also under LANCELOT. The passages relating to Map cited above have been frequently quoted by scholars, *e.g.* Hucher, *Le Grand Saint Graal*; Paulin Paris, *Romans de la Table Ronde*; Alfred Nutt, *Studies in the Legend of the Holy Grail.* (J. L. W.)

MAP, a representation, on a plane and a reduced scale, of part or the whole of the earth's surface. If specially designed to meet the requirements of seamen it is called a chart, if on an exceptionally large scale a plan. The words map and chart are derived from *mappa* and *charta*, the former being the Latin for napkin or cloth, the latter for papyrus or parchment. Maps were thus named after the material upon which they were drawn or painted, and it should be noted that even at present maps intended for use in the open air, by cyclists, military men and others, are frequently printed on cloth. In Italian, Spanish and Portuguese the word *mappa* has retained its place, by the side of *carta*, for marine charts, but in other languages both kinds of maps[1] are generally known by a word derived from the Latin *charta*, as *carte* in French, *Karte* in German, *Kaart* in Dutch. A chart, in French, is called *carte hydrographique, marine or des côtes*; in Spanish or Portuguese *carta de marear*, in Italian *carta da navigare*, in German *Seekarte* (to distinguish it from *Landkarte*), in Dutch *Zeekaart* or *Paskaart*. A chart on Mercator's projection is called *Wassende graadkaart* in Dutch, *carte réduite* in French. Lastly, a collection of maps is called an atlas, after the figure of Atlas, the Titan, supporting the heavens, which ornamented the title of Lafreri's and Mercator's atlases in the 16th century.

Classification of Maps.—Maps differ greatly, not only as to the scale on which they are drawn, but also with respect to the fullness or the character of the information which they convey. Broadly speaking, they may be divided into two classes, of which the first includes topographical, chorographical and general maps, the second the great variety designed for special purposes.

Topographical maps and plans are drawn on a scale sufficiently large to enable the draughtsman to show most objects on a scale true to nature.[2] Its information should not only be accurate, but also conveyed intelligibly and with taste. Exaggeration, however, is not always to be avoided, for even on the British 1 in. ordnance map the roads appear as if they were 130 ft. in width.

Chorographical (Gr. χώρα, country or region) and general maps are either reduced from topographical maps or compiled from such miscellaneous sources as are available. In the former case the cartographer is merely called upon to reduce and generalize the information given by his originals, to make a judicious selection of place names, and to take care that the map is not overcrowded with names and details. Far more difficult is his task where no surveys are available, and the map has to be compiled from a variety of sources. These materials generally include reconnaissance survey of small districts, route surveys and astronomical observations supplied by travellers, and information obtained from native sources. The compiler, in combining these materials, is called upon to examine the various sources of information, and to form an estimate of their value, which he can only do if he have himself some knowledge of surveying and of the methods of determining positions by astronomical observation. A knowledge of the languages in which the accounts of travellers are written, and even of native languages, is almost indispensable. He ought not to be satisfied with compiling his map from existing maps, but should subject each explorer's account to an independent examination, when he will frequently find that either the explorer himself, or the draughtsman employed by him, has failed to introduce into his map the whole of the information available. Latitudes from the observations of travellers may generally be trusted, but longitudes should be accepted with caution; for so competent an observer as Captain Speke placed the capital of Uganda in longitude 32° 44′ E., when its true longitude as determined by more trustworthy observations is 32° 26′ E., an error of 18′. Again, on the map illustrating Livingstone's "Last Journals" the Luapula is shown as issuing from the Bangweulu in the north-west, when an examination of the account of the natives who carried the great explorer's remains to the coast would have shown that it leaves that lake on the south.

The second group includes all maps compiled for special purposes. Their variety is considerable, for they are designed to illustrate physical and political geography, travel and navigation, trade and commerce, and, in fact, every subject connected with geographical distribution and capable of being illustrated by means of a map. We thus have (1) physical maps in great variety, including geological, orographical and hydrographical maps, maps illustrative of the geographical distribution of meteorological phenomena, of plants and animals, such as are to be found in Berghaus's "Physical Atlas," of which an enlarged English edition is published by J. G. Bartholomew of Edinburgh; (2) political maps, showing political boundaries; (3) ethnological maps, illustrating the distribution of the varieties of man, the density of population, &c.; (4) travel maps, showing roads or railways and ocean-routes (as is done by Philips' "Marine Atlas"), or designed for the special use of cyclists or aviators; (5) statistical maps, illustrating commerce and industries; (6) historical maps; (7) maps specially designed for educational purposes.

Scale of Maps.—Formerly map makers contented themselves with placing upon their maps a linear scale of miles, deduced from the central meridian or the equator. They now add the proportion which these units of length have to nature, or state how many of these units are contained within some local measure of length. The former method, usually called the "natural scale," may be described as "international," for it is quite independent of local measures of length, and depends exclusively upon the size and figure of the earth. Thus a scale of 1:1,000,000 signifies that each unit of length on the map represents one million of such units in nature. The second method is still employed in many cases, and we find thus:—

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[1] The ancient Greeks called a map *Pinax*, The Romans *Tabula geographica*. *Mappa mundi* was the medieval Latin for a map of the world which the ancients called *Tabula totius orbis descriptionem continens.*

[2] Close, "The Ideal Topographical Map," *Geog. Journal*, vol. xxv. (1905).

1 in. = 1 statute mile (of 63,366 in.)	corresponds to	1 : 63,366
6 in. = 1 " "	"	1 : 10,560
1 in. = 5 chains (of 858 in.)	"	1 : 4,890
1 in. = 1 nautical mile (of 73,037 in.)	"	1 : 73,037
1 in. = 1 verst (of 42,000 in.)	"	1 : 42,000
2 Vienna in. = 1 Austrian mile (of 288,000 in.)	"	1 : 144,000
1 cm. = 500 metres (of 100 cm.)	"	1 : 50,000

In cases where the draughtsman has omitted to indicate the scale we can ascertain it by dividing the actual length of a meridian degree by the length of a degree measure upon the map. Thus a degree between 50° and 51° measures 111,226,000 mm.; on the map it is represented by 111 mm. Hence the scale is 1 : 1,000,000 approximately.

The linear scale of maps can obviously be used only in the case of maps covering a small area, for in the case of maps of greater extension measurements would be vitiated owing to the distortion or exaggeration inherent in all projections, not to mention the expansion or shrinking of the paper in the process of printing. As an extreme instance of the misleading character of the scale given on maps embracing a wide area we may refer to a map of a hemisphere. The scale of that map, as determined by the equator or centre meridian, we will suppose to be 1 : 125,000,000, while the encircling meridian indicates a scale of 1 : 80,000,000; and a "mean" scale, equal to the square root of the proportion which the area of the map bears to the actual area of a hemisphere, is 1 : 112,000,000. In adopting a scale for their maps, cartographers will do well to choose a multiple of 1000 if possible, for such a scale can claim to be international, while in planning an atlas they ought to avoid a needless multiplicity of scales.

Map Projections are dealt with separately below. It will suffice therefore to point out that the ordinary needs of the cartographer can be met by conical projections, and, in the case of maps covering a wide area, by Lambert's equal area projection. The indiscriminate use of Mercator's projection, for maps of the world, is to be deprecated owing to the inordinate exaggeration of areas in high latitudes. In the case of topographical maps sheets bounded by meridians and parallels are to be commended.

The meridian of Greenwich has been universally accepted as the initial meridian, but in the case of most topographical maps of foreign countries local meridians are still adhered to—the more important among which are:—

Paris (Obs. nationale)	2° 20′ 14″ E.	of Greenwich.
Pulkova (St Petersburg)	30° 19′ 39″ E.	"
Stockholm	18° 3′ 30″ E.	"
Rome (Collegio Romano)	12° 28′ 40″ E.	"
Brussels (Old town)	4° 22′ 11″ E.	"
Madrid	3° 41′ 16″ W.	"
Ferro (assumed)	20° 0′ 0″ W.	of Paris.

The *outline* includes coast-line, rivers, roads, towns, and in fact all objects capable of being shown on a map, with the exception of the hills and of woods, swamps, deserts and the like, which the draughtsman generally describes as "ornament." Conventional signs and symbols are universally used in depicting these objects.

Delineation of the Ground.—The mole-hills and serrated ridges of medieval maps were still in almost general use at the close of the 18th century, and are occasionally met with at the present day, being cheaply produced, readily understood by the unlearned, and in reality preferable to the uncouth and misleading hatchings still to be seen on many maps. Far superior are those scenographic representations which enable a person consulting the map to identify prominent landmarks, such as the Pic du Midi, which rises like a pillar to the south of Pau, but is not readily discovered upon an ordinary map. This advantage is still fully recognized, for such views of distant hills are still commonly given on the margin of marine charts for the assistance of navigators; military surveyors are encouraged to introduce sketches of prominent landmarks upon their reconnaissance plans, and the general public is enabled to consult "Picturesque Relief Maps"—such as F. W. Delkeskamp's *Switzerland* (1830) or his *Panorama of the Rhine*. Delineations such as these do not, however, satisfy scientific requirements. All objects on a map are required to be shown as projected horizontally upon a plane. This principle must naturally be adhered to when delineating the features of the ground. This was recognized by J. Picard and other members of the Academy of Science whom Colbert, in 1668, directed to prepare a new map of France, for on David Vivier's map of the environs of Paris (1674, scale 1 : 86,400) very crude hachures bounding the rivers have been substituted for the scenographic hills of older maps. Little progress in the delineation of the ground, however, was made until towards the close of the 18th century, when horizontal contours and hachures regulated according to the angle of inclination of all slopes, were adopted. These contours intersect the ground at a given distance above or below the level of the sea, and thus bound a series of horizontal planes (see fig. 1). Contours of this kind were first utilized by M. S. Cruquius in his chart of the Merwede (1728); Philip Buache (1737) introduced such contours or isobaths (Gr. ἴσος, equal; βαθύς, deep) upon his chart of the Channel, and intended to introduce similar contours or isohypses (ὕψος, height) for a representation of the land. Dupain-Triel, acting upon a suggestion of his friend M. Ducarla, published his *La France considérée dans les différentes hauteurs de ses plaines* (1791), upon which equidistant contours at intervals of 16 toises found a place. The scientific value of these contoured maps is fully recognized. They not only indicate the height of the land, but also enable us to compute the declivity of the mountain slopes; and if minor features of ground lying between two contours—such as ravines, as also rocky precipices and glaciers—are indicated, as is done on the Siegfried atlas of Switzerland, they fully meet the requirements of the scientific man, the engineer and the mountain-climber. At the same time it cannot be denied that these maps, unless the contours are inserted at short intervals, lack graphic expression. Two methods are employed to attain this: the first distinguishes the strata or layers by colours; the second indicates the varying slopes by shades or hachures. The first of these methods yields a hypsographical, or—if the sea-bottom be included, in which case all contours are referred to a common datum line—a bathy hypsographical map. Carl Ritter, in 1806, employed graduated tints, increasing in lightness on proceeding from the lowlands to the highlands; while General F. von Hauslab, director of the Austrian Surveys, in 1842, advised that the darkest tints should be allotted to the highlands, so that they might not obscure details in the densely peopled plains. The desired effect may be produced by a graduation of the same colour, or by a polychromatic scale—such as white, pale red, pale brown, various shades of green, violet and purple, in ascending order. C. von Sonklar, in his map of the Hohe Tauern (1 : 144,000; 1864) coloured plains and valleys green; mountain slopes in five shades of brown; glaciers blue or white. E. G. Ravenstein's map of Ben Nevis (1887) first employed the colours of the spectrum, viz. green to brown, in ascending order for the land; blue, indigo and violet for the sea, increasing in intensity with the height or the depth. At first cartographers chose their colours rather arbitrarily. Thus Horsell, who was the first to introduce tints

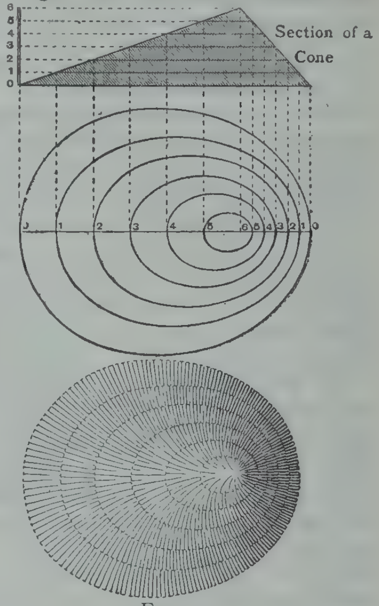

FIG. 1.

on his map of Sweden and Norway (1:600,000; 1835), coloured the lowlands up to 300 ft. in green, succeeded by red, yellow and white for the higher ground; while A. Papen, on his hypsographical map of Central Europe (1857) introduced a perplexing range of colours. At the present time compilers of strata maps generally limit themselves to two or three colours, in various shades, with green for the lowlands, brown for the hills and blue for the sea. On the international map of the world, planned by Professor A. Penck on a scale of 1 : 1,000,000, which has been undertaken by the leading governments of the world, the ground is shown by contours at intervals of 100 metres (to be increased to 200 and 500 metres in mountainous districts); the strata are in graded tints, viz. blue for the sea, green for lowlands up to 300 metres, yellow between 300 and 500 metres, brown up to 2000 metres, and reddish tints beyond that height.

The declivities of the ground are still indicated in most topographical maps by a system of strokes or hachures, first devised by L. Chr. Müller (*Plan und Kartenzeichnen*, 1788) and J. G. Lehmann, who directed a survey of Saxony, 1780–1806, and published his *Theorie der Bergzeichnung* in 1799. By this method the slopes are indicated by strokes or hachures crossing the contour lines at right angles, in the direction of flowing water, and varying in thickness according to the degree of declivity they represent (cf. for example, the map of SWITZERLAND in this work). The light is supposed to descend vertically upon the country represented, and in a true scale of shade the intensity increases with the inclination from 0° to 90°; but as such a scale does not sufficiently differentiate the lesser inclinations which are the most important, the author adopted a conventional scale, representing a slope of 45° or more, supposed to be inaccessible, as absolutely black, the level surfaces, which reflect all the light which falls upon them, as perfectly white, and the intervening slopes by a proportion between black and white, as in fig. 2. The main principles of this system have been maintained, but its details have been modified frequently to suit special cases. Thus the French survey commission of 1828 fixed the proportion of black to white at one and a half times the angle of slope; while in Austria, where steep mountains constitute an important feature, solid black has been reserved for a slope of 80°, the proportion of black to white varying from 80:0 (for 50°) to 8 : 72 (for 5°). On the map of Germany (1:100,000) a slope of 50° is shown in solid black while stippled hachures are used for gentle slopes up to 10°. Instead of shading lines following the greatest slopes, lines following the contours and varying in their thickness and in their intervals apart, according to the slope of the ground to be represented, may be employed This method affords a ready and expeditious means of sketching the ground, if the draughtsman limits himself to characteristically indicating its features by what have been called "form lines." This method can be recommended in the case of plotting the results of an explorer's route, or in the case of countries of which we have no regular survey (cf. the map of AFGHANISTAN in this work).

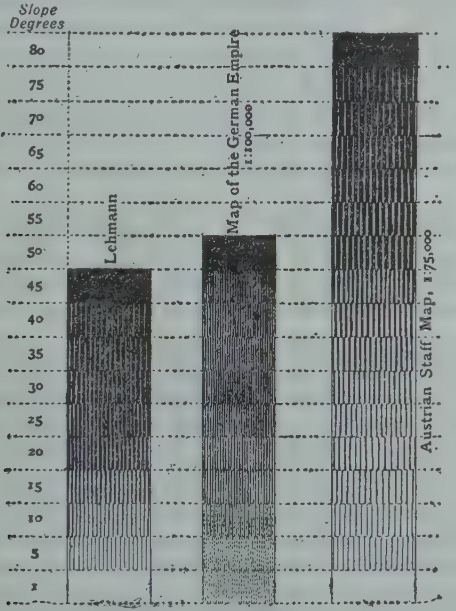

FIG. 2.

Instead of supposing the light to fall vertically upon the surface it is often supposed to fall obliquely, generally at an angle of 45° from the upper left-hand corner. It is claimed for this method that it affords a means of giving a graphic representation of Alpine districts where other methods of shading fail. The Dufour map of Switzerland (1:100,000) is one of the finest examples of this style of hill-shading. For use in the field, however, and for scientific work, a contoured map like Siegfried's atlas of Switzerland, or, in the case of hilly country, a map shaded on the assumption of a vertical light, will prove more useful than one of these, notwithstanding that truth to nature and artistic beauty are claimed on their behalf.

Instead of shading by lines, a like effect may be produced by mezzotint shading (cf. the map of ITALY, or other maps, in this work, on a similar method), and if this be combined with contour lines very satisfactory results can be achieved. If this tint be printed in grey or brown, isohypses, in black or red, show distinctly above it. The same combination is possible if hills engraved in the ordinary manner are printed in colours, as is done in an edition of the 1-inch ordnance map, with contours in red and hills hachured in brown.

Efforts have been made of late years to improve the available methods of representing ground, especially in Switzerland, but the so-called stereoscopic or relief maps produced by F. Becker, X. Imfeld, Kümmerly, F. Leuzinger and other able cartographers, however admirable as works of art, do not, from the point of utility, supersede the combination of horizontal contours with shaded slopes, such as have been long in use. There seems to be even less chance for the combination of coloured strata and hachures proposed by K. Peucker, whose theoretical disquisitions on aerial perspective are of interest, but have not hitherto led to satisfactory practical results.[1]

The above remarks apply more particularly to topographic maps. In the case of general maps on a smaller scale, the orographic features must be generalized by a skilful draughtsman and artist. One of the best modern examples of this kind is Vogel's map of Germany, on a scale of 1:500,000.

Selection of Names and Orthography.—The nomenclature or "lettering" of maps is a subject deserving special attention. Not only should the names be carefully selected with special reference to the objects which the map is intended to serve, and to prevent overcrowding by the introduction of names which can serve no useful object, but they should also be arranged in such a manner as to be read easily by a person consulting the map. It is an accepted rule now that the spelling of names in countries using the Roman alphabet should be retained, with such exceptions as have been familiarized by long usage. In such cases, however, the correct native form should be added within brackets, as Florence (Firenze), Leghorn (Livorno), Cologne (Cöln) and so on. At the same time these corrupted forms should be eliminated as far as possible. Names in languages not using the Roman alphabet, or having no written alphabet should be spelt phonetically, as pronounced on the spot. An elaborate universal alphabet, abounding in diacritical marks, has been devised for the purpose by Professor Lepsius, and various other systems have been adopted for Oriental languages, and by certain missionary societies, adapted to the languages in which they teach. The following simple rules, laid down by a Committee of the Royal Geographical Society, will be found sufficient as a rule; according to this system the vowels are to be sounded as in Italian, the consonants as in English, and no redundant letters are to be introduced. The diphthong *ai* is to be pronounced as in *aisle*; *au* as *ow* in *how*; *aw* as in *law*. *Ch* is always to be sounded as in *church*, *g* is always hard; *y* always represents a consonant; whilst *kh* and *gh* stand for gutturals. One accent only is to be used, the acute, to denote the syllable on which stress is laid. This system has in great measure been followed throughout the present work, but it is obvious that in numerous instances these rules must prove inadequate. The introduction of additional diacritical marks, such as ¯ and ˘, used to express quantity, and the diaeresis, as in *aï*, to express consecutive vowels, which are to be pronounced separately, may prove of service, as also such letters as *ä*, *ö* and *ü*, to be pronounced as in German, and in lieu of the French *ai*, *eu* or *u*.

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[1] K. Peucker, *Schattenplastik und Farbenplastik* (Vienna, 1898); *Geograph. Zeitschrift* (1902 and 1908).

The United States Geographic Board acts upon rules practically identical with those indicated, and compiles official lists of place-names, the use of which is binding upon government departments, but which it would hardly be wise to follow universally in the case of names of places outside America.

MEASUREMENT ON MAPS

Measurement of Distance.—The shortest distance between two places on the surface of a globe is represented by the arc of a great circle. If the two places are upon the same meridian or upon the equator the exact distance separating them is to be found by reference to a table giving the lengths of arcs of a meridian and of the equator. In all other cases recourse must be had to a map, a globe or mathematical formula. Measurements made on a topographical map yield the most satisfactory results. Even a general map may be trusted, as long as we keep within ten degrees of its centre. In the case of more considerable distances, however, a globe of suitable size should be consulted, or—and this seems preferable—they should be calculated by the rules of spherical trigonometry. The problem then resolves itself in the solution of a spherical triangle.

In the formulae which follow we suppose l and l' to represent the latitudes, a and b the co-latitudes ($90°-l$ or $90°-l'$), and t the difference in longitude between them or the meridian distance, whilst D is the distance required.

If both places have the same latitude we have to deal with an isosceles triangle, of which two sides and the included angle are given. This triangle, for the convenience of calculation, we divide into two right-angled triangles. Then we have $\sin \frac{1}{2} D = \sin a \sin \frac{1}{2}t$, and since $\sin a = \sin (90° - l) = \cos l$, it follows that

$$\sin \tfrac{1}{2}D = \cos l \sin \tfrac{1}{2}t.$$

If the latitudes differ, we have to solve an oblique-angled spherical triangle, of which two sides and the included angle are given. Thus,

$$\cos t = \frac{\cos D - \cos a \cos b}{\sin a \sin b}$$

$$\begin{aligned} \cos D &= \cos a \cos b + \sin a \sin b \cos t \\ &= \sin l \sin l' + \cos l \cos l' \cos t. \end{aligned}$$

In order to adapt this formula to logarithms, we introduce a subsidiary angle p, such that $\cot p = \cot l \cos t$; we then have

$$\cos D = \sin l \cos(l' - p) / \sin p.$$

In the above formulae our earth is assumed to be a sphere, but when calculating and reducing to the sea-level, a base-line, or the side of a primary triangulation, account must be taken of the spheroidal shape of the earth and of the elevation above the sea-level. The error due to the neglect of the former would at most amount to 1%, while a reduction to the mean level of the sea necessitates but a trifling reduction, amounting, in the case of a base-line 100,000 metres in length, measured on a plateau of 3700 metres (12,000 ft.) in height, to 57 metres only.

These orthodromic distances are of course shorter than those measured along a loxodromic line, which intersects all parallels at the same angle. Thus the distance between New York and Oporto, following the former (great circle sailing), amounts to 3000 m., while following the rhumb, as in Mercator sailing, it would amount to 3120 m.

These direct distances may of course differ widely with the distance which it is necessary to travel between two places along a road, down a winding river or a sinuous coast-line. Thus, the direct distance, as the crow flies, between Brig and the hospice of the Simplon amounts to 4·42 geogr. m. (slope nearly 9°), while the distance by road measures 13·85 geogr. m. (slope nearly 3°). Distances such as these can be measured only on a topographical map of a fairly large scale, for on general maps many of the details needed for that purpose can no longer be represented. Space runners for facilitating these measurements, variously known as chartometers, curvimeters, opisometers, &c., have been devised in great variety. Nearly all these instruments register the revolution of a small wheel of known circumference, which is run along the line to be measured.

The Measurement of Areas is easily effected if the map at our disposal is drawn on an equal area projection. In that case we need simply cover the map with a network of squares—the area of each of which has been determined with reference to the scale of the map—count the squares, and estimate the contents of those only partially enclosed within the boundary, and the result will give the area desired. Instead of drawing these squares upon the map itself, they may be engraved or etched upon glass, or drawn upon transparent celluloid or tracing-paper. Still more expeditious is the use of a planimeter, such as Captain Prytz's "Hatchet Planimeter," which yields fairly accurate results, or G. Coradi's "Polar Planimeter," one of the most trustworthy instruments of the kind.[1]

When dealing with maps not drawn on an equal area projection we substitute quadrilaterals bounded by meridians and parallels, the areas for which are given in the "Smithsonian Geographical Tables" (1894), in Professor H. Wagner's tables in the geographical *Jahrbuch*, or similar works.

It is obvious that the area of a group of mountains projected on a horizontal plane, such as is presented by a map, must differ widely from the area of the superficies or physical surface of those mountains exposed to the air. Thus, a slope of 45° having a surface of 100 sq. m. projected upon a horizontal plane only measures 59 sq. m., whilst 100 sq. m. of the snowclad Sentis in Appenzell are reduced to 10 sq. m. A hypsographical map affords the readiest solution of this question. Given the area A of the plane between the two horizontal contours, the height h of the upper above the lower contour, the length of the upper contour l, and the area of the face presented by the edge of the upper stratum $l.h = A_1$, the slope α is found to be $\tan \alpha = h.l / (A - A_1)$; hence its superficies, $A = A_2 \sec \alpha$. The result is an approximation, for inequalities of the ground bounded by the two contours have not been considered.

The hypsographical map facilitates likewise the determination of the *mean height* of a country, and this height, combined with the area, the determination of volume, or cubic contents, is a simple matter.[2]

Relief Maps are intended to present a representation of the ground which shall be absolutely true to nature. The object, however, can be fully attained only if the scale of the map is sufficiently large, if the horizontal and vertical scales are identical, so that there shall be no exaggeration of the heights, and if regard is had, eventually, to the curvature of the earth's surface. Relief maps on a small scale necessitate a generalization of the features of the ground, as in the case of ordinary maps, as likewise an exaggeration of the heights. Thus on a relief on a scale of 1 : 1,000,000 a mountain like Ben Nevis would only rise to a height of 1·3 mm.

The methods of producing reliefs vary according to the scale and the materials available. A simple plan is as follows—draw an outline of the country of which a map is to be produced upon a board; mark all points the altitude of which is known or can be estimated by pins or wires clipped off so as to denote the heights; mark river-courses and suitable profiles by strips of vellum and finally finish your model with the aid of a good map, in clay or wax. If contoured maps are available it is easy to build up a strata-relief, which facilitates the completion of the relief so that it shall be a fair representation of nature, which the strata-relief cannot claim to be. A pantograph armed with cutting-files[3] which carve the relief out of a block of gypsum, was employed in 1893–1900 by C. Perron of Geneva, in producing his relief map of Switzerland on a scale of 1 : 100,000. After copies of such reliefs have been taken in gypsum, cement, statuary pasteboard, fossil dust mixed with vegetable oil, or some other suitable material, they are painted. If a number of copies is required it may be advisable to print a map of the country represented in colours, and either to emboss this map, backed with papier-mâché, or paste it upon a copy of the relief—a task of some difficulty. Relief maps are frequently objected to on

[1] Professor Henrici, *Report on Planimeters* (64th meeting of the British Association, Oxford, 1894); J. Tennant, "The Planimeter" (*Engineering*, xlv. 1903).

[2] H. Wagner's *Lehrbuch* (Hanover, 1908, pp. 241–252) refers to numerous authorities who deal fully with the whole question of measurement.

[3] Kienzl of Leoben in 1891 had invented a similar apparatus which he called a Relief Pantograph (*Zeitschrift*, Vienna Geog. Soc. 1891).

account of their cost, bulk and weight, but their great use in teaching geography is undeniable.

Globes.[1]—It is impossible to represent on a plane the whole of the earth's surface, or even a large extent of it, without a considerable amount of distortion. On the other hand a map drawn on the surface of a sphere representing a terrestrial globe will prove true to nature, for it possesses, in combination, the qualities which the ingenuity of no mathematician has hitherto succeeded in imparting to a projection intended for a map of some extent, namely, equivalence of areas of distances and angles. Nevertheless, it should be observed that our globes take no account of the oblateness of our sphere; but as the difference in length between the circumference of the equator and the perimeter of a meridian ellipse only amounts to 0·16%, it could be shown only on a globe of unusual size.

The method of manufacturing a globe is much the same as it was at the beginning of the 16th century. A matrix of wood or iron is covered with successive layers of papers, pasted together so as to form pasteboard. The shell thus formed is then cut along the line of the intended equator into two hemispheres, they are then again glued together and made to revolve round an axis the ends of which passed through the poles and entered a metal meridian circle. The sphere is then coated with plaster or whiting, and when it has been smoothed on a lathe and dried, the lines representing meridians and parallels are drawn upon it. Finally the globe is covered with the paper gores upon which the map is drawn. The adaption of these gores to the curvature of the sphere calls for great care. Generally from 12 to 24 gores and two small segments for the polar regions printed on vellum paper are used for each globe. The method of preparing these gores was originally found empirically, but since the days of Albert Dürer it has also engaged the minds of many mathematicians, foremost among whom was Professor A. G. Kästner of Göttingen. One of the best instructions for the manufacture of globes we owe to Altmütter of Vienna.[2]

Larger globes are usually on a stand the top of which supports an artificial horizon. The globe itself rotates within a metallic meridian to which its axis is attached. Other accessories are an hour-circle, around the north pole, a compass placed beneath the globe, and a flexible quadrant used for finding the distances between places. These accessories are indispensable if it be proposed to solve the problems usually propounded in books on the "use of the globes," but can be dispensed with if the globe is to serve only as a map of the world. The size of a globe is usually given in terms of its diameter. To find its scale divide the mean diameter of the earth (1,273,500 m.) by the diameter of the globe; to find its circumference multiply the diameter by π (3·1416).

Map Printing.—Maps were first printed in the second half of the 15th century. Those in the *Rudimentum novitiarum* published at Lübeck in 1475 are from woodcuts, while the maps in the first two editions of Ptolemy published in Italy in 1472 are from copper plates. Wood engraving kept its ground for a considerable period, especially in Germany, but copper in the end supplanted it, and owing to the beauty and clearness of the maps produced by a combination of engraving and etching it still maintains its ground. The objection that a copper plate shows signs of wear after a thousand impressions have been taken has been removed, since duplicate plates are readily produced by electrotyping, while transfers of copper engravings, on stone, zinc or aluminium, make it possible to turn out large editions in a printing-machine, which thus supersedes the slow-working hand-press.[3] These impressions from transfers, however, are liable to be inferior to impressions taken from an original plate or an electrotype. The art of lithography greatly affected the production of maps. The work is either engraved upon the stone (which yields the most satisfactory result at half the cost of copper-engraving), or it is drawn upon the stone by pen, brush or chalk (after the stone has been "grained"), or it is transferred from a drawing upon transfer paper in lithographic ink. In chromolithography a stone is required for each colour. Owing to the great weight of stones, their cost and their liability of being fractured in the press, zinc plates, and more recently aluminium plates, have largely taken the place of stone. The processes of zincography and of algraphy (aluminium printing) are essentially the same as lithography. Zincographs are generally used for producing surface blocks or plates which may be printed in the same way as a wood-cut. Another process of producing such blocks is known as cerography (Gr. κηρός), wax. A copper plate having been coated with wax, outline and ornament are cut into the wax, the lettering is impressed with type, and the intaglio thus produced is electrotyped.[4] Movable types are utilized in several other ways in the production of maps. Thus the lettering of the map, having been set up in type, is inked in and transferred to a stone or a zinc-plate, or it is impressed upon transfer-paper and transferred to the stone. Photographic processes have been utilized not only in reducing maps to a smaller scale, but also for producing stones and plates from which they may be printed. The manuscript maps intended to be produced by photographic processes upon stone, zinc or aluminium, are drawn on a scale somewhat larger than the scale on which they are to be printed, thus eliminating all those imperfections which are inherent in a pen-drawing. The saving in time and cost by adopting this process is considerable, for a plan, the engraving of which takes two years, can now be produced in two days. Another process, photo- or heliogravure, for obtaining an engraved image on a copper plate, was for the first time employed on a large scale for producing a new topographical map of the Austrian Empire in 718 sheets, on a scale of 1 : 75,000, which was completed in seventeen years (1873–1890). The original drawings for this map had to be done with exceptional neatness, the draughtsman spending twelve months on that which he would have completed in four months had it been intended to engrave the map on copper; yet an average chart, measuring 530 by 630 mm., which would have taken two years and nine months for drawing and engraving, was completed in less than fifteen months—fifty days of which were spent in "retouching" the copper plate. It only cost £169 as compared with £360 had the old method been pursued.

For details of the various methods of reproduction see LITHOGRAPHY; PROCESS, &c.

HISTORY OF CARTOGRAPHY

A capacity to understand the nature of maps is possessed even by peoples whom we are in the habit of describing as "savages." Wandering tribes naturally enjoy a great advantage in this respect over sedentary ones. Our arctic voyagers—Sir E. W. Parry, Sir J. Ross, Sir F. L. MacClintock and others—have profited from rough maps drawn for them by Eskimos. Specimens of such maps are given in C. F. Hall's *Life with the Esquimaux* (London, 1864). Henry Youle Hind, in his work on the Labrador Peninsula (London, 1863) praises the map which the Montagnais and Nasquapee Indians drew upon bark. Similar essays at map-making are reported in connexion with Australians, Maoris and Polynesians. Tupaya, a Tahitian, who accompanied Captain Cook in the "Endeavour" to Europe, supplied his patron with maps; Raraka drew a map in chalk of the Paumotu archipelago on the deck of Captain Wilkes's vessel; the Marshall islanders, according to Captain Winkler (*Marine Rundschau*, Oct. 1893) possess maps upon which the bearings of the islands are indicated by small strokes. Far superior were the maps found among the semi-civilized Mexicans when the Spaniards first discovered and invaded their country. Among them were cadastral plans of villages, maps of the provinces of the empire of the Aztecs, of towns and of the coast. Montezuma presented Cortes with a map, painted on Nequen cloth, of the Gulf coast. Another map did the Conquistador good service on his campaign against Honduras (Lorenzana, *Historia de nueva España*, Mexico, 1770; W. H. Prescott, *History of the Conquest of Mexico*, New

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[1] M. Fiorini, *Erd- und Himmelsgloben, frei bearbeitet von S. Günther* (Leipzig, 1895).

[2] *Jahrb. des polytechn. Instituts in Wien*, vol. xv.

[3] Compare the maps of EUROPE, ASIA, &c., in this work.

[4] The great majority of the maps in this work are made by this process.

York, 1843). Peru, the empire of the Incas, had not only ordinary maps, but also maps in relief, for Pedro Sarmiento da Gamboa (*History of the Incas*, translated by A. R. Markham, 1907) tells us that the 9th Inca (who died in 1191) ordered such reliefs to be produced of certain localities in a district which he had recently conquered and intended to colonize. These were the first relief maps on record. It is possible that these primitive efforts of American Indians might have been further developed, but the Spanish conquest put a stop to all progress, and for a consecutive history of the map and map-making we must turn to the Old World, and trace this history from Egypt and Babylon, through Greece, to our own age.

The ancient Egyptians were famed as "geometers," and as early as the days of Rameses II. (Sesostris of the Greeks, 1333–1300 B.C.) there had been made a cadastral survey of the country showing the rows of pillars which separated the nomens as well as the boundaries of landed estates. It was upon a map based upon such a source that Eratosthenes (276–196 B.C.) measured the distance between Syene and Alexandria which he required for his determination of the length of a degree. Ptolemy, who had access to the treasures of the famous library of Alexandria was able, no doubt, to utilize these cadastral plans when compiling his *geography*. It should be noted that he places Syene only two degrees to the east of Alexandria instead of three degrees, the actual meridian distance between the two places; a difference which would result from an error of only 7° is the orientation of the map used by Ptolemy. Scarcely any specimens of ancient Egyptian cartography have survived. In the Turin Museum are preserved two papyri with rough drawings of gold mines established by Sesostris in the Nubian Desert.[1] These drawings have been commented upon by S. Birch, F. Chabas, R. J. Lauth and other Egyptologists, and have been referred to as the two most ancient maps in existence. They can, however, hardly be described as maps, while in age they are surpassed by several cartographical clay tablets discovered in Babylonia. On another papyrus in the same museum is depicted the victorious return of Seti I. (1366–1333) from Syria, showing the road from Pelusium to Heroopolis, the canal from the Nile with crocodiles, and a lake (mod. Lake Timsah) with fish in it. Apollonius of Rhodes who succeeded Eratosthenes as chief librarian at Alexandria (196 B.C.) reports in his *Argonautica* (iv. 279) that the inhabitants of Colchis whom, like Herodotus (ii., 104) he looks upon as the descendants of Egyptian colonists, preserved, as heirlooms, certain graven tablets (κύρβεις) on which land and sea, roads and towns were accurately indicated.[2] Eustathius (since 1160 archbishop of Thessalonica) in his commentary on Dionysius Periegetes, mentions route-maps which Sesostris caused to be prepared, while Strabo (i., 1. 5) dwells at length upon the wealth of geographical documents to be found in the library of Alexandria.

A cadastral survey for purposes of taxation was already at work in Babylonia in the age of Sargon of Akkad, 3800 B.C. In the British Museum may be seen a series of clay tablets, circular in shape and dating back to 2300 or 2100 B.C., which contain surveys of lands. One of these depicts in a rough way lower Babylonia encircled by a "salt water river," Oceanus.

Development of Map-making among the Greeks[3]—Ionian mercenaries and traders first arrived in Egypt, on the invitation of Psammetichus I. about the middle of the 7th century B.C. Among the visitors to Egypt, there were, no doubt, some who took an interest in the science of the Egyptians. One of the most distinguished among them was Thales of Miletus (640–543 B.C.), the founder of the Ionian school of philosophy, whose pupil, Anaximander (611–546 B.C.) is credited by Eratosthenes with having designed the first map of the world. Anaximander looked upon the earth as a section of a cylinder, of considerable thickness, suspended in the centre of the circular vault of the heavens, an idea perhaps borrowed from the Babylonians, for Job (xxvi. 7) already speaks of the earth as "hanging upon nothing." Like Homer he looked upon the habitable world (οἰκουμένη) as being circular in outline and bounded by a circumfluent river. The geographical knowledge of Anaximander was naturally more ample than that of Homer, for it extended from the Cassiterides or Tin Islands in the west to the Caspian in the east, which he conceived to open out into Oceanus. The Aegean Sea occupied the centre of the map, while the line where ocean and firmament seemed to meet represented an enlarged horizon.

Anaximenes, a pupil of Anaximander, was the first to reject the view that the earth was a circular plane, but held it to be an oblong rectangle, buoyed up in the midst of the heavens by the compressed air upon which it rested. Circular maps, however, remained in the popular favour long after their erroneousness had been recognized by the learned.

Even Hecataeus of Miletus (549–472 B.C.), the author of a *Periodos* or description of the earth, of whom Herodotus borrowed the terse saying that Egypt was the gift of the Nile, retained this circular shape and circumfluent ocean when producing his map of the world, although he had at his disposal the results of the voyage of Scylax of Caryanda from the Indus to the Red Sea, of Darius' campaign in Scythia (513), the information to be gathered among the merchants from all parts of the world who frequented an emporium like Miletus, and what he had learned in the course of his own extensive travels. Hecataeus was probably the author of the "bronze tablets upon which was engraved the whole circuit of the earth, the sea and rivers" (Herod. v. 49), which Aristagoras, the tyrant of Miletus, showed to Cleomenes, the king of Sparta, in 504, whose aid he sought in vain in a proposed revolt against Darius, which resulted disastrously in 494 in the destruction of Miletus. The map of the world brought upon the stage in Aristophanes' comedy of *The Clouds* (423 B.C.), whereon a disciple of the Sophists points out upon it the position of Athens and of other places known to the audience, was probably of the popular circular type, which Herodotus (iv. 36) not many years before had derided and which was discarded by Greek cartographers ever after. Thus Democritus of Abdera (b. *c.* 450, d. after 360), the great philosopher and founder, with Leucippus, of the atomic theory, was also the author of a map of the inhabited world which he supposed to be half as long again from west to east, as it was broad.

Dicaearcus of Messana in Sicily, a pupil of Aristotle (326–296 B.C.), is the author of a topographical account of Hellas, with maps, of which only fragments are preserved; he is credited with having estimated the size of the earth, and, as far as known he was the first to draw a parallel across a map.[4] This parallel, or dividing line, called *diaphragm* (partition) by a commentator, extended due east from the Pillars of Hercules, through the Mediterranean, and along the Taurus and Imaus (Himalaya) to the eastern ocean. It divided the inhabited world, as then known, into a northern and a southern half. In compiling his map he was able to avail himself of the information obtained by the *bematists* (surveyors who determined distances by pacing) who accompanied Alexander the Great on his campaigns; of the results of the voyage of Nearchus from the Indus to the Euphrates, and of the "Periplus" of Scylax of Caryanda, which described the coast from between India and the head of the Arabian Gulf. On the other hand he unwisely rejected the results of the observations for latitude made by Pytheas in 326 B.C. at his native town, Massilia, and during a subsequent voyage to northern Europe. In the end the map of Dicaearcus resembled that of Democritus.

Scientific geography profited largely from the labours of Eratosthenes of Cyrene, whom Ptolemy Euergetes appointed keeper of the famous library of Alexandria in 247 B.C., and died in that city in 195 B.C. He won fame as having been the first to determine the size of the earth by a scientific method. Having determined the difference of latitude between Alexandria and Syene which he erroneously believed to lie on the same meridian, and obtained the distance of those places from each other from the surveys made by Egyptian geometers, he concluded that a degree of the meridan measured 700 stadia.[1]

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[1] Lepsius, *Urkundenbuch*, Pl. XXII.

[2] These Colchians certainly were not Egyptians. The maps referred to may have been Assyrian.

[3] We are indebted to Strabo for nearly all we know about Greek cartographers anterior to Ptolemy, for none of their maps has been preserved.

[4] The gnomon was known to the Chinese in the 5th century B.C., and reached the Greeks (Anaximander) through Babylon. Pytheas, as far as known, was the first to utilize it for the determination of a latitude.

Eratosthenes is the author of a treatise which deals systematically with the geographical knowledge of his time, but of which only fragments have been preserved by Strabo and others. This treatise was intended to illustrate and explain his map of the world. In this task he was much helped by the materials collected in his library. Among the travellers of whose information he was thus able to avail himself were Pytheas of Massilia, Patroclus, who had visited the Caspian (285–282 B.C.), Megasthenes, who visited Palibothra on the Ganges, as ambassador of Seleucus Nicator (302–291 B.C.), Timosthenus of Rhodes, the commander of the fleet of Ptolemy Philadelphus (284–246 B.C.) who wrote a treatise "On harbours," and Philo, who visited Meroe on the upper Nile. His map formed a parallelogram measuring 75,800 stadia from Usisama (Ushant island) or Sacrum Promontorium in the west to the mouth of the Ganges and the land of the Coniaci (Comorin) in the east, and 46,000 stadia from Thule in the north to the supposed southern limit of Libya. Across it were drawn seven parallels, running through Meroe, Syene, Alexandria, Rhodes, Lysimachia on the Hellespont, the mouth of the Borysthenes and Thule, and these were crossed at right angles by seven meridians, drawn at irregular intervals, and passing through the Pillars of Hercules, Carthage, Alexandria, Thapsacus on the Euphrates, the Caspian gates, the mouth of the Indus and that of the Ganges. The position of all the places mentioned was supposed to have been determined by trustworthy authorities. The inhabited world thus delineated formed an island of irregular shape, surrounded on all sides by the ocean, the Erythrean Sea freely communicating with the western ocean. In his text Eratosthenes ignored the popular division of the world into Europe, Asia and Libya, and substituted for it a northern and southern division, divided by the parallel of Rhodes, each of which he subdivided into *sphragides* or *plinthia*—seals or plinths. The principles on which these divisions were made remain an enigma to the present day.

This map of Eratosthenes, notwithstanding its many errors, such as the assumed connexion of the Caspian with a northern ocean and the supposition that Carthage, Sicily and Rome lay on the same meridian, enjoyed a high reputation in his day. Even Strabo (*c.* 30 B.C.) adopted its main features, but while he improved the European frontier, he rejected the valuable information secured by Pytheas and retained the connexion between the Caspian and the outer ocean. In the extreme east his information extended no further than that of Eratosthenes, viz. to India and Taprobane (Ceylon) and the Sacae (Kirghiz).

Hipparchus, the famous astronomer, on the other hand, (*c.* 150 B.C.) proved a somewhat captious critic. He justly objected to the arbitrary network of the map of Eratosthenes. The parallels or *climata*[2] drawn through places, of which the longest day is of equal length and the decimation (distance) from the equator is the same, he maintained, ought to have been inserted at equal intervals, say of half an hour, and the meridians inserted on a like principle. In fact, he demanded that maps should be based upon a regular projection, several descriptions of which he had adopted for his star maps. He moreover accuses Eratosthenes, (whose determination of a degree he accepts without hesitation) with trusting too much to hypothesis in compiling his map instead of having recourse to latitudes and longitudes deduced by astronomical observations. Such observations, however, were but rarely available at the time. A few latitudes had indeed been observed, but although Hipparchus had shown how longitudes could be determined by the observation of eclipses, this method was in reality not available for want of trustworthy time-keepers. The determination of an ocean surrounding the inhabited earth he declared to be based on a mere hypothesis and that it would be equally allowable to describe the Erythraea as a sea surrounded by land. Hipparchus is not known to have compiled a map himself.

About the same time Crates of Mallus (d. 145 B.C.) embodied the views of the Stoic school of philosophy in a globe which has become typical as one of the insignia of royalty. On this globe an equatorial and a meridional ocean divide our earth into four quarters, each inhabited, thus anticipating the discovery of North and South America and Australia.[3]

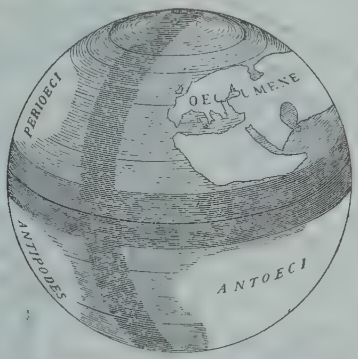

FIG. 2.—The Globe of Crates of Mallus.

The period between Eratosthenes and Marinus of Tyre was one of great political importance. Carthage had been destroyed (146 B.C.), Julius Caesar had carried on his campaign in Gaul (58–51 B.C.), Egypt had been occupied (30 B.C.), Britannia conquered (A.D. 41–79), and the Roman empire had attained its greatest extent and power under the emperor Trajan (A.D. 98–117). But although military operations added to our knowledge of the world, scientific cartography was utterly neglected.

Among Greek works written during this period there are several which either give us an idea of the maps available at that time, or furnish information of direct service to the compiler of a map. Among the latter a Periplus or coastal guide of the Erythrean Sea, which clearly reveals the peninsular shape of India (A.D. 90) and Arrian's *Periplus Ponti Euxeni* (A.D. 131) which Festus Avienus translated into Latin. Among travellers Eudoxus of Cyzicus occupies a foremost rank, since, between 115–87 B.C. he visited India and the east coast of Africa, which subsequently he attempted in vain to circumnavigate by following the route of Hanno, along the west coast. Among geographers should be mentioned Posidonius (13–551), the head of the Stoic school of Rhodes, who is stated to be responsible for having reduced the length of a degree to 500 stadia; Artemidorus of Ephesus, whose " Geographumena " (*c.* 100 B.C.) are based upon his own travels and a study of itineraries, and above all, Strabo, who has already been referred to. Among historians who looked upon geography as an important aid in their work are numbered Polybius (*c.* 210–120 B.C.), Diodorus Siculus (*c.* 30 B.C.) and Agathachidus of Cnidus (*c.* 120 B.C.) to whom we are indebted for a valuable account of the Erythrean Sea and the adjoining parts of Arabia and Ethiopia. The *Periegesis* of Dionysius of Alexandria is a popular description of the world in hexameters, of no particular scientific value (*c.* A.D. 130). He as well as Artemidorus and others accepted a circular or ellipsoidal shape of the world and a circumfluent ocean; Strabo alone adhered to the scientific theories of Eratosthenes.

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[1] If, with W. Dörpfeld, we assume an Attic stadium of 200 steps (500 ft.) to be equal to 164 metres, a degree of 700 stad. would be equal to 114,800 metres, its actual length according to modern measurement being 110,808 metres.

[2] *Climata* based on the length of the longest day were introduced by Hippocrates (*c.* 400 B.C.). *Zones* similar to those already drawn out for the celestial sphere were first introduced by the Pythagoreans. Parmenides of Elea (544–430 B.C.) distinguishes five of these zones, viz. a torrid zone, between the tropics of summer and winter, which was uninhabitable on account of heat; two frigid zones, uninhabitable on account of cold, and two intermediate temperate zones.

[3] Celestial globes were made much earlier than terrestrial ones. In the museum of Naples there is a celestial globe, 2 metres in diameter, supported upon the shoulders of an Atlas, which E. Heis, judging by the constellations engraved upon it (*Atlas coelestis novus*, Bonn, 1872) judges to date from the 4th century B.C. It may even be the work of Eudoxus (d. 386 B.C.) the famous astronomer. Aratus of Soli in Cilicia, in his poetical *Prognostics of Stars and the World*, refers to a globe in his possession. Archimedes, the famous mathematician, had a celestial globe of glass, in the centre of which was a small terrestrial globe. Hero of Alexandria (284–221 B.C.), the ingenious inventor of "Hero's Fountain," is believed to have possessed a similar apparatus. The celestial globe of Hipparchus still existed in the Alexandrian library in the time of Ptolemy, who himself refers to globes in his *Almagest*, as also in the *Geography*. Leontius, who wrote a book on the manufacture of globes (first published at Basel in 1539), is identified by Fiorini with a bishop of Neapolis (Cyprus) of the time of Constantine III. (642–668).

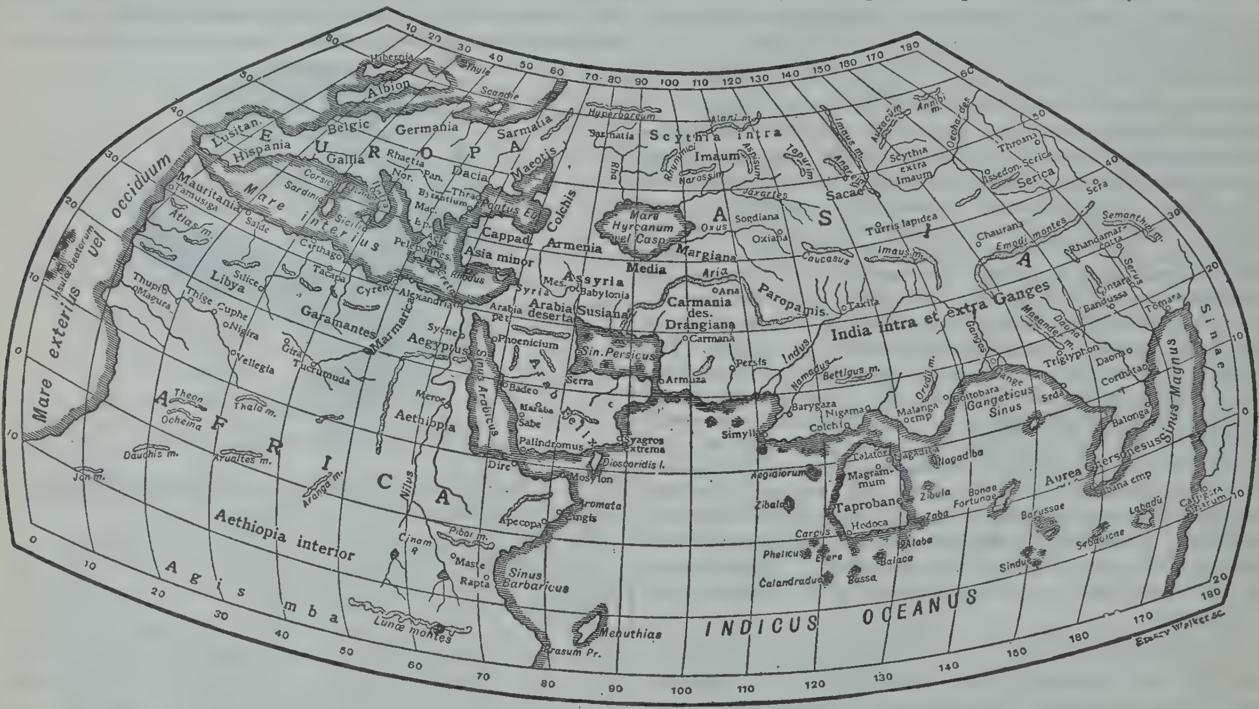

Hibernia
Thyle
Scandia
Albion
Lusitan.
Hispania
Belgic
Germania
Sarmatia
E U R O P A
Gallia
Rhaetia
Nor.
Pan.
Dacia
Maeotis
Hyperboreum
Sarmatia
Scythia intra Imaum
Scythia extra Imaum
Throana
Serica
Sera
Issedon. Serica
Mauritania
Tamusiga
Mare interius
Corsica
Sardinia
Sicilia
Byzantium
Thrac.
Mac.
Ep.
Pontus Eux.
Colchis
Mare Hyrcanum vel Casp.
Sacae
Sogdiana
Oxus
Oxiana
Jaxartes
Imaus m.
A S I A
Turris lapidea
Chaurana
Emodi montes
Semanthini m.
Rhandamarcotta
occidum
Atlas m.
Sala
Carthago
Peloponnes
Cappad.
Armenia
Asia minor
Rhodus
Creta
Media
Margiana
Caucasus
Aria
Paropamisus
Taxila
India intra et extra Ganges
Cyrene
Alexandria
Syria
Mes.
Assyria
Babylonia
Susiana
Carmania des.
Drangiana
Carmana
Persis
Indus
Gangeticus
Maeander m.
Bandussa
Cintaca
Temara
Sinae
Sinus Magnus
Mare exterius
Insula Beatorum vel
Thupis
Magura
Libya
Silice
Thige
Cuphe
Nigira
Garamantes
Marmarica
Aegyptus
Syene
Arabia deserta
Arabia Pet.
Phoenicium
Sin. Persicus
Armuza
Nomadus
Bettigus m.
Orudii m.
Barygaza
Nigama
Colchis
Malanga emp
Sitobara
Gangeticus Sinus
Triglyphon
Daona
Corthitao
Balonga
Sinus Arabicus
Vellegia
Gira
Tucrumuda
Meroe
Badeo
Mariaba
Sabe
Serra
Aethiopia
Theon Ochema
Thala m.
A F R I C A
Palindromus
Syagros extrema
Simylla
Dauchis m.
Arualtes m.
Aranga m.
Jon m.
Dire
Mosylon
Dioscoridis I.
Aegialorum
Zibala
Taprobane
Talator
Magramum
Nagadiba
Zibula
Bonae Fortunae
Aurea Chersonesus
Zaba
Sinus emp
Labadu
Cattigara Statarum
Aethiopia interior
Nilus
Cinam.
Apecopa
Aromata
Pibar m.
Maste
Rapta
Sinus Barbaricus
Carcus
Phelicus
Erere
Hodoca
Alaba
Bazaca
Calandradua
Bassa
Barussae
Sabadicae
Sindae
A g i s y m b a
Lunae montes
Menuthias
Prasum Pr.
INDICUS OCEANUS
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
Emery Walker sc.

FIG. 3.—Ptolemy's Map.

The credit of having returned to the scientific principles innovated by Eratosthenes and Hipparchus is due to Marinus of Tyre (*c.* A.D. 120) which, though no longer occupying the pre-eminent position of former times, was yet an emporium of no inconsiderable importance, having extensive connexions by sea and land. The map of Marinus and the descriptive accounts which accompanied it have perished, but we learn sufficient concerning them from Ptolemy to be able to appreciate their merits and demerits. Marinus was the first who laid down the position of places on a projection according to their latitude and longitude, but the projection used by him was of the rudest. Parallels and meridians were represented by straight lines intersecting each other at right angles, the relative proportions between degrees of longitude and latitude being retained only along the parallel of Rhodes. The distortion of the countries represented would thus increase with the distance, north and south, from this central parallel. The number of places whose position had been determined by astronomical observation was as yet very small, and the map had thus to be compiled mainly from itineraries furnished by travellers or the dead reckoning of seamen. The errors due to an exaggeration of distances were still further increased on account of his assuming a degree to be equal to 500 stadia, as determined by Posidonius, instead of accepting the 700 stadia of Eratosthenes. He was thus led to assume that the distance from the first meridian drawn through the Fortunate islands to Sera (mod. Si-ngan-fu), the capital of China, was equal to 225°, which Ptolemy reduced to 177°, but which in reality only amount to 126°. A like overestimate of the distances covering the march of Julius Maternus to Agisymba, which Marinus places 24° south of the equator, a latitude which Ptolemy reduces to 18°, but which is probably no farther south than lat. 12° N. The map of Marinus was accompanied by a list of places arranged according to latitude and longitude. It must have been much in demand, for three editions of it were prepared. Masudi (10th century) saw a copy of it and declared it to be superior to Ptolemy's map.

Ptolemy (*q.v.*) was the author of a *Geography*[1] (*c.* A.D. 150) in eight books. " Geography," in the sense in which he uses the term, signifies the delineation of the known world, in the shape of a map, while chorography carries out the same objects in fuller detail, with regard to a particular country. In Book I. he deals with the principles of mathematical geography, map projections, and sources of information with special reference to his predecessor Marinus. Books II. to VII. form an index to the maps. They contain about 8000 names, with their

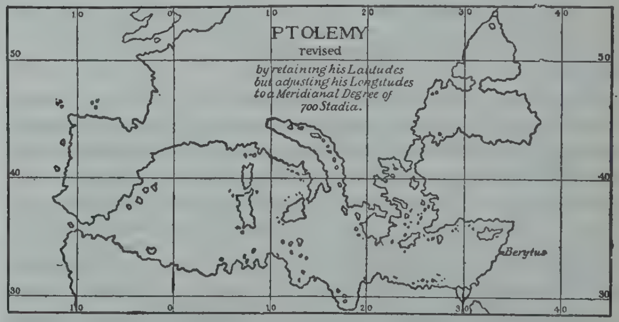

PTOLEMY
revised
by retaining his Latitudes
but adjusting his Longitudes
to a Meridional Degree of
700 Stadia.
Berytus
10
0
10
20
30
40
50
40
30

FIG. 4.

---

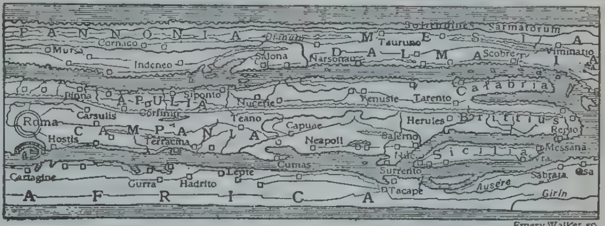
[1] The oldest MS. of Ptolemy's *Geography* is found in the Vatopedi monastery of Mt Athos. It dates from the 12th or 13th century and was published by Victor Langlois in 1867. For the latest edition we are indebted to the late Carl Müller (Paris, 1883–1906) to whom we are likewise indebted for an edition of the *Geographi graeci minores* (1855–1861).

latitudes and longitudes, and with their aid it is possible to reconstruct the maps. These maps existed, as a matter of course, before such an index could be compiled, but it is doubtful whether the maps in our available manuscript, which are attributed to Agathodaemon, are copies of Ptolemy's originals or have been compiled, after their loss, from this index. Book VIII. gives further details with reference to the principal towns of each map, as to geographical position, length of day, climata, &c.

Ptolemy's great merit consists in having accepted the views of Hipparchus with respect to a projection suited for a map of the world. Of the two projections proposed by him one is a modified conical projection with curved parallels and straight meridians; in the second projection (see fig. 3) both parallels and meridians are curved. The correct relations in the length of degrees of latitude and longitude are maintained in the first case along the latitude of Thule and the equator, in the second along the parallel of Agisymba, the equator and the parallels of Meroe, Syene and Thule. Following Hipparchus he divided the equator into 360° drawing his prime meridian through the Fortunate Islands (Canaries). The 26 special maps are drawn on a rectangular projection. As a map compiler Ptolemy does not take a high rank. In the main he copied Marinus whose work he revised and supplemented in some points, but he failed to realize the peninsular shape of India, erroneously exaggerated the size of Taprobane (Ceylon), and suggested that the Indian Ocean had no connexion with the western ocean, but formed Mare Clausum. Ptolemy knew but of a few latitudes which had been determined by actual observation, while of three longitudes resulting from simultaneous observation of eclipses he unfortunately accepted the least satisfactory, namely, that which placed Arbela 45° to the east of Carthage, while the actual meridian distance only amounts to 34°. An even graver source of error was Ptolemy's acceptance of a degree of 500 instead of 700 stadia. The extent to which the more correct proportion would have affected the delineation of the Mediterranean is illustrated by fig. 4. But in spite of his errors the scientific method pursued by Ptolemy was correct, and though he was neglected by the Romans and during the middle ages, once he had become known, in the 15th century, he became the teacher of the modern world.

Map-Making among the Romans.—We learn from Cicero, Vitruvius, Seneca, Suetonius, Pliny and others, that the Romans had both general and topographical maps. Thus, Varro (*De rustici*) mentions a map of Italy engraved on marble, in the temple of Tellus, Pliny, a map of the seat of war in Armenia, of the time of the emperor Nero, and the more famous map of the Roman Empire which was ordered to be prepared for Julius Caesar (44 B.C.), but only completed in the reign of Augustus, who placed a copy of it, engraved in marble, in the Porticus of his sister Octavia (7 B.C.). M. Vipsanius Agrippa, the son-in-law of Augustus (d. 12 B.C.), who superintended the completion of this famous map, also wrote a commentary illustrating it, quotations from which of Ammianus Marcellinus of Antioch (d. 330), Pliny and others, afford the only means of judging of its character. The map is supposed to be based upon actual surveys or rather reconnaissances, and if it be borne in mind that the Roman Empire at that time was traversed in all directions by roads furnished with mile-stones, that the Agrimensores employed upon such a duty were skilled surveyors, and that the official reports of the commanders of military expeditions and of provincial governors were available, this map, as well as the provincial maps upon which it was based, must have been a work of superior excellence, the loss of which is much to be regretted. A copy of it may possibly have been utilized by Marinus and Ptolemy in their compilations. The Romans have been reproached for having neglected the scientific methods of map-making advocated by Hipparchus. Their maps, however, seem to have met the practical requirements of political administration and of military undertakings.

Only two specimens of Roman cartography have come down to us, viz. parts of a plan of Rome, of the time of the emperor Septimius Severus (A.D. 193–211), now in the Museo Capitolino, and an *itinerarium scriptum*, or road map of the world, compressed within a strip 745 mm. in length and 34 mm. broad. Of its character the reduced copy of one of its 12 sections (fig. 5) conveys an idea. The map, apparently of the 3rd century, was copied by a monk at Colmar, in 1265, who fortunately contented himself with adding a few scriptural names, and having been acquired by the learned Conrad Peutinger of Augsburg it became known as *Tabula peutingeriana*. The original is now in the imperial library of Vienna.[1]



Emery Walker sc.

FIG. 5.—A Section of Peutinger's Tabula.

Map-Making in the Middle Ages.—In scientific matters the early middle ages were marked by stagnation and retrogression. The fathers of the church did not encourage scientific pursuits, which Lactantius (4th century) declared to be unprofitable. The doctrine of the sphericity of the earth was still held by the more learned, but the heads of the church held it to be unscriptural. Pope Zachary, when in 741 he condemned the views of Virgilius, the learned bishop of Salzburg, an Irishman who had been denounced as a heretic by St Boniface, declares it to be *perversa et iniqua doctrina*. Even after Gerbert of Aurillac, better known as Pope Sylvester II. (999–1063), Adam of Bremen (1075), Albertus Magnus (d. 1286), Roger Bacon (d. 1294), and indeed all men of leading had accepted as a fact and not a mere hypothesis the geocentric system of the universe and sphericity of the globe, the authors of maps of the world, nearly all of whom were monks, still looked in the main to the Holy Scriptures for guidance in outlining the inhabited world. We have to deal thus with three types of these early maps, viz. an oblong rectangular, a circular and an oval type, the latter being either a compromise between the two former, or an artistic development of the circular type. In every instance the inhabited world is surrounded by the ocean. The authors of rectangular maps look upon the Tabernacle as an image of the world at large, and believe that such expressions as the "four corners of the earth" (Isa. x. 12), could be reconciled only with a rectangular world. On the other hand there was the expression "circuit of the earth" (Isa. xl. 22), and the statement (Ezek. v. 5) that "God had set Jerusalem in the midst of the nations and countries." In

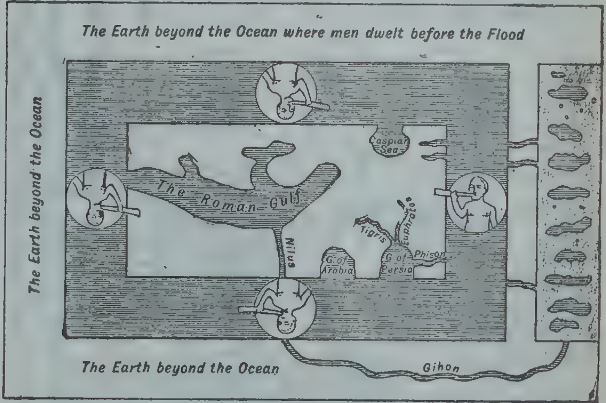

The Earth beyond the Ocean where men dwelt before the Flood
The Earth beyond the Ocean
Caspian Sea
The Roman Gulf
Tigris
Euphrates
Nilus
G. of Arabia
G. of Persia
Phison
The Earth beyond the Ocean
Gihon

FIG. 6.—The World according to Cosmas Indicopleustes (535).

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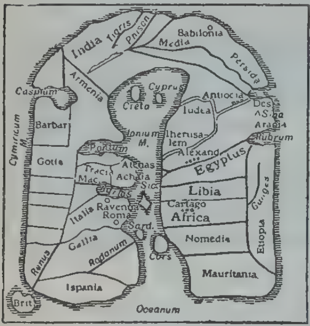
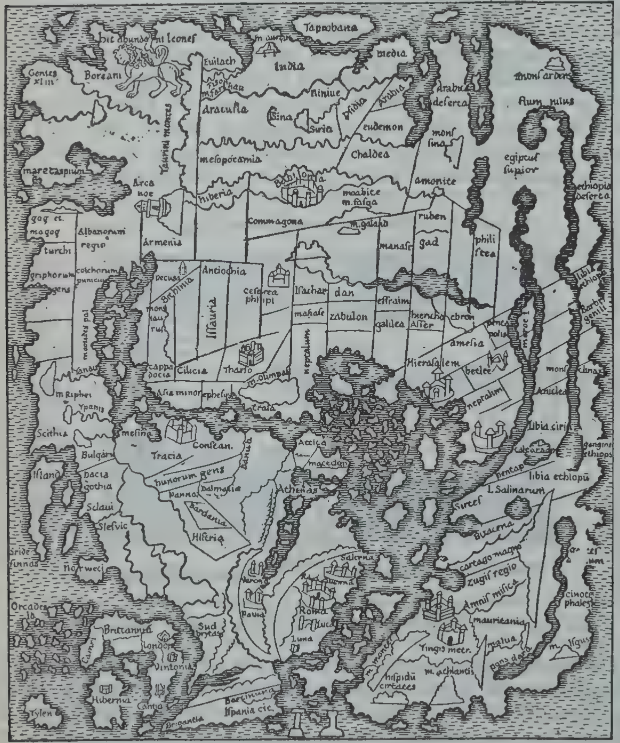
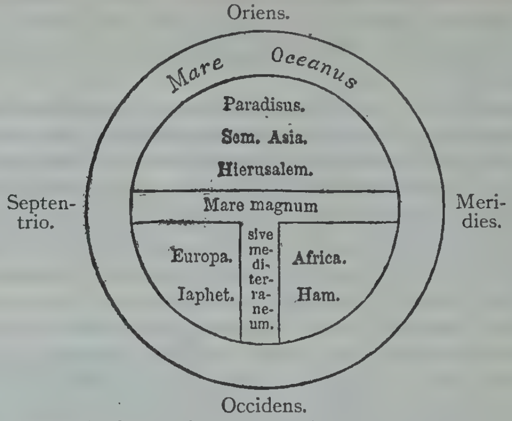
[1] Facsimiles of it have been published by Desjardins (1869–1871), by K. Miller (1886), who ascribes it to Castorius, A.D. 366, and by others.

nearly every case the East occupies the top of the map. Neither parallels nor meridians are indicated, nor is there a scale. Other features frequently met with are the Paradise in the Far East, miniatures of towns, plants, animals, human beings and monsters, and an indication of the twelve winds around the margin.


India
Tigris
Phison
Babilonia
Media
Persida
Caspium
Armenia
Cyprus
Creta
Antiocia
Iudea
Barbari
Ionium M.
Iherusalem
Alexand.
Egyptus
Rubrum
Gotia
Tracia
Mac.
Achaia
Libia
Cartago
Africa
Ravenna
Roma
Sard.
Italia
Gallia
Rodanum
Nomedia
Mauritania
Ispania
Brit.
Oceanum
FIG. 7.—Map of Albi (8th century).

The oldest rectangular map of the world is contained in a most valuable work written by Cosmas, an Alexandrian monk, surnamed Indicopleustes, after returning from a voyage to India (535 A.D.), and entitled *Christian Topography*. According to Cosmas (fig. 6) the inhabited earth has the shape of an oblong rectangle surrounded by an ocean which breaks in in four great gulfs—the Roman or Mediterranean, the Arabian, Persian and Caspian Sea. Beyond this ocean lies another world, which was occupied by man before the Deluge, and within which Cosmas placed the Terrestrial Paradise. Above this rise the walls of the heavens like unto the tent of the Tabernacle. Far more simple is a small map of the world of the 8th century found in a codex in the library of Albi, an archiepiscopal seat in the department of Tarn. Its scanty nomenclature is almost wholly derived from the "Historiae adversum paganos" of Paulus Orosius (418). Far greater interest attaches to the so-called Anglo-Saxon Map of the World in the British Museum (Cotton MSS.), where it is bound up in a codex which also contains a copy of the *Periegesis* of Priscianus. Map and Periegesis are copies by the same hand, but no other connexion exists between them. More than half the nomenclature of the map is derived from Orosius, an annotated Anglo-Saxon version of which had been produced by King Alfred (871–901). The Anglo-Saxons of the time were of course well acquainted with Island (first thus named in 870) Slesvic and Norweci (Norway), and there is no need to have recourse to Adam of Bremen (1076) to account for their presence upon this map. The broad features of the map were derived no doubt from an older document which may likewise have served as the basis for the map of the world engraved on silver for Charlemagne, and was also consulted by the compilers of the Hereford and Ebstorf maps (see fig. 11).

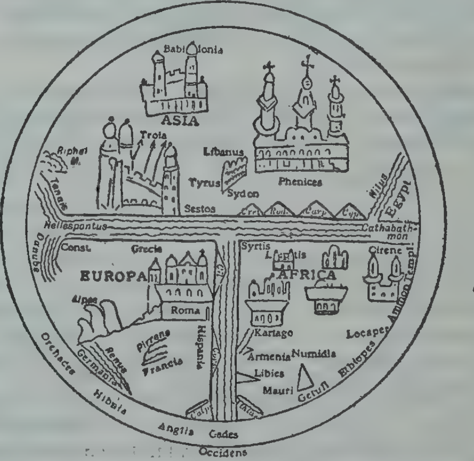

Taprobana
India
media
Boreani
Aracusia
Sina
Siria
Arabia
Chaldea
mesopotamia
mare caspium
Arca noe
Armenia
Commagona
Antiochia
Cilicia
Asia minor
Tracia
Bulgari
Dacia
Gothia
Sclaui
Slesvic
Island
Norweci
Orcadas
Brittannia
London
Hibernia
Hispania citer.
Roma
Luna
Athenas
Constan.
Hierusalem
Libia ethiopi
Cartago magna
Zugis regio
Mauritania
Ethiopia deserta
egiptus superior
FIG. 8.—Anglo-Saxon Map of the World (9th century).


Oriens.
Mare Oceanus
Paradisus.
Sem. Asia.
Hierusalem.
Septentrio.
Mare magnum
sive mediterraneum.
Meridies.
Europa.
Iaphet.
Africa.
Ham.
Occidens.
FIG. 9.—T map from Isidor of Seville's *Origines*.

The map or diagram of which Leonardo Dati in his poem on the Sphere (Della Spera) wrote in 1422 "un T dentre a uno O mostra il disegno" (a T within an O shows the design) is one of the most persistent types among the circular or wheel maps of the world. It perpetuates the tripartite division of the world by the ancient Greeks and survives in the Royal Orb. A diagram of this description will be found in Isidor of Seville's *Origines* (630), see fig. 9.

T maps of more elaborate design illustrate the MS. copies of Sallust's *Bellum jugurthinum*; one of these taken from a codex of the 11th century in the Leipzig town library is shown in fig. 10.

The outlines of several medieval maps resemble each other to such an extent that there can be no doubt that they are derived from the same original source. This source by some authors is assumed to have been the official map of the Roman Empire, but if we compare the crude outline given to the Mediterranean with the more correct delineation of Ptolemy, who was certainly in a position to avail himself of these official sources, such an assumption is untenable. The earliest delineation of the description has already been referred to as the Anglo-Saxon map of the world. Next in the order of age, follows the oval map which Henry, canon of Mayence Cathedral, dedicated to Mathilda, consort of the emperor Henry V. (1110). Of far greater importance is the map seen in Hereford Cathedral. It is the work of Richard of Haldingham, and has a diameter of 134 cm. (53 ins.). The "survey" ordered by Julius Caesar is referred to in the legend, evidently derived from the Cosmography of


Babilonia
ASIA
Riphei M.
Troia
Libanus
Tyrus
Sydon
Phenices
Sestos
Hellespontus
Cathabathmon
Nilus
Egypt
Danubius
Const.
Grecia
EUROPA
Alpes
Roma
Syrtis
AFRICA
Cirene
Kartago
Armenia
Numidia
Libies
Mauri
Getuli
Ethiopes
Locapes
Hispania
Francia
Pirrene
Germania
Orchadre
Hibinia
Anglia
Gades
Occidens
FIG. 10.—Map illustrating Sallust's *Bellum jugurthinum* (11th century, Leipzig).

Aethicus a work widely read at the time, but this does not prove that the author was able to avail himself of a map based upon that survey. A map essentially identical with that of Hereford, but larger—its diameter is 156 cm. (6 in.), and consequently

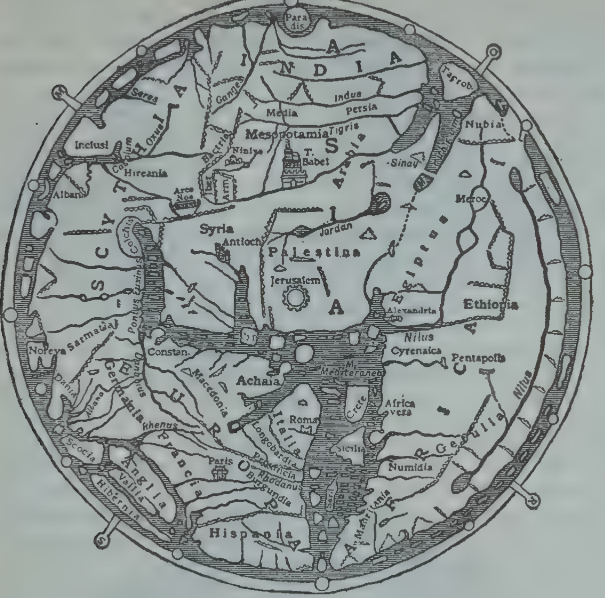

Paradis
I N D I A
Seres
Taprob.
Media
Persia
Indus
Mesopotamia
Tigris
Nubia
Inclusi
T. Babel
Ninive
Sinai
Hircania
Arca Noe
Albani
Meroe
Syria
Antioch
Jordan
Palestina
Jerusalem
A
Ethiopia
Alexandria
Norvega
Sarmatia
Nilus
Constan.
Cyrenaica
Pentapolis
Mediterraneum
Macedonia
Achaia
Roma
Creta
Africa vera
Germania
Rhenus
Italia
Sicilia
Numidia
Scocia
Paris
Burgundia
Anglia
Hibernia
Hispania

FIG. 11.—The Hereford Map (*c.* 1280).

fuller of information—was discovered in 1830 in the old monastery of Ebstorf in Hanover. Its date is 1484. Both maps abound in miniature pictures of towns, animals, fabulous beings and other subjects. The Hereford map is surmounted by a picture of the Day of Judgment. Similar in design, though much smaller of scale and oval in form, are the maps which illustrate the popular *Polychronicon* of Ranulf Higden, a monk of St Werburgh's Abbey of Chester (d. 1363).

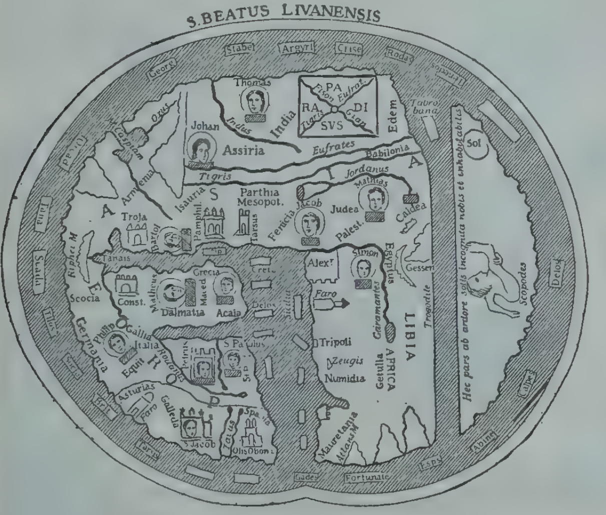

S. BEATUS LIVANENSIS
Thomas
PA RA DI SVS
Edem
Johan
Assiria
India
Indus
Eufrates
Babilonia
Sol
Tigris
Jordanus
Armenia
Parthia
Mesopot.
Judea
Troja
Palest.
Tanais
Grecia
Creta
Alexr
Gessen
Scocia
Const.
Dalmatia
Acaia
Faro
Italia
Tripoli
Zeugis
Numidia
AFRICA
LIBIA
Germania
Asturias
Galletia
Mauretania
Gadez
Fortunate
Hec pars ab ardore solis incognita nobis et inhabitabilis

FIG. 12.—The Map of Beatus (776).

Pomponius Mela tells us that beyond the Ethiopian Ocean which sweeps round Africa in the south and the uninhabitable torrid zone, there lies an *alter orbis*, or fourth part of the world inhabited by *Antichthones*. On a diagram illustrating the *origines* of Isidore of Seville (d. 636) this country is shown, but is described as a *terra inhabitabilis*. It is shown likewise upon a number of maps which illustrate the *Commentaries on the Apocalypse*, by Beatus, a Benedictine monk of the abbey of Valcavado at the foot of the hills of Liebana in Asturia (776).

Our little map (fig. 12) is taken from a copy of Beatus' work made in 1203, and preserved at Burgo de Osma in Castille. Similar maps illustrating the *Commentaries* exist at St Sever (1050), Paris (1203), and Tunis; others are rectangular, the oldest being in Lord Ashburnham's library (970). Beatus, too, describes the southern land as *inhabitabilis*. The habitable world is divided among the twelve apostles, whose portraits are given. On the maps illustrating the encyclopaedic *Liber floridus* by Lambert,

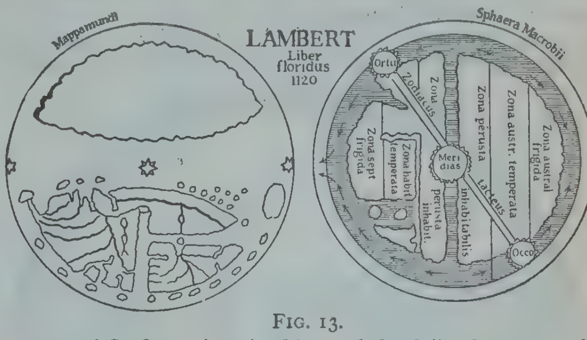

Mappamundi
LAMBERT
Liber floridus
1120
Sphaera Macrobii
Ortus
Zodiacus
Zona sept frigida
Zona habit. temperata
Meri dias
perusta inhabit.
Zona perusta
inhabitabilis
Zona austr. temperata
Zona austral frigida
Occ.

FIG. 13.

a canon of St Omer (1120), this south land "unknown to the sons of Adam," is stated to be inhabited "according to the philosophers" by Antipodes. Lambert, indeed, seems to have believed in the sphericity of the earth. Fig. 13 shows his map of the world reduced from a MS. at Wolfenbüttel, to which is added a diagram of the zones from a MS. at Ghent, which illustrates Macrobius' commentary on Cicero's *Somnium Scipionis*. Diagrams illustrating the division of the world into climata, are to be found in the *opus majus* of Roger Bacon (d. 1294) and in Cardinal Pierre d'Ailly's *De imagine Mundi* (1410).

Among countries represented on a larger scale on maps, Palestine not unnaturally occupies a prominent place in this age of pilgrimages and crusades (1095–1291). The maps which accompany St Jerome's translation of the *Onomasticon* of St Eusebius (388). The same subject is illustrated by a picture-map in mosaic, portions of which were discovered in 1896 on the floor of the church of Madaba to the east of the Dead Sea. This is the oldest original of a map in existence, for it dates back to the 6th century. Among more recent maps of Palestine, that by Petrus Vesconte (1320) is greatly superior to the earlier maps. It illustrates Marino Sanuto's *Secreta fidelium crucis*, in which its author vainly appeals to Christendom to undertake another crusade. One of the earliest plans of Jerusalem is contained in *Gesta Francorum*, a history of the Crusades up to 1106, based upon information furnished by Fulcherius of Chartres (*c.* 1109).

There existed, no doubt, special maps of European countries, but the only documents of that description are two maps of Great Britain, the one of the 12th century, the other by Matthew of Paris, the famous historiographer of the monastery of St Albans (1236–1259).[1]

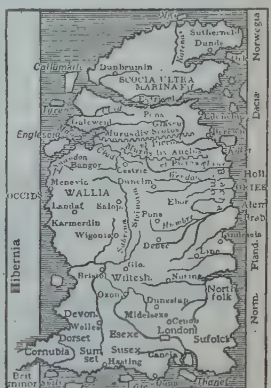

Norwegia
Dacia
Hibernia
Sutherneli
Dunbrutain
SCOCIA ULTRA MARINA
WALLIA
Menevia
Landaf
Karmerdin
Bangor
London
Wigornia
Bristol
Oxon
Wiltesh.
Devon
Welles
Dorset
Cornubia
Sumerset
Essexe
Susex
Hasting
Midelsexe
Londoni
Sufolc
Northfolk
Cestria
Hell.
Holl.
Alem
Flandr.
Norm.
Thanet
AUSTER

FIG. 14.—Matthew of Paris (1236–1259).

Celestial globes were known in the time of Bede; they formed part of the educational apparatus of the monastic schools. Gerbert of Aurillac is known to have made such globes (929). Their manufacture is described by Alphonso the Wise (1252), as also in *De sphaera solida* of G. Campanus of Novara (1303). Terrestrial globes, however, are not referred to.

Map-making among the Arabians and other Nations of the East.—Bagdad early became a famous seat of learning. Indian astronomers found apt pupils there among the Arabs; the works of

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[1] R. Gough, *British Topography* (London 1768). His "Histories" are published in *Rerum brit. scriptores* XL. and LVII. 1866–1869.

Ptolemy were translated into Arabic, and in 827, in the reign of the caliph Abdullah al Mamun, an arc of the meridian was measured in the plain of Mesopotamia. Most famous among these Arabian astronomers were Al Batani (d. 998), Ibn Yunis of Cairo (d. 1008), Zarkala (Azarchel), who determined the meridian distance between his observatory in Toledo and Bagdad to amount to 51° 30′, an error of 3° only, as compared with Ptolemy's error of 18°, and Abul Hassan (1230) who reduced the great axis of the Mediterranean to 44°.

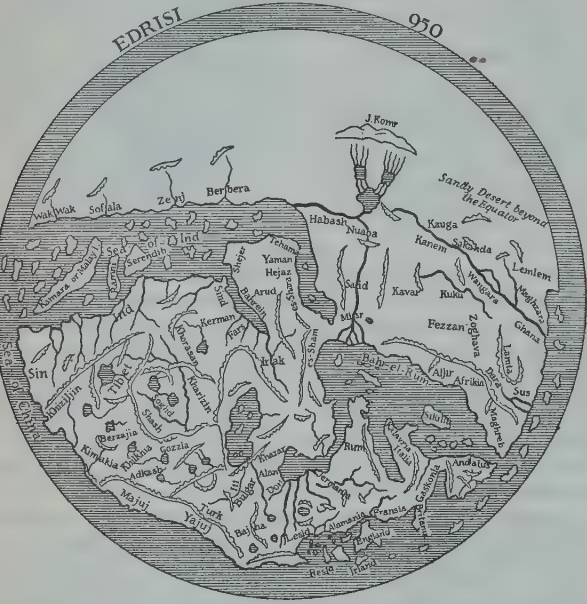
EDRISI
950
J. Komr
Sandy Desert beyond the Equator
Wak Wak
Sofala
Zenj
Berbera
Habash
Nuaba
Kauga
Kanem
Lemlem
Wangara
Ghana
Lamta
Dara
Sus
Kuku
Kavar
Said
Misr
Fezzan
Zoghawa
Afrikia
Maghreb
Bahr-el-Rum
Sikilia
Andalus
Rum
Sea of Ind
Serendib
Tehama
Yaman
Hejaz
Sind
Kerman
Fars
Arud
Irak
esh-Sham
Khorasan
Kharizm
Tibet
Sin
Sea of China
Berzajia
Shash
Gozzla
Kimakia
Adkash
Majuj
Yajuj
Turk
Bulgar
Khazar
Alan
Germania
Fransia
Alamania
England
Irland
Resla
Italia

FIG. 15.—Idrisi (1154).

Further materials serviceable to the compilers of maps were supplied by numerous Arabian travellers and geographers, among whom Masudi (915–940), Istakhri (950), Ibn Haukal (942–970), Al Biruni (d. 1038), Ibn Batuta (1325–1356) and Abul Feda (1331–1370), occupy a foremost place, yet the few maps which have reached us are crude in the extreme. Masudi, who saw the maps in the Horismos or Rasm el Ard, a description of the world by Abu Jafar Mahommed ben Musa of Khiva, the librarian of the caliph el Mamun (833), declares them to be superior to the maps of Ptolemy or Marinus, but maps of a later date by Istakhri (950) or Ibn al Wardi (1349) are certainly of a most rudimentary type. Nor can Idrisi's map of the world, which was engraved for King Roger of Sicily upon a silver plate, or the rectangular map in 70 sheets which accompanies his geography (Nushat-ul Mushtat) take rank with Ptolemy's work. These maps are based upon information collected during many years at the instance of King Roger. The seven climates adopted by Idrisi are erroneously supposed to be equal in latitudinal extent. The Mediterranean occupies nearly half the inhabited world in longitude, and the east coast of Africa is shown as if it extended due east.

The Arabians are not known to have produced a terrestrial globe, but several of their celestial globes are to be found in our collections. The oldest of these globes was made at Valentia, and is now in the museum of Florence. Another globe (of 1225) is at Velletri; a third by Ibn Hula of Mosul (1275) is the property of the Royal Asiatic Society of London; a fourth (1289) from the observatory of Maragha, in the Dresden Museum, two globes of uncertain age at Paris (see fig. 17) and another in London. All these globes are of metal (bronze), or they might not have survived so many years.

The charts in use of the medieval navigators of the Indian Ocean—Arabs, Persians or Dravidas—were equal in value if not superior to the charts of the Mediterranean. Marco Polo mentions such charts; Vasco da Gama (1498) found them in the hands of his Indian pilot, and their nature is fully explained in the *Mohit* or encyclopaedia of the sea compiled from ancient sources by the Turkish admiral Sidi Ali Ben Hosein in 1554.[1] These charts are covered with a close network of lines intersecting each other at right angles. The horizontal lines are parallels, depending upon the altitude of the pole star, the Calves of the Little Bear and the Barrow of the Great Bear above the horizon. This altitude was expressed in *isbas* or inches each equivalent to 1° 42′ 50″. Each *isba* was divided into *zams* or eighths. The interval between two parallels thus only amounted to 12′ 51″. These intervals were mistaken by the Portuguese occasionally for degrees, which account for Malacca, which is in lat. 2′ 13″ N., being placed on Cantino's Chart (1502) in lat. 14′ S. It may have been a map of this kind which accounts for Ptolemy's moderate exaggerations of the size of Taprobana (Ceylon). A first meridian, separating a leeward from a windward region, passed through Ras Kumhari (Comorin) and was thus nearly identical with the first meridian of the Indian astronomers which passed through the sacred city of Ujjain (Ozere of Ptolemy) or the meridian of Azin of the Arabs. Additional meridians were drawn at intervals of *zams*, supposed to be equal to three hours' sail.

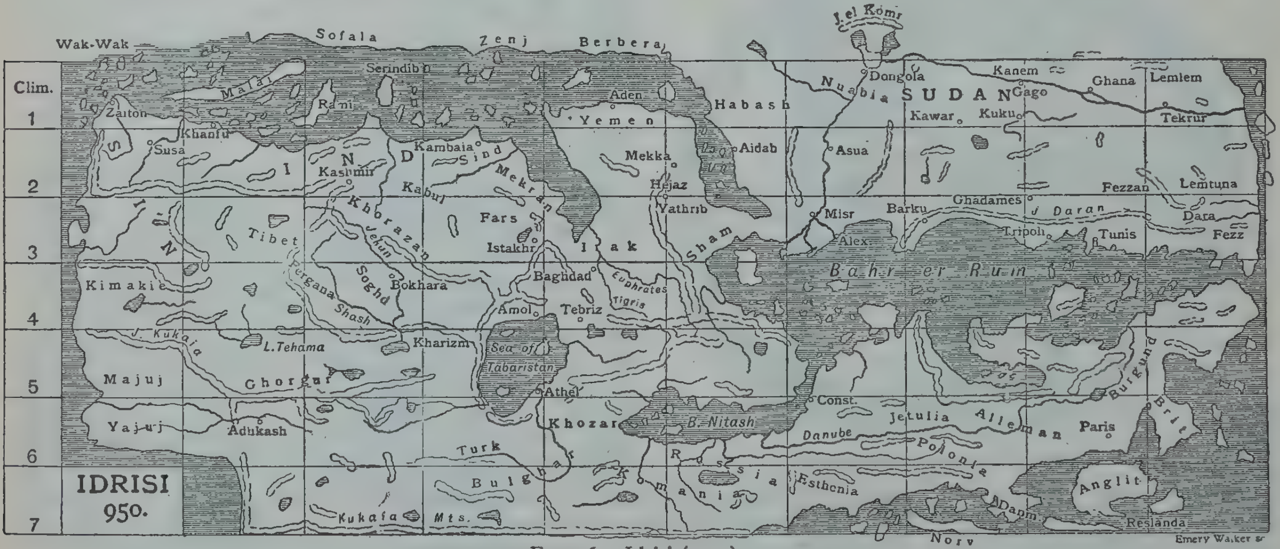
Wak-Wak
Sofala
Zenj
Berbera
J. el Komr
Clim.
1
2
3
4
5
6
7
Serendib
Malai
Rami
Zaiton
Aden
Yemen
Habash
Dongola
Nuabia
SUDAN
Kanem
Gago
Ghana
Lemlem
Kawar
Kuku
Tekrur
Khanfu
Susa
SIN
IND
Kambaia
Sind
Kashmir
Mekran
Mekka
Hejaz
Aidab
Asua
Kabul
Fezzan
Lemtuna
Ghadames
Daran
Dara
Fezz
Khorazan
Fars
Yathrib
Misr
Barku
Tripoli
Tunis
Alex.
Tibet
Istakhr
Irak
Sham
Bahr er Rum
Kimakie
Fergana
Soghd
Bokhara
Baghdad
Euphrates
Tigris
Shash
Amol
Tebriz
J. Kukaia
L. Tehama
Kharizm
Sea of Tabaristan
Majuj
Ghorgar
Athel
Bulgund
Brit
Const.
Yajuj
Adukash
Khozar
B. Nitash
Jetulia
Alleman
Paris
Danube
Polonia
Turk
Bulghar
Rossia
Komania
Esthenia
Anglit
Danmark
Reslanda
Norv
Kukaia Mts.
IDRISI 950.
Emery Walker sc

FIG. 16.—Idrisi (1154).

In China, maps in the olden time were engraved on bronze or stone, but after the 10th century they were printed from wood-blocks. Among the more important productions of more recent times, may be mentioned a map of the empire, said to be based upon actual surveys by Yhang (721), who also manufactured a celestial globe (an older globe by Ho-shing-tien, 4 metres in circumference was produced in 450), and an atlas of the empire on a large scale by Thu-sie-pun (1311–1312) of which new enlarged editions with many maps were published in the 16th century and in 1799. None of these maps was graduated, which is all the more surprising as the Chinese astronomers are credited with having made use of the gnomon as early as 1000 B.C. for determining latitudes.

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[1] M. Bittner, *Die topogr. Capital des ind. Seespiegels* (Vienna, 1897).

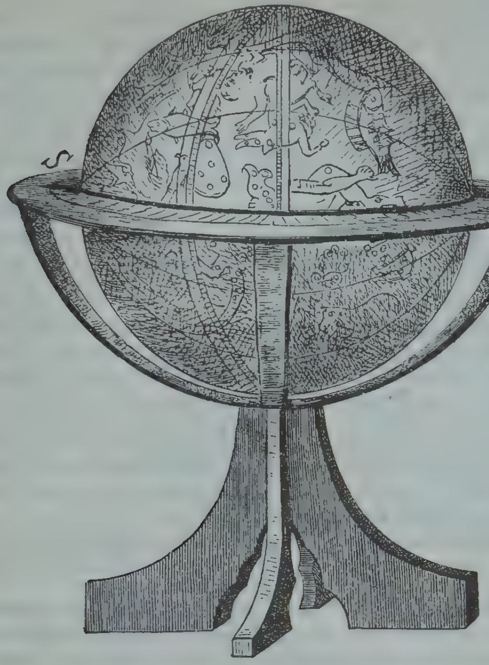


FIG. 17.—Globe in Bibliothèque Nationale, Paris

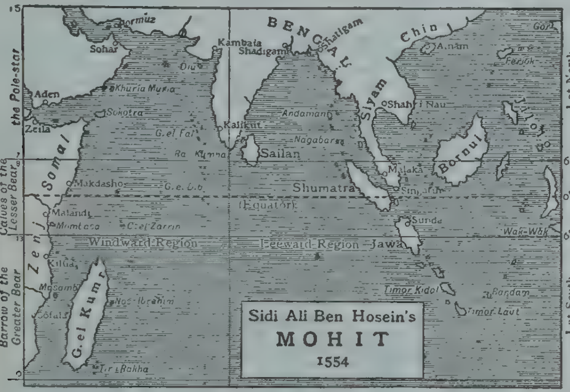

Hormuz
Sohar
Kambaia
Shadigam
BENGAL
Shatigam
Chin
A.nam
Gor
Ferjok
Diu
Aden
Khuria Muria
Sokotra
Zeila
Somal
G.el Fal
Kalikut
Andaman
Nagabar
Siyam
Shahri Nau
Ra Kumna
Sailan
Malaka
Bornui
Makdasho
Shumatra
Singapur
(Equator)
Malandi
Mombasa
C.el Zarrin
Sunda
Windward Region
Leeward Region
Jawa
Wak-Wak
Zenj
Kilua
Mosamb
Sofala
G.el Kumr
Nos Ibrahim
Timor Kidol
Bandam
Timor Laut
Tir Bakha
Sidi Ali Ben Hosein's
MOHIT
1554
Lat. North
Lat. South
6°
0°
6°
Atitude, in Isbas, of the the Pole-star
Calues of the Lesser Bear
Barrow of the Greater Bear

FIG. 18.—The Indian Ocean according to Mohit, as interpreted by Dr Tomaschek.

In the case of Japan, the earliest reference to a map is of 646, in which year the emperor ordered surveys of certain provinces to be made.

Portolano Maps.—During the long period of stagnation in cartography, which we have already dealt with, there survived among the seamen of the Mediterranean charts of remarkable accuracy, illustrating the *Portolani* or sailing directories in use among them. Charts of this description are first mentioned in connexion with the Crusade of Louis XI. in 1270, but they originated long before that time, and in the eastern part of the Mediterranean they embody materials available even in the days before Ptolemy, while the correct delineation of the west seems to be of a later date, and may have been due to Catalan seamen. These charts are based upon estimated bearings and distances between the principal ports or capes, the intervening coast-line being filled in from more detailed surveys. The bearings were dependent upon the seaman's observation of the heavens, for these charts were in use long before the compass had been introduced on board ship (as early as 1205, according to Guiot de Provins) although it became fully serviceable only after the needle had been attached to the compass card, an improvement probably introduced by Flavio Gioja of Amalfi in the beginning of the 14th century. The compass may of course have been used for improving these charts, but they originated without its aid, and it is therefore misleading to describe them as *Compass or Loxodromic* charts, and they are now known as *Portolano* charts.

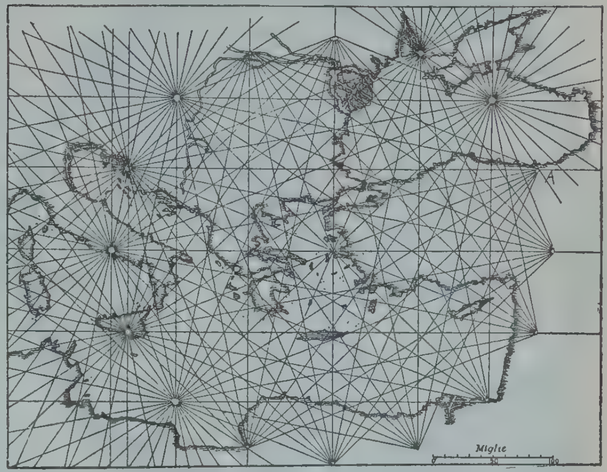


FIG. 19.—The Eastern Mediterranean, by Petrus Vesconte (1311).

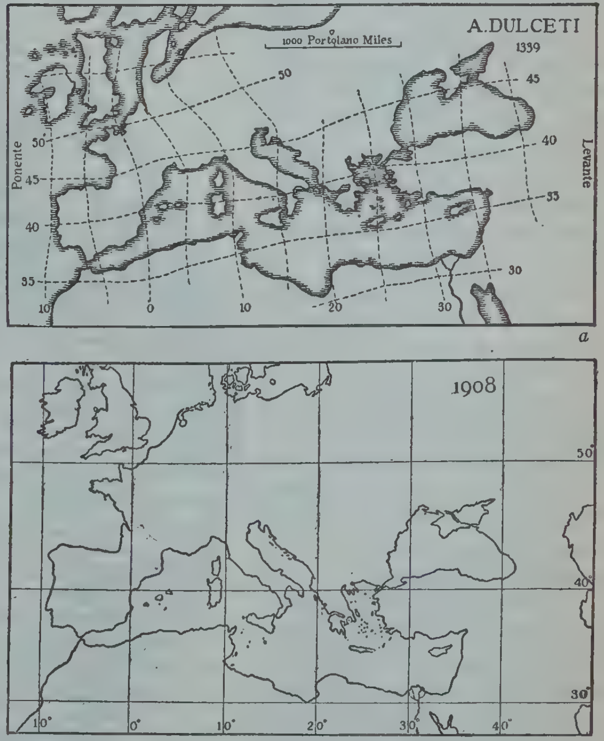
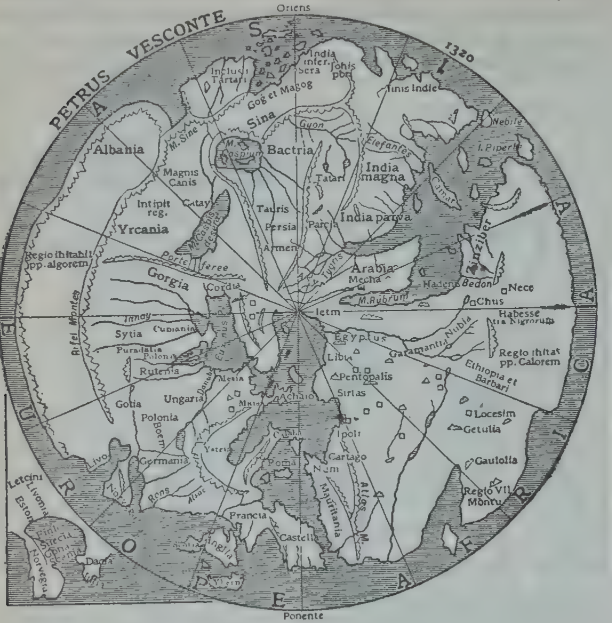

A.DULCETI
1339
1000 Portolano Miles
Ponente
Levante
50
45
40
35
10
0
10
20
30
40
33
30
a
1908
50°
40°
30°
10°
0°
10°
20°
30°
40°

FIG. 20.—The Mediterranean. b
a, According to A. Dulceti, 1339, and
b, On Mercator's projection, according to modern maps.

None of these charts is graduated, and the horizontal and vertical lines which cross many of them represent neither parallels nor meridians. Their most characteristic feature, and one by which they can most readily be recognized, is presented by groups or systems of rhumb-lines, each group of these lines radiating from a common centre, the central group being generally encircled by eight or sixteen satellite groups. In the course of time the centres of radiation of all these groups had imposed upon them ornate *rose dei venti*, or windroses, such as may still be seen upon our compass-cards. Each chart was furnished with a scale of miles. These miles, however, were not the ordinary Roman miles of 1000 paces or 5000 ft., but smaller miles of Greek or Oriental origin, of which six were equal to five Roman miles, and as the latter were equal to 1480 metres, the Portolano miles had a length of only 1233 metres, and 75·2 of the former, and 90·3 of the latter were equal to a degree. The difference between these miles was known, however, only to the more learned among the map-makers, and when the charts were extended to the Atlantic seaboard the two were assumed to be identical.

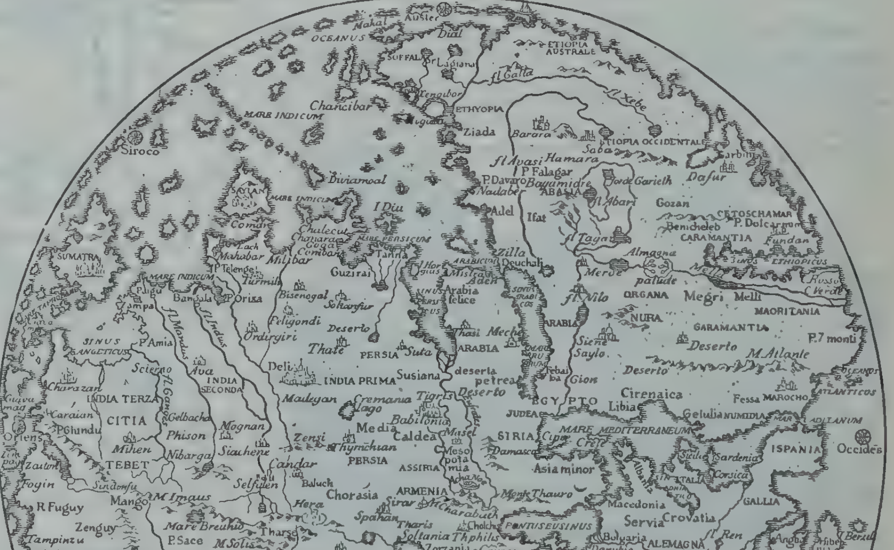

Oriens
PETRUS VESCONTE
1320
ASIA
AFRICA
EUROPA
Ponente
India infer.
Johis pbri
Gog et Magog
Sina
finis Indie
Albania
Magnis Canis
Bactria
India magna
India parva
Tauris
Persia
Yrcania
Arabia
Mecha
M. Rubrum
Gorgia
Jerusalem
Egyptus
Nubia
Ethiopia et Barbari
Regio inhitat pp. Calorem
Regio inhitabil pp. algorem
Sytia
Rutenia
Ungaria
Polonia
Gotia
Germania
Roma
Cartago
Affrica
Maurítania
Francia
Anglia
Castella
Dacia
Norvegia
Livonia
Gaulolla
Getulia
Locesim
Pentapolis
Sirtas
FIG. 21.—Map illustrating Marino Sanuto's *Liber secretorum fidelium crucis*.

On these old charts the Mediterranean is delineated with surprising fidelity. The meridian distance between the Straits of Gibraltar and Beirut in Syria amounts upon them to about 3000 Portolano miles, equal in lat. 36° N. to 40·9°, as compared with an actual difference of 41·2°, and a difference of 61° assumed by Ptolemy. There exists, however, a serious error of orientation, due, according to Professor H. Wagner, to the inexperience of the cartographers who first combined the charts of the separate basins of the Mediterranean so as to produce a chart of the whole. This accounts for Gibraltar and Alexandria being shown as lying due east and west of each other, although there is a difference of 5° of latitude between them, a fact known long before Ptolemy.

The production of these charts employed numerous licensed draughtsmen in the principal seaports of Italy and Catalonia, and among seamen these MS. charts remained popular long after the productions of the printing-press had become available. The oldest of these maps which have been preserved, the so-called "Pisan chart," which belongs probably to the middle of the 13th century, and a set of eight charts, known by the name of its former owner, the Cavaliere Tamar Luxoro, of somewhat later date, are both the work of Genoese artists. Among more eminent Genoese cartographers are Joannes da Carignano (d. 1344), Petrus Vesconte, who worked in 1311 and 1327, and is the draughtsman of the maps illustrating Marino Sanuto's *Liber secretorum fidelium crucis*, which was to have roused Christendom to engage in another crusade (figs. 19 and 21) Battista Beccario (1426, 1435) and Bartolomeo Pareto (1455). Venice ranks next to Genoa as a centre of cartographic activity. Associated with it are Francesco Pizigano (1367–1373), Francesco de Cesanis (1421), Giacomo Giroldi (1422–1446), Andrea Bianco (1436–1448) Giovanni Leardo (1442–1452), Alvise Cadamosto, who was associated with the Portuguese explorers on the west coast of Africa (1454–1456) and whose *Portolano* was printed at Venice in 1490, and Fra Mauro (1457).

Associated with Ancona are Grazioso Benincasa and his son Andreas, whose numerous charts were produced between 1461 and 1508, and Count Ortomano Freducci (1497–1538).

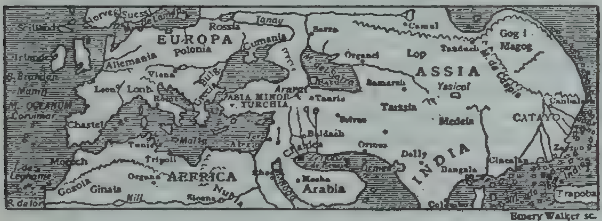
The earliest among Majorcan and Catalonian cartographers is Angelino Dulcert (1325–1339) whom A. Managhi claims as a Genoese, whose true name according to him was Angelino Dalorto.


OCEANUS
ETIOPIA AUSTRALE
Chancibar
MARE INDICUM
ETHYOPIA
Siroco
Ziada
ETIOPIA OCCIDENTALE
Adel
SUMATRA
Guzirat
Arabia felice
Aden
Nilo
Merõe
Megri
Melli
MAORITANIA
GARAMANTIA
Deserto
M. Atlante
Orisa
Bangala
INDIA PRIMA
Susiana
PERSIA
ARABIA
Egypto
Cirenaica
Libia
Gelulia
NUMIDIA
INDIA TERZA
INDIA SECONDA
CITIA
TEBET
Caldea
Babilonia
Media
SIRIA
Damasco
MARE MEDITERRANEUM
Creta
Sicilia
Sardenia
Corsica
ISPANIA
Occides
Oriens
Asia minor
ARMENIA
Chorasia
Macedonia
Servia
Croatia
GALLIA
Mare Breuhio
Danubio
ALEMAGNA
Anglia
Scotia
SERICA
Zagatai
TARTARIA
UNGARIA
POLANA
Praga
PRUSIA
NORVEGIA
Samargant
P. Gothan
Rossia rossa
LITUANA
Rossia negra
Riga
SVETIA
CHATAJO
Tangut
Rossia biancha
ALANA
Rossia noza
Novogrado
ROSSIA
PILANDIA
Islanda
Moschouia
P. Balimata
P. SIBIR
P. Meschiera
P. Destini
PERMIA
P. Cestan
Cavode Rossia
Septentrion
TRAMONTANA
FIG. 22.—Fra Mauro (1457).

Other Catalans are Jahuda Cresques, a Jew of Barcelona, the supposed author of the famous Catalan map of the world (1375), Guglielmo Solerio (1384), Mecia de Viladestes (1413–1433) Gabriel de Valleseche (1439–1447) and Pietro Roselli, a pupil of Beccario of Genoa (1462).

These maps were originally intended for the use of seamen navigating the Mediterranean and the coasts of the Atlantic, but in the course of time they were extended to the mainland and ultimately developed into maps of the whole world as then known. Thus Pizigano's map of 1367 extends as far east as the Gulf of Persia, whilst the Medicean map of 1356 (at Florence) is remarkable on account of a fairly correct delineation of the Caspian, the Shari river in Africa, and the correct direction given to the west coast of India, which had already been pointed out in a letter of the friar Giovanni da Montecorvino of 1252. Most of the expansions of Portolano maps into maps of the world are circular in shape, and resemble the wheel maps of an earlier period. This is the character of the map of Petrus Vesconte of 1320 (fig. 21), of Giovanni Leardo (1448) and of a Catalan map of 1450. Jerusalem occupies the centre of these maps, Arab sources of information are largely drawn upon, while Ptolemy is neglected and contemporary travellers are ignored. Far superior to these maps is Fra Mauro's map (1457), for the author has availed himself not only of the information collected by Marco Polo and earlier travellers, but was able, by personal intercourse, to gather additional information from Nicolo de' Conti, who had returned from the east in 1440, and more especially from Abyssinians who lived in Italy at that time. His delineation of Abyssinia, though unduly spread over a wide area, is indeed wonderfully correct.

Very different in character is the Catalan map of 1375, for its author, discarding Ptolemy, shows India as a peninsula. On the other hand, an anonymous Genoese would-be reformer of maps (1457; fig. 24), still adheres to the erroneous Ptolemaic delineation of southern Asia, and the same error is perpetuated by Henricus Marvellus Germanus on a rough map showing the Portuguese discoveries up to 1489. None of these maps is graduated, but if we give the Mediterranean a length of 3000 Portolano miles, equivalent in 36° N. to 41°, then the longitudinal extent of the old world as measured on the Genoese map of 1457 would be 136° instead of 177° or more as given by Ptolemy.


EUROPA
Polonia
Rossia
Tanay
Sarra
Camul
Gog Magog
Irlanda
Alemania
Viena
ASIA MINOR TURCHIA
Samarcha
ASSIA
Tarssia
Medeia
CATAYO
Tripoli
AFFRICA
Nubia
Arabia
INDIA
Trapoba

Emery Walker sc.

FIG. 23.—Catalan Map of the World (1375).

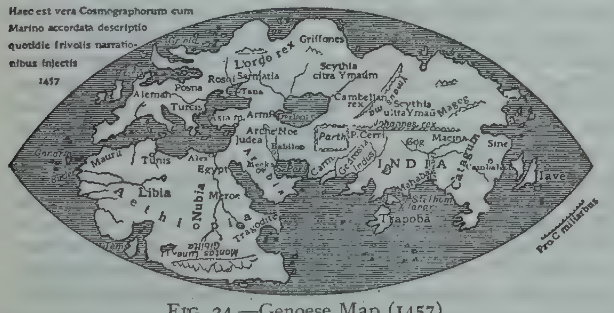

Haec est vera Cosmographorum cum Marino accordata descriptio quotidie frivolis narrationibus injectis 1457
Griffones
Lordo rex
Scythia citra Ymaum
Sarmatia
Alemani
Posna
Tana
Turcia
Cambellan rex
Scythia ultra Ymaum
Johannes rex
Asia m.
Armenia
Arche Noe
Judea
Babilon
Parthia
P. Cerri
Macina
Sine
INDIA
Tunis
Egypt
Libia
Nubia
Meroe
ethiopia
Trapoba
Iave
Montes lune
Pro C millibus

FIG. 24.—Genoese Map (1457).

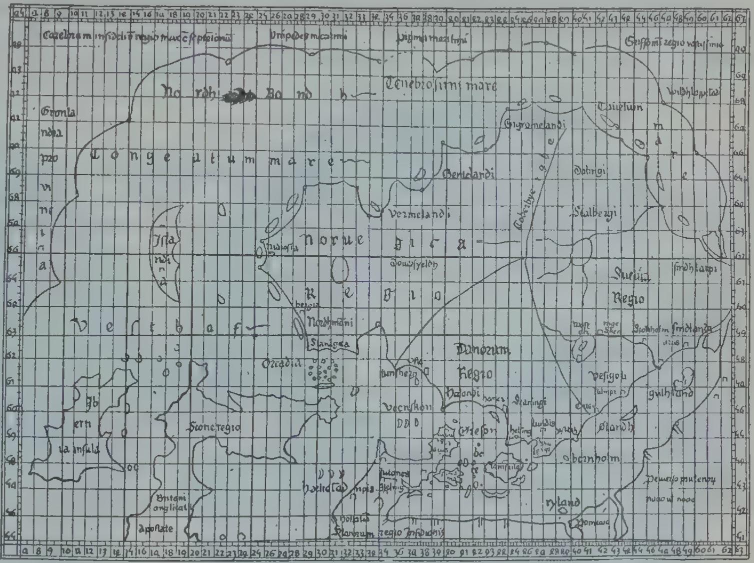

Tenebrosũ mare
Gronla
Vermelandi
Norue gia
Regio
Danorum Regio
Scone regio
Suecia Regio
Stalbergi
Bornholm
Ylland
Britani anglicati

FIG. 25.—*Claudius Clavus Swartha* (1427).

The Revival of Ptolemy.—Ptolemy's great work became known in western Europe after Jacobus Angelus de Scarparia had translated it into Latin in 1410. This version was first printed in 1475 at Vicenza, but its contents had become known through MS. copies before this, and their study influenced the construction of maps in two respects. They led firstly to the addition of degree lines to maps, and secondly to the compilation of new maps of those countries which had been inadequately represented by Ptolemy. Thus Claudius Clavus Swartha (Niger), who was at Rome in 1424, compiled a map of the world, extending westward as far as Greenland. The learned Cardinal Nicolaus Krebs, of Cusa (Cues) on the Moselle, who died 1464, drew a map of Germany which was first published in 1491; D. Nicolaus Germanus, a monk of Reichenbach, in 1466 prepared a set of Ptolemy's maps on a new projection with converging meridians; and Paolo del Pozzo Toscanelli in 1474 compiled a new chart on a rectangular projection, which was to guide the explorer across the western ocean to Cathay and India.

Of the seven editions of Ptolemy which were published up to the close of the 15th century, all except that of Vicenza (1475) contained Ptolemy's 27 maps, while Francesco Berlinghieri's version (Florence 1478), and two editions published at Ulm (1482 and 1486), contained four or five modern maps in addition, those of Ulm being by Nicolaus Germanus.

The geographical ideas which prevailed at the time Columbus started in search of Cathay may be most readily gathered from two contemporary globes, the one known as the Laon globe because it was picked up in 1860 at a curiosity shop in that town, the other produced at Nuremberg in 1492 by Martin Behaim.[1] The Laon globe is of copper gilt, and has a diameter of 170 mm. The information which it furnishes, in spite of a legend intended to lead us to believe that it presents us with the results of Portuguese explorations up to the year 1493, is of more ancient date. The Nuremberg globe is a work of a more ambitious order. It was undertaken at the suggestion of George Holzschuher, a travelled member of the town council. The work was entrusted to Martin Behaim, who had resided for six years in Portugal and the Azores, and was believed to be a thoroughly qualified cosmographer.

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[1] E. G. Ravenstein, *Martin Behaim, his Life and his Globe* (London, 1908). On the original only equator, ecliptics, tropics, polar circles and one meridian 80° to the west of Lisbon are laid down.

The globe is of pasteboard covered with whiting and parchment, and has a diameter of 507 mm. The author followed Ptolemy not only in Asia, but also in the Mediterranean. He did not avail himself of the materials available in his day. Not even the coasts of western Africa are laid down correctly, although the author claimed to have taken part in one of the Portuguese expeditions. The ocean separating Europe from Asia is assumed as being only 126° wide, in accordance with Toscanelli's ideas of 1474. Very inadequate use has been made of the travels of Marco Polo, Nicolo de' Conti, and of others in the east.[1] On the other hand, the globe is made gay with flags and other decorations, the work of George Glockendon, a well-known illuminator of the time.

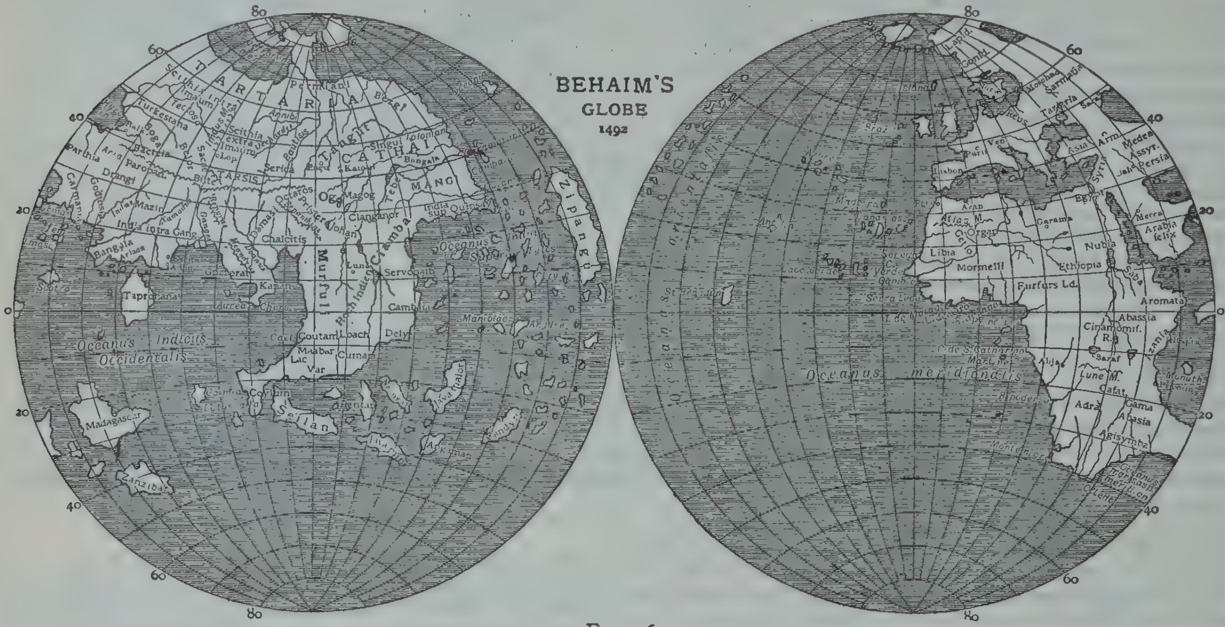

Fig. 26.

The maritime discoveries and surveys of that age of great discoveries were laid down upon so-called "plane-charts," that is, charts having merely equidistant parallels indicated upon them, together with the equator, the tropics and polar circles, or, in a more advanced stage, meridians also. The astrolabe quadrant or cross-staff enabled the mariner to determine his latitude with a certain amount of accuracy, but for his longitude he was dependent upon dead reckoning, for although various methods for determining a longitude were known, the available astronomical ephemerides were not trustworthy, and errors of 30° in longitude were by no means rare. It was only after the publication of Kepler's *Rudolphine Table* (1626) that more exact results could be obtained. A further difficulty arose in connexion with the variation of the compass, which induced Pedro Reinel to introduce two scales of latitude on his map of the northern Atlantic (1504; fig. 27).

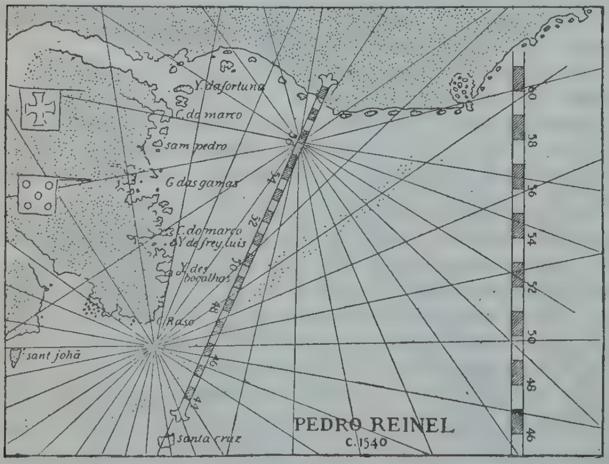

Fig. 27.

The chart of the world by Juan de la Cosa, the companion of Columbus, is the earliest extant which depicts the discoveries in the new world (1500), Nicolaus de Canerio, a Genoese, and the map which Alberto Cantino caused to be drawn at Lisbon for Hercules d'Este of Ferrara (1502), illustrating in addition the recent discoveries of the Portuguese in the East. Other cosmographers of distinction were Pedro Reinel (1504–1542), Nuno Garcia de Toreno (1520), to whom we are indebted for 21 charts, illustrating Magellan's voyage, Diogo Ribero (maps of the world 1527, 1529),[2] Alonzo de Santa Cruz, of Seville, whose *Isolario general* includes charts of all parts of the world (1541), John Rotz or Rut (1542), Sebastian Cabot (1544), as also Nicolas Desliens, Pierre Desceliers, G. Breton and V. Vallard, all of Arques, near Dieppe, whose charts were compiled between 1541 and 1554.

Of the many general maps of the world or of particular countries, a large number illustrate such works as G. Reisch's *Margarita philosophica* (1163), the cosmographies of Peter Apianus or Bienewitz (1520, 1522, 1530), Seb. Münster (1544), J. Honter (1546) and Gulielmus Postel (1561) or the *Geographia* of Livio Sanuto (1588); others, and these the more numerous and important, supplement the original maps of several editions of Ptolemy. Thus the Roman edition of 1507, edited by Marcus Benaventura and Joa Cota, contains 6 modern maps, and to these was added in 1508 Joh. Ruysch's famous map of the world on a modified conical projection. The next edition published at Venice in 1511 contained a heart-shaped world by Bernhard Sylvanus. The Strassburg Ptolemy of 1513 has a supplement of as many as 20 modern maps by Martin Waldseemüller or Ilacomilus, several among which are copied from Portuguese originals. Waldseemüller was one of the most distinguished cartographers of his day. He was born at Radolfzell in Baden in 1470, was associated with Ringmann at the gymnasium of

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[1] See fig. 23, Catalan Map of the World (1375).

[2] J. G. Kohl published facsimiles of the American section of the maps (Weimar, 1860).

St Dié, and died in 1521. He published in 1507 a huge map of the world, in 12 sheets, together with a small globe of a diameter of 110 mm., the segments for which were printed from wood-blocks. On these documents the new world is called America, after Amerigo Vespucci, its supposed discoverer. In 1511 Waldseemüller published a large map of Europe, in 1513 he prepared his maps for the Strassburg edition of Ptolemy, and in 1516 he engraved a copy of Canerio's map of the world. The Strassburg Ptolemy of 1522 contains Waldseemüller's maps,[1] edited on a reduced scale by Laurentius Frisius, together with three additional ones. The same set of maps is reprinted in the Strassburg edition of 1524, newly translated by W. Pirckheimer with notes by Joh. Müller Regiomontanus, and in the Lyon edition of 1535, edited by Michael Servetus. The new maps of the Basel edition of 1540, twenty-one in number, are by Sebastian Münster; Jacob Gastaldo supplied the Venice edition of 1548 with 34 modern maps, and these with a few additions are repeated in Girolamo Ruscelli's Italian translation of Ptolemy published at Venice in 1561.

Equally interesting with these Ptolemaic supplements are collections like that of Anton Lafreri, which contains reprints of 142 maps of all parts of the world originally published between 1556 and 1572 (*Geografica tavole moderne*, Rome, n.d.), or that of J. F. Camocio, published at Venice in 1576, which contains 88 reprints.

The number of cartographers throughout Europe was considerable, and we confine ourselves to mentioning a few leading men. Among them Germany is then represented by G. Glockedon, the author of an interesting road-map of central Europe (1501), Sebastian Münster (1489–1552), Elias Camerarius, whose map of the mark of Brandenburg won the praise of Mercator; Wolfgang Latz von Lazius, to whom we are indebted for maps of Austria and Hungary (1561), and Philip Apianus, who made a survey of Bavaria (1553–1563), which was published 1568 on the reduced scale of 1:144,000, and is fairly described as the topographical masterpiece of the 16th century. For maps of Switzerland we are indebted to Konrad Türst (1495–1497), Johann Stumpf (1548) and Aegidius Tschudi (1538). A map of the Netherlands from actual survey was produced by Jacob of Deventer (1536–1539). Leonardo da Vinci, the famous artist, while in the service of Cesare Borgia as military engineer, made surveys of several districts in central Italy. Other Italian cartographers of merit were Giovanni Battiste Agnese of Venice, whose atlases (1517–1564) enjoyed a wide popularity; Benedetto Bordone (1528); Giacomo Gastaldo, cosmographer of the Venetian Republic (1534–1568), and his successor, Paolo Forlani. New maps of Spain and Portugal appeared in 1560, the former being due to Pedro de Medina, the latter to Fernando Alvarez Secco and Hernando Alvaro. Among the French map-makers of this period may be mentioned Oronce Finée (Finaeus), who in 1525 published a map of France, and Jean Jolivet (*c.* 1560). Gregorio Lilly (1546) and Humphrey Lhuyd of Denbigh (d. 1510) furnished maps of the British Isles, Olaus Magnus (1539) of Scandinavia, Anton Wied (1542), Sigismund von Herberstein (1549) and Anthony Jenkinson (1562) of Muscovy.

The cylindrical and modified conical projections of Marinus and Ptolemy were still widely used, the stereographical projection of Hipparchus, was for the first time employed for terrestrial maps in the 16th century, but new projections were introduced in addition to these. The earliest of these, a trapeziform projection with equidistant parallels, by D. Nicolaus Germanus (1466), naturally led to what is generally known as Flamsteed's projection. Joh. Stabius (1502) and his pupil J. Werner (1514) devised three heart-shaped projections, one of which was equivalent. Petrus Apianus (1524) gave his map an elliptical shape. H. Glareanus (1510) was the first to employ an equidistant zenithal polar projection.

No reasonable fault can be found with the marine surveyors of this period, but the scientific cartographers allowed themselves too frequently to be influenced by Ptolemaic traditions. Thus Gastaldo (1548) presents us with a map of Italy, which, except as to nomenclature, differs but little from that of Ptolemy, although on the Portolano charts the peninsula had long since assumed its correct shape. Many of the local maps, too, were excellent specimens of cartography, but when we follow any cartographer of the period into regions the successful delineation of which depended upon an intelligent interpretation of itineraries, and of information collected by recent travellers, they are generally found to fail utterly. This is illustrated by the four sketch maps shown in fig. 28.

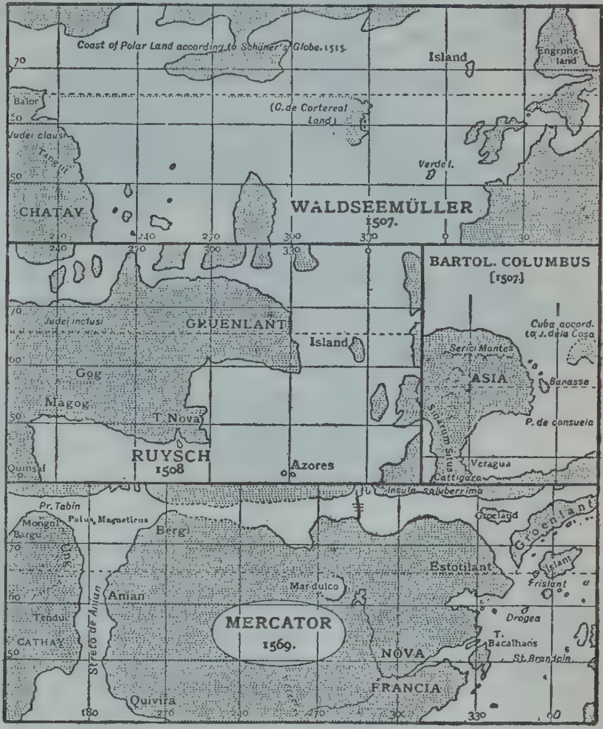

FIG. 28.

Columbus, trusting to Toscanelli's misleading chart, looked upon the countries discovered by him as belonging to eastern Asia, a view still shared about 1507 by his brother Bartolomeo. Waldseemüller (1507) was the first to separate America and Asia by an ocean of considerable width, but J. Ruysch (1508) returns to the old idea, and even joins Greenland (Gruenlant) to eastern Asia. Bologninus Zalterius on a map of 1566, and Mercator on his famous chart of 1569, separates the two continents by a narrow strait which they call Streto de Anian, thus anticipating the discovery of Bering Strait by more than a hundred and fifty years. Anian, however, which they place upon the American coast, is no other than Marco Polo's Anica or Anin, our modern Annam. Such an error could never have arisen had the old compilers of maps taken the trouble to plan Marco Polo's routes.

Globes, both celestial and terrestrial, became popular after the discovery of America. They were included among the scientific apparatus of ships and of educational establishments. Columbus and Magellan had such globes, those of the latter produced by P. Reinel (1519), and Conrad Celtes tells us that he illustrated his lectures at the university of Vienna with the help of globes (1501). Globes were still engraved on copper, or painted by hand, but since 1507, in which year Waldseemüller published a small globe of a diameter of 110 mm., covered with printed segments or gores, this cheap and expeditious method has come into general use. Waldseemüller constructed his gores graphically, A. Dürer (1525) and Hen. Loriti Glareanus (1527) were the first who dealt scientifically with the principles underlying their construction. Globes

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[1] Facsimiles of the maps of 1507 and 1517 were published by J. Fischer and F. M. von Wieser (Innsbruck, 1903).

covered with printed gores were produced by L. Boulenger (1514), Joh. Schöner (1515), P. Apianus, Gemma Frisius (1530) and G. Mercator (1541). Leonardo da Vinci's rough map of the world in 8 segments (*c.* 1513) seems likewise to have been intended for a globe. Of J. Schöner we know that he produced four globes, three printed from segments (1515, 1523, 1533), and one of larger size (diam. 822 mm.), which is drawn by hand, and is preserved in the Germanic Museum at Nuremberg. Among engraved globes, one of the most interesting is that which was discovered by R. M. Hunt in Paris, and is preserved in the Lenox Library, New York. Its diameter is only 4½ in. (127 mm.). The so-called "Nancy globe" is of chased silver, richly ornamented, and formerly served the purpose of a pyx. Its diameter is 160 mm., its date about 1530. About the same date is assigned to a globe by Robert de Bailly, engraved on copper and gilt (diam. 440 mm.). Celestial globes were manufactured by Regiomontanus (d. 1476) at Nuremberg, by Joh. Stöffler (1499), and by G. Hartmann (1535).

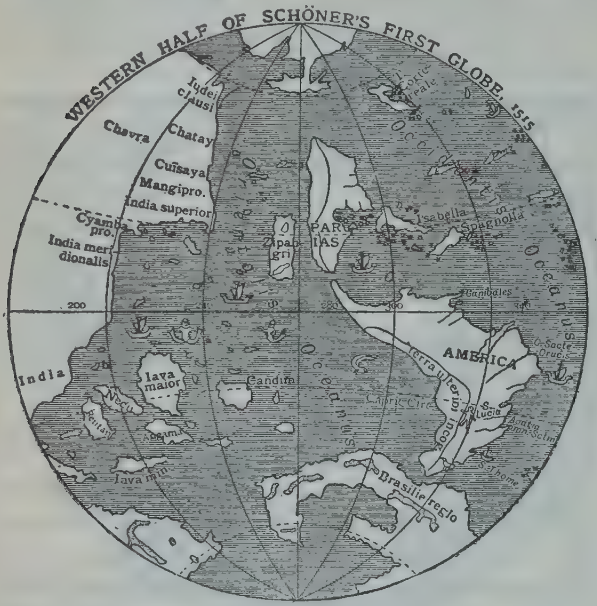

FIG. 29.

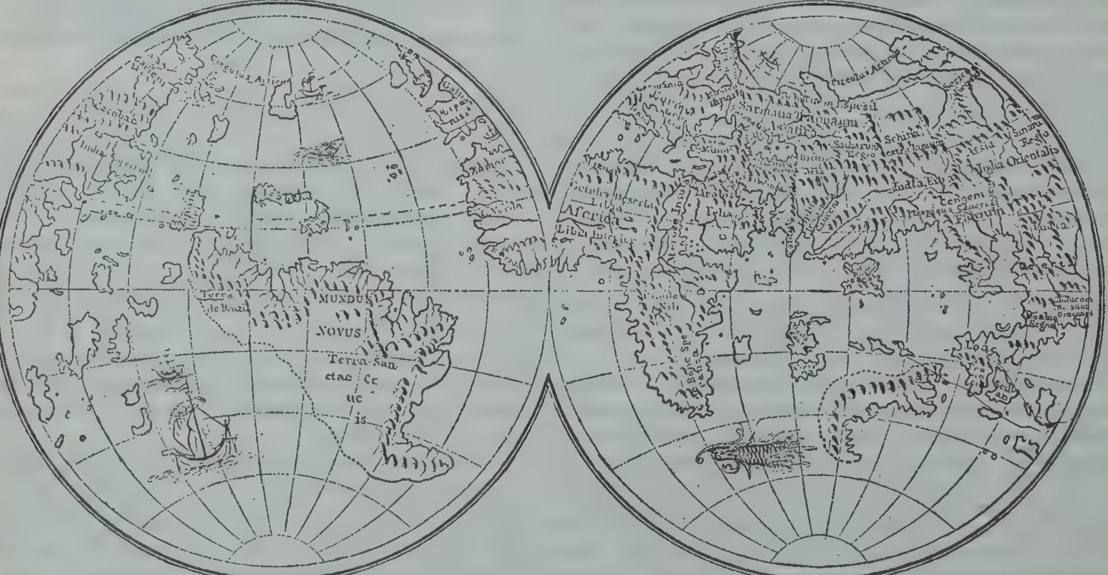

FIG. 30.—Lenox Globes (1510).

Mercator and his Successors.—Of Gerhard Kremer (1512–1594) the earliest works are a map of Palestine (1537), a map of the world on a double heart-shaped projection (1525), and a topographical map of Flanders based upon his own surveys (1540), a pair of globes (1541, diam. 120 mm.), and a large map of Europe which has been praised deservedly for its accuracy (1554). He is best known by his marine chart (1569) and his atlas. The projection of the former may have been suggested by a note by W. Pirkheimer in his edition of Ptolemy (1525). Mercator constructed it graphically, the mathematical principles underlying it being first explained by E. Wright (1594). The "Atlas" was only published after Mercator's death, in 1595. It only contained nine maps, but after the plates had been sold to Jodocus (Jesse) Hondius the number of maps was rapidly increased, although Mercator's name was retained. Mercator's maps are carefully engraved on copper. Latin letters are used throughout; the miniatures of older maps are superseded by symbols, and in the better-known countries the maps are fairly correct, but they fail lamentably when we follow their author into regions—the successful delineation of which depends upon a critical combination of imperfect information.

Even before Mercator's death, Antwerp and Amsterdam had become great centres of cartographic activity, and they maintained their pre-eminence until the beginning of the 18th century. Abraham Ortelius (1527–1592), of Antwerp, a man of culture and enterprise, but not a scientific cartographer, published the first edition of his *Theatrum orbis terrarum* in 1570. It then contained 53 maps, by various authors. By 1595 the number of maps had increased to 119, including a *Parergon* or supplement of 12 maps illustrating ancient history. In 1578 was published the *Speculum orbis terrarum* of Gerard de Jude or de Judaeis. Lucas Janszon Waghenaer (Aurigarius) of Enkhuizen published the first edition of his *Spiegel der Zeevaart* (Mariners' Mirror) at Leiden in 1585. It was the first collection of marine maps, lived through many editions, was issued in several languages and became known as *Charettier* and *Waggoner*. In the same year Adrian Gerritsz published a valuable *Paskaarte* of the European Sea. Ten years afterwards, in 1595, W. Barentszoon published a marine atlas of the Mediterranean, the major axis of which he reduced to 42 degrees. Jodocus Hondius has already been referred to as the purchaser of Mercator's plates. The business founded by him about 1602 was continued by his sons and his son-in-law, Jan Janszon (Jansonius) and others. By 1653 this firm had already produced atlases including 451 charts. Willem Janszon, the father of Hondius's partner, published a collection of charts (1608), to which he gave the title of *Het Licht der Zeevaart* (the seaman's light).

Another cartographic publishing firm was established at Amsterdam in 1612 by Willem Janszon Blaeu (1571–1638), a friend of Tycho Brahe, from 1633 "mapmaker" of the states-general, and a man of scientific culture. He was succeeded by his son Jan (d. 1673) and grandson Cornelius, and before the end of the century turned out a *Zee-Spiegel* of 108 charts (1623), an *Atlas novus* (*Nieuwe Atlas*), 1642, enlarged in the course of time until it consisted of 12 folio volumes containing hundreds of maps. J. A. Colom in 1633 published a collection of maps under the quaint title of *Vurig Colom der Zeevaert* (Fiery Column of Navigation). Among more recent Dutch map publishers are Nicolaus Vischer (Piscator), R. Goos, H. Doncker, F. de Wit, and J. and G. van Keulen, whose atlases were published between 1681 and 1722. These Dutch maps and charts are generally accompanied by descriptive notes or sailing directions printed on the back of them. A similar work is the *Arcano del mare* of Sir Robert Dudley, duke of Northumberland, the numerous sheets of which are on Mercator's projection (1631).

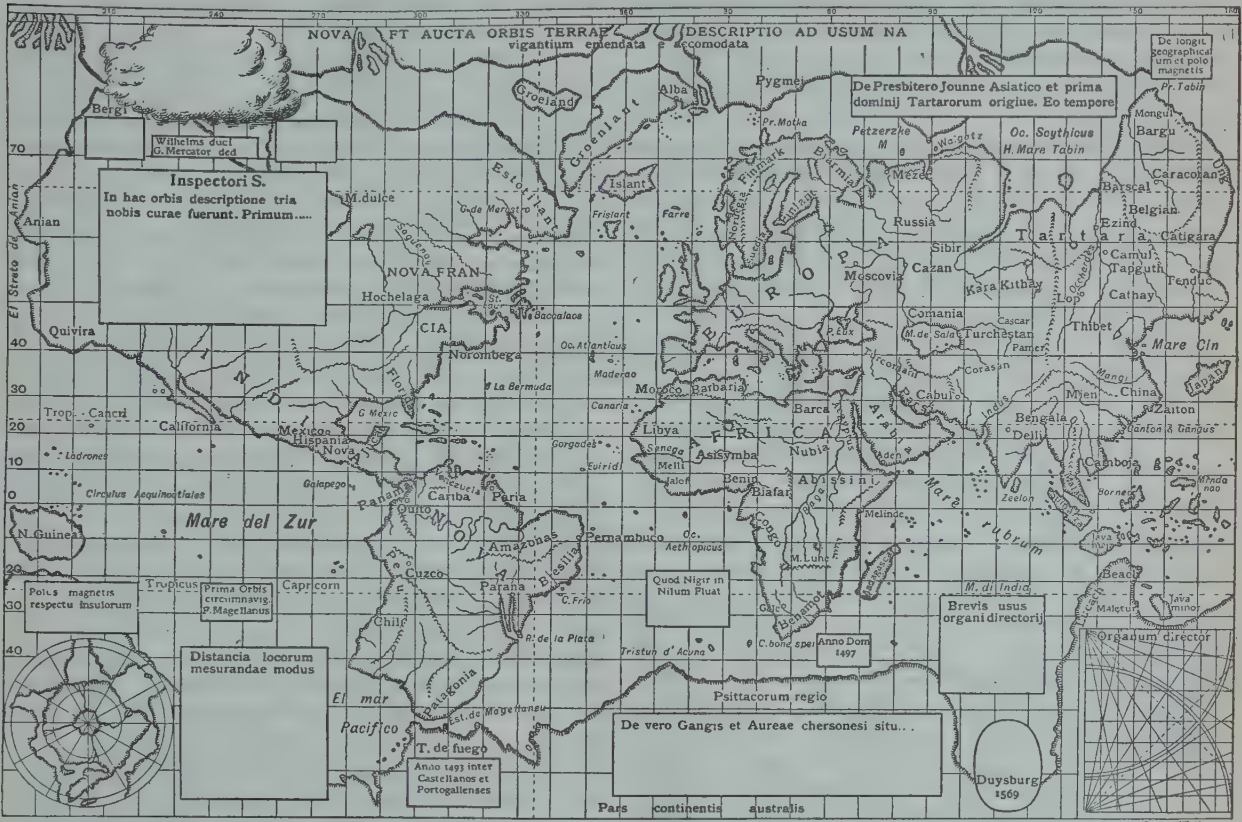
NOVA ET AUCTA ORBIS TERRAE DESCRIPTIO AD USUM NAVIGANTIUM EMENDATA E ACCOMODATA
De longit. geographicarum et polo magnetis
Bergi
Wilhelms duci G. Mercator ded
Inspectori S.
In hac orbis descriptione tria nobis curae fuerunt. Primum.....
De Presbitero Jounne Asiatico et prima dominij Tartarorum origine. Eo tempore
Groeland
Groenlant
Alba
Pygmei
Pr. Motka
Petzerzke
Waigatz
Oc. Scythicus
H. Mare Tabin
Pr. Tabin
Mongul
Bargu
Estotilant
Islant
Finmark
Biarmia
Meze
Caracoran
Barscal
Belgian
Ezind
M. dulce
Anian
El Strecto de Anian
G. de Merosiro
Frisland
Farre
Russia
Tartaria
Catigara
Camul
Tanguth
Tenduc
Sibir
Cazan
Moscovia
EUROPA
Kara Kithay
Lop
Cathay
NOVA FRANCIA
Hochelaga
Baccalaos
Comania
Cascar
Thibet
Mare Cin
Quivira
CIA
Norombega
Oc. Atlanticus
M. de Sala
Turchestan
Pamer
INDIA
Florida
Maderao
La Bermuda
Corasan
Mangi
China
Iapan
Marocco
Barbaria
Cabulo
Mien
Trop. Cancri
California
G. Mexic
Canaria
Barca
Arabia
Bengala
Delli
Zaiton
Canton & Gangus
Mexico
Hispania Nova
Libya
AFRICA
Nubia
Aden
Gorgades
Euirid
Senega
Melli
Asisymba
Cambo ja
Ladrones
Galapego
Jalof
Benin
Biafar
Abissini
Mare rubrum
Mindanao
Circulus Aequinoctiales
Panama
Caribana
Paria
Borneo
Zeelon
Quito
NOVA
Melinde
Mare del Zur
N. Guinea
Amazones
Pernambuco
Oc. Aethiopicus
Congo
M. Luna
Madagascar
Java
Peru
Brasilia
Cuzco
Parana
Beach
Tropicus Capricorni
Prima Orbis circumnavig. P. Magellanus
Polus magnetis respectu insulorum
Quod Nigir in Nilum Fluat
C. Frio
Chile
M. di India
Brevis usus organi directorij
Maletur
Java minor
Lucach
Benomo
Anno Dom 1497
Organum director
Distancia locorum mesurandae modus
R. de la Plata
Tristun d' Acuna
C. bone sper
Psittacorum regio
El mar Pacifico
Patagonia
Est. de Magellanes
T. de fuego
Anno 1493 inter Castellanos et Portogallenses
De vero Gangis et Aureae chersonesi situ..
Duysburg 1569
Pars continentis australis
70
50
40
30
20
10
0
20
30
40
210
240
270
300
330
360
30
60
90
120
150
180

FIG. 31.—Mercator's Chart of the World (1569).

Emery Walker sc.

In France, in the meantime, an arc of the meridian had been measured (1669–1670) by Jean Picard, numerous longitudes had been observed between 1672 and 1680 by the same, and by Phil. de Lahire (d. 1719), and these were utilized in a *Carte de France* "as corrected from the observations of the members of the Academy of Sciences" (1666–1699), in a map of the world (1694) by D. Cassini, as also in *Le Neptune François* (1693) with contributions by Pene, D. Cassini and others. These corrected longitudes were not yet available for the maps produced by Nicolas Sanson of Abbeville, since 1627. The cartographical establishment founded by him in that year was carried on after his death in 1667 by his sons, his son-in-law, P. Duval (d. 1683) and his grandson Robert du Vaugondy (d. 1766). Among the cartographers whom he employed were M. Tavernier and Mariette, and in many instances he mentioned the authors whose maps he copied. By 1710 the maps published by the firm numbered 466. Nicolas de Fer, the great rival of Sanson, and his heirs, are stated to have published as many as 600 maps after 1700.

In no other country of Europe was there at the close of the 16th century a geographical establishment capable of competing with the Dutch towns or with Sanson, but the number of those who produced maps, in many instances based upon original surveys, was large. Germany is thus represented, among others, by C. Henneberger (map of Prussia, 1576), by M. Oeder, (survey of Saxony, 1586–1607), A. Rauh (fine hill features on a map of the environs of Wangen and Lindau, 1617), W. Schickhardt (survey of Württemberg, 1624–1635), and G. M. Vischer (map of Austria and Styrai, 1669–1786); Switzerland by H. C. Gyger (Canton of Zürich, a masterpiece, 1667); Italy by G. A. Magini (1558–1610), and V. Coronelli, appointed cosmographer of the Venetian Republic, 1685, and founder of the Ac. Cosmogr. dei Argonauti, the earliest geographical society, and Diogo Homem, a Portuguese settled at Venice (1558–1574); Denmark by J. Mejer of Husum (1650); Sweden by A. Buraeus, the "father of Swedish cartographers" (1650–1660); the British Islands by Ch. Saxton (County Atlas of England and Wales 1575), J. Speed (*Theatrum* of Great Britain, 1610), Timothy Pont and Robert Gordon of Strathloch (map of Scotland, 1608), and A. Moll. A *Novus atlas sinensis*, based upon Chinese surveys, was published in 1655 by Martin Martini, S.J., a missionary recently returned from China. Isaac Voss, in his work *De Nili* (1659), published a map of central Africa, in which he anticipated D'Anville by rejecting all the fanciful details which found a place upon Filippo Pigafetta's map of that continent.

The first maps illustrating the variation of the compass were published by Chris. Burrus (d. 1632) and Athanasius Kircher (*Magnes*, Rome, 1643), and maps of the ocean and tidal currents by the latter in his *Mundus subterraneus* (1665). Edmund Halley, the astronomer, compiled the first variation chart of scientific value (1683), as also a chart of the winds (1686).

Globes manufactured for commercial purposes by Blaeu and others have already been mentioned, but several large globes, for show rather than for use, were produced in addition to these. Thus A. Busch, of Limburg (1656–1664), manufactured a globe for Duke Frederick of Holstein, formerly at Gottorp, but since 1713 at Tsarskoye Zelo. It has a diameter of 11 ft. (3·57 metres) and is hollow, the inner surface of the shell being covered with a star map, and the outer surface with a map of the world. Professor Erh. Weigel (1696) produced a hollow celestial globe in copper, having a small terrestrial globe in its centre. Its diameter is 3·25 metres. Lastly there is a pair of giant globes of artistic design, turned out by V. Coronelli (1623), and intended as presents to Louis XIV. Their diameter is nearly 5 metres. A pair of globes of 1592 by Emeric Molineux (diam. 610 mm.) is now in the Temple Library, and is referred to in Blundeville's *Exercises* (1594).

The Eighteenth Century.—It was no mere accident which enabled France to enjoy a pre-eminence in cartographic work during the greater part of the 18th century. Not only had French men of science and scientific travellers done excellent work as explorers in different parts of the world, but France could also boast of two men, Guillaume Delisle and J. B. Bourguignon d'Anville, able to utilize in the compilation of their maps the information they acquired.

Delisle (1675–1726) published 98 maps, and although as works of art they were inferior to the maps of certain contemporaries, they were far superior to them in scientific value. On one of his earliest maps compiled under advice of his father Claude (1700), he gave the Mediterranean its true longitudinal extension of 41°. It was Delisle who assumed the meridian of Ferro, which had been imposed upon French navigators by royal order (1634), to lie exactly 20° to the west of Paris. The work of reform was carried further by B. D'Anville (1697–1782). Altogether he published 211 maps, of which 66 are included in his *Atlas gênéral* (1737–1780); he swept away the fanciful lakes from off the face of Africa, thus forcibly bringing home to us the poverty of our knowledge (fig. 32), delineated the Chinese Empire in accordance with the map based on the surveys conducted during the reign of the emperor Kanghi, with the aid of Jesuit missionaries, and published in 1718; boldly refused to believe in the existence of an Antarctic continent covering half the southern hemisphere, and always brought a sound judgment to bear upon the materials which the ever-increasing number of travellers placed at his disposal. Among other French works of importance deserving notice are *Le Neptune oriental* of Mannevillette (1745) and more especially the *Carte gêometrique de la France*, which is based upon surveys carried on (1744–1783) by César François Cassini de Thury and his son Dominique de Cassini. It is on a transversal cylindrical (rectangular) projection devised by Jacques Cassini (d. 1746). The hills are shown in rough hachures.

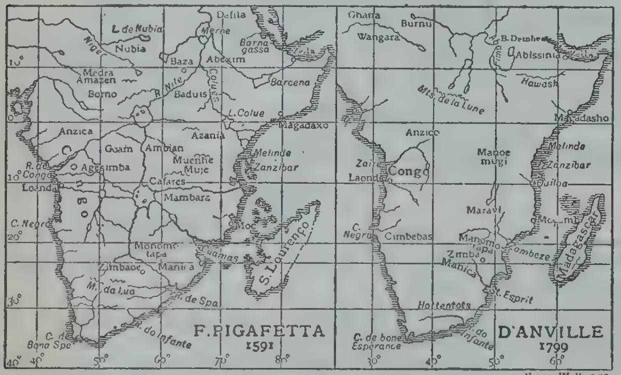

Fig. 32.

England, which had entered upon a career of naval conquest and scientific exploration, had reason to be proud of J. F. W. Desbarres, *Atlantic Neptune* (1774), a North-American Pilot (1779), which first made known the naval surveys of J. Cook and of others; and Tho. Jefferys's *West Indian* and *American Atlases* (1775, 1778). James Rennell (1742–1830), who was surveyor-general of India, published the *Bengal Atlas* (1781), and sagaciously arranged the vast mass of information collected by British travellers and others in India and Africa, but it is chiefly with the name of Aaron Arrowsmith, who came to London in 1778, and his successors, with which the glory of the older school of cartographers is most intimately connected. His nephew John died in 1873. Among local cartographers may be mentioned H. Moll (d. 1732), J. Senex, whose atlas was published in 1725, and Dowet, whose atlas was brought out at the expense of the duke of Argyll.

In Germany J. B. Homann (d. 1724) founded a geographical establishment in 1702, which depended at first upon copies of British and French maps, but in course of time published also original maps such as J. M. Hase's *Africa* (1727) and Tobias Meyer's *Mappa critica* of Germany (1780), J. T. Güssfeld's map of Brandenburg (1773), John Majer's Württemburg (1710), and J. C. Müller's Bavaria, both based on trigonometrical surveys. Colonel Schmettau's excellent survey of the country to the west of the Weser (1767–1787) was never published, as Frederick the Great feared it might prove of use to his military enemies. Switzerland is represented by J. J. Scheuchzer (1712), J. Gessner (d. 1790), G. Walser (*Atlas novus Helvetiae*, 1769), and W. R. Meyer, *Atlas der Schweiz* (1786–1802). Of the Austrian Netherlands, Count Joseph de Ferrari published a chorographic map on the same scale as Cassini's *Carte de la France* (1777). Of Denmark a fine map was published under the auspices of the Academy of Science of Copenhagen (1766–1825) of Spain and Portugal an atlas in 102 sheets by Thomas Lopez (1765–1802); of Russia a map by J. N. Delisle in 19 sheets (1739–1745); charts illustrating the variation of the compass and of magnetic "dip" by E. Dunn (1776); J. C. Wiffe (1768); a chart of the world by W. Dampier (1789). Map projections were dealt with by two eminent mathematicians, J. H. Lambert (1772) and Leonh. Euler (1777).

On the maps of Delisle and d'Anville the ground is still represented by "molehills." Hachures of a rude nature first made their appearance on David Vivier's map of the environs of Paris (1674), and on Cassini's *Carte de la France*. Contour lines (isobaths) were introduced for the first time on a chart of the Merwede by M. S. Cruquius (1728), and on a chart of the English Channel by Phil. Buache (1737). Dupain-Triel, acting on a suggestion of Du Carla, compiled a contoured map of France (1791), and it only needed the introduction of graduated tints between these contours to secure a graphic picture of the features of the ground. It was J. G. Lehmann (1783) who based his method of hill-shading or hachuring upon these horizontal contours. More than 80 methods of showing the hills have found advocates since that time, but all methods must be based upon contours to be scientifically satisfactory.

Two relief maps of Central Switzerland deserve to be mentioned, the one by R. L. Pfyffer in wax, now in Lucerne, the other by J. R. Meyer of Aarau and Müller of Engelberg in papier mâché, now in Zurich. Globes of the usual commercial type were manufactured in France by Delisle (1700), Forbin (1710–1731), R. and J. de Vaugondy (1752), Lalande (1771); in England by E. and G. Adams (1710–1766); Germany by Homann and Seutter (1750). A hollow celestial globe 18 ft. in diameter was set up by Dr Roger Long at Cambridge; the terrestrial globe which Count Ch. Gravie of Vergennes presented to Louis XVI. in 1787 had a diameter of 26 metres, or 85 ft.

Modern Cartography.—The compiler of maps of the present day enjoys many advantages not enjoyed by men similarly occupied a hundred years ago. Topographical surveys are gradually extending, and explorers of recent years are better trained for their work than they were a generation ago, whilst technical processes of recent invention—such as lithography, photography and heliogravure—facilitate or expedite the completion of his task. This task, however, has grown more difficult and exacting. Mere outline maps, such as formerly satisfied the public, suffice no longer. He is called upon more especially to give a satisfactory delineation of the ground, he must meet the requirements of various classes of the public, and be prepared to record cartographically all the facts of physical or political geography which are capable of being recorded on his maps. The ingenuity of the compiler is frequently taxed when called upon to illustrate graphically the results of statistical information of every description.

Germany since the middle of the 19th century has become the headquarters of scientific cartography. This is due as much to the inspiriting teachings of Ritter and Humboldt as to the general culture and scientific training combined with technical skill commanded by the men who more especially devote themselves to this branch of geography, which elsewhere is too frequently allowed to fall into the hands of mere mechanics. Men like H. Berghaus (1797–1884), H. Kiepert (1818–1899), and A. Petermann (1822–1878) must always occupy a foremost place in the history of cartography. Among the geographical establishments of Germany, that founded by Justus Perthes (1785), at Gotha, occupies the highest rank. Among its publications are A. Stieler's *Hand-Atlas* (1817–1832), K. von Spruner's *Historical Atlas* (1438–1488), H. Berghaus' *Physical Atlas* (1838–1842), E. von Sydow's *Wall Maps for Schools* (1838–1840) and *School Atlas* (1847). The titles of these atlases survive, though the authors of the original editions are long dead, and the maps have been repeatedly superseded by others bringing the information up to the date of publication. To the same firm we are indebted for Petermann's *Mitteilungen*, started in 1855 by A. Petermann, after whose death in 1902 they were successively edited by E. Behm, A. Supan and P. Langhans, as also the *Geographisches Jahrbuch* (since 1866), at first edited by E. Behm, afterwards by Professor H. Wagner. Among other geographical institutes in Germany which deserve mention are the Weimar Institut, founded in 1791 by F. J. Bertuch, and directed in 1845–1852 by H. Kiepert; Paul Fleming at Glogau (K. Sohr's Handatlas, 1845), A. Ravenstein at Frankfort, D. Reimer at Berlin (H. Kiepert, *Handatlas*, 1860); R. Andree (*Hand-Atlas*, 1880), and E. Debes (*Hand-Atlas*, 1894) in Leipzig, and E. Hölzer in Vienna (Vincenz von Haardt's maps). France is represented by the publishing firms of Ch. Delagrave (Levaseur's maps), Hachette (Vivien de St Martin's *Atlas universel*, in progress since 1875, F. Schrader's *Atlas de géographie moderne*, 1880), and Armand Colin (Vidal de la Blache's *Atlas général*, 1894). In Great Britain A. Arrowsmith established himself in London in 1770 (*General Atlas*, 1817), but the cartographical business ceased on the death of John Arrowsmith in 1873. John Walker, to whose initiative the charts published by the admiralty are indebted for the perspicuous, firm and yet artistic execution, which facilitate their use by the mariner, was also the author of the maps published by the Society for the Diffusion of Useful Knowledge (1829–1840). Among more recent firms are W. and A. K. Johnston (founded 1825; *Royal Atlas*, 1855); J. Bartholomew & Co., now carried on by J. G. Bartholomew (Reduced Survey maps, *Atlas of the World's Commerce*, 1906); Philip & Sons (*Imperial Atlas*, 1890; *Systematic Atlas* by E. G. Ravenstein, 1894; *Mercantile Marine Atlas*, 1904, globes), and E. Stanford (*London Atlas*).

In 1890 Professor A. Penck proposed to prepare a map of the world, including the oceans, on a scale of 1 : 1,000,000, and his scheme was promised the support of a committee which met in London in 1909, and upon which were represented the leading powers of the world. Maps on that scale of a great part of Africa, Asia and America have been published by British, French, German and United States authorities. A bathymetrical chart of the oceans, by Professor J. Thoulet was published in 1904 at the expense of Prince Albert of Monaco.

Reliefs from printed maps were first produced by Bauerkeller of Darmstadt and Dondorf at Frankfort, from originals furnished by A. Ravenstein (1838–1844). The exaggeration in altitude, on these maps and on those of a later date and on a larger scale, was very considerable. No such exaggeration exists in the case of reliefs of parts of the Alps, on a large scale, by P. Keil and Pelikan (1890), X. Imfeld (1891), P. Oberlerchner (1891–1895), C. Perron (1893–1900), F. Becker (1900), A. Heim (1904) and others. A relief globe was first suggested in a letter of M. Maestlin to J. Kepler (1596). The first globe of this description for the use of the blind, was made by A. Zeune in 1810. H. Erben is the author of a rough relief on a convex surface (1842), but the finest example of this description is a relief of Italy, by César Pomba and H. Fritsche, on a scale of 1 : 1,000,000 and without exaggeration of heights (1880–1884). A map of Italy in the baptistery of St Peter at Rome has occasionally been described as a relief, though it is merely a rude outline map of Italy, by Carlo Fontana (1698), carved into a convex surface.

Several globes of unusual dimensions were produced in the course of last century. That which Colonel Langlois erected in the Champs Elysées (1824) had a diameter of 39 metres. James Wyld's hollow globe, or "Georama," diam. 18 metres, occupied Leicester Square until swept away as a nuisance. The giant globe proposed by Elisée Reclus in 1895 has never been erected; he has, however, produced maps on a concave surface, as suggested by J. D. Hauber in 1742.

AUTHORITIES.—The history of maps is dealt with ably in Vivien de Saint Martin's *Histoire de la géographie* (Paris, 1875), and in Peschel's *Geschichte der Erdkunde* (2nd ed. by Sophus Ruge, Berlin, 1877), as also by W. Wollkenhauer (*Leitfaden zur Geschichte der Kartographie*, Breslau, 1895), and H. Zondervan (*Allgemeine Kartenkunde*, Leipzig, 1901). J. Lelewel's *Geographie du moyen âge*, with an atlas (Brussels, 1850–1857), has in part been superseded by more recent researches. There are, however, a number of works, beautifully illustrated, which deal fully with particular periods of the subject. Among these may be mentioned Konrad Miller's *Die ältesten Weltkarten* (Stuttgart, 1895–1897), which only deals with maps not influenced by the ideas of Ptolemy. The contents of the following collections are more varied in their nature, viz. E. F. Jomard's *Monuments de la géographie* (Paris, 1862), Santarem's *Atlas composé de mappemondes et de portulans*, &c. (Paris, 1842–1853, 78 plates). A. E. Nordenskiöld's *Facsimile Atlas* (Stockholm, 1889), Gabriel Marcell, *Choix de cartes et de mappemondes* ***XIV***^{e} *et XV*^{e} *siècles* (Paris, 1896) C. H. Coote's *Remarkable Maps of the XVth, XVIth and XVIIth Centuries reproduced in their Original Size* (Amsterdam, 1894–1897), and *Bibliotheca lindesiana* (London, 1898) with facsimiles of the Harleian and other Dieppese maps of the 16th century. Nautical charts are dealt with in A. E. Nordenskiöld's *Periplus* (Stockholm, 1869), and Th. Fischer's *Sammlung mittelälterlicher Welt- und Seekarten* (Vienna, 1886). The discovery and mapping of America are illustrated by F. Kunstmann's *Entdeckung Amerikas* (Munich, 1859), K. Kretschmer's *Atlas zur Entdeckung Amerikas* (Berlin, 1892), G. Marcel's *Reproductions de cartes et de globes relatives à la découverte de l'Amerique du XVI*^{e} *au XVIII*^{e} *siècle* (Paris, 1893) and E. L. Stevenson's *Maps Illustrating the early Discovery and Exploration of America, 1502–1530* (New Brunswick, N.J., 1906). In addition to these collections, numerous single maps have been published in geographical periodicals or separately. See also V. Hantzsch and L. Schmidt, *Kartog. Denkmäler zur Entdeckungsgeschichte von Amerika, Asien, Australien und Afrika aus der k. Bibliothek zu Dresden* (Leipzig, 1903), and the Crown Collection of photographs of American maps (1600–1800), selected and edited by A. B. Hulbert (Cleveland, 1904–1909).

For reports on the progress of cartography, see *Geographisches Jahrbuch* (Gotha, since 1866); for announcements of new publications, *Bibliotheca geographica*, published annually by the Berlin Geographical Society, and to the *geographical Journal* (London).

Topographical Surveys.

United Kingdom.

The year 1784 marks the beginning of the ordnance survey, for in that year Major-General Roy measured a base line of 27,404 ft. on Hounslow Heath. Six additional base lines were measured up to 1849, including the Lough Foyle, in 1827–1828, and that on Salisbury Plain, in 1849. The primary triangulation was only completed in 1858, but in the meantime, in 1791, the detail survey had begun. At first it was merely intended to produce a map sufficiently accurate on a scale of 1 in. to a mile (1 : 63,360). Ireland having been surveyed (1824–1842) on a scale of 6 in. to a mile (1 : 10,560), it was determined in 1840, after the whole of England and Wales, with the exception of Lancashire and Yorkshire, had been completed on one-inch scales, to adopt that scale for the whole of the United Kingdom. Finally, in 1854, a cadastral survey of the whole of the United Kingdom, only excepting uncultivated districts, was resolved upon, on a scale of 1 : 2500, still larger scales (1 : 500 or 1 : 1000) being adopted for town plans. Parish boundaries are laid down with the help of local meresmen appointed by justices at quarter sessions. The horizontal contours are based upon instrumental measurement, and as a whole these ordnance maps were undoubtedly superior in accuracy, with rare exceptions, to similar maps published by foreign governments. Even though the hill hachures on the older one-inch maps are not quite satisfactory, this deficiency is in a large measure compensated for by the presence of absolutely trustworthy contours. Originally the maps were engraved on copper, and the progress of publication was slow; but since the introduction of modern processes, such as electrotyping (in 1840), photography (in 1855) and zincography (in 1859), it has been rapid. A plan, the engraving of which formerly took two years, can now be produced in two days.

The one-inch map for the whole of the United Kingdom was completed in 1890. It covers 697 sheets (or 488 of a "new series" in large sheets), and is published in three editions, viz. (*a*) in outline, with contours in black, (*b*) with hills hachured in brown or black, and (*c*) printed in five colours. Carefully revised editions of these and of the other maps are brought out at intervals of 15 years at most. Since 1898 the department has also published maps on a smaller scale, viz. a map of England and Wales, on a scale of 2 m. to 1 in., in two editions, both printed in colour, the one with hills stippled in brown, the other coloured on the "layer system" as a strata-relief map; a map of the United Kingdom on a scale of 4 m. to 1 in., also in two editions, the one in outline, showing five classes of roads and parish boundaries, the other in colours, with stippled hills; a map on a scale of 10 m. to 1 in., also in two editions, and finally a map of the United Kingdom on a scale of 1 : 1,000,000.

The geological surveys of Great Britain and Ireland were connected from 1832 to 1853 with the ordnance survey, but are now carried on independently. The ordnance survey, too, no longer depends on the war office but upon the board of agriculture and fisheries. A *Bathymetrical Survey of the Freshwater Lochs of Scotland*, under the direction of Sir John Murray and L. Pullar, was completed in 1908, and the results published by the Royal Geographical Society.

France.

Proposals for a new map of France, to replace the famous Cassini map of 1744–1793 were made in 1802 and again by R. Bonne in 1808, but owing to the wars then devastating Europe no steps were taken until 1817, and the *Carte de France de l'état major* on a scale of 1 : 80,000 was only completed in 1880. It is engraved on copper. The hachured hills are based upon contours, and are of admirable commensurability. It has served as a basis for a *Carte de la France*, published by the Service Vicinal on a scale of 1 : 100,000, in 596 sheets, and of a general map prepared by the ministère des travaux publics on a scale of 1 : 200,000 in 80 sheets. On both these maps the hills are printed in grey chalk. A third topographical map of France is being published in accordance with the recommendation of a committee presided over by General de la Noix in 1897. The surveys for this map were begun in 1905. The maps are based upon the cadastral plans (1 : 1000), thoroughly revised and connected with the triangulation of France and furnished with contours at intervals of 5 m. by precise measurement. These *minutes* are published on a scale of 1 : 10,000 or 1 : 20,000 for mountain districts, while the scale of the general map is 1 : 50,000. Each sheet is bounded by parallels and meridians. The hills are shown in brown contours at intervals of 10 m. and grey shading in chalk (Berthaut, *La Carte de France, 1750–1898*; Paris, 1899). A geological map of France on a scale of 1 : 80,000 is nearly completed, there are also a map (1 : 500,000) by Carez and Vasseur, and an official *Carte géologique* (1 : 1,000,000; 1906).

Germany.

By the middle of the 19th century topographical maps of the various German states had been completed, and in several instances surveys of a more exact nature had been completed or begun, when in 1878 the governments of Prussia, Saxony, Bavaria and Württemberg agreed to supersede local maps by publishing a map of the empire (*Reichskarte*) in 674 sheets on a scale of 1:100,000. The earlier sheets of this excellent map were lithographed, but these are gradually being superseded by maps engraved on copper. Colour-printing is employed since 1901. The hills are hachured and in some instances contours at intervals of 50 metres are introduced. The map was completed in 1909, but is continually undergoing renewal. The *Messtischblätter*, called *Positionsblätter* in Bavaria, are on a scale of 1:25,000. The older among them leave much to be desired, but those of a later date are satisfactory. This applies more especially to the maps of Saxony (since 1879) and Württemberg (since 1893). The features of the ground on most of these maps are shown by contours at intervals of 10 metres. The map produced on this large scale numbers over 5000 sheets, and is used as a basis for the geological surveys carried on in several of the states of Germany. A general map of the German Empire (*Uebersichtskarte*) on a scale of 1 : 200,000, in 196 sheets, is in progress since 1893. It is printed in three colours, and gives contours at intervals of 10 metres. In addition to these maps there are D. G. Reymann's well-known *Specialkarte von Mittel Europa* (1 : 200,000), acquired by the Prussian government in 1874 (it will ultimately consist of 796 sheets), a government and Liebenow's map of central Europe (1:300,000) and C. Vogel's beautiful map of Germany (1 : 500,000).

Austria-Hungary.

The *Specialkarte* of Austria-Hungary on a scale of 1:75,000 (765 sheets), based upon a triangulation and cadastral surveys (1816–1867), was completed in 1889, and published in heliogravure. This map was repeatedly revised, but as it no longer met modern requirements as to accuracy the director of the military geographical establishment at Vienna, Field Marshal Chr. von Steeb, in 1896, organized what practically amounts to a re-survey of the entire monarchy, to be completed in 75 years. At the same time the cadastral plans, reduced to a scale of 1:25,000, are being published in photo-lithography. A general map of central Europe in 283 sheets published by the Austrian government (1:200,000) includes nearly the whole of the Balkan Peninsula.

Switzerland.

The famous map of Switzerland, with which is associated the name of General H. Dufour (d. 1875), is based upon a triangulation (1809–1833) and surveys on a scale of 1:25,000 for the lowlands, 1:50,000 for the alpine districts, and was published (1842–1865) on a scale of 1:100,000. The hills are hachured, the light, in the case of the loftier regions, being supposed to fall obliquely. The original surveys, carefully revised, have been published since 1870 as a *Topographical Atlas of Switzerland*—the so-called *Siegfried Atlas*, in 552 sheets. They are printed in three colours, contours at intervals of 10 and 20 metres being in brown, incidental features (ravines, cliffs, glaciers) in black or blue. To mountain-climbers these contour maps are invaluable, but for ordinary purposes "strata maps," such as J. M. Ziegler's hypsometric maps (1856) or so-called "relief maps," which attempt to delineate the ground so as to give the impression of a relief, are generally preferred.

Belgium.

The new survey of Belgium was completed in 1872 and there have been published 527 plane-table sections or *planchettes* on a scale of 1:20,000 (1866–1880), a "Carte topographique de la Belgique," in 72 sheets, on a scale of 1:40,000 (1861–1883), and a more recent map in 26 sheets on a scale of 1:100,000 (1903–1912). The last is printed in five colours, the ground is shown in contours of 10 metres interval and grey stippling.

Holland.

The new survey of the Netherlands, based upon General Krayenhoff's primary triangulation (1802–1811) was completed in 1855. The results have been published on a scale of 1:25,000 (776 sheets, since 1866), 1:50,000 (Topographic and Military Map, 62 sheets, 1850–1864, and a Waterstaatskaart, 1864–1892), and 1:200,000 (Topographical Atlas, 21 sheets, 1868–1871).

Denmark.

In Denmark, on the proposal of the Academy of Science, a survey was carried out in 1766–1825, but the maps issued by the Danish general staff depend upon more recent surveys. These include plane-table sections (*Maalebordsblade*), 1209 sheets on a scale of 1:20,000, with contours at intervals of 5 to 10 ft., published since 1830; *Atlasblad* of Jutland and of *De Danske Öer*, on a scale of 1:40,000, the former in 131 sheets, since 1870, the latter, on the same scale, in 94 sheets, since 1890, and still in progress, and a general staff map on a scale of 1:100,000, in 68 sheets, since 1890. Maps of the Faroer and of Iceland have likewise been issued.

Scandinavia.

Modern surveys in Sweden date from the organization of a corps of "Landemätare," known since 1874 as a topographical department of the general staff. The maps issued by this authority include one of southern Sweden, 1:100,000, another of northern Sweden, 1:200,000, and a general map on a scale of 1:1,000,000. In Norway a geographical survey (*Opmaaling*) has been in progress since 1783, but the topographical map of the kingdom on a scale of 1:100,000 in 340 sheets, has not yet been completed.

Russia.

Of Russia in Europe only the more densely peopled governments have been surveyed, since 1816, in the manner of other European countries, while for most regions there are only so-called "military surveys." The most readily available map of the whole country is the 10-verst map (1:420,000), known as General J. A. Strelbitzki's, and published 1865–1880. A topographic map (1:126,000) embracing the whole of western Russia, with Poland and the country of the Don Cossacks, is designed to be extended over the whole empire. Certain governments—Moscow, Kief, Volhynia, Bessarabia, the Crimea, &c.—have been published on a scale of 1:24,000, while Finland, as far as 61° N., was re-surveyed in 1870–1895, and a map on a scale of 1:42,000 is approaching completion.

Surveys in Asiatic Russia are conducted by the topographical departments organized at Orenburg, Tashkent, Omsk, Irkutsk and Tiflis. To the latter we are indebted for a valuable map of Caucasia, 1:210,000, which since the first publication (1863–1885) has undergone careful revision. The Siberian departments have published a number of maps on a scale of 1:420,000. In addition to these the survey for the Trans-Siberian railway has been published on a scale of 1:630,000, as also maps of the Russo-Chinese frontier districts, 1:210,000 and 1:1,168,000. A map of Asiatic Russia, 1:420,000, by Bolshef, in 192 sheets, is in course of publication.

Portugal and Spain.

Passing to southern Europe we find that Portugal has completed a *Charta chorographica* (1:100,000) since 1856. In Spain a plane-table survey on a scale of 1:20,000 has been in progress since 1870, but of the map of Spain in 1078 sheets on a scale of 1:50,000 only 150 had been issued by the depósito de la guerra up to 1910. Meanwhile reference may be made to B. F. Coello's *Atlas de la España* (1848–1890), the maps of which are on a scale of 1:200,000.

Italy.

In Italy *Tavulette rilevata* on a scale of 1:25,000 or 1:50,000, with contours, based on surveys made 1862–1890, are being published, and a *Carta del regno d'Italia*, 1:100,000, is practically complete. There are a *Carta idrologica* and a *Carta geologica* on the same scale, and a *Carta orografica* on a scale of 1:500,000.

Greece.

Greece is still dependent upon foreigners for its maps, among which the *Carte de Grèce* (1:200,000) from rapid surveys made by General Palet in 1828, was published in a new edition in 1880. A similar map, mainly based upon surveys made by Austrian officers and revised by H. Kiepert (1:300,000), was published by the Military Geographical Institute of Vienna in 1885. Far superior to these maps is the *Karte von Attika* (1:100,000 and 1:25,000) based upon careful surveys made by Prussian officers and published by E. Curtius and J. H. Kaupert on behalf of the German Archaeological Institute in Athens (1878), or A. Philippson's map of the Peloponnese (1:300,000; 1901).

Balkan States.

For maps of the Balkan Peninsula we are still largely indebted to the rapid surveys carried on by Austrian and Russian officers. The Austrian map of central Europe embraces the whole of the Balkan Peninsula on a scale of 1:200,000; the Russian surveys (1877–1879) are embodied in a map of the eastern part of the Balkan on a scale 1:126,000, and a map of Bulgaria and southern Rumelia, on a scale 1:200,000, both published in 1883. A map of Turkey in Europe, scale 1:210,000, was published by the Turkish general staff (1899), and another map, scale 1:250,000, by the intelligence division of the British war office is in progress since 1906. Bosnia and Herzegovina are now included with the surveys of the Austrian Empire, the kingdom of Servia has been surveyed (1880–1891) and the results published on a scale of 1:75,000; in eastern Rumania surveys have been in progress since 1874 and the results have been published on a scale of 1:50,000; a general map of the entire kingdom, scale 1:200,000, was published in 1906–1907; a map of Montenegro (1:75,000), based on surveys by Austrian and Russian officers, was published at Vienna in 1894.

Asia.

In Asiatic Turkey several districts of historical interest have been surveyed, and surveys have likewise been made in the interest of railways, or by boundary commissions, but there is no such thing as a general survey carried on under the direction of government. We are thus, to a large extent, still dependent upon compilations, such as R. Kiepert's *Asia Minor* (1:400,000; 1904–1908), a map of eastern Turkey in Asia, Syria and western Persia (1:2,000,000; 1910), published by the Royal Geographical Society, or a Russian general map (1:630,000, published 1880–1885). Among maps based upon actual surveys those of Palestine, by Lieutenant G. R. Conder and H. H. (afterwards Lord) Kitchener (1:63,360, 1880), of the Sinai Peninsula by Sir C. W. Wilson and H. S. Palmer (1:126,730, 1870), of Arabia Petraea by Dr A. Musil (1:300,000, 1907) or of the Aden territory (1905) are among the more interesting. Of Cyprus an excellent map from surveys by Major (Lord) H. H. Kitchener was published in 1884 (1:63,360).

In the case of Persia and Afghanistan we are still dependent upon compilations such as a Russian staff map (1:840,000, published in 1886), Colonel Sir T. H. Holdich's map of Persia (1:1,014,000, Simla, 1897–1899), or a smaller map (1:2,028,000 and 1:4,056,000), published by the geographical division of the general staff. The settlement of boundaries in northern Afghanistan (1883) and in Seistan (1870) has necessitated surveys of some interest.

A trigonometrical survey of British India was begun in 1800 and the country can now boast of a survey which in most respects is equal to those of most European states. The surveys are made on scales varying according to the necessities of the case or the nature of the country, and they have been extended since 1862 beyond the boundaries of India proper. Revenue surveys for land settlement are published on a scale of 1:4000, but the usual scale for topographical maps is 1:63,360. An *Indian Atlas*, on a scale of 1:255,660, includes also Ceylon and the Malay Peninsula, but although begun so long ago as 1827 many of its sheets are unpublished. There are in addition an official map of India (1:1,000,000), the first edition of which was published in 1903, as also maps of the great provinces of India, including Burma, all on a scale of 1:2,827,520, and a variety of physical and statistical maps. Ceylon and the Straits Settlements, with the Federal Malay States, have their own surveyors-general. The British North Borneo Company published a *Map of British North Borneo*, on a scale of 1:633,600 (1905).

In Siam a regular survey was organized by Mr J. McCarthy (1881–1883), a former official of the Indian survey, which did good work in connexion with the determination of the Franco-Siamese frontier (1906). The surveys are made on the scales of 1:4000, 1:31,680 and 1:63,360.

In French Indo-China surveys have been in progress since 1881. The Bureau of the Indo-Chinese general staff, has published a map of Indo-China, including Cambodia, in 45 sheets (1:200,000, 1895), while to the service géographique de l'Indo-Chine, organized in 1899, we owe a *Carte de l'Indo-Chine* (1:500,000).

For China we are still largely dependent upon careful compilations like Baron F. von Richthofen's *Atlas von China* (1:750,000, Berlin, 1885–1890) or Bretschneider's *Map of China* (1:4,600,000) a new edition of which appeared at St Petersburg in 1900. There are good survey maps of the British colony of Hong-Kong, of Wei-hai-Wei and of the country around Kiao-chou, and the establishment of topographical offices at Peking and Ngan-king holds out some promise of native surveys. In the meantime large scale maps prepared by European authorities are to be welcomed, such as maps of Chih-li and Shan-tung (1:200,000), from surveys by Prussian officers, 1901–1905, maps on East China (1:1,000,000) and of Yun-nan by British, German and Indian officers, of the Indo-Chinese frontier (1:200,000, Paris 1908), and of the upper Yangtsze-kiang by S. Chevalier (Shanghai, 1900).

Japan has a regular survey department originated by Europeans and successfully carried on by natives. The primary triangulation was completed in 1880, a topographical map coloured geologically (1:200,000) was published 1889–1897, and in addition to this there are being published an agronomical map on a scale of 1:100,000 (since 1887) and others. The Japanese government has likewise published a map of Korea (1:1,000,000; 1898).

The Philippine Islands are represented in a carefully compiled map by C. W. Hodgson (1:1,115,000, New York, 1908). Of Java we possess an excellent topographical map based upon surveys made 1850–1887 (1:100,000). A similar map has been in progress for Sumatra since 1883, while the maps for the remaining Dutch Indies are still based, almost exclusively, upon flying surveys. For general purposes the *Atlas der Nederlandsche Bezittingen in Oost-Indie* by J. N. Stemfoort and J. J. Ten Siethoff, of which a new edition has been published since 1900, may be consulted with confidence.

Africa.

In Africa nearly all the international boundaries have been carefully surveyed and marked on the ground, since 1880, and yield a good basis as a guide for the map compiler. A general map of Africa, by Colonel Lannoy de Bissy, on a scale of 1 : 2,000,000 was first published in 1882–1888, but is carefully revised from time to time. The geographical section of the British general staff is publishing maps of all Africa on scales of 1 : 250,000 and 1 : 1,000,000. In Egypt excellent work has been done by a survey department organized and directed by Captain H. G. Lyons up to 1909. It has published a topographical map of the Nile valley (1:50,000), an irrigation map (1:100,000), a general map (1:250,000), numerous cadastral plans, &c. Work on similar lines is carried on in the Anglo-Egyptian Sudan. Algeria has been in course of survey since 1868, Tunis since 1878, and the results have been published on scales of 1:50,000 and 1:250,000. Of Morocco there are many maps, among which several compiled by the French service géographique de l'armée, including a *Carte du Maroc* (1:200,000), in progress since 1909. In the British colonies of tropical and of South Africa[1] surveys for the most part are carried on actively. Of the Gambia Colony there is a map by Major E. L. Cowie (1:250,000, 1904–1905); the survey of the Gold Coast Colony is being published by Major F. G. Guggisberg since 1907 (1:125,000 and 1:200,000); southern and northern Nigeria are adequately represented on the maps of the general staff (1:250,000). The states of British South Africa have each their surveyor-general, and a reconnaissance survey has been in progress since 1903. It is based upon a careful triangulation, superintended by Sir D. Gill, and carried in 1907 within 70 m. of Lake Tanganyika. This survey is rapidly superseding other maps, such as the surveyor-general's map of Cape Colony (1:127,000); A. Duncan's map of the Orange River State (1:148,705; 1902–1904) and Jeppe's map of the Transvaal (1:476,000; 1899). The results of a survey of southern Rhodesia are given on the map of the British general staff (1:500,000; 1909), while of north-eastern Rhodesia we have an excellent map compiled by C. L. Beringer in 1907 (1:1,000,000). Surveys in British Central Africa were taken up in 1894; a survey of Lake Nyasa, by Lieut. E. L. Rhoades and W. B. Phillips, was published in 1902. As regards British East Africa and Uganda, the surveys in the latter (on scales of 1:10,000 and 1:125,000) have made considerable progress. The Victoria Nyanza was surveyed by Captain B. Whitehouse (1898–1900), and the results have been published on a scale of 1:292,000. These British possessions, together with the whole of Somaliland and southern Abyssinia, are satisfactorily represented on the maps of the British general staff.

Maps of the French Africa Colonies have been published by the service géographique de l'Afrique occidental and the service géographique des colonies. A map of Senegal (1:100,000) is in progress since 1905. The official maps of the other colonies have been compiled by A. Meunier between 1902 and 1909. They include French West Africa, (1:2,000,000, 2nd ed., 1908), French Guinea (1:500,000; 1902) and the Ivory Coast and Dahomey (1:1,500,000; 1907–1908). A map of the French Congo by J. Hansen (1:1,500,000), was published in 1907. In Madagascar a topographical bureau was established by General J. S. Gallieni in 1896, and the surveys are being published since 1900 on a scale of 1:100,000.

As regards the German colonies we are dependent upon compilations by R. Kiepert, P. Sprigade and M. Moisel. Good maps of the Portuguese colonies are to be found in an *Atlas colonial Portugues*, a second edition of which was published by the Commissão de Cartographia in 1909. Of the Congo State we have an official map on a scale of 1:1,000,000, published in 1907. Of Italian Eritrea we have excellent maps on various scales of 1:100,000, 1:200,000 and 1:500,000, based upon surveys made between 1888 and 1900.

Australia.

In the states of Australia cadastral surveys conducted by surveyors-general have been in progress for many years, as also trigonometrical surveys (Western Australia excepted), and the publication of parish and township or county maps keeps pace with the settlement of the country; but with the exception of Victoria none of these states is in possession of a topographical map equal in accuracy to similar maps published in Europe. In Victoria the so-called geodetic survey was begun in 1858; the maps are published on a scale of 1:126,730. There exists also a general map, on a scale of 1:506,930. Maps on the same scale are available of New South Wales, South Australia and Tasmania, on a scale of 1:560,000 for Western Australia, on a scale of 1:253,460 for Queensland. There are likewise maps on smaller scales, which undergo frequent revision. The map of British New Guinea is on a scale of 1:330,200 (1898). New Zealand has a good general map on a scale of 1:633,700. A trigonometrical survey was given up and only details of immediate practical use are required. The "Lands Department" of the Fiji Islands has published a map on a scale of 1:380,000 (1908).

North America.

The cadastral surveys in Canada are carried on by a commission of Crown-lands in the old provinces and by a Dominion land office, which lays out townships as in the United States, but with greater accuracy. A surveyor-general is attached to the department of the interior, at Ottawa. He publishes the topographical maps (1:63,366) since 1906. They are based upon theodolite traverses 15 m. apart, and connected with the United States lake and coast surveys, the details being filled in by plane-table surveys on a scale of 1:31,680. The contours, 25 ft. apart, depend upon spirit-levelling. In the Rocky Mountains surveys photographic apparatus is successfully employed. The surveyor-general issues also "sectional maps" (1:190,000 and 1:40,000) and so-called "Standard" topographical maps for the thinly peopled west, on scales of 1:250,000 and 1:500,000. He is responsible likewise for maps of Yukon and of Labrador, supplied by the geological survey, the former on a scale of 1:380,200, the latter of 1:1,584,000. The intelligence branch of the Canadian department of military defence is publishing since 1904 topographical maps on scales of 1:63,366 and 1:126,730, with contours. A geodetic survey department, under Dr. W. F. King, chief astronomer of the Dominion, was established in 1909.

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[1] See "The Survey in British Africa": the *Annual Report* of the Colonial Survey Commission.

Maps of Newfoundland, orographical as well as geological, scale 1 : 1,584,200, have been published.

In the United States a "geological survey" was organized in 1879, under Clarence King as director, whose successor, Major J. W. Powell, rightly conceived that it was necessary to produce good topographical maps before a geological survey could be pursued with advantage. It is under his wise guidance that the survey has attained its present efficiency. It is based upon a triangulation by the U.S. Coast and Geodetic Survey. The maps of the more densely peopled parts of the Union are published on a scale of 1 : 62,500, and those of the remainder of the country on half or a quarter of that scale. The hills are shown by contours at intervals of 10 or 100 ft. The details given are considered sufficient to admit of the selection of general routes for railways or other public works. The survey progresses at the rate of about 40,000 sq. m. annually, and in course of time it will supersede the map of the separate states, based on older surveys. A "reconnaissance" map of Alaska (on a scale of 1 : 250,000) was published in 1908.

Central America.

In Mexico the surveys are in charge of a comision geografica-exploradora attached to the secretaria de Fomento, but only about 140 sheets of a *Carta general* on a scale of 1 : 100,000 have been published. There are also a map of the state of S. Luis Potosi (1 : 250,000), of the environs of Puebla (1 : 50,000) and a *Carta general de la republica mexicana* (1 : 250,000).

A useful map of Central America has been published by the topographical section of the British general staff on a scale of 1 : 170,300. Of great value for cartographical work is a careful survey, carried out by American engineers (1897–1898), for a continental railway running along the west coast from Mexico to Chile. In South America, in proportion to the area of the country, only few surveys of a thoroughly scientific nature have been made, and it is therefore satisfactory that the service géographique of the French army should be publishing, since 1900, a map of the entire continent on a scale of 1 : 1,000,000.

Colombia is but inadequately represented by rough maps. For Colombia we have F. L. Vergara y Velasco's *Atlas de geografia colombiana* (1906–1908); Ecuador is fairly well represented by Th. Wolf (1892) and Hans Meier (1907); in the case of Peru we still largely depend upon Paz Soldan's *Atlas geografica* (1865–1867) and A. Raimondi's *Mapa del Peru* (1 : 500,000) based upon surveys made before 1869. Sir Martin Conway's "Map of the Andes of La Paz" (1 : 600,000; 1900) as well as Major P. H. Fawcett's survey of the Brazilian boundary (1906–1907) are welcome additions to our knowledge of Bolivia. In Chile a comision topografico was appointed as long ago as 1848, but the map produced under its auspices by Professor F. Pissis (1 : 250,000, 1870–1877), leaves much to be desired. Since that time, however, valuable maps have been published by an *Oficina de mensura de tierras*, by a *seccion de geografia y minas* connected with the department of public works, by the *Oficina hidrografica*, and more especially in connexion with surveys necessitated by the boundary disputes with Argentina, which were settled by arbitration in 1899 and 1902. The surveys which led to the latter were conducted by Sir Thomas Holdich.

In Venezuela a commission for producing a *plano militar* or military map of the country was appointed by General Castro in 1904, but little progress seems to have been made, and meantime we are dependent upon a revised edition of A. Codazzi's map of 1840 which was published in 1884. In Brazil little or nothing is done by the central government, but the progressive states of São Paulo and Mines Gerães have commissãos geographicos e geologicos engaged in the production of topographical maps. Valuable materials have likewise been acquired by several river surveys including those of the Amazonas by Azevedo and Pinto (1862–1864) and W. Chandless (1862–1869) and of the Rio Madeira by Colonel G. Earl Church and Keller-Leuzinger (1869–1875). The proposal of a committee presided over by the Marshal H. de Beaurepaire-Rohan (1876) to prepare a map of Brazil on a scale of 1 : 200,000 has never been acted upon, and in the meantime we are dependent upon works like the *Atlas do imperio do Brazil* by Mendes de Almeida (1868) or the maps in our general atlases.

In Argentina an official geographical institute was established in 1879, but neither A. Seelstrang's *Atlas* (1886–1892) nor H. Hoskold's *Mapa topografica* (1 : 2,000,000; London, 1895), which were published by it, nor any of the numerous provincial maps are based upon scientific surveys.

It need hardly be said that hydrographic surveys have been of great service to compilers of maps. There are few coast-lines, frequented by shipping, which have not yet been surveyed in a definite manner. In this work the British hydrographic office may justly claim the credit of having contributed the chief share. Great Britain has likewise taken the lead in those deep-sea explorations which reveal to us the configuration of the sea-bottom, and enable us to construct charts of the ocean bed corresponding to the contoured maps of dry land yielded by topographical surveys.

(E. G. R.)

MAP PROJECTIONS

In the construction of maps, one has to consider how a portion of spherical surface, or a configuration traced on a sphere, can be represented on a plane. If the area to be represented bear a very small ratio to the whole surface of the sphere, the matter is easy: thus, for instance, there is no difficulty in making a map of a parish, for in such cases the curvature of the surface does not make itself evident. If the district is larger and reaches the size of a county, as Yorkshire for instance, then the curvature begins to be sensible, and one requires to consider how it is to be dealt with. The sphere cannot be opened out into a plane like the cone or cylinder; consequently in a plane representation of configurations on a sphere it is impossible to retain the desired proportions of lines or areas or equality of angles. But though one cannot fulfil all the requirements of the case, we may fulfil some by sacrificing others; we may, for instance, have in the representation exact similarity to all very small portions of the original, but at the expense of the areas, which will be quite misrepresented. Or we may retain equality of areas if we give up the idea of similarity. It is therefore usual, excepting in special cases, to steer a middle course, and, by making compromises, endeavour to obtain a representation which shall not involve large errors of scale.

A globe gives a perfect representation of the surface of the earth; but, practically, the necessary limits to its size make it impossible to represent in this manner the details of countries. A globe of the ordinary dimensions serves scarcely any other purpose than to convey a clear conception of the earth's surface as a whole, exhibiting the figure, extent, position and general features of the continents and islands, with the intervening oceans and seas; and for this purpose it is indeed absolutely essential and cannot be replaced by any kind of map.

The construction of a map virtually resolves itself into the drawing of two sets of lines, one set to represent meridians, the other to represent parallels. These being drawn, the filling in of the outlines of countries presents no difficulty. The first and most natural idea that occurs to one as to the manner of drawing the circles of latitude and longitude is to draw them according to the laws of perspective. Perhaps the next idea which would occur would be to derive the meridians and parallels in some other simple geometrical way.

Cylindrical Equal Area Projection.—Let us suppose a model of the earth to be enveloped by a cylinder in such a way that the cylinder touches the equator, and let the plane of each parallel such as PR be prolonged to intersect the cylinder in the circle pr. Now unroll the cylinder and the projection will appear as in fig. 2. The whole world is now represented as a rectangle, each parallel is a straight line, and its total length is the same as that of the equator, the distance of each parallel from the equator is $\sin l$ (where l is the latitude and the radius of the model earth is taken as unity). The meridians are parallel straight lines spaced at equal distances.

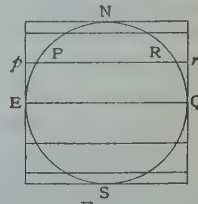
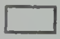


Fig. 1.

This projection possesses an important property. From the elementary geometry of sphere and cylinder it is clear that each strip of the projection is *equal in area* to the zone on the model which it represents, and that each portion of a strip is equal in area to the corresponding portion of a zone. Thus, each small four-sided figure (on the model) bounded by meridians and parallels is represented on the projection by a rectangle  which is of exactly the same area, and this applies to any such figure however small. It therefore follows that any figure, of any shape on the model, is correctly represented as regards area by its corresponding figure on the projection. Projections having this property are said to be *equal-area projections* or *equivalent projections*; the name of the projection just described is "the cylindrical equal-area projection." This projection will serve to exemplify the remark made in the first paragraph that it is possible to select certain qualities of the model which shall be represented truthfully, but only at the expense of other qualities. For instance, it is clear that in this case all meridian lengths are too small and all lengths along the parallels, except the equator, are too large. Thus although the areas are preserved the shapes are, especially away from the equator, much distorted.

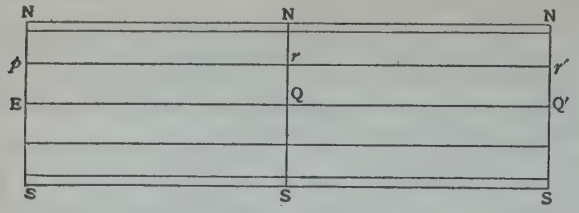


FIG. 2.

The property of preserving areas is, however, a valuable one when the purpose of the map is to exhibit areas. If, for example, it is desired to give an idea of the area and distribution of the various states comprising the British Empire, this is a fairly good projection. Mercator's, which is commonly used in atlases, preserves local shape at the expense of area, and is valueless for the purpose of showing areas.

Many other projections can be and have been devised, which depend for their construction on a purely geometrical relationship between the imaginary model and the plane. Thus projections may be drawn which are derived from cones which touch or cut the sphere, the parallels being formed by the intersection with the cones of planes parallel to the equator, or by lines drawn radially from the centre. It is convenient to describe all projections which are derived from the model by a simple and direct geometrical construction as "geometrical projections." All other projections may be known as "non-geometrical projections." Geometrical projections, which include perspective projections, are generally speaking of small practical value. They have loomed much more largely on the map-maker's horizon than their importance warrants. It is not going too far to say that the expression "map projection" conveys to most well-informed persons the notion of a geometrical projection; and yet by far the greater number of useful projections are non-geometrical. The notion referred to is no doubt due to the very term "projection," which unfortunately appears to indicate an arrangement of the terrestrial parallels and meridians which can be arrived at by direct geometrical construction. Especially has harm been caused by this idea when dealing with the group of conical projections. The most useful conical projections have nothing to do with the secant cones, but are simply projections in which the meridians are straight lines which converge to a point which is the centre of the circular parallels. The number of really useful geometrical projections may be said to be four: the *equal-area cylindrical* just described, and the following perspective projections—the *central*, the *stereographic* and *Clarke's external*.

Perspective Projections.

In perspective drawings of the sphere, the plane on which the representation is actually made may generally be any plane perpendicular to the line joining the centre of the sphere and the point of vision. If V be the point of vision, P any point on the spherical surface, then p, the point in which the straight line VP intersects the plane of the representation, is the projection of P.

Orthographic Projection.—In this projection the point of vision is at an infinite distance and the rays consequently parallel; in this case the plane of the drawing may be supposed to pass through the centre of the sphere. Let the circle (fig. 3) represent the plane of the equator on which we propose to make an orthographic representation of meridians and parallels. The centre of this circle is clearly the projection of the pole, and the parallels are projected into circles having the pole for a common centre. The diameters aa', bb' being at right angles, let the semicircle bab' be divided into the required number of equal parts; the diameters drawn through these points are the projections of meridians. The distances of c, of d and of e from the diameter aa' are the radii of the successive circles representing the parallels. It is clear that, when the points of division are very close, the parallels will be very much crowded towards the outside of the map; so much so, that this projection is not much used.

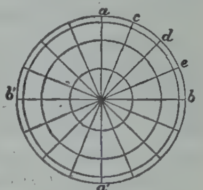


FIG. 3.

For an orthographic projection of the globe on a meridian plane let $qnrs$ (fig. 4) be the meridian, ns the axis of rotation, then qr is the projection of the equator. The parallels will be represented by straight lines passing through the points of equal division; these lines are, like the equator, perpendicular to ns. The meridians will in this case be ellipses described on ns as a common major axis, the distances of c, of d and of e from ns being the minor semiaxes.

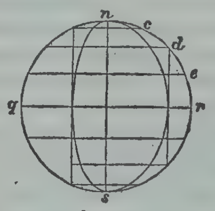


FIG. 4.

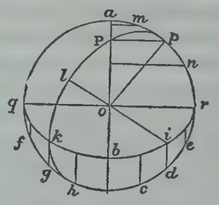


FIG. 5.

Let us next construct an orthographic projection of the sphere on the horizon of any place.

Set off the angle aop (fig. 5) from the radius oa, equal to the latitude. Drop the perpendicular pP on oa, then P is the projection of the pole. On ao produced take $ob = p\text{P}$, then ob is the minor semiaxis of the ellipse representing the equator, its major axis being qr at right angles to ao. The points in which the meridians meet this elliptic equator are determined by lines drawn parallel to aob through the points of equal subdivision $cdefgh$. Take two points, as d and g, which are 90° apart, and let ik be their projections on the equator; then i is the pole of the meridian which passes through k. This meridian is of course an ellipse, and is described with reference to i exactly as the equator was described with reference to P. Produce io to l, and make lo equal to half the shortest chord that can be drawn through i; then lo is the semi-axis of the elliptic meridian, and the major axis is the diameter perpendicular to iol.

For the parallels: let it be required to describe the parallel whose co-latitude is u; take $pm = pn = u$, and let $m'n'$ be the projections of m and n on $o\text{P}a$; then $m'n'$ is the minor axis of the ellipse representing the parallel. Its centre is of course mid-way between m' and n', and the greater axis is equal to mn. Thus the construction is obvious. When pm is less than pa the whole of

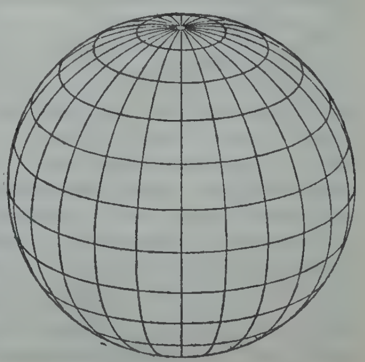


FIG. 6.—Orthographic Projection.

the ellipse is to be drawn. When pm is greater than pa the ellipse touches the circle in two points; these points divide the ellipse into two parts, one of which, being on the other side of the meridian plane aqr, is invisible. Fig. 6 shows the complete orthographic projection.

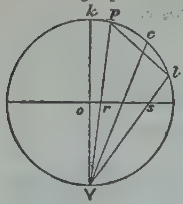


FIG. 7.

Stereographic Projection.—In this case the point of vision is on the surface, and the projection is made on the plane of the great circle whose pole is V. Let kplV (fig. 7) be a great circle through the point of vision, and ors the trace of the plane of projection. Let c be the centre of a small circle whose radius is $cp=cl$; the straight line pl represents this small circle in orthographic projection.

We have first to show that the stereographic projection of the small circle pl is itself a circle; that is to say, a straight line through V, moving along the circumference of pl, traces a circle on the plane of projection ors. This line generates an oblique cone standing on a circular base, its axis being cV (since the angle $p\mathrm{V}c$=angle $c\mathrm{V}l$); this cone is divided symmetrically by the plane of the great circle kpl, and also by the plane which passes through the axis Vc, perpendicular to the plane kpl. Now $\mathrm{V}r\cdot\mathrm{V}p$, being $=\mathrm{V}o \sec k\mathrm{V}p\cdot\mathrm{V}k \cos k\mathrm{V}p=\mathrm{V}o\cdot\mathrm{V}k$, is equal to $\mathrm{V}s\cdot\mathrm{V}l$; therefore the triangles Vrs, Vlp are similar, and it follows that the section of the cone by the plane rs is similar to the section by the plane pl. But the latter is a circle, hence also the projection is a circle; and since the representation of every infinitely small circle on the surface is itself a circle, it follows that in this projection the representation of small parts is strictly similar. Another inference is that the angle in which two lines on the sphere intersect is represented by the same angle in the projection. This may otherwise be proved by means of fig. 8, where Vok is the diameter of the sphere passing through the point of vision, fgh the plane of projection, kt a great circle, passing of course through V, and ouv the line of intersection of these two planes. A tangent plane to the surface at t cuts the plane of projection in the line rvs perpendicular to ov; tv is a tangent to the circle kt at t, tr and ts are any two tangents to the surface at t. Now the angle vtu (u being the projection of t) is $90° - ot\mathrm{V} = 90° - o\mathrm{V}t = ou\mathrm{V} = tuv$, therefore tv is equal to uv; and since tvs and uvs are right angles, it follows that the angles vts and vus are equal. Hence the angle rts also is equal to its projection rus; that is, any angle formed by two intersecting lines on the surface is truly represented in the stereographic projection.

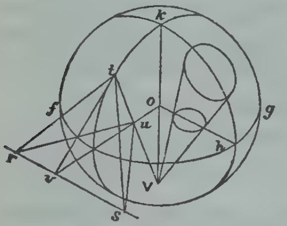


FIG. 8.

In this projection, therefore, angles are correctly represented and every small triangle is represented by a similar triangle. Projections having this property of similar representation of small parts are called *orthomorphic*, *conform* or *conformable*. The word orthomorphic, which was introduced by Germain[1] and adopted by Craig,[2] is perhaps the best to use.

Since in orthomorphic projections very small figures are correctly represented, it follows that the scale is the same in all directions round a point in its immediate neighbourhood, and orthomorphic projections may be defined as possessing this property. There are many other orthomorphic projections, of which the best known is Mercator's. These are described below.

We have seen that the stereographic projection of any circle of the sphere is itself a circle. But in the case in which the circle to be projected passes through V, the projection becomes, for a great circle, a line through the centre of the sphere; otherwise, a line anywhere. It follows that meridians and parallels are represented in a projection on the horizon of any place by two systems of orthogonally cutting circles, one system passing through two fixed points, namely, the poles; and the projected meridians as they pass through the poles show the proper differences of longitude.

To construct a stereographic projection of the sphere on the horizon of a given place. Draw the circle $vlkr$ (fig. 9) with the diameters kv, lr at right angles; the latter is to represent the central meridian. Take koP equal to the co-latitude of the given place, say u; draw the diameter PoP¹, and vP, vP′ cutting lr in pp': these are the projections of the poles, through which all the circles representing meridians have to pass. All their centres then will be in a line smn which crosses pp' at right angles through its middle point m. Now to describe the meridian whose west longitude is ω, draw pn making the angle $opn=90°-\omega$, then n is the centre of the required circle, whose direction as it passes through p will make an angle $opg=\omega$ with pp'. The lengths of the several lines are

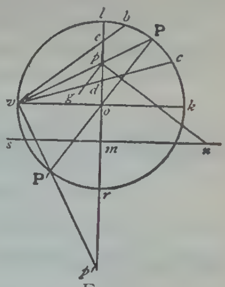


FIG. 9.

$$op=\tan\tfrac{1}{2}u;\ op'=\cot\tfrac{1}{2}u;\ om=\cot u;\ mn=\operatorname{cosec} u \cot \omega.$$

Again, for the parallels, take Pb=Pc equal to the co-latitude, say c, of the parallel to be projected; join vb, vc cutting lr in e, d. Then ed is the diameter of the circle which is the required projection; its centre is of course the middle point of ed, and the lengths of the lines are

$$od=\tan\tfrac{1}{2}(u-c);\quad oe=\tan\tfrac{1}{2}(u+c).$$

The line sn itself is the projection of a parallel, namely, that of which the co-latitude $c=180°-u$, a parallel which passes through the point of vision.

Notwithstanding the facility of construction, the stereographic projection is not much used in map-making. It is sometimes used for maps of the hemispheres in atlases, and for star charts.

External Perspective Projection.—We now come to the general case in which the point of vision has any position outside the sphere. Let $abcd$ (fig. 10) be the great circle section of the sphere by a plane passing through c, the central point of the portion of surface to be represented, and V the point of vision. Let pj perpendicular to Vc be the plane of representation, join mV cutting pj in f, then f is the projection of any point m in the circle abc, and ef is the representation of cm.

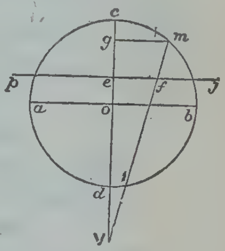


FIG. 10.

Let the angle $com=u$, V$e=k$, V$o=h$, $ef=\rho$; then, since ef : eV = mg : gV, we have $\rho=k \sin u/(h+\cos u)$, which gives the law connecting a spherical distance u with its rectilinear representation ρ. The relative scale at any point in this system of projection is given by

$$\sigma=d\rho/du,\ \sigma'=\rho/\sin u,$$
$$\sigma=k(1+h \cos u)/(h+\cos u)^2;\ \sigma'=k/(h+\cos u),$$

the former applying to measurements made in a direction which passes through the centre of the map, the latter to the transverse direction. The product $\sigma\sigma'$ gives the exaggeration of areas. With respect to the alteration of angles we have $\Sigma=(h+\cos u)/(1+k\cos u)$, and the greatest alteration of angle is

$$=\sin^{-1}\left(\frac{h-1}{h+1}\tan^2\frac{u}{2}\right).$$

This vanishes when $h=1$, that is if the projection be stereographic; or for $u=0$, that is at the centre of the map. At a distance of 90° from the centre, the greatest alteration is $90°-2\cot^{-1}\sqrt{h}$. (See *Phil. Mag.* 1862.)

Clarke's Projection.—The constants h and k can be determined, so that the total misrepresentation, viz.:

$$\mathrm{M}=\int_0^\beta\{(\sigma-1)^2+(\sigma'-1)^2\} \sin u du,$$

shall be a minimum, β being the greatest value of u, or the spherical radius of the map. On substituting the expressions for σ and σ' the integration is effected without difficulty. Put

$$\lambda=(1-\cos\beta)/(h+\cos\beta);\quad \nu=(h-1)\lambda,$$
$$\mathrm{H}=\nu-(h+1)\log_e(\lambda+1),\ \mathrm{H}'=\lambda(2-\nu+\tfrac{1}{3}\nu^2)/(h+1).$$

Then the value of M is

$$\mathrm{M}=4\sin^2\tfrac{1}{2}\beta+2k\mathrm{H}+k^2\mathrm{H}'.$$

When this is a minimum,

$$d\mathrm{M}/dh=0;\quad d\mathrm{M}/dk=0$$
$$\therefore k\mathrm{H}'+\mathrm{H}=0;\ 2d\mathrm{H}/dh+kdh\mathrm{H}'/dh=0.$$

Therefore $\mathrm{M}=4\sin^2\frac{1}{2}\beta-\mathrm{H}^2/\mathrm{H}^1$, and h must be determined so as to make $\mathrm{H}^2:\mathrm{H}'$ a maximum. In any particular case this maximum can only be ascertained by trial, that is to say, $\log \mathrm{H}^2-\log \mathrm{H}'$ must be calculated for certain equidistant values of h, and then the particular value of h which corresponds to the required maximum can be obtained by interpolation. Thus we find that if it be required to make the best possible perspective representation of a hemisphere, the values of h and k are $h=1\cdot47$ and $k=2\cdot034$; so that in this case

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[1] A. Germain, *Traité des Projections* (Paris, 1865).

[2] T. Craig, *A Treatise on Projections* (U.S. Coast and Geodetic Survey, Washington, 1882).

$$\rho=\frac{2\cdot034\sin u}{1\cdot47+\cos u}.$$

For a map of Africa or South America, the limiting radius β we may take as 40°; then in this case

$$\rho=\frac{2\cdot543\sin u}{1\cdot625+\cos u}.$$

For Asia, $\beta=54$, and the distance h of the point of sight in this case is 1·61. Fig. 11 is a map of Asia having the meridians and parallels laid down on this system.

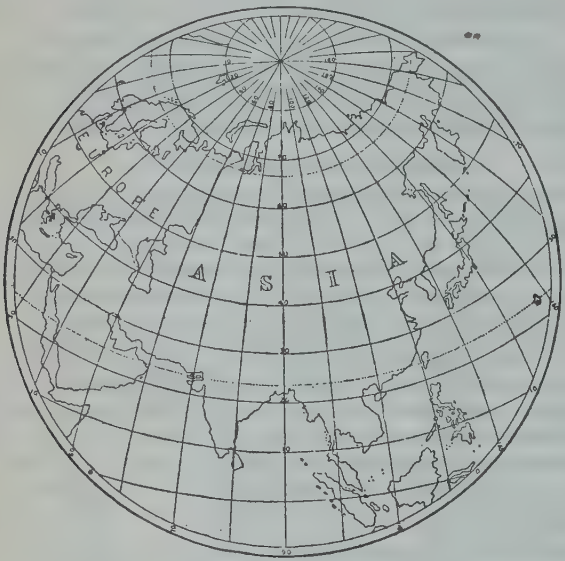

FIG. 11.

Fig. 12 is a perspective representation of more than a hemisphere, the radius β being 108°, and the distance h of the point of vision, 1·40.

The co-ordinates xy of any point in this perspective may be expressed in terms of latitude and longitude of the corresponding point on the sphere in the following manner. The co-ordinates originating at the centre take the central meridian for the axis of y and a line perpendicular to it for the axis of x. Let the latitude of the point G, which is to occupy the centre of the map, be γ; if ϕ, ω be the latitude and longitude of any point P (the longitude being reckoned from the meridian of G), u the distance PG, and μ the azimuth of P at G, then the spherical triangle whose sides are $90°-\gamma$, $90°-\phi$, and u gives these relations—

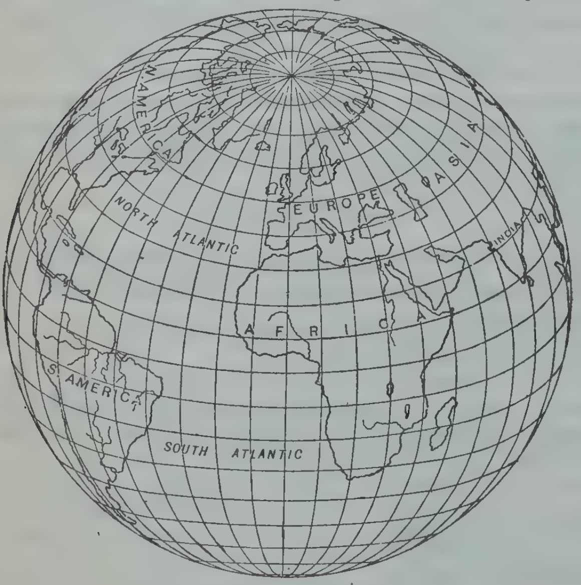

FIG. 12.—Twilight Projection. Clarke's Perspective Projection for a Spherical Radius of 108°.

$$\begin{aligned}\sin u\sin\mu&=\cos\phi\sin\omega,\\ \sin u\cos\mu&=\cos\gamma\sin\phi-\sin\gamma\cos\phi\cos\omega,\\ \cos u&=\sin\gamma\sin\phi+\cos\gamma\cos\phi\cos\omega.\end{aligned}$$

Now $x=\rho\sin\mu$, $y=\rho\cos\mu$, that is,

$$\frac{x}{k}=\frac{\cos\phi\sin\omega}{h+\sin\gamma\sin\phi+\cos\gamma\cos\phi\cos\omega},$$

$$\frac{y}{k}=\frac{\cos\gamma\sin\phi-\sin\gamma\cos\phi\cos\omega}{h+\sin\gamma\sin\phi+\cos\gamma\cos\phi\cos\omega},$$

by which x and y can be computed for any point of the sphere. If from these equations we eliminate ω, we get the equation to the parallel whose latitude is ϕ; it is an ellipse whose centre is in the central meridian, and its greater axis perpendicular to the same. The radius of curvature of this ellipse at its intersection with the centre meridian is $k\cos\phi/(h\sin\gamma+\sin\phi)$.

The elimination of ϕ between x and y gives the equation of the meridian whose longitude is ω, which also is an ellipse whose centre and axes may be determined.

The following table contains the computed co-ordinates for a map of Africa, which is included between latitudes 40° north and 40° south and 40° of longitude east and west of a central meridian.

ϕ	Values of x and y.				
	$\omega=0°$	$\omega=10°$	$\omega=20°$	$\omega=30°$	$\omega=40°$
0°	$x=$ 0·00 $y=$ 0·00	9·69 0·00	19·43 0·00	29·25 0·00	39·17 0·00
10°	$x=$ 0·00 $y=$ 9·69	9·60 9·75	19·24 9·92	28·95 10·21	38·76 10·63
20°	$x=$ 0·00 $y=$ 19·43	9·32 19·54	18·67 19·87	28·07 20·43	37·53 21·25
30°	$x=$ 0·00 $y=$ 29·25	8·84 29·40	17·70 29·87	26·56 30·67	35·44 31·83
40°	$x=$ 0·00 $y=$ 39·17	8·15 39·36	16·28 39·94	24·39 40·93	32·44 42·34

Central or Gnomonic (*Perspective*) *Projection.*—In this projection the eye is imagined to be at the centre of the sphere. It is evident that, since the planes of all great circles of the sphere pass through the centre, the representations of all great circles on this projection will be straight lines, and this is the special property of the *central projection*, that any great circle (*i.e.* shortest line on the spherical surface) is represented by a straight line. The plane of projection may be either parallel to the plane of the equator, in which case the parallels are represented by concentric circles and the meridians by straight lines radiating from the common centre; or the plane of projection may be parallel to the plane of some meridian, in which case the meridians are parallel straight lines and the parallels are hyperbolas; or the plane of projection may be inclined to the axis of the sphere at any angle λ.

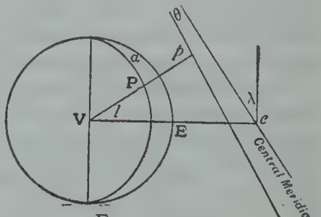

FIG. 13.

In the latter case, which is the most general, if θ is the angle any meridian makes (on paper) with the central meridian, α the longitude of any point P with reference to the central meridian, l the latitude of P, then it is clear that the central meridian is a straight line at right angles to the equator, which is also a straight line, also $\tan\theta=\sin\lambda\tan\alpha$, and the distance of p, the projection of P, from the equator along its meridian is (on paper) $m\sec\alpha\sin l\,/\sin(l+x)$, where $\tan x=\cot\lambda\cos\alpha$, and m is a constant which defines the scale.

The three varieties of the central projection are, as is the case with other perspective projections, known as polar, meridian or horizontal, according to the inclination of the plane of projection.

Fig. 14 is an example of a *meridian central projection* of part of the Atlantic Ocean. The term "gnomonic" was applied to this projection because the projection of the meridians is a similar problem to that of the graduation of a sun-dial. It is, however, better to use the term "central," which explains itself. The central projection is useful for the study of direct routes by sea and land. The United States Hydrographic Department has published some charts on this projection. False notions of the direction of shortest lines, which are engendered by a study of maps on Mercator's projection, may be corrected by an inspection of maps drawn on the central projection.

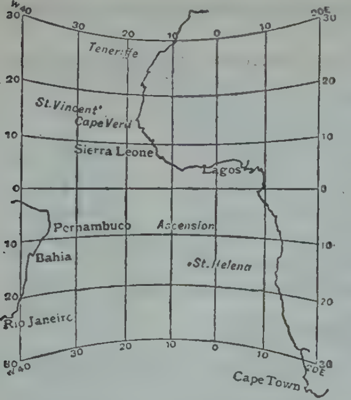

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FIG. 14.—Part of the Atlantic Ocean on a Meridian Central Projection. The shortest path between any two points is shown on this projection by a straight line.

There is no projection which accurately possesses the property of showing shortest paths by straight lines when applied to the spheroid; one which very nearly does so is that which results from the intersection of terrestrial normals with a plane.

We have briefly reviewed the most important projections which are derived from the sphere by direct geometrical construction, and we pass to that more important branch of the subject which deals with projections which are not subject to this limitation.

Conical Projections.

Conical projections are those in which the parallels are represented by concentric circles and the meridians by equally spaced radii. There is no necessary connexion between a conical projection and any touching or secant cone. Projections for instance which are derived by geometrical construction from secant cones are very poor projections, exhibiting large errors, and they will not be discussed. The name conical is given to the group embraced by the above definition, because, as is obvious, a projection so drawn can be bent round to form a cone. The simplest and, at the same time, one of the most useful forms of conical projection is the following:

Conical Projection with Rectified Meridians and Two Standard Parallels.—In some books this has been, most unfortunately, termed the "secant conical," on account of the fact that there are two parallels of the correct length. The use of this term in the past has caused much confusion. Two selected parallels are represented by concentric circular arcs of their true lengths; the meridians are their radii. The degrees along the meridians are represented by their true lengths; and the other parallels are circular arcs through points so determined and are concentric with the chosen parallels.

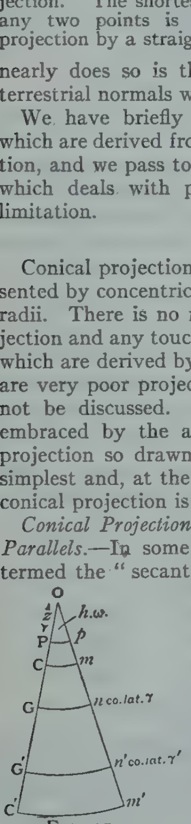

FIG. 15.

Thus in fig. 15 two parallels Gn and G$'n'$ are represented by their true lengths on the sphere; all the distances along the meridian PGG$'$, pnn' are the true spherical lengths rectified.

Let γ be the co-latitude of Gn; γ' that of Gn'; ω be the true difference of longitude of PGG$'$ and pnn'; $h\omega$ be the angle at O; and OP $=z$, where Pp is the representation of the pole. Then the true length of parallel Gn on the sphere is $\omega \sin \gamma$, and this is equal to the length on the projection, *i.e.* $\omega \sin \gamma = h\omega(z+\gamma)$; similarly $\omega \sin \gamma' = h\omega(z+\gamma')$.

The radius of the sphere is assumed to be unity, and z and γ are expressed in circular measure. Hence $h = \sin \gamma/(z+\gamma) = \sin \gamma'(z+\gamma')$; from this h and z are easily found.

In the above description it has been assumed that the two errorless parallels have been *selected*. But it is usually desirable to impose some condition which itself will fix the errorless parallels. There are many conditions, any one of which may be imposed. In fig. 15 let Cm and C$'m'$ represent the extreme parallels of the map, and let the co-latitudes of these parallels be c and c', then any one of the following conditions may be fulfilled:—

(*a*) The errors of scale of the extreme parallels may be made equal and may be equated to the error of scale of the parallel of maximum error (which is near the mean parallel).

(*b*) Or the errors of scale of the extreme parallels may be equated to that of the mean parallel. This is not so good a projection as (*a*).

(*c*) Or the absolute errors of the extreme and mean parallels may be equated.

(*d*) Or in the last the parallel of maximum error may be considered instead of the mean parallel.

(*e*) Or the mean length of all the parallels may be made correct. This is equivalent to making the total area between the extreme parallels correct, and must be combined with another condition, for example, that the errors of scale on the extreme parallels shall be equal.

We will now discuss (*a*) above, viz. a conical projection with rectified meridians and two standard parallels, the scale errors of the extreme parallels and parallel of maximum error being equated.

Since the scale errors of the extreme parallels are to be equal,

$$\frac{h(z+c)}{\sin c}-1=\frac{h(z+c')}{\sin c'}-1,\text{ whence } z=\frac{c'\sin c-c\sin c'}{\sin c'-\sin c} \qquad \text{(i.)}$$

The error of scale along any parallel (near the centre), of which the co-latitude is b is

$$1-\{h(z+b)/\sin b\}. \qquad \text{(ii.)}$$

This is a maximum when

$$\tan b-b=z,\text{ whence } b \text{ is found.}$$

Also
$$1-\frac{h(z+b)}{\sin b}=\frac{h(z+c)}{\sin c}-1,\text{ whence } h \text{ is found.} \qquad \text{(iii.)}$$

For the errorless parallels of co-latitudes γ and γ' we have

$$h=(z+\gamma)/\sin \gamma=(z+\gamma')/\sin \gamma'.$$

If this is applied to the case of a map of South Africa between the limits 15° S. and 35° S. (see fig. 16) it will be found that the parallel of maximum error is 25° 20′; the errorless parallels, to the nearest degree, are those of 18° and 32°. The greatest scale error in this case is about 0·7 %.

In the above account the earth has been treated as a sphere. Of course its real shape is approximately a spheroid of revolution, and the values of the axes most commonly employed are those of Clarke or of Bessel. For the spheroid, formulae arrived at by the same principles but more cumbrous in shape must be used. But it will usually be sufficient for the selection of the errorless parallels to use the simple spherical formulae given above; then, having made the selection of these parallels, the true spheroidal lengths along the meridians between them can be taken out of the ordinary tables (such as those published by the Ordnance Survey or by the U.S. Coast and Geodetic Survey). Thus, if a_1, a_2, are the lengths of 1° of the errorless parallels (taken from the tables), d the true rectified length of the meridian arc between them (taken from the tables),

$$h=\{(a_2-a_1)/d\}180/\pi,$$

and the radius on paper of parallel, a_1 is $a_1d/(a_2-a_1)$, and the radius of any other parallel = radius of $a_1 \pm$ the true meridian distance between the parallels.

This class of projection was used for the 1/1,000,000 Ordnance map of the British Isles. The three maximum scale errors in this case work out to 0·23 %, the range of the projection being from 50° N. to 61° N., and the errorless parallels are 59° 31′ and 51° 44′.

Where no great refinement is required it will be sufficient to take the errorless parallels as those distant from the extreme parallels about one-sixth of the total range in latitude. Thus suppose it is required to plot a projection for India between latitudes 8° and 40° N. By this rough rule the errorless parallels should be distant from the extreme parallels about 32°/6, *i.e.* 5° 20′; they should therefore, to the nearest degree, be 13° and 35° N. The maximum scale errors will be about 2 %.

The scale errors vary approximately as the square of the range of latitude; a rough rule is, largest scale error $=L^2/50{,}000$, where L is the range in the latitude in degrees. Thus a country with a range of 7° in latitude (nearly 500 m.) can be plotted on this projection with a maximum linear scale error (along a parallel) of about 0·1 %;[1] there is no error along any meridian. It is immaterial with this projection (or with any conical projection) what the extent in longitude is. It is clear that this class of projection is accurate, simple and useful.

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[1] This error is much less than that which may be expected from contraction and expansion of the paper upon which the projection is drawn or printed.

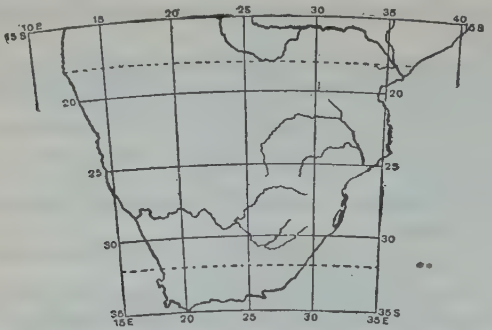

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FIG. 16.—South Africa on a conical projection with rectified meridians and two standard parallels. Scale 800 m. to 1 in.

In the projections designated by (*c*) and (*d*) above, absolute errors of length are considered in the place of errors of scale, *i.e.* between any two meridians (*c*) the absolute errors of length of the extreme parallels are equated to the absolute error of length of the middle parallel. Using the same notation

$$h\ (z+c)-\sin c=h\ (z+c')-\sin c'=-h\ (z+\tfrac{1}{2}c+\tfrac{1}{2}c')-\sin \tfrac{1}{2}\ (c+c').$$

L. Euler, in the *Acta Acad. Imp. Petrop.* (1778), first discussed this projection.

If a map of Asia between parallels 10° N. and 70° N. is constructed on this system, we have $c=20°$, $c'=80°$, whence from the above equations $z=66{\cdot}7°$ and $h=\cdot 6138$. The absolute errors of length along parallels 10°, 40° and 70° between any two meridians are equal but the scale errors are respectively 5, 6·7, and 15%.

The modification (*d*) of this projection was selected for the 1:1,000,000 map of *India and Adjacent Countries* under publication by the Survey of India. An account of this is given in a pamphlet produced by that department in 1903. The limiting parallels are 8° and 40° N., and the parallel of greatest error is 23° 40′ 51″. The errors of scale are 1·8, 2·3, and 1·9%.

It is not as a rule desirable to select this form of the projection. If the surface of the map is everywhere equally valuable it is clear that an arrangement by which errors of scale are larger towards the pole than towards the equator is unsound, and it is to be noted that in the case quoted the great bulk of the land is in the north of the map. Projection (*a*) would for the same region have three equal maximum scale errors of 2%. It may be admitted that the practical difference between the two forms is in this case insignificant, but linear scale errors should be reduced as much as possible in maps intended for general use.

f. In the fifth form of the projection, the total area of the projection between the extreme parallels and any two meridians is equated to the area of the portion of the sphere which it represents, and the errors of scale of the extreme parallels are equated. Then it is easy to show that

$$z=(c'\sin c-c\sin c')/(\sin c'-\sin c);$$
$$h=(\cos c-\cos c')/(c'-c)\{z+\tfrac{1}{2}\ (c+c')\}.$$

It can also be shown that any other zone of the same range in latitude will have the same scale errors along its limiting parallels. For instance, a series of projections may be constructed for zones, each having a range of 10° of latitude, from the equator to the pole. Treating the earth as a sphere and using the above formulae, the series will possess the following properties: the meridians will all be true to scale, the area of each zone will be correct, the scale errors of the limiting parallels will all be the same, so that the length of the upper parallel of any zone will be equal to that of the lower parallel of the zone above it. But the curvatures of these parallels will be different, and two adjacent zones will not fit but will be capable of exact rolling contact. Thus a very instructive flat model of the globe may be constructed which will show by suitably arranging the points of contact of the zones the paths of great circles on the sphere. The flat model was devised by Professor J. D. Everett, F.R.S., who also pointed out that the projection had the property of the equality of scale errors of the limiting parallels for zones of the same width. The projection may be termed *Everett's Projection.*

Simple Conical Projection.—If in the last group of projections the two selected parallels which are to be errorless approach each other indefinitely closely, we get a projection in which all the meridians are, as before, of the true rectified lengths, in which one parallel is errorless, the curvature of that parallel being clearly that which would result from the unrolling of a cone touching the sphere along the parallel represented. And it was in fact originally by a consideration of the tangent cone that the whole group of conical projections came into being. The quasi-geometrical way of regarding conical projections is legitimate in this instance.

The simple conical projection is therefore arrived at in this way: imagine a cone to touch the sphere along any selected parallel, the radius of this parallel on paper (P*p*, fig. 17) will be *r* cot *φ*, where *r* is the radius of the sphere and *φ* is the latitude; or if the spheroidal shape is taken into account, the radius of the parallel on paper will be *ν* cot *φ* where *ν* is the normal terminated by the minor axis (the value *ν* can be found from ordinary geodetic tables). The meridians are generators of the cone and every parallel such as HH′ is a circle, concentric with the selected parallel P*p* and distant from it the true rectified length of the meridian arc between them.

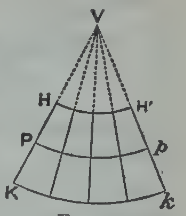


FIG. 17.

This projection has no merits as compared with the group just described. The errors of scale along the parallels increase rapidly as the selected parallel is departed from, the parallels on paper being always too large. As an example we may take the case of a map of South Africa of the same range as that of the example given in (*a*) above, viz. from 15° S. to 35° S. Let the selected parallel be 25° S.; the radius of this parallel on paper (taking the radius of the sphere as unity) is cot 25°; the radius of parallel 35° S. = radius of 25° − meridian distance between 25° and 35° = $\cot 25°-10\pi/180=1{\cdot}970$. Also $h=$ sin of selected latitude $=\sin 25°$, and length on paper along parallel 35° of $\omega°=\omega h\times 1{\cdot}970=\omega\times 1{\cdot}970\times\sin 25°$,

but length on sphere of $\omega=\omega\cos 35°$,

$$\text{hence scale error}=\frac{1{\cdot}970\ \sin\ 25°}{\cos\ 35°}-1=1{\cdot}6\%,$$

an error which is more than twice as great as that obtained by method (*a*).

Bonne's Projection.—This projection, which is also called the "modified conical projection," is derived from the simple conical, just described, in the following way: a central meridian is chosen and drawn as a straight line; degrees of latitude spaced at the true rectified distances are marked along this line; the parallels are concentric circular arcs drawn through the proper points on the central meridian, the centre of the arcs being fixed by describing one chosen parallel with a radius of *ν* cot *φ* as before; the meridians on each side of the central meridian are drawn as follows: along *each* parallel distances are marked equal to the true lengths along the parallels on sphere or spheroid, and the curve through corresponding points so fixed are the meridians (fig. 18).

This system is that which was adopted in 1803 by the "Dépôt de la Guerre" for the map of France, and is there known by the title of *Projection de Bonne.* It is that on which the ordnance survey map of Scotland on the scale of 1 in. to a mile is constructed, and it is frequently met with in ordinary atlases. It is ill-adapted for countries having great extent in longitude, as the intersections of the meridians and parallels become very oblique—as will be seen on examining the map of Asia in most atlases.

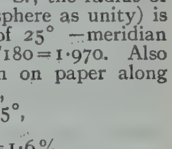


FIG. 18.

If ϕ_o be taken as the latitude of the centre parallel, and co-ordinates be measured from the intersection of this parallel with the central meridian, then, if ρ be the radius of the parallel of latitude ϕ, we have $\rho=\cot\phi_o+\phi_o-\phi$. Also, if S be a point on this parallel whose co-ordinates are x, y, so that $VS=\rho$, and θ be the angle VS makes with the central meridian, then $\rho\theta=\omega\cos\phi$; and $x=\rho\sin\theta$, $y=\cot\phi_o-\rho\cos\theta$.

The projection has the property of equal areas, since each small element bounded by two infinitely close parallels is equal in length and width to the corresponding element on the sphere or spheroid. Also all the meridians cross the chosen parallel (but no other) at right angles, since in the immediate neighbourhood of that parallel the projection is identical with the simple conical projection. Where an equal-area projection is required for a country having no great extent in longitude, such as France, Scotland or Madagascar, this projection is a good one to select.

Sinusoidal Equal-area Projection.—This projection, which is sometimes known as Sanson's, and is also sometimes incorrectly called Flamsteed's, is a particular case of Bonne's in which the selected parallel is the equator. The equator is a straight line at right angles to the central meridian which is also a straight line. Along the central meridian the latitudes are marked off at the true rectified distances, and from points so found the parallels are drawn as straight lines parallel to the equator, and therefore at right angles to the central meridian. True rectified lengths are marked along the parallels and through corresponding points the meridians are drawn. If the earth is treated as a sphere the meridians are clearly sine curves, and for this reason d'Avezac has given the projection the name sinusoidal. But it is equally easy to plot the spheroidal lengths. It is a very suitable projection for an equal-area map of Africa.

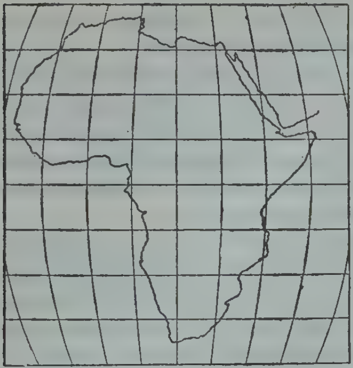


FIG. 19.—Sinusoidal Equal-area Projection.

Werner's Projection.—This is another limiting case of Bonne's equal-area projection in which the selected parallel is the pole. The parallels on paper then become incomplete circular arcs of which the pole is the centre. The central meridian is still a straight line which is cut by the parallels at true distances. The projection (after Johann Werner, 1468–1528), though interesting, is practically useless.

Polyconic Projections.

These pseudo-conical projections are valuable not so much for their intrinsic merits as for the fact that they lend themselves to tabulation. There are two forms, the *simple* or *equidistant polyconic*, and the *rectangular polyconic*.

The Simple Polyconic.—If a cone touches the sphere or spheroid along a parallel of latitude ϕ and is then unrolled, the parallel will on paper have a radius of $\nu \cot \phi$, where ν is the normal terminated by the minor axis. If we imagine a series of cones, each of which touches one of a selected series of parallels, the apex of each cone will lie on the prolonged axis of the spheroid; the generators of each cone lie in meridian planes, and if each cone is unrolled and the generators in any one plane are superposed to form a straight central meridian, we obtain a projection in which the central meridian is a straight line and the parallels are circular arcs each of which has a different centre which lies on the prolongation of the central meridian, the radius of any parallel being $\nu \cot \phi$.

So far the construction is the same for both forms of polyconic. In the *simple polyconic* the meridians are obtained by measuring outwards from the central meridian along each parallel the true lengths of the degrees of longitude. Through corresponding points so found the meridian curves are drawn. The resulting projection is accurate near the central meridian, but as this is departed from the parallels increasingly separate from each other, and the parallels and meridians (except along the equator) intersect at angles which increasingly differ from a right angle. The real merit of the projection is that each particular parallel has for every map the same absolute radius, and it is thus easy to construct tables which shall be of universal use. This is especially valuable for the projection of single sheets on comparatively large scales. A sheet of a degree square on a scale of 1:250,000 projected in this manner differs inappreciably from the same sheet projected on a better system, *e.g.* an orthomorphic conical projection or the conical with rectified meridians and two standard parallels; there is thus the advantage that the simple polyconic when used for single sheets and large scales is a sufficiently close approximation to the better forms of conical projection. The simple polyconic is used by the topographical section of the general staff, by the United States coast and geodetic survey and by the topographical division of the U.S. geological survey. Useful tables, based on Clarke's spheroid of 1866, have been published by the war office and by the U.S. coast and geodetic survey.

Rectangular Polyconic.—In this the central meridian and the parallels are drawn as in the simple polyconic, but the meridians are curves which cut the parallels at right angles.

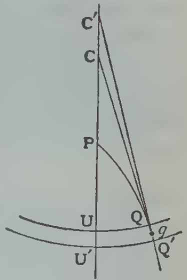


FIG. 20.

In this case, let P (fig. 20) be the north pole, CPU the central meridian, U, U′ points in that meridian whose co-latitudes are z and $z+dz$, so that $UU'=dz$. Make $PU=z$, $UC=\tan z$, $U'C'=\tan (z+dz)$; and with CC′ as centres describe the arcs UQ, U′Q′, which represent the parallels of co-latitude z and $z+dz$. Let PQQ′ be part of a meridian curve cutting the parallels at right angles. Join CQ, C′Q′; these being perpendicular to the circles will be tangents to the curve. Let $UCQ=2\alpha$, $UC'Q'=2(\alpha+d\alpha)$, then the small angle CQC′, or the angle between the tangents at QQ′, will $=2d\alpha$. Now

$$CC'=C'U'-CU-UU'=\tan (z+dz)-\tan z-dz=\tan^2 z\,dz.$$

The tangents CQ, C′Q′ will intersect at q, and in the triangle $CC'q$ the perpendicular from C on $C'q$ is (omitting small quantities of the second order) equal to either side of the equation

$$\tan^2 z\,dz \sin 2\alpha = -2 \tan z\,d\alpha.$$

$$-\tan z\,dz = 2d\alpha/\sin 2\alpha,$$

which is the differential equation of the meridian: the integral is $\tan \alpha = \omega \cos z$, where ω, a constant, determines a particular meridian curve. The distance of Q from the central meridian, $\tan z \sin 2\alpha$, is equal to

$$\frac{2 \tan z \tan \alpha}{1 + \tan^2 \alpha} = \frac{2\omega \sin z}{1 + \omega^2 \cos^2 \alpha}$$

At the equator this becomes simply 2ω. Let any equatorial point whose actual longitude is 2ω be represented by a point on the developed equator at the distance 2ω from the central meridian, then we have the following very simple construction (due to O'Farrell of the ordnance survey). Let P (fig. 21) be the pole, U any point in the central meridian, QUQ′ the represented parallel whose radius $CU=\tan z$. Draw SUS′ perpendicular to the meridian through U; then to determine the point Q, whose longitude is, say, 3°, lay off US equal to half the true length of the arc of parallel on the sphere, *i.e.* 1° 30′ to radius $\sin z$, and with the centre S and radius SU describe a circular arc, which will intersect the parallel in the required point Q. For if we suppose 2ω to be the longitude of the required point Q, US is by construction $=\omega \sin z$, and the angle subtended by SU at C is

$$\tan^{-1}\left(\frac{\omega \sin z}{\tan z}\right) = \tan^{-1} (\omega \cos z) = \alpha,$$

and therefore $UCQ=2\alpha$ as it should be. The advantages of this method are that with a remarkably simple and convenient mode of construction we have a map in which the parallels and meridians intersect at right angles.

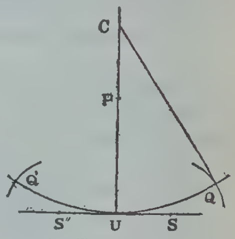


FIG. 21.

Fig. 22 is a representation of this system of the continents of Europe and Africa, for which it is well suited. For Asia this system would not do, as in the northern latitudes, say along the parallel of 70°, the representation is much cramped.

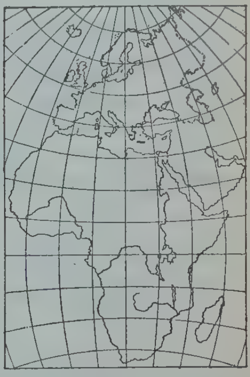


FIG. 22.

With regard to the distortion in the map of Africa as thus constructed, consider a small square in latitude 40° and in 40° longitude east or west of the central meridian, the square being so placed as to be transformed into a rectangle. The sides, originally unity, became 0·95 and 1·13, and the area 1·08, the diagonals intersecting at 90°±9° 56′. In Clarke's perspective projection a square of unit side occupying the same position, when transformed to a rectangle, has its sides 1·02 and 1·15, its area 1·17, and its diagonals intersect at 90°±7° 6′. The latter projection is therefore the best in point of "similarity," but the former represents areas best. This applies, however, only to a particular part of the map; along the equator towards 30° or 40° longitude, the polyconic is certainly inferior, while along the meridian it is better than the perspective—except, of course, near the centre. Upon the whole the more even distribution of distortion gives the advantage to the perspective system. For single sheets on large scales there is nothing to choose between this projection and the simple polyconic. Both are sensibly perfect representations. The rectangular polyconic is occasionally used by the topographical section of the general staff.

Zenithal Projections.

Some point on the earth is selected as the central point of the map; great circles radiating from this point are represented by straight lines which are inclined at their true angles at the point of intersection. Distances along the radiating lines vary according to any law outwards from the centre. It follows (on the spherical assumption), that circles of which the selected point is the centre are also circles on the projection. It is obvious that all perspective projections are zenithal.

Equidistant Zenithal Projection.—In this projection, which is commonly called the "equidistant projection," any point on the sphere being taken as the centre of the map, great circles through this point are represented by straight lines of the true rectified lengths, and intersect each other at the true angles.

In the general case—

if z_1 is the co-latitude of the centre of the map, z the co-latitude of any other point, α the difference of longitude of the two points, A the azimuth of the line joining them, and c the spherical length of the line joining them, then the position of the intersection of any meridian with any parallel is given (on the spherical assumption) by the solution of a simple spherical triangle.

Thus—

let $\tan\theta = \tan z \cos\alpha$, then $\cos c = \cos z \sec\theta \cos(z-\theta)$, and $\sin A = \sin z \sin\alpha \operatorname{cosec} c$.

The most useful case is that in which the central point is the pole; the meridians are straight lines inclined to each other at the true angular differences of longitude, and the parallels are equidistant circles with the pole as centre. This is the best projection to use for maps exhibiting the progress of polar discovery, and is called the *polar equidistant projection.* The errors are smaller than might be supposed. There are no scale errors along the meridians, and along the parallels the scale error is $(z/\sin x)-1$, where z is the co-latitude of the parallel. On a parallel 10° distant from the pole the error of scale is only 0·5%.

General Theory of Zenithal Projections.—For the sake of simplicity it will be at first assumed that the pole is the centre of the map, and that the earth is a sphere. According to what has been said above, the meridians are now straight lines diverging from the pole, dividing the 360° into equal angles; and the parallels are represented by circles having the pole as centre, the radius of the parallel whose co-latitude is z being ρ, a certain function of z. The particular function selected determines the nature of the projection.

Let Ppq, Prs (fig. 23) be two contiguous meridians crossed by parallels rp, sq, and O$p'q'$, O$r's'$ the straight lines representing these meridians. If the angle at P is $d\mu$, this also is the value of the angle at O. Let the co-latitude

$$Pp = z,\ Pq = z + dz;\ Op' = \rho,\ Oq' = \rho + d\rho,$$

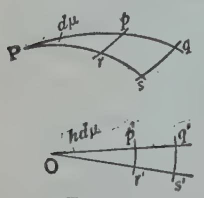


FIG. 23.

the circular arcs $p'r'$, $q's'$ representing the parallels pr, qs. If the radius of the sphere be unity,

$$p'q' = d\rho;\ p'r' = \rho d\mu,$$
$$pq = dz;\ pr = \sin z d\mu.$$

Put

$$\sigma = d\rho/dz;\ \sigma' = \rho/\sin z,$$

then $p'q' = \sigma pq$ and $p'r' = \sigma' pr$. That is to say, σ, σ' may be regarded as the relative scales, at co-latitude z, of the representation, σ applying to meridional measurements, σ' to measurements perpendicular to the meridian. A small square situated in co-latitude z, having one side in the direction of the meridian—the length of its side being i—is represented by a rectangle whose sides are $i\sigma$ and $i\sigma'$; its area consequently is $i^2\sigma\sigma'$.

If it were possible to make a perfect representation, then we should have $\sigma = 1$, $\sigma' = 1$ throughout. This, however, is impossible. We may make $\sigma = 1$ throughout by taking $\rho = z$. This is the *Equidistant Projection* just described, a very simple and effective method of representation.

Or we may make $\sigma' = 1$ throughout. This gives $\rho = \sin z$, a perspective projection, namely, the *Orthographic.*

Or we may require that areas be strictly represented in the development. This will be effected by making $\sigma\sigma' = 1$, or $\rho d\rho = \sin z dz$, the integral of which is $\rho = 2 \sin\frac{1}{2}z$, which is the *Zenithal Equal-area Projection* of Lambert, sometimes, though wrongly referred to as *Lorgna's Projection* after Antonio Lorgna (b. 1736). In this system there is misrepresentation of form, but no misrepresentation of areas.

Or we may require a projection in which all small parts are to be represented in their true forms *i.e.* an orthomorphic projection. For instance, a small square on the spherical surface is to be represented as a small square in the development. This condition will be attained by making $\sigma = \sigma'$, or $d\rho/\rho = dz/\sin z$, the integral of which is, c being an arbitrary constant, $\rho = c \tan\frac{1}{2}z$. This, again, is a perspective projection, namely, the *Stereographic.* In this, though all small parts of the surface are represented in their correct shapes, yet, the scale varying from one part of the map to another, the *whole* is not a similar representation of the original. The scale, $\sigma = \frac{1}{2}c\sec^2\frac{1}{2}z$, at any point, applies to all directions round that point.

These two last projections are, as it were, at the extremes of the scale; each, perfect in its own way, is in other respects objectionable. We may avoid both extremes by the following considerations. Although we cannot make $\sigma = 1$ and $\sigma' = 1$, so as to have a perfect picture of the spherical surface, yet considering $\sigma - 1$ and $\sigma' - 1$ as the local errors of the representation, we may make $(\sigma-1)^2 + (\sigma'-1)^2$ a minimum over the whole surface to be represented. To effect this we must multiply this expression by the element of surface to which it applies, viz. $\sin z dz d\mu$, and then integrate from the centre to the (circular) limits of the map. Let β be the spherical radius of the segment to be represented, then the total misrepresentation is to be taken as

$$\int_0^\beta \left\{ \left(\frac{d\rho}{dz}-1\right)^2 + \left(\frac{\rho}{\sin z}-1\right)^2 \right\} \sin z dz,$$

which is to be made a minimum. Putting $\rho = z + y$, and giving to y only a variation subject to the condition $\delta y = 0$ when $z = 0$, the equations of solution—using the ordinary notation of the calculus of variations—are

$$N - \frac{d(P)}{dz} = 0;\ P\beta = 0,$$

Pβ being the value of $2p \sin z$ when $z = \beta$. This gives

$$\sin^2 z\frac{d^2y}{dz^2} + \sin z \cos z\frac{dy}{dz} - y = z - \sin z\left(\frac{dy}{dz}\right)_\beta = 0.$$

This method of development is due to Sir George Airy, whose original paper—the investigation is different in form from the above, which is due to Colonel Clarke—will be found in the *Philosophical Magazine* for 1861. The solution of the differential equation leads to this result—

$$\rho = 2 \cot\tfrac{1}{2}z \log_e \sec\tfrac{1}{2}z + C \tan\tfrac{1}{2}z,$$
$$C = 2 \cot^2\tfrac{1}{2}\beta \log_e \sec\tfrac{1}{2}\beta.$$

The limiting radius of the map is $R = 2C \tan\frac{1}{2}\beta$. In this system, called by Sir George Airy *Projection by balance of errors*, the total misrepresentation is an absolute minimum. For short it may be called *Airy's Projection.*

Returning to the general case where ρ is any function of z, let us consider the local misrepresentation of direction. Take any indefinitely small line, length $= i$, making an angle α with the meridian in co-latitude z. Its projections on a meridian and parallel are $i \cos\alpha$, $i \sin\alpha$, which in the map are represented by $i\sigma \cos\alpha$, $i\sigma' \sin\alpha$. If then α' be the angle in the map corresponding to α,

$$\tan\alpha' = (\sigma'/\sigma) \tan\alpha.$$

Put

$$\sigma'/\sigma = \rho dz/\sin z d\rho = \Sigma,$$

and the error $\alpha' - \alpha$ of representation $= \epsilon$, then

$$\tan\epsilon = \frac{(\Sigma-1)\tan\alpha}{1+\Sigma\tan^2\alpha}.$$

Put $\Sigma = \cot^2\zeta$, then ϵ is a maximum when $\alpha = \zeta$, and the corresponding value of ϵ is

$$\epsilon = \tfrac{1}{2}\pi - 2\zeta.$$

For simplicity of explanation we have supposed this method of development so applied as to have the pole in the centre. There is, however, no necessity for this, and any point on the surface of the sphere may be taken as the centre. All that is necessary is to calculate by spherical trigonometry the azimuth and distance, with reference to the assumed centre, of all the points of intersection of meridians and parallels within the space which is to be represented in a plane. Then the azimuth is represented unaltered, and any spherical distance z is represented by ρ. Thus we get all the points of intersection transferred to the representation, and it remains merely to draw continuous lines through these points, which lines will be the meridians and parallels in the representation.

Thus treating the earth as a sphere and applying the *Zenithal Equal-area Projection* to the case of Africa, the central point selected being on the equator, we have, if θ be the spherical distance of any point from the centre, ϕ, a the latitude and longitude (with reference to the centre), of this point, $\cos\theta = \cos\phi\cos a$. If A is the azimuth of this point at the centre, $\tan A = \sin a \cot\phi$. On paper a line from the centre is drawn at an azimuth A, and the distance θ is represented by $2\sin\frac{1}{2}\theta$. This makes a very good projection for a single-sheet equal-area map of Africa. The exaggeration in such systems, it is important to remember, whether of linear scale, area, or angle, is the same for a given distance from the centre, whatever be the azimuth; that is, the exaggeration is a function of the distance from the centre only.

General Theory of Conical Projections.

Meridians are represented by straight lines drawn through a point, and a difference of longitude ω is represented by an angle $h\omega$. The parallels of latitude are circular arcs, all having as centre the point of divergence of the meridian lines. It is clear that perspective and zenithal projections are particular groups of conical projections.

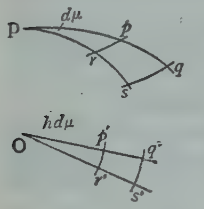


FIG. 24.

Let z be the co-latitude of a parallel, and ρ, a function of z, the radius of the circle representing this parallel. Consider the infinitely small space on the sphere contained by two consecutive meridians, the difference of whose longitude is $d\mu$, and two consecutive parallels whose co-latitudes are z and $z+dz$. The sides of this rectangle are $pq=dz$, $pr=\sin z d\mu$; in the projection $p'q'r's'$ these become $p'q'=d\rho$, and $p'r'=\rho h d\mu$.

The scales of the projection as compared with the sphere are $p'q'/pq=d\rho/dz=$ the scale of meridian measurements $=\sigma$, say, and $p'r'/pr=\rho h d\mu/\sin z d\mu=\rho h/\sin z=$ scale of measurements perpendicular to the meridian $=\sigma'$, say.

Now we may make $\sigma=1$ throughout, then $\rho=z+$const. This gives either the group of *conical projections with rectified meridians*, or as a particular case the *equidistant zenithal*.

We may make $\sigma=\sigma'$ throughout, which is the same as requiring that at any point the scale shall be the same in all directions. This gives a group of *orthomorphic projections*.

In this case $d\rho/dz=\rho h/\sin z$, or $d\rho/\rho=h dz/\sin z$.

Integrating, $$\rho=k(\tan\tfrac{1}{2}z)^h, \qquad \text{(i.)}$$
where k is a constant.

Now h is at our disposal and we may give it such a value that two selected parallels are of the correct lengths. Let z_1, z_2 be the co-latitudes of these parallels, then it is easy to show that

$$h=\frac{\log\sin z_1-\log\sin z_2}{\log\tan\frac{1}{2}z_1-\log\tan\frac{1}{2}z_2} \qquad \text{(ii.)}$$

This projection, given by equations (i.) and (ii.), is Lambert's orthomorphic projection—commonly called Gauss's projection; its descriptive name is the *orthomorphic conical projection with two standard parallels.*

The constant k in (i.) defines the scale and may be used to render the scale errors along the selected parallels not nil but the *same*; and some other parallel, *e.g.* the central parallel may then be made errorless.

The value $h=\frac{1}{3}$, as suggested by Sir John Herschel, is admirably suited for a map of the world. The representation is fan-shaped, with remarkably little distortion (fig. 24).

If any parallel of co-latitude z is true to scale $hk(\tan\frac{1}{2}z_1)^h=\sin z$, if this parallel is the equator, so that $z_1=90°$, $kh=1$, then equation (i.) becomes $\rho=(\tan\frac{1}{2}z)^h/h$, and the radius of the equator $=1/h$. The distance r of any parallel from the equator is $1/h-(\tan\frac{1}{2}z)^h/h=(1/h)\{1-(\tan\frac{1}{2}z)^h\}$.

If, instead of taking the radius of the earth as unity we call it a, $r=(a/h)\{1-(\tan\frac{1}{2}z)^h\}$. When h is very small, the angles between the meridian lines in the representation are very small; and proceeding to the limit, when h is zero the meridians are parallel—that is, the vertex of the cone has removed to infinity. And at the limit when h is zero we have $r=a\log_e\cot\frac{1}{2}z$, which is the characteristic equation of Mercator's projection.

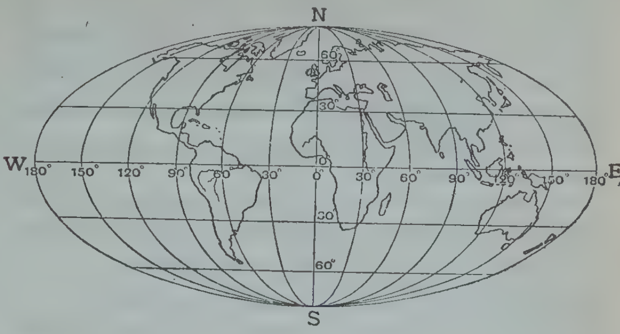


FIG. 25.—Elliptical equal-area Projection, showing the whole surface of the globe.

Mercator's Projection.—From the manner in which we have arrived at this projection it is clear that it retains the characteristic property of orthomorphic projections—namely, similarity of representation of small parts of the surface. In Mercator's chart the equator is represented by a straight line, which is crossed at right angles by a system of parallel and equidistant straight lines representing the meridians. The parallels are straight lines parallel to the equator, and the distance of the parallel of latitude ϕ from the equator is, as we have seen above, $r=a\log_e\tan(45°+\frac{1}{2}\phi)$. In the vicinity of the equator, or indeed within 30° of latitude of the equator, the representation is very accurate, but as we proceed northwards or southwards the exaggeration of area becomes larger, and eventually excessive—the poles being at infinity. This distance of the parallels may be expressed in the form $r=a(\sin\phi+\frac{1}{3}\sin^3\phi+\frac{1}{5}\sin^5\phi+\ldots)$, showing that near the equator r is nearly proportional to the latitude. As a consequence of the similar representation of small parts, a curve drawn on the sphere cutting all meridians at the same angle—the loxodromic curve—is projected into a straight line, and it is this property which renders Mercator's chart so valuable to seamen. For instance: join by a straight line on the chart Land's End and Bermuda, and measure the angle of intersection of this line with the meridian. We get thus the bearing which a ship has to retain during its course between these ports. This is not great-circle sailing, and the ship so navigated does not take the shortest path. The projection of a great circle (being neither a meridian nor the equator) is a curve which cannot be represented by a simple algebraic equation.

If the true spheroidal shape of the earth is considered, the semi-axes being a and b, putting $e=\sqrt{(a^2-b^2)}/a$, and using common logarithms, the distance of any parallel from the equator can be shown to be

$$(a/M)\{\log\tan(45°+\tfrac{1}{2}\phi)-e^2\sin\phi-\tfrac{1}{3}e^4\sin^3\phi\ldots\}$$

where M, the modulus of common logarithms, $=0{\cdot}434294$. Of course Mercator's projection was not originally arrived at in the manner above described; the description has been given to show that Mercator's projection is a particular case of the conical orthomorphic group. The introduction of the projection is due to the fact that for navigation it is very desirable to possess charts which shall give correct local outlines (*i.e.* in modern phraseology shall be orthomorphic) and shall at the same time show as a straight line any line which cuts the meridians at a constant angle. The latter condition clearly necessitates parallel meridians, and the former a continuous increase of scale as the equator is departed from, *i.e.* the scale at any point must be equal to the scale at the equator × sec. latitude. In early days the calculations were made by assuming that for a small increase of latitude, say 1′, the scale was constant, then summing up the small lengths so obtained. Nowadays (for simplicity the earth will be taken as a sphere) we should say that a small length of meridian $a d\phi$ is represented in this projection by $a\sec\phi d\phi$, and the length of the meridian in the projection between the equator and latitude ϕ,

$$\int_0^\phi a\sec\phi d\phi=a\log_e\tan(45°+\tfrac{1}{2}\phi);$$

which is the direct way of arriving at the law of the construction of this very important projection.

Mercator's projection, although indispensable at sea, is of little value for land maps. For topographical sheets it is obviously unsuitable; and in cases in which it is required to show large areas on small scales on an orthomorphic projection, that form should be chosen which gives two standard parallels (Lambert's conical orthomorphic). Mercator's projection is often used in atlases for maps of the world. It is not a good projection to select for this purpose on account of the great exaggeration of scale near the poles. The misconceptions arising from this exaggeration of scale may, however, be corrected by the juxtaposition of a map of the world on an equal-area projection.

It is now necessary to revert to the general consideration of conical projections.

It has been shown that the scales of the projection (fig. 23) as compared with the sphere are $p'q'/pq = d\rho/dz = \sigma$ along a meridian, and $p'r'/pr' = \rho h/\sin z = \sigma'$ at right angles to a meridian.

Now if $\sigma\sigma' = 1$ the areas are correctly represented, then

$$h\rho d\rho = \sin z dz, \text{ and integrating } \tfrac{1}{2}h\rho^2 = C - \cos z; \qquad \text{(i.)}$$

this gives the whole group of *equal-area conical projections*.

As a special case let the pole be the centre of the projected parallels, then when

$$z = o,\ \rho = o, \text{ and const} = 1, \text{ we have } \rho = 2\sin\tfrac{1}{2}z/\delta h \qquad \text{(ii.)}$$

Let z_1 be the co-latitude of some parallel which is to be correctly represented, then $2h \sin \frac{1}{2}z_1/\delta h = \sin z_1$, and $h = \cos^2 \frac{1}{2}z_1$; putting this value of h in equation (ii.) the radius of any parallel

$$= \rho = 2 \sin \tfrac{1}{2}z \sec \tfrac{1}{2}z_1 \qquad \text{(iii.)}$$

This is Lambert's *conical equal-area projection with one standard parallel*, the pole being the centre of the parallels.

If we put $z_1 = \theta$, then $h = 1$, and the meridians are inclined at their true angles, also the scale at the pole becomes correct, and equation (iii.) becomes

$$\rho = 2 \sin \tfrac{1}{2}z; \qquad \text{(iv.)}$$

this is the *zenithal equal-area projection*.

Reverting to the general expression for *equal-area conical projections*

$$\rho = \sqrt{\{2(C - \cos z)/h\}} \qquad \text{(i.)}$$

we can dispose of C and h so that any two selected parallels shall be their true lengths; let their co-latitudes be z_1 and z_2, then

$$2h(C - \cos z_1) = \sin^2 z_1 \qquad \text{(v.)}$$
$$2h(C - \cos z_2) = \sin^2 z_2 \qquad \text{(vi.)}$$

from which C and h are easily found, and the radii are obtained from (i.) above. This is H. C. Albers' *conical equal-area projection with two standard parallels*. The pole is not the centre of the parallels.

Projection by Rectangular Spheroidal Co-ordinates.

If in the simple conical projection the selected parallel is the equator, this and the other parallels become parallel straight lines and the meridians are straight lines spaced at equatorial distances, cutting the parallels at right angles; the parallels are their true distances apart. This projection is the *simple cylindrical*. If now we imagine the touching cylinder turned through a right-angle in such a way as to touch the sphere along any meridian, a projection is obtained exactly similar to the last, except that in this case we represent, not parallels and meridians, but small circles parallel to the given meridian and great circles at right angles to it. It is clear that the projection is a special case of conical projection. The position of any point on the earth's surface is thus referred, on this projection, to a selected meridian as one axis, and any great circle at right angles to it as the other. Or, in other words, any point is fixed by the length of the perpendicular from it on to the fixed meridian and the distance of the foot of the perpendicular from some fixed point on the meridian, these spherical or spheroidal co-ordinates being plotted as plane rectangular co-ordinates.

The perpendicular is really a plane section of the surface through the given point at right angles to the chosen meridian, and may be briefly called a great circle. Such a great circle clearly diverges from the parallel; the exact difference in latitude and longitude between the point and the foot of the perpendicular can be at once obtained by ordinary geodetic formulae, putting the azimuth = 90°. Approximately the difference of latitude in seconds is $x^2 \tan \phi \operatorname{cosec} 1''/2\rho\nu$ where x is the length of the perpendicular, ρ that of the radius of curvature to the meridian, ν that of the normal terminated by the minor axis, ϕ the latitude of the foot of the perpendicular. The difference of longitude in seconds is approximately $x \sec \rho \operatorname{cosec} 1''/\nu$. The resulting error consists principally of an exaggeration of scale north and south and is approximately equal to sec x (expressing x in arc); it is practically independent of the extent in latitude.

It is on this projection that the 1/2,500 Ordnance maps and the 6-in. Ordnance maps of the United Kingdom are plotted, a meridian being chosen for a group of counties. It is also used for the 1-in., ½ in. and ¼ in. Ordnance maps of England, the central meridian chosen being that which passes through a point in Delamere Forest in Cheshire. This projection should not as a rule be used for topographical maps, but is suitable for cadastral plans on account of the convenience of plotting the rectangular co-ordinates of the very numerous trigonometrical or traverse points required in the construction of such plans. As regards the errors involved, a range of about 150 miles each side of the central meridian will give a maximum error in scale in a north and south direction of about 0·1%.

Elliptical Equal-area Projection.

In this projection, which is also called Mollweide's projection the parallels are parallel straight lines and the meridians are ellipses, the central meridian being a straight line at right angles to the equator, which is equally divided. If the whole world is represented on the spherical assumption, the equator is twice the length of the central meridian. Each elliptical meridian has for one axis the central meridian, and for the other the intercepted portion of the equally divided equator. It follows that the meridians 90° east and west of the central meridian form a circle. It is easy to show that to preserve the property of equal areas the distance of any parallel from the equator must be $\sqrt{2} \sin \delta$ where $\pi \sin \phi = 2\delta + \sin 2\delta$, ϕ being the latitude of the parallel. The length of the central meridian from pole to pole $= 2\sqrt{2}$, where the radius of the sphere is unity. The length of the equator $= 4\sqrt{2}$.

The following equal-area projections may be used to exhibit the entire surface of the globe: Cylindrical equal area, Sinusoidal equal area and Elliptical equal area.

Conventional or Arbitrary Projections.

These projections are devised for simplicity of drawing and not for any special properties. The most useful projection of this class is the *globular projection*. This is a conventional representation of a hemisphere in which the equator and central meridian are two equal straight lines at right angles, their intersection being the centre of the circular boundary. The meridians divide the equator into equal parts and are arcs of circles passing through points so determined and the poles. The parallels are arcs of circles which divide the central and extreme meridians into equal parts. Thus in fig. 26 NS = EW and each is divided into equal parts (in this case each division is 10°); the circumference NESW is also divided into 10° spaces and circular arcs are drawn through the corresponding points. This is a simple and effective projection and one well suited for conveying ideas of the

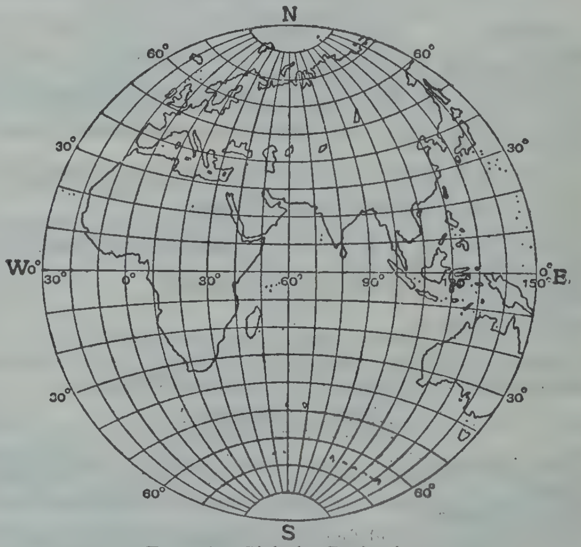
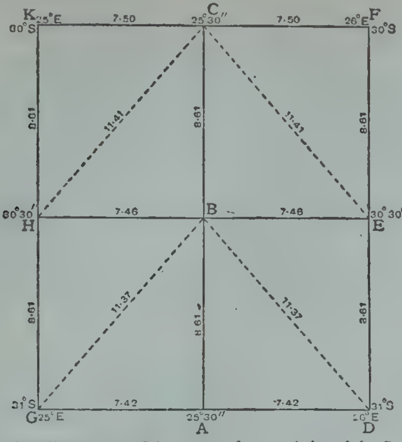


FIG. 26.—Globular Projection.

general shape and position of the chief land masses; it is better for this purpose than the stereographic, which is commonly employed in atlases.



(From *Text Book of Topographical Surveying*, by permission of the Controller of H.M. Stationery Office.)

FIG. 27.—Plane Table Graticule, dimensions in inches, for a scale of 4 in. to 1 m.

Projections for Field Sheets.

Field sheets for topographical surveys should be on conical projections with rectified meridians; these projections for small areas and ordinary topographical scales—not less than 1/500,000—are sensibly errorless. But to save labour it is customary to employ for this purpose either form of polyconic projection, in which the errors for such scales are also negligible. In some surveys, to avoid the difficulty of plotting the flat arcs required for the parallels, the arcs are replaced by polygons, each side being the length of the portion of the arc it replaces. This method is especially suitable for scales of 1:125,000 and larger, but it is also sometimes used for smaller scales.

Fig. 27 shows the method of plotting the projection for a field sheet. Such a projection is usually called a graticule. In this case ABC is the central meridian; the true meridian lengths of 30′ spaces are marked on this meridian, and to each of these, such as AB, the figure (in this case representing a square half degree), such as ABED, is applied. Thus the point D is the intersection of a circle of radius AD with a circle of radius BD, these lengths being taken from geodetic tables. The method has no merit except that of convenience.

Summary.

The following projections have been briefly described:—

Perspective
1. Cylindrical equal-area.
2. Orthographic.
3. Stereographic (which is orthomorphic).
4. General external perspective.
5. Minimum error „ (Clarke's).
6. Central.

Conical
7. Conical, with rectified meridians and two standard parallels (5 forms).
8. Simple conical.
9. Simple cylindrical (a special case of 8).
10. Modified conical equal-area (Bonne's).
11. Sinusoidal „ „ (Sanson's).
12. Werner's conical „ „
13. Simple polyconic.
14. Rectangular polyconic.
15. Conical orthomorphic with 2 standard parallels (Lambert's, commonly called Gauss's).
16. Cylindrical orthomorphic (Mercator's).
17. Conical equal-area with one standard parallel.
18. „ „ „ „ two „ parallels.
19. Projection by rectangular spheroidal co-ordinates.

Zenithal
20. Equidistant zenithal.
21. Zenithal equal-area.
22. Zenithal projection by balance of errors (Airy's).
23. Elliptical equal-area (Mollweide's).
24. Globular (conventional).
25. Field sheet graticule.

Of the above 25 projections, 23 are conical or quasi-conical, if zenithal and perspective projections be included. The projections may, if it is preferred, be grouped according to their properties. Thus in the above list 8 are equal-area, 3 are orthomorphic, 1 balances errors, 1 represents all great circles by straight lines, and in 5 one system of great circles is represented correctly.

Among projections which have not been described may be mentioned the circular orthomorphic (Lagrange's) and the rectilinear equal-area (Collignon's) and a considerable number of conventional projections, which latter are for the most part of little value.

The choice of a projection depends on the function which the map is intended to fulfil. If the map is intended for statistical purposes to show areas, density of population, incidence of rainfall, of disease, distribution of wealth, &c., an *equal-area* projection should be chosen. In such a case an area scale should be given. At sea, *Mercator's* is practically the only projection used except when it is desired to determine graphically great circle courses in great oceans, when the *central* projection must be employed. For conveying good general ideas of the shape and distribution of the surface features of continents or of a hemisphere *Clarke's perspective* projection is the best. For exhibiting the progress of polar exploration the *polar equidistant* projection should be selected. For special maps for general use on scales of 1/1,000,000 and smaller, and for a series of which the sheets are to fit together, the *conical, with rectified meridians and two standard parallels*, is a good projection. For topographical maps, in which each sheet is plotted independently and the scale is not smaller than 1/500,000, either form of *polyconic* is very convenient.

The following are the projections adopted for some of the principal official maps of the British Empire:—

Conical, with Rectified Meridians and Two Standard Parallels.—The 1 : 1,000,000 Ordnance map of the United Kingdom, special maps of the topographical section, General Staff, *e.g.* the 64-mile map of Afghanistan and Persia. The 1 : 1,000,000 Survey of India series of India and adjacent countries.

Modified Conical, Equal-area (Bonne's).—The 1 in., $\frac{1}{2}$ in., $\frac{1}{4}$ in. and $\frac{1}{10}$ in. Ordnance maps of Scotland and Ireland. The 1 : 800,000 map of the Cape Colony, published by the Surveyor-General.

Simple Polyconic and Rectangular Polyconic maps on scales of 1 : 1,000,000, 1 : 500,000, 1 : 250,000 and 1 : 125,000 of the topographical section of the General Staff, including all maps on these scales of British Africa. A rectilinear approximation to the simple polyconic is also used for the topographical sheets of the Survey of India. The simple polyconic is used for the 1 in. maps of the Militia Department of Canada.

Zenithal Projection by Balance of Errors (Airy's).—The 10-mile to 1 in. Ordnance map of England.

Projection by Rectangular Spheroidal Co-ordinates.—The 1 : 2500 and the 6 in. Ordnance sheets of the United Kingdom, and the 1 in., $\frac{1}{2}$ in. and $\frac{1}{4}$ in. Ordnance maps of England. The cadastral plans of the Survey of India, and cadastral plans throughout the empire.

AUTHORITIES.—See *Traité des projections des cartes géographiques*, by A. Germain (Paris, 1865) and *A Treatise on Projections*, by T. Craig, United States Coast and Geodetic Survey (Washington, 1882). Both Germain and Craig (following Germain) make use of the term *projections by development*, a term which is apt to convey the impression that the spherical surface is developable. As this is not the case, and since such projections are conical, it is best to avoid the use of the term. For the history of the subject see d'Avezac, "Coup d'œil historique sur la projection des cartes géographiques," *Société de géographie de Paris* (1863).

J. H. Lambert (*Beiträge zum Gebrauch der Mathematik, u.s.w.* Berlin, 1772) devised the following projections of the above list: 1, 15, 17, and 21; his transverse cylindrical orthomorphic and the transverse cylindrical equal-area have not been described, as they are seldom used. Among other contributors we mention Mercator, Euler, Gauss, C. B. Mollweide (1774–1825), Lagrange, Cassini, R. Bonne (1727–1795), Airy and Colonel A. R. Clarke. (C. F. CL.; A. R. C.)

MAPLE, SIR JOHN BLUNDELL, BART. (1845–1903), English business magnate, was born on the 1st of March 1845. His father, John Maple (d. 1900), had a small furniture shop in Tottenham Court Road, London, and his business began to develop about the time that his son entered it. The practical management soon devolved on the younger Maple, under whom it attained colossal dimensions. The firm became a limited liability company, with a capital of two millions, in 1890, with Mr Maple as chairman. He entered parliament as Conservative member for Dulwich in 1887, was knighted in 1892, and was made a baronet in 1897. He was the owner of a large stud of race-horses, and from 1885 onwards won many important races, appearing at first under the name of "Mr Childwick." His public benefactions included a hospital and a recreation ground to the city of St Albans, near which his residence, Childwickbury, was situated, and the rebuilding, at a cost of more than £150,000, of University College Hospital, London. He died on the 24th of November 1903. His only surviving daughter married in 1896 Baron von Eckhardstein, of the German Embassy.

MAPLE, in botany. The maple (O. E. *mapel-trēow*, *mapulder*) and sycamore trees are species of *Acer*, of the order *Acerineae*. The genus includes about sixty species, natives of Europe, North America and Asia, especially the Himalayas, China and Japan. Maples are for the most part trees with opposite, long-stalked, palmately lobed leaves. The flowers are in fascicles, appearing before the leaves as in the Norway maple, or in racemes or panicles appearing with, or later than, the leaves as in sycamore. Some of the flowers are often imperfect, the stamens or pistil being more or less aborted. The fruit is a two-winged "samara." The genus was represented in the Tertiary flora of Europe, when it extended into the polar regions; nineteen species have been recorded from the Miocene strata of Oeningen in Switzerland. The common maple, *A. campestre*, is the only species indigenous to Great Britain. This and the sycamore were described by Gerard in 1597 (*Herball*, p. 1299), the latter being "a stranger to England." Many species have been introduced, especially from Japan, for ornamental purposes. The following are more especially worthy of notice.

Acer campestre, the common maple, is common in hedgerows, but less often seen as a tree, when it is seldom more than 20 ft. high, though in sheltered situations 30 ft. or more is attained. The leaves are generally less than 2 in. across, and the five main lobes are blunter than in the sycamore. The clusters of green flowers terminate the young shoots and are erect; the two wings of the fruit spread almost horizontally, and are smaller than in the sycamore. It occurs in northern Europe, the Caucasus, and northern Asia. The wood is excellent fuel, and makes the best charcoal. It is compact, of a fine grain, sometimes beautifully veined, and takes a high polish. Hence it has been celebrated from antiquity for tables, &c. The wood of the roots is frequently knotted, and valuable for small objects of cabinet work. The young shoots, being flexible and tough, are employed in France as whips.

A. pseudo-platanus, the sycamore or great maple, is a handsome tree of quick growth, with a smooth bark. The leaves are large, with finely acute and serrated lobes, affording abundant shade. The flowers are borne in long pendulous racemes, and the two wings of the fruit are ascending. It lives from 140 to 200 years. It is found wild chiefly in wooded mountainous situations in central Europe. The wood when young is white, but old heartwood is yellow or brownish. Like the common maple it is hard and takes a high polish. It is much prized by wheelwrights, cabinet-makers, sculptors, &c., on the Continent; while knotted roots are used for inlaying. Sugar has been obtained from the sap of this as from other species, the most being one ounce from a quart of sap. The latter has also been made into wine in the Highlands of Scotland. It withstands the sea and mountain breezes better than most other timber trees, and is often planted near farm-houses and cottages in exposed localities for the sake of its dense foliage. Its wood is valued in turnery for cups, bowls and pattern blocks. It produces abundance of seeds, and is easily raised, but it requires good and tolerably dry soil; it will not thrive on stiff clays nor on dry sands or chalks. There are many varieties, the variegated and cut-leaved being the most noticeable. The lobed shape of its leaf and its dense foliage caused it to be confused with the true sycamore —*Ficus sycamorus*—of scripture.

A. platanoides, the Norway maple, is met with from Norway to Italy, Greece, and central and south Russia. It was introduced into Britain in 1683. It is a lofty tree (from 40 to 70 ft.), resembling the sycamore, but with yellow flowers, appearing before the leaves, and more spreading wings to the fruit. There are several varieties. The wood is used for the same purposes as that of the sycamore. Sugar has been made from the sap in Norway and Sweden.

Many varieties of *A. palmatum*, generally known as *polymorphum*, with variously laciniated and more or less coloured foliage, have been introduced from Japan as ornamental shrubs. The branches and corolla are purple, the fruit woolly. The foliage of the typical form is bright green with very pointed lobes. It occurs in the central mountains of Nippon and near Nagasaki. Beautiful varieties have been introduced under the varietal names, *ampelopsifolium*, *atropurpureum*, *dissectum*, &c. They are remarkable for the coppery purple tint that pervades the leaves and young growths of some of the varieties. Other Japanese species are *A. japonicum*, the varieties of which are among the most handsome of small deciduous shrubs; *A. rufinerve*, with the habit of the sycamore; *A. distylum*, bearing leaves without lobes; *A. diabolicum*, with large plane-like leaves; and *A. carpinifolium*, with foliage resembling that of the hornbeam.

A. saccharinum, a North American species, the sugar, rock, or bird's-eye maple, was introduced in 1735. It sometimes attains to 70 or even over 100 ft., more commonly 50 to 60 ft. It is remarkable for the whiteness of the bark. The wood is white, but acquires a rosy tinge after exposure to light. The grain is fine and close, and when polished has a silky lustre. The timber is used instead of oak where the latter is scarce, and is employed for axle-trees and spokes, as well as for Windsor chairs, &c. It exhibits two accidental forms in the arrangement of the fibres, an undulated one like those of the curled maple (*A. rubrum*), and one of spots, which gives the name bird's-eye to the wood of this species. Like the curled maple, it is used for inlaying mahogany. It is much prized for bedsteads, writing-desks, shoe-lasts, &c. The wood forms excellent fuel and charcoal, while the ashes are rich in alkaline principles, furnishing a large proportion of the potash exported from Boston and New York. Sugar is principally extracted from this species, the sap being boiled and the syrup when reduced to a proper consistence runs into moulds to form cakes. Trees growing in low and moist situations afford the most sap but least sugar. A cold north-west wind, with frosty nights and sunny days in alternation, tends to incite the flow, which is more abundant during the day than the night. A thawing night is said to promote the flow, and it ceases during a south-west wind and at the approach of a storm; and so sensitive are the trees to aspect and climatic variations that the flow of sap on the south and east side has been noticed to be earlier than on the north and west side of the same tree. The average quantity of sap per tree is from 12 to 24 gallons in a season.

A. rubrum, the red-flowering or scarlet maple, is a middle-sized tree, and was introduced in 1656. The bright scarlet or dull red flowers appear before the leaves in March and April. The wood, like that of other species, is applicable to many purposes—as for the seats of Windsor chairs, turnery, &c. The grain in very old trees is sometimes undulated, which suggested the name of curled maple, and gives beautiful effects of light and shade on polished surfaces. The most constant use of curled maple is for the stocks of fowling-pieces and rifles, as it affords toughness and strength combined with lightness and elegance. The inner bark is dusky red. On boiling, it yields a purple colour which with sulphate of iron affords a black dye. The wood is inferior to that of the preceding species in strength and as fuel. Sugar was made from the sap by the French Canadians, but the production is only half as great as that from the sugar maple. In Britain it is cultivated as an ornamental tree, as being conspicuous for its flowers in spring, and for its red fruit and foliage in autumn.

A. macrophyllum, a north-western American species, is a valuable timber tree.

For a good account of the North American species see C. S. Sargent's *Silva of North America*, vol. ii. See also under SUGAR.

MAPU, ABRAHAM (1808–1867), Hebrew novelist. His works are chiefly historical romances in Hebrew. His most famous books were *The Love of Zion* and the *Transgression of Samaria*. Besides their intrinsic merits, these novels stand high among the works which produced the romantic movement in modern Hebrew literature. Mapu's plots were somewhat sensational, incident being more prominent than characterization. But underlying all was a criticism of contemporary life. His novels made a deep impression and became instantly popular. Mapu's Hebrew style is simple and classical. An English translation of the *Love of Zion* bears the title *Amnon, Prince and Peasant*, by F. Jaffe (1887). Mapu's stories have been often translated into other languages.

See N. Slouschz, *The Renascence of Hebrew Literature* (1909), ch. v. (I. A.)

MAQQARĪ, or MAḲḲARĪ [Abū-l-ʿAbbās Aḥmad ibn Maḥommed ul-Maqqarī] (*c.* 1591–1632), Arabian historian, was born at Tlemcen in Algeria and studied at Fez and Marrakesh, where he remained engaged in literary work until he made the pilgrimage to Mecca in 1618. In the following year he settled in Cairo. In 1620 he visited Jerusalem and Damascus, and during the next six years made the pilgrimage five times. In 1628 he was again in Damascus, where he gave a course of lectures on Bukhārī's collection of *Traditions*, spoke much of the glories of Moslem Spain, and received the impulse to write his work on this subject later. In the same year he returned to Cairo, where he spent a year in writing his history. He was just making preparations to settle definitely in Damascus when he died in 1632.

His great work, *The Breath of Perfume from the Branch of Green Andalusia and Memorials of its Vizier Lisān ud-Dīn ibn ul-Khaṭīb*, consists of two parts. The first is a compilation from many authors on the description and history of Moslem Spain; it was published by Wright, Krehl, Dozy and Dugat as *Analectes sur l'histoire et la littérature des Arabes d'Espagne* (Leiden, 1855–1861), and in an abridged English translation by P. de Gayangos (London, 1840–1843). The whole work has been published at Būlāq (1863) and Cairo (1885).

For other works of Maqqarī see C. Brockelmann's *Gesch. der arabischen Litteratur* (Berlin, 1902), ii. 297. (G. W. T.)

MAQRĪZĪ, or Makrizi [Taqī ud-Dīn Aḥmad ibn ʿAlī] (1364–1442), Arabian historian, known as al-Maqrīzī because of his ancestral connexion with Maqrīz, a suburb of Baalbek, was born at Cairo and spent most of his life in Egypt, where he was trained in the Hanifite school of law, though later he became a Shāfiʿite with an inclination to Zāhirite views. In 1385 he made the pilgrimage. For some time he was secretary in a government office, and in 1399 became inspector of markets for Cairo and northern Egypt. This post he soon gave up to become preacher at the mosque of ʿAmr, president of the mosque ul-Hākim, and a lecturer on tradition. In 1408 he went to Damascus to become inspector of the Qalānisīyya and lecturer. Later he retired into private life at Cairo. In 1430 he made the pilgrimage with his family and travelled for some five years. His learning was great, his observation accurate and his judgment good, but his books are largely compilations, and he does not always acknowledge the sources to which he is indebted. Most of his works are concerned with Egypt. The most important is the *Mawāʿiz wal-Iʿtibār fī dhikr ul-Ḥitaṭ wal-Āthār* (2 vols., Bulāq, 1854), translated into French by U. Bouriant as *Description topographique et historique de l'Égypte* (Paris, 1895-1900; cf. A. R. Guest, "A List of Writers, Books and other Authorities mentioned by El Maqrīzī in his *Khiṭat*," in *Journal of the Royal Asiatic Society*, 1902, pp. 103–125). Of his *History of the Fatimites* an extract was published by J. G. L. Kosegarten in his *Chrestomathia* (Leipzig, 1828), pp. 115–123; the *History of the Ayyūbit and Mameluke Rulers* has been translated into French by E. Quatremère (2 vols., Paris, 1837–1845). Maqrīzī began a large work called the *Muqaffā*, a cyclopaedia of Egyptian biography in alphabetic order. It was intended to be in 80 volumes, but only 16 were written. Three autograph volumes exist in MS. in Leiden, and one in Paris.

Among smaller works published are the *Mahommedan Coinage* (ed. O. G. Tychsen, Rostock, 1797; French translation by S. de Sacy, Paris, 1797); *Arab Weights and Measures* (ed. Tychsen, Rostock, 1800); the *Arabian Tribes that migrated to Egypt* (ed. F Wüstenfeld, Göttingen, 1847); the *Account of Hadhramaut* (ed. P. B. Noskowyj, Bonn, 1866); the *Strife between the Banī Umayya and the Banī Hāshim* (ed G. Vos, Leiden, 1888), and the *Moslems in Abyssinia* (ed. F. T. Rink, Leiden, 1790). For Maqrīzī's life see the quotations from contemporary biographies in S. de Sacy's *Chrestomathie arabe* (2nd ed., Paris, 1826), ii. 112 seq., and for other works still in MS. C. Brockelmann, *Gesch. der arabischen Litteratur* (Berlin, 1902), ii. 38–41. (G. W. T.)

MAR, EARLDOM OF. Mar, one of the ancient divisions or provinces of Scotland, comprised the larger portion of Aberdeenshire, extending from north of the Don southward to the Mounth. Like other such districts, it was in Celtic times under the rule of a *mormaer*. In the 12th century his place was taken by an earl, but no definite succession of earls appears till the 13th century, nor is any connexion established between them and the *mormaers*. From the middle of the 13th century the earls were recognized as among "the seven earls of Scotland" and held a great position. Earl Gratney (*fl. c.* 1300) married a sister of (King) Robert Bruce, who brought him the lordship of Garioch and castle of Kildrummy, which she held against the earl of Athole, an ally of the English (1335). Their son Donald was made regent in July 1332, but was disastrously defeated and slain at Dupplin next month. His daughter and eventual heir, Margaret, brought the earldom to her husband, William, earl of Douglas, and on the accession of her daughter Isabel a troublous time followed.

While she was living as a widow at her castle of Kildrummy, it was stormed by Alexander Stewart, a bastard, who forced her to execute a charter (August 12, 1404) settling the reversion to the earldom on himself and his heirs. This act she revoked by a charter of the 19th of September 1404, which cannot now be found; but on marrying him, on the 9th of December 1404, she granted him the earldom for life, the king confirming this on the 21st of June 1405. After her death in 1408 the earl played a great part, commanding the royal forces at the battle of Harlaw, when the Lord of the Isles was defeated in 1411, and afterwards acting as warden of the Marches. In 1426 he resigned the earldom to the Crown, the king granting it by a fresh creation to him and certain heirs, with reversion to the Crown. On the earl's death in 1435 the earldom was claimed by Robert, Lord Erskine, as heir of Gratney, earl of Mar, through a daughter; but the Crown claimed as reversionary under the creation of 1426. A long struggle followed, till in 1457 James II. obtained from a justiciary court at Aberdeen a recognition of the Crown's right to the earldom and its lands, and shortly after bestowed them on his son John as earl of Mar and Garioch. He died unmarried in 1479, and in 1483 his elder brother Alexander duke of Albany received the earldom, but was soon forfeited. James III. created his son John earl of Mar and Garioch in 1486, and after his death unmarried in 1503, James IV. alienated to Lord Elphinstone (1507–1510) many of the Mar lands, including Kildrummy. The title was not revived till 1562, when James Stewart, earl of Murray, held it for a few months.

In 1565 John, Lord Erskine, succeeded in getting returned heir to the earldom, and shortly after (June 23, 1565) Queen Margaret restored the charter to him and his heirs "all and hail the said earldom of Mar." As earl he took part against the queen in 1567, and in 1571 was made regent of Scotland, which post he retained till his death (1572). His son, earl John (*c.* 1558–1634), played a great part in the history of the family. His great achievement was the recovery of the Mar estates, alienated by the Crown during the long period that his family had been out of possession, including Kildrummy, the "head" of the earldom. It was in his time that the precedence of the earldom (see below) was settled. John, the next earl (*c.* 1585–1654) was a Royalist, as was his son John (d. 1668), much to the injury of the family fortune, which was further impaired by the attachment of the family, after the Revolution, to the Stuarts. His son Charles (1650–1689) was arrested by the government just before his death (1689), and the next earl, John (1675–1732), a prominent Jacobite (see below), was attainted, the earldom remaining under forfeiture for 108 years; by the Old Pretender he was created duke of Mar.

Alloa and other Erskine estates of the attainted earl were repurchased for the family, and descended to John Francis Erskine (1741–1825), his heir-male, who was also his heir of line through his daughter. To him, in his eighty-third year, as grandson and lineal representative of the attainted earl, the earldom was restored by act of parliament in 1824. His grandson, who succeeded him in 1828, inherited the earldom of Kellie (1619) and other Erskine dignities by decision of 1835. At his death in 1866, his earldom of Mar was the subject of rival claims, and the right to the succession was not determined till 1875. His estates passed to his cousin and heir-male, who succeeded to his earldom of Kellie and claimed "the honour and dignity of earl of Mar." But the latter was also claimed by a Mr Goodeve, whose father had married the late earl's eldest sister, and who assumed the title. It was not suggested that the late earl had more than one earldom of Mar, but Lord Kellie claimed it as descendible to heirs-male under a creation by Queen Mary, and Mr Goodeve as descendible to heirs of line under an earlier creation. The House of Lords decided (Feb. 25, 1875) that Lord Kellie was entitled to the earldom as having been created by Queen Mary in 1565, with a limitation which must be presumed to be to heirs-male of the body. This decision gave great dissatisfaction, but was described as "final, right or wrong, and not to be questioned" by Lord Selborne and the lord chancellor in 1877, and Lord Kellie was thenceforth recognized as holding the earldom on the Union Roll, the only one known, though Mr Goodeve continued to assume the title. The Lords' decision could not be reversed, but in 1885, after much agitation, a means was found of evading it in practice by the "Earldom of Mar Restitution Act." By "an equivocation on the facts of the case," it was recited that "doubts may exist whether the said ancient honour, dignity, and title of peerage of earl of Mar . . . was or was not . . . by any lawful means surrendered or merged in the Crown" before 1565, and that the House of Lords had decided that Queen Mary's known charter of 1565 applied only to lands and "did not operate or extend to restore" the peerage dignity, and enacted that "John Francis Erskine Goodeve Erskine" (which last name the claimant had added) should be "restored to" the ancient earldom. His previous assumption of the title was thus rejected as invalid, but from the passing of the act two earldoms of Mar were in existence, that of Lord Kellie being confirmed and allowed the precedence of 1565, while the restored earldom was allowed that of the dignity on the Union Roll, the only one known till then. This precedence had been assigned to it by the Decreet of Ranking (1606), and assigns to it an origin in 1404 (or, as some say, 1395). It is frequently, but absurdly, stated to have been "created before 1014," and wrongly spoken of as the Premier Scottish Earldom (see Earl). A barony of Garioch is also wrongly said to be annexed to it, but the title is used by the earl's eldest son in default of any other.

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MAR, JOHN ERSKINE, 1st or 6th Earl of (d. 1572), regent of Scotland, was a son of John, 5th Lord Erskine (d. 1552), who was guardian of King James V., and afterwards of Mary Queen of Scots. The younger John, who succeeded his father as 6th Lord Erskine in 1552, joined the religious reformers, but he was never very ardent in the cause, although he subscribed the letter asking Knox to return to Scotland in 1557. The custody of Edinburgh Castle was in his hands, and during the struggle between the regent, Mary of Lorraine, and the lords of the Congregation he appears to have acted consistently in the interests of peace. When Mary Stuart returned to Scotland in 1561 Lord Erskine was a member of her council, he favoured her marriage with Lord Darnley, and his wife, Annabella Murray, called by Knox a "verray Jesabell," was a frequent companion of the queen. In 1565 Erskine was granted the earldom of Mar (see above). As guardian of James, afterwards King James VI., he prevented the young prince from falling into the hands of Bothwell, and when the Scottish nobles rose against Mary and Bothwell, Mar was one of their leaders; he took part in the government of Scotland during Mary's imprisonment at Lochleven, and also after her subsequent abdication. In September 1571 he was chosen regent of Scotland, but he was overshadowed and perhaps slighted by the earl of Morton, and he died at Stirling on the 29th of October 1572.

MAR, JOHN ERSKINE, 2nd or 7th Earl of (*c.* 1558–1634), Scottish politician, was the only son of the preceding. Together with King James VI. he was educated by George Buchanan. After attaining his majority he was nominally the guardian of the young king, who was about seven years his junior, and who lived with him at Stirling; but he was in reality a puppet in the hands of the regent, the earl of Morton; and he lost power and position when Morton was imprisoned. He was concerned in the seizure of James VI. in 1582 (a plot known as the raid of Ruthven); but when James escaped from his new custodians the earl fled into the west of Scotland. Then leaving his hiding-place Mar seized Stirling Castle, whereupon James marched against him, and he took refuge in England. Queen Elizabeth interceded for him, but in vain, and after some futile communications between the governments of England and Scotland Mar and his friends gathered an army, entered the presence of the king at Stirling, and were soon in supreme authority (1585). Mar was restored to his lands and titles. Henceforward he stood high in the royal favour; he became governor of Edinburgh Castle and was made tutor to James's son, Prince Henry, and for his second wife he married Mary, daughter of Esmé Stewart, duke of Lennox. In 1601 the earl was sent as envoy to London; here Elizabeth assured him that James should be her successor, and his mission was conducted with tact and prudence. Having joined the English privy council Mar was created Lord Cardross in 1610; he was a member of the Court of High Commission and was lord high treasurer of Scotland from 1615 to 1630. He died at Stirling on the 14th of December 1634. John (*c.* 1585–1654), his only son by his first wife, succeeded to his earldom; by his second wife he had five sons, among them being James (d. 1640), earl of Buchan; Henry (d. 1628), whose son David (d. 1671) succeeded to the barony of Cardross; and Charles, the ancestor of the earls of Rosslyn.

MAR, JOHN ERSKINE, 6th or 11th Earl of (1675–1732), Scottish Jacobite, was the eldest son of Charles, the 5th earl (1650–1689), from whom he inherited estates which were heavily loaded with debt. He was associated with the party favourable to the English government; he was one of the commissioners for the Union, and was made a Scottish secretary of state, becoming after the Union of 1707 a representative peer for Scotland, keeper of the signet and a privy councillor. In 1713 Mar was made an English secretary of state by the Tories, but he seems to have been equally ready to side with the Whigs, and in 1714 he assured the new king, George I., of his loyalty. However, like the other Tories, he was deprived of his office, and in August 1715 he went in disguise to Scotland and placed himself at the head of the adherents of James Edward, the Old Pretender. Meeting many Highland chieftains at Aboyne he avowed an earnest desire for the independence of Scotland, and at Braemar on the 6th of September 1715 he proclaimed James VIII. king of Scotland, England, France and Ireland. Gradually the forces under his command were augmented, but as a general he was a complete failure. Precious time was wasted at Perth, a feigned attack on Stirling was resultless, and he could give little assistance to the English Jacobites. At Sheriffmuir, where a battle was fought in November 1715, Mar's forces largely outnumbered those of his opponent, Archibald Campbell, afterwards 3rd duke of Argyll; but no bravery could atone for the signal incompetence displayed by the earl, and the fight was virtually a decisive defeat for the Jacobites. Mar then met James Edward at Fetteresso; the cause however was lost, and the prince and the earl fled to France. Mar sought to interest foreign powers in the cause of the Stuarts; but in the course of time he became thoroughly distrusted by the Jacobites. In 1721 he accepted a pension of £3500 a year from George I., and in the following year his name was freely mentioned in connexion with the trial of Bishop Atterbury, whom it was asserted that Mar had betrayed. This charge may perhaps be summarized as not proven. At the best his conduct was highly imprudent, and in 1724 he left the Pretender's service. His later years were spent in Paris and at Aix-la-Chapelle, where he died in May 1732.

Mar, who was known as "bobbing John," married for his second wife, Frances (d. 1761), daughter of the 1st duke of Kingston, and was thus a brother-in-law of Lady Mary Wortley Montagu. He had been attainted in 1716, and his only son, Thomas, Lord Erskine, died childless in March 1766.

Mar's brother, James Erskine (1679–1754), was educated as a lawyer and became lord justice clerk of the Court of Session and Lord Grange in 1710. He took no part in the rising of 1715, although there is little doubt that at times he was in communication with the Jacobites; but was rather known for his piety and for his sympathy with the Presbyterians. He is more famous, however, owing to the story of his wife's disappearance. This lady, Rachel Chicely, was a woman of disordered intellect; probably with reason she suspected her husband of infidelity, and after some years of unhappiness Grange arranged a plan for her seizure. In January 1732 she was conveyed with great secrecy from Edinburgh to the island of Hesker, thence to St Kilda, where she remained for about ten years, thence she was taken to Assynt in Sutherland, and finally to Skye. To complete the idea that she was dead her funeral was publicly celebrated, but she survived until May 1745. Meanwhile in 1734 Grange had resigned his judgeship and had become an English member of parliament; here he was a bitter opponent of Sir Robert Walpole. He died in London on the 20th of January 1754.

See the *Journal of the Earl of Mar* (1716); R. Patten, *History of the late Rebellion* (1717); and A. Lang, *History of Scotland*, vol. iv. (1907).

MARA, GERTRUD ELISABETH (1749–1833), German singer, was born at Cassel, the daughter of a poor musician named Schmeling. From him she learnt the violin, and while still a child her playing at the fair at Frankfort was so remarkable that money was collected to provide for her. She was helped by influential friends, and studied under Hillel at Leipzig for five years, proving to be endowed with a wonderful soprano voice. She began to sing in public in 1771, and was soon recognized as the greatest singer that Germany had produced. She was permanently engaged for the Prussian Court, but her marriage to a debauched violinist named Mara created difficulties, and in 1780 she was released. After singing at Vienna, Munich and elsewhere, she appeared in Paris in 1782, where her rivalry with the singer Todi developed into a regular faction. In 1784 she went to London, and continued to appear there with great success, with visits at intervals to Italy and to Paris till 1802, when for some years she retired to Russia. She visited England again in 1819, but then abandoned the stage. She went to Livonia, and died on the 20th of January 1833 at Revel.

MARABOUT (the French form of the Arab. *murābit*, "one who pickets his horse on a hostile frontier"; cf. Portug. *marabute*; Span. *morabito*), in Mahommedan religion a hermit or devotee. The word is derived from *ribāṭ*, a fortified frontier station. To such stations pious men betook them to win religious merit in war against the infidel; their leisure was spent in devotion, and the habits of the convent superseded those of the camp (see McG. De Slane in *Jour. As.*, 1842, i. 168; Dozy, *Suppl.* i. 502). Thus *ribāṭ* came to mean a religious house or hospice (*zāwiya*). The great sphere of the marabouts is North Africa. There it was that the community formed by Yahya b. Ibrāhīm and the doctor Abdullah developed into the conquering empire of the Murābiṭs, or, as Christian writers call them, the ALMORAVIDES (*q.v.*), and there still, among the Berbers, the marabouts enjoy extraordinary influence, being esteemed as living saints and mediators. They are liberally supported by alms, direct all popular assemblies, and have a decisive voice in intertribal quarrels and all matters of consequence. On their death their sanctity is transferred to their tombs (also called marabouts), where chapels are erected and gifts and prayers offered. The marabouts took a prominent part in the resistance offered to the French by the Algerian Moslems; and they have been similarly active in politico-religious movements in Tunisia and Tripoli.

See L. Rinn, *Marabouts et Khouan* (Algiers, 1884); and the article DERVISH.

MARACAIBO, a large lake of western Venezuela, extending southward from the Gulf of Venezuela, into which it opens through a long neck, or strait, obstructed at its mouth by islands and bars, and having a large drainage basin bounded on the W. by the Eastern Cordillera, on the S.E. by the Cordillera de Merida, and on the E. by a low range of mountains extending N. by W. from Trujillo to the coast. The lake is roughly quadrangular in shape, and extends from the 9th to the 11th parallel of S. lat. and from the 71st to the 72nd meridian. It opens into the Gulf through 13 channels, the depth on the bar in the main channel ranging from 7 ft. at low water to 12 ft. at high water. Inside the bar the depth is about 30 ft., and the lake is navigable for vessels of large size. It receives the waters of many rivers, principally on its west and south sides, the largest of which are the Catatumbo and Zulia, Escalante, Chanudo, Ceniza, Sant'Ana, Negro, Apan and Palmar. The first three have navigable channels for river steamers. There are a number of small lakes near Lake Maracaibo's southern and western margins, the largest of which is the Laguna de Zulia. The heavy rainfall on the eastern slopes of the Eastern Cordillera, which is said to exceed 86 in. per annum, is responsible for the great volume of water discharged into the lake. The average annual precipitation over the whole basin is said to be 70 in. In the upper half of the lake the water is sweet, but below that, where the tidal influence is stronger, it becomes brackish. The only port of consequence on the lake is Maracaibo, but there are small ports at its upper end which are in direct communication with the inland cities of Trujillo, Merida and San Cristobal. The Catatumbo River, which enters from the west near the north end of the lake, and its principal tributary, the Zulia, are navigable as far as Villamizar, in Colombia, and afford an excellent transportation route for the coffee and other products of Santander.

MARACAIBO (sometimes MARACAYBO), a city and seaport of Venezuela and capital of the state of Zulia (formerly Maracaibo), on the west shore of the broad channel or neck which connects Lake Maracaibo with the Gulf of Venezuela, or Maracaibo, about 25 m. from the mouth of the channel opening into the latter. Pop. (1889), 34,284; (1905), 49,817; there is a considerable German element in the vicinity. The best residential suburb, Haticos, extends along the lake shore toward the south. The city is provided with tramways, telephone service and electric lighting, but the water supply and drainage are inferior. The most important buildings are the executive's residence, the legislative chambers, the municipal hall, the Baralt theatre, the prison, the market, a hospital and six churches. The city also has a school of arts, a public library, and a public garden. In colonial times Maracaibo had a famous Jesuits' college (now gone) and was one of the educational centres of Spanish America; the city now has a national college and a nautical school. The industries include shipbuilding, and the manufacture of saddlery and other leather products, bricks and tile, rum, beer, chocolate and coco-nut oil. Maracaibo is chiefly known, however, as one of the principal commercial centres and shipping ports on the northern coast of South America. The bar at the entrance to Maracaibo channel does not admit vessels drawing more than 12 ft., but there is a depth of 30 ft. inside and near the city. Steam communication is maintained on the Catatumbo and Zulia rivers to Villamizar, and on the Escalante to Santa Cruz. The principal exports from Maracaibo are coffee, hides and skins, cabinet and dye-woods, cocoa, and mangrove bark, to which may be added dividivi, sugar, copaiba, gamela and hemp straw for paper-making, and fruits. In 1906, 26% of the coffee exports was of Colombian origin.

Maracaibo was founded in 1571 by Alonso Pacheco, who gave it the name Nueva Zamora. Up to 1668 the entrepôt for the inland settlements was a station named Gibraltar at the head of the lake, but the destruction of that station by pirates in that year transferred this valuable trade to Maracaibo. The city did not figure actively in the War of Independence until 1821 (Jan. 28), when the province declared its independence and sought an alliance with Colombia. This brought to an end the armistice between Bolívar and Morillo, and thenceforward the city experienced all the changing fortunes of war until its final capture by the revolutionists in 1823.

MARĀGHA, a town of Persia in the province of Azerbaijan, on the Safi River, in 37° 23′ N., 46° 16′ E., 80 m. from Tabriz. Pop. about 16,000. It is pleasantly situated in a narrow valley running nearly north and south at the eastern extremity of a well-cultivated plain opening towards Lake Urmia, which lies 18 m. to the west. The town is encompassed by a high wall ruined in many places, and has four gates. Two stone bridges in good condition, said to have been constructed during the reign of Hulaku Khan (1256–1265), and since then several times repaired, lead over the Safi River on the western side of the town. The place is surrounded by extensive vineyards and orchards, all well watered by canals led from the river, and producing great quantities of fruit for exportation to Russia. On a hill west of the town are the remains of a famous observatory (*rasad*) constructed under the direction of the great astronomer Nasr-ud-din of Tus. The hills west of the town consist of horizontal strata of sandstone covered with irregular pieces of basalt and the top of the hill on which the observatory stood was made level by taking away the basalt. The building, which no doubt served as a citadel as well, enclosed a space of 380 yds. by 150, and the foundations of the walls were 4½ to 5 ft. in thickness. The marble, which is known throughout Persia as Marāgha marble, is a travertine obtained at the village of Dashkesen (Turkish for

“ stone-breakers ” (about 30 m. north-west from Maragha. It is deposited from water, which bubbles up from a number of springs in the form of horizontal layers, which at first are thin crusts and can easily be broken, but gradually solidify and harden into blocks with a thickness of 7 to 8 in. It is a singularly beautiful substance, being of pink, greenish, or milk-white colour, streaked with reddish, copper-coloured veins. An analysis of the marble gave the following result: calcium carbonate, 90·93; magnesium, ·75; iron, 1·37; manganese, 4·34; calcium sulphate, 2·30; calcium phosphate, ·24 (R. T. Günther, *Geog. Journ.* xiv. 517).

MARANHÃO, or MARANHAM (Span. *Marañon*, the name given to the upper Amazon), a northern state of Brazil, bounded N. by the Atlantic, E. and S.E. by Piauhy, S.W. and W. by Goyaz and Pará. Area, 177,569 sq. m.; pop. (1890), 430,854; (1900), 499,308. The coastal zone and the north-west corner of the state belong to the Amazon valley region, being a heavily forested plain traversed by numerous rivers. The eastern and southern parts, however, belong to the lower terraces of the great Brazilian plateau, broken by eroded river-courses between which are high open plains. There are no true mountain ranges in Maranhão, those indicated on the maps being only plateau escarpments marking either its northern margin or the outlines of river valleys. The climate is hot, and the year is divided into a wet and dry season, extreme humidity being characteristic of the former. The heat, however, is greatly modified on the coast by the south-east trade winds, and the climate is generally considered healthy, though beri-beri and eruptive diseases are common on the coast. The coast itself is broken and dangerous, there being many small indentations, which are usually masked by islands or shoals. The largest of these are the Bay of Tury-assú, facing which is the island of São João, and several others of small size, and the contiguous bays of São Marcos and São José, between which is the large island of Maranhão. The rivers of the state all flow northward to the Atlantic and a majority of them have navigable channels. The Parnahyba forms the eastern boundary of Maranhão, but it has one large tributary, the Balsas, entirely within the state. A part of the western boundary is formed by the Tocantins, and another part by the Gurupy, which separates the state from Pará. The principal rivers of the state are the Maracassumé and Tury-assú, the Mearim and its larger tributaries (the Pindaré, Grajahú, Flôres and Corda) which discharge into the Bay of São Marcos, and the Itapicurú and Monim which discharge into the Bay of São José. Like the Amazon, the Mearim has a *pororoca* or bore in its lower channel, which greatly interferes with navigation. There are a number of small lakes in the state, some of which are, apparently, merely reservoirs for the annual floods of the rainy season.

The principal industries of Maranhão are agricultural, the river valleys and coastal zone being highly fertile and being devoted to the cultivation of sugar-cane, cotton, rice, coffee, tobacco, mandioca and a great variety of fruits. The southern highlands, however, are devoted to stock-raising, which was once an important industry. Troublesome insects, vampire bats, and the failure to introduce new blood into the degenerated herds, are responsible for its decline. Agriculture has also greatly declined, the state producing for export only a comparatively small quantity of cotton, rice, sugar and *aguardiente*. Besides São Luiz, the capital of the state, the principal towns, with the population of their municipal districts in 1890, are: Caxias (19,443), Alcantara (4730), Carolina (7266), Grajahú (11,704), Tury-assú (8983) and Viana (9965).

The coast of Maranhão was first discovered by Pinzon in 1500, but it was included in the Portuguese grant of captaincies in 1534. The first European settlement, however, was made by a French trading expedition under Jacques Riffault, of Dieppe, in 1594, who lost two of his three vessels in the vicinity of the island of Maranhão, and left a part of his men on that island when he returned home. Subsequently Daniel de la Rivardière was sent to report on the place, and was then commissioned by the French crown to found a colony on the island; this was done in 1612. The French were expelled by the Portuguese in 1615, and the Dutch held the island from 1641 to 1644. In 1621 Ceará, Maranhão and Pará were united and called the “ Estado do Maranhão,” which was made independent of the southern captaincies. Ceará was subsequently detached, but the “ state ” of Maranhão remained independent until 1774, when it again became subject to the colonial administration of Brazil. Maranhão did not join in the declaration of independence of 1822, but in the following year the Portuguese were driven out by Admiral Lord Cochrane and the province became a part of the new empire of Brazil.

MARANO (accursed or banned), a term applied to Jewish Christians in Spain. Converted to Roman Catholicism under compulsion, these “ New Christians ” often continued to observe Jewish rites in their homes, as the Inquisition records attest. It was in fact largely due to the Maranos that the Spanish Inquisition was founded. The Maranos made rapid strides in prosperity, and “ accumulated honours, wealth and popular hatred ” (Lea, *History of the Spanish Inquisition*, i. 125). This was one of the causes that led to the expulsion of the Jews from Spain in 1492. Maranos emigrated to various countries, but many remained in the Peninsula. Subsequently distinguished individuals left home for more tolerant lands. The Jewish community in London was refounded by Maranos in the first half of the 17th century. Hamburg commerce, too, owed much to the enterprise of Portuguese Maranos. In Amsterdam many Maranos found asylum; Spinoza was descended from such a family. There are still remnants of Marano families in Portugal.

See Lea, *loc. cit.* and elsewhere; see index *s.v.* “ New Christian ”; Graetz, *History of the Jews*, Eng. trans, see index *s.v.* “ Marranos ”; M. Kayserling, in *Jewish Encyclopedia*, viii. 318 seq.; and for the present day *Jewish Quarterly Review*, xv. 251 seq. (I. A.)

MARASH (anc. *Germanicia-Marasion*), the chief town of a sanjak of the same name in the Aleppo vilayet, altitude 2600 ft. situated E. of the Jihan river, at the foot of Mt Taurus. The sanjak lies almost wholly in Mt Taurus, and includes the Armenian town of Zeitun. Marash is prosperous, and has a large trade in Kurd carpets and embroideries. The climate is good, except in summer. Of the population (50,000) about half are Turkish-speaking Armenians. There are a college, church and schools belonging to the American mission, a native Protestant church and a Jesuit establishment. The site, which lies near the mouths of the three main passes over the eastern Taurus—viz. those descending from Geuksun (Cocysus), Albistan-Yarpuz (Arabissus), and Malatia (Melitene)—is shown to have had early importance, not only by the occurrence of *Marasi* in Assyrian inscriptions, but by the discovery of several “ Hittite ” monuments on the spot. These, said to have been unearthed, for the most part, near the Kirk Geuz spring above the modern town, are now in Constantinople and America, and include an inscribed lion, once built into the wall of the citadel known in the middle ages as al-Marwani, and several *stelae*. No more is known of the place until it appears as Germanicia-Caesarea, striking imperial coins with the head of L. Verus (middle of 2nd cent. A.D.). The identification of Marash with Germanicia has been disputed, but successfully defended by Sir W. M. Ramsay; and it is borne out by the Armenian name *Kermanig*, which has been given to the place since at least the 12th century. Before the Roman period Marash doubtless shared the fortunes of the Seleucid kingdom of Commagene. *Germanicia-Marasion* played a great part in Byzantine border warfare: Heraclius was there in A.D. 640; but before 700 it had passed into Saracen hands and been rebuilt by the caliph Moawiya. During the 8th and 9th centuries, when the direct pass from Cocysus came into military use, Marasion (the older name had returned into general use) was often the Byzantine objective and was more than once retaken; but after 770, when Mansur incorporated it in “ Palestine ” it remained definitely in Moslem power and was refortified by Harun-al-Rashid. It was seized by the crusaders after their march across Mt Taurus, A.D. 1097, became an important town of Lesser Armenia and was taken by the Seljuks in 1147. In the 16th century it was added to the Osmanli Empire by Selim I. Marash passed with the rest of Syria into Egyptian hands in 1832, and in 1839 received fugitives from the defeat of Nizib, among whom was Moltke. Ibrahim Pasha was encamped near it when directed by his father, at the bidding of the powers, to stay his further advance. Since its reversion to Ottoman power (1840) the history of Marash has been varied only by Armenian troubles, largely connected with the fortunes of Zeitun, for the reduction of which place it has more than once been used as a base. There was less disturbance there in 1895–1896 than in other north Syrian towns. (D. G. H.)

MARAT, JEAN PAUL (1743–1793), French revolutionary leader, eldest child of Jean Paul Marat, a native of Cagliari in Sardinia, and Louise Cabrol of Geneva, was born at Boudry, in the principality of Neuchâtel, on the 24th of May 1743. His father was a designer, who had abandoned his country and his religion, and married a Swiss Protestant. On his mother's death in 1759 Marat set out on his travels, and spent two years at Bordeaux in the study of medicine, whence he moved to Paris, where he made use of his knowledge of his two favourite sciences, optics and electricity, to subdue an obstinate disease of the eyes. After some years in Paris he went to Holland, and then on to London, where he practised his profession. In 1773 he made his first appearance as an author with a *Philosophical Essay on Man*. The book shows a wonderful knowledge of English, French, German, Italian and Spanish philosophers, and directly attacks Helvetius, who had in his *De l'esprit* declared a knowledge of science unnecessary for a philosopher. Marat declares that physiology alone can solve the problems of the connexion between soul and body, and proposes the existence of a nervous fluid as the true solution. In 1774 he published *The Chains of Slavery*, which was intended to influence constituencies to return popular members, and reject the king's friends. Its author declared later that it procured him an honorary membership of the patriotic societies of Carlisle, Berwick and Newcastle. He remained devoted to his profession, and in 1775 published in London a little *Essay on Gleets*, and in Amsterdam a French translation of the first two volumes of his *Essay on Man*. In this year he visited Edinburgh, and on the recommendation of certain Edinburgh physicians was made an M.D. of St Andrews. On his return to London he published an *Enquiry into the Nature, Cause, and Cure of a Singular Disease of the Eyes*, with a dedication to the Royal Society. In the same year there appeared the third volume of the French edition of the *Essay on Man*, which reached Ferney, and exasperated Voltaire, by its onslaught on Helvetius, into a sharp attack which only made the young author more conspicuous. His fame as a clever doctor was now great, and on the 24th of June 1777, the comte d'Artois, afterwards Charles X. of France, made him by brevet physician to his guards with 2000 livres a year and allowances.

Marat was soon in great request as a court doctor among the aristocracy; and even Brissot, in his *Mémoires*, admits his influence in the scientific world of Paris. The next years were much occupied with scientific work, especially the study of heat, light and electricity, on which he presented memoirs to the Académie des Sciences, but the academicians were horrified at his temerity in differing from Newton, and, though acknowledging his industry, would not receive him among them. His experiments greatly interested Benjamin Franklin, who used to visit him and Goethe always regarded his rejection by the academy as a glaring instance of scientific despotism. In 1780 he had published at Neuchâtel a *Plan de législation criminelle*, founded on the principles of Beccaria. In April 1786 he resigned his court appointment. The results of his leisure were in 1787 a new translation of Newton's *Optics*, and in 1788 his *Mémoires académiques, ou nouvelles découvertes sur la lumière*.

His scientific life was now over, his political life was to begin; in the notoriety of that political life his great scientific and philosophical knowledge was to be forgotten, the high position he had given up denied, and he himself scoffed at as an ignorant charlatan, who had sold quack medicines about the streets of Paris, and been glad to earn a few sous in the stables of the comte d'Artois. In 1788 the notables had met, and advised the assembling of the states-general. The elections were the cause of a flood of pamphlets, of which one, *Offrande à la patrie*, was by Marat, and, though now forgotten, dwelt on much the same points as the famous brochure of the Abbé Siéyès: *Qu'est-ce que le tiers état?* When the states-general met, Marat's interest was as great as ever, and in June 1789 he published a supplement to his *Offrande*, followed in July by *La constitution*, in which he embodies his idea of a constitution for France, and in September by his *Tableau des vices de la constitution d'Angleterre*, which he presented to the Assembly. The latter alone deserves remark. The Assembly was at this time full of anglomaniacs, who desired to establish in France a constitution similar to that of England. Marat had seen that England was at this time being ruled by an oligarchy using the forms of liberty, which, while pretending to represent the country, was really being gradually mastered by the royal power. His heart was now all in politics; and he decided to start a paper. At first appeared a single number of the *Moniteur patriote*, followed on the 12th of September by the first number of the *Publiciste parisien*, which on the 16th of September took the title of *L'Ami du peuple* and which he edited, with some interruptions, until the 21st of September 1792.

The life of Marat now becomes part of the history of the French Revolution. From the beginning to the end he stood alone. He was never attached to any party; the tone of his mind was to suspect whoever was in power. About his paper, the incarnation of himself, the first thing to be said is that the man always meant what he said; no poverty, no misery or persecution, could keep him quiet; he was perpetually crying, "Nous sommes trahis." Whoever suspected any one had only to denounce him to the *Ami du peuple*, and the denounced was never let alone till he was proved innocent or guilty. Marat began by attacking the most powerful bodies in Paris—the Constituent Assembly, the ministers, the corps municipal, and the court of the Châtelet. Denounced and arrested, he was imprisoned from the 8th of October to the 5th of November 1789. A second time, owing to his violent campaign against Lafayette, he narrowly escaped arrest and had to flee to London (Jan. 1790). There he wrote his *Dénonciation contre Necker*, and in May dared to return to Paris and continue the *Ami du peuple*. He was embittered by persecution, and continued his vehement attacks against all in power, and at last, after the day of the Champs du Mars (July 17, 1790), against the king himself. All this time he was in hiding in cellars and sewers, where he was attacked by a horrible skin disease, tended only by the woman Simonne Evrard, who remained true to him. The end of the Constituent Assembly he heard of with joy and with bright hopes for the future, soon dashed by the behaviour of the Legislative Assembly. When almost despairing, in December 1791, he fled once more to London, where he wrote his *Ecole du citoyen*. In April 1792, summoned again by the Cordeliers' Club, he returned to Paris, and published No. 627 of the *Ami*. The war was now the question, and Marat saw clearly that it was to serve the purposes of the Royalists and the Girondins, who thought of themselves alone. Again denounced, Marat had to remain in hiding until the 10th of August. The early days of the war being unsuccessful, the proclamation of the duke of Brunswick excited all hearts; who could go to save France on the frontiers and leave Paris in the hands of his enemies? Marat, like Danton, foresaw the massacres of September. After the events of the 10th of August he took his seat at the commune, and demanded a tribunal to try the Royalists in prison. No tribunal was formed, and the massacres in the prisons were the inevitable result. In the elections to the Convention, Marat was elected seventh out of the twenty-four deputies for Paris, and for the first time took his seat in an assembly of the nation. At the declaration of the republic, he closed his *Ami du peuple*, and commenced, on the 25th, a new paper, the *Journal de la république française*, which was to contain his sentiments as its predecessor had done, and to be always on the watch. In the Assembly Marat had no party; he would always suspect and oppose the powerful, refuse power for himself. After the battle of Valmy, Dumouriez was the greatest man in France; he could almost have restored the monarchy; yet Marat did not fear to denounce him in placards as a traitor.

His unpopularity in the Assembly was extreme, yet he insisted on speaking on the question of the king's trial, declared it unfair to accuse Louis for anything anterior to his acceptance of the constitution, and though implacable towards the king, as *the* one man who must die for the people's good, he would not allow Malesherbes, the king's counsel, to be attacked in his paper, and speaks of him as a "sage et respectable vieillard." The king dead, the months from January to May 1793 were spent in an unrelenting struggle between Marat and the Girondins. Marat despised the ruling party because they had suffered nothing for the republic, because they talked too much of their feelings and their antique virtue, because they had for their own virtues plunged the country into war; while the Girondins hated Marat as representative of that rough red republicanism which would not yield itself to a Roman republic, with themselves for tribunes, orators and generals. The Girondins conquered at first in the Convention, and ordered that Marat should be tried before the Revolutionary Tribunal. But their victory ruined them, for on the 24th of April Marat was acquitted, and returned to the Convention with the people at his back. The fall of the Girondins on the 31st of May was a triumph for Marat. But it was his last. The skin disease he had contracted in the subterranean haunts was rapidly closing his life; he could only ease his pain by sitting in a warm bath, where he wrote his journal, and accused the Girondins, who were trying to raise France against Paris. Sitting thus on the 13th of July he heard in the evening a young woman begging to be admitted to see him, saying that she brought news from Caen, where the escaped Girondins were trying to rouse Normandy. He ordered her to be admitted, asked her the names of the deputies then at Caen, and, after writing their names, said, "They shall be soon guillotined," when the young girl, whose name was Charlotte Corday (*q.v.*), stabbed him to the heart.

His death caused a great commotion at Paris. The Convention attended his funeral, and placed his bust in the hall where it held its sessions. Louis David painted "Marat Assassinated," and a veritable cult was rendered to the Friend of the People, whose ashes were transferred to the Panthéon with great pomp on the 21st of September 1794—to be cast out again in virtue of the decree of the 8th of February 1795.

Marat's name was long an object of execration on account of his insistence on the death penalty. He stands in history as a bloodthirsty monster, yet in judging him one must remember the persecutions he endured and the terrible disease from which he suffered.

Besides the works mentioned above, Marat wrote: *Recherches physiques sur l'électricité, &c.* (1782); *Recherches sur l'électricité médicale* (1783); *Notions élémentaires d'optique* (1764); *Lettres de l'observateur Bon Sens à M. de M. . . . sur la fatale catastrophe des infortunés Pilatre de Rozier et Romain, les aéronautes et l'aérostation* (1785); *Observations de M. l'amateur Avec à M. l'abbé Sans . . . &c.*, (1785); *Éloge de Montesquieu* (1785), published 1883 by M. de Bresetz; *Les Charlatans modernes, ou lettres sur le charlatanisme académique* (1791); *Les Aventures du comte Potowski* (published in 1847 by Paul Lacroix, the "bibliophile Jacob"); *Lettres polonaises* (unpublished). Marat's works were published by A. Vermorel, *Œuvres de J. P. Marat, l'ami du peuple, recueillies et annotées* (1869). Two of his tracts, (1) *On Gleets*, (2) *A Disease of the Eyes*, were reprinted, ed. J. B. Bailey, in 1891.

See A. Vermorel, *Jean Paul Marat* (1880); François Chévremont, *Marat: esprit politique, accomp. de sa vie* (2 vols., 1880); Auguste Cabanès, *Marat inconnu* (1891); A. Bougeart, *Marat, l'ami du peuple* (2 vols., 1865); M. Tourneux, *Bibliographie de l'histoire de Paris pendant la révolution française* (vol. ii., 1894; vol. iv., 1906), and E. B. Bax, *J. P. Marat* (1900). The *Correspondance de Marat* has been edited with notes by C. Villay (1908). (R. A.*)

MARATHI (properly *Marāthī*),[1] the name of an important Indo-Aryan language spoken in western and central India. In 1901 the number of speakers was 18,237,899, or about the same as the population of Spain. Marathi occupies an irregular triangular area of approximately 100,000 sq.m., having its apex about the district of Balaghat in the Central Provinces, and for its base the western coast of the peninsula from Daman on the Gulf of Cambay in the north to Karwar on the open Arabian Sea in the south. It covers parts of two provinces of British India—Bombay and the Central Provinces (including Berar)—with numerous settlers in Central India and Madras, and is also the principal language of Portuguese India and of the north-western portion of His Highness the Nizam's dominions. The standard form of speech is that of Poona in Bombay, and, in its various dialects it covers the larger part of that province, in which it is the vernacular of more than eight and a half millions of people.

As explained in the article INDO-ARYAN LANGUAGES, there were in ancient times two main groups of these forms of speech—one, the language of the Midland, spoken in the country near the Gangetic Doab, and the other, the languages of the so-called "Outer Band," containing the Midland on three sides, west, east and south. The country to the south of the Midland, in which members of this Outer group of languages were formerly spoken, included the modern Rajputana and Gujarat, and extended to the basin of the river Nerbudda, being bounded on the south by the Vindhya hills. In the course of time the population of the Midland expanded, and gradually occupied this tract, reaching the sea in Gujarat. The language of the Outer Band was thus forced farther afield. Its speakers crossed the Vindhyas and settled in the central plateau of the Deccan and on the Konkan coast. Here they came into contact with speakers of the Dravidian languages of southern India. As happened elsewhere in India, they retained their own Aryan tongue, and gradually through the influence of their superior civilization imposed it upon the aborigines, so that all the inhabitants of this tract became the ancestors of the speakers of modern Marathi.

In Rajputana and Gujarat the language (see GUJARAT) is to a certain extent mixed. Near the original Midland there are few traces of the Outer language, but as we go farther and farther away from that centre we find, as might be expected, the influence of the Midland language becoming weaker and weaker, and traces of the Outer language becoming more and more evident, until in Gujarati we recognize several important survivals of the old language once spoken by the earlier Aryan inhabitants.

Dialects.—Besides the standard form of speech, there is only one real dialect of Marathi, viz. Konkani (Kōnkaṇī), spoken in the country near Goa. There are also several local varieties, and we may conveniently distinguish between the Marathi of the Deccan, that of the Central Provinces (including Berar), and that of the northern and central Konkan. In the southern part of the district of Ratnagiri this latter Konkani variety of Marathi gradually merges into the true Konkani dialect through a number of intermediate forms of speech. There are also several broken jargones, based upon Marathi, employed by aboriginal tribes surviving in the hill country.

Relations with other Indo-Aryan Languages.—Marathi has to its north, in order from west to east, Gujarati, Rajasthani, Western Hindi and Eastern Hindi. To its east and south it has the Dravidian languages, Gondi, Telugu and Kanarese. Elsewhere in India Aryan languages gradually fade away into each other, so that it is impossible to fix any definite boundary line between them. But this is not the case with Marathi. It does not merge into any of the cognate neighbouring forms of speech, but possesses a distinct linguistic frontier. A native writer[2] says: "The Gujarati language agrees very closely with the languages of the countries lying to the north of it, because the Gujarati people came from the north. If a native of Delhi, Ajmere, Marwar, Mewar, Jaipur, &c., comes into Gujarat, the Gujarati people find no difficulty in understanding his language. But it is very wonderful that when people from countries bordering Gujarat on the south, as the Konkan, Maharashtra, &c.

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[1] The name is sometimes spelt *Mahrāthī*, with an *h* before the *r*, but, according to a phonetic law of the Aryan languages of western India, this is incorrect. The original *h* in "Māhārāṣṭrī," from which the word is derived, is liable to elision on coming between two vowels.

[2] Shastri Vrajlal Kalidas, quoted by Beames in *Comparative Grammar*, i. 102.

(*i.e.* people speaking Marathi) come to Gujarat, the Gujarati people do not in the least comprehend what they say." This isolated character of Marathi is partly due to the barrier of the Vindhya range which lies to its north, and partly to the fact that none of the northern languages belongs now to the Outer Band, but are in more or less close relationship to the language of the Midland. There was no common ground either physical or linguistic, upon which the colliding forms of speech could meet on equal terms. Eastern Hindi is more closely related to Marathi than the others, and in its case, in its bordering dialects, we do find a few traces of the influence of Marathi—traces which are part of the essence of the language, and not mere borrowed waifs floating on the top of a sea of alien speech and not absorbed by it.

Written Character.—Marathi books are generally printed in the well-known Nagari character (see SANSKRIT), and this is also used to a great extent in private transactions and correspondence. In the Maratha country it is known as the *Bālbōdh* ("teachable to children," *i.e.* "easy") character. A cursive form of Nagari called *Mōḍī*, or "twisted," is also employed as a handwriting. It is said to have been invented in the 17th century by Balaji Avaji, the secretary of the celebrated Sivaji. Its chief merit is that each word can be written as a whole without lifting the pen from the paper, a feat which is impossible in the case of Nagari.[1]

Origin of the Language.—The word "Marāṭhī" signifies (the language) of the Maratha country. It is the modern form of the Sanskrit *Māhārāṣṭrī*, just as "Marāṭhā" represents the old *Mahā-rāṣṭra*, or Great Kingdom. *Māhārāṣṭrī* was the name given by Sanskrit writers to the particular form of Prakrit spoken in Mahārāṣṭra, the great Aryan kingdom extending southwards from the Vindhya range to the Kistna, broadly corresponding to the southern part of the Bombay Presidency and to the state of Hyderabad. As pointed out in the article PRAKRIT this Māhārāṣṭrī early obtained literary pre-eminence in India, and became the form of Prakrit employed as the language not only of lyric poetry but also of the formal epic (*kāvya*). Dramatic works were composed in it, and it was the vehicle of the non-canonical scriptures of the Jaina religion. The oldest work in the language of which we have any knowledge is the *Sattasaī*, or Seven Centuries of verses, compiled at Pratiṣṭhāna, on the Gōdāvarī, the capital of King Hāla, at some time between the 3rd and 7th centuries A.D. Pratiṣṭhāna is the modern Paithan in the Aurangabad district of Hyderabad, and that city was for long famous as a centre of literary composition. In later times the political centre of gravity was changed to Poona, the language of which district is now accepted as the standard of the best Marathi.

General Character of the Language.—In the following account of the main features of Marathi, the reader is presumed to be familiar with the leading facts stated in the articles INDO-ARYAN LANGUAGES and PRAKRIT. In the Prakrit stage of the Indo-Aryan languages we can divide the Prakrits into two well-defined groups, an Inner, Śaurasēnī and its connected dialects on the one hand, and an Outer, Māhārāṣṭrī, Ardhamāgadhī, and Māgadhī with their connected dialects on the other. These two groups differed in their phonetic laws, in their systems of declension and conjugation, in vocabulary, and in general character.[2] In regard to the last point reference may be made to the frequent use of meaningless suffixes, such as *-alla*, *-illa*, *-ulla*, &c., which can be added, almost *ad libitum* to any noun, adjective or particle in Māhārāṣṭrī and Ardhamāgadhī, but which are hardly ever met in Śaurasēnī. These give rise to numerous secondary forms of words, used, it might be said, in a spirit of playfulness, which give a distinct flavour to the whole language. Similarly the late Mr Beames (*Comparative Grammar*, i. 103) well describes Marathi as possessing "a very decided individuality, a type quite its own, arising from its comparative isolation for so many centuries." Elsewhere (p. 38) he uses language which would easily well apply to Māhārāṣṭrī Prakrit when he says, "Marathi is one of those languages which we may call playful—it delights in all sorts of jingling formations, and has struck out a larger quantity of secondary and tertiary words, diminutives, and the like, than any of the cognate tongues," and again (p. 52):—

> "In Marathi we see the results of the Pandit's file applied to a form of speech originally possessed of much natural wildness and licence. The hedgerows have been pruned and the wild briars and roses trained into order. It is a copious and beautiful language, second only to Hindi. It has three genders, and the same elaborate preparation of the base as Sindhi, and, owing to the great corruption which has taken place in its terminations, the difficulty of determining the gender of nouns is as great in Marathi as in German. In fact, if we were to institute a parallel in this respect, we might appropriately describe Hindi as the English, Marathi as the German of the Indian group—Hindi having cast aside whatever could possibly be dispensed with, Marathi having retained whatever has been spared by the action of time. To an Englishman Hindi commends itself by its absence of form, and the positional structure of its sentences resulting therefrom; to our High-German cousins the Marathi, with its fuller array of genders, terminations, and inflexions, would probably seem the completer and finer language."

In the article PRAKRIT it is explained that the literary Prakrits were not the direct parents of the modern Indo-Aryan vernaculars. Each Prakrit had first to pass through an intermediate stage—that of the Apabhramśa—before it took the form current at the present day. While we know a good deal about Māhārāṣṭrī and very little about Śaurasēnī Prakrit, the case is reversed in regard to their respective Apabhramśas. The Śaurasēnā Apabhramśa is the only one concerning which we have definite information. Although it would be quite possible to reason from analogy, and thus to obtain what would be the corresponding forms of Māhārāṣṭra Apabhramśa, we should often be travelling upon insecure ground, and it is therefore advisable to compare Marathi, not with the Apabhramśa from which it is immediately derived, but with its grandmother, Māhārāṣṭrī Prakrit. We shall adopt this course, so far as possible, in the following pages.

Vocabulary.—In the article INDO-ARYAN LANGUAGES it is explained that, allowing for phonetic development, the vocabulary of Śaurasēnī Prakrit was the same as that of Sanskrit, but that the farther we go from the Midland, the more examples we meet of a new class of words, the so-called *dēśyas*, descendants of the old Primary Prakrits spoken outside the Midland, and strange to Sanskrit. Māhārāṣṭrī Prakrit, the most independent of the Outer languages, was distinguished by the large proportion of these *dēśyas* found in its vocabulary, and the same is consequently the case in Marathi. The Brahmins of the Maratha country have always had a great reputation for learning, and their efforts to create a literary language out of their vernacular took, as in other parts of India, the direction of borrowing *tatsamas* from Sanskrit, to lend what they considered to be dignity to their sentences. But the richness of the language in *dēśya* words has often rendered such borrowing unnecessary, and has saved Marathi, although the proportion of *tatsamas* to *tadbhavas*[3] in the language is more than sufficiently high, from the fate of the Pandit-ridden literary Bengali, in which 80 to 90 % of the vocabulary is pure Sanskrit. There is indeed a tradition of stylistic chastity in the Maratha country from the earliest times, and even Sanskrit writers contrasted the simple elegance of the Deccan (or *Vaidarbhī*) style with the flowery complexity of eastern India.

The proportion of Persian and, through Persian, of Arabic words in the Marathi vocabulary is comparatively low, when compared with, say, Hindostani. The reason is, firstly, the predominance in the literary world of these learned Brahmins, and, secondly, the fact that the Maratha country was not conquered by the Mussulmans till a fairly late period, nor was it so thoroughly occupied by them as were Sind, the Punjab, and the Gangetic valley.

Phonetics.[4]—In the standard dialect the vowels are the same as in Sanskrit, but *r̥* and *l̥* only appear in words borrowed directly from that language (*tatsamas*). Final short vowels (*a*, *i* and *u*) have all disappeared in prose pronunciation, except in a few local dialects, and final *i* and *u* are not even written. On the other hand, in the Nagari character, the non-pronunciation of a final *a* is not indicated. After an accented syllable a medial *a* is pronounced very lightly, even when the accent is not the main accent of the word. Thus, if we indicate the main accent by ′, and subsidiary accents (equivalent to the Hebrew *methegh*) by ˋ, then the word *kā́rawat*, a saw, is pronounced *kár^{a}wat*; and *kàḷakáḷaṇē̃*, to be agitated, is pronounced *kàḷ^{a}kaḷ^{a}ṇē̃*. In Kònkani the vowel *a* assumes the sound of *o* in " hot," a sound which is also heard in the language of Bengal. In dialectic speech *ē* is often interchangeable with short or long *a*, so that the standard *sāṅgit^{a}lē̃*, it was said, may appear as *sāṅgit^{a}lā* or *sāṅgit^{a}lā̃*. The vowels *ē* and *ō* are apparently always long in the standard dialect, thus following Sanskrit; but in Konkani there is a short and a long form of each vowel. Very probably, although the distinction is not observed in writing, and has not been noticed by native scholars, these vowels are also pronounced short in the standard dialect under the circumstances to be now described. When a long *ā*, *ī* or *ū̆* precedes an accented syllable it is usually shortened. In the case of *ā* the shortening is not indicated by the spelling, but the written long *ā* is pronounced short like the *ă* in the Italian *ballo*. Thus, the dative of *pīk*, a ripe crop, is *pikā́s*, and that of *hāt*, a hand, is *hātā́s*, pronounced *hătā́s*. Almost the only compound consonants which survived in the Prakrit stage were double letters, and in M. these are usually simplified, the preceding vowel being lengthened in compensation. Thus, the Prakrit *kannō* becomes *kān*, an ear; Pr. *bhikkhā* becomes *bhīk*, alms; and Pr. *puttō* becomes *pūt*, a son. In the Piśāca (see Indo-Aryan Languages) and other languages of north-western India it is not usual to lengthen the vowel in compensation, and the same tendency is observable in Konkani, which, it may be remarked, appears to contain many relics of the old Prakrit (Saurāṣṭrī) spoken in the Gujarat country before the invasion from the Midland. Thus, in Konkani, we have *put* as well as *pūt*, while the word corresponding to the Pr. *ekkō*, one, is *ek* as well as the standard *ēk*.

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[1] See B. A. Gupte in *Indian Antiquary* (1905), xxxiv. 27.

[2] For details see Dr Sten Konow's article on Māhārāṣṭrī and Marāṭhī in *Indian Antiquary* (1903), xxxii. 180 seq.

[3] For the explanation of these terms see INDO-ARYAN LANGUAGES.

[4] Abbreviations: Skr. = Sanskrit. Pr. = Māhārāṣṭrī Prakrit. M. = Marathi.

On the whole, the consonantal system is much the same as in other Indian languages. Nasalization of long vowels is very common, especially in Konkani. In this article it is indicated by the sign ˜ placed over the affected vowel. The palatals are pronounced as in Skr. in words borrowed from that language or from Hindostani, and also in Marathi *tadbhavas* before *i*, *ī*, *ē* or *y*. Thus, *caṇḍ* (*tatsama*), fierce; *jamā* (Hindostani), collected; *cikhal* (M. *tadbhava*), mud. In other cases they are pronounced *ts*, *tsh*, *dz*, *dzh* respectively. Thus *tsākar* (for *cākar*), a servant; *dzāṇē̃* (for *jāṇē̃*), to go. There are two *s*-sounds in the standard dialect which are very similarly distinguished. *Ś*, pronounced like an English *sh*, is used before *i*, *ī*, *ē* or *y*; and *s*, as in English " sin," elsewhere. Thus, *śimphī*, a caste-name; *śīl*, a stone; *śēt*, a field; *śyām*, dark blue; but *sāp*, a snake; *sumār* (Persian *shumār*), an estimate; *strī*, a woman. In the dialects *s* is practically the only sibilant used, and that is changed by the vulgar speakers of Konkani to *h* (again as in north-western India). Aspirated letters show a tendency to lose their aspiration, especially in Konkani. Thus, *bhīk* (for *bhīkh*), alms, quoted above; *hāt* (Pr. *hatthō*), a hand. In Konkani we have words such as *boiṇ*, a sister, against standard *bhain*; *gēr*, standard *gharī*, in a house; *āmī*, standard *āmhī*, we. Here again we have agreement with north-western India. Generally speaking Marathi closely follows Māhārāṣṭrī when that differs from the Prakrits of other parts of India. Thus we have Skr. *vrajati*, Māhārāṣṭrī *vaccai* (instead of *vajjai*), he goes; Konkani *votsū*, to go; Saurasēnī *genhiduim*, Māhārāṣṭrī *ghettuṁ*, to take; Marathi *ghēt^{a}lē̃*, taken. There is similarly both in Marathi and Māhārāṣṭrī a laxness in distinguishing between cerebral and dental letters (which again reminds us of north-western India). Thus, Skr. *daśati*, Māhārāṣṭrī *ḍasai*, he bites; M. *ḍas^{a}ṇē̃* to bite; Skr. *dahati*, Māhārāṣṭrī *ḍahai*, he burns; M. *ḍādz^{a}ṇē̃*, to be hot; Skr. *gardabhas*; Śaurasēnī *gaddahō*; Hindostani *gadhā*; but Māhārāṣṭrī *gaḍḍahō*; M. *gāḍhav*, an ass; and so many others. In Māhārāṣṭrī every *n* becomes *ṇ*, but in Jaina MSS. when the *n* was initial or doubled it remained unchanged. A similar rule is followed regarding *l* and the cerebral *ḷ* common in Vedic Sanskrit, in MSS. coming from southern India, and, according to the grammarians, also in the Piśāca dialects of the north-west. In M. a Pr. double *nn* or *ll* is simplified, according to the usual rule, to *n* or *l* respectively, with lengthening of the preceding vowel in compensation. Both *ṇ* and *ḷ* are of frequent occurrence in M., but only as medial letters, and then only when they represent *ṇ* or *ḷ* in the Pr. stage. When the letter is initial or represents a double *nn* or *ll* of Pr. it is always *n* or *l* respectively, thus offering a striking testimony to the accuracy of the Jaina and southern MSS. Thus, ordinary Māhārāṣṭrī *ṇa*, but Jaina Māhārāṣṭrī *na*, M. *na*, not; Māhārāṣṭrī (both kinds) *ghaṇō*, M. *ghaṇ*, dense; Māhārāṣṭrī *soṇṇaaṁ*, Jaina *sonnaaṁ*, M. *sōnē̃*, gold; Māhārāṣṭrī *kālō*, time, southern MSS. of the same *kāḷō*, M. *kāḷ*, time; Māhārāṣṭrī *callai*, M. *tsālē*, he goes or used to go. In some of the local dialects, following the Vedic practice, we find *ḷ* where *ḍ* is employed elsewhere, as in (Berar) *ghōḷā* for *ghōḍā*, a horse; and there are instances of this change occurring even in Māhārāṣṭrī; *e.g.* Skr. *taḍagaṁ*, Māhārāṣṭrī *taḷāam*, M. *taḷē̃*, a pond.

The Skr. compound consonant *jñ* is pronounced *dny* in the standard dialect, but *gy* in the Konkan. Thus, Skr. *jñānaṁ* becomes *dnyān* or *gyān* according to locality.

Declension.—Marathi and Gujarati are the only Indo-Aryan languages which have retained the three genders, masculine, feminine and neuter, of Sanskrit and Prakrit. In rural dialects of Western Hindi and of Rajasthani sporadic instances of the neuter gender have survived, but elsewhere the only example occurs in the interrogative pronoun. In Marathi the neuter denotes not only inanimate things but also animate beings when both sexes are included, or when the sex is left undecided. Thus, *ghōḍē̃*, neut., a horse, without regard to sex. In the Konkan the neuter gender is further employed to denote females below the age of puberty, as in *cēḍū*, a girl. Numerous masculine and feminine words, however, denote inanimate objects. The rules for distinguishing the gender of such nouns are as complicated as in German, and must be learned from the grammars. For the most part, but not always, words follow the genders of their Skr. originals, and the abrasion of terminations in the modern language renders it impossible to lay down any complete set of rules on the subject. We may, however, say that strong bases (see below) in *ā*—and these do not include *tatsamas*—are masculine, and that the corresponding feminine and neuter words end in *ī* and *ē̃* respectively. Thus, *mul^{a}gā*, a son; *mul^{a}gī*, a daughter; *mul^{a}gē̃*, a child of so and so. As a further guide we may say that sex is usually distinguished by the use of the masculine and feminine genders, and that large and powerful inanimate objects are generally masculine, while small, delicate things are generally feminine. In the case of some animals (as in our " horse " and " mare ") sex is distinguished by the use of different words; *e.g.* *bōkaḍ*, he-goat, and *śēḷī*, a nanny-goat.

The nominative form of a *tadbhava* word is derived from the nominative form in Sanskrit and Prakrit, but *tatsama* words are generally borrowed in the form of the Sanskrit crude base. Thus, Skr. crude base *mālin*, nom. sing. *mālī*; Pr. nom. *māliō* (*māḷiō*); M. *māḷī* (*tadbhava*), a gardener; Skr. base *mati-*; nom. *matis*; M. *mati* (*tatsama*). Some *tatsamas* are, however, borrowed in the nominative form, as in Skr. *dhanin*, nom. *dhanī*; M. *dhanī*, a rich man. In Prakrit the nominative singular of many masculine *tatsamas* ended in *ō*. In the Apabhraṁśa stage this *ō* was weakened to *u*, and in modern Marathi, under the general rule, this final short *u* was dropped, the noun thus reverting as stated above to the form of the Sanskrit crude base. But in old Marathi, the short *u* was still retained. Thus, the Sanskrit *īśvaras*, lord, became, as a Prakrit *tatsama*, *īśvarō*, which in Apabhraṁśa took the form *īśvaru*. The old Marathi form was also *īśvaru*, but in modern Marathi we have *īśvar*. *Tadbhavas* derived from Sanskrit bases in *a* are treated very similarly, the termination being dropped in the modern language. Thus, Skr. nom. masc. *karṇas*, Pr. *kannō*, M. *kān*; Skr. nom. sing. fem. *khaṭvā*, Pr. *khaṭṭā*, M. *khāṭ*, a bed; Skr. nom. sing. neut. *gṛhaṁ*, Pr. *gharaṁ*, M. *ghar*, a house. Sometimes the Skr. nom. sing. fem. of these nouns ends in *ī*, but this makes no difference, as in Skr. and Pr. *cullī*, M. *cūl*, a fireplace. There is one important set of exceptions to this rule. In the article Prakrit attention is drawn to the frequent use of pleonastic suffixes, especially of -(*a*)*ka*- (masc. and neut.), -(*i*)*kā* (fem.). This could in Sanskrit be added to any noun, whatever the termination of the base might be. In Prakrit the *k* of this suffix, being medial, was elided, so that we get forms like Skr. nom. sing. masc. *ghōṭa-kas*, Pr. *ghōḍa-ō*, M. *ghōḍā*, a horse; Skr. nom. sing. fem. *ghōṭi-kā*, Pr. *ghōḍi-ā*, M. *ghōḍī*, a mare; Skr. *ghōṭa-kaṁ*, Pr. *ghōḍa-*(*y*)*aṃ*, M. *ghōḍē*, a horse (without distinction of sex). Such modern forms made with this pleonastic suffix, and ending in *ā*, *ī* or *ē̃* are called " strong forms," while all those made without it are called " weak forms." As a rule the fact that a noun is in a weak or a strong form does not affect its meaning, but sometimes the use of a masculine strong form indicates clumsiness or hugeness. Thus *bhākaṛ* (weak form) means " bread," while *bhāk^{a}rā* (strong form) means " a huge loaf of bread." The other pleonastic suffixes mentioned under Prakrit are also employed in Marathi, but usually with specific senses. Thus the suffix *-illa-* generally forms adjectives, while *-ḍa-ka-* (in M. *-ḍā*, fem. *-ḍī*, neut. *-ḍē̃*) implies contempt.

The synthetic declension of Sanskrit and Prakrit has been preserved in Marathi more completely than in any other Indo-Aryan language. While Māhārāṣṭrī Prakrit, like all others, passed through the Apabhraṁśa stage in the course of its development, the conservative character of the language retained even in that stage some of the old pure Māhārāṣṭrī forms. In the article Prakrit we have seen how there gradually arose a laxity in distinguishing the cases. In Māhārāṣṭri the Sanskrit dative fell into almost entire disuse, the genitive being used in its place, while in Apabhraṁśa the case terminations become worn down to *-hu*, *-ho*, *-hi*, *-hī̃* and *-hã*, of which *-hi* and *-hĩ* were employed for several cases, both singular and plural. There was also a marked tendency for these terminations to become confused, so that in the earliest stages of most of the modern Indo-Aryan vernaculars we find *-hi* freely employed for any oblique case of the singular, and *-hĩ* for any oblique case of the plural. Another feature of Prakrit was the simplification of the complicated declensional system of Sanskrit by assimilating it in all cases to the declension of *a*-bases, corresponding to the first and second declensions in Latin.

In the formation of the plural the Prakrit declensions are very closely followed by Marathi. We shall confine our remarks to *a*-bases, which may be either weak or strong forms, and of which the feminine ends sometimes in *ā*, and sometimes in *ī*. In Prakrit the nom. plur. of these nouns ends masc. *ā*, fem. *āō*, *īō*, neut. *āiṁ*. We thus get the following:—

	Masculine.		Feminine.				Neuter.	
	Nom. Sing.	Nom. Plur.	Nom. Sing.	Nom. Plur.	Nom. Sing.	Nom. Plur.	Nom. Sing.	Nom. Plur.
Weak form.								
Prakrit	*kannō*, an ear.	*kannā*	*khaṭṭā*, a bed.	*khaṭṭāō*	*cullī*, a fireplace.	*cullīō*	*gharaṁ*, a house.	*gharāiṁ*
Marathi	*kān*	*kān*	*khāṭ*	*khāṭā*	*cūl*	*cūlī*	*ghar*	*gharē̃*
Strong form.								
Prakrit	*ghōḍaō*, a horse.	*ghōḍayā*	*ghōḍiā*, a mare.	*ghōḍiāō*	—	—	**ghōḍayaṁ*, a horse.	**ghōḍayāiṁ*
Marathi	*ghōḍā*	*ghōḍē*	*ghōḍī*	*ghōḍyā*	—	—	*ghōḍē̃*	*ghōḍī*

Several of the old synthetic cases have survived in Marathi, especially in the antique form of the language preserved in poetry. Most of them have fallen into disuse in the modern prose language. We may note the following, some of which have preserved the Māhārāṣṭrī forms, while others are directly derived from the Apabhraṁśa stage of the language. We content ourselves with giving some of the synthetic cases of one noun, a weak neuter *a*-base, *ghar*, a house.

	Māhārāṣṭrī Prakrit.	Apabhraṁśa.	Marathi.
Sing.			
Nominative . .	*gharaṁ*	*gharu*	*ghar*
Dative . . .	*gharassa* (genitive)	*gharaho* (genitive)	*gharās* (dative)
Locative . .	*gharē*	*gharahi* (–*hī*)	*gharī̃*, *gharā*
General oblique	*gharassa* (genitive)	*gharaho* (genitive)	*gharās*, *gharā*
Plur.			
Nominative .	*gharāiṁ*	*gharaī̃*	*gharē̃*
Locative . .	*gharēsu*	*gharahi* (–*hī*)	*gharī̃*
General oblique	*gharāṇa* (genitive)	*gharahā̃* (genitive)	*gharā̃*

As already stated, in Prakrit the genitive is employed instead of the dative, and thus forms the basis of the Marathi dative singular. The genitive plural is not used as a dative plural in Marathi, but it is the basis of the plural general oblique case. The Marathi singular general oblique case is really the same as the Marathi dative singular, but in the standard form of speech when so used the final *s* is dropped, *gharās*, as a general oblique case, being only found in dialects. This general oblique case is the result of the confusion of the various oblique cases originally distinguished in Sanskrit and in literary Prakrit. In Apabhraṁśa the genitive began to usurp the function of all the other cases. It is obvious that if it were regularly employed in so indeterminate a sense, it would give rise to great confusion. Hence when it was intended to show clearly what particular case was meant, it became usual to add, to this indeterminate genitive, defining particles corresponding to the English "of," "to," "from," "by," &c., which, as in all Indo-Aryan languages they follow the main word, are called "postpositions." Before dealing with these, it will be convenient to give the modern Marathi synthetic declension of the commoner forms of nouns. The only synthetic case which is now employed in prose is the dative, and this can always be formed from the general oblique case by adding an *s* to the end of the word. It is therefore not given in the following table.

The accusative is usually the same as the nominative, but when definiteness is required the dative is employed instead. The termination *nē̃*, with its plural *nī̃*, is, as explained in the article GUJARATI, really the oblique form, by origin a locative, of the *nā* or *nō*, employed in Gujarati to form the genitive. The suffix *nā* of the dative plural is derived from the same word. Here it is probably a corruption of the Apabhraṁśa *nāu* or *naho*. The postposition *lā* is probably a corruption of the Sanskrit *lābhē*, Apabhraṁśa *lahi*, for the benefit (of). As regards the ablative, we have in old Marathi poetry a form corresponding to *gharāhu-niyā̃*, which explains the derivation. *Gharāhu* is a by-form of the Prakrit synthetic ablative *gharāu*, to which *niyā*, another oblique form of *nā*, is added to define the meaning. The locative termination ˜*t* is a contraction of the Pr. *antō*, Skr. *antar*, within.

The genitive *gharātsā* is really an adjective meaning "belonging to the house," and agrees in gender, number and case with the noun which is possessed. Thus:

māḷyātsā ghōḍā, the gardener's horse. *māḷyācē ghōḍē*, the gardener's horses.

māḷyācī ghōḍī, the gardener's mare. *māḷyācyā ghōḍyā*, the gardener's mares.

māḷyācē̃ ghōḍē̃, the gardener's horse (neut.). *māḷyācī̃ ghōḍī*, the gardener's horses (neut.).

The suffix *tsā*, *cī*, *cē̃*, is derived from the Sanskrit suffix *tyakas*, Pr. *caō*, which is used in much the same sense. In Sanskrit it may be added either to the locative or to the unmodified base of the word to which it is attached, thus, *ghōṭakē-tyakas* or *ghōṭaka-tyakas*. Similarly in Marathi, while it is usually added to the general oblique base, it may also be added to the unmodified noun, in which case it has a more distinctly adjectival force. The use of *tsā* has been influenced by the fact that the Sanskrit word *kṛtyas*, Pr. *kiccaō*, also takes the same form in Marathi. As explained in the article HINDOSTANI, synonyms of this word are used in other Indo-Aryan languages to form suffixes of the genitive.[1]

Strong adjectives, including genitives, can be declined like substantives, and agree with the qualified noun in gender, number and case. When the substantive is in an oblique case, the adjective is put into the general oblique form without any defining postposition, which is added to the substantive alone. Weak adjectives are not inflected in modern prose, but are inflected in poetry. As in other Indo-Aryan languages, comparison is effected by putting the noun with which comparison is made in the ablative case.

	Masculine.			Feminine.			Neuter.		
Meaning.	Ear.	Horse.	Gardener.	Bed.	Fireplace.	Mare.	House.	Horse.	Pearl.
Sing.									
Nom.	*kān*	*ghōḍā*	*māḷī*	*khāṭ*	*cūl*	*ghōḍī*	*ghar*	*ghōḍē̃*	*motī*
Gen. obl.	*kānā*	*ghōḍyā*	*māḷyā*	*khāṭē*	*cūlī*	*ghōḍī*	*gharā*	*ghōḍyā*	*mōtyā*
Plur.									
Nom.	*kān*	*ghōḍē̃*	*māḷī*	*khāṭā*	*cūlī*	*ghōḍyā*	*gharē̃*	*ghōḍī̃*	*mōtyē̃*
Gen. obl.	*kānā̃*	*ghōḍyā̃*	*māḷyā̃*	*khāṭā̃*	*cūlī*	*ghōḍyā̃*	*gharā̃*	*ghōḍyā̃*	*mōtyā̃*

The usual postpositions are:—

Instrumental: *nē̃*, plural *nī̃*, by. Dative: *lā*, plural also *nā*, to or for. Ablative: *hūn*. *ūn*, from. Genitive: *tsā*, of. Locative: ˜*t*, in. We thus get the following complete modern declension of *ghar*, a house (neut.):—

	Sing.	Plur.
Nom.	*ghar*	*gharē̃*
Acc.	*ghar*	*gharē̃*
Instr.	*gharānē̃*	*gharā̃nī̃*
Dat.	*gharās*, *gharālā*	*gharā̃s*, *gharā̃lā*, *gharā̃nā*
Abl.	*gharāhūn*, *gharūn*	*gharā̃hūn*
Gen.	*gharātsā*	*gharā̃tsa*
Loc.	*gharā̃t*	*gharā̃t*

The pronouns closely follow the Prakrit originals. The origin of all these is discussed in the article HINDOSTANI, and the account need not be repeated here. As usual in these languages, there is no pronoun of the third person, its place being supplied by the demonstratives. The following are the principal pronominal forms:—

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[1] Fuller information regarding all the above postpositions will be found in G. A. Grierson's article "On Certain Suffixes in the Modern Indo-Aryan Vernaculars," on pp 473 seq. of the *Zeitschrift für vergleichende Sprachforschung* for 1903.

mī̃, I, instr. *mī̃*, *myā̃*, dat. *malā*, obl. *madz*; *āmhī*, we, instr. *āmhī̃*, obl. *āmhā̃*; *mādzhā*, my, of me; *āmtsā*, our, of us.

tū̃, thou, instr. *tū̃*, *twā*, dat. *tulā*, obl. *tudz*; *tumhī*, you, instr. *tumhī̃*, obl. *tumhā̃*; *tudzhā*, thy, of thee; *tumtsā*, your, of you.

āpaṇ, self, obl. *āpᵃṇa*, gen. *āpᵃlā*. This is also employed as an honorific pronoun of the second person, and, in addition, to mean "we including you."

hā, this, fem. *hī*, neut. *hē̃*; *tō*, he, that, fem. *tī*, neut. *tē̃*; *dzō*, who, fem. *jī*, neut. *jē̃*.

kōṇ, who? *kāy*, what? obl. *kāśa*; *kōṇī*, any one; *kā̃hī*, anything. In all these the plural is employed honorifically instead of the singular.

Conjugation.—In Prakrit (*q.v.*) the complicated system of Sanskrit conjugation had already disappeared, and all verbs fell into two classes, the first, or *a*-, conjugation, and the second, or *ē*-, conjugation, in which the *ē* represents the *aya* of the Sanskrit tenth conjugation and of causal and denominative verbs. Marathi follows Prakrit in this respect and has two conjugations. The first, corresponding to the Prakrit *a*-class, as a rule consists of intransitive verbs, and the second, corresponding to the *e*- or causal class, of transitive verbs, but there are numerous exceptions. Verbs whose roots end in vowels or in *h* belong partly to one and partly to the other conjugation. These conjugations differ only in the present and past participles and in the tenses formed from them. Here, in the first conjugation an *a*, and in the second conjugation an *i*, is inserted between the base and the termination.

The only original Prakrit tenses which have survived in Marathi are the present and the imperative. The present has lost its original meaning and is now a habitual past. It is also the base of the Marathi future. These three tenses, the habitual past, the imperative and the future, are conjugated as follows. They should be compared with the corresponding forms in the article PRAKRIT. The verb selected is the root *uṭh*, rise, of the first conjugation.

Person.	Habitual past (old present), I used to rise.		Imperative. Let me rise.		Future. I shall rise.	
	Sing.	Plural.	Sing.	Plural.	Sing.	Plural.
1	*uṭhē̃*	*uṭhū̃*	*uṭhū̃*	*uṭhū̃*	*uṭhēn*	*uṭhū̃*
2	*uṭhēs*	*uṭhā̃*	*uṭh*	*uṭhā*	*uṭhᵃśīl*	*uṭhāl*
3	*uṭhē*	*uṭhat*	*uṭhō*	*uṭhōt*	*uṭhēl*	*uṭhᵃtīl*

As in Rajasthani, Bihari and the Indo-Aryan language of Nepal (see PAHARI), the future is formed by adding *l*, or in the first person singular *n*, to the old present. In the second person singular the *l* has been added to a form derived from the Pr. *uṭṭhasi*, which is also the origin of the old present *uṭhēs*. Some scholars, however, see in *uṭhaśī* a derivation of the Prakrit future *uṭṭhihisi*, thou shalt arise, and a confusion of the Prakrit present and future is quite possible.

The remaining tenses are modern forms derived from the participles. The verbal nouns, participles and infinitives are as follows:—

	Prakrit (First Conjugation).	Marathi First Conjugation.	Marathi Second Conjugation.
Verbal Noun	*uṭṭhaṇīaṁ*	*uthᵃṇē̃*, the act of rising.	*mārᵃṇē̃*, the act of killing.
Infinitive	*uṭṭhiuṁ*	*uṭhū̃*, to rise.	*mārū̃*, to kill.
Present Participle	*uṭṭhantō*, *uṭṭhantaō*	*uṭhat*, *uṭhᵃtā*, rising.	*mārīt*, *māritā*, killing.
Past Participle	*uṭṭhiallaō*	*uṭhᵃlā*, risen.	*mārilā*, killed.
Future Participle Active	*uṭṭhaṇaaḍō*	*uṭhᵃṇār*, about to rise.	*mārᵃṇār*, about to kill.
Future Participle Passive	*uṭṭhiavvaō*	*uṭhāwā*, about to be risen.	*mārāwā*, about to be killed.
Conjunctive Participle	*uṭṭhiu*	*uṭhūn*, having risen.	*mārūn*, having killed.

The only form that requires notice is that of the conjunctive participle. It is derived from the Apabhraṁśa form *uṭṭhiu*, to which the dative suffix *n* (old Marathi *ni*, *niyā̃*) has been added.

Various tenses are formed by adding personal suffixes to the present, past or future passive participle. When the subject of the verb is in the nominative the tense so formed agrees with it in gender, number and person. We may note four such tenses: a present, *uṭhᵃtō̃*, I rise; a past, *uṭhᵃlō̃*, I rose; past conditional, *uṭhᵃtō̃*, had I risen; and a subjunctive, *uṭhāwā*, I should rise. In the present, the terminations are relics of the verb substantive, and in the other tenses of the personal pronouns. In these latter, as there is no pronoun of the third person, the third persons have no termination, but are simply the unmodified participle. We thus get the present and the past conjugated as follows, with a masculine subject:—

	Present, I rise.		Past, I rose.	
	Singular.	Plural.	Singular.	Plural.
1	*uṭhᵃtō̃*	*uṭhᵃtō*	*uṭhᵃlō̃*	*uṭhᵃlō̃*
2	*uṭhᵃtōs*	*uṭhᵃtā̃*	*uṭhᵃlās*	*uṭhᵃlā̃*
3	*uṭhᵃtō*	*uṭhᵃtāt*	*uṭhᵃlā*	*uṭhᵃlē*

The feminine and neuter forms differ from the above: thus, *uṭhᵃtēs*, thou (fem.) risest; *uṭhᵃlīs*, thou (fem.) didst rise; and so on for the other persons and for the neuter.

It will be observed that, in the case of transitive verbs, while the present participle is active, the past and future passive participles are passive in meaning. The same is the case with the future passive participle of the intransitive verb. In tenses, therefore, formed from these participles the sentence must be construed passively. The subject must be put into the instrumental case, and the participle inflected to agree with the object. If the object is not expressed, or, as is sometimes the case, is expressed in the guise of a kind of ethic dative, the participle is construed impersonally, and is employed in the neuter form. Thus (present tense) *mulᵃgā* (nom. masc.) *pōthī vācitō*, the boy reads a book, but (past tense) *mulᵃgyānē̃* (instrumental *pōthī* (nom. fem.) *vācilī* (fem.) the boy read a book, literally, by-the-boy a-book was-read; or *mulᵃgyānē̃ pōthīlā* (dative) *vācilē̃* (neuter), the boy read the book, literally, by-the-boy, with-reference-to-the-book, it-(impersonal)-was-read. Similarly in the subjunctive formed from the future passive participle, *mulᵃgyānē̃ pōthī vācāwī*, the boy should read a book (by-the-boy a-book is-to-be-read) or *mulᵃgyānē̃ pōthīlā vācāwē̃*, the boy should read the book [by-the-boy with-reference-to-the-book, it (impersonal)-is-to-be-read]. As an example of the subjunctive of an intransitive verb, we have *twā uṭhāwē̃*, by-thee it-is-to-be-risen, thou shouldst rise. As in intransitive verbs the passive sense is not so strong, in their case the tense may also be used actively, as in *tū̃ uṭhāwās*, thou shouldst rise, *lit.*, thou (art) to-be-risen. It will be noted that when a participle is used passively it takes no personal suffix.

We have seen that the present tense is formed by compounding the present participle with the verb substantive. Further tenses are similarly made by suffixing, without compounding, various tenses of the verb substantive to the various participles. Thus *mī uṭhat āhē̃*, I am rising; *mī uṭhat hōtō̃*, I was rising; *myā uṭhāvē̃ hōtē̃* (impersonal construction), I should have risen. In the case of tenses formed from the past participle, the auxiliary is appended, not to the participle, but to the past tense, as in *mī̃ uṭhᵃlō̃ āhē*, I have risen; *myā̃ mārilā āhē* (personal passive construction) or *myā̃ mārilē̃ āhē* impersonal passive construction), I have killed. Similarly *mī uṭhᵃlō̃ hōtō̃* (active construction), I had risen. The usual forms of the present and past of the verb substantive are:—

	Present, I am.		Past, I was (masc).	
	Singular.	Plural.	Singular.	Plural.
1	*āhē̃*	*āhē̃*	*hōtō̃*	*hōtō̃*
2	*āhēs*	*āhā̃*	*hōtās*	*hōtā̃*
3	*āhē*	*āhēt*	*hōtā*	*hōtē*

The past changes for gender, but the present is immutable in this respect. *Āhē̃* is usually considered to be a descendant of the Sanskrit *asmi*, I am,[1] while *hōtō̃* is derived from the Pr. *hoṁtaō*, the present participle of what corresponds to the Skr. root *bhū*, become.

A potential passive and a causal are formed by adding *av* to the root of a simple verb. The former follows the first, or intransitive, and the latter the second or transitive conjugation. The potential passive of a neuter verb is necessarily construed impersonally. The causal verb denotes indirect agency; thus, *karᵃnē̃*, to do, *karavᵃnē̃*, to cause a person to do; *tyācyā-kaḍūn myā tē̃ karavilē̃*, I caused him to do that, literally, by-means-of-him by-me that was-caused-to-be-done. The potential, being passive, has the subject in the dative (cf. Latin *mihi est ludendum*) or in the instrumental of the genitive, as in *malā* (dative), or *mājhyānē̃* (instr. of *mādzhā*, of me), *uthᵃvatē̃*, I can rise, literally, for-me, or by-my-(action), rising-can-be-done. So, *Rāmālā*, or *Rāmācyānē̃*, *pōthī vācᵃvalī*, Rām could read a book (by R. a book could be read).

Several verbs are irregular. These must be learnt from the grammars. Here we may mention *hōṇē̃*, to become, past participle *dzhālā*; *yēṇē̃*, to come, past participle *ālā*; and *dzāṇē̃*, to go, past participle *gēlā*. There are also numerous compound verbs. One of these, making a passive, is formed by conjugating the verb *dzāṇē̃*, to go, with the past participle of the principal verb. Thus, *mārilā dzātō*, he is being killed, literally, he goes killed.

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[1] See, however, Hoernle, *Comparative Grammar*, p. 364.

Literature.—As elsewhere in India, the modern vernacular literature of the Maratha country arose under the influence of the religious reformation inaugurated by Rāmānuja early in the 12th century. He and his followers taught devotion to a personal deity instead of the pantheism hitherto prevalent. The earliest writer of whom we have any record is Nāmdēv (13th century), whose hymns in honour of Vithoba, a personal form of Vishnu, have travelled far beyond the home of their writer, and are even found in the Sikh *Ādi Granth.* Dnyānōbā, a younger contemporary, wrote a paraphrase of the Sanskrit *Bhagavad Gītā*, which is still much admired. Passing over several intermediate writers we come to the period of the warrior Sivaji, the opponent of Aurangzeb. He was a disciple of Rāmdās (1608–1681), who exercised great influence over him, and whose *Dāsbōdh*, a work on religious duty, is a classic. Contemporary with Rāmdās and Sivaji was Tukārām (1608–1649), a Śūdra by caste, and yet the greatest writer in the language. He began life as a petty shopkeeper, and being unsuccessful both in his business and in his family relations, he abandoned the world and became a wandering ascetic. His *Abhangs* or "unbroken" hymns, probably so called from their indefinite length and loose, flowing metre, are famous in the country of his birth. They are fervent, but though abounding in excellent morality, do not rise to any great height as poetry. Other Marathi poets who may be mentioned are Śrīdhar (1678–1728), the most copious of all, who translated the *Bhāgavata Purāṇa*, and the learned Mayūra or Mōrōpant (1729–1794), whose works smell too much of the lamp to satisfy European standards of criticism. Mahīpati (1715–1790) was an imitator of Tukārām, but his chief importance rests on the fact that he collected the popular traditions about national saints, and was thus the author of the *Acta sanctorum* of the Marathas. *Lāvaṇīs*, or erotic lyrics, by various writers, are popular, but are often more passionate than decent. Another branch of Marathi literature is composed of *Pāwāḍās* or war-ballads, mostly by nameless poets, which are sung everywhere throughout the country. There is a small prose literature, consisting of narratives of historical events (the so-called *Bakhars*), moral maxims and popular tales.

In the 19th century the facilities of the printing press are responsible for a great mass of published matter. Most of the best works have been written in English by learned natives, upon whom the methods of European scholarship have exercised more influence than elsewhere in India, and have given rise to a happy combination of western science with Oriental lore. No vernacular authors of outstanding merit have appeared during the last century.

Konkani once had a literature of its own, which is said to have been destroyed by the Inquisition at Goa. Temples and manuscripts were burnt wholesale. Under Roman Catholic auspices a new literature arose, the earliest writer being an Englishman, Thomas Stephens (Thomaz Estevão), who came to Goa in 1579, wrote the first Konkani grammar, and died there in 1619. Amongst other works, he was the author of a Konkani paraphrase of the New Testament in metrical form, which has been several times reprinted and is still a favourite work with the native Christians. Since his time there has grown up a considerable body of Christian literature from the pens of Portuguese missionaries and native converts.

Authorities.—Marathi is fortunate in possessing the best dictionary of any modern Indian language, J. T. Molesworth's (2nd ed., Bombay, 1857). Navalkar's (3rd ed., Bombay, 1894) is the best grammar. The earliest students of Marathi were the Portuguese, who were familiar only with the language as spoken on the coast, *i.e.* with the standard dialect of the northern Konkan and with Konkani. They have since devoted themselves to these two forms of speech. For the former, reference may be made to the *Grammatica da lingua Concani no dialecto do norte*, by J. F. da Cunha Rivara (Goa, 1858). For Konkani proper, see A. F. X. Maffei's *Grammar* (Mangalore, 1882) and *Dictionaries* (ibid., 1883). These are in English. Monsenhor S. R. Dalgado is the author of a *Konkan-Portuguese Dictionary* (Bombay, 1893).

For further information regarding Marathi in general, see the list of authorities under Indo-Aryan Languages. For accounts of Marathi literature, see the preface to Molesworth's *Dictionary*; also J. Murray Mitchell's "The Chief Marathi Poets" in *Transactions of the Congress of Orientalists, London, 1892*, i. 282 sqq., and ch. viii. of M. G. Ranade's *Rise of the Maratha Power* (Bombay, 1900). For Konkani literature, see J. Gerson da Cunha's "Materials for the History of Oriental Studies among the Portuguese," in the *Proceedings of the Fourth International Congress of Orientalists*, ii. 179 sqq. (Florence, 1881). A full account of Marathi, given in great detail, will be found in vol. vii. of the *Linguistic Survey of India* (Calcutta, 1905). (G. A. Gr.)

MARATHON, a plain on the N.E. coast of Attica, divided from the plain of Athens by the range of Pentelicus; it contained four villages—Marathon, Probalinthos, Tricorythos and Oenoe—which originally formed an independent *tetrapolis* and in historical times still upheld peculiar rites and legendary associations, chiefly connected with Heracles and Theseus. In the 6th century B.C. it served as a base for Peisistratus (*q.v.*), who owned much property in that district, for securing the rest of Attica. The plain derives its fame mainly from the battle in which the Athenians and Plataeans defeated the Persians (490 B.C.). The Persian force had been sent by King Darius to punish the Athenians for previous interferences in Asia and to restore their tyrant Hippias. It was probably by advice of the latter that the generals Datis and Artaphernes landed their troops, numbering perhaps 50,000, at Marathon. The Athenians, on the recommendation of their strategus Miltiades, resolved to meet this force in the open field, and sent out their full levy of 9000 heavy infantry under the polemarch Callimachus. They were joined on the way by 1000 Plataeans, but were disappointed of the assistance which they expected from Sparta. From their station at the head of the Vrana valley, which slopes down to Marathon plain, the Athenians for some days observed the Persian army, which gave no sign of proceeding to attack. After some waiting, Miltiades, who seems throughout to have played a more prominent part than his superior Callimachus, drew up the Athenian army for battle and charged down upon the enemy, whose line was formed on the level about a mile distant. The Athenian wings, whose formation had been made specially deep, broke the opposing divisions by their impact; the centre was at first overborne by the superior weight of the native Persians, but ultimately was relieved by the victorious wings, which closed in upon the Persian centre. The Persians were thereupon driven back into the sea all along the line, and, although the majority regained their ships, no less than 6400 were left dead, as against 192 Athenians. The Persian fleet, of which perhaps a detachment had been sent on before the battle, now sailed round Cape Sunium in order to effect a landing at Phalerum, close by Athens, and with the help of traitors within the walls to take the city by surprise. But Miltiades, who had suspected some plot all along, and had lately been warned by a signal on Mt Pentelicus which he interpreted as a message to the Persians, marched back the victorious army in time to defend Athens. The enemy, upon noticing his presence, did not venture a second disembarcation and retired straightway out of Greek waters. The details of the battle, and the Persian plan of campaign, are not made clear by our ancient sources, but reconstructions have been attempted by numerous modern authorities. (M. O. B. C.)

The tumulus or "Soros" was excavated by M. Stais in 1891 and 1892. A slight previous excavation had brought to light some prehistoric implements, and it was supposed that the mound had no connexion with the battle; but it has now been discovered that the presence of those prehistoric objects was accidental. Underlying the mound was found a stratum about 85 ft. long by 20 broad, consisting of a layer of sand, above which lay the ashes and bones of many corpses; together with these were the remains of many lecythi and other vases, some of them contemporary with the Persian wars, some of them of much earlier style, and probably taken in the emergency from neighbouring cemeteries. It is conjectured with some probability that a large vase containing ashes may have been used as the burial urn of one of the Athenian generals who fell. There was also, in the middle of the stratum, a trench for funeral offerings about 30 ft. by 3; it contained bones of beasts, with ashes and fragments of vases. There can therefore be no doubt that the tumulus was piled up to commemorate the Athenians who fell in the battle, and that it marks the place where the carnage was thickest. A selection from the contents of the tumulus has been placed in the National Museum at Athens. (E.Gr.)

See Herodotus vi. 102–117; W. M. Leake, *The Topography of Athens* (London, 1841), ii. 203–227; R. W. Macan, *Herodotus*, iv.–vi. (London, 1895), ii. 149–248; G. B. Grundy, *The Great Persian War* (London, 1901), pp. 145–194; J. A. Munro in *Journal of Hellenic Studies*, 1899, pp. 186–197. For the tumulus, Ἀρχαιολογικὸν Δελτίον 1891, pp. 67 sqq. See also Miltiades.

MARAZION, a small seaport in the St Ives parliamentary division of Cornwall, England, on the shore of Mount's Bay, 2 m. E. of Penzance, served by the Great Western railway. Pop. (1901), 1251. A causeway of boulders and pebbles, thrown up by the sea and passable at low tide, unites Marazion with the insular St Michael's Mount (*q.v.*). The church of St Hilary, destroyed by fire in 1853, had a very fine spire, which has been faithfully reproduced in the restored building. Unusual archaeological interest attaches to the churchyard. Its inscribed stones date from the 4th century, one being in honour of Constantine the Great. Another has Cornish lettering, which can no longer be deciphered; and there are British and Roman crosses. Market gardening and fishing are the main industries.

The charter attributed to Robert count of Mortain, granting lands and liberties to St Michael's Mount, opposite Marazion, included a market on Thursdays. This appears to have been held from the first on the mainland. From it is probably derived the Marghasbigan (*Parvum Forum*) of the earlier and the Marghasyewe or Marketjew (*Forum Jovis*) of the later charters. It may be added that a Jewish origin has been ascribed to the place from the name Marketjew. It is certain that Richard king of the Romans provided that the three fairs, on the two feasts of St Michael and at Mid-Lent, and the three markets which had hitherto been held by the priors of St Michael's Mount on land not their own at Marghasbighan, should in future be held on their own land at Marchadyou. He transferred in fact the fairs and markets from the demesne lands of the Bloyous in Marazion to those of the prior. To remedy the loss incurred by this measure Ralph Bloyou in 1331 procured for himself and his heirs a market on Mondays and a fair on the vigil, feast and morrow of St Andrew at Marghasyon. In Leland's time the market was held at Marhasdeythyow (*Forum Jovis*), and both Norden (1582) and Carew (1602) tell us that Marcajewe signifies the Thursday's market, which, whether etymologically sound or not, shows that the prior's market had prevailed over its rival. In 1595 Queen Elizabeth granted to Marazion a charter of incorporation. This ratified the grant of St Andrew's fair, provided for another on the Feast of St Barnabas and established a market on Saturdays. The corporation was to consist of a mayor, 8 aldermen and 12 capital burgesses. This corporation continued to administer the affairs of the borough until it was dissolved under the Municipal Corporations Act in 1835, when the property belonging to it was vested in charity commissioners. The chairman of the commissioners retains possession of the regalia. Of the fairs only the Michaelmas fair has survived and all the markets have gone. It is frequently stated that Marazion had formerly the right of returning two members to parliament, but that owing to its inability to pay the members' expenses the right was lost. Under the Commonwealth an attempt was made to secure or recover the right, and two members are said to have been returned, but they were not allowed to take their seats. Remains of an ancient bronze furnace, discovered near the town, tend to prove that tin-smelting was practised here at an early period. Marazion was once a flourishing town, and owed its prosperity to the throng of pilgrims who came to visit St Michael's Mount. During the first half of the 16th century it was twice plundered; first by the French, and later by the Cornish rebels. The rise and progress of the neighbouring borough of Penzance in the 17th century was the undoing of Marazion.

MARBLE (from Lat. *marmor*, Gr. μάρμαρος, shining stone), a term applied to any limestone or dolomite which is sufficiently close in texture to admit of being polished. Many other ornamental stones—such as serpentine, alabaster and even granite—are sometimes loosely designated marble, but by accurate writers the term is invariably restricted to those crystalline and compact varieties of carbonate of lime (occasionally with carbonate of magnesia) which, when polished, are applicable to purposes of decoration. The crystalline structure is typically shown in statuary marble. A fractured surface of this stone displays a multitude of sparkling facets, which are the rhombohedral cleavage-planes of the component grains. The beautiful lustre of polished statuary marble is due to the light penetrating for a short distance into the rock and then suffering reflection at the surfaces of the deeper-lying crystals. The durability of marble in a dry atmosphere or when protected from rain renders it a valuable building stone (*q.v.*); on the other hand, when exposed to the weather or the acid atmosphere of large cities, its surface readily crumbles.

Statuary and Economic Marbles.—Among statuary marbles the first place may be assigned to the famous Pentelic marble, the material in which Pheidias, Praxiteles, and other Greek sculptors executed their principal works. The characteristics of this stone are well seen in the Elgin marbles, which were removed from the Parthenon at Athens, and are now at the British Museum. The marble was derived from the quarries of Mount Pentelicus in Attica. Several large buildings have recently been constructed with this marble in London. The neighbouring mountain of Hymettus likewise yielded marbles, but these were neither so pure in colour nor so fine in texture as those of Pentelicus. Parian marble, another stone much used by Greek sculptors and architects, was quarried in the isle of Paros, chiefly at Mount Marpessa. It is called by ancient writers *lychnites* (from the Gr. λύχνος, a lamp) in allusion to the fact that the quarries were worked by the light of lamps. The Venus de' Medici is a notable example of work in this material. Carrara marble is better known than any of the Greek marbles, inasmuch as it constitutes the stone invariably employed by the best sculptors of the present day. This marble occurs abundantly in the Apuan Alps, an offshoot of the Apennines, and is largely worked in the neighbourhood of Carrara, Massa and Serravezza. Stone from this district was employed in Rome for architectural purposes in the time of Augustus, but the finer varieties, adapted to the needs of the sculptor, were not discovered until some time later. It is in Carrara marble that the finest works of Michelangelo and of Canova are executed. The purest varieties of this stone are of snow-white colour and of fine saccharoidal texture. Silica is disseminated through some of the marble, becoming a source of annoyance to the workman; while occasionally it separates as beautifully pellucid crystals of quartz known as "Carrara diamonds." The geological age of the marbles of the Apuan Alps has been a subject of much dispute, some geologists regarding them as metamorphosed Triassic, Liassic or Rhaetic rocks. Much of the common marble is of a bluish colour, and therefore unfit for statuary purposes; when streaked with blue and grey veins the stone is known as *bardiglio*. Curiously enough, the common white marble of Tuscany comes to England as Sicilian marble—a name probably due to its having been formerly re-shipped from some port in Sicily.

Although crystalline marbles fit for statuary work are not found to any extent in Great Britain, the limestones of the Palaeozoic formations yield a great variety of marbles well suited for architectural purposes. The Devonian rocks of south Devon are rich in handsome marbles, presenting great diversity of tint and pattern. Plymouth, Torquay, Ipplepen, Babbacombe and Chudleigh may be named as the principal localities. Many of these limestones owe their beauty to the fossil corals which they contain, and are hence known as "madrepore marbles."

Of far greater importance than the marbles of the Devonian system are those of Carboniferous age. It is from the Carboniferous or Mountain Limestone that British marbles are mainly derived. Marbles of this age are worked in Derbyshire and Yorkshire, in the neighbourhood of Bristol, in North Wales, in the Isle of Man, and in various parts of Ireland. One of the most beautiful of these stones is the "encrinital marble," a material which owes its peculiarities to the presence of numerous encrinites, or stone-lilies. These fossils, when cut in various directions, give a characteristic pattern to the stone. The joints of the stems and arms are known from their shape as "wheel-stones," and the rock itself has been called "entrochal marble." The most beautiful varieties are those in which the calcareous fossils appear as white markings on a ground of grey limestone. In Belgium a black marble with small sections of crinoid stems is known as *petit granit*, while in Derbyshire a similar rock, crowded with fragments of minute encrinites, is termed "bird's-eye marble."

Perhaps the most generally useful marbles yielded by the Carboniferous system are the black varieties, which are largely employed for chimney-pieces, vases, and other ornamental objects. The colour of most black limestone is due to the presence of bituminous matter. Such limestone commonly emits a fetid odour when struck; and the colour, being of organic origin, is discharged on calcination. Black marbles, more or less dense in colour, are quarried in various parts of Ireland, especially at Kilkenny and near Galway, but the finest kind is obtained from near Ashford in Derbyshire. From Ashford is also derived a very beautiful stone known as "rosewood marble." This is a dense brown laminated limestone, displaying when polished a handsome pattern somewhat resembling the grain of rosewood; it occurs in very limited quantity, and is used chiefly for inlaid work. The black marble of Frosterley, Yorkshire, is another Carboniferous example which owes its "figure" or pattern to the presence of large corals.

With the rosewood marble may be compared the well-known "landscape marble" or Cotham stone, an argillaceous limestone with peculiar dendritic markings, due probably to the infiltration of water containing oxide of manganese. This limestone occurs in irregular masses near the base of the White Lias, or uppermost division of the Rhaetic series. It is found principally in the neighbourhood of Bristol. The arborescent forms depicted in bluish-grey upon this landscape marble form a marked contrast to the angular markings of warm brown colour which are seen on slabs of "ruin marble" from Florence—a stone occasionally known also as landscape stone, or *pietra paesina*.

British limestones of Secondary and Tertiary age are not generally compact enough to be used as marbles, but some of the shelly beds are employed to a limited extent for decorative purposes. "Ammonite marble" is a dark brown limestone from the Lower Lias of Somersetshire, crowded with ammonites, principally *A. planicostata*. Under the name of Forest marble, geologists recognize a local division of the Lower Oolitic series, so named by W. Smith from Wychwood Forest in Oxfordshire, where shelly limestones occur; and these, though of little economic value, are capable of being used as rough marbles. But the most important marbles of the Secondary series are the shelly limestones of the Purbeck formation. Purbeck marble was a favourite material with medieval architects, who used it freely for slender clustered columns and for sepulchral monuments. It consists of a mass of the shells of a fresh-water snail, *Paludina carinifera*, embedded in a blue, grey or greenish limestone, and is found in the Upper Purbeck beds of Swanage in Dorsetshire. Excellent examples of its use may be seen in Westminster Abbey and in the Temple Church, as well as in the cathedrals of Salisbury, Winchester, Worcester and Lincoln. Sussex marble is a very similar stone, occurring in thin beds in the Weald clay, and consisting largely of the shells of *Paludina*, principally *P. sussexiensis* and *P. fluviorum*. The altar stones and the episcopal chair in Canterbury Cathedral are of this material.

Certain calcareous metamorphic rocks frequently form stones which are sufficiently beautiful to be used for ornamental purposes, and are generally classed as marbles. Such serpentinous limestones are included by petrologists under the term "ophicalcite." The famous *verde antico* is a rock of this character. Mona marble is an ophicalcite from the metamorphic series of the Isle of Anglesey, while the "Irish green" of architects is a similar rock from Connemara in western Galway. It is notable that some of the "white marble" of Connemara has been found by W. King and T. H. Rowney to consist almost wholly of malacolite, a silicate of calcium and magnesium.

A beautiful marble has been worked to a limited extent in the island of Tiree, one of the Hebrides, but the quarry appears to be now exhausted. This Tiree marble is a limestone having a delicate carnelian colour diffused through it in irregular patches, and containing rounded crystals of sahlite, a green augitic mineral resembling malacolite in composition.

Many marbles which are prized for the variegated patterns they display owe these patterns to their formation in concentric zones—such marbles being in fact stalagmitic deposits of carbonate of lime, sometimes consisting of aragonite. One of the most beautiful stalagmitic rocks is the so-called onyx marble of Algeria. This stone was largely used in the buildings of Carthage and Rome, but the quarries which yielded it were not known to modern sculptors until 1849, when it was rediscovered near Oued-Abdallah. The stone is a beautifully translucent material, delicately clouded with yellow and brown, and is greatly prized by French workmen. Large deposits of a very fine onyx-like marble, similar to the Algerian stone, have been worked at Técali, about 35 miles from the city of Mexico. Among other stalagmitic marbles, mention may be made of the well-known Gibraltar stone, which is often worked into models of cannon and other ornamental objects. This stalagmite is much deeper in colour and less translucent than the onyx marbles of Algeria and Mexico. A richly tinted stalagmitic stone worked in California is known as Californian marble. It is worth noting that the "alabaster" of the ancients was stalagmitic carbonate of lime, and that this stone is therefore called by mineralogists "Oriental alabaster" in order to distinguish it from our modern "alabaster," which is a sulphate, and not a carbonate, of lime. Gypsum capable of taking a polish is found at Fauld in Staffordshire and in Italy and Spain.

The brown and yellow colours which stalagmitic marbles usually present are due to the presence of oxide of iron. This colouring matter gives special characters to certain stones, such as the *giallo antico*, or antique yellow marble of the Italian antiquaries. Siena marble is a reddish mottled stone obtained from the neighbourhood of Siena in Tuscany; and a somewhat similar stone is found in King's County, Ireland. True red marble is by no means common, but it does occur, of bright and uniform colour, though in very small quantity, in the Carboniferous limestone of Derbyshire and north-east Staffordshire. The red marble called *rosso antico* is often confounded with the *porfiro rosso antico*, which is really a mica-hornblende porphyrite owing its red colour to the mineral withamite.

Fire marble is the name given to a brown shelly limestone containing ammonites and other fossil shells, which present a brilliant display of iridescent colours, like those of precious opal. It occurs in rocks of Liassic age at the lead-mines of Bleiberg in Carinthia, and is worked into snuff-boxes and other small objects. By mineralogists it is often termed *lumachella*, an Italian name which may, however, be appropriately applied to any marble which contains small shells.

The quarries of France, Belgium, Italy and Spain, not to mention less important localities, yield a great diversity of marbles, and almost each stone bears a distinctive name, often of trivial meaning; but in this article it is impossible to enumerate the local names used by marble-workers in different countries to distinguish the various stones which pass under their hands.

America possesses some valuable deposits of marble, which in the eastern States have been extensively worked. The crystalline limestones of western New England furnish an abundance of white and grey marble, while a beautiful material fit for statuary work has been quarried near Rutland in Vermont. A grey bird's-eye marble is obtained from central New York, and the greyish clouded limestones of Thomaston in Maine have been extensively quarried. Of the variegated and coloured marbles, perhaps the most beautiful are those from the northern part of Vermont, in the neighbourhood of Lake Champlain. A fine brecciated marble is found on the Maryland side of the Potomac, below Point of Rocks. Among the principal localities for black marble may be mentioned Shoreham in Vermont and Glen Falls in New York. In 1908 the American States producing marble were, in order of value, Vermont, Georgia, Tennessee, New York, Massachusetts, Alabama, Pennsylvania, Maryland, California, Colorado, Alaska, N. Carolina, Kentucky, New Mexico, Utah, Missouri and Idaho. In Canada the crystalline limestones of the pre-Cambrian series yield beautiful marbles.

In India we find important quarries at Makrana in Rajputana, —a locality which is said to have yielded the marble for the famous Taj Mahal at Agra. In the valley of the Nerbudda, near Jabalpur, there is a large development of marble. The white marble which is used for the delicately pierced screens called *jalee* work is obtained from near Raialo, in Ulwar. (F. W. R.*)

Petrography.—Marbles are uniformly crystalline, and hence have no bedding or schistosity which would tend to make them fissile, but are entirely massive and free from grain. The microstructure of pure marble is comparatively simple. In thin sections they are seen to be built up of somewhat rounded grains of calcite, fitting closely together in a mosaic; very rarely do any grains show traces of crystalline form. They are colourless and transparent, and are usually traversed by a lattice-work of sharply defined cleavage cracks, which correspond to the rhombohedral faces. In polarized light the colours are pinkish or greenish white, or in very thin sections iridescent because the mineral has a very strong double refraction. They may also be crossed by bars or stripes, each of which indicates a twin plate, for the crystals are usually polysynthetic. This twinning may be produced by pressure acting either during the crystallization of the rock or at a later period.

The purest marbles generally contain some accessory minerals, and in many of these rocks they form a considerable proportion of the whole mass. The commonest are quartz in small rounded grains, scales of colourless or pale yellow mica (muscovite and phlogopite), dark shining flakes of graphite and small crystals of pyrites or iron oxides. Even fine Carrara marble leaves a residue of this sort when dissolved in acid. Many marbles contain other minerals which are usually silicates of lime or magnesia. The list of these accessories is a very large one. Augite is very frequent and may be white (malacolite) or pale green (coccolite, sahlite, diopside); hornblende occurs as white bladed tremolite or pale green actinolite; feldspars may be present also, such as orthoclase, or more frequently some plagioclase such as albite, labradorite and anorthite; scapolite (or wernerite); various kinds of garnet; vesuvianite, spinel, forsterite, periclase, brucite, talc, zoisite and epidote, chondrodite, biotite, datolite, sphene and apatite may be mentioned as typical accessory minerals. The presence of metalliferous minerals such as galena, grey or red silver ores, zinc blende, antimonite, chalcopyrite, molybdenite, cassiterite, usually indicates impregnation by ore-bearing solutions, especially if these substances occur in workable quantities. The rubies of Burma are found in crystalline limestones and are constantly accompanied by precious spinel (or balas-ruby).

These minerals represent impurities in the original limestone which crystallized at the time that the marble became crystalline. The silicates derive their silica mainly from sand or infiltrated siliceous deposits; the alumina represents an admixture of clay; the iron came from limonite or hematite in the original state of the rock. Where the silicates bulk largely because the original limestone was highly impure, all the carbonic acid may be driven out and replaced by silica during the process of recrystallization. The rock is then a calc-silicate rock, hard, tough, flinty and no longer readily soluble in acids. They are sometimes fine-grained hornstones (known as calc-silicate hornfelses). Where white minerals predominate (wollastonite, tremolite, feldspar) these rocks may have a close resemblance to marbles, but often they are green from the abundance of green augites and amphiboles, or brown (when garnet and vesuvianite are present in quantity) or yellow (with epidote, chondrodite or sphene). Decomposition induces further changes in colour owing to the formation of green or yellow serpentine, pale green talc, red hematite, and brown limonite. Most of the coloured or variegated crystalline marbles have originated in this manner. Often bands of calc-silicate rock alternate with bands of marble, and they may be folded or bent; in other cases, nodules and patches of silicates occur in a matrix of pure marble. Earth movements may shatter the rocks, producing fissures afterwards filled with veins of calcite; in this way the beautiful brecciated or veined marbles are produced. Sometimes the broken fragments are rolled and rounded by the flow of the marble under pressure and pseudo-conglomerates or "crush conglomerates" result. In other cases the banding of the marble indicates the original bedding of the calcareous sediments. Crystalline limestones which contain much mica may be called cipollins; in them quartz, garnet and hornblende often also occur. The ophicalcites are marbles containing much serpentine, which has been formed by the decomposition of forsterite, olivine or augite. The much-discussed *Eozoon*, at one time supposed to be the earliest known fossil and found in Archaean limestones in Canada, is now known to be inorganic and to belong to the ophicalcites.

Many marbles, probably all of them, are metamorphosed limestones. The passage of limestones rich in fossils into true marbles as they approach great crystalline intrusions of granite is a phenomenon seen in many parts of the world; occasionally the recrystallization of the rock has not completely obliterated the organic structures (*e.g.* at Carrara and at Bergen in Norway). The agencies which have induced the metamorphism are heat and pressure, the heat arising from the granite and the pressure from overlying masses of rock, for these changes took place before the granite cooled and while it was still deeply buried beneath the surface. In 1806 Sir James Hall described a series of experiments proving this. He enclosed chalk in a gun-barrel securely plugged and heated it to a high temperature in a furnace. Carbonic acid was given off by the chalk and produced a great pressure in the interior of the tube. After slow cooling the mass was found to have become converted into granular crystalline marble. As rocks which have undergone changes of this kind are commonest in the oldest and deepest layers of the earth's crust, most marbles are Palaeozoic or pre-Cambrian. They occur very often with mica schists, phyllites, &c., which were beds of clay alternating with the original limestone. Formerly it was supposed that some of these marbles were crystalline sediments or even igneous rocks, but the tendency of modern geology is to assume that they were ordinary limestones, many of which may have been fossiliferous. In regions where the sedimentary rocks have been converted into schists, gneisses and granulites, the limestones are represented by calc schists, cipollins and marbles. Often no granite or other intrusive rock is present which may be regarded as the cause of the metamorphism. The marbles are often banded or schistose, and under the microscope show crushing and deformation of the component crystals, such as would have been produced by the earth pressures which accompany rock-folding. These crush structures have been obtained experimentally in marbles subjected to great pressures in steel cylinders. In the recrystallization of these limestones the direct heating action of igneous intrusions may have played no part, but the rise of temperature and increase of pressure due to the folding of great rock masses have probably been the operating causes. This type of metamorphism has been distinguished by the name *marmarosis* (Sir A. Geikie, *Text Book of Geology*, 1882).

For descriptions of ancient marbles see F. Corsi, *Delle pietre antiche* (Rome, 1845); M. W. Porter, *What Rome was built with* (Oxford, 1907), and for marbles in general consult E. Hull, *Building and Ornamental Stones* (1872); G. P. Merrill, *Stones for Building and Decoration* (3rd ed., 1905, New York). (J. S. F.)

MARBLEHEAD, a township of Essex county, Massachusetts, U.S.A., occupying a rocky promontory on Massachusetts Bay, about 16 m. N. of Boston. Pop. (1890), 8202; (1900), 7582; (1905), 7209; (1910), 7338. Area, about 4 sq. m. Marblehead is served by the Boston & Maine railroad, and by electric railways connecting with Salem, Lynn and Boston. It is a quaint old town, with a number of houses dating back to the 17th and 18th centuries. Among the older buildings are the Lee mansion (1768), St Michael's church (P. E., 1714), and the old town-hall (1727), sometimes called Marblehead's "Cradle of Liberty." Abbot Hall (1877), the municipal building, also contains the public library and several noteworthy paintings, including "The Spirit of '76" or "Yankee Doodle" by Archibald M. Willard. The post office and custom-house was completed in 1904. There are several parks (Crocker, Fort Sewall, Seaside, and Fountain), and an old burying-ground, in which many of the early settlers and a number of soldiers of the War of Independence (including General John Glover) are buried; and a granite monument near the railway station commemorates the taking of the British supply and powder ship "Hope" off Marblehead in 1776 by Captain James Mugford, who was killed during the fight. The commodious harbour, nearly landlocked, is formed by a rocky peninsula known as Marblehead Neck. On this are the club-houses of the Eastern and Corinthian Yacht clubs; and Marblehead is a popular yachting centre. The manufacture of children's shoes is the principal industry. Shipbuilding, once important, has been superseded by yacht and launch construction.

Marblehead, originally a part of Salem, known as Marble Harbor, was settled about 1629 by English emigrants (probably mostly from Lincolnshire and Devonshire); later (after about 1700) many emigrants from the Channel Islands settled here, and to them the dialectical peculiarities of Marblehead have often (perhaps mistakenly) been attributed. Marblehead was separately incorporated as a town in 1649. In the colonial period Marblehead was an important commercial port, and at one time was one of the most populous places in Massachusetts. After the passage of the Boston Port Bill (1774) it was made the port of entry instead of Boston, but its merchants refused to take advantage of this opportunity and patriotically invited the Boston merchants to use their wharves and warehouses. During the War of Independence many "state cruisers" (chartered at the Continental expense) set out from this port, the most famous being the "Lee," commanded by John Manley[1] (1733–93); in November 1775 this cruiser captured the "Nancy" with military stores valued at £20,541, which were taken to the American army at Cambridge. The "Lee" was manned by fifty men of the "amphibious regiment," which under General John Glover (1732–1797) rendered invaluable services to

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[1] See Robert E. Peabody, "Naval Career of Captain John Manley of Marblehead," in *Essex Institute Historical Collections* (Salem, Mass.) for January 1909.

Washington in conveying his troops across the East River after the battle of Long Island, and later in ferrying them across the Delaware before the battle of Trenton. Marblehead furnished more than 1000 men to the Continental army. During the war of 1812 the sea fight between the "Chesapeake" and the "Shannon" took place (June 1, 1813) off the adjacent coast. Marblehead was the scene of Benjamin (nicknamed "Flood") Ireson's ride, immortalized by J. G. Whittier.

See Samuel Roads, jun., *The History and Traditions of Marblehead* (Boston, 1880; 3rd ed., Marblehead, 1897).

MARBLES, a children's game of great antiquity, wide distribution, and uncertain origin, played with small spheres of stone, glass, baked clay or other material, from one-third of an inch to two inches in diameter. The game was once popular with all classes. Tradition, both at Oxford and Cambridge, attests that the game was formerly prohibited among undergraduates on the steps of the Bodleian or the Senate House. There is a similar tradition at Westminster School that the boys were forbidden to play marbles in Westminster Hall on account of the complaints made by members of parliament and lawyers. An anonymous poem of the 17th century speaks of a boy about to leave Eton as

> "A dunce at syntax, but a dab at taw."

Rogers, in *The Pleasures of Memory*, recalls how

> "On yon grey stone that fronts the chancel-door,
> Worn smooth by busy feet, now seen no more,
> Each eve we shot the marble through the ring."

Defoe (1720) writes of the seer Duncan Campbell: "Marbles, which he used to call children's playing at bowls, yielded him mighty diversion; and he was so dexterous an artist at shooting that little alabaster globe from between the end of his forefinger and the knuckle of his thumb, that he seldom missed hitting plumb, as the boys call it, the marble he aimed at, though at the distance of two or three yards." The *locus classicus* on marbles in the 19th century is in the trial in *Pickwick*, where Serjeant Buzfuz pathetically says of Master Bardell that "his 'alley tors' and his 'commoneys' are alike neglected; he forgets the long familiar cry of 'knuckle down,' and at tip-cheese, or odd and even, his hand is out." Many similar passages might be adduced to prove the former popularity of marbles with the young of all classes. In some rural parts of Sussex Good Friday was known as "marble-day" till late in the 19th century, since on that day both old and young, including many who would never have thought of playing marbles at other times, took part in the game. There was some traditional reason for regarding marbles as a Lenten sport—perhaps, as the Rev. W. D. Parish suggests, "to keep people from more boisterous and mischievous enjoyments."

The origin of the game is concealed in the mists of antiquity. Marbles used by Egyptian and Roman children before the Christian era are to be seen in the British Museum. Probably some of the small stone spheres found among neolithic remains, which Evans (*Ancient Stone Implements*, 2nd ed., p. 420) admits to be too small for projectiles, are prehistoric marbles. It is commonly assumed that the game which the youthful Augustus, like other Roman children, played with nuts was a form of marbles, and that the Latin phrase of *relinquere nuces*, in the sense of putting away childish things, referred to this game. Strutt believed that nuts of the roundest sort were the original "marbles." The earliest unmistakable reference to marbles in literature seems to be in a French poem of the 12th century, quoted by Littré *s.v. Bille.*

The marbles with which various games are nowadays played are small spheres of stone, glass or baked clay. In the 18th century they were mostly made from chips of marble (whence the name) or other stone, which were ground into a roughly spherical shape by attrition in a special iron mill. Nuremberg was then the centre of the trade in marbles, though some were made in Derbyshire, and indeed wherever there was a stone-mason's yard to afford raw material. The "alley taw," as its name indicates, was made of alabaster. In the first decade of the 20th century English marbles were all imported from central Germany, and the alleys, or most valuable marbles, used for shooting, were mostly made of coloured glass, sold retail from ten a penny to a penny each. Coloured stone marbles and so-called china marbles—really of baked clay—were sold at prices varying from forty to a hundred a penny, though even the cheapest of these were painted by hand with concentric rings. The well-made and highly valued alleys of earlier times were no longer procurable, owing to the decline in popularity of the sport. In the United States, however, much more expensive and accurately rounded marbles were still manufactured, the latest being of hollow steel.

There has never been any recognized authority on the game of marbles, and it is probable that, in the past as in the present, every parish and school and set of boys made its own rules. There are, however, three or four distinct games which are traditional, and may be found, with trifling variations, wherever the game is played. Strutt, writing at the end of the 18th century, describes these as follows: (1) "Taw, wherein a number of boys put each of them one or two marbles in a ring and shoot at them alternately with other marbles, and he who obtains the most of them by beating them out of the ring is the conqueror." The marbles placed in the ring—whence the game is often known as "ring-taw"—are usually of the cheaper kind known as "commoneys," "stoneys" or "potteys," and the marble with which the player shoots is a more valuable one, known as an "alley," or "alley taw," sometimes spelt "tor," as by Dickens. Usually it is necessary that the alley should emerge from the ring as well as drive out another marble; under other rules the ring is smaller, not more than a foot in diameter, and the player must be skilful enough to leave his alley inside it, whilst driving the object marble outside. (2) "Nine holes: which consists in bowling of marbles at a wooden bridge with nine arches." Each arch bears a number, and the owner of the bridge pays that number of marbles to the player who shoots through it, making his profit from the missing marbles, which he confiscates; or the game may simply be played so many up—usually 100. (3) "There is also another game of marbles where four, five or six holes, and sometimes more, are made in the ground at a distance from each other; and the business of every one of the players is to bowl a marble by a regular succession into all the holes, which he who completes in the fewest bowls obtains the victory." This primitive form of golf is played by Zulu adults with great enthusiasm, and is still popular among the car-drivers of Belfast. (4) "Boss out, or boss and span, also called hit and span, wherein one bowls a marble to any distance that he pleases, which serves as a mark for his antagonist to bowl at, whose business it is to hit the marble first bowled, or lay his own near enough to it for him to span the space between them and touch both marbles; in either case he wins, if not, his marble remains where it lay and becomes a mark for the first player, and so alternately until the game be won." In rural parts of England this was known as a "going-to-school game," because it helped the players along the road.

Mr F. W. Hackwood states that, in the middle of the 19th century, taverns in the Black Country had regular marble alleys, consisting of a cement bed 20 ft. long by 12 ft. wide and 18 in. from the ground with a raised wooden rim to prevent the marbles from running off. Players knelt down to shoot, and had to "knuckle down" fairly—*i.e.* to place the knuckle of the shooting hand on the ground, so that the flip of the thumb was not aided by a jerk of the wrist. The game was usually ring-taw. But marbles is now obsolete in England as a game for adults (*Old English Sports*, London, 1907).

A writer in *Notes and Queries* (IX. ii. 314) thus describes the marbles used by English boys in the middle of the 19th century: "In ring-taw the player put only commoneys in the ring, and shot with the taws, which included stoneys, alleys and blood-alleys. Commoneys were unglazed; potteys glazed in the kiln. Stoneys were made from common pebbles such as were used for road-mending; alleys and blood-alleys out of marble. The blood-alleys were highly prized, and were called by this name because of the spots or streaks of red in them. In Derbyshire, where large numbers were made, they had relative values. The stoney was worth three commoneys or two potteys. An alley was worth six commoneys or four potteys. Blood-alleys were worth more, according to the depth and arrangement of colour—from twelve to fifty commoneys and stoneys in proportion." "A taw with a history was prized above rubies," another correspondent observes (IX. ii. 76). "All the best-made marbles were taws, and no commoneys or potteys were used for shooting with, either in ring-taw or the various hole-games." In Belfast, 1854–1858, the marble season extended from Easter to June, when the ground was usually dry and hard. The marbles were stoneys, of composition painted; crockeries, of slightly glazed stone-ware, dark brown and yellow; clayeys, of red brick clay baked in the fire; marbles, of white marble; china alleys, with white glaze and painted rings; and glass marbles. The two chief games were ring-taw and hole and taw; in the latter three holes were made in a line, 6 ft. to 12 ft. apart, and the player had to go three times up and down according to somewhat elaborate rules (*Notes and Queries*, IX. iii. 65). The stoneys and crockeries were sold at twenty a penny; the clayeys were cheaper and were not used as stakes; the marbles proper and china alleys, used as taws for shooting, cost a halfpenny and a farthing respectively. In other parts of the country the phraseology of marbles affords some interesting problems for the philologist. We hear of "alleys, barios, poppos and stoneys"; of "marididdles," home-made marbles of rolled and baked clay; in Scotland of "bools, whinnies, glassies, jauries"; of "Dutch alleys," and so forth. "Dubs, trebs and fobs," stand for twos, threes and fours. To be "mucked" is to lose all one's "mivvies" or marbles. When the taw stayed in the ring it was a "chuck." "Phobbo slips" was a phrase used to forbid the correction of an error.

The fullest account of the various games of marbles played by English children is to be found in Mrs Gomme's *Traditional Games of England, Scotland and Ireland* (London, 1898), under the headings Boss-out, Bridgeboard, Bun-hole, Cob, Ho-go, Holy Bang, Hundreds, Lag, Long-Tawl, Marbles, Nine-Holes, Ring-taw, Three-Holes. Other games are known as Plum-pudding, or Picking the Plums, in which one shoots at marbles in a row; Pyramids, in which the marbles are arranged in a pyramid; Bounce About, Bounce Eye, Conqueror, Die Shot, Fortifications, Handers, Increase Pound, Knock Out, Rising Taw, Spanners, Tip-shears; Strutt's *Sports and Pastimes*, ed. J. C. Cox (London, 1902). Much information will also be found in *Notes and Queries, passim*—especially the 9th series. For marbles in France see Larousse, *s.v. Billes*. See also SOLITAIRE. (W. E. G. F.)

MARBOT, JEAN BAPTISTE ANTOINE MARCELIN, BARON DE (1782–1854), French soldier, son of General Jean Antoine de Marbot (1754–1800), who died in the defence of Genoa under Masséna, was born at La Rivière (Corrèze), on the 18th of August 1782. He joined the republican army as a volunteer in 1799, rose rapidly to commissioned rank, and was aide-de-camp to Marshal Augereau, commanding the VII. corps, in the war against Prussia and Russia in 1806–7. After this he served with great distinction in the Peninsular War under Lannes and Masséna, and showed himself to be a dashing leader of light cavalry in the Russian War of 1812 and the German campaign of the following year. After a slow recovery from the wounds he had received at Leipzig and Hanau, he was promoted general of brigade by Napoleon during the Hundred Days, and took part in, and was wounded at, the battle of Waterloo. He was exiled at the second restoration and only returned to France in 1819, after which, however, his intimacy with the duke of Orleans secured him important military positions. After the July restoration he was made *maréchal-de-camp*, and in this rank he was present at the siege of Antwerp in 1832. He was promoted lieutenant-general in 1836. From 1835 to 1840 he served in various Algerian expeditions, and in 1845 he was made a member of the Chamber of Peers. Three years later, at the fall of Louis Philippe, he retired into private life. He died at Paris on the 16th of November 1854. Marbot wrote two pamphlets, *Remarques critiques sur l'ouvrage de M. le général Roguet, intitulé Considérations sur l'art de la guerre* (1820), and *La Nécessité d'augmenter les forces militaires de la France* (1825), but his fame rests chiefly, if not indeed wholly, on the fascinating *Memoirs of his Life and Campaigns* which were published in Paris in 1891 (Eng. trans., 1902). To ordinary readers and to students of history alike these give a picture of the Napoleonic age of warfare which for vividness and romantic interest has never been surpassed.

His elder brother, ANTOINE ADOLPHE MARCELIN DE MARBOT (1781–1844), was born at La Rivière, on the 22nd of March 1781, entered the army at an early age, obtained commissioned rank in the revolutionary wars and became aide-de-camp to Bernadotte. In 1802 he was arrested on the ground of being concerned in a plot of the Republicans against the Consulate, but he was released, though Napoleon continued to regard him as an opponent of the established régime. After a term of duty with the army in Santo Domingo he participated in the campaigns of 1806–7, and from 1808 to 1811 he was employed in the Peninsular War. In the Russian War of 1812 he was wounded and made prisoner. At the end of two years of captivity he returned to France at the general peace, was aide-de-camp to Marshal Davout during the Hundred Days, and thereafter passed into retirement, from which he did not emerge till 1830. He attained the rank of *maréchal-de-camp* under Louis Philippe, and died at Bra, near Tulle, on the 2nd of June 1844.

MARBURG, a town of Austria, in Styria, 41 m. S. of Graz by rail. Pop. (1900), 24,501. It is very picturesquely situated on the left bank of the river Drave, on a plain called the Pettauer-Feld, at the base of the well-wooded Bachergebirge. To the north of the town the train passes through the Leitersberg tunnel (725 yds. long), opened in 1846, while the Drave, which has here a width of 200 yds., is spanned by a magnificent iron bridge, built in 1845. The principal buildings are the cathedral, dating from the 16th century, the tower of which, erected in 1623, is 136 ft. high, and the old castle. Its situation in the midst of a fertile vine and fruit-growing district, connected by the navigable Drave with Hungary, and by railway with Vienna, Trieste, Tirol and Carinthia, makes it the centre of a considerable traffic in wine and grain. Its industrial products are leather, boots and shoes, iron and tin wares, liqueurs and sparkling wine, and it also contains the extensive workshops of the South Austrian railway. Marburg is the seat of the bishop of Lavant, and is the native town of the famous Austrian admiral, Baron Wilhelm of Tegetthoff (1827–1871). Near Marburg is the village of Mariarast, the church of which is a popular place of pilgrimage.

MARBURG, an ancient university town of Germany, in the Prussian province of Hesse-Nassau, situated on the slope of a hill on the right bank of the Lahn, 60 m. by rail N. of Frankfort-on-Main, on the main line to Cassel. Pop. (1905), 20,137. On the opposite bank of the river, here spanned by two bridges, lie the suburb of Weidenhausen and the railway station of the Prussian state railway. The hill on which the town lies is crowned by the extensive old Schloss, a fine Gothic building, the most noteworthy parts of which are the Rittersaal, dating from 1277–1312, and the beautiful little chapel. This Schloss was formerly the residence of the landgraves of Hesse, served afterwards as a prison, and is now the repository of the historically interesting and valuable archives of Hesse. The chief architectural ornament of Marburg is, however, the Elisabethenkirche, a veritable gem of the purest Early Gothic style, erected by the grand master of the Teutonic Order in 1235–1283, to contain the tomb of St Elizabeth of Hungary. The remains of the saint were deposited in a rich silver-gilt sarcophagus, which may still be seen, and were afterwards visited by myriads of pilgrims, until the Protestant zeal of Landgrave Philip the Generous caused him to remove the body to some unknown spot in the church. The church also contains the tombs of numerous Hessian landgraves and knights of the Teutonic Order. The Lutheran church is another good Gothic edifice, dating mainly from the 15th century. The town-hall, built in 1512, and several fine houses in the Renaissance style, also deserve mention. The university of Marburg, founded by Philip the Magnanimous in 1527, was the first university established without papal privileges, and speedily acquired a great reputation throughout Protestant Europe. It has a library of 140,000 volumes, is admirably equipped with medical and other institutes, which form some of the finest modern buildings in the town, and was attended, in 1905, by 1576 students. Marburg also possesses a gymnasium, a "Realschule," an agricultural school, a society of naturalists, a hospital, and an extensive lunatic asylum. It is the seat of a district court, and of superintendents of the Lutheran and Reformed Churches. Marburg pottery is renowned; and leather, iron wares and surgical instruments are also manufactured there. The environs are very picturesque.

Marburg is first historically mentioned in a document of the beginning of the 13th century, and received its municipal charter from the landgrave Louis of Thuringia in 1227. On his death it became the residence of his wife, Elizabeth of Hungary, who built a hospital there, and died in 1231, at the age of twenty-four, worn out with works of religion and charity. She was canonized in 1235 at the instance of the Teutonic Knights, who had settled in Marburg in 1233 and were zealous in promoting her cult. By 1247 Marburg had already become the second town of Hesse, and in the 15th and 16th centuries it alternated with Cassel as the seat of the landgraves. In 1529 the famous conference between Luther and Zwingli on the subject of Transubstantiation took place there in the Rittersaal of the Schloss (see MARBURG, COLLOQUY OF). During the Thirty Years' and Seven Years' Wars Marburg suffered considerably from sieges and famine. In 1806, and again in 1810, it was the centre of an abortive rising against the French, in consequence of which the fortifications of the castle were destroyed.

See Kolbe, *Marburg im Mittelalter* (Marb., 1879); Bücking, *Mittheilungen aus Marburgs Vorzeit* (Marb., 1886); Schoof, *Marburg die Perle des Hessenlandes* (2nd ed., 1903).

MARBURG, COLLOQUY OF (*Marburger Religionsgespräch*), the name given to a conference of divines held in 1529 in the interests of the unity of Protestant Germany. The circumstances in which it was held, the influence of the men who conducted its deliberations, and the result of its proceedings, combine to render it of no small importance for the history of the Reformation in Germany.

After the Imperial Diet of Spires in 1526 had decreed that all states of the empire should observe the Edict of Worms (1521), banning Luther and his adherents, in such a manner that they should not be afraid to answer it before God and the emperor, the reform movement had received such an access of strength that the Catholic party felt itself menaced in earnest, and in 1529 again passed a resolution at Spires, deigned not merely to preclude any further expansion of the Reformation, but even to prevent it from maintaining the ground already won. This decision was at once challenged, on the 19th of April, by the protest of the Evangelical states (whence the name Protestants); and the effect of this disclaimer was not small. Still, it was devoid of political significance, unless backed by the united force of all the princes and states subscribing to the Evangelical teaching; and this unity was wanting. The feud which raged round the doctrine of the Lord's Supper had already broken out before the first diet of Spires, and had aroused great and immediate excitement. At a very early period, however, efforts were made to allay the dissension. Strassburg pronounced for conciliation: but the most powerful and zealous champion of peace was to be found in the landgrave Philip of Hesse, who recognized the absolute necessity—from a political standpoint—of the union of all German Protestants. It is probable that he had invited Luther to a religious conference as early as the year 1527; but on that occasion he met with a refusal. True, the impression conveyed by the attitude of the Catholic party at the second Diet of Spires had served to awaken the feeling for solidarity among the Evangelicals there assembled; and on the 22nd of April they had even secured the basis for a provisional alliance in the shape of a formula drawn up by Bucer and dealing with the Lord's Supper. But it was obvious that a permanent coalition could not be expected unless some definite understanding on the debated point could be attained; and on the very same day the landgrave despatched to Zwingli an invitation to a colloquy, and received his prompt acquiescence. Melanchthon, who in the tension which prevailed at the synod had shown himself inclined to negotiation, became suspicious on his return, and endeavoured to influence the elector of Saxony and Luther in accordance with his views. The landgrave, however, was so far successful that the beginning of October (1529) saw the colloquy opened in the castle at Marburg. With Zwingli, who had arrived on the 27th of September, he had several interviews of considerable political importance before the Wittenberg divines made their appearance. These interviews settled the preliminaries of an alliance; but they rested on the assumption that the theological feud between Wittenberg and Zürich could be removed, or its violence at least abated.

The proceedings opened on the 1st of October with conferences between Luther and Oecolampadius, and Melanchthon and Zwingli: then on the two following days the discussion proper—confined almost entirely to Luther and Zwingli—was held before the landgrave and his guest Duke Ulrich of Württemberg, in the presence of more than fifty persons. As regards the main point of contention, *i.e.* the doctrine of the Lord's Supper, no agreement was found practicable; and the private conversations on the 4th of October, which formed the sequel of the debate, carried matters no farther. "You have another spirit," said Luther. Since the landgrave, however, was reluctant to see the colloquy brought to an absolutely fruitless close, he requested Luther to draw up a list of the most important points of doctrine on which it might yet be possible to arrive at some degree of unanimity. This was done on the 4th of October; and a few alterations were introduced to meet the wishes of the Swiss deputies. The *Articles of Marburg*, which thus came into being, contain the doctrine of the Trinity, of the personality of Christ, of faith and justification, of the Scriptures, of baptism, of good works, of confession, of government, of tradition, and of infant baptism. The fifteenth article, treating of the Lord's Supper, defines the ground common to both parties even in this debateable region, recognizing the necessity of participation in both kinds, and rejecting the sacrifice of the Mass. It then proceeds to fix the point of difference in the fact that no agreement had been reached on the question "whether the true body and blood of Christ are corporeally present in the bread and wine" ("Nit vergleicht haben wir uns, ob der war leib und plut Christi leiblich im brot und wein sey"). Nevertheless, the adherents of each doctrine are recommended to display Christian charity to those of the other. These articles were signed by the ten official members of the colloquy: Luther, Jonas, Melanchthon, Osiander, Agricola, Brenz, Oecolampadius, Bucer, Hedio and Zwingli. The personal contact between Luther and Zwingli led to no mental *rapprochement* between the two; but in the following year the Articles of Marburg did good service as one of the preliminaries to the Augsburg Confession, and remain a valuable document for the fundamental principles common to the Lutheran and Reformed Churches.

See T. Kolde, *s.v.* "Marburger Religionsgespräch," in *Realencyklopädie f. protestant. Theologie*, 3rd ed. xii. 248 seq. (C. M.)

MARCA, PIERRE DE (1594–1662), French prelate and historian, was born at Gan, near Pau, on the 24th of January 1594. His family was known among judicial circles in the 16th century, and maintained the Roman Catholic faith after the official introduction of the Reformed religion into Navarre. After having studied law at the university of Toulouse he practised successfully at Pau. But he was ambitious, and turned to a larger sphere. He ardently called for the armed intervention of King Louis XIII. in Béarn, and on this occasion published his first writing, *Discours d'un Béarnais, très fidèle sujet du roi, sur l'édit du rétablissement de l'exercice de la religion catholique dans tout le Béarn* (1618). After the easy campaign of 1620, the possessions which had been taken by the Protestants were given back to the Roman Catholic church; this task was performed, under his supervision, with judgment and moderation. During the siege of La Rochelle he performed a mission which brought him in touch with Richelieu, who shortly afterwards nominated him *intendant de justice* in Béarn (1631), and in 1639 summoned him to Paris with the title of counsellor of state. The following year, the question of the intervention of kings in the election of bishops having been raised in a pamphlet by Charles Hersent (*Optatus Gallus de cavendo schismate*, 1640), Marca defended what were then called the liberties of the Gallican Church, in his celebrated treatise *De concordia sacerdotii et imperii, seu de libertatibus ecclesiae gallicanae* (1641). He was soon rewarded for this service. Although he had not yet taken even the minor holy orders, he was nominated bishop of Couserans by the king on the 28th of December 1641, but the pope refused to give his sanction. It was only after Marca had formally denied those propositions contained in *De concordia* which were displeasing to Rome that he was proclaimed in the consistory (Jan. 13, 1648). During this time, and until 1651, he was governor of the province of Catalonia, then occupied by the French. After the Treaty of the Pyrenees, he was sent to direct the conference which had been formed to fix the limits of Roussillon, which had just been ceded to France (1660). Marca now interested himself in the fortunes of Mazarin, and remained faithful to him even during the

Fronde. As a recompense, he was nominated archbishop of Toulouse (May 28, 1652), but had to wait for the bulls of investiture till the 23rd of March 1654. It was difficult for him to please both pope and king. In the struggle against the Jansenists he used all the influence he had with the clergy to secure the passage of the apostolic constitution of the 31st of March 1653 (*Relation de ce qui s'est fait depuis 1653 dans les assemblées des évêques au sujet des cinq propositions*, 1657); but in the rebellion raised by Retz, archbishop of Paris, against the king, he took the part of the king against the pope. Michel Le Tellier having ordered him to refute a thesis of the college of Clermont on the infallibility of the pope, Marca wrote a treatise which was most Gallican in its ideas, but refused to publish it for fear of drawing down "the indignation of Rome." These tactics were successful, and when Retz, weary of a struggle without definite results, resigned the archbishopric, Marca became his successor (Feb. 26, 1662). He did not derive much profit from this new favour, as he died on the 29th of June following, without his nomination having been sanctioned by the pope.

Marca, clever and covetous, was also an historian of note. When very young he showed his interest in the past history of his native land, and in 1617, at the age of twenty-three, he had set to work looking through archives, copying charters, and corresponding with the principal men of learning of his time, the brothers Dupuy, André Duchesne and Jean Besly, whom he visited in Poitou. His *Histoire de Béarn* was published at Paris in 1640. It was not so well received as his *De concordia*, but is more appreciated by posterity. If Marca's criticism is too often undecided, both in the ancient epochs, where he supports the text by a certain amount of guesswork and in certain points where he touches on religion, yet he always gives the text correctly. A number of chapters end with an interesting collection of charters. It is to be regretted that this incomplete work does not go beyond 1300. During his long stay in Catalonia he made preparations for a geographical and historical description of this province, which was bound to France by so many political and literary associations. Baluze, who became his secretary in 1656, helped him with the work and finished it, adding clever appendices and publishing the whole in 1688 under the title *Marca hispanica*.

Marca married Marguerite de Forgues on the 4th of June 1618, and had one son and three daughters. His son, Galactoire, who was president of the parlement of Navarre, died on the 10th of February 1689.

Marca's biography was written in Latin by two of his intimate friends, Étienne Baluze, his secretary (*Epistola ad Samuelem Sorbierium, de vita, gestis et scriptis Petri de Marca*, Paris, 1663), and his cousin, Paul de Faget (at the beginning of a collection of Marca's theological pamphlets, first published by Paul de Faget in 1668). This contained four treatises on the Eucharist, the sacrifice of the Mass, the erection of the patriarchate of Constantinople (in Latin), and the sacrament of the Eucharist (in French). It was supposed to contain heretical propositions and caused a good deal of scandal, inciting Baluze against Faget, both of whom abused the other, to defend the memory of the prelate.

See Bayle's article in the *Dictionnaire historique et critique* (*s.v.* "Marca"), and the Vie de Marca in the *Histoire de Béarn* (vol. i., 1894) of V. Dubarat.

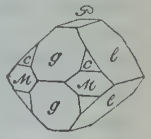
MARCANTONIO [MARCANTONIO RAIMONDI], the chief Italian master of the art of engraving in the age of the Renaissance, and the first who practised it in order to reproduce, not designs of his own invention, as earlier craftsmen had commonly done, but those of other artists almost exclusively. The date of his birth is uncertain, nor is there any good authority for assigning it, as is commonly done, approximately to the year 1488. He was probably born some years at least earlier than this, inasmuch as he is mentioned by a contemporary writer, Achillini, as being an artist of repute in 1504. His earliest dated plate, illustrating the story of Pyramus and Thisbe, belongs to the following year, 1505. Marcantonio received his training in the workshop of the famous goldsmith and painter of Bologna, Francesco Raibolini, usually called Francia. "Having more aptitude in design," says Vasari, "than his master, and managing the graver with facility and grace, he made waist-buckles and many other things in niello, such being then greatly in fashion, and made them most beautifully, as being in truth most excellent in that craft." The real fame, however, of Marcantonio was destined to be founded on his attainments, not in the goldsmith's art generally, but in that particular development of it which consists of engraving designs on metal plates for the purpose of reproduction by the printing press. This art was not new in Italy in the days of Marcantonio's apprenticeship. It had been practised, in a more or less elementary form, for not less than forty or fifty years in the workshops alike of Venetia, the Emilia, Tuscany and Lombardy. But the technical aim of the Italian engravers had not hitherto been directed, like that of Schongauer or Dürer north of the Alps, towards securing such freedom and precision in the use of the burin as should impart to the impressions taken from their engraved plates both a striking decorative effect and a power of suggesting to the eye a complex variety of natural objects and surfaces in light and shade. The Italian masters had been satisfied with much more rudimentary effects. The Florentine primitives had been content either with very simple cloudy patches of cross-hatching in fine straight lines, or with broad open shadings in the manner of a bold pen-drawing. Mantegna and Pollaiuolo, the two chief original masters who practised the art, had used the latter method with great power but at the same time great simplicity.

By the beginning of the 16th century a desire for a more complicated kind of effects was already arising among the followers of the art in Italy. Both backgrounds and passages of foreground detail were often imitated, inartificially enough, from the works of the northern masters. Marcantonio himself was among the foremost in this movement. About eighty engravings can be referred to the first five or six years of his career (1505–1511). Their subjects are very various, including many of pagan mythology, and some of obscure allegory, along with those of Christian devotion. The types of figures and drapery, and the general character of the compositions, bespeak for the most part the inspiration, and sometimes the direct authorship, of Francia. But the influence of German example is very perceptible also, particularly in the landscape backgrounds, and in the endeavour to express form by means of light and shadow with greater freedom than had been hitherto the practice of the southern schools. In a few subjects also the figures themselves correspond to a coarse Teutonic, instead of to the refined Italian, ideal. But so far we find Marcantonio only indirectly leaning on the north for the sake of self-improvement. It must have been for the sake of commercial profit that he by-and-by produced a series of direct counterfeits on copper from Albert Dürer's woodcuts. These facsimiles are sixty-nine in number, including seventeen of Dürer's "Life of the Virgin," thirty-seven of his "Little Passion," on wood, and a number of single pieces. According to Vasari, Dürer's indignation over those counterfeits was the cause of his journey to Venice, where he is said to have lodged a complaint against Marcantonio, and induced the Senate to prohibit the counterfeiting of his monogram, at any rate, upon any future imitations of the kind. Vasari's account must certainly be mistaken, inasmuch as Dürer's journey to Venice took place in 1506, and neither of the two series of woodcuts imitated by Marcantonio was published until 1511. The greater part of the designs for the "Life of the Virgin" had, it is true, been made and engraved seven years earlier than the date of their publication; and it is to be remarked that, whereas Marcantonio's copies of the "Little Passion" leave out the monogram of Dürer, it is inserted in his copies of the "Life of the Virgin"; whence it would, after all, seem possible that he had seen and counterfeited a set of impressions of this series at the time when they were originally executed, and before their publication. But the real nature of the transaction, if transaction there was, which took place between Dürer and Marcantonio we cannot now hope to recover. Enough that the Bolognese engraver evidently profited, both in money and in education of the hand, by his work in imitating in a finer material the energetic characters of these northern woodcuts. He was soon to come under a totally different influence, and to turn the experience he had gained to account in interpreting the work of a master of a quite other stamp. Up till the year 1510 Marcantonio had lived entirely at Bologna, with the exception, it would appear, of a visit or visits to Venice. (A few of his early engravings are from drawings of the school of Giorgione.) Very soon afterwards he was attracted, for good and all, into the circle which surrounded Raphael at Rome. Where or when he had first made Raphael's acquaintance is uncertain. His passage to Rome by way of Florence has been supposed to be marked by an engraving, dated 1510, and known as "The Climbers," *Les Grimpeurs* (Bartsch, 487), in which he has reproduced a portion of the design of Michelangelo's cartoon of the Soldiers surprised bathing, and has added behind the figures a landscape imitated from the then young Dutch engraver Lucas of Leiden. Contemporary or somewhat earlier than this is a large engraving done by him from a design by Baldassare Peruzzi, a Sienese artist drawn about the same time into the Raphael circle. The piece in which he is recorded to have first tried his hand after Raphael himself is the Lucretia (Bartsch 192). From that time until he disappears in the catastrophe of 1527, Marcantonio was almost exclusively engaged in reproducing by means of engraving the designs of Raphael or of his immediate pupils. Raphael, the story goes, was so delighted with the print of the Lucretia that he personally trained and helped Marcantonio afterwards. A printing establishment was set up under the charge of Raphael's colour-grinder, Il Baviera, and the profits, in the early stage of the business, were shared between the engraver and the printer. The sale soon became very great; pupils gathered round about Marcantonio, of whom the two most distinguished were Marco Dente, known as Marco da Ravenna, and Agostino de' Musi, known as Agostino Veneziano; and he and they, during the last ten years of Raphael's life, and for several years following his death, gave forth a great profusion of engravings after the master's work—not copying, in most instances, his finished paintings, but working up, with the addition of simple backgrounds and accessories, his first sketches and trials, which often give the composition in a different form from the finished work, and are all the more interesting on that account.

The best of these engravings produced in the workshop of Marcantonio—those, namely, done by his own hand, and especially those done during the first few years after he had attached himself to Raphael—count among the most prized and coveted examples of the art. In them he enters into the genius of his master, and loses little of the chastened science and rhythmical purity of Raphael's contours, or of the inspired and winning sentiment of his faces; while in the parts where he is left to himself—the rounding and shading, the background and landscape—he manages his burin with all the skill and freedom which he had gained by the imitation of northern models, but puts away the northern emphasis and redundance of detail. His work, however, does not long remain at the height marked by pieces like the Lucretia, the Dido, the Judgment of Paris, the Poetry, the Philosophy, or the first Massacre of the Innocents. Marcantonio's engravings after the works of Raphael's later years are cold, ostentatious, and soulless by comparison. Still more so, as is natural, were those which he and his pupils produced after the designs of the degenerate scholars of Raphael and Michelangelo, of a Giulio Romano, a Polidoro, or a Bandinelli. Marcantonio's association with Giulio Romano was the cause of his first great disaster in life. He engraved a series of obscene designs by that painter in illustration of the *Sonnetti lussuriosi* of Pietro Aretino, and thereby incurred the anger of pope Clement VII., at whose order he was thrown into prison. Marcantonio's ruin was completed by the calamities attendant on the sack of Rome in 1527. He had to pay a heavy ransom in order to escape from the hands of the Spaniards, and fled from Rome, in the words of Vasari, "all but a beggar." It is said that he took refuge in his native city, Bologna; but he never again emerges from obscurity, and all we know with certainty is that in 1534 he was dead. (S. C.)

MARCASITE, a mineral with the same chemical composition as pyrites, being iron disulphide FeS_2, but crystallizing in the orthorhombic instead of in the cubic system. The name is of Arabic origin and was long applied to crystallized pyrites (*q.v.*); it was restricted to the present species by W. Haidinger in 1845. The mineral was known to G. Agricola in 1546 under the names *Wasserkies* or *Weisserkies* and *Leberkies*, and it has been variously known as white pyrites, hepatic pyrites, lamellar pyrites, radiated pyrites (German *Strahlkies*) and prismatic pyrites. The orthorhombic form of the crystals, as distinct from the cubic form of pyrites, was recognized by Romé de l'Isle in 1772, though later R. J. Haüy considered the crystals to be only distorted cubic forms.

The crystals are isomorphous with mispickel (*q.v.*), but only rarely are they distinctly developed and simple (fig.). Usually they are twinned on a prism plane, *M*, producing pentagonal stellate groups of five crystals; twinning on the plain *g*, in which the crystals intercross at angles of nearly 60°, is less common. This frequent twinning gives rise to characteristic forms, with many re-entrant angles, to which the names "spear pyrites" and "cockscomb pyrites" are applied. The commonest state of aggregation is that of radially arranged fibres, the external surface of the mass being globular, nodular or stalactitic in form.



Apart from crystalline form, the external characters of marcasite are very similar to those of pyrites, and when distinct crystals are not available the two species cannot always be easily distinguished. The colour is usually pale bronze-yellow, often rather lighter than that of pyrites; on freshly fractured surfaces of pure marcasite the colour is tin-white, but this rapidly tarnishes on exposure to air. The lustre is metallic and brilliant. The streak is greyish or brownish-black. The hardness (6–6½) is the same as that of pyrites, and the specific gravity (4·8–4·9) as a rule rather less. Arsenical varieties of marcasite, containing up to 5% of arsenic, are known as lonchidite and kyrosite.

Marcasite readily oxidizes on exposure to moist air, with the production of sulphuric acid and a white fibrous efflorescence of ferrous sulphate, and in course of time specimens in collections often became completely disintegrated. In nature it is frequently altered to limonite with the separation of native sulphur. Marcasite is thus the less stable of the two modifications of iron disulphide. Many experiments have been made with a view to determining the difference in chemical constitution of marcasite and pyrites, but with no very definite results. It is a noteworthy fact that whilst pyrites has been prepared artificially, marcasite has not.

Marcasite occurs under the same conditions as pyrites, but is much less common. Whilst pyrites is found abundantly in the older crystalline rocks and slates, marcasite is more abundant in clays, and has often been formed as a concretion around organic remains. It is abundant, for example, in the plastic clay of the Brown Coal formation at Littmitz, near Carlsbad, in Bohemia, at which place it has been extensively mined for the manufacture of sulphur and ferrous sulphate. In the Chalk of the south-east of England nodules of marcasite with a fibrous radiated structure are abundant, and in the Chalk Marl between Dover and Folkestone fine twinned groups of "spear pyrites" are common. The mineral is also met with in metalliferous veins, though much less frequently than pyrites; for example the "cockscomb pyrites" of the lead mines of Derbyshire and Cumberland. (L. J. S.)

MARCEAU-DESGRAVIERS, FRANÇOIS SÉVERIN (1769–1796), French general, was born at Chartres on the 1st of March 1769. His father was a law officer, and he was educated for a legal career, but at the age of sixteen he enlisted in the regiment of Savoy-Carignan. Whilst on furlough in Paris Marceau joined in the attack on the Bastille (July 14, 1789); after that event he took his discharge from the regular army and returned to Chartres, but the embarrassments of his family soon compelled him to seek fresh military employment. He became drill instructor, and afterwards captain in the departmental (Eure-et-Loire) regiment of the National Guard. Early in March 1792 he was elected lieutenant-colonel of one of the battalions of the Eure-et-Loire; he took part in the defence of Verdun in 1792, and it fell to his lot to bear the proposals of capitulation to the Prussian camp. The spiritless conduct of the defenders excited the wrath of the revolutionary authorities, and Marceau was fortunate in escaping arrest and finding re-employment as a captain in the regular service. Early in 1793 he became with other officers "suspect," and was for some time imprisoned. On his release he hurried to take part in the defence of Saumur against the Vendéan royalists, and distinguished himself at the combat of Saumur (June 10, 1793) by gallantly rescuing the representative Bourbotte from the hands of the insurgents. The Convention voted him the thanks of the country, and thenceforward his rise was rapid. His conduct at Chantonnay (Sept. 5) won him the provisional rank of general of brigade. On the 17th of October he bore a great part in the victory of Cholet, and on the field of this battle began his friendship with Kléber. For the victory of Cholet Kléber was made general of division and Marceau confirmed as general of brigade. Their advice was of the greatest value to the generals in command, and the military talents of each were the complement of the other's. Marceau, who became general of division (Nov. 10), succeeded to the chief command *ad interim*, and with his friend won important victories near Le Mans (Dec. 12–13) and Savenay (Dec. 23). After the battle of Le Mans, Marceau rescued and protected a young Royalist lady, Angélique des Mesliers. It is often supposed that he was in love with his prisoner; but the help even of the commander-in-chief did not avail to save her from the guillotine (Jan. 22, 1794). Marceau had already retired from the war, exhausted by the fatigues of the campaign, and he and Kléber were saved from arrest and execution only by the intervention of Bourbotte. Marceau became affianced about this time to Agathe Leprêtre de Châteaugiron, but his constant military employment, his broken health, and the opposition of the comte de Châteaugiron on the one hand and of Marceau's devoted half-sister "Emira," wife of the Republican politician Sergent, on the other, prevented the realization of his hopes. After spending the winter of 1793–1794 in Paris he took a command in the army under Jourdan, in which Kléber also served. He took part in the various battles about Charleroi, and at the final victory of Fleurus (June 26, 1794) he had a horse shot under him. He distinguished himself again at Jülich and at Aldenhoven, and stormed the lines of Coblenz on the 23rd of October. With the Army of the Sambre and Meuse he took his share in the campaign of 1795 on the Rhine and the Lahn, distinguishing himself particularly with Kléber in the fighting about Neuwied on the 18th and 19th of October, and at Sulzbach on the 17th of December. In the campaign of 1796 the famous invasion of Germany by the armies of Jourdan and Moreau ended in disaster, and Marceau's men covered Jourdan's retreat over the Rhine. He fought the desperate actions on the Lahn (Sept. 16 and 18), and at Altenkirchen on the 19th received a mortal wound, of which he died on the 21st, at the early age of twenty-seven. The Austrians vied with his own countrymen in doing honour to the dead general. His body was burned, and his ashes, which at the time were placed under a pyramid designed by Kléber, were transferred in 1889 to the Pantheon at Paris.

See Maze, *Le Général Marceau* (1889); Parfait, *Le Général Marceau* (1892); and T. C. Johnson, *Marceau* (London, 1896).

MARCEL, ÉTIENNE (d. 1358), provost of the merchants of Paris under King John II., belonged by birth to the wealthy Parisian *bourgeoisie*, being the son of a clothier named Simon Marcel and of Isabelle Barbou. He is mentioned as provost of the Grande-Confrérie of Notre Dame in 1350, and in 1354 he succeeded Jean de Pacy as provost of the Parisian merchants. His political career began in 1356, when John was made prisoner after the battle of Poitiers. In conjunction with Robert le Coq, bishop of Laon, he played a leading part in the states-general called together by the dauphin Charles on the 17th of October. A committee of eighty members, constituted on their initiative, pressed their demands with such insistence that the dauphin prorogued the states-general; but financial straits obliged him to summon them once more on the 3rd of February 1357, and the promulgation of a great edict of reform was the consequence. John the Good forbade its being put into effect, whereupon a conflict began between Marcel and the dauphin, Marcel endeavouring to set up Charles the Bad, king of Navarre, in opposition to him. The states-general assembled again on the 13th of January 1358, and on the 22nd of February the populace of Paris, led by Marcel, invaded the palace and murdered the marshals of Champagne and Normandy before the prince's eyes. Thenceforward Marcel was in open hostility to the throne. After vainly hoping that the insurrection of the Jacquerie might turn to his advantage, he next supported the king of Navarre, whose armed bands infested the neighbourhood of Paris. On the night of the 31st of July Marcel was about to open the gates of the capital to them, but Jean Maillart prevented the execution of this design, and killed him before the Porte Saint-Antoine. During the following days his adherents were likewise put to death, and the dauphin was enabled to re-enter Paris. Étienne Marcel married first Jeanne de Dammartin, and secondly Marguerite des Essars, who survived him.

See F. T. Perrens, *Étienne Marcel et le gouvernement de la bourgeoisie au xiv^{e} siècle* (Paris, 1860); P. Frémaux, *La Famille d'Étienne Marcel*, in the *Mémoires* of the *Société de l'histoire de Paris et de l'Île de France* (1903), vol. xxx.; and Hon. R. D. Denman, *Étienne Marcel* (1898). (J. V.*)

MARCELLINUS, ST, according to the Liberian catalogue, became bishop of Rome on the 30th of June, 296; his predecessor was Caius or Gaius. He is not mentioned in the *Martyrologium hieronymianum*, or in the *Depositio episcoporum*, or in the *Depositio martyrum*. The *Liber pontificalis*, basing itself on the Acts of St Marcellinus, the text of which is lost, relates that during Diocletian's persecution Marcellinus was called upon to sacrifice, and offered incense to idols, but that, repenting shortly afterwards, he confessed the faith of Christ and suffered martyrdom with several companions. Other documents speak of his defection, and it is probably this lapse that explains the silence of the ancient liturgical calendars. In the beginning of the 5th century Petilianus, the Donatist bishop of Constantine, affirmed that Marcellinus and his priests had given up the holy books to the pagans during the persecution and offered incense to false gods. St Augustine contents himself with denying the affair (*Contra litt. Petiliani*, ii. 202; *De unico baptismo*, 27). The records of the pseudo-council of Sinuessa, which were fabricated at the beginning of the 6th century, state that Marcellinus after his fall presented himself before a council, which refused to try him on the ground that *prima sedes a nemine iudicatur*. According to the *Liber pontificalis*, Marcellinus was buried, on the 26th of April 304, in the cemetery of Priscilla, on the Via Salaria, 25 days after his martyrdom; the Liberian catalogue gives as the date the 25th of October. The fact of the martyrdom, too, is not established with certainty. After a considerable interregnum he was succeeded by Marcellus, with whom he has sometimes been confounded.

See L. Duchesne, *Liber pontificalis*, I. lxxiii.–lxxiv. 162–163, and II. 563. (H. De.)

MARCELLO, BENEDETTO (1686–1739), Italian musical composer, was born in 1686, either on the 31st of July or on the 1st of August. He was of noble family (in his compositions he is frequently described as "Patrizio Veneto"), and although a pupil of Lotti and Gasparini, was intended by his father to devote himself to the law. In 1711 he was a member of the Council of Forty, and in 1730 went to Pola as Provveditore. His health having been impaired by the climate of Istria, he retired after eight years to Brescia in the capacity of Camerlengo, and died there on the 24th of July 1739.

Marcello is best remembered by his *Estro poetico-armonico* (Venice, 1724–1727), a musical setting for voices and strings of the first fifty Psalms, as paraphrased in Italian by G. Giustiniani. They were much admired by Charles Avison, who with John Garth brought out an edition with English words (London, 1757). Some extracts are to be found in Hawkins's *History of Music*. His other works are chiefly cantatas, either for one voice or several; the library of the Brussels conservatoire possesses some interesting volumes of chamber-cantatas composed for his mistress. Although he produced an opera, *La Fede riconosciuta*, at Vicenza in 1702, he had little sympathy with this form of composition, and vented his opinions on the state of musical drama at the time in the satirical pamphlet *Il Teatro alla moda*, published anonymously in Venice in 1720. This little work, which was frequently reprinted, is not only extremely amusing, but is also most valuable as a contribution to the history of opera.

A catalogue of his works is given in *Monatshefte für Musikgeschichte*, vol. xxiii. (1891).

MARCELLUS, the name of two popes.

MARCELLUS I. succeeded Marcellinus, after a considerable interval, most probably in May 308, under Maxentius. He was banished from Rome in 309 on account of the tumult caused by the severity of the penances he had imposed on Christians who had lapsed under the recent persecution. He died the same year, being succeeded by Eusebius. He is commemorated on the 16th of January.

MARCELLUS II. (Marcello Cervini), the successor of Julius III., was born on the 6th of May 1501, and was elected pope on the 9th of April 1555. He had long been identified with the rigorist party in the church, and as president of the Council of Trent had incurred the anger of the emperor by his jealous defence of papal prerogative. His motives were lofty, his life blameless, his plans for reform nobly conceived. But death removed him (April 30, 1555) before he could do more than give an earnest of his intentions. He was followed by Paul IV.

Contemporary lives are to be found in Panvinio, continuator of Platina, *De vitis pontiff. rom.*; and Ciaconius, *Vitae et res gestae summorum pontiff. rom.* (Rome, 1601–1602). P. Polidoro, *De gestis, vita et moribus Marcelli II.* (Rome, 1744), makes use of an unpublished biography of the pope by his brother, Alessandro Cervini. See also Brilli, *Intorno alla vita e alle azioni di Marcello II.* (Montepulciano, 1846); Ranke, *Popes* (Eng. trans., Austin), i. 284 seq.; A. von Reumont, *Gesch. der Stadt Rom*), iii. 2, 512, seq. (T. F. C.)

MARCELLUS, a Roman plebeian family belonging to the Claudian gens. Its most distinguished members were the following:—

1. MARCUS CLAUDIUS MARCELLUS (*c.* 268–208 B.C.), one of the Roman generals during the Second Punic War and conqueror of Syracuse. He first served against Hamilcar in Sicily. In his first consulship (222) he was engaged, with Cn. Cornelius Scipio as colleague, in war against the Insubrian Gauls, and won the *spolia opima* for the third and last time in Roman history by slaying their chief Viridomarus or Virdumarus (Polybius ii. 34; Propertius v. 10, 39). In 216, after the defeat at Cannae, he took command of the remnant of the army at Canusium, and although he was unable to prevent Capua going over to Hannibal, he saved Nola and southern Campania. In 214 he was in Sicily as consul at the time of the revolt of Syracuse; he stormed Leontini and besieged Syracuse, but the skill of Archimedes repelled his attacks. After a two years' siege he gradually forced his way into the city and took it in the face of strong Punic reinforcements. He spared the lives of the inhabitants, but carried off their art treasures to Rome, the first instance of a practice afterwards common. Consul again in 210, he took Salapia in Apulia, which had revolted to Hannibal, by help of the Roman party there, and put to death the Numidian garrison. Proconsul in 209, he attacked Hannibal near Venusia, and after a desperate battle retired to that town; he was accused of bad generalship, and had to leave the army to defend himself in Rome. In his last consulship (208), he and his colleague, while reconnoitring near Venusia, were unexpectedly attacked, and Marcellus was killed. His successes have been exaggerated by Livy, but the name often given to him, the "sword of Rome," was well deserved.

Livy xxiii. 14–17, 41–46; xxiv. 27–32, 35–39; xxv. 5–7, 23–31; xxvi. 26, 29–32; xxvii. 1–5, 21–28; Polybius viii. 5–9, x. 32; Appian, *Hannib.* 50; Florus ii. 6.

2. M. CLAUDIUS MARCELLUS, an inveterate opponent of Julius Caesar. During his consulship (51 B.C.) he proposed to remove Caesar from his army in March 49, but this decision was delayed by Pompey's irresolution and the skilful opposition of the tribune C. Curio (see CAESAR, JULIUS). In January 49 he tried to put off declaring war against Caesar till an army could be got ready, but his advice was not taken. When Pompey left Italy, Marcus and his brother Gaius followed, while his cousin withdrew to Liternum. After Pharsalus M. Marcellus retired to Mytilene, where he practised rhetoric and studied philosophy. In 46 his cousin and the senate successfully appealed to Caesar to pardon him, and Marcellus reluctantly consented to return. On this occasion Cicero's[1] speech *Pro Marcello* was delivered. Marcellus left for Italy, but was murdered in May by one of his own attendants, P. Magius Chilo, in the Peiraeus. Marcellus was a thorough aristocrat. He was an eloquent speaker (Cicero, *Brutus*, 71), and a man of firm character, although not free from avarice.

See Cicero, *Ad fam.* iv. 4, 7, 10, and *Ad Att.* v. 11 (ed. Tyrrell and Purser); Caesar, *B. C.* i. 2; Suetonius, *Caesar*, 29; G. Boissier, *Cicero and his Friends* (Eng. trans., 1897).

3. M. CLAUDIUS MARCELLUS (*c.* 43–23 B.C.), son of C. Marcellus and Octavia, sister of Augustus. In 25 he was adopted by the emperor and married to his daughter Julia. This seemed to mark him out as the heir to the throne, but Augustus, when attacked by a serious illness, gave his signet to M. Vipsanius Agrippa. In 23 Marcellus, then curule aedile, died at Baiae. Livia was suspected of having poisoned him to get the empire for her son Tiberius. Great hopes had been built on the youth, and he was celebrated by many writers, especially by Virgil in a famous passage (*Aeneid*, vi. 860). He was buried in the Campus Martius, and Augustus himself pronounced the funeral oration. The Theatrum Marcelli (remains of which can still be seen) was afterwards dedicated in his honour.

Horace, *Odes*, i. 12; Propertius iii. 18; Dio Cassius liii. 28, 30; Tacitus, *Annals*, ii. 41; Suetonius, *Augustus*, 63; Vell. Pat. ii. 93.

MARCESCENT (Lat. *marcescens*, withering), a botanical term for withering without falling off.

MARCH, EARLS OF, title derived from the "marches" or boundaries (1) between England and Wales, and (2) England and Scotland, and held severally by great feudal families possessed of lands in those border districts. The earls of March on the Welsh borders were descended from Roger de Mortemer (so called from his castle of Mortemer in Normandy), who was connected by marriage with the dukes of Normandy. His son Ralph (d. *c.* 1104) figures in Domesday as the holder of vast estates in Shropshire, Herefordshire and other parts of England, especially in the west; and his grandson Hugh de Mortimer, founder of the priory of Wigmore in Herefordshire, was one of the most powerful of the barons reduced to submission by Henry II., who compelled him to surrender his castles of Cleobury and Wigmore. The Mortimers, however, continued to exercise almost undisputed sway, as lords of Wigmore, over the western counties and the Welsh marches.

I. *Welsh Marches.*—ROGER DE MORTIMER (*c.* 1286–1330), 8th baron of Wigmore and 1st earl of March, being an infant at the death of his father, Edmund, was placed by Edward I. under the guardianship of Piers Gaveston, and was knighted by Edward in 1306; Mortimer's mother being a relative of Edward's consort, Eleanor of Castile. Through his marriage with Joan de Joinville, or Genevill, Roger not only acquired increased possessions on the Welsh marches, including the important castle of Ludlow, which became the chief stronghold of the Mortimers, but also extensive estates and influence in Ireland, whither he went in 1308 to enforce his authority. This brought him into conflict with the De Lacys, who turned for support to Edward Bruce, brother of Robert Bruce, king of Scotland. Mortimer was appointed lord-lieutenant of Ireland by Edward II. in 1316, and at the head of a large army drove Bruce to Carrickfergus, and the De Lacys into Connaught, wreaking vengeance on their adherents whenever they were to be found. He was then occupied for some years with baronial disputes on the Welsh border until about 1318, when he began to interest himself in the growing opposition to Edward II. and his favourites, the Despensers; and he supported Humphrey de Bohun, earl of Hereford, in refusing to obey the king's summons to appear before him in 1321. Forced to surrender to the king at Shrewsbury in January 1322, Mortimer was consigned to the Tower of London, whence he escaped to France in August 1324. In the following year Isabella, wife of Edward II., anxious to escape from her husband, obtained his consent to her going to France to use her influence with her brother, Charles IV., in favour of peace. At the French court the queen found Roger Mortimer; she became his mistress soon afterwards, and at his instigation refused to return to England so long as the Despensers retained power as the king's favourites. The scandal of Isabella's relations with Mortimer compelled them both to withdraw from the French court to Flanders, where they obtained assistance for an invasion of England. Landing in England in September 1326, they were joined by Henry, earl of Lancaster; London rose in support of the queen; and Edward took flight to the west, whither he was pursued by Mortimer and Isabella. After wandering helplessly for some weeks in Wales, the king was taken on the 16th of November, and was compelled to abdicate in favour of his son. But though the latter was crowned as Edward III. in January 1327, the country was ruled by Mortimer and Isabella, who procured the murder of Edward II. in the following September. Rich estates and offices of profit and power were now heaped on Mortimer, and in September 1328 he was created earl of March. Greedy and grasping, he was no more competent than the Despensers to conduct the government of the country. The jealousy and anger of Lancaster having been excited by March's arrogance, Lancaster prevailed upon the young king, Edward III., to throw off the yoke of his mother's paramour. At a parliament held at Nottingham in October 1330 a plot was successfully carried out by which March was arrested in the castle, and, in spite of Isabella's entreaty to her son to "have pity on the gentle Mortimer," was conveyed to the Tower. Accused of assuming royal power and of various other high misdemeanours, he was condemned without trial and hanged at Tyburn on the 29th of November 1330, his vast estates being forfeited to the crown. March's wife, by whom he had four sons and eleven daughters, survived till 1356. The daughters all married into powerful families, chiefly of Marcher houses. His eldest son, Edmund, was father of Roger Mortimer (*c.* 1328–1360), who was knighted by Edward III. in 1346, and restored to his grandfather's title as 2nd earl of March.

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[1] The authorship of this speech has been disputed.

EDMUND DE MORTIMER (1351–1381), 3rd earl of March, was son of Roger, 2nd earl of March, by his wife Philippa, daughter of William Montacute, 1st earl of Salisbury. Being an infant at the death of his father, Edmund, as a ward of the crown, was placed by Edward III. under the care of William of Wykeham and Richard Fitzalan, earl of Arundel. The position of the young earl, powerful on account of his possessions and hereditary influence in the Welsh marches, was rendered still more important by his marriage in 1368 to Philippa, only daughter of Lionel, duke of Clarence, third son of Edward III. Lionel's wife was Elizabeth, daughter and heiress of William de Burgh, 6th Lord of Connaught and 3rd earl of Ulster, and Lionel had himself been created earl of Ulster before his marriage. The earl of March, therefore, not only became the representative of one of the chief Anglo-Norman lordships in Ireland in right of his wife Philippa, but the latter, on the death of her father shortly after her marriage, stood next in succession to the crown after the Black Prince and his sickly son Richard, afterwards king Richard II. This marriage had, therefore, far-reaching consequences in the history of England, giving rise to the claim of the house of York to the crown of England, contested in the War of the Roses; Edward IV. being descended from the third son of Edward III. as great-great-grandson of Philippa, countess of March, and in the male line from Edmund, duke of York, fifth son of Edward III.

Mortimer, now styled earl of March and Ulster, became marshal of England in 1369, and was employed in various diplomatic missions during the next following years. He was a member of the committee appointed by the Peers to confer with the Commons in 1373—the first instance of such a joint conference since the institution of representative parliaments—on the question of granting supplies for John of Gaunt's war in France; and in the opposition to Edward III. and the court party, which grew in strength towards the end of the reign, March took the popular side, being prominent in the Good Parliament of 1376 among the lords who, encouraged by the Prince of Wales, concerted an attack upon the court party led by John of Gaunt. The Speaker of the Commons in this parliament was March's steward, Peter de la Mare; he firmly withstood John of Gaunt in stating the grievances of the Commons, in supporting the impeachment of several high court officials, and in procuring the banishment of the king's mistress, Alice Perrers. March was a member of the administrative council appointed by the same parliament after the death of the Black Prince to attend the king and advise him in all public affairs. On the accession of Richard II., a minor, in 1377, the earl became a member of the standing council of government; though as father of the heir-presumptive to the crown he wisely abstained from claiming any actually administrative office. The most powerful person in the realm was, however, John of Gaunt, duke of Lancaster, whose jealousy of March led to the acceptance by the latter of the lieutenancy of Ireland in 1379. March succeeded in asserting his authority in eastern Ulster, but failed to subdue the O'Neills farther west. Proceeding to Munster to put down the turbulency of the chieftains of the south, March died at Cork on the 27th of December 1381. He was buried in Wigmore Abbey, of which he had been a benefactor, and where his wife Philippa who died about the same time was also interred. The earl had two sons and two daughters, the elder of whom, Elizabeth, married Henry Percy (Hotspur), son of the earl of Northumberland. His eldest son Roger succeeded him as 4th earl of March and Ulster. His second son Edmund (1376–1409) played an important part in conjunction with his brother-in-law Hotspur against Owen Glendower; but afterwards joined the latter, whose daughter he married about 1402.

ROGER DE MORTIMER, 4th earl of March and Ulster (1374–1398), son of the 3rd earl, succeeded to the titles and estates of his family when a child of seven, and a month afterwards he was appointed lord-lieutenant of Ireland, his uncle Sir Thomas Mortimer acting as his deputy. Being a ward of the Crown, his guardian was the earl of Kent, half-brother to Richard II.; and in 1388 he married Kent's daughter, Eleanor. The importance which he owed to his hereditary influence and possessions, and especially to his descent from Edward III., was immensely increased when Richard II. publicly acknowledged him as heir-presumptive to the crown in 1385. In 1394 he accompanied Richard to Ireland, but notwithstanding a commission from the king as lieutenant of the districts over which he exercised nominal authority by hereditary right, he made little headway against the native Irish chieftains. March enjoyed great popularity in England though he took no active part in opposing the despotic measures of the king; in Ireland he illegally assumed the native Irish costume. In August 1398 he was killed in fight with an Irish clan, and was buried in Wigmore Abbey. March's daughter Anne married Richard earl of Cambridge, son of Edmund duke of York, fifth son of Edward III.; their son Richard, duke of York, was father of King Edward IV., who thus derived his title to the crown and acquired the estates of the house of Mortimer.

EDMUND DE MORTIMER (1391–1425), 5th earl of March and Ulster, son of the 4th earl, succeeded to his father's claim to the crown as well as to his title and estates on the death of the latter in Ireland in 1398. In the following year Richard II. was deposed and the crown seized by Henry of Lancaster. The young earl of March and his brother Roger were then kept in custody by Henry IV., who, however, treated them honourably, until March 1405, when they were carried off from Windsor Castle by the opponents of the Lancastrian dynasty, of whom their uncle Sir Edmund Mortimer (see above) and his brother-in-law Henry Percy (Hotspur) were leaders in league with Owen Glendower. The boys were recaptured, and in 1409 were committed to the care of the prince of Wales. On the accession of the latter as Henry V., in 1413, the earl of March was set at liberty and restored to his estates, his brother Roger having died some years previously; and he continued to enjoy the favour of the king in spite of a conspiracy in 1415 to place him on the throne, in which his brother-in-law, the earl of Cambridge, played the leading part. March accompanied Henry V. throughout his wars in France, and on the king's death in 1422 became a member of the council of regency. He died in Ireland in 1425, and as he left no issue the earldom of March in the house of Mortimer became extinct, the estates passing to the last earl's nephew Richard, who in 1435 was officially styled duke of York, earl of March and Ulster, and baron of Wigmore. Richard's son Edward having ascended the throne in 1461 as Edward IV., the earldom of March became merged in the crown.

See Thomas Rymer, *Foedera*, &c. (London, 1704–1732); T. F. Tout, *The Political History of England*, vol. iii., ed. by William Hunt and R. L. Poole (London, 1905); Sir William Dugdale, *Monasticon anglicanum* (3 vols., London, 1655–1673); William Stubbs, *Constitutional History of England*, vol. ii.

II. *Scottish Marches.*—The Scottish earls of March were descended from Crinan, whose son Maldred married Algitha, daughter of Ughtred, earl of Northumberland, by Elgiva, daughter of the Saxon king Æthelred. Maldred's son Cospatrick, or Gospatrick, was made earl of Northumberland by William the Conqueror; but being soon afterwards deprived of this position he fled to Scotland, where Malcolm Canmore, king of Scotland, welcomed him and granted him Dunbar and the adjoining lands. Two generations of Cospatricks followed in lineal succession, bearing the title of earl, but without territorial designation. Cospatrick II. witnessed the charter of Alexander I. founding the abbey of Scone in 1115. The 3rd earl, also named Cospatrick, a liberal benefactor of Melrose Abbey, died in 1166, leaving two sons, the younger of whom was the ancestor of the earls of Home. The elder son, Waltheof, was the first of the family to be styled "Comes de Dunbar," about the year 1174. His importance is proved by the fact that he was one of the hostages for the performance of the Treaty of Falaise for the liberation of William the Lion in 1175. Waltheof's son Patrick Dunbar (the name Dunbar, derived from the family estates, now becoming an hereditary surname), styled 5th earl of Dunbar, although his father had been the first to adopt the territorial designation, was keeper of Berwick Castle, and married Ada, natural daughter of William the Lion. His grandson Patrick, 7th earl, headed the party that liberated King Alexander III. in 1255 from the Comyns, and in the same year was nominated guardian of the king and queen by the Treaty of Roxburgh. He signed the Treaty of Perth (July 6, 1266) by which Magnus VI. of Norway ceded the Isle of Man and the Hebrides to Scotland. His wife was Christian, daughter of Robert Bruce, the competitor for the crown of Scotland.

Patrick Dunbar, 8th earl of Dunbar and 1st earl of March, claimed the crown of Scotland in 1291 as descendant of Ada, daughter of William the Lion. He was one of the "seven earls of Scotland," a distinct body separate from the other estates of the realm, who claimed the right to elect a king in cases of disputed succession, and whose authority was, perhaps, to be traced to the seven provinces of the Pictish kingdom. He was the first of the earls of Dunbar to appear in the records as "comes de Marchia," or earl of March. Like most of his family in later times, he was favourable to the English interest in Scottish affairs, and he did homage to Edward I. of England. His wife Marjory, daughter of Alexander Comyn, earl of Buchan, took the other side and held the castle of Dunbar for Baliol, but was forced to surrender it to Edward in 1296. In 1298 he was appointed the English king's lieutenant in Scotland.

Patrick Dunbar (1285–1369), 9th earl of Dunbar and 2nd earl of March, son of the preceding, gave refuge to Edward II. of England after Bannockburn, and contrived his escape by sea to England. Later, he made peace with Robert Bruce, and by him was appointed governor of Berwick Castle, which he held against Edward III. until the defeat of the Scots at Halidon Hill (July 19, 1333) made it no longer tenable. His countess, known in Scottish history and romance as "Black Agnes," daughter of Thomas Randolph, earl of Moray (Murray), and grandniece of Robert Bruce, is famous for her defence of Dunbar Castle against the English under the earl of Salisbury in 1338, Salisbury being forced to abandon the attempt after a fierce siege lasting nineteen weeks. This lady succeeded to the estates and titles of her brother, John Randolph, 3rd earl of Moray. The earldom of Moray passed after her death to her second son, John Dunbar, who married Marjory, daughter of King Robert II. Black Agnes also bore to the earl of March two daughters, the elder of whom, Agnes, after being the mistress of King David II., married Sir James Douglas, lord of Dalkeith, from whom were descended the first three earls of Morton; the younger, Elizabeth, married John Maitland of Lethington, ancestor of the duke of Lauderdale, whose second title was marquess of March.

George Dunbar (d. 1420), 10th earl of Dunbar and 3rd earl of March, great-nephew of the 8th earl and warden of the marches, accompanied Douglas in his foray into England in 1388, and commanded the Scots after Otterburn. He afterwards quarrelled with the Douglases, because his daughter was passed over in favour of a daughter of Archibald, "the Grim Earl of Douglas," as wife for David, duke of Rothesay, son of Robert III. When Douglas seized March's lands the latter fled to England, where he was welcomed by Henry IV., to whom he was related. He fought on the English side at Homildon Hill; and, having revealed to Henry the defection of the Percies, who were in league with Douglas and Owen Glendower, he fought against those allies at the battle of Shrewsbury (July 23, 1403). Becoming reconciled with Douglas, he returned to Scotland in 1409, and was restored to his earldom by the regent Albany. He died in 1420.

George Dunbar, 11th earl of Dunbar and 4th earl of March, was one of the negotiators for the release of James I. of Scotland in 1423 from his captivity in England, and was knighted at that king's coronation. In 1434, however, on the ground that the regent had had no power to reverse his father's forfeiture for treason, March was imprisoned and his castle of Dunbar seized by the king; and the parliament at Perth declared his lands and titles forfeited to the crown. The earl, being released, retired to England with his son Patrick, whose daughter and heiress Margaret was ancestress of Patrick, 5th earl of Dumfries, now represented by the marquess of Bute.

The earldom of March in the house of Dunbar having thus been forfeited to the crown, James II. in 1455 conferred the title, together with that of warden of the marches, on his second son Alexander, duke of Albany; but this prince entered into treasonable correspondence with Edward IV. of England, and in 1487 the earldom of March and the barony and castle of Dunbar were again declared forfeited and annexed to the crown of Scotland.

The title of earl of March was next held by the house of Lennox. In 1576 the earldom of Lennox became extinct on the death without male issue of Charles (father of Lady Arabella Stuart), 5th earl of Lennox; and it was then revived in favour of Robert Stuart, a grand-uncle of King James VI., second son of John, 3rd earl of Lennox. But in 1579 Esmé Stuart, a member of a collateral branch which in 1508 had inherited the lordship of Aubigny in France, came to Scotland and obtained much favour with James VI. The earldom of Lennox (soon afterwards raised to a dukedom) was taken from Robert and conferred upon Esmé; and Robert was compensated by being created earl of March and baron of Dunbar (1582). Robert died without legitimate issue in 1586, when the earldom of March again reverted to the crown. In 1619 Esmé, 3rd duke of Lennox, was created earl of March; and his son James was created duke of Richmond in 1641. On the death without issue of Charles, 6th duke of Lennox and 3rd duke of Richmond, in 1672, his titles devolved upon King Charles II. as nearest collateral heir-male. In 1675 Charles conferred the titles of duke of Richmond and Lennox and earl of March on Charles Lennox, his natural son by Louise de Kerouaille, duchess of Portsmouth, from whom the earldom of March has descended to its present holder the duke of Richmond and Gordon. (See RICHMOND, EARLS AND DUKES OF; and LENNOX.)

The title of earl of March in the peerage of Scotland, by another creation, was conferred in 1697 on William Douglas, second son of William, 1st duke of Queensberry. His grandson William, 3rd earl of March, became 4th duke of Queensberry on the death without surviving male issue of his cousin Charles, 3rd duke of Queensberry, in 1778. Dying unmarried in 1810, the several titles of the duke passed to different branches of the house of Douglas. The earldom of March is stated by Sir Bernard Burke and other authorities to have devolved upon Francis, 8th earl of Wemyss, great-great-grandson of David, 3rd earl of Wemyss, whose wife was Anne, daughter of the 1st duke of Queensberry and sister of the 1st earl of March; and the title is now assumed by the earl of Wemyss. On the other hand, Francis, 8th earl of Wemyss, not having been an heir of the body of the 1st earl of March, Sir Robert Douglas says in *The Peerage of Scotland* that on the death of the 4th duke of Queensberry in 1810 "the earldom of March, it is supposed, became extinct."

See Andrew Lang, *History of Scotland* (4 vols., London, 1900–1907); Sir Bernard Burke, *A Genealogical History of Dormant and Extinct Peerages* (London, 1866); Sir Robert Douglas, *The Peerage of Scotland* (2 vols., Edinburgh 1813); Lady Elizabeth Cust, *Some Account of the Stuarts of Aubigny in France* (London, 1891). (R. J. M.)

MARCH, AUZIAS (*c.* 1395–1458), Catalan poet, was born at Valencia towards the end of the 14th century. Little is known of his career except that he was twice married—first to Na Ysabel Martorell, and second to Na Johanna Scorna—that he died on the 4th of November 1458, and that he left several natural children. Inheriting an easy fortune from his father, the treasurer to the duke of Gandia, and enjoying the powerful patronage of Prince Carlos de Viana of Aragon, March was enabled to devote himself to poetical composition. He is an undisguised follower of Petrarch, carrying the imitation to such a point that he addresses his *Cants d'amor* to a lady whom he professes to have seen first in church on Good Friday; so far as the difference of language allows, he reproduces the rhythmical cadences of his model, and in the *Cants de mort* touches a note of brooding sentiment peculiar to himself. Though his poems are disfigured by obscurity and a monotonous morbidity, he was fully entitled to the supremacy which he enjoyed among his contemporaries, and the success of his innovation no doubt encouraged Boscán to introduce the Italian metres into Castilian.

His verses were first printed in Catalan in 1543, but they had already become known through the Castilian translation published by Baltasar de Romani in 1539.

MARCH, FRANCIS ANDREW (1825–), American philologist and educationalist, was born on the 25th of October 1825 in Millbury, Massachusetts. He graduated in 1845 at Amherst, where his attention was turned to the study of Anglo-Saxon by Noah Webster. He was a teacher at Swanzey, New Hampshire, and at the Leicester Academy, Massachusetts, in 1845–1847, and attempted the philological method of teaching English "like Latin and Greek," later described in his *Method of Philological Study of the English Language* (1865); at Amherst in 1847–1849; at Fredericksburg, Virginia, in 1852–1855; and in 1855 became a tutor at Lafayette College, where he became adjunct professor of belles-lettres and English literature in 1856, and professor of English language and comparative philology—the first chair of the kind established—in 1857. He lectured on constitutional and public law and Roman law in 1875–1877, and also taught subjects as diverse as botany and political economy. In 1907 he became professor emeritus. At Lafayette he introduced the first carefully scientific study of English in any American college, and in 1870 published *A Comparative Grammar of the Anglo-Saxon Language, in which its Forms are Illustrated by Those of the Sanskrit, Greek, Latin, Gothic, Old Saxon, Old Friesic, Old Norse and Old High German*, and *An Anglo-Saxon Reader*; he was editor of the "Douglass Series of Christian Greek and Latin Classics," to which he contributed *Latin Hymns* (1874); he was chairman of the Commission of the State of Pennsylvania on Amended Orthography; and was consulting editor of the *Standard Dictionary*, and in 1879–1882 was director of the American readers for the Philological Society's (New Oxford) *Dictionary*. He was president of the American Philological Association in 1873–1874 and in 1895–1896, of the Spelling Reform Association after 1876, and of the Modern Language Association in 1891–1893. Among American linguistic scholars March ranks with Whitney, Child and Gildersleeve; and his studies in English, though practically pioneer work in America, are of undoubted value. His article "On Recent Discussions of Grimm's Law" in the *Transactions and Proceedings* of the American Philological Association for 1873 in large part anticipated Verner's law. With his son, Francis Andrew March, jun. (b. 1863), adjunct-professor of modern languages in 1884–1891 and subsequently professor of English literature at Lafayette, he edited *A Thesaurus Dictionary of the English Language* (1903).

See *Addresses in Honor of Professor Francis A. March, LL.D., L.H.D.*, delivered at Easton, Pennsylvania, on the 24th of October 1895.

MARCH, a market town in the Wisbech parliamentary division of Cambridgeshire, England, 30 m. N. by W. of Cambridge. Pop. of urban district (1901), 7565. It lies in the midst of the flat fen country, on the old course of the river Nene. It is an important junction on the Great Eastern railway and the starting-point of a line worked by that company jointly with the Great Northern to Lincoln and Doncaster. The church of St Wendreda, in Early English and later styles, is remarkable for a magnificent Perpendicular timber roof, beautifully carved. There are agricultural implement and engineering works, and corn mills.

MARCH, the third month of the modern calendar, containing thirty-one days. It was the Romans' first month until the adoption of the Julian calendar, 46 B.C., and it continued to be the beginning of the legal year in England until the 18th century. In France it was reckoned the first month of the year until 1564, when, by an edict of Charles IX., January was decreed to be thenceforth the first month. Scotland followed the example of France in 1599; but in England the change did not take place before 1752. The Romans called the month *Martius*, a name supposed to have been conferred on it by Romulus in honour of his putative father, Mars, the god of war; but Ovid declares the month to have existed before the time of Romulus, though in a different position in the calendar. The Anglo-Saxons called March *Hlyd-monath*, "loud or stormy month," or *Lencten-monath*, "lengthening month," in allusion to the fact that the days then rapidly become longer. There is an old saying, common to both England and Scotland—which has its equivalent among the Basques and many European peoples—representing March as borrowing three days from April; the last three days of March being called the "borrowing" or the "borrowed days." As late as the end of the 18th century the first three days of March were known in Devonshire as "Blind Days," and were deemed so unlucky that no farmer would sow seed then.

The chief festival days of March are the 1st, St David; the 12th, St Gregory; the 17th, St Patrick; and the 25th, Lady Day, one of the quarter days in England.

MARCH (1) (from Fr. *marcher*, to walk; the earliest sense in French appears to be "to trample," and the origin has usually been found in the Lat. *marcus*, hammer; Low Lat. *marcare*, to hammer; hence to beat the road with the regular tread of a soldier: cf. "beat," of a policeman's round), the movement of military troops with regular rhythmical steps, often with the time marked by the beat of drum, the sound of pipes or bugles or the music of a military band; hence the advance or movement of a body of troops from one point to another, and the distance covered in so doing. The word is also naturally applied to the music composed for marching to, and to the steady regular advance or progress of non-military bodies or persons, or of events, &c. In the military sense, "marching" is walking in formed bodies of troops, either during drill evolutions on parade or on the "line of march" from one place to another. In both senses the word is used with mounted troops as well as with dismounted men. Formerly all evolutions were carried out at the so-called "parade-march" pace of about 75–80 paces to the minute, and in one or two armies of the 18th century the parade step cadence was as slow as 60. These cadences are now, however, reserved in all armies for ceremonial occasions, and the usual manœuvre and marching pace ("quick march") is about 120, the "double" march pace (*pas gymnastique*) about 180. The "quick" march, translated into miles and hours, is about $3\frac{1}{2}$ or $3\frac{5}{8}$ miles an hour in all armies, though a few special bodies of light troops such as the Italian *Bersaglieri* are trained to move at a much faster rate for hours together, either by alternate "quick" and "double" marching or by an unvarying "jog-trot." The paces recognized for cavalry are the walk, the trot, the canter and the gallop; the usual practice on the line of march being to alternate the walk and the trot, which combination gives a speed of about 5 miles an hour for many hours together. A "day's march," or more simply a "march," is usually reckoned to be 15–16 miles for a large body of troops, a "forced" march being one of 20 miles or over, or one in which, from whatever cause, the troops are on foot for more than about seven hours. For large bodies of troops the rate of movement on the line of march rarely exceeds 3 miles an hour. The immense assistance afforded by music to marching troops has been recognized from the earliest times of organized armies, and a great deal of special march-music has been written for military bands, formerly often in $\frac{3}{4}$ or $\frac{6}{8}$ time (one bar representing one pace with the foot), but now almost invariably in common or $\frac{2}{4}$ time, which is more suitable for the "quick march." The music itself is usually a combination of simple, lively melody and well-marked accents for the drums, with little attempt at contrapuntal writing. The fife or piccolo, the natural bugle (in Italy and elsewhere the chromatic key-bugle is used), and the drum are the principal instruments, the "band," as distinct from the "drums" and "bugles," having in addition to drum and fifes clarinets (saxophones in France and Belgium) and saxhorns of all types. In Scottish regiments, and in a few isolated cases elsewhere, bagpipes provide the marching music. The importance of music on the march is attested further by the almost universal practice of singing or whistling marching songs, and even playing them on concertinas, &c., in the absence of the band and drums.

2. From *marche*, the French form of a common Teutonic word represented in English by "mark" (*q.v.*), a boundary or frontier region between two countries or districts. The word appears to have been first used in this sense in the 8th century, and the earliest "mark" or "march" districts were tracts of land on the borders of the Carolingian Empire. Wherever Charlemagne pushed forward the frontiers of the Frankish realm he provided for the security of his lands, new and old alike, by establishing mark districts on the borders. The defence and oversight of these were entrusted to special officers, afterwards called margraves, or counts of the mark, who usually enjoyed more extensive powers than fell to the lot of an ordinary count. It is at this time that we hear first of the Spanish mark (*marca hispanica*) and the Bavarian mark (*marca bajoariae*). These mark districts were practically obliterated during the reigns of the feeble sovereigns who succeeded Charlemagne, but the system was revived with the accession of Henry the Fowler to the German throne early in the 10th century and with a renewal of the work of conquering and colonizing the regions east of the Elbe, and in eastern Germany generally. Under Henry and his son, Otto the Great, marks were again set upon the borders of Germany, and this time the organization was more lasting. The mark districts increased in size and strength, especially those which fell under the dominion of an able and energetic ruler, and some of them became powerful states, retaining the name mark long after the original significance of the word had been forgotten. It is interesting to note that the two most important of the modern German states, Austria and Prussia, both had their origin in mark districts, the mark of Brandenburg, the nucleus of the kingdom of Prussia, being at first a border district to the east of the duchy of Saxony, and the east mark, or mark of Austria, being a border district of the duchy of Bavaria. In Italy march districts made their appearance about the same time as in other parts of the Frankish Empire. The best known of these is the march of Ancona, which with other marches and adjoining districts, was known later as the Marches, a province lying about the centre of Italy between the Apennines and the Adriatic Sea. After forming part of the states of the Church the Marches were united with the kingdom of Italy in 1860 (see MARCHES, THE).

In England in the same connexion the plural word "marches" was the form commonly adopted, and soon after the Norman Conquest the disturbed districts on the borders of Wales began to be known as the Welsh marches. Lands therein were granted to powerful nobles on condition that they undertook the defence of the neighbouring counties of England. These lords of the marches, or lords marcher, as they were often called, had special privileges, but they were generally so fully occupied in fighting against each other and in seeking to increase their own wealth and power that the original object of their appointment was entirely forgotten. The condition of the marches grew worse and worse, and during disturbed reigns, like those of Henry III. and Edward II., lawlessness was rampant and rebellion was centred therein. A more satisfactory condition of affairs, however, prevailed after the conclusion of the Wars of the Roses; and the establishment by Henry VIII. in 1542 of a council of Wales and the marches was followed by a notable diminution of disorder in this region. About the time of Elizabeth the Welsh marches ceased to have any but an historical importance. In 1328 Roger Mortimer, a member of one of the most powerful of the marcher families, was created earl of March (*comes de marchia Waliae*), and in the reign of Edward III. (1354) the marches were declared to be no part of the principality, but directly subject to the English crown. It is difficult to define the boundaries of the Welsh marches, as their extent varied considerably from time to time, but under Edward I. and again under the Lancastrian kings the marcher lordships included more than half of the area of Wales; they embraced practically the whole of the principality except the counties of Anglesea, Carnarvon and Merioneth in the north and Carmarthen and Cardigan in the south, together with parts of the English border counties, Monmouth, Hereford and Shropshire.

The debateable ground between England and Scotland was also known as the marches, although its condition began to attract the attention of the southern kingdom somewhat later than was the case with Wales. Arrangements were made for garrisoning them and at one time they were divided into three sections: the east, the west, and the middle marches, the oversight of each being entrusted to a warden. Roughly speaking, they embraced the modern counties of Northumberland and Cumberland, together with a tract on the Scottish side of the border. The need for protecting them ceased soon after the accession of James VI. of Scotland to the English throne, and they have now only an historical and legendary significance. About 1290 Patrick de Dunbar, earl of Dunbar, called himself earl of March, taking the name from the merse, or march, a tract of land in Berwickshire.

In France under the *ancien régime* there was a county of La Marche, and in north-east Germany there was the county of La Marck, now part of the kingdom of Prussia.

MARCHE, or LA MARCHE, one of the former provinces of France. It owes its name to its position, it having been in the 10th century a march or border district between the duchy of Aquitaine and the domains of the Frankish kings in central

France. Sometimes it was called the *Marche Limousine*, and originally it was a small district cut partly from Limousin and partly from Poitou. Its area was increased during the 13th century, after which, however, it remained unaltered until the time of the Revolution. It was bounded on the N. by Berry; on the E. by Bourbonnais and Auvergne; on the S. by Limousin; and on the W. by Poitou. It embraced the greater part of the modern department of Creuse, a considerable part of Haute Vienne, and a fragment of Indre. Its area was about 1900 sq. m.; its capital was Charroux and later Guéret, and among its other principal towns were Dorat, Bellac and Confolens.

Marche first appears as a separate fief about the middle of the 10th century when William III., duke of Aquitaine, gave it to one of his vassals named Boso, who took the title of count. In the 12th century it passed to the counts of Limousin, and this house retained it until the death of the childless Count Hugh in 1303, when it was seized by the French king, Philip IV. In 1316 it was made a duchy for Prince Charles, afterwards King Charles IV., and a few years later (1327) it passed into the hands of the family of Bourbon. The family of Armagnac held it from 1435 to 1477, when it reverted to the Bourbons, and in 1527 it was seized by Francis I. and became part of the domains of the French crown. It was divided into Haute Marche and Basse Marche, the estates of the former being in existence until the 17th century. From 1470 until the Revolution the province was under the jurisdiction of the parlement of Paris.

See A. Thomas, *Les États provinciaux de la France centrale* (1879).

MARCHE, a town of Belgium in the province of Luxemburg, 33 m. S.W. of Liége and about 28 m. S.E. of Namur. Pop. (1904), 3540. It dates from the 7th century, when it was the chief town of the *pagus falmiensis*, as it still is of the same district now called Famène. Formerly it was fortified, and a treaty was signed there in 1577 between Philip II. and the United Provinces. In 1792 Lafayette was taken prisoner by the Austrians in a skirmish near it.

MARCHENA, a town of southern Spain, in the province of Seville, on the Cordova-Utrera and Marchena-La Roda railways. Pop. (1900), 12,468. Marchena occupies a sandy valley near the river Corbones, a left-hand territory of the Guadalquivir. Formerly it was surrounded with walls and towers, a large portion of which still remains. Among the principal buildings is the palace of the dukes of Arcos, within the enclosure of which is an ancient Moorish building, now the church of Santa Maria de la Mota. At the eastern end of the town is a sulphur spring. There is some trade in wheat, barley, olives, oil and wine. Marchena (perhaps the *Castra Gemina* of Pliny) was taken from the Moors by St Ferdinand in 1240.

MARCHENA RUIZ DE CASTRO, JOSÉ (1768–1821?), Spanish author, was born at Utrera on the 18th of November 1768 and studied with distinction at the university of Seville. He took minor orders and was for some time professor at the seminary of Vergara, but he became a convert to the doctrines of the French *philosophes*, scandalizing his acquaintances by his professions of materialism and his denunciations of celibacy. His writings being brought before the Inquisition in 1792, Marchena escaped to Paris, where he is said to have collaborated with Marat in *L'Ami du peuple*; at a later date he organized a revolutionary movement at Bayonne, returned to Paris, avowed his sympathies with the Girondists, and refused the advances of Robespierre. He acted as editor of *L'Ami des lois* and other French journals till 1799, when he was expelled from France; he succeeded, however, in obtaining employment under Moreau, upon whose fall in 1804 he declared himself a Bonapartist. In 1808 he accompanied Murat to Spain as private secretary; in this same year he was imprisoned by the Inquisition, but was released by Joseph Bonaparte, who appointed him editor of the official *Gaceta*. In 1813 Marchena retired to Valencia, and thence to France, where he supported himself by translating into Spanish the works of Montesquieu, Rousseau, Voltaire and Volney. The Liberal triumph of 1820 opened Spain to him once more, but he was coldly received by the revolutionary party. He died at Madrid shortly before the 26th of February 1821. The interest of his voluminous writings is almost wholly ephemeral, but they are excellent specimens of trenchant journalism. His *Fragmentum Petronii* (Basel, 1802), which purports to reconstruct missing passages in the current text of Petronius, is a testimony to Marchena's fine scholarship; but, by the irony of fate, Marchena is best known by his ode to Christ Crucified, which breathes a spirit of profound and tender piety.

MARCHES, THE (It. *Le Marche*), a territorial division of Italy, embracing the provinces of Pesaro and Urbino, Ancona, Macerata, and Ascoli Piceno, with an area of 3763 sq. m., and a population of 1,088,763 in 1901. It is bounded by the Emilia on the N., the Adriatic on the E., the Abruzzi on the S., and Umbria and Tuscany on the W. The four provinces follow one another in the order given from north to south and have a certain amount of coast-line. The chief rivers, all of which run into the Adriatic eastwards and north-eastwards, are the Metauro (anc. *Metaurus*, *q.v.*) and the Tronto (anc. *Truentus*), the latter forming the southern boundary of the *compartimento* for some distance. Except for the river valleys and the often very narrow coast strip, the general level is more than 500 ft. above the sea. The lower hills are very largely composed of loose, clayey, unstable earth, while the Apennines are of limestone. The province of Pesaro and Urbino falls within the boundaries of the ancient Umbria (*q.v.*), while the territory of the other three belonged to Picenum (*q.v.*). The railway from Bologna to Brindisi runs along the coast-line of the entire territory. At Ancona it is joined by the main line from Foligno and Rome; at Porto Civitanova is a branch to Macerata, San Severino and Fabriano (a station on the line from Ancona to Rome and the junction for Urbino); at Porto S. Giorgio is a branch to Fermo and, at Porto d'Ascoli, a branch to Ascoli Piceno. But, with the exception of the railway along the coast, there is no communication north and south, owing to the mountainous nature of the country, except by somewhat devious roads.

Owing largely to the *mezzadria* or *métayer* system, under which products are equally divided between the owners and the cultivators of the land, the soil is fairly highly cultivated, though naturally poor in quality. The silk industries, making of straw-plait and straw hats, rearing of silkworms and cocoons, with some sugar-refining, tobacco, terra-cotta manufacture, brick-works and ironworks, furnish the chief occupations of the people next after agriculture and pastoral pursuits. Another important branch of activity is the paper industry, especially at Fabriano. Chiaravalle possesses one of the largest tobacco factories of the Italian *régie*. Limestone quarries and sulphur mines supply building stone and sulphur to the regions of central Italy; chalk and petroleum are also found. As regards maritime trade the province possesses facilities in the port of Ancona (the only really good harbour, where are also important shipbuilding works), the canal ports of Senegallia (Sinigaglia), Pesaro, Fano and other smaller harbours chiefly used by fishing boats. Fishing is carried on by the entire coast population, which furnishes a large contingent of sailors to the Italian navy.

For the early history of the territory of the Marches see Picenum. From the Carolingian period onwards the name Marca begins to appear—first the Marca Fermana for the mountainous part of Picenum, the Marca Camerinese for the district farther north, including a part of Umbria, and the Marca Anconitana for the former Pentapolis. In 1080 the Marca Anconitana was given in investiture to Robert Guiscard by Gregory VII., to whom the countess Matilda ceded the Marches of Camerino and of Fermo. In 1105 we find the emperor Henry IV. investing Werner with the whole territory of the three marches under the name of March of Ancona. It was afterwards once more recovered by the Church and governed by papal legates. It became part of the kingdom of Italy in 1860.

The pictorial art of the Marches from the 13th century onwards has become the object of considerable interest since the important exhibition held at Macerata in 1905, when many interesting works, scattered all over the district in small towns and villages, were brought together. The result was something of a revelation, for, though the influence of Umbria was always considerable, there were many independent elements (see F. M. Perkins in *Rassegna d' Arte*, 1906, 49 sqq.). (T. As.)

MARCHMONT, EARLS OF. The 1st earl of Marchmont was Sir Patrick Hume or Home (1641–1724), son of Sir Patrick Hume, bart. (d. 1648), of Polwarth, Berwickshire, and a descendant of another Sir Patrick Hume, a supporter of the Reformation in Scotland. A member of the same family was Alexander Hume (*c.* 1560–1609), the Scottish poet, whose *Hymns and Sacred Songs* were published in 1599 (new ed. 1832). Polwarth, as Patrick Hume was usually called, became a member of the Scottish parliament in 1665. Here he was active in opposing the harsh policy of the earl of Lauderdale towards the Covenanters, and for his contumacy he was imprisoned. After his release he went to London, where he associated himself with the duke of Monmouth. Suspected of complicity in the Rye House plot, he remained for a time in hiding and then crossed over to the Netherlands, where he took part in the deliberations of Monmouth, the earl of Argyll and other exiles about the projected invasion of Great Britain. Although he appeared to distrust Argyll, Polwarth sailed to Scotland with him in 1685, and after the failure of the rising he escaped to Utrecht, where he lived in great poverty until 1688. He accompanied William of Orange to England, and in 1689 he was again a member of the Scottish parliament. In 1690 he was made a peer as Lord Polwarth; in 1696 he became lord high chancellor of Scotland, and in 1697 was created earl of Marchmont. When Anne became queen in 1702 he was deprived of the chancellorship. He died on the 2nd of August 1724. His son Alexander, the 2nd earl (1676–1740), took the name of Campbell instead of Hume after his marriage in 1697 with Margaret, daughter and heiress of Sir George Campbell of Cessnock, Ayrshire. He was a lord of session from 1704 to 1714; ambassador to Denmark from 1715 to 1721, and lord clerk register from 1716 to 1733. His son Hugh Hume, 3rd earl (1708–1794), who entered parliament in 1734 at the same time as his twin brother Alexander (d. 1756), afterwards lord clerk register of Scotland, was keeper of the great seal of Scotland, one of Bolingbroke's most intimate friends and one of Pope's executors. His two sons having predeceased their father, the earldom became dormant, Marchmont House, Berwickshire, and the estates passing to Sir Hugh Purves, bart., a descendant of the 2nd earl, who took the name of Hume-Campbell. The 3rd earl had, however, three daughters, one of whom, Diana (d. 1827), married Walter Scott of Harden, Berwickshire; and in 1835 her son Hugh Hepburne-Scott (1758–1841) successfully claimed the Scottish barony of Polwarth. In 1867 his grandson, Walter Hugh (b. 1838), became 6th Lord Polwarth.

See *The Marchmont Papers*, ed. Sir G. H. Rose (1831).

MARCHPANE, or Marzipan, a sweetmeat made of sweet almonds and sugar pounded and worked into a paste, and moulded into various shapes, or used in the icing of cakes, &c. The best marchpane comes from Germany, that from Königsberg being celebrated. The origin of the word has been much discussed. It is common in various forms in most European languages, Romanic or Teutonic; Italian has *marzapane*, French *massepain*, and German *marzipan*, which has in English to some extent superseded the true English form "marchpane." Italian seems to have been the source from which the word passed into other languages. In Johann Burchard's *Diarium curiae romanae* (1483–1492) the Latin form appears as *martiapanis* (Du Cange, *Glossarium s.v.*), and Minshseu explains the word as *Martius panis*, bread of Mars, from the "towers, castles and such like" that appeared on elaborate works of the confectioner's art made of this sweatmeat. Another derivation is that from Gr. *μάζα*, barley cake, and Lat. *panis*. A connexion has been sought with the name of a Venetian coin, *matapanus* (Du Cange, *s.v.*), on which was a figure of Christ enthroned, struck by Enrico Dandolo, doge of Venice (1192–1205). From the coin the word was applied to a small box, and hence apparently to the sweetmeat contained in it.

MARCIAN (*c.* 390–457), emperor of the East (450–457), was born in Thrace or Illyria, and spent his early life as an obscure soldier. He subsequently served for nineteen years under Ardaburius and Aspar, and took part in the wars against the Persians and Vandals. Through the influence of these generals he became a captain of the guards, and was later raised to the rank of tribune and senator. On the death of Theodosius II. he was chosen as consort by the latter's sister and successor, Pulcheria, and called upon to govern an empire greatly humbled and impoverished by the ravages of the Huns. Marcian repudiated the payment of tribute to Attila; he reformed the finances, checked extravagance, and repeopled the devastated districts. He repelled attacks upon Syria and Egypt (452), and quelled disturbances on the Armenian frontier (456). The other notable event of his reign is the Council of Chalcedon (451), in which Marcian endeavoured to mediate between the rival schools of theology.

See Gibbon, *The Decline and Fall of the Roman Empire* (ed. Bury, London, 1896), iii. 384, iv. 444–445; J. Bury, *The Later Roman Empire* (London, 1889), i. 135–136.

MARCIANUS (*c.* A.D. 400), Greek geographer, was born at Heraclea in Pontus. Two of his works have been preserved in a more or less mutilated condition. In the first, the *Periplus of the Outer Sea*, in two books, in which he proposed to give a complete description of the coasts of the eastern and western oceans, his chief authority is Ptolemy; the distances from one point to another are given in stades, with the object of rendering the work easier for the ordinary student. In this he follows Protagoras, who, according to Photius (cod. 188), wrote a sketch of geography in six books. The work contains nothing that cannot be learned from Ptolemy, whom he follows in calling the promontory of the Novantae (*Mull of Galloway*) the most northern point of Britain. Improving on Ptolemy, he makes the island of Taprobane (*Ceylon*) twenty times as large as it is in reality. The second, the *Periplus of the Inner Sea* (the Mediterranean), is a meagre epitome of a similar work by Menippus of Pergamum, who lived during the times of Augustus and Tiberius. It contains a description of the southern coast of the Euxine from the Thracian Bosporus to the river Iris in Pontus. A few fragments remain of an epitome by Marcianus of the eleven books of the *Geographumena* of Artemidorus of Ephesus.

See J. Hudson, *Geographiae veteris scriptores graeci minores*, vol. i. (1698), with Dodwell's dissertation; C. W. Müller, *Geographici graeci minores*, vol. i. pp. cxxix., 515–573; E. Miller, *Périple de Marcien d'Héraclée* (1839); S. F. G. Hoffmann, *Marciani Periplus* (1841); E. H. Bunbury, *Hist. of Ancient Geography* (1879), ii. 660; A. Forbiger, *Handbuch der alten Geographie*, vol. i. (1842).

MARCION and **THE MARCIONITE CHURCHES.** In the period between 130 and 180 A.D. the varied and complicated Christian fellowships in the Roman Empire crystallized into close and mutually exclusive societies—churches with fixed constitutions and creeds, schools with distinctive esoteric doctrines, associations for worship with peculiar mysteries, and ascetic sects with special rules of conduct. Of ecclesiastical organizations the most important, next to Catholicism, was the Marcionite community. Like the Catholic Church, this body professed to comprehend everything belonging to Christianity. It admitted all believers without distinction of age, sex, rank or culture. It was no mere school for the learned, disclosed no mysteries for the privileged, but sought to lay the foundation of the Christian community on the pure gospel, the authentic institutes of Christ. The pure gospel, however, Marcion found to be everywhere more or less corrupted and mutilated in the Christian circles of his time. His undertaking thus resolved itself into a reformation of Christendom. This reformation was to deliver Christendom from false Jewish doctrines by restoring the Pauline conception of the gospel, —Paul being, according to Marcion, the only apostle who had rightly understood the new message of salvation as delivered by Christ. In Marcion's own view, therefore, the founding of his church—to which he was first driven by opposition—amounts to a reformation of Christendom through a return to the gospel of Christ and to Paul; nothing was to be accepted beyond that. This of itself shows that it is a mistake to reckon Marcion among the Gnostics. A dualist he certainly was, but he was not a Gnostic. For he ascribed salvation, not to "knowledge" but to "faith"; he appealed openly to the whole Christian world; and he nowhere consciously added foreign elements to the revelation given through Christ. It is true that in many features his Christian system—if we may use the expression—resembles the so-called Gnostic systems; but the first duty of the historian is to point out what Marcion plainly aimed at; only in the second place have we to inquire how far the result corresponded with those purposes.

The doctrines of Marcion and the history of his churches from the 2nd to the 7th century are known to us from the controversial works of the Catholic fathers. From Justin onwards, almost every eminent Church teacher takes some notice of Marcion, while very many write extensive treatises against him. The most important of those which have come down to us are the controversial pieces of Irenaeus (in his great work against heretics), Tertullian (*Adv. Marc.* i.–v.), Hippolytus, Pseudo-Origen Adamantius, Epiphanius, and the Armenian Esnik.[1] From these works the contents of the Marcionite Gospel, and also the text of Paul's epistles in Marcion's recension, can be settled with tolerable accuracy. His opponents, moreover, have preserved some expressions of his, with extracts from his principal work; so that our knowledge of Marcion's views is in part derived from the best sources.

Marcion was a wealthy shipowner, belonging to Sinope in Pontus. He appears to have been a convert from Paganism to Christianity, although it was asserted in later times that his father had been a bishop. That report is probably as untrustworthy as another, that he was excommunicated from the Church for seducing a virgin. What we know for certain is that after the death of Hyginus, bishop of Rome (or *c.* 139 A.D.), he arrived, in the course of his travels, at Rome, and made a handsome donation of money to the local church. Even then, however, the leading features of his peculiar system must have been already thought out. At Rome he tried to gain acceptance for them in the college of presbyters and in the church; indeed he had previously made similar attempts in Asia Minor. But he now encountered such determined opposition from the majority of the congregation that he found it necessary to withdraw from the great church and establish in Rome a community of his own. This was about the year 144. The new society increased in the two following decades; and very soon numerous sister-churches were flourishing in the east and west of the empire. Marcion took up his residence permanently in Rome, but still undertook journeys for the propagation of his opinions. In Rome he became acquainted with the Syrian Gnostic Cerdo, whose speculations influenced the development of the Marcionite theology. Still Marcion seems never to have abandoned his design of gaining over the whole Church to his gospel. The proof of this is found, partly in the fact that he tried to establish relations with Polycarp of Smyrna, from whom he got a sharp rebuff, partly in a legend to the effect that towards the end of his life he sought readmission to the Church. Such, presumably, was the construction put in after times on his earnest endeavour to unite Christians on the footing of the "pure gospel." When he died is not known, but his death can scarcely have been much later than the year 165.

The distinctive teaching of Marcion originated in a comparison of the Old Testament with the gospel of Christ and the theology of the apostle Paul. Its motive was not cosmological or metaphysical, but religious and historical. In the gospel he found a God revealed who is goodness and love, and who desires faith and love from men. This God he could not discover in the Old Testament; on the contrary, he saw there the revelation of a just, stern, jealous, wrathful and variable God, who requires from his servants blind obedience, fear and outward righteousness. Overpowered by the majesty and novelty of the Christian message of salvation, too conscientious to rest satisfied with the ordinary attempts at the solution of difficulties, while prevented by the limitations of his time from reaching an historical insight into the relation of Christianity to the Old Testament and to Judaism, he believed that he expressed Paul's view by the hypothesis of two Gods: the just God of the law (the God of the Jews, who is also the Creator of the world), and the good God, the Father of Jesus Christ. Paradoxes in the history of religion and revelation which Paul draws out, and which Marcion's contemporaries passed by as utterly incomprehensible, are here made the foundation of an ethico-dualistic conception of history and of religion. It may be said that in the 2nd century only one Christian—Marcion—took the trouble to understand Paul; but it must be added that he misunderstood him. The profound reflections of the apostle on the radical antithesis of law and gospel, works and faith, were not appreciated in the 2nd century. Marcion alone perceived their decisive religious importance, and with them confronted the legalizing, and in this sense judaizing, tendencies of his Christian contemporaries. But the Pauline ideas lost their truth under his treatment; for, when it is denied that the God of redemption is at the same time the almighty Lord of heaven and earth, the gospel is turned upside down.

The assumption of two Gods necessarily led to cosmological speculations. Under the influence of Cerdo, Marcion carried out his ethical dualism in the sphere of cosmology; but the fact that his system is not free from contradictions is the best proof that all along religious knowledge, and not philosophical, had the chief values in his eyes. The main outlines of his teaching are as follows. Man is, in spirit, soul and body, a creature of the just and wrathful god. This god created man from ὕλη (matter),[2] and imposed on him a strict law. Since no one could keep this law, the whole human race fell under the curse, temporal and eternal, of the Demiurge. Then a higher God, hitherto unknown, and concealed even from the Demiurge, took pity on the wretched, condemned race of men. He sent his Son (whom Marcion probably regarded as a manifestation of the supreme God Himself)[3] down to this earth in order to redeem men. Clothed in a visionary body, in the likeness of a man of thirty years old, the Son made his appearance in the fifteenth year of Tiberius, and preached in the synagogue at Capernaum. But none of the Jewish people understood him. Even the disciples whom he chose did not recognize his true nature, but mistook him for the Messiah promised by the Demiurge through the prophets, who as warrior and king was to come and set up the Jewish empire. The Demiurge himself did not suspect who the stranger was; nevertheless he became angry with him, and, although Jesus had punctually fulfilled his law, caused him to be nailed to the cross. By that act, however, he pronounced his own doom. For the risen Christ appeared before him in his glory, and charged him with having acted contrary to his own law. To make amends for this crime, the Demiurge had now to deliver up to the good God the souls of those who were to be redeemed; they are, as it were, purchased from him by the death of Christ. Christ then proceeded to the underworld to deliver the spirits of the departed. It was not the Old Testament saints, however, but only sinners and malefactors like Cain, Esau and Saul, who obeyed his summons. The prophets and patriarchs, having been often deceived by the Demiurge, suspected a trick and would not avail themselves of the promised salvation, remaining content with the bliss of being in Abraham's bosom. Then, to gain the living, Christ raised up Paul as his apostle. He alone understood the gospel, and recognized the difference between the just God and the good. Accordingly, he opposed the original apostles with their Judaistic doctrines, and founded small congregations of true Christians. But the preaching of the false Jewish Christians gained the upper hand; nay, they even falsified the evangelical oracles and the letters of Paul. Marcion himself was the next raised up by the good God, to proclaim once more the true gospel. This he did by setting aside the spurious gospels, purging the real gospel (the Gospel of Luke) from supposed judaizing interpolations, and restoring the true text of the Pauline epistles.[1] He likewise composed a book, called the *Antitheses*,[2] in which he proved the disparity of the two Gods, from a comparison of the Old Testament with the evangelical writings.

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[1] Esnik's presentation of the Marcionite system is a late production, and contains many speculations that cannot be charged upon Marcion himself.

[2] On the relation of matter to the Creator, Marcion himself seems not to have speculated, though his followers may have done so.

[3] Marcion's teaching at this point forestalls the patripassian christology of Noetus and Praxeas (see Neander, *Church Hist.* ii. 143).—[ED.]

On the basis of these writings Marcion proclaimed the true Christianity, and founded churches. He taught that all who put their trust in the good God, and his crucified Son, renounce their allegiance to the Demiurge, and approve themselves by good works of love, shall be saved. But he taught further—and here we trace the influence of the current gnosticism on Marcion—that only the spirit of man is saved by the good God; the body, because material, perishes. Accordingly his ethics also were thoroughly dualistic. By the "works of the Demiurge," which the Christian is to flee, he meant the whole "service of the perishable." The Christian must shun everything sensual, and especially marriage, and free himself from the body by strict asceticism. The original ethical contrast of "good" and "just" is thus transformed into the cosmological contrast of "spirit" and "matter." The good God appears as the god of spirit, the Old Testament God as the god of matter. That is Gnosticism; but it is at the same time illogical. For, since, according to Marcion, the spirit of man is derived, not from the good, but from the just God, it is impossible to see why the spiritual should yet be more closely related to the good God than the material. There is yet another direction in which the system ends with a contradiction. According to Marcion, the good God never judges, but everywhere manifests His goodness—is, therefore, not to be feared, but simply to be loved, as a father. But here the question occurs, What becomes of the men who do not believe the gospel? Marcion answers, The good God does not judge them, but merely removes them from His presence. Then they fall under the power of the Demiurge, who—rewards them for their fidelity? No, says Marcion, but on the contrary—punishes them in his hell! The contradiction here is palpable; and at the same time the antithesis of "just" and "good" ultimately vanishes. For the Demiurge now appears as an inferior being, who in reality executes the purposes of the good God. It is plain that dualism here terminates in the idea of the sole supremacy of the good God.

It is not surprising, therefore, that even in the 2nd century the disciples of Marcion diverged in several directions. Rigorous asceticism, the rejection of the Old Testament, and the recognition of the "new God" remained common to all Marcionites, who, moreover, like the Catholics, lived together in close communities ruled by bishops and presbyters (although their constitution was originally very loose, and sought to avoid every appearance of "legality"). Some, however, accepted three first principles (the evil, the just, the good); others held by two, but regarded the Demiurge as the god of evil, *i.e.* the devil; while a third party, like Apelles, the most distinguished of Marcion's pupils, saw in the Demiurge only an apostate angel of the good God—thus returning to monotheism. The golden age of the Marcionite churches falls between the years 150 and 250. During that time they were really dangerous to the great Church; for in fact they maintained certain genuine Christian ideas, which the Catholic Church had forgotten. The earliest inscription (A.D. 318) on a Christian place of worship is Marcionite, and was found on a stone which had stood over the doorway of a house in a Syrian village. From the beginning of the 4th century they began to die out in the West, or rather they fell a prey to Manichaeism. In the East also many Marcionites went over to the Manichaeans; but there they survived much longer. They can be traced down to the 7th century, and then they seem to vanish. But it was unquestionably from Marcionite impulses that the new sects of the Paulicians and Bogomils arose; and in so far as the western Cathari, and the antinomian and anticlerical sects of the 13th century are connected with these, they also may be included in the history of Marcionitism.

See A. Harnack, *History of Dogma*, i. 266, 286; F. Loofs, *Dogmengeschichte* pp. 111–114; G. Krüger, *Early Christian Literature*, and art. in Hauck-Herzog's *Realencyklopädie für prot. Theol. und Kirche*, xii.; F. J. Foakes Jackson's *Christian Difficulties of the Second and Twentieth Centuries*, is a study of Marcion and his relation to modern thought. (A. Ha.)

MARCOMANNI (*i.e.* men of the mark, or border), the name of a Suevic tribe. With kindred peoples they were often in conflict with the Roman Empire, and gave their name to the Marcomannic War, a struggle waged by the emperor Marcus Aurelius against them and the Quadi. The Marcomanni disappeared from history during the 4th century, being probably merged in the Baiouarii, the later Bavarians.

See Suebi; also F. M. Wittmann, *Die älteste Geschichte der Markomannen* (Munich, 1855), and E. Devrient, "Hermunduren und Markomannen" in *Neues Jahrb. f. das klassische Altertum* (1901), 51.

MARCOS DE NIZA (*c.* 1495–1558), a Franciscan friar born in Nice about 1495. He went to America in 1531, and after serving his order zealously in Peru, Guatemala and Mexico, was chosen to explore the country north of Sonora, whose wealth was pictured in the hearsay stories of Alvar Nuñez Cabeza de Vaca. Preceded by Estevanico, the negro companion of Cabeza de Vaca in his wanderings and the "Black Mexican" of Zuñi traditions, Fray Marcos left Culiacan in March 1539, crossed south-eastern Arizona, penetrated to Zuñi or the "Seven Cities of Cibola," and in September returned to Culiacan. He saw Zuñi only from a distance, and his description of it as equal in size to the city of Mexico was probably exact; but he embodied much mere hearsay in his report, the *Descubrimiento de las siete ciudades*, which led F. V. de Coronado to make his famous expedition next year to Zuñi, of which Fray Marcos was the guide; and the realities proved a great disappointment. Fray Marcos was made Provincial of his order for Mexico before the second trip to Zuñi, and returned in 1541 to the capital, where he died on the 25th of March 1558.

The *Descubrimiento* is one of the world's famous narratives of travel. It may be found in J. F. Pacheco's *Documentos* (vol. iii.) and Hakluyt's *Voyages* (vol. iii.); also in G. Ramusio, *Navigazione* (vol. iii.) and H. Ternaux-Compans, *Voyages* (vol. iii.). See A. F. A. Bandelier, *The Gilded Man* (*El Dorado*), (New York, 1893); H. H. Bancroft, *Arizona and New Mexico* (San Francisco, 1888), and, for critical opinions, G. P. Winship, "The Coronado Expedition," in *U.S. Bureau of Ethnology, Fourteenth Annual Report* (for 1892–1893), (Washington, 1896).

MARCOU, JULES (1824-1898), an eminent Swiss-American geologist, was born at Salins, in the department of Jura, in France, on the 20th of April 1824. He was educated at Besançon and at the college of St Louis, Paris. He worked in early years with J. Thurmann (1804–1855) on the geology of the Jura mountains. In 1847 he went to North America as travelling geologist for the *Jardin des Plantes*, and in the following year in Boston he joined Agassiz, whom he had met in Switzerland, and accompanied him to the Lake Superior region. Marcou spent two years in studying the geology of various parts of the United States and Canada, and returned to Europe for a short time in 1850. In 1853 he published a *Geological Map of the United States, and the British Provinces of North America.* In 1855 he became professor of geology and palaeontology at the polytechnic school of Zurich, but relinquished this office in 1859, and in 1861 again returned to the United States, when he assisted Agassiz in founding the Museum of Comparative Zoology. In 1861 he published his *Geological Map of the World* (2nd ed. 1875). Of his published papers the more noteworthy are those on the Jura-Cretaceous formations of the Jura, on the "Dyas" (Permian) of Nebraska, and on the Taconic rocks of Vermont and Canada. His other works include *Lettres sur les roches du Jura et leur distribution géographique dans les deux hémisphères* (1857–1860) and *Geology of North America* (1858). Marcou died at Cambridge, Mass., on the 17th of April 1898.

MARCUS AURELIUS ANTONINUS (121–180), Roman emperor and Stoic philosopher, was born in Rome A.D. 121, the date of his birth being variously stated as the 6th, 21st and 26th of April.

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[1] Marcion was the earliest critical student of the New Testament canon and text. It is noteworthy that he refused to admit the genuineness of the Pastoral Epistles and said that the letter to the Ephesians was really addressed to the Laodiceans (Tertullian, *Adv. Marc.* v. 11, 21).—(Ed.)

[2] Some have seen a reference to this work in 1 Tim. vi. 20.—(Ed.)

His original name was Marcus Annius Verus.[1] His mother Domitia Calvilla (or Lucilla) was a lady of consular rank, and the family of his father Annius Verus (prefect of the city and thrice consul), originally Spanish, had received patrician rank from Vespasian. Marcus was three months old when his father died, and was thereupon adopted by his grandfather. The moral training which he received from his grandfather and his mother must have been all but perfect. The noble qualities of the child attracted the attention of Hadrian, who, playing upon the name "Verus," said that it should be changed to "Verissimus" (BHPICCIMOC on medals). Hadrian adopted, as his successor, Titus Antoninus Pius (uncle of Marcus), on condition that he in turn adopted both Marcus (then seventeen) and Lucius Ceionius Commodus, the son of Aelius Caesar, who had originally been intended by Hadrian as his successor, but had died before him. Marcus had been, at the age of fifteen, betrothed to Fabia, the sister of Commodus; the engagement was broken off by Antoninus Pius, and he was betrothed to Faustina, the daughter of the latter. In 139 the title of Caesar was conferred upon him and he dropped the name of Verus. The full name he then bore was Marcus Aelius Aurelius Antoninus, Aelius coming from Hadrian's family, and Aurelius being the original name of Antoninus Pius. In 140 he was made consul.

The education of Aurelius in his youth was minute (see *Medit.* i. 1–16). A better guardian than Antoninus Pius could not be conceived. Marcus himself says, "To the gods I am indebted for having good grandfathers, good parents, a good sister, good teachers, good associates, good kinsmen and friends, nearly everything good." He was educated, not at school, but by tutors, Herodes Atticus and M. Cornelius Fronto (*q.v.*) in the usual curriculum of rhetoric and poetry; but at the age of eleven he became acquainted with Diognetus the painter and Stoic philosopher (*Hist. script. aug.* i. 305, notes), was fascinated by the philosophy he taught, assumed the dress of his sect, and ultimately abandoned rhetoric and poetry for philosophy and law, having among his teachers of the one Sextus of Chaeronea, grandson of Plutarch, and later Q. Junius Rusticus, and of the other L. Volusius Maecianus (or Metianus), a distinguished jurist. He went thoroughly into the practice as well as the theory of Stoicism, and lived so abstemious and laborious a life that he injured his health. From his Stoic teachers he learned to work hard, to deny himself, to avoid listening to slander, to endure misfortunes, never to deviate from his purpose, to be grave without affectation, delicate in correcting others, "not frequently to say to any one, nor to write in a letter, that I have no leisure," nor to excuse the neglect of duties by alleging urgent occupations. Through all his Stoical training Aurelius preserved the natural sweetness of his nature.

During the reign of Antoninus Pius (138 to 161), the concord between him and Aurelius was complete; Capitolinus (*c.* 7) says "nec praeter duas noctes per tot annos mansit diversis vicibus." The two were associated in the administration and in the simple country occupations of the seaside villa of Lorium, the birthplace of Pius, to which he loved to retire. It has been assumed on the strength of a passage in Capitolinus that Aurelius married Faustina in 146, but the passage is not clear, and other evidence points strongly to 140; at all events it seems certain that a daughter was born to him in 140. Antoninus Pius died in 161, having recommended as his successor Aurelius, then forty years of age, without mentioning Commodus, his other adopted son, commonly called Lucius Verus. It is believed that the senate urged Aurelius to take the sole administration. But he showed the magnanimity of his nature by at once admitting Verus as his partner, giving him the tribunician and proconsular powers, and the titles Caesar and Augustus. This was the first time that Rome had two emperors as colleagues. Verus, a weak, self-indulgent man, had a high respect for his adoptive brother, and deferred uniformly to his judgment. In the first year of his reign Faustina gave birth to twins, one of whom became the emperor Commodus.

The early part of the reign of Aurelius was clouded by national misfortunes. An inundation of the Tiber swept away a large part of Rome, destroying fields, drowning cattle, and causing a famine (162); then came earthquakes, fires and plagues of insects; the soldiers in Britain tried to induce their general Statius Priscus to proclaim himself emperor; finally, the Parthians under Vologaeses III. resumed hostilities, annihilated the Roman forces under Severianus at Elegia in Cappadocia, and devastated Syria. Verus, originally a man of considerable courage and ability, was sent to oppose the Parthians, but gave himself up to sensual excesses, and the Roman cause in Armenia would have been lost, and the empire itself, perhaps, imperilled, had not Verus had under him able generals,[2] the chief of whom was Avidius Cassius (see CASSIUS, AVIDIUS). By them the Parthian War was brought to a conclusion in 165, but Verus and his army brought back with them a terrible pestilence, which spread through the whole empire. The people seem to have thought that the last days of the empire had come. The Parthians had at the best been beaten, not subdued; the Britons threatened revolt; there were signs that various tribes beyond the Alps intended to break into Italy. Indeed, the bulk of the reign of Aurelius was spent in efforts to ward off the attacks of the barbarians. He went himself to the wars with Verus in 167, first to Aquileia and then on into Pannonia and Noricum, wintering at Sirmium in Pannonia. Ultimately the Marcomanni, the fiercest of the tribes that inhabited the country between Illyria and the sources of the Danube, sued for peace in 168. In January or February 169 Verus died at Altinum, apparently of apoplexy, though some ventured to say that he was poisoned by Aurelius.

Aurelius was thenceforth indisputed master of the empire, during one of the most troubled periods of its history. His reign is well described by F. W. Farrar (*Seekers after God*): "He regarded himself as being, in fact, the servant of all. The registry of the citizens, the suppression of litigation, the elevation of public morals, the care of minors, the retrenchment of public expenses, the limitation of gladiatorial games and shows, the care of roads, the restoration of senatorial privileges, the appointment of none but worthy magistrates, even the regulation of street traffic, these and numberless other duties so completely absorbed his attention that, in spite of indifferent health, they often kept him at severe labour from early morning till long after midnight. His position, indeed, often necessitated his presence at games and shows, but on these occasions he occupied himself either in reading, in being read to, or in writing notes. He was one of those who held that nothing should be done hastily, and that few crimes were worse than the waste of time." The comprehensiveness of his legal and judicial reforms is very striking. Slaves, heirs, women and children, were benefited, and he made serious attempts to deal with the steady fall in the birth-rate of legitimate children.

In the autumn of 169 two of the German tribes, the Quadi and the Marcomanni, with their allies the Vandals, Iazyges and Sarmatians, renewed hostilities and, for three years, Aurelius resided almost constantly at Carnuntum. In the end the Marcomanni were driven out of Pannonia, and were almost destroyed in their retreat across the Danube. In 174 Aurelius gained over the Quadi a decisive victory, which is commemorated by one of the sculptures on the column of Antonine. The story is that the Romans, entangled in a defile, were suffering from thirst. A sudden storm gave abundance of rain, while hail and thunder confounded their enemies, and enabled the Romans to gain an easy and complete victory. This triumph was universally considered at the time, and for long afterwards, to have been a miracle, and bore the title of "The Miracle of the Thundering Legion." The pagan writers (*e.g.* Dio Cassius, lxx. 8–10) ascribed the victory to the magic arts of an Egyptian named Arnuphis who prevailed on Mercury and other gods to give relief, while the Christians attributed it to the prayers of their brethren in a legion to which, they affirmed, the emperor then gave the name of "The Thundering." Dacier, however, and others who adhere to the Christian view of the miracle, admit that the appellation of "Thundering" or "Lightning" (*κεραυνοβόλος*, or *κεραυνοφόρος*) was given to the legion because there was a figure of lightning on their shields. It has also been virtually proved that it had the title even in the reign of Augustus.

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[1] Capitolinus states that he was originally called Catilius Severus after his mother's grandfather; if so the name was early discarded.

[2] Aurelius has been severely criticized for sending Verus. Among various reasons, the most convincing is that the presence of Aurelius was required in Rome; moreover, the real leader was evidently Cassius.

Aurelius next marched to Germany. There news reached him that Avidius Cassius, the commander of the Roman troops in Asia, had revolted and proclaimed himself emperor (175). But after three months Cassius was assassinated, and his head was brought to Aurelius, who with characteristic magnanimity, persuaded the senate to pardon all the family of Cassius. It is a proof of the wisdom of Aurelius's clemency that he had little or no trouble in pacifying the provinces which had been the scene of rebellion. He treated them all with forbearance, and it is said that when the correspondence of Cassius was brought him he burnt it without reading it. During his journey of pacification, Faustina, who had borne him eleven children, died. Dio Cassius and Capitolinus charge Faustina with the most shameless infidelity to her husband, who is even blamed for not paying heed to her crimes. But none of these stories rests on trustworthy evidence; on the other hand, there can be no doubt that Aurelius trusted her while she lived, and mourned her loss.

After the death of Faustina and the pacification of Syria, Aurelius proceeded, on his return to Italy, through Athens, and was initiated in the Eleusinian mysteries, the reason assigned for his doing so being that it was his custom to conform to the established rites of the countries he visited. He gave large sums of money for the endowment of chairs in philosophy and rhetoric, with a view to making the schools the resort of students from all parts of the empire. Along with his son Commodus he entered Rome in 176, and obtained a triumph for victories in Germany. In 177 occurred that persecution of Christians, the share of Aurelius in which has been the subject of so much controversy. Meanwhile the German War continued, and the two Quintilii, who had been left in command, begged Aurelius once more to take the field. In this campaign Aurelius, after a series of successes, was attacked, according to some authorities, by an infectious disease, of which he died after a seven days' illness, either in his camp at Sirmium (Mitrovitz), on the Save, in Lower Pannonia, or at Vindobona (Vienna), on the 17th of March 180, in the fifty-ninth year of his age. Other accounts are: (1) that he was poisoned in the interests of Commodus (Dio. Cass. lxxi. 33, 4), (2) that he died of a chronic stomachic disease; the latter is perhaps the most likely. His ashes (according to some authorities, his body) were taken to Rome. By common consent he was deified and all those who could afford the cost obtained his statue or bust; for a long time his statues held a place among the penates of the Romans. Commodus, who was with his father when he died, erected to his memory the Antonine column (now in the Piazza Colonna at Rome), round the shaft of which are sculptures in relief commemorating the miracle of the Thundering Legion and the various victories of Aurelius over the Quadi and the Marcomanni. A bronze equestrian statue was set up in the Forum, now on the Capitol.

Aurelius throughout his reign was hostile to Christianity. The Christians suffered from systematic persecution, and many historians, with a strange lack of historical insight, have poured denunciation upon him for an attitude which was the natural outcome of his convictions. During his reign the atmosphere of Roman society was heavily charged with the popular Greek philosophy to which, ethics apart, Christianity was diametrically opposed. Under Antoninus the "pursuit" of Christians was unknown; under Trajan and Hadrian it was forbidden (cf. Keim, *Aus dem Urchrist*, p. 99). But Aurelius was an eager patriot and a man of logical mind. From his earliest youth he had learned to identify the ritual of the Roman religion with the very essence of the imperial idea. He became a Salian priest at the age of eight, and soon knew by heart all the forms and liturgical order of the official worship, and even the sacred music. In the earliest statue we have he is a youth offering incense; he is a priest at the sacrificial altar in the latest triumphal reliefs. Naturally he felt that the prevalence of Christianity was incompatible with his ideal of Roman prosperity, and therefore that the policy of the Flavian emperors was the only logical solution of an important problem. Neumann argued that the recrudescence of active persecution was initiated by a deliberate *ad hoc* rescript issued probably in A.D. 176. Sir W. M. Ramsay, however, doubts this (*The Church in the Roman Empire*, London, 1893), and argues that it was due to a long series of instructions to provincial governors (*mandata*, not *decreta*) who interpreted their duty largely in conformity with the attitude of the reigning emperor. In other words the governors were ordered merely to punish sacrilege, and, under Aurelius, Christianity was regarded as such. In the second place, though it is true that the persecutions indicated by Celsus (Origen, *Celsus*, viii. 69), Justin, Melito (in Eusebius, *H.E.*, iv. 26), Athenagoras (*Libellus pro Christianis*) and the *Acts of Martyrs*, were greatly in excess of those recorded in previous reigns, it must not be forgotten that it was only in this period that the Christians began to keep records. Thirdly, there can be no doubt that the Christians had recently assumed a much bolder attitude, and thus segregated themselves from the mass of those unorthodox sects which the Roman could afford to despise. Like the Druids in Gaul (cf. T. Mommsen, *Prov. Rom. Emp.*, Eng. trans. i. 105, and V. Duruy, *Rev. archéol.*, Apr. 1880), the Christians were particularly dangerous, inasmuch as they taught a unity which transcended that of the Roman Empire, and must, therefore, have been regarded as antagonistic to the existing political and social organism.

When, therefore, we remember that Aurelius knew little of the Christians, that the only mention of them in the *Meditations* is a contemptuous reference to certain fanatics of their number whom even Clement of Alexandria compares for their thirst for martyrdom to the Indian gymnosophists, and finally that the least worthy of them were doubtless the most prominent, we cannot doubt that Aurelius was acting unquestionably in the best interests of a perfectly intelligible ideal. He was "Roman in resolution and repression, Roman in civic nobility and pride, Roman in tenacity of imperial aim, Roman in respect for law, Roman in self-effacement for the service of the State" (G. H. Rendall).

Philosophy.—The book which contains the philosophy of Aurelius is known by the title of his *Reflections*, or *Meditations*, although that is not the name which he gave to it himself (Τὰ εἰς ἑαυτόν). Of the genuineness of the work no doubts are now entertained. It is believed that he wrote also an autobiography, which has perished. The *Meditations* were written, it is evident, as occasion offered—in the midst of public business, and on the eve of battles on which the fate of the empire depended—hence their fragmentary appearance, but hence also much of their practical value and even of their charm. It is believed by many critics that they were intended for the guidance of Aurelius's son, Commodus (*q.v.*); at all events they are generally considered as one of the most precious of the legacies of antiquity. Renan even called them "the most human of all books," and they are described by J. S. Mill in his *Utility of Religion* as almost equal in ethical elevation to the Sermon on the Mount.

Aurelius throughout his life adhered to the Stoical philosophy. But, as Tenneman says, he imparted to it "a character of gentleness and benevolence, by making it subordinate to a love of mankind, allied to religion." His thoughts represent a transitional movement, and it is difficult to discover in them anything like a systematic philosophy. From the manner, however, in which he seeks to distinguish between matter and cause or reason, and from the earnestness with which he advises men to examine all the impressions on their minds, it may be inferred that he held the view of Anaxagoras—that God and matter exist independently, but that God governs matter. There can be no doubt that Aurelius believed in a deity, although Schultz is probably right in maintaining that all his theology amounts to this—the soul of man is most intimately united to his body, and together they make one animal which we call man; and so the deity is most intimately united to the world or the material universe, and together they form one whole. We find in the *Meditations* no speculations on the absolute nature of the deity, and no clear expressions of opinion as to a future state.

We may also observe here that, like Epictetus, he is by no means so decided on the subject of suicide as the older Stoics. Aurelius is, above all things, a practical moralist. The goal in life to be aimed at, according to him, is not happiness, but tranquillity, or equanimity. This condition of mind can be obtained only by "living conformably to nature," that is to say, one's whole nature, and as a means to that man must cultivate the four chief virtues, each of which has its distinct sphere—wisdom, or the knowledge of good and evil; justice, or the giving to every man his due; fortitude, or the enduring of labour and pain; and temperance, or moderation in all things. It is no "fugitive and cloistered virtue" that Aurelius seeks to encourage; on the contrary, man must lead the "life of the social animal," must "live as on a mountain"; and "he is an abscess on the universe who withdraws and separates himself from the reason of our common nature through being displeased with the things which happen." While the prime principle in man is the social, "the next in order is not to yield to the persuasions of the body, when they are not conformable to the rational principle which must govern." This divinity "within a man," this "legislating faculty," which, looked at from one point of view, is conscience, and from another is reason, must be implicitly obeyed. He who thus obeys it will attain tranquillity of mind; nothing can irritate him, for everything is according to nature, and death itself "is such as generation is, a mystery of nature, a composition out of the same elements, and a decomposition into the same, and altogether not a thing of which any man should be ashamed, for it is not contrary to the nature of a reasonable animal, and not contrary to the reason of our constitution."

The morality of Marcus Aurelius cannot be said to have been new when it was given to the world. Its charm lies in its exquisite accent and its infinite tenderness. But above all, what gives the sentences of Marcus Aurelius their enduring value and fascination, and renders them superior to the utterances of Epictetus and Seneca, is that they are the gospel of his life. His precepts are simply the records of his practice. To the saintliness of the cloister he added the wisdom of the man of the world; he was constant in misfortune, not elated by prosperity, never "carrying things to the sweating-point," but preserving, in a time of universal corruption, unreality and self-indulgence, a nature sweet, pure, self-denying, unaffected.

BIBLIOGRAPHY.—P. B. Watson's *M. Aurelius Antoninus* (1884) contains a general account—life, character, philosophy, relations with Christianity—as well as a bibliography; see also art. in Pauly-Wissowa, *Realencyclopädie, s.v.* "Annius" (No. 94), col. 2279. For special points see: (1) *Historical*: Authorities under ROME: *Ancient History*; S. Dill, *Roman Society from Nero to M. Aurelius* (London, 1904). (2) *Relations to Christianity*: Sir W. M. Ramsay, *op. cit.*; W. Moeller, *History of the Christian Church*, A.D. 1–600 (Eng. trans., A. Rutherford, 1892); W. E. Addis, *Christianity and the Roman Empire* (1893); E. G. Hardy, *Christianity and the Roman Government* (1894), pp. 145 sqq., which criticizes both Neumann and Ramsay; Leonard Alston, *Stoic and Christian of the 2nd century* (1906); J. Dartigue-Peyrou, *Marc-Aurèle dans ses rapports avec le christianisme* (Paris, 1897). (3) *Philosophical*: Besides article STOICS, E. Renan, *Marc. Antoninus et la fin du monde antique* (Paris, 1882; Eng. trans., W. Hutchinson, 1904); W. Pater, *Marius the Epicurean* (London, 1888); Matthew Arnold's *Essays*; C. H. W. Davis, *Greek and Roman Stoicism* (1903); editions of the *Meditations* (5, below). (4) *Military*: E. Napp, *De rebus imperat. M. Aurel. Anton. in oriente gestis* (Bonn, 1879); Conrad, *Mark Aurels Markomannenkrieg* (1889); Th. Mommsen, *Provinces of the Roman Empire* (Eng. trans., W. P. Dickson, London, 1886); for the Aurelius column, E. Petersen, A. von Domaszewski, and G. Calderini, *Die Marcussäule* (Munich, 1896), with historical introduction by Th. Mommsen. (5) The *Meditations* were published by Xylander in 1558; the best critical edition is that of J. Stich in the Teubner series (Leipzig, 1882; 2nd ed., 1903); textual emendations also in *Journal of Philology*, xxiii. 116-160 (G. H. Rendall); *Classical Review*, xix. (1905), pp. 18 sqq. (Herbert Richards), ibid., pp. 301 sqq. (A. J. Kronenberg). Translations exist in almost every language; that of George Long (London, 1862, re-edited 1900) has been superseded by those of G. H. Rendall (London, 1898, with valuable introduction) and J. Jackson (Oxford, 1906, with introduction by Charles Bigg). (6) For a full account of the correspondence of Aurelius and Fronto, see Robinson Ellis, *Correspondence of Fronto and M. Aurelius* (Oxford, 1904). (J. M. M.)

MARCY, WILLIAM LEARNED (1786–1857), American statesman, was born in Southbridge (then part of Sturbridge), Massachusetts, on the 12th of December 1786. He graduated at Brown University in 1808, studied law, was admitted to the bar in Troy, New York, and began practice there in 1810. During the War of 1812 he served first as a lieutenant and afterwards as a captain of volunteers, and on the 22nd of October 1812 took part in the storming of the British post at St Regis, Canada. In 1816 he became recorder of Troy, but as he sided with the Anti-Clinton faction of the Democratic-Republican Party, known as the "Bucktails," he was removed from office in 1818 by his political opponents. As editor of the Troy *Budget* (daily) he was a vigorous supporter of Martin Van Buren, and when Van Buren's followers acquired control of the legislature in 1821 Marcy was made adjutant-general of the New York militia. From 1823 to 1829 Marcy was comptroller of the state, an office then especially important on account of the large expenditures for internal improvements, and during this period he became the leading member of the famous "Albany Regency," a group of able Democratic politicians who exerted a powerful influence throughout the state by their control of the party patronage and machinery. He was one of the associate justices of the New York Supreme Court from 1829 to 1831, presiding over the trial of the alleged murderers of William Morgan and in other important cases; and was a member of the United States Senate from December 1831 to July 1832, when he resigned to become governor of New York. In a speech in the Senate defending Van Buren against an attack by Henry Clay, Marcy made the unfortunate remark that "to the victors belong the spoils of the enemy," and thereby became widely known as a champion of the proscription of political opponents. He served as governor of New York for six years (Jan. 1, 1833 to Dec. 31, 1838), but was defeated in 1838 by the Whig candidate, William H. Seward. As governor he checked the issue of bank charters by the legislature and secured the enactment, in 1838, of a general banking law, which abolished the monopoly features incident to the old banking system. In 1839–1842 Marcy was a member of a commission appointed by President Van Buren, in accordance with the treaty of 1839 between the United States and Mexico to "examine and decide upon" certain claims of citizens of the United States against Mexico. In 1843 he presided over the Democratic state convention at Syracuse, and in 1844–1845 he was recognized as one of the leaders of the "Hunkers," or regular Democrats in New York, and an active opponent of the "Barnburners." He was secretary of war under President Polk from 1845 to 1849, and as such discharged with ability the especially onerous duties incident to the conduct of the Mexican War; he became involved, however, in controversies with Generals Scott and Taylor, who accused him, it seems very unjustly, of seeking to embarrass their operations in the field because they were political opponents of the administration. In the Democratic convention at Baltimore, in 1852, Marcy was a prominent candidate for the presidential nomination, and from 1853 to 1857 he was secretary of state in the cabinet of President Pierce. Few cabinet officers in time of peace have had more engrossing duties. His circular of the 1st of June 1853 to American diplomatic agents abroad, recommending that, whenever practicable, they should "appear in the simple dress of an American citizen," created much discussion in Europe; in 1867 his recommendation was enacted into a law of Congress. One of the most important matters with which he was called upon to deal was the "Koszta Affair";[1] his "Hülsemann letter" (1853), is an important state paper, and the principles it enunciates have been approved by leading authorities on international law. In the same year he secured the negotiation of the Gadsden Treaty (see GADSDEN, JAMES), by which the boundary dispute between Mexico and the United States was adjusted and a large area was added to the Federal domain; and in June 1854 he concluded with Lord Elgin, governor-general of Canada, acting for the British Government, a treaty designed to settle the fisheries question and providing for tariff reciprocity (as regards certain enumerated commodities) between Canada and the United States. In 1854 Marcy had to deal with the complications growing out of the bombardment of San Juan del Norte (Greytown), Nicaragua, by the United States sloop-of-war "Cyane" for insults offered the American minister by its inhabitants and for their refusal to make restitution for damages to American property. The expedition of William Walker (*q.v.*) to Nicaragua in 1855 further complicated the Central American question. The Crimean War, on account of the extensive recruiting therefor by British consuls in several American cities, in violation of American neutrality, led to a diplomatic controversy with Great Britain, and in May 1856 the British minister, John F. T. Crampton (1805–1886), received his passports, and the exequaturs of the British consuls at New York, Philadelphia and Cincinnati were revoked. The incident created great excitement in England, but in 1857 the British government sent Sir Francis Napier to Washington to take Crampton's place. To the Declaration of Paris of 1856, prescribing certain rules of naval warfare, Marcy on behalf of his government refused to subscribe, because Great Britain had rejected his proposed amendment exempting from seizure in time of war all private property not contraband. The diplomatic relations of the United States and Spain furnished, perhaps, the most perplexing of Marcy's problems. Upon the seizure (on Feb. 28, 1854) of the American vessel "Black Warrior," the confiscation of her cargo, and the fining of her captain by the Cuban authorities, on the ground that this vessel had violated the customs regulations of the port of Havana, slavery propagandists sought to force the administration into an attitude that would lead to war with Spain and make possible the seizure of Cuba; and it was largely due to Marcy's influence that war was averted, Spain restoring the confiscated cargo and remitting the captain's fine.[1] The secretary, however, was not averse to increasing his popularity and his chances for the presidency by obtaining Cuba in an honourable manner, and it was at his suggestion that James Buchanan, J. Y. Mason and Pierre Soulé, the ministers respectively to Great Britain, France and Spain, met at Ostend and Aix-la-Chapelle in October 1854 to discuss the Cuban question. But the remarkable "Ostend Manifesto" (see BUCHANAN, JAMES), the outcome of their conference, was quite unexpected, and Marcy promptly disavowed the document. Marcy died at Ballston Spa, New York, on the 4th of July 1857, a short time after the close of Pierce's administration. In domestic affairs Marcy was a shrewd, but honest partisan; in diplomacy he exhibited the qualities of a broad-minded, patriotic statesman, endowed, however, with vigour, rather than brilliancy, of intellect.

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[1] The "Koszta Affair" involved an interesting question of international law—*i.e.* the right of an alien domiciled in any country to the protection of that country—and has served as a precedent for the American government in somewhat similar cases that have arisen. Martin Koszta, a Hungarian revolutionist of 1848, had emigrated to the United States and had there taken the preliminary step for naturalization by formally declaring his intention to become a citizen of the United States. In 1853 he went on personal business to Smyrna, where he secured a passport from the American consul; the Austrian consul, however, caused him to be seized and detained on an Austrian brig-of-war. Soon afterward Captain Duncan N. Ingraham (1802–1891), in command of a United States sloop-of-war, arrived at Smyrna, and threatened to attack the Austrian vessel unless Koszta were released; and as a compromise Koszta was placed in the custody of the French consul. To Chevalier Hülsemann, then representing Austria at Washington, who had demanded from the United States the disavowal of the acts of its agents, the complete surrender of Koszta, and "satisfaction proportionate to the magnitude of the outrage," Marcy wrote on the 26th of September 1853, that Koszta "when seized and imprisoned was invested with the nationality of the United States" and had a right to the protection of the United States government, and added: "Whenever by the law of nations an individual becomes clothed with our national

For his early career, consult J. S. Jenkins, *Lives of the Governors of New York* (Auburn, New York, 1851), and for his work as secretary of state, see James Ford Rhodes, *History of the United States* (vols. i. and ii., New York, 1892), and an article by Sidney Webster, "Mr Marcy, the Cuban Question, and the Ostend Manifesto," in vol. viii. of the *Political Science Quarterly* (New York, 1893).

MARDIN, the chief town of a sanjak of the Diarbekr vilayet of Asiatic Turkey. It is a military station on the Diarbekr-Mosul road. It occupies a remarkable site on the south side of a conical hill of soft limestone, and the houses rise tier above tier. The streets are narrow and paved in steps, while often the roadway runs along the roof of the house in the tier below. The hill is almost surrounded by old walls, while on the summit are the remains of the famous castle of the Kaleh Shubha (Lat. *Maride* or *Marde*,) which from Roman times has played an important part in history. The Arab geographers considered it impregnable, and from its steep approaches and well-arranged defences it was able to offer a protracted resistance to the Mongolian conqueror Hulagu and to the armies of Timur. It was also for several centuries the residence of more or less independent princes of the Ortokid Turkoman dynasty. The climate is healthy and dry, and fruit grows well, but water is sometimes scanty in the summer. Mardin is the centre of a good corn-growing district, and is important chiefly as a border town for the Kurds on the north and the Arab tribes to the south. It is the chief centre of the Jacobite Christians, who have many villages in the Tor Abdin hills to the north-east, and whose patriarch lives at Deir Zaferan, a Syrian monastery of the 9th century not far off in the same direction. The population is estimated at 27,000, of whom about one-half are Christians of the Armenian, Chaldean, Jacobite, Protestant and Roman Catholic communities. Besides many mosques and churches there are three monasteries (Syrian, Franciscan and Capuchin), and an important American Mission station, with church, schools and a medical officer.

MARDUK (Bibl. MERODACH[2]), the name of the patron deity of the city of Babylon, who, when Babylon permanently became the political centre of the united states of the Euphrates valley under Khammurabi (*c.* 2250 B.C.), rose to the position of the head of the Babylonian pantheon. His original character was that of a solar deity, and he personifies more specifically the sun of the spring-time who conquers the storms of the winter season. He was thus fitted to become the god who triumphs over chaos that reigned in the beginning of time. This earlier Marduk, however, was effaced by the reflex of the political development through which the Euphrates valley passed and which led to imbuing him with traits belonging to gods who at an earlier period were recognized as the heads of the pantheon. There are more particularly two gods—Ea and Bel—whose powers and attributes pass over to Marduk. In the case of Ea the transfer proceeds pacifically and without involving the effacement of the older god. Marduk is viewed as the son of Ea. The father voluntarily recognizes the superiority of the son and hands over to him the control of humanity. This association of Marduk and Ea, while indicating primarily the passing of the supremacy once enjoyed by Eridu to Babylon as a religious and political centre, may also reflect an early dependence of Babylon upon Eridu, not necessarily of a political character but, in view of the spread of culture in the Euphrates valley from the south to the north, the recognition of Eridu as the older centre on the part of the younger one. At all events, traces of a cult of Marduk at Eridu are to be noted in the religious literature, and the most reasonable explanation for the existence of a god Marduk in Eridu is to assume that Babylon in this way paid its homage to the old settlement at the head of the Persian Gulf.

While the relationship between Ea (*q.v.*) and Marduk is thus marked by harmony and an amicable abdication on the part of the father in favour of his son, Marduk's absorption of the power and prerogatives of Bel of Nippur was at the expense of the latter's prestige. After the days of Khammurabi, the cult of Marduk eclipses that of Bel (*q.v.*), and although during the five centuries of Cassite control in Babylonia (*c.* 1750–1200 B.C.), Nippur and the cult of the older Bel enjoy a period of renaissance, when the reaction ensued it marked the definite and permanent triumph of Marduk over Bel until the end of the Babylonian empire. The only serious rival to Marduk after 1200 B.C. is Assur (*q.v.*) in Assyria. In the south Marduk reigns supreme, and his supremacy is indicated most significantly by making him the *Bel*, "the lord," *par excellence*.

The old myths in which Bel of Nippur was celebrated as the hero were transformed by the priests of Babylon in the interest

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character—he can claim the protection of this government, and it may respond to that claim without being obliged to explain its conduct to any foreign power; for it is its duty to make its nationality respected by other nations and respectable in every quarter of the globe." Eventually Koszta was released and returned to the United States. The Hülsemann letter was published and greatly increased Marcy's popularity.

[1] See Henry L. James, "The Black Warrior Affair" in the *American Historical Review*, vol. xii. (1907).

[2] The name Mordecai denotes "belonging to Maduk."

of the Marduk cult with the chief rôle assigned to their favourite. The hymns once sung in the temple of Bel were re-edited and adapted to the cult of Babylon. In this process the older Bel was deliberately set aside, and the climax was reached when the conquest of the monster Tiamat, symbolizing the chaos prevailing in primeval days, was ascribed to Marduk instead of, as in the older form of the epic, to Bel. With this stroke Marduk became the creator of the world, including mankind—again setting aside the far older claims of Bel to this distinction.

Besides absorbing the prerogatives of Ea and Bel, Marduk was also imbued with the attributes of other of the great gods, such as Adad, Shamash, Nergal and Ninib, so that, more particularly as we approach the days of the Neo-Babylonian Empire, the impression is created that Marduk was the only real deity recognized, and that the other gods were merely the various forms under which he manifested himself. So far as one can speak of a monotheistic tendency in Babylonia it connects itself with this conception that was gradually crystallized in regard to the old solar deity of Babylon.

The history of the city of Babylon can now be traced back to the days of Sargon of Agade (before 3000 B.C.) who appears to have given the city its name. There is every reason to assume, therefore, that the cult of Marduk existed already at this early period, though it must always be borne in mind that, until the days of Khammurabi, his jurisdiction was limited to the city of which he was the patron and that he was viewed solely as a solar deity.

On monuments and cylinders he is represented as armed with the weapon with which he despatched the monster Tiamat. At times this monster is also depicted lying vanquished at his feet, and occasionally the monster with the lance or the lance alone is reproduced instead of the god himself.

In the astral-theological system, Marduk is identified with the planet Jupiter. As the creator of the world, the New Year's festival, known as Zagmuk and celebrated at the time of the vernal equinox, was sacred to him. The festival, which lasted for eleven days, symbolized the new birth of nature—a reproduction therefore of the creation of the world. The arbiter of all fates, Marduk, was pictured as holding an assembly of the gods during the New Year's festival for the purpose of deciding the lot of each individual for the year to come. The epic reciting his wonderful deed in despatching the monster Tiamat and in establishing law and order in the world in the place of chaos was recited in his temple at Babylon known as E-Saggila, "the lofty house," and there are some reasons for believing that the recital was accompanied by a dramatical representation of the epic.

The meaning of the name Marduk is unknown. By a species of word-play the name was interpreted as "the son of the chamber," with reference perhaps to the sacred chamber of fate in which he sat in judgment on the New Year's festival. Ideographically he is represented by two signs signifying "child of the day" (or "of the sun") which is a distinct allusion to his original solar character. Other ideographic signs describe him as the "strong and universal ruler." The name of his consort was Sarpanit, *i.e.* the shining or brilliant one—again an allusion to Marduk's solar traits—and this name was playfully twisted by the Babylonian priests to mean "the seed-producing" (as though compounded of *zēr*, seed, and *bānit*, producing, which was regarded as an appropriate appellation for the female counterpart of the creator of mankind and of life in general. The punning etymology betrays the evident desire of the priests to see in Marduk's consort a form or manifestation of the great mother-goddess Ishtar (*q.v.*), just as in Assyria Ishtar frequently appears as the consort of the chief god of Assyria, known as Assur (*q.v.*). (M. Ja.)

MARE, the English term for the female of any animal of the family *Equidae*, of the ass, or zebra, but particularly of the horse. It is also used of the camel. To find a "mare's nest" is an old proverbial saying for a purely imaginary discovery. In "night-mare," an oppressive or terrifying dream, the termination is a word appearing as *mar*, *maer* and *mara* in various Teutonic languages for a goblin, supposed to sit on a sleeper's chest and cause these dreams: cf. elf. This Teutonic word also appears in the French *cauchemar*, the first part being from *caucher*, to tread or trample upon, Lat. *calcare*.

MARE CLAUSUM and **MARE LIBERUM** (Lat. for "closed sea" and "free sea"), in international law, terms associated with the historic controversy which arose out of demands on the part of different states to assert exclusive dominion over areas of the open or high sea. Thus Spain laid claim to exclusive dominion over whole oceans, Great Britain to all her environing narrow seas and so on. These claims gave rise to vigorous opposition by other powers and led to the publication of Grotius's work (1609) called *Mare liberum*. In *Mare clausum* (1635) John Selden endeavoured to prove that the sea was practically as capable of appropriation as territory. Owing to the conflict of claims which grew out of the controversy, maritime states had to moderate their demands and base their pretensions to maritime dominion on the principle that it extended seawards from land.

A formula was found by Bynkershoek in his *De dominio maris* (1702) for the restriction of dominion over the sea to the actual distance to which cannon range could protect it. This became universally adopted and developed into the three-mile belt (see Territorial Waters). In recent times controversies have arisen in connexion with the Baltic, the Black Sea and more especially the Bering Sea. In the latter case the United States, after the purchase of Alaska, vainly attempted to assert dominion beyond the three-mile limit. Still more recently the hardship of treating the greater part of Moray Firth as open sea to the exclusion of British and to the advantage of foreign fishermen has been raised (see North Sea Fisheries Convention; Territorial Waters).

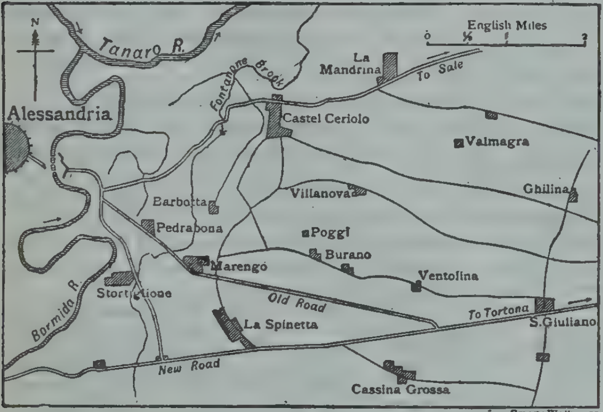
Conventions for the suppression of the slave trade, including the Brussels General Act of 1885, and the North Sea Fisheries Convention, have placed restrictions on the freedom of the high sea, and possibly, in the general interest, other agreements will bring it further under control, on the principle that what is the property of all nations must be used without detriment to its use by others (see High Seas). (T. Ba.)

MAREE, LOCH, a fresh-water lake in the county of Ross and Cromarty, Scotland. Its name—of which Maroy and Mourie are older variants—does not, as is often supposed, commemorate the Virgin, but St Maelrubha, who came from Bangor in Ireland in 671 and founded a monastery at Applecross and a chapel (now in ruins) on Isle Maree. Trending in a south-easterly to north-westerly direction, the lake has a length of 13½ m. from Kinlochewe at the head of the dam erected in the 16th century (or earlier) by the iron-smelters of the Cheardach Ruardh, or Red Smiddy, on the short but impetuous river Ewe by which it drains to the sea. It lies at a height of 32 ft. above sea-level; the greatest breadth is just over 2 m. at Slattadale, the mean breadth being $\frac{9}{10}$ of a mile; and the greatest depth, 367 ft., occurs in the upper basin, the mean depth being 125 ft. Its waters cover an area of fully 11 sq. m., and its islands nearly 1 sq. m., while the drainage area is 171 sq. m. A remarkable feature is the large number (more than 30) and considerable area of the islands. Excepting Loch Cròcach, a small lake in the Assynt district of Sutherlandshire, its insularity (*i.e.* the ratio of the total area of the islands to that of the water surface) is higher than that of any other lake in Great Britain, Loch Lomond coming next. Nearly all the islands lie north and east of Slattadale, the largest being Eilean Subhainn, or St Swithin's Isle, which contains a small lake 750 ft. long, 300 ft. broad and 64 ft. deep. For two-thirds of its length the loch is flanked by magnificent mountains. On the north-east the principal heights are Ben Slioch (3217 ft.), whose sugar-loaf form dominates the landscape, Ben Lair (2817) and Ben Airidh-a-Char (2593), and, on the south-west, the peaks of Ben Eay, four of which exceed 3000 ft.

MAREMMA (a corruption of *Marittima*, "situated on the sea"), a marshy region of Tuscany, Italy, extending from the mouth of the Cecina to Orbetello and varying in breadth from 15 to 20 m. In Etruscan and Roman times the Maremma was a populous and fertile coast plain, with considerable towns situated on the hills—Populonia, Russellae, Cosa, &c., and was drained by a complete system of subterranean canals which were brought to light by the excavations made in connexion with the railways passing through the district. But the decline of agriculture at the end of the Republic led to a conversion of the land to pasture, and later the unsettled state of affairs consequent on the fall of the Roman Empire resulted in neglect of the watercourses. Leopold II. of Tuscany (1822–1844) made the first successful efforts to counteract the malaria which has affected the district, by drainage, the filling up of swamps, and the establishment of new farms, and since his time continuous efforts have been made with considerable success.

MARENGO, a village of north Italy, on the road between Alessandria and Tortona, and 4¾ m. E.S.E. of the gates of the former. It is situated on the Fontanone brook, a small affluent of the Tanaro which marks the western edge of the plain of Marengo, the scene of the great victory won by Napoleon over the Austrians under Baron Melas (1729–1806) on the 14th of June 1800. The antecedents of the battle are described under French Revolutionary Wars).

The French army, in ignorance of its opponent's position, had advanced westward from the Scrivia towards Alessandria on the 12th, and its outposts had reached the Bormida on the evening of the 13th. But contact with the main Austrian army was not obtained, and on the assumption that it was moving towards either Valenza or Genoa Napoleon weakened his army by considerable detachments sent out right and left to find the enemy and to delay his progress. Unknown, however, to Napoleon Melas's army was still at Alessandria, and on the morning of the 14th of June it filed out of the fortress and began its advance into the great plain of Marengo, one of the few favourable cavalry battle-grounds in north Italy.



Emery Walker sc.

The dispersion of the French army allowed only a fragmentary, though most energetic, resistance to be offered to the Austrian onset. The latter, considerably delayed at first by the crossing of the river Bormida, broke up into two columns,[1] which advanced, the right by the main road on Marengo, the left on Castel Ceriolo. The former, personally commanded by Melas, was 20,000 strong, and General Victor, its immediate opponent, about 10,000, or including some 5000 of Lannes' corps who fought on his right, about 15,000 strong; the Austrians were, moreover, greatly superior in guns and cavalry. The French disputed every yard of ground, holding their first line until they had by fire and counter-attack forced practically the whole of the Austrian right to deploy, and two hours passed before the Austrians managed to reach the Fontanone brook. But Victor's troops, being disorganized and short of ammunition, had then to retire more rapidly across the plain. The retreat was orderly, according to Victor's report, and made in échelon from the centre, and it is certain that at any rate the regiments held together, for the 6000 Austrian sabres found no opportunity to charge home. Many guns and wagons were, however, abandoned.

On the French right, opposed to the column of Lieut.-Field-Marshal Ott, was Lannes, with some 4000 men (excluding Watrin's division which was with Victor) against 7500. He too was after a time forced to retire, with heavy losses. Thus, about 11 a.m. the First Consul, who was at some distance from the field, was at last convinced that he had to deal with Melas's army. At once he sent out his staff officers to bring back his detachments, and pushed forward his only reserve, Monnier's division, to support Lannes and Victor. But before this help arrived Lannes had been driven out of Castel Ceriolo, and Victor and Watrin forced back almost to San Giuliano. A little after 2 p.m. Monnier's division (3500) came into action, and its impetuous advance drove the Austrians out of Castel Ceriolo. But after an hour it was forced back in its turn, and by 3 p.m. therefore, the 20,000 French troops, disordered and exhausted, and in one line without reserves,[2] held a ragged line of battle to the right and left of San Giuliano. The best that could be expected was a prolongation of the struggle till nightfall and a fairly orderly retreat. The Austrian general, believing that the battle was won, returned to Alessandria, leaving a younger man, his chief of staff Zach, to organize the pursuit.

Then followed one of the most dramatic events in military history. Of the two detachments sent away by Napoleon in search of the enemy, one only received its orders of recall. This was Boudet's division of Desaix's corps, away to the south at Rivalta and at noon heading for Pozzolo-Formigaro on the Alessandria-Genoa road. At 1 p.m. a brief message, "Revenez, au nom de Dieu!" altered the direction of the column, and between 4 and 5, after a forced march, the division, headed by Desaix, came on to the battle-field. It was deployed as a unit and moved forward at the word of command along the main road Alessandria-Tortona, the sight of their closed line giving fresh courage to the men of Lannes and Victor. Then, while on the other side Zach was arraying a deep column of troops to pursue along the main road, Napoleon and Desaix, themselves under fire, hastily framed a plan of attack. All arms were combined. First, Marmont with eight of Boudet's guns and ten others (the rest had been abandoned in the retirement) came into action on the right of the road, replying to the fire of the Austrian guns and checking their advanced infantry; close in rear of the artillery was Desaix's infantry with the remnants of Lannes' and Victor's troops rallying on its right and left; on Lannes' right, still facing Ott's column, was Monnier, supported by the Consular Guard of horse and foot; lastly 400 sabres of Kellermann's cavalry brigade, which had already been engaged several times and had lost heavily, formed up on the right of Desaix. About 5 p.m. Desaix advanced against the head of the Austrian main column formed by Zach. He himself fell in the attack, but the onset of his intact troops drove back the leading Austrians upon their supports, and at the critical moment when the attack of Boudet's single weak division had almost spent its force, Kellermann with his 400 sabres sallied out of the French line. Marmont had brought up two guns to assist the infantry, and as he fired his last round of case-shot the cavalry raced past him to the front, wheeled inwards against the flank of the great column, and rode through and through it. Zach was taken prisoner with more than 2000 men, and Kellermann, rallying some of his troopers, flung himself upon the astonished Austrian cavalry and with the assistance of the Consular Guard cavalry defeated it. The "will to conquer" spread along the whole French line, while the surprise of the Austrians suddenly and strangely became mere panic. Lannes, Victor and Monnier advanced afresh, pushing the Austrians back on Marengo. A few Austrian battalions made a gallant stand at that place, while Melas himself, as night came on, rallied the fugitives beyond. Next day the completely exhausted, but victorious,

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[1] A third column was sent out to the extreme right (3000 under O'Reilly). This destroyed a small French detachment on the extreme left, but took little or no part in the main battle.

[2] The Austrians, too, fighting in "linear" formation had few reserves. About one-third only of the imperial forces in Italy was actually engaged in the battle.

French army extorted from the dazed Austrians a convention by which all Italy up to the Mincio was evacuated by them. The respective losses were: French about 4000, Austrians 9500.

See the French official *Campagne de l'armée de réserve*, vol. ii., by C. de Cugnac.

MAREOTIS (Arabic *Mariut*), the most westerly of the lakes in the Delta of Egypt. On the narrow strip of land separating the lake from the Mediterranean the city of Alexandria is built. (See EGYPT; and ALEXANDRIA.)

MARE'S-TAIL, in botany, the popular name for an aquatic herb known botanically as *Hippuris vulgaris* (natural order Haloragaceae). It grows on margins of lakes, ponds and similar localities, and has a submerged stout creeping rootstock from which spring many-jointed cylindrical stems bearing numerous narrow leaves close-set in whorls. The minute greenish flowers are borne in the leaf-axils. Like many fresh-water plants it has a wide distribution, occurring in arctic and temperate regions in the northern hemisphere and reappearing in antarctic South America.

MARET, HUGUES-BERNARD, DUC DE BASSANO (1763–1839), French statesman and publicist, was born at Dijon. After receiving a sound education, he entered the legal profession and became advocate at the King's Council at Paris. The ideas of the French Revolution profoundly influenced him, and wholly altered his career. The interest aroused by the debates of the first National Assembly suggested to him the idea of publishing them, conjointly with Méjean, in the *Bulletin de l'Assemblée.* The publicist Charles Joseph Panckoucke (1736–1798), owner of the *Mercure de France* and publisher of the famous *Encyclopédie* (1781), persuaded him to merge this in a larger paper, the *Moniteur universel*, which gained a wide repute for correctness and impartiality. He was a member of the moderate club, the Feuillants; but after the overthrow of the monarchy on the 10th of August 1792 he accepted an office in the ministry of foreign affairs, where he sometimes exercised a steadying influence. On the withdrawal of the British legation from Paris Maret went on a mission to London, where he had a favourable interview with Pitt on the 2nd of December 1792. All hope of an accommodation was, however, in vain. After the execution of Louis XVI. (Jan. 21, 1793), the chief French diplomatic agent, Chauvelin, was ordered to leave England, while the French Convention declared war (Feb. 1, 1793). These events precluded the possibility of success attending a second mission of Maret to London in January. After a space, in which he held no diplomatic post, he became ambassador of the French Republic at Naples; but, while repairing thither with De Sémonville he was captured by the Austrians and was kept in durance by them for some thirty months, until, at the close of 1795, the two were set free in return for the liberation of the daughter of Louis XVI. For a time Maret betook himself to journalism; but he played a useful part in the negotiations for a peace with Great Britain which went on at Lille during the summer of 1797, until the victory of the Jacobins at Paris in the *coup d'état* of Fructidor (Sept. 1797) frustrated the hopes of Pitt for peace and inflicted on Maret another reverse of fortune. On the return of Bonaparte from Egypt in 1799 Maret joined the general's party which came to power with the *coup d'état* of Brumaire (Nov. 9–10, 1799).

Maret now became one of the First Consul's secretaries and shortly afterwards secretary of state. In this position his moderation, industry, good sense, knowledge of men and of affairs, made his services of great value. The *Moniteur*, which became the official journal of the state in 1800, was placed under his control. He sometimes succeeded in toning down the hard, abrupt language of Napoleon's communications, and in every way proved a useful intermediary. It is known that he had a share in the drawing up of the new constitutions for the Batavian and Italian Republics. In 1804 he became Minister; in 1807 he was named count, and in 1809 he received the title of duc de Bassano, an honour which marked the sense entertained by Napoleon of his strenuous toil, especially in connexion with the diplomatic negotiations and treaties of this period. His personal devotion to the emperor was of that absolute unwavering kind which Napoleon highly valued; it is seen in the attempt to defend the unworthy artifices adopted by the great man in April–May 1808 in order to make himself master of the destinies of Spain. Maret also assisted in drawing up the constitution destined for Spain, which the Spaniards at once rejected.

Maret accompanied Napoleon through most of his campaigns, including that of 1809; and at its close he expressed himself in favour of the marriage alliance with the archduchess Marie Louise of Austria, which took place in 1810. In the spring of 1811, the duc de Bassano replaced Champagny, duc de Cadore, as minister of Foreign Affairs. In this capacity he showed his usual industry and devotion, concluding the treaties between France and Austria and France and Prussia, which preceded the French invasion of Russia in 1812. He was with Napoleon through the greater part of that campaign; and after its disastrous conclusion helped to prepare the new forces with which Napoleon waged the equally disastrous campaign of 1813. But in November 1813 Napoleon replaced him by Caulaincourt, duc de Vicence, who was thought to be more devoted to the cause of peace and personally grateful to the emperor Alexander I. of Russia. Maret, however, as private secretary of the emperor, remained with his master through the campaign of 1814, as also during that of 1815. After the second restoration of the Bourbons he was exiled, and retired to Grätz where he occupied himself with literary work. In 1820 he was allowed to return to France, and after the Revolution of 1830, Louis Philippe, king of the French, made him a peer of France; he also held two high offices for a few days. He died at Paris in 1839. He shares with Daru the honour of being the hardest worker and most devoted supporter in Napoleon's service; but it has generally been considered that he carried devotion to the length of servility, and thus often compromised the real interests of France. This view has been contested by Baron Ernouf in his work *Maret, duc de Bassano*, which is the best biography.

For Maret's mission to England in 1792 and his work at Lille in 1797, see Augustus W. Miles, *Letters on the French Revolution*; J. H. Rose, *The Life and Times of William Pitt*, and for other incidents of Maret's career, the memoirs of Bourrienne, Pasquier, Méneval and Savary (duc de Rovigo), may be consulted. Thiers's account of Maret is in general hostile to him. (J. HL. R.)

MARGARET (Fr. *Marguerite*, It. *Margherita*, Ger. *Margareta*, and *Margarete*, with dim. *Grete*, *Gretchen*, *Meta*, fr. Lat. *margarita*, Gr. *μαργαρίτης*, a pearl), a female proper name, which became very popular in all Christian countries as that of the saint noticed below. Biographies of some who have borne it are arranged below in the following order: saints, queens of Scotland, queens of other countries, princesses and duchesses.

MARGARET, ST (SANCTA MARGARITA), virgin and martyr, is celebrated by the Church of Rome on the 20th of July. According to the legend, she was a native of Antioch, daughter of a pagan priest named Aedesius. She was scorned by her father for her Christian faith, and lived in the country with a foster mother keeping sheep. Olybrius, the "praeses orientis," offered her marriage as the price of her renunciation of Christianity. Her refusal led to her being cruelly tortured, and after various miraculous incidents, she was put to death. Among the Greeks she is known as Marina, and her festival is on the 17th of July. She has been identified with St Pelagia (*q.v.*)—Marina being the Latin equivalent of Pelagia—who, according to a legend, was also called Margarito. We possess no historical documents on St Margaret as distinct from St Pelagia. An attempt has been made, but without success, to prove that the group of legends with which that of St Margaret is connected is derived from a transformation of the pagan divinity Aphrodite into a Christian saint. The problem of her identity is a purely literary question. The cult of St Margaret was very widespread in England, where more than 250 churches are dedicated to her.

See *Acta sanctorum*, July, v. 24–45; *Bibliotheca hagiographica, Latina* (Brussels, 1899), n. 5303–5313; Frances Arnold-Forster, *Studies in Church Dedications* (London, 1899), i. 131–133 and iii. 19. (H. DE.)

MARGARET, ST (*c.* 1045–1093), the queen of Malcolm III. Canmore king of Scotland, was the daughter of the English prince Edward, son of Edmund Ironside, and sister of Edgar Ætheling, and was probably born in Hungary. In 1067 the widow and children of Edward fled from Northumberland with a large number of followers and sought the protection of the Scottish king. The marriage of Malcolm and Margaret soon took place and was followed by several invasions of Northumberland by the Scottish king, probably in support of the claims of his brother-in-law Edgar. These, however, had little result beyond the devastation of the province. Far more important were the effects of this alliance upon the history of Scotland. A considerable portion of the old Northumbrian kingdom had been reduced by the Scottish kings in the previous century, but up to this time the English population had little influence upon the ruling element of the kingdom. Malcolm's marriage undoubtedly improved the condition of the English to a great extent, and under Margaret's sons, Edgar, Alexander I. and David I., the Scottish court practically became anglicized. Margaret died on the 17th of November 1093, four days after her husband and her eldest son Edward, who were slain in an invasion of Northumberland. She rebuilt the monastery of Iona, and was canonized in 1251 on account of her great benefactions to the Church.

See *Chronicles of the Picts and Scots* (Edinburgh, 1867), edited 1876, by W. F. Skene; and W. F. Skene, *Celtic Scotland* (Edinburgh).

MARGARET (1489–1541), queen of Scotland, eldest daughter of Henry VII., king of England, by his wife Elizabeth, daughter of Edward IV., was born at Westminster on the 29th of November 1489. Before she was six years old negotiations were opened, which dragged on for several years, for marrying the princess to James IV. of Scotland, whose support of the pretender Perkin Warbeck it was hoped to avert by such an alliance. Eventually the marriage was celebrated in Edinburgh on the 8th of August 1503. The avaricious Henry VII. gave his daughter a scanty dowry and quarrels on this head embittered the relations between the two kingdoms, which the marriage, although accompanied by a treaty of perpetual peace, did nothing to heal. The whole of Margaret's life after her marriage with James IV. was an unending series of intrigues, first with one political faction then with another; at one time in favour of her native country, at another in hostility to it, her conduct being mainly influenced at all times by considerations affecting her pocket.

Margaret was crowned at Edinburgh in March 1504. Until 1507 she had no children; between that date and 1510 two sons and a daughter were born, all of whom died in infancy; in 1512 she gave birth to a son who succeeded his father as James V.; in 1514 she bore a posthumous son, Alexander, created duke of Ross, who died in the following year. A dispute with her brother Henry VIII. over a legacy claimed by Margaret was a contributory cause of the war which ended at Flodden, where James IV. was killed on the 9th of September 1513, having by his will appointed Margaret sole guardian of her infant son, now King James V. Scotland was divided mainly into two parties, one in favour of alliance with England, and the other with France. The leader of the latter was John Stewart, duke of Albany, next heir to the crown of Scotland after Margaret's sons; Margaret herself for the most part inclined to the English faction; and when Albany returned to Scotland from France on the invitation of the Scottish parliament in the spring of 1514, the conflict grew almost to civil war. Various projects for Margaret's remarriage had already been started, Louis XII. of France and the emperor Maximilian being proposed as suitable husbands for the young widow, when the queen privately married Archibald Douglas, earl of Angus, on the 6th of August 1514. The consequences of this marriage were to alienate many of the most powerful of the nobility, especially the earls of Arran and Home, and to make Margaret entirely dependent on the house of Douglas; while it furnished the council with a pretext for removing her from the regency and guardianship of the king in favour of Albany in July 1515. Albany had to blockade Margaret in Stirling Castle before she would surrender her sons. After being obliged to capitulate, Margaret returned to Edinburgh, and being no longer responsible for the custody of the king she fled to England in September, where a month later she bore to Angus a daughter, Margaret, who afterwards became countess of Lennox, mother of Lord Darnley and grandmother of James I. of England.

In the summer of 1516 Margaret went to her brother's court in London, while Angus, much to his wife's displeasure, returned to Scotland, where he made his peace with Albany and was restored to his estates. The rivalry between the French and English factions in Scotland was complicated by private feuds of the Hamiltons and Douglases, the respective heads of which houses, Arran and Angus, were contending for the supreme power in the absence of Albany in France, where at the instance of Henry VIII. he was detained by Francis I. Margaret, quarrelling with her husband over money matters, sided at first with Arran and began to agitate for a divorce from Angus. In this she was probably aided by Albany, who had been in Rome, and who found an unexpected ally in the queen-mother, Margaret being temporarily alienated from the English party by her brother Henry's opposition to her divorce. When Albany returned to Scotland in 1521 his association with Margaret gave rise to the accusation that it was with the intention of marrying her himself that he favoured her divorce from Angus, and it was even suggested that she was Albany's mistress. As Albany was strongly supported by the Scottish parliament, Angus found it necessary to withdraw to France till 1524. During these years there was constant warfare between the English and the Scots on the border, but in May 1524 Albany was obliged to retire to France. Henry VIII. continually aimed at securing the person of his nephew, the king of Scots; while Margaret veered from faction to faction without any settled policy, unless it were the "erection" of her son, *i.e.* his proclamation as a reigning sovereign, which she successfully brought about in July 1524. The queen-mother had at this time fallen in love with Henry Stewart, second son of Lord Avondale, whom she married immediately after obtaining her divorce from Angus in 1527. Margaret and her new husband, who was created Lord Methven, now became for a time the ruling influence in the counsels of James V. But when her desire to arrange a meeting between James and Henry VIII. in 1534 was frustrated by the opposition of the clergy and the council, Margaret in her disappointment revealed certain secrets to Henry which led to her being accused by her son of betraying him for money and of acting as an English spy. In 1537 she was anxious to obtain a divorce from Methven, and her desire was on the point of being realized when it was defeated by the intervention of James. Two years later she was reconciled to her husband, by whom she had no children; and, continuing to the end to intrigue both in Scotland and England, she died at Methven Castle on the 18th of October 1541.

See Andrew Lang, *History of Scotland*, vol. i. (London, 1900); Mary A. E. Green, *Lives of the Princesses of England* (6 vols., London, 1849–1855); *The Hamilton Papers*, ed. by J. Bain (2 vols., Edinburgh, 1890); John Leslie, *History of Scotland*, ed. by T. Thompson (4 vols., Edinburgh, 1830); Sir H. Ellis, *Original Letters Illustrative of English History* (London, 1825–1846). (R. J. M.)

MARGARET (1283–1290), titular queen of Scotland, and generally known as the "maid of Norway," was the daughter of Eric II. king of Norway, and Margaret, daughter of Alexander III. king of Scotland. Her mother died soon after Margaret's birth, and in 1284 the estates of Scotland decided that if Alexander died childless the crown should pass to his granddaughter. In March 1286 Alexander was killed and Margaret became queen. The English king Edward I. was closely watching affairs in Scotland, and in 1289 a marriage was arranged between the infant queen and Edward's son, afterwards Edward II. Margaret sailed from Norway and reached the Orkneys, where she died about the end of September 1290. The news of this occurrence was first made known in a letter dated the 7th of October 1290. Some mystery, however, surrounded her death, and about 1300 a woman from Leipzig declared she was Queen Margaret. The impostor, if she were such, was burned as a witch at Bergen.

See A. Lang, *History of Scotland*, vol. i. (Edinburgh, 1904).

MARGARET (1353–1412), queen of Denmark, Norway and Sweden, the daughter of Valdemar IV. of Denmark, was born in 1353 and married ten years later to King Haakon VI. of Norway. Her first act, after her father's death (1375), was to procure the election of her infant son Olaf as king of Denmark. Olaf died in 1387, having in 1380 also succeeded his father; and in the following year Margaret, who had ruled both kingdoms in his name, was chosen regent of Norway and Denmark. She had already given proofs of her superior statesmanship by recovering possession of Schleswig from the Holstein counts, who had held it absolutely for a generation, and who now received it back indeed as a fief (by the compact of Nyborg 1386), but under such stringent conditions that the Danish crown got all the advantage of the arrangement. By this compact, moreover, the chronically rebellious Jutish nobility lost the support they had hitherto always found in Schleswig-Holstein, and Margaret, free from all fear of domestic sedition, could now give her undivided attention to Sweden, where the mutinous nobles were already in arms against their unpopular king, Albert of Mecklenburg. At a conference held at Dalaborg Castle, in March 1388, the Swedes were compelled to accept all Margaret's conditions, elected her "Sovereign Lady and Ruler," and engaged to accept from her any king she chose to appoint. On the 24th of February 1389, Albert, who had returned from Mecklenburg with an army of mercenaries, was routed and taken prisoner at Aasle near Falköping, and Margaret was now the omnipotent mistress of three kingdoms. Stockholm then almost entirely a German city, still held out; fear of Margaret induced both the Mecklenburg princes and the Wendish towns to hasten to its assistance; and the Baltic and the North Sea speedily swarmed with the privateers of the *Viktualien brödre* or *Vitalianer*, so called because their professed object was to revictual Stockholm. Finally the Hansa intervened, and by the compact of Lindholm (1395) Albert was released by Margaret on promising to pay 60,000 marks within three years, the Hansa in the meantime to hold Stockholm in pawn. Albert failing to pay his ransom within the stipulated time, the Hansa surrendered Stockholm to Margaret in September 1398, in exchange for very considerable commercial privileges.

It had been understood that Margaret should, at the first convenient opportunity, provide the three kingdoms with a king who was to be her nearest kinsman, and in 1389 she proclaimed her infant cousin, Eric of Pomerania, king of Norway. In 1396 homage was rendered to him in Denmark and Sweden likewise, Margaret reserving to herself the office of regent during his minority. To weld the united kingdoms still more closely together, Margaret summoned a congress of the three councils of state to Kalmar in June 1397; and on Trinity Sunday, the 17th of June, Eric was solemnly crowned king of Denmark, Norway and Sweden. The proposed act of union divided the three *Rigsraads*, but the actual deed embodying the terms of the union never got beyond the stage of an unratified draft. Margaret revolted at the clauses which insisted that each country should retain exclusive possession of its own laws and customs, and be administered by its own dignitaries, as tending in her opinion to prevent the complete amalgamation of Scandinavia. But with her usual prudence she avoided every appearance of an open rupture.

A few years after the union of Kalmar, Eric, now in his eighteenth year, was declared of age and homage was rendered to him in all his three kingdoms, but during her lifetime Margaret was the real ruler of Scandinavia. So long as the union was insecure, Margaret had tolerated the presence near the throne of "good men" from all three realms (the *Rigsraad*, or council of state, as these councillors now began to be called); but their influence was always insignificant. In every direction the royal authority remained supreme. The offices of high constable and earl marshal were left vacant; the *Danehoffer* or national assemblies fell into desuetude, and the great queen, an ideal despot, ruled through her court officials acting as superior clerks. But law and order were well maintained; the licence of the nobility was sternly repressed; the kingdoms of Sweden and Norway were treated as integral parts of the Danish state, and national aspirations were frowned upon or checked, though Norway, as being more loyal, was treated more indulgently than Sweden. Margaret also recovered for the Crown all the landed property which had been alienated during the troublous days of Valdemar IV. This so-called "reduktion," or land-recovery, was carried out with the utmost rigour, and hundreds of estates fell into the Crown. Margaret also reformed the Danish currency, substituting good silver coins for the old and worthless copper tokens, to the great advantage both of herself and the state. She had always large sums of money to dispose of, and a considerable proportion of this treasure was dispensed in works of charity. Margaret's foreign policy was sagaciously circumspect, in sharp contrast with the venturesomeness of her father's. The most tempting offer of alliance, the most favourable conjunctures, could never move her from her system of neutrality. On the other hand she spared no pains to recover lost Danish territory. Gotland she purchased from its actual possessors, Albert of Mecklenburg and the Livonian Order, and the greater part of Schleswig was regained in the same way.

Margaret died suddenly on board her ship in Flensborg harbour on the 28th of October 1412. We know very little of her private character. Contemporary records are both scanty and hostile to a sovereign who squeezed the utmost out of the people. Craft and wiliness are the qualities most generally attributed to her, coupled with the cynical praise that "in temporal matters she was very lucky."

See *Danmarks riges historie, den senere Middelalder*, pp. 358–412 (Copenhagen, 1897–1905); Erslev, *Danmarks historie under dronning Margrethe* (Copenhagen, 1882–1901); Hill, *Margaret of Denmark* (London, 1898). (R. N. B.)

MARGARET OF ANJOU (1430–1482), queen of England, daughter of René of Anjou, titular king of Naples and Jerusalem, was born on the 23rd of March 1430. When just fourteen she was betrothed to Henry VI. king of England, and in the following year was brought to England and married at Titchfield Abbey, near Southampton, on the 23rd of April 1445. On the 28th of May she was welcomed at London with a great pageant, and two days later crowned at Westminster. Margaret's marriage had been negotiated by William de la Pole, duke of Suffolk, and when she came to England, Suffolk and his wife were her only friends. Naturally she fell under Suffolk's influence, and supported his policy. This, added to her French origin and sympathies, made her from the start unpopular. Though clever and good-looking, she was self-willed and imperious, and without the conciliatory manners which her difficult position required. In almost everything she was the opposite of her gentle husband, but entered into his educational schemes, and gave her patronage to the foundation of Queen's College, Cambridge. Margaret's really active share in politics began after Suffolk's fall in 1450. She not only supported Edmond Beaufort, duke of Somerset, in his opposition to Richard of York, but concerned herself also in the details of government, seeking not over-wisely pecuniary benefits for herself and her friends. But as a childless queen her influence was limited; and when at last her only son, Edward, was born on the 13th of October 1453, her husband was stricken with insanity. From this time she was the ardent champion of her husband's and son's rights; to her energy the cause of Lancaster owed its endurance, but her implacable spirit contributed to its failure. When York's protectorate was ended by Henry's recovery in January 1455, Margaret, not content with the restoration of Somerset and her other friends to liberty and office, pushed her politics to extremes. The result was the defeat of the Lancastrians at St Albans, and for a year Margaret had to acquiesce in York's power. Yet at this time one wrote of her: "The queen is a great and strong laboured woman, for she spareth no pain to sue her things to an intent and conclusion to her power" (*Paston Letters*, i. 378). All the while she was organizing her party; and ultimately, in October 1456 at Coventry, procured some change in the government. Though formally reconciled to York in March 1458, she continued to intrigue with her partisans in England, and even with friends in France, like Pierre de Brezé, the seneschal of Normandy. After the Yorkist failure at Ludlow in 1459, it was Margaret's vindictiveness that embittered the struggle by a wholesale proscription of her opponents in the parliament at Coventry. She was not present with her husband at Northampton on the 10th of July 1460. After romantic adventures, in which she owed her safety to the loyalty of a boy of fourteen, her only companion, she escaped with her little son to Harlech. Thence after a while she made her way to Scotland. From Mary of Gelderland, the queen regent, she purchased the promise of help at the price of surrendering Berwick. Margaret was still in Scotland at the date of Wakefield, so was not, as alleged by hostile writers, responsible for the barbarous treatment of York's body. But she at once joined her friends, and was with the northern army which defeated Warwick at St Albans on the 17th of February 1461; for the executions which followed she must bear the blame. After Towton Margaret with her husband and son once more took refuge in Scotland.

A year later she went to France, and with help from her father and Louis XI. equipped an expedition under Pierre de Brezé. She landed in Northumberland in October, and achieved some slight success; but when on the way to seek further help from Scotland the fleet was overwhelmed in a storm, and Margaret herself barely escaped in an open boat to Berwick. In the spring she was again trying to raid Northumberland, meeting with many hardships and adventures. Once she owed her escape from capture to the generosity of a Yorkist squire, who carried her off on his own horse; finally she and her son were brought to Bamburgh through the compassionate help of a robber, whom they had encountered in the forest. Thence in August 1463 she crossed to Sluys in Flanders. She was almost destitute, but was courteously treated by Charles the Bold, then count of Charolais, and so made her way to her father in France. For seven years she lived at Saint-Michel-en-Barrois, educating her son with the help of Sir John Fortescue, who wrote at this time: "We be all in great poverty, but yet the queen sustaineth us in meat and drink. Her highness may do no more than she doth" (*Works*, ii. 72, ed. Clermont). Margaret never lost her hopes of her son's restoration. But when at last the quarrel between Warwick and Edward IV. brought her the opportunity, it was with difficulty that she could consent to be reconciled to so old and bitter an enemy. After Warwick's success and Henry's restoration Margaret still remained in France. When at last she was ready to sail she was delayed by contrary winds. So it was only on the very day of Warwick's defeat at Barnet (14th of April) that Margaret and Edward landed at Weymouth. Three weeks later the Lancastrians were defeated at Tewkesbury, and Edward was killed. Margaret was not at the battle; she was captured a few days after, and brought to London on the 21st of May. For five years she remained a prisoner, but was treated honourably and for part at least of the time was in charge of her old friend the duchess of Suffolk. Finally Louis XI. ransomed her under the Treaty of Pecquigny, and she returned to France on the 29th of January 1476. Margaret lived for six years at different places in Bar and Anjou, in poverty and dependent for a pension on Louis, who made her surrender in return her claims to her father's inheritance. She died on the 25th of April 1482 and was buried at Angers Cathedral. René, whom she probably never saw after 1470, had died in the previous year. During her last years Chastellain wrote for her consolation his *Temple de Bocace* dealing with the misfortunes of contemporary princes.

As the courageous champion of the rights of her son and her husband, Margaret must command a certain sympathy. But she was politically unwise, and injured their cause by her readiness to purchase foreign help at the price of English interests. Comines wrote well of her that she would have done more prudently if she had endeavoured to adjust the disputes of the rival factions instead of saying "I am of this party, and will maintain it" (*Mémoires* vi. ch. 13). Her fierce partisanship embittered her enemies, and the Yorkists did not hesitate to allege that her son was a bastard. This, like the scandal concerning Margaret and Suffolk, is baseless; the tradition, however, continued and found expression in the *Mirror for Magistrates* and in Drayton's *Heroical Epistles*, as well as in Shakespeare's *Henry VI.*

Bibliography.—For contemporary English authorities see under Henry VI. French authorities and especially the *Chroniques* of George de Chastellain, and the *Mémoires* of Philippes de Comines contain much that is of value. The *Letters of Margaret of Anjou* (Camden Soc., 1863) have small historical importance. There have been numerous biographies, the chief is Mrs Hookham's *Life of Margaret of Anjou* (1872). But the best modern accounts are to be found in G. du Fresne de Beaucourt's *Histoire de Charles VII.*, Dr Gairdner's Introductions to the *Paston Letters*, Sir James Ramsay's *Lancaster and York* (1892), and *The Political History of England*, vol. iv. (1906), by Professor C. Oman. Dr Karl Schmidt's *Margareta von Anjou, vor und bei Shakespeare* (Palaestra, liv., Berlin, 1906) is a useful digest of authorities. (C. L. K.)

MARGARET OF AUSTRIA (1480–1530), duchess of Savoy and regent of the Netherlands from 1507 to 1530, daughter of the archduke Maximilian of Austria, afterwards the emperor Maximilian I., was born at Brussels on the 10th of January 1480. At two years of age she was betrothed to the dauphin Charles, son of Louis XI. of France, and was brought up at the French court. In 1489, however, Charles, now king as Charles VIII., to prevent Maximilian taking as his second wife the duchess Anne of Brittany, threw over Margaret and married the Breton heiress himself. Her ambitious father now sought for Margaret another throne, and in April 1497 she was married at Burgos to the Infant John, heir to the throne of Castile and Aragon. She was left a widow, however, a few months later. In 1501 Margaret became the wife of Philibert II., duke of Savoy, who only survived until 1504. The sudden death of her brother the archduke, Philip the Handsome (Sept 25, 1506), opened out to her a new career. In 1507 she was appointed by her father regent of the Netherlands and guardian of her nephew Charles, afterwards the emperor Charles V. Charles came of age in 1515, but he entrusted Margaret with the regency, as the vast extent of his dominions permitted him but seldom to visit the Netherlands, and she continued to hold the post until her death in 1530. She was a wise and prudent ruler, of masculine temper and intrepidity, and very capable in affairs.

See E. Münch, *Margaretha von Österreich* (Leipzig, 1883); Th. Juste, *Charles-Quint et Marguérite d'Autriche* (Brussels, 1858); A. Le Glay, *Maximilien I. et Marguérite d'Autriche* (with correspondence, Paris, 1839); De Quinsonas, *Matériaux pour servir à l'histoire de Marguérite d'Autriche* (Paris, 1855), and E. E. Tremayne, *The First Governors of the Netherlands: Margaret of Austria* (1908).

MARGARET OF AUSTRIA (1522–1586), duchess of Parma and regent of the Netherlands from 1559 to 1567, was a natural daughter of Charles V. Her mother, Margaret van Ghent, was a Fleming. She was brought up by her aunts Margaret of Austria and Maria of Hungary, who were successively regents of the Netherlands from 1507 to 1530 and from 1530 to 1555. In 1533 she was married to Alexander de' Medici, duke of Florence, who was assassinated in 1537, after which she became the wife of Ottavio Farnese, duke of Parma, in 1542. The union proved an unhappy one. Like her aunts, who had trained her, she was a woman of masculine abilities, and Philip II., when he left the Netherlands in 1559 for Spain, acted wisely in appointing her regent. In ordinary times she would probably have proved as successful a ruler as her two predecessors in that post, but her task was very different from theirs. She had to face the rising storm of discontent against the Inquisition and Spanish despotism, and Philip left her but nominal authority. He was determined to pursue his own arbitrary course, and the issue was the revolt of the Netherlands. In 1567 Margaret resigned her post into the hands of the duke of Alva and retired to Italy. She had the satisfaction of seeing her son Alexander Farnese appointed to the office she had laid down, and to watch his successful career as governor-general of the Netherlands. She died at Ortona in 1586.

See L. P. Gachard, *Correspondance de Marguérite d'Autriche avec Phillippe II. 1554–1568* (Brussels, 1867–1887); R. Fruin, *Het voorspel van den tachtig jarigen vorlog* (Amsterdam, 1856); E. Rachfahl, *Margaretha von Parma, Statthalterin der Niederlande, 1559–1567* (Munich, 1895); also bibliography in *Cambridge Modern History*, iii. 795–809 (1904).

MARGARET OF PROVENCE (1221–1295), queen of France, was the daughter of Raymond Berenger V., count of Provence. She was married to Saint Louis at Sens on the 27th of May 1234, and was crowned the next day. Blanche of Castile, the queen-mother, arranged the marriage to win over to the cause of France the powerful count of Provence, but treated her daughter-in-law most unkindly. and her jealousy of the energetic young queen was naturally shared by Louis, whose coldness towards and suspicion of his wife are well known. Margaret did not lack courage, she followed the king on his crusade, and bore herself heroically at Damietta. But her ambition and strong personal prejudices often led her to actions injurious to the realm. This is most noticeable in her hostility to her brother-in-law Charles of Anjou, who had married her sister Beatrice, and her devotion to Henry III. of England, who had married her other sister Eleanor. Aspiring during the reign of her son to the same rôle which she had seen Blanche of Castile play, she induced, in 1263, the young Philip, heir to the throne, to promise to obey her in everything up to the age of thirty; and Saint Louis was obliged to ask for a bull from Urban IV. which would release the prince from his oath. After Saint Louis' death, Margaret continued obstinately to claim her rights on the county of Provence against Charles of Anjou. She sought to employ force of arms, calling upon her son, her nephew Edward II. of England, and the German king Rudolph of Habsburg. She did not give up her claim until after the death of Charles of Anjou (1285), when Philip the Bold succeeded in getting her to accept an income from the county of Anjou in exchange for her rights in Provence. She died on the 31st of December 1295.

See E. Boutaric, *Marguérite de Provence*, in *Revue des questions historiques* (1867), pp. 417-458.

MARGARET MAULTASCH (1318–1369), countess of Tirol, who received the name of Maultasch (pocket-mouth) on account of the shape of her mouth, was the daughter and heiress of Henry, duke of Carinthia and count of Tirol. When Henry died in 1335 Carinthia passed to Albert II., duke of Austria; but Tirol was inherited by Margaret and her young husband, John Henry, son of John, king of Bohemia, whom she had married in 1330. This union was not a happy one, and the Tirolese disliked the government of Charles, afterwards the emperor Charles IV., who ruled the county for his brother. The result was that John Henry was driven from Tirol, and Margaret's cause was espoused by the emperor Louis IV., who was anxious to add the county to his possessions. Declaring her marriage dissolved on the ground that it had not been consummated, Louis married Margaret in 1342 to his own son Louis, margrave of Brandenburg. But as this action on the emperor's part entrenched on the privileges of the Church, Pope Clement VI. placed father and son under the ban, from which they were not released until 1359. In 1361 Margaret's husband died, followed two years later by her only son, Meinhard, when she handed over Tirol to Rudolph IV., duke of Austria, and retired to Vienna, where she died on the 3rd of October 1369. She lived long in the memory of the people of Carinthia, who regarded her as an amazon, and called her the *Wicked Gretl*.

See A. Huber, *Geschichte der Vereinigung Tirols mit Oesterreich* (Innsbruck, 1864).

MARGARINE, the name, first given by Chevreul, to an artificial substitute for butter, made from beef and other animal fats, and sometimes mixed with real butter. The name of "butterine" has also been used. Artificial butter, or "margarine-mouries," was for some years manufactured in Paris according to a method made public by the eminent chemist Mège-Mouries. Having surmised that the formation of butter contained in milk was due to the absorption of fat contained in the animal tissues, he was led to experiment on the splitting up of animal fat. The process he ultimately adopted consisted in heating finely minced beef suet with water, carbonate of potash, and fresh sheep's stomach cut up into small fragments. The mixture he raised to a temperature of 45° C. (113° F.). The influence of the pepsine of the sheep's stomach with the heat separated the fat from the cellular tissue; he removed the fatty matter, and submitted it when cool to powerful hydraulic pressure, separating it into stearin and oleomargarin, which last alone he used for butter-making. Of this fat about the proportions of 10 ℔ with 4 pints of milk, and 3 pints of water were placed in a churn, to which a small quantity of anatto was added for colouring, and the whole churned together. The compound so obtained when well washed was in general appearance, taste and consistency like ordinary butter, and when well freed from water it was found to keep a longer time. Margarine is a perfectly wholesome butter-substitute, and is now largely used, but the ease with which it may be passed off as real butter has led to much discussion and legislative action. (See ADULTERATION.)

MARGARITA, an island in the Caribbean Sea belonging to Venezuela, about 12 m. N. of the peninsula of Araya, and constituting, under the constitution of 1904,—with Tortuga, Cubagua and Coche—a political division called the Eastern Federal District. The island is about 40 m. long from east to west, has an area of 400 sq. m., and consists of two mountainous extremities, nearly separated by the Laguna Grande on the south, but connected by a low, narrow isthmus. The highest elevation on the island is the peak of Macanao, 4484 ft., in the western part, the highest point in the eastern part being the peak of Copei, 4170 ft. The higher valleys of the interior are highly fertile and are well adapted to grazing and stock-raising. The principal industries are fishing and the making of salt. The pearl fisheries, which were so productive in the 16th and 17th centuries, are no longer important. A domestic industry of the women is that of making coarse straw hats, which are sold on the mainland. The products of Margarita, however, are insufficient to support its population, and large numbers periodically emigrate to the mainland, preventing the increase in population which its healthful climate favours. The population was estimated in 1904 at 40,000, composed in great part of half-caste Guayqueri Indians. The capital is Asunción (pop. about 3000), on the east side of the island, and its principal port is Pompatar on the south coast. The two small ports of Puebla de la Mar (*Porlamar*) and Puebla del Norte are merely open roadsteads.

The island of Margarita (from Span. *Margarita*, pearl) was discovered by Columbus in 1498, and was bestowed in 1524 upon Marceto Villalobos by Charles V. In 1561 the freebooter Lope de Aguirre ravaged the island, and in 1662 the town of Pompatar was destroyed by the Dutch. For a long time Margarita was attached to Cumana, but in the eighteenth century it was made administratively independent. Its traders and sailors rendered invaluable assistance to the revolutionists in the war of independence, and the Spanish general, Morillo, was driven from its shores in 1817; in recognition of this it was made a separate state and was renamed Nueva Esparta (New Sparta). In 1904–1909 it was a part of the Federal District with Asunción as its capital. The first Spanish settlement in South America was Nueva Cadiz, founded in 1515 on the barren island of Cubagua; but the place was abandoned when pearl-fishing and slave-trading ceased to be profitable.

MARGATE, a municipal borough and seaside resort in the Isle of Thanet parliamentary division of Kent, England, 74 m. E. by S. of London by the South Eastern & Chatham railway. Pop. (1891), 18,662; (1901), 23,118. It lies on the north coast of Thanet, and is practically contiguous with Westgate on the west and with Broadstairs on the south-east, owing to the modern extension of these popular watering-places. An electric tramway connects Margate with Broadstairs and Ramsgate, and during the season it is served by numerous pleasure steamers from London. An esplanade faces the sea along nearly the entire front of the town, and is lined with hotels, shops and dwelling-houses. A jetty exceeding a quarter of a mile in length permits the approach of vessels at all tides. It was built in 1854 and subsequently enlarged, but a pier was constructed by John Rennie in 1815, and is now chiefly used by fishermen and colliers. The church of St John the Baptist, founded in 1050, contains some portions of Norman architecture, the remainder being Decorated and Perpendicular. It is rich in ancient brasses and monuments, including a brass to Sir John Daundelyon (1443), whose family occupied a manor in the neighbourhood as early as the 13th century. The manor house of Daundelyon, or Dent de Lion, with its gateway of the early part of the 15th century, remains between Margate and Westgate. Charitable institutions include a deaf and dumb asylum (1875–1886), the Metropolitan infirmary for children (1841), and the royal sea-bathing infirmary, established in 1791 and enlarged through the munificence of Sir Erasmus Wilson in 1882. Dane Park (33 acres) was opened in 1898.

Margate (Meregate, Mergate), formerly a small fishing village, was an ancient and senior non-corporate member of Dover. In 1347 it contributed 15 ships of small tonnage at the time of the siege of Calais. Throughout the 14th century references are made to Margate in crown regulations regarding fisheries and shipping. A pier existed before 1500, but by the reign of Henry VIII. it was in a decayed condition. The amount of corn shipped was evidently small, the droits being insufficient to keep the pier in repair. Under Elizabeth Margate was still an obscure fishing village employing about 20 small vessels (" hoys ") in the coasting and river trades, chiefly in the conveyance of grain, on which in 1791 it chiefly subsisted. The droits increased, but were not properly collected until 1724. In 1777 the pier was rebuilt. It was about this time that Margate first began to be known as a bathing-place owing to its fine stretch of firm sand. In 1835 Margate was still a liberty of Dover and no right of citizenship could be acquired. In 1857 it was incorporated. In 1777 a weekly market was granted on Wednesday and Saturday. It is now held daily, but principally on those two days.

MARGGRAF, ANDREAS SIGISMUND (1709–1782), German chemist, was born at Berlin on the 3rd of March 1709. After studying chemistry at Berlin and Strassburg, medicine at Halle, and mineralogy and metallurgy at Freiberg, he returned to his native city in 1735 as assistant to his father, Henning Christian Marggraf, chief apothecary at the court. Three years later he was elected to the Berlin Academy of Sciences, which in 1754 put him in charge of its chemical laboratory and in 1760 appointed him director of its physics class. He died in Berlin on the 7th of August 1782. His name is especially associated with the discovery of sugar in beetroot. In 1747 he published an account of experiments undertaken with the definite view of obtaining true sugar from indigenous plants, and found that for this purpose the first place is taken by beetroot and carrot, that in those plants sugar like that of cane exists ready formed, and that it may be extracted by boiling the dried roots in alcohol, from which it is deposited on cooling. This investigation is also memorable because he detected the minute sugar-crystals in the roots by the help of the microscope, which was thus introduced as an adjunct to chemical inquiry. In another research dealing with the nature of alum he showed that one of the constituents of that substance, alumina, is contained in common clay, and further that the salt cannot be prepared by the action of sulphuric acid on alumina alone, the addition of an alkali being necessary. He explained and simplified the process of obtaining phosphorus from urine, and made some admirable observations on phosphoric acid; but though he noted the increase in weight that attends the conversion of phosphorus into phosphoric acid he was content to remain an adherent of the phlogistic doctrine. For his time he was a skilful chemical analyst; he knew how to distinguish potash and soda by the different colorations they produce in flame, and how to test for iron with prussiate of potash: he was aware that sulphate of potash, gypsum and heavy spar, in spite of their different appearances, all contain sulphuric acid; and he recognized that there are different varieties of urinary calculi. In metallurgy he devised improved methods for the manufacture of zinc and the purification of silver, tin and other metals.

His papers, mostly written in French, were presented to the Berlin Academy, and with the exception of a few of the latest were collected in two volumes of *Chymische Schriften* in 1761–1767.

MARGHELAN, or MARGHILAN, a town of Asiatic Russia, situated in 40° 28′ N. and 71° 45′ E., the administrative centre of the province of Ferghana. Pop. (1900), 42,855, mostly Sarts, with Tajiks and Jews. It is a very old town, with high earthen walls and twelve gates, commanded by a fort. It lies in a beautiful, extraordinary fertile and well irrigated district. The heat in summer is excessive. The principal industry is the manufacture of silk; camels' hair and woollen fabrics are also made. The new Russian town, founded in 1877, is 10 m. distant to the south-east, and has a population (1897) of 8977.

MARGRAVE (Ger. *Markgraf*), a German title meaning literally " count of the March " (Lat. *marchio*, *comes marchae*, *marchisus*). The margraves had their origin in the counts established by Charlemagne and his successors to guard the frontier districts of the empire, and for centuries the title was always associated with this function. The margraves had within their own jurisdiction the authority of dukes, but at the outset they were subordinate to the dukes in the feudal army of the empire. In the 12th century, however, the margraves of Brandenburg and Austria (the north and east marks) asserted their position as tenants-in-chief of the empire; with the break-up of the great duchies the others did the same; and the margraves henceforward took rank with the great German princes. The title of margrave very early lost its original significance, and was borne by princes whose territories were in no sense frontier districts, *e.g.* by Hermann, a son of Hermann, margrave of Verona, who assumed in 1112 the title of margrave of Baden. Thus, too, when the elector Albert Achilles of Brandenburg in 1473 gave Bayreuth and Ansbach as apanages to his sons and their descendants these styled themselves margraves. The title, however, retained in Germany its sovereign significance, and has not, like " marquis " in France and " marchese " in Italy, sunk into a mere title of nobility; it is not, therefore, in its present sense the equivalent of the English title " marquess." The German margraviates have now all been absorbed into other sovereignties, and the title margrave is borne only as a subsidiary title in the full style of their sovereigns.

MARGUERITE, the popular name for the plant known botanically as *Pyrethrum* (or *Chrysanthemum*) *frutescens* (natural order Compositae), a shrubby perennial with smooth leaves cut pinnately into narrow segments and flower-heads two to three inches across produced singly in summer and autumn on slender erect stalks. The white ray-florets surround a yellow disk. It is a native of the Canary Isles, and a favourite for decoration and for greenhouse cultivation, window-boxes and open ground in the summer. The yellow marguerite (*étoile d'or*) has somewhat larger pale yellow flowers and glaucous leaves. The plant is propagated from cuttings taken in autumn from old plants and placed in sandy loamy soil in cold frames. By pruning the shoots in autumn the plants may be grown into very large specimens in the course of a few seasons.

MARGUERITE DE VALOIS. The name Marguerite was common in the Valois dynasty, and during the 16th century there were three princesses, all of whom figure in the political as well as in the literary history of the time, and who have been not unfrequently confounded. The first and last are the most important, but all deserve some account.

I. MARGUERITE D'ANGOULÊME (1492–1549). This, the most celebrated of the Marguerites, bore no less than four surnames. By family she was entitled to the name of Marguerite de Valois; as the daughter of Charles d'Orléans, count d'Angoulême, she is more properly, and by careful writers almost invariably, called Marguerite d'Angoulême. From her first husband she took, during no small part of her life, the appellation Marguerite d'Alençon, and from her second, Henri d'Albret, king of Navarre, that of Marguerite de Navarre. She was born at Angoulême on the 11th of April 1492, and was two years older than her brother Francis I. She was betrothed early to Charles, duke d'Alençon, and married him in 1509. She was not very fortunate in this first marriage, but her brother's accession to the throne made her, next to their mother Louise of Savoy, the most powerful woman of the kingdom. She became a widow in 1525, and was sought in marriage by many persons of distinction, including, it is said, Charles V. and Henry VIII. In 1527 she married Henri d'Albret, titular king of Navarre, who was considerably younger than herself, and whose character was not faultless, but who seems on the whole, despite slander, to have both loved and valued his wife. Navarre was not reconquered for the couple as Francis had promised, but ample apanages were assigned to Marguerite, and at Nérac and Pau miniature courts were kept up, which yielded to none in Europe in the intellectual brilliancy of their frequenters. Marguerite was at once one of the chief patronesses of letters that France possessed, and the chief refuge and defender of advocates of the Reformed doctrines. Round her gathered C. Marot, Bonaventure Des Périers, N. Denisot, J. Peletier, V. Brodeau, and many other men of letters, while she protected Rabelais, E. Dolet, &c. For a time her influence with her brother, to whom she was entirely devoted, and whom she visited when he was imprisoned in Spain, was effectual, but latterly political rather than religious considerations made him discourage Lutheranism, and a fierce persecution was begun against both Protestants and freethinkers, a persecution which drove Des Périers to suicide and brought Dolet to the stake. Marguerite herself, however, was protected by her brother, and her personal inclinations seem to have been rather towards a mystical pietism than towards dogmatic Protestant sentiments. Nevertheless bigotry and the desire to tarnish the reputation of women of letters have led to the bringing of odious accusations against her character, for which there is not the smallest foundation. Marguerite died at Odot-en-Bigorre on the 21st of September 1549. By her first husband she had no children, by her second a son who died in infancy, and a daughter, Jeanne d'Albret, who became the mother of Henry IV. Although the poets of the time are unwearied in celebrating her charms, she does not, from the portraits which exist, appear to have been regularly beautiful, but as to her sweetness of disposition and strength of mind there is universal consent.

Her literary work consists of the *Heptameron*, of poems entitled *Les Marguerites de la marguerite des princesses*, and of *Letters*. The *Heptameron*, constructed, as its name indicates, on the lines of the *Decameron* of Boccaccio, consists of seventy-two short stories told to each other by a company of ladies and gentlemen who are stopped in the journey homewards from Cauterets by the swelling of a river. It was not printed till 1558, ten years after the author's death, and then under the title of *Les Amants fortunés*. Internal evidence is strongly in favour of its having been a joint work, in which more than one of the men of letters who composed Marguerite's household took part. It is a delightful book, and strongly characteristic of the French Renaissance. The sensuality which characterized the period appears in it, but in a less coarse form than in the great work of Rabelais; and there is a poetical spirit which, except in rare instances, is absent from *Pantagruel*. The *Letters* are interesting and good. The *Marguerites* consist of a very miscellaneous collection of poems, mysteries, farces, devotional poems of considerable length, spiritual and miscellaneous songs, &c. The *Dernières poésies*, not printed till 1896 (by M. A. Lefranc), are interesting and characteristic, consisting of verse-epistles, *comédies* (pieces in dramatic form on the death of Francis I., &c.), *Les Prisons*, a long allegorical poem of amorous-religious-historical tenor; some miscellaneous verse chiefly in dizains, and a later and remarkable piece, *Le Navire*, expressing her despair at her brother's death. Of the other works, never yet completely edited, the best editions are, for the *Heptameron*, Leroux de Lincy (1855); for the *Lettres*, Genin (1841–1842); and for the *Marguerites*, &c., Frank (1873), English translations of the *Heptameron* are rather numerous: one appeared in 1887 by A. Machen, with an introduction by Miss A. M. F. Robinson (Mme Darmesteter) and another (anonymous) in 1894, with an essay by G. Saintsbury. The religious poem, *Le Miroir de l'âme pécheresse* was translated by Queen Elizabeth. Books on Marguerite and her court are also many. There may be noted Durand's *Marguerite de Valois et la cour de François Ier* (1848); La Ferrière's *Marguerite d'Angoulême* (1891); Lotheissen's *Königin Margareta von Navarra* (1885); Miss Edith Sichel's *Women and Men of the French Renaissance* (1901), and P. Courtault's *Marguerite de Navarre* (1904).

II. The second MARGUERITE (1523–1574), daughter of Francis I., was born on the 5th of June, 1523, at St Germain-en-Laye, and, at an age the lateness of which caused lampoons, married Emmanuel Philibert, duke of Savoy, in 1559. Like her aunt and her niece she was a good scholar and strongly interested in men of letters. She is noteworthy as having given the chief impulse at the court of her brother Henry II. to the first efforts of the Pléiade (see RONSARD), and as having continued her patronage of literature at Turin. The poet Marc Antonio Flaminio, for instance, congratulates himself in pretty Latin verses on her singing his poems.

Her *Letters* have been published by A. G. Spinelli.

III. The third MARGUERITE (1553–1615), called more particularly Marguerite de Valois, was great-niece of the first and niece of the second, being daughter of Henry II. by Catherine de' Medici. She was born on the 14th of May 1553. When very young she became famous for her beauty, her learning, and the looseness of her conduct. She was married, after a liaison with the duke of Guise, to Henry of Navarre, afterwards Henry IV., on the eve of St Bartholomew's Day. Both husband and wife were extreme examples of the licentious manners of the time, but they not unfrequently lived together for considerable periods, and nearly always on good terms. Later, however, Marguerite was established in the castle of Usson in Auvergne, and after the accession of Henry the marriage was dissolved by the pope. But Henry and Marguerite still continued friends; she still bore the title of queen; she visited Marie de' Medici on equal terms; and the king frequently consulted her on important affairs, though his somewhat parsimonious spirit was grieved by her extravagance. Marguerite exhibited during the rest of her life, which was not a short one, the strange Valois mixture of licentiousness, pious exercises, and the cultivation of art and letters, and died in Paris on the 27th of March 1615. She left letters and memoirs the latter of which are admirably written, and rank among the best of the 16th century. She was the idol of Pierre de Bourdeille Brantôme, and is the "Reine Margot" of anecdotic history and romance.

The *Mémoires* are contained in the collection of Michaud and Poujoulat, and have been published separately by Guessard (the best, 1842), Lalanne, Caboche, &c. An English translation with introduction by Violet Fane appeared in 1892. Her character, and still more her circumstances, made the pen very unamiably busy with her in her lifetime, the chief of many lampoons being the famous *Divorce satirique*, variously attributed to Agrippa d'Aubigné, Palma Cayet, and others. The chief recent book on her is Saint Poucy's *Histoire de Marguerite de Valois* (1887).

(G. SA.)

MARGUERITTE, PAUL (1860–) and **VICTOR** (1866–), French novelists, both born in Algeria, were the sons of General Jean Auguste Margueritte (1823–1870), who after an honourable career in Algeria was mortally wounded in the great cavalry charge at Sedan, and died in Belgium, on the 6th of September 1870. An account of his life was published by Paul Margueritte as *Mon père* (1884; enlarged ed., 1897). The names of the two brothers are generally associated, on account of their collaboration. Paul Margueritte, who has given a picture of his home in Algiers in *Le Jardin du passé* (1895), was sent to the military school of La Flèche for the sons of officers, and became in 1880 clerk to the minister of public instruction. He designed two pantomimes, *Pierrot assassin de sa femme* (Théâtre Libre, 1882), and *Colombine pardonnée* (Cercle funambulesque, 1888), in which the traditional Pierrot, played by Margueritte himself, became a nervous, tragic creature. He resigned his clerkship in 1889 to devote himself entirely to literature, producing in rapid succession a series of novels, among which were *Tous quatre* (1885), *La Confession posthume* (1886), *Maison ouverte* (1887), *Pascal Géfosse* (1887), *Jours d'épreuve* (1889), *Amants* (1890), *La Force des choses* (1891), *Sur le retour* (1892), *La Tourmente* (1893), *Ma grande* (1892), *Âme d'enfant* (1894) and *L'Eau qui dort* (1896). Paul Margueritte had begun as a realistic novelist, but he was one of the five writers who signed a manifesto against Zola's *La Terre*, and he made his reputation by delicate, sober studies of the by-ways of sentiment. His brother Victor entered his father's regiment, the 1st chasseurs d'Afrique, in 1888, and served in the army until 1896, when he resigned his commission. He was already known by some volumes of poetry, and by a translation from Calderon (*La Double méprise*, played at the Odéon, 1898) when he began to collaborate with his brother. From the time of this collaboration Paul Margueritte's work gained in colour and force.

Among the books written in common by the brothers, the most famous is the series known under the collective title, *Une Époque*, dealing with the events of 1870–1871, and including the novels *Le Désastre* (1898), *Les Tronçons du glaive* (1900), *Les Braves gens* (1901), *La Commune* (1904). They also collaborated in an *Histoire de la guerre de 1870–1871* (1903). These books were founded on a mass of documentary and verbal information, amassed with great care and arranged with admirable art; the authors are historians rather than novelists. The disasters and humiliations of the campaigns are faithfully described, but are traced to defects of organization and leadership; while the courage and patriotism of the army itself is made the basis of an assured confidence in the destinies of France. *La Commune* is a bold indictment of the methods adopted by the victorious party. The novelists also attacked the laws governing marriage and divorce and the abuses entailed by the dowry demanded from the bride, in pamphlets and in the novels, *Femmes nouvelles* (1899), *Les Deux vies* (1902), and *Le Prisme* (1905). Their literary partnership was dissolved in 1907. Paul Margueritte was one of the original members of the Académie de Goncourt.

See *P. et V. Margueritte* (1905) by E. Pilon, in the series of *Célébrités d'aujourd'hui*, and A. France, *La Vie littéraire* (4th series, 1892).

MARHEINEKE, PHILIP KONRAD (1780–1846), German Protestant divine, was born at Hildesheim, Hanover, on the 1st of May 1780. He studied at Göttingen, and in 1805 was appointed professor extraordinarius of philosophy at Erlangen; in 1807 he moved to Heidelberg. In 1811 he became professor ordinarius at Berlin, where from 1820 he was also preacher at Trinity Church and worked with Schleiermacher. When he died, on the 31st of May 1846, he was a member of the supreme consistorial council. At first influenced by Schelling, Marheineke found a new master in Hegel, and came to be regarded as the leader of the Hegelian Right. He sought to defend and explain all the orthodox doctrines of the Church in an orthodox way in the terms of Hegel's philosophy. The dogmatic system that resulted from this procedure was inevitably more Hegelian than Christian; it was in fact an essentially new form of Christianity. Marheineke's developed views on dogmatics are given in the third edition (1847) of his *Die Grundlehren der christlichen Dogmatik als Wissenschaft*. When he published the first edition (1819) he was still under the influence of Schelling; the second edition (1827) marked his change of view. His works on symbolics show profound scholarship, keen critical insight, and rare impartiality. The *Christliche Symbolik* (1810–1814) has been pronounced his masterpiece.

His other works include *Institutiones symbolicae* (1812; 3rd ed., 1830), *Geschichte der deutschen Reformation* (1816; 2nd ed., 1831–1834); *Die Reformation, ihre Entstehung und Verbreitung in Deutschland* (1846; 2nd ed., 1858), and the posthumous *Theol. Vorlesungen* (1847–1849).

See F. Lichtenberger, *History of German Theology* (1889); A. Weber, *Le Système dogmatique de Marheineke* (1857); and cf. O. Pfleiderer, *Development of Theology in Germany* (1890).

MARIANA, JUAN DE (1536–1624), Spanish historian, was born at Talavera. He studied at the university of Alcalá, and was admitted at the age of seventeen into the Society of Jesus. In 1561 he went to teach theology in Rome, reckoning among his pupils Robert Bellarmine, afterwards cardinal; then passed into Sicily; and in 1569 he was sent to Paris, where his expositions of the writings of Thomas Aquinas attracted large audiences. In 1574, owing to ill health, he obtained permission to return to Spain; the rest of his life being passed at the Jesuits' house in Toledo in vigorous literary activity. He died at Madrid, on the 17th of February 1624.

Mariana's great work, *Historiae de rebus Hispaniae*, first appeared in twenty books at Toledo in 1592; ten books were subsequently added (1605), bringing the work down to the accession of Charles V. in 1519, and in a still later abstract of events the author completed it to the accession of Philip IV. in 1621. It was so well received that Mariana was induced to translate it into Spanish (the first part in 1601; completed, 1609; Eng. trans., by J. Stevens, 1699). Mariana's *Historiae*, though in many parts uncritical, is justly esteemed for its research, accuracy, sagacity and style. Of his other works the most interesting is the treatise *De rege et regis institutione* (Toledo, 1598). In its sixth chapter the question whether it is lawful to overthrow a tyrant is freely discussed and answered in the affirmative, a circumstance which brought much odium upon the Jesuits, especially after the assassination of Henry IV. of France, in 1610. A volume entitled *Tractatus VII. theologici et historici* (published by Mariana at Cologne, in 1609, containing in particular a tract, "*De morte et immortalitate*," and another, "*De mutatione monetae*") was put upon the index expurgatorius, and led to the confinement of its author by the Inquisition. During his confinement there was found among his papers a criticism upon the Jesuits, which was printed after his death as *Discursus de erroribus qui in forma gubernationis societatis Jesu occurrunt* (Bordeaux, 1625), and was reprinted by order of Charles III. when he banished the Jesuits from Spain.

See L. von Ranke, *Zur Kritik neuerer Geschichtsschreiber* (Leipzig, 1874), and Cirot, *Études sur les historiographes espagnols; Mariana, historien* (Bordeaux, 1905).

MARIANAO, a city of the province of Havana, Cuba, 6 m. W. by S. of the city of Havana, with which it is connected by the Marianao railway. Pop. (1899), 5416; (1907), 9332. Marianao is on a range of hills about 1500 ft. above the sea, is noted for its salubrious climate, and is mainly a place of residence for the families of prosperous business men of Havana. On the neighbouring coast is Marianao Beach, a popular bathing resort. The city dates from about 1830.

MARIANAS, MARIANNES, or LADRONES (Ger. *Marianen*), an archipelago in the north-western Pacific Ocean, in about 12° to 21° N. and 145° E. With the exception of the island of Guam (United States) it belongs to Germany, and administratively forms part of the New Guinea protectorate. It consists of two groups—a northern of ten volcanic main islands, of which only four (Agrigan, Anatahan, Alamagan and Pagan) are inhabited; and a southern of five coralline limestone islands (Rota, Guam, Aguijan, Tinian and Saypan), all inhabited save Aguijan. In the volcanic group an extreme elevation of about 2700 ft. is reached, and there are craters showing signs of activity, while earthquakes are not uncommon. Coral reefs fringe the coasts of the southern isles, which are of slight elevation. The total area, excluding Guam, is about 245 sq. m. and the population 2500, mostly descendants of the Tagal immigrants from the Philippines. All the islands except Farallon de Medinilla and Urracas or Mangs (in the northern group) are more or less densely wooded, and the vegetation is luxuriant, much resembling that of the Carolines, and also of the Philippines, whence many species of plants have been introduced. Owing to the humidity of the soil cryptogams are numerous, as also most kinds of grasses. Coco-nut and areca palms, yams, sweet potatoes, manioc, coffee, cocoa, sugar, cotton, tobacco and mother-of-pearl are the chief products, and copra is the principal export. Agriculture is neglected, in spite of the exceptional advantages offered by the climate and soil. On most of the islands there is a plentiful supply of water. The native population known to the early Spanish colonists as Chamorros has died out as a distinct people, though their descendants have intermarried with the immigrant Tagals and natives of the Carolines. At the Spanish occupation in 1668 the Chamorros were estimated at 40,000 to 60,000, but less than a century later only 1800 remained. They were typical Micronesians, with a considerable civilization. In the island of Tinian are some remarkable remains attributed to them, consisting of two rows of massive square stone columns, about 5 ft. 4 in. broad and 14 ft. high, with heavy round capitals. According to early Spanish accounts cinerary urns were found imbedded in the capitals.

The fauna of the Marianas, though inferior in number and variety, is similar in character to that of the Carolines, and certain species are indigenous to both colonies. Swine and oxen run wild, and are hunted when required: the former were known to the earlier inhabitants; the latter with most other domestic animals were introduced by the Spaniards. The climate though damp is healthy, while the heat, being tempered by the trade winds, is milder than that of the Philippines; the variations of temperature are not great.

The discovery of this archipelago is due to Magellan, who on the 6th of March 1521 observed the two southernmost islands, and sailed between them (O. Peschel, *Geschichte des Zeitalters der Entdeckungen*, Stuttgart, 1877). The name *Islas de los Ladrones* (or "Islands of the Thieves") was given them by the ship's crew of Magellan on account of the thieving propensity of the inhabitants; and the islands are still commonly called the Ladrones. Magellan himself styled them *Islas de las Velas Latinas* ("Islands of the Lateen Sails"). San Lazarus archipelago, Jardines and Prazeres are among the names applied to them by later navigators. They received the name *Las Marianas* in 1668 in honour of Maria Anna of Austria, widow of Philip IV. of Spain. Research in the archipelago was carried out by Commodore Anson, who in August 1742 landed upon the island of Tinian (George, Lord Anson, *Voyage round the World*, bk. iii., 1748). The Ladrones were visited by Byron in 1765, Wallis in 1767 and Crozet in 1772. The entire archipelago (except Guam) together with the Caroline and Pelew Islands was sold by Spain to Germany for £837,500 in 1899.

See Anson, *op. cit.*; L. de Freycinet, *Voyage autour du monde* (Paris, 1826–1844); "The Marianas Islands" in *Nautical Magazine*, xxxiv., xxxv. (London, 1865–1866); O. Finsch, *Karolinen und Marianen* (Hamburg, 1900); Costenoble, "*Die Marianen*" in Globus, lxxxviii. (1905).

MARIANAS, or MARANHAS, a tribe of South American Indians on the river Jutahy, north-western Brazil. They wear small pieces of wood in their ears and lips, but are not tattooed. Marianas are also found on the upper reaches of the Putumayo across to the Yapurá.

MARIANUS SCOTUS (1028–1082 or 1083), chronicler (who must be distinguished from his namesake Marianus Scotus, d. 1088, abbot of St Peter's, Regensburg), was an Irishman by birth, and called Moelbrigte, or servant of Bridget. He was educated by a certain Tigernach, and having become a monk he crossed over to the continent of Europe in 1056, and his subsequent life was passed in the abbeys of St Martin at Cologne and of Fulda, and at Mainz. He died at Mainz, on the 22nd of December 1082 or 1083.

Marianus wrote a *Chronicon*, which purports to be a universal history from the creation of the world to 1082. The *Chronicon* was very popular during the middle ages, and in England was extensively used by Florence of Worcester and other writers. It was first printed at Basel in 1559, and has been edited with an introduction by G. Waitz for the *Monumenta Germaniae historica. Scriptores* (Bd. v.). See also W. Wattenbach, *Deutschlands Geschichtsquellen* (Bd. ii., 1894).

MARIA STELLA, the self-styled legitimate daughter of Philip, duke of Orleans. According to her, Louis Philippe was not the son of Philip duke of Orleans, but a suppositious child, his father being one Lorenzo Chiappini, constable at the village of Modigliana in Tuscany. The story is that the duke and duchess of Orleans, travelling under the incognito of Comte and Comtesse de Joinville, were at this village in April 1773, when the duchess gave birth to a daughter; and that the duke, desiring a son in order to prevent the rich Penthièvre inheritance from reverting to his wife's relations in the event of her death, bribed the Chiappinis to substitute their newly-born male child for his own.

Maria Stella, the supposed daughter of Chiappini, went on the stage at Florence, where her putative parents had settled, and there at the age of thirteen became the wife of the first Lord Newborough, after whose death she married the Russian Count Ungern-Sternberg. On the death of her putative father in 1821 she received a letter, written by him shortly before his death, in which he confessed that she was not his daughter, adding "Heaven has repaired my fault, since you are in a better position than your real father, though he was of almost similar rank" (*i.e.* a French nobleman). Maria Stella henceforward devoted her time and fortune to establishing her identity. Her first success was the judgment of the episcopal court at Faenza, which in 1824 declared that the Comte Louis de Joinville exchanged his daughter for the son of Lorenzo Chiappini, and that the Demoiselle de Joinville had been baptized as Maria Stella, "with the false statement that she was the daughter of L. Chiappini and his wife." The discovery that Joinville was a countship of the Orleans family, and a real or fancied resemblance of Louis Philippe to Chiappini, convinced her that the duke of Orleans was the person for whose sake she had been cheated of her birthright, a conviction strengthened by the striking resemblance which many people discovered in her to the princesses of the Orleans family. In 1830 she published her proofs under the title *Maria Stella ou un échange d'une demoiselle du plus haut rang contre un garçon de plus vile condition* (reprinted 1839 and 1849). This coincided with the advent of Louis Philippe to the throne, and her claim became a weapon for those who wished to throw discredit and ridicule on the "bourgeois monarch." He for his part treated the whole thing with amused contempt, and Baroness Newborough-Sternburg de Joinville, or Marie Étoile d'Orléans, as she called herself, was suffered to live in Paris until on the 23rd of December 1843 she died in poverty and obscurity.

In spite of much discussion and investigation, the case of Maria Stella remains one of the unsolved problems of history. Sir Ralph Payne Gallwey's *Mystery of Maria Stella, Lady Newborough* (London, 1907), is founded on her own accounts and argues in favour of her point of view. More convincing, however, is Maurice Vitrac's *Philippe-Égalité et M. Chiappini* (Paris, 1907), which is based on unpublished material in the *Archives nationales*. M. Vitrac seeks to overthrow Maria Stella's case by an *alibi*. The duke and duchess of Chartres could not have been at Modigliana in April 1773, for the simple reason that they can be proved at that time to have been in Paris. On the 8th of April the duke, according to the official *Gazette de France*, took part in the Maundy Thursday ceremonies at Versailles; from the 7th to the 14th he was in constant attendance at the lodge of Freemasons of which he had just been elected grand master. Moreover, it was impossible for the first prince of the blood royal to leave France without the royal permission, and his absence would certainly have been remarked. Lastly, the duchess's accouchement, a semi-public function in the case of royal princesses, did not take place till the 6th of October. M. Vitrac identifies the real father of Maria Stella with Count Carlo Battaglini of Rimini, who died in 1796 without issue; the case being not one of substitution, but of ordinary "farming out" to avoid a scandal.

MARIA THERESA (1717–1780), archduchess of Austria, queen of Hungary and Bohemia, and wife of the Holy Roman emperor Francis I., was born at Vienna on the 13th of May 1717. She was the eldest daughter of the Emperor Charles VI. (*q.v.*) and his wife Elizabeth of Brunswick-Wolfenbüttel. On the 12th of February 1736 she was married to her cousin Francis of Lorraine (*q.v.*), then grand duke of Tuscany, and afterwards emperor. Five sons and eleven daughters were born of this marriage. From the date of her father's death on the 20th of October 1740, till her own death in 1780, Maria Theresa was one of the central figures in the wars and politics of Europe. But unlike some sovereigns, whose reigns have been agitated, but whose personal character has left little trace, Maria Theresa had a strong and in the main a noble individuality. Her great qualities were relieved by human traits which make her more sympathetic. It must be allowed that she was fairly open to the criticism implied in a husbandly jest attributed to Francis I. While they were returning from the opera house at Vienna she said to him that the singer they had just heard was the greatest actress who had ever lived, and he answered "Next to you, Madam." Maria Theresa had undoubtedly an instinctive histrionic sense of the perspective of the theatre, and could adopt the appropriate attitude and gesture, passionate, dignified or pathetic, required to impress those she wished to influence. But there was no affectation in her assumption of a becoming bearing or in her picturesque words. The common story, that she appeared before the Hungarian magnates in the diet at Pressburg in 1741 with her infant son, afterwards

Joseph II., in her arms, and so worked on their feelings that they shouted *Moriamur pro rege nostro Maria Theresia*, is only mythically true. But during the delicate negotiations which were required to secure the support of the Hungarian nobles she undoubtedly did appeal to them with passionate eloquence, and, we may believe, with a very pardonable sense of the advantage she obtained from her youth, her beauty and her sex. Her beauty, inherited from her mother, was of an open and noble German type. The official portrait by Muytens, engraved by Petit, gives a less convincing impression that an excellent chalk drawing of the head by Gabriel Mattei. In the conflict between her sense of what was morally just and her sense of duty to the state she laid herself open to the scoffing taunt of Frederick of Prussia, who said that in the first partition of Poland *elle pleurait et prenait toujours*. But the king of Prussia's taunt is deprived of its sting by the almost incredible candour of her own words to Kaunitz, that if she was to lose her reputation before God and man for respecting the rights of others it must not be for a small advantage—if, in fact, Austria was to share in the plunder of Poland, she was to be consoled for the distress caused to her feelings by the magnitude of her share of the booty. There was no hypocrisy in the tears of the empress. Her intellectual honesty was as perfect as Frederick's own, and she was as incapable as he was of endeavouring to blind herself to the quality of her own acts. No ruler was ever more loyal to a conception of duty. Maria Theresa considered herself first and foremost as the heiress of the rights of the house of Austria. Therefore, when her inheritance was assailed at the beginning of her reign, she fought for it with every weapon an honest woman could employ, and for years she cherished the hope of recovering the lost province of Silesia, conquered by Frederick. Her practical sense showed her the necessity of submitting to spoliation when she was overpowered. She accepted the peace of Berlin in 1742 in order to have a free hand against her Bavarian enemy, the emperor Charles VII. (*q.v.*). When Frederick renewed the war she accepted the struggle cheerfully, because she hoped to recover her own. Down to the peace of Aix-la-Chapelle in 1748 she went on fighting for Silesia or its equivalent. In the years following the peace she applied herself to finding allies in France and Russia who would help her to recover Silesia. Here, as later in the case of Poland, she subordinated her feelings to her duty to the state. Though she denied that she had ever written directly to Madame de Pompadour, it is certain that she allowed her ministers to make use of the favourite's influence over the French king. When fate decided against her in the Seven Years' War she bowed to the inevitable, and was thenceforward a resolute advocate of peace.

In her internal government she showed herself anxious to promote the prosperity of her people, and to give more unity to an administration made up by the juxtaposition of many states and races with different characters and constitutions. Her instincts, like those of her enemy Frederick and her son Joseph II., were emphatically absolutist. She suspended the meetings of the estates in most parts of her dominions. She was able to do so because the mass of her subjects found her hand much lighter than that of the privileged classes who composed these bodies. Education, trade, religious toleration, the emancipation of the agricultural population from feudal burdens—all had her approval up to a certain point. She would favour them, but on the distinct condition that nothing was to be done to weaken the bonds of authority. She took part in the suppression of the Jesuits, and she resisted the pope in the interest of the state. Her methods were those of her cautious younger son, Leopold II., and not of her eldest son and immediate successor, Joseph II. She did not give her consent even to the suppression of torture in legal procedure without hesitation, lest the authority of the law should be weakened. Her caution had its reward, for whatever she did was permanently gained, whereas her successor in his boundless zeal for reform brought his empire to the verge of a general rebellion.

In her private life Maria Theresa was equally the servant of the state and the sovereign of all about her. She was an affectionate wife to her husband Francis I.; but she was always the queen of Hungary and Bohemia and archduchess of Austria, like her ancestress, Isabella the Catholic, who never forgot, nor allowed her husband to forget, that she was "proprietary queen" of Castile and Leon. She married her daughters in the interest of Austria, and taught them *not* to forget their people and their father's house. In the case of Marie Antoinette (*q.v.*), who married the dauphin, afterwards Louis XVI., she gave an extraordinary proof of her readiness to subordinate everything to the reason of state. She instructed her daughter to show a proper respect to her husband's grandfather, Louis XV., by behaving with politeness to his mistresses, in order that the alliance between the two courts might run no risk. The signing of the peace of Teschen, which averted a great war with Prussia, on the 13th of May 1779, was the last great act of her reign, and so Maria Theresa judged it to be in a letter to Prince Kaunitz; she said that she had now finished her life's journey and could sing a *Te Deum*, for she had secured the repose of her people at whatever cost to herself. The rest, she said, would not last long. Her fatal illness developed in the autumn of the following year, and she died on the 28th of November 1780. When she lay painfully on her deathbed her son Joseph said to her, "You are not at ease," and her last words were the answer, "I am sufficiently at my ease to die."

See A. von Arneth, *Geschichte Maria Theresas* (Vienna, 1863–1879) and J. F. Bright, *Maria Theresa* (London, 1897); also the article AUSTRIA.

MARIAZELL, a village of Austria, in Styria, 89 m. N. of Graz. Pop. (1900), 1499. It is picturesquely situated in the valley of the Salza, amid the north Styrian Alps. Its entire claim to notice lies in the fact that it is the most frequented sanctuary in Austria, being visited annually by about 200,000 pilgrims. The object of veneration is a miracle-working image of the Virgin, carved in lime-tree wood, and about 18 in. high. This was presented to the place in 1157, and is now enshrined in a chapel lavishly adorned with objects of silver and other costly materials. The large church of which the chapel forms part was erected in 1644 as an expansion of a smaller church built by Louis I., king of Hungary, after a victory over the Turks in 1363. In the vicinity of Mariazell is the pretty Alpine lake of Erlafsee.

See M. M. Rabenlehrer, *Mariazell, Österreichs Loreto* (Vienna, 1891); and O. Eigner, *Geschichte des aufgeshobenen Benedictinerstiftes Mariazell* (Vienna, 1900).

MARIE AMÉLIE THÉRÈSE (1782–1866), queen of Louis Philippe, king of the French, was the daughter of Ferdinand IV., king of Naples, and the archduchess Maria Carolina, daughter of the empress Maria Theresa, and belonged to the house of Bourbon. She was born at Caserta, on the 26th of April 1782, and received a careful education which developed the naturally pious and honourable disposition that earned for her in the family circle the nickname of La Santa. Driven from Naples in 1798, the Neapolitan royal family fled to Palermo, and the years from 1800 to 1802 were spent by Marie Amélie with her mother at the Austrian court. In 1806 they were again in flight before the armies of Masséna, and it was during the second residence of her father's court at Palermo that she met the exiled Louis Philippe, then duke of Orleans, whom she married in November 1809. Returning to France in 1814, the duke and duchess of Orleans had barely established themselves in the Palais Royal in Paris when the Hundred Days drove them into exile. Marie Amélie took refuge with her four children in England, where she spent two years at Orleans House, Twickenham. Again in France in 1817, her life at Neuilly until 1828 was the happiest period of her existence. Neither then nor at any other time did she take any active share in politics; but she was not without indirect influence on affairs, because her strong royalist and legitimist traditions prevented the court from including her in the suspicion with which her husband's liberal views were regarded. Her attention was absorbed by the care and education of her numerous family, even after the revolution of 1830 had made her queen of the French, a position accepted by her with forebodings of disaster justified by her early experience of revolutions. During her second exile, from 1848 to the end of her life, she lived at Claremont, where her charity and piety endeared her to the many English friends of the Orleans family. Marie Amélie died at Claremont, on the 24th of March 1866.

See A. Trognon, *Vie de Marie Amélie* (1872); A. L. Baron Imbert de St Amand, *La Jeunesse de Marie Amélie* (1891), *Marie Amélie au Palais Royal* (1892), *Marie Amélie et la cour de Palerme* (1891), *Marie Amélie et la cour des Tuileries* (1892), *Marie Amélie et l'apogée de règne de Louis Philippe* (1893), *Marie Amélie et la société française en 1847* (1894), and *Marie Amélie et la duchesse d'Orleans* (1893).

MARIE ANTOINETTE (1755–1793), queen of France, ninth child of Maria Theresa and the emperor Francis I., was born at Vienna, on the 2nd of November 1755. She was brought up under a simple and austere régime and educated with a view to the French marriage arranged by Maria Theresa, the abbé Vermond being appointed as her tutor in 1769. Her marriage with the dauphin, which took place at Versailles on the 16th of May 1770, was intended to crown the policy of Choiseul and confirm the alliance between Austria and France. This fact, combined with her youth and the extreme corruption of the French court, made her position very difficult. Madame du Barry, whose influence over Louis XV. was at that time supreme, formed the centre of a powerful anti-Choiseul cabal, which succeeded in less than a year after the dauphin's marriage in bringing about the fall of Choiseul and seriously threatening the stability of the Austrian alliance. Thus the young princess was surrounded by enemies both at court and in the dauphin's household, and came to rely almost entirely upon the Austrian ambassador, the comte de Mercy-Argenteau, whom Maria Theresa had instructed to act as her mentor, at the same time arranging that she herself should be kept informed of all that concerned her daughter, so that she might at once advise her and safeguard the alliance. Hence arose the famous secret correspondence of Mercy-Argenteau, an invaluable record of all the details of Marie Antoinette's life from her marriage in 1770 till the death of Maria Theresa in 1780.

Marie Antoinette soon won the affection and confidence of the dauphin and endeared herself to the king, but her position was precarious, and both Mercy and Maria Theresa had continually to urge her to conquer her violent dislike for the favourite and try to conciliate her.

The accession of the young king and queen on the death of Louis XV. (May 10, 1774), was hailed with great popular enthusiasm. But her first steps brought Marie Antoinette into open hostility with the anti-Austrian party. She was urgent in obtaining the dismissal of d'Aiguillon, and did all in her power to secure the recall of Choiseul, though without success. Thus from the very first she appeared in the light of a partisan, having against her all the enemies of Choiseul and of the Austrian alliance, and was already given the nickname of "l'autrichienne" by mesdames the king's aunts. At the same time her undisguised impatience of the cumbrous court etiquette shocked many people, and her taste for pleasure led her to seek the society of the comte d'Artois and his young and dissolute circle. But the greatest weakness in her position lay in her unsatisfactory relations with her husband. The king, though affectionate, was cold and apathetic, and it was not till seven years after her marriage that there was any possibility of her bearing him an heir. This fact naturally decreased her popularity, and as early as September 1774, was made the subject of offensive pamphlets and the like, as in the case of the *affaire Beaumarchais*. (See BEAUMARCHAIS.)

The end of the period of mourning for the late king was the signal for a succession of gaieties, during which the queen displayed a passion for amusement and excitement which led to unfortunate results. Being childless, and with a husband who could not command her respect, her longing for affection led her to form various intimate friendships, above all with the princesse de Lamballe and the comtesse Jules de Polignac, who soon obtained such an empire over her affections that no favour was too great for them to ask, and often to obtain. Thus for the benefit of Madame de Lamballe the queen revived the superfluous and expensive office of superintendent of her household, which led to constant disagreements and jealousies among her ladies and offended many important families. In frequenting the salons of her friends the queen not only came in contact with a number of the younger and more dissipated courtiers, whose high play and unseemly amusements she countenanced, but she fell under the influence of various ambitious intriguers, such as the baron de Bésenval, the comte de Vaudreuil, the duc de Lauzun and the comte d'Adhémar, whose interested manœuvres she was induced to further by her affection for her favourites. Thus she was often led to interfere for frivolous reasons in public affairs, sometimes with serious results, as in the case of the trial of the comte de Guines (1776), when her interference was responsible for the fall of Turgot. At the same time her extravagance in dress, jewelry and amusements (including the gardens and theatricals at Trianon, of the cost of which such exaggerated reports were spread about) and her presence at horse-races and masked balls in Paris without the king, gave rise to great scandal, which was seized upon by her enemies, among whom were Mesdames, the count of Provence, and the duke of Orleans and the Palais Royal clique.

At this critical period her brother, the emperor Joseph II., decided to visit France. As the result of his visit he left with the queen a memorandum in which he pointed out to her in plain terms the dangers of her conduct.[1] He also took advantage of his visit to advise the king, with such success that at last, in 1778, the queen had the hope of becoming a mother. For a time the emperor's remonstrances had some effect, and after the birth of her daughter, Marie Thérèse Charlotte (afterwards duchesse d'Angoulême) in December 1778, the queen lived a more quiet life. The death of Maria Theresa (Nov. 29, 1780) deprived her of a wise and devoted friend, and by removing all restraint on the rashness of Joseph II. was bound to increase the dislike of the Austrian alliance and cause embarrassment to Marie Antoinette. Her position was very much strengthened by the birth (Oct. 22, 1781) of a dauphin, Louis Joseph Xavier François, and on the death of Maurepas, which left the king without a chief minister, she might have exerted a considerable influence in public affairs had she taken a consistent interest in them; but her repugnance to serious matters triumphed, and she preferred to occupy herself with the education of her children, to whom she was a wise and devoted mother,[2] and with her friends and amusements at Trianon. Personal motives alone would lead her to interfere in public affairs, especially when it was a question of obtaining places or favours for her favourites and their friends. The influence of the Polignacs was now at its height, and they obtained large sums of money, a dukedom, and many nominations to places. It was Madame de Polignac who obtained the appointment of Calonne as controller-general of the finances,[3] and who succeeded Madame de Guéménée as "governess of the children of France" after the bankruptcy of the prince de Guéménée in 1782.[4] Again, in response to Mercy and Joseph II.'s urgent representations, Marie Antoinette exerted herself on behalf of Austria in the affairs of the opening of the Scheldt (1783–1784) and the exchange of Bavaria (1785), in which, though she failed to provoke active interference on the part of France, she succeeded in obtaining the payment of considerable indemnities to Austria, a fact which led to the popular legend of her having sent millions to Austria, and aroused much indignation against her. Later, on the recommendation of Mercy and Vermond, she supported the nomination of Loménie de Brienne in 1787, an appointment which, though widely approved at the time, was laid to the queen's blame when it ended in failure.

Two more children were born to her; Louis Charles, duke of Normandy, afterwards dauphin, on the 27th of March 1785, and Sophie Hélène Beatrix (d. June 19, 1787), on the 9th of July 1786. In 1785–1786 the affair of the Diamond Necklace (*q.v.*)

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[1] See Arneth, *Marie Antoinette, Joseph II. and Leopold II.*, pp. 1–18.

[2] v. the *Instructions données à la marquise de Tourzel*, governess of the children of France, dated the 24th of July, 1789, in la Rocheterie and Beaucourt, *Lettres de Marie Antoinette*, ii. 131.

[3] But see Arneth and Flammermont, i. 228, foot-note.

[4] This had reflected discredit on the queen, Madame de Guéménée having been one of her intimate friends.

revealed the depth of the hatred which her own follies and the calumnies of her enemies had aroused against her. The public held her responsible for the bankrupt state of the country; and though in 1788, following the popular outcry, she prevailed upon the king to recall Necker, it was impossible for him to avert the Revolution. The year 1789 was one of disaster for Marie Antoinette; on the 10th of March her brother Joseph II. died, and on the 4th of June her eldest son. The same year saw the assembling of the States-general, which she had dreaded, the taking of the Bastille, and the events leading to the terrible days of the 5th and 6th of October at Versailles and the removal of the royal family to the Tuileries. Then began the negotiations with Mirabeau, whose high estimate of the queen is well-known (*e.g.* his famous remark, "The king has only one man on his side, and that is his wife"). But the queen was violently prejudiced against him, believing him among other things to be responsible for the events of the 5th and 6th of October, and he never gained her full confidence. She was naturally incapable of seeing the full import of the Revolution, and merely temporised with Mirabeau. She dreaded the thought of civil war; and even when she had realized the necessity for decisive action the king's apathy and indecision made it impossible for her to persuade him to carry into effect Mirabeau's plan of leaving Paris and appealing to the provinces. Her difficulties were increased by the departure of Mercy for the Hague in September 1790, for Montmorin who now took his place in the negotiations had not her confidence to the same extent. Feeling herself helpless and almost isolated in Paris, she now relied chiefly on her friends outside France—Mercy, Count Axel Fersen, and the baron de Breteuil; and it was by their help and that of Bouillé that after the death of Mirabeau, on the 8th of April 1791, the plan was arranged of escaping to Montmédy, which ended in the flight to Varennes (June 21, 1791).

After the return from Varennes the royal family were closely guarded, but in spite of this they still found channels of communication with the outside world. The king being sunk in apathy, the task of negotiation devolved upon the queen; but in her inexperience and ignorance of affairs, and the uncertainty of information from abroad, it was hard for her to follow any clear policy. Her courageous bearing during the return from Varennes had greatly impressed Barnave, and he now approached her on behalf of the Feuillants and the constitutional party. For about a year she continued to negotiate with them, forwarding to Mercy and the emperor Leopold II. letters and memoranda dictated by them, while at the same time secretly warning her friends not to accept these letters as her own opinions, but to realize that she was dependent on the Constitutionals.[1] She agreed with their plan of an armed congress, and on this idea both she and Fersen insisted with all their might, Fersen leaving Brussels and going on a mission to the emperor to try and gain support and checkmate the *émigrés*, whose desertion the queen bitterly resented, and whose rashness threatened to frustrate her plans and endanger the lives of her family.

As to the acceptance of the constitution (Sept. 1791), "tissue of absurdities" though the queen thought it, and much as she would have preferred a bolder course, she considered that in the circumstances the king was bound to accept it in order to inspire confidence.[2] Mercy was also in correspondence with the Constitutionals, and in letter after letter to him and the emperor, the queen, strongly supported by Fersen, insisted that the congress should be formed as soon as possible, her appeals increasing in urgency as she saw that Barnave's party would soon be powerless against the extremists. But owing to the lengthy negotiations of the powers the congress was continually postponed. On the 1st of March 1792 Leopold II. died, and was succeeded by the young Francis II. Marie Antoinette's actions were now directed entirely by Fersen, for she suspected Mercy and the emperor of sacrificing her to the interests of Austria (*Fersen*, i. 251; Arneth, pp. 254, 256, &c.). The declaration of war which the king was forced to make (April 20) threw her definitely into opposition to the Revolution, and she betrayed to Mercy and Fersen the plans of the French generals (Arneth, p. 259; *Fersen*, ii. 220, 289, 308, 325, 327). She was now certain that the life of the king was threatened, and the events of the 20th of June added to her terrors. She considered their only hope to lie in the intervention of the powers and in the appeal to force, and endorsed the suggestion of a threatening manifesto[3] which should hold the National Assembly and Paris responsible for the safety of the king and royal family. Immediately after Brunswick's manifesto followed the storming of the Tuileries and the removal of the royal family to the Temple (Aug. 10). During all these events and the captivity in the Temple Marie Antoinette showed an unvarying courage and dignity, in spite of her failing health and the illness of her son. After the execution of the king (Jan. 17, 1793) several unsuccessful attempts were made by her friends to rescue her and her children, among others by Jarjayes, Toulan and Lepître, and the "baron de Batz," and negotiations for her release or exchange were even opened with Danton; but as the allied armies approached her trial and condemnation became a certainty. She had already been separated from her son, the sight of whose ill-treatment added terribly to her sufferings; she was now parted from her daughter and Madame Elizabeth, and removed on the 1st of August 1793 to the Conciergerie. Even here, where she was under the closest guard and subjected to the most offensive espionnage, attempts were made to rescue her, among others Michonis' "Conspiration de l'oeillet."

On the 14th of October began her trial, her defence being entrusted to Chauveau-Lagarde and Tronson-Ducourdray. Her noble attitude, even in the face of the atrocious accusations of Fouquier-Tinville, commanded the admiration even of her enemies, and her answers during her long examination were clear and skilful. The following were the questions finally put to the jury:—

(1) Is it established that manœuvres and communications have existed with foreign powers and other external enemies of the republic, the said manœuvres, &c., tending to furnish them with assistance in money, give them an entry into French territory, and facilitate the progress of their armies?

(2) Is Marie Antoinette of Austria, the widow Capet, convicted of having co-operated in these manœuvres and maintained these communications?

(3) Is it established that a plot and conspiracy has existed tending to kindle civil war within the republic, by arming the citizens against one another?

(4) Is Marie Antoinette, the widow Capet, convicted of having participated in this plot and conspiracy?

The jury decided unanimously in the affirmative, and on the 16th of October 1793 Marie Antoinette was led to the guillotine, leaving behind her a touching letter to Madame Elizabeth, known as her "Testament."

As to the justice of these charges, we have seen how the queen was actually guilty of betraying her country, though it was only natural for her to identify the cause of the monarchy with that of France. To civil war she was consistently opposed, and never ceased to dissociate herself from the plans of the *émigrés*, but here again her very position made her an enemy of the republic. In any case, all her actions had as their aim—firstly, the safeguarding of the monarchy and the king's position, and later, when she saw this to be impossible, that of securing the safety of her husband and her son.

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[1] Letters of 31st July 1791 to Mercy. Arneth, p. 193 and 194, and letter of 1st August.

[2] Arneth, pp. 196, 203; Klinckowström, *Fersen*, i. 192.

[3] H. Belloc, *Marie-Antoinette*, pp. 311–312, states that clause VIII. of Brunswick's manifesto was "drafted" by Marie Antoinette, *i.e.* that the idea of holding Paris responsible for the safety of the royal family was first suggested by her. He bases this statement entirely upon the queen's letters of July 3rd to Fersen, of July 4th to Mercy, the reception of which Fersen notes in his Journal on July 8th and 9th (Fersen ii. 21). But these letters were obviously the answer to Fersen's letter of June 30th to the queen (Fersen ii. 315), in which he tells her the terms of the manifesto. Moreover, the suggestion of holding the Assembly responsible is to be found as early as in the memo. of the Constitutionals of September the 8th, 1791, and is included in the Instructions of Mallet du Pan (Mems. ed. Sayous, i. 281, and appendix 445). Fersen (*Fersen* ii. 329, 337, 18th July and 28th July to the queen, and p. 338, 29th July to Taube) states that it was he who drew up the manifesto by means of the marquis de Limon.

For a bibliographical study see: M. Tourneux, *Marie Antoinette devant l'histoire. Essai bibliographique* (2nd ed., Paris, 1901); id. *Bibliogr. de la ville de Paris* . . .(vol. iv. 1906), nos. 20980–21338; also *Bibliogr. de femmes célèbres* (Turin and Paris, 1892, &c.). The most important material for her life is to be found in her letters and in the correspondence of Mercy-Argenteau, but a large number of forgeries have found their way into certain of the collections, such as those of Paul Vogt d'Hunolstein (*Correspondance inédite de Marie Antoinette*, (3rd ed., Paris, 1864), and F. Feuillet des Conches *Louis XVI., Marie Antoinette et Madame Élisabeth, lettres et documents inédits* (6 vols., Paris, 1864–1873), while most of the works on Marie Antoinette published before the appearance of Arneth's publications (1865, &c.) are based partly on these forgeries. For a detailed examination of the question of the authenticity of the letters see the introduction to *Lettres de Marie Antoinette. Recueil des lettres authentiques de la reine, publié pour la société d'histoire contemporaine, par M. de la Rocheterie et le marquis de Beaucourt* (2 vols., Paris, 1895–1896); also A. Geffroy, *Gustave III. et la cour de France* (2 vols., Paris, 1869), vol. ii., appendix. Of the highest importance are the letters from the archives of Vienna published by Alfred von Arneth and others: A. von Arneth, *Maria Theresia und Marie Antoinette, ihr Briefwechsel* 1770–1780 (Paris and Vienna, 1865); id., *Marie Antoinette, Joseph II. und Leopold II. ihr Briefwechsel* (Leipzig, Paris and Vienna, 1866); id. and A. Geffroy, *Correspondance secrète de Marie-Thérèse et du comte de Mercy-Argenteau* (3 vols., Paris, 1874); id. and J. Flammermont, *Correspondance secrète du comte de Mercy-Argenteau avec Joseph II. et le prince de Kaunitz* (2 vols., Paris, 1889–1891); for further letters see Comte de Reiset, *Lettres de la reine Marie Antoinette à la landgrave Louise de Hesse-Darmstadt* (1865); id. *Lettres inédites de Marie Antoinette et de Marie-Clotilde, reine de Sardaigne* (1877). See also *Correspondance entre le comte de Mirabeau et le comte de la Marck, 1789–1791, recueillie . . . par F. de Bacourt* (3 vols., Paris, 1857), and Baron R. M. de Klinckowström, *Le Comte de Fersen et la cour de France* (2 vols., Paris, 1877–1878). *Memoirs*: See most contemporary memoirs, *e.g.* those of the prince de Ligne, Choiseul, Ségur, Bouillé, Dumouriez, &c. Some, such as those of Madame Campan, Weber, Cléry, Mme de Tourzel, are prejudiced in her favour; others, such as those of Besenval, Lauzun, Soulavie, are equally prejudiced against her. M. Tourneux (*op. cit.*) discusses the authenticity of the memoirs of Tilly, Cléry, Lauzun, &c. The chief of these memoirs are: Mme Campan, *Mémoires sur la vie privée de Marie Antoinette* (5th ed., 2 vols., Paris, 1823, Eng. trans. 1887), the inaccuracy of which is clearly demonstrated by J. Flammermont in *Études critiques sur les sources de l'histoire du xviii^e^ siècle: Les Mémoires de Mme Campan*, in the *Bulletin de la Faculté des lettres de Poitiers* (4th year, 1886, pp. 56, 109); J. Weber, *Mémoires concernant Marie Antoinette* (3 vols., London, 1804–1809; Eng. trans., 3 vols., London, 1805–1806); *Mémoires de M. le baron de Besenval* (3 vols., Paris, 1805); *Mémoires de M. le duc de Lauzun* (2nd ed., 2 vols., Paris, 1822); E. Bavoux, *Méms. secrets de J. M. Augeard, secrétaire des commandements de la reine M. Antoinette* (Paris, 1866); Mme Vigée-Le-Brun, *Mes souvenirs* (2 vols., Paris, 1867); *Mémoires de Mme la duchesse de Tourzel*, ed. by the duc de Cars (2 vols., Paris, 1883); *Mémoires de la baronne d'Oberkirch* (2 vols., Paris, 1853).

GENERAL WORKS:—See the general works on the period and on Louis XVI., and bibliographies to articles LOUIS XVI. and FRENCH REVOLUTION. A. Sorel, *L'Europe et la Rév. fr.* (ii. *passim*) contains a good estimate of Marie Antoinette. See also E. and J. de Goncourt, *Histoire de Marie Antoinette* (Paris, 1859); P. de Nolhac, *Marie Antoinette, dauphine* (Paris, 1897); id. *La Reine Marie Antoinette* (8th ed., 1898), which gives good descriptions of Versailles, Trianon, &c.; M. de la Rocheterie, *Histoire de Marie Antoinette* (2 vols., Paris, 1890); A. L. Bicknell, *The Story of Marie Antoinette*; R. Prölss, *Königin Marie Antoinette, Bilder aus ihrem Leben* (Leipzig, 1894); G. Desjardins, *Le Petit-Trianon* (Versailles, 1885). For her trial and death, see E. Campardon, *Marie Antoinette à la Conciergerie* (1863). H. Belloc's *Marie Antoinette* (London, 1909) is very biassed and sometimes misleading. (C. B. P.)

MARIE DE FRANCE (*fl. c.* 1175–1190), French poet and fabulist. In the introduction (*c.* 1240) to his *Vie Seint Edmund le Rey*[1] Denis Pyramus says she was one of the most popular of authors with counts, barons and knights, but especially with ladies. She is also mentioned by the anonymous author of the *Couronnement Renart*. Her lays were translated into Norwegian[2] by order of Haakon IV.; and Thomas Chestre, who is generally supposed to have lived in the reign of Henry VI., gave a version of *Lanval*.[3] Very little is known about her history, and until comparatively recently the very century in which she lived remained a matter of dispute. In spite of her own statement in the epilogue to her fables: "Marie ai num, si suis de France," generally interpreted to mean that Marie was a native of the Île de France, she seems to have been of Norman origin, and certainly spent most of her life in England. Her language, however, shows little trace of Anglo-Norman provincialism. Like Wace, she used a literary dialect which probably differed very widely from common Norman speech. The manuscripts in which Marie's poems are preserved date from the late 13th or even the 14th century, but the language fixes the date of the poems in the second half of the 12th century. The *Lais* are dedicated to an unknown king, who is identified as Henry II. of England; and the fables, her *Ysopet*, were written according to the *Epilogus* for a Count William, generally recognized to be William Longsword, earl of Salisbury. The author of *Couronnement Renart*, says that Marie had dedicated her poem to the count William to whom the unknown poet addresses himself. This is William of Dampierre (d. 1251), the husband of the countess Margaret of Flanders, and his identification with Marie's count William is almost certainly an error. Marie lived and wrote at the court of Henry II., which was very literary and purely French. Queen Eleanor was a Provençal, and belonged to a family in which the patronage of poetry was a tradition. There is no evidence to show whether Marie was of noble origin or simply pursued the profession of a *trouvère* for her living.

The origin of the *lais* has been the subject of much discussion. Marie herself says that she had heard them sung by Breton minstrels. It seems probable that it is the lesser or French Brittany from which the stories were derived, though something may be due to Welsh and Cornish sources. Gaston Paris (*Romania*, vol. xv.) maintained that Marie had heard the stories from English minstrels, who had assimilated the Celtic legends. In any case the Breton lays offer abundant evidence of traditions from Scandinavian and Oriental sources. The *Guigemar* of Marie de France presents marked analogies with the ordinary Oriental romance of escape from a harem, for instance, with details superadded from classical mythology. Marie seems to have contented herself with giving new literary form to the stories she heard by turning them into Norman octosyllabic verse, and apparently made few radical changes from her originals. Joseph Bédier thinks that the lays of the Breton minstrels were prose recitals interspersed with short lyrics something after the manner of the cante-fable of *Aucassin et Nicolette*. Marie's task was to give these cante-fables a narrative form destined to be read rather than sung or recited.

The *Lais* which may be definitely attributed to Marie are: *Guigemar, Equitan, Le Frêne, Le Bisclavret* (the werewolf), *Les Deux amants, Laustic, Chaitivel, Lanval, Le Chèvrefeuille, Milon, Yonec* and *Eliduc*. The other similar lays are anonymous except the *Lai d'Ignaure* by Renant and the *Lai du cor* of Robert Biket, two authors otherwise unknown. They vary in length from some twelve thousand lines to about a hundred. *Le Chèvrefeuille*, a short episode of the Tristan story, telling how Tristan makes known his presence in the wood to Iseult, is the best known of them all. Laustic[4] (*Le Rossignol*) is almost as short and simple. In *Yonec* a mysterious bird visits the lady kept in durance by an old husband, and is turned into a valiant knight. The lover is killed by the husband, but in due time is avenged by his son. The scene of the story is partly laid in Chester, but the fable in slightly different forms occurs in the folk-lore of many countries.[5] *Lanval*[6] is a fairy story, and the hero vanishes eventually with his fairy princess to the island of Avallon or Avilion. *Eliduc* is more elaborately planned than any of these, and the action is divided between Exeter and Brittany. Here again the story of the man with two brides is not new, but the three characters of the story are so dealt with that each wins the reader's sympathy. The resignation of the wife of Eliduc and her reception of the new bride find a parallel in another of the lays,

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[1] Cotton MS. Domit. A xi. (British Museum), edited for the Rolls Series by Thomas Arnold in 1892.

[2] Edited by R. Keyser and C. R. Unger as *Strengleikar eða Lioðabok* (Christiania, 1850).

[3] Chestre's *Sir Launfal* was printed by J. Ritson in *Ancient English Metrical Romances* (1802); and by L. Erling (Kempten, 1883).

[4] The *soi-disant* Breton folk-song "Ann Eostik" on the same subject translated by La Villemarque in his *Barzaz-Breiz* (1840) is rejected by competent authorities. Similar stories in which the nightingale is slain by an angry husband occur in *Renard contrefait* and in the *Gesta Romanorum*.

[5] Cf. the *Oiseau bleu* of Mme d'Aulnoy.

[6] Sir Lambewell in Bishop Percy's Folio MS. (ed. Hales and Furnivall, vol. ii., 1867), is another version of *Lanval*, and differs from Chestre's. For the relations between *Lanval* and the *Lai de Graelent*, wrongly ascribed to Marie by Roquefort, see W. H. Schofield, "The Lays of Graelent and Lanval, and the story of Wayland," in the *Publications* of the Mod. Lang. Assoc. of America, vol. xv. (Baltimore, 1900).

Le Frêne. The story is in both cases more human and less repugnant than the, in some respects, similar story of Griselda.

Marie's *Ysopet* is translated from an English original which she erroneously attributed to Alfred the Great, who had, she said, translated it from the Latin. The collection includes many fables that have come down from Phaedrus, some Oriental stories derived from Jewish sources, with many popular apologues that belong to the Renard cycle, and differ from those of older origin in that they are intended to amuse rather than to instruct. Marie describes the misery of the poor under the feudal régime, but she preaches resignation rather than revolt. The popularity of this collection is attested by the twenty-three MSS. of it that have been preserved.

Another poem attributed to Marie de France is *L'Espurgatoire Seint Patriz*, a translation from the *Tractatus de purgatorio S. Patricii* (*c.* 1185) of Henri de Salterey, which brings her activity down almost to the close of the century.

See *Die Fabeln der Marie de France* (1898), edited by Karl Warnke with the help of materials left by Eduard Mall; and *Die Lais der Marie de France* (2nd ed., 1900), edited by Karl Warnke, with comparative notes by Reinhold Köhler; the two works being vols. vi. and iii. of the *Bibliotheca Normannica* of Hermann Suchier; also an extremely interesting article by Joseph Bédier in the *Revue des deux mondes* (Oct. 1891); another by Alice Kemp-Welch in the *Nineteenth Century* (Dec. 1907). For an analysis of the *Lais* see *Revue de philologie française*, viii. 161 seq.; Karl Warnke, *Die Quellen der Esope der Marie de France* (1900). The *Lais* were first published in 1819 by B. de Roquefort. *L'Espurgatoire Seint Patriz* was edited by T. A. Jenkins (Philadelphia, 1894). Some of the *Lays* were paraphrased by Arthur O'Shaughnessy in his *Lays of France* (1872).

MARIE DE' MEDICI (1573–1642), queen consort and queen regent of France, daughter of Francis de' Medici, grand duke of Tuscany, and Joanna, an Austrian archduchess, was born in Florence on the 26th of April 1573. After Joanna's death in 1578 duke Francis married the notorious Bianca Capello, and the grand-ducal children were brought up away from their father at the Pitti Palace in Florence, where after the death of her brother and sister and the marriage of her elder sister Eleonora, duchess of Mantua, a companion was chosen for Marie, this being Leonora Dori, afterwards known as Leonora Galigaï. She received a good education in company with her half-brother Antonio. After many projects of marriage for Marie had failed Henry IV. of France, who was under great monetary obligations to the house of Medici, offered himself as a suitor although his marriage with Marguerite de Valois was not yet dissolved; but the marriage was not celebrated until October 1600. Her eldest son, the future Louis XIII., was born at Fontainebleau in September of the next year; the other children who survived were Gaston duke of Orleans; Elizabeth queen of Spain; Christine duchess of Savoy; and Henrietta Maria queen of England. During her husband's lifetime Marie de' Medici showed little sign of political taste or ability; but after his murder in 1610 when she became regent, she devoted herself to affairs with unfailing regularity and developed an inherited passion for power. She gave her confidence chiefly to Concini, the husband of Leonora Galigaï, who squandered the public money and secured a series of important charges with the title of Maréchal d'Ancre. Under the regent's lax and capricious rule the princes of the blood and the great nobles of the kingdom revolted; and the queen, too weak to assert her authority, consented at Sainte Menehould (May 15, 1614) to buy off the discontented princes. In 1616 her policy was strengthened by the accession to her councils of Richelieu, who had come to the front at the meeting of the states general in 1614; but Louis XIII., who was now sixteen years old, was determined to throw off the tutelage of his mother and Concini. By his orders Concini was murdered, Leonora Galigaï was tried for sorcery and beheaded, Richelieu was banished to his bishopric, and the queen was exiled to Blois. After two years of virtual imprisonment she escaped in 1619 and became the centre of a new revolt. Louis XIII. easily dispersed the rebels, but through the mediation of Richelieu was reconciled with his mother, who was allowed to hold a small court at Angers, and resumed her place in the royal council in 1621. But differences between her and the cardinal rapidly arose, and the queen mother intrigued to drive Richelieu again from court. For a single day the *journée des dupes*, the 12th of November 1630, she seemed to have succeeded; but the triumph of Richelieu was followed by her exile to Compiègne, whence she escaped in 1631 to Brussels. From that time till her death at Cologne on the 3rd of July 1642 she intrigued in vain against the cardinal.

Among contemporary authorities for the history of Marie de' Medici, see Mathieu de Morgues, *Deux faces de la vie et de la mort de Marie de Médicis* (Antwerp, 1643); J. B. Matthieu, *Éloge historial de Marie de Médicis* (Paris, 1626); Florentin du Ruau, *Le Tableau de la régence de Marie de Médicis* (Poitiers, 1615); F. E. Mézeray, *Histoire de la mère et du fils, ou de Marie de Médicis et de Louis XIII.* (Amsterdam, 1730); and A. P. Lord, *The Regency of Marie de Médicis* (London, 1904). For the political history see the bibliographies to HENRY IV. and LOUIS XIII.

There are lives by Thiroux d'Arconville (3 vols., Paris, 1774) by Miss J. S. H. Pardoe (London, 1852, and again 1890); and by B. Zeller, *Henri IV. et Marie de Médicis* (Paris, 1877). There is a technical discussion of the causes of her death in A. Masson's *La Sorcellerie et la science des poisons au xvii^e^ siècle* (Paris, 1904), and the minutest details of her private life are in L. Batiffol's *La Vie intime d'une reine de France* (Paris, 1906; Eng. trans., 1908).

MARIE GALANTE, an island in the French West Indies. It lies in 15° 55′ N. and 61° 17′ W., 16 m. S.E. of Guadeloupe, of which it is a dependency. It is nearly circular in shape and 55 sq. m. in area. A rocky limestone plateau, rising in the east to a height of 675 ft., occupies the centre of the island, and from it the land descends in a series of well-wooded terraces to the sea. The shores are rocky, there are no harbours, and the roadstead off Grand Bourg is difficult of access, owing to the surrounding reefs. The climate is healthy and the soil rich; sugar, coffee and cotton being the chief products. The largest town is Grand Bourg (pop. 6901) on the south-west coast. The island was discovered by Columbus in 1493, and received its name from the vessel on which he was sailing. The French who settled here in 1648 suffered numerous attacks both from the Dutch and the British, but since 1766, except for a short period of British rule in the early part of the 19th century, they have held undisturbed possession.

MARIE LESZCZYNSKA (1703–1768), queen consort of France, was born at Breslau on the 23rd of June 1703, being the daughter of Stanislas Leszczynski (who in 1704 became king of Poland) and of Catherine Opalinska. During a temporary flight from Warsaw the child was lost, and eventually discovered in a stable; on another occasion she was for safety's sake hidden in an oven. In his exile Stanislas found his chief consolation in superintending the education of his daughter. Madame de Prie first suggested the Polish princess as a bride for Louis duke of Bourbon, but she was soon betrothed not to him but to Louis XV., a step which was the outcome of the jealousies of the houses of Condé and Orléans, and was everywhere regarded as a *mésalliance* for the French king. The marriage took place at Fontainebleau on the 5th of September 1725. Marie's one attempt to interfere in politics, an effort to prevent the disgrace of the duke of Bourbon, was the beginning of her husband's alienation from her; and after the birth of her seventh child Louise, Marie was practically deserted by Louis, who openly avowed his *liaison* with Louise de Nesle, comtesse de Mailly, who was replaced in turn by her sisters Pauline marquise de Vintimille, and Marie Anne, duchess de Châteauroux, and these by Madame de Pompadour. In the meantime the queen saw her father Stanislas established in Lorraine, and the affectionate intimacy which she maintained with him was the chief consolation of her harassed life. After a momentary reconciliation with Louis during his illness at Metz in 1744, Marie shut herself up more closely with her own circle of friends until her death at Versailles on the 24th of June 1768.

See V. des Diguières, *Lettres inédites de la reine Marie Leczinska et de la duchesse de Luynes au Président Hénault* (1886); Marquise des Réaux, *Le Roi Stanislas et Marie Leczinska* (1895); P. de Raynal, *Le Mariage d'un roi* (Paris, 1887); H. Gauthier Villars, *Le Mariage de Louis XV. d'après des documents nouveaux* (1900); P. de Nolhac, *La Reine Marie Leczinska* (1900) and *Louis XV. et Marie Leczynska* (1900); P. Boyé, *Lettres du roi Stanislas à Marie Leszczynska 1754–1766* (Paris and Nancy, 1901); and C. Stryienski's book on Marie Joséphs de Saxe (*La Mère des trois derniers Bourbons*, Paris, 1902). See also the memoirs of Président Hénault and of the duc de Luynes (ed. Dussieux and Soulié, 1860, &c.).

MARIE LOUISE (1791–1847), second wife of Napoleon I., was the daughter of Francis I., emperor of Austria, and of the princess Theresa of Naples, and was born on the 12th of December 1791. Her disposition, fresh and natural but lacking the qualities that make for distinction, gave no promise of eminence until reasons of state brought Napoleon shortly after his divorce of Josephine to sue for her hand (see NAPOLEON and JOSEPHINE). It is probable, though not quite certain, that the first suggestions as to this marriage alliance emanated secretly from the Austrian chancellor, Metternich. The prince de Ligne claimed to have been instrumental in arranging it. In any case the proposal was well received at Paris both by Napoleon and by his ministers; and though there were difficulties respecting the divorce, of Josephine, yet these were surmounted in a way satisfactory to the emperor and the prelates of Austria. The marriage took place by proxy in the church of St Augustine, Vienna, on the 11th of March 1810. The new empress was escorted into France by Queen Caroline Murat, for whom she soon conceived a feeling of distrust. The civil and religious contracts took place at Paris early in April, and during the honeymoon, spent at the palace of Compiègne, the emperor showed the greatest regard for his wife. "He is so evidently in love with her," wrote Metternich "that he cannot conceal his feelings, and all his customary ways of life are subordinate to her wishes." His joy was complete when on the 20th of March 1811 she bore him a son who was destined to bear the empty titles of "king of Rome" and "Napoleon II." The regard of Napoleon for his consort was evidenced shortly before the birth of this prince, when he bade the physicians, if the lives of the mother and of the child could not both be saved, to spare her life. Under Marie Louise the etiquette of the court of France became more stately and the ritual of religious ceremonies more elaborate. Before the campaign of 1812 she accompanied the emperor to Dresden; but after that scene of splendour misfortunes crowded upon Napoleon. In January 1814 he appointed her to act as regent of France (with Joseph Bonaparte as lieutenant-general) during his absence in the field.

At the time of Napoleon's first abdication (April 11, 1814), Joseph and Jerome Bonaparte tried to keep the empress under some measure of restraint at Blois; but she succeeded in reaching her father the emperor Francis while Napoleon was on his way to Elba. She, along with her son, was escorted into Austria by Count von Neipperg, and refused to comply with the entreaties and commands of Napoleon to proceed to Elba; and her alienation from him was completed when he ventured to threaten her with a forcible abduction if she did not obey. During the Hundred Days she remained in Austria and manifested no desire for the success of Napoleon in France. At the Congress of Vienna the Powers awarded to her and her son the duchies of Parma, Piacenza and Guastalla, in conformity with the terms of the treaty of Fontainebleau (March, 1814); in spite of the determined opposition of Louis XVIII. she gained this right for herself owing largely to the support of the emperor Alexander, but she failed to make good the claims of her son to the inheritance (see NAPOLEON II.). She proceeded alone to Parma, where she fell more and more under the influence of the count von Neipperg, and had to acquiesce in the title "duke of Reichstadt" accorded to her son. Long before the tidings of the death of Napoleon at St Helena reached her she was living in intimate relations with Neipperg at Parma, and bore a son to him not long after that event. Napoleon on the other hand spoke of her in his will with marked tenderness, and both excused and forgave her infidelity to him. Thereafter Neipperg became her morganatic husband; and they had other children. In 1832, at the time of the last illness of the duke of Reichstadt, she visited him at Vienna and was there at the time of his death; but in other respects she shook off all association with Napoleon. Her rule in Parma, conjointly with Neipperg, was characterized by a clemency and moderation which were lacking in the other Italian states in that time of reaction. She preserved some of the Napoleonic laws and institutions; in 1817 she established the equality of women in heritage, and ordered the compilation of a civil code which was promulgated in January 1820. The penal code of November 1821 abolished many odious customs and punishments of the old code, and allowed publicity in criminal trials. On the death of Neipperg in 1829 his place was taken by Baron Werklein, whose influence was hostile to popular liberty. During the popular movements of 1831 Marie Louise had to take refuge with the Austrian garrison at Piacenza; on the restoration of her rule by the Austrians its character deteriorated, Parma becoming an outwork of the Austrian empire. She died at Vienna on the 18th of December 1847.

See *Correspondance de Marie Louise 1799–1847* (Vienna, 1887); J. A. Baron von Helfert, *Marie Louise* (Vienna, 1873); E. Wertheimer, *Die Heirath der Erzherzogin Marie Louise mit Napoléon I.* (Vienna, 1882); and *The Duke of Reichstadt* (Eng. ed., London, 1905). See also the *Memoirs* of Bausset, Mme Durand Méneval and Metternich; and Max Billard, *The Marriage Ventures of Marie Louise*, English version by Evelyn duchess of Wellington (1910).

MARIENBAD, a town of Bohemia, Austria, 115 m. W. of Prague by rail. Pop. (1900), 4588. It is one of the most frequented watering-places of Europe, lying on the outskirts of the Kaiserwald at an altitude of 2093 ft., and is 40 m. S.W. of Carlsbad by rail. Marienbad is enclosed on all sides except the south by gently sloping hills clad with fragrant pine forests, which are intersected by lovely walks. The principal buildings are: the Roman Catholic church, which was completed in 1851; the English church, the theatre, the *Kurhaus*, built in 1901, and several bathing establishments and hospitals. The mineral springs, which belong to the adjoining abbey of Tepl, are eight in number, and are used both for bathing and drinking, except the Marienquelle, which is used only for bathing. Some of them, like the Kreuzbrunnen and the Ferdinandsbrunnen, contain alkaline-saline waters which resemble those of Carlsbad, except that they are cold and contain nearly twice the quantity of purgative salts. Others, like the Ambrosiusbrunnen and the Karolinenbrunnen, are among the strongest iron waters in the world, while the Rudolfsbrunnen is an earthy-alkaline spring. The waters are used in cases of liver affections, gout, diabetes and obesity; and the patients must conform during the cure to a strictly regulated diet. Besides the mineral water baths there are also *moor* or mud-baths, and the peat used for these baths is the richest in iron in the world. About 1,000,000 bottles of mineral water are exported annually.

Amongst the places of interest round Marienbad is the basaltic rock of Podhorn (2776 ft.), situated about 3 m. to the east, from which an extensive view of the Böhmerwald, Fichtelgebirge and Erzgebirge is obtained. About 7 m. in the same direction lies the old and wealthy abbey of Tepl, founded in 1193. The actual building dates from the end of the 17th and the beginning of the 18th century, and contains a fine library with a collection of rare manuscripts and incunabula; near it is the small and old town of Tepl (pop. 2789). To the north-east of Marienbad lies the small watering-place of Königswart; near it is a castle belonging since 1618 to the princes of Metternich, which contains an interesting museum, created by the famous Austrian statesman in the first part of the 19th century. It contains, besides a fine library, a collection of the presents he received during his long career; numerous autographs, and other historical relics, a collection of rare coins, armour, portraits and various minerals.

Marienbad is among the youngest of the Bohemian watering-places, although its springs were known from of old. They appear in a document dating from 1341, where they are called "the Auschowitzer springs belonging to the abbey of Tepl;" but it was only through the efforts of Dr Josef Nehr, the doctor of the abbey, who from 1779 until his death in 1820 worked hard to demonstrate the curative properties of the springs, that the waters began to be used for medicinal purposes. The place obtained its actual name of Marienbad in 1808; became a watering-place in 1818, and received its charter as a town in 1868.

See Lang, *Führer durch Marienbad und Umgebung* (Marienbad. 1902); and Kisch, Marienbad, seine Umgebung und Heilmittel (Marienbad, 1895).

MARIENBERG, a town of Germany, in the kingdom of Saxony 16 m. S.E. of Chemnitz on the Flöha-Reitzenhain railway.

Pop. (1905), 7603. It has an Evangelical church, a Roman Catholic church, a non-commissioned officers' school and a preparatory school; and the industries comprise wool-spinning, flax-dressing, the making of lace, toys and cigars, and silver-mining.

MARIENBURG (Polish, *Malborg*), a town of Germany, in the Prussian province of West Prussia, 30 m. by rail to the S.E. of Danzig in a fertile plain on the right bank of the Nogat, a channel of the Vistula, here spanned by a handsome railway bridge and by a bridge of boats. Pop. (1905), 13,095. Marienburg contains large chemical wool-cleaning works and several other factories, carries on a considerable trade in grain, wood, linen, feathers and brushes, and is the seat of important cattle, horse and wool markets. Its educational institutions include a gymnasium and a Protestant normal school. In the old market-place, many of the houses in which are built with arcades, stands a Gothic town-hall, dating from the end of the 14th century. The town is also embellished with a fine statue of Frederick the Great, who added this district to Prussia, and a monument commemorating the war of 1870–71. Marienburg is chiefly interesting from its having been for a century and a half the residence of the grand masters of the Teutonic order. The large castle of the order here was originally founded in 1274 as the seat of a simple commandery against the pagan Prussians, but in 1309 the headquarters of the grand master were transferred hither from Venice, and the "Marienburger Schloss" soon became one of the largest and most strongly fortified buildings in Germany. On the decline of the order in the middle of the 15th century, the castle passed into the hands of the Poles, by whom it was allowed to fall into neglect and decay. It came into the possession of Prussia in 1772, and was carefully restored at the beginning of the 19th century. This interesting and curious building consists of three parts, the Alt- or Hochschloss, the Mittelschloss, and the Vorburg. It is built of brick, in a style of architecture peculiar to the Baltic provinces, and is undoubtedly one of the most important secular buildings of the middle ages in Germany.

Of the numerous monographs published in Germany on the castle of Marienburg, it will suffice to mention here Büsching's *Schloss der deutschen Ritter zu Marienburg* (Berlin, 1828); Voigt's *Geschichte von Marienburg* (Königsberg, 1824); Bergau's *Ordenshaupthaus Marienburg* (Berlin, 1871); and Steinbrecht, *Schloss Marienburg in Preussen* (8th ed., Berlin, 1905).

MARIENWERDER, a town of Germany, in the Prussian province of West Prussia, 3 m. E. of the Vistula, 23 m. S. of Marienburg by rail. Pop. (1905), 10,258. The town was founded in the year 1233 by the Teutonic order. It has a cathedral of the same century, a triple Gothic edifice, restored in 1874 and containing the tombs of several grand masters of the Teutonic order; a (Gothic) town-hall (1880); a Roman Catholic basilica (1858); a non-commissioned officers' school; a monument of the war of 1870–71 (1897); an archaeological collection; and a seminary for female teachers. The industries include iron-foundries, saw-mills, sugar-refineries, breweries and printing-works.

MARIE THÉRÈSE (1638–1683), queen consort of France, was born on the 10th of September 1638 at the Escurial, being the daughter of Philip IV. of Spain and Elizabeth of France. By pretending to seek a bride for his master in Margaret of Savoy, Mazarin had induced the king of Spain to make proposals for the marriage of his daughter with Louis XIV., and the treaty of the Pyrenees in 1659 stipulated for her marriage with the French king, Marie renouncing any claim to the Spanish succession. As the treaty, however, hinged on the payment of her dowry, which was practically impossible for Spain, Mazarin could evade the other terms of the contract. Marie Thérèse was married in June 1660, when Philip IV. with his whole court accompanied the bride to the Isle of Pheasants in the Bidassoa, where she was met by Louis. The new queen's amiability and her undoubted virtues failed to secure her husband's regard and affection. She saw herself neglected in turn for Louise de la Vallière, Mme. de Montespan and others; but Marie Thérèse was too pious and too humble openly to resent the position in which she was placed by the king's avowed infidelities. With the growing influence of Madame de Maintenon over his mind and affections he bestowed more attention on his wife, which she repaid by lavishing kindness on the mistress. She had no part in political affairs except in 1672, when she acted as regent during Louis XIV.'s campaign in Holland. She died on the 30th of July 1683 at Versailles, not without suspicion of foul play on the part of her doctors. Of her six children only one survived her, the dauphin Louis, who died in 1711.

See the funeral oration of Bossuet (Paris, 1684), E. Ducéré, *Le Mariage de Louis XIV. d'après les contemporains et des documents inédits* (Bayonne, 1905); Dr Cabanès, *Les Morts mystérieuses de l'histoire* (1900), and the literature dealing with her rivals Louise de la Vallière, Madame de Montespan and Madame de Maintenon.

MARIETTA, a city and the county-seat of Cobb county, Georgia, U.S.A., in the N.W. of the state, about 17 m. N.W. of Atlanta. Pop. (1890), 3384; (1900), 4446, of whom 1928 were negroes; (1910), 5949. The city is served by the Louisville & Nashville, the Nashville, Chattanooga & St. Louis, and the Western & Atlantic railways, and is connected with Atlanta by an electric line. Marietta is situated about 1118 ft. above the sea, has a good climate, and is both a summer and a winter resort. The principal industries are the manufacture of chairs and paper, and the preparation of marble for the markets; there are also locomotive works, planing mills, a canning factory, a knitting mill, &c. At Marietta there is a national cemetery, in which more than 10,000 Federal soldiers are buried, and at Kenesaw Mountain (1809 ft.), about 2½ m. west of the city, one of the fiercest battles of the Civil War was fought. After the Confederate retreat from Dalton in May 1864, General William T. Sherman, the Federal commander, made Marietta his next intermediate point in his Atlanta campaign, and the Confederate commander, General Joseph E. Johnston, established a line of defence west of the town. After several preliminary engagements Sherman on the 26th and 27th of June made repeated unsuccessful attempts to drive the Confederates from their defences at Kenesaw Mountain; he then resorted to a flanking movement which forced the Confederate general to retire (July 2) toward Atlanta. Marietta was settled about 1840, and was chartered as a city in 1852.

MARIETTA, a city and the county-seat of Washington county, Ohio, U.S.A., on the Ohio River, at the mouth of the Muskingum, about 115 m. S.E. of Columbus. Pop. (1890), 8273; (1900), 13,348, including 679 foreign-born and 361 negroes; (1910), 12,923. It is served by the Pennsylvania (Marietta Division), the Baltimore & Ohio (Marietta & Parkersburg, Marietta & Zanesville, and Ohio River divisions) and the Marietta, Columbus & Cleveland railways, and by steamboat lines to several river ports; a bridge across the Ohio connects it with Williamstown, West Virginia. The city is in a hilly country of much natural beauty, and is of considerable historic interest. On the banks of the Muskingum is a public park, facing which stood the oldest church in the state; this was burned in 1905, but was subsequently rebuilt in the old style. Near by are some 18th century buildings, some interesting earthworks of the "mound-builders," and a cemetery in which are buried many soldiers who fought in the War of Independence. Marietta is the seat of Marietta College, dating from 1830, which in 1908 had more than 500 students. It possesses a library of 60,000 volumes, including some rare collections, especially the Stimson collection of books bearing on the history of the North-West Territory. Petroleum, coal, and iron-ore abound in the neighbouring region, and the city has a considerable trade in these and in its manufactures of chairs, leather, flour, carriages, wagons, boats, boilers, bricks and glass. In 1905 the factory products were valued at $2,599,287.

Marietta, named in honour of Marie Antoinette, is the oldest settlement in the state and in the North-west Territory. It was founded in 1788 by a company of Revolutionary officers from New England under the leadership of General Rufus Putnam, and in the same year the North-West Territory was formally organized here. The pseudo-classicism of the period of Marietta's foundation is indicated by the names—*Capitolium* for one of the public squares, *Sacra Via* for one of the principal streets, and *Campus Martius* for the fortification. The settlement was incorporated as a town in 1800 and chartered as a city in 1852. In 1890 the village of Harmar, including the site on which Fort Harmar was built in 1785, was annexed.

See Henry Howe, *Historical Collections of Ohio* (Columbus, 1891).

MARIETTE, AUGUSTE FERDINAND FRANÇOIS (1821–1881), French Egyptologist, was born on the 11th of February 1821 at Boulogne, where his father was town clerk. Educated at the Boulogne municipal college, where he distinguished himself and showed much artistic talent, he went to England in 1839 when eighteen as professor of French and drawing at a boys' school at Stratford-on-Avon. In 1840 he became pattern-designer to a ribbon manufacturer at Coventry; but weary of ill-paid exile he returned the same year to Boulogne, and in 1841 took his degree at Douai. He now became a professor at his old college, and for some years supplemented his salary by giving private lessons and writing on historical and archaeological subjects for local periodicals. Meanwhile his cousin Nestor L'Hôte, the friend and fellow-traveller of Champollion, died, and upon Mariette devolved the task of sorting the papers of the deceased savant. He thenceforth became passionately interested in Egyptology, devoted himself to the study of hieroglyphs and Coptic, and in 1847 published a *Catalogue analytique* of the Egyptian Gallery of the Boulogne Museum; in 1849, being appointed to a subordinate position in the Louvre, he left Boulogne for Paris. Entrusted with a government mission for the purpose of seeking and purchasing Coptic, Syriac, Arabic and Ethiopic MSS. for the national collection, he started for Egypt in 1850; and soon after his arrival he made his celebrated discovery of the ruins of the Serapeum and the subterraneous catacombs of the Apisbulls. His original mission being abandoned, funds were now advanced for the prosecution of his researches, and he remained in Egypt for four years, excavating, discovering and despatching archaeological treasures to the Louvre, of which museum he was on his return appointed an assistant conservator. In 1858 he accepted the position of conservator of Egyptian monuments to the ex-khedive, Ismail Pasha, and removed with his family to Cairo. His history thenceforth becomes a chronicle of unwearied exploration and brilliant success. The museum at Bula was founded immediately. The pyramid-fields of Memphis and Sakkara, and the necropolis of Meydum, and those of Abydos and Thebes were examined; the great temples of Dendera and Edfu were disinterred; important excavations were carried out at Karnak, Medinet-Habu and Deir el-Bahri; Tanis (the Zoan of the Bible) was partially explored in the Delta; and even Gebel Barkal in the Sudan. The Sphinx was bared to the rock-level, and the famous granite and alabaster monument miscalled the "Temple of the Sphinx" was discovered. Mariette was raised successively to the rank of bey and pasha in his own service. Honours and orders were showered on him: the Legion of Honour and the Medjidie in 1852; the Red Eagle (first class) of Prussia in 1855; the Italian order of SS. Maurice and Lazarus in 1857; and the Austrian order of Francis-Joseph in 1858. In 1873 the Academy of Inscriptions decreed to him the biennial prize of 20,000 francs, and in 1878 he was elected a member of the Institute. He was also an honorary member of most of the learned societies of Europe. In 1877 his health broke down through overwork. He lingered for a few years, working to the last, and died at Cairo on the 19th of January 1881.

His chief published works are: *Le Sérapéum de Memphis* (1857 and following years); *Dendérah*, five folios and one 4to (1873–1875); *Abydos*, two folios and one 4to (1870–1880); *Karnak*, folio and 4to (1875); *Deir el-Bahari*, folio and 4to (1877); *Listes géographiques des pylônes de Karnak*, folio (1875); *Catalogue du Musée de Boulaq* (six editions 1864–1876); *Aperçu de l'histoire d'Égypte* (four editions, 1864–1874, &c.); *Les Mastabas de l'ancien empire* (edited by Maspero) (1883). See "Notice biographique," by Maspero in *Auguste Mariette. Œuvres diverses* (tome 1, Paris, 1904), and art. EGYPT: *Exploration and Research.*

MARIGNAC, JEAN CHARLES GALISSARD DE (1817–1894), Swiss chemist, was born at Geneva on the 24th of April 1817. When sixteen years old he began to attend the École Polytechnique in Paris, and from 1837 to 1839 studied at the École des Mines. Then, after a short time in Liebig's laboratory at Giessen, and in the Sèvres porcelain factory, he became in 1841 professor of chemistry in the academy of Geneva. In 1845 he was appointed professor of mineralogy also, and held both chairs till 1878, when ill-health obliged him to resign. He died at Geneva on the 15th of April 1894. Marignac's name is well known for the careful and exact determinations of atomic weights which he carried out for twenty-eight of the elements. In undertaking this work he had, like J. S. Stas, the purpose of testing Prout's hypothesis, but he remained more disposed than the Belgian chemist to consider the possibility that it may have some degree of validity. Throughout his life he paid great attention to the "rare earths" and the problem of separating and distinguishing them; in 1878 he extracted ytterbia from what was supposed to be pure erbia, and two years later found gadolinia and samaria in the samarskite earths. In 1858 he pointed out the isomorphism of the fluostannates and the fluosilicates, thus settling the then vexed question of the composition of silicic acid; and subsequently he studied the fluosalts of zirconium, boron, tungsten, &c., and prepared silicotungstic acid, one of the first examples of the complex inorganic acids. In physical chemistry he carried out many researches on the nature and process of solution, investigating in particular the thermal effects produced by the dilution of saline solutions, the variation of the specific heat of saline solutions with temperature and concentration, and the phenomena of liquid diffusion.

A memorial lecture by P. T. Cleve, printed in the *Journal of the London Chemical Society* for 1895, contains a list of Marignac's papers.

MARIGNAN, BATTLE OF, fought on the 13th and 14th of September 1515 between the French army under Francis I. and the Swiss. The scene of the battle—which was also that of a hard fought engagement in 1859 (see ITALIAN WARS)—was the northern outskirts of the village of Melegnano, on the river Lambro, 10 m. S.E. of Milan. The circumstances out of which the battle of Marignan arose, almost inconceivable to the modern mind, were not abnormal in the conditions of Italian warfare and politics then prevailing. The young king of France had gathered an army about Lyons, wherewith to overrun the Milanese; his allies were the republics of Venice and Genoa. The duke of Milan, Maximilian Sforza, had secured the support of the emperor, the king of Spain, and the pope, and also that of the Swiss cantons, which then supplied the best and most numerous mercenary soldiers in Europe. The practicable passes of the Alps and the Apennines were held by Swiss and papal troops. Francis however boldly crossed the Col de l'Argentière (Aug. 1515) by paths that no army had hitherto used, and Marshal de La Palisse surprised and captured a papal corps at Villafranca near Pinerolo, whereupon the whole of the enemy's troops fell back on Milan. The king then marching by Vercelli, Novara and Pavia, joined hands with Alviano, the Venetian commander, and secured a foothold in the Milanese. But in order to avoid the necessity of besieging Milan itself, he offered the Swiss a large sum to retire into their own country. They were about to accept his offer, not having received their subsidies from the pope and the king of Spain, when a fresh corps of mercenaries descended into Italy, desirous both of gaining booty and of showing their prowess against their new rivals the French and Lower Rhine "lansquenets" (Landsknechts) and against the French gendarmerie, whom (alluding to the "Battle of the Spurs" at Guinegatte in 1513) they called "hares in armour." The French took position at Melegnano to face the Swiss, the Venetians at Lodi to hold in check the Spanish army at Piacenza. Alviano, who was visiting the king when the Swiss appeared before Melegnano, hurried off to bring thither his own army. Meantime the French and the Swiss engaged in an incredibly fierce struggle.

The king's army was grouped in front of the village, facing in the direction of Milan, with a small stream separating it from the oncoming Swiss. On either side of the Milan road was a large body of landsknechts, a third being in reserve. The French and Gascon infantry (largely armed with arquebuses) was on the extreme right, the various bodies of gendarmerie in the centre. In front of all was the French artillery. The battle opened in the afternoon of the 13th of September. As the Swiss advanced in three huge columns, the French guns fired into them with terrible effect, but the assailants reached the intersected ground bordering the stream, and thus protected from the rush of the French gendarmerie, they debouched on the other side, and fell upon the landsknechts. The crowd of combatants, the gathering darkness, and the dust, prevented any general direction being given to the battle by the leaders of either side. Francis himself at the head of two hundred gendarmes charged and drove back two large bodies of Swiss which were pressing the landsknechts hard. The battle went on by moonlight till close on midnight, when the Swiss retired a short distance. Both sides spent the rest of the night on the battlefield, reorganizing their broken corps. Francis and his gendarmes were the outpost line of the French army, and remained all night mounted, lance in hand and helmet on head. Next morning at sunrise, the battle was renewed. The Swiss now left their centre inactive opposite the king and with two strong corps attempted to work round his flanks. That on the left made for the French baggage, but found it strongly guarded by landsknechts, who drove them back. The nearest French gendarmerie joined in the pursuit, but a detachment from the Swiss centre fell upon these and destroyed them. This detachment in turn followed up its advantage until as Francis himself expressed it, " the whole camp turned out " to aid the landsknechts and " hunted out " the Swiss. Meantime the Swiss left attack had closed with the French infantry bands and the " aventuriers" (afterwards the famous corps of Picardie and Piedmont), who were commanded on this day be the famous engineer Pedro Navarro. It was in the main struggle of arquebus against pike, but it was not the arquebus alone, or even principally, that gave the victory to the French. When the Swiss ranks had been disordered, the short pike and the sword came into play, and aided by the constable de Bourbon with a handful of the gendarmerie, the French right more than held its own until Alviano with the cavalry from Lodi rode on to the field and completed the rout of the Swiss. In the centre meanwhile the two infantries stood fast for eight hours, separated by the brook, while the artillery on both sides fired into it at short range. But the landsknechts, animated by the king, endured it as well as the Swiss; and at the last, Francis leading a final advance of his exhausted troops, the Swiss gave way and fled. Only 3000 Swiss escaped out of some 25,000 who fought. On the French side probably 8000 were killed or died of wounds. The battle lasted twenty-eight hours. Its tactical lesson was the efficacy of combining two arms against one. The French gendarmerie, burning to avenge the insult of " hares in armour," made more than thirty charges by squadrons, and they were admirably supported by their light artillery. The landsknechts retrieved their first day's defeat by their conduct on the second day. Nevertheless Marignan was in the main the work of the gendarmerie, the last and greatest triumph of the armoured lancer; and as a fitting close to the battle the young king was knighted by Bayard on the field.

MARIGNOLLI, GIOVANNI DE', a notable traveller to the Far East in the 14th century, born probably before 1290, and sprung from a noble family in Florence. The family is long extinct, but a street near the cathedral (Via de' Cerretani) formerly bore the name of the Marignolli. In 1338 there arrived at Avignon, where Benedict XII. held his court, an embassy from the great khan of Cathay (the Mongol-Chinese emperor), bearing letters to the pontiff from the khan himself, and from certain Christian nobles of the Alan race in his service. These latter represented that they had been eight years (since Monte Corvino's death) without a spiritual guide, and earnestly desired one. The pope replied to the letters, and appointed four ecclesiastics as his legates to the khan's court. The name of John of Florence, *i.e.* Marignolli, appears third on the letters of commission. A large party was associated with the four chief envoys; when in Peking the embassy still numbered thirty-two, out of an original fifty.

The mission left Avignon in December 1338; picked up the Tatar envoys at Naples; stayed nearly two months in Constantinople (Pera, May 1—June 24, 1339); and sailed across the Black Sea to Kaffa, whence they travelled to the court of Mahommed Uzbeg, khan of the Golden Horde, at Sarai on the Volga. The khan entertained them hospitably during the winter of 1339–1340 and then sent them across the steppes to Armalec, Almalig or Almaligh (Kulja), the northern seat of the house of Chaghatai, in what is now the province of Ili. " There," says Marignolli, " we built a church, bought a piece of ground . . . sung masses, and baptized several persons, notwithstanding that only the year before the bishop and six other minor friars had there undergone glorious martyrdom for Christ's salvation." Quitting Almaligh in 1341, they seem to have reached Peking (by way of Kamul or Hami) in May or June 1342. They were well received by the reigning khan, the last of the Mongol dynasty in China. An entry in the Chinese annals fixes the year of Marignolli's presentation by its mention of the arrival of the great horses from the kingdom of Fulang (*Farang* or Europe), one of which was 11 ft. 6 in. in length, and 6 ft. 8 in. high, and black all over.

Marignolli stayed at Peking or Cambalec three or four years, after which he travelled through eastern China to Zayton or Amoy Harbour, quitting China apparently in December 1347, and reaching Columbum (Kaulam or Quilon in Malabar) in Easter week of 1348. At this place he found a church of the Latin communion, probably founded by Jordanus of Séverac, who had been appointed bishop of Columbum by Pope John XXII. in 1330. Here Marignolli remained sixteen months, after which he proceeded on what seems a most devious voyage. First he visited the shrine of St Thomas near the modern Madras, and then proceeded to what he calls the kingdom of Saba, and identifies with the Sheba of Scripture, but which seems from various particulars to have been Java. Taking ship again for Malabar on his way to Europe, he encountered great storms. They found shelter in the little port of *Pervily or Pervilis* (Beruwala or Berberyn) in the south-west of Ceylon; but here the legate fell into the hands of " a certain tyrant Coya Jaan (Khoja Jahān), a eunuch and an accursed Saracen," who professed to treat him with all deference, but detained him four months, and plundered all the gifts and Eastern rarities that he was carrying home. This detention in *Seyllan* enables Marignolli to give a variety of curious particulars regarding Adam's Peak, Buddhist monasticism, the aboriginal races of Ceylon, and other marvels. After this we have only fragmentary notices, showing that his route to Europe lay by Ormuz, the ruins of Babel, Bagdad, Mosul, Aleppo and thence to Damascus and Jerusalem. In 1353 he arrived at Avignon, and delivered a letter from the great khan to Pope Innocent VI. In the following year the emperor Charles IV., on a visit to Italy, made Marignolli one of his chaplains. Soon after, the pope made him bishop of Bisignano; but he seems to have been in no hurry to reside there. He appears to have accompanied the emperor to Prague in 1354–1355; in 1356 he is found acting as envoy to the Pope from Florence; and in 1357 he is at Bologna. We know not when he died. The last trace of Marignolli is a letter addressed to him, which was found in the 18th century among the records in the Chapter Library at Prague. The writer is an unnamed bishop of Armagh, easily identified with Richard Fitz Ralph, a strenuous foe of the Franciscans, who had broken lances in controversy with Ockham and Burley. The letter implies that some intention had been intimated from Avignon of sending Marignolli to Ireland in connexion with matters then in debate—a project which stirs Fitz Ralph's wrath.

The fragmentary notes of Marignolli's Eastern travels often contain vivid remembrance and graphic description, but combined with an incontinent vanity, and an incoherent lapse from one thing to another. They have no claim to be called a narrative, and it is with no small pains that anything like a narrative can be pieced out of them. Indeed the mode in which they were elicited curiously illustrates how little medieval travellers thought of publication

The emperor Charles, instead of urging his chaplain to write a history of his vast journeys, set him to the repugnant task of recasting the annals of Bohemia; and he consoled himself by salting the insipid stuff by interpolations, *à propos de bottes*, of his recollections of Asiatic travel.

Nobody seems to have noticed the work till 1768, when the chronicle was published in vol. ii. of the *Monumenta hist. Bohemiae nusquam antehac edita* by Father Gelasius Dobner. But, though Marignolli was thus at last in type, no one seems to have read him till 1820, when an interesting paper on his travels was published by J. G. Meinert. Professor Friedrich Kunstmann of Munich also devoted to the subject one of his admirable series of papers on the ecclesiastical travellers of the middle ages.

See *Fontes rerum bohemicarum*, iii. 492–604 (1882, best text); G. Dobner's *Monumenta hist. boh.*, vol. ii. (Prague, 1768); J. G. Meinert, in *Abhandl. der k. böhm. Gesellsch. der Wissenschaften*, vol. vii.; F. Kunstmann, in *Historisch-politische Blätter von Phillips und Görres*, xxxviii. 701–719, 793–813 (Munich, 1859); Luke Wadding, *Annales minorum, A.D. 1338*, vii. 210–219 (ed. of 1733, &c.); Sbaralea, *Supplementum et castigatio ad scriptores trium ordinum S. Francisci a Waddingo*, p. 436 (Rome, 1806); John of Winterthur, in Eccard, *Corpus historicum medii aevi*, vol. i., 1852; Mosheim, *Historia Tartarorum ecclesiastica*, part i., p. 115; Henry Yule, *Cathay and the Way Thither*, ii. 309–394 (Hak. Soc., 1866); C. Raymond Beazley, *Dawn of Modern Geography*, iii. 142, 180–181, 184–185, 215, 231, 236, 288–309 (1906). (H. Y.; C. R. B.)

MARIGNY, ENGUERRAND DE (1260–1315), French chamberlain, and minister of Philip IV. the Fair, was born at Lyons-la-Forêt in Normandy, of an old Norman family of the smaller baronage called Le Portier, which took the name of Marigny about 1200. Enguerrand entered the service of Hugues de Bonville, chamberlain and secretary of Philip IV., as a squire, and then was attached to the household of Queen Jeanne, who made him one of the executors of her will. He married her goddaughter, Jeanne de St Martin. In 1298 he received the custody of the castle of Issoudun. After the death of Pierre Flotte and Hugues de Bonville at the battle of Mons-en-Pevèle in 1304, he became Philip's grand chamberlain and chief minister. In 1306 he was sent to preside over the exchequer of Normandy. He received numerous gifts of land and money from Philip as well as a pension from Edward II. of England. Possessed of an ingratiating manner, politic, learned and astute, he acted as an able instrument in carrying out Philip's plans, and received corresponding confidence. He shared the popular odium which Philip incurred by debasing the coinage. He acted as the agent of Philip in his contest with Louis de Nevers, the son of Robert count of Flanders, imprisoning Louis and forcing Robert to surrender Lille, Douay and Béthune. He obtained for his half-brother Philip de Marigny in 1301 the bishopric of Cambray, and in 1309 the archbishopric of Sens, and for his brother Jean in 1312 the bishopric of Beauvais. Still another relative, Nicolas de Fréauville, became the king's confessor and a cardinal. He addressed the estates general in 1314 and succeeded in getting further taxes for the Flemish war, incurring at the same time much ill will. This soon came to a head when the princes of the blood, eager to fight the Flemings, were disappointed by his negotiating a peace in September. He was accused of receiving bribes, and Charles of Valois denounced him to the king himself; but Philip stood by him and the attack was of no avail. The death of Philip IV. on the 29th of November 1314 was a signal for a reaction against his policy. The feudal party, whose power the king had tried to limit, turned on his ministers and chiefly on his chamberlain. Enguerrand was arrested by Louis X. at the instigation of Charles of Valois, and twenty-eight articles of accusation including charges of receiving bribes were brought against him. He was refused a hearing; but his accounts were correct, and Louis was inclined to spare him anything more than banishment to the island of Cyprus. Charles then brought forward a charge of sorcery which was more effectual. He was condemned at once and hanged on the public gallows at Montfaucon, protesting that in all his acts he had only been carrying out Philip's commands (April 30, 1315). Louis X. seems to have repented of his treatment of Marigny, and left legacies to his children. When his chief enemy, Charles of Valois, lay dying in 1325, he was stricken with remorse and ordered alms to be distributed among the poor of Paris with a request to "pray for the souls of Enguerrand and Charles." Marigny founded the collegiate church of Notre Dame d'Escoës near Rouen in 1313. He was twice married, first to Jeanne de St Martin, by whom he had three children, Louis, Marie and Isabelle (who married Robert, son of Robert de Tancarville); and the second time to Alips de Mons.

See contemporary chroniclers in vols. xx. to xxiii. of D. Bouquet, *Historiens de la France;* P. Clément, *Trois drames historiques* (Paris, 1857); Ch. Dufayard, *La Réaction féodale sous les fils de Philippe le Bel*, in the *Revue historique* (1894, liv. 241–272) and lv. 241–290.

MARIGNY, JEAN DE (d. 1350), French bishop, was a younger brother of the preceding. Entering the church at an early age, he was rapidly advanced until in 1313 he was made bishop of Beauvais. During the next twenty years he was one of the most notable of the members of the French episcopate, and was particularly in favour with King Philip VI. He devoted himself in 1335 to the completion of the choir of Beauvais Cathedral, the enormous windows of which were filled with the richest glass. But this building activity, which has left one of the most notable Gothic monuments in Europe, was broken into by the Hundred Years' War. Jean de Marigny, a successful administrator and man of affairs rather than a saintly churchman, was made one of the king's lieutenants in southern France in 1341 against the English invasion. His most important military operation, however, was when in 1346 he successfully held out in Beauvais against a siege by the English, who had overrun the country up to the walls of the city. Created archbishop of Rouen in 1347 as a reward for this defence, he enjoyed his new honours only three years; he died on the 26th of December 1350.

MARIGOLD. This name has been given to several plants, of which the following are the best known: *Calendula officinalis*, the pot-marigold; *Tagetes erecta*, the African marigold; *T. patula*, the French marigold; and *Chrysanthemum segetum*, the corn marigold. All these belong to the order Compositae; but *Caltha palustris*, the marsh marigold, belongs to the order Ranunculaceae.

The first-mentioned is the familiar garden plant with large orange-coloured blossoms, and is probably not known in a wild state. There are now many fine garden varieties of it. The florets are unisexual, the "ray" florets being female, the "disk" florets male. This and the double variety have been in cultivation for at least three hundred years, as well as a proliferous form, *C. prolifera*, or the "fruitful marigolde" of Gerard (*Herball*, p. 602), in which small flower-heads proceed from beneath the circumference of the flower. The figure of "the greatest double marigold," *C. multiflora maxima*, given by Gerard (*loc. cit.* p. 600) is larger than most specimens now seen, being 3 in. in diameter. He remarks of "the marigolde" that it is called *Calendula* "as it is to be seene to flower in the calends of almost euerie moneth." It was supposed to have several specific virtues, but they are non-existent. "The marigold, that goes to bed wi' the sun," is mentioned by Shakespeare, *Winter's Tale*, iv. 3.

Tagetes patula, and *T. erecta*, the French and African marigolds, are natives of Mexico, and are equally familiar garden plants, having been long in cultivation. Gerard figures five varieties of *Flos africanus*, of the single and double kind (*loc. cit.*, p. 609). Besides the above species the following have been introduced later, *T. lucida*, *T. signata*, also from Mexico, and *T. tenuifolia* from Peru.

Chrysanthemum segetum, the yellow corn marigold, is indigenous to Great Britain, and is frequent in corn-fields in most parts of England. When dried it has been employed as hay. It is also used in Germany for dyeing yellow. Gerard observes that in his day "the stalke and leaues of Corne Marigolde, as Dioscorides saith, are eaten as other potherbes are."

Caltha palustris, the marsh marigold, or king-cups, the "winking Mary-buds" of Shakespeare (*Cymb.*, ii. 3), is a common British plant in marshy meadows and beside water. It bears smooth heart-shaped leaves, and flowers with a golden yellow calyx but no corolla, blossoming in March and April. The flower-buds preserved in salted vinegar are a good substitute for capers. A double-flowered variety is often cultivated, and is occasionally found wild.

MARIINSK, a town of Russia, in West Siberia and the government of Tomsk, on the bank of the Kiya river and on the Siberian railway, 147 m. E.S.E. of Tomsk. Pop. (1897), 8300. It is built of timber, but has a stately cathedral. There are tanneries and soapworks; and Mariinsk is an entrepôt for the goldmines.

MARILLAC, CHARLES DE (*c.* 1510–1560), French prelate and diplomatist, came of a good family of Auvergne, and at the age of twenty-two was advocate at the parlement of Paris. Suspected, however, of sympathizing with the reformers, he deemed it prudent to leave Paris, and in 1535 went to the East with his cousin Jean de la Forêt, the first French ambassador at Constantinople. Cunning and ambitious, he soon made his mark, and his cousin having died during his embassy, Marillac was appointed his successor. He did not return from the East until 1538, when he was sent almost immediately to England, where he remained ambassador until 1543. He retained his influence during the reign of Henry II., fulfilling important missions in Switzerland and at the imperial court (1547–1551), and at the courts of the German princes (1553–1554). In 1555 he was one of the French deputies at the conferences held at Mark near Ardres to discuss peace with England. His two last missions were at Rome (1557) and at the Diet of Augsburg (1559). In 1550 he was given the bishopric of Vannes, and in 1557 the archbishopric of Vienne; he also became a member of the privy council. He distinguished himself as a statesman at the Assembly of Notables at Fontainebleau in 1560, when he delivered an exceedingly brilliant discourse, in which he opposed the policy of violence and demanded a national council and the assembly of the states general. Irritated by his opposition, the Guises compelled him to leave the court, and he died on the 2nd of December of the same year.

His works include: *Discours sur la roupture de la Trefve en l'an 1556* (Paris, 1556), and "Sommaire de l'ambassade en Allemagne de feu M^r. l'archévesque de Vienne en l'an 1550," published in Ranke's *Deutsche Geschichte im Zeitalter der Reformation*, vol. vi. (Leipzig, 1882). See J. Kaulek, *Correspondance politique de Castillon et Marillac (1537–1542)* (Paris, 1885); P. de Vassière, *Charles de Marillac* (Paris, 1896).

MARINES (from Lat. *mare*, sea), the technical term for sea-soldiers, *i.e.* troops appropriated and specially adapted to the requirements of maritime war. This force—formerly (1694) styled "mariners"—is in origin, use and application peculiarly British. The only other nation possessing a special force discharging exactly similar functions is the United States (see below). In the armed forces of the great European Powers marines and marine artillery are mentioned, but these troops have little in common with British and American marines. In France their duties are to garrison military forts and colonies and take part in marine and other wars. In Germany they are used for coast defence. In Holland, Austria and Italy they have a military organization, but not as complements of sea-going ships.

The origin of the British marine force was an order in council 1664, directing "1200 Land souldgers to be forthwith rayzed to be in readiness to be distributed in His Majesty's fleete prepared for sea service." This body was named the "Admiral's regiment." At this period land warfare had developed a system and was waged by men organized, disciplined and trained. Sea warfare was left "to every man's own conceit." War-ships were built to be manned in a hurry, by "the press," when needed. Men were thus obtained by force and grouped without organization or previous training in ships. When no longer required they were turned adrift. The administration of England's fleet was "a prodigy of wastefulness, corruption and indolence; no estimate could be trusted, no contract was performed, no check was enforced." Such officers as had been "bred to the sea seemed a strange and savage race." They robbed the king and cheated the seamen. As regards land force, it was a violation of the law to keep at home in the king's pay "any other body of armed men, save as a guard for the royal person." On the other hand it was "illegal to land press men" in a foreign country, but soldiers "only required a little persuasion to land." Thus by thrusting into naval chaos and confusion a nucleus of disciplined, trained and organized land troops, an expedient was found which offered a solution of the many political and administrative difficulties of the time. This "Admiral's regiment," was the germ which by a constant process of evolution during a period of over 235 years has produced not merely the marine forces, but the royal navy, organized, disciplined and trained as it is to-day. In 1668 the experiment of the Admiral's regiment was extended. At a council held "to discourse about the fitness for entering men presently for manning the fleete," King Charles II. "cried very civilly, 'If ever you intend to man the fleet without being cheated by the captains and pursers, you may go to bed and resolve never to have it manned.'" This seems to throw some light on the council's order a few days later "to draw out and furnish such numbers of His Majesty's Foot Guards for His Majesty's service at sea this summer, as H.R.H. the duke of York, lord high admiral of England, shall from time to time desire." The men were to be paid and accounted for by their own officers. This maritime force subsequently disappeared, but two new regiments of "marines" were raised in 1694, the House of Commons directing they "were to be employed in the service of the navy only." One regiment only was to be on shore at a time, and to be employed in the dockyards with extra pay. None of the officers were to be sea commanders, save two colonels. The intention was to make these regiments feeders for the navy, captains being ordered to report periodically "the names of such soldiers as shall in any measure be made seamen, and how far each of them is qualified toward being an able seaman." In 1697 these regiments were disbanded, but early in the reign of Queen Anne a number of regiments of marines were raised, and independent companies of marines were also enlisted in the West Indies. At the peace of Utrecht (1713) the marines were disbanded, but reappeared in 1739 as part of the army; and in 1740 three regiments of marines were raised in America, the colonels being appointed by the crown, the captains by the provinces. In 1747 the marine regiments were transferred from the control of the secretary at war to that of the admiralty, and the next year once more wholly disappeared on the treaty of Aix-la-Chapelle (1748).

During the preceding period of fifty-four years the marine force appeared and disappeared with war. It was a military body, applied to naval purposes. Its main functions were threefold—(1) for fighting in ships; (2) for seizing and holding land positions necessary or advantageous to the naval operations of war; (3) for maintaining discipline of the ships, and by "expertness in handling arms to incite our seamen to the imitation of them." Incidentally the force came to be regarded as so good a feeder for the navy that Admiral Vernon (1739) urged "the necessity of converting most of our marching regiments into marines, and if, as they became seamen they were admitted to be discharged as such, that would make a good nursery for the breeding of them."

The organization of the force was purely military. Regiments were embarked in fleets, and distributed in the ships. The officers were interchangeable with those of the guards and line. John Churchill (afterwards duke of Marlborough) and George Rooke (afterwards Admiral Sir George Rooke) were together at one time ensigns of marines. During this period the marines were never regarded as a reserve for the fleet. The navy in peace did without them. The necessities of maritime war demanded a mobile military force adapted to naval conditions and at naval disposal, and so in all naval operations during these eighty-four years the marines played a conspicuous part. The navy had been slowly groping towards a system. For example, sea officers had been granted a uniform, and a naval academy (1729) had been established for the education of young gentlemen for the sea service. But in its main features the navy remained in 1748 as it was in 1664. The sailor was kidnapped and forced into ships, to become an outcast when no longer wanted. The marine when not in a ship was comfortably housed and looked after by his officers in barracks on shore.

In 1755 the marine force once more reappeared under the Admiralty, and from that date its history has been continuous.

But the regimental system was abandoned, and an entirely new principle of organization was applied. Companies were raised, and these companies were grouped into great depots, called divisions, at Portsmouth, Plymouth and Chatham. At these divisions this force could be increased and reduced at pleasure, without disturbing the basis of organization, and from them could be supplied as many or as few sea-soldiers as fleets or ships needed, while preserving in the varying units so provided all the essentials of uniformity of system, drill, training, ties of comradeship and *esprit de corps*. This force then and for ninety-eight years afterwards was the only continuously trained, disciplined and organized fighting force placed by the country at the disposal of naval officers. On the establishment of this new marine force the purchase of commissions was abolished, but interchange with the army was for a time permitted. When embarked, marines were under the naval code of discipline; when on shore, under the marine Mutiny Act, identical with that of the army. When the seamen of the fleet mutinied at the Nore, at the close of the 18th century, and turned their officers out of the ships, the marines, undaunted, stood firm by theirs.

Mutiny lurked beneath the deck of many a ship before and long years after that event. The control of admirals and captains over their own men was precarious in the extreme. This was the natural result of the country's neglect of its seamen. The discipline of the fleet in those days rested on the firm bayonets of the marines. What England owes to them may be gathered from Lord St Vincent's recorded testimony: "There never was an appeal made to them for honour, courage or loyalty, that they did not more than realize my highest expectation. If ever real danger should come to England, the marines will be found the country's sheet-anchor." At his earnest solicitation the marines were made a royal corps in 1802. It is worthy of note that in those days of masts, yards, sails and pure seamanship, this greatest of naval statesmen, this matchless naval strategist, whose practical experience of maritime war was unrivalled, strenuously advocated as the true policy for England what in these days of steam and mastless ships would be scouted and ridiculed. It was to make service afloat as marines a part of the duty of every regiment of the line in rotation.

Down to 1804 the marines were an infantry force; the improvement in artillery towards the close of the century had necessitated the occasional putting into the fleet of detachments of Royal Artillery. This, as regards gunnery duties in the fleet, was repeating on a smaller scale the expedient adopted in the time of Charles II. So much friction arose between the naval and the artillery officers that a special corps of Royal Marine Artillery was raised in 1804, on the recommendation of Nelson. This special corps fulfilled the expectations of its founders. It was charged with the care, equipment and working of the larger ordnance afloat and field-guns ashore, and was employed also as a body of gunnery instructors to the fleet. In 1831, a certain number of naval officers being thought to be sufficiently trained in gunnery, this corps, of which Napier wrote, "Never in my life have I seen soldiers like the Royal Marine Artillery," was, without warning, abolished. Then the marine force ceased to be composed of two corps, artillery and infantry, and it reverted to a single one of infantry. Very soon afterwards, however, the Admiralty began to build up what they had so suddenly and ruthlessly destroyed, by ordering the conversion of one company of each infantry marine division into artillery. The number of these artillery companies gradually increased, and were grouped in a separate depot. Just as the wars from Charles II. to George III. had demanded marines, so the Crimean War led to their increase. Thus in 1859 the artillery companies of marines were formed into a separate division, and in 1862 the old name of Royal Marine Artillery was restored.

The marines thus became once more and still remain two corps, the official designation of the whole being Royal Marine Forces. In 1855 the marine infantry corps became light infantry, and in 1869 the Woolwich division (added in 1805) was abolished; and more recently a marine depot, as a feeder of the other divisions, was established at Walmer. The headquarters of the R.M.A. are at Eastney, Southsea. The divisions R.M.L.I. are at Gosport, Chatham and Devonport. The uniform of the R.M.A. is blue with red facings, that of R.M.L.I. red with blue facings. The badge of both corps is the globe surrounded with the laurel wreath, with the motto "Per mare per terram." The Royal Marine Forces share with the 3rd Battalion Grenadier Guards, the East Kent Regiment (formerly the Buffs), and the Royal London Militia the privilege of marching through the city of London with colours flying, bands playing and bayonets fixed. This is due to a common original association with the London train bands.

War Services.—To describe these would be to review the wars waged by England by sea and by land for over 200 years. In every sea fight, great or small, marines have taken part, and on every continent they have served in big and little wars, sometimes as part of the army, sometimes with naval contingents, sometimes alone.

Throughout the Napoleonic war the marines took part in every sort of operation afloat and ashore. During the Crimean War, mortar-boat flotillas in the Baltic and Black Sea were commanded and manned by R.M.A., while comrades in the same corps served with the Royal Artillery in the trenches before Sebastopol—a marine infantry brigade occupying the heights of Balaclava. During the Indian Mutiny, marines (artillery and infantry) served with the Naval Brigade under Peel. In the China wars batteries and brigades of the marine force played a prominent part, and likewise were represented in all the Egyptian and Sudan campaigns, 1881 to 1898. In one action the R.M.A. gunners came to the relief of the Royal Horse Artillery when exhausted, and fought their guns; in another the R.M.A., out of the débris of the enemy's Krupp guns captured, built up one complete gun and fought it with effect; in the final campaign gunboats were brought up in pieces, put together and fought by a detachment of the R.M.A.

In 1899 in the Boer War the marine artillery and infantry took part with the Naval Brigade, maintaining their historic reputation, and at the battle of Enslin their losses were exceptionally severe.

Characteristics of Marine System.—The recruit first goes to the depot at Walmer, and is trained as a soldier before joining his division to complete instruction as a marine. His division is his permanent military home, from which he goes on service and to which he returns at its conclusion. Restrictions on marriage, necessary under the army system, are not necessary in the marine forces. The permanent home of the wife and family is not broken up by the marine going abroad; the wife thus can continue any local goodwill in any business her industry may secure. This fixed home enables a marine to learn a trade in the workshops of his division which supply the clothing, &c., to the corps. Marines are enlisted for 12 years, and if of good character they can re-engage to complete 21 years, entitling to pension. The periods of service abroad for marines are shorter (generally 3 years), but more constantly recurrent than for the army. The administrative, as distinct from the instructional, staff necessary for a marine division is more simple and less expensive than that of a numerical army equivalent expressed in regiments. The system of pay and accounts is also less complex. The following table shows the relative proportions of marine forces to the whole navy at different periods up to the South African War of 1899:—

Year.	Navy proper. Officers and Men.	Marines. Officers and Men.	Grand Total.	Maritime. Peace or War.	Percent. Marines to Total Forces.	Nature of Ships.
1805	90,000	30,000	120,000	War (Trafalgar)	25	Sailing.
1838	23,165	9,000	32,165	Peace	28	Sailing.
1858	40,219	14,919	55,138		27	Sailing with auxiliary steam.
1878	42,046	13,727	55,773		24	Steam with auxiliary sail.
1898	78,441[1]	17,099	95,540		17	Steam and mastless ships.

The above table indicates a gradual change in naval policy and practice as regards marines. It will be observed that, concurrently with the gradual disappearance of masts, sails and yards, the proportion of marines has steadily declined. Down to very recent times the marine spent more time ashore than afloat. Now the reverse is the case.

By the introduction of the Continuous Service Act 1853, the blue-jacket was placed on exactly the same footing as the marine in respect of conditions of service and pension, and now the blue-jacket when not afloat is quartered in barracks. The main difference between the blue-jacket and marine is the dress and the pay. The blue-jacket is better paid than the marine. As regards opportunity of discipline, there is now no difference; and in short, all the reasons for the existence of a marine force have disappeared except as regards duties on shore incidental to naval operations of war, *e.g.* the holding of ports and the seizing of minor positions necessary to prosecution of maritime war. The facts that modern ships cannot now as formerly carry a supernumerary force sufficient for such purposes, and are more dependent on fixed bases of supply and repair than in old days, point to a different method of using and applying the marine force to the sole purpose for which they are now necessary as a distinct branch of the naval service. If employed at the headquarters of a naval station, their efficiency as marines could be preserved by occasional embarcation of the officers and men in rotation. The substitution of marine for army garrisons at coaling stations would also relieve the army of a class of duties incidental to naval warfare which the marine force formerly performed, and which prejudicially affects the organization and arrangement of the army as a mobile field force.

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[1] Including 22,289 of the engineer branch providing the locomotion of modern ships—just as seamen from 1805–1858 provided it for ships of the past.

Marine Corps, United States.—This dates from the establishment of the American navy. It is a wholly separate military body, though under the control of the Navy Department. It was formed in 1775, and it has a history of brilliant services rendered by land and sea in all the wars of America since that date. The headquarters of the corps are at Washington, and the strength of the corps was fixed by Act of Congress (March 3, 1899) at 211 officers and 5920 non-commissioned officers and men. Its organization and system are based on the British model, and the dress corresponds to that of the United States army. The corps is commanded by a brigadier-general who bears to the secretary a relation similar to that of a chief of bureau. Although the organization closely follows the army system, regimental or even permanent battalion organizations are impracticable, owing to their numerous and widely-separated stations. Practically all shore stations have barracks where marines are enlisted and drilled. At these places they also do sentry, police and orderly duties. From such stations they are sent to ships for sea duty. Nearly all ships carry a body of marines known as the guard, varying in size from a few men commanded by a sergeant, on small ships, to eighty or more, with one or more commissioned officers, on large vessels. It is customary to cause all marines to serve at sea three of the four years of each enlistment. On board ship they perform sentry and orderly duty, and assist in police duties. They are also instructed in many exercises pertaining to the navy, as rowing, naval signalling, gun drill, &c. In action they act as riflemen, and on many ships serve a portion of the guns. When circumstances require a force to be landed from ships present to guard American interests in foreign countries, legations, &c., the marine guard is usually sent, though, if numerically insufficient, sailors are landed also. Marines also garrison places beyond the territorial limits of the United States which are under navy control. Candidates for first enlistment must be between the ages of 21 and 35 and unmarried, must be citizens of the United States, be able to read, write and speak English, and pass a physical examination. Second lieutenants are appointed from civil life after examination or from the graduates of the Naval Academy. Promotion is by seniority as in the navy.

Admiral Farragut's opinion that "the marine guard is one of the great essentials of a man-of-war" is corroborated by that of Admiral Wilkes, who considered that "marines constituted the great difference between a man-of-war and a privateer." In the famous battles between the "Bonhomme Richard" and "Serapis" in 1777, and in that between the "Chesapeake" and "Shannon," the American marines displayed brilliant gallantry; and while on the one hand they at Derne in 1803 first planted the American flag on a fortress of the Old World, for which exploit "Tripoli" is inscribed on their colours, they on the other shared in the hard fighting of the Mexican War as well as all the important coast actions of the Civil War of 1861–65. A proposal to incorporate them with the army after the struggle met with universal condemnation from the authorities best qualified to judge of their value. A brigade of three battalions served in the Philippines in 1899. Their device is a globe resting on an anchor and surmounted by an eagle. "Ever faithful" is the title which Captain Luce. the historian of the force, appropriately applies to them. (J. C. R. C.)

MARINETTE, a city and the county-seat of Marinette county, Wisconsin, U.S.A., 162 m. N. of Milwaukee, on the W. shore of Green Bay, at the mouth of the Menominee River. Pop. (1890), 11,523; (1900), 16,195, of whom 5542 were foreign-born; (1905), 15,354; (1910), 14,610. It is served directly by the Wisconsin & Michigan, the Chicago, Milwaukee & St Paul, and the Chicago & North-Western railways, and by several steamboat lines connecting with lake ports; and is connected by ferry with Frankfort, Michigan (served by the Ann Arbor railroad). The city has a fine harbour and a considerable commerce in iron and lumber products. Five bridges connect Marinette with Menominee, Michigan, on the other side of the river. Marinette has a Federal building; the Stephenson public library, founded by Senator Isaac Stephenson (b. 1829), a local "lumber king"; a county agricultural school and training school for rural teachers, and three public parks. The Northern Chautauqua Assembly holds its annual summer session in Chautauqua Park, on the shore of Green Bay. The growth of Marinette began with the development of the neighbouring pine forests; and the manufacture of lumber and lumber products has always been its principal industry. The water-power of the Menominee River is largely utilized for the manufacture of paper and flour. Other manufactures are boxes, furniture and woodware, boats, boilers and agricultural machinery. In 1905 the factory products were valued at $3,633,399. The first white settlement was made here on the site of a Menominee Indian village in 1830, and the city was named in honour of the daughter of an Indian chief, Marinette (Jacobs), whose name was a composite of Marie and Antoinette. A city charter was granted in 1887.

MARINI (or Marino), **GIAMBATTISTA** (1569–1625), Italian poet, was born at Naples on the 18th of October 1569. After a somewhat disreputable youth, during which he became known for his *Canzone de' baci*, he secured the powerful patronage of Cardinal Aldobrandini, whom he accompanied from Rome to Ravenna and Turin. An edition of his poems, *La Lira*, was published at Venice in 1602-1614. His ungoverned pen and disordered life compelled him to leave Turin and take refuge from 1615 to 1622 in Paris, where he was favourably recognized by Marie de' Medici. There his long poem *Adone* was published in 1623. He died at Naples on the 25th of March 1625. The licence, extravagance and conceits of Marini, the chief of the school of "Secentisti" (see Italy: *Literature*), were characteristic of a period of literary decadence.

See M. Menghini, *G. B. Marini* (Rome, 1888).

MARINO, a town of Italy, in the province of Rome, 15 m. S.E. of it by rail, and also accessible by electric tramway. Pop. (1901), 7307. It is picturesquely situated on a spur of the Alban Hills, 1165 ft. above sea level, and occupies the site of the ancient Castrimoenium, a *municipium* of no great importance, though the surrounding district, which now produces much wine, is full of remains of ancient villas. The origin of the name is uncertain; perhaps it is derived from the medieval *Morena* (itself derived from the Latin *Murena*, from one of the Roman owners of the district), a name originally given to the lower ground between the 9th and 11th mile of the Via Latina In the early 13th century it belonged to the Frangipani family, but passed into the hands of the Orsini in 1266. In 1378 a battle took place here between the partisans of Urban VI. and those of the anti-pope Clement VII. of Geneva (the Orsini having taken the side of the latter), who were, however, defeated; and in 1399 Marino was apparently under the Papacy. In 1408 it passed to the Colonna family, to whom it still belongs. There are some remains of the medieval fortifications.

See G. Tomassetti, *La Via latina nel medio evo* (Rome, 1886), p. 96 seq.; T. Ashby, in *Papers of the British School at Rome*, vol. iv. (1907). (T. As.)

MARINUS, the name of two popes. Marinus I., sometimes called Martin II., pope from 882 to 884, was the son of a Tuscan priest, and entered the church at an early age, becoming a deacon about 862. Three successive popes sent him as legate to Constantinople, his mission in each case having reference to the controversy excited by Photius (*q.v.*); and having become an archdeacon and a bishop, he also negotiated on behalf of pope John VIII. with the emperor Charles the Fat. About the end of December 882 he succeeded John VIII. as pope, but his election did not pass unchallenged either in eastern or in western Europe. However, having secured his position, Marinus restored Formosus, cardinal-bishop of Porto, and anathematized Photius. This pope was on friendly terms with the English king, Alfred the Great. He died in May 884, and was succeeded by Adrian III.

MARINUS II., sometimes called Martin III., pope from 942 to 946, was merely the puppet of Alberic (d. 954), prince and senator of the Romans. He died in May 946, and was succeeded by Agapetus II.

MARINUS, neo-Platonist philosopher, was born in Palestine and was early converted to the old Greek religion. He came to Athens at a time when, with the exception of Proclus, there was a great dearth of eminent men in the neo-Platonic school. It was for this reason rather than for any striking ability of his own that he succeeded to the headship of the school on the death of Proclus. During this period the professors of the old Greek religion suffered severe persecution at the hands of the Christians and Marinus was compelled to seek refuge at Epidaurus. His chief work was a biography of Proclus, which is extant. It was first published with the works of Marcus Antoninus in 1559; it was republished separately by Fabricius at Hamburg in 1700, and re-edited in 1814 by Boissonade with emendations and notes. Other philosophical works are attributed to him, including commentaries on Aristotle and on the *Philebus*. It is said that he destroyed the latter because Isidore, his successor, expressed disapproval of it.

MARINUS OF TYRE, geographer and mathematician, the founder of mathematical geography, flourished in the 2nd century A.D. He lived before Ptolemy, who acknowledges his great obligations to him. His chief merits were that he assigned to each place its proper latitude and longtitude, and introduced improvements in the construction of his maps. He also carefully studied the works of his predecessors and the diaries of travellers. His geographical treatise is lost.

See A. Forbiger, *Handbuch der alten Geographie*, vol. i. (1842); E. H. Bunbury, *Hist. of Ancient Geography* (1879), ii. p. 519; and especially E. H. Berger, *Geschichte der wissenschaftlichen Erdkunde der Griechen* (1903).

MARIO, GIUSEPPE, COUNT OF CANDIA (1810–1883), Italian singer, the most famous tenor of the 19th century, son of General di Candia, was born at Cagliari in 1810. His career as a singer was the result of accidental circumstances. While serving as an officer in the Sardinian army he was imprisoned at Cagliari for some trifling offence. When his period of confinement was over, he resigned his commission. His resignation was refused, and he fled to Paris. There his success as an amateur vocalist produced an offer of an engagement at the Opera. He studied singing for two years under M. Ponchard and Signor Bordogni, and made his début in 1838 as the hero of Meyerbeer's *Robert le Diable*. His success was immediate and complete, but he did not stay long at the Opera. In 1839 he joined the company of the Théâtre Italien, which then included Malibran, Sontag, Persiani and Grisi, Rubini, Tamburini and Lablache. His first appearance here was made in the character of Nemorino in Donizetti's *Elisir d'Amore*. He sang in London for the first time in the same year. His success in Italian opera far surpassed that which he had won in French, and in a short time he acquired a European reputation. He had a handsome face and a graceful figure, and his voice, though less powerful than that of Rubini or that of Tamberlik, had a velvety softness and richness which have never been equalled. Experience gave him ease as an actor, but he never excelled in tragic parts. He was an ideal stage lover, and he retained the grace and charm of youth long after his voice had begun to show signs of decay. He created very few new parts, that of Ernesto in *Don Pasquale* (1843) being perhaps the only one deserving of mention. Among the most successful of his other parts were Otello in Rossini's opera of that name, Gennaro in *Lucrezia Borgia*, Alamviva in *Il Barbiere di Siviglia*, Fernando in *La Favorita*, and Manrico in *Il Trovatore*. Mario made occasional appearances in oratorio singing at the Birmingham Festival of 1849 and at the Hereford Festival of 1855, and undertook various concert tours in the United Kingdom, but his name is principally associated with triumphs in the theatre. In 1856 he married Giulia Grisi, the famous soprano, by whom he had five daughters. Mario bade farewell to the stage in 1871. He died at Rome in reduced circumstances on the 11th of December 1883.

MARION, FRANCIS (1732–1795), American soldier, was born in 1732, probably at Winyah, near Georgetown, South Carolina, of Huguenot ancestry. In 1759 he settled on Pond Bluff plantation near Eutaw Springs, in St John's parish, Berkeley county. In 1761 he served as a lieutenant under William Moultrie in a campaign against the Cherokees. In 1775 he was a member of the South Carolina Provincial Congress; and on the 21st of June was commissioned captain in the 2nd South Carolina regiment under W. Moultrie, with whom he served in June 1776 in the defence of Fort Sullivan (Fort Moultrie), in Charleston Harbor. In September 1776 the Continental Congress commissioned him a lieutenant-colonel. In the autumn of 1779 he took part in the siege of Savannah, and early in 1780, under General Benjamin Lincoln, was engaged in drilling militia. After the capture of Charleston (May 12, 1780) and the defeats of General Isaac Huger at Monk's Corner (Berkeley county, South Carolina) and Lieut.-Colonel Abraham Buford at the Waxhaws (near the North Carolina line, in what is now Lancaster county), Marion organized a small troop—which usually consisted of between 20 and 70 men—the only force then opposing the British in the state. Governor John Rutledge made him a brigadier-general of state troops, and in August 1780 Marion took command of the scanty militia, ill equipped and ill fed. With this force he was identified for almost all the remainder of the war in a partisan warfare in which he showed himself a singularly able leader of irregular troops. On the 20th of August he captured 150 Maryland prisoners, and about a score of their British guard; and in September and October repeatedly surprised larger bodies of Loyalists or British regulars. Colonel Banastre Tarleton, sent out to capture him, despaired of finding the "old swamp fox," who eluded him by following swamp paths. When General Nathanael Greene took command in the south, Marion and Colonel Henry Lee were ordered in January 1781 to attack Georgetown, but they were unsuccessful. In April, however, they took Fort Watson and in May Fort Motte, and they succeeded in breaking communications between the British posts in the Carolinas. On the 31st of August Marion rescued a small American force hemmed in by Major C. Fraser with 500 British; and for this he received the thanks of Congress. He commanded the right wing under General Greene at Eutaw Springs. In 1782, during his absence as state senator at Jacksonborough, his brigade deteriorated and there was a conspiracy to turn him over to the British. In June of the same year he put down a Loyalist uprising on the banks of the Pedee river; and in August he left his brigade and returned to his plantation. He served several terms in the state Senate, and in 1784, in recognition of his services, was made commander of Fort Johnson, practically a courtesy title with a salary of £500 per annum. He died on his estate on the 27th of February 1795. Marion was small, slight and sickly-looking. As a soldier he was quick, watchful, resourceful and calm, the greatest of partisan leaders in the bitter struggle in the Carolinas.

See the *Life* (New York, 1844) by W. G. Simms; Edward McCrady, *South Carolina in the Revolution* (New York, 1901–1902); and a careful study of Marion's ancestry and early life by "R. Y." in vols. i. and ii. of the *Southern and Western Monthly Magazine and Review* (Charleston, 1845).

MARION, HENRI FRANÇOIS (1846–1896), French philosopher and educationalist, was born at Saint-Parize-en-Viry (Nièvre) on the 9th of September 1846. He studied at Nevers, and at the École Normale, where he graduated in 1868. After occupying several minor positions, he returned to Paris in 1875 as professor of the Lycée Henri IV., and in 1880 he became *docteur-ès-lettres.* In the same year he was elected a member of the Council of Public Instruction, and devoted himself to improving the scheme of French education, especially in girls' schools. He was largely instrumental in the foundation of *écoles normales* in provincial towns, and himself gave courses of lectures on psychology and practical ethics in their early days. He died in Paris on the 5th of April 1896.

His chief philosophical works were an edition of the *Théodicée* of Leibnitz (1874), a monograph on Locke (1878), *Devoirs et droits de l'homme* (1880), *Glissonius utrum Leibnitio de natura substantiae cogitanti quidquam tribuerit* (1880); *De La solidarité morale* (4th ed., 1893). His lectures at Fontenoy have been published in two volumes entitled *Leçons de psychologie appliquée à l'éducation*, and *Leçons de morale*; those delivered at the Sorbonne are collected in *L'Éducation dans l'université* (1892).

MARION, a city and the county-seat of Grant county, Indiana, U.S.A., about 60 m. N.E. of Indianapolis, on the Mississinewa River. Pop. (1910), 19,359. It is served by the Chicago, Cincinnati & Louisville, the Cleveland, Cincinnati, Chicago & St Louis, the Pittsburgh, Cincinnati, Chicago & St Louis, and the Toledo, St Louis & Western railways, and by interurban electric lines connecting with Indianapolis, Muncie, Fort Wayne, Kokomo and many other towns and cities. The city is the seat of the Marion Normal College and Business University, and has a Carnegie library. Marion lies in a good farming country and in the centre of the state's natural gas region. Among the manufactures are glass, stoves, iron bedsteads, foundry and machine-shop products, steel, planing-mill products, paper and pulp, and leather. The total value of the factory products in 1905 was $4,290,166, the value of the glass product alone being $1,042,057, or 24.3% of the total. Marion was settled in 1832, and was named in honour of General Francis Marion.

MARION, a city and the county-seat of Marion county, Ohio, U.S.A., 44 m. N. by W. of Columbus. Pop. (1900), 11,862, including 782 foreign-born and 112 negroes; (1910), 18,232. Marion is served by the Pennsylvania, the Erie, the Cleveland, Cincinnati, Chicago & St. Louis, and the Hocking Valley railways, and by interurban electric railway to Columbus. It is the trade centre of a rich farming district. Limestone is abundant, and the city has various manufactures, including lime, foundry and machine-shop products, agricultural implements, planing-mill products, engines, steam shovels, dredges, pianos and silks. In 1905 the value of factory products was $3,227,712, being 33.1% greater than in 1900. Marion was laid out in 1821, and was chartered as a city in 1890.

MARIONETTES (probably from Ital. *morio*, a fool or buffoon, but also said to be derived from the *mariolettes*, or little figures of the Virgin Mary), FANTOCCINI (from *fantino*, a child) or PUPPETS (Fr. *poupée* Lat. *pupa*, a baby or doll), the names given to figures, generally below life-size, suspended by threads or wires and imitating with their limbs and heads the movements of living persons.

The high antiquity of puppets appears from the fact that figures with movable limbs have been discovered in the tombs of Egypt and among the remains of Etruria; they were also common among the Greeks, from whom they were imported to Rome. Plays in which the characters are represented by puppets or by the shadows of moving figures, worked by concealed performers who deliver the dialogue, are not only popular in India and China, but during several centuries past maintained an important position among the amusements of the people in most European countries. Goethe and Lessing deemed them worthy of attention; and in 1721 Le Sage wrote plays for puppets to perform.

The earliest performances in English were drawn or founded upon Bible narratives and the lives of the saints, in the same vein as the "morality" plays which they succeeded. Popular subjects in the 16th century were *The Prodigal Son* and *Nineveh, with Jonah and the Whale.* And in a pamphlet of 1641, describing Bartholomew Fair, we read, "Here a knave in a fool's coat, with a trumpet sounding or a drum beating, invites you to see his puppets. Here a rogue like a wild woodman, or in an antic shape like an incubus, desires your company to view his motion." In 1667 Pepys recorded how at Bartholomew Fair he found "my Lady Castlemaine at a puppet play, Patient Grizill." Besides *The Sorrows of Griselda*, other puppet plays of the period were *Dick Whittington*, *The Vagaries of Merry Andrew*, and *The Humours of Bartholomew Fair.* Powell's noted marionette show was the subject of an article in *The Tatler*, 1709, and again in *The Spectator*, 1711. The latter refers also to Pinkethman, a "motion-maker," in whose scenes the divinities of Olympus ascended and descended to the strains of music. An idea of the class of representation may be gathered from an advertisement of Crawley, a rival of Pinkethman, which sets forth—"The Old Creation of the World, with the addition of Noah's Flood," also several fountains playing water during the time of the play. The best scene represented "Noah and his family coming out of the ark, with all the animals two by two, and all the fowls of the air seen in a prospect sitting upon trees; likewise over the ark is the sun rising in a gorgeous manner; moreover a multitude of angels in a double rank," the angels ringing bells. "Likewise machines descending from above, double, with Dives rising out of hell and Lazarus seen in Abraham's bosom; besides several figures dancing jiggs, sarabands, and country dances, with the merry conceits of Squire Punch and Sir John Spendall." Yates showed a moving picture of a city, with an artificial cascade, and a temple—with mechanical birds in which attention was called to the exact imitation of living birds, the quick motion of the bills, just swelling of the throat, and fluttering of the wings. The puppets were wax figures 5 ft. in stature. Toward the end of the 18th century, Flockton's show presented five hundred figures at work at various trades. Brown's Theatre of Arts showed at country fairs, from 1830 to 1840, the battle of Trafalgar, Napoleon's army crossing the Alps, and the marble palace of St Petersburg; and at a still later date Clapton's similar exhibition presented Grace Darling rescuing the crew of the "Forfarshire" steamer wrecked on the Fern Islands, with many ingenious moving figures of quadrupeds, and, in particular, a swan which dipped its head into imitation water, opened its wings, and with flexible neck preened and trimmed its plumage. In these mechanical scenes the figures, painted upon a flat surface and cut out, commonly of pasteboard, are slid along grooves arranged transversely in front of the set scenery, the actions of legs and arms being worked by wires from the hands of persons below the stage, though sometimes use is made of clockwork. In recent days the literature for the marionette stage has had an important literary recruit in the person of the Belgian author Maurice Maeterlinck.

Marionettes proper, and the dolls exhibited in puppet shows (not including Punch and his companion actors), are constructed of wood or of pasteboard, with faces of composition, sometimes of wax; and each figure is suspended by a number of threads to a short bar of wood which is commonly held in one hand of the hidden performer while the finger of his other hand poses the figure or gives action to it by means of the threads. In the mode of constructing the joints, and the greater elaboration with which the several parts of the limbs are supported and moved, and especially in the fine degrees of movement given to the heads, marionettes have been so improved as to present very exact imitations of the gestures of actors and actresses, and the postures and evolutions of acrobats; and, in addition, ingenious exhibitors such as Theodon, who introduced many novelties in the 'sixties of the 19th century, have employed mechanical arrangements for accomplishing the tricks of pantomime harlequinade. Among the puppet personages presented in the small street shows are generally included a sailor who dances a hornpipe, a hoop-dancer, a dancer of the Highland fling, a wooden-legged pensioner, a vaulter on a pole also balancing two chairs, a clown playing with a butterfly, a dancing figure without head until the head rises out of the body, gradually displaying an enormously long neck, and a skeleton, seen at first in scattered parts lying about the stage, but piece successively flying to piece, the body first sitting up, then standing, and finally capped by the skull, when the completed figure begins to dance.

Ombres Chinoises are performances by means of the shadows of figures projected upon a stretched sheet of thin calico or a gauze scene painted as a transparency. The cardboard flat figures are held behind this screen, illuminated from behind—the performer supporting each figure by a long wire held in one hand while wires from all the movable parts terminate in rings in which are inserted the fingers of his other hand.

See also C. Magnin, *Histoire des marionettes* (1852; 2nd ed., 1862); L. de Neuville, *Histoire des marionettes* (1892).

MARIOTTE, EDME (*c.* 1620–1684), French physicist, spent most of his life at Dijon, where he was prior of St Martin sous Beaune. He was one of the first members of the Academy of Sciences founded at Paris in 1666. He died at Paris on the 12th of May 1684. The first volume of the *Histoire et mémoires de l'Académie* (1733) contains many original papers by him upon a great variety of physical subjects, such as the motion of fluids, the nature of colour, the notes of the trumpet, the barometer, the fall of bodies, the recoil of guns, the freezing of water, &c.

His *Essais de physique*, four in number, of which the first three were published at Paris between 1676 and 1679, are his most important works, and form, together with a *Traité de la percussion des corps*, the first volume of the *Œuvres de Mariotte* (2 vols., Leiden, 1717). The second of these essays (*De La nature de l'air*) contains the statement of the law that the volume of a gas varies inversely as the pressure, which, though very generally called by the name of Mariotte, had been discovered in 1660 by Robert Boyle. The fourth essay is a systematic treatment of the nature of colour, with a description of many curious experiments and a discussion of the rainbow, halos, parhelia, diffraction, and the more purely physiological phenomena of colour. The discovery of the blind spot is noted in a short paper in the second volume of his collected works.

MARIPOSAN, or YOKUTS, a linguistic stock of North American Indians, including some 40 small tribes. Its former territory was in southern California, around Tulare lake. The Mariposans were fishers and hunters. Their villages consisted of a single row of wedge-shaped huts, with an awning of brush along the front. In 1850 they numbered some 3000; in 1905 there were 154 on the Tule river reservation.

MARIS, JACOB (1837–1899), Dutch painter, first studied at the Antwerp Academy, and subsequently in Hébert's studio during a stay in Paris from 1865 till 1871. He returned to Holland when the Franco-Prussian War broke out, and died there in August 1899. Though he painted, especially in early life, domestic scenes and interiors invested with deeply sympathetic feeling, it is as a landscape painter that Maris will be famous. He was the painter of bridges and windmills, of old quays, massive towers, and level banks; even more was he the painter of water, and misty skies, and chasing clouds. In all his works, whether in water or oil colour, and in his etchings, the subject is always subordinate to the effect. His art is suggestive rather than decorative, and his force does not seem to depend on any preconceived method, such as a synthetical treatment of form or gradations of tone. And yet, though his means appear so simple, the artist's mind seems to communicate with the spectator's by directness of pictorial instinct, and we have only to observe the admirable balance of composition and truthful perspective to understand the sure knowledge of his business that underlies such purely impressionist handling. Maris has shown all that is gravest or brightest in the landscape of Holland, all that is heaviest or clearest in its atmosphere—for instance, in the "Grey Tower, Old Amsterdam," in the "Landscape near Dordrecht," in the "Sea-weed Carts, Scheveningen," in "A Village Scene," and in the numerous other pictures which have been exhibited in the Royal Academy, London, in Edinburgh (1885), Paris, Brussels and Holland, and in various private collections. "No painter," says M. Philippe Zilcken, "has so well expressed the ethereal effects, bathed in air and light through floating silvery mist, in which painters delight, and the characteristic remote horizons blurred by haze; or again, the grey yet luminous weather of Holland, unlike the dead grey rain of England or the heavy sky of Paris."

See Max Rooses, *Dutch Painters of the Nineteenth Century* (London, 1899); R. A. M. Stevenson, "Jacob Maris," *Magazine of Art* (1900); Ph. Zilcken, *Peintres Hollandais modernes* (Amsterdam, 1893); Jan Veth, "Een Studie over Jacob Maris," *Onze Kunst* (Antwerp, 1902).

MARITIME PROVINCE (Russ., *Primorskaya Oblast*), a province of Russia, in East Siberia. It consists of a strip of territory along the coast of the Pacific from Korea to the Arctic Ocean, including also the peninsula of Kamchatka, part of the island of Sakhalin, and several small islands along the coast. Its western boundary stretches northwards from a point S.W. of Peter the Great Bay (42° 40′ N.) by Lake Hanka or Khanka and along the Usuri, then goes due north from the mouth of the Usuri as far as 52° N., runs along the Stanovoi watershed, crosses the spurs of this plateau through barren *tundras*, and finally reaches the Arctic Ocean at Chaun Bay (70° N.). Area, 715,735 sq. m.

The northern part lies between the Arctic Ocean and the Seas of Bering and Okhotsk, and has the character of a barren plateau 1000 to 2000 ft. high, deeply indented by the rivers of the Anadyr basin and by long fiords, such as Kolyuchin Bay (the wintering-place of Nordenskjöld's "Vega"), the Gulf of Anadyr, and the Bays of Penzhina and Ghizhiga. To the north this plateau is bordered by a chain of mountains, several summits of which reach 8000 ft. (Makachinga peak), while the promontories by which the Asiatic continent terminates towards Bering Strait run up to 1000 to 2000 ft. Only lichens and mosses, with a few dwarf species of Siberian trees, grow in this district. The fauna, however, is far richer than might be expected. A few American birds and mammals cross the strait when it is frozen. This country, and the seas which surround it, have for the last two centuries supplied Siberian trade with its best furs. The blue fox and black sable have been nearly exterminated, and the whale has become very rare. The sea-otter is rapidly becoming extinct, as well as the sea-lion (*Otaria stelleri*); while the sea-cow (*Rhytina stelleri*) was completely extirpated in the course of forty years. The sea-bear (*Otaria ursina*), which at one time seemed likely to meet with the same fate, is now nearly domesticated, and multiplies rapidly. The middle part of the province is a narrow strip (40 to 60 m. wide) along the Sea of Okhotsk, including the basin of the Uda in the south. This area is occupied by rugged mountains, 4000 to 7000 ft. high, forming the eastern border of the high plateau of East Siberia. Thick forests of larch clothe the mountains half way up, as well as the deep valleys. The undulating hills of the basin of the Uda, which is a continuation to the south-west, between the Stanovoi and Bureya mountains, of the deep indentation of the Sea of Okhotsk, are covered with forests and marshes.

The southern part of the province includes two distinct regions. From the north-eastern extremity of the Bureya, or Little Khingan range, of which the group of the Shantar Islands is a continuation, a wide, deep depression runs south-west to the confluence of the Amur and the Usuri, and thence to the lowlands of the lower Sungari. This is for the most part less than 500 ft. above sea-level. The region on the right banks of the Amur and the Usuri, between these rivers and the coast, is occupied by several systems of mountains, usually represented as a single range, the Sikhota-alin. The summits reach 5150 ft. (Golaya Gora), and the average elevation of the few passes is about 2500 ft. There is, however, one depression occupied by Lake Kidzi, which may have been at one time an outflow of the Amur to the sea. The Sikhota-alin mountains are covered with impenetrable forests. The flora and fauna of this region (especially in the Usuri district) exhibit a striking combination of species of warm climates with those of subarctic regions; the wild vine clings to the larch and the cedar-pine, and the tiger meets the bear and the sable. The quantity of fish in the rivers is immense, and in August the Amur and the Usuri swarm with salmon.

The best part of the Maritime Province is at its southern extremity in the valley of the Suifeng river, which enters the Pacific in the Gulf of Peter the Great, and on the shores of the bays of the southern coast. But even there the climate is very harsh. The warm sea-current of the Kuro-Siwo does not reach the coasts of Siberia, while a cold current originating in the Sea of Okhotsk brings its icy water and chilling fogs to the coasts of Sakhalin, and flows along the Pacific shore to the eastern coast of Korea. The high mountains of the sea-coast and the monsoons of the Chinese Sea produce in the southern parts of the Maritime Province cold winters and wet summers. Accordingly, at Vladivostok (on the Gulf of Peter the Great), although it has the same latitude as Marseilles, the average yearly temperature is only 39·5° F., and the harbour is frozen for nearly three months in the year; the Amur and the Usuri are frozen in November. Towards the end of summer the moist monsoons bring heavy rains, which destroy the harvests and give rise to serious inundations of the Amur. The sea-coast farther north has a continental and arctic climate. At Nikolayevsk, temperatures as low as −41·5° F. are observed in winter, and as high as 94·6° in summer, the average yearly temperature being below zero (−0·9°). At Ayan (56° 27′ N.) the average temperature of the year is 25·5° (−0·4° in winter and 50·5° in summer), and at Okhotsk (59° 21′ N.) it is 23° (−6° in winter and 52·5° in summer).

Russian settlements occur throughout the whole of the province, but, with the exception of those on the banks of the Amur and the Usuri, and the southern ports of the sea-coast, they are mere centres of administration.

Okhotsk is one of the oldest towns of East Siberia, having been founded in 1649. Nikolayevsk, on the left bank of the Amur, was formerly the capital of the Maritime Province; but the difficulties of navigation and of communication with the interior, and the complete failure of the governmental colonization of the Amur, caused the seat of government to be transferred to Khabarovsk. Since the loss (1905) of Port Arthur to the Japanese, Vladivostok on Peter the Great Bay has again become the chief naval station of Russia on the Pacific. The trade is in the hands of the Chinese, who export stags' horns, seaweed and mushrooms, and of the Germans, who import groceries and spirits.

The total population was 209,516 in 1897, of whom 57·7% were Russians, the others being Tunguses, Golds, Orochons, Lamuts, Chuvantses, Chukchis, Koryaks, Ghilyaks and Kamchadales. Their chief occupations are hunting and fishing; the Russians carry on agriculture and trade in furs. Active measures were taken in 1883–1897 for increasing the Russian population in the South Usuri district, the result being that over 29,000 immigrants, chiefly Little Russian peasants, settled there; while Cossacks from the Don and Orenburg came to settle among the Usuri Cossacks. Agriculture is gradually developing in the South Usuri region. Gold-mining has been started on the Amguñ, a tributary of the Amur. Coal is found near Vladivostok, as well as in Kamchatka. Roads exist only in the South Usuri district. A railway runs from Vladivostok to Nikolsk (69 m.), and thence to Khabarovsk along the right bank of the Usuri (412 m.). At Nikolsk the Manchurian railway begins.

(P. A. K.; J. T. Be.)

MARITIME TERRITORY, a term used in international law to denote coastal waters which are not Territorial Waters though in immediate contact with the sea. In the case of Territorial Waters (*q.v.*) the dominion of the adjacent state is subject to a limitation. Dominion over maritime territory is not subject to any limitation. Thus any strait through which the right of passage of foreign vessels can be forbidden (as the Solent or the Inland Sea of Japan), or bays so land-locked that they cannot be held to form part of any ocean-highway, are maritime territory.

MARIUPOL, a seaport of Russia, on the north shore of the Sea of Azov, at the mouth of the Kalmius, in the government of Ekaterinoslav, 67 m. W. of Taganrog. Pop. (1900), 52,770, including the inhabitants of two suburbs, Mariinsk and Kara-su. The place is said to have been inhabited in remote times under the name of Adamakha; the present town was built only in 1779, by Greek emigrants from the Crimea. Its inhabitants are engaged in agriculture, cattle-breeding, fishing, and the manufacture of leather, agricultural implements, iron goods and bricks. In export trade Mariupol ranks next to Taganrog among the ports of the Sea of Azov; but its harbour is open to the south-east and shallow, though it is being gradually deepened by systematic dredging. The principal articles of export are cereals, with some oilcake, phosphate and coal; but the total value is only about £2,000,000 annually. The imports do not reach a quarter of a million sterling.

MARIUS OF AVENCHES (or Aventicum) (d. 593 or 594), chronicler and ecclesiastic, was born in the neighbourhood of Autun probably in 530, and became bishop of Avenches about 573. In addition to being a good bishop, Marius was a clever goldsmith; he was present at the council of Mâcon in 585, and transferred the seat of his bishopric from Avenches to Lausanne. He died on the 31st of December 593 or 594. As a continuation of the *Chronicon* of Prosper of Aquitaine, Marius wrote a short *Chronicon* dealing with the period from 455 to 581; and although he borrowed from various sources his work has some importance for the history of Burgundy. Regarding himself and his land as still under the authority of the Roman empire, he dates his *Chronicon* according to the years of the Roman consuls and of the East Roman emperors.

The only extant manuscript of the *Chronicon* is in the British Museum. Among several editions may be mentioned the one in the *Monumenta Germaniae historica, chronica minora*, Band II. (1893), with introduction by T. Mommsen. See also W. Arndt, *Bischof Marius von Aventicum* (Leipzig, 1875); and W. Wattenbach, *Deutschlands Geschichtsquellen*, Bd. I. (1904).

MARIUS, GAIUS (155–86 b.c.), Roman general, of plebeian descent, the son of a small farmer of Cereatae (mod. *Casamare*, "home of Marius") near Arpinum. He served first in Spain under the great Scipio Africanus, and rose from the ranks to be an officer. In 119 as tribune he proposed a law intended to limit the influence of the nobles at elections. This brought him into conflict with the aristocratic party, who prevented him from obtaining the aedileship. When about forty years of age he married a lady of patrician rank, Julia, the aunt of Julius Caesar. This gave him a new social status, and being at the same time a popular favourite and a brave, energetic soldier, he was in 115 elected praetor, in which capacity he effected the subjugation of the troublesome province of Further Spain. In the war with Jugurtha (109–106) he came to the front as lieutenant of the consul Quintus Caecilius Metellus Numidicus. When he had already achieved some important successes over Jugurtha (*q.v.*), in 107 he was elected consul for the first time (an almost unheard-of honour for a "new man"), his popularity with the army and people being sufficient to bear down all opposition. In the following year, in conjunction with Sulla, he brought the war to a triumphant issue, and passed two years in his province of Numidia, which he thoroughly subdued and annexed. The surrender of the person of Jugurtha to Sulla gave rise to the view that he, not Marius, had really ended the war, and so laid the foundation of the subsequent enmity between the two leaders.

By this time Marius was generally recognized as the ablest general of the day, and was appointed to the chief command against the Cimbri and Teutones. Two Roman armies had been destroyed near the Lake of Geneva, and it seemed as if a repetition of the disaster of the Allia and the capture of Rome itself might not be impossible. Marius, out of unpromising materials and a demoralized soldiery, organized a well-disciplined army, with which he inflicted on the invaders two decisive defeats, the first in 102 at Aquae Sextiae (*Aix*), 18 m. north of Marseilles, and the second in the following year on the Raudian plain near Vercellae (*Vercelli*), about midway between Turin and Milan. For some centuries afterwards Rome remained unmolested by northern barbarians. In 101 Marius was elected consul a fifth time (previously in 107, 104, 103, 102), hailed as the "saviour of his country," and honoured with a triumph of unprecedented splendour.

The glorious part of his career was now over. Though a very able soldier, he was without the intellectual culture which the Gracchi, his political ancestors, possessed. As a politician he on the whole failed, though he retained the confidence of the popular party almost to the last. But he unfortunately associated himself with the demagogues Saturninus (*q.v.*) and Glaucia, in order to secure the consulship for the sixth time (100). The manner in which he turned against his former associates (although he probably had no choice in the matter) alienated the sympathies of the plebs; and Marius, feeling that his only chance of rehabilitation lay in war, left Rome for Asia, where he endeavoured to provoke Mithradates to hostilities. On his return he served as legate in the Social War (90), and defeated the Marsi on two occasions. In 88 war broke out with Mithradates, and Sulla was appointed by the senate to the chief command, which was eagerly desired by Marius. This led to a rupture. With the assistance of the tribune Sulpicius Rufus, Marius succeeded in getting the command transferred to himself. Sulla marched upon Rome and defeated Marius, who fled to the marshes of Minturnae in Latium. He was discovered and taken prisoner; and the local magistrates, in accordance with Sulla's proclamation, resolved to put him to death. The Gallic trooper sent to strike off the old man's head quailed, it is said, before the fire of his eyes, and fled exclaiming, "I cannot kill Gaius Marius." The inhabitants out of compassion then allowed Marius to depart, and put him on board a ship which conveyed him to Carthage. When forbidden to land, he told the messenger to inform the governor that he had seen Marius sitting as a fugitive among the ruins of Carthage. Having been joined by his son, he took refuge in the island of Cercina. Meantime, Sulla having left Italy for the Mithradatic war, Cinna's sudden and violent revolution put the senate at the mercy of the popular leaders, and Marius greedily caught at the opportunity of a bloody vengeance, which became in fact a reign of terror in which senators and nobles were slaughtered wholesale. He had himself elected consul for the seventh time, in fulfilment of a prophecy given to him in early manhood. Less than three weeks afterwards he died of fever, on the 13th of January 86.

Marius was not only a great general, but also a great military reformer. From his time a citizen militia was replaced by a professional soldiery, which had hitherto been little liked by the Roman people. He further made the cohort the military unit instead of the maniple, and his cavalry and light-armed troops were drawn from foreign countries, so that it may be said that Marius was the originator of the mercenary army. The Roman soldier was henceforth a man who had no trade but war. A great general could hardly fail to become the foremost man in the state. Marius, however, unlike Caesar, did not attempt to overturn the oligarchy by means of the army; he used rather such expedients as the constitution seemed to allow, though they had to be backed up by riot and violence. He failed as a political reformer because the merchants and the moneyed classes, whom the Gracchi had tried to conciliate, feared that they would themselves be swept away by a revolution of which the mob and its leaders would be the ultimate controllers. Marius had a decided tinge of fanaticism and superstition. In canvassing for the consulship he was guided by the counsels of an Etruscan soothsayer, and was accompanied in his campaigns by a Syrian prophetess. The fashionable accomplishments of the day, and the new Greek culture, were wholly alien to his taste.

For the life of Marius the original sources are numerous passages in Cicero's works, Sallust's *Jugurtha*, the epitomes of the lost books of Livy, Plutarch's *Lives* of Sulla and Marius, Velleius Paterculus, Florus and Appian's *Bellum civile*. See F. D. Gerlach, *Marius und Sulla* (Basel, 1856); I. Gilles, *Campagne de Marius dans la Gaule* (1870); W. Votsch, *Marius als Reformator des römischen Heerwesens* (with notes and references to ancient authorities, 1886); A. H. J. Greenidge, *History of Rome*, vol. i. (1904); also ROME: *History*, II. "The Republic."

MARIVAUX, PIERRE CARLET DE CHAMBLAIN DE (1688–1763), French novelist and dramatist, was born at Paris on the 4th of February 1688. His father was a financier of Norman extraction whose real name was Carlet, but who assumed the surname of Chamblain, and then superadded that of Marivaux. M. Carlet de Marivaux was a man of good reputation, and he received the appointment of director of the mint at Riom in Auvergne, where and at Limoges the young Pierre was brought up. It is said that he developed literary tastes early, and wrote his first play, the *Père prudent et équitable*, when he was only eighteen; it was not, however, published till 1712, when he was twenty-four. His chief attention in those early days was paid to novel writing, not the drama. In the three years from 1713 to 1715 he produced three novels—*Effets surprenants de la sympathie*; *La Voiture embourbée*, and a book which had three titles—*Pharsamon*, *Les Folies romanesques*, and *Le Don Quichotte moderne*. All these books were in a curious strain, not in the least resembling the pieces which long afterwards were to make his reputation, but following partly the Spanish romances and partly the heroic novels of the preceding century, with a certain intermixture of the marvellous. Then Marivaux's literary ardour took a new phase. He fell under the influence of Antoine Hondar[d] de La Motte, and thought to serve the cause of that ingenious paradoxer by travestying Homer, an ignoble task, which he followed up (perhaps, for it is not certain) by performing the same office in regard to Fénelon. His friendship for La Motte, however, introduced him to the *Mercure*, the chief newspaper of France, where in 1717 he produced various articles of the "Spectator" kind, which were distinguished by much keenness of observation and not a little literary skill. It was at this time that the peculiar style called Marivaudage first made its appearance in him. The year 1720 and those immediately following were very important ones for Marivaux; not only did he produce a comedy, now lost except in small part, entitled *L'Amour et la vérité*, and another and far better one entitled *Arlequin poli par l'amour*, but he wrote a tragedy, *Annibal* (printed 1737), which was and deserved to be unsuccessful. Meanwhile his wordly affairs underwent a sudden revolution. His father had left him a comfortable subsistence, but he was persuaded by friends to risk it in the Mississippi scheme, and after vastly increasing it for a time lost all that he had. His prosperity had enabled him to marry (perhaps in 1721) a certain Mlle Martin, of whom much good is said, and to whom he was deeply attached, but who died very shortly. His pen now became almost his sole resource. He had a connexion with both the fashionable theatres, for his *Annibal* had been played at the Comédie Française and his *Arlequin poli* at the Comédie Italienne, where at the time a company who were extremely popular, despite their imperfect command of French, were established. He endeavoured too to turn his newspaper practice in the *Mercure* to more account by starting a weekly *Spectateur Français* (1722–1723), to which he was the sole contributor. But his habits were the reverse of methodical; the paper appeared at the most irregular intervals; and, though it contained some excellent work, its irregularity killed it. For nearly twenty years the theatre, and especially the Italian theatre, was Marivaux's chief support, for his pieces, though they were not ill received by the actors at the Français, were rarely successful there. The best of a very large number of plays (Marivaux's theatre numbers between thirty and forty items) were the *Surprise de l'amour* (1722), the *Triomphe de Plutus* (1728), the *Jeu de l'amour et du hasard* (1730), *Les Fausses confidences* (1737), all produced at the Italian theatre, and *Le Legs* (1736), produced at the French. Meanwhile he had at intervals returned to both his other lines of composition. A periodical publication called *L'Indigent philosophe* appeared in 1727, and another called *Le Cabinet du philosophe* in 1734, but the same causes which had proved fatal to the *Spectateur* prevented these later efforts from succeeding. In 1731 Marivaux published the first two parts of his best and greatest work, *Marianne*, a novel of a new and remarkable kind. The eleven parts appeared in batches at intervals during a period of exactly the same number of years, and after all it was left unfinished. In 1735 another novel, *Le Paysan parvenu*, was begun, but this also was left unfinished. He was elected a member of the Academy in 1742. He survived for more than twenty years, and was not idle, again contributing occasionally to the *Mercure*, writing plays, "reflections" (which were seldom of much worth), and so forth. He died on the 12th February 1763, aged seventy-five years.

The personal character of Marivaux was curious and somewhat contradictory, though not without analogies, one of the closest of which is to be found in Goldsmith. He was, however, unlike Goldsmith, at least as brilliant in conversation as with the pen. He was extremely good-natured, but fond of saying very severe things, unhesitating in his acceptance of favours (he drew a regular annuity from Helvetius), but exceedingly touchy if he thought himself in any way slighted. He was, though a great cultivator of *sensibilité*, on the whole decent and moral in his writings, and was unsparing in his criticism of the rising *Philosophes*. This last circumstance, and perhaps jealousy as well, made him a dangerous enemy in Voltaire, who lost but few opportunities of speaking disparagingly of him. He had good friends, not merely in the rich, generous and amiable Helvetius, but in Mme de Tencin, in Fontenelle and even in Mme de Pompadour, who gave him, it is said, a considerable pension, of the source of which he was ignorant. His extreme sensitiveness is shown by many stories. He had one daughter, who took the veil, the duke of Orleans, the regent's successor, furnishing her with her dowry.

The so-called Marivaudage is the main point of importance about Marivaux's literary work, though the best of the comedies have great merits, and *Marianne* is an extremely important step in the legitimate development of the French novel—legitimate, that is, in opposition to the brilliant but episodic productions of Le Sage. Its connexion, and that of *Le Paysan parvenu*, with the work not only of Richardson but of Fielding is also an interesting though a difficult subject. The subject matter of Marivaux's peculiar style has been generally and with tolerable exactness described as the metaphysic of love-making. His characters, in a happy phrase of Claude Prosper Jolyot Crébillon's, not only tell each other and the reader everything they have thought, but everything that they would like to persuade themselves that they have thought. The style chosen for this is justly regarded as derived mainly from Fontenelle, and through him from the Précieuses, though there are traces of it even in La Bruyère. It abuses metaphor somewhat, and delights to turn off a metaphor itself in some unexpected and bizarre fashion. Now it is a familiar phrase which is used where dignified language would be expected; now the reverse. In the criticism of Crébillon's already quoted occurs another happy description of Marivaux's style as being "an introduction to each other of words which have never made acquaintance, and which think that they will not get on together," a phrase as happy in its imitation as in its satire of the style itself. This kind of writing, of course, recurs at several periods of literature, and did so remarkably at the end of the 19th century in more countries than one. Yet this fantastic embroidery of language has a certain charm, and suits perhaps better than any other style the somewhat unreal gallantry and *sensibilité* which it describes and exhibits. The author possessed, moreover, both thought and observation, besides considerable command of pathos.

The best and most complete edition of Marivaux is that of 1781 in 12 vols. reprinted with additions 1825–1830. The plays had been published during the author's lifetime in 1740 and 1748. There are modern editions by Paul de Saint Heylli Victor (1863), by G. d'Heylli (1876) and by E. Fournier (1878), while issues of selections and separate plays and novels are numerous. Of works concerning him J. Fleury's *Marivaux et le Marivaudage* (Paris, 1881), G. Larroumet's *Marivaux, sa vie et ses œuvres* (1882; new ed., 1894), the standard work on the subject, and G. Deschamps's *Marivaux* (1897), in the *Grands écrivains français*, are the most important. Separate articles on him will be found in the collected essays of the chief modern French critics from Sainte-Beuve onwards. (G. SA.)

MARJORAM, (O. Fr. *majorane*, Med. Lat. *majorana*; not connected with *major*, greater, nor with *amaracus*), in botany, the common name for some aromatic herbs or undershrubs, belonging to the genus *Origanum* (natural order Labiatae). Wild marjoram is *O. vulgare*, a perennial common in England in dry copses and on hedge-banks, with many stout stems 1 to 3 ft. high, bearing short-stalked somewhat ovate leaves and clusters of purple flowers. Sweet or knotted marjoram, *O. Marjorana*, and pot marjoram, *O. Onites*, are cultivated for the use of their aromatic leaves, either green or dry, for culinary purposes; the tops are cut as the plants begin to flower and are dried slowly in the shade.

MARK, ST, the traditional author of the second Gospel. His name occurs in several books of the New Testament, and doubtless refers in all cases to the same person, though this has been questioned. In the Acts of the Apostles (xii. 12) we read of "John, whose surname was Mark," and gather that Peter was a familiar visitor at the house of his mother Mary, which was a centre of Christian life in Jerusalem. That he was, as his Roman surname would suggest, a Hellenist, follows from the fact that he was also cousin ("nephew" is a later sense of ἀνεψιός, see J. B. Lightfoot on Col. iv. 10) of Barnabas, who belonged to Cyprus. When Barnabas and Paul returned from their relief visit to Judaea (*c.* A.D. 46), Mark accompanied them (xii. 25). Possibly he had shown in connexion with their relief work that practical capacity which seems to have been his distinctive excellence (cf. 2 Tim. iv. 11). When, not long after, they started on a joint mission beyond Syria, Mark went as their assistant, undertaking the minor personal duties connected with travel, as well as with their work proper (xiii. 5). As soon, however, as their plans developed, after leaving Cyprus and on arrival at Perga in Pamphylia (see PAUL), Mark withdrew, probably on some matter of principle, and returned to Jerusalem (xiii. 13). When, then, Paul proposed, after the Jerusalem council of Acts xv., to revisit with Barnabas the scenes of their joint labours, he naturally demurred to taking Mark with them again, feeling that he could not be relied on should fresh openings demand a new policy. But Barnabas stood by his younger kinsman and "took Mark and sailed away to Cyprus" (xv. 38 seq.). Barnabas does not reappear, unless we trust the tradition which makes him an evangelist in Alexandria (Clem. *Hom.* i. 9 seq., cf. the attribution to him of the Alexandrine *Epistle of Barnabas*).

When Mark appears once more, it is in Paul's company at Rome, as a fellow-worker joining in salutations to Christians at Colossae (Col. iv. 10; Philem. 24). We gather, too, that his restoration to Paul's confidence took place some time earlier, as the Colossians had already been bidden by oral message or letter to welcome him if he should visit them. This points to a reconciliation during Paul's last sojourn in Jerusalem or Caesarea. Not long after Col. iv. 10 Mark seems to have been sent by Paul to some place in the province of Asia, lying on the route between Ephesus and Rome. For in 2 Tim. iv. 11 Paul bids Timothy, "Pick up Mark and bring him with thee, for he is useful to me for ministering."

Once more Mark's name occurs in the New Testament, this time with yet another leader, Peter, the friend of his earliest Christian years in Jerusalem, to whom he attached himself after the deaths of Barnabas and Paul. Peter's words, "Mark, my son," show how close was the spiritual tie between the older and the younger man (1 Pet. v. 13); and as he is writing from Rome ("Babylon," since Paul's death and the change of policy it implied), this forms a link between the New Testament and early tradition, which speaks of Mark as an Evangelist writing his Gospel under the influence of Peter's preaching (in Rome). This is the essence of the tradition preserved from "the elders of former days" by Clement of Alexandria (in Eus. ii. 15, vi. 14), a tradition probably based on Papias's record (cf. Eus. iii. 39) of the explanation given by "the Elder" (John) as to the contrast in form between Mark's memoirs of Peter's discourses and the Gospel of Matthew (see GOSPELS; PAPIAS), but defining the place where these memoirs were written as Rome. That he acted to some degree as Peter's interpreter or dragoman (ἑρμηνεύς), owing to the apostle's imperfect mastery of Greek, is held by some but denied by others (*e.g.* by Zahn). His rôle throughout his career was *servus servorum dei*; and the fact that he was this successively to Barnabas, Paul and Peter, helps to show the essential harmony of their message.

The identification of the author of the second Gospel with Mark, which we owe to tradition, enables us to fill in our picture of him a little further. Thus it is possible that Mark was himself the youth (νεανίσκος) to whom his Gospel refers as present at Jesus's arrest (xiv. 51 seq.; cf. his detailed knowledge as to the place of the last supper, 13 seq.). It is probably as evangelist, and not in his own person, that he became known as "he of the stunted extremities" (κολοβοδάκτυλος, "curt-fingered"), a title first found in Hippolytus (*Haer.* vii. 30), in a context which makes its metaphorical reference to his Gospel pretty evident.[1] It was too as evangelist that he became personally a subject of later interest, and of speculative legends due to this, *e.g.* he was one of the Seventy (first found in Adamantius, *Dial. de recta fide*, 4th century), he was the founder of the Alexandrine Church (recorded as a tradition by Eusebius, ii. 16) and its first bishop (id. ii. 2), and was author of the local type of liturgy (cf. the *Acts of Mark*, ch. vii., not earlier than the end of the 4th century).

As to his last days and death nothing is really known. It is possible—even probable, if we accept the theory that he had already[2] been there with Barnabas—that Alexandria was his final sphere of work, as the earliest tradition on the point implies (the Latin *Prologue*, and Eusebius as above, probably after Julius Africanus in the early 3rd century), and as was widely assumed in the 4th century. That he died and was buried there is first stated by Jerome (*De vir. ill.* 8), to which his *Acts* adds the glory of martyrdom (cf. Ps.-Hippolytus, *De LXX Apostolis*).

LITERATURE.—H. B. Swete, *The Gospel acc. to St Mark* (1898), Introduction, § I., where the authorities are fully cited; also the art. in Hastings's *Dict. Bible.* The Patristic and other legends are discussed at length by R. A. Lipsius, *Die apokr. Apostelgesch. u.s.w.* (1884), ii. 2, and T. Schermann, *Propheten- und Apostellegenden* (1907), 285 seq. (with sepcial reference to Ps.-Hippolytus and Ps.-Dorotheus). (J. V. B.)

Medieval Legends.

The majority of medieval writers on the subject state that Mark was a Levite; but this is probably no more than an inference from his supposed relationship to Barnabas. The Alexandrian tradition seems to have been that he was of Cyrenaean origin; and Severus, a writer of the 10th century, adds to this the statement that his father's name was Aristobulus, who, with his wife Mary, was driven from the Pentapolis to Jerusalem by an invasion of barbarians

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[1] The divergent lines of the later attempts at a literal interpretation—*e.g.* he amputated his thumb in order to escape the Levitical priesthood (Latin *Prologue*), or it was a natural defect (*Cod. Tolet.*)—suggest that all they had to start from was the epithet itself.

[2] Nicephorus Callistus, *Hist. Eccl.* ii. 43, assumes this in his picturesque account of Mark's preaching in a quarter of the city which seems to have contained the tomb of the early bishops of Alexandria (cf. his *Acts*).

(Severus Aschimon in Renaudot, *Hist. patriarch. alex.*, p. 2). In the apocryphal Acts of Barnabas, which profess to be written by him, he speaks of himself as having been formerly a servant of Cyrillus, the high priest of Zeus, and as having been baptized at Iconium. The presbyter John, whom Papias quotes, says distinctly that "he neither heard the Lord nor accompanied Him" (Eusebius, *loc. cit.*); and this positive statement is fatal to the tradition, which does not appear until about two hundred and fifty years afterwards, that he was one of the seventy disciples (Epiphanius, pseudo-Origen *De recta in Deum fide*, and the author of the *Paschal Chronicle*). Various other results of the tendency to fill up blank names in the gospel history must be set aside on the same ground; it was, for example, believed that Mark was one of the disciples who "went back" because of the "hard saying" (pseudo-Hippolyt., *De LXX Apostolis* in Cod. Barocc. Migne, *Patrol. graec.* x. 955); there was an Alexandrian tradition that he was one of the servants at the miracle of Cana of Galilee, that he was the "man bearing a pitcher of water" in whose house the last supper was prepared, and that he was also the owner of the house in which the disciples met on the evening of the resurrection (Renaudot, *loc. cit.*); and even in modern times there has been the conjecture that he was the "certain young man" who "fled naked" from Gethsemane, Mark xiv. 51, 52 (Olshausen).

A tradition which was widely diffused, and which is not in itself improbable, was that he afterwards preached the gospel and presided over the church at Alexandria (the earliest extant testimony is that of Eusebius, *H. E.* ii. 16, 1; ii. 24; for the fully-developed legend of later times see Symeon Metaphrastes, *Vita S. Marci*, and Eutychius *Origines ecclesiae Alexandrinae*). There was another, though perhaps not incompatible, tradition that he preached the gospel and presided over the church at Aquileia in North Italy. The earliest testimony in favour of this tradition is the vague statement of Gregory of Nazianzus that Mark preached in Italy, but its existence in the 7th century is shown by the fact that in A.D. 629 Heraclius sent the patriarchal chair from Alexandria to Grado, to which city the patriarchate of Aquileia had been then transferred (*Chron. patriarch. Gradens.*, in Ughelli, *Italia sacra*, tom. v. p. 1086; for other references to the general tradition see De Rubeis, *Monum. eccles. aquileien.*, c. 1; *Acta sanctorum*, ad April, xxv.). It was through this tradition that Mark became connected with Venice, whither the patriarchate was further transferred from Grado; an early Venetian legend, which is represented in the Cappella Zen in the basilica of St Mark, antedates this connexion by picturing the evangelist as having been stranded on the Rialto, while it was still an uninhabited island, and as having had the future greatness of the city revealed to him (Danduli, *Chron.* iv. 1, ap. Muratori, *Rer. ital. script.* xii. 14).

The earliest traditions appear to imply that he died a natural death (Eusebius, Jerome, and even Isidore of Seville); but the Martyrologies claim him as a martyr, though they do not agree as to the manner of his martyrdom. According to the pseudo-Hippolytus he was burned; but Symeon Metaphrastes and the *Paschal Chronicle* represent him to have been dragged over rough stones until he died. But, however that may be, his tomb appears to have been venerated at Alexandria, and there was a firm belief at Venice in the middle ages that his remains had been translated thither in the 9th century (the fact of the translation is denied even by Tillemont; the weakness of the evidence in support of the tradition is apparent even in Molini's vigorous defence of it, lib. ii. c. 2; the minute account which the same writer gives, lib., ii. c. 11, of the discovery of the supposed actual bones of the evangelist in A.D. 1811, is interesting). There was another though less widely accepted tradition, that the remains soon after their translation to Venice were retranslated to the abbey of Reichenau on Lake Constance; a circumstantial account of this retranslation is given in the treatise *Ex miraculis S. Marci*, in Pertz, *Mon. hist. german. script.*, tom. iv. p. 449. It may be added that the Venetians prided themselves on possessing, not only the body of St Mark, but also the autograph of his Gospel; this autograph, however, proved on examination to be only part of a 6th-century book of the Gospels, the remainder of which was published by Bianchini as the *Evangeliarium forojuliense*; the Venetian part of this MS. was found some years ago to have been wholly destroyed by damp.

It has been at various times supposed that Mark wrote other works besides the Gospel. Several books of the New Testament have been attributed to him: viz. the Epistle to the Hebrews (Spanheim, *Op. miscell.* ii. 240), the Epistle of Jude (cf. Holtzmann, *Die synoptischen Evangelien*, p. 373), the Apocalypse (Hitzig, *Ueber Johannes Marcus*, Zürich, 1843). The apocryphal *Acta Barnabae* purport to have been written by him. There is a liturgy which bears his name, and which exists in two forms; the one form was found in a MS. of the 12th century in Calabria, and is, according to Renaudot, the foundation of the three liturgies of St Basil, St Gregory Nazianzen and St Cyril; the other is that which is used by the Maronite and Jacobite Syrians. Both forms have been published by Renaudot, *Liturg. oriental. collect*, i. 127, and ii. 176, and in Neale's *History of the Holy Eastern Church*; but neither has any substantial claim to belong to the ante-Nicene period of Christian literature.

The symbol by which Mark is designated in Christian art is usually that of a lion. Each of the "four living creatures" of Ezekiel and the Apocalypse has been attributed to each of the four evangelists in turn; Augustine and Bede think that Mark is designated by the "man"; Theophylact and others think that he is designated by the eagle; Anastasius Sinaita makes his symbol the ox; but medieval art acquiesced in the opinion of Jerome that he was indicated by the lion. Most of the martyrologies and calendars assign April 25 as the day on which he should be commemorated; but the *Martyr. Hieron.* gives the 23rd of September, and some Greek martyrologies give the 11th of January. This unusual variation probably arises from early differences of opinion as to whether there was one Mark or more than one.

See Canon Molini of Venice, *De vita et lipsanis S. Marci Evangelistae*, edited, after the author's death, by S. Pieralisi, the librarian of the Barberini library (1864); R. A. Lipsius, *Die apokryphen Apostelgesch. und Apostellegenden* (1883 foll). vol. ii. part 2, pp. 321-353.

MARK, a word of which the principal meanings are in their probable order of development,—boundary, an object set up to indicate a boundary or position; hence a sign or token, impression or trace. The word in O. Eng. is *mearc*, and appears in all Teutonic languages, cf. Du. *merk*, Ger. *Mark*, boundary, *marke*, sign, impression; Romanic languages have borrowed the word, cf. Fr. *marque*, Ital. *marca*. Cognate forms outside Teutonic have been found in Lat. *margo*, "margin," and Pers. *marz*, boundary. Others would refer to the Lith. *margas*, striped, parti-coloured, and Sanskrit *marga*, trace, especially of hunted game. In the sense of boundary, or a tract of country on or near a boundary or frontier, "mark" in English usage proper is obsolete, and "march" (*q.v.*) has established itself. It still remains, however, to represent the German *mark*, a tract of land held in common by a village community (see MARK SYSTEM), and also historically the name of certain principalities, such as the mark of Brandenburg. The Italian *marca* is also sometimes rendered by "mark," as in the mark of Ancona.

Mark is also the name of a modern silver coin of the German empire. This is apparently a distinct word and not of Teutonic origin; it is found in all Teutonic and Romanic languages, Latinized as *marca* or *marcus*. The mark was originally a measure of weight only for gold and silver and was common throughout western Europe and was equivalent to 8 oz. The variations, however, throughout the middle ages were considerable (see Du Cange, *Gloss. med. et infim. Lat.*, *s.v. Marca* for a full list). In England the "mark" was never a coin, but a money of account only, and apparently came into use in the 10th century through the Danes. It first was taken as equal to 100 pennies, but after the Norman Conquest was equal to 160 pennies (20 pennies to the oz.) $= \frac{2}{3}$ of the pound sterling, or 13s. 4d., and therefore in Scotland $13\frac{1}{2}$d. English; the mark (merk) Scots was a silver coin of this value, issued first in 1570 and afterwards in 1663. The modern German *mark* was adopted in 1873 as the standard of value and the money of account. It is of the value of 6·146 grains of gold, 900 fine, and is equal to English standard gold of the value of 11·747 pence. The modern silver coin, nearly equal in value to the English shilling, was first issued in 1875. (See NUMISMATICS, § iv.)

MARK, GOSPEL OF ST, the second of the four canonical Gospels of the Christian Church. Till quite recent times this Gospel, though nominally equal to the others in authority, has unquestionably not aroused the same interest or feelings of attachment as they have, partly from its not bearing the name of an apostle for its author, as the first and fourth do, partly, also, owing to the fact that the first and third, while they include most of what is found in it, contain much additional matter, which is of the highest value. Of late, however, it has acquired new importance through the critical inquiries which have led to the conclusion that the two other synoptic Gospels are based upon it, or upon a document which is upon the whole most truly represented in it (see GOSPEL), so that it possesses the advantage of being an earlier source of information, or at least of bringing us more fully into contact with such a source. The significance of all that we can learn as to the history of the composition of Mark's Gospel is clearly enhanced by this consideration.

(1) *Early Account of a Writing by Mark.*—According to a fragment of Papias (ap. Eus. *Hist. Eccl.* III. 39) taken from

a work probably written *c.* A.D. 140, Mark, who was the follower and interpreter of Peter, recorded after the latter's decease the words of Christ and the narratives of His deeds which he had heard the Apostle deliver, but he could not arrange the matter "in order," because he had not himself been a personal follower of Jesus. This account Papias had derived, he tells us, from an informant who had heard it repeatedly given by "the elder," a Christian of the first generation.

There can be little doubt that the work to which Papias himself supposed this story to apply was the Gospel of Mark virtually as we know it. The tradition in regard to this work must have been continuous between his time and that of Irenaeus, who (*c.* A.D. 180) gives a similar account of its composition. It may be noted also that the same view of the origin of the Gospel of Mark appears to have been held by a contemporary of Papias, Justin Martyr. In his *Dialogue with Trypho* (*c.* 106) he cites a fact about the name of Peter from "his Memoirs," and adds also another similar fact about the name given to the sons of Zebedee, just as they are stated in Mark iii. 16, 17, and nowhere else so far as we know. He may well have been ready to call the work "Peter's," though he believed that Mark actually composed it, on the ground that the latter recorded what the Apostle said (cf. ibid. *c.* 103).

But is our Gospel of Mark also to be identified with the writing by Mark spoken of by "the elder" whose account had been reported to Papias? Some confusion is here more conceivable; while, if it is supposed that such a writing was worked up in our second Gospel, this may seem sufficient to explain the connexion of Mark's name with the latter.

In support of this view it is urged, though it is so much less often now than it used to be, that the description "not in order" does not fit our Gospel of Mark, the order in which is from an historical point of view as good as, if not better than, in the other Gospels. But from whomsoever the expression proceeds—whether from Papias, or his informant, or "the elder"—we may feel sure that considerations such as appeal to us from our training in historical criticism are not those which suggested it, but rather the want of agreement between this Gospel and some standard which on altogether different grounds was applied to it. This argument, then, for supposing that the original writing by Mark differed widely in form and contents from the Gospel which now bears his name appears to be without force. The question whether the two differed to any, and if so to what, extent can be decided only from an examination of the Gospel itself.

(2) *The Question of the Integrity of the Gospel of Mark.*—There are in a good many parts of this Gospel indications that the narrative has been derived from Simon Peter, or some one else who was a personal follower of Jesus in the days of His earthly ministry. It has been widely felt that the account of the call of the first four disciples and of the events which immediately followed (i. 15–39) at the opening of the Galilean ministry, bears strong marks of proceeding from Simon Peter. Other passages might be pointed out in which it is suitable to suppose that this disciple in particular was the informant. But we will content ourselves with noticing signs that the reminiscences of some eyewitness are recorded. (*a*) Traits appear which are wholly without importance, and upon which no stress is laid in the context, but which it was natural for a narrator who was actually present, and only for such a one to introduce, because he remembered them as associated with the principal events. The following are instances and others might be cited: the mention of "other boats," iv. 36; the half-foolish remark made by Peter when in a dazed condition at the Transfiguration, ix. 5, 6; the young man who, when Jesus was arrested, followed, "having a linen cloth cast about him," xiv. 51, 52; the fact that Simon of Cyrene was "coming from the country," xv. 21. (*b*) There is great truth of local colouring. The references to places and the descriptions of natural features (the lake-shore, i. 16; ii. 13; iii. 7; the hills near at hand, iii. 13; v. 5, 13; vi. 46; the desert places among the hills or by the shore, i. 35, 45; vi. 31, 32) appear to be accurate; the routes indicated in the journeys that are taken are probable (vii. 24, 31; viii. 27; x. 17, 32, 46; xi. 1). Again, the term "village-towns" (i. 38) is a remarkably appropriate one (cf. Josephus, B. I. III. iii. 2). There would, indeed, be an exception to the general correctness of the topography if we were compelled to suppose that "country of the Gerasenes" (which is the best reading according to existing MS. evidence at Mark v. 1) must mean the territory of the city of Gerasa. But it is easy to imagine that some confusion may have arisen in the transliteration of the name into Greek, and that the place really indicated is Khersa, near the middle of the eastern shore of the lake. The pair of references (vi. 45, 53) which might also be adduced as an exception, will be noticed below. Further, the conditions of life and thought in Palestine at the time in question are faithfully represented, Aramaic words spoken on some important occasions are preserved (iii. 17; v. 41; xv. 34). And, to mention a point of a different kind, the parts played by different sections among the Jewish people are such as might be expected. The point of view of speakers and actors is throughout that belonging to the time of the ministry of Jesus, not to that when the Christian Church had come into existence. (*c*) The good order in this Gospel, *i.e.* the natural development of the narrative, will be indicated below. It has without good reason, as we have seen, been supposed to show that it cannot be the record by Mark referred to by Papias. And in reality it would be difficult to account for this feature except on the supposition that one who had lived through the events had been accustomed, when required to give a comprehensive sketch of the history of the ministry and sufferings of Jesus, to relate the facts in the main as they happened; and that a hearer of his has to a considerable extent reproduced them in the same order.

The last consideration seems to show that the general form and structure of the Gospel, and not merely certain portions of it, are original. In point of style, also, there is a large amount of uniformity. The chief exceptions are that, whereas some incidents are related in a very concise manner (*e.g.* i. 23–28, and 40–45), there is in other cases considerable amplitude of description (see esp. v. 1–20, 35–43 and ix. 14–27). But Mark's own writing might exhibit this variety, according to what he had been told or could remember. Moreover, a tendency to amplitude of language may be noticed here and there in some of the more concise narratives. Further, it would be unreasonable to suppose that Mark, even if he relied chiefly on what he had heard Peter teach, would refrain from using any other sources of information which he possessed. Some have supposed that the same Logian document in Greek which was used by the first and third evangelists was also used by Mark. This is highly improbable, but he may have derived particular sayings from the Aramaic source itself of that document by independent translation; and may also have learned both sayings and narratives in other ways. It would seem also that the Discourse on the Last Things in ch. xiii., differing as it does both in its greater length and in its systematic structure from other discourses recorded by him, must have come to his hands in a written form. In it some genuine sayings of Christ appear to have been worked up along with matter taken from Jewish Apocalypses and in accordance with an Apocalyptic model.

There does not, then, seem to be good reason for thinking that the work which proceeded from the hands of Mark differed widely in character and contents from the Gospel which now bears his name. But there are indications that some passages have been interpolated in it: *e.g.* in Mark iv. 10 there is some want of fitness in the inquiry of the disciples as to the meaning of "the parables" after only one has been given, and again a want of agreement between that inquiry and the words of Jesus at *v.* 13, "Know ye not *this* parable, and how shall ye know all the parables?" We notice further that the two parables in *vv.* 26–32 are somewhat loosely appended. It looks as if they were insertions in the passage as it originally stood, and that the references to parables in the plural, together with the statement at vv. 33, 34, had been introduced in order to adapt the context to these additions. This view is confirmed by the fact that in Luke viii. 4 seq. only one parable, that of the sower, is given or referred to. This evangelist has probably here followed the original form of Mark. Similarly the collection of sayings after Mark ix. 40 (vv. 41–50) has probably been interpolated. They are thrown together in a way unusual with Mark, who is accustomed to place each important saying in a setting of its own. Here again we note that they do not appear at the corresponding point in Luke, though some of them are given by him in other contexts. The account of the crossing of the lake (vi. 45–53) after the feeding of the five thousand furnishes an instance of a different kind. The difficulty as to the position of Bethsaida, or (if *εἰς τὸ πέραν*, "unto the other side," at v. 45 is taken to refer only to the crossing of a bay at the north-eastern corner of the lake) the discrepancy between "crossing" in this sense and in that of v. 53 would be explained if the narrative (which is not in Luke) may be held to be an interpolation by one not familiar with the localities. Once more, the account of the feeding of the four thousand (viii. 1–9) resembles that of the feeding of the five thousand (vi. 35–44) closely in all respects except that of the numbers given, about which differences might easily arise in tradition, and it looks therefore as if it might be a "doublet," *i.e.* another form of the same narrative derived through a different channel. And it is not so likely that Mark should have mistaken it for a distinct incident as that an editor of his Gospel should have done so. Some other instances, of greater or less probability, might be mentioned.

In addition to such larger insertions, the text of the original document seems to have undergone a certain amount of revision. Some of the cases in which the first and third evangelist agree against Mark in a word or clause may be best accounted for by their both having reproduced the common source (an example may be seen under 4 below).

As we have found it necessary to distinguish between the original composition by Mark, to whom in the main the work appears to be due, and some enlargement and alteration which it subsequently underwent whereby it reached its present form, these stages must be borne in mind in considering dates that may be assigned in connexion with this Gospel. According to Papias, Mark wrote after the death of Peter, *i.e.* after A.D. 64, if we suppose, as it is usual to do, that Peter was martyred in the massacre by Nero after the burning of Rome. It would be natural for Mark to set himself to make his record soon after the Apostle's death; and in confirmation of the view that he did so it may be pointed out that in the form of the prophecy in ch. xiii. of the calamities that were to come upon Jerusalem, no details occur of a kind to suggest that it had actually taken place. Further, Mark's work may very probably have been used by Luke in its original form. On the other hand, it was known to our first evangelist very nearly in the form in which we have it. The chief revision of Mark would seem, then, to have taken place between the times of the composition of the first and third Gospels, which cannot be far removed from one another (see MATTHEW, GOSPEL OF ST). The last twelve verses were added later still, probably early in the 2nd century, probably to take the place of the ending which had been lost, or which was regarded as defective. (On the evidence that the last 12 verses are not by the same hand as the rest of the Gospels see Westcott and Hort's *New Testament in Greek*, append., p. 29 seq. and Swete's *St Mark in loc.* and p. xcvi. seq. of his introduction.)

(3) *The Gospel History as represented in Mark.*—After a (i) prefatory passage, i. 1–13, the Gospel deals with (ii) *Christ's ministry in Galilee and other parts of northern Palestine*, i. 14–ix. 50. This portion of the history may suitably be divided into three periods: (*a*) *Early period.* From the opening of the work of Jesus to the first plot to destroy Him (i. 14–iii. 6). (*b*) *Middle period.* From the gathering of crowds from all parts and appointment of the Twelve to the sending forth of the Twelve to extend Christ's work and the alarm of Herod (iii. 7–vi. 29). (*c*) *Closing period.* From Christ's withdrawal with His disciples after their return from their mission to His final departure from Galilee (vi. 30–ix. 50). Throughout we can trace a development as to (*a*) the stir created and the attitude of men towards Jesus: i. 32–34, 37 (excitement at Capernaum); 38, 45 (fame spreads through a wide district); iii. 7, 8 (people from distant parts appear in the crowds); iv. 2 seq. (the word of the Kingdom is received in very various ways); viii. 28 (great diversity of opinions as to the claims of Jesus); (*b*) the opposition to Him, ii. 1–iii. 6–iii. 22 (scribes come from Jerusalem and a more heinous charge is preferred); (*c*) the formation of a band of disciples and the position accorded to them: i. 16–20 (four are called to follow Him); ii. 14 (yet another); iii. 14 (He "makes twelve" including those before called); vi. 7 seq (He sends them out to preach and work cures); (*d*) the methods which he adopts: i. 21, 39–iii. 1 (preaches in the synagogues, later more commonly by the lake-shore or on the mountain sides; or He teaches in a house where He happens to be); at iv. 1 seq. he adopts a new mode of address because a sifting-process was required; from vi. 45 onwards He mainly devotes Himself to the training of the Twelve, while seeking retirement from the multitude; (*e*) in the districts which he visits: i. 38 (tour in the neighbourhood of Capernaum); v. 1 (crosses to eastern shore of the lake); vi. 6b (a tour which includes Nazareth); vi. 45 (Bethsaida); vii. 31 (journey to Tyre and Sidon and back through Decapolis); viii. 22, 27 (is at Bethsaida and visits neighbourhood of Caesarea Philippi); (*f*) His self-revelation; viii. 27 seq. (first unambiguous declaration of His Messiahship).

(iii) *The Journey from Galilee to Jerusalem, the Last Days, Passion and Resurrection*, x. 1 to end. He goes first to "the borders of Judaea and beyond Jordan" (Peraea), and exercises His ministry there, x. 1–16. In connexion with the journey from this region to Jerusalem three striking incidents are recorded, x. 17–52. The account of the time in Jerusalem includes a series of conflicts with opponents xi. 27–xii. 40, and the discourse on the Last Things, xiii. The only notes of time in the Gospel occur in connexion with the conspiracy to kill Jesus (xiv. 1) and the Last Supper (verse 12).

(4) *The Leading Ideas of St Mark.*—Ch. i. 1, which stands as a title, was probably, even according to the short form of it which is supported by MS. evidence, due to a reviser of the original. Both Matthew and Luke show signs of having had a somewhat different beginning before them. Nevertheless, that title fitly describes the work. It is emphatically "the Gospel," because it sets forth the person and work of the Christ. The evangelist is conscious of this aim. It appears not only at great moments of the history such as the Baptism (i. 11), the confession of Peter (viii. 29), the Transfiguration (ix. 7); nor again merely in the prominence given to the miracles of Jesus and in particular to the casting out of devils, but also in many of the sayings recorded in it, as in the great series contained in the narratives in ch. ii. 5, 10, 17, 19; and again in the reply of Jesus to those who charged Him with being in collusion with Satan (iii. 27). The character of the genuine disciples of the Christ and the demands that are made of them form, as it were, the complement to the representation of what He Himself is, and are set forth in other striking sayings, related along with the memorable occasions on which they were spoken: (iii. 34, 35; viii. 34–36; ix. 23, 29, 35–37; x. 14, 15, 42–45).

See Swete, *Commentary on St Mark* (2nd ed., 1902); A. Menzies, *The Earliest Gospel* (1901); D. W. Wrede, *Das Messiasgeheimniss in den Evangelien, zugleich ein Beitrag zum Verständniss des Markusevangeliums* (1901); E. J. Weiss, *Das älteste Evangelium* (1903). Also bibliography to the article GOSPEL.

(V. H. S.)

MARKBY, SIR WILLIAM (1829–), English jurist, the fourth son of the Rev. William Henry Markby, rector of Duxford St Peter's, was born at Duxford, Cambridge, in 1829. He was educated at Bury St Edmunds and Merton College, Oxford, where he took his degree in 1850. In 1856 he was called to the bar, and in 1865 he became recorder of Buckingham. In 1866 he went to India as judge of the High Court of Calcutta. This post he held for twelve years, and on his retirement was appointed Reader in Indian Law at Oxford. In 1892 he was a member of the Commission to inquire into the administration of justice at Trinidad and Tobago. Besides *Lectures on Indian Law*, he wrote *Elements of Law considered with reference to the General Principles of Jurisprudence*. The latter, being intended in the first place for Indian students, calls attention to many difficulties in the definition and application of legal conceptions which are usually passed over in textbooks, and it ranks as one of the few books on the philosophy of law which are both useful to beginners and profitable to teachers and thinkers. In 1897 appeared *The Indian Evidence Act, with Notes.* Sir William Markby also contributed to the law magazines, articles on *Law and Fact*, *German Jurists and Roman Law*, *Legal Fictions*, &c., several of which are embodied in the later editions of the *Elements*. He was made D.C.L. of Oxford in 1879, and K.C.I.E. in 1889.

MARKET (Lat. *mercatus*, trade or place of trade). This term is used in two well-defined senses. (1) It means a definite place where (*a*) traders who are retail sellers of a specific class of commodity or commodities are in the habit of awaiting buyers every day in shops or stalls; or whither (*b*) they are in the habit of proceeding on specified days at more or less frequent regular intervals. Covent Garden market for fruit and flowers, and Leadenhall market for meat and poultry, are good examples in London of the kind of institution included in class (*a*). They are a very ancient economic phenomenon, dating from the earliest period of the development of organized communities of human beings, and in general characteristics have changed little since they began to exist. Markets of the type of class (*b*) are also of very ancient origin (see FAIRS), but inasmuch as they are constituted essentially by the presence of persons, many of whom assemble from various places outside the place of meeting, they were capable of a little more development than those belonging to class (*a*), owing to increased facilities for locomotion. The nature of an ancient market of class (*a*), whither a citizen, say of Athens, or his chief slave, proceeded daily to make household purchases, differs little from the group of shops visited by the wives of the less wealthy citizens of modern states. In many places abroad, and not a few in England, actual markets still exist. It may be said that the huge collections of shops, such as the various co-operative stores, are only a revival of the old "market-place," with its shops or booths gathered round a central area, adapted to the needs of modern big cities. (2) The term "market" has come to be used in another and more general sense in modern times. According to Jevons, a market is "any body of persons who are in intimate business relations, and carry on extensive transactions in any commodity." He adds that "these markets may or may not be localized," and he instances the money market as a case in which the term "market" denotes no special locality. As a rule, however, most of the business of a market is transacted at some particular place, such as the London Stock Exchange, the Baltic, the Bourse of Paris, the Chicago "Wheat-pit." Even in the case of the London money market, merchants still meet twice a week at the Royal Exchange to deal in foreign bills, although a considerable part of the dealings in these securities is arranged daily at offices and counting-houses by personal visits or by telegraphic or telephonic communication. The markets in any important article are all closely interconnected. The submarine cable has long ago made Chicago as important an influence on the London corn market as Liverpool, or rather both London and Liverpool affect and are simultaneously affected by Chicago and other foreign markets. In like manner the Liverpool cotton market is influenced by the markets in New Orleans and other American cities separated from it widely in space. In a minor degree the dealers in all places where a cotton market exists affect the bigger markets to some extent. What is true of the cotton market is also true to some extent of all markets, though few markets are so highly organized or show such large transactions as that for cotton. Among other markets of the first class may be mentioned those for pig-iron, wheat, copper, coffee, and sugar. There are many articles the markets for which are of considerable dimensions at times, but are of an intermittent character, such as the London Wool Sales, which take place now in five "series" during the year. Formerly the number of "series" was four. (For "market overt" see SALE OF GOODS and STOLEN GOODS.)

Characteristics of Markets.—The conditions required in order that the operations of a trading body may display the fully-developed features of a modern market, whether for commodities or securities, are:—

(1) A large number of parties dealing.

(2) A large amount of the commodities or securities to be dealt with.

(3) An organization by which all persons interested in the commodity or security can rapidly communicate with one another.

(4) Existence and frequent publication of statistical and other information as to the present and probable future supply of the commodity or security.

Movements of Prices.

The movements which take place in prices in any market, whether fully organized or not, depend largely on changes of opinion among buyers and sellers. The changes of opinion may be caused by erroneous as well as by correct information. They may also be the result of wrong inferences drawn from correct information. In markets for commodities of the first importance, such as wheat, cotton, iron, and other articles which are dealt in daily, the state of opinion may vary much during a few hours. The broad characteristics of markets of this class are similar. There is a tendency in all of them to show phenomena of annual periodicity, due partly to the seasons, the activity of certain months being in normal years greater in the case of any given market than that of other months. This tendency was always liable to be interfered with by the special forces at work in particular years; and the great increase in the facilities of communication between dealers by telegraph, and of transportation of commodities between widely distant points, which was one of the marked features of the development of the economic organism in all actively commercial countries during the last thirty years of the 19th century, has still further interfered with it. Nevertheless, a tendency to annual periodicity is still perceptible, especially in markets for produce of the soil, the supply of which largely depends on the meteorological conditions of the areas where they are grown on a scale sufficient to furnish an appreciable proportion of the total produce.

Cycles.

Periodicity of another kind known as "cyclic," and due to a different set of causes, is believed to exist by many persons competent to form a judgment; but although the evidence for this view is very strong, the theory expounding it is not yet in a sufficiently advanced state to admit of its being regarded as established.

Phenomena of Markets.—Bagehot said of the money market that it is "often very dull and sometimes extremely excited." This classical description of the market for "money" applies to a large extent to all markets.

Tendency to Equilibrium.

Every market is at every moment tending to an equilibrium between the quantity of commodities offered and that of commodities desired; supposing equilibrium to have been attained in a given market, and that for some appreciable period it is not disturbed, the price for the commodity dealt in, in the market, will remain practically unchanged during that period. Not that there will be no transactions going on, but that the amounts offered daily will be approximately equal to the amounts demanded daily.

Disturbance of Equilibrium.

We have briefly described the statical condition of a market; we must now briefly examine its dynamics. Disturbance may take place through a change in—

(1) Supply, or opinion as to future probable supply.

(2) Demand, or opinion as to future probable demand.

(3) In both simultaneously, but such a change that demand is increased or decreased more than the supply, or vice versa.

A moderate disturbance caused by one of the above changes, or a combination of them, will produce an immediate effect on the price of the commodity, which again will tend to react on both the supply and the demand by altering the opinions of sellers and buyers. If no further change tending to disturb the market takes place, the market will gradually settle down again to a state of equilibrium. But if the disturbance has been considerable, a relatively long time may elapse before the market becomes quiet; and very likely the level of price at which the new equilibrium is established will be very different from that ruling before the disturbance set in. Further scientific investigation of the dynamics of a market is in any case very difficult, and is impossible without a complete analysis of the statical condition, such as is found at length in the textbooks of mathematical economics; but it is possible to describe briefly certain dynamical phenomena of markets which are of a comparatively simple character, and are also of practical interest.

Future Delivery.

Every great market is organized with a view not merely to the purchase and sale of a commodity at once, or "on the spot," but also with a view to the future requirements of buyers and sellers. This organization arises naturally from the necessities of business, since modern industry and commerce are carried on continuously, and provision has to be made for the requirements, say, of a spinning-mill, by arranging for the delivery of successive quantities of cotton, wool or silk over a period of months "ahead." In the case of cotton, "forward deliveries" can be purchased six or seven months in advance, and the person who undertakes to deliver the cotton at the times stated is said in the language of the market to "sell forward." If the quantity of cotton produced each year were always the same, no very remarkable results would follow from this mode of doing business, except the economy resulting to the spinner from not being compelled to lock up part of his capital in raw material before he could use it. But as the cotton and other crops vary considerably from year to year, some curious consequences follow from the practice of "selling forward." The seller, of course, makes his bargain in the belief that he will be able to "cover" the sale he has made at a profit—that is, he hopes to be able to buy the cotton he has to deliver at a lower price than he undertook to deliver it at. If so, all is well for both parties, for the buyer has had the advantage of having insured a supply of cotton. But supposing something has happened to raise the price considerably, such as a great "shortage" of the crop, the seller may lose. If a great many other persons have taken the same mistaken view of the probabilities of the market, a condition of things may arise in which they may be "cornered." (See COTTON.)

"Corners."

A "corner" in an exchangeable article is an abnormal condition of the market for it, in which, owing to a serious miscalculation of probable supply, many traders who have made contracts to deliver at a certain date are unable to fulfil them. In most cases the fact that the market is "oversold" becomes known some time before the date for the completion of the contracts, and other traders take advantage of the position to raise the price against those who are "short" of the article. A corner is therefore usually a result of the failure of a speculation for the fall. Theoretically a trader who has undertaken to deliver 100 tons of an article, but cannot, after every endeavour, obtain more than 90 tons, could be made to pay his whole capital in order to be relieved from the bargain. In practice he gets off more easily than this. Frequently when many traders have sold largely "forward" other traders deliberately try to use that position as a basis for creating a "corner." Generally, however, they only succeed in causing great inconvenience to all parties, themselves included, for as a rule they are only able to make the "corner" effective by buying up so much of the article that when they have compelled their opponents to pay largely to be relieved of contracts to deliver, they are left with so big a stock of the article that they cannot sell it except at a loss, which is sometimes big enough to absorb the gain previously secured. In the case of very small markets "corners" may be complete, but in big markets they are never complete, something always happening to prevent the full realization of the operators' plans. The idea of a "corner" is, however, so fascinating to the commercial mind, especially in the United States, that probably no year passes without an attempt at some operation of the kind, though the conditions may in most cases prevent any serious result.

"Corners" have what is called a "moral" aspect. It is curious to note that the indignation of the "market" at the disturbance to prices which results from operations of this kind is generally directed against the speculators for the fall, while that of the public, including trade consumers, is directed against the operator for the rise. The operator for the fall, or "bear," is denounced for "selling what he has not got," a very inaccurate description of his action, while the "bull" or operator for the rise is spoken of by a much wider circle as a heartless person who endeavours to make a profit out of the necessities of others. From a strict ethical standpoint there is really nothing to choose between the two.

The Money Market.—There is one market which presents features of so peculiar a character that it is necessary to describe it more particularly than other phenomena of the kind, and that is the money market. The term money is here used to denote "money-market money" or "bankers' money," a form of wealth which has existed from early times, but not in great abundance until within the last two or three hundred years. Immense wealth has existed in certain countries at various epochs, owing to the fertility of the soil, success in trade, or the plunder of other communities, and all states which have been great have at the time of their greatness possessed wealth; but the wealth which the countries, or a few fortunate individuals belonging to them, owned consisted largely of what is still called real property—that is, land and buildings—and of the produce of the soil or of mines. The balance consisted partly of merchandise of various kinds and shipping, and to a large extent of the precious metals in the form of coin or bullion, or of precious stones and jewelry. Where no settled government was established no one could become or remain very wealthy who was not in a position to defend himself by the strong hand or allied with those who were; and as a rule the only people who could so defend themselves were possessors of large areas of rich land, who were able to retain the services of those who dwelt on it either through their personal military qualities or in virtue of habit and custom. The inhabitants of wealthy cities were able to protect themselves to some extent, but they nearly always found it necessary to ally themselves with the neighbouring land-owners, whom they aided with money in return for military support.

A money market in the modern sense of the word could only exist in a rudimentary form under these conditions. There was a sort of money market, for there was a changing rate of interest and a whole code of law relating to it (Macleod, *Banking*, 3rd ed., p. 174) in republican Rome; but although large lending and borrowing transactions were part of the daily life of the Roman business world, as well as of those of the Greek cities and of Carthage and its dependencies, none of these communities presented the phenomena of a highly organised market. Money-lending was also a regular practice in Egypt, Chaldea and other ancient seats of civilization, as recent discoveries show. It was only in comparatively recent times, however, when Europe had formed itself into more or less organized states, with conditions fairly favourable to the steady growth of trade and industry, that organized money markets came into existence in places such as Venice, Genoa, Augsburg, Basel, the Hanse towns, and various cities in the Low Countries, Spain and Portugal, as well as in London. The financial strength of these rudimentary money markets was not very great, and as it depended a good deal on the possession by individuals of actual cash, the existence of these markets was precarious. "Hoarded ducats" were too often an attraction to needy princes, whose unwelcome attentions a rich merchant, even when an influential burgher of a powerful city, was less able to resist than the violence of a housebreaker, against whom strong vaults and well-secured chests situated in defensible mansions were a good protection. The necessitous potentate could often urge his desire for a "loan" by very persuasive methods. Occasionally, if his predecessors had acquired the confidence of the banking class sufficiently to induce them to place their cash reserves in one of his strong places "for safety" an unscrupulous ruler could help himself, as Charles II. helped himself to the stores of the London goldsmiths which were left in the Mint. The power of the banking class continued to grow, however, and a real market for money had come into existence in many cities of Europe by the middle of the 17th century. (See BANKS AND BANKING.)

The Early Money Market.

In the 18th century the "money market" consisted of the Bank of England and various banks and merchants, and distinction between the two being still not complete. Towards the end of that century arose an important class of dealers in credit, the bill brokers, and with their appearance the modern money market of London may be said to have assumed its present form, for though the process of development has not ceased, the changes have been of the nature of growth and not of the acquisition of new organs. The formation of joint-stock banks and discount companies, however, and the reconstitution of the Bank of England by the Act of 1844, exercised an important influence on the way in which the money market of London has developed. It must be explained that in the every-day talk of the City "the market" has a special meaning, by which only the banks and discount houses, or even only the latter in some cases, are denoted, as in the phrases constantly seen in the daily reports published in the newspapers towards the end of a quarter, "the market has to-day borrowed largely from the Bank of England," or, "the market was obliged to renew part of the loans which fell due to the Bank to-day." But this use of the term in a special sense, thoroughly understood by those to whom it is habitual, and resulting in no ambiguity in practice, is not in accord with the requirements of economic analysis.

The Modern Money Market of London.

The working organs of the money market of London at the beginning of the 20th century were:—

A. (1) The Bank of England.
(2) Banks, joint-stock and private, including several great foreign banks.
(3) Discount houses and bill-brokers.
B. (4) Certain members of the Stock Exchange.
(5) Certain great merchants and finance houses.

The institutions included in group A are the most constantly active organs of the money market; those included in group B are intermittently active, but in the case of section (4), though their activity is greater at some times than others, they are never wholly outside the market. Even in the case of (5) a certain amount of qualification is needed, which is indicated by the fact that most of the great merchant houses are "registered" as bankers, though they do not perform the functions usually associated with that term in the United Kingdom. Several of the great houses were originally and still are nominally merchants, but are largely concerned with finance business—that is, with the making of loans to foreign governments and the issue of capital on behalf of companies. These powerful capitalists often have large amounts of money temporarily in their hands, and lend it in the money market or on the Stock Exchange; one or two of them are large buyers of bills from time to time, and generally the members of this group may be said to be in sufficiently close touch with the active organs of the money market to form part of it.

The Working of the Money Market.

The actual working of the money market has been described by Walter Bagehot in his *Lombard Street*, a work which has attained the rank of a classic. Most of what he said in 1873 is true now, but in certain minor respects developments have taken place, the most important being the greater extent to which money is "used up" every day, or rather every night. In Bagehot's time the discount houses only quoted "allowance" rates for "loans at call and short notice," based on the rate "allowed" by the banks for loans at seven days' notice; but since then the bill-brokers have been obliged—(1) occasionally to fix their terms independently of the banks, and (2) to "allow" a rate for "money for the night." This latter practice became usual about 1888 or 1889. The change it introduced was not a vital one, but has some importance from the point of view of the historian. A good deal of the "money" thus dealt with is derived from the group of traders included in class (5). It is (*a*) money which is temporarily in the hands of houses or institutions which have just received subscriptions to loans or other capital offered to the public; (*b*) balances left temporarily with finance houses or banks on behalf of foreign governments or other parties who have payments to make in London. In the former case the "money" is almost invariably only available for a short time, probably only for a few days; in the latter case also it probably will be only available for a few days, but *may* be available for months. Money derived from either of these sources is usually to be had cheap, but is not, in the slang of the City, "good," because it is uncertain how long loans at call obtained from either of them will remain undisturbed. Nevertheless, there has been at times so much "money" of this fugitive character, and derived from such varied sources since about 1888, that its cheapness has been an attraction to the less wealthy bill-brokers, who have occasionally been able to go on using it profitably for many continuous weeks, or even months, in their business. The risk run by employing it is, of course, the certainty that it will be "called" from the borrower sooner or later, and probably at a time when it is very inconvenient to repay it. The more wealthy houses take money of this kind when it suits them, but never rely on it as a basis for business.

The Great Banks.

Since Bagehot wrote the growth of the big joint-stock banks has been enormous, not so much through the increased business done by banks generally, though the expansion in banking has been considerable, as by the absorption of a great number of small banks by three or four large institutions (see BANKS AND BANKING). The growth of these large institutions tends to facilitate combination for purposes of common concern among banks generally—*e.g.* to support the Bank of England in maintaining its reserve, which is the sole reserve of all the banks, at a proper level, and thus render the money market more stable. Two or three of the banks have for a long time, owing to their large holding of bills, had much more influence than the Bank of England over the foreign exchanges, on which the foreign bullion movements chiefly depend; and since 1890 persons of weight in the joint-stock banking body have implicitly, though not explicitly, admitted a certain degree of responsibility in the matter on behalf of their institutions. It is, however, characteristic of British business arrangements that the question of the responsibility for the reserve of the Bank of England, the ultimate reserve of the whole country, is still in as nebulous a condition, so far as explicit acceptance of responsibility by any institution is concerned, as it was in 1870. There has been no improvement in theory, though in practice there has been real improvement, since Bagehot's time. The tendency is, indeed, decidedly in the direction of closer combination between the Bank and the banks. On more than one occasion the Bank has, not merely by borrowing "in the market," but by more or less private negotiations with the big banks, obtained temporary control of large sums belonging to the banks in order to take cash off the market. This proceeding, and its concomitants, did not meet with universal approval; but the results were satisfactory on the whole, and on the later occasions when the measure was carried out there was little or no friction.

Effect of Big Foreign Loans.

The enormous war loans raised by Japan in 1904, 1905, 1906 exemplified aptly the more modern methods of dealing with the disturbance to the money market which such operations produce. The loans were issued by three banks, one of which was a Japanese institution and represented the Japanese government in the operations connected with the various loans. Of the other two, one was a leading London bank and the other the principal British bank doing business in China. These large loans were issued with the minimum of disturbance to the London money market. The very large amounts of cash which were suddenly withdrawn from other banks, and deposited with the institutions issuing the loan as "application money," were lent out again in the short loan market as soon as possible, usually on the afternoon of the day of issue. The work involved was very heavy, as a great number of cheques had to be cleared in a brief space of time, but by skilful organization this was done. Similar promptitude was displayed when the successive instalments on the loans became due and were paid, most of the cash being available for borrowers a few hours after it was paid in by the holders of the scrip which represented the loans until the definitive bonds were ready. The task of dealing with cash forming instalments of the loans was not, however, the only problem before the banks which issued them. As the scrip of each loan gradually became "fully paid" the proceeds of the loan in the hands of the banks became a very large sum. The Japanese government held the whole of it at its disposal, and might have seriously embarrassed the London money market if it had not dealt with its huge balances considerately. The Japanese government had promised not to withdraw any portion of the loans raised in London in gold, but it was under no restrictions as to how it should employ the money lying to its account. It might have kept it locked up until it had a bill for ships or clothing to pay. As might be expected, the government from the outset transferred a portion of what was deposited with the banks to the Bank of England, finding it advantageous on various grounds to do so. The remainder was lent for short periods by the banks, but for some time no means were available for lending for any considerable length of time, though the Japanese government had no immediate use for the whole of it. It was suggested to the government by its advisers that it would be a convenience to the money market, and no inconvenience to Japanese policy, if any balances which were not likely to be wanted for some months were invested in British treasury bills, and the government, after fully acquainting itself with the nature of the operation, agreed to it. The plan was found to work well; it released for definite periods money that would otherwise have been of little use to the money market, and it was of pecuniary benefit to the Japanese exchequer to the extent of the interest earned by the portion of the balances so employed. Incidentally it suited the British treasury; the Japanese demand, which became a constant feature in connexion with treasury bill issues, lowered the discount rates at which "sixes" were placed. The Japanese not only applied for treasury bills and bought them in the market, but they also took up some of the exchequer bonds issued in connexion with the South African war towards the end of their currency, thus relieving the money market of a further part of the weight of British government paper which it would otherwise have had to take on itself. A further important development of Japanese management of its London balances took place in 1906, when a portion of these balances was placed under the control of agents of the Bank of England, to be lent, or not lent, in the market as suited the Bank's policy, which was at that time directed to raising the value of money in order to protect and increase its reserve. The plan worked very well on the whole. It was merely an adaptation of a practice initiated some years before, whereby the Bank sometimes obtained temporary control of moneys belonging to the India Council. The same idea, that of "intercepting" market funds, which were beating down the discount rate, depressing the foreign exchanges and depleting the Bank's reserve, has been employed in regard to the clearing banks themselves, the banks having on more than one occasion agreed to lend the Bank of England a certain portion of their balances.

The Discount Houses.

The discount houses, though an important body of institutions, are not of so much importance as they were before 1866, when they suffered a serious blow through the failure of "Overend's," from which as a body they have never fully recovered. The five large concerns which still exist are, however, very powerful and exercise considerable influence on the market. They hold considerable quantities of bills at all times; occasionally their holdings are very large, but they turn out the contents of their bill cases readily if they think fit. Their business is different in practice from that of the smaller "bill-brokers," who usually are what their name suggests, namely, persons who do not hold many bills, but find them for banks who need them, charging a small commission. The small bill-brokers borrow from the Bank of England much more freely than the big discount houses. The latter only "go to the bank" in ordinary times perhaps once or twice a year. During the South African War, which disturbed the money market very much, they obtained accommodation from the Bank more frequently than usual. The small brokers almost always have to borrow from the Bank at the end of every quarter, when money is scarce owing to the regular quarterly requirements of business, and also, to some extent, because certain of the banks make it a practice to call in loans at the end of each month in order to show a satisfactory cash reserve in their monthly balance-sheet. This practice is not approved by the best authorities, for although it does no great harm in quiet times, the banks who follow it might find it difficult, or even impossible, to call in their loans in times of severe stringency.

AUTHORITIES.—Walter Bagehot, *Lombard Street* (1873); Arthur Ellis, *Rationale of Market Fluctuations*; Robert Giffen, *Stock Exchange Securities* (1879); W. Stanley Jevons, *Theory of Political Economy* (2nd ed., 1879), pp. 91 seq., and *Investigations in Currency and Finance*; Henry Sidgwick, *Principles of Political Economy*, book ii. ch. ii.; Augustin Cournot, *Theory of Wealth* (1838), translated by Nathaniel T. Bacon; George Clare, *A Money Market Primer and Key to the Exchanges*; John Stuart Mill, *Principles of Political Economy*, book iii. ch. i.–vi.; John Shield Nicholson, *Bankers' Money*; Hartley Withers, *The Meaning of Money* (1909). (W. Ho.)

MARKET BOSWORTH, a market town in the Bosworth parliamentary division of Leicestershire, England; 105 m. N.N.W. from London on a branch from Nuneaton of the London & North Western and Midland railways, near the Ashby-de-la-Zouch canal. Pop. (1901), 659. The church of St Peter is Perpendicular, with a lofty tower and spire. At the grammar school, founded in 1528, Dr Samuel Johnson was a master about 1732, but found the work unbearable. The trade of Market Bosworth is principally agricultural, and there are brickworks. Two miles south is the scene of the battle of Bosworth, in 1485, where Richard III. fell before Henry earl of Richmond, who thereupon assumed the crown as Henry VII.

MARKET DRAYTON, a market town in the Newport division of Shropshire, England, on the river Tern and the Shropshire Union canal, 178 m. N.W. from London. Pop. (civil parish of Drayton-in-Hales, 1901), 5167. The Wellington-Crewe line of the Great Western railway is here joined by a branch into Staffordshire of the North Staffordshire railway. The church of St Mary has Norman remains but is modernised by restoration. The town is a centre of agricultural trade, and there are large iron foundries. It is in the parish of Drayton-in-Hales, a name sometimes applied to it; and it is also known as Drayton Magna. It is an ancient town, of which the manor was held successively by the abbots of St Ebrulph in Normandy and Combermere in Cheshire. On Blore Heath, 3 m. east in Staffordshire, Audley Cross marks a great battle in the Wars of the Roses (1459), in which the Yorkists were successful and Lord Audley fell.

MARKET HARBOROUGH, a market town in the Harborough parliamentary division of Leicestershire, England; on the river Welland and the Grand Union Canal. Pop. of urban district (1901), 7735. It is 81 m. N.N.W. from London by the Midland railway, and is served by branches of the London & North Western and Great Northern railways. The church of St Dionysius is Decorated and Perpendicular, with a fine tower and spire. The grammar school was founded in 1614; it occupies modern buildings, but the original house remains, a picturesque half-timbered building, raised upon pillars of wood. Both British and Roman remains have been found in the vicinity. There are malt-houses and boot, shoe and stay factories. The town is also an important fox-hunting centre.

MARKHAM, SIR CLEMENTS ROBERT (1830–), English traveller, geographer and author, son of the Rev. David F. Markham, canon of Windsor, and of Catherine, daughter of Sir W. Milner, Bart., of Nunappleton, Yorkshire, was born on the 20th of July 1830 at Stillingfleet, near York, and educated at Westminster School. He entered the navy in 1844, became midshipman in 1846, and passed for a lieutenant in 1851. In 1850–1851 he served on the Franklin search expedition in the Arctic regions, under Captain Austin. He retired from the navy in 1852, and in

1852–1854 travelled in Peru and the forests of the eastern Andes. He visited South America again in 1860–1861, in order to arrange for the introduction of the cinchona plant into India, a service of the highest value to humanity. In 1865–1866 he visited Ceylon and India, to inspect and report upon the Tinnevelly pearl-fishery and the cinchona plantations. On the Abyssinian expedition of 1867–68 he served as geographer, and was present at the storming of Magdala. In 1874 he accompanied the Arctic expedition under Sir George Nares as far as Greenland. In later years Sir Clements Markham travelled extensively in western Asia and the United States. In 1855 he became a clerk in the Board of Control. From 1867–1877 he was in charge of the geographical department of the Indian Office. He was secretary to the Hakluyt Society from 1858–1887, and became its president in 1890. From 1863–1888 he acted as secretary to the Royal Geographical Society, and on his retirement received the society's gold medal for his distinguished services to geography. He was elected president of the same society in 1893, and retained office for the unprecedented period of twelve years, taking an active share in the work of the society and in increasing its usefulness in various directions. It was almost entirely due to his exertions that funds were obtained for the National Antarctic Expedition under Captain Robert Scott, which left England in the summer of 1901. Sir Clements Markham was elected F.R.S. in 1873; was created C.B. in 1871, and K.C.B. in 1896; became an honorary member of the principal geographical societies; and was president of the International Geographical Congress which met in London in 1895.

Sir Clements Markham conducted the *Geographical Magazine* from 1872–1878, when it became merged in the *Proceedings of the Royal Geographical Society*. Among his other publications may be mentioned the following: *Franklin's Footsteps* (1852); *Cuzco and Lima* (1856); *Travels in Peru and India* (1862); *A Quichua Grammar and Dictionary* (1863); *Spanish Irrigation* (1867); *A History of the Abyssinian Expedition* (1869); *A Life of the Great Lord Fairfax* (1870); *Ollanta, a Quichua Drama* (1871); *Memoir on the Indian Surveys* (1871; 2nd ed., 1878); *General Sketch of the History of Persia* (1873); *The Threshold of the Unknown Region* (1874, 4 editions); *A Memoir of the Countess of Chinchon*, (1875); *Missions to Thibet*, (1877; 2nd ed., 1879); *Memoir of the Indian Surveys*; *Peruvian Bark* (1880); *Peru* (1880); *The War between Chili and Peru* (1879–81; 3rd ed., 1883); *The Sea Fathers* (1885); *The Fighting Veres* (1888); *Paladins of King Edwin* (1896); *Life of John Davis the Navigator* (1889); a *Life of Richard III.* (1906), in which he maintained that the king was not guilty of the murder of the two princes in the Tower; also lives of *Admiral Fairfax*, *Admiral John Markham*, *Columbus* and *Major Rennel*; *a History of Peru*; editions with introductions of twenty works for the Hakluyt Society, of which fourteen were also translations; about seventy papers in the Royal Geographical Society's *Journal*; the *Reports on the Moral and Material Progress of India* for 1871–1872 and 1872–1873; *Memoir of Sir John Harington* for the Roxburghe Club (1880); the Peruvian chapters for J. Winsor's *History of America*, and the chapters on discovery and surveying for Clowes's *History of the Navy*.

MARKHAM, GERVASE (or JERVIS) (1568?–1637), English poet and miscellaneous writer, third son of Sir Robert Markham of Cotham, Nottinghamshire, was born probably in 1568. He was a soldier of fortune in the Low Countries, and later was a captain under the earl of Essex's command in Ireland. He was acquainted with Latin and several modern languages, and had an exhaustive practical acquaintance with the arts of forestry and agriculture. He was a noted horse-breeder, and is said to have imported the first Arab. Very little is known of the events of his life. The story of the murderous quarrel between Gervase Markham and Sir John Holles related in the *Biographia Britannica* (*s.v.* Holles) has been generally connected with him, but in the *Dictionary of National Biography*, Sir Clements R. Markham, a descendant from the same family, refers it to another contemporary of the same name, whose monument is still to be seen in Laneham church. Gervase Markham was buried at St Giles's, Cripplegate, London, on the 3rd of February 1637. He was a voluminous writer on many subjects, but he repeated himself considerably in his works, sometimes reprinting the same books under other titles. His booksellers procured a declaration from him in 1617 that he would produce no more on certain topics.

Markham's writings include: *The Teares of the Beloved* (1600) and *Marie Magdalene's Teares* (1601) long and rather commonplace poems on the Passion and Resurrection of Christ, both reprinted by Dr A. B. Grosart in the *Miscellanies of the Fuller Worthies Library* (1871); *The most Honorable Tragedy of Sir Richard Grinvile* (1595), reprinted (1871) by Professor E. Arber, a prolix and euphuistic poem in eight-lined stanzas which was no doubt in Tennyson's mind when he wrote his stirring ballad; *The Poem of Poems, or Syon's Muse* (1595), dedicated to Elizabeth, daughter of Sir Philip Sidney; *Devoreux, Vertues Teares* (1597). *Herod and Antipater, a Tragedy* (1622) was written in conjunction with William Sampson, and with Henry Machin he wrote a comedy called *The Dumbe Knight* (1608). *A Discourse of Horsemanshippe* (1593) was followed by other popular treatises on horsemanship and farriery. *Honour in his Perfection* (1624) is in praise of the earls of Oxford, Southampton and Essex, and the *Souldier's Accidence* (1625) turns his military experiences to account. He edited Juliana Berners's *Boke of Saint Albans* under the title of *The Gentleman's Academie* (1595), and produced numerous books on husbandry, many of which are catalogued in Lowndes's *Bibliographer's Manual* (Bohn's ed., 1857–1864).

MARKHAM, MRS, the pseudonym of Elizabeth Penrose (1780–1837), English writer, daughter of Edmund Cartwright the inventor of the power-loom. She was born at her father's rectory at Goadby Marwood, Leicestershire, on the 3rd of August 1780. In 1804 she married the Rev. John Penrose, a country clergyman in Lincolnshire and a voluminous theological writer. During her girlhood Mrs Penrose had frequently stayed with relatives at Markham, a village in Nottinghamshire, and from this place she took the *nom de plume* of "Mrs Markham," under which she gained celebrity as a writer of history and other books for the young. The best known of her books was *A History of England from the First Invasion by the Romans to the End of the Reign of George III.* (1823), which went through numerous editions. In 1828 she published a *History of France*. Both these works enjoyed a wide popularity in America as well as in England. The distinctive characteristic of "Mrs Markham's" histories was the elimination of all the "horrors" of history, and of the complications of modern party politics, as being unsuitable for the youthful mind; and the addition to each chapter of "Conversations" between a fictitious group consisting of teacher and pupils bearing upon the subject matter. Her less well-known works were *Amusements of Westernheath, or Moral Stories for Children* (2 vols., 1824); *A Visit to the Zoological Gardens* (1829); two volumes of stories entitled *The New Children's Friend* (1832); *Historical Conversations for Young People* (1836); *Sermons for Children* (1837). Mrs Markham died at Lincoln on the 24th of January 1837.

See Samuel Smiles, *A Publisher and his Friends* (2 vols., London, 1891); G. C. Boase and W. P. Courtney, *Bibliotheca Cornubiensis* (3 vols., London, 1874–1882).

MARKHAM, WILLIAM (1719–1807), archbishop of York, was educated at Westminster and at Christ Church, Oxford. He was one of the best scholars of his day, and attained to the headship of his old school and college in 1753 and 1767 respectively. He held from time to time a number of livings, and in 1771 was made bishop of Chester and tutor to George prince of Wales. In 1777 he became archbishop of York, and also lord high almoner and privy councillor. He was for some time a close friend of Edmund Burke, but his strong championship of Warren Hastings caused a breach. He was accused by Lord Chatham of preaching pernicious doctrines, and was a victim of the Gordon riots in 1780. He died in 1807.

MARKHOR ("snake-eater"), the Pushtu name of a large Himalayan wild goat (*Capra falconeri*), characterized by its spirally twisted horns, and long shaggy winter coat. From the Pir-Panjal range of Kashmir the markhor extends westwards into Baltistan, Astor, Hunza, Afghanistan and the trans-Indus ranges of the Punjab. The twist of the horns varies to a great extent locally, the spiral being most open and corkscrew-like in the typical Astor animal, and closest and most screw-like in the race (*C. falconeri jerdoni*) inhabiting the Suleiman and adjacent ranges.

MARKIRCH (French, *Ste-Marie-aux-Mines*), a town of Germany, in Upper Alsace, prettily situated in the valley of the Leber, an affluent of the Rhine, near the French frontier. Pop. (1900), 12,372. The once productive silver, copper and lead mines of the neighbourhood were practically unworked during the whole of the 19th century, but have recently been reopened. The main industries of the place are, however, weaving and dyeing, and it is estimated that there are about 40,000 workpeople in the industrial district of which Markirch is the centre. The small river Leber, which intersects the town, was at one time the boundary between the German and French languages, and traces of this separation still exist. The German-speaking inhabitants on the right bank were Protestants, and subject to the counts of Rappoltstein, while the French inhabitants were Roman Catholics, and under the rule of the dukes of Lorraine.

See Mühlenbeck, *Documents historiques concernant Ste-Marie aux Mines* (Markirch, 1876–1877); Hauser, *Das Bergbaugebiet von Markirch* (Strass., 1900).

MARKLAND, JEREMIAH (1693–1776), English classical scholar, was born at Childwall in Lancashire on the 29th (or 18th) of October 1693. He was educated at Christ's Hospital and Peterhouse, Cambridge. He died at Milton, near Dorking, on the 7th of July 1776.

His most important works are *Epistola critica* (1723), the *Sylvae* of Statius (1728), notes to the editions of Lysias by Taylor, of Maximus of Tyre by Davies, of Euripides' *Hippolytus* by Musgrave, editions of Euripides' *Supplices, Iphigenia in Tauride* and *in Aulide* (ed. T. Gaisford, 1811); and *Remarks on the Epistles of Cicero to Brutus* (1745).

See J. Nichols's *Literary Anecdotes* (1812), iv. 272; also biography by F. A. Wolf, *Literarische Analekten*, ii. 370 (1818).

MARKO KRALYEVICH, Servian hero, was a son of the Servian king or prince, Vukashin (d. 1371). Chagrined at not himself becoming king after his father's death, he headed a revolt against the new ruler of the Servians. Later he passed into the service of the sultan of Turkey, and was killed in battle about 1394. Marko, however, is more celebrated in legend than in history. He is regarded as the personification of the Servian race, and stories of strength and wonder have gathered round his name. He is supposed to have lived for 300 years, to have ridden a horse 150 years old, and to have used his enormous physical strength against oppressors, especially against the Turks. He is a great figure in Servian poetry, and his deeds are also told in the epic poems of the Rumanians and the Bulgarians. One tradition relates how he retired from the world owing to the advent of firearms, which, he held, made strength and valour of no account in battle. Goethe regards Marko as the counterpart of Hercules and of the Persian Rustem.

The Servian poems about him were published in 1878; a German translation by Gröber (*Marko, der Königssohn*) appeared at Vienna in 1883.

MARK SYSTEM, the name given to a social organization which rests on the common tenure and common cultivation of the land by small groups of freemen. Both politically and economically the mark was an independent community, and its earliest members were doubtless blood relatives. In its origin the word is the same as mark or march (*q.v.*), a boundary. First used in this sense, it was then applied to the land cleared by the settlers in the forest areas of Germany, and later it was used for the system which prevailed—to what extent or for how long is uncertain—in that country. It is generally assumed that the lands of the mark were divided into three portions, forest, meadow and arable, and as in the manorial system which was later in vogue elsewhere, a system of rotation of crops in two, three or even six fields was adopted, each member of the community having rights of pasture in the forest and the meadow, and a certain share of the arable. The mark was a self-governing community. Its affairs were ordered by the markmen who met together at stated times in the markmoot. Soon, however, their freedom was encroached upon, and in the course of a very short time it disappeared altogether.

The extent and nature of the mark system has been, and still is, a subject of controversy among historians. One school holds that it was almost universal in Germany; that it was, in fact, the typical Teutonic method of holding and cultivating the land. From Germany, it is argued, it was introduced by the Angle and Saxon invaders into England, where it was extensively adopted, being the foundation upon which the prevailing land system in early England was built. An opposing school denies entirely the existence of the mark system, and a French writer, Fustel de Coulanges, refers to it contemptuously as "a figment of the Teutonic imagination." This view is based largely upon the supposition that common ownership of the land was practically unknown among the early Germans, and was by no means general among the early English. The truth will doubtless be found to lie somewhere between the two extremes. The complete mark system was certainly not prevalent in Anglo-Saxon England, nor did it exist very widely, or for any very long period in Germany, but the system which did prevail in these two countries contained elements which are also found in the mark system.

The chief authority on the mark system is G. L. von Maurer, who has written *Einleitung zur Geschichte der Mark- Hof- Dorf- und Stadtverfassung und der öffentlichen Gewalt* (Munich, 1854; new ed., Vienna, 1896), and *Geschichte der Markenverfassung in Deutschland* (Erlangen, 1856). See also N. D. Fustel de Coulanges, *Recherches sur quelques problèmes de l'histoire* (1885); and a translation from the same writer's works called *The Origin of Property in Land*, by M. Ashley. This contains an introductory chapter by Professor W. J. Ashley. Other authorities are K. Lamprecht, *Deutsches Wirtschaftsleben im Mittelalter* (Leipzig, 1886); R. Schröder, *Lehrbuch der deutschen Rechtsgeschichte* (Leipzig, 1902); and W. Stubbs, *Constitutional History of England*, vol. i. (1891).

MARL (from O. Fr. *marle*, Late Lat. *margila*, dim. of *marga*; cf. Du. and Ger. *Mergel*), a calcareous clay, or a mixture of carbonate of lime with argillaceous matter. It is impossible to give a strict definition of a marl, for the term is applied to a great variety of rocks and soils with a considerable range of composition. On the one hand, the marls graduate into clays by diminution in the amount of lime that they contain, and on the other hand they pass into argillaceous limestones (see LIMESTONE). From 25–75% of carbonate of lime may be regarded as characteristic of the marls. But in popular usage many substances are called marls which would not be included under the definition given here. The practice formerly much in vogue of top-dressing land with marls, and the use of many different kinds of earth and clay for that purpose, has led to a very general misapplication of the term; for all sorts of rotted rock, some being of igneous origin while others are rain-wash, loams, and various superficial deposits, have been called "marls" in different parts of Britain, if only it was believed that an application of them to the surface of the fields would result in increased fertility.

The typical marls are soft, earthy, and of a white, grey or brownish colour. Many of them disintegrate in water; and they are readily attacked by dilute hydrochloric acid, which dissolves the carbonate of lime rapidly, giving off bubbles of carbon dioxide. The lime of some marls is present in the form of shells, whole or broken; in others it is a fine impalpable powder mixed with the clay. In many marls there is organic matter (plant fragments or humus). Sand is usually not abundant but is rarely absent. Gypsum occurs in some marls, occasionally in large simple crystals with the form of lozenge-shaped plates or in twinned groups resembling an arrow-head; fine examples of these are obtained in the marls of Montmartre near Paris, where celestine (strontium sulphate) occurs also in nodular or concretionary masses. Large crystals of calcite or of dolomite, lumps of iron pyrites or radiate nodules of marcasite, and small crystals of quartz are found in certain marl deposits; and in Westphalia the marls of the Senonian (part of the Cretaceous system) at Hamm yield masses of strontianite up to two feet in length. A very large variety of accessory minerals may be proved to exist in marls by microscopic examination.

The rocks known as shell marls are found in many parts of Britain and other northern countries, and are much valued by farmers as a source of carbonate of lime, though rarely burned to produce quicklime. They are generally obtained by digging pits in marshy spots or meadows, and often occur below considerable thicknesses of peat. Large numbers of shells of fresh-water mollusca are scattered through a matrix of clay; usually retaining their shapes though they are in a friable and semi-decomposed state. The species represented are very few, and from their unbroken state it is obvious that they have not been transported but lived in the place where their remains are found. As mollusca of this kind thrive best in open stretches of clear water, the sites of the marl deposits must have been shallow lakes and open pools.

Among the older strata it is not uncommon to find beds which have the same composition and in many cases the same origin as shell marl. While some of them are fresh-water deposits, others are of marine origin. The "crag beds" of the Pliocene formation in Norfolk, Suffolk and Essex are essentially sand and gravel, which are often rich in shells; with them occur clays such as the Chillesford clay; and many of these beds have actually been used as marls for dressing the surface of agricultural land. Better examples occur among the Oligocene beds of the Hampshire basin and the Isle of Wight, where the Steadon, Bembridge and Hempstead marls are clays, more or less sandy, containing fresh-water shells. In the Cretaceous rocks of the south of England soft argillaceous limestones of marine origin, which may be described as marls, occur on several horizons. At its base the white chalk is often mixed with clay, and the "chalk marl" is a rock of this kind; it is known in Cambridgeshire, at Folkestone, in the Isle of Wight, &c. The chloritic marl, which underlies the chalk and is well developed in the Isle of Wight, is a greenish argillaceous limestone, the colour being due to the presence of glauconite, not of chlorite; it is often very fossiliferous. The Gault, an argillaceous type of the Upper Greensand, is a stiff greyish calcareous clay, beneath the white chalk, well known for the excellent preservation of its fossils. It outcrops along the base of the escarpment of the North and South Downs; the original name given to it by William Smith was "the blue marl." In the Jurassic rocks of England there are marls or shelly fresh-water clays in the Purbeck series and also in the estuarine beds of the Great Oolite, but the name "marlstone" has long been reserved for the argillaceous limestone of the Middle Lias. It ranges from the Dorset coast, through Edge Hill in Warwickshire and Lincolnshire, and thence to the sea in the north of Yorkshire, presenting many variations in this long extent of country and often accompanied by, or converted into, beds of clay ironstone. The marlstone is typically a firm, greyish limestone weathering to a rusty brown colour, and is always more or less argillaceous.

In the Triassic rocks of Britain there is a very important series of red, green and mottled clays, over a thousand feet thick in some places, which have been called the New Red marls. They belong to the Keuper or uppermost division of the system, and in Cheshire contain valuable deposits of rock salt, the principal sources of that mineral in Great Britain. In the strict sense these rocks are not marls, being ferruginous clays rather than calcareous clays. Most of them appear to have been laid down in saline lakes in desert regions. As a rule they contain very few fossils, and often they have little or no carbonate of lime, but beds and veins of fibrous gypsum occur in them in considerable profusion. These rocks cover a wide area in the midland counties extending to the south coast near Exmouth, and reappear in the north in the Vale of Eden and a few places in southern Scotland. The clays are used for brickmaking, and yield a stiff soil, mostly devoted to pasture and dairy farming. In the Rhaetic beds which immediately overlie the Triassic rocks there are three seams of calcareous clay, often only a few feet thick, which have been called the "grey marls" and the "tea-green marls."

To rocks older than these the name marl has not often been given, probably because, though argillaceous limestones are often common in the Carboniferous and Silurian rocks, they are usually firm and compact, while marls usually comprise rocks which are more or less soft and friable. In other countries, and especially in Germany, many different kinds of marl and of marl-slate are described. Two of these are of especial importance—the dark copper-bearing marl slate of the Permian rocks near Mansfeld in Germany, which has been long and extensively worked as sources of copper, and the white or creamy Solenhofen limestone, much quarried in Bavaria, and used as a lithographic stone. (J. S. F.)

MARLBOROUGH, EARLS AND DUKES OF. The earldom of Marlborough was held by the family of Ley from 1626 to 1679. James Ley, the 1st earl (*c.* 1550–1629), was lord chief justice of the King's Bench in Ireland and then in England; he was an English member of parliament and was lord high treasurer from 1624 to 1628. In 1624 he was created Baron Ley and in 1626 earl of Marlborough. The 3rd earl was his grandson James (1618–1665), a naval officer who was killed in action with the Dutch. James was succeeded by his uncle William, a younger son of the 1st earl, on whose death in 1679 the earldom became extinct.

In 1689 John Churchill was created earl and in 1702 duke of Marlborough (see below). After the death of his only son Charles in 1703 an act of parliament was passed in 1706 settling the duke's titles upon his daughters and their issue. Consequently when he died in June 1722 his eldest daughter Henrietta (1681–1733), wife of Francis Godolphin, 2nd earl of Godolphin, became duchess of Marlborough. She died without sons and was succeeded by her nephew Charles Spencer, 5th earl of Sunderland (1706–1758), a son of the great duke's second daughter Anne (d. 1716). Although at this time Charles handed over the Sunderland estates to his younger brother John, the ancestor of the earls Spencer, he did not obtain Blenheim until Sarah, the dowager duchess, died in 1744. His eldest son George Spencer, the 4th duke (1739–1817), left three sons. The eldest, George Spencer, the 5th duke (1766–1840), was summoned to the House of Lords as Baron Spencer of Wormleighton in 1806, and in 1817, after succeeding to the dukedom, he took the name of Spencer-Churchill. The 4th duke's second son was Lord Henry John Spencer (1770–1795), envoy to Sweden and to Prussia; and his third son was Lord Francis Almeric Spencer (1779–1845), who was created a peer as Baron Churchill of Whichwood in 1815. His grandson Victor Albert Francis Charles Spencer (b. 1864) succeeded his father as 3rd Baron Churchill in 1886, and was raised to the rank of a viscount in 1902.

The 7th duke of Marlborough, John Winston Spencer-Churchill (1822–1883), a prominent Conservative politician, was lord-lieutenant of Ireland 1876–1880, and when marquess of Blandford (the courtesy title borne by the duke's eldest son in his father's lifetime) was responsible for the act of 1856 called the "Blandford Act," enabling populous parishes to be divided for purposes of Church work. In 1892 his grandson Charles Richard John Spencer-Churchill (b. 1871) became 9th duke of Marlborough.

MARLBOROUGH, JOHN CHURCHILL, 1st Duke of (1650–1722), English soldier, was born in the small manor house of Ash, in Musbury, Devonshire, near Axminster, in May or June 1650. Arabella Churchill, his eldest sister, and the mother of the duke of Berwick, was born in the same house on the 28th of February 1648. They were the children of Winston Churchill of Glanville Wotton in Dorset and Elizabeth the fourth daughter of Sir John Drake, who died in 1636; his widow, after the close of the civil war, received her son-in-law into her own house. From 1663 to 1665 John Churchill went to St Paul's school, and there is a tradition that during this period he showed the bent of his taste by reading and re-reading Vegetius *De re militari.* When fifteen years old he became page of honour to the duke of York, and about the same time his sister Arabella became maid of honour to the duchess, two events which contributed greatly to the advancement of the Churchills. On the 14th of September 1667 he received through the influence of his master a commission in the Guards, and left England for service at Tangier but returned home in the winter of 1670–1671. For a short interval Churchill remained in attendance at the court, and it was during this period that the natural carefulness of his disposition was shown by his investing in an annuity a present of £5,000 given him by the duchess of Cleveland.

In June 1672, when England to her shame sent six thousand troops to aid Louis XIV. in his attempt to subdue the Dutch, Churchill was made a captain in the company of which the duke of York was colonel, and soon attracted the attention of Turenne, by whose profound military genius the whole army was directed. At the siege of Nimeguen Churchill acquitted himself with such success that the French commander predicted his ultimate rise to distinction. When Maestricht was besieged in June 1673 he saved the life of the duke of Monmouth, and received the thanks of Louis XIV. for his services. In 1678 he was married to Sarah Jennings (b. June 5, 1660), the favourite attendant on the Princess Anne, younger daughter of the duke of York. Her father, Richard Jennings of Sandridge, near St Albans, had twenty-two brothers and sisters; one of the latter married a London tradesman named Francis Hill, and their daughter Abigail Hill afterwards succeeded her cousin the duchess of Marlborough as favourite to Queen Anne.

On the accession of James II. the Churchills received a great increase in fortune. Colonel Churchill had been created a Scotch peer as Lord Churchill of Eyemouth on the 21st of December 1682; and as a reward for his services in going on a special mission from the new monarch to Louis XIV. he was advanced on the 14th of May 1685 to the English peerage under the title of Baron Churchill of Sandridge in Hertfordshire. When the duke of Monmouth attempted his ill-fated enterprise in the western counties, the second position in command of the king's army was bestowed on Lord Churchill, and on the 3rd of July 1685 he was raised to the rank of major-general. Through his vigilance and energy at the battle of Sedgemoor (July 6) victory declared itself on the king's side. After the death of Monmouth he withdrew as far as possible from the administration of public business, but both he and his wife remained the favourite attendants of the princess Anne. Whilst on his embassy to the French court he had declared with emphasis that if the king of England should change the religion of the state he should at once leave his service, and it was not long before the design of James became apparent to the world. Churchill was one of the first to send overtures of obedience to the prince of Orange, to whom he had gone on a commission in 1678. Although he continued in a high position under James and drew the emoluments of his places, he promised William of Orange to use every exertion to bring over the troops to his side. James had been warned against putting any trust in the loyalty of the man on whom he had showered so many favours, but the warnings were in vain, and on the landing of the Dutch prince at Brixham Churchill was promoted to be lieutenant-general (Nov. 7, 1688) and was sent against him with five thousand men. When the royal army had advanced to the downs of Wiltshire and a battle seemed imminent, James was dismayed at finding that in the dead of night his general had stolen away like a thief into the opposite camp.

Churchill was sworn as a privy councillor on the 14th of February 1688/9 and on the 9th of April became earl of Marlborough. William felt, however, that he could not place implicit reliance in his friend's integrity; and, with a clear sense of the manner in which Marlborough's talents might be employed without any detriment to the stability of his throne, he sent him in June 1689 with the army into the Netherlands, and in the autumn of 1690 into Ireland, where owing to his generalship Cork and Kinsale fell into his hands after short sieges. For some time there was no open avowal of any distrust in Marlborough's loyalty, but in May 1692 he was thrown into the Tower on an accusation of treason. Though the evidence which could be brought against him was slight, and he was soon set at liberty, there is no doubt that Marlborough was in close relations with the exiled king at St Germains, and that he even went so far as to disclose, in May 1694, to his late master the intention of the English to attack the town of Brest. The talents of the statesmen of this reign were chiefly displayed in their attempts to convince both the exiled and the reigning king of England of their attachment to his fortunes. The sin of Marlborough lay in the fact that he had been favoured above his fellows by each in turn, and that he betrayed both alike apparently without scruple or without shame. Once again during the Fenwick plot of 1696 he was charged with treason, but William, knowing that if he pushed Marlborough and his friends to extremities there were no other statesmen on whom he could rely, contented himself with ignoring the accusation of Sir John Fenwick, and with executing that conspirator himself. In 1698 the forgiven traitor was made governor to the young duke of Gloucester, the only one of Anne's numerous children who gave promise of attaining to manhood. During the last years of William's reign Marlborough once more was placed in positions of responsibility. His daughters were married into the most prominent families of the land; Henrietta, the eldest, became the wife of Francis, the eldest son of Lord Godolphin; the second, the loveliest woman at the court, with her father's tact and temper and her mother's beauty, married Charles, Lord Spencer, the only surviving son of the earl of Sunderland. Higher honours came on the accession of Queen Anne in March 1702. He was at once appointed a Knight of the Garter, captain-general of the English troops both at home and abroad, and master-general of the ordnance. The new queen did not forget the life-long service of his wife; three positions at the court by which she was enabled to continue by the side of the sovereign were united in her person. The queen showed her devotion to her friend by another signal mark of favour. The rangership of Windsor Park was granted her for life, with the especial object of enabling Lady Marlborough to live in the Great Lodge. These were the opening days of many years of fame and power. A week or two after the death of William it was agreed by the three great powers, England, Holland and Austria, which formed the grand alliance, that war should be declared against France on the same day, and on the 4th of May 1702 the War of the Spanish Succession was declared by the three countries. Marlborough was made commander-in-chief of the united armies of England and Holland, but throughout the war his plans were impeded by the jealousy of the commanders who were nominally his inferiors, and by the opposite aims of the various countries that were striving to break the power of France. He himself wished to penetrate into the French lines; the anxiety of the Dutch was for the maintenance of their frontier and for an augmentation of their territory; the desire of the Austrian emperor was to secure that his son the Archduke Charles should rule over Spain. To secure concerted action by these different powers taxed all the diplomacy of Marlborough, but he succeeded for the most part in his desires. In the first year of the campaign it was shown that the armies of the French were not invincible. Several fortresses which Louis XIV. had seized upon surrendered to the allies. Kaiserswerth on the Rhine surrendered on the 15th of June, and Venlo on the Meuse on the 23rd of September. The prosperous commercial town of Liége with its commanding citadel capitulated on the 29th of October. The successes of Marlborough caused much rejoicing in his own country, and for these brilliant exploits he was raised (Dec. 14, 1702) to be duke of Marlborough, and received a grant of £5000 per annum for the queen's life. In the spring of the following year a crushing blow fell upon the duke and duchess. Their eldest and only surviving son, the marquess of Blandford, was seized whilst at King's College, Cambridge (under the care of Francis Hare, afterwards bishop of Chichester), with the small-pox, and died on the 20th of February 1703, in his seventeenth year. His talents had already justified the prediction that he would rise to the highest position in the state.

The result of the campaign of 1703 inspired the French king with fresh hopes of ultimate victory. The dashing plans of Marlborough were frustrated by the opposition of his Dutch colleagues. When he wished to invade the French territory they urged him to besiege Bonn, and he was compelled to accede to their wishes. It surrendered on the 15th of May, whereupon he returned to his original plan of attacking Antwerp; but, in consequence of the incapacity of the Dutch leaders, the generals (Villeroi and Boufflers) of the French army surprised the Dutch division on the 30th of June and inflicted on it a loss of many thousands of men. Marlborough was forced to abandon his enterprise, and all the compensation which he received was the capture of the insignificant forts of Huy and Limburg. After a year of comparative failure for the allies, Louis XIV. was emboldened to enter upon an offensive movement against Austria; and Marlborough, smarting under the misadventures of 1703, was eager to meet him. A magnificent army was sent by the French king, under the command of Marshal Tallard, to join the forces of the elector of Bavaria and to march by the Danube so as to seize Vienna itself. Marlborough divined the intention of the expedition, and while making a feint of marching into Alsace led his troops into Bavaria. The two armies (that under Marlborough and Prince Eugène numbering more than fifty thousand men, whilst Tallard's forces were nearly four thousand stronger) met in battle near the village of Blenheim on the left bank of the Danube. The French commander made the mistake of supposing that the enemy's attack would be directed against his position in the village, and he concentrated an excessive number of his troops at that point. The early part of the fight was in favour of the French. Three times were the troops led by Prince Eugène, which were attacking the Bavarians, the enemy's left wing, driven back in confusion; Marlborough's cavalry failed on their first attack in breaking the line of the enemy's centre. But in the end the victory of the allies was conclusive. Nearly thirty thousand of the French and Bavarians were killed and wounded, and eleven thousand of the French who had been driven down to the Danube were forced to surrender. Bavaria fell into the hands of the allies. Never was a victory more eagerly welcomed than this, and never was a conquering leader more rewarded than Marlborough. Poets and prose writers were employed to do him honour, and the lines of Addison comparing the English commander to the angel who passed over "pale Britannia" in the storm of 1703 have been famous for over two centuries. The manor of Woodstock, which was transferred by act of parliament from the crown to the duke, was a reward more after his own heart. The gift even in that form was noble, but the queen heightened it by instructing Sir John Vanbrugh to build a palace in the park at the royal expense, and £240,000 of public money was spent on the buildings. He was also created a prince of the empire and the principality of Mindelheim was formed in his honour.

The following year was not marked by any stirring incident. Marlborough was hampered by tedious formalities at the Hague and by jealousies at the German courts. The armies of the French were again brought up to their full standard, but the generals of Louis were instructed to entrench themselves behind earthworks and to act on the defensive. In the darkness of a July night these lines were broken through near Tirlemont, and the French were forced to take shelter under the walls of Louvain. Marlborough in vain urged an attack upon them in their new position, and when 1705 had passed away the forces of the French king had suffered no diminution. This immunity from disaster tempted Villeroi in the next spring into meeting the allied forces in an open fight, but his assurance proved his ruin. Through the superior tactics of Marlborough the battle of Ramillies (May 23, 1706) ended in the total rout of the French, and caused the transference of nearly the whole of Brabant and Flanders to the allies. Five days afterwards the victor entered Brussels in state, and the inhabitants acknowledged the rule of the archduke. Antwerp and Ostend surrendered themselves with slight loss. Menin held out until three thousand of the soldiers of the allies were laid low around its walls, but Dendermonde, which Louis had forty years previously besieged in vain, quickly gave itself up to the resistless Marlborough. Again a year of activity and triumph was succeeded by a period of languor and depression. During the whole of 1707 fortune inclined to the other side, with the result that in July 1708 Ghent and Bruges returned to the allegiance of the French, and Marlborough, fearing that their example might be followed by the other cities, advanced with his whole army towards Oudenarde. Had the counsels of Vendôme, one of the ablest of the French generals, prevailed, the fight might have had a different issue, but his suggestions were disregarded by the duke of Burgundy, the grandson of Louis, and the battle, which raged on the high ground above Oudenarde, ended in their defeat (July 11, 1708). After this victory Marlborough, ever anxious for decisive measures, wished to advance on Paris, but he was overruled. The allied army invested the town of Lille, on the fortifications of which Vauban had expended an immensity of thought; and after a struggle of nearly four months, and the loss to the combatants of thirty thousand men, the citadel was surrendered by Marshal Boufflers on the 9th of December. By the end of the year Brabant was again subject to the rule of the allies. The suffering in France at this time weighed so heavily upon the people that its proud king humbled himself to sue for peace. Each of the allies in turn did he supplicate, and Torcy his minister endeavoured by promises of large sums of money to obtain the support of Marlborough to his proposals. These attempts were in vain, and when the winter passed away a French army of one hundred and ten thousand, under the command of Villars, took the field. On the 3rd of September 1709 Tournay capitulated, and the two leaders, Marlborough and Eugène, led their forces to Mons, in spite of the attempt of Villars to prevent them. For the last time during the protracted war the two armies met in fair fight at Malplaquet, on the south of Mons (Sept. 11, 1709), where the French leader had strengthened his position by extensive earthworks. The fight was long and doubtful, and although the French ultimately retreated under the direction of Boufflers, for Villars had been wounded on the knee, it was in good order, and their losses were less than those of their opponents. The campaign lasted for a year or two after this indecisive contest, but it was not signalized by any such "glorious victory" as Blenheim. All that the English could plume themselves on was the acquisition of a few such fortresses as Douai and Bethune, and all that the French had to fear was the gradual tightening of the enemy's chain until it reached the walls of Paris. The energies of the French were concentrated in the construction of fresh lines of defence, until their commander boasted that his position was impregnable. In this way the war dragged on until the conclusion of the Peace of Utrecht in June 1712.

These victorious campaigns had not prevented the position of Marlborough from being undermined by party intrigues at home. In the early part of Queen Anne's reign his political friends were to be found among the Tories, and the ministry under Sidney Godolphin was chiefly composed of members of that party. After a year or two, however, the more ardent Tories withdrew, and two younger adherents of the same cause, Harley and St John, were introduced in May 1704 into the ministry. The duchess, partly through the influence of her son-in-law, the earl of Sunderland, who came into office against the queen's wish on the 3rd of December 1706, and partly through the opposition of the Tories to the French war, had gone over to the Whig cause, and she pressed her views on the sovereign with more vehemence than discretion. She had obtained for her indigent cousin, Abigail Hill, a small position at court, and the poor relation very soon began to injure the benefactor who had befriended her. With Hill's assistance Harley and St John widened the breach with the queen which was commenced by the imperious manner of the duchess. The love of the two friends changed into hate, and no opportunity for humiliating the family of Marlborough was allowed to pass neglected. Sunderland and Godolphin were the first to fall (July–Aug. 1710); a few months later the duchess was dismissed from her offices; and, although Marlborough himself was permitted to continue in his position a short time longer, his fall was only delayed until the last day of 1711. Life in England had become so unpleasant that he went to the Continent in November 1712 and remained abroad until the death of Anne (Aug. 1, 1714).

Then he once more returned to England and resumed his old military posts, but he took little part in public affairs. Even if he had wished to regain his commanding position in the country, ill health would have prevented him from obtaining his desires. Johnson indeed says, in the *Vanity of Human Wishes*, that "the streams of dotage" flowed from his eyes; but this is a poetical exaggeration. It is certain that at the time of his death he was able to understand the remarks of others and to express his own wishes. At four o'clock on the morning of the 16th of June 1722 he died at Cranbourn Lodge, near Windsor. His remains were at first deposited in Westminster Abbey, in the vault at the east end of King Henry VII.'s chapel, but they now rest in a mausoleum in the chapel at Blenheim.

His widow, to whom must be assigned a considerable share both in his rise and in his fall, survived till the 18th of October 1744. Those years were spent in bitter animosity with many within and without her own family. Left by her husband with the command of boundless wealth, she used it for the vindication of his memory and for the justification of her own resentment. Two of the leading opponents of the Whig ministry, Chesterfield and Pitt, were especially honoured by her attentions. To Pitt she left ten thousand pounds, to the other statesman twice that sum and a reversionary interest in her landed property at Wimbledon. Whilst a widow she received numerous offers of marriage from titled suitors. She refused them all: from her marriage to her death her heart had no other inmate than the man as whose wife she had become almost a rival to royalty.

The rapid rise of Marlborough to the highest position in the State was due to his singular tact and his diplomatic skill in the management of men. In an age remarkable for grace of manner and for adroitness of compliment, his courteous demeanour and the art with which he refused or granted a favour extorted the admiration of every one with whom he came in contact. Through his consideration for the welfare of his soldiers he held together for years an army drawn from every nation in Christendom. His talents may not have been profound (he possessed "an excellent plain understanding and sound judgment" is the opinion of Lord Chesterfield), but they were such as Englishmen love. Alike in planning and in executing, he took infinite pains in all points of detail. Nothing escaped his observation, and in the hottest moment of the fight the coolness of his intellect shone conspicuous. His enemies indeed affected to attribute his uniform success in the field to fortune, and they magnified his love of money by drawing up balance sheets which included every penny which he had received, but omitted the pounds which he had spent in the cause he had sincerely at heart. All that can be alleged in excuse of his attempts to serve two masters, the king whom he had deserted and the king who had received him into favour, is that not one of his associates was without sin in this respect.

The books on Marlborough are very numerous. Under his name in the catalogue of the British Museum there are 165 entries, and 44 under that of his wife. The chief works are Lediard's, Archdeacon William Coxe's (1818–1819), Sir Archibald Alison's (1855), and Viscount Wolseley's (1894) *Lives*, but Wolseley stops with the accession of Queen Anne; a French memoir in three volumes, 1808; Marlborough's *Letters and Despatches*, edited by Sir George Murray (5 vols., 1845); and the interesting summaries of Mrs Creighton (1879) and George Saintsbury (1885). The descriptions in John Hill Burton's *Reign of Queen Anne* of the battle scenes of Marlborough are from personal observation. A good account of his birthplace and country will be found in G. P. R. Pulman's *Book of the Axe District* (4th ed., 1875); and for the home of the duchess the reader can refer to the *History of Hertfordshire*, by J. E. Cussans. A memoir of her, by one of her descendants, Mrs Arthur Colville, appeared in 1904. The pamphlets written on her conduct at court relate to matters of little interest at the present time. (W. P. C.)

MARLBOROUGH, a market town and municipal borough in the Devizes parliamentary division of Wiltshire, England, $75\frac{3}{4}$ m. W. of London, on the Great Western and the Midland and South Western Junction railways. Pop. (1901), 3887. It is an old-fashioned place on the skirts of Savernake Forest, lying in a valley of the chalk uplands known as Marlborough Downs, and traversed by the river Kennet. It consists mainly of one broad street, in which a majority of the houses are Jacobean; those on the north side, which have projecting upper storeys, forming the colonnade commended in the Diary of Samuel Pepys for 1668. St Peter's church, a Perpendicular building, is said to have been the scene of the ordination of Cardinal Wolsey in 1498. The church of Preshute, largely rebuilt, but preserving its Norman pillars, has a curious piscina, and a black basalt font of great size dating from 1100–1150, in which according to a very old tradition King John was baptized. Other noteworthy buildings are the town-hall, 16th century grammar school and Marlborough College. This important public school was opened in 1843, originally for the sons of clergymen, by whom alone certain scholarships are tenable. The number of boys is about 600. Marlborough possesses little trade other than agricultural; but there are breweries, tanneries and roperies. The town is governed by a mayor, 4 aldermen and 12 councillors. Area, 598 acres.

The antiquity of Marlborough is shown by the Castle Mound, a British earthwork, which local legend makes the grave of Merlin; and the name of Marlborough has been regarded as a corrupt form of Merlin's Berg or Rock.

Near the site of the modern Marlborough (*Merleberge, Marleberge*) was originally a Roman *castrum* called Cunetio, and later there was a Norman fortress in which William I. established a mint. In Domesday it was royal demesne and during the following centuries figures in numerous grants generally as the dowry of queens. The castle, built under Henry I., by Roger, bishop of Salisbury, was held for Matilda against Stephen, and became a favourite residence of Henry II., Savernake being a royal deer-park. In 1267 Henry III. held his last parliament here, at which the Statute of Marlborough was passed. The castle ceased to be an important stronghold after the Wars of the Roses, but was garrisoned for Charles I. by its owners, the Seymour family. Marlborough itself, however, is mentioned by Clarendon as "the most notoriously disaffected [town] in Wiltshire," and was captured by the royal forces in 1642, and partly burnt. At the Restoration Charles II. was received and magnificently entertained by Lord Seymour, whose mansion forms the oldest part of Marlborough College. The town was constituted a suffragan see by Henry II. Sacheverell, the politician and divine, was born here in 1674, and educated at the grammar school. In 1653 the town was nearly destroyed by fire, and it again suffered in 1679 and 1690; after which an act was passed forbidding the use of thatch. Marlborough, from its position on the Great Bath Road, was a famous coaching centre.

The first charter was granted by John in 1204, and conferred a gild merchant, together with freedom from all pleas except pleas of the Crown and from all secular exactions by sea and land. This was confirmed by subsequent sovereigns from Henry III. to Henry VIII. Later charters were obtained from Henry IV. in 1407 and from Elizabeth in 1576. The former granted some additional exemptions whilst the latter incorporated the town under the title of mayor and burgesses of Marlborough. The corporation was finally reconstructed in 1835 under the title of a mayor, 4 aldermen and 12 councillors. Marlborough returned two members to parliament until 1867 when the number was reduced to one, and in 1885 the representation was merged in that of the county. A yearly fair was granted by John in 1204, for eight days from August 14, and two more by Henry III. for three days from November 11 and June 29 respectively. In 1204 John also granted a weekly market on Wednesday and Saturday. In Tudor times the corn trade prospered here.

See "Victoria County History": *Wilts*; James Waglen, *History of Marlboro* (London, 1854).

MARLBOROUGH, a city of Middlesex county, Massachusetts, U.S.A., about 28 m. W. of Boston. Pop. (1900), 13,609 (3311 were foreign-born); (1910), 14,579; it is served by the Boston & Maine and the New York New Haven & Hartford railways, and by inter-urban electric lines. The city, with a total area of 21·08 sq. m., lies in a fertile hilly country, and contains several ponds, including the beautiful Williams Pond, which covers $\frac{1}{4}$ sq. m. A public library was established here in 1792; it was housed in a new building in 1904. Other public buildings are the city hall, the Federal building and a state armoury. There is a boarding school for girls, St Ann's Academy (1887), under the direction of the Sisters of St Ann. The city's importance is industrial; in 1905 its factory product was valued at $7,468,849 (an increase of 66% since 1900), of which 88·6% was the value of boots and shoes. Whether the city is named from Marlborough in Wiltshire, or, as seems more probable, because of early spellings "Marlberg" and "Marlbridge," from the presence of marl in the neighbourhood, is uncertain. Settlers from Sudbury in 1665 took possession of a hill called by the Indians Whipsuffenicke and gradually hemmed in the Christian Indian village of Ockoocangansett (or Ognoikonguamescitt), on an adjoining hill still bearing this name. The town was incorporated in 1660. It was destroyed by Indians in March 1676, during King Philip's war, and was abandoned for a year. Westborough was separated from it in 1717, Southborough in 1727, and a part of Berlin in 1784; parts of it were annexed to Northborough in 1807, to Bolton in 1829 and to Hudson in 1866; and it annexed parts of Framingham in 1791, and of Southborough in 1843. In 1890 it was incorporated as a city.

See S. A. Drake, *History of Middlesex County*, ii. 137 sqq., "Marlborough" by Rev. R. S. Griffin and E. L. Bigelow (Boston, 1880).

MARLITT, E., the pseudonym of EUGENIE JOHN (1825–1887), German novelist, who was born at Arnstadt in Thuringia, the daughter of a merchant, on the 5th of December 1825. By her musical talent she attracted the notice of the reigning princess of Schwarzburg-Sondershausen, who provided for her training as a singer at the Vienna Conservatoire. After three years' study she made a successful stage début, but was compelled in consequence of deafness to abandon this career. She then became reader and travelling companion to her patroness, and her life at the court and on her many travels furnished her with material for her novels. In 1863 she resigned her post, and then lived with her brother at Arnstadt until her death on the 22nd of June 1887.

Her first novel, *Die zwölf Apostel*, was published in the *Gartenlaube* in 1865 and this was followed in 1866 by *Goldelse* (23rd ed., 1890), with which she established her literary reputation. Among others of her novels may be mentioned *Blaubart* (1866); *Das Geheimnis der alten Mamsell* (1867; 13th ed., 1888); *Reichsgräfin Gisela* (1869; 9th ed., 1900), *Das Heideprinzesschen* (1871; 8th ed., 1888) and *Im Hause des Kommerzienrats* (1877; 5th ed., 1891). All these works are directed against social prejudices, but, although attractively written, are deficient in higher literary qualities and appeal mostly to juvenile readers.

E. Marlitt's *Gesammelte Romane und Novellen* were published in 10 volumes (1888–1890; 2nd ed., 1891–1894), to which is appended a biographical memoir.

MARLOW (GREAT MARLOW), a market town in the Wycombe parliamentary division of Buckinghamshire, England, 31½ m. W. of London on a branch of the Great Western railway. Pop. of urban district (1901), 4526. It is beautifully situated on the north (left) bank of the Thames, which is here confined closely between low wooded hills. A weir and lock, near which rise the high tower and spire of the modern church of All Saints, separate two fine reaches of the river, and the town is a favourite resort for boating and fishing. The village of Little Marlow, where the foundations of a Benedictine nunnery of the time of Henry III. have been revealed by excavation, lies near the river two miles below. The town is, as a whole, modern in appearance, but a few old houses remain, such as the grammar school, founded as a bluecoat school in 1624, adjoining which is a house occupied by the poet Shelley in 1817. The town has manufactures of chairs, lace and embroidery, paper mills and breweries.

Great Marlow (*Merlaue, Merlawe, Marlowe, Marlow*) appears as a manor in Domesday Book, but its "borough and liberties" are not mentioned before 1261. It was then held by the earls of Gloucester, and its importance was probably due to the bridge across the Thames, first built, according to tradition, by the Templars at Bisham. No charter of incorporation was ever granted to the town, but there are faint traces of its constitution in the 14th century. In 1342 the mayor and burgesses presented to a chantry and continued to be the patrons till 1394. Later writs addressed to the town only mention two bailiffs as officers of the borough, nor were the pontage rights and dues held by it until the 15th century. Two burgesses sat in parliament from 1300 to 1309, but the representation of the borough lapsed until 1621, when the right to return members was re-established. After the Reform Bill of 1832 the boundaries of the parliamentary borough were enlarged, but in 1867 its representation was reduced to one member, and in 1885 was merged in that of the county. No grant of a market in the borough has been found, but a market was held by the Despensers who had succeeded the De Clares as lords of the manor in the 14th century. In the 16th century the market seems to have been given up, but it was revived and held in the 18th century, only to disappear again before 1862. Fairs were mentioned in 1306 on the death of Gilbert de Clare, when they were held on St Luke's Day and on the Wednesday in Whit-week by the earl of Gloucester, and Hugh le Despenser was granted a fair in his manor of Marlow in 1324. In 1792 there were two fairs, one of which, for horses and cattle, is still held on the 29th of October. Lace and satin-stitch work used to be made to a considerable extent.

MARLOWE, CHRISTOPHER (1564–1593), English dramatist, the father of English tragedy, and instaurator of dramatic blank verse, the eldest son of a shoemaker at Canterbury, was born in that city on the 6th of February 1564. He was christened at St George's Church, Canterbury, on the 26th of February, 1563/4, some two months before Shakespeare's baptism at Stratford-on-Avon. His father, John Marlowe, is said to have been the grandson of John Morley or Marlowe, a substantial tanner of Canterbury. The father, who survived by a dozen years or so his illustrious son, married on the 22nd of May 1561 Catherine, daughter of Christopher Arthur, at one time rector of St Peter's, Canterbury, who had been ejected by Queen Mary as a married minister. The dramatist received the rudiments of his education at the King's School, Canterbury, which he entered at Michaelmas 1578, and where he had as his fellow-pupils Richard Boyle, afterwards known as the great earl of Cork, and Will Lyly, the brother of the dramatist. Stephen Gosson entered the same school a little before, and William Harvey, the famous physician, a little after Marlowe. He went to Cambridge as one of Archbishop Parker's scholars from the King's School, and matriculated at Benet (Corpus Christi) College, on the 17th of March 1571, taking his B.A. degree in 1584, and that of M.A. three or four years later.

Francis Kett, the mystic, burnt in 1589 for heresy, was a fellow and tutor of his college, and may have had some share in developing Marlowe's opinions in religious matters. Marlowe's classical acquirements were of a kind which was then extremely common, being based for the most part upon a minute acquaintance with Roman mythology, as revealed in Ovid's *Metamorphoses*. His spirited translation of Ovid's *Amores* (printed 1596), which was at any rate commenced at Cambridge, does not seem to point to any very intimate acquaintance with the grammar and syntax of the Latin tongue. Before 1587 he seems to have quitted Cambridge for London, where he attached himself to the Lord Admiral's Company of Players, under the leadership of the famed actor Edward Alleyn, and almost at once began writing for the stage. Of Marlowe's career in London, apart from his four great theatrical successes, we know hardly anything; but he evidently knew Thomas Kyd, who shared his unorthodox opinions. Nash criticized his verse, Greene affected to shudder at his atheism; Gabriel Harvey maligned his memory. On the other hand Marlowe was intimate with the Walsinghams of Scadbury, Chiselhurst, kinsmen of Sir Francis Walsingham: he was also the personal friend of Sir Walter Raleigh, and perhaps of the poetical earl of Oxford, with both of whom, and with such men as Walter Warner and Robert Hughes the mathematicians, Thomas Harriott the notable astronomer, and Matthew Royden, the dramatist is said to have met in free converse. Either this free converse or the licentious character of some of the young dramatist's tirades seems to have sown a suspicion among the strait-laced that his morals left everything to be desired. It is probable enough that this attitude of reprobation drove a man of so exalted a disposition as Marlowe into a more insurgent attitude than he would have otherwise adopted. He seems at any rate to have been associated with what was denounced as Sir Walter Raleigh's school of atheism, and to have dallied with opinions which were then regarded as putting a man outside the pale of civilized humanity. As the result of some depositions made by Thomas Kyd under the influence of torture, the Privy Council were upon the eve of investigating some serious charges against Marlowe when his career was abruptly and somewhat scandalously terminated. The order had already been issued for his arrest, when he was slain in a quarrel by a man variously named (Archer and Ingram) at Deptford, at the end of May 1593, and he was buried on the 1st of June in the churchyard of St Nicholas at Deptford. The following September Gabriel Harvey referred to him as "dead of the plague." The disgraceful particulars attached to the tragedy of Marlowe in the popular mind would not seem to have appeared until four years later (1597) when Thomas Beard, the Puritan author of *The Theatre of God's Judgements*, used the death of this playmaker and atheist as one of his warning examples of the vengeance of God. Upon the embellishments of this story, such as that of Francis Meres the critic, in 1598, that Marlowe came to be "stabbed to death by a bawdy servingman, a rival of his in his lewde love," or that of William Vaughan in the *Golden Grove* of 1600, in which the unfortunate poet's dagger is thrust into his own eye in prevention of his felonious assault upon an innocent man, his guest, it is impossible now to pronounce. We really do not know the circumstances of Marlowe's death. The probability is he was killed in a brawl, and his atheism must be interpreted not according to the *ex parte* accusation of one Richard Baines, a professional informer (among the Privy Council records), but as a species of rationalistic antinomianism, dialectic in character, and closely related to the deflection from conventional orthodoxy for which Kett was burnt at Norwich in 1589. A few months before the end of his life there is reason to believe that he transferred his services from the Lord Admiral's to Lord Strange's Company, and may have thus been brought into communication with Shakespeare, who in such plays as *Richard II.* and *Richard III.* owed not a little to the influence of his romantic predecessor.

Marlowe's career as a dramatist lies between the years 1587 and 1593, and the four great plays to which reference has been made were *Tamburlaine the Great*, an heroic epic in dramatic form divided into two parts of five acts each (1587, printed in 1590); *Dr Faustus* (1588, entered at Stationers' Hall 1601); *The Famous Tragedy of the Rich Jew of Malta* (dating perhaps from 1589, acted in 1592, printed in 1633); and *Edward the Second* (printed 1594). The very first words of *Tamburlaine* sound the trumpet note of attack in the older order of things dramatic:—

> "From jigging veins of riming mother wits
> And such conceits as clownage keeps in pay
> We'll lead you to the stately tent of war,
> Where you shall hear the Scythian Tamburlaine
> Threatening the world with high astounding terms
> And scourging kingdoms with his conquering sword."

It leapt with a bound to a place beside Kyd's *Spanish Tragedy*, and few plays have been more imitated by rivals (Greene's *Alphonsus of Aragon*, Peele's *Battle of Alcazar*, *Selimus*, *Scanderbeg*) or more keenly satirized by the jealousy and prejudice of out-distanced competitors. (T. SE.)

The majestic and exquisite excellence of various lines and passages in Marlowe's first play must be admitted to relieve, if it cannot be allowed to redeem, the stormy monotony of Titanic truculence which blusters like a simoom through the noisy course of its ten fierce acts. With many and heavy faults, there is something of genuine greatness in *Tamburlaine the Great*; and for two grave reasons it must always be remembered with distinction and mentioned with honour. It is the first poem ever written in English blank verse, as distinguished from mere rhymeless decasyllabics; and it contains one of the noblest passages, perhaps indeed the noblest, in the literature of the world, ever written by one of the greatest masters of poetry in loving praise of the glorious delights and sublime submission to the everlasting limits of his art. In its highest and most distinctive qualities, in unfaltering and infallible command of the right note of music and the proper tone of colour for the finest touches of poetic execution, no poet of the most elaborate modern school, working at ease upon every consummate resource of luxurious learning and leisurely refinement, has ever excelled the best and most representative work of a man who had literally no models before him and probably or evidently was often if not always compelled to write against time for his living.

The just and generous judgment passed by Goethe on the *Faustus* of his English predecessor in tragic treatment of the same subject is somewhat more than sufficient to counterbalance the slighting or the sneering references to that magnificent poem which might have been expected from the ignorance of Byron or the incompetence of Hallam. And the particular note of merit observed, the special point of the praise conferred, by the great German poet should be no less sufficient to dispose of the vulgar misconception yet lingering among sciolists and pretenders to criticism, which regards a writer than whom no man was ever born with a finer or a stronger instinct for perfection of excellence in execution as a mere noble savage of letters, a rough self-taught sketcher or scribbler of crude and rude genius, whose unhewn blocks of verse had in them some veins of rare enough metal to be quarried and polished by Shakespeare. What most impressed the author of *Faust* in the work of Marlowe was a quality the want of which in the author of *Manfred* is proof enough to consign his best work to the second or third class at most. "How greatly it is all planned!" the first requisite of all great work, and one of which the highest genius possible to a greatly gifted barbarian could by no possibility understand the nature or conceive the existence. That Goethe "had thought of translating it" is perhaps hardly less precious a tribute to its greatness than the fact that it has been actually and admirably translated by the matchless translator of Shakespeare—the son of Victor Hugo; whose labour of love may thus be said to have made another point in common, and forged as it were another link of union, between Shakespeare and the young master of Shakespeare's youth. Of all great poems in dramatic form it is perhaps the most remarkable for absolute singleness of aim and simplicity of construction; yet is it wholly free from all possible imputation of monotony or aridity. *Tamburlaine* is monotonous in the general roll and flow of its stately and sonorous verse through a noisy wilderness of perpetual bluster and slaughter; but the unity of tone and purpose in *Doctor Faustus* is not unrelieved by change of manner and variety of incident. The comic scenes, written evidently with as little of labour as of relish, are for the most part scarcely more than transcripts, thrown into the form of dialogue, from a popular prose *History of Dr Faustus*, and therefore should be set down as little to the discredit as to the credit of the poet. Few masterpieces of any age in any language can stand beside this tragic poem—it has hardly the structure of a play—for the qualities of terror and splendour, for intensity of purpose and sublimity of note. In the vision of Helen, for example, the intense perception of loveliness gives actual sublimity to the sweetness and radiance of mere beauty in the passionate and spontaneous selection of words the most choice and perfect; and in like manner the sublimity of simplicity in Marlowe's conception and expression of the agonies endured by Faustus under the immediate imminence of his doom gives the highest note of beauty, the quality of absolute fitness and propriety, to the sheer straightforwardness of speech in which his agonizing horror finds vent ever more and more terrible from the first to the last equally beautiful and fearful verse of that tremendous monologue which has no parallel in all the range of tragedy.

It is now a commonplace of criticism to observe and regret the decline of power and interest after the opening acts of *The Jew of Malta*. This decline is undeniable, though even the latter part of the play (the text of which is very corrupt) is not wanting in rough energy; but the first two acts would be sufficient foundation for the durable fame of a dramatic poet. In the blank verse of Milton alone—who perhaps was hardly less indebted than Shakespeare was before him to Marlowe as the first English master of word-music in its grander forms—has the glory or the melody of passages in the opening soliloquy of Barabbas been possibly surpassed. The figure of the hero before it degenerates into caricature is as finely touched as the poetic execution is excellent; and the rude and rapid sketches of the minor characters show at least some vigour and vivacity of touch.

In *Edward the Second* the interest rises and the execution improves as visibly and as greatly with the course of the advancing story as they decline in *The Jew of Malta*. The scene of the king's deposition at Kenilworth is almost as much finer in tragic effect and poetic quality as it is shorter and less elaborate than the corresponding scene in Shakespeare's *King Richard II.* The terror of the death-scene undoubtedly rises into horror; but this horror is with skilful simplicity of treatment preserved from passing into disgust. In pure poetry, in sublime and splendid imagination, this tragedy is excelled by *Doctor Faustus*; in dramatic power and positive impression of natural effect it is certainly the masterpiece of Marlowe. It was almost inevitable, in the hands of any poet but Shakespeare, that none of the characters represented should be capable of securing or even exciting any finer sympathy or more serious interest than attends on the mere evolution of successive events or the mere display of emotions (except always in the great scene of the deposition) rather animal than spiritual in their expression of rage or tenderness or suffering. The exact balance of mutual effect, the final note of scenic harmony, between ideal conception and realistic execution is not yet struck with perfect accuracy of touch and security of hand; but on this point also Marlowe has here come nearer by many degrees to Shakespeare than any of his other predecessors have ever come near to Marlowe.

Of *The Massacre at Paris* (acted in 1593, printed 1600?) it is impossible to judge fairly from the garbled fragment of its genuine text which is all that has come down to us. To Mr Collier, among numberless other obligations, we owe the discovery of a noble passage excised in the piratical edition which gives us the only version extant of this unlucky play, and which, it must be allowed, contains nothing of quite equal value. This is obviously an occasional and polemical work, and being as it is overcharged with the anti-Catholic passion of the time has a typical quality which gives it some empirical significance and interest. That antipapal ardour is indeed the only note of unity in a rough and ragged chronicle which shambles and stumbles onward from the death of Queen Jeanne of Navarre to the murder of the last Valois. It is possible to conjecture, what it would be fruitless to affirm, that it gave a hint in the next century to Nathaniel Lee for his far superior and really admirable tragedy on the same subject, issued ninety-seven years after the death of Marlowe.

In the tragedy of *Dido Queen of Carthage* (completed by Thomas Nash, produced and printed 1594), a servile fidelity to the text of Virgil's narrative has naturally resulted in the failure which might have been expected from an attempt at once to transcribe what is essentially inimitable and to reproduce it under the hopelessly alien conditions of dramatic adaptation. The one really noble passage in a generally feeble and incomposite piece of work is, however, uninspired by the unattainable model to which the dramatists have been only too obsequious in their subservience. It is as nearly certain as anything can be which depends chiefly upon cumulative and collateral evidence that the better part of what is best in the serious scenes of *King Henry VI.* is mainly the work of Marlowe. That he is at any rate the principal author of the second and third plays passing under that name among the works of Shakespeare, but first and imperfectly printed as *The Contention between the two Famous Houses of York and Lancaster*, can hardly be now a matter of debate among competent judges. The crucial difficulty of criticism in this matter is to determine, if indeed we should not rather say to conjecture, the authorship of the humorous scenes in prose, showing as they generally do a power of comparatively high and pure comic realism to which nothing in the acknowledged works of any pre-Shakespearian dramatist is even remotely comparable. Yet, especially in the original text of these scenes as they stand unpurified by the ultimate revision of Shakespeare or his editors, there are tones and touches which recall rather the clownish horseplay and homely ribaldry of his predecessors than anything in the lighter interludes of his very earliest plays. We find the same sort of thing which we find in their writings, only better done than they usually do it, rather than such work as Shakespeare's a little worse done than usual. And even in the final text of the tragic or metrical scenes the highest note struck is always, with one magnificent and unquestionable exception, rather in the key of Marlowe at his best than of Shakespeare while yet in great measure his disciple.

A Taming of a Shrew, the play on which Shakespeare's comedy was founded, has been attributed, without good reason, to Marlowe. The passages in the play borrowed from Marlowe's works provide an argument against, rather than for his authorship; while the humorous character of the play is not in keeping with his other work. He may have had a share in *The Troublesome Raigne of King John* (1591), and Fleay conjectured that the plays *Edward III.* and *Richard III.* usually included in editions of Shakespeare are at least based on plays by Marlowe. *Lust's Dominion*, printed in 1657, was incorrectly ascribed to him, and a play no longer extant, *The True History of George Scanderbage*, was assumed by Fleay on the authority of an obscure passage of Gabriel Harvey to be his work. *The Maiden's Holiday*, assigned to Day and Marlowe, was destroyed by Warburton's cook. Day was considerably Marlowe's junior, and collaboration between the two is not probable.

Had every copy of Marlowe's boyish version or perversion of Ovid's *Elegies* (P. Ovidii Nasonis *Amorum* compressed into three books) deservedly perished in the flames to which it was judicially condemned by the sentence of a brace of prelates, it is possible that an occasional bookworm, it is certain that no poetical student, would have deplored its destruction, if its demerits could in that case have been imagined. His translation of the first book of Lucan alternately rises above the original and falls short of it,—often inferior to the Latin in point and weight of expressive rhetoric, now and then brightened by a clearer note of poetry and lifted into a higher mood of verse. Its terseness, vigour and purity of style would in any case have been praiseworthy, but are nothing less than admirable, if not wonderful, when we consider how close the translator has on the whole (in spite of occasional slips into inaccuracy) kept himself to the most rigid limit of literal representation, phrase by phrase and often line by line. The really startling force and felicity of occasional verses are worthier of remark than the inevitable stiffness and heaviness of others, when the technical difficulty of such a task is duly taken into account.

One of the most faultless lyrics and one of the loveliest fragments in the whole range of descriptive and fanciful poetry would have secured a place for Marlowe among the memorable men of his epoch, even if his plays had perished with himself. His *Passionate Shepherd* remains ever since unrivalled in its way—a way of pure fancy and radiant melody without break or lapse. The untitled fragment, on the other hand, has been very closely rivalled, perhaps very happily imitated, but only by the greatest lyric poet of England—by Shelley alone. Marlowe's poem of *Hero and Leander* (entered at Stationers' Hall in September 1593; completed and brought out by George Chapman, who divided Marlowe's work into two sestiads and added four of his own, 1598), closing with the sunrise which closes the night of the lovers' union, stands alone in its age, and far ahead of the work of any possible competitor between the death of Spenser and the dawn of Milton. In clear mastery of narrative and presentation, in melodious ease and simplicity of strength, it is not less pre-eminent than in the adorable beauty and impeccable perfection of separate lines or passages. It is doubtful whether the heroic couplet has ever been more finely handled.

The place and the value of Christopher Marlowe as a leader among English poets it would be almost impossible for historical criticism to over-estimate. To none of them all, perhaps, have so many of the greatest among them been so deeply and so directly indebted. Nor was ever any great writer's influence upon his fellows more utterly and unmixedly an influence for good. He first, and he alone, guided Shakespeare into the right way of work; his music, in which there is no echo of any man's before him, found its own echo in the more prolonged but hardly more exalted harmony of Milton's. He is the greatest discoverer, the most daring and inspired pioneer, in all our poetic literature. Before him there was neither genuine blank verse nor a genuine tragedy in our language. After his arrival the way was prepared, the paths were made straight, for Shakespeare. (A. C. S.)

Marlowe's fame, so finely appreciated by Shakespeare and Drayton, was in obscuration from the fall of the theatres until the generation of Lamb and Hazlitt. A collected edition was brought out by Pickering in 1826. This was greatly improved upon by A. Dyce (1858, 1865, 1876). A one-volume edition was prepared by Colonel Francis Cunningham in 1871. The standard edition of Mr A. H. Bullen in 3 vols. appeared in 1884–1885 and is now under revision. The "Best Plays" were edited for the Mermaid series by Havelock Ellis with an Introduction by J. A. Symonds (1887–1889). The best modern text is that edited by C. F. Tucker Brooke (Oxf. Univ. Press, 1910). A sketch in outline of Marlowe's Life was essayed by J. G. Lewis (Canterbury, 1891). A not very conclusive monograph on *Christopher Marlowe and his Associates* by J. H. Ingram, followed in 1904. For further information the reader should consult the histories of the stage by Collier, Ward, Fleay, Schelling, and the studies of Shakespeare's Predecessors by Symonds, Mezières, Boas, Manley, Churton Collins, Feuillerat and J. M. Robertson. See also Verity's *Essay on Marlowe's Influence* (1886); *Mod. Lang. Rev.* iv. 167 (M. at Cambridge); Swinburne, *Study of Shakespeare* (1880); Elze, *Notes*, and Hazlitt *Dramatic Lit. of the Age of Elizabeth*; *Fortnightly Review*, xiii., lxxi., and Sept.–Oct., 1905; Jusserand, *Hist. of English Lit.*; the *Cambridge Hist. of English Lit.*; Seccombe and Allen, *Age of Shakespeare* (vol. ii. 3rd ed., 1909), and the separate editions of *Dr Faustus*, *Edward II.*, &c. The main sources of Marlowe were as follows: for *Tamburlaine*, Pedro Mexia's *Life of Timur* in his *Silva* (Madrid, 1543), anglicized by Fortescue in his *Foreste* (1571) and Petrus Perondinus *Vita Magni Tamerlanis* (1551); for *Faustus*: a contemporary English version of the Faust-buch or *Historia von D. Johann Fausten* (Frankfort, 1587), and for *Edward II.*, the *Chronicles* of Fabyan (1516), Holinshed (1577) and Stow (1580). (T. Se.)

MARLOWE, JULIA [Sarah Frances Frost] (1870–), American actress, was born near Keswick, England, on the 17th of August 1870, and went with her family to America in 1875. Her first formal appearance on the stage was in New York in 1887, although she had before that travelled with a juvenile opera company in *H.M.S. Pinafore*, and afterwards was given such parts as Maria in *Twelfth Night* in Miss Josephine Riley's travelling company. Her first great success was as Parthenia in *Ingomar*, and her subsequent presentations of Rosalind, Viola, and Julia in *The Hunchback* confirmed her position as a "star." In 1894 she married Robert Taber, an actor, with whom she played until their divorce in 1900. Subsequently she had great success as Barbara Frietchie in Clyde Fitch's play of that name, and other dramas; and from 1904 to 1907 she acted with E. H. Sothern in a notable series of Shakespeare plays, as well as in modern drama.

MARLY-LE-ROI, a village of northern France in the department of Seine-et-Oise, 5 m. N. by W. of Versailles by road. Pop. (1906), 1409. Notwithstanding some fine country houses, Marly is dull and unattractive, and owes all its celebrity to the sumptuous château built towards the end of the 17th century by Louis XIV., and now destroyed. It was originally designed as a simple hermitage to which the king could occasionally retire with a few of his more intimate friends from the pomp of Versailles, but gradually it grew until it became one of the most ruinous extravagances of the Grand Monarque. The central pavilion (inhabited by the king himself) and its twelve subsidiary pavilions were intended to suggest the sun surrounded by the signs of the zodiac. Seldom visited by Louis XV., and wholly abandoned by Louis XVI., it was demolished after the Revolution, its art treasures having previously been dispersed, and the remains now consist of a large basin, the Abreuvoir, a few mouldering ivy-grown walls, some traces of parterres with magnificent trees, the park, and the forest of 8½ sq. m., one of the most pleasant promenades of the neighbourhood of Paris, containing the shooting preserves of the President of the Republic.

Close to the Seine, half-way between Marly-le-Roi and St Germain, is the village of Port-Marly, and one mile farther up is the hamlet of Marly-la-Machine. Here, in 1684, an immense hydraulic engine, driven by the current of the river, was erected; it raised the water to a high tower, where the aqueduct of Marly began (700 yds. in length, 75 in height, with 36 arches, still well-preserved), carrying the waters of the Seine to Versailles.

MARMALADE (adopted from Fr. *marmelade*, from *marmelo*, a quince, derived through the Lat. *melimelum*, from Gr. μέλι, honey, and μῆλον, an apple, an apple grafted on a quince), a preserve originally made of quinces, but now commonly of Seville oranges. The "marmalade-tree" (*Lucuma mammosa*) bears a fruit whose thick pulp resembles marmalade and is called natural marmalade. "Marmalade box" is the name of the fruit of the *Genipa Americana*, which opens in the same manner as a walnut, the nut being replaced by a soft pulp.

MARMANDE, a town of south-western France, capital of an arrondissement in the department of Lot-et-Garonne, 35 m. N.W. of Agen, on the Southern railway from Bordeaux to Cette. Pop. (1906), town 6373; commune, 9748. Marmande is situated at the confluence of the Trec with the Garonne on the right bank of the latter river, which is here crossed by a suspension bridge. Public institutions include the sub-prefecture, the tribunals of first instance and commerce, the communal college and schools of commerce and industry and of agriculture. Apart from the administrative offices, the only building of importance is the church of Nôtre-Dame, which dates from the 13th, 14th and 15th centuries. The graceful windows of the nave, the altar-piece of the 18th century, and in particular, the Renaissance cloister adjoining the south side, are its most interesting features. Among the industries are iron-founding, steam sawing, the manufacture of woollens, carriage-making, cooperage and brandy-distilling. There is a large trade in wine, plums, cattle, grain and other agricultural produce.

Marmande was a *bastide* founded about 1195 on the site of a more ancient town by Richard Cœur de Lion, who granted it a liberal measure of self-government. Its position on the banks of the Garonne made it an important place of toll. It soon passed into the hands of the counts of Toulouse, and was three times besieged and taken during the Albigensian crusade, its capture by Amaury de Montfort in 1219 being followed by a massacre of the inhabitants. It was united to the French crown under Louis IX. A short occupation by the English in 1447, an unsuccessful siege by Henry IV. in 1577 and its resistance of a month to a division of Wellington's army in 1814, are the chief events in its subsequent history.

MARMIER, XAVIER (1809–1892), French author, was born at Pontarlier, in Doubs, on the 24th of June 1809. He had a passion for travelling, and this he combined throughout his life with the production of literature. After journeying in Switzerland, Belgium and Holland, he was attached in 1835 to the Arctic expedition of the "Recherche"; and after a couple of years at Rennes as professor of foreign literature, he visited (1842) Russia, (1845) Syria, (1846) Algeria, (1848–1849) North and South America, and numerous volumes from his pen were the result. In 1870 he was elected to the Academy, and he was for many years prominently identified with the Sainte-Geneviève library. He did much to encourage the study of Scandinavian literature in France, publishing translations of Holberg, Oehlenschläger and others. He died in Paris on the 11th of October 1892.

MARMONT, AUGUSTE FRÉDÉRIC LOUIS VIESSE DE, Duke of Ragusa (1774–1852), marshal of France, was born at Châtillon-sur-Seine, on the 20th of July 1774. He was the son of an ex-officer in the army who belonged to the *petite noblesse* and adopted the principles of the Revolution. His love of soldiering soon showing itself, his father took him to Dijon to learn mathematics prior to entering the artillery, and there he made the acquaintance of Bonaparte, which he renewed after obtaining his commission when he served in Toulon. The acquaintance ripened into intimacy; Marmont became General Bonaparte's aide-de-camp, remained with him during his disgrace and accompanied him to Italy and Egypt, winning distinction and promotion to general of brigade. In 1799 he returned to Europe with his chief; he was present at the *coup d'état* of the 18th Brumaire, and organized the artillery for the expedition to Italy, which he commanded with great effect at Marengo. For this he was at once made general of division. In 1801 he became inspector-general of artillery, and in 1804 grand officer of the Legion of Honour, but was greatly disappointed at being omitted from the list of officers who were made marshals. In 1805 he received the command of a corps, with which he did good service at Ulm. He was then directed to take possession of Dalmatia with his army, and occupied Ragusa. For the next five years he was military and civil governor of Dalmatia, and traces of his beneficent régime still survive both in great public works and in the memories of the people. In 1808 he was made duke of Ragusa, and in 1809, being summoned by Napoleon to take part in the Austrian War, he marched to Vienna and bore a share in the closing operations of the campaign. Napoleon now made him a marshal and governor-general of all the Illyrian provinces of the empire. In July 1810 Marmont was hastily summoned to succeed Masséna in the command of the French army in the north of Spain. The skill with which he manœuvred his army during the year he commanded it has been always acknowledged. His relief of Ciudad Rodrigo in the autumn of 1811 in spite of the presence of the English army was a great feat, and in the manœuvring which preceded the battle of Salamanca he had the best of it. But Wellington more than retrieved his position in the battle (see SALAMANCA), and inflicted a severe defeat on the French, Marmont himself being gravely wounded in the right arm and side. He retired to France to recover, and was still hardly cured when in April 1813 Napoleon, who soon forgot his fleeting resentment for the defeat, gave him the command of a corps. With it he served at the battles of Lützen, Bautzen and Dresden, and throughout the great defensive campaign of 1814 until the last battle before Paris, from which he drew back his forces to the commanding position of Essonne. Here he had 20,000 men in hand, and was the pivot of all thoughts. Napoleon said of this camp of Essonne, "C'est là que viendront s'addresser toutes les intrigues, toutes les trahisons; aussi y ai-je placé Marmont, mon enfant élevé sous ma tente." Marmont then took upon himself a political rôle which has, no doubt justly, been stigmatized as ungrateful and treasonable. A secret convention was concluded, and Marmont's corps was surrounded by the enemy. Napoleon, who still hoped to retain the crown for his infant son, was prostrated, and said with a sadness deeper than violent words, "Marmont me porte le dernier coup."

This act was never forgiven by Marmont's countrymen. On the restoration of the Bourbons he was indeed made a peer of France and a major-general of the royal guard, and in 1820 a knight of the Saint Esprit and a grand officer of the order of St Louis; but he was never trusted. He was the major-general of the guard on duty in July 1830, and was ordered to put down with a strong hand any opposition to the ordinances (see FRANCE). Himself opposed to the court policy, he yet tried to do his duty, and only gave up the attempt to suppress the revolution when it became clear that his troops were outmatched. This brought more obloquy upon him, and the duc d'Angoulême even ordered him under arrest, saying, "Will you betray us, as you betrayed him?" Marmont did not betray them; he accompanied the king into exile and forfeited his marshalate thereby. His desire to return to France was never gratified and he wandered in central and eastern Europe, settling finally in Vienna, where he was well received by the Austrian government, and strange to say made tutor to the duke of Reichstadt, the young man who had once for a few weeks been styled Napoleon II. He died at Venice on the 22nd of March 1852.

Much of his time in his last years was spent upon his *Mémoires*, which are of great value for the military history of his time, though they must be read as a personal defence of himself in various junctures rather than as an unbiased account of his times. They show Marmont, as he really was, an embittered man, who never thought his services sufficiently requited, and above all, a man too much in love with himself and his own glory to be a true friend or a faithful servant. His strategy indeed tended to become pure virtuosity, and his tactics, though neat, appear frigid and antiquated when contrasted with those of the instinctive leaders, the fighting generals whom the theorists affect to despise. But his military genius is undeniable, and he was as far superior to the mere theorist as Lannes and Davout were to the pure *divisionnaire* or "fighting" general.

His works are *Voyage en Hongrie*, &c. (4 vols., 1837); *Voyage en Sicile* (1838); *Esprit des institutions militaires* (1845); *César*; *Xenophon*; and *Mémoires* (8 vols., published after his death in 1856). See the long and careful notice by Sainte-Beuve, *Causeries du Lundi*, vol. vi.

MARMONTEL, JEAN FRANÇOIS (1723–1799), French writer, was born of poor parents at Bort, in Cantal, on the 11th of July 1723. After studying with the Jesuits at Mauriac, he taught in their colleges at Clermont and Toulouse; and in 1745, acting on the advice of Voltaire, he set out for Paris to try for literary honours. From 1748 to 1753 he wrote a succession of tragedies which,[1] though only moderately successful on the stage, secured the admission of the author to literary and fashionable circles. He wrote for the *Encyclopédie* a series of articles evincing considerable critical power and insight, which in their collected form, under the title *Éléments de Littérature*, still rank among the French classics. He also wrote several comic operas, the two best of which probably are *Sylvain* (1770) and *Zémire et Azore* (1771). In the Gluck-Piccini controversy he was an eager partisan of Piccini with whom he collaborated in *Didon* (1783) and *Pénélope* (1785). In 1758 he gained the patronage of Madame de Pompadour, who obtained for him a place as a civil servant, and the management of the official journal *Le Mercure*, in which he had already begun the famous series of *Contes moraux*. The merit of these tales lies partly in the delicate finish of the style, but mainly in the graphic and charming pictures of French society under Louis XV. The author was elected to the French Academy in 1763. In 1767 he published a romance, *Bélisaire*, now remarkable only on account of a chapter on religious toleration which incurred the censure of the Sorbonne and the archbishop of Paris. Marmontel retorted in *Les Incas* (1778) by tracing the cruelties in Spanish America to the religious fanaticism of the invaders.

He was appointed historiographer of France (1771), secretary to the Academy (1783), and professor of history in the Lycée (1786). In his character of historiographer Marmontel wrote a history of the regency (1788) which is of little value. Reduced to poverty by the Revolution, Marmontel in 1792 retired during the Terror to Evreux, and soon after to a cottage at Abloville in the department of Eure. To that retreat we owe his *Mémoires d'un père* (4 vols., 1804) giving a picturesque review of his whole life, a literary history of two important reigns, a great gallery of portraits extending from the venerable Massillon, whom more than half a century previously he had seen at Clermont, to Mirabeau. The book was nominally written for the instruction of his children. It contains an exquisitely drawn picture of his own childhood in the Limousin; its value for the literary historian is very great. Marmontel lived for some time under the roof of Mme Geoffrin, and was present at her famous dinners given to artists; he was, indeed, an *habitué* of most of the houses where the encyclopaedists met. He had thus at his command the best material for his portraits, and made good use of his opportunities. After a short stay in Paris when elected in 1797 to the Conseil des Anciens, he died on the 31st of December 1799 at Abloville.

See Sainte-Beuve, *Causeries du lundi*, iv.; Morellet, *Éloge* (1805).

MARMORA (anc. *Proconnesus*), an island in the sea of the same name. Originally settled by Greeks from Miletus in the 8th century B.C., Proconnesus was annexed by its powerful neighbour Cyzicus in 362. The island has at all times been noted for its quarries of white marble which supplied the material for several famous buildings of antiquity (*e.g.* the palace of Mausolus at Halicarnassus).

See C. Texier, *Asie mineure* (Paris, 1839–1849); M. I. Gedeon, *Προικόννησος* (Constantinople, 1895); an exhaustive monograph by F. W. Hasluck in *Journ. Hell. Stud.*, xxix., 1909.

MARMORA, SEA OF (anc. *Propontis*; Turk. *Mermer Deñisi*), the small inland sea which (in part) separates the Turkish dominions in Europe from those in Asia, and is connected through the Bosporus with the Black Sea (*q.v.*) and through the Dardanelles with the Aegean. It is 170 m. long (E. to W.) and nearly 50 m. in extreme width, and has an area of 4500 sq. m. Its greatest depth is about 700 fathoms, the deepest parts (over 500 fathoms) occurring in three depressions in the northern portion—one close under the European shore to the south of Rodosto, another near the centre of the sea, and a third at the mouth of the Gulf of Ismid. There are several considerable islands, of which the largest, Marmora, lies in the west, off the peninsula of Kapu Dagh, along with Afsia, Aloni and smaller islands. In the east, off the Asiatic shore between the Bosporus and the Gulf of Ismid, are the Princes' Islands.

MARMOSET, a name derived from Fr. *marmouset* (meaning "of a gross figure"), and used to designate the small tropical American monkeys classed by naturalists in the family *Hapalidae* (or *Chrysothricidae*). Marmosets are not larger than squirrels, and present great variation in colour; all have long tails, and many have the ears tufted. They differ from the other American monkeys in having one pair less of molar teeth in each jaw. The common marmoset, *Hapale* (or *Chrysothrix*) *jacchus*, is locally known as the *oustiti*, while the name piriché is applied to another species (see PRIMATES).

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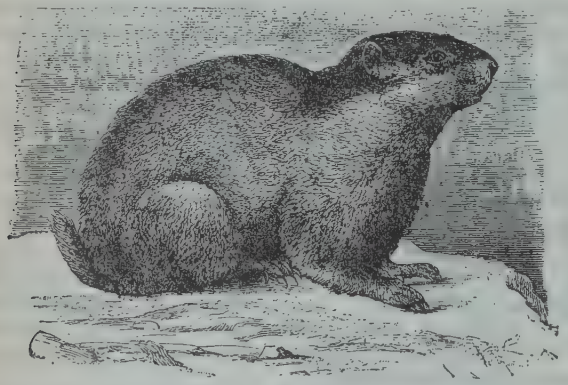
[1] *Denys le Tyran* (1748); *Aristomène* (1749); *Cléopâtre* (1750); *Héraclides* (1752); *Egyptus* (1753).

MARMOT, the vernacular name of a large, thickly built, burrowing Alpine rodent mammal, allied to the squirrels, and typifying the genus *Arctomys*, of which there are numerous species ranging from the Alps through Asia north of (but including the inner ranges of) the Himalaya, and recurring in North America. All these may be included under the name marmot. In addition to their stout build and long thickly haired tails, marmots are characterized by the absence of cheek-pouches, and the rudimentary first front-toe, which is furnished with a flat nail, as well as by certain features of the skull and cheek-teeth. Europe possesses two species, the Alpine or true marmot (*A. marmotta*), and the more eastern bobac (*A. bobac*); and there are numerous kinds in Central Asia, one of which, the red marmot (*A. caudata*), is a much larger animal, with a longer tail. Marmots inhabit open country, either among mountains, or, more to the north, in the plains; and associate in large colonies, forming burrows, each tenanted by a single family. During the daytime the hillock at the entrance to the burrow is frequently occupied by one or more members of the family, which at the approach of strangers sit up on their hind-legs in order to get a better view. If alarmed they utter a shrill loud whistle, and rush down the burrow, but reappear after a few minutes to see if the danger is past. In the winter when the ground is deep in snow, marmots retire to the depths of their burrows, where as many as ten or fifteen may occupy the same chamber. No store of food is accumulated, and the winter sleep is probably unbroken. From two to four is the usual number of young in a litter. In America marmots are known as "wood-chucks" (*q.v.*), the commonest species being *A. monax*. The so-called prairie-dogs, which are smaller and more slender North American rodents with small cheek-pouches, form a separate genus, *Cynomys*; while the term pouched-marmots denotes the various species of souslik (*q.v.*), *Spermophilus* (or *Citillus*), which are common to both hemispheres, and distinguished by the presence of large cheek-pouches (see RODENTIA). (R.L.*)


The Alpine Marmot (*Arctomys marmotta*).

MARNE, a river of northern France, rising on the Plateau of Langres, 3 m. S. by E. of Langres, and uniting with the Seine at Charenton, an eastern suburb of Paris. Leaving Langres on the left the river flows northward, passing Chaumont, as far as a point a little above St Dizier. Here it turns west and enters the department of Marne, where it waters the Perthois and the wide plain of Champagne-Pouilleuse. Soon after its entrance into this department it receives the Blaise; and turning north-west passes Vitry-le-François where it receives the Saulx, Châlons, below which it resumes a westerly course, and Epernay, where it enters picturesque and undulating country. Its subsequent course lies through the departments of Aisne, where it flows through Chateau-Thierry; Seine-et-Marne, where it drives the picturesque mills of Meaux; Seine-et-Oise and Seine. Its chief tributaries in those departments are the Petit-Morin, the Ourcq and the Grand-Morin. The length of the Marne is 328 m., the area of its basin 4894 sq. m. It is joined a mile from its source of the Marne-Saône canal which is continued at Rouvroy by the Haute-Marne canal as far as Vitry-le-François. From that town, which is the starting-point of the canal between the Marne and the Rhine, it is accompanied by the lateral canal of the Marne to Dizy where its own channel is canalized. At Condé, above Epernay, the river is joined by the canal connecting it with the Aisne. From Lizy, above Meaux, it is accompanied on the right bank, though at some distance, by the Ourcq canal.

MARNE, a department of north-eastern France, made up from Champagne-Pouilleuse, Rémois, Haute-Champagne, Perthois, Tardenois, Bocage and Brie-Pouilleuse, districts formerly belonging to Champagne, and bounded W. by Seine-et-Marne and Aisne, N. by Aisne and Ardennes, E. by Meuse, and S. by Haute-Marne and Aube. Pop. (1906), 434,157. Area 3167 sq. m.

About one-half consists of Champagne-Pouilleuse, a monotonous and barren plain covering a bed of chalk 1300 ft. in thickness. On the west and on the east it is commanded by two ranges of hills. The highest point in the department (920 ft.) is in the hill district of Reims, which rises to the south-west of the town of the same name, between the Vesle and the Marne. The lowest level (164 ft.) where the Aisne leaves the department, is not far distant. To the south of the Marne the hills of Reims are continued by the heights of Brie (700 to 800 ft.). All these belong geologically to the basin of Paris. They slope gently towards the west, but command the plain of Champagne-Pouilleuse by a steep descent on the east. On the farther side of the plain are the heights of Argonne (860 ft.) formed of beds of the Lower Chalk, and covered by forests; they unite the calcareous formations of Langres to the schists of Ardennes, and a continuation of them stretches southward into Perthois and the marshy Bocage. The department belongs entirely to the Seine basin, but includes only 13 miles of that river, in the south-west; it there receives the Aube, which flows for 10 miles within the department. The principal river is the Marne, which runs through the department for 105 miles in a great sweep concave to the south-west. The Aisne enters the department at a point 12 miles from its source, and traverses it for 37 miles. Two of its affluents on the left, the Suippes and the Vesle, on which stands Reims, have a longer course from south-east to north-west across the department.

Marne has the temperate climate of the region of the Seine; the annual mean temperature is 50° F., the rainfall about 24 in. Oats, wheat, rye and barley among the cereals, lucerne, sainfoin and clover, and potatoes, mangold-wurzels and sugar-beet are the principal agricultural crops. The raising of sheep of a mixed merino breed and of other stock together with bee-farming are profitable. The vineyards, concentrated chiefly round Reims and Épernay, are of high value; the manufacture of the sparkling Champagne wines being a highly important industry, of which Épernay, Reims and Châlons are the chief centres. Several communes supply the more valuable vegetables, such as asparagus, onions, &c. The principal orchard fruits are the apple, plum and cherry. Pine woods are largely planted in Champagne-Pouilleuse. The department produces peat, millstones and chalk.

The woollen industry has brought together in the neighbourhood of Reims establishments for spinning, carding, dyeing and weaving. The materials wrought are flannels, merinoes, tartans, shawls, rugs and fancy articles; the manufacture of woollen and cotton hosiery must also be mentioned. The manufacture of wine-cases, corks, casks and other goods for the wine trade is actively carried on. Marne contains blast-furnaces, iron and copper foundries, and manufactories of agricultural implements. Besides these there are tan-yards, currying and leather-dressing establishments and glassworks, which, with sugar, chemical, whiting and oil works, potteries, flour-mills and breweries, complete the list of the most important industries. Biscuits and gingerbread are a speciality of Reims. The chief imports are wool and coal; the exports are wine, grain, live-stock, stone, whiting, pit-props and woollen stuffs. Communication is afforded chiefly by the river Marne with its canal connexions, and by the Eastern railway. There are five arrondissements—those of Châlons (the capital), Épernay, Reims, Ste Ménehould and Vitry-le-François—with 33 cantons and 662 communes. The department belongs partly to the archbishopric of Reims and partly to the see of Châlons. Châlons is the headquarters of the VI. army corps. Its educational centre and court of appeal are at Paris. The principal towns—Châlons-sur-Marne, Reims, Épernay and Vitry-le-François—are separately treated. The towns next in population are Ay (4994) and Sézanne (4504). Other places of interest are Ste Ménehould (3348), formerly an important fortress and capital of the Argonne; Montmort with a Renaissance château once the property of Sully; Trois-Fontaines with a ruined church of the 12th century and the remains of a Cistercian abbey founded in 1115; and Orbais with an abbey church dating from about 1200.

MARNIAN EPOCH, the name given by G. de Mortillet to the period usually called in France the Gallic, which extends from about five centuries before the Christian era to the conquest of Gaul by Caesar. M. de Mortillet objects to the term "Gallic," as the civilization characteristic of the epoch was not peculiar to the ancient Gauls, but was common to nearly all Europe at the same date. The name is derived from the fact that the French department of Marne has afforded the richest "finds."

MAROCHETTI, CARLO, BARON (1805–1867), Italian sculptor, was born at Turin. Most of his early life was spent in France, his first systematic instruction being given him by Bosio and Gros in Paris. Here his statue of "A Young Girl playing with a Dog" won a medal in 1829. But between 1822 and 1830 he studied chiefly in Rome. From 1832 to 1848 he lived in France. His "Fallen Angel" was exhibited in 1831. In 1848 Marochetti removed to London, and there he lived for the greater part of his time till his death in 1867. Among his chief works were statues of Queen Victoria, Lord Clyde (the obelisk in Waterloo Place), Richard Cœur-de-Lion (Westminster), Emmanuel Philibert (1833, Turin), the tomb of Bellini (Père-la-Chaise), and the altar in the Madeleine. His style was vigorous and effective, but rather popular than artistic. Marochetti, who was created a baron by the king of Sardinia, was also a chevalier of the Legion of Honour.

MARONITES (Arab. *Mawarina*), a Christian people of the Ottoman Empire in communion with the Papal Church, but forming a distinct denomination. The original seat and present home of the nucleus of the Maronites is Mt Lebanon; but they are also to be found in considerable force in Anti-Lebanon and Hermon, and more sporadically in and near Antioch, in Galilee, and on the Syrian coast. Colonies exist in Cyprus (with a large convent near Cape Kormakiti), in Alexandria, and in the United States of America. These began to be formed during the troubles of 1860. The Lebanon community numbers about 300,000, and the total of the whole denomination cannot be much under half a million.

The origin of Maronism has been much obscured by the efforts of learned Maronites like Yusuf as-Simani (Assemanus), Vatican librarian under Clement XII., Faustus Nairon, Gabriel Sionita and Abraham Ecchellensis to clear its history from all taint of heresy. We are told of an early Antiochene, Mar Marun or Maro, who died about A.D. 400 in the odour of sanctity in a convent at Ribla on the Orontes, whence orthodoxy spread over mid-Syria. But nothing sure is known of him, and not much more about a more historical personage, Yuhanna Marun (John Sirimensis of Suedia), said to have been patriarch of Antioch, to have converted Lebanon from Monothelism, and to have died in A.D. 707. It is, however, certain that the Lebanon Christians as a whole were not orthodox in the time of Justinian II., against whose supporters, the Melkites, they ranged themselves after having co-operated awhile with the emperor against the Moslems. They were then called Mardaites or rebels, and were mainly Monothelite in the 12th century, and remained largely so even a century later. The last two facts are attested by William of Tyre and Barhebraeus. It seems most probable that the Lebanon offered refuge to Antiochene Monothelites flying from the ban of the Constantinopolitan Council of A.D. 680; that these converted part of the old mountain folk, who already held some kind of Incarnationist creed; and that their first patriarch and his successors, for about 500 years at any rate, were Monothelite, and perhaps also Monophysite. It is worth noting that even as late as the close of the 16th century the Maronite patriarch found it necessary to protest by anathema against imputations of heresy. In 1182 it is said that Amaury, patriarch of Antioch, induced some Maronite bishops, who had fallen under crusading influences, to rally to Rome; and a definite acceptance of the Maronite Church into the Roman communion took place at the Council of Florence in 1445. But it is evident that the local particularism of the Lebanon was adverse to this union, and that even Gregory XIII., who sent the *pallium* to the patriarch Michael, and Clement VII. who in 1596 dispatched a mission to a synod convoked at Kannobin, the old patriarchal residence, did not prevail on the lower clergy or the mass of the Maronites. A century and a half later Clement XII. was more successful. He sent to Syria, Assemanus, a Maronite educated at the Roman college of Gregory XIII.; and at last, at a council held at the monastery of Lowaizi on the 30th of September 1736, the Maronite Church accepted from Rome a constitution which is still in force, and agreed to abandon some of its more incongruous usages such as mixed convents of monks and nuns. It retained, however, its Syriac liturgy and a non-celibate priesthood. The former still persists unchanged, while the Bible is read and exhortations are given in Arabic; and priests may still be ordained after marriage. But marriage is not permitted subsequent to ordination, nor does it any longer usually precede it. The tendency to a celibate clergy increases, together with other romanizing usages, promoted by the papal legate in Beirut, the Catholic missioners, and the higher native clergy who are usually educated in Rome or at St Sulpice. The legate exercises growing influence on patriarchal and other elections, and on Church government and discipline. The patriarch receives confirmation from Rome, and the political representation of the Maronites at Constantinople is in the hands of the vicar apostolic. Rome has incorporated most of the Maronite saints in her calendar, while refusing (despite their apologists) to canonize either of the reputed eponymous founders of Maronism.

While retaining many local usages, the Maronite Church does not differ now in anything essential from the Papal, either in dogma or practice. It has, like the Greek Church, two kinds of clergy—parochial and monastic. The former are supported by their parishes; the latter by the revenues of the monasteries, which own about one-sixth of the Lebanon lands. There are some 1400 monks in about 120 monastic establishments (many of these being mere farms in charge of one or two monks). All are of the order of St Anthony, but divided into three congregations, the Ishaya, the Halebiyeh (Aleppine) and the Beladiyeh or Libnaniyeh (local). The distinction of the last named dates only from the early 18th century. The lower clergy are educated at the theological college of Ain Warka. There are five archbishoprics and five bishoprics under the patriarch, who alone can consecrate. The sees are Aleppo, Baalbek, Tripoli, Ehden, Damascus, Beirut, Tyre, Cyprus and Jebeil (held by the patriarch himself *ex officio*). There are also four prelates *in partibus*.

The Maronites are most numerous and unmixed in the north of Lebanon (districts of Bsherreh and Kesrawan). Formerly they were wholly organized on a clan system under feudal chiefs, of whom those of the house of Khazin were the most powerful; and these fought among themselves rather than with the Druses or other denominations down to the 18th century, when the Arab family of Shehab for its own purposes began to stir up strife between Maronites and Druses (see DRUSES). Feudalism died hard, but since 1860 has been practically extinct; and so far as the Maronites own a chief of their own people it is the "Patriarch of Antioch and the whole East," who resides at Bkerkeh near Beirut in winter, and at a hill station (Bdiman or Raifun) in summer. The latter, however, has no recognized jurisdiction except over his clergy. The Maronites have four members on the provincial council, two of whom are the sole representatives of the two *mudirats* of Kesrawan; and they have derived benefit from the fact that so far the governor of the privileged province has always been a Catholic (see LEBANON). The French protection of them, which dates from Louis XIV., is no longer operative but to French official representatives is still accorded a courteous precedence. The Maronite population has greatly increased at the expense of the Druses, and is now obliged to emigrate in considerable numbers. Increase of wealth and the influence of returned emigrants tend to soften Maronite character, and the last remnants of the barbarous state of the community—even the obstinate blood-feud—are disappearing.

See C. F. Schnurrer, *De ecclesia Maronitica* (1810); F. J. Bliss in *Pal. Expl. Fund Quarterly Statement* (1892); and authorities for Druses and Lebanon. (D. G. H.)

MAROONS. A *nègre marron* is defined by Littré as a fugitive slave who betakes himself to the woods; a similar definition of *cimarron* (apparently from *cima*, a mountain top) is given in the *Dictionary* of the Spanish Academy. The old English form of the word is *symaron* (see Hawkins's *Voyage*, § 68). The term "Maroons" is applied almost as a proper name to the descendants of those negroes in Jamaica who at the first English occupation in the 17th century fled to the mountains. (See Jamaica.)

MAROS-VÁSÁRHELY, a town of Hungary in Transylvania, capital of the county of Maros-Torda, 79 m. E. of Kolozsvár by rail. Pop. (1900), 19,522. It is situated on the left bank of the Maros, and is a well-built town, once the capital of the territory of the Szeklers. On a hill dominating the town stands the old fortress, which contains a beautiful church in Gothic style built about 1446, where in 1571 the diet was held which proclaimed the equality of the Unitarian Church with the Roman Catholic, the Lutheran, and Calvinistic Churches. The Teleki palace contains the Teleki collections, which include a library of 70,000 volumes and several valuable manuscripts (*e.g.* the Teleki Codex), a collection of old Hungarian poems, and a manuscript of Tacitus, besides a collection of antiquities and another of minerals. Maros-Vásárhely has also an interesting Szekler industrial museum. The trade is chiefly in timber, grain, wine, tobacco, fruit and other products of the neighbourhood. There are manufactures of sugar, spirits and beer.

MAROT, CLÉMENT (1496–1544), French poet, was born at Cahors, the capital of the province of Quercy, some time during the winter of the year 1496–1497. His father, Jean Marot (*c.* 1463–1523), whose more correct name appears to have been des Mares, Marais or Marets, was a Norman of the neighbourhood of Caen. Jean was himself a poet of considerable merit, and held the post of *escripvain* (apparently uniting the duties of poet laureate and historiographer) to Anne of Brittany. He had however resided in Cahors for a considerable time, and was twice married there, his second wife being the mother of Clément. The boy was "brought into France"—it is his own expression, and is not unnoteworthy as showing the strict sense in which that term was still used at the beginning of the 16th century—in 1506, and he appears to have been educated at the university of Paris, and to have then begun the study of law. But, whereas most other poets have had to cultivate poetry against their father's will, Jean Marot took great pains to instruct his son in the fashionable forms of verse-making, which indeed required not a little instruction. It was the palmy time of the *rhétoriqueurs*, poets who combined stilted and pedantic language with an obstinate adherence to the allegorical manner of the 15th century and to the most complicated and artificial forms of the *ballade* and the *rondeau*. Clément himself practised with diligence this poetry (which he was to do more than any other man to overthrow), and he has left panegyrics of its coryphaeus Guillaume Crétin, the supposed original of the Raminagrobis of Rabelais, while he translated Virgil's first eclogue in 1512. Nor did he long continue even a nominal devotion to law. He became page to Nicolas de Neuville, seigneur de Villeroy, and this opened to him the way to court life. Besides this, his father's interest must have been not inconsiderable, and the house of Valois, which was about to hold the throne of France for the greater part of a century, was devoted to letters.

As early as 1514, before the accession of Francis I., Clément presented to him his *Judgment of Minos*, and shortly afterwards he was either styled or styled himself *facteur* (poet) *de la reine* to Queen Claude. In 1519 he was attached to the suite of Marguerite d'Angoulême, the king's sister, who was for many years to be the mainstay not only of him but of almost all French men of letters. He was also a great favourite of Francis himself, attended the Field of the Cloth of Gold in 1520, and duly celebrated it in verse. Next year he was at the camp in Flanders, and writes of the horrors of war. It is certain that Marot, like most of Marguerite's literary court, and perhaps more than most of them, was greatly attracted by her gracious ways, her unfailing kindness, and her admirable intellectual accomplishments, but there is not the slightest ground for thinking that his attachment was other than platonic. It is, however, evident that at this time either sentiment or matured critical judgment effected a great change in his style, a change which was wholly for the better. At the same time he celebrates a certain Diane, whom it has been sought to identify with Diane de Poitiers. There is nothing to support this idea and much against it, for it was an almost invariable habit of the poets of the 16th century, when the mistresses whom they celebrated were flesh and blood at all (which was not always the case), to celebrate them under pseudonyms. In the same year, 1524, Marot accompanied Francis on his disastrous Italian campaign. He was wounded and taken at Pavia, but soon released, and he was back again at Paris by the beginning of 1525. His luck had, however, turned. Marguerite for intellectual reasons, and her brother for political, had hitherto favoured the double movement of *Aufklärung*, partly humanist, partly Reforming, which distinguished the beginning of the century. Formidable opposition to both forms of innovation, however, now began to be manifested, and Marot, who was at no time particularly prudent, was arrested on a charge of heresy and lodged in the Châtelet, February 1526. But this was only a foretaste of the coming trouble, and a friendly prelate, acting for Marguerite, extricated him from his durance before Easter. The imprisonment gave him occasion to write a vigorous poem on it entitled *Enfer*, which was afterwards imitated by his luckless friend Étienne Dolet. His father died about this time, and Marot seems to have been appointed to the place which Jean had latterly enjoyed, that of valet de chambre to the king. He was certainly a member of the royal household in 1528 with a stipend of 250 livres, besides which he had inherited property in Quercy. In 1530, probably, he married. Next year he was again in trouble, not it is said for heresy, but for attempting to rescue a prisoner, and was again delivered; this time the king and queen of Navarre seem to have bailed him themselves.

In 1532 he published (it had perhaps appeared three years earlier), under the title of *Adolescence Clémentine*, a title the characteristic grace of which excuses its slight savour of affectation, the first printed collection of his works, which was very popular and was frequently reprinted with additions. Dolet's edition of 1538 is believed to be the most authoritative. Unfortunately, however, the poet's enemies were by no means discouraged by their previous ill-success, and the political situation was very unfavourable to the Reforming party. In 1535 Marot was implicated in the affair of "The Placards,"[1] and this time he was advised or thought it best to fly. He passed through Béarn, and then made his way to Renée, duchess of Ferrara, a supporter of the French reformers as steadfast as her aunt Marguerite, and even more efficacious, because her dominions were out of France. At Ferrara he wrote a good deal, his work there including his celebrated *Blasons* (a descriptive poem, improved upon medieval models[2]), which set all the verse-writers of France imitating them. But the duchess Renée was not able to persuade her husband, Ercole d'Este, to share her views, and Marot had to quit the city.

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[1] These "placards" were the work of the extreme Protestants. Pasted up in the principal streets of Paris on the night of the 17th of October 1534, they vilified the Mass and its celebrants, and thus led to a renewal of the religious persecution.

[2] The *blason* was defined by Thomas Sibilet as a perpetual praise or continuous vituperation of its subject. The *blasons* of Marot's followers were printed in 1543 with the title of *Blasons anatomiques du corps féminin.*

He then went to Venice, but before very long the pope Paul III. remonstrated with Francis I. on the severity with which the Protestants were treated, and they were allowed to return to Paris on condition of recanting their errors. Marot returned with the rest, and abjured his heresy at Lyons. In 1539 Francis gave him a house and grounds in the suburbs.

It was at this time that his famous translations of the Psalms appeared. The merit of these has been sometimes denied, it is, however, considerable, and the powerful influence which the book exercised on contemporaries is not denied by anyone. The great persons of the court chose different pieces, each as his or her favourite. They were sung in court and city, and they are said, with exaggeration doubtless, but still with a basis of truth, to have done more than anything else to advance the cause of the Reformation in France. Indeed, the vernacular prose translations of the Scriptures were in that country of little merit or power, and the form of poetry was still preferred to prose, even for the most incongruous subjects. At the same time Marot engaged in a curious literary quarrel characteristic of the time, with a bad poet named Sagon, who represented the reactionary Sorbonne. Half the verse-writers of France ranged themselves among the Marotiques or the Sagontiques, and a great deal of versified abuse was exchanged. The victory, as far as wit was concerned, naturally rested with Marot, but his biographers are probably not fanciful in supposing that a certain amount of odium was created against him by the squabble, and that, as in Dolet's case, his subsequent misfortunes were not altogether unconnected with a too little governed tongue and pen.

The publication of the Psalms gave the Sorbonne a handle, and the book was condemned by that body. In 1543 it was evident that he could not rely on the protection of Francis. Marot accordingly fled to Geneva; but the stars were now decidedly against him. He had, like most of his friends, been at least as much of a freethinker as of a Protestant, and this was fatal to his reputation in the austere city of Calvin. He had again to fly, and made his way into Piedmont, and he died at Turin in the autumn of 1544.

In character Marot seems to have been a typical Frenchman of the old stamp, cheerful, good-humoured and amiable enough, but probably not very much disposed to elaborately moral life and conversation or to serious reflection. He has sometimes been charged with a want of independence of character; but it is fair to remember that in the middle ages men of letters naturally attached themselves as dependants to the great. Such scanty knowledge as we have of his relations with his equals is favourable to him. He certainly at one time quarrelled with Dolet, or at least wrote a violent epigram against him, for which there is no known cause. But, as Dolet quarrelled with almost every friend he ever had, and in two or three cases played them the shabbiest of tricks, the presumption is not against Marot in this matter. With other poets like Mellin de Saint Gelais and Brodeau, with prose writers like Rabelais and Bonaventure Desperiers, he was always on excellent terms. And whatever may have been his personal weaknesses, his importance in the history of French literature is very great, and was long rather under than over-valued. Coming immediately before a great literary reform—that of the Pléiade—Marot suffered the drawbacks of his position; he was both eclipsed and decried by the partakers in that reform. In the reaction against the Pléiade he recovered honour; but its restoration to virtual favour, a perfectly just restoration, again unjustly depressed him. Yet Marot is in no sense one of those writers of transition who are rightly obscured by those who come after them. He himself was a reformer, and a reformer on perfectly independent lines, and he carried his own reform as far as it would go. His early work was couched in the *rhétoriqueur* style, the distinguishing characteristics of which are elaborate metre and rhyme, allegoric matter and pedantic language. In his second stage he entirely emancipated himself from this, and became one of the easiest, least affected and most vernacular poets of France. In these points indeed he has, with the exception of La Fontaine, no rival, and the lighter verse-writers ever since have taken one or the other or both as model. In his third period he lost a little of this flowing grace and ease, but acquired something in stateliness, while he certainly lost nothing in wit. Marot is the first poet who strikes readers of French as being distinctively modern. He is not so great a poet as Villon nor as some of his successors of the Pléiade, but he is much less antiquated than the first (whose works, as well as the *Roman de la rose*, it may be well to mention that he edited) and not so elaborately artificial as the second. Indeed if there be a fault to find with Marot, it is undoubtedly that in his gallant and successful effort to break up, supple, and liquefy the stiff forms and stiffer language of the 15th century, he made his poetry almost too vernacular and pedestrian. He *has* passion, and picturesqueness, but rarely; in his hands, and while the *style Marotique* was supreme, French poetry ran some risk of finding itself unequal to anything but graceful *vers de société*. But it is only fair to remember that for a century and more its best achievements, with rare exceptions, had been *vers de société* which were not graceful.

The most important early editions of Marot's *Œuvres* are those published at Lyons in 1538 and 1544. In the second of these the arrangement of his poems which has been accepted in later issues was first adopted. In 1596 an enlarged edition was edited by François Mizière. Others of later date are those of N. Lenglet du Fresnoy (the Hague, 1731) and P. Jannet (1868–1872; new ed., 1873–1876), on the whole the best, but there is a very good selection with a still better introduction by Charles d'Héricault, the joint editor of the Jannet edition in the larger *Collection Garnier* (no date). An elaborate edition by G. Guiffrey remained incomplete, only vols. ii. and iii. (1875–1881) having been issued. For information about Marot himself see *Notices biographiques des trois Marot*, edited from the MS. of Guillaume Colletet by G. Guiffrey (1871); H. Morley, *Clément Marot*, a study of Marot as a reformer; O. Douen, *Clément Marot et le psautier huguenot*; the section concerning him in G. Saintsbury's *The Early Renaissance* (1901); and A. Tilley, *Literature of the French Renaissance*, vol. i., ch. iv. (1904). (G. Sa.)

MAROT, DANIEL (seventeenth century), French architect, furniture designer and engraver, and pupil of Jean le Pautre (*q.v.*), was the son of Jean Marot (1620–1679), who was also an architect and engraver. He was a Huguenot, and was compelled by the Revocation of the Edict of Nantes in 1685 to settle in Holland. His earlier work is characteristic of the second period of Louis XIV., but eventually it became tinged with Dutch influence, and in the end the English style which is loosely called "Queen Anne" owed much to his manner. In Holland he was taken almost immediately into the service of the Stadtholder, who, when he shortly afterwards became William III. of England, appointed him one of his architects and master of the works. Comparatively little is known of his architectural achievements, and his name cannot be attached to any English building, although we know from his own engraving that he designed the great hall of audience for the States-General at the Hague. He also decorated many Dutch country-houses. In England his activities appear to have been concentrated upon the adornment of Hampton Court Palace. Among his plans for gardens is one inscribed: "Parterre d'Amton-court inventé par D. Marot." Much of the furniture—especially the mirrors, guéridons and beds—at Hampton Court bears unmistakable traces of his authorship; the tall and monumental beds, with their plumes of ostrich feathers, their elaborate valances and *chantournes* in crimson velvet or other rich stuffs agree very closely with his published designs. As befits an artist of the time of Louis XIV. splendour and elaboration are the outstanding characteristics of Marot's style, and he appears even to have been responsible for some of the curious and rather barbaric silver furniture which was introduced into England from France in the latter part of the 17th century. At Windsor Castle there is a silver table, attributed to him, supported by caryatid legs and gadrooned feet, with a foot-rail supporting the pine-apple which is so familiar a motive in work of this type. The slab is engraved with the arms of William III. and with the British national emblems with crowns and cherubs. Unquestionably it is an exceedingly fine example of its type. During his life in France Marot made many designs for André Charles Boulle (*q.v.*), more especially for long case and bracket clocks. The bracket clocks were intended to be mounted in chased and gilded bronze, and with their garlands and masquerons and elegant dials are far superior artistically to those of the "grandfather" variety. It is impossible to examine the designs for Marot's long clocks without suspecting that Chippendale derived from them some at least of the inspiration which made him a master of that kind of furniture. Marot's range was extraordinarily wide. He designed practically every detail in the internal ornamentation of the house—carved chimney-pieces, ceilings, panels for walls, girandoles and wall brackets, and even tea urns and cream jugs—he was indeed a prolific designer of gold and silver plate. Many of his interiors are very rich and harmonious although commonly over-elaborated. The craze for collecting china which was at its height in his time is illustrated in his lavish designs for receptacles for porcelain—in one of his plates there are more than 300 pieces of china on the chimney-piece alone. Marot was still living in 1718, and the date of his death is unknown.

We owe much of our knowledge of his work to the volume of his designs published at Amsterdam in 1712: *Œuvres du Sieur D. Marot, architecte de Guillaume III. Roi de la Grande Bretagne*, and to *Receuil des planches des sieurs Marot, père et fils*. In addition to decorative work these books contain prints of scenes in Dutch history, and engravings of the statues and vases, produced by Marot, at the Palace of Loo.

MARPLE, an urban district in the Hyde parliamentary division of Cheshire, England, 12 m. S.E. of Manchester, served by the Great Central, Midland & Sheffield and Midland railways, and the Cheshire lines. Pop. (1901), 5595. It lies on and above the valley of the Goyt, and its situation has brought the town into favour as a residential centre for those whose business lies in Manchester, Stockport, and the great manufacturing district to the west. Marple Hall, a beautiful Elizabethan mansion, is connected with the youth, and sometimes stated to be the birthplace, of John Bradshaw the regicide (1602–1659).

MARPRELATE CONTROVERSY, a war of pamphlets waged in 1588 and 1589 between a puritan writer who employed the pseudonym "Martin Marprelate" and defenders of the Established Church. Martin's tracts are characterized by violent and personal invective against the Anglican dignitaries, by the assumption that the writer had numerous and powerful adherents and was able to enforce his demands for reform, and by a plain and homely style combined with pungent wit. While he maintained the puritan doctrines as a whole, the special point of his attack was the Episcopacy. The pamphlets were printed at a secret press established by John Penry, a Welsh puritan, with the help of the printer Robert Waldegrave, about midsummer 1588, for the issue of puritan literature forbidden by the authorities. The first tract by "Martin Marprelate," known as the *Epistle*, appeared at Molesey in November 1588. It is in answer to *A Defence of the Government established in the Church of Englande*, by Dr. John Bridges, dean of Salisbury, itself a reply to earlier puritan works, and besides attacking the episcopal office in general assails certain prelates with much personal abuse. The *Epistle* attracted considerable notice, and a reply was written by Thomas Cooper, bishop of Winchester, under the title *An Admonition to the People of England*, but this was too long and too dull to appeal to the same class of readers as the Marprelate pamphlets, and produced little effect. Penry's press, now removed to Fawsley, near Northampton, produced a second tract by Martin, the *Epitome*, which contains more serious argument than the *Epistle* but is otherwise similar, and shortly afterwards, at Coventry, Martin's reply to the *Admonition*, entitled *Hay any Worke for Cooper* (March 1589). It now appeared to some of the ecclesiastical authorities that the only way to silence Martin was to have him attacked in his own railing style, and accordingly certain writers of ready wit, among them John Lyly, Thomas Nashe and Robert Greene, were secretly commissioned to answer the pamphlets. Among the productions of this group were *Pappe with an Hatchet* (Sept. 1589), probably by Lyly, and *An Almond for a Parrat* (1590), which, with certain tracts under the pseudonym of Pasquil, has been attributed to Nashe (*q.v.*). Some anti-Martinist plays or shows (now lost) performed in 1589 were perhaps also their work. Meanwhile, in July 1589, Penry's press, now at Wolston, near Coventry, produced two tracts purporting to be by "sons" of Martin, but probably by Martin himself, namely, *Theses Martinianae* by Martin Junior, and *The Just Censure of Martin Junior* by Martin Senior. Shortly after this, *More Work for Cooper*, a sequel to *Hay any Worke*, was begun at Manchester, but while it was in progress the press was seized. Penry however was not found, and in September issued from Wolston or Haseley *The Protestation of Martin Marprelate*, the last work of the series, though several of the anti-Martinist pamphlets appeared after this date. He then fled to Scotland, but was later apprehended in London, charged with inciting rebellion, and hanged (May 1593). The authorship of the tracts has been attributed to several persons: to Penry himself, who however emphatically denied it and whose acknowledged works have little resemblance in style to those of Martin, to Job Throckmorton, and to Henry Barrow.

See, for list and full titles of the tracts, related documents, and discussion of the authorship, E. Arber's *Introductory Sketch to the Martin Marprelate Controversy* (1880), which, however, gives no connected account of the matter. A good summary, with quotations from the pamphlets, will be found in H. M. Dexter's *Congregationalism* (New York, 1880), pp. 129–202. See also articles on John Penry and Job Throckmorton in *Dict. of Nat. Biography*; and for the history of the press, *Bibliographica*, ii. 172–180. Maskell's *Martin Marprelate Controversy* (1845) is of little service. The more important tracts have been reprinted by Petheram in his series of *Puritan Discipline Tracts* (1842–1860), in Arber's *English Scholar's Library* (1879–1880), in R. W. Bond's edition of Lyly and in the editions of Nashe. (R. B. McK.)

MARQUAND, HENRY GURDON (1819–1902), American philanthropist and collector, was born in New York City on the 11th of April 1819. In 1839, upon the retirement from the jewelry business of his brother Frederick (1799–1882), who was a liberal benefactor of Yale College and of the Union Theological Seminary, he became his brother's agent. He was one of the purchasers in 1868 of the Iron Mountain railroad, afterwards its president, and a director of the Missouri-Pacific system. He was the first honorary member of the American Institute of Architects, and president (1889–1902) of the Metropolitan Museum of Art, to which he made valuable presents and loans from his collection of paintings. He died in New York City, on the 26th of February 1902. His varied and valuable art collection and rare books were sold in 1903. He was a benefactor of Princeton University and other institutions. His son, ALLAN MARQUAND (b. 1853), graduated at Princeton in 1874, and in 1883 became professor of archaeology and art.

MARQUARDT, JOACHIM (1812–1882), German historian and writer on Roman antiquities, was born at Danzig on the 19th of April 1812. He studied at Berlin and Leipzig, held various educational appointments from 1833 onwards at Berlin, Danzig and Posen, and became in 1859 head of the gymnasium in Gotha, where he died on the 30th of November 1882. The dedication of his treatise *Historiae equitum romanorum libri quatuor* (1841) to Lachmann led to his being recommended to the publisher of W. A. Becker's *Handbuch der römischen Alterthümer* to continue the work on the death of the author in 1846. It took twenty years to complete, and met with such success that a new edition was soon called for. Finding himself unequal to the task single-handed, Marquardt left the preparation of the first three volumes (*Römisches Staatsrecht*) to Theodor Mommsen, while he himself contributed vols. iv.–vi. (*Römische Staatsverwaltung*, 1873–1878; 2nd ed., 1881–1885, vol. v. by H. Dessau and A. von Domaszewski, vol. vi. by G. Wissowa) and vol. vii. (*Das Privatleben der Römer*, 1879–1882; 2nd ed., by A. Mau, 1886). Its clearness of style, systematic arrangement and abundant references to authorities ancient and modern, will always render it valuable to the student.

See E. Förstemann in *Allgemeine deutsche Biographie*, Bd. XX; R. Ehwald, *Gedächtnisrede* (progr. Gotha, 1883).

MARQUESAS or MENDAÑA ISLANDS (Fr. *Les Marquises*), an archipelago of the Pacific Ocean lying between 7° 50′ and 10° 35′ S. and 138° 50′ and 140° 50′ W., and belonging to France. It extends over 250 m. from S.E. to N.W., and has a total area of 490 sq. m. The southern or Mendaña group consists of the islands Fatuhiva or Magdalena, Motane or San Pedro, Tahuata or Santa Christina and Hivaoa or Dominica, the last with a coast-line of more than 60 m. With these is often included the rocky islet of Fatuhuku or Hood, lying in mid-channel to the north of Hivaoa. The north-western or Washington group is formed of seven islands, the four largest being Huapu or Adams, Huahuna or Washington, Nukuhiva (70 m. in circumference) and Eiao.[1] Along the centre of each island is a ridge of mountains, attaining an altitude of 4042 ft. in Huapu, whence rugged spurs forming deep valleys stretch towards the sea. The volcanic origin of the whole archipelago is proved by the principal rocks being of basalt, trachyte and lava. Vegetation is luxuriant in the valleys, which are well watered with streams and, from their seaward termination in small bays, are themselves known as "bays." The flora includes about four hundred known species, many of them identical with those belonging to the Society Islands. The vegetable products comprise bananas, bread-fruit, yams, plantains, wild cotton, bamboos, sugar-cane, coco-nut and dwarf palms, and several kinds of timber trees. The land fauna however is very poor; there are few mammals with the exception of dogs, rats and pigs; and amphibia and insects are also generally scarce. Of twenty species of birds more than half belong to the sea, where animal life is as abundant as about other sub-tropical Polynesian groups. The climate, although hot and damp, is not unhealthy. During the greater part of the year moderate easterly trade-winds prevail, and at the larger islands there are often both land and sea breezes. The rainy season accompanied by variable winds sets in at the end of November, and lasts for about six months. During this period the thermometer varies from 84° to 91° F.; in the dry season its average range is from 77° to 86°. The archipelago, which has some small trade in copra, cotton and cotton seeds, is administered by a French resident, and has a total population of about 4300, nearly all natives.

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[1] Most of the islands have each three or four alternative names.

The natives, a pure Polynesian race, are usually described as physically the finest of all South Sea Islanders. Their traditions point to Samoa as the colonizing centre from which they sprang. Their complexion is a healthy bronze. Until the introduction of civilization they were remarkable for their elaborate tattooing. Their cannibalism seems to have been dictated by taste, for it was never associated with their religion, the sacrifices to their gods being always swine. Of these and fowls they rear a great quantity. Their native drink is *kava*. Their houses are unlike those usual in Polynesia in being built on platforms raised from the ground. In disposition the islanders are friendly and hospitable, brave and somewhat bloodthirsty; and, although naturally indolent and morose, they have proved industrious and keen traders. As among their kinsfolk the Tahitians, debauchery was systematized and infanticide an organized institution. A population which at the time of the annexation by France (1842) was 20,000 has been reduced to little over 4000. Latterly the natives have for the most part outwardly adopted Christianity.

The Marquesas Islands were discovered on the 21st of July 1595 by Alvaro Mendaña, who, however, only knew of the south-eastern group, to which he gave the name by which they are generally known (although they also bear his own), in honour of Don Garcia Hurtado de Mendoza, marquis of Cañete, viceroy of Peru, and patron of the voyage. Captain Cook pursuing the same track rediscovered this group, with the addition of Fatuhuku, in 1774. The north-western islands were first sighted by the American Captain Ingraham in 1791, and given the name of Washington by him; the French Captain Marchand followed in the same year, and Lieut. Hergest in 1792. The Russian explorer, Adam Ivan Krusenstern, made an extensive investigation of the archipelago in 1804. In 1813 the American Commodore David Porter failed to establish a colony here; and in May 1842, after French Roman Catholic missionaries had prepared the way, Rear-admiral Dupetit-Thouars took formal possession of the archipelago for France. A complete settlement was not effected without bloodshed and about 1860–1870 the colony was practically abandoned.

See Vincendon-Dumoulin *Îles Marquises* (Paris, 1843); E. Jardin, *Essai sur l'histoire naturelle de l'archipel de Mendaña* (Paris, 1860); Clavel, *Les Marquisiens* (Paris, 1885); Dordillon, *Grammaire et dictionnaire de la langue des Îles Marquises* (Paris, 1904).

MARQUESS, or MARQUIS (Fr. *marquis*, Ital. *marchese*; from med. Lat. *marchio*, *marchisus*, *i.e. comes marchiae*, "count of the March"), a title and rank of nobility. In the British peerage it is the second in order and therefore next to duke. In this sense the word was a reintroduction from abroad; but lords of the Welsh and Scottish "marches" are occasionally termed *marchiones* from an early date. The first marquess in England was Robert de Vere, the 9th earl of Oxford, who was created marquess of Dublin by Richard II. on the 1st of December 1385 and assigned precedence between dukes and earls. On the 13th of October following the patent of this marquessate was recalled, Robert de Vere then having been raised to a dukedom. John de Beaufort, earl of Somerset, the second legitimate son of John of Gaunt, was raised to the second marquessate as marquess of Dorset on the 29th of September 1397, but degraded again to earl in 1399. The Commons petitioned for the restoration of his marquessate in 1402, but he himself objected because "le noun de Marquys feust estraunge noun en cest Roialme." From that period this title appears to have been dormant till the reign of Henry VI., when it was revived (1442), and thenceforward it maintained its place in the British peerage. Anne Boleyn was created marchioness of Pembroke in 1532. A marquess is "most honourable," and is styled "my lord marquess." His wife, who is also "most honourable," is a marchioness, and is styled "my lady marchioness." The coronet is a circlet of gold on which rest four leaves and as many large pearls, all of them of equal height and connected. The cap and lining, if worn, are the same as in the other coronets (see CROWN and CORONET). The mantle of parliament is scarlet, and has three and a half doublings of ermine.

In France, so early as the 9th century, counts who held several counties and had succeeded in making themselves quasi-independent began to describe themselves as *marchiones*, this use of the word being due to the fact that originally none but the margraves, or counts of the marches, had been allowed to hold more than one county. The *marchio* or marquess thus came to be no more than a count of exceptional power and dignity, the original significance of the title being lost. In course of time the title was recognized as ranking between those of duke and count; but with the decay of feudalism it lost much of its dignity, and by the 17th century the savour of pretentiousness attached to it had made it a favourite subject of satire for Molière and other dramatists of the classical comedy. Abolished at the Revolution, the title of marquess was not restored by Napoleon, but it was again revived by Louis XVIII., who created many of Napoleon's counts marquesses. This again tended to cheapen the title, a process hastened under the republic by its frequent assumption on very slender grounds in the absence of any authority to prevent its abuse. In Italy too the title of *marchese*, once borne only by the powerful margraves of Verona, has shared the fate of most other titles of nobility in becoming common and of no great social significance. (See also MARGRAVE.) (J. H. R.)

MARQUETRY (Fr. *marqueterie*, from *marqueter*, to inlay, literally to mark, *marquer*), an inlay of ornamental woods, ivory, bone, brass and other metals, tortoise-shell, mother-of-pearl, &c., in which shaped pieces of different materials or tints are combined to form a design. It is a later development of the ornamental inlays of wood known by the name of Intarsia, and though in the main the latter was a true inlay of one or more colours upon a darker or lighter ground, while marquetry is composed of pieces of quite thin wood or other material of equal thickness laid down upon a matrix with glue, there are examples of Intarsia in which this mode of manufacture was evidently followed. For instance, the backs of the stalls in the cathedral of Ferrara show the perspective lines of some of the subjects traced upon the ground where the marquetry has fallen off, but none of the sinkings in the surface which would be there if the panels had been executed as true inlays. In the endeavour to gain greater relief, shading and tinting the wood were resorted to, the shading being generally produced by scorching, either with a hot iron or hot sand, and the tinting by chemical washes and even by the use of actual colour, but the result is usually hardly commensurate with the labour expended. A combination of tortoise-shell and metal, the one forming the ground and the other the pattern upon it, which may be classed as marquetry also appears in the 17th century. The subjects of the *intarsiatori* are generally arabesques or panels with elaborate perspectives, either of buildings or cupboards with different articles upon the shelves seen through half-open doors, which themselves are frequently of lattice-work delineated with extraordinary perfection, though figure subjects occur also. The later *marqueteurs* used a freer form of design for the most part, and scrolls and bunches of flowers appear in profusion, while if architectural forms occur they are generally in the shape of ruins amid landscape. The greater portion of the examples in England are importations, either from Holland (in which country very fine work was produced during the latter half of the 16th and 17th centuries) or from France. The reputation of the Dutch *marqueteurs* was so great that Colbert engaged two, named Pierre Gole and Vordt, for the Gobelins at the beginning of the 17th century. Jean Macé of Blois, the first Frenchman known to have practised the art, who was at work in Paris from 1644 (when he was lodged in the Louvre), or earlier, till 1672, as a sculptor and painter, learnt it in the Netherlands. His title was "menuisier et faiseur de cabinets et tableaux en marqueterie de bois"; but as early as 1576 a certain Hans Kraus had been called "marqueteur du roi." Jean Macé's daughter married Pierre Boulle, and the greatest of the family, André Charles Boulle (*q.v.*), succeeded to his lodging in the Louvre on his death in 1672. The members of this family are perhaps the best known of the French *marqueteurs*. Their greatest triumphs were gained in the marquetry of metal and tortoise-shell combined with beautifully chiselled ormulu mountings; but many foreign workmen found employment in France from the time of Colbert, and some of them rose to the highest eminence. The names of Roentgen, under whom the later German marquetry perhaps reached its highest point, Riesener and Oeben, testify to their nationality. A good deal of marquetry was executed in England in the later Stuart period, mainly upon long-case clocks, cabinets and chests of drawers, and it is often of real excellence. Marquetry in a shallower form was also extensively used in the latter part of the 18th century. The most beautiful examples of the art in Italy are mainly panels of choir stalls or sacristy cupboards, though marriage coffers were also often sumptuously decorated in this manner. With the increase in luxury and display in the 17th and 18th centuries in France and Germany cabinets and escritoires became objects upon which extraordinary talent and expenditure were lavished. In South Germany musical instruments, weapons and bride chests were often lavishly decorated with marquetry. The cabinets are of elaborate architectural design with inlays of ebony and ivory or with veneers of black and white, the design counterchanging so that one cutting produced several repeats of the same pattern in one colour or the other. In modern practice as many as four or even six thicknesses are put together and so cut. When all the parts have been cut and fitted together face downwards paper is glued over them to keep them in place and the ground and the veneer are carefully levelled and toothed so as to obtain a freshly worked surface. The ground is then well wetted with glue at a high temperature and the surfaces squeezed tightly together between frames called "cauls" till the glue is hard. There are several modes of ensuring the accurate fitting of the various parts, which is a matter of the first importance.

MARQUETTE, JACQUES (1637–1675), French Jesuit missionary and explorer, re-discoverer (with Louis Joliet) of the Mississippi. He was born at Laon, went to Canada in 1666, and was sent in 1668 to the upper lakes of the St Lawrence. Here he worked at Sault Ste Marie, St Esprit (near the western extremity of Lake Superior) and St Ignace (near Michilimackinac or Mackinaw, on the strait between Huron and Michigan). In 1673 he was chosen with Joliet for the exploration of the Mississippi, of which the French had begun to gain knowledge from Indians of the central prairies. The route taken lay up the north-west side of Lake Michigan, up Green Bay and Fox river, across Lake Winnebago, over the portage to the Wisconsin river, and down the latter into the Mississippi, which was descended to within 700 m. of the sea, at the confluence of the Arkansas river. Entering the Mississippi on the 17th of May, Joliet and his companion turned back on the 17th of July, and returned to Green Bay and Michigan (by way of the Illinois river) at the end of September 1673. On the journey Marquette fell ill of dysentery; and a fresh excursion which he undertook to plant a mission among the Indians of the Illinois river in the winter of 1674–1675 proved fatal. He died on his way home to St Ignace on the banks of a small stream (the lesser and older Marquette River) which enters the east side of Lake Michigan in Marquette Bay (May 18, 1675). His name is now borne by a larger watercourse which flows some distance from the scene of his death.

See Marquette's *Journal*, first published in Melchissédech Thévenot's *Recueil de Voyages* (Paris, 1681), and fully given in Martin's *Relations inédites*, and in Shea's *Discovery and Exploration of the Mississippi Valley* (New York, 1852); cf. also Pierre Margry's *Découvertes . . . des Français dans l'ouest et dans le sud de l'Amérique septentrionale (1614–1754)*; *Mémoires et documents originaux* (Paris, 1875), containing Joliet's *Détails* and *Relations*; Francis Parkman, *La Salle and the Discovery of the Great West* (Boston 1869–1878), esp. pp. x., 20, 32–33, 49–72.

MARQUETTE, a city, a port of entry and the county seat of Marquette county, Michigan U.S.A., on the south shore of Lake Superior. Pop. (1900), 10,058 (3460 foreign-born); (1910), 11,503. It is served by the Duluth, South Shore & Atlantic, the Marquette & South-Eastern, the Chicago, Milwaukee & St Paul, the Chicago & North-Western, and the Lake Superior & Ishpeming railways. The city, which is situated on a bluff 100 ft. above the lake, in a region characterized by rounded hills and picturesque irregularities, has a delightful climate, and is a popular summer resort. Presque Isle park (400 acres), a headland north of the city, is one of its principal attractions. Marquette is the seat of the Northern State Normal School (established 1899) and of the state house of correction and branch prison (established 1885). A county-court-house, the Peter White library, and the Federal building are the most prominent public buildings. Marquette is the seat of Roman Catholic and Protestant Episcopal bishoprics. The city is best known as a shipping centre of one of the richest iron-ore districts in the world, and its large and well-equipped ore docks are among its most prominent features. Marquette is the port of entry of the customs district of Superior. In 1896 its imports were valued at $358,505 and its exports at $4,708,302; in 1908, imports $1,845,724 and exports $7,040,473. Foundries, railway machine-shops, lumber and planing-mills, brewery and bottling works, and quarries of brownish-red sandstone contribute largely to the city's economic importance. The charcoal iron blast-furnaces of the city manufacture pig-iron, and, as by-products, wood alcohol and acetic acid, recovered from the smoke of the charcoal pits. The value of the city's factory products increased from $1,585,083 in 1900 to $2,364 081 in 1905, or 49·1 %. The first settlement was made about 1845, and in 1849 it was named Worcester; but "Marquette" was soon substituted in honour of Jacques Marquette. It was incorporated as a village in 1859, and chartered as a city in 1871.

MARR, CARL (1858–), American artist, was born at Milwaukee, Wisconsin, on the 14th of February 1858, the son of an engraver. He was a pupil of Henry Vianden in Milwaukee, of Schauss in Weimar, of Gussow in Berlin, and subsequently of Otto Seitz, Gabriel and Max Lindenschmitt in Munich. His first work, "Ahasuerus, the Wandering Jew," received a medal in Munich. One of his pictures, "Episode of 1813," is in the Royal Hanover Gallery, and his "Germany in 1806" received a gold medal in Munich and is in the Royal Academy of Koenigsberg. A large canvas "The Flagellants," now in the Milwaukee public library, received a gold medal at the Munich Exposition in 1889. Another canvas, "Summer Afternoon," in the Phoebe Hearst collection, received a gold medal in Berlin, in 1892. Marr became a professor in the Munich Academy in 1893, and in 1895 a member of the Berlin Academy of Arts.

MARRADI, GIOVANNI (1852–), Italian poet, was born at Leghorn, and educated at Pisa and Florence. At the latter place he started with others a short-lived review, the *Nuovi Goliardi*, which made some literary sensation. He became a teacher at various colleges, and eventually an educational inspector in Massa Carrara. He was much influenced by Carducci, and became known not only as a critic but as a charming descriptive poet, his principal volumes of verse being *Canzone moderne* (1870), *Fantasie marnie* (1881), *Canzoni e fantasie* (1853), *Ricordi lirici* (1884), *Poesie* (1887), *Nuovi canti* (1891) and *Ballate moderne* (1895).

MARRĀKESH (erroneously MOROCCO or MAROCCO CITY), one of the quasi-capitals of the sultanate of Morocco, Fez and Mequinez being the other two. It lies in a spacious plain—Blad el Hamra, "The Red"—about 15 m. from the northern underfalls of the Atlas, and 96 m. E.S.E. of Saffi, at a height variously estimated at 1639 ft. (Hooker and Ball) and 1410 ft. (Beaumier). Ranking during the early centuries of its existence as one of the greatest cities of Islām, Marrākesh has long been in a state of grievous decay, but it is rendered attractive by the exceptional beauty of its situation, the luxuriant groves and gardens by which it is encompassed and interspersed, and the magnificent outlook which it enjoys towards the mountains. The wall, 25 or 30 ft. high, and relieved at intervals of 360 ft. by square towers, is so dilapidated that foot-passengers, and in places even horsemen, can find their way through the breaches. Open spaces of great extent are numerous within the walls, but for the most part they are defaced by mounds of rubbish and putrid refuse. With the exception of the tower of the Kutubia Mosque and a certain archway which was brought in pieces from Spain, there is not, it is asserted, a single stone building in the city; and even bricks (although the local manufacture is of excellent quality) are sparingly employed. *Tabiya* or rammed concrete of red earth and stone is the almost universal building material, and the houses are consequently seldom more than two storeys in height. The palace of the sultan covers an extensive area, and beyond it lie the imperial parks of Agudal, the inner one reserved for the sultan's exclusive use. The tower of the Kutubia is a memorial of the constructive genius of the early Moors; both it and the similar Hasan tower at Rabat are after the type of the contemporary Giralda at Seville, and if tradition may be trusted, all three were designed by the same architect, Jabir. The mosque to which the tower belongs is a large brick building erected by 'Abd el Mumin; the interior is adorned with marble pillars, and the whole of the crypt is occupied by a vast cistern excavated by Yakūb el Mansur. Other mosques of some note are those of Ibn Yusef, El Mansur and El Mo'izz; the chapel of Sidi Bel Abbas, in the extreme north of the city, possesses property of great value, and serves as an almshouse and asylum. There is a special Jews' quarter walled off from the rest. The general population is of a very mixed and turbulent kind; crimes of violence are common, and there are many professional thieves. The murder of a Frenchman, Dr Mauchamp, in March 1907, by the rabble of Marrākesh was the immediate cause of the occupation of Udja by France (see MOROCCO: *History*). Almost the only manufacture extensively prosecuted is that of Morocco leather, mainly red and yellow, about 1,500 men being employed as tanners and shoemakers. Scottish missionaries and a few European traders have become established here. The city was founded in 1062 by Yusef bin Tashfin. Before it was a hundred years old it is said to have had 700,000 inhabitants, but the population in 1906 probably did not exceed 50,000 to 60,000.

See Leo Africanus, and Paul Lambert's detailed description in *Notice sur la ville de Maroc* (Paris, 1868). Lambert's plan of Marrākesh is reproduced with some additions by Dr A. Leared, and another may be found in Gatell.

MARRI, a Baluch tribe on the Dera Ghazi Khan border of Baluchistan. In the census of 1901 they numbered 19,161 and their fighting strength is about 3000. Their relations with the British commenced in 1840 with attacks made on the communications of Sir John Keane's army, after it had passed through the Bolan. An attempt was made to punish the tribe, which ended in disastrous failure. Major Clibborn was repulsed in an attempt to storm the Naffusak Pass, losing 179 killed and 92 wounded out of 650. Many of his force died of heat and thirst. The fort of Kahan, which he was trying to relieve at the time, was forced to capitulate with the honours of war. The Marris, however, joined the British against the Bugtis in 1845. After the annexation of Sind in 1843 the Marris gave much trouble, but were pacified by the policy of General John Jacob and Sir Robert Sandeman. In 1880 during the second Afghan War they made frequent raids on the British line of communications, ending with the plunder of a treasure convoy. A force of 3070 British troops under Brigadier-General Macgregor marched through the country, and the tribe submitted and paid 1¼ lakh (£12,500) out of a fine of 2 lakhs (£20,000); they also gave hostages for their future good behaviour. Since then they have given little trouble.

The Marri-Bugti country is classed as a tribal area in Baluchistan, politically controlled from Sibi, but enjoying a large measure of autonomy under its own chieftains. Total area, 7129 sq. m.; total pop. (1901), 38,919, almost equally divided between the two tribes of Marris and Bugtis.

MARRIAGE. Marriage (Fr. *mariage*, from *marier*, to marry; Lat. *maritare*, from *mas*, *maris*, a male), or "matrimony" (Lat. *matrimonium*, from *mater*, a mother), may be defined either (*a*) as the act, ceremony, or process by which the legal relationship of husband and wife is constituted; or (*b*) as a physical, legal and moral union between man and woman in complete community of life for the establishment of a family.[1] It is possible to discriminate between three stages, taking marriage in the latter sense as an institution—the animal or physical stage, the proprietary or legal stage, and the personal or moral stage. In the first or physical stage the relation of the sexes was unregulated, and in many cases of brief duration. In the second or legal stage greater permanence was secured in marriage by assigning the husband a property right in his wife or wives. In the last stage the proprietary relation falls more and more into the background, and the relation of husband and wife approximates that of two individuals entirely equal before the law. Although in the history of marriage these three stages have been roughly successive, the order of their entering the conscious experience of the individual is usually the reverse of their order in the development of the race; and in the solemnization of a marriage based upon affection and choice the growth of the relation begins with the moral, advances to the legal and culminates in the physical union, each one of these deriving its meaning and its worth from the preceding. In most legal systems marriage, in the sense of a ceremony, takes the form of a contract—the mutual assent of the parties being the prominent and indispensable feature. Whether it is really a contract or not, and if so to what class of contracts it belongs, are questions which have been much discussed, but into which it is not necessary to enter. While the consent of parties is universally deemed one of the conditions of a legal marriage, all the incidents of the relationship constituted by the act are absolutely fixed by law. The jurist has to deal with marriage in so far as it creates the legal status of husband and wife. It should be added that, while marriage is generally spoken of by lawyers as a contract, its complete isolation from all other contracts is invariably recognized. Its peculiar position may be seen at once by comparing it with other contracts giving rise to continuous relationships with more or less indefinite obligations, like those of landlord and tenant, master and servant, &c. In these the parties may in general make their rights and duties what they please, the law only intervening when they are silent. In marriage every resulting right and duty is fixed by the law.

Besides true marriage, inferior forms of union have from time to time been recognized, and may be briefly noticed here. These have all but disappeared from modern society, depending as they do on matrimonial restrictions now obsolete.

The institution of slavery is a fruitful source of this kind of debased matrimony. In Roman law no slave could contract marriage whether with another slave or a free person. The union of male and female slaves (*contubernium*) was recognized for various purposes; a free woman entering into a union with a slave incurred under the S.C. Claudianum the forfeiture of her own liberty; but the bondwoman might be the concubine of a freeman. In the United States, where slavery was said to be regulated by the principle of the civil law, the marriage of slaves was so far recognized that on emancipation complete matrimony took effect and the children became legitimate without any new ceremony.

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[1] It is doubtless true, as anthropologists have pointed out, that in the history of the race "marriage is rooted in the family rather than the family in marriage" (WESTERMARCK: *History of Human Marriage*, p. 22); but in that conscious experience of the individual with which law and ethics are especially concerned, this relationship is reversed, and the family originates in marriage (see FAMILY, and allied headings).

In Roman law no legal marriage could be contracted unless there was *connubium* between the parties. Originally there was no connubium between plebs and patricians, and the privilege was conceded after a long struggle by the Lex Canuleia. In later times Latini and Peregrini were excluded from connubium except where the right had been expressly conferred. The great matrimonial law of the early empire (Lex Julia et Papia Poppaea) introduced restrictions depending on the condition of the parties which later legislation extended and perpetuated. Senators under that law were forbidden to marry freedwomen or women of inferior rank, and the husband of a freedwoman becoming a senator was set free from his marriage. In the canon law[1] new restrictions were developed. Persons who bound themselves not to marry were deemed incapable of marrying. The order of the clergy were forbidden to marry. And disparity of faith was recognized by the early church as a bar to matrimony, *e.g.* between Christians and pagans and between orthodox and heretics (see *Dictionary of Christian Antiquities*, art. "Marriage").

CONCUBINAGE, which such restrictions tended to develop, is noticed under a separate heading (*q.v.*). It might be described as marriage which has no consequences, or only slight and peculiar consequences, in legal *status*. In the left-handed or "morganatic" marriages of the German royal families we have the nearest approach ever made by concubinage to true marriage, the children being legitimate, but neither they nor the wife acquiring any right to the rank or fortune of the husband. The marriage of persons of different religions frequently requires the intervention of the law as to the faith of the children, more particularly in Europe as between Roman Catholics and Protestants. English law gives the father, except under special circumstances, the right to dictate the faith of his children (see INFANT). The practice on this point varies in Europe—the question being ignored in French law, Germany following in some parts the same rule as England, in others giving effect to ante-nuptial stipulations. In Ireland mixed marriages (*i.e.* between Roman Catholic and Protestant) were by 19 Geo. II. c. 13 null and void if celebrated by a Roman Catholic priest. This act was repealed by 33 & 34 Vict. c. 110, which permits mixed marriages to be validly celebrated by an Episcopalian or Roman Catholic clergyman, subject to conditions set forth in § 38.

Roman law.—The three primitive modes of marriage were *confarreatio*, *coemptio in manum*, and *usus*, all of which had the effect of placing the woman in the "power" (*manus*) of her husband, and on the same footing as the children. The first was a religious ceremony before ten witnesses, in which an ox was sacrificed and a wheaten cake broken and divided between the spouses by the priest. *Coemptio* was a conveyance of the woman by *mancipatio*, and might be described as a fictitious sale *per aes et libram*, like that employed in emancipation and testamentary disposition and other processes. *Usus* was the acquisition of the wife by prescription, through her cohabiting with the husband for one year, without having been absent from his house three continuous nights. But a true marriage might be concluded without adopting any of these modes, and they all fell into desuetude and with them the subjection of the wife to the *manus*. Marriage without *manus* was contracted by the interchange of consent, without writing or formality of any kind. By some jurists it is regarded as incomplete until consummated by delivery of the woman, and is accordingly referred to the class of *real* contracts. The restrictions as to age, relationship by consanguinity and affinity, previous marriage, &c., were in the main those which have continued to prevail in modern Europe with one important exception. The consent of the *paterfamilias* to the marriage of the children under his power was essential.

Canon law.—The canon law of marriage is based partly on the Roman law, the validity of which the Church from the first recognized, partly on the Jewish law as modified by the new principles introduced by Christ and his apostles, developed by the fathers of the Church and medieval schoolmen, and regulated and defined by popes and councils. The most important of these principles was that of the indissolubility of marriage, proclaimed by Christ without qualification according to Mark x. 11, 12, and with the qualifying clause "saving for the cause of fornication" according to Matt. v. 32. This lofty view of marriage, according to which man and wife are made "one flesh" by the act of God ("What therefore God hath joined together, let no man put asunder," Mark x. 9) was, however, modified by the idea of the consummating act of marriage as in itself something unholy, a result of the Fall. Christ himself, indeed, did not teach this; but for St Paul marriage is clearly a concession to the weakness of the flesh (1 Cor. vii.). "The time is short," and in view of the imminent coming of the Lord the procreation of children a matter of no importance (v. 29), but "it is better to marry than to burn" (v. 9). He is, however, obviously not clear on the point, and at the end of his argument strikes a note of doubt (v. 40); elsewhere he defends marriage, against those who would have forbidden it altogether, as a gift of God (1 Tit. iv. 3–5) and even, in seeming contradiction to 1 Cor. vii. 29, commands the bearing of children (1 Tit. v. 14). Finally it is to St Paul that the idea of marriage as a sacrament is to be traced, in the mystic comparison of the relations of husband and wife to those of Christ and his Church (Eph. v. 23–32). These are the main foundations in Scripture on which the Christian law of marriage is built up, and they are obviously principles which admit of a large amount of variety of interpretation and of practice. They were developed in the early Church under the influence of the rapidly growing passion for the celibate life, partly an outcome of the same dualistic principle which produced the asceticism of the Jewish Essenes and of the Gnostics, partly perhaps a natural reaction from the appalling moral corruption of the decaying empire. Marriage, it is true, from being no more than a terminable civil contract, became a thing holy, a mystic union of souls and bodies never to be divided; valid, indeed, but not spiritually complete, without the public blessing of the Church (Tertullian, *Ad uxorem*, lib. ii. cap. 9); and from Augustine's time onward it was reckoned as a sacrament. But at the same time there was a tendency to restrict its rights and its range. So far as marriage was a physical union, this had for its object solely the perpetuation of the race and the avoidance of fornication; the most that was conceded was that the intention of having offspring not only made the conjugal act blameless, but even gave to the desire that inspired it an element of good (Augustine, *de nupt. et conc.* 3). But the ideal married life was that attributed to Mary and Joseph. Thus Augustine cited this as an example that a true marriage may exist where there is a mutual vow of chastity (*op. cit.* 12), and held that the sooner this relation was established the better (*de bono conjug.* 22). Marriage being then an inferior state, to be discouraged rather than the reverse, the tendency was rapidly to narrow the field within which it might be contracted. Remarriage (bigamy) was only allowed after many struggles, and then only to the laity; St Paul had laid down that a "bishop" must be "the husband of one wife," and to this day the priests of the Orthodox Eastern Church may not remarry. Clerical celibacy, at first a counsel of perfection, was soon to become the rule of the Church, though it was long before it was universally enforced in the West; in the East it still applies only to monks, nuns and bishops (see CELIBACY). The marriage of the laity was hampered by the creation of a number of impediments. The few and definite prohibitions of the Roman and of the Jewish law (Lev. xviii. 6–18; xx.) in the matter of marriage between kindred, were indefinitely extended; until in 506 the council of Agde laid it down that any consanguinity or affinity whatever constituted an impediment.[2] Moreover, man and wife being "one flesh," the Church exaggerated relationship by affinity into equal importance with that of consanguinity as an impediment to matrimony; and, finally, to all this added the impediments created by "spirtual affinity," *i.e.* the relations established between baptizer and baptized, confirmer and confirmed, and between godparents, their godchildren and their godchildren's relatives.

The result of this system was hopeless confusion and uncertainty, and it was early found necessary to modify it. This was done by Pope Gregory I., who limited the impediment to the 7th degree of relationship inclusive (civil computation)[1] which was afterwards made the law of the empire by Charlemagne. Later still Innocent III. found it necessary again to issue a decree (4th Lateran Council) permitting marriages between a husband and the relations of his wife, and vice versa, beyond the 4th degree inclusive (canonical computation).[2] This remains the canonical rule of the Roman Catholic Church. As regards impediments due to spiritual affinity, these were limited by the Council of Trent to the relation of the baptizer and baptized; the baptizer and the parents of the baptized; the baptizer and the godfather and godmother; the godparents and the baptized and its parents: *i.e.* a godfather may not marry the mother of the child he has held at the font, nor the godmother the father of such child.

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[1] The restrictions are enumerated in the following lines:—

Error, Conditio, Votum, Cognatio, Crimen,
Cultus, Disparitas, Vis, Ordo, Ligamen, Honestas,
Aetas, Affinis, si Clandestinus et Impos,
Raptave sit mulier nec parti reddita tutae.

[2] Canon lxi. Aut qui ex propria consanguinitate aliquam, aut quam consanguineus habuit . . . duceret uxorem . . . incestos esse non dubitamus (Mansi *Conc.* viii. p. 336). According to the canon law "affinity" is the relation between two persons of whom one has had commerce, licit or illicit, with a relation of the other.

In the fully developed canon law impediments to marriage are of two kinds, public and private (*impedimenta publica* and *privata*), *i.e.*, according as the objection arises out of the very nature of marriage itself or from consideration for the rights of particular persons; near relationship, for instance, is a public impediment, impotence (*impotentia*) and force (*vis et metus*) are private impediments. Impediments are further divided into separating (*impedimenta dirimentia*) or merely suspensive (*impedimenta tantum impedientia*); to the first class belongs, *e.g.* a previous marriage not dissolved by death, which involves the nullification of the marriage even where through ignorance the crime of bigamy is not involved; to the second belongs the case of one or both of the contracting parties being under the age of puberty.[3] Impediments, moreover, are absolute or relative, according as they are of universal application or only affect certain persons; near relationship, for instance, is an absolute impediment, difference of religion between the parties a relative impediment. In addition to consanguinity and affinity, impuberty and existing marriage, the canon law lays down as public and absolute impediments to marriage the taking of holy orders and the vows of chastity made on entering any of the religious orders approved by the Holy See. In these impediments the canon law further distinguishes between those which are based on the law of nature (*jus naturae*) and those which are based on the law of the Church (*jus ecclesiae*). From impediments based on the law of nature, or of God, there is no power even in the pope to dispense; *e.g.* marriage of father and daughter, brother and sister, or remarriage of husband or wife during the lifetime of the wife or husband of another marriage, which is held to be a violation of the very nature of marriage as an indissoluble union.[4] From impediments arising out of the law of the Church dispensations are granted, more or less readily, either by the pope or by the bishop of the diocese in virtue of powers delegated by the pope (see DISPENSATION). Thus dispensations may be granted for marriage between persons related by consanguinity in any beyond the 2nd degree and not in the direct line of ascent or descent; *e.g.* between uncle and niece (confined by the council of Trent to the case of royal marriages for reasons of state) and between cousins-german, or in the case of marriage with a heretic. In this latter case a dispensation is now (*i.e.* since the papal decrees *ne temere* of the 2nd of August 1907, which came into force at Easter 1908) only granted on condition that the parties are married by a Catholic bishop, or a priest accredited by him, that no religious ceremony shall take place except in a Catholic church, and that all the children shall be brought up in the Roman Catholic faith.[5]

In the absence of any impediment a marriage is according to the canon law completed between baptized persons by the facts of consent and consummation; the principle is still maintained that the parties to the marriage, not the priest, are the "ministers of the sacrament" (*ministri sacramenti*).[6] From the first, however, the Church, while recognizing the validity of private contracts, enjoined the addition of a public religious ceremony, so that they might be "sanctified by the word of God and prayer" (1 Tim. iv. 5).[7] Tertullian (*de pudicitia*, cap. iv.) says that clandestine marriages, not professed in the Church, were reckoned among Christians as all but fornication, and he speaks of the custom of seeking permission to marry from the bishop, priests and deacons (*de monogamia*, cap. xi.). This latter precaution became increasingly necessary as impediments were multiplied, and Charlemagne, in a capitulary of 802, forbade the celebration of a marriage until "the bishops, priests and elders of the people" had made diligent inquiry into the question of the consanguinity of the parties. This was the origin of the publication of banns which, long customary in France, was made obligatory on the whole Church by Pope Innocent III. In the Eastern Church the primitive practice survives in the ceremonial blessing by the priest of the betrothal, as distinguished from the marriage ceremony. The ecclesiastical recognition of clandestine marriages, however, survived until the crying evil was remedied by a decree of the council of Trent (Sess. xiv. *de matrim.*),[1] which laid it down that for a valid marriage it was at least necessary that consent should be declared before a priest and in the presence of three witnesses. According to the actual law of the Roman Catholic Church, then, a civil marriage is only valid when the Tridentine decree has not been published; where this has been published, or has been in practice without publication, such a marriage can only become valid if followed by a religious ceremony in the prescribed form. Where such form has not followed the ecclesiastical courts must treat the marriage as voidable through the *impedimentum clandestinitatis.*

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[1] The civil law counts, in the direct line, as many degrees as there are generations between the parties; *e.g.* the son is in regard to his father in the 1st degree, the grandson in the 2nd, and vice versa. In the collateral line it computes degrees by generations, *i.e.* from one of the relations to the common ancestor, without including him or her, and from him or her back to the other relation; *e.g.* two brothers are in the 2nd degree of relationship to one another, uncle and nephew in the 3rd, cousins-german in the 4th.

The canon law, which in this case derives from the old Germanic law, has the same computation as regards the direct line. In the case of collateral relations, however, it differs, having two rules: (1) In the case of *equal line*—*i.e.* when the collaterals are equally removed from the common progenitor, it reckons the same number of degrees between the collaterals as between one of them and the progenitor; *e.g.* brothers are related in the 1st degree, while cousins-german are related in the 2nd degree because they are two generations from the common grandfather. (2) In the case of *unequal line*—*i.e.* when the collaterals are unequally removed from the common ancestor, the degree of their relationship is that of the most remote from the common progenitor; *e.g.* uncle and niece are related in the 2nd degree—*i.e.* that of the niece to the grandfather.

The civil computation was furiously attacked by canonists as tending to laxity (see Peter Damianus, "De parentelae gradibus," in Migne, *Patrol. Lat.* cxlv. 191, &c.).

[2] Innocent III. also decided that the husband's relations were not related to those of the wife, and vice versa, thus establishing the rule that "affinity does not breed affinity" (*affinitas non parit affinitatem*).

[3] This is fixed by the canon law at 14 for a male, 12 for a female. If, however, owing to the precocious physical development of a girl, the marriage has been consummated before she has reached this age, it cannot be nullified.

[4] It is maintained that no pope has ever given a dispensation for such a marriage. Such a case seems, however, to be narrated by Ordericus Vitalis (*Hist. eccles.* viii. 23; ed. A. le Prevost, Paris, 1838–1855, t. iii. p. 408; ed. A. Duchesne, 1619, 704 B). Robert Mowbray, earl of Northumberland, had only been married to Maud de Laigle three months when he was condemned to perpetual imprisonment for rebellion against King William Rufus. After describing her forlorn state Orderic continues: "Nec ipsa eo vivente, secundum legem Dei, alteri nubere legitime valebat. Tandum, permissu Paschalis Papae (II.), cui res, a curiosis enucleata, patuit, post multos dies Nigellus de Albineo ipsam uxorem accepit." This may mean no more, of course, than that the *curiosi* "untied the knot" by discovering an impediment—the usual expedient in such cases. In any case the fact that Nigel de Albini, in his turn, soon afterwards obtained a "divorce" from her on the ground that her first husband was his relative by consanguinity, hardly points to a strict view of the sanctity of the marriage tie.

[5] The customary rule for more than three centuries after the Council of Trent was that male children followed the religion of the father, female children that of the mother. On the general subject of the attitude of the Church towards mixed marriages see O. D. Watkins, *Holy Matrimony*, pp. 468 et seq. For the Roman Catholic view see "An Instruction on Mixed Marriages" in Bishop Ullathorne's *Eccl. Discourses* (London, 1876).

[6] Among the "errors" denounced by Pope Pius IX. in the Syllabus of 1864 is lxvi.: Matrimonii sacramentum non est, nisi quid contractui accessorium ab eoque separabile, ipsumque sacramentum in una tantum nuptiali benedictione situm est." This condemns the attempts of certain canonists (*e.g.* Melchior Cano) to distinguish between the *contractus naturalis* and *sacramentalis*. This view, which was first advanced by the jurist and theologian Johann Gropper (1502–1559) at the council of Cologne (1536), and gained support especially in France, makes the "matter" of the sacrament the consent of the parties, the "form" the prayers and benedictions, the "minister" the priests (see *e.g.* "Du sacrament de mariage" in vol. v. of the *Dissertationes selectae* of Petrus de Marca, d. 1662, archbishop of Paris, Bamberg, 1789, p. 148).

[7] See the list of quotations from the early fathers given by Watkins, *Holy Matrimony*, p. 93.

Divorce, *i.e.* the annulment of marriage for any cause but an impediment which makes the marriage *ipso facto* void, is unknown to the Roman Catholic Church. Separation *a vinculo matrimonii* is only possible under the canon law by a judicial decree of nullity (*annullatio matrimonii*), which implies, not the severing of the ties of a real marriage, but the solemn declaration that such marriage has never existed. There may, however, be a "separation from bed and board" (*a thoro et mensa*), even perpetual, which does not however give either party the right to remarry during the lifetime of the other. But, marriage not being regarded as a sacrament until consummated, it may be dissolved, if non-consummation be proved, by one or both parties taking the religious vows, or by papal dispensation. The Church claims exclusive control over marriage, and the council of Trent anathematized the opinion held by Luther and other Reformers, that it was properly a subject for the civil courts (*si quis dixerit causas matrimoniales non spectare ad judices ecclesiasticos anathema sit*, Sess. xxiv. cap. 2). This attitude became of extreme political importance when even in Catholic countries the codes established civil marriage as the only legally binding form.

England.—Marriage may be the subject of an ordinary contract on which an action may be brought by either party. It is not necessary that the promise should be in writing, or that any particular time should be named. Promises to marry are not within the meaning of "agreement made in consideration of marriage" in the statute of frauds, which requires such agreements to be in writing. Contracts in restraint of marriage, *i.e.* whose object is to prevent a person from marrying anybody whatever, are void, as are also contracts undertaking for reward to procure a marriage between two persons. These latter are termed marriage brocage contracts.

Any man and woman are capable of marrying, subject to certain disabilities, some of which are said to be canonical as having been formerly under the cognisance of the ecclesiastical courts, others civil. The effect of a canonical disability as such was to make the marriage not void but voidable. The marriage must be set aside by regular process, and sentence pronounced during the lifetime of the parties. Natural inability at the time of the marriage to procreate children is a canonical disability. So was relationship within the prohibited degrees, which has been made an absolute avoidance of marriage by the Marriage Act 1835. Civil disabilities are (1) the fact that either party is already married and has a spouse still living;[2] (2) the fact that either person is a party of unsound mind; (3) want of full age, which for this purpose is fixed at the age of puberty as defined in the Roman law, viz. fourteen for males and twelve for females;[3] (4) relationship within the prohibited degrees.

The statute which lawyers regard as establishing the rule on this last point is the 32 Hen. VIII. c. 38 (repealed in part by 2 & 3 Edw. VI. c. 23, in whole by 1 & 2 P. and M. c. 8, but revived by 1 Eliz. c. 1, and so left as under the Act of Edward), which enacts that "no prohibition, God's law except, shall trouble or impeach any marriage without the Levitical degrees." The forbidden marriages, as more particularly specified in previous statutes, are those between persons in the ascending and descending line *in infinitum*, and those between collaterals to the third degree inclusive, according to the computation of the civil law. The prohibitions extend not only to *consanguinei* (related by blood) but to *affines* (related by marriage), now altered so far as a deceased wife's sister is concerned (see below). The act of 1835 enacted that "all marriages which shall hereafter be celebrated between persons within the prohibited degrees of consanguinity or affinity shall be absolutely null and void to all intents and purposes whatsoever." They had previously been only voidable. The act at the same time legalized marriages within the prohibited degrees of affinity (but not consanguinity) actually celebrated before the 31st of August 1835.

Marriage with a Deceased Wife's Sister.

For many years an active and ceaseless agitation was carried on on behalf of the legalization in England of marriage with a deceased wife's sister. In all the self-governing colonies, with the exception of Newfoundland, the restriction had ceased to exist. The first act legalizing marriage with a deceased wife's sister was adopted by South Australia. The royal assent, however, was not given till the parliament of that state had five times passed the bill. In quick succession similar statutes followed in Victoria, Tasmania, New South Wales, Queensland, New Zealand, West Australia, Barbados, Canada, Mauritius, Natal and Cape Colony. As regards the Channel Islands, marriages of the kind in question were made legal in 1899, and in 1907 in the Isle of Man.

In England the bill to render marriage with a deceased wife's sister valid was first adopted by the House of Commons in 1850, and rejected by the House of Lords in 1851. It was subsequently brought before the legislature in 1855, 1856, 1858, 1859, 1861, 1862, 1866, 1869, 1870, 1871, 1872, 1873, 1875, 1877 and 1878 (Colonial bills), 1879 (6th May, when in the House of Lords the prince of Wales and the duke of Edinburgh voted in favour of it), 1880, 1882, 1883, 1884, 1886, 1888, 1889, 1890, 1891, 1896, and 1898 and 1900 (Colonial bills). In most cases it passed the House of Commons but was rejected in the House of Lords. The bill of 1896, however, which was judiciously drafted to avoid the compulsory celebration by clergymen of marriages against which they had conscientious scruples, was carried in the Lords. Both the prince of Wales and the duke of York were among the "contents." The prime minister and eighteen bishops, including the two archbishops, voted against the bill, the earl of Rosebery and Lord Kimberley for it. At the third reading the bill was carried by 142 to 104 votes. Its promoters, however, did not succeed in getting an opportunity of bringing it before the House of Commons.

From 1896 to 1901 no further direct steps were taken, but in 1898 and again in 1900 (May 28) the subject was brought forward in the House of Lords by Lord Strathcona in the form of a bill under which marriages with a deceased wife's sister contracted in any British colony should be deemed valid for all purposes within the United Kingdom. In 1898, and again in 1900, the bill was carried on the third reading without a dissentient vote. The House of Commons took no action on either occasion. An imperial bill reached a second reading in the House of Commons in 1901 and again in 1902, but it was blocked by the High Church opponents of the measure when attempts were made to get it to the committee stage (Feb. 5 and June 6). The reform was, however, finally adopted in 1906 under the title of the Colonial Marriages (Deceased Wife's Sister) Act. The effect of the act was to make such marriages legal in all respects, including the right of succession to real property and to honours and dignities within the United Kingdom. The natural sequence of the passing of the act of 1906 was the reintroduction in 1907 of the bill relating to England. Introduced by a private member, it was adopted by the government, passed the House of Commons, and finally the House of Lords (on the second reading by 111 votes to 79), and became law as the Deceased Wife's Sister Marriage Act, 1907. The act contains a proviso justifying clergymen in refusing to solemnize marriages with a deceased wife's sister, and it preserves the peculiar status of the wife's sister under the Matrimonial Causes Act 1857, under which adultery with her by the husband is incestuous adultery.

The celebration of marriages is now regulated wholly by statutory legislation. The most important acts in force are the Marriage Acts 1823, 1836, 1886 and 1898.[4] The former regulates marriages within the Church of England, but was intended to be of universal application, Jews and Quakers only being excepted by section 31. It requires either the previous publication of banns, or a licence from the proper ecclesiastical authority. As to banns, the rule of the rubric, so far as not altered by the statute, is required to be observed. They must be published on three successive Sundays at morning service after the second lesson, in the church of the parish in which the parties dwell; the bishop may, however, authorize the publication of banns in a public chapel. Seven days' notice must be given to the clergyman of the names of the parties, their place of abode, and the time during which they have lived there. If either party is under age, the dissent of the parents or guardians expressed at the time of publication of banns renders such publication null and void. Licence in lieu of banns may only be granted by the archbishop, bishop or other authority, for the solemnization of a marriage within the church of the parish in which one of the parties shall have resided for fifteen days before. Before a licence can be granted an oath must be taken as to the fact of residence and that the necessary consent has been obtained in the case of persons under age. The father, or lawful guardian, is the proper person to consent to the marriage of a minor, and the place of any such person incapacitated mentally is taken by the lord chancellor. The absence of such consent does not, however, avoid a marriage once solemnized. But if persons wilfully intermarry (unless by special licence) in a place not being a church or public chapel, or without due publication of banns or proper licence, or before a person not in holy orders, the marriage is null and void to all purposes. Marriage must be celebrated within three months after banns or licence, and between the hours of eight in the morning and three in the afternoon.

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[1] The later teaching of the Eastern Church is laid down in the Orthodox Confession of Peter Mogilas, patriarch of Kiev (1640). There are three essentials for a Christian marriage: (1) suitable matter (ὕλη ἁρμόδιος), *i.e.* a man and woman whose union no impediment bars, (2) a duly ordained bishop or priest, (3) the invocation of the Holy Ghost, and the solemnity of the formularies (τὸ εἶδος τῶν λογίων).

[2] A divorce *nisi* does not enable the parties to marry until it is made absolute.

[3] A marriage in which either of the parties is below the age of consent is, however, said to be not absolutely void; if the parties agree to continue together at the age of consent no new marriage is necessary, but either of them may disagree and avoid the marriage.

[4] A complete list of the acts regulating the solemnization of marriage or confirming marriages, which through some defect might be void, will be found in Phillimore's *Ecclesiastical Law* (2nd ed. 1895).

For the relief of the great body of Dissenters the act of 1836 was passed. It permits marriage to be solemnized in two additional ways—viz. (1) by certificate of the superintendent registrar of a district without licence, and (2) by such certificate with licence. In the first case, notice must be given to the registrar of the district or districts within which the parties have resided for seven days previous, which notice is inscribed in a marriage-notice book, open to public inspection at all reasonable times, and thereafter suspended for twenty-one days in some conspicuous place in the registrar's office. Any person whose consent is necessary to an ecclesiastical licence may forbid the issue of a certificate, but in default of such prohibition the certificate will issue at the end of the twenty-one days. The marriage may then take place on any day within three months of the entry of notice, and in one of the following ways: (1) in a certified place of religious worship, registered for the solemnization of marriage; in that case a registrar of the district with two witnesses must be present, and the ceremony must include a mutual declaration of assent by the parties and a disavowal of any impediment; (2) at the superintendent registrar's office, with the same declaration, but with no religious service; (3) in a church according to the usual form, the consent of the minister thereof having been previously obtained; (4) according to the usages of Jews and Quakers. The place of marriage in all cases must have been specified in the notice and certificate.

In the second case, when it is desired to proceed by licence, notice must be given to the registrar of the district in which one of the persons resides, together with a declaration that he or she has resided for fifteen days therein, that there is no impediment, and that the necessary consents if any have been obtained. The notice is not exhibited in the registrar's office, and the certificate may be obtained at the expiration of one whole day after entry, together with the licence. No registrar's licence can be granted for a marriage in church or according to the forms of the Church of England—the ecclesiastical authorities retaining their jurisdiction in that respect. It is also provided that in the case of persons wilfully intermarrying in a place other than that mentioned in the notice and certificate, or without notice or certificate, &c., the marriage shall be null and void.

The various rules as to consent of parents, &c., to the marriages of minors are regulations of procedure only. The absence of the necessary consent is not a disability invalidating a marriage actually solemnized.

The Act 26 Geo. II. c. 33, commonly known as Lord Hardwicke's Act, which forbids the solemnization of marriage without banns or licence, also enacts that "in no case whatsoever shall any suit or proceeding be had in any ecclesiastical court in order to compel a celebration *in facie ecclesiae*, by reason of any contract of matrimony whatsoever whether *per verba de presenti* or *per verba de futuro*." Blackstone observes that previous to this act "any contract made *per verba de presenti*, or in words of the present tense, and in case of cohabitation *per verba de futuro* also, was deemed valid marriage to many purposes; and the parties might be compelled in the spiritual courts to celebrate it *in facie ecclesiae*."

Royal marriages in England have been subject to special laws. The Royal Marriage Act of 1772 (12 Geo. III. c. 11), passed in consequence of the marriages of the dukes of Cumberland and Gloucester, enacted that "no descendant of his late majesty George II. (other than the issue of princesses married or who may marry into foreign families) shall be capable of contracting matrimony without the previous consent of his majesty, his heirs and successors, signified under the Great Seal. But in case any descendant of George II., being above twenty-five years old, shall persist to contract a marriage disapproved of by his majesty, such descendant, after giving twelve months' notice to the privy council, may contract such marriage, and the same may be duly solemnized without the consent of his majesty, &c., and shall be good except both Houses of Parliament shall declare their disapprobation thereto."

In 1886 an act was passed in the British parliament to remove doubts which had been entertained as to the validity of certain marriages solemnized in England when one of the parties was resident in Scotland. The Summary Jurisdiction (Married Women) Act of 1895 enabled a wife whose husband is convicted of an assault on her, or who has been deserted by him, or been obliged owing to his cruelty to live apart from him, to apply to the justices, who are empowered by the act to make an order for separation and for payment by the husband to his wife of such weekly sum, not exceeding two pounds, as they may consider reasonable. The Marriage Act 1898 authorized the celebration of marriages in places of worship duly registered for the solemnization of marriages under the Marriage Act of 1836 without the presence of the registrar, on condition of their being solemnized in the presence of a person duly authorized by the governing body of the place of worship in question. It also made further provision for the due recording of all marriages in the general registers. The Marriages Validity Act of 1899 removed doubts as to the validity of marriages in England on Irish banns and in Ireland on English banns. Lastly, the Marriage with Foreigners Act 1906 enabled a British subject desirous of marrying a foreigner in a foreign country to comply with the foreign law by obtaining from a registrar a certificate that no legal impediment to the marriage has been shown. Similar certificates, by arrangement between His Majesty and foreign countries, are issued in the case of a foreigner desirous of marrying a British subject in the United Kingdom.

The Foreign Marriage Act 1892 has consolidated the English law relating to marriages celebrated abroad, and brings it into harmony with the current tendencies of marriage law reform generally. Under it a marriage between British subjects abroad is as valid as a marriage duly solemnized in England (as heretofore), if celebrated in accordance with the local law or in the presence of diplomatic or consular agents who are appointed to act as "marriage officers." The old fiction of assimilation of a British embassy to British soil can no longer be relied upon to uphold a marriage at a British embassy solemnized by an ordained clergyman. An order in council of the 28th of October 1892, moreover, provides that in the case of any marriage under the act, if it appears to the marriage officer that the woman about to be married is a British subject, and that the man is an alien, he must be satisfied that the marriage will be recognized by the law of the foreign country to which the alien belongs.

A marriage may be solemnized on board one of His Majesty's ships at a foreign station, provided a warrant of a secretary of state has authorized the commanding officer to be a marriage officer. At sea, marriages on British public or private ships seem still valid at common law, if performed by an episcopally ordained minister. The Merchant Shipping Act 1894 (sect. 240) provides that the master of a ship for which an official log is required shall enter in it every marriage taking place on board, with the names and ages of the parties.

Again, under the Foreign Marriage Act all marriages solemnized within the British lines by a chaplain or officer or other person officiating under the orders of the commanding officer of a British army serving abroad, are as valid in law as if they had been solemnized within the United Kingdom subject to due observance of all forms required by law. The Naval Marriages Act 1908 authorizes, for the purpose of marriages in the United Kingdom, the publication of banns and the issue of certificates on board His Majesty's ships in certain cases, or when one of the parties to a marriage intended to be solemnized in the United Kingdom is an officer, seaman or marine, borne on the books of one of His Majesty's ships at sea.

The principle of the English law of marriage, that a marriage contracted abroad is valid if it has been solemnized according to the *lex loci*, may be now taken to apply just as much to a marriage in a heathen as in a Christian country. Whether the marriage has or has not been celebrated according to Christian laws has no bearing upon the question, providing it is a monogamous marriage—a marriage which prevents the man who enters into it from marrying any other woman while his wife continues alive.

Scotland.—The chief point of distinction, as compared with English law, is the recognition of irregular marriages. (1) "A public or regular marriage," says Fraser, "is one celebrated, after due proclamation of banns, by a minister of religion; and it may be celebrated either in a church or in a private house, and on any day of the week at any hour of the day." The ministers of the National Church at first alone could perform the ceremony; but the privilege was extended to Episcopalians by 10 Anne c. 7 (1711), and to other ministers by 4 and 5 Will. IV. c. 28 (1834). (2) A marriage may also "be constituted by declarations made by the man and the woman that they *presently* do take each other for husband and wife." These declarations "may be emitted on any day at any time and without the presence of witnesses," and either by writing or orally or by signs, and in any form which is clearly expressive of intention. Such a marriage is as effectual to all intents and purposes as a public marriage. The children of it would be legitimate; and the parties to it would have all the rights in the property of each other, given by the law of Scotland to husband and wife. (3) A promise followed by *copula* does not constitute marriage, unless followed either by solemnization *in facie ecclesiae* or declarator. Lord Moncreiff's opinion in the case of *Brown* v. *Burns* is admitted to be good law, viz. that declarator is essential to the constitution of a marriage of this kind, so that, if no such declarator be brought in the lifetime of both parties, the marriage can never be established afterwards. The *copula* is presumed to have reference to the promise, but evidence may be adduced to show that such was not the case.

By the Marriage (Scotland) Act 1856 it is enacted that no *irregular* marriage shall be valid in Scotland, unless one of the parties has lived in Scotland for the twenty-one days next preceding the marriage, or has his or her usual residence there at the time.

"Habit and repute" has sometimes been spoken of as constituting marriage in the law of Scotland, but it is more correctly described as evidence from which marriage may be inferred. The repute must be the general, constant, and unvarying belief of friends and neighbours, not merely the controverted opinion of a section of them. The cohabitation must be in Scotland, but in one case proof of cohabitation in another country was allowed, as tending to throw light on the nature of the cohabitation in Scotland.

The consent of parents is not necessary to the validity of the marriage, even of minors, but marriage under the age of puberty with or without such consent is void.

United States.—The absence of ecclesiastical courts has suggested difficulties as to the extent to which the law of England on this subject continued to prevail after the revolution. Bishop holds it to be the universal fact running through all the cases that everywhere in the country the English decisions on marriage and divorce are referred to with the same apparent deference which is shown on other subjects to the decisions of the English common law and equity tribunals. The same author observes that "all our marriage and divorce laws, and of course all our statutes on the subject, in so far as they pertain to localities embraced within the limits of particular states, are state laws and state statutes, the national power with us not having legislative or judicial cognisance of the matter within those localities." Some of the states have extended the ages below which marriage cannot take place. The common law of the states is assumed to be that "a contract *per verba de presenti*, or *per verba de futuro cum copula*, constitutes a complete marriage." Conditions, however, may be imposed by the various state legislatures, and as to these the rule has established itself in American jurisprudence that "a marriage good at common law is good notwithstanding the existence of any statute on the subject, unless the statute contains express words of nullity." Thus in Pennsylvania, where a statute provided that all marriages "should be solemnized before twelve witnesses," marriages not so celebrated were nevertheless held to be good. In New Hampshire justices and ministers of the gospel are authorized to solemnize marriage, and all other persons are forbidden to do so under penalties; yet a marriage by consent, as at common law, without justice or minister, has been held valid. On the other hand, under a very similar statute in Massachusetts, it was held that "parties could not solemnize their own marriage," and that a marriage by mutual agreement, not in accordance with the statute, was void. Bishop regards this as an isolated exception to the general course of the decisions. So when state legislation requires any particular form to be used the want thereof only invalidates the act if the statute expressly so enacts. Many of the state codes inflict penalties on ministers or justices for celebrating the marriage of minors without the consent of the parents or guardians. The original law as to prohibited degrees has been considerably modified in the states. The prohibition of marriage with a deceased wife's sister has been abolished in the United States. But New Hampshire, Ohio, Indiana, Kansas, Arkansas, Nevada, Washington, the Dakotas and Montana have for long forbidden marriages between first cousins by blood, and Louisiana, Oregon, Pennsylvania, Michigan, Nebraska, Utah and Wisconsin have since adopted the same principle. Virginia prohibits the marriage of a woman with the husband of her brother's or sister's daughter.

Attention is also being paid to the question of marriage from a physical point of view. New Jersey prohibits the marriage of any person who has been confined in any public asylum as an epileptic, insane or feeble-minded patient, without a medical certificate from two physicians of complete recovery, and that there is no probability of the transmission of such defects. This prohibits the granting of a marriage licence where either party is an habitual drunkard, epileptic, imbecile or insane, or where the applicant at the time of making application is under the influence of any intoxicant or narcotic drug. In Michigan, Minnesota, Kansas and Oregon, marriage is prohibited to epileptics, &c., except when the woman is over forty-five. In Michigan, also, marriage is forbidden to anyone who has suffered from a venereal disease and has not been cured. The equality of property rights between husband and wife is fully established in America. Indeed, in many states the movement has gone so far as to give the wife in matters of property and in reference to divorce greater privileges than the husband. Thus a husband is often liable for a wife's debts where a wife would not be, *mutatis mutandis*, for a husband's; and a wife may usually obtain a decree of divorce for any ground on which one may be awarded to the husband, and, in addition, for neglect to provide sustenance or support. Emphasis on the personal or moral relation of the parties in marriage tends to throw into the background the legal aspects and requirements; and it tends also to minimize, so far as the state is concerned, the religious and sacramental aspect of marriage. Marriage tends to become a relation established by parties between themselves, and one in which the consent of the parties becomes the only constitutive element. In the theory of American law no ceremony is essential to create the marriage relation. But this position has never been endorsed by any considerable proportion of the community, and in fact probably $\frac{9}{10}$ths and perhaps $\frac{99}{100}$ths of the marriages in the United States are contracted through some ceremony.

France.—Articles 144–226 of the Code Napoléon, as amended by an act of 1907, prescribe the qualifications and conditions of marriage. The man must be eighteen and the woman fifteen years of age. A son and daughter under twenty-one cannot marry without consent of the father and mother, or of the father only if they disagree, or of the survivor if one be dead. If both are dead grandfather and grandmother take their place. Between the ages of twenty-one and thirty the parties must still obtain the consent of their parents, but if this be refused it can be regulated by means of a "respectful and formal act" before a notary. If the consent is not given within thirty days the marriage may take place without it. If neither parents nor grandparents be alive, parties under twenty-one require the consent of the family council. These rules apply to natural children when affiliated; those not affiliated require the consent of a specially appointed guardian. Marriage is prohibited between all ascendants and descendants in the direct line, and between persons related by marriage in the same line, between brother and sister, between uncle and niece, and brother-in-law and sister-in-law.

Before the solemnization of marriage banns are required to be published for a period of ten days, which must include two Sundays, containing the names, occupations, and domiciles of the parties and their parents. There must be an interval of three days before the marriage can take place, and if a year is allowed to elapse fresh banns must be put up. On the day appointed by the parties, and in the parish to which one of them belongs, the marriage is celebrated by the civil officer or registrar reading over to them the various necessary documents, with the chapter of the code relating to husband and wife, receiving from each a declaration that they take each other for husband and wife, and drawing up the act of marriage. All this has to be done in the presence of four witnesses.

Marriages contracted abroad between French subjects or between French subjects and foreigners are valid in France if celebrated according to the forms of the foreign law, provided the French conditions as to consent of parents have been observed. (See also Marriage with Foreigners Act, *supra*.)

Germany.—The code of 1900 lays down rules applicable to the celebration of all marriages within the German Empire. Civil marriage alone is recognized by the code. It is effected by the declaration of the parties before a registrar in the presence of each other of their intention to be married. Two witnesses of full age must be present. The registrar asks each of the parties whether he or she will marry the other, and on their answer in the affirmative declares them duly married and enters the marriage in the register. The marriage must be preceded by a public notice. Marriages are void between descendants and ascendants; relatives by marriage in the ascending or descending line; brother and sister of the whole or half blood.

Other Countries.—In the great majority of the other European countries civil marriage is obligatory. In Roman Catholic countries the parties usually supplement the obligatory civil marriage by a religious ceremony, more especially since the papal decree *Ne temere* of the 2nd of August 1907 (which came into force at Easter 1908), which requires marriages between Roman Catholics, or between Roman Catholics and those not professing that faith, to be celebrated before a bishop or priest duly authorized for the celebration thereof.

Authorities.—Eversley, *The Law of Domestic Relations* (3rd ed., London, 1906); Lush, *The Law of Husband and Wife* (London, 1909); Crawley, *The Law of Husband and Wife* (London, 1892); Geary, *Marriage and Family Relations* (London, 1892); Griffiths, *Married Women's Property Acts* (London, 1891); Vaizley, *Law of Settlements of Property made on Marriage* (London, 1887); Bishop, (America) *Marriage, Divorce and Separation* (Chicago, 1892); David Murray, (Scotland) *The Law relating to the Property of Married Persons* (Glasgow, 1892); E. A. Westermarck, *History of Human Marriage* (3rd ed., 1901), with other works cited in the article Family. M. Neustadt, *Kritische Studien zum Familienrecht des bürgerlichen Gesetzbuchs* (Berlin, 1907); O. D. Watkins, *Holy Matrimony* (London, 1895), a comprehensive study of the history and theory of Christian marriage, from the High Anglican point of view, with special reference to missions dealing with heathen converts; J. Wickham Legg, "Notes on the Marriage Service in the Book of Common Prayer of 1549," in *Ecclesiological Essays* (London, 1905), a valuable comparative study of Christian marriage rites, with numerous references; the articles "Ehe, Christliche," by Gottschick, and "Eherecht" (many references), by Sehling, in Herzog-Hauck, *Realencyklopädie* (3rd ed., Leipzig, 1898, vol. v.); Abbé André, *Cours de droit canon* (3rd ed., Wagner, Paris, 1901), art. "Mariage," "Affinité," &c.

See also Age; Divorce; Family; Husband and Wife; Legitimacy and Legitimation; Morganatic Marriage.

MARRUCINI, an ancient tribe which occupied a small strip of territory round about Teate (mod. Chieti), on the east coast of Italy. It is first mentioned in history as a member of a confederacy with which the Romans came into conflict in the second Samnite War, 325 B.C., and it entered the Roman Alliance as a separate unit at the end of that war (see further Paeligni). We know something of the language of the Marrucini from an inscription known as the "Bronze of Rapino," which belongs to about the middle of the 3rd century B.C. It is written in Latin alphabet, but in a dialect which belongs to the North Oscan group (see Paeligni). The name of the city or tribe which it gives us is *touta marouca*, and it mentions also a citadel with the epithet *tarincris*. Several of its linguistic features, both in vocabulary and in syntax, are of considerable interest to the student of Latin or Italic grammar (*e.g.* the use of the subjunctive, without any conjunction, to express purpose, a clause prescribing a sacrifice to Ceres being followed immediately by *pacr si ut propitia sit*). The earliest Latin inscriptions are of Ciceronian date.

The form of the name is of considerable interest, as it shows the suffix -NO- superimposed upon the suffix -CO-, a change which probably indicates some conquest of an earlier tribe by the invading Safini (or Sabini, *q.v.*).

For further details as to Marrucine inscriptions and place-names see R. S. Conway, *The Italic Dialects*, p. 253 seq. (R. S. C.)

MARRUVIUM, the chief town of the Marsi, on the E. bank of the Lacus Fucinus, 4 m. S. of Cerfennia on the Via Valeria. Though no doubt of great antiquity, nothing is known of its history before the imperial period; and none of the remains visible there (city walls, various buildings within them, an amphitheatre, &c.), from which it seems to have been a place of some importance, can be attributed to an earlier date. On the site is the insignificant village of St Benedetto.

MARRYAT, FREDERICK (1792–1848), English sailor and novelist, was born at Westminster on the 10th of July 1792. He was the grandson of Thomas Marryat (physician, author of *The Philosophy of Masons*, and writer of verse), and son of Joseph Marryat, agent for the island of Grenada, who wrote pamphlets in defence of the Slave Trade. His mother was a Bostonian of German extraction. Young Marryat distinguished himself as a boy by frequently running away to go to sea; and at last, at the age of fourteen, he was allowed to enter the navy. His first service was under Lord Cochrane (afterwards tenth earl of Dundonald) in the famous "Impérieuse," and no midshipman ever had a livelier apprenticeship to the sea. During his two and a half years of service under Cochrane, the young midshipman witnessed more than fifty engagements, and had much experience of service on the coast of Spain in the early stage of the Peninsular War, in the attack on the French squadron in the Roads (April 1809) and in the Walcheren expedition. Before the general peace of 1815 he had served in North America and the West Indies and gained a wide knowledge of conditions of life on board ship under various commanders. In 1815 he was promoted to the rank of commander. After holding various commands he commissioned the "Larne," 20, for the East Indies and was senior naval officer at Rangoon during the Burmese War from May to September 1824. In the early part of the next year he commanded an expedition up the Bassein River, in which Bassein was occupied and the Burmese stores seized. His services were acknowledged by a nomination as C.B. in 1826. He frequently received honourable mention for his behaviour in action, and in 1818 he received the medal of the Humane Society for "at least a dozen" gallant rescues. Marryat's honours were not confined to gallant exploits. He adapted Sir Home Popham's code of signals to a code for the Mercantile Marine, for which he was made F.R.S. in 1819, and received the Legion of Honour from Louis Philippe in 1833. A pamphlet written to propose a substitute for the system of impressment in 1822 is said to have offended King William IV.

Marryat brought ripe experience and unimpaired vivacity to his work when he began to write novels. *Frank Mildmay, or the Naval Officer*, was published in 1829, and *The King's Own* followed in 1830. The novels of the sea captain at once won public favour. The freshness of the new field which was opened up to the imagination—so full of vivid lights and shadows, light-hearted fun, grinding hardship, stirring adventure, heroic action, warm friendships, bitter hatreds—was in exhilarating contrast to the world of the historical romancer and the fashionable novelist, to which the mind of the general reader was at that date given over. He had an admirable gift of lucid, direct narrative, and an unfailing fund of incident, and of humour, sometimes bordering on farce. Of all his portraits of adventurous sailors, "Gentleman Chucks" in *Peter Simple* and "Equality Jack" in *Mr Midshipman Easy* are the most famous, but he created many other types which take rank among the characteristic figures in English fiction. Marryat's first attempt was somewhat severely criticized from an artistic point of view, and he was accused of gratifying private grudges by introducing real personages too thinly disguised; and as he attributed some of his own adventures to Frank Mildmay he was rather shocked to learn that readers identified him with that disagreeable character. *The King's Own* was a vast improvement, in point of construction, upon *Frank Mildmay*; and he went on, through a quick succession of tales, *Newton Forster* (1832), *Peter Simple* (1834), *Jacob Faithful* (1834), *The Pacha of Many Tales* (1835), *Japhet in Search of a Father* (1836), *Mr Midshipman Easy* (1836), *The Pirate and the Three Cutters* (1836), till he reached his high-water mark of constructive skill in *Snarley-yow, or the Dog Fiend* (1837). The best of his books after this date are those written expressly for boys, the favourites being *Masterman Ready* (1841), *The Settlers in Canada* (1844), and *The Children of the New Forest* (1847). Among his other works are *The Phantom Ship* (1839); *A Diary in America* (1839); *Olla Podrida* (1840), a collection of miscellaneous papers; *Poor Jack* (1840); *Joseph Rushbrook* (1841); *Percival Keene* (1842); *Monsieur Violet* (1842); *The Privateer's*

Man (1844); *The Mission, or Scenes in Africa* (1845); *The Little Savage* (1848–1849), published posthumously; and *Valerie*, not completed (1849). His novels form an important link between Smollett and Fielding and Charles Dickens.

Captain Marryat had retired from the naval service in 1830, becoming equerry to the duke of Sussex. He edited the *Metropolitan Magazine* from 1832 to 1835, and some of his best stories appeared in that paper. He spent a great part of his time in Brussels, where he was very popular. He visited Canada during Papineau's revolt and the United States in 1837, and gave a disparaging account of American institutions in a *Diary* published on his return to England. While at New York he wrote a play, *The Ocean Waif, or Channel Outlaw*, which was acted, and is forgotten. His versatility is further shown by the fact that he drew rough caricatures and other sketches with some spirit. Some capital snatches of verse are scattered throughout his novels, the best being "Poll put her arms akimbo" in *Snarleyyow*, and the "Hunter and the Maid" in *Poor Jack*. In 1843 he settled at Langham Manor, Norfolk. He indulged in costly experiments in farming, so that in spite of the large income earned by his books he was not a rich man. He died at Langham on the 9th of August 1848, his death being hastened by news of the loss of his son by shipwreck.

His daughter, Florence Marryat, herself a novelist, published his *Life and Letters* in 1872. See also David Hannay, *Life of Marryat* (1889). (D. H.)

MARS, MLLE [ANNE FRANÇOISE HYPPOLYTE BOUTET] (1779–1847), French actress, was born in Paris on the 9th of February 1779, the natural daughter of the actor-author named Monvel [Jacques Marie Boutet, 1745-1812], and Mlle Mars Salvetat, an actress whose southern accent had made her Paris *début* a failure. Mlle Mars began her stage career in children's parts, and by 1799, after the rehabilitation of the Comédie Française, she and her sister (Mars *aînée*) joined that company, of which she remained an active member for thirty-three years. Her beauty and talents soon placed her at the top of her profession. She was incomparable in *ingénue* parts, and equally charming as the coquette. Molière, Marivaux, Sedaine, and Beaumarchais had no more accomplished interpreter, and in her career of half a century, besides many comedy rôles of the older *rêpertoire*, she created fully a hundred parts in plays which owed success largely to her. For her farewell performance she selected Elmire in *Tartuffe*, and Silvia in *Jeu de l'amour et du hasard*, two of her most popular rôles; and for her benefit, a few days after, Célimène in *Le Misanthrope* and Araminthe in *Les Femmes savantes*. She retired in 1841, and died in Paris on the 20th of March 1847.

MARS (MAVORS, MARMAR, MARSPITER OR MASPITER), after Jupiter the most important deity of the Roman state, and one who, unlike most Roman deities, was never so much affected by foreign influences as to lose his essentially Roman and Italian character. Traces of his worship are found in all parts of central and southern Italy, in Umbria, Picenum, Samnium, and in one or two Etruscan cities, as well as in Latium; and in several communities, as we learn from Ovid (*Fasti*, 3. 93 seq.), he gave his name to a month, as at Rome to the first month of the old Roman year. We know little of the character of his cult except at Rome, and even at Rome it has been variously interpreted. He has been explained as a sun-god, a god of wind and storm, a god of the year and a god of vegetation; and he has been compared with Apollo by Roscher (*Apollo, and Mars*, 1873, and in the article "Mars" in his *Lexicon of Mythology*). But in historical times his chief function at Rome was to protect the state in war, and it is as a god of war that he is known to all readers of Roman literature. So entirely did this characteristic get the better of all others, that his name came to be used as a synonym for *bellum*; and in the latest and most careful of all accounts of the Roman religion he is pronounced to have been from first to last a god of war only (see Wissowa, *Religion und Kultus der Römer*, p. 129 seq.).

Until the time of Augustus Mars had but two temples at Rome, and both are connected with warlike operations. One of these was originally only an altar; it was in the Campus Martius, the exercising-ground of the army. The other was outside the Porta Capena, the gate through which the army marched on its way to campaigns to the south: here too each year the Equites met in order to start in procession through the city (*Dion. Hal.* 6. 13). Each of these sites was outside the *pomerium*, and this has been explained to mean that the war-god "must be kept at a distance" (Carter, *Religion of Numa*, p. 19). But in the heart of the city there was a *sacrarium* of Mars in the *regia*, originally the king's house, in which the sacred spears of Mars were kept, and the fact that on the outbreak of war the consul had to shake these spears, saying as he did it, *Mars vigila* ("Mars, wake up!"), shows that the god was believed to reside here in some spiritual sense. If the spears moved of themselves, the omen was bad and called for expiation. The *ancilia*, or sacred shields, also formed part of this symbolic armoury of the Roman state: they were carried in procession by the Salii (*q.v.*) or dancing warrior-priests of Mars on several occasions during the month of March up to the 23rd (*tubilustrium*), when the military trumpets (*tubae*) were lustrated: and again in October to the 19th (*armilustrium*), when both the *ancilia* and the arms of the exercitus were purified and put away for the winter. During the four months of the Italian winter the worship of Mars seems at a standstill: we have no trace of it in the calendar or in Roman literature. His activity is all in the warm season, *i.e.* in the season of warfare. It is only at the end of February that we find indications of the coming force of the Mars-cult in the month which bears his name: Quirinus, who was probably the Mars of the community settled on the Quirinal Hill, and had his twelve Salii corresponding to those of the Palatine Mars, held his festival on the 17th of February, and on the 27th was the first festival called Equirria, the second being on the 14th of March. The name indicates horse-racing; horses were bred and used at Rome chiefly for military purposes, and it is possible to see here, as in the Equirria of the 14th of March, which we know was a festival of Mars (W. W. Fowler, *Roman Festivals*, p. 44), an exercise of the war-horses, accompanied with sacrifice to Mars, preparatory to the opening of the season of arms.

There is thus abundant evidence, based on the ancient calendars and the features of the cult, that Mars was all along a deity especially connected with warfare; and it is hardly necessary to add proof of a less convincing kind, *e.g.* that the wolf, his special animal, is a warlike beast, or that Nerio, a female deity who may anciently have been coupled with him, seems to be etymologically "the strong one," or that he is in legend the father of Romulus the warlike king and founder of the Roman army, as compared with Numa, who instituted the Roman law and religion. Enough has been said to show why Mars should have become exclusively a god of war, even if the Roman state in its advance in the conquest of other peoples had not given a continual impulse to this aspect of the cult. In founding his famous temple of Mars Ultor (the avenger of Caesar) in the Forum Augusti, Augustus gave a new turn to this worship, and for a time it seems to have been a rival of that of the Capitoline Jupiter (see Carter, *Religion of Numa*, p. 174 seq.), and late in the period of the empire Mars became the most prominent of the *di militares* worshipped by the Roman legions.

There are however certain features in the Mars cult which make it probable that this god was not entirely warlike in character. He seems, in early times, at least, to have been also associated with agriculture; and this is in harmony with the facts: (1) that the season of arms is also the season of the growth, ripening and harvesting of the crops; (2) that the early Roman community was an agricultural as well as a military one, as is indicated in its religious calendar (Fowler, *Roman Festivals*, p. 334). Thus Mars was invoked in the ancient hymn of the Arval Brothers, whose religious duties had as their object to keep off enemies of all kinds from crops and herds (Henzen, *Acta Fratr. Arv.* p. 26, 1874; Wordsworth, *Fragments and Specimens of Early Latin*, p. 385 seq.); and his association here with the Lares (*q.v.*) proves that he is not regarded as a war-god who could avert the raid of an enemy. Still more striking is the invocation of Mars (with the cult-title Silvanus) in the yearly lustration of his land by the Roman farmer (Cato, *De re rustica*, 141), where it is not a human enemy, but disease, and all unwholesome influences, which the god is besought to avert from the farm and land, plantations and flocks. Three times the procession went round the land, reciting prayers and driving the victims to be sacrificed, viz. ox, sheep and pig (*suovetaurilia*), representing the farmer's most valuable stock. We can hardly doubt that in the state ceremony of the Ambarvalia, *i.e.* the *lustratio* of the ager romanus in its earliest form, the same god was invoked and the same ritual used (Fowler, *op. cit.* p. 124 seq.). Again in the curious ritual of the sacrifice to Mars of the October horse (Oct. 15: Fowler *op. cit.* 241), though the animal was undoubtedly a war-horse, the head was cut off and decked with cakes, as we are told (Paul. Diac. 220) *ob frugum eventum.* Even Quirinus, the form of Mars worshipped in the Quirinal community, is not without an association with agricultural perils, for it was his *flamen* who sacrificed the victims at the Robigalia on the 25th of April, when the spirit of the mildew (robigus) was invoked to spare the corn (Ovid, *Fasti*, 4. 901 seq.).

War and agriculture are thus the two factors of human life and experience which are unquestionably prominent in the cult of Mars, and explain his importance in a community like that of Rome: and there is no need, in a short account of this religious conception, to determine whether he was by origin a solar deity, a storm-god, or a vegetation-spirit. His name gives us no help, its etymology is uncertain (Roscher in *Mythological Lexicon, s.v.* "Mars," p. 2436). But we are safe in conjecturing that Mars first came into prominence among the Latins and kindred peoples in the course of their long struggle for settlements among the mountains and forests of Italy. The clearing of primeval woodland, the perils of agriculture from the raids of enemies and of wild beasts, and from the ravages of disease, are all indicated in the later Mars cult. The wolf and the woodpecker, denizens of the forest, always remained his sacred animals, and were believed in Italian legend to have led the Piceni and Hirpini to their places of settlement. Mars is specially associated with the early foundation legends of Italy, as was the case at Rome: and it was to him that the *ver sacrum* was dedicated, *i.e.* the entire produce of a spring, including the children born then, who were eventually driven forth from their homes to form new settlements elsewhere (Roscher in *Lex. Myth.* 2411). The fierce character of the god, gained no doubt in this period of struggle and danger, never entirely left him. Even in the hymn of the Fratres Arvales he is the "fierce Mars" (*fere Mars*), and in the prayer of Cato's farmer, though he has become "Father Mars," he is Silvanus (*q.v.*), the dweller in the woodland which surrounded the agricultural clearing.

See Roscher in *Myth. Lex. s.v.* 2385 seq.; Wissowa, *Religion und Kultus der Römer*, p. 129 seq.; Preller, *Römische Mythologie*, ed. Jordan, i. 332 seq.; Fowler, *Roman Festivals*, p. 33 seq. (W. W. F.*)

MARS, in astronomy, the fourth planet in the order of distance from the sun, and the next outside the earth. To the naked eye it appears as a bright star of a decidedly reddish or lurid tint, which contrasts strongly with the whiteness of Venus and Jupiter. At opposition it is brighter than a first magnitude star, sometimes outshining even Sirius. It is by virtue of its position the most favourably situated of all the planets for observation from the earth. The eccentricity of its orbit, 0·0933, is greater than that of any other major planet except Mercury. The result is that at an opposition near perihelion Mars is markedly nearer to the earth than at an opposition near aphelion, the one distance being about 35 million miles; the other 63 million. These numbers express only the minimum distances at or near opposition, and not the distance at other times. The time of revolution of Mars is 686·98 days. The mean interval between oppositions is 2 years 49½ days, but, owing to the eccentricity of the orbit, the actual excess over two years ranges from 36 days to more than 2½ months. Its period of rotation is 24 h. 37 m. 22·66 s. (H. G. Bakhuyzen).

Motions.—The accompanying diagram will convey a notion of the varied aspects presented by the planet, of the cycles of change through which they go, and of the order in which the oppositions follow each other. The outer circle represents the orbit of Mars, the inner one that of the earth. AE is the line of the equinoxes from which longitudes are counted. The perihelion of Mars is in longitude 335° at the point π. The ascending node Ω is in longitude 47°. The line of nodes makes an angle of 74° with the major axis, so that Mars is south of the ecliptic near perihelion, but north of it near aphelion. Around the inner circle, representing the earth's orbit, are marked the months during which the earth passes through the different parts of the orbit. It will be seen that the distance of Mars at the time of any opposition depends upon the month in which opposition occurs. The least possible distance would occur in an opposition about the end of August, a little before Mars reached the perihelion, because the eccentricity of the earth's orbit throws our planet a little farther from the sun and nearer the orbit of Mars in July than it does in August. The opposition of 1909 occurred on the 24th of September, at a point marked by the year near the equinox, and the month and years of the oppositions following, up to 1941, are also shown in the same way. Tracing them around, it will be seen that the points of opposition travel around the orbit in about 16 years, so that oppositions near perihelion, when Mars is therefore nearest the earth, occur at intervals of 15 or 17 years.

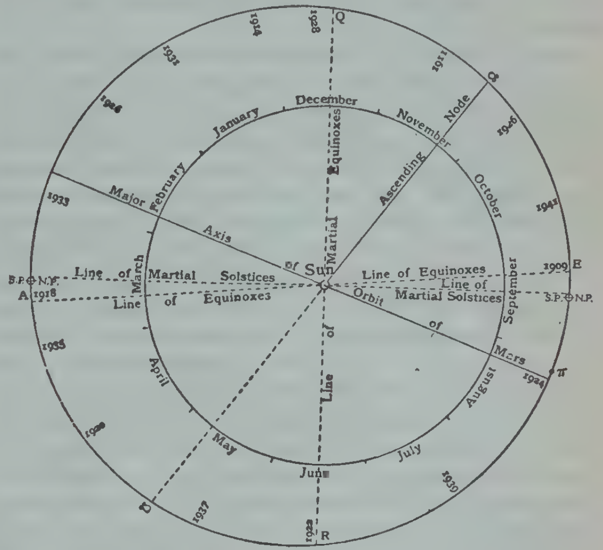

FIG. 1.—Orbits of Mars and the Earth, showing aspects of the planet relative to the earth and sun.

The axis of rotation of the planet is inclined between 23° and 24° to the orbit, and the equator of the planet has the same inclination to the plane of the orbit. The north pole is directed toward a point in longitude 355°, in consequence of which the projection of the planet's axis upon the plane of the ecliptic is nearly parallel to the line of our equinoxes. This projection is shown by the dotted line SP–NP, which corresponds closely to the line of the Martian solstices. It will be seen that at a September opposition the north pole of the planet is turned away from the sun, so that only the southern hemisphere is presented to us, and only the south pole can be seen from the earth. The Martian vernal equinox is near Q and the northern solstice near A. Here at the point S.P. the northern hemisphere is turned toward the sun. It will be seen that the aspect of the planet at opposition, especially the hemisphere which is visible, varies with the month of opposition, the general rule being that the northern hemisphere of the planet is entirely seen only near aphelion oppositions, and therefore when farthest from us, while the southern hemisphere is best seen near perihelion oppositions. The distances of the planet from the sun at aphelion and at perihelion are nearly in the ratio 6 : 5. The intensity of the sun's radiation on the planet is as the inverse square of this ratio. It is therefore more than 40% greater near perihelion than near aphelion. It follows from all this that the southern hemisphere is subjected to a more intense solar heat than the northern, and must therefore have a warmer summer season. But the length of the seasons is the inverse of this, the summer of the northern hemisphere being longer and the heat of the southern hemisphere shorter in proportion.

Surface Features.—The surface features of the planet will be better understood by first considering what is known of its atmosphere and of the temperature which probably prevails on its surface. One method of detecting an atmosphere is through its absorption of the different rays in the spectrum of the sunlight reflected from the planet. Several observers have thought that they saw fairly distinct evidence of such absorption when the planet was examined with the spectroscope. But the observations were not conclusive; and with the view of setting the question at rest if possible, W. W. Campbell at the Lick Observatory instituted a very careful series of spectroscopic observations.[1] To reduce the chances of error to a minimum the spectrum of Mars was compared with that of the moon when the two bodies were near each other. Not the slightest difference could be seen between any of the lines in the two spectra. It being certain that the spectrum of the moon is not affected by absorption, it followed that any absorption produced by the atmosphere of Mars is below the limit of perception. It was considered by Campbell that if the atmosphere of Mars were ¼ that of the earth in density, the absorption would have been visible. Consequently the atmosphere of Mars would be of a density less than ¼ that of the earth.[2]

Closely related to the question of an atmosphere is that of possible clouds above the surface of the planet, the existence of which, if real, would necessarily imply an atmosphere of a density approaching the limit set by Campbell's observations. The most favourable opportunity for seeing clouds would be when they are formed above a region of the planet upon which the sun is about to rise, or from which it has just been setting. The cloud will then be illuminated by the sun's rays while the surface below it is in darkness, and will appear to an observer on the earth as a spot of light outside the terminator, or visible edge of the illuminated part of the disk. It is noticeable that phenomena more or less of this character, though by no means common, have been noted by observers on several occasions. Among these have been the Mt Hamilton and Lowell observers, and W. H. Pickering at Arequipa. Campbell has shown that many of them may be accounted for by supposing the presence of mountains not more than two miles in height, which may well exist on the planet. While this hypothesis will serve to explain several of these appearances, this can scarcely be said of a detached spot observed on the evening of the 26th of May 1903, at the Lowell Observatory.[3] Dr Slipher, who first saw it, was so struck by the appearance of the projection from the terminator upon the dark side of the disk that he called the other observers to witness it. Micrometric measures showed that it was some 300 miles in length, and that its highest point stood some 17 miles above the surface of the planet. That a cloud should be formed at such a height in so rare an atmosphere seems difficult to account for except on the principle that the rate of diminution of the density of an atmosphere with its height is proportional to the intensity of gravity, which is smaller on Mars than on the earth. The colour was not white, but tawny, of the tint exhibited by a cloud of dust. Percival Lowell therefore suggests that this and other appearances of the same kind seen from time to time are probably dust clouds, travelling over the desert, as they sometimes do on the earth, and settling slowly again to the ground.

Temperature.—Up to a recent time all that could be said of the probable temperature of Mars was that, being more distant from the sun than the earth, and having a rarer atmosphere, it had a general mean temperature probably below that of the earth. Greater precision can now be given to this theoretical conclusion by recent determination of the law of radiation of heat by bodies at different temperatures. Regarding it as fairly well established that at ordinary temperatures the radiation varies directly as the fourth power of the absolute temperature, it is possible when the "solar constant" is known to compute the temperature of a non-coloured body at the distance of Mars which presents every part of its surface in rapid succession to the sun's rays in the absence of atmosphere only. This has been elaborately done for the major planets by J. H. Poynting,[4] who computes that the mean temperature of Mars is far below the freezing point of water. On the other hand an investigation made by Lowell in 1907,[5] taking into account the effect of the rare atmosphere on the heat lost by reflection, and of several other factors in the problem hitherto overlooked, led him to the conclusion that the mean temperature is about 48° Fahr.[6] But the temperature may rise much above the mean on those regions of the surface exposed to a nearly vertical noon-day sun. The diurnal changes of temperature, being diminished by an atmosphere, must be greater on Mars than on the earth, so that the vicissitudes of temperature are there very great, but cannot be exactly determined, because they must depend upon the conductivity and thermal capacity of the matter composing the surface of the planet. What we can say with confidence is that, during the Martian winter of between eight and twelve of our months, the regions around either pole must fall to a temperature nearer the absolute zero than any known on this planet. In fact the climatic conditions in all but the equatorial regions are probably of the same nature as those which prevail on the tops of our highest mountains, except that the cold is more intense.[7]

Having these preliminary considerations in mind, we may now study the features presented to our view by the surface of the planet. These have a permanence and invariability which markedly differentiate them from the ever varying surfaces of Jupiter and Saturn, and show that what we see is a solid surface, like that of our earth. They were observed and delineated by the leading astronomers of the 16th century, especially Huygens, Cassini and Hooke. These observers could only distinguish the different regions upon the planet as bright or dark. Reasoning as they did in the case of the moon, it was naturally supposed that the brighter regions were land and the darker ones seas. The observers of our time find that the darker regions have a slightly blue-green aspect, which might suggest the idea of water, but are variegated in a way to show that they must be composed of a solid crust, like the brighter regions. The latter have a decidedly warm red or ochre tint, which gives the characteristic colour to the planet as seen by the naked eye. The regions in equatorial and middle latitudes, which are those best seen from our planet, show a surface of which the general aspect is not dissimilar to that which would be presented by the deserts of our earth when seen from the moon. With each improvement in the telescope the numerous drawings of the planet show more definiteness and certainty in details. About 1830 a fairly good map was made by W. Beer and J. H. Mädler, a work which has been repeated by a number of observers since that time. The volume of literature on the subject, illustrated by drawings and maps, has become so great that it is impossible here to present even an abstract of it; and it would not be practicable, even were it instructive, to enter upon any detailed description of Martian topography. A few great and well-marked features were depicted by the earliest observers, who saw them so plainly that they may be recognized by their drawings at the present time. There is also a general agreement among nearly all observers with good instruments as to the general features of the planet, but even in the latest drawings there is a marked divergence as to the minuter details. This is especially true of the boundaries of the more ill-defined regions, and of the faint and difficult markings of various kinds which are very numerous on every part of the planet. There is not even a close agreement between the drawings by the same observer at different oppositions; but this may be largely due to seasonal and other changes.

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[1] *Astronomy and Astrophysics*, iii. 752, and *Astron. Soc. of the Pacific, Publications*, vi. 273 and ix. 109.

[2] According to Percival Lowell these results were, however, inconclusive because the strong atmospheric lines lie redwards beyond the part of the spectrum then possible to observe. Subsequently, by experimenting with sensitizing dyes, Dr Slipher of the Lowell Observatory succeeded in 1908 in photographing the spectrum far into the red. Comparison spectrograms of Mars and the Moon, taken by him at equal altitudes on such plates, eight in all, show the "a" band, the great band of water-vapour was distinctly stronger in the spectrum of Mars, thus affording what appeared decisive evidence of water vapour in the atmosphere of the planet.

[3] Lowell, *Mars and its Canals*, p. 101.

[4] *Phil. Trans.*, vol. 202 A, p. 525.

[5] *Proc. Amer. Acad. Arts and Sciences*, vol. xlii. No. 25.

[6] Professor F. W. Very concurs with Lowell (*Phil. Mag.*, 1908).

[7] According to Lowell, the climatic conditions are proportionally warm in summer.

The most striking feature, and one which shows the greatest resemblance to a familiar terrestrial process, is that when either polar region comes into view after being turned nearly a year away from the sun, it is found to be covered with a white cap. This gradually contracts in extent as the sun shines upon it during the remaining half of the Martian year, sometimes nearly disappearing. That this change is due to the precipitation of watery vapour in the form of ice, snow or frost during the winter, and its melting or evaporation when exposed to the sun's rays, is so obvious a conclusion that it has never been seriously questioned. It has indeed been suggested that the deposit may be frozen carbonic acid. While we cannot pronounce this out of the question, the probabilities seem in favour of the deposit being due to the precipitation of aqueous vapour in a frozen form. At a temperature of −50° C, which is far above what we can suppose to prevail in the polar regions during the winter, the tension of aqueous vapour is 0·034 mm. On the other hand Faraday found the tension of carbonic acid to be still an entire atmosphere at as low a temperature as −80° C. Numerically exact statements are impossible owing to our want of knowledge of the actual temperature, which must depend partly upon air currents between the equator and the poles of Mars. It can, however, be said, in a general way, that a proportion of aqueous vapour in the rare atmosphere of Mars, far smaller than that which prevails on the earth, would suffice to explain the observed formation and disappearances of the polar caps. Since every improvement in the telescope and in the conditions of observation must enable modern observers to see all that their predecessors did and yet more, we shall confine our statements to the latest results. These may be derived from the work of Professor Lowell of Boston, who in 1894 founded an observatory at Flagstaff, Arizona, 7250 ft. above sea-level, and supplied it with a 24″ telescope, of which the main purpose was the study of Mars. This work has been continued with such care and assiduity that its results must take precedence of all others in everything that relates to our present subject.[1]

Among the more probable conclusions to be drawn from Lowell's observations, the following are of most interest. The darker areas are all seamed by lines and dots darker than themselves, which are permanent in position, so that there can be no bodies of water on the planet. On the other hand, their colour, blue-green, is that of vegetation. This fades out as vegetation would at certain seasons to faint blue-green, but in some places to a tawny brown. Each hemisphere undergoes these changes in its turn, the changes being opposite in opposite hemispheres. The changes in the dark areas follow some time after the melting of the polar caps. The aspect of these areas suggests old sea bottoms, and when on the terminator appear as depressions, though this may be only apparent and due to the dark colour. The smoothness and soft outline of the terminator shows that there are no mountains on Mars comparable with ours, but that the surface is surprisingly flat. White spots are occasionally visible in the tropical and temperate regions, which are perhaps due to the condensation of frost or snow, or to saline exudation such as seasonally occurs in India (Lowell). Moreover in winter the temperate zones are more or less covered by a whitish veil, which may be either hoar frost or cloud. A spring haze seems to surround the north polar cap during its most extensive melting; otherwise the Martian sky is quite clear, like that of a dry desert land. When either polar cap is melting it is bordered by a bluish area, which Lowell attributes to the water produced by the melting. But the obliquity at which the sun's rays strike the surface as the cap is melting away is so great that it would seem to preclude the possibility of a temperature high enough to melt the snow into water. Under the low barometric pressure prevailing on the planet, snow would evaporate under the influence of the sun's rays without changing into water. It is also contended that what looks like such a bluish border may be formed around a bright area by the secondary aberration of a refracting telescope.[2]

The modern studies of Mars which have aroused so much public interest began with the work of Schiaparelli in 1877. Accepting the term "ocean," used by the older observers, to designate the widely extended darker regions on the planet, and holding that they were really bodies of water, he found that they were connected by comparatively narrow streaks. (Schiaparelli considered them really water until after the Lowell observations.) In accordance with the adopted system of nomenclature, he termed these streaks *canale*, a word of which the proper rendering into English would be *channels*. But the word was actually translated into both English and French as *canal*, thus connoting artificiality in the supposed waterways, which were attributed to the inhabitants of the planet. The fact that they were many miles in breadth, and that it was therefore absurd to call them canals, did not prevent this term from being so extensively used that it is now scarcely possible to do away with it. A second series of observations was made by Schiaparelli at the opposition of 1879, when the planet was farther away, but was better situated as to altitude above the horizon. He now found a number of additional channels, which were much finer than those he had previously drawn. The great interest attaching to their seemingly artificial character gave an impetus to telescopic study of the planet which has continued to the present time. New canals were added, especially at the Lowell Observatory, until the entire number listed in 1908 amounted to more than 585. The general character of this complex system of lines is described by Lowell as a network covering the whole face of the planet, light and dark regions alike, and connecting at either end with the respective polar caps there. At their junctions are small dark pinheads of spots. The lines vary in size between themselves, but each maintains its own width throughout. But the more difficult of these objects are only seen occasionally and are variable in definiteness. Of two canals equally well situated for seeing, only one may be visible at one time and only the other at other times. If this variability of aspect among different canals is true as they are seen from the Lowell Observatory, we find it true to a much greater extent when we compare descriptions by different observers. At Flagstaff, the most favourably situated of all the points of observation, they are seen as fine sharp lines, sometimes as well marked as if drawn with a pencil. But other observers see them with varying degrees of breadth and diffuseness.

One remarkable feature of these objects is their occasional

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[1] The great space penetration of the Lowell Observatory is shown in the case of stars. More stars have been mapped there in a given space than at the Lick, and Mr Ritchey of the Yerkes Observatory found stars easily visible there which were only just perceptible at Yerkes.

[2] As against this, Lowell's answer is that the effect is not optical; for the belt surrounds the *melting*, not the *making* cap.

"gemination," some of the canals appearing as if doubled. This was first noticed by Schiaparelli, and has been confirmed, so far as observations can confirm it, by other observers. Different explanations of this phenomenon have been suggested, but the descriptions of it are not sufficiently definite to render any explanation worthy of entire confidence possible. Indeed the more cautious astronomers, who have not specially devoted themselves to the particular phenomena, reserve a doubt as to how far the apparent phenomena of the finer canals are real, and what the markings which give rise to their appearance might prove to be if a better and nearer view of the planet than is now possible could be obtained. Of the reality of the better marked ones there can be no doubt, as they have been seen repeatedly by many observers, including those at the Lick Observatory, and have actually been photographed at the Lowell Observatory. The doubt is therefore confined to the vast network of lines so fine that they never certainly have been seen elsewhere than at Flagstaff. The difficulty of pronouncing upon their reality arises from the fact that we have to do mainly with objects not plainly visible (or, as Lowell contends, not plainly visible elsewhere). The question therefore becomes one of psychological optics rather than of astronomy. When the question is considered from this point of view it is found that combinations of light and shaded areas very different from continuous lines, will, under certain conditions, be interpreted by the eye as such lines; and when such is the case, long practice by an observer, however carefully conducted, may confirm him in this interpretation. To give a single example of the principles involved; it is found by experiment that if, through a long line so fine as to approach the limit of visibility, segments not too near each other, or so short that they would not be visible by themselves, be taken out, their absence from the line will not be noticed, and the latter will still seem continuous.[1] In other words we do not change the aspect of the line by taking away from it a part which by itself would be invisible. This act of the eye, in interpreting a discontinuous series of very faint patches as a continuous line, is not, properly speaking, an optical illusion, but rather a habit. The arguments for the reality of all the phenomena associated with the canals, while cogent, have not sufficed to bring about a general consensus of opinion among critics beyond the limit already mentioned.

Accepting the view that the dark lines on Mars are objectively real and continuous, and are features as definite in reality as they appear in the telescope, Professor Lowell has put forth an explanation of sufficient interest to be mentioned here. His first proposition is that lines frequently thousands of miles long, each following closely a great circle, must be the product of design rather than of natural causes. His explanation is that they indicate the existence of irrigating canals which carry the water produced annually by the melting of the polar snows to every part of the planet. The actual canals are too minute to be visible to us. What we really see as dark lines are broad strips of vegetation, produced by artificial cultivation extending along each border of the irrigating streams. On the other hand, in the view of his critics, the quantity of ice or snow which the sun's rays could melt around the poles of Mars, the rate of flow and evaporation as the water is carried toward the equator, and several other of the conditions involved, require investigation before the theory can be established.[2]

The accompanying illustrations of Mars and its canals are those of Lowell, and represent the planet as seen by the Flagstaff observers.

Satellites and Pole of Mars.—At the opposition of Mars which occurred in August 1877 the planet was unusually near the earth. Asaph Hall, then in charge of the 26″ telescope at the Naval Observatory in Washington, took advantage of this favourable circumstance to make a careful search for a visible satellite of the planet. On the night of the 11th of August he found a faint object near the planet. Cloudy weather intervened, and the object was not again seen until the 16th, when it was found to be moving with the planet, leaving no doubt as to its being a satellite. On the night following an inner satellite much nearer the planet was observed. This discovery, apart from its intrinsic

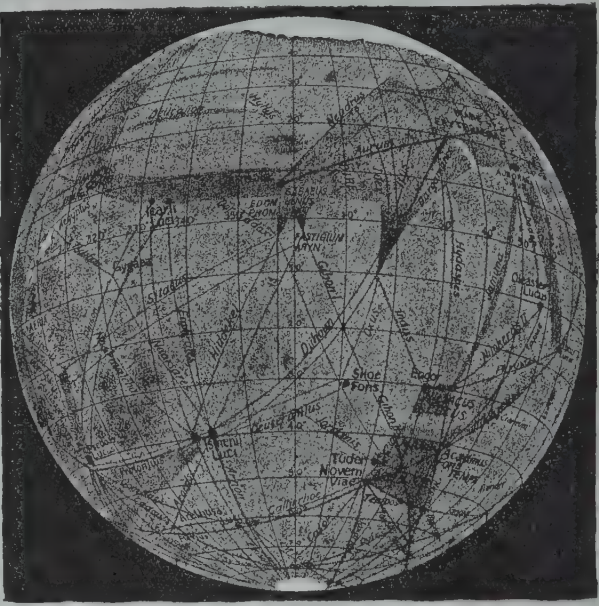

FIG. 2.

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[1] For limits of this theory and Lowell's view of its inapplicability to Mars, see *Astrophys. Jour.*, Sept. 1907.

[2] Prof. Lowell's theory is supported by so much evidence of different kinds that his own exposition should be read *in extenso* in *Mars and its canals* and *Mars as the abode of life*. In order, however, that his views may be adequately presented here, he has kindly supplied the following summary in his own words:—

"Owing to inadequate atmospheric advantages generally, much misapprehension exists as to the definiteness with which the surface of Mars is seen under good conditions. In steady air the canals are perfectly distinct lines, not unlike the Fraunhofer ones of the Spectrum, pencil lines or gossamer filaments according to size. All the observers at Flagstaff concur in this. The photographs of them taken there also confirm it up to the limit of their ability. Careful experiments by the same observers on artificial lines show that if the canals had breaks amounting to 16 m. across, such breaks would be visible. None are; while the lines themselves are thousands of miles long and perfectly straight (*Astrophys. Journ.*, Sept. 1907). Between expert observers representing the planet at the same epoch the accordance is striking; differences in drawings are differences of time and are due to seasonal and secular changes in the planet itself. These seasonal changes have been carefully followed at Flagstaff, and the law governing them detected. They are found to depend upon the melting of the polar caps. After the melting is under way the canals next the cap proceed to darken, and the darkening thence progresses regularly down the latitudes. Twice this happens every Martian year, first from one cap and then six Martian months later from the other. The action reminds one of the quickening of the Nile valley after the melting of the snows in Abyssinia; only with planet-wide rhythm. Some of the canals are paired. The phenomenon is peculiar to certain canals, for only about one-tenth of the whole number, 56 out of 585, ever show double and these do so regularly. Each double has its special width; this width between the pair being 400 m. in some cases, only 75 in others. Careful plotting has disclosed the fact that the doubles cluster round the planet's equator, rarely pass 40° Lat., and never occur at the poles, though the planet's axial tilt reveals all its latitudes to us in turn. They are thus features of those latitudes where the surface is greatest compared with the area of the polar cap, which is suggestive. Space precludes mention of many other equally striking peculiarities of the canals' positioning and development. At the junctions of the canals are small, dark round spots, which also wax and wane with the seasons. These facts and a host of others of like significance have led Lowell to the conclusion that the whole canal system is of artificial origin, first because of each appearance and secondly because of the laws governing its development. Every opposition has added to the assurance that the canals are artificial; both by disclosing their peculiarities better and better and by removing generic doubts as to the planet's habitability. The warmer temperature disclosed from Lowell's investigation on the subject, and the spectrographic detection by Slipher of water-vapour in the Martian air, are among the latest of these confirmations."—[ED.]

interest, is also noteworthy as the first of a series of discoveries of satellites of the outer planets. The satellites of Mars are difficult to observe, on account not merely of their faintness, but of their proximity to the planet, the light of which is so bright as to nearly blot out that of the satellite. Intrinsically the inner satellite is brighter than the outer one, but for the reason just mentioned it is more difficult to observe. The names given them by Hall were Deimos for the outer satellite and Phobos for the inner one, derived from the mythological horses that drew the chariot of the god Mars. A remarkable feature of the orbit of Phobos is that it is so near the planet as to perform a revolution in less than one-third that of the diurnal rotation of Mars. The result is that to an inhabitant of Mars this satellite would rise in the west and set in the east, making two apparent diurnal revolutions every day. The period of Deimos is only six days greater than that of a Martian day; consequently its apparent motion around the planet would be so slow that more than two days elapse between rising and setting, and again between setting and rising.

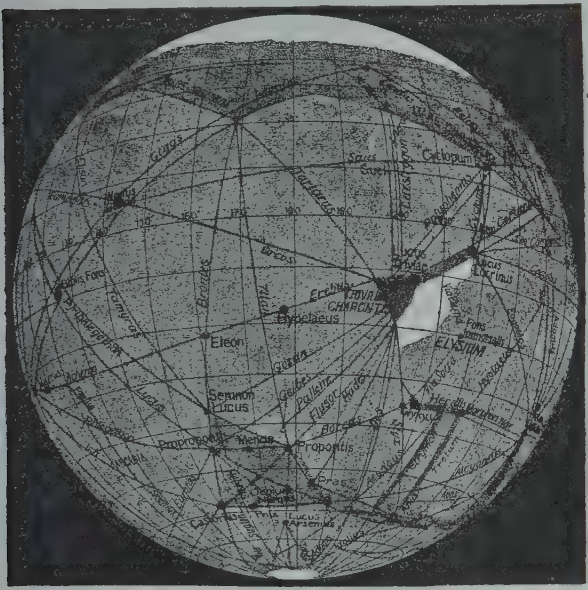

FIG. 3.

Owing to the minuteness of these bodies it is impossible to make any measures of their diameters. These can be inferred only from their brightness. Assuming them to be of the same colour as Mars, Lowell estimates them to be about ten miles for Deimos and somewhat more for Phobos. But these estimates are uncertain, not only from the somewhat hypothetical character of the data on which they rest, but from the difficulty of accurately estimating the brightness of such an object in the glare of the planet.

A long and careful series of observations was made upon these bodies by other observers. Later, especially at the very favourable oppositions of 1892 and 1894, observations were made by Hermann Struve at Poulkova, who subjected all the observations up to 1898 to a very careful discussion. He showed that the inclination of the planes of the orbits to the equator of the planet is quite small, thus making it certain that these two planes can never wander far from each other. In the following statement of the numerical elements of the entire system, Struve's results are given for the satellites, while those of Lowell are adopted for the position of the plane of the equator.

The relations of the several planes can be best conceived by considering the points at which lines perpendicular to them, or their poles, meet the celestial sphere. By theory, the pole of the orbital plane of each satellite revolves round the pole of a certain fixed plane, differing less from the plane of the equator of Mars the nearer the satellite is to Mars. Lowell from a combination of his own observations with those of Schiaparelli, Lohse and Cerulli, found for the pole of the axis of rotation of Mars[1]:—

R.A. = 317·5°; Dec. = + 54·5°; Epoch, 1905.

Tilt[2] of Martian Equator to Martian ecliptic, 23°. 59′. Hermann Struve, from the observations of the satellites, found theoretically the following positions of this pole, and of those of the fixed planes of the satellite orbits for 1900:—

Pole of Mars: R.A. = 317·25° Dec. = 52·63°
Pole of fixed plane for Phobos = 317·24° = 52·64°
Pole of fixed plane for Deimos = 316·20° = 53·37°

Lowell's position of the pole is that now adopted by the British Nautical Almanac.

The actual positions of the poles of the satellite—orbits revolve around these poles of the two fixed planes in circles. Putting N for the right-ascensions of their nodes on the plane of the terrestrial equator, and J for their angular distance from the north terrestrial pole, N, and J, for the corresponding poles of the fixed planes, and t for the time in years after 1900, Struve's results are:—

Deimos.

$$N_1 = 46°.12'\ 0{\cdot}463'\,t;\ J = 36°.42' - 0{\cdot}24'\,t$$
$$(N - N_1)\sin J = 97{\cdot}6'\sin(356{\cdot}8° - 6{\cdot}375°\,t)$$
$$J - J_1 = 97{\cdot}6\cos(356{\cdot}8° - 6{\cdot}375°\,t)$$

Phobos.

$$N_1 = 47°\ 14{\cdot}3' + 0{\cdot}46'\,t;\ J_1 = 37°\ 21{\cdot}9' - 0{\cdot}24'\,t$$
$$(N - N_1)\sin J = 53{\cdot}1'\sin(257°{\cdot}1' - 158{\cdot}0°\,t)$$
$$J - J_1 = 53{\cdot}1\cos(257°1' - 158{\cdot}0\,t)$$

The other elements are:—

	Deimos.	Phobos.
Mean long. 1894, Oct. 0.0. G.M.T	186·25°	296·13°
Mean daily motion (tropical)	285·16198°	1128·84396°
Mean distance (Δ = 1)	32·373″	12·938″
Long. of pericentre, (π+N)	264°+6·375° *t*	14°+158·0° *t*
Eccentricity of orbit	0·0031	0·0217
Epoch for *t*	1900·0	1900·0

BIBLIOGRAPHY.—Flammarion, *La Planète Mars et ses conditions d'habitilité* (Paris, 1892), embodies so copious a *résumé* of all the publications and drawings relating to Mars up to 1891 that there is little occasion for reference in detail to early publications. Among the principal sources may be mentioned the *Monthly Notices* and *Memoirs* of the Royal Astronomical Society, the publications of the Astronomical Society of the Pacific, especially vols. vi., viii. and ix., containing observations and discussions by the Mt Hamilton astronomers, and the journals, *Sidereal Messenger*, *Astronomy* and *Astrophysics* and *Astrophysical Journal.* Schiaparelli's extended memoirs appeared under the general title *Osservazioni astronomiche e fisiche sull' asse di rotazione e sulla topografia del pianeta Marte,* and were published in different volumes of the *Memoirs* of the *Reale Accademia dei Lincei* of Rome. The observations and drawings of Lowell are found *in extenso* in *Annals* of the Lowell Observatory. Lowell's conclusions are summarized in *Mars and its Canals*, by Percival Lowell (1906), and *Mars as the Abode of Life* (1909). In connexion with his work may be mentioned *Mars and its Mystery*, by Edward S. Morse (Boston, 1906), the work of a naturalist who made studies of the planet at the Lowell Observatory in 1905. Brief discussions and notices will also be found in the Lowell Observatory *Bulletins.* The optical principles involved in the interpretations of the canals are discussed in recent volumes of the *Monthly Notices, R.A.S.*, and in the *Astrophysical Journal.* In 1907 the veteran A. R. Wallace disputed Lowell's views vigorously in his *Is Mars Habitable?* and was briefly answered by Lowell in *Nature*, who contended that Wallace's theory was not in accord with celestial mechanics. (S. N.)

MARSALA, a seaport of Sicily, in the province of Trapani, 19 m. by rail S. of Trapani. Pop. (1881), 19,732; (1901), 57,567. The low coast on which it is situated is the westernmost point of the island. The town is the seat of a bishop, and the cathedral contains 16 grey marble columns, which are said to have been intended for Canterbury Cathedral in England, the vessel conveying them having been wrecked here. The town owes its importance mainly to the trade in Marsala wine.

Marsala occupies the site of *Lilybaeum*, the principal stronghold of the Carthaginians in Sicily, founded by Himilco after the abandonment of *Motya.* Neither Pyrrhus nor the Romans were able to reduce it by siege, but it was surrendered to the latter in 241 B.C. at the end of the First Punic War. In the later wars it was a starting point for the Roman expeditions against Carthage;

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[1] *Bulletin Lowell Obsy.*, *Monthly Notices*, *R.A.S.* (1905), 66, p. 51.
[2] *St Petersburg Memoirs*, series viii., Phys. Mars-classe, vol. viii.

and under Roman rule it enjoyed considerable prosperity (*C.I.L.* x. p. 742). It obtained municipal rights from Augustus and became a colony under Pertinax or Septimus Severus. The Saracens gave it its present name, *Marsa Ali*, port of Ali. The harbour, which lay on the north-east, was destroyed by Charles V. to prevent its occupation by pirates. The modern harbour lies to the south-east. In 1860 Garibaldi landed at Marsala with 1000 men and began his campaign in Sicily. Scanty remains of the ancient *Lilybaeum* (fragments of the city walls, of squared stones, and some foundations of buildings between the walls and the sea) are visible; and the so-called grotto and spring of the Sibyl may be mentioned. To the east of the town is a great fosse which defended it on the land side, and beyond this again are quarries like those of Syracuse on a small scale. The modern town takes the shape of the Roman camp within the earlier city, one of the gates of which still existed in 1887. The main street (the Cassaro) perpetuates the name *castrum*.

MARSDEN, WILLIAM (1754–1836), English orientalist, the son of a Dublin merchant, was born at Verval, Co. Wicklow on the 16th of November 1754. He was educated in Dublin, and having obtained an appointment in the civil service of the East India Company arrived at Benkulen, Sumatra, in 1771. There he soon rose to the office of principal secretary to the government, and acquired a knowledge of the Malay language and country. Returning to England in 1779 with a pension, he wrote his *History of Sumatra*, published in 1783. Marsden was appointed in 1795 second secretary and afterwards first secretary to the admiralty. In 1807 he retired and published in 1812 his *Grammar and Dictionary of the Malay Language*, and in 1818 his translation of the *Travels of Marco Polo*. He was a member of many learned societies, and treasurer and vice-president of the Royal Society. In 1834 he presented his collection of oriental coins to the British Museum, and his library of books and Oriental MSS. to King's College, London. He died on the 6th of October 1836.

Marsden's other works are: *Numismata orientalia* (London, 1823–1825); *Catalogue of Dictionaries, Vocabularies, Grammars and Alphabets* (1796); and several papers on Eastern topics in the *Philosophical Transactions* and the *Archaelogia*.

MARSEILLES, a city of southern France, chief seaport of France and of the Mediterranean, 219 m. S. by E. of Lyons and 534 m. S.S.E. of Paris, by the Paris-Lyon-Méditerranée railway. Pop. (1906), commune 517,498; town 421,116. Marseilles is situated on the Golfe du Lion on the eastern shore of a bay protected to the south by Cape Croisette but open towards the west; to the east the horizon is bounded by an amphitheatre of hills, those in the foreground clothed with vegetation while the more distant eminences are bare and rugged. The city is built on undulating ground and the south-western and most aristocratic quarter covers the slopes of the ridge crowned by a fort and the church of Notre-Dame de la Garde and projecting westward into the bay to form a protection for the harbour. The newest and most pleasant portion lies on the south-eastern slope of the ridge, between the southern end of the Rue Paradis and the Prado avenues, which is better protected than most other quarters from the mistral that blows down the Rhone valley, and where in summer the temperature is always a little lower than in the centre of the town. The old harbour of Marseilles opens on the west to the Golfe du Lion, the famous Rue Cannebière[1] prolonged by the Rue Noailles leading E.N.E. from its inner end. These two streets are the centre of the life of the city. Continued in the Allées de Meilhan and the Boulevard de la Madeleine, they form one of its main arteries. The other, at right angles with the first, connects the Place d'Aix with the spacious and fashionable Promenade du Prado, by way of the Cours Belsunce and the Rue de Rome. Other fine streets—the Rue St Ferréol, the Rue Paradis and the Rue Breteuil are to the south of the Cannebière running parallel with the Rue de Rome. To these must be added the neighbouring avenue of Pierre Puget named after the sculptor whose statue stands in the Borély Park. The Prado, with its avenues of trees and fine houses, runs to within a quarter of a mile of the Huveaune, a stream that borders the city on the south-east, then turns off at right angles and extends to the sea, coming to an end close to the Borély Park and the race-course. From its extremity the Chemin de la Corniche runs northwards along the coast, fringed by villas and bathing establishments, to the Anse des Catalans, a distance of 4½ miles.

The old town of Marseilles is bounded W. by the Joliette basin and the sea, E. by the Cours Belsunce, S. by the northern quay of the old port, and N. by the Boulevard des Dames. It consists of a labyrinth of steep, dark and narrow streets inhabited by a seafaring population. Through its centre runs the broad Rue de la République, extending from the Cannebière to the Place de la Joliette. The entrance to the old harbour is defended by Fort St Jean on the north and Fort St Nicolas on the south. Behind the latter is the Anse (Creek) de la Réserve. Beyond this again, situated in succession along the shore, come the Château du Pharo, given by the empress Eugénie to the town, the Anse du Pharo, the military exercising ground, and the Anse des Catalans. To the old harbour, which covers only 70 acres with a mean depth of 19½ ft. and is now used by sailing vessels, the basin of La Joliette (55 acres) with an entrance harbour was added in 1853. Communicating with the old harbour by a channel which passes behind Fort St Jean, this dock opens on the south into the outer harbour, opposite the palace and the Anse du Pharo. A series of similar basins separated from the roadstead by a jetty 2½ m. long was subsequently added along the shore to the north, viz. the basins of Lazaret and Arenc, bordered by the harbour railway station and the extensive warehouses of the Compagnie des Docks et Entrepôts, the Bassin de la Gare Maritime with the warehouses of the chamber of commerce; the Bassin National with the refitting basin, comprising six dry docks behind it; and the Bassin de la Pinède entered from the northern outer harbour. These new docks have a water area of 414 acres and over 11 m. of quays, and are commodious and deep enough for the largest vessels to manœuvre easily.

In the roads to the south-west of the port lie the islands of Ratonneau and Pomègue, united by a jetty forming a quarantine port. Between them and the mainland is the islet of Château d'If, in which the scene of part of Dumas' *Monte Cristo* is laid.

Marseilles possesses few remains of either the Greek or Roman periods of occupation, and is poor in medieval buildings. The old cathedral of la Major (Sainte-Marie-Majeure), dating chiefly from the 12th century and built on the ruins of a temple of Diana, is in bad preservation. The chapel of St Lazare (late 15th century) in the left aisle is in the earliest Renaissance style, and a bas-relief of white porcelain by Lucca della Robbia is of artistic value. Beside this church and alongside the Joliette basin is a modern building begun in 1852, opened for worship in 1893 and recognized as the finest modern cathedral in France. It is a Byzantine basilica, in the form of a Latin cross, 460 ft. long, built in green Florentine stone blended with white stone from the neighbourhood of Arles. The four towers which surmount it—two at the west front, one over the crossing, one at the east end—are roofed with cupolas. Near the cathedral stands the bishop's palace, and the Place de la Major, which they overlook, is embellished with the statue of Bishop Belsunce, who displayed great devotion during the plague of 1720–1721. The celebrated Notre-Dame de la Garde, the steeple of which, surmounted by a gilded statue of the Virgin, 30 ft. in height, rises 150 ft. above the summit of the hill on which it stands, commands a view of the whole port and town, as well as of the surrounding mountains and the neighbouring sea. The present chapel is modern and occupies the site of one built in 1214.

On the south side of the old harbour near the Fort St Nicolas stands the church of St Victor, built in the 13th century and once attached to an abbey founded early in the 4th century. With its lofty crenellated walls and square towers built of large blocks of uncemented stone, it resembles a fortress. St Victor is built above crypts dating mainly from the 11th century but also embodying architecture of the Carolingian period and of the early centuries of the Christian era. Tradition relates that St Lazarus inhabited the catacombs under St Victor; and the black image of the Virgin, still preserved there, is popularly attributed to St Luke. The spire, which is the only relic of the ancient church of Accoules, marks the centre of Old Marseilles. At its foot are a "calvary" and a curious underground chapel in rock work, both modern. Notre-Dame du Mont Carmel, also in the old town, occupies the place of what was the citadel of the Massaliots when they were besieged by Julius Caesar.

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[1] From the Latin *cannabis*, Provençal *cannèbe*, "hemp," in allusion to the rope-walks formerly occupying its site.

Of the civil buildings of the city, the prefecture, one of the finest in France, the Palais de Justice, in front of which is the statue of the advocate Antoine Berryer (1790–1868) and the Exchange, all date from the latter half of the 19th century. The Exchange, built at the expense of the Chamber of Commerce, includes the spacious hall of that institution with its fine mural paintings and gilding. The hôtel-de-ville (17th century) stands on the northern quay of the old harbour. All these buildings are surpassed by the Palais Longchamp (1862–1870), situated in the north-east of the town at the end of the Boulevard Longchamp. The centre of the building is occupied by a monumental *château d'eau* (reservoir). Colonnades branch off from this, uniting it on the left to the picture gallery, with a fine collection of ancient and modern works, and on the right to the natural history museum, remarkable for its conchological department and collection of ammonites. In front are ornamental grounds; behind are extensive zoological gardens, with the astronomical observatory. The museum of antiquities is established in the Château Borély (1766–1778) in a fine park at the end of the Prado. It includes a Phoenician collection (containing the remains that support the hypothesis of the Phoenician origin of Marseilles), an Egyptian collection, numerous Greek, Latin, and Christian inscriptions in stone, &c. A special building within the city contains the school of art with a valuable library and a collection of medals and coins annexed to it. The city also has a colonial museum and a laboratory of marine zoology. The triumphal arch of Aix, originally dedicated to the victors of the Trocadéro, was in 1830 appropriated to the conquests of the empire.

The canal de Marseille, constructed from 1837 to 1848, which has metamorphosed the town and its arid surroundings by bringing to them the waters of the Durance, leaves the river opposite Pertuis. It has a length of 97 miles (including its four main branches) of which 13 are underground, and irrigates some 7500 acres. After crossing the valley of the Arc, between Aix and Rognac, by the magnificent aqueduct of Roquefavour, it purifies its waters, charged with ooze, in the basins of Réaltort. It draws about 2200 gallons of water per second from the Durance, supplies 2450 horse-power to works in the vicinity of Marseilles, and ensures a good water-supply and efficient sanitation to the city.

Marseilles is the headquarters of the XV. army corps and the seat of a bishop and a prefect. It has tribunals of first instance and of commerce, a chamber of commerce, a board of trade arbitration, and a branch of the Bank of France. The educational institutions include a faculty of science, a school of medicine and pharmacy, and a faculty (*faculté libre*) of law, these three forming part of the university of Aix-Marseille; lycées for boys and girls, a conservatoire of music, a school of fine art, a higher school of commerce, a school for ships' boys, a school of navigation and industrial schools for both sexes.

Trade and Industry.—Marseilles is the western emporium for the Levant trade and the French gate of the Far East. It suffers, however, from the competition of Genoa, which is linked with the Rhine basin by the Simplon and St Gotthard railway routes, and from lack of communication with the inland waterways of France. In January 1902 the chamber of deputies voted £3,656,000 for the construction of a canal from Marseilles to the Rhone at Arles. This scheme was designed to overcome the difficulties of egress from the Rhone and to make the city the natural outlet of the rich Rhone basin. Much of the activity of the port is due to the demand for raw material created by the industries of Marseilles itself. The imports include raw silk, sesame, ground-nuts and other oil-producing fruits and seeds largely used in the soap manufacture, cereals and flour, wool, hides and skins, olive and other oils, raw cotton, sheep and other livestock, woven goods, table fruit, wine, potatoes and dry vegetables, lead, cocoon silk, coffee, coal, timber. The total value of imports was £64,189,000 in 1907, an increase of £18,000,000 in the preceding decade. The exports, of which the total value was £52,901,000 (an increase of £21,000,000 in the decade) included cotton fabrics, silk fabrics, cereals and flour, hides and skins, wool fabrics, worked skins, olive and other oils, chemical products, wine, refined sugar, raw cotton, wool, coal, building-material, machinery and pottery.

The port is the centre for numerous lines of steamers, of which the chief are the Messageries Maritimes, which ply to the eastern Mediterranean, the east coast of Africa, Australia, India, Indo-China, Havre and London, and the Compagnie Générale Transatlantique, whose vessels run to Algiers, Tunis, Malta, Corsica, Morocco and the Antilles. In addition many important foreign lines call at the port, among them being the P. and O., the Orient, the North German Lloyd, and the German East Africa lines.

Marseilles has five chief railway stations, two of which serve the new harbours, while one is alongside the old port; the city is on the main line of the Paris-Lyon-Méditerranée railway from the Riviera and Toulon to Paris via Arles, Avignon and Lyons, another less important line connecting it with Aix.

Soap-making, introduced in antiquity from Savona and Genoa, is carried on in upwards of fifty factories. These utilize the products of the oil-distilleries and of the chemical works, the latter being also an important adjunct to the manufacture of candles, another leading industry. A large quantity of iron, copper and other ores is smelted in the blast-furnaces of Saint Louis in the vicinity and in other foundries, and the Mediterranean Engineering Company and other companies have large workshops for the construction or repair of marine steam-engines and every branch of iron ship-building. To these industries must be added flour-milling, the manufacture of semolina and other farinaceous foods and of biscuits, bricks and tiles, rope, casks, capsules for bottles and other tin-goods, tanning, distilling, brewing and sulphur- and sugar-refining. There are state tobacco and match factories.

History.—The Greek colony of Massalia (Lat. *Massilia*) was founded by the mariners of Phocaea in Asia Minor, about 600 B.C. The settlement of the Greeks in waters which the Carthaginians reserved for their own commerce was not effected without a naval conflict; it is not improbable that the Phoenicians were settled at Marseilles before the Greek period, and that the name of the town is the Phoenician for "settlement." Whether the judges (*sophetim*, "suffetes") of the Phoenician sacrificial tablet of Marseilles were the rulers of a city existing before the advent of the Phocaeans, or were consuls for Punic residents in the Greek period, is disputed. In 542 B.C. the fall of the Phocaean cities before the Persians probably sent new settlers to the Ligurian coast and cut off the remote city of Massalia from close connexion with the mother country. Isolated amid alien populations, the Massaliots made their way by prudence in dealing with the inland tribes, by vigilant administration of their oligarchical government, and by frugality united to remarkable commercial and naval enterprise. Their colonies spread east and west along the coast from Monaco to Cape St Martin in Spain, carrying with them the worship of Artemis; the inland trade, in which wine was an important element, can be traced by finds of Massalian coins across Gaul and through the Alps as far as Tirol. In the 4th century B.C. the Massaliot Pytheas visited the coasts of Gaul, Britain and Germany, and Euthymenes is said to have sailed down the west coast of Africa as far as Senegal. The great rival of Massalian trade was Carthage, and in the Punic Wars the city took the side of Rome, and was rewarded by Roman assistance in the subjugation of the native tribes of Liguria. In the war between Caesar and Pompey Massilia took Pompey's side and in A.D. 49 offered a vain resistance to Caesar's lieutenant Trebonius. In memory of its ancient services the city, "without which," as Cicero says, "Rome had never triumphed over the Transalpine nations," was left as a *civitas libera*, but her power was broken and most of her dependencies taken from her. From this time Massilia has little place in Roman history; it became for a time an important school of letters and medicine, but its commercial and intellectual importance declined. The town appears to have been christianized before the end of the 3rd century, and at the beginning of the 4th century was the scene of the martyrdom of St Victor. Its reputation partly revived through the names of Gennadius and Cassian, which give it prominence in the history of Semi-Pelagianism and the foundation of western monachism.

After the ravages of successive invaders, Marseilles was repeopled in the 10th century under the protection of its viscounts. The town gradually bought up their rights, and at the beginning of the 13th century was formed into a republic, governed by a *podestat*, who was appointed for life, and exercised his office in conjunction with 3 notables, and a municipal council, composed of 80 citizens, 3 clerics, and 6 principal tradesmen. During the rest of the middle ages, however, the higher town was governed by the bishop, and had its harbour at the creek of La Joliette which at that period ran inland to the north of the old town. The southern suburb was governed by the abbot of St Victor, and owned the Port des Catalans. Situated between the two, the lower town, the republic, retained the old harbour, and was the most powerful of the three divisions. The period of the crusades brought prosperity to Marseilles, though throughout the middle ages it suffered from the competition of Pisa, Genoa and Venice. In 1245 and 1256 Charles of Anjou, count of Provence, whose predecessors had left the citizens a large measure of independence, established his authority above that of the republic. In 1423 Alphonso V. of Aragon sacked the town. King René, who had made it his winter residence, however, caused trade, arts and manufactures again to flourish. On the embodiment of Provence in the kingdom of France in 1481, Marseilles preserved a separate administration directed by royal officials. Under Francis I. the disaffected constable Charles de Bourbon vainly besieged the town with the imperial forces in 1524. During the wars of religion, Marseilles took part against the Protestants, and long refused to acknowledge Henry IV. The loss of the ancient liberties of the town brought new disturbances under the Fronde, which Louis XIV. came in person to suppress. He entered the town by a breach in the walls and afterwards had Fort St Nicolas constructed. Marseilles repeatedly suffered from the plague, notably from May 1720 to May 1721.

During the Revolution the people rose against the aristocracy, who up to that time had governed the commune. In the Terror they rebelled against the Convention, but were promptly subdued by General Carteaux. The wars of the empire, by dealing a blow to their maritime commerce, excited the hatred of the inhabitants against Napoleon, and they hailed the return of the Bourbons and the defeat of Waterloo. The news of the latter provoked a bloody reaction in the town against those suspected of imperialism. The prosperity of the city received a considerable impulse from the conquest of Algeria and from the opening of the Suez Canal.

See P. Castanier, *Histoire de la Provence dans l'antiquité*, vol. ii. (Paris, 1896); E. Caman, *Marseille au XX*^{me} *siècle* (Paris, 1905); P. Joanne, *Marseille et ses environs*.

MARSH, ADAM (Adam de Marisco) (d. *c.* 1258), English Franciscan, scholar and theologian, was born about 1200 in the diocese of Bath, and educated at Oxford under the famous Grosseteste. Before 1226 Adam received the benefice of Wearmouth from his uncle, Richard Marsh, bishop of Durham; but between that year and 1230 he entered the Franciscan order. About 1238 he became the lecturer of the Franciscan house at Oxford, and within a few years was regarded by the English province of that order as an intellectual and spiritual leader. Roger Bacon, his pupil, speaks highly of his attainments in theology and mathematics. His fame, however, rests upon the influence which he exercised over the statesmen of his day. Consulted as a friend by Grosseteste, as a spiritual director by Simon de Montfort, the countess of Leicester and the queen, as an expert lawyer and theologian by the primate, Boniface of Savoy, he did much to guide the policy both of the opposition and of the court party in all matters affecting the interests of the Church. He shrank from office, and never became provincial minister of the English Franciscans, though constantly charged with responsible commissions. Henry III. and Archbishop Boniface unsuccessfully endeavoured to secure for him the see of Ely in 1256. In 1257 Adam's health was failing, and he appears to have died in the following year. To judge from his correspondence he took no interest in secular politics. He sympathized with Montfort as with a friend of the Church and an unjustly treated man; but on the eve of the baronial revolution he was on friendly terms with the king. Faithful to the traditions of his order, he made it his ambition to be a mediator. He rebuked both parties in the state for their shortcomings, but he did not break with either.

See his correspondence, with J. S. Brewer's introduction, in *Monumenta franciscana*, vol. i. (Rolls ser., 1858); the biographical notice in A. G. Little's *Grey Friars in Oxford* (Oxford, 1892), where all the references are collected. On Marsh's relations with Grosseteste, see *Roberti Grosseteste epistolae*, ed. H. R. Luard (Rolls ed., 1861), and F. S. Stevenson, *Robert Grosseteste* (London, 1809). (H. W. C. D.)

MARSH, GEORGE PERKINS (1801–1882), American diplomatist and philologist, was born at Woodstock, Vermont, on the 15th of March 1801. He graduated at Dartmouth College in 1820, was admitted to the bar in 1825, and practised law at Burlington, Vermont, devoting himself also with ardour to philological studies. In 1835 he was a member of the Supreme Executive Council of Vermont, and from 1843 to 1849 a Whig representative in Congress. In 1849 he was appointed United States minister resident in Turkey, and in 1852–1853 discharged a mission to Greece in connexion with the imprisonment by the authorities of that country of an American missionary, Dr Jonas King (1792–1869). He returned to Vermont in 1854, and in 1857 was a member of the state railway commission. In 1861 he became the first United States minister to the kingdom of Italy, and died in that office at Vallombrosa on the 23rd of July 1882. He was buried in a Protestant cemetery in Rome. Marsh was an able linguist, writing and speaking with ease the Scandinavian and half a dozen other European languages, a remarkable philologist for his day, and a scholar of great breadth, knowing much of military science, engraving and physics, as well as of Icelandic, which was his specialty. He wrote many articles for Johnson's *Universal Cyclopaedia*, and contributed many reviews and letters to the *Nation*. His chief published works are: *A Compendious Grammar of the Old Northern or Icelandic Language* (1838), compiled and translated from the grammars of Rask; *The Camel, his Organization, Habits, and Uses, with Reference to his Introduction into the United States* (1856); *Lectures on the English Language* (1860); *The Origin and History of the English Language* (1862; revised ed., 1885); and *Man and Nature* (1865). The last-named work was translated into Italian in 1872, and, largely rewritten, was issued in 1874 under the title *The Earth as Modified by Human Action*; a revised edition was published in 1885. He also published a work on *Mediaeval and Modern Saints and Miracles* (1876). His valuable library was presented in 1883 by Frederick Billings to the university of Vermont. His second wife, Caroline (Crane) Marsh (1816–1901), whom he married in 1839, published *Wolfe of the Knoll and other Poems* (1860), and the *Life and Letters of George Perkins Marsh* (New York, 1888). This last work was left incomplete, the second volume never having been published. She also translated from the German of Johann C. Biernatzki (1795–1840), *The Hallig; or the Sheepfold in the Waters* (1856).

MARSH, HERBERT (1757–1839), English divine, was born at Faversham, Kent, on the 10th of December 1757, and was educated at St John's College, Cambridge, where he was elected fellow in 1782, having been second wrangler and second Smith's prizeman. For some years he studied at Leipzig, and between 1793 and 1801 published in four volumes a translation of J. D. Michaelis's *Introduction to the New Testament*, with notes of his own, in which he may be said to have introduced German methods of research into English biblical scholarship. His *History of the Politics of Great Britain and France* (1799) brought him much notice and a pension from William Pitt. In 1807 he was appointed Lady Margaret professor of divinity at Cambridge, and lectured to large audiences on biblical criticism, substituting English for the traditional Latin. Both here, and afterwards as bishop of Llandaff (1816) and of Peterborough (1819), he stoutly opposed hymn-singing, Calvinism, Roman Catholicism, and the Evangelical movement as represented by Charles Simeon and the Bible Society. Among his writings are *Lectures on the Criticism and Interpretation of the Bible* (1828), *A Comparative View of the Churches of England and Rome* (1814), and *Horae Pelasgicae* (1815). He died at Peterborough on the 1st of May 1839.

MARSH, NARCISSUS (1638–1713), archbishop of Dublin and Armagh, was born at Hannington, Wiltshire, and educated at Oxford. He became a fellow of Exeter College, Oxford, in 1658. In 1662 he was ordained, and presented to the living of Swindon, which he resigned in the following year. After acting as chaplain to Seth Ward, bishop of Exeter and Salisbury, and Lord Chancellor Clarendon, he was elected principal of St Alban Hall, Oxford, in 1673. In 1679 he was appointed provost of Trinity College, Dublin, where he did much to encourage the study of the Irish language. He helped to found the Royal Dublin Society, and contributed to it a paper entitled "Introductory Essay to the Doctrine of Sounds" (printed in *Philosophical Transactions*, No. 156, Oxford, 1684). In 1683 he was consecrated bishop of Ferns and Leighlin, but after the accession of James II. he was compelled by the turbulent soldiery to flee to England (1689), where he became vicar of Gresford, Flint, and canon of St Asaph. Returning to Ireland in 1691 after the battle of the Boyne, he was made archbishop of Cashel, and three years later he became archbishop of Dublin. About this time he founded the Marsh Library in Dublin. He became archbishop of Armagh in 1703. Between 1699 and 1711 he was six times a lord justice of Ireland. He died on the 2nd of November 1713.

MARSH, OTHNIEL CHARLES (1831–1899), American palaeontologist, was born in Lockport, New York, on the 29th of October 1831. He graduated at Yale College in 1860, and studied geology and mineralogy in the Sheffield scientific school, New Haven, and afterwards palaeontology and anatomy in Berlin, Heidelberg and Breslau. Returning to America in 1866 he was appointed professor of vertebrate palaeontology at Yale College, and there began the researches of the fossil vertebrata of the western states, whereby he established his reputation. He was aided by a private fortune from his uncle, George Peabody, whom he induced to establish the Peabody Museum of Natural History (especially devoted to zoology, geology and mineralogy) in the college. In May 1871 he discovered the first pterodactyl remains found in America, and in subsequent years he brought to light from Wyoming and other regions many new genera and families, and some entirely new orders of extinct vertebrata, which he described in monographs or periodical articles. These included remains of the Cretaceous toothed birds *Hesperornis* and *Ichthyornis*, the Cretaceous flying-reptiles (*Pteranodon*), the swimming reptiles or Mosasauria, and the Cretaceous and Jurassic land reptiles (*Dinosauria*) among which were the *Brontosaurus* and *Atlantosaurus*. The remarkable mammals which he termed Brontotheria (now grouped as Titanotheriidae), and the huge Dinocerata, one being the *Uintatherium*, were also brought to light by him. Among his later discoveries were remains of early ancestors of horses in America. On becoming vice-president of the American Association for the Advancement of Science in 1875 he gave an address on the "Introduction and Succession of Vertebrate Life in America," summarizing his conclusions to that date. He repeatedly organized and often accompanied scientific exploring expeditions in the Rocky Mountains, and their results tended in an important degree to support the doctrines of natural selection and evolution. He published many papers on these, and found time—besides that necessarily given to the accumulation and care of the most extensive collection of fossils in the world—to write *Odontornithes: A Monograph on the Extinct Toothed Birds of North America* (1880); *Dinocerata: A Monograph on an Extinct Order of Gigantic Mammals* (1884); and *The Dinosaurs of North America* (1896). His work is full of accurately recorded facts of permanent value. He was long in charge of the division of vertebrate palaeontology in the United States Geological Survey, and received many scientific honours, medals and degrees, American and foreign. He died in New Haven on the 18th of March 1899.

See obituary by Dr Henry Woodward (with portrait) in *Geol. Mag.* (1899), p. 237.

MARSH (O. F. *mersc*, for *merisc*, a place full of "meres" or pools; cf. Ger. *Meer*, sea, Lat. *mare*), an area of low-lying watery land. The significance of a marsh area is not so much in the manner of its formation as in the peculiar chemical and physical results that accompany it, and its relation to the ecology of plant and animal life. Chemically it is productive of such gases as arise from decomposing vegetation and are transitory in their effects, and in the production of hydrated iron oxide, which may be seen floating as an iridescent scum at the edge of rusty, marshy pools. This sinks into the soil and forms a powerful iron cement to many sandstones, binding them into a hard local mass, while the surrounding sandstones are loose and friable. A curious morphological inversion follows in a later geological period, the marsh area forming the hard cap of a hill (see MESA) while the surrounding sandstones are weathered away. Salt marshes are a feature of many low-lying sea-coasts and areas of inland drainage.

MARSHAL (med. Lat. *marescalcus*, from O.H.Ger. *marah*, horse, and *scalc*, servant), a title given in various countries to certain military and civil officers, usually of high rank. The origin and development of the meaning of the designation is closely analogous with that of constable (*q.v.*). Just as the title of constable, in all its medieval and modern uses, is traceable to the style and functions of the Byzantine count of the stable, so that of marshal was evolved from the title of the *marescalci*, or masters of the horse, of the early Frankish kings. In this original sense the word survived down to the close of the Holy Roman empire in the titular office of *Erz-Marschalk* (arch-marshal), borne by the electors of Saxony. Elsewhere the meaning of office and title was modified. The importance of cavalry in medieval warfare led to the marshalship being associated with military command; this again led to the duty of keeping order in court and camp, of deciding questions of chivalry, and to the assumption of judicial and executive functions. The marshal, as a military leader, was originally a subordinate officer, the chief command under the king being held by the constable; but in the 12th century, though still nominally second to the constable, the marshal has come to the forefront as commander of the royal forces and a great officer of state. In England after the Conquest the marshalship was hereditary in the family which derived its surname from the office, and the hereditary title of earl-marshal originated in the marriage of William Marshal with the heiress of the earldom of Pembroke (see EARL MARSHAL). Similarly, in Scotland, the office of marischal (from the French *maréchal*), probably introduced under David I., became in the 14th century hereditary in the house of Keith. In 1485 the Scottish marischal became an earl under the designation of earl-marischal, the dignity coming to an end by the attainder of George, 10th earl-marischal, in 1716. In France, on the other hand, though under Philip Augustus the marshal of France (*marescalcus Franciae*) appears as commander-in-chief of the forces, care was taken not to allow the office to become descendible; under Francis I. the number of marshals of France was raised to two, under Henry III. to four, and under Louis XIV. to twenty. Revived by Napoleon, the title fell into abeyance with the downfall of the Second empire.

In England the use of the word marshal in the sense of commander of an army appears very early; so Matthew Paris records that in 1214 King John constituted William, earl of Salisbury, *marescalcus* of his forces. The modern military title of field marshal, imported from Germany by King George II. in 1736, is derived from the high dignity of the *marescalcus* in a roundabout way. The *marescalcus campi*, or *maréchal des champs*, was originally one of a number of officials to whom the name, with certain of the functions, of the marshal was given. The marshal, being responsible for order in court and camp, had to employ subordinates, who developed into officials often but nominally dependent upon him. On military expeditions it was usual for two such marshals to precede the army, select the site of the camp and assign to the lords and knights their places in it. In time of peace they preceded the king on a journey and arranged for his lodging and maintenance. In France *maréchal des logis* is the title of superior non-commissioned officers in the cavalry.

Similarly at the king's court the *marescalcus aulae* or *intrinsecus* was responsible for order, the admission or exclusion of those seeking access, ceremonial arrangements, &c. Such "marshals" were maintained, not only by the king, but by great lords and ecclesiastics. The more dignified of their functions, together with the title, survive in the various German courts, where the court marshal (*Hofmarschall*) is equivalent to the English lord chamberlain. Just as the *marescalcus intrinsecus* acted as the vicar of the marshal for duties "within" the court, so the *marescalcus forinsecus* was deputed to perform those acts of serjeanty due from the marshal to the Crown "without." Similarly there appears in the statute 5 Edw. III. cap. 8, a *marescalcus banci regii* (*maréchal du Banc du Roy*), or marshal of the king's bench, who presided over the Marshalsea Court, and was responsible for the safe custody of prisoners, who were bestowed in the *mareschalcia*, or Marshalsea prison. The office of marshal of the queen's bench survived till 1849 (see Lord Steward; and Marshalsea). The official known as a judge's marshal, whose office is of considerable antiquity, and whose duties consisted of making abstracts of indictments and pleadings for the use of the judge, still survives, but no longer exercises the above functions. He accompanies a judge of assize on circuit and is appointed by him at the beginning of each circuit. His travelling and other expenses are paid by the judge, and he receives an allowance of two guineas a day, which is paid through the Treasury. He introduces the high sheriff of the county to the judge of assize on his arrival, and swears in the grand jury. For the French *maréchaussée* see France: § *Law and Institutions*.

In the sense of executive legal officer the title marshal survives in the United States of America in two senses. The United States marshal is the executive officer of the Federal courts, one being appointed for each district, or exceptionally, one for two districts. His duties are to open and close the sessions of the district and circuit courts, serve warrants, and execute throughout the district the orders of the court. There are United States marshals also in Alaska, Hawaii, Porto Rico and the Philippines. They are appointed by the President, with the advice and consent of the Senate, for a term of four years, and, besides their duties in connexion with the courts, are employed in the service of the internal revenue, public lands, post office, &c. The temporary police sworn in to maintain order in times of disturbance, known in England as special constables, are also termed marshals in the United States. In some of the southern and western states of the Union the title marshal has sunk to that of the village policeman, as distinct from the county officers known as sheriffs and those of the justices' courts called constables.

In England the title of marshal, as applied to an executive officer, survives only in the army, where the provost marshal is chief of the military police in large garrisons and in field forces. Office and title were borrowed from the French *prévot des maréchaux*, the modern equivalent of the medieval *praepositus marescalcorum* or *guerrarum*.

MARSHALL, ALFRED (1842–), English economist, was born in London on the 26th of July 1842. He was educated at the Merchant Taylors' School and St John's College, Cambridge, being second wrangler in 1865, and in the same year becoming fellow of his college. He became principal of University College, Bristol, in 1877, and was lecturer and fellow of Balliol College, Oxford in 1883–1884. He was professor of political economy at Cambridge University from 1885 to 1908, and was a member of the Royal Commission on Labour in 1891. He became a fellow of the British Academy in 1902. He wrote (in conjunction with his wife) *Economics of Industry* (1879), whilst his *Principles of Economics* (1st ed., 1890) is a standard English treatise.

MARSHALL, JOHN (1755–1835), American jurist, chief-justice of the U.S. Supreme Court, was born on the 24th of September 1755 at Germantown (now Midland), in what four years later became Fauquier county, Virginia. He was of English descent, the son of Thomas Marshall (1732–1806) and his wife Mary Isham Keith. Marshall served first as lieutenant and after July 1778 as captain in the Continental Army during the War of Independence. He resigned his commission early in 1781; was admitted to the bar after a brief course of study, first practised in Fauquier county; and after two years began to practise in Richmond. In 1786 we find him counsel in a case of great importance, *Hite v. Fairfax*, involving the original title of Lord Fairfax to that large tract of country between the headwaters of the Potomac and Rappahannock, known as the northern neck of Virginia. Marshall represented tenants of Lord Fairfax and won his case. From this time, as is shown by an examination of Call's *Virginia Reports* which cover the period, he maintained the leadership of the bar of Virginia. He was a member of the Virginia Assembly in 1782–1791 and again in 1795–1797; and in 1788, he took a leading part in the Virginia Convention called to act on the proposed constitution for the United States, with Madison ably urging the ratification of that instrument. In 1795 Washington offered him the attorney-generalship, and in 1796, after the retirement of James Monroe, the position of minister to France. Marshall declined both offers because his situation at the bar appeared to him "to be more independent and not less honourable than any other," and his "preference for it was decided." He spent the autumn and winter of 1797–1798 in France as one of the three commissioners appointed by President John Adams to adjust the differences between the young republic and the directory. The commission failed, but the course pursued by Marshall was approved in America, and with the resentment felt because of the way in which the commission had been treated in France, made him, on his return, exceedingly popular. To this popularity, as well as to the earnest advocacy of Patrick Henry, he owed his election as a Federalist to the National House of Representatives in the spring of 1799, though the feeling in Richmond was overwhelmingly in favour of the opposition or Republican party. His most notable service in Congress was his speech on the case of Thomas Nash, alias Jonathan Robbins, in which he showed that there is nothing in the constitution of the United States which prevents the Federal government from carrying out an extradition treaty. He was secretary of state under President Adams from the 6th of June 1800 to the 4th of March 1801. In the meantime he had been appointed chief-justice of the Supreme Court, his commission bearing date the 31st of January. Thus while still secretary he presided as chief-justice.

At the time of Marshall's appointment it was generally considered that the Supreme Court was the one department of the new government which had failed in its purpose. John Jay, the first chief-justice, who had resigned in 1795, had just declined a reappointment to the chief-justiceship on the ground that he had left the bench perfectly convinced that the court would never acquire proper weight and dignity, its organization being fatally defective. The advent of the new chief-justice was marked by a change in the conduct of business in the court. Since its organization, following the prevailing English custom, the judges had pronounced their opinions seriatim. But beginning with the December term 1801, the chief-justice became practically the sole mouthpiece of the court. For eleven years the opinions are almost exclusively his, and there are few recorded dissents. The change was admirably adapted to strengthen the power and dignity of the court. The chief-justice embodied the majesty of the judicial department of the government almost as fully as the president stood for the power of the executive. That this change was acquiesced in by his associates without diminishing their goodwill towards their new chief is testimony to the persuasive force of Marshall's personality; for his associates were not men of mediocre ability. After the advent of Mr Justice Joseph Story the practice was abandoned. Marshall, however, still delivered the opinion in the great majority of cases, and in practically all cases of any importance involving the interpretation of the Constitution. During the course of his judicial life his associates were as a rule men of learning and ability. During most of the time the majority were the appointees of

Democratic presidents, and before their elevation to the bench supposed to be out of sympathy with the federalistic ideas of the chief-justice. Yet in matters pertaining to constitutional construction, they seem to have had hardly any other function than to add the weight of their silent concurrence to the decision of their great chief. Thus the task of expounding the constitution during the most critical period of its history was his, and it was given to him to preside over the Supreme Court when it was called upon to decide four cases of vital importance: *Marbury* v. *Madison*, *M'Culloch* v. *Maryland*, *Cohens* v. *Virginia* and *Gibbons* v. *Ogden*. In each of these cases it is Marshall who writes the opinion of the court; in each the continued existence of the peculiar Federal system established by the Constitution depended on the action of the court, and in each the court adopted a principle which is now generally perceived to be essential to the preservation of the United States as a federal state.

In *Marbury* v. *Madison*, which was decided two years after his elevation to the bench, he decided that it was the duty of the court to disregard any act of Congress, and, therefore, a fortiori any act of a legislature of one of the states, which the court thought contrary to the Federal Constitution.

In *Cohens* v. *Virginia*, in spite of the contention of Jefferson and the then prevalent school of political thought that it was contrary to the Constitution for a person to bring one of the states of the United States, though only as an appellee, into a court of justice, he held that Congress could lawfully pass an act which permitted a person who was convicted in a state court, to appeal to the Supreme Court of the United States, if he alleged that the state act under which he was convicted conflicted with the Federal Constitution or with an act of Congress.

In *M'Culloch* v. *Maryland*, though admitting that the Federal government is one of delegated powers and cannot exercise any power not expressly given in the Constitution, he laid down the rule that Congress in the exercise of a delegated power has a wide latitude in the choice of means, not being confined in its choice of means to those which must be used if the power is to be exercised at all.

Lastly, in *Gibbons* v. *Ogden*, he held that when the power to regulate interstate and foreign commerce was conferred by the Constitution on the Federal government, the word "commerce" included not only the exchange of commodities, but the means by which interstate and foreign intercourse was carried on, and therefore that Congress had the power to license vessels to carry goods and passengers between the states, and an act of one of the states making a regulation which interfered with such regulation of Congress was, *pro tanto*, of no effect. It will be seen that in the first two cases he established the Supreme Court as the final interpreter of the Constitution.

The decision in *M'Culloch* v. *Maryland*, by leaving Congress unhampered in the choice of means to execute its delegated powers, made it possible for the Federal government to accomplish the ends of its existence. "Let the end be legitimate," said Marshall in the course of its opinion, "let it be within the scope of the Constitution, and all means which are appropriate, which are plainly adapted to that end, which are not prohibited, but consist with the letter and spirit of the Constitution, are constitutional."

If the decision in *M'Culloch* v. *Maryland* gave vigour to all Federal power, the decision in *Gibbons* v. *Ogden*, by giving the Federal government control over the means by which interstate and foreign commerce is carried on, preserved the material prosperity of the country. The decision recognizes what the framers of the Constitution recognized, namely that the United States is an economic union, and that business which is national should be under national, not state, control.

Though for the reasons stated, the four cases mentioned are the most important of his decisions, the value of his work as an expounder of the Constitution of the United States is not to be measured by these cases alone. In all he decided forty-four cases involving constitutional questions. Nearly every important part of the Constitution of the United States as it existed before the amendments which were adopted after the Civil War, is treated in one or more of them. The Constitution in its most important aspects is the Constitution as he interpreted it. He did not work out completely the position of the states in the Federal system, but he did grasp and establish the position of the Federal legislature and the Federal judiciary. To appreciate his work, however, it is necessary to see that it was the work not of a statesman but of a judge. Had Marshall been merely a far-seeing statesman, while most of his important cases would have been decided as he decided them, his life-work would have been a failure. It was not only necessary that he should decide great constitutional questions properly, but also that the people of the United States should be convinced of the correctness of his interpretation of the Constitution. His opinions, therefore, had to carry to those who studied them a conviction that the constitution as written had been interpreted according to its evident meaning. They fulfilled this prime requisite. Their chief characteristic is the cumulative force of the argument. The ground for the premiss is carefully prepared, the premiss itself is clearly stated; nearly every possible objection is examined and answered; and then comes the conclusion. There is little or no repetition, but there is a wealth of illustration, a completeness of analysis, that convinces the reader, not only that the subject has been adequately treated, but that it has been exhausted. His style, reflecting his character, suits perfectly the subject matter. Simple in the best sense of the word, his intellectual processes were so clear that he never doubted the correctness of the conclusion to which they led him. Apparently from his own point of view, he merely indicated the question at issue, and the inexorable rules of logic did the rest. Thus his opinions are simple, clear, dignified. Intensely interesting, the interest is in the argument, not in its expression. He had, in a wonderful degree, the power of phrase. He expressed important principles of law in language which tersely yet clearly conveyed his exact meaning. Not only is the Constitution interpreted largely as he taught the people of the United States to interpret it, but when they wish to express important constitutional principles which he enunciated they use his exact words. Again, his opinions show that he adhered closely to the words of the Constitution; indeed no one who has attempted to expound that instrument has confined himself more strictly to an examination of the text. In the proper, though not in the historical, sense he was the strictest of strict constructionalists, and as a result his opinions are practically devoid of theories of government, sovereignty and the rights of man.

A single illustration of his avoidance of all theory and his adherence to the words of the Constitution will suffice. In the case of the *United States* v. *Fisher* the constitutional question involved was the power of Congress to give to the United States a preference over all other creditors in the distribution of the assets of a bankrupt. Such an act can be upheld on the ground that all governments have necessarily the right to give themselves priority. Not so Marshall. To him the act must be supported, if supported at all, not on any theory of the innate nature of the government, national or otherwise, but as a reasonable means of carrying out one of the express powers conferred by the Constitution on the Federal government. Thus, he upholds the act in question because of the power expressly conferred on the Federal government to pay the debts of the union, and as a necessary consequence of this power the right to make remittances by bills or otherwise and to take precautions which will render the transactions safe.

It is important to emphasize the fact that Marshall adhered in his opinions to the Constitution as written, not only because it is a fact which must be recognized if we are to understand the correct value of his work in the field of constitutional law, but also because there exists to-day a popular impression that by implication he stretched to the utmost the powers of the Federal government. This impression is due primarily to the ignorance of many of those who have undertaken to praise him. During his life he was charged by followers of the States Rights School of political thought with upholding Federal power in cases not warranted by the constitution. Later, however, those who admired a strong national government, without taking the trouble to ascertain whether the old criticism by members of the States Rights Party was just, regarded the assumption on which it was founded as Marshall's best claim to his country's gratitude.

As a constitutional lawyer, Marshall stands without a rival. His work on international law and admiralty is of first rank. But though a good, he was not a great, common law or equity lawyer. In these fields he did not make new law nor clarify what was obscure, and his constitutional opinions which to-day are found least satisfactory are those in which the question to be solved necessarily involves the discussion of some common-law conception, especially those cases in which he was required to construe the restriction imposed by the Constitution on any state impairing the obligation of contracts. His decision in the celebrated case of *Dartmouth College* v. *Woodward*, in which he held that a state could not repeal a charter of a private corporation, because a charter is a contract which a subsequent act of the state repealing the charter impairs, though of great economic importance, does not touch any fundamental question of constitutional law. The argument which he advances lacks the clearness and finality for which most of his opinions are celebrated. It is not certain with whom he thought the contract was made: with the corporation created by the charter, with the trustees of the corporation, or with those who had contributed money to its objects.

Of the wonderful persuasive force of Marshall's personality there is abundant evidence. His influence over his associates, already referred to, is but one example though a most impressive one. From the moment he delivered the opinion in *Marbury* v. *Madison* the legal profession knew that he was a great judge. Each year added to his reputation and made for a better appreciation of his intellectual and moral qualities. The bar of the Supreme Court during his chief-justiceship was the most brilliant which the United States has ever known. Leaders, not only of legal, but political thought were among its members; one, Webster, was a man of genius and commanding position. To a very great degree Marshall impressed on the members of this bar and on the profession generally his own ideas of the correct interpretation of the Constitution and his own love for the union. He did this, not merely by his arguments but by the influence which was his by right of his strong, sweet nature. Statesmen and politicians, great and small, were at this time, almost without exception, members of the bar. To influence the political thought of the bar was to a great extent to influence the political thought of the people.

In 1782 he married Mary Willis Ambler, the daughter of the then treasurer of Virginia. They had ten children, six of whom grew to full age. For the greater part of the forty-eight years of their married life Mrs Marshall suffered intensely from a nervous affliction. Her condition called out the love and sympathy of her husband's deep and affectionate nature. Judge Story tells us: "That which, in a just sense, was his highest glory, was the purity, affectionateness, liberality and devotedness of his domestic life." For the first thirty years of his chief-justiceship his life was a singularly happy one. He never had to remain in Washington for more than three months. During the rest of the year, with the exception of a visit to Raleigh, which his duties as circuit judge required him to make, and a visit to his old home in Fauquier county, he lived in Richmond. His house on Shockhoe Hill is still standing.

On Christmas Day 1831 his wife died. He never was quite the same again. On returning from Washington in the spring of 1835 he suffered severe contusions, from an accident to the stage coach in which he was riding. His health, which had not been good, now rapidly declined and in June he returned to Philadelphia for medical attendance. There he died on the 6th of July. His body, which was taken to Richmond, lies in Shockhoe Hill Cemetery under a plain marble slab, on which is a simple inscription written by himself. In addition to his decisions Marshall wrote a famous biography of George Washington (5 vols., 1804–1807; 2nd ed., 2 vols., 1832), which though prepared hastily contains much material of value.

The principal sources of information are: an essay by James B. Thayer (Boston and New York, 1904); *Great American Lawyers* (Philadelphia, 1908), ii. 313–408, an essay by Wm. Draper Lewis; and Allan B. Magruder, *John Marshall* (Boston, 1885), in the "American Statesmen Series." The addresses delivered on Marshall Day, the 4th of February 1901, are collected by John F. Dillon (Chicago, 1903). In the "Appendix" to Dillon's collection will be found the "Discourse" by Joseph Story and the "Eulogy" by Horace Binney, both delivered soon after Marshall's death. For a study of Marshall's decisions, the *Constitutional Decisions of John Marshall*, edited by Joseph P. Collon, Jr. (New York and London, 1905), is of value. (W. D. L.)

MARSHALL, JOHN (1818–1891), British surgeon and physiologist, was born at Ely, on the 11th of September 1818, his father being a lawyer of that city. He entered University College, London, in 1838, and in 1847 he was appointed assistant-surgeon at the hospital, becoming in 1866 surgeon and professor of surgery. He was professor of anatomy at the Royal Academy from 1873 till his death. In 1883 he was president of the College of Surgeons, also Bradshaw lecturer (on "Nerve-stretching for the relief or cure of pain"), Hunterian orator in 1885, and Morton lecturer in 1889. In 1867 he published his well-known textbook *The Outlines of Physiology* in two volumes. He died on the 1st of January 1891. "Marshall's fame," wrote Sir W. MacCormac in his volume on the *Centenary of the College of Surgeons* (1900), "rests on the great ability with which he taught anatomy in relation to art, on the introduction into modern surgery of the galvano-cautery, and on the operation for the excision of varicose veins. He was one of the first to show that cholera might be spread by means of drinking water, and issued a report on the outbreak of cholera in Broad Street, St James's, 1854. He also invented the system of circular wards for hospitals, and to him are largely owing the details of the modern medical student's education."

MARSHALL, STEPHEN (*c.* 1594–1655), English Nonconformist divine, was born at Godmanchester in Huntingdonshire, and was educated at Emmanuel College, Cambridge (M.A. 1622, B.D. 1629). After holding the living of Wethersfield in Essex he became vicar of Finchingfield in the same county, and in 1636 was reported for "want of conformity." He was a preacher of great power, and influenced the elections for the Short Parliament of 1640. Clarendon esteemed his influence on the parliamentary side greater than that of Laud on the royalist. In 1642 he was appointed lecturer at St Margaret's, Westminster, and delivered a series of addresses to the Commons in which he advocated episcopal and liturgical reform. He had a share in writing *Smectymnuus*, was appointed chaplain to the earl of Essex's regiment in 1642, and a member of the Westminster Assembly in 1643. He represented the English Parliament in Scotland in 1643, and attended the parliamentary commissions at the Uxbridge Conference in 1645. He waited on Archbishop Laud before his execution, and was chaplain to Charles I. at Holmby House and at Carisbrooke. A moderate and judicious presbyterian, he prepared with others the "Shorter Catechism" in 1647, and was one of the "Triers," 1654. He died in November 1655 and was buried in Westminster Abbey, but his body was exhumed and maltreated at the Restoration. His sermons, especially that on the death of John Pym in 1643, reveal eloquence and fervour. The only "systematic" work he published was *A Defence of Infant Baptism*, against John Tombes (London, 1646).

MARSHALL, a city and the county-seat of Saline county, Missouri, U.S.A., situated a little W. of the centre of the state, near the Salt Fork of the La Mine River. Pop. (1890), 4297; (1900), 5086 (208 being foreign-born and 98 negroes); (1910) 4869. It is served by the Missouri Pacific and the Chicago & Alton railways. The city is laid out regularly on a high, undulating prairie. It is the seat of Missouri Valley College (opened 1889; coeducational), which was established by the Cumberland Presbyterian church, and includes a preparatory department and a conservatory of music. The court-house (1883), a Roman Catholic convent and a high school (1907) are the principal buildings. The Missouri colony for the feeble-minded and epileptic (1899) is at Marshall. The principal trade is with the surrounding farming country. The municipality owns and operates the waterworks. Marshall was first settled and was made the county seat in 1839; it became a town in 1866 (re-incorporated 1870) and a city in 1878.

MARSHALL, a city and the county-seat of Harrison county, Texas, U.S.A., about 145 m. E. by S. of Dallas. Pop. (1890), 7207; (1900) 7855 (3769 negroes); (1910) 11,452. Marshall is served by the Texas & Pacific and the Marshall & East Texas railways, which have large shops here. Wiley University was founded in 1873 by the Freedman's Aid Society of the Methodist Episcopal Church, and Bishop College, was founded in 1881 by the American Baptist Home Mission Society and incorporated in 1885. Marshall is situated in a region growing cotton and Indian corn, vegetables, small fruits and sugar-cane; in the surrounding country there are valuable forests of pine, oak and gum. In the vicinity of the city there are several lakes (including Caddo Lake) and springs (including Hynson and Rosborough springs). The city has a cotton compress, and among its manufactures are cotton-seed oil, lumber, ice, foundry products and canned goods. The municipality owns and operates the waterworks. Marshall was first settled in 1842, was incorporated in 1843, and received a city charter in 1848; in 1909 it adopted the commission form of government.

MARSHALL ISLANDS, an island group in the western Pacific Ocean (Micronesia) belonging to Germany. The group consists of a number of atolls ranged in two almost parallel lines, which run from N.W. to S.E. between 4° and 15° N. and 161° and 174° E. The north-east line, with fifteen islands, is called Ratak, the other, numbering eighteen, Ralik. These atolls are of coralline formation and of irregular shape. They rise but little above high-water mark. The highest elevation occurs on the island of Likieb, but is only 33 ft. The lagoon is scarcely more than 150 ft. deep and is accessible through numerous breaks in the reef. On the outward side the shore sinks rapidly to a great depth. The surface of the atolls is covered with sand, except in a few places where it has been turned into soil through the admixture of decayed vegetation. The reef in scarcely any instance exceeds 600 ft. in width.

The climate is moist and hot, the mean temperature being 80·50° F. Easterly winds prevail all the year round. There is no difference between the seasons, which, though the islands belong to the northern hemisphere, have the highest temperature in January and the lowest in July. Vegetation, on the whole, is very poor. There are many coco-nut palms, bread-fruit trees (*Artocarpus incisa*), various kinds of bananas, yams and taro, and pandanus, of which the natives eat the seeds. From the bark of another plant they manufacture mats. There are few animals. Cattle do not thrive, and even poultry are scarce. Pigs, cats, dogs and rats have been imported. There are a few pigeons and aquatic birds, butterflies and beetles. Crustacea and fish abound on the reefs.

The natives are Micronesians of a dark brown colour, though lighter shades occur. Their hair is not woolly but straight and long. They practise tattooing, and show Papuan influence by distending the ear-lobes by the insertion of wooden disks. They are expert navigators, and construct curious charts of thin strips of wood tied together with fibres, some giving the position of the islands and some the direction of the prevailing winds. Their canoes carry sails and are made of the trunk of the bread-fruit tree. The people are divided into four classes, of which only two are allowed to own land. The islands lie entirely within the German sphere of interest, and the boundaries were agreed upon between Great Britain and Germany on the 10th of April 1889. Their area is estimated at 160 sq. m., with 15,000 inhabitants, who are apparently increasing, though the contrary was long believed. All but about 250 are natives. The administrator of the islands is the governor of German New Guinea, but a number of officials reside on the islands. There is no military force, the natives being of peaceful disposition. The chief island and seat of government is Jaluit. The most populous island is Majeru, with 1600 inhabitants. The natives are generally pagans, but a Roman Catholic mission has been established, and the American Mission Board maintains coloured teachers on many of the islands. There is communication with Sydney by private steamer, and a steamer sails between Jaluit and Ponape to connect with the French boats for Singapore. The chief products for export are copra, tortoise-shell, mother-of-pearl, sharks' fins and trepang. The natives are clever boat-builders, and find a market for their canoes on neighbouring islands. They have made such progress in their art that they have even built seaworthy little schooners of 30 to 40 tons. The only other articles they make are a few shell ornaments.

The Marshall Islands may have been visited by Alvaro de Saavedra in 1529, Captain Wallis touched at the group in 1767, and in 1788 Captains Marshall and Gilbert explored it. The Germans made a treaty with the chieftains of Jaluit in 1878 and annexed the group in 1885–1886.

See C. Hager, *Die Marshall-Inseln* (Leipzig, 1886); Steinbach and Grösser, *Wörterbuch der Marshall-Sprache* (Hamburg, 1902).

MARSHALLTOWN, a city and the county-seat of Marshall county, Iowa, U.S.A., near the Iowa River and about 60 m. N.E. of Des Moines. Pop. (1890), 8914; (1900), 11,544, of whom 1590 were foreign-born; (1910 census) 13,374. Marshalltown is served by the Chicago & North-Western, the Chicago Great Western, and the Iowa Central railways, the last of which has machine shops here. At Marshalltown are the Iowa soldiers' home, supported in part by the Federal Government, and St. Mary's institute, a Roman Catholic commercial and business school. The city is situated in a rich agricultural region, and is a market for grain, neat cattle, horses and swine. There are miscellaneous manufactures, and in 1905 the factory product was valued at $3,090,312. The municipality owns and operates its waterworks and its electric-lighting plant. Marshalltown, named in honour of Chief Justice John Marshall, was laid out in 1853, and became the county-seat in 1860. It was incorporated as a town in 1863, and was chartered as a city in 1868.

MARSHALSEA, a prison formerly existing in Southwark, London. It was attached to the court of that name held by the steward and marshal of the king's house (see LORD STEWARD and MARSHAL). The date of its first establishment is unknown, but it existed as early as the reign of Edward III. It was consolidated in 1842 with the queen's bench and the Fleet, and was then described as "a prison for debtors and for persons charged with contempt of Her Majesty's courts of the Marshalsea, the court of the queen's palace of Westminster, and the high court of admiralty, and also for admiralty prisoners under sentence of courts martial." It was abolished in 1849. The Marshalsea Prison is described in Charles Dickens' *Little Dorrit*.

MARSHBUCK, a book-name proposed for such of the African bushbucks or harnessed antelopes as have abnormally long hoofs to support them in walking on marshy or swampy ground. (See BUSHBUCK and ANTELOPE.)

MARSHFIELD, a city of Wood county, Wisconsin, about 165 m. N.W. of Milwaukee. Pop. (1890), 3450; (1900), 5240, of whom 1161 were foreign-born; (1905) 6036; (1910) 5783. It is served by the Chicago & North-Western, the Chicago, St Paul, Minneapolis & Omaha, and the Minneapolis, St Paul & Sault Ste Marie railways. It contains the mother-house of the Sisters of the Sorrowful Mother. Lumbering is the most important industry, and there are various manufactures. The city is situated in a clover region, in which dairying is important, and Guernsey and Holstein-Friesland cattle are raised. The municipality owns and operates the waterworks and the electric-lighting plant. The site of Marshfield was part of a tract granted by the Federal government to the Fox River Improvement Company, organized to construct a waterway between the Mississippi river and Green Bay, and among the original owners of the town site were Samuel Marsh of Massachusetts (in whose honour the place was named) and Horatio Seymour, Ezra Cornell, Erastus Corning, and William A. Butler of New York. Marshfield was settled about 1870, and was first chartered as a city in 1883.

MARSH GAS (methane), CH_4, the first member of the series of paraffin hydrocarbons. It occurs as a constituent of the "fire-damp" of coal-mines, in the gases evolved from volcanoes, and in the gases which arise in marshy districts (due to the decomposition of vegetable matter under the surface of water). It is found associated with petroleum and also in human intestinal gases. It is a product of the destructive distillation of complex organic matter (wood, coal, bituminous shale, &c.), forming in this way from 30 to 40% of ordinary illuminating gas. It may be synthetically obtained by passing a mixture of the vapour of carbon bisulphide with sulphuretted hydrogen over red-hot copper (M. Berthelot, *Comptes rendus*, 1856, 43, p. 236), $CS_2 + 2H_2S + 8Cu = 4Cu_2S + CH_4$; by passing a mixture of hydrogen and carbon monoxide over reduced nickel at 200–250° C., or hydrogen and carbon dioxide at 230–300° C. (P. Sabatier and J. B. Senderens, *Comptes rendus*, 1902, 134, pp. 514, 689); by the decomposition of aluminium carbide with water [H. Moissan, *Bull. Soc. Chim.*, 1894, (3) 11, p. 1012]; and by heating phosphonium iodide with carbon bisulphide in a sealed tube to 120–140° C. (H. Jahn, *Ber.*, 1880, 13, p. 127). It is also obtained by the reduction of many methyl compounds with nascent hydrogen; thus methyl iodide dissolved in methyl alcohol readily yields methane when acted on by the zinc-copper couple (J. H. Gladstone and A. Tribe, *Jour. Chem. Soc.*, 1884, 45, p. 156) or by the aluminium-mercury couple. It may be obtained in an indirect manner from methyl iodide by conversion of this compound into zinc methyl, or into magnesium methyl iodide (formed by the action of magnesium on methyl iodide dissolved in anhydrous ether), and decomposing these latter substances with water (E. Frankland, 1856; V. Grignard, 1900),

$$Zn(CH_3)_2+H_2O=2CH_4+ZnO;\ 2CH_3MgI+H_2O=2CH_4+MgI_2+MgO.$$

In the laboratory it is usually prepared by J. B. A. Dumas' method (*Ann.*, 1840, 33, p. 181), which consists in heating anhydrous sodium acetate with soda lime, $CH_3CO_2Na + NaOH = Na_2CO_3 + CH_4$. The product obtained by this method is not pure, containing generally more or less ethylene and hydrogen.

Methane is a colourless gas of specific gravity 0·559 (air = 1). It may be condensed to a colourless liquid at −155° to −160° C. under atmospheric pressure (S. Wroblewsky, *Comptes rendus*, 1884, 99, p. 136). It boils at −162° C. and freezes at −186°C. Its critical temperature is −99·5° C. (J. Dewar). The gas is almost insoluble in water, but is slightly soluble in alcohol. It decomposes into its constituents when passed through a red-hot tube, small quantities of other hydrocarbons (ethane, ethylene, acetylene, benzene, &c.) being formed at the same time. It burns with a pale flame, and when mixed with air or oxygen forms a highly explosive mixture. W. A. Bone (*Jour. Chem. Soc.*, 1902, 81, p. 535; 1903, 83, p. 1074) has shown that in the oxidation of methane by oxygen at 450–500° C. formaldehyde (or possibly methyl alcohol) is formed as an intermediate product, and is ultimately oxidized to carbon dioxide. Methane is an exceedingly stable gas, being unaffected by the action of chromic acid, nitric acid, or a mixture of nitric and sulphuric acids. Chlorine and bromine, however, react with methane, gradually replacing hydrogen and forming chlor- and brom- substitution products.

MARSHMAN, JOSHUA (1768–1837), English Baptist missionary and orientalist, was born on the 20th of April 1768, at Westbury Leigh, in Wiltshire. He followed the occupation of a weaver until 1794, but having meanwhile devoted himself to study he removed to Broadmead, Bristol, to take charge of a small school. In 1799 he was sent by the Baptist Missionary Society to join their mission at Serampur. Here, in addition to his more special duties, he studied Bengali and Sanskrit, and afterwards Chinese. He translated the Bible into various dialects, and, aided by his son, established newspapers and founded Serampur College. He received the degree of D.D. from Brown University, U.S.A., in 1810. He died at Serampur on the 5th of December 1837. His son, John Clark Marshman (1794–1877), was official Bengali translator; he published a *Guide to the Civil Law* which, before the work of Macaulay, was the civil code of India, and wrote a *History of India* (1842).

Marshman translated into Chinese the book of Genesis, the Gospels, and the Epistles of Paul to the Romans and the Corinthians; in 1811 he published *The Works of Confucius, containing the Original Text, with a Translation*, and in 1814 his *Clavis Sinica*. He was also the author of *Elements of Chinese Grammar, with Preliminary Dissertation on the Characters and Colloquial Mediums of the Chinese*, and was associated with W. Carey in the preparation of a Sanskrit grammar and of a Bengali-English dictionary.

See J. C. Marshman, *Life and Times of Carey, Marshman and Ward* (2 vols., 1859).

MARSI, an ancient people of Italy, whose chief centre was Marruvium, on the eastern shore of Lake Fucinus. They are first mentioned as members of a confederacy with the Vestini, Paeligni and Marrucini (Liv. viii. 29, cf. viii. 6, and Polyb. ii. 24, 12). They joined the Samnites in 308 B.C. (Liv. ix. 41), and on their submission became allies of Rome in 304 B.C. (Liv. ix. 45). After a short-lived revolt two years later, for which they were punished by loss of territory (Liv. x. 3), they were readmitted to the Roman alliance and remained faithful down to the social war, their contingent (*e.g.* Liv. xliv. 46) being always regarded as the flower of the Italian forces (*e.g.* Hor. *Od.* ii. 20, 18). In this war, which, owing to the prominence of the Marsian rebels is often known as the Marsic War, they fought bravely against odds under their leader Q. Pompaedius Silo, and, though they were frequently defeated, the result of the war was the enfranchisement of the allies (see ROME: *History*, "The Republic"). The Marsi were a hardy mountain people, famed for their simple habits and indomitable courage. It was said that the Romans had never triumphed over them or without them (Appian). They were also renowned for their magicians, who had strange remedies for various diseases.

The Latin colony of Alba Fucens near the north-west corner of the lake was founded in the adjoining Aequian territory in 303, so that from the beginning of the 3rd century the Marsians were in touch with a Latin-speaking community, to say nothing of the Latin colony of Carsioli (298 B.C.) farther west. The earliest pure Latin inscriptions of the district seem to be *C.I.L.* ix. 3827 and 3848 from the neighbourhood of Supinum; its character generally is of the Gracchan period, though it might be somewhat earlier.

Mommsen (*Unteritalische Dialekten*, p. 345) pointed out that in the social war all the coins of Pompaedius Silo have the Latin legend "Italia," while the other leaders in all but one case used Oscan.

The chief record of the dialect or patois we owe to the goddess Angitia, whose chief temple and grove stood at the south-west corner of Lake Fucinus, near the inlet to the *emissarius* of Claudius (restored by Prince Torlonia), and the modern village of Luco. She (or they, for the name is in the plural in the Latin inscription next cited) was widely worshipped in the central highlands (Sulmo, *C.I.L.* ix. 3074, Furfo Vestinorum, ibid. 3515) as a goddess of healing, especially skilled to cure serpent bites by charms and the herbs of the Marsian woods. Her worshippers naturally practised the same arts—as their descendants do (see A. de Nino's charming collection of *Usi e costumi abruzzesi*), their country being in Rome counted the home of witchcraft; see Hor. *Sat.* 1, 9, 29, *Epod.* 17, 28, &c.

The earliest local inscriptions date from about 300 to 150 B.C. and include the interesting and difficult bronze of Lake Fucinus, which seems to record a votive offering to Angitia, if *A(n)ctia*, as is probable, was the local form of her name. Their language differs very slightly from Roman Latin of that date; for apparently contracted forms like *Fougno* instead of *Fucino* may really only be a matter of spelling. In final syllables the diphthongs *ai*, *ei*, *oi*, all appear as *ē*. On the other hand, the older form of the name of the tribe (dat. plur. *Martses* = Lat. *Martiis*) shows its derivation and exhibits the assibilation of *-tio-* into *-tso-* proper to many Oscan dialects (see OSCA LINGUA) but strange to classical Latin.

See R. S. Conway, *The Italic Dialects*, pp. 290 seq. (from which some portions of this article are taken by permission of the syndics of the Camb. Univ. Press); on the Fucino-Bronze, ib. p. 294. (R. S. C.)

MARSIGLI [Latinized MARSILIUS], **LUIGI FERDINANDO,** COUNT (1658–1730), Italian soldier and scientific writer, was born at Bologna on the 10th of July 1658. After a course of scientific studies in his native city he travelled through Turkey collecting data on the military organization of that empire, as well as on its natural history. On his return he entered the service of the emperor Leopold (1682) and fought with distinction against the Turks, by whom he was wounded and captured in an action on the river Raab, and sold to a pasha whom he accompanied to the siege of Vienna. His release was purchased in 1684, and he afterwards took part in the war of the Spanish succession. In 1703 he was appointed second in command under Count Arco in the defence of Alt-Breisach. The fortress surrendered to the duke of Burgundy, and both Arco and Marsigli were court martialled; the former was condemned to death and the latter cashiered, although acquitted of blame by public opinion. Having thus been forced to give up soldiering, he devoted the rest of his life to scientific investigations, in the pursuit of which he made many journeys through Europe, spending a considerable time at Marseilles to study the nature of the sea. In 1712 he presented his collections to his native city, where they formed the nucleus of the Bologna Institute of Science and Art. He died at Bologna on the 1st of November 1730. Marsigli was a fellow of the London Royal Society and a member of the Paris Academy of Science.

Bibliography.—A list of his works, over twenty in number, is given in Niceron's *Memoirs*; his *Breve ristretto del saggio fisico intorno alla storia del mare* was published at Venice in 1711, and again at Amsterdam (in French) in 1725; the *Stato militare dell' impero ottomano* was published at Amsterdam and the Hague in Italian and French (1732), the *Osservazioni intorno al Bosforo Tracio* in Rome (1681) and the *Danubius pannonico-mysicus*, a large work in six volumes containing much valuable historic and scientific information on the Danubian countries, at the Hague (1725). See Fontenelle, "Éloge" in the *Mém. de l'acad. des sciences* (Paris, 1730); Quincy, *Mémoires sur la vie de M. le comte Marsigli* (Zurich, 1741), and Fantuzzi's biography of Marsigli (Bologna, 1770).

MARSILIUS OF PADUA [Marsiglio Mainardino] (1270–1342), Italian medieval scholar, was born at Padua, and at first studied medicine in his own country. After practising various professions, among others that of a soldier, he went to Paris about 1311. The reputation which he had gained in the physical sciences soon caused him to be raised to the position of rector of the university (for the first term of the year 1313). While still practising medicine he entered into relations with another master of Paris, the philosopher John of Jandun, who collaborated with him in the composition of the famous *Defensor pacis* (1324), one of the most extraordinary political and religious works which appeared during the 14th century. A violent struggle had just broken out between pope John XXII. and Louis of Bavaria, king of the Romans, and the latter, on being excommunicated and called upon to give up the empire, only replied to the pope's threats with fresh provocations. Marsilius of Padua and John of Jandun, though they had both reason to be grateful for the benefits of John XXII., chose this moment to demonstrate, by plausible arguments, the supremacy of the Empire, its independence of the Holy See, and the emptiness of the prerogatives "usurped" by the sovereign pontiffs—a demonstration naturally calculated to give them a claim on the gratitude of the German sovereign.

The *Defensor pacis*, as its name implies, is a work intended to restore peace, as the most indispensable benefit of human society. The author of the law is the people, *i.e.* the whole body, or at least the most important part (*valentior*) of the citizens; the people should themselves elect, or at least appoint, the head of the government, who, lest he should be tempted to put himself above the scope of the laws, should have at his disposal only a limited armed force. This chief is responsible to the people for his breaches of the law, and in serious cases they can condemn him to death. The real cause of the trouble which prevails among men is the papacy, a "fictitious" power, the development of which is the result of a series of usurpations. Marsilius denies, not only to the pope, but to the bishops and clergy, any coercive jurisdiction or any right to pronounce on their own authority excommunications and interdicts, or in any way to impose the observation of the divine law. He is not opposed to penalties against heretics, but he would have them pronounced only by civil tribunals. Desiring to see the clergy practise a holy poverty, he proposes the suppression of tithes and the seizure by the secular power of the greater part of the property of the church. The clergy, thus deprived of its wealth, privileges and jurisdiction, is further to be deprived of independence, for the civil power is to have the right of appointing to benefices, &c. The supreme authority in the church is to be the council, but a council summoned by the emperor. The pope, no longer possessing any more power than other bishops (though Marsilius recognizes that the supremacy of the Church of Rome goes back to the earliest times of Christianity), is to content himself with a pre-eminence mainly of an honorary kind, without claiming to interpret the Holy Scriptures, define dogmas or distribute benefices; moreover, he is to be elected by the Christian people, or by the delegates of the people, *i.e.* the princes, or by the council, and these are also to have the power to punish, suspend or depose him. Such is this famous work, full of obscurities, redundancies and contradictions, in which the thread of the argument is sometimes lost in a labyrinth of reasonings and citations, both sacred and profane, but which nevertheless expresses, both in religion and politics, such audacious and novel ideas that it has been possible to trace in it, as it were, a rough sketch of the doctrines developed during the periods of the Reformation and of the French Revolution. The theory was purely democratic, but was all ready to be transformed, by means of a series of fictions and implications, into an imperialist doctrine; and in like manner it contained a visionary plan of reformation which ended, not in the separation of the church from the state, but in the subjection of the church to the state. To overthrow the ecclesiastical hierarchy, to deprive the clergy of all their privileges, to reduce the pope to the rank of a kind of president of a Christian republic, which governs itself, or rather submits to the government of Caesar—such is the dream formed in 1324 by two masters of the university of Paris.

When in 1326 Louis of Bavaria saw the arrival in Nuremberg of the two authors of the book dedicated to him, startled by the boldness of their political and religious theories, he was at first inclined to treat them as heretics. He soon changed his mind, however, and, admitting them to the circle of his intimates, loaded them with favours. Having become one of the chief inspirers of the imperial policy, Marsilius accompanied Louis of Bavaria to Italy, where he preached or circulated written attacks against the pope, especially at Milan, and where he came within the sight of the realization of his wildest utopias. To see a king of the Romans crowned emperor at Rome, not by the pope, but by those who claimed to be the delegates of the people (Jan. 17, 1328), to see John XXII. deposed by the head of the Empire (April 18), and a mendicant friar, Pietro de Corbara, raised by an imperial decree to the throne of St Peter (as Nicholas V.) after a sham of a popular election (May 12), all this was merely the application of principles laid down in the *Defensor pacis*. The two authors of this book played a most active part in the Roman Revolution. Marsilius, appointed imperial vicar, abused his power to persecute the clergy who had remained faithful to John XXII. In recompense for his services, he seems to have been appointed archbishop of Milan, while his collaborator, John of Jandun, obtained from Louis of Bavaria the bishopric of Ferrara.

Marsilius of Padua also composed a treatise *De translatione imperii romani*, which is merely a rearrangement of a work of Landolfo Colonna, *De jurisdictione imperatoris in causa matrimoniali*, intended to prove the exclusive jurisdiction of the emperor in matrimonial affairs, or rather, to justify the intervention of Louis of Bavaria, who, in the interests of his policy, had just annulled the marriage of the son of the king of Bohemia and the countess of Tirol. But, above all, in an unpublished work preserved at Oxford, the *Defensor minor*, Marsilius completed and elaborated in a curious manner certain points in the doctrine laid down in the *Defensor pacis*. In it he deals with ecclesiastical jurisdiction, penances, indulgences, crusades and pilgrimages, vows, excommunication, the pope and the council, marriage and divorce. Here his democratic theory still more clearly leads up to a proclamation of the imperial omnipotence.

Marsilius of Padua does not seem to have lived long after 1342. But the scandal provoked by his *Defensor pacis*, condemned by the court of Avignon in 1326, lasted much longer. Benedict XII. and Clement VI. censured it in turn; Louis of Bavaria disowned it. Translated into French, then into Italian (14th century) and into English (16th century), it was known by Wycliffe and Luther, and was not without an influence on the Reform movement.

See J. Sullivan, *American Historical Review*, vol. ii. (1896–1897), and *English Historical Review* for April 1905; *Histoire littéraire de la France* (1906), xxxiii. 528–623; Sigmund Riezler, *Die literarischen Widersacher der Päpste zur Zeit Ludwig des Baiers* (Leipzig, 1874).

There are numerous manuscripts of the *Defensor pacis* extant. We will here mention only one edition, that given by Goldast, in 1614, in vol. i. of his *Monarchia sacri imperii*; an unpublished last chapter was published by Karl Müller, in 1883, in the *Göttingische gelehrte Anzeigen*, pp. 923–925.

Count Lützow in *The Life and Times of Master John Hus* (London and New York, 1909), pp. 5–9, gives a good abstract of the *Defensor pacis* and the relations of Marsilius to other precursors of the Reformation. (N. V.)

MARSIVAN, or MERZIFUN (anc. *Phazemon*?), a town in the Amasia sanjak of the Sivas vilayet of Asia Minor, situated at the foot of the Tavshan Dagh. Pop. about 20,000, two-thirds Mussulman. It is a centre of American missionary and educational enterprise, and the seat of Anatolia College, a theological seminary, and schools which were partly destroyed in the anti-Armenian riots of 1893 and 1895. There is also a Jesuit school. Marsivan is an unusually European place both in its aspect and the commodities procurable in the bazaar.

MARS-LA-TOUR, a village of Lorraine, between Metz and the French frontier, which formed part of the battlefield of the 16th of August 1870. The battle is often called the battle of Mars-la-Tour, though it is more usually named after Vionville. (See METZ; and FRANCO-GERMAN WAR.) At Mars-la-Tour occurred the destruction of the German 38th brigade.

MARSTON, JOHN (*c.* 1575–1634), English dramatist and satirist, eldest son of John Marston of Coventry, at one time lecturer of the Middle Temple, was born in 1575, or early in 1576. Swinburne notes his affinities with Italian literature, which may be partially explained by his parentage, for his mother was the daughter of an Italian physician, Andrew Guarsi. He entered Brasenose College, Oxford, in 1592, taking his B.A. degree in 1594. The elder Marston in his will expresses regret that his son, to whom he left his law-books and the furniture of his rooms in the Temple, had not been willing to follow his profession. John Marston married Mary Wilkes, daughter of one of the royal chaplains, and Ben Jonson said that "Marston wrote his father-in-law's preachings, and his father-in-law his sermons." His first work was *The Metamorphosis of Pigmalions Image, and certaine Satyres* (1598). "Pigmalion" is an erotic poem in the metre of *Venus and Adonis*, and Joseph Hall attached a rather clumsy epigram to every copy that was exposed for sale in Cambridge. In the same year Marston published, under the pseudonym of W. Kinsayder, already employed in the earlier volume, his *Scourge of Villanie*, eleven satires, in the sixth of which he asserted that Pigmalion was intended to parody the amorous poetry of the time. Both this volume and its predecessor were burnt by order of the archbishop of Canterbury. The satires, in which Marston avowedly took Persius as his model, are coarse and vigorous. In addition to a general attack on the vices of his age he avenges himself on Joseph Hall who had assailed him in *Virgidemiae*. He had a great reputation among his contemporaries. John Weever couples his name with Ben Jonson's in an epigram; Francis Meres in *Palladis tamia* (1598) mentions him among the satirists; a long passage is devoted to "Monsieur Kinsayder" in the *Return from Parnassus* (1606), and Dr Brinsley Nicholson has suggested that *Furor poeticus* in that piece may be a satirical portrait of him. But his invective by its general tone, goes far to justify Mr W. J. Courthope's [1] judgment that "it is likely enough that in seeming to satirize the world without him, he is usually holding up the mirror to his own prurient mind."

On the 28th of September 1599 Henslowe notices in his diary that he lent "unto Mr Maxton, the new poete, the sum of forty shillings," as an advance on a play which is not named. Another hand has amended "Maxton" to "Mastone." The earliest plays to which Marston's name is attached are *The History of Antonio and Mellida. The First Part*; and *Antonio's Revenge. The Second Part* (both entered at Stationers' Hall in 1601 and printed 1602). The second part is preceded by a prologue which, in its gloomy forecast of the play, moved the admiration of Charles Lamb, who also compares the situation of Andrugio and Lucia to Lear and Kent, but the scene which he quotes gives a misleading idea of the play and of the general tenor of Marston's work.

The melodrama and the exaggerated expression of these two plays offered an opportunity to Ben Jonson, who had already twice ridiculed Marston, and now pilloried him as Crispinus in *The Poetaster* (1601). The quarrel was patched up, for Marston dedicated his *Malcontent* (1604) to Jonson, and in the next year he prefixed commendatory verses to *Sejanus*. Far greater restraint is shown in *The Malcontent* than in the earlier plays. It was printed twice in 1604, the second time with additions by John Webster. *The Dutch Courtezan* (1605) and *Parasitaster, or the Fawne* (1606) followed. In 1605 *Eastward Hoe*,[2] a gay comedy of London life, which gave offence to the king's Scottish friends, caused the playwrights concerned in its production—Marston, Chapman and Jonson—to be imprisoned at the instance of Sir James Murray. *The Wonder of Women, or the Tragedie of Sophonisba* (1606), seems to have been put forward by Marston as a model of what could be accomplished in tragedy. In the preface he mocks at those authors who make a parade of their authorities and their learning, and the next play, *What you Will* (printed 1607; but probably written much earlier), contains a further attack on Jonson. The tragedy of *The Insatiate Countesse* was printed in 1613, and again, this time anonymously, in 1616. It was not included in the collected edition of Marston's plays in 1633, and in the Duke of Devonshire's library there is a copy bearing the name of William Barksteed, the author of the poems, *Myrrha, the Mother of Adonis* (1607), and *Hiren and the Fair Greek* (1611). The piece contains many passages superior to anything to be found in Marston's well-authenticated plays, and Mr A. H. Bullen suggests that it may be Barksteed's version of an earlier one drafted by Marston. The character and history of Isabella are taken chiefly from "The Disordered Lyfe of the Countess of Celant" in William Paynter's *Palace of Pleasure*, derived eventually from Bandello. There is no certain evidence of Marston's authorship in *Histriomastix* (printed 1610, but probably produced before 1599), or in *Jacke Drums Entertainement, or the Comedie of Pasquil and Katherine* (1616), though he probably had a hand in both. Mr R. Boyle (*Englische Studien*, vol. xxx., 1901), in a critical study of Shakespeare's *Troilus and Cressida*, assigns to Marston's hand the whole of the action dealing with Hector, with the prologue and epilogue, and attributes to him the bombast and coarseness in the last scenes of the play. It will be seen that his undoubted dramatic work was completed in 1607. It is uncertain at what time he exchanged professions, but in 1616 he was presented to the living of Christchurch, Hampshire. He formally resigned his charge in 1631, and when his works were collected in 1633 the publisher, William Sheares, stated that the author "in his autumn and declining age" was living "far distant from this place." Nevertheless he died in London, in the parish of Aldermanbury, on the 25th of June 1634. He was buried in the Temple Church.

Marston's works were first published in 1633, once anonymously as *Tragedies and Comedies*, and then in the same year as *Workes of Mr John Marston. The Works of John Marston* (3 vols.) were reprinted by Mr J. O. Halliwell (Phillipps) in 1856, and again by Mr. A. H. Bullen (3 vols.) in 1887. His *Poems* (2 vols.) were edited by Dr A. B. Grosart in 1879. The British Museum Catalogue tentatively assigns to Marston *The Whipper of the Satyre his pennance in a white sheete; or, the Beadle's Confutation* (1601), a pamphlet in answer to *The Whipping of the Satyre.* For an account of the quarrel of Dekker and Marston with Ben Jonson see Dr R. A. Small, *The*

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[1] *Hist. of Eng. Poetry*, iii. 70.

[2] Revived at Drury Lane (1751) as *The Prentices*, in 1775 as *Old City Manners*, and said to have suggested Hogarth's "Industrious and Idle Prentices."

Stage Quarrel between Ben Jonson and the so-called Poetasters; in E. Koelbing, *Forschungen zur englischen Sprache und Litteratur*, pt. i. (1899). See also three articles *John Marston als Dramatiker*, by Ph. Aronstein in *Englische Studien* (vols. xx. and xxi., 1895), and "Quellenstudien zu den Dramen Ben Jonsons, John Marstons . . ." by Emil Koeppel (*Münchener Beiträge zur roman. und engl. Philologie*, pt. xi. 1895).

MARSTON, PHILIP BOURKE (1850–1887), English poet, was born in London on the 13th of August 1850. His father, JOHN WESTLAND MARSTON (1819–1890), of Lincolnshire origin, the friend of Dickens, Macready and Charles Kean, was the author of a series of metrical dramas which held the stage in succession to the ambitious efforts of John Tobin, Talfourd, Bulwer and Sheridan Knowles. His chief plays were *The Patrician's Daughter* (1841), *Strathmore* (1849), *A Hard Struggle* (1858) and *Donna Diana* (1863). He was looked up to as the upholder of the outworn tradition of the acted poetic drama, but his plays showed little vitality, and Marston's reviews for the *Athenaeum*, including one of Swinburne's *Atalanta in Calydon*, and his dramatic criticisms embodied in *Our Recent Actors* (1888) will probably claim a more enduring reputation. His *Dramatic and Poetical Works* were collected in 1876. The son, Philip Bourke, was born in a literary atmosphere. His sponsors were Philip James Bailey and Dinah Mulock (Mrs Craik). At his father's house near Chalk Farm he met authors and actors of his father's generation, and subsequently the Rossettis, Swinburne, Arthur O'Shaughnessy and Irving. From his earliest years his literary precocity was overshadowed by misfortunes. In his fourth year, in part owing to an accident, his sight began to decay, and he gradually became almost totally blind. His mother died in 1870. His *fiancée*, Mary Nesbit, died in 1871; his closest friend, Oliver Madox Brown, in 1874; his sister Cicely, his amanuensis, in 1878; in 1879 his remaining sister, Eleanor, who was followed to the grave after a brief interval by her husband, the poet O'Shaughnessy, and her two children. In 1882 the death of his chief poetic ally and inspirer, Rossetti, was followed closely by the tragedy of another kindred spirit, the sympathetic pessimist, James Thomson ("B. V."), who was carried dying from his blind friend's rooms, where he had sought refuge from his latest miseries early in June of the same year. It is said that Marston came to dread making new friendships, for fear of evil coming to the recipients of his affection. In the face of such calamities it is not surprising that Marston's verse became more and more sorrowful and melancholy. The idylls of flower-life, such as the early and very beautiful "The Rose and the Wind" were succeeded by dreams of sleep and the repose of death. These qualities and gradations of feeling, reflecting the poet's successive ideals of action and quiescence, are traceable through his three published collections, *Songtide* (1871), *All in All* (1875) and *Wind Voices* (1883). The first and third, containing his best work, went out of print, but Marston's verse was collected in 1892 by Mrs Louise Chandler Moulton, a loyal and devoted friend, and herself a poet. Marston read little else but poetry; and of poetic values, especially of the intenser order, his judgment could not be surpassed in sensitiveness. He was saturated with Rossetti and Swinburne, and his imitative power was remarkable. In his later years he endeavoured to make money by writing short stories in *Home Chimes* and other American magazines, through the agency of Mrs Chandler Moulton. His popularity in America far exceeded that in his own country. His health showed signs of collapse from 1883; in January 1887 he lost his voice, and suffered intensely from the failure to make himself understood. He died on the 13th of February 1887.

He was commemorated in Dr Gordon Hake's "Blind Boy," and in a fine sonnet by Swinburne, beginning "The days of a man are threescore years and ten." There is an intimate sketch of the blind poet by a friend, Mr Coulson Kernahan, in *Sorrow and Song* (1894), p. 127. (T. SE.)

MARSTON MOOR, BATTLE OF, was fought on the 2nd of July 1644 on a moor (now enclosed) seven miles west of York, between the Royalist army under Prince Rupert and the Parliamentary and Scottish armies under the earl of Manchester, Lord Fairfax and Lord Leven. For the operations that preceded the battle see GREAT REBELLION. Rupert had relieved York and joined forces with the marquess of Newcastle's army that had defended that city, and the Parliamentarians and Scots who had besieged it had drawn off south-westward followed by the Royalists. On the morning of the 2nd of July, however, Rupert's attack on their rearguard forced them to halt and deploy on rising ground on the south edge of the moor, their position being defined on the right and left by Long Marston and Tockwith and divided from the Royalist army on the moor by a lane connecting these two villages. The respective forces were—Royalists about 18,000, Parliamentarians and Scots about 27,000. The armies stood front to front. On the Royalist right was half the cavalry under Rupert; the infantry was in the centre in two lines and the left wing of cavalry was under General (Lord) Goring. The lane along the front was held by skirmishers. On the other side the cavalry of the Eastern Association under Lieut.-General Cromwell and that of the Scots under Major-General Leslie (Lord Newark) formed the left, the infantry of the Eastern Association under Major-General Crawford, of the Scots under Lord Leven, and of the Yorkshire Parliamentarians under Lord Fairfax was in the centre and the Yorkshire cavalry under Sir Thomas Fairfax was on the right wing.

During the afternoon there was a desultory cannonade, but neither side advanced. At last, concluding from movements in the enemy's lines that there would be no fighting that day, Rupert and Newcastle strolled away to their coaches and their soldiers dismounted and lay down to rest. But seeing this Cromwell instantly advanced his wing to the attack (5 p.m.). His dragoons drove away the skirmishers along the lane, and the line cavalry crossed into the moor. The general forward movement spread along the Parliamentary line from left to right, the Eastern Association infantry being the first to cross the road. In Rupert's momentary absence, the surprised Royalist cavalry could make no head against Cromwell's charge, although the latter was only made piecemeal as each unit crossed the lane and formed to the front. Rupert soon galloped up with his fresh second line and drove back Cromwell's men, Cromwell himself being wounded, but Leslie and the Scots Cavalry, taking ground to their left, swung in upon Rupert's flank, and after a hard struggle the hitherto unconquered cavalry of the prince was broken and routed. Then, being unlike other cavalry of the time, a thoroughly disciplined force, the Eastern Association cavalry rallied, leaving the pursuit to the Scots light horse. On the Parliamentary right, Goring had swept away the Yorkshire horse, and although most of his troopers had followed in disorderly pursuit, Sir Charles Lucas with some squadrons was attacking the exposed right of Leven's infantry. At the same time the Parliamentary infantry had mostly crossed the lane and was fighting at close quarters and suffering severely, Newcastle's north-country "White-Coat" brigade driving back and finally penetrating their centre. Lord Leven gave up the battle as lost and rode away to Tadcaster. But the Scots on the right of the foot held firm against Lucas's attacks, and Cromwell and Leslie with their cavalry passed along the rear of the Royal army, guided by Sir Thomas Fairfax (who though wounded in the rout of his Yorkshire horse had made his way to the other flank). Then, on the ground where Goring had routed Fairfax, Cromwell and Leslie won an easy victory over Goring's scattered and disordered horsemen. The Eastern Association infantry had followed the horse and was now in rear of the Royalists. The original Parliamentary centre of foot, a remnant, but one containing only the bravest and steadiest men, held fast, and soon the Royalist infantry was broken up into isolated regiments and surrounded by the victorious horse and foot of the enemy. The White-Coats retreated into an enclosure and there defended themselves to the last man. The rest were cut down on the field or scattered in the pursuit and at nightfall the Royalist army had ceased to exist. Some of Rupert's foot regiments made their way to York, but the dispirited garrison only held out for a fortnight. Rupert rallied some six thousand of the men and escaped over the hills into Lancashire, thence rejoining King Charles in the south. But the Northern army, the main hope of the Royalist cause, was destroyed.

MARSUPIALIA (from Lat. *marsupium*, a "pouch," or "bag"), the group of mammals in which the young are usually carried for some time after birth in a pouch on the under-surface of the body of the female. The group, which has also the alternative title of Didelphia, is by some authorities regarded as a sub-class of the mammalia of equal rank with the Monotremata, while by others it is brigaded with the placentals, so that the two together form a sub-class of equal grade with the one represented by the monotremes. There is much to be urged in favour of either view; and in adopting the former alternative, it must be borne in mind that the difference between monotremes and marsupials is vastly greater than that which separates the latter from placentals. In elevating the marsupials to the rank of a sub-class the name Metatheria has been suggested as the title for the higher grade, with Marsupialia as the designation for the single order by which they are now represented. It is, however, less liable to cause confusion, and in many other ways more convenient to employ the better known term Marsupialia in both senses.

Marsupials may be defined as viviparous (that is non-egg-laying) mammals, in which the young are born in an imperfect condition, and almost immediately attached to the teats of the mammary glands; the latter being generally enclosed in a pouch, and the front edge of the pelvis being always furnished with epipubic or "marsupial" bones. As a rule there is no allantoic placenta forming the means of communication between the blood of the parent and the foetus, and when such a structure does occur its development is incomplete. In all cases a more or less full series of teeth is developed, these being differentiated into incisors, canines, premolars and molars, when all are present; but only a single pair of teeth in each jaw has deciduous predecessors.

The pouch from which the marsupials take their name is supported by the two epipubic bones, but does not correspond to the temporary breeding-pouch of the monotremes. It may open either forward or backwards; and although present in the great majority of the species, and enclosing the teats, it may, as in many of the opossums, be completely absent, when the teats extend in two rows along the whole length of the under-surface of the body. Whether a pouch is present or not, the young are born in an exceedingly imperfect state of development, after a very short period of gestation, and are immediately transferred by the female parent to the teats, where they remain firmly attached for a considerable time; the milk being injected into their mouths at intervals by means of a special muscle which compresses the glands. In the case of the great grey kangaroo, for instance, the period of gestation is less than forty days, and the newly-born embryo, which is blind, naked, and unable to use its bud-like limbs, is little more than an inch in length.

As additional features of the subclass may be mentioned the absence of a corpus callosum connecting the right and left hemispheres of the brain,[1] and of a fossa in the septum between the two auricles of the heart. In the skull there are always vacuities, or unossified spaces in the bones of the palate, while the "angle," or lower hind extremity of each half of the lower jaw is strongly bent inwards so as to form a kind of shelf, and the alisphenoid bone takes a share in the formation of the tympanum, or auditory bladder, or bulla. Didelphia, the alternative name of the group was given in allusion to the circumstance that the uterus has two separate openings; while other features are the inclusion of the openings of the alimentary canal and the urino-genital sinus in a common sphincter muscle, and the position of the scrotum in advance of the penis. The bandicoots alone possess a placenta. Lastly the number of trunk-vertebrae is always nineteen, while there are generally thirteen pairs of ribs.

As regards the teeth, in all cases except the wombats the number of upper incisors differs from that of the corresponding lower teeth. As already stated, there is no vertical displacement and succession of the functional teeth except in the case of a single tooth on each side of each jaw, which is the third of the premolar series, and is preceded by a tooth having more or less of the characters of a molar (see fig. 1). In some cases (as in rat-kangaroos) this tooth retains its place and function until the animal has nearly, if not quite, attained its full stature, and is not shed and replaced by its successor until after all the other teeth, including the molars, are in place and use. In others, as the thylacine, it is rudimentary, being shed or absorbed before any of the other teeth have cut the gum, and therefore functionless. It may be added that there are some marsupials, such as the wombat, koala, marsupial ant-eater and the dasyures, in which no such deciduous tooth, even in a rudimentary state, has been discovered. In addition to this replacement of a single pair of functional teeth in each jaw, it has been discovered that marsupials possess rudimentary tooth-germs which never cut the gum. According to one theory, these rudimentary teeth, together with the one pair of functional teeth in each jaw that has vertical successors, represent the milk-teeth of placental mammals. On the other hand, there are those who believe that the functional dentition (other than the replacing premolar and the molars) correspond to the milk-dentition of placentals, and that the rudimentary tooth-germs represent a "prelacteal" dentition. The question, however, is of academic rather than of practical interest, and whichever way it is answered does not affect our general conception of the nature and relationships of the group.

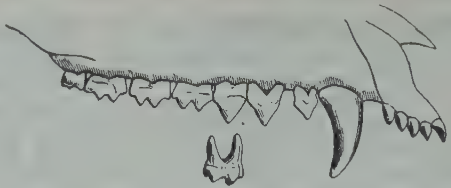

FIG. 1.—Teeth of Upper Jaw of Opossum (*Didelphys marsupialis*), all of which are unchanged, except the third premolar, the place of which is occupied in the young animal by a molariform tooth, represented in the figure below the line of the other teeth.

Unfortunately the homology of the functional series does not by any means end the uncertainty connected with the marsupial dentition; as there is also a difference of opinion with regard to the serial homology of some of the cheek-teeth. For instance, according to the older view, the dental formula in the thylacine or Tasmanian wolf is i. $\frac{4}{3}$, c, $\frac{1}{1}$, p. $\frac{3}{3}$, m. $\frac{4}{4}=46$. On the other hand, in the opinion of the present writer, this formula, so far as the cheek-teeth are concerned, should be altered to p. $\frac{4}{4}$, m. $\frac{3}{3}$, thus bringing it in accord, so far as these teeth are concerned, with the placental formula, and making the single pair of replacing teeth the third premolars. It may be added that the formula given above shows that the marsupial dentition may comprise more teeth than the 44 which form the normal full placental complement.

As regards geographical distribution, existing marsupials, with the exception of two families, *Didelphyidae* and *Epanorthidae*, are mainly limited to the Australian region, forming the chief mammalian fauna of Australia, New Guinea, and some of the adjacent islands. The *Didelphyidae* are almost exclusively Central and South American, only one or two species ranging into North America. Fossil remains of members of this family have also been found in Europe in strata of the Oligocene period.

History.—The origin and evolution of the Australian marsupials have been discussed by Mr B. A. Bensley. In broad contrast to the views of Dr A. R. Wallace, this author is of opinion that marsupials did not effect an entrance into Australia till about the middle of the Tertiary period, their ancestors being probably opossums of the American type. They were then arboreal; but they speedily entered upon a rapid, although short-lived, course of evolution, during which leaping terrestrial forms like the kangaroos were developed. The short period of this evolution is at least one factor in the primitive grade of even the most specialized members of the group. In the advance of their molar teeth from a tritubercular to a grinding type, the author traces a curious parallelism between marsupials and placentals. Taking opossums to have been the ancestors of the group, the author considers that the present writer may be right in his view that marsupials entered Australia from Asia by way of New Guinea. On the other hand there is nothing absolutely decisive against their origin being southern.

Again, taking as a text Mr L. Dollo's view that marsupials were originally arboreal, that, on account of their foot-structure, they could not have been the ancestors of placentals, and that they themselves are degenerate placentals, Mr Bensley contrasts this with Huxley's scheme of mammalian evolution. According to the latter, the early monotremes which became specialized into modern monotremes, gave rise to the ancestors of the modern marsupials; while the modern placentals are likewise an offshoot from the ancestral marsupial stock. This phylogeny, the author thinks, is the most probable of all. It is urged that the imperfect placenta of the bandicoots instead of being vestigial, may be an instance of parallelism, and that in marsupials generally the allantois failed to form a placental connexion. Owing to the antiquity of both placentals and marsupials, the arboreal character of the feet of the modern forms of the latter is of little importance. Further, it is considered that too much weight has been assigned to the characters distinguishing monotremes from other mammals, foetal marsupials showing a monotreme type of coracoid, while it is probable that in the long run it will be found impossible to maintain the essential dissimilarity between the milk-glands of monotremes and other mammals.

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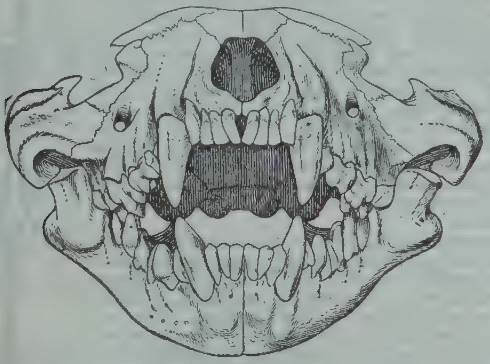
[1] The presence or absence of the corpus callosum has been much disputed; the latest researches, however, indicate its absence.

Another view is to regard both marsupials and placentals as derivates from implacental ancestors more or less nearly related to the creodont carnivora, or possibly as independently descended from anomodont reptiles (see Creodonta). Finally, there is the hypothesis that marsupials are the descendants of placentals, in which case, as was suggested by its discoverer, the placenta of the bandicoots would be a true vestigial structure.

Classification.

Existing marsupials may be divided into three main divisions or sub-orders, of which the first, or Polyprotodontia, is common to America and Australasia; the second, or Paucituberculata, is exclusively South American; while the third, or Diprotodonts, is as solely Australasian inclusive of a few in the eastern Austro-Malayan islands.

1. *Polyprotodonts.*—The Polyprotodonts are characterized by their numerous, small, sub-equal incisors, of which there are either five or four pairs in the upper and always three in the lower jaw, (fig. 2) and the generally strong and large canines, as well as by the presence of from four to five sharp cusps or tubercles on the crown of the molars. The pouch is often absent, and may open backwards. For the most part the species are carnivorous or insectivorous.



From Flower, *Quart. Jour. Geol. Soc.*

Fig. 2.—Front View of Skull of the Tasmanian Devil (*Sarcophilus ursinus*) to exhibit polyprotodont type of dentition.

The first family is that of the true or American opossums—*Didelphyidae*, in which there are five pairs of upper incisors, while the feet are of the presumed primitive arboreal type, the hind foot having the four outer toes subequal and separate, with the first opposable to them all. With the exception of the water-opossum, forming the genus *Chironectes*, all the living members of the family may be included in the genus *Didelphys*. The latter may, however, be split up into several sub-generic groups, such as *Metachirus*, *Philander*, *Marmosa* (*Micoureus* or *Grymaeomys*), *Peramys*, *Dromiciops*, &c. The small South American forms included in *Marmosa*, which lack the pouch, and have numerous teats, and molar teeth of a primitive type, are doubtless the most generalized representatives of the group (see Opossum; and Water-Opossum).

Nearly allied is the Australian family *Dasyuridae*, characterized by the presence of only four pairs of upper incisors, the generally small and rudimentary condition of the first hind toe, which can but seldom be opposed to the rest, and the absence of prehensile power in the tail; the pouch being either present or absent, and the fore feet always five-toed. The stomach is simple, and there is no caecum to the intestine, although this is present in the opossums.

The largest representative of the family is the Tasmanian wolf, or thylacine, alone representing the genus *Thylacinus*, in which the dentition numbers i. $\frac{4}{3}$, c. $\frac{1}{1}$, p. $\frac{4}{4}$, m. $\frac{3}{3}$ = 46; with the incisors small and vertical, the outer one in the upper jaw being larger than the others. Summits of the lower incisors, before they are worn, with a deep transverse groove, dividing it into an anterior and a posterior cusp. Canines long, strong and conical. Premolars with compressed crowns, increasing in size from before backwards. Molars in general characters resembling those of *Sarcophilus*, but of more simple form, the cusps being less distinct and not so sharply pointed. Deciduous molar very small, and shed before the animal leaves the mother's pouch. General form dog-like, with the head elongated, the muzzle pointed, and the ears moderate, erect and triangular. Fur short and closely applied to the skin. Tail of moderate length, thick at the base and tapering towards the apex, clothed with short hair. First hind toe (including the metacarpal bone) absent. Vertebrae: C. 7, D. 13, L. 6, S. 2, Ca. 23. Marsupial bones unossified. The gradual passage of the thick root of the tail into the body is a character common to the Tasmanian wolf and the aard-vark, and may be directly inherited from reptilian ancestors (see Thylacine).

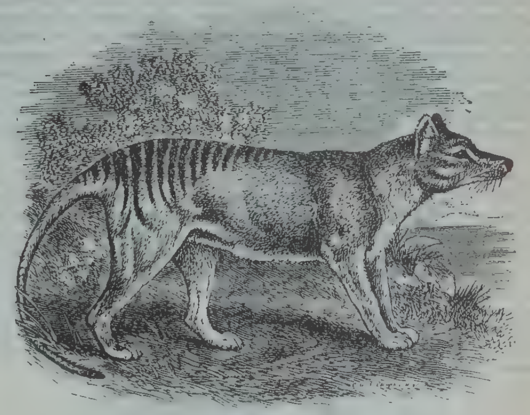


Fig. 3.—The Tasmanian Wolf, or Thylacine (*Thylacinus cynocephalus*).

The next genus is represented solely by the Tasmanian devil, *Sarcophilus* (or *Diabolus*) *ursinus*, a medium-sized animal with a dental formula similar to that of the dasyures, but with teeth (fig. 2) approximating to those of the thylacine, though markedly different in details. The first hind toe is absent.

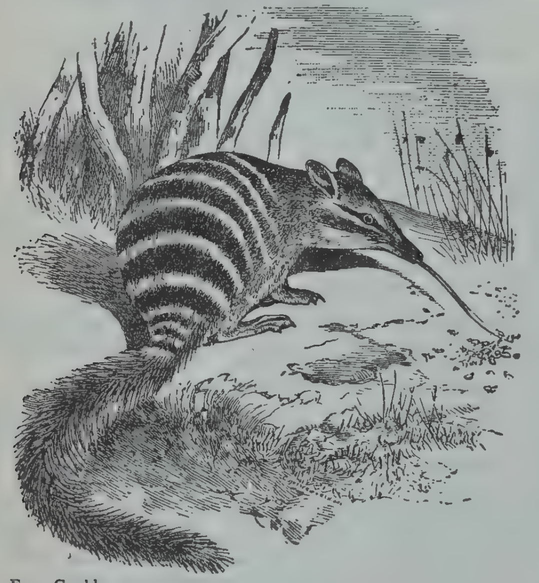
In the "native cats," or dasyures, constituting the genus *Dasyurus*, the dental formula is i. $\frac{4}{3}$, c. $\frac{1}{1}$, p. $\frac{2}{2}$, m. $\frac{4}{4}$: total 42. The upper incisors are nearly equal and vertical, with the first slightly longer, narrower, and separated from the rest. Lower incisors sloping forward and upward. Canines large and sharply pointed. First two premolars with compressed and sharp-pointed crowns, and slightly developed anterior and posterior accessory basal cusps. Molars with numerous sharp-pointed cusps. In the upper jaw the first two with crowns having a triangular free surface; the last small, simple, narrow and placed transversely. In the lower jaw the molars more compressed, with longer cusps; the last not notably smaller than the others. Ears of moderate size, prominent and obtusely pointed. First hind toe rudimentary, clawless or absent; its metatarsal bone always present. Tail generally long and well clothed with hair. Vertebrae: C. 7, D. 13, L. 6, S. 2, Ca. 18–20 (see Dasyure).

The genus *Phascologale* comprises a number of small marsupials, none exceeding a rat in size, differing from the dasyures in possessing an additional premolar—the dentition being i. $\frac{4}{3}$, c. $\frac{1}{1}$, p. $\frac{4}{4}$, m. $\frac{3}{3}$: total 46—and in having the teeth generally developed upon an insectivorous rather than a carnivorous pattern, the upper middle incisors being larger and inclined forward, the canines relatively smaller, and the molars with broad crowns, armed with prickly tubercles. The muzzle is pointed. Ears moderately rounded, and nearly naked. Fore feet with five sub-equal toes, with compressed, slightly curved pointed claws. Hind feet with the four outer toes sub-equal, with claws similar to those in the fore feet; the first toe almost always distinct and partially opposable, though small and nailless, sometimes absent.

In some respects intermediate between the preceding and the next genus is *Dasyuroides byrnei*, of Central Australia, an animal of the size of a rat, with one lower premolar less than in *Phascologale*, without the first hind toe, and with a somewhat thickened tail. The pouch is incomplete, with two lateral folds, and the number of teats six.

Sminthopsis includes several very small species, with the same dental formula as *Phascologale*, but distinguished from that genus by the narrowness of the hind foot, in which the first toe is present, and the granulated or hairy (in place of broad, smooth and naked) soles. A pouch is present, and there are eight or ten teats. Nearly allied is the jumping *Antechinomys laniger*, of East Central Australia, an elegant mouse-like creature, with large oval ears, elongated limbs, a long and tufted tail and no first hind toe. In connexion with the large size of the ears is the excessive inflation of the auditory bulla of the skull.

From all other members of the family the marsupial, or banded, ant-eater (*Myrmecobius fasciatus*) differs by the presence of more than seven pairs of cheek-teeth in each jaw, as well as by the exceedingly long and protrusile tongue. Hence it is made the type of a distinct subfamily, the *Myrmecobiinae*, as distinct from the *Dasyurinae*, which includes all the other members of the family. From the number of its cheek-teeth, the banded ant-eater has been regarded as related to some of the primitive Jurassic mammals; but this view is disputed by Mr Bensley, who regards this multiplicity of teeth as a degenerate feature. On the other hand, it is noteworthy that this marsupial retains in its lower jaw the so-called mylo-hyoid groove, which is found in the aforesaid Jurassic mammals. *Myrmecobius* has a total of 52 or 54 teeth, which may be classed as i. $\frac{4}{3}$, c. $\frac{1}{1}$, p. + m. $\frac{8 \text{ or } 9}{8 \text{ or } 9}$. The teeth are all small and (except the four posterior inferior molars) separated from each other by an interval. Head elongated, but broad behind; muzzle long and pointed; ears of moderate size, ovate and rather pointed. Fore-feet with five toes, all having strong pointed, compressed claws, the second, third and fourth nearly equal, the fifth somewhat and the first considerably shorter. Hind-feet with no trace of first toe externally, but the metatarsal bone is present. Tail long, clothed with long hairs. Fur rather harsh and bristly. Female without pouch, the young when attached to the nipples being concealed by the long hair of the abdomen. Vertebrae: C. 7, D. 13, L. 6, S. 3, Ca. 23.



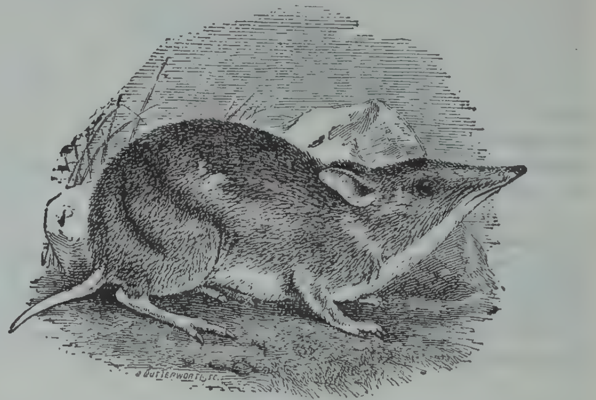
From Gould.

FIG. 4.—The Marsupial or Banded Ant-eater (*Myrmecobius fasciatus*).

The single species, which is a native of western and southern Australia, is about the size of an English squirrel, to which its long bushy tail gives it some resemblance; but it lives entirely on the ground, especially in sterile sandy districts, feeding on ants. Its prevailing colour is chestnut-red, but the hinder part of the back is marked with broad, white, transverse bands on a dark ground.

With the bandicoots, or *Peramelidae*, we come to a family of polyprotodonts which resemble the diprotodonts in the peculiarly specialized structure of their hind limbs; an adaptation which we must apparently regard as having been independently acquired in the two groups. The dentition is i. $\frac{5}{3}$, c. $\frac{1}{1}$, p. $\frac{4}{4}$, m. $\frac{3}{3}$; total, 48; the upper incisors being small, with short, broad crowns; the lower incisors moderate, narrow, proclivous; canines well developed. Premolars compressed, pointed; and the molars with quadrate tuberculated crowns. Deciduous premolar preceded by a minute molariform tooth, which remains in place until the animal is nearly full grown. Fore feet with two or three of the middle toes of nearly equal size, and provided with strong, sharp, slightly curved claws, the other toes rudimentary. Hind feet long and narrow; the first toe rudimentary or absent; the second and third very slender and united in a common integument; the fourth very large, with a stout elongated conical claw; the fifth smaller than the fourth (see fig. 6). The terminal phalanges of the large toes of both feet cleft at their extremities. Head elongated, with the muzzle long, narrow and pointed. Stomach simple. Caecum of moderate size. Pouch complete, generally opening backwards. Alone among marsupials bandicoots have no clavicles. More remarkable still is the development of a small allantoic placenta.

In the true bandicoots of the genus *Perameles* (fig. 5) the fore-feet have the three middle toes well developed, the third slightly larger than the second, the fourth somewhat shorter, provided with long, strong, slightly curved, pointed claws. First and fifth toes very short and without claws. Hind feet with one or two phalanges, in the first toe forming a distinct tubercle visible externally; the second and third toes very slender, of equal length, joined as far as the terminal phalange, but with distinct claws; the fifth intermediate in length between these and the largely developed fourth toe. Ears of moderate or small size, ovate, pointed. Tail rather short, clothed with short depressed hairs. Fur short and harsh. Pouch opening backwards. Vertebrae: C. 7, D. 13, L. 6, S. 1, Ca. 17. (see BANDICOOT.)



From Gould.

FIG. 5.—Gunn's Bandicoot (*Perameles gunni*).

The rabbit-bandicoot, *Peragale* (or *Thylacomys*) represents a genus in which the cheek-teeth are curved, with longer crowns and shorter roots than in the last. Hind extremities proportionally longer with inner toe represented only by a small metatarsal bone. Muzzle much elongated and narrow. Fur soft and silky. Ears very large, long and pointed. Tail long, its apical half-clothed on the dorsal surface with long hairs. Pouch opening forwards. Vertebrae: C. 7, D. 13, L. 6, S. 2, Ca. 23.

The one species, from Western Australia, is the largest member of the family, being about the size of a rabbit, to which it bears sufficient superficial resemblance to have acquired the name of "native rabbit" from the colonists. It burrows in the ground, but in other respects resembles bandicoots in habits.

In the pig-footed bandicoot (*Choeropus castanotis*) the dentition generally resembles that of *Perameles*, but the canines are less developed, and in the upper jaw two-rooted. Limbs very slender; posterior nearly twice the length of the anterior. Fore feet with the functional toes reduced to two, the second and third, of equal length, with closely united metacarpals and short, sharp, slightly curved, compressed claws. First toe represented by a minute rudiment of a metacarpal bone; the fourth by a metacarpal and two small phalanges without a claw, and not reaching the middle of the metacarpal of the third; fifth entirely absent. Hind foot long and narrow, mainly composed of the strongly developed fourth toe, terminating in a conical pointed nail, with a strong pad behind it; the first toe represented by a rudimentary metatarsal; the remaining toes completely developed, with claws, but exceedingly slender; the united second and third reaching a little way beyond the metatarso-phalangeal articulation of the fourth; the fifth somewhat shorter. Tail not quite so long as the body, and covered with short hairs. Ears large and pointed, and folded down when the animal is at rest. Fur soft and loose. Pouch opening backwards. Vertebrae: C. 7, D. 13, L. 6, S. 1, Ca. 20.

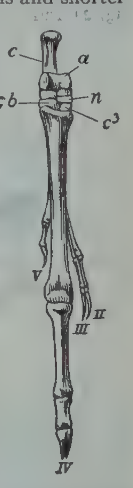
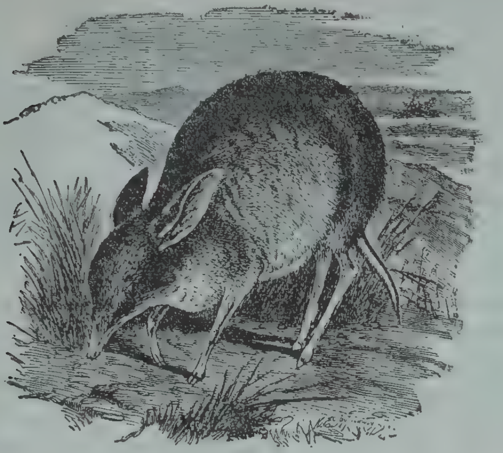


FIG. 6.—Skeleton of Hind Foot of *Choeropus castanotis*.

c, calcanium; *a*, astralagus; *cb*, cuboid; *n*, navicular; *c*³, ectocuneiform; II. and III. the conjoined second and third digits; IV. the large and only functional digit; V. the rudimentary fifth digit.

The only species of this genus is about the size of a small rat, found in the interior of Australia. Its general habits and food appear to resemble those of other bandicoots. A separate family, *Notoryctidae*, is represented by the marsupial mole (*Notoryctes typhlops*), of the deserts of south Central Australia, a silky, golden-haired, burrowing creature, with a curious leathery muzzle, and a short, naked stumpy tail. The limbs are five-toed, with the third and fourth toes of the front pair armed with enormous digging claws;

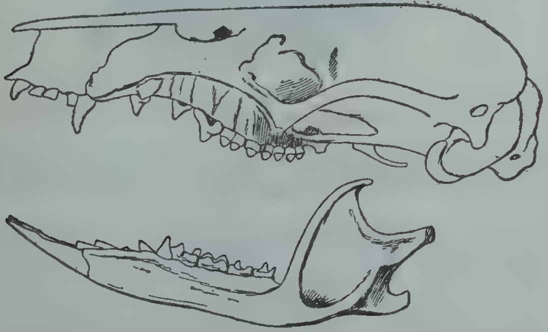
there are no external ear-conchs; and the dentition includes four pairs of upper, and three of lower, incisors, and distinctly tritubercular cheek-teeth. The small pouch, supported by the usual epipubic bones, opens backwards. In correlation with its burrowing habits, some of the vertebrae of the neck and of the loins are respectively welded together. The eyes have degenerated to a greater extent than those of any other burrowing mammal, the retina being reduced to a mass of simple cells, and the cornea and sclerotic ("white") to a pear-shaped fibrous capsule enclosing a ball of pigment. The reason for this extreme degeneration is probably to be found in the sandy nature of the soil in which the creature burrows, a substance which would evidently irritate and inflame any functional remnant of an eye. The portion of the lachrymal duct communicating with the cavity of the nose has, on the other hand, been abnormally developed, apparently for the purpose of cleansing that chamber from particles of sand which may obtain an entrance while the animal is burrowing. (See MARSUPIAL MOLE.)



From Gould.

FIG. 7.—The Pig-footed Bandicoot (*Choeropus castanotis*).

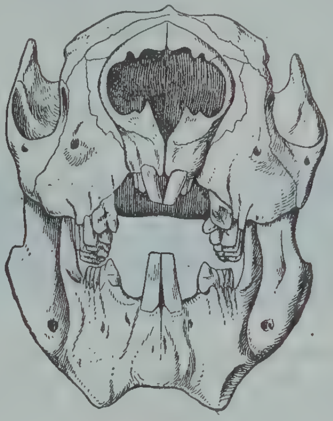
2. *Paucituberculates.*—The second suborder of marsupials, the Paucituberculata, is exclusively South American, and typically represented by the family *Epanorthidae*, the majority of the members of which are extinct, their remains being found in the probably Miocene Santa Cruz beds of Patagonia, although one existing genus (*Caenolestes*) survives in Ecuador and Colombia. One of the two living species was, indeed, described so long ago as the year 1863, under the preoccupied name of *Hyracodon*, but attracted little or no attention, as its affinities were not fully recognized. Externally *Caenolestes* has a shrew-like appearance. The elongated skull (fig. 8) has four pairs of upper incisors and long upper canines, while in the lower jaw there is a single pair of procumbent incisors, followed by several small teeth representing the canine and earlier premolars. The three pairs of molars in each jaw are, like the last premolar, quadritubercular oblong teeth. The five-toed feet are of normal structure, and the rat-like tail is prehensile towards the tip. The female has a small pouch. The extinct members of the family are represented by the genera *Epanorthus*, *Acdestis*, *Garzonia*, &c. In a second family—*Abderitidae*—also from the Patagonian Miocene, the penultimate premolar is developed into an enormous tooth, with a tall, secant and grooved crown, somewhat after the fashion of the enlarged premolar of *Plagiaulax*. From the structure of the skull, it is thought probable that *Abderites* had an elongated snout, like that of many Insectivora. As a sub-order, the Paucituberculata are characterized by the presence of four pairs of upper and three of lower incisor teeth; the enlargement and forward inclination of the first pair of lower incisors, and the presence of four or five sharp cusps on the cheek-teeth, coupled with the absence of "syndactylism" in the hind limbs.



After Thomas.

FIG. 8.—Skull of *Caenolestes obscurus*.

3. *Diprotodonts.*—The third and last sub-order of marsupials is the Diprotodontia, which is exclusively Australasian and includes the wombats, koala, cuscuses, kangaroos and their relatives. There are never more than three pairs of upper and one of lower incisors, of which the middle upper and the single lower pair are large and chisel-like (fig. 9); the canines are small or absent; the cheek-teeth have bluntly tuberculate or transversely-ridged crowns in most cases; and the hind-feet are syndactylous. With one exception, the intestine has a caecum, and the pouch is large and opens forwards. It should be added that Professor Elliot Smith has pointed out a certain peculiarity in its commissures whereby the brain of the diprotodonts differs markedly from that of the polyprotodonts and approximates to the placental type. Dr Einar Lönnberg has also recorded certain adaptive peculiarities in the stomach. Most of the species, particularly the specialized types, are more or less completely herbivorous.



From Flower, *Quart. Journ. Geol. Soc.*

FIG. 9.—Front view of Skull of the Koala (*Phascolarctus cinereus*) to exhibit Diprotodont type of dentition.

The first family, *Phascolomyidae*, is typified by the wombats; but according to the view adopted by Mr H. Winge, and endorsed by Professor Max Weber, is also taken to include the koala. In this wider sense the family may be characterized as follows. The tympanic process of the alisphenoid bone of the skull is short, not covering the cavity of the tympanum, nor reaching the paroccipital process. The tail is rudimentary, the first hind-toe opposable, the first pair of upper incisors very large, but the second and third either absent or small and placed partially behind the larger pair; and only five pairs of cheek-teeth in each jaw. The stomach has a cardiac gland, and the number of teats is two.

In the wombats (*Phascolomys*) the dentition is i. $\frac{1}{1}$, c. $\frac{0}{0}$, p. + m. $\frac{5}{5}$, total 24; all the teeth growing from persistent pulps, and the incisors large and chisel-like, with enamel only on the front surface. The cheek-teeth strongly curved, forming from the base to the summit about a quarter of a circle, the concavity being directed outwards in the upper and inwards in the lower teeth. The first of the series (which appears to have no predecessor) single-lobed; the other four composed of two lobes, each subtriangular in section. Limbs equal, stout and short. Fore-feet with five distinct toes, each furnished with a long, strong and slightly curved nail, the first and fifth considerably shorter than the other three. Hind-feet with a very short nail-less first toe, the second, third and fourth toes partially united by integument, of nearly equal length, the fifth distinct and rather shorter; all four with long and curved nails. In the skeleton the second and third toes are distinctly more slender than the fourth, showing a tendency towards the character so marked in the following families. Tail rudimentary. Caecum very short and wide, with a vermiform appendage (see WOMBAT).

In addition to remains referable to the existing genus, the Pleistocene deposits of Australia have yielded evidence of an extinct giant wombat constituting the genus *Phascolonus* (*Sceparnodon*).

The koala, or "native bear" (*Phascolarctus cinereus*), which differs widely from the wombats in its arboreal habits, is less specialized as regards its dentition, of which the formula is i. $\frac{3}{1}$, c. $\frac{1}{0}$, p. + m. $\frac{5}{5}$, total 30. Upper incisors crowded together, cylindroidal, the first much larger than the others, with a bevelled cutting edge (fig. 9). Canine very small; a considerable interval between it and the first premolar, which is as long from before backwards but not so broad as the molars, and has a cutting edge, with a smaller parallel inner ridge. The molar-like teeth slightly diminishing in size from the first to the fourth, with square crowns, each bearing four pyramidal cusps. The lower incisors are partially inclined forwards, compressed and tapering, bevelled at the ends. Cheek-teeth in continuous series, as in the upper jaw. Fore-feet with the two inner toes slightly separated from and opposable to the remaining three, all with strong curved and much compressed claws. Hind-foot (fig. 10) with the first toe placed far back, large and broad, the second and third (united) toes considerably smaller than the other two; the fourth the largest. No external tail. Fur dense and woolly. Ears of moderate size, thickly clothed with long hair. Caecum very long and dilated, with numerous folds. Vertebrae: C. 7, D. 11, L. 8, S. 2, Ca. 8. Ribs eleven pairs (see KOALA).

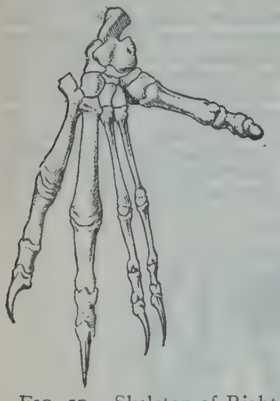
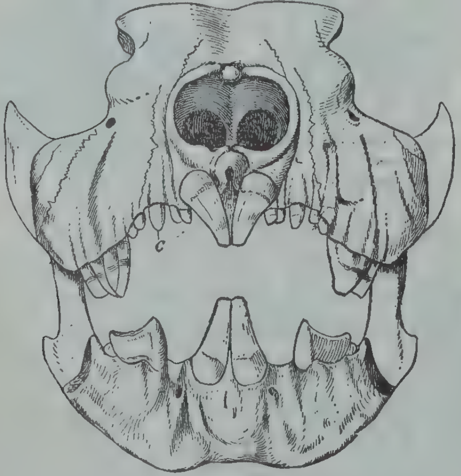


FIG. 10.—Skeleton of Right Hind-Foot of Koala (*Phascolarctus cinereus*), showing stout opposable hallux, followed by two slender toes, which in the living animal are enclosed as far as the nails in a common integument.

Here may be noticed three genera of large extinct marsupials from the Pleistocene of Australia whose affinities appear to ally them to the wombat-group on the one hand and to the phalangers on the other. The longest known is *Diprotodon*, an animal of the size of a rhinoceros, with a dental formula of i. $\frac{3}{1}$, c. $\frac{0}{0}$, p. $\frac{1}{1}$, m. $\frac{4}{4}$, total 28. The first upper incisor very large and chisel-like, molars with prominent transverse ridges, as in *Macropus*, but without the longitudinal connecting ridge. Complete skeletons disinterred by Dr E. C. Stirling indicate that in the structure of the feet this creature presents resemblances both to the wombats and the phalangers, but is nearer to the former than to the latter. On the other hand, the considerably smaller *Nototherium*, characterized by its sharp and broad skull and smaller incisors, seems to have been much more wombat-like, and may perhaps have possessed similar burrowing habits.

The last of the three is *Thylacoleo carnifex*, so named on account of its supposed carnivorous habits. In the adult the dentition (fig. 11) is i. $\frac{3}{1}$, c. $\frac{1}{0}$, p.+m. $\frac{4}{3}$, total 24. The first upper incisor is much larger than the others; canine and first two premolars rudimentary. In the lower jaw there are also one or two small and early deciduous premolars; third premolars of both jaws formed on the same type as that of the rat-kangaroos, but relatively much larger; molars rudimentary, tubercular. The functional teeth are reduced to one pair of large cutting incisors situated close to the middle line, and one great, cutting, compressed premolar, on each side above and below. As already mentioned, *Thylacoleo* was originally regarded as a carnivorous creature, but this view was subsequently disputed, and its diet supposed to consist of soft roots, bulbs and fruits, with an occasional small bird or mammal. Recently, however, the pendulum of opinion has swung back towards the original view: and Dr R. Broom believes *Thylacoleo* to have been "a purely carnivorous animal, and one which would be quite able to, and probably did, kill animals as large or larger than itself." The affinities of the creature are clearly with the phalangers.

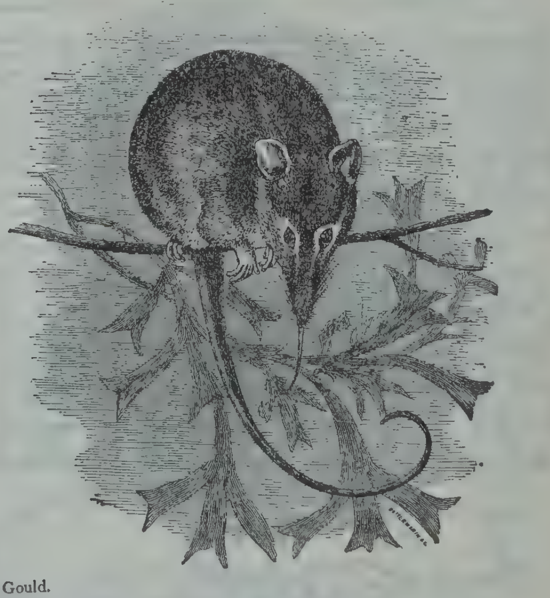


From Flower, *Quart. Journ. Geol. Soc.*

FIG. 11.—Front view of Skull of *Thylacoleo carnifex*, restored.

By means of the little musk-kangaroo, the cuscuses and phalangers constituting the family *Phalangeridae*, are so closely connected with the kangaroos, or *Macropodidae*, that in the opinion of some naturalists they ought all to be included in a single family, with three sub-families. Theoretically, no doubt, this is correct, but the typical members of the two groups are so different from one another that, as a matter of convenience, the retention of the two families seems advisable. From the *Phascolomyidae*, the two families, which may be collectively designated Phalangeroidea, differ by the circumstance that in the skull the tympanic process of the alisphenoid covers the tympanic cavity and reaches the paroccipital process. The tail is long and in some cases prehensile; the first hind-toe may be either large, small or absent; the dentition usually includes three pairs of upper and one of lower incisors, and six or seven pairs of cheek-teeth in each jaw; the stomach is either simple or sacculated, without a cardiac gland; and there are four teats.

With the exception of the aberrant long-snouted phalanger, the members of the family *Phalangeridae* have the normal number of functional incisors, in addition to which there may be one or two rudimentary pairs in the lower jaw. The first in the upper jaw is strong, curved and cutting, the other two generally somewhat smaller; the single lower functional incisor large, more or less inclined forwards; canines $\frac{1}{1 \text{ or } 0}$, upper small or moderate, conical and sharp-pointed; lower absent or rudimentary; premolars variable; molars $\frac{3}{3}$, or $\frac{2}{2}$, with four obtuse tubercles, sometimes forming crescents. Limbs subequal. Fore-feet with five distinct subequal toes with claws. Hind-feet short and broad, with five well-developed toes; the first large, nailless and opposable; the second and third slender and united by a common integument as far as the claws. Caecum present (except in *Tarsipes*), and usually large. The lower jaw has no pocket on the outer side. All are animals of small or moderate size and arboreal habits, feeding on a vegetable or mixed diet, and inhabiting Australia, Papua and the Moluccan Islands.



From Gould.

FIG. 12.—The Long-snouted Phalanger (*Tarsipes rostratus*).

As the first example of the group may be taken the elegant little long-snouted phalanger (*Tarsipes rostratus*, fig. 12), a west Australian creature of the size of a mouse, which may be regarded as representing by itself a sub-family (*Tarsipediinae*), characterized by the rudimentary teeth, the long and extensile tongue, and absence of a caecum. The head is elongated, with a slender muzzle and the mouth-opening small. The two lower incisors are long, very slender, sharp-pointed and horizontally placed. All the other teeth are simple, conical, minute and placed at considerable and irregular intervals apart in the jaws, the number appearing to vary in different individuals and even on different sides of the jaw of the same individuals. The formula in one specimen was i.$\frac{2-2}{1-1}$, c.$\frac{1-1}{0-0}$, p.+m.$\frac{3-4}{2-3}$; total 20. The lower jaw is slender, nearly straight, and without a coronoid process or inflected angle. Fore-feet with five well-developed toes, carrying small, flat, scale-like nails, not reaching the extremity of the digits. Hind-feet rather long and slender, with a well-developed opposable and nailless first toe;

second and third digits united, with sharp, compressed curved claws; the fourth and fifth free, with small flat nails. Ears of moderate size and rounded. Tail longer than the body and head, scantily clothed with short hairs, prehensile. Vertebrae: C. 7, D. 13, L. 5, S. 3, Ca. 24.

As indicated in the accompanying illustration, the long-snouted phalanger is arboreal in habits, extracting honey and probably small insects from long-tubed flowers by means of its extensile tongue.

The remaining members of the family may be included in the sub family *Phalangerinae*, characterized by the normal nature of the dentition (which shows rudimentary lower canines) and tongue. Cuscuses and phalangers form a numerous group, all the members of which are arboreal, and some of which are provided with lateral expansions of skin enabling them to glide from tree to tree like flying-squirrels. The typical members of the group are the cuscuses (*Phalanger*), ranging from the Moluccas and Celebes to New Guinea, in which the males are often different in colour from the females. The true phalangers, or opossums of the colonists, constitute the genus *Trichosurus*, while the ring-tailed species are known as *Pseudochirus*; the latter ranging to New Guinea. *Dactylopsila* is easily recognized by its attenuated fourth finger and parti-coloured fur; the flying species are classed as *Petauroides*, *Petaurus*, *Gymnobelideus* and *Acrobates*, the last no larger than a mouse; while *Dromicia*, *Distaechurus* and *Acrobates* are allied types without parachutes (see PHALANGER).

An equally brief notice must suffice of the kangaroo tribe or *Macropodidae*, since these receive a special notice elsewhere. The dentition is i. $\frac{3}{1}$, c. $\frac{0 \text{ or } 1}{0}$, p. $\frac{3}{3}$, m. $\frac{3}{3}$; the incisors being sharp and cutting, and those of the lower jaw frequently having a scissor-like action against one another. The broad molars are either bluntly tuberculated or transversely ridged; the outer side of the hind part of the lower jaw has a deep pocket; and the hind-limbs are generally very long, with the structure of the foot similar to that of the bandicoots. The family is connected with the *Phalangeridae* by means of the musk-kangaroo (*Hypsiprymnodon moschatus*); forming the sub-family *Hypsiprymnodontinae*. Then come the rat-kangaroos, or kangaroo-rats, constituting the sub-family *Potoroinae*; while the tree-kangaroos (*Dendrolagus*), rock-wallabies (*Petrogale*), and wallabies and kangaroos (*Macropus*) form the *Macropodinae* (see KANGAROO).

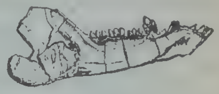
Extinct Marsupials

Reference has been made to the Australasian Pleistocene genera *Phascolonus*, *Diprotodon*, *Nototherium* and *Thylacoleo*, whose affinities are with the wombats and phalangers. The same deposits have also yielded remains of extinct types of kangaroo, some of gigantic size, constituting the genera *Sthenurus*, *Procoptodon* and *Palorchestes*. Numerous types more or less nearly allied to the phalangers, such as *Burramys* and *Triclis* have also been described, as well as a flying form, *Palaeopetaurus*. It is also interesting to note that fossil remains indicate the former occurrence of thylacines and Tasmanian devils on the Australian mainland. Of more interest is the imperfectly known *Wynyardia*, from older Tertiary beds in Tasmania, which apparently presents points of affinity both to phalangers and dasyures. From the Oligocene deposits of France and southern England have been obtained numerous remains of opossums referable to the American family *Didelphyidae*. These ancient opossums have been separated generically from *Didelphys* (in its widest sense) on account of certain differences in the relative sizes of the lower premolars, but as nearly the whole of the species have been formed on lower jaws, of which some hundreds have been found, it is impossible to judge how far these differences are correlated with other dental or osteological characters. In the opinion of Dr H. Filhol, the fossils themselves represent two genera, *Peratherium*, containing the greater part of the species, about twenty in number, and *Amphiperatherium*, with three species only. All are comparatively small animals, few of them exceeding the size of a rat.

Besides these interesting European fossils, a certain number of didelphian bones have been found in the caves of Brazil, but these are either closely allied to or identical with the species now living in the same region.

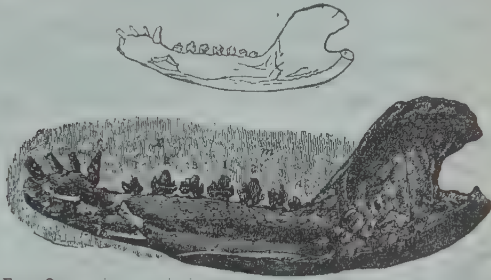
The occurrence in the Santa Cruz beds of Patagonia of fossil marsupials allied to the living *Caenolestes* has been mentioned above. The alleged occurrence in the same beds of marsupials allied to the thylacine is based on remains now more generally regarded as referable to the creodont carnivores (see CREODONTA).

Mesozoic Mammals.—Under the heading of MULTITUBERCULATA will be found a brief account of certain extinct mammals from the Mesozoic formations of Europe and North America which have been regarded as more or less nearly related to the monotremes. The same deposits have yielded remains of small mammals whose dentition approximates more nearly to that of either polyprotodont marsupials or insectivores; and these may be conveniently noticed here without prejudice to their true affinities. Before proceeding further it may be mentioned that the remains of many of these mammals are very scarce, even in formations apparently in every way suitable to the preservation of such fossils, and it hence seems probable that these creatures are stragglers from a country where primitive small mammals were abundant. Not improbably this country was either "Gondwana-land," connecting Mesozoic India with Africa, or perhaps Africa itself. At any rate, there seems little doubt that it was the region where creodonts and other primitive mammals were first differentiated from their reptilian ancestors.



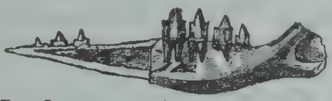
From Owen.

FIG. 13.—Lower Jaw of *Triconodon mordax* (nat. size).



From Owen.

FIG. 14.—Lower Jaw and Teeth of *Phascolotherium bucklandi* (nat. size in outline).

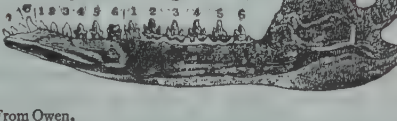


From Owen.

FIG. 15.—*Spalacotherium tricuspidens* Purbeck beds.

Of the Old World forms, the family *Triconodontidae* is typified by the genus *Triconodon*, from the English Purbeck, in which the cheek-teeth carry three cutting cusps arranged longitudinally. There seems to have been a replacement of some of these teeth; and it has been suggested that this was of the marsupial type. To the same family are referred *Phascolotherium* (fig. 14), of the Lower Jurassic Stonesfield slate of England, and *Spalacotherium* (fig. 15), of the Dorsetshire Purbeck; the latter having the three cusps of the cheek-teeth rotated so as to assume a tritubercular type. Other genera are *Menacodon* and *Priacodon*, the former American, and the latter common to Europe and North America. By one authority *Amphilestes* (fig. 16), of the Stonesfield Slate, is included in the same group, while by a second it is regarded as representing a family by itself. *Amphitherium*, of the Stonesfield Slate, typifies the family *Amphitheriidae*, which includes the American *Dryolestes*, and in which some would class the European Purbeck genus *Amblotherium*, although Professor H. F. Osborn has made the last the type of a distinct family. Yet another family, according to the palaeontologist last named, is typified by the genus *Stylacodon*, of the English Purbeck. To mention the other forms which have received names will be unnecessary on this occasion.

It will be observed from the figures of the lower jaws, which are in most cases the only parts known, that in many instances the number of cheek-teeth exceeds that found in modern marsupials except *Myrmecobius*. The latter has indeed been regarded as the direct descendant of these Mesozoic forms; but as already stated, in the opinion of Mr B. A. Bensley, this is incorrect. It may be added that the division of these teeth into premolars and molars in figs. 14 and 16 is based upon the view of Sir R. Owen, and is not altogether trustworthy, while the restoration of some of the missing teeth is more or less conjectural. As regards the affinities of the creatures to which these jaws belonged, Professor Osborn has referred the *Triconodontidae* and *Amphitheriidae*, together with the *Curtodontidae* (as represented by the English Purbeck *Curtodon*), to a primitive group of marsupials, while he has assigned the *Amblotheriidae* and *Stylacodontidae* to an ancestral assemblage of Insectivora. On the other hand, in the opinion of Professor H. Winge, a large number of these creatures are primitive monotremes. Besides the above, in the Trias of North America we have *Dromotherium* and *Microconodon*, extremely primitive forms, representing the family



From Owen.

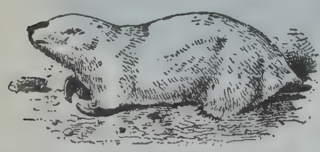
FIG. 16.—Lower Jaw and Teeth of *Amphilestes broderipi*.

Dromotheriidae, and apparently showing decided traces of reptilian affinity. It may be added that a few traces of mammals have been obtained from the English Wealden, among which an incisor tooth foreshadows the rodent type.

AUTHORITIES.—The above article is partly based on that by Sir W. H. Flower in the 9th edition of this work. See also O. Thomas, Catalogue of Monotremata and Marsupialia in the British Museum (1888); "On *Caenolestes*, a Survivor of the *Epanorthidae*," *Proc. Zool. Soc. London* (1895); J. D. Ogilby, Catalogue of Australian Mammals (Sydney, 1895); B. A. Bensley, "A Theory of the Origin and Evolution of the Australian Marsupialia," *American Naturalist* (1901); "On the Evolution of the Australian Marsupialia, &c.," *Trans. Linn. Soc.* (vol. ix., 1903); L. Dollo, "Arboreal Ancestry of Marsupials," *Miscell. Biologiques* (Paris, 1899); B. Spencer, "Mammalia of the Horn Expedition" (1896); "Wynyardia, a Fossil Marsupial from Tasmania," *Proc. Zool. Soc. London* (1900); J. P. Hill, "Contributions to the Morphology of the Female Urino-genital Organs in Marsupialia," *Proc. Linn. Soc. N. S. Wales*, vols. xxiv. and xxv.; "Contributions to the Embryology of the Marsupialia," *Quart. Journ. Micr. Science*, vol. xliii.; E. C. Stirling, "On *Notoryctes typhlops*," *Proc. Zool. Soc. London* (1891); "Fossil Remains of Lake Cadibona," Part I. *Diprotodon, Mem. R. Soc. S. Australia* (vol. i., 1889); R. Broom, "On the Affinities of *Thylacoleo*," *Proc. Linn. Soc. N. S. Wales* (1898); H. F. Osborn, "Mesozoic Mammalia," *Journ. Acad. Nat. Sci. Philadelphia* (vol. ix., 1888); E. S. Goodrich, "On the Fossil Mammalia from the Stonesfield Slate," *Quart. Journ. Micr. Science* (vol. xxxv., 1894).

(R. L.*)

MARSUPIAL MOLE (*Notoryctes typhlops*), the "Ur-quamata" of the natives, an aberrant polyprotodont from central South Australia, constituting a family (*Notoryctidae*). This is a small burrowing animal, of a pale golden-yellow colour, with long silky hair, a horny shield on the nose, and a stumpy leathery tail. The feet are five-toed, and the third and fourth toes of the front pair armed with enormous claws adapted for digging. Neither ear-conches nor eyes are visible externally. There are but three pairs of incisor teeth in each jaw, and the upper molars are tricuspid. This animal spends most of its time burrowing in the sand in search of insects and their larvae, but occasionally makes its appearance on the surface.



Marsupial Mole (*Notoryctes typhlops*).

MARSUS, DOMITIUS, Latin poet, the friend of Virgil and Tibullus, and contemporary of Horace. He survived Tibullus (d. 19 B.C.), but was no longer alive when Ovid wrote (*c.* A.D. 12) the epistle from Pontus (*Ex Ponto*, iv. 16) containing a list of poets. He was the author of a collection of epigrams called *Cicuta* ("hemlock")[1] from their bitter sarcasm, and of a beautiful epitaph on the death of Tibullus; of elegiac poems, probably of an erotic character; of an epic poem *Amazonis*; and of a prose work on wit (*De urbanitate*). Martial often alludes to Marsus as one of his predecessors, but he is never mentioned by Horace, although a passage in the *Odes* (iv. 4, 19) is supposed to be an indirect allusion to the *Amazonis* (M. Haupt, *Opuscula*, iii. 332).

See J. A. Weichert, *Poetarum latinorum vitae et reliquiae* (1830); R. Unger, *De Dom. Marsi cicuta* (Friedland, 1861).

MARSYAS, in Greek mythology, a Phrygian god or Silenus, son of Hyagnis. He was originally the god of the small river of the same name near Celaenae, an old Phrygian town. He represents the art of playing the flute as opposed to the lyre—the one the accompaniment of the worship of Cybele, the other that of the worship of Apollo. According to the legend, Athena, who had invented the flute, threw it away in disgust, because it distorted the features. Marsyas found it, and having acquired great skill in playing it, challenged Apollo to a contest with his lyre. Midas, king of Phrygia, who had been appointed judge, declared in favour of Marsyas, and Apollo punished Midas by changing his ears into ass's ears. In another version, the Muses were judges and awarded the victory to Apollo, who tied Marsyas to a tree and flayed him alive. Marsyas, as well as Midas and Silenus, are associated in legend with Dionysus and belong to the cycle of legends of Cybele. A statue of Marsyas was set up in the Roman forum and colonies as a symbol of liberty. The contest and punishment of Marsyas were favourite subjects in Greek art, both painting and sculpture. In Florence there are several statues of Marsyas hanging on the tree as he is going to be flayed (see GREEK ART, fig. 54, Pl. II.); Apollo and the executioner complete the group. In the Lateran museum at Rome there is a statue representing Marsyas in the act of picking up the flute, a copy of a masterpiece by Myron (Hyginus, *Fab.* 167, 191; Apollodorus i. 4, 2; Ovid, *Metam.* vi. 382–400, xi. 145–193), for which see GREEK ART, fig. 64 (Pl. III.).

MARTABAN, a town in the Thaton district of Lower Burma, on the right bank of the Salween, opposite Moulmein. It is said to have been founded in A.D. 573, by the first king of Pegu, and was once the capital of a powerful Talaing kingdom; but it is now little more than a village. Martaban is frequently mentioned by European voyagers of the 16th century; and it has given the name of "Martavans" to a class of large vessels of glazed pottery, also known in India as "Pegu jars." It was twice captured by the British, in 1824 and 1852. The Bay of Martaban receives the rivers Irrawaddy and Salween.

MARTELLO TOWER, a kind of tower formerly used in English coast defence. The name is a corruption of Mortella. The Martello tower was introduced in consequence of an incident of the French revolutionary wars. In September 1793 a British squadron of three ships of the line and two frigates was ordered to support the Corsican insurgents. It was determined in the first place to take a tower on Cape Mortella which commanded the only secure anchorage in the Gulf of San Fiorenzo. This tower, according to James, was named "after its inventor"; but the real derivation appears to be the name of a wild myrtle which grew thickly around. The tower, which mounted one 24-pounder and two 18-pounders on its top, was bombarded for a short time by the frigates, was then deserted by its little garrison, and occupied by a landing party. The tower was afterwards retaken by the French from the Corsicans. So far it had done nothing to justify its subsequent reputation. In 1794, however, a fresh attempt was made to support the insurgents. On the 7th of February 1400 troops were landed, and the tower was attacked by land and sea on the 8th. The "Fortitude" and "Juno" kept up a cannonade for 2½ hours and then hauled off, the former being on fire and having sixty-two men killed and wounded. The fire from the batteries on shore produced no impression until a hot shot set fire to the "bass junk with which, to the depth of 5 ft., the immensely thick parapet was lined." The garrison of thirty-three men then surrendered. The armament was found to consist only of two 18-pounders and one 6-pounder. The strong resistance offered by these three guns seems to have led to the conclusion that towers of this description were specially formidable, and Martello towers were built in large numbers, and at heavy expense, along the shores of England, especially on the southern and eastern coasts, which in certain parts are lined with these towers at short intervals. They are structures of solid masonry, containing vaulted rooms for the garrison, and providing a platform at the top for two or three guns, which fire over a low masonry parapet. Access is provided by a ladder, communicating with a door about 20 ft. above the ground. In some cases a deep ditch is provided around the base. The chief defect of the tower was its weakness against vertical fire; its masonry was further liable to be cut through by breaching batteries. The French *tours modèles* were somewhat similar to the Martello towers; their chief use was to serve as keeps to unrevetted works. While the Martello tower owes its reputation and its widespread adoption in Great Britain to a single incident of modern warfare, the round masonry structure entered by a door raised high above the base is to be found in many lands, and is one of the earliest types of masonry fortification.

MARTEN, HENRY (1602–1680), English regicide, was the elder son of Sir Henry Marten, and was educated at University College, Oxford. As a public man he first became prominent in 1639 when he refused to contribute to a general loan, and in 1640 he entered parliament as one of the members for

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[1] According to others, a reed-pipe made of the stalks of hemlock; the reading *scutica* ("whip") has also been proposed.

Berkshire. In the House of Commons he joined the popular party, spoke in favour of the proposed bill of attainder against Strafford, and in 1642 was a member of the committee of safety. Some of his language about the king was so frank that Charles demanded his arrest and his trial for high treason. When the Great Rebellion broke out Marten did not take the field, although he was appointed governor of Reading, but in parliament he was very active. On one occasion his zeal in the parliamentary cause led him to open a letter from the earl of Northumberland to his countess, an impertinence for which, says Clarendon, he was "cudgelled" by the earl; and in 1643, on account of some remark about extirpating the royal family, he was expelled from parliament and was imprisoned for a few days. In the following year, however, he was made governor of Aylesbury, and about this time took some small part in the war. Allowed to return to parliament in January 1646, Marten again advocated extreme views. He spoke of his desire to prepare the king for heaven; he attacked the Presbyterians, and, supporting the army against the parliament, he signed the agreement of August 1647. He was closely associated with John Lilburne and the Levellers, and was one of those who suspected the sincerity of Cromwell, whose murder he is said personally to have contemplated. However, he acted with Cromwell in bringing Charles I. to trial; he was one of the most prominent of the king's judges and signed the death warrant. He was then energetic in establishing the republic and in destroying the remaining vestiges of the monarchical system. He was chosen a member of the council of state in 1649, and as compensation for his losses and reward for his services during the war, lands valued at £1000 a year were settled upon him. In parliament he spoke often and with effect, but he took no part in public life during the Protectorate, passing part of this time in prison, where he was placed on account of his debts. Having sat among the restored members of the Long Parliament in 1659, Marten surrendered himself to the authorities as a regicide in June 1660, and with some others he was excepted from the act of indemnity, but with a saving clause. He behaved courageously at his trial, which took place in October 1660, but he was found guilty of taking part in the king's death. Through the action, or rather the inaction of the House of Lords, he was spared the death penalty, but he remained a captive, and was in prison at Chepstow Castle when he died on the 9th of September 1680. Although a leading Puritan, Marten was a man of loose morals. He wrote and published several pamphlets, and in 1662 there appeared *Henry Marten's Familiar Letters to his Lady of Delight*, which contained letters to his mistress, Mary Ward.

Marten's father, Sir Henry Marten (*c.* 1562–1641), was born in London and was educated at Winchester school and at New College, Oxford, becoming a fellow of the college in 1582. Having become a barrister, he secured a large practice and soon came to the front in public life. He was sent abroad on some royal business, was made chancellor of the diocese of London, was knighted, and in 1617 became a judge of the admiralty court. Later he was appointed a member of the court of high commission and dean of the arches. He became a member of parliament in 1625, and in 1628 represented the university of Oxford, taking part in the debates on the petition of right.

See J. Forster, *Statesmen of the Commonwealth* (1840); M. Noble, *Lives of the English Regicides* (1798); the article by C. H. Firth in *Dict. Nat. Biog.* (1893); and S. R. Gardiner, *History of the Great Civil War* and *History of the Commonwealth and Protectorate*.

MARTEN,[1] a name originally belonging to the pine-marten (*Mustela martes*), but now applied to all members of the same genus of carnivorous mammals (see CARNIVORA). Martens are limited to the northern hemisphere, ranging throughout the greater part of the northern temperate regions of both Old and New Worlds, and southwards in America to 35° N. lat., while in Asia one species is met with in Java.

The species appear to be similar in their habits. They live in woods and rocky places, and spend most of their time in trees, although descending to the ground in quest of prey. They climb with great facility, and are agile and graceful in their movements. Some are said occasionally to resort to berries and other fruit for food, but as a rule they are carnivorous, feeding chiefly on birds and their eggs, small mammals, as squirrels, hares, rabbits and moles, but chiefly mice of various kinds, and occasionally snakes, lizards and frogs. In proportion to their size they are among the most bloodthirsty of animals, though less so than the weasels. The female makes her nest of moss, dried leaves and grass in the hollow of a tree, but sometimes in a hole among rocks or ruined buildings, and produces several young at a birth, usually from four to six. Though wild and untameable to a great degree if captured when fully grown, if taken young they are docile, and have frequently been made pets, not having the strong unpleasant odour of the smaller *Mustelidae*. The pine-marten appears to have been partially domesticated by the Greeks and Romans, and used to keep houses clear from rats and mice. In the same way, according to Brian Hodgson, the yellow-bellied weasel (*Putorius kathia*) "is exceedingly prized by the Nepalese for its service in ridding houses of rats. It is easily tamed; and such is the dread of it common to all murine animals that not one will approach a house where it is domiciled." It is, however, to the great value attached to the pelts of these animals that their importance to man is chiefly due. Though all yield fur of serviceable quality, the commercial value varies immensely, not only according to the species from which it is obtained, but according to individual variation, depending upon age, sex, season, and other circumstances. The skins from northern regions are more full and of a finer colour and gloss than those from more temperate climates, as are those of animals killed in winter compared to the same individuals in summer. Fashion has, moreover, set fictitious values upon slight shades of colour. Enormous numbers of animals are caught, chiefly in traps, to supply the demand of the fur trade, Siberia and North America being the principal localities from which they are obtained.

With the exception of the pekan (*M. pennanti*), the martens are much alike in size, general colouring and cranial and dental characters. The following description by Dr Elliott Coues of the American marten (*M. americana*) will apply almost equally well to most of the others. "It is almost impossible to describe the colour of the marten, except in general terms, without going into the details of the endless diversities occasioned by age, sex, season, or other incidents. The animal is 'brown,' of a shade from orange or tawny to quite blackish; the tail and feet are ordinarily the darkest, the head lightest, often quite whitish; the ears usually have a whitish rim, while on the throat there is usually a large tawny-yellowish or orange-brown patch, from the chin to the fore legs, sometimes entire, sometimes broken into a number of smaller, irregular blotches, sometimes wanting, sometimes prolonged on the whole under surface, when the animal is bicolor like a stoat in summer. The general 'brown' has a greyish cast, as far as the under fur is concerned, and is overlaid with rich lustrous blackish-brown in places where the long bristly hairs prevail. The claws are whitish; the naked nose pad and whiskers are black. The tail occasionally shows interspersed white hairs, or a white tip."

The following are the best-known species:—

Mustela foina: the beech-marten, stone-marten or white-breasted marten.—Distinguished from the following by the greater breadth of the skull, and some minute but constant dental characters, by the dull greyish-brown colour of the fur of the upper parts and the pure white of the throat and breast. It inhabits the greater part of the continent of Europe, but is more southern than the next in its distribution, not being found in Sweden or Norway.

M. martes, the pine-marten (see figure).—Fur rich dark brown; under fur reddish-grey, with clear yellow tips; breast spot usually yellow, varying from bright orange to pale cream-colour or yellowish-white. Length of head and body 16 to 18 in., of tail (including the hair) 9 to 12 in. This species is extensively distributed throughout northern Europe and Asia, and was formerly common in most parts of Great Britain and Ireland. It is still found in the northern counties of England and North Wales, but in decreasing numbers. In Scotland it is rare, but in Ireland may be found in almost every county occasionally. Though commonly called "pine-marten," it does not appear to have any special preference for coniferous trees.

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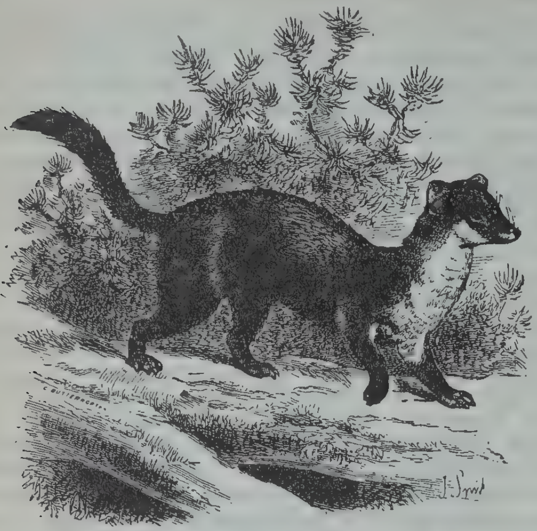
[1] By all old authors, as Ray, Pennant, Shaw and Fleming, the word is written "Martin," but this form of spelling is now generally reserved for the bird (see MARTIN). The word, as applied to the animal here described, occurs in most Germanic and Romanic languages: German, *marder*; Dutch, *marter*; Swedish, *mard*; Danish, *maar*; English, *marteron*, *martern*, *marten*, *martin* and *martlett*; French, *marte* and *martre*; Italian, *martora* and *martorella*; Spanish and Portuguese, *marta*. Its earliest known use is in the form *martes* (Martial, *Ep.* x. 37), but it can scarcely be an old Latin word, as it is not found in Pliny or other classical writers, and Martial often introduced foreign words into his Latin. Its etymology has been connected with the German "martern," to torment. A second Romanic name for the same animal is *fuina*, in French *fouine*. The term "Marten Cat" is also used.



The Pine-Marten (*Mustela martes*).

Next comes *M. zibellina*, the sable (German, *Zobel* and *Zebel*; Swedish, *sabel*; Russian, *sobel*, a word probably of Turanian origin), which closely resembles the last, if indeed it differs except in the quality of the fur—the most highly valued of that of all the group. The sable is found chiefly in eastern Siberia.

Very distinct is the brilliantly coloured orange-and-black Indian marten (*M. flavigula*), found from the Himalaya and Ceylon to Java.

The North American *M. americana* is closely allied to the pine-marten and Asiatic sable. The importance of the fur of this animal as an article of commerce may be judged of from the fact that 15,000 skins were sold in one year by the Hudson's Bay Company as long ago as 1743. It is ordinarily caught in wooden traps of simple construction, being little enclosures of stakes or brush in which the bait is placed upon a trigger, with a short upright stick supporting a log of wood, which falls upon its victim on the slightest disturbance. A line of such traps, several to a mile, often extends many miles. The bait is any kind of meat, a mouse, squirrel, piece of fish or bird's head. It is principally trapped during the colder months, from October to April, when the fur is in good condition, as it is nearly valueless during the shedding in summer. It maintains its numbers partly in consequence of its shyness, which keeps it away from the abodes of men, and partly because it is so prolific, bringing forth six to eight young at a litter. Its home is sometimes a den under ground or beneath rocks, but oftener the hollow of a tree, and it is said to take possession of a squirrel's nest, driving off or devouring the rightful proprietor.

The pekan or Pennant's marten, also called fisher marten, though there appears to be nothing in its habits to justify the appellation, is the largest of the group, the head and body measuring from 24 to 30 in., and the tail 14 to 18 in. It is also more robust in form than the others, its general aspect being more that of a fox than a weasel; in fact its usual name among the American hunters is "black fox." Its general colour is blackish, lighter by mixture of brown or grey on the head and upper fore part of the body, with no light patch on the throat, and unlike other martens generally darker below than above. It was generally distributed in wooded districts throughout the greater part of North America, as far north as Great Slave Lake, lat. 63° N., and Alaska, and extending south to the parallel of 35°; but at the present time is almost exterminated in the settled parts of the United States east of the Mississippi.

(W. H. F.)

MARTENS, FRÉDÉRIC FROMMHOLD DE (1845–1909), Russian jurist, was born at Pernau in Livonia. In 1868 he entered the Russian ministry of foreign affairs, was admitted in 1871 as a *Dozent* in international law in the university of St Petersburg, and in 1871 became lecturer and then (1872) professor of public law in the Imperial School of Law and the Imperial Alexander Lyceum. In 1874 when Prince Gorchakov, then imperial chancellor, needed assistance for certain kinds of special work, Martens was chosen to afford it. His book on *The Right of Private Property in War* had appeared in 1869, and had been followed in 1873 by that upon *The Office of Consul and Consular Jurisdiction in the East*, which had been translated into German and republished at Berlin. These were the first of a long series of studies which won for their author a world-wide reputation, and raised the character of the Russian school of international jurisprudence in all civilized countries. First amongst them must be placed the great *Recueil des traités et conventions conclus par la Russie avec les puissances étrangères* (13 vols., 1874–1902). This collection, published in Russian and French in parallel columns, contains not only the texts of the treaties but valuable introductions dealing with the diplomatic conditions of which the treaties were the outcome. These introductions are based largely on unpublished documents from the Russian archives. Of Martens' original works his *International Law of Civilized Nations* is perhaps the best known; it was written in Russian, a German edition appearing in 1884–1885, and a French edition in 1887–1888. It displays much judgment and acumen, though some of the doctrines which it defends by no means command universal assent. More openly "tendencious" in character are such treatises as *Russia and England in Central Asia* (1879); *Russia's Conflict with China* (1881), *The Egyptian Question* (1882), and *The African Conference of Berlin and the Colonial Policy of Modern States* (1887). In the delicate questions raised in some of these works Martens stated his case with learning and ability, even when it was obvious that he was arguing as a special pleader. Martens was repeatedly chosen to act in international arbitrations. Among the controversies which he helped to adjust were that between Mexico and the United States—the first case determined by the permanent tribunal of The Hague—and the difference between Great Britain and France in regard to Newfoundland in 1891. He played an important part in the negotiations between his own country and Japan, which led to the peace of Portsmouth (Aug. 1905) and prepared the way for the Russo-Japanese convention. He was employed in laying the foundations for The Hague Conferences. He was one of the Russian plenipotentiaries at the first conference and president of the fourth committee—that on maritime law—at the second conference. His visits to the chief capitals of Europe in the early part of 1907 were an important preliminary in the preparation of the programme. He was judge of the Russian supreme prize court established to determine cases arising during the war with Japan. He received honorary degrees from the universities of Oxford, Cambridge and Yale; he was also awarded the Nobel Peace Prize in 1902. In April 1907 he addressed a remarkable letter to *The Times* on the position of the second Duma, in which he argued that the best remedy for the ills of Russia would be the dissolution of that assembly and the election of another on a narrower franchise. He died suddenly on the 20th of June 1909.

See T. E. Holland, in *Journal of the Society of Comparative Legislation* for October 1909, where a list of the writings of Martens appears.

MARTENS, GEORG FRIEDRICH VON (1756–1821), German jurist and diplomatist, was born at Hamburg on the 22nd of February 1756. Educated at the universities of Göttingen, Regensburg and Vienna, he became professor of jurisprudence at Göttingen in 1783 and was ennobled in 1789. He was made a counsellor of state by the elector of Hanover in 1808, and in 1810 was president of the financial section of the council of state of the kingdom of Westphalia. In 1814 he was appointed privy cabinet-councillor (*Geheimer Kabinetsrat*) by the king of Hanover, and in 1816 went as representative of the king to the diet of the new German Confederation at Frankfort, where he died on the 21st of February 1821.

Of his works the most important is the great collection of treaties *Recueil des traités, &c.*) from 1761 onwards. Of this the first seven volumes were published at Göttingen (1791–1801), followed by four supplementary volumes partly edited by his nephew Karl von Martens (see below). These were followed by *Nouveau recueil*, of treaties subsequent to 1808, in 16 vols. (Göttingen, 1817–1842), of which G. F. von Martens edited the first four, the fifth being the work of K. von Martens, the others (6–9) by F. Saalfeld and (10–16) F. Murhard. A *Nouveau supplément*, in 3 vols., filling gaps in the previous collection, was also published by Murhard (Göttingen, 1839–1842). This was followed by *Nouveau recueil . . . continuation du grand recueil de Martens*, in 20 vols. (Göttingen, 1843–1875), edited in turn by F. Murhard, C. Murhard, J. Pinhas, C. Samwer and J. Hopf, with a general index of treaties from 1494 to 1874 (1876). This was followed by *Nouveau recueil, 2me série* (Göttingen, 1876–1896; vols. xxii.–xxxv., Leipzig, 1897–1908). From vol. xi. on this series was edited by Felix Störk, professor of public law at Greifswald. In 1909 appeared vol. i. of a further *Continuation (troisième série)* under the editorship of Professor Heinrich Triepel of Kiel University.

Of Martens' other works the most important are the *Précis du droit des gens modernes de l'Europe* (1789; 3rd ed., Göttingen, 1821; new ed., G. S. Pinheiro-Ferreira, 2 vols., 1858, 1864); *Erzählungen merkwürdiger Fälle des neueren europäischen Völkerrechts*, 2 vols. (Göttingen, 1800–1802); *Cours diplomatique ou tableau des relations des puissances de l'Europe*, 3 vols. (Berlin, 1801); *Grundriss einer diplomatischen Gesch. der europ. Staatshändel u. Friedensschlüsse seit dem Ende des 15. Jahrhunderts* (ibid. 1807).

His nephew KARL VON MARTENS (1790–1863), who at his death was minister resident of the grand-duke of Weimar at Dresden, published a *Manuel diplomatique* (Leipzig, 1823), re-issued as *Guide diplomatique* in two vols. in 1832 (5th ed. by Geffcken, 1866), a valuable textbook of the rules and customs of the diplomatic service; *Causes célèbres du droit des gens* (2 vols., ibid., 1827) and *Nouvelles causes célèbres* (2 vols., ibid., 1843), both republished, in 5 vols. (1858–1861); *Recueil manuel et pratique de traités* (7 vols., ibid., 1846–1857); continued by Geffcken in 3 vols., 1885–1888).

MARTENSEN, HANS LASSEN (1808–1884), Danish divine, was born at Flensburg on the 19th of August 1808. He studied in Copenhagen, and was ordained in the Danish Church. At Copenhagen he was lektor in theology in 1838, professor extraordinarius in 1840, court preacher also in 1845, and professor ordinarius in 1850. In 1854 he was made bishop of Seeland. In his studies he had come under the influence of Schleiermacher, Hegel and Franz Baader; but he was a man of independent mind, and developed a peculiar speculative theology which showed a disposition towards mysticism and theosophy. His contributions to theological literature included treatises on Christian ethics and dogmatics, on moral philosophy, on baptism, and a sketch of the life of Jakob Boehme, who exercised so marked an influence on the mind of the great English theologian of the 18th century, William Law. Martensen was a distinguished preacher, and his works were translated into various languages. The "official" eulogy he pronounced upon Bishop Jakob P. Mynster (1775–1854) in 1854, brought down upon his head the invectives of the philosopher Sören Kierkegaard. He died at Copenhagen on the 3rd of February 1884.

Amongst his works are: *Grundriss des Systems der Moralphilosophie* (1841; 3rd ed., 1879; German, 1845), *Die christl. Taufe und die baptistische Frage* (2nd ed., 1847; German, 2nd ed., 1860), *Den Christelige Dogmatik* (4th ed., 1883; Eng. trans., 1866; German by himself, 4th ed., 1897); *Christliche Ethik* (1871; Eng. trans., Part I. 1873, Part II. 1881 seq.); *Hirtenspiegel* (1870–1872); *Katholizismus und Protestantismus* (1874); *Jacob Böhme* (1882; Eng. trans., 1885). An autobiography, *Aus meinem Leben*, appeared in 1883, and after his death the *Briefwechsel zwischen Martensen und Dorner* (1888).

MARTHA'S VINEYARD, an island including the greater part of Dukes county, Massachusetts, U.S.A., lying about 3 m. off the southern coast of that state. Its extreme length (east to west) is about 20 m., and its extreme width (north to south) about 9½ m. Along its north-west and a portion of its north-east shore lies Vineyard Sound. Its principal bays are Vineyard Haven Harbor, a deep indentation at the northernmost angle of the island; and, on the eastern coast, Edgartown Harbor and Katama Bay, both formed by the juxtaposition of Chappaquiddick Island. The surface is mainly flat, excepting a strip about 2 m. broad along the north-western coast, and the two western townships (Chilmark and Gay Head), which are hilly, with several eminences of 200 to 300 ft.—the highest, Prospect Peak, in Chilmark township, 308 ft. Gay Head Light, a beacon near the western extremity, stands among picturesque cliffs, 145 ft. above the sea. Along the southern coast are many ponds, all shut off from the ocean by a narrow strip of land, excepting Tisbury Great Pond, which has a small outlet to the sea. Others are Sengekontacket Pond on the eastern coast; Lagoon Pond, which is practically an arm of Vineyard Haven Harbor; and, about a mile east of the Harbor, Chappaquonsett Pond. Martha's Vineyard is divided into the following townships (from east to west): Edgartown (in the south-eastern part of the island), pop. (1910), 1191; area, 29·7 sq. m.; Oak Bluffs (north-eastern portion), pop. (1910), 1084; area, 7·9 sq. m.; Tisbury, pop. (1910), 1196; area, 7·1 sq. m.; West Tisbury, pop. (1910), 437; area, 30·5 sq. m.; Chilmark, pop. (1910), 282; area, 19·4 sq. m.; and Gay Head, pop. (1910), 162; area 5·2 sq. m. The population of the county, including the Elizabeth Ids. (Gosnold town, pop. 152), N. W. of Martha's Vineyard; Chappaquiddick Island (Edgartown township), and No Man's Land (a small island south-west of Martha's Vineyard), was 4561 in 1900 (of whom 645 were foreign-born, including 79 Portuguese and 72 English-Canadians, and 154 Indians), and in 1910, 4504. The principal villages are Oak Bluffs on the north-east coast, facing Vineyard Sound; Vineyard Haven, in Tisbury township, beautifully situated on the west shore of Vineyard Haven Harbor, and Edgartown on Edgartown Harbor—all summer resorts. No Man's Land, included politically in Chilmark township, lies about 6½ m. south of Gay Head. It is about 1½ m. long (east and west) and about 1 m. wide, is composed of treeless swamps, and is used mainly for sheep-grazing; the neighbouring waters are excellent fishing ground. Martha's Vineyard is served by steamship lines from Wood's Hole and New Bedford to Vineyard Haven, Oak Bluffs, and Edgartown. The Martha's Vineyard railway (from Oak Bluffs to the south-east extremity of the island, by way of Edgartown), opened in 1874, was not a financial success, and had been practically abandoned in 1909, but an electric line from Oak Bluffs to Vineyard Haven provides transit facilities for that part of the island.

For more than a century whale fishing was practically the sole industry of Martha's Vineyard. It was carried on at first from the shore in small boats; but by the first decade of the 18th century vessels especially built for the purpose were being used, and by 1760 shore fishing had been practically abandoned. The industry, seriously crippled by invasions of British troops during the War of American Independence—especially by a force which landed at Holmes's Hole (Vineyard Haven) in September 1778—and again during the War of 1812, revived and was at its height in 1840–1850, only to receive another setback during the Civil War. In the last part of the 19th century its decline was rapid, not only because of the increasing scarcity of whales, but because of the introduction of the mineral oils, and by the end of the century whaling had ceased to be of any economic importance. Herring fishing, on both the north and the south shore, occupies a small percentage of the inhabitants, and there is also some deep-sea fishing. Sheep-raising, especially for wool, is an industry of considerable importance, and Dukes county is one of the three most important counties of the state in this industry.

Martha's Vineyard was discovered in 1602 by Captain Bartholomew Gosnold, who landed (May 21) on the island now called No Man's Land, and named it Martha's Vineyard,[1] which name was subsequently applied to the larger island. Captain Gosnold rounded Gay Head, which he named Dover Cliff, and established on what is now Cuttyhunk Island, which he called Elizabeth Island, the first (though, as it proved, a temporary) English settlement in New England. The entire line of sixteen islands, of which Cuttyhunk is the westernmost of the larger ones, have since been called the Elizabeth Islands; they form the dividing line between Buzzards Bay and Vineyard Sound, and in 1864 were incorporated as Gosnold township (pop. in 1905, 161) of Dukes county.

The territory within the jurisdiction of the Council for New England was parcelled in 1635 among the patentees in such terms—owing to insufficient knowledge of the geography of the coast—that both William Alexander, earl of Stirling, and Sir Ferdinando Gorges, proprietor of Maine, claimed Martha's Vineyard. In 1641 Stirling's agent, Forrett, sold to Thomas Mayhew (1592–1682),[1] of Watertown, Massachusetts, for $200, the island of Nantucket, with several smaller neighbouring islands, and also Martha's Vineyard. It seems probable that Forrett acted without authority, and his successor, Forrester, was arrested by the Dutch in New Amsterdam and sent to Holland before he could confirm the transfer. In 1644 the Commissioners of the United Colonies, apparently at the request of the inhabitants of Martha's Vineyard, annexed the island to Massachusetts, but ten years later the islanders declared their independence of that colony, and apparently for the next decade managed their own affairs. Meanwhile Mayhew had recognized the jurisdiction of Maine;[2] and though the officials of that province showed no disposition to press their claim, it seems that this technical suzerainty continued until 1664, when the Duke of York received from his brother, Charles II., the charter for governing New York, New Jersey, and other territory, including Martha's Vineyard. In 1671 Governor Francis Lovelace, of New York, appointed Mayhew governor for life of Martha's Vineyard; in 1683, the island, with Nantucket, the Elizabeth Islands, No Man's Land, and Chappaquiddick Island were erected into Dukes county, and in 1695 the county was re-incorporated by Massachusetts with Nantucket excluded. Under the new charter of Massachusetts Bay (1691), after some dispute between Massachusetts and New York, Martha's Vineyard became a part of Massachusetts.

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[1] In the 17th century both "Martha's Vineyard" and "Martin's Vineyard" were used, and the latter appears in a book as early as 1638 and in another as late as 1699, and on a map as late as 1670. It seems probable that the original form was *Martin*, the name of one of Gosnold's crew; according to some authorities the name Martha's Vineyard was adopted by Mayhew in honour of his wife or daughter.

There is a tradition that the first settlement of Martha's Vineyard was made in 1632, at or near the present site of Edgartown village, by several English families forming part of a company bound for Virginia, their ship having put in at this harbour on account of heavy weather. It is certain, however, that in 1642, the year after Thomas Mayhew bought the island, his son, also named Thomas Mayhew (*c.* 1616–1657), and several other persons established a plantation on the site of what is now Edgartown village. This settlement was at first called "Great Harbor," but soon after Mayhew was appointed governor of the island it was named Edgartown, probably in honour of the only surviving son of the Duke of York. The younger Mayhew, soon after removing to Martha's Vineyard, devoted himself to missionary work among the Indians, his work beginning at about the same time as that of John Eliot; he was lost at sea in 1657 while on his way to secure financial assistance in England, and his work was continued successfully by his father.[3] The township of Edgartown was incorporated in 1671, and is the county-seat of Dukes county. In 1783 several Edgartown families joined the association made up of Martha's Vineyard, Nantucket, Providence and Newport whalers, who founded Hudson, on the Hudson river, in Columbia county, New York. Oak Bluffs had its origin as a settlement in the camp meetings, which were begun here in 1835, and by 1860 had grown to large proportions. As the village expanded it took the name of Cottage City. In 1880 the township was incorporated under that name, which it retained until January 1907, when the name (and that of the village also) was changed to Oak Bluffs. Tisbury township was bought from the Indians in 1669 and was incorporated in 1671. Its principal village, Vineyard Haven, was called "Holmes's Hole" (in honour of one of the early settlers) until 1871, when the present name was adopted. West Tisbury township was set off from Tisbury, and incorporated in 1892. Chilmark township was incorporated in 1694. Gay Head township was set off from Chilmark, and incorporated in 1870.

See C. Gilbert Hine, *The Story of Martha's Vineyard* (New York, 1908); Charles E. Banks, "Martha's Vineyard and the Province of Maine" in *Collections and Proceedings* of the Maine Historical Society, 2nd series, vol. ix. p. 123 (Portland, Maine, 1898); and Walter S. Tower, *A History of the American Whale Fishery* (Philadelphia, 1907). (G. G.*)

MARTÍ, JUAN JOSÉ (1570?–1604), Spanish novelist, was born at Orihuela (Valencia) about 1570. He graduated as bachelor of canon law at Valencia in 1591, and in 1598 took his degree as doctor of canon law; in the latter year he was appointed co-examiner in canon law at Valencia University, and held the post for six years. He died at Valencia, and was buried in the cathedral of that city on the 22nd of December 1604. Martí joined the Valencian *Academia de los nocturnos*, under the name of "Atrevimiento," but is best known by another pseudonym, Mateo Luján de Sayavedra, under which he issued an apocryphal continuation (1602) of Alemán's *Guzmán de Alfarache* (1599). Martí obtained access to Alemán's unfinished manuscript, and stole some of his ideas; this dishonesty lends point to the sarcastic congratulations which Alemán, in the genuine sequel (1604) pays to his rival's sallies: "I greatly envy them, and should be proud that they were mine." Martí's book is clever, but the circumstances in which it was produced account for its cold reception and afford presumption that the best scenes are not original.

It has been suggested that Martí is identical with Avellaneda, the writer of a spurious continuation (1614) to *Don Quixote*; but he died before the first part of *Don Quixote* was published (1605).

MARTIAL (Marcus Valerius Martialis), Latin epigrammatist, was born in one of the years A.D. 38–41, for in book x., of which the poems were composed in the years 95–98, he is found celebrating his fifty-seventh birthday (x. 24). Our knowledge of his career is derived almost entirely from himself. Reference to public events enables us approximately to fix the date of the publication of the different books of epigrams, and from these dates to determine those of various important events in his life. The place of his birth was Bilbilis, officially Augusta Bilbilis, in Spain. His name seems to imply that he was born a Roman citizen, but he speaks of himself as "sprung from the Celts and Iberians, and a countryman of the Tagus;" and, in contrasting his own masculine appearance with that of an effeminate Greek, he draws especial attention to "his stiff Spanish hair" (x. 65, 7). His parents, Fronto and Flaccilla, appear to have died in his youth (v. 34). His home was evidently one of rude comfort and plenty, sufficiently in the country to afford him the amusements of hunting and fishing, which he often recalls with keen pleasure, and sufficiently near the town to afford him the companionship of many comrades, the few survivors of whom he looks forward to meeting again after his four-and-thirty years' absence (x. 104). The memories of this old home, and of other spots, the rough names and local associations which he delights to introduce into his verse, attest the enjoyment which he had in his early life, and were among the influences which kept his spirit alive in the routine of social life in Rome. But his Spanish home could impart, not only the vigorous vitality which was one condition of his success as a wit and poet, but the education which made him so accomplished a writer. The literary distinction obtained by the Senecas, by Lucan, by Quintilian, who belonged to a somewhat older generation, and by his friends and contemporaries, Licinianus of Bilbilis, Decianus of Emerita, and Canius of Gades, proves how eagerly the novel impulse of letters was received in Spain in the first century of the empire. The success of his countrymen may have been the motive which induced Martial to remove to Rome when he had completed his education. This he did in A.D. 64, one year before the fall of Seneca and Lucan, who were probably his earliest patrons.

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[1] Mayhew was born at Tisbury, Wiltshire, was a merchant in Southampton, emigrated to Massachusetts about 1633, settled at Watertown, Mass., in 1635; was a member of the Massachusetts General Court in 1636–1644, and after 1644 or 1645 lived on Martha's Vineyard.

[2] It appears from a letter from Mayhew to Governor Andros in 1675 that about 1641 Mayhew obtained a conveyance to Martha's Vineyard from Richard Vines, agent of Gorges. See F. B. Hough, *Papers Relating to the Island of Nantucket, with Documents Relating to the Original Settlement of that Island, Martha's Vineyard, &c.* (Albany, N.Y., 1856).

[3] In 1901, a boulder memorial was erected to the younger Mayhew on the West Tisbury road, between the village of that name and Edgartown, marking the spot where the missionary bade farewell to several hundred Indians. The Martha's Vineyard Indians were subject to the Wampanoag tribe, on the mainland, were expert watermen, and were very numerous when the whites first came. Nearly all of them were converted to Christianity by the Mayhews, and they were friendly to the settlers during King Philip's war. By 1698 their numbers had been reduced to about 1000, and by 1764 to about 300. Soon after this they began to intermarry with negroes, and now only faint traces of them remain.

Of the details of his life for the first twenty years or so after he came to Rome we do not know much. He published some juvenile poems of which he thought very little in his maturer years, and he laughs at a foolish bookseller who would not allow them to die a natural death (i. 113). Martial had neither youthful passion nor youthful enthusiasm to make him precociously a poet. His faculty ripened with experience and with the knowledge of that social life which was both his theme and his inspiration; and many of his best epigrams are among those written in his last years. From many answers which he makes to the remonstrances of friends—among others to those of Quintilian—it may be inferred that he was urged to practise at the bar, but that he preferred his own lazy Bohemian kind of life. He made many influential friends and patrons, and secured the favour both of Titus and Domitian. From them he obtained various privileges, among others the *semestris tribunatus*, which conferred on him equestrian rank. He failed, however, in his application to the latter for more substantial advantages, although he commemorates the glory of having been invited to dinner by him, and also the fact that he procured the privilege of citizenship for many persons in whose behalf he appealed to him. The earliest of his extant works, that known by the name of *Liber spectaculorum*, was first published at the opening of the Colosseum in the reign of Titus, and relates to the theatrical performances given by him; but the book as it now stands was given to the world in or about the first year of Domitian, *i.e.* about A.D. 81. The favour of the emperor procured him the countenance of some of the worst creatures at the imperial court—among them of the notorious Crispinus, and probably of Paris, the supposed author of Juvenal's exile, for whose monument Martial afterwards wrote a eulogistic epitaph. The two books, numbered by editors xiii. and xiv., and known by the names of *Xenia* and *Apophoreta*—inscriptions in two lines each for presents,—were published at the Saturnalia of 84. In 86 he gave to the world the first two of the twelve books on which his reputation rests. From that time till his return to Spain in A.D. 98 he published a volume almost every year. The first nine books and the first edition of book x. appeared in the reign of Domitian; and book xi. at the end of A.D. 96, shortly after the accession of Nerva. A revised edition of book x., that which we now possess, appeared in A.D. 98, about the time of the entrance of Trajan into Rome. The last book was written after three years' absence in Spain, shortly before his death, which happened about the year A.D. 102 or 103.

These twelve books bring Martial's ordinary mode of life between the age of five-and-forty and sixty very fully before us. His regular home for five-and-thirty years was Rome. He lived at first up three pairs of stairs, and his "garret" overlooked the laurels in front of the portico of Agrippa. He had a small villa and unproductive farm near Nomentum, in the Sabine territory, to which he occasionally retired from the bores and noises of the city (ii. 38, xii. 57). In his later years he had also a small house on the Quirinal, near the temple of Quirinus. At the time when his third book was brought out he had retired for a short time to Cisalpine Gaul, in weariness, as he tells us, of his unremunerative attendance on the levées of the great. For a time he seems to have felt the charm of the new scenes which he visited, and in a later book (iv. 25) he contemplates the prospect of retiring to the neighbourhood of Aquileia and the Timavus. But the spell exercised over him by Rome and Roman society was too great; even the epigrams sent from Forum Corneli and the Aemilian Way ring much more of the Roman forum, and of the streets, baths, porticos and clubs of Rome, than of the places from which they are dated. So too his motive for his final departure from Rome in A.D. 98 was a weariness of the burdens imposed on him by his social position, and apparently the difficulties of meeting the ordinary expenses of living in the metropolis (x. 96); and he looks forward to a return to the scenes familiar to his youth. The well-known epigram addressed to Juvenal (xii. 18) shows that for a time his ideal was realized; but the more trustworthy evidence of the prose epistle prefixed to book xii. proves that his contentment was of short duration, and that he could not live happily away from the literary and social pleasures of Rome. The one consolation of his exile was the society of a lady, Marcella, of whom he writes rather as if she were his patroness—and it seems to have been a necessity of his being to have always a patron or patroness—than his wife or mistress.

During his life at Rome, although he never rose to a position of real independence, and had always a hard struggle with poverty, he seems to have known everybody, especially every one of any eminence at the bar or in literature. In addition to Lucan and Quintilian, he numbered among his friends or more intimate acquaintances Silius Italicus, Juvenal, the younger Pliny; and there were many others of high position whose society and patronage he enjoyed. The silence which he and Statius, although authors writing at the same time, having common friends and treating often of the same subjects, maintain in regard to one another may be explained by mutual dislike or want of sympathy. Martial in many places shows an undisguised contempt for the artificial kind of epic on which Statius's reputation chiefly rests; and it seems quite natural that the respectable author of the *Thebaid* and the *Silvae* should feel little admiration for either the life or the works of the Bohemian epigrammatist.

Martial's faults are of the most glaring kind, and are exhibited without the least concealment. Living under perhaps the worst of the many bad emperors who ruled the world in the 1st century, he addresses him and his favourites with the most servile flattery in his lifetime, censures him immediately after his death (xii. 6), and offers incense at the shrine of his successor. He is not ashamed to be dependent on his wealthy friends and patrons for gifts of money, for his dinner, and even for his dress. We cannot feel sure that even what seem his sincerest tributes of regard may not be prompted by the hope of payment. Further, there are in every book epigrams which cannot be read with any other feelings than those of extreme distaste.

These faults are so unmistakable and undeniable that many have formed their whole estimate of Martial from them, and have declined to make any further acquaintance with him. Even those who greatly admire his genius, and find the freshest interest in his representation of Roman life and his sketches of manners and character, do not attempt to palliate his faults, though they may partially account for them by reference to the morals of his age and the circumstances of his life. The age was one when literature had either to be silent or to be servile. Martial was essentially a man of letters: he was bound either to gain favour by his writings or to starve. Even Statius, whose writings are in other respects irreproachable, is nearly as fulsome in his adulation. The relation of client to patron had been recognized as an honourable one by the best Roman traditions. No blame had attached to Virgil or Horace on account of the favours which they received from Augustus and Maecenas, or of the return which they made for these favours in their verse. That old honourable relationship had, however, greatly changed between Augustus and Domitian. Men of good birth and education, and sometimes even of high official position (Juv. i. 117), accepted the dole (*sportula*). Martial was merely following a general fashion in paying his court to "a lord," and he made the best of the custom. In his earlier career he used to accompany his patrons to their villas at Baiae or Tibur, and to attend their morning levées. Later on he went to his own small country house, near Nomentum, and sent a poem, or a small volume of his poems, as his representative at the early visit. The fault of grossness Martial shares with nearly all ancient and many modern writers who treat of life from the baser or more ridiculous side. That he offends more than perhaps any of them is not, apparently, to be explained on the ground that he had to amuse a peculiarly corrupt public. Although there is the most cynical effrontery and want of self-respect in Martial's use of language, there is not much trace of the satyr in him—much less, many readers will think, than in Juvenal.

It remains to ask, What were those qualities of nature and intellect which enable us to read his best work—even the great body of his work—with the freshest sense of pleasure in the present day? He had the keenest capacity for enjoyment, the keenest curiosity and power of observation. He had also a very just discernment. It is rare to find any one endowed with so quick a perception of the ridiculous who is so little of a caricaturist. He was himself singularly free from cant, pedantry or affectation of any kind. Though tolerant of most vices, he had a hearty scorn of hypocrisy. There are few better satirists of social and literary pretenders in ancient or modern times. Living in a very artificial age, he was quite natural, hating pomp and show, and desiring to secure in life only what really gave him pleasure. To live one's own life heartily from day to day without looking before or after, and to be one's self without trying to be that for which nature did not intend him, is the sum of his philosophy. Further, while tolerant of much that is bad and base—the characters of Crispinus and Regulus, for instance—he shows himself genuinely grateful for kindness and appreciative of excellence. He has no bitterness, malice or envy in his composition. He professes to avoid personalities in his satire;—"Ludimus innocui" is the character he claims for it. Pliny, in the short tribute which he pays to him on hearing of his death, says, "He had as much good-nature as wit and pungency in his writings" (*Ep.* iii. 21).

Honour and sincerity (*fides* and *simplicitas*) are the qualities which he most admires in his friends. Though many of his epigrams indicate a cynical disbelief in the character of women, yet others prove that he could respect and almost reverence a refined and courteous lady. His own life in Rome afforded him no experience of domestic virtue; but his epigrams show that, even in the age which is known to modern readers chiefly from the *Satires* of Juvenal, virtue was recognized as the purest source of happiness. The tenderest element in Martial's nature seems, however, to have been his affection for children and for his dependents.

The permanent literary interest of Martial's epigrams arises not so much from their verbal brilliancy, though in this they are unsurpassed, as from the amount of human life and character which they contain. He, better than any other writer, enables us to revive the outward spectacle of the imperial Rome. If Juvenal enforces the lesson of that time, and has penetrated more deeply into the heart of society, Martial has sketched its external aspect with a much fairer pencil and from a much more intimate contact with it. Martial was to Rome in the decay of its ancient virtue and patriotism what Menander was to Athens in its decline. They were both men of cosmopolitan rather than of a national type, and had a closer affinity to the life of Paris or London in the 18th century than to that of Rome in the days of the Scipios or of Athens in the age of Pericles. The form of epigram was fitted to the critical temper of Rome as the comedy of manners was fitted to the dramatic genius of Greece. Martial professes to be of the school of Catullus, Pedo, and Marsus, and admits his inferiority only to the first. But, though he is a poet of a less pure and genuine inspiration he is a greater epigrammatist even than his master. Indeed the epigram bears to this day the form impressed upon it by his unrivalled skill.

Authorities.—The MSS. of Martial are divided by editors into three families according to the recension of the text which they offer. Of these the oldest and best is represented by three MSS. which contain only selected extracts. The second family is derived from an inferior source, a MS. which was edited in A.D. 401 by Torquatus Gennadius; it comprises four MSS. and contains the whole of the text. The third family, of which the MSS. are very numerous, also contains the whole of the text in a recension slightly different from that of the other two; the best representative of this family is the MS. preserved in the Advocates' Library at Edinburgh.

The best separate edition of the text is that of Lindsay (Oxford, 1902); earlier editions of importance are those of Schneidewin (1842 and 1853), and of Gilbert (Leipzig, 1886). The best commentary is that of L. Friedländer (Leipzig, 1886) in two volumes with German notes) and in the same scholar's *Sittengeschichte Roms* much will be found that explains and illustrates Martial's epigrams. There is a large selection from the epigrams with English notes by Paley and Stone (1875), a smaller selection with notes by Stephenson (1880); see also Edwin Post, *Selected Epigrams of Martial* (1908), with introduction and notes. The translation into English verse by Elphinston (London, 1782) is famous for its absurdity, which drew an epigram from Burns. (W. Y. S.)

MARTIALIS, QUINTUS GARGILIUS, a Latin writer on horticultural subjects. He has been identified by some with the military commander of the same name, mentioned in a Latin inscription of A.D. 260 (*C. I. L.* viii. 9047) as having lost his life in the colony of Auzia (*Aumale*) in Mauretania Caesariensis. Considerable fragments of his work (probably called *De hortis*), which treated of the cultivation of trees and vegetables, and also of their medicinal properties, have survived, chiefly in the body of and as an appendix to the *Medicina Plinii* (an anonymous 4th century handbook of medical recipes based upon Pliny, *Nat. Hist.* xx.–xxxii.). Extant sections treat of apples, peaches, quinces, almonds and chestnuts. Gargilius also wrote a treatise on the tending of cattle (*De curis boum*), and a biography of the emperor Alexander Severus is attributed by two of the Scriptores historiae Augustae (Aelius Lampridius and Flavius Vopiscus) to a Gargilius Martialis, who may be the same person.

Bibliography.—*Gargilii Martialis . . . fragmenta*, ed. A. Mai (1846); *Plinii secundi quae fertur medicina*, ed. V. Rose (1876); *De curis boum*, ed. E. Lommatzsch (1903) with Vegetius Renatus's *Mulomedicina*; "Gargilius Martialis und die Maurenkriege," C. Cichorius in G. Curtius, *Leipziger Studien*. x. (1887), where the inscription referred to above is fully discussed; see also Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans.), § 380.

MARTIAL LAW. "Martial law" is an unfortunate term and in a sense a misnomer. It describes a suspension of ordinary law, rendered necessary by circumstances of war or rebellion. The confusion arose from the fact that the marshal's court administered military law before the introduction of articles of war, which were in their turn merged in the Army Act. But martial law is not a law in the proper sense of the term. It is the exercise of the will of the military commander, who takes upon himself the responsibility of suspending ordinary law in order to ensure the safety of the state. It is declared, by a proclamation issued by the executive, that ordinary law is inadequate to cope with the circumstances, and provides exceptional means of arrest and punishment of persons who resist the government or aid the enemy. But such a proclamation, while invariably issued in order to give publicity to the suspension of ordinary law, does not invest the step with the force of law. It is simply military authority exercised in accordance with the laws and usages of war, and is limited by military necessity. Yet in reality it is part of common law which justifies acts done by necessity for the defence of the commonwealth when there is war. H. W. Halleck in his work on International Law (i. 544), says, "Martial law originates either in the prerogative of the crown, as in Great Britain, or from the exigency of the occasion, as in other states: it is one of the rights of sovereignty, and is essential to the existence of a state, as is the right to declare or to carry on war."

This opinion, however, must be read, as regards the British Empire, with the passage in the Petition of Right which is reproduced in the preamble of each annual Army Act, and asserts the illegality of martial law in time of peace in the following terms:—"No man shall be fore-judged or subjected in time of peace to any kind of punishment within this realm by martial law." Therefore, whilst martial law is declared illegal in time of peace, it is indirectly declared lawful in time of war and intestinal commotion when the courts are closed, or when there is no time for their cumbrous action. C. M. Clode, in *Military Forces of the Crown*, argues that the words of the Petition of Right and of the Military Act since the reign of Anne are plain in this respect "that . . . the crown possesses the right of issuing commissions in war and rebellion." But he rightly adds that the military commander may permit the usual courts to continue their jurisdiction upon such subjects as he thinks proper. Legislative enactments have also sanctioned this special jurisdiction at various times, notably in 1798, 1799, 1801, and in 1803. These enactments lay down that exceptional powers may be exercised "whether the ordinary courts shall or shall not be open." As an invariable rule an act of indemnity has been passed on the withdrawal of martial law, but only to protect any person in charge of the execution of martial law who has exceeded his powers in good faith.

There has been much discussion as to whether, in districts where martial law has not been proclaimed, a person can be sent for trial from such district into a district where martial law was in operation. It is argued that if the ordinary courts were open and at work in the non-proclaimed district recourse should be had to them. The Privy Council in 1902 (*re* Marais) refused leave to appeal where the Supreme Court of Cape Colony had declined to issue a writ of Habeas Corpus in these circumstances. Mr Justice Blackburn in his charge in *R.* v. *Eyre* says, "I have come to the conclusion that, looking at what martial law was, the bringing of a person into the proclaimed district to be tried might, in a proper case, be justified." The learned judge admits that there should be a power of summary trial, observing all the substantials of justice, in order to stamp out an insurrection by speedy trial.

Whilst martial law is the will of the commanders, and is only limited by the customs of war and the discretion of those who administer it, still, as far as practicable, the procedure of military law is followed, and a military court is held on the same lines as a court-martial. Charges are simply framed without technicalities. The prisoner is present, the evidence of prosecution and prisoner is taken on oath, the proceedings are recorded, and the sentence of the court must be confirmed according to the rules of the Army Act. Sentences of death and penal servitude must be referred to headquarters for confirmation. In the South African War (1899–1902) these limits of procedure were observed, and when possible will always be.

Different Applications of Martial Law.

Entering more into detail, the term martial law has been employed in several senses:—(1) As applied to the military forces of the crown, apart from the military law under the old Mutiny Acts, and the present annual Army Acts. (2) As applied to the enemy. (3) As applied to rebels. (4) As applied to civilian subjects who are not in rebellion, but in a district where the ordinary course of civil life cannot be maintained owing to war or rebellion.

1. In regard to the military forces of the crown, the superseding of justice as administered under the Army Act could only occur in a time of great need; *e.g.* mutiny of five or six regiments in the field, with no time to take the opinion of any executive authority. The officer in command would then be bound to take measures for the purpose of suppressing such mutiny, even to putting soldiers to death if necessary. It would be a case where necessity forced immediate action.

2. Martial law as applied to the enemy or the population of the enemy's country, is in the words of the duke of Wellington, "the will of the general of the army, though it must be administered in accordance with the customs of war."

3, 4. But it is as affecting the subjects of the crown in rebellion that the subject of martial law really obtains its chief importance; and it is in this sense that the term is generally used; *i.e.* the suspension of ordinary law and the temporary government of the country, or parts of it, or all of it, by military tribunals. It has often been laid down that martial law in this sense is unknown to the law of England. A. V. Dicey, for instance, restricts martial law to only another expression for "the common right of the crown and its servants to repel force by force, in the case of invasion, insurrection, or riot, or generally of any violent resistance." But more than this is understood by the term martial law.

When the proposition was laid down that martial law in this sense is unknown to the law of England, it is to be remembered that fortunately in England there never had been a state at all similar to that prevailing in Cape Colony in 1900–1902, and it may perhaps be questioned whether the statement would have been made with such certainty if similar events had been present to the writers' minds.

In the charge delivered by Mr Justice Blackburn in the Jamaica case the law as affecting the general question of martial law is well set out.

> "By the laws of this country," said Mr Justice Blackburn, "beginning at Magna Carta and getting more and more established, down to the time of the Revolution, when it was finally and completely established, the general rule was that a subject was not to be tried or punished except by due course of law; all crimes are to be determined by juries subject to the guidance of the judge; that is the general rule, and is established law. But from the earliest times there was this also which was the law, and is the law still, that when there was a foreign invasion or an insurrection, it was the duty of every good subject, in obedience to the officers and magistrates, to resist the rebels, . . . in such a case as that of insurrection prevailing so far that the courts of law cannot sit, there must really be anarchy unless there is some power to keep the people in order, . . . before that principle the crown claimed the prerogative to exercise summary proceedings by martial law . . . in time of war when this disturbance was going on, over others than the army. And further than that, the crown made this further claim against the insurgents, that whilst it existed, pending the insurrection and for a short time afterwards, the crown had . . . the power to proclaim martial law in the sense of using summary proceedings, to punish the insurgents and to check and stop the spread of the rebellion by summary proceedings against the insurgents, so as . . . to stamp out the rebellion. Now no doubt the extent to which the crown had power to do that has never been yet decided. Our law has been declared from time to time and has always been a practical science, that is, the judges have decided so much as was necessary for the particular case, and that has become part of the law. But it never has come to be decided what this precise power is."

So far as the United Kingdom is concerned the need has never arisen. It has always been found possible to employ the ordinary courts directly the rebels have been defeated in the field and have been made prisoners or surrendered. "Fortunately in England only three occasions have arisen since the Revolution when the authority of the civil power was for a time, and then only partially, suspended," 1715, 1745 and 1780. Clode, *Military Forces*, ii. 163, says: "Upon the threat of invasion followed by rebellion in 1715, the first action of the government was to issue a proclamation authorizing all officers, civil and military, by force of arms (if necessary) to suppress the rebellion." This, therefore, would only seem to fall within the limited sense in which Dicey understands martial law to be legal, "the right of the crown and its servants to repel force by force." There was no attempt to bring persons before courts-martial who ought to be tried by the common law, and all the extraordinary acts of the crown were sanctioned by parliament. After the rebellion had been suppressed two statutes were passed, one for indemnity and the other for pardon. Before the revolution of 1745 similar action was adopted, a proclamation charging civil magistrates to do their utmost to prevent and suppress all riots, and acts of parliament suspending Habeas Corpus, providing for speedy trials; and of indemnity. In the Gordon Riots of 1780 a very similar course was pursued, and nothing was done which would not fall within Dicey's limitation. No prisoners were tried by martial law.

In Ireland the ordinary law was suspended in 1798–1801 and in 1803. In 1798 an order in Council was issued to all general officers commanding H.M. forces to punish all persons acting in, aiding, or in any way assisting the rebellion, according to *martial law*, either by death or otherwise, as to them should seem expedient for the suppression and punishment of all rebels; but the order was communicated to the Irish houses of parliament, who expressed their approval by addresses to the viceroy. It was during the operation of this order that Wolfe Tone's case arose. Tone, a subject of the king, was captured on board a French man-of-war, and condemned to death by a court-martial. Curran, his counsel, applied to the king's bench at Dublin for a Habeas Corpus, on the grounds that only when war was raging could courts-martial be endured, not while the court of king's bench sat. The court granted his application; but no ultimate decision was ever given, as Tone died before it could be arrived at.

In 1799 application was made to parliament for express sanction to martial law. The preamble of the act declared that "The Rebellion still continues . . . and stopped the ordinary course of justice and of the common law; and that many persons . . . who had been taken by H.M. forces . . . have availed themselves of such partial restoration of the ordinary course of the common law to evade the punishment of their crimes, whereby it had become necessary for parliament to interfere." The act declared that martial law should prevail and be put in force whether the ordinary courts were or were not open, &c. And nothing in the act could be held to take away, abridge or eliminate the acknowledged prerogative of war, for the public safety to resort to the exercise of martial law against open enemies or traitors, &c.

After the suppression of the rebellion an act of indemnity was passed in 1801.

In 1803 a similar act was passed by the parliament of the United Kingdom as it was after the Act of Union. In introducing it Mr Pitt stated: "The bill is not one to enable the government in Ireland to declare martial law in districts where insurrection exists, for that is a power which His Majesty already possesses—the object will be to enable the lord-lieutenant, when any persons shall be taken in rebellion, to order them to be tried immediately by a court-martial."

During the 19th century martial law was proclaimed by the British government in the following places:—

1. Barbados, 1805–1816.
2. Demerara, 1823.
3. Jamaica, 1831–1832; 1865.
4. Canada, 1837–1838.
5. Ceylon, 1817 and 1848.
6. Cephalonia, 1848.
7. Cape of Good Hope, 1834; 1849–1851.
8. St Vincent, 1863.
9. South Africa, 1899–1901.

The proclamation was always based on the grounds of necessity, and where any local body of a representative character existed it would seem that its assent was given, and an act of indemnity obtained after the suppression of the rebellion. (Jno. S.)

MARTIGNAC, JEAN BAPTISTE SYLVERE GAY, Vicomte de (1778–1832), French statesman, was born at Bordeaux on the 20th of June 1778. In 1798 he acted as secretary to Sieyès; then after serving for a while in the army, he turned to literature, producing several light plays. Under the Empire he practised with success as an advocate at Bordeaux, where in 1818 he became advocate-general of the *cour royale*. In 1819 he was appointed *procureur-général* at Limoges, and in 1821 was returned for Marmande to the Chamber of Deputies, where he supported the policy of Villèle. In 1822 he was appointed councillor of state, in 1823 he accompanied the duc d'Angoulême to Spain as civil commissary; in 1824 he was created a viscount and appointed director-general of registration. In contact with practical politics his ultra-royalist views were gradually modified in the direction of the Doctrinaires, and on the fall of Villèle he was selected by Charles X. to carry out the new policy of compromise. On the 4th of January 1828 he was appointed minister of the interior, and, though not bearing the title of president, became the virtual head of the cabinet. He succeeded in passing the act abolishing the press censorship, and in persuading the king to sign the ordinances of the 16th of June 1828 on the Jesuits and the little seminaries. He was exposed to attack from both the extreme Left and the extreme Right, and when in April 1829 a coalition of these groups defeated him in the chamber, Charles X., who had never believed in the policy he represented, replaced him by the prince de Polignac. In March 1830 Martignac voted with the majority for the address protesting against the famous ordinances; but during the revolution that followed he remained true to his legitimist principles. His last public appearance was in defence of Polignac in the Chamber of Peers in December 1830. He died on the 3rd of April 1832.

Martignac published *Bordeaux au mois de Mars 1815* (Paris, 1830), and an *Essai historique sur les révolutions d'Espagne et l'intervention française de 1823* (Paris, 1832). See also E. Daudet, *Le Ministère de M. de Martignac* (Paris, 1875).

MARTIGUES, a port of south-eastern France in the department of Bouches-du-Rhône, on the southern shore of the lagoon of Berre, and at the eastern extremity of that of Caronte, by which the former is connected with the Mediterranean. Pop. (1906), 4,178. Martigues is 23 m. W.N.W. of Marseilles by rail. Divided into three quarters by canals, the place has been called the Venice of Provence. It has a harbour (used by coasting and fishing vessels), marine workshops, oil and soap manufactures and cod-drying works. A special industry consists in the preparation of *boutargue* from the roes of the grey mullet caught in the salt lagoons, which rivals Russian caviare.

Built in 1232 by Raymond Bérenger, count of Provence, Martigues was made a viscountship by Joanna I., queen of Naples. Henry IV. made it a principality, in favour of a princess of the house of Luxembourg. It afterwards passed into the hands of the duke of Villars.

MARTIN, ST (*c.* 316–400), bishop of Tours, was born of heathen parents at Sabaria (Stein am Agger) in Pannonia, about the year 316. When ten years old he became a catechumen, and at fifteen he reluctantly entered the army. While stationed at Amiens he divided his cloak with a beggar, and on the following night had the vision of Christ making known to his angels this act of charity to Himself on the part of "Martinus, still a catechumen." Soon afterwards he received baptism, and two years later, having left the army, he joined Hilary of Poitiers, who wished to make him a deacon, but at his own request ordained him to the humbler office of an exorcist. On a visit home he converted his mother, but his zeal against the Arians roused persecution against him and for some time he lived an ascetic life on the desert island of Gallinaria near Genoa. Between 360 and 370 he was again with Hilary at Poitiers, and founded in the neighbourhood the monasterium locociagense (Licugé). In 371–372 the people of Tours chose him for their bishop. He did much to extirpate idolatry from his diocese and from France, and to extend the monastic system. To obtain privacy for the maintenance of his personal religion, he established the monastery of Marmoutier-les-Tours (Martini monasterium) on the banks of the Loire. At Trèves, in 385, he entreated that the lives of the Priscillianist heretics should be spared, and he ever afterwards refused to hold ecclesiastical fellowship with those bishops who had sanctioned their execution. He died at Candes in the year 400, and is commemorated by the Roman Church on the 11th of November (duplex). He left no writings, the so-called *Confessio* being spurious. He is the patron saint of France and of the cities of Mainz and Würzburg. The *Life* by his disciple Sulpicius Severus is practically the only source for his biography, but it is full of legendary matter and chronological errors. Gregory of Tours gives a list of 206 miracles wrought by him after his death; Sidonius Apollinaris composed a metrical biography of him. The Feast of St Martin (Martinmas) took the place of an old pagan festival, and inherited some of its usages (such as the *Martinsmännchen*, *Martinsfeuer*, *Martinshorn* and the like, in various parts of Germany); by this circumstance is probably to be explained the fact that Martin is regarded as the patron of drinking and jovial meetings, as well as of reformed drunkards.

See A. Dupuy, *Geschichte des heiligen Martins* (Schaffhausen, 1855); J. G. Cazenove in *Dict. chr. biog.* iii. 838.

MARTIN (Martinus), the name of several popes.

Martin I. succeeded Theodore I. in June or July 649. He had previously acted as papal apocrisiarius at Constantinople, and was held in high repute for learning and virtue. Almost his first official act was to summon a synod (the first Lateran) for dealing with the Monothelite heresy. It met in the Lateran church, was attended by one hundred and five bishops (chiefly from Italy, Sicily and Sardinia, a few being from Africa and other quarters), held five sessions or "secretarii" from the 5th to the 31st of October 649, and in twenty canons condemned the Monothelite heresy, its authors, and the writings by which it had been promulgated. In this condemnation were included, not only the *Ecthesis* or exposition of faith of the patriarch Sergius for which the emperor Heraclius had stood sponsor, but also the Typus of Paul, the successor of Sergius, which had the support of the reigning emperor (Constans II.). Martin published the decrees of his Lateran synod in an encyclical, and Constans replied by enjoining his exarch to seize the pope and send him prisoner to Constantinople. Martin was arrested in the Lateran (June 15, 653), hurried out of Rome, and conveyed first to Naxos and subsequently to Constantinople (Sept. 17, 654). He was ultimately banished to Cherson, where he arrived on the 26th of March 655, and died on the 16th of September following. His successor was Eugenius I. (L. D.*)

A full account of the events of his pontificate will be found in Hefele's *Conciliengeschichte*, vol. iii. (1877).

Martin II., the name commonly given in error to Marinus I. (*q.v.*).

Martin III., see Marinus II.

Martin IV. (Simon Mompitié de Brion), pope from the 22nd of February 1281 to the 28th of March 1285, should have been named Martin II. He was born about 1210 in Touraine. He became a priest at Rouen and canon of St Martin's at Tours, and was made chancellor of France by Louis IX. in 1260 and cardinal-priest of Sta Cecilia by Urban IV. in 1261. As papal legate in France he held several synods for the reformation of the clergy and conducted the negotiations for the assumption of the crown of Sicily by Charles of Anjou. It was through the latter's influence that he succeeded Nicholas III., after a six-months' struggle between the French and Italian cardinals. The Romans at first declined to receive him, and he was consecrated at Orvieto on the 23rd of March 1281. Peaceful and unassuming, he relied completely on Charles of Anjou, and showed little ability as pope. His excommunication of the emperor Michael Palaeologus (Nov. 1281), who stood in the way of the French projects against Greece, weakened the union with the Eastern Christians, dating from the Lyons Council of 1274. He unduly favoured his own countrymen, and for three years after the Sicilian Vespers (Mar. 31, 1282) he employed all the spiritual and material resources at his command on behalf of his patron against Peter of Aragon. He was driven from Rome by a popular uprising and died at Perugia. His successor was Honorius IV. (C. H. Ha.)

His registers have been published in the *Bibliothèque des écoles françaises d'Athènes et de Rome* (Paris, 1901).

See A. Potthast, *Regesta pontif. roman.*, vol. 2 (Berlin, 1875); K. J. von Hefele, *Conciliengeschichte*, Bd. 6, 2nd ed.; F. Gregorovius, *Rome in the Middle Ages*, vol. 5, trans. by Mrs G. W. Hamilton (London, 1900–1902); H. H. Milman, *Latin Christianity*, vol. 6 (London, 1899); W. Norden, *Das Papsttum u. Byzanz* (Berlin, 1903); E. Choullier, "Recherches sur la vie du pape Martin IV.," in *Revue de Champagne*, vol. 4 (1878); *Processo istorico dell' insurrezione di Sicilia dell' anno 1282*, ed. by G. di Marzo (Palermo, 1882).

Martin V. (Otto Colonna) (1417–1431) was elected at Constance on St Martin's Day, in a conclave composed of twenty-three cardinals and thirty delegates from the five different "nations" of the council. Son of Agapito Colonna, who had himself become a bishop and cardinal, the new pope belonged to one of the greatest Roman families; to Urban VI. had been due his entry, as *referendarius*, upon an ecclesiastical career. Having become a cardinal under Innocent VII., he had seceded from Gregory XII. in 1408, and together with the other cardinals at Pisa, had taken part in the election of Alexander V. and afterwards of John XXIII. At Constance, his rôle had been chiefly that of an arbiter; he was a good and gentle man, leading a simple life, free from intrigue. While refraining from making any pronouncement as to the validity of the decrees of the fourth and fifth sessions, which had seemed to proclaim the superiority of the council over the pope, Martin V. nevertheless soon revealed his personal feelings by having a constitution read in consistory which forbade any appeal from the judgment of the sovereign pontiff in matters of faith (May 10, 1418). As to the reform, of which everybody felt the necessity, the fathers in council had not succeeded in arriving at any agreement. Martin V. himself settled a great number of points, and then passed a series of special concordats with Germany, France, Italy, Spain and England. Though this was not the thorough reform of which need was felt, the council itself gave the pope a *satisfecit*. When the council was dissolved Martin V. made it his task to regain Italy. After staying for long periods at Mantua and Florence, where the deposed pope, Baldassare Cossa (John XXIII.), came and made submission to him, Martin V. was enabled to enter Rome (Sept. 30, 1420) and measure the extent of the ruins left there by the Great Schism of the West. He set to work to restore some of these ruins, to reconstitute and pacify the Papal State, to put an end to the Schism, which showed signs of continuing in Aragon and certain parts of southern France; to enter into negotiations, unfortunately unfruitful, with the Greek Church also with a view to a return to unity, to organize the struggle against heresy in Bohemia; to interpose his pacific mediation between France and England, as well as between the parties which were rending France; and, finally, to welcome and act as patron to saintly reformers like Bernardino of Siena and Francesca Romana, foundress of the nursing sisterhood of the Oblate di Tor de' Specchi (1425).

In accordance with the decree *Frequens*, and the promises which he had made, Martin V., after an interval of five years, summoned a new council, which was almost immediately transferred from Pavia to Siena, in consequence of an epidemic (1423). But the small number of fathers who attended at the latter town, and above all, the disquieting tendencies which began to make themselves felt there, induced the pope to force on a dissolution of the synod. Pending the reunion of the new council which had been summoned at Basel for the end of a period of seven years, Martin V. himself endeavoured to effect a reformation in certain points, but he was carried off by apoplexy (Feb. 20, 1431), just as he had designated the young and brilliant Cardinal Giuliano Cesarini to preside in his place over the council of Basel.

See L. Pastor, *Geschichte der Päpste* (1901), i. 205–279; J. Guiraud, *L'État pontifical après le Grand Schisme* (1896); Müntz, *Les Arts à la cour des papes pendant le xv^e^ et le xvi^e^ siècle* (1878); N. Valois, *La Crise religieuse du xv^e^ siècle; le pape et le concile* (1909), vol. i. p. i.–xxix., 1–93. (N. V.)

MARTIN, BON LOUIS HENRI (1810–1883), French historian, was born on the 20th of February 1810 at St Quentin (Aisne), where his father was a judge. Trained as a notary, he followed this profession for some time but having achieved success with an historical romance, *Wolfthurm* (1830), he applied himself to historical research. Becoming associated with Paul Lacroix ("le Bibliophile Jacob"), he planned with him a history of France, to consist of excerpts from the chief chroniclers and historians, with original matter filling up gaps in the continuity. The first volume, which appeared in 1833, encouraged the author to make the work his own, and his *Histoire de France*, in fifteen volumes (1833–1836), was the result. This *magnum opus*, rewritten and further elaborated (4th ed., 16 vols. and index, 1861–1865) gained for the author in 1856 the first prize of the Academy, and in 1869 the grand biennial prize of 20,000 francs. A popular abridgment in seven volumes was published in 1867. This, together with the continuation, *Histoire de France depuis 1789 jusqu'à nos jours* (6 vols. 1878–1883), gives a complete history of France, and superseded Sismondi's *Histoire des Français*.

This work is in parts defective; Martin's descriptions of the Gauls are based rather on romance than on history, and in this respect he was too much under the influence of Jean Reynaud and his cosmogonic philosophy. However he gave a great impetus to Celtic and anthropological studies. His knowledge of the mddile ages is inadequate, and his criticisms are not discriminating. As a free-thinking republican, his prejudices often biassed his judgment on the political and religious history of the *ancien régime*. The last six volumes, devoted to the 17th and 18th centuries, are superior to the earlier ones. Martin sat in the *assemblée nationale* as deputy for Aisne in 1871, and was elected life senator in 1878, but he left no mark as a politician. He died in Paris on the 14th of December 1883.

Among his minor works may be mentioned:—*De la France, de son génie et de ses destinées* (1847); *Daniel Manin* (1860), *La Russie et l'Europe* (1866); *Études d'archéologie celtique* (1872); *Les Napoléon et les frontières de la France* (1874). See his biography by Gabriel Hanotaux, *Henri Martin; sa vie, ses œuvres, son temps* (1885).

MARTIN, CLAUD (1735–1800), French adventurer and officer in the army of the English East India Company, was born at Lyons on the 4th of January 1735, the son of a cooper. He went out to India in 1751 to serve under Dupleix and Lally in the Carnatic wars. When Pondicherry fell in 1761, he seems, like others of his countrymen, to have accepted service in the Bengal army of the English, obtaining an ensign's commission in 1763, and steadily rising to the rank of major-general. He was employed on the building of the new Fort William at Calcutta, and afterwards on the survey of Bengal under Rennell. In 1776 he was allowed to accept the appointment of superintendent of the arsenal of the nawab of Oudh at Lucknow, retaining his rank but being ultimately placed on half pay. He acquired a large fortune, and on his death (Sept. 13, 1800) he bequeathed his residuary estate to found institutions for the education of European children at Lucknow, Calcutta and Lyons, all known by the name of "La Martinière." That at Lucknow is the best known. It was housed in the palace that he had built called Constantia, which, though damaged during the Mutiny, retains many personal memorials of its founder.

See S. C. Hill, *The Life of Claud Martin* (Calcutta, 1901).

MARTIN, FRANÇOIS XAVIER (1762–1846), American jurist and author, was born in Marseilles, France, on the 17th of March 1762, of Provençal descent. In 1780 he went to Martinique, and before the close of the American war of Independence went to North Carolina, where (in New Bern) he taught French and learnt English, and set up as a printer. He studied law, and was admitted to the North Carolina bar in 1789. He published various legal books, and edited *Acts of the North Carolina Assembly from 1715 to 1803* (2nd ed., 1809). He was a member of the lower house of the General Assembly in 1806–1807. In 1809 he was commissioned a judge of the superior court of the territory of Mississippi, and in March 1810 became judge of the superior court of the territory of Orleans. Here the law was in a chaotic condition, what with French law before O'Reilly's rule, then a Spanish code, and in 1808 the Digest of the Civil Laws, an adaptation by James Brown and Moreau Lislet of the code of Napoleon, which repealed the Spanish fueros, partidas, recopilationes and laws of the Indies only as they conflicted with its provisions. Martin published in 1811 and 1813 reports of cases decided by the superior court of the territory of Orleans. For two years from February 1813 Martin was attorney-general of the newly established state of Louisiana, and then until March 1846 was a judge and (from 1836 to 1846) presiding judge of the supreme court of the state. For the period until 1830 he published reports of the decisions of the supreme court; and in 1816 he published two volumes, one French and one English, of *A General Digest of the Acts of Legislatures of the Late Territory of Orleans and of the State of Louisiana.* He won the name of the "father of Louisiana jurisprudence" and his work was of great assistance to Edward Livingston, Pierre Derbigny and Moreau Lislet in the Louisiana codification of 1821–1826. Martin's eyesight had begun to fail when he was seventy, and after 1836 he could no longer write opinions with his own hand.[1] He died in New Orleans on the 11th of December 1846.

Martin translated Robert J. Pothier *On Obligations* (1802), and wrote *The History of Louisiana from the Earliest Period* (2 vols. 1827–1829) and *The History of North Carolina* (2 vols., 1829). There is a memoir by Henry A. Bullard in part ii. of B. F. French's *Historical Collections of Louisiana* (Philadelphia, 1850), and one by W. W. Howe in John F. Condon's edition of Martin's *History of Louisiana* (New Orleans, 1882).

MARTIN, HOMER DODGE (1836–1897), American artist, was born at Albany, New York, on the 28th of October 1836. A pupil for a short time of William Hart, his earlier work followed the lines of the Hudson River School. He was elected as associate of the National Academy of Design, New York, in 1868, and a full academician in 1874. During a trip to Europe in 1876 he was captivated by the Barbizon school, and from 1882 to 1886 he lived in France spending much of the time in Normandy. At Villerville he painted his "Harp of the Winds," now at the Metropolitan Museum of Art, New York. Among his important canvases are "Westchester Hills," "Adirondack Scenery," "The Cinquebœuf Church," "Sand Dunes," and "A Newport Landscape." Martin is generally spoken of as one of the great trio of American landscapists, the other two being Inness and Wyant, and examples of his work are in most of the important American collections. He died at St. Paul, Minnesota, on the 2nd of February 1897.

MARTIN, JOHN (1789–1854), English painter, was born at Haydon Bridge, near Hexham, on the 19th of July 1789. He was apprenticed by his father to a coachbuilder to learn heraldic painting, but owing to a quarrel the indentures were cancelled, and he was placed under Bonifacio Musso, an Italian artist, father of the enamel painter Charles Musso. With his master Martin removed to London in 1806, where he married at the age of nineteen, and supported himself by giving drawing lessons, and by painting in water colours, and on china and glass. His leisure was occupied in the study of perspective and architecture. His first picture, "Sadak in Search of the Waters of Oblivion," was exhibited in the Royal Academy of 1812, and sold for fifty guineas. It was followed by the "Expulsion" (1813), "Paradise" (1813), "Clytie" (1814), and "Joshua" (1815). In 1821 appeared his "Belshazzar's Feast," which excited much favourable and hostile comment, and was awarded a prize of £200 at the British Institution, where the Joshua had previously carried off a premium of £100. Then came the "Destruction of Herculaneum" (1822), the "Creation" (1824), the "Eve of the Deluge" (1841), and a series of other Biblical and imaginative subjects. In 1832-1833 Martin received £2000 for drawing and engraving a fine series of designs to Milton, and with Westall he produced a set of Bible illustrations. He was also occupied with schemes for the improvement of London, and published various pamphlets and plans dealing with the metropolitan water supply, sewage, dock and railway systems. During the last four years of his life he was engaged upon his large subjects of "The Judgment," the "Day of Wrath," and the "Plains of Heaven." He was attacked with paralysis while painting, and died in the Isle of Man on the 17th of February 1854.

MARTIN, LUTHER (1748–1826), American lawyer, was born in New Brunswick, New Jersey, on the 9th of February 1748. He graduated at the college of New Jersey (now Princeton University) at the head of a class of thirty-five in 1766, and immediately afterwards removed to Maryland, teaching at Queenstown in that colony until 1770, and being admitted to the bar in 1771. He practised law for a short time in Virginia, then returned to Maryland, and became recognized as the leader of the Maryland bar and as one of the ablest lawyers in the United States. From 1778 to 1805 he was attorney-general of Maryland; in 1814–1816 he was chief judge of the court of Oyer and Terminer for the city of Baltimore; and in 1818–1822 he was attorney-general of Maryland. He was one of Maryland's representatives in the Continental Congress in 1784–1785 and in the Constitutional Convention of 1787 at Philadelphia, but opposed the constitution and refused to affix his signature. He subsequently allied himself with the Federalists, and was an opponent of Thomas Jefferson, who in 1807 spoke of him as the "Federal Bull-Dog." His ability was shown in his famous defence of Judge Samuel Chase (*q.v.*) in the impeachment trial before the United States Senate in 1804–1805, and in his defence of Aaron

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[1] His holographic will in favour of his brother (written in 1844 and devising property worth nearly $400,000) was unsuccessfully contested by the state of Louisiana on the ground that the will was void as being a legal and physical impossibility, or as being an attempted fraud on the state, as under it the state would not receive a 10% tax if the property went to the heirs of Martin (as intestate) in France.

Burr (*q.v.*) against the charge of treason in 1807. He has been described by the historian Henry Adams, writing of the Chase trial, as at that time the "most formidable of American advocates." Though he received a large income, he was so improvident that he was frequently in want, and on the 22nd of February 1822 the legislature of Maryland passed a remarkable resolution—the only one of the kind in American history—requiring every lawyer in the state to pay an annual licence fee of five dollars, to be handed over to trustees appointed "for the appropriation of the proceeds raised by virtue of this resolution to the use of Luther Martin." This resolution was rescinded on the 6th of February 1823. Martin died at the home of Aaron Burr in New York on the 10th of July 1826. In 1783 he had married a daughter of the Captain Michael Cresap (1742–1775), who was unjustly charged by Jefferson, in his *Notes on Virginia*, with the murder of the family of the Indian chief, John Logan, and whom Martin defended in a pamphlet long out of print.

See the biographical sketch by Henry P. Goddard, *Luther Martin, the Federal Bull-Dog* (Baltimore, 1887), No. 24 of the "Peabody Fund Publications," of the Maryland Historical Society.

MARTIN, SIR THEODORE (1816–1909), British author and translator, the son of a solicitor, was born at Edinburgh on the 16th of September 1816, and educated at the Royal High School and the University, from which he subsequently received the honorary degree of LL.D. He practised for some time as a solicitor in Edinburgh, but in 1846 went to London, where he became senior partner in the firm of Martin & Leslie, parliamentary agents. He early contributed to *Fraser's Magazine* and *Tait's Magazine*, under the signature of "Bon Gaultier," and in 1856, in conjunction with Professor Aytoun, he published the *Book of Ballads* under the same pseudonym. This work at once obtained popular favour. In 1858 he published a volume of translations of the *Poems and Ballads of Goethe*, and this was followed by a rendering of the Danish poet Henrik Hertz's lyric drama, *King René's Daughter*. The principal character in this drama, Iolanthe, was sustained by Helena Faucit (*q.v.*), who in 1851 became the author's wife. Martin's translations of Öhlenschläger's dramas, *Correggio* (1854) and *Aladdin, or the Wonderful Lamp* (1857), widened the fame of the Danish poet in England. In 1860 appeared Martin's metrical translation of the *Odes of Horace*; and in 1870 he wrote a volume on *Horace* for the series of "Ancient Classics for English Readers." In 1882 his Horatian labours were concluded by a translation of the poet's whole works, with a life and notes, in two volumes. A poetical translation of *Catullus* was published in 1861, followed by a privately printed volume of *Poems, Original and Translated*, in 1863. The came translations of the *Vita Nuova* of Dante, and the first part of Goethe's *Faust*. A metrical translation of the second part of *Faust* appeared in 1866. Martin wrote a memoir of his friend Aytoun in 1867, and while engaged upon this work he was requested by Queen Victoria, to whom he was introduced by his friend Sir Arthur Helps, to undertake the *Life of His Royal Highness the Prince Consort*. The first volume of this well-known work was published in 1874. In 1878 Martin's translation of Heine's *Poems and Ballads* appeared. Two years later the *Life of the Prince Consort* was brought to a successful conclusion by the publication of the fifth volume. A knighthood was then conferred upon him. In the following November he was elected lord rector of the university of St Andrews. Martin's *Life of Lord Lyndhurst*, based upon papers furnished by the family, was published in 1883. In 1889 appeared *The Song of the Bell, and other Translations from Schiller, Goethe, Uhland, and Others*; in 1894 *Madonna Pia, a Tragedy, and three Other Dramas*; a translation of Leopardi's poems in 1905; and in 1901 he published a biography of his wife. The kindly relations which subsisted between Queen Victoria and Sir Theodore Martin were continued after the completion of the *Life* of the prince consort up to the queen's death. Sir Theodore's account of these relations was privately printed in 1902, and, with King Edward's consent, for general publication in 1908. This little book, *Queen Victoria as I knew her*, throws a good deal of light on the Queen's character and private life. Sir Theodore Martin died on the 18th of August 1909.

MARTIN, WILLIAM (1767–1810), English naturalist, the son of a hosier, was born at Mansfield, Nottinghamshire, in 1767. He studied drawing at an early age from James Bolton at Halifax, and gained from him a taste for the study of natural history. In 1805 he was appointed drawing master in the grammar school at Macclesfield. Meanwhile he cultivated his taste for natural history, and was in 1796 elected a fellow of the Linnaean Society. He is best known for his early works on British fossils, entitled *Petrifacta derbiensia or Figures and Descriptions of Petrifactions collected in Derbyshire* (1809); and *Outlines of an Attempt to establish a Knowledge of Extraneous Fossils on Scientific Principles* (1809). He died at Macclesfield on the 31st of May 1810.

MARTIN, SIR WILLIAM FANSHAWE (1801–1895), British admiral, son of Admiral of the Fleet Sir Thomas Byam Martin, comptroller of the navy, and grandson, on the mother's side, of Captain Robert Fanshawe, who commanded the "Namur" 90 in Rodney's victory of the 12th of April 1782, was born on the 5th of December 1801. Entering the navy at the age of twelve, his father's interest secured his rapid promotion: he was made a lieutenant on the 15th of December 1820; on the 8th of February 1823 he was promoted to be commander of the "Fly" sloop, his good service in which in support of the interests of British merchants at Callao secured his promotion as captain on the 5th of June 1824. He afterwards served in the Mediterranean and on the home station. In 1849–1852 he was commodore commanding the Channel squadron, and gave evidence of a remarkable aptitude for command. He was made rear-admiral in May 1853, and for the next four years was superintendent of Portsmouth dockyard. He was made vice-admiral in February 1858, and after a year as a lord of the admiralty, was appointed commander-in-chief in the Mediterranean. The discipline of the navy was then bad. It was a tradition sprung from the wholesale shipment of gaol-birds during the old war, that the men were to be treated without consideration; moreover the ships had been largely filled up with "bounty men" bought into the service with a £10 note without training. Out of this unpromising material Martin formed the fleet which was at that time the ideal of excellence. He had no war service, and, beyond the Italian disturbance of 1860–61, no opportunity for showing diplomatic ability. But his memory lives as that of the reformer of discipline and the originator of a comprehensive system of steam manœuvres. He became an admiral in November 1863, and on the 4th of December succeeded to the baronetcy which had been conferred on his grandfather. His last appointment was the command at Plymouth, 1866–1869, and in 1870 he was put on the retired list. In 1873 the G.C.B. was conferred on him, and in 1878 he was made rear-admiral. He died at Upton Grey, near Winchfield, on the 24th of March 1895. He was twice married, and left, besides daughters, one son, who succeeded to the baronetcy.

MARTIN OF TROPPAU, or MARTIN THE POLE (d. 1278), chronicler, was born at Troppau, and entered the order of St Dominic at Prague. Afterwards he went to Rome and became papal chaplain under Clement IV. and other popes. In 1278 Pope Nicholas III. appointed him archbishop of Gnesen, but he died at Bologna whilst proceeding to Poland to take up his new duties. Martin wrote some sermons and some commentaries on the canon law; but more important is his *Chronicon pontificum et imperatorum*, a history of the popes and emperors to 1277. Written at the request of Clement IV. the *Chronicon* is jejune and untrustworthy, and was mainly responsible for the currency of the legend of Pope Joan, and the one about the institution of seven electors by the pope. Nevertheless it enjoyed an extraordinary popularity and found many continuators; but its value to students arises solely from the fact that it was used by numerous chroniclers during the 14th, 15th and 16th centuries. In the 15th century it was translated into French, and as part of the *Chronique martiniane* was often quoted by controversialists. It has also been translated into German, Italian and Bohemian.

The Latin text is printed, with introduction by L. Weiland, in Band XXII. of the *Monumenta Germaniae historica* (Hanover and Berlin, 1826 seq.). See G. Waitz, H. Brosien and others in the *Neues Archiv der Gesellschaft für ältere deutsche Geschichtskunde* (Hanover, 1876 seq.); W. Wattenbach, *Deutschlands Geschichtsquellen*, Band II. (Berlin, 1894); and A. Molinier, *Les Sources de l'histoire de France*, Tome III. (Paris, 1903).

MARTIN[1] (Fr. *Martinet*), the *Hirundo urbica* of Linnaeus and *Chelidon urbica* of modern ornithologists, a bird well known throughout Europe, including even Lapland, where it is abundant, retiring in winter to the south of Africa. It also inhabits the western part of Asia, and appears from time to time in large flocks in India. The martin (or house-martin, as it is often called, to distinguish it from the sand-martin) commonly reaches its summer quarters a few days later than the Swallow (*q.v.*), with which it is often confused in spite of the differences between them, the martin's white rump and lower parts being conspicuous as it flies or clings to its nest attached to houses. This nest, made of the same material as the swallow's, is, however, a more difficult structure to rear, and a week or more is often occupied in laying its foundations—the builders clinging to the wall while depositing the mud of which it is composed. The base once fixed, the superstructure is often quickly added, till the whole takes the shape of the half or quarter of a hemisphere, and is finished with a lining of feathers mixed with a few bents or straws. The martin builds soon after its return, and a nest that has outlasted the winter is almost at once re-occupied. The bird usually in the course of the summer raises a second, or rarely a third, brood of offspring—though the latest broods often die in the nest, apparently through failure of food. What seem to be adults are observed in England every year so late as November, and sometimes within a few days of the winter solstice, but these late birds are almost certainly strangers.

The sand-martin, *Hirundo riparia* of Linnaeus and *Cotile riparia* of modern writers, differs much in appearance and habits from the former. Its smaller size, mouse-coloured upper surface and jerking flight distinguish it from the other British *Hirundinidae*; but it is seldom discriminated, and, being the first of the family to return to its northern home, the so-called "early swallow" is nearly always of this species. Instead of the clay-built nest of the house-martin, this bird bores horizontal galleries in an escarpment. When beginning its excavation, it clings to the face of the bank, and with its bill loosens the earth, working from the centre outwards, and often hanging head downwards. The tunnel may extend to 4, 6, or even 9 ft. The gallery seems intended to be straight, but inequalities of the ground, and especially the meeting with stones, often causes it to take a sinuous course. At the end is formed a nest lined with a few grass-stalks and feathers. The sand-martin has several broods in the year, and is more regular than other *Hirundinidae* in its departure for the south. The kind of soil needed for its nesting habits makes it somewhat local, but no species of the order *Passeres* has a geographical range that can compare with this. In Europe it is found nearly to the North Cape, and thence to the Sea of Okhotsk. In winter it visits many parts of India and South Africa to the Transvaal. In America its range extends (having due regard to the season) from Melville Island to Caiçara in Brazil, and from Newfoundland to Alaska.

The purple martin of America, *Progne purpurea*, is a favourite in Canada and the United States. Naturally breeding in hollow trees, it readily adapts itself to the nest-boxes which are commonly set up for it; but its numbers are in some years and places diminished in a manner unexplained. The limits of its range in winter are not determined, chiefly owing to the differences of opinion as to the validity of certain supposed kindred species found in South America; but according to some authorities it reaches the border of Patagonia, while in summer it is known to inhabit lands within the Arctic Circle. The male is almost wholly of a glossy steel-blue, while the female is duller in colour above, and beneath of a brownish-grey.

Birds that may be called martins occur almost all over the world except in New Zealand, which is not regularly inhabited by any member of the family. The ordinary martin of Australia is the *Petrochelidon nigricans* of most ornithologists, and another and more beautiful form is the ariel or fairy-martin of the same country, *Petrochelidon ariel*. This last builds a bottle-shaped nest of mud, as does also the rock-martin of Europe, *Cotile rupestris*. The eggs of martins are from four to seven in number, and generally white, while those of swallows usually have brown, grey or lilac markings. (A. N.)

MARTINEAU, HARRIET (1802–1876), English writer, was born at Norwich, where her father was a manufacturer, on the 12th of June 1802. The family was of Huguenot extraction (see Martineau, James) and professed Unitarian views. The atmosphere of her home was industrious, intellectual and austere; she herself was clever, but weakly and unhappy; she had no sense of taste or smell, and moreover early grew deaf. At the age of fifteen the state of her health and nerves led to a prolonged visit to her father's sister, Mrs Kentish, who kept a school at Bristol. Here, in the companionship of amiable and talented people, her life became happier. Here, also, she fell under the influence of the Unitarian minister, Dr Lant Carpenter, from whose instructions, she says, she derived "an abominable spiritual rigidity and a truly respectable force of conscience strangely mingled together." From 1819 to 1830 she again resided chiefly at Norwich. About her twentieth year her deafness became confirmed. In 1821 she began to write anonymously for the *Monthly Repository*, a Unitarian periodical, and in 1823 she published *Devotional Exercises and Addresses, Prayers and Hymns*.

In 1826 her father died, leaving a bare maintenance to his wife and daughters. His death had been preceded by that of his eldest son, and was shortly followed by that of a man to whom Harriet was engaged. Mrs Martineau and her daughters soon after lost all their means by the failure of the house where their money was placed. Harriet had to earn her living, and, being precluded by deafness from teaching, took up authorship in earnest. Besides reviewing for the *Repository* she wrote stories (afterwards collected as *Traditions of Palestine*), gained in one year (1830) three essay-prizes of the Unitarian Association, and eked out her income by needlework. In 1831 she was seeking a publisher for a series of tales designed as *Illustrations of Political Economy*. After many failures she accepted disadvantageous terms from Charles Fox, to whom she was introduced by his brother, the editor of the *Repository*. The sale of the first of the series was immediate and enormous, the demand increased with each new number, and from that time her literary success was secured. In 1832 she moved to London, where she numbered among her acquaintance Hallam, Milman, Malthus, Monckton Milnes, Sydney Smith, Bulwer, and later Carlyle. Till 1834 she continued to be occupied with her political economy series and with a supplemental series of *Illustrations of Taxation*. Four stories dealing with the poor-law came out about the same time. These tales, direct, lucid, written without any appearance of effort, and yet practically effective, display the characteristics of their author's style. In 1834, when the series was complete, Miss Martineau paid a long visit to America. Here her open adhesion to the Abolitionist party, then small and very unpopular, gave great offence, which was deepened by the publication, soon after her return, of *Society in America* (1837) and a *Retrospect of Western Travel* (1838). An article in the *Westminster Review*, "The Martyr Age of the United States," introduced English readers to the struggles of the Abolitionists. The American books were followed by a novel, *Deerbrook* (1839)—a story of middle-class country life. To the same period belong a few little handbooks, forming parts of a *Guide to Service*. The veracity of her *Maid of All Work* led to a widespread belief, which she regarded with some complacency, that she had once been a maid of all work herself.

In 1839, during a visit to the Continent, Miss Martineau's health broke down. She retired to solitary lodgings in Tyne-mouth, and remained an invalid till 1844. Besides a novel, *The Hour and the Man* (1840), *Life in the Sickroom* (1844), and the *Playfellow* (1841), she published a series of tales for children containing some of her most popular work: *Settlers at Home, The Peasant and the Prince, Feats on the Fiord*, &c. During this illness she for a second time declined a pension on the civil list, fearing to compromise her political independence. Her letter on the subject was published, and some of her friends raised a small annuity for her soon after.

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[1] The older English form, martlet (French, *Martelet*), is, except in heralds' language, almost obsolete, and when used is now applied in some places to the Swift (*q.v.*). The bird called martin by French colonists in the Old World is a mynah (*Acridotheres*). (See Grackle.)

In 1844 Miss Martineau underwent a course of mesmerism, and in a few months was restored to health. She eventually published an account of her case, which had caused much discussion, in sixteen *Letters on Mesmerism*. On her recovery she removed to Ambleside, where she built herself "The Knoll," the house in which the greater part of her after life was spent. In 1845 she published three volumes of *Forest and Game Law Tales*. In 1846 she made a tour with some friends in Egypt, Palestine and Syria, and on her return published *Eastern Life, Present and Past* (1848). This work showed that as humanity passed through one after another of the world's historic religions, the conception of the Deity and of Divine government became at each step more and more abstract and indefinite. The ultimate goal Miss Martineau believed to be philosophic atheism, but this belief she did not expressly declare. She published about this time *Household Education*, expounding the theory that freedom and rationality, rather than command and obedience, are the most effectual instruments of education. Her interest in schemes of instruction led her to start a series of lectures, addressed at first to the school children of Ambleside, but afterwards extended, at their own desire, to their elders. The subjects were sanitary principles and practice, the histories of England and North America, and the scenes of her Eastern travels. At the request of Charles Knight she wrote, in 1849, *The History of the Thirty Years' Peace, 1816–1846*—an excellent popular history written from the point of view of a "philosophical Radical," completed in twelve months.

In 1851 Miss Martineau edited a volume of *Letters on the Laws of Man's Nature and Development*. Its form is that of a correspondence between herself and H. G. Atkinson, and it expounds that doctrine of philosophical atheism to which Miss Martineau in *Eastern Life* had depicted the course of human belief as tending. The existence of a first cause is not denied, but is declared unknowable, and the authors, while regarded by others as denying it, certainly considered themselves to be affirming the doctrine of man's moral obligation. Atkinson was a zealous exponent of mesmerism, and the prominence given to the topics of mesmerism and clairvoyance heightened the general disapprobation of the book, which caused a lasting division between Miss Martineau and some of her friends.

She published a condensed English version of the *Philosophie Positive* (1853). To the *Daily News* she contributed regularly from 1852 to 1866. Her *Letters from Ireland*, written during a visit to that country in the summer of 1852, appeared in that paper. She was for many years a contributor to the *Westminster Review*, and was one of the little band of supporters whose pecuniary assistance in 1854 prevented its extinction or forced sale. In the early part of 1855 Miss Martineau found herself suffering from heart disease. She now began to write her autobiography, but her life, which she supposed to be so near its close, was prolonged for twenty years. She died at "The Knoll" on the 27th of June 1876.

She cultivated a tiny farm at Ambleside with success, and her poorer neighbours owed much to her. Her busy life bears the consistent impress of two leading characteristics—industry and sincerity. The verdict which she records on herself in the autobiographical sketch left to be published by the *Daily News* has been endorsed by posterity. She says—"Her original power was nothing more than was due to earnestness and intellectual clearness within a certain range. With small imaginative and suggestive powers, and therefore nothing approaching to genius, she could see clearly what she did see, and give a clear expression to what she had to say. In short, she could popularize while she could neither discover nor invent." Her judgment on large questions was clear and sound, and was always the judgment of a mind naturally progressive and Protestant.

See her *Autobiography, with Memorials by Maria Weston Chapman* (1877) and Mrs. Fenwick Miller, *Harriet Martineau* (1884, "Eminent Women Series").

MARTINEAU, JAMES (1805–1900), English philosopher and divine, was born at Norwich on the 21st of April 1805, the seventh child of Thomas Martineau and Elizabeth Rankin, the sixth, his senior by almost three years, being his sister Harriet (see above). He was descended from Gaston Martineau, a Huguenot surgeon and refugee, who married in 1693 Marie Pierre, and settled soon afterwards in Norwich. His son and grandson—respectively the great-grandfather and grandfather of James Martineau—were surgeons in the same city, while his father was a manufacturer and merchant. James was educated at Norwich Grammar School under Edward Valpy, as good a scholar as his better-known brother Richard. But the boy proving too sensitive for the life of a public day school, was sent to Bristol to the private academy of Dr Lant Carpenter, under whom he studied for two years. On leaving he was apprenticed to a civil engineer at Derby, where he acquired "a store of exclusively scientific conceptions,"[1] but also experienced the hunger of mind which forced him to look to religion for satisfaction. Hence came his "conversion," and the sense of vocation for the ministry which impelled him in 1822 to enter Manchester College, then lodged at York. Here he "woke up to the interest of moral and metaphysical speculations." Of his teachers, one, the Rev. Charles Wellbeloved, was, Martineau said, "a master of the true Lardner type, candid and catholic, simple and thorough, humanly fond indeed of the counsels of peace, but piously serving every bidding of sacred truth." "He never justified a prejudice; he never misdirected our admiration; he never hurt an innocent feeling or overbore a serious judgment; and he set up within us a standard of Christian scholarship to which it must ever exalt us to aspire."[2] The other, the Rev. John Kenrick, he described as a man so learned as to be placed by Dean Stanley "in the same line with Blomfield and Thirlwall,"[3] and as "so far above the level of either vanity or dogmatism, that cynicism itself could not think of them in his presence."[4]

On leaving the college in 1827 Martineau returned to Bristol to teach in the school of Lant Carpenter; but in the following year he was ordained for a Unitarian church in Dublin, whose senior minister was a relative of his own. But his career there was in 1832 suddenly cut short by difficulties growing out of the "regium donum," which had on the death of the senior minister fallen to him. He conceived it as "a religious monopoly" to which "the nation at large contributes," while "Presbyterians alone receive," and which placed him in "a relation to the state" so "seriously objectionable" as to be "impossible to hold."[5] The invidious distinction it drew between Presbyterians on the one hand, and Catholics, Friends, freethinking Christians, unbelievers and Jews on the other, who were compelled to support a ministry they "conscientiously disapproved," offended his always delicate conscience; while possibly the intellectual and ecclesiastical atmosphere of the city proved uncongenial to his liberal magnanimity. From Dublin he was called to Liverpool, and there for a quarter of a century he exercised extraordinary influence as a preacher, and achieved a high reputation as a writer in religious philosophy. In 1840 he was appointed professor of mental and moral philosophy and political economy in Manchester New College, the seminary in which he had himself been educated, and which had now removed from York to the city after which it was named. This position he held for forty-five years. In 1853 the college removed to London, and four years later he followed it thither. In 1858 he was called to occupy the pulpit of Little Portland Street chapel in London, which he did at first for two years in conjunction with the Rev. J. J. Tayler, who was also his colleague in the college, and then for twelve years alone. In 1866 the chair of the philosophy of mind and logic in University College, London, fell vacant, and Martineau became a candidate. But potent opposition was offered to the appointment of a minister of religion, and the chair went to George Croom Robertson—then an untried man—between whom and Martineau a cordial friendship came to exist. In 1885 he retired, full of years and honours, from the principalship of the college he had so long served and adorned. Martineau, who was in his youth denied the benefit of a university education, yet in his age found famous universities eager to confer upon him their highest distinctions. He was made LL.D. of Harvard in 1872, S.T.D. of Leiden in 1874, D.D. of Edinburgh in 1884, D.C.L. of Oxford in 1888 and D.Litt. of Dublin in 1891. He died in London on the 11th of January 1900.

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[1] *Types of Ethical Theory*, i. 8.

[2] *Essays, Reviews and Addresses*, iv. 54.

[3] Ibid. i. 397.

[4] *Essays, Reviews and Addresses*, i. 419.

[5] Martineau's "Letter to the Dissenting Congregation of Eustace Street" (Dublin).

The life of Martineau was so essentially the life of the thinker, and was so typical of the century in which he lived and the society within which he moved, that he can be better understood through his spoken mind than through his outward history. He was a man happy in his ancestry; he inherited the dignity, the reserve, the keen and vivid intellect, and the picturesque imagination of the French Huguenot, though they came to him chastened and purified by generations of Puritan discipline exercised under the gravest ecclesiastical disabilities, and of culture maintained in the face of exclusion from academic privileges. He had the sweet and patient temper which knew how to live, unrepining and unsoured, in the midst of the most watchful persecution, public and private; and it is wonderful how rarely he used his splendid rhetoric for the purposes of invective against the spirit and policy from which he must have suffered deeply, while, it may be added, he never hid an innuendo under a metaphor or a trope. He was fundamentally too much a man of strong convictions to be correctly described as open-minded, for if nature ever determined any man's faith, it was his; the root of his whole intellectual life, which was too deep to be disturbed by any superficial change in his philosophy, being the feeling for God. He has, indeed, described in graphic terms the greatest of the more superficial changes he underwent; how he had "carried into logical and ethical problems the maxims and postulates of physical knowledge," and had moved within the narrow lines drawn by the philosophical instructions of the class-room "interpreting human phenomena by the analogy of external nature"; how he served in willing captivity "the 'empirical' and 'necessarian' mode of thought," even though "shocked" by the dogmatism and acrid humours "of certain distinguished representatives";[1] and how in a period of "second education" at Berlin, "mainly under the admirable guidance of Professor Trendelenburg," he experienced "a new intellectual birth" which "was essentially the gift of fresh conceptions, the unsealing of hidden openings of self-consciousness, with unmeasured corridors and sacred halls behind; and, once gained, was more or less available throughout the history of philosophy, and lifted the darkness from the pages of Kant and even Hegel."[2] But though this momentous change of view illuminated his old beliefs and helped him to re-interpret and re-articulate them, yet it made him no more of a theist than he had been before. And as his theism was, so was his religion and his philosophy. Certainly it was true of him, in a far higher degree than of John Henry Newman, that the being of God and himself were to his mind two absolutely self-luminous truths—though both his God and his self were almost infinitely remote from Newman's. And as these truths were self-evident, so the religion he deduced from them was sufficient, not only for his own moral and intellectual nature, but also for man as he conceived him, for history as he knew it, and for society as he saw it.

We may, alternatively, describe Martineau's religion as his applied philosophy or his philosophy as his explicated religion, and both as the expression of his singularly fine ethical and reverent nature. But to understand these in their mutual and explanatory relations it will be necessary to exhibit the conditions under which his thought grew into consistency and system. His main function made him in his early life a preacher even more emphatically than a teacher. In all he said and all he thought he had the preacher's end in view. He was, indeed, no mere orator or speaker to multitudes. He addressed a comparatively small and select circle, a congregation of thoughtful and devout men, who cultivated reverence and loved religion all the more that their own beliefs were limited to the simplest and sublimest truths. He felt the majesty of these truths to be the greater that they so represented to him not only the most fundamental of human beliefs, but also all that man could be reasonably expected to believe, though to believe with his whole reason. Hence the beliefs he preached were never to him mere speculative ideas, but rather the ultimate realities of being and thought, the final truths as to the character and ways of God interpreted into a law for the government of conscience and the regulation of life. And so he became a positive religious teacher by virtue of the very ideas that made the words of the Hebrew prophets so potent and sublime. But he did more than interpret to his age the significance of man's ultimate theistic beliefs, he gave them vitality by reading them through the consciousness of Jesus Christ. His religion was what he conceived the personal religion of Jesus to have been; and He was to him more a person to be imitated than an authority to be obeyed, rather an ideal to be revered than a being to be worshipped.

Martineau's mental qualities fitted him to fulfil these high interpretative functions. He had the imagination that invested with personal being and ethical qualities the most abstruse notions. To him space became a mode of divine activity, alive with the presence and illuminated by the vision of God; time was an arena where the divine hand guided and the divine will reigned. And though he did not believe in the Incarnation, yet he held deity to be in a sense manifest in humanity; its saints and heroes became, in spite of innumerable frailties, after a sort divine; man underwent an apotheosis, and all life was touched with the dignity and the grace which it owed to its source. The 19th century had no more reverent thinker than Martineau; the awe of the Eternal was the very atmosphere that he breathed, and he looked at man with the compassion of one whose thoughts were full of God.

To his function as a preacher we owe some of his most characteristic and stimulating works, especially the discourses by which it may be said he won his way to wide and influential recognition—*Endeavours after the Christian Life*, 1st series, 1843; 2nd series, 1847; *Hours of Thought*, 1st series, 1876; 2nd series, 1879; the various hymn-books he issued at Dublin in 1831, at Liverpool in 1840, in London in 1873; and the *Home Prayers* in 1891. But besides the vocation he had freely selected and assiduously laboured to fulfil, two more external influences helped to shape Martineau's mind and define his problem and his work; the awakening of English thought to the problems which underlie both philosophy and religion, and the new and higher opportunities offered for their discussion in the periodical press. The questions which lived in the earlier and more formative period of his life concerned mainly the idea of the church, the historical interpretation of the documents which described the persons who had created the Christian religion, especially the person and work of its founder; but those most alive in his later and maturer time chiefly related to the philosophy of religion and ethics. In one respect Martineau was singularly happy; he just escaped the active and, on the whole, belittling period of the old Unitarian controversy. When his ministry began its fires were slowly dying down, though the embers still glowed. We feel its presence in his earliest notable work, *The Rationale of Religious Enquiry*, 1836; and may there see the rigour with which it applied audacious logic to narrow premisses, the tenacity with which it clung to a limited literal supernaturalism which it had no philosophy to justify, and so could not believe without historical and verbal authority. This traditional conservatism survived in the statement, which, while it caused vehement discussion when the book appeared, was yet not so much characteristic of the man as of the school in which he had been trained, that "in no intelligible sense can any one who denies the supernatural origin of the religion of Christ be termed a Christian," which term, he explained, was used not as "a name of praise," but simply as "a designation of belief."[3] He censured the German rationalists "for having preferred, by convulsive efforts of interpretation, to compress the memoirs of Christ and His apostles into the dimensions of ordinary life, rather than admit the operation of miracle on the one hand, or proclaim their abandonment of Christianity on the other."[4] The echoes of the dying controversy are thus distinct and not very distant in this book, though it also offers in its larger outlook, in the author's evident uneasiness under the burden of inherited beliefs, and his inability to reconcile them with his new standpoint and accepted principles, a curious forecast of his later development, while in its positive premisses it presents a still more instructive contrast to the conclusions of his later dialectic. Nor did the sound of the ancient controversy ever cease to be audible to him. In 1839 he sprang to the defence of Unitarian doctrine, which had been assailed by certain Liverpool clergymen, of whom Fielding Ould was the most active and Hugh McNeill the most famous. As his share in the controversy, Martineau published five discourses, in which he discussed "the Bible as the great autobiography of human nature from its infancy to its perfection," "the Deity of Christ," "Vicarious Redemption," "Evil," and "Christianity without Priest and without Ritual."[1] He remained to the end a keen and vigilant apologist of the school in which he had been nursed. But the questions proper to the new day came swiftly upon his quick and susceptible mind—enlarged, deepened and developed it. Within his own fold new light was breaking. To W. E. Channing (*q.v.*), whom Martineau had called "the inspirer of his youth," Theodore Parker had succeeded, introducing more radical ideas as to religion and a more drastic criticism of sacred history. Blanco White, "the rationalist A'Kempis," who had dared to appear as "a religious sceptic in God's presence," had found a biographer and interpreter in Martineau's friend and colleague, John Hamilton Thom. Within the English Church men with whom he had both personal and religious sympathy rose—Whately, of whom he said, "We know no living writer who has proved so little and disproved so much";[2] and Thomas Arnold, "a man who could be a hero without romance";[3] F. D. Maurice, whose character, marked by "religious realism," sought in the past "the witness to eternal truths, the manifestation by time-samples of infinite realities and unchanging relations";[4] and Charles Kingsley, "a great teacher," though one "certain to go astray the moment he becomes didactic."[5] Beside these may be placed men like E. B. Pusey and J. H. Newman, whose mind Martineau said was "critical, not prophetic, since without immediateness of religious vision," and whose faith is "an escape from an alternative scepticism, which receives the *veto* not of his reason but of his will,"[6] as men for whose teachings and methods he had a potent and stimulating antipathy. The philosophic principles and religious deductions of Dean Mansel he disliked as much as those of Newman, but he respected his arguments more. Apart from the Churches, men like Carlyle and Matthew Arnold—with whom he had much in common—influenced him; while Herbert Spencer in England and Comte in France afforded the antithesis needful to the dialectical development of his own views. He came to know German philosophy and criticism, especially the criticism of Baur and the Tübingen school, which affected profoundly his construction of Christian history. And these were strengthened by French influences, notably those of Renan and the Strassburg theologians. The rise of evolution, and the new scientific way of looking at nature and her creative methods, compelled him to rethink and reformulate his theistic principles and conclusions, especially as to the forms under which the relation of God to the world and His action within it could be conceived. Under the impulses which came from these various sides Martineau's mind lived and moved, and as they successively rose he promptly, by appreciation or criticism, responded to the dialectical issues which they raised.

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[1] *Types of Ethical Theory*, i. pp. vii.–ix.

[2] Ibid. p. xiii.

[3] *Rationale*, 2nd ed., pref., p. vii.

[4] Ibid. p. 133.

In the discussion of these questions the periodical press supplied him with the opportunity of taking an effective part. At first his literary activity was limited to sectional publications, and he addressed his public, now as editor and now as leading contributor, in the *Monthly Repository*, the *Christian Reformer*, the *Prospective*, the *Westminster* and the *National Review*. Later, especially when scientific speculation had made the theistic problem urgent, he was a frequent contributor to the literary monthlies. And when in 1890 he began to gather together the miscellaneous essays and papers written during a period of sixty years, he expressed the hope that, though "they could lay no claim to logical consistency," they might yet show "beneath the varying complexion of their thought some intelligible moral continuity," "leading in the end to a view of life more coherent and less defective than was presented at the beginning."[7] And though it is a proud as well as a modest hope, no one could call it unjustified. For his essays are fine examples of permanent literature appearing in an ephemeral medium, and represent work which has solid worth for later thought as well as for the speculation of their own time. There is hardly a name or a movement in the religious history of the century which he did not touch and illuminate. It was in this form that he criticized the "atheistic mesmerism" to which his sister Harriet had committed herself, and she never forgave his criticism. But his course was always singularly independent, and, though one of the most affectionate and most sensitive of men, yet it was his fortune to be so fastidious in thought and so conscientious in judgment as often to give offence or create alarm in those he deeply respected or tenderly loved.

The theological and philosophical discussions which thus appeared he later described as "the tentatives which gradually prepared the way for the more systematic expositions of the *Types of Ethical Theory* and *The Study of Religion*, and, in some measure, of *The Seat of Authority in Religion*."[8] These books expressed his mature thought, and may be said to contain, in what he conceived as a final form, the speculative achievements of his life. They appeared respectively in 1885, 1888 and 1890, and were without doubt remarkable feats to be performed by a man who had passed his eightieth year. Their literary and speculative qualities are indeed exceptionally brilliant; they are splendid in diction, elaborate in argument, cogent yet reverent, keen while fearless in criticism. But they have also most obvious defects: they are unquestionably the books of an old man who had thought much as well as spoken and written often on the themes he discusses, yet who had finally put his material together in haste at a time when his mind had lost, if not its dialectic vigour, yet its freshness and its sense of proportion; and who had been so accustomed to amplify the single stages of his argument that he had forgotten how much they needed to be reduced to scale and to be built into an organic whole. In the first of these books his nomenclature is unfortunate; his division of ethical theories into the "unpsychological," "idiopsychological," and the "hetero-psychological," is incapable of historical justification; his exposition of single ethical systems is, though always interesting and suggestive, often arbitrary and inadequate, being governed by dialectical exigencies rather than historical order and perspective. In the second of the above books his idea of religion is somewhat of an anachronism; as he himself confessed, he "used the word in the sense which it invariably bore half a century ago," as denoting "belief in an ever-living God, a divine mind and will ruling the universe and holding moral relations with mankind." As thus used, it was a term which governed the problems of speculative theism rather than those connected with the historical origin, the evolution and the organization of religion. And these are the questions which are now to the front. These criticisms mean that his most elaborate discussions came forty years too late, for they were concerned with problems which agitated the middle rather than the end of the 19th century. But if we pass from this criticism of form to the actual contents of the two books, we are bound to confess that they constitute a wonderfully cogent and persuasive theistic argument. That argument may be described as a criticism of man and his world used as a basis for the construction of a reasoned idea of nature and being. Man and nature, thought and being, fitted each other. What was implicit in nature had become explicit in man; the problem of the individual was one with the problem of universal experience. The interpretation of man was therefore the interpretation of his universe. Emphasis was made to fall on the reason, the conscience and the will of the finite personality; and just as these were found to be native in him they were held to be immanent in the cause of his universe. What lived in time belonged to eternity; the microcosm was the epitome of the macrocosm; the reason which reigned in man interpreted the law that was revealed in conscience and the power which governed human destiny, while the freedom which man realized was the direct negation both of necessity and of the operation of any fortuitous cause in the cosmos.

It was not possible, however, that the theistic idea could be discussed in relation to nature only. It was necessary that it should be applied to history and to the forces and personalities active within it. And of these the greatest was of course the Person that had created the Christian religion. What did Jesus signify? What authority belonged to Him and to the books that contain His history and interpret His person? This was the problem which Martineau attempted to deal with in *The Seat of Authority in Religion*. The workmanship of the book is unequal: historical and literary criticism had never been Martineau's strongest point, although he had almost continuously maintained an amount of New Testament study, as his note-books show. In its speculative parts the book is quite equal to those that had gone before, but in its literary and historical parts there are indications of a mind in which a long-practised logic had become a rooted habit. While a comparison of his expositions of the Pauline and Johannine Christologies with the earlier Unitarian exegesis in which he had been trained shows how wide is the interval, the work does not represent a mind that had throughout its history lived and worked in the delicate and judicial investigations he here tried to conduct.

Martineau's theory of the religious society or church was that of an idealist rather than of a statesman or practical politician. He stood equally remote from the old Voluntary principle, that "the State had nothing to do with religion," and from the sacerdotal position that the clergy stood in an apostolic succession, and either constituted the Church or were the persons into whose hands its guidance had been committed. He hated two things intensely, a sacrosanct priesthood and an enforced uniformity. He may be said to have believed in the sanity and sanctity of the state rather than of the Church. Statesmen he could trust as he would not trust ecclesiastics. And so he even propounded a scheme, which fell still-born, that would have repealed uniformity, taken the church out of the hands of a clerical order, and allowed the coordination of sects or churches under the state. Not that he would have allowed the state to touch doctrine, to determine polity or discipline; but he would have had it to recognize historical achievement, religious character and capacity, and endow out of its ample resources those societies which had vindicated their right to be regarded as making for religion. His ideal may have been academic, but it was the dream of a mind that thought nobly both of religion and of the state.

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[1] They stand as Lectures ii., v., vi., xi., xii. in the volume *Unitarianism Defended*, 1839.

[2] *Essays, Reviews and Addresses*, ii. 10.

[3] Ibid. i. 46.

[4] Ibid. i. 258, 262.

[5] Ibid. ii. 285.

[6] Ibid. i. 233.

[7] *Essays, Reviews and Addresses*, i., iii.

[8] Ibid. iii., pref., p. vi.

See *Life and Letters* by J. Drummond and C. B. Upton (2 vols., 1901); J. E. Carpenter, *James Martineau, Theologian and Teacher* (1905); J. Crawford, *Recollections* of James Martineau (1903); A. W. Jackson, *James Martineau, a Biography and a Study* (Boston, 1900); H. Sidgwick, *Lectures on the Ethics of Green, Spencer and Martineau* (1902); and J. Hunt, *Religious Thought in England in the 19th Century*. (A. M. F.)

MARTINET, a military term (more generally used in a disparaging than in a complimentary sense) implying a strict disciplinarian or drill-master. The term originated in the French army about the middle of Louis XIV.'s reign, and was derived from Jean Martinet (d. 1672), who as lieutenant-colonel of the King's regiment of foot and inspector-general of infantry drilled and trained that arm in the model regular army created by Louis and Louvois between 1660 and 1670. Martinet seems also to have introduced the copper pontoons with which Louis bridged the Rhine in 1672. He was killed, as a *maréchal de camp*, at the siege of Duisburg in the same year, being accidentally shot by his own artillery while leading the infantry assault. His death, and that of the Swiss captain Soury by the same discharge gave rise to a *bon mot*, typical of the polite ingratitude of the age, that Duisburg had only cost the king a martin and a mouse. The "martin" as a matter of fact shares with Vauban and other professional soldiers of Louis XIV. the glory of having made the French army the first and best regular army in Europe. Great nobles, such as Turenne, Condé and Luxemburg, led this army and inspired it, but their fame has obscured that of the men who made it manageable and efficient. It was about this time that the soldier of fortune, who joined a regiment with his own arms and equipment and had learned his trade by varied experience, began to give place to the soldier regularly enlisted as a recruit in permanent regiments and trained by his own officers. The consequence of this was the introduction of a uniform, or nearly uniform system of drill and training, which in all essentials has endured to the present day. Thus Martinet was the forerunner of Leopold of Dessau and Frederick William, just as Jean Jacques de Fourilles, the organizer of the cavalry, who was forced into an untimely charge at Seneffe (1674) by a brutal taunt of Condé, and there met his death, was the forerunner of Zieten and Seydlitz. These men, while differing from the creators of the Prussian army in that they contributed nothing to the tactics of their arms, at least made tactics possible by the thorough drilling and organization they imparted to the formerly heterogeneous and hardly coherent elements of an army.

MARTÍNEZ DE LA ROSA, FRANCISCO DE PAULA (1789–1862), Spanish statesman and dramatist, was born on the 10th of March 1789 at Granada, and educated at the university there. He won popularity with a series of epigrams on local celebrities published under the title of *El Cementerio de momo*. During the struggle against Napoleon he took the patriotic side, was elected deputy, and at Cadiz produced his first play, *Lo que puede un empleo*, a prose comedy in the manner of the younger Moratin. *La Viuda de Padilla* (1814), a tragedy modelled upon Alfieri, was less acceptable to the Spanish public. Meanwhile the author became more and more engulfed in politics, and in 1814 was banished to Africa, where he remained till 1820, when he was suddenly recalled and appointed prime minister. During the next three years he was the most unpopular man in Spain; denounced as a revolutionist by the Conservatives and as a reactionary by the Liberals, he alienated the sympathies of all parties, and his rhetoric earned for him the contemptuous nickname of *Rosita la Pastelera*. Exiled in 1823, he took refuge in Paris, where he issued his *Obras literarias* (1827), including his *Arte poêtica*, in which he exaggerated the literary theories already promulgated by Luzán. Returning to Spain in 1831, he became prime minister on the death of Ferdinand VII., but proved incapable of coping with the insurrectionary movement and resigned in 1834. He was ambassador at Paris in 1839–1840 and at Rome in 1842–1843, joined the Conservative party, held many important offices, and was president of congress and director of the Spanish academy at the time of his death, which took place at Madrid on the 7th of February 1862. As a statesman, Martínez de la Rosa never rose above mediocrity. It was his misfortune to be in place without real power, to struggle against a turbulent pseudo-democratic movement promoted by unscrupulous soldiers, and to contend with the intrigues of the king, the court camarilla and the clergy. But circumstances which hampered him in politics favoured his career in literature. He was not a great natural force; his early plays and poems are influenced by Moratin or by Meléndez Valdés; his *Espíritu del siglo* (1835) is an elegant summary of all the commonplaces concerning the philosophy of history; his *Doña Isabel de Solís* (1837–1846) is a weak imitation of Walter Scott's historical novels. Still his place in the history of Spanish literature is secure, if not eminent. Through the happy accident of his exile at Paris he was thrown into relations with the leaders of the French romantic movement, and was so far impressed with the innovations of the new school as to write in French a romantic piece entitled *Aben-Humeya* (1830), which was played at the Porte Saint-Martin. The experiment was not unsuccessful, and on his return to Madrid Martínez de la Rosa produced *La Conjuración de Venecia* (April 23, 1834), which entitles him to be called the pioneer of the romantic drama in Spain. The play is more reminiscent of Casimir Delavigne than of Victor Hugo; but it was unquestionably effective, and smoothed the way for the bolder essays of Rivas, Garcia Gutiérrez and Hartzenbusch.

MARTINI, GIOVANNI BATTISTA (1706–1784), Italian musician, was born at Bologna on the 24th of April 1706. His father, Antonio Maria Martini, a violinist, taught him the elements of music and the violin; later he learned singing and harpsichord playing from Padre Pradieri, and counterpoint from Antonio Riccieri. Having received his education in classics from the fathers of the oratory of San Filippo Neri, he afterwards entered upon a noviciate at the Franciscan monastery at Lago, at the close of which he was received as a Minorite on the 11th of September 1722. In 1725, though only nineteen years old, he received the appointment of chapel-master in the Franciscan church at Bologna, where his compositions attracted attention. At the invitation of amateurs and professional friends he opened a school of composition at which several celebrated musicians were trained; as a teacher he consistently declared his preference for the traditions of the old Roman school of composition. Padre Martini was a zealous collector of musical literature, and possessed an extensive musical library. Burney estimated it at 17,000 volumes; after Martini's death a portion of it passed to the Imperial library at Vienna, the rest remaining in Bologna, now in the Liceo Rossini. Most contemporary musicians speak of Martini with admiration, and Mozart's father consulted him with regard to the talents of his son. Abt Vogler, however, makes reservations in his praise, condemning his philosophical principles as too much in sympathy with those of Fox, which had already been expressed by P. Vallotti. He died at Bologna on the 4th of August 1784. His *Elogio* was published by Pietro della Valle at Bologna in the same year.

The greater number of Martini's sacred compositions remain unprinted. The Liceo of Bologna possesses the MSS. of two oratorios; and a requiem, with some other pieces of church music, are now in Vienna. *Litaniae atque antiphonae finales B. V. Mariae* were published at Bologna in 1734, as also twelve *Sonate d'intavolatura*; six *Sonate per l'organo ed il cembalo* in 1747; and *Duetti da camera* in 1763. Martini's most important works are his *Storia della musica* (Bologna, 1757–1781) and his *Saggio di contrapunto* (Bologna, 1774–1775). The former, of which the three published volumes relate wholly to ancient music, and thus represent a mere fragment of the author's vast plan, exhibits immense reading and industry, but is written in a dry and unattractive style, and is overloaded with matter which cannot be regarded as historical. At the beginning and end of each chapter occur puzzle-canons, wherein the primary part or parts alone are given, and the reader has to discover the canon that fixes the period and the interval at which the response is to enter. Some of these are exceedingly difficult, but Cherubini solved the whole of them. The *Saggio* is a learned and valuable work, containing an important collection of examples from the best masters of the old Italian and Spanish schools, with excellent explanatory notes. It treats chiefly of the tonalities of the plain chant, and of counterpoints constructed upon them. Besides being the author of several controversial works, Martini drew up a *Dictionary of Ancient Musical Terms*, which appeared in the second volume of G. B. Doni's *Works*; he also published a treatise on *The Theory of Numbers as applied to Music*. His celebrated canons, published in London, about 1800, edited by Pio Cianchettini, show him to have had a strong sense of musical humour.

MARTINI, SIMONE (1283–1344), Sienese painter, called also Simone di Martino, and more commonly, but not correctly, Simon Memmi,[1] was born in 1283. He followed the manner of painting proper to his native Siena, as improved by Duccio, which is essentially different from the style of Giotto and his school, and the idea that Simone was himself a pupil of Giotto is therefore wide of the mark. The Sienese style is less natural, dignified and reserved than the Florentine; it has less unity of impression, has more tendency to pietism, and is marked by exaggerations which are partly related to the obsolescent Byzantine manner, and partly seem to forebode certain peculiarities of the fully developed art which we find prevalent in Michelangelo. Simone, in especial, tended to an excessive and rather affected tenderness in his female figures; he was more successful in single figures and in portraits than in large compositions of incident. He finished with scrupulous minuteness, and was elaborate in decorations of patterning, gilding, &c.

The first known fresco of Simone is the vast one which he executed in the hall of the Palazzo Pubblico in Siena—the "Madonna Enthroned, with the Infant," and a number of angels and saints; its date is 1315, at which period he was already an artist of repute throughout Italy. In S. Lorenzo Maggiore of Naples he painted a life-sized picture of King Robert crowned by his brother Lewis, bishop of Toulouse; this also is extant, but much damaged. In 1320 he painted for the high altar of the church of S. Caterina in Pisa the Virgin and Child between six saints; above are archangels, apostles and other figures. The compartmented portions of this work are now dispersed, some of them being in the academy of Siena. Towards 1321 he executed for the church of S. Domenico in Orvieto a picture of the bishop of Savona kneeling before the Madonna attended by saints, now in the Fabriceria of the cathedral. Certain frescoes in Assisi in the chapel of San Martino, representing the life of that saint, ascribed by Vasari to Puccio Capanna, are now, upon internal evidence, assigned to Simone. He painted also, in the south transept of the lower church of the same edifice, figures of the Virgin and eight saints. In 1328 he produced for the sala del consilio in Siena a striking equestrian portrait of the victorious general Guidoriccio Fogliani de' Ricci.

Simone had married in 1324 Giovanna, the daughter of Memmo (Guglielmo) di Filippuccio. Her brother, named Lippo Memmi, was also a painter, and was frequently associated with Simone in his work; and this is the only reason why Simone has come down to us with the family-name Memmi. They painted together in 1333 the "Annunciation" which is now in the Uffizi gallery. Simone kept a bottega (or shop), undertaking any ornamental work, and his gains were large. In 1339 he settled at the papal court in Avignon, where he made the acquaintance of Petrarch and Laura; and he painted for the poet a portrait of his lady, which gave occasion for two of Petrarch's sonnets, in which Simone is eulogized. He also illuminated for the poet a copy of the commentary of Servius upon Virgil, now preserved in the Ambrosian library of Milan. He was largely employed in the decorations of the papal buildings in Avignon, and several of his works still remain—in the cathedral, in the hall of the consistory, and, in the two chapels of the palace, the stories of the Baptist, and of Stephen and other saints. One of his latest productions (1342) is the picture of "Christ Found by his Parents in the Temple," now in the Liverpool Gallery. Simone died in Avignon in July 1344.

Some of the works with which Simone's name and fame have been generally identified are not now regarded as his. Such are the compositions, in the Campo Santo of Pisa, from the legend of S. Ranieri, and the "Assumption of the Virgin"; and the great frescoes in the Cappellone degli Spagnuoli, in S. Maria Novella, Florence, representing the Triumph of Religion through the work of the Dominican order, &c. (W. M. R.)

MARTINIQUE, an island of the West Indies, belonging to the chain of the Lesser Antilles, and constituting a French colony, between the British islands of Dominica and St Lucia, 25 m. S. of the one and 20 m. N. of the other, about 14° 40′ N., 61° W. Its length is 40 m., its greatest width 21 m.; and the area comprises 380 sq. m. A cluster of volcanic mountains in the north, a similar group in the south, and a line of lower heights between them, form the backbone of the island. Its deep ravines and precipitous escarpments are reduced in appearance to gentle undulations by the drapery of the forests. The massif of Mont Pelé in the north is the culminating point of the island (4430 ft.); that of Carbet is little inferior (3963 ft.), but the mountains in the south are much lower. Mont Pelé is notorious for an appalling eruption in May 1902.

Of the numerous streams which traverse the few miles of country between the watershed and the sea (the longest radiating from Mount Carbet), about seventy-five are of considerable size, and in the rainy season become deep and often destructive torrents. On the north-west and north the coast is elevated and bold; and similarly on the south, where a lateral range, branching from the backbone of the island, forms a blunt peninsula bounding the low-shored western bay of Fort de France on the south. Another peninsula, called Caravelle, projects from the middle part of the east coast, and south of this the coast is low and fretted, with many islets and cays lying off it. Coral reefs occur especially in this locality. Plains, most numerous and extensive in the south, occupy about one-third of the total area of the island.

The mean annual temperature is 80° F. in the coast region, the monthly mean for June being 83°, and that for January 77°. Of the annual rainfall of 87 in., August has the heaviest share (11·3 in.), though the rainy season extends from June to October; March, the driest month, has 3·7. Martinique enjoys a marked immunity from hurricanes. The low coastal districts are not very healthy for Europeans in the hotter months, but there are numerous sanatoria in the forest region at an elevation of about 1500 ft., where the average temperature is some 10° F. lower than that already quoted. The north winds which prevail from November to February are comparatively fresh and dry; those from the south (July to October) are damp and warm. From March to June easterly winds are prevalent.

The population increased from 162,861 in 1878 to 175,863 in 1888 and 203,781 in 1901. In 1902 the great eruption of Mont Pelé occurred, and in 1905 the population was only 182,024. The bulk of the population consists of Creole negroes and half-castes of various grades, ranging from the "Saccatra," who has retained hardly any trace of Caucasian blood, to the so-called "Sangmêlé," with only a suspicion of negro commixture. The capital of the island is Fort de France, on the west-coast bay of the same name, with a fine harbour defended by three forts, and a population of 18,000. The other principal centres of population are, on the west coast Lamentin, on the same bay as the capital, and on the east coast Le François and Le Robert. The colony is administered by a governor and a general council, and returns a senator and two deputies. There are elective municipal councils. The chief product is sugar, and some coffee, cocoa, tobacco and cotton are grown. The island is served by British, French and American steamship lines, and local communications are carried on by small coasting steamers and by subsidized mail coaches, as there are excellent roads. In 1905 the total value of the exports, consisting mainly of sugar, rum and cocoa, was £725,460, France taking by far the greater part, while imports were valued at £596,294, of which rather more than one-half by value came from France, the United States of America being the next principal importing country. In 1903, the year following the eruption of Mont Pelé, exports were valued at £604,163.

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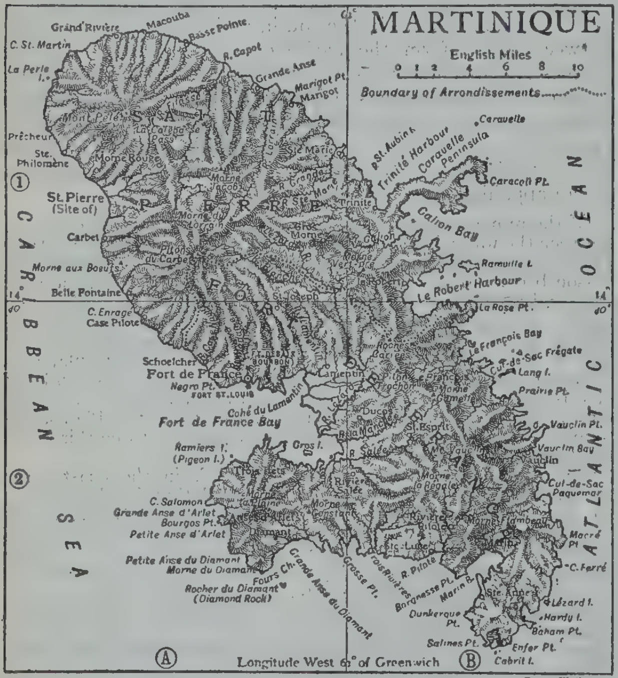
[1] The ordinary account of Simone is that given by Vasari, and since repeated in a variety of forms. Modern research shows that it is far from correct, the incidents being erroneous, and the paintings attributed to Simone in various principal instances not his. We follow the authority of Crowe and Cavalcaselle.

Martinique, the name of which may be derived from a native form Madiana or Mantinino, was probably discovered by Columbus on the 15th of June 1502; although by some authorities its discovery is placed in 1493. It was at that time inhabited by Caribs who had expelled or incorporated an older stock. It was not until the 25th of June 1635 that possession was taken of the island in the name of the French *Compagnie des Îles d'Amérique.* Actual settlement was carried out in the same year by Pierre Belain, Sieur d'Esnambuc, captain-general of the island of St Christopher. In 1637 his nephew Dyel Duparquet (d. 1658) became captain-general of the colony, now numbering seven hundred men, and subsequently obtained the seigneurie of the island by purchase from the company under the authority of the king of France. In 1654 welcome was given to three hundred Jews expelled from Brazil, and by 1658 there were at least five thousand people exclusive of the Caribs, who were soon after exterminated. Purchased by the French government from Duparquet's children for 120,000 livres, Martinique was assigned to the West India Company, but in 1674 it became part of the royal domain. The *habitants* (French landholders) at first devoted themselves to the cultivation of cotton and tobacco; but in 1650 sugar plantations were begun, and in 1723 the coffee plant was introduced. Slave labour having been introduced at an early period of the occupation, there were 60,000 blacks in the island by 1736. This slavery was abolished in 1860. Martinique had a full share of wars. In early days the Caribs were not brought under subjection without severe struggles. In 1666 and 1667 the island was attacked by the British without success, and hostilities were terminated by the treaty of Breda. The Dutch made similar attempts in 1674, and the British again attacked the island in 1693. Captured by Rodney in 1762, Martinique was next year restored to the French; but after the conquest by Sir John Jervis and Sir Charles Grey in 1793 it was retained for eight years; and, seized again in 1809, it was not surrendered till 1814. The island was the birth-place of the Empress Josephine.


MARTINIQUE
English Miles
0 1 2 4 6 8 10
Boundary of Arrondissements
Grand Rivière
Macouba
Basse Pointe
C. St. Martin
La Perle I.
R. Capot
Grande Anse
Marigot Pt.
Marigot
Mont Pelé
SAINT PIERRE
FORT DE FRANCE
Prêcheur
Ste. Philomène
Morne Rouge
Ste Marie
Caravelle
St. Aubin
Trinité Harbour
Caravelle Peninsula
Caracoli Pt.
①
②
St. Pierre (Site of)
Morne Jacob
Trinité
Galion Bay
Carbet
Pitons du Carbet
Gros Morne
Morne aux Boeufs
Ramville I.
Le Robert Harbour
Le Robert
Belle Fontaine
St. Joseph
14°
40'
C. Enrage
Case Pilote
La Rose Pt.
Le François Bay
Cul-de-Sac Frégate
Lang I.
Schoelcher
Fort de France
FT. DESAIX (BOURBON)
Negro Pt.
FORT ST. LOUIS
Lamentin
Prairie Pt.
Cohé du Lamentin
Fort de France Bay
Ducos
St. Esprit
Vauclin Pt.
Ramiers I. (Pigeon I.)
Gros I.
R. Salée
Vauclin Bay
Vauclin
Trois Ilets
Rivière Salée
Morne la Régale
Cul-de-Sac Paquemar
C. Salomon
Grande Anse d'Arlet
Bourgos Pt.
Petite Anse d'Arlet
Anses d'Arlet
Diamant
Morne Constant
Rivière Pilote
Morne Flambeau
Marin
Macré Pt.
Ste. Luce
Petite Anse du Diamant
Morne du Diamant
Fours Ch.
Rocher du Diamant (Diamond Rock)
Grande Anse du Diamant
Grosse Pt.
Trois Rivières
R. Pilote
Borgnesse Pt.
Marin B.
C. Ferré
Ste. Anne
Lézard I.
Hardy I.
Dunkerque Pt.
Baham Pt.
Salines Pt.
Enfer Pt.
Cabrit I.
CARIBBEAN SEA
ATLANTIC OCEAN
Ⓐ
Ⓑ
Longitude West 61° of Greenwich
Emery Walker sc.

Martinique has suffered from occasional severe storms, as in 1767, when 1600 persons perished, and M. de la Pagerie, father of the Empress Josephine, was practically ruined, and in 1839, 1891 and 1903, when much damage was done to the sugar crop. Earthquakes have also been frequent, but the most terrible natural disaster was the eruption of Mont Pelé in 1902, by which the town of St Pierre, formerly the chief commercial centre of the island, was destroyed. During the earlier months of the year various manifestations of volcanic activity had occurred; on the 25th of April there was a heavy fall of ashes, and on the 2nd and 3rd of May a heavy eruption destroyed extensive sugar plantations north of St Pierre, and caused a loss of some 150 lives. A few days later the news that the Souffrière in St Vincent was in eruption reassured the inhabitants of St Pierre, as it was supposed that this outbreak might relieve the volcano of Pelé. But on the 8th of May the final catastrophe came without warning; a mass of fire, compared to a flaming whirlwind, swept over St Pierre, destroying the ships in the harbour, among which, however, one, the "Roddam" of Scrutton, escaped. A fall of molten lava and ashes followed the flames, accompanied by dense gases which asphyxiated those who had thus far escaped. The total loss of life was estimated at 40,000. Consternation was caused not only in the West Indies, but in France and throughout the world, and at first it was seriously suggested that the island should be evacuated, but no countenance was lent to this proposal by the French government. Relief measures were undertaken and voluntary subscriptions raised. The material losses were estimated at £4,000,000; but, besides St Pierre, only one-tenth of the island had been devastated, and although during July there was further volcanic activity, causing more destruction, the economic situation recovered more rapidly than was expected.

See *Annuaire de la Martinique* (Fort de France); H. Mouet, *La Martinique* (Paris, 1892); M. J. Guët, *Origines de la Martinique* (Vannes, 1893); G. Landes, *Notice sur la Martinique* (with full bibliography), (Paris, 1900); M. Dumoret, *Au pays du sucre* (Paris, 1902); and on the eruption of 1902, A. Heilprin, *Mont Pelée and the Tragedy of Martinique* (Philadelphia and London, 1903); A. Lacroix, *La Montagne Pelée et ses éruptions* (Paris, 1904); and the report of Drs J. S. Flett and T. Anderson (November 20, 1902), who investigated the eruptions on behalf of the Royal Society; cf. T. Anderson, "Recent Volcanic Eruptions in the West Indies," in *Geographical Journal*, vol. xxi. (1903).

MARTINSBURG, a town and the county-seat of Berkeley county, West Virginia, U.S.A., about 74 m. W.N.W. of Washington, D.C. Pop. (1890) 7226; (1900) 7564 (678 negroes); (1910) 10,698. It is served by the Baltimore & Ohio and the Cumberland Valley railways; the former has repair shops here. It lies in the Lower Shenandoah Valley at the foot of Little North mountain, in the midst of a fruit-growing region, peaches and apples being the principal crops. Slate and limestone also abound in the vicinity. The town has a fine Federal Building and a King's Daughters' hospital. There are grain elevators, and various manufactures, including hosiery, woollen goods, dressed lumber, &c. Martinsburg owns its waterworks, the supply being derived from a neighbouring spring. A town was laid out here a short time before the War of Independence and was named Martinstown in honour of Colonel Thomas Bryan Martin, a nephew of Thomas, Lord Fairfax (1692–1782); in 1778 it was incorporated under its present name. During the Civil War Martinsburg was occupied by several different Union and Confederate forces.

MARTINS FERRY, a city of Belmont county, Ohio, U.S.A., on the Ohio River, nearly opposite Wheeling, West Virginia. Pop. (1890), 6250; (1900), 7760, including 1033 foreign-born and 252 negroes; (1910), 9133. It is served by the Pennsylvania (Cleveland & Pittsburg Division), the Baltimore & Ohio, and the Wheeling & Lake Erie (Wabash System) railways, and by several steamboat lines. The city is situated on two plateaus; the lower is occupied chiefly by factories, the upper by dwellings. Coal mining and manufacturing are the principal industries; among factory products are iron, steel, tin, stoves, machinery and glassware. The municipality owns and operates the waterworks and an electric-lighting plant. A settlement was attempted here in 1785, but was abandoned on account of trouble with the Indians. In 1795 a town was laid out by Absalom Martin and was called Jefferson, but this, too, was abandoned, on account of its not being made the county-seat. The town was laid out again in 1835 by Ebenezer Martin (son of Absalom Martin) and was called Martinsville; the present name was substituted a few years later. The Martins and other pioneers are buried in Walnut Grove Cemetery within the city limits. Martins Ferry was incorporated as a town in 1865 and chartered as a city in 1885.

MARTINUZZI, GEORGE [György Utiešenović] (1482–1551), Hungarian statesman, who, since he usually signed himself "Frater Georgius," is known in Hungarian history as Frater György or simply The Frater, was born at Kamičic in Croatia, the son of Gregory Utiešenović, a Croatian gentleman. His mother was a Martinuzzi, a Venetian patrician family. From his eighth to his twentieth year he was attached to the court of John Corvinus; subsequently, entering the service of the Zapolya family, he saw something of warfare under John Zapolya but, tiring of a military life, he entered the Paulician Order in his twenty-eighth year. His historical career began when his old patron Zapolya, now king of Hungary, forced to fly before his successful rival Ferdinand, afterwards the emperor Ferdinand I., sent him on a diplomatic mission to Hungary. It was due to his tact and ability that John recovered Buda (1529), and henceforth Frater György became his treasurer and chief counsellor. In 1534 he became bishop of Grosswardein; in 1538 he concluded with Austria the peace of Grosswardein, whereby the royal title and the greater part of Hungary were conceded to Zapolya. King John left the Frater the guardian of his infant son John Sigismund, who was proclaimed and crowned king of Hungary, the Frater acting as regent. He frustrated all the attempts of the queen mother, Isabella, to bring in the Austrians, and when, in 1541, an Austrian army appeared beneath the walls of Buda, he arrested the queen and applied to the Porte for help. On the 28th of August 1541, the Frater did homage to the sultan, but during his absence with the baby king in the Turkish camp, the grand vizier took Buda by subtlety. Then only the Frater recognized the necessity of a composition with both Austria and Turkey. He attained it by the treaty of Gyula (Dec. 29, 1541), whereby western Hungary fell to Ferdinand, while Transylvania, as an independent principality under Turkish suzerainty, reverted to John Sigismund. It included, besides Transylvania proper, many Hungarian counties on both sides of the Theiss, and the important city of Kassa. It was the Frater's policy to preserve Transylvania neutral and intact by cultivating amicable relations with Austria without offending the Porte. It was a difficult policy, but succeeded brilliantly for a time. In 1545, encouraged by the growing unpopularity of Ferdinand, owing to his incapacity to defend Hungary against the Turks, the Frater was tempted to unite Austrian Hungary to Transylvania and procure the election of John Sigismund as the national king. But recognizing that this was impossible, he aimed at an alliance with Ferdinand on terms of relative equality, and to this system he adhered till his death. Queen Isabella, who hated the Frater and constantly opposed him, complained of him to the sultan, who commanded that either the traitor himself or his head should be sent to Constantinople (1550). A combination was then formed against him of the queen, the hospodars of Moldavia and Wallachia and the Turks; but the Frater shut the queen up in Gyula-Fehérvár, drove the hospodars out of Transylvania, defeated the Turks at Déva, and finally compelled Isabella to accept a composition with Austria very profitable to her family and to Transylvania, at the same time soothing the rage of the sultan by flatteries and gifts. This compact, a masterpiece of statesmanship, was confirmed by the diet of Kolozsvár in August 1551. The Frater retained the governorship of Transylvania, and was subsequently consecrated archbishop of Esztergom and received the red hat. Thus Hungary was once more reunited, but the inability of Ferdinand to defend it against the Turks, as promised, forced the Frater, for the common safety, to resume the payment of tribute to the Porte in December 1551. Unfortunately, the Turks no longer trusted a diplomatist they could not understand, while Ferdinand suspected him of an intention to secure Hungary for himself. When the Turks (in 1551) took Csanád and other places, the Frater and the imperial generals Castaldo and Pallavicini combined their forces against the common foe; but when the Frater privately endeavoured to mediate between the Turks and the Hungarians, Castaldo represented him to Ferdinand as a traitor, and asked permission to kill him if necessary. The Frater's secretary Marco Aurelio Ferrari was hired, and stabbed his master from behind at the castle of Alvinczy while reading a letter, on the 18th of December 1551; but the cardinal, though in his sixty-ninth year, fought for his life, and was only despatched with the aid of Pallavicini and a band of bravos Ferdinand took the responsibility of the murder on himself He sent to Julius III. an accusation of treason against the Frater in eighty-seven articles, and after long hesitation, and hearing one hundred and sixteen witnesses, the pope exonerated Ferdinand of blame.

See A. Bechet, *Histoire du ministère du cardinal Martinusius* (Paris, 1715); O. M. Utiešenović, *Lebensgeschichte des Cardinals Georg Utiesenović* (Vienna, 1881); *Codex epistolaris Fratris Georgii 1535-1551*, ed. A. Károlyi (Budapest, 1881). But the most vivid presentation of Frater is to be found in M. Jókai's fine historical romance, *Brother George* (Hung.) (Budapest, 1893). (R. N. B.)

MARTIUS, CARL FRIEDRICH PHILIPP VON (1794–1868), German botanist and traveller, was born on the 17th of April 1794 at Erlangen, where he graduated M.D. in 1814, publishing as his thesis a critical catalogue of plants in the botanic garden of the university. He afterwards devoted himself to botanical study, and in 1817 he and J. B. von Spix were sent to Brazil by the king of Bavaria. They travelled from Rio de Janeiro through several of the southern and eastern provinces of Brazil, and ascended the river Amazon to Tabatinga, as well as some of its larger affluents. On his return to Europe in 1820 he was appointed conservator of the botanic garden at Munich, and in 1826 professor of botany in the university there, and held both offices till 1864. He devoted his chief attention to the flora of Brazil, and in addition to numerous short papers he published the *Nova Genera et Species Plantarum Brasiliensium* (1823–1832, 3 vols.) and *Icones selectae Plantarum Cryptogamicarum Brasiliensium* (1827), both works being finely illustrated. An account of his travels in Brazil appeared in 3 vols. 4to, 1823–1831, with an atlas of plates, but probably the work by which he is best known is his *Historia Palmarum* (1823–1850) in 3 large folio volumes, of which one describes the palms discovered by himself in Brazil. In 1840 he began the *Flora Brasiliensis*, with the assistance of the most distinguished European botanists, who undertook monographs of the various orders. Its publication was continued after his death under the editorship of A. W. Eichler (1839–1887) until 1887, and subsequently of Ignaz von Urban. He also edited several works on the zoological collections made in Brazil by Spix, after the death of the latter in 1826. On the outbreak of potato disease in Europe he investigated it and published his observations in 1842. He also published works and short papers on the aborigines of Brazil, on their civil and social condition, on their past and probable future, on their diseases and medicines, and on the languages of the various tribes, especially the Tupi. He died at Munich on the 13th of December 1868.

MARTOS, CHRISTINO (1830–1893), Spanish politician, was born at Granada on the 13th of September 1830. He was educated there and at Madrid University, where his Radicalism soon got him into trouble, and he narrowly escaped being expelled for his share in student riots and other demonstrations against the governments of Queen Isabella. He distinguished himself as a journalist on *El Tribuno*. He joined O'Donnell and Espartero in 1854 against a revolutionary cabinet, and shortly afterwards turned against O'Donnell, to assist the Democrats and Progressists under Prim, Rivero, Castelar, and Sagasta in the unsuccessful movements of 1866, and was obliged to go abroad. His political career had not prevented Martos from rising into note at the bar, where he was successful for forty years. After remaining abroad three years, he returned to Spain to take his seat in the Cortes of 1869 after the revolution of 1868. Throughout the revolutionary period he represented in cabinets with Prim, Serrano and Ruiz Zorilla, and lastly under King Amadeus, the advanced Radical tendencies of the men who wanted to give Spain a democratic monarchy. After the abdication of Amadeus of Savoy, Martos played a prominent part in the proclamation of the federal republic, in the struggle between the executive of that republic and the permanent committee of the Cortes, backed by the generals and militia, who nearly put an end to the executive and republic in April 1873. When the republicans triumphed Martos retired into exile, and soon afterwards into private life. He reappeared for a few months after General Pavia's *coup d'état* in January 1874, to join a coalition cabinet formed by Marshal Serrano, with Sagasta and Ulloa. Martos returned to the Bar in May 1874, and quietly looked on when the restoration took place at the end of that year. He stuck to his democratic ideals for some years, even going to Biarritz in 1881 to be present at a republican congress presided over by Ruiz Zorilla. Shortly afterwards Martos joined the dynastic Left organized by Marshal Serrano, General Lopez Dominguez, and Moret, Becerra, Balaguer, and other quondam revolutionaries. He sat in several parliaments of the reign of Alphonso XII. and of the regency of Queen Christina, joined the dynastic Liberals under Sagasta, and gave Sagasta not a little trouble when the latter allowed him to preside over the House of Deputies. Having failed to form a rival party against Sagasta, Martos subsided into political insignificance, despite his great talent as an orator and debater, and died in Madrid on the 16th of January 1893.

MARTOS, a town of southern Spain, in the province of Jaen, 16 m. W.S.W. of Jaen, by the Jaen-Lucena railway. Pop. (1900), 17,078. Martos is situated on an outlying western peak of the Jabalcuz mountains, which is surmounted by a ruined castle and overlooks the plain of Andalusia. In the neighbourhood are two sulphurous springs with bathing establishments. The local trade is almost exclusively agricultural.

Martos perhaps stands on or near the site of the *Tucci* of Ptolemy, which was fortified and renamed *Colonia Augusta Gemella* by the Romans. By Ferdinand III. it was taken from the Moors in 1225, and given to the knights of Calatrava; it was here that the brothers Carvajal, commanders of the order, were in 1312 executed by command of Ferdinand IV. Before their death they summoned Ferdinand to meet them within thirty days at the judgment-seat of God. Ferdinand died a month later and thus received the popular name of *el Emplazado*—" the Summoned."

MARTYN, HENRY (1781–1812), English missionary to India, was born on the 18th of February 1781, at Truro, Cornwall. His father, John Martyn, was a " captain " or mine-agent at Gwennap. The lad was educated at Truro grammar school under Dr Cardew, entered St John's College, Cambridge, in the autumn of 1797, and was senior wrangler and first Smith's prizeman in 1801. In 1802 he was chosen a fellow of his college. He had intended to go to the bar, but in the October term of 1802 he chanced to hear Charles Simeon speaking of the good done in India by a single missionary, William Carey, and some time afterwards he read the life of David Brainerd, the apostle of the Indians of North America. He resolved, accordingly, to become a Christian missionary. On the 22nd of October, 1803, he was ordained deacon at Ely, and afterwards priest, and served as Simeon's curate at the church of Holy Trinity, taking charge of the neighbouring parish of Lolworth. He was about to offer his services to the Church Missionary Society, when a disaster in Cornwall deprived him and his unmarried sister of the provision their father had made for them, and rendered it necessary that he should obtain a salary that would support her as well as himself. He accordingly obtained a chaplaincy under the East India Company and left for India on the 5th of July 1805. For some months he was stationed at Aldeen, near Serampur; in October 1806 he proceeded to Dinapur, where he was soon able to conduct worship among the natives in the vernacular, and established schools. In April 1809 he was transferred to Cawnpore, where he preached in his own compound, in spite of interruptions and threats. He occupied himself in linguistic study, and had already, during his residence at Dinapur, been engaged in revising the sheets of his Hindostani version of the New Testament. He now translated the whole of the New Testament into Hindi also, and into Persian twice. He translated the Psalms into Persian, the Gospels into Judaeo-Persic, and the Prayer-book into Hindostani, in spite of ill-health and " the pride, pedantry and fury of his chief munshi Sabat." Ordered by the doctors to take a sea voyage, he obtained leave to go to Persia and correct his Persian New Testament, whence he wished to go to Arabia, and there compose an Arabic version. Accordingly, on the 1st of October 1810, having seen his work at Cawnpore crowned on the previous day by the opening of a church, he left for Calcutta, whence he sailed on the 7th of January 1811, for Bombay, which he reached on his thirtieth birthday. From Bombay he set out for Bushire, bearing letters from Sir John Malcolm to men of position there, as also at Shiraz and Isfahan. After an exhausting journey from the coast he reached Shiraz, and was soon plunged into discussion with the disputants of all classes, " Sufi, Mahommedan, Jew, and Jewish-Mahommedan, even Armenian, all anxious to test their powers of argument with the first English priest who had visited them." Having made an unsuccessful journey to Tabriz to present the shah with his translation of the New Testament, he was seized with fever, and after a temporary recovery, had to seek a change of climate. On the 12th of September 1812, he started with two Armenian servants, crossed the Araxes, rode from Tabriz to Erivan, from Erivan to Kars, from Kars to Erzerum, from Erzerum to Chiflik, urged on from place to place by a thoughtless Tatar guide, and, though the plague was raging at Tokat (near Eski-Shehr in Asia Minor), he was compelled by prostration to stop there. On the 6th of October he died. Macaulay's youthful lines, written early in 1813, testify to the impression made by his career.

His *Journals and Letters* were published by Samuel Wilberforce in 1837. See also *Lives* by John Sargent (1819; new ed. 1885), and G. Smith (1892); and *The Church Quarterly Review* (Oct. 1881).

MARTYN, JOHN (1699–1768), English botanist, was born in London on the 12th of September 1699. Originally intended for a business career, he abandoned it in favour of medical and botanical studies. He was one of the founders (with J. J. Dillen and others) and the secretary of a botanical society which met for a few years in the Rainbow Coffee-house, Watling Street; he also started the *Grub Street Journal*, a weekly satirical review, which lasted from 1730 to 1737. In 1732 he was appointed professor of botany in Cambridge University, but, finding little encouragement and hampered by lack of appliances, he soon discontinued lecturing. He retained his professorship, however, till 1762, when he resigned in favour of his son Thomas (1735–1825), author of *Flora rustica* (1792–1794). Although he had not taken a medical degree, he long practised as a physician at Chelsea, where he died on the 29th of January 1768. His reputation chiefly rests upon his *Historia plantarum rariorum* (1728–1737), and his translation, with valuable agricultural and botanical notes, of the *Eclogues* (1749) and *Georgics* (1741) of Virgil. On resigning the botanical chair at Cambridge he presented the university with a number of his botanical specimens and books.

See memoir by Thomas Martyn in *Memoirs of John Martyn and Thomas Martyn*, by G. C. Gorham (1830).

MARTYR (Gr. *μάρτυρ* or *μάρτυς*), a word meaning literally " witness " and often used in that sense in the New Testament *e.g.* Matt. xviii. 16; Mark xiv. 63. During the conflict between Paganism and Christianity when many Christians " testified " to the truth of their convictions by sacrificing their lives, the word assumed its modern technical sense. The beginnings of this use are to be seen in such passages as Acts xxii. 20; Rev. ii. 13, xiii. 6. During the first three centuries the fortitude of these " witnesses " won the admiration of their brethren. Ardent spirits craved the martyr's crown, and to confess Christ in persecution was to attain a glory inferior only to that won by those who actually died. Confessors were visited in prison, martyrs' graves were scenes of pilgrimage, and the day on which they suffered was celebrated as the birthday of their glory. Martyrology was the most popular literature in the early Church. While the honour paid to martyrdom was a great support to early champions of the faith, it was attended by serious evils. It was thought that martyrdom would atone for sin, and imprisoned confessors not only issued to the Churches commands which were regarded almost as inspired utterances, but granted pardons in rash profusion to those who had been excommunicated by the regular clergy, a practice which caused Cyprian and his fellow bishops much difficulty. The zeal of Ignatius (*c.* 115), who begs the Roman Church to do nothing to avert from him the martyr's death, was natural enough in a spiritual knight-errant, but with others in later days, especially in Phrygia and North Africa, the passion became artificial. Fanatics sought death by insulting the magistrates or by breaking idols, and in their enthusiasm for martyrdom became self-centred and forgetful of their normal duty. None the less it is true that these men and women endured torments, often unthinkable in their cruelty, and death rather than abandon their faith. The same phenomena have been witnessed, not only in the conflicts within the Church that marked the 13th to the 16th centuries, but in the different mission fields, and particularly in Madagascar and China.

See A. J. Mason, *The Historic Martyrs of the Primitive Church* (London, 1905); H. B. Workman, *Persecution in the Early Church* (London, 1906); Paul Allard, *Ten Lectures on the Martyrs* (London, 1907); John Foxe, *The Book of Martyrs*; Mary I. Bryson, *Cross and Crown* (London, 1904).

MARTYROLOGY, a catalogue or list of *martyrs*, or, more exactly, of *saints*, arranged in the order of their anniversaries. This is the now accepted meaning in the Latin Church. In the Greek Church the nearest equivalent to the martyrology is the Synaxarium (*q.v.*). As regards form, we should distinguish between simple martyrologies, which consist merely of an enumeration of names, and historical martyrologies, which also include stories or biographical details. As regards documents, the most important distinction is between local and general martyrologies. The former give a list of the festivals of some particular Church; the latter are the result of a combination of several local martyrologies. We may add certain compilations of a factitious character, to which the name of martyrology is given by analogy, *e.g.* the *Martyrologe universel* of Châtelain (1709). As types of local martyrologies we may quote that of Rome, formed from the *Depositio martyrum* and the *Depositio episcoporum* of the chronograph of 354; the Gothic calendar of Ulfila's Bible, the calendar of Carthage published by Mabillon, the calendar of fasts and vigils of the Church of Tours, going back as far as Bishop Perpetuus (d. 490), and preserved in the *Historia francorum* (xi. 31) of Gregory of Tours. The Syriac martyrology discovered by Wright (*Journal of Sacred Literature*, 1866) gives the idea of a general martyrology. The most important ancient martyrology preserved to the present day is the compilation falsely attributed to St Jerome, which in its present form goes back to the end of the 6th century. It is the result of the combination of a general martyrology of the Eastern Churches, a local martyrology of the Church of Rome, some general martyrologies of Italy and Africa, and a series of local martyrologies of Gaul. The task of critics is to distinguish between its various constituent elements. Unfortunately, this document has reached us in a lamentable condition. The proper names are distorted, repeated or misplaced, and in many places the text is so corrupt that it is impossible to understand it. With the exception of a few traces of borrowings from the Passions of the martyrs, the compilation is in the form of a simple martyrology. Of the best-known historical martyrologies the oldest are those which go under the name of Bede and of Florus (*Acta sanctorum Martii*, vol. ii.); of Wandelbert, a monk of Prüm (842); of Rhabanus Maurus (*c.* 845); of Ado (d. 875); of Notker (896); and of Wolfhard (*c.* 896 v. *Analecta bollandiana*, xvii. 11). The most famous is that of Usuard (*c.* 875), on which the Roman martyrology was based. The first edition of the Roman martyrology appeared at Rome in 1583. The third edition, which appeared in 1584, was approved by Gregory XIII., who imposed the Roman martyrology upon the whole Church. In 1586 Baronius published his annotated edition, which in spite of its omissions and inaccuracies is a mine of valuable information.

The chief works on the martyrologies are those of Rosweyde, who in 1613 published at Antwerp the martyrology of Ado (also edition of Giorgi, Rome, 1745); of Sollerius, to whom we owe a learned edition of Usuard (*Acta sanctorum Junii*, vols. vi. and vii.); and of Fiorentini, who published in 1688 an annotated edition of the *Martyrology of St Jerome*. The critical edition of the latter by J. B. de Rossi and Mgr. L. Duchesne, was published in 1894, in vol. ii. of the *Acta sanctorum Novembris*. The historical martyrologies taken as a whole have been studied by Dom Quentin (1908). There are also numerous editions of calendars or martyrologies of less universal interest, and commentaries upon them. Mention ought to be made of the famous calendar of Naples, commented on by Mazocchi (Naples, 1744) and Sabbatini (Naples, 1744).

See C. de Smedt, *Introductio generalis ad historiam ecclesiasticam* (Gandavi, 1876), pp. 127–156; H. Matagne and V. de Buck in De Backer, *Bibliothèque des écrivains de la Compagnie de Jésus*, 2nd ed., vol. iii. pp. 369–387; De Rossi-Duchesne, *Les Sources du martyrologe hiéronymien* (Rome, 1885); H. Achelis, *Die Martyrologien, ihre Geschichte und ihr Wert* (Berlin, 1900); H. Delehaye, "Le Témoignage des martyrologes," in *Analecta bollandiana*, xxvi. 78–99 (1907); H. Quentin, *Les Martyrologes historiques du moyen âge* (Paris, 1908). (H. De.)

MARULLUS, MICHAEL TARCHANIOTA (d. 1500), Greek scholar, poet, and soldier, was born at Constantinople. In 1453, when the Turks captured Constantinople, he was taken to Ancona in Italy, where he became the friend and pupil of J. J. Pontanus, with whom his name is associated by Ariosto (*Orl. Fur.* xxxvii. 8). He received his education at Florence, where he obtained the patronage of Lorenzo de' Medici. He was the author of epigrams and *hymni naturales*, in which he happily imitated Lucretius. He took no part in the work of translation, then the favourite exercise of scholars, but he was understood to be planning some great work when he was drowned, on the 10th of April 1500, in the river Cecina near Volterra. He was a bitter enemy of Politian, whose successful rival he had been in the affections of the beautiful and learned Alessandra Scala. He is remembered chiefly for the brilliant emendations on Lucretius which he left unpublished; these were used for the Juntine edition (Munro's *Lucretius*, Introduction).

The hymns, some of the epigrams, and a fragment, *De Principum institutione*, were reprinted in Paris by C. M. Sathas in *Documents inédits relatifs à l'histoire de la Grèce au moyen âge*, vol. vii. (1888).

MARUM, MARTIN VAN (1750–1837), Dutch man of science, was born on the 20th of March 1750 at Groningen, where he graduated in medicine and philosophy. He began to practise medicine at Haarlem, but devoted himself mainly to lecturing on physical subjects. He became secretary of the scientific society of that city, and under his management the society was advanced to the position of one of the most noted in Europe. He was also entrusted with the care of the collection left to Haarlem by P. Teyler van der Hulst (1702–1778). His name is not associated with any discovery of the first order, but his researches (especially in connexion with electricity) were remarkable for their number and variety. He died at Haarlem on the 26th of December 1837.

MARUTS, in Hindu mythology, storm-gods. Their numbers vary in the different scriptures, usually thrice seven or thrice sixty. In the Vedas they are called the sons of Rudra. They are the companions of Indra, and associated with him in the wielding of thunderbolts, sometimes as his equals, sometimes as his servants. They are armed with golden weapons and lightnings. They split drought (*Vritra*) and bring rain, and cause earthquakes. Various myths surround their birth. A derivative word, Maruti or Maroti, is the popular name throughout the Deccan for Hanuman (*q.v.*).

MARVELL, ANDREW (1621–1678), English poet and satirist, son of Andrew Marvell and his wife Anne Pease, was born at the rectory house, Winestead, in the Holderness division of Yorkshire, on the 31st of March 1621. In 1624 his father exchanged the living of Winestead for the mastership of Hull grammar school. He also became lecturer at Holy Trinity Church and master of the Charterhouse in the same town. Thomas Fuller (*Worthies of England*, ed. 1811, i. 165) describes him as "a most excellent preacher." The younger Marvell was educated at Hull grammar school until his thirteenth year, when he matriculated on the 14th of December 1633 (according to a doubtful statement in Wood's *Athen. oxon.*) at Trinity College, Cambridge. It is related by his early biographer, Thomas Cooke, that he was induced by some Jesuit priests to leave the university. After some months he was discovered by his father in a bookseller's shop in London, and returned to Cambridge.[1] He contributed two poems to the *Musa cantabrigiensis* in 1637, and in the following year he received a scholarship at Trinity College, and took his B.A. degree in 1639. His father was drowned in 1640 while crossing the Humber in company with the daughter of a Mrs Skinner, almost certainly connected with the Cyriack Skinner to whom two of Milton's sonnets are addressed. It is said that Mrs Skinner adopted Marvell and provided for him at her death. The Conclusion Book of Trinity College, Cambridge, registers the decision (Sept. 24, 1641) that he with others should be excluded from further advantages from the college either because they were married, or did not attend their "days" or "acts." He travelled for four years on the Continent, visiting Holland, France, Italy and Spain. In Rome he met Richard Flecknoe, whom he satirized in the amusing verses on "Flecnoe, an English priest at Rome."

Although Marvell ranks as a great Puritan poet his sympathies were at first with Charles I., and in the lines on "Tom May's Death" he found no words too strong to express his scorn for the historian of the Long Parliament. He himself was no partisan, but had a passion for law and order. He acquiesced, accordingly, in the strong rule of Cromwell, but in his famous "Horatian Ode upon Cromwell's Return from Ireland" (1650)[2] he inserts a tribute to the courage and dignity of Charles I., which forms the best-known section of the poem. In 1650 he became tutor to Lord Fairfax's daughter Mary, afterwards duchess of Buckingham, then in her twelfth year. During his life with the Fairfaxes at Nunappleton, Yorkshire, he wrote the poems "Upon the Hill and Grove at Billborow" and "On Appleton House." Doubtless the other poems on country life, and his exquisite "garden poetry" may be referred to this period. "Clorinda and Damon" and "The Nymph complaining for the Death of her Faun" are good examples of the beauty and simplicity of much of this early verse. But he had affinities with John Donne and the metaphysical poets, and could be obscure on occasion.

Marvell was acquainted with Milton probably through their common friends, the Skinners, and in February 1653 Milton sent him with a letter to the lord president of the council, John Bradshaw, recommending him as "a man of singular desert for the state to make use of," and suggesting his appointment as assistant to himself in his duties as foreign secretary. The appointment was, however, given at the time to Philip Meadows, and Marvell became tutor to Cromwell's ward, William Dutton. In 1653 he was established with his pupil at Eton in the house of John Oxenbridge, then a fellow of the college, but formerly a minister in the Bermudas. No doubt the well-known verses, "Bermudas," were inspired by intercourse with the Oxenbridges. At Eton he enjoyed the society of John Hales, then living in retirement. He was employed by Milton in 1654 to convey to Bradshaw a copy of the *Defensio secunda*, and the letter to Milton in which he describes the reception of the gift is preserved. When the secretaryship again fell vacant in 1657 Marvell was appointed, and retained the appointment until the accession of Charles II. During this period he wrote many political poems, all of them displaying admiration for Cromwell. His "Poem upon the Death of his late Highness the Lord Protector" has been unfavourably compared to Edmund Waller's "Panegyric," but Marvell's poem is inspired with affection.

Marvell's connexion with Hull had been strengthened by the marriages of his sisters with persons of local importance, and in January 1659 he was elected to represent the borough in parliament. He was re-elected in 1660, again in 1661, and continued to represent the town until his death. According to Milton's nephew, Edward Phillips, the poet owed his safety at the Restoration largely to the efforts of Marvell, who "made a considerable party for him" in the House of Commons. From 1663 to 1665 he acted as secretary to Charles Howard, 1st earl of Carlisle, on his difficult and unsuccessful embassy to Muscovy, Sweden, and Denmark; and this is the only official post he filled during the reign of Charles. With the exception of this absence, for which he had leave from his constituents, and of shorter intervals of travel on private business which took him to Holland, Marvell was constant in his parliamentary attendance to the day of his death. He seldom spoke in the House, but his parliamentary influence is established by other evidence. He was an excellent man of affairs, and looked after the special interests of the port of Hull. He was a member of the corporation of Trinity House, both in London and Hull, and became a younger warden of the London Trinity House. His correspondence with his constituents, from 1660 to 1678, some 400 letters in all, printed by Dr Grosart (*Complete Works*, vol. ii.), forms a source of information all the more valuable because by a resolution passed at the Restoration the publication of the proceedings of the House without leave was forbidden. He made it a point of duty to write at each post—that is, every two or three days—both on local interests and on all matters of public interest. The discreet reserve of these letters, natural at a time when the post office was a favourite source of information to the government, contrasts curiously with the freedom of the few private letters which state opinions as well as facts. Marvell's constituents, in their turn, were not unmindful of their member. He makes frequent references to their presents, usually of Hull ale and of salmon, and he regularly drew from them the wages of a member, six-and-eightpence a day during session.

The development of Marvell's political opinions may be traced in the satirical verse he published during the reign of Charles II., and in his private letters. With all his admiration for Cromwell he had retained his sympathies with the royal house, and had loyally accepted the Restoration. In 1667 the Dutch fleet sailed up the Thames, and Marvell expressed his wrath at the gross mismanagement of public affairs in "Last Instructions to a Painter," a satire which was published as a broadside and of course remained anonymous. Edmund Waller had published in 1665 a gratulatory poem on the duke of York's victory in that year over the Dutch as "Instructions to a Painter for the drawing up and posture of his Majesty's forces at sea. . ." A similar form was adopted in Sir John Denham's four satirical "Directions to a Painter," and Marvell writes on the same model. His indignation was well grounded, but he had no scruples in the choice of the weapons he employed in his warfare against the corruption of the court, which he paints even blacker than do contemporary memoir writers; and his satire often descends to the level of the lampoon. The most inexcusable of his scandalous verses are perhaps those on the duchess of York. In the same year he attacked Lord Clarendon, evidently hoping that with the removal of the "betrayer of England and Flanders" matters would improve. But in 1672 when he wrote his "Poem on the Statue in the Stocks-Market" he had no illusions left about Charles, whom he describes as too often "purchased and sold," though he concludes with "Yet we'd rather have him than his bigoted brother." "An Historical Poem," "Advice to a Painter," and "Britannia and Raleigh" urge the same advice in grave language. In the last-named poem, probably written early in 1674, Raleigh pleads that "'tis god-like good to save a fallen king," but Britannia has at length decided that the tyrant cannot be divided from the Stuart, and proposes to reform the state on the republican model of Venice. These and other equally bold satires were probably handed round in MS., or secretly printed, and it was not until after the Revolution that they were collected with those of other writers in *Poems on Affairs of State* (3 pts., 1689; 4 pts., 1703–1707). Marvell's controversial prose writings are wittier than his verse satires, and are free from the scurrility which defaces the "Last Instructions to a Painter." A short and brilliant example of his irony is "His Majesty's Most Gracious Speech to both Houses of Parliament" (printed in *Grosart*, ii. 431 seq.), in which Charles is made to take the house into the friendliest confidence on his domestic affairs.

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[1] There is an allusion to this escapade addressed by another anxious parent to the elder Marvell in the Hull Corporation Records (No. 498) [see Grosart, i. xxviii.]. The document is without address or signature, but the identification seems safe.

[2] This poem has been highly praised by Goldwin Smith (T. H. Ward's *English Poets*, ii. 383 (1880)). It was first printed, so far as we know, in 1776, and the only external testimony to Marvell's authorship is the statement of Captain Thompson, who had included many poems by other writers in his edition of Marvell, that this ode was in poet's own handwriting. The internal evidence in favour of Marvell may, however, be accepted as conclusive.

Marvell was among the masters of Jonathan Swift, who, in the "Apology" prefixed to the *Tale of a Tub*, wrote that his answer to Samuel Parker could be still read with pleasure, although the pamphlets that provoked it were long since forgotten. Parker had written a *Discourse of Ecclesiastical Politye* (1670) and other polemics against Dissenters, to which Marvell replied in *The Rehearsal Transposed* (2 pts., 1672 and 1673). The book contains some passages of dignified eloquence, and some coarse vituperation, but the prevailing tone is that of grave and ironical banter of Parker as "Mr Bayes." Parker was attacked, says Bishop Burnet (*Hist. of His Own Time*, ed. 1823, i. 451), "by the liveliest droll of the age, who writ in a burlesque strain, but with so peculiar and entertaining a conduct, that, from the king down to the tradesman, his books were read with great pleasure." He certainly humbled Parker, but whether this effect extended, as Burnet asserts, to the whole party, is doubtful. Parker had intimated that Milton had a share in the first part of Marvell's reply. This Marvell emphatically denied (*Grosart*, iii. 498). He points out that Parker had, like Milton, profited by the royal clemency, and that he had first met him at Milton's house. He takes the opportunity to praise Milton's "great learning and sharpness of wit," and to the second edition of *Paradise Lost* (1674) he contributed some verses of just and eloquent praise.

His *Mr Smirke, or the Divine in Mode* . . . (1676) was a defence of Herbert Croft, bishop of Hereford, against the criticisms of Dr Francis Turner, master of St John's College, Cambridge. A far more important work was *An Account of the Growth of Popery and Arbitrary Government in England, more particularly from the Long Prorogation of Parliament* . . . (1677). This pamphlet was written in the same outspoken tone as the verse satires, and brought against the court the indictment of nursing designs to establish absolute monarchy and the Roman Catholic religion at the same time. A reward was offered for the author, whose identity was evidently suspected, and it is said that Marvell was in danger of assassination. He died on the 16th of August 1678 in consequence of an overdose of an opiate taken during an attack of ague. He was buried in the church of St Giles-in-the Fields, London. Joint administration of his estate was granted to one of his creditors, and to his widow, Mary Marvell, of whom we have no previous mention.

As a humorist, and as a great "parliament man," no name is of more interest to a student of the reign of Charles II. than that of Marvell. He had friends among the republican thinkers of the times. Aubrey says that he was intimate with James Harrington, the author of *Oceana*, and he was probably a member of the "Rota" club. In the heyday of political infamy, he, a needy man, obliged to accept wages from his constituents, kept his political virtue unspotted, and he stood throughout his career as the champion of moderate and tolerant measures. There is a story that his old schoolfellow, Danby, was sent by the king to offer the incorruptible poet a place at court and a gift of £1000, which Marvell refused with the words: "I live here to serve my constituents: the ministry may seek men for their purpose; I am not one." When self-indulgence was the ordinary habit of town life, Marvell was a temperate man. His personal appearance is described by John Aubrey: "He was of a middling stature, pretty strong set, roundish faced, cherry cheeked, hazel eyed, brown haired. In his conversation he was modest and of very few words." ("Lives of Eminent Persons," printed in *Letters* . . . *in the 17th and 18th Centuries*, 1813).

Among Marvell's works is also a *Defence of John Howe on God's Prescience* . . . (1678), and among the spurious works fathered on him are: *A Seasonable Argument* . . . *for a new Parliament* (1677), *A Seasonable Question and a Useful Answer* . . . (1676), *A Letter from a Parliament Man* . . . (1675), and a translation of *Suetonius* (1672). Marvell's satires were no doubt first printed as broadsides, but very few are still extant in that form. Such of his poems as were printed during his lifetime appeared in collections of other men's works. The earliest edition of his non-political verse is *Miscellaneous Poems* (1681), edited by his wife, Mary Marvell. The political satires were printed as *A Collection of Poems on Affairs of State, by A—— M——l, Esq. and other Eminent Wits* (1689), with second and third parts in the same year. The works of Andrew Marvell contained in these two publications were also edited by Thomas Cooke (2 vols., 1726), who added some letters. Cooke's edition was reprinted by Thomas Davies in 1772. Marvell's next editor was Captain Thompson of Hull, who was connected with the poet's family, and made further additions from a commonplace book since lost. Other editions followed, but were superseded by Dr A. B. Grosart's laborious work, which, in spite of many defects of style, remains indispensable to the student. *The Complete Works in Verse and Prose of Andrew Marvell, M.P.* (4 vols., 1872–1875) forms part of his "Fuller Worthies Library." See also the admirable edition of the *Poems and Satires of Andrew Marvell*. . . (2 vols., 1892) in the "Muses' Library," where a full bibliography of his works and of the commentaries on them is provided; also *The Poems and some Satires of Andrew Marvell* (ed. Edward Wright, 1904), and *Andrew Marvell* (1905), by Augustine Birrell in the "English Men of Letters" series.

MARX, HEINRICH KARL (1818–1883), German socialist, and head of the International Working Men's Association, was born on the 5th of May 1818 in Trèves (Rhenish Prussia). His father, a Jewish lawyer, in 1824 went over to Christianity, and he and his whole family were baptized as Christian Protestants. The son went to the high grammar school at Trèves, and from 1835 to the universities of Bonn and Berlin. He studied first law, then history and philosophy, and in 1841 took the degree of doctor of philosophy. In Berlin he had close intimacy with the most prominent representatives of the young Hegelians—the brothers Bruno and Edgar Bauer and their circle, the so-called "Freien." He at first intended to settle as a lecturer at Bonn University, but his Radical views made a university career out of the question, and he accepted work on a Radical paper, the *Rheinische Zeitung*, which expounded the ideas of the most advanced section of the Rhenish Radical *bourgeoisie*. In October 1842 he became one of the editors of this paper, which, however, after an incessant struggle with press censors, was suppressed in the beginning of 1843. In the summer of this year Marx married Jenny von Westphalen, the daughter of a high government official. Through her mother Jenny von Westphalen was a lineal descendant of the earl of Argyle, who was beheaded under James II. She was a most faithful companion to Marx during all the vicissitudes of his career, and died on the 2nd of December 1881; he outliving her only fifteen months.

Already in the *Rheinische Zeitung* some socialist voices had been audible, couched in a somewhat philosophical strain. Marx, though not accepting these views, refused to criticize them until he had studied the question thoroughly. For this purpose he went in the autumn of 1843 to Paris, where the socialist movement was then at its intellectual zenith, and where he, together with Arnold Ruge, the well-known literary leader of Radical Hegelianism, was to edit a review, the *Deutsch-französische Jahrbücher*, of which, however, only one number appeared. It contained two articles by Marx—a criticism of Bruno Bauer's treatment of the Jewish question, and an introduction to a criticism of Hegel's philosophy of the law. The first concluded that the social emancipation of the Jews could only be achieved together with the emancipation of society from Judaism, *i.e.* commercialism. The second declared that in Germany no partial political emancipation was possible; there was now only one class from which a real and reckless fight against authority was to be expected—namely, the proletariate. But the proletariate could not emancipate itself except by breaking all the chains, by dissolving the whole constituted society, by recreating man as a member of the human society in the place of established states and classes. "Then the day of German resurrection will be announced by the crowing of the Gallican cock." Both articles thus relegated the solution of the questions then prominent in Germany to the advent of socialism, and so far resembled in principle other socialist publications of the time. But the way of reasoning was different, and the final words of the last quoted sentence pointed to a political revolution, to begin in France as soon as the industrial evolution had created a sufficiently strong proletariate. In contradistinction to most of the socialists of the day, Marx laid stress upon the political struggle as the lever of social emancipation. In some letters which formed part of a correspondence between Marx, Ruge, Ludwig Feuerbach, and Mikhail Bakunin, published as an introduction to the review, this opposition of Marx to socialistic "dogmatism" was enunciated in a still more pronounced form: "Nothing prevents us," he said, "from combining our criticism with the criticism of politics, from participating in politics, and consequently in real struggles. We will not, then, oppose the world like doctrinarians with a new principle: here is truth, kneel down here! We expose new principles to the world out of the principles of the world itself. We don't tell it: 'Give up your struggles, they are rubbish, we will show you the true war-cry.' We explain to it only the real object for which it struggles, and consciousness is a thing it *must* acquire even if it objects to it."

In Paris Marx met FRIEDRICH ENGELS (1820–1895), from whom the *Deutsch-französische Jahrbücher* had two articles—a powerfully written outline of a criticism of political economy, and a letter on Carlyle's *Past and Present.* Engels, the son of a wealthy cotton-spinner, was born in 1820 at Barmen. Although destined by his father for a commercial career, he attended a classical school, and during his apprenticeship and whilst undergoing in Berlin his one year's military service, he had given up part of his free hours to philosophical studies. In Berlin he had frequented the society of the "Freien," and had written letters to the *Rheinische Zeitung.* In 1842 he had gone to England, his father's firm having a factory near Manchester, and had entered into connexion with the Owenite and Chartist movements, as well as with German communists. He contributed to Owen's *New Moral World* and to the Chartist *Northern Star*, gave up much of his abstract speculative reasoning for a more positivist conception of things, and took to economic studies. Now, in September 1844, on a short stay in Paris, he visited Marx, and the two found that in regard to all theoretical points there was perfect agreement between them. From that visit dates the close friendship and uninterrupted collaboration and exchange of ideas which lasted during their lives, so that even some of Marx's subsequent works, which he published under his own name, are more or less also the work of Engels. The first result of their collaboration was the book *Die heilige Familie oder Kritik der kritischen Kritik, gegen Bruno Bauer und Konsorten*, a scathing exposition of the perverseness of the high-sounding speculative radicalism of Bauer and the other Berlin "Freie." By aid of an analysis, which, though not free from exaggeration and a certain diffuseness, bears testimony to the great learning of Marx and the vigorous discerning faculty of both the authors, it is shown that the supposed superior criticism—the "critical criticism" of the Bauer school, based upon the doctrine of a "self-conscious" idea, represented by or incarnated in the critic—was in fact inferior to the older Hegelian idealism. The socialist and working-class movements in Great Britain, France and Germany are defended against the superior criticism of the "holy" Bauer family.

In Paris, where he had very intimate intercourse with Heinrich Heine, who always speaks of him with the greatest respect, and some of whose poems were suggested by Marx, the latter contributed to a Radical magazine, the *Vorwärts*; but in consequence of a request by the Prussian government, nearly the whole staff of the magazine soon got orders to leave France. Marx now went to Brussels, where he shortly afterwards was joined by Engels. In Brussels he published his second great work, *La Misère de la philosophie*, a sharp rejoinder to the *Philosophie de la misère ou contradictions économiques* of J. P. Proudhon. In this he deals with Proudhon, whom in the former work he had defended against the Bauers, not less severely than with the latter. It is shown that in many points Proudhon is inferior to both the middle-class economists and the socialists, that his somewhat noisily proclaimed discoveries in regard to political economy were made long before by English socialists, and that his main remedies, the "constitution of the labour-value" and the establishment of exchange bazaars, were but a repetition of what English socialists had already worked out much more thoroughly and more consistently. Altogether the book shows remarkable knowledge of political economy. In justice to Proudhon, it must be added that it is more often his mode of speaking than the thought underlying the attacked sentences that is hit by Marx's criticism. In Brussels Marx and Engels also wrote a number of essays, wherein they criticized the German literary representatives of that kind of socialism and philosophic radicalism which was mainly influenced by the writings of Ludwig Feuerbach, and deduced its theorems or postulates from speculations on the "nature of man." They mockingly nicknamed this kind of socialism "German or True Socialism," and ridiculed the idea that by disregarding historical and class distinctions a conception of society and socialism superior to that of the English and French workers and theorists could be obtained. Some of these essays were published at the time, two or three, curiously enough, by one of the attacked writers in his own magazine; one, a criticism of Feuerbach himself, was in a modified form published by Engels in 1885, but others have remained in manuscript. They were at first intended for publication in two volumes as a criticism of post-Hegelian German philosophy, but the Revolution of 1848 postponed for a time all interest in theoretical discussions.

In Brussels Marx and Engels came into still closer contact with the socialist working-class movement. They founded a German workers' society, acquired a local German weekly, the *Brüsseller deutsche Zeitung*, and finally joined a communistic society of German workers, the "League of the Just," a secret society which had its main branches in London, Paris, Brussels and several Swiss towns. For this league, which till then had adhered to the rough-and-ready communism of the gifted German workman Wilhelm Weitling, but which now called itself "League of the Communists," and gave up its leanings towards conspiracy and became an educational and propagandistic body, Marx and Engels at the end of 1847 wrote their famous pamphlet, *Manifest der Kommunisten.* It was a concise exposition of the history of the working-class movement in modern society according to their views, to which was added a critical survey of the existing socialist and communist literature, and an explanation of the attitude of the Communists towards the advanced opposition parties in the different countries. Scarcely was the manifesto printed when, in February 1848, the Revolution broke out in France, and "the crowing of the Gallican cock" gave the signal for an upheaval in Germany such as Marx had prophesied. After a short stay in France, Marx and Engels went to Cologne in May 1848, and there with some friends they founded the *Neue rheinische Zeitung*, with the sub-title "An Organ of Democracy," a political daily paper on a large scale, of which Marx was the chief editor. They took a frankly revolutionary attitude, and directed their criticism to a great extent against the middle-class democratic parties, who, by evading all decisive issues, delayed the achievement of the upheaval. When in November 1848 the king of Prussia dissolved the National Assembly, Marx and his friends advocated the non-payment of taxes and the organization of armed resistance. Then the state of siege was declared in Cologne, the *Neue rheinische Zeitung* was suspended, and Marx was put on trial for high treason. He was unanimously acquitted by a middle-class jury, but in May 1849 he was expelled from Prussian territory. He went to Paris, but was soon given the option of either leaving France or settling at a small provincial place. He preferred the former, and went to England. He settled in London, and remained there for the rest of his life.

At first he tried to reorganize the Communist League; but soon a conflict broke out in its ranks, and after some of its members had been tried in Germany and condemned for high treason, Marx, who had done everything to save the accused, dissolved the Communist League altogether. Nor was a literary enterprise, a review, also called the *Neue rheinische Zeitung*, more successful; only six numbers of it were issued. It contained, however, some very remarkable contributions; and a series of articles on the career of the French Revolution of 1848, which first appeared there, was in 1895 published by Engels in book form under the title of *Die Klassenkämpfe in Frankreich von 1848* "by Karl Marx." Carlyle's *Latter Day Pamphlets*, published at that time, met with a very vehement criticism in the *Neue rheinische Zeitung*. The endeavours of Ernest Jones and others to revive the Chartist movement were heartily supported by Marx, who contributed to several of the Chartist journals of the period, mostly, if not wholly, without getting or asking payment. He lived at this time in great financial straits, occupied a few small rooms in Dean Street, Soho, and all his children then born died very young. At length he was invited to write letters for the *New York Tribune*, whose staff consisted of advanced democrats and socialists of the Fourierist school. For these letters he was paid at the rate of a guinea each. Part of them, dealing with the Eastern Question and the Crimean War, were republished in 1897 (London, Sonnenschein). Some were even at the time reprinted in pamphlet form. The co-operation of Marx, who was determinedly anti-Russian, since Russia was the leading reactionary power in Europe, was obtained by David Urquhart and his followers. A number of Marx's articles were issued as pamphlets by the Urquhartite committees, and Marx wrote a series of articles on the diplomatic history of the 18th century for the Urquhartite *Free Press* (Sheffield and London, 1856–1857). When in 1859 the Franco-Austrian War about Italy broke out, Marx denounced it as a Franco-Russian intrigue, directed against Germany on the one hand and the revolutionary movement in France on the other. He opposed those democrats who supported a war which in their eyes aimed at the independence of the Italian nation and promised to weaken Austria, whose superiority in Germany was the hindrance to German unity. Violent derogatory remarks directed against him by the well-known naturalist Karl Vogt gave occasion to a not less violent rejoinder, *Herr Vogt*, a book full of interesting material for the student of modern history. Marx's contention, that Vogt acted as an agent of the Bonapartist clique, seems to have been well founded, whilst it must be an open question how far Vogt acted from dishonourable motives. The discussions raised by the war also resulted in a great estrangement between Marx and Ferdinand Lassalle. Lassalle had taken a similar view of the war to that advocated by Vogt, and fought tooth and nail for it in letters to Marx. In the same year, 1859, Marx published as a first result of his renewed economic studies the book *Zur Kritik der politischen Ökonomie*. It was the first part of a much larger work planned to cover the whole ground of political economy. But Marx found that the arrangement of his materials did not fully answer his purpose, and that many details had still to be worked out. He consequently altered the whole plan and sat down to rewrite the book, of which in 1867 he published the first volume under the title *Das Kapital*.

In the meantime, in 1864, the International Working Men's Association was founded in London, and Marx became in fact though not in name, the head of its general council. All its addresses and proclamations were penned by him and explained in lectures to the members of the council. The first years of the International went smoothly enough. Marx was then at his best. He displayed in the International a political sagacity and toleration which compare most favourably with the spirit of some of the publications of the Communist League. He was more of its teacher than an agitator, and his expositions of such subjects as education, trade unions, the working day, and co-operation were highly instructive. He did not hurry on extreme resolutions, but put his proposals in such a form that they could be adopted by even the more backward sections, and yet contained no concessions to reactionary tendencies. But this condition of things was not permitted to go on. The anarchist agitation of Bakunin, the Franco-German War, and the Paris Commune created a state of things before which the International succumbed. Passions and prejudices ran so high that it proved impossible to maintain any sort of centralized federation. At the congress of the Hague, September 1872, the general council was removed from London to New York. But this was only a makeshift, and in July 1876 the rest of the old International was formally dissolved at a conference held in Philadelphia. That its spirit had not passed away was shown by subsequent international congresses, and by the growth and character of socialist labour parties in different countries. They have mostly founded their programmes on the basis of its principles, but are not always in their details quite in accordance with Marx's views. Thus the programme which the German socialist party accepted at its congress in 1875 was very severely criticized by Marx. This criticism, reprinted in 1891 in the review *Die neue Zeit*, is of great importance for the analysis of Marx's conception of socialism.

The dissolution of the International gave Marx an opportunity of returning to his scientific work. He did not, however, succeed in publishing further volumes of *Das Kapital*. In order to make it—and especially the part dealing with property in land—as complete as possible, he took up, as Engels tells us, a number of new studies, but repeated illness interrupted his researches, and on the 14th of March 1883 he passed quietly away.

From the manuscripts he left Engels compiled a second and a third volume of *Das Kapital* by judiciously and elaborately using complete and incomplete chapters, rough copies and excerpts, which Marx had at different times written down. Much of the copy used dates back to the 'sixties, *i.e.* represents the work as at first conceived by Marx, so that, *e.g.*, the matter published as the third volume was in the main written much earlier than the matter which was used for compiling the second volume. The same applies to the fourth volume. Although the work thus comprises the four volumes promised in the preface to the book, it can only in a very restricted sense be regarded as complete. In substance and demonstration it must be regarded as a torso. And it is perhaps not quite accidental that it should be so. Marx, if he had lived longer and had enjoyed better health, would have given the world a much greater amount of scientific work of high value than is now the case. But it seems doubtful whether he would have brought *Das Kapital*, his main work, to a satisfactory conclusion.

Das Kapital proposes to show up historically and critically the whole mechanism of capitalist economy. The first volume deals with the processes of producing capital, the second with the circulation of capital, the third with the movements of capital as a whole, whilst the fourth gives the history of the theories concerning capital. Capital is, according to Marx, the means of appropriating *surplus-value* as distinguished from ground rent (rent on every kind of terrestrial property, such as land, mines, rivers, &c., based upon the monopolist nature of such property). Surplus-value is created in the process of production only, it is this part of the value of the newly created product which is not given to the workman as a return—the *wage*—of the labour-force he expended in working. If at first taken by the employer, it is in the different phases of economic intercourse split up into the profit of industrial enterprise, commercial or merchants' profit, interest and ground rent. The value of every commodity consists in the labour expended on it, and is measured according to the time occupied by the labour employed on its production. Labour in itself has no value, being only the measure of value, but the labour-force of the workman has a value, the value of the means required to maintain the worker in normal conditions of social existence. Thus, in distinction to other commodities, in the determination of the value of labour-force, besides the purely economical, a *moral* and *historical* element enter. If to-day the worker receives a wage which covers the bare necessaries of life, he is underpaid—he does not receive the real value of his labour-force. For the value of any commodity is determined by its socially necessary costs of production (or in this case, maintenance). "Socially necessary" means, further, that no more labour is embodied in a commodity than is required by applying labour-force, tools, &c., of average or normal efficiency, and that the commodity is produced in such quantity as is required to meet the effective demand for it. As this generally cannot be known in advance, the market value of a commodity only gravitates round its (abstract) value. But in the long run an equalization takes place, and for his further deductions Marx assumes that commodities exchange according to their value.

That part of an industrial capital which is employed for installations, machines, raw and auxiliary materials, is called by Marx *constant capital*, for the value of it or of its wear and tear reappears in equal proportions in the value of the new product. It is otherwise with labour. The new value of the product must by necessity be always higher than the value of the employed labour-force. Hence the capital employed in buying labour-force, *i.e.* in wages, is called *variable capital.* It is the tendency of capitalist production to reduce the amount spent in wages and to increase the amount invested in machines, &c. For with natural and social, legal and other limitations of the working day, and the opposition to unlimited reduction of wages, it is not possible otherwise to cheapen production and beat competition. According to the proportion of constant to variable capital, Marx distinguishes capitals of *lowest average* and *highest composition*, the highest composition being that where proportionately the least amount of variable (wages) capital is employed.

The ratio of the wages which workmen receive to the surplus-value which they produce Marx calls the *rate of surplus-value*; that of the surplus-value produced to the whole capital employed is the *rate of profit.* It is evident, then, that at the same time the rate of surplus-value can increase and the rate of profit decrease, and this in fact is the case. There is a continuous tendency of the rates of profit to decrease, and only by some counteracting forces is their decrease temporarily interrupted, protracted, or even sometimes reversed. Besides, by competition and movement of capitals the rates of profit in the different branches of trade are pressed towards an *equalization* in the shape of an *average rate of profits.* This average rate or profits, added to the actual cost price of a given commodity, constitutes its *price of production,* and it is this price of production which appears to the empirical mind of the business man as the value of the commodity. The real law of value, on the contrary, disappears from the surface in a society where, as to-day, commodities are bought and sold against money and not exchanged against other commodities. Nevertheless, according to Marx, it is also to-day this law of value (" labour-value ") which in the last resort rules the prices and profits.

The tendency to cheapen production by increasing the relative proportion of constant capital—the fixed capital of the classical economist plus that portion of the circulating capital which consists of raw and auxiliary materials, &c.—leads to a continuous increase in the size of private enterprises, to their growing concentration. It is the larger enterprise that beats and swallows the smaller. The number of dependent workmen—" proletarians "—is thus continually growing, whilst employment only periodically keeps pace with their number. Capital alternately attracts and repels workmen, and creates a constant surplus-population of workmen—a *reserve-army* for its requirements—which helps to lower wages and to keep the whole class in economic dependency. A decreasing number of capitalists usurp and monopolize all the benefits of industrial progress, whilst the mass of misery, of oppression, of servitude, of depravation, and of exploitation increases. But at the same time the working class continuously grows in numbers, and is disciplined, united and organized by the very mechanism of the capitalist mode of production. The centralization of the means of production and the socialization of the mode of production reach a point where they will become incompatible with their capitalist integument. Then the knell of capitalist private property will have been rung. Those who used to expropriate will be expropriated. Individual property will again be established based upon co-operation and common ownership of the earth and the means of production produced by labour.

These are the principal outlines of *Das Kapital.* Its purely economic deductions are dominated throughout by the *theory of surplus-value.* Its leading sociological principle is the *materialist conception of history.* This theory is in *Das Kapital* only laid down by implication, but it has been more connectedly explained in the preface of *Zur Kritik* and several works of Engels. According to it the material basis of life, the manner in which life and its requirements are produced, determines in the last instance the social ideas and institutions of the time or historical epoch, so that fundamental changes in the former produce in the long run also fundamental changes in the latter. A set of social institutions answer to a given mode of production, and periods where the institutions no longer answer to the mode of production are periods of social revolution, which go on until sufficient adjustment has taken place. The main *subjective* forces of the struggle between the old order and the new are *the classes* into which society is divided after the dissolution of the communistic or semi-communistic tribes and the creation of states. And as long as society is divided into classes a class war will persist, sometimes in a more latent or disguised, sometimes in a more open or acute form, according to circumstances. In advanced capitalist society the classes between whom the decisive war takes place are the capitalist owners of the means of production and the non-propertied or wage-earning workers, the " proletariate." But the proletariate cannot free itself without freeing all other oppressed classes, and thus its victory means the end of exploitation and political repression altogether. Consequently the state as a repressive power will die out, and a free association will take its place.

Almost from the first *Das Kapital* and the publications of Marx and Engels connected with it have been subjected to all kinds of criticisms. The originality of its leading ideas has been disputed, the ideas themselves have been declared to be false or only partially true, and consequently leading to wrong conclusions; and it has been said of many of Marx's statements that they are incorrect, and that many of the statistics upon which he bases his deductions do not prove what he wants them to prove. In regard to the first point, it must be conceded that the *disjecta membra* of Marx's value theory and of his materialist conception of history are already to be found in the writings of former socialists and sociologists. It may even be said that just those points of the Marxist doctrine which have become popular are in a very small degree the produce of Marx's genius, and that what really belongs to Marx, the methodical conjunction and elaboration of these points, as well as the finer deductions drawn from their application, are generally ignored. But this is an experience repeated over and over again in the history of deductive sciences, and is quite irrelevant for the question of Marx's place in the history of socialism and social science.

It must further be admitted that in several places the statistical evidence upon which Marx bases his deductions is insufficient or inconclusive. Moreover—and this is one of the most damaging admissions—it repeatedly happens that he points out all the phenomena connected with a certain question, but afterwards ignores some of them and proceeds as if they did not exist. Thus, *e.g.*, he speaks at the end of the first volume, where he sketches the historical tendency of capitalist accumulation, of the decreasing number of magnates of capital as of an established fact. But all statistics show that the number of capitalists does not decrease, but increase; and in other places in *Das Kapital* this fact is indeed fully admitted, and even accentuated. Marx was, as the third volume shows, also quite aware that limited liability companies play an important part in the distribution of wealth. But he leaves this factor, too, quite out of sight, and confuses the concentration of private enterprises with the centralization of fortunes and capitals. By these and other omissions, quite apart from developments he could not well foresee, he announces a coming evolution which is very unlikely to take place in the way described.

In this and in other features of his work a *dualism* reveals itself which is also often observable in his actions in life—the alternating predominance of the spirit of the scholar and the spirit of the radical revolutionary. Marx originally entitled his great social work *Criticism of Political Economy,* and this is still the sub-title of *Das Kapital.* But the conception of *critic* or *criticize* has with Marx a very pronounced meaning. He uses them mostly as identical with fundamentally opposing. Much as he had mocked the " critical criticism " of the Bauers, he is in this respect yet of their breed and relapses into their habits. He retained in principle the Hegelian dialectical method, of which he said that in order to be rationally employed it must be " turned upside down," *i.e.* put upon a materialist basis. But as a matter of fact he has in many respects contravened against this prescription. Strict materialist dialectics cannot conclude much beyond actual facts. Dialectical materialism is revolutionary in the sense that it recognizes no finality, but otherwise it is necessarily positivist in the general meaning of that term. But Marx's opposition to modern society was fundamental and revolutionary, answering to that of the proletarian to the *bourgeois.* And here we come to the main and fatal contradiction of his work. He wanted to proceed, and to a very great extent did proceed, scientifically. Nothing was to be deduced from preconceived ideas; from the observed evolutionary laws and forces of modern society alone were conclusions to be drawn. And yet the final conclusion of the work, as already noted, *is* a preconceived idea; it is the announcement of a state of society logically opposed to the given one. Imperceptibly the dialectical movement of *ideas* is substituted for the dialectical movement of facts, and the real movement of facts is only considered so far as is compatible with the former. Science is violated in the service of speculation. The picture given at the end of the first volume answers to a conception arrived at by speculative socialism in the 'forties. True, Marx calls this chapter " the historical tendency of capitalist accumulation," and " tendency " does not necessarily mean realization in every detail. But on the whole the language used there is much too absolute to allow of the interpretation that Marx only wanted to give a speculative picture of the goal to which capitalist accumulation would lead if unhampered by socialist counteraction. The epithet " historical " indicates rather that the passage in question was meant to give in the main the true outline of the forthcoming social revolution. We are led to this conclusion also by the fact that, in language which is not in the least conditional, it is there said that the change of capitalist property into social property will mean " only the expropriation of a few usurpers by the mass of the people." In short, the principal reason for the undeniable contradictions in *Das Kapital* is to be found in the fact that where Marx has to do with details or subordinate subjects he mostly notices the important changes which actual evolution had brought about since the time of his first socialist writings, and thus himself states how far their presuppositions have been corrected by facts. But when he comes to general conclusions, he adheres in the main to the original propositions based upon the old uncorrected presuppositions. Besides, the complex character of modern society is greatly underestimated, so that, *e.g.*, such important features as the influence of the changes of traffic and aggregation on modern life are scarcely considered at all; and industrial and political problems are viewed only from the aspect of class antagonism, and never under their administrative aspect. With regard to the theory of surplus-value and its foundation, the theory of labour-value, so much may be safely said that, its premisses accepted, it is most ingeniously and most consistently worked out. And since its principal contention is in any case so far true that the wage-earning workers as a whole produce more than they receive, the theory has the great merit of demonstrating in an admirably lucid way the relations between wages and surplus-produce and the growth and movements of capital. But the theory of labour-value as the determining factor of the exchange or market value of commodities can with justification be disputed, and is surely not more true than those theories of value based on social demand or utility. Marx himself, in placing in the third volume what he calls the *law of value* in the background and setting out the formation of the "price of production" as the empirical determinator of prices in modern society, justifies those who look upon the conception of labour-value as an abstract formula which does not apply to individual exchanges of commodities at all, but which only serves to show an imagined typical example of what in reality to-day is only true with regard to the production of the whole of social wealth. Thus understood, the conception of labour-value is quite unobjectionable, but it loses much of the significance attributed to it by most of the disciples of Marx and occasionally by Marx himself. It is a means of analysing and exemplifying surplus labour, but quite inconclusive as to the proof of the surplus value, or as an indication of the degree of the exploitation of the workers. This becomes the more apparent the more the reader advances in the second and third volumes of *Das Kapital*, where commercial capital, money capital and ground rent are dealt with. Though full of fine observations and deductions, they form, from a revolutionary standpoint, an anti-climax to the first volume. It is difficult to see how, after all that is explained there on the functions of the classes that stand between industrial employers and workers, Marx could have returned to those sweeping conclusions with which the first volume ends.

The great scientific achievement of Marx lies, then, not in these conclusions, but in the *details* and yet more in the *method* and *principles* of his investigations in his *philosophy of history*. Here he has, as is now generally admitted, broken new ground and opened new ways and new outlooks. Nobody before him had so clearly shown the rôle of the productive agencies in historical evolution; nobody so masterfully exhibited their great determining influence on the forms and ideologies of social organisms. The passages and chapters dealing with this subject form, notwithstanding occasional exaggerations, the crowning parts of his works. If he has been justly compared with Darwin, it is in these respects that he ranks with that great genius, not through his value theory, ingenious though it be. With the great theorist of biological transformation he had also in common the indefatigable way in which he made painstaking studies of the minutest details connected with his researches. In the same year as Darwin's epoch-making work on the origin of species there appeared also Marx's work *Zur Kritik der politischen Ökonomie*, where he explains in concise sentences in the preface that philosophy of history which has for the theory of the transformation or evolution of social organisms the same significance that the argument of Darwin had for the theory of the transformation of biological organisms.

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MARY[1] (Μαρία Μαριάμ), the mother of Jesus. At the time when the gospel history begins, she had her home in Galilee, at the village of Nazareth. Of her parentage nothing is recorded in any extant historical document of the 1st century, for the genealogy in Luke iii. (cf. i. 27) is manifestly that of Joseph. In early life she became the wife of Joseph (*q.v.*) and the mother of Jesus Christ; that she afterwards had other children is a natural inference from Matt. i. 25, which the evangelists, who frequently allude to "the brethren of the Lord," are at no pains to obviate. The few incidents mentioned in Scripture regarding her show that she followed our Lord to the very close of His earthly career with unfailing motherliness, but the "Magnificat" assigned to her in Luke i. is the only passage which would distinctly imply on her part a high prophetic appreciation of His divine mission. It is however doubtful whether Luke really intended to assign this hymn to Mary or to Elizabeth (cf. especially *Niceta of Remesiana* by A. E. Burn, Cambridge, 1905; Harnack's "Das Magnificat der Elizabeth" in the *Sitzungsberichte* of the Berlin Academy for 1900, and Burkitt's "Who spoke the Magnificat?" in the *Journal of Theological Studies*, Jan. 1906). The original text of Luke probably mentioned no name in introducing the Magnificat; scribes supplied the ambiguity by inserting, some Mary, others Elizabeth. It is doubtful which represents the intention of the writer: there is perhaps more to be said for the view that he meant to assign the Magnificat to Elizabeth. Mary was present at the Crucifixion, where she was commended by Jesus to the care of the apostle John (John xix. 26, 27), Joseph having apparently died before this time. Mary is mentioned in Acts i. 14 as having been among those who continued in prayer along with the apostles at Jerusalem during the interval between the Ascension and Pentecost. There is no allusion in the New Testament to the time or place of her death.

The subsequent growth of ecclesiastical tradition and belief regarding Mary will be traced most conveniently under the separate heads of (1) her perpetual virginity, (2) her absolute sinlessness, (3) her peculiar relation to the Godhead, which specially fits her for successful intercession on behalf of mankind.

Her Perpetual Virginity.—This doctrine was, to say the least, of no importance in the eyes of the evangelists, and so far as extant writings go there is no evidence of its having been anywhere taught within the pale of the Catholic Church of the first three centuries. On the contrary, to Tertullian the fact of

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[1] The name (Heb. מִרְיָם), that of the sister of Moses and Aaron, is of uncertain etymology; many interpretations have been suggested, including *Stella maris* ("star of the sea"), which, though it has attained considerable currency through Jerome (the *Onomasticon*), may be at once dismissed. It seems to have been very common among the Jews in New Testament times: besides the subject of the present notice there are mentioned (1) "Mary (the wife) of Clopas," who was perhaps the mother of James "the little" (ὁ μικρός) and of Joses; (2) Mary Magdalene, *i.e.* of Magdala; (3) Mary of Bethany, sister of Martha and Lazarus; (4) Mary, the mother of Mark; and (5) Mary, an otherwise unknown benefactress of the apostle Paul (Rom. xvi. 6).

Mary's marriage after the birth of Christ is a useful argument for the reality of the Incarnation against gnostic notions, and Origen relies upon the references to the Lord's brethren as disproving the Docetism with which he had to contend. The ἀειπαρθενία though very ancient, is in reality a doctrine of non-Catholic origin, and first occurs in a work proscribed by the earliest papal *Index librorum prohibitorum* (attributed to Gelasius) as heretical,—the so-called *Protevangelium Jacobi*, written, it is generally admitted, within the 2nd century. According to this very early source, which seems to have formed the basis of the later *Liber de infantia Mariae et Christi salvatoris* and *Evangelium de nativitate Mariae*, the name of Mary's father was Joachim (in the *Liber de infantia* a shepherd of the tribe of Judah, living in Jerusalem); he had long been married to Anna her mother, whose continual childlessness had become a cause of much humiliation and sorrow to them both. The birth of a daughter was at last angelically predicted to each parent separately. From her third to her twelfth year "Mary was in the Temple as if she were a dove that dwelt there, and she received food from the hand of an angel." When she became of nubile age a guardian was sought for her by the priests among the widowers of Israel "lest she should defile the sanctuary of the Lord"; and Joseph, an elderly man with a family, was indicated for this charge by a miraculous token. Some time afterwards the annunciation took place; when the Virgin's pregnancy was discovered, Joseph and she were brought before the high priest, and, though asserting their innocence in all sincerity, were acquitted only after they had been tried with "the water of the ordeal of the Lord" (Num. v. 11). Numerous details regarding the birth at Bethlehem are then given. The perpetual physical virginity of Mary, naïvely insisted upon in this apocryphon, is alluded to only with a half belief and a "some say" by Clement of Alexandria (*Strom.* vii. 16), but became of much importance to the leaders of the Church in the 4th century, as for example to Ambrose, who sees in Ezek. xliv. 1–3 a prophetic indication of so great a mystery.[1] Those who continued to believe that Mary, after the miraculous birth of Jesus, had become the mother of other children by Joseph came accordingly to be spoken of as her enemies—Antidicomarianitae (Epiphanius) or Antidicomaritae (Augustine)—and the first-mentioned author devotes a whole chapter (ch. 78) of his great work upon heresies to their confutation. For holding the same view Bonosus of Sardica was condemned by the synod of Capua in 391. To Jerome the perpetual virginity not only of Mary but even of Joseph appeared of so much consequence that while a young man he wrote (387) the long and vehement tract *Against Helvidius*, in which he was the first to broach the theory (which has since gained wide currency) that the brethren of our Lord were children neither of Mary by her husband nor of Joseph by a former marriage, but of another Mary, sister to the Virgin and wife of Clopas or Alphaeus. At last the epithet of ἀεὶ παρθένος was authoritatively applied to the Virgin by the council of Chalcedon in 451, and the doctrine implied has ever since been an undisputed point of orthodoxy both in the Eastern and in the Roman Churches, some even seeking to hold the Anglican Church committed to it on account of the general declaration (in the *Homilies*) of concurrence in the decisions of the first four general councils.

Her Absolute Sinlessness.—While much of the apocryphal literature of the early sects in which she is repeatedly spoken of as "undefiled before God" would seem to encourage some such doctrine as this, many passages from the acknowledged fathers of the Church could be cited to show that it was originally quite unknown to Catholicism. Even Augustine repeatedly asserts that she was born in original sin (*De gen. ad lit.* x. 18); and the *locus classicus* regarding her possible immunity from actual transgression, on which the subsequent doctrine of Lombardus and his commentators was based, is simply an extremely guarded passage (*De nat. et grat.* ch. 36), in which, while contradicting the assertion of Pelagius that many had lived free from sin, he wishes exception to be made in favour of "the holy Virgin Mary, of whom out of honour to the Lord I wish no question to be made where sins are treated of—for how do we know what mode of grace wholly to conquer sin may have been bestowed upon her who was found meet to conceive and bear Him of whom it is certain that He had no sin." A writer so late as Anselm (*Cur deus homo*, ii. 16). declares that "the Virgin herself whence He (Christ) was assumed was conceived in iniquity, and in sin did her mother conceive her, and with original sin was she born, because she too sinned in Adam in whom all sinned," and the same view was expressed by Damiani. For the growth of the modern Roman doctrine of the immaculate conception from the time in the 12th century, when the canons of Lyons sought to institute a festival in honour of her "holy conception," and were remonstrated with by Bernard, see IMMACULATE CONCEPTION. The epithets applied to her in the Greek Church are such as ἀμόλυντος, πάναγνος, ἁγία, παναγία; but in the East generally no clear distinction is drawn between immunity from actual sin and original sinlessness.

Her Peculiar Relation to the Godhead, which specially fits Her for Successful Intercession on Behalf of Mankind.—It seems probable that the epithet θεοτόκος ("Mother of God") was first applied to Mary by theologians of Alexandria towards the close of the 3rd century; but it does not occur in any genuine extant writing of that period, unless we are to assign an early date to the apocryphal *Transitus Mariae*, in which the word is of frequent occurrence. In the 4th century it is met with frequently, being used by Eusebius, Athanasius, Didymus and Gregory of Nazianzus,—the latter declaring that the man who believes not Mary to have been θεοτόκος has no part in God (*Orat.* li. p. 738).[2] If its use was first recommended by a desire to bring into prominence the divinity of the Incarnate Word, there can be no doubt that latterly the expression came to be valued as directly honourable to Mary herself and as corresponding to the greatly increased esteem in which she personally was held throughout the Catholic world, so that when Nestorius and others began to dispute its propriety, in the following century, their temerity was resented, not as an attack upon the established orthodox doctrine of the Nicene creed, but as threatening a more vulnerable and more tender part of the popular faith. It is sufficient in illustration of the drift of theological opinion to refer to the first sermon of Proclus, preached on a certain festival of the Virgin (πανήγυρις παρθενική) at Constantinople about the year 430 or to that of Cyril of Alexandria delivered in the church of the Virgin Mary at the opening of the council of Ephesus in 431. In the former the orator speaks of "the holy Virgin and Mother of God" as "the spotless treasure-house of virginity, the spiritual paradise of the second Adam; the workshop in which two natures were welded together . . . . the one bridge between God and men";[3] in the latter she is saluted as the "mother and virgin," "through whom (δι' ἧς) the Trinity is glorified and worshipped, the cross of the Saviour exalted and honoured, through whom heaven triumphs, the angels are made glad, devils driven forth, the tempter overcome, and the fallen creature raised up even to heaven." The response which such language found in the popular heart was sufficiently shown by the shouts of joy with which the Ephesian mob heard of the deposition of Nestorius, escorting his judges with torches and incense to their homes, and celebrating the occasion by a general illumination. The causes which in the preceding century had led to this exaltation of the Mother of God in the esteem of the Catholic world are not far to seek. On the one hand the solution of the Arian controversy, however correct it may have been theoretically, undoubtedly had the practical effect of relegating the God-man redeemer for ordinary minds into a far away region of "remote and awful Godhead," so that the need for a mediator to deal with the very Mediator could not fail to be felt. On the other hand, the religious instincts of mankind are very ready to pay worship, in grosser or more refined forms, to the idea of womanhood; at all events many of those who became professing Christians at the political fall of Paganism entered the Church with such instincts (derived from the nature-religions in which they had been brought up) very fully developed. Probably it ought to be added that the comparative colourlessness with which the character of Mary is presented, not only in the canonical gospels but even in the most copious of the apocrypha, left greater scope for the untrammelled exercise of devout imagination than was possible in the case of Christ, in the circumstances of whose humiliation and in whose recorded utterances there were many things which the religious consciousness found difficulty in understanding or in adapting to itself. At all events, from the time of the council of Ephesus, to exhibit figures of the Virgin and Child became the approved expression of orthodoxy, and the relationship of motherhood in which Mary had been formally declared to stand to God[1] was instinctively felt to give the fullest and freest sanction of the Church to that invocation of her aid which had previously been resorted to only hesitatingly and occasionally. Previously to the council of Ephesus, indeed, the practice had obtained complete recognition, so far as we know, in those circles only in which one or other of the numerous redactions of the *Transitus Mariae* passed current.[2] There we read of Mary's prayer to Christ: "Do Thou bestow Thine aid upon every man calling upon, or praying to, or naming the name of Thine handmaid"; to which His answer is, "Every soul that calls upon Thy name shall not be ashamed, but shall find mercy and support and confidence both in the world that now is and in that which is to come in the presence of My Father in the heavens." But Gregory of Nazianzus also, in his panegyric upon Justina, mentions with incidental approval that in her hour of peril she "implored Mary the Virgin to come to the aid of a virgin in her danger."[3] Of the growth of the Marian cultus, alike in the East and in the West, after the decision at Ephesus it would be impossible to trace the history, however slightly, within the limits of the present article. Justinian in one of his laws bespeaks her advocacy for the empire, and he inscribes the high altar in the new church of St Sophia with her name. Narses looks to her for directions on the field of battle. The emperor Heraclius bears her image on his banner. John of Damascus speaks of her as the sovereign lady to whom the whole creation has been made subject by her son. Peter Damian recognizes her as the most exalted of all creatures, and apostrophizes her as deified and endowed with all power in heaven and in earth, yet not forgetful of our race.[4] In a word, popular devotion gradually developed the entire system of doctrine and practice which Protestant controversialists are accustomed to call by the name of Mariolatry. With reference to this much-disputed phrase it is always to be kept in mind that the directly authoritative documents, alike of the Greek and of the Roman Church, distinguish formally between *latria* and *dulia*, and declare that the "worship" to be paid to the mother of God must never exceed that superlative degree of *dulia* which is vaguely described as *hyperdulia*. But the comparative reserve shown by the council of Trent in its decrees, and even in its catechism,[5] on this subject has not been observed by individual theologians, and in view of the fact of the canonization of some of these (such as Liguori)—a fact guaranteeing the absence of erroneous teaching from their writings—it does not seem unfair, to hold the Roman Church responsible for the natural interpretations and just inferences which may be drawn even from apparently exaggerated expressions in such works as the well-known *Glories of Mary* and others frequently quoted in controversial literature. There is a good *résumé* of Catholic developments of the cultus of Mary in Pusey's *Eirenicon*.

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[1] *De Inst. Virg.*, "quæ est hæc porta nisi Maria? . . . per quam Christus intravit in hunc mundum, quando virginali fusus est partu et genitalia virginitatis claustra non solvit."

[2] See Gieseler (*KG.*, Bd. i. Abth. 1), who points out instances in which anti-Arianizing zeal went so far as to call David θεοπάτωρ and James ἀδελφόθεος.

[3] Labbé, *Conc.* iii. 51. Considerable extracts are given by Augusti (*Denkw.* iii.); see also Milman (*Lat. Christ.* i. 185), who characterizes much of it as a "wild labyrinth of untranslatable metaphor."

The following are the principal feasts of the Virgin in the order in which they occur in the ecclesiastical year. (1) That of the Presentation (*Praesentatio B. V. M.*, *τὰ εἰσόδια τῆς θεοτόκου*), to commemorate the beginning of her stay in the Temple, as recorded in the *Protevangelium Jacobi*. It is believed to have originated in the East in the 8th century, the earliest allusion to it being made by George of Nicomedia (9th century); Manuel Comnenus made it universal for the Eastern Empire, and in the modern Greek Church it is one of the five great festivals in honour of the Deipara. It was introduced into the Western Church late in the 14th century, and, after having been withdrawn from the calendar by Pius V., was restored by Sixtus V., the day observed in both East and West being the 21st of November. It is not mentioned in the English calendar. (2) the Feast of the Conception (*Conceptio B. V. M.*, *Conceptio immaculata B. V. M.*, *σύλληψις τῆς ἁγίας Ἄννης*), observed by the Roman Catholic Church on the 8th of December, and by all the Eastern Churches on the 9th of December, has already been explained; in the Greek Church it only ranks as one of the middle festivals of Mary. (3) The Feast of the Purification (*Occursus*, *Obviatio*, *Praesentatio*, *Festum SS Simeonis et Annae*, *Purificatio*, *Candelaria*, *ὑπαπαντή*, *ὑπαντή*) is otherwise known as CANDLEMAS. (4) The Feast of the Annunciation of the Virgin Mary (*Annunciatio*, *Εὐαγγελισμός*). It may be mentioned that at the council of Toledo in 656 it was decreed that this festival should be observed on the 18th of December, in order to keep clear of Lent. (5) The Feast of the Visitation (*Visitatio B. V. M.*) was instituted by Urban VI., promulgated in 1389 by Boniface IX., and reappointed by the council of Basel in 1441 in commemoration of the visit paid by Mary to Elizabeth. It is observed on the 2nd of July, and has been retained in the English calendar. (6) The Feast of the Assumption (*Dormitio*, *Pausatio*, *Transitus*, *Depositio*, *Migratio*, *Assumptio*, *κοίμησις*, *μετάστασις*, *ἀνάληψις*) has reference to the apocryphal story related in several forms in various documents of the 4th century condemned by Pope Gelasius. Their general purport is that as the time drew nigh for "the most blessed Virgin" (who is also spoken of as "Holy Mary," "the queen of all the saints," "the holy spotless Mother of God") to leave the world, the apostles were miraculously assembled round her deathbed at Bethlehem on the Lord's Day, whereupon Christ descended with a multitude of angels and received her soul. After "the spotless and precious body" had been laid in the tomb, "suddenly there shone round them (the apostles) a miraculous light," and it was taken up into heaven. The first Catholic writer who relates this story is Gregory of Tours (*c.* 590); Epiphanius two centuries earlier had declared that nothing was known as to the circumstances of Mary's death and burial; and one of the documents of the council of Ephesus implies a belief that she was buried in that city. The Sleep of the Theotokos is observed in the Greek Church as a great festival on the 15th of August; the Armenian Church also commemorates it, but the Ethiopic Church celebrates her death and burial on two separate days. The earliest allusion to the existence of such a festival in the Western Church seems to be that found in the proceedings of the synod of Salzburg in 800; it is also spoken of in the thirty-sixth canon of the reforming synod of Mainz, held in 813. It was not at that time universal, being mentioned as doubtful in the capitularies of Charlemagne. The doctrine of the bodily assumption of the Virgin into heaven, although extensively believed, and indeed flowing as a natural theological consequence from that of her sinlessness, has never been declared to be "de fide" by the Church of Rome, and is still merely a "pia sententia." (7) The Nativity of Mary (*Nativitas*, γενέθλιον τῆς θεοτόκου) observed on the 8th of September, is first mentioned in one of the homilies of Andrew of Crete (*c.* 750), and with the Feasts of the Purification, the Annunciation and the Assumption, it was appointed to be observed by the synod of Salzburg in 800, but seems to have been unknown at that time in the Gallican Church, and even two centuries later it was by no means general in Italy. In the Roman Catholic Church a large number of minor festivals in honour of the Virgin are locally celebrated; and all the Saturdays of the year as well as the entire month of May are also regarded as sacred to her.

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[1] The term *θεοτόκος* does not actually occur in the canons of Ephesus. It is found, however, in the creed of Chalcedon.

[2] It is true that Irenaeus (*Haer.* v. 19, 1) in the passage in which he draws his well-known parallel and contrast between the first and second Eve (cf. Justin, *Dial. c. Tryph.* 100), to the effect that "as the human race fell into bondage to death by a virgin, so is it rescued by a virgin," takes occasion to speak of Mary as the "advocata" of Eve; but it seems certain that this word is a translation of the Greek *συνήγορος*, and implies hostility and rebuke rather than advocacy.

[3] It is probable that the commemorations and invocations of the Virgin which occur in the present texts of the ancient liturgies of "St James" and "St Mark" are due to interpolation. In this connexion ought also to be noted the chapter in Epiphanius (*Haer.*, 79) against the "Collyridians," certain women in Thrace, Scythia and Arabia, who were in the habit of worshipping the Virgin (*ἀεὶ παρθένον*) as a goddess, the offering of a cake (*κολλυρίδα τινα*) being one of the features of their worship. He rebukes them for offering the worship which was due to the Trinity alone; "let Mary be held in honour, but by no means worshipped." The cultus was probably a relic of heathenism; cf. Jer. xliv. 19.

[4] "Numquid quia ita deificata, ideo nostrae humanitatis oblita es? Nequaquam, Domina. . . . Data est tibi omnis potestas in coelo et in terra. Nil tibi impossibile." *Serm. de nativ. Mariae*, ap. Gieseler, *KG.*, Bd. ii. Abth. 1.

[5] The points taught in the catechism are—that she is truly the Mother of God, and the second Eve, by whose means we have received blessing and life; that she is the Mother of Pity, and very specially our advocate; that her merits are highly exalted, and that her dispositions towards us are extremely gracious; that her images are of the utmost utility. In the *Missal* her intercessions (though alluded to in the canon and elsewhere) are seldom directly appealed to except in the Litany and in some of the later offices, such as those for the 8th of September and for the Festival of the Seven Sorrows (decree by Benedict XIII. in 1727). Noteworthy are the versicles in the office for the 8th of December (The Feast of the Immaculate Conception), "Tota pulchra es, Maria, et macula originalis non est in te," and "Gloriosa dicta sunt de te, Maria, quia fecit tibi magna qui potens est."

The chief apocryphal writings concerned with Mary are the following: (1) The *Portevangelium Jacobi*, with its derivatives the *De nativitate Mariae*, the *Evangelium Ps.-Matthaei*, the *Historia Josephi fabri lignarii* (all edited by Tischendorf, *Evangelia apocrypha*; cf. Harnack, *Geschichte der altchristlichen Litteratur*, p. 20 seq. and *Chronologie*, i. 598 sqq.). (2) *Evangelium Mariae* (see *Sitzungsberichte der Berlinischen Akademie der Wissenschaften* 1896, pp. 839–847). (3) Ἰωάννου τοῦ θεολόγου λόγος εἰς τὴν κοίμησιν τῆς θεοτόκου, which appears in Latin under the title of the *Transitus Mariae* (ed. Tischendorf, *Apocalypses apocryphae* and *Evangelia apocrypha*, and see Bonnet, *Zeitschr. f. wissensch. Theol.*, 1880, pp. 222–247).

(J. S. Bl.; K. L.)

MARY, known as Mary Magdalene, a woman mentioned in the Gospels, first in Luke viii. 2, as one of a company who "healed of evil spirits and infirmities . . . ministered unto them (Jesus and the apostles) of their substance." It is said that seven demons were cast out of her, but this need not imply simply one occasion. Her name implies that she came from Magdala (el-Mejdel, 3 m. N.W. from Tiberias: in Matt. xv. 39 the right reading is not Magdala but Magadan). She went with Jesus on the last journey to Jerusalem, witnessed the Crucifixion, followed to the burial, and returned to prepare spices. John xx. gives an account of her finding the tomb empty and of her interview with the risen Jesus. Mary of Magdala has been confounded (1) with the unnamed fallen woman who in Simon's house anointed Christ's feet (Luke vii. 37); (2) with Mary of Bethany, sister of Lazarus and Martha.

MARY I., queen of England (1516–1558), unpleasantly remembered as "the Bloody Mary" on account of the religious persecutions which prevailed during her reign, was the daughter of Henry VIII. and Catherine of Aragon, born in the earlier years of their married life, when as yet no cloud had darkened the prospect of Henry's reign. Her birth occurred at Greenwich, on Monday, the 18th February 1516, and she was baptized on the following Wednesday, Cardinal Wolsey standing as her godfather. She seems to have been a singularly precocious child, and is reported in July 1520, when scarcely four and a half years old, as entertaining some visitors by a performance on the virginals. When she was little over nine she was addressed in a complimentary Latin oration by commissioners sent over from Flanders on commercial matters, and replied to them in the same language "with as much assurance and facility as if she had been twelve years old" (Gayangos, iii. pt. 1, 82). Her father was proud of her achievements. About the same time that she replied to the commissioners in Latin he was arranging that she should learn Spanish, Italian and French. A great part, however, of the credit of her early education was undoubtedly due to her mother, who not only consulted the Spanish scholar Vives upon the subject, but was herself Mary's first teacher in Latin. She was also well instructed in music, and among her principal recreations as she grew up was that of playing on the virginals and lute.

It was a misfortune that she shared with high-born ladies generally in those days that her prospects in life were made a matter of sordid bargaining from the first. Mary was little more than two years old when she was proposed in marriage to the dauphin, son of Francis I. Three years afterwards the French alliance was broken off, and in 1522 she was affianced to her cousin the young emperor Charles V. by the Treaty of Windsor. No one, perhaps, seriously expected either of these arrangements to endure; and, though we read in grave state papers of some curious compliments and love tokens (really the mere counters of diplomacy) professedly sent by the girl of nine to her powerful cousin, not many years passed away before Charles released himself from this engagement and made a more convenient match. In 1526 a rearrangement was made of the royal household, and it was thought right to give Mary an establishment of her own along with a council on the borders of Wales, for the better government of the Marches. For some years she accordingly kept her court at Ludlow, while new arrangements were made for the disposal of her hand. She was now proposed as a wife, not for the dauphin as before, but for his father Francis I., who had just been redeemed from captivity at Madrid, and who was only too glad of an alliance with England to mitigate the severe conditions imposed on him by the emperor. Wolsey, however, on this occasion, only made use of the princess as a bait to enhance the terms of the compact, and left Francis free in the end to marry the emperor's sister.

It was during this negotiation, as Henry afterwards pretended, that the question was first raised whether Henry's own marriage with Catherine was a lawful one. Grammont, bishop of Tarbes, who was one of the ambassadors sent over by Francis to ask the princess in marriage, had, it was said, started an objection that she might possibly be considered illegitimate on account of her mother having been once the wife of her father's brother. The statement was a mere pretence to shield the king when the unpopularity of the divorce became apparent. It is proved to be untrue by the strongest evidence, for we have pretty full contemporary records of the whole negotiation. On the contrary, it is quite clear that Henry, who had already for some time conceived the project of a divorce, kept the matter a dead secret, and was particularly anxious that the French ambassadors should not know it, while he used his daughter's hand as a bait for a new alliance. The alliance itself, however, was actually concluded by a treaty dated Westminster, the 30th of April 1527, in which it was provided, as regards the Princess Mary, that she should be married either to Francis himself or to his second son Henry duke of Orleans. But the real object was only to lay the foundation of a perfect mutual understanding between the two kings, which Wolsey soon after went into France to confirm.

During the next nine years the life of Mary, as well as that of her mother, was rendered miserable by the conduct of Henry VIII. in seeking a divorce. During most of that period mother and daughter seem to have been kept apart. Possibly Queen Catherine had the harder trial; but Mary's was scarcely less severe. Removed from court and treated as a bastard, she was, on the birth of Anne Boleyn's daughter, required to give up the dignity of princess and acknowledge the illegitimacy of her own birth. On her refusal her household was broken up, and she was sent to Hatfield to act as lady-in-waiting to her own infant half-sister. Nor was even this the worst of her trials; her very life was in danger from the hatred of Anne Boleyn. Her health, moreover, was indifferent, and even when she was seriously ill, although Henry sent his own physician, Dr Buttes, to attend her, he declined to let her mother visit her. So also at her mother's death, in January 1536, she was forbidden to take a last farewell of her. But in May following another change occurred. Anne Boleyn, the real cause of all her miseries, fell under the king's displeasure and was put to death. Mary was then urged to make a humble submission to her father as the means of recovering his favour, and after a good deal of correspondence with the king's secretary, Cromwell, she actually did so. The terms exacted of her were bitter in the extreme, but there was no chance of making life tolerable otherwise, if indeed she was permitted to live at all; and the poor friendless girl, absolutely at the mercy of a father who could brook no contradiction, at length subscribed an act of submission, acknowledging the king as "Supreme Head of the Church of England under Christ," repudiating the pope's authority, and confessing that the marriage between her father and mother "was by God's law and man's law incestuous and unlawful."

No act, perhaps, in the whole of Henry's reign gives us a more painful idea of his revolting despotism. Mary was a high-spirited girl, and undoubtedly popular. All Europe looked upon her at that time as the only legitimate child of her father, but her father himself compelled her to disown the title and pass an unjust stigma on her own birth and her mother's good name. Nevertheless Henry was now reconciled to her, and gave her a household in some degree suitable to her rank. During the rest of the reign we hear little about her except in connexion with a number of new marriage projects taken up and abandoned successively, one of which, to the count palatine Philip, duke of Bavaria, was specially repugnant to her in the matter of religion. Her privy purse expenses for nearly the whole of this period have been published, and show that Hatfield, Beaulieu or Newhall in Essex, Richmond and Hunsdon were among her principal places of residence. Although she was still treated as of illegitimate birth, it was believed that the king, having obtained from parliament the extraordinary power to dispose of the crown by will, would restore her to her place in the succession, and three years before his death she was so restored by statute, but still under conditions to be regulated by her father's will.

Under the reign of her brother, Edward VI. she was again subjected to severe trials, which at one time made her seriously meditate taking flight and escaping abroad. Edward himself indeed seems to have been personally not unkind to her, but the religious revolution in his reign assumed proportions such as it had not done before, and Mary, who had done sufficient violence to her own convictions in submitting to a despotic father, was not disposed to yield an equally tame obedience to authority exercised by a factious council in the name of a younger brother not yet come to years of discretion. Besides, the cause of the pope was naturally her own. In spite of the forced declaration formerly wrung from herself, no one really regarded her as a bastard, and the full recognition of her rights depended on the recognition of the pope as head of the Church. Hence, when Edward's parliament passed an Act of Uniformity enjoining services in English and communion in both kinds, the law appeared to her totally void of authority, and she insisted on having Mass in her own private chapel under the old form. When ordered to desist, she appealed for protection to the emperor Charles V., who, being her cousin, intervened for some time not ineffectually, threatening war with England if her religious liberty was interfered with. But Edward's court was composed of factions of which the most violent eventually carried the day. Lord Seymour, the admiral, was attainted of treason and beheaded in 1549. His brother, the Protector Somerset, met with the same fate in 1552. Dudley, duke of Northumberland, then became paramount in the privy council, and easily obtained the sanction of the young king to those schemes for altering the succession which led immediately after his death to the usurpation of Lady Jane Grey. Dudley had, in fact, overawed all the rest of the privy council, and when the event occurred he took such energetic measures to give effect to the scheme that Lady Jane was actually recognized as queen for some days, and Mary had even to fly from Hunsdon into Norfolk. But the country was really devoted to her cause, as indeed her right in law was unquestionable, and before many days she was royally received in London, and took up her abode within the Tower.

Her first acts at the beginning of her reign displayed a character very different from that which she still holds in popular estimation. Her clemency towards those who had taken up arms against her was altogether remarkable. She released from prison Lady Jane's father, Suffolk, and had difficulty even in signing the warrant for the execution of Northumberland. Lady Jane herself she fully meant to spare, and did spare till after Wyatt's formidable insurrection. Her conduct, indeed, was in every respect conciliatory and pacific, and so far as they depended on her personal character the prospects of the new reign might have appeared altogether favourable. But unfortunately her position was one of peculiar difficulty, and the policy on which she determined was far from judicious. Inexperienced in the art of governing, she had no trusty councillor but Gardiner; every other member of the council had been more or less implicated in the conspiracy against her. And though she valued Gardiner's advice she was naturally led to rely even more on that of her cousin, the emperor, who had been her mother's friend in adversity, and had done such material service to herself in the preceding reign. Following the emperor's guidance she determined almost from the first to make his son Philip her husband, though she was eleven years his senior. She was also strongly desirous of restoring the old religion and wiping out the stigma of illegitimacy upon her birth, so that she might not seem to reign by virtue of a mere parliamentary settlement.

Each of these different objects was attended by difficulties or objections peculiar to itself; but the marriage was the most unpopular of all. A restoration of the old religion threatened to deprive the new owners of abbey lands of their easy and comfortable acquisitions; and it was only with an express reservation of their interests that the thing was actually accomplished. A declaration of her own legitimacy necessarily cast a slur on that of her sister Elizabeth, and cut her off from the succession. But the marriage promised to throw England into the arms of Spain and place the resources of the kingdom at the command of the emperor's son. The Commons sent her a deputation to entreat that she would not marry a foreigner, and when her resolution was known insurrections broke out in different parts of the country. Suffolk, whose first rebellion had been pardoned, proclaimed Lady Jane Grey again in Leicestershire, while young Wyatt raised the county of Kent and, though denied access by London Bridge, led his men round by Kingston to the very gates of London before he was repulsed. In the midst of the danger Mary showed great intrepidity, and the rebellion was presently quelled; after which, unhappily, she got leave to pursue her own course unchecked. She married Philip, restored the old religion, and got Cardinal Pole to come over and absolve the kingdom from its past disobedience to the Holy See.

It was a more than questionable policy thus to ally England with Spain—a power then actually at war with France. By the treaty, indeed, England was to remain neutral; but the force of events, in the end, compelled her, as might have been expected, to take part in the quarrel. Meanwhile the country was full of faction, and seditious pamphlets of Protestant origin inflamed the people with hatred against the Spaniards. Philip's Spanish followers met with positive ill-usage everywhere, and violent outbreaks occurred. A year after his marriage Philip went over to Brussels to receive from his father the government of the Low Countries and afterwards the kingdom of Spain. Much to Mary's distress, his absence was prolonged for a year and a half, and when he returned in March 1557 it was only to commit England completely to the war; after which he went back to Brussels in July, to return no more to England.

Hostilities with France were inevitable, because France had encouraged disaffection among Mary's subjects, even during the brief truce of Vaucelles. Conspiracies had been hatched by English refugees in Paris, and an attempt to seize Scarborough had been made with the aid of vessels from the Seine. But perhaps the strangest thing about the situation was that the pope took part with France against Spain; and so the very marriage which Mary had contracted to bring England back to the Holy See made her the wife of the pope's enemy. It was, moreover, this war with France that occasioned the final calamity of the loss of Calais, which sank so deeply into Mary's heart some time before she died.

The cruel persecution of the Protestants, which has cast so much infamy upon her reign, was not due, as commonly supposed, to inhumanity on her part. When the kingdom was reconciled to Rome and absolved by Cardinal Pole, it followed, almost as a matter of necessity, that the old heresy laws should be revived, as they were then by Act of Parliament. They had been abolished by the Protector Somerset for the express purpose of promoting changes of doctrine which did violence to what was still the prevailing religious sentiment; and now the old religion required to be protected from insult and fanatical outrages. Doubts were felt as to the result even from the first; but the law having been once passed could not be relaxed merely because the victims were so numerous; for that would only have encouraged the irreverence which it was intended to check. No doubt there were milder men among the heretics, but as a class their stern fanaticism and ill-will to the old religion made them dangerous, even to the public peace. Rogers, the first of the martyrs, was burnt on the 4th of February 1555. Hooper, bishop of Gloucester, had been condemned six days before, and suffered the same fate upon the 9th. From this time the persecution went on uninterrupted for three years and three quarters, numbering among its victims Ridley, Latimer and Cranmer. It came to an end at last on the death of Mary. It seems to have been more severe in the eastern and southern parts of England, and the largest number of sufferers was naturally in the diocese of Bonner, bishop of London. From first to last nearly three hundred victims are known to have perished at the stake; and their fate certainly created a revulsion against Rome that nothing else was likely to have effected.

Mary was of weak constitution and subject to frequent illnesses, both before and after her accession. One special infirmity caused her to believe a few months after her marriage that she was with child, and thanksgiving services were ordered throughout the diocese of London in November 1554. The same delusion recurred in March 1558, when though she did not make her expectation public, she drew up a will in anticipation of the dangers of childbirth, constituting her husband regent during the minority of her prospective heir. To this she added a codicil on the 28th of October following, when the illness that was to be her last had set in, showing that she had ceased to have much expectation of maternity, and earnestly entreating her "next heir and successor by the laws" (whom she did not name) to allow execution of the instrument. She died on the 17th of November.

Her name deserved better treatment than it has generally met with; for she was far from cruel. Her kindness to poor people is undoubted, and the severe execution of her laws seemed only a necessity. Even in this matter, moreover, she was alive to the injustice with which the law was usually strained in behalf of the prerogative; and in appointing Sir Richard Morgan chief justice of the Common Pleas she charged him "not to sit in judgment otherwise for her highness than for her subjects," and to avoid the old error of refusing to admit witnesses against the Crown (Holinshed III. 1112). Her conduct as queen was certainly governed by the best possible intentions; and it is evident that her very zeal for goodness caused most of the trouble she brought upon herself. Her subjects were entirely released, even by papal authority, from any obligation to restore the confiscated lands of the Church. But she herself made it an object, at her own expense, to restore several of the monasteries; and courtiers who did not like to follow her example, encouraged the fanatics to spread an alarm that it would even yet be made compulsory. So the worldly minded joined hands with the godly heretics in stirring up enmity against her. (J. Ga.)

MARY II. (1662–1694), queen of England and wife of king William III., elder daughter of James, duke of York, afterwards King James II., by his first wife, Anne, daughter of Edward Hyde, 1st earl of Clarendon, was born in London on the 30th of April 1662. She was educated as a Protestant, and as it was probable that she would succeed to the English throne after the deaths of her uncle, Charles II., and her father, the choice of a husband for her was a political event of high importance. About 1672 the name of William, prince of Orange, was mentioned in this connexion; and after some hesitation on both sides caused by the condition of European politics, the betrothal of William and Mary took place in October 1677, and was quickly followed by their marriage in London on the 4th of November. Mary's married life in Holland does not appear to have been a happy one. Although she soon became popular among the Dutch, she remained childless, while William treated her with neglect and even with insult; and her troubles were not diminished after her father became king of England in 1685. James had treated his daughter very shabbily in money matters; and it was increasingly difficult for her to remain loyal to both father and husband when they were so divergent in character and policy. Although Mary never entirely lost her affection for her father the wife prevailed over the daughter; and after the birth of her half-brother, the prince of Wales, in 1688, she regarded the dethronement of James as inevitable. It cannot be said, however, that William merited this confidence. Possibly he was jealous of his wife as the heiress of the English throne, contrasting her future position with his own; but according to Burnet, who was then staying at the Hague, this cause of difference was removed by the tactful interference of Burnet himself. The latter asserts that having divined the reason of the prince's jealousy he mentioned the matter to the princess, who in her ignorance of statecraft had never considered the relative positions of herself and her husband with regard to the English throne; and that Mary, by telling the prince "she would be no more but his wife, and that she would do all that lay in her power to make him king for life" (Burnet, *Supplement*, ed. Foxcroft, p. 309), probably mollified her husband's jealousy. On the other hand Macaulay's statement that henceforward there was "entire friendship and confidence" between them must be taken with some reserve. Mary shared heartily in the events which immediately preceded William's expedition to England in 1688. After the success of the undertaking she arrived in London in February 1689; and by her faithful adherence to her promise made a satisfactory settlement of the English crown possible. William and Mary were together proclaimed king and queen of England, and afterwards of Scotland, and were crowned on the 11th of April 1689. During the king's absence from England the queen, assisted by a committee of the privy council, was entrusted with the duties of government, duties which she performed faithfully, but which she gladly laid down on William's return. In these times of danger, however, she acted when necessary with courage and promptitude, as when in 1690 she directed the arrest of her uncle Henry Hyde, 2nd earl of Clarendon; but she was constantly anxious for William's safety, and unable to trust many of her advisers. She was further distressed by a quarrel with her sister Anne in 1692 following the dismissal of Marlborough, and this event somewhat diminished her popularity, which had hitherto been one of the mainstays of the throne. Weak in body and troubled in mind, the queen died at Kensington Palace from small-pox on the 28th of December 1694, and was buried in Westminster Abbey. Mary was a woman of a remarkably modest and retiring disposition, whose outstanding virtue was perhaps her unswerving loyalty to William. Burnet has passed a remarkable panegyric upon her character. She was extremely pious and charitable; her blameless private life was in marked contrast with her surroundings, both in England and Holland; without bigotry she was greatly attached to the Protestant faith and to the Church of England; and she was always eager to improve the tone of public morals, and to secure a better observance of Sunday. Greenwich Hospital for Seamen was founded in her honour.

For the political events of Mary's life see William III. For her private life see Sir John Dalrymple, *Memoirs of Great Britain and Ireland* (London, 1790); Countess Bentinck, *Lettres et mémoires de Marie, reine d'Angleterre* (The Hague, 1880); *Memoires and Letters of Mary Queen of England* (ed. by R. Doebner, Leipzig, 1886); F. J. L. Krämer, *Maria II. Stuart* (Utrecht, 1890); Agnes Strickland, *Lives of the Queens of England*, vols. x. and xi. (London, 1847); G. Burnet, *History of my own Time* (Oxford, 1833); and O. Klopp, *Der Fall des Hauses Stuart* (Vienna, 1875–1888).

MARY QUEEN OF SCOTS[1] (1542–1587), daughter of King James V. and his wife Mary of Lorraine, was born in December 1542, a few days before the death of her father, heart-broken by the disgrace of his arms at Solway Moss, where the disaffected nobles had declined to encounter an enemy of inferior force in the cause of a king whose systematic policy had been directed against the privileges of their order, and whose representative on the occasion was an unpopular favourite appointed general in defiance of their ill-will. On the 9th of September following the ceremony of coronation was duly performed upon the infant. A scheme for her betrothal to Edward, prince of Wales, was defeated by the grasping greed of his father, whose obvious ambition to annex the crown of Scotland at once to that of England aroused instantly the general suspicion and indignation of Scottish patriotism. In 1548 the queen of six years old was betrothed to the dauphin Francis, and set sail for France, where she arrived on the 15th of August. The society in which the child was thenceforward reared is known to readers of Brantôme as well as that of imperial Rome at its worst is known to readers of Suetonius or Petronius as well as that of papal Rome at its worst is known to readers of the diary kept by the domestic chaplain of Pope Alexander VI. Only in their pages can a parallel be found to the gay and easy record which reveals without sign of shame or suspicion of offence the daily life of a court compared to which the court of King Charles II. is as the court of Queen Victoria to the society described by Grammont. Debauchery of all kinds, and murder in all forms, were the daily matter of excitement or of jest to the brilliant circle which revolved around Queen Catherine de' Medici. After ten years' training under the tutelage of the woman whose main instrument of policy was the corruption of her own children, the queen of Scots, aged fifteen years and five months, was married to the eldest and feeblest of the brood on the 24th of April 1558. On the 17th of November Elizabeth became queen of England, and the princes of Lorraine—Francis the great duke of Guise, and his brother the cardinal—induced their niece and her husband to assume, in addition to the arms of France and Scotland, the arms of a country over which they asserted the right of Mary Stuart to reign as legitimate heiress of Mary Tudor. Civil strife broke out in Scotland between John Knox and the queen-dowager—between the self-styled "congregation of the Lord" and the adherents of the regent, whose French troops repelled the combined forces of the Scotch and their English allies from the beleaguered walls of Leith, little more than a month before the death of their mistress in the castle of Edinburgh, on the 10th of June 1560. On the 25th of August Protestantism was proclaimed and Catholicism suppressed in Scotland by a convention of states assembled without the assent of the absent queen. On the 5th of December Francis II. died; in August 1561 his widow left France for Scotland, having been refused a safe-conduct by Elizabeth on the ground of her own previous refusal to ratify the treaty made with England by her commissioners in the same month of the preceding year. She arrived nevertheless in safety at Leith, escorted by three of her uncles of the house of Lorraine, and bringing in her train her future biographer, Brantôme, and Chastelard, the first of all her voluntary victims. On the 21st of August she first met the only man able to withstand her; and their first passage of arms left, as he has recorded, upon the mind of John Knox an ineffaceable impression of her "proud mind, crafty wit and indurate heart against God and His truth." And yet her acts of concession and conciliation were such as no fanatic on the opposite side could have approved. She assented, not only to the undisturbed maintenance of the new creed, but even to a scheme for the endowment of the Protestant ministry out of the confiscated lands of the Church. Her half-brother, Lord James Stuart, shared the duties of her chief counsellor with William Maitland of Lethington, the keenest and most liberal thinker in the country. By the influence of Lord James, in spite of the earnest opposition of Knox, permission was obtained for her to hear Mass celebrated in her private chapel—a licence to which, said the Reformer, he would have preferred the invasion of ten thousand Frenchmen. Through all the first troubles of her reign the young queen steered her skilful and dauntless way with the tact of a woman and the courage of a man. An insurrection in the north, headed by the earl of Huntly under pretext of rescuing from justice the life which his son had forfeited by his share in a homicidal brawl, was crushed at a blow by the Lord James against whose life, as well as against his sister's liberty, the conspiracy of the Gordons had been aimed, and on whom, after the father had fallen in fight and the son had expiated his double offence on the scaffold, the leading rebel's earldom of Murray was conferred by the gratitude of the queen. Exactly four months after the battle of Corrichie, and the subsequent execution of a criminal whom she is said to have "loved entirely," had put an end to the first insurrection raised against her, Pierre de Boscosel de Chastelard, who had returned to France with the other companions of her arrival, and in November 1562 had revisited Scotland, expiated with his head the offence or the misfortune of a second detection at night in her bed-chamber. In the same month, twenty-five years afterwards, the execution of his mistress, according to the verdict of her contemporaries in France, avenged the blood of a lover who had died without uttering a word to realize the apprehension which (according to Knox) had before his trial impelled her to desire her brother "that, as he loved her, he would slay Chastelard, and let him never speak word." And in the same month, two years from the date of Chastelard's execution, her first step was unconsciously taken on the road to Fotheringhay, when she gave her heart at first sight to her kinsman Henry, Lord Darnley, son of Matthew Stuart, earl of Lennox, who had suffered an exile of twenty years in expiation of his intrigues with England, and had married the niece of King Henry VIII., daughter of his sister Margaret, the widow of James IV., by her second husband, the earl of Angus. Queen Elizabeth, with the almost incredible want of tact or instinctive delicacy which distinguished and disfigured her vigorous intelligence, had recently proposed as a suitor to the queen of Scots her own low-born favourite, Lord Robert Dudley, the widower if not the murderer of Amy Robsart; and she now protested against the project of marriage between Mary and Darnley. Mary who had already married her kinsman in secret at Stirling Castle with Catholic rites celebrated in the apartment of David Rizzio, her secretary for correspondence with France, assured the English ambassador, in reply to the protest of his mistress, that the marriage would not take place for three months, when a dispensation from the pope would allow the cousins to be publicly united without offence to the Church. On the 29th of July 1565 they were accordingly remarried at Holyrood. The hapless and worthless bridegroom had already incurred the hatred of two powerful enemies, the earls of Morton and Glencairn; but the former of these took part with the queen against the forces raised by Murray, Glencairn and others, under the nominal leadership of Hamilton, duke of Chatelherault, on the double plea of danger to the new religion of the country, and of the illegal proceeding by which Darnley had been proclaimed king of Scots without the needful constitutional assent of the estates of the realm. Murray was cited to attend the "raid" or array levied by the king and queen, and was duly denounced by public blast of trumpet for his non-appearance. He entered Edinburgh with his forces, but failed to hold the town against the guns of the castle, and fell back upon Dumfries before the advance of the royal army, which was now joined by James Hepburn, earl of Bothwell, on his return from a three years' outlawed exile in France. He had been accused in 1562 of a plot to seize the queen and put her into the keeping of the earl of Arran, whose pretensions to her hand ended only when his insanity could no longer be concealed. Another new adherent was the son of the late earl of Huntly, to whom the forfeited honours of his house were restored a few months before the marriage of his sister to Bothwell. The queen now appealed to France for aid; but Castelnau, the French ambassador, replied to her passionate pleading by sober and earnest advice to make peace with the malcontents. This counsel was rejected, and in October 1565 the queen marched an army of 18,000 men against them from Edinburgh; their forces dispersed in face of superior numbers, and Murray, on seeking shelter in England, was received with contumely by Elizabeth, whose half-hearted help had failed to support his enterprise, and whose intercession for his return found at first no favour with the queen of Scots. But the conduct of the besotted boy on whom at their marriage she had bestowed the title of king began at once to justify the enterprise and to play into the hands of all his enemies alike. His father set him on to demand the crown matrimonial, which would at least have assured to him the rank and station of independent royalty for life. Rizzio, hitherto his friend and advocate, induced the queen to reply by a reasonable refusal to this hazardous and audacious request. Darnley at once threw himself into the arms of the party opposed to the policy of the queen and her secretary—a policy which at that moment was doubly and trebly calculated to exasperate the fears of the religious and the pride of the patriotic. Mary was invited if not induced by the king of Spain to join his league for the suppression of Protestantism; while the actual or prospective endowment of Rizzio with Morton's office of chancellor, and the projected attainder of Murray and his allies, combined to inflame at once the anger and the apprehension of the Protestant nobles. According to one account, Darnley privately assured his uncle George Douglas of his wife's infidelity; he had himself, if he might be believed, discovered the secretary in the queen's apartment at midnight, under circumstances yet more unequivocally compromising than those which had brought Chastelard to the scaffold. Another version of the pitiful history represents Douglas as infusing suspicion of Rizzio into the empty mind of his nephew, and thus winning his consent to a deed already designed by others. A bond was drawn in which Darnley pledged himself to support the confederates who undertook to punish "certain privy persons" offensive to the state, "especially a strange Italian, called Davie"; another was subscribed by Darnley and the banished lords, then biding their time in Newcastle, which engaged him to procure their pardon and restoration, while pledging them to insure to him the enjoyment of the title he coveted, with the consequent security of an undisputed succession to the crown, despite the counter claims of the house of Hamilton, in case his wife should die without issue—a result which, intentionally or not, he and his fellow-conspirators did all that brutality could have suggested to accelerate and secure. On the 9th of March the palace of Holyrood was invested by a troop under the command of Morton, while Rizzio was dragged by force out of the queen's presence and slain without trial in the heat of the moment. The parliament was discharged by proclamation issued in the name of Darnley as king; and in the evening of the next day the banished lords, whom it was to have condemned to outlawry, returned to Edinburgh. On the day following they were graciously received by the queen, who undertook to sign a bond for their security, but delayed the subscription till next morning under plea of sickness. During the night she escaped with Darnley, whom she had already seduced from the party of his accomplices, and arrived at Dunbar on the third morning after the slaughter of her favourite. From thence they returned to Edinburgh on the 28th of March, guarded by two thousand horsemen under the command of Bothwell, who had escaped from Holyrood on the night of the murder, to raise a force on the queen's behalf with his usual soldierly promptitude. The slayers of Rizzio fled to England, and were outlawed; Darnley was permitted to protest his innocence and denounce his accomplices; after which he became the scorn of all parties alike, and few men dared or cared to be seen in his company. On the 19th of June a son was born to his wife, and in the face of his previous protestations he was induced to acknowledge himself the father. But, as Murray and his partisans returned to favour and influence no longer incompatible with that of Bothwell and Huntly, he grew desperate enough with terror to dream of escape to France. This design was at once frustrated by the queen's resolution. She summoned him to declare his reasons for it in presence of the French ambassador and an assembly of the nobles; she besought him for God's sake to speak out, and not spare her; and at last he left her presence with an avowal that he had nothing to allege. The favour shown to Bothwell had not yet given occasion for scandal, though his character as an adventurous libertine was as notable as his reputation for military hardihood; but as the summer advanced his insolence increased with his influence at court and the general aversion of his rivals. He was richly endowed by Mary from the greater and lesser spoils of the Church; and the three wardenships of the border, united for the first time in his person, gave the lord high admiral of Scotland a position of unequalled power. In the gallant discharge of its duties he was dangerously wounded by a leading outlaw, whom he slew in single combat; and while yet confined to Hermitage Castle he received a visit of two hours from the queen, who rode thither from Jedburgh and back through 20 miles of the wild borderland where her person was in perpetual danger from the freebooters whom her father's policy had striven and had failed to extirpate. The result of this daring ride was a ten days' fever, after which she removed by short stages to Craigmillar, where a proposal for her divorce from Darnley was laid before her by Bothwell, Murray, Huntly, Argyle and Lethington, who was chosen spokesman for the rest. She assented on condition that the divorce could be lawfully effected without impeachment of her son's legitimacy; whereupon Lethington undertook in the name of all present that she should be rid of her husband without any prejudice to the child—at whose baptism a few days afterwards Bothwell took the place of the putative father, though Darnley was actually residing under the same roof, and it was not till after the ceremony that he was suddenly struck down by a sickness so violent as to excite suspicions of poison. He was removed to Glasgow, and left for the time in charge of his father; but on the news of his progress towards recovery a bond was drawn up for execution of the sentence of death which had secretly been pronounced against the twice-turned traitor who had earned his doom at all hands alike. On the 22nd of the next month (Jan. 1567) the queen visited her husband at Glasgow and proposed to remove him to Craigmillar Castle, where he would have the benefit of medicinal baths; but instead of this resort he was conveyed on the last day of the month to the lonely and squalid shelter of the residence which was soon to be made memorable by his murder. Between the ruins of two sacred buildings, with the town-wall to the south and a suburban hamlet known to ill fame as the Thieves' Row to the north of it, a lodging was prepared for the titular king of Scotland, and fitted up with tapestries taken from the Gordons after the battle of Corrichie. On the evening of Sunday, the 9th of February, Mary took her last leave of the miserable boy who had so often and so mortally outraged her as consort and as queen. That night the whole city was shaken out of sleep by an explosion of gunpowder which shattered to fragments the building in which he should have slept and perished; and the next morning the bodies of Darnley and a page were found strangled in a garden adjoining it, whither they had apparently escaped over a wall, to be despatched by the hands of Bothwell's attendant confederates.

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[1] In a letter dated the 4th of April 1882, referring to the publication of his drama *Mary Stuart*, Swinburne wrote to Edmund Clarence Stedman: "*Mary Stuart* has procured me two satisfactions which I prefer infinitely to six columns of adulation in *The Times* and any profit thence resulting. (1) A letter from Sir Henry Taylor . . . (2) An application from the editor of the *Encyclopaedia Britannica*—who might, I suppose, as in Macaulay's time, almost command the services of the most eminent scholars and historians of the country—to me, a mere poet, proposing that I should contribute to that great repository of erudition the biography of Mary Queen of Scots. I doubt if the like compliment was ever paid before to one of our 'idle trade.'" The present article is the biography contributed by the poet to the 9th ed. in response to the invitation referred to in this letter.

Upon a view which may be taken of Mary's conduct during the next three months depends the whole debateable question of her character. According to the professed champions of that character, this conduct was a tissue of such dastardly imbecility, such heartless irresolution and such brainless inconsistency as for ever to dispose of her time-honoured claim to the credit of intelligence and courage. It is certain that just three months and six days after the murder of her husband she became the wife of her husband's murderer. On the 11th of February she wrote to the bishop of Glasgow, her ambassador in France, a brief letter of simple eloquence, announcing her providential escape from a design upon her own as well as her husband's life. A reward of two thousand pounds was offered by proclamation for discovery of the murderer. Bothwell and others, his satellites or the queen's, were instantly placarded by name as the criminals. Voices were heard by night in the streets of Edinburgh calling down judgment on the assassins. Four days after the discovery of the bodies, Darnley was buried in the chapel of Holyrood with secrecy as remarkable as the solemnity with which Rizzio had been interred there less than a year before. On the Sunday following, Mary left Edinburgh for Seton Palace, 12 miles from the capital, where scandal asserted that she passed the time merrily in shooting-matches with Bothwell for her partner against Lords Seton and Huntly; other accounts represent Huntly and Bothwell as left at Holyrood in charge of the infant prince. Gracefully and respectfully, with statesmanlike yet feminine dexterity, the demands of Darnley's father for justice on the murderers of his son were accepted and eluded by his daughter-in-law. Bothwell, with a troop of fifty men, rode through Edinburgh defiantly denouncing vengeance on his concealed accusers. As weeks elapsed without action on the part of the royal widow, while the cry of blood was up throughout the country, raising echoes from England and abroad, the murmur of accusation began to rise against her also. Murray, with his sister's ready permission, withdrew to France. Already the report was abroad that the queen was bent on marriage with Bothwell, whose last year's marriage with the sister of Huntly would be dissolved, and the assent of his wife's brother purchased by the restitution of his forfeited estates. According to the *Memoirs* of Sir James Melville, both Lord Herries and himself resolved to appeal to the queen in terms of bold and earnest remonstrance against so desperate and scandalous a design; Herries, having been met with assurances of its unreality and professions of astonishment at the suggestion, instantly fled from court; Melville, evading the danger of a merely personal protest without backers to support him, laid before Mary a letter from a loyal Scot long resident in England, which urged upon her consideration and her conscience the danger and disgrace of such a project yet more freely than Herries had ventured to do by word of mouth; but the sole result was that it needed all the queen's courage and resolution to rescue him from the violence of the man for whom, she was reported to have said, she cared not if she lost France, England and her own country, and would go with him to the world's end in a white petticoat before she would leave him. On the 28th of March the privy council, in which Bothwell himself sat, appointed the 12th of April as the day of his trial, Lennox, instead of the crown, being named as the accuser, and cited by royal letters to appear at "the humble request and petition of the said Earl Bothwell," who, on the day of the trial, had 4000 armed men behind him in the streets, while the castle was also at his command. Under these arrangements it was not thought wonderful that Lennox discreetly declined the danger of attendance, even with 3000 men ready to follow him, at the risk of desperate street fighting. He pleaded sickness, asked for more time, and demanded that the accused, instead of enjoying special favour, should share the treatment of other suspected criminals. But, as no particle of evidence on his side was advanced, the protest of his representative was rejected, and Bothwell, acquitted in default of witnesses against him, was free to challenge any persistent accuser to the ancient ordeal of battle. His wealth and power were enlarged by gift of the parliament which met on the 14th and rose on the 19th of April—a date made notable by the subsequent supper at Ainslie's tavern, where Bothwell obtained the signatures of its leading members to a document affirming his innocence, and pledging the subscribers to maintain it against all challengers, to stand by him in all his quarrels and finally to promote by all means in their power the marriage by which they recommended the queen to reward his services and benefit the country. On the second day following Mary went to visit her child at Stirling, where his guardian, the earl of Mar, refused to admit more than two women in her train. It was well known in Edinburgh that Bothwell had a body of men ready to intercept her on the way back, and carry her to Dunbar—not, as was naturally inferred, without good assurance of her consent. On the 24th of April, as she approached Edinburgh, Bothwell accordingly met her at the head of 800 spearmen, assured her (as she afterwards averred) that she was in the utmost peril, and escorted her, together with Huntly, Lethington and Melville, who were then in attendance, to Dunbar Castle. On the 3rd of May Lady Jane Gordon, who had become countess of Bothwell on the 22nd of February of the year preceding, obtained, on the ground of her husband's infidelities, a separation which, however, would not under the old laws of Catholic Scotland have left him free to marry again; on the 7th, accordingly, the necessary divorce was pronounced, after two days' session, by a clerical tribunal which ten days before had received from the queen a special commission to give judgment on a plea of somewhat apocryphal consanguinity alleged by Bothwell as the ground of an action for divorce against his wife. The fact was studiously evaded or concealed that a dispensation had been granted by the archbishop of St Andrews for this irregularity, which could only have arisen through some illicit connexion of the husband with a relative of the wife between whom and himself no affinity by blood or marriage could be proved. On the day when the first or Protestant divorce was pronounced, Mary and Bothwell returned to Edinburgh with every prepared appearance of a peaceful triumph. Lest her captivity should have been held to invalidate the late legal proceedings in her name, proclamation was made of forgiveness accorded by the queen to her captor in consideration of his past and future services, and her intention was announced to reward them by further promotion; and on the same day (May 12), he was duly created duke of Orkney and Shetland. The duke, as a conscientious Protestant, refused to marry his mistress according to the rites of her Church, and she, the chosen champion of its cause, agreed to be married to him, not merely by a Protestant but by one who before his conversion had been a Catholic bishop, and should therefore have been more hateful and contemptible in her eyes than any ordinary heretic, had not religion as well as policy, faith as well as reason, been absorbed or superseded by some more mastering passion or emotion. This passion or emotion, according to those who deny her attachment to Bothwell, was simply terror—the blind and irrational prostration of an abject spirit before the cruel force of circumstances and the crafty wickedness of men. Hitherto, according to all evidence, she had shown herself on all occasions, as on all subsequent occasions she indisputably showed herself, the most fearless, the most keen-sighted, the most ready-witted, the most high-gifted and high-spirited of women; gallant and generous, skilful and practical, never to be cowed by fortune, never to be cajoled by craft; neither more unselfish in her ends nor more unscrupulous in her practice than might have been expected from her training and her creed. But at the crowning moment of trial there are those who assert their belief that the woman who on her way to the field of Corrichie had uttered her wish to be a man, that she might know all the hardship and all the enjoyment of a soldier's life, riding forth "in jack and knapscull"—the woman who long afterwards was to hold her own for two days together without help of counsel against all the array of English law and English statesmanship, armed with irrefragable evidence and supported by the resentment of a nation—showed herself equally devoid of moral and of physical resolution; too senseless to realize the significance and too heartless to face the danger of a situation from which the simplest exercise of reason, principle or courage must have rescued the most unsuspicious and inexperienced of honest women who was not helplessly deficient in self-reliance and self-respect. The famous correspondence produced next year in evidence against her at the conference of York may have been, as her partisans affirm, so craftily garbled and falsified by interpolation, suppression, perversion, or absolute forgery as to be all but historically worthless. Its acceptance or its rejection does not in any degree whatever affect, for better or for worse, the rational estimate of her character. The problem presented by the simple existence of the facts just summed up remains in either case absolutely the same.

That the coarse and imperious nature of the hardy and able ruffian who had now become openly her master should no less openly have shown itself even in the first moments of their inauspicious union is what any bystander of common insight must inevitably have foreseen. Tears, dejection and passionate expressions of a despair "wishing only for death," bore fitful and variable witness to her first sense of a heavier yoke than yet had galled her spirit and her pride. At other times her affectionate gaiety would give evidence as trustworthy of a fearless and improvident satisfaction. They rode out in state together, and if he kept cap in hand as a subject she would snatch it from him and clap it on his head again; while in graver things she took all due or possible care to gratify his ambition, by the insertion of a clause in their contract of marriage which made their joint signature necessary to all documents of state issued under the sign-manual. She despatched to France a special envoy, the bishop of Dumblane, with instructions setting forth at length the unparalleled and hitherto ill-requited services and merits of Bothwell, and the necessity of compliance at once with his passion and with the unanimous counsel of the nation—a people who would endure the rule of no foreign consort, and whom none of their own countrymen were so competent to control, alike by wisdom and by valour, as the incomparable subject of her choice. These personal merits and this political necessity were the only pleas advanced in a letter to her ambassador in England. But that neither plea would avail her for a moment in Scotland she had ominous evidence on the thirteenth day after her marriage, when no response was made to the usual form of proclamation for a raid or levy of forces under pretext of a campaign against the rievers of the border. On the 6th or 7th of June Mary and Bothwell took refuge in Borthwick Castle, twelve miles from the capital, where the fortress was in the keeping of an adherent whom the diplomacy of Sir James Melville had succeeded in detaching from his allegiance to Bothwell. The fugitives were pursued and beleaguered by the earl of Morton and Lord Hume, who declared their purpose to rescue the queen from the thraldom of her husband. He escaped, leaving her free to follow him or to join the party of her professed deliverers. But whatever cause she might have found since marriage to complain of his rigorous custody and domineering brutality was insufficient to break the ties by which he held her. Alone, in the disguise of a page, she slipped out of the castle at midnight, and rode off to meet him at a tower two miles distant, whence they fled together to Dunbar. The confederate lords on entering Edinburgh were welcomed by the citizens, and after three hours' persuasion Lethington, who had now joined them, prevailed on the captain of the castle to deliver it also into their hands. Proclamations were issued in which the crime of Bothwell was denounced, and the disgrace of the country, the thraldom of the queen and the mortal peril of her infant son, were set forth as reasons for summoning all the lieges of the chief cities of Scotland to rise in arms on three hours' notice and join the forces assembled against the one common enemy. News of his approach reached them on the night of June 14, and they marched before dawn with 2200 men to meet him near Musselburgh. Mary meanwhile had passed from Dunbar to Haddington, and thence to Seton, where 1600 men rallied to her side. On the 15th of June, one month from their marriage day, the queen and Bothwell, at the head of a force of fairly equal numbers but visibly inferior discipline, met the army of the confederates at Carberry Hill, some six miles from Edinburgh. Du Croc, the French ambassador, obtained permission through the influence of Maitland to convey to the queen the terms proposed by their leaders—that she and Bothwell should part, or that he should meet in single combat a champion chosen from among their number. Bothwell offered to meet any man of sufficient quality; Mary would not assent. As the afternoon wore on their force began to melt away by desertion and to break up for lack of discipline. Again the trial by single combat was proposed, and thrice the proposal fell through, owing to objections on this side or on that. At last it was agreed that the queen should yield herself prisoner, and Bothwell be allowed to retire in safety to Dunbar with the few followers who remained to him. Mary took leave of her first and last master with passionate anguish and many parting kisses; but in face of his enemies, and in hearing of the cries which burst from the ranks, demanding her death by fire as a murderess and harlot, the whole heroic and passionate spirit of the woman, represented by her admirers as a spiritless imbecile, flamed out in responsive threats to have all the men hanged and crucified, in whose power she now stood helpless and alone. She grasped the hand of Lord Lindsay as he rode beside her, and swore "by this hand" she would "have his head for this." In Edinburgh she was received by a yelling mob, which flaunted before her at each turn a banner representing the corpse of Darnley with her child beside it invoking on his knees the retribution of divine justice. From the violence of a multitude in which women of the worst class were more furious than the men she was sheltered in the house of the provost, where she repeatedly showed herself at the window, appealing aloud with dishevelled hair and dress to the mercy which no man could look upon her and refuse. At nine in the evening she was removed to Holyrood, and thence to the port of Leith, where she embarked under guard, with her attendants, for the island castle of Lochleven. On the 20th a silver casket containing letters and French verses, miscalled sonnets, in the handwriting of the queen, was taken from the person of a servant who had been sent by Bothwell to bring it from Edinburgh to Dunbar. Even in the existing versions of the letters, translated from the lost originals and retranslated from this translation of a text which was probably destroyed in 1603 by order of King James on his accession to the English throne—even in these possibly disfigured versions, the fiery pathos of passion, the fierce and piteous fluctuations of spirit between love and hate, hope and rage and jealousy, have an eloquence apparently beyond the imitation or invention of art (see CASKET LETTERS[1]). Three days after this discovery Lord Lindsay, Lord Ruthven and Sir Robert Melville were despatched to Lochleven, there to obtain the queen's signature to an act of abdication in favour of her son, and another appointing Murray regent during his minority. She submitted, and a commission of regency was established till the return from France of Murray, who, on the 15th of August, arrived at Lochleven with Morton and Athole. According to his own account, the expostulations as to her past conduct which preceded his admonitions for the future were received with tears, confessions and attempts at extenuation or excuse; but when they parted next day on good terms she had regained her usual spirits. Nor from that day forward had they reason to sink again, in spite of the close keeping in which she was held, with the daughters of the house for bedfellows. Their mother and the regent's, her father's former mistress, was herself not impervious to her prisoner's lifelong power of seduction and subjugation. Her son George Douglas fell inevitably under the charm. A rumour transmitted to England went so far as to assert that she had proposed him to their common half-brother Murray as a fourth husband for herself; a later tradition represented her as the mother of a child by him. A third report, at least as improbable as either, asserted that a daughter of Mary and Bothwell, born about this time, lived to be a nun in France. It is certain that the necessary removal of George Douglas from Lochleven enabled him to devise a method of escape for the prisoner on the 25th of March, 1568, which was frustrated by detection of her white hands under the disguise of a laundress. But a younger member of the household, Willie Douglas, aged eighteen, whose devotion was afterwards remembered and his safety cared for by Mary at a time of utmost risk and perplexity to herself, succeeded on the 2nd of May in assisting her to escape by a postern gate to the lake-side, and thence in a boat to the mainland, where George Douglas, Lord Seton and others were awaiting her. Thence they rode to Seton's castle of Niddry, and next day to Hamilton palace, round which an army of 6000 men was soon assembled, and whither the new French ambassador to Scotland hastened to pay his duty. The queen's abdication was revoked, messengers were despatched to the English and French courts, and word was sent to Murray at Glasgow that he must resign the regency, and should be pardoned in common with all offenders against the queen. But on the day when Mary arrived at Hamilton Murray had summoned to Glasgow the feudatories of the Crown to take arms against the insurgent enemies of the infant king. Elizabeth sent conditional offers of help to her kinswoman, provided she would accept of English intervention and abstain from seeking foreign assistance; but the messenger came too late. Mary's followers had failed to retake Dunbar Castle from the regent, and made for Dumbarton instead, marching two miles south of Glasgow, by the village of Langside. Here Murray, with 4500 men, under leaders of high distinction, met the 6000 of the queen's army, whose ablest man, Herries, was as much distrusted by Mary as by every one else, while the Hamiltons could only be trusted to think of their own interests, and were suspected of treasonable designs on all who stood between their house and the monarchy. On the 13th of May the battle or skirmish of Langside determined the result of the campaign in three-quarters of an hour. Kirkaldy of Grange, who commanded the regent's cavalry, seized and kept the place of vantage from the beginning, and at the first sign of wavering on the other side shattered at a single charge the forces of the queen with a loss of one man to three hundred. Mary fled 60 miles from the field of her last battle before she halted at Sanquhar, and for three days of flight, according to her own account, had to sleep on the hard ground, live on oatmeal and sour milk, and fare at night like the owls, in hunger, cold and fear. On the third day from the rout of Langside she crossed the Solway and landed at Workington in Cumberland, May 16, 1568. On the 20th Lord Scrope and Sir Francis Knollys were sent from court to carry messages and letters of comfort from Elizabeth to Mary at Carlisle. On the 11th of June Knollys wrote to Cecil at once the best description and the noblest panegyric extant of the queen of Scots—enlarging, with a brave man's sympathy, on her indifference to form and ceremony, her daring grace and openness of manner, her frank display of a great desire to be avenged of her enemies, her readiness to expose herself to all perils in hope of victory, her delight to hear of hardihood and courage, commending by name all her enemies of approved valour, sparing no cowardice in her friends, but above all things athirst for victory by any means at any price, so that for its sake pain and peril seemed pleasant to her, and wealth and all things, if compared with it, contemptible and vile. What was to be done with such a princess, whether she were to be nourished in one's bosom, above all whether it could be advisable or safe to try any diplomatic tricks upon such a lady, Knollys left for the minister to judge. It is remarkable that he should not have discovered in her the qualities so obvious to modern champions of her character—easiness, gullibility, incurable innocence and invincible ignorance of evil, incapacity to suspect or resent anything, readiness to believe and forgive all things. On the 15th of July, after various delays interposed by her reluctance to leave the neighbourhood of the border, where on her arrival she had received the welcome and the homage of the leading Catholic houses of Northumberland and Cumberland, she was removed to Bolton Castle in North Yorkshire. During her residence here a conference was held at York between her own and Elizabeth's commissioners and those appointed to represent her son as a king of Scots. These latter, of whom Murray himself was the chief, privately laid before the English commissioners the contents of the famous casket. On the 24th of October the place of the conference was shifted from York to London, where the inquiry was to be held before Queen Elizabeth in council. Mary was already aware that the chief of the English commissioners, the duke of Norfolk, was secretly an aspirant to the peril of her hand; and on the 21st of October she gave the first sign of assent to the suggestion of a divorce from Bothwell. On the 26th of October the charge of complicity in the murder of Darnley was distinctly brought forward against her in spite of Norfolk's reluctance and Murray's previous hesitation. Elizabeth, by the mouth of her chief justice, formally rebuked the audacity of the subjects who durst bring such a charge against their sovereign, and challenged them to advance their proofs. They complied by the production of an indictment under five heads, supported by the necessary evidence of documents. The number of English commissioners was increased, and they were bound to preserve secrecy as to the matters revealed. Further evidence was supplied by Thomas Crawford, a retainer of the house of Lennox, tallying so exactly with the text of the casket letters as to have been cited in proof that the latter must needs be a forgery. Elizabeth, on the close of the evidence, invited Mary to reply to the proofs alleged before she could be admitted to her presence; but Mary simply desired her commissioners to withdraw from the conference. She declined with scorn the proposal made by Elizabeth through Knollys, that she should sign a second abdication in favour of her son. On the 10th of January, 1569, the judgment given at the conference acquitted Murray and his adherents of rebellion, while affirming that nothing had been proved against Mary—a verdict accepted by Murray as equivalent to a practical recognition of his office as regent for the infant king. This position he was not long to hold; and the fierce exultation of Mary at the news of his murder gave to those who believed in her complicity with the murderer, on whom a pension was bestowed by her unblushing gratitude, fresh reason to fear, if her liberty of correspondence and intrigue were not restrained, the likelihood of a similar fate for Elizabeth. On the 26th of January 1569 she had been removed from Bolton Castle to Tutbury in Staffordshire, where proposals were conveyed to her, at the instigation of Leicester, for a marriage with the duke of Norfolk, to which she gave a graciously conditional assent; but the discovery of these proposals consigned Norfolk to the Tower, and on the outbreak of an insurrection in the north Mary, by Lord Hunsdon's advice, was again removed to Coventry, when a body of her intending deliverers was within a day's ride of Tutbury. On the 23rd of January following Murray was assassinated; and a second northern insurrection was crushed in a single sharp fight by Lord Hunsdon. In October Cecil had an interview with Mary at Chatsworth, when the conditions of her possible restoration to the throne in compliance with French demands were debated at length. The queen of Scots, with dauntless dignity, refused to yield the castles of Edinburgh and Dumbarton into English keeping, or to deliver up her fugitive English partisans then in Scotland; upon other points they came to terms, and the articles were signed the 16th of October. On the same day Mary wrote to Elizabeth, requesting with graceful earnestness the favour of an interview which might reassure her against the suggestion that this treaty was a mere pretence. On the 28th of November she was removed to Sheffield Castle, where she remained for the next fourteeen years in charge of the earl of Shrewsbury. The detection of a plot, in which Norfolk was implicated, for the invasion of England by Spain on behalf of Mary, who was then to take him as the fourth and most contemptible of her husbands, made necessary the reduction of her household and the stricter confinement of her person. On the 28th of May 1572 a demand from both houses of parliament for her execution as well as Norfolk's was generously rejected by Elizabeth; but after the punishment of the traitorous pretender to her hand, on whom she had lavished many eloquent letters of affectionate protestation, she fell into "a passion of sickness" which convinced her honest keeper of her genuine grief for the ducal caitiff. A treaty projected on the news of the massacre of St Bartholomew, by which Mary should be sent back to Scotland for immediate execution, was broken off by the death of the earl of Mar, who had succeeded Lennox as regent; nor was it found possible to come to acceptable terms on a like understanding with his successor Morton, who in 1577 sent a proposal to Mary for her restoration, which she declined, in suspicion of a plot laid to entrap her by the policy of Sir Francis Walsingham, the most unscrupulously patriotic of her English enemies, who four years afterwards sent word to Scotland that the execution of Morton, so long the ally of England, would be answered by the execution of Mary. But on that occasion Elizabeth again refused her assent either to the trial of Mary or to her transference from Sheffield to the Tower. In 1581 Mary accepted the advice of Catherine de' Medici and Henry III. that she should allow her son's title to reign as king of Scotland conjointly with herself when released and restored to a share of the throne. This plan was but part of a scheme including the invasion of England by her kinsman the duke of Guise, who was to land in the north and raise a Scottish army to place the released prisoner of Sheffield beside her son on the throne of Elizabeth. After the overthrow of the Scottish accomplices in this notable project, Mary poured forth upon Elizabeth a torrent of pathetic and eloquent reproach for the many wrongs she had suffered at the hands of her hostess, and pledged her honour to the assurance that she now aspired to no kingdom but that of heaven. In the spring of 1583 she retained enough of this saintly resignation to ask for nothing but liberty, without a share in the government of Scotland; but Lord Burghley not unreasonably preferred, if feasible, to reconcile the alliance of her son with the detention of his mother. In 1584 the long-suffering earl of Shrewsbury was relieved of his fourteen years' charge through the involuntary good offices of his wife, whose daughter by her first husband had married a brother of Darnley; and their orphan child Arabella, born in England, of royal descent on the father's side, was now, in the hopeful view of her grandmother, a more plausible claimant than the king or queen of Scots to the inheritance of the English throne. In December 1583 Mary had laid before the French ambassador her first complaint of the slanders spread by Lady Shrewsbury and her sons, who were ultimately compelled to confess the falsehood of their imputations on the queen of Scots and her keeper. It was probably at the time when a desire for revenge on her calumniatress made her think the opportunity good and safe for discharge of such a two-edged dart at the countess and the queen that Mary wrote, but abstained from despatching, the famous and terrible letter in which, with many gracious excuses and professions of regret and attachment, she transmits to Elizabeth a full and vivid report of the hideous gossip retailed by Bess of Hardwick regarding her character and person at a time when the reporter of these abominations was on friendly terms with her husband's royal charge. In the autumn of 1584 she was removed to Wingfield Manor under charge of Sir Ralph Sadler and John Somers, who accompanied her also on her next removal to Tutbury in January 1585. A letter received by her in that cold, dark and unhealthy castle, of which fifteen years before she had made painful and malodorous experience, assured her that her son would acknowledge her only as queen-mother, and provoked at once the threat of a parent's curse and an application to Elizabeth for sympathy. In April 1585 Sir Amyas Paulet was appointed to the office of which Sadler, accused of careless indulgence, had requested to be relieved; and on Christmas Eve she was removed from the hateful shelter of Tutbury to the castle of Chartley in the same county. Her correspondence in cipher from thence with her English agents abroad, intercepted by Walsingham and deciphered by his secretary, gave eager encouragement to the design for a Spanish invasion of England under the prince of Parma,—an enterprise in which she would do her utmost to make her son take part, and in case of his refusal would induce the Catholic nobles of Scotland to betray him into the hands of Philip, from whose tutelage he should be released only on her demand, or if after her death he should wish to return, nor then unless he had become a Catholic. But even these patriotic and maternal schemes to consign her child and re-consign the kingdom to the keeping of the Inquisition, incarnate in the widower of Mary Tudor, were superseded by the attraction of a conspiracy against the throne and life of Elizabeth. Anthony Babington, in his boyhood a ward of Shrewsbury, resident in the household at Sheffield Castle, and thus subjected to the charm before which so many victims had already fallen, was now induced to undertake the deliverance of the queen of Scots by the murder of the queen of England. It is maintained by those admirers of Mary who assume her to have been an almost absolute imbecile, gifted with the power of imposing herself on the world as a woman of unsurpassed ability, that, while cognisant of the plot for her deliverance by English rebels and an invading army of foreign auxiliaries, she might have been innocently unconscious that this conspiracy involved the simultaneous assassination of Elizabeth. In the conduct and detection of her correspondence with Babington, traitor was played off against traitor, and spies were utilized against assassins, with as little scruple as could be required or expected in the diplomacy of the time. As in the case of the casket letters, it is alleged that forgery was employed to interpolate sufficient evidence of Mary's complicity in a design of which it is thought credible that she was kept in ignorance by the traitors and murderers who had enrolled themselves in her service,—that one who pensioned the actual murderer of Murray and a would-be murderer of Elizabeth was incapable of approving what her keen and practised intelligence was too blunt and torpid to anticipate as inevitable and inseparable from the general design. In August the conspirators were netted, and Mary was arrested at the gate of Tixall Park, whither Paulet had taken her under pretence of a hunting party. At Tixall she was detained till her papers at Chartley had undergone thorough research. That she was at length taken in her own toils even such a dullard as her admirers depict her could not have failed to understand; that she was no such dastard as to desire or deserve such defenders the whole brief course of her remaining life bore consistent and irrefragable witness. Her first thought on her return to Chartley was one of loyal gratitude and womanly sympathy. She cheered the wife of her English secretary, now under arrest, with promises to answer for her husband to all accusations brought against him, took her new-born child from the mother's arms, and in default of clergy baptized it, to Paulet's Puritanic horror, with her own hands by her own name. The next or the twin-born impulse of her indomitable nature was, as usual in all times of danger, one of passionate and high-spirited defiance on discovering the seizure of her papers. A fortnight afterwards her keys and her money were confiscated, while she, bedridden and unable to move her hand, could only ply the terrible weapon of her bitter and fiery tongue. Her secretaries were examined in London, and one of them gave evidence that she had first heard of the conspiracy by letter from Babington, of whose design against the life of Elizabeth she thought it best to take no notice in her reply, though she did not hold herself bound to reveal it. On the 25th of September she was removed to the strong castle of Fotheringay in Northamptonshire. On the 6th of October she was desired by letter from Elizabeth to answer the charges brought against her before certain of the chief English nobles appointed to sit in commission on the cause. In spite of her first refusal to submit, she was induced by the arguments of the vice-chamberlain, Sir Christopher Hatton, to appear before this tribunal on condition that her protest should be registered against the legality of its jurisdiction over a sovereign, the next heir of the English crown.

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[1] It is to be observed that the above conclusion as to the authenticity of the Casket Letters is the same as that arrived at upon different grounds by the most recent research on the subject.—ED. E. B.

On the 14th and 15th of October 1586 the trial was held in the hall of Fotheringay Castle. Alone, "without one counsellor on her side among so many," Mary conducted the whole of her own defence with courage incomparable and unsurpassable ability. Pathos and indignation, subtlety and simplicity, personal appeal and political reasoning, were the alternate weapons with which she fought against all odds of evidence or inference; and disputed step by step every inch of debatable ground. She repeatedly insisted on the production of proof in her own handwriting as to her complicity with the project of the assassins who had expiated their crime on the 20th and 21st of the month preceding. When the charge was shifted to the question of her intrigues with Spain, she took her stand resolutely on her own right to convey whatever right she possessed, though now no kingdom was left her for disposal, to whomsoever she might choose. One single slip she made in the whole course of her defence; but none could have been more unluckily characteristic and significant. When Burghley brought against her the unanswerable charge of having at that moment in her service, and in receipt of an annual pension, the instigator of a previous attempt on the life of Elizabeth, she had the unwary audacity to cite in her justification the pensions allowed by Elizabeth to her adversaries in Scotland, and especially to her son. It is remarkable that just two months later, in a conversation with her keepers, she again made use of the same extraordinary argument in reply to the same inevitable imputation, and would not be brought to admit that the two cases were other than parallel. But except for this single instance of oversight or perversity her defence was throughout a masterpiece of indomitable ingenuity, of delicate and steadfast courage, of womanly dignity and genius. Finally she demanded, as she had demanded before, a trial either before the estates of the realm lawfully assembled or else before the queen in council. So closed the second day of the trial; and before the next day's work could begin a note of two or three lines hastily written at midnight informed the commissioners that Elizabeth had suddenly determined to adjourn the expected judgment and transfer the place of it to the star-chamber. Here, on the 25th of October, the commissioners again met; and one of them alone, Lord Zouch, dissented from the verdict by which Mary was found guilty of having, since the 1st of June preceding, compassed and imagined divers matters tending to the destruction of Elizabeth. This verdict was conveyed to her, about three weeks later, by Lord Buckhurst and Robert Beale, clerk of the privy council. At the intimation that her life was an impediment to the security of the received religion, "she seemed with a certain unwonted alacrity to triumph, giving God thanks, and rejoicing in her heart that she was held to be an instrument" for the restoration of her own faith. This note of exultation as in martyrdom was maintained with unflinching courage to the last. She wrote to Elizabeth and the duke of Guise two letters of almost matchless eloquence and pathos, admirable especially for their loyal and grateful remembrance of all her faithful servants. Between the date of these letters and the day of her execution wellnigh three months of suspense elapsed. Elizabeth, fearless almost to a fault in face of physical danger, constant in her confidence even after discovery of her narrow escape from the poisoned bullets of household conspirators, was cowardly even to a crime in face of subtler and more complicated peril. She rejected with resolute dignity the intercession of French envoys for the life of the queen-dowager of France; she allowed the sentence of death to be proclaimed and welcomed with bonfires and bell-ringing throughout the length of England; she yielded a respite of twelve days to the pleading of the French ambassador, and had a charge trumped up against him of participation in a conspiracy against her life; at length, on the 1st of February 1587, she signed the death-warrant, and then made her secretaries write word to Paulet of her displeasure that in all this time he should not of himself have found out some way to shorten the life of his prisoner, as in duty bound by his oath, and thus relieve her singularly tender conscience from the guilt of bloodshed. Paulet, with loyal and regretful indignation, declined the disgrace proposed to him in a suggestion "to shed blood without law or warrant"; and on the 7th of February the earls of Shrewsbury and Kent arrived at Fotheringay with the commission of the council for execution of the sentence given against his prisoner. Mary received the announcement with majestic tranquillity, expressing in dignified terms her readiness to die, her consciousness that she was a martyr for her religion, and her total ignorance of any conspiracy against the life of Elizabeth. At night she took a graceful and affectionate leave of her attendants, distributed among them her money and jewels, wrote out in full the various legacies to be conveyed by her will, and charged her apothecary Gorion with her last messages for the king of Spain. In these messages the whole nature of the woman was revealed. Not a single friend, not a single enemy, was forgotten; the slightest service, the slightest wrong, had its place assigned in her faithful and implacable memory for retribution or reward. Forgiveness of injuries was as alien from her fierce and loyal spirit as forgetfulness of benefits; the destruction of England and its liberties by Spanish invasion and conquest was the strongest aspiration of her parting soul. At eight next morning she entered the hall of execution, having taken leave of the weeping envoy from Scotland, to whom she gave a brief message for her son; took her seat on the scaffold, listened with an air of even cheerful unconcern to the reading of her sentence, solemnly declared her innocence of the charge conveyed in it and her consolation in the prospect of ultimate justice, rejected the professional services of Richard Fletcher, dean of Peterborough, lifted up her voice in Latin against his in English prayer, and when he and his fellow-worshippers had fallen duly silent prayed aloud for the prosperity of her own church, for Elizabeth, for her son, and for all the enemies whom she had commended overnight to the notice of the Spanish invader; then, with no less courage than had marked every hour and every action of her life, received the stroke of death from the wavering hand of the headsman.

Mary Stuart was in many respects the creature of her age, of her creed, and of her station; but the noblest and most noteworthy qualities of her nature were independent of rank, opinion or time. Even the detractors who defend her conduct on the plea that she was a dastard and a dupe are compelled in the same breath to retract this implied reproach, and to admit, with illogical acclamation and incongruous applause, that the world never saw more splendid courage at the service of more brilliant intelligence, that a braver if not "a rarer spirit never did steer humanity." A kinder or more faithful friend, a deadlier or more dangerous enemy, it would be impossible to dread or to desire. Passion alone could shake the double fortress of her impregnable heart and ever-active brain. The passion of love, after very sufficient experience, she apparently and naturally outlived; the passion of hatred and revenge was as inextinguishable in her inmost nature as the emotion of loyalty and gratitude. Of repentance it would seem that she knew as little as of fear, having been trained from her infancy in a religion where the Decalogue was supplanted by the Creed. Adept as she was in the most exquisite delicacy of dissimulation, the most salient note of her original disposition was daring rather than subtlety. Beside or behind the voluptuous or intellectual attractions of beauty and culture, she had about her the fresher charm of a fearless and frank simplicity, a genuine and enduring pleasure in small and harmless things no less than in such as were neither. In 1562 she amused herself for some days by living "with her little troop" in the house of a burgess of St Andrews "like a burgess's wife," assuring the English ambassador that he should not find the queen there,—"nor I know not myself where she is become." From Sheffield Lodge, twelve years later, she applied to the archbishop of Glasgow and the cardinal of Guise for some pretty little dogs, to be sent her in baskets very warmly packed,—"for besides reading and working, I take pleasure only in all the little animals that I can get." No lapse of reconciling time, no extent of comparative indulgence, could break her in to resignation, submission, or toleration of even partial restraint. Three months after the massacre of St Bartholomew had caused some additional restrictions to be placed upon her freedom of action, Shrewsbury writes to Burghley that "rather than continue this imprisonment she sticks not to say she will give her body, her son, and country for liberty"; nor did she ever show any excess of regard for any of the three. For her own freedom of will and of way, of passion and of action, she cared much; for her creed she cared something; for her country she cared less than nothing. She would have flung Scotland with England into the hell fire of Spanish Catholicism rather than forgo the faintest chance of personal revenge. Her profession of a desire to be instructed in the doctrines of Anglican Protestantism was so transparently a pious fraud as rather to afford confirmation than to arouse suspicion of her fidelity to the teaching of her church. Elizabeth, so shamefully her inferior in personal loyalty, fidelity and gratitude, was as clearly her superior on the one all-important point of patriotism. The saving salt of Elizabeth's character, with all its wellnigh incredible mixture of heroism and egotism, meanness and magnificence, was simply this, that, overmuch as she loved herself, she did yet love England better. Her best though not her only fine qualities were national and political, the high public virtues of a good public servant; in the private and personal qualities which attract and attach a friend to his friend and a follower to his leader, no man or woman was ever more constant and more eminent than Mary Queen of Scots. (A. C. S.)

Bibliography.—The biography of Mary Stuart being virtually the history of Scotland during the period covered by her life, with which the history of England at the same period is also largely concerned, the chief events in which she figured are related in all the general *Histories* of both countries. The most important original authorities are the voluminous *State Papers* of the period, with other MS. documents preserved at the British Museum, the Cambridge University Library, Hatfield and elsewhere. See especially the *Reports* of the Hist. MSS. Commission; *Calendar of State Papers relating to Scotland and Mary Queen of Scots* (Scottish Record Publ. 1898); *Calendar of Letters and State Papers relating to English Affairs, principally in the Archives at Simancas* (vols. i.–iv., 1892–1899); and the *Calendars of State Papers: Domestic Series, Edw. VI.–James I.; Foreign Series, Elizabeth; Venice Series.*

The most important unofficial contemporary works are the *Histories* of John Knox, Bishop John Lesley, George Buchanan, and Robert Lindsay of Pitscottie; the *Diurnal of Remarkable Occurrents from the death of James IV. till 1575* (Bannatyne Club, 1833); Robert Birrell's "Diary" in Sir J. G. Dalzell's *Fragments of Scottish History* (Edinburgh, 1798); *History of Mary Stuart*, by her secretary Claude Nau, ed. by J. Stevenson (Edinburgh, 1883); Sir James Melville's *Memoirs of his own Life* (Bannatyne Club, 1827); Richard Bannatyne, *Memoriales of Transactions in Scotland* (Edinburgh, 1836); William Camden's *Annales* (Eng. trans., London, 1635); Michel de Castelnau's *Mémoires* (Brussels, 1731); the *Mémoires* of Brantôme (ed. by L. Lalanne, 12 vols., Paris, 1864–1896); *Relations politiques de la France et de l'Espagne avec l'Ecosse au 16e siècle* (ed. by J. B. A. Teulet, 5 vols., Paris, 1862), containing important original letters and documents; Thomas Wright's *Queen Elizabeth and her Times* (2 vols., London, 1838), consists of private letters of Elizabethan statesmen many of which refer to Mary Stuart, and others are to be found in Sir Henry Ellis's *Original Letters illustrative of English History* (London, 1825–1846); much of Mary's own correspondence will be found in Prince A. Labanoff's *Lettres inédites, 1558–1587* (Paris, 1839), and *Lettres, instructions, et mémoires de Marie Stuart* (7 vols., London, 1844), selections from which have been translated into English by W. Turnbull in *Letters of Mary Queen of Scots* (London, 1845), and by Agnes Strickland in *Letters of Mary Queen of Scots and Documents connected with her Personal History* (3 vols., London, 1842).

Among authorities not actually contemporary but written within a century of Mary's death are David Calderwood's *Hist. of the Kirk of Scotland* (8 vols., Edinburgh, 1842–1849); Archbishop Spottiswoode's *Hist. of the Church of Scotland* (ed. by M. Russell, 3 vols., Edinburgh, 1847–1851), and Robert Keith's *Hist. of Affairs of Church and State in Scotland* (Spottiswoode Society ed., 1844); to which should be added the modern classic, George Grub's *Ecclesiastical History of Scotland* (4 vols., Edinburgh, 1861).

Of modern general histories those of chief importance on the subject are the *Histories of England* by Hume, Lingard and Froude; and the *Histories of Scotland* by Robertson, P. F. Tytler, John Hill Burton, Malcolm Laing and Andrew Lang. Numerous biographies of Mary Stuart have been published, as well as essays and treatises dealing with particular episodes in her life, of which the most worthy of mention are: George Chalmers, *Life of Mary Queen of Scots*, (2 vols., London, 1818); Henry Glassford Bell, *Life of Mary Queen of Scots* (2 vols., Edinburgh, 1828–1831); the "Life" in Agnes Strickland's *Lives of the Queens of Scotland* (8 vols., Edinburgh, 1850); J. D. Leader, *Mary Queen of Scots in Captivity* (Sheffield, 1880); Colin Lindsay, *Mary Queen of Scots and her Marriage with Bothwell* (London, 1883); Mrs Maxwell-Scott, *The Tragedy of Fotheringay* (London, 1895); F. A. M. Mignet, *Histoire de Marie Stuart* (2 vols., Brussels, 1851); Martin Philippson, *Histoire du règne de Marie Stuart* (3 vols., Paris, 1891); Sir John Skelton, *Mary Stuart* (London, 1893), *Maitland of Lethington and the Scotland of Mary Stuart* (2 vols., Edinburgh, 1887), *The Impeachment of Mary Stuart* (Edinburgh, 1878), and *Essays in History and Biography, including the Defence of Mary Stuart* (Edinburgh, 1883); Joseph Stevenson, *Mary Stuart: The First Eighteen Years of her Life* (Edinburgh, 1886); D. Hay Fleming, *Mary Stuart* (2nd ed. 1898); Jane Stoddart, *Girlhood of Mary Queen of Scots.*

With special reference to the controversy concerning the Casket Letters, in addition to the article Casket Letters and the above-mentioned works by Sir John Skelton, the following should be consulted: Walter Goodall, *Examination of the Letters said to be written by Mary Queen of Scots to Bothwell* (2 vols., Edinburgh, 1754), which contains the letters themselves; William Tytler, *Inquiry into the Evidence against Mary Queen of Scots* (2 vols., London, 1790); John Whitaker, *Mary Queen of Scots Vindicated* (3 vols., London, 1788); F. de Peyster, *Mary Stuart, Bothwell and the Casket Letters* (London, 1890); T. F. Henderson, *The Casket Letters and Mary Queen of Scots* (Edinburgh, 1889); Andrew Lang, *The Mystery of Mary Stuart* (London, 1900).

In 1690 Giovanni Francesco Savaro published a play *La Maria Stuarda*, and since then the story of the Queen of Scots has been the subject of numerous poems and dramas, of which the most celebrated are Schiller's *Maria Stuart*, and three tragedies by A. C. Swinburne—*Chastelard* (1865), *Bothwell* (1874), and *Mary Stuart* (1881).

MARY (1457–1482), duchess of Burgundy, only child of Charles the Bold, duke of Burgundy, and his wife Isabella of Bourbon, was born on the 13th of February 1457. As heiress of the rich Burgundian domains her hand was eagerly sought by a number of princes. When her father fell upon the field of Nancy, on the 5th of January 1477, Mary was not yet twenty years of age. Louis XI. of France seized the opportunity afforded by his rival's defeat and death to take possession of the duchy of Burgundy as a fief lapsed to the French crown, and also of Franche Comté, Picardy and Artois. He was anxious that Mary should marry the Dauphin Charles and thus secure the inheritance of the Netherlands for his descendants. Mary, however, distrusted Louis; declined the French alliance, and turned to her Netherland subjects for help. She obtained the help only at the price of great concessions. On the 11th of February 1477 she was compelled to sign a charter of rights, known as "the Great Privilege," by which the provinces and towns of the Netherlands recovered all the local and communal rights which had been abolished by the arbitrary decrees of the dukes of Burgundy in their efforts to create in the Low Countries a centralized state. Mary had to undertake not to declare war, make peace, or raise taxes without the consent of the States, and not to employ any but natives in official posts. Such was the hatred of the people to the old régime that two influential councillors of Charles the Bold, the Chancellor Hugonet and the Sire d'Humbercourt, having been discovered in correspondence with the French king, were executed at Ghent despite the tears and entreaties of the youthful duchess. Mary now made her choice among the many suitors for her hand, and selected the archduke Maximilian of Austria, afterwards the emperor Maximilian I., and the marriage took place at Ghent on the 18th of August 1477. Affairs now went more smoothly in the Netherlands, the French aggression was checked, and internal peace was in a large measure restored, when the duchess met her death by a fall from her horse on the 27th of March 1482. Three children had been the issue of her marriage, and her elder son, Philip, succeeded to her dominions under the guardianship of his father.

See E. Münch, *Maria von Burgund, nebst d. Leben v. Margaretha v. York* (2 vols., Leipzig, 1832), and the *Cambridge Mod. Hist.* (vol. i., c. xii., bibliography, 1903).

MARY (1496–1533), queen of France, was the daughter of Henry VII. of England and Elizabeth of York. At first it was intended to marry her to Charles of Austria, the future emperor Charles V., and by the treaty of Calais (Dec. 21, 1507) it was agreed that the marriage should take place when Charles should have attained the age of fourteen, the contract being secured by bonds taken from various princes and cities in the Low Countries. On the 17th of December 1508 the Sieur de Bergues, who had come over as Charles's representative at the head of a magnificent embassy, married the princess by proxy. The contract, originally made by Henry VII., was renewed on the 17th of October 1513 by Henry VIII. at a meeting with Margaret of Savoy at Lille, the wedding being fixed for the following year. But the emperor Maximilian I., to whom Louis XII. had proposed his daughter Renée as wife for Charles, with Brittany for dowry, postponed the match with the English princess in a way that left no doubt of his intention to withdraw from the contract altogether. He was forestalled by the diplomacy of Wolsey, at whose instance peace was signed with France on the 7th of August 1514, and on the same date a treaty was concluded for the marriage of Mary Tudor with Louis XII., who had recently lost his wife Anne of Brittany. The marriage was celebrated at Abbeville on the 9th of October. The bridegroom was a broken man of fifty-two; the bride a beautiful, well-educated and charming girl of eighteen, whose heart was already engaged to Charles Brandon, duke of Suffolk, her future husband. The political marriage was, however, no long one. Mary was crowned queen of France on the 5th of November 1514; on the 1st of January following King Louis died. Mary had only been induced to consent to the marriage with Louis by the promise that, on his death, she should be allowed to marry the man of her choice. But there was danger that the agreement would not be kept. In France the dukes of Lorraine and Savoy were mentioned as possible suitors, and meanwhile the new king, Francis I., was making advances to her, and only desisted when she confessed to him her previous attachment to Suffolk. The duke himself was at the head of the embassy which came from England to congratulate the new king, and to the detriment of his political mission he used the opportunity to win the hand of the queen. Francis good-naturedly promised to use his influence in his favour; Henry VIII. himself was not averse to the match, but Mary feared the opposition of the lords of the council, and, in spite of Suffolk's promise to the king not to take any steps in the matter until after his return, she persuaded him to marry her secretly before he left Paris. On their return to England in April, Suffolk was for a while in serious danger from the king's indignation, but was ultimately pardoned through Wolsey's intercession, on payment of a heavy fine and the surrender of all the queen's jewels and plate. The marriage was publicly solemnized at Greenwich on the 13th of May 1515. Suffolk had been already twice married, and his first wife was still alive. He thought it necessary later on (1528) to obtain a bull from Pope Clement VII. declaring his marriage with his first wife invalid and his union with Mary therefore canonical. Mary's life after this was comparatively uneventful. She lived mainly in the retirement of the country, but shared from time to time in the festivities of the court, and was present at the Field of the Cloth of Gold. She died on the 24th of June 1533. By the duke of Suffolk she had three children: Henry, born on the 11th of March 1516, created earl of Lincoln (1525), who died young; Frances, born on the 16th of July 1517, the wife of Henry Grey, marquess of Northampton, and mother of Lady Jane Grey (*q.v.*); and Eleanor.

See *Lettres de Louis XII. et du cardinal Géorgés d'Amboise* (Brussels, 1712); *Letters and Papers of Henry VIII.* (Cal. State Pap.); M. A. E. Green, *Lives of the Princesses of England* (vol. v., 1849–1855); Life by James Gairdner in *Dict. Nat. Biog.*

MARY OF LORRAINE (1515–1560), generally known as MARY OF GUISE, queen of James V. and afterwards regent of Scotland, was born at Bar on the 22nd of November 1515. She was the eldest child of Claude of Guise and Antoinette of Bourbon, and married in 1534 Louis II. of Orleans, duke of Longueville, to whom in 1535 she bore a son, Francis (d. 1551). The duke died in June 1537, and Mary was sought in marriage by James V., whose wife Magdalene died in July, and by Henry VIII. after the death of Jane Seymour. Henry persisted in his offers after the announcement of her betrothal to James V. Mary, who was made by adoption a daughter of France, received a papal dispensation for her marriage with James, which was celebrated by proxy in Paris (May 1538) and at St Andrews on her arrival in Scotland. Her two sons, James (b. May 1540) and Robert or Arthur (b. April 1541), died within a few days of one another in April 1541, and her husband died in December 1542, within a week of the birth of his daughter and heiress, Mary, Queen of Scots. Cardinal David Beton, the head of the French and Catholic party and therefore Mary of Lorraine's friend and ally, produced a will of the late king in which the primacy in the regency was assigned to himself. John Knox accused the queen of undue intimacy with Beton, and a popular report of a similar nature, probably unfounded, was revived in 1543 by Sir Ralph Sadler, the English envoy. Beton was arrested and the regency fell to the heir presumptive James, earl of Arran, whose inclinations were towards England and the Protestant party, and who hoped to secure the hand of the infant princess for his own son. Mary of Lorraine was approached by the English commissioner, Sir Ralph Sadler, to induce her to further her daughter's marriage contract with Edward VI. She informed Sadler that Arran had asked her whether Henry had made propositions of marriage to herself, and that she had stated that "if Henry should mind or offer her such an honour she must account herself much bounden." Sadler further learnt that she was "singularly well affected to Henry's desires." The marriage treaty between Mary, not then one year old, and Edward VI. was signed on the 1st of July at Greenwich, and guaranteed that Mary should be placed in Henry's keeping when she was ten years old. The queen dowager and her daughter were carefully watched at Linlithgow, but on the 23rd of July 1543 they escaped, with the help of Cardinal Beton, to the safer walls of Stirling castle. After the queen's coronation in September Mary of Lorraine was made principal member of the council appointed to direct the affairs of the kingdom. She was constantly in communication with her kinsmen in France, and was already planning to secure for her daughter a French alliance, which was opposed on different grounds by all her advisers. She made fresh alliances with the earl of Angus and Sir George Douglas, and in 1544 she made a premature attempt to seize the regency; but a reconciliation with Arran was brought about by Cardinal Beton. The assassination of Beton left her the cleverest politician in Scotland. The English invasions of 1547, undertaken with a view to enforcing the English marriage, gave Mary the desired pretext for a French alliance. In June 1548 a French fleet, with provisions and 5000 soldiers on board, under the command of André de Montalembert, seigneur d'Essé, landed at Leith to reinforce the Scots army, and laid siege to Haddington, then in the hands of the English. The Scottish parliament agreed to the marriage of the young queen with the dauphin of France, and, on the plea of securing her safety from English designs, she set sail from Dumbarton in August 1548 to complete her education at the French court.

Mary of Lorraine now gave her energies to the expulsion of the English and to the difficult task of keeping the peace between the Scots and their French auxiliaries. In September 1550 she visited France and obtained from Henry II. the confirmation of the dukedom and revenues of Châtelherault for the earl of Arran, in the hope of inducing him to resign the regency. On her way back to Scotland she was driven by storms to Portsmouth harbour and paid a friendly visit to Edward VI. Arran refused, however, to relinquish the regency until April 1554, when he resigned after receiving an assurance of his rights to the succession. The new regent had to deal with an empty exchequer and with a strong opposition to her daughter's marriage with the dauphin. The gift of high offices of state to Frenchmen lent to the Protestant opposition the aspect of a national resistance to foreign domination. The hostility of Arran and his brother Archbishop Hamilton forced Mary into friendly relations with the lords who favoured the Protestant party. Soon after her marriage miners had been brought from Lorraine to dig for gold at Crawford Moor, and she now carried on successful mining enterprises for coal and lead, which enabled her to meet the expenses of her government. In 1554 she took into her service William Maitland of Lethington, who as secretary of state gained very great influence over her. She also provoked a dangerous enemy in John Knox by her expressed contempt for a letter which he had written to her, but the first revolt against her authority arose from an attempt to establish a standing army. When she provoked a war with England in 1557 the nobles refused to cross the border. In matters of religion she at first tried to hold the balance between the Catholic and Protestant factions and allowed the Presbyterian preachers the practice of their religion so long as they refrained from public preachings in Edinburgh and Leith. The marriage of Francis II. and her daughter Mary in 1558 strengthened her position, and in 1559 she relinquished her conciliatory tactics to submit to the dictation of her relatives, the Guises, by falling more into line with their religious policy. She was reconciled with Archbishop Hamilton, and took up arms against the Protestants of Perth, who, incited by Knox, had destroyed the Charterhouse, where many of the Scottish kings were buried. The reformers submitted on condition that no foreign garrison was to be imposed on Perth and that the religious questions in dispute should be brought before the Scottish parliament. Mary of Lorraine broke the spirit of this agreement by garrisoning Perth with Scottish troops in the pay of France. The lords of the Congregation soon assembled in considerable force on Cupar Muir. Mary retreated to Edinburgh and thence to Dunbar, while Edinburgh opened its gates to the reformers, who issued a proclamation (Oct. 21, 1559) claiming that the regent was deposed. The lords of the Congregation sought help from Elizabeth, while the regent had recourse to France, where an expedition under her brother, René of Lorraine, marquis of Elbeuf, was already in preparation. Mary, with the assistance of a French contingent, began to fortify Leith. The strength of her opponents was increased by the defection of Châtelherault and his son Arran; and an even more serious danger was the treachery of her secretary Maitland, who betrayed her plans to the lords of the Congregation. In October 1559 they made an unsuccessful attack on Leith and the seizure of an English convoy on the way to their army by James Hepburn, earl of Bothwell, increased their difficulties. Mary entered Edinburgh and conducted a campaign in Fife. Meanwhile Maitland of Lethington had been at the English court, and an English fleet under William Winter was sent to the Forth in January 1560 to waylay Elbeuf's fleet, which was, however, driven back by a storm to Calais. Elbeuf had been commissioned by Francis I. and Mary to take over Mary's regency on account of her failing health. An English army under Lord Grey entered Scotland on the 29th of March 1560, and the regent received an asylum in Edinburgh castle, which was held strictly neutral by John Erskine. When she knew that she was dying Mary sent for the lords of the Congregation, with whom she pleaded for the maintenance of the French alliance. She even consented to listen to the exhortations of the preacher John Willock. She died on the 11th of June 1560. Her body was taken to Reims and buried in the church of the nunnery of St Peter, of which her sister was abbess.

The chief sources for her history are the Calendar of State Papers for the reigns of Henry VIII. and Edward VI. in the Rolls Series; A. Teulet, *Papiers d'état . . . relatifs à l'histoire de l'Écosse au XVI^e siècle* (Paris, 3 vols., 1851), for the Bannatyne Club; *Hamilton Papers*, ed. J. Bain (Edinburgh, 2 vols., 1890–1899); *Calendar of State Papers relating to Scotland and Mary Queen of Scots, 1547–1603* (Edinburgh, 2 vols., 1898–1900), &c. There is a Life in Miss Strickland's *Queens of Scotland* (vols. i.–ii.) based on original documents.

MARY OF MODENA [Maria Beatrice Anne Margaret Isabel d'Este] (1658–1718), queen of the English king James II., was the daughter of Alphonso IV., duke of Modena, and the Duchess Laura, of the Roman family Martinozzi. She was born at Modena on the 5th of October 1658. Her education was strict, and her own wish was to be a nun in a convent of the order of the Visitation founded by her mother. As a princess she was not free to choose for herself, and was selected, mainly by the king of France, Louis XIV., as the wife of James, duke of York, heir-presumptive to the English throne. The duke had become a Roman Catholic, and it was a point of policy with the French king to provide him with a Roman Catholic wife. Mary Beatrice of Este was chosen partly on the ground of her known religious zeal, but also because of her beauty. The marriage was celebrated by proxy on the 30th of September 1673. She reached England in November. In later life she confessed that her first feelings towards her husband could only be expressed by tears. In England the duchess, who was commonly spoken of as Madam East, was supposed to be an agent of the pope, who had indeed exerted himself to secure her consent. Her beauty and her fine manners secured her the respect of her brother-in-law, Charles II., and she lived on good terms with her husband's daughters by his first marriage, but she was always disliked by the nation. The birth of her first son (who died in infancy) on the 16th of January 1675 was regretted. During the Popish Plot, to which her secretary Coleman was a victim, she went abroad with her husband. After her husband's accession she suffered much domestic misery through his infidelity. Her influence on him was unfortunate, for she was a strong supporter of the Jesuit party which was in favour of extreme measures. Her second son, James Francis Edward, was born on the 10th of June (o.s.) 1688. The public refused to believe that the baby was Mary's child, and declared that a fraud had been perpetrated to secure a Roman Catholic heir. When the revolution had broken out she made the disastrous mistake of consenting to escape to France (Dec. 10, 1688) with her son. She urged her husband to follow her to France when it was his manifest interest to stay in England, and when he went to Ireland she pressed incessantly for his return. Her daughter, Louisa Maria, was born at St Germain on the 28th of June 1692. When her husband died on the 6th of September 1701, she succeeded in inducing King Louis to recognize her son as king of England, an act which precipitated the war of the Spanish Succession. Queen Mary survived her husband for seventeen years and her daughter for two. She received a pension of 100,000 crowns, which was largely spent in supporting Jacobite exiles. At the close of her life she had some success in obtaining payment of her jointure. She lived at St Germain or at Chaillot, a religious house of the Visitation. Her death occurred on the 7th of May 1718, and is said by Saint-Simon to have been that of a saint.

See Miss Strickland, *Queens of England* (vols. 9 and 10, London, 1846); Campana di Cavelli, *Les Derniers Stuarts à Saint-Germain en-Laye* (London, 1871); and Martin Haile *Mary of Modena* (London, 1905).

MARY OF ORANGE (1631–1660), eldest daughter of the English king Charles I., was born in London on the 4th of November 1631. Her father wished her to marry a son of Philip IV., king of Spain, while her cousin, the elector palatine, Charles Louis, was also a suitor for her hand, but both proposals fell through and she became the wife of a Dutch prince, William, son of Frederick Henry, prince of Orange. The marriage took place in London on the 2nd of May 1641, but owing to the tender years of the bride it was not consummated for several years. However in 1642 Mary crossed over to Holland with her mother, Queen Henrietta Maria, and in 1644, as the daughter-in-law of the stadtholder, she began to take her place in public life. In 1647 her husband, William II., succeeded his father as stadtholder, but three years later, just after his attempt to capture Amsterdam, he died; a son, afterwards the English king William III., being born to him a few days later (Nov. 14, 1650). Mary was obliged to share the guardianship of her infant son with his grandmother Amelia, the widow of Frederick Henry, and with Frederick William, elector of Brandenburg; moreover, she was unpopular with the Dutch owing to her sympathies with her kinsfolk, the Stuarts, and at length public opinion having been further angered by the hospitality which she showed to her brothers, Charles II. and James, duke of York, she was forbidden to receive her relatives. From 1654 to 1657 the princess passed most of her time away from Holland. In 1657 she was appointed regent on behalf of her son for the principality of Orange, but the difficulties of her position led her to implore the assistance of Louis XIV., and the French king answered by seizing Orange himself. The position both of Mary and of her son in Holland was greatly bettered through the restoration of Charles II. in Great Britain. In September 1660 Mary journeyed to England. She was taken ill of small-pox, and died in London on the 24th of December 1660, her death, says Bishop Burnet, being "not much lamented."

MARYBOROUGH, a market town and the county town of Queen's County, Ireland. Pop. (1901), 2957. It lies in the broad lowland east of the Slieve Bloom mountains, on the river Triogue, an affluent of the Barrow, and on the main line of the Great Southern & Western railway, by which it is 51 m. W.S.W. of Dublin. The town was chosen as county town in the reign of Mary (1556), in whose honour both town and county received their names. Its charter was granted in 1570, but its present appearance, save a bastion of the ancient castle, is wholly modern. There are flour-mills and a considerable general trade. Maryborough returned two members to the Irish parliament from 1585 until the union in 1800. The singular lofty rock of Dunamase or Dunmall, about 3 m. from the town, bears on its summit extensive ruins of a castle, originally belonging to the kings of Leinster, but probably built in the main by William Bruce (*c.* 1200) and dismantled in 1650 by Cromwell's troops.

MARYBOROUGH, a town of March county, Queensland, Australia, on the left bank and 25 m. from the mouth of the Mary river, 180 m. by rail N. of Brisbane. Pop. (1901), 10,159. Besides a handsome court-house and town hall, the principal buildings are the hospital, a technical college, a library, the Anglican Church of St Paul with a fine tower and peal of bells, and the grammar schools. There is a large shipbuilding yard, and breweries, distilleries, a tannery, boot factories, soap works, saw-mills, flour-mills, carriage works and iron foundries, besides extensive sugar factories in the neighbourhood. The largest smelting works in Australia are 5 m. distant, in which ore from all the states is treated. Maryborough is the port of shipment for a wide agricultural district yielding maize and sugar, and also for the Gympie gold-fields. Timber abounds in the neighbourhood and is exported. Maryborough is also the second coaling port in Queensland, the government railway wharf being in direct communication with the Burrum coal-fields.

MARYBOROUGH, a municipal town of Talbot county, Victoria, Australia, 112 m. by rail N.W. of Melbourne. Pop. (1901), 5633. It has fine government buildings, a town hall, a botanical garden, and numerous park lands. It is an important railway centre, and has extensive railway workshops, as well as coach factories, breweries and foundries. The gold mining of the district is deep alluvial. Wheat, oats and wine are the chief agricultural products of the neighbourhood.

MARYLAND, a South Atlantic state of the United States, and one of the original thirteen, situated between latitudes 37° 53′ and 39° 44′ N. and longitudes 75° 4′ and 79° 33′ W. (the precise western boundary has not been determined). It is bounded N. by Pennsylvania and Delaware; E. by Delaware and the Atlantic Ocean; S. and W. by the Potomac river and its north branch, which separate it, except on the extreme W. border, from Virginia and West Virginia; W., also, by West Virginia. It is one of the small states of the Union—only seven are smaller—its total area being 12,327 sq. m. of which 2386 sq. m. are water surface.

Physical Features.—Maryland is crossed from north to south by each of the leading topographical regions of the east section of the United States—the Coastal Plain, the Piedmont Plateau, the Appalachian Mountains, and the Appalachian Plateau—hence its great diversity of surface. The portion within the Coastal Plain embraces nearly the whole of the south-east half of the state and is commonly known as tide-water Maryland. It is marked off from the Piedmont Plateau by a "Fall Line" extending from Washington (D.C.) north-east through Baltimore to a point a little south of the north-east corner of the state, and is divided by the Chesapeake Bay into two parts known as the East Shore and the West Shore. The East Shore is a low level plain, the least elevated section of the state. Along its entire Atlantic border extends the narrow sandy Sinepuxent Beach, which encloses a shallow lagoon or bay also called Sinepuxent at the north, where, except in the extreme north, it is very narrow, and Chincoteague at the south, where its width is in most places from 4 to 5 m. Between this and the Chesapeake to the west and north-west there is a slight general rise, a height of about 100 ft. being reached in the extreme north. A water-parting extending from north-east to south-west and close to the Atlantic border separates the East Shore into two drainage systems, though that next to the Atlantic is insignificant. That on the Chesapeake side is drained chiefly by the Pocomoke, Nanticoke, Choptank and Chester rivers, together with their numerous branches, the general direction of all of which is south-west. The branches as well as the upper parts of the main streams flow through broad and shallow valleys; the middle courses of the main streams wind their way through reed-covered marshes, the water ebbing and flowing with the tide; in their lower courses they become estuarine and the water flows between low banks. The West Shore is somewhat more undulating than the East and also more elevated. Its general slope is from north-west to south-east; along the west border are points 300 ft. or more in height. The principal rivers crossing this section are the Patuxent, Patapsco and Gunpowder, with which may be grouped the Potomac, forming the state's southern boundary. These rivers, lined in most instances with terraces 30 to 40 ft. high on one or both sides, flow south-east into the Chesapeake Bay through valleys bounded by low hills. The Fall Line, which forms the boundary between the Coastal Plain and the Piedmont Plateau, is a zone in which a descent of about 100 ft. or more is made in many places within a few miles and in consequence is marked by waterfalls, cascades and rapids.

The part of Maryland within the Piedmont Plateau extends west from the Fall Line to the base of Catoctin Mountain, or the west border of Frederick county, and has an area of about 2500 sq. m. In general it has a broad rolling surface. It is divided into two sections by an elevated strip known as Parr's Ridge, which extends from north-east to south-west a short distance west of the middle. The east section rises from about 450 ft. along the Fall Line to from 850 to 900 ft. along the summit of Parr's Ridge. Its principal streams are those that cross the West Shore of the Coastal Plain and here wind their way from Parr's Ridge rapidly toward the south-east in narrow steep-sided gorges through broad limestone valleys. To the west of Parr's Ridge the surface for the most part slopes gently down to the east bank of the Monocacy river (which flows nearly at a right angle with the streams east of the Ridge), and then from the opposite bank rises rapidly toward the Catoctin Mountain; but just above the mouth of the Monocacy on the east side of the valley is Sugar Loaf Mountain, which makes a steep ascent of 1250 ft.

The portion of the state lying within the Appalachian Region is commonly known as Western Maryland. To the eastward it abounds in mountains and valleys; to the westward it is a rolling plateau. West of Catoctin Mountain (1800 ft.) is Middletown Valley, with Catoctin Creek running through it from north to south, and the Blue Ridge Mountains (2400 ft.), near the Pennsylvania border, forming its west slope. Farther west the serrated crests of the Blue Ridge overlook the Greater Appalachian Valley, here 73 m. in width, the broad gently-rolling slopes of the Great Cumberland or Hagerstown Valley occupying its eastern and the Appalachian Ridges its western portion. Through the eastern portion Antietam Creek to the east and Conococheague Creek to the west flow rapidly in meandering trenches that in places exceed 75 ft. in depth. The Appalachian Ridges of the western portion begin with North Mountain on the east and end with Wills Mountain on the west. They are long, narrow, uniformly-sloping and level-crested mountains, extending along parallel lines from north-east to south-west, and reaching a maximum height in Martin's Ridge of more than 2000 ft. Overlooking them from the west are the higher ranges of the Alleghenies, among which the Savage, Backbone and Negro Mountains reach elevations of 3000 ft. or more. In the extreme west part of the state these mountains merge, as it were, into a rolling plateau, the Appalachian Plateau, having an average elevation of 2500 ft. All rivers of Western Maryland flow south into the Potomac except in the extreme west, where the waters of the Youghiogheny and its tributaries flow north into the Monongahela.

Fauna and Flora.—In primitive times deer, ducks, turkeys, fish and oysters were especially numerous, and wolves, squirrels and crows were a source of annoyance to the early settlers. Deer, black bears and wild cats (lynx) are still found in some uncultivated sections. Much more numerous are squirrels, rabbits, "groundhogs" (woodchucks), opossums, skunks, weasels and minks. Many species of ducks are also still found; and the reed-bird (bobolink), "partridge" (elsewhere called quail or "Bob White"), ruffed grouse (elsewhere called partridge), woodcock, snipe, plover and Carolina rail still abound. The waters of the Chesapeake Bay are especially rich in oysters and crabs, and there, also, shad, alewives, "striped" (commonly called "rock") bass, menhaden, white perch and weak-fish ("sea-trout") occur in large numbers. Among the more common trees are several species of oak, pine, hickory, gums and maple, and the chestnut, the poplar, the beech, the cypress and the red cedar; the merchantable pine has been cut, but the chestnut and other hard woods of West Maryland are still a product of considerable value. Among wild fruit-trees are the persimmon and Chickasaw plum; grape-vines and a large variety of berry-bushes grow wild and in abundance.

Climate.—The climate of Maryland in the south-east is influenced by ocean and bay—perhaps also by the sandy soil—while in the west it is influenced by the mountains. The prevailing winds are westerly; but generally north-west in winter in the west section and south-west in summer in the south section. In the south the normal winter is mild, the normal summer rather hot; in the west the normal winter is cold, the normal summer cool. The normal average annual temperature for the entire state is between 53° and 54° F., ranging from 48° at Grantsville in the north-west to 53° at Darlington in the north-east, and to 57° at Princess Anne in the south-east. The normal temperature for the state during July (the warmest month) is 75·2° F., and during January (the coldest month) 32·14° F. Although the west section is generally much the cooler in summer, yet both of the greatest extremes recorded since 1891 were at points not far apart in Western Maryland: 109° F. at Boettcherville and − 26° F. at Sunnyside. The normal annual precipitation for the state is about 43 in. It is greatest, about 53 in., on the east slope of Catoctin Mountain, owing to the elevations which obstruct the moisture-bearing winds, and is above the average along the middle of the shores of the Chesapeake. It is least, from 25 to 35 in., in the Greater Appalachian Valley, in the south on the West Shore, and along the Atlantic border. During spring and summer the precipitation throughout the state is about 2 in. more than during autumn and winter.

Soils and Agriculture.—The great variety of soils is one of the more marked features of Maryland. On the East Shore to the north is a marly loam overlying a yellowish-red clay sub-soil, to the south is a soil quite stiff with light coloured clay, while here and there, especially in the middle and south, are considerable areas both of light sandy soils and tidal marsh loams. On the West Shore the soils range from a light sandy loam in the lower levels south from Baltimore to rather heavy loams overlying a yellowish clay on the rolling uplands and on the terraces along the Potomac and Patuxent. Crossing the state along the lower edge of the Fall Line is a belt heavy with clay, but so impervious to water as to be of little value for agricultural purposes. The soils of the Piedmont Plateau east of Parr's Ridge are, like the underlying rocks, exceptionally variable in composition, texture and colour. For the most part they are considerably heavier with clay than are those of the Coastal Plain, and better adapted to general agricultural purposes. Light loams, however, are found both in the north-east and south-east. A soil of very close texture, the gabbro, is found, most largely in the north-east. Alluvial loams occupy the narrow river valleys; but the most common soil of the section is that formed from gneiss with a large per cent. of clay in the subsoil. West of Parr's Ridge in the Piedmont, the principal soils are those the character of which is determined either by decomposed red sandstone or by decomposed limestone. In the east portion of the mountainous region the soil so well adapted to peach culture contains much clay, together with particles of Cambrian sandstone. In Hagerstown Valley are rich red or yellow limestone-clay soils. The Allegheny ridges have only a thin stony soil; but good limestone, sandstone, shale and alluvial soils, occur in the valleys and in some of the plateaus of the extreme west.

Of the total land surface of the state 82% was in 1900 included in farms and 68% of the farmland was improved. There were 46,012 farms, of which 15,833 contained less than 50 acres, 3940 contained 260 acres or more, and 79 contained 1,000 acres or more—the average size being 112·4 acres. In 1890, 69% of the farms were worked by the owners or their managers, in 1900 only 66·4%; but share tenants outnumber cash tenants by almost three to one. Of the total number of farms about seven times as many are operated by white as by negro farmers, though the number of farms operated by white share tenants outnumber those operated by negro share tenants by only about five to one. Of all the inhabitants of the state, at least ten years old, who in 1900 were engaged in gainful occupations, 20·8% were farmers. The leading agricultural pursuits are the growing of Indian corn and wheat and the raising of livestock, yet it is in the production of fruits, vegetables and tobacco, that Maryland ranks highest as an agricultural state, and in no other state except South Carolina is so large a per cent. of the value of the crop expended for fertilizers. In 1907, according to the *Year Book* of the U.S. Department of Agriculture, the Indian corn crop was 22,196,000 bushels, valued at $11,986,000; the wheat crop was 14,763,000 bushels, valued at $14,172,000; the oat crop was 825,000 bushels, valued at $404,000; and the crop of rye was 315,000 bushels, valued at $236,000. Of the livestock, hogs were the most numerous in 1900, cattle next, sheep third, and horses fourth. The hay and forage crop of 1899 (exclusive of corn-stalks) grew on 374,848 acres. Until after the middle of the 18th century tobacco was the staple crop of Maryland, and the total yield did not reach its maximum until 1860 when the crop amounted to 51,000 hhds.; from this it decreased to 14,000 hhds., or 12,356,838 lb in 1889; in 1899 it rose again to 24,589,480 lb, in 1907 the crop was only 16,962,000 lb, less than that of nine other states. In market-garden products, including small fruits, Maryland ranked in 1899 sixth among the states of the Union, the crop being valued at $4,766,760, an increase of 350·9% over that of 1889. In the yield both of strawberries and of tomatoes it ranked first; the yield of raspberries and blackberries is also large. In its crop of green-peas Maryland was exceeded (1899) by New York only; in sweet Indian corn it ranked fifth; in kale, second; in spinach, third; in cabbages, ninth. The number of peach-trees, especially in the west part of the state, where the quality is of the best, is rapidly increasing, and in the yield of peaches and nectarines the state ranked thirteenth in 1899; in the yield of pears it ranked fifth; in apples seventeenth.

The Indian-corn, wheat and livestock sections of the state, are in the Piedmont Plateau, the Hagerstown Valley and the central portion of the East Shore. Garrett county in the extreme north-west, however, raises the largest number of sheep. Most of the tobacco is grown in the south counties of the West Shore. The great centre for vegetables and small fruits is in the counties bordering on the north-west shore of the Chesapeake, and in Howard, Frederick and Washington counties, directly west, Anne Arundel county producing the second largest quantity of strawberries of all the counties in the Union in 1899. Peaches and pears grow in large quantities in Kent and neighbouring counties on the East Shore and in Washington and Frederick counties; apples grow in abundance in all parts of the Piedmont Plateau.

The woodland area of the state in 1900 was 4400 sq. m., about 44% (estimated in 1907 to be 3450 sq. m., about 35%) of the total land area, but with the exception of considerable oak and chestnut, some maple and other hard woods in west Maryland, about all of the merchantable timber has been cut. The lumber industry, nevertheless, has steadily increased in importance, the value of the product in 1860 amounting to only $605,864, that in 1890 to $1,600,472, and that in 1900 to $2,650,082, of which sum $2,495,169 was the value of products under the factory system; in 1905 the value of the factory product was $2,750,339.

Fisheries.—In 1897 the value of the fishery product of Maryland was exceeded only by that of Massachusetts, but by 1901, although it had increased somewhat during the four years, it was exceeded by the product of New Jersey, of Virginia and of New York. Oysters constitute more than 80% of the total value, the product in 1901 amounting to 5,685,561 bushels, and being valued at $3,031,518. The supply on natural beds has been diminishing, but the planting of private beds promises a large increase. Crabs are next in value and are caught chiefly along the East Shore and in Anne Arundel and Calvert counties on the West Shore. Shad, to the number of 3,111,181 and valued at $120,602, were caught during 1901. In Somerset and Worcester counties clams are a source of considerable value. The terrapin catch decreased in value from $22,333 in 1891 to $1,139 in 1901. The total value of the fish product of 1901 was $3,767,461. The state laws for the protection of fish and shell-fish were long carelessly enforced because of the fishermen's strong feeling against them, but this sentiment has slowly changed and enforcement has become more vigorous.

Minerals and Manufactures.—The coal deposits, which form a part of the well-known Cumberland field, furnish by far the most important mineral product of the state; more than 98% of this, in 1901, was mined in Allegany county from a bed about 20 m. long and 5 m. wide and the remainder in Garrett county, whose deposits, though undeveloped, are of great value. The coal is of two varieties: bituminous and semi-bituminous. The bituminous is of excellent quality for the manufacture of coke and gas, but up to 1902 had been mined only in small quantities. Most of the product has been of the semi-bituminous variety and of the best quality in the country for the generation of steam. Nearly all the high grade blacksmithing coal mined in the United States comes from Maryland. The deposits were discovered early in the 19th century (probably first in 1804 near the present Frostburg), but were not exploited until railway transport became available in 1842, and the output was not large until after the close of the Civil War; in 1865 it was 1,025,208 short tons, from which it steadily increased to 5,532,628 short tons in 1907. From 1722 until the War of Independence the iron-ore product of North and West Maryland was greater than that of any of the other colonies, but since then ores of superior quality have been discovered in other states and the output in Maryland, taken chiefly from the west border of the Coastal Plain in Anne Arundel and Prince George's counties, has become comparatively of little importance—24,367 long tons in 1902 and only 8269 tons in 1905. Gold, silver and copper ores, have been found in the state, and attempts have been made to mine them, without much success. The Maryland building stone, of which there is an abundance of good quality, consists chiefly of granites, limestones, slate, marble and sandstones, the greater part of which is quarried in the east section of the Piedmont Plateau especially in Cecil county, though some limestones, including those from which hydraulic cement is manufactured, and some sandstones are obtained from the western part of the Piedmont Plateau and the east section of the Appalachian region; the value of stone quarried in the state in 1907 was $1,439,355, of which $1,183,753 was the value of granite, $142,825 that of limestone, $98,918 that of marble, and $13,859 that of sandstone. Brick, potter's and tile clays are obtained most largely along the west border of the Coastal Plain, and fire-clay from the coal region of West Maryland; in 1907 the value of clay products was $1,886,362. Materials for porcelain, including flint, feldspar and kaolin, abound in the east portion of the Piedmont, the kaolin chiefly in Cecil county, and material for mineral paint in Anne Arundel and Prince George's counties, as well as farther north-west.

Between 1850 and 1900, while the population increased 103·8%, the average number of wage-earners employed in manufacturing establishments increased 258·5%, constituting 5·2% of the total population in 1850 and 9·1% in 1900. In 1900 the total value of manufactured goods was $242,552,990, an increase of 41·1% over that of 1890. Of the total given for 1900, $211,076,143 was the value of products under the factory system; and in 1905 the value of factory products was $243,375,996, being 15·3% more than in 1900. The products of greatest value in 1905 were: custom-made men's clothing; fruits and vegetables and oysters, canned and preserved; iron and steel; foundry and machine-shop products, including stoves and furnaces; flour and grist mill products; tinware, coppersmithing and sheet iron working; fertilizers; slaughtering

and meat-packing; cars and repairs by steam railways; shirts; cotton goods; malt liquors; and cigars and cigarettes. In the value of fertilizers manufactured, and in that of oysters canned and preserved, Maryland was first among the states in 1900 and second in 1905; in 1900 and in 1905 it was fourth among the states in the value of men's clothing. Baltimore is still the great manufacturing centre, but of the state's total product the percentage in value of that manufactured there decreased from 82·5 in 1890 to 66·5 in 1900, and to 62·3 (of the factory product) in 1905. The largest secondary centres are Cumberland, Hagerstown and Frederick the total value of whose factory products in 1905 was less than $10,000,000.

Communications.—Tide-water Maryland is afforded rather unusual facilities of water transportation by the Chesapeake Bay, with its deep channel, numerous deep inlets and navigable tributaries, together with the Chesapeake and Delaware Canal, which crosses the state of Delaware and connects its waters with those of the Delaware river and bay. As early as 1783 steps were taken to extend these facilities to the navigable waters of the Ohio, chiefly by improving the navigation of the Potomac above Georgetown. By 1820 this project was merged into a movement for a Chesapeake and Ohio canal along the same line. Ground was broken in 1828 and in 1850 the canal was opened to navigation from Georgetown to Cumberland, a distance of 186 m. In 1878 and again in 1889 it was wrecked by a freshet, and since then has been of little service.[1] However, on the same day that ground was broken for this canal, ground was also broken for the Baltimore & Ohio railway, of which 15 m. was built in 1828–1830 and which was one of the first steam railway lines in operation in the United States. Since then railway building has progressed steadily. In Maryland (and including the District of Columbia) there were 259 m. of railway in 1850, 386 m. in 1860, 671 m. in 1870, and 1040 m. in 1880; in 1890, in Maryland alone, the mileage was 1270·04 m., and in 1909 it was 1394·19 m. The more important railway lines are the Baltimore & Ohio, the Philadelphia, Baltimore & Washington (controlled by the Pennsylvania and a consolidation of the Philadelphia, Wilmington & Baltimore, and the Baltimore & Potomac), the Western Maryland, the West Virginia Central & Pittsburg (leased by the Western Maryland), the Northern Central, the Maryland electric railways (including what was formerly the Baltimore & Annapolis Short Line), and the Washington, Baltimore & Annapolis electric railway. Baltimore is the chief railway centre and its harbour is one of the most important in the country.

Inhabitants.—The population of Maryland in 1880 was 934,943; in 1890, 1,042,390, an increase of 11·5%; in 1900, 1,188,044 (14%); in 1910, 1,295,346 (increase 9%). Of the total population in 1900 there were 952,424 whites, 235,064 negroes, 544 Chinese, 9 Japanese and 3 Indians, the increase in the white population from 1890 to 1900 being 15·2%, while that of the negroes was only 9%. In 1900 there were 1,094,110 native born to 93,934 foreign-born, and of the foreign-born 44,990 were natives of Germany and 68,600 were residents of the city of Baltimore. The urban population, *i.e.* total population of cities of 4000 or more inhabitants, in 1900, was 572,795, or 48·2% of the total and an increase of 16·6% over that of 1890; while the rural population, *i.e.* population outside of incorporated places, was 539,685, an increase of about 8% over that of 1890. There are about 59 religious sects, of which the members of the Roman Catholic Church, which was prominent in the early history of Maryland, are far the most numerous, having in 1906 166,941 members out of 473,257 communicants of all denominations; in the same year there were 137,156 Methodists, 34,965 Protestant Episcopalians, 32,246 Lutherans, 30,928 Baptists, 17,895 Presbyterians and 13,442 members of the Reformed Church in the United States. The chief cities are Baltimore, pop. (1910) 558,485, Cumberland 21,839, Hagerstown 16,507, Frederick 10,411 and Annapolis 8609.

Government.—The state constitution of 1867, the one now in force, has been frequently amended, all that is required for its amendment being a three-fifths vote of all of the members elected to each of the two houses of the General Assembly, followed by a majority vote of the state electorate, and it is further provided that once in twenty years, beginning with 1887, the wish of the people in regard to calling a convention for altering the constitution shall be ascertained by a poll. Any constitution or constitutional amendment proposed by such constitutional convention comes into effect only if approved by a majority of the votes cast in a popular election. Since 1870 suffrage has been the right of all male citizens (including negroes) twenty-one years of age or over who shall have lived within the state for one year and within the county or the legislative district of the city of Baltimore in which they may offer to vote for six months immediately preceding an election; persons convicted of larceny or other infamous crime and not since pardoned by the governor, as well as lunatics or those who have been convicted of bribery at a previous election are excepted. In 1908 the General Assembly passed a law providing for annual direct primary elections (outside of Baltimore; and making the Baltimore special primary law applicable to state as well as city officials), but, as regards state officers, making only a slight improvement upon previous conditions inasmuch as the county or district is the unit and the vote of county or district merely "instructs" delegates to the party's state nominating convention, representation in which is not strictly in proportion to population, the rural counties having an advantage over Baltimore; no nomination petition is required. In the same year a separate law was passed providing for primary elections for the choice of United States senators; but here also the method is not that of nomination by a plurality throughout the state, but by the vote of counties and legislative districts, so that this measure, like the other primary law, is not sufficiently direct to give Baltimore a vote proportional to its population.

The chief executive authority is vested in a governor elected by popular vote for a term of four years. Since becoming a state Maryland has had no lieutenant-governor except under the constitution of 1864; and the office of governor is to be filled in case of a vacancy by such person as the General Assembly may elect.[3] Any citizen of Maryland may be elected to the office who is thirty years of age or over, who has been for ten years a citizen of the state, who has lived in the state for five years immediately preceding election, and who is at the time of his election a qualified voter therein. Until 1838 the governor had a rather large appointing power, but since that date most of the more important offices have been filled by popular election. He, however, still appoints, subject to the confirmation of the senate, the secretary of state, the superintendent of public education, the commissioner of the land office, the adjutant-general, justices of the peace, notaries public, the members of numerous administrative boards, and other administrative officers. He is himself one of the board of education, of the board of public works, and of the board for the management of the house of correction. No veto power whatever was given to the governor until 1867, when, in the present constitution, it was provided that no bill vetoed by him should become a law unless passed over his veto by a three-fifths vote of the members elected to each house, and an amendment of 1890 (ratified by the people in 1891) further provides that any item of a money bill may likewise be separately vetoed. The governor's salary is fixed by the constitution at $4500 a year. Other executive officers are a treasurer, elected by joint ballot of the General Assembly for a term of two years, a comptroller elected by popular vote for a similar term, and an attorney-general elected by popular vote for four years.

The legislature, or General Assembly, meets biennially in even-numbered years, at Annapolis, and consists of a Senate and a House of Delegates. Senators are elected, one from each of the twenty-three counties and one from each of the four legislative districts of the city of Baltimore, for a term of four years, the terms of one-half expiring every two years. Delegates are elected for a term of two years, from each county and from each legislative district of Baltimore, according to population, as follows: for a population of 18,000 or less, two delegates; 18,000 to 28,000, three; 28,000 to 40,000, four; 40,000 to 55,000, five; 55,000 and upwards, six. Each legislative district of Baltimore is entitled to the number of delegates to which the largest county shall or may be entitled under the foregoing apportionment, and the General Assembly may from time to time alter the boundaries of Baltimore city districts in order to equalize their population. This system of apportionment gives to the rural counties a considerable political advantage over the city of Baltimore, which, with 42·8% of the total population according to the census of 1900, has only 4 out of 27 members of the Senate and only 24 out of 101 members of the House of Delegates. Since far back in the colonial era, no minister, preacher, or priest has been eligible to a seat in either house. A senator must be twenty-five years of age or over, and both senators and delegates must have lived within the state at least three years and in their county or legislative district at least one year immediately preceding their election.

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[1] Maryland and Delaware together began the construction of the Chesapeake and Delaware canal ($13\frac{1}{2}$ m. long) across the north part of the state of Delaware, between the Delaware river and Chesapeake Bay; this canal received Federal aid in 1828, was completed in 1829, and in 1907 was chosen as the most practicable route for a proposed ship waterway between the Chesapeake and the Delaware.

[2] The population at previous censuses was as follows: 319,728 in 1790; 341,548 in 1800; 380,546 in 1810; 407,350 in 1820; 447,040 in 1830; 470,019 in 1840; 583,034 in 1850; 687,049 in 1860; and 780,894 in 1870.

[3] The General Assembly regularly elected the governor during the period 1776–1838.

The constitution provides that no bill or joint resolution shall pass either house except by an affirmative vote of a majority of all the members elected to that house and requires that on the final vote the yeas and nays be recorded.

Justice, &c.—The administration of justice is entrusted to a court of appeals, circuit courts, special courts for the city of Baltimore, orphans' courts, and justices of the peace. Exclusive of the city of Baltimore, the state is divided into seven judicial circuits, in each of which are elected for a term of fifteen years one chief judge and two associate judges, who at the time of their election must be members of the Maryland bar, between the ages of thirty and seventy, and must have been residents of the state for at least five years. The seven chief judges so elected, together with one elected from the city of Baltimore, constitute the court of appeals, the governor with the advice and consent of the senate designating one of the eight as chief judge of that court. The court has appellate jurisdiction only. The three judges elected in each circuit constitute the circuit court of each of the several counties in such circuit. The courts have both original and appellate jurisdiction and are required to hold at least two sessions to which jurors shall be summoned every year in each county of its circuit, and if only two such terms are held, there must be two other and intermediate terms to which jurors shall not be summoned. Three other judges are elected for four-year terms, in each county and in the city of Baltimore to constitute an orphans' court. The number of justices of the peace for each county is fixed by local law; they are appointed by the governor, subject to the confirmation of the Senate, for a term of two years.

In the colonial era Maryland had an interesting list of governmental subdivisions—the manor, the hundred, the parish, the county, and the city—but the two last are about all that remain and even these are in considerable measure subject to the special local acts of the General Assembly. In general, each county has from three to seven commissioners—the number is fixed by county laws—elected on a general ticket of each county for a term of from two to six years, entrusted with the charge and control of property owned by the county, empowered to appoint constables, judges of elections, collectors of taxes, trustees of the poor, and road supervisors, to levy taxes, to revise taxable valuations of real property, and open or close public roads.

In Maryland a wife holds her property as if single except that she can convey real estate only by a joint deed with her husband (this requirement being for the purpose of effecting a release of the husband's "dower interest"), neither husband nor wife is liable for the separate debts of the other, and on the death of either the rights of the survivor in the estate of the other are about equal. Wife-beating is made punishable by whipping in gaol, not exceeding forty lashes. Prior to 1841 a divorce was granted by the legislature only, from then until 1851 it could be granted by either the legislature or the equity courts, since 1851 by the courts only. The grounds for a divorce *a mensa et thoro*, which may be granted for ever or for a limited time only, are cruelty, excessively vicious conduct, or desertion; for a divorce *a vinculo matrimonii* the chief grounds are impotence at the time of marriage, adultery or deliberate abandonment for three years. There is no homestead exemption law and exemptions from levy for the satisfaction of debts extend only to $100 worth of property, besides wearing apparel and books and tools used by the debtor in his profession or trade, and to all money payable in the nature of insurance. Employers of workmen in a clay or coal mine, stone quarry, or on a steam or street railway are liable for damage in case of an injury to any of their workmen where such injury is caused by the negligence of the employer or of any servant or employee of the employer. The chief of the bureau of labour statistics is directed in case of danger of a strike or lockout to seek to mediate between the parties and if unsuccessful in that, then to endeavour to secure their consent to the formation of a board of arbitration.

The state penal and charitable institutions include a penitentiary at Baltimore; a house of correction at Jessups, two houses of refuge at Baltimore; a house of reformation in Prince George's county; St Mary's industrial school for boys at Baltimore; an industrial home for negro girls at Melvale; an asylum and training school for the feeble-minded at Owings Mills; an infirmary at Cumberland; the Maryland hospital for the insane at Catonsville; the Springfield state hospital for the insane; the Maryland school for the deaf and dumb at Frederick city; and the Maryland school for the blind at Baltimore. Each of these is under the management of a board appointed by the governor subject to the confirmation of the senate. Besides these there are a large number of state-aided charitable institutions. In 1900 there was created a board of state aid and charities, composed of seven members appointed by the governor for a term of two years, not more than four to be reappointed. There is also a state lunacy commission of four members, who are appointed for terms of four years, one annually, by the governor.

Education.—The basis of the present common school system was laid in 1865, after which a marked development was accompanied by some important changes in the system and its administration, and the percentage of total illiteracy (*i.e.* inability to write among those ten years old and over) decreased from 19·3 in 1800 to 11·1 in 1900, while illiteracy among the native whites decreased during the same period from 7·8 to 4·1 and among negroes from 59·6 to 35·2. At the head of the system is a state board and a state superintendent, and under these in each county is a county board which appoints a superintendent for the county and a board of trustees for each school district none of which is to be more than four miles square. The state board is composed of the governor as its president, the state superintendent as its secretary, six other members appointed by the governor for a term of six years, and, as *ex-officio* members without the right to vote, the principals of the state and other normal schools. Prior to 1900 the principal of the state normal was *ex-officio* state superintendent, but since then the superintendent has been appointed by the governor for a term of four years. Each county board is also appointed by the governor for a term of six years. In both the state and the county boards at least one-third of the members appointed by the governor are not to be of the dominant political party and only one-third of the members are to be appointed every two years. The state board enacts by-laws for the administration of the system; its decision of controversies arising under the school law is final; it may suspend or remove a county superintendent for inefficiency or incompetency; it issues life state certificates, but applicants must have had seven years of experience in teaching, five in Maryland, and must hold a first-class certificate or a college or normal school diploma; and it pensions teachers who have taught successfully for twenty-five years in any of the public or normal schools of the state, who have reached the age of sixty, and who have become physically or mentally incapable of teaching longer, the pension amounting to $200 a year. The legislature of 1908 passed a law under which the minimum pay for a teacher holding a first-class certificate should be $350 a year after three years' teaching, $400 after five years' teaching and $450 after eight years' teaching. By a law of 1904 all teachers who taught an average of 15 pupils were to receive at least $300. School books are purchased out of the proceeds of the school tax, but parents may purchase if they prefer. In 1908 the average school year was nine and seven-tenths months—ten in the cities and nine and four-tenths in the counties; the aim is ten months throughout, and a law of 1904 provides that if a school is taught less than nine months a portion of the funds set apart for it shall be withheld. A compulsory education law of 1902—to operate, however, only in the city of Baltimore and in Allegany county—requires the attendance for the whole school year of children between the ages of eight and twelve and also of those between the ages of twelve and sixteen who are not employed at home or elsewhere. A separate school for negro children is to be maintained in every election district in which the population warrants it. The system is maintained by a state tax of 16 cents on each $100 of taxable property.

The higher state educational institutions are two normal schools and one agricultural college. One of the normal schools was opened in Baltimore in 1866, the other at Frostburg in 1904. Both are under the management of the state Board of Education, which appoints the principals and teachers and prescribes the course of study. There is besides, in Washington College at Chestertown, a normal department supported by the state and under the supervision of the state Board of Education. The Maryland Agricultural College, to which an experiment station has been added, was opened in 1859; it is at College Park in Prince George's county, and is largely under state management. Maryland supports no state university, but Johns Hopkins University, one of the leading institutions of its kind in the country, receives $25,000 a year from the state; the medical department of the university of Maryland receives an annual appropriation of about $2500, and St John's College, the academic department of the university of Maryland, receives from the state $13,000 annually and gives for each county in the state one free scholarship and one scholarship covering all expenses. Among the principal institutions in the state are the university of Maryland, an outgrowth of the medical college of Maryland (1807) in Baltimore, with a law school (reorganized in 1869), a dental school (1882), a school of pharmacy (1904), and, since 1907, a department of arts and science in St John's College (non-sect., opened in 1789) at Annapolis; Washington College, with a normal department (non-sect., opened in 1782) at Chestertown; Mount St Mary's College (Roman Catholic, 1808) at Emmitsburg; New Windsor College (Presbyterian, 1843) at New Windsor; St Charles College (Roman Catholic, opened in 1848) and Rock Hill College (Roman Catholic, 1857) near Ellicott City; Loyola College (Roman Catholic, 1852) at Baltimore; Western Maryland College (Methodist Protestant, 1867) at Westminster; Johns Hopkins University (non-sect., 1876) at Baltimore; Morgan College (coloured, Methodist, 1876) at Baltimore; Goucher College (Methodist, founded 1884, opened 1888) at Baltimore; several professional schools mostly in Baltimore (*q.v.*); the Peabody Institute at Baltimore; and the United States Naval Academy at Annapolis.

Revenue.—The state's revenue is derived from a general direct property tax, a licence tax, corporation taxes, a collateral inheritance tax, fines, forfeitures and fees; and the penitentiary yields an annual net revenue of about $40,000. There is no provision for a general periodic assessment, but a state tax commissioner appointed by the governor, treasurer and comptroller assesses the corporations, and the county commissioners (in the counties) and the appeal tax court (in the city of Baltimore) revise valuations of real property every two years. From 1820 to 1836 Maryland, in its enthusiasm over internal improvements, incurred an indebtedness of more than $16,000,000. To meet the interest, such heavy taxes were levied that anti-tax associations were formed to resist the collection, and in 1842 the state failed to pay what was due; but the accumulated interest had been funded by 1848 and was paid soon afterwards, the expenses of the government were curtailed by the constitution of 1851, and after the Civil War the amount of indebtedness steadily decreased until in 1902 the funded debt was $6,909,326 and the net debt only $2,797,269·13, while on the 1st of October 1908 the net debt was $366,643·91. As a result of incurring the large debt, a clause in the constitution prohibits the legislature from contracting a debt without providing by the imposition of taxes for the payment of the interest annually and the principal within fifteen years, except to meet a temporary deficiency not exceeding $50,000. The first bank of the state was established in 1790, and by 1817 there was one in each of twelve counties and several in Baltimore; in 1818–1820 and in 1837–1839 there were several serious bank failures, but there have been no serious failures since. A constitutional provision makes each stockholder in a state bank liable to the amount of his share or shares for all the bank's debts and liabilities. A savings bank is taxed on its deposits, and a state bank is taxed on its capital-stock.

History.—The history of Maryland begins in 1632 with the procedure of Charles I. to grant a charter conveying almost unlimited territorial and governmental rights therein to George Calvert, first Lord Baltimore (1580?–1632), and styling him its absolute lord and proprietor. George Calvert died before the charter had passed the great seal, but about two months later in the same year it was issued to his eldest son, Cecilius. In November 1633 two vessels, the "Ark" and the "Dove," carrying at least two hundred colonists under Leonard Calvert (*c.* 1582–1647), a brother of the proprietor, as governor, sailed from Gravesend and arrived in Maryland late in March of the following year. Friendly relations were at the outset established with the Indians, and the province never had much trouble with that race; but with William Claiborne (1589?–1676?), the arch-enemy of the province as long as he lived, it was otherwise. He had opposed the grant of the Maryland charter, had established a trading post on Kent Island in Chesapeake Bay in 1631, and when commanded to submit to the new government he and his followers offered armed resistance. A little later, during his temporary absence in England, his followers on the island were reduced to submission; but in 1644, while the Civil War in England was in progress, he was back in the province assisting Richard Ingle, a pirate who claimed to be acting in the interest of parliament, in raising an insurrection which deprived Governor Calvert of his office for about a year and a half. Finally, the lord proprietor was deprived of his government from 1654 to 1658 in obedience to instructions from parliament which were originally intended to affect only Virginia, but were so modified, through the influence of Claiborne and some Puritan exiles from Virginia who had settled in Maryland, as to apply also to "the plantations within Chesapeake Bay." Then the long continued unrest both in the mother country and in the province seems to have encouraged Josias Fendall, the proprietor's own appointee as governor, to strike a blow against the proprietary government and attempt to set up a commonwealth in its place; but this revolt was easily suppressed and order was generally preserved in the province from the English Restoration of 1660 to the English Revolution of 1688.

Meanwhile an interesting internal development had been in progress. The proprietor was a Roman Catholic and probably it was his intention that Maryland should be an asylum for persecuted Roman Catholics, but it is even more clear that he was desirous of having Protestant colonists also. To this end he promised religious toleration from the beginning and directed his officers accordingly; this led to the famous toleration act passed by the assembly in 1649, which, however, extended its protection only to sects of Trinitarian Christianity. Again, although the charter reserved to the proprietor the right of calling an assembly of the freemen or their delegates at such times and in such form and manner as he should choose, he surrendered in 1638 his claim to the sole right of initiating legislation. By 1650 the assembly had been divided into two houses, in one of which sat only the representatives of the freemen without whose consent no bill could become a law, and annual sessions as well as triennial elections were coming to be the usual order. When suffrage had thus come to be a thing really worth possessing, the proprietor, in 1670, sought to check the opposition by disfranchising all freemen who did not have a freehold of fifty acres or a visible estate of forty pounds sterling. But this step was followed by more and more impassioned complaints against him, such as: that he was interfering with elections, that he was summoning only a part of the delegates elected, that he was seeking to overawe those summoned, that he was abusing his veto power, and that he was keeping the government in the hands of Roman Catholics, who were mostly members of his own family. About this time also the north and east boundaries of the province were beginning to suffer from the aggressions of William Penn. The territory now forming the state of Delaware was within the boundaries defined by the Maryland charter, but in 1682 it was transferred by the duke of York to William Penn and in 1685 Lord Baltimore's claim to it was denied by an order in council, on the ground that it had been inhabited by Christians before the Maryland charter was granted. In the next place, although it was clear from the words of the charter that the parallel of 40° N. was intended for its north boundary, and although Penn's charter prescribed that Pennsylvania should extend on the south to the "beginning of the fortieth degree of Northern Latitude," a controversy arose with regard to the boundary between the two provinces, and there was a long period of litigation; in 1763–1767 Charles Mason and Jeremiah Dixon, two English mathematicians, established the line named from them (see MASON AND DIXON LINE), which runs along the parallel 39° 43′ 26″·3 N. and later became famous as the dividing line between the free states and the slave states. While the proprietor was absent defending his claims against Penn the English Revolution of 1688 was started. Owing to the death of a messenger there was long delay in proclaiming the new monarchs in Maryland; this delay, together with a rumor of a Popish plot to slaughter the Protestants, enabled the opposition to overthrow the proprietary government, and then the crown, in the interest of its trade policy, set up a royal government in its place, in 1692, without, however, divesting the proprietor of his territorial rights. Under the royal government the Church of England was established, the people acquired a strong control of their branch of the legislature and they were governed more by statute law and less by executive ordinance. The proprietor having become a Protestant, the proprietary government was restored in 1715. Roman Catholics were disfranchised immediately afterward. In 1730 Germans began to settle in considerable numbers in the west-central part of the colony, where they greatly promoted its industrial development but at the same time added much strength to the opposition. The first great dispute between proprietor and people after the restoration of 1715 was with regard to the extension of the English statutes to Maryland, the popular branch of the legislature vigorously contending that all such statutes except those expressly excluded extended to the province, and the lord proprietor contending that only those in which the dominions were expressly mentioned were in force there. Many other disputes speedily followed and when the final struggle between the English and French for possession in America came, although appropriations were made at its beginning to protect her own west frontier from the attacks of the enemy, a dead-lock between the two branches of the assembly prevented Maryland from responding to repeated appeals from the mother country for aid in the latter part of that struggle. This failure was used as an argument in favour of imposing the famous Stamp Act. Nevertheless, popular clamour against parliament on account of that measure was even greater than it had been against the proprietor. The stamp distributor was driven out, and the arguments of Daniel Dulany (1721–1797), the ablest lawyer in the province, against the act were quoted by speakers in parliament for its repeal.

In the years immediately preceding the Declaration of Independence Maryland pursued much the same course as did other leading colonies in the struggle—a vessel with tea on board was even burned to the water's edge—and yet when it came to the decisive act of declaring independence there was hesitation. As the contest against the proprietor had been nearly won, the majority of the best citizens desired the continuance of the old government and it was not until the Maryland delegates in the Continental Congress were found almost alone in holding back that their instructions not to vote for independence were rescinded. The new constitution drawn and adopted in 1776 to take the place of the charter was of an aristocratic rather than a democratic nature. Under it the property qualification for suffrage was a freehold of 50 acres or £30 current money, the property qualifications for delegates £500, for senators £1000, and for governor £5000. Four delegates were chosen from each county and two each from Baltimore and Annapolis, the same as under the proprietary government, population not being taken into account. Senators were chosen by a college of fifteen electors elected in the same manner as the delegates, and the governor by a joint ballot of the two houses of assembly. In 1802 negroes were disfranchised, and in 1810 property qualifications for suffrage and office were abolished. The system of representation that, with the rapid growth of population in the north-east sections, especially in the city of Baltimore, placed the government in the hands of a decreasing minority also began to be attacked about this time; but the fear of that minority which represented the tobacco-raising and slave-holding counties of south Maryland, with respect to the attitude of the majority toward slavery prevented any changes until 1837, when the opposition awakened by the enthusiasm over internal improvements effected the adoption of amendments which provided for the election of the governor and senators by a direct vote of the people, a slight increase in the representation of the city of Baltimore and the larger counties, and a slight decrease in that of the smaller counties. Scarcely had these amendments been carried when the serious financial straits brought on by debt incurred through the state's promotion of internal improvements gave rise to the demand for a reduction of governmental expenses and a limitation of the power of the General Assembly to contract debts. The result was the new constitution of 1851, which fully established representation in the counties on the basis of population and further increased that of Baltimore. The constitution of 1851 was however chiefly a patchwork of compromises. So, when during the Civil War Maryland was largely under Federal control and the demand arose for the abolition of slavery by the state, another constitutional convention was called, in 1864, which framed a constitution providing that those who had given aid to the Rebellion should be disfranchised and that only those qualified for suffrage in accordance with the new document could vote on its adoption. This was too revolutionary to stand long and in 1867 it was superseded by the present constitution. In national affairs Maryland early took a stand of perhaps far-reaching consequences in refusing to sign the Articles of Confederation (which required the assent of all the states before coming into effect), after all the other states had done so (in 1779), until those states claiming territory between the Alleghany Mountains and the Mississippi and north of the Ohio—Virginia, New York, Massachusetts and Connecticut—should have surrendered such claims. As those states finally yielded, the Union was strengthened by reason of a greater equality and consequently less jealousy among the original states, and the United States came into possession of the first territory in which all the states had a common interest and out of which new states were to be created. In the War of 1812 Frederick, Havre de Grace, and Frenchtown were burned by the British; but particularly noteworthy were the unsuccessful movements of the enemy by land and by sea against Baltimore, in which General Robert Ross (*c.* 1766–1814), the British commander of the land force, was killed before anything had been accomplished and the failure of the fleet to take Fort McHenry after a siege of a day and a night inspired the song *The Star-spangled Banner*, composed by Francis Scott Key who had gone under a flag of truce to secure from General Ross the release of a friend held as a prisoner by the British and during the attack was detained on his vessel within the British lines. In 1861 Maryland as a whole was opposed to secession but also opposed to coercing the seceded states. During the war that followed the west section was generally loyal to the north while the south section favoured the Confederacy and furnished many soldiers for its army; but most of the state was kept under Federal control, the writ of habeas corpus being suspended. The only battle of much importance fought on Maryland soil during the war was that of Sharpsburg or Antietam on the 16th and 17th of September 1862. As between political parties the state has usually been quite equally divided. From 1820 to 1860, however, the Whigs were in general a trifle the stronger; and from 1866 to 1895 the Democrats were triumphant; in 1895 a Republican governor was elected; in 1896 Maryland gave McKinley 32,232 votes more than it gave Bryan; and in 1904 seven Democratic electors and one Republican were chosen; and in 1908 five Democratic and three Republican.

The proprietors of Maryland were: Cecilius Calvert, second Lord Baltimore (1605[?]–1675) from 1632 to 1675; Charles Calvert, third Lord Baltimore (1629–1715) from 1675 to 1715; Benedict Leonard Calvert, fourth Lord Baltimore (1684?–1715) 1715; Charles Calvert, fifth Lord Baltimore (1699–1751) from 1715 to 1751; Frederick Calvert, sixth and last Lord Baltimore (1731–1771) from 1751 to 1771; Henry Harford, from 1771 to 1776.

Governors of Maryland.

Proprietary.

Leonard Calvert	1633–1645
Richard Ingle (usurper)	1645
Edward Hill (chosen by the council)	1646
Leonard Calvert	1646–1647
Thomas Greene	1647–1649
William Stone	1649–1652
Richard Bennett Edmund Curtis William Claiborne (commissioners of parliament)	1652
William Stone	1652–1654
William Fuller and others (appointed by the commissioners of parliament)	1654–1658
Josias Fendall	1658–1660
Philip Calvert	1660–1661
Charles Calvert	1661–1675
Charles Calvert, third Lord Baltimore	1675–1676
Cecilius Calvert (titular) and Jesse Wharton (real)	1676
Thomas Notley	1676–1679
Charles Calvert, third Lord Baltimore	1679–1684
Benedict Leonard Calvert (titular) and council (real)	1684–1688
William Joseph (president of the council)	1688–1689
Protestant Associators under John Coode	1689–1692

Royal.

Sir Lionel Copley	1692–1693
Sir Edmund Andros	1693–1694
Francis Nicholson	1694–1699
Nathaniel Blackistone	1699–1702
Thomas Tench (president of the council)	1702–1704
John Seymour	1704–1709
Edward Lloyd (president of the council)	1709–1714
John Hart	1714–1715
John Hart	1715–1720
Charles Calvert	1720–1727
Benedict Leonard Calvert	1727–1731
Samuel Ogle	1731–1732
Charles Calvert, fifth Lord Baltimore	1732–1733
Samuel Ogle	1733–1742
Thomas Bladen	1742–1747
Samuel Ogle	1747–1752
Benjamin Tasker (president of the council)	1752–1753
Horatio Sharpe	1752–1769
Robert Eden	1769–1774
Robert Eden (nominal) and Convention and Council of Safety (real)	1774–1776

STATE

Thomas Johnson	1777–1779
Thomas Sim Lee	1779–1782
William Paca	1782–1785
William Smallwood	1785–1788
John Eager Howard	1788–1791
George Plater[1]	1791–1792

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[1] Died in office.

James Brice (acting)		1792
Thomas Sim Lee		1792–1794
John H. Stone		1794–1797
John Henry	Democratic Republican	1797–1798
Benjamin Ogle	Federalist	1798–1801
John Francis Mercer	Democratic Republican	1801–1803
Robert Bowie	„ „	1803–1806
Robert Wright[1]	„ „	1806–1808
James Butcher (acting)		1808–1809
Edward Lloyd	Whig	1809–1811
Robert Bowie	Democratic Republican	1811–1812
Levin Winder	Federalist	1812–1815
Charles Ridgely	„	1815–1818
Charles Goldsborough	„	1818–1819
Samuel Sprigg	Democratic Republican	1819–1822
Samuel Stevens, jun.	„ „	1822–1825
Joseph Kent	„ „	1825–1828
Daniel Martin	Anti-Jackson	1828–1829
Thomas King Carroll	Jackson Democrat	1829–1830
Daniel Martin	Anti-Jackson	1830–1831
George Howard (acting)	Whig	1831–1832
George Howard	„	1832–1833
James Thomas	„	1833–1835
Thomas W. Veazey	„	1835–1838
William Grason	Democrat	1838–1841
Francis Thomas	„	1841–1844
Thomas G. Pratt	Whig	1844–1847
Philip Francis Thomas	Democrat	1847–1850
Enoch Louis Lowe	„	1850–1853
Thomas Watkins Ligon	„	1853–1857
Thomas Holliday Hicks	American or Know-Nothing	1857–1861
Augustus W. Bradford	Unionist	1861–1865
Thomas Swann	„	1865–1868
Oden Bowie	Democrat	1868–1872
William Pinkney Whyte[2]	„	1872–1874
James Black Groome	„	1874–1876
John Lee Carroll	„	1876–1880
William T. Hamilton	„	1880–1884
Robert M. McLane	„	1884–1885
Henry Lloyd	„	1885–1888
Elihu E. Jackson	„	1888–1892
Frank Brown	„	1892–1896
Lloyd Lowndes	Republican	1896–1900
John Walter Smith	Democrat	1900–1904
Edwin Warfield	„	1904–1908
Austin L. Crothers	„	1908–

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(N. D. M.)

MARYPORT, a market town and seaport in the Cockermouth parliamentary division of Cumberland, England, 25 m. W.S.W. of Carlisle, on the Maryport & Carlisle railway. Pop. of urban district (1901), 11,897. It is irregularly built on the shore of the Irish Sea and on the cliffs above, at the mouth of the river Ellen. Until 1750 there were only a few huts here, the spot being called Ellenfoot, but at this time the harbour was built by Humphrey Senhouse. In 1892 Maryport became an independent port with Workington, Whitehaven and Millom subordinate to it. Coal and pig-iron are exported from the mining district inland, and shipbuilding is carried on. There are also rope and sail works, iron-foundries, saw-mills, breweries and tanneries. On the hill north of the town there is a Roman fort which guarded the coast, and many remains of this period have been discovered. The fort was called Uxellodunum.

MARZABOTTO, a village of Emilia, Italy, in the province of Bologna, 17 m. S.S.W. of Bologna by rail. Pop. (1901), 617 (village); 5272 (commune). It lies in the valley of the Reno, 443 ft. above sea-level. In and below the grounds of the Villa Aria, close to it, are the remains of an Etruscan town of the 5th century B.C., protected on the west by the mountains, on the east and south by the river, which by a change of course has destroyed about half of it. The acropolis was just below the villa: here remains of temples were found. The town lay below the modern high-road and was laid out on a rectangular plan divided by main streets into eight quarters, and these in turn into blocks or *insulae*. Cemeteries were found on the east and north of the site. The name of the place is unknown: it was partially inhabited later by the Gauls, but was not occupied by the Romans.

The discoveries of 1888–1889 (with references to previous works) are described by E. Brizio in *Monumenti dei Lincei* (1891), i. 249 sqq.

(T. As.)

MASACCIO (1402–1429), Italian painter. Tommaso Guidi, son of a notary, Ser Giovanni di Simone Guidi, of the family of the Scheggia, who had property in Castel S. Giovanni di Val d'Arno, was born in 1402 (according to Milanesi, on the 21st of December 1401), and acquired the nickname of Masaccio, which may be translated "Lubberly Tom," in consequence of his slovenly dressing and deportment. From childhood he showed a great inclination for the arts of design, and he is said to have studied under his contemporary Masolino da Panicale. In 1421, or perhaps 1423, he was enrolled in the gild of the speziali (druggists) in Florence, in 1424 in the gild of painters. His first attempts in painting were made in Florence, and then in Pisa. Next he went to Rome, still no doubt very young; although the statement that he returned from Rome to Florence, in 1420, when only eighteen or nineteen, seems incredible, considering the works he undertook in the papal city. These included a series of frescoes still extant in a chapel of the church of S. Clemente, a Crucifixion, and scenes from the life of St Catherine and of St Clement, or perhaps some other saint. Though much inferior to his later productions, these paintings are, for naturalism and propriety of representation, in advance of their time. Some critics, however, consider that the design only, if even that, was furnished by Masaccio, and the execution left to an inferior hand; this appears highly improbable, as Masaccio, at his early age, can scarcely have held the position of a master laying out work for subordinates; indeed Vasari says that Lubberly Tom was held in small esteem at all times of his brief life. In the Crucifixion subject the group of the Marys is remarkable; the picture most generally admired is that of Catherine, in the presence of Maxentius, arguing against and converting eight learned doctors. After returning to Florence, Masaccio was chiefly occupied in painting in the church of the Carmine, and especially in that "Brancacci Chapel" which he has rendered famous almost beyond rivalry in the annals of painting.

The chapel had been built early in the 15th century by Felice Michele di Piuvichese Brancacci, a noble Florentine. Masaccio's work in it began probably in 1423, and continued at intervals until he finally quitted Florence in 1428. There is a whole library-shelf of discussion as to what particular things were done by Masaccio and what by Masolino, and long afterwards by Filippino Lippi, in the Brancacci Chapel, and also as to certain other paintings by Masaccio in the Carmine. He began with a trial piece, a majestic figure of St Paul, not in the chapel; this has perished. A monochrome of the Procession for the Consecration of the Chapel, regarded as a wonderful example, for that early period, of perspective and of grouping, has also disappeared; it contains portraits of Brunelleschi, Donatello and many others. In the cloister of the Carmine was discovered in recent years a portion of a fresco by Masaccio representing a procession; but this, being in colours and not in monochrome, does not appear to be the Brancacci procession. As regards the works in the Brancacci chapel itself, the prevalent opinion now is that Masolino, who used to be credited with a considerable portion of them, did either nothing, or at most the solitary compartment which represents St Peter restoring Tabitha to life, and the same saint healing a cripple. The share which Filippino Lippi bore in the work admits of little doubt; to him are due various items on which the fame of Masaccio used principally to be based—as for instance the figure of St Paul addressing Peter in prison, which Raphael partly appropriated; and hence it may be observed that an eloquent and often-quoted outpouring of Sir Joshua Reynolds in praise of Masaccio ought in great part to be transferred to Filippino. What Masaccio really painted in the chapel appears with tolerable certainty to be as follows, and is ample enough to sustain the high reputation he has always enjoyed:—(1) The "Temptation of Adam and Eve"; (2) "Peter and the Tribute-Money"; (3) The "Expulsion from Eden"; (4) "Peter Preaching"; (5) "Peter Baptizing"; (6) "Peter Almsgiving"; (7) "Peter and John curing the Sick"; (8) "Peter restoring to Life the Son of King Theophilus of Antioch" was begun by Masaccio, including the separate incident of "Peter Enthroned," but a large proportion is by Filippino; (9) the double subject already allotted to Masolino may perhaps be by Masaccio, and in that case it must have been one of the first in order of execution. A few words may be given to these pictures individually. (1) The "Temptation" shows a degree of appreciation of nude form, corresponding to the feeling of the antique, such as was at that date unexampled in painting. (2) The "Tribute-Money," a full, harmonious and expressive composition, contains a head reputed to be the portrait of Masaccio himself—one of the apostles, with full locks, a solid resolute countenance and a pointed beard. (3) The "Expulsion" was so much admired by Raphael that, with comparatively slight modifications, he adopted it as his own in one of the subjects of the Logge of the Vatican. (5) "Peter Baptizing" contains some nude figures of strong naturalistic design; that of the young man, prepared for the baptismal ceremony, who stands half-shivering in the raw air, has always been a popular favourite and an object of artistic study. (8) The restoration of the young man to life has been open to much discussion as to what precise subject was in view, but the most probable opinion is that the legend of King Theophilus was intended.

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[1] Resigned on the 6th of May 1808.

[2] Resigned in 1874 to become (March 4, 1875) U.S. senator from Maryland.

In 1427 Masaccio was living in Florence with his mother, then for the second time a widow, and with his younger brother Giovanni, a painter of no distinction; he possessed nothing but debts. In 1428 he was working, as we have seen, in the Brancacci chapel. Before the end of that year he disappeared from Florence, going, as it would appear, to Rome, to evade the importunities of creditors. Immediately afterwards, in 1429, when his age was twenty-seven or twenty-eight, he was reported dead. Poisoning by jealous rivals in art was rumoured, but of this nothing is known. The statement that several years afterwards, in 1443, he was buried in the Florentine Church of the Carmine, without any monument, seems to be improbable, and to depend upon a confused account of the dates, which have now, after long causing much bewilderment, been satisfactorily cleared up from extant documents.

It has been said that Masaccio introduced into painting the plastic boldness of Donatello, and carried out the linear perspective of Paolo Uccello and Brunelleschi (who had given him practical instruction), and he was also the first painter who made some considerable advance in atmospheric perspective. He was the first to make the architectural framework of his pictures correspond in a reasonable way to the proportions of the figures. In the Brancacci chapel he painted with extraordinary swiftness. The contours of the feet and articulations in his pictures are imperfect; and his most prominent device for giving roundness to the figures (a point in which he made a great advance upon his predecessors) was a somewhat mannered way of putting the high lights upon the edges. His draperies were broad and easy, and his landscape details natural, and superior to his age. In fact, he led the way in representing the objects of nature correctly, with action, liveliness and relief. Soon after his death, his work was recognized at its right value, and led to notable advances; and all the greatest artists of Italy, through studying the Brancacci chapel, became his champions and disciples.

Of the works attributed to Masaccio in public or private galleries hardly any are authentic. The one in the Florentine Academy, the "Virgin and Child in the Lap of St Anna," is an exception. The so-called portrait of Masaccio in the Uffizi Gallery is more probably Filippino Lippi; and Filippino, or Botticelli, may be the real author of the head, at first termed a Masaccio, in the National Gallery, London.

An early work on Masaccio was that of T. Patch, *Life with Engravings* (Florence, 1770–1772). See Layard, *The Brancacci Chapel*, &c. (1868); H. Eckstein, *Life of Masaccio, Giotto*, &c. (1882); Charles Yriarte, *Tommaso dei Guidi* (1894). (W. M. R.)

MASAI, an Eastern Equatorial African people of Negro-Hamitic stock, speaking a Nilotic language. The Hamitic element, which is not great, has probably been derived from the Galla. The Masai were probably isolated in the high mountains or plateaus which lie between the Nile and the Karamojo country. There they originally had their home, and there to-day the Latuka, who show affinities with them, still live. Famine or inter-tribal wars drove the Masai in the direction of Mount Elgon and Lake Rudolf. After a long settlement there they split into two groups, the Masai proper and the Wa-Kuafi or agricultural Masai, and this at no very remote date, as the two tribes speak practically the same language. The more powerful Masai were purely nomadic and pastoral, their wealth consisting in enormous herds. The Wa-Kuafi, losing their cattle to their stronger kinsmen, split up again into the Burkeneji, the Gwas Ngishu, and the Nyarusi (Enjamusi) and settled as agriculturists. Meantime the Masai became masters of the greater part of inner East Africa from Ugogo and the Unyamwezi countries on the south and west to Mount Kenya and Galla-land on the north, and eastward to the hundred-mile strip of more or less settled Bantu country on the coast of the Indian Ocean.

The Masai physical type is slender, but among the finest in Africa. A tall, well-made people, the men are often well over six feet, with slim wiry figures, chocolate-coloured, with eyes often slightly oblique like the Mongolians, but the nose especially being often almost Caucasian in type, with well formed bridge and finely cut nostrils. Almost all the men and women knock out the two lower incisor teeth. For this custom they give the curious explanation that lockjaw was once very common in Masai-land, and that it was found to be easy to feed the sufferer through the gap thus made. All the hair on the body of both sexes is pulled out with iron tweezers; a Masai with a moustache or beard is unknown. The hair of the head is shaved in women and married men; but the hair of a youth at puberty is allowed to grow till it is long enough to have thin strips of leather plaited into it. In this way the hair, after a coating of red clay and mutton fat, is made into pigtails, the largest of which hangs down the back, another over the forehead, and one on each side. The warriors smear their whole bodies with the clay and fat, mixed in equal proportion.

No tattooing or scarring is performed on the men, but Sir Harry Johnston noticed women with parallel lines burnt into the skin round the eyes. In both sexes the lobes of the ears are distended into great loops, through holes in which large disks of wood are thrust. Bead necklaces, bead and wood armlets are worn by men, and before marriage the Masai girl has thick iron wire wound round her legs so tightly as to check the calf development. The women wear dressed hides or calico; the old men wear a skin or cloth cape. The warriors wind red calico round their waists, a circle of ostrich feathers round their face (or a cap of lion or colobus skin) and fringes of long white fur round the knee. Masai houses are of two kinds. The agricultural tribes build round huts with walls of reeds or sticks, and conical, grass-thatched roofs. The true Masai nomads, however, have houses unlike those of any other neighbouring negro tribe. Long, low (not more than 6 ft. high), flat-roofed, they are built on a framework of sticks with strong partitions dividing the structure into separate compartments, each a dwelling, with low, oblong door. Mud and cow-dung are plastered on to the brushwood used in the roofing. Beds are made of brushwood neatly stacked and covered with hides. The fireplace is a circle of stones. The only furniture, besides cooking-pots, consists of long gourds used as milkcans, half-gourds as cups, and small three-legged stools cut out of a single block of wood and used by the elder men to sit on. The Masai are not hunters of big game except lions, but they eat the eland and kudu. The domestic animals are cattle, sheep, goats, donkeys and dogs. Only women and the married men smoke. The dead are ordinarily not buried, but the bodies are carried a short distance from the village and left on the ground to be devoured by hyenas, jackals and vultures. Important chiefs are buried, however, and a year later the eldest son or successor recovers the skull, which is treasured as a charm. The medicine men of Masai are often the chiefs, and the supreme chief is almost always a medicine man.

The Masai believe in a nature-god as a supreme being—Ngai ("sky")—and his aid is invoked in cases of drought by a ceremonial chant of the children, standing in a circle after sunset, each with a bunch of grass in its hand. They have creation-myths involving four gods, the black, white, grey and red deities. They believe there is no future for women or common people, but that such distinction is reserved for chiefs. Pythons and a species of snake are revered as the reincarnated forms of their more celebrated ancestors. A kind of worship is paid to the hyena in some districts: the whole tribe going into mourning if the beast crosses their path. The Masai also have a vague tree-worship, and grass is a sacred symbol. When making peace a tuft is held in the right hand, and when the warriors start out on a raid their sweethearts throw grass after them or lay it in the forks of trees. But the oddest of their superstitious customs is the importance attached to spitting. To spit upon a person or thing is regarded as a sign of reverence and goodwill, as among other Nilotic tribes. Newly born children are spat on by every one who sees them. Johnston states that every Masai before extending his hand to him spat on it first. They spit when they meet and when they part, and bargains are sealed in this way. Joseph Thomson writes, "being regarded as a wizard of the first water, the Masai flocked to me . . . and the more copiously I spat on them the greater was their delight." The Masai has no love for work, and practises no industries. The women attend to his personal needs; and trades such as smelting and forging are left to enslaved tribes such as the Dorobo (Wandorobo). These manufacture spears with long blades and butts and the peculiar swords or *simés* like long slender leaves, very narrow towards the hilt and broad at the point. Most of the Masai live in the British East Africa Protectorate.

See A. C. Hollis, *The Masai, their Language and Folklore* (1905); M. Merker, *Die Nasai* (1904); Sir H. H. Johnston, *Kilimanjaro Expedition* (1886) and *Uganda Protectorate* (1902); Joseph Thomson, *Through Masai-land* (1885); O. Baumann, *Durch Massai-land zur Nilquelle* (1894); F. Kallenberg, *Auf dem Kriegspfad gegen die Massai* (1892).

MASANIELLO, an abbreviation of Tommaso Aniello (1622–1647), an Amalfi fisherman, who became leader of the revolt against Spanish rule in Naples in 1647. Misgovernment and fiscal oppression having aroused much discontent throughout the two Sicilies, a revolt broke out at Palermo in May 1647, and the people of Naples followed the example of the Sicilians. The immediate occasion of the latter rising was a new tax on fruit, the ordinary food of the poor, and the chief instigator of the movement was Masaniello, who took command of the malcontents. The outbreak began on the 7th of July 1647 with a riot at the city gates between the fruit-vendors of the environs and the customs officers; the latter were forced to flee, and the customs office was burnt. The rioters then poured into Naples and forced their way into the palace of the viceroy, the hated Count d'Arcos, who had to take refuge first in a neighbouring convent, then in Castel Sant' Elmo, and finally in Castelnuovo. Masaniello attempted to discipline the mob and restrain its vandalic instincts, and to some extent he succeeded; attired in his fisherman's garb, he gave audiences and administered justice from a wooden scaffolding outside his house. Several rioters, including the duke of Maddaloni, an opponent of the viceroy, and his brother Giuseppe Caraffa, who had come to Naples to make trouble, were condemned to death by him and executed. The mob, which every day obtained more arms and was becoming more intractable, terrorized the city, drove off the troops summoned from outside, and elected Masaniello "captain-general"; the revolt was even spreading to the provinces. Finally, the viceroy, whose negotiations with Masaniello had been frequently interrupted by fresh tumults, ended by granting all the concessions demanded of him. On the 13th of July, through the mediation of Cardinal Filomarino, archbishop of Naples, a convention was signed between D'Arcos and Masaniello as "leader of the most faithful people of Naples," by which the rebels were pardoned, the more oppressive taxes removed, and the citizens granted certain rights, including that of remaining in arms until the treaty should have been ratified by the king of Spain. The astute D'Arcos then invited Masaniello to the palace, confirmed his title of "captain-general of the Neapolitan people," gave him a gold chain of office, and offered him a pension. Masaniello refused the pension and laid down his dignities, saying that he wished to return to his old life as a fisherman; but he was entertained by the viceroy and, partly owing to the strain and excitement of the past days, partly because he was made dizzy by his astonishing change of fortune, or perhaps, as it was believed, because he was poisoned, he lost his head and behaved like a frenzied maniac. The people continued to obey him for some days, until, abandoned by his best friends, who went over to the Spanish party, he was murdered while haranguing a mob on the market-place on the 16th of July 1647; his head was cut off and brought by a band of roughs to the viceroy and the body buried outside the city. But the next day the populace, angered by the alteration of the measures for weighing bread, repented of its insane fury; the body of Masaniello was dug up and given a splendid funeral, at which the viceroy himself was represented.

Masaniello's insurrection appealed to the imagination of poets and composers, and formed the subject of several operas, of which the most famous is Auber's *La Muette de Portici* (1828).

See Saavedra, *Insurreccion de Napoli en 1647* (2 vols., Madrid, 1849); A. von Reumont, *Die Caraffa von Maddaloni* (2 vols., Berlin, 1849); Capasso, *La Casa e famiglia di Masaniello* (Naples, 1893); V. Spinazzola, *Masaniello e la sua famiglia, secondo un codice bolognese del sec. xvi.* (in the review *Flegrea*, 1900); A. G. Meissner, *Masaniello* (in German); E. Bourg, *Masaniello* (in French); F. Palermo, *Documenti diversi sulle novità accadute in Napoli l'anno 1647* (in the *Archivio storico italiano*, 1st series, vol. ix.). See also Naples.

MASAYA, the capital of the department of Masaya, Nicaragua, 13 m. W.N.W. of Lake Nicaragua and the city of Granada, on the eastern shore of Lake Masaya, and on the Granada-Managua railway. Pop. (1905), about 20,000. The city is built in the midst of a very fertile lowland region, which yields large quantities of tobacco. The majority of the inhabitants are Indians or half-castes. Lake Masaya occupies an extinct crater; the isolated volcano of Masaya (3000 ft.) on the opposite side of the lake was active at the time of the conquest of Nicaragua in 1522, and the conquerors, thinking the lava they saw was gold, had themselves lowered into the crater at the risk of their lives. The volcano was in eruption in 1670, 1782, 1857 and 1902.

MASCAGNI, PIETRO (1863–), Italian operatic composer, was born at Leghorn, the son of a baker, and educated for the law; but he neglected his legal studies for music, taking secret lessons at the Instituto Luigi Cherubini. There a symphony by him was performed in 1879, and various other compositions attracted attention, so that money was provided by a wealthy amateur for him to study at the Milan Conservatoire. But Mascagni chafed at the teaching, and soon left Milan to become conductor to a touring operatic company. After a somewhat chequered period he suddenly leapt into fame by the production at Rome in 1890 of his one-act opera *Cavalleria Rusticana*, containing a tuneful "intermezzo," which became wildly popular. Mascagni was the musical hero of the hour, and *Cavalleria Rusticana* was performed everywhere. But his later work failed to repeat this success. *L'Amico Fritz* (1891), *I Rantzau* (1892), *Guglielmo Ratcliff* (1895), *Silvano* (1895), *Zanetto* (1896), *Iris* (1898), *Le Maschere* (1901), and *Amica* (1905), were coldly or adversely received; and though *Cavalleria Rusticana*, with its catchy melodies, still held the stage, this succession of failures involved a steady decline in the composer's reputation. From 1895 to 1903 Mascagni was director of the Pesaro Conservatoire, but in the latter year, having left his post in order to tour through the United States, he was dismissed from the appointment.

MASCARA, chief town of an arrondissement in the department of Oran, Algeria, 60 m. S.E. of Oran. It lies 1800 ft. above the sea, on the southern slope of a range forming part of the Little Atlas Mountains, and occupies two small hills separated by the Wad Tudman, which is crossed by three stone bridges. The walls, upwards of two miles in circuit, and strengthened by bastions and towers, give the place a somewhat imposing appearance. Mascara is a town of the French colonial type, few vestiges of the Moorish period remaining. Among the public buildings are two mosques, in one of which Abd-el-Kader preached the *jihad*. The town also contains the usual establishments attaching to the seat of a sub-prefect and the centre of a military subdivision. The principal industry is the making of wine, the white wines of Mascara being held in high repute. There is also a considerable trade in grains and oil. A branch railway eight miles long connects Mascara with the line from the seaport of Arzeu to Ain Sefra. Access is also gained by this line to Oran, Algiers, &c. Pop. (1906) of the town, 18,989; of the commune, which includes several villages, 22,934; of the arrondissement, comprising eleven communes, 190,154.

Mascara (*i.e.* "mother of soldiers") was the capital of a Turkish beylik during the Spanish occupation of Oran from the 16th to the close of the 18th century; but for the most of that period it occupied a site about two miles distant from the present position. On the removal of the bey to Oran its importance rapidly declined; and it was an insignificant place when in 1832 Abd-el-Kader, who was born in the neighbourhood, chose it as the seat of his power. It was laid in ruins by the French under Marshal Clausel and the duke of Orleans in 1835, the amir retreating south. Being reoccupied by Abd-el-Kader in 1838, Mascara was again captured in 1841 by Marshal Bugeaud and General Lamoricière.

MASCARENE ISLANDS (occasionally Mascarenhas), the collective title of a group in the Indian Ocean east of Madagascar, viz. Mauritius, Réunion and Rodriguez (*q.v.*). The collective title is derived from the Portuguese navigator Mascarenhas, by whom Réunion, at first called Mascarenhas, was discovered.

MASCARON, JULES (1634–1703), French preacher, was the son of a barrister at Aix. Born at Marseilles in 1634, he early entered the French Oratory, and obtained great reputation as a preacher. Paris confirmed the judgment of the provinces; in 1666 he was asked to preach before the court, and became a great favourite with Louis XIV., who said that his eloquence was one of the few things that never grew old. In 1671 he was appointed bishop of Tulle; eight years later he was transferred to the larger diocese of Agen. He still continued, however, to preach regularly at court, being especially in request for funeral orations. A panegyric on Turenne, delivered in 1675, is considered his masterpiece. His style is strongly tinged with *préciosité*; and his chief surviving interest is as a glaring example of the evils from which Bossuet delivered the French pulpit. During his later years he devoted himself entirely to his pastoral duties at Agen, where he died in 1703.

Six of his most famous sermons were edited, with a biographical sketch of their author, by the Oratorian Borde in 1704.

MASCHERONI, LORENZO (1750–1800), Italian geometer, was professor of mathematics at the university of Pavia, and published a variety of mathematical works, the best known of which is his *Geometria del compasso* (Pavia, 1797), a collection of geometrical constructions in which the use of the circle alone is postulated. Many of the solutions are most ingenious, and some of the constructions of considerable practical importance.

There is a French translation by A. M. Carette (Paris, 1798), who also wrote a biography of Mascheroni. See Poggendorff, *Biog. Lit. Handwörterbuch.*

MASCOT (Fr. slang: perhaps from Port. *mascotto*, "witchcraft"), the term for any person, animal, or thing supposed to bring luck. The word was first popularized by Edmond Audran through his comic opera *La Mascotte* (1880), but it had been common in France long before among gamblers. It has been traced back to a dialectic use in Provence and Gascony, where it meant something which brought luck to a household. The suggestion that it is from *masqué* (masked or concealed), the provincial French for a child born with a caul, in allusion to the lucky destiny of such children, is improbable.

MASDEU, JUAN FRANCISCO (1744–1817), Spanish historian, was born at Palermo on the 4th of October 1744. He joined the Company of Jesus on the 19th of December 1759, and became professor in the Jesuit seminaries at Ferrara and Ascoli. He visited Spain in 1799, was exiled, and returned in 1815, dying at Valencia on the 11th of April 1817. His *Storia critica di Spagna e della cultura spagnuola in ogni genere* (2 vols., 1781–1784) was finally expanded into the *Historia critica de España y de la cultura española* (1783–1805), which, though it consists of twenty volumes, was left unfinished; had it been continued on the same scale, the work would have consisted of fifty volumes. Masdeu wrote in a critical spirit and with a regard for accuracy rare in his time; but he is more concerned with small details than with the philosophy of history. Still, his narrative is lucid, and later researches have not yet rendered his work obsolete.

MASERU, the capital of Basutoland, British South Africa. It is pleasantly situated on the left bank of the Caledon river, 90 m. by rail E. by S. of Bloemfontein, and 40 m. N.E. of Wepener. It is in the centre of a fertile grain-growing district. Pop. (1904), 862, of whom 99 were Europeans. The principal buildings are Government House, the church of the Paris Evangelical Missionary Society, the hospital, and the railway station. (See Basutoland.)

MASHAM, ABIGAIL, Lady (d. 1734), favourite of Anne, queen of England, was the daughter of Francis Hill, a London merchant, her mother being an aunt of Sarah Jennings, duchess of Marlborough. The family being reduced to poor circumstances through Hill's speculations, Lady Churchill (as she then was), lady of the bedchamber to the Princess Anne, befriended her cousin Abigail, whom she took into her own household at St Albans, and for whom after the accession of the princess to the throne she procured an appointment in the queen's household about the year 1704. It was not long before Abigail Hill began to supplant her powerful and imperious kinswoman in the favour of Queen Anne. Whether she was guilty of the deliberate ingratitude charged against her by the duchess of Marlborough is uncertain. It is not unlikely that, in the first instance at all events, Abigail's influence over the queen was not so much due to subtle scheming on her part as to the pleasing contrast between her gentle and genial character and the dictatorial temper of the duchess, which after many years of undisputed sway had at last become intolerable to Anne. The first intimation of her protégé's growing favour with the queen came to the duchess in the summer of 1707, when she learned that Abigail Hill had been privately married to a gentleman of the queen's household named Samuel Masham, and that the queen herself had been present at the marriage. Inquiry then elicited the information that Abigail had for some time enjoyed considerable intimacy with her royal mistress, no hint of which had previously reached the duchess. Abigail was said to be a cousin of Robert Harley, earl of Oxford, and after the latter's dismissal from office in February 1708 she assisted him in maintaining confidential relations with the queen. The completeness of her ascendancy was seen in 1710 when the queen compelled Marlborough, much against his will, to give an important command to Colonel John Hill, Abigail's brother; and when Sunderland, Godolphin, and the other Whig ministers were dismissed from office, largely owing to her influence, to make way for Oxford and Bolingbroke. In the following year the duchess of Marlborough was also dismissed from her appointment at court, Mrs Masham taking her place as keeper of the privy purse. In 1711 the ministers, intent on bringing about the disgrace of Marlborough and arranging the Peace of Utrecht, found it necessary to secure their position in the House of Lords by creating twelve new peers; one of these was Samuel Masham, the favourite's husband, though Anne showed some reluctance to raise her bedchamber woman to a position in which she might show herself less ready to give her personal services to the queen. Lady Masham soon quarrelled with Oxford, and set herself to foster by all the means in her power the queen's growing personal distaste for her minister. Oxford's vacillation between the Jacobites and the adherents of the Hanoverian succession to the Crown probably strengthened the opposition of Lady Masham, who now warmly favoured the Jacobite party led by Bolingbroke and Atterbury. Altercations took place in the queen's presence between Lady Masham and the minister; and finally, on the 27th of July 1714, Anne dismissed Oxford from his office of lord high treasurer, and three days later gave the staff to the duke of Shrewsbury. Anne died on the 1st of August, and Lady Masham then retired into private life. She died on the 6th of December 1734.

Lady Masham was by no means the vulgar, ill-educated person she was represented to have been by her defeated rival, the duchess of Marlborough; her extant letters, showing not a little refinement of literary style, prove the reverse. Swift, with whom both she and her husband were intimate, describes Lady Masham as "a person of a plain sound understanding, of great truth and sincerity, without the least mixture of falsehood or disguise." The barony of Masham became extinct when Lady Masham's son, Samuel, the 2nd baron, died in June 1776.

AUTHORITIES.—Gilbert Burnet, *History of My Own Time*, vol. vi. (2nd ed., 6 vols., Oxford, 1833); F. W. Wyon, *History of Great Britain during the Reign of Queen Anne* (2 vols., London, 1876); Earl Stanhope, *History of England, comprising the Reign of Queen Anne until the Peace of Utrecht* (London, 1870), and *History of England from the Peace of Utrecht*, vol. i. (7 vols., London, 1836–1854); Justin McCarthy, *The Reign of Queen Anne* (2 vols., London, 1902); *An Account of the Conduct of the Dowager Duchess of Marlborough from first coming to Court to 1710*, edited by Nathaniel Hooke, with an anonymous reply entitled *A Review of a Late Treatise* (London, 1842); *Private Correspondence of Sarah, Duchess of Marlborough* (2 vols., London, 1838); *Letters of Sarah, Duchess of Marlborough* (London, 1875); Mrs Arthur Colville, *Duchess Sarah* (London, 1904). Numerous references to Lady Masham will also be found scattered through Swift's *Works* (2nd ed., 19 vols., Edinburgh, 1824).

(R. J. M.)

MASHAM, SAMUEL CUNLIFFE LISTER, 1ST BARON (1815–1906), English inventor, born at Calverley Hall, near Bradford, on the 1st of January 1815, was the fourth son of Ellis Cunliffe (1774–1853), who successively took the names of Lister and Lister-Kay, and was the first member of parliament elected for Bradford after the Reform Act of 1832. It was at first proposed that he should take orders, but he preferred a business career and became a clerk at Liverpool. In 1838 he and his elder brother John started as worsted spinners and manufacturers in a new mill which their father built for them at Manningham, and about five years later he turned his attention to the problem of mechanical wool-combing, which, in spite of the efforts of E. Cartwright and numerous other inventors, still awaited a satisfactory solution. Two years of hard work spent in modifying and improving existing devices enabled him to produce a machine which worked well, and subsequently he consolidated his position by buying up rival patents, as well as by taking out additional ones of his own. His combing machines came into such demand that though they were made for only £200 apiece he was able to sell them for £1200, and the saving they effected in the cost of production not only brought about a reduction in the price of clothing, but in consequence of the increase in the sales created the necessity for new supplies of wool, and thus contributed to the development of Australian sheep-farming. In 1855 he was sent a sample of silk waste (the refuse left in reeling silk from the cocoons) and asked whether he could find a way of utilizing the fibre it contained. The task occupied his time for many years and brought him to the verge of bankruptcy, but at last he succeeded in perfecting silk-combing appliances which enabled him to make yarn that in one year sold for 23s. a pound, though produced from raw material costing only 6d. or 1s. a pound. Another important and lucrative invention in connexion with silk manufacture was his velvet loom for piled fabrics; and this, with the silk comb worked at his Manningham mill, yielded him an annual income of £200,000 for many years. But the business was seriously affected by the prohibitory duties imposed by America, and this was one reason why he was an early and determined critic of the British policy of free imports. In 1891 he was made a peer; he took his title from the little Yorkshire town of Masham, close to which is Swinton Park, purchased by him in 1888. In 1886 an Albert medal was awarded him for his inventions, which were mostly related to the textile industries, though he occasionally diverged to other subjects, such as an air-brake for railways. He was fond of outdoor sports, especially coursing and shooting, and was a keen patron of the fine arts. He died at Swinton Park on the 2nd of February 1906, and was succeeded in the title by his son.

MASHONA, a Bantu-negro people, inhabitants of Mashonaland, Southern Rhodesia. The name Mashona has been derived from the contemptuous term *Amashuina* applied by the Matabele to the aborigines owing to the habit of the latter of taking refuge in the rocky hills with which the country abounds. Before the Matabele invasion about 1840 most of Southern Rhodesia was occupied by the Makalanga, the Makorikori and the Banyai, all closely related. Most of them became subject to the Matabele, but although they suffered severely from their attacks, the Mashona preserved a certain national unity. In 1890 the Mashona came under British protection (see RHODESIA). They are in general a peaceful, mild-mannered people, industrious and successful farmers, skilful potters, and weavers of bark cloth.

The crafts, however, in which they excel are the smelting and forging of iron and wood-carving. They are also great hunters; and they are very fond of music, the most usual instrument being the "piano" with iron keys. Bows and arrows, assegais and axes are the native weapons, but all who can get them now use guns. Up to their conquest by the Matabele the Mashona worked the gold diggings which are scattered over their country; indeed as late as 1870 certain Mashona were still extracting gold from quartz (*Geog. Jour.* April 1906).

For the possible connexion of these people with the builders of the ruins at Zimbabwe and elsewhere, see RHODESIA: *Archaeology*; and ZIMBABWE.

MASK (Fr. *masque*, apparently from med. Lat. *mascus*, *masca*, spectre, through Ital. *maschera*, Span. *mascara*), a covering for the face, taking various forms, used either as a protective screen or as a disguise. In the latter sense masks are mostly associated with the artificial faces worn by actors in dramatic representations, or assumed for exciting terror (*e.g.* in savage rites). The spelling "masque," representing the same word, is now in English used more specially for certain varieties of drama in which masks were originally worn (see DRAMA); so also "masquerade," particularly in the sense of a masked ball or an entertainment where the personages are disguised. Both "mask" and "masquerade" have naturally passed into figurative and technical meanings, the former especially for various senses of face and head (head of a fox, grotesque faces in sculpture), or as equivalent to "cloak" or "screen" (as in fortification or other military uses, fencing, &c.). And in the case of "death-masks" the term is employed for the portrait-casts, generally of plaster or metallic foil, taken from the face of a dead person (also similarly from the living), an ancient practice of considerable interest in art. An interesting collection made by Laurence Hutton (see his *Portraits in Plaster*, 1894), is at Princeton University in the United States. (For the historical mystery of the "man in the iron mask," see IRON MASK.)

The ancient Greek and Roman masks worn by their actors—hollow figures of heads—had the double object of identifying the performers with the characters assumed, and of increasing the power of the voice by means of metallic mouthpieces. They were derived like the drama from the rural religious festivities, the wearing of mock faces or beards being a primitive custom, connected no doubt with many early types of folk-lore and religion. The use of the dramatic mask was evolved in the later theatre through the mimes and the Italian popular comedy into pantomime; and the masquerade similarly came from Italy, where the *domino* was introduced from Venice. The *domino* (originally apparently an ecclesiastical garment) was a loose cloak with a small half-mask worn at masquerades and costume-balls by persons not otherwise dressed in character; and the word is applied also to the person wearing it.

See generally Altmann, *Die Masken der Schauspieler* (1875; new ed., 1896); and Dale, *Masks, Labrets and Certain Aboriginal Customs* (1885); also DRAMA.

MASKELYNE, NEVIL (1732–1811), English astronomer-royal, was born in London on the 6th of October 1732. The solar eclipse of 1748 made a deep impression upon him; and having graduated as seventh wrangler from Trinity College, Cambridge, in 1754, he determined to devote himself wholly to astronomy. He became intimate with James Bradley in 1755, and in 1761 was deputed by the Royal Society to make observations of the transit of Venus at St Helena. During the voyage he experimented upon the determination of longitude by lunar distances, and ultimately effected the introduction of the method into navigation (*q.v.*). In 1765 he succeeded Nathaniel Bliss as astronomer-royal. Having energetically discharged the duties of his office during forty-six years, he died on the 9th of February 1811.

Maskelyne's first contribution to astronomical literature was "A Proposal for Discovering the Annual Parallax of Sirius," published in 1760 (*Phil. Trans.* li. 889). Subsequent volumes of the same series contained his observations of the transits of Venus (1761 and 1769), on the tides at St Helena (1762), and on various astronomical phenomena at St Helena (1764) and at Barbados (1764). In 1763 he published the *British Mariner's Guide*, which includes the suggestion that in order to facilitate the finding of longitude at sea lunar distances should be calculated beforehand for each year and published in a form accessible to navigators. This important proposal, the germ of the *Nautical Almanac*, was approved of by the government, and under the care of Maskelyne the *Nautical Almanac* for 1767 was published in 1766. He continued during the remainder of his life the superintendence of this invaluable annual. He further induced the government to print his observations annually, thereby securing the prompt dissemination of a large mass of data inestimable from their continuity and accuracy. Maskelyne had but one assistant, yet the work of the observatory was perfectly organized and methodically executed. He introduced several practical improvements, such as the measurement of time to tenths of a second; and he prevailed upon the government to replace Bird's mural quadrant by a repeating circle 6 ft. in diameter. The new instrument was constructed by E. Troughton; but Maskelyne did not live to see it completed. In 1772 he suggested to the Royal Society the famous Schehallion experiment for the determination of the earth's density and carried out his plan in 1774 (*Phil. Trans.* l. 495), the apparent difference of latitude between two stations on opposite sides of the mountain being compared with the real difference of latitude obtained by triangulation. From Maskelyne's observations Charles Hutton deduced a density for the earth 4·5 times that of water (ib. lxviii. 782). Maskelyne also took a great interest in various geodetical operations, notably the measurement of the length of a degree of latitude in Maryland and Pennsylvania (ibid. lviii. 323), executed by Mason and Dixon in 1766–1768, and later the determination of the relative longitude of Greenwich and Paris (ib. lxxvii. 151). On the French side the work was conducted by Count Cassini, Legendre, and Méchain; on the English side by General Roy. This triangulation was the beginning of the great trigonometrical survey which has since been extended all over the country. His observations appeared in four large folio volumes (1776–1811). Some of them were reprinted in S. Vince's *Astronomy* (vol. iii.). (A. M. C.)

MASOLINO DA PANICALE (1383–*c.* 1445), Florentine painter, was said to have been born at Panicale di Valdelsa, near Florence. It is more probable, however, that he was born in Florence itself, his father, Cristoforo Fini, who was an "imbiancatore," or whitewasher, having been domiciled in the Florentine quarter of S. Croce. There is reason to believe that Tommaso, nicknamed Masolino, was a pupil of the painter Starnina, and was principally influenced in style by Antonio Veneziano; he may probably enough have become in the sequel the master of Masaccio. He was born in 1383; he died later than 1429, perhaps as late as 1440 or even 1447. Towards 1423 he entered the service of Filippo Scolari, the Florentine-born *obergespann* of Temeswar in Hungary, and stayed some time in that country, returning towards 1427 to Italy. The only works which can with certainty be assigned to him are a series of wall paintings executed towards 1428, commissioned by Cardinal Branda Castiglione, in the church of Castiglione d'Olona, not far from Milan, and another series in the adjoining baptistery. The first set is signed as painted by "Masolinus de Florentia." It was recovered in 1843 from a coating of whitewash, considerably damaged; its subject matter is taken from the lives of the Virgin and of SS Lawrence and Stephen. The series in the baptistery relates to the life and death of John the Baptist. The reputation of Masolino had previously rested almost entirely upon the considerable share which he was supposed to have had in the celebrated frescoes of the Brancacci Chapel, in the Church of the Carmine in Florence; he was regarded as the precursor of Masaccio, and by many years the predecessor of Filippino Lippi, in the execution of a large proportion of these works. But from a comparison of the Castiglione with the Brancacci frescoes, and from other data, it is very doubtful whether Masolino had any hand at all in the latter series. Possibly he painted in the Brancacci Chapel certain specified subjects which are now either destroyed or worked over. Several paintings assigned to Masolino on the authority of Vasari are now ascribed to Masaccio. (W. M. R.)

MASON, FRANCIS (1799–1874), American missionary, was born in York, England, on the 2nd of April 1799. His grandfather, Francis Mason, was the founder of the Baptist Society in York, and his father, a shoemaker by trade, was a Baptist lay preacher there. After working with his father as a shoemaker for several years, he emigrated in 1818 to the United States, and in Massachusetts was licensed to preach as a Baptist in 1827. In 1830 he was sent by the American Baptist Missionary Convention to labour among the Karens in Burma. Besides conducting a training college for native preachers and teachers at Tavoy, he translated the Bible into the two principal dialects of the Karens, the Sgaw and the Pwo (his translation being published in 1853), and Matthew, Genesis, and the Psalms into the Bghai dialect. He also published *A Pali Grammar on the Basis of Kachchayano, with Chrestomathy and Vocabulary* (1868). In 1852 he published a book of great value on the fauna and flora of British Burma, of which an improved edition appeared in 1860 under the title *Burmah, its People and Natural Productions*, and a third edition (2 vols.) revised and enlarged by W. Theobald in 1882–1883. He died at Rangoon on the 3rd of March 1874.

See his autobiography, *The Story of a Working Man's Life, with Sketches of Travel in Europe, Asia, Africa and America* (New York, 1870).

MASON, GEORGE (1725–1792), American statesman, was born in Stafford county (the part which is now Fairfax county), Virginia, in 1725. His family was of Royalist descent and emigrated to America after the execution of Charles I. His colonial ancestors held official positions in the civil and military service of Virginia. Mason was a near neighbour and a lifelong friend of George Washington, though in later years they disagreed in politics. His large estates and high social standing, together with his personal ability, gave Mason great influence among the Virginia planters, and he became identified with many enterprises, such as the organization of the Ohio Company and the founding of Alexandria (1749). He was a member of the Virginia House of Burgesses in 1759–1760. In 1769 he drew up for Washington a series of non-importation resolutions, which were adopted by the Virginia legislature. In July 1774 he wrote for a convention in Fairfax county a series of resolutions known as the Fairfax Resolves, in which he advocated a congress of the colonies and suggested non-intercourse with Great Britain, a policy subsequently adopted by Virginia and later by the Continental Congress. He was a member of the Virginia Committee of Safety from August to December 1775, and of the Virginia Convention in 1775 and 1776; and in 1776 he drew up the Virginia Constitution and the famous Bill of Rights, a radically democratic document which had great influence on American political institutions. In 1780 he outlined the plan which was subsequently adopted by Virginia for ceding to the Federal government her claim to the "back lands," *i.e.* to territory north and north-west of the Ohio river. From 1776 to 1788 he represented Fairfax county in the Virginia Assembly. He was a member of the Virginia House of Delegates in 1776–1780 and again in 1787–1788, and in 1787 was a member of the convention that framed the Federal Constitution, and as one of its ablest debaters took an active part in the work. Particularly notable was his opposition to the compromises in regard to slavery and the slave-trade. Indeed, like most of the prominent Virginians of the time, Mason was strongly in favour of the gradual abolition of slavery. He objected to the large and indefinite powers given by the completed Constitution to

Congress, so he joined with Patrick Henry in opposing its ratification in the Virginia Convention (1788). Failing in this he suggested amendments, the substance of several of which was afterwards embodied in the present Bill of Rights. Declining an appointment as a United States Senator from Virginia, he retired to his home, Gunston Hall (built by him about 1758 and named after the family home in Staffordshire, England). where he died on the 7th of October 1792. With James Madison and Thomas Jefferson, Mason carried through the Virginia legislature measures disestablishing the Episcopal Church and protecting all forms of worship. In politics he was a radical republican, who believed that local government should be kept strong and central government weak; his democratic theories had much influence in Virginia and other southern and western states.

See Kate Mason Rowland, *Life and Writings of George Mason* (2 vols., New York, 1892).

MASON, GEORGE HEMMING (1818–1872), English painter, was born at Wetley Abbey, the eldest son of a Staffordshire county gentleman. He was educated at King Edward's School, Birmingham, and studied for the medical profession for five years under Dr Watt of that city. But all his thoughts being given to art, he abandoned medicine in 1844 and travelled for a time on the Continent, finally settling in Rome, where he remained for some years and sought to make a living as an artist. During this period he underwent many privations which permanently affected his health; but he continued to labour assiduously, making studies of the picturesque scenery that surrounded him, and with hardly any instruction except that received from Nature and from the Italian pictures he gradually acquired the painter's skill. At least two important works are referable to this period: "Ploughing in the Campagna," shown in the Royal Academy of 1857, and "In the Salt Marshes, Campagna," exhibited in the following year. After Mason's return from the continent, in 1858, when he settled at Wetley Abbey, he continued for a while to paint Italian subjects from studies made during his stay abroad, and then his art began to touch in a wonderfully tender and poetic way the peasant life of England, especially of his native Staffordshire, and the homely landscape in the midst of which that life was set. The first picture of this class was "Wind on the Wold," and it was followed—along with much else of admirable quality—by the painter's three greatest works: The "Evening Hymn" (1868), a band of Staffordshire mill-girls returning from their work; "Girls dancing by the Sea" (1869); and the "Harvest Moon" (1872). He left Staffordshire in 1865 and went to live at Hammersmith; and he was elected an associate of the Royal Academy in 1869. By that time he had fully established his position as an artist of unusual power and individuality. Mason died on the 22nd of October 1872. In his work he laboured under the double disadvantage of feeble and uncertain health, and a want of thorough art-training, so that his pictures were never produced easily, or without strenuous and long-continued effort. His art is great in virtue of the solemn pathos which pervades it, of the dignity and beauty in rustic life which it reveals, of its keen perception of noble form and graceful motion, and of rich effects of colour and subdued light. In *motif* and treatment it has something in common with the art of Millet and Jules Breton, as with that of Frederick Walker among Englishmen; though he had neither the occasional uncouth robustness of Millet nor the firm actuality of Jules Breton. His pictures "Wind on the Wold" and "The Cast Shoe" are in the National Gallery of British Art.

MASON, JAMES MURRAY (1798–1871), American political leader, was born in Fairfax county, Virginia, on the 3rd of November 1798, the grandson of George Mason (1725–1792). Educated at the university of Pennsylvania and the college of William and Mary, he was admitted to the bar in 1820. He was a member of the Virginia House of Delegates in 1826–1827 and 1828–1831, of the state Constitutional Convention of 1829, of the National House of Representatives (1837–1839), of the United States Senate from 1847 until July 1861 (when, with other Southern senators he was formally expelled—he had previously withdrawn), and of the Virginia Secession Convention in April 1861. Entering politics as a Jacksonian Democrat, Mason was throughout his career a consistent strict constructionist, opposing protective tariffs, internal improvements by the national government, and all attempts to restrict or control the spread of slavery, which he sincerely believed to be essential to the social and political welfare of the South. He was the author of the Fugitive Slave Act of 1850, and in 1860 was chairman of the Senate committee which investigated the John Brown raid. After Lincoln's election as President he was one of the strongest advocates of secession in Virginia. He was appointed in August 1861 commissioner of the Confederate States to Great Britain. The British ship "Trent," upon which he and John Slidell, the commissioner to France, sailed, was intercepted (Nov. 8, 1861) by a United States ship-of-war (the "San Jacinto," Captain Charles Wilkes), and the two commissioners were seized and carried as prisoners to Boston. Great Britain immediately demanded their release, and war for a time seemed imminent; but owing mainly to the tactful diplomacy of the prince consort, Lincoln acknowledged that the seizure of Mason and Slidell was a violation of the rights of Great Britain as a neutral, and on the 1st of January 1862 released the commissioners. The incident has become known in history as the "Trent Affair." Mason at once proceeded to London, where, however, he was unable to secure official recognition, and his commission to Great Britain was withdrawn late in 1863. He remained in Europe, spending most of his time at Paris and holding blank commissions which he was authorized to fill in at his discretion in case the presence of a Confederate commissioner should seem desirable at any particular European court. These commissions, however, he did not use. After the war he lived for several years in Canada, but returned in 1869 to Virginia, and on the 28th of April 1871 died at Alexandria.

See *The Public Life and Diplomatic Correspondence of James M. Mason, with some Personal History* (Roanoke, Va., 1903), by his daughter, Virginia Mason; Sir Theodore Martin, *Life of the Prince Consort*.

MASON, SIR JOHN (1503–1566), English diplomatist, was born of humble parentage at Abingdon in 1503, and was educated at Oxford, where he became Fellow of All Souls in 1521. He was ordained before 1531. Most of his early years were spent on the Continent, where he witnessed the meeting between Henry VIII. and Francis I. at Calais in 1532, and where he was employed in collecting information for the English government, gaining in this work the reputation of a capable diplomatist. By his never-failing caution, moderation and pliancy, Mason succeeded in keeping himself in favour with four successive sovereigns of the Tudor monarchy. In 1537 he became secretary to the English ambassador at Madrid, Sir Thomas Wyat; but when the latter was put on his trial for treason in 1541 Mason was unmolested, and soon afterwards was appointed clerk of the privy council, and procured for himself sundry other posts and privileges. Mason was knighted and made dean of Winchester by Edward VI. He was one of the commissioners to negotiate the treaty by which Boulogne was restored to France in 1550, and in the same year he became English ambassador in Paris, where he helped to arrange the bethrothal of Edward VI. to the princess Elizabeth of France. He returned to England at the end of 1551, became clerk of parliament, received extensive grants of land, and in 1552 was made chancellor of Oxford University. He was elected member of parliament in the same year. On the death of Edward VI., he at first joined the party of Northumberland and the Lady Jane Grey; but quickly perceiving his mistake he took an active part in procuring the proclamation of Mary as queen. Mason now received fresh tokens of royal favour, being confirmed in all his secular, though not in his ecclesiastical, offices; and in 1553 he was appointed English ambassador at the court of the emperor Charles V., of whose abdication at Brussels in October 1555 he wrote a vivid account. He took a prominent share in the administrative business of the government in the first years of Elizabeth's reign, and largely influenced her foreign policy until his death, which occurred on the 20th of April 1566. Sir John Mason married Elizabeth, daughter of Sir Thomas Isley of Sundridge, Kent, and widow of Richard Hill. He had no children, and his heir was Anthony Wyckes, whom he had adopted, and who assumed the name of Mason and left a large family.

See J. A. Froude, *History of England* (12 vols., London, 1856–1870); Charles Wriothesley, *Chronicle of England during the Reigns of the Tudors*, edited by W. D. Hamilton (Camden Soc., 2 vols., London, 1875); P. F. Tytler, *England under the Reigns of Edward VI. and Mary* (2 vols., London, 1839); John Strype, *Ecclesiastical Memorials* (3 vols., Oxford, 1824) and *Memorials of Thomas Cranmer* (3 vols., Oxford, 1848); *Acts of the Privy Council of England* (new series), edited by J. R. Dasent, vols. i.–vii.

MASON, JOHN (1586–1635), founder of New Hampshire, U.S.A., was born in King's Lynn, Norfolk, England. In 1610 he commanded a small naval force sent by James I. to assist in subduing the Hebrides Islands. From 1615 to 1621 he was governor of the English colony on the north side of Conception Bay in Newfoundland; he explored the island, made the first English map of it (published in 1625), and wrote a descriptive tract entitled *A Briefe Discourse of the Newfoundland* (Edinburgh, 1620) to promote the colonization of the island by Scotsmen. Here he was brought into official relations with Sir Ferdinando Gorges, then a commissioner to regulate the Newfoundland fisheries. In March 1622 Mason obtained from the Council for New England, of which Gorges was the most influential member, a grant of the territory (which he named Mariana) between the Naumkeag or Salem river and the Merrimac, and in the following August he and Gorges together received a grant of the region between the Merrimac and Kennebec rivers, and extending 60 m. inland. From 1625 to 1629 Mason was engaged as treasurer and paymaster of the English army in the wars which England was waging against Spain and France. Towards the close of 1629 Mason and Gorges agreed upon a division of the territory held jointly by them, and on the 7th of November 1629 Mason received from the Council a separate grant of the tract between the Merrimac and the Piscataqua, which he now named New Hampshire. Thinking that the Piscataqua river had its source in Lake Champlain, Mason with Gorges and a few other associates secured, on the 17th of November 1629, a grant of a region which was named Laconia (apparently from the number of lakes it was supposed to contain), and was described as bordering on Lake Champlain, extending 10 m. east and south from it and far to the west and north-west, together with 1000 acres to be located along some convenient harbour, presumably near the mouth of the Piscataqua. In November 1631 Mason and his associates obtained, under the name of the Pescataway Grant, a tract on both sides of the Piscataqua river, extending 30 m. inland and including also the Isles of Shoals. Mason became a member of the Council for New England in June 1632, and its vice-president in the following November; and in 1635, when the members decided to divide their territory among themselves and surrender their charter, he was allotted as his share all the region between the Naumkeag and Piscataqua rivers extending 60 m. inland, the southern half of the Isles of Shoals, and a ten-thousand acre tract, called Masonia, on the west side of the Kennebec river. In October 1635 he was appointed vice-admiral of New England, but he died early in December, before crossing the Atlantic. He was buried in Westminster Abbey. Forty-four years after his death New Hampshire was made a royal province.

See *Captain John Mason, the Founder of New Hampshire* (Boston, 1887; published by the Prince Society), which contains a memoir by C. W. Tuttle and historical papers relating to Mason's career, edited by J. W. Dean.

MASON, JOHN YOUNG (1799–1859), American political leader and diplomatist, was born in Greenesville county, Virginia, on the 18th of April 1799. Graduating at the university of North Carolina in 1816, he studied law in the famous Litchfield (Connecticut) law school, and in 1819 was admitted to practice in Southampton county, Virginia. He served in the Virginia house of delegates in 1823–1827, in the state constitutional convention of 1829–1830, and from 1831 to 1837 in the National House of Representatives, being chairman of the committee on foreign affairs in 1835–1836. He was secretary of the navy in President Tyler's cabinet (1844–1845), and was attorney-general (1845–1846) and secretary of the navy (1846–1849), succeeding George Bancroft, under President Polk. He was president of the Virginia constitutional convention of 1851, and from 1853 until his death at Paris on the 3rd of October 1859, was United States minister to France. In this capacity he attracted attention by wearing at the court of Napoleon III. a simple diplomatic uniform (for this he was rebuked by Secretary of State W. L. Marcy, who had ordered American ministers to wear a plain civilian costume), and by joining with James Buchanan and Pierre Soulé, ministers to Great Britain and Spain respectively, in drawing up (Oct. 1854) the famous Ostend Manifesto. Hawthorne called him a "fat-brained, good-hearted, sensible old man"; and in politics he was a typical Virginian of the old school, a state's rights Democrat, upholding slavery and hating abolitionism.

MASON, SIR JOSIAH (1795–1881), English pen-manufacturer, was born in Kidderminster on the 23rd of February 1795, the son of a carpet-weaver. He began life as a street hawker of cakes, fruits and vegetables. After trying his hand in his native town at shoemaking, baking, carpentering, blacksmithing, house-painting and carpet-weaving, he moved in 1814 to Birmingham. Here he found employment in the gilt-toy trade. In 1824 he set up on his own account as a manufacturer of split-rings by machinery, to which he subsequently added the making of steel pens. Owing to the circumstance of his pens being supplied through James Perry, the London stationer whose name they bore, he was less well known than Joseph Gillott and other makers, although he was really the largest producer in England. In 1874 the business was converted into a limited liability company. Besides his steel-pen trade Mason carried on for many years the business of electro-plating, copper-smelting, and india-rubber ring making, in conjunction with George R. Elkington. Mason was almost entirely self-educated, having taught himself to write when a shoemaker's apprentice, and in later life he felt his deficiencies keenly. It was this which led him in 1860 to establish his great orphanage at Erdington, near Birmingham. Upon it he expended about £300,000, and for this munificent endowment he was knighted in 1872. He had previously given a dispensary to his native town and an almshouse to Erdington. In 1880 Mason College, since incorporated in the university of Birmingham, was opened, the total value of the endowment being about £250,000. Mason died on the 16th of June 1881.

See J. T. Bunce, *Josiah Mason* (1882).

MASON, LOWELL (1792–1872), American musician, was born at Medfield, Massachusetts. For some years he led a business life, but was always studying music; and in 1827, as the result of his work in forming the collection of church music published in 1821 at Boston by the Handel and Haydn Society, he moved to Boston and there first became president of the society and then founder of the Boston Academy of Music (1832). He published some successful educational books, and was a pioneer of musical instruction in the public schools, adopted in 1838. He received the degree of doctor of music from New York University in 1855. He died at Orange, New Jersey, on the 11th of August 1872.

His son William Mason (1829–1908), an accomplished pianist and composer, published an interesting volume of reminiscences, *Memoirs of a Musical Life*, in 1901.

MASON, WILLIAM (1725–1797), English poet, son of William Mason, vicar of Holy Trinity, Hull, was born on the 12th of February 1725, was educated at St John's College, Cambridge, and took holy orders. In 1744 he wrote *Musaeus*, a lament for Pope in imitation of *Lycidas*, and in 1749 through the influence of Thomas Gray he was elected a fellow of Pembroke College. He became a devoted friend and admirer of Gray, who addressed him as "Skroddles," and corrected the worst solecisms in his verses. In 1748 he published *Isis*, a poem directed against the supposed Jacobitism of the university of Oxford, which provoked Thomas Warton's *Triumph of Isis*. Mason conceived the ambition of reconciling modern drama with ancient forms by strict observance of the unities and the restoration of the chorus. These ideas were exemplified in *Elfrida* (1752) and *Caractacus* (1759), two frigid performances no doubt intended to be read rather than acted, but produced with some alterations at Covent Garden in 1772 and 1776 respectively. Horace Walpole described *Caractacus* as "laboured, uninteresting, and no more resembling the manners of Britons than of Japanese"; while Gray declared he had read the manuscript "not with pleasure only, but with emotion." In 1754 Mason was presented to the rectory of Aston, near Rotherham, Yorkshire, and in 1757 through the influence of the duke of Devonshire he became one of the king's chaplains. He also received the prebend of Holme in York Minster (1756), was made canon residentiary in 1762, and in 1763 became precentor and prebendary of Driffield. He married in 1764 Mary Sherman, who died three years later. When Gray died in 1771 he made Mason his literary executor. In the preparation of the *Life and Letters of Gray*, which appeared in 1774, he had much help from Horace Walpole, with whom he corresponded regularly until 1784 when Mason opposed Fox's India Bill, and offended Walpole by thrusting on him political advice unasked. Twelve years of silence followed, but in the year before his death the correspondence was renewed on friendly terms. Mason died at Aston on the 7th of April 1797.

His correspondence with Gray and Walpole shows him to have been a man of cultivated tastes. He was something of an antiquarian, a good musician, and an amateur of painting. He is said to have invented an instrument called the celestina, a modified pianoforte. Gray rewarded his faithful admiration with good-humoured kindness. He warned him against confounding Mona with the Isle of Man, or the Goths with the Celts, corrected his grammar, pointed out his plagiarisms, and laughed gently at his superficial learning. His powers show to better advantage in the unacknowledged satirical poems which he produced under the pseudonym of Malcolm Macgregor. In editing Gray's letters he took considerable liberties with his originals, and did not print all that related to himself.

Mason's other works included *Odes* (1756); *The English Garden*, a didactic poem in blank verse, the four books of which appeared in 1772, 1777, 1779 and 1782; *An Heroic Epistle to Sir William Chambers* (1774); an *Ode to Mr Pinchbeck* (1776) and an *Epistle to Dr Shebbeare* (1777)—all these by "Malcolm Macgregor"; *Essay, Historical and Critical, of Church Music* (1795), and a lyrical drama, *Sappho* (1797).

His poems were collected in 1764 and 1774, and an edition of his *Works* appeared in 1811. His poems with a *Life* are included in Alexander Chalmers's *English Poets*. His correspondence with Walpole was edited by J. Mitford in 1851; and his correspondence with Gray by the same editor in 1853. See also the standard editions of the letters of Gray and of Walpole. There is a very pleasant picture of Mason's character in Southey's *Doctor* (ch. cxxvi.).

MASON AND DIXON LINE, in America, the boundary line (lat. 39° 43′ 26·3″ N.) between Maryland and Pennsylvania, U.S.A.; popularly the line separating "free" states and "slave" states before the Civil War. The line derives its name from Charles Mason (1730–1787) and Jeremiah Dixon, two English astronomers, whose survey of it to a point about 244 m. west of the Delaware between 1763 and 1767[1] marked the close of the protracted boundary dispute (arising upon the grant of Pennsylvania to William Penn in 1681) between the Baltimores and Penns, proprietors respectively of Maryland and Pennsylvania. The dispute arose from the designation, in the grant to Penn, of the southern boundary of Pennsylvania mainly as the parallel marking the "beginning of the fortieth degree of Northerne Latitude," after the northern boundary of Maryland had been defined as a line "which lieth under the fortieth degree of north latitude from the equinoctial." The eastern part of the line as far as Sideling Hill in the western part of the present Washington county, was originally marked with milestones brought from England, every fifth of which bore on one side the arms of Baltimore and on the opposite side those of Penn; but the difficulties in transporting them to the westward were so great that many of them were not set up. Owing to the removal of the stone marking the north-east corner of Maryland, this point was again determined and marked in 1849–1850 by Lieut.-Colonel J. D. Graham of the U.S. topographical engineers; and as the western part of the boundary was not marked by stones, and local disputes arose, the line was again surveyed between 1901 and 1903 under the direction of a commission appointed by Pennsylvania and Maryland.

The use of the term "Mason and Dixon Line" to designate the boundary between the free and the slave states (and in general between the North and the South) dates from the debates in Congress over the Missouri Compromise in 1819–1820. As so used it may be defined as not only the Mason and Dixon Line proper, but also the line formed by the Ohio River from its intersection with the Pennsylvania boundary to its mouth, thence the eastern, northern and western boundaries of Missouri, and thence westward the parallel 36° 30′—the line established by the Missouri Compromise to separate free and slave territory in the "Louisiana Purchase," except as regards Missouri. It is to be noted, however, that the Missouri Compromise did not affect the territory later acquired from Mexico.

MASON CITY, a city and the county-seat of Cerro Gordo county, Iowa, U.S.A., on Lime Creek, in the northern part of the state. Pop. (1905, state census), 8357 (929 foreign-born); (1910) 11,230. It is served by the Chicago Milwaukee & St Paul, the Chicago & North-Western, the Chicago Great Western, the Iowa Central and the St Paul & Des Moines railways, and also by the Mason City & Clear Lake (electric) railway, which connects Mason City with Clear Lake, a pleasure resort, 10 m. west of the city. At Mason City is Memorial University (co-educational; founded in 1900 by the National Encampment of the Sons of Veterans, and opened in 1902), dedicated to the Grand Army of the Republic, the special aim of which is to teach American history. The city is situated in a good agricultural region, and there are valuable stone quarries in the vicinity. The manufactures include lime, Portland cement, brick and tile. Mason City was settled in 1853, laid out in 1855, incorporated as a town in 1870 and chartered as a city in 1881.

MASONRY,[2] the art of building in stone. The earliest remains (apart from the primitive work in rude stone—see STONE MONUMENTS; ARCHAEOLOGY, &c.) are those of the ancient temples of India and Egypt. Many of these early works were constructed of stones of huge size, and it still remains a mystery how the ancients were able to quarry and raise to a considerable height above the ground blocks seven or eight hundred tons in weight. Many of the early buildings of the middle ages were entirely constructed of masses of concrete, often faced with a species of rough cast. The early masonry seems to have been for the most part worked with the axe and not with the chisel. A very excellent example of the contrast between the earlier and later Norman masonry may be seen in the choir of Canterbury Cathedral. In those times the groining was frequently filled in with a light tufa stone, said by some to have been brought from Italy, but more probably from the Rhine. The Normans imported a great quantity of stone from Caen, it being easily worked, and particularly fit for carving. The freestones of England were also much used; and in the first Pointed period, Purbeck and Bethersden marbles were employed for column shafts, &c. The methods of working and setting stone were much the same as at present, except that owing to difficulties of conveyance the stones were used in much smaller sizes. As time went on the art of masonry advanced till in England, in point of execution, it at length rivalled that of any country.

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[1] These surveyors also surveyed and marked the boundary between Maryland and Delaware.

[2] The English word "mason" is from the French, which appears in the two forms, *machun* and *masson* (from the last comes the modern Fr. form *maçon*, which means indifferently a bricklayer or mason. In O. H. Ger. the word is *mezzo*, which survives in the German for a stone-mason, *Steinmetz*. The med. Lat. form, *machio*, was connected with *machina*—obviously a guess. The Low Lat., *macheria* or *maceria* (see Du Cange, *Glossarium*, *s.v. macio*), a wall, has been suggested as showing some connexion. Some popular Lat. form as *macio* or *mattio* is probably the origin. No Teut. word, according to the *New English Dictionary*, except that which appears in "mattock," seems to have any bearing on the ultimate origin.

Tools.—The mason's tools may be grouped under five heads—hammers and mallets, saws, chisels, setting-out and setting tools, and hoisting appliances.

Hammers and Mallets.

There are several different kinds of iron hammers used by the stone worker; the mash hammer has a short handle and heavy head for use with chisels; the iron hammer, used in carving, in shape resembles a carpenter's mallet but is smaller; the waller's hammer is used for roughly shaping stones in rubble work; the spalling hammer for roughly dressing stones in the quarry; the scabbling-hammer, for the same purpose, has one end pointed for use on hard stone; the pick has a long head pointed at both ends, weighs from 14 to 20 lb, and is used for rough dressing and splitting; the axe has a double wedge-shaped head and is used to bring stones to a fairly level face preparatory to their being worked smooth; the patent axe, or patent hammer, is formed with a number of plates with sharpened edges bolted together to form a head; the mallet of hard wood is used for the finishing chisel work and carving; and the dummy is of similar shape but smaller.

Saws.

A hand saw similar to that used by the carpenter is used for cutting small soft stones. Larger blocks are cut with the two-handed saw worked by two men. For the largest blocks the frame saw is used, and is slung by a rope and pulleys fitted with balance weights to relieve the operator of its weight. The blade is of plain steel, the cutting action being supplied by sand with water as a lubricant constantly applied.

Chisels.

There are perhaps even more varieties of chisels than of hammers. The point and the punch have very small cutting edges, a quarter of an inch or less in width. The former is used on the harder and the latter on the softer varieties of stone after the rough hammer dressing. The pitching tool has a wide thick edge and is used in rough dressing. Jumpers are shafts of steel having a widened edge, and are used for boring holes in hard stone. Chisels are made with edges from a quarter-inch to one and a half inches wide; those that exceed this width are termed boasters. The claw chisel has a number of teeth from one-eighth to three-eighths wide, and is used on the surface of hard stones after the point has been used. The drag is a semi-circular steel plate, the straight edge having teeth cut on it. It is used to level down the surfaces of soft stones. Cockscombs are used for the same purpose on mouldings and are shaped to various curves. Wedges of various sizes are used in splitting stones and are inserted either in holes made with the jumper or in chases cut with the stone-pick.

Setting-out and Setting Tools.

The implements for setting out the work are similar to those used, by the bricklayer and other tradesmen, comprising the rule, square, set square, the bevel capable of being set to any required angle, compasses, spirit level, plumb-rule and bob and mortar trowels. Gauges and moulds are required in sinking moulds to the proper section.

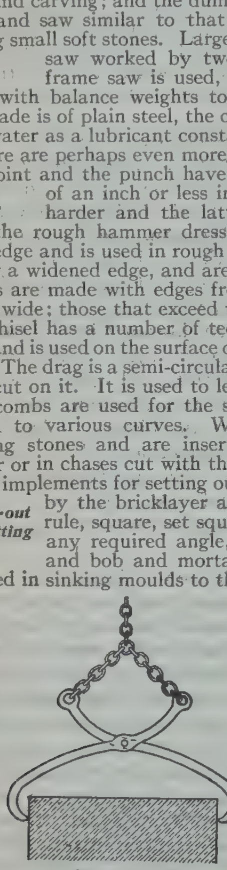

FIG. 1.

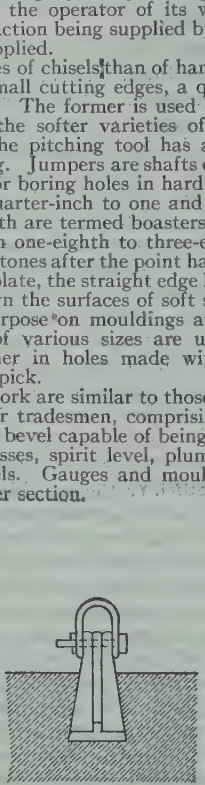

FIG. 2.

Hoisting Appliances.

The *nippers* (fig. 1), or *scissors*, as they are sometimes termed, have two hooked arms fitting into notches in the opposite sides of the block to be lifted. These arms are riveted together in the same way as a pair of scissors, the upper ends having rings attached for the insertion of a rope or chain which when pulled tight in the operation of lifting causes the hooked ends to grip the stone. *Lewises* (fig. 2.) are wedge-shaped pieces of steel which are fitted into a dovetailed mortise in the stone to be hoisted. They are also used for setting blocks too large to be set by hand, and are made in several forms. These are the usual methods of securing the stone to the hoisting rope or chain, the hoisting being effected by a pulley and fall, by a crane, or by other means.

Scaffolding.—For rubble walls single scaffolds, resting partly on the walls, similar to those used for brickwork (*q.v.*), are employed; for ashlar and other gauged stonework (see below) self-supporting scaffolds are used with a second set of standards and ledgers erected close to the wall, the whole standing entirely independent. The reason for the use of this double scaffold is that otherwise holes for the putlogs to rest in would have to be left in the wall, and obviously in an ashlar stone wall it would be impossible properly to make these good on the removal of the scaffold (see further SCAFFOLD).

Seasoning Stone.—Stone freshly quarried is full of sap, and thus admits of being easily worked. On being exposed to the air the sap dries out, and the stone becomes much harder in consequence. For this reason, and because carriage charges are lessened by the smaller bulk of the worked stone as compared with the rough block, the stone for a building is often specified to be quarry-worked. Vitruvius recommended that stone should be quarried in summer when driest, and that it should be seasoned by being allowed to lie two years before being used, so as to allow the natural sap to evaporate. In the erection of St Paul's Cathedral, Sir Christopher Wren required that the stone after being quarried should be exposed for three years on the sea-beach before its introduction into the building.

The regular and determined form of bricks makes it to a large extent a matter of practice to enable a man to become a good bricklayer, but beyond these a continual exercise of judgment is required of the workman in stone, who has for the most part to deal with masses of all forms and of all sizes.

Setting Stones.—All beds and joints should be truly worked and perfectly level. If the surface be convex it will give rise to wide unsightly joints; if concave the weight thrown on the stone will rest on the edges and probably cause them to "flush" or break off and disfigure the work. Large stones are placed in position with the aid of hoisting appliances and should be tried in position before being finally set. Great care should be taken to avoid fracturing or chipping the stone in the process of handling, as it is impossible to make good such damage. All stratified stones—and this includes by far the largest proportion of building stones—when set in a level position should be laid on their natural bed, *i.e.* with their laminae horizontal. The greatest strength of a stone is obtained when the laminae lie at right angles to the pressure placed upon it. In the case of arches these layers should be parallel with the centre line of the voussoirs and at right angles to the face of the arch. For cornices (except the corner-stones) and work of a like nature, the stone is set with the laminae on edge and perpendicular to the face of the work. With many stones it is easy to determine the bed by moistening with water, when the laminae will become apparent. Some stones, however, it is impossible to read in this way, and it is therefore advisable to have them marked in the quarry. A horizontal line in a quarry does not in all cases give the proper bed of the stone, for since the deposits were made ages ago natural upheavals have possibly occurred to alter the "lie" of the material.

For the shafts of columns especially it is necessary to have the layers horizontally placed, and a stone should be selected from a quarry with a bed of the required depth. An example of the omission of this precaution is visible in the arcading of the Royal Courts of Justice, London, where the small shafts of the front arcade in red sandstone have been turned with the laminae in a vertical position, with the result that nearly every shaft is flaking away or is cracked.

Use of Mortar.—See BRICKWORK. Of whatever quality the stone may be of which a wall is built, it should consist as much of stone and as little of mortar as possible. Only fine mortar is admissible if we are to obtain as thin joints as possible. The joints should be well raked out and pointed in Portland cement mortar. This applies only to some sandstones, as marbles and many limestones are stained by the use of Portland cement. For these a special cement must be employed, composed of plaster of Paris, lime, and marble or stone-dust.

Bonding.—Bond (see BRICKWORK) is of not less importance in stone walling than in brickwork. In ashlar-work the work is bonded uniformly, the joints being kept perpendicularly one over the other; but in rubble-work, instead of making the joints recur one over the other in alternate courses they should be carefully made to lock, so as to give the strength of two or three courses or layers between a joint in one course and the joint that next occurs vertically above it in another course. In the through or transverse bonding of a wall a good proportion of header stones running about two-thirds of the distance through the width of the wall should be provided to bind the whole structure together. The use of through stones, *i.e.* stones running through the whole thickness of the wall from front to back, is not to be recommended. Such stones are liable to fracture and convey damp to the internal face.

Slip Joints.—As with brickwork so in masonry great care must be exercised to prevent the different parts of a building settling unequally. When two portions of a building differing considerably in height come together, it is usual to employ a slip or housed joint instead of bonding the walls into each other. This arrangement allows the heavier work to settle to a greater extent than the low portion without causing any defect in the stones.

Footings.—The footings of stone walls should consist of large stones of even thickness proportionate to their length; if possible they should be the full breadth in one piece. Each course should be well bedded and levelled.

Walling.—There are broadly speaking two classes of stone walling: rubble and ashlar. Rubble walls are built of stones more or less irregular in shape and size and coarsely jointed. Ashlar walls are constructed of carefully worked blocks of regular dimensions and set with fine joints.

Random Rubble (fig. 3) is the roughest form of stonework. It is built with irregular pieces of stone usually less than 9 in. thick, loosely packed without much regard to courses, the interstices between the large stones being occupied by small ones, the remaining crevices filled up with mortar. Bond stones or headers should be used frequently in every course. This form of walling is much used in stone districts for boundary walls and is often set dry without mortar. For this work the mason uses no tool but the trowel to lay on the mortar, the scabbling hammer to break off the most repulsive irregularities from the stone, and the plumb-rule to keep his work perpendicular.

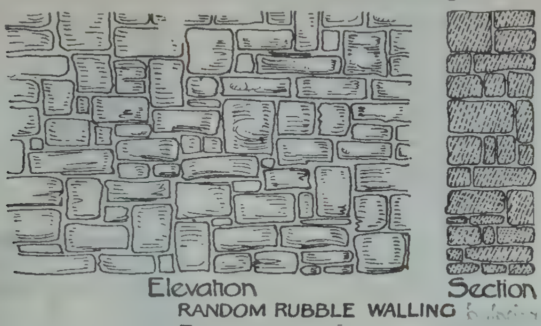

FIG. 3.

Coursed Rubble (fig. 4) is levelled up in courses 12 or 18 in. deep, the depth varying in different courses according to the sizes of the stones. The stones are dressed by the workman before he begins building, to obtain a fairly level bed and perpendicular face.

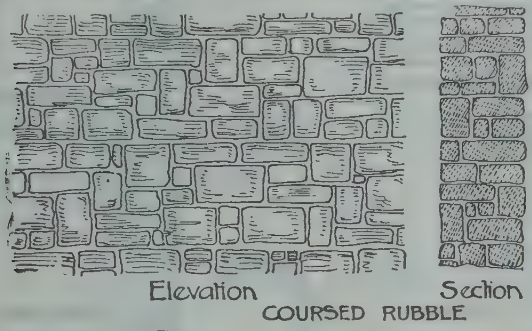

FIG. 4.

Irregularly Coursed Squared Rubble is a development of uncoursed random rubble, the stones in this case being squared with the hammer and roughly faced up with the axe. The courses jump abruptly from one level to another as the sizes of the blocks demand; the interstices are filled in with small pieces of stone called "snecks."

For *Coursed Squared Rubble* the stone is faced in a similar manner and set in courses, the depth of each course being made up of one or more stones.

In *Regular Coursed Rubble* all the stones in one course are of the same height.

Block-in-course is the name applied to a form of stone walling that has some of the characteristics of ashlar but the execution of which is much rougher. The courses are usually less than 12 in. high. It is much used by engineers for waterside and railway work where a good appearance is desired.

The *Angles* or *Quoins* of rubble-work are always carefully and precisely worked and serve as a gauge for the rest of the walling. Frequently the quoins and jambs are executed in ashlar, which gives a neat and finished appearance and adds strength to the work.

The name *Ashlar* is given, without regard to the finish of the face of the stone, to walling composed of stones carefully dressed, from 12 to 18 in. deep, the mortar joints being about an eighth of an inch or less in thickness. No stone except the hardest should exceed in length three times its depth when required to resist a heavy load and its breadth should be from one and a half to three times its depth. The hardest stone may have a length equal to four or perhaps five times its depth and a width three times its depth. The face of ashlar-work may be plain and level, or have rebated, chamfered, or moulded joints.

Backing to Stonework.

The great cost of this form of stonework renders the employment of a backing of an inferior nature very general. This backing varies according to the district in which the building operations are being carried on, being rubble stonework in stone districts and brick or concrete elsewhere, the whole being thoroughly tied together both transversely and longitudinally with bondstones. In England a stone much used for backing ashlar and Kentish rag rubble-work is a soft sandstone called "hassock." In the districts where it is quarried it is much cheaper than brickwork. (For brickbacking see BRICKWORK.) Ashlar facing usually varies from 4 to 9 in. in thickness. The work must not be all of one thickness, but should vary in order that effective bond with the backing may be obtained. If the work is in courses of uneven depth the narrow courses are made of the greater thickness and the deep courses are narrow. It is sometimes necessary to secure the stone facing back with iron ties, but this should be avoided wherever possible, as they are liable to rust and split the stonework. When it is necessary to use them they should be covered with some protective coating. The use of a backing to a stone wall, besides lessening the cost, gives a more equable temperature inside the building and prevents the transmission of wet by capillary attraction to the interior, which would take place if single stones were used for the entire thickness.

All work of this description must be executed in Portland cement, mortar of good strength, to avoid as much as possible the unequal settlement of the deep courses of stone facing and the narrower courses of the brick or rough stone backing. If the backing is of brick it should never be less than 9 in. thick, and whether of stone or brick it should be levelled up in courses of the same thickness as the ashlar.

Walling.

There are many different sorts of walling, or modes of structure, arising from the nature of the materials available in various localities. That is perhaps of most frequent occurrence in which either squared, broken, or round flints are used. This, when executed with care, has a distinctly decorative appearance. To give stability to the structure, lacing courses of tiles, bricks or dressed stones are introduced, and brick or stone piers are built at intervals, thus forming a flint panelled wall. The quoins, too, in this type of wall are formed in dressed stone or brick work.

Uncoursed rubble built with irregular blocks of ragstone, an unstratified rock quarried in Kent, is in great favour for facing the external walls of churches and similar works (fig. 5).

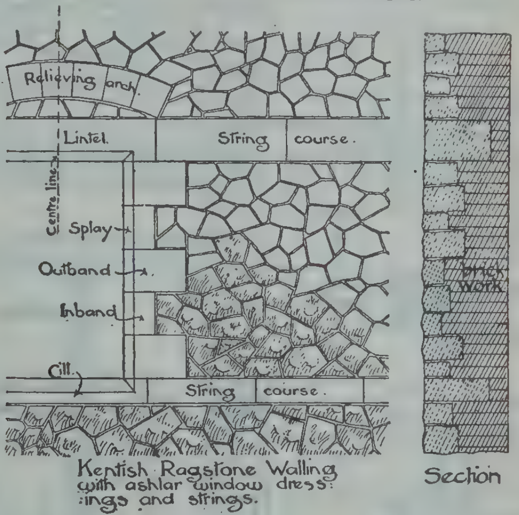

FIG. 5.

Pointing.—As with brickwork this is generally done when the work is completed and before the scaffolding is removed. Suitable weather should be chosen, for if the weather be either frosty or too hot the pointing will suffer. The joints are raked out to a depth of half an inch or more, well wetted, and then refilled with a fine mortar composed specially to resist the action of the weather. This is finished flat or compressed with a special tool to a shaped joint, the usual forms of which are shown in fig. 6.

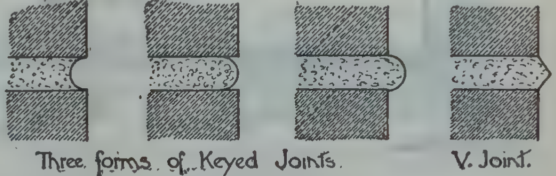

FIG. 6.

Stonewash.—To give a uniform appearance to the stonework and preserve the finished face until a hardened skin has formed, it is usual to coat the surface of exposed masonry with a protective compound of ordinary limewhite with a little size mixed in it, or a special mixture of stone-dust, lime, salt, whiting and size with a little ochre to tone it down. After six months or more the work is cleaned down with water and stiff bristle or wire brushes. Sometimes muriatic acid much diluted with water is used.

Technical Terms.—Of the following technical terms, many will be found embodied in the drawing of a gable wall (fig. 7), which shows the manner and position in which many different members are used.

Apex Stone.—The topmost stone of a gable forming a finial for the two sloping sides; it is sometimes termed a "saddle" (fig. 7).

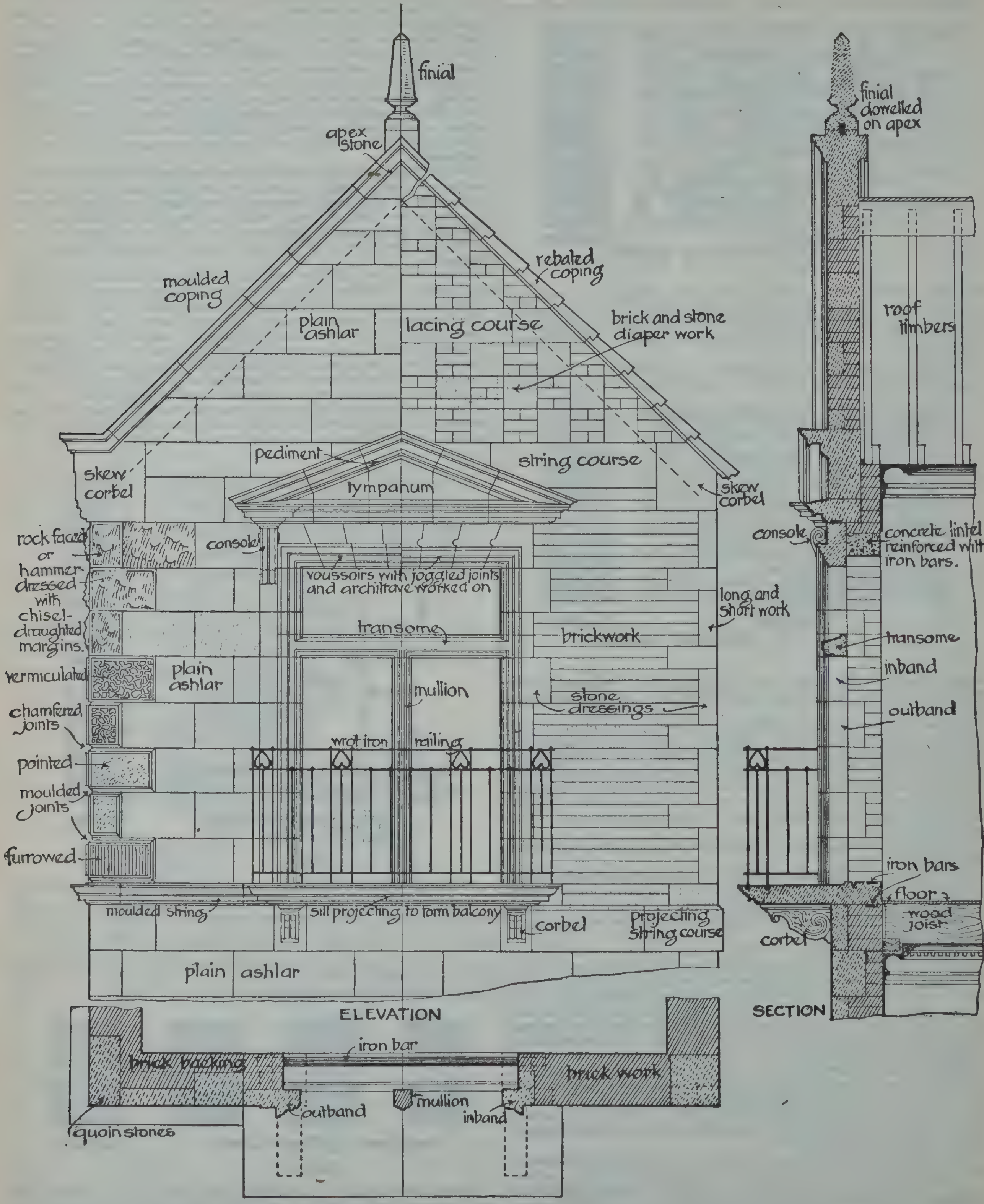
finial
apex stone
rebated coping
moulded coping
plain ashlar
lacing course
brick and stone diaper work
pediment
string course
tympanum
skew corbel
skew corbel
rock faced or hammer-dressed with chisel-draughted margins.
console
voussoirs with joggled joints and architrave worked on
long and short work
transome
brickwork
vermiculated
plain ashlar
mullion
chamfered joints
stone dressings
pointed
wrot iron railing
moulded joints
furrowed
moulded string
sill projecting to form balcony
corbel
Projecting String course
plain ashlar
ELEVATION
finial dowelled on apex
roof timbers
console
concrete lintel reinforced with iron bars.
transome
inband
outband
iron bars
floor
wood joist
corbel
SECTION
iron bar
brick backing
brick work
outband
mullion
inband
quoin stones
PLAN

Fig. 7.

Blocking Course, a heavy course of stone above a cornice to form a parapet and weigh down the back of the cornice (fig. 8).

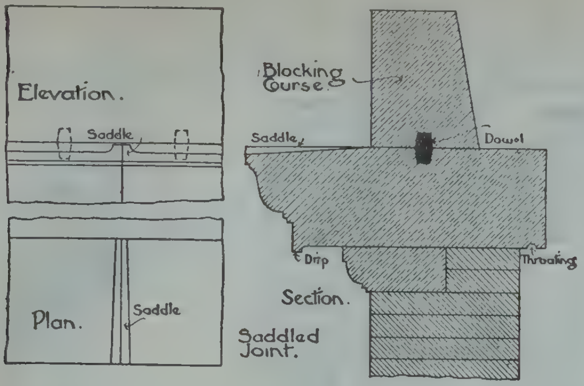

FIG. 8.

Bed.—The *bed* surface upon which a stone is set or bedded should be worked truly level in every part. Many workmen to form a neat thin joint with a minimum amount of labour hollow the bed and thus when the stone is set all weight is thrown upon the edges with the frequent result that these are crushed.

Coping.—The *coping* or *capping* stones are placed on the top of walls not covered by a roof, spanning their entire width and throwing off the rain and snow, thus keeping the interior of the wall dry. The fewer the number of joints the better the security, and for this reason it is well to form copings with as long stones as possible. To throw water off clear, and prevent it from running down the face of the wall, the coping should project an inch or two on each side and have a throat worked on the under-side of the projections (fig. 7).

Cornice, a projecting course of moulded stone crowning a structure, forming a cap or finish and serving to throw any wet clear of the walls. A deep drip should always be worked in the upper members of a cornice to prevent the rain trickling down and disfiguring the face of the moulding and the wall below (fig. 8).

Corbel, a stone built into a wall and projecting to form a cantilever, supporting a load beyond the face of the wall. It is frequently richly ornamented by carving (fig. 7).

Skew Corbel, a stone placed at the base of the sloping side of a gable wall to resist any sliding tendency of the sloping coping. Stones placed for a similar purpose at intervals along the sloping side, tailing into the wall, are termed "kneelers" and have the section of the coping worked upon them (fig. 7).

Corbel Table, a line of small corbels placed at short distances apart supporting a parapet or arcade. This forms an ornamental feature which was much employed in early Gothic times. It probably originates from the machicolations of ancient fortresses.

Dressings, the finished stones of window and door jambs and quoins. For example, a "brick building with stone dressings" would have brick walls with stone door and window jambs, heads and sills, and perhaps also stone quoins (fig. 7).

Diaper, a square pattern formed on the face of the stonework by means of stones of different colours and varieties or by patterns carved on the surface (fig. 7).

Finial, a finishing ornament applied usually to a gable end (fig. 7).

Gablet, small gable-shaped carved panels frequently used in Gothic stonework for apex stones, and in spires, &c.

Gargoyle, a detail, not often met with in modern work, which consists of a waterspout projecting so as to throw the rain-water from the gutters clear of the walls. In early work it was often carved into grotesque shapes of animal and other forms.

Galleting.—The joints of rubble are sometimes enriched by having small pebbles or chips of flint pressed into the mortar whilst green. The joints are then said to be "galleted."

Jamb.—Window and door jambs should always be of dressed stone, both on account of the extra strength thus gained and in order to give a finish to the work. The stones are laid alternately as stretchers and headers; the former are called outbands, the latter inbands (fig. 7).

Label Moulding, a projecting course of stone running round an arch. When not very large it is sometimes cut on the voussoirs, but is usually made a separate course of stone. Often, and especially in the case of door openings, a small sinking is worked on the top surface of the moulding to form a gutter which leads to the sides any water that trickles down the face of the wall.

Lacing Stone.—This is placed as a voussoir in brick arches of wide span, and serves to bond or lace several courses together (see BRICKWORK).

Lacing Course, a course of dressed stone, bricks or tiles, run at intervals in a wall of rubble or flint masonry to impart strength and tie the whole together (fig. 7).

Long and Short Work, a typical Saxon method of arranging quoin stones, flat slabs and long narrow vertical stones being placed alternately. Earls Barton church in Northamptonshire is an example of their use in old work. In modern work long and short work, sometimes termed "block and start," is little used (fig. 7).

Parapet, a fence wall at the top of a wall at the eaves of the roof. The gutter lies behind, and waterways are formed through the parapet wall for the escape of the rain-water.

Plinth, a projecting base to a wall serving to give an appearance of stability to the work.

Quoin, the angle at the junction of two walls. Quoins are often executed in dressed stone (Fig. 7).

Rag-bolt, the end of an iron bolt when required to be let into stone is roughed or ragged. A dovetailed mortise is prepared in the stone and the ragged end of the bolt placed in this, and the mortise filled in with molten lead or sand and sulphur (fig. 9).

Sill, the stone which forms a finish to the wall at the bottom of an opening. Sills should always be weathered, slightly in the case of door sills, more sharply for windows, and throated on the under side to throw off the wet. The weathering is not carried through the whole length of the sill, but a stool is left on at each end to form a square end for building in (fig. 7).

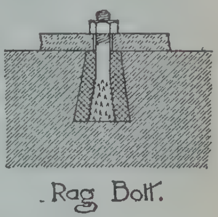

FIG. 9.

String Courses, horizontal bands of stone, either projecting beyond or flush with the face of the wall and often moulded or carved. They are frequently continuations of the sills or head lines of windows (figs. 5 and 7).

Scontion.—In a thick wall the dressed stones forming the inside angles of the jamb of a window or door opening are termed scontions.

Spalls, small pieces chipped off whilst working a stone.

Templates, slabs of hard stone set in a wall to take the ends of a beam or girder so as to distribute the load over a larger area of the wall.

Tympanum, the triangular filling of masonry in a pediment between the cornices, or between the horizontal head of a window or door and the under-side of the relieving arch above it. It is often panelled or enriched with carved ornament (fig. 7).

Throat, a groove worked on the under-side of projecting external members to intercept rain-water and cause it to drop off the member clear of the work beneath (fig. 8).

Weathering.—The surface of an exposed stone is weathered when it is worked to a slope so as to throw off the water. Cornices, copings, sills and string courses should all be so weathered.

Voussoirs, the wedge-shaped blocks of which an arch is built up.

Methods of finishing Face of Stones.—The *self face* or *quarry face* is the natural surface formed when the stone is detached from the mass in the quarry or when a stone is split.

Saw-face, the surface formed by sawing.

Hammer-dressed, Rock-faced, or Pitch-faced.—This face is used for ashlar-work, usually with a chisel-draughted margin around each block. It gives a very massive and solid appearance to the lower storeys of masonry buildings, and is formed with little labour, and is therefore the cheapest face to adopt for ashlar-work (fig. 7).

Broached and Pointed Work.—This face is also generally used with a chisel-draughted margin. The stone as left from the scabbling hammer at the quarry has its rocky face worked down to an approximate level by the point. In broached work the grooves made by the tool are continuous, often running obliquely across the face of the block. In pointed work the lines are not continuous; the surface is rough or fine pointed according as the point is used over every inch or half-inch of the stone. The point is used more upon hard stones than soft ones (fig. 7).

Tooth-chiselled Work.—The cheapest method of dressing soft stones is by the toothed chisel which gives a surface very much like the pointed work of hard stones.

Droved Work.—This surface is obtained with a chisel about two and a half inches wide, no attempt being made to keep the cuts in continuous lines.

Tooled Work is somewhat similar to droved work and is done with a flat chisel, the edge of which is about four inches wide, care being taken to make the cuts in continuous lines across the width of the stone.

Combed or Dragged Work.—For soft stones the steel comb or drag is often employed to remove all irregularities from the face and thus form a fine surface. These tools are specially useful for moulded work, as they are formed to fit a variety of curves.

Rubbed Work.—For this finish the surface of the stone is previously brought with the chisel to a level and approximately smooth face, and then the surface is rubbed until it is quite smooth with a piece of grit stone aided by fine sand and water as a lubricant. Marbles are polished by being rubbed with gritstone, then with pumice, and lastly with emery powder.

Besides these, the most usual methods of finishing the faces of stonework, there are several kinds of surface formed with hammers or axes of various descriptions. These types of hammers are more used on the continent of Europe and in America perhaps than in England, but they deserve notice here.

The *toothed axe* has its edges divided into teeth, fine or coarse according to the work to be done. It is used to reduce the face of limestones and sandstones to a condition ready for the chisel. The *bush hammer* has a heavy square-shaped double-faced head, upon which are cut projecting pyramidal points. It is used to form a surface full of little holes, and with it the face of sand and limestones may be brought to a somewhat ornamental finish. The *patent hammer* is used on granite and other hard rocks, which have been first dressed to a medium surface with the point. The fineness of the result is determined by the number of blades in the hammer, and the work is said to be "six," "eight" or "ten-cut" work according to the number of blades inserted or bolted in the hammer head. The *crandall* has an iron handle slotted at one end with a hole ⅜ in. wide and 3 in. long. In this slot are fixed by a key ten or eleven double-headed points of ¼ in. square steel about 9 in. long. It is used for finishing sandstone and soft stones after the surface has been levelled down with the axe or chisel. It gives a fine pebbly sparkling appearance.

There are several methods of finishing stone which involve a great deal of labour and are therefore expensive to work, but which result in imparting a very stiff and unnatural appearance to the masonry.

Vermiculated Work.—This is formed by carving a number of curling worm-like lines over the face of the block, sinking in between the worms to a depth of a fourth of an inch. The surface of the strings is worked smooth, and the sinkings are pock-marked with a pointed tool (fig. 7).

Furrowed Work.—In this face the stone is cut with a chisel into a number of small parallel grooves or furrows (fig. 7).

Reticulated Face is a finish somewhat similar to vermiculated work, but the divisions are more nearly squares.

Face Joints of Ashlar.—The face joints of ashlar stonework are often sunk or rebated to form what are termed rusticated joints; sometimes the angles of each block are moulded or chamfered to give relief to the surface or to show a massive effect (fig. 7).

Joints in Stonework.—The joints between one block of stone and another are formed in many ways by cramps, dowels and joggles of various descriptions.

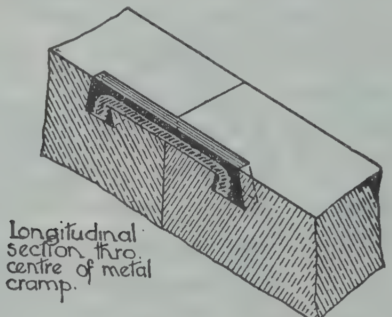

FIG. 10.

Cramps. The stones of copings, cornices and works of a similar nature, are often tied together with metal cramps to check any tendency for the stones to separate under the force of the wind (figs. 10 and 11). Cramps are made of iron (plain or galvanized), copper or gun-metal, of varying sections and lengths to suit the work. A typical cramp would be about 9 in. long, 1 or 1½ in. wide, and from ¼ to ⅜ in. thick, and turned down about 1½ in. at each end. A dovetailed mortise is formed at a suitable point in each of the stones to be joined and connected by a chase. The cramp is placed in this channel with its turned-down ends in the mortises, and it is then fixed with molten lead, sulphur and sand, or Portland cement. Lead shrinks on cooling, and if used at all should be well caulked when cold. Double dovetailed slate cramps bedded in Portland cement are occasionally used (fig. 11).

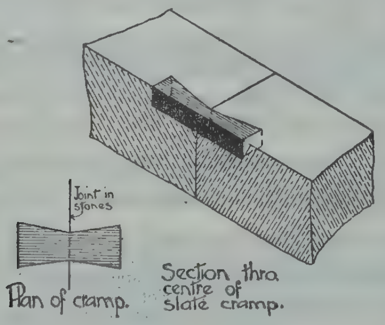

FIG. 11.

Dowels. Dowels are used for connecting stones where the use of cramps would be impracticable, as in the joints of window mullions, the shafts of small columns, and in similar works (figs. 7, 8 and 20). Dowels for bed and side joints may be used. They are of slate, metal, or sometimes of hard wood.

Joggles. There are many ways of making a joggle joint. The joggle may be worked on one of the stones so as to fit into a groove in the adjoining stone, or grooves may be cut in both the stones and an independent joggle of slate, pebbles, or Portland cement fitted, the joggle being really a kind of dowel. The pebble joggle joint is formed with the aid of pebbles as small dowels fitted into mortises in the jointing faces of two stones and set with Portland cement; but joggles of slate have generally taken the place of pebbles. Portland cement joggles are formed by pouring cement grout into a vertical or oblique mortise formed by cutting a groove in each of the joining surfaces of the stones. What is known as a he-and-she joggle, worked on the edges of the stones themselves, is shown in fig. 13.

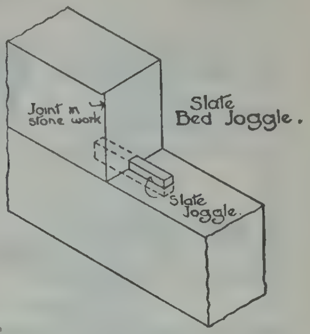

FIG. 12.

Plugs or dowels of lead are formed by pouring molten lead through a channel into dovetailed mortises in each stone (figs. 14 and 15). When cold the metal is caulked to compress it tightly into the holes.

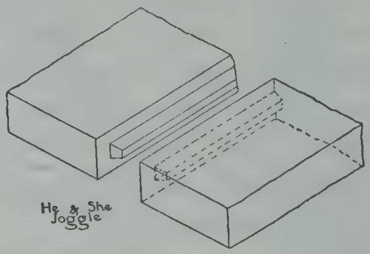

FIG. 13.

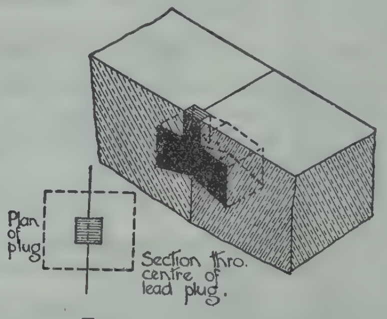

FIG. 14.

The saddle joint is used for cornices, and is formed when a portion of the stone next the joint is left raised so as to guide rain-water away from the joint (fig. 8).

Two forms of rebated joints for stone copings and roofs are common. In one form (shown in fig. 7) the stones forming the coping are thicker at their lower and rebated edge than at the top plain edge, giving a stepped surface. The other form has a level surface and the stone is of the same thickness throughout and worked to a rebate on top and bottom edges. In laying stone roofs the joints are usually lapped over with an upper slab of stone.

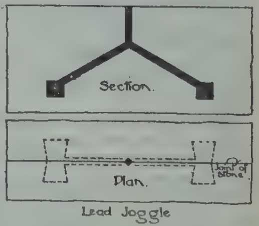

FIG. 15.

Joints in Spires.—Four forms of jointing for the battering stonework of spires are shown in fig. 16. A is a plain horizontal joint. B is a similar joint formed at right angles to the face of the work. This is the most economical form of joint, the stone being cut with its sides square with each other; but if the mortar in the joint decay moisture is allowed to penetrate. With these forms dowelling is frequently necessary for greater stability. The joints C and D are more elaborate and much more expensive on account of the extra labour involved in working and fitting.

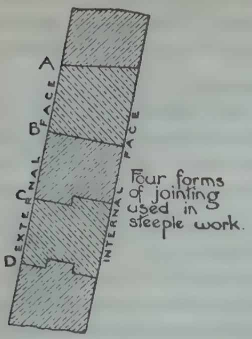

FIG. 16.

Where a concentrated weight is carried by piers or columns the bed joints are in many cases formed without the use of mortar, a thin sheet of milled lead being placed between the blocks of stone to fill up any slight inequalities.

Moulded Work.—The working of mouldings in stone is an important part of the mason's craft, and forms a costly item in the erection of a stone structure. Much skill and care is required to retain the arrises sharp and the curved members of accurate and proportionate outline. As in the case of wood mouldings, machinery now plays an important part in the preparation of stone moulded work. The process of working a stone by hand labour is as follows: The profile of the moulding is marked on to a zinc template on opposite ends of the stone to be worked; a short portion, an inch or two in length termed a "draught," is at each end worked to the required section. The remaining portion is then proceeded with, the craftsman continually checking the accuracy of his work with a straight-edge and zinc templates. A stone to be moulded by machinery is fixed to a moving table placed under a shaped tool which is fixed in an immovable portion of the machine, and is so adjusted as to cut or chip off a small layer of stone. Each time the stone passes under the cutter it is automatically moved a trifle nearer, and thus it gradually reduces the stone until the required shape is attained.

Iron in Stonework.—The use of iron dowels or cramps in stonework, unless entirely and permanently protected from oxidation is attended by the gravest risks; for upon the expansion of the iron by rusting the stone may split, and perhaps bring about a more or less serious failure in that portion of the building. A case in point is that of the church of St Mary-le-Strand, London, where the ashlar facing was secured to the backing with iron cramps; these were inefficiently protected from damp, with the result that many of the blocks have been split in consequence of rusting. John Smeaton in his Eddystone Lighthouse used dowels of Purbeck marble.

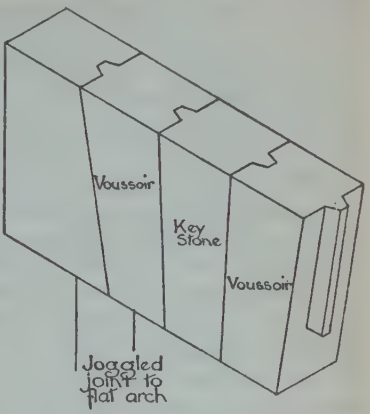

FIG. 17.

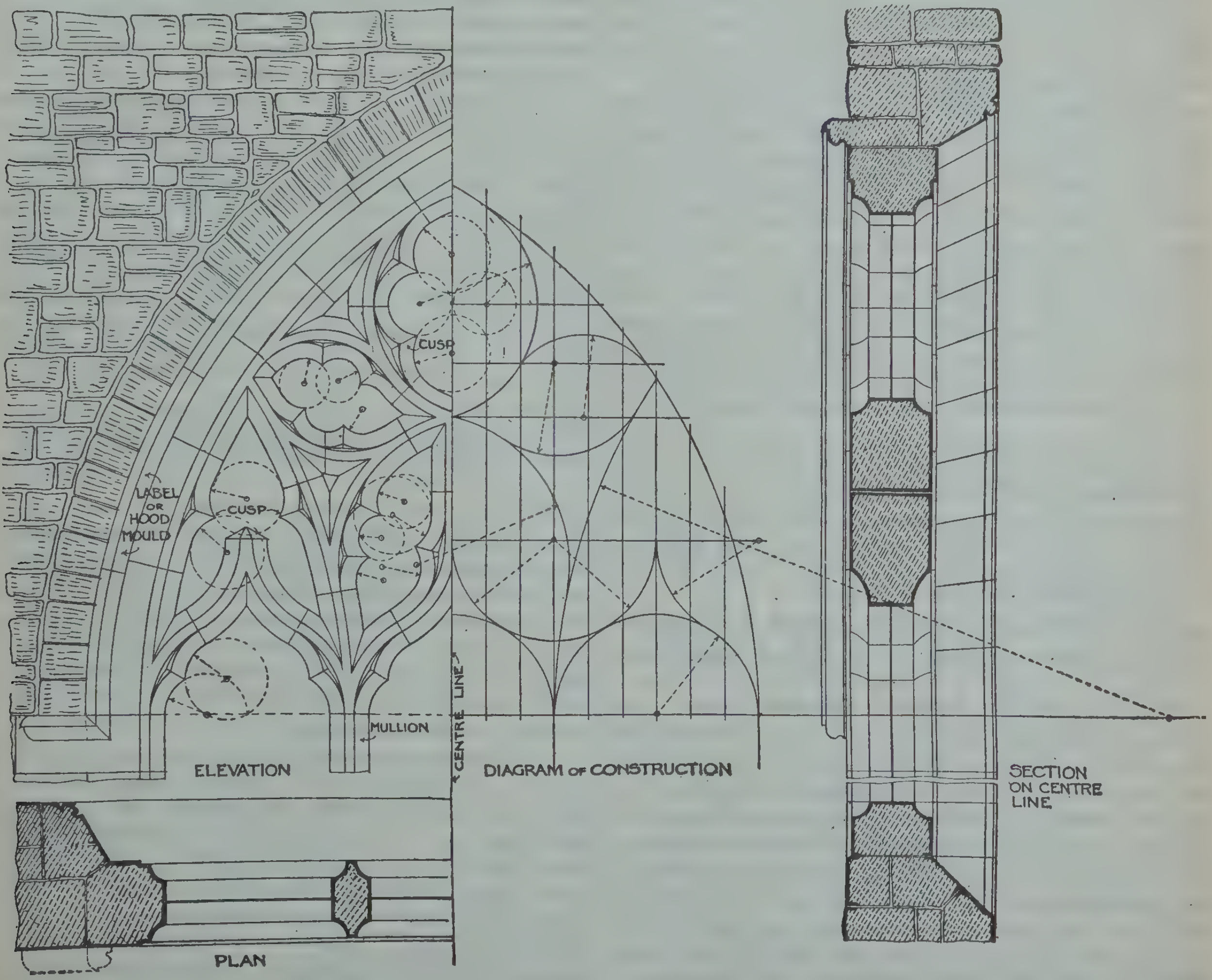

FIG. 18.

Stone Arches.—Stone arches are very frequently used both in stone and brick buildings. (For general definitions and terms see BRICKWORK.) They may be built in a great variety of styles, either flat, segmental, circular, elliptical or pointed. Each block or voussoir should be cut to fit exactly in its appointed place, the joints being made as fine as possible. The joints should radiate from the centre from which the soffit or intrados is struck, or in the case of an elliptical arch they should be at right angles to a tangent drawn to the intrados at that point. The extrados or back of the arch is usually concentric with the intrados, but is sometimes made thicker in one portion than in another; thus the arch may be deeper at the crown than at the sides, or at the sides than in the centre. In some cases two or more voussoirs are of one stone, having a false joint cut in the centre; this is economical, and in some cases adds to the stability of the arch. Generally the arch is divided into an uneven number of voussoirs so as to give a keystone, the voussoirs being laid from each side of the keystone and fitting exactly in the centre of the arch. The keystone is not a necessity, arches being frequently formed with an even number of voussoirs; some architects hold that the danger of the voussoirs cracking is thereby lessened. Where lintels are used in a stone wall over openings of small span it is usual to build a relieving arch above to take the superincumbent weight of masonry; or the same purpose may be effected in walls of ashlar by a flat relieving or "save" arch, formed in the next course of three stones above the lintel, the tapering keystone resting between the two side stones which are tailed well into the wall.

In very many cases it is desired to form square heads to openings of greater span than it is convenient to obtain lintels for in one piece, and some form of flat arch must therefore be adopted. The voussoirs are connected by joggles worked on their joints, as in fig. 17. The weight of the superimposed wall is taken by a lintel with relieving arch above at the back of the arch.

Arches built to an elliptical form when used for large spans (if of flat curve they should bridge over 8 ft. or 10 ft.) are liable if heavily loaded to fail by the voussoirs at the centre being forced down, or else to burst up at the haunches. With arches of this description there is a large amount of outward thrust, and abutments of ample strength must be placed to receive the springers.

Stone Tracery.—The designs of Gothic and other tracery stonework are almost infinite, and there are many methods, ingenious and otherwise, of setting out such work. Nearly all diagrams of construction are planned on the principle of geometrical intersections. In the example illustrated in fig. 18 the method of setting out and finishing the design is very clearly shown, together with the best positions for the joints of the various parts. The jointing is a matter which must be carefully considered in order to avoid any waste of stone and labour. It will be observed that the right-hand side of the elevation shows the method of setting out the tracery by the centre lines of the various intersecting branches, the other half giving the completed design with the cusping drawn in and the positions of joints. All the upper construction of windows and doors and of aisle arches should be protected from superincumbent pressure by strong relieving arches above the labels, as shown in the figure, which should be worked with the ordinary masonry, and so set that the weight above should avoid pressure on the fair work, which would be liable to flush or otherwise destroy the joints of the tracery.

Carving.—Stone carving is a craft quite apart from the work of the ordinary stonemason, and like carving in wood needs an artistic feeling and special training. Carving-stone should be of fine grain and sufficiently soft to admit of easy working. The Bath stones in England and the Caen stone of France are largely used for internal work, but if for the exterior they should be treated with some chemical preservative. Carving is frequently done after the stone is built into position, the face being left rough—"boasted"—and projecting sufficiently for the intended design.

See E. Viollet-le-Duc, *Dictionnaire raisonné de l'architecture française*; W. R. Purchase, *Practical Masonry*; J. O. Baker, *A Treatise on Masonry Construction*; C. F. Mitchell, *Brickwork and Masonry*; W. Diack, *The Art of Masonry in Britain*. (J. Bt.)

MASPERO, GASTON CAMILLE CHARLES (1846-), French Egyptologist, was born in Paris on the 23rd of June 1846, his parents being of Lombard origin. While at school he showed a special taste for history, and when fourteen years old was already interested in hieroglyphic writing. It was not until his second year at the École Normale in 1867 that Maspero met with an Egyptologist in the person of Mariette, who was then in Paris as commissioner for the Egyptian section of the exhibition. Mariette gave him two newly discovered hieroglyphic texts of considerable difficulty to study, and, self-taught, the young scholar produced translations of them in less than a fortnight, a great feat in those days when Egyptology was still almost in its infancy. The publication of these in the same year established his reputation. A short time was spent in assisting a gentleman in Peru, who was seeking to prove an Aryan affinity for the dialects spoken by the Indians of that country, to publish his researches; but in 1868 Maspero was back in France at more profitable work. In 1869 he became a teacher (*répétiteur*) of Egyptian language and archaeology at the École des Hautes Études; in 1874 he was appointed to the chair of Champollion at the Collège de France.

In November 1880 Professor Maspero went to Egypt as head of an archaeological mission despatched thither by the French government, which ultimately developed into the well-equipped Institut Français de l'Archéologie Oriental. This was but a few months before the death of Mariette, whom Maspero then succeeded as director-general of excavations and of the antiquities of Egypt. He held this post till June 1886; in these five years he had organized the mission, and his labours for the Bulak museum and for archaeology had been early rewarded by the discovery of the great cache of royal mummies at Deir el-Bahri in July 1881. Maspero now resumed his professorial duties in Paris until 1899, when he returned to Egypt in his old capacity as director-general of the department of antiquities. He found the collections in the Cairo Museum enormously increased, and he superintended their removal from Gizeh to the new quarters at Kasr en-Nil in 1902. The vast catalogue of the collections made rapid progress under Maspero's direction. Twenty-four volumes or sections were already published in 1909. The repairs and clearances at the temple of Karnak, begun in his previous tenure of office, led to the most remarkable discoveries in later years (see KARNAK), during which a vast amount of excavation and exploration has been carried on also by unofficial but authorized explorers of many nationalities.

Among his best-known publications are the large *Histoire ancienne des peuples de l'Orient classique* (3 vols., Paris, 1895–1897, translated into English by Mrs McClure for the S.P.C.K.), displaying the history of the whole of the nearer East from the beginnings to the conquest by Alexander; a smaller *Histoire des peuples de l'Orient*, 1 vol., of the same scope, which has passed through six editions from 1875 to 1904; *Études de mythologie et d'archéologie égyptiennes* (Paris, 1893, &c.), a collection of reviews and essays originally published in various journals, and especially important as contributions to the study of Egyptian religion; *L'Archéologie égyptienne* (latest ed., 1907), of which several editions have been published in English. He also established the journal *Recueil de travaux relatifs à la philologie et à l'archéologie égyptiennes et assyriennes*; the *Bibliothèque égyptologique*, in which the scattered essays of the French Egyptologists are collected, with biographies, &c.; and the *Annales du service des antiquités de l'Égypte*, a repository for reports on official excavations, &c.

Maspero also wrote: *Les Inscriptions des pyramides de Saqqarah* (Paris, 1894); *Les Momies royales de Deir el-Baharî* (Paris, 1889); *Les Contes populaires de l'Égypte ancienne* (3rd ed., Paris, 1906); *Causeries d'Égypte* (1907), translated by Elizabeth Lee as *New Light on Ancient Egypt* (1908).

MASS (O.E. *maesse*; Fr. *messe*; Ger. *Messe*; Ital. *messa*; from eccl. Lat. *missa*), a name for the Christian eucharistic service, practically confined since the Reformation to that of the Roman Catholic Church. The various orders for the celebration of Mass are dealt with under LITURGY; a detailed account of the Roman order is given under MISSAL; and the general development of the eucharistic service, including the Mass, is described in the article EUCHARIST. The present article is confined (1) to the consideration of certain special meanings which have become attached to the word Mass and are the subject of somewhat acute controversy, (2) to the Mass in music.

The origin of the word *missa*, as applied to the Eucharist, is obscure. The first to discuss the matter is Isidore of Seville (*Etym.* vi. 19), who mentions an "evening office" (*officium vespertinum*), a "morning office" (*officium matutinum*), and an office called *missa*. Of the latter he says: "Missa tempore sacrificii est, quando catechumeni foras mittuntur, clamante levita 'si quis catechumenus remansit, exeat foras.' Et inde 'missa,' quia sacramentis altaris interesse non possunt, qui nondum regenerati sunt" ("The *missa* is at the time of the sacrifice, when the catechumens are sent out, the deacon crying, 'If any catechumen remain, let him go forth.'" Hence *missa*, because those who are as yet unregenerate—*i.e.* unbaptized—may not be present at the sacraments of the altar). This derivation of the word Mass, which would connect it with the special formula of dismissal still preserved in the Roman liturgy—*Ite, missa est*—once generally accepted, is now disputed. It is pointed out that the word *missa* long continued to be applied to any church service, and more particularly to the lections (see Du Cange for numerous examples), and it is held that such services received their name of *missal* from the solemn form of dismissal with which it was customary to conclude them; thus, in the 4th century *Pilgrimage of Etheria* (*Silvia*) the word *missa* is used indiscriminately of the Eucharist, other services, and the ceremony of dismissal. F. Kattenbusch (Herzog-Hauck, *Realencyklop. s.* "Messe") ingeniously, but with little evidence, suggests that the word may have had a double origin and meaning: (1) in the sense of *dimissio*, "dismissal"; (2) in that of *commissio*, "commission," "official duty," *i.e.* the exact Latin equivalent of the Greek λειτουργία (see LITURGY), and hence the conflicting use of the term. It is, however, far more probable that it was a general term that gradually became crystallized as applying to that service in which the dismissal represented a more solemn function. In the narrower sense of "Mass" it is first found in St Ambrose (*Ep.* 20, 4, ed. Ballerini): "Missam facere coepi. Dum offero. . ." which evidently identifies the *missa* with the sacrifice. It continued, however, to be used loosely, though its tendency to become proper only to the principal Christian service is clear from a passage in the 12th homily of Caesarius, bishop of Arles (d. 542): "If you will diligently attend, you will recognize that *missae* are not celebrated when the divine readings are recited in the church, but when gifts are offered and the Body and Blood of the Lord are consecrated." The complete service (*missa ad integrum*), the bishop goes on to say, cannot be had at home by reading and prayer, but only in the house of God, where, besides the Eucharist, "the divine word is preached and the blessing is given to the people."

Whatever its origin, the word Mass had by the time of the Reformation been long applied only to the Eucharist; and, though in itself a perfectly colourless term, and used as such during the earlier stages of the 16th century controversies concerning the Eucharist, it soon became identified with that sacrificial aspect of the sacrament of the altar which it was the chief object of the Reformers to overthrow. In England, so late as the first Prayer-book of Edward VI., it remained one of the official designations of the Eucharist, which is there described as "The Supper of the Lorde and holy Communion, commonly called the Masse." This, however, like the service itself, represented a compromise which the more extreme reformers would not tolerate, and in the second Prayer-book, together with such language in the canon as might imply the doctrine of transubstantiation and of the sacrifice, the word Mass also disappears. That this abolition of the word Mass, as implying the offering of Christ's Body and Blood by the priest for the living and the dead was deliberate is clear from the language of those who were chiefly responsible for the change. Bishops Ridley and Latimer, the two most conspicuous champions of "the new religion," denounced "the Mass" with unmeasured violence; Latimer said of "Mistress Missa" that "the devil hath brought her in again"; Ridley said: "I do not take the Mass as it is at this day for the communion of the Church, but for a popish device," &c. (*Works*, ed. Parker Soc., pp. 121, 120), and again: "In the stead of the Lord's holy table they give the people, with much solemn disguising, a thing which they call their mass; but in deed and in truth it is a very masking and mockery of the true Supper of the Lord, or rather I may call it a crafty juggling, whereby these false thieves and jugglers have bewitched the minds of the simple people . . . unto pernicious idolatory" (ib. p. 409). This language is reflected in the 31st of the Articles of Religion of the Church of England: "Wherefore the sacrifices of Masses, in which it was commonly said that the Priest did offer Christ for the quick and the dead, to have remission of pain and guilt, were blasphemous fables and dangerous deceits." Clearly the word Mass had ceased to be a colourless term generally applicable to the eucharistic service; it was, in fact, not only proscribed officially, but in the common language of English people it passed entirely out of use except in the sense in which it is defined in Johnson's Dictionary, *i.e.* that of the "Service of the Romish Church at the celebration of the Eucharist." In connexion with the Catholic reaction in the Church of England, which had its origin in the "Oxford Movement" of the 19th century, efforts have been made by some of the clergy to reintroduce the term "Mass" for the Holy Communion in the English Church.

See Du Cange, *Glossarium, s.v.* "Missa"; F. Kattenbusch in Herzog-Hauck, *Realencyklopädie* (ed. 1903), *s.v.* "Messe, dogmengeschichtlich"; for the facts as to the use of the word "Mass" at the time of the Reformation see the article by J. H. Round in the *Nineteenth Century* for May 1897. (W. A. P.)

MASS, IN MUSIC: 1. *Polyphonic Masses.*—The composition of musical settings of the Mass plays a part in the history of music which is of special importance up to and including the 16th century. As an art-form the musical Mass is governed to a peculiar degree by the structure of its text. It so happens that the supremely important parts of the Mass are those which have the smallest number of words, namely the *Kyrie*, important as being the opening prayer; the *Sanctus* and *Benedictus*, embodying the central acts and ideas of the service; and the *Agnus Dei*, the prayer with which it concludes. The 16th-century methods were specially fitted for highly developed music when words were few and embodied ideas of such important emotional significance or finality that they could be constantly repeated without losing force. Now the texts of the *Gloria* and *Credo* were more voluminous than any others which 16th-century composers attempted to handle in a continuous scheme. The practical limits of the church service made it impossible to break them up by setting each clause to a separate movement, a method by which 16th-century music composers contrived to set psalms and other long texts to compositions lasting an hour or longer. Accordingly, Palestrina and his great contemporaries and predecessors treated the *Gloria* and *Credo* in a style midway in polyphonic organization and rhythmic breadth between that of the elaborate motet (adopted in the *Sanctus*) and the homophonic reciting style of the Litany. The various ways in which this special style could be modified by the scale of the work, and contrasted with the broader and more elaborate parts, gave the Mass (even in its merely technical aspects) a range which made it to the 16th-century composer what the symphony is to the great instrumental classics. Moreover, as being inseparably associated with the highest act of worship, it inspired composers in direct proportion to their piety and depth of mind. Of course there were many false methods of attacking the art-problem, and many other relationships, true and false, between the complexity of the settings of the various parts of the Mass and of motets. The story of the action of the council of Trent on the subject of corruption of church music is told elsewhere (see MUSIC and PALESTRINA); and it has been recently paralleled by a decree of Pope Pius X., which has restored the 16th-century polyphonic Mass to a permanent place in the Roman Catholic Church music.

2. *Instrumental Masses in the Neapolitan Form.*—The next definite stage in the musical history of the Mass was attained by the Neapolitan composers who were first to reach musical coherence after the monodic revolution at the beginning of the 17th century. The fruit of their efforts came to maturity in the Masses of Mozart and Haydn. By this time the resources of music were such that the long and varied text of the *Gloria* and *Credo* inevitably either overbalanced the scheme or met with an obviously perfunctory treatment. It is almost impossible, without asceticism of a radically inartistic kind, to treat with the resources of instrumental music and free harmony such passages as that from the *Crucifixus* to the *Resurrexit*, without an emotional contrast which inevitably throws any natural treatment of the *Sanctus* into the background, and makes the *Agnus Dei* an inadequate conclusion to the musical scheme. So unfavourable were the conditions of 18th-century music for the formation of a good ecclesiastical style that only a very small proportion of Mozart's and Haydn's Mass music may be said to represent their ideas of religious music at all. The best features of their Masses are those that combine faithfulness to the Neapolitan forms with a contrapuntal richness such as no Neapo-

litan composer ever achieved. Thus Mozart's most perfect as well as most ecclesiastical example is his extremely terse Mass in F, written at the age of seventeen, which is scored simply for four-part chorus and solo voices accompanied by the organ with a largely independent bass and by two violins mostly in independent real parts. This scheme, with the addition of a pair of trumpets and drums and, occasionally, oboes, forms the normal orchestra of 18th-century Masses developed or degenerated from this model. Trombones often played with the three lower voices, a practice of high antiquity surviving from a time when there were soprano trombones or *cornetti* (*Zincken*, a sort of treble *serpent*) to play with the sopranos.

3. *Symphonic Masses.*—The enormous dramatic development in the symphonic music of Beethoven made the problem of the Mass with orchestral accompaniment almost insoluble. This makes it all the more remarkable that Beethoven's second and only important Mass (in D, *Op.* 123) is not only the most dramatic ever penned but is, perhaps, the last classical Mass that is thoughtfully based upon the liturgy, and is not a mere musical setting of what happens to be a liturgic text. It was intended for the installation of Beethoven's friend, the archduke Rudolph, as archbishop of Olmütz; and, though not ready until two years after that occasion, it shows the most careful consideration of the meaning of a church service, no doubt of altogether exceptional length and pomp, but by no means impossible for its unique occasion. Immense as was Beethoven's dramatic force, it was equalled by his power of sublime repose; and he was accordingly able once more to put the supreme moment of the music where the service requires it to be, viz. in the *Sanctus* and *Benedictus*. In the *Agnus Dei* the circumstances of the time gave him something special to say which has never so imperatively demanded utterance since. Europe had been shattered by the Napoleonic wars. Beethoven read the final prayer of the Mass as a "prayer for inward and outward peace," and, giving it that title, organized it on the basis of a contrast between terrible martial sounds and the triumph of peaceful themes, in a scheme none the less spiritual and sublime because those who first heard it had derived their notions of the horror of war from living in Vienna during its bombardment. Critics who have lived in London during the relief of Mafeking have blamed Beethoven for his realism.

Schubert's Masses show rather the influence of Beethoven's not very impressive first Mass, which they easily surpass in interest, though they rather pathetically show an ignorance of the meaning of the Latin words. The last two Masses are later than Beethoven's Mass in D and contain many remarkable passages. It is evident from them that a dramatic treatment of the *Agnus Dei* was "in the air"; all the more so, since Schubert does not imitate Beethoven's realism.

4. *Lutheran Masses.*—Music with Latin words is not excluded from the Lutheran Church, and the *Kyrie* and *Gloria* are frequently sung in succession and entitled a Mass. Thus the *Four Short Masses* of Bach are called short, not because they are on a small scale, which is far from being the case, but because they consist only of the *Kyrie* and *Gloria*. Bach's method is to treat each clause of his text as a separate movement, alternating choruses with groups of arias; a method which was independently adopted by Mozart in those larger masses in which he transcends the Neapolitan type, such as the great unfinished Mass in C minor. This method, in the case of an entire Mass, results in a length far too great for a Roman Catholic service; and Bach's B minor Mass, which is such a setting of the entire test, must be regarded as a kind of oratorio. It thus has obviously nothing to do with the Roman liturgy; but as an independent setting of the text it is one of the most sublime and profoundly religious works in all art; and its singular perfection as a design is nowhere more evident than in its numerous adaptations of earlier works.

The most interesting of all these adaptations is the setting of the words: "Et expecto resurrectionem mortuorum et vitam venturi saeculi.—Amen." Obviously the greatest difficulty in any elaborate instrumental setting of the *Credo* is the inevitable anti-climax after the *Resurrexit*. Bach contrives to give this anti-climax a definite artistic value; all the more from the fact that his *Crucifixus* and *Resurrexit*, and the contrast between them, are among the most sublime and directly impressive things in all music. To the end of his *Resurrexit* chorus he appends an orchestral *ritornello*, summing up the material of the chorus in the most formal possible way, and thereby utterly destroying all sense of finality as a member of a large group, while at the same time not in the least impairing the force and contrast of the whole—that contrast having ineffaceably asserted itself at the moment when it occurred. After this the aria "Et in spiritum sanctum," in which the next dogmatic clauses are enshrined like relics in a casket, furnishes a beautiful decorative design on which the listener can repose his mind; and then comes the voluminous ecclesiastical fugue, *Confiteor unum baptisma*, leading, as through the door and world-wide spaces of the Catholic Church, to that veil which is not all darkness to the eye of faith. At the words "Et expecto resurrectionem mortuorum" the music plunges suddenly into a slow series of some of the most sublime and mysterious modulations ever written, until it breaks out as suddenly into a *vivace e allegro* of broad but terse design, which comes to its climax very rapidly and ends as abruptly as possible, the last chord being carefully written as a short note without a pause. This gives the utmost possible effect of finality to the whole *Credo*, and contrasts admirably with the coldly formal instrumental end of the *Resurrexit* three movements further back. Now, such subtleties seem as if they must be unconscious on the part of the composer; yet here Bach is so far aware of his reasons that his *vivace e allegro* is an arrangement of the second chorus of a church cantata, *Gott man lobet dich in der Stille*; and in the cantata the chorus has introductory and final symphonies and a middle section with a *da capo!*

5. *The Requiem.*—The *Missa pro defunctis* or *Requiem Mass* has a far less definite musical history than the ordinary Mass; and such special musical forms as it has produced have little in common with each other. The text of the *Dies Irae* so imperatively demands either a very dramatic elaboration or none at all, that even in the 16th century it could not possibly be set to continuous music on the lines of the *Gloria* and *Credo*. Fortunately, however, the Gregorian *canto fermo* associated with it is of exceptional beauty and symmetry; and the great 16th century masters either, like Palestrina, left it to be sung as plain-chant, or obviated all occasion for dramatic expression by setting it in versicles (like their settings of the *Magnificat* and other canticles) for two groups of voices alternatively, or for the choir in alternation with the plain chant of the priests.

With modern orchestral conditions the text seems positively to demand an unecclesiastical, not to say sensational, style, and probably the only instrumental Requiem Masses which can be said to be great church music are the sublime unfinished work of Mozart (the antecedents of which would be a very interesting subject) and the two beautiful works by Cherubini. These latter, however, tend to be funereal rather than uplifting. The only other artistic solution of the problem is to follow Berlioz, Verdi and Dvořák in the complete renunciation of all ecclesiastical style.

Brahms's *Deutsches requiem* has nothing to do with the Mass for the dead, being simply a large choral work on a text compiled from the Bible by the composer. (D. F. T.)

MASSA, a town of Tuscany, Italy, the joint capital with Carrara of the province of Massa and Carrara, and sharing with it the episcopal see, 20 m. S.E. of Spezia by rail, 246 ft. above sea-level. Pop. (1901), 10,559 (town); 26,118 (commune). The Palazzo Ducale (now the prefecture) was erected in 1701, and was a summer residence of Napoleon's sister, Elisa Baciocchi, princess of Lucca, who caused the ancient cathedral opposite to be destroyed. The hills round the town yield marble, and there is a narrow-gauge railway to the Marina d'Avenza, where the marble is shipped.

MASSACHUSETTS (an Indian name, originally applied to a tribe of Indians), one of the original thirteen states of the American Union, bounded on the N. by Vermont and New Hampshire, on the E. by the Atlantic, on the S. by Rhode Island

and Connecticut, and on the W. by New York. It lies approximately between 41° 15′ and 42° 50′ N. lat. and 69° 55′ and 73° 30′ W. long. The bulk of its area—which is about 8266 sq. m. (of which 227 are water)—forms a parallelogram of 130 m. E. and W., 46 m. N. and S., the additional area lying in a projection at the S.E. and a lesser one at the N.E., which give the mainland a breadth of 90 m. where it borders upon the ocean, while the general irregularity of the coast-line gives a sea frontage of about 250 m.

Physical Features.—The east and south-east portions are in general undulating or level, the central hilly and broken, and the west rugged and mountainous. (For geological details see UNITED STATES: *Geology*; *ad fin.*) The Hoosac Hills (1200–1600 ft. high), separating the valleys of the Housatonic and Connecticut, are a range of the Berkshires, a part of the Appalachian system, and a continuation of the Green Mountains of Vermont, and with the Taconic range on the west side of the Housatonic Valley—of which the highest peaks are Greylock, or "Saddleback" (3535 ft.), and Mt Williams (3040 ft.)—in the extreme north-west corner of the state, form the only considerable elevated land.[1] Bordering on the lowlands of the Connecticut, Mt Tom (1214 ft.) and a few other hills (Mt Holyoke, 954 ft.; Mt Toby, 1275) form conspicuous landmarks. East of this valley the country continues more or less hilly and rocky, but the elevations eastward become increasingly slight and of little consequence. Mt Lincoln (1246 ft.) and especially Mt Wachusett (2108 ft.), to the east in a level country, are very exceptional. The Blue Hills in Milton are the nearest elevations to the coast, and are conspicuous to navigators approaching Boston. The south-east corner of the state is a sandy lowland, generally level with a slightly elevated ridge (Manomet) south of Plymouth, and well watered by ponds.

With the exception of this corner, Massachusetts is a part of the slanting upland that includes all of southern New England. This upland is an uplifted peneplain of subaerial denudation,[2] now so far advanced in a "second" cycle of weathering and so thoroughly dissected that to an untrained eye it appears to be only a country of hills confusedly arranged. The general contour of the upland, marked by a remarkably even sky-line, is evident at almost every locality in the state. In the nature and position of the upland rocks—mainly crystalline schists and gneisses, excessively complicated and disordered in mass, and also internally deformed—there is found abundant proof that the peneplain is a degraded mountain region. The upland is interrupted by the rivers, and on the coast by great lowlands, and is everywhere marked by hills somewhat surmounting the generally even skyline. Monadnock (in New Hampshire, near N.E. Massachusetts), the Blue Hills near Boston, Greylock, in the north-west, and Wachusett in the centre, are the most commanding remnant-summits (known generically as "Monadnocks") of the original mountain system. But in the derivant valley peneplains developed in the present cycle of denudation, and there are residual summits also; in the Connecticut Valley trap ridges, of which Mt Tom and Mt Holyoke are the best examples; at Mt Holyoke, lava necks; occasionally in the lowlands, ridges of resistant sandstone, like Deerfield Mountain near Northampton; in the Berkshire Valley, summits of resistant schists, like Greylock, the highest summit in the state. The larger streams have cut their channels to very moderate gradients, but the smaller ones are steeper. The Housatonic and Millers (and the Connecticut also, but not in its course within Massachusetts alone) afford beautiful examples of the dependence of valley breadth upon the strike of soft or harder rocks across the stream. The Connecticut lowland is cut from 5 to 18 m. wide in soft sandstones and shales. The glacial era has left abundant evidences in the topography of the state. The ice covered even the Monadnocks. Till drumlins, notably abundant on the lowland about Boston and the highland near Spencer; morainic hills, extending, *e.g.* all along Cape Cod; eskers, kames and river terraces afford the plainest evidences of the extent of the glacial sheet. The Berkshire country—Berkshire, Hampden, Hampshire and Franklin counties—is among the most beautiful regions of the United States. It is a rolling highland dominated by long, wooded hill-ridges, remarkably even-topped in general elevation, intersected and broken by deep valleys. Scores of charming lakes lie in the hollows. The district is often called the Lake Region of America, partly from the comparableness of its scenic beauties with the English Lake Country (Matthew Arnold, however, wrote: "The country is pleasing but not to be compared with Westmoreland. It is wider and opener, and neither hills nor lakes are so effective."), and partly from the parallelism of literary associations. It has become since 1850, and especially in much more recent years, a favoured resort of summer residents. Owing to topography, and also to the manner in which Massachusetts was settled, the western counties were long connected commercially more closely with New York than with Massachusetts, and this territory was long in dispute between these two states.

The Connecticut is the most considerable stream, and is navigable by small craft. Its valley, much the richest portion of the state agriculturally, is celebrated for the quiet variety and beauty of its scenery. The Housatonic, in portions placid, in others wild and rapid, winding along the deflecting barrier of the Hoosac Hills, is the most beautiful river of the state, despite the mercantile use of its water-power. The Merrimac, the second stream of the state in volume, runs in a charming valley through the extreme north-east corner, and affords immensely valuable water-power at Lowell, Lawrence and Haverhill.

South of Cohasset the shore is sandy, with a few isolated rocky ledges and boulders. About Boston, and to the north of it, the shore is rocky and picturesque. Cape Cod, like a human arm doubled at the elbow, 40 m. from shoulder to elbow and 30 from elbow to hand, is nowhere more than a few miles broad. It is a sandy ridge, dotted with summer resorts and cottages. Cape Ann has a rugged interior and a ragged, rocky coast. It, too, is a summer recreation ground, with much beautiful scenery. Boston Harbor (originally known as Massachusetts Bay, a name which now has a much broader signification) is the finest roadstead on the coast. The extreme hook of the Cape Cod Peninsula forms Provincetown Harbor, which is an excellent and capacious port of refuge for vessels approaching Boston. Salem Harbor is the most considerable other haven on Massachusetts Bay; on Buzzard's Bay New Bedford has a good harbour, and on the Atlantic coast are the excellent harbours of Gloucester and Marblehead, both frequented by summer residents. Gloucester has the largest fishery interests of any place in the country, and is one of the chief fishing ports of the world. Buzzard's Bay is also a popular yachting ground, and all about its shores are towns of summer residence. Wood's Hole is a station of the United States Bureau of Fisheries, and a marine biological laboratory is there.

The principal islands lie off the south coast. The largest is Martha's Vineyard, about 20 m. long, with an extreme breadth of about 9½ m. It has in Vineyard Haven (Holmes's Hole) a spacious harbour, much frequented by wind-bound vessels seeking a passage round Cape Cod. The island is covered with stunted trees. Its population was formerly dependent wholly upon the sea, but its climate has made it a popular summer resort, Oak Bluffs being one of the chief resorts of the Atlantic coast. Farther east, Nantucket, a smaller island of triangular shape, is likewise the home of a seafaring folk who still retain in some degree primitive habits, though summer visitors are more and more affecting its life.

Flora and Fauna.—Massachusetts lies entirely in the humid area of the Transition life-zone, with the exception of the extreme north-western corner of the state, which lies in the Boreal zone. Thus the original native trees and plants were those common to New England and northern New York. The presence of a dense population has driven out some, and brought in others, including some noxious weeds. The larger wild animals have disappeared, excepting an occasional black bear or deer. Of the smaller fur-bearing animals, the beaver was long ago exterminated, the otter is seen very rarely, and the mink only in the most isolated districts; but foxes, skunks, weasels, musk-rats, rabbits, and grey and red squirrels are not uncommon. Copperhead snakes and rattlesnakes are occasionally seen, and there are several species of harmless serpents. Of game birds the most characteristic is the partridge (ruffed grouse), exclusively a woodland bird; the Wilson's snipe and the woodcock are not uncommon in favourable localities, and several species of ducks are found especially in the bays and marshes near the coast during the seasons of migration. A stray eagle is sometimes seen. Very interesting to ornithologists are the few heath hens, the eastern representative of the prairie hen (pinnated grouse), which are found on the island of Martha's Vineyard, and are the sole survivors in the eastern states of one of the finest of American game birds, now practically exterminated even on the western plains. There are many insectivorous birds; among the song birds are the hermit thrush, the wood thrush, the Wilson's thrush, the brown thrasher, the bobolink, the catbird, the oven bird, the house wren, the song sparrow, the fox sparrow, the vesper sparrow, the white-throated sparrow (Peabody bird), the goldfinch and the robin. Brook trout are found, especially in the streams in the western part of the state, and bass, pickerel, perch and smaller fish occur in the rivers and other inland waters. Fish are so abundant on the coast that the cod is sometimes used as an emblem of the state; thus a figure of one hangs in the representatives' chamber at the State House. The artificial propagation and preservation of salmon and other edible fresh-water fish have been carried on successfully under the supervision of a state commission. The commonwealth has expended large sums since 1890 in a vain attempt to exterminate the gipsy moth (*Ocneria*, or more exactly *Porthetria, dispar*), accidentally allowed to escape in 1869 by a French naturalist.

Climate.—The climate is trying, showing great extremes of temperature (20° F. below zero to 100° above) and marked local variations. The south-eastern coast and islands are mildest. The mean average temperature of Boston is 48° F. In the interior it is slightly lower. The mean summer temperature generally over the state is about 70° F. Changes are often sudden, and the passage from winter to summer is through a rapid spring. The ocean tempers the climate considerably on the seaboard. Boston Harbor has been frozen over in the past, but steamtugs plying constantly now prevent the occurrence of such obstruction. In the elevated region in the west the winters are decidedly severe, and the springs and summers often late and cold. Williamstown has a winter mean of about 23° F. The yearly precipitation is about 39 to 45 in., decreasing inland, and is evenly distributed throughout the year. Fogs are common on the coast, and east wind drizzles; the north-east winds being the weather bane of spring and late autumn. In the summer and the autumn the weather is commonly fine, and often most beautiful; and especially in the Berkshires a cool, pure and elastic atmosphere prevails, relatively dry, and altogether delightful.

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[1] At least seventy hills in the state, mainly in this quarter, have an elevation of 1500 ft. (twenty-four above 2000 ft.).

[2] In some localities it is not easy to establish irrefutably and in detail the inter-arrangement of drainage and rock structure that proves it to be a subaerial peneplain instead of an uplifted submarine platform; but the general proof is very clear.

Agriculture.—The soil, except in some of the valleys, is not naturally fertile; and sandy wastes are common in the south-east parts. High cultivation, however, has produced valuable market-gardens about Boston and the larger towns; and industry has made tillage remunerative in most other parts. The gross value of agricultural products is not great compared with that of other industries, but they are of great importance in the economy of the state. The total value of farm property in 1900 was $182,646,704, including livestock valued at $15,798,464. Of the increase in the total value of farm property between 1850 and 1900 more than half was in the decade 1890–1900; this increase being due partly to the rising value of suburban realty, but also to a development of intensive farming that has been very marked since 1880. The total value of farm products in 1899 was $42,298,274 (expenditure for fertilizers $1,320,600); crops representing 54·7 and animal products 45·3% of this total. The leading crops and their percentages of the total crop value were hay and forage (39·1%), vegetables (23·9%), fruits and nuts (11·7%), forest products (8·4%), and flowers and plants (7·1%). Of the animal products 67·3% were dairy products, and 20·8% poultry and eggs. Cereals[1] have been for many years declining, although Indian corn is a valuable subsidiary to the dairy interest, which is the most thriving farm industry. The value of farms on which dairying was the chief source of income in 1900 was 46% of the total farm value of the state; the corresponding percentages for livestock, vegetables, hay and grain, flowers and plants, fruit and tobacco, being respectively 14·6, 10·2, 8·0, 4·2, 3·2, and 1·8%. The shrinkage of cereal crops has been mainly responsible for the idea that Massachusetts is agriculturally decadent. Parallel to this shrinkage was the decrease in ranging sheep (82·0% from 1850–1900; 34·2% from 1890–1900), and cattle, once numerous in the hill counties of the west, and in the Connecticut Valley; Boston, then ranking after London as the second wool market of the world, and being at one time the chief packing centre of the country. Dairy cows increased, however, from 1850 to 1900 by 41·9% (1890–1900, 7·3%). The amount of improved farmland decreased in the same period 39·4%, decreasing even more since 1880 than earlier, and amounting in 1900 to no more than 25·1% of the area of the state; but this decrease has been compensated by increased value of products, especially since the beginning of intensive agriculture. An unusual density of urban settlement, furnishing excellent home markets and transportation facilities, are the main props of this new interest. Worcester and Middlesex counties are agriculturally foremost. Tobacco, which has been cultivated since colonial times, especially since the Civil War, is grown exclusively in the Connecticut Valley or on its borders. In the swamps and bogs of the south-east coast cranberry culture is practised, this district producing in 1900 three-fifths of the entire yield of the United States. "Abandoned farms" (aggregating, in 1890, 3·4% of the total farm area, and 6·85% in Hampshire county) are common, especially in the west and south-east.

Mines and Mining.—Granite is the chief mineral, and granite quarrying is the principal mineral industry of the state. In 1900 the value of manufactures based primarily upon the products of mines and quarries was $196,930,979, or 19% of the state's total manufactured product. In 1906 Massachusetts led all states in the value of its granite output, but in 1907 and 1908 it was second to Vermont. The value of the product (including a small output of igneous rocks) was in 1903, $2,351,027; 1904, $2,554,748; 1905, $2,251,319; 1906, $3,327,416; 1907, $2,328,777; 1908, $2,027,463.

Granite boulders were used for construction in Massachusetts as early as 1650. Systematic quarrying of siliceous crystalline rocks in New England began at Quincy in about 1820. The Gloucester quarries, opened in 1824, were probably the next to be worked regularly. The principal granite quarries are in Milford, (Worcester county), Quincy and Milton (Norfolk county), Rockport (Essex county) and Becket (Berkshire county). Of the fourteen quarries of "Milford granite," twelve are in the township of that name, and two in Hopkinton township, Middlesex county. B. K. Emerson and J. H. Perry classify this granite as post-Cambrian. They describe it[2] as "a compact, massive rock, somewhat above medium grain, and of light colour. The light flesh colour of the feldspar, and the blue of the quartz give it in some places a slight pinkish tint, and it is now much used as a building-stone under the name of 'pink granite.'"

The Quincy granite district lies around the north-east end of the Blue Hill region, about 11 m. south of Boston. For monumental purposes this granite is classified as "medium," "dark," and "extra dark." Quincy granite takes a very high polish, owing to the absence of mica and to the coarser cleavage of its hornblende and augite. The lightest of the monumental stone quarried at Quincy is called gold-leaf; it is bluish-green gray, speckled with black and light yellow brown. Another variety has small, rather widely separated cherry-red dots.

The Rockport granite is found along or near the seashore, between Rockport and Bay View, and within about three-quarters of a mile of Cape Ann. The granite is of two kinds, known commercially as "grey granite" and "green granite." Both varieties are hard and take a very high polish.

The Becker granite (known as "Chester dark" and "Chester light") is a muscovite-biotite granite varying from medium grey to medium bluish grey colour, and fine in texture. It is used principally for monuments.

In 1907 Massachusetts ranked sixth among the states in the value of its trap rock product ($432,604), and eighth in sandstone ($243,328). The value of the marble produced in the same year was $212,438, the state ranking fifth in the value of the total product and fourth in building-marble. Other minerals are emery, limestone and quartz. The state ranked fifth in 1906 in the total value of stone quarried ($4,333,616), and eighth in 1908 ($2,955,195). The output of lime in 1908 was 107,813 tons, valued at $566,022. Second in value to the various stones were the clay products of the state, which were valued in 1906 at $2,172,733 (of which $1,415,864 was the value of common brick) and in 1908 at $1,647,362 (of which $950,921 was the value of common brick). There are many mineral springs in the state, more than half being in Essex and Middlesex counties. The total amount of mineral waters sold in 1908 was valued at $227,907. In that year the total value of the minerals and mining products of the state was $5,925,949. Gold has been found in small quantities in Middlesex, Norfolk and Plymouth counties.

Manufactures.—Though only four states of the Union are smaller, only three exceeded Massachusetts in 1905 in the value of manufactured products (six exceeding it in population); and this despite very scant native resources of raw materials and a very limited home market. Historical priority of development, exceptionally extensive and well utilized water-power, and good transportation facilities are largely responsible for the exceptional rank of Massachusetts as a manufacturing state. Vast water-power is developed on the Merrimac at Lawrence and Lowell, and on the Connecticut at South Hadley, and to a less extent at scores of other cities on many streams and artificial ponds; many of the machines that have revolutionized industrial conditions since the beginning of the factory system have been invented by Massachusetts men; and the state contains various technical schools of great importance. In 1900 the value of manufactures was $1,035,198,989, an increase from 1890 of 16·6%; that from 1880 to 1890 having been 40·7%. In textiles—cottons, worsteds, woollens and carpets—in boots and shoes, in rubber foot-wear, in fine writing paper, and in other minor products, it is the leading state of the country. The textile industries (the making of carpets and rugs, cotton goods, cotton smallwares, dyeing and finishing textiles, felt goods, felt hats, hosiery and knit goods, shoddy, silk and silk goods, woollen goods, and worsted goods), employed 32·5% of all manufacturing wage earners in 1905, and their product ($271,369,816) was 24·1% of the total, and of this nearly one-half ($129,171,449) was in cotton goods, being 28·9% of the total output of the country, as compared with 11% for South Carolina, the nearest competitor of Massachusetts. There is a steadily increasing product of fine grade fabrics. The output of worsted goods in 1905 ($51,973,944) was more than three-tenths that of the entire country, Rhode Island being second with $44,477,596; in Massachusetts the increase in the value of this product was 28·2% between 1900 and 1905. The value of woollen goods in 1905 ($44,653,940) was more than three-tenths of the entire product for the country; and it was 44·6% more than that of 1900. The value of boots and shoes and cut stock in 1905 was $173,612,660, being 23% greater than in 1900; the value of boots and shoes in 1905 ($144,291,426) was 45·1% of the country's output, that of New York, the second state, being only 10·7%. In this industry, as in the manufacture of cotton goods, Massachusetts has long been without serious rivalry; Brockton, Lynn.

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[1] The yield of cereals and of such other crops in 1907 as are recorded in the *Yearbook* of the United States Department of Agriculture was as follows: Indian corn, 1,584,000 bushels; oats, 245,000 bushels; barley, 64,000 bushels; buckwheat, 42,000 bushels; potatoes, 3,600,000 bushels; hay, 760,000 tons; tobacco, 7,167,500 lb. In the same year, according to the same authority, there were in the state 196,000 milch cows, 92,000 other neat cattle, 45,000 sheep and 70,000 swine.

[2] *The Green Schists and Associated Granites and Porphyries of Rhode Island*, Bulletin, U.S. Geological Survey, No. 311, 1907.

Haverhill, Marlboro and Boston, in the order named, being the principal centres. The third industry in 1905 was that of foundry and machine-shop products ($58,508,793), of which Boston and Worcester are the principal centres. Lesser interests, in the order of importance, with the product value of each in 1905, were: rubber goods ($53,133,020), tanned, curried and finished leather ($33,352,999), in the manufacture of which Massachusetts ranked second among the states; paper and wood pulp[1] ($32,012,247), in the production of which the state ranked second among the states of the Union; slaughtering and meat packing ($30,253,838); printing and publishing ($33,900,748, of which $21,020,237 was the value of newspapers and periodicals); clothing ($21,724,056); electrical machinery, apparatus and supplies ($15,882,216); lumber ($12,636,329); iron and steel, steel works and rolling-mills products ($11,947,731; less than in 1900); cordage and twine ($11,173,521), in the manufacture of which Massachusetts was second only to New York; furniture ($11,092,581); malt liquors ($11,080,944); jewelry ($10,073,595), Massachusetts ranking second to Rhode Island; confectionery ($9,317,996), in which Massachusetts was third among the states.

Many of these industries have a history going back far into colonial times, some even dating from the first half of the 17th century. Textile products were really varied and of considerable importance before 1700. The policy of the British government towards such industries in the colonial period was in general repressive. The non-importation sentiment preceding the War of Independence fostered home manufactures considerably, and the Embargo and Non-Intercourse Acts before the war of 1812, as well as that war itself (despite the subsequent glut of British goods) had a much greater effect; for they mark the introduction of the factory system, which by 1830 was firmly established in the textile industry and was rapidly transforming other industries. Improvements were introduced much more slowly than in England, the cost of cotton machinery as late as 1826 being 50–60% greater in America. The first successful power loom in America was set up at Waltham in 1814. Carding, roving and spinning machines were constructed at Bridgewater in 1786. The first cotton mill had been established in Beverly in 1788, and the first real woollen factory at Byfield in 1794. Woolcard machinery destined to revolutionize the industry was devised by Amos Whittemore (1759–1828) in 1797; spinning jennies were in operation under water-power before 1815. Carpet-weaving was begun at Worcester in 1804. "Not a yard of fancy wool fabric had ever been woven by the power-loom in any country till done by William Crompton at the Middlesex Mills, Lowell, in 1840" (Samuel Lawrence).[2] The introduction of the remarkably complete machinery of the shoe industry was practically complete by 1865, this being the last of the great industries to come under the full dominance of machinery. At Pittsfield and at Dalton is centred the manufacture of fine writing papers, including that of paper used by the national government for bonds and paper money. Four-fifths of all loft-dried paper produced in the country from 1860–1897 was made within 15 m. of Springfield; Holyoke and South Hadley being the greatest producers. Vulcanized rubber is a Massachusetts invention. Most of the imitation jewelry of the United States is produced at Attleboro and North Attleboro, and in Providence, Rhode Island. In 1905 Boston produced 16·4% of all the manufactures of the state, and Lynn, the second city, which had been fifth in 1900, 4·9%. Some industries which have since become dead or of relatively slight magnitude were once of much greater significance, economically or socially: such as the rum-distilling connected with the colonial slave trade, and various interests concerned with shipbuilding and navigation. The packing of pork and beef formerly centred in Boston; but, while the volume of this business has not diminished, it has been greatly exceeded in the west. For many years Massachusetts controlled a vast lumber trade, drawing upon the forests of Maine, but the growth of the west changed the old channels of trade, and Boston carpenters came to make use of western timber. It was between 1840 and 1850 that the cotton manufactures of Massachusetts began to assume large proportions; and about the same time the manufacture of boots and shoes centred there. Medford ships began to be famous shortly after the beginning of the 19th century, and by 1845 that town employed one quarter of all the shipwrights in the state.

Fishing is an important industry. Drift whales were utilized in the earliest years of the colony, and shore boating for the baleen (or "right") whale—rich in bone and in blubber yielding common oil—was an industry already regulated by various towns before 1650; but the pursuit of the sperm whale did not begin until about 1713. The former industry had died out before the War of Independence; the latter is not yet quite extinct. Nantucket and New Bedford were the centres of the whaling trade, which, for the energy and skill required and the length (three to five years when sailing vessels were employed) of the ever-widening voyages which finally took the fishermen into every quarter of the globe, contributes the most romantic chapters in the history of American commerce. At one time it gave occupation to a thousand ships, but the introduction of petroleum gradually diminished this resource of the lesser ports. The Newfoundland Bank fisheries were of greater economic importance and are still very important. Gloucester is the chief centre of the trade. The value of fishery products in 1895 was $5,703,143, and in 1905 $7,025,249; and 15,694 persons were engaged in the fisheries. Though cod is much the most important fish (in 1905 fresh cod were valued at $991,679, and salted cod at $696,928), haddock (fresh, $1,051,910; salted, $17,194), mackerel (value in 1905, including horse mackerel, $970,876), herring (fresh, $266,699; salted, $114,997), pollock ($267,927), hake ($258,438), halibut ($218,232), and many other varieties are taken in great quantities. The shell fisheries are less important than those of Maine.

Commerce.—Already by 1660 New England products were an "important element in the commerce and industries of the mother country" (Weeden). Codfish was perhaps the truest basis of her commerce, which soon came to include the West Indies, Africa and southern Europe. Of fundamental importance was the trade with the French West Indies, licit and illicit, particularly after the Peace of Utrecht (1713). Provisions taken to Newfoundland, poor fish to the West Indies, molasses to New England, rum to Africa and good cod to France and Spain, were the commonest ventures of foreign trade. The English Navigation Acts were generally evaded, and were economically of little effect; politically they were of great importance in Massachusetts as a force that worked for independence. Privateering, piracy and slave-trading—which though of less extent than in Rhode Island became early of importance, and declined but little before the American War of Independence—give colour to the history of colonial trade.

Trade with China and India from Salem was begun in 1785 (first voyage from New York, 1784), and was first controlled there, and afterwards in Boston till the trade was lost to New York. The Boston trade to the Canadian north-west coast was begun in 1788. The first regular steamship line from Boston to other American Atlantic ports was established in 1824. In commercial relations the chief port of Massachusetts attained its greatest importance about 1840, when it was selected as the American terminus of the first steamship line (Cunard) connecting Great Britain with the United States; but Boston lost the commercial prestige then won by the failure of the state to promote railway communication with the west, so as to equal the development effected by other cities. The decline of commerce, however, had already begun, manufacturing supplanting it in importance; and this decline was rapid by 1850. From 1840 to 1860 Massachusetts-built ships competed successfully in the carrying trade of the world. Before 1840 a ship of 500 tons was a large ship, but after the discovery of gold in California the size of vessels increased rapidly and their lines were more and more adapted to speed. The limit of size was reached in an immense clipper of 4555 tons, and the greatest speed was attained in a passage from San Francisco to Boston in seventy-five days, and from San Francisco to Cork in ninety-three days. The development of steam navigation for the carrying of large cargoes has driven this fleet from the sea. Only a small part of the exports and imports of Massachusetts is now carried in American bottoms.[3] The first grain elevator built in Boston, and one of the first in the world, was erected in 1843, when Massachusetts sent Indian corn to Ireland. When the Civil War and steam navigation put an end to the supremacy of Massachusetts wooden sailing ships, much of the capital which had been employed in navigation was turned into developing railway facilities and coasting steamship lines. In 1872 the great fire in Boston made large drains upon the capital of the state, and several years of depression followed. But in 1907 Boston was the second port of the United States in the magnitude of its foreign commerce. In that year the value of imports at the Boston-Charlestown customs district was $123,411,168, and the value of exports was $104,610,908; for 1909 the corresponding figures were $127,025,654 and $72,936,869. Other ports of entry in the state in 1909 were Newburyport, Gloucester, Salem, Marblehead, Plymouth, Barnstable, Nantucket, Edgartown, New Bedford and Fall River. A protective tariff was imposed in early colonial times and protection was generally approved in the state until toward the close of the 19th century, when a strong demand became apparent for reciprocity with Canada and for tariff reductions on the raw materials (notably hides) of Massachusetts manufactures.

At the end of 1908 the length of railway lines within the state was 2,109·33 miles. The Hoosac Tunnel, $5\frac{3}{4}$ m. long, pierces the Hoosac Mountain in the north-west corner of the state, affording a communication with western lines. It cost about $20,000,000, the state lending its credit, and was built between 1855 and 1874. The inter-urban electric railways are of very great importance in the state; in 1908 the total mileage of street and inter-urban electric railways was 2841·59 m. (2233·85 m. being first main track). The Cape Cod canal, 12 m. long, from Sandwich on Barnstable Bay to Buzzard's Bay, was begun in June 1909, with a view to shortening the distance by water from Boston to New York and eliminating the danger of the voyage round Cape Cod.

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[1] In 1905 Massachusetts produced 60·7% of the writing paper manufactured in the country. Besides writing paper, book paper and building paper are made in the state, but very little newspaper.

[2] It must be noted, however, that the first successful construction of cards, drawing and roving, and of spindles, on the Arkwright principle was by S. Slater at Pawtucket, Rhode Island in 1790.

[3] The tax valuation on ships engaged in foreign trade was lowered between 1884 and 1900 from $2,801,405 to $147,768.

Population.—The population of the state in 1910 was 3,366,416, the increases in successive decades after 1790 being respectively 11·6, 11·6, 10·9, 16·6, 20·9, 34·8, 23·8, 18·4, 22·4, 25·6, 25·3 and 20%.[1] With the exception of Rhode Island, it is the most densely populated state in the Union, the average number to the square mile in 1900 being 349 (in 1910, 418·8), and the urban population, *i.e.* the population of places having above 8000 or more inhabitants, being 69·9 % in 1890 and in 1900 76·0 % of the total population (in places above 2500, 91·5 %; in places above 25,000, 58·3 %). The female population is greater (and has been since 1765, at least) than the male, the percentage being in 1900 greater than in any other state of the Union (51·3 %; District of Columbia, owing to clerks in government service 52·6 %). In 1900 less than 1·3 % of the population was coloured; 30·2 % were foreign-born (this element having almost continuously risen from 16·49 % in 1855), and 62·3 % of all inhabitants and 46·5 % of those native-born had one or both parents of foreign birth. Ireland contributed the largest proportion of the foreign-born (29·5 %), although since 1875 the proportion of Irish in the total population has considerably fallen. After the Irish the leading foreign elements are Canadian English (18·7 %), Canadian French (15·8 %) and English (9·7 %), these four constituting three-fourths of the foreign population. Since 1885 the natives of southern Italy have greatly increased in number. Of the increase in total population from 1856–1895 only a third could be attributed to the excess of births over deaths; two-thirds being due to immigration from other states or from abroad. Boston is the second immigrant port of the country. A large part of the trans-atlantic immigrants pass speedily to permanent homes in the west, but by far the greater part of the Canadian influx remains.

According to the census of 1910 there were 32 incorporated cities[2] in Massachusetts, of which 6 had between 12,000 and 20,000 inhabitants; 3 between 20,000 and 25,000 (Gloucester, Medford and North Adams); 11 between 25,000 and 50,000 (Malden, Haverhill, Salem, Newton, Fitchburg, Taunton, Everett, Quincy, Pittsfield, Waltham, Chicopee); 7 between 50,000 and 100,000 (New Bedford, Lynn, Springfield, Lawrence, Somerville, Holyoke, Brockton); and 5 more than 100,000 (Boston, 670,585; Worcester, 145,986; Fall River, 119,295; Lowell, 106,294; Cambridge, 104,839).

Taking quinquennial periods from 1856–1905 the birth-rates were 29·5, 25·3, 26·0, 27·6, 24·2, 25·0, 25·8, 27·6, 27·0 and 24·2 per 1,000; and the death-rates 17·7, 20·7, 18·2, 20·8, 18·8, 19·8, 19·4, 19·8, 18·0 and 16·4.[3] Pneumonia and consumption, approximately of equal fatality (15 to 18 per 10,000 each), exceed more than twofold the diseases of next lower fatality, cancer and cholera infantum.

Of males (1,097, 581) engaged in 1900 in gainful occupations 47·1 % were engaged in manufacturing and mechanical pursuits (77·9 in every 100 in 1870 and 73 in 1900), 27·1 in trade and transportation, 14·2 in domestic and personal service, 7·4 in agricultural pursuits and 4·2 in professional service. The corresponding percentages for females (1,169,467) were 46·4 in manufacturing (in 1890, 52 %), 32·3 in domestic and personal service, 13·6 in trade and transportation, 7·1 in professional service and 0·6 in agriculture. Formerly farmers' daughters of native stock were much employed in factories; but since operatives of foreign birth or parentage have in great part taken their places, they have sought other occupations, largely in the manufacture of small wares in the cities, and particularly in departments of trade where skilled labour is essential. Household service is seldom now done, as it formerly was, by women of native stock. The federal census of 1900 showed that of every 100 persons employed for gain only 37·5 % were of native descent (that is, had a native-born father). Natives heavily predominated in agriculture and the professions, slightly in trade, and held barely more than half of all governmental positions; but in transportation, personal service, manufactures, labour and domestic service, the predominance of the foreign element warranted the assertion of the state Bureau of Statistics of Labour that "the strong industrial condition of Massachusetts has been secured and is held not by the labour of what is called the 'native stock,' but by that of the immigrants." After the original and exclusively English immigration from 1620 to 1640 there was nothing like regular foreign immigration until the 19th century; and it was a favourite assertion of Dr Palfrey that the blood of the fishing folk on Cape Cod was more purely English through two centuries than that of the inhabitants of any English county.

With foreign immigration the strength of the Roman Catholic Church has greatly increased: in 1906 of every 1000 of estimated population 355 were members of the Roman Catholic Church (a proportion exceeded only in New Mexico and in Rhode Island; 310 was the number per 1000 in Louisiana), and only 148 were communicants of Protestant bodies; in 1906 there were 1,080,706 Roman Catholics (out of a total of 1,562,621 communicants of all denominations), 119,196 Congregationalists, 80,894 Baptists, 65,498 Methodists and 51,636 Protestant Episcopalians.

Reference has been made to "abandoned farms" in Massachusetts. The desertion of farms was an inevitable result of the opening of the great cereal regions of the west, but it is by no means characteristic of Massachusetts alone. The Berkshire district affords an excellent example of the interrelations of topography, soil and population. Many hill towns once thriving have long since become abandoned, desolate and comparatively inaccessible; though with the development of the summer resident's interests many will probably eventually regain prosperity. Almost half of the highland towns reached their maximum population before the opening of the 19th century, although Berkshire was scarcely settled till after 1760; and three-fourths of them before 1850. On the other hand three-fourths of the lowland towns reached their maximum since that date, and half of them since 1880. The lowland population increased six and a half times in the century, the upland diminished by an eighth. Socially and educationally the upland has furnished an interesting example of decadence. Since 1865 (at least) various parts of Cape Cod have shrunk greatly in population, agriculture and manufactures, and even in fishing interests; this reconstruction of industrial and social interests being, apparently, simply part of the general urban movement—a movement toward better opportunities. What prosperity or stability remains in various Cape Cod communities is largely due to foreign immigrants—especially British-Americans and Portuguese from the Azores; although the population remains, to a degree exceptional in northern states, of native stock.

Government.—Representative government goes back to 1634, and the bicameral legislature to 1644. The constitution of 1780, which still endures (the only remaining state constitution of the 18th century), was framed in the main by Samuel Adams, and as an embodiment of colonial experience and revolutionary principles, and as a model of constitution-making in the early years of independence, is of very great historical interest. It has been amended with considerable freedom (37 amendments up to 1907), but with more conservatism than has often prevailed in the constitutional reform of other states; so that the constitution of Massachusetts is not so completely in harmony with modern democratic sentiment as are the public opinion and statute law of the state. The commonwealth, for example, is still denominated "sovereign," and education is not declared a constitutional duty of the commonwealth. One unique feature is the duty of the supreme court to give legal advice, on request, to the governor and council. Another almost equally exceptional feature is the persistence of the colonial executive council, consisting of members chosen to represent divisions of the state, who assist the governor in his executive functions. Massachusetts is also one of the few states in which the legislature meets in annual session.[4] Townships were represented as such in this body (called the General Court) until 1856. Religious qualifications for suffrage and office-holding were somewhat relaxed, except in the case of

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[1] The population of the state was 378,787 in 1790; 422,845 in 1800; 472,040 in 1810; 523,287 in 1820; 610,408 in 1830; 737,699 in 1840; 994,514 in 1850; 1,231,066 in 1860; 1,457,351 in 1870; 1,783,085 in 1880; 2,238,943 in 1890; and 2,805,346 in 1900. In 1905, according to the state census, the population was 3,003,680, or about 7·7 % more than in 1900.

[2] In 1910 the following townships each had populations of more than 15,000: Revere, Leominster, Westfield, Attleborough, Peabody, Hyde Park.

[3] The birth-rates every fifth (census) year up to 1895 varied for natives from 14·48 to 19·49; for foreigners from 45·87 to 66·68. The marriage rates in quinquennial periods up to 1905 were 19·6, 18·6, 21·0, 19·8, 15·6, 18·6, 18·6, 18·6, 17·4 and 17·4; the ratio of marriages to the marriageable population was for males (above 16 years) 61·5, for females (above 14) 46·0; the fecundity of marriages seemed to have increased, being about twice as high for foreigners as for natives. See *Annual Report* of the Board of Health (1896), by S. W. Abbott; and *Sixty-fourth Report of Births, Marriages and Deaths in Massachusetts* (1906).

[4] The number of representatives from 1832 to 1908 varied from 240 to 635, and the length of session from 58 to 206 days (since 1867 none of under 100 days), with an almost continual increase in both respects.

Roman Catholics, after 1691.[1] Real toleration in public opinion grew slowly through the 18th century, removing the religious tests of voters; and a constitutional amendment in 1821 explicitly forbade such tests in the case of office-holders. Property qualifications for the suffrage and for office-holding—universal through colonial times—were abolished in the main in 1780. From 1821 to 1891 the payment of at least a poll-tax was a condition precedent to the exercise of the suffrage. An educational test (dating from 1857) is exacted for the privilege of voting, every voter being required to be able to read the constitution of the commonwealth in the English language, and to write his name. The property qualification of the governor was not abolished until 1892. In the presidential election of 1896, when an unprecedentedly large vote was cast, the number of voters registered was nearly 20 % of the population, and of these nearly 82 % actually voted. Massachusetts is one of the only two states in the Union in which elections for state officers are held annually. In 1888 an act was passed providing for the use in state elections of a blanket ballot, on which the names of all candidates for each office are arranged alphabetically under the heading of that office, and there is no arrangement in party columns. This was the first state law of the kind in the country. The same method of voting has been adopted in about two-thirds of the townships of the state. A limited suffrage was conferred upon women in 1879. Every female citizen having the qualifications of a male voter may vote in the city and town elections for members of the school committee.

A householder with a family may, by recording the proper declaration in a registry of deeds, hold exempt from attachment, levy on execution, and sale for the payment of debts thereafter contracted an estate of homestead, not exceeding $800 in value, in a farm or lot with buildings thereon which he lawfully possesses by lease or otherwise and occupies as his residence. The exemption does not extend, however, to the prohibition of sale for taxes, and in case the householder's buildings are on land which he has leased those buildings are not exempt from sale or levy for the ground rent. If the householder has a wife he can mortgage or convey his estate of homestead only with her consent, and if he dies leaving a widow or minor children the homestead exemption survives until the youngest child is twenty-one years of age, or until the death or marriage of the widow, provided the widow or a child continues to occupy it.

The scope of state activity has become somewhat remarkable. In addition to the usual state boards of education (1837), agriculture (1852), railroad commissioners (1869), health (1869), statistics of labour, fisheries and game, charity (1879), the dairy bureau (1891), of insanity (1898), prison, highways, insurance and banking commissions, there are also commissions on ballot-law, voting machines, civil service (1884), uniformity of legislation, gas and electric lighting corporations, conciliation and arbitration in labour disputes (1886), &c. There are efficient state boards of registration in pharmacy, dentistry and medicine. Foods and drugs have been inspected since 1882. In general it may be said that the excellence of administrative results is noteworthy. The work of the Bureau of Statistics of Labor, of the Bureau of Health, of the Board of Railroad Commissioners, and of the Board of Conciliation and Arbitration, and the progress of civil service, have been remarkable for value and efficiency. Almost all state employees are under civil service rules; the same is true of the city of Boston; and of the clerical, stenographic, prison, police, civil engineering, fire, labour-foreman, inspection and bridge tender services of all cities; and under a law (1894) by which cities and towns may on petition enlarge the application of their civil service rules. Various other public services, including even common labourers of the larger towns, are rapidly passing under civil service regulation. Veterans of the Civil War have privileges in the administration of the state service. In the settlement of labour disputes conciliatory methods were successful in the formative period, when the parties to disputes adopted customary attitudes of hostility and fought to the end unless they were reconciled by the Board to a final agreement or to an agreement to arbitrate.[2] In this earlier period (before 1900), thanks to the efforts of the board there was an increase in the frequency of appeal to arbitration, and settlements by compromise were often made. Afterwards the number of arbitrations by the board increased in number: from 1900 to 1908 (inclusive), of 568 controversies submitted to the board, 525 were settled by an award and 43 by an induced agreement. In the same period the mediation of the Board settled disputes affecting 5560 establishments; and in the latter half of this period labour disputes involving hostilities and of the magnitude contemplated by the statute governing the Board of Conciliation and Arbitration had almost disappeared. The laws relating to labour are full, but, as compared with those of other states, present few features calling for comment.[3] In 1899 eight hours were made to constitute a day's work for all labourers employed by or for any city or town adopting the act at an annual election. Acts have been passed extending the common-law liability of employers, prohibiting the manufacture and sale of sweat-shop clothing, and authorizing cities and towns to provide free lectures and to maintain public baths, gymnasia and playgrounds. Boston has been a leader in the establishment of municipal baths. The state controls and largely maintains two beaches magnificently equipped near the city. The Massachusetts railroad commission, though preceded in point of time by that of New Hampshire of 1844, was the real beginning of modern state commissions. Its powers do not extend to direct and mandatory regulation, being supervisory and advisory only, but it can make recommendations at its discretion, appealing if necessary to the General Court; and it has had great influence and excellent results. The Torrens system of land registration was adopted in 1898, and a court created for its administration. In the case of all quasi-public corporations rigid laws exist prohibiting the issue of stock or bonds unless the par value is first paid in; prohibiting the declaration of any stock or scrip dividend, and requiring that new stock shall be offered to stockholders at not less than its market value, to be determined by the proper state officials, any shares not so subscribed for to be sold by public auction. These laws are to prevent fictitious capitalization and "stock-watering." In the twenty years preceding 1880 60 % of all sentences for crime were found traceable to liquor. In 1881 a local option law was passed, by which the granting of licences for the sale of liquor was confined to cities and towns voting at the annual election to authorize their issue. In 1888 the number of licences to be granted in municipalities voting in favour of their issue was limited to one for each 1000 inhabitants, except in Boston, where one licence may be issued for every 500 inhabitants. The vote varies from year to year, and it is not unusual for a certain number of municipalities to change from "licence" to "no licence," and vice versa. The general result has been that centres of population, especially where the foreign element is large, usually vote for licence, while those in which native population predominates, as well as the smaller towns, usually vote for prohibition. Through a growing acquiescence in the operation of the local option law, the relative importance of the vote of the Prohibition Party has diminished. Since 1895 indeterminate sentences have been imposed on all convicts sentenced to the state prison otherwise than for life or as habitual criminals; *i.e.* maximum and minimum terms are established by law and on the expiration of the latter a revocable permit of liberty may be issued. Execution by electricity has been the death penalty since 1898. Stringent legislation controls prison labour.

The extension of state activity presents some surprising features in view of the strength of local self-sufficiency nurtured by the old system of township government. But this form of pure democracy was in various cases long since inevitably abandoned: by Boston reluctantly in 1822, and subsequently by many other townships or cities, as growing population made action in town meeting unbearably cumbersome. In modern times state activity has encroached on the cities. Especially has the commonwealth undertaken certain noteworthy enterprises as the agent of the several municipalities in the immediate vicinity of Boston, constituting what is known as the Metropolitan District; as, for example, in bringing water thither from the Nashua River at Clinton, 40 m. from Boston, and in the development of a magnificent park system of woods, fells, river-banks and seashore, unrivalled elsewhere in the country. The commonwealth joined the city of Boston in the construction of a subway beneath the most congested portion of the city for the passage of electric cars. For the better accommodation of the increasing commerce of the port of Boston, the commonwealth bought a considerable frontage upon the harbour lines and constructed a dock capable of receiving the largest vessels, and has supplemented the work of the United States government in deepening the approaches to the wharves. It has secured as public reservations the summit and sides of Greylock (3535 ft.) in the north-west corner of the state, and of Wachusett (2108 ft.) near the centre. Since 1885 a large expenditure has been incurred in the abolition of grade crossings of railways and highways,[1] and in 1894 the commonwealth began the construction and maintenance of state highways.[2]

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[1] However, every office-holder was, and every subject might be, required to take (though this was not a condition of the franchise) the oaths enjoined by parliament in the first year of the reign of William and Mary as a substitute for the oaths of Allegiance and Supremacy; and the same still applies to the signing of the Declaration.

[2] From 1887–1900, out of 290 cases settled, only 107 were formal arbitrations, 124 agreements were effected by the mediation of the Board, 100 were effected otherwise while proceedings were pending, and in 59 cases the Board interposed when the parties preferred hostilities.

[3] For a summary statement of state labour laws in the United States in 1903 see *Bulletin 54* of the United States Bureau of Labor, September 1904; and for a summary of labour laws in force at the end of 1907 see 22nd *Annual Report* (for 1907) of the U.S. Commissioner of Labor (Washington, 1908).

Since 1885, in Boston, and since 1894, in Fall River, the administration of the city police departments, including the granting of liquor licences, has been in the hands of state commissioners (one commissioner in Boston, a board in Fall River) appointed by the governor. But though in each case the result has been an improved administration, it has been generally conceded that only most exceptional circumstances can justify such interference with local self-government, and later attempts to extend the practice have failed. The referendum has been sparingly used in matters of local concern. Beginning in 1892 various townships and cities, numbering 18 in 1903, adopted municipal ownership and operation of lighting works. The gasworks have been notably more successful than the electric plants.

In Massachusetts, as in New England generally, the word "town" is used, officially and colloquially, to designate a township, and during the colonial era the New England town-meeting was a notable school for education in self-government. The members of the first group of settlers in these colonies were mostly small farmers, belonged to the same church, and dwelt in a village for protection from the Indians. They adapted to these conditions some of the methods for managing local affairs with which they had been familiar in England, and called the resultant institution a town. The territorial extent of each town was determined by its grant or grants from the general court, which the towns served as agents in the management of land. A settlement or "plantation" was sometimes incorporated first as a "district" and later as a town, the difference being that the latter had the right of corporate representation in the general court, while the former had no such right. The towns elected (until 1856) the deputies to the general court, and were the administrative units for the assessment and collection of taxes, maintaining churches and schools, organizing and training the militia, preserving the peace, caring for the poor, building and repairing roads and bridges, and recording deeds, births, deaths and marriages; and to discuss questions relating to these matters as well as other matters of peculiarly local concern, to determine the amount of taxes for town purposes, and to elect officers. All the citizens were expected to attend the annual town-meeting, and such male inhabitants as were not citizens were privileged to attend and to propose and discuss measures, although they had no right to vote. Generally several villages have grown up in the same "town," and some of the more populous "towns," usually those in which manufacturing has become more important than farming, have been incorporated as "cities"; thus either a town or a city may now include a farming country and various small villages. Although the tendency in Massachusetts is towards chartering as cities "towns" which have a population of 12,000 or more, the democratic institution of the town-meeting persists in many large municipalities which are still technically towns.[3] Most "towns" hold their annual meeting in March, but some hold them in February and others in April. In the larger "towns" the officers elected at this meeting may consist of five, seven or nine selectmen, a clerk, a treasurer, three or more assessors, three or more overseers of the poor, one or more collectors of taxes, one or more auditors, one or more surveyors of highways, a road commissioner, a sewer commissioner, a board of health, one or more constables, two or more field drivers, two or more fence viewers, and a tree warden; but in the smaller "towns" the number of selectmen may be limited to three, the selectmen may assess the taxes, be overseers of the poor, and act as a board of health, and the treasurer or constable may collect the taxes. The term of all these officers may be limited to one year, or the selectmen, clerk, assessors and overseers of the poor may be elected for a term of three years, in which case a part only of the selectmen, assessors and overseers of the poor are elected each year. The selectmen have the general management of a "town's" affairs during the interval between town-meetings. They may call special town-meetings; they appoint election officers and may appoint additional constables or public officers, and such minor officials as inspectors of milk, inspectors of buildings, gauger of measures, cullers of staves and hoops, fish warden and forester. A school committee consisting of any number of members divisible by three is chosen, one-third each year, at the annual town-meeting or at a special meeting which is held in the same month. Any "town" having a village or district within its limits that contains 1000 inhabitants or more may authorize that village or district to establish a separate organization for lighting its streets, building and maintaining sidewalks, and employing a watchman or policeman, the officers of such organization to include at least a prudential committee and a clerk. All laws relative to "towns" are applied to "cities" in so far as they are not inconsistent with general or special laws relative to the latter, and the powers of the selectmen are vested in the mayor and aldermen.

Education.—For cities of above 8000 inhabitants (for which alone comparative statistics are annually available), in 1902–1903 the ratio of average attendance to school enrolment, the average number of days' attendance of each pupil enrolled, and the value of school property per capita of pupils in average attendance were higher than in any other state; the average length of the school term was slightly exceeded in eight states; and the total cost of the schools per capita of pupils in average attendance ($39·05) was exceeded in six other states. In 1905–1906 the percentage of average attendance in the public schools to the number of children (between 5 and 15 years) in the state was 80; in Barnstable county it was 95, and in Plymouth 92; and the lowest rate of any county was 68, that of Bristol. In the same year the amount of the various school taxes and other contributions was $30·53 for each child in the average membership of the public schools, and the highest amount for each child in any county was $35·77 in Suffolk county, and in any township or city $68·01—in Lincoln. The school system is not one of marked state centralization—as contrasted, *e.g.* with New York. A state board of education has general control, its secretary acting as superintendent of the state system in conjunction with local superintendents and committees. Women are eligible for these positions, and among the teachers in the schools they are greatly in excess over men (more than 10 to 1), especially in lower grades. No recognition exists in the schools of race, colour or religion. The proportion of the child population that attends schools is equalled in but two or three states east of the Mississippi river. The services of Horace Mann (*q.v.*) as secretary of the state board (1837–1848) were productive of almost revolutionary benefits not only to Massachusetts but to the entire country. His reforms, which reached every part of the school system, were fortunately introduced just at the beginning of railway and city growth. Since 1850 truant and compulsory attendance laws (the first compulsory education law was passed in 1642) have been enforced in conjunction with laws against child labour. In 1900 the average period of schooling per inhabitant for the United States was 4·3 years, for Massachusetts 7 years. (The same year the ratio of wealth productivity was as 66 to 37.) Massachusetts stands "foremost in the Union in the universality of its provision for secondary education."[4] The laws practically offer such education free to every child of the commonwealth. Illiterate persons not less than ten years of age constituted in 1900 5·9 % of the population; and 0·8, 14·6, 10·7 % respectively of native whites, foreign-born whites and negroes. More patents are issued, relatively, to citizens of Massachusetts than to those of any other state except Connecticut. Post office statistics indicate a similarly high average of intelligence.

The public school system includes common, high and normal schools, and various evening, industrial and truant schools. Many townships and cities maintain free evening schools. In 1894 manual training was made a part of the curriculum in all municipalities having 20,000 inhabitants. There are also many private business colleges, academic schools and college-preparatory schools. The high schools enjoy an exceptional reputation. An unusual proportion of teachers in the public schools are graduates of the state normal schools, of which the first were founded in 1839 at Lexington and Barre, the former being the first normal school of the United

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[1] The usual allotment of the cost of this work is as follows: 65 % is paid by the railway company, 25 % by the commonwealth and 10 % by the municipality in which the crossing is located.

[2] The cost was apportioned between the commonwealth and the local government in the proportion of 3 to 1.

[3] Boston remained a township, governed by town-meetings, until 1822, when it had a population of some 47,000. The government of Brookline (pop. in 1905, 23,436) is an interesting example of the adaptation of the township system to urban conditions. The town is frequently referred to as a model residential suburb; its budgets are very large, its schools are excellent, and, among other things, it has established a township gymnasium. The town hall is not large enough for an assemblage of all the voters, but actually the attendance is usually limited to about 200, and since 1901 there has been in force a kind of referendum, under which any measure passed by a town-meeting attended by 700 or more voters may be referred, upon petition of 100 legal voters, to a regular vote at the polls. Much of the work of the town-meetings is done through special committees.

[4] E. G. Brown, in *Monographs on Education in the United States* prepared for the Paris Exposition of 1900 and edited by N. M. Butler.

States.[1] These two schools were removed subsequently to Framingham (1853) and Westfield (1844), where they are still active; while others flourish at Bridgewater (1840), Salem (1854), Worcester (1874), Fitchburg (1895), North Adams (1897), Hyannis (1897) and Lowell (1897), that at Framingham being open to women only. There is also a state normal art school at Boston (1873) for both sexes.

The commonwealth contributes to the support of textile schools in cities in which 450,000 spindles are in operation. Such schools exist (1909) in Lowell, Fall River and New Bedford. The commonwealth also maintains aboard a national ship a nautical training school (1891) for instruction in the science and practice of navigation. During the Spanish-American War of 1898 more than half of the graduates and cadets of the school enlisted in the United States service.

There are several hundred private schools, whose pupils constituted in 1905–1906 15·7 % of the total school-enrolment of the state. Of higher academies and college-preparatory schools there are scores. Among those for boys Phillips Academy, at Andover, the Groton school, and the Mount Hermon school are well-known examples. For girls the largest school is the Northfield Seminary at East Northfield. In Boston and in the towns in its environs are various famous schools, among them the boys' classical school in Boston, founded in 1635, one of the oldest secondary schools in the country. The leading educational institution of the state, as it is the oldest and most famous of the country, is Harvard University (founded 1636) at Cambridge. In the extreme north-west of the state, at Williamstown, is Williams College (1793), and in the Connecticut Valley is Amherst College (1821), both of these unsectarian. Boston University (Methodist Episcopal, 1867); Tufts College (1852), a few miles from Boston in Medford, originally a Universalist school; Clark University (1889, devoted wholly to graduate instruction until 1902, when Clark College was added), at Worcester, are important institutions. Two Roman Catholic schools are maintained—Boston College (1863) and the College of the Holy Cross (1843), at Worcester. Of various institutions for the education of women, Mount Holyoke (1837) at South Hadley, Smith College (1875) at Northampton, Wellesley College (1875) at Wellesley near Boston, Radcliffe College (1879) in connexion with Harvard at Cambridge and Simmons College (1899) at Boston, are of national repute. The last emphasizes scientific instruction in domestic economy.

For agricultural students the state supports a school at Amherst (1867), and Harvard University the Bussey Institution. In technological science special instruction is given—in addition to the scientific departments of the schools already mentioned—in the Worcester Polytechnic Institute (1865), and the Massachusetts Institute of Technology (opened in 1865). There are schools of theology at Cambridge (Protestant Episcopal), Newton (Baptist) and Waltham (New Church), as well as in connexion with Boston University (Methodist), Tufts College (Universalist) and Harvard (non-sectarian, and the affiliated Congregational Andover Theological Seminary at Cambridge). Law and medical schools are maintained in Boston and Harvard universities.

Public Institutions.—Massachusetts was in 1903, in proportion to the population, more richly provided with public collections of books than any other state: in that year she had nearly a seventh of all books in public, society and school libraries in the country, and a much larger supply of books per capita (2·56) than any other state. The rate for New York, the only state having a larger number of books in such libraries, being only 1·19. The Boston public library, exceeded in size in the United States by the library of Congress at Washington—and probably first, because of the large number of duplicates in the library of Congress—and the largest free municipal library in the world; the library of Harvard, extremely well chosen and valuable for research; the collections of the Massachusetts Historical Society (1791); the Boston Athenaeum (1807); the State Library (1826); the New England Historic Genealogical Society (1845); the Congregational Library; the American Academy of Arts and Sciences (1780); and the Boston Society of Natural History (1830), all in Boston, leave it easily unrivalled, unless by Washington, as the best research centre of the country. The collections of the American Antiquarian Society (1812) at Worcester are also notable. Massachusetts led, about 1850, in the founding of town and city libraries supported by public taxes, and by 1880 had established more of such institutions than existed in all other states combined. In 1900 out of 353 towns and cities only five, representing less than half of 1 %, were without free library facilities, and three of these five had association libraries charging only a small fee.

The state is very well supplied with charitable and reformatory institutions, in which noteworthy methods have been employed with success. The state institutions, each governed by a board of trustees, and all under the supervision of the state board of charity, include a state hospital at Tewksbury, for paupers (1866); a state farm at Bridgewater (1887) for paupers and petty criminals; the Lyman school for boys at Westboro, a reformatory for male criminals under fifteen years of age sentenced to imprisonment for terms less than life in connexion with which a very successful farm is maintained for the younger boys at Berlin; an industrial school for girls at Lancaster, also a reformatory school—a third reformatory school for boys was planned in 1909; a state sanatorium at Rutland for tuberculous patients (the first public hospital for such in the United States) and a hospital school at Canton for the care and instruction of crippled and deformed children. Three more hospitals for consumptives were planned in 1909. Under the supervision of the state board of insanity, and each under the government of a board of seven trustees (of whom two are women) are state hospitals for the insane at Worcester (1833), Taunton, Northampton, Danvers, Westboro and Medford, a state colony for the insane at Gardner, a state hospital for epileptics at Palmer, a state school for the feeble-minded at Waltham (governed by six trustees), a state school at Wrentham, state "hospital cottages for children" (1882) at Baldwinville (governed by five trustees), and the Foxboro state hospital for dipsomaniacs and insane. There are also semi-state institutions for the insane at Waverley, Barre, Wrentham and Baldwinville, and nineteen small private institutions, all under the supervision of the state board of insanity. Under the supervision of a board of prison commissioners, which appoints the superintendent and warden of each, are a reformatory prison for women at Sherborn (1877), a state reformatory for men at Concord (1884), a state prison at Boston (Charlestown), and a prison camp and hospital at Rutland (1905). There is a prison department at the state farm which receives misdemeanants. Other institutions receiving state aid, each governed by trustees appointed by the governor, are the Massachusetts general hospital at Boston, the Massachusetts charitable eye and ear infirmary at Boston, the Massachusetts homoeopathic hospital at Boston, the Perkins Institution and Massachusetts school for the blind at South Boston and the soldiers' home in Massachusetts at Boston. The Horace Mann school in Boston, a public day school for the deaf, the New England industrial school for deaf mutes at Beverly and the Clarke school for the deaf at Northampton are maintained in part by the state. Finally, many private charitable corporations (about 500 in 1905) report to the state board of charity, and town and city almshouses (205 in 1904) are subject to visitation. The Perkins Institution is memorable for its association with the fame of S. G. Howe (*q.v.*), whose reforms in charity methods were felt through all the charitable interests of the state. The net yearly cost of support and relief from 1884 to 1904 averaged $2,136,653, exclusive of vagrancy cases (average $31,714). The whole number of paupers, besides vagrants, in 1908 was 23·02 per 1000 of state population, and the cost of relief ($5,104,255) was $1·699 for each inhabitant of the state. The number of sane paupers declined steadily and markedly from 1863 to 1904.

Finance.—Massachusetts is a very rich state, and Boston a very wealthy city. The debt of the state (especially the contingent debt, secured by sinking funds) has been steadily rising since 1888, and especially since 1896, chiefly owing to the erection of important public buildings, the construction of state highways and metropolitan park roadways, the improvement of Boston harbour, the abolition of grade crossings on railways, and the expenses incurred for the Spanish-American War of 1898.

The net direct funded debt (also secured by accumulating sinking funds) in December 1908 was $17,669,372 (3·61 millions in 1893). The average interest on this and the contingent debt ($60,428,223 in December 1908) combined was only 3·35 %. The net debts of towns and cities rose in the years 1885–1908 from $63,306,213 to $163,558,325. The county debts in 1908 aggregated $6,076,867. The assessed valuation of realty in the state in 1908 was $2,799,062,707 and of personalty $1,775,073,438. No other state has given so vigorous a test of the ordinary American general-property tax, and the results have been as discouraging as elsewhere. The "dooming" process (*i.e.* estimation by assessors, without relief for over-valuation except for excess more than 50% above the proper valuation) was introduced in 1868 as a method of securing returns of personalty. But the most rigorous application of the doomage law has only proved its complete futility as an effort to reach unascertained corporate and personal property.[2] Various special methods are used for the taxation of banks, insurance companies, railways, tramways, trust companies and corporations, some of them noteworthy. In the case of corporations realty and machinery are taxed generally by the local authorities, and stock values by the commonwealth. The Boston stock exchange is the second of the country in the extent of the securities in which it deals. The proportion of holders of U.S. bonds among the total population is higher than that in any other state.

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[1] This is an especially honourable distinction, for William T. Harris has said that "The history of education since the time of Horace Mann is very largely an account of the successive modifications introduced into elementary schools through the direct or indirect influence of the normal school."

[2] In 1869 the personalty valuation was 60 % that of realty; but it steadily fell thereafter, amounting in 1893 to 32 %. From 1874–

History.—It is possible that the coasts of Massachusetts were visited by the Northmen, and by the earliest navigators who followed Cabot, but this is only conjecture. In 1602 Bartholomew Gosnold landed at and named Cape Cod and coasted as far south as the present No-Man's Land, which he named Martin's or Martha's Vineyard, a name later transferred to a neighbouring larger island. Pring and Champlain at a later date coasted along what is now Massachusetts, but the map of Champlain is hardly recognizable. The first sufficient explorations for cartographical record were made by John Smith in 1614, and his map was long the basis—particularly in its nomenclature—of later maps. Permanency of occupation, however, dates from the voyage of the "Mayflower," which brought about a hundred men, women and children who had mostly belonged to an English sect of Separatists, originating in Yorkshire, but who had passed a period of exile for religion's sake in Holland. In the early winter of 1620 they made the coast of Cape Cod; they had intended to make their landing farther south, within the jurisdiction of the Virginia Company, which had granted them a patent; but stress of weather prevented their doing so. Finding themselves without warrant in a region beyond their patent, and threatened with the desertion of disaffected members of their company (probably all servants or men of the "lesser" sort) unless concessions were made to these, they drew up and signed before landing a democratic compact of government which is accounted the earliest written constitution in history.[1] After some exploration of the coast they made a permanent landing on the 21st of December 1620 (N.S.) at Plymouth, a harbour which had already been so named by John Smith in his maps of 1614 and 1616. During the first winter nearly one-half their number died from exposure, and the relations of the survivors with their partners of the London Company, who had insisted that for seven years the plantation should be managed as a joint stock company, were unsatisfactory. However, about thirty-five new colonists arrived in 1622 and ninety-six more in 1623. The abandonment of the communal system was begun in the latter year, and with the dissolution of the partnership with the adventurers of the London Company in 1627 Plymouth became a corporate colony with its chief authority vested in the whole body of freemen convened in the General Court. Upon the death of the first governor, John Carver, in the spring of 1621, the General Court chose William Bradford as his successor, and with him was chosen one assistant. The subsequent elections were annual, and within a few years the number of assistants was increased to seven. The General Court was the legislature and the electorate; the governor and assistants were the executive and the judiciary. The whole body of freemen composed the General Court until other towns than Plymouth had been organized, the first of which were Scituate in 1636 and Duxbury in 1637, and then the representative form of government was adopted and there was a gradual differentiation between Plymouth the town and Plymouth the colony. When it had become known that the colony was within the territory of the New England Council, John Pierce, in 1621, procured from that body a grant which made the colonists its tenants. A year later Pierce surrendered this and procured another, which in effect made him proprietor of the colony, but he was twice shipwrecked and was forced to assign to the adventurers his second patent. In 1629 Governor Bradford procured from the same council a definite grant of the tract which corresponds to the south-eastern portion of the present state. But all attempts to procure a royal charter for Plymouth Colony were unsuccessful, and in 1691 it was annexed to the Colony of Massachusetts Bay under what is termed the Provincial Charter.

King James having by patent in 1620 created a Council for New England to whom he made a large grant of territory, the council in 1628 made a sub-grant, confirmed by a royal charter that passed the seals on the 4th of March 1629, to the "Governor and Company of the Massachusetts Bay in Newe England." There had been various minor expeditions during the few years since Smith was on the coast before this company, in the Puritan interests, had sent over John Endecott with a party in 1628 to what is now Salem. In 1630 the government of the company, with questionable right (for the charter seems evidently to have contemplated the residence of the company in England), transferred itself to their territory, and under the leadership of John Winthrop laid the foundations anew of the Massachusetts colony, when they first settled Boston in the autumn of that year. Winthrop served repeatedly, though not continuously, as governor of the colony till his death in 1649, his rejection in 1636 being due to a party of theological revolt which chose Henry Vane (afterwards Sir Henry) to the office. This was an incident in a famous episode, important rather as a symptom than in itself, namely, the Antinomian controversy, "New England's earliest protest against formulas," in which Vane and Ann Hutchinson took the lead in criticizing the official orthodoxy of the colony.

The magistrates successfully asserted themselves to the discomfiture of their critics (Ann Hutchinson being banished), and this was characteristic of the colony's early history. The charter gave the company control over the admission of "freemen" (co-partners in the enterprise, and voters), "full and absolute power and authority to correct, punish and rule" subjects settling in the territory comprised in their grant, and power to "resist . . . by all fitting ways and means whatever" all persons attempting the "destruction, invasion, detriment or annoyance" of the plantation. Some writers deny the company's right under this instrument to rule as they proceeded to do; but at any rate what they did was to make the suffrage dependent on stringent religious tests, and to repress with determined zeal all theological "vagaries" and "whimsies." Criticism of church or magistrates was not tolerated. Laws were modelled closely on the Bible. The clergy were a ruling class. The government was frankly theocratic. Said Winthrop (1637): "We see not that any should have authority to set up any other exercises besides what authority hath already set up"; and a synod at Cambridge in 1637 catalogued eighty-two "opinions, some blasphemous, others erroneous and all unsafe," besides nine "unwholesome expressions," all of which were consigned "to the devil of hell from whence they came." Another synod at Cambridge in 1647 more formally established the principle of state control. The legislation against Baptists (about 1644–1678) and the persecution of the Quakers (especially 1656–1662) partook of the brutality of the time, including scourging, boring of tongues, cutting of ears and in rare cases capital punishment. It cannot be denied that men like Roger Williams and some of the persecuted Quakers, though undeniably contentious and aggressive in their conscientious dissent, showed a spirit which to-day seems sweeter in tolerance and humanity than that of the Puritans. And it seems necessary to emphasize these facts because until about 1870 it was almost unchallenged tradition to regard the men of Massachusetts Bay as seekers and champions of "religious liberty." They left England, indeed, for liberty to discard the "poperies" of the English Church, and once in Massachusetts they even discarded far more than those

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1882 the assessment of realty increased nearly twelve times as much as personalty. In the intervening period the assessed valuation of realty in Boston increased more than 100%, while that of personalty slightly diminished (the corresponding figures for the entire United States from 1860 to 1890 being 172% and 12%), yet the most competent business and expert opinions regarded the true value of personalty as at least equal to and most likely twice as great as that of realty.

[1] In this document, whose democracy is characteristic of differences between the Plymouth Colony and that of Massachusetts Bay, the signatories "solemnly and mutually . . . covenant and combine ourselves together into a civil body politic, for our better ordering and preservation and furtherance of the ends aforesaid; and by virtue hereof to enact, constitute and frame—[laws]—unto which we promise all due submission and obedience." This was signed 11/21 of November 1620 by 41 persons.

"poperies." But religious liberty in our modern sense they did not seek for themselves, nor accord to others; they abhorred it, they trampled on it, and their own lives they subjected to all the rigid restrictions to which they subjected others. They were narrow but strong; no better example can be imagined of what the French call "the defects of one's qualities." Their failures were small compared with those of their contemporaries in England and elsewhere in Europe, and public opinion did not long sustain violent persecution of opinion. More than once mobs freed Quaker prisoners. Also it is to be said that with the single exception of religious toleration the record of the state in devotion to human rights has been from the first a splendid one, whether in human principles of criminal law, or in the defence of the civil rights commonly declared in American constitutions. It was once generally assumed that the repression practised attained its end of securing harmony of opinion. The fact seems to be that intellectual speculation was as strong in America as in Puritan England; the assumption that the inhibition of its expression was good seems wholly gratuitous, and contrary to general convictions underlying modern freedom of speech. A safer opinion is probably that "the spiritual growth of Massachusetts withered under the shadow of dominant orthodoxy; the colony was only saved from mental atrophy by its vigorous political life" (J. A. Doyle). In literature the second half of the 17th century is a sterile waste of forbidding theology; and its life, judged by the present day, singularly sombre.

In addition to the few persons banished to Rhode Island, theological and political differences led many to emigrate thither. Others, discontented with Massachusetts autocracy and wishing, too, "to secure more room," went to Connecticut (*q.v.*) where they established a bulwark against the Dutch of New York.

A witchcraft scare (at its worst in 1691–1697, though the earliest Connecticut case was in 1646–1647 and the earliest in Boston in 1648) led to another tragedy of ignorance. In all thirty-two persons were executed (according to W. F. Poole, about a thousandth part of those executed for witchcraft in the British Isles in the 16th and 17th centuries). Salem was the scene of the greatest excitement in 1691–1692.

Exceptionally honourable to the early colonists was their devotion to education (see HARVARD UNIVERSITY and BOSTON). Massachusetts Bay had a large learned element; it is supposed that about 1640 there was an Oxford or Cambridge graduate to every 250 persons in the colony. The earliest printing in the British-American colonies was done at Cambridge in 1639; it was not until 1674 that the authorities of the colony permitted printing, except at Cambridge. Boston and Cambridge remain leading publishing centres to-day. The first regular newspaper of Boston, the *Boston Newsletter*, was the pioneer of the American newspaper press.

The early history was rendered unquiet at times by wars with the Indians, the chief of which were the Pequot War in 1637, and King Philip's War in 1675–76; and for better combining against these enemies, Massachusetts, with Connecticut, New Haven and New Plymouth, formed a confederacy in 1643, considered the prototype of the larger union of the colonies which conducted the War of American Independence (1775–83). The struggle with the Crown, which ended in independence, began at the foundation of the colony, with assumptions of power under the charter which the colonial government was always trying to maintain, and the crown was as assiduously endeavouring to counteract. After more than half a century of struggle, the crown finally annulled the charter of the colony in 1684, though not until 1686 was the old government actually supplanted on the arrival of Joseph Dudley, a native of the colony, as president of a provisional council; later, Sir Edmund Andros was sent over with a commission to unite New York and New England under his rule. The colonists had been for many years almost independent; they made their own laws, the Crown appointed natives as officials, and the colonial interpretation of the old charter had in general been allowed to stand. Massachusetts had excluded the English Book of Common Prayer, she had restricted the franchise, laid the death penalty on religious opinions, and passed various other laws repugnant to the Crown, notably to Charles II. and James II.; she had caused laws and writs to run in her own name, she had neglected to exact the oath of allegiance to the sovereign, though carefully exacting an oath of fidelity to her own government, she had protected the regicides, she had coined money with her own seal, she had blocked legal appeals to the English courts, she had not compelled the observance of the navigation acts. The revocation of the charter aroused the strongest fears of the colonists Andros speedily met determined opposition by measures undertaken relative to taxation and land titles, by efforts to secure a church for Episcopal service, and an attempt to curb the town meetings. His government was supported by a small party (largely an Anglican Church party), but was intensely unpopular with the bulk of the people; and—it is a disputed question, whether before or after news arrived of the landing in England of William of Orange—in April 1689 the citizens of Boston rose in revolution, deposed Andros, imprisoned him and re-established their old colonial form of government. Then came a struggle, carried on in England by Increase Mather as agent (1688–1692) of the colony, to secure such a form of government under a new charter as would preserve as many as possible of their old liberties. Plymouth Colony, acting through its agent in London, endeavoured to secure a separate existence by royal charter, but accepted finally union with Massachusetts when association with New York became the probable alternative. The province of Maine was also united in the new provincial charter of 1691, and Sir William Phips came over with it, commissioned as the first royal governor. As has been mentioned already, the new charter softened religious tests for office and the suffrage, and accorded "liberty of conscience" except to Roman Catholics. The old religious exclusiveness had already been greatly lessened: the clergy were less powerful, heresy had thrived under repression, Anglican churchmen had come to the colony and were borne with perforce, devotion to trade and commerce had weakened theological tests in favour of ideals of mere good order and prosperity, and a spirit of toleration had grown.

Throughout the continuance of the government under the provincial charter, there was a constant struggle between a prerogative party, headed by the royal governor, and a popular party who cherished recollections of their practical independence under the colonial charter, and who were nursing the sentiments which finally took the form of resistance in 1775. The intercharter period, 1686–1691, is of great importance in this connexion. The popular majority kept up the feeling of hostility to the royal authority in recurrent combats in the legislative assembly over the salary to be voted to the governor; though these antagonisms were from time to time forgotten in the wars with the French and Indians. During the earl of Bellomont's administration, New York was again united with Massachusetts under the same executive (1697–1701). The scenes of the recurrent wars were mostly distant from Massachusetts proper, either in Maine or on Canadian or Acadian territory, although some savage inroads of the Indians were now and then made on the exposed frontier towns, as, for instance, upon Deerfield in 1704 and upon Haverhill in 1708. Phips, who had succeeded in an attack on Port Royal, had ignominiously failed when he led the Massachusetts fleet against Quebec in 1690; and the later expedition of 1711 was no less a failure. The most noteworthy administration was that of William Shirley (1741–1749 and 1753–1756), who at one time was the commanding officer of the British forces in North America. He made a brilliant success of the expedition against Louisburg in 1745, William Pepperell, a Maine officer, being in immediate command. Shirley with Massachusetts troops also took part in the Oswego expedition of 1755; and Massachusetts proposed, and lent the chief assistance in the expedition of Nova Scotia in 1755 which ended in the removal of the Acadians. Her officers and troops also played an important part in the Crown Point and second Louisburg expedition (1758).

The first decided protests against the exercise of sovereign power by the crown, the first general moral and political revolt that marked the approach of the American War of Independence, took place in Massachusetts; so that the most striking events in the general history of the colonies as a whole from 1760 to 1775 are an intimate part of her annals. The beginning of the active opposition to the crown may be placed in the resistance, led by James Otis, to the issuing of writs (after 1752, Otis's famous argument against them being made in 1760–1761) to compel citizens to assist the revenue officers; followed later by the outburst of feeling at the imposition of the Stamp Act (1765), when Massachusetts took the lead in confronting the royal power. The governors put in office at this time by the crown were not of conciliatory temperaments, and the measures instituted in parliament (see UNITED STATES) served to increase bitterness of feeling. Royal troops sent to Boston (several regiments, 1768) irritated the populace, who were highly excited at the time, until in an outbreak on the 5th of March 1770 a file of garrison troops shot down in self-defence a few citizens in a crowd which assailed them. This is known as the "Boston Massacre." The merchants combined to prevent the importation of goods which by law would yield the crown a revenue; and the patriots—as the anti-prerogative party called themselves—under the lead of Samuel Adams, instituted regular communication between the different towns, and afterwards, following the initiative of Virginia, with the other colonies, through "committees of correspondence"; a method of the utmost advantage thereafter in forcing on the revolution by intensifying and unifying the resistance of the colony, and by inducing the co-operation of other colonies. In 1773 (Dec. 16) a party of citizens, disguised as Indians and instigated by popular meetings, boarded some tea-ships in the harbour of Boston, and to prevent the landing of their taxable cargoes threw them into the sea; this incident is known in history as the "Boston tea-party." Parliament in retaliation closed the port of Boston (1774), a proceeding which only aroused more bitter feeling in the country towns and enlisted the sympathy of the other colonies. The governorship was now given to General Thomas Gage, who commanded the troops which had been sent to Boston. Everything foreboded an outbreak. Most of the families of the highest social position were averse to extreme measures; a large number were not won over and became expatriated loyalists. The popular agitators, headed by Samuel Adams—with whom John Hancock, an opulent merchant and one of the few of the richer people who deserted the crown, leagued himself—forced on the movement, which became war in April 1775, when Gage sent an expedition to Concord and Lexington to destroy military stores accumulated by the patriots and to capture Adams and Hancock, temporarily staying at Lexington. This detachment, commanded by Lord Percy, was assaulted, and returned with heavy loss. The country towns now poured their militia into Cambridge, opposite Boston; troops came from neighbouring colonies, and Artemas Ward, a Massachusetts general, was placed in command of the irregular force, which with superior numbers at once shut the royal army up in Boston. An attempt of the provincials to seize and hold a commanding hill in Charlestown brought on the battle of Bunker Hill (June 17, 1775), in which the provincials were driven from the ground, although they lost much less heavily than the royal troops. Washington, chosen by the Continental Congress to command the army, arrived in Cambridge in July 1775, and stretching his lines around Boston, forced its evacuation in March 1776. The state was not again the scene of any conflict during the war. Generals Henry Knox and Benjamin Lincoln were the most distinguished officers contributed by the state to the revolutionary army. Out of an assessment at one time upon the states of $5,000,000 for the expenses of the war, Massachusetts was charged with $820,000, the next highest being $800,000 for Virginia. Of the 231,791 troops sent by all the colonies into the field, reckoning by annual terms, Massachusetts sent 67,907, the next highest being 31,939 from Connecticut, Virginia furnishing only 26,678; and her proportion of sailors was very much greater still. In every campaign in every colony save in 1779–80 her soldiery were in absolute, and still more in relative, number greater than those of any other colony.

After the outbreak of the war a somewhat indefinite, heterogeneous provisional government was in power till a constitution was adopted in 1780, when John Hancock became the first governor. Governor James Bowdoin in 1786–1787 put down with clemency an almost bloodless insurrection in the western counties (there was strong disaffection, however, as far east as Middlesex), known as the Shays Rebellion, significant of the rife ideas of popular power, the economic distress, and the unsettled political conditions of the years of the Confederation. Daniel Shays (1747–1825), the leader, was a brave Revolutionary captain of no special personal importance. The state debt was large, taxation was heavy, and industry was unsettled; worthless paper money was in circulation, yet some men demanded more; debtors were made desperate by prosecution; the state government seemed weak, the Federal government contemptibly so; the local courts would not, or from intimidation feared to, punish the turbulent, and demagogues encouraged ideas of popular power. A convention of delegates representing the malcontents of numerous towns in Worcester county met at Worcester on the 15th of August 1786 to consider grievances, and a week later a similar convention assembled at Hatfield, Hampshire county. Encouraged by these and other conventions in order to obstruct the collection of debts and taxes, a mob prevented a session of the Court of Common Pleas and General Sessions of the Peace at Northampton on the 29th of August, and in September other mobs prevented the same court from sitting in Worcester, Middlesex and Berkshire counties. About 1000 insurgents under Shays assembled at Springfield on the 26th of September to prevent the sitting there of the Supreme Court, from which they feared indictments. To protect the court and the national arsenal at Springfield, for which the Federal government was powerless to provide a guard, Major-General William Shepard (1737–1817) ordered out the militia, called for volunteers, and supplied them with arms from the arsenal, and the court sat for three days. The Federal government now attempted to enlist recruits, ostensibly to protect the western frontier from the Indians, but actually for the suppression of the insurrection; but the plan failed from lack of funds, and the insurgents continued to interrupt the procedure of the courts. In January 1787, however, Governor Bowdoin raised an army of 4400 men and placed it under the command of Major-General Benjamin Lincoln (1733–1810). While Lincoln was at Worcester Shays planned to capture the arsenal at Springfield, but on the 25th of January Shepard's men fired upon Shays's followers, killing four and putting the rest to flight. Lincoln pursued them to Petersham, Worcester county, where on the 4th of February he routed them and took 150 prisoners. Subsequently the insurgents gathered in small bands in Berkshire county; but here, a league having been formed to assist the government, 84 insurgents were captured at West Stockbridge, and the insurrection practically terminated in an action at Sheffield on the 27th of February, in which the insurgents lost 2 killed and 30 wounded and the militia 2 killed and 1 wounded. Two of the insurgent leaders, Daniel Shays and Eli Parsons, escaped to Vermont soon after the rout at Petersham. Fourteen other insurgents who were tried by the Supreme Court in the spring of 1787 were found guilty of treason and sentenced to death. They were, however, held rather as hostages for the good behaviour of worse offenders who had escaped, and were pardoned in September. In February 1788 Shays and Parsons petitioned for pardon, and this was granted by the legislature in the following June. The outcome of the uprising was an encouraging test of loyalty to the commonwealth; and the insurrection is regarded as having been very potent in preparing public opinion throughout the country for the adoption of a stronger national government. The Federal Constitution was ratified by Massachusetts by only a small majority on the 6th of February 1788, after its rejection had been at one time imminent; but Massachusetts became a strong Federalist state. Indeed, the general interest of her history in the quarter-century after the adoption of the Constitution lies mainly in her connexion with the fortunes of that great political party. Her leading politicians were out of sympathy with the conduct of national affairs (in the conduct of foreign relations, the distribution of political patronage, naval policy, the question of public debt) from 1804—when Jefferson's party showed its complete supremacy—onward; and particularly after the passage of the Embargo Act of 1807, which caused great losses to Massachusetts commerce, and, so far from being accepted by her leaders as a proper diplomatic weapon, seemed to them designed in the interests of the Democratic party. The Federalist preference for England over France was strong in Massachusetts, and her sentiment was against the war with England of 1812–15. New England's discontent culminated in the Hartford Convention (Dec. 1814), in which Massachusetts men predominated. The state, however, bore her full part in the war, and much of its naval success was due to her sailors.

During the interval till the outbreak of the Civil War in 1861, Massachusetts held a distinguished place in national life and politics. As a state she may justly be said to have been foremost in the struggle against slavery.[1] She opposed the policy that led to the Mexican War in 1846, although a regiment was raised in Massachusetts by the personal exertions of Caleb Cushing. The leaders of the ultra non-political abolitionists (who opposed the formation of the Liberty party) were mainly Massachusetts men, notably W. L. Garrison and Wendell Phillips. The Federalist domination had been succeeded by Whig rule in the state; but after the death of the great Whig, Daniel Webster, in 1852, all parties disintegrated, re-aligning themselves gradually in an aggressive anti-slavery party and the temporizing Democratic party. First, for many years the Free-Soilers gained strength; then in 1855 in an extraordinary party upheaval the Know-Nothings quite broke up Democratic, Free-Soil and Whig organizations; the Free-Soilers however captured the Know-Nothing organization and directed it to their own ends; and by their junction with the anti-slavery Whigs there was formed the Republican party. To this the original Free-Soilers contributed as leaders Charles Sumner and C. F. Adams; the Know-Nothings, Henry Wilson and N. P. Banks; and later, the War Democrats, B. F. Butler—all men of mark in the history of the state. Charles Sumner, the most eminent exponent of the new party, was the state's senator in Congress (1851–1874). The feelings which grew up, and the movements that were fostered till they rendered the Civil War inevitable, received something of the same impulse from Massachusetts which she had given a century before to the feelings and movements forerunning the War of American Independence. When the war broke out it was her troops who first received hostile fire in Baltimore, and turning their mechanical training to account opened the obstructed railroad to Washington. In the war thus begun she built, equipped and manned many vessels for the Federal navy, and furnished from 1861 to 1865 26,163 (or, including final credits, probably more than 30,000) men for the navy. During the war all but twelve small townships raised troops in excess of every call, the excess throughout the state amounting in all to more than 15,000 men; while the total recruits to the Federal army (including re-enlistments) numbered, according to the adjutant-general of the state, 159,165 men, of which less than 7000 were raised by draft.[2] The state, as such, and the townships spent $42,605,517.19 in the war; and private contributions of citizens are reckoned in addition at about $9,000,000, exclusive of the aid to families of soldiers, paid then and later by the state.

Since the close of the war Massachusetts has remained generally steadfast in adherence to the principles of the Republican party, and has continued to develop its resources. Navigation, which was formerly the distinctive feature of its business prosperity, has under the pressure of laws and circumstances given place to manufactures, and the development of carrying facilities on the land rather than on the sea.

In the Spanish-American War of 1898 Massachusetts furnished 11,780 soldiers and sailors, though her quota was but 7388; supplementing from her own treasury the pay accorded them by the national government.

No statement of the influence which Massachusetts has exerted upon the American people, through intellectual activity, and even through vagary, is complete without an enumeration of the names which, to Americans at least, are the signs of this influence and activity. In science the state can boast of John Winthrop, the most eminent of colonial scientists; Benjamin Thompson (Count Rumford); Nathaniel Bowditch, the translator of Laplace; Benjamin Peirce and Morse the electrician; not to include an adopted citizen in Louis Agassiz. In history, Winthrop and Bradford laid the foundations of her story in the very beginning; but the best example of the colonial period is Thomas Hutchinson, and in later days Bancroft, Sparks, Palfrey, Prescott, Motley and Parkman. In poetry, a pioneer of the modern spirit in American verse was Richard Henry Dana; and later came Bryant, Longfellow, Whittier, Lowell and Holmes. In philosophy and the science of living, Jonathan Edwards, Franklin, Channing, Emerson and Theodore Parker. In education, Horace Mann; in philanthropy, S. G. Howe. In oratory, James Otis, Fisher Ames, Josiah Quincy, junr., Webster, Choate, Everett, Sumner, Winthrop and Wendell Phillips; and, in addition, in statesmanship, Samuel Adams, John Adams and John Quincy Adams. In fiction, Hawthorne and Mrs Stowe. In law, Story, Parsons and Shaw. In scholarship, Ticknor, William M. Hunt, Horatio Greenough, W. W. Story and Thomas Ball. The "transcendental movement," which sprang out of German affiliations and produced as one of its results the well-known community of Brook Farm (1841–1847), under the leadership of Dr George Ripley, was a Massachusetts growth, and in passing away it left, instead of traces of an organization, a sentiment and an aspiration for higher thinking which gave Emerson his following. When Massachusetts was called upon to select for Statuary Hall in the capitol at Washington two figures from the long line of her worthies, she chose as her fittest representatives John Winthrop, the type of Puritanism and state-builder, and Samuel Adams (though here the choice was difficult between Samuel Adams and John Adams) as her greatest leader in the heroic period of the War of Independence.

Governors of Plymouth Colony

(Chosen annually by the people).

John Carver	1620–1621
William Bradford	1621–1633
Edward Winslow	1633–1634
Thomas Prence (or Prince)	1634–1635
William Bradford	1635–1636
Edward Winslow	1636–1637
William Bradford	1637–1638
Thomas Prence (or Prince)	1638–1639
William Bradford	1639–1644
Edward Winslow	1644–1645
William Bradford	1645–1657
Thomas Prence (or Prince)	1657–1673
Josiah Winslow	1673–1680
Thomas Hinckley	1680–1686
Sir Edmund Andros	1686–1689
Thomas Hinckley	1689–1692

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[1] Slavery had existed as a social fact from the earliest years, and legally after 1641; but it was never profitable, and was virtually abolished long before the War of American Independence; still it was never abolished explicitly by Massachusetts, though the slave trade was prohibited in 1788, and though a number of negroes were declared free after the adoption of the constitution of 1780 on the strength of the sweeping declaration of human rights in that instrument.

[2] According to the final report of the U.S. Adjutant-General in 1885, the enlistments were 146,730 men, of whom 13,942 died in war. These figures are probably less accurate than those of the state.

Governors of Massachusetts.

(Under the First Charter—chosen annually).

John Endecott [1]	1629–1630
John Winthrop	1630–1634
Thomas Dudley	1634–1635
John Haynes	1635–1636
Henry Vane	1636–1637
John Winthrop	1637–1640
Thomas Dudley	1640–1641
Richard Bellingham	1641–1642
John Winthrop	1642–1644
John Endecott	1644–1645
Thomas Dudley	1645–1646
John Winthrop	1646–1649
John Endecott	1649–1650
Thomas Dudley	1650–1651
John Endecott	1651–1654
Richard Bellingham	1654–1655
John Endecott	1655–1665
Richard Bellingham	1665–1672
John Leverett (acting, 1672–1673)	1672–1679
Simon Bradstreet	1679–1686

Sir Edmund Andros	1686–1689
Simon Bradstreet	1689–1692

Under Second Charter—appointed by the Crown.[2]

Sir William Phips	1692–1694
William Stoughton (acting)	1694–1699
Richard Coote, earl of Bellomont	1699–1700
William Stoughton (acting)	1700–1701
Joseph Dudley	1702–1715
William Tailer (acting)	1715–1716
Samuel Shute	1716–1722
William Dummer (acting)	1722–1728
William Burnet	1728–1729
William Dummer (acting)	1729–1730
William Tailer (acting)	1730
Jonathan Belcher	1730–1741
William Shirley	1741–1749
Spencer Phips (acting)	1749–1753
William Shirley	1753–1756
Spencer Phips (acting)	1756–1757
Thomas Pownal	1757–1760
Thomas Hutchinson (acting)	1760
Sir Francis Bernard, Bart	1760–1769
Thomas Hutchinson (acting)	1769–1771
Thomas Hutchinson	1771–1774
Thomas Gage [3]	1774–1775

Under the Constitution.

John Hancock		1780–1785
James Bowdoin		1785–1787
John Hancock		1787–1793
Samuel Adams (acting)		1793–1794
Samuel Adams		1794–1797
Increase Sumner	Federalist	1797–1799
Moses Gill (lieut.-governor; acting)	„	1799–1800
Caleb Strong	„	1800–1807
Jas. Sullivan	Democratic-Republican	1807–1808
Levi Lincoln (acting)	„	1808–1809
Christopher Gore	Federalist	1809–1810
Elbridge Gerry	Democratic-Republican	1810–1812
Caleb Strong	Federalist	1812–1816
John Brooks	„	1816–1823
William Eustis	Democratic-Republican	1823–1825
Levi Lincoln	„	1825–1834
John Davis	Whig	1834–1835
Edward Everett	„	1836–1840
Marcus Morton	Democrat	1840–1841
John Davis	Whig	1841–1843
Marcus Morton	Democrat	1843–1844
George N. Briggs	Whig	1844–1851
George S. Boutwell	Free-Soil Democrat	1851–1853
John H. Clifford	Whig	1853–1854
Emory Washburn	„	1854–1855
Henry J. Gardner	Know-Nothing	1855–1858
Nathaniel P. Banks	Republican	1858–1861
John A. Andrew	Republican	1861–1866
Alexander H. Bullock	„	1866–1869
William Claflin	„	1869–1872
William B. Washburn	„	1872–1874
Thomas Talbot (acting)	„	1874–1875
William Gaston	Democrat	1875–1876
Alexander H. Rice	Republican	1876–1879
Thomas Talbot	„	1879–1880
John Davis Long	„	1880–1883
Benjamin F. Butler	Democrat	1883–1884
George D. Robinson	Republican	1884–1887
Oliver Ames	„	1887–1890
John Q. A. Brackett	„	1890–1891
William E. Russell	Democrat	1891–1894
Frederic T. Greenhalge	Republican	1894–1896
Roger Wolcott	„	1896–1897
Roger Wolcott	„	1897–1900
W. Murray Crane	„	1900–1903
John L. Bates	„	1903–1905
William L. Douglas	Democrat	1905–1906
Curtis L. Guild	Republican	1906–1909
Eben S. Draper	„	1909–1911
Eugene N. Foss	Democrat	1911–

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[1] Endecott, by commission dated the 30th of April 1629, was made "governor of London's plantation in the Massachusetts Bay." Matthew Cradock, first governor of the Company, from the 4th of March 1629 to the 20th of October 1629, was succeeded on the latter date by John Winthrop, who, on reaching Salem on the 12th of June 1630 with the charter, superseded Endecott.

[2] During three periods, 1701–1702, in February 1715, and from April to August 1757 the affairs of the colony were administered by the Executive Council.

[3] General Gage was military governor, Hutchinson remaining nominally civil governor.

standard general history was that of J. G. Pálfrey, *History of New England* (5 vols., Boston, 1858–1890), to the War of Independence. It is generally accurate in facts but written in an unsatisfactorily eulogistic vein. Of importance in more modern views is a volume of *Lectures Delivered . . . before the Lowell Institute . . . by Members of the Massachusetts Historical Society on Subjects Relating to the Early History of Massachusetts* (Boston, 1869), perhaps especially the lectures of G. E. Ellis, later expanded, and in the process somewhat weakened, into his *Puritan Age and Rule in the Colony of the Massachusetts Bay, 1629–1685* (Boston, 1888; 3rd ed., 1891). See C. F. Adams, *Massachusetts: its Historians and its History* (Boston, 1893), for a critique of the "filiopietistic" traditions of Massachusetts writers; also his *Three Episodes of Massachusetts History*,—namely, Settlement of the Colony, Antinomianism, and church and town government in Quincy from 1634–1888 (2 vols., Boston, 1892). On town government see further E. Channing in Johns Hopkins University, *Studies in History* vol. ii. (1884); P. E. Aldrich in American Antiquarian Society, *Proceedings*, new series, vol. 3, pp. 111–124; and C. F. Adams and others in Massachusetts Historical Society, *Proceedings*, 2nd series, vol. vii (1892). On the Pilgrims and Puritans: See article PLYMOUTH; also E. H. Byington, *The Puritan in England and America* (Boston, 1896) and *The Puritan as Colonist and Reformer* (Boston, 1899). On the Quaker Persecution: R. P. Hallowell, *The Quaker Invasion of Massachusetts* (Boston, 1883; rev. ed., 1887). On Witchcraft: See C. W. Upham, *Witchcraft in Salem* (2 vols., Boston, 1867); S. G. Drake, *Annals of Witchcraft* (Boston, 1869) and *The Witchcraft Delusion in New England* (3 vols., Roxbury, 1866), this last a reprint of accounts of the time by Cotton Mather and R. Calef; W. F. Poole, "Cotton Mather and Salem Witchcraft" (*North American Review*, April 1869); and controversy of A. C. Goodell and G. H. Moore in Massachusetts Historical Society, *Proceedings*. On Slavery: G. H. Moore, *Notes on the History of Slavery* (New York, 1866); E. Washburn in *Collections*, Massachusetts Historical Society, series 4, iv., 333–346; C. Deane in same, pp. 375–442, and in *Proceedings*, American Antiquarian Society, new series, iv., 191–222. In the essays of J. R. Lowell are two on "New England two Centuries Ago" and "Witchcraft." For economic history, W. B. Weeden, *Economic and Social History of New England, 1620–1789* (2 vols., Boston, 1890); C. H. J. Douglas, *The Financial History of Massachusetts . . . to the American Revolution* (in Columbia University Studies, vol i., 1892). On the revolutionary epoch, Mellen Chamberlain, *John Adams . . . with other Essays and Addresses* (Boston, 1898); T. Hutchinson, *Diary and Letters* (2 vols., Boston, 1884–1886); H. A. Cushing, *Transition from Provincial to Commonwealth Government in Massachusetts* (Columbia University Studies in History, vol. iii., 1896); S. B. Harding, *Contest over the Ratification of the Federal Constitution in Massachusetts* (Harvard University Studies, New York, 1896); and on the Shays Rebellion compare J. P. Warren in *American Historical Review* (Oct., 1905). On New England discontent preceding 1812, Henry Adams, *Documents Relating to New England Federalism, 1780–1815* (Boston, 1877); T. W. Higginson, *Massachusetts in the Army and Navy during the War of 1861–65* (Official, Boston, 2 vols., 1896). For a list of the historical societies of the state consult A. M. Davis in *Publications* of the Colonial Society of Massachusetts, vol. i.; the most important are the Massachusetts Historical Society, established 1791, publishing *Collections* and *Proceedings* (Boston) and the American Antiquarian Society, established 1812, publishing *Proceedings* (Worcester). In many cases the most valuable material on various periods is indicated under the biographies (or autobiographies in some cases) of the public men named in the above article, to which add Timothy Pickering, George Cabot, Joseph Warren, Elbridge Gerry, Benjamin F. Butler, G. S. Boutwell and George F. Hoar. Many townships have published their local records, and many township and county histories contain valuable matter of general interest (*e.g.* as showing in detail township action before the War of Independence), though generally weighted heavily with genealogy and matters of merely local interest. In American works of fiction, particularly of New England authors, the reader will find a wealth of description of Massachusetts and New England life, past and present, as in the writings of William D. Howells, Sarah O. Jewett, Mary E. Wilkins-Freeman, Harriet B. Stowe and others.

MASSACRE, a wholesale indiscriminate killing of persons, and also, in a transferred sense, of animals. The word is adopted from the French; but its origin is obscure. The meaning and the old form *macecle* seem to point to it being a corruption of the Lat. *macellum*, butcher's shop or shambles, hence meat market; this is probably from the root *mac*–, seen in μάχεσθαι, to fight, μάχαιρα, sword, and Lat. *mactare*, to sacrifice. Another derivation connects with the Old Low Ger. *matsken*, to cut in pieces; cf. mod. Ger. *metzeln*, to massacre.

MASSAGE. The word *massage* has of late years come into general use to signify the method of treating disease or other physical conditions by manipulating the muscles and joints. According to Littré the word is derived from the Arabic *mass*, and has the specific meaning of "pressing the muscular parts of the body with the hands, and exercising traction on the joints in order to give suppleness and stimulate vitality." It was probably adopted from the Arabian physicians by the French, who have played a leading part in reviving this method of treatment, which has been practised from time immemorial, and by the most primitive people, but has from time to time fallen into disuse among Western nations. In the *Odyssey* the women are described as rubbing and kneading the heroes on their return from battle. In India, under the name "shampoo" (*tshāmpuā*), the same process has formed part of the native system of medicine from the most remote times; professional massers were employed there by Alexander the Great in 327 B.C. In China the method is also of great antiquity, and practised by a professional class; the Swedish gymnastic system instituted by Pehr Henrik Ling is derived from the book of Cong-Fou, the bonze of Tao-Sse. Hippocrates describes and enjoins the use of manipulation, especially in cases of stiff joints, and he was followed by other Greek physicians. Oribasius gives an account of the application of friction with the bare hands, which exactly corresponds with the modern practice of massage. It is worthy of note that the treatment, after being held in high esteem by the leading Greek physicians, fell into disrepute with the profession, apparently on account of its association with vicious abuses. The same drawback has made itself felt in the present day, and can only be met by the most scrupulous care in the choice of agents and the manner of their employment. Among the Greeks, Romans, Egyptians, and later the Turks, massage came to be part of the ordinary procedure of the bath without any special therapeutic intention, and the usage has survived until to-day; but that mode of application was no doubt a refinement of civilized life. Medical rubbing is older and more elementary than bathing, as we see from its employment by savages. Probably it was evolved independently among different races from the natural instinct—shared by the lower animals—which teaches to rub, press or lick any part of the body in which uneasiness is felt, and is therefore the oldest of all therapeutic means.

According to Weiss, the therapeutic use of massage was revived in Europe by Hieronymus Fabricius ab Aquapendente (1537–1619), who applied it to stiff joints and similar conditions. Paracelsus in his *De medicina Aegyptiorum* (1591), gives a description of methodical massage as practised by the Egyptians quite on modern lines. Thereafter it appears to have been adopted here and there by individual practitioners, and various references are made to it, especially by French writers. The word "massage" occurs in an essay written by Pierre Adolphe Piorry (1794–1879) for a large encyclopaedia which appeared in 1818, but it was probably used before. The practice was gradually advocated by an increasing number of medical men. In Great Britain it was called "medical rubbing," and at Edinburgh Beveridge had a staff of eight trained male rubbers. A book published by Estradère in 1863 attracted much attention, but the man who contributed most to the modern popularity of massage was Metzger of Amsterdam, who began to use it tentatively in 1853, and then proceeded to study and apply it methodically. He published an essay on the subject in 1868. The modern refinements of the treatment are chiefly due to him. At the same time, its application by Dr Silas Weir Mitchell to hysterical and other nervous conditions, in conjunction with the "rest cure," has done much to make it known.

Massage, as now practised, includes several processes, some of which are passive and others active. The former are carried out by an operator, and consist of rubbing and kneading the skin and deeper tissues with the hands, and exercising the joints by bending the patient's limbs. The active movements consist of a special form of gymnastics, designed to exercise particular muscles or groups of muscles. In what is called "Swedish massage" the operator moves the limbs while the patient resists, thus bringing the opposing muscles into play. Some writers insist on confining the word "massage" to the rubbing processes, and use the general term "manipulation" to cover all the movements mentioned; but this is a verbal subtlety of no importance. It is evident that alike among the Greeks, the Orientals, and savage races, the two processes have always been applied as part of the same treatment, and the definition quoted above from Littré goes to show that the word "massage" is properly applied to both.

Rubbing has been subdivided into several processes, namely (1) stroking, (2) kneading, (3) rubbing, and (4) tapping, and some practitioners attach great importance to the application of a particular process in a particular way. As a rule, oils and other lubricants are not used. But, however it may be applied, the treatment acts essentially by increasing circulation and improving nutrition. It has been shown by Lauder Brunton that more blood actually flows through the tissues during and after rubbing. The number of red corpuscles, and, to some extent, their haemoglobin value, are also said to be increased (Mitchell). At the same time the movement of the lymph stream is accelerated. In order to assist the flow of blood and lymph, stroking is applied centripetally, that is to say, upwards along the limbs and the lower part of the body, downwards from the head. The effects of the increased physiological activity set up are numerous. Functional ability is restored to exhausted muscles by the removal of fatigue products and the induction of a fresh blood supply; congestion is relieved; collections of serous fluid are dispersed; secretion and excretion are stimulated; local and general nutrition are improved. These effects indicate the conditions in which massage may be usefully applied. Such are various forms of paralysis and muscular wasting, chronic and subacute affections of the joints, muscular rheumatism, sciatica and other neuralgias, local congestions, sprains, contractions, insomnia and some forms of headache, in which downward stroking from the head relieves cerebral congestion. It has also been used in anaemia, hysteria and "neurasthenia," disorders of the female organs, melancholia and other forms of insanity, morphinism, obesity, constipation, inflammatory and other affections of the eye, including even cataract. General massage is sometimes applied, as a form of passive exercise, to indolent persons whose tissues are overloaded with the products of incomplete metabolism.

As with other methods of treatment, there has been a tendency on the part of some practitioners to exalt it into a cure-all, and of others to ignore it altogether. Of its therapeutic value, when judiciously used, there is no doubt, but it is for the physician or surgeon to say when and how it should be applied. Affections to which it is not applicable are fevers, pregnancy, collections of pus, acute inflammation of the joints, inflamed veins, fragile arteries, wounds of the skin and, generally speaking, those conditions in which it is not desirable to increase the circulation, or in which the patient cannot bear handling. In such conditions it may have a very injurious and even dangerous effect, and therefore should not be used in a haphazard manner without competent advice.

The revival of massage in Europe and America has called into existence a considerable number of professional operators, both male and female, who may be regarded as forming a branch of the nursing profession. Some of these are trained in hospitals or other institutions, some by private practitioners and some not at all. Similarly some are attached to organized societies or institutions while others pursue their calling independently. Several things are required for a good operator. One is physical strength. Deep massage is very laborious work, and cannot be carried on for an hour, or even half an hour, without unusual muscular power. Feeble persons cannot practise it effectively at all. The duration of a sitting may vary from five or ten minutes to an hour. For general massage at least half an hour is required. A masser should have strength enough to do the work without too obvious exhaustion, which gives the patient an unpleasant impression. A second requirement is tactile and muscular sensibility. A person not endowed with a fine sense of touch and resistance is liable to exert too great or too little pressure; the one hurts the patient, the other is ineffective. Then skill and knowledge, which can only be acquired by a course of instruction, are necessary. Finally, some guarantee of cleanliness and character is almost indispensable. Independent massers may possess all these qualifications in a higher degree than those connected with an institution, but they may also be totally devoid of them, whereas connexion with a recognized hospital or society is a guarantee for a certain standard of efficiency. In London there are several such institutions, which train and send out both male and female massers. The fee is 5s. an hour, or from two to four guineas a week. On the European continent, where trained massers are much employed by some practitioners, the fee is considerably lower; in the United States it is higher. For reasons mentioned above, it is most desirable that patients should be attended by operators of their own sex. If this is not insisted upon, a valuable therapeutic means will be in danger of falling into disrepute both with the medical profession and the general public. (A. Sl.)

MASSAGETAE, an ancient warlike people described by Herodotus (i. 203–216; iv. 22, 172) as dwelling beyond the Araxes (*i.e.* the Oxus) in what is now Balkh and Bokhara. It was against their queen Tomyris that Cyrus undertook the expedition in which according to one story he met his end. In their usages some tribes were nomads like the people of Scythia (*q.v.*), others with their community of wives and habit of killing and eating their parents recalled the Issedones (*q.v.*); while the dwellers in the islands of the river were fish-eating savages. Probably the name denoted no ethnic unity, but included all the barbarous north-eastern neighbours of the Persians. Herodotus says they only used gold and copper (or bronze), not silver or iron. Their lavish use of gold has caused certain massive ornaments from southern Siberia, now in the Hermitage at St Petersburg, to be referred to the Massagetae. (E. H. M.)

MASSA MARITTIMA, a town and episcopal see of the province of Grosseto, Tuscany, Italy, 24 m. N.N.W. of Grosseto direct and 16 m. by rail N.E. of Follonica (which is 28 m. N.W. of Grosseto on the main coast railway), 1444 ft. above sea-level. Pop. (1901), (town) 9219; (commune) 17,519. It has a cathedral of the 13th century containing a Romanesque font (1267 with a cover of 1447) and a Gothic reliquary (1324) of the saint Cerbone, to whom the cathedral is dedicated. The battlemented municipal palace of the 13th century is picturesque. There are mineral springs, mines of iron, mercury, lignite and copper, with foundries, ironworks and olive-oil mills. At Follonica on the coast, but in this commune, are the furnaces in which are smelted the iron ore of Elba.

MASSAWA, or Massowah, a fortified town on the African coast of the Red Sea, chief port of the Italian colony of Eritrea, in 15° 36′ N. and 39° 28′ E. Pop. about 10,000. The town stands at the north end of the bay of Massawa and is built partly on a coral island of the same name—where was the original settlement—and partly on the islets of Tautlub and Sheik Said, and the neighbouring mainland. Massawa Island is from 20 to 25 ft. above the sea, its length does not exceed $\frac{1}{2}$ m. and its breadth is about $\frac{1}{4}$ m. The harbour is formed by the channel between the island and the mainland. It affords good anchorage in from 5 to 9 fathoms. The town possesses several good public buildings, chiefly built of coral, as are the houses of the principal European and Arab merchants. Landward the town is guarded by forts erected by the Italians since 1885. Water was formerly scarce; but in 1872 an ancient aqueduct from Mokullu (5 m. distant westward) was restored and continued by an embankment to the town. A railway connects Massawa with Asmara, the capital of the colony. Besides the Abyssinians, who speak a Tigré dialect corrupted with Arabic, the inhabitants comprise Italian officials and traders, Greeks, Indians, Arabs from Yemen and Hadramut, Gallas and Somalis. Massawa is the natural port for northern Abyssinia but commerce is undeveloped owing to the lack of rapid means of communication. The trade done consists mainly in exporting hides, butter, Abyssinian coffee and civet, and importing European and Indian cotton goods and silks. It increased in value from about £65,000 per annum in 1865 (the last year of Turkish control) to from £240,000 to £280,000 between 1879 and 1881, when under the administration of Egypt. Under the Italians trade greatly developed. The returns for the five years 1901–1905 showed an average annual value of £1,800,000, about two-thirds being imports.

The island of Massawa has probably been inhabited from a very early date. It appears to have formed part of the Abyssinian dominions for many centuries. It was at Massawa (Matzua, as it is called by the Portuguese chroniclers) that Christopher da Gama and his comrades landed in July 1541 on their way to aid the Abyssinians against the Moslem invaders. Captured by the Turks in 1557, the island remained a Turkish possession over two hundred years. A military colony of Bosnians settled at Arkiko (a port on the bay 4 m. south of Massawa Island) was appointed not only to defend it in case of attack from the mainland, but to keep it supplied with water in return for $1400 per month from the town's customs. For some time at the close of the 18th century Massawa was held by the sherif of Mecca, and it afterwards passed to Mehemet Ali of Egypt. The Turks were reinstated about 1850, but in 1865 they handed the island back to Egypt for an annual tribute of 2½ million piastres. In February 1885 Massawa was occupied by an Italian force, the Egyptian garrison stationed there being withdrawn in the November following (see Egypt; Italy; Abyssinia). The port was the capital of the Italian colony until 1900 when the seat of administration was removed to Asmara (see Eritrea).

For a description of the town in 1769 see the *Travels* of James Bruce. At that time the governor, though appointed by the Turks, paid one half of the customs receipts to the negus of Abyssinia in return for the protection of that monarch.

MASSÉNA, ANDRÉ, or Andrea, duke of Rivoli, prince of Essling (1756–1817), the greatest of Napoleon's marshals, son of a small wine merchant, it is said of Jewish origin, was born at Nice on the 6th of May 1756. His parents were very poor, and he began life as a cabin boy, but he did not care much for the sea, and in 1775 he enlisted in the Royal-Italien regiment. He quickly rose to be under-officer-adjutant; but, finding his birth would prevent his ever getting a commission, he left the army in 1789, retired to his native city, and married. At the sound of war, however, and the word republic, his desire to see service increased, and he once more left Italy, and joined the 3rd battalion of the volunteers of the Var in 1791. In those days when men elected their officers, and many of the old commissioned officers had emigrated, promotion to a man with a knowledge of his drill was rapid, and by February 1792 Masséna was a lieutenant-colonel. His regiment was one of those in the army which occupied Nice, and in the advance to the Apennines which followed, his knowledge of the country, of the language, and of the people was so useful that in December 1793 he was already a general of division. In command of the advanced guard he won the battle of Saorgio in August 1794, capturing ninety guns, and after many successes he at last, on the 23rd of November 1795, with the right wing of the army of Italy, had the greatest share in the victory of Loano, won by Schérer over the Austrians and Sardinians. In Bonaparte's great campaign of 1796–97 Masséna was his most trusted general of division; in each battle he won fresh laurels, up to the crowning victory of Rivoli, from which he afterwards took his title. It was during this campaign that Bonaparte gave him the title of *enfant gâté de la victoire*, which he was to justify till he met the English in 1810. In 1798 he commanded the army of Rome for a short time, but was displaced by the intrigues of his subordinate Berthier. Masséna's next important service was in command of the army in Switzerland, which united the army in Germany under Moreau, and that in Italy under Joubert. There he proved himself a great captain, as he had already proved himself a great lieutenant; the archduke Charles and Suvarov had each been successful in Germany and in Italy, and now turned upon Masséna in Switzerland. That general held his ground well against the archduke, and then suddenly, leaving Soult to face the Austrians, he transported his army to Zürich, where, on the 26th of September 1799, he entirely defeated Korsakov, taking 200 guns and 5000 prisoners. This campaign and battle placed his reputation on a level with that of his compatriot Bonaparte, and he might have made the revolution of Brumaire, but he was sincerely attached to the republic, and had no ambition beyond a desire to live well and to have plenty of money to spend. Bonaparte, now First Consul, sent him to Genoa to command the débris of the army of Italy, and he nobly defended Genoa from February to June to the very last extremity, giving time for Bonaparte to strike his great blow at Marengo. He now went to Paris, where he sat in the Corps Législatif in 1803, and actually defended Moreau without drawing upon himself the ill-will of Napoleon, who well knew his honesty and lack of ambition.

In 1804 he was made one of the first marshals of France of the new régime, and in 1805 was decorated with the Grand Eagle of the Legion of Honour. In that year Napoleon needed an able general to keep in check the archduke Charles in Italy, while he advanced through Germany with the grand army. Masséna was chosen; he kept the archduke occupied till he received news of the surrender of Ulm, and then on the 30th of October defeated him in the battle of Caldiero. After the peace of Pressburg had been signed, Masséna was ordered to take possession of the kingdom of Naples, and to place Joseph Bonaparte on the throne. This task done, Napoleon summoned Masséna to Poland, where he as usual distinguished himself, and where he for the time gave up his republican principles. In 1808 he was made duke of Rivoli. In 1808 he was accidentally wounded by his old enemy Berthier when both were in attendance on the emperor at a shooting party, and he lost the sight of one eye. In the campaign in 1809 he covered himself with glory at Landshut and at Eckmühl, and finally at the battle of Aspern-Essling his magnificent leadership made what would without him have been an appalling disaster into a mere reverse of which the enemy could make no use. On the field of Wagram Masséna, though too ill to ride, directed from his carriage the movements of the right wing. For his great services he was created prince of Essling, and given the princely castle of Thouars. He was then ordered to Spain to "drive the English into the sea." (For the campaigns of 1810 and 1811, the advance to and the retreat from Torres Vedras see Peninsular War.) Masséna himself, with some justice, ascribed his failure to the frequent disobedience of his subordinates Ney, Reynier and Junot, and public opinion attributed this disobedience to the presence with the army of Masséna's mistress, and to the resentment thereat felt by the wives of the three generals. Still, unsuccessful as he was, Masséna displayed the determination of the defence of Genoa and the fertility in expedients of the campaign of Zürich, and kept his army for five weary months close up to Wellington's impregnable position before retiring. His retreat through a devastated country was terrible, but his force of character kept his men together, and Ney having shown the worst side of his character now showed the best in the frequent and brilliant rear-guard actions, until a new act of insubordination at last made the old marshal dismiss Ney from his command. Soon Masséna was once again ready to try his fortune, and he nearly defeated Wellington at Fuentes d'Oñoro, though much hampered by Bessières. But his recall soon followed this and he returned home to find his prestige gone. The old marshal felt he had a right to complain of Ney and of Napoleon himself, and, it is said, opened communications with Fouché and the remnant of the republican party. Whether this be true or not, Napoleon gave his greatest marshal no more employment in the field, but made him merely a territorial commandant at Marseilles. This command he still held at the restoration, when Louis XVIII. confirmed him in it, and with true Bourbon stupidity gave him letters of naturalization, as if the great leader of the French armies had not ceased to be an Italian. When Napoleon returned from Elba, Masséna, probably by the advice of Fouché, kept Marseilles quiet to await events, the greatest service he could do the royalists, but afterwards imputed to him as a fault. After the second restoration Masséna was summoned to sit on the court-martial which tried Marshal Ney, but, though he had been on bad terms with that general, and attributed his own disgrace to him, the old soldier would not be his comrade's judge. This refusal was used by the royalists to attack the marshal, against whom they raked up every offence they could think of. This annoyance shortened his life, and on the 4th of April 1817 the old hero died. He was buried in Père-la-Chaise, with only the word "Masséna" upon his tombstone.

In private life indolent, greedy, rapacious, ill-educated and morose, in war Masséna was, like Napoleon, the incarnation of battle. Only his indolence and his consequent lack of far-ranging imagination prevented him being as great in strategy as in tactics. His genius needed the presence of the enemy to stimulate it, but once it sprang to life Masséna became an ideal leader, absolutely brave, resourceful, unrelenting and indefatigable. He was as great a master of the strategy of forces in immediate contact—of gathering up as it were the threads of the fugue into a "stretto." For the planning of a whole perfect campaign he had neither knowledge nor inclination, and he falls short therefore of the highest rank amongst great generals; but his place amongst the greatest of soldiers is beyond challenge.

See Thiébault's *Éloge funèbre*, and Koch's *Mémoires de Masséna* (4 vols., 1849), a valuable work, carefully compiled. In more modern times E. Gachot has produced several important works dealing with Masséna's campaigns.

MASSENBACH, CHRISTIAN KARL AUGUST LUDWIG VON (1758–1827), Prussian soldier, was born at Schmalkalden on the 16th of April 1758, and educated at Heilbronn and Stuttgart, devoting himself chiefly to mathematics. He became an officer of the Württemberg army in 1778, and left this for the service of Frederick the Great in 1782. The pay of his rank was small, and his appointment on the quartermaster-general's staff made it necessary to keep two horses, so that he had to write mathematical school-books in his spare time to eke out his resources. He was far however from neglecting the science and art of war, for thus early he had begun to make his name as a theorist as well as a mathematician. After serving as instructor in mathematics to the young prince Louis, he took part with credit in the expedition into Holland, and was given the order *Pour le mérite*. On returning to Prussia he became mathematical instructor at the school of military engineering, leaving this post in 1792 to take part as a general staff officer in the war against France. He was awarded a prebend at Minden for his services as a topographical engineer on the day of Valmy, and after serving through the campaigns of 1793 and 1794 he published a number of memoirs on the military history of these years. He was chiefly occupied however with framing schemes for the reorganization of the then neglected general staff of the Prussian army, and many of his proposals were accepted. Bronsart von Schellendorf in his *Duties of the General Staff* says of Massenbach's work in this connexion, "the organization which he proposed and in the main carried out survived even the catastrophes of 1806–1807, and exists even at the present moment in its original outline." This must be accounted as high praise when it is remembered how much of the responsibility for these very disasters must be laid to Massenbach's account. The permanent gain to the service due to his exertions was far more than formal, for it is to him that the general staff owes its tradition of thorough and patient individual effort. But the actual doctrine taught by Massenbach, who was now a colonel, may be summarized as the doctrine of positions carried to a ludicrous excess; the claims put forward for the general staff, that it was to prepare cut-and-dried plans of operations in peace which were to be imposed on the troop leaders in war, were derided by the responsible generals; and the memoirs on proposed plans of campaign to suit certain political combinations were worked out in quite unnecessary detail. It was noteworthy that none of the proposed plans of campaign considered France as an enemy.

In 1805 came threats of the war with Napoleon which Massenbach had strongly opposed. He was made quartermaster-general (chief of staff) to Prince Hohenlohe, over whom he soon obtained a fatal ascendancy. War was averted for a moment by the result of the battle of Austerlitz, but it broke out in earnest in October 1806. Massenbach's influence clouded all the Prussian operations. The battles of Jena and Auerstädt were lost, and the capitulation of Prince Hohenlohe's army was negotiated. Even suggestions of disloyalty were not wanting; an attempt to try him by court-martial was only frustrated by Prince Hohenlohe's action in taking upon himself, as commander-in-chief, the whole responsibility for Massenbach's actions. He then retired to his estate in the Posen province, and occupied himself in writing pamphlets, memoirs, &c. When his estates passed into the grand duchy of Warsaw, he chose to remain a Prussian subject, and on the outbreak of the war of liberation he asked in vain for a post on the Prussian staff. After the fall of Napoleon he took part in Württemberg politics, was expelled from Stuttgart and Heidelberg, and soon afterwards arrested at Frankfurt, delivered over to the Prussian authorities and condemned to fourteen years' fortress imprisonment for his alleged publication of state secrets in his memoirs. He was kept in prison till 1826, when Frederick William III., having recovered from an accident, pardoned those whom he considered to have wronged him most deeply. He died on the 21st of November 1827, at his estate of Bialokoscz, Posen.

The obituary in *Neuer Nekrolog der Deutschen*, pt. ii. (Ilmenau, 1827) is founded on a memoir (*Der Oberst C. v. Massenbach*) which was published at the beginning of his imprisonment.

MASSENET, JULES ÉMILE FRÉDÉRIC (1842–   ), French composer, was born at Montaud, on the 12th of May 1842. He studied at the Paris Conservatoire, where he obtained the Grand Prix de Rome in 1863 with the cantata *David Rizzio*. Massenet became one of the most prolific composers of his time. His operas include the following: *La Grande tante*, one act, opéra comique (1867); *Don César de Bazan*, three acts, opéra comique (1872); *Le Roi de Lahore*, five acts, opéra (1877); *Hérodiade*, five acts (Brussels, 1881); *Manon*, five acts, opéra comique (1884); *Le Cid*, four acts, opéra (1885); *Esclarmonde*, four acts, opéra comique (1889); *Le Mage*, five acts, opéra (1891); *Werther*, four acts (Vienna, 1892); *Thaïs*, three acts, opéra (1894); *Le Portrait de Manon*, one act, opéra comique (1894); *La Navarraise*, two acts (Covent Garden, 1894); *Sapho*, opéra comique (1897); *Cendrillon*, opéra comique (1900); *Grisélidis*, opéra comique (1901); *Le Jongleur de Notre Dame* (Mentone, 1902). Of these the most popular is *Manon*. Massenet's other works include *Marie Madeleine*, sacred drama (1873); *Eve*, a mystery (1875); *La Vierge*, sacred legend (1880); six orchestral suites entitled *Scènes hongroises*, *Scènes pittoresques*, *Scènes dramatiques*, *Scènes napolitaines*, *Scènes de féerie*, *Scènes alsaciennes*; music to the tragedy *Les Erynnies*, to *Théodora*, *Le Crocodile*, *L'Hetman*; a requiem, *Narcisse*; an idyll, *Biblis*; a *Scène antique*; several sets of songs, entitled *Poème d'avril*, *Poème d'amour*, *Poème d'hiver*, *Poème d'octobre*, *Poème pastoral*, *Poème du souvenir*; also a large number of detached songs. He was professor of composition at the Conservatoire from 1878 to 1896, among his pupils being Hillemacher, Marty, Bruneau, Vidal, Pierné, Leroux and Charpentier. Massenet undoubtedly possesses a style of his own. He is at his best in music descriptive of the tender passion, and many of the love scenes in his operas are very beautiful.

MASSEREENE, JOHN CLOTWORTHY, 1st Viscount (d. 1665), Anglo-Irish politician, was a son of Sir Hugh Clotworthy, sheriff of county Antrim. He was elected to the Irish parliament as member for county Antrim in 1634, and was a member both of the Short and of the Long Parliament in England. Clotworthy was a vehement opponent of the earl of Strafford, in whose impeachment he took an active share. He also took part in the prosecution of Archbishop Laud. Having unsuccessfully negotiated with Ormond for the surrender of Dublin to the Parliamentary forces in 1646, he was accused in the following year of having betrayed his cause, and also of embezzlement; in consequence of these charges he fled to the Continent, but returned to parliament in June 1648. On the 12th of December in that year he was arrested, and remained in prison for nearly three years. Having taken an active part in forwarding the Restoration, he was employed in Ireland in arranging the affairs of the soldiers and other adventurers who had settled in Ireland. Clotworthy in no way abated his old animosity against "papists" and high Anglicans, and he championed the cause of the Irish Presbyterians; but being personally agreeable to Charles II., his ecclesiastical views were overlooked, and on the 21st of November 1660 he was created Baron Loughneagh and Viscount Massereene in the Irish peerage, with remainder in default of male heirs to his son-in-law, Sir John Skeffington. Massereene died without male issue in September 1665, and the title devolved on Skeffington, whose great-grandson, the fifth viscount, was created earl of Massereene in 1756. The earldom became extinct on the death of the fourth earl without male issue in 1816, the viscounty and barony of Loughneagh descending to his daughter Harriet, whose husband, Thomas Foster, took the name of Skeffington, and inherited from his mother in 1824 the titles of Viscount Ferrard and Baron Oriel of Collon in the Irish peerage, and from his father in 1828 that of Baron Oriel of Ferrard in the peerage of the United Kingdom.

MASSEY, SIR EDWARD (*c.* 1619–*c.* 1674), English soldier in the Great Rebellion, was the son of John Massey of Coddington, Cheshire. Little is known of his early life, but it is said that he served in the Dutch army against the Spaniards. In 1639 he appears as a captain of pioneers in the army raised by Charles I. to fight against the Scots. At the outbreak of the Great Rebellion he was with the king at York, but he soon joined the Parliamentary army. As lieutenant-colonel under the earl of Stamford he became deputy governor of Gloucester, where he remained till towards the end of the first Civil War, becoming governor early in 1643. He conducted minor operations against numerous small bodies of Royalists, and conducted the defence of Gloucester against the king's main army in August 1643, with great steadiness and ability, receiving the thanks of parliament and a grant of £1000 for his services. In 1644 Massey continued to keep the field and to disperse the local Royalists, and on several occasions he measured swords with Prince Rupert. In May 1644 he was made general of the forces of the Western Association. In 1645 he took the offensive against Lord Goring and the western Royalists, advanced to the relief of Taunton, and in the autumn co-operated effectively with Sir Thomas Fairfax and the New Model army in the Langport campaign. After taking part in the desultory operations which closed the first war, he took his seat in the House of Commons as member for Gloucester. He then began to take an active part in politics on the Presbyterian side, and was one of the generals who was impeached by the army on the ground that they were attempting to revive the Civil War in the Presbyterian interests. Massey fled from England in June 1647, and though he resumed his seat in the house in 1648 he was again excluded by Pride's Purge, and after a short imprisonment escaped to Holland. Thence, taking the side of the king openly and definitely like many other Presbyterians, he accompanied Charles II. to Scotland. He fought against Cromwell at the bridge of Stirling and Inverkeithing, and commanded the advanced guard of the Royalist army in the invasion of England in 1651. It was hoped that Massey's influence would win over the towns of the Severn valley to the cause of the king, and the march of the army on Worcester was partly inspired by this expectation. However, he effected little, and after riding with the king for some distance from the field of Worcester, fell into the hands of his former comrades and was lodged in the Tower. He again managed to escape to Holland. While negotiating with the English Presbyterians for the restoration of Charles, he visited England twice, in 1654 and 1656. In 1660 he was active in preparing for Charles's return, and was rewarded by a knighthood and a grant of £3000. The rest of his life was spent in political, and occasionally in military and administrative business, and he is said to have died in Ireland in 1674 or 1675.

MASSEY, GERALD (1828–1907), English poet, was born near Tring, Hertfordshire, on the 29th of May 1828. His parents were in humble circumstances, and Massey was little more than a child when he was set to hard work in a silk factory, which he afterwards deserted for the equally laborious occupation of straw-plaiting. These early years were rendered gloomy by much distress and deprivation, against which the young man strove with increasing spirit and virility, educating himself in his spare time, and gradually cultivating his innate taste for literary work. He was attracted by the movement known as Christian Socialism, into which he threw himself with whole-hearted vigour, and so became associated with Maurice and Kingsley. His first public appearance as a writer was in connexion with a journal called the *Spirit of Freedom*, of which he became editor, and he was only twenty-two when he published his first volume of poems, *Voices of Freedom and Lyrics of Love*. These he followed in rapid succession by *The Ballad of Babe Christabel* (1854), *War Waits* (1855), *Havelock's March* (1860), and *A Tale of Eternity* (1869). Many years afterwards in 1889, he collected the best of the contents of these volumes, with additions, into a two-volume edition of his poems called *My Lyrical Life*. He also published works dealing with spiritualism, the study of Shakespeare's sonnets (1872 and 1890), and theological speculation. It is generally understood that he was the original of George Eliot's *Felix Holt*. Massey's poetry has a certain rough and vigorous element of sincerity and strength which easily accounts for its popularity at the time of its production. He treated the theme of Sir Richard Grenville before Tennyson thought of using it, with much force and vitality. Indeed, Tennyson's own praise of Massey's work is still its best eulogy, for the Laureate found in him "a poet of fine lyrical impulse, and of a rich half-Oriental imagination." The inspiration of his poetry is essentially British; he was a patriot to the core. It is, however, as an Egyptologist that Gerald Massey is best known in the world of letters. He first published *The Book of the Beginnings*, followed by *The Natural Genesis*; but by far his most important work is *Ancient Egypt: The Light of the World*, published shortly before his death. He died on the 29th of October 1907.

See an article by J. Churton Collins in the *Contemporary Review* (May 1904).

MASSICUS, MONS, a mountain ridge of ancient Italy, in the territory of the Aurunci, and on the border of Campania and Latium adjectum—attributed by most authors to the latter. It projects south-west from the volcanic system of Rocca Monfina (see SUESSA AURUNCA) as far as the sea, and separates the lower course of the Liris from the plain of Campania. It consists of limestone, with a superstratum of pliocenic and volcanic masses, and was once an island; its highest point is 2661 ft. above sea-level.

It was very famous for its wine in ancient times. There was just room along the coast for the road to pass through; the pass was guarded by the Auruncan town of Vescia (probably on the mountain side), which ceased to exist in 314 B.C. after the defeat of the Ausones, but left its name to the spot. Its successor, Sinuessa, on the coast, a station on the Via Appia, was constructed in 312 B.C., and a colony was founded there in 295 B.C. It is not infrequently mentioned by classical writers as a place in which travellers halted. Here Virgil joined Horace on the famous journey to Brundusium. Domitian considerably increased its importance by the construction of the Via Domitiana, which left the Via Appia here and ran to Cumae and Puteoli, and it was he, no doubt, who raised it to the position of *colonia Flavia*. The town was destroyed by the Saracens, but some ruins of it are still visible two miles north-west of the modern village of Mondragone. The mineral springs which still rise here were frequented in antiquity.

MASSIF, a French term, adopted in geology and physical geography for a mountainous mass or group of connected heights, whether isolated or forming part of a larger mountain system. A "massif" is more or less clearly marked off by valleys.

MASSILLON, JEAN BAPTISTE (1663–1742), French bishop and preacher, was born at Hyères on the 24th of June 1663, his father being a royal notary of that town. At the age of eighteen he joined the Congregation of the Oratory and taught for a time in the colleges of his order at Pézenas, and Montbrison and at the Seminary of Vienne. On the death of Henri de Villars, archbishop of Vienne, in 1693, he was commissioned to deliver a funeral oration, and this was the beginning of his fame. In obedience to Cardinal de Noailles, archbishop of Paris, he left the Cistercian abbey of Sept-Fonds, to which he had retired, and settled in Paris, where he was placed at the head of the famous seminary of Saint Magloire. He soon gained a wide reputation as a preacher and was selected to be the Advent preacher at the court of Versailles in 1699. He was made bishop of Clermont in 1717, and two years later was elected a member of the French Academy. The last years of his life were spent in the faithful discharge of his episcopal duties; his death took place at Clermont on the 18th of September 1742. Massillon enjoyed in the 18th century a reputation equal to that of Bossuet and of Bourdaloue, and has been much praised by Voltaire, D'Alembert and kindred spirits among the *Encyclopaedists*. His popularity was probably due to the fact that in his sermons he lays little stress on dogmatic questions, but treats generally of moral subjects, in which the secrets of the human heart and the processes of man's reason are described with poetical feeling. He has usually been contrasted with his predecessor Bourdaloue, the latter having the credit of vigorous denunciation, Massillon that of gentle persuasiveness. Besides the *Petit Carême*, a sermon which he delivered before the young king Louis XV. In 1718, his sermons on the Prodigal Son, on the small number of the elect, on death, for Christmas Day, and for the Fourth Sunday in Advent, may be perhaps cited as his masterpieces. His funeral oration on Louis XIV. is only noted now for the opening sentence: "Dieu seul est grand." But in truth Massillon is singularly free from inequality. His great literary power, his reputation for benevolence, and his known toleration and dislike of doctrinal disputes caused him to be much more favourably regarded than most churchmen by the *philosophes* of the 18th century.

The first edition of Massillon's complete works was published by his nephew, also an Oratorian (Paris, 1745–1748), and upon this, in the absence of MSS., succeeding reprints were based. The best modern edition is that of the Abbé Blampignon (Paris, 1865–1868, 4 vols.; new ed. 1886).

See Abbé Blampignon, *Massillon, d'après des documents inédits* (Paris, 1879); and *L'Épiscopat de Massillon d'après des documents inédits, suivi de sa correspondance* (Paris, 1884); F. Brunetière "L'Éloquence de Massillon" in *Études critiques* (Paris, 1882); Père Ingold, *L'Oratoire et le jansénisme au temps de Massillon* (Paris, 1880); and Louis Petit de Julleville's *Histoire de la langue et de la littérature française*, v. 372–385 (Paris, 1898).

MASSILLON, a city of Stark county, Ohio, U.S.A., on the Tuscarawas river and the Ohio canal, 8 m. W. of Canton, and about 50 m. S. by E. of Cleveland. Pop. (1900), 11,944 (1693 foreign-born); (1910), 13,879. It is served by the Pennsylvania (Pittsburg, Ft Wayne & Chicago Division), the Baltimore & Ohio and the Wheeling & Lake Erie railways. Massillon is built among hills in a part of the state noted for its large production of coal and wheat and abounding in white sandstone, iron ore and potter's clay. The city has various manufactures, including iron, engines, furnaces, reapers, threshers and bottles. The total value of the factory products in 1905 was $3,707,013, an increase of 34·8% over that of 1900. The first settlement was made in 1825; in 1826 the town was laid out and named in honour of Jean Baptiste Massillon; it was incorporated a village in 1853, and became a city in 1868.

MASSIMO, or MASSIMI, a Roman princely family of great antiquity, said to be descended from the ancient Maximi of republican Rome. The name is first mentioned in 1012 in the person of Leo de Maximis, and the family played a considerable part in the history of the city in the middle ages. The brothers Pietro and Francesco Massimi acquired fame by protecting and encouraging the German printer Ulrich Hahn, who came to Rome in 1467. In the 16th century the Massimi were the richest of the Roman nobles. A marquisate was conferred on them in 1544, and the lordship of Arsoli in 1574. To-day there are two branches of the Massimi, viz. the Principi Massimo, descended from Camillo Massimiliano (1770–1840), and the dukes of Rignano, descended from Francesco Massimo (1773–1844). One of the sons of the present Prince Camillo Carlo Alberto, Don Fabrizio, married Princess Beatrice, daughter of Don Carlos of Bourbon (duke of Madrid), the pretender to the Spanish throne. The Palazzo Massimo in Rome was built by Baldassare Peruzzi by order of Pietro Massimo, on the ruins of an earlier palace destroyed in the sack of Rome in 1527.

See F. Gregorovius, *Geschichte der Stadt Rom* (Stuttgart, 1880); A. von Reumont, *Geschichte der Stadt Rom* (Berlin, 1868); *Almanach de Gotha*; J. H. Douglas, *The Principal Noble Families of Rome* (Rome, 1905).

MASSINGER, PHILIP (1583–1640), English dramatist, son of Arthur Massinger or Messanger, was baptized at St Thomas's, Salisbury, on the 24th of November 1583. He apparently belonged to an old Salisbury family, for the name occurs in the city records as early as 1415. He is described in his matriculation entry at St Alban Hall, Oxford (1602), as the son of a gentleman. His father, who had also been educated at St Alban Hall, was a member of parliament, and was attached to the household of Henry Herbert, 2nd earl of Pembroke, who recommended him in 1587 for the office of examiner in the court of the marches. The 3rd earl of Pembroke, the William Herbert whose name has been connected with Shakespeare's sonnets, succeeded to the title in 1601. It has been suggested that he supported the poet at Oxford, but the significant omission of any reference to him in any of Massinger's prefaces points to the contrary. Massinger left Oxford without a degree in 1606. His father had died in 1603, and he was perhaps dependent on his own exertions. The lack of a degree and the want of patronage from Lord Pembroke may both be explained on the supposition that he had become a Roman Catholic. On leaving the university he went to London to make his living as a dramatist, but his name cannot be definitely affixed to any play until fifteen years later, when *The Virgin Martyr* (ent. at Stationers' Hall, Dec. 7, 1621) appeared as the work of Massinger and Dekker. During these years he worked in collaboration with other dramatists. A joint letter, from Nathaniel Field, Robert Daborne and Philip Massinger, to Philip Henslowe, begs for an immediate loan of five pounds to release them from their "unfortunate extremitie," the money to be taken from the balance due for the "play of Mr Fletcher's and ours." A second document shows that Massinger and Daborne owed Henslowe £3 on the 4th of July 1615. The earlier note probably dates from 1613, and from this time Massinger apparently worked regularly with John Fletcher, although in editions of Beaumont and Fletcher's works his co-operation is usually unrecognized. Sir Aston Cokayne, Massinger's constant friend and patron, refers in explicit terms to this collaboration in a sonnet addressed to Humphrey Moseley on the publication of his folio edition of Beaumont and Fletcher (*Small Poems of Divers Sorts*, 1658), and in an epitaph on the two poets he says:—

> "Plays they did write together, were great friends,
> And now one grave includes them in their ends."

After Philip Henslowe's death in 1616 Massinger and Fletcher began to write for the King's Men. Between 1623 and 1626 Massinger produced unaided for the Lady Elizabeth's Men then playing at the Cockpit three pieces, *The Parliament of Love*, *The Bondman* and *The Renegado*. With the exception of these plays and *The Great Duke of Florence*, produced in 1627 by the Queen's servants, Massinger continued to write regularly for the King's Men until his death. The tone of the dedications of his later plays affords evidence of his continued poverty. Thus in the preface to *The Maid of Honour* (1632) he wrote, addressing Sir Francis Foljambe and Sir Thomas Bland: "I had not to this time subsisted, but that I was supported by your frequent courtesies and favours." The prologue to *The Guardian* (licensed 1633) refers to two unsuccessful plays and two years of silence, when the author feared he had lost the popular favour. S. R. Gardiner, in an essay on "The Political Element in Massinger" (*Contemp. Review*, Aug. 1876), maintained that Massinger's dramas are before all else political, that the events of his day were as openly criticized in his plays as current politics are in the cartoons of *Punch*. It is probable that this break in his production was owing to his free handling of public matters. In 1631 Sir Henry Herbert, the master of the revels, refused to license an unnamed play by Massinger because of "dangerous matter as the deposing of Sebastian, King of Portugal," calculated presumably to endanger good relations between England and Spain. There is little doubt that this was the same piece as *Believe as You List*, in which time and place are changed, Antiochus being substituted for Sebastian, and Rome for Spain. In the prologue Massinger ironically apologizes for his ignorance of history, and professes that his accuracy is at fault if his picture comes near "a late and sad example." The obvious "late and sad example" of a wandering prince could be no other than Charles I.'s brother-in-law, the elector palatine. An allusion to the same subject may be traced in *The Maid of Honour*. In another play by Massinger, not extant, Charles I. is reported to have himself struck out a passage put into the mouth of Don Pedro, king of Spain, as "too insolent." The poet seems to have adhered closely to the politics of his patron, Philip Herbert, earl of Montgomery, and afterwards 4th earl of Pembroke, who had leanings to democracy and was a personal enemy of the duke of Buckingham. In *The Bondman*, dealing with the history of Timoleon, Buckingham is satirized as Gisco. The servility towards the Crown displayed in Beaumont and Fletcher's plays reflected the temper of the court of James I. The attitude of Massinger's heroes and heroines towards kings is very different. Camiola's remarks on the limitations of the royal prerogative (*Maid of Honour*, act IV. sc. v.) could hardly be acceptable at court.

Massinger died suddenly at his house near the Globe theatre, and was buried in the churchyard of St Saviour's, Southwark, on the 18th of March 1640. In the entry in the parish register he is described as a "stranger," which, however, implies nothing more than that he belonged to another parish.

The supposition that Massinger was a Roman Catholic rests upon three of his plays, *The Virgin Martyr* (licensed 1620), *The Renegado* (licensed 1624) and *The Maid of Honour* (*c.* 1621). The religious sentiment is certainly such as would obviously best appeal to an audience sympathetic to Roman Catholic doctrine. *The Virgin Martyr*, in which Dekker probably had a large share, is really a miracle play, dealing with the martyrdom of Dorothea in the time of Diocletian, and the supernatural element is freely used. Little stress can be laid on this performance as elucidating Massinger's views. It is not entirely his work, and the story is early Christian, not Roman Catholic. In *The Renegado*, however, the action is dominated by the beneficent influence of a Jesuit priest, Francisco, and the doctrine of baptismal regeneration is enforced. In *The Maid of Honour* a complicated situation is solved by the decision of the heroine, Camiola, to take the veil. For this she is held up "to all posterity a fair example for noble maids to imitate." Among all Massinger's heroines Camiola is distinguished by genuine purity and heroism.

His plays have generally an obvious moral intention. He sets himself to work out a series of ethical problems through a succession of ingenious and effective plots. In the art of construction he has, indeed, few rivals. But the virtue of his heroes and heroines is rather morbid than natural, and often singularly divorced from common-sense. His *dramatis personae* are in general types rather than living persons, and their actions do not appear to spring inevitably from their characters, but rather from the exigencies of the plot. The heroes are too good, and the villains too wicked to be quite convincing. Moreover their respective goodness and villainy are too often represented as extraneous to themselves. This defect of characterization shows that English drama had already begun to decline.

It seems doubtful whether Massinger was ever a popular playwright, for the best qualities of his plays would appeal rather to politicians and moralists than to the ordinary playgoer. He contributed, however, at least one great and popular character to the English stage. Sir Giles Overreach, in *A New Way to Pay Old Debts*, is a sort of commercial Richard III., a compound of the lion and the fox, and the part provides many opportunities for a great actor. He made another considerable contribution to the comedy of manners in *The City Madam*. In Massinger's own judgment *The Roman Actor* was "the most perfect birth of his Minerva." It is a study of the tyrant Domitian, and of the results of despotic rule on the despot himself and his court. Other favourable examples of his grave and restrained art are *The Duke of Milan*, *The Bondman* and *The Great Duke of Florence*.

Massinger was a student and follower of Shakespeare. The form of his verse, especially in the number of run-on lines, approximates in some respects to Shakespeare's later manner. He is rhetorical and picturesque, but rarely rises to extraordinary felicity. His verse is never mean, but it sometimes comes perilously near to prose, and in dealing with passionate situations it lacks fire and directness.

The plays attributed to Massinger alone are: *The Duke of Milan, a Tragedy* (*c.* 1618, pr. 1623 and 1638); *The Unnatural Combat, a Tragedy* (*c.* 1619, pr. 1639); *The Bondman, an Antient Storie* (licensed 1623, pr. 1624); *The Renegado, a Tragaecomedie* (lic. 1624, pr. 1630); *The Parliament of Love* (lic. 1624; ascribed, no doubt erroneously, in the Stationers' Register, 1660, to W. Rowley; first printed by Gifford from an imperfect MS. in 1805); *A New Way to Pay Old Debts, a Comoedie* (*c.* 1625, pr. 1632); *The Roman Actor. A Tragaedie* (lic. 1626, pr. 1629); *The Maid of Honour* (dating perhaps from 1621, pr. 1632); *The Picture, a Tragecomedie* (lic. 1629, pr. 1630); *The Great Duke of Florence, a Comicall Historie* (lic. 1627, pr. 1635); *The Emperor of the East, a Tragaecomoedie* (lic. and pr. 1631), founded on the story of Theodosius the Younger; *Believe as You List* (rejected by the censor in January, but licensed in May, 1631; pr. 1848–1849 for the Percy Society); *The City Madam, a Comedie* (lic. 1632, pr. 1658), which Mr Fleay (*Biog. Chron. of the Eng. Drama*, i. 226), however, considers to be a *rifaciamento* of an older play, probably by Jonson; *The Guardian* (lic. 1633, pr. 1655); and *The Bashful Lover* (lic. 1636, pr. 1655). *A Very Woman, or The Prince of Tarent*, licensed in 1634 as the work of Massinger alone, is generally referred to his collaboration with Fletcher. The "exquisite temperance and justice" of this piece are, according to Swinburne, foreign to Fletcher's genius, and afford a striking example of Massinger's artistic skill and moderation.

Twelve plays of Massinger are said to be lost, but the titles of some of these may be duplicates of those of existing plays. Five of these lost plays were MSS. used by John Warburton's cook for pie-covers. The numerous plays in which Massinger's co-operation with John Fletcher is generally assumed are dealt with under BEAUMONT and FLETCHER. But it may be here noted that Mr R. Boyle has constructed an ingenious case for the joint authorship by Fletcher and Massinger of the two "Shakespearian" plays, *Henry VIII.* and *Two Noble Kinsmen* (see the New Shakspere Society's *Transactions*, 1884 and 1882). Mr Boyle sees the touch of Massinger in the first two acts of the *Second Maiden's Tragedy* (Lansdowne MS., lic. 1611), a play with which the names of Fletcher and Tourneur are also associated by different critics. *The Fatall Dowry, a Tragedy* (*c.* 1619, pr. 1632), which was adapted without acknowledgment by Nicholas Rowe in his *Fair Penitent*, was written in conjunction with Nathaniel Field; and *The Virgin Martir, a Tragedie* (lic. 1620, pr. 1621), with Thomas Dekker.

Massinger's independent works were collected by Coxeter (4 vols., 1759, revised edition with introduction by Thomas Davies, 1779), by J. Monck Mason (4 vols., 1779), by William Gifford (4 vols., 1805, 1813), by Hartley Coleridge (1840), by Lieut.-Colonel Cunningham (1867), and selections by Mr Arthur Symons in the *Mermaid Series* (1887–1889). Gifford's remains the standard edition, and formed the basis of Cunningham's text. It contains "An Essay on the Dramatic Writings of Massinger" by Dr John Ferriar.

Massinger has been the object of a good deal of criticism. A metrical examination of the plays in which Massinger was concerned is given in *Englische Studien* (Halle, v. 74, vii. 66, viii. 39, ix. 209 and x. 383), by Mr R. Boyle, who also contributed the life of the poet in the *Dictionary of National Biography*. The sources of his plays are dealt with by E. Koeppel in *Quellen Studien zu den Dramen Chapman's, Massinger's und Ford's* (Strassburg, 1897). For detailed criticism, beside the introductions to the editions quoted, see A. W. Ward, *Hist. of Eng. Dram. Lit.* (1899), iii. 1–47, and F. G. Fleay, *Biog. Chron. of the Eng. Drama* (1891), under *Fletcher*; a general estimate of Massinger, dealing especially with his moral standpoint, is given in Sir Leslie Stephen's *Hours in a Library* (3rd series, 1879); Swinburne, in the *Fortnightly Review* (July 1889), while acknowledging the justice of Sir L. Stephen's main strictures, found much to say in praise of the poet.

MASSINISSA (*c.* 238–149 B.C.), king of Massylian or eastern Numidia. He was educated, like many of the Numidian chiefs, at Carthage, learnt Latin and Greek, and was an accomplished as well as a naturally clever man. Although his kingdom was nominally independent of Carthage, it really stood to it in a relation of vassalage; it was directly under Carthaginian influences, and was imbued to a very considerable extent with Carthaginian civilization. It was to this that Massinissa owed his fame and success; he was a barbarian at heart, but he had a varnish of culture, and to this he added the craft and cunning in which Carthaginian statesmen were supposed to excel. While yet a young man (212) he forced his neighbour Syphax, prince of western Numidia, who had recently entered into an alliance with Rome, to fly to the Moors in the extreme west of Africa. Soon afterwards he appeared in Spain, fighting for Carthage with a large force of Numidian cavalry against the Romans under the two Scipios. The defeat of the Carthaginian army in 206 led him to cast in his lot with Rome. Scipio Africanus is said to have cultivated his friendship. Massinissa now quitted Spain for a while for Africa, and was again engaged in a war with Syphax in which he was decidedly worsted. Scipio's arrival in Africa in 204 gave him another chance, and no sooner had he joined the Roman general than he crushed his old enemy Syphax, and captured his capital Cirta (Constantine). Here occurs the romantic story of Sophonisba, daughter of the Carthaginian Hasdrubal, who had been promised in marriage to Massinissa, but had subsequently become the wife of Syphax. Massinissa, according to the story, married Sophonisba immediately after his victory, but was required by Scipio to dismiss her as a Carthaginian, and consequently an enemy to Rome.

To save her from such humiliation he sent her poison, with which she destroyed herself. Massinissa was now accepted as a loyal ally of Rome, and was confirmed by Scipio in the possession of his kingdom. In the battle of Zama (202) (see PUNIC WARS), he commanded the cavalry on Scipio's right wing, and materially assisted the Roman victory. For his services he received the kingdom of Syphax, and thus under Roman protection he became master of the whole of Numidia, and his dominions completely enclosed the Carthaginian territories, now straitened and reduced at the close of the Second Punic War. It would seem that he had thoughts of annexing Carthage itself with the connivance of Rome. In a war which soon followed he was successful; the remonstrances of Carthage with Rome on the behaviour of her ally were answered by the appointment of Scipio as arbitrator; but, as though intentionally on the part of Rome, no definite settlement was arrived at, and thus the relations between Massinissa and the Carthaginians continued strained. Rome, it is certain, deliberately favoured her ally's unjust claims with the view of keeping Carthage weak, and Massinissa on his part was cunning enough to retain the friendship of the Roman people by helping them with liberal supplies in their wars against Perseus of Macedon and Antiochus. As soon as Carthage seemed to be recovering herself, and some of Massinissa's partisans were driven from the city into exile, his policy was to excite the fears of Rome, till at last in 149 war was declared—the Third Punic War, which ended in the final overthrow of Carthage. The king took some part in the negotiations which preceded the war, but died soon after its commencement in the ninetieth year of his age and the sixtieth of his reign.

Massinissa was an able ruler and a decided benefactor to Numidia. He converted a plundering tribe into a settled and civilized population, and out of robbers and marauders made efficient and disciplined soldiers. To his sons he bequeathed a well-stored treasury, a formidable army, and even a fleet. Cirta (*q.v.*), his capital, became a famous centre of Phoenician civilization. In fact Massinissa changed for the better the whole aspect of a great part of northern Africa. He had much of the Arab nature, was singularly temperate, and equal to any amount of fatigue. His fidelity to Rome was merely that of temporary expediency. He espoused now one side, and now the other, but on the whole supported Rome, so that orators and historians could speak of him as "a most faithful ally of the Roman people."

See Livy xxiv. 49, xxviii. 11, 35, 42, xxix. 27, xxx. 3, 12, 28, 37, xlii. 23, 29, xliii. 3; Polybius iii. 5, ix. 42, xiv. 1, xxxii. 2, xxxvii. 3; Appian, *Hisp.* 37, *Punica*, 11, 27, 105; Justin xxxiii. 1; A. H. J. Greenidge, *Hist. of Rome* (London, 1904).

MASSON, DAVID (1822–1907), Scottish man of letters, was born at Aberdeen on the 2nd of December 1822, and educated at the grammar school there and at Marischal College. Intending to enter the Church, he proceeded to Edinburgh University, where he studied theology under Dr Chalmers, whose friendship he enjoyed until the divine's death in 1847. However, abandoning his project of the ministry, he returned to his native city to undertake the editorship of the *Banner*, a weekly paper devoted to the advocacy of Free Kirk principles. After two years he resigned this post and went back to the capital, bent upon pursuing a purely literary career. There he wrote a great deal, contributing to *Fraser's Magazine*, *Dublin University Magazine* (in which appeared his essays on Chatterton) and other periodicals. In 1847 he went to London, where he found wider scope for his energy and knowledge. He was secretary (1851–1852) of the "Society of the Friends of Italy." In a famous interview with Mrs Browning at Florence he contested her admiration for Napoleon III. He had known De Quincey, whose biography he contributed in 1878 to the "English Men of Letters" series, and he was an enthusiastic friend and admirer of Carlyle. In 1852 he was appointed professor of English literature at University College, London, in succession to A. H. Clough, and from 1858 to 1865 he edited the newly established *Macmillan's Magazine*. In 1865 he was selected for the chair of rhetoric and English literature at Edinburgh, and during the early years of his professorship actively promoted the movement for the university education of women. In 1879 he became editor of the Register of the Scottish Privy Council, and in 1893 was appointed Historiographer Royal for Scotland. Two years later he resigned his professorship. His *magnum opus* in his *Life of Milton in Connexion with the History of His Own Time* in six volumes, the first of which appeared in 1858 and the last in 1880. He also edited the library edition of Milton's *Poetical Works* (3 vols., 1874), and De Quincey's *Collected Works* (14 vols., 1889–1890). Among his other publications are *Essays, Biographical and Critical* (1856, reprinted with additions, 3 vols., 1874), *British Novelists and their Styles* (1859), *Drummond of Hawthornden* (1873), *Chatterton* (1873) and *Edinburgh Sketches* (1892). He died on the 6th of October 1907. A bust of Masson was presented to the senate of the university of Edinburgh in 1897. Professor Masson had married Rosaline Orme. His son Orme Masson became professor of chemistry in the university of Melbourne, and his daughter Rosaline is known as a writer and novelist.

MASSON, LOUIS CLAUDE FRÉDÉRIC (1847–   ), French historian, was born at Paris on the 8th of March 1847. His father, Francis Masson, a solicitor, was killed on the 23rd of June 1848, when major in the *garde nationale*. Young Masson was educated at the college of Sainte Barbe, and at the lycée Louis-le-Grand, and then travelled in Germany and in England; from 1869 to 1880 he was librarian at the Foreign Office. At first he devoted himself to the history of diplomacy, and published between 1877 and 1884 several volumes connected with that subject. Later he published a number of more or less curious memoirs illustrating the history of the Revolution and of the empire. But he is best known for his books connected with Napoleon. In *Napoléon inconnu* (1895), Masson, together with M. Guido Biagi, brought out the unpublished writings (1786–1793) of the future emperor. These were notes, extracts from historical, philosophical and literary books, and personal reflections in which one can watch the growth of the ideas later carried out by the emperor with modifications necessitated by the force of circumstances and his own genius. But this was only one in a remarkable series: *Joséphine de Beauharnais, 1763–1796* (1898); *Joséphine, impératrice et reine* (1899); *Joséphine répudiée 1809–1814* (1901); *L'Impératrice Marie Louise* (1902); *Napoléon et les femmes* (1894); *Napoléon et sa famille* (9 vols., 1897–1907); *Napoléon et son fils* (1904); and *Autour de l'Île d'Elbe* (1908). These works abound in details and amusing anecdotes, which throw much light on the events and men of the time, laying stress on the personal, romantic and dramatic aspects of history. The author was made a member of the Académie française in 1903. From 1886 to 1889 he edited the review *Arts and Letters*, published in London and New York.

A bibliography of his works, including anonymous ones and those under an assumed name, has been published by G. Vicaire (*Manuel de l'amateur des livres du XIX^{e} siècle*, tome v., 1904). *Napoléon et les femmes* has been translated into English as *Napoleon and the Fair Sex* (1894).

MAST (1) (O. Eng. *maest*; a common Teutonic word, cognate with Lat. *malus*; from the medieval latinized form *mastus* comes Fr. *mât*), in nautical language, the name of the spar, or straight piece of timber, or combination of spars, on which are hung the yards and sails of a vessel of any size. It has been ingeniously supposed that man himself was the first mast. He discovered by standing up in his prehistoric "dugout," or canoe, that the wind blowing on him would carry his craft along. But the origin of the mast, like that of the ship, is lost in times anterior to all record. The earliest form of mast which prevailed till the close of the middle ages, and is still in use for small vessels, was and is a single spar made of some tough and elastic wood; the conifers supply the best timber for the purpose. In sketching the history of the development of the mast, we must distinguish between the increase in the number erected, and the improvements made in the mast itself. The earliest ships had only one, carrying a single sail. So little is known of the rigging of classical ships that nothing can be affirmed of them with absolute confidence. The Norse vessels carried one mast placed in the middle. The number gradually increased till it reached four or five. All were at first upright, but the mast which stood nearest the bow was by degrees lowered forward till it became the bow-sprit of modern times, and lost the name of mast. The next from the bows became the foremast—called in Mediterranean sea language *mizzana*, in French *misaine*. Then came the main-mast—in French *grand mât*; and then the mizen—in French, which follows the Mediterranean usage, the *artimon*, *i.e.* "next the rudder," *timon*. A small mast was sometimes erected in the very end of the ship, and called in English a "bonaventure mizen." It had a close resemblance to the jigger of yawl-rigged yachts. By the close of the 16th century it had become the established rule that a ship proper had three masts—fore, main and mizen. The third takes its name not as the other two do, from its place, but from the lateen sail originally hoisted on it (see RIGGING), which was placed fore and aft in the middle (Italian, *mizzo*) of the ship, and did not lie across like the courses and topsails. With the development of very large sailing clippers in the middle of the 19th century a return was made to the practice of carrying more than three masts. Ships and barques are built with four or five. Some of the large schooners employed in the American coast trade have six or seven, and some steamers have had as many.

The mast was for long made out of a single spar. Thence the Mediterranean name of "palo" (spar) and the Spanish "arbol" (tree). The typical Mediterranean mast of "lateen" (Latin) vessels is short and bends forward. In other classes it is upright, or bends slightly backwards with what is called a "rake." The mast is grounded, or in technical language "stepped," on the kelson (or keelson), the solid timber or metal beam lying parallel with, and above the keel. As the 15th century advanced the growth of the ship made it difficult, or even impossible, to find spars large enough to make a mast. The practice of dividing it into lower, and upper or topmast, was introduced. At first the two were fastened firmly, and the topmast could not be lowered. In the 16th century the topmast became movable. No date can be given for the change, which was gradual, and was not simultaneously adopted. When the masting of sailing ships was fully developed, the division was into lower or standing mast, topmast, topgallant mast, and topgallant royal. The topgallant royal is a small spar which is often a continuation of the topgallant mast, and is fixed. Increase of size also made it impossible to construct each of these subdivisions out of single timbers. A distinction was made between "whole" or single-spar masts and "armed" and "made masts." The first were used for the lighter spars, for small vessels and the Mediterranean craft called "polacras." Armed masts were composed of two single timbers. Made masts were built of many pieces, bolted and "coaked," *i.e.* dovetailed and fitted together, fastened round by iron hoops, and between them by twelve or thirteen close turns of rope, firmly secured. "Made masts" are stronger than those made of a single tree and less liable to be sprung. The general principle of construction is that it is built round a central shaft, called in English the "spindle" or "upper tree," and in French the *mèche* or wick. The other pieces—"side trees," "keel pieces," "side fishes," "cant pieces" and "fillings" are "coaked," *i.e.* dovetailed and bolted on to and around the "spindle," which itself is made of two pieces, coaked and bolted. The whole is bound by iron bands, and between the bands, by rope firmly "woulded" or turned round, and nailed tight. The art of constructing made masts, like that of building wooden ships, is in process of dying out. In sailing men-of-war the mizen-mast often did not reach to the kelson, but was stepped on the orlop deck. Hollow metal cylinders are now used as masts. In the case of a masted screw steamer the masts abaft the engines could not be stepped on the kelson because they would interfere with the shaft of the screw. It is therefore necessary to step them on the lower deck, where they are supported by stanchions, or on a horseshoe covering the screw shaft. The size of masts naturally varies very much. In a 110-gun ship of 2164 tons the proportions of the mainmast were: for the lower mast, length 117 ft., diameter 3 ft. 3 in.; topmast, 70 ft., and $20\frac{3}{4}$ in.; topgallant mast, 35 ft., and $11\frac{5}{8}$ in., 222 ft. in all. At the other end of the scale, a cutter of 200 tons had a lower mast of 88 ft., of 22 in. diameter, and a topgallant mast (there was no topmast between them) of 44 ft., of $9\frac{3}{4}$ in. in diameter, 132 ft. in all; topgallant mast of 44 ft., and $9\frac{3}{4}$ in. in diameter. The masts of a warship were more lofty than those of a merchant ship of the same tonnage. At present masts are only used by warships for signalling and military purposes. In sailing merchant ships, the masts are more lofty than they were about a century ago. A merchant ship of 1300 tons, in 1830, had a mainmast 179 ft. in height; a vessel of the same size would have a mast of 198 ft. to-day.

A "jury mast" is a temporary mast put up by the crew when the spars have been carried away in a storm or in action, or have been cut away to relieve pressure in a storm. The word has been supposed without any foundation to be short for "injury" mast; it may be a mere fanciful sailor adaptation of "jury" in some connexion now lost. Skeat suggests that it is short for O. Fr. *ajourie*, Lat. *adjutare*, to aid. There is no reason to connect with *jour*, day.

See L. Jal, *Glossaire Nautique* (Paris, 1848); Sir Henry Manwayring, *The Seaman's Dictionary* (London, 1644); N. Hutchinson, *Treatise on Naval Architecture and Practical Seamanship* (Liverpool, 1777); David Steel, *Elements and Practice of Rigging, Seamanship and Naval Tactics* (London, 1800); William Burney's *Falconer's Dictionary* (London, 1830); Sir Gervais Nares's *Seamanship* (Portsmouth, 1882); and John Fincham, *On Masting Ships and Mast Making* (London, 1829). (D. H.)

MAST (2) (Anglo-Saxon *maest*, food, common to some Teutonic languages, and ultimately connected with "meat"), the fruit of the beech, oak, and other forest trees, used as food for swine.

MASTABA (Arab. for "bench"), in Egyptian architecture, the term given to the rectangular tombs in stone with raking sides and a flat roof. There were three chambers inside. In one the walls were sometimes richly decorated with paintings and had a low bench of stone in them on which incense was burnt. The second chamber was either closed, with holes pierced in the wall separating it from the first chamber, or entered through a narrow passage through which the fumes of the incense passed; this chamber contained the *serdab* or figure of the deceased. A vertical well-hole cut in the rock descended to a third chamber in which the mummy was laid.

MASTER (Lat. *magister*, related to *magis*, more, as the corresponding *minister* is to *minus*, less; the English form is due partly to the O. Eng. *maegister*, and partly to O. Fr. *maistre*, mod. *maître*; cf. Du. *meester*, Ger. *Meister*, Ital. *maestro*), one holding a position of authority, disposition or control over persons or things. The various applications of the word fall roughly into the following main divisions; as the title of the holder of a position of command or authority; as that of the holder of certain public or private offices, and hence a title of address; and as implying the relationship of a teacher to his pupils or of an employer to the persons he employs. As a title of the holder of an office, the use of the Lat. *magister* is very ancient. *Magister equitum*, master of the horse, goes back to the early history of the Roman Republic (see DICTATOR; and for the British office, MASTER OF THE HORSE). In medieval times the title was of great frequency. In Du Cange (*Glossarium*) the article *magister* contains over 120 sub-headings. In the British royal household most of the offices bearing this title are now obsolete. Of the greater offices, that of master of the buckhounds was abolished by the Civil List Act 1901. The master of the household, master of the ceremonies, master of the king's music still survive. Since 1870 the office of master of the mint has been held by the chancellor of the exchequer, all the administrative and other duties being exercised by the deputy master.

At sea, a "master" is more properly styled "master mariner." In the merchant service he is the commander of a ship, and is by courtesy known as the captain. In the British navy he was the officer entrusted with the navigation under the captain. He had no royal commission, but a warrant from the Navy Board. Very often he had been a merchant captain. His duties are now performed by the staff commander or navigating lieutenant. The master-at-arms is the head of the internal police of a ship; the same title is borne by a senior gymnastic instructor in the army. In the United States navy, the master is a commissioned officer below the rank of lieutenant.

"Master" appears as the title of many legal functionaries (for the masters of the supreme court see CHANCERY; and KING'S BENCH, COURT OF; for masters in lunacy see INSANITY: § *Law*; see also MASTER OF THE ROLLS, below). The "master of the faculties" is the chief officer of the archbishop of Canterbury in his court of faculties. His duties are concerned with the appointment of notaries and the granting of special licences of marriage. The duties are performed *ex officio* by the judge of the provincial courts of Canterbury and York, who is also dean of Arches, in accordance with § 7 of the Public Worship

Regulation Act 1874. The "master of the Temple" is the title of the priest-in-charge of the Temple Church in London. It was formerly the title of the grand master of the Knights Templars. The priest-in-charge of the Templars' Church was properly styled the *custos*, and this was preserved by the Knights Hospitallers when they were granted the property of the Templars at the dissolution of that order. The act of 1540 (32 Henry VIII.), which dissolved the order of the Hospitallers, wrongly styled the *custos* master of the Temple, and the mistake has been continued. The proper title of a bencher of the Inns of Court is "master of the Bench" (see Inns of Court). The title of "Master-General of the Ordnance" was revived in 1904 for the head of the Ordnance Department in the British military administration.

"Master" is the ordinary word for a teacher, very generally used in the compound "schoolmaster." The word also is used in a sense transferred from this to express the relation between the founder of a school of religion, philosophy, science, art, &c., and his disciples. It is partly in this sense and partly in that of one whose work serves as a model or type of superlative excellence that such terms as "old masters" are used. In medieval universities *magister* was particularly applied to one who had been granted a degree carrying with it the *licentia docendi*, the licence to teach. In English usage this survives in the faculty of arts. The degree is that of *artium magister*, master of arts, abbreviated M.A. In the other faculties the corresponding degree is doctor. Some British universities give a master's degree in surgery, *magister chirurgiae*, C.M. or M.Ch., and also in science, *magister scientiae*, M.Sc. The academic use of "master" as the title of the head of certain colleges at the universities of Oxford and Cambridge is to be referred to the frequent application of the term to the holder of a presiding office in an institution.

Master was the usual prefix of address to a man's name, though originally confined to people of some social standing. Probably under the influence of "mistress," it was corrupted in sound to "mister," and was abbreviated to "Mr." In the case of the puisne judges of the High Court "Mr Justice" is still used as the proper official form of written address. The Speaker of the House of Commons is also formally addressed as "Mr Speaker." In some Scottish peerages below the rank of earl, "master" is used in the courtesy title of the heir, *e.g.* the "Master of Ruthven."

MASTER AND SERVANT. These are scarcely to be considered as technical terms in English law. The relationship which they imply is created when one man hires the labour of another for a term. Thus it is not constituted by merely contracting with another for the performance of a definite work, or by sending an article to an artificer to be repaired, or engaging a builder to construct a house. Nor would the employment of a man for one definite act of personal service—*e.g.* the engagement of a messenger for a single occasion—generally make the one master and the other servant. It was held, however, in relation to the offence of embezzlement, that a drover employed on one occasion to drive cattle home from market was a servant within the statute. On the other hand, there are many decisions limiting the meaning of "servants" under wills giving legacies to the class of servants generally. Thus "a person who was not obliged to give his whole time to the master, but was yet in some sense a servant," was held not entitled to share in a legacy to the servants. These cases are, however, interpretations of wills where the intention obviously is to benefit domestic servants only. And so in other connexions questions may arise as to the exact nature of the relations between the parties—whether they are master and servant, or principal and agent, or landlord and tenant, or partners, &c.

The terms of the contract of service are for the most part such as the parties choose to make them, but in the absence of express stipulations terms will be implied by the law. Thus, "where no time is limited either expressly or by implication for the duration of a contract of hiring and service, the hiring is considered as a general hiring, and in point of law a hiring for a year." But "in the case of domestic and menial servants there is a well-known rule, founded solely on custom, that their contract of service may be determined at any time by giving a month's warning or paying a month's wages, but a domestic or other yearly servant, *wrongfully* quitting his master's service, forfeits all claim to wages for that part of the current year during which he has served, and cannot claim the sum to which his wages would have amounted had he kept his contract, merely deducting therefrom one month's wages. Domestic servants have a right by custom to leave their situations at any time on payment of a calendar month's wages in advance, just as a master may discharge them in a similar manner" (Manley Smith's *Law of Master and Servant*, chs. ii. and iii.). The following are sufficient grounds for discharging a servant: (1) wilful disobedience of any lawful order; (2) gross moral misconduct; (3) habitual negligence; (4) incompetence or permanent disability caused by illness. A master has a right of action against any person who deprives him of the services of his servant, by enticing him away, harbouring or detaining him after notice, confining or disabling him, or by seducing his female servant. Indeed, the ordinary and only available action for seduction in English law is in form of a claim by a parent for the loss of his daughter's services. The death of either master or servant in general puts an end to the contract. A servant wrongfully discharged may either treat the contract as rescinded and sue for services actually rendered, or he may bring a special action for damages for the breach. The common law liabilities of a master towards his servants have been further regulated by the Workmen's Compensation Acts (see Employer's Liability). A master is bound to provide food for a servant living under his roof, and wilful breach of duty in that respect is a misdemeanour under the Offences against the Person Act 1861.

A servant has no right to demand "a character" from an employer, and if a character be given it will be deemed a privileged communication, so that the master will not be liable thereon to the servant unless it be false and malicious. A master by knowingly giving a false character of a servant to an intending employer may render himself liable—should the servant for example rob or injure his new master.

Reference may be made to the articles on Labour Legislation for the cases in which special terms have been introduced into contracts of service by statute (*e.g.* Truck Acts).

MASTER OF THE HORSE, in England, an important official of the sovereign's household. The master of the horse is the third dignitary of the court, and is always a member of the ministry (before 1782 the office was of cabinet rank), a peer and a privy councillor. All matters connected with the horses and hounds of the sovereign, as well as the stables and coach-houses, the stud, mews and kennels, are within his jurisdiction. The practical management of the royal stables and stud devolves on the chief or crown equerry, formerly called the gentleman of the horse, who is never in personal attendance on the sovereign and whose appointment is permanent. The clerk marshal has the supervision of the accounts of the department before they are submitted to the Board of Green Cloth, and is in waiting on the sovereign on state occasions only. Exclusive of the crown equerry there are seven regular equerries, besides extra and honorary equerries, one of whom is always in attendance on the sovereign and rides at the side of the royal carriage. They are always officers of the army, and each of them is "on duty" for about the same time as the lords and grooms in waiting. There are also several pages of honour in the master of the horse's department, who must not be confounded with the pages of various kinds who are in the department of the lord chamberlain. They are youths aged from twelve to sixteen, selected by the sovereign in person, to attend on him at state ceremonies, when two of them, arrayed in an antique costume, assist the groom of the stole in carrying the royal train.

In France the master of the horse ("Grand Écuyer," or more usually "Monsieur le grand") was one of the seven great officers of the crown from 1617. As well as the superintendence of the royal stables, he had that of the retinue of the sovereign, also the charge of the funds set aside for the religious functions of the court, coronations, &c. On the death of a sovereign he had the right to all the horses and their equipment in the royal stables. Distinct from this officer and independent of him, was the first equerry (" Premier Écuyer "), who had charge of the horses which the sovereign used personally (" la petite écurie "), and who attended on him when he rode out. The office of master of the horse existed down to the reign of Louis XVI. Under Louis XVIII. and Charles X. the duties were discharged by the first equerry, but under Napoléon I. and Napoléon III. the office was revived with much of its old importance.

In Germany the master of the horse (Oberststallmeister) is a high court dignitary; but his office is merely titular, the superintendence of the king's stables being carried out by the Oberstallmeister, an official corresponding to the crown equerry in England.

MASTER OF THE ROLLS, the third member of the Supreme Court of Judicature in England, the lord chancellor, president of the chancery division, being the first, and the lord chief justice, president of the king's bench division, being the second. At first he was the principal clerk of the chancery, and as such had charge of the records of the court, especially of the register of original writs and of all patents and grants under the Great Seal. Until the end of the 15th century he was called either the clerk or the keeper of the rolls, and he is still formally designated as the master or keeper of the rolls. The earliest mention of him as master of the rolls is in an act of 1495; and in another act of the same year he is again described as clerk of the rolls, showing that his official designation still remained unsettled. About the same period, however, the chief clerks of the chancery came to be called masters in chancery, and the clerk, master or keeper of the rolls was always the first among them, whichever name they bore. In course of time, from causes which are not very easy to trace, his original functions as keeper of the records passed away from him and he gradually assumed a jurisdiction in the court of chancery second only to that of the lord chancellor himself. In the beginning he only heard causes in conjunction with the other masters in chancery, and his decrees were invalid until they had been approved and signed by the lord chancellor. Sitting in the Rolls chapel or in the court in Rolls yard, he heard causes without assistance, and his decrees held good until they were reversed on petition either to the lord chancellor or afterwards to the lords justices of appeal. Before any judge with the formal title of vice-chancellor was appointed the master of the rolls was often spoken of as vice-chancellor, and in theory acted as such, sitting only when the lord chancellor was not sitting and holding his court in the evening from six o'clock to ten. Only since 1827 has the master of the rolls sat in the morning hours. By the Public Record Office Act 1838 the custody of the records was restored to him, and he is chairman of the State Papers and Historical Manuscripts Commissions. Under the Judicature Act 1875, and the Appellate Jurisdiction Act 1876, he now always sits with the lords justices in the court of appeal (which usually sits in two divisions of three judges, the master of the rolls presiding over one division), whose decisions can be questioned only in the House of Lords. The master of the rolls was formerly eligible to a seat in the House of Commons—a privilege enjoyed by no other member of the judicial bench;[1] but he was deprived of it by the Supreme Court of Judicature Act 1873, which provides that all judges of the High Court of Justice and the court of appeal shall be incapable of being elected to or sitting in the House of Commons. The master of the rolls is always sworn of the privy council. His salary is £6000 a year.

See Lord Hardwicke, *Office of the Master of the Rolls.*

MASTIC, or MASTICH (Gr. μαστίχη, probably connected with μασᾶσθαι, to chew, since mastic is used in the East as a chewing gum), a resinous exudation obtained from the lentisk, *Pistacia lentiscus*, an evergreen shrub of the natural order Anacardiaceae. The lentisk or mastic plant is indigenous to the Mediterranean coast region from Syria to Spain, but grows also in Portugal, Morocco and the Canaries. Although experiments have proved that excellent mastic might be obtained in other islands in the archipelago, the production of the substance has been, since the time of Dioscorides, almost exclusively confined to the island of Chios. The mastic districts of that island are for the most part flat and stony, with little hills and few streams. The shrubs are about 6 ft. high. The resin is contained in the bark and not in the wood, and in order to obtain it numerous vertical incisions are made, during June, July and August, in the stem and chief branches. The resin speedily exudes and hardens into roundish or oval tears, which are collected, after about fifteen days, by women and children in little baskets lined with white paper or cotton wool. The ground around the trees is kept hard and clean, and flat pieces of stone are often laid beneath them to prevent any droppings of resin from becoming contaminated with dirt. The collection is repeated three or four times between June and September, a fine tree being found to yield about 8 or 10 lb of mastic during the season. Besides that obtained from the incisions, mastic of very fine quality spontaneously exudes from the small branches. The harvest is affected by showers of rain during the period of collection, and the trees are much injured by frost, which is, however, of rare occurrence in the districts where they grow. Mastic occurs in commerce in the form of roundish tears about the size of peas. They are transparent, with a glassy fracture, of a pale yellow or faint greenish tinge, which darkens slowly by age. During the 15th, 16th and 17th centuries mastic enjoyed a high reputation as a medicine, and formed an ingredient in a large number of medical compounds; but its use in medicine is now obsolete, and it is chiefly employed for making varnish.

Pistacia Khinjuk and *P. cabulica*, trees growing throughout Sindh, Baluchistan and Cabul, yield a kind of mastic which is met with in the Indian bazaars under the name of *Mustagirūmī*, *i.e.* Roman mastic. This when occurring in the European market is known as East Indian or Bombay mastic. In Algeria *P. Atlantica* yields a solid resin, which is collected and used by the Arabs as a masticatory. Cape mastic is the produce of *Euryops multifidus*, the resin bush, or *harpuis bosch* of the Boers—a plant of the composite order growing abundantly in the Clanwilliam district. Dammar resin is sometimes sold under the name of mastic. The West Indian mastic tree is the *Bursera gummifera* and the Peruvian mastic is *Schinus molle*; but neither of these furnishes commercial resins. The name mastic tree is also applied to a timber tree, *Sideroxylon mastichodendron*, nat. ord. Sapotaceae, which grows in the West Indies and on the coast of Florida.

MASTIGOPHORA, a group of Protozoa, moving and ingesting food by long flagella (Gr. μάστιξ, whip), usually few in number, and multiplying by fission, usually longitudinal, in the active condition. They were separated off from the rest of the old " Infusoria " by K. Düsing, and subdivided by O. Bütschli and E. R. Lankester into (1) Flagellata (*q.v.*), including Haemoflagellata (*q.v.*), (2) Dinoflagellata (*q.v.*) and Rhyncho = Cystoflagellata E. Haeckel (*q.v.*) = Rhynchoflagellata E. R. Lankester. The Mastigophora are frequently termed Flagellata or Flagellates.

MASTODON (Gr. μαστός, breast, ὀδούς, tooth), a name given by Cuvier to the Pliocene and Miocene forerunners of the elephants, on account of the nipple-like prominences on the molar teeth of some of the species (fig. 2), which are of a much simpler type than those of true elephants. Mastodons, like elephants, always have a pair of upper tusks, while the earlier ones likewise have a short pair in the lower jaw, which is prolonged into a snout-like symphysis for their support. These long-chinned mastodons are now regarded as forming a genus by themselves (*Tetrabelodon*), well-known examples of this group being *Tetrabelodon angustidens* from the Miocene and *T. longirostris* (fig. 1 C.) from the Lower Pliocene of the Continent. In the former the upper tusks are bent down so as to cross the tips of the short and chisel-like lower pair. These long-chinned mastodons must have had an extremely elongated muzzle, formed by the upper lip and nose above and the lower lip below, with which they were able to reach the ground, the neck being probably rather longer than in elephants. On the other hand, in the short-chinned mastodons, as represented by the Pleistocene North American *Mastodon americanus* and the Pliocene European *M. turicensis* (fig. 1), the chin had shrunk to the dimensions characteristic of elephants, with the loss of the lower incisors (or with temporary retention of rudimentary ones), while at the same time a true elephant-like trunk must have been developed by the shortening of the lower lip and the prolongation of the combined upper lip and nose.

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[1] Sir John Romilly, M.P. for Devonport, 1847 to 1852, was the last master of the rolls to sit in Parliament. He was appointed master of the rolls in 1851.

Mastodons are found in almost all parts of the world. In Asia they gave rise to the elephants, while they themselves originated in Africa from ungulates of more normal type. (See Proboscidea.)

The upper tusks of the early mastodons differ from those of elephants in retaining longitudinal bands of enamel. The molar teeth are six in number on each side, increasing in size from before backwards, and, as in the elephants, with a horizontal succession, the anterior teeth being lost before the full development of the posterior ones, which gradually move forward, taking the place of those that are destroyed by wear. This process is, however, less fully developed than in elephants, and as many as three teeth may be in place in each jaw at one time. There is, moreover, in many species a vertical succession, affecting either the third, or the third and second, or (in one American species, *Tetrabelodon productus*) the first, second and third of the six molar teeth. These three are therefore reckoned as milk-molars, and their successors as premolars, while the last three correspond to the true molars of other mammals. The mode of succession of the teeth in the mastodons exhibits so many stages of the process by which the dentition of elephants has been derived from that of more ordinary mammals. It also shows that the anterior molars of elephants do not correspond to the premolars of other ungulates, but to the milk-molars, the early loss of which in consequence of the peculiar process of horizontal forward-moving succession does not require their replacement by premolars. Specialized species like *Mastodon americanus* have completely lost the rudimentary premolars.

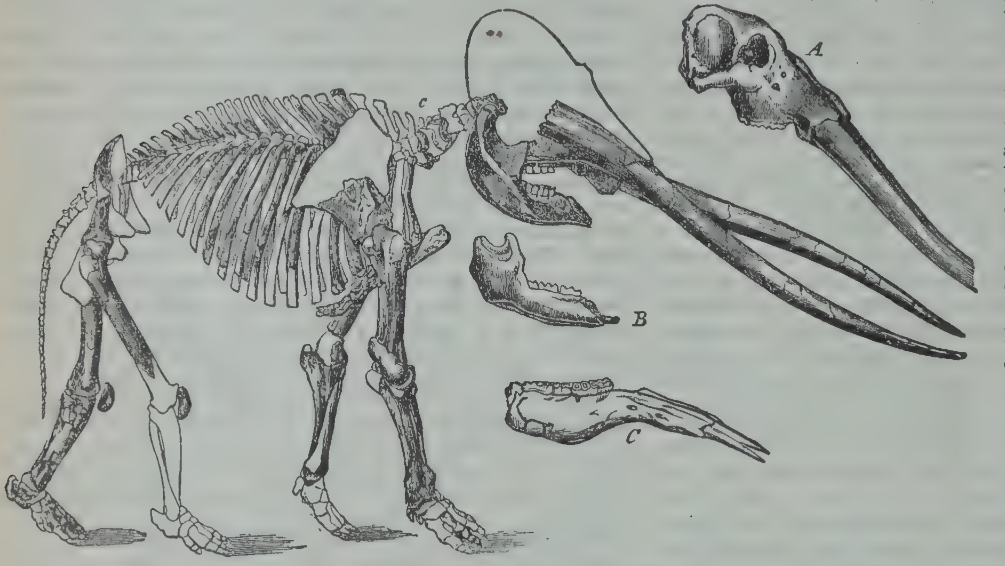
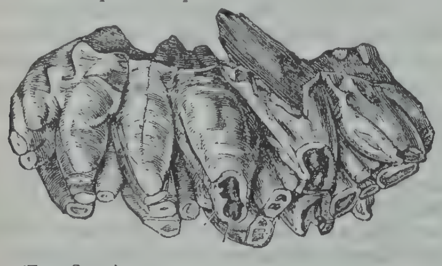


Fig. 1.—*Mastodon turicensis* (Pliocene).
A, B, Skull and Lower Jaw of *Mastodon americanus*. C, Lower Jaw of *Tetrabelodon longirostris*.



(From Owen.)

Fig. 2.—Upper Molar of *Mastodon arvernensis*, viewed from below.

Mastodons have fewer ridges on their molar teeth than elephants; the ridges are also less elevated, wider apart, with a thicker enamel covering, and scarcely any cement filling the space between them. Sometimes (as in *M. americanus*) the ridges are simple transverse wedge-shaped elevations with straight or concave edges. In other species the summits of the ridges are divided into conical cusps, and may have accessory cusps clustering around them (as in *M. arvernensis*, fig. 2). When the summits of these are worn by mastication their surfaces present circles of dentine surrounded by a border of enamel, and as attrition proceeds different patterns are produced by the union of the bases of the cusps, a trefoil form being characteristic of some species.

Certain of the molar teeth of the middle of the series in both elephants and mastodons have the same number of principal ridges; those in front having fewer, and those behind a greater number. These teeth are distinguished as "intermediate" molars. In elephants there are only two, the last milk-molar and the first true molar (or the third and fourth of the whole series), which are alike in the number of ridges; whereas in mastodons there are three such teeth, the last milk-molar and the first and second molars (or the third, fourth and fifth of the whole series). In elephants the number of ridges on the intermediate molars always exceeds five, but in mastodons it is nearly always three or four, and the tooth in front has usually one fewer and that behind one more, so that the ridge-formula (*i.e.* a formula expressing the number of ridges on each of the six molar teeth) of most mastodons can be reduced either to 1, 2, 3, 3, 3, 4, or 2, 3, 4, 4, 4, 5. Three-ridged and four-ridged types occur both in *Mastodon* and *Tetrabelodon*. (R. L.*)

MASʽŪDĪ (Abū-l Ḥasan ʽAlī ibn Ḥusain ibn ʽAlī ul-Masʽūdī] (d. *c.* 956), Arabian historian, was born at Bagdad towards the close of the 9th century. Much of his life was spent in travel. After he had been in Persia and Kerman, he visited Istakhr in 915, and went in the following year to Mūltān and Manṣūra, thence to Cambay, Saimur and Ceylon, to Madagascar and back to Oman. He seems about this time to have been as far as China. After a visit to the shores of the Caspian Sea he visited Tiberias in Palestine, examined the Christian church there, and described its relics. In 943 he was in Antioch, studying the ruins, and two years later in Damascus. The last ten years of his life he spent in Syria and Egypt. His great object in life had been to study with his own eyes the peculiarities of every land and to collect whatever was of interest for archaeology, history and manners. Himself a Moʽtazilite (see Mahommedan Religion: *Sects*), he was singularly free from bigotry, and took his information, when necessary, from Persians, Jews, Indians, and even the chronicle of a Christian bishop.

His most extensive work was the *Kitāb akhbār uz-Zamān* or *Annals*, in 30 volumes with a supplement, the *Kitāb ul-Ausaṭ*, a chronological sketch of general history. Of these the first part only of the former is extant in MS. in Vienna, while the latter seems to be in the Bodleian Library, also in MS. The substance of the two was united by him in the work by which he is now best known, the *Murūj udh-Dhahab wa Maʽādin ul-Jawāhir* ("Meadows of Gold and Mines of Precious Stones"), an historical work which he completed in 947. In 956 he finished a second edition of this and made it double its former size, but no copy of this seems to be extant. The original edition has been published at Bulāq and Cairo, and with French translation by C. Barbier de Meynard and Pavet de Courteille (9 vols., Paris, 1861–1877). Another work of Masʽūdī, written in the last year of his life, is the *Kitāb ut-Tanbīh wal Ishrāf* (the "Book of Indication and Revision"), in which he summarizes the work of his life and corrects and completes his former writings. It has been edited by M. J. de Goeje (Leiden, 1894), and a French translation has been made by Carra de Vaux (Paris, 1896); cf. also the memoir of S. de Sacy published in Meynard's edition of the *Murūj*.

An account of Masʽūdī's works is to be found in de Sacy's memoir and in Goeje's preface to his edition of the *Tanbīh*, and of the works extant in C. Brockelmann's *Gesch. der Arabischen Litteratur*, i. 144–145 (Weimar, 1898). C. Field's *Tales of the Caliphs* (1909) is based on Masʽūdī. (G. W. T.)

MASULIPATAM, or BANDAR, a seaport of British India, administrative headquarters of the Kistna district of Madras, on one of the mouths of the river Kistna, 215 m. N. of Madras city. Pop. (1901), 39,507. Masulipatam was the earliest English settlement on the Coromandel coast, its importance being due to the fact that it was the *bandar* or port of Golconda. An agency was established there in 1611. During the wars of the Carnatic, the English were temporarily expelled the town, which was held by the French for some years. In 1759 the town and fort were carried by storm by Colonel Forde, an achievement followed by the acquisition of the Northern Circars (*q.v.*). In 1864 a great storm-wave swept over the entire town and is said to have destroyed 30,000 lives. Weavers form a large portion of the inhabitants, though their trade has greatly declined since the beginning of the 19th century. Their operations, besides weaving, include printing, bleaching washing and dressing. In former days the chintzes of Masulipatam had a great reputation abroad for the freshness and permanency of their dyes. Masulipatam is a station of the Church Missionary Society. The port is only a roadstead, where vessels anchor 5 m. out. A branch line from Bezwada on the Southern Mahratta railway was opened in 1908. The chief educational institution is the Noble College of the C.M.S.

MAT (O. Eng. *meatt*, from late Lat. *matta*, whence Ital. *matta*, Ger. and Dan. *matte*, Du. *mat*, &c.), an article of various sizes and shapes, according to the purpose for which it is intended, and made of plaited or woven materials, such as coir, hemp, coco-nut fibre, straw, rushes, &c., or of rope or coarse twine. The finer fabrics are known as "matting" (*q.v.*). Mats are mainly used for covering floors, or in horticulture as a protection against cold or exposure for plants and trees. When used near the entrance to a house for people to wipe their boots on "door mats" are usually made of coarse coco-nut fibre, or india-rubber, cork, or of thickly coiled wire. Bags, rolls or sacks made of matting are used to hold coffee, flax, rice and other produce, and the term is often used with reference to the specific quantities of such produce, *e.g.* so many "mats" of coffee, rice, &c.

To be distinguished from the above is the term "mat" in glass-painting or gilding, meaning dull, unpolished or unburnished. This is the same as Ger. *matt*, dead, dull, cf. *matt-blau*, Med. Lat. *mattus*, adapted from Persian *māt*, dazed, astonished, at a loss, helpless, and seen in "mate" in chess, from Pers. *shāh māt* the king is dead.

MATABELE ("vanishing" or "hidden" people, so called from their appearance in battle, hidden behind enormous oxhide shields), a people of Zulu origin who began national life under the chief Mosilikatze. Driven out of the Transvaal by the Boers in 1837, Mosilikatze crossed the Limpopo with a military host which had been recruited from every tribe conquered by him during his ten years' predominance in the Transvaal. In their new territories the Matabele absorbed into their ranks many members of the conquered Mashona tribes and established a military despotism. Their sole occupation was war, for which their laws and organization were designed to fit them. This system of constant warfare is, since the conquest of Matabeleland by the British in 1893, a thing of the past. The Matabele are now herdsmen and agriculturists. (See RHODESIA.)

MATACHINES (Span. *matachin*, clown, or masked dancer), bands of mummers or itinerant players in Mexico, especially popular around the Rio Grande, who wander from village to village during Lent, playing in rough-and-ready style a set drama based on the history of Montezuma. Dressed in fantastic Indian costumes and carrying rattles as their orchestra, the chief characters are *El Monarca* "the monarch" (Montezuma); *Malinche*, or *Malintzin*, the Indian mistress of Hernando Cortes; *El Toro*, "the bull," the malevolent "comic man" of the play, dressed in buffalo skin with the animal's horns on his head; *Aguelo*, the "grandfather," and *Aguela*, "grandmother." With the help of a chorus of dancers they portray the desertion of his people by Montezuma, the luring of him back by the wiles and smiles of Malinche, the final reunion of king and people, and the killing of El Toro, who is supposed to have made all the mischief.

MATADOR, a Spanish word meaning literally "killer," from *matar*, Lat. *mactare*, especially applied to the principal performer in a bull-fight, whose function it is to slay the bull (see BULL-FIGHTING). The word is also used of certain important cards in such games as quadrille, ombre, &c., and more particularly of a special form of the game of dominoes.

MATAMOROS, a town and port of the state of Tamaulipas, Mexico, on the S. bank of the Rio Grande, 28 m. from its mouth, opposite Brownsville, Texas. Pop. (1900), 8347. Matamoros stands in an open plain, the commercial centre for a large district, but its import trade is prejudiced by the bar at the mouth of the Rio Grande, which permits the entrance of small vessels only. The exports include hides, wool and live stock. The importance of the town in the foreign trade of northern Mexico, however, has been largely diminished by the great railways. Formerly it was the centre of a large contraband trade with Brownsville, Texas. Matamoros was founded early in the 19th century, and was named in honour of the Mexican patriot Mariano Matamoros (*c.* 1770–1814). In the war between the United States and Mexico, Matamoros was easily taken by the Americans on the 18th of May 1846, following General Zachary Taylor's victories at Palo Alto and Resaca de la Palma. Matamoros was occupied by the Mexican imperialists under Mejia in 1864, and by the French in 1866.

MATANZAS, an important city of Cuba, capital of Matanzas Province, situated on a large deep bay on the N. coast, about 54 m. (by rail) E. of Havana. Pop. (1907), 36,009. There are railway outlets W., S. and E., and Matanzas is served by steamships to New York and by the coast steamers of the Herrera Line. The bay, unlike all the other better harbours of the island, has a broad mouth, 2 m. across, but there is good shelter against all winds except from the N.E. A coral reef lies across the entrance. Three rivers emptying into the bay—the San Juan, Canimar and Yumuri—have deposited much silt, necessitating the use of lighters in loading and unloading large ships. The city is finely placed at the head of the bay, on a low, sloping plain backed by wooded hills, over some of which the city itself has spread. The conical Pan de Matanzas (1277 ft.) is a striking land-mark for sailors. The San Juan and Yumuri rivers divide Matanzas into three districts. The Teatro Esteban, Casino Español and Government House are noteworthy among the buildings. The broad Paseo de Marti (Alameda de Versalles, Paseo de Santa Cristina) extends along the edge of the harbour, and is perhaps the handsomest parkway and boulevard in Cuba. At one end is a statue of Ferdinand VII., at the other a monument to 63 Cubans executed by the Spanish Government as traitors for bearing arms in the cause of independence. A splendid military road continues the Paseo to the Castillo de San Serverino (built in 1694–1695, reconstructed in 1773 and following years). There are two smaller forts, established in the 18th century. Near Matanzas are two of the most noted natural resorts of Cuba: the valley of the Yumuri, and the caves of Bellamar. Commanding the Yumuri Valley is the hill called Cumbre, on which is the Hermitage of Monteserrate (1870), with a famous shrine. Matanzas is the second port of the island in commerce. Sugar and molasses are the chief exports. The city is the chief outlet for the sugar product of the province, which, with the province of Santa Clara, produces two-thirds of the crop of the island. There are many large warehouses, rum distilleries, sugar-mills and railway machine-shops. Matanzas is frequently mentioned in the annals of the 16th and 17th centuries, when its bay was frequented by buccaneers; but the city was not laid out until 1693. In the next year it received an *ayuntamiento* (council). Its prosperity rapidly increased after the establishment of free commerce early in the 19th century. In 1815 it was made a department capital. The mulatto poet, Gabriel de la Concepción Valdés, known as Plácido (1809–1844), was born in Matanzas, and was executed there for participation in the supposed conspiracy of negroes in 1844, which is one of the most famous episodes in Cuban history. The hurricanes of 1844 and 1846 are the only other prominent local events. American commercial influence has always been particularly strong.

MATARÓ (anc. *Iluro*), a seaport of north-eastern Spain, in the province of Barcelona, on the Mediterranean Sea and the Barcelona-Perpignan railway. Pop. (1900), 19,704. The streets of the new town, lying next the sea, are wide and regularly built; those of the old town, farther up the hill, still preserve much of their ancient character. The parish church of Santa Maria has some good pictures and wood carvings. The wine of the neighbourhood, which resembles port, is shipped in large quantities from Barcelona; and the district furnishes fine roses and strawberries for the Barcelona market. The leading industries are manufactures of linen and cotton goods, especially canvas and tarpaulin, and of soap, paper, chemicals, starch, glass, leather, spirits and flour. The railway to Barcelona, opened in October 1848, was the first to be constructed in Spain. Outside the town is the much-frequented carbonated mineral spring of Argentona.

MATCH: 1. O. Eng. *gemaecca*, a cognate form of "make," meaning originally "fit" or "suitable"; a pair, or one of a pair of objects, persons or animals. As particularly applied to a husband and wife, and hence to a marriage, the word is especially used of two persons or things which correspond exactly to each other. The verb "to match" has also the meaning to "pit one against each other," and so is applied in sport to an arranged contest between individuals or sides.

2. O. Fr. *mesche*; apparently from a latinized form of Gr. *μύξα*, mucus from the nose, applied to the nozzle of a lamp; primarily the wick which conveys oil or molten wax to the flame of a lamp or candle (this use is now obsolete), the word being then applied to various objects having the property of carrying fire. With early firearms a match, consisting of a cord of hemp or similar material treated with nitre and other substances so that it continued to smoulder after it had been ignited, was used for firing the charge, being either held in the gunner's hand or attached to the cock of the musket or arquebus and brought down by the action of the trigger on the powder priming ("matchlock"); and more or less similar preparations, made to burn more or less rapidly as required ("quick-match" and "slow-match"), are employed as fuses in blasting and demolition work in military operations. The word "match" was further used of a splint of wood, tipped with sulphur so that it would readily ignite, but it now most commonly means a slip of wood or other combustible material, having its end covered with a composition which takes fire when rubbed either on any rough surface or on another specially prepared composition.

The first attempt to make matches in the modern sense may probably be ascribed to Godfrey Haukwitz, who, in 1680, acting under the direction of Robert Boyle, who at that time had just discovered how to prepare phosphorus, employed small pieces of that element, ignited by friction, to light splints of wood dipped in sulphur. This device, however, did not come into extensive use owing to its danger and inconvenience and to the cost of the phosphorus, and till the beginning of the 19th century flint and steel with tinder-box and sulphur-tipped splints of wood—"spunks" or matches—were the common means of obtaining fire for domestic and other purposes. The sparks struck off by the percussion of flint and steel were made to fall among the tinder, which consisted of carbonized fragments of cotton and linen; the entire mass of the tinder was set into a glow, developing sufficient heat to ignite the sulphur with which the matches were tipped, and thereby the splints themselves were set on fire. In 1805 one Chancel, assistant to Professor L. J. Thénard of Paris, introduced an apparatus consisting of a small bottle containing asbestos, saturated with strong sulphuric acid, with splints or matches coated with sulphur, and tipped with a mixture of chlorate of potash and sugar. The matches so prepared, when brought into contact with the sulphuric acid in the bottle, ignited, and thus, by chemical action, fire was produced. In 1823 a decided impetus was given to the artificial production of fire by the introduction of the Döbereiner lamp, so called after its inventor, J. W. Döbereiner of Jena. The first really practical friction matches were made in England in 1827, by John Walker, a druggist of Stockton-on-Tees. These were known as "Congreves" after Sir William Congreve, the inventor of the Congreve rocket, and consisted of wooden splints or sticks of cardboard coated with sulphur and tipped with a mixture of sulphide of antimony, chlorate of potash and gum. With each box which was retailed at a shilling, there was supplied a folded piece of glass paper, the folds of which were to be tightly pressed together, while the match was drawn through between them. The same idea occurred to Sir Isaac Holden independently two and a half years later. The so-called "Prometheans," patented by S. Jones of London in 1830, consisted of a short roll of paper with a small quantity of a mixture of chlorate of potash and sugar at one end, a thin glass globule of strong sulphuric acid being attached at the same point. When the sulphuric acid was liberated by pinching the glass globule, it acted on the mixed chlorate and sugar, producing fire. The phosphorus friction-match of the present day was first introduced on a commercial scale in 1833. It appears to have been made almost simultaneously in several distinct centres. The name most prominently connected with the early stages of the invention is that of J. Preschel of Vienna, who in 1833 had a factory in operation for making phosphorus matches, fusees, and amadou slips tipped with igniting composition. At the same time also matches were being made by F. Moldenhauer in Darmstadt; and for a long series of years Austria and the South-German states were the principal centres of the new industry.

But the use of ordinary white or yellow phosphorus as a principal ingredient in the igniting mixture of matches was found to be accompanied with very serious disadvantages. It is a deadly poison, and its free dissemination has led to many accidental deaths, and to numerous cases of wilful murder and suicide. Workers also who are exposed to phosphoric vapours are subject to a peculiarly distressing disease which attacks the jaw, and ultimately produces necrosis of the jaw-bone ("phossy jaw"), though with scrupulous attention to ventilation and cleanliness much of the risk of the disease may be avoided. The most serious objections to the use of phosphorus, however, were overcome by the discovery of the modified form of that body known as red or amorphous phosphorus. That substance was utilized for the manufacture of the well-known "safety matches" by J. E. Lundström, of Jönköping, Sweden, in 1852; its employment for this purpose had been patented eight years previously by another Swede, G. E. Pasch, who, however, regarded it as an oxide of phosphorus. Red phosphorus is in itself a perfectly innocuous substance, and no evil effects arise from freely working the compositions of which it forms an ingredient. The fact again that safety matches ignite only in exceptional circumstances on any other than the prepared surfaces which accompany the box—which surfaces and not the matches themselves contain the phosphorus required for ignition—makes them much less liable to cause accidental fires than other kinds.

The processes carried out in a match factory include preparing the splints, dipping them first in molten paraffin wax and then in the igniting composition, and filling the matches into boxes. All these operations are performed by complicated automatic machinery, in the development of which the Diamond Match Company of America has taken a leading part, with the minimum of manual intervention.

The chief element in the igniting mixture of ordinary or "strike anywhere" matches used to be common yellow phosphorus, combined with one or more other bodies which readily part with oxygen under the influence of heat. Chief among these latter substances is chlorate of potash, others being red lead, nitrate of lead, bichromate of potash and peroxide of manganese. But at the beginning of the 20th century many countries took steps to stop the use of yellow phosphorus owing to the danger to health attending its manipulation. In Sweden matches made with it have been prohibited for home consumption, but not for export, since 1901. In 1905 and 1906 two conferences, attended by representatives of most of the governments of Europe, were held at Berne to consider the question of prohibiting yellow phosphorus, but no general agreement was reached owing to the objections entertained by Sweden, Norway, Spain and Portugal, and also Japan. Germany, France, Italy, Denmark, Holland, Switzerland and Luxemburg, however, agreed to a convention whereby yellow phosphorus was prohibited as from 1912, and to this Great Britain expressed her adherence after the passing of the White Matches Prohibition Act 1908, which forbade the manufacture and importation of such matches from the 1st of January 1910; though to avoid hardship to retailers and others holding large stocks it permitted their sale for a year longer. Phosphorous sulphide (sesquisulphide of phosphorus) is one of the substances widely employed as a substitute for yellow phosphorus in matches which will strike anywhere without the need of a specially prepared surface.

Safety matches contain no phosphorus in the heads; according to one formula that has been published the mixture with which they are tipped consists of chlorate of potash, 32 parts; bichromate of potash, 12; red lead, 32; sulphide of antimony, 24; while the ingredients of a suitable rubbing surface are eight parts of amorphous phosphorus to nine of sulphide of antimony. There is no doubt, however, that there is considerable diversity in the composition of the mixtures actually employed.

"Vestas" are matches in which short pieces of thin "wax taper" are used in place of wooden splints. Fusees or vesuvians consist of large oval heads fixed on a round splint. These heads consist of a porous mixture of charcoal, saltpetre, cascarilla or other scented bark, glass and gum, tipped with common igniting composition. When lighted they form a glowing mass, without flame.

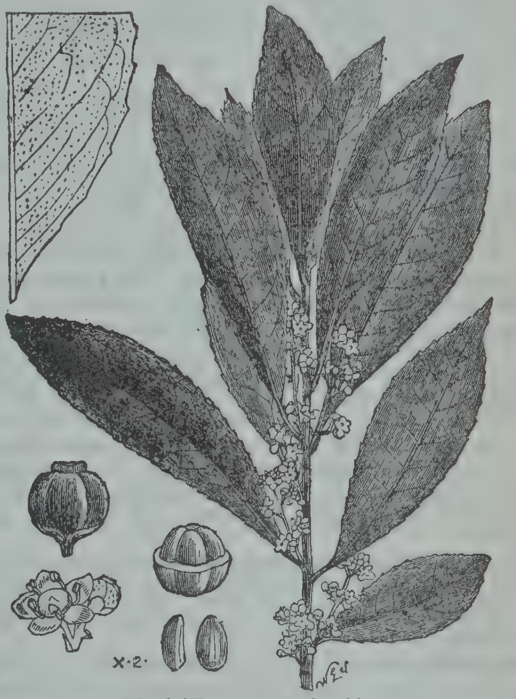
It is calculated that in the principal European countries from six to ten matches are used for each inhabitant daily, and the world's annual output must reach a total which requires twelve or thirteen figures for its expression. In the United States the manufacture is under the control of the Diamond Match Company, formed in 1881; which company also has an important share in the industry in Great Britain, where it has established large works. Similarly the manufacture of safety matches in Sweden is largely controlled by one big combination. In France matches are a government monopoly, and are both dear in price and inferior in quality, as compared with other countries where the industry is left to private enterprise. The French government formerly leased the manufacture to a company (*Société générale des allumettes chimiques*), but since 1890 it has been undertaken directly by the state.

MATE (a corruption of *make*, from O. Eng. *gemaca*, a "comrade"), a companion. In the language of the sea, the mate is the companion or assistant of the master, or of any officer at the head of a division of the crew. In the merchant service the mates are the officers who serve under the master, commonly called the captain, navigate the vessel under his direction, and replace him if he dies, or is disabled. In a war-ship mates serve under the gunner, boatswain, carpenter, &c. They are officers told off to attend to a particular part of the ship, as for example mate of the upper deck, whose duty is to see that it is kept clean, or mate of the hold, who is employed to serve out the water and other stores, and to keep the weights adjusted so as to preserve the trim—or balance—of the ship. (For "mate" in chess, see CHESS.)

MATÉ, or PARAGUAY TEA, the dried leaves of *Ilex paraguariensis*,[1] an evergreen shrub or small tree belonging to the same genus as the common holly, a plant to which it bears some resemblance in size and habit. The leaves are from 6 to 8 in. long, shortly stalked, with a somewhat acute tip and finely toothed at the margin. The small white flowers grow in forked clusters in the axils of the leaves; the sepals, petals and stamens are four in number, or occasionally five; and the berry is 4-seeded. The plant grows abundantly in Paraguay, and the south of Brazil, forming woods called *yerbales*. One of the principal centres of the maté industry is the Villa Real, a small town above Asuncion on the Paraguay river; another is the Villa de San Xavier, in the district between the rivers Uruguay and Parana.

Although maté appears to have been used from time immemorial by the Indians, the Jesuits were the first to attempt its cultivation. This was begun at their branch missions in Paraguay and the province of Rio Grande de San Pedro, where some plantations still exist, and yield the best tea that is made. From this circumstance the names Jesuits' tea, tea of the Missions, St Bartholomew's tea, &c., are sometimes applied to maté. Under cultivation the quality of the tea improves, but the plant remains a small shrub with numerous stems, instead of forming, as in the wild state, a tree with a rounded head. From cultivated plants the leaves are gathered every two or three years, that interval being necessary for restoration to vigorous growth. The collection of maté is, however, chiefly effected by Indians employed for that purpose by merchants, who pay a money consideration to government for the privilege.

When a yerbal or maté wood is found, the Indians, who usually travel in companies of about twenty-five in number, build wigwams and settle down to the work for about six months. Their first operation is to prepare an open space, called a *tatacua*, about 6 ft. square, in which the surface of the soil is beaten hard and smooth with mallets. The leafy branches of the maté are then cut down and placed on the tatacua, where they undergo a preliminary roasting from a fire kindled around it. An arch of poles, or of hurdles, is then erected above it, on which the maté is placed, a fire being lighted underneath. This part of the process demands some care, since by it the leaves have to be rendered brittle enough to be easily pulverized, and the aroma has to be developed, the necessary amount of heat being only learned by experience. After drying, the leaves are reduced to coarse powder in mortars formed of pits in the earth well rammed. Maté so prepared is called *caa gazu* or *yerva do polos*, and is chiefly used in Brazil. In Paraguay and the vicinity of Parana in the Argentine Republic, the leaves are deprived of the midrib before roasting; this is called *caa-miri*. A very superior quality, or *caa-cuys*, is also prepared in Paraguay from the scarcely expanded buds. Another method of drying maté has been adopted, the leaves being heated in large cast-iron pans set in brickwork, in the same way that tea is dried in China; it is afterwards powdered by machinery.



Maté (*Ilex paraguariensis*).

Portion of plant. Flower, drupe and nuts. Part of under-side of leaf showing minute glands, natural size.

The different methods of preparation influence to a certain extent the value of the product, the maté prepared in Paraguay being considered the best, that of Oran and Paranagua very inferior. The leaves when dried are packed tightly in serons or oblong packages made of raw hides, which are then carefully sewed up. These shrink by exposure to the sun, and in a couple of days form compact parcels each containing about 200 ℔ of tea; in this form it keeps well. The tea is generally prepared for use in a small silver-mounted calabash, made of the fruit of *Crescentia cujete* (Cuca) or of *Lagenaria* (Cabaço), usually about the size of a large orange, the tapering end of the latter serving for a handle. In the top of the calabash, or *maté*,[2] a circular hole about the size of a florin is made, and through this opening the tea is sucked by means of a bombilla. This instrument consists of a small tube 6 or 7 in. long, formed either of metal or a reed, which has at one end a bulb made either of extremely fine basket-work or of metal perforated with minute holes, so as to prevent the particles of the tea-leaves from being drawn up into the mouth. Some sugar and a little hot water are first placed in the gourd, the yerva is then added, and finally the vessel is filled to the brim with boiling water, or milk previously heated by a spirit lamp.

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[1] *I. gigantea*, *I. ovalifolia*, *I. Humboldtiana*, and *I. nigropunctata*, besides several varieties of these species, are also used for preparing maté.

[2] The word *caa* signified the plant in the native Indian language. The Spaniards gave it a similar name, *yerba*. *Maté* comes from the language of the Incas, and originally means a calabash. The Paraguay tea was called at first *yerva do maté*, and then, the *yerva* being dropped, the name *maté* came to signify the same thing.

A little burnt sugar or lemon juice is sometimes added instead of milk. The beverage is then handed round to the company, each person being furnished with a bombilla. The leaves will bear steeping about three times. The infusion, if not drunk soon after it is made, rapidly turns black. Persons who are fond of maté drink it before every meal, and consume about 1 oz. of the leaves per day. In the neighbourhood of Parana it is prepared and drunk like Chinese tea. Maté is generally considered disagreeable by those unaccustomed to it, having a somewhat bitter taste; moreover, it is the custom to drink it so hot as to be unpleasant. But in the south-eastern republics it is a much-prized article of luxury, and is the first thing offered to visitors. The *gaucho* of the plains will travel on horseback for weeks asking no better fare than dried beef washed down with copious draughts of maté, and for it he will forego any other luxury, such as sugar, rice or biscuit. Maté acts as a restorative after great fatigue in the same manner as tea. Since it does not lose its flavour so quickly as tea by exposure to the air and damp it is more valuable to travellers.

Since the beginning of the 17th century maté has been drunk by all classes in Paraguay, and it is now used throughout Brazil and the neighbouring countries.

The virtues of this substance are due to the occurrence in it of caffeine, of which a given quantity of maté, as prepared for drinking, contains definitely less than a similar quantity of tea or coffee. It is less astringent than either of these, and thus is, on all scores, less open to objection.

See Scully, *Brazil* (London, 1866); Mansfield, *Brazil* (London, 1856); Christy, *New Commercial Plants*, No. 3 (London, 1880); *Kew Bulletin* (1892), p. 132.

MATERA, a city of Basilicata, Italy, in the province of Potenza, from which it is 68 m. E. by road (13 m. S. of the station of Altamura), 1312 ft. above sea-level. Pop. (1901), 17,801. Part of it is built on a level plateau and part in deep valleys adjoining, the tops of the campaniles of the lower portions being on a level with the streets of the upper. The principal building is the cathedral of the archbishopric of Acerenza and Matera, formed in 1203 by the union of the two bishoprics, dating respectively from 300 and 398. The western façade of the cathedral is plain, while the utmost richness of decoration is lavished on the south front which faces the piazza. Almost in the centre of this south façade is an exquisitely sculptured window, from which letters from the Greek patriarch at Constantinople used to be read. The campanile is 175 ft. high. In the vicinity are the troglodyte caverns of Monte Scaglioso, still inhabited by some of the lower classes, and other caves with 13th-century frescoes.

Neolithic pottery has been found here, but the origin of the town is uncertain. Under the Normans Matera was a countship for William Bras de Fer and his successors. It was the chief town of the Basilicata from 1664 till 1811, when the French transferred the administration to Potenza.

MATERIALISM (from Lat. *materia*, matter), in philosophy, the theory which regards all the facts of the universe as explainable in terms of matter and motion, and in particular explains all psychical processes by physical and chemical changes in the nervous system. It is thus opposed both to natural realism and to idealism. For the natural realist stands upon the common-sense position that minds and material objects have equally effective existence; while the idealist explains matter by mind and denies that mind can be explained by matter. The various forms into which materialism may be classified correspond to the various causes which induce men to take up materialistic views. *Naïve materialism* is due to a cause which still, perhaps, has no small power, the natural difficulty which persons who have had no philosophic training experience in observing and appreciating the importance of the immaterial facts of consciousness. The pre-Socratics may be classed as naïve materialists in this sense; though, as at that early period the contrast between matter and spirit had not been fully realized and matter was credited with properties that belong to life, it is usual to apply the term hylozoism (*q.v.*) to the earliest stage of Greek metaphysical theory. It is not difficult to discern the influence of naïve materialism in contemporary thinking. We see it in Huxley, and still more in Haeckel, whose materialism (which he chooses to term "monism") is evidently conditioned by ignorance of the history and present position of speculation. *Cosmological materialism* is that form of the doctrine in which the dominant motive is the formation of a comprehensive world-scheme: the Stoics and Epicureans were cosmological materialists. In *anti-religious materialism* the motive is hostility to established dogmas which are connected, in the Christian system especially, with certain forms of spiritual doctrine. Such a motive weighed much with Hobbes and with the French materialists of the 18th century, such as La Mettrie and d'Holbach. The cause of *medical materialism* is the natural bias of physicians towards explaining the health and disease of mind by the health and disease of body. It has received its greatest support from the study of insanity, which is now fully recognized as conditioned by disease of the brain. To this school belong Drs Maudsley and Mercier. The highest form of the doctrine is *scientific materialism*, by which term is meant the doctrine so commonly adopted by the physicist, zoologist and biologist.

It may perhaps be fairly said that materialism is at present a necessary methodological postulate of natural-scientific inquiry. The business of the scientist is to explain everything by the physical causes which are comparatively well understood and to exclude the interference of spiritual causes. It was the great work of Descartes to exclude rigorously from science all explanations which were not scientifically verifiable; and the prevalence of materialism at certain epochs, as in the enlightenment of the 18th century and in the German philosophy of the middle 19th, were occasioned by special need to vindicate the scientific position, in the former case against the Church, in the latter case against the pseudo-science of the Hegelian dialectic. The chief definite periods of materialism are the pre-Socratic and the post-Aristotelian in Greece, the 18th century in France, and in Germany the 19th century from about 1850 to 1880. In England materialism has been endemic, so to speak, from Hobbes to the present time, and English materialism is more important perhaps than that of any other country. But, from the national distrust of system, it has not been elaborated into a consistent metaphysic, but is rather traceable as a tendency harmonizing with the spirit of natural science. Hobbes, Locke, Hume, Mill and Herbert Spencer are not systematic materialists, but show tendencies towards materialism.

See METAPHYSICS; and Lange's *History of Materialism*.

MATER MATUTA (connected with Lat. *mane*, *matutinus*, "morning"), an old Italian goddess of dawn. The idea of light being closely connected with childbirth, whereby the infant is brought into the light of the world, she came to be regarded as a double of Juno, and was identified by the Greeks with Eilithyia. Matuta had a temple in Rome in the Forum Boarium, where the festival of Matralia was celebrated on the 11th of June. Only married women were admitted, and none who had been married more than once were allowed to crown her image with garlands. Under hellenizing influences, she became a goddess of sea and harbours, the Ino-Leucothea of the Greeks. In this connexion it is noticeable that, as Ino tended her nephew Dionysus, so at the Matralia the participants prayed for the welfare of their nephews and nieces before that of their own children. The transformation was complete in 174 B.C., when Tiberius Sempronius Gracchus, after the conquest of Sardinia, placed in the temple of Matuta a map commemorative of the campaign, containing a plan of the island and the various engagements. The progress of navigation and the association of divinities of the sky with maritime affairs probably also assisted to bring about the change, although the memory of her earlier function as a goddess of childbirth survived till imperial times.

Ovid, *Fasti*, vi. 475; Livy xli. 28; Plutarch, *Quaestiones romanae*, 16, 17.

MATHEMATICS (Gr. *μαθηματική*, *sc.* *τέχνη* or *ἐπιστήμη*; from *μάθημα*, "learning" or "science"), the general term for the various applications of mathematical thought, the traditional field of which is number and quantity. It has been usual to define mathematics as "the science of discrete and continuous magnitude." Even Leibnitz,[1] who initiated a more modern point of view, follows the tradition in thus confining the scope of mathematics properly so called, while apparently conceiving it as a department of a yet wider science of reasoning. A short consideration of some leading topics of the science will exemplify both the plausibility and inadequacy of the above definition. Arithmetic, algebra, and the infinitesimal calculus, are sciences directly concerned with integral numbers, rational (or fractional) numbers, and real numbers generally, which include incommensurable numbers. It would seem that "the general theory of discrete and continuous quantity" is the exact description of the topics of these sciences. Furthermore, can we not complete the circle of the mathematical sciences by adding geometry? Now geometry deals with points, lines, planes and cubic contents. Of these all except points are quantities: lines involve lengths, planes involve areas, and cubic contents involve volumes. Also, as the Cartesian geometry shows, all the relations between points are expressible in terms of geometric quantities. Accordingly, at first sight it seems reasonable to define geometry in some such way as "the science of dimensional quantity." Thus every subdivision of mathematical science would appear to deal with quantity, and the definition of mathematics as "the science of quantity" would appear to be justified. We have now to consider the reasons for rejecting this definition as inadequate.

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[1] Cf. *La Logique de Leibnitz*, ch. vii., by L. Couturat (Paris, 1901).

Types of Critical Questions.—What are numbers? We can talk of five apples and ten pears. But what are "five" and "ten" apart from the apples and pears? Also in addition to the cardinal numbers there are the ordinal numbers: the fifth apple and the tenth pear claim thought. What is the relation of "the fifth" and "the tenth" to "five" and "ten"? "The first rose of summer" and "the last rose of summer" are parallel phrases, yet one explicitly introduces an ordinal number and the other does not. Again, "half a foot" and "half a pound" are easily defined. But in what sense is there "a half," which is the same for "half a foot" as "half a pound"? Furthermore, incommensurable numbers are defined as the limits arrived at as the result of certain procedures with rational numbers. But how do we know that there is anything to reach? We must know that $\sqrt{2}$ exists before we can prove that any procedure will reach it. An expedition to the North Pole has nothing to reach unless the earth rotates.

Also in geometry, what is a point? The straightness of a straight line and the planeness of a plane require consideration. Furthermore, "congruence" is a difficulty. For when a triangle "moves," the points do not move with it. So what is it that keeps unaltered in the moving triangle? Thus the whole method of measurement in geometry as described in the elementary textbooks and the older treatises is obscure to the last degree. Lastly, what are "dimensions"? All these topics require thorough discussion before we can rest content with the definition of mathematics as the general science of magnitude; and by the time they are discussed the definition has evaporated. An outline of the modern answers to questions such as the above will now be given. A critical defence of them would require a volume.[1]

Cardinal Numbers.—A one-one relation between the members of two classes α and β is any method of correlating all the members of α to all the members of β, so that any member of α has one and only one correlate in β, and any member of β has one and only one correlate in α. Two classes between which a one-one relation exists have the same cardinal number and are called cardinally similar; and the cardinal number of the class α is a certain class whose members are themselves classes—namely, it is the class composed of all those classes for which a one-one correlation with α exists. Thus the cardinal number of α is itself a class, and furthermore α is a member of it. For a one-one relation can be established between the members of α and α by the simple process of correlating each member of α with itself. Thus the cardinal number one is the class of unit classes, the cardinal number two is the class of doublets, and so on. Also a unit class is any class with the property that it possesses a member x such that, if y is any member of the class, then x and y are identical. A doublet is any class which possesses a member x such that the modified class formed by all the other members except x is a unit class. And so on for all the finite cardinals, which are thus defined successively. The cardinal number zero is the class of classes with no members; but there is only one such class, namely—the null class. Thus this cardinal number has only one member. The operations of addition and multiplication of two given cardinal numbers can be defined by taking two classes α and β, satisfying the conditions (1) that their cardinal numbers are respectively the given numbers, and (2) that they contain no member in common, and then by defining by reference to α and β two other suitable classes whose cardinal numbers are defined to be respectively the required sum and product of the cardinal numbers in question. We need not here consider the details of this process.

With these definitions it is now possible to *prove* the following six premisses applying to finite cardinal numbers, from which Peano[2] has shown that all arithmetic can be deduced:—

i. Cardinal numbers form a class.
ii. Zero is a cardinal number.
iii. If a is a cardinal number, $a+1$ is a cardinal number.
iv. If s is any class and zero is a member of it, also if when x is a cardinal number and a member of s, also $x+1$ is a member of s, then the whole class of cardinal numbers is contained in s.
v. If a and b are cardinal numbers, and $a+1=b+1$, then $a=b$.
vi. If a is a cardinal number, then $a+1 \neq 0$.

It may be noticed that (iv) is the familar principle of mathematical induction. Peano in an historical note refers its first explicit employment, although without a general enunciation, to Maurolycus in his work, *Arithmeticorum libri duo* (Venice, 1575).

But now the difficulty of confining mathematics to being the science of number and quantity is immediately apparent. For there is no self-contained science of cardinal numbers. The proof of the six premisses requires an elaborate investigation into the general properties of classes and relations which can be deduced by the strictest reasoning from our ultimate logical principles. Also it is purely arbitrary to erect the consequences of these six principles into a separate science. They are excellent principles of the highest value, but they are in no sense the necessary premisses which must be proved before any other propositions of cardinal numbers can be established. On the contrary, the premisses of arithmetic can be put in other forms, and, furthermore, an indefinite number of propositions of arithmetic can be proved directly from logical principles without mentioning them. Thus, while arithmetic may be defined as that branch of deductive reasoning concerning classes and relations which is concerned with the establishment of propositions concerning cardinal numbers, it must be added that the introduction of cardinal numbers makes no great break in this general science. It is no more than an interesting subdivision in a general theory.

Ordinal Numbers.—We must first understand what is meant by "order," that is, by "serial arrangement." An order of a set of things is to be sought in that relation holding between members of the set which constitutes that order. The set viewed as a class has many orders. Thus the telegraph posts along a certain road have a space-order very obvious to our senses; but they have also a time-order according to dates of erection, perhaps more important to the postal authorities who replace them after fixed intervals. A set of cardinal numbers have an order of magnitude, often called *the* order of the set because of its insistent obviousness to us; but, if they are the numbers drawn in a lottery, their time-order of occurrence in that drawing also ranges them in an order of some importance. Thus the order is defined by the "serial" relation. A relation (R) is serial[3] when (1) it implies diversity, so that, if x has the relation R to y, x is diverse from y; (2) it is transitive, so that if x has the relation R to y, and y to z, then x has the relation R to z; (3) it has the property of connexity, so that if x and y are things to which any things bear the relation R, or which bear the relation R to any things, then *either* x is identical with y, *or* x has the relation R to y, *or* y has the relation R to x. These conditions are necessary and sufficient to secure that our ordinary ideas of "preceding" and "succeeding" hold in respect to the relation R. The "field" of the relation R is the class of things ranged in order by it. Two relations R and R′ are said to be ordinally similar, if a one-one relation holds between the members of the two fields of R and R′, such that if x and y are any two members of the field of R, such that x has the relation R to y, and if x' and y' are the correlates in the field of R′ of x and y, then in all such cases x' has the relation R′ to y', and conversely, interchanging the dashes on the letters, *i.e.* R and R′, x and x', &c. It is evident that the ordinal similarity of two relations implies the cardinal similarity of their fields, but not conversely. Also, two relations need not be serial in order to be ordinally similar; but if one is serial, so is the other. The relation-number of a relation is the class whose members are all those relations which are ordinally similar to it. This class will include the original relation itself. The relation-number of a relation should be compared with the cardinal number of a class. When a relation is serial its relation-number is often called its serial type. The addition and multiplication of two relation-numbers is defined by taking two relations R and S, such that (1) their fields have no terms in common; (2) their relation-numbers are the two relation-numbers in question, and then by defining by reference to R and S two other suitable relations whose relation-numbers are defined to be respectively the sum and product of the relation-numbers in question. We need not consider the details of this process. Now if n be any finite cardinal number, it can be proved that the class of those serial relations, which have a field whose cardinal number is n, is a relation-number. This relation-number is the ordinal number corresponding to n; let it be symbolized by $\dot{n}$. Thus, corresponding to the cardinal numbers 2, 3, 4 . . . there are the ordinal numbers $\dot{2}, \dot{3}, \dot{4}$ . . . The definition of the ordinal number 1 requires some little ingenuity owing to the fact that no serial relation can have a field whose cardinal number is 1; but we must omit here the explanation of the process. The ordinal number $\dot{0}$ is the class whose sole member is the null relation—that is, the relation which never holds between any pair of entities. The definitions of the finite ordinals can be expressed without use of the corresponding cardinals, so there is no essential priority of cardinals to ordinals. Here also it can be seen that the science of the finite ordinals is a particular subdivision of the general theory of classes and relations. Thus the illusory nature of the traditional definition of mathematics is again illustrated.

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[1] Cf. *The Principles of Mathematics*, by Bertrand Russell (Cambridge, 1903).

[2] Cf. *Formulaire mathématique* (Turin, ed. of 1903); earlier formulations of the bases of arithmetic are given by him in the editions of 1898 and of 1901. The variations are only trivial.

[3] Cf. Russell, *loc. cit.*, pp. 199–256.

Cantor's Infinite Numbers.—Owing to the correspondence between the finite cardinals and the finite ordinals, the propositions of cardinal arithmetic and ordinal arithmetic correspond point by point. But the definition of the cardinal number of a class applies when the class is not finite, and it can be proved that there are different infinite cardinal numbers, and that there is a least infinite cardinal, now usually denoted by $\aleph_0$, where $\aleph$ is the Hebrew letter aleph. Similarly, a class of serial relations, called *well-ordered* serial relations, can be defined, such that their corresponding relation-numbers include the ordinary finite ordinals, but also include relation-numbers which have many properties like those of the finite ordinals, though the fields of the relations belonging to them are not finite. These relation-numbers are the infinite ordinal numbers. The arithmetic of the infinite cardinals does not correspond to that of the infinite ordinals. The theory of these extensions of the ideas of number is dealt with in the article NUMBER. It will suffice to mention here that Peano's fourth premiss of arithmetic does not hold for infinite cardinals or for infinite ordinals. Contrasting the above definitions of number, cardinal and ordinals, with the alternative theory that number is an ultimate idea incapable of definition, we notice that our procedure exacts a greater attention, combined with a smaller credulity; for every idea, assumed as ultimate, demands a separate act of faith.

The Data of Analysis.—Rational numbers and real numbers in general can now be defined according to the same general method. If m and n are finite cardinal numbers, the rational number m/n is the relation which any finite cardinal number x bears to any finite cardinal number y when $n \times x = m \times y$. Thus the rational number one, which we will denote by 1_r, is not the cardinal number 1; for 1_r is the relation 1/1 as defined above, and is thus a relation holding between certain pairs of cardinals. Similarly, the other rational integers must be distinguished from the corresponding cardinals. The arithmetic of rational numbers is now established by means of appropriate definitions, which indicate the entities meant by the operations of addition and multiplication. But the desire to obtain general enunciations of theorems without exceptional cases has led mathematicians to employ entities of ever-ascending types of elaboration. These entities are not created by mathematicians, they are employed by them, and their definitions should point out the construction of the new entities in terms of those already on hand. The real numbers, which include irrational numbers, have now to be defined. Consider the serial arrangement of the rationals in their order of magnitude. A real number is a class (α, say) of rational numbers which satisfies the condition that it is the same as the class of those rationals each of which precedes at least one member of α. Thus, consider the class of rationals less than 2_r; any member of this class precedes some other members of the class—thus 1/2 precedes 4/3, 3/2 and so on; also the class of predecessors of predecessors of 2_r is itself the class of predecessors of 2_r. Accordingly this class is a real number; it will be called the real number 2_R. Note that the class of rationals less than or equal to 2_r is not a real number, For 2_r is not a predecessor of some member of the class. In the above example 2_R is an integral real number, which is distinct from a rational integer, and from a cardinal number. Similarly, any rational real number is distinct from the corresponding rational number. But now the irrational real numbers have all made their appearance. For example, the class of rationals whose squares are less than 2_r satisfies the definition of a real number; it is the real number $\sqrt{2}$. The arithmetic of real numbers follows from appropriate definitions of the operations of addition and multiplication. Except for the immediate purposes of an explanation, such as the above, it is unnecessary for mathematicians to have separate symbols, such as 2, 2_r and 2_R, or 2/3 and $(2/3)_R$. Real numbers with signs (+ or −) are now defined. If a is a real number, $+a$ is defined to be the relation which any real number of the form $x+a$ bears to the real number x, and $-a$ is the relation which any real number x bears to the real number $x+a$. The addition and multiplication of these "signed" real numbers is suitably defined, and it is proved that the usual arithmetic of such numbers follows. Finally, we reach a complex number of the nth order. Such a number is a "one-many" relation which relates n signed real numbers (or n algebraic complex numbers when they are already defined by this procedure) to the n cardinal numbers 1, 2 . . . n respectively. If such a complex number is written (as usual) in the form $x_1e_1+x_2e_2+\ldots+x_ne_n$, then this particular complex number relates x_1 to 1, x_2 to 2, . . . x_n to n. Also the "unit" e_1 (or e_s) considered as a number of the system is merely a shortened form for the complex number $(+1)\,e_1+0e_2+\ldots+0e_n$. This last number exemplifies the fact that one signed real number, such as 0, may be correlated to many of the n cardinals, such as 2 . . . n in the example, but that each cardinal is only correlated with one signed number. Hence the relation has been called above "one-many." The sum of two complex numbers $x_1e_1+x_2e_2+\ldots+x_ne_n$ and $y_1e_1+y_2e_2+\ldots+y_ne_n$ is always defined to be the complex number $(x_1+y_1)e_1+(x_2+y_2)e_2+\ldots+(x_n+y_n)e_n$. But an indefinite number of definitions of the product of two complex numbers yield interesting results. Each definition gives rise to a corresponding algebra of higher complex numbers. We will confine ourselves here to algebraic complex numbers—that is, to complex numbers of the second order taken in connexion with that definition of multiplication which leads to ordinary algebra. The product of two complex numbers of the second order—namely, $x_1e_1+x_2e_2$ and $y_1e_1+y_2e_2$, is in this case defined to mean the complex $(x_1y_1-x_2y_2)e_1+(x_1y_2+x_2y_1)e_2$. Thus $e_1 \times e_1 = e_1$, $e_2 \times e_2 = -e_1$, $e_1 \times e_2 = e_2 \times e_1 = e_2$. With this definition it is usual to omit the first symbol e_1, and to write i or $\sqrt{-1}$ instead of e_2. Accordingly, the typical form for such a complex number is $x+yi$, and then with this notation the above-mentioned definition of multiplication is invariably adopted. The importance of this algebra arises from the fact that in terms of such complex numbers with this definition of multiplication the utmost generality of expression, to the exclusion of exceptional cases, can be obtained for theorems which occur in analogous forms, but complicated with exceptional cases, in the algebras of real numbers and of signed real numbers. This is exactly the same reason as that which has led mathematicians to work with signed real numbers in preference to real numbers, and with real numbers in preference to rational numbers. The evolution of mathematical thought in the invention of the data of analysis has thus been completely traced in outline.

Definition of Mathematics.—It has now become apparent that the traditional field of mathematics in the province of discrete and continuous number can only be separated from the general abstract theory of classes and relations by a wavering and indeterminate line. Of course a discussion as to the mere application of a word easily degenerates into the most fruitless logomachy. It is open to any one to use any word in any sense. But on the assumption that "mathematics" is to denote a science well marked out by its subject matter and its methods from other topics of thought, and that at least it is to include all topics habitually assigned to it, there is now no option but to employ "mathematics" in the general sense[1] of the "science concerned with the logical deduction of consequences from the general premisses of all reasoning."

Geometry.—The typical mathematical proposition is: "If x, y, z . . . satisfy such and such conditions, then such and such other conditions hold with respect to them." By taking fixed conditions for the hypothesis of such a proposition a definite department of mathematics is marked out. For example, geometry is such a department. The "axioms" of geometry are the fixed conditions which occur in the hypotheses of the geometrical propositions. The special nature of the "axioms" which constitute geometry is considered in the article GEOMETRY (*Axioms*). It is sufficient to observe here that they are concerned with special types of classes of classes and of classes of relations, and that the connexion of geometry with number and magnitude is in no way an essential part of the foundation of the science. In fact, the whole theory of measurement in geometry arises at a comparatively late stage as the result of a variety of complicated considerations.

Classes and Relations.—The foregoing account of the nature of mathematics necessitates a strict deduction of the general properties of classes and relations from the ultimate logical premisses. In the course of this process, undertaken for the first time with the rigour of mathematicians, some contradictions have become apparent. That first discovered is known as Burali-Forti's contradiction,[1] and consists in the proof that there both is and is not a greatest infinite ordinal number. But these contradictions do not depend upon any theory of number, for Russell's contradiction[2] does not involve number in any form. This contradiction arises from considering the class possessing as members all classes which are not members of themselves. Call this class w; then to say that x is a w is equivalent to saying that x is not an x. Accordingly, to say that w is a w is equivalent to saying that w is not a w. An analogous contradiction can be found for relations. It follows that a careful scrutiny of the very idea of classes and relations is required. Note that classes are here required in extension, so that the class of human beings and the class of rational featherless bipeds are identical; similarly for relations, which are to be determined by the entities related. Now a class in respect to its components is many. In what sense then can it be one? This problem of "the one and the many" has been discussed continuously by the philosophers.[3] All the contradictions can be avoided, and yet the use of classes and relations can be preserved as required by mathematics, and indeed by common sense, by a theory which denies to a class—or relation—existence or being in any sense in which the entities composing it—or related by it—exist. Thus, to say that a pen is an entity and the class of pens is an entity is merely a play upon the word "entity"; the second sense of "entity" (if any) is indeed derived from the first, but has a more complex signification. Consider an incomplete proposition, incomplete in the sense that some entity which ought to be involved in it is represented by an undetermined x, which may stand for any entity. Call it a propositional function; and, if ϕx be a propositional function, the undetermined variable x is the argument. Two propositional functions ϕx and ψx are "extensionally identical" if any determination of x in ϕx which converts ϕx into a true proposition also converts ψx into a true proposition, and conversely for ψ and ϕ. Now consider a propositional function $F\chi$ in which the variable argument χ is itself a propositional function. If $F\chi$ is true when, and only when, χ is determined to be either ϕ or some other propositional function extensionally equivalent to ϕ, then the proposition $F\phi$ is of the form which is ordinarily recognized as being about the class determined by ϕx taken in extension—that is, the class of entities for which ϕx is a true proposition when x is determined to be any one of them. A similar theory holds for relations which arise from the consideration of propositional functions with two or more variable arguments. It is then possible to define by a parallel elaboration what is meant by classes of classes, classes of relations, relations between classes, and so on. Accordingly, the number of a class of relations can be defined, or of a class of classes, and so on. This theory[4] is in effect a theory of the *use* of classes and relations, and does not decide the philosophic question as to the sense (if any) in which a class in extension is one entity. It does indeed deny that it is an entity in the sense in which one of its members is an entity. Accordingly, it is a fallacy for any determination of x to consider "x is an x" or "x is not an x" as having the meaning of propositions. Note that for any determination of x, "x is an x" and "x is not an x," are neither of them fallacies but are both meaningless, according to this theory. Thus Russell's contradiction vanishes, and an examination of the other contradictions shows that they vanish also.

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[1] The first unqualified explicit statement of *part* of this definition seems to be by B. Peirce, "Mathematics is the science which draws necessary conclusions" (*Linear Associative Algebra*, § i. (1870), republished in the *Amer. Journ. of Math.*, vol. iv. (1881)). But it will be noticed that the second half of the definition in the text—"from the general premisses of all reasoning"—is left unexpressed. The full expression of the idea and its development into a philosophy of mathematics is due to Russell, *loc. cit.*

Applied Mathematics.—The selection of the topics of mathematical inquiry among the infinite variety open to it has been guided by the useful applications, and indeed the abstract theory has only recently been disentangled from the empirical elements connected with these applications. For example, the application of the theory of cardinal numbers to classes of physical entities involves in practice some process of counting. It is only recently that the *succession* of processes which is involved in any act of counting has been seen to be irrelevant to the idea of number. Indeed, it is only by experience that we can know that any definite process of counting will give the true cardinal number of some class of entities. It is perfectly possible to imagine a universe in which any act of counting by a being in it annihilated some members of the class counted during the time and only during the time of its continuance. A legend of the Council of Nicea[5] illustrates this point: "When the Bishops took their places on their thrones, they were 318; when they rose up to be called over, it appeared that they were 319; so that they never could make the number come right, and whenever they approached the last of the series, he immediately turned into the likeness of his next neighbour." Whatever be the historical worth of this story, it may safely be said that it cannot be disproved by deductive reasoning from the premisses of abstract logic. The most we can do is to assert that a universe in which such things are liable to happen on a large scale is unfitted for the practical application of the theory of cardinal numbers. The application of the theory of real numbers to physical quantities involves analogous considerations. In the first place, some physical process of addition is presupposed, involving some inductively inferred law of permanence during that process. Thus in the theory of masses we must know that two pounds of lead when put together will counterbalance in the scales two pounds of sugar, or a pound of lead and a pound of sugar. Furthermore, the sort of continuity of the series (in order of magnitude) of rational numbers is known to be different from that of the series of real numbers. Indeed, mathematicians now reserve "continuity" as the term for the latter kind of continuity; the mere property of having an infinite number of terms between any two terms is called "compactness." The compactness of the series of rational numbers is consistent with quasi-gaps in it—that is, with the possible absence of limits to classes in it. Thus the class of rational numbers whose squares are less than 2 has no upper limit among the rational numbers. But among the real numbers all classes have limits. Now, owing to the necessary inexactness of measurement, it is impossible to discriminate directly whether any kind of continuous physical quantity possesses the compactness of the series of rationals or the continuity of the series of real numbers. In calculations the latter hypothesis is made because of its mathematical simplicity. But, the assumption has certainly no a priori grounds in its favour. and it is not very easy to see how to base it upon experience. For example, if it should turn out that the mass of a body is to be estimated by counting the number of corpuscles (whatever they may be) which go to form it, then a body with an irrational measure of mass is intrinsically impossible. Similarly, the continuity of space apparently rests upon sheer assumption unsupported by any a priori or experimental grounds. Thus the current applications of mathematics to the analysis of phenomena can be justified by no a priori necessity.

In one sense there is no science of applied mathematics. When once the fixed conditions which any hypothetical group of entities are to satisfy have been precisely formulated, the deduction of the further propositions, which also will hold respecting them, can proceed in complete independence of the question as to whether or no any such group of entities can be found in the world of phenomena. Thus rational mechanics, based on the Newtonian Laws, viewed as mathematics is independent of its supposed application, and hydrodynamics remains a coherent and respected science though it is extremely improbable that any perfect fluid exists in the physical world. But this unbendingly logical point of view cannot be the last word upon the matter. For no one can doubt the essential difference between characteristic treatises upon "pure" and "applied" mathematics. The difference is a difference in method. In pure mathematics the hypotheses which a set of entities are to satisfy are given, and a group of interesting deductions are sought. In "applied mathematics" the "deductions" are given in the shape of the experimental evidence of natural science, and the hypotheses from which the "deductions" can be deduced are sought. Accordingly, every treatise on applied mathematics, properly so-called, is directed to the criticism of the "laws" from which the reasoning starts, or to a suggestion of results which experiment may hope to find. Thus if it calculates the result of some experiment, it is not the experimentalist's well-attested results which are on their trial, but the basis of the calculation. Newton's *Hypotheses non fingo* was a proud boast, but it rests upon an entire misconception of the capacities of the mind of man in dealing with external nature.

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[1] "Una questione sui numeri transfiniti," *Rend. del circolo mat. di Palermo*, vol. xi. (1897); and Russell, *loc. cit.*, ch. xxxviii.

[2] Cf. Russell, *loc. cit.*, ch. x.

[3] Cf. *Pragmatism: a New Name for some Old Ways of Thinking* (1907).

[4] Due to Bertrand Russell, cf. "Mathematical Logic as based on the Theory of Types," *Amer. Journ. of Math.* vol. xxx. (1908). It is more fully explained by him, with later simplifications, in *Principia mathematica* (Cambridge).

[5] Cf. Stanley's *Eastern Church*, Lecture v.

Synopsis of Existing Developments of Pure Mathematics.—A complete classification of mathematical sciences, as they at present exist, is to be found in the *International Catalogue of Scientific Literature* promoted by the Royal Society. The classification in question was drawn up by an international committee of eminent mathematicians, and thus has the highest authority. It would be unfair to criticize it from an exacting philosophical point of view. The practical object of the enterprise required that the proportionate quantity of yearly output in the various branches, and that the liability of various topics as a matter of fact to occur in connexion with each other, should modify the classification.

Section A deals with pure mathematics. Under the general heading "*Fundamental Notions*" occur the subheadings "*Foundations of Arithmetic*," with the topics rational, irrational and transcendental numbers, and aggregates; "*Universal Algebra*," with the topics complex numbers, quaternions, ausdehnungslehre, vector analysis, matrices, and algebra of logic; and "*Theory of Groups*," with the topics finite and continuous groups. For the subjects of this general heading see the articles ALGEBRA, UNIVERSAL; GROUPS, THEORY OF; INFINITESIMAL CALCULUS; NUMBER; QUATERNIONS; VECTOR ANALYSIS. Under the general heading "*Algebra and Theory of Numbers*" occur the subheadings "*Elements of Algebra*," with the topics rational polynomials, permutations, &c., partitions, probabilities; "*Linear Substitutions*," with the topics determinants, &c., linear substitutions, general theory of quantics; "*Theory of Algebraic Equations*," with the topics existence of roots, separation of and approximation to, theory of Galois, &c. "*Theory of Numbers*," with the topics congruences, quadratic residues, prime numbers, particular irrational and transcendental numbers. For the subjects of this general heading see the articles ALGEBRA; ALGEBRAIC FORMS; ARITHMETIC; COMBINATORIAL ANALYSIS; DETERMINANTS; EQUATION; FRACTION, CONTINUED; INTERPOLATION; LOGARITHMS; MAGIC SQUARE; PROBABILITY. Under the general heading "*Analysis*" occur the subheadings "*Foundations of Analysis*," with the topics theory of functions of real variables, series and other infinite processes, principles and elements of the differential and of the integral calculus, definite integrals, and calculus of variations; "*Theory of Functions of Complex Variables*," with the topics functions of one variable and of several variables; "*Algebraic Functions and their Integrals*," with the topics algebraic functions of one and of several variables, elliptic functions and single theta functions, Abelian integrals; "*Other Special Functions*," with the topics Euler's, Legendre's, Bessel's and automorphic functions; "*Differential Equations*," with the topics existence theorems, methods of solution, general theory; "*Differential Forms and Differential Invariants*," with the topics differential forms, including Pfaffians, transformation of differential forms, including tangential (or contact) transformations, differential invariants; "*Analytical Methods connected with Physical Subjects*," with the topics harmonic analysis, Fourier's series, the differential equations of applied mathematics, Dirichlet's problem; "*Difference Equations and Functional Equations*," with the topics recurring series, solution of equations of finite differences and functional equations. For the subjects of this heading see the articles DIFFERENTIAL EQUATIONS; FOURIER'S SERIES; CONTINUED FRACTIONS; FUNCTION; FUNCTION OF REAL VARIABLES; FUNCTION COMPLEX; GROUPS, THEORY OF; INFINITESIMAL CALCULUS; MAXIMA AND MINIMA; SERIES; SPHERICAL HARMONICS; TRIGONOMETRY; VARIATIONS, CALCULUS OF. Under the general heading "*Geometry*" occur the subheadings "*Foundations*," with the topics principles of geometry, non-Euclidean geometries, hyperspace, methods of analytical geometry; "*Elementary Geometry*," with the topics planimetry, stereometry, trigonometry, descriptive geometry; "*Geometry of Conics and Quadrics*," with the implied topics; "*Algebraic Curves and Surfaces of Degree higher than the Second*," with the implied topics; "*Transformations and General Methods for Algebraic Configurations*," with the topics collineation, duality, transformations, correspondence, groups of points on algebraic curves and surfaces, genus of curves and surfaces, enumerative geometry, connexes, complexes, congruences, higher elements in space, algebraic configurations in hyperspace; "*Infinitesimal Geometry: applications of Differential and Integral Calculus to Geometry*," with the topics kinematic geometry, curvature, rectification and quadrature, special transcendental curves and surfaces; "*Differential Geometry: applications of Differential Equations to Geometry*," with the topics curves on surfaces, minimal surfaces, surfaces determined by differential properties, conformal and other representation of surfaces on others, deformation of surfaces, orthogonal and isothermic surfaces. For the subjects under this heading see the articles CONIC SECTIONS; CIRCLE; CURVE; GEOMETRICAL CONTINUITY; GEOMETRY, *Axioms of*; GEOMETRY, *Euclidean*; GEOMETRY, *Projective*; GEOMETRY, *Analytical*; GEOMETRY, *Line*; KNOTS, MATHEMATICAL THEORY OF; MENSURATION; MODELS; PROJECTION; SURFACE; TRIGONOMETRY.

This survey of the existing developments of pure mathematics confirms the conclusions arrived at from the previous survey of the theoretical principles of the subject. Functions, operations, transformations, substitutions, correspondences, are but names for various types of relations. A group is a class of relations possessing a special property. Thus the modern ideas, which have so powerfully extended and unified the subject, have loosened its connexion with "number" and "quantity," while bringing ideas of form and structure into increasing prominence. Number must indeed ever remain the great topic of mathematical interest, because it is in reality the great topic of applied mathematics. All the world, including savages who cannot count beyond five, daily "apply" theorems of number. But the complexity of the idea of number is practically illustrated by the fact that it is best studied as a department of a science wider than itself.

Synopsis of Existing Developments of Applied Mathematics.—Section B of the *International Catalogue* deals with mechanics. The heading "*Measurement of Dynamical Quantities*" includes the topics units, measurements, and the constant of gravitation. The topics of the other headings do not require express mention. These headings are: "*Geometry and Kinematics of Particles and Solid Bodies*"; "*Principles of Rational Mechanics*"; "*Statics of Particles, Rigid Bodies, &c.*"; "*Kinetics of Particles, Rigid Bodies, &c.*"; "*General Analytical Mechanics*"; "*Statics and Dynamics of Fluids*"; "*Hydraulics and Fluid Resistances*"; "*Elasticity*." For the subjects of this general heading see the articles MECHANICS; DYNAMICS, ANALYTICAL; GYROSCOPE; HARMONIC ANALYSIS; WAVE; HYDROMECHANICS; ELASTICITY; MOTION, LAWS OF; ENERGY; ENERGETICS; ASTRONOMY (*Celestial Mechanics*); TIDE. Mechanics (including dynamical astronomy) is that subject among those traditionally classed as "applied" which has been most completely transfused by mathematics—that is to say, which is studied with the deductive spirit of the pure mathematician, and not with the covert inductive intention overlaid with the superficial forms of deduction, characteristic of the applied mathematician.

Every branch of physics gives rise to an application of mathematics. A prophecy may be hazarded that in the future these applications will unify themselves into a mathematical theory of a hypothetical substructure of the universe, uniform under all the diverse phenomena. This reflection is suggested by the following articles: AETHER; MOLECULE; CAPILLARY ACTION; DIFFUSION; RADIATION, THEORY OF; and others.

The applications of mathematics to statistics (see STATISTICS and PROBABILITY) should not be lost sight of; the leading fields for these applications are insurance, sociology, variation in zoology and economics.

The History of Mathematics.—The history of mathematics is in the main the history of its various branches. A short account of the history of each branch will be found in connexion with the article which deals with it. Viewing the subject as a whole, and apart from remote developments which have not in fact seriously influenced the great structure of the mathematics of the European races, it may be said to have had its origin with the Greeks, working on pre-existing fragmentary lines of thought derived from the Egyptians and Phœnicians. The Greeks created the sciences of geometry and of number as applied to the measurement of continuous quantities. The great abstract ideas (considered directly and not merely in tacit use) which have dominated the science were due to them—namely, ratio, irrationality, continuity, the point, the straight line, the plane. This period lasted[1] from the time of Thales, *c.* 600 B.C., to the capture of Alexandria by the Mahommedans, A.D. 641. The medieval Arabians invented our system of numeration and developed algebra. The next period of advance stretches from the Renaissance to Newton and Leibnitz at the end of the 17th century. During this period logarithms were invented, trigonometry and algebra developed, analytical geometry invented, dynamics put upon a sound basis, and the period closed with the magnificent invention of (or at least the perfecting of) the differential calculus by Newton and Leibnitz and the discovery of gravitation. The 18th century witnessed a rapid development of analysis, and the period culminated with the genius of Lagrange and Laplace. This period may be conceived as continuing throughout the first quarter of the 19th century. It was remarkable both for the brilliance of its achievements and for the large number of French mathematicians of the first rank who flourished during it. The next period was inaugurated in analysis by K. F. Gauss, N. H. Abel and A. L. Cauchy. Between them the general theory of the complex variable, and of the various "infinite" processes of mathematical analysis, was established, while other mathematicians, such as Poncelet, Steiner, Lobatschewsky and von Staudt, were founding modern geometry, and Gauss inaugurated the differential geometry of surfaces. The applied mathematical sciences of light, electricity and electromagnetism, and of heat, were now largely developed. This school of mathematical thought lasted beyond the middle of the century, after which a change and further development can be traced. In the next and last period the progress of pure mathematics has been dominated by the critical spirit introduced by the German mathematicians under the guidance of Weierstrass, though foreshadowed by earlier analysts, such as Abel. Also such ideas as those of invariants, groups and of form, have modified the entire science. But the progress in all directions has been too rapid to admit of any one adequate characterization. During the same period a brilliant group of mathematical physicists, notably Lord Kelvin (W. Thomson), H. V. Helmholtz, J. C. Maxwell, H. Hertz, have transformed applied mathematics by systematically basing their deductions upon the Law of the conservation of energy, and the hypothesis of an ether pervading space.

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[1] Cf. *A Short History of Mathematics*, by W. W. R. Ball.

BIBLIOGRAPHY.—References to the works containing expositions of the various branches of mathematics are given in the appropriate articles. It must suffice here to refer to sources in which the subject is considered as one whole. Most philosophers refer in their works to mathematics more or less cursorily, either in the treatment of the ideas of number and magnitude, or in their consideration of the alleged a priori and necessary truths. A bibliography of such references would be in effect a bibliography of metaphysics, or rather of epistemology. The founder of the modern point of view, explained in this article, was Leibnitz, who, however, was so far in advance of contemporary thought that his ideas remained neglected and undeveloped until recently; cf. *Opuscules et fragments inédits de Leibnitz. Extraits des manuscrits de la bibliothèque royale de Hanovre*, by Louis Couturat (Paris, 1903), especially pp. 356–399, "Generales inquisitiones de analysi notionum et veritatum" (written in 1686); also cf. *La Logique de Leibnitz*, already referred to. For the modern authors who have rediscovered and improved upon the position of Leibnitz, cf. *Grundgesetze der Arithmetik, begriffsschriftlich abgeleitet von Dr G. Frege, a.o. Professor an der Univ. Jena* (Bd. i., 1893; Bd. ii., 1903, Jena); also cf. Frege's earlier works, *Begriffsschrift, eine der arithmetischen nachgebildete Formelsprache des reinen Denkens* (Halle, 1879), and *Die Grundlagen der Arithmetik* (Breslau, 1884); also cf. Bertrand Russell, *The Principles of Mathematics* (Cambridge, 1903), and his article on "Mathematical Logic" in *Amer. Quart. Journ. of Math.* (vol. xxx., 1908). Also the following works are of importance, though not all expressly expounding the Leibnitzian point of view: cf. G. Cantor, "Grundlagen einer allgemeinen Mannigfaltigkeitslehre," *Math. Annal.*, vol. xxi. (1883) and subsequent articles in vols. xlvi. and xlix.; also R. Dedekind, *Stetigkeit und irrationales Zahlen* (1st ed., 1872), and *Was sind und was sollen die Zahlen?* (1st ed., 1887), both tracts translated into English under the title *Essays on the Theory of Numbers* (Chicago, 1901). These works of G. Cantor and Dedekind were of the greatest importance in the progress of the subject. Also cf. G. Peano (with various collaborators of the Italian school), *Formulaire de mathématiques* (Turin, various editions, 1894–1908; the earlier editions are the more interesting philosophically); Felix Klein, *Lectures on Mathematics* (New York, 1894); W. K. Clifford, *The Common Sense of the exact Sciences* (London, 1885); H. Poincaré, *La Science et l'hypothèse* (Paris, 1st ed., 1902), English translation under the title, *Science and Hypothesis* (London, 1905); L. Couturat, *Les Principes des mathématiques* (Paris, 1905); E. Mach, *Die Mechanik in ihrer Entwickelung* (Prague, 1883), English translation under the title, *The Science of Mechanics* (London, 1893); K. Pearson, *The Grammar of Science* (London, 1st ed., 1892; 2nd ed., 1900, enlarged); A. Cayley, *Presidential Address* (Brit. Assoc., 1883); B. Russell and A. N. Whitehead, *Principia Mathematica* (Cambridge, 1911). For the history of mathematics the one modern and complete source of information is M. Cantor's *Vorlesungen über Geschichte der Mathematik* (Leipzig, 1st Bd., 1880; 2nd Bd., 1892; 3rd Bd., 1898; 4th Bd., 1908; 1st Bd., *von den ältesten Zeiten bis zum Jahre 1200, n. Chr.*; 2nd Bd., *von 1200–1668*; 3rd Bd., *von 1668–1758*; 4th Bd., *von 1795 bis 1799*); W. W. R. Ball, *A Short History of Mathematics* (London 1st ed., 1888, three subsequent editions, enlarged and revised, and translations into French and Italian). (A. N. W.)

MATHER, COTTON (1663–1728), American Congregational clergyman and author, was born in Boston, Massachusetts, on the 12th of February 1663. He was the grandson of Richard Mather, and the eldest child of Increase Mather (*q.v.*), and Maria, daughter of John Cotton. After studying under the famous Ezekiel Cheever (1614–1708), he entered Harvard College at twelve, and graduated in 1678. While teaching (1678–1685), he began the study of theology, but soon, on account of an impediment in his speech, discontinued it and took up medicine. Later, however, he conquered the difficulty and finished his preparation for the ministry. He was elected assistant pastor in his father's church, the North, or Second, Church of Boston, in 1681 and was ordained as his father's colleague in 1685. In 1688, when his father went to England as agent for the colony, he was left at twenty-five in charge of the largest congregation in New England, and he ministered to it for the rest of his life. He soon became one of the most influential men in the colonies. He had much to do with the witchcraft persecution of his day; in 1692 when the magistrates appealed to the Boston clergy for advice in regard to the witchcraft cases in Salem he drafted their reply, upon which the prosecutions were based; in 1689 he had written *Memorable Providences Relating to Witchcraft and Possessions*, and even his earlier diaries have many entries showing his belief in diabolical possession and his fear and hatred of it. Thinking as he did that the New World had been the undisturbed realm of Satan before the settlements were made in Massachusetts, he considered it natural that the Devil should make a peculiar effort to bring moral destruction on these godly invaders. He used prayer and fasting to deliver himself from evil enchantment; and when he saw ecstatic and mystical visions promising him the Lord's help and great usefulness in the Lord's work, he feared that these revelations might be of diabolic origin. He used his great influence to bring the suspected persons to trial and punishment. He attended the trials, investigated many of the cases himself, and wrote sermons on witchcraft, the *Memorable Providences* and *The Wonders of the Invisible World* (1693), which increased the excitement of the people. Accordingly, when the persecutions ceased and the reaction set in, much of the blame was laid upon him; the influence of Judge Samuel Sewall, after he had come to think his part in the Salem delusion a great mistake, was turned against the Mathers; and the liberal leaders of Congregationalism in Boston, notably the Brattles, found this a vulnerable point in Cotton Mather's armour and used their knowledge to much effect, notably by assisting Robert Calef (d. *c.* 1723) in the preparation of *More Wonders of the Invisible World* (1700) a powerful criticism of Cotton Mather's part in the delusion at Salem.

Mather took some part as adviser in the Revolution of 1689 in Massachusetts. In 1690 he became a member of the Corporation (probably the youngest ever chosen as Fellow) of Harvard College, and in 1707 he was greatly disappointed at his failure to be chosen president of that institution. He received the degree of D.D. from the University of Glasgow in 1710, and in 1713 was made a Fellow of the Royal Society. Like his father he was deeply grieved by the liberal theology and Church polity of the new Brattle Street Congregation, and conscientiously opposed its pastor Benjamin Colman, who had been irregularly ordained in England and by a Presbyterian body; but with his father he took part in 1700 in services in Colman's church. Harvard College was now controlled by the Liberals of the Brattle Street Church, and as it grew farther and farther away from Calvinism, Mather looked with increasing favour upon the college in Connecticut; before September 1701 he had drawn up a "scheme for a college," the oldest document now in the Yale archives; and finally (Jan. 1718) he wrote to a London merchant, Elihu Yale, and persuaded him to make a liberal gift to the college, which was named in his honour. During the smallpox epidemic of 1721 he attempted in vain to have treatment by inoculation employed, for the first time in America; and for this he was bitterly attacked on all sides, and his life was at one time in danger; but, nevertheless, he used the treatment on his son, who recovered, and he wrote *An Account of the Method and further Success of Inoculating for the Small Pox in London* (1721). In addition he advocated temperance, missions, Bible societies, and the education of the negro; favoured the establishing of libraries for working men and of religious organizations for young people, and organized societies for other branches of philanthropic work. His later years were clouded with many sorrows and disappointments; his relations with Governor Joseph Dudley were unfriendly; he lost much of his former prestige in the Church—his own congregation dwindled—and in the college; his uncle John Cotton was expelled from his charge in the Plymouth Church; his son Increase turned out a ne'er-do-well; four of his children and his second wife died in November 1713; his wife's brothers and the husbands of his sisters were ungodly and violent men; his favourite daughter Katherine, who "understood Latin and read Hebrew fluently," died in 1716; his third wife went mad in 1719; his personal enemies circulated incredible scandals about him; and in 1724-1725 he saw a Liberal once more preferred to him as a new president of Harvard. He died in Boston on the 13th of February 1728 and is buried in the Copps Hill burial-ground, Boston. He was thrice married—to Abigail Phillips (d. 1702) in 1686, to Mrs Elizabeth Hubbard (d. 1713) in 1703, and in 1715 to Mrs Lydia George (d. 1734). Of his fifteen children only two survived him.

Though self-conscious and vain, Cotton Mather had on the whole a noble character. He believed strongly in the power of prayer and repeatedly had assurances that his prayers were heard; and when he was disappointed by non-fulfilment his grief and depression were terrible. His spiritual nature was high-strung and delicate; and this condition was aggravated by his constant study, his long fasts and his frequent vigils—in one year, according to his diary, he kept sixty fasts and twenty vigils. In his later years his diaries have less and less of personal detail, and repeated entries prefaced by the letters "G.D." meaning Good Device, embodying precepts of kindliness and practical Christianity. He was remarkable for his godliness, his enthusiasm for knowledge, and his prodigious memory. He became a skilled linguist, a widely read scholar—though much of his learning was more curious than useful—a powerful preacher, a valued citizen, and a voluminous writer, and did a vast deal for the intellectual and spiritual quickening of New England. He worked with might and main for the continuation of the old theocracy, but before he died it had given way before an increasing Liberalism—even Yale was infected with the Episcopalianism that he hated.

Among his four hundred or more published works, many of which are sermons, tracts and letters, the most notable is his *Magnalia Christi Americana: or the Ecclesiastical History of New England, from Its First Planting in the Year 1620 unto the Year of Our Lord, 1698*. Begun in 1693 and finished in 1697, this work was published in London, in 1702, in one volume, and was republished in Hartford in 1820 and in 1853-1855, in two volumes. It is in seven books and concerns itself mainly with the settlement and religious history of New England. It is often inaccurate, and it abounds in far-fetched conceits and odd and pedantic features. Its style, though in the main rather unnatural and declamatory, is at its best spontaneous, dignified and rhythmical; the book is valuable for occasional facts and for its picture of the times, and it did much to make Mather the most eminent American writer of his day. His other writings include *A Poem Dedicated to the Memory of the Reverend and Excellent Mr Urian Oakes* (1682); *The Present State of New England* (1690); *The Life of the Renowned John Eliot* (1691), later included in Book III. of the *Magnalia*; *The Short History of New England* (1694); *Bonifacius*, usually known as *Essays To Do Good* (Boston, 1710; Glasgow, 1825; Boston, 1845), one of his principal books and one which had a shaping influence on the life of Benjamin Franklin; *Psalterium Americanum* (1718), a blank verse translation of the Psalms from the original Hebrew; *The Christian Philosopher: A Collection of the Best Discoveries in Nature, with Religious Improvements* (1721); *Parentator* (1724), a memoir of his father; *Ratio Disciplinae* (1726), an account of the discipline in New England churches; *Manuductio ad Ministerium: Directions for a Candidate of the Ministry* (1726), one of the most readable of his books. He also left a number of works in manuscript, including diaries, a medical treatise and a huge commentary on the Bible, entitled "Biblia Americana."

See *The Life of Cotton Mather* (Boston, 1729), by his son, Samuel Mather; William B. O. Peabody, *The Life of Cotton Mather* (1836) (in Jared Sparks's "Library of American Biography," vol. vi.); Enoch Pond, *The Mather Family* (Boston, 1844); John L. Sibley, *Biographical Sketches of Graduates of Harvard University*, vol. iii. (Cambridge, 1885); Barrett Wendell, *Cotton Mather, the Puritan Priest* (New York, 1891), a remarkably sympathetic study and particularly valuable for its insight into (and its defence of) Mather's attitude toward witchcraft; Abijah P. Marvin, *The Life and Times of Cotton Mather* (Boston, 1892); M. C. Tyler, *A History of American Literature during the Colonial Period*, vol. ii. (New York, 1878); and Barrett Wendell, *A Literary History of America* (New York, 1900).

Cotton Mather's son, SAMUEL MATHER (1706-1785), also a clergyman, graduated at Harvard in 1723, was pastor of the North Church, Boston, from 1732 to 1742, when, owing to a dispute among his congregation over revivals, he resigned to take charge of a church established for him in North Bennett Street.

Among his works are *The Life of Cotton Mather* (1729); *An Apology for the Liberties of the Churches in New England* (1738), and *America Known to the Ancients* (1773). (W. L. C.*)

MATHER, INCREASE (1639-1723), American Congregational minister, was born in Dorchester, Massachusetts, on the 21st of June 1639, the youngest son of Richard Mather.[1] He entered Harvard in 1651, and graduated in 1656. In 1657, on his eighteenth birthday, he preached his first sermon; in the same year he went to visit his eldest brother in Dublin, and studied there at Trinity College, where he graduated M.A. in 1658. He was chaplain to the English garrison at Guernsey in April-December 1659 and again in 1661; and in the latter year, refusing valuable livings in England offered on condition of conformity, he returned to America. In the winter of 1661-1662 he began to preach to the Second (or North) Church of Boston, and was ordained there on the 27th of May 1664. As a delegate from Dorchester, his father's church, to the Synod of 1662, he opposed the Half-Way Covenant adopted by the Synod and defended by Richard Mather and by Jonathan Mitchell (1624-1668) of Cambridge; but soon afterwards he "surrendered a glad captive" to "the truth so victoriously cleared by Mr Mitchell," and like his father and his son became one of the chief exponents of the Half-Way Covenant. He was bitterly opposed, however, to the liberal practices that followed the Half-Way Covenant and (after 1677) in particular to "Stoddardeanism," the doctrine of Solomon Stoddard (1643-1729) that all "such Persons as have a good Conversation and a Competent Knowledge may come to the Lord's Supper," only those of openly immoral life being excluded. In May 1679 Mather was a petitioner to the General Court for the call of a Synod to consider the reformation in New England of "the Evils that have Provoked the Lord to bring his Judgments,"[2] and when the "Reforming Synod" met in September it appointed him one of a committee to draft a creed; this committee reported in May 1680, at the Synod's second session, of which Mather was moderator, the Savoy Declaration (slightly modified, notably in ch. xxiv., "Of the Civil Magistrate"), which was approved but was not made mandatory on the churches by the General Court, and in 1708 was reaffirmed at Saybrook, Connecticut. With the Cambridge Platform of 1646, drafted by his father, the Confession of 1680, for which Increase Mather was largely responsible, was printed as a book of doctrine and government for the churches of Massachusetts.

After the threat of a *Quo Warranto* writ in 1683 for the surrender of the Massachusetts charter, Mather used all his tremendous influence to persuade the colonists not to give up the charter; and the Boston freemen unanimously voted against submission. The royal agents immediately afterwards sent to London a treasonable letter, falsely attributed to Mather; but its spuriousness seems to have been suspected in England and Mather was not "fetch'd over and made a Sacrifice." He became a leader in the opposition to Sir Edmund Andros, to his secretary Edward Randolph, and to Governor Joseph Dudley. He was chosen by the General Court to represent the colony's interests in England, eluded officers sent to arrest him,[3] and in disguise boarded a ship on which he reached Weymouth on the 6th of May 1688. In London he acted with Sir Henry Ashurst, the resident agent, and had two or three fruitless audiences with James II. His first audience with William III. was on the 9th of January 1689; he was active in influencing the Commons to vote (1689) that the New England charters should be restored; and he published *A Narrative of the Miseries of New-England, By Reason of an Arbitrary Government Erected there Under Sir Edmund Andros* (1688), *A Brief Relation for the Confirmation of Charter Privileges* (1691), and other pamphlets. In 1690 he was joined by Elisha Cooke (1638–1715) and Thomas Oakes (1644–1719), additional agents, who were uncompromisingly for the renewal of the old charter. Mather, however, was instrumental in securing a new charter (signed on Oct. 7, 1691), and prevented the annexation of the Plymouth Colony to New York. The nomination of officers left to the Crown was reserved to the agents. Mather had expressed strong dissatisfaction with the clause giving the governor the right of veto, and regretted the less theocratic tone of the charter which made all freemen (and not merely church members) electors. With Sir William Phips, the new governor, a member of Mather's church, he arrived in Boston on the 14th of May 1692. The value of his services to the colony at this time is not easily over-estimated. In England he won the friendship of divines like Baxter, Tillotson and Burnet, and effectively promoted the union in 1691 of English Presbyterians and Congregationalists. He was at heavy expense throughout his stay, and even greater than his financial loss was his loss of authority and control in the church and in Harvard College because of his absence.

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[1] He was so christened "because of the never-to-be-forgotten increase, of every sort, wherewith God favoured the country about the time of his nativity." He often latinized his name, spelling it *Crescentius Matherus*.

[2] That is, King Philip's War, the Boston fires of 1676, when Mather's church and home were burned, and 1679, the threatened introduction of Episcopacy, and the general spiritual decay of the country.

[3] He had previously been arrested and acquitted on a charge of having attributed the forged letter to Randolph.

Mather had been acting president of Harvard College in 1681–1682, and in June 1685 he again became acting president (or rector), but still preached every Sunday in Boston and would not comply with an order of the General Court that he should reside in Cambridge. In 1701 after a short residence there he returned to Boston and wrote to the General Court to "think of another President for the Colledge." The opposition to him had been increasing in strength, his resignation was accepted, and Samuel Willard took charge of the college as vice-president, although he also refused to reside in Cambridge. That Mather's administration of the college was excellent is admitted even by his harsh critic, Josiah Quincy, in his *History of Harvard University*.[1] The Liberal party, which now came into control in the college repeatedly disappointed the hopes of Cotton Mather (*q.v.*) that he might be chosen president, and by its ecclesiastical laxness and its broader views of Church polity forced the Mathers to turn from Harvard to Yale as a truer school of the prophets.

The Liberal leaders, John Leverett (1662–1724), William Brattle (1662–1713)—who graduated with Leverett in 1680, and with him as tutor controlled the college during Increase Mather's absence in England—William Brattle's eldest brother, Thomas Brattle (1658–1713), and Ebenezer Pemberton (1671–1717), pastor of the Old South Church, desired an "enrichment of the service," and greater liberality in the matter of baptism. In 1697 the Second Boston Church, in which Cotton Mather had been his father's colleague since 1685, upbraided the Charlestown Church "for betraying the liberties of the churches in their late putting into the hands of the whole inhabitants the choice of a minister." In 1699 Increase Mather published *The Order of the Gospel*, which severely (although indirectly, criticized the methods of the "Liberals" in establishing the Brattle Street Church and especially the ordination of their minister Benjamin Colman by a Presbyterian body in London; the Liberals replied with *The Gospel Order Revived*, which was printed in New York to lend colour to the (partly true) charge of its authors that the printers of Massachusetts would print nothing hostile to Increase Mather.[2] The autocracy of the Mathers in church, college, colony and press, had slipped from them. The later years of Mather's life were spent almost entirely in the work of the ministry, now beginning to be a less varied career than when he entered on it. He died on the 23rd of August 1723. He married in 1662 Maria, daughter of Sarah and John Cotton. His first wife died in 1714; and in 1715 he married Ann Lake, widow of John Cotton, of Hampton, N.H., a grandson of John Cotton of Boston.

Increase Mather was a great preacher with a simple style and a splendid voice, which had a "Tonitruous Cogency," to quote his son's phrase. His style was much simpler and more vernacular than his son's. He was an assiduous student, commonly spending sixteen hours a day among his books; but his learning (to quote Justin Winsor's contrast between Increase and Cotton Mather) "usually left his natural ability and his education free from entanglements." He was not so much self-seeking and personally ambitious as eager to advance the cause of the church in which he so implicitly believed. That it is a mistake to consider him a narrow churchman is shown by his assisting in 1718 at the ordination of Elisha Callender in the First Baptist Church of Boston. Like the most learned men of his time he was superstitious and a firm believer in "praesagious impressions"; his *Essay for the Recording of Illustrious Providences: Wherein an Account is Given of many Remarkable and very Memorable Events which have Hapned in this Last Age, Especially in New England* (1684) shows that he believed only less thoroughly than his son in witchcraft, though in his *Cases of Conscience Concerning Evil Spirits* (1693) he considered some current proofs of witchcraft inadequate. The revulsion of feeling after the witchcraft delusion undermined his authority greatly, and Robert's Calef's *More Wonders of the Spiritual World* (1700) was a personal blow to him as well as to his son. With Jonathan Edwards, than whom he was much more of a man of affairs, and with Benjamin Franklin, whose mission in England somewhat resembled Mather's, he may be ranked among the greatest Americans of the period before the War of Independence.

The first authority for the life of Increase Mather is the work of his son Cotton Mather, *Parentator*: *Memoirs of Remarkables in the Life and Death of the Ever Memorable Dr Increase Mather* (Boston, 1724); there are also a memoir and constant references in Cotton Mather's *Magnalia* (London, 1702) especially vol. iv.; there is an excellent sketch in the first volume of J. L. Sibley's *Biographical Sketches of Graduates of Harvard University* (Cambridge, 1873), with an exhaustive list of Mather's works (about 150 titles); there is much valuable matter in Williston Walker's *Ten New England Leaders* (New York, 1901) and in his *Creeds and Platforms of Congregationalism* (New York, 1893); for literary criticism of the Mathers see ch. xii. of M. C. Tyler's *History of American Literature, 1607–1676* (New York, 1878), and Barrett Wendell's *Cotton Mather* (New York, 1891). Mather's worth has been under-estimated by Josiah Quincy, Justin Winsor and other historians out of sympathy with his ecclesiastical spirit, who represent him as only an ambitious narrow-minded schemer. (R. We.)

MATHER, RICHARD (1596–1669), American Congregational clergyman, was born in Lowton, in the parish of Winwick, near Liverpool, England, of a family which was in reduced circumstances but entitled to bear a coat-of-arms. He studied at Winwick grammar school, of which he was appointed a master in his fifteenth year, and left it in 1612 to become master of a newly established school at Toxteth Park, Liverpool. After a few months at Brasenose College, Oxford, he began in November 1618 to preach at Toxteth, and was ordained there, possibly only as deacon, early in 1619. In August–November 1633 he was suspended for nonconformity in matters of ceremony; and in 1634 was again suspended by the visitors of Richard Neile, archbishop of York, who, hearing that he had never worn a surplice during the fifteen years of his ministry, refused to reinstate him and said that "it had been better for him that he had gotten Seven Bastards." He had a great reputation as a preacher in and about Liverpool; but, advised by letters of John Cotton and Thomas Hooker, and persuaded by his own elaborate formal "Arguments tending to prove the Removing from Old-England to New. . . . to be not only lawful, but also necessary for them that are not otherwise tyed, but free," he left England and on the 17th of August 1635, and landed in Boston after an "extraordinary and miraculous deliverance" from a terrible storm. As a famous preacher "he was desired at Plimouth, Dorchester, and Roxbury." He went to Dorchester, where the Church had been greatly depleted by migrations to Windsor, Connecticut; and where, after a delay of several months, in August 1636 there was constituted by the consent of magistrates and clergy a church of which he was "teacher" until his death in Dorchester on the 22nd of April 1669.

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[1] Mather led the resistance to the royal demand instigated by Edward Randolph in 1683, for the annulment of the college charter, and after its vacation in 1684 strove for the grant of a new charter; King James promised him a confirmation of the former charter; the new provincial charter granted by William and Mary confirmed all gifts and grants to colleges; in 1692 Mather drafted an act incorporating the college, which was signed by Phips but was disallowed in England; and in 1696, 1697, 1699, and 1700, Mather repeated his efforts for a college charter.

[2] Mather was made a licenser of the Press in 1674 when the General Court abolished the monopoly of the Cambridge Press.

He was an able preacher, "aiming," said his biographer, "to shoot his arrows not over his people's heads, but into their Hearts and Consciences"; and he was a leader of New England Congregationalism, whose policy he defended and described in the tract *Church Government and Church Covenant Discussed, in an Answer of the Elders of the Severall Churches of New England to Two and Thirty Questions* (written 1639; printed 1643), and in his *Reply to Mr Rutherford* (1647), a polemic against the Presbyterianism to which the English Congregationalists were then tending. He drafted the Cambridge Platform, an ecclesiastical constitution in seventeen chapters, adopted (with the omission of Mather's paragraph favouring the "Half-way Covenant," of which he strongly approved) by the general synod in August 1646. In 1657 he drafted the declaration of the Ministerial Convention on the meaning and force of the Half-way Covenant; this was published in 1659 under the title: *A Disputation concerning Church Members and their Children in Answer to XXI. Questions.* With Thomas Welde and John Eliot he wrote the "Bay Psalm Book," or, more accurately, *The Whole Booke of Psalmes Faithfully Translated into English Metre* (1640), probably the first book printed in the English colonies.

He married in 1624 Katherine Hoult or Holt (d. 1655), and secondly in 1656 Sarah Hankredge (d. 1676), the widow of John Cotton. Of six sons, all by his first wife, four were ministers: SAMUEL (1626–1671), the first fellow of Harvard College who was a graduate, chaplain of Magdalen College, Oxford, in 1650–1653, and pastor (1656–1671, excepting suspension in 1660–1662) of St Nicholas's in Dublin; NATHANIEL (1630–1697), who graduated at Harvard in 1647, was vicar of Barnstaple, Devon, in 1656–1662, pastor of the English Church in Rotterdam, his brother's successor in Dublin in 1671–1688, and then until his death pastor of a church in London; ELEAZAR (1637–1669), who graduated at Harvard in 1656 and after preaching in Northampton, Massachusetts, for three years, became in 1661 pastor of the church there; and INCREASE MATHER (*q.v.*). Horace E. Mather, in his *Lineage of Richard Mather* (Hartford, Connecticut, 1890), gives a list of 80 clergymen descended from Richard Mather, of whom 29 bore the name Mather and 51 other names, the more famous being Storrs and Schauffler.

See *The Life and Death of That Reverend Man of God, Mr Richard Mather* (Cambridge, 1670; reprinted 1850, with his *Journal* for 1635, by the Dorchester Antiquarian and Historical Society), with an introduction by Increase Mather, who may have been the author; W. B. Sprague's *Annals of the American Pulpit*, vol. i. (New York, 1857); Cotton Mather's *Magnalia* (London, 1702); an essay on Richard Mather in Williston Walker's *Ten New England Leaders* (New York, 1901); and the works referred to in the article on Increase Mather. (R. WE.)

MATHERAN, a hill sanatorium in India, in the Kolaba district of Bombay, 2460 ft. above the sea, and about 30 m. E. of Bombay city. Pop. (1901), 3060. It consists of several thickly wooded ridges, on a spur of the Western Ghats, with a magnificent outlook over the plain below and the distant sea. First explored in 1850, it has since become the favourite resort of the middle classes of Bombay (especially the Parsis) during the spring and autumn months. It has recently been connected by a 2 ft. gauge mountain line with Neral station on the Great Indian Peninsula railway, 54 m. from Bombay.

MATHESON, GEORGE (1842–1906), Scottish theologian and preacher, was born in Glasgow in 1842, the son of George Matheson, a merchant. He was educated at the university of Glasgow, where he graduated first in classics, logic and philosophy. In his twentieth year he became totally blind, but he held to his resolve to enter the ministry, and gave himself to theological and historical study. His first ministry began in 1868 at Innellan, on the Argyllshire coast between Dunoon and Toward. His books on *Aids to the Study of German Theology, Can the Old Faith live with the New? The Growth of the Spirit of Christianity from the First Century to the Dawn of the Lutheran Era*, established his reputation as a liberal and spiritually minded theologian; and Queen Victoria invited him to preach at Balmoral. In 1886 he removed to Edinburgh, where he became minister of St Bernard's Parish Church. Here his chief work as a preacher was done. In 1879 the university of Edinburgh conferred upon him the honorary degree of D.D., and the same year he declined an invitation to the pastorate of Crown Court, London, in succession to Dr John Cumming (1807–1881). In 1881 he was chosen as Baird lecturer, and took for his subject "Natural Elements of Revealed Theology," and in 1882 he was the St Giles lecturer, his subject being "Confucianism." In 1890 he was elected a fellow of the Royal Society of Edinburgh, Aberdeen gave him its honorary LL.D., and in 1899 he was appointed Gifford lecturer by that university, but declined on grounds of health. In the same year he severed his active connexion with St Bernard's. One of his hymns, "O love that will not let me go," has passed into the popular hymnology of the Christian Church. He died suddenly of apoplexy on the 28th of August 1906. His exegesis owes its interest to his subjective resources rather than to breadth of learning; his power lay in spiritual vision rather than balanced judgment, and in the vivid apprehension of the factors which make the Christian personality, rather than in constructive doctrinal statement.

MATHEW, THEOBALD (1790–1856), Irish temperance reformer, popularly known as Father Mathew, was descended from a branch of the Llandaff family, and was born at Thomastown, Tipperary, on the 10th of October 1790. He received his school education at Kilkenny, whence he passed for a short time to Maynooth; from 1808 to 1814 he studied at Dublin, where in the latter year he was ordained to the priesthood. Having entered the Capuchin order, he, after a brief time of service at Kilkenny, joined the mission in Cork, which was the scene of his religious and benevolent labours for many years. The movement with which his name is most intimately associated began in 1838 with the establishment of a total abstinence association, which in less than nine months, thanks to his moral influence and eloquence, enrolled no fewer than 150,000 names. It rapidly spread to Limerick and elsewhere, and some idea of its popularity may be formed from the fact that at Nenagh 20,000 persons are said to have taken the pledge in one day, 100,000 at Galway in two days, and 70,000 in Dublin in five days. In 1844 he visited Liverpool, Manchester and London with almost equal success. Meanwhile the expenses of his enterprise had involved him in heavy liabilities, and led on one occasion to his arrest for debt; from this embarrassment he was only partially relieved by a pension of £300 granted by Queen Victoria in 1847. In 1849 he paid a visit to the United States, returning in 1851. He died at Queenstown on the 8th of December, 1856.

See *Father Mathew, a Biography*, by J. F. Maguire, M.P. (1863).

MATHEWS, CHARLES (1776–1835), English actor, was born in London on the 28th of June 1776. His father was "a serious bookseller," who also officiated as minister in one of Lady Huntingdon's chapels. Mathews was educated at Merchant Taylors' School. His love for the stage was formed in his boyhood, when he was apprentice to his father, and the latter in 1794 unwillingly permitted him to enter on a theatrical engagement in Dublin. For several years Mathews had not only to content himself with thankless parts at a low salary, but in May 1803 he made his first London appearance at the Haymarket as Jabel in Cumberland's *The Jew* and as Lingo in *The Agreeable Surprise*. From this time his professional career was an uninterrupted triumph. He had a wonderful gift of mimicry, and could completely disguise his personality without the smallest change of dress. The versatility and originality of his powers were admirably displayed in his "At

Homes," begun in the Lyceum theatre in 1818, which, according to Leigh Hunt, "for the richness and variety of his humour, were as good as half a dozen plays distilled." Off the stage his simple and kind-hearted disposition won him affection and esteem. In 1822 Mathews visited America, his observation on his experiences there forming for the reader a most entertaining portion of his biography. From infancy his health had been uncertain, and the toils of his profession gradually undermined it. In 1834 he paid a second visit to America. His last appearance in New York was on the 11th of February 1835, when he played Samuel Coddle in *Married Life* and Andrew Steward in *The Lone House*. He died at Plymouth on the 28th of June 1835. In 1797 he had married Eliza Kirkham Strong (d. 1802), and in 1803 Anne Jackson, an actress, the author of the popular and diverting *Memoirs, by Mrs Mathews* (4 vols., 1838–1839).

His son Charles James Mathews (1803–1878), who was born at Liverpool on the 26th of December 1803, became even better known as an actor. After attending Merchant Taylors' School he was articled as pupil to an architect, and continued for some years nominally to follow this profession. His first public appearance on the stage was made on the 7th of December 1835, at the Olympic, London, as George Rattleton in his own play *The Humpbacked Lover*, and as Tim Topple the Tiger in Leman Rode's *Old and Young Stager*. In 1838 he married Madame Vestris, then lessee of the Olympic, but neither his management of this theatre, nor subsequently of Covent Garden, nor of the Lyceum, resulted in pecuniary success, although the introduction of scenery more realistic and careful in detail than had hitherto been employed was due to his enterprise. In the year of his marriage he visited America, but without receiving a very cordial welcome. As an actor he held in England an unrivalled place in his peculiar vein of light eccentric comedy. The easy grace of his manner, and the imperturbable solemnity with which he perpetrated his absurdities, never failed to charm and amuse; his humour was never broad, but always measured and restrained. It was as the leading character in such plays as the *Game of Speculation*, *My Awful Dad*, *Cool as a Cucumber*, *Patter versus Clatter*, and *Little Toddlekins*, that he specially excelled. In 1856 Mme Vestris died, and in the following year Mathews again visited the United States, where in 1858 he married Mrs A. H. Davenport. In 1861 they gave a series of "At Homes" at the Haymarket theatre, which were almost as popular as had been those of the elder Mathews. Charles James Mathews was one of the few English actors who played in French successfully,—his appearance in Paris in 1863 in a French version of *Cool as a Cucumber*, written by himself, being received with great approbation. He also played there again in 1865 as Sir Charles Coldcream in the original play *L'Homme blasé* (English version by Boucicault, *Used up*). After reaching his sixty-sixth year, Mathews set out on a tour round the world, in which was included a third visit to America, and on his return in 1872 he continued to act without interruption till within a few weeks of his death on the 24th of June 1878. He made his last appearance in New York at Wallack's theatre on the 7th of June 1872, in H. J. Byron's *Not such a Fool as he Looks*. His last appearance in London was at the Opéra Comique on the 2nd of June 1877, in *The Liar* and *The Cosy Couple*. At Stalybridge he gave his last performance on the 8th of June 1878, when he played Adonis Evergreen in his own comedy *My Awful Dad*.

See the *Life of Charles James Mathews*, edited by Charles Dickens (2 vols., 1879); H. G. Paine in *Actors and Actresses of Great Britain and the United States* (New York, 1886).

MATHEWS, THOMAS (1676–1751), British admiral, son of Colonel Edward Mathews (d. 1700), and grandson on his mother's side of Sir Thomas Armstrong (1624–1684), who was executed for the Rye House Plot, was born at Llandaff Court, Llandaff. He entered the navy and became lieutenant in 1699, being promoted captain in 1703. During the short war with Spain (1718–20) he commanded the "Kent" in the fleet of Sir George Byng (Lord Torrington), and from 1722 to 1724 he had the command of a small squadron sent to the East Indies to repress the pirates of the coast of Malabar. He saw no further service till March 1741, when he was appointed to the command in the Mediterranean, and plenipotentiary to the king of Sardinia and the other courts of Italy. It is impossible to understand upon what grounds he was selected. As an admiral he was not distinguished; he was quite destitute of the experience and the tact required for his diplomatic duties; and he was on the worst possible terms with his second in command, Richard Lestock (1679?–1746). Yet the purpose for which he was sent out in his double capacity was not altogether ill performed. In 1742 Mathews sent a small squadron to Naples to compel King Charles III., afterwards king of Spain, to remain neutral. It was commanded by commodore, afterwards admiral, William Martin (1696?–1756), who refused to enter into negotiations, and gave the king half an hour in which to return an answer. In June of the same year a squadron of Spanish galleys, which had taken refuge in the Bay of Saint Tropez, was burnt by the fireships of Mathews' fleet. In the meantime a Spanish squadron of line-of-battleships had taken refuge in Toulon, and was watched by the British fleet from its anchorage at Hyères. In February 1744 the Spaniards put to sea in company with a French force. Mathews, who had now returned to his flagship, followed, and an engagement took place on the 11th of February. The battle was highly discreditable to the British fleet, and not very honourable to their opponents, but it is of the highest historical importance in the history of the navy. It marked the lowest pitch reached in discipline and fighting and efficiency by the fleet in the 18th century, and it had a very bad effect in confirming the pedantic system of tactics set up by the old Fighting Instructions. The British fleet followed the enemy in light winds on the 10th of February, and became scattered. Mathews hoisted the signal to form the line, and then when night fell, to lie to. At that moment Lestock, who commanded in the rear, was at a considerable distance from the body of the fleet, and he ought undoubtedly to have joined his admiral before lying to, but he obeyed the second order, with the result, which it is impossible not to feel that he foresaw and desired, that when morning came he was a long way off the flag of Mathews. The enemy were within striking distance of the van and centre of the British fleet, and Mathews attacked their rear. The battle was ill fought, as it had been ill prepared. Lestock never came into action at all. One Spanish line-of-battleship, the "Poder" (74), was taken, but afterwards burnt. Several of the British captains behaved very badly, and Mathews in a heat of confused anger bore down on the enemy out of his line, while the signal to keep the line was still flying at his mast head. The French and Spaniards got away, and were not pursued by Mathews, though they were of inferior strength.

Deep indignation was aroused at home by this naval miscarriage, and the battle led to more than twenty courts-martial and a parliamentary inquiry. The evils which had overrun the navy were clearly displayed, and in so far some good was done. It was shown for instance that one of the captains whose ship behaved worst was a man of extreme age who was nearly blind and deaf. One of the captains was so frightened at the prospect of a trial that he deserted on his way home and disappeared into Spain. Mathews resigned and returned home after the battle. In consequence of the parliamentary motion for inquiry, Lestock was brought to trial, and acquitted on the ground that he had obeyed orders. Then Mathews was tried in 1746, and was condemned to be dismissed the service on the ground that he had not only failed to pursue the enemy but had taken his fleet into action in a confused manner. He had in fact not waited till he had his fleet in a line with the enemy before bearing down on them, and he had disordered his own line. To the country at large it appeared strange that the admiral who had actually fought should be condemned, while the admiral who had kept at a distance was acquitted. Mathews looked upon his condemnation as the result of mere party spirit. Sheer pedantry on the part of the officers forming the court-martial affords a more satisfactory explanation. They judged that a naval officer was bound not to go beyond the Fighting Instructions as Mathews had undoubtedly done, and therefore condemned him. Their decision had a serious effect in fixing the rule that all battles, at any rate against enemies of equal or nearly equal numbers, were to be fought on one pattern. Mathews died on the 2nd of October 1751 in London. There is a portrait of him in the Painted Hall at Greenwich.

In Beatson's *Naval and Military Memoirs*, vol. i., will be found a fair account of the battle of February 1744. It is fully dealt with by Montagu Burrows in his *Life of Hawke*. The French account may be found in Tronde's *Batailles Navales de la France*. The Spanish view is in the *Vida de Don Josef Navarro* by Don Josef de Vargas. The battle led to a violent pamphlet controversy. The charges and findings at the courts-martial on both Lestock and Mathews were published at the time. The minor trials arising out of the action are collected in a folio under the title "Copies of all the Minutes and Proceedings taken at and upon the several Tryals of Captain George Burrish" (1746). A "Narrative" was published by, or for, Lestock in 1744, and answered by, or on behalf of, Mathews under the title "Ad——l M——w's Conduct in the late Engagement Vindicated" in 1745. (D. H.)

MATHY, KARL (1807–1868), Badenese statesman, was born at Mannheim on the 17th of March 1807. He studied law and politics at Heidelberg, and entered the Baden government department of finance in 1829. His sympathy with the revolutionary ideas of 1830, expressed in his paper the *Zeitgeist*, cost him his appointment in 1834, and he made his way to Switzerland, where he contributed to the *Jeune Suisse* directed by Mazzini. On his return to Baden in 1840 he edited the *Landtagszeitung* at Carlsruhe, and in 1842 he entered the estates for the town of Constance. He became one of the opposition leaders and in 1847 helped to found the *Deutsche Zeitung*, a paper which eventually did much to further the cause of German unity. He took part in the preliminary parliament and in the assembly of Frankfort in 1848–1849, where he supported the policy of H. W. A. von Gagern, and after the refusal of Frederick William IV. to accept the imperial crown he still worked for the cause of unity. He was made finance minister in Baden in May 1849, but was dismissed after a few days of office. He then applied his financial knowledge to banking business in Cologne, Berlin, Gotha and Leipzig. He was recalled to Baden in 1862, and in 1864 became president of the new ministry of commerce. He sought to bring Baden institutions into line with those of northern Germany with a view to ultimate union, and when in 1866 Baden took sides with Austria against Prussia he sent in his resignation. After the war he became president of a new cabinet, but he did not live to see the realization of the policy for which he had striven. He died at Carlsruhe on the 3rd of February 1868.

His letters during the years 1846–1848 were edited by Ludwig Mathy (Leipzig, 1899), and his life was written by G. Freytag (Leipzig, 2nd ed., 1872).

MATILDA (1102–1164), queen of England and empress, daughter of Henry I. of England, by Matilda, his first wife, was born in 1102. In 1109 she was betrothed to the emperor-elect, Henry V., and was sent to Germany, but the marriage was delayed till 1114. Her husband died after eleven years of wedlock, leaving her childless; and, since both her brothers were now dead, she was recalled to her father's court in order that she might be recognized as his successor in England and Normandy. The Great Council of England did homage to her under considerable pressure. Their reluctance to acknowledge a female sovereign was increased when Henry gave her in marriage to Geoffrey Plantagenet, the heir of Anjou and Maine (1129); nor was it removed by the birth of the future Henry II. in 1133. On the old king's death both England and Normandy accepted his nephew, Stephen, of Mortain and Boulogne. Matilda and her husband were in Anjou at the time. They wasted the next few years in the attempt to win Normandy; but Earl Robert of Gloucester, the half-brother of the empress, at length induced her to visit England and raise her standard in the western shires, where his influence was supreme. Though on her first landing Matilda only escaped capture through the misplaced chivalry of her opponent, she soon turned the tables upon him with the help of the Church and the barons of the west. Stephen was defeated and captured at Lincoln (1141); the empress was acclaimed lady or queen of England (she used both titles indifferently) and crowned at London. But the arrogance which she displayed in her prosperity alienated the Londoners and the papal legate, Bishop Henry of Winchester. Routed at the siege of Winchester, she was compelled to release Stephen in exchange for Earl Robert, and thenceforward her cause steadily declined in England. In 1148, having lost by the earl's death her principal supporter, she retired to Normandy, of which her husband had in the meantime gained possession. Henceforward she remained in the background, leaving her eldest son Henry to pursue the struggle with Stephen. She outlived Henry's coronation by ten years; her husband had died in 1151. As queen-mother she played the part of a mediator between her sons and political parties. Age mellowed her temper, and she turned more and more from secular ambitions to charity and religious works. She died on the 30th of January 1164.

See O. Rössler, *Kaiserin Mathilde* (Berlin, 1897); J. H. Round, *Geoffrey de Mandeville* (London, 1892). (H. W. C. D.)

MATILDA (1046–1115), countess or margravine of Tuscany, popularly known as the Great Countess, was descended from a noble Lombard family. Her great-grandfather, Athone of Canossa, had been made count of Modena and Reggio by the emperor Otto I., and her grandfather had, in addition, acquired Mantua, Ferrara and Brescia. Her own father, Boniface II., the Pious, secured Tuscany, the duchy of Spoleto, the county of Parma, and probably that of Cremona; and was loyal to the emperor until Henry plotted against him. Through the murder of Count Boniface in 1052 and the death of her older brother and sister three years later, Matilda was left, at the age of nine, sole heiress to the richest estate in Italy. She received an excellent education under the care of her mother, Beatrice of Bar, the daughter of Frederick of Lorraine and aunt of Henry III., who, after a brief detention in Germany by the emperor, married Godfrey IV. of Lorraine, brother of Pope Stephen IX. (1057–1058). Thenceforth Matilda's lot was cast against the emperor in the great struggle over investiture, and for over thirty years she maintained the cause of the successive pontiffs, Gregory VII., Victor III., Urban II., Paschal II., with varying fortune, but with undaunted resolution. She aided the pope against the Normans in 1074, and in 1075 attended the synod at which Guibert was condemned and deprived of the archbishopric of Ravenna. Her hereditary fief of Canossa was the scene (Jan. 28, 1077) of the celebrated penance of Henry IV. before Gregory VII. She provided an asylum for Henry's second wife, Praxides, and urged his son Conrad to revolt against his father. In the course of the protracted struggle her villages were plundered, her fortresses demolished, and Pisa and Lucca temporarily lost, but she remained steadfast in her allegiance, and, before her death, had, by means of a league of Lombard cities which she formed, recovered all her possessions. The donation of her estates to the Holy See, originally made in 1077 and renewed on the 17th of November 1102, though never fully consummated on account of imperial opposition, constituted the greater part of the temporal dominion of the papacy. Matilda was twice married, first to Godfrey V. of Lorraine, surnamed the Humpbacked, who was the son of her step-father and was murdered on the 26th of February 1076; and secondly to the 17-year-old Welf V. of Bavaria, from whom she finally separated in 1095—both marriages of policy, which counted for little in her life. Matilda was an eager student: she spoke Italian, French and German fluently, and wrote many Latin letters; she collected a considerable library; she supervised an edition of the Pandects of Justinian; and Anselm of Canterbury sent her his *Meditations*. She combined her devotion to the papacy and her learning with very deep personal piety. She died after a long illness at Bodeno, near Modena, on the 24th of July 1115, and was buried in the Benedictine church at Polirone, whence her remains were taken to Rome by order of Urban VIII. in 1635 and interred in St Peter's.

The contemporary record of Matilda's life in rude Latin verse, by her chaplain Domnizone (Donizo or Domenico), is preserved in the Vatican Library. The best edition is that of Bethmann in the *Monumenta germ. hist. scriptores*, xii. 348–409. The text, with an Italian translation, was published by F. Davoli under the title *Vita della granda contessa Matilda di Canossa* (Reggio nell' Emilia 1888 seq.).

See A. Overmann, *Gräfin Mathilde von Tuscien; ihre Besitzungen . . . u. ihre Regesten* (Innsbruck, 1895); A. Colombo, *Una Nuova vita della contessa Matilda* in *R. accad. d. sci. Atti*, vol. 39 (Turin, 1904); L. Tosti, *La Contessa Matilda ed i romani pontefici* (Florence, 1859); A. Pannenborg, *Studien zur Geschichte der Herzogin Matilde von Canossa* (Göttingen, 1872); F. M. Fiorentini, *Memorie della Matilda* (Lucca, 1756); and Nora Duff, *Matilda of Tuscany* (1910). (C. H. Ha.)

MATINS (Fr. *matines*, med. Lat. *matutinae*, *sc.* possibly *vigiliae*, morning watches; from *matutinus*, "belonging to the morning"), a word now only used in an ecclesiastical sense for one of the canonical hours in the Roman Breviary, originally intended to be said at midnight, but sometimes said at dawn, after which "lauds" were recited or sung. In the modern Roman Catholic Church, outside monastic services, the office is usually said on the preceding afternoon or evening. The word is also used in the Roman Catholic Church for the public service held on Sunday mornings before the mass (see Breviary; and Hours, Canonical). In the Church of England since the Reformation matins is used for the order of public morning prayer.

MATLOCK, a market town in the western parliamentary division of Derbyshire, England, on the river Derwent, 17 m. N. by W. of Derby on the Midland railway. Pop. (1901), of urban district of Matlock, 5979; of Matlock Bath and Scarthin Nick, 1819. The entire township includes the old village of Matlock, the commercial and manufacturing district of Matlock Bridge, and the fashionable health resorts of Matlock Bath and Matlock Bank. The town possesses cotton, corn and paper mills, while in the vicinity there are stone-quarries and lead mines. A peculiar local industry is the manufacture of so-called "petrified" birds' nests, plants, and other objects. These are steeped in water from the mineral springs until they become encrusted with a calcareous deposit which gives them the appearance of fossils. Ornaments fashioned out of spar and stalactites have also a considerable sale.

Matlock Bath, one and a half miles south of Matlock, having a separate railway station, overlooks the narrow and precipitous gorge of the Derwent, and stands in the midst of woods and cliffs, deriving its name from three medicinal springs, which first became celebrated towards the close of the 17th century. They were not known to the Romans, although lead-mining was carried on extensively in the district in the 1st and 2nd centuries A.D. The mean temperature of the springs is 68° F. Extensive grounds have been laid out for public use; and in the neighbourhood there are several fine stalactite caverns.

Sheltered under the high moorlands of Darley, Matlock Bank has grown up about a mile north-east of the old village, and has become celebrated for the number and excellence of its hydropathic establishments. A tramway, worked by a single cable, over a gradient said to be the steepest in the world, affords easy communication with Matlock Bridge.

MATOS FRAGOSO, JUAN DE (1614?–1689), Spanish dramatist, of Portuguese descent, was born about 1614 at Alsito (Alemtejo). After taking his degree in law at the university of Evora, he proceeded to Madrid, where he made acquaintance with Perez de Montalbán, and thus obtained an introduction to the stage. He quickly displayed great cleverness in hitting the public taste, and many contemporaries of superior talent eagerly sought his aid as a collaborator. The earliest of his printed plays is *La Defensa de la fé y príncipe prodigioso* (1651), and twelve more pieces were published in 1658. But though his popularity continued long after his death (January 4, 1689), Matos Fragoso's dramas do not stand the test of reading. His emphatic preciosity and sophistical insistence on the "point of honour" are tedious and unconvincing; in *La Venganza en el despeño*, in *Á lo que obliga un agravio*, and in other plays, he merely recasts, very adroitly, works by Lope de Vega.

MATRASS (mod. Lat. *matracium*), a glass vessel with a round or oval body and a long narrow neck, used in chemistry, &c., as a digester or distiller. The Florence flask of commerce is frequently used for this purpose. The word is possibly identical with an old name "matrass" (Fr. *materas*, *matelas*) for the bolt or quarrel of a cross-bow. If so, some identity of shape is the reason for the application of the word; "bolt-head" is also used as a name for the vessel. Another connexion is suggested with the Arabic *matra*, a leather bottle.

MATRIARCHATE ("rule of the mother"), a term used to express a supposed earliest and lowest form of family life, typical of primitive societies, in which the promiscuous relations of the sexes result in the child's father being unknown (see Family). In such communities the mother took precedence of the father in certain important respects, especially in line of descent and inheritance. Matriarchate is assumed on this theory to have been universal in prehistoric times. The prominent position then naturally assigned women did not, however, imply any personal power, since they were in the position of mere chattels: it simply constituted them the sole relatives of their children and the only centre of any such family life as existed. The custom of tracing descent through the female is still observed among certain savage tribes. In Fiji father and son are not regarded as relatives. Among the Bechuanas the chieftainship passes to a brother, not to a son. In Senegal, Loango, Congo and Guinea, relationship is traced through the female. Among the Tuareg Berbers a child takes rank, freeman's or slave's, from its mother.

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MATRIMONY (Lat. *matrimonium*, marriage, which is the ordinary English sense), a game at cards played with a full whist pack upon a table divided into three compartments labelled "Matrimony," "Intrigue" and "Confederacy," and two smaller spaces, "Pair" and "Best." These names indicate combinations of two cards, any king and queen being "Matrimony," any queen and knave "Intrigue," any king and knave "Confederacy"; while any two cards of the same denomination form a "Pair" and the diamond ace is "Best." The dealer distributes a number of counters, to which an agreed value has been given, upon the compartments, and the other players do likewise. The dealer then gives one card to each player, face down, and a second, face up. If any turned-up card is the diamond ace, the player holding it takes everything on the space and the deal passes. If not turned, the diamond ace has only the value of the other three aces. If it is not turned, the players, beginning with the eldest hand, expose their second cards, and the resulting combinations, if among the five successful ones, win the counters of the corresponding spaces. If the counters on a space are not won, they remain until the next deal.

MATRIX, a word of somewhat wide application, chiefly used in the sense of a bed or enclosing mass in which something is shaped or formed (Late Lat. *matrix*, womb; in classical Latin *matrix* was only applied to an animal kept for breeding). Matrix is thus used of a mould of metal or other substance in which a design or pattern is made in intaglio, and from which an impression in relief is taken. In die-sinking and coining, the matrix is the hardened steel mould from which the die-punches are taken. The term "seal" should strictly be applied to the impression only on wax of the design of the matrix, but is often used both of the matrix and of the impression (see SEALS). In mineralogy, the matrix is the mass in which a crystal mineral or fossil is embedded. In mathematics, the name "matrix" is used of an arrangement of numbers or symbols in a rectangular or square figure. (See ALGEBRAIC FORMS.)

In med. Latin *matrix* and the diminutive *matricula* had the meaning of a roll or register, particularly one containing the names of the members of an institution, as of the clergy belonging to a cathedral, collegiate or other church, or of the members of a university. From this use is derived "matriculation," the admission to membership of a university, also the name of the examination for such admission. *Matricula* was also the name of the contributions in men and money made by the various states of the Holy Roman Empire, and in the modern German Empire the contributions made by the federal states to the imperial finances are called *Matrikularbeiträge*, matricular contributions. (See GERMANY: *Finance*.)

MATROSS, the name (now obsolete) for a soldier of artillery, who ranked next below a gunner. The duty of a matross was to assist the gunners in loading, firing and sponging the guns. They were provided with firelocks, and marched with the store-wagons, acting as guards. In the American army a matross ranked as a private of artillery. The word is probably derived from Fr. *matelot*, a sailor.

MATSUKATA, MARQUIS (1835–), Japanese statesman, was born at Kagoshima in 1835, being a son of a *samurai* of the Satsuma clan. On the completion of the feudal revolution of 1868 he was appointed governor of the province of Tosa, and having served six years in this office, was transferred to Tōkyō as assistant minister of finance. As representative of Japan at the Paris Exhibition of 1878, he took the opportunity afforded by his mission to study the financial systems of the great European powers. On his return home, he held for a short time in 1880 the portfolio of home affairs, and was in 1881 appointed minister of finance. The condition of the currency of Japan was at that time deplorable, and national bankruptcy threatened. The coinage had not only been seriously debased during the closing years of the Tokugawa régime, but large quantities of paper currency had been issued and circulated, both by many of the feudal lords, and by the central government itself, as a temporary expedient for filling an impoverished exchequer. In 1878 depreciation had set in, and the inconvertible paper had by the close of 1881 grown to such an extent that it was then at a discount of 80% as compared with silver. Matsukata showed the government the danger of the situation, and urged that the issue of further paper currency should be stopped at once, the expenses of administration curtailed, and the resulting surplus of revenue used in the redemption of the paper currency and in the creation of a specie reserve. These proposals were acted upon: the Bank of Japan was established, and the right of issuing convertible notes given to it; and within three years of the initiation of these financial reforms, the paper currency, largely reduced in quantity, was restored to its full par value with silver, and the currency as a whole placed on a solvent basis. From this time forward Japan's commercial and military advancement continued to make uninterrupted progress. But *pari passu* with the extraordinary impetus given to its trade by the successful conclusion of the war with China, the national expenditure enormously increased, rising within a few years from 80 to 250 million yen. The task of providing for this expenditure fell entirely on Matsukata, who had to face strong opposition on the part of the diet. But he distributed the increased taxation so equally, and chose its subjects so wisely, that the ordinary administrative expenditure and the interest on the national debt were fully provided for, while the extraordinary expenditure for military purposes was met from the Chinese indemnity. As far back as 1878 Matsukata perceived the advantages of a gold standard, but it was not until 1897 that his scheme could be realized. In this year the bill authorizing it was under his auspices submitted to the diet and passed; and with this financial achievement Matsukata saw the fulfilment of his ideas of financial reform, which were conceived during his first visit to Europe. Matsukata, who in 1884 was created Count, twice held the office of prime minister (1891–1892, 1896–1898), and during both his administrations he combined the portfolio of finance with the premiership; from October 1898 to October 1900 he was minister of finance only. His name in Japanese history is indissolubly connected with the financial progress of his country at the end of the 19th century. In 1902 he visited England and America, and he was created G.C.M.G., and given the Oxford degree of D.C.L. In September 1907 he was advanced to the rank of Marquis.

MATSYS (MASSYS or METZYS), **QUINTIN** (1466–1530), Flemish artist, was born at Louvain, where he first learned a mechanical art. During the greater part of the 15th century the centres in which the painters of the Low Countries most congregated were Bruges, Ghent and Brussels. Towards the close of the same period Louvain took a prominent part in giving employment to workmen of every craft. It was not till the opening of the 16th century that Antwerp usurped the lead which it afterwards maintained against Bruges and Ghent, Brussels, Mechlin and Louvain. Quintin Matsys was one of the first men of any note who gave repute to the gild of Antwerp. A legend relates how the smith of Louvain was induced by affection for the daughter of an artist to change his trade and acquire proficiency in painting. A less poetic but perhaps more real version of the story tells that Quintin had a brother with whom he was brought up by his father Josse Matsys, a smith, who held the lucrative offices of clockmaker and architect to the municipality of Louvain. It came to be a question which of the sons should follow the paternal business, and which carve out a new profession for himself. Josse the son elected to succeed his father, and Quintin then gave himself to the study of painting. We are not told expressly by whom Quintin was taught, but his style seems necessarily derived from the lessons of Dierick Bouts, who took to Louvain the mixed art of Memlinc and Van der Weyden. When he settled at Antwerp, at the age of twenty-five, he probably had a style with an impress of its own, which certainly contributed most importantly to the revival of Flemish art on the lines of Van Eyck and Van der Weyden. What particularly characterizes Quintin Matsys is the strong religious feeling which he inherited from earlier schools. But that again was permeated by realism which frequently degenerated into the grotesque. Nor would it be too much to say that the facial peculiarities of the boors of Van Steen or Ostade have their counterparts in the pictures of Matsys, who was not, however, trained to use them in the same homely way. From Van der Weyden's example we may trace the dryness of outline and shadeless modelling and the pitiless finish even of trivial detail, from the Van Eycks and Memlinc through Dierick Bouts the superior glow and richness of transparent pigments, which mark the pictures of Matsys. The date of his retirement from Louvain is 1491, when he became a master in the gild of painters at Antwerp. His most celebrated picture is that which he executed in 1508 for the joiners' company in the cathedral of his adopted city. Next in importance to that is the Marys of Scripture round the Virgin and Child, which was ordered for a chapel in the cathedral of Louvain. Both altar-pieces are now in public museums, one at Antwerp, the other at Brussels. They display great earnestness in expression, great minuteness of finish, and a general absence of effect by light or shade. As in early Flemish pictures, so in those of Matsys, superfluous care is lavished on jewelry, edgings and ornament. To the great defect of want of atmosphere such faults may be added as affectation, the result of excessive straining after tenderness in women, or common gesture and grimace suggested by a wish to render pictorially the brutality of gaolers and executioners. Yet in every instance an effort is manifest to develop and express individual character. This tendency in Matsys is chiefly illustrated in his pictures of male and female market bankers

(Louvre and Windsor), in which an attempt is made to display concentrated cupidity and avarice. The other tendency to excessive emphasis of tenderness may be seen in two replicas of the "Virgin and Child" at Berlin and Amsterdam, where the ecstatic kiss of the mother is quite unreal. But in these examples there is a remarkable glow of colour which makes up for many defects. Expression of despair is strongly exaggerated in a Lucretia at the museum of Vienna. On the whole the best pictures of Matsys are the quietest; his "Virgin and Christ" or "Ecce Homo" and "Mater Dolorosa" (London and Antwerp) display as much serenity and dignity as seems consistent with the master's art. He had considerable skill as a portrait painter. Egidius at Longford, which drew from Sir Thomas More a eulogy in Latin verse, is but one of a numerous class, to which we may add the portrait of Maximilian of Austria in the gallery of Amsterdam. Matsys in this branch of practice was much under the influence of his contemporaries Lucas of Leiden and Mabuse. His tendency to polish and smoothness excluded to some extent the subtlety of modulation remarkable in Holbein and Dürer. There is reason to think that he was well acquainted with both these German masters. He probably met Holbein more than once on his way to England. He saw Dürer at Antwerp in 1520. Quintin died at Antwerp in 1530. The puritan feeling which slumbered in him was fatal to some of his relatives. His sister Catherine and her husband suffered at Louvain in 1543 for the then capital offence of reading the Bible, he being decapitated, she buried alive in the square fronting the cathedral.

Quintin's son, Jan Matsys, inherited the art but not the skill of his parent. The earliest of his works, a "St Jerome," dated 1537, in the gallery of Vienna, the latest, a "Healing of Tobias," of 1564, in the museum of Antwerp, are sufficient evidence of his tendency to substitute imitation for original thought.

MATTEAWAN, a village of Fishkill township, Dutchess county, New York, U.S.A., on the eastern bank of the Hudson river, opposite Newburgh and 15 m. S. of Poughkeepsie. Pop. (1890), 4278; (1900), 5807 (1044 foreign-born); (1905, state census), 5584; (1910), 6727. The village is served by the Central New England railway, and is the seat of the Matteawan state hospital for the criminal insane, the Highland hospital, and the Sargeant industrial school. The Teller House dates back to the beginning of the 18th century. Near Matteawan is Beacon Hill, the highest of the highlands, which has an electric railway to its summit. There are manufactures of hats, rubber goods, machinery (notably "fuel-economizers"), &c., water-power being furnished by Fishkill Creek. The village owns its water-works, the supply for which is derived from Beacon Hill. Matteawan was incorporated as a village in 1886.

MATTER. Our conceptions of the nature and structure of matter have been profoundly influenced in recent years by investigations on the Conduction of Electricity through Gases (see CONDUCTION, ELECTRIC) and on Radio-activity (*q.v.*). These researches and the ideas which they have suggested have already thrown much light on some of the most fundamental questions connected with matter; they have, too, furnished us with far more powerful methods for investigating many problems connected with the structure of matter than those hitherto available. There is thus every reason to believe that our knowledge of the structure of matter will soon become far more precise and complete than it is at present, for now we have the means of settling by testing directly many points which are still doubtful, but which formerly seemed far beyond the reach of experiment.

The Molecular Theory of Matter—the only theory ever seriously advocated—supposes that all visible forms of matter are collocations of simpler and smaller portions. There has been a continuous tendency as science has advanced to reduce further and further the number of the different kinds of things of which all matter is supposed to be built up. First came the molecular theory teaching us to regard matter as made up of an enormous number of small particles, each kind of matter having its characteristic particle, thus the particles of water were supposed to be different from those of air and indeed from those of any other substance. Then came Dalton's Atomic Theory which taught that these molecules, in spite of their almost infinite variety, were all built up of still smaller bodies, the atoms of the chemical elements, and that the number of different types of these smaller bodies was limited to the sixty or seventy types which represent the atoms of the substance regarded by chemists as elements.

In 1815 Prout suggested that the atoms of the heavier chemical elements were themselves composite and that they were all built up of atoms of the lightest element, hydrogen, so that all the different forms of matter are edifices built of the same material—the atom of hydrogen. If the atoms of hydrogen do not alter in weight when they combine to form atoms of other elements the atomic weights of all elements would be multiples of that of hydrogen; though the number of elements whose atomic weights are multiples or very nearly so of hydrogen is very striking, there are several which are universally admitted to have atomic weights differing largely from whole numbers. We do not know enough about gravity to say whether this is due to the change of weight of the hydrogen atoms when they combine to form other atoms, or whether the primordial form from which all matter is built up is something other than the hydrogen atom. Whatever may be the nature of this primordial form, the tendency of all recent discoveries has been to emphasize the truth of the conception of a common basis of matter of all kinds. That the atoms of the different elements have a common basis, that they behave as if they consisted of different numbers of small particles of the same kind, is proved to most minds by the Periodic Law of Mendeléeff and Newlands (see ELEMENT). This law shows that the physical and chemical properties of the different elements are determined by their atomic weights, or to use the language of mathematics, the properties of an element are functions of its atomic weight. Now if we constructed models of the atoms out of different materials, the atomic weight would be but one factor out of many which would influence the physical and chemical properties of the model, we should require to know more than the atomic weight to fix its behaviour. If we were to plot a curve representing the variation of some property of the substance with the atomic weight we should not expect the curve to be a smooth one, for instance two atoms might have the same atomic weight and yet if they were made of different materials have no other property in common. The influence of the atomic weight on the properties of the elements is nowhere more strikingly shown than in the recent developments of physics connected with the discharge of electricity through gases and with radio-activity. The transparency of bodies to Röntgen rays, to cathode rays, to the rays emitted by radio-active substances, the quality of the secondary radiation emitted by the different elements are all determined by the atomic weight of the element. So much is this the case that the behaviour of the element with respect to these rays has been used to determine its atomic weight, when as in the case of Indium, uncertainty as to the valency of the element makes the result of ordinary chemical methods ambiguous.

The radio-active elements indeed furnish us with direct evidence of this unity of composition of matter, for not only does one element uranium, produce another, radium, but all the radio-active substances give rise to helium, so that the substance of the atoms of this gas must be contained in the atoms of the radio-active elements.

It is not radio-active atoms alone that contain a common constituent, for it has been found that all bodies can by suitable treatment, such as raising them to incandescence or exposing them to ultra-violet light, be made to emit negatively electrified particles, and that these particles are the same from whatever source they may be derived. These particles all carry the same charge of negative electricity and all have the same mass, this mass is exceedingly small even when compared with the mass of an atom of hydrogen, which until the discovery of these particles was the smallest mass known to science. These particles are called corpuscles or electrons; their mass according to the most recent determinations is only about $\frac{1}{1700}$ of that of an atom of hydrogen, and their radius is only about one hundred-thousandth part of the radius of the hydrogen atom. As corpuscles of this kind can be obtained from all substances, we infer that they form a constituent of the atoms of all bodies. The atoms of the different elements do not all contain the same number of corpuscles—there are more corpuscles in the atoms of the heavier elements than in the atoms of the lighter ones; in fact, many different considerations point to the conclusion that the number of corpuscles in the atom of any element is proportional to the atomic weight of the element. Different methods of estimating the exact number of corpuscles in the atom have all led to the conclusion that this number is of the same order as the atomic weight; that, for instance, the number of corpuscles in the atom of oxygen is not a large multiple of 16. Some methods indicate that the number of corpuscles in the atom is equal to the atomic weight, while the maximum value obtained by any method is only about four times the atomic weight. This is one of the points on which further experiments will enable us to speak with greater precision. Thus one of the constituents of all atoms is the negatively charged corpuscle; since the atoms are electrically neutral, this negative charge must be accompanied by an equal positive one, so that on this view the atoms must contain a charge of positive electricity proportional to the atomic weight; the way in which this positive electricity is arranged is a matter of great importance in the consideration of the constitution of matter. The question naturally arises, is the positive electricity done up into definite units like the negative, or does it merely indicate a property acquired by an atom when one or more corpuscles leave it? It is very remarkable that we have up to the present (1910), in spite of many investigations on this point, no direct evidence of the existence of positively charged particles with a mass comparable with that of a corpuscle; the smallest positive particle of which we have any direct indication has a mass equal to the mass of an atom of hydrogen, and it is a most remarkable fact that we get positively charged particles having this mass when we send the electric discharge through gases at low pressures, whatever be the kind of gas. It is no doubt exceedingly difficult to get rid of traces of hydrogen in vessels containing gases at low pressures through which an electric discharge is passing, but the circumstances under which the positively electrified particles just alluded to appear, and the way in which they remain unaltered in spite of all efforts to clear out any traces of hydrogen, all seem to indicate that these positively electrified particles, whose mass is equal to that of an atom of hydrogen, do not come from minute traces of hydrogen present as an impurity but from the oxygen, nitrogen, or helium, or whatever may be the gas through which the discharge passes. If this is so, then the most natural conclusion we can come to is that these positively electrified particles with the mass of the atom of hydrogen are the natural units of positive electricity, just as the corpuscles are those of negative, and that these positive particles form a part of all atoms.

Thus in this way we are led to an electrical view of the constitution of the atom. We regard the atom as built up of units of negative electricity and of an equal number of units of positive electricity; these two units are of very different mass, the mass of the negative unit being only $\frac{1}{1700}$ of that of the positive. The number of units of either kind is proportional to the atomic weight of the element and of the same order as this quantity. Whether this is anything besides the positive and negative electricity in the atom we do not know. In the present state of our knowledge of the properties of matter it is unnecessary to postulate the existence of anything besides these positive and negative units.

The atom of a chemical element on this view of the constitution of matter is a system formed by n corpuscles and n units of positive electricity which is in equilibrium or in a state of steady motion under the electrical forces which the charged $2n$ constituents exert upon each other. Sir J. J. Thomson (*Phil. Mag.*, March 1904, "Corpuscular Theory of Matter") has investigated the systems in steady motion which can be formed by various numbers of negatively electrified particles immersed in a sphere of uniform positive electrification, a case, which in consequence of the enormous volume of the units of positive electricity in comparison with that of the negative has much in common with the problem under consideration, and has shown that some of the properties of n systems of corpuscles vary in a periodic way suggestive of the Periodic Law in Chemistry as n is continually increased.

Mass on the Electrical Theory of Matter.—One of the most characteristic things about matter is the possession of mass. When we take the electrical theory of matter the idea of mass takes new and interesting forms. This point may be illustrated by the case of a single electrified particle; when this moves it produces in the region around it a magnetic field, the magnetic force being proportional to the velocity of the electrified particle.[1] In a magnetic field, however, there is energy, and the amount of energy per unit volume at any place is proportional to the square of the magnetic force at that place. Thus there will be energy distributed through the space around the moving particle, and when the velocity of the particle is small compared with that of light we can easily show that the energy in the region around the charged particle is $\frac{\mu e^2}{3a}$, when v is the velocity of the particle, e its charge, a its radius, and μ the magnetic permeability of the region round the particle. If m is the ordinary mass of the particle, the part of the kinetic energy due to the motion of this mass is $\frac{1}{2}mv^2$, thus the total kinetic energy is $\frac{1}{2}\left(m + \frac{2}{3}\frac{\mu e^2}{a}\right)$. Thus the electric charge on the particle makes it behave as if its mass were increased by $\frac{2}{3}\frac{\mu e^2}{a}$. Since this increase in mass is due to the energy in the region outside the charged particle, it is natural to look to that region for this additional mass. This region is traversed by the tubes of force which start from the electrified body and move with it, and a very simple calculation shows that we should get the increase in the mass which is due to the electrification if we suppose that these tubes of force as they move carry with them a certain amount of the ether, and that this ether had mass. The mass of ether thus carried along must be such that the amount of it in unit volume at any part of the field is such that if this were to move with the velocity of light its kinetic energy would be equal to the potential energy of the electric field in the unit volume under consideration. When a tube moves this mass of ether only participates in the motion at right angles to the tube, it is not set in motion by a movement of the tube along its length. We may compare the mass which a charged body acquires in virtue of its charge with the additional mass which a ball apparently acquires when it is placed in water; a ball placed in water behaves as if its mass were greater than its mass when moving in vacuo; we can easily understand why this should be the case, because when the ball in the water moves the water around it must move as well; so that when a force acting on the ball sets it in motion it has to move some of the water as well as the ball, and thus the ball behaves as if its mass were increased. Similarly in the case of the electrified particle, which when it moves carries with it its lines of force, which grip the ether and carry some of it along with them. When the electrified particle is moved a mass of ether has to be moved too, and thus the apparent mass of the particle is increased. The mass of the electrified particle is thus resident in every part of space reached by its lines of force; in this sense an electrified body may be said to extend to an infinite distance; the amount of the mass of the ether attached to the particle diminishes so rapidly as we recede from it that the contributions of regions remote from the particle are quite insignificant, and in the case of a particle as small as a corpuscle not one millionth part of its mass will be farther away from it than the radius of an atom.

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[1] We may measure this velocity with reference to any axes, provided we refer the motion of all the bodies which come into consideration to the same axes.

The increase in the mass of a particle due to given charges varies as we have seen inversely as the radius of the particle; thus the smaller the particle the greater the increase in the mass. For bodies of appreciable size or even for those as small as ordinary atoms the effect of any realizable electric charge is quite insignificant, on the other hand for the smallest bodies known, the corpuscle, there is evidence that the whole of the mass is due to the electric charge. This result has been deduced by the help of an extremely interesting property of the mass due to a charge of electricity, which is that this mass is not constant but varies with the velocity. This comes about in the following way. When the charged particle, which for simplicity we shall suppose to be spherical, is at rest or moving very slowly the lines of electric force are distributed uniformly around it in all directions; when the sphere moves, however, magnetic forces are produced in the region around it, while these, in consequence of electro-magnetic induction in a moving magnetic field, give rise to electric forces which displace the tubes of electric force in such a way as to make them set themselves so as to be more at right angles to the direction in which they are moving than they were before. Thus if the charged sphere were moving along the line AB, the tubes of force would, when the sphere was in motion, tend to leave the region near AB and crowd towards a plane through the centre of the sphere and at right angles to AB, where they would be moving more nearly at right angles to themselves. This crowding of the lines of force increases, however, the potential energy of the electric field, and since the mass of the ether carried along by the lines of force is proportional to the potential energy, the mass of the charged particle will also be increased. The amount of variation of the mass with the velocity depends to some extent on the assumptions we make as to the shape of the corpuscle and the way in which it is electrified. The simplest expression connecting the mass with the velocity is that when the velocity is v the mass is equal to $\frac{2}{3}\frac{\mu e^2}{a}\frac{1}{\left\{1-\frac{v^2}{c^2}\right\}^{\frac{1}{2}}}$ where c is the velocity of light. We see from this that the variation of mass with velocity is very small unless the velocity of the body approaches that of light, but when, as in the case of the β particles emitted by radium, the velocity is only a few per cent. less than that of light, the effect of velocity on the mass becomes very considerable; the formula indicates that if the particles were moving with a velocity equal to that of light they would behave as if their mass were infinite. By observing the variation in the mass of a corpuscle as its velocity changes we can determine how much of the mass depends upon the electric charge and how much is independent of it. For since the latter part of the mass is independent of the velocity, if it predominates the variation with velocity of the mass of a corpuscle will be small; if on the other hand it is negligible the variation in mass with velocity will be that indicated by theory given above. The experiment of Kaufmann (*Göttingen Nach.*, Nov. 8, 1901), Bucherer (*Ann. der Physik.*, xxviii. 513, 1909) on the masses of the β particles shot out by radium, as well as those by Hupka (*Berichte der deutsch. physik. Gesell.*, 1909, p. 249) on the masses of the corpuscle in cathode rays are in agreement with the view that the *whole* of the mass of these particles is due to their electric charge.

The alteration in the mass of a moving charge with its velocity is primarily due to the increase in the potential energy which accompanies the increase in velocity. The connexion between potential energy and mass is general and holds for any arrangement of electrified particles; thus if we assume the electrical constitution of matter, there will be a part of the mass of any system dependent upon the potential energy and in fact proportional to it. Thus every change in potential energy, such for example as occurs when two elements combine with evolution or absorption of heat, must be attended by a change in mass. The amount of this change can be calculated by the rule that if a mass equal to the change in mass were to move with the velocity of light its kinetic energy would equal the change in the potential energy. If we apply this result to the case of the combination of hydrogen and oxygen, where the evolution of heat, about $1 \cdot 6 \times 10^{11}$ ergs per gramme of water, is greater than in any other known case of chemical combination, we see that the change in mass would only amount to one part in 3000 million, which is far beyond the reach of experiment. The evolution of energy by radio-active substances is enormously larger than in ordinary chemical transformations; thus one gramme of radium emits per day about as much energy as is evolved in the formation of one gramme of water, and goes on doing this for thousands of years. We see, however, that even in this case it would require hundreds of years before the changes in mass became appreciable.

The evolution of energy from the gaseous emanation given off by radium is more rapid than that from radium itself, since according to the experiments of Rutherford (Rutherford, *Radio-activity*, p. 432) a gramme of the emanation would evolve about $2 \cdot 1 \times 10^{16}$ ergs in four days; this by the rule given above would diminish the mass by about one part in 20,000; but since only very small quantities of the emanation could be used the detection of the change of mass does not seem feasible even in this case.

On the view we have been discussing the existence of potential energy due to an electric field is always associated with mass; wherever there is potential energy there is mass. On the electro-magnetic theory of light, however, a wave of light is accompanied by electric forces, and therefore by potential energy; thus waves of light must behave as if they possessed mass. It may be shown that it follows from the same principles that they must also possess momentum, the direction of the momentum being the direction along which the light is travelling; when the light is absorbed by an opaque substance the momentum in the light is communicated to the substance, which therefore behaves as if the light pressed upon it. The pressure exerted by light was shown by Maxwell (*Electricity and Magnetism*, 3rd ed., p. 440) to be a consequence of his electro-magnetic theory, its existence has been established by the experiment of Lebedew, of Nichols and Hull, and of Poynting.

Weight.

We have hitherto been considering mass from the point of view that the constitution of matter is electrical; we shall proceed to consider the question of weight from the same point of view. The relation between mass and weight is, while the simplest in expression, perhaps the most fundamental and mysterious property possessed by matter. The weight of a body is proportional to its mass, that is if the weights of a number of substances are equal the masses will be equal, whatever the substances may be. This result was verified to a considerable degree of approximation by Newton by means of experiments with pendulums; later, in 1830 Bessel by a very extensive and accurate series of experiments, also made on pendulums, showed that the ratio of mass to weight was certainly to one part in 60,000 the same for all the substances examined by him, these included brass, silver, iron, lead, copper, ivory, water.

The constancy of this ratio acquires new interest when looked at from the point of view of the electrical constitution of matter. We have seen that the atoms of all bodies contain corpuscles, that the mass of a corpuscle is only $\frac{1}{1700}$ of the mass of an atom of hydrogen, that it carries a constant charge of negative electricity, and that its mass is entirely due to this charge, and can be regarded as arising from ether gripped by the lines of force starting from the electrical charge. The question at once suggests itself, Is this kind of mass ponderable? does it add to the weight of the body? and, if so, is the proportion between mass and weight the same as for ordinary bodies? Let us suppose for a moment that this mass is not ponderable, so that the corpuscles increase the mass but not the weight of an atom. Then, since the mass of a corpuscle is $\frac{1}{1700}$ of that of an atom of hydrogen, the addition or removal of one corpuscle would in the case of an atom of atomic weight x alter the mass by one part in 1700 x, without altering the weight, this would produce an effect of the same magnitude on the ratio of mass to weight and would in the case of the atoms of the lighter elements be easily measurable in experiments of the same order of accuracy as those made by Bessel. If the number of corpuscles in the atom were proportional to the atomic weight, then the ratio of mass to weight would be constant whether the corpuscles were ponderable or not. If the number were not proportional there would be greater discrepancies in the ratio of mass to weight than is consistent with Bessel's experiments if the corpuscles had no weight. We have seen there are other grounds for concluding that the number of corpuscles in an atom is proportional to the atom weight, so that the constancy of the ratio of mass to weight for a large number of substances does not enable us to determine whether or not mass due to charges of electricity is ponderable or not.

There seems some hope that the determination of this ratio for radio-active substances may throw some light on this point. The enormous amount of heat evolved by these bodies may indicate that they possess much greater stores of potential energy than other substances. If we suppose that the heat developed by one gramme of a radio-active substance in the transformations which it undergoes before it reaches the non-radio-active stage is a measure of the excess of the potential energy in a gramme of this substance above that in a gramme of non-radio-active substance, it would follow that a larger part of the mass was due to electric charges in radio-active than in non-radio-active substances; in the case of uranium this difference would amount to at least one part in 20,000 of the total mass. If this extra mass had no weight the ratio of mass to weight for uranium would differ from the normal amount by more than one part in 20,000, a quantity quite within the range of pendulum experiments. It thus appears very desirable to make experiments on the ratio of mass to weight for radio-active substances. Sir J. J. Thomson, by swinging a small pendulum whose bob was made of radium bromide, has shown that this ratio for radium does not differ from the normal by one part in 2000. The small quantity of radium available prevented the attainment of greater accuracy. Experiments just completed (1910) by Southerns at the Cavendish Laboratory on this ratio for uranium show that it is normal to an accuracy of one part in 200,000; indicating that in non-radio-active, as in radio-active, substances the electrical mass is proportional to the atomic weight.

Though but few experiments have been made in recent years on the value of the ratio of mass to weight, many important investigations have been made on the effect of alterations in the chemical and physical conditions on the weight of bodies. These have all led to the conclusion that no change which can be detected by our present means of investigation occurs in the weight of a body in consequence of any physical or chemical changes yet investigated. Thus Landolt, who devoted a great number of years to the question whether any change in weight occurs during chemical combination, came finally to the conclusion that in no case out of the many he investigated did any measurable change of weight occur during chemical combination. Poynting and Phillips (*Proc. Roy. Soc.*, 76, p. 445), as well as Southerns (78, p. 392), have shown that change in temperature produces no change in the weight of a body; and Poynting has also shown that neither the weight of a crystal nor the attraction between two crystals depends at all upon the direction in which the axis of the crystal points. The result of these laborious and very carefully made experiments has been to strengthen the conviction that the weight of a given portion of matter is absolutely independent of its physical condition or state of chemical combinations. It should, however, be noticed that we have as yet no accurate investigation as to whether or not any changes of weight occur during radio-active transformations, such for example as the emanation from radium undergoes when the atoms themselves of the substance are disrupted.

It is a matter of some interest in connexion with a discussion of any views of the constitution of matter to consider the theories of gravitation which have been put forward to explain that apparently invariable property of matter—its weight. It would be impossible to consider in detail the numerous theories which have been put forward to account for gravitation; a concise summary of many of these has been given by Drude (Wied. *Ann.* 62, p. 1):[1] there is no dearth of theories as to the cause of gravitation, what is lacking is the means of putting any of them to a decisive test.

There are, however, two theories of gravitation, both old, which seem to be especially closely connected with the idea of the electrical constitution of matter. The first of these is the theory, associated with the two fluid theory of electricity, that gravity is a kind of residual electrical effect, due to the attraction between the units of positive and negative electricity being a little greater than the repulsion between the units of electricity of the same kind. Thus on this view two charges of equal magnitude, but of opposite sign, would exert an attraction varying inversely as the square of the distance on a charge of electricity of either sign, and therefore an attraction on a system consisting of two charges equal in magnitude but opposite in sign forming an electrically neutral system. Thus if we had two neutral systems, A and B, A consisting of m positive units of electricity and an equal number of negative, while B has n units of each kind, then the gravitational attraction between A and B would be inversely proportional to the square of the distance and proportional to $n\,m$. The connexion between this view of gravity and that of the electrical constitution of matter is evidently very close, for if gravity arose in this way the weight of a body would only depend upon the number of units of electricity in the body. On the view that the constitution of matter is electrical, the fundamental units which build up matter are the units of electric charge, and as the magnitude of these charges does not change, whatever chemical or physical vicissitudes matter, the weight of matter ought not to be affected by such changes. There is one result of this theory which might possibly afford a means of testing it: since the charge on a corpuscle is equal to that on a positive unit, the weights of the two are equal; but the mass of the corpuscle is only $\frac{1}{1700}$ of that of the positive unit, so that the acceleration of the corpuscle under gravity will be 1700 times that of the positive unit, which we should expect to be the same as that for ponderable matter or 981.

The acceleration of the corpuscle under gravity on this view would be $1{\cdot}6\times10^6$. It does not seem altogether impossible that with methods slightly more powerful than those we now possess we might measure the effect of gravity on a corpuscle if the acceleration were as large as this.

The other theory of gravitation to which we call attention is that due to Le Sage of Geneva and published in 1818. Le Sage supposed that the universe was thronged with exceedingly small particles moving with very great velocities. These particles he called ultra-mundane corpuscles, because they came to us from regions far beyond the solar system. He assumed that these were so penetrating that they could pass through masses as large as the sun or the earth without being absorbed to more than a very small extent. There is, however, some absorption, and if bodies are made up of the same kind of atoms, whose dimensions are small compared with the distances between them, the absorption will be proportional to the mass of the body. So that as the ultra-mundane corpuscles stream through the body a small fraction, proportional to the mass of the body, of their momentum is communicated to it. If the direction of the ultra-mundane corpuscles passing through the body were uniformly distributed, the momentum communicated by them to the body would not tend to move it in one direction rather than in another, so that a body, A, alone in the universe and exposed to bombardment by the ultra-mundane corpuscles would remain at rest. If, however, there were a second body, B, in the neighbourhood of A, B will shield A from some of the corpuscles moving in the direction BA; thus A will not receive as much momentum in this direction as when it was alone; but in this case it only received just enough to keep it in equilibrium, so that when B is present the momentum in the opposite direction will get the upper hand and A will move in the direction AB, and will thus be attracted by B. Similarly, we see that B will be attracted by A. Le Sage proved that the rate at which momentum was being communicated to A or B by the passage through them of his corpuscles was proportional to the product of the masses of A and B, and if the distance between A and B was large compared with their dimensions, inversely proportional to the square of the distance between them; in fact, that the forces acting on them would obey the same laws as the gravitational attraction between them. Clerk Maxwell (article "ATOM," *Ency. Brit.*, 9th ed.) pointed out that this transference of momentum from the ultra-mundane corpuscles to the body through which they passed involved the loss of kinetic energy by the corpuscles, and if the loss of momentum were large enough to account for the gravitational attraction, the loss of kinetic energy would be so large that if converted into heat it would be sufficient to keep the body white hot. We need not, however, suppose that this energy is converted into heat; it might, as in the case where Röntgen rays are produced by the passage of electrified corpuscles through matter, be transformed into the energy of a still more penetrating form of radiation, which might escape from the gravitating body without heating it. It is a very interesting result of recent discoveries that the machinery which Le Sage introduced for the purpose of his theory has a very close analogy with things for which we have now direct experimental evidence. We know that small particles moving with very high speeds do exist, that they possess considerable powers of penetrating solids, though not, as far as we know at present, to an extent comparable with that postulated by Le Sage; and we know that the energy lost by them as they pass through a solid is to a large extent converted into a still more penetrating form of radiation, Röntgen rays. In Le Sage's theory the only function of the corpuscles is to act as carriers of momentum, any systems which possessed momentum, moved with a high velocity and had the power of penetrating solids, might be substituted for them; now waves of electric and magnetic force, such as light waves or Röntgen rays, possess momentum, move with a high velocity, and the latter at any rate possess considerable powers of penetration; so that we might formulate a theory in which penetrating Röntgen rays replaced Le Sage's corpuscles. Röntgen rays, however, when absorbed do not, as far as we know, give rise to more penetrating Röntgen rays as they should to explain attraction, but either to less penetrating rays or to rays of the same kind.

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[1] A theory published after Drude's paper in that of Professor Osborne Reynolds, given in his Rede lecture "On an Inversion of Ideas as to the Structure of the Universe."

We have confined our attention in this article to the view that the constitution of matter is electrical; we have done so because this view is more closely in touch with experiment than any other yet advanced. The units of which matter is built up on this theory have been isolated and detected in the laboratory, and we may hope to discover more and more of their properties. By seeing whether the properties of matter are or are not such as would arise from a collection of units having these properties, we can apply to this theory tests of a much more definite and rigorous character than we can apply to any other theory of matter. (J. J. T.)

MATTERHORN, one of the best known mountains (14,782 ft.) in the Alps. It rises S.W. of the village of Zermatt, and on the frontier between Switzerland (canton of the Valais) and Italy. Though on the Swiss side it appears to be an isolated obelisk, it is really but the butt end of a ridge, while the Swiss slope is not nearly as steep or difficult as the grand terraced walls of the Italian slope. It was first conquered, after a number of attempts chiefly on the Italian side, on the 14th of July 1865, by Mr E. Whymper's party, three members of which (Lord Francis Douglas, the Rev. C. Hudson and Mr Hadow) with the guide, Michel Croz, perished by a slip on the descent. Three days later it was scaled from the Italian side by a party of men from Val Tournanche. Nowadays it is frequently ascended in summer, especially from Zermatt.

MATTEUCCI, CARLO (1811–1868), Italian physicist, was born at Forlì on the 20th of June 1811. After attending the École Polytechnique at Paris, he became professor of physics successively at Bologna (1832), Ravenna (1837) and Pisa (1840). From 1847 he took an active part in politics, and in 1860 was chosen an Italian senator, at the same time becoming inspector-general of the Italian telegraph lines. Two years later he was minister of education. He died near Leghorn on the 25th of June 1868.

He was the author of four scientific treatises: *Lezioni di fisica* (2 vols., Pisa, 1841), *Lezioni sui fenomeni fisicochimici dei corpi viventi* (Pisa, 1844), *Manuale di telegrafia elettrica* (Pisa, 1850) and *Cours spécial sur l'induction, le magnetisme de rotation*, &c. (Paris, 1854). His numerous papers were published in the *Annales de chimie et de physique* (1829–1858); and most of them also appeared at the time in the Italian scientific journals. They relate almost entirely to electrical phenomena, such as the magnetic rotation of light, the action of gas batteries, the effects of torsion on magnetism, the polarization of electrodes, &c., sufficiently complete accounts of which are given in Wiedemann's *Galvanismus*. Nine memoirs, entitled "Electro-Physiological Researches," were published in the *Philosophical Transactions*, 1845–1860. See Bianchi's *Carlo Matteucci e l'Italia del suo tempo* (Rome, 1874).

MATTHEW, ST (Μαθθαῖος or Ματθαῖος, probably a shortened form of the Hebrew equivalent to Theodorus), one of the twelve apostles, and the traditional author of the First Gospel, where he is described as having been a tax-gatherer or customs-officer (τελώνης, x. 3), in the service of the tetrarch Herod. The circumstances of his call to become a follower of Jesus, received as he sat in the "customs house" in one of the towns by the Sea of Galilee—apparently Capernaum (Mark ii. 1, 13), are briefly related in ix. 9. We should gather from the parallel narrative in Mark ii. 14, Luke v. 27, that he was at the time known as "Levi the son of Alphaeus" (compare Simon Cephas, Joseph Barnabas): if so, "James the son of Alphaeus" may have been his brother. Possibly "Matthew" (Yahweh's gift) was his Christian surname, since two native names, neither being a patronymic, is contrary to Jewish usage. It must be noted, however, that Matthew and Levi were sometimes distinguished in early times, as by Heracleon (*c.* 170 A.D.), and more dubiously by Origen (*c. Celsum*, i. 62), also apparently in the Syriac *Didascalia* (sec. iii.), V. xiv. 14. It has generally been supposed, on the strength of Luke's account (v. 29), that Matthew gave a feast in Jesus' honour (like Zacchaeus, Luke xix. 6 seq.). But Mark (ii. 15), followed by Matthew (ix. 10), may mean that the meal in question was one in Jesus' own home at Capernaum (cf. v. 1). In the lists of the Apostles given in the Synoptic Gospels and in Acts, Matthew ranks third or fourth in the second group of four—a fair index of his relative importance in the apostolic age. The only other facts related of Matthew on good authority concern him as Evangelist. Eusebius (*H.E.* iii. 24) says that he, like John, wrote only at the spur of necessity. "For Matthew, after preaching to Hebrews, when about to go also to others, committed to writing in his native tongue the Gospel that bears his name; and so by his writing supplied, for those whom he was leaving, the loss of his presence." The value of this tradition, which may be based on Papias, who certainly reported that "Matthew compiled the Oracles (of the Lord) in Hebrew," can be estimated only in connexion with the study of the Gospel itself (see below). No historical use can be made of the artificial story, in *Sanhedrin* 43a, that Matthew was condemned to death by a Jewish court (see Laible, *Christ in the Talmud*, 71 seq.). According to the Gnostic Heracleon, quoted by Clement of Alexandria (*Strom.* iv. 9), Matthew died a natural death. The tradition as to his ascetic diet (in Clem. Alex. *Paedag.* ii. 16) may be due to confusion with Matthias (cf. *Mart. Matthaei*, i.). The earliest legend as to his later labours, one of Syrian origin, places them in the Parthian kingdom, where it represents him as dying a natural death at Hierapolis (= Mabog on the Euphrates). This agrees with his legend as known to Ambrose and Paulinus of Nola, and is the most probable in itself. The legends which make him work with Andrew among the Anthropophagi near the Black Sea, or again in Ethiopia (Rufinus, and Socrates, *H.E.* i. 19), are due to confusion with Matthias, who from the first was associated in his Acts with Andrew (see M. Bonnet, *Acta Apost. apocr.*, 1898, II. i. 65). Another legend, his *Martyrium*, makes him labour and suffer in Mysore. He is commemorated as a martyr by the Greek Church on the 16th of November, and by the Roman on the 21st of September, the scene of his martyrdom being placed in Ethiopia. The Latin Breviary also affirms that his body was afterwards translated to Salerno, where it is said to lie in the church built by Robert Guiscard. In Christian art (following Jerome) the Evangelist Matthew is generally symbolized by the "man" in the imagery of Ezek. i. 10, Rev. iv. 7.

For the historical Matthew, see *Ency. Bibl.* and Zahn, *Introd. to New Test.*, ii. 506 seq., 522 seq. For his legends, as under MARK. (J. V. B.)

MATTHEW, TOBIAS, or TOBIE (1546–1628), archbishop of York, was the son of Sir John Matthew of Ross in Herefordshire, and of his wife Eleanor Crofton of Ludlow. He was born at Bristol in 1546. He was educated at Wells, and then in succession at University College and Christ Church, Oxford. He proceeded B.A. in 1564, and M.A. in 1566. He attracted the favourable notice of Queen Elizabeth, and his rise was steady though not very rapid. He was public orator in 1569, president of St John's College, Oxford, in 1572, dean of Christ Church in 1576, vice-chancellor of the university in 1579, dean of Durham in 1583, bishop of Durham in 1595, and archbishop of York in 1606. In 1581 he had a controversy with the Jesuit Edmund Campion, and published at Oxford his arguments in 1638 under the title, *Piissimi et eminentissimi viri Tobiae Matthew, archiepiscopi olim Eboracencis concio apologetica adversus Campianam.* While in the north he was active in forcing the recusants to conform to the Church of England, preaching hundreds of sermons and carrying out thorough visitations. During his later years he was to some extent in opposition to the administration of James I. He was exempted from attendance in the parliament of 1625 on the ground of age and infirmities, and died on the 29th of March 1628. His wife, Frances, was the daughter of William Barlow, bishop of Chichester.

His son, SIR TOBIAS, or TOBIE, MATTHEW (1577–1655), is remembered as the correspondent and friend of Francis Bacon. He was educated at Christ Church, and was early attached to the court, serving in the embassy at Paris. His debts and dissipations were a great source of sorrow to his father, from whom he is known to have received at different times £14,000, the modern equivalent of which is much larger. He was chosen member for Newport in Cornwall in the parliament of 1601, and member for St Albans in 1604. Before this time he had become the intimate friend of Bacon, whom he replaced as member for St Albans. When peace was made with Spain, on the accession of James I., he wished to travel abroad. His family, who feared his conversion to Roman Catholicism, opposed his wish, but he promised not to go beyond France. When once safe out of England he broke his word and went to Italy. The persuasion of some of his countrymen in Florence, one of whom is said to have been the Jesuit Robert Parsons, and a story he heard of the miraculous liquefaction of the blood of San Januarius at Naples, led to his conversion in 1606. When he returned to England he was imprisoned, and many efforts were made to obtain his reconversion without success. He would not take the oath of allegiance to the king. In 1608 he was exiled, and remained out of England for ten years, mostly in Flanders and Spain. He returned in 1617, but went abroad again in 1619. His friends obtained his leave to return in 1621. At home he was known as the intimate friend of Gondomar, the Spanish ambassador. In 1623 he was sent to join Prince Charles, afterwards Charles I., at Madrid, and was knighted on the 23rd of October of that year. He remained in England till 1640, when he was finally driven abroad by the parliament, which looked upon him as an agent of the pope. He died in the English college in Ghent on the 13th of October 1655. In 1618 he published an Italian translation of Bacon's essays. The "Essay on Friendship" was written for him. He was also the author of a translation of *The Confessions of the Incomparable Doctor St Augustine*, which led him into controversy. His correspondence was published in London in 1660.

For the father, see John Le Neve's *Fasti ecclesiae anglicanae* (London, 1716), and Anthony Wood's *Athenae oxonienses*. For the son, the notice in *Athenae oxonienses*, an abridgment of his autobiographical *Historical Relation* of his own life, published by Alban Butler in 1795, and A. H. Matthew and A. Calthrop, *Life of Sir Tobie Matthew* (London, 1907).

MATTHEW, GOSPEL OF ST, the first of the four canonical Gospels of the Christian Church. The indications of the use of this Gospel in the two or three generations following the Apostolic Age (see GOSPEL) are more plentiful than of any of the others. Throughout the history of the Church, also, it has held a place second to none of the Gospels alike in public instruction and in the private reading of Christians. The reasons for its having impressed itself in this way and become thus familiar are in large part to be found in the characteristics noticed below. But in addition there has been from an early time the belief that it was the work of one of those publicans whose heart Jesus touched and of whose call to follow Him the three Synoptics contain an interesting account, but who is identified as Matthew (*q.v.*) only in this one (Matt. ix. 9–13 = Mark ii. 13–17 = Luke v. 27–32).

1. *The Connexion of our Greek Gospel of Matthew with the Apostle whose name it bears.*—The earliest reference to a writing by Matthew occurs in a fragment taken by Eusebius from the same work of Papias from which he has given an account of the composition of a record by Mark (Euseb. *Hist. Eccl.* iii. 39; see MARK, GOSPEL OF ST). The statement about Matthew is much briefer and is harder to interpret. In spite of much controversy, the same measure of agreement as to its meaning cannot be said to have been attained. This is the fragment: "Matthew, however, put together and wrote down the Oracles (τὰ λόγια συνέγραψεν) in the Hebrew language, and each man interpreted them as he was able." Whether "the elder" referred to in the passage on Mark, or some other like authority, was the source of this statement also does not appear; but it is probable that this was the case from the context in which Eusebius gives it. Conservative writers on the Gospels have frequently maintained that the writing here referred to was virtually the Hebrew original of our Greek Gospel which bears his name. And it is indeed likely that Papias himself closely associated the latter with the Hebrew (or Aramaic) work by Matthew, of which he had been told, since the traditional connexion of this Greek Gospel with Matthew can hardly have begun later than this time. It is reasonable also to suppose that there was some ground for it. The description, however, of what Matthew did suits better the making of a collection of Christ's discourses and sayings than the composition of a work corresponding in form and character to our Gospel of Matthew.

The next reference in Christian literature to a Gospel-record by Matthew is that of Irenaeus in his famous passage on the four Gospels (*Adv. haer.* iii. i. 1). He says that it was written in Hebrew; but in all probability he regarded the Greek Gospel, which stood first in his, as it does in our, enumeration, as in the strict sense a translation of the Apostle's work; and this was the view of it universally taken till the 16th century, when some of the scholars of the Reformation maintained that the Greek Gospel itself was by Matthew.

The actual phenomena, however, of this Gospel, and of its relation to sources that have been used in it, cannot be explained consistently with either of the two views just mentioned. It is a composite work in which two chief sources, known in Greek to the author of our present Gospel, have, together with some other matter, been combined. It is inconceivable that one of the Twelve should have proceeded in this way in giving an account of Christ's ministry. One of the chief documents, however, here referred to seems to correspond in character with the description given in Papias' fragment of a record of the compilation of "the divine utterances" made by Matthew; and the use made of it in our first Gospel may explain the connexion of this Apostle's name with it. In the Gospel of Luke also, it is true, this same source has been used for the teaching of Jesus. But the original Aramaic Logian document may have been more largely reproduced in our Greek Matthew. Indeed, in the case of one important passage (v. 17–48) this is suggested by a comparison with

Luke itself, and there are one or two others where from the character of the matter it seems not improbable, especially vi. 1–18 and xxiii. 1–5, 7b–10, 15–22. On the whole, as will be seen below, what appears to be a Palestinian form of the Gospel-tradition is most fully represented in this Gospel; but in many instances at least this may well be due to some other cause than the use of the original Logian document.

2. *The Plan on which the Contents is arranged.*—In two respects the arrangement of the book itself is significant.

(*a*) As to the general outline in the first half of the account of the Galilean ministry (iv. 23–xi. 30). Immediately after relating the call of the first four disciples (iv. 18–22) the evangelist gives in iv. 23 a comprehensive summary of Christ's work in Galilee under its two chief aspects, teaching and healing. In the sequel both these are illustrated. First, he gives in the Sermon on the Mount (v.–vii.) a considerable body of teaching, of the kind required by the disciples of Jesus generally, and a large portion of which probably also stood not far from the beginning of the Logian document. After this he turns to the other aspect. Up to this point he has mentioned no miracle. He now describes a number in succession, introducing all but the first of those told between Mark i. 23 and ii. 12, and also four specially remarkable ones, which occurred a good deal later according to Mark's order (Matt. viii. 23–34 = Mark iv. 35–v. 20; Matt. ix. 18–26 = Mark v. 21–43); and he also adds some derived from another source, or other sources (viii. 5–13; ix. 27–34). Then, after another general description at ix. 35, similar to that at iv. 23, he brings strikingly before us the needs of the masses of the people and Christ's compassion for them, and so introduces the mission of the Twelve (which again occurs later according to Mark's order, viz. at vi. 7 seq.), whereby the ministry both of teaching and of healing was further extended (ix. 36–x. 42). Finally, the message of John the Baptist, and the reply of Jesus, and the reflections that follow (xi.), bring out the significance of the preceding narrative. It should be observed that examples have been given of every kind of mighty work referred to in the reply of Jesus to the messengers of the Baptist; and that in the discourse which follows their departure the perversity and unbelief of the people generally are condemned, and the faith of the humble-minded is contrasted therewith. The greater part of the matter from ix. 37 to end of xi. is taken from the Logian document. After this point, *i.e.* from xii. 1 onwards, the first evangelist follows Mark almost step by step down to the point (Mark xvi. 8), after which Mark's Gospel breaks off, and another ending has been supplied; and gives in substance almost the whole of Mark's contents, with the exception that he passes over the few narratives that he has (as we have seen) placed earlier. At the same time he brings in additional matter in connexion with most of the Marcan sections.

(*b*) With the accounts of the words of Jesus spoken on certain occasions, which our first evangelist found given in one or another of his sources, he has combined other pieces, taken from other parts of the same source or from different sources, which seemed to him connected in subject, *e.g.* into the discourse spoken on a mountain, when crowds from all parts were present, given in the Logian document, he has introduced some pieces which, as we infer from Luke, stood separately in that document (cf. Matt. vi. 19–21 with Luke xii. 33, 34; Matt. vi. 22, 23 with Luke xi. 34–36; Matt. vi. 24 with Luke xvi. 13; Matt. vi. 25–34 with Luke xii. 22–32; Matt. vii. 7–11 with Luke xi. 9–13). Again, the address to the Twelve in Mark vi. 7–11, which in Matthew is combined with an address to disciples, from the Logian document, is connected by Luke with the sending out of seventy disciples (Luke x. 1–16). Our first evangelist has also added here various other sayings (Matt. x. 17–39, 42). Again, with the Marcan account of the charge of collusion with Satan and Christ's reply (Mark iii. 22–30), the first evangelist (xii. 24–45) combines the parallel account in the Logian document and adds Christ's reply to another attack (Luke xi. 14–16, 17–26, 29–32). These are some examples. He has in all in this manner constructed eight discourses or collections of sayings, into which the greater part of Christ's teaching is gathered: (1) On the character of the heirs of the kingdom (v.–vii.); (2) The Mission address (x.); (3) Teaching suggested by the message of John the Baptist (xi.); (4) The reply to an accusation and a challenge (xii. 22–45); (5) The teaching by parables (xiii.); (6) On offences (xviii.); (7) Concerning the Scribes and Pharisees (xxiii.); (8) On the Last Things (xxiv., xxv.). In this arrangement of his material the writer has in many instances disregarded chronological considerations. But his documents also gave only very imperfect indications of the occasions of many of the utterances; and the result of his method of procedure has been to give us an exceedingly effective representation of the teaching of Jesus.

In the concluding verses of the Gospel, where the original Marcan parallel is wanting, the evangelist may still have followed in part that document while making additions as before. The account of the silencing of the Roman guard by the chief priests is the sequel to the setting of this guard and their presence at the Resurrection, which at an earlier point are peculiar to Matthew (xxvii. 62–66, xxviii. 4). And, further, this matter seems to belong to the same cycle of tradition as the story of Pilate's wife and his throwing the guilt of the Crucifixion of Jesus upon the Jews, and the testimony borne by the Roman guard (as well as the centurion) who kept watch by the cross (xxvii. 15–26, 54), all which also are peculiar to this Gospel. It cannot but seem probable that these are legendary additions which had arisen through the desire to commend the Gospel to the Romans.

On the other hand, the meeting of Jesus with the disciples in Galilee (Matt. xxviii. 16 seq.) is the natural sequel to the message to them related in Mark xvi. 7, as well as in Matt. xxviii. 7. Again, the commission to them to preach throughout the world is supported by Luke xxiv. 47, and by the present ending of Mark (xvi. 15), though neither of these mention Galilee as the place where it was given. The baptismal formula in Matt. xxviii. 19, is, however, peculiar, and in view of its non-occurrence in the Acts and Epistles of the New Testament must be regarded as probably an addition in accordance with Church usage at the time the Gospel was written.

3. *The Palestinian Element.*—Teaching is preserved in this Gospel which would have peculiar interest and be specially required in the home of Judaism. The best examples of this are the passages already referred to near end of §1, as probably derived from the Logian document. There are, besides, a good many turns of expression and sayings peculiar to this Gospel which have a Semitic cast, or which suggest a point of view that would be natural to Palestinian Christians, *e.g.* "kingdom of heaven" frequently for "kingdom of God"; xiii. 52 ("every scribe"); xxiv. 20 ("neither on a Sabbath"). See also v. 35 and xix. 9; x. 5, 23. Again, several of the quotations which are peculiar to this Gospel are not taken from the LXX., as those in the other Gospels and in the corresponding contexts in this Gospel commonly are, but are wholly or partly independent renderings from the Hebrew (ii. 6, 15, 18; viii. 17, xii. 17–21, &c.). Once more, there is somewhat more parallelism between the fragments of the Gospel according to the Hebrews and this Gospel than is the case with Luke, not to say Mark.

4. *Doctrinal Character.*—In this Gospel, more decidedly than in either of the other two Synoptics, there is a doctrinal point of view from which the whole history is regarded. Certain aspects which are of profound significance are dwelt upon, and this without there being any great difference between this Gospel and the two other Synoptics in respect to the facts recorded or the beliefs implied. The effect is produced partly by the comments of the evangelist, which especially take the form of citations from the Old Testament; partly by the frequency with which certain expressions are used, and the prominence that is given in this and other ways to particular traits and topics.

He sets forth the restriction of the mission of Jesus during His life on earth to the people of Israel in a way which suggests at first sight a spirit of Jewish exclusiveness. But there are various indications that this is not the true explanation. In particular the evangelist brings out more strongly than either Mark or Luke the national rejection of Jesus, while the Gospel ends with the commission of Jesus to His disciples after His resurrection to "make disciples of all the peoples." One may divine in all this an intention to "justify the ways of God" to the Jew, by proving that God in His faithfulness to His ancient people had given them the first opportunity of salvation through Christ, but that now their national privilege had been rightly forfeited. He was also specially concerned to show that prophecy is fulfilled in the life and work of Jesus, but the conception of this fulfilment which is presented to us is a large one; it is to be seen not merely in particular events or features of Christ's ministry, but in the whole new dispensation, new relations between God and men, and new rules of conduct which Christ has introduced. The divine meaning of the work of Jesus is thus made apparent, while of the majesty and glory of His person a peculiarly strong impression is conveyed.

Some illustrations in detail of these points are subjoined. Where there are parallels in the other Gospels they should be compared and the words in Matthew noted which in many instances serve to emphasize the points in question.

(a) *The Ministry of Jesus among the Jewish People as their promised Messiah, their rejection of Him, and the extension of the Gospel to the Gentiles.* The mission to Israel: Matt. i. 21; iv. 23 (note in these passages the use of ὁ λαός, which here, as generally in Matthew, denotes the chosen nation), ix. 33, 35, xv. 31. For the rule limiting the work of Jesus while on earth see xv. 24 (and note ἐξελθοῦσα in verse 22, which implies that Jesus had not himself entered the heathen borders), and for a similar rule prescribed to the disciples, x. 5, 6 and 23.

The rejection of Jesus by the people in Galilee, xi. 21; xiii. 13–15, and by the heads of "the nation," xxvi. 3, 47 and by "the whole nation," xxvii. 25; their condemnation xxiii. 38.

Mercy to the Gentiles and the punishment of "the sons of the kingdom" is foretold viii. 11, 12. The commission to go and convert Gentile peoples (ἔθνη) is given after Christ's resurrection (xxviii. 19).

(b) *The Fulfilment of Prophecy.*—In the birth and childhood of Jesus, i. 23; ii. 6, 15, 18, 23. By these citations attention is drawn to the lowliness of the beginnings of the Saviour's life, the unexpected and secret manner of His appearing, the dangers to which from the first He was exposed and from which He escaped.

The ministry of Christ's forerunner, iii. 3. (The same prophecy, Isa. xl. 3, is also quoted in the other Gospels.)

The ministry of Jesus. The quotations serve to bring out the significance of important events, especially such as were turning-points, and also to mark the broad features of Christ's life and work, iv. 15, 16; viii. 17; xii. 18 seq.; xiii. 35; xxi. 5; xxvii. 9.

(c) *The Teaching on the Kingdom of God.*—Note the collection of parables "of the Kingdom" in xiii.; also the use of ἡ βασιλεία ("the Kingdom") without further definition as a term the reference of which could not be misunderstood, especially in the following phrases peculiar to this Gospel: τὸ εὐαγγέλιον τῆς βασιλείας ("the Gospel of the Kingdom") iv. 23, ix. 35, xxiv. 14; and ὁ λόγος τῆς βασιλείας ("the word of the kingdom") xiii. 19. The following descriptions of the kingdom, peculiar to this Gospel, are also interesting ἡ βασιλεία τοῦ πατρὸς αὐτῶν ("the kingdom of their father") xiii. 43 and τοῦ πατρός μου ("of my father") xxvi. 29.

(d) *The Relation of the New Law to the Old.*—Verses 17–48, cf. also, addition at xxii. 40 and xix. 19b. Further, his use of δικαιοσύνη ("righteousness") and δίκαιος ("righteous") (specially frequent in this Gospel) is such as to connect the New with the Old; the standard in mind is the law which "fulfilled" that previously given.

(e) *The Christian Ecclesia.*—Chap. xvi. 18, xviii. 17.

(f) *The Messianic Dignity and Glory of Jesus.*—The narrative in i. and ii. show the royalty of the new-born child. The title "Son of David" occurs with special frequency in this Gospel. The following instances are without parallels in the other Gospels: ix. 27; xii. 23; xv. 22; xxi. 9; xxi. 15. The title "Son of God" is also used with somewhat greater frequency than in Mark and Luke: ii. 15; xiv. 33; xvi. 16; xxii. 2 seq. (where it is implied); xxvii. 40, 43.

The thought of the future coming of Christ, and in particular of the judgment to be executed by Him then, is much more prominent in this Gospel than in the others. Some of the following predictions are peculiar to it, while in several others there are additional touches: vii. 22, 23; x. 23, 32, 33; xiii. 39–43; xvi. 27, 28; xix. 28; xxiv. 3, 27, 30, 31, 37, 39; xxv. 31–46; xxvi. 64.

The majesty of Christ is also impressed upon us by the signs at His crucifixion, some of which are related only in this Gospel, xxvii. 51–53, and by the sublime vision of the Risen Christ at the close, xxviii. 16–20.

(5) *Time of Composition and Readers addressed.*—The signs of dogmatic reflection in this Gospel point to its having been composed somewhat late in the 1st century, probably after Luke's Gospel, and this is in accord with the conclusion that some insertions had been made in the Marcan document used by this evangelist which were not in that used by Luke (see LUKE, GOSPEL OF ST). We may assign A.D. 80–100 as a probable time for the composition.

The author was in all probability a Jew by race, and he would seem to have addressed himself especially to Jewish readers; but they were Jews of the Dispersion. For although he was in specially close touch with Palestine, either personally or through the sources at his command, or both, his book was composed in Greek by the aid of Greek documents.

See commentaries by Th. Zahn (1903) and W. C. Allen (in the series of International Critical Commentaries, 1907); also books on the Four Gospels or the Synoptic Gospels cited at the end of GOSPEL. (V. H. S.)

MATTHEW CANTACUZENUS, Byzantine emperor, was the son of John VI. Cantacuzenus (*q.v.*). In return for the support he gave to his father during his struggle with John V. he was allowed to annex part of Thrace under his own dominion and in 1353 was proclaimed joint emperor. From his Thracian principality he levied several wars against the Servians. An attack which he prepared in 1350 was frustrated by the defection of his Turkish auxiliaries. In 1357 he was captured by his enemies, who delivered him to the rival emperor, John V. Compelled to abdicate, he withdrew to a monastery, where he busied himself with writing commentaries on the Scriptures.

MATTHEW OF PARIS (d. 1259), English monk and chronicler known to us only through his voluminous writings. In spite of his surname, and of his knowledge of the French language, his attitude towards foreigners attests that he was of English birth. He may have studied at Paris in his youth, but the earliest fact which he records of himself is his admission as a monk at St Albans in the year 1217. His life was mainly spent in this religious house. In 1248, however, he was sent to Norway as the bearer of a message from Louis IX. of France to Haakon VI.; he made himself so agreeable to the Norwegian sovereign that he was invited, a little later, to superintend the reformation of the Benedictine monastery of St Benet Holme at Trondhjem. Apart from these missions, his activities were devoted to the composition of history, a pursuit for which the monks of St Albans had long been famous. Matthew edited anew the works of Abbot John de Cella and Roger of Wendover, which in their altered form constitute the first part of his most important work, the *Chronica majora.* From 1235, the point at which Wendover dropped his pen, Matthew continued the history on the plan which his predecessors had followed. He derived much of his information from the letters of important personages, which he sometimes inserts, but much more from conversation with the eye-witnesses of events. Among his informants were Earl Richard of Cornwall and Henry III. With the latter he appears to have been on terms of intimacy. The king knew that Matthew was writing a history, and showed some anxiety that it should be as exact as possible. In 1257, in the course of a week's visit to St Albans, Henry kept the chronicler beside him night and day, "and guided my pen," says Paris, "with much good will and diligence." It is therefore curious that the *Chronica majora* should give so unfavourable an account of the king's policy. Luard supposes that Matthew never intended his work to see the light in its present form, and many passages of the autograph have against them the note *offendiculum,* which shows that the writer understood the danger which he ran. On the other hand, unexpurgated copies were made in Matthew's lifetime; though the offending passages are duly omitted or softened in his abridgment of his longer work, the *Historia Anglorum* (written about 1253), the real sentiments of the author must have been an open secret. In any case there is no ground for the old theory that he was an official historiographer.

Matthew Paris was unfortunate in living at a time when English politics were peculiarly involved and tedious. His talent is for narrative and description. Though he took a keen interest in the personal side of politics he has no claim to be considered a judge of character. His appreciations of his contemporaries throw more light on his own prejudices than on their aims and ideas. His work is always vigorous, but he imputes motives in the spirit of a partisan who never pauses to weigh the evidence or to take a comprehensive view of the situation. His redeeming feature is his generous admiration for strength of character, even when it goes along with a policy of which he disapproves. Thus he praises Grosseteste, while he denounces Grosseteste's scheme of monastic reform. Matthew is a vehement supporter of the monastic orders against their rivals, the secular clergy and the mendicant friars. He is violently opposed to the court and the foreign favourites. He despises the king as a statesman, though for the man he has some kindly feeling. The frankness with which he attacks the court of Rome for its exactions is remarkable; so, too, is the intense nationalism which he displays in dealing with this topic. His faults of presentment are more often due to carelessness and narrow views than to deliberate purpose. But he is sometimes guilty of inserting rhetorical speeches which are not only fictitious, but also misleading as an account of the speaker's sentiments. In other cases he tampers with the documents which he inserts (as, for instance, with the text of Magna Carta). His chronology is, for a contemporary, inexact; and he occasionally inserts duplicate versions of the same incident in different places. Hence he must always be rigorously checked where other authorities exist and used with caution where he is our sole informant. None the less, he gives a more vivid impression of his age than any other English chronicler; and it is a matter for regret that his great history breaks off in 1259, on the eve of the crowning struggle between Henry III and the baronage.

AUTHORITIES.—The relation of Matthew Paris's work to those of John de Cella and Roger of Wendover may best be studied in H. R. Luard's edition of the *Chronica majora* (7 vols., Rolls series, 1872–1883), which contains valuable prefaces. The *Historia*

Anglorum sive historia minor (1067–1253) has been edited by F. Madden (3 vols., Rolls series, 1866–1869). Matthew Paris is often confused with "Matthew of Westminster," the reputed author of the *Flores historiarum* edited by H. R. Luard (3 vols., Rolls series, 1890). This work, compiled by various hands, is an edition of Matthew Paris, with continuations extending to 1326. Matthew Paris also wrote a life of Edmund Rich (*q.v.*), which is probably the work printed in W. Wallace's *St Edmund of Canterbury* (London, 1893) pp. 543–588, though this is attributed by the editor to the monk Eustace; *Vitae abbatum S Albani* (up to 1225) which have been edited by W. Watts (1640, &c.); and (possibly) the *Abbreviatio chronicorum* (1000–1255), edited by F. Madden, in the third volume of the *Historia Anglorum*. On the value of Matthew as an historian see F. Liebermann in G. H. Pertz's *Scriptores* xxviii. pp. 74–106; A. Jessopp's *Studies by a Recluse* (London, 1893); H. Plehn's *Politische Character Matheus Parisiensis* (Leipzig, 1897).

(H. W. C. D.)

MATTHEW OF WESTMINSTER, the name of an imaginary person who was long regarded as the author of the *Flores Historiarum*. The error was first discovered in 1826 by Sir F. Palgrave, who said that Matthew was "a phantom who never existed," and later the truth of this statement was completely proved by H. R. Luard. The name appears to have been taken from that of Matthew of Paris, from whose *Chronica majora* the earlier part of the work was mainly copied, and from Westminster, the abbey in which the work was partially written.

The *Flores historiarum* is a Latin chronicle dealing with English history from the creation to 1326, although some of the earlier manuscripts end at 1306; it was compiled by various persons, and written partly at St Albans and partly at Westminster. The part from 1306 to 1326 was written by Robert of Reading (d. 1325) and another Westminster monk. Except for parts dealing with the reign of Edward I. its value is not great. It was first printed by Matthew Parker, archbishop of Canterbury, in 1567, and the best edition is the one edited with introduction by H. R. Luard for the Rolls series (London, 1890). It has been translated into English by C. D. Yonge (London, 1853). See Luard's introduction, and C. Bémont in the *Revue critique d'histoire* (Paris, 1891).

MATTHEWS, STANLEY (1824–1889), American jurist, was born in Cincinnati, Ohio, on the 21st of July 1824. He graduated from Kenyon College in 1840, studied law, and in 1842 was admitted to the bar of Maury county, Tennessee. In 1844 he became assistant prosecuting attorney of Hamilton county, Ohio; and in 1846–1849 edited a short-lived anti-slavery paper, the *Cincinnati Herald*. He was clerk of the Ohio House of Representatives in 1848–1849, a judge of common pleas of Hamilton county in 1850–1853, state senator in 1856–1858, and U.S. district-attorney for the southern district of Ohio in 1858–1861. First a Whig and then a Free-Soiler, he joined the Republican party in 1861. After the outbreak of the Civil War he was commissioned a lieutenant of the 23rd Ohio, of which Rutherford B. Hayes was major; but saw service only with the 57th Ohio, of which he was colonel, and with a brigade which he commanded in the Army of the Cumberland. He resigned from the army in 1863, and was judge of the Cincinnati superior court in 1863–1864. He was a Republican presidential elector in 1864 and 1868. In 1872 he joined the Liberal Republican movement, and was temporary chairman of the Cincinnati convention which nominated Horace Greeley for the presidency, but in the campaign he supported Grant. In 1877, as counsel before the Electoral Commission, he opened the argument for the Republican electors of Florida and made the principal argument for the Republican electors of Oregon. In March of the same year he succeeded John Sherman as senator from Ohio, and served until March 1879. In 1881 President Hayes nominated him as associate justice of the Supreme Court, to succeed Noah H. Swayne; there was much opposition, especially in the press, to this appointment, because Matthews had been a prominent railway and corporation lawyer and had been one of the Republican "visiting statesmen" who witnessed the canvass of the vote of Louisiana[1] in 1876; and the nomination had not been approved when the session of Congress expired. Matthews was renominated by President Garfield on the 15th of March, and the nomination was confirmed by the Senate (22 for, 21 against) on the 12th of May. He was an honest, impartial and conscientious judge. He died in Washington, on the 22nd of March 1889.

MATTHIAE, AUGUST HEINRICH (1769–1835), German classical scholar, was born at Göttingen, on the 25th of December 1769, and educated at the university. He then spent some years as a tutor in Amsterdam. In 1798 he returned to Germany, and in 1802 was appointed director of the Friedrichsgymnasium at Altenburg, which post he held till his death, on the 6th of January 1835. Of his numerous important works the best-known are his *Greek Grammar* (3rd ed., 1835), translated into English by E. V. Blomfield (5th ed., by J. Kenrick, 1832), his edition of *Euripides* (9 vols., 1813–1829), *Grundriss der Geschichte der griechischen und römischen Litteratur* (3rd ed., 1834, Eng. trans., Oxford, 1841) *Lehrbuch für den ersten Unterricht in der Philosophie* (3rd ed., 1833), *Encyklopädie und Methodologie der Philologie* (1835). His *Life* was written by his son Constantin (1845).

His brother, FRIEDRICH CHRISTIAN MATTHIAE (1763–1822), rector of the Frankfort gymnasium, published valuable editions of Seneca's *Letters*, Aratus, and Dionysius Periegetes.

MATTHIAS, the disciple elected by the primitive Christian community to fill the place in the Twelve vacated by Judas Iscariot (Acts i. 21–26). Nothing further is recorded of him in the New Testament. Eusebius (*Hist. Eccl.*, I. xii.) says he was, like his competitor, Barsabas Justus, one of the seventy, and the Syriac version of Eusebius calls him throughout not Matthias but Tolmai, *i.e.* Bartholomew, without confusing him with the Bartholomew who was originally one of the Twelve, and is often identified with the Nathanael mentioned in the Fourth Gospel (*Expository Times*, ix. 566). Clement of Alexandria says some identified him with Zacchaeus, the Clementine *Recognitions* identify him with Barnabas, Hilgenfeld thinks he is the same as Nathanael.

Various works—a Gospel, Traditions and Apocryphal Words—were ascribed to him; and there is also extant *The Acts of Andrew and Matthias*, which places his activity in "the city of the cannibals" in Ethiopia. Clement of Alexandria quotes two sayings from the Traditions: (1) Wonder at the things before you (suggesting, like Plato, that wonder is the first step to new knowledge); (2) If an elect man's neighbour sin, the elect man has sinned.

MATTHIAS (1557–1619), Roman emperor, son of the emperor Maximilian II. and Maria, daughter of the emperor Charles V., was born in Vienna, on the 24th of February 1557. Educated by the diplomatist O. G. de Busbecq, he began his public life in 1577, soon after his father's death, when he was invited to assume the governorship of the Netherlands, then in the midst of the long struggle with Spain. He eagerly accepted this invitation, although it involved a definite breach with his Spanish kinsman, Philip II., and entering Brussels in January 1578 was named governor-general; but he was merely a cipher, and only held the position for about three years, returning to Germany in October 1581. Matthias was appointed governor of Austria in 1593 by his brother, the emperor Rudolph II.; and two years later, when another brother, the archduke Ernest, died, he became a person of more importance as the eldest surviving brother of the unmarried emperor. As governor of Austria Matthias continued the policy of crushing the Protestants, although personally he appears to have been inclined to religious tolerance; and he dealt with the rising of the peasants in 1595, in addition to representing Rudolph at the imperial diets, and gaining some fame as a soldier during the Turkish War. A few years later the discontent felt by the members of the Habsburg family at the incompetence of the emperor became very acute, and the lead was taken by Matthias. Obtaining in May 1605 a reluctant consent from his brother, he took over the conduct of affairs in Hungary, where a revolt had broken out, and was formally recognized by the Habsburgs as their head in April 1606, and was promised the succession to the Empire. In June 1606 he concluded the peace of Vienna with the rebellious Hungarians, and was thus in a better position to treat with the sultan, with whom peace was made in November. This pacific policy was displeasing to Rudolph, who prepared to renew the Turkish War; but having secured the support of the national party in Hungary and gathered an army, Matthias forced his brother to cede to him this kingdom, together with Austria and Moravia, both of which had thrown in their lot with Hungary (1608). The king of Hungary, as Matthias now became, was reluctantly compelled to grant religious liberty to the inhabitants of Austria. The strained relations which had arisen between Rudolph and Matthias as a result of these proceedings were temporarily improved, and a formal reconciliation took place in 1610; but affairs in Bohemia soon destroyed this fraternal peace. In spite of the letter of majesty (*Majestätsbrief*) which the Bohemians had extorted from Rudolph, they were very dissatisfied with their ruler, whose troops were ravaging their land; and in 1611 they invited Matthias to come to their aid. Accepting this invitation, he inflicted another humiliation upon his brother, and was crowned king of Bohemia in May 1611. Rudolph, however, was successful in preventing the election of Matthias as German king, or king of the Romans, and when he died, in January 1612, no provision had been made for a successor. Already king of Hungary and Bohemia, however, Matthias obtained the remaining hereditary dominions of the Habsburgs, and in June 1612 was crowned emperor, although the ecclesiastical electors favoured his younger brother, the archduke Albert (1559–1621).

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[1] It seems certain that Matthews and Charles Foster of Ohio gave their written promise that Hayes, if elected, would recognize the Democratic governors in Louisiana and South Carolina.

The short reign of the new emperor was troubled by the religious dissensions of Germany. His health became impaired and his indolence increased, and he fell completely under the influence of Melchior Klesl (*q.v.*), who practically conducted the imperial business. By Klesl's advice he took up an attitude of moderation and sought to reconcile the contending religious parties; but the proceedings at the diet of Regensburg in 1613 proved the hopelessness of these attempts, while their author was regarded with general distrust. Meanwhile the younger Habsburgs, led by the emperor's brother, the archduke Maximilian, and his cousin, Ferdinand, archduke of Styria, afterwards the emperor Ferdinand II., disliking the peaceful policy of Klesl, had allied themselves with the unyielding Roman Catholics, while the question of the imperial succession was forcing its way to the front. In 1611 Matthias had married his cousin Anna (d. 1618), daughter of the archduke Ferdinand (d. 1595), but he was old and childless and the Habsburgs were anxious to retain his extensive possessions in the family. Klesl, on the one hand, wished the settlement of the religious difficulties to precede any arrangement about the imperial succession; the Habsburgs, on the other, regarded the question of the succession as urgent and vital. Meanwhile the disputed succession to the duchies of Cleves and Jülich again threatened a European war; the imperial commands were flouted in Cologne and Aix-la-Chapelle, and the Bohemians were again becoming troublesome. Having decided that Ferdinand should succeed Matthias as emperor, the Habsburgs had secured his election as king of Bohemia in June 1617, but were unable to stem the rising tide of disorder in that country. Matthias and Klesl were in favour of concessions, but Ferdinand and Maximilian met this move by seizing and imprisoning Klesl. Ferdinand had just secured his coronation as king of Hungary when there broke out in Bohemia those struggles which heralded the Thirty Years' War; and on the 20th of March 1619 the emperor died at Vienna.

For the life and reign of Matthias the following works may be consulted: J. Heling, *Die Wahl des römischen Königs Matthias* (Belgrade, 1892); A. Gindely, *Rudolf II. und seine Zeit* (Prague, 1862–1868); F. Stieve, *Die Verhandlungen über die Nachfolge Kaisers Rudolf II.* (Munich, 1880); P. von Chlumecky, *Karl von Zierotin und seine Zeit* (Brünn, 1862–1879); A. Kerschbaumer, *Kardinal Klesel* (Vienna, 1865); M. Ritter, *Quellenbeiträge zur Geschichte des Kaisers Rudolf II.* (Munich, 1872); *Deutsche Geschichte im Zeitalter der Gegenreformation und des dreissigjährigen Krieges* (Stuttgart, 1887, seq.); and the article on Matthias in the *Allgemeine deutsche Biographie*, Bd. XX. (Leipzig, 1884); L. von Ranke, *Zur deutschen Geschichte vom Religionsfrieden bis zum 30-jährigen Kriege* (Leipzig, 1888); and J. Janssen, *Geschichte des deutschen Volks seit dem Ausgang des Mittelalters* (Freiburg, 1878 seq.), Eng. trans. by M. A. Mitchell and A. M. Christie (London, 1896, seq.).

MATTHIAS I., HUNYADI (1440–1490), king of Hungary, also known as Matthias Corvinus, a surname which he received from the raven (*corvus*) on his escutcheon, second son of János Hunyadi and Elizabeth Szilágyi, was born at Kolozsvár, probably on the 23rd of February 1440. His tutors were the learned János Vitéz, bishop of Nagyvárad, whom he subsequently raised to the primacy, and the Polish humanist Gregory Sanocki. The precocious lad quickly mastered the German, Latin and principal Slavonic languages, frequently acting as his father's interpreter at the reception of ambassadors. His military training proceeded under the eye of his father, whom he began to follow on his campaigns when only twelve years of age. In 1453 he was created count of Bistercze, and was knighted at the siege of Belgrade in 1454. The same care for his welfare led his father to choose him a bride in the powerful Cilli family, but the young Elizabeth died before the marriage was consummated, leaving Matthias a widower at the age of fifteen. On the death of his father he was inveigled to Buda by the enemies of his house, and, on the pretext of being concerned in a purely imaginary conspiracy against Ladislaus V., was condemned to decapitation, but was spared on account of his youth, and on the king's death fell into the hands of George Poděbrad, governor of Bohemia, the friend of the Hunyadis, in whose interests it was that a national king should sit on the Magyar throne. Poděbrad treated Matthias hospitably and affianced him with his daughter Catherine, but still detained him, for safety's sake, in Prague, even after a Magyar deputation had hastened thither to offer the youth the crown. Matthias was the elect of the Hungarian people, gratefully mindful of his father's services to the state and inimical to all foreign candidates; and though an influential section of the magnates, headed by the palatine László Garai and the voivode of Transylvania, Miklós Ujlaki, who had been concerned in the judicial murder of Matthias's brother László, and hated the Hunyadis as semi-foreign upstarts, were fiercely opposed to Matthias's election, they were not strong enough to resist the manifest wish of the nation, supported as it was by Matthias's uncle Mihály Szilágyi at the head of 15,000 veterans. On the 24th of January 1458, 40,000 Hungarian noblemen, assembled on the ice of the frozen Danube, unanimously elected Matthias Hunyadi king of Hungary, and on the 14th of February the new king made his state entry into Buda.

The realm at this time was environed by perils. The Turks and the Venetians threatened it from the south, the emperor Frederick III. from the west, and Casimir IV. of Poland from the north, both Frederick and Casimir claiming the throne. The Czech mercenaries under Giszkra held the northern counties and from thence plundered those in the centre. Meanwhile Matthias's friends had only pacified the hostile dignitaries by engaging to marry the daughter of the palatine Garai to their nominee, whereas Matthias not unnaturally refused to marry into the family of one of his brother's murderers, and on the 9th of February confirmed his previous nuptial contract with the daughter of George Poděbrad, who shortly afterwards was elected king of Bohemia (March 2, 1458). Throughout 1458 the struggle between the young king and the magnates, reinforced by Matthias's own uncle and guardian Szilágyi, was acute. But Matthias, who began by deposing Garai and dismissing Szilágyi, and then proceeded to levy a tax, without the consent of the Diet, in order to hire mercenaries, easily prevailed. Nor did these complications prevent him from recovering the fortress of Galamboc from the Turks, successfully invading Servia, and reasserting the suzerainty of the Hungarian crown over Bosnia. In the following year there was a fresh rebellion, when the emperor Frederick was actually crowned king by the malcontents at Vienna-Neustadt (March 4, 1459); but Matthias drove him out, and Pope Pius II. intervened so as to leave Matthias free to engage in a projected crusade against the Turks, which subsequent political complications, however, rendered impossible. From 1461 to 1465 the career of Matthias was a perpetual struggle punctuated by truces. Having come to an understanding with his father-in-law Poděbrad, he was able to turn his arms against the emperor Frederick, and in April 1462 Frederick restored the holy crown for 60,000 ducats and was allowed to retain certain Hungarian counties with the title of king; in return for which concessions, extorted from Matthias by the necessity of coping with a simultaneous rebellion of the Magyar noble in league with Poděbrad's son Victorinus, the emperor recognized Matthias as the actual sovereign of Hungary. Only now was Matthias able to turn against the Turks, who were again threatening the southern provinces. He began by defeating Ali Pasha, and then penetrated into Bosnia, and captured the newly built fortress of Jajce after a long and obstinate defence (Dec. 1463). On returning home he was crowned with the holy crown on the 29th of March 1464, and, after driving the Czechs out of his northern counties, turned southwards again, this time recovering all the parts of Bosnia which still remained in Turkish hands.

A political event of the first importance now riveted his attention upon the north. Poděbrad, who had gained the throne of Bohemia with the aid of the Hussites and Utraquists, had long been in ill odour at Rome, and in 1465 Pope Paul II. determined to depose the semi-Catholic monarch. All the neighbouring princes, the emperor, Casimir IV. of Poland and Matthias, were commanded in turn to execute the papal decree of deposition, and Matthias gladly placed his army at the disposal of the Holy See. The war began on the 31st of May 1468, but, as early as the 27th of February 1469, Matthias anticipated an alliance between George and Frederick by himself concluding an armistice with the former. On the 3rd of May the Czech Catholics elected Matthias king of Bohemia, but this was contrary to the wishes of both pope and emperor, who preferred to partition Bohemia. But now George discomfited all his enemies by suddenly excluding his own son from the throne in favour of Ladislaus, the eldest son of Casimir IV., thus skilfully enlisting Poland on his side. The sudden death of Poděbrad on the 22nd of March 1471 led to fresh complications. At the very moment when Matthias was about to profit by the disappearance of his most capable rival, another dangerous rebellion, headed by the primate and the chief dignitaries of the state, with the object of placing Casimir, son of Casimir IV., on the throne, paralysed Matthias's foreign policy during the critical years 1470–1471. He suppressed this domestic rebellion indeed, but in the meantime the Poles had invaded the Bohemian domains with 60,000 men, and when in 1474 Matthias was at last able to take the field against them in order to raise the siege of Breslau, he was obliged to fortify himself in an entrenched camp, whence he so skilfully harried the enemy that the Poles, impatient to return to their own country, made peace at Breslau (Feb. 1475) on an *uti possidetis* basis, a peace subsequently confirmed by the congress of Olmütz (July 1479). During the interval between these peaces, Matthias, in self-defence, again made war on the emperor, reducing Frederick to such extremities that he was glad to accept peace on any terms. By the final arrangement made between the contending princes, Matthias recognized Ladislaus as king of Bohemia proper in return for the surrender of Moravia, Silesia and Upper and Lower Lusatia, hitherto component parts of the Czech monarchy, till he should have redeemed them for 400,000 florins. The emperor promised to pay Matthias 100,000 florins as a war indemnity, and recognized him as the legitimate king of Hungary on the understanding that he should succeed him if he died without male issue, a contingency at this time somewhat improbable, as Matthias, only three years previously (Dec. 15, 1476), had married his third wife, Beatrice of Naples, daughter of Ferdinand of Aragon.

The endless tergiversations and depredations of the emperor speedily induced Matthias to declare war against him for the third time (1481), the Magyar king conquering all the fortresses in Frederick's hereditary domains. Finally, on the 1st of June 1485, at the head of 8000 veterans, he made his triumphal entry into Vienna, which he henceforth made his capital. Styria, Carinthia and Carniola were next subdued, and Trieste was only saved by the intervention of the Venetians. Matthias consolidated his position by alliances with the dukes of Saxony and Bavaria, with the Swiss Confederation, and the archbishop of Salzburg, and was henceforth the greatest potentate in central Europe. His far-reaching hand even extended to Italy. Thus, in 1480, when a Turkish fleet seized Otranto, Matthias, at the earnest solicitation of the pope, sent Balasz Magyar to recover the fortress, which surrendered to him on the 10th of May 1481. Again in 1488, Matthias took Ancona under his protection for a time and occupied it with a Hungarian garrison.

Though Matthias's policy was so predominantly occidental that he soon abandoned his youthful idea of driving the Turks out of Europe, he at least succeeded in making them respect Hungarian territory. Thus in 1479 a huge Turkish army, on its return home from ravaging Transylvania, was annihilated at Szászváros (Oct. 13), and in 1480 Matthias recaptured Jajce, drove the Turks from Servia and erected two new military banates, Jajce and Srebernik, out of reconquered Bosnian territory. On the death of Mahommed II. in 1481, a unique opportunity for the intervention of Europe in Turkish affairs presented itself. A civil war ensued in Turkey between his sons Bayezid and Jem, and the latter, being worsted, fled to the knights of Rhodes, by whom he was kept in custody in France (see BAYEZID II.). Matthias, as the next-door neighbour of the Turks, claimed the custody of so valuable a hostage, and would have used him as a means of extorting concessions from Bayezid. But neither the pope nor the Venetians would hear of such a transfer, and the negotiations on this subject greatly embittered Matthias against the Curia. The last days of Matthias were occupied in endeavouring to secure the succession to the throne for his illegitimate son János (see CORVINUS, JÁNOS); but Queen Beatrice, though childless, fiercely and openly opposed the idea and the matter was still pending when Matthias, who had long been crippled by gout, expired very suddenly on Palm Sunday, the 4th of April 1490.

Matthias Hunyadi was indisputably the greatest man of his day, and one of the greatest monarchs who ever reigned. The precocity and universality of his genius impress one the most. Like Napoleon, with whom he has often been compared, he was equally illustrious as a soldier, a statesman, an orator, a legislator and an administrator. But in all moral qualities the brilliant adventurer of the 15th was infinitely superior to the brilliant adventurer of the 19th century. Though naturally passionate, Matthias's self-control was almost superhuman, and throughout his stormy life, with his innumerable experiences of ingratitude and treachery, he never was guilty of a single cruel or vindictive action. His capacity for work was inexhaustible. Frequently half his nights were spent in reading, after the labour of his most strenuous days. There was no branch of knowledge in which he did not take an absorbing interest, no polite art which he did not cultivate and encourage. His camp was a school of chivalry, his court a nursery of poets and artists. Matthias was a middle-sized, broad-shouldered man of martial bearing, with a large fleshy nose, hair reaching to his heels, and the clean-shaven, heavy chinned face of an early Roman emperor.

See Vilmós Fraknói, *King Matthias Hunyadi* (Hung., Budapest, 1890, German ed., Freiburg, 1891); Ignácz Acsády *History of the Hungarian Realm* (Hung. vol. i., Budapest, 1904); József Teleki, *The Age of the Hunyadis in Hungary* (Hung., vols. 3–5, Budapest, 1852–1890); V. Fraknói *Life of János Vitez* (Hung. Budapest 1879); Karl Schober, *Die Eroberung Niederösterreichs durch Matthias Corvinus* (Vienna, 1879); János Huszár, *Matthias's Black Army* (Hung. Budapest, 1890); Antonio Bonfini, *Rerum hungaricarum decades* (7th ed., Leipzig, 1771); Aeneas Sylvius, *Opera* (Frankfort, 1707); *The Correspondence of King Matthias* (Hung. and Lat., Budapest, 1893); V. Fraknói, *The Embassies of Cardinal Carvajal to Hungary* (Hung., Budapest, 1889); Marzio Galeotti, *De egregie sapienter et jocose dictis ac factis Matthiae regis* (*Script. reg. hung. I.*) (Vienna, 1746). Of the above the first is the best general sketch and is rich in notes; the second somewhat chauvinistic but excellently written; the third the best work for scholars; the seventh, eighth and eleventh are valuable as being by contemporaries.

(R. N. B.)

MATTHISSON, FRIEDRICH VON (1761–1831), German poet, was born at Hohendodeleben near Magdeburg, the son of the village pastor, on the 23rd of January 1761. After studying theology and philology at the university of Halle, he was appointed in 1781 master at the classical school Philanthropin in Dessau. This once famous seminary was, however, then rapidly decaying in public favour, and in 1784 Matthisson was glad to accept a travelling tutorship. He lived for two years with the Swiss author Bonstetten at Nyon on the lake of Geneva.

In 1794 he was appointed reader and travelling companion to the princess Louisa of Anhalt-Dessau. In 1812 he entered the service of the king of Württemberg, was ennobled, created counsellor of legation, appointed intendant of the court theatre and chief librarian of the royal library at Stuttgart. In 1828 he retired and settled at Wörlitz near Dessau, where he died on the 12th of March 1831. Matthisson enjoyed for a time a great popularity on account of his poems, *Gedichte* (1787; 15th ed., 1851; new ed., 1876), which Schiller extravagantly praised for their melancholy sweetness and their fine descriptions of scenery. The verse is melodious and the language musical, but the thought and sentiments they express are too often artificial and insincere. His *Adelaide* has been rendered famous owing to Beethoven's setting of the song. Of his elegies, *Die Elegie in den Ruinen eines alten Bergschlosses* is still a favourite. His reminiscences, *Erinnerungen* (5 vols., 1810–1816), contain interesting accounts of his travels.

Matthisson's *Schriften* appeared in eight volumes (1825–1829), of which the first contains his poems, the remainder his *Erinnerungen*; a ninth volume was added in 1833 containing his biography by H. Döring. His *Literarischer Nachlass*, with a selection from his correspondence, was published in four volumes by F. R. Schoch in 1832.

MATTING, a general term embracing many coarse woven or plaited fibrous materials used for covering floors or furniture, for hanging as screens, for wrapping up heavy merchandise and for other miscellaneous purposes. In the United Kingdom, under the name of "coir" matting, a large amount of a coarse kind of carpet is made from coco-nut fibre; and the same material, as well as strips of cane, Manila hemp, various grasses and rushes, is largely employed in various forms for making door mats. Large quantities of the coco-nut fibre are woven in heavy looms, then cut up into various sizes, and finally bound round the edges by a kind of rope made from the same material. The mats may be of one colour only, or they may be made of different colours and in different designs. Sometimes the names of institutions are introduced into the mats. Another type of mat is made exclusively from the above-mentioned rope by arranging alternate layers in sinuous and straight paths, and then stitching the parts together. It is also largely used for the outer covering of ships' fenders. Perforated and otherwise prepared rubber, as well as wire-woven material, are also largely utilized for door and floor mats. Matting of various kinds is very extensively employed throughout India for floor coverings, the bottoms of bedsteads, fans and fly-flaps, &c.; and a considerable export trade in such manufactures is carried on. The materials used are numerous; but the principal substances are straw, the bulrushes *Typha elephantina* and *T. angustifolia*, leaves of the date palm (*Phoenix sylvestris*), of the dwarf palm (*Chamaerops Ritchiana*), of the Palmyra palm (*Borassus flabelliformis*), of the coco-nut palm (*Cocos nucifera*) and of the screw pine (*Pandanus odoratissimus*), the munja or munj grass (*Saccharum Munja*) and allied grasses, and the mat grasses *Cyperus textilis* and *C. Pangorei*, from the last of which the well-known Palghat mats of the Madras Presidency are made. Many of these Indian grass-mats are admirable examples of elegant design, and the colours in which they are woven are rich, harmonious and effective in the highest degree. Several useful household articles are made from the different kinds of grasses. The grasses are dyed in all shades and plaited to form attractive designs suitable for the purposes to which they are to be applied. This class of work obtains in India, Japan and other Eastern countries. Vast quantities of coarse matting used for packing furniture, heavy and coarse goods, flax and other plants, &c., are made in Russia from the bast or inner bark of the lime tree. This industry centres in the great forest governments of Viatka, Nizhniy-Novgorod, Kostroma, Kazan, Perm and Simbirsk.

MATTOCK (O.E. *mattuc*, of uncertain origin), a tool having a double iron head, of which one end is shaped like an adze, and the other like a pickaxe. The head has a socket in the centre in which the handle is inserted transversely to the blades. It is used chiefly for grubbing and rooting among tree stumps in plantations and copses, where the roots are too close for the use of a spade, or for loosening hard soil.

MATTO GROSSO, an inland state of Brazil, bounded N. by Amazonas and Pará, E. by Goyaz, Minas Geraes, São Paulo and Paraná, S. by Paraguay and S.W. and W. by Bolivia. It ranks next to Amazonas in size, its area, which is largely unsettled and unexplored, being 532,370 sq. m., and its population only 92,827 in 1890 and 118,025 in 1900. No satisfactory estimate of its Indian population can be made. The greater part of the state belongs to the western extension of the Brazilian plateau, across which, between the 14th and 16th parallels, runs the water-shed which separates the drainage basins of the Amazon and La Plata. This elevated region is known as the plateau of Matto Grosso, and its elevations so far as known rarely exceed 3000 ft. The northern slope of this great plateau is drained by the Araguaya-Tocantins, Xingû, Tapajos and Guaporé-Mamoré-Madeira, which flow northward, and, except the first, empty into the Amazon; the southern slope drains southward through a multitude of streams flowing into the Paraná and Paraguay. The general elevation in the south part of the state is much lower, and large areas bordering the Paraguay are swampy, partially submerged plains which the sluggish rivers are unable to drain. The lowland elevations in this part of the state range from 300 to 400 ft. above sea-level, the climate is hot, humid and unhealthy, and the conditions for permanent settlement are apparently unfavourable. On the highlands, however, which contain extensive open *campos*, the climate, though dry and hot, is considered healthy. The basins of the Paraná and Paraguay are separated by low mountain ranges extending north from the *sierras* of Paraguay. In the north, however, the ranges which separate the river valleys are apparently the remains of the table-land through which deep valleys have been eroded. The resources of Matto Grosso are practically undeveloped, owing to the isolated situation of the state, the costs of transportation and the small population.

The first industry was that of mining, gold having been discovered in the river valleys on the southern slopes of the plateau, and diamonds on the head-waters of the Paraguay, about Diamantino and in two or three other districts. Gold is found chiefly in placers, and in colonial times the output was large, but the deposits were long ago exhausted and the industry is now comparatively unimportant. As to other minerals little is definitely known. Agriculture exists only for the supply of local needs, though tobacco of a superior quality is grown. Cattle-raising, however, has received some attention and is the principal industry of the landowners. The forest products of the state include fine woods, rubber, ipecacuanha, sarsaparilla, jaborandi, vanilla and copaiba. There is little export, however, the only means of communication being down the Paraguay and Paraná rivers by means of subsidized steamers. The capital of the state is Cuyabá, and the chief commercial town is Corumbá at the head of navigation for the larger river boats, and 1986 m. from the mouth of the La Plata. Communication between these two towns is maintained by a line of smaller boats, the distance being 517 m.

The first permanent settlements in Matto Grosso seem to have been made in 1718 and 1719, in the first year at Forquilha and in the second at or near the site of Cuyabá, where rich placer mines had been found. At this time all this inland region was considered a part of São Paulo, but in 1748 it was made a separate *capitania* and was named Matto Grosso ("great woods"). In 1752 its capital was situated on the right bank of the Guaporé river and was named Villa Bella da Santissima Trindade de Matto Grosso, but in 1820 the seat of government was removed to Cuyabá and Villa Bella has fallen into decay. In 1822 Matto Grosso became a province of the empire and in 1889 a republican state. It was invaded by the Paraguayans in the war of 1860–65.

MATTOON, a city of Coles county, Illinois, U.S.A., in the east central part of the state, about 12 m. south-east of Peoria. Pop. (1890), 6833; (1900), 9622, of whom 430 were foreign-born; (1910 census) 11,456. It is served by the Illinois Central and Cleveland, Cincinnati, Chicago & St Louis railways, which have repair shops here, and by inter-urban electric lines. The city has a public library, a Methodist Episcopal Hospital, and an Old Folks' Home, the last supported by the Independent Order of Odd Fellows. Mattoon is an important shipping point for Indian corn and broom corn, extensively grown in the vicinity, and for fruit and livestock. Among its manufactures are foundry and machine shop products, stoves and bricks; in 1905 the factory product was valued at $1,308,781, an increase of 71·2% over that in 1900. The municipality owns the waterworks and an electric lighting plant. Mattoon was first settled about 1855, was named in honour of William Mattoon, an early landowner, was first chartered as a city in 1857, and was reorganized under a general state law in 1879.

MATTRESS (O.Fr. *materas*, mod. *matelas*; the origin is the Arab. *al-materah*, cushion, whence Span. and Port. *almadraque*, Ital. *materasso*), the padded foundation of a bed, formed of canvas or other stout material stuffed with wool, hair, flock or straw; in the last case it is properly known as a "palliasse" (Fr. *paille*, straw; Lat. *palea*); but this term is often applied to an under-mattress stuffed with substances other than straw. The padded mattress on which lay the feather-bed has been replaced by the "wire-mattress," a network of wire stretched on a light wooden or iron frame, which is either a separate structure or a component part of the bedstead itself. The "wire-mattress" has taken the place of the "spring mattress," in which spiral springs support the stuffing. The term "mattress" is used in engineering for a mat of brushwood, faggots, &c., corded together and used as a foundation or as surface in the construction of dams, jetties, dikes, &c.

MATURIN, CHARLES ROBERT (1782–1824), Irish novelist and dramatist, was born in Dublin in 1782. His grandfather, Gabriel Jasper Maturin, had been Swift's successor in the deanery of St Patrick. Charles Maturin was educated at Trinity College, Dublin, and became curate of Loughrea and then of St Peter's, Dublin. His first novels, *The Fatal Revenge; or, the Family of Montorio* (1807), *The Wild Irish Boy* (1808), *The Milesian Chief* (1812), were issued under the pseudonym of "Dennis Jasper Murphy." All these were mercilessly ridiculed, but the irregular power displayed in them attracted the notice of Sir Walter Scott, who recommended the author to Byron. Through their influence Maturin's tragedy of *Bertram* was produced at Drury Lane in 1816, with Kean and Miss Kelly in the leading parts. A French version by Charles Nodier and Baron Taylor was produced in Paris at the Théâtre Favart. Two more tragedies, *Manuel* (1817) and *Fredolfo* (1819), were failures, and his poem *The Universe* (1821) fell flat. He wrote three more novels, *Women* (1818), *Melmoth, the Wanderer* (1820), and *The Albigenses* (1824). *Melmoth*, which forms its author's title to remembrance, is the best of them, and has for hero a kind of "Wandering Jew." Honoré de Balzac wrote a sequel to it under the title of *Melmoth réconcilié à l'église* (1835). Maturin died in Dublin on the 30th of October 1824.

MATVYEEV, ARTAMON SERGYEEVICH (–1682), Russian statesman and reformer, was one of the greatest of the precursors of Peter the Great. His parentage and the date of his birth are uncertain. Apparently his birth was humble, but when the obscure figure of the young Artamon emerges into the light of history we find him equipped at all points with the newest ideas, absolutely free from the worst prejudices of his age, a ripe scholar, and even an author of some distinction. In 1671 the tsar Alexius and Artamon were already on intimate terms, and on the retirement of Orduin-Nashchokin Matvyeev became the tsar's chief counsellor. It was at his house, full of all the wondrous, half-forbidden novelties of the west, that Alexius, after the death of his first consort, Martha, met Matvyeev's favourite pupil, the beautiful Natalia Naruishkina, whom he married on the 21st of January 1672. At the end of the year Matvyeev was raised to the rank of *okolnichy*, and on the 1st of September 1674 attained the still higher dignity of *boyar*. Matvyeev remained paramount to the end of the reign and introduced play-acting and all sorts of refining western novelties into Muscovy. The deplorable physical condition of Alexius's immediate successor, Theodore III. suggested to Matvyeev the desirability of elevating to the throne the sturdy little tsarevich Peter, then in his fourth year. He purchased the allegiance of the *stryeltsi*, or musketeers, and then, summoning the boyars of the council, earnestly represented to them that Theodore, scarce able to live, was surely unable to reign, and urged the substitution of little Peter. But the reactionary boyars, among whom were the near kinsmen of Theodore, proclaimed him tsar and Matvyeev was banished to Pustozersk, in northern Russia, where he remained till Theodore's death (April 27, 1682). Immediately afterwards Peter was proclaimed tsar by the patriarch, and the first *ukaz* issued in Peter's name summoned Matvyeev to return to the capital and act as chief adviser to the tsaritsa Natalia. He reached Moscow on the 15th of May, prepared "to lay down his life for the tsar," and at once proceeded to the head of the Red Staircase to meet and argue with the assembled stryeltsi, who had been instigated to rebel by the anti-Petrine faction. He had already succeeded in partially pacifying them, when one of their colonels began to abuse the still hesitating and suspicious musketeers. Infuriated, they seized and flung Matvyeev into the square below, where he was hacked to pieces by their comrades.

See R. Nisbet Bain, *The First Romanovs* (London, 1905); M. P. Pogodin, *The First Seventeen Years of the Life of Peter the Great* (Rus.), (Moscow, 1875); S. M. Solovev, *History of Russia* (Rus.), (vols. 12, 13, (St Petersburg, 1895, &c.); L. Shchepotev, *A.S.Matvyeev as an Educational and Political Reformer* (Rus.), (St Petersburg, 1906). (R. N. B.)

MAUBEUGE, a town of northern France, in the department of Nord, situated on both banks of the Sambre, here canalized, 23½ m. by rail E. by S. of Valenciennes, and about 2 m. from the Belgian frontier. Pop. (1906), town 13,569, commune 21,520. As a fortress Maubeuge has an old enceinte of bastion trace which serves as the centre of an important entrenched camp of 18 m. perimeter, constructed for the most part after the war of 1870, but since modernized and augmented. The town has a board of trade arbitration, a communal college, a commercial and industrial school; and there are important foundries, forges and blast-furnaces, together with manufactures of machine-tools, porcelain, &c. It is united by electric tramway with Hautmont (pop. 12,473), also an important metallurgical centre.

Maubeuge (*Malbodium*) owes its origin to a double monastery, for men and women founded in the 7th century by St Aldegonde, relics of whom are preserved in the church. It subsequently belonged to the territory of Hainault. It was burnt by Louis XI., by Francis I., and by Henry II., and was finally assigned to France by the Treaty of Nijmwegen. It was fortified at Vauban by the command of Louis XIV., who under Turenne first saw military service there. Besieged in 1793 by Prince Josias of Coburg, it was relieved by the victory of Wattignies, which is commemorated by a monument in the town. It was unsuccessfully besieged in 1814, but was compelled to capitulate, after a vigorous resistance, in the Hundred Days.

MAUCH CHUNK, a borough and the county-seat of Carbon county, Pennsylvania, U.S.A., on the W. bank of the Lehigh river and on the Lehigh Coal and Navigation Company's Canal, 46 m. by rail W.N.W. of Easton. Pop. (1890), 4101; (1900), 4029, (571 foreign-born); (1910), 3952. Mauch Chunk is served by the Central of New Jersey railway and, at East Mauch Chunk, across the river, connected by electric railway, by the Lehigh Valley railway. The borough lies in the valley of the Lehigh river, along which runs one of its few streets and in another deeply cut valley at right angles to the river; through this second valley east and west runs the main street, on which is an electric railway; parallel to it on the south is High Street, formerly an Irish settlement; half way up the steep hill, and on the north at the top of the opposite hill is the ward of Upper Mauch Chunk, reached by the electric railway. An incline railway, originally used to transport coal from the mines to the river and named the "Switch-Back," now carries tourists up the steep slopes of Mount Pisgah and Mount Jefferson, to Summit Hill, a rich anthracite coal region, with a famous "burning mine," which has been on fire since 1832, and then back. An electric railway to the top of Flagstaff Mountain, built in 1900, was completed in 1901 to Lehighton, 4 m. south.

east of Mauch Chunk, where coal is mined and silk and stoves are manufactured, and which had a population in 1900 of 4629, and in 1910 of 5316. Immediately above Mauch Chunk the river forms a horseshoe; on the opposite side, connected by a bridge, is the borough of East Mauch Chunk (pop. 1900, 3458; 1910, 3548); and 2 m. up the river is Glen Onoko, with fine falls and cascades. The principal buildings in Mauch Chunk are the county court house, a county gaol, a Young Men's Christian Association building, and the Dimmick Memorial Library (1890). The borough was long a famous shipping point for coal. It now has ironworks and foundries, and in East Mauch Chunk there are silk mills. The name is Indian and means "Bear Mountain," this English name being used for a mountain on the east side of the river. The borough was founded by the Lehigh Coal and Navigation Company in 1818. This company began in 1827 the operation of the "Switch-Back," probably the first railway in the country to be used for transporting coal. In 1831 the town was opened to individual enterprise, and in 1850 it was incorporated as a borough. Mauch Chunk was for many years the home of Asa Packer, the projector and builder of the Lehigh Valley railroad from Mauch Chunk to Easton.

MAUCHLINE, a town in the division of Kyle, Ayrshire, Scotland. Pop. (1901), 1767. It lies 8 m. E.S.E. of Kilmarnock and 11 m. E. by N. of Ayr by the Glasgow and South-Western railway. It is situated on a gentle slope about 1 m. from the river Ayr, which flows through the south of the parish of Mauchline. It is noted for its manufacture of snuff-boxes and knick-knacks in wood, and of curling-stones. There is also some cabinet-making, besides spinning and weaving; and its horse fairs and cattle markets have more than local celebrity. The parish church, dating from 1829, stands in the middle of the village, and on the green a monument, erected in 1830, marks the spot where five Covenanters were killed in 1685. Robert Burns lived with his brother Gilbert on the farm of Mossgiel, about a mile to the north, from 1784 to 1788. Mauchline kirkyard was the scene of the "Holy Fair"; at "Poosie Nansie's" (Agnes Gibson's)—still, though much altered, a popular inn—the "Jolly Beggars" held their high jinks; near the church (in the poet's day an old, barn-like structure) was the Whiteford Arms inn, where on a pane of glass Burns wrote the epitaph on John Dove, the landlord; "auld Nanse Tinnock's" house, with the date of 1744 above the door, nearly faces the entrance to the churchyard; the Rev. William Auld was minister of Mauchline, and "Holy Willie," whom the poet scourged in the celebrated "Prayer," was one of "Daddy Auld's" elders; behind the kirkyard stands the house of Gavin Hamilton, the lawyer and firm friend of Burns, in which the poet was married. The braes of Ballochmyle, where he met the heroine of his song, "The Lass o' Ballochmyle," lie about a mile to the south-east. Adjoining them is the considerable manufacturing town of CATRINE (pop. 2340), with cotton factories, bleach fields and brewery, where Dr Matthew Stewart (1717–1785), the father of Dugald Stewart—had a mansion, and where there is a big water-wheel said to be inferior in size only to that of Laxey in the Isle of Man. Barskimming House, 2 m. south by west of Mauchline, the seat of Lord-President Miller (1717–1789), was burned down in 1882. Near the confluence of the Fail and the Ayr was the scene of Burns's parting with Highland Mary.

MAUDE, CYRIL (1862–), English actor, was born in London and educated at Charterhouse. He began his career as an actor in 1883 in America, and from 1896 to 1905 was co-manager with F. Harrison of the Haymarket Theatre, London. There he became distinguished for his quietly humorous acting in many parts. In 1906 he went into management on his own account, and in 1907 opened his new theatre The Playhouse. In 1888 he married the actress Winifred Emery (b. 1862), who had made her London début as a child in 1875, and acted with Irving at the Lyceum between 1881 and 1887. She was a daughter of Samuel Anderson Emery (1817–1881) and granddaughter of John Emery (1777–1822), both well-known actors in their day.

MAULE, a coast province of central Chile, bounded N. by Talca, E. by Linares and Nuble, and S. by Concepción, and lying between the rivers Maule and Itata, which form its northern and southern boundaries. Pop. (1895), 119,791; area, 2475 sq. m. Maule is traversed from north to south by the coast range and its surfaces are much broken. The Buchupureo river flows westward across the province. The climate is mild and healthy. Agriculture and stock-raising are the principal occupations, and hides, cattle, wheat and timber are exported. Transport facilities are afforded by the Maule and the Itata, which are navigable, and by a branch of the government railway from Cauquenes to Parral, an important town of southern Linares. The provincial capital, Cauquenes (pop., in 1895, 8574; 1902 estimate, 9895), is centrally situated on the Buchupureo river, on the eastern slopes of the coast cordilleras. The town and port of Constitución (pop., in 1900, about 7000) on the south bank of the Maule, one mile above its mouth, was formerly the capital of the province. The port suffers from a dangerous bar at the mouth of the river, but is connected with Talca by rail and has a considerable trade.

The Maule river, from which the province takes its name, is of historic interest because it is said to have marked the southern limits of the Inca Empire. It rises in the Laguna del Maule, an Andean lake near the Argentine frontier, 7218 ft. above sea-level, and flows westward about 140 m. to the Pacific, into which it discharges in 35° 18′ S. The upper part of its drainage basin, to which the *Anuario Hydrografico* gives an area of 8000 sq. m., contains the volcanoes of San Pedro (11,800 ft.), the Descabezado (12,795 ft.), and others of the same group of lower elevations. The upper course and tributaries of the Maule, principally in the province of Linares, are largely used for irrigation.

MAULÉON, SAVARI DE (d. 1236), French soldier, was the son of Raoul de Mauléon, vicomte de Thouars and lord of Mauléon (now Châtillon-sur-Sèvre). Having espoused the cause of Arthur of Brittany, he was captured at Mirebeau (1202), and imprisoned in the château of Corfe. But John set him at liberty in 1204, gained him to his side and named him seneschal of Poitou (1205). In 1211 Savari de Mauléon assisted Raymond VI. count of Toulouse, and with him besieged Simon de Montfort in Castelnaudary. Philip Augustus bought his services in 1212 and gave him command of a fleet which was destroyed in the Flemish port of Damme. Then Mauléon returned to John, whom he aided in his struggle with the barons in 1215. He was one of those whom John designated on his deathbed for a council of regency (1216). Then he went to Egypt (1219), and was present at the taking of Damietta. Returning to Poitou he was a second time seneschal for the king of England. He defended Saintonge against Louis VIII. in 1224, but was accused of having given La Rochelle up to the king of France, and the suspicions of the English again threw him back upon the French. Louis VIII. then turned over to him the defence of La Rochelle and the coast of Saintonge. In 1227 he took part in the rising of the barons of Poitiers and Anjou against the young Louis IX. He enjoyed a certain reputation for his poems in the *langue d'oc*.

See Chilhaud-Dumaine, "Savari de Mauléon," in *Positions des Thèses des élèves de l'École des Chartes* (1877); *Histoire littéraire de la France*, xviii. 671–682.

MAULSTICK, or MAHLSTICK, a stick with a soft leather or padded head, used by painters to support the hand that holds the brush. The word is an adaptation of the Dutch *maalstok*, *i.e.* the painter's stick, from *malen*, to paint.

MAUNDY THURSDAY (through O. Fr. *mandé* from Lat. *mandatum*, commandment, in allusion to Christ's words: "A new commandment give I unto you," after he had washed the disciples' feet at the Last Supper), the Thursday before Easter. Maundy Thursday is sometimes known as *Sheer* or *Chare* Thursday, either in allusion, it is thought, to the "shearing" of heads and beards in preparation for Easter, or more probably in the word's Middle English sense of "pure," in allusion to the ablutions of the day. The chief ceremony, as kept from the early middle ages onwards—the washing of the feet of twelve or more poor men or beggars—was in the early Church almost unknown. Of Chrysostom and St Augustine, who both speak of Maundy Thursday as being marked by a solemn celebration of the Sacrament, the former does not mention the foot-washing, and the latter merely alludes to it. Perhaps an indication of it may be discerned as early as the 4th century in a custom, current in Spain, northern Italy and elsewhere, of washing the feet of the catechumens towards the end of Lent before their baptism. It was not, however, universal, and in the 48th canon of the synod of Elvira (A.D. 306) it is expressly prohibited (cf. *Corp. Jur. Can.*, c. 104, *caus.* i. *qu.* 1). From the 4th century ceremonial foot-washing became yearly more common, till it was regarded as a necessary rite, to be performed by the pope, all Catholic sovereigns, prelates, priests and nobles. In England the king washed the feet of as many poor men as he was years old, and then distributed to them meat, money and clothes. At Durham Cathedral, until the 16th century, every charity-boy had a monk to wash his feet. At Peterborough Abbey, in 1530, Wolsey made "his maund in Our Lady's Chapel, having fifty-nine poor men whose feet he washed and kissed; and after he had wiped them he gave every of the said poor men twelve pence in money, three ells of good canvas to make them shirts, a pair of new shoes, a cast of red herrings and three white herrings." Queen Elizabeth performed the ceremony, the paupers' feet, however, being first washed by the yeomen of the laundry with warm water and sweet herbs. James II. was the last English monarch to perform the rite. William III. delegated the washing to his almoner, and this was usual until the middle of the 18th century. Since 1754 the foot-washing has been abandoned, and the ceremony now consists of the presentation of Maundy money, officially called Maundy Pennies. These were first coined in the reign of Charles II. They come straight from the Mint, and have their edges unmilled. The service which formerly took place in the Chapel Royal, Whitehall, is now held in Westminster Abbey. A procession is formed in the nave, consisting of the lord high almoner representing the sovereign, the clergy and the yeomen of the guard, the latter carrying white and red purses in baskets. The clothes formerly given are now commuted for in cash. The full ritual is gone through by the Roman Catholic archbishop of Westminster, and abroad it survives in all Catholic countries, a notable example being that of the Austrian emperor. In the Greek Church the rite survives notably at Moscow, St Petersburg and Constantinople. It is on Maundy Thursday that in the Church of Rome the sacred oil is blessed, and the chrism prepared according to an elaborate ritual which is given in the *Pontificale.*

MAUPASSANT, HENRI RENÉ ALBERT GUY DE (1850–1893), French novelist and poet, was born at the Château of Miromesnil in the department of Seine-Inférieure on the 5th August 1850. His grandfather, a landed proprietor of a good Lorraine family, owned an estate at Neuville-Champ-d'Oisel near Rouen, and bequeathed a moderate fortune to his son, a Paris stockbroker, who married Mademoiselle Laure Lepoitevin. Maupassant was educated at Yvetot and at the Rouen lycée. A copy of verses entitled *Le Dieu créateur*, written during his year of philosophy, has been preserved and printed. He entered the ministry of marine, and was promoted by M. Bardoux to the Cabinet de l'Instruction publique. A pleasant legend says that, in a report by his official chief, Maupassant is mentioned as not reaching the standard of the department in the matter of style. He may very well have been an unsatisfactory clerk, as he divided his time between rowing expeditions and attending the literary gatherings at the house of Gustave Flaubert, who was not, as he is often alleged to be, connected with Maupassant by any blood tie. Flaubert was not his uncle, nor his cousin, nor even his godfather, but merely an old friend of Madame de Maupassant, whom he had known from childhood. At the literary meetings Maupassant seldom shared in the conversation. Upon those who met him—Tourgenieff, Alphonse Daudet, Catulle Mendès, José-Maria de Heredia and Émile Zola—he left the impression of a simple young athlete. Even Flaubert, to whom Maupassant submitted some sketches, was not greatly struck by their talent, though he encouraged the youth to persevere. Maupassant's first essay was a dramatic piece twice given at Étretat in 1873 before an audience which included Tourgenieff, Flaubert and Meilhac. In this indecorous performance, of which nothing more is heard, Maupassant played the part of a woman. During the next seven years he served a severe apprenticeship to Flaubert, who by this time realized his pupil's exceptional gifts. In 1880 Maupassant published a volume of poems, *Des Vers*, against which the public prosecutor of Etampes took proceedings that were finally withdrawn through the influence of the senator Cordier. From Flaubert, who had himself been prosecuted for his first book, *Madame Bovary*, there came a letter congratulating the poet on the similarity between their first literary experiences. *Des Vers* is an extremely interesting experiment, which shows Maupassant to us still hesitating in his choice of a medium; but he recognized that it was not wholly satisfactory, and that its chief deficiency—the absence of verbal melody—was fatal. Later in the same year he contributed to the *Soirées de Médan*, a collection of short stories by MM. Zola, J.-K. Huysmans, Henry Céard, Léon Hennique and Paul Alexis; and in *Boule de suif* the young unknown author revealed himself to his amazed collaborators and to the public as an admirable writer of prose and a consummate master of the *conte*. There is perhaps no other instance in modern literary history of a writer beginning, as a fully equipped artist, with a genuine masterpiece. This early success was quickly followed by another. The volume entitled *La Maison Tellier* (1881) confirmed the first impression, and vanquished even those who were repelled by the author's choice of subjects. In *Mademoiselle Fifi* (1883) he repeated his previous triumphs as a *conteur*, and in this same year he, for the first time, attempted to write on a larger scale. Choosing to portray the life of a blameless girl, unfortunate in her marriage, unfortunate in her son, consistently unfortunate in every circumstance of existence, he leaves her, ruined and prematurely old, clinging to the tragic hope, which time, as one feels, will belie, that she may find happiness in her grandson. This picture of an average woman undergoing the constant agony of disillusion Maupassant calls *Une Vie* (1883), and as in modern literature there is no finer example of cruel observation, so there is no sadder book than this, while the effect of extreme truthfulness which it conveys justifies its sub-title—*L'Humble vérité*. Certain passages of *Une Vie* are of such a character that the sale of the volume at railway bookstalls was forbidden throughout France. The matter was brought before the chamber of deputies, with the result of drawing still more attention to the book, and of advertising the *Contes de la bécasse* (1883), a collection of stories as improper as they are clever. *Au soleil* (1884), a book of travels which has the eminent qualities of lucid observation and exact description, was less read than *Clair de lune*, *Miss Harriet*, *Les Sœurs Rondoli* and *Yvette*, all published in 1883–1884 when Maupassant's powers were at their highest level. Three further collections of short tales, entitled *Contes et nouvelles*, *Monsieur Parent*, and *Contes du jour et de la nuit*, issued in 1885, proved that while the author's vision was as incomparable as ever, his fecundity had not improved his impeccable form. To 1885 also belongs an elaborate novel, *Bel-ami*, the cynical history of a particularly detestable, brutal scoundrel who makes his way in the world by means of his handsome face. Maupassant is here no less vivid in realizing his literary men, financiers and frivolous women than in dealing with his favourite peasants, boors and servants, to whom he returned in *Toine* (1886) and in *La Petite roque* (1886). About this time appeared the first symptoms of the malady which destroyed him; he wrote less, and though the novel *Mont-Oriol* (1887) shows him apparently in undiminished possession of his faculty, *Le Horla* (1887) suggests that he was already subject to alarming hallucinations. Restored to some extent by a sea-voyage, recorded in *Sur l'eau* (1888), he went back to short stories in *Le Rosier de Madame Husson* (1888), a burst of Rabelaisian humour equal to anything he had ever written. His novels *Pierre et Jean* (1888), *Fort comme la mort* (1889), and *Notre cœur* (1890) are penetrating studies touched with a profounder sympathy than had hitherto distinguished him; and this softening into pity for the tragedy of life is deepened in some of the tales included in *Inutile beauté* (1890). One of these, *Le Champ d'Oliviers*, is an unsurpassable example of poignant, emotional narrative. With *La Vie errante* (1890), a volume of travels, Maupassant's career practically closed. *Musotte*, a theatrical piece written in collaboration with M. Jacques Normand, was published in 1891. By this time inherited nervous maladies, aggravated by excessive physical exercises and by the imprudent use of drugs, had undermined his constitution. He began to take an interest in religious problems, and for a while made the *Imitation* his handbook; but his misanthropy deepened, and he suffered from curious delusions as to his wealth and rank. A victim of general paralysis, of which *La Folie des grandeurs* was one of the symptoms, he drank the waters at Aix-les-Bains during the summer of 1891, and retired to Cannes, where he purposed passing the winter. The singularities of conduct which had been observed at Aix-les-Bains grew more and more marked. Maupassant's reason slowly gave way. On the 6th of January 1892 he attempted suicide, and was removed to Paris, where he died in the most painful circumstances on the 6th of July 1893. He is buried in the cemetery of Montparnasse. The opening chapters of two projected novels, *L'Angélus* and *L'Ame étrangère*, were found among his papers; these, with *La Paix du ménage*, a comedy in two acts, and two collections of tales, *Le Père Milon* (1898) and *Le Colporteur* (1899), have been published posthumously. A correspondence, called *Amitié amoureuse* (1897), and dedicated to his mother, is probably unauthentic. Among the prefaces which he wrote for the works of others, only one—an introduction to a French prose version of Mr Swinburne's *Poems and Ballads*—is likely to interest English readers.

Maupassant began as a follower of Flaubert and of M. Zola, but, whatever the masters may have called themselves, they both remained essentially *romantiques*. The pupil is the last of the "naturalists": he even destroyed naturalism, since he did all that can be done in that direction. He had no psychology, no theories of art, no moral or strong social prejudices, no disturbing imagination, no wealth of perplexing ideas. It is no paradox to say that his marked limitations made him the incomparable artist that he was. Undisturbed by any external influence, his marvellous vision enabled him to become a supreme observer, and, given his literary sense, the rest was simple. He prided himself in having no invention; he described nothing that he had not seen. The peasants whom he had known as a boy figure in a score of tales; what he saw in Government offices is set down in *L'Héritage;* from Algiers he gathers the material for *Maroca;* he drinks the waters and builds up *Mont-Oriol;* he enters journalism, constructs *Bel-ami*, and, for the sake of precision, makes his brother, Hervé de Maupassant, sit for the infamous hero's portrait; he sees fashionable society, and, though it wearied him intensely, he transcribes its life in *Fort comme la mort* and *Notre cœur*. Fundamentally he finds all men alike. In every grade he finds the same ferocious, cunning, animal instincts at work: it is not a gay world, but he knows no other; he is possessed by the dread of growing old, of ceasing to enjoy; the horror of death haunts him like a spectre. It is an extremely simple outlook. Maupassant does not prefer good to bad, one man to another; he never pauses to argue about the meaning of life, a senseless thing which has the one advantage of yielding materials for art; his one aim is to discover the hidden aspect of visible things, to relate what he has observed, to give an objective rendering of it, and he has seen so intensely and so serenely that he is the most exact transcriber in literature. And as the substance is, so is the form: his style is exceedingly simple and exceedingly strong; he uses no rare or superfluous word, and is content to use the humblest word if only it conveys the exact picture of the thing seen. In ten years he produced some thirty volumes. With the exception of *Pierre et Jean*, his novels, excellent as they are, scarcely represent him at his best, and of over two hundred *contes* a proportion must be rejected. But enough will remain to vindicate his claim to a permanent place in literature as an unmatched observer and the most perfect master of the short story.

See also F. Brunetière, *Le Roman naturaliste* (1883); J. Lemaître, *Les Contemporains* (vols. i. v. vi.); R. Doumic, *Ecrivains d'aujourd'hui* (1894); an introduction by Henry James to *The Odd Number . . .* (1891); a critical preface by the earl of Crewe to *Pierre and Jean* (1902); A. Symons, *Studies in Prose and Verse* (1904). There are many references to Maupassant in the *Journal des Goncourt*, and some correspondence with Marie Bashkirtseff was printed with *Further Memoirs* of that lady in 1901. (J. F.-K.)

MAUPEOU, RENÉ NICOLAS CHARLES AUGUSTIN (1714–1792), chancellor of France, was born on the 25th of February 1714, being the eldest son of René Charles de Maupeou (1688–1775), who was president of the parlement of Paris from 1743 to 1757. He married in 1744 a rich heiress, Anne de Roncherolles, a cousin of Madame d'Epinay. Entering public life, he was his father's right hand in the conflicts between the parlement and Christophe de Beaumont, archbishop of Paris, who was supported by the court. Between 1763 and 1768, dates which cover the revision of the case of Jean Calas and the trial of the comte de Lally, Maupeou was himself president of the parlement. In 1768, through the protection of Choiseul, whose fall two years later was in large measure his work, he became chancellor in succession to his father, who had held the office for a few days only. He determined to support the royal authority against the parlement, which in league with the provincial magistratures was seeking to arrogate to itself the functions of the states-general. He allied himself with the duc d'Aiguillon and Madame du Barry, and secured for a creature of his own, the Abbé Terrai, the office of comptroller-general. The struggle came over the trial of the case of the duc d'Aiguillon, ex-governor of Brittany, and of La Chalotais, procureur-général of the province, who had been imprisoned by the governor for accusations against his administration. When the parlement showed signs of hostility against Aiguillon, Maupeou read letters patent from Louis XV. annulling the proceedings. Louis replied to remonstrances from the parlement by a *lit de justice*, in which he demanded the surrender of the minutes of procedure. On the 27th of November 1770 appeared the *Édit de règlement et de discipline*, which was promulgated by the chancellor, forbidding the union of the various branches of the parlement and correspondence with the provincial magistratures. It also made a strike on the part of the parlement punishable by confiscation of goods, and forbade further obstruction to the registration of royal decrees after the royal reply had been given to a first remonstrance. This edict the magistrates refused to register, and it was registered in a *lit de justice* held at Versailles on the 7th of December, whereupon the parlement suspended its functions. After five summonses to return to their duties, the magistrates were surprised individually on the night of the 19th of January 1771 by musketeers, who required them to sign yes or no to a further request to return. Thirty-eight magistrates gave an affirmative answer, but on the exile of their former colleagues by *lettres de cachet* they retracted, and were also exiled. Maupeou installed the council of state to administer justice pending the establishment of six superior courts in the provinces, and of a new parlement in Paris. The *cour des aides* was next suppressed.

Voltaire praised this revolution, applauding the suppression of the old hereditary magistrature, but in general Maupeou's policy was regarded as the triumph of tyranny. The remonstrances of the princes, of the nobles, and of the minor courts, were met by exile and suppression, but by the end of 1771 the new system was established, and the Bar, which had offered a passive resistance, recommenced to plead. But the death of Louis XV. in May 1774 ruined the chancellor. The restoration of the parlements was followed by a renewal of the quarrels between the new king and the magistrature. Maupeou and Terrai were replaced by Malesherbes and Turgot. Maupeou lived in retreat until his death at Thuit on the 29th of July 1792, having lived to see the overthrow of the *ancien régime*. His work, in so far as it was directed towards the separation of the judicial and political functions and to the reform of the abuses attaching to a hereditary magistrature, was subsequently endorsed by the Revolution; but no justification of his violent methods or defence of his intriguing and avaricious character is possible. He aimed at securing absolute power for Louis XV., but his action was in reality a serious blow to the monarchy.

The chief authority for the administration of Maupeou is the *compte rendu* in his own justification presented by him to Louis XVI. in 1789, which included a dossier of his speeches and edicts, and is preserved in the Bibliothèque nationale. These documents, in the hands of his former secretary, C. F. Lebrun, duc de Plaisance, formed the basis of the judicial system of France as established under the consulate (cf. C. F. Lebrun, *Opinions, rapports et choix d'écrits politiques*, published posthumously in 1829). See further *Maupeouana* (6 vols., Paris, 1775), which contains the pamphlets directed against him; *Journal hist. de la révolution opérée . . . par M. de Maupeou* (7 vols., 1775); the official correspondence of Mercy-Argenteau, the letters of Mme d'Épinay; and Jules Flammermont, *Le Chancelier Maupeou et les parlements* (1883).

MAUPERTUIS, PIERRE LOUIS MOREAU DE (1698–1759), French mathematician and astronomer, was born at St Malo on the 17th of July 1698. When twenty years of age he entered the army, becoming lieutenant in a regiment of cavalry, and employing his leisure on mathematical studies. After five years he quitted the army and was admitted in 1723 a member of the Academy of Sciences. In 1728 he visited London, and was elected a fellow of the Royal Society. In 1736 he acted as chief of the expedition sent by Louis XV. into Lapland to measure the length of a degree of the meridian (see EARTH, FIGURE OF), and on his return home he became a member of almost all the scientific societies of Europe. In 1740 Maupertuis went to Berlin on the invitation of the king of Prussia, and took part in the battle of Mollwitz, where he was taken prisoner by the Austrians. On his release he returned to Berlin, and thence to Paris, where he was elected director of the Academy of Sciences in 1742, and in the following year was admitted into the Academy. Returning to Berlin in 1744, at the desire of Frederick II., he was chosen president of the Royal Academy of Sciences in 1746. Finding his health declining, he repaired in 1757 to the south of France, but went in 1758 to Basel, where he died on the 27th of July 1759. Maupertuis was unquestionably a man of considerable ability as a mathematician, but his restless, gloomy disposition involved him in constant quarrels, of which his controversies with König and Voltaire during the latter part of his life furnish examples.

The following are his most important works: *Sur la figure de la terre* (Paris, 1738); *Discours sur la parallaxe de la lune* (Paris, 1741); *Discours sur la figure des astres* (Paris, 1742); *Éléments de la géographie* (Paris, 1742); *Lettre sur la comète de 1742* (Paris, 1742); *Astronomie nautique* (Paris, 1745 and 1746); *Vénus physique* (Paris, 1745); *Essai de cosmologie* (Amsterdam, 1750). His *Œuvres* were published in 1752 at Dresden and in 1756 at Lyons.

MAU RANIPUR, a town of British India in Jahnsi district, in the United Provinces. Pop. (1901), 17,231. It contains a large community of wealthy merchants and bankers. A special variety of red cotton cloth, known as *kharua*, is manufactured and exported to all parts of India. Trees line many of the streets, and handsome temples ornament the town.

MAUREL, ABDIAS (d. 1705), Camisard leader, became a cavalry officer in the French army and gained distinction in Italy; here he served under Marshal Catinat, and on this account he himself is sometimes known as Catinat. In 1702, when the revolt in the Cévennes broke out, he became one of the Camisard leaders, and in this capacity his name was soon known and feared. He refused to accept the peace made by Jean Cavalier in 1704, and after passing a few weeks in Switzerland he returned to France and became one of the chiefs of those Camisards who were still in arms. He was deeply concerned in a plot to capture some French towns, a scheme which, it was hoped, would be helped by England and Holland. But it failed; Maurel was betrayed, and with three other leaders of the movement was burned to death at Nîmes on the 22nd of April 1705. He was a man of great physical strength; but he was very cruel, and boasted he had killed 200 Roman Catholics with his own hands.

MAUREL, VICTOR (1848–), French singer, was born at Marseilles, and educated in music at the Paris Conservatoire. He made his début in opera at Paris in 1868, and in London in 1873, and from that time onwards his admirable acting and vocal method established his reputation as one of the finest of operatic baritones. He created the leading part in Verdi's *Otello*, and was equally fine in Wagnerian and Italian opera.

MAURENBRECHER, KARL PETER WILHELM (1838–1892), German historian, was born at Bonn on the 21st of December, 1838, and studied in Berlin and Munich under Ranke and Von Sybel, being especially influenced by the latter historian. After doing some research work at Simancas in Spain, he became professor of history at the university of Dorpat in 1867; and was then in turn professor at Königsberg, Bonn and Leipzig. He died at Leipzig on the 6th of November, 1892.

Many of Maurenbrecher's works are concerned with the Reformation, among them being *England im Reformationszeitalter* (Düsseldorf, 1866); *Karl V. und die deutschen Protestanten* (Düsseldorf, 1865); *Studien und Skizzen zur Geschichte der Reformationszeit* (Leipzig, 1874); and the incomplete *Geschichte der Katholischen Reformation* (Nördlingen, 1880). He also wrote *Don Karlos* (Berlin, 1876); *Gründung des deutschen Reiches 1859–1871* (Leipzig, 1892, and again 1902); and *Geschichte der deutschen Königswahlen* (Leipzig, 1889). See G. Wolf, *Wilhelm Maurenbrecher* (Berlin, 1893).

MAUREPAS, JEAN FRÉDÉRIC PHÉLYPEAUX, COMTE DE (1701–1781), French statesman, was born on the 9th of July 1701 at Versailles, being the son of Jérôme de Pontchartrain, secretary of state for the marine and the royal household. Maurepas succeeded to his father's charge at fourteen, and began his functions in the royal household at seventeen, while in 1725 he undertook the actual administration of the navy. Although essentially light and frivolous in character, Maurepas was seriously interested in scientific matters, and he used the best brains of France to apply science to questions of navigation and of naval construction. He was disgraced in 1749, and exiled from Paris for an epigram against Madame de Pompadour. On the accession of Louis XVI., twenty-five years later, he became a minister of state and Louis XVI.'s chief adviser. He gave Turgot the direction of finance, placed Lamoignon-Malesherbes over the royal household and made Vergennes minister for foreign affairs. At the outset of his new career he showed his weakness by recalling to their functions, in deference to popular clamour, the members of the old parlement ousted by Maupeou, thus reconstituting the most dangerous enemy of the royal power. This step, and his intervention on behalf of the American states, helped to pave the way for the French revolution. Jealous of his personal ascendancy over Louis XVI., he intrigued against Turgot, whose disgrace in 1776 was followed after six months of disorder by the appointment of Necker. In 1781 Maurepas deserted Necker as he had done Turgot, and he died at Versailles on the 21st of November 1781.

Maurepas is credited with contributions to the collection of facetiae known as the *Étrennes de la Saint Jean* (2nd ed., 1742). Four volumes of *Mémoires de Maurepas*, purporting to be collected by his secretary and edited by J. L. G. Soulavie in 1792, must be regarded as apocryphal. Some of his letters were published in 1896 by the *Soc. de l'hist. de Paris.* His *éloge* in the Academy of Sciences was pronounced by Condorcet.

MAURER, GEORG LUDWIG VON (1790–1872), German statesman and historian, son of a Protestant pastor, was born at Erpolzheim, near Dürkheim, in the Rhenish Palatinate, on the 2nd of November 1790. Educated at Heidelberg, he went in 1812 to reside in Paris, where he entered upon a systematic study of the ancient legal institutions of the Germans. Returning to Germany in 1814, he received an appointment under the Bavarian government, and afterwards filled several important official positions. In 1824 he published at Heidelberg his *Geschichte des altgermanischen und namentlich altbayrischen öffentlichmündlichen Gerichtsverfahrens*, which obtained the first prize of the academy of Munich, and in 1826 he became professor in the university of Munich. In 1829 he returned to official life, and was soon offered an important post. In 1832, when Otto (Otho), son of Louis I., king of Bavaria, was chosen to fill the throne of Greece, a council of regency was nominated during his minority, and Maurer was appointed a member. He applied himself energetically to the task of creating institutions adapted to the requirements of a modern civilized community; but grave difficulties soon arose and Maurer was recalled in 1834, when he returned to Munich. This loss was a serious one for Greece. Maurer was the ablest, most energetic and most liberal-minded member of the council, and it was through his enlightened efforts that Greece obtained a revised penal code, regular tribunals and an improved system of civil procedure. Soon after his recall he published *Das griechische Volk in öffentlicher, kirchlicher, und privatrechtlicher Beziehung vor und nach dem Freiheitskampfe bis zum 31 Juli 1834* (Heidelberg, 1835–1836), a useful source of information for the history of Greece before Otto ascended the throne, and also for the labours of the council of regency to the time of the author's recall. After the fall of the ministry of Karl von Abel (1788–1859) in 1847, he became chief Bavarian minister and head of the departments of foreign affairs and of justice, but was overthrown in the same year. He died at Munich on the 9th of May 1872. His only son, Conrad von Maurer (1823–1902), was a Scandinavian scholar of some repute, and like his father was a professor at the university of Munich.

Maurer's most important contribution to history is a series of books on the early institutions of the Germans. These are: *Einleitung zur Geschichte der Mark-, Hof-, Dorf-, und Stadtverfassung und der öffentlichen Gewalt* (Munich, 1854); *Geschichte der Markenverfassung in Deutschland* (Erlangen, 1856); *Geschichte der Fronhöfe, der Bauernhöfe, und der Hofverfassung in Deutschland* (Erlangen, 1862–1863); *Geschichte der Dorfverfassung in Deutschland* (Erlangen, 1865–1866); and *Geschichte der Städteverfassung in Deutschland* (Erlangen, 1869–1871). These works are still important authorities for the early history of the Germans. Among other works are, *Das Stadt- und Landrechtsbuch Ruprechts von Freising, ein Beitrag zur Geschichte des Schwabenspiegels* (Stuttgart, 1839); *Über die Freipflege (plegium liberale), und die Entstehung der grossen und kleinen Jury in England* (Munich, 1848); and *Über die deutsche Reichsterritorial- und Rechtsgeschichte* (1830).

See K. T. von Heigel, *Denkwürdigkeiten des bayrischen Staatsrats G. L. von Maurer* (Munich, 1903).

MAURETANIA, the ancient name of the north-western angle of the African continent, and under the Roman Empire also of a large territory eastward of that angle. The name had different significations at different times; but before the Roman occupation, Mauretania comprised a considerable part of the modern Morocco *i.e.* the northern portion bounded on the east by Algiers. Towards the south we may suppose it bounded by the Atlas range, and it seems to have been regarded by geographers as extending along the coast to the Atlantic as far as the point where that chain descends to the sea, in about 30 N. lat. (Strabo, p. 825). The magnificent plateau in which the city of Morocco is situated seems to have been unknown to ancient geographers, and was certainly never included in the Roman Empire. On the other hand, the Gaetulians to the south of the Atlas range, on the date-producing slopes towards the Sahara, seem to have owned a precarious subjection to the kings of Mauretania, as afterwards to the Roman government. A large part of the country is of great natural fertility, and in ancient times produced large quantities of corn, while the slopes of Atlas were clothed with forests, which, besides other kinds of timber, produced the celebrated ornamental wood called *citrum* (Plin. *Hist. Nat.* 13–96), for tables of which the Romans gave fabulous prices. (For physical geography, see Morocco.)

Mauretania, or Maurusia as it was called by Greek writers, signified the land of the Mauri, a term still retained in the modern name of Moors (*q.v.*). The origin and ethnical affinities of the race are uncertain; but it is probable that all the inhabitants of this northern tract of Africa were kindred races belonging to the great Berber family, possibly with an intermingled fair-skinned race from Europe (see Tissot, *Géographie comparée de la province romaine d'Afrique*, i. 400 seq.; also Berbers). They first appear in history at the time of the Jugurthine War (110–106 B.C.), when Mauretania was under the government of Bocchus and seems to have been recognized as organized state (Sallust, *Jugurtha*, 19). To this Bocchus was given, after the war, the western part of Jugurtha's kingdom of Numidia, perhaps as far east as Saldae (Bougie). Sixty years later, at the time of the dictator Caesar, we find two Mauretanian kingdoms, one to the west of the river Mulucha under Bogud, and the other to the east under a Bocchus; as to the date or cause of the division we are ignorant. Both these kings took Caesar's part in the civil wars, and had their territory enlarged by him (Appian, B.C. 4, 54). In 25 B.C., after their deaths, Augustus gave the two kingdoms to Juba II. of Numidia (see under Juba), with the river Ampsaga as the eastern frontier (Plin. 5. 22; Ptol. 4. 3. 1). Juba and his son Ptolemaeus after him reigned till A.D. 40, when the latter was put to death by Caligula, and shortly afterwards Claudius incorporated the kingdom into the Roman state as two provinces, viz. Mauretania Tingitana to the west of the Mulucha and M. Caesariensis to the east of that river, the latter taking its name from the city Caesarea (formerly Iol), which Juba had thus named and adopted as his capital. Thus the dividing line between the two provinces was the same as that which had originally separated Mauretania from Numidia (*q.v.*). These provinces were governed until the time of Diocletian by imperial procurators, and were occasionally united for military purposes. Under and after Diocletian M. Tingitana was attached administratively to the *dioicesis* of Spain, with which it was in all respects closely connected; while M. Caesariensis was divided by making its eastern part into a separate government, which was called M. Sitifensis from the Roman colony Sitifis.

In the two provinces of Mauretania there were at the time of Pliny a number of towns, including seven (possibly eight) Roman colonies in M. Tingitana and eleven in M. Caesariensis; others were added later. These were mostly military foundations, and served the purpose of securing civilization against the inroads of the natives, who were not in a condition to be used as material for town-life as in Gaul and Spain, but were under the immediate government of the procurators, retaining their own clan organization. Of these colonies the most important, beginning from the west, were Lixus on the Atlantic, Tingis (Tangier), Rusaddir (Melila, Melilla), Cartenna (Tenes), Iol or Caesarea (Cherchel), Icosium (Algiers), Saldae (Bougie), Igilgili (Jijelli) and Sitifis (Setif). All these were on the coast but the last, which was some distance inland. Besides these there were many municipia or *oppida civium romanorum* (Plin. 5. 19 seq.), but, as has been made clear by French archaeologists who have explored these regions, Roman settlements are less frequent the farther we go west, and M. Tingitana has as yet yielded but scanty evidence of Roman civilization. On the whole Mauretania was in a flourishing condition down to the irruption of the Vandals in A.D. 429; in the *Notitia* nearly a hundred and seventy episcopal sees are enumerated here, but we must remember that numbers of these were mere villages.

In 1904 the term Mauretania was revived as an official designation by the French government, and applied to the territory north of the lower Senegal under French protection (see Senegal).

To the authorities quoted under Africa, Roman, may be added here Göbel, *Die West-küste Afrikas im Alterthum.* (W. W. F.*)

MAURIAC, a town of central France, capital of an arrondissement in the department of Cantal, 39 m. N.N.W. of Aurillac by rail. Pop. (1906), 2558. Mauriac, built on the slope of a volcanic hill, has a church of the 12th century, and the buildings of an old abbey now used as public offices and dwellings; the town owes its origin to the abbey, founded during the 6th century. It is the seat of a sub-prefect and has a tribunal of first instance and a communal college. There are marble quarries in the vicinity.

MAURICE [or Mauritius], **ST** (d. *c.* 286), an early Christian martyr, who, with his companions, is commemorated by the Roman Catholic Church on the 22nd of September. The oldest form of his story is found in the *Passio* ascribed to Eucherius, bishop of Lyons, *c.* 450, who relates how the "Theban" legion commanded by Mauritius was sent to north Italy to reinforce the army of Maximinian. Maximinian wished to use them in persecuting the Christians, but as they themselves were of this faith, they refused, and for this, after having been twice decimated, the legion was exterminated at Octodurum (Martigny) near Geneva. In late versions this legend was expanded and varied, the martyrdom was connected with a refusal to take part in a great sacrifice ordered at Octodurum and the name of Exsuperius was added to that of Mauritius. Gregory of Tours (*c.* 539–593) speaks of a company of the same legion which suffered at Cologne.

The *Magdeburg Centuries*, in spite of Mauritius being the patron saint of Magdeburg, declared the whole legend fictitious; J. A. du Bordien *La Légion thébéenne* (Amsterdam, 1705); J. J. Hottinger in *Helvetische Kirchengeschichte* (Zürich, 1708); and F. W. Rettberg, *Kirchengeschichte Deutschlands* (Göttingen, 1845–1848) have also demonstrated its untrustworthiness, while the Bollandists, De Rivaz and Joh. Friedrich uphold it. Apart from the a priori improbability of a whole legion being martyred, the difficulties are that in 286 Christians everywhere throughout the empire were not molested, that at no later date have we evidence of the presence of Maximinian in the Valais, and that none of the writers nearest to the event (Eusebius, Lactantius, Orosius, Sulpicius Severus) know anything of it. It is of course quite possible that isolated cases of officers being put to death for their faith occurred during Maximinian's reign, and on some such cases the legend may have grown up during the century and a half between Maximinian and Eucherius. The cult of St Maurice and the Theban legion is found in Switzerland (where two places bear the name in Valais, besides St Moritz in Grisons), along the Rhine, and in north Italy. The foundation of the abbey of St Maurice (Agaunum) in the Valais is usually ascribed to Sigismund of Burgundy (515). Relics of the saint are preserved here and at Brieg and Turin.

MAURICE (MAURICIUS FLAVIUS TIBERIUS) (*c.* 539–602), East Roman emperor from 582 to 602, was of Roman descent, but a native of Arabissus in Cappadocia. He spent his youth at the court of Justin II., and, having joined the army, fought with distinction in the Persian War (578–581). At the age of forty-three he was declared Caesar by the dying emperor Tiberius II., who bestowed upon him the hand of his daughter Constantina. Maurice brought the Persian War to a successful close by the restoration of Chosroes II. to the throne (591). On the northern frontier he at first bought off the Avars by payments which compelled him to exercise strict economy in his general administration, but after 595 inflicted several defeats upon them through his general Crispus. By his strict discipline and his refusal to ransom a captive corps he provoked to mutiny the army on the Danube. The revolt spread to the popular factions in Constantinople, and Maurice consented to abdicate. He withdrew to Chalcedon, but was hunted down and put to death after witnessing the slaughter of his five sons.

The work on military art (στρατηγικά) ascribed to him is a contemporary work of unknown authorship (ed. Scheffer, *Arriani tactica et Mauricii ars militaris*, Upsala, 1664; see Max Jähns, *Gesck. d. Kriegswissensch.*, i. 152–156).

See Theophylactus Simocatta, *Vita Mauricii* (ed. de Boor, 1887); E. Gibbon, *The Decline and Fall of the Roman Empire* (ed. Bury, London, 1896, v. 19–21, 57); J. B. Bury, *The Later Roman Empire* (London, 1889, ii. 83–94); G. Finlay, *History of Greece* (ed. 1877, Oxford, i. 299–306).

MAURICE (1521–1553), elector of Saxony, elder son of Henry, duke of Saxony, belonging to the Albertine branch of the Wettin family, was born at Freiberg on the 21st of March 1521. In January 1541 he married Agnes, daughter of Philip, landgrave of Hesse. In that year he became duke of Saxony by his father's death, and he continued Henry's work in forwarding the progress of the Reformation. Duke Henry had decreed that his lands should be divided between his two sons, but as a partition was regarded as undesirable the whole of the duchy came to his elder son. Maurice, however, made generous provision for his brother Augustus, and the desire to compensate him still further was one of the minor threads of his subsequent policy. In 1542 he assisted the emperor Charles V. against the Turks, in 1543 against William, duke of Cleves, and in 1544 against the French; but his ambition soon took a wider range. The harmonious relations which subsisted between the two branches of the Wettins were disturbed by the interference of Maurice in Cleves, a proceeding distasteful to the Saxon elector, John Frederick; and a dispute over the bishopric of Meissen having widened the breach, war was only averted by the mediation of Philip of Hesse and Luther. About this time Maurice seized the idea of securing for himself the electoral dignity held by John Frederick, and his opportunity came when Charles was preparing to attack the league of Schmalkalden. Although educated as a Lutheran, religious questions had never seriously appealed to Maurice. As a youth he had joined the league of Schmalkalden, but this adhesion, as well as his subsequent declaration to stand by the confession of Augsburg, cannot be regarded as the decision of his maturer years. In June 1546 he took a decided step by making a secret agreement with Charles at Regensburg. Maurice was promised some rights over the archbishopric of Magdeburg and the bishopric of Halberstadt; immunity, in part at least, for his subjects from the Tridentine decrees; and the question of transferring the electoral dignity was discussed. In return the duke probably agreed to aid Charles in his proposed attack on the league as soon as he could gain the consent of the Saxon estates, or at all events to remain neutral during the impending war. The struggle began in July 1546, and in October Maurice declared war against John Frederick. He secured the formal consent of Charles to the transfer of the electoral dignity and took the field in November. He had gained a few successes when John Frederick hastened from south Germany to defend his dominions. Maurice's ally, Albert Alcibiades, prince of Bayreuth, was taken prisoner at Rochlitz; and the duke, driven from electoral Saxony, was unable to prevent his own lands from being overrun. Salvation, however, was at hand. Marching against John Frederick, Charles V., aided by Maurice, gained a decisive victory at Mühlberg in April 1547, after which by the capitulation of Wittenberg John Frederick renounced the electoral dignity in favour of Maurice, who also obtained a large part of his kinsman's lands. The formal investiture of the new elector took place at Augsburg in February 1548.

The plans of Maurice soon took a form less agreeable to the emperor. The continued imprisonment of his father-in-law, Philip of Hesse, whom he had induced to surrender to Charles and whose freedom he had guaranteed, was neither his greatest nor his only cause of complaint. The emperor had refused to complete the humiliation of the family of John Frederick; he had embarked upon a course of action which boded danger to the elector's Lutheran subjects, and his increased power was a menace to the position of Maurice. Assuring Charles of his continued loyalty, the elector entered into negotiations with the discontented Protestant princes. An event happened which gave him a base of operations, and enabled him to mask his schemes against the emperor. In 1550 he had been entrusted with the execution of the imperial ban against the city of Magdeburg, and under cover of these operations he was able to collect troops and to concert measures with his allies. Favourable terms were granted to Magdeburg, which surrendered and remained in the power of Maurice, and in January 1552 a treaty was concluded with Henry II. of France at Chambord. Meanwhile Maurice had refused to recognize the *Interim* issued from Augsburg in May 1548 as binding on Saxony; but a compromise was arranged on the basis of which the Leipzig *Interim* was drawn up for his lands. It is uncertain how far Charles was ignorant of the elector's preparations, but certainly he was unprepared for the attack made by Maurice and his allies in March 1552. Augsburg was taken, the pass of Ehrenberg was forced, and in a few days the emperor left Innsbruck as a fugitive. Ferdinand undertook to make peace, and the Treaty of Passau, signed in August 1552, was the result. Maurice obtained a general amnesty and freedom for Philip of Hesse, but was unable to obtain a perpetual religious peace for the Lutherans. Charles stubbornly insisted that this question must be referred to the Diet, and Maurice was obliged to give way. He then fought against the Turks, and renewed his communications with Henry of France. Returning from Hungary the elector placed himself at the head of the princes who were seeking to check the career of his former ally, Albert Alcibiades, whose depredations were making him a curse to Germany. The rival armies met at Sievershausen on the 9th of July 1553, where after a fierce encounter Albert was defeated. The victor, however, was wounded during the fight and died two days later.

Maurice was a friend to learning, and devoted some of the secularized church property to the advancement of education. Very different estimates have been formed of his character. He has been represented as the saviour of German Protestantism on the one hand, and on the other as a traitor to his faith and country. In all probability he was neither the one nor the other, but a man of great ambition who, indifferent to religious considerations, made good use of the exigencies of the time. He was generous and enlightened, a good soldier and a clever diplomatist. He left an only daughter Anna (d. 1577), who became the second wife of William the Silent, prince of Orange.

The elector's *Politische Korrespondenz* has been edited by E. Brandenburg (Leipzig, 1900–1904); and a sketch of him is given by Roger Ascham in *A Report and Discourse of the Affairs and State of Germany* (London, 1864–1865). See also F. A. von Langenn, *Moritz Herzog und Churfürst zu Sachsen* (Leipzig, 1841); G. Voigt, *Moritz von Sachsen* (Leipzig, 1876); E. Brandenburg, *Moritz von Sachsen* (Leipzig, 1898); S. Issleib, *Moritz von Sachsen als protestantischer Fürst* (Hamburg, 1898); J. Witter, *Die Beziehung und der Verkehr des Kurfürsten Moritz mit König Ferdinand* (Jena, 1886); L. von Ranke, *Deutsche Geschichte im Zeitalter der Reformation*, Bde. IV. and V. (Leipzig, 1882); and W. Maurenbrecher in the *Allgemeine deutsche Biographie*, Bd. XXII. (Leipzig, 1885). For bibliography see Maurenbrecher; and *The Cambridge Modern History*, vol. ii. (Cambridge, 1903).

MAURICE, JOHN FREDERICK DENISON (1805–1872), English theologian, was born at Normanston, Suffolk, on the 29th of August, 1805. He was the son of a Unitarian minister, and entered Trinity College, Cambridge, in 1823, though it was then impossible for any but members of the Established Church to obtain a degree. Together with John Sterling (with whom he founded the Apostles' Club) he migrated to Trinity Hall, whence he obtained a first class in civil law in 1827; he then came to London, and gave himself to literary work, writing a novel, *Eustace Conyers*, and editing the *London Literary Chronicle* until 1830, and also for a short time the *Athenaeum*. At this time he was much perplexed as to his religious opinions, and he ultimately found relief in a decision to take a further university course and to seek Anglican orders. Entering Exeter College, Oxford, he took a second class in classics in 1831. He was ordained in 1834, and after a short curacy at Bubbenhall in Warwickshire was appointed chaplain of Guy's Hospital, and became thenceforward a sensible factor in the intellectual and social life of London. From 1839 to 1841 Maurice was editor of the *Education Magazine*. In 1840 he was appointed professor of English history and literature in King's College, and to this post in 1846 was added the chair of divinity. In 1845 he was Boyle lecturer and Warburton lecturer. These chairs he held till 1853. In that year he published *Theological Essays*, wherein were stated opinions which savoured to the principal, Dr R. W. Jelf, and to the council, of unsound theology in regard to eternal punishment. He had previously been called on to clear himself from charges of heterodoxy brought against him in the *Quarterly Review* (1851), and had been acquitted by a committee of inquiry. Now again he maintained with great warmth of conviction that his views were in close accordance with Scripture and the Anglican standards, but the council, without specifying any distinct "heresy" and declining to submit the case to the judgment of competent theologians, ruled otherwise, and he was deprived of his professorships. He held at the same time the chaplaincy of Lincoln's Inn, for which he had resigned Guy's (1846–1860), but when he offered to resign this the benchers refused. Nor was he assailed in the incumbency of St. Peter's, Vere Street, which he held for nine years (1860–1869), and where he drew round him a circle of thoughtful people. During the early years of this period he was engaged in a hot and bitter controversy with H. L. Mansel (afterwards dean of St Paul's), arising out of the latter's Bampton lecture upon reason and revelation.

During his residence in London Maurice was specially identified with two important movements for education. He helped to found Queen's College for the education of women (1848), and the Working Men's College (1854), of which he was the first principal. He strongly advocated the abolition of university tests (1853), and threw himself with great energy into all that affected the social life of the people. Certain abortive attempts at co-operation among working men, and the movement known as Christian Socialism, were the immediate outcome of his teaching. In 1866 Maurice was appointed professor of moral philosophy at Cambridge, and from 1870 to 1872 was incumbent of St Edward's in that city. He died on the 1st of April 1872.

He was twice married, first to Anna Barton, a sister of John Sterling's wife, secondly to a half-sister of his friend Archdeacon Hare. His son Major-General Sir J. Frederick Maurice (b. 1841), became a distinguished soldier and one of the most prominent military writers of his time.

Those who knew Maurice best were deeply impressed with the spirituality of his character. "Whenever he woke in the night," says his wife, "he was always praying." Charles Kingsley called him "the most beautiful human soul whom God has ever allowed me to meet with." As regards his intellectual attainments we may set Julius Hare's verdict "the greatest mind since Plato" over against Ruskin's "by nature puzzle-headed and indeed wrong-headed." Such contradictory impressions bespeak a life made up of contradictory elements. Maurice was a man of peace, yet his life was spent in a series of conflicts; of deep humility, yet so polemical that he often seemed biased; of large charity, yet bitter in his attack upon the religious press of his time; a loyal churchman who detested the label "Broad," yet poured out criticism upon the leaders of the Church. With an intense capacity for visualizing the unseen, and a kindly dignity, he combined a large sense of humour. While most of the "Broad Churchmen" were influenced by ethical and emotional considerations in their repudiation of the dogma of everlasting torment, he was swayed by purely intellectual and theological arguments, and in questions of a more general liberty he often opposed the proposed Liberal theologians, though he as often took their side if he saw them hard pressed. He had a wide metaphysical and philosophical knowledge which he applied to the history of theology. He was a strenuous advocate of ecclesiastical control in elementary education, and an opponent of the new school of higher biblical criticism, though so far an evolutionist as to believe in growth and development as applied to the history of nations.

As a preacher, his message was apparently simple; his two great convictions were the fatherhood of God, and that all religious systems which had any stability lasted because of a portion of truth which had to be disentangled from the error differentiating them from the doctrines of the Church of England as understood by himself. His love to God as his Father was a passionate adoration which filled his whole heart. The prophetic, even apocalyptic, note of his preaching was particularly impressive. He prophesied in London as Isaiah prophesied to the little towns of Palestine and Syria, "often with dark foreboding, but seeing through all unrest and convulsion the working out of a sure divine purpose." Both at King's College and at Cambridge Maurice gathered round him a band of earnest students, to whom he directly taught much that was valuable drawn from wide stores of his own reading, wide rather than deep, for he never was, strictly speaking, a learned man. Still more did he encourage the habit of inquiry and research, more valuable than his direct teaching. In his Socratic power of convincing his pupils of their ignorance he did more than perhaps any other man of his time to awaken in those who came under his sway the desire for knowledge and the process of independent thought.

As a social reformer, Maurice was before his time, and gave his eager support to schemes for which the world was not ready. From an early period of his life in London the condition of the poor pressed upon him with consuming force; the enormous magnitude of the social questions involved was a burden which he could hardly bear. For many years he was the clergyman whom working men of all opinions seemed to trust even if their faith in other religious men and all religious systems had faded, and he had a marvellous power of attracting the zealot and the outcast.

His works cover nearly 40 volumes, often obscure, often tautological, and with no great distinction of style. But their high purpose and philosophical outlook give his writings a permanent place in the history of the thought of his time. The following are the more important works—some of them were rewritten and in a measure recast, and the date given is not necessarily that of the first appearance of the book, but of its more complete and abiding form: *Eustace Conway, or the Brother and Sister*, a novel (1834); *The Kingdom of Christ* (1842); *Christmas Day and Other Sermons* (1843); *The Unity of the New Testament* (1844); *The Epistle to the Hebrews* (1846); *The Religions of the World* (1847); *Moral and Metaphysical Philosophy* (at first an article in the *Encyclopaedia Metropolitana*, 1848); *The Church a Family* (1850); *The Old Testament* (1851); *Theological Essays* (1853); *The Prophets and Kings of the Old Testament* (1853); *Lectures on Ecclesiastical History* (1854); *The Doctrine of Sacrifice* (1854); *The Patriarchs and Lawgivers of the Old Testament* (1855); *The Epistles of St John* (1857); *The Commandments as Instruments of National Reformation* (1866); *On the Gospel of St Luke* (1868); *The Conscience: Lectures on Casuistry* (1868); *The Lord's Prayer, a Manual* (1870). The greater part of these works were first delivered as sermons or lectures. Maurice also contributed many prefaces and introductions to the works of friends, as to Archdeacon Hare's *Charges*, Kingsley's *Saint's Tragedy*, &c.

See *Life* by his son (2 vols., London, 1884), and a monograph by C. F. G. Masterman (1907) in "Leader of the Church" series; W. E. Collins in *Typical English Churchmen*, pp. 327-360 (1902), and T. Hughes in *The Friendship of Books* (1873).

MAURICE OF NASSAU, prince of Orange (1567–1625), the second son of William the Silent, by Anna, only daughter of the famous Maurice, elector of Saxony, was born at Dillenburg. At the time of his father's assassination in 1584 he was being educated at the university of Leiden, at the expense of the states of Holland and Zeeland. Despite his youth he was made stadtholder of those two provinces and president of the council of state. During the period of Leicester's governorship he remained in the background, engaged in acquiring a thorough knowledge of the military art, and in 1586 the States of Holland conferred upon him the title of prince. On the withdrawal of Leicester from the Netherlands in August 1587, Johan van Oldenbarneveldt, the advocate of Holland, became the leading statesman of the country, a position which he retained for upwards of thirty years. He had been a devoted adherent of William the Silent and he now used his influence to forward the interests of Maurice. In 1588 he was appointed by the States-General captain and admiral-general of the Union, in 1590 he was elected stadtholder of Utrecht and Overysel, and in 1591 of Gelderland. From this time forward, Oldenbarneveldt at the head of the civil government and Maurice in command of the armed forces of the republic worked together in the task of rescuing the United Netherlands from Spanish domination (for details see Holland). Maurice soon showed himself to be a general second in skill to none of his contemporaries. He was especially famed for his consummate knowledge of the science of sieges. The twelve years' truce on the 9th of April 1609 brought to an end the cordial relations between Maurice and Oldenbarneveldt. Maurice was opposed to the truce, but the advocate's policy triumphed and henceforward there was enmity between them. The theological disputes between the Remonstrants and contra-Remonstrants found them on different sides; and the theological quarrel soon became a political one. Oldenbarneveldt, supported by the states of Holland, came forward as the champion of provincial sovereignty against that of the states-general; Maurice threw the weight of his sword on the side of the union. The struggle was a short one, for the army obeyed the general who had so often led them to victory. Oldenbarneveldt perished on the scaffold, and the share which Maurice had in securing the illegal condemnation by a packed court of judges of the aged patriot must ever remain a stain upon his memory.

Maurice, who had on the death of his elder brother Philip William, in February 1618, become prince of Orange, was now supreme in the state, but during the remainder of his life he sorely missed the wise counsels of the experienced Oldenbarneveldt. War broke out again in 1621, but success had ceased to accompany him on his campaigns. His health gave way, and he died, a prematurely aged man, at the Hague on the 4th of April 1625. He was buried by his father's side at Delft.

Bibliography.—I. Commelin, *Wilhelm en Maurits v. Nassau, pr. v. Orangien, haer leven en bedrijf* (Amsterdam, 1651); G. Groen van Prinsterer, *Archives ou correspondance de la maison d'Orange-Nassau*, 1e série, 9 vols. (Leiden, 1841–1861); G. Groen van Prinsterer, *Maurice et Barneveldt* (Utrecht, 1875); J. L. Motley, *Life and Death of John of Barneveldt* (2 vols., The Hague, 1894); C. M. Kemp, v.d. *Maurits v. Nassau, prins v. Oranje in zijn leven en verdiensten* (4 vols., Rotterdam, 1843); M. O. Nutting, *The Days of Prince Maurice* (Boston and Chicago, 1894).

MAURISTS, a congregation of French Benedictines called after St Maurus (d. 565), a disciple of St Benedict and the legendary introducer of the Benedictine rule and life into Gaul.[1] At the end of the 16th century the Benedictine monasteries of France had fallen into a state of disorganization and relaxation. In the abbey of St Vaune near Verdun a reform was initiated by Dom Didier de la Cour, which spread to other houses in Lorraine, and in 1604 the reformed congregation of St Vaune was established, the most distinguished members of which were Ceillier and Calmet. A number of French houses joined the new congregation; but as Lorraine was still independent of the French crown, it was considered desirable to form on the same lines a separate congregation for France. Thus in 1621 was established the famous French congregation of St Maur. Most of the Benedictine monasteries of France, except those belonging to Cluny, gradually joined the new congregation, which eventually embraced nearly two hundred houses. The chief house was Saint-Germain-des-Prés, Paris, the residence of the superior-general and centre of the literary activity of the congregation. The primary idea of the movement was not the undertaking of literary and historical work, but the return to a strict monastic régime, and the faithful carrying out of Benedictine life; and throughout the most glorious period of Maurist history the literary work was not allowed to interfere with the due performance of the choral office and the other duties of the monastic life. Towards the end of the 18th century a tendency crept in, in some quarters, to relax the monastic observances in favour of study; but the constitutions of 1770 show that a strict monastic régime was maintained until the end. The course of Maurist history and work was checkered by the ecclesiastical controversies that distracted the French Church during the 17th and 18th centuries. Some of the members identified themselves with the Jansenist cause; but the bulk, including nearly all the greatest names, pursued a middle path, opposing the lax moral theology condemned in 1679 by Pope Innocent XI., and adhering to those strong views on grace and predestination associated with the Augustinian and Thomist schools of Catholic theology; and like all the theological faculties and schools on French soil, they were bound to teach the four Gallican articles. It seems that towards the end of the 18th century a rationalistic and free-thinking spirit invaded some of the houses. The congregation was suppressed and the monks scattered at the revolution, the last superior-general with forty of his monks dying on the scaffold in Paris. The present French congregation of Benedictines initiated by Dom Guéranger in 1833 is a new creation and has no continuity with the congregation of St Maur.

The great claim of the Maurists to the gratitude and admiration of posterity is their historical and critical school, which stands quite alone in history, and produced an extraordinary number of colossal works of erudition which still are of permanent value. The foundations of this school were laid by Dom Tarisse, the first superior-general, who in 1632 issued instructions to the superiors of the monasteries to train the young monks in the habits of research and of organized work. The pioneers in production were Ménard and d'Achery.

The following tables give, divided into groups, the most important Maurist works, along with such information as may be useful to students. All works are folio when not otherwise noted:—

I.—The Editions of the Fathers

Epistle of Barnabas (editio princeps)	Ménard	1645	1 in4to
Lanfranc	d'Achery	1648	1
Guibert of Nogent	d'Achery	1651	1
Robert Pulleyn and Peter of Poitiers	Mathou	1655	1
Bernard	Mabillon	1667	2
Anselm	Gerberon	1675	1
Cassiodorus	Garet	1679	1
Augustine (see Kukula, *Die Mauriner-Ausgabe des Augustinus*, 1898)	Delfau, Blampin, Coustant, Guesnie	1681–1700	11
Ambrose	du Frische	1686–1690	2
Acta martyrum sincera	Ruinart	1689	1
Hilary	Coustant	1693	1
Jerome	Martianay	1693–1706	5
Athanasius	Loppin and Montfaucon	1698	3
Gregory of Tours	Ruinart	1699	1
Gregory the Great	Sainte-Marthe	1705	4
Hildebert of Tours	Beaugendre	1708	1
Irenaeus	Massuet	1710	1
Chrysostom	Montfaucon	1718–1738	13
Cyril of Jerusalem	Touttée and Maran	1720	1
Epistolae romanorum pontificum [2]	Coustant	1721	1
Basil	Garnier and Maran	1721–1730	3
Cyprian	(Baluze, not a Maurist) finished by Maran	1726	1
Origen	Ch. de la Rue (1, 2, 3) V. de la Rue (4)	1733–1759	4
Justin and the Apologists	Maran	1742	1
Gregory Nazianzen [3]	Maran and Clémencet	1778	1

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[1] His festival is kept on the 15th of January. He founded the monastery of Glanfeuil or St Maur-sur-Loire.

[2] 14 vols. of materials collected for the continuation are at Paris.

[3] The printing of vol. ii. was impeded by the Revolution.

II.—Biblical Works

St Jerome's Latin Bible	Martianay	1693	1
Origen's Hexapla	Montfaucon	1713	2
Old Latin versions	Sabbathier	1743–1749	3

III.—Great Collections of Documents

Spicilegium	d'Achery	1655–1677	13 in 4^{to}
Veterae analecta	Mabillon	1675–1685	4 in 8^{vo}
Musaeum italicum	Mabillon	1687–1689	2 in 4^{to}
Collectio nova patrum graecorum	Montfaucon	1706	2
Thesaurus novus anecdotorum	Martène and Durand	1717	5
Veterum scriptorum collectio	Martène and Durand	1724–1733	9
De antiquis ecclesiae ritibus	Martène (Final form)	1690–1706 1736–1738	4

IV.—Monastic History

Acta of the Benedictine Saints	d'Achery, Mabillon and Ruinart	1668–1701	9
Benedictine Annals (to 1157)	Mabillon (1–4), Massuet (5), Martène (6)	1703–1739	6

V.—Ecclesiastical History and Antiquities of France

A.—*General.*

Gallia christiana (3 other vols. were published 1856–1865)	Sainte-Marthe (1, 2, 3)	1715–1785	13
Monuments de la monarchie française	Montfaucon	1729–1733	5
Histoire littéraire de la France (16 other vols. were published 1814–1881)	Rivet, Clémencet, Clément	1733–1763	12 in 4^{to}
Recueil des historiens de la France (4 other vols. were published 1840–1876)	Bouquet (1–8), Brial (12–19)	1738–1833	19
Concilia Galliae (the printing of vol. ii. was interrupted by the Revolution; there were to have been 8 vols.	Labbat	1789	1

B.—*Histories of the Provinces.*

Bretagne	Lobineau	1707	2
Paris	Félibien and Lobineau	1725	5
Languedoc	Vaissette and de Vic	1730–1745	5
Bourgogne	Plancher (1–3), Merle (4)	1739–1748, 1781	4
Bretagne	Morice	1742–1756	5

VI.—Miscellaneous Works of Technical Erudition

De re diplomatica	Mabillon	1681	1
Ditto Supplement	Mabillon	1704	1
Nouveau traité de diplomatique	Toustain and Tassin	1750–1765	6 in 4^{to}
Paleographia graeca	Montfaucon	1708	1
Bibliotheca coisliniana	Montfaucon	1715	1
Bibliotheca bibliothecarum manuscriptorum nova	Montfaucon	1739	2
L'Antiquité expliqué	Montfaucon	1719–1724	15
New ed. of Du Cange's glossarium	Dantine and Carpentier	1733–1736	6
Ditto Supplement	Carpentier	1766	4
Apparatus ad bibliothecam maximam patrum	le Nourry	1703	2
L'Art de vérifier les dates	Dantine, Durand, Clémencet	1750	1 in 4^{to}
Ed. 2	Clément	1770	1
Ed. 3	Clément	1783–1787	3

The 58 works in the above list comprise 199 great folio volumes and 39 in 4^{to} or 8^{vo}. The full Maurist bibliography contains the names of some 220 writers and more than 700 works. The lesser works in large measure cover the same fields as those in the list, but the number of works of purely religious character, of piety, devotion and edification, is very striking. Perhaps the most wonderful phenomenon of Maurist work is that what was produced was only a portion of what was contemplated and prepared for. The French Revolution cut short many gigantic undertakings, the collected materials for which fill hundreds of manuscript volumes in the Bibliothèque nationale of Paris and other libraries of France. There are at Paris 31 volumes of Berthereau's materials for the Historians of the Crusades, not only in Latin and Greek, but in the oriental tongues; from them have been taken in great measure the *Recueil des historiens des croisades*, whereof 15 folio volumes have been published by the Académie des Inscriptions. There exist also the preparations for an edition of Rufinus and one of Eusebius, and for the continuation of the Papal Letters and of the Concilia Galliae. Dom Caffiaux and Dom Villevielle left 236 volumes of materials for a *Trésor généalogique*. There are Benedictine Antiquities (37 vols.), a Monasticon Gallicanum and a Monasticon Benedictinum (54 vols.). Of the Histories of the Provinces of France barely half a dozen were printed, but all were in hand, and the collections for the others fill 800 volumes of MSS. The materials for a geography of Gaul and France in 50 volumes perished in a fire during the Revolution.

When these figures were considered, and when one contemplates the vastness of the works in progress during any decade of the century 1680–1780; and still more, when not only the quantity but the quality of the work, and the abiding value of most of it is realized, it will be recognized that the output was prodigious and unique in the history of letters, as coming from a single society. The qualities that have made Maurist work proverbial for sound learning are its fine critical tact and its thoroughness.

The chief source of information on the Maurists and their work is Dom Tassin's *Histoire littéraire de la congregation de Saint-Maur* (1770); it has been reduced to a bare bibliography and completed by de Lama, *Bibliothèque des écrivains de la congr. de S.-M.* (1882). The two works of de Broglie, *Mabillon* (2 vols., 1888) and *Montfaucon* (2 vols., 1891), give a charming picture of the inner life of the great Maurists of the earlier generation in the midst of their work and their friends. Sketches of the lives of a few of the chief Maurists will be found in McCarthy's *Principal Writers of the Congr. of S. M.* (1868). Useful information about their literary undertakings will be found in De Lisle's *Cabinet des MSS. de la Bibl. Nat. Fonds St Germain-des-Prés*. General information will be found in the standard authorities: Helyot, *Hist. des ordres religieux* (1718), vi. c. 37; Heimbucher, *Orden und Kongregationen* (1907) i. § 36; Wetzer und Welte, *Kirchenlexicon* (ed. 2) and Herzog-Hauck's *Realencyklopädie* (ed. 3), the latter an interesting appreciation by the Protestant historian Otto Zöckler of the spirit and the merits of the work of the Maurists.

(E. C. B.)

MAURITIUS, an island and British colony in the Indian Ocean (known whilst a French possession as the *Île de France*). It lies between 57° 18′ and 57° 49′ E., and 19° 58′ and 20° 32′ S., 550 m. E. of Madagascar, 2300 m. from the Cape of Good Hope, and 9500 m. from England via Suez. The island is irregularly elliptical—somewhat triangular—in shape, and is 36 m. long from N.N.E. to S.S.W., and about 23 m. broad. It is 130 m. in circumference, and its total area is about 710 sq. m. (For map see MADAGASCAR.) The island is surrounded by coral reefs, so that the ports are difficult of access.

From its mountainous character Mauritius is a most picturesque island, and its scenery is very varied and beautiful. It has been admirably described by Bernardin de St Pierre, who lived in the island towards the close of the 18th century, in *Paul et Virginie*. The most level portions of the coast districts are the north and north-east, all the rest being broken by hills, which vary from 500 to 2700 ft. in height. The principal mountain masses are the north-western or Pouce range, in the district of Port Louis; the south-western, in the districts of Rivière Noire and Savanne; and the south-eastern range, in the Grand Port district. In the first of these, which consists of one principal ridge with several lateral spurs, overlooking Port Louis, are the singular peak of the Pouce (2650 ft.), so called from its supposed resemblance to the human thumb; and the still loftier Pieter Botte (2685 ft.), a tall obelisk of bare rock, crowned with a globular mass of stone. The highest summit in the island is in the south-western mass of hills, the Piton de la Rivière Noire, which is 2711 ft. above the sea. The south-eastern group of hills consists of the Montagne du Bambou, with several spurs running down to the sea. In the interior are extensive fertile plains, some 1200 ft. in height, forming the districts of Moka, Vacois, and Plaines Wilhelms; and from nearly the centre of the island an abrupt peak, the Piton du Milieu de l'Île rises to a height of 1932 ft. Other prominent summits are the Trois Mamelles, the Montagne du Corps de Garde, the Signal Mountain, near Port Louis, and the Morne Brabant, at the south-west corner of the island.

The rivers are small, and none is navigable beyond a few hundred yards from the sea. In the dry season little more than brooks, they become raging torrents in the wet season. The principal stream is the Grande Rivière, with a course of about 10 m. There is a remarkable and very deep lake, called

Grand Bassin, in the south of the island, it is probably the extinct crater of an ancient volcano; similar lakes are the Mare aux Vacois and the Mare aux Joncs, and there are other deep hollows which have a like origin.

Geology.—The island is of volcanic origin, but has ceased to show signs of volcanic activity. All the rocks are of basalt and greyish-tinted lavas, excepting some beds of upraised coral. Columnar basalt is seen in several places. The remains of ancient craters can be distinguished, but their outlines have been greatly destroyed by denudation. There are many caverns and steep ravines, and from the character of the rocks the ascents are rugged and precipitous. The island has few minerals, although iron, lead and copper in very small quantities have in former times been obtained. The greater part of the surface is composed of a volcanic breccia, with here and there lava-streams exposed in ravines, and sometimes on the surface. The commonest lavas are dolerites. In at least two places sedimentary rocks are found at considerable elevations. In the Black River Mountains, at a height of about 1200 ft., there is a clay-slate; and near Midlands, in the Grand Port group of mountains, a chloritic schist occurs about 1700 ft. above the sea, forming the hill of La Selle. This schist is much contorted, but seems to have a general dip to the south or south-east. Evidence of recent elevation of the island is furnished by masses of coral reef and beach coral rock standing at heights of 40 ft. above sea-level in the south, 12 ft. in the north and 7 ft. on the islands situated on the bank extending to the north-east.[1]

Climate.—The climate is pleasant during the cool season of the year, but oppressively hot in summer (December to April), except in the elevated plains of the interior, where the thermometer ranges from 70° to 80° F., while in Port Louis and on the coast generally it ranges from 90° to 96°. The mean temperature for the year at Port Louis is 78·6°. There are two seasons, the cool and comparatively dry season, from April to November, and the hotter season, during the rest of the year. The climate is now less healthy than it was, severe epidemics of malarial fever having frequently occurred, so that malaria now appears to be endemic among the non-European population. The rainfall varies greatly in different parts of the island. Cluny in the Grand Port (south-eastern) district has a mean annual rainfall of 145 in.; Albion on the west coast is the driest station, with a mean annual rainfall of 31 in. The mean monthly rainfall for the whole island varies from 12 in. in March to 2·6 in. in September and October. The Royal Alfred Observatory is situated at Pamplemousses, on the north-west or dry side of the island. From January to the middle of April, Mauritius, in common with the neighbouring islands and the surrounding ocean from 8° to 30° of southern latitude is subject to severe cyclones, accompanied by torrents of rain, which often cause great destruction to houses and plantations. These hurricanes generally last about eight hours, but they appear to be less frequent and violent than in former times, owing, it is thought, to the destruction of the ancient forests and the consequent drier condition of the atmosphere.

Fauna and Flora.—Mauritius being an oceanic island of small size, its present fauna is very limited in extent. When first seen by Europeans it contained no mammals except a large fruit-eating bat (*Pteropus vulgaris*), which is plentiful in the woods; but several mammals have been introduced, and are now numerous in the uncultivated region. Among these are two monkeys of the genera *Macacus* and *Cercopithecus*, a stag (*Cervus hippelaphus*), a small hare, a shrew-mouse, and the ubiquitous rat. A lemur and one of the curious hedgehog-like *Insectivora* of Madagascar (*Centetes ecaudatus*) have probably both been brought from the larger island. The avifauna resembles that of Madagascar; there are species of a peculiar genus of caterpillar shrikes (*Campephagidae*), as well as of the genera *Pratincola*, *Hypsipetes*, *Phedina*, *Tchitrea*, *Zosterops*, *Foudia*, *Collocalia* and *Coracopsis*, and peculiar forms of doves and parakeets. The living reptiles are small and few in number. The surrounding seas contain great numbers of fish; the coral reefs abound with a great variety of molluscs; and there are numerous land-shells. The extinct fauna of Mauritius has considerable interest. In common with the other Mascarene islands, it was the home of the dodo (*Didus ineptus*); there were also *Aphanapteryx*, a species of rail, and a short-winged heron (*Ardea megacephala*), which probably seldom flew. The defenceless condition of these birds led to their extinction after the island was colonized. Considerable quantities of the bones of the dodo and other extinct birds—a rail (*Aphanapteryx*), and a short-winged heron—have been discovered in the beds of some of the ancient lakes (see DODO). Several species of large fossil tortoises have also been discovered; they are quite different from the living ones of Aldabra, in the same zoological region.

Owing to the destruction of the primeval forests for the formation of sugar plantations, the indigenous flora is only seen in parts of the interior plains, in the river valleys and on the hills; and it is not now easy to distinguish between what is native and what has come from abroad. The principal timber tree is the ebony (*Diospyros ebeneum*), which grows to a considerable size. Besides this there are bois de cannelle, olive-tree, benzoin (*Croton Benzoe*), colophane (*Colophonia*), and iron-wood, all of which are useful in carpentry; the coco-nut palm, an importation, but a tree which has been so extensively planted during the last hundred years that it is extremely plentiful; the palmiste (*Palma dactylifera latifolia*), the latanier (*Corypha umbraculifera*) and the date-palm. The vacoa or vacois, (*Pandanus utilis*) is largely grown, the long tough leaves being manufactured into bags for the export of sugar, and the roots being also made of use; and in the few remnants of the original forests the traveller's tree (*Urania speciosa*), grows abundantly. A species of bamboo is very plentiful in the river valleys and in marshy situations. A large variety of fruit is produced, including the tamarind, mango, banana, pine-apple, guava, shaddock, fig, avocado-pear, litchi, custard-apple and the mabolo (*Diospyros discolor*), a fruit of exquisite flavour, but very disagreeable odour. Many of the roots and vegetables of Europe have been introduced, as well as some of those peculiar to the tropics, including maize, millet, yams, manioc, dhol, gram, &c. Small quantities of tea, rice and sago, have been grown, as well as many of the spices (cloves, nutmeg, ginger, pepper and allspice), and also cotton, indigo, betel, camphor, turmeric and vanilla. The Royal Botanical Gardens at Pamplemousses, which date from the French occupation of the island, contain a rich collection of tropical and extra-tropical species.

Inhabitants.—The inhabitants consist of two great divisions, those of European blood, chiefly French and British, together with numerous half-caste people, and those of Asiatic or African blood. The population of European blood, which calls itself Creole, is greater than that of any other tropical colony; many of the inhabitants trace their descent from ancient French families, and the higher and middle classes are distinguished for their intellectual culture. French is more commonly spoken than English. The Creole class is, however, diminishing, though slowly, and the most numerous section of the population is of Indian blood.

The introduction of Indian coolies to work the sugar plantations dates from the period of the emancipation of the slaves in 1834–1839. At that time the negroes who showed great unwillingness to work on their late masters' estates, numbered about 66,000. Immigration from India began in 1834, and at a census taken in 1846, when the total population was 158,462, there were already 56,245 Indians in the island. In 1851 the total population had increased to 180,823, while in 1861 it was 310,050. This great increase was almost entirely due to Indian immigration, the Indian population, 77,996 in 1851, being 192,634 in 1861. From that year the increase in the Indian population has been more gradual but steady, while the non-Indian population has decreased. From 102,827 in 1851 it rose to 117,416 in 1861 to sink to 99,784 in 1871. The figures for the three following census years were:—

	1881.	1891.	1901.
Indians	248,993	255,920	259,086
Others	110,881	114,668	111,937
Total	359,874	370,588	371,023

Including the military and crews of ships in harbour, the total population in 1901 was 373,336.[2] This total included 198,958 Indo-Mauritians, *i.e.* persons of Indian descent born in Mauritius, and 62,022 other Indians. There were 3,509 Chinese, while the remaining 108,847 included persons of European, African or mixed descent, Malagasy, Malays and Sinhalese. The Indian female population increased from 51,019 in 1861 to 115,986 in 1901. In the same period the non-Indian female population but slightly varied, being 56,070 in 1861 and 55,485 in 1901. The Indo-Mauritians are now dominant in commercial, agricultural and domestic callings, and much town and agricultural land has been transferred from the Creole planters to Indians and Chinese. The tendency to an Indian peasant proprietorship is marked. Since 1864 real property to the value of over £1,250,000 has been acquired by Asiatics. Between 1881 and 1901 the number of sugar estates decreased from 171 to 115, those sold being held in small parcels by Indians. The average death-rate for the period 1873–1901 was 32·6 per 1000. The average birth-rate in the Indian community is 37 per 1000; in the non-Indian community 34 per 1000. Many Mauritian Creoles have emigrated to South Africa. The great increase in the population since 1851 has made Mauritius one of the most densely peopled regions of the world, having over 520 persons per square mile.

Chief Towns.—The capital and seat of government, the city of Port Louis, is on the north-western side of the island, in 20° 10′ S., 57° 30′ E. at the head of an excellent harbour, a deep inlet about a mile long, available for ships of the deepest draught. This is protected by Fort William and Fort George, as well as by the citadel (Fort Adelaide), and it has three graving-docks connected with the inner harbour, the depths alongside quays and berths being from 12 to 28 ft. The trade of the island passes almost entirely through the port. Government House is a three-storeyed structure with broad verandas, of no particular style of architecture, while the Protestant cathedral was formerly a powder magazine, to which a tower and spire have been added. The Roman Catholic cathedral is more pretentious in style, but is tawdry in its interior. There are, besides the town-hall, Royal College, public offices and theatre, large barracks and military stores. Port Louis, which is governed by an elective municipal council, is surrounded by lofty hills and its unhealthy situation is aggravated by the difficulty of effective drainage owing to the small amount of tide in the harbour. Though much has been done to make the town sanitary, including the provision of a good water-supply, the death-rate is generally over 44 per 1000. Consequently all those who can make their homes in the cooler uplands of the interior. As a result the population of the city decreased from about 70,000 in 1891 to 53,000 in 1901. The favourite residential town is Curepipe, where the climate resembles that of the south of France. It is built on the central plateau about 20 m. distant from Port Louis by rail and 1800 ft. above the sea. Curepipe was incorporated in 1888 and had a population (1901) of 13,000. On the railway between Port Louis and Curepipe are other residential towns—Beau Bassin, Rose Hill and Quatre Bornes. Mahébourg, pop. (1901), 4810, is a town on the shores of Grand Port on the south-east side of the island, Souillac a small town on the south coast.

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[1] See *Geog. Journ.* (June 1895), p. 597.

[2] The total population of the colony (including dependencies) on the 1st of January 1907 was estimated at 383,206.

Industries.—The Sugar Plantations: The soil of the island is of considerable fertility; it is a ferruginous red clay, but so largely mingled with stones of all sizes that no plough can be used, and the hoe has to be employed to prepare the ground for cultivation. The greater portion of the plains is now a vast sugar plantation. The bright green of the sugar fields is a striking feature in a view of Mauritius from the sea, and gives a peculiar beauty and freshness to the prospect. The soil is suitable for the cultivation of almost all kinds of tropical produce, and it is to be regretted that the prosperity of the colony depends almost entirely on one article of production, for the consequences are serious when there is a failure, more or less, of the sugar crop. Guano is extensively imported as a manure, and by its use the natural fertility of the soil has been increased to a wonderful extent. Since the beginning of the 20th century some attention has been paid to the cultivation of tea and cotton, with encouraging results. Of the exports, sugar amounts on an average to about 95 % of the total. The quantity of sugar exported rose from 102,000 tons in 1854 to 189,164 tons in 1877. The competition of beet-sugar and the effect of bounties granted by various countries then began to tell on the production in Mauritius, the average crop for the seven years ending 1900–1901 being only 150,449 tons. The Brussels Sugar Convention of 1902 led to an increase in production, the average annual weight of sugar exported for the three years 1904–1906 being 182,000 tons. The value of the crop was likewise seriously affected by the causes mentioned, and by various diseases which attacked the canes. Thus in 1878 the value of the sugar exported was £3,408,000; in 1888 it had sunk to £1,911,000, and in 1898 to £1,632,000. In 1900 the value was £1,922,000, and in 1905 it had risen to £2,172,000. India and the South African colonies between them take some two-thirds of the total produce. The remainder is taken chiefly by Great Britain, Canada and Hong-Kong. Next to sugar, aloe-fibre is the most important export, the average annual export for the five years ending 1906 being 1840 tons. In addition, a considerable quantity of molasses and smaller quantities of rum, vanilla and coco-nut oil are exported. The imports are mainly rice, wheat, cotton goods, wine, coal, hardware and haberdashery, and guano. The rice comes principally from India and Madagascar; cattle are imported from Madagascar, sheep from South Africa and Australia, and frozen meat from Australia. The average annual value of the exports for the ten years 1896–1905 was £2,153,159; the average annual value of the imports for the same period £1,453,089. These figures when compared with those in years before the beet and bounty-fed sugar had entered into severe competition with cane sugar, show how greatly the island had thereby suffered. In 1864 the exports were valued at £2,249,000; in 1868 at £2,339,000; in 1877 at £4,201,000 and in 1880 at £3,634,000. And in each of the years named the imports exceeded £2,000,000 in value. Nearly all the aloe-fibre exported is taken by Great Britain and France, while the molasses goes to India. Among the minor exports is that of *bambara* or sea-slugs, which are sent to Hong-Kong and Singapore. This industry is chiefly in Chinese hands. The great majority of the imports are from Great Britain or British possessions.

The currency of Mauritius is rupees and cents of a rupee, the Indian rupee (=16*d.*) being the standard unit. The metric system of weights and measures has been in force since 1878.

Communications.—There is a regular fortnightly steamship service between Marseilles and Port Louis by the Messageries Maritimes, a four-weekly service with Southampton via Cape Town by the Union Castle, and a four-weekly service with Colombo direct by the British India Co.'s boats. There is also frequent communication with Madagascar, Réunion and Natal. The average annual tonnage of ships entering Port Louis is about 750,000 of which five-sevenths is British. Cable communication with Europe, via the Seychelles, Zanzibar and Aden, was established in 1893, and the Mauritius section of the Cape-Australian cable, via Rodriguez, was completed in 1902.

Railways connect all the principal places and sugar estates on the island, that known as the Midland line, 36 miles long, beginning at Port Louis crosses the island to Mahébourg, passing through Curepipe, where it is 1822 ft. above the sea. There are in all over 120 miles of railway, all owned and worked by the government. The first railway was opened in 1864. The roads are well kept and there is an extensive system of tramways for bringing produce from the sugar estates to the railway lines. Traction engines are also largely used. There is a complete telegraphic and telephonic service.

Government and Revenue.—Mauritius is a crown colony. The governor is assisted by an executive council of five official and two elected members, and a legislative council of 27 members, 8 sitting *ex officio*, 9 being nominated by the governor and 10 elected on a moderate franchise. Two of the elected members represent St Louis, the 8 rural districts into which the island is divided electing each one member. At least one-third of the nominated members must be persons not holding any public office. The number of registered electors in 1908 was 6186. The legislative session usually lasts from April to December. Members may speak either in French or English. The average annual revenue of the colony for the ten years 1896–1905, was £608,245, the average annual expenditure during the same period £663,606. Up to 1854 there was a surplus in hand, but since that time expenditure has on many occasions exceeded income, and the public debt in 1908 was £1,305,000, mainly incurred however on reproductive works.

The island has largely retained the old French laws, the *codes civil, de procédure, du commerce*, and *d'instruction criminelle* being still in force, except so far as altered by colonial ordinances. A supreme court of civil and criminal justice was established in 1831 under a chief judge and three puisne judges.

Religion and Education.—The majority of the European inhabitants belong to the Roman Catholic faith. They numbered at the 1901 census 117,102, and the Protestants 6644. Anglicans, Roman Catholics and the Church of Scotland are helped by state grants. At the head of the Anglican community is the bishop of Mauritius; the chief Romanist dignitary is styled bishop of Port Louis. The Mahommedans number over 30,000, but the majority of the Indian coolies are Hindus.

The educational system, as brought into force in 1900, is under a director of public instruction assisted by an advisory committee, and consists of two branches (1) superior or secondary instruction, (2) primary instruction. For primary instruction there are government schools and schools maintained by the Roman Catholics, Protestants and other faiths, to which the government gives grants in aid. In 1908 there were 67 government schools with 8400 scholars and 90 grant schools with 10,200 scholars, besides Hindu schools receiving no grant. The Roman Catholic scholars number 67·72 %; the Protestants 3·80 %; Mahommedans 8·37 %; and Hindus and others 20·11 %. Secondary and higher education is given in the Royal College and associated schools at Port Louis and Curepipe.

Defence.—Mauritius occupies an important strategic position on the route between South Africa and India and in relation to Madagascar and East Africa, while in Port Louis it possesses one of the finest harbours in the Indian Ocean. A permanent garrison of some 3000 men is maintained in the island at a cost of about £180,000 per annum. To the cost of the troops Mauritius contributes 5½ % of its annual revenue—about £30,000.

History.—Mauritius appears to have been unknown to European nations, if not to all other peoples, until the year 1505, when it was discovered by Mascarenhas, a Portuguese navigator. It had then no inhabitants, and there seem to be no traces of a previous occupation by any people. The island was retained for most of the 16th century by its discoverers, but they made no settlements in it. In 1598 the Dutch took possession, and named the island "Mauritius," in honour of their stadtholder, Count Maurice of Nassau. It had been previously called by the Portuguese "Ilha do Cerné," from the belief that it was the island so named by Pliny. But though the Dutch built a fort at Grand Port and introduced a number of slaves and convicts, they made no permanent settlement in Mauritius, finally abandoning the island in 1710. From 1715 to 1767 (when the French government assumed direct control) the island was held by agents of the French East India Company, by whom its name was again changed to "Île de France." The Company was fortunate in having several able men as governors of its colony, especially the celebrated Mahé de Labourdonnais (*q.v.*), who made sugar planting the main industry of the inhabitants.[1] Under his direction roads were made, forts built, and considerable portions of the forest were cleared, and the present capital, Port Louis, was founded. Labourdonnais also promoted the planting of cotton and indigo, and is remembered as the most enlightened and best of all the French governors. He also put down the maroons or runaway slaves who had long been the pest of the island. The colony continued to rise in value during the time it was held by the French crown, and to one of the intendants,[2] Pierre Poivre, was due the introduction of the clove, nutmeg and other spices. Another governor was D'Entrecasteaux, whose name is kept in remembrance by a group of islands east of New Guinea.

During the long war between France and England, at the commencement of the 19th century, Mauritius was a continual source of much mischief to English Indiamen and other merchant vessels; and at length the British government determined upon an expedition for its capture. This was effected in 1810; and upon the restoration of peace in 1814 the possession of the island was confirmed to Britain by the Treaty of Paris. By the eighth article of capitulation it was agreed that the inhabitants should retain their own laws, customs, and religion; and thus the island is still largely French in language, habits, and predilections; but its name has again been changed to that given by the Dutch. One of the most distinguished of the British governors was Sir Robert Farquhar (1810–1823), who did much to abolish the Malagasy slave trade and to establish friendly relations with the rising power of the Hova sovereign of Madagascar. Later governors of note were Sir Henry Barkly (1863–1871), and Sir J. Pope Hennessy (1883–1886 and 1888).

The history of the colony since its acquisition by Great Britain has been one of social and political evolution. At first all power was concentrated in the hands of the governor, but in 1832 a legislative council was constituted on which non-official nominated members served. In 1884–1885 this council was transformed into a partly elected body. Of more importance than the constitutional changes were the economic results which followed the freeing of the slaves (1834–1839)—for the loss of whose labour the planters received over £2,000,000 compensation. Coolies were introduced to supply the place of the negroes, immigration being definitely sanctioned by the government of India in 1842. Though under government control the system of coolie labour led to many abuses. A royal commission investigated the matter in 1871 and since that time the evils which were attendant on the system have been gradually remedied. One result of the introduction of free labour has been to reduce the descendants of the slave population to a small and unimportant class—Mauritius in this respect offering a striking contrast to the British colonies in the West Indies. The last half of the 19th century was, however, chiefly notable in Mauritius for the number of calamities which overtook the island. In 1854 cholera caused the death of 17,000 persons; in 1867 over 30,000 people died of malarial fever; in 1892 a hurricane of terrific violence caused immense destruction of property and serious loss of life; in 1893 great part of Port Louis was destroyed by fire. There were in addition several epidemics of small-pox and plague, and from about 1880 onward the continual decline in the price of sugar seriously affected the islanders, especially the Creole population. During 1902–1905 an outbreak of surra, which caused great mortality among draught animals, further tried the sugar planters and necessitated government help. Notwithstanding all these calamities the Mauritians, especially the Indo-Mauritians, have succeeded in maintaining the position of the colony as an important sugar-producing country.

Dependencies.—Dependent upon Mauritius and forming part of the colony are a number of small islands scattered over a large extent of the Indian Ocean. Of these the chief is Rodriguez (*q.v.*), 375 m. east of Mauritius. Considerably north-east of Rodriguez lie the Oil Islands or Chagos archipelago, of which the chief is Diego Garcia (see CHAGOS). The Cargados, Carayos or St Brandon islets, deeps and shoals, lie at the south end of the Nazareth Bank about 250 m. N.N.E. of Mauritius. Until 1903 the Seychelles, Amirantes, Aldabra and other islands lying north of Madagascar were also part of the colony of Mauritius. In the year named they were formed into a separate colony (see SEYCHELLES). Two islands, Farquhar and Coetivy, though geographically within the Seychelles area, remained dependent on Mauritius, being owned by residents in that island. In 1908, however, Coetivy was transferred to the Seychelles administration. Amsterdam and St Paul, uninhabited islands in the South Indian Ocean, included in an official list of the dependencies of Mauritius drawn up in 1880, were in 1893 annexed by France. The total population of the dependencies of Mauritius was estimated in 1905 at 5400.

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MAURY, JEAN SIFFREIN (1746–1817), French cardinal and archbishop of Paris, the son of a poor cobbler, was born on the 26th of June 1746 at Valréas in the Comtat-Venaissin, the district in France which belonged to the pope. His acuteness was observed by the priests of the seminary at Avignon, where he was educated and took orders. He tried his fortune by writing *éloges* of famous persons, then a favourite practice; and in 1771 his *éloge* on Fénelon was pronounced next best to Laharpe's by the Academy. The real foundation of his fortunes was the success of a panegyric on St Louis delivered before the Academy in 1772, which caused him to be recommended for an abbacy. In 1777 he published under the title of *Discours choisis* his panegyrics on Saint Louis, Saint Augustine and Fénelon, his remarks on Bossuet and his *Essai sur l'éloquence de la chaire*, a volume which contains much good criticism, and remains a French classic. The book was often reprinted as *Principes de l'éloquence*. He became a favourite preacher in Paris, and was Lent preacher at court in 1781, when King Louis XVI. said of his sermon: "If the abbé had only said a few words on religion he would have discussed every possible subject." In 1781 he obtained the rich priory of Lyons, near Péronne, and in 1785 he was elected to the Academy, as successor of Lefranc de Pompignan. His morals were as loose as those of his great rival Mirabeau, but he was famed in Paris for his wit and gaiety. In 1789 he was elected a member of the states-general by the clergy of the bailliage of Péronne, and from the first proved to be the most able and persevering defender of the *ancien régime*, although he had drawn up the greater part of the *cahier* of the clergy of Péronne, which contained a considerable programme of reform. It is said that he attempted to emigrate both in July and in October 1789; but after that time he held firmly to his place, when almost universally deserted by his friends. In the Constituent Assembly he took an active part in every important debate, combating with especial vigour the alienation of the property of the clergy. His life was often in danger, but his ready wit always saved it, and it was said that one *bon mot* would preserve him for a month.

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[1] Labourdonnais is credited by several writers with the introduction of the sugar cane into the island. Leguat, however, mentions it as being cultivated during the Dutch occupation.

[2] The régime introduced in 1767 divided the administration between a governor, primarily charged with military matters, and an intendant.

When he did emigrate in 1792 he found himself regarded as a martyr to the church and the king, and was at once named archbishop *in partibus*, and extra nuncio to the diet at Frankfort, and in 1794 cardinal. He was finally made bishop of Montefiascone, and settled down in that little Italian town—but not for long, for in 1798 the French drove him from his retreat, and he sought refuge in Venice and St Petersburg. Next year he returned to Rome as ambassador of the exiled Louis XVIII. at the papal court. In 1804 he began to prepare his return to France by a well-turned letter to Napoleon, congratulating him on restoring religion to France once more. In 1806 he did return; in 1807 he was again received into the Academy; and in 1810, on the refusal of Cardinal Fesch, was made archbishop of Paris. He was presently ordered by the pope to surrender his functions as archbishop of Paris. This he refused to do. On the restoration of the Bourbons he was summarily expelled from the Academy and from the archiepiscopal palace. He retired to Rome, where he was imprisoned in the castle of St Angelo for six months for his disobedience to the papal orders, and died in 1817, a year or two after his release, of disease contracted in prison and of chagrin. As a critic he was a very able writer, and Sainte-Beuve gives him the credit of discovering Father Jacques Bridayne, and of giving Bossuet his rightful place as a preacher above Massillon; as a politician, his wit and eloquence make him a worthy rival of Mirabeau. He sacrificed too much to personal ambition, yet it would have been a graceful act if Louis XVIII. had remembered the courageous supporter of Louis XVI., and the pope the one intrepid defender of the Church in the states-general.

The *Œuvres choisies du Cardinal Maury* (5 vols., 1827) contain what is worth preserving. Mgr Ricard has published Maury's *Correspondance diplomatique* (2 vols., Lille, 1891). For his life and character see *Vie du Cardinal Maury*, by Louis Siffrein Maury, his nephew (1828); J. J. F. Poujoulat, *Cardinal Maury, sa vie et ses œuvres* (1855); Sainte-Beuve, *Causeries du lundi* (vol. iv.); Mgr Ricard, *L'Abbé Maury* (1746–1791), *L'Abbé Maury avant 1789*, *L'Abbé Maury et Mirabeau* (1887); G. Bonet-Maury, *Le Cardinal Maury d'après ses mémoires et sa correspondance inédits* (Paris, 1892); A. Aulard, *Les Orateurs de la constituante* (Paris, 1882). Of the many libels written against him during the Revolution the most noteworthy are the *Petit carême de l'abbé Maury*, with a supplement called the *Seconde année* (1790), and the *Vie privée de l'abbé Maury* (1790), claimed by J. R. Hébert, but attributed by some writers to Restif de la Bretonne. For further bibliographical details see J. M. Quérard, *La France littéraire*, vol. v. (1833).

MAURY, LOUIS FERDINAND ALFRED (1817–1892), French scholar, was born at Meaux on the 23rd of March 1817. In 1836, having completed his education, he entered the Bibliothèque Nationale, and afterwards the Bibliothèque de l'Institut (1844), where he devoted himself to the study of archaeology, ancient and modern languages, medicine and law. Gifted with a great capacity for work, a remarkable memory and an unbiassed and critical mind, he produced without great effort a number of learned pamphlets and books on the most varied subjects. He rendered great service to the Académie des Inscriptions et Belles Lettres, of which he had been elected a member in 1857. Napoleon III. employed him in research work connected with the *Histoire de César*, and he was rewarded, proportionately to his active, if modest, part in this work, with the positions of librarian of the Tuileries (1860), professor at the College of France (1862) and director-general of the Archives (1868). It was not, however, to the imperial favour that he owed these high positions. He used his influence for the advancement of science and higher education, and with Victor Duruy was one of the founders of the École des Hautes Études. He died at Paris four years after his retirement from the last post, on the 11th of February 1892.

BIBLIOGRAPHY.—His works are numerous: *Les Fées au moyen âge* and *Histoire des légendes pieuses au moyen âge*; two books filled with ingenious ideas, which were published in 1843, and reprinted after the death of the author, with numerous additions under the title *Croyances et légendes du moyen âge* (1896); *Histoire des grandes forêts de la Gaule et de l'ancienne France* (1850, a 3rd ed. revised appeared in 1867 under the title *Les Forêts de la Gaule et de l'ancienne France*); *La Terre et l'homme*, a general historical sketch of geology, geography and ethnology, being the introduction to the *Histoire universelle*, by Victor Duruy (1854); *Histoire des religions de la Grèce antique*, (3 vols., 1857–1859); *La Magie et l'astrologie dans l'antiquité et dans le moyen âge* (1863); *Histoire de l'ancienne académie des sciences* (1864); *Histoire de l'Académie des Inscriptions et Belles Lettres* (1865); a learned paper on the reports of French archaeology, written on the occasion of the universal exhibition (1867); a number of articles in the *Encyclopédie moderne* (1846–1851), in Michaud's *Biographie universelle* (1858 and seq.), in the *Journal des savants* in the *Revue des deux mondes* (1873, 1877, 1879–1880, &c.). A detailed bibliography of his works has been placed by Auguste Longnon at the beginning of the volume *Les Croyances et légendes du moyen âge*.

MAURY, MATTHEW FONTAINE (1806–1873), American naval officer and hydrographer, was born near Fredericksburg in Spottsylvania county, Virginia, on the 24th of January 1806. He was educated at Harpeth academy, and in 1825 entered the navy as midshipman, circumnavigating the globe in the "Vincennes," during a cruise of four years (1826–1830). In 1831 he was appointed master of the sloop "Falmouth" on the Pacific station, and subsequently served in other vessels before returning home in 1834, when he married his cousin, Ann Herndon. In 1835–1836 he was actively engaged in producing for publication a treatise on navigation, a remarkable achievement at so early a stage in his career; he was at this time made lieutenant, and gazetted astronomer to a South Sea exploring expedition, but resigned this position and was appointed to the survey of southern harbours. In 1839 he met with an accident which resulted in permanent lameness, and unfitted him for active service. In the same year, however, he began to write a series of articles on naval reform and other subjects, under the title of *Scraps from the Lucky-Bag*, which attracted much attention; and in 1841 he was placed in charge of the Dépôt of Charts and Instruments, out of which grew the United States Naval Observatory and the Hydrographic Office. He laboured assiduously to obtain observations as to the winds and currents by distributing to captains of vessels specially prepared log-books; and in the course of nine years he had collected a sufficient number of logs to make two hundred manuscript volumes, each with about two thousand five hundred days' observations. One result was to show the necessity for combined action on the part of maritime nations in regard to ocean meteorology. This led to an international conference at Brussels in 1853, which produced the greatest benefit to navigation as well as indirectly to meteorology. Maury attempted to organize co-operative meteorological work on land, but the government did not at this time take any steps in this direction. His oceanographical work, however, received recognition in all parts of the civilized world, and in 1855 it was proposed in the senate to remunerate him, but in the same year the Naval Retiring Board, erected under an act to promote the efficiency of the navy, placed him on the retired list. This action aroused wide opposition, and in 1858 he was reinstated with the rank of commander as from 1855. In 1853 Maury had published his *Letters on the Amazon and Atlantic Slopes of South America*, and the most widely popular of his works, the *Physical Geography of the Sea*, was published in London in 1855, and in New York in 1856; it was translated into several European languages. On the outbreak of the American Civil War in 1861, Maury threw in his lot with the South, and became head of coast, harbour and river defences. He invented an electric torpedo for harbour defence, and in 1862 was ordered to England to purchase torpedo material, &c. Here he took active part in organizing a petition for peace to the American people, which was unsuccessful. Afterwards he became imperial commissioner of emigration to the emperor Maximilian of Mexico, and attempted to form a Virginian colony in that country. Incidentally he introduced there the cultivation of cinchona. The scheme of colonization was abandoned by the emperor (1866), and Maury, who had lost nearly his all during the war, settled for a while in England, where he was presented with a testimonial raised by public subscription, and among other honours received the degree of LL.D. of Cambridge University (1868). In the same year, a general amnesty admitting of his return to America, he accepted the professorship of meteorology in the Virginia Military Institute, and settled at Lexington, Virginia, where he died on the 1st of February 1873.

Among works published by Maury, in addition to those mentioned, are the papers contributed by him to the *Astronomical Observations* of the United States Observatory, *Letter concerning Lanes for Steamers crossing the Atlantic* (1855); *Physical Geography* (1864) and *Manual of Geography* (1871). In 1859 he began the publication of a series of *Nautical Monographs*.

See Diana Fontaine Maury Corbin (his daughter), *Life of Matthew Fontaine Maury* (London, 1888).

MAUSOLEUM, the term given to a monument erected to receive the remains of a deceased person, which may sometimes take the form of a sepulchral chapel. The term *cenotaph* (Gr. κενός, empty, τάφος, tomb) is employed for a similar monument where the body is not buried in the structure. The term "mausoleum" originated with the magnificent monument erected by Queen Artemisia in 353 B.C. in memory of her husband King Mausolus, of which the remains were brought to England in 1859 by Sir Charles Newton and placed in the British Museum. The tombs of Augustus and of Hadrian in Rome are perhaps the largest monuments of the kind ever erected.

MAUSOLUS (more correctly Maussollus), satrap and practically ruler of Caria (377–353 B.C.). The part he took in the revolt against Artaxerxes Mnemon, his conquest of a great part of Lycia, Ionia and of several of the Greek islands, his co-operation with the Rhodians and their allies in the war against Athens, and the removal of his capital from Mylasa, the ancient seat of the Carian kings, to Halicarnassus are the leading facts of his history. He is best known from the tomb erected for him by his widow Artemisia. The architects Satyrus and Pythis, and the sculptors Scopas, Leochares, Bryaxis and Timotheus, finished the work after her death. (See Halicarnassus.) An inscription discovered at Mylasa (Böckh, *Inscr. gr.* ii. 2691 *c.*) details the punishment of certain conspirators who had made an attempt upon his life at a festival in a temple at Labranda in 353.

See Diod. Sic. xv. 90, 3, xvi. 7, 4, 36, 2; Demosthenes, *De Rhodiorum libertate*; J. B. Bury, *Hist. of Greece* (1902), ii. 271; W. Judeich, *Kleinasiatische Studien* (Marburg, 1892), pp. 226–256, and authorities under Halicarnassus.

MAUVE, ANTON (1838–1888), Dutch landscape painter, was born at Zaandam, the son of a Baptist minister. Much against the wish of his parents he took up the study of art and entered the studio of Van Os, whose dry academic manner had, however, but little attraction for him. He benefited far more by his intimacy with his friends Jozef Israels and W. Maris. Encouraged by their example he abandoned his early tight and highly finished manner for a freer, looser method of painting, and the brilliant palette of his youthful work for a tender lyric harmony which is generally restricted to delicate greys, greens, and light blue. He excelled in rendering the soft hazy atmosphere that lingers over the green meadows of Holland, and devoted himself almost exclusively to depicting the peaceful rural life of the fields and country lanes of Holland—especially of the districts near Oosterbeek and Wolfhezen, the sand dunes of the coast at Scheveningen, and the country near Laren, where he spent the last years of his life. A little sad and melancholy, his pastoral scenes are nevertheless conceived in a peaceful soothing lyrical mood, which is in marked contrast to the epic power and almost tragic intensity of J. F. Millet. There are fourteen of Mauve's pictures at the Mesdag Museum at the Hague, and two ("Milking Time" and "A Fishing Boat putting to Sea") at the Ryks Museum in Amsterdam. The Glasgow Corporation Gallery owns his painting of "A Flock of Sheep." The finest and most representative private collection of pictures by Mauve was made by Mr J. C. J. Drucker, London.

MAVROCORDATO, Mavrocordat or Mavrogordato, the name of a family of Phanariot Greeks, distinguished in the history of Turkey, Rumania and modern Greece. The family was founded by a merchant of Chios, whose son Alexander Mavrocordato (*c.* 1636–1709), a doctor of philosophy and medicine of Bologna, became dragoman to the sultan in 1673, and was much employed in negotiations with Austria. It was he who drew up the treaty of Karlowitz (1699). He became a secretary of state, and was created a count of the Holy Roman Empire. His authority, with that of Hussein Kupruli and Rami Pasha, was supreme at the court of Mustapha II., and he did much to ameliorate the condition of the Christians in Turkey. He was disgraced in 1703, but was recalled to court by Sultan Ahmed III. He left some historical, grammatical, &c. treatises of little value.

His son Nicholas Mavrocordato (1670–1730) was grand dragoman to the Divan (1697), and in 1708 was appointed hospodar (prince) of Moldavia. Deposed, owing to the sultan's suspicions, in favour of Demetrius Cantacuzene, he was restored in 1711, and soon afterwards became hospodar of Walachia. In 1716 he was deposed by the Austrians, but was restored after the peace of Passarowitz. He was the first Greek set to rule the Danubian principalities, and was responsible for establishing the system which for a hundred years was to make the name of Greek hateful to the Rumanians. He introduced Greek manners, the Greek language and Greek costume, and set up a splendid court on the Byzantine model. For the rest he was a man of enlightenment, founded libraries and was himself the author of a curious work entitled *Περὶ καθήκοντων* (Bucharest, 1719). He was succeeded as grand dragoman (1709) by his son John (Ioannes), who was for a short while hospodar of Moldavia, and died in 1720.

Nicholas Mavrocordato was succeeded as prince of Walachia in 1730 by his son Constantine. He was deprived in the same year, but again ruled the principality from 1735 to 1741 and from 1744 to 1748; he was prince of Moldavia from 1741 to 1744 and from 1748 to 1749. His rule was distinguished by numerous tentative reforms in the fiscal and administrative systems. He was wounded and taken prisoner in the affair of Galati during the Russo-Turkish War, on the 5th of November 1769, and died in captivity.

Prince Alexander Mavrocordato (1791–1865), Greek statesman, a descendant of the hospodars, was born at Constantinople on the 11th of February 1791. In 1812 he went to the court of his uncle Ioannes Caradja, hospodar of Walachia, with whom he passed into exile in Russia and Italy (1817). He was a member of the Hetairia Philike and was among the Phanariot Greeks who hastened to the Morea on the outbreak of the War of Independence in 1821. He was active in endeavouring to establish a regular government, and in January 1822 presided over the first Greek national assembly at Epidaurus. He commanded the advance of the Greeks into western Hellas the same year, and suffered a defeat at Peta on the 16th of July, but retrieved this disaster somewhat by his successful resistance to the first siege of Missolonghi (Nov. 1822 to Jan. 1823). His English sympathies brought him, in the subsequent strife of factions, into opposition to the "Russian" party headed by Demetrius Ypsilanti and Kolokotrones; and though he held the portfolio of foreign affairs for a short while under the presidency of Petrobey (Petros Mavromichales), he was compelled to withdraw from affairs until February 1825, when he again became a secretary of state. The landing of Ibrahim Pasha followed, and Mavrocordato again joined the army, only escaping capture in the disaster at Sphagia (Spakteria), on the 9th of May 1815, by swimming to Navarino. After the fall of Missolonghi (April 22, 1826) he went into retirement, until President Capo d'Istria made him a member of the committee for the administration of war material, a position he resigned in 1828. After Capo d'Istria's murder (Oct. 9, 1831) and the resignation of his brother and successor, Agostino Capo d'Istria (April 13, 1832), Mavrocordato became minister of finance. He was vice-president of the National Assembly at Argos (July, 1832), and was appointed by King Otto minister of finance, and in 1833 premier. From 1834 onwards he was Greek envoy at Munich, Berlin, London and—after a short interlude as premier in Greece in 1841—Constantinople. In 1843, after the revolution of September, he returned to Athens as minister without portfolio in the Metaxas cabinet, and from April to August 1844 was head of the government formed after the fall of the "Russian" party. Going into opposition, he distinguished himself by his violent attacks on the Kolettis government. In 1854–1855 he was again head of the government for a few months. He died in Aegina on the 18th of August 1865.

See E. Legrand, *Genealogie des Mavrocordato* (Paris, 1886).

MAWKMAI (Burmese *Maukmè*), one of the largest states in the eastern division of the southern Shan States of Burma. It lies approximately between 19° 30′ and 20° 30′ N. and 97° 30′ and 98° 15′ E., and has an area of 2,787 sq. m. The central portion of the state consists of a wide plain well watered and under rice cultivation. The rest is chiefly hills in ranges running north and south. There is a good deal of teak in the state, but it has been ruinously worked. The sawbwa now works as contractor for government, which takes one-third of the net profits. Rice is the chief crop, but much tobacco of good quality is grown in the Langkö district on the Têng river. There is also a great deal of cattle-breeding. The population in 1901 was 29,454, over two-thirds of whom were Shans and the remainder Taungthu, Burmese, Yangsek and Red Karens. The capital, MAWKMAI, stands in a fine rice plain in 20° 9′ N. and 97° 25′ E. It had about 150 houses when it first submitted in 1887, but was burnt out by the Red Karens in the following year. It has since recovered. There are very fine orange groves a few miles south of the town at Kantu-awn, called Kadugate by the Burmese.

MAXENTIUS, MARCUS AURELIUS VALERIUS, Roman emperor from A.D. 306 to 312, was the son of Maximianus Herculius, and the son-in-law of Galerius. Owing to his vices and incapacity he was left out of account in the division of the empire which took place in 305. A variety of causes, however, had produced strong dissatisfaction at Rome with many of the arrangements established by Diocletian, and on the 28th of October 306, the public discontent found expression in the massacre of those magistrates who remained loyal to Flavius Valerius Severus and in the election of Maxentius to the imperial dignity. With the help of his father, Maxentius was enabled to put Severus to death and to repel the invasion of Galerius; his next steps were first to banish Maximianus, and then, after achieving a military success in Africa against the rebellious governor, L. Domitius Alexander, to declare war against Constantine as having brought about the death of his father Maximianus. His intention of carrying the war into Gaul was anticipated by Constantine, who marched into Italy. Maxentius was defeated at Saxa Rubra near Rome and drowned in the Tiber while attempting to make his way across the Milvian bridge into Rome. He was a man of brutal and worthless character; but although Gibbon's statement that he was "just, humane and even partial towards the afflicted Christians" may be exaggerated, it is probable that he never exhibited any special hostility towards them.

See De Broglie, *L'Église et l'empire Romain au quatrième siècle* (1856–1866), and on the attitude of the Romans towards Christianity generally, app. 8 in vol. ii. of J. B. Bury's edition of Gibbon (Zosimus ii. 9–18; Zonaras xii. 33, xiii. 1; Aurelius Victor, *Epit.* 40; Eutropius, x. 2).

MAXIM, SIR HIRAM STEVENS (1840–), Anglo-American engineer and inventor, was born at Sangerville, Maine, U.S.A., on the 5th of February 1840. After serving an apprenticeship with a coachbuilder, he entered the machine works of his uncle, Levi Stevens, at Fitchburg, Massachusetts, in 1864, and four years later he became a draughtsman in the Novelty Iron Works and Shipbuilding Company in New York City. About this period he produced several inventions connected with illumination by gas; and from 1877 he was one of the numerous inventors who were trying to solve the problem of making an efficient and durable incandescent electric lamp, in this connexion introducing the widely-used process of treating the carbon filaments by heating them in an atmosphere of hydrocarbon vapour. In 1880 he came to Europe, and soon began to devote himself to the construction of a machine-gun which should be automatically loaded and fired by the energy of the recoil (see MACHINE-GUN). In order to realize the full usefulness of the weapon, which was first exhibited in an underground range at Hatton Garden, London, in 1884, he felt the necessity of employing a smokeless powder, and accordingly he devised maximite, a mixture of trinitrocellulose, nitroglycerine and castor oil, which was patented in 1889. He also undertook to make a flying machine, and after numerous preliminary experiments constructed an apparatus which was tried at Bexley Heath, Kent, in 1894. (See FLIGHT.) Having been naturalized as a British subject, he was knighted in 1901. His younger brother, Hudson Maxim (b. 1853), took out numerous patents in connexion with explosives.

MAXIMA AND MINIMA, in mathematics. By the *maximum* or *minimum* value of an expression or quantity is meant primarily the "greatest" or "least" value that it can receive. In general, however, there are points at which its value ceases to increase and begins to decrease; its value at such a point is called a maximum. So there are points at which its value ceases to decrease and begins to increase; such a value is called a minimum. There may be several maxima or minima, and a minimum is not necessarily less than a maximum. For instance, the expression $(x^2+x+2)/(x-1)$ can take all values from $-\infty$ to -1 and from $+7$ to $+\infty$, but has, so long as x is real, no value between -1 and $+7$. Here -1 is a maximum value, and $+7$ is a minimum value of the expression, though it can be made greater or less than any assignable quantity.

The first general method of investigating maxima and minima seems to have been published in A.D. 1629 by Pierre Fermat. Particular cases had been discussed. Thus Euclid in book III. of the *Elements* finds the greatest and least straight lines that can be drawn from a point to the circumference of a circle, and in book VI. (in a proposition generally omitted from editions of his works) finds the parallelogram of greatest area with a given perimeter. Apollonius investigated the greatest and least distances of a point from the perimeter of a conic section, and discovered them to be the normals, and that their feet were the intersections of the conic with a rectangular hyperbola. Some remarkable theorems on maximum areas are attributed to Zenodorus, and preserved by Pappus and Theon of Alexandria. The most noteworthy of them are the following:—

1. Of polygons of n sides with a given perimeter the regular polygon encloses the greatest area.
2. Of two regular polygons of the same perimeter, that with the greater number of sides encloses the greater area.
3. The circle encloses a greater area than any polygon of the same perimeter.
4. The sum of the areas of two isosceles triangles on given bases, the sum of whose perimeters is given, is greatest when the triangles are similar.
5. Of segments of a circle of given perimeter, the semicircle encloses the greatest area.
6 The sphere is the surface of given area which encloses the greatest volume.

Serenus of Antissa investigated the somewhat trifling problem of finding the triangle of greatest area whose sides are formed by the intersections with the base and curved surface of a right circular cone of a plane drawn through its vertex.

The next problem on maxima and minima of which there appears to be any record occurs in a letter from Regiomontanus to Roder (July 4, 1471), and is a particular numerical example of the problem of finding the point on a given straight line at which two given points subtend a maximum angle. N. Tartaglia in his *General trattato de numeri et mesuri* (*c.* 1556) gives, without proof, a rule for dividing a number into two parts such that the continued product of the numbers and their difference is a maximum.

Fermat investigated maxima and minima by means of the principle that in the neighbourhood of a maximum or minimum the differences of the values of a function are insensible, a method virtually the same as that of the differential calculus, and of great use in dealing with geometrical maxima and minima. His method was developed by Huygens, Leibnitz, Newton and others, and in particular by John Hudde, who investigated maxima and minima of functions of more than one independent variable, and made some attempt to discriminate between maxima and minima, a question first definitely settled, so far as one variable is concerned, by Colin Maclaurin in his *Treatise on Fluxions* (1742). The method of the differential calculus was perfected by Euler and Lagrange.

John Bernoulli's famous problem of the "brachistochrone," or curve of quickest descent from one point to another under the action of gravity, proposed in 1696, gave rise to a new kind of maximum and minimum problem in which we have to find a curve and not points on a given curve. From these problems arose the "Calculus of Variations." (See VARIATIONS, CALCULUS OF.)

The only general methods of attacking problems on maxima and minima are those of the differential calculus or, in geometrical problems, what is practically Fermat's method. Some problems may be solved by algebra; thus if $y=f\ (x)\div\phi\ (x)$, where $f\ (x)$ and $\phi\ (x)$ are polynomials in x, the limits to the values of y may be found from the consideration that the equation $y\phi\ (x)-f\ (x)=0$ must have real roots. This is a useful method in the case in which $\phi\ (x)$ and $f\ (x)$ are quadratics, but scarcely ever in any other case. The problem of finding the maximum product of n positive quantities whose sum is given may also be found, algebraically, thus. If a and b are any two real unequal quantities whatever $\{\frac{1}{2}(a+b)\}^2>ab$, so that we can increase the product leaving the sum unaltered by replacing any two terms by half their sum, and so long as any two of the quantities are unequal we can increase the product. Now, the quantities being all positive, the product cannot be increased without limit and must somewhere attain a maximum, and no other form of the product than that in which they are all equal can be the maximum, so that the product is a maximum when they are all equal. Its minimum value is obviously zero. If the restriction that all the quantities shall be positive is removed, the product can be made equal to any quantity, positive or negative. So other theorems of algebra, which are stated as theorems on inequalities, may be regarded as algebraic solutions of problems on maxima and minima.

For purely geometrical questions the only general method available is practically that employed by Fermat. If a quantity depends on the position of some point P on a curve, and if its value is equal at two neighbouring points P and P′, then at some position between P and P′ it attains a maximum or minimum, and this position may be found by making P and P′ approach each other indefinitely. Take for instance the problem of Regiomontanus "to find a point on a given straight line which subtends a maximum angle at two given points A and B." Let P and P′ be two near points on the given straight line such that the angles APB and AP′B are equal. Then ABPP′ lie on a circle. By making P and P′ approach each other we see that for a maximum or minimum value of the angle APB, P is a point in which a circle drawn through AB touches the given straight line. There are two such points, and unless the given straight line is at right angles to AB the two angles obtained are not the same. It is easily seen that both angles are maxima, one for points on the given straight line on one side of its intersection with AB, the other for points on the other side. For further examples of this method together with most other geometrical problems on maxima and minima of any interest or importance the reader may consult such a book as J. W. Russell's *A Sequel to Elementary Geometry* (Oxford, 1907).

The method of the differential calculus is theoretically very simple. Let u be a function of several variables $x_1, x_2, x_3, \ldots x_n$, supposed for the present independent; if u is a maximum or minimum for the set of values $x_1, x_2, x_3, \ldots x_n$, and u becomes $u+\delta u$, when $x_1, x_2, x_3, \ldots x_n$ receive small increments $\delta x_1, \delta x_2, \ldots \delta x_n$; then δu must have the same sign for all possible values of $\delta x_1, \delta x_2, \ldots \delta x_n$.

Now
$$\delta u=\Sigma\frac{\delta u}{\delta x_1}\delta x_1+\tfrac{1}{2}\left\{\Sigma\frac{\delta^2 u}{\delta x_1^2}\delta x_1^2+2\Sigma\frac{\delta^2 u}{\delta x_1\delta x_2}\delta x_1\ \delta x_2\ \ .\ \ .\ \ \right\}+\ .\ \ .$$

The sign of this expression in general is that of $\Sigma(\delta u/\delta x_1)\delta x_1$, which cannot be one-signed when $x_1, x_2, \ldots x_n$ can take all possible values, for a set of increments $\delta x_1, \delta x_2, \ldots \delta x_n$ will give an opposite sign to the set $-\delta x_1, -\delta x_2, \ldots -\delta x_n$. Hence $\Sigma(\delta u/\delta x_1)\delta x_1$ must vanish for all sets of increments $\delta x_1, \ldots \delta x_n$, and since these are independent, we must have $\delta u/\delta x_1=0$, $\delta u/\delta x_2=0, \ldots \delta u/\delta x_n=0$. A value of u given by a set of solutions of these equations is called a "critical value" of u. The value of δu now becomes

$$\tfrac{1}{2}\left\{\Sigma\frac{\delta^2 u}{\delta x_1^2}\ \delta x_1^2+2\ \Sigma\frac{\delta^2 u}{\delta x_1 dx_2}\delta x_1\delta x_2+\ldots\right\};$$

for u to be a maximum or minimum this must have always the same sign. For the case of a single variable x, corresponding to a value of x given by the equation $du/dx=0$, u is a maximum or minimum as d^2u/dx^2 is negative or positive. If d^2u/dx^2 vanishes, then there is no maximum or minimun unless d^3u/dx^3 vanishes, and there is a maximum or minimum according as d^4u/dx^4 is negative or positive. Generally, if the first differential coefficient which does not vanish is even, there is a maximum or minimum according as this is negative or positive. If it is odd, there is no maximum or minimum.

In the case of several variables, the quadratic

$$\Sigma\frac{\delta^2 u}{\delta x_1^2}\delta x_1^2+2\ \Sigma\frac{\delta^2 u}{\delta x_1\delta x_2}\ \delta x_1\delta x_2\ +\ldots$$

must be one-signed. The condition for this is that the series of discriminants

$$a_{11}\ ,\ \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}\ ,\ \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}\ ,\ \ldots$$

where a_{pq} denotes $\delta^2 u/\delta a_p\delta a_q$ should be all positive, if the quadratic is always positive, and alternately negative and positive, if the quadratic is always negative. If the first condition is satisfied the critical value is a minimum, if the second it is a maximum. For the case of two variables the conditions are

$$\frac{\delta^2 u}{\delta x_1^2}\cdot\ \frac{\delta^2 u}{\delta x_2^2}>\left(\frac{\delta^2 u}{\delta x_1\delta x_2}\right)^2$$

for a maximum or minimum at all and $\delta^2 u/\delta x_1^2$ and $\delta^2 u/\delta x_2^2$ both negative for a maximum, and both positive for a minimum. It is important to notice that by the quadratic being one-signed is meant that it cannot be made to vanish except when $\delta x_1, \delta x_2, \ldots \delta x_n$ all vanish. If, in the case of two variables,

$$\frac{\delta^2 u}{\delta x_1^2}\cdot\ \frac{\delta^2 u}{\delta x_2^2}=\left(\frac{\delta^2 u}{\delta x_1\delta x_2}\right)^2$$

then the quadratic is one-signed unless it vanishes, but the value of u is not necessarily a maximum or minimum, and the terms of the third and possibly fourth order must be taken account of.

Take for instance the function $u\ \ x^3-xy^2+y^3$. Here the values $x=0$, $y=0$ satisfy the equations $\delta u/\delta x=0$, $\delta u/\delta y=0$, so that zero is a critical value of u, but it is neither a maximum nor a minimum although the terms of the second order are $(\delta x)^2$, and are never negative. Here $\delta u=\delta x^2-\delta x\delta y^2+\delta y^3$, and by putting $\delta x=0$ or an infinitesimal of the same order as δy^2, we can make the sign of δu depend on that of δy^3, and so be positive or negative as we please. On the other hand, if we take the function $u=x^2-xy^2+y^4$, $x=0$, $y=0$ make zero a critical value of u, and here $\delta u=\delta x^2-\delta x\delta y^2+\delta y^4$, which is always positive, because we can write it as the sum of two squares, viz. $(\delta x-\frac{1}{2}\delta y^2)^2+\frac{3}{4}\delta y^4$; so that in this case zero is a minimum value of u.

A critical value usually gives a maximum or minimum in the case of a function of one variable, and often in the case of several independent variables, but all maxima and minima, particularly absolutely greatest and least values, are not necessarily critical values. If, for example, x is restricted to lie between the values a and b and $\phi'(x)=0$ has no roots in this interval, it follows that $\phi'(x)$ is one-signed as x increases from a to b, so that $\phi(x)$ is increasing or diminishing all the time, and the greatest and least values of $\phi(x)$ are $\phi(a)$ and $\phi(b)$, though neither of them is a critical value. Consider the following example: A person in a boat a miles from the nearest point of the beach wishes to reach as quickly as possible a point b miles from that point along the shore. The ratio of his rate of walking to his rate of rowing is cosec α. Where should he land?

Here let AB be the direction of the beach, A the nearest point to the boat O, and B the point he wishes to reach. Clearly he must land, if at all, between A and B. Suppose he lands at P. Let the angle AOP be θ, so that OP$=a$ sec θ, and PB$=b-a$ tan θ. If his rate of rowing is V miles an hour his time will be a sec θ/V$+$ $(b-a$ tan $\theta)$ sin α/V hours. Call this T. Then to the first power of $\delta\theta$, δT$=(a/$V$)$ sec$^2\theta$ (sin $\theta-$sin $\alpha)\delta\theta$, so that if AOB$>\alpha$, δT and $\delta\theta$ have opposite signs from $\theta=0$ to $\theta=\alpha$, and the same signs from $\theta=\alpha$ to $\theta=$AOB. So that when AOB is $>\alpha$, T decreases from $\theta=0$ to $\theta=\alpha$, and then increases, so that he should land at a point distant a tan α from A, unless a tan $\alpha>b$. When this is the case, δT and $\delta\theta$ have opposite signs throughout the whole range of θ, so that T decreases as θ increases, and he should row direct to B. In the first case the minimum value of T is also a critical value; in the second case it is not.

The greatest and least values of the bending moments of loaded rods are often at the extremities of the divisions of the rods and not at points given by critical values.

In the case of a function of several variables, $x_1, x_2, \ldots x_n$, not independent but connected by m functional relations $u_1=0$, $u_2=0, \ldots, u_m=0$, we might proceed to eliminate m of the variables; but Lagrange's "Method of undetermined Multipliers" is more elegant and generally more useful.

We have $\delta u_1=0$, $\delta u_2=0, \ldots, \delta u_m=0$. Consider instead of δu, what is the same thing, viz., $\delta u+\lambda_1\delta u_1+\lambda_2\delta u_2+\ldots+\lambda_m\delta u_m$, where $\lambda_1, \lambda_2, \ldots \lambda_m$, are arbitrary multipliers. The terms of the first order in this expression are

$$\Sigma\frac{\delta u}{\delta x_1}\delta x_1+\lambda_1\ \Sigma\frac{\delta u_1}{\delta x_1}\delta x_1+\ldots+\lambda_m\Sigma\frac{\delta u_m}{\delta x_1}\delta x_1.$$

We can choose $\lambda_1, \ldots \lambda_m$, to make the coefficients of δx_1, δx_2, $\ldots \delta x_m$, vanish, and the remaining δx_{m+1} to δx_n may be regarded as independent, so that, when u has a critical value, their coefficients must also vanish. So that we put

$$\frac{\delta u}{\delta x_r}+\lambda_1\frac{\delta u_1}{\delta x_r}+\ldots+\lambda_m\frac{\delta u_m}{\delta x_r}=0$$

for all values of r. These equations with the equations $u_1=0, \ldots$, $u_m=0$ are exactly enough to determine $\lambda_1, \ldots, \lambda_m$, $x_1\ x_1, \ldots, x_n$, so that we find critical values of u, and examine the terms of the second order to decide whether we obtain a maximum or minimum.

To take a very simple illustration; consider the problem of determining the maximum and minimum radii vectors of the ellipsoid $x^2/a^2+y^2/b^2+z^2/c^2=1$, where $a^2>b^2>c^2$. Here we require the maximum and minimum values of $x^2+y^2+z^2$ where $x^2/a^2+y^2/b^2+z^2/c^2=1$.

We have $$\delta u=2x\delta x\left(1+\frac{\lambda}{a^2}\right)+2y\delta y\left(1+\frac{\lambda}{b^2}\right)+2z\delta z\left(1+\frac{\lambda}{c^2}\right)$$
$$+\delta x^2\left(1+\frac{\lambda}{a^2}\right)+\delta y^2\left(1+\frac{\lambda}{b^2}\right)+\delta z^2\left(1+\frac{\lambda}{c^2}\right).$$

To make the terms of the first order disappear, we have the three equations:—

$$x(1+\lambda/a^2)=0,\ y(1+\lambda/b^2)=0,\ z(1+\lambda/c^2)=0.$$

These have three sets of solutions consistent with the conditions $x^2/a^2+y^2/b^2+z^2/c^2=1$, $a^2>b^2>c^2$, viz.:—

(1) $y=0$, $z=0$, $\lambda=-a^2$; (2) $z=0$, $x=0$, $\lambda=-b^2$;
(3) $x=0$, $y=0$, $\lambda=-c^2$.

In the case of (1) $\delta u=\delta y^2\ (1-a^2/b^2)\ +\ \delta z^2\ (1-a^2/c^2)$, which is always negative, so that $u=a^2$ gives a maximum.

In the case of (3) $\delta u=\delta x^2\ (1-c^2/a^2)+\delta y^2\ (1-c^2/b^2)$, which is always positive, so that $u=c^2$ gives a minimum.

In the case of (2) $\delta u=\delta x^2(1-b^2/a^2)-\delta z^2(b^2/c^2-1)$, which can be made either positive or negative, or even zero if we move in the planes $x^2(1-b^2/a^2)=z^2(b^2/c^2-1)$, which are well known to be the central planes of circular section. So that $u=b^2$, though a critical value, is neither a maximum nor minimum, and the central planes of circular section divide the ellipsoid into four portions in two of which $a^2>r^2>b^2$, and in the other two $b^2>r^2>c^2$.

(A. E. J.)

MAXIMIANUS, a Latin elegiac poet who flourished during the 6th century A.D. He was an Etruscan by birth, and spent his youth at Rome, where he enjoyed a great reputation as an orator. At an advanced age he was sent on an important mission to the East, perhaps by Theodoric, if he is the Maximianus to whom that monarch addressed a letter preserved in Cassiodorus (*Variarum*, i. 21). The six elegies extant under his name, written in old age, in which he laments the loss of his youth, contain descriptions of various amours. They show the author's familiarity with the best writers of the Augustan age.

Editions by J. C. Wernsdorf, *Poetae latini minores*, vi.; E. Bährens, *Poetae latini minores*, v.; M. Petschenig (1890), in C. F. Ascherson's *Berliner Studien*, xi.; R. Webster (Princeton, 1901; see *Classical Review*, Oct. 1901), with introduction and commentary; see also Robinson Ellis in *American Journal of Philology*, v. (1884) and Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans.), § 490. There is an English version (as from Cornelius Gallus), by Hovenden Walker (1689), under the title of *The Impotent Lover*.

MAXIMIANUS, MARCUS AURELIUS VALERIUS, surnamed HERCULIUS, Roman emperor from A.D. 286 to 305, was born of humble parents at Sirmium in Pannonia. He achieved distinction during long service in the army, and having been made Caesar by Diocletian in 285, received the title of Augustus in the following year (April 1, 286). In 287 he suppressed the rising of the peasants (Bagaudae) in Gaul, but in 289, after a three years' struggle, his colleague and he were compelled to acquiesce in the assumption by his lieutenant Carausius (who had crossed over to Britain) of the title of Augustus. After 293 Maximianus left the care of the Rhine frontier to Constantius Chlorus, who had been designated Caesar in that year, but in 297 his arms achieved a rapid and decisive victory over the barbarians of Mauretania, and in 302 he shared at Rome the triumph of Diocletian, the last pageant of the kind ever witnessed by that city. On the 1st of May 305, the day of Diocletian's abdication, he also, but without his colleague's sincerity, divested himself of the imperial dignity at Mediolanum (Milan), which had been his capital, and retired to a villa in Lucania; in the following year, however, he was induced by his son Maxentius to reassume the purple. In 307 he brought the emperor Flavius Valerius Severus a captive to Rome, and also compelled Galerius to retreat, but in 308 he was himself driven by Maxentius from Italy into Illyricum, whence again he was compelled to seek refuge at Arelate (Arles), the court of his son-in-law, Constantine. Here a false report was received, or invented, of the death of Constantine, at that time absent on the Rhine. Maximianus at once grasped at the succession, but was soon driven to Massilia (Marseilles), where, having been delivered up to his pursuers, he strangled himself.

See Zosimus ii. 7–11; Zonaras xii. 31–33; Eutropius ix. 20, x. 2, 3; Aurelius Victor p. 39. For the emperor Galerius Valerius Maximianus see GALERIUS.

MAXIMILIAN I. (1573–1651), called "the Great," elector and duke of Bavaria, eldest son of William V. of Bavaria, was born at Munich on the 17th of April 1573. He was educated by the Jesuits at the university of Ingolstadt, and began to take part in the government in 1591. He married in 1595 his cousin, Elizabeth, daughter of Charles II., duke of Lorraine, and became duke of Bavaria upon his father's abdication in 1597. He refrained from any interference in German politics until 1607, when he was entrusted with the duty of executing the imperial ban against the free city of Donauwörth, a Protestant stronghold. In December 1607 his troops occupied the city, and vigorous steps were taken to restore the supremacy of the older faith. Some Protestant princes, alarmed at this action, formed a union to defend their interests, which was answered in 1609 by the establishment of a league, in the formation of which Maximilian took an important part. Under his leadership an army was set on foot, but his policy was strictly defensive and he refused to allow the league to become a tool in the hands of the house of Habsburg. Dissensions among his colleagues led the duke to resign his office in 1616, but the approach of trouble brought about his return to the league about two years later.

Having refused to become a candidate for the imperial throne in 1619, Maximilian was faced with the complications arising from the outbreak of war in Bohemia. After some delay he made a treaty with the emperor Ferdinand II. in October 1619, and in return for large concessions placed the forces of the league at the emperor's service. Anxious to curtail the area of the struggle, he made a treaty of neutrality with the Protestant Union, and occupied Upper Austria as security for the expenses of the campaign. On the 8th of November 1620 his troops under Count Tilly defeated the forces of Frederick, king of Bohemia and count palatine of the Rhine, at the White Hill near Prague. In spite of the arrangement with the union Tilly then devastated the Rhenish Palatinate, and in February 1623 Maximilian was formally invested with the electoral dignity and the attendant office of imperial steward, which had been enjoyed since 1356 by the counts palatine of the Rhine. After receiving the Upper Palatinate and restoring Upper Austria to Ferdinand, Maximilian became leader of the party which sought to bring about Wallenstein's dismissal from the imperial service. At the diet of Regensburg in 1630 Ferdinand was compelled to assent to this demand, but the sequel was disastrous both for Bavaria and its ruler. Early in 1632 the Swedes marched into the duchy and occupied Munich, and Maximilian could only obtain the assistance of the imperialists by placing himself under the orders of Wallenstein, now restored to the command of the emperor's forces. The ravages of the Swedes and their French allies induced the elector to enter into negotiations for peace with Gustavus Adolphus and Cardinal Richelieu. He also proposed to disarm the Protestants by modifying the Restitution edict of 1629; but these efforts were abortive. In March 1647 he concluded an armistice with France and Sweden at Ulm, but the entreaties of the emperor Ferdinand III. led him to disregard his undertaking. Bavaria was again ravaged, and the elector's forces defeated in May 1648 at Zusmarshausen. But the peace of Westphalia soon put an end to the struggle. By this treaty it was agreed that Maximilian should retain the electoral dignity, which was made hereditary in his family; and the Upper Palatinate was incorporated with Bavaria. The elector died at Ingolstadt on the 27th of September 1651. By his second wife, Maria Anne, daughter of the emperor Ferdinand II., he left two sons, Ferdinand Maria, who succeeded him, and Maximilian Philip. In 1839 a statue was erected to his memory at Munich by Louis I., king of Bavaria. Weak in health and feeble in frame, Maximilian had high ambitions both for himself and his duchy, and was tenacious and resourceful in prosecuting his designs. As the ablest prince of his age he sought to prevent Germany from becoming the battleground of Europe, and although a rigid adherent of the Catholic faith, was not always subservient to the priest.

See P. P. Wolf, *Geschichte Kurfürst Maximilians I. und seiner Zeit* (Munich, 1807–1809); C. M. Freiherr von Aretin, *Geschichte des bayerschen Herzogs und Kurfürsten Maximilian des Ersten* (Passau, 1842); M. Lossen, *Die Reichstadt Donauwörth und Herzog Maximilian* (Munich, 1866); F. Stieve, *Kurfürst Maximilian I. von Bayern* (Munich, 1882); F. A. W. Schreiber, *Maximilian I. der Katholische Kurfürst von Bayern, und der dreissigjährige Krieg* (Munich, 1868); M. Högl, *Die Bekehrung der Oberpfalz durch Kurfürst Maximilian I.* (Regensburg, 1903).

MAXIMILIAN I. (MAXIMILIAN JOSEPH) (1756–1825), king of Bavaria, was the son of the count palatine Frederick of Zweibrücken-Birkenfeld, and was born on the 27th of May 1756. He was carefully educated under the supervision of his uncle, Duke Christian IV. of Zweibrücken, took service in 1777 as a colonel in the French army, and rose rapidly to the rank of major-general. From 1782 to 1789 he was stationed at Strassburg, but at the outbreak of the revolution he exchanged the French for the Austrian service, taking part in the opening campaigns of the revolutionary wars. On the 1st of April 1795 he succeeded his brother, Charles II., as duke of Zweibrücken, and on the 16th of February 1799 became elector of Bavaria on the extinction of the Sulzbach line with the death of the elector Charles Theodore.

The sympathy with France and with French ideas of enlightenment which characterized his reign was at once manifested. In the newly organized ministry Count Max Josef von Montgelas (*q.v.*), who, after falling into disfavour with Charles Theodore, had acted for a time as Maximilian Joseph's private secretary, was the most potent influence, an influence wholly "enlightened" and French. Agriculture and commerce were fostered, the laws were ameliorated, a new criminal code drawn up, taxes and imposts equalized without regard to traditional privileges, while a number of religious houses were suppressed and their revenues used for educational and other useful purposes. In foreign politics Maximilian Joseph's attitude was from the German point of view less commendable. With the growing sentiment of German nationality he had from first to last no sympathy, and his attitude throughout was dictated by wholly dynastic, or at least Bavarian, considerations. Until 1813 he was the most faithful of Napoleon's German allies, the relation being cemented by the marriage of his daughter to Eugène Beauharnais. His reward came with the treaty of Pressburg (Dec. 26, 1805), by the terms of which he was to receive the royal title and important territorial acquisitions in Swabia and Franconia to round off his kingdom. The style of king he actually assumed on the 1st of January 1806.

The new king of Bavaria was the most important of the princes belonging to the Confederation of the Rhine, and remained Napoleon's ally until the eve of the battle of Leipzig, when by the convention of Ried (Oct. 8, 1813) he made the guarantee of the integrity of his kingdom the price of his joining the Allies. By the first treaty of Paris (June 3, 1814), however, he ceded Tirol to Austria in exchange for the former duchy of Würzburg. At the congress of Vienna, too, which he attended in person, Maximilian had to make further concessions to Austria, ceding the quarters of the Inn and Hausruck in return for a part of the old Palatinate. The king fought hard to maintain the contiguity of the Bavarian territories as guaranteed at Ried; but the most he could obtain was an assurance from Metternich in the matter of the Baden succession, in which he was also doomed to be disappointed (see BADEN: *History*, iii. 506).

At Vienna and afterwards Maximilian sturdily opposed any reconstitution of Germany which should endanger the independence of Bavaria, and it was his insistence on the principle of full sovereignty being left to the German reigning princes that largely contributed to the loose and weak organization of the new German Confederation. The Federal Act of the Vienna congress was proclaimed in Bavaria, not as a law but as an international treaty. It was partly to secure popular support in his resistance to any interference of the federal diet in the internal affairs of Bavaria, partly to give unity to his somewhat heterogeneous territories, that Maximilian on the 26th of May 1818 granted a liberal constitution to his people. Montgelas, who had opposed this concession, had fallen in the previous year, and Maximilian had also reversed his ecclesiastical policy, signing on the 24th of October 1817 a concordat with Rome by which the powers of the clergy, largely curtailed under Montgelas's administration, were restored. The new parliament proved so intractable that in 1819 Maximilian was driven to appeal to the powers against his own creation; but his Bavarian "particularism" and his genuine popular sympathies prevented him from allowing the Carlsbad decrees to be strictly enforced within his dominions. The suspects arrested by order of the Mainz Commission he was accustomed to examine himself, with the result that in many cases the whole proceedings were quashed, and in not a few the accused dismissed with a present of money. Maximilian died on the 13th of October 1825 and was succeeded by his son Louis I.

In private life Maximilian was kindly and simple. He loved to play the part of *Landesvater*, walking about the streets of his capital *en bourgeois* and entering into conversation with all ranks of his subjects, by whom he was regarded with great affection. He was twice married: (1) in 1785 to Princess Wilhelmine Auguste of Hesse-Darmstadt, (2) in 1797 to Princess Caroline Friederike of Baden.

See G. Freiherr von Lerchenfeld, *Gesch. Bayerns unter König Maximilian Joseph I.* (Berlin, 1854); J. M. Söltl, *Max Joseph, König von Bayern* (Stuttgart, 1837); L. von Kobell, *Unter den vier ersten Königen Bayerns. Nach Briefen und eigenen Erinnerungen* (Munich, 1894).

MAXIMILIAN II. (1811–1864), king of Bavaria, son of king Louis I. and of his consort Theresa of Saxe-Hildburghausen, was born on the 28th of November 1811. After studying at Göttingen and Berlin and travelling in Germany, Italy and Greece, he was introduced by his father into the council of state (1836). From the first he showed a studious disposition, declaring on one occasion that had he not been born in a royal cradle his choice would have been to become a professor. As crown prince, in the château of Hohenschwangau near Füssen, which he had rebuilt with excellent taste, he gathered about him an intimate society of artists and men of learning, and devoted his time to scientific and historical study. When the abdication of Louis I. (March 28, 1848) called him suddenly to the throne, his choice of ministers promised a liberal régime. The progress of the revolution, however, gave him pause. He strenuously opposed the unionist plans of the Frankfort parliament, refused to recognize the imperial constitution devised by it, and assisted Austria in restoring the federal diet and in carrying out the federal execution in Hesse and Holstein. Although, however, from 1850 onwards his government tended in the direction of absolutism, he refused to become the tool of the clerical reaction, and even incurred the bitter criticism of the Ultramontanes by inviting a number of celebrated men of learning and science (*e.g.* Liebig and Sybel) to Munich, regardless of their religious views. Finally, in 1859, he dismissed the reactionary ministry of von der Pfordten, and met the wishes of his people for a moderate constitutional government. In his German policy he was guided by the desire to maintain the union of the princes, and hoped to attain this as against the perilous rivalry of Austria and Prussia by the creation of a league of the "middle" and small states—the so-called Trias. In 1863, however, seeing what he thought to be a better way, he supported the project of reform proposed by Austria at the Fürstentag of Frankfort. The failure of this proposal, and the attitude of Austria towards the Confederation and in the Schleswig-Holstein question, undeceived him; but before he could deal with the new situation created by the outbreak of the war with Denmark he died suddenly at Munich, on the 10th of March 1864.

Maximilian was a man of amiable qualities and of intellectual attainments far above the average, but as a king he was hampered by constant ill-health, which compelled him to be often abroad, and when at home to live much in the country. By his wife, Maria Hedwig, daughter of Prince William of Prussia, whom he married in 1842, he had two sons, Louis II., king of Bavaria, and Otto, king of Bavaria, both of whom lost their reason.

See J. M. Söltl, *Max der Zweite, König von Bayern* (Munich, 1865); biography by G. K. Heigel in *Allgem. Deutsche Biographie*, vol. xxi. (Leipzig, 1885). Maximilian's correspondence with Schlegel was published at Stuttgart in 1890.

MAXIMILIAN I. (1459–1519), Roman emperor, son of the emperor Frederick III. and Leonora, daughter of Edward, king of Portugal, was born at Vienna Neustadt on the 22nd of March 1459. On the 18th of August 1477, by his marriage at Ghent to Mary, who had just inherited Burgundy and the Netherlands from her father Charles the Bold, duke of Burgundy, he effected a union of great importance in the history of the house of Habsburg. He at once undertook the defence of his wife's dominions from an attack by Louis XI., king of France, and defeated the French forces at Guinegatte, the modern Enguinegatte, on the 7th of August 1479. But Maximilian was regarded with suspicion by the states of Netherlands, and after suppressing a rising in Gelderland his position was further weakened by the death of his wife on the 27th of March 1482. He claimed to be recognized as guardian of his young son Philip and as regent of the Netherlands, but some of the states refused to agree to his demands and disorder was general. Maximilian was compelled to assent to the treaty of Arras in 1482 between the states of the Netherlands and Louis XI. This treaty provided that Maximilian's daughter Margaret should marry Charles, the dauphin of France, and have for her dowry Artois and Franche-Comté, two of the provinces in dispute, while the claim of Louis on the duchy of Burgundy was tacitly admitted. Maximilian did not, however, abandon the struggle in the Netherlands. Having crushed a rebellion at Utrecht, he compelled the burghers of Ghent to restore Philip to him in 1485, and returning to Germany was chosen king of the Romans, or German king, at Frankfort on the 16th of February 1486, and crowned at Aix-la-Chapelle on the 9th of the following April. Again in the Netherlands, he made a treaty with Francis II., duke of Brittany, whose independence was threatened by the French regent, Anne of Beaujeu, and the struggle with France was soon renewed. This war was very unpopular with the trading cities of the Netherlands, and early in 1488 Maximilian, having entered Bruges, was detained there as a prisoner for nearly three months, and only set at liberty on the approach of his father with a large force. On his release he had promised he would maintain the treaty of Arras and withdraw from the Netherlands; but he delayed his departure for nearly a year and took part in a punitive campaign against his captors and their allies. On his return to Germany he made peace with France at Frankfort in July 1489, and in October several of the states of the Netherlands recognized him as their ruler and as guardian of his son. In March 1490 the county of Tirol was added to his possessions through the abdication of his kinsman, Count Sigismund, and this district soon became his favourite residence.

Meanwhile the king had formed an alliance with Henry VII. king of England, and Ferdinand II., king of Aragon, to defend the possessions of the duchess Anne, daughter and successor of Francis, duke of Brittany. Early in 1490 he took a further step and was betrothed to the duchess, and later in the same year the marriage was celebrated by proxy; but Brittany was still occupied by French troops, and Maximilian was unable to go to the assistance of his bride. The sequel was startling. In December 1491 Anne was married to Charles VIII., king of France, and Maximilian's daughter Margaret, who had resided in France since her betrothal, was sent back to her father. The inaction of Maximilian at this time is explained by the condition of affairs in Hungary, where the death of king Matthias Corvinus had brought about a struggle for this throne. The Roman king, who was an unsuccessful candidate, took up arms, drove the Hungarians from Austria, and regained Vienna, which had been in the possession of Matthias since 1485; but he was compelled by want of money to retreat, and on the 7th of November 1491 signed the treaty of Pressburg with Ladislaus, king of Bohemia, who had obtained the Hungarian throne. By this treaty it was agreed that Maximilian should succeed to the crown in case Ladislaus left no legitimate male issue. Having defeated the invading Turks at Villach in 1492, the king was eager to take revenge upon the king of France; but the states of the Netherlands would afford him no assistance. The German diet was indifferent, and in May 1493 he agreed to the peace of Senlis and regained Artois and Franche-Comté.

In August 1493 the death of the emperor left Maximilian sole ruler of Germany and head of the house of Habsburg; and on the 16th of March 1494 he married at Innsbruck Bianca Maria Sforza, daughter of Galeazzo Sforza, duke of Milan (d. 1476). At this time Bianca's uncle, Ludovico Sforza, was invested with the duchy of Milan in return for the substantial dowry which his niece brought to the king. Maximilian harboured the idea of driving the Turks from Europe; but his appeal to all Christian sovereigns was ineffectual. In 1494 he was again in the Netherlands, where he led an expedition against the rebels of Gelderland, assisted Perkin Warbeck to make a descent upon England, and formally handed over the government of the Low Countries to Philip. His attention was next turned to Italy, and, alarmed at the progress of Charles VIII. in the peninsula, he signed the league of Venice in March 1495, and about the same time arranged a marriage between his son Philip and Joanna, daughter of Ferdinand and Isabella, king and queen of Castile and Aragon. The need for help to prosecute the war in Italy caused the king to call the diet to Worms in March 1495, when he urged the necessity of checking the progress of Charles. As during his father's lifetime Maximilian had favoured the reforming party among the princes, proposals for the better government of the empire were brought forward at Worms as a necessary preliminary to financial and military support. Some reforms were adopted, the public peace was proclaimed without any limitation of time and a general tax was levied. The three succeeding years were mainly occupied with quarrels with the diet, with two invasions of France, and a war in Gelderland against Charles, count of Egmont, who claimed that duchy, and was supported by French troops. The reforms of 1495 were rendered abortive by the refusal of Maximilian to attend the diets or to take any part in the working of the new constitution, and in 1497 he strengthened his own authority by establishing an Aulic Council (*Reichshofrath*), which he declared was competent to deal with all business of the empire, and about the same time set up a court to centralize the financial administration of Germany.

In February 1499 the king became involved in a war with the Swiss, who had refused to pay the imperial taxes or to furnish a contribution for the Italian expedition. Aided by France they defeated the German troops, and the peace of Basel in September 1499 recognized them as virtually independent of the empire. About this time Maximilian's ally, Ludovico of Milan, was taken prisoner by Louis XII., king of France, and Maximilian was again compelled to ask the diet for help. An elaborate scheme for raising an army was agreed to, and in return a council of regency (*Reichsregiment*) was established, which amounted, in the words of a Venetian envoy, to a deposition of the king. The relations were now very strained between the reforming princes and Maximilian, who, unable to raise an army, refused to attend the meetings of the council at Nuremberg, while both parties treated for peace with France. The hostility of the king rendered the council impotent. He was successful in winning the support of many of the younger princes, and in establishing a new court of justice, the members of which were named by himself. The negotiations with France ended in the treaty of Blois, signed in September 1504, when

Maximilian's grandson Charles was betrothed to Claude, daughter of Louis XII., and Louis, invested with the duchy of Milan, agreed to aid the king of the Romans to secure the imperial crown. A succession difficulty in Bavaria-Landshut was only decided after Maximilian had taken up arms and narrowly escaped with his life at Regensburg. In the settlement of this question, made in 1505, he secured a considerable increase of territory, and when the king met the diet at Cologne in 1505 he was at the height of his power. His enemies at home were crushed, and their leader, Berthold, elector of Mainz, was dead; while the outlook abroad was more favourable than it had been since his accession.

It is at this period that Ranke believes Maximilian to have entertained the idea of a universal monarchy; but whatever hopes he may have had were shattered by the death of his son Philip and the rupture of the treaty of Blois. The diet of Cologne discussed the question of reform in a halting fashion, but afforded the king supplies for an expedition into Hungary, to aid his ally Ladislaus, and to uphold his own influence in the East. Having established his daughter Margaret as regent for Charles in the Netherlands, Maximilian met the diet at Constance in 1507, when the imperial chamber (*Reichskammergericht*) was revised and took a more permanent form, and help was granted for an expedition to Italy. The king set out for Rome to secure his coronation, but Venice refused to let him pass through her territories; and at Trant, on the 4th of February 1508, he took the important step of assuming the title of Roman Emperor Elect, to which he soon received the assent of pope Julius II. He attacked the Venetians, but finding the war unpopular with the trading cities of southern Germany, made a truce with the republic for three years. The treaty of Blois had contained a secret article providing for an attack on Venice, and this ripened into the league of Cambray, which was joined by the emperor in December 1509. He soon took the field, but after his failure to capture Padua the league broke up; and his sole ally, the French king, joined him in calling a general council at Pisa to discuss the question of Church reform. A breach with pope Julius followed, and at this time Maximilian appears to have entertained, perhaps quite seriously, the idea of seating himself in the chair of St Peter. After a period of vacillation he deserted Louis and joined the Holy League, which had been formed to expel the French from Italy; but unable to raise troops, he served with the English forces as a volunteer and shared in the victory gained over the French at the battle of the Spurs near Thérouanne on the 16th of August 1513. In 1500 the diet had divided Germany into six circles, for the maintenance of peace, to which the emperor at the diet of Cologne in 1512 added four others. Having made an alliance with Christian II., king of Denmark, and interfered to protect the Teutonic Order against Sigismund I., king of Poland, Maximilian was again in Italy early in 1516 fighting the French who had overrun Milan. His want of success compelled him on the 4th of December 1516 to sign the treaty of Brussels, which left Milan in the hands of the French king, while Verona was soon afterwards transferred to Venice. He attempted in vain to secure the election of his grandson Charles as king of the Romans, and in spite of increasing infirmity was eager to lead the imperial troops against the Turks. At the diet of Augsburg in 1518 the emperor heard warnings of the Reformation in the shape of complaints against papal exactions, and a repetition of the complaints preferred at the diet of Mainz in 1517 about the administration of Germany. Leaving the diet, he travelled to Wels in Upper Austria, where he died on the 12th of January 1519. He was buried in the church of St George in Vienna Neustadt, and a superb monument, which may still be seen, was raised to his memory at Innsbruck.

Maximilian had many excellent personal qualities. He was not handsome, but of a robust and well-proportioned frame. Simple in his habits, conciliatory in his bearing, and catholic in his tastes, he enjoyed great popularity and rarely made a personal enemy. He was a skilled knight and a daring huntsman, and although not a great general, was intrepid on the field of battle. His mental interests were extensive. He knew something of six languages, and could discuss art, music, literature or theology. He reorganized the university of Vienna and encouraged the development of the universities of Ingolstadt and Freiburg. He was the friend and patron of scholars, caused manuscripts to be copied and medieval poems to be collected. He was the author of military reforms, which included the establishment of standing troops, called *Landsknechte*, the improvement of artillery by making cannon portable, and some changes in the equipment of the cavalry. He was continually devising plans for the better government of Austria, and although they ended in failure, he established the unity of the Austrian dominions. Maximilian has been called the second founder of the house of Habsburg, and certainly by bringing about marriages between Charles and Joanna and between his grandson Ferdinand and Anna, daughter of Ladislaus, king of Hungary and Bohemia, he paved the way for the vast empire of Charles V. and for the influence of the Habsburgs in eastern Europe. But he had many qualities less desirable. He was reckless and unstable, resorting often to lying and deceit, and never pausing to count the cost of an enterprise or troubling to adapt means to ends. For absurd and impracticable schemes in Italy and elsewhere he neglected Germany, and sought to involve its princes in wars undertaken solely for private aggrandizement or personal jealousy. Ignoring his responsibilities as ruler of Germany, he only considered the question of its government when in need of money and support from the princes. As the "last of the knights" he could not see that the old order of society was passing away and a new order arising, while he was fascinated by the glitter of the medieval empire and spent the better part of his life in vague schemes for its revival. As "a gifted amateur in politics" he increased the disorder of Germany and Italy and exposed himself and the empire to the jeers of Europe.

Maximilian was also a writer of books, and his writings display his inordinate vanity. His *Geheimes Jagdbuch*, containing about 2500 words, is a treatise purporting to teach his grandsons the art of hunting. He inspired the production of *The Dangers and Adventures of the Famous Hero and Knight Sir Teuerdank*, an allegorical poem describing his adventures on his journey to marry Mary of Burgundy. The emperor's share in the work is not clear, but it seems certain that the general scheme and many of the incidents are due to him. It was first published at Nuremberg by Melchior Pfintzing in 1517, and was adorned with woodcuts by Hans Leonhard Schäufelein. The *Weisskunig* was long regarded as the work of the emperor's secretary, Marx Treitzsaurwein, but it is now believed that the greater part of the book at least is the work of the emperor himself. It is an unfinished autobiography containing an account of the achievements of Maximilian, who is called "the young white king." It was first published at Vienna in 1775. He also is responsible for *Freydal*, an allegorical account of the tournaments in which he took part during his wooing of Mary of Burgundy; *Ehrenpforten*, *Triumphwagen* and *Der weisen könige Stammbaum*, books concerning his own history and that of the house of Habsburg, and works on various subjects, as *Das Stahlbuch*, *Die Baumeisterei* and *Die Gärtnerei*. These works are all profusely illustrated, some by Albrecht Dürer, and in the preparation of the woodcuts Maximilian himself took the liveliest interest. A facsimile of the original editions of Maximilian's autobiographical and semi-autobiographical works has been published in nine volumes in the *Jahrbücher der kunsthistorischen Sammlungen des Kaiserhauses* (Vienna, 1880–1888). For this edition S. Laschitzer wrote an introduction to *Sir Teuerdank*, Q. von Leitner to *Freydal*, and N. A. von Schultz to *Der Weisskunig*. The Holbein society issued a facsimile of *Sir Teuerdank* (London, 1884) and *Triumphwagen* (London, 1883).

See *Correspondance de l'empereur Maximilien I. et de Marguerite d'Autriche, 1507–1519*, edited by A. G. le Glay (Paris, 1839); *Maximilians I. vertraulicher Briefwechsel mit Sigmund Prüschenk*, edited by V. von Kraus (Innsbruck, 1875); J. Chmel, *Urkunden, Briefe und Aktenstücke zur Geschichte Maximilians I. und seiner Zeit.* (Stuttgart, 1845) and *Aktenstücke und Briefe zur Geschichte des Hauses Habsburg im Zeitalter Maximilians I.* (Vienna, 1854–1858); K. Klüpfel, *Kaiser Maximilian I.* (Berlin, 1864); H. Ulmann, *Kaiser Maximilian I.* (Stuttgart, 1884); L. P. Gachard, *Lettres inédites de Maximilien I. sur les affaires des Pays Bas* (Brussels, 1851–1852); L. von Ranke, *Geschichte der romanischen und germanischen Völker, 1494–1514* (Leipzig, 1874); R. W. S. Watson, *Maximilian I.* (London, 1902); A. Jäger, *Über Kaiser Maximilians I. Verhältnis zum Papstthum* (Vienna, 1854); H. Ulmann, *Kaiser Maximilians I. Absichten auf das Papstthum* (Stuttgart, 1888), and A. Schulte, *Kaiser Maximilian I. als Kandidat für den päpstlichen Stuhl* (Leipzig, 1906).

(A. W. H.*)

MAXIMILIAN II. (1527–1576), Roman emperor, was the eldest son of the emperor Ferdinand I. by his wife Anne, daughter of Ladislaus, king of Hungary and Bohemia, and was born in Vienna on the 31st of July 1527. Educated principally in Spain, he gained some experience of warfare during the campaign of Charles V. against France in 1544, and also during the war of the league of Schmalkalden, and soon began to take part in imperial business. Having in September 1548 married his cousin Maria, daughter of Charles V., he acted as the emperor's representative in Spain from 1548 to 1550, returning to Germany in December 1550 in order to take part in the discussion over the imperial succession. Charles V. wished his son Philip (afterwards king of Spain) to succeed him as emperor, but his brother Ferdinand, who had already been designated as the next occupant of the imperial throne, and Maximilian objected to this proposal. At length a compromise was reached. Philip was to succeed Ferdinand, but during the former's reign Maximilian, as king of the Romans, was to govern Germany. This arrangement was not carried out, and is only important because the insistence of the emperor seriously disturbed the harmonious relations which had hitherto existed between the two branches of the Habsburg family; and the estrangement went so far that an illness which befell Maximilian in 1552 was attributed to poison given to him in the interests of his cousin and brother-in-law, Philip of Spain. About this time he took up his residence in Vienna, and was engaged mainly in the government of the Austrian dominions and in defending them against the Turks. The religious views of the king of Bohemia, as Maximilian had been called since his recognition as the future ruler of that country in 1549, had always been somewhat uncertain, and he had probably learned something of Lutheranism in his youth; but his amicable relations with several Protestant princes, which began about the time of the discussion over the succession, were probably due more to political than to religious considerations. However, in Vienna he became very intimate with Sebastian Pfauser (1520–1569), a court preacher with strong leanings towards Lutheranism, and his religious attitude caused some uneasiness to his father. Fears were freely expressed that he would definitely leave the Catholic Church, and when Ferdinand became emperor in 1558 he was prepared to assure Pope Paul IV. that his son should not succeed him if he took this step. Eventually Maximilian remained nominally an adherent of the older faith, although his views were tinged with Lutheranism until the end of his life. After several refusals he consented in 1560 to the banishment of Pfauser, and began again to attend the services of the Catholic Church. This uneasiness having been dispelled, in November 1562 Maximilian was chosen king of the Romans, or German king, at Frankfort, where he was crowned a few days later, after assuring the Catholic electors of his fidelity to their faith, and promising the Protestant electors that he would publicly accept the confession of Augsburg when he became emperor. He also took the usual oath to protect the Church, and his election was afterwards confirmed by the papacy. In September 1563 he was crowned king of Hungary, and on his father's death, in July 1564, succeeded to the empire and to the kingdoms of Hungary and Bohemia.

The new emperor had already shown that he believed in the necessity for a thorough reform of the Church. He was unable, however, to obtain the consent of Pope Pius IV. to the marriage of the clergy, and in 1568 the concession of communion in both kinds to the laity was withdrawn. On his part Maximilian granted religious liberty to the Lutheran nobles and knights in Austria, and refused to allow the publication of the decrees of the council of Trent. Amid general expectations on the part of the Protestants he met his first Diet at Augsburg in March 1566. He refused to accede to the demands of the Lutheran princes; on the other hand, although the increase of sectarianism was discussed, no decisive steps were taken to suppress it, and the only result of the meeting was a grant of assistance for the Turkish War, which had just been renewed. Collecting a large and splendid army Maximilian marched to defend his territories; but no decisive engagement had taken place when a truce was made in 1568, and the emperor continued to pay tribute to the sultan for Hungary. Meanwhile the relations between Maximilian and Philip of Spain had improved; and the emperor's increasingly cautious and moderate attitude in religious matters was doubtless due to the fact that the death of Philip's son, Don Carlos, had opened the way for the succession of Maximilian, or of one of his sons, to the Spanish throne. Evidence of this friendly feeling was given in 1570, when the emperor's daughter, Anne, became the fourth wife of Philip; but Maximilian was unable to moderate the harsh proceedings of the Spanish king against the revolting inhabitants of the Netherlands. In 1570 the emperor met the diet at Spires and asked for aid to place his eastern borders in a state of defence, and also for power to repress the disorder caused by troops in the service of foreign powers passing through Germany. He proposed that his consent should be necessary before any soldiers for foreign service were recruited in the empire; but the estates were unwilling to strengthen the imperial authority, the Protestant princes regarded the suggestion as an attempt to prevent them from assisting their coreligionists in France and the Netherlands, and nothing was done in this direction, although some assistance was voted for the defence of Austria. The religious demands of the Protestants were still unsatisfied, while the policy of toleration had failed to give peace to Austria. Maximilian's power was very limited; it was inability rather than unwillingness that prevented him from yielding to the entreaties of Pope Pius V. to join in an attack on the Turks both before and after the victory of Lepanto in 1571; and he remained inert while the authority of the empire in north-eastern Europe was threatened. His last important act was to make a bid for the throne of Poland, either for himself or for his son Ernest. In December 1575 he was elected by a powerful faction, but the diet which met at Regensburg was loath to assist; and on the 12th of October 1576 the emperor died, refusing on his deathbed to receive the last sacraments of the Church.

By his wife Maria he had a family of nine sons and six daughters. He was succeeded by his eldest surviving son, Rudolph, who had been chosen king of the Romans in October 1575. Another of his sons, Matthias, also became emperor; three others, Ernest, Albert and Maximilian, took some part in the government of the Habsburg territories or of the Netherlands, and a daughter, Elizabeth, married Charles IX. king of France.

The religious attitude of Maximilian has given rise to much discussion, and on this subject the writings of W. Maurenbrecher, W. Goetz and E. Reimann in the *Historische Zeitschrift*, Bände VII., XV., XXXII. and LXXVII. (Munich, 1870 fol.) should be consulted, and also O. H. Hopfen, *Maximilian II. und der Kompromisskatholizismus* (Munich, 1895); C. Haupt. *Melanchthons und seiner Lehrer Einfluss auf Maximilian II.* (Wittenberg, 1897); F. Walter, *Die Wahl Maximilians II.* (Heidelberg, 1892); W. Goetz, *Maximilians II. Wahl zum römischen Könige* (Würzburg, 1891), and T. J. Scherg, *Über die religiöse Entwickelung Kaiser Maximilians II. bis zu seiner Wahl zum römischen Könige* (Würzburg, 1903). For a more general account of his life and work see *Briefe und Akten zur Geschichte Maximilians II.*, edited by W. E. Schwarz (Paderborn, 1889–1891); M. Koch, *Quellen zur Geschichte des Kaisers Maximilian II. in Archiven gesammelt* (Leipzig, 1857–1861); R. Holtzmann, *Kaiser Maximilian II. bis zu seiner Thronbesteigung* (Berlin, 1903); E. Wertheimer, *Zur Geschichte der Türkenkriege Maximilians II* (Vienna, 1875); L. von Ranke, *Über die Zeiten Ferdinands I. und Maximilians II.* in Band VII. of his *Sämmtliche Werke* (Leipzig, 1874), and J. Janssen, *Geschichte des deutschen Volkes seit dem Ausgang des Mittelalters*, Bände IV. to VIII. (Freiburg, 1885–1894), English translation by M. A. Mitchell and A. M. Christie (London, 1896 fol.).

MAXIMILIAN (1832–1867), emperor of Mexico, second son of the archduke Francis Charles of Austria, was born in the palace of Schönbrunn, on the 6th of July 1832. He was a particularly clever boy, showed considerable taste for the arts, and early displayed an interest in science, especially botany. He was trained for the navy, and threw himself into this career with so much zeal that he quickly rose to high command, and was mainly instrumental in creating the naval port of Trieste and the fleet with which Tegethoff won his victories in the Italian War. He had some reputation as a Liberal, and this led, in February 1857, to his appointment as viceroy of the Lombardo-Venetian kingdom; in the same year he married the Princess Charlotte, daughter of Leopold I., king of the Belgians. On the outbreak of the war of 1859 he retired into private life, chiefly at Trieste, near which he built the beautiful chateau of Miramar. In this same year he was first approached by Mexican exiles with the proposal to become the candidate for the throne of Mexico. He did not at first accept, but sought to satisfy his restless desire for adventure by a botanical expedition to the tropical forests of Brazil. In 1863, however, under pressure from Napoleon III., and after General Forey's capture of the city of Mexico and the plebiscite which confirmed his proclamation of the empire, he consented to accept the crown. This decision was contrary to the advice of his brother, the emperor Francis Joseph, and involved the loss of all his rights in Austria. Maximilian landed at Vera Cruz on the 28th of May 1864; but from the very outset he found himself involved in difficulties of the most serious kind, which in 1866 made apparent to almost every one outside of Mexico the necessity for his abdicating. Though urged to this course by Napoleon himself, whose withdrawal from Mexico was the final blow to his cause, Maximilian refused to desert his followers. Withdrawing, in February 1867, to Querétaro, he there sustained a siege for several weeks, but on the 15th of May resolved to attempt an escape through the enemy's lines. He was, however, arrested before he could carry out this resolution, and after trial by court-martial was condemned to death. The sentence was carried out on the 19th of June 1867. His remains were conveyed to Vienna, where they were buried in the imperial vault early in the following year. (See MEXICO.)

Maximilian's papers were published at Leipzig in 1867, in seven volumes, under the title *Aus meinem Leben, Reiseskizzen, Aphorismen, Gedichte.* See Pierre de la Gorce, *Hist. du Second Empire,* IV., liv. xxv. ii. (Paris, 1904); article by von Hoffinger in *Allgemeine Deutsche Biographie*, xxi. 70, where authorities are cited.

MAXIMINUS, GAIUS JULIUS VERUS, Roman emperor from A.D. 235 to 238, was born in a village on the confines of Thrace. He was of barbarian parentage and was brought up as a shepherd. His immense stature and enormous feats of strength attracted the attention of the emperor Septimius Severus. He entered the army, and under Caracalla rose to the rank of centurion. He carefully absented himself from court during the reign of Heliogabalus, but under his successor Alexander Severus, was appointed supreme commander of the Roman armies. After the murder of Alexander in Gaul, hastened, it is said, by his instigation, Maximinus was proclaimed emperor by the soldiers on the 19th of March 235. The three years of his reign, which were spent wholly in the camp, were marked by great cruelty and oppression; the widespread discontent thus produced culminated in a revolt in Africa and the assumption of the purple by Gordian (*q.v.*). Maximinus, who was in Pannonia at the time, marched against Rome, and passing over the Julian Alps descended on Aquileia; while detained before that city he and his son were murdered in their tent by a body of praetorians. Their heads were cut off and despatched to Rome, where they were burnt on the Campus Martius by the exultant crowd.

Capitolinus, *Maximini duo*; Herodian vi. 8, vii., viii. 1–5; Zosimus i. 13–15).

MAXIMINUS [MAXIMIN], **GALERIUS VALERIUS,** Roman emperor from A.D. 308 to 314, was originally an Illyrian shepherd named Daia. He rose to high distinction after he had joined the army, and in 305 he was raised by his uncle, Galerius, to the rank of Caesar, with the government of Syria and Egypt. In 308, after the elevation of Licinius, he insisted on receiving the title of Augustus; on the death of Galerius, in 311, he succeeded to the supreme command of the provinces of Asia, and when Licinius and Constantine began to make common cause with one another Maximinus entered into a secret alliance with Maxentius. He came to an open rupture with Licinius in 313, sustained a crushing defeat in the neighbourhood of Heraclea Pontica on the 30th of April, and fled, first to Nicomedia and afterwards to Tarsus, where he died in August following. His death was variously ascribed "to despair, to poison, and to the divine justice." Maximinus has a bad name in Christian annals, as having renewed persecution after the publication of the toleration edict of Galerius, but it is probable that he has been judged too harshly.

See MAXENTIUS; Zosimus ii. 8; Aurelius Victor, *Epit.* 40.

MAXIMS, LEGAL. A maxim is an established principle or proposition. The Latin term *maxima* is not to be found in Roman law with any meaning exactly analogous to that of a legal maxim in the modern sense of the word, but the treatises of many of the Roman jurists on *Regulae definitiones*, and *Sententiae juris* are, in some measure, collections of maxims (see an article on "Latin Maxims in English Law" in *Law Mag. and Rev.* xx. 285); Fortescue (*De laudibus*, c. 8) and Du Cange treat *maxima* and *regula* as identical. The attitude of early English commentators towards the maxims of the law was one of unmingled adulation. In *Doctor and Student* (p. 26) they are described as "of the same strength and effect in the law as statutes be." Coke (Co. *Litt.* 11 A) says that a maxim is so called "Quia maxima est ejus dignitas et certissima auctoritas, atque quod maxime omnibus probetur." "Not only," observes Bacon in the Preface to his *Collection of Maxims*, "will the use of maxims be in deciding doubt and helping soundness of judgment, but, further, in gracing argument, in correcting unprofitable subtlety, and reducing the same to a more sound and substantial sense of law, in reclaiming vulgar errors, and, generally, in the amendment in some measure of the very nature and complexion of the whole law." A similar note was sounded in Scotland; and it has been well observed that "a glance at the pages of Morrison's *Dictionary* or at other early reports will show how frequently in the older Scots law questions respecting the rights, remedies and liabilities of individuals were determined by an immediate reference to legal maxims" (J. M. Irving, *Encyclo. Scots Law*, *s.v.* "Maxims"). In later times less value has been attached to the maxims of the law, as the development of civilization and the increasing complexity of business relations have shown the necessity of qualifying the propositions which they enunciate (see Stephen, *Hist. Crim. Law*, ii. 94 *n.*: *Yarmouth* v. *France*, 1887, 19 Q.B.D., per Lord Esher, at p. 653, and American authorities collected in Bouvier's *Law Dict. s.v.* "Maxim"). But both historically and practically they must always possess interest and value.

A brief reference need only be made here, with examples by way of illustration, to the field which the maxims of the law cover.

Commencing with rules founded on public policy, we may note the famous principle—*Salus populi suprema lex* (xii. Tables: Bacon, *Maxims*, reg. 12)—"the public welfare is the highest law." It is on this maxim that the coercive action of the State towards individual liberty in a hundred matters is based. To the same category belong the maxims—*Summa ratio est quae pro religione facit* (Co. *Litt.* 341 a)—"the best rule is that which advances religion"—a maxim which finds its application when the enforcement of foreign laws or judgments supposed to violate our own laws or the principles of natural justice is in question; and *Dies dominicus non est juridicus*, which exempts Sunday from the lawful days for juridical acts. Among the maxims relating to the crown, the most important are *Rex non potest peccare* (2 Rolle R. 304)—"The King can do no wrong"—which enshrines the principle of ministerial responsibility, and *Nullum tempus occurrit regi* (2 Co. Inst. 273)—"lapse of time does not bar the crown," a maxim qualified by various enactments in modern times. Passing to the judicial office and the administration of justice, we may refer to the rules—*Audi alteram partem*—a proposition too familiar to need either translation or comment; *Nemo debet esse judex in propriâ suâ causâ* (12 Co. *Rep.* 114)—"no man ought to be judge in his own cause"—a maxim which French law, and the legal systems based upon or allied to it, have embodied in an elaborate network of rules for judicial challenge; and the maxim which defines the relative functions of judge and jury, *Ad quaestionem facti non respondent judices, ad quaestionem legis non respondent juratores* (8 Co. *Rep.* 155). The maxim *Boni judicis est ampliare jurisdictionem* (Ch. Prec. 329) is certainly erroneous as it stands, as a judge has no right to "extend his jurisdiction." If *justitiam* is substituted for *jurisdictionem*, as Lord Mansfield said it should be (1 Burr. 304), the maxim is near the truth. A group of maxims supposed to embody certain fundamental principles of legal right and obligations may next be referred to: (a) *Ubi jus ibi remedium* (see Co. *Litt.* 197 b)—a maxim to which the evolution of the flexible "action on the case," by which wrongs unknown to the "original writs" were dealt with, was historically due, but which must be taken with the gloss *Damnum absque injuria*—"there are forms of actual damage which do not constitute legal injury" for which the law supplies no remedy; (b) *Actus Dei nemini facit injuriam* (2 Blackstone, 122)—and its allied maxim, *Lex non cogit ad impossibilia* (Co. *Litt.* 231 b)—on which the whole doctrine of *vis major* (*force majeure*) and impossible conditions in the law of contract has been built up. In this category may also be classed *Volenti non fit injuria* (Wingate, *Maxims*), out of which sprang the theory—now profoundly modified by statute—of "common employment" in the law of employers' liability; see *Smith* v. *Baker*, 1891, A.C. 325. Other maxims deal with rights of property—*Qui prior est tempore, potior est jure* (Co. *Litt.* 14 a), which consecrates the position of the *beati possidentes* alike in municipal and in international law; *Sic utere tuo ut alienum non laedas* (9 Co. *Rep.* 59), which has played its part in the determination of the rights of adjacent owners; and *Domus sua cuique est tutissimum refugium* (5 Co. *Rep.* 92)—"a man's house is his castle," a doctrine which has imposed limitations on the rights of execution creditors (see Execution). In the laws of family relations there are the maxims *Consensus non concubitus facit matrimonium* (Co. *Litt.* 33 a)—the canon law of Europe prior to the council of Trent, and still law in Scotland, though modified by legislation in England; and *Pater is est quem nuptiae demonstrant* (see Co. *Litt.* 7 b), on which, in most civilized countries, the presumption of legitimacy depends. In the interpretation of written instruments, the maxim *Noscitur a sociis* (3 *Term Reports*, 87), which proclaims the importance of the context, still applies. So do the rules *Expressio unius est exclusio alterius* (Co. *Litt.* 210 a), and *Contemporanea expositio est optima et fortissima in lege*(2 Co. *Inst.* 11), which lets in evidence of contemporaneous user as an aid to the interpretation of statutes or documents; see *Van Diemen's Land Co.* v. *Table Cape Marine Board*, 1906, A.C. 92, 98. We may conclude this sketch with a miscellaneous summary: *Caveat emptor* (Hob. 99)—"let the purchaser beware"; *Qui facit per alium facite per se*, which affirms the principal's liability for the acts of his agent; *Ignorantia juris neminem excusat*, on which rests the ordinary citizen's obligation to know the law; and *Vigilantibus non dormientibus jura subveniunt* (2 Co. *Inst.* 690), one of the maxims in accordance with which courts of equity administer relief. Among other "maxims of equity" come the rules that "he that seeks equity must do equity," *i.e.* must act fairly, and that "equity looks upon that as done which ought to be done"—a principle from which the "conversion" into money of land directed to be sold, and of money directed to be invested in the purchase of land, is derived.

The principal collections of legal maxims are: *English Law*: Bacon, *Collection of Some Principal Rules and Maxims of the Common Law* (1630); Noy, *Treatise of the principal Grounds and Maxims of the Law of England* (1641, 8th ed., 1824); Wingate, *Maxims of Reason* (1728); Francis, *Grounds and Rudiments of Law and Equity* (2nd ed. 1751); Lofft (annexed to his *Reports*, 1776); Broom, *Legal Maxims* (7th ed. London, 1900). *Scots Law*: Lord Trayner, *Latin Maxims and Phrases* (2nd ed., 1876); Stair, *Institutions of the Law of Scotland*, with Index by More (Edinburgh, 1832). *American Treatises*: A. I. Morgan, *English Version of Legal Maxims* (Cincinnati, 1878); S. S. Peloubet, *Legal Maxims in Law and Equity* (New York, 1880). (A. W. R.)

MAXIMUS, the name of four Roman emperors.

I. M. Clodius Pupienus Maximus, joint emperor with D. Caelius Calvinus Balbinus during a few months of the year A.D. 238. Pupienus was a distinguished soldier, who had been proconsul of Bithynia, Achaea, and Gallia Narbonensis. At the advanced age of seventy-four, he was chosen by the senate with Balbinus to resist the barbarian Maximinus. Their complete equality is shown by the fact that each assumed the titles of pontifex maximus and princeps senatus. It was arranged that Pupienus should take the field against Maximinus, while Balbinus remained at Rome to maintain order, a task in which he signally failed. A revolt of the praetorians was not repressed till much blood had been shed and a considerable part of the city reduced to ashes. On his march, Pupienus, having received the news that Maximinus had been assassinated by his own troops, returned in triumph to Rome. Shortly afterwards, when both emperors were on the point of leaving the city on an expedition—Pupienus against the Persians and Balbinus against the Goths—the praetorians, who had always resented the appointment of the senatorial emperors and cherished the memory of the soldier-emperor Maximinus, seized the opportunity of revenge. When most of the people were at the Capitoline games, they forced their way into the palace, dragged Balbinus and Pupienus through the streets, and put them to death.

See Capitolinus, *Life of Maximus and Balbinus*; Herodian vii. 10, viii. 6; Zonaras xii. 16; Orosius vii. 19; Eutropius ix. 2; Zosimus i. 14; Aurelius Victor, *Caesares*, 26, *epit.* 26; H. Schiller, *Geschichte der römischen Kaiserzeit*, i. 2; Gibbon, *Decline and Fall*, ch. 7 and (for the chronology) appendix 12 (Bury's edition).

II. Magnus Maximus, a native of Spain, who had accompanied Theodosius on several expeditions and from 368 held high military rank in Britain. The disaffected troops having proclaimed Maximus emperor, he crossed over to Gaul, attacked Gratian (*q.v.*), and drove him from Paris to Lyons, where he was murdered by a partisan of Maximus. Theodosius being unable to avenge the death of his colleague, an agreement was made (384 or 385) by which Maximus was recognized as Augustus and sole emperor in Gaul, Spain and Britain, while Valentinian II. was to remain unmolested in Italy and Illyricum, Theodosius retaining his sovereignty in the East. In 387 Maximus crossed the Alps, Valentinian was speedily put to flight, while the invader established himself in Milan and for the time became master of Italy. Theodosius now took vigorous measures. Advancing with a powerful army, he twice defeated the troops of Maximus—at Siscia on the Save, and at Poetovio on the Danube. He then hurried on to Aquileia, where Maximus had shut himself up, and had him beheaded. Under the name of Maxen Wledig, Maximus appears in the list of Welsh royal heroes (see R. Williams, *Biog. Dict. of Eminent Welshmen*, 1852; "The Dream of Maxen Wledig," in the *Mabinogion*).

Full account with classical references in H. Richter, *Das weströmische Reich, besonders unter den Kaisern Gratian, Valentinian II. und Maximus* (1865); see also H. Schiller, *Geschichte der römischen Kaiserzeit*, ii. (1887); Gibbon, *Decline and Fall*, ch. 27; Tillemont, *Hist. des empereurs*, v.

III. Maximus Tyrannus, made emperor in Spain by the Roman general, Gerontius, who had rebelled against the usurper Constantine in 408. After the defeat of Gerontius at Arelate (Arles) and his death in 411 Maximus renounced the imperial title and was permitted by Constantine to retire into private life. About 418 he rebelled again, but, failing in his attempt, was seized, carried into Italy, and put to death at Ravenna in 422.

See Orosius vii. 42; Zosimus vi. 5; Sozomen ix. 3; E. A. Freeman, "The Tyrants of Britain, Gaul and Spain, A.D. 406–411," in *English Historical Review*, i. (1886).

IV. Petronius Maximus, a member of the higher Roman nobility, had held several court and public offices, including those of *praefectus Romae* (420) and *Italiae* (439–441 and 445), and consul (433, 443). He was one of the intimate associates of Valentinian III., whom he assisted in the palace intrigues which led to the death of Aëtius in 454; but an outrage committed on the wife of Maximus by the emperor turned his friendship into hatred. Maximus was proclaimed emperor immediately after Valentinian's murder (March 16, 455), but after reigning less than three months, he was murdered by some Burgundian mercenaries as he was fleeing before the troops of Genseric, who, invited by Eudoxia, the widow of Valentinian, had landed at the mouth of the Tiber (May or June 455).

See Procopius, *Vand.* i. 4; Sidonius Apollinaris, *Panegyr. Aviti*, ep. ii. 13; the various *Chronicles*; Gibbon, *Decline and Fall*, chs. 35, 36; Tillemont, *Hist. des empereurs*, vi.

MAXIMUS, ST (*c.* 580–662), abbot of Chrysopolis, known as "the Confessor" from his orthodox zeal in the Monothelite (*q.v.*) controversy, or as "the monk," was born of noble parentage at Constantinople about the year 580. Educated with great care, he early became distinguished by his talents and acquirements, and some time after the accession of the emperor Heraclius in 610 was made his private secretary. In 630 he abandoned the secular life and entered the monastery of Chrysopolis (Scutari), actuated, it was believed, less by any longing for the life of a recluse than by the dissatisfaction he felt with the Monothelite leanings of his master. The date of his promotion to the abbacy is uncertain. In 633 he was one of the party of Sophronius of Jerusalem (the chief original opponent of the Monothelites) at the council of Alexandria; and in 645 he was again in Africa, when he held in presence of the governor and a number of bishops the disputation with Pyrrhus, the deposed and banished patriarch of Constantinople, which resulted in the (temporary) conversion of his interlocutor to the Dyothelite view. In the following year several African synods, held under the influence of Maximus, declared for orthodoxy. In 649, after the accession of Martin I., he went to Rome, and did much to fan the zeal of the new pope, who in

October of that year held the (first) Lateran synod, by which not only the Monothelite doctrine but also the moderating *ecthesis* of Heraclius and *typus* of Constans II. were anathematized. About 653 Maximus, for the part he had taken against the latter document especially, was apprehended (together with the pope) by order of Constans and carried a prisoner to Constantinople. In 655, after repeated examinations, in which he maintained his theological opinions with memorable constancy, he was banished to Byzia in Thrace, and afterwards to Perberis. In 662 he was again brought to Constantinople and was condemned by a synod to be scourged, to have his tongue cut out by the root, and to have his right hand chopped off. After this sentence had been carried out he was again banished to Lazica, where he died on the 13th of August 662. He is venerated as a saint both in the Greek and in the Latin Churches. Maximus was not only a leader in the Monothelite struggle but a mystic who zealously followed and advocated the system of Pseudo-Dionysius, while adding to it an ethical element in the conception of the freedom of the will. His works had considerable influence in shaping the system of John Scotus Erigena.

The most important of the works of Maximus will be found in Migne, *Patrologia graeca*, xc. xci., together with an anonymous life; an exhaustive list in Wagenmann's article in vol. xii. (1903) of Hauck-Herzog's *Realencyklopädie* where the following classification is adopted: (*a*) exegetical, (*b*) scholia on the Fathers, (*c*) dogmatic and controversial, (*d*) ethical and ascetic, (*e*) miscellaneous. The details of the disputation with Pyrrhus and of the martyrdom are given very fully and clearly in Hefele's *Conciliengeschichte*, iii. For further literature see H. Gelzer in C. Krumbacher's *Geschichte der byzantinischen Litteratur* (1897).

MAXIMUS OF SMYRNA, a Greek philosopher of the Neoplatonist school, who lived towards the end of the 4th century A.D. He was perhaps the most important of the followers of Iamblichus. He is said to have been of a rich and noble family, and exercised great influence over the emperor Julian, who was commended to him by Aedesius. He pandered to the emperor's love of magic and theurgy, and by judicious administration of the omens won a high position at court. His overbearing manner made him numerous enemies, and, after being imprisoned on the death of Julian, he was put to death by Valens. He is a representative of the least attractive side of Neoplatonism. Attaching no value to logical proof and argument, he enlarged on the wonders and mysteries of nature, and maintained his position by the working of miracles. In logic he is reported to have agreed with Eusebius, Iamblichus and Porphyry in asserting the validity of the second and third figures of the syllogism.

MAXIMUS OF TYRE (CASSIUS MAXIMUS TYRIUS), a Greek rhetorician and philosopher who flourished in the time of the Antonines and Commodus (2nd century A.D.). After the manner of the sophists of his age, he travelled extensively, delivering lectures on the way. His writings contain many allusions to the history of Greece, while there is little reference to Rome; hence it is inferred that he lived longer in Greece, perhaps as a professor at Athens. Although nominally a Platonist, he is really an Eclectic and one of the precursors of Neoplatonism. There are still extant by him forty-one essays or discourses (διαλέξεις) on theological, ethical, and other philosophical commonplaces. With him God is the supreme being, one and indivisible though called by many names, accessible to reason alone; but as animals form the intermediate stage between plants and human beings, so there exist intermediaries between God and man, viz. daemons, who dwell on the confines of heaven and earth. The soul in many ways bears a great resemblance to the divinity; it is partly mortal, partly immortal, and, when freed from the fetters of the body, becomes a daemon. Life is the sleep of the soul, from which it awakes at death. The style of Maximus is superior to that of the ordinary sophistical rhetorician, but scholars differ widely as to the merits of the essays themselves.

Maximus of Tyre must be distinguished from the Stoic Maximus, tutor of Marcus Aurelius.

Editions by J. Davies, revised with valuable notes by J. Markland (1740); J. J. Reiske (1774); F. Dübner (1840, with Theophrastus, &c., in the Didot series). Monographs by R. Rohdich (Beuthen, 1879); H. Hobein, *De Maximo Tyrio quaestiones philol.* (Jena, 1895). There is an English translation (1804) by Thomas Taylor, the Platonist.

MAX MÜLLER, FRIEDRICH (1823–1900), Anglo-German orientalist and comparative philologist, was born at Dessau on the 6th of December 1823, being the son of Wilhelm Müller (1794–1827), the German poet, celebrated for his phil-Hellenic lyrics, who was ducal librarian at Dessau. The elder Müller had endeared himself to the most intellectual circles in Germany by his amiable character and his genuine poetic gift; his songs had been utilized by musical composers, notably Schubert; and it was his son's good fortune to meet in his youth with a succession of eminent friends, who, already interested in him for his father's sake, and charmed by the qualities which they discovered in the young man himself, powerfully aided him by advice and patronage. Mendelssohn, who was his godfather, dissuaded him from indulging his natural bent to the study of music; Professor Brockhaus of the University of Leipzig, where Max Müller matriculated in 1841, induced him to take up Sanskrit; Bopp, at the University of Berlin (1844), made the Sanskrit student a scientific comparative philologist; Schelling at the same university, inspired him with a love for metaphysical speculation, though failing to attract him to his own philosophy; Burnouf, at Paris in the following year, by teaching him Zend, started him on the track of inquiry into the science of comparative religion, and impelled him to edit the *Rig Veda*; and when, in 1846, Max Müller came to England upon this errand, Bunsen, in conjunction with Professor H. H. Wilson, prevailed upon the East India Company to undertake the expense of publication. Up to this time Max Müller had lived the life of a poor student, supporting himself partly by copying manuscripts, but Bunsen's introductions to Queen Victoria and the prince consort, and to Oxford University, laid the foundation for him of fame and fortune. In 1848 the printing of his *Rig Veda* at the University Press obliged him to settle in Oxford, a step which decided his future career. He arrived at a favourable conjuncture: the Tractarian strife, which had so long thrust learning into the background, was just over, and Oxford was becoming accessible to modern ideas. The young German excited curiosity and interest, and it was soon discovered that, although a genuine scholar, he was no mere bookworm. Part of his social success was due to his readiness to exert his musical talents at private parties. Max Müller was speedily subjugated by the *genius loci*. He was appointed deputy Taylorian professor of modern languages in 1850, and the German government failed to tempt him back to Strassburg. In the following year he was made M.A. and honorary fellow of Christ Church, and in 1858 he was elected a fellow of All Souls. In 1854 the Crimean War gave him the opportunity of utilizing his oriental learning in vocabularies and schemes of transliteration. In 1857 he successfully essayed another kind of literature in his beautiful story *Deutsche Liebe*, written both in German and English. He had by this time become an extensive contributor to English periodical literature, and had written several of the essays subsequently collected as *Chips from a German Workshop*. The most important of them was the fascinating essay on "Comparative Mythology" in the *Oxford Essays* for 1856. His valuable *History of Ancient Sanskrit Literature*, so far as it illustrates the primitive religion of the Brahmans (and hence the Vedic period only), was published in 1859.

Though Max Müller's reputation was that of a comparative philologist and orientalist, his professional duties at Oxford were long confined to lecturing on modern languages, or at least their medieval forms. In 1860 the death of Horace Hayman Wilson, professor of Sanskrit, seemed to open a more congenial sphere to him. His claims to the succession seemed incontestable, for his opponent, Monier Williams, though well qualified as a Sanskritist, lacked Max Müller's brilliant versatility, and although educated at Oxford, had held no University office. But Max Müller was a Liberal, and the friend of Liberals in university matters, in politics, and in theology, and this consideration united with his foreign birth to bring the country clergy in such hosts to the poll that the voice of resident Oxford was overborne, and Monier Williams was elected by a large majority. It was the one great disappointment of Max Müller's life, and made a lasting impression upon him. It was, nevertheless, serviceable to his influence and reputation by permitting him to enter upon a wider field of subjects than would have been possible otherwise. Directly, Sanskrit philology received little more from him, except in connexion with his later undertaking of *The Sacred Books of the East*; but indirectly he exalted it more than any predecessor by proclaiming its commanding position in the history of the human intellect by his *Science of Language*, two courses of lectures delivered at the Royal Institution in 1861 and 1863. Max Müller ought not to be described as "the introducer of comparative philology into England." Prichard had proved the Aryan affinities of the Celtic languages by the methods of comparative philology so long before as 1831; Winning's *Manual of Comparative Philology* had been published in 1838; the discoveries of Bopp and Pott and Pictet had been recognized in brilliant articles in the *Quarterly Review*, and had guided the researches of Rawlinson. But Max Müller undoubtedly did far more to popularize the subject than had been done, or could have been done, by any predecessor. He was on less sure ground in another department of the study of language—the problem of its origin. He wrote upon it as a disciple of Kant, whose *Critique of Pure Reason* he translated. His essays on mythology are among the most delightful of his writings, but their value is somewhat impaired by a too uncompromising adherence to the seductive generalization of the solar myth.

Max Müller's studies in mythology led him to another field of activity in which his influence was more durable and extensive, that of the comparative science of religions. Here, so far as Great Britain is concerned, he does deserve the fame of an originator, and his *Introduction to the Science of Religion* (1873: the same year in which he lectured on the subject, at Dean Stanley's invitation, in Westminster Abbey, this being the only occasion on which a layman had given an address there) marks an epoch. It was followed by other works of importance, especially the four volumes of Gifford lectures, delivered between 1888 and 1892; but the most tangible result of the impulse he had given was the publication under his editorship, from 1875 onwards, of *The Sacred Books of the East*, in fifty-one volumes, including indexes, all but three of which appeared under his superintendence during his lifetime. These comprise translations by the most competent scholars of all the really important non-Christian scriptures of Oriental nations, which can now be appreciated without a knowledge of the original languages. Max Müller also wrote on Indian philosophy in his latter years, and his exertions to stimulate search for Oriental manuscripts and inscriptions were rewarded with important discoveries of early Buddhist scriptures, in their Indian form, made in Japan. He was on particularly friendly terms with native Japanese scholars, and after his death his library was purchased by the university of Tôkyô.

In 1868 Max Müller had been indemnified for his disappointment over the Sanskrit professorship by the establishment of a chair of Comparative Philology to be filled by him. He retired, however, from the actual duties of the post in 1875, when entering upon the editorship of *The Sacred Books of the East*. The most remarkable external events of his latter years were his delivery of lectures at the restored university of Strassburg in 1872, when he devoted his honorarium to the endowment of a Sanskrit lectureship, and his presidency over the International Congress of Orientalists in 1892. But his days, if uneventful, were busy. He participated in every movement at Oxford of which he could approve, and was intimate with nearly all its men of light and leading; he was a curator of the Bodleian Library, and a delegate of the University Press. He was acquainted with most of the crowned heads of Europe, and was an especial favourite with the English royal family. His hospitality was ample, especially to visitors from India, where he was far better known than any other European Orientalist. His distinctions, conferred by foreign governments and learned societies, were innumerable, and, having been naturalized shortly after his arrival in England, he received the high honour of being made a privy councillor. In 1898 and 1899 he published autobiographical reminiscences under the title of *Auld Lang Syne*. He was writing a more detailed autobiography when overtaken by death on the 28th of October 1900. Max Müller married in 1859 Georgiana Adelaide Grenfell, sister of the wives of Charles Kingsley and J. A. Froude. One of his daughters, Mrs Conybeare, distinguished herself by a translation of Scherer's *History of German Literature*.

Though undoubtedly a great scholar, Max Müller did not so much represent scholarship pure and simple as her hybrid types—the scholar-author and the scholar-courtier. In the former capacity, though manifesting little of the originality of genius, he rendered vast service by popularizing high truths among high minds. In his public and social character he represented Oriental studies with a brilliancy, and conferred upon them a distinction, which they had not previously enjoyed in Great Britain. There were drawbacks in both respects: the author was too prone to build upon insecure foundations, and the man of the world incurred censure for failings which may perhaps be best indicated by the remark that he seemed too much of a diplomatist. But the sum of foibles seems insignificant in comparison with the life of intense labour dedicated to the service of culture and humanity.

Max Müller's *Collected Works* were published in 1903. (R. G.)

MAXWELL, the name of a Scottish family, members of which have held the titles of earl of Morton, earl of Nithsdale, Lord Maxwell, and Lord Herries. The name is taken probably from Maccuswell, or Maxwell, near Kelso, whither the family migrated from England about 1100. Sir Herbert Maxwell won great fame by defending his castle of Carlaverock against Edward I. in 1300; another Sir Herbert was made a lord of the Scottish parliament before 1445; and his great-grandson John, 3rd Lord Maxwell, was killed at Flodden in 1513. John's son Robert, the 4th lord (d. 1546), was a member of the royal council under James V.; he was also an extraordinary lord of session, high admiral, and warden of the west marches, and was taken prisoner by the English at the rout of Solway Moss in 1542. Robert's grandson John, 7th Lord Maxwell (1553–1593), was the second son of Robert, the 5th lord (d. 1552), and his wife Beatrix, daughter of James Douglas, 3rd earl of Morton. After the execution of the regent Morton, the 4th earl, in 1581 this earldom was bestowed upon Maxwell, but in 1586 the attainder of the late earl was reversed and he was deprived of his new title. He had helped in 1585 to drive the royal favourite James Stewart, earl of Arran, from power, and he made active preparations to assist the invading Spaniards in 1588. His son John, the 8th lord (*c.* 1586–1613), was at feud with the Johnstones, who had killed his father in a skirmish, and with the Douglases over the earldom of Morton, which he regarded as his inheritance. After a life of exceptional and continuous lawlessness he escaped from Scotland and in his absence was sentenced to death; having returned to his native country he was seized and was beheaded in Edinburgh. In 1618 John's brother and heir Robert (d. 1646) was restored to the lordship of Maxwell, and in 1620 was created earl of Nithsdale, surrendering at this time his claim to the earldom of Morton. He and his son Robert, afterwards the 2nd earl, fought under Montrose for Charles I. during the Civil War. Robert died without sons in October 1667, when a cousin John Maxwell, 7th Lord Herries (d. 1677), became third earl.

William, 5th earl of Nithsdale (1676–1744), a grandson of the third earl, was like his ancestor a Roman Catholic and was attached to the cause of the exiled house of Stuart. In 1715 he joined the Jacobite insurgents, being taken prisoner at the battle of Preston and sentenced to death. He escaped, however, from the Tower of London through the courage and devotion of his wife Winifred (d. 1749), daughter of William Herbert, 1st marquess of Powis. He was attainted in 1716 and his titles became extinct, but his estates passed to his son William (d. 1776), whose descendant, William Constable-Maxwell, regained the title of Lord Herries in 1858. The countess of Nithsdale wrote an account of her husband's escape, which is published in vol. i. of the *Transactions of the Society of Antiquaries of Scotland*.

A few words may be added about other prominent members of the Maxwell family. John Maxwell (*c.* 1590–1647), archbishop of Tuam, was a Scottish ecclesiastic who took a leading part in helping Archbishop Laud in his futile attempt to restore the liturgy in Scotland. He was bishop of Ross from 1633 until 1638, when he was deposed by the General Assembly; then crossing over to Ireland he was bishop of Killala and Achonry from 1640 to 1645, and archbishop of Tuam from 1645 until his death. James Maxwell of Kirkconnell (*c.* 1708–1762), the Jacobite, wrote the *Narrative of Charles Prince of Wales's Expedition to Scotland in 1745*, which was printed for the Maitland Club in 1841. Robert Maxwell (1695–1765) was the author of *Select Transactions of the Society of Improvers* and was a great benefactor to Scottish agriculture. Sir Murray Maxwell (1775–1831), a naval officer, gained much fame by his conduct when his ship the "Alceste" was wrecked in Gaspar Strait in 1817. William Hamilton Maxwell (1792–1850), the Irish novelist, wrote, in addition to several novels, a *Life of the Duke of Wellington* (1839–1841 and again 1883), and a *History of the Irish Rebellion in 1798* (1845 and 1891). Sir Herbert Maxwell, 7th bart. (b. 1845), member of parliament for Wigtownshire from 1880 to 1906, and president of the Society of Antiquaries of Scotland, became well known as a writer, his works including *Life and Times of the Right Hon. W. H. Smith* (1893); *Life of the Duke of Wellington* (1899); *The House of Douglas* (1902); *Robert the Bruce* (1897) and *A Duke of Britain* (1895).

MAXWELL, JAMES CLERK (1831–1879), British physicist, was the last representative of a younger branch of the well-known Scottish family of Clerk of Penicuik, and was born at Edinburgh on the 13th of November 1831. He was educated at the Edinburgh Academy (1840–1847) and the university of Edinburgh (1847–1850). Entering at Cambridge in 1850, he spent a term or two at Peterhouse, but afterwards migrated to Trinity. In 1854 he took his degree as second wrangler, and was declared equal with the senior wrangler of his year (E. J. Routh, *q.v.*) in the higher ordeal of the Smith's prize examination. He held the chair of Natural Philosophy in Marischal College, Aberdeen, from 1856 till the fusion of the two colleges there in 1860. For eight years subsequently he held the chair of Physics and Astronomy in King's College, London, but resigned in 1868 and retired to his estate of Glenlair in Kirkcudbrightshire. He was summoned from his seclusion in 1871 to become the first holder of the newly founded professorship of Experimental Physics in Cambridge; and it was under his direction that the plans of the Cavendish Laboratory were prepared. He superintended every step of the progress of the building and of the purchase of the very valuable collection of apparatus with which it was equipped at the expense of its munificent founder the seventh duke of Devonshire (chancellor of the university, and one of its most distinguished alumni). He died at Cambridge on the 5th of November 1879.

For more than half of his brief life he held a prominent position in the very foremost rank of natural philosophers. His contributions to scientific societies began in his fifteenth year, when Professor J. D. Forbes communicated to the Royal Society of Edinburgh a short paper of his on a mechanical method of tracing Cartesian ovals. In his eighteenth year, while still a student in Edinburgh, he contributed two valuable papers to the *Transactions* of the same society—one of which, "On the Equilibrium of Elastic Solids," is remarkable, not only on account of its intrinsic power and the youth of its author, but also because in it he laid the foundation of one of the most singular discoveries of his later life, the temporary double refraction produced in viscous liquids by shearing stress. Immediately after taking his degree, he read to the Cambridge Philosophical Society a very novel memoir, "On the Transformation of Surfaces by Bending." This is one of the few purely mathematical papers he published, and it exhibited at once to experts the full genius of its author. About the same time appeared his elaborate memoir, "On Faraday's Lines of Force," in which he gave the first indication of some of those extraordinary electrical investigations which culminated in the greatest work of his life. He obtained in 1859 the Adams prize in Cambridge for a very original and powerful essay, "On the Stability of Saturn's Rings." From 1855 to 1872 he published at intervals a series of valuable investigations connected with the "Perception of Colour" and "Colour-Blindness," for the earlier of which he received the Rumford medal from the Royal Society in 1860. The instruments which he devised for these investigations were simple and convenient, but could not have been thought of for the purpose except by a man whose knowledge was co-extensive with his ingenuity. One of his greatest investigations bore on the "Kinetic Theory of Gases." Originating with D. Bernoulli, this theory was advanced by the successive labours of John Herapath, J. P. Joule, and particularly R. Clausius, to such an extent as to put its general accuracy beyond a doubt; but it received enormous developments from Maxwell, who in this field appeared as an experimenter (on the laws of gaseous friction) as well as a mathematician. He wrote an admirable textbook of the *Theory of Heat* (1871), and a very excellent elementary treatise on *Matter and Motion* (1876).

But the great work of his life was devoted to electricity. He began by reading, with the most profound admiration and attention, the whole of Faraday's extraordinary self-revelations, and proceeded to translate the ideas of that master into the succinct and expressive notation of the mathematicians. A considerable part of this translation was accomplished during his career as an undergraduate in Cambridge. The writer had the opportunity of perusing the MS. of "On Faraday's Lines of Force," in a form little different from the final one, a year before Maxwell took his degree. His great object, as it was also the great object of Faraday, was to overturn the idea of action at a distance. The splendid researches of S. D. Poisson and K. F. Gauss had shown how to reduce all the phenomena of statical electricity to mere attractions and repulsions exerted at a distance by particles of an imponderable on one another. Lord Kelvin (Sir W. Thomson) had, in 1846, shown that a totally different assumption, based upon other analogies, led (by its own special mathematical methods) to precisely the same results. He treated the resultant electric force at any point as analogous to the *flux of heat* from sources distributed in the same manner as the supposed electric particles. This paper of Thomson's, whose ideas Maxwell afterwards developed in an extraordinary manner, seems to have given the first hint that there are at least two perfectly distinct methods of arriving at the known formulae of statical electricity. The step to magnetic phenomena was comparatively simple; but it was otherwise as regards electromagnetic phenomena, where current electricity is essentially involved. An exceedingly ingenious, but highly artificial, theory had been devised by W. E. Weber, which was found capable of explaining all the phenomena investigated by Ampère as well as the induction currents of Faraday. But this was based upon the assumption of a distance-action between electric particles, the intensity of which depended on their relative motion as well as on their position. This was, of course, even more repugnant to Maxwell's mind than the statical distance-action developed by Poisson. The first paper of Maxwell's in which an attempt at an admissible physical theory of electromagnetism was made was communicated to the Royal Society in 1867. But the theory, in a fully developed form, first appeared in 1873 in his great treatise on *Electricity and Magnetism*. This work was one of the most splendid monuments ever raised by the genius of a single individual. Availing himself of the admirable generalized co-ordinate system of Lagrange, Maxwell showed how to reduce all electric and magnetic phenomena to stresses and motions of a material medium, and, as one preliminary, but excessively severe, test of the truth of his theory, he pointed out that (if the electromagnetic medium be that which is required for the explanation of the phenomena of light) the velocity of light in vacuo should be numerically the same as the ratio of the electromagnetic and electrostatic units. In fact, the means of the best determinations of each of these quantities separately agree with one another more closely than do the various values of either.

One of Maxwell's last great contributions to science was the editing (with copious original notes) of the *Electrical Researches of the Hon. Henry Cavendish*, from which it appeared that Cavendish, already famous by many other researches (such as the mean density of the earth, the composition of water, &c.), must be looked on as, in his day, a man of Maxwell's own stamp as a theorist and an experimenter of the very first rank.

In private life Clerk Maxwell was one of the most lovable of men, a sincere and unostentatious Christian. Though perfectly free from any trace of envy or ill-will, he yet showed on fit occasion his contempt for that pseudo-science which seeks for the applause of the ignorant by professing to reduce the whole system of the universe to a fortuitous sequence of uncaused events.

His collected works, including the series of articles on the properties of matter, such as "Atom," "Attraction," "Capillary Action," "Diffusion," "Ether," &c., which he contributed to the 9th edition of this encyclopaedia, were issued in two volumes by the Cambridge University Press in 1890; and an extended biography, by his former schoolfellow and lifelong friend Professor Lewis Campbell, was published in 1882. (P. G. T.)

MAXWELLTOWN, a burgh of barony and police burgh of Kirkcudbrightshire, Scotland. Pop. (1901), 5796. It lies on the Nith, opposite to Dumfries, with which it is connected by three bridges, being united with it for parliamentary purposes. It has a station on the Glasgow & South-Western line from Dumfries to Kirkcudbright. Its public buildings include a court-house, the prison for the south-west of Scotland, and an observatory and museum, housed in a disused windmill. The chief manufactures are woollens and hosiery; besides dyeworks and sawmills. It was a hamlet known as Bridgend up till 1810, in which year it was erected into a burgh of barony under its present name. To the north-west lies the parish of Terregles, said to be a corruption of Tir-eglwys (*terra ecclesia*, that is, "Kirk land"). The parish contains the beautiful ruin of Lincluden Abbey (see DUMFRIES), and Terregles House, once the seat of William Maxwell, last earl of Nithsdale. In the parish of Lochrutton, a few miles south-west of Maxwelltown, there is a good example of a stone circle, the "Seven Grey Sisters," and an old peel-tower in the Mains of Hills.

MAY, PHIL (1864–1903), English caricaturist, was born at Wortley, near Leeds, on the 22nd of April 1864, the son of an engineer. His father died when the child was nine years old, and at twelve he had begun to earn his living. Before he was fifteen he had acted as time-keeper at a foundry, had tried to become a jockey, and had been on the stage at Scarborough and Leeds. When he was about seventeen he went to London with a sovereign in his pocket. He suffered extreme want, sleeping out in the parks and streets, until he obtained employment as designer to a theatrical costumier. He also drew posters and cartoons, and for about two years worked for the *St Stephen's Review*, until he was advised to go to Australia for his health. During the three years he spent there he was attached to the *Sydney Bulletin*, for which many of his best drawings were made. On his return to Europe he went to Paris by way of Rome, where he worked hard for some time before he appeared in 1892 in London to resume his interrupted connexion with the *St Stephen's Review*. His studies of the London "guttersnipe" and the coster-girl rapidly made him famous. His overflowing sense of fun, his genuine sympathy with his subjects, and his kindly wit were on a par with his artistic ability. It was often said that the extraordinary economy of line which was a characteristic feature of his drawings had been forced upon him by the deficiencies of the printing machines of the *Sydney Bulletin*. It was in fact the result of a laborious process which involved a number of preliminary sketches, and of a carefully considered system of elimination. His later work included some excellent political portraits. He became a regular member of the staff of *Punch* in 1896, and in his later years his services were retained exclusively for *Punch* and the *Graphic*. He died on the 5th of August 1903.

There was an exhibition of his drawings at the Fine Arts Society in 1895, and another at the Leicester Galleries in 1903. A selection of his drawings contributed to the periodical press and from *Phil May's Annual* and *Phil May's Sketch Books*, with a portrait and biography of the artist, entitled *The Phil May Folio*, appeared in 1903.

MAY, THOMAS (1595–1650), English poet and historian, son of Sir Thomas May of Mayfield, Sussex, was born in 1595. He entered Sidney Sussex College, Cambridge, in 1609, and took his B.A. degree three years later. His father having lost his fortune and sold the family estate, Thomas May, who was hampered by an impediment in his speech, made literature his profession. In 1620 he produced *The Heir*, an ingeniously constructed comedy, and, probably about the same time, *The Old Couple*, which was not printed until 1658. His other dramatic works are classical tragedies on the subjects of Antigone, Cleopatra, and Agrippina. F. G. Fleay has suggested that the more famous anonymous tragedy of *Nero* (printed 1624, reprints in A. H. Bullen's *Old English Plays* and the *Mermaid Series*) should also be assigned to May. But his most important work in the department of pure literature was his translation (1627) into heroic couplets of the *Pharsalia* of Lucan. Its success led May to write a continuation of Lucan's narrative down to the death of Caesar. Charles I. became his patron, and commanded him to write metrical histories of Henry II. and Edward III., which were completed in 1635. When the earl of Pembroke, then lord chamberlain, broke his staff across May's shoulders at a masque, the king took him under his protection as "my poet," and Pembroke made him an apology accompanied with a gift of £50. These marks of the royal favour seem to have led May to expect the posts of poet-laureate and city chronologer when they fell vacant on the death of Ben Jonson in 1637, but he was disappointed, and he forsook the court and attached himself to the party of the Parliament. In 1646 he is styled one of the "secretaries" of the Parliament, and in 1647 he published his best known work, *The History of the Long Parliament*. In this official apology for the moderate or Presbyterian party, he professes to give an impartial statement of facts, unaccompanied by any expression of party or personal opinion. If he refrained from actual invective, he accomplished his purpose, according to Guizot, by "omission, palliation and dissimulation." Accusations of this kind were foreseen by May, who says in his preface that if he gives more information about the Parliament men than their opponents it is that he was more conversant with them and their affairs. In 1650 he followed this with another work written with a more definite bias, a *Breviary of the History of the Parliament of England*, in Latin and English, in which he defended the position of the Independents. He stopped short of the catastrophe of the king's execution, and it seems likely that his subservience to Cromwell was not quite voluntary. In February 1650 he was brought to London from Weymouth under a strong guard for having spread false reports of the Parliament and of Cromwell. He died on the 13th of November in the same year, and was buried in Westminster Abbey, but after the Restoration his remains were exhumed and buried in a pit in the yard of St Margaret's, Westminster. May's change of side made him many bitter enemies, and he is the object of scathing condemnation from many of his contemporaries.

There is a long notice of May in the *Biographia Britannica*. See also W. J. Courthope, *Hist. of Eng. Poetry*, vol. 3; and Guizot, *Études biographiques sur la révolution d'Angleterre* (pp. 403–426, ed. 1851).

MAY, or MEY(E), **WILLIAM** (d. 1560), English divine, was the brother of John May, bishop of Carlisle. He was educated at Cambridge, where he was a fellow of Trinity Hall, and in 1537, president of Queen's College. May heartily supported the Reformation, signed the Ten Articles in 1536, and helped in the production of *The Institution of a Christian Man*. He had close connexion with the diocese of Ely, being successively chancellor, vicar-general and prebendary. In 1545 he was made a prebendary of St Paul's, and in the following year dean. His favourable report on the Cambridge colleges saved them from dissolution. He was dispossessed during the reign of Mary, but restored to the deanery on Elizabeth's accession. He died on the day of his election to the archbishopric of York.

MAY, the fifth month of our modern year, the third of the old Roman calendar. The origin of the name is disputed; the derivation from Maia, the mother of Mercury, to whom the Romans were accustomed to sacrifice on the first day of this month, is usually accepted. The ancient Romans used on May Day to go in procession to the grotto of Egeria. From the 28th of April to the 2nd of May was kept the festival in honour of Flora, goddess of flowers. By the Romans the month was regarded as unlucky for marriages, owing to the celebration on the 9th, 11th and 13th of the Lemuria, the festival of the unhappy dead. This superstition has survived to the present day.

In medieval and Tudor England, May Day was a great public holiday. All classes of the people, young and old alike, were up with the dawn, and went "a-Maying" in the woods. Branches of trees and flowers were borne back in triumph to the towns and villages, the centre of the procession being occupied by those who shouldered the maypole, glorious with ribbons and wreaths. The maypole was usually of birch, and set up for the day only; but in London and the larger towns the poles were of durable wood and permanently erected. They were special eyesores to the Puritans. John Stubbes in his *Anatomy of Abuses* (1583) speaks of them as those "stinckyng idols," about which the people "leape and daunce, as the heathen did." Maypoles were forbidden by the parliament in 1644, but came once more into favour at the Restoration, the last to be erected in London being that set up in 1661. This pole, which was of cedar, 134 ft. high, was set up by twelve British sailors under the personal supervision of James II., then duke of York and lord high admiral, in the Strand on or about the site of the present church of St Mary's-in-the-Strand. Taken down in 1717, it was conveyed to Wanstead Park in Essex, where it was fixed by Sir Isaac Newton as part of the support of a large telescope, presented to the Royal Society by a French astronomer.

For an account of the May Day survivals in rural England see P. H. Ditchfield, *Old English Customs extant at Present Times* (1897).

MAY, ISLE OF, an island belonging to Fifeshire, Scotland, at the entrance to the Firth of Forth, 5 m. S.E. of Crail and Anstruther. It has a N.W. to S.E. trend, is more than 1 m. long, and measures at its widest about ⅓ m. St Adrian, who had settled here, was martyred by the Danes about the middle of the 9th century. The ruins of the small chapel dedicated to him, which was a favourite place of pilgrimage, still exist. The place where the pilgrims—of whom James IV. was often one—landed is yet known as Pilgrims' Haven, and traces may yet be seen of the various wells of St Andrew, St John, Our Lady, and the Pilgrims, though their waters have become brackish. In 1499 Sir Andrew Wood of Largo, with the "Yellow Carvel" and "Mayflower," captured the English seaman Stephen Bull, and three ships, after a fierce fight which took place between the island and the Bass Rock. In 1636 a coal beacon was lighted on the May and maintained by Alexander Cunningham of Barns. The oil light substituted for it in 1816 was replaced in 1888 by an electric light.

MAYA, an important tribe and stock of American Indians, the dominant race of Yucatan and other states of Mexico and part of Central America at the time of the Spanish conquest. They were then divided into many nations, chief among them being the Maya proper, the Huastecs, the Tzental, the Pokom, the Mame and the Cakchiquel and Quiché. They were spread over Yucatan, Vera Cruz, Tabasco, Campeche, and Chiapas in Mexico, and over the greater part of Guatemala and Salvador. In civilization the Mayan peoples rivalled the Aztecs. Their traditions give as their place of origin the extreme north; thence a migration took place, perhaps at the beginning of the Christian era. They appear to have reached Yucatan as early as the 5th century. From the evidence of the Quiché chronicles, which are said to date back to about A.D. 700, Guatemala was shortly afterwards overrun. Physically the Mayans are a dark-skinned, round-headed, short and sturdy type. Although they were already decadent when the Spaniards arrived they made a fierce resistance. They still form the bulk of the inhabitants of Yucatan. For their culture, ruined cities, &c. see CENTRAL AMERICA and MEXICO.

MAYAGUEZ, the third largest city of Porto Rico, a seaport, and the seat of government of the department of Mayaguez, on the west coast, at the mouth of Rio Yaguez, about 72 m. W. by S. of San Juan. Pop. of the city (1899), 15,187, including 1381 negroes and 4711 of mixed races; (1910), 16,591; of the municipal district, 35,700 (1899), of whom 2687 were negroes and 9933 were of mixed races. Mayaguez is connected by the American railroad of Porto Rico with San Juan and Ponce, and it is served regularly by steamboats from San Juan, Ponce and New York, although its harbour is not accessible to vessels drawing more than 16 ft. of water. It is situated at the foot of Las Mesas mountains and commands picturesque views. The climate is healthy and good water is obtained from the mountain region. From the shipping district along the water-front a thoroughfare leads to the main portion of the city, about 1 m. distant. There are four public squares, in one of which is a statue of Columbus. Prominent among the public buildings are the City Hall (containing a public library), San Antonio Hospital, Roman Catholic churches, a Presbyterian church, the court-house and a theatre. The United States has an agricultural experiment station here, and the Insular Reform School is 1 m. south of the city. Coffee, sugar-cane and tropical fruits are grown in the surrounding country; and the business of the city consists chiefly in their export and the import of flour. Among the manufactures are sugar, tobacco and chocolate. Mayaguez was founded about the middle of the 18th century on the site of a hamlet which was first settled about 1680. It was incorporated as a town in 1836, and became a city in 1873. In 1841 it was nearly all destroyed by fire.

MAYAVARAM, a town of British India, in the Tanjore district of Madras, on the Cauvery river; junction on the South Indian railway, 174 m. S.W. of Madras. Pop. (1901), 24,276. It possesses a speciality of fine cotton and silk cloth, known as Kornad from the suburb in which the weavers live. During October and November the town is the scene of a great pilgrimage to the holy waters of the Cauvery.

MAYBOLE, a burgh of barony and police burgh of Ayrshire, Scotland. Pop. (1901), 5892. It is situated 9 m. S. of Ayr and 50¼ m. S.W. of Glasgow by the Glasgow & South-Western railway. It is an ancient place, having received a charter from Duncan II. in 1193. In 1516 it was made a burgh of regality, but for generations it remained under the subjection of the Kennedys, afterwards earls of Cassillis and marquesses of Ailsa, the most powerful family in Ayrshire. Of old Maybole was the capital of the district of Carrick, and for long its characteristic feature was the family mansions of the barons of Carrick. The castle of the earls of Cassillis still remains. The public buildings include the town-hall, the Ashgrove and the Lumsden fresh-air fortnightly homes, and the Maybole combination poorhouse. The leading manufactures are of boots and shoes and agricultural implements. Two miles to the south-west are the ruins of Crossraguel (Cross of St Regulus) Abbey, founded about 1240. KIRKOSWALD, where Burns spent his seventeenth year, learning land-surveying, lies a little farther west. In the parish churchyard lie "Tam o' Shanter" (Douglas Graham) and "Souter Johnnie" (John Davidson). Four miles to the west of Maybole on the coast is Culzean Castle, the chief seat of the marquess of Ailsa, dating from 1777; it stands on a basaltic cliff, beneath which are the Coves of Culzean, once the retreat of outlaws and a resort of the fairies. Farther south are the ruins of Turnberry Castle, where Robert Bruce is said to have been born. A few miles to the north of Culzean are the ruins of Dunure Castle, an ancient stronghold of the Kennedys.

MAYEN, a town of Germany, in the Prussian Rhine province, on the northern declivity of the Eifel range, 16 m. W. from Coblenz, on the railway Andernach-Gerolstein. Pop. (1905), 13,435. It is still partly surrounded by medieval walls, and the ruins of a castle rise above the town. There are some small industries, embracing textile manufactures, oil mills and tanneries, and a trade in wine, while near the town are extensive quarries of basalt. Having been a Roman settlement, Mayen became a town in 1291. In 1689 it was destroyed by the French.

MAYENNE, CHARLES OF LORRAINE, Duke of (1554–1611), second son of Francis of Lorraine, second duke of Guise, was born on the 26th of March 1554. He was absent from France at the time of the massacre of Saint Bartholomew, but took part in the siege of La Rochelle in the following year, when he was created duke and peer of France. He went with Henry of Valois, duke of Anjou (afterwards Henry III.), on his election as king of Poland, but soon returned to France to become the energetic supporter and lieutenant of his brother, the 3rd duke of Guise. In 1577 he gained conspicuous successes over the Huguenot forces in Poitou. As governor of Burgundy he raised his province in the cause of the League in 1585. The assassination of his brothers at Blois on the 23rd and 24th of December 1588 left him at the head of the Catholic party. The Venetian ambassador, Mocenigo, states that Mayenne had warned Henry III. that there was a plot afoot to seize his person and to send him by force to Paris. At the time of the murder he was at Lyons, where he received a letter from the king saying that he had acted on his warning, and ordering him to retire to his government. Mayenne professed obedience, but immediately made preparations for marching on Paris. After a vain attempt to recover the persons of those of his relatives who had been arrested at Blois he proceeded to recruit troops in his government of Burgundy and in Champagne. Paris was devoted to the house of Guise and had been roused to fury by the news of the murder. When Mayenne entered the city in February 1589 he found it dominated by representatives of the sixteen quarters of Paris, all fanatics of the League. He formed a council general to direct the affairs of the city and to maintain relations with the other towns faithful to the League. To this council each quarter sent four representatives, and Mayenne added representatives of the various trades and professions of Paris in order to counterbalance this revolutionary element. He constituted himself "lieutenant-general of the state and crown of France," taking his oath before the parlement of Paris. In April he advanced on Tours. Henry III. in his extremity sought an alliance with Henry of Navarre, and the allied forces drove the leaguers back, and had laid siege to Paris, when the murder of Henry III. by a Dominican fanatic changed the face of affairs and gave new strength to the Catholic party.

Mayenne was urged to claim the crown for himself, but he was faithful to the official programme of the League and proclaimed Charles, cardinal of Bourbon, at that time a prisoner in the hands of Henry IV., as Charles X. Henry IV. retired to Dieppe, followed by Mayenne, who joined his forces with those of his cousin Charles, duke of Aumale, and Charles de Cossé, comte de Brissac, and engaged the royal forces in a succession of fights in the neighbourhood of Arques (September 1589). He was defeated and out-marched by Henry IV., who moved on Paris, but retreated before Mayenne's forces. In 1590 Mayenne received additions to his army from the Spanish Netherlands, and took the field again, only to suffer complete defeat at Ivry (March 14, 1590). He then escaped to Mantes, and in September collected a fresh army at Meaux, and with the assistance of Alexander Farnese, prince of Parma, sent by Philip II., raised the siege of Paris, which was about to surrender to Henry IV. Mayenne feared with reason the designs of Philip II., and his difficulties were increased by the death of Charles X., the "king of the league." The extreme section of the party, represented by the Sixteen, urged him to proceed to the election of a Catholic king and to accept the help and the claims of their Spanish allies. But Mayenne, who had not the popular gifts of his brother, the duke of Guise, had no sympathy with the demagogues, and himself inclined to the moderate side of his party, which began to urge reconciliation with Henry IV. He maintained the ancient forms of the constitution against the revolutionary policy of the Sixteen, who during his absence from Paris took the law into their own hands and in November 1591 executed one of the leaders of the more moderate party, Barnabé Brisson, president of the parlement. He returned to Paris and executed four of the chief malcontents. The power of the Sixteen diminished from that time, but with it the strength of the League.[1]

Mayenne entered into negotiations with Henry IV. while he was still appearing to consider with Philip II. the succession to the French crown of the Infanta Elizabeth, granddaughter, through her mother Elizabeth of Valois, of Henry II. He demanded that Henry IV. should accomplish his conversion to Catholicism before he was recognized by the leaguers. He also desired the continuation to himself of the high offices which had accumulated in his family and the reservation of their provinces to his relatives among the leaguers. In 1593 he summoned the States General to Paris and placed before them the claims of the Infanta, but they protested against foreign intervention. Mayenne signed a truce at La Villette on the 31st of July 1593. The internal dissensions of the league continued to increase, and the principal chiefs submitted. Mayenne finally made his peace only in October 1595. Henry IV. allowed him the possession of Chalon-sur-Saône, of Seurre and Soissons for three years, made him governor of the Isle of France and paid a large indemnity. Mayenne died at Soissons on the 3rd of October 1611.

A *Histoire de la vie et de la mort du duc de Mayenne* appeared at Lyons in 1618. See also J. B. H. Capefigue, *Hist. de la Réforme, de la ligue et du règne de Henri IV.* (8 vols., 1834–1835) and the literature dealing with the house of Guise (*q.v.*).

MAYENNE, a department of north-western France, three-fourths of which formerly belonged to Lower Maine and the remainder to Anjou, bounded on the N. by Manche and Orne, E. by Sarthe, S. by Maine-et-Loire and W. by Ille-et-Vilaine. Area, 2012 sq. m. Pop. (1906), 305,457. Its ancient geological formations connect it with Brittany. The surface is agreeably undulating; forests are numerous, and the beauty of the cultivated portions is enhanced by the hedgerows and lines of trees by which the farms are divided. The highest point of the department, and indeed of the whole north-west of France, is the Mont des Avaloirs (1368 ft.). Hydrographically Mayenne belongs to the basins of the Loire, the Vilaine and the Sélune, the first mentioned draining by far the larger part of the entire area. The principal stream is the Mayenne, which passes successively from north to south through Mayenne, Laval and Château-Gontier; by means of weirs and sluices it is navigable below Mayenne, but traffic is inconsiderable. The chief affluents are the Jouanne on the left, and on the right the Colmont, the Ernée and the Oudon. A small area in the east of the department drains by the Erve into the Sarthe; the Vilaine rises in the west, and in the north-west two small rivers flow into the Sélune. The climate of Mayenne is generally healthy except in the neighbourhood of the numerous marshes. The temperature is lower and the moisture of the atmosphere greater than in the neighbouring departments; the rainfall (about 32 in. annually) is above the average for France.

Agriculture and stock-raising are prosperous. A large number of horned cattle are reared, and in no other French department are so many horses found within the same area; the breed, that of Craon, is famed for its strength. Craon has also given its name to the most prized breed of pigs in western France. Mayenne produces excellent butter and poultry and a large quantity of honey. The cultivation of the vine is very limited, and the most common beverage is cider. Wheat, oats, barley and buckwheat, in the order named, are the most important crops, and a large quantity of flax and hemp is produced. Game is abundant. The timber grown is chiefly beech, oak, birch, elm and chestnut. The department produces antimony, auriferous quartz and coal. Marble, slate and other stone are quarried. There are several chalybeate springs. The industries include flour-milling, brick and tile making, brewing, cotton and wool spinning, and the production of various textile fabrics (especially ticking) for which Laval and Château-Gontier are the centres, agricultural implement making, wood and marble sawing, tanning and dyeing. The exports include agricultural produce, live-stock, stone and textiles; the chief imports are coal, brandy, wine, furniture and clothing. The department is served by the Western railway. It forms part of the circumscriptions of the IV. army corps, the académie (educational division) of Rennes, and the court of appeal of Angers. It comprises three arrondissements (Laval, Château-Gontier and Mayenne), with 27 cantons and 276 communes. Laval, the capital, is the seat of a bishopric of the province of Tours. The other principal towns are Château-Gontier and Mayenne, which are treated under separate headings. The following places are also of interest: Evron, which has a church of the 12th and 13th centuries; Jublains, with a Roman fort and other Roman remains; Lassay, with a fine château of the 14th and 16th centuries; and Ste Suzanne, which has remains of medieval ramparts and a fortress with a keep of the Romanesque period.

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[1] The estates of the League in 1593 were the occasion of the famous *Satire Ménippée*, circulated in MS. in that year, but only printed at Tours in 1594. It was the work of a circle of men of letters who belonged to the *politiques* or party of the centre and ridiculed the League. The authors were Pierre Le Roy, Jean Passerat, Florent Chrestien, Nicolas Rapin and Pierre Pithou. It opened with "La vertu du catholicon," in which a Spanish quack (the cardinal of Plaisance) vaunts the virtues of his drug "catholicon composé," manufactured in the Escurial, while a Lorrainer rival (the cardinal of Pellevé) tries to sell a rival cure. A mock account of the estates, with harangues delivered by Mayenne and the other chiefs of the League, followed. Mayenne's discourse is said to have been written by the jurist Pithou [illegible]

MAYENNE, a town of north-western France, capital of an arrondissement in the department of Mayenne, 19 m. N.N.E. of Laval by rail. Pop., town 7003, commune 10,020. Mayenne is an old feudal town, irregularly built on hills on both sides of the river Mayenne. Of the old castle overlooking the river several towers remain, one of which has retained its conical roof; the vaulted chambers and chapel are ornamented in the style of the 13th century; the building is now used as a prison. The church of Notre-Dame, beside which there is a statue of Joan of Arc, dates partly from the 12th century; the choir was rebuilt in the 19th century. In the Place de Cheverus is a statue, by David of Angers, to Cardinal Jean de Cheverus (1768–1836), who was born in Mayenne. Mayenne has a subprefecture, tribunals of first instance and of commerce, a chamber of arts and manufactures, and a board of trade-arbitration. There is a school of agriculture in the vicinity. The chief industry of the place is the manufacture of tickings, linen, handkerchiefs and calicoes.

Mayenne had its origin in the castle built here by Juhel, baron of Mayenne, the son of Geoffrey of Maine, in the beginning of the 11th century. It was taken by the English in 1424, and several times suffered capture by the opposing parties in the wars of religion and the Vendée. At the beginning of the 16th century the territory passed to the family of Guise, and in 1573 was made a duchy in favour of Charles of Mayenne, leader of the League.

MAYER, JOHANN TOBIAS (1723–1762), German astronomer, was born at Marbach, in Würtemberg, on the 17th of February 1723, and brought up at Esslingen in poor circumstances. A self-taught mathematician, he had already published two original geometrical works when, in 1746, he entered J. B. Homann's cartographic establishment at Nuremberg. Here he introduced many improvements in map-making, and gained a scientific reputation which led (in 1751) to his election to the chair of economy and mathematics in the university of Göttingen. In 1754 he became superintendent of the observatory, where he laboured with great zeal and success until his death, on the 20th of February 1762. His first important astronomical work was a careful investigation of the libration of the moon (*Kosmographische Nachrichten*, Nuremberg, 1750), and his chart of the full moon (published in 1775) was unsurpassed for half a century. But his fame rests chiefly on his lunar tables, communicated in 1752, with new solar tables, to the Royal Society of Göttingen, and published in their *Transactions* (vol. ii.). In 1755 he submitted to the English government an amended body of MS. tables, which James Bradley compared with the Greenwich observations, and found to be sufficiently accurate to determine the moon's place to 75″, and consequently the longitude at sea to about half a degree. An improved set was afterwards published in London (1770), as also the theory (*Theoria lunae juxta systema Newtonianum*, 1767) upon which the tables are based. His widow, by whom they were sent to England, received in consideration from the British government a grant of £3000. Appended to the London edition of the solar and lunar tables are two short tracts—the one on determining longitude by lunar distances, together with a description of the repeating circle (invented by Mayer in 1752), the other on a formula for atmospheric refraction, which applies a remarkably accurate correction for temperature.

Mayer left behind him a considerable quantity of manuscript, part of which was collected by G. C. Lichtenberg and published in one volume (*Opera inedita*, Göttingen, 1775). It contains an easy and accurate method for calculating eclipses; an essay on colour, in which three primary colours are recognized; a catalogue of 998 zodiacal stars; and a memoir, the earliest of any real value, on the proper motion of eighty stars, originally communicated to the Göttingen Royal Society in 1760. The manuscript residue includes papers on atmospheric refraction (dated 1755), on the motion of Mars as affected by the perturbations of Jupiter and the Earth (1756), and on terrestrial magnetism (1760 and 1762). In these last Mayer sought to explain the magnetic action of the earth by a modification of Euler's hypothesis, and made the first really definite attempt to establish a mathematical theory of magnetic action (C. Hansteen, *Magnetismus der Erde*, i. 283). E. Klinkerfuss published in 1881 photo-lithographic reproductions of Mayer's local charts and general map of the moon; and his star-catalogue was re-edited by F. Baily in 1830 (*Memoirs Roy. Astr. Soc.* iv. 391) and by G. F. J. A. Auvers in 1894.

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(A. M. C.)

MAYER, JULIUS ROBERT (1814–1878), German physicist, was born at Heilbronn on the 25th of November 1814, studied medicine at Tübingen, Munich and Paris, and after a journey to Java in 1840 as surgeon of a Dutch vessel obtained a medical post in his native town. He claims recognition as an independent a priori propounder of the "First Law of Thermodynamics," but more especially as having early and ably applied that law to the explanation of many remarkable phenomena, both cosmical and terrestrial. His first little paper on the subject, "*Bemerkungen über die Kräfte der unbelebten Natur*," appeared in 1842 in Liebig's *Annalen*, five years after the republication, in the same journal, of an extract from K. F. Mohr's paper on the nature of heat, and three years later he published *Die organische Bewegung in ihren Zusammenhange mit dem Stoffwechsel*.

It has been repeatedly claimed for Mayer that he calculated the value of the dynamical equivalent of heat, indirectly, no doubt, but in a manner altogether free from error, and with a result according almost exactly with that obtained by J. P. Joule after years of patient labour in direct experimenting. This claim on Mayer's behalf was first shown to be baseless by W. Thomson (Lord Kelvin) and P. G. Tait in an article on "Energy," published in *Good Words* in 1862, which gave rise to a long but lively discussion. A calm and judicial annihilation of the claim is to be found in a brief article by Sir G. G. Stokes, *Proc. Roy. Soc.*, 1871, p. 54. See also Maxwell's *Theory of Heat*, chap. xiii. Mayer entirely ignored the grand fundamental principle laid down by Sadi Carnot—that nothing can be concluded as to the relation between heat and work from an experiment in which the working substance is left at the end of an operation in a different physical state from that in which it was at the commencement. Mayer has also been styled the discoverer of the fact that heat consists in (the energy of) motion, a matter settled at the very end of the 18th century by Count Rumford and Sir H. Davy; but in the teeth of this statement we have Mayer's own words, "We might much rather assume the contrary—that in order to become heat motion must cease to be motion."

Mayer's real merit consists in the fact that, having for himself made out, on inadequate and even questionable grounds, the conservation of energy, and having obtained (though by inaccurate reasoning) a numerical result correct so far as his data permitted, he applied the principle with great power and insight to the explanation of numerous physical phenomena. His papers, which were republished in a single volume with the title *Die Mechanik der Wärme* (3rd ed., 1893), are of unequal merit. But some, especially those on *Celestial Dynamics* and *Organic Motion*, are admirable examples of what really valuable work may be effected by a man of high intellectual powers, in spite of imperfect information and defective logic.

Different, and it would appear exaggerated, estimates of Mayer are given in John Tyndall's papers in the *Phil. Mag.*, 1863–1864 (whose avowed object was "to raise a noble and a suffering man to the position which his labours entitled him to occupy"), and in E. Dühring's *Robert Mayer, der Galilei des neunzehnten Jahrhunderts*, Chemnitz, 1880. Some of the simpler facts of the case are summarized by Tait in the *Phil. Mag.*, 1864, ii. 289.

MAYFLOWER, the vessel which carried from Southampton, England, to Plymouth, Massachusetts, the Pilgrims who established the first permanent colony in New England. It was of about 180 tons burden, and in company with the "Speedwell" sailed from Southampton on the 5th of August 1620, the two having on board 120 Pilgrims. After two trials the "Speedwell" was pronounced unseaworthy, and the "Mayflower" sailed alone from Plymouth, England, on the 6th of September with the 100 (or 102) passengers, some 41 of whom on the 11th of November (O.S.) signed the famous "Mayflower Compact" in Provincetown Harbor, and a small party of whom, including William Bradford, sent to choose a place for settlement, landed at what is now Plymouth, Massachusetts, on the 11th of December (21st N.S.), an event which is celebrated, as Forefathers' Day, on the 22nd of December. A "General Society of Mayflower Descendants" was organized in 1894 by lineal descendants of passengers of the "Mayflower" to "preserve their memory, their records, their history, and all facts relating to them, their ancestors and their posterity." Every lineal descendant, over eighteen years of age, of any passenger of the "Mayflower" is eligible to membership. Branch societies have since been organized in several of the states and in the District of Columbia, and a triennial congress is held in Plymouth.

See Azel Ames, *The May-Flower and Her Log* (Boston, 1901); Blanche McManus, *The Voyage of the Mayflower* (New York, 1897); *The General Society of Mayflower: Meetings, Officers and Members, arranged in State Societies, Ancestors and their Descendants* (New York, 1901). Also the articles PLYMOUTH, Mass.; MASSACHUSETTS, § *History*; PILGRIM; and PROVINCETOWN, Mass.

MAY-FLY. The Mayflies belong to the Ephemeridae, a remarkable family of winged insects, included by Linnaeus in his order Neuroptera, which derive their scientific name from ἐφήμερος, in allusion to their very short lives. In some species it is possible that they have scarcely more than one day's existence, but others are far longer lived, though the extreme limit is probably rarely more than a week. The family has very sharply defined characters, which separate its members at once from all other neuropterous (or pseudo-neuropterous) groups.

These insects are universally aquatic in their preparatory states. The eggs are dropped into the water by the female in large masses, resembling, in some species, bunches of grapes in miniature. Probably several months elapse before the young larvae are excluded. The sub-aquatic condition lasts a considerable time: in *Cloeon*, a genus of small and delicate species, Sir J. Lubbock (Lord Avebury) proved it to extend over more than six months; but in larger and more robust genera (*e.g. Palingenia*) there appears reason to believe that the greater part of three years is occupied in preparatory conditions.

The larva is elongate and campodeiform. The head is rather large, and is furnished at first with five simple eyes of nearly equal size; but as it increases in size the homologues of the facetted eyes of the imago become larger, whereas those equivalent to the ocelli remain small. The antennae are long and thread-like, composed at first of few joints, but the number of these latter apparently increases at each moult. The mouth parts are well developed, consisting of an upper lip, powerful mandibles, maxillae with three-jointed palpi, and a deeply quadrifid labium or lower lip with three-jointed labial palpi. Distinct and conspicuous maxillulae are associated with the tongue or hypopharynx. There are three distinct and large thoracic segments, whereof the prothorax is narrower than the others; the legs are much shorter and stouter than in the winged insect, with monomerous tarsi terminated by a single claw. The abdomen consists of ten segments, the tenth furnished with long and slender multi-articulate tails, which appear to be only two in number at first, but an intermediate one gradually develops itself (though this latter is often lost in the winged insect). Respiration is effected by means of external gills placed along both sides of the dorsum of the abdomen and hinder segments of the thorax. These vary in form: in some species they are entire plates, in others they are cut up into numerous divisions, in all cases traversed by numerous tracheal ramifications. According to the researches of Lubbock and of E. Joly, the very young larvae have no breathing organs, and respiration is effected through the skin. Lubbock traced at least twenty moults in *Cloeon*; at about the tenth rudiments of the wing-cases began to appear. These gradually become larger, and when so the creature may be said to have entered its "nymph" stage; but there is no condition analogous to the pupa-stage of insects with complete metamorphoses.

There may be said to be three or four different modes of life in these larvae: some are fossorial, and form tubes in the mud or clay in which they live; others are found on or beneath stones; while others again swim and crawl freely among water plants. It is probable that some are carnivorous, either attacking other larvae or subsisting on more minute forms of animal life; but others perhaps feed more exclusively on vegetable matters of a low type, such as diatoms.

The most aberrant type of larva is that of the genus *Prosopistoma*, which was originally described as an entomostracous crustacean on account of the presence of a large carapace overlapping the greater part of the body. The dorsal skeletal elements of the thorax and of the anterior six abdominal segments unite with the wing-cases to form a large respiratory chamber, containing five pairs of tracheal gills, with lateral slits for the inflow and a posterior orifice for the outflow of water. Species of this genus occur in Europe, Africa and Madagascar.

When the aquatic insect has reached its full growth it emerges from the water or seeks its surface; the thorax splits down the back and the winged form appears. But this is not yet perfect, although it has all the form of a perfect insect and is capable of flight; it is what is variously termed a "pseud-imago," "sub-imago" or "pro-imago." Contrary to the habits of all other insects, there yet remains a pellicle that has to be shed, covering every part of the body. This final moult is effected soon after the insect's appearance in the winged form; the creature seeks a temporary resting-place, the pellicle splits down the back, and the now perfect insect comes forth, often differing very greatly in colours and markings from the condition in which it was only a few moments before. If the observer takes up a suitable position near water, his coat is often seen to be covered with the cast sub-imaginal skins of these insects, which had chosen him as a convenient object upon which to undergo their final change. In some few genera of very low type it appears probable that, at any rate in the female, this final change is never effected and that the creature dies a sub-imago.

The winged insect differs considerably in form from its sub-aquatic condition. The head is smaller, often occupied almost entirely above in the male by the very large eyes, which in some species are curiously double in that sex, one portion being pillared, and forming what is termed a "turban," the mouth parts are aborted, for the creature is now incapable of taking nutriment either solid or fluid; the antennae are mere short bristles, consisting of two rather large basal joints and a multi-articulate thread. The prothorax is much narrowed, whereas the other segments (especially the mesothorax) are greatly enlarged; the legs long and slender, the anterior pair often very much longer in the male than in the female; the tarsi four- or five-jointed; but in some genera (*e.g. Oligoneuria* and allies) the legs are aborted, and the creatures are driven helplessly about by the wind. The wings are carried erect: the anterior pair large, with numerous longitudinal nervures, and usually abundant transverse reticulation; the posterior pair very much smaller, often lanceolate, and frequently wanting absolutely. The abdomen consists of ten segments; at the end are either two or three long multi-articulate tails; in the male the ninth joint bears forcipated appendages; in the female the oviducts terminate at the junction of the seventh and eighth ventral segments. The independent opening of the genital ducts and the absence of an ectodermal vagina and ejaculatory duct are remarkable archaic features of these insects, as has been pointed out by J. A. Palmén. The sexual act takes place in the air, and is of very short duration, but is apparently repeated several times, at any rate in some cases.

Ephemeridae are found all over the world, even up to high northern latitudes. F. J. Pictet, A. E. Eaton and others have given us valuable works or monographs on the family; but the subject still remains little understood, partly owing to the great difficulty of preserving such delicate insects; and it appears probable they can only be satisfactorily investigated as moist preparations. The number of described species is less than 200, spread over many genera.

From the earliest times attention has been drawn to the enormous abundance of species of the family in certain localities. Johann Anton Scopoli, writing in the 18th century, speaks of them as so abundant in one place in Carniola that in June twenty cartloads were carried away for manure! *Polymitarcys virgo*, which, though not found in England, occurs in many parts of Europe (and is common at Paris), emerges from the water soon after sunset, and continues for several hours in such myriads as to resemble snow showers, putting out lights, and causing inconvenience to man, and annoyance to horses by entering their nostrils. In other parts of the world they have been recorded in multitudes that obscured passers-by on the other side of the street. And similar records might be multiplied almost to any extent. In Britain, although they are often very abundant, we have scarcely anything analogous.

Fish, as is well known, devour them greedily, and enjoy a veritable feast during the short period in which any particular species appears. By anglers the common English species of *Ephemera* (*vulgata* and *danica*, but more especially the latter, which is more abundant) is known as the "may-fly," but the terms "green drake" and "bastard drake" are applied to conditions of the same species. Useful information on this point will be found in Ronalds's *Fly-Fisher's Entomology*, edited by Westwood.

Ephemeridae belong to a very ancient type of insects, and fossil imprints of allied forms occur even in the Devonian and Carboniferous formations.

There is much to be said in favour of the view entertained by some entomologists that the structural and developmental characteristics of may-flies are sufficiently peculiar to warrant the formation for them of a special order of insects, for which the names Agnatha, Plectoptera and Ephemeroptera have been proposed. (See HEXAPODA, NEUROPTERA.)

BIBLIOGRAPHY.—Of especial value to students of these insects are A. E. Eaton's monograph (*Trans. Linn. Soc.* (2) iii. 1883–1885) and A. Vayssière's "Recherches sur l' organisation des larves" (*Ann. Sci. Nat. Zool.* (6) xiii. 1882 (7) ix. 1890). J. A. Palmén's memoirs *Zur Morphologie des Tracheensystems* (Leipzig, 1877) and *Über paarige Ausführungsgänge der Geschlechtsorgane bei Insekten* (Helsingfors, 1884), contain important observations on may-flies. See also L. C. Miall, *Nat. Hist. Aquatic Insects* (London, 1895); J. G. Needham and others (New York State Museum, Bull. 86, 1905).

(R. McL.; G. H. C.)

MAYHEM (for derivation see MAIMING), an old Anglo-French term of the law signifying an assault whereby the injured person is deprived of a member proper for his defence in fight, *e.g.* an arm, a leg, a fore tooth, &c. The loss of an ear, jaw tooth, &c., was not mayhem. The most ancient punishment in English law was retaliative—*membrum pro membro*, but ultimately at common law fine and imprisonment. Various statutes were passed aimed at the offence of maiming and disfiguring, which is now dealt with by section 18 of the Offences against the Person Act 1861. Mayhem may also be the ground of a civil action, which had this peculiarity that the court on sight of the wound might increase the damages awarded by the jury.

MAYHEW, HENRY (1812–1887), English author and journalist, son of a London solicitor, was born in 1812. He was sent to Westminster school, but ran away to sea. He sailed to India, and on his return studied law for a short time under his father. He began his journalistic career by founding, with Gilbert à Beckett, in 1831, a weekly paper, *Figaro in London*. This was followed in 1832 by a short-lived paper called *The Thief*; and he produced one or two successful farces. His brothers Horace (1816–1872) and Augustus Septimus (1826–1875) were also journalists, and with them Henry occasionally collaborated, notably with the younger in *The Greatest Plague of Life* (1847) and in *Acting Charades* (1850). In 1841 Henry Mayhew was one of the leading spirits in the foundation of *Punch*, of which he was for the first two years joint-editor with Mark Lemon. He afterwards wrote on all kinds of subjects, and published a number of volumes of no permanent reputation—humorous stories, travel and practical handbooks. He is credited with being the first to "write up" the poverty side of London life from a philanthropic point of view; with the collaboration of John Binny and others he published *London Labour and London Poor* (1851; completed 1864) and other works on social and economic questions. He died in London, on the 25th of July 1887. Horace Mayhew was for some years sub-editor of *Punch*, and was the author of several humorous publications and plays. The books of Horace and Augustus Mayhew owe their survival chiefly to Cruikshank's illustrations.

MAYHEW, JONATHAN (1720–1766), American clergyman, was born at Martha's Vineyard on the 8th of October 1720, being fifth in descent from Thomas Mayhew (1592–1682), an early settler and the grantee (1641) of Martha's Vineyard. Thomas Mayhew (*c.* 1616–1657), the younger, his son John (d. 1689) and John's son, Experience (1673–1758), were active missionaries among the Indians of Martha's Vineyard and the vicinity. Jonathan, the son of Experience, graduated at Harvard in 1744. So liberal were his theological views that when he was to be ordained minister of the West Church in Boston in 1747 only two ministers attended the first council called for the ordination, and it was necessary to summon a second council. Mayhew's preaching made his church practically the first "Unitarian" Congregational church in New England, though it was never officially Unitarian. In 1763 he published *Observations on the Charter and Conduct of the Society for Propagating the Gospel in Foreign Parts*, an attack on the policy of the society in sending missionaries to New England contrary to its original purpose of "Maintaining Ministers of the Gospel" in places "wholly destitute and unprovided with means for the maintenance of ministers and for the public worship of God;" the *Observations* marked him as a leader among those in New England who feared, as Mayhew said (1762), "that there is a scheme forming for sending a bishop into this part of the country, and that our Governor,[1] a true churchman, is deeply in the plot." To an American reply to the *Observations*, entitled *A Candid Examination* (1763), Mayhew wrote a *Defense*; and after the publication of an *Answer*, anonymously published in London in 1764 and written by Thomas Secker, archbishop of Canterbury, he wrote a *Second Defense*. He bitterly opposed the Stamp Act, and urged the necessity of colonial union (or "communion") to secure colonial liberties. He died on the 9th of July 1766. Mayhew was Dudleian lecturer at Harvard in 1765, and in 1749 had received the degree of D.D. from the University of Aberdeen.

See Alden Bradford, *Memoir of the Life and Writings of Rev. Jonathan Mayhew* (Boston, 1838), and "An Early Pulpit Champion of Colonial Rights," chapter vi., in vol. i. of M. C. Tyler's *Literary History of the American Revolution* (2 vols., New York, 1897).

MAYHEW, THOMAS, English 18th century cabinet-maker. Mayhew was the less distinguished partner of William Ince (*q.v.*). The chief source of information as to his work is supplied by his own drawings in the volume of designs, *The universal system of household furniture*, which he published in collaboration with his partner. The name of the firm appears to have been Mayhew and Ince, but on the title page of this book the names are reversed, perhaps as an indication that Ince was the more extensive contributor. In the main Mayhew's designs are heavy and clumsy, and often downright extravagant, but he had a certain lightness of accomplishment in his applications of the bizarre Chinese style. Of original talent he possessed little, yet it is certain that much of his Chinese work has been attributed to Chippendale. It is indeed often only by reference to books of design that the respective work of the English cabinet-makers of the second half of the 18th century can be correctly attributed.

MAYMYO, a hill sanatorium in India, in the Mandalay district of Upper Burma, 3500 ft. above the sea, with a station on the

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[1] Francis Bernard, whose project for a college at Northampton seemed to Mayhew and others a move to strengthen Anglicanism.

Mandalay-Lashio railway 422 m. from Rangoon. Pop. (1901), 6223. It consists of an undulating plateau, surrounded by hills, which are covered with thin oak forest and bracken. Though not entirely free from malaria, it has been chosen for the summer residence of the lieutenant-governor; and it is also the permanent headquarters of the lieutenant-general commanding the Burma division, and of other officials.

MAYNARD, FRANÇOIS DE (1582–1646), French poet, was born at Toulouse in 1582. His father was *conseiller* in the parlement of the town, and François was also trained for the law, becoming eventually president of Aurillac. He became secretary to Margaret of Valois, wife of Henry IV., for whom his early poems are written. He was a disciple of Malherbe, who said that in the workmanship of his lines he excelled Racan, but lacked his rival's energy. In 1634 he accompanied the Cardinal de Noailles to Rome and spent about two years in Italy. On his return to France he made many unsuccessful efforts to obtain the favour of Richelieu, but was obliged to retire to Toulouse. He never ceased to lament his exile from Paris and his inability to be present at the meetings of the Academy, of which he was one of the earliest members. The best of his poems is in imitation of Horace, "Alcippe, reviens dans nos bois." He died at Toulouse on the 23rd of December 1646.

His works consist of odes, epigrams, songs and letters, and were published in 1646 by Marin le Roy de Gomberville.

MAYNE, JASPER (1604–1672), English author, was baptized at Hatherleigh, Devonshire, on the 23rd of November 1604. He was educated at Westminster School and at Christ Church, Oxford, where he had a distinguished career. He was presented to two college livings in Oxfordshire, and was made D.D. in 1646. During the Commonwealth he was dispossessed, and became chaplain to the duke of Devonshire. At the Restoration he was made canon of Christ Church, archdeacon of Chichester and chaplain in ordinary to the king. He wrote a farcical domestic comedy, *The City Match* (1639), which is reprinted in vol. xiii. of Hazlitt's edition of Dodsley's *Old Plays*, and a fantastic tragi-comedy entitled *The Amorous War* (printed 1648). After receiving ecclesiastical preferment he gave up poetry as unbefitting his profession. His other works comprise some occasional gems, a translation of Lucian's *Dialogues* (printed 1664) and a number of sermons. He died on the 6th of December 1672 at Oxford.

MAYNOOTH, a small town of county Kildare, Ireland, on the Midland Great Western railway and the Royal Canal, 15 m. W. by N. of Dublin. Pop. (1901), 948. The Royal Catholic College of Maynooth, founded by an Act of the Irish parliament in 1795, is the chief seminary for the education of the Roman Catholic clergy of Ireland. The building is a fine Gothic structure by A. W. Pugin, erected by a parliamentary grant obtained in 1846. The chapel, with fine oak choir-stalls, mosaic pavements, marble altars and stained glass, and with adjoining cloisters, was dedicated in 1890. The average number of students is about 500—the number specified under the act of 1845—and the full course of instruction is eight years. Near the college stand the ruins of Maynooth Castle, probably built in 1176, but subsequently extended, and formerly the residence of the Fitzgerald family. It was besieged in the reigns of Henry VIII. and Edward VI., and during the Cromwellian Wars, when it was demolished. The beautiful mansion of Carton is about a mile from the town.

MAYO, RICHARD SOUTHWELL BOURKE, 6th Earl of (1822–1872), British statesman, son of Robert Bourke, the 5th earl (1797–1867), was born in Dublin on the 21st of February, 1822, and was educated at Trinity College, Dublin. After travelling in Russia he entered parliament, and sat successively for Kildare, Coleraine and Cockermouth. He was chief secretary for Ireland in three administrations, in 1852, 1858 and 1866, and was appointed viceroy of India in January 1869. He consolidated the frontiers of India and met Shere Ali, amir of Afghanistan, in durbar at Umballa in March 1869. His reorganization of the finances of the country put India on a paying basis; and he did much to promote irrigation, railways, forests and other useful public works. Visiting the convict settlement at Port Blair in the Andaman Islands, for the purpose of inspection, the viceroy was assassinated by a convict on the 8th of February 1872. His successor was his son, Dermot Robert Wyndham Bourke (b. 1851) who became 7th earl of Mayo.

See Sir W. W. Hunter, *Life of the Earl of Mayo*, (1876), and *The Earl of Mayo* in the Rulers of India Series (1891).

MAYO, a western county of Ireland, in the province of Connaught, bounded N. and W. by the Atlantic Ocean, N.E. by Sligo, E. by Roscommon, S.E. and S. by Galway. The area is 1,380,390 acres, or about 2157 sq. m., the county being the largest in Ireland after Cork and Galway. About two-thirds of the boundary of Mayo is formed by sea, and the coast is very much indented, and abounds in picturesque scenery. The principal inlets are Killary Harbour between Mayo and Galway; Clew Bay, in which are the harbours of Westport and Newport; Blacksod Bay and Broad Haven, which form the peninsula of the Mullet; and Killala Bay between Mayo and Sligo. The islands are very numerous, the principal being Inishturk, near Killary Harbour; Clare Island, at the mouth of Clew Bay, where there are many islets, all formed of drift; and Achill, the largest island off Ireland. The coast scenery is not surpassed by that of Donegal northward and Connemara southward, and there are several small coast-towns, among which may be named Killala on the north coast, Belmullet on the isthmus between Blacksod Bay and Broad Haven, Newport and Westport on Clew Bay, with the watering-place of Mallaranny. The majestic cliffs of the north coast, however, which reach an extreme height in Benwee Head (892 ft.), are difficult of access and rarely visited. In the eastern half of the county the surface is comparatively level, with occasional hills; the western half is mountainous. Mweelrea (2688 ft.) is included in a mountain range lying between Killary Harbour and Lough Mask. The next highest summits are Nephin (2646 ft.), to the west of Lough Conn, and Croagh Patrick (2510 ft.), to the south of Clew Bay. The river Moy flows northwards, forming part of the boundary of the county with Sligo, and falls into Killala Bay. The courses of the other streams are short, and except when swollen by rains their volume is small. The principal lakes are Lough Mask and Lough Corrib, on the borders of the county with Galway, and Loughs Conn in the east, Carrowmore in the north-west, Beltra in the west, and Carra adjoining Lough Mask. These loughs and the smaller loughs, with the streams generally, afford admirable sport with salmon, sea-trout and brown trout, and Ballina is a favourite centre.

Geology.—The wild and barren west of this county, including the great hills on Achill Island, is formed of "Dalradian" rocks, schists and quartzites, highly folded and metamorphosed, with intrusions of granite near Belmullet. At Blacksod Bay the granite has been quarried as an ornamental stone. Nephin Beg, Nephin and Croagh Patrick are typical quartzite summits, the last named belonging possibly to a Silurian horizon but rising from a metamorphosed area on the south side of Clew Bay. The schists and gneisses of the Ox Mountain axis also enter the county north of Castlebar. The Muilrea and Ben Gorm range, bounding the fine fjord of Killary Harbour, is formed of terraced Silurian rocks, from Bala to Ludlow age. These beds, with intercalated lavas, form the mountainous west shore of Lough Mask, the east, like that of Lough Corrib, being formed of low Carboniferous Limestone ground. Silurian rocks, with Old Red Sandstone over them, come out at the west end of the Curlew range at Ballaghaderreen. Clew Bay, with its islets capped by glacial drift, is a submerged part of a synclinal of Carboniferous strata, and Old Red Sandstone comes out on the north side of this, from near Achill to Lough Conn. The country from Lough Conn northward to the sea is a lowland of Carboniferous Limestone, with L. Carboniferous Sandstone against the Dalradian on the west.

Industries.—There are some very fertile regions in the level portions of the county, but in the mountainous districts the soil is poor, the holdings are subdivided beyond the possibility of affording proper sustenance to their occupiers, and, except where fishing is combined with agricultural operations, the circumstances of the peasantry are among the most wretched of any district of Ireland. The proportion of tillage to pasturage is roughly as 1 to 3½. Oats and potatoes are the principal crops. Cattle, sheep, pigs and poultry are reared. Coarse linen and woollen cloths are manufactured to a small extent. At Foxford woollen-mills are established at a nunnery, in connexion with a scheme of technical instruction. Keel, Belmullet and Ballycastle are the headquarters of sea and coast fishing districts, and Ballina of a salmon-fishing district, and these fisheries are of some value to the poor inhabitants. A branch of the Midland Great Western railway enters the county from Athlone, in the south-east, and runs north to Ballina and Killala on the coast, branches diverging from Claremorris to Ballinrobe, and from Manulla to Westport and Achill on the west coast. The Limerick and Sligo line of the Great Southern and Western passes from south to north-east by way of Claremorris.

Population and Administration.—The population was 218,698 in 1891, and 199,166 in 1901. The decrease of population and the number of emigrants are slightly below the average of the Irish counties. Of the total population about 97% are rural, and about the same percentage are Roman Catholics. The chief towns are Ballina (pop. 4505), Westport (3892) and Castlebar (3585), the county town. Ballaghaderreen, Claremorris (Clare), Crossmolina and Swineford are lesser market towns; and Newport and Westport are small seaports on Clew Bay. The county includes nine baronies. Assizes are held at Castlebar, and quarter sessions at Ballina, Ballinrobe, Belmullet, Castlebar, Claremorris, Swineford and Westport. In the Irish parliament two members were returned for the county, and two for the borough of Castlebar, but at the union Castlebar was disfranchised. The division since 1885 is into north, south, east and west parliamentary divisions, each returning one member. The county is in the Protestant diocese of Tuam and the Roman Catholic dioceses of Taum, Achonry, Galway and Kilmacduagh, and Killala.

History and Antiquities.—Erris in Mayo was the scene of the landing of the chief colony of the Firbolgs, and the battle which is said to have resulted in the overthrow and almost annihilation of this tribe took place also in this county, at Moytura near Cong. At the close of the 12th century what is now the county of Mayo was granted, with other lands, by king John to William, brother of Hubert de Burgh. After the murder of William de Burgh, 3rd earl of Ulster (1333), the Bourkes (de Burghs) of the collateral male line, rejecting the claim of William's heiress (the wife of Lionel, son of King Edward III.) to the succession, succeeded in holding the bulk of the De Burgh possessions, what is now Mayo falling to the branch known by the name of "MacWilliam Oughter," who maintained their virtual independence till the time of Elizabeth. Sir Henry Sydney, during his first viceroyalty, after making efforts to improve communications between Dublin and Connaught in 1566, arranged for the shiring of that province, and Mayo was made shire ground, taking its name from the monastery of Maio or Mageo, which was the seat of a bishop. Even after this period the MacWilliams continued to exercise very great authority, which was regularized in 1603, when "the MacWilliam Oughter," Theobald Bourke, surrendered his lands and received them back, to hold them by English tenure, with the title of Viscount Mayo (see BURGH, DE). Large confiscations of the estates in the county were made in 1586, and on the termination of the wars of 1641; and in 1666 the restoration of his estates to the 4th Viscount Mayo involved another confiscation, at the expense of Cromwell's settlers. Killala was the scene of the landing of a French squadron in connexion with the rebellion of 1798. In 1879 the village of Knock in the south-east acquired notoriety from a story that the Virgin Mary had appeared in the church, which became the resort of many pilgrims.

There are round towers at Killala, Turlough, Meelick and Balla, and an imperfect one at Aughagower. Killala was formerly a bishopric. The monasteries were numerous, and many of them of considerable importance: the principal being those at Mayo, Ballyhaunis, Cong, Ballinrobe, Ballintober, Burrishoole, Cross or Holycross in the peninsula of Mullet, Moyne, Roserk or Rosserick and Templemore or Strade. Of the old castles the most notable are Carrigahooly near Newport, said to have been built by the celebrated Grace O'Malley, and Deel Castle near Ballina, at one time the residence of the earls of Arran.

See Hubert Thomas Knox, *History of the County of Mayo* (1908).

MAYOR, JOHN EYTON BICKERSTETH (1825–), English classical scholar, was born at Baddegama, Ceylon, on the 28th of January 1825, and educated in England at Shrewsbury School and St John's College, Cambridge. From 1863 to 1867 he was librarian of the university, and in 1872 succeeded H. A. J. Munro in the professorship of Latin. His best-known work, an edition of thirteen satires of Juvenal, is marked by an extraordinary wealth of illustrative quotations. His *Bibliographical Clue to Latin Literature* (1873), based on E. Hübner's *Grundriss zu Vorlesungen über die römische Litteraturgeschichte* is a valuable aid to the student, and his edition of Cicero's *Second Philippic* is widely used. He also edited the English works of J. Fisher, bishop of Rochester, i. (1876); Thomas Baker's *History of St John's College, Cambridge* (1869); Richard of Cirencester's *Speculum historiale de gestis regum Angliae 447–1066* (1863–1869); Roger Ascham's *Schoolmaster* (new ed., 1883); the *Latin Heptateuch* (1889); and the *Journal of Philology*.

His brother, JOSEPH BICKERSTETH MAYOR (1828–), classical scholar and theologian, was educated at Rugby and St John's College, Cambridge, and from 1870 to 1879 was professor of classics at King's College, London. His most important classical works are an edition of Cicero's *De natura deorum* (3 vols., 1880–1885) and *Guide to the Choice of Classical Books* (3rd ed., 1885, with supplement, 1896). He also devoted attention to theological literature and edited the epistles of St James (2nd ed., 1892), St Jude and St Peter (1907), and the *Miscellanies* of Clement of Alexandria (with F. J. A. Hort, 1902). From 1887 to 1893 he was editor of the *Classical Review*. His *Chapters on English Metre* (1886) reached a second edition in 1901.

MAYOR (Lat. *major*, greater), in modern times the title of a municipal officer who discharges judicial and administrative functions. The French form of the word is *maire*. In Germany the corresponding title is *Bürgermeister*, in Italy *sindico*, and in Spain *alcalde*. "Mayor" had originally a much wider significance. Among the nations which arose on the ruins of the Roman empire of the West, and which made use of the Latin spoken by their "Roman" subjects as their official and legal language, *major* and the Low Latin feminine *majorissa* were found to be very convenient terms to describe important officials of both sexes who had the superintendence of others. Any female servant or slave in the houselold of a barbarian, whose business it was to overlook other female servants or slaves, would be quite naturally called a *majorissa*. So the male officer who governed the king's household would be the *major domus*. In the households of the Frankish kings of the Merovingian line, the *major domus*, who was also variously known as the *gubernator*, *rector*, *moderator* or *praefectus palatii*, was so great an officer that he ended by evicting his master. He was the "mayor of the palace" (*q.v.*). The fact that his office became hereditary in the family of Pippin of Heristal made the fortune of the Carolingian line. But besides the *major domus* (the major-domo), there were other officers who were *majores*, the *major cubiculi*, mayor of the bedchamber, and *major equorum*, mayor of the horse. In fact a word which could be applied so easily and with accuracy in so many circumstances was certain to be widely used by itself, or in its derivatives. The post-Augustine *majorinus*, "one of the larger kind," was the origin of the medieval Spanish *merinus*, who in Castillian is the *merino*, and sometimes the *merino mayor*, or chief merino. He was a judicial and administrative officer of the king's . The *gregum merinus* was the superintendent of the flocks of the corporation of sheep-owners called the *mesta*. From him the sheep, and then the wool, have come to be known as *merinos*—a word identical in origin with the municipal title of mayor. The latter came directly from the heads of gilds, and other associations of freemen, who had their banner and formed a group on the populations of the towns, the *majores baneriae* or *vexilli*.

In England the major is the modern representative of the lord's bailiff or reeve (see BOROUGH). We find the chief magistrate of London bearing the title of portreeve for considerably more than a century after the Conquest. This official was elected by popular choice, a privilege secured from king John. By the beginning of the 11th century the title of portreeve[1] gave way to that of mayor as the designation of the chief officer of

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[1] If a place was of mercantile importance it was called a port (from *porta*, the city gate), and the reeve or bailiff, a "portreeve."

London,[1] and the adoption of the title by other boroughs followed at various intervals.

A mayor is now in England and America the official head of a municipal government. In the United Kingdom the Municipal Corporations Act, 1882, s. 15, regulates the election of mayors. He is to be a fit person elected annually on the 9th of November by the council of the borough from among the aldermen or councillors or persons qualified to be such. His term of office is one year, but he is eligible for re-election. He may appoint a deputy to act during illness or absence, and such deputy must be either an alderman or councillor. A mayor who is absent from the borough for more than two months becomes disqualified and vacates his office. A mayor is *ex officio* during his year of office and the next year a justice of the peace for the borough. He receives such remuneration as the council thinks reasonable. The office of mayor in an English borough does not entail any important administrative duties. It is generally regarded as an honour conferred for past services. The mayor is expected to devote much of his time to ornamental functions and to preside over meetings which have for their object the advancement of the public welfare. His administrative duties are merely to act as returning officer at municipal elections, and as chairman of the meetings of the council.

The position and power of an English mayor contrast very strongly with those of the similar official in the United States. The latter is elected directly by the voters within the city, usually for several years; and he has extensive administrative powers.

The English method of selecting a mayor by the council is followed for the corresponding functionaries in France (except Paris), the more important cities of Italy, and in Germany, where, however, the central government must confirm the choice of the council. Direct appointment by the central government exists in Belgium, Holland, Denmark, Norway, Sweden and the smaller towns of Italy and Spain. As a rule, too, the term of office is longer in other countries than in the United Kingdom. In France election is for four years, in Holland for six, in Belgium for an indefinite period, and in Germany usually for twelve years, but in some cases for life. In Germany the post may be said to be a professional one, the burgomaster being the head of the city magistracy, and requiring, in order to be eligible, a training in administration. German burgomasters are most frequently elected by promotion from another city. In France the *maire*, and a number of experienced members termed "adjuncts," who assist him as an executive committee, are elected directly by the municipal council from among their own number. Most of the administrative work is left in the hands of the *maire* and his adjuncts, the full council meeting comparatively seldom. The *maire* and the adjuncts receive no salary.

Further information will be found in the sections on local government in the articles on the various countries; see also A. Shaw, *Municipal Government in Continental Europe*; J. A. Fairlie, *Municipal Administration*; S. and B. Webb, *English Local Government*; Redlich and Hirst, *Local Government in England*; A. L. Lowell, *The Government of England.*

MAYOR OF THE PALACE.—The office of mayor of the palace was an institution peculiar to the Franks of the Merovingian period. A landowner who did not manage his own estate placed it in the hands of a steward (*major*), who superintended the working of the estate and collected its revenues. If he had several estates, he appointed a chief steward, who managed the whole of the estates and was called the *major domus*. Each great personage had a *major domus*—the queen had hers, the king his; and since the royal house was called the palace, this officer took the name of "mayor of the palace." The mayor of the palace, however, did not remain restricted to domestic functions; he had the discipline of the palace and tried persons who resided there. Soon his functions expanded. If the king were a minor, the mayor of the palace supervised his education in the capacity of guardian (*nutricius*), and often also occupied himself with affairs of state. When the king came of age, the mayor exerted himself to keep this power, and succeeded. In the 7th century he became the head of the administration and a veritable prime minister. He took part in the nomination of the counts and dukes; in the king's absence he presided over the royal tribunal; and he often commanded the armies. When the custom of commendation developed, the king charged the mayor of the palace to protect those who had commended themselves to him and to intervene at law on their behalf. The mayor of the palace thus found himself at the head of the *commendati*, just as he was at the head of the functionaries.

It is difficult to trace the names of some of the mayors of the palace, the post being of almost no significance in the time of Gregory of Tours. When the office increased in importance the mayors of the palace did not, as has been thought, pursue an identical policy. Some—for instance, Otto, the mayor of the palace of Austrasia towards 640—were devoted to the Crown. On the other hand, mayors like Flaochat (in Burgundy) and Erkinoald (in Neustria) stirred up the great nobles, who claimed the right to take part in their nomination, against the king. Others again, sought to exercise the power in their own name both against the king and against the great nobles—such as Ebroïn (in Neustria), and, later, the Carolingians Pippin II., Charles Martel, and Pippin III., who, after making use of the great nobles, kept the authority for themselves. In 751 Pippin III., fortified by his consultation with Pope Zacharias, could quite naturally exchange the title of mayor for that of king; and when he became king, he suppressed the title of mayor of the palace. It must be observed that from 639 there were generally separate mayors of Neustria, Austrasia and Burgundy, even when Austrasia and Burgundy formed a single kingdom; the mayor was a sign of the independence of the region. Each mayor, however, sought to supplant the others; the Pippins and Charles Martel succeeded, and their victory was at the same time the victory of Austrasia over Neustria and Burgundy.

See G. H. Pertz, *Geschichte der merowingischen Hausmeier* (Hanover, 1819); H. Bonnell, *De dignitate majoris domus* (Berlin, 1858); E. Hermann, *Das Hausmeieramt, ein echt germanisches Amt*, vol. ix. of *Untersuchungen zur deutschen Staats- und Rechtsgeschichte*, ed. by O. Gierke (Breslau, 1878, seq.); G. Waitz, *Deutsche Verfassungsgeschichte*, 3rd ed., revised by K. Zeumer; and Fustel de Coulanges, *Histoire des institutions politiques de l' ancienne France: La monarchie franque* (Paris, 1888). (C. Pf.)

MAYORUNA, a tribe of South American Indians of Panoan stock. Their country is between the Ucayali and Javari rivers, north-eastern Peru. They are a fine race, roaming the forests and living by hunting. They cut their hair in a line across the forehead and let it hang down their backs. Many have fair skins and beards, a peculiarity sometimes explained by their alleged descent from Ursua's soldiers, but this theory is improbable. They are famous for the potency of their blow-gun poison.

MAYO-SMITH, RICHMOND (1854–1901), American economist, was born in Troy, Ohio, on the 9th of February 1854. Educated at Amherst, and at Berlin and Heidelberg, he became assistant professor of economics at Columbia University in 1877. He was an adjunct professor from 1878 to 1883, when he was appointed professor of political economy and social science, a post which he held until his death on the 11th of November 1901. He devoted himself especially to the study of statistics, and was recognized as one of the foremost authorities on the subject. His works include *Emigration and Immigration* (1890); *Sociology and Statistics* (1895), and *Statistics and Economics* (1899).

MAYOTTE, one of the Comoro Islands, in the Mozambique Channel between Madagascar and the African mainland. It has belonged to France since 1843 (see Comoro Islands).

MAYOW, JOHN (1643–1679), English chemist and physiologist, was born in London in May 1643. At the age of fifteen he went up to Wadham College, Oxford, of which he became a scholar a year later, and in 1660 he was elected to a fellowship at All Souls. He graduated in law (bachelor, 1665, doctor, 1670), but made medicine his profession, and "became noted for his practice therein, especially in the summer time, in the city of Bath." In 1678, on the proposal of R. Hooke, he was chosen a fellow of the Royal Society. The following year, after a marriage which was "not altogether to his content," he died in London in September 1679. He published at Oxford in 1668 two tracts, on respiration and rickets, and in 1674 these were reprinted, the former in an enlarged and corrected form, with three others "De sal-nitro et spiritu nitro-aereo," "De respiratione foetus in utero et ovo," and " De motu musculari et spiritibus animalibus " as *Tractatus quinque medico-physici*. The contents of this work, which was several times republished and translated into Dutch, German and French, show him to have been an investigator much in advance of his time.

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[1] The mayors of certain cities in the United Kingdom (London, York, Dublin) have acquired by prescription the prefix of "lord." In the case of London it seems to date from 1540. It has also been conferred during the closing years of the 19th century by letters patent on other cities—Birmingham, Liverpool, Manchester, Bristol, Sheffield, Leeds, Cardiff, Bradford, Newcastle-on-Tyne, Belfast, Cork. In 1910 it was granted to Norwich. Lord mayors are entitled to be addressed as "right honourable."

Accepting as proved by Boyle's experiments that air is necessary for combustion, he showed that fire is supported not by the air as a whole but by a " more active and subtle part of it." This part he called *spiritus igneo-aereus*, or sometimes *nitro-aereus*; for he identified it with one of the constituents of the acid portion of nitre which he regarded as formed by the union of fixed alkali with a *spiritus acidus*. In combustion the *particulae nitro-aereae*—either pre-existent in the thing consumed or supplied by the air—combined with the material burnt; as he inferred from his observation that antimony, strongly heated with a burning glass, undergoes an increase of weight which can be attributed to nothing else but these particles. In respiration he argued that the same particles are consumed, because he found that when a small animal and a lighted candle were placed in a closed vessel full of air the candle first went out and soon afterwards the animal died, but if there was no candle present it lived twice as long. He concluded that this constituent of the air is absolutely necessary for life, and supposed that the lungs separate it from the atmosphere and pass it into the blood. It is also necessary, he inferred, for all muscular movements, and he thought there was reason to believe that the sudden contraction of muscle is produced by its combination with other combustible (salino-sulphureous) particles in the body; hence the heart, being a muscle, ceases to beat when respiration is stopped. Animal heat also is due to the union of nitro-aerial particles, breathed in from the air, with the combustible particles in the blood, and is further formed by the combination of these two sets of particles in muscle during violent exertion. In effect, therefore, Mayow—who also gives a remarkably correct anatomical description of the mechanism of respiration—preceded Priestley and Lavoisier by a century in recognizing the existence of oxygen, under the guise of his *spiritus nitro-aereus*, as a separate entity distinct from the general mass of the air; he perceived the part it plays in combustion and in increasing the weight of the calces of metals as compared with metals themselves; and, rejecting the common notions of his time that the use of breathing is to cool the heart, or assist the passage of the blood from the right to the left side of the heart, or merely to agitate it, he saw in inspiration a mechanism for introducing oxygen into the body, where it is consumed for the production of heat and muscular activity, and even vaguely conceived of expiration as an excretory process.

MAYSVILLE, a city and the county-seat of Mason county, Kentucky, U.S.A., on the Ohio river, 60 m. by rail S.E. of Cincinnati. Pop. (1890) 5358; (1900) 6423 (1155 negroes); (1910) 6141. It is served by the Louisville & Nashville, and the Chesapeake & Ohio railways, and by steamboats on the Ohio river. Among its principal buildings are the Mason county public library (1878), the Federal building and Masonic and Odd Fellows' temples. The city lies between the river and a range of hills; at the back of the hills is a fine farming country, of which tobacco of excellent quality is a leading product. There is a large plant of the American Tobacco Company at Maysville, and among the city's manufactures are pulleys, ploughs, whisky, flour, lumber, furniture, carriages, cigars, foundry and machine-shop products, bricks and cotton goods. The city is a distributing point for coal and other products brought to it by Ohio river boats. Formerly it was one of the principal hemp markets of the country. The place early became a landing point for immigrants to Kentucky, and in 1784 a double log cabin and a blockhouse were erected here. It was then called Limestone, from the creek which flows into the Ohio here, but several years later the present name was adopted in honour of John May, who with Simon Kenton laid out the town in 1787, and who in 1790 was killed by the Indians. Maysville was incorporated as a town in 1787, was chartered as a city in 1833, and became the county-seat in 1848.

In 1830, when the question of " internal improvements " by the National government was an important political issue, Congress passed a bill directing the government to aid in building a turnpike road from Maysville to Lexington. President Andrew Jackson vetoed the bill on the ground that the proposed improvement was a local rather than a national one; but one-half the capital was then furnished privately, the other half was furnished through several state appropriations, and the road was completed in 1835 and marked the beginning of a system of turnpike roads built with state aid.

MAZAGAN (*El Jadīda*), a port on the Atlantic coast of Morocco in 33° 16′ N. 8° 26′ W. Pop. (1908), about 12,000, of whom a fourth are Jews and some 400 Europeans. It is the port for Marrákesh, from which it is 110 m. nearly due north, and also for the fertile province of Dukálla. Mazagan presents from the sea a very un-Moorish appearance; it has massive Portuguese walls of hewn stone. The exports, which include beans, almonds, maize, chick-peas, wool, hides, wax, eggs, &c., were valued at £360,000 in 1900, £364,000 in 1904, and £248,000 in 1906. The imports (cotton goods, sugar, tea, rice, &c.) were valued at £280,000 in 1900, £286,000 in 1904, and £320,000 in 1906. About 46% of the trade is with Great Britain and 34% with France. Mazagan was built in 1506 by the Portuguese, who abandoned it to the Moors in 1769 and established a colony, New Mazagan, on the shores of Para in Brazil.

See A. H. Dyé, " Les ports du Maroc " in *Bull. Soc. Geog. Comm. Paris*, xxx. 325–332 (1908), and British consular reports.

MAZAMET, an industrial town of south-western France in the department of Tarn, 41 m. S.S.E. of Albi by rail. Pop. (1906), town, 11,370; commune, 14,386. Mazamet is situated on the northern slope of the Montagnes Noires and on the Arnette, a small sub-tributary of the Agout. Numerous establishments are employed in wool-spinning and in the manufacture of " swan-skins " and flannels, and clothing for troops, and hosiery, and there are important tanneries and leather-dressing, glove and dye works. Extensive commerce is carried on in wool and raw hides from Argentina, Australia and Cape Colony.

MAZANDARAN, a province of northern Persia, lying between the Caspian Sea and the Elburz range, and bounded E. and W. by the provinces of Astarabad and Gilan respectively, 220 m. in length and 60 m. in (mean) breadth, with an area of about 10,000 sq. m. and a population estimated at from 150,000 to 200,000. Mazandaran comprises two distinct natural regions presenting the sharpest contrasts in their relief, climate and products. In the north the Caspian is encircled by the level and swampy lowlands, varying in breadth from 10 to 30 m., partly under impenetrable jungle, partly under rice, cotton, sugar and other crops. This section is fringed northwards by the sandy beach of the Caspian, here almost destitute of natural harbours, and rises somewhat abruptly inland to the second section, comprising the northern slopes and spurs of the Elburz, which approach at some points within 1 or 2 m. of the sea, and are almost everywhere covered with dense forest. The lowlands, rising but a few feet above the Caspian, and subject to frequent floodings, are extremely malarious, while the highlands, culminating with the magnificent Demavend (19,400 ft.), enjoy a tolerably healthy climate. But the climate, generally hot and moist in summer, is everywhere capricious and liable to sudden changes of temperature, whence the prevalence of rheumatism, dropsy and especially ophthalmia, noticed by all travellers. Snow falls heavily in the uplands, where it often lies for weeks on the ground. The direction of the long sandbanks at the river mouths, which project with remarkable uniformity from west to east, shows that the prevailing winds blow from the west and north-west. The rivers themselves, of which there are as many as fifty, are little more than mountain torrents, all rising on the northern slopes of Elburz, flowing mostly in independent channels to the Caspian, and subject to sudden freshets and inundations along their lower course. The chief are the Sardab-rud, Chalus, Herhaz (Lar in its upper course), Babul, Tejen and Nika, and all are well stocked with trout, salmon (*azad-mahi*), perch (*safid-mahi*), carp (*kupur*), bream (*subulu*), sturgeon (*sag-mahi*) and other fish, which with rice form the staple food of the inhabitants; the sturgeon supplies the caviare for the Russian market. Near their mouths the rivers, running counter to the prevailing winds and waves of the Caspian, form long sand-hills 20 to 30 ft. high and about 200 yds. broad, behind which are developed the so-called *múrd-áb*, or " dead waters," stagnant pools and swamps characteristic of this coast, and a main cause of its unhealthiness.

The chief products are rice, cotton, sugar, a little silk, and fruits in great variety, including several kinds of the orange, lemon and citron. Some of the slopes are covered with extensive thickets of the pomegranate, and the wild vine climbs to a great height round the trunks of the forest trees. These woodlands are haunted by the tiger, panther, bear, wolf and wild boar in considerable numbers. Of the domestic animals, all remarkable for their small size, the chief are the black, humped cattle somewhat resembling the Indian variety, and sheep and goats.

Kinneir, Fraser and other observers speak unfavourably of the Mazandarani people, whom they describe as very ignorant and bigoted, arrogant, rudely inquisitive and almost insolent towards strangers. The peasantry, however, are far from dull, and betray much shrewdness where their interests are concerned. In the healthy districts they are stout and well made, and are considered a warlike race, furnishing some cavalry (800 men) and eight battalions of infantry (5600 men) to government. They speak a marked Persian dialect, but a Tūrki idion closely akin to the Turkoman is still current amongst the tribes, although they have mostly already passed from the nomad to the settled state. Of these tribes the most numerous are the Modaunlū, Khojehvand and Abdul Maleki, originally of Lek or Kurd stock, besides branches of the royal Afshār and Kājār tribes of Tūrki descent. All these are exempt from taxes in consideration of their military service.

The export trade is chiefly with Russia from Meshed-i-Sar, the principal port of the province, to Baku, where European goods are taken in exchange for the white and coloured calicoes, caviare, rice, fruits and raw cotton of Mazandarān. Great quantities of rice are also exported to the interior of Persia, principally to Teheran and Kazvin. Owing to the almost impenetrable character of the country there are scarcely any roads accessible to wheeled carriages, and the great causeway of Shah Abbas along the coast has in many places even disappeared under the jungle. Two routes, however, lead to Teheran, one by Firuz Kuh, 180 m. long, the other by Larijan, 144 m. long, both in tolerably good repair. Except where crossed by these routes the Elburz forms an almost impassable barrier to the south.

The administration is in the hands of a governor, who appoints the sub-governors of the nine districts of Amol, Barfarush, Meshed-i-Sar, Sari, Ashref, Farah-abad, Tunakabun, Kelarrustak and Kujur into which the province is divided. There is fair security for life and property; and, although otherwise indifferently administered, the country is quite free from marauders; but local disturbances have latterly been frequent in the two last-named districts. The revenue is about £30,000, of which little goes to the state treasury, most being required for the governors, troops and pensions. The capital is Sari, the other chief towns being Barfarush, Meshed-i-Sar, Ashref and Farah-abad. (A. H.-S.)

MAZARIN, JULES (1602–1661), French cardinal and statesman, elder son of a Sicilian, Pietro Mazarini, the intendant of the household of Philip Colonna, and of his wife Ortensia Buffalini, a connexion of the Colonnas, was born at Piscina in the Abruzzi on the 14th of July 1602. He was educated by the Jesuits at Rome till his seventeenth year, when he accompanied Jerome Colonna as chamberlain to the university of Alcala in Spain. There he distinguished himself more by his love of gambling and his gallant adventures than by study, but made himself a thorough master, not only of the Spanish language and character, but also of that romantic fashion of Spanish love-making which was to help him greatly in after life, when he became the servant of a Spanish queen. On his return to Rome, about 1622, he took his degree as Doctor *utriusque juris*, and then became captain of infantry in the regiment of Colonna, which took part in the war in the Valtelline. During this war he gave proofs of much diplomatic ability, and Pope Urban VIII. entrusted him, in 1629, with the difficult task of putting an end to the war of the Mantuan succession. His success marked him out for further distinction. He was presented to two canonries in the churches of St John Lateran and Sta Maria Maggiore, although he had only taken the minor orders, and had never been consecrated priest; he negotiated the treaty of Turin between France and Savoy in 1632, became vice-legate at Avignon in 1634, and nuncio at the court of France from 1634 to 1636. But he began to wish for a wider shpere than papal negotiations, and, seeing that he had no chance of becoming a cardinal except by the aid of some great power, he accepted Richelieu's offer of entering the service of the king of France, and in 1639 became a naturalized Frenchman.

In 1640 Richelieu sent him to Savoy, where the regency of Christine, the duchess of Savoy, and sister of Louis XIII., was disputed by her brothers-in-law, the princes Maurice and Thomas of Savoy, and he succeeded not only in firmly establishing Christine but in winning over the princes to France. This great service was rewarded by his promotion to the rank of cardinal on the presentation of the king of France in December 1641. On the 4th of December 1642 Cardinal Richelieu died, and on the very next day the king sent a circular letter to all officials ordering them to send in their reports to Cardinal Mazarin, as they had formerly done to Cardinal Richelieu. Mazarin was thus acknowledged supreme minister, but he still had a difficult part to play. The king evidently could not live long, and to preserve power he must make himself necessary to the queen, who would then be regent, and do this without arousing the suspicions of the king or the distrust of the queen. His measures were ably taken, and when the king died, on the 14th of May 1643, to everyone's surprise her husband's minister remained the queen's. The king had by a royal edict cumbered the queen-regent with a council and other restrictions, and it was necessary to get the parlement of Paris to overrule the edict and make the queen absolute regent, which was done with the greatest complaisance. Now that the queen was all-powerful, it was expected she would at once dismiss Mazarin and summon her own friends to power. One of them, Potier, bishop of Beauvais, already gave himself airs as prime minister, but Mazarin had had the address to touch both the queen's heart by his Spanish gallantry and her desire for her son's glory by his skilful policy abroad, and he found himself able easily to overthrow the clique of Importants, as they were called. That skilful policy was shown in every arena on which the great Thirty Years' War was being fought out. Mazarin had inherited the policy of France during the Thirty Years' War from Richelieu. He had inherited his desire for the humiliation of the house of Austria in both its branches, his desire to push the French frontier to the Rhine and maintain a counterpoise of German states against Austria, his alliances with the Netherlands and with Sweden, and his four theatres of war—on the Rhine, in Flanders, in Italy and in Catalonia.

During the last five years of the great war it was Mazarin alone who directed the French diplomacy of the period. He it was who made the peace of Brömsebro between the Danes and the Swedes, and turned the latter once again against the empire; he it was who sent Lionne to make the peace of Castro, and combine the princes of North Italy against the Spaniards, and who made the peace of Ulm between France and Bavaria, thus detaching the emperor's best ally. He made one fatal mistake—he dreamt of the French frontier being the Rhine and the Scheldt, and that a Spanish princess might bring the Spanish Netherlands as dowry to Louis XIV. This roused the jealousy of the United Provinces, and they made a separate peace with Spain in January 1648; but the valour of the French generals made the skill of the Spanish diplomatists of no avail, for Turenne's victory at Zusmarshausen, and Condé's at Lens, caused the peace of Westphalia to be definitely signed in October 1648. This celebrated treaty belongs rather to the history of Germany than to a life of Mazarin; but two questions have been often asked, whether Mazarin did not delay the peace as long as possible in order to more completely ruin Germany, and whether Richelieu would have made a similar peace. To the first question Mazarin's letters, published by M. Chéruel, prove a complete negative, for in them appears the zeal of Mazarin for the peace. On the second point, Richelieu's letters in many places indicate that his treatment of the great question of frontier would have been more thorough, but then he would not have been hampered in France itself.

At home Mazarin's policy lacked the strength of Richelieu's. The Frondes were largely due to his own fault. The arrest of Broussel threw the people on the side of the parlement. His avarice and unscrupulous plundering of the revenues of the realm, the enormous fortune which he thus amassed, his supple ways, his nepotism, and the general lack of public interest in the great foreign policy of Richelieu, made Mazarin the especial object of hatred both by bourgeois and nobles. The irritation of the latter was greatly Mazarin's own fault; he had tried consistently to play off the king's brother Gaston of Orleans against Condé, and their respective followers against each other, and had also, as his *carnets* prove, jealously kept any courtier from getting into the good graces of the queen-regent except by his means, so that it was not unnatural that the nobility should hate him, while the queen found herself surrounded by his creatures alone. Events followed each other quickly; the day of the barricades was followed by the peace of Ruel, the peace of Ruel by the arrest of the princes, by the battle of Rethel, and Mazarin's exile to Brühl before the union of the two Frondes. It was while in exile at Brühl that Mazarin saw the mistake he had made in isolating himself and the queen, and that his policy of balancing every party in the state against each other had made every party distrust him. So by his counsel the queen, while nominally in league with De Retz and the parliamentary Fronde, laboured to form a purely royal party, wearied by civil dissensions, who should act for her and her son's interest alone, under the leadership of Mathieu Molé, the famous premier president of the parlement of Paris. The new party grew in strength, and in January 1652, after exactly a year's absence, Mazarin returned to the court. Turenne had now become the royal general, and out-manœuvred Condé, while the royal party at last grew to such strength in Paris that Condé had to leave the capital and France. In order to promote a reconciliation with the parlement of Paris Mazarin had again retired from court, this time to Sedan, in August 1652, but he returned finally in February 1653. Long had been the trial, and greatly had Mazarin been to blame in allowing the Frondes to come into existence, but he had retrieved his position by founding that great royal party which steadily grew until Louis XIV. could fairly have said "L'État, c'est moi." As the war had progressed, Mazarin had steadily followed Richelieu's policy of weakening the nobles on their country estates. Whenever he had an opportunity he destroyed a feudal castle, and by destroying the towers which commanded nearly every town in France, he freed such towns as Bourges, for instance, from their long practical subjection to the neighbouring great lord.

The Fronde over, Mazarin had to build up afresh the power of France at home and abroad. It is to his shame that he did so little at home. Beyond destroying the brick-and-mortar remains of feudalism, he did nothing for the people. But abroad his policy was everywhere successful, and opened the way for the policy of Louis XIV. He at first, by means of an alliance with Cromwell, recovered the north-western cities of France, though at the price of yielding Dunkirk to the Protector. On the Baltic, France guaranteed the Treaty of Oliva between her old allies Sweden, Poland and Brandenburg, which preserved her influence in that quarter. In Germany he, through Hugues de Lionne, formed the league of the Rhine, by which the states along the Rhine bound themselves under the headship of France to be on their guard against the house of Austria. By such measures Spain was induced to sue for peace, which was finally signed in the Isle of Pheasants on the Bidassoa, and is known as the Treaty of the Pyrenees. By it Spain recovered Franche Comté, but ceded to France Roussillon, and much of French Flanders; and, what was of greater ultimate importance to Europe, Louis XIV. was to marry a Spanish princess, who was to renounce her claims to the Spanish succession if her dowry was paid, which Mazarin knew could not happen at present from the emptiness of the Spanish exchequer. He returned to Paris in declining health, and did not long survive the unhealthy sojourn on the Bidassoa; after some political instruction to his young master he passed away at Vincennes on the 9th of March 1661, leaving a fortune estimated at from 18 to 40 million livres behind him, and his nieces married into the greatest families of France and Italy.

The man who could have had such success, who could have made the Treaties of Westphalia and the Pyrenees, who could have weathered the storm of the Fronde, and left France at peace with itself and with Europe to Louis XIV., must have been a great man; and historians, relying too much on the brilliant memoirs of his adversaries, like De Retz, are apt to rank him too low. That he had many a petty fault there can be no doubt; that he was avaricious and double-dealing was also undoubted; and his *carnets* show to what unworthy means he had recourse to maintain his influence over the queen. What that influence was will be always debated, but both his *carnets* and the Brühl letters show that a real personal affection, amounting to passion on the queen's part, existed. Whether they were ever married may be doubted; but that hypothesis is made more possible by M. Chéruel's having been able to prove from Mazarin's letters that the cardinal himself had never taken more than the minor orders, which could always be thrown off. With regard to France he played a more patriotic part than Condé or Turenne, for he never treated with the Spaniards, and his letters show that in the midst of his difficulties he followed with intense eagerness every movement on the frontiers. It is that immense mass of letters that prove the real greatness of the statesman, and disprove De Retz's portrait, which is carefully arranged to show off his enemy against the might of Richelieu. To concede that the master was the greater man and the greater statesman does not imply that Mazarin was but a foil to his predecessor. It is true that we find none of those deep plans for the internal prosperity of France which shine through Richelieu's policy. Mazarin was not a Frenchman, but a citizen of the world, and always paid most attention to foreign affairs; in his letters all that could teach a diplomatist is to be found, broad general views of policy, minute details carefully elaborated, keen insight into men's characters, cunning directions when to dissimulate or when to be frank. Italian though he was by birth, education and nature, France owed him a great debt for his skilful management during the early years of Louis XIV., and the king owed him yet more, for he had not only transmitted to him a nation at peace, but had educated for him his great servants Le Tellier, Lionne and Colbert. Literary men owed him also much; not only did he throw his famous library open to them, but he pensioned all their leaders, including Descartes, Vincent Voiture (1598–1648), Jean Louis Guez de Balzac (1597–1654) and Pierre Corneille. The last-named applied, with an adroit allusion to his birthplace, in the dedication of his *Pompée*, the line of Virgil:—

> "Tu regere imperio populos, Romane, memento."

(H. M. S.)

AUTHORITIES.—All the earlier works on Mazarin, and early accounts of his administration, of which the best were Bazin's *Histoire de France sous Louis XIII. et sous le Cardinal Mazarin*, 4 vols. (1846), and Saint-Aulaire's *Histoire de la Fronde*, have been superseded by P. A. Chéruel's admirable *Histoire de France pendant la minorité de Louis XIV.*, 4 vols. (1879–1880), which covers from 1643–1651, and its sequel *Histoire de France sous le ministère de Cardinal Mazarin*, 2 vols. (1881–1882), which is the first account of the period written by one able to sift the statements of De Retz and the memoir writers, and rest upon such documents as Mazarin's letters and *carnets*. Mazarin's *Lettres*, which must be carefully studied by any student of the history of France, have appeared in the *Collection des documents inédits*, 9 vols. For his *carnets* reference must be made to V. Cousin's articles in the *Journal des Savants*, and Chéruel in *Revue historique* (1877), see also Chéruel's *Histoire de France pendant la minorité*, &c., app. to vol. iii.; for his early life to Cousin's *Jeunesse de Mazarin* (1865), and for the careers of his nieces to Renée's *Les Nièces de Mazarin* (1856). For the Mazarinades or squibs written against him in Paris during the Fronde, see C. Moreau's *Bibliographie des mazarinades* (1850), containing an account of 4082 Mazarinades. See also A. Hassall, *Mazarin* (1903).

MAZAR-I-SHARIF, a town of Afghanistan, the capital of the province of Afghan Turkestan. Owing to the importance of the military cantonment of Takhtapul, and its religious sanctity, it has long ago supplanted the more ancient capital of Balkh. It is situated in a malarious, almost desert plain, 9 m. E. of Balkh, and 30 m. S. of the Pata Kesar ferry on the Oxus river. In this neighbourhood is concentrated most of the Afghan army north of the Hindu Kush mountains, the fortified cantonment of Dehdadi having been completed by Sirdar Ghulam Ali Khan and incorporated with Mazar. Mazar-i-Sharif also contains a celebrated mosque, from which the town takes its name. It is a huge ornate building with minarets and a lofty cupola faced with shining blue tiles. It was built by Sultan Ali Mirza about A.D. 1420, and is held in great veneration by all Mussulmans, and especially by Shiites, because it is supposed to be the tomb of Ali, the son-in-law of Mahomet.

MAZARRÓN, a town of eastern Spain, in the province of Murcia, 19 m. W. of Cartagena. Pop. (1900), 23,284. There are soap and flour mills and metallurgic factories in the town, and iron, copper and lead mines in the neighbouring Sierra de Almenara. A railway 5 m. long unites Mazarrón to its port on the Mediterranean, where there is a suburb with 2500 inhabitants (mostly engaged in fisheries and coasting trade), containing barracks, a custom-house, and important leadworks. Outside of the suburb there are saltpans, most of the proceeds of which are exported to Galicia.

MAZATLÁN, a city and port of the state of Sinaloa, Mexico, 120 m. (direct) W.S.W. of the city of Durango, in lat. 23° 12′ N., long. 106° 24′ W. Pop. (1895), 15,852; (1900), 17,852. It is the Pacific coast terminus of the International railway which crosses northern Mexico from Ciudad Porfirio Diaz, and a port of call for the principal steamship lines on this coast. The harbour is spacious, but the entrance is obstructed by a bar. The city is built on a small peninsula. Its public buildings include a fine town-hall, chamber of commerce, a custom-house and two hospitals, besides which there is a nautical school and a meteorological station, one of the first established in Mexico. The harbour is provided with a sea-wall at Olas Altas. A government wireless telegraph service is maintained between Mazatlán and La Paz, Lower California. Among the manufactures are saw-mills, foundries, cotton factories and ropeworks, and the exports are chiefly hides, ixtle, dried and salted fish, gold, silver and copper (bars and ores), fruit, rubber, tortoise-shell, and gums and resins.

MAZE, a network of winding paths, a labyrinth (*q.v.*). The word means properly a state of confusion or wonder, and is probably of Scandinavian origin; cf. Norw. *mas*, exhausting labour, also chatter, *masa*, to be busy, also to worry, annoy; Swed. *masa*, to lounge, move slowly and lazily, to dream, muse. Skeat (*Etym.* Dict.) takes the original sense to be probably "to be lost in thought," "to dream," and connects with the root *ma-man-*, to think, cf. "mind," "man," &c. The word "maze" represents the addition of an intensive suffix.

MAZEPA-KOLEDINSKY, IVAN STEPANOVICH (1644?–1709), hetman of the Cossacks, belonging to a noble Orthodox family, was born possibly at Mazeptsina, either in 1629 or 1644, the latter being the more probable date. He was educated at the court of the Polish king, John Casimir, and completed his studies abroad. An intrigue with a Polish married lady forced him to fly into the Ukraine. There is a trustworthy tradition that the infuriated husband tied the naked youth to the back of a wild horse and sent him forth into the steppe. He was rescued and cared for by the Dnieperian Cossacks, and speedily became one of their ablest leaders. In 1687, during a visit to Moscow, he won the favour of the then all-powerful Vasily Golitsuin, from whom he virtually purchased the hetmanship of the Cossacks (July 25). He took a very active part in the Azov campaigns of Peter the Great and won the entire confidence of the young tsar by his zeal and energy. He was also very serviceable to Peter at the beginning of the Great Northern War, especially in 1705 and 1706, when he took part in the Volhynian campaign and helped to construct the fortress of Pechersk. The power and influence of Mazepa were fully recognized by Peter the Great. No other Cossack hetman had ever been treated with such deference at Moscow. He ranked with the highest dignitaries in the state; he sat at the tsar's own table. He had been made one of the first cavaliers of the newly established order of St Andrew, and Augustus of Poland had bestowed upon him, at Peter's earnest solicitation, the universally coveted order of the White Eagle. Mazepa had no temptations to be anything but loyal, and loyal he would doubtless have remained had not Charles XII. crossed the Russian frontier. Then it was that Mazepa, who had had doubts of the issue of the struggle all along, made up his mind that Charles, not Peter, was going to win, and that it was high time he looked after his own interests. Besides, he had his personal grievances against the tsar. He did not like the new ways because they interfered with his old ones. He was very jealous of the favourite (Menshikov), whom he suspected of a design to supplant him. But he proceeded very cautiously. Indeed, he would have preferred to remain neutral, but he was not strong enough to stand alone. The crisis came when Peter ordered him to co-operate actively with the Russian forces in the Ukraine. At this very time he was in communication with Charles's first minister, Count Piper, and had agreed to harbour the Swedes in the Ukraine and close it against the Russians (Oct. 1708). The last doubt disappeared when Menshikov was sent to supervise Mazepa. At the approach of his rival the old hetman hastened to the Swedish outposts at Horki, in Severia. Mazepa's treason took Peter completely by surprise. He instantly commanded Menshikov to get a new hetman elected and raze Baturin, Mazepa's chief stronghold in the Ukraine, to the ground. When Charles, a week later, passed Baturin by, all that remained of the Cossack capital was a heap of smouldering mills and ruined houses. The total destruction of Baturin, almost in sight of the Swedes, overawed the bulk of the Cossacks into obedience, and Mazepa's ancient prestige was ruined in a day when the metropolitan of Kiev solemnly excommunicated him from the high altar, and his effigy, after being dragged with contumely through the mud at Kiev, was publicly burnt by the common hangman. Henceforth Mazepa, perforce, attached himself to Charles. What part he took at the battle of Poltava is not quite clear. After the catastrophe he accompanied Charles to Turkey with some 1500 horsemen (the miserable remnant of his 80,000 warriors). The sultan refused to surrender him to the tsar, though Peter offered 300,000 ducats for his head. He died at Bender on the 22nd of August 1709.

See N. I. Kostomarov, *Mazepa and the Mazepanites* (Russ.) (St Petersburg), 1885; R. Nisbet Bain, *The First Romanovs* (London, 1905); S. M. Solovev, *History of Russia* (Russ.), vol. xv. (St Petersburg, 1895). (R. N. B.)

MAZER, the name of a special type of drinking vessel, properly made of maple-wood, and so-called from the spotted or "birds-eye" marking on the wood (Ger. *Maser*, spot, marking, especially on wood; cf. "measles"). These drinking vessels are shallow bowls without handles, with a broad flat foot and a knob or boss in the centre of the inside, known technically as the "print." They were made from the 13th to the 16th centuries, and were the most prized of the various wooden cups in use, and so were ornamented with a rim of precious metal, generally of silver or silver gilt; the foot and the "print" being also of metal. The depth of the mazers seems to have decreased in course of time, those of the 16th century that survive being much shallower than the earlier examples. There are examples with wooden covers with a metal handle, such as the Flemish and German mazers in the Franks Bequest in the British Museum. On the metal rim is usually an inscription, religious or bacchanalian, and the "print" was also often decorated. The later mazers sometimes had metal straps between the rim and the foot.

A very fine mazer with silver gilt ornamentation 3 in. deep and $9\frac{1}{2}$ in. in diameter was sold in the Braikenridge collection in 1908 for £2300. It bears the London hall-mark of 1534. This example is illustrated in the article PLATE: see also DRINKING VESSELS.

MAZURKA (Polish for a woman of the province of Mazovia), a lively dance, originating in Poland, somewhat resembling the polka. It is danced in couples, the music being in $\frac{3}{8}$ or $\frac{3}{4}$ time.

MAZZARA DEL VALLO, a town of Sicily, in the province of Trapani, on the south-west coast of the island, 32 m. by rail S. of Trapani. Pop. (1901), 20,130. It is the seat of a bishop; the cathedral, founded in 1093, was rebuilt in the 17th century. The castle, at the south-eastern angle of the town walls, was erected in 1073. The mouth of the river, which bears the same name, serves as a port for small ships only. Mazzara was in origin a colony of Selinus: it was destroyed in 409, but it is mentioned again as a Carthaginian fortress in the First Punic War and as a post station on the Roman coast road, though whether it had municipal rights is doubtful.[1] A few inscriptions of the imperial period exist, but no other remains of importance. On the west bank of the river are grottoes cut in the rock, of uncertain date: and there are quarries in the neighbourhood resembling those of Syracuse, but on a smaller scale.

See A. Castiglione, *Sulle cose antiche della città di Mazzara* (Alcamo, 1878).

MAZZINI, GIUSEPPE (1805–1872), Italian patriot, was born on the 22nd of June 1805 at Genoa, where his father, Giacomo Mazzini, was a physician in good practice, and a professor in the university. His mother is described as having been a woman of great personal beauty, as well as of active intellect and strong affections. During infancy and childhood his health was extremely delicate, and it appears that he was nearly six years of age before he was quite able to walk; but he had already begun to devour books of all kinds and to show other signs of great intellectual precocity. He studied Latin with his first tutor, an old priest, but no one directed his extensive course of reading. He became a student at the university of Genoa at an unusually early age, and intended to follow his father's profession, but being unable to conquer his horror of practical anatomy, he decided to graduate in law (1826). His exceptional abilities, together with his remarkable generosity, kindness and loftiness of character, endeared him to his fellow students. As to his inner life during this period, we have only one brief but significant sentence; "for a short time," he says, "my mind was somewhat tainted by the doctrines of the foreign materialistic school; but the study of history and the intuitions of conscience—the only tests of truth—soon led me back to the spiritualism of our Italian fathers."

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[1] Th. Mommsen in *Corpus inscr. lat.* (Berlin, 1883), x. 739.

The natural bent of his genius was towards literature, and, in the course of the four years of his nominal connexion with the legal profession, he wrote a considerable number of essays and reviews, some of which have been wholly or partially reproduced in the critical and literary volumes of his *Life and Writings*. His first essay, characteristically enough on "Dante's Love of Country," was sent to the editor of the *Antologia fiorentina* in 1826, but did not appear until some years afterwards in the *Subalpino*. He was an ardent supporter of romanticism as against what he called "literary servitude under the name of classicism"; and in this interest all his critiques (as, for example, that of Giannoni's "Exile" in the *Indicatore Livornese*, 1829) were penned. But in the meantime the "republican instincts" which he tells us he had inherited from his mother had been developing, and his sense of the evils under which Italy was groaning had been intensified; and at the same time he became possessed with the idea that Italians, and he himself in particular, "*could* and therefore *ought* to struggle for liberty of country." Therefore, he at once put aside his dearest ambition, that of producing a complete history of religion, developing his scheme of a new theology uniting the spiritual with the practical life, and devoted himself to political thought. His literary articles accordingly became more and more suggestive of advanced liberalism in politics, and led to the suppression by government of the *Indicatore Genovese* and the *Indicatore Livornese* successively. Having joined the Carbonari, he soon rose to one of the higher grades in their hierarchy, and was entrusted with a special secret mission into Tuscany; but, as his acquaintance grew, his dissatisfaction with the organization of the society increased, and he was already meditating the formation of a new association stripped of foolish mysterious and theatrical formulae, which instead of merely combating existing authorities should have a definite and purely patriotic aim, when shortly after the French revolution of 1830 he was betrayed, while initiating a new member, to the Piedmontese authorities. He was imprisoned in the fortress of Savona on the western Riviera for about six months, when, a conviction having been found impracticable through deficiency of evidence, he was released, but upon conditions involving so many restrictions of his liberty that he preferred the alternative of leaving the country. He withdrew accordingly into France, living chiefly in Marseilles.

While in his lonely cell at Savona, in presence of "those symbols of the infinite, the sky and the sea," with a greenfinch for his sole companion, and having access to no books but "a Tacitus, a Byron, and a Bible," he had finally become aware of the great mission or "apostolate" (as he himself called it) of his life; and soon after his release his prison meditations took shape in the programme of the organization which was destined soon to become so famous throughout Europe, that of *La Giovine Italia*, or Young Italy. Its publicly avowed aims were to be the liberation of Italy both from foreign and domestic tyranny, and its unification under a republican form of government; the means to be used were education, and, where advisable, insurrection by guerrilla bands; the motto was to be "God and the people," and the banner was to bear on one side the words "Unity" and "Independence" and on the other "Liberty," "Equality," and "Humanity," to describe respectively the national and the international aims. In April 1831 Charles Albert, "the ex-Carbonaro conspirator of 1821," succeeded Charles Felix on the Sardinian throne, and towards the close of that year Mazzini, making himself, as he afterwards confessed, "the interpreter of a hope which he did not share," wrote the new king a letter, published at Marseilles, urging him to take the lead in the impending struggle for Italian independence. Clandestinely reprinted, and rapidly circulated all over Italy, its bold and outspoken words produced a great sensation, but so deep was the offence it gave to the Sardinian government that orders were issued for the immediate arrest and imprisonment of the author should he attempt to cross the frontier. Towards the end of the same year appeared the important Young Italy "Manifesto," the substance of which is given in the first volume of the *Life and Writings* of Mazzini; and this was followed soon afterwards by the society's *Journal*, which, smuggled across the Italian frontier, had great success in the objects for which it was written, numerous "congregations" being formed at Genoa, Leghorn, and elsewhere. Representations were consequently made by the Sardinian to the French government, which issued in an order for Mazzini's withdrawal from Marseilles (Aug. 1832); he lingered for a few months in concealment, but ultimately found it necessary to retire into Switzerland.

From this point it is somewhat difficult to follow the career of the mysterious and terrible conspirator who for twenty years out of the next thirty led a life of voluntary imprisonment (as he himself tells us) "within the four walls of a room," and "kept no record of dates, made no biographical notes, and preserved no copies of letters." In 1833, however, he is known to have been concerned in an abortive revolutionary movement which took place in the Sardinian army; several executions took place, and he himself was laid under sentence of death. Before the close of the same year a similar movement in Genoa had been planned, but failed through the youth and inexperience of the leaders. At Geneva, also in 1833, Mazzini set on foot *L'Europe Centrale*, a journal of which one of the main objects was the emancipation of Savoy; but he did not confine himself to a merely literary agitation for this end. Chiefly through his agency a considerable body of German, Polish and Italian exiles was organized, and an armed invasion of the duchy planned. The frontier was actually crossed on the 1st of February 1834, but the attack ignominiously broke down without a shot having been fired. Mazzini, who personally accompanied the expedition, is no doubt correct in attributing the failure to dissensions with the Carbonari leaders in Paris, and to want of a cordial understanding between himself and the Savoyard Ramorino, who had been chosen as military leader.

In April 1834 the "Young Europe" association "of men believing in a future of liberty, equality and fraternity for all mankind, and desirous of consecrating their thoughts and actions to the realization of that future" was formed also under the influence of Mazzini's enthusiasm; it was followed soon afterwards by a "Young Switzerland" society, having for its leading idea the formation of an Alpine confederation, to include Switzerland, Tyrol, Savoy and the rest of the Alpine chain as well. But *La Jeune Suisse* newspaper was compelled to stop within a year, and in other respects the affairs of the struggling patriot became embarrassed. He was permitted to remain at Grenchen in Solothurn for a while, but at last the Swiss diet, yielding to strong and persistent pressure from abroad, exiled him about the end of 1836. In January 1837 he arrived in London, where for many months he had to carry on a hard fight with poverty and the sense of spiritual loneliness, so touchingly described by himself in the first volume of the *Life and Writings*. Ultimately, as he gained command of the English language, he began to earn a livelihood by writing review articles, some of which have since been reprinted, and are of a high order of literary merit; they include papers on "Italian Literature since 1830" and "Paolo Sarpi" in the *Westminster Review*, articles on "Lamennais," "George Sand," "Byron and Goethe" in the *Monthly Chronicle*, and on "Lamartine," "Carlyle," and "The Minor Works of Dante" in the *British and Foreign Review*. In 1839 he entered into relations with the revolutionary committees sitting in Malta and Paris, and in 1840 he originated a working men's association, and the weekly journal entitled *Apostolato Popolare*, in which the admirable popular treatise "On the Duties of Man" was commenced. Among the patriotic and philanthropic labours undertaken by Mazzini during this period of retirement in London may be mentioned a free evening school conducted by himself and a few others for some years, at which several hundreds of Italian children received at least the rudiments of secular and religious education. He also exposed and combated the infamous traffic carried on in southern Italy, where scoundrels bought small boys from poverty-stricken parents and carried them off to England and elsewhere to grind organs and suffer martyrdom at the hands of cruel taskmasters.

The most memorable episode in his life during the same period was perhaps that which arose out of the conduct of Sir James Graham, the home secretary, in systematically, for some months, opening Mazzini's letters as they passed through the British post office, and communicating their contents to the Neapolitan government—a proceeding which was believed at the time to have led to the arrest and execution of the brothers Bandiera, Austrian subjects, who had been planning an expedition against Naples, although the recent publication of Sir James Graham's life seems to exonerate him from the charge. The prolonged discussions in parliament, and the report of the committee appointed to inquire into the matter, did not, however, lead to any practical result, unless indeed the incidental vindication of Mazzini's character, which had been recklessly assailed in the course of debate. In this connexion Thomas Carlyle wrote to *The Times*: "I have had the honour to know Mr Mazzini for a series of years, and, whatever I may think of his practical insight and skill in worldly affairs, I can with great freedom testify that he, if I have ever seen one such, is a man of genius and virtue, one of those rare men, numerable unfortunately but as units in this world, who are worthy to be called martyr souls; who in silence, piously in their daily life, practise what is meant by that."

Mazzini did not share the enthusiastic hopes everywhere raised in the ranks of the Liberal party throughout Europe by the first acts of Pius IX., in 1846, but at the same time he availed himself, towards the end of 1847, of the opportunity to publish a letter addressed to the new pope, indicating the nature of the religious and national mission which the Liberals expected him to undertake. The leaders of the revolutionary outbreaks in Milan and Messina in the beginning of 1848 had long been in secret correspondence with Mazzini; and their action, along with the revolution in Paris, brought him early in the same year to Italy, where he took a great and active interest in the events which dragged Charles Albert into an unprofitable war with Austria; he actually for a short time bore arms under Garibaldi immediately before the reoccupation of Milan, but ultimately, after vain attempts to maintain the insurrection in the mountain districts, found it necessary to retire to Lugano. In the beginning of the following year he was nominated a member of the short-lived provisional government of Tuscany formed after the flight of the grand-duke, and almost simultaneously, when Rome had, in consequence of the withdrawal of Pius IX., been proclaimed a republic, he was declared a member of the constituent assembly there. A month afterwards, the battle of Novara having again decided against Charles Albert in the brief struggle with Austria, into which he had once more been drawn, Mazzini was appointed a member of the Roman triumvirate, with supreme executive power (March 23, 1849). The opportunity he now had for showing the administrative and political ability which he was believed to possess was more apparent than real, for the approach of the professedly friendly French troops soon led to hostilities, and resulted in a siege which terminated, towards the end of June, with the assembly's resolution to discontinue the defence, and Mazzini's indignant resignation. That he succeeded, however, for so long a time, and in circumstances so adverse, in maintaining a high degree of order within the turbulent city is a fact that speaks for itself. His diplomacy, backed as it was by no adequate physical force, naturally showed at the time to very great disadvantage, but his official correspondence and proclamations can still be read with admiration and intellectual pleasure, as well as his eloquent vindication of the revolution in his published "Letter to MM. de Tocqueville and de Falloux." The surrender of the city on the 30th of June was followed by Mazzini's not too precipitate flight by way of Marseilles into Switzerland, whence he once more found his way to London. Here in 1850 he became president of the National Italian Committee, and at the same time entered into close relations with Ledru-Rollin and Kossuth. He had a firm belief in the value of revolutionary attempts, however hopeless they might seem; he had a hand in the abortive rising at Mantua in 1852, and again, in February 1853, a considerable share in the ill-planned insurrection at Milan on the 6th of February 1853, the failure of which greatly weakened his influence; once more, in 1854, he had gone far with preparations for renewed action when his plans were completely disconcerted by the withdrawal of professed supporters, and by the action of the French and English governments in sending ships of war to Naples.

The year 1857 found him yet once more in Italy, where, for complicity in short-lived émeutes which took place at Genoa, Leghorn and Naples, he was again laid under sentence of death. Undiscouraged in the pursuit of the one great aim of his life by any such incidents as these, he returned to London, where he edited his new journal *Pensiero ed Azione*, in which the constant burden of his message to the overcautious practical politicians of Italy was: "I am but a voice crying *Action*; but the state of Italy cries for it also. So do the best men and people of her cities. Do you wish to destroy my influence? *Act.*" The same tone was at a somewhat later date assumed in the letter he wrote to Victor Emmanuel, urging him to put himself at the head of the movement for Italian unity, and promising republican support. As regards the events of 1859–1860, however, it may be questioned whether, through his characteristic inability to distinguish between the ideally perfect and the practically possible, he did not actually hinder more than he helped the course of events by which the realization of so much of the great dream of his life was at last brought about. If Mazzini was the prophet of Italian unity, and Garibaldi its knight errant, to Cavour alone belongs the honour of having been the statesman by whom it was finally accomplished. After the irresistible pressure of the popular movement had led to the establishment not of an Italian republic but of an Italian kingdom, Mazzini could honestly enough write, "I too have striven to realize unity under a monarchical flag," but candour compelled him to add, "The Italian people are led astray by a delusion at the present day, a delusion which has induced them to substitute material for moral unity and their own reorganization. Not so I. I bow my head sorrowfully to the sovereignty of the national will; but monarchy will never number me amongst its servants or followers." In 1865, by way of protest against the still uncancelled sentence of death under which he lay, Mazzini was elected by Messina as delegate to the Italian parliament, but, feeling himself unable to take the oath of allegiance to the monarchy, he never took his seat. In the following year, when a general amnesty was granted after the cession of Venice to Italy, the sentence of death was at last removed, but he declined to accept such an "offer of oblivion and pardon for having loved Italy above all earthly things." In May 1869 he was again expelled from Switzerland at the instance of the Italian government for having conspired with Garibaldi; after a few months spent in England he set out (1870) for Sicily, but was promptly arrested at sea and carried to Gaeta, where he was imprisoned for two months. Events soon made it evident that there was little danger to fear from the contemplated rising, and the occasion of the birth of a prince was seized for restoring him to liberty. The remainder of his life, spent partly in London and partly at Lugano, presents no noteworthy incidents. For some time his health had been far from satisfactory, but the immediate cause of his death was an attack of pleurisy with which he was seized at Pisa, and which terminated fatally on the 10th of March 1872. The Italian parliament by a unanimous vote expressed the national sorrow with which the tidings of his death had been received, the president pronouncing an eloquent eulogy on the departed patriot as a model of disinterestedness and self-denial, and one who had dedicated his whole life ungrudgingly to the cause of his country's freedom. A public funeral took place at Pisa on the 14th of March, and the remains were afterwards conveyed to Genoa. (J. S. Bl.)

The published writings of Mazzini, mostly occasional, are very voluminous. An edition was begun by himself and continued by A. Saffi, *Scritti editi e inediti di Giuseppe Mazzini*, in 18 vols. (Milan and Rome, 1861–1891); many of the most important are found in the partially autobiographical *Life and Writings of Joseph Mazzini* (1864–1870) and the two most systematic—*Thoughts upon Democracy in Europe*, a remarkable series of criticisms on Benthamism, St Simonianism, Fourierism, and other economic and socialistic schools of the day, and the treatise *On the Duties of Man*, an admirable primer of ethics, dedicated to the Italian working class—will be found in *Joseph Mazzini: a Memoir*, by Mrs E. A. Venturi (London, 1875). Mazzini's "first great sacrifice," he tells us, was "the renunciation of the career of literature for the more direct path of political action," and as late as 1861 we find him still recurring to the long-cherished hope of being able to leave the stormy arena of politics and consecrate the last years of his life to the dream of his youth. He had specially contemplated three considerable literary undertakings—a volume of *Thoughts on Religion*, a popular *History of Italy*, to enable the working classes to apprehend what he conceived to be the "mission" of Italy in God's providential ordering of the world, and a comprehensive collection of translations of ancient and modern classics into Italian. None of these was actually achieved. No one, however, can read even the briefest and most occasional writing of Mazzini without gaining some impression of the simple grandeur of the man, the lofty elevation of his moral tone, his unwavering faith in the living God, who is ever revealing Himself in the progressive development of humanity. His last public utterance is to be found in a highly characteristic article on Renan's *Réforme Morale et Intellectuelle*, finished on the 3rd of March 1872, and published in the *Fortnightly Review* for February 1874. Of the 40,000 letters of Mazzini only a small part have been published. In 1887 two hundred unpublished letters were printed at Turin (*Duecento lettere inedite di Giuseppe Mazzini*), in 1895 the *Lettres intimes* were published in Paris, and in 1905 Francesco Rosso published *Lettre inedite di Giuseppe Mazzini* (Turin, 1905). A popular edition of Mazzini's writings has been undertaken by order of the Italian government.

For Mazzini's biography see Jessie White Mario, *Della vita di Giuseppe Mazzini* (Milan, 1886), a useful if somewhat too enthusiastic work; Bolton King, *Mazzini* (London, 1903); Count von Schack, *Joseph Mazzini und die italienische Einheit* (Stuttgart, 1891). A. Luzio's *Giuseppe Mazzini* (Milan, 1905) contains a great deal of valuable information, bibliographical and other, and Dora Melegari in *La giovine Italia e Giuseppe Mazzini* (Milan, 1906) publishes the correspondence between Mazzini and Luigi A. Melegari during the early days of "Young Italy." For the literary side of Mazzini's life see Peretti, *Gli scritti letterarii di Giuseppe Mazzini* (Turin, 1904). (L. V.*)

MAZZONI, GIACOMO (1548–1598), Italian philosopher, was born at Cesena and died at Ferrara. A member of a noble family and highly educated, he was one of the most eminent savants of the period. He occupied chairs in the universities of Pisa and Rome, was one of the founders of the Della Crusca Academy, and had the distinction, it is said, of thrice vanquishing the Admirable Crichton in dialectic. His chief work in philosophy was an attempt to reconcile Plato and Aristotle, and in this spirit he published in 1597 a treatise *In universam Platonis et Aristotelis philosophiam praecludia*. He wrote also *De triplici hominum vita*, wherein he outlined a theory of the infinite perfection and development of nature. Apart from philosophy, he was prominent in literature as the champion of Dante, and produced two works in the poet's defence: *Discorso composto in difesa della comedia di Dante* (1572), and *Della difesa della comedia di Dante* (1587, reprinted 1688). He was an authority on ancient languages and philology, and gave a great impetus to the scientific study of the Italian language.

MAZZONI, GUIDO (1859–), Italian poet, was born at Florence, and educated at Pisa and Bologna. In 1887 he became professor of Italian at Padua, and in 1894 at Florence. He was much influenced by Carducci, and became prominent both as a prolific and well-read critic and as a poet of individual distinction. His chief volumes of verse are *Versi* (1880), *Nuove poesie* (1886), *Poesie* (1891), *Voci della vita* (1893).

MEAD, LARKIN GOLDSMITH (1835–), American sculptor, was born at Chesterfield, New Hampshire, on the 3rd of January 1835. He was a pupil (1853–1855) of Henry Kirke Brown. During the early part of the Civil War he was at the front for six months, with the army of the Potomac, as an artist for *Harper's Weekly*; and in 1862–1865 he was in Italy, being for part of the time attached to the United States consulate at Venice, while William D. Howells, his brother-in-law, was consul. He returned to America in 1865, but subsequently went back to Italy and lived at Florence. His first important work was a statue of Ethan Allen, now at the State House, Montpelier, Vermont. His principal works are: the monument to President Lincoln, Springfield, Illinois; "Ethan Allen" (1876), National Hall of Statuary, Capitol, Washington; an heroic marble statue, "The Father of Waters," New Orleans; and "Triumph of Ceres," made for the Columbian Exposition, Chicago.

His brother, William Rutherford Mead (1846–), graduated at Amherst College in 1867, and studied architecture in New York under Russell Sturgis, and also abroad. In 1879 he and J. F. McKim, with whom he had been in partnership for two years as architects, were joined by Stanford White, and formed the well-known firm of McKim, Mead & White.

MEAD, RICHARD (1673–1754), English physician, eleventh child of Matthew Mead (1630–1699), Independent divine, was born on the 11th of August 1673 at Stepney, London. He studied at Utrecht for three years under J. G. Graevius; having decided to follow the medical profession, he then went to Leiden and attended the lectures of Paul Hermann and Archibald Pitcairne. In 1695 he graduated in philosophy and physic at Padua, and in 1696 he returned to London, entering at once on a successful practice. His *Mechanical Account of Poisons* appeared in 1702, and in 1703 he was admitted to the Royal Society, to whose *Transactions* he contributed in that year a paper on the parasitic nature of scabies. In the same year he was elected physician to St Thomas's Hospital, and appointed to read anatomical lectures at the Surgeons' Hall. On the death of John Radcliffe in 1714 Mead became the recognized head of his profession; he attended Queen Anne on her deathbed, and in 1727 was appointed physician to George II., having previously served him in that capacity when he was prince of Wales. He died in London on the 16th of February 1754.

Besides the *Mechanical Account of Poisons* (2nd ed., 1708), Mead published a treatise *De imperio solis et lunae in corpora humana et morbis inde oriundis* (1704), *A Short Discourse concerning Pestilential Contagion, and the Method to be used to prevent it* (1720), *De variolis et morbillis dissertatio* (1747), *Medica sacra, sive de morbis insignioribus qui in bibliis memorantur commentarius* (1748), *On the Scurvy* (1749), and *Monita et praecepta medica* (1751). A *Life* of Mead by Dr Matthew Maty appeared in 1755.

MEAD. (1) A word now only used more or less poetically for the commoner form "meadow," properly land laid down for grass and cut for hay, but often extended in meaning to include pasture-land. "Meadow" represents the oblique case, *mǽdwe*, of O. Eng. *mǽd*, which comes from the root seen in "mow"; the word, therefore, means "mowed land." Cognate words appear in other Teutonic languages, a familiar instance being Ger. *matt*, seen in place-names such as Zermatt, Andermatt, &c. (See Grass.) (2) The name of a drink made by the fermentation of honey mixed with water. Alcoholic drinks made from honey were common in ancient times, and during the middle ages throughout Europe. The Greeks and Romans knew of such under the names of ὀδρόμελι and *hydromel*; *mulsum* was a form of mead with the addition of wine. The word is common to Teutonic languages (cf. Du. *mede*, Ger. *Met* or *Meth*), and is cognate with Gr. μέθυ, wine, and Sansk. *mádhu*, sweet drink. "Metheglin," another word for mead, properly a medicated or spiced form of the drink, is an adaptation of the Welsh *meddyglyn*, which is derived from *meddyg*, healing (Lat. *medicus*) and *llyn*, liquor. It therefore means "spiced or medicated drink," and is not etymologically connected with "mead."

MEADE, GEORGE GORDON (1815–1872), American soldier, was born of American parentage at Cadiz, Spain, on the 31st of December 1815. On graduation at the United States Military Academy in 1835, he served in Florida with the 3rd Artillery against the Seminoles. Resigning from the army in 1836, he became a civil engineer and constructor of railways, and was engaged under the war department in survey work. In 1842 he was appointed a second lieutenant in the corps of the topographical engineers. In the war with Mexico he was on the staffs successively of Generals Taylor, J. Worth and Robert Patterson, and was brevetted for gallant conduct at Monterey. Until the Civil War he was engaged in various engineering works, mainly in connexion with lighthouses, and later as a captain of topographical engineers in the survey of the northern lakes. In 1861 he was appointed brigadier-general of volunteers, and had command of the 2nd brigade of the Pennsylvania Reserves in the Army of the Potomac under General M'Call. He served in the Seven Days, receiving a severe wound at the action of Frazier's Farm. He was absent from his command until the second battle of Bull Run, after which he obtained the command of his division. He distinguished himself greatly at the battles of South Mountain and Antietam. At Fredericksburg he and his division won great distinction by their attack on the position held by Jackson's corps, and Meade was promoted major-general of volunteers, to date from the 29th of November. Soon afterwards he was placed in command of the V. corps. At Chancellorsville he displayed great intrepidity and energy, and on the eve of the battle of Gettysburg was appointed to succeed Hooker. The choice was unexpected, but Meade justified it by his conduct of the operations, and in the famous three days' battle he inflicted a complete defeat on General Lee's army. His reward was the commission of brigadier-general in the regular army. In the autumn of 1863 a war of manœuvre was fought between the two commanders, on the whole favourably to the Union arms. Grant, commanding all the armies of the United States, joined the Army of the Potomac in the spring of 1864, and remained with it until the end of the war; but he continued Meade in his command, and successfully urged his appointment as major-general in the regular army (Aug. 18, 1864), eulogizing him as the commander who had successfully met and defeated the best general and the strongest army on the Confederate side. After the war Meade commanded successively the military division of the Atlantic, the department of the east, the third military district (Georgia and Alabama) and the department of the south. He died at Philadelphia on the 6th of November, 1872. The degree of LL.D. was conferred upon him by Harvard University, and his scientific attainments were recognized by the American Philosophical Society and the Philadelphia Academy of Natural Sciences. There are statues of General Meade in Philadelphia and at Gettysburg.

See I. R. Pennypacker, *General Meade* ("Great Commanders" series, New York, 1901).

MEADE, WILLIAM (1789–1862), American Protestant Episcopal bishop, the son of Richard Kidder Meade (1746–1805), one of General Washington's aides during the War of Independence, was born on the 11th of November 1789, near Millwood, in that part of Frederick county which is now Clarke county, Virginia. He graduated as valedictorian in 1808 at the college of New Jersey (Princeton); studied theology under the Rev. Walter Addison of Maryland, and in Princeton; was ordained deacon in 1811 and priest in 1814; and preached both in the Stone Chapel, Millwood, and in Christ Church, Alexandria, for some time. He became assistant bishop of Virginia in 1829; was pastor of Christ Church, Norfolk, in 1834–1836; in 1841 became bishop of Virginia; and in 1842–1862 was president of the Protestant Episcopal Theological Seminary in Virginia, near Alexandria, delivering an annual course of lectures on pastoral theology. In 1819 he had acted as the agent of the American Colonization Society to purchase slaves, illegally brought into Georgia, which had become the property of that state and were sold publicly at Milledgeville. He had been prominent in the work of the Education Society, which was organized in 1818 to advance funds to needy students for the ministry of the American Episcopal Church, and in the establishment of the Theological Seminary near Alexandria, as he was afterwards in the work of the American Tract Society, and the Bible Society. He was a founder and president of the Evangelical Knowledge Society (1847), which, opposing what it considered the heterodoxy of many of the books published by the Sunday School Union, attempted to displace them by issuing works of a more evangelical type. A low Churchman, he strongly opposed Tractarianism. He was active in the case against Bishop Henry Ustick Onderdonk (1789–1858) of Pennsylvania, who because of intemperance was forced to resign and was suspended from the ministry in 1844; in that against Bishop Benjamin Tredwell Onderdonk (1791–1861) of New York, who in 1845 was suspended from the ministry on the charge of intoxication and improper conduct; and in that against Bishop G. W. Doane of New Jersey. He fought against the threatening secession of Virginia, but acquiesced in the decision of the state and became presiding bishop of the Southern Church. He died in Richmond, Virginia, on the 14th of March 1862.

Among his publications, besides many sermons, were *A Brief Review of the Episcopal Church in Virginia* (1845); *Wilberforce, Cranmer, Jewett and the Prayer Book on the Incarnation* (1850); *Reasons for Loving the Episcopal Church* (1852); and *Old Churches, Ministers and Families of Virginia* (1857); a storehouse of material on the ecclesiastical history of the state.

See the *Life* by John Johns (Baltimore, 1867).

MEADVILLE, a city and the county-seat of Crawford county, Pennsylvania, U.S.A., on French Creek, 36 m. S. of Erie. Pop. (1900), 10,291, of whom 912 were foreign-born and 173 were negroes; (1910 census) 12,780. It is served by the Erie, and the Bessemer & Lake Erie railways. Meadville has three public parks, two general hospitals and a public library, and is the seat of the Pennsylvania College of Music, of a commercial college, of the Meadville Theological School (1844, Unitarian), and of Allegheny College (co-educational), which was opened in 1815, came under the general patronage of the Methodist Episcopal Church in 1833, and in 1909 had 322 students (200 men and 122 women). Meadville is the commercial centre of a good agricultural region, which also abounds in oil and natural gas. The Erie Railroad has extensive shops here, which in 1905 employed 46·7% of the total number of wage-earners, and there are various manufactures. The factory product in 1905 was valued at $2,074,600, being 24·4% more than that of 1900. Meadville, the oldest settlement in N.W. Pennsylvania, was founded as a fortified post by David Mead in 1793, laid out as a town in 1795, incorporated as a borough in 1823 and chartered as a city in 1866.

MEAGHER, THOMAS FRANCIS (1823–1867), Irish nationalist and American soldier, was born in Waterford, Ireland, on the 3rd of August 1823. He graduated at Stonyhurst College, Lancashire, in 1843, and in 1844 began the study of law at Dublin. He became a member of the Young Ireland Party in 1845, and in 1847 was one of the founders of the Irish Confederation. In March 1848 he made a speech before the Confederation which led to his arrest for sedition, but at his trial the jury failed to agree and he was discharged. In the following July the Confederation created a "war directory" of five, of which Meagher was a member, and he and William Smith O'Brien travelled through Ireland for the purpose of starting a revolution. The attempt proved abortive; Meagher was arrested in August, and in October was tried for high treason before a special commission at Clonmel. He was found guilty and was condemned to death, but his sentence was commuted to life imprisonment in Van Diemen's Land, whither he was transported in the summer of 1849. Early in 1852 he escaped, and in May reached New York City. He made a tour of the cities of the United States as a popular lecturer, and then studied law and was admitted to the New York bar in 1855. He made two unsuccessful ventures in journalism, and in 1857 went to Central America, where he acquired material for another series of lectures. In 1861 he was captain of a company (which he had raised) in the 69th regiment of New York volunteers and fought at the first battle of Bull Run; he then organized an Irish brigade, of whose first regiment he was colonel until the 3rd of February 1862, when he was appointed to the command of this organization with the rank of brigadier-general. He took part in the siege of Yorktown, the battle of Fair Oaks, the seven days' battle before

Richmond, and the battles of Antietam, Fredericksburg, where he was wounded, and Chancellorsville, where his brigade was reduced in numbers to less than a regiment, and General Meagher resigned his commission. On the 23rd of December 1863 his resignation was cancelled, and he was assigned to the command of the military district of Etowah, with headquarters at Chattanooga. At the close of the war he was appointed by President Johnson secretary of Montana Territory, and there, in the absence of the territorial governor, he acted as governor from September 1866 until his death from accidental drowning in the Missouri River near Fort Benton, Montana, on the 1st of July 1867. He published *Speeches on the Legislative Independence of Ireland* (1852).

W. F. Lyons, in *Brigadier-General Thomas Francis Meagher* (New York, 1870), gives a eulogistic account of his career.

MEAL. (1) (A word common to Teutonic languages, cf. Ger. *Mehl*, Du. meel; the ultimate source is the root seen in various Teutonic words meaning "to grind," and in Eng. "mill," Lat. *mola*, *molĕre*, Gr. μύλη), a powder made from the edible part of any grain or pulse, with the exception of wheat, which is known as "flour." In America the word is specifically applied to the meal produced from Indian corn or maize, as in Scotland and Ireland to that produced from oats, while in South Africa the ears of the Indian corn itself are called "mealies." (2) Properly, eating and drinking at regular stated times of the day, as breakfast, dinner, &c., hence taking of food at any time and also the food provided. The word was in O.E. *mael*, which also had the meanings (now lost) of time, mark, measure, &c., which still appear in many forms of the word in Teutonic languages; thus Ger. *mal*, time, mark, cf. *Denkmal*, monument, *Mahl*, meal, repast, or Du. *maal*, Swed. *mal*, also with both meanings. The ultimate source is the pre-Teutonic root *me- ma-*, to measure, and the word thus stood for a marked-out point of time.

MEALIE, the South African name for Indian corn or maize. The word as spelled represents the pronunciation of the Cape Dutch *milje*, an adaptation of *milho* (*da India*), the millet of India, the Portuguese name for millet, used in South Africa for maize.

MEAN, an homonymous word, the chief uses of which may be divided thus. (1) A verb with two principal applications, to intend, purpose or design, and to signify. This word is in O.E. *maenan*, and cognate forms appear in other Teutonic languages, cf. Du. *meenen*, Ger. *meinen*. The ultimate origin is usually taken to be the root *men-*, to think, the root of "mind." (2) An adjective and substantive meaning "that which is in the middle." This is derived through the O. Fr. *men*, *meien* or *moien*, modern *moyen*, from the late Lat. adjective *medianus*, from *medius*, middle. The law French form *mesne* is still preserved in certain legal phrases (see MESNE). The adjective "mean" is chiefly used in the sense of "average," as in mean temperature, mean birth or death rate, &c.

"Mean" as a substantive has the following principal applications; it is used of that quality, course of action, condition, state, &c., which is equally distant from two extremes, as in such phrases as the "golden (or happy) mean." For the philosophic application see ARISTOTLE and ETHICS.

In mathematics, the term "mean," in its most general sense, is given to some function of two or more quantities which (1) becomes equal to each of the quantities when they themselves are made equal, and (2) is unaffected in value when the quantities suffer any transpositions. The three commonest means are the arithmetical, geometrical, and harmonic; of less importance are the contraharmonical, arithmetico-geometrical, and quadratic.

From the sense of that which stands between two things, "mean," or the plural "means," often with a singular construction, takes the further significance of agency, instrument, &c., of which that produces some result, hence resources capable of producing a result, particularly the pecuniary or other resources by which a person is enabled to live, and so used either of employment or of property, wealth, &c. There are many adverbial phrases, such as "by all means," "by no means," &c., which are extensions of "means" in the sense of agency.

The word "mean" (like the French *moyen*) had also the sense of middling, moderate, and this considerably influenced the uses of "mean" (3). This, which is now chiefly used in the sense of inferior, low, ignoble, or of avaricious, penurious, "stingy," meant originally that which is common to more persons or things than one. The word in O. E. is *gemaéne*, and is represented in the modern Ger. *gemein*, common. It is cognate with Lat. *communis*, from which "common" is derived. The descent in meaning from that which is shared alike by several to that which is inferior, vulgar or low, is paralleled by the uses of "common."

In astronomy the "mean sun" is a fictitious sun which moves uniformly in the celestial equator and has its right ascension always equal to the sun's mean longitude. The time recorded by the mean sun is termed mean-solar or clock time; it is regular as distinct from the non-uniform solar or sun-dial time. The "mean moon" is a fictitious moon which moves around the earth with a uniform velocity and in the same time as the real moon. The "mean longitude" of a planet is the longitude of the "mean" planet, *i.e.* a fictitious planet performing uniform revolutions in the same time as the real planet.

The arithmetical mean of n quantities is the sum of the quantities divided by their number n. The geometrical mean of n quantities is the nth root of their product. The harmonic mean of n quantities is the arithmetical mean of their reciprocals. The significance of the word "mean," *i.e.*, middle, is seen by considering 3 instead of n quantities; these will be denoted by a, b, c. The arithmetic mean b, is seen to be such that the terms a, b, c are in arithmetical progression, *i.e.* $b=\frac{1}{2}(a+c)$; the geometrical mean b places a, b, c in geometrical progression, *i.e.* in the proportion $a : b :: b : c$ or $b^2=ac$; and the harmonic mean places the quantities in harmonic proportion, *i.e.* $a : c :: a-b : b-c$, or $b=2ac/(a+c)$. The contraharmonical mean is the quantity b given by the proportion $a : c :: b-c : a-b$, *i.e.* $b=(a^2+c^2)/(a+c)$. The arithmetico-geometrical mean of two quantities is obtained by first forming the geometrical and arithmetical means, then forming the means of these means, and repeating the process until the numbers become equal. They were invented by Gauss to facilitate the computation of elliptic integrals. The quadratic mean of n quantities is the square root of the arithmetical mean of their squares.

MEASLES, (*Morbilli*, *Rubeola*; the M. E. word is *maseles*, properly a diminutive of a word meaning "spot," O.H.G. *māsa*, cf. "mazer"; the equivalent is Ger. *Masern*; Fr. *Rougeole*), an acute infectious disease occurring mostly in children. It is mentioned in the writings of Rhazes and others of the Arabian physicians in the 10th century. For long, however, it was held to be a variety of small-pox. After the non-identity of these two diseases had been established, measles and scarlet-fever continued to be confounded with each other; and in the account given by Thomas Sydenham of epidemics of measles in London in 1670 and 1674 it is evident that even that accurate observer had not as yet clearly perceived their pathological distinction, although it would seem to have been made a century earlier by Giovanni Filippo Ingrassias (1510–1580), a physician of Palermo. The specific micro-organism responsible for measles has not been definitely isolated.

Its progress is marked by several stages more or less sharply defined. After the reception of the contagion into the system, there follows a period of incubation or latency during which scarcely any disturbance of the health is perceptible. This period generally lasts for from ten to fourteen days, when it is followed by the invasion of the symptoms specially characteristic of measles. These consist in the somewhat sudden onset of acute catarrh of the mucous membranes. At this stage minute white spots in the buccal mucous membrane frequently occur; when they do, they are diagnostic of the disease. Sneezing, accompanied with a watery discharge, sometimes bleeding, from the nose, redness and watering of the eyes, cough of a short, frequent, and noisy character, with little or no expectoration, hoarseness of the voice, and occasionally sickness and diarrhoea, are the chief local phenomena of this stage. With these there is well-marked febrile disturbance, the temperature being elevated (102°–104° F.), and the pulse rapid, while headache, thirst, and restlessness are usually present. In some instances, these initial symptoms are slight, and the child is allowed to associate with others at a time when, as will be afterwards seen, the contagion of the disease is most active. In rare cases, especially in young children, convulsions usher in, or occur in the course of, this stage of invasion, which lasts as a rule for four or five days, the febrile symptoms, however, showing some tendency to undergo abatement after the second day. On the fourth or fifth day after the invasion, sometimes later, rarely earlier, the characteristic eruption appears on the skin, being first noticed on the brow, cheeks, chin, also behind the ears, and on the neck. It consists of small spots of a dusky red or crimson colour, just like flea-bites, slightly elevated above the surface, at first isolated, but tending to become grouped into patches of irregular, occasionally crescentic, outline, with portions of skin free from the eruption intervening. The face acquires a swollen and bloated appearance, which, taken with the catarrh of the nostrils and eyes, is almost characteristic, and renders the diagnosis at this stage a matter of no difficulty. The eruption spreads downwards over the body and limbs, which are soon thickly studded with the red spots or patches. Sometimes these become confluent over a considerable surface. The rash continues to come out for two or three days, and then begins to fade in the order in which it first showed itself, namely from above downwards. By the end of about a week after its first appearance scarcely any trace of the eruption remains beyond a faint staining of the skin. Usually during convalescence slight peeling of the epidermis takes place, but much less distinctly than is the case in scarlet fever. At the commencement of the eruptive stage the fever, catarrh, and other constitutional disturbance, which were present from the beginning, become aggravated, the temperature often rising to 105° or more, and there is headache, thirst, furred tongue, and soreness of the throat, upon which red patches similar to those on the surface of the body may be observed. These symptoms usually decline as soon as the rash has attained its maximum, and often there occurs a sudden and extensive fall of temperature, indicating that the crisis of the disease has been reached. In favourable cases convalescence proceeds rapidly, the patient feeling perfectly well even before the rash has faded from the skin.

Measles may, however, occur in a very malignant form, in which the symptoms throughout are of urgent character, the rash but feebly developed, and of dark purple hue, while there is great prostration, accompanied with intense catarrh of the respiratory or gastro-intestinal mucous membrane. Such cases are rare, occurring mostly in circumstances of bad hygiene, both as regards the individual and his surroundings. On the other hand, cases of measles are often of so mild a form throughout that the patient can scarcely be persuaded to submit to treatment.

Measles as a disease derives its chief importance from the risk, by no means slight, of certain complications which are apt to arise during its course, more especially inflammatory affections of the respiratory organs. These are most liable to occur in the colder seasons of the year and in very young and delicate children. It has been already stated that irritation of the respiratory passages is one of the symptoms characteristic of measles, but that this subsides with the decline of the eruption. Not unfrequently, however, these symptoms, instead of abating, become aggravated, and bronchitis of the capillary form (see BRONCHITIS), or pneumonia, generally of the diffuse or lobular variety (see PNEUMONIA), supervene. By far the greater proportion of the mortality in measles is due to its complications, of which those just mentioned are the most common, but which also include inflammatory affections of the larynx, with attacks resembling croup, and also diarrhoea assuming a dysenteric character. Or there may remain as direct results of the disease chronic ophthalmia, or discharge from the ears with deafness, and occasionally a form of gangrene affecting the tissues of the mouth or cheeks and other parts of the body, leading to disfigurement and gravely endangering life.

Apart from those immediate risks there appears to be a tendency in many cases for the disease to leave behind a weakened and vulnerable condition of the general health, which may render children, previously robust, delicate and liable to chest complaints, and is in not a few instances the precursor of some of those tubercular affections to which the period of childhood and youth is liable. These various effects or sequelae of measles indicate that although in itself a comparatively mild ailment, it should not be regarded with indifference. Indeed it is doubtful whether any other disease of early life demands more careful watching as to its influence on the health. Happily many of those attending evils may by proper management be averted.

Measles is a disease of the earlier years of childhood. Like other infectious maladies, it is admittedly rare, though not unknown, in nurslings or infants under six months old. It is comparatively seldom met with in adults, but this is due to the fact that most persons have undergone an attack in early life. Where this has not been the case, the old suffer equally with the young. All races of men appear liable to this disease, provided that which constitutes the essential factor in its origin and spread exists, namely, contagion. Some countries enjoy long immunity from outbreaks of measles, but it has frequently been found in such cases that when the contagion has once been introduced the disease extends with great rapidity and virulence. This was shown by the epidemic in the Faroe Islands in 1846, where, within six months after the arrival of a single case of measles, more than three-fourths of the entire population were attacked and many perished; and the similarly produced and still more destructive outbreak in Fiji in 1875, in which it was estimated that about one-fourth of the inhabitants died from the disease in about three months. In both these cases the great mortality was due to the complications of the malady, specially induced by overcrowding, insanitary surroundings, the absence of proper nourishment and nursing for the sick, and the utter prostration and terror of the people, and to the disease being specially malignant, occurring on what might be termed virgin soil.[1] It may be regarded as an invariable rule that the first epidemic of any disease in a community is specially virulent, each successive attack conferring a certain immunity.

In many lands, such as the United Kingdom, measles is rarely absent, especially from large centres of population, where sporadic cases are found at all seasons. Every now and then epidemics arise from the extension of the disease among those members of a community who have not been in some measure protected by a previous attack. There are few diseases so contagious as measles, and its rapid spread in epidemic outbreaks is no doubt due to the well-ascertained fact that contagion is most potent in the earlier stages, even before its real nature has been evinced by the characteristic appearances on the skin. Hence the difficulty of timely isolation, and the readiness with which the disease is spread in schools and families. The contagion is present in the skin and the various secretions. While the contagion is generally direct, it can also be conveyed by the particles from the nose and mouth which, after being expelled, become dry and are conveyed as dust on clothes, toys, &c. Fortunately the germs of measles do not retain their virulence long under such conditions, comparing favourably with those of some other diseases.

Treatment.—The treatment embraces the preventive measures to be adopted by the isolation of the sick at as early a period as possible. Epidemics have often, especially in limited localities, been curtailed by such a precaution. In families with little house accommodation this measure is frequently, for the reason given regarding the communicable period of the disease, ineffectual; nevertheless where practicable it ought to be tried. The unaffected children should be kept from school for a time (probably about three weeks from the outbreak in the family would suffice if no other case occur in the interval), and all clothing in contact with the patient or nurses should be disinfected. In extensive epidemics it is often desirable to close the schools for a time. As regards special treatment, in an ordinary case of measles little is required beyond what is necessary in febrile conditions generally. Confinement to bed in a somewhat darkened room, into which, however, air is freely admitted; light, nourishing, liquid diet (soups, milk, &c.), water almost *ad lib.* to drink, and mild diaphoretic remedies such as the acetate of ammonia or ipecacuanha, are all that is necessary in the febrile stage. When the fever is very severe, sponging the body generally or the chest and arms affords relief. The serious chest complications of measles are to be dealt with by those measures applicable for the relief of the particular symptoms (see BRONCHITIS; PNEUMONIA). The preparations of ammonia are of special efficacy. During convalescence the patient must be guarded from exposure to cold, and for a time after recovery the state of the health ought to be watched with a view of averting the evils, both local and constitutional, which too often follow this disease.

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[1] *Transactions of the Epidemiological Society* (London, 1877).

"German measles" (*Rötheln*, or *Epidemic Roseola*) is a term applied to a contagious eruptive disorder having certain points of resemblance to measles, and also to scarlet fever, but exhibiting its distinct individuality in the fact that it protects from neither of these diseases. It occurs most commonly in children, but frequently in adults also, and is occasionally seen in extensive epidemics. Beyond confinement to the house in the eruptive stage, which, from the slight symptoms experienced, is often difficult of accomplishment, no special treatment is called for. There is little doubt that the disease is often mistaken for true measles, and many of the alleged second attacks of the latter malady are probably cases of rötheln. The chief points of difference are the following: (1) The absence of distinct premonitory symptoms, the stage of invasion, which in measles is usually of four days' duration, and accompanied with well-marked fever and catarrh, being in rötheln either wholly absent or exceedingly slight, enduring only for one day. (2) The eruption of rötheln, which, although as regards its locality and manner of progress similar to measles, differs somewhat in its appearance, the spots being of smaller size, paler colour, and with less tendency to grouping in crescentic patches. The rash attains its maximum in about one day, and quickly disappears. There is not the same increase of temperature in this stage as in measles. (3) The presence of white spots on the buccal mucous membrane, in the case of measles. (4) The milder character of the symptoms of rötheln throughout its whole course, and the absence of complications and of liability to subsequent impairment of health such as have been seen to appertain to measles.

MEAT, a word originally applied to food in general, and so still used in such phrases as "meat and drink"; but now, except as an archaism, generally used of the flesh of certain domestic animals, slaughtered for human food by butchers, "butcher's meat," as opposed to "game," that of wild animals, "fish" or "poultry." Cognate forms of the O. Eng. *mete* are found in certain Teutonic languages, *e.g.* Swed. *mat*, Dan. *mad* and O. H. Ger. *Maz*. The ultimate origin has been disputed; the *New English Dictionary* considers probable a connexion with the root *med-*, "to be fat," seen in Sansk. *mēda*, Lat. *madere*, "to be wet," and Eng. "mast," the fruit of the beech as food for pigs.

See DIETETICS; FOOD PRESERVATION; PUBLIC HEALTH; AGRICULTURE; and the sections dealing with agricultural statistics under the names of the various countries.

MEATH (pronounced with *th* soft, as in *the*), a county of Ireland in the province of Leinster, bounded E. by the Irish Sea, S.E. by Dublin, S. by Kildare and King's County, W. by Westmeath, N.W. by Cavan and Monaghan, and N.E. by Louth. Area 579,320 acres, or about 905 sq. m. In some districts the surface is varied by hills and swells, which to the west reach a considerable elevation, although the general features of a fine champain country are never lost. The coast, low and shelving, extends about 10 m., but there is no harbour of importance. Laytown is a small seaside resort, 5 m. S.E. of Drogheda. The Boyne enters the county at its south-western extremity, and flowing north-east to Drogheda divides it into two almost equal parts. At Navan it receives the Blackwater, which flows south-west from Cavan. Both these rivers are noted for their trout, and salmon are taken in the Boyne. The Boyne is navigable for barges as far as Navan whence a canal is carried to Trim. The Royal Canal passes along the southern boundary of the county from Dublin.

In the north is a broken country of Silurian rocks with much igneous material, partly contemporaneous, partly intrusive, near Slane. Carboniferous Limestone stretches from the Boyne valley to the Dublin border, giving rise to a flat plain especially suitable for grazing. Outliers of higher Carboniferous strata occur on the surface; but the Coal Measures have all been removed by denudation.

The climate is genial and favourable for all kinds of crops, there being less rain than even in the neighbouring counties. Except a small portion occupied by the Bog of Allen, the county is verdant and fertile. The soil is principally a rich deep loam resting on limestone gravel, but varies from a strong clayey loam to a light sandy gravel. The proportion of tillage to pasturage is roughly as 1 to 3½. Oats, potatoes and turnips are the principal crops, but all decrease. The numbers of cattle, sheep and poultry, however, are increasing or well maintained. Agriculture is almost the sole industry, but coarse linen is woven by hand-looms, and there are a few woollen manufactories. The main line of the Midland Great Western railway skirts the southern boundary, with a branch line north from Clonsilla to Navan and Kingscourt (county Cavan). From Kilmessan on this line a branch serves Trim and Athboy. From Drogheda (county Louth) a branch of the Great Northern railway crosses the county from east to West by Navan and Kells to Oldcastle.

The population (76,111 in 1891; 67,497 in 1901) suffers a large decrease, considerably above the average of Irish counties, and emigration is heavy. Nearly 93% are Roman Catholics. The chief towns are Navan (pop. 3839), Kells (2428) and Trim (1513), the county town. Lesser market towns are Oldcastle and Athboy, an ancient town which received a charter from Henry IV. The county includes eighteen baronies. Assizes are held at Trim, and quarter sessions at Kells, Navan and Trim. The county is in the Protestant dioceses of Armagh, Kilmore and Meath, and in the Roman Catholic dioceses of Armagh and Meath. Before the Union in 1800 it sent fourteen members to parliament, but now only two members are returned, for the north and south divisions of the county respectively.

History and Antiquities.—A district known as Meath (Midhe), and including the present county of Meath as well as Westmeath and Longford, with parts of Cavan, Kildare and King's County, was formed by Tuathal (*c.* 130) into a kingdom to serve as mensal land or personal estate of the Ard Ri or over-king of Ireland. Kings of Meath reigned until 1173, and the title was claimed as late as the 15th century by their descendants, but at the date mentioned Hugh de Lacy obtained the lordship of the country and was confirmed in it by Henry II. Meath thus came into the English "Pale." But though it was declared a county in the reign of Edward I. (1296), and though it came by descent into the possession of the Crown in the person of Edward IV., it was long before it was fully subdued and its boundaries clearly defined. In 1543 Westmeath was created a county apart from that of Meath, but as late as 1598 Meath was still regarded as a province by some, who included in it the counties Westmeath, East Meath, Longford and Cavan. In the early part of the 17th century it was at last established as a county, and no longer considered as a fifth province of Ireland.

There are two ancient round towers, the one at Kells and the other in the churchyard of Donaghmore, near Navan. By the river Boyne near Slane there is an extensive ancient burial-place called Brugh. Here are some twenty burial mounds, the largest of which is that of New Grange, a domed tumulus erected above a circular chamber, which is entered by a narrow passage enclosed by great upright blocks of stone, covered with carvings. The mound is surrounded by remains of a stone circle, and the whole forms one of the most remarkable extant erections of its kind. Tara (*q.v.*) is famous in history, especially as the seat of a royal palace referred to in the well-known lines of Thomas Moore. Monastic buildings were very numerous in Meath, among the more important ruins being those of Duleek, which is said to have been the first ecclesiastical building in Ireland of stone and mortar; the extensive remains of Bective Abbey; and those of Clonard, where also were a cathedral and a famous college. Of the old fortresses, the castle of Trim still presents an imposing appearance. There are many fine old mansions.

MEAUX, a town of northern France, capital of an arrondissement in the department of Seine-et-Marne, and chief town of the agricultural region of Brie, 28 m. E.N.E. of Paris by rail. Pop. (1906), 11,989. The town proper stands on an eminence on the right bank of the Marne; on the left bank lies the old suburb of Le Marché, with which it is united by a bridge of the 16th century. Two rows of picturesque mills of the same period are built across the river. The cathedral of St Stephen dates from the 12th to the 16th centuries, and was restored in the 19th century. Of the two western towers, the completed one is that to the north of the façade, the other being disfigured by an unsightly slate roof. The building, which is 275 ft. long and 105 ft. high, consists of a short nave, with aisles, a fine transept, a choir and a sanctury. The choir contains the statue and the tomb of Bossuet, bishop from 1681 to 1704, and the pulpit of the cathedral has been reconstructed with the panels of that from which the "eagle of Meaux" used to preach. The transept terminates at each end in a fine portal surmounted by a rose-window. The episcopal palace (17th century) has several curious old rooms; the buildings of the choir school are likewise of some archaeological interest. A statue of General Raoult (1870) stands in one of the squares.

Meaux is the centre of a considerable trade in cereals, wool, Brie cheeses, and other farm-produce, while its mills provide much of the flour with which Paris is supplied. Other industries are saw-milling, metal-founding, distilling, the preparation of vermicelli and preserved vegetables, and the manufacture of mustard, hosiery, plaster and machinery. There are nursery-gardens in the vicinity. The Canal de l'Ourcq, which surrounds the town, and the Marne furnish the means of transport. Meaux is the seat of a bishopric dating from the 4th century, and has among its public institutions a sub-prefecture, and tribunals of first instance and of commerce.

In the Roman period Meaux was the capital of the Meldi, a small Gallic tribe, and in the middle ages of the Brie. It formed part of the kingdom of Austrasia, and afterwards belonged to the counts of Vermandois and Champagne, the latter of whom established important markets on the left bank of the Marne. Its communal charter, received from them, is dated 1179. A treaty signed at Meaux in 1229 after the Albigensian War sealed the submission of Raymond VII., count of Toulouse. The town suffered much during the Jacquerie, the peasants receiving a severe check there in 1358; during the Hundred Years' War; and also during the Religious Wars, in which it was an important Protestant centre. It was the first town which opened its gates to Henry IV. in 1594. On the high-road for invaders marching on Paris from the east of France, Meaux saw its environs ravaged by the army of Lorraine in 1652, and was laid under heavy requisitions in 1814, 1815 and 1870. In September 1567 Meaux was the scene of an attempt made by the Protestants to seize the French king Charles IX., and his mother Catherine de' Medici. The plot, which is sometimes called the "enterprise of Meaux," failed, the king and queen with their courtiers escaping to Paris. This conduct, however, on the part of the Huguenots had doubtless some share in influencing Charles to assent to the massacre of St Bartholomew.

MECCA (Arab. *Makkah*),[1] the chief town of the Hejaz in Arabia, and the great holy city of Islām. It is situated two camel marches (the resting-place being Bahra or Hadda), or about 45 m. almost due E., from Jidda on the Red Sea. Thus on a rough estimate Mecca lies in 21° 25′ N., 39° 50′ E. It is said in the Koran (*Sur.* xiv. 40) that Mecca lies in a sterile valley, and the old geographers observe that the whole Haram or sacred territory round the city is almost without cultivation or date palms, while fruit trees, springs, wells, gardens and green valleys are found immediately beyond. Mecca in fact lies in the heart of a mass of rough hills, intersected by a labyrinth of narrow valleys and passes, and projecting into the Tehāma or low country on the Red Sea, in front of the great mountain wall that divides the coast-lands from the central plateau, though in turn they are themselves separated from the sea by a second curtain of hills forming the western wall of the great Wādi Marr. The inner mountain wall is pierced by only two great passes, and the valleys descending from these embrace on both sides the Mecca hills.

Holding this position commanding two great routes between the lowlands and inner Arabia, and situated in a narrow and barren valley incapable of supporting an urban population, Mecca must have been from the first a commercial centre.[2] In the palmy days of South Arabia it was probably a station on the great incense route, and thus Ptolemy may have learned the name, which he writes Makoraba. At all events, long before Mahomet we find Mecca established in the twofold quality of a commercial centre and a privileged holy place, surrounded by an inviolable territory (the Haram), which was not the sanctuary of a single tribe but a place of pilgrimage, where religious observances were associated with a series of annual fairs at different points in the vicinity. Indeed in the unsettled state of the country commerce was possible only under the sanctions of religion, and through the provisions of the sacred truce which prohibited war for four months of the year, three of these being the month of pilgrimage, with those immediately preceding and following. The first of the series of fairs in which the Meccans had an interest was at Okaz on the easier road between Mecca and Taif, where there was also a sanctuary, and from it the visitors moved on to points still nearer Mecca (Majanna, and finally Dhul-Majāz, on the flank of Jebel Kabkab behind Arafa) where further fairs were held,[3] culminating in the special religious ceremonies of the great feast at 'Arafa, Quzaḥ (Mozdalifa), and Mecca itself. The system of intercalation in the lunar calendar of the heathen Arabs was designed to secure that the feast should always fall at the time when the hides, fruits and other merchandise were ready for market,[4] and the Meccans, who knew how to attract the Bedouins by hospitality, bought up these wares in exchange for imported goods, and so became the leaders of the international trade of Arabia. Their caravans traversed the length and breadth of the peninsula. Syria, and especially Gaza, was their chief goal. The Syrian caravan intercepted, on its return, at Badr (see MAHOMET) represented capital to the value of £20,000, an enormous sum for those days.[5]

The victory of Mahommedanism made a vast change in the position of Mecca. The merchant aristocracy became satraps or pensioners of a great empire; but the seat of dominion was removed beyond the desert, and though Mecca and the Hejāz strove for a time to maintain political as well as religious predominance, the struggle was vain, and terminated on the death of Ibn Zubair, the Meccan pretendant to the caliphate, when the city was taken by Hajjāj (A.D. 692). The sanctuary and feast of Mecca received, however, a new prestige from the victory of Islām. Purged of elements obviously heathen, the Ka'ba became the holiest site, and the pilgrimage the most sacred ritual observance of Mahommedanism, drawing worshippers from so wide a circle that the confluence of the petty traders of the desert was no longer the main feature of the holy season. The pilgrimage retained its importance for the commercial well-being of Mecca; to this day the Meccans live by the Hajj—letting rooms, acting as guides and directors in the sacred ceremonies, as contractors and touts for land and sea transport, as well as exploiting the many benefactions that flow to the holy city; while the surrounding Bedouins derive support from the camel-transport it demands and from the subsidies by which they are engaged to protect or abstain from molesting the pilgrim caravans. But the ancient "fairs of heathenism" were given up, and the traffic of the pilgrim season, sanctioned by the Prophet in *Sur.* ii. 194, was concentrated at Minā and Mecca, where most of the pilgrims still have something to buy or sell, so that Minā, after the sacrifice of the feast day, presents the aspect of a huge international fancy fair.[1] In the middle ages this trade was much more important than it is now. Ibn Jubair (ed. Wright, p. 118 seq.) in the 12th century describes the mart of Mecca in the eight days following the feast as full of gems, unguents, precious drugs, and all rare merchandise from India, Irāk, Khorāsān, and every part of the Moslem world.

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[1] A variant of the name Makkah is Bakkah (*Sur.* iii. 90; Bakrī, 155 seq.). For other names and honorific epithets of the city see Bakrī, *ut supra*, Azraqī, p. 197, Yāqūt iv. 617 seq. The lists are in part corrupt, and some of the names (Kūthā and 'Arsh or 'Ursh, "the huts") are not properly names of the town as a whole.

[2] Mecca, says one of its citizens, in Wāqidī (Kremer's ed., p. 196, or *Muh. in Med*, p. 100), is a settlement formed for trade with Syria in summer and Abyssinia in winter, and cannot continue to exist if the trade is interrupted.

[3] The details are variously related. See Bīrūnī, p. 328 (E. T., p. 324); Asma'i in Yāqūt, iii. 705, iv. 416, 421; Azraqī, p. 129 seq.; Bakrī, p. 661. Jebel Kabkab is a great mountain occupying the angle between W. Namān and the plain of Arafa. The peak is due north of Sheddād, the hamlet which Burckhardt (i. 115) calls Shedad. According to Azraqī, p. 80, the last shrine visited was that of the three trees of Uzzā in W. Nakhla.

[4] So we are told by Bīrūnī, p. 62 (E. T., 73).

[5] Wāqidī, ed. Kremer, pp. 20, 21; *Muh. in Med*. p. 39.

The hills east and west of Mecca, which are partly built over and rise several hundred feet above the valley, so enclose the city that the ancient walls only barred the valley at three points, where three gates led into the town. In the time of Ibn Jubair the gates still stood though the walls were ruined, but now the gates have only left their names to quarters of the town. At the northern or upper end was the Bāb el Mā'lā, or gate of the upper quarter, whence the road continues up the valley towards Minā and Arafa as well as towards Zeima and the Nejd. Beyond the gate, in a place called the Hajūn, is the chief cemetery, commonly called el Mā'lā, and said to be the resting-place of many of the companions of Mahomet. Here a cross-road, running over the hill to join the main Medina road from the western gate, turns off to the west by the pass of Kadā, the point from which the troops of the Prophet stormed the city (A.H. 8).[2] Here too the body of Ibn Zubair was hung on a cross by Ḥajjāj. The lower or southern gate, at the Masfala quarter, opened on the Yemen road, where the rain-water from Mecca flows off into an open valley. Beyond, there are mountains on both sides; on that to the east, commanding the town, is the great castle, a fortress of considerable strength. The third or western gate, Bāb el-Omra (formerly also Bāb el-Zāhir, from a village of that name), lay almost opposite the great mosque, and opened on a road leading westwards round the southern spurs of the Red Mountain. This is the way to Wādi Fātima and Medīna, the Jidda road branching off from it to the left. Considerable suburbs now lie outside the quarter named after this gate; in the middle ages a pleasant country road led for some miles through partly cultivated land with good wells, as far as the boundary of the sacred territory and gathering place of the pilgrims at Tanīm, near the mosque of Ayesha. This is the spot on the Medīna road now called the Omra, from a ceremonial connected with it which will be mentioned below.

The length of the sinuous main axis of the city from the farthest suburbs on the Medina road to the suburbs in the extreme north, now frequented by Bedouins, is, according to Burckhardt, 3500 paces.[3] About the middle of this line the longitudinal thoroughfares are pushed aside by the vast courtyard and colonnades composing the great mosque, which, with its spacious arcades surrounding the Ka'ba and other holy places, and its seven minarets, forms the only prominent architectural feature of the city. The mosque is enclosed by houses with windows opening on the arcades and commanding a view of the Ka'ba. Immediately beyond these, on the side facing Jebel Abu Kobais, a broad street runs south-east and north-west across the valley. This is the Mas'ā (sacred course) between the eminences of Safā and Merwa, and has been from very early times one of the most lively bazaars and the centre of Meccan life. The other chief bazaars are also near the mosque in smaller streets. The general aspect of the town is picturesque; the streets are fairly spacious, though ill-kept and filthy; the houses are all of stone, many of them well-built and four or five storeys high, with terraced roofs and large projecting windows as in Jidda—a style of building which has not varied materially since the 10th century (Mukaddasī, p. 71), and gains in effect from the way in which the dwellings run up the sides and spurs of the mountains. Of public institutions there are baths, ribāṭs, or hospices, for poor pilgrims from India, Java, &c., a hospital and a public kitchen for the poor.

The mosque is at the same time the university hall, where between two pilgrim seasons lectures are delivered on Mahommedan law, doctrine and connected branches of science. A poorly provided public library is open to the use of students. The madrassehs or buildings around the mosque, originally intended as lodgings for students and professors, have long been let out to rich pilgrims. The minor places of visitation for pilgrims, such as the birthplaces of the prophet and his chief followers, are not notable.[4] Both these and the court of the great mosque lie beneath the general level of the city, the site having been gradually raised by accumulated rubbish. The town in fact has little air of antiquity; genuine Arab buildings do not last long, especially in a valley periodically ravaged by tremendous floods when the tropical rains burst on the surrounding hills. The history of Mecca is full of the record of these inundations, unsuccessfully combated by the great dam drawn across the valley by the caliph Omar (*Kutbeddin*, p. 76), and later works of Mahdī.[5]

The fixed population of Mecca in 1878 was estimated by Assistant-Surgeon 'Abd el-Razzāq at 50,000 to 60,000; there is a large floating population—and that not merely at the proper season of pilgrimage, the pilgrims of one season often beginning to arrive before those of the former season have all dispersed. At the height of the season the town is much overcrowded, and the entire want of a drainage system is severely felt. Fortunately good water is tolerably plentiful; for, though the wells are mostly undrinkable, and even the famous Zamzam water only available for medicinal or religious purposes, the underground conduit from beyond Arafa, completed by Sultan Selim II. in 1571, supplies to the public fountains a sweet and light water, containing, according to 'Abd el-Razzāq, a large amount of chlorides. The water is said to be free to townsmen, but is sold to the pilgrims at a rather high rate.[6]

Medieval writers celebrate the copious supplies, especially of fine fruits, brought to the city from Tāif and other fertile parts of Arabia. These fruits are still famous; rice and other foreign products are brought by sea to Jidda; mutton, milk and butter are plentifully supplied from the desert.[7] The industries all centre in the pilgrimage, the chief object of every Meccan—from the notables and sheikhs, who use their influence to gain custom for the Jidda speculators in the pilgrim traffic, down to the cicerones, pilgrim brokers, lodging-house keepers, and mendicants at the holy places—being to pillage the visitor in every possible way. The fanaticism of the Meccan is an affair of the purse; the mongrel population (for the town is by no means purely Arab) has exchanged the virtues of the Bedouin for the worst corruptions of Eastern town life, without casting off the ferocity of the desert, and it is hardly possible to find a worse certificate of character than the three parallel gashes on each cheek, called Tashrīṭ, which are the customary mark of birth in the holy city. The unspeakable vices of Mecca are a scandal to all Islām, and a constant source of wonder to pious pilgrims.[8] The slave trade has connexions with the pilgrimage which are not thoroughly clear; but under cover of the pilgrimage a great deal of importation and exportation of slaves goes on.

Since the fall of Ibn Zubair the political position of Mecca has always been dependent on the movements of the greater Mahommedan world. In the splendid times of the caliphs immense sums were lavished upon the pilgrimage and the holy city; and conversely the decay of the central authority of Islām brought with it a long period of faction, wars and misery, in which the most notable episode was the sack of Mecca by the Carmathians at the pilgrimage season of A.D. 930. The victors carried off the "black stone," which was not restored for twenty-two years, and then only for a great ransom, when it was plain that even the loss of its palladium could not destroy the sacred character of the city. Under the Fatimites Egyptian influence began to be strong in Mecca; it was opposed by the sultans of Yemen, while native princes claiming descent from the Prophet —the Hāshimite amīrs of Mecca, and after them the amīrs of the house of Qatāda (since 1202)—attained to great authority and aimed at independence; but soon after the final fall of the Abbasids the Egyptian overlordship was definitely established by sultan Bībars (A.D. 1269). The Turkish conquest of Egypt transferred the supremacy to the Ottoman sultans (1517), who treated Mecca with much favour, and during the 16th century executed great works in the sanctuary and temple. The Ottoman power, however, became gradually almost nominal, and that of the amīrs or sherīfs increased in proportion, culminating under Ghālib, whose accession dates from 1786. Then followed the wars of the Wahhābīs (see ARABIA and WAHHĀBĪS) and the restoration of Turkish rule by the troops of Mehemet ʽAli. By him the dignity of sherīf was deprived of much of its weight, and in 1827 a change of dynasty was effected by the appointment of Ibn ʽAun. Afterwards Turkish authority again decayed. Mecca is, however, officially the capital of a Turkish province, and has a governor-general and a Turkish garrison, while Mahommedan law is administered by a judge sent from Constantinople. But the real sovereign of Mecca and the Hejāz is the sherīf, who, as head of a princely family claiming descent from the Prophet, holds a sort of feudal position. The dignity of sherīf (or grand sherīf, as Europeans usually say for the sake of distinction, since all the kin of the princely houses reckoning descent from the Prophet are also named sherīfs), although by no means a religious pontificate, is highly respected owing to its traditional descent in the line of Hasan, son of the fourth caliph ʽAli. From a political point of view the sherīf is the modern counterpart of the ancient amīrs of Mecca, who were named in the public prayers immediately after the reigning caliph. When the great Mahommedan sultanates had become too much occupied in internecine wars to maintain order in the distant Hejāz, those branches of the Hassanids which from the beginning of Islām had retained rural property in Arabia usurped power in the holy cities and the adjacent Bedouin territories. About A.D. 960 they established a sort of kingdom with Mecca as capital. The influence of the princes of Mecca has varied from time to time, according to the strength of the foreign protectorate in the Hejāz or in consequence of feuds among the branches of the house; until about 1882 it was for most purposes much greater than that of the Turks. The latter were strong enough to hold the garrisoned towns, and thus the sultan was able within certain limits—playing off one against the other the two rival branches of the aristocracy, viz. the kin of Ghālib and the house of IbnʽAun—to assert the right of designating or removing the sherīf, to whom in turn he owed the possibility of maintaining, with the aid of considerable pensions, the semblance of his much-prized lordship over the holy cities. The grand sherīf can muster a considerable force of freedmen and clients, and his kin, holding wells and lands in various places through the Hejāz, act as his deputies and administer the old Arabic customary law to the Bedouin. To this influence the Hejāz owes what little of law and order it enjoys. During the last quarter of the 19th century Turkish influence became preponderant in western Arabia, and the railway from Syria to the Hejāz tended to consolidate the sultan's supremacy. After the sherīfs, the principal family of Mecca is the house of Shaibah, which holds the hereditary custodianship of the Kaʽba.

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[1] The older fairs were not entirely deserted till the troubles of the last days of the Omayyads (Azraqī, p. 131).

[2] This is the cross-road traversed by Burckhardt (i. 109), and described by him as cut through the rocks with much labour.

[3] Iṣṭakhrī gives the length of the city proper from north to south as 2 m., and the greatest breadth from the Jiyād quarter east of the great mosque across the valley and up the western slopes as two-thirds of the length.

[4] For details as to the ancient quarters of Mecca, where the several families or septs lived apart, see Azraqī, 455 pp. seq., and compare Ya'qūbī, ed. Juynboll, p. 100. The minor sacred places are described at length by Azraqī and Ibn Jubair. They are either connected with genuine memories of the Prophet and his times, or have spurious legends to conceal the fact that they were originally holy stones, wells, or the like, of heathen sanctity.

[5] Balādhurī, in his chapter on the floods of Mecca (pp. 53 seq.), says that 'Omar built two dams.

[6] The aqueduct is the successor of an older one associated with the names of Zobaida, wife of Harūn al-Rashīd, and other benefactors. But the old aqueduct was frequently out of repair, and seems to have played but a secondary part in the medieval water supply. Even the new aqueduct gave no adequate supply in Burckhardt's time.

[7] In Ibn Jubair's time large supplies were brought from the Yemen mountains.

[8] The corruption of manners in Mecca is no new thing. See the letter of the caliph Mahdi on the subject; Wüstenfeld, *Chron. Mek.*, iv. 168.

The Great Mosque and the Kaʽba.—Long before Mahomet the chief sanctuary of Mecca was the Kaʽba, a rude stone building without windows, and having a door 7 ft. from the ground, and so named from its resemblance to a monstrous *astragalus* (die) of about 40 ft. cube, though the shapeless structure is not really an exact cube nor even exactly rectangular.[1] The Kaʽba has been rebuilt more than once since Mahomet purged it of idols and adopted it as the chief sanctuary of Islām, but the old form has been preserved, except in secondary details;[2] so that the "Ancient House," as it is titled, is still essentially a heathen temple, adapted to the worship of Islām by the clumsy fiction that it was built by Abraham and Ishmael by divine revelation as a temple of pure monotheism, and that it was only temporarily perverted to idol worship from the time when ʽAmr ibn Lohai introduced the statue of Hobal from Syria[3] till the victory of Islām. This fiction has involved the superinduction of a new mythology over the old heathen ritual, which remains practically unchanged. Thus the chief object of veneration is the black stone, which is fixed in the external angle facing Safā. The building is not exactly oriented, but it may be called the south-east corner. Its technical name is the black corner, the others being named the Yemen (south-west), Syrian (north-west), and Irāk (north-east) corners, from the lands to which they approximately point. The black stone is a small dark mass a span long, with an aspect suggesting volcanic or meteoric origin, fixed at such a height that it can be conveniently kissed by a person of middle size. It was broken by fire in the siege of A.D. 683 (not, as many authors relate, by the Carmathians), and the pieces are kept together by a silver setting. The history of this heavenly stone, given by Gabriel to Abraham, does not conceal the fact that it was originally a fetish, the most venerated of a multitude of idols and sacred stones which stood all round the sanctuary in the time of Mahomet. The Prophet destroyed the idols, but he left the characteristic form of worship—the *ṭawāf*, or sevenfold circuit of the sanctuary, the worshipper kissing or touching the objects of his veneration—and besides the black stone he recognized the so-called "southern" stone, the same presumably as that which is still touched in the ṭawāf at the Yemen corner (*Muh. in Med.* pp. 336, 425). The ceremony of the ṭawāf and the worship of stone fetishes was common to Mecca with other ancient Arabian sanctuaries.[4] It was, as it still is, a frequent religious exercise of the Meccans, and the first duty of one who returned to the city or arrived there under a vow of pilgrimage; and thus the outside of the Kaʽba was and is more important than the inside. Islām did away with the worship of idols; what was lost in interest by their suppression has been supplied by the invention of spots consecrated by recollections of Abraham, Ishmael and Hagar, or held to be acceptable places of prayer. Thus the space of ten spans between the black stone and the door, which is on the east side, between the black and Irāk corners, and a man's height from the ground, is called the *Multazam*, and here prayer should be offered after the ṭawāf with outstretched arms and breast pressed against the house. On the other side of the door, against the same wall, is a shallow trough, which is said to mark the original site of the stone on which Abraham stood to build the Ka'ba. Here the growth of the legend can be traced, for the place is now called the "kneading-place" (Ma'jan), where the cement for the Ka'ba was prepared. This name and story do not appear in the older accounts. Once more, on the north side of the Ka'ba, there projects a low semicircular wall of marble, with an opening at each end between it and the walls of the house. The space within is paved with mosaic, and is called the Ḥijr. It is included in the ṭawāf, and two slabs of *verde antico* within it are called the graves of Ishmael and Hagar, and are places of acceptable prayer. Even the golden or gilded *mīzāb* (water-spout) that projects into the Ḥijr marks a place where prayer is heard, and another such place is the part of the west wall close to the Yemen corner.

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[1] The exact measurements (which, however, vary according to different authorities) are stated to be: sides 37 ft. 2 in. and 38 ft. 4 in.; ends 31 ft. 7 in. and 29 ft.; height 35 ft.

[2] The Kaʽba of Mahomet's time was the successor of an older building, said to have been destroyed by fire. It was constructed in the still usual rude style of Arabic masonry, with string courses of timber between the stones (like Solomon's Temple). The roof rested on six pillars; the door was raised above the ground and approached by a stair (probably on account of the floods which often swept the valley); and worshippers left their shoes under the stair before entering. During the first siege of Mecca (A.D. 683), the building was burned down, the Ibn Zubair reconstructed it on an enlarged scale and in better style of solid ashlar-work. After his death his most glaring innovations (the introduction of two doors on a level with the ground, and the extension of the building lengthwise to include the Ḥijr) were corrected by Ḥajjāj, under orders from the caliph, but the building retained its more solid structure. The roof now rested on three pillars, and the height was raised one-half. The Kaʽba was again entirely rebuilt after the flood of A.D. 1626, but since Ḥajjāj there seem to have been no structural changes.

[3] Hobal was set up within the Temple over the pit that contained the sacred treasures. His chief function was connected with the sacred lot to which the Meccans were accustomed to betake themselves in all matters of difficulty.

[4] See Ibn Hishām i. 54, Azraḳī p. 80 ('Uzzā in Baṭn Marr); Yāḳūt iii. 705 (Otheydā); Bar Hebraeus on Psalm xii. 9. Stones worshipped by circling round them bore the name *dawār* or *duwār* (Krehl, *Rel. d. Araber*, p. 69). The later Arabs not unnaturally viewed such cultus as imitated from that of Mecca (Yāqūt iv. 622, cf. Dozy, *Israeliten te Mekka*, p. 125, who draws very perverse inferences).

The feeling of religious conservatism which has preserved the structural rudeness of the Ka'ba did not prohibit costly surface decoration. In Mahomet's time the outer walls were covered by a veil (or *kiswa*) of striped Yemen cloth. The caliphs substituted a covering of figured brocade, and the Egyptian government still sends with each pilgrim caravan from Cairo a new kiswa of black brocade, adorned with a broad band embroidered with golden inscriptions from the Korān, as well as a richer curtain for the door.[1] The door of two leaves, with its posts and lintel, is of silver gilt.

The interior of the Ka'ba is now opened but a few times every year for the general public, which ascends by the portable staircase brought forward for the purpose. Foreigners can obtain admission at any time for a special fee. The modern descriptions, from observations made under difficulties, are not very complete. Little change, however, seems to have been made since the time of Ibn Jubair, who describes the floor and walls as overlaid with richly variegated marbles, and the upper half of the walls as plated with silver thickly gilt, while the roof was veiled with coloured silk. Modern writers describe the place as windowless, but Ibn Jubair mentions five windows of rich stained glass from Irāk. Between the three pillars of teak hung thirteen silver lamps. A chest in the corner to the left of one entering contained Korans, and at the Irāk corner a space was cut off enclosing the stair that leads to the roof. The door to this stair (called the door of mercy—Bāb el-Raḥma) was plated with silver by the caliph Motawakkil. Here, in the time of Ibn Jubair, the *Maqām* or standing stone of Abraham was usually placed for better security, but brought out on great occasions.[2]

The houses of ancient Mecca pressed close upon the Ka'ba, the noblest families, who traced their descent from Ḳoṣai, the reputed founder of the city, having their dwellings immediately round the sanctuary. To the north of the Ka'ba was the Dār el-Nadwa, or place of assembly of the Koreish. The multiplication of pilgrims after Islām soon made it necessary to clear away the nearest dwellings and enlarge the place of prayer around the Ancient House. Omar, Othmān and Ibn Jubair had all a share in this work, but the great founder of the mosque in its present form, with its spacious area and deep colonnades, was the caliph Mahdī, who spent enormous sums in bringing costly pillars from Egypt and Syria. The work was still incomplete at his death in A.D. 785, and was finished in less sumptuous style by his successor. Subsequent repairs and additions, extending down to Turkish times, have left little of Mahdī's work untouched, though a few of the pillars probably date from his days. There are more than five hundred pillars in all, of very various style and workmanship, and the enclosure—250 paces in length and 200 in breadth, according to Burckhardt's measurement—is entered by nineteen archways irregularly disposed.

After the Ka'ba the principal points of interest in the mosque are the well Zamzam and the Maqām Ibrāhīm. The former is a deep shaft enclosed in a massive vaulted building paved with marble, and, according to Mahommedan tradition, is the source (corresponding to the Beer-lahai-roi of Gen. xvi. 14) from which Hagar drew water for her son Ishmael. The legend tells that the well was long covered up and rediscovered by 'Abd al-Moṭṭalib, the grandfather of the Prophet. Sacred wells are familiar features of Semitic sanctuaries, and Islām, retaining the well, made a quasi-biblical story for it, and endowed its tepid waters with miraculous curative virtues. They are eagerly drunk by the pilgrims, or when poured over the body are held to give a miraculous refreshment after the fatigues of religious exercise; and the manufacture of bottles or jars for carrying the water to distant countries is quite a trade. Ibn Jubair mentions a curious superstition of the Meccans, who believed that the water rose in the shaft at the full moon of the month Shaban. On this occasion a great crowd, especially of young people, thronged round the well with shouts of religious enthusiasm, while the servants of the well dashed buckets of water over their heads. The Maqām of Abraham is also connected with a relic of heathenism, the ancient holy stone which once stood on the Ma'jan, and is said to bear the prints of the patriarch's feet. The whole legend of this stone, which is full of miraculous incidents, seems to have arisen from a misconception, the Maqām Ibrāhīm in the Korān meaning the sanctuary itself; but the stone, which is a block about 3 spans in height and 2 in breadth, and in shape "like a potter's furnace" (Ibn Jubair), is certainly very ancient. No one is now allowed to see it, though the box in which it lies can be seen or touched through a grating in the little chapel that surrounds it. In the middle ages it was sometimes shown, and Ibn Jubair describes the pious enthusiasm with which he drank Zamzam water poured on the footprints. It was covered with inscriptions in an unknown character, one of which was copied by Fākihī in his history of Mecca. To judge by the facsimile in Dozy's *Israeliten te Mekka*, the character is probably essentially one with that of the Syrian Safā inscriptions, which extended through the Nejd and into the Ḥejāz.[3]

Safā and Merwa.—In religious importance these two points or "hills," connected by the Mas'ā, stand second only to the Ka'ba. Safā is an elevated platform surmounted by a triple arch, and approached by a flight of steps.[4] It lies south-east of the Ka'ba, facing the black corner, and 76 paces from the "Gate of Safā," which is architecturally the chief gate of the mosque. Merwa is a similar platform, formerly covered with a single arch, on the opposite side of the valley. It stands on a spur of the Red Mountain called Jebel Kuayḳian. The course between these two sacred points is 493 paces long, and the religious ceremony called the "sa'y" consists in traversing it seven times, beginning and ending at Safā. The lowest part of the course, between the so-called green milestones, is done at a run. This ceremony, which, as we shall presently see, is part of the omra, is generally said to be performed in memory of Hagar, who ran to and fro between the two eminences vainly seeking water for her son. The observance, however, is certainly of pagan origin; and at one time there were idols on both the so-called hills (see especially Azraqī, pp. 74, 78).

The Ceremonies and the Pilgrimage.—Before Islām the Ka'ba was the local sanctuary of the Meccans, where they prayed and did sacrifice, where oaths were administered and hard cases submitted to divine sentence according to the immemorial custom of Semitic shrines. But, besides this, Mecca was already a place of pilgrimage. Pilgrimage with the ancient Arabs was the fulfilment of a vow, which appears to have generally terminated—at least on the part of the well-to-do—in a sacrificial feast. A vow of pilgrimage might be directed to other sanctuaries than Mecca—the technical word for it (*ihlāl*) is applied, for example, to the pilgrimage to Manāt (*Bakri*, p. 519). He who was under such a vow was bound by ceremonial observances of abstinence from certain acts (*e.g.* hunting) and sensual pleasures, and in particular was forbidden to shear or comb his hair till the fulfilment of the vow. This old Semitic usage has its close parallel in the vow of the Nazarite. It was not peculiarly connected with Mecca; at Tāif, for example, it was customary on return to the city after an absence to present oneself at the sanctuary, and there shear the hair (*Muh. in Med.*, p. 381). Pilgrimages to Mecca were not tied to a single time, but they were naturally associated with festive occasions, and especially with the great annual feast and market. The pilgrimage was so intimately connected with the wellbeing of Mecca, and had already such a hold on the Arabs round about, that Mahomet could not afford to sacrifice it to an abstract purity of religion, and thus the old usages were transplanted into Islām in the double form of the omra or vow of pilgrimage to Mecca, which can be discharged at any time, and the ḥajj or pilgrimage at the great annual feast. The latter closes with a visit to the Kaʽba, but its essential ceremonies lie outside Mecca, at the neighbouring shrines where the old Arabs gathered before the Meccan fair.

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[1] The old *kiswa* is removed on the 25th day of the month before the pilgrimage, and fragments of it are bought by the pilgrims as charms. Till the 10th day of the pilgrimage month the Ka'ba is bare.

[2] Before Islām the Ka'ba was opened every Monday and Thursday; in the time of Ibn Jubair it was opened with considerable ceremony every Monday and Friday, and daily in the month Rajab. But, though prayer within the building is favoured by the example of the Prophet, it is not compulsory on the Moslem, and even in the time of Ibn Baṭūṭa the opportunities of entrance were reduced to Friday and the birthday of the Prophet.

[3] See De Vogüé, *Syrie centrale: inscr. sem.*; Lady Anne Blunt *Pilgrimage of Nejd*, ii., and W. R. Smith, in the *Athenaeum*, March 20, 1880.

[4] Ibn Jubair speaks of fourteen steps, Ali Bey of four, Burckhardt of three. The surrounding ground no doubt has risen so that the old name "hill of Safā" is now inapplicable.

The omra begins at some point outside the Ḥaram (or holy territory), generally at Tanim, both for convenience sake and because Ayesha began the omra there in the year 10 of the Hegira. The pilgrim enters the Ḥaram in the antique and scanty pilgrimage dress (iḥrām), consisting of two cloths wound round his person in a way prescribed by ritual. His devotion is expressed in shouts of "Labbeyka" (a word of obscure origin and meaning; he enters the great mosque, performs the ṭawāf and the saʽy[1] and then has his head shaved and resumes his common dress. This ceremony is now generally combined with the ḥajj, or is performed by every stranger or traveller when he enters Mecca, and the iḥrām (which involves the acts of abstinence already referred to) is assumed at a considerable distance from the city. But it is also proper during one's residence in the holy city to perform at least one omra from Tanim in connexion with a visit to the mosque of Ayesha there. The triviality of these rites is ill concealed by the legends of the saʽy of Hagar and of the ṭawāf being first performed by Adam in imitation of the circuit of the angels about the throne of God; the meaning of their ceremonies seems to have been almost a blank to the Arabs before Islām, whose religion had become a mere formal tradition. We do not even know to what deity the worship expressed in the ṭawāf was properly addressed. There is a tradition that the Kaʽba was a temple of Saturn (Shahrastānī, p. 431); perhaps the most distinctive feature of the shrine may be sought in the sacred doves which still enjoy the protection of the sanctuary. These recall the sacred doves of Ascalon (Philo vi. 200 of Richter's ed.), and suggests Venus-worship as at least one element (cf. Herod i. 131, iii. 8; Ephr. Syr., *Op. Syr.* ii. 457).

To the ordinary pilgrim the omra has become so much an episode of the ḥajj that it is described by some European pilgrims as a mere visit to the mosque of Ayesha; a better conception of its original significance is got from the Meccan feast of the seventh month (Rajab), graphically described by Ibn Jubair from his observations in A.D. 1184. Rajab was one of the ancient sacred months, and the feast, which extended through the whole month and was a joyful season of hospitality and thanksgiving, no doubt represents the ancient feasts of Mecca more exactly than the ceremonies of the ḥajj, in which old usage has been overlaid by traditions and glosses of Islām. The omra was performed by crowds from day to day, especially at new and full moon.[2] The new moon celebration was nocturnal; the road to Tanim, the Masʽā, and the mosque were brilliantly illuminated; and the appearing of the moon was greeted with noisy music. A genuine old Arab market was held, for the wild Bedouins of the Yemen mountains came in thousands to barter their cattle and fruits for clothing, and deemed that to absent themselves would bring drought and cattle plague in their homes. Though ignorant of the legal ritual and prayers, they performed the ṭawāf with enthusiasm, throwing themselves against the Kaʽba and clinging to its curtains as a child clings to its mother. They also made a point of entering the Kaʽba. The 29th of the month was the feast day of the Meccan women, when they and their little ones had the Kaʽba to themselves without the presence even of the Sheybās.

The central and essential ceremonies of the ḥajj or greater pilgrimage are those of the day of Arafa, the 9th of the "pilgrimage month" (Dhu'l Ḥijja), the last of the Arab year; and every Moslem who is his own master, and can command the necessary means, is bound to join in these once in his life, or to have them fulfilled by a substitute on his behalf and at his expense. By them the pilgrim becomes as pure from sin as when he was born, and gains for the rest of his life the honourable title of ḥajj. Neglect of many other parts of the pilgrim ceremonial may be compensated by offerings, but to miss the "stand" (*woqūf*) at Arafa is to miss the pilgrimage. Arafa or Arafat is a space, artificially limited, round a small isolated hill called the Hill of Mercy, a little way outside the holy territory, on the road from Mecca to Taif. One leaving Mecca after midday can easily reach the place on foot the same evening. The road is first northwards along the Mecca valley and then turns eastward. It leads through the straggling village of Mina, occupying a long narrow valley (Wādi Mina), two to three hours from Mecca, and thence by the mosque of Mozdalifa over a narrow pass opening out into the plain of Arafa, which is an expansion of the great Wādi Naman, through which the Taif road descends from Mount Kara. The lofty and rugged mountains of the Hodheyl tower over the plain on the north side and overshadow the little Hill of Mercy, which is one of those bosses of weathered granite so common in the Hejāz. Arafa lay quite near Dhul-Majaz, where, according to Arabian tradition, a great fair was held from the 1st to the 8th of the pilgrimage month; and the ceremonies from which the ḥajj was derived were originally an appendix to this fair. Now, on the contrary, the pilgrim is expected to follow as closely as may be the movements of the prophet at his "farewell pilgrimage" in the year 10 of the Hegira (A.D. 632). He therefore leaves Mecca in pilgrim garb on the 8th of Dhu'l Ḥijja, called the day of *tarwīya* (an obscure and pre-Islamic name), and, strictly speaking, should spend the night at Mina. It is now, however, customary to go right on and encamp at once at Arafa. The night should be spent in devotion, but the coffee booths do a lively trade, and songs are as common as prayers. Next forenoon the pilgrim is free to move about, and towards midday he may if he please hear a sermon. In the afternoon the essential ceremony begins; it consists simply in "standing" on Arafa shouting "Labbeyka" and reciting prayers and texts till sunset. After the sun is down the vast assemblage breaks up, and a rush (technically *ifāḍa*, *dafʽ*, *nafr* is made in the utmost confusion to Mozdalifa, where the night prayer is said and the night spent. Before sunrise next morning (the 10th) a second "stand" like that on Arafa is made for a short time by torchlight round the mosque of Mozdalifa, but before the sun is fairly up all must be in motion in the second *ifāḍa* towards Mina. The day thus begun is the "day of sacrifice," and has four ceremonies—(1) to pelt with seven stones a cairn (*jamrat al ʽaqaba*) at the eastern end of W. Mina, (2) to slay a victim at Mina and hold a sacrificial meal, part of the flesh being also dried and so preserved, or given to the poor,[3] (3) to be shaved and so terminate the *iḥrām*, (4) to make the third *ifāḍa*, *i.e.* go to Mecca and perform the ṭawāf and saʽy (*ʽomrat al-ifāḍa*), returning thereafter to Mina. The sacrifice and visit to Mecca may, however, be delayed till the 11th, 12th or 13th. These are the days of Mina, a fair and joyous feast, with no special ceremony except that each day the pilgrim is expected to throw seven stones at the *jamrat al ʽaqaba*, and also at each of two similar cairns in the valley. The stones are thrown in the name of Allah, and are generally thought to be directed at the devil. This is, however, a custom older than Islām, and a tradition in Azraqī, p. 412, represents it as an act of worship to idols at Mina. As the stones are thrown on the days of the fair, it is not unlikely that they have something to do with the old Arab mode of closing a sale by the purchaser throwing a stone (Bīrūnī, p. 328).[4] The pilgrims leave Mina on the 12th or 13th, and the ḥajj is then over. (See further MAHOMMEDAN RELIGION.)

The colourless character of these ceremonies is plainly due to the fact that they are nothing more than expurgated heathen rites. In Islām proper they have no *raison d'être*; the legends about Adam and Eve on Arafa, about Abraham's sacrifice of the ram at Thabii by Mina, imitated in the sacrifices of the pilgrimage, are clumsy afterthoughts, as appears from their variations and only partial acceptance. It is not so easy to get at the nature of the original rites, which Islām was careful to suppress. But we find mention of practices condemned by the orthodox, or forming no part of the Moslem ritual, which may be regarded as traces of an older ceremonial. Such are nocturnal illuminations at Mina (Ibn Baṭūta i. 396), Arafa and Mozdalifa (Ibn Jubair, 179), and ṭawāfs performed by the ignorant at holy spots at Arafa not recognized by law (Snouck-Hurgronje p. 149 sqq.). We know that the rites at Mozdalifa were originally connected with a holy hill bearing the name of the god Quzah (the Edomite Kozē) whose bow is the rainbow, and there is reason to think that the *ifāḍas* from Arafa and Quzah, which were not made as now after sunset and before sunrise, but when the sun rested on the tops of the mountains, were ceremonies of farewell and salutation to the sun-god.

The statistics of the pilgrimage cannot be given with certainty and vary much from year to year. The quarantine office keeps a record of arrivals by sea at Jidda (66,000 for 1904); but to these must be added those travelling by land from Cairo, Damascus and Irāk, the pilgrims who reach Medina from Yanbu and go on to Mecca, and those from all parts of the peninsula. Burckhardt in 1814 estimated the crowd at Arafa at 70,000, Burton in 1853 at 50,000, ‘Abd el-Razzāk in 1858 at 60,000. This great assemblage is always a dangerous centre of infection, and the days of Mina especially, spent under circumstances originally adapted only for a Bedouin fair, with no provisions for proper cleanliness, and with the air full of the smell of putrefying offal and flesh drying in the sun, produce much sickness.

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[1] The latter perhaps was no part of the ancient omra; see Snouck-Hurgronje, *Het Mekkaansche Feest* (1880) p. 115 sqq.

[2] The 27th was also a great day, but this day was in commemoration of the rebuilding of the Kaʽba by Ibn Jubair.

[3] The sacrifice is not indispensable except for those who can afford it and are combining the hajj with the omra.

[4] On the similar pelting of the supposed graves of Abū Lahab and his wife (Ibn Jubair, p. 110) and of Abū Righāl at Mughammas, see Nöldeke's translation of Ṭabarī, p. 208.

Literature.—Besides the Arabic geographers and cosmographers, we have Ibn ‘Abd Rabbih's description of the mosque, early in the 10th century (‘*Iḳd Farīd*, Cairo ed., iii. 362 sqq.), but above all the admirable record of Ibn Jubair (A.D. 1184), by far the best account extant of Mecca and the pilgrimage. It has been much pillaged by Ibn Baṭūta. The Arabic historians are largely occupied with fabulous matter as to Mecca before Islām; for these legends the reader may refer to C. de Perceval's *Essai*. How little confidence can be placed in the pre-Islamic history appears very clearly from the distorted accounts of Abraha's excursion against the Hejāz, which fell but a few years before the birth of the Prophet, and is the first event in Meccan history which has confirmation from other sources. See Nöldeke's version of Ṭabarī, p. 204 sqq. For the period of the Prophet, Ibn Hishām and Wāḳidī are valuable sources in topography as well as history. Of the special histories and descriptions of Mecca published by Wüstenfeld (*Chroniken der Stadt Mekka*, 3 vols., 1857–1859, with an abstract in German, 1861), the most valuable is that of Azraqī. It has passed through the hands of several editors, but the oldest part goes back to the beginning of the 9th Christian century. Kutbeddin's history (vol. iii. of the *Chroniken*) goes down with the additions of his nephew to A.D. 1592.

Of European descriptions of Mecca from personal observation the best is Burckhardt's *Travels in Arabia* (cited above from the 8vo ed., 1829). *The Travels of Aly Bey* (Badia, London, 1816) describe a visit in 1807; Burton's *Pilgrimage* (3rd ed., 1879) often supplements Burckhardt; Von Maltzan's *Wallfahrt nach Mekka* (1865) is lively but very slight. ‘Abd el-Razzāq's report to the government of India on the pilgrimage of 1858 is specially directed to sanitary questions; C. Snouck-Hurgronje, *Mekka* (2 vols., and a collection of photographs, The Hague, 1888–1889), gives a description of the Meccan sanctuary and of the public and private life of the Meccans as observed by the author during a sojourn in the holy city in 1884–1885 and a political history of Mecca from native sources from the Hegira till 1884. For the pilgrimage see particularly Snouck-Hurgronje, *Het Mekkaansche Feest* (Leiden, 1880). (W. R. S.)

MECHANICS. The subject of mechanics may be divided into two parts: (1) theoretical or abstract mechanics, and (2) applied mechanics.

1. Theoretical Mechanics

Historically theoretical mechanics began with the study of practical contrivances such as the lever, and the name *mechanics* Gr. τὰ μηχανικά), which might more properly be restricted to the theory of mechanisms, and which was indeed used in this narrower sense by Newton, has clung to it, although the subject has long attained a far wider scope. In recent times it has been proposed to adopt the term *dynamics* (from Gr. δύναμις force,) as including the whole science of the action of force on bodies, whether at rest or in motion. The subject is usually expounded under the two divisions of *statics* and *kinetics*, the former dealing with the conditions of rest or equilibrium and the latter with the phenomena of motion as affected by force. To this latter division the old name of *dynamics* (in a restricted sense) is still often applied. The mere geometrical description and analysis of various types of motion, apart from the consideration of the forces concerned, belongs to *kinematics*. This is sometimes discussed as a separate theory, but for our present purposes it is more convenient to introduce kinematical motions as they are required. We follow also the traditional practice of dealing first with statics and then with kinetics. This is, in the main, the historical order of development, and for purposes of exposition it has many advantages. The laws of equilibrium are, it is true, necessarily included as a particular case under those of motion; but there is no real inconvenience in formulating as the basis of statics a few provisional postulates which are afterwards seen to be comprehended in a more general scheme.

The whole subject rests ultimately on the Newtonian laws of motion and on some natural extensions of them. As these laws are discussed under a separate heading (Motion, Laws of), it is here only necessary to indicate the standpoint from which the present article is written. It is a purely empirical one. Guided by experience, we are able to frame rules which enable us to say with more or less accuracy what will be the consequences, or what were the antecedents, of a given state of things. These rules are sometimes dignified by the name of "laws of nature," but they have relation to our present state of knowledge and to the degree of skill with which we have succeeded in giving more or less compact expression to it. They are therefore liable to be modified from time to time, or to be superseded by more convenient or more comprehensive modes of statement. Again, we do not aim at anything so hopeless, or indeed so useless, as a *complete* description of any phenomenon. Some features are naturally more important or more interesting to us than others; by their relative simplicity and evident constancy they have the first hold on our attention, whilst those which are apparently accidental and vary from one occasion to another are ignored, or postponed for later examination. It follows that for the purposes of such description as is possible some process of abstraction is inevitable if our statements are to be simple and definite. Thus in studying the flight of a stone through the air we replace the body in imagination by a mathematical point endowed with a mass-coefficient. The size and shape, the complicated spinning motion which it is seen to execute, the internal strains and vibrations which doubtless take place, are all sacrificed in the mental picture in order that attention may be concentrated on those features of the phenomenon which are in the first place most interesting to us. At a later stage in our subject the conception of the ideal rigid body is introduced; this enables us to fill in some details which were previously wanting, but others are still omitted. Again, the conception of a force as concentrated in a mathematical line is as unreal as that of a mass concentrated in a point, but it is a convenient fiction for our purpose, owing to the simplicity which it lends to our statements.

The laws which are to be imposed on these ideal representations are in the first instance largely at our choice. Any scheme of abstract dynamics constructed in this way, provided it be self-consistent, is mathematically legitimate; but from the physical point of view we require that it should help us to picture the sequence of phenomena as they actually occur. Its success or failure in this respect can only be judged a posteriori by comparison of the results to which it leads with the facts. It is to be noticed, moreover, that all available tests apply only to the scheme as a whole; owing to the complexity of phenomena we cannot submit any one of its postulates to verification apart from the rest.

It is from this point of view that the question of relativity of motion, which is often felt to be a stumbling-block on the very threshold of the subject, is to be judged. By "motion" we mean of necessity motion relative to some frame of reference which is conventionally spoken of as "fixed." In the earlier stages of our subject this may be any rigid, or apparently rigid, structure fixed relatively to the earth. If we meet with phenomena which do not fit easily into this view, we have the alternatives either to modify our assumed laws of motion, or to call to our aid adventitious forces, or to examine whether the discrepancy can be reconciled by the simpler expedient of a new basis of reference. It is hardly necessary to say that the latter procedure has hitherto been found to be adequate. As a first step we adopt a system of rectangular axes whose origin is fixed in the earth, but whose directions are fixed by relation to the stars; in the planetary theory the origin is transferred to the sun, and afterwards to the mass-centre of the solar system; and so on. At each step there is a gain in accuracy and comprehensiveness; and the conviction is cherished that *some* system of rectangular axes exists with respect to which the Newtonian scheme holds with all imaginable accuracy.

A similar account might be given of the conception of time as a measurable quantity, but the remarks which it is necessary to make under this head will find a place later.

The following synopsis shows the scheme on which the treatment is based:—

Part 1.—Statics.

1. Statics of a particle.
2. Statics of a system of particles.
3. Plane kinematics of a rigid body.
4. Plane statics.
5. Graphical statics.
6. Theory of frames.
7. Three-dimensional kinematics of a rigid body.
8. Three-dimensional statics.
9. Work.
10. Statics of inextensible chains.
11. Theory of mass-systems.

Part 2.—Kinetics.

12. Rectilinear motion.
13. General motion of a particle.
14. Central forces. Hodograph.
15. Kinetics of a system of discrete particles.
16. Kinetics of a rigid body. Fundamental principles.
17. Two-dimensional problems.
18. Equations of motion in three dimensions.
19. Free motion of a solid.
20. Motion of a solid of revolution.
21. Moving axes of reference.
22. Equations of motion in generalized co-ordinates.
23. Stability of equilibrium. Theory of vibrations.

PART I.—STATICS

§ 1. *Statics of a Particle.*—By a *particle* is meant a body whose position can for the purpose in hand be sufficiently specified by a mathematical point. It need not be "infinitely small," or even small compared with ordinary standards; thus in astronomy such vast bodies as the sun, the earth, and the other planets can for many purposes be treated merely as points endowed with mass.

A *force* is conceived as an effort having a certain direction and a certain magnitude. It is therefore adequately represented, for mathematical purposes, by a straight line AB drawn in the direction in question, of length proportional (on any convenient scale) to the magnitude of the force. In other words, a force is mathematically of the nature of a "vector" (see VECTOR ANALYSIS, QUATERNIONS). In most questions of pure statics we are concerned only with the *ratios* of the various forces which enter into the problem, so that it is indifferent what *unit* of force is adopted. For many purposes a gravitational system of measurement is most natural; thus we speak of a force of so many pounds or so many kilogrammes. The "absolute" system of measurement will be referred to below in PART II., KINETICS. It is to be remembered that all "force" is of the nature of a push or a pull, and that according to the accepted terminology of modern mechanics such phrases as "force of inertia," "accelerating force," "moving force," once classical, are proscribed. This rigorous limitation of the meaning of the word is of comparatively recent origin, and it is perhaps to be regretted that some more technical term has not been devised, but the convention must now be regarded as established.

The fundamental postulate of this part of our subject is that the two forces acting on a particle may be compounded by the "parallelogram rule." Thus, if the two forces P,Q be represented by the lines OA, OB, they can be replaced by a single force R represented by the diagonal OC of the parallelogram determined by OA, OB. This is of course a physical assumption whose propriety is justified solely by experience. We shall see later that it is implied in Newton's statement of his Second Law of motion. In modern language, forces are compounded by "vector-addition"; thus, if we draw in succession vectors $\overrightarrow{HK}$, $\overrightarrow{KL}$ to represent P, Q, the force R is represented by the vector $\overrightarrow{HL}$ which is the "geometric sum" of $\overrightarrow{HK}$, $\overrightarrow{KL}$.

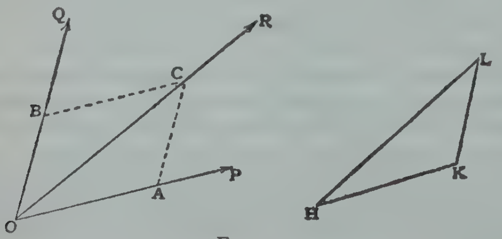

FIG. 1.

By successive applications of the above rule any number of forces acting on a particle may be replaced by a single force which is the vector-sum of the given forces; this single force is called the *resultant*. Thus if $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{CD}$ . . . , $\overrightarrow{HK}$ be vectors representing the given forces, the resultant will be given by $\overrightarrow{AK}$. It will be understood that the figure ABCD . . . K need not be confined to one plane.

If, in particular, the point K coincides with A, so that the resultant vanishes, the given system of forces is said to be *in equilibrium*—*i.e.* the particle could remain permanently at rest under its action. This is the proposition known as the *polygon of forces*. In the particular case of three forces it reduces to the *triangle of forces*, viz. "If three forces acting on a particle are represented as to magnitude and direction by the sides of a triangle taken in order, they are in equilibrium."

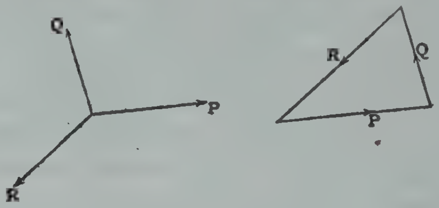

FIG. 2.

A sort of converse proposition is frequently useful, viz. if three forces acting on a particle be in equilibrium, and any triangle be constructed whose sides are respectively parallel to the forces, the magnitudes of the forces will be to one another as the corresponding sides of the triangle. This follows from the fact that all such triangles are necessarily similar.

As a simple example of the geometrical method of treating statical problems we may consider the equilibrium of a particle on a "rough" inclined plane. The usual empirical law of sliding friction is that the mutual action between two plane surfaces in contact, or between a particle and a curve or surface, cannot make with the normal an angle exceeding a certain limit λ called the *angle of friction*. If the conditions of equilibrium require an obliquity greater than this, sliding will take place. The precise value of λ will vary with the nature and condition of the surfaces in contact. In the case of a body simply resting on an inclined plane, the reaction must of course be vertical, for equilibrium, and the slope α of the plane must therefore not exceed λ. For this reason λ is also known as the *angle of repose*. If $\alpha > \lambda$, a force P must be applied in order to maintain equilibrium; let θ be the inclination of P to the plane, as shown in the left-hand diagram. The relations between this force P, the gravity W of the body, and the reaction S of the plane are then determined by a triangle of forces HKL. Since the inclination of S to the normal cannot exceed λ on either side, the value of P must lie between two limits which are represented by L_1H, L_2H, in the right-hand diagram. Denoting these limits by P_1, P_2, we have

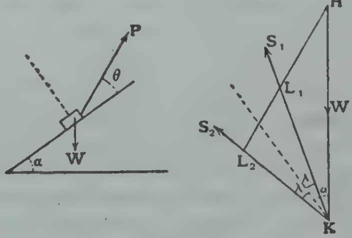

FIG. 3.

$$P_1/W = L_1H/HK = \sin(\alpha-\lambda)/\cos(\theta+\lambda),$$
$$P_2/W = L_2H/HK = \sin(\alpha+\lambda)/\cos(\theta-\lambda).$$

It appears, moreover, that if θ be varied P will be least when L_1H is at right angles to KL_1, in which case $P_1 = W \sin(\alpha-\lambda)$, corresponding to $\theta = -\lambda$.

Just as two or more forces can be combined into a single resultant, so a single force may be *resolved* into *components* acting in assigned directions. Thus a force can be uniquely resolved into two components acting in two assigned directions in the same plane with it by an inversion of the parallelogram construction of fig. 1. If, as is usually most convenient, the two assigned directions are at right angles, the two components of a force P will be P cos θ, P sin θ, where θ is the inclination of P to the direction of the former component. This leads to formulae for the analytical reduction of a system of coplanar forces acting on a particle. Adopting rectangular axes Ox, Oy, in the plane of the forces, and distinguishing the various forces of the system by suffixes, we can replace the system by two forces X, Y, in the direction of co-ordinate axes; viz.—

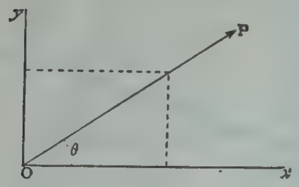

FIG. 4.

$$\left.\begin{aligned} X &= P_1\cos\theta_1 + P_2\cos\theta_2 + \dots = \Sigma\,(P\cos\theta),\\ Y &= P_1\sin\theta_1 + P_2\sin\theta_2 + \dots = \Sigma\,(P\sin\theta).\end{aligned}\right\} \tag{1}$$

These two forces X, Y, may be combined into a single resultant R making an angle ϕ with Ox, provided

$$X = R\cos\phi, \quad Y = R\sin\phi, \tag{2}$$

whence

$$R^2 = X^2 + Y^2, \quad \tan\phi = Y/X. \tag{3}$$

For equilibrium we must have $R=0$, which requires $X=0$, $Y=0$; in words, the sum of the components of the system must be zero for each of two perpendicular directions in the plane.

A similar procedure applies to a three-dimensional system, Thus if, O being the origin, $\overrightarrow{OH}$ represent any force P of the system, the planes drawn through H parallel to the co-ordinate planes will enclose with the latter a parallelepiped, and it is evident that $\overrightarrow{OH}$ is the geometric sum of $\overrightarrow{OA}$, $\overrightarrow{AN}$, $\overrightarrow{NH}$, or $\overrightarrow{OA}$, $\overrightarrow{OB}$, $\overrightarrow{OC}$, in the figure. Hence P is equivalent to three forces Pl, Pm, Pn acting along Ox, Oy, Oz, respectively, where l, m, n, are the "direction-ratios" of $\overrightarrow{OH}$. The whole system can be reduced in this way to three forces

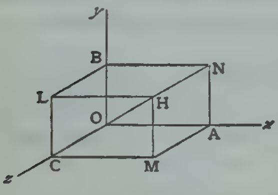

FIG. 5.

$$X = \Sigma\,(Pl), \quad Y = \Sigma\,(Pm), \quad Z = \Sigma\,(Pn), \tag{4}$$

acting along the co-ordinate axes. These can again be combined into a single resultant R acting in the direction (λ, μ, ν), provided

$$X = R\lambda,\ Y = R\mu,\ Z = R\nu. \tag{5}$$

If the axes are rectangular, the direction-ratios become direction-cosines, so that $\lambda^2 + \mu^2 + \nu^2 = 1$, whence

$$R^2 = X^2 + Y^2 + Z^2. \tag{6}$$

The conditions of equilibrium are $X=0$, $Y=0$, $Z=0$.

§ 2. *Statics of a System of Particles.*—We assume that the mutual forces between the pairs of particles, whatever their nature, are subject to the "Law of Action and Reaction" (Newton's Third Law); *i.e.* the force exerted by a particle A on a particle B, and the force exerted by B on A, are equal and opposite in the line AB. The problem of determining the possible configurations of equilibrium of a system of particles subject to extraneous forces which are known functions of the positions of the particles, and to internal forces which are known functions of the distances of the pairs of particles between which they act, is in general determinate For if n be the number of particles, the $3n$ conditions of equilibrium (three for each particle) are equal in number to the $3n$ Cartesian (or other) co-ordinates of the particles, which are to be found. If the system be subject to frictionless constraints, *e.g.* if some of the particles be constrained to lie on smooth surfaces, or if pairs of particles be connected by inextensible strings, then for each geometrical relation thus introduced we have an unknown reaction (*e.g.* the pressure of the smooth surface, or the tension of the string), so that the problem is still determinate.

The case of the *funicular polygon* will be of use to us later. A number of particles attached at various points of a string are acted on by given extraneous forces P_1, P_2, P_3 . . . respectively. The relation between the three forces acting on any particle, viz. the extraneous force and the tensions in the two adjacent portions of the string can be exhibited by means of a triangle of forces; and if the successive triangles be drawn to the same scale they can be fitted together so as to constitute a single *force-diagram*, as shown in fig. 6. This diagram consists of a polygon whose successive sides represent the given forces P_1, P_2, P_3 . . . , and of a series of lines connecting the vertices with a point O. These latter lines measure the tensions in the successive portions of string. As a special, but very important case, the forces P_1, P_2, P_3 . . . may be parallel, *e.g.* they may be the weights of the several particles. The polygon of forces is then made up of segments of a vertical line. We note that the tensions have now the same horizontal projection (represented by the dotted line in fig. 7). It is further of interest to note that if the weights be all equal, and at equal horizontal intervals, the vertices of the funicular will lie on a parabola whose axis is vertical. To prove this statement, let A, B, C, D . . . be successive vertices, and let H, K . . . be the middle points of AC, BD . . . ; then BH, CK . . . will be vertical by the hypothesis, and since the geometric sum of $\overrightarrow{BA}$, $\overrightarrow{BC}$ is represented by $2\overrightarrow{BH}$, the tension in BA : tension in BC : weight at B as BA : BC : 2BH. The tensions in the successive portions of the string are therefore proportional to the respective lengths, and the lines BH, CK . . . are all equal. Hence AD, BC are parallel and are bisected by the same vertical line; and a parabola with vertical axis can therefore be described through A, B, C, D. The same holds for the four points B, C, D, E and so on; but since a parabola is uniquely determined by the direction of its axis and by three points on the curve, the successive parabolas ABCD, BCDE, CDEF . . . must be coincident.

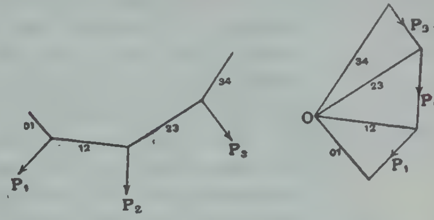

FIG. 6.

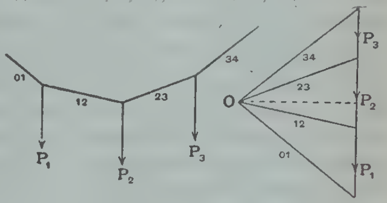

FIG. 7.

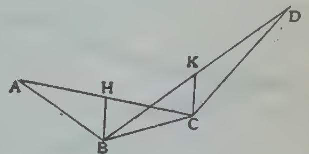

FIG. 8.

§ 3. *Plane Kinematics of a Rigid Body.*—The ideal *rigid body* is one in which the distance between any two points is invariable. For the present we confine ourselves to the consideration of displacements in two dimensions, so that the body is adequately represented by a thin lamina or plate.

The position of a lamina movable in its own plane is determinate when we know the positions of any two points A, B of it. Since the four co-ordinates (Cartesian or other) of these two points are connected by the relation which expresses the invariability of the length AB, it is plain that virtually three independent elements are required and suffice to specify the position of the lamina. For instance, the lamina may in general be fixed by connecting any three points of it by rigid links to three fixed points in its plane. The three independent elements may be chosen in a variety of ways (*e.g.* they may be the lengths

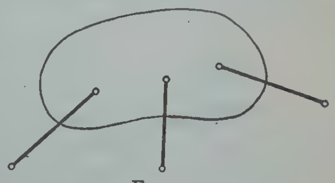

FIG. 9.

of the three links in the above example). They may be called (in a generalized sense) the *co-ordinates* of the lamina. The lamina when perfectly free to move in its own plane is said to have *three degrees of freedom.*

By a theorem due to M. Chasles any displacement whatever of the lamina in its own plane is equivalent to a rotation about some finite or infinitely distant point J. For suppose that in consequence of the displacement a point of the lamina is brought from A to B, whilst the point of the lamina which was originally at B is brought to C. Since AB, BC, are two different positions of the same line in the lamina they are equal, and it is evident that the rotation could have been effected by a rotation about J, the centre of the circle ABC, through an angle AJB. As a special case the three points A, B, C may be in a straight line; J is then at infinity and the displacement is equivalent to a pure *translation,* since every point of the lamina is now displaced parallel to AB through a space equal to AB.

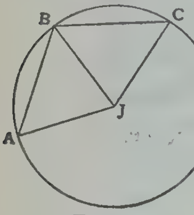

FIG. 10.

Next, consider any continuous motion of the lamina. The latter may be brought from any one of its positions to a neighbouring one by a rotation about the proper centre. The limiting position J of this centre, when the two positions are taken infinitely close to one another, is called the *instantaneous centre.* If P, P′ be consecutive positions of the same point, and $\delta\theta$ the corresponding angle of rotation, then ultimately PP′ is at right angles to JP and equal to JP . $\delta\theta$. The instantaneous centre will have a certain locus in space, and a certain locus in the lamina. These two loci are called *pole-curves* or *centrodes,* and are sometimes distinguished as the *space-centrode* and the *body-centrode,* respectively. In the continuous motion in question the latter curve rolls without slipping on the former (M. Chasles). Consider in fact any series of successive positions 1, 2, 3 . . . of the lamina (fig. 11); and let J_{12}, J_{23}, J_{34} . . . be the positions in space of the centres of the rotations by which the lamina can be brought from the first position to the second, from the second to the third, and so on. Further, in the position 1, let J_{12}, J'_{23}, J'_{34} . . . be the points of the lamina which have become the successive centres of rotation. The given series of positions will be assumed in succession if we imagine the lamina to rotate first about J_{12} until J'_{23} comes into coincidence with J_{23}, then about J_{23} until J'_{34} comes into coincidence with J_{34}, and so on. This is equivalent to imagining the polygon J_{12} J'_{23} J'_{34} . . . , supposed fixed in the lamina, to roll on the polygon J_{12} J_{23} J_{34} . . . , which is supposed fixed in space. By imagining the successive positions to be taken infinitely close to one another we derive the theorem stated. The particular case where both centrodes are circles is specially important in mechanism.

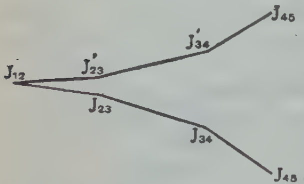

FIG. 11.

The theory may be illustrated by the case of "three-bar motion." Let ABCD be any quadrilateral formed of jointed links. If, AB being held fixed, the quadrilateral be slightly deformed, it is obvious that the instantaneous centre J will be at the intersection of the straight lines AD, BC, since the displacements of the points D, C are necessarily at right angles to AD, BC, respectively. Hence these displacements are proportional to JD, JC, and therefore to DD′, CC′, where C′D′ is any line drawn parallel to CD, meeting BC, AD in C′, D′, respectively. The determination of the centrodes in three-bar motion is in general complicated, but in one case, that of the "crossed parallelogram" (fig. 13), they assume simple forms. We then have AB = DC and AD = BC, and from the symmetries of the figure it is plain that

$$AJ + JB = CJ + JD = AD.$$

Hence the locus of J relative to AB, and the locus relative to CD are equal ellipses of which A, B and C, D are respectively the foci. It may be noticed that the lamina in fig. 9 is not, strictly speaking, fixed, but admits of infinitesimal displacement, whenever the directions of the three links are concurrent (or parallel).

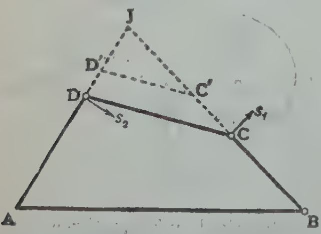

FIG. 12.

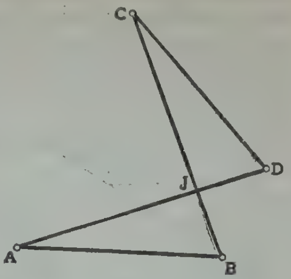

FIG. 13.

The matter may of course be treated analytically, but we shall only require the formula for infinitely small displacements. If the origin of rectangular axes fixed in the lamina be shifted through a space whose projections on the original directions of the axes are λ, μ, and if the axes are simultaneously turned through an angle ϵ, the co-ordinates of a point of the lamina, relative to the original axes, are changed from x, y to $\lambda + x\cos\epsilon - y\sin\epsilon$, $\mu + x\sin\epsilon + y\cos\epsilon$, or $\lambda + x - y\epsilon$, $\mu + x\epsilon + y$, ultimately. Hence the component displacements are ultimately

$$\delta x = \lambda - y\epsilon,\ \delta y = \mu + x\epsilon \qquad (1)$$

If we equate these to zero we get the co-ordinates of the instantaneous centre.

§ 4. *Plane Statics.*—The statics of a rigid body rests on the following two assumptions:—

(i) A force may be supposed to be applied indifferently at any point in its line of action. In other words, a force is of the nature of a "bound" or "localized" vector; it is regarded as resident in a certain line, but has no special reference to any particular point of the line.

(ii) Two forces in intersecting lines may be replaced by a force which is their geometric sum, acting through the intersection. The theory of parallel forces is included as a limiting case. For if O, A, B be any three points, and m, n any scalar quantities, we have in vectors

$$m\,.\,\overrightarrow{OA} + n\,.\,\overrightarrow{OB} = (m+n)\,\overrightarrow{OC}, \qquad (1)$$

provided

$$m\,.\,\overrightarrow{CA} + n\,.\,\overrightarrow{CB} = 0. \qquad (2)$$

Hence if forces P, Q act in OA, OB, the resultant R will pass through C, provided

$$m = P/OA, \quad n = Q/OB;$$

also

$$R = P\,.\,OC/OA + Q\,.\,OC/OB, \qquad (3)$$

and

$$P\,.\,AC : Q\,.\,CB = OA : OB. \qquad (4)$$

These formulae give a means of constructing the resultant by means of any transversal AB cutting the lines of action. If we now imagine the point O to recede to infinity, the forces P, Q and the resultant R are parallel, and we have

$$R = P + Q, \quad P\,.\,AC = Q\,.\,CB. \qquad (5)$$

When P, Q have opposite signs the point C divides AB externally on the side of the greater force. The investigation fails when P+Q=0, since it leads to an infinitely small resultant acting in an infinitely distant line. A combination of two equal, parallel, but oppositely directed forces cannot in fact be replaced by anything simpler, and must therefore be recognized as an independent entity in statics. It was called by L. Poinsot, who first systematically investigated its properties, a *couple.*

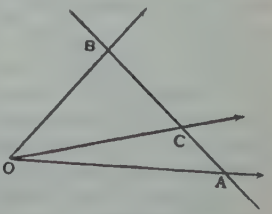

FIG. 14.

We now restrict ourselves for the present to the systems of forces in one plane. By successive applications of (ii) any such coplanar system can in general be reduced to a *single resultant* acting in a definite line. As exceptional cases the system may reduce to a couple, or it may be in equilibrium.

The *moment* of a force about a point O is the product of the force into the perpendicular drawn to its line of action from O, this perpendicular being reckoned positive or negative according as O lies on one side or other of the line of action. If we mark off a segment AB along the line of action so as to represent the force completely, the moment is represented as to magnitude by twice the area of the triangle OAB, and the usual convention as to sign is that the area is to be reckoned positive or negative according as the letters O, A, B, occur in "counter-clockwise" or "clockwise" order.

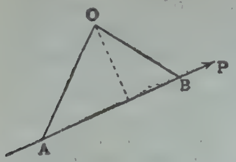

FIG. 15.

The sum of the moments of two forces about any point O is equal to the moment of their resultant (P. Varignon, 1687). Let AB, AC (fig. 16) represent the two forces, AD their resultant; we have to prove that the sum of the triangles OAB, OAC is equal to the triangle OAD, regard being had to signs. Since the side OA is common, we have to prove that the sum of the perpendiculars from B and C on OA is equal to the perpendicular from D on OA, these perpendiculars being reckoned positive or negative according as they lie to the right or left of AO. Regarded as a statement concerning the orthogonal projections of the vectors $\overrightarrow{AB}$ and $\overrightarrow{AC}$ (or $\overrightarrow{BD}$), and of their sum $\overrightarrow{AD}$, on a line perpendicular to AO, this is obvious.

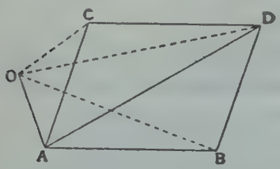

FIG. 16.

It is now evident that in the process of reduction of a coplanar system no change is made at any stage either in the sum of the projections of the forces on any line or in the sum of their moments about any point. It follows that the single resultant to which the system in general reduces is uniquely determinate, *i.e.* it acts in a definite line and has a definite magnitude and sense. Again it is necessary and sufficient for equilibrium that the sum of the projections of the forces on each of two perpendicular directions should vanish, and (moreover) that the sum of the moments about some one point should be zero. The fact that three independent conditions must hold for equilibrium is important. The conditions may of course be expressed in different (but equivalent) forms; *e.g.* the sum of the moments of the forces about each of the three points which are not collinear must be zero.

The particular case of three forces is of interest. If they are not all parallel they must be concurrent, and their vector-sum must be zero. Thus three forces acting perpendicular to the sides of a triangle at the middle points will be in equilibrium provided they are proportional to the respective sides, and act all inwards or all outwards. This result is easily extended to the case of a polygon of any number of sides; it has an important application in hydrostatics.

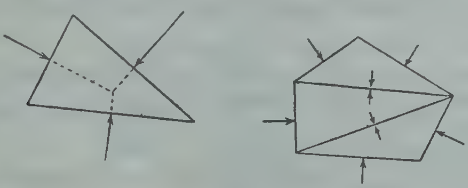

FIG. 17.

Again, suppose we have a bar AB resting with its ends on two smooth inclined planes which face each other. Let G be the centre of gravity (§ 11), and let $AG=a$, $GB=b$. Let α, β be the inclinations of the planes, and θ the angle which the bar makes with the vertical. The position of equilibrium is determined by the consideration that the reactions at A and B, which are by hypothesis normal to the planes, must meet at a point J on the vertical through G. Hence

$$JG/a=\sin(\theta-\alpha)/\sin\alpha,\quad JG/b=\sin(\theta+\beta)/\sin\beta,$$

whence

$$\cot\theta=\frac{a\cot\alpha-b\cot\beta}{a+b}. \tag{6}$$

If the bar is uniform we have $a=b$, and

$$\cot\theta=\tfrac{1}{2}(\cot\alpha-\cot\beta). \tag{7}$$

The problem of a rod suspended by strings attached to two points of it is virtually identical, the tensions of the strings taking the place of the reactions of the planes.

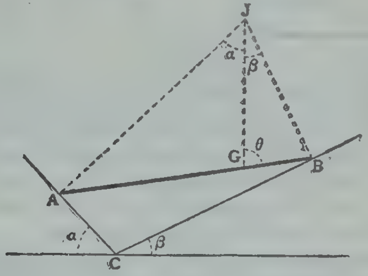

FIG. 18.

Just as a system of forces is in general equivalent to a single force, so a given force can conversely be replaced by combinations of other forces, in various ways. For instance, a given force (and consequently a system of forces) can be replaced in one and only one way by three forces acting in three assigned straight lines, provided these lines be not concurrent or parallel. Thus if the three lines form a triangle ABC, and if the given force F meet BC in H, then F can be resolved into two components acting in HA, BC, respectively. And the force in HA can be resolved into two components acting in BC, CA, respectively. A simple graphical construction is indicated in fig. 19, where the dotted lines are parallel. As an example, any system of forces acting on the lamina in fig. 9 is balanced by three determinate tensions (or thrusts) in the three links, provided the directions of the latter are not concurrent.

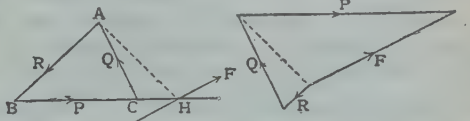

FIG. 19.

If P, Q, R, be any three forces acting along BC, CA, AB, respectively, the line of action of the resultant is determined by the consideration that the sum of the moments about any point on it must vanish. Hence in "trilinear" co-ordinates, with ABC as fundamental triangle, its equation is $P\alpha+Q\beta+R\gamma=0$. If $P:Q:R=a:b:c$, where a, b, c are the lengths of the sides, this becomes the "line at infinity," and the forces reduce to a couple.

The sum of the moments of the two forces of a couple is the same about any point in the plane. Thus in the figure the sum of the moments about O is P . OA − P . OB or P . AB, which is independent of the position of O. This sum is called the *moment of the couple*; it must of course have the proper sign attributed to it. It easily follows that any two couples of the same moment are equivalent, and that any number of couples can be replaced by a single couple whose moment is the sum of their moments. Since a couple is for our purposes sufficiently represented by its moment, it has been proposed to substitute the name *torque* (or twisting effort), as free from the suggestion of any special pair of forces.

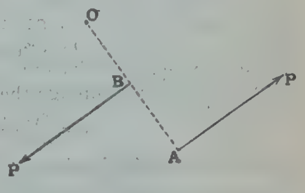

FIG. 20.

A system of forces represented completely by the sides of a plane polygon taken in order is equivalent to a couple whose moment is represented by twice the area of the polygon; this is proved by taking moments about any point. If the polygon intersects itself, care must be taken to attribute to the different parts of the area their proper signs.

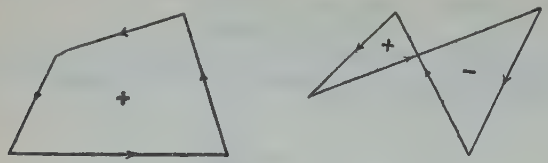

FIG. 21.

Again, any coplanar system of forces can be replaced by a single force R acting at any assigned point O, together with a couple G. The force R is the geometric sum of the given forces, and the moment (G) of the couple is equal to the sum of the moments of the given forces about O. The value of G will in general vary with the position of O, and will vanish when O lies on the line of action of the single resultant.

The formal analytical reduction of a system of coplanar forces is as follows. Let (x_1, y_1), (x_2, y_2), ... be the rectangular co-ordinates of any points A_1, A_2, ... on the lines of action of the respective forces. The force at A_1 may be replaced by its components X_1, Y_1, parallel to the co-ordinate axes; that at A_2 by its components X_2, Y_2, and so on. Introducing at O two equal and opposite forces $\pm X_1$ in Ox, we see that X_1 at A_1 may be replaced by an equal and parallel force at O together with a couple $-y_1X_1$. Similarly the force Y_1 at A_1 may be replaced by a force Y_1 at O together with a couple x_1Y_1. The forces X_1, Y_1, at O can thus be transferred to O provided we introduce a couple $x_1Y_1 - y_1X_1$. Treating the remaining forces in the same way we get a force $X_1 + X_2 + \dots$ or $\Sigma(X)$ along Ox, a force $Y_1 + Y_2 + \dots$ or $\Sigma(Y)$ along Oy, and a couple $(x_1Y_1 - y_1X_1) + (x_2Y_2 - y_2X_2) + \dots$ or $\Sigma(xY - yX)$. The three conditions of equilibrium are therefore

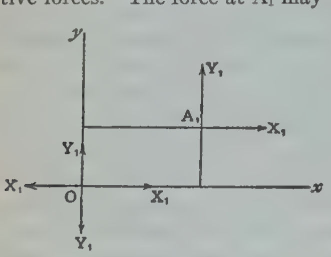

FIG. 22.

$$\Sigma(X) = 0, \quad \Sigma(Y) = 0, \quad \Sigma(xY - yX) = 0. \tag{8}$$

If O′ be a point whose co-ordinates are (ξ, η), the moment of the couple when the forces are transferred to O′ as a new origin will be $\Sigma\{(x-\xi)\,Y - (y-\eta)\,X\}$. This vanishes, *i.e.* the system reduces to a single resultant through O′, provided

$$-\xi.\Sigma(Y) + \eta.\Sigma(X) + \Sigma(xY - yX) = 0. \tag{9}$$

If ξ, η be regarded as current co-ordinates, this is the equation of the line of action of the single resultant to which the system is in general reducible.

If the forces are all parallel, making say an angle θ with Ox, we may write $X_1 = P_1 \cos\theta$, $Y_1 = P_1 \sin\theta$, $X_2 = P_2 \cos\theta$, $Y_2 = P_2 \sin\theta$, ... The equation (9) then becomes

$$\{\Sigma(xP) - \xi.\Sigma(P)\} \sin\theta - \{\Sigma(yP) - \eta.\Sigma(P)\} \cos\theta = 0. \tag{10}$$

If the forces P_1, P_2, ... be turned in the same sense through the same angle about the respective points A_1, A_2, ... so as to remain parallel, the value of θ is alone altered, and the resultant $\Sigma(P)$ passes always through the point

$$\bar{x} = \frac{\Sigma(xP)}{\Sigma(P)}, \quad \bar{y} = \frac{\Sigma(yP)}{\Sigma(P)}, \tag{11}$$

which is determined solely by the configuration of the points A_1, A_2, ... and by the ratios $P_1 : P_2 : \dots$ of the forces acting at them respectively. This point is called the *centre* of the given system of parallel forces; it is finite and determinate unless $\Sigma(P) = 0$. A geometrical proof of this theorem, which is not restricted to a two-dimensional system, is given later (§ 11). It contains the theory of the *centre of gravity* as ordinarily understood. For if we have an assemblage of particles whose mutual distances are small compared with the dimensions of the earth, the forces of gravity on them constitute a system of sensibly parallel forces, sensibly proportional to the respective masses. If now the assemblage be brought into any other position relative to the earth, without alteration of the mutual distances, this is equivalent to a rotation of the directions of the forces relatively to the assemblage, the ratios of the forces remaining unaltered. Hence there is a certain point, fixed relatively to the assemblage, through which the resultant of gravitational action always passes; this resultant is moreover equal to the sum of the forces on the several particles.

The theorem that any coplanar system of forces can be reduced to a force acting through any assigned point, together with a couple, has an important illustration in the theory of the distribution of shearing stress and bending moment in a horizontal beam, or other structure, subject to vertical extraneous forces. If we consider any vertical section P, the forces exerted across the section by the portion of the structure on one side on the portion on the other may be reduced to a vertical force F at P and a couple M. The force measures the *shearing stress*, and the couple the *bending moment* at P; we will reckon these quantities positive when the senses are as indicated in the figure.

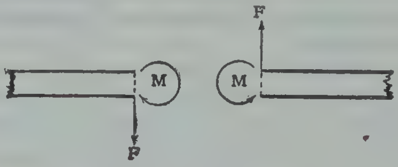

FIG. 23.

If the remaining forces acting on the portion of the structure on either side of P are known, then resolving vertically we find F, and taking moments about P we find M. Again if PQ be any segment of the beam which is free from load, Q lying to the right of P, we find

$$F_P = F_Q, \quad M_P - M_Q = -F.PQ; \tag{12}$$

hence F is constant between the loads, whilst M decreases as we travel to the right, with a constant gradient $-F$. If PQ be a short segment containing an isolated load W, we have

$$F_Q - F_P = -W, \quad M_Q = M_P; \tag{13}$$

hence F is discontinuous at a concentrated load, diminishing by an amount equal to the load as we pass the loaded point to the right, whilst M is continuous. Accordingly the graph of F for any system of isolated loads will consist of a series of horizontal lines, whilst that of M will be a continuous polygon.

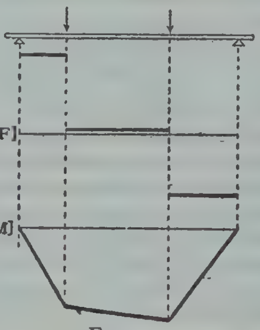

FIG. 24.

To pass to the case of continuous loads, let x be measured horizontally along the beam to the right. The load on an element δx of the beam may be represented by $w\delta x$, where w is in general a function of x. The equations (12) are now replaced by

$$\delta F = -w\delta x, \quad \delta M = -F\delta x,$$

whence

$$F_Q - F_P = -\int_P^Q w\,dx, \quad M_Q - M_P = -\int_P^Q F\,dx. \tag{14}$$

The latter relation shows that the bending moment varies as the area cut off by the ordinate in the graph of F. In the case of uniform load we have

$$F = -wx + A, \quad M = \tfrac{1}{2}wx^2 - Ax + B, \tag{15}$$

where the arbitrary constants A,B are to be determined by the conditions of the special problem, *e.g.* the conditions at the ends of the beam. The graph of F is a straight line; that of M is a parabola with vertical axis. In all cases the graphs due to different distributions of load may be superposed. The figure shows the case of a uniform heavy beam supported at its ends.

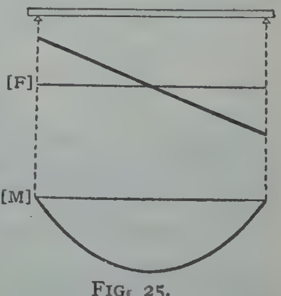

FIG. 25.

§ 5. *Graphical Statics.*—A graphical method of reducing a plane system of forces was introduced by C. Culmann (1864). It involves the construction of two figures, a *force-diagram* and a *funicular polygon*. The force-diagram is constructed by placing end to end a series of vectors representing the given forces in magnitude and direction, and joining the vertices of the polygon thus formed to an arbitrary *pole* O. The funicular or link polygon has its vertices on the lines of action of the given forces, and its sides respectively parallel to the lines drawn from O in the force-diagram; in particular, the two sides meeting in any vertex are respectively parallel to the lines drawn from O to the ends of that side of the force-polygon which represents the corresponding force. The relations will be understood from the annexed diagram, where corresponding lines in the force-diagram (to the right) and the funicular (to the left) are numbered similarly. The sides of the force-polygon may in the first instance be arranged in any order; the force-diagram can then be completed in a doubly infinite number of ways, owing to the arbitrary position of O; and for each force-diagram a simply infinite number of funiculars can be drawn. The two diagrams being supposed constructed, it is seen that each of the given systems of forces can be replaced by two components acting in the sides of the funicular which meet at the corresponding vertex, and that the magnitudes of these components will be given by the corresponding triangle of forces in the force-diagram; thus the force 1 in the figure is equivalent to two forces represented by O1 and 12. When this process of replacement is complete, each terminated side of the funicular is the seat of two forces which neutralize one another, and there remain only two uncompensated forces, viz., those resident in the first and last sides of the funicular. If these sides intersect, the resultant acts through the intersection, and its magnitude and direction are given by the line joining the first and last sides of the force-polygon (see fig. 26, where the resultant of the four given forces is denoted by R). As a special case it may happen that the force-polygon is closed, *i.e.* its first and last points coincide; the first and last sides of the funicular will then be parallel (unless they coincide), and the two uncompensated forces form a couple. If, however, the first and last sides of the funicular coincide, the two outstanding forces neutralize one another, and we have equilibrium. Hence the necessary and sufficient conditions of equilibrium are that the force-polygon and the funicular should both be closed. This is illustrated by fig. 26 if we imagine the force R, reversed, to be included in the system of given forces.

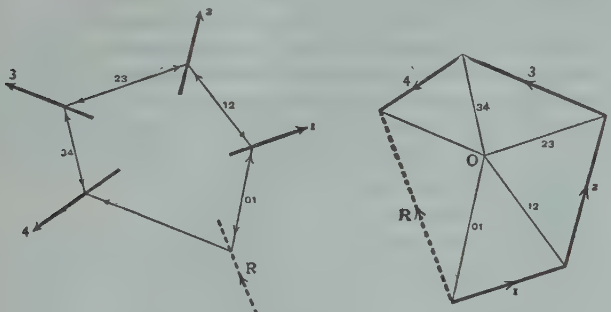

FIG. 26.

It is evident that a system of jointed bars having the shape of the funicular polygon would be in equilibrium under the action of the given forces, supposed applied to the joints; moreover any bar in which the stress is of the nature of a tension (as distinguished from a thrust) might be replaced by a string. This is the origin of the names "link-polygon" and "funicular" (cf. § 2).

If funiculars be drawn for two positions O,O′ of the pole in the force-diagram, their corresponding sides will intersect on a straight line parallel to OO′. This is essentially a theorem of projective geometry, but the following statical proof is interesting. Let AB (fig. 27) be any side of the force-polygon, and construct the corresponding portions of the two diagrams, first with O and then with O′ as pole. The force corresponding to AB may be replaced by the two components marked x, y; and a force corresponding to BA may be represented by the two components marked x', y'. Hence the forces x, y, x', y' are in equilibrium. Now x, x' have a resultant through H, represented in magnitude and direction by OO′, whilst y,y' have a resultant through K represented in magnitude and direction by O′O. Hence HK must be parallel to OO′. This theorem enables us, when one funicular has been drawn, to construct any other without further reference to the force-diagram.

The complete figures obtained by drawing first the force-diagrams of a system of forces in equilibrium with two distinct poles O, O′, and secondly the corresponding funiculars, have various interesting relations. In the first place, each of these figures may be conceived as an orthogonal projection of a closed plane-faced polyhedron.

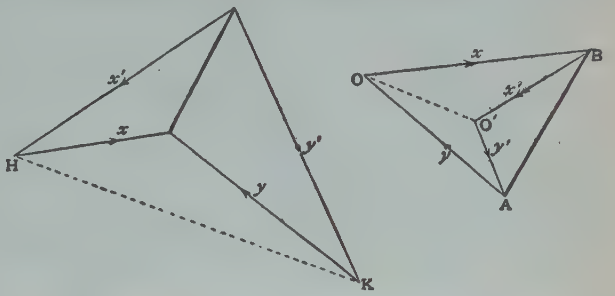

FIG. 27.

As regards the former figure this is evident at once; viz. the polyhedron consists of two pyramids with vertices represented by O, O′, and a common base whose perimeter is represented by the force-polygon (only one of these is shown in fig. 28). As regards the funicular diagram, let LM be the line on which the pairs of corresponding sides of the two polygons meet, and through it draw any two planes ω, ω'. Through the vertices A, B, C, . . . and A′, B′, C′, . . of the two funiculars draw normals to the plane of the diagram, to meet ω and ω' respectively. The points thus obtained are evidently the vertices of a polyhedron with plane faces.

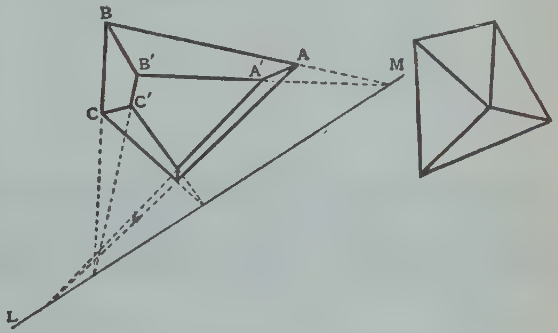

FIG. 28.

To every line in either of the original figures corresponds of course a parallel line in the other; moreover, it is seen that concurrent lines in either figure correspond to lines forming a closed polygon in the other. Two plane figures so related are called *reciprocal*, since the properties of the first figure in relation to the second are the same as those of the second with respect to the first. A still simpler instance of reciprocal figures is supplied by the case of concurrent forces in equilibrium (fig. 29). The theory of these reciprocal figures was first studied by J. Clerk Maxwell, who showed amongst other things that a reciprocal can always be drawn to any figure which is the orthogonal projection of a plane-faced polyhedron. If in fact we take the pole of each face of such a polyhedron with respect to a paraboloid of revolution, these poles will be the vertices of a second polyhedron whose edges are the "conjugate lines" of those of the former. If we project both polyhedra orthogonally on a plane perpendicular to the axis of the paraboloid, we obtain two figures which are reciprocal, except that corresponding lines are orthogonal instead of parallel. Another proof will be indicated later (§ 8) in connexion with the properties of the linear complex. It is

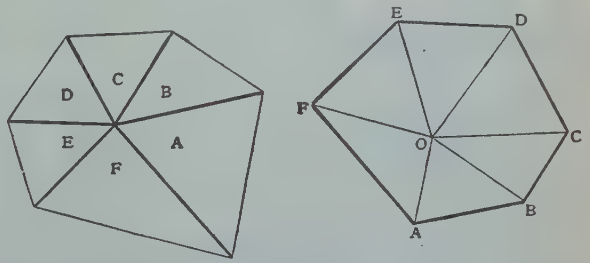

FIG. 29.

convenient to have a notation which shall put in evidence the reciprocal character. For this purpose we may designate the points in one figure by letters A, B, C, . . . and the corresponding polygons in the other figure by the same letters; a line joining two points A, B in one figure will then correspond to the side common to the two polygons A, B in the other. This notation was employed by R. H. Bow in connexion with the theory of frames (§ 6, and see also APPLIED MECHANICS below) where reciprocal diagrams are frequently of use (cf. DIAGRAM).

When the given forces are all parallel, the force-polygon consists of a series of segments of a straight line. This case has important practical applications; for instance we may use the method to find the pressures on the supports of a beam loaded in any given manner. Thus if AB, BC, CD represent the given loads, in the force-diagram, we construct the sides corresponding to OA, OB, OC, OD in the funicular; we then draw the *closing line* of the funicular polygon, and a parallel OE to it in the force diagram. The segments DE, EA then represent the upward pressures of the two supports on the beam, which pressures together with the given loads constitute a system of forces in equilibrium. The pressures of the beam on the supports are of course represented by ED, AE. The two diagrams are portions of reciprocal figures, so that Bow's notation is applicable.

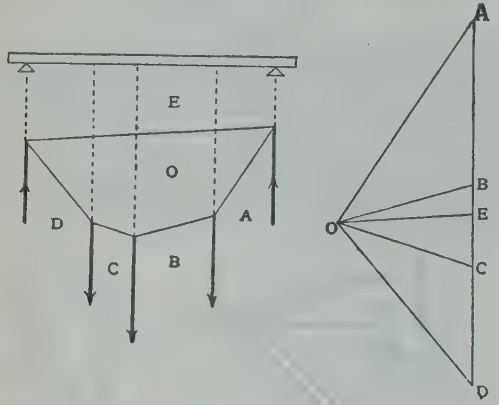

FIG. 30.

A graphical method can also be applied to find the moment of a force, or of a system of forces, about any assigned point P. Let F be a force represented by AB in the force-diagram. Draw a parallel through P to meet the sides of the funicular which correspond to OA, OB in the points H, K. If R be the intersection of these sides,

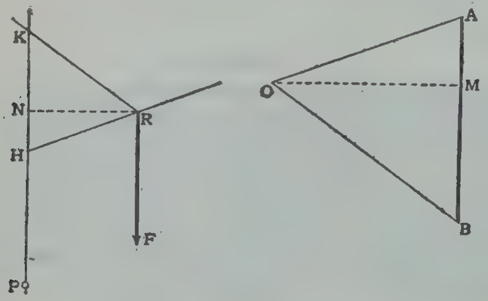

FIG. 31.

the triangles OAB, RHK are similar, and if the perpendiculars OM, RN be drawn we have

$$HK . OM = AB . RN = F . RN,$$

which is the moment of F about P. If the given forces are all parallel (say vertical) OM is the same for all, and the moments of the several forces about P are represented on a certain scale by the lengths intercepted by the successive pairs of sides on the vertical through P. Moreover, the moments are compounded by adding (geometrically) the corresponding lengths HK. Hence if a system of vertical forces be in equilibrium, so that the funicular polygon is closed, the length which this polygon intercepts on the vertical through any point P gives the sum of the moments about P of all the forces on one side of this vertical. For instance, in the case of a beam in equilibrium under any given loads and the reactions at the supports, we get a graphical representation of the distribution of bending moment over the beam. The construction in fig. 30 can easily be adjusted so that the closing line shall be horizontal; and the figure then becomes identical with the bending-moment diagram of § 4. If we wish to study the effects of a movable load, or system of loads, in different positions on the beam, it is only necessary to shift the lines of action of the pressures of the supports relatively to the funicular, keeping them at the same distance apart; the only change is then in the position of the closing line of the funicular. It may be remarked that since this line joins homologous points of two "similar" rows it will envelope a parabola.

The "centre" (§ 4) of a system of parallel forces of given magnitudes, acting at given points, is easily determined graphically. We have only to construct the line of action of the resultant for each of two arbitrary directions of the forces; the intersection of the two lines gives the point required. The construction is neatest if the two arbitrary directions are taken at right angles to one another.

§ 6. *Theory of Frames.*—A *frame* is a structure made up of pieces, or *members*, each of which has two *joints* connecting it with other members. In a two-dimensional frame, each joint may be conceived as consisting of a small cylindrical pin fitting accurately and smoothly into holes drilled through the members which it connects. This supposition is a somewhat ideal one, and is often only roughly approximated to in practice. We shall suppose, in the first instance, that extraneous forces act on the frame at the joints only, *i.e.* on the pins.

On this assumption, the reactions on any member at its two joints must be equal and opposite. This combination of equal and opposite forces is called the *stress* in the member; it may be a *tension* or a *thrust*. For diagrammatic purposes each member is sufficiently represented by a straight line terminating at the two joints; these lines will be referred to as the *bars* of the frame.

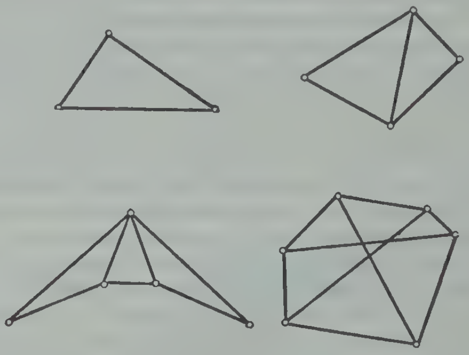

FIG. 32.

In structural applications a frame must be *stiff*, or *rigid*, *i.e.* it must be incapable of deformation without alteration of length in at least one of its bars. It is said to be *just rigid* if it ceases to be rigid when any one of its bars is removed. A frame which has more bars than are essential for rigidity may be called *over-rigid*; such a frame is in general self-stressed, *i.e.* it is in a state of stress independently of the action of extraneous forces. A plane frame of n joints which is just rigid (as regards deformation in its own plane) has $2n-3$ bars, for if one bar be held fixed the $2(n-2)$ co-ordinates of the remaining $n-2$ joints must just be determined by the lengths of the remaining bars. The total number of bars is therefore $2(n-2) + 1$. When a plane frame which is just rigid is subject to a given system of equilibrating extraneous forces (in its own plane) acting on the joints, the stresses in the bars are in general uniquely determinate. For the conditions of equilibrium of the forces on each pin furnish $2n$ equations, viz. two for each point, which are linear in respect of the stresses and the extraneous forces. This system of equations must involve the three conditions of equilibrium of the extraneous forces which are already identically satisfied, by hypothesis; there remain therefore $2n - 3$ independent relations to determine the $2n-3$ unknown stresses. A frame of n joints and $2n-3$ bars may of course fail to be rigid owing to some parts being over-stiff whilst others are deformable; in such a case it will be found that the statical equations, apart from the three identical relations imposed by the equilibrium of the extraneous forces, are not all independent but are equivalent to less than $2n-3$ relations. Another exceptional case, known as the *critical case*, will be noticed later (§ 9).

A plane frame which can be built up from a single bar by successive steps, at each of which a new joint is introduced by two new bars meeting there, is called a *simple* frame; it is obviously just rigid. The stresses produced by extraneous forces in a simple frame can be found by considering the equilibrium of the various joints in a proper succession; and if the graphical method be employed the various polygons of force can be combined into a single force-diagram. This procedure was introduced by W. J. M. Rankine and J. Clerk Maxwell (1864). It may be noticed that if we take an arbitrary pole in the force-diagram, and draw a corresponding funicular in the skeleton diagram which represents the frame together with the lines of action of the extraneous forces, we obtain two complete reciprocal figures, in Maxwell's sense. It is accordingly convenient to use Bow's notation (§ 5), and to distinguish the several compartments of the frame-diagram by letters. See fig. 33, where the successive triangles in the diagram of forces may be constructed in the order XYZ, ZXA, AZB. The class of "simple" frames includes many of the frameworks used in the construction of roofs, lattice girders and suspension bridges; a number of examples will be found in the article BRIDGES. By examining the senses in which the respective forces act at each joint we can ascertain which members are in tension and which are in thrust; in fig. 33 this is indicated by the directions of the arrowheads.

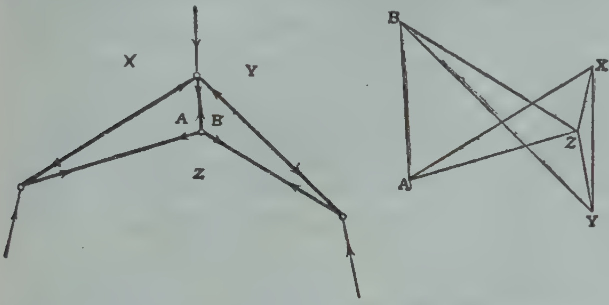

FIG. 33.

When a frame, though just rigid, is not "simple" in the above sense, the preceding method must be replaced, or supplemented, by one or other of various artifices. In some cases the *method of sections* is sufficient for the purpose. If an ideal section be drawn across the frame, the extraneous forces on either side must be in equilibrium with the forces in the bars cut across; and if the section can be drawn so as to cut only three bars, the forces in these can be found, since the problem reduces to that of resolving a given force into three components acting in three given lines (§ 4). The "critical case" where the directions of the three bars are concurrent is of course excluded. Another method, always available, will be explained under "Work" (§ 9).

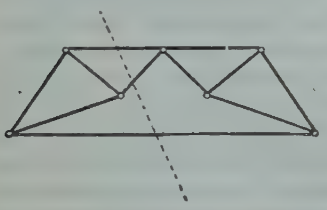

FIG. 34.

When extraneous forces act on the bars themselves the stress in each bar no longer consists of a simple longitudinal tension or thrust. To find the reactions at the joints we may proceed as follows. Each extraneous force W acting on a bar may be replaced (in an infinite number of ways) by two components P, Q in lines through the centres of the pins at the extremities. In practice the forces W are usually vertical, and the components P, Q are then conveniently taken to be vertical also. We first alter the problem by transferring the forces P, Q to the pins. The stresses in the bars, in the problem as thus modified, may be supposed found by the preceding methods; it remains to infer from the results thus obtained the reactions in the original form of the problem. To find the pressure exerted by a bar AB on the pin A we compound with the force in AB given by the diagram a force equal to P. Conversely, to find the pressure of the pin A on the bar AB we must compound with the force given by the diagram a force equal and opposite to P. This question arises in practice in the theory of "three-jointed" structures; for the purpose in hand such a structure is sufficiently represented by two bars AB, BC. The right-hand figure represents a portion of the force-diagram; in particular $\overrightarrow{ZX}$ represents the pressure of AB on B in the modified problem where the loads W_1 and W_2 on the two bars are replaced by loads P_1, Q_1, and P_2, Q_2 respectively, acting on the pins. Compounding with this $\overrightarrow{XV}$, which represents Q_1, we get the actual pressure $\overrightarrow{ZV}$ exerted by AB on B. The directions and magnitudes of the reactions at A and C are then easily ascertained. On account of its practical importance several other graphical solutions of this problem have been devised.

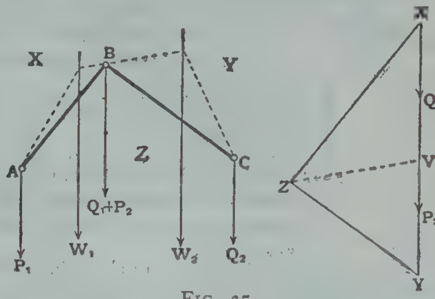

FIG. 35.

§ 7. *Three-dimensional Kinematics of a Rigid Body.*—The position of a rigid body is determined when we know the positions of three points A, B, C of it which are not collinear, for the position of any other point P is then determined by the three distances PA, PB, PC. The nine co-ordinates (Cartesian or other) of A, B, C are subject to the three relations which express the invariability of the distances BC, CA, AB, and are therefore equivalent to six independent quantities. Hence a rigid body not constrained in any way is said to have six degrees of freedom. Conversely, any six geometrical relations restrict the body in general to one or other of a series of definite positions, none of which can be departed from without violating the conditions in question. For instance, the position of a theodolite is fixed by the fact that its rounded feet rest in contact with six given plane surfaces. Again, a rigid three-dimensional frame can be rigidly fixed relatively to the earth by means of six links.

The six independent quantities, or "co-ordinates," which serve to specify the position of a rigid body in space may of course be chosen in an endless variety of ways. We may, for instance, employ the three Cartesian co-ordinates of a particular point O of the body, and three angular co-ordinates which express the orientation of the body with respect to O. Thus in fig. 36, if OA, OB, OC be three mutually perpendicular lines in the solid, we may denote by θ the angle which OC makes with a fixed direction OZ, by ψ the azimuth of the plane ZOC measured from some fixed plane through OZ, and by ϕ the inclination of the plane COA to the plane ZOC. In fig. 36 these various lines and planes are represented by their intersections with a unit sphere having O as centre. This very useful, although unsymmetrical, system of angular co-ordinates was introduced by L. Euler. It is exemplified in "Cardan's suspension," as used in connexion with a compass-bowl or a gyroscope. Thus in the gyroscope the "flywheel" (represented by the globe in fig. 37) can turn about a diameter OC of a ring which is itself free to turn about a diametral axis OX at right angles to the former; this axis is carried by a second ring which is free to turn about a fixed diameter OZ, which is at right angles to OX.

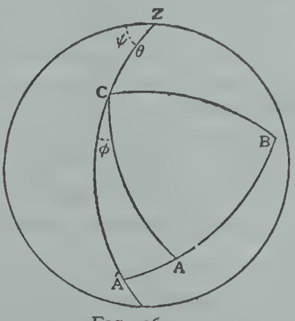

FIG. 36.

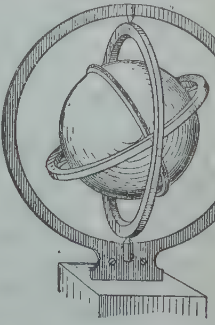

FIG. 37.

We proceed to sketch the theory of the finite displacements of a rigid body. It was shown by Euler (1776) that any displacement in which one point O of the body is fixed is equivalent to a pure *rotation* about some axis through O. Imagine two spheres of equal radius with O as their common centre, one fixed in the body and moving with it, the other fixed in space. In any displacement about O as a fixed point, the former sphere slides over the latter, as in a "ball-and-socket" joint. Suppose that as the result of the displacement a point of the moving sphere is brought from A to B, whilst the point which was at B is brought to C (cf. fig. 10). Let J be the pole of the circle ABC (usually a "small circle" of the fixed sphere), and join JA, JB, JC, AB, BC by great-circle arcs. The spherical isosceles triangles AJB, BJC are congruent, and we see that AB can be brought into the position BC by a rotation about the axis OJ through an angle AJB.

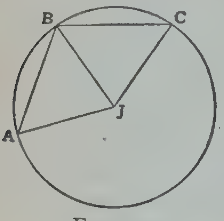

FIG. 10.

It is convenient to distinguish the two senses in which rotation may take place about an axis OA by opposite signs. We shall reckon a rotation as positive when it is related to the direction from O to A as the direction of rotation is related to that of translation in a right-handed screw. Thus a negative rotation about OA may be regarded as a positive rotation about OA′, the prolongation of AO. Now suppose that a body receives first a positive rotation α about OA, and secondly a positive rotation β about OB; and let A, B be the intersections of these axes with a sphere described about O as centre. If we construct the spherical triangles ABC, ABC′ (fig. 38), having in each case the angles at A and B equal to $\frac{1}{2}\alpha$ and $\frac{1}{2}\beta$ respectively, it is evident that the first rotation will bring a point from C to C′ and that the second will bring it back to C; the result is therefore equivalent to a rotation about OC. We note also that if the given rotations had been effected in the inverse order, the axis of the resultant rotation would have been OC′, so that finite rotations do not obey the "commutative law." To find the angle of the equivalent rotation, in the actual case, suppose that the second rotation (about OB) brings a point from A to A′. The spherical triangles ABC, A′BC (fig. 39) are "symmetrically equal," and the angle of the resultant rotation, viz. ACA′, is $2\pi-2C$. This is equivalent to a negative rotation 2C about OC, whence the theorem that the effect of three successive positive rotations 2A, 2B, 2C about OA, OB, OC, respectively, is to leave the body in its original position, provided the circuit ABC is left-handed as seen from O. This theorem is due to O. Rodrigues (1840). The composition of finite rotations about parallel axes is a particular case of the preceding; the radius of the sphere is now infinite, and the triangles are plane.

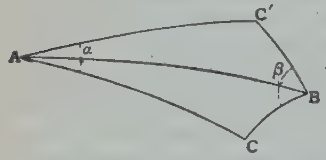

FIG. 38.

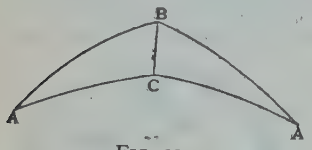

FIG. 39.

In any continuous motion of a solid about a fixed point O, the limiting position of the axis of the rotation by which the body can be brought from any one of its positions to a consecutive one is called the *instantaneous axis*. This axis traces out a certain cone in the body, and a certain cone in space, and the continuous motion in question may be represented as consisting in a rolling of the former cone on the latter. The proof is similar to that of the corresponding theorem of plane kinematics (§ 3).

It follows from Euler's theorem that the most general displacement of a rigid body may be effected by a pure translation which brings any one point of it to its final position O, followed by a pure rotation about some axis through O. Those planes in the body which are perpendicular to this axis obviously remain parallel to their original positions. Hence, if σ, σ' denote the initial and final positions of any figure in one of these planes, the displacement could evidently have been effected by (1) a translation perpendicular to the planes in question, bringing σ into some position σ'' in the plane of σ', and (2) a rotation about a normal to the planes, bringing σ'' into coincidence with σ (§ 3). In other words, the most general displacement is equivalent to a translation parallel to a certain axis combined with a rotation about that axis; *i.e.* it may be described as a *twist* about a certain *screw*. In particular cases, of course, the translation, or the rotation, may vanish.

The preceding theorem, which is due to Michel Chasles (1830), may be proved in various other interesting ways. Thus if a point of the body be displaced from A to B, whilst the point which was at B is displaced to C, and that which was at C to D, the four points A, B, C, D lie on a helix whose axis is the common perpendicular to the bisectors of the angles ABC, BCD. This is the axis of the required screw; the amount of the translation is measured by the projection of AB or BC or CD on the axis; and the angle of rotation is given by the inclination of the aforesaid bisectors. This construction was given by M. W. Crofton. Again, H. Wiener and W. Burnside have employed the *half-turn* (*i.e.* a rotation through two right angles) as the fundamental operation. This has the advantage that it is completely specified by the axis of the rotation, the sense being immaterial. Successive half-turns about parallel axes *a*, *b* are equivalent to a translation measured by double the distance between these axes in the direction from *a* to *b*. Successive half-turns about intersecting axes *a*, *b* are equivalent to a rotation about the common perpendicular to *a*, *b* at their intersection, of amount equal to twice the acute angle between them, in the direction from *a* to *b*. Successive half-turns about two skew axes *a*, *b* are equivalent to a twist about a screw whose axis is the common perpendicular to *a*, *b*, the translation being double the shortest distance, and the angle of rotation being twice the acute angle between *a*, *b*, in the direction from *a* to *b*. It is easily shown that any displacement whatever is equivalent to two half-turns and therefore to a screw.

In mechanics we are specially concerned with the theory of infinitesimal displacements. This is included in the preceding, but it is simpler in that the various operations are commutative. An infinitely small rotation about any axis is conveniently represented geometrically by a length AB measures along the axis and proportional to the angle of rotation, with the convention that the direction from A to B shall be related to the rotation as is the direction of translation to that of rotation in a right-handed screw. The consequent displacement of any point P will then be at right angles to the plane PAB, its amount will be represented by double the area of the triangle PAB, and its sense will depend on the cyclical order of the letters P, A, B. If AB, AC represent infinitesimal rotations about intersecting axes, the consequent displacement of any point O in the plane BAC will be at right angles to this plane, and will be represented by twice the sum of the areas OAB, OAC, taken with proper signs. It follows by analogy with the theory of moments (§ 4) that the resultant rotation will be represented by AD, the vector-sum of AB, AC (see fig. 16). It is easily inferred as a limiting case, or proved directly, that two infinitesimal rotations α, β about parallel axes are equivalent to a rotation $\alpha+\beta$ about a parallel axis in the same plane with the two former, and dividing a common perpendicular AB in a point C so that $AC/CB=\beta/\alpha$. If the rotations are equal and opposite, so that $\alpha+\beta=0$, the point C is at infinity, and the effect is a translation perpendicular to the plane of the two given axes, of amount $\alpha.AB$. It thus appears that an infinitesimal rotation is of the nature of a "localized vector," and is subject in all respects to the same mathematical laws as a force, conceived as acting on a rigid body. Moreover, that an infinitesimal translation is analogous to a couple and follows the same laws. These results are due to Poinsot.

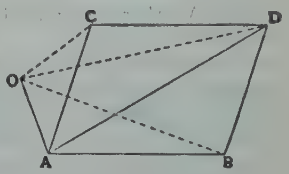

FIG. 16.

The analytical treatment of small displacements is as follows. We first suppose that one point O of the body is fixed, and take this as the origin of a "right-handed" system of rectangular co-ordinates; *i.e.* the positive directions of the axes are assumed to be so arranged that a positive rotation of 90° about Ox would bring Oy into the position of Oz, and so on. The displacement will consist of an infinitesimal rotation ϵ about some axis through O, whose direction-cosines are, say, l, m, n. From the equivalence of a small rotation to a localized vector it follows that the rotation ϵ will be equivalent to rotations ξ, η, ζ about Ox, Oy, Oz, respectively, provided

$$\xi = l\epsilon,\ \eta = m\epsilon,\ \zeta = n\epsilon, \tag{1}$$

and we note that

$$\xi^2 + \eta^2 + \zeta^2 = \epsilon^2. \tag{2}$$

Thus in the case of fig. 36 it may be required to connect the infinitesimal rotations ξ, η, ζ about OA, OB, OC with the variations of the angular co-ordinates θ, ψ, ϕ. The displacement of the point C of the body is made up of $\delta\theta$ tangential to the meridian ZC and $\sin\theta\ \delta\psi$ perpendicular to the plane of this meridian. Hence, resolving along the tangents to the arcs BC, CA, respectively, we have

$$\xi = \delta\theta \sin\phi - \sin\theta\ \delta\psi \cos\phi,\ \eta = \delta\theta \cos\phi + \sin\theta\ \delta\psi \sin\phi. \tag{3}$$

Again, consider the point of the solid which was initially at A′ in the figure. This is displaced relatively to A′ through a space $\delta\phi$ perpendicular to the plane of the meridian, whilst A′ itself is displaced through a space $\cos\theta\ \delta\psi$ in the same direction. Hence

$$\zeta = \delta\phi + \cos\theta\ \delta\psi. \tag{4}$$

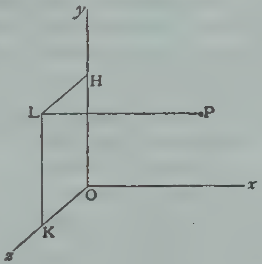

FIG. 40.

To find the component displacements of a point P of the body, whose co-ordinates are x, y, z, we draw PL normal to the plane yOz, and LH, LK perpendicular to Oy, Oz, respectively. The displacement of P parallel to Ox is the same as that of L, which is made up of ηz and $-\zeta y$. In this way we obtain the formulae

$$\delta x = \eta z - \zeta y,\quad \delta y = \zeta x - \xi z,\quad \delta z = \xi y - \eta x. \tag{5}$$

The most general case is derived from this by adding the component displacements λ, μ, ν (say) of the point which was at O; thus

$$\left.\begin{aligned} \delta x &= \lambda + \eta z - \zeta y, \\ \delta y &= \mu + \zeta x - \xi z, \\ \delta z &= \nu + \xi y - \eta x. \end{aligned}\right\} \tag{6}$$

The displacement is thus expressed in terms of the six independent quantities $\xi, \eta, \zeta, \lambda, \mu, \nu$. The points whose displacements are in the direction of the resultant axis of rotation are determined by $\delta x : \delta y : \delta z = \xi : \eta : \zeta$, or

$$(\lambda + \eta z - \zeta y)/\xi = (\mu + \zeta x - \xi z)/\eta = (\nu + \xi y - \eta x)/\zeta. \tag{7}$$

These are the equations of a straight line, and the displacement is in fact equivalent to a twist about a screw having this line as axis. The translation parallel to this axis is

$$l\delta x + m\delta y + n\delta z = (\lambda\xi + \mu\eta + \nu\zeta)/\epsilon. \tag{8}$$

The linear magnitude which measures the ratio of translation to rotation in a screw is called the *pitch*. In the present case the pitch is

$$(\lambda\xi + \mu\eta + \nu\zeta)/(\xi^2 + \eta^2 + \zeta^2). \tag{9}$$

Since $\xi^2 + \eta^2 + \zeta^2$, or ϵ^2, is necessarily an absolute invariant for all transformations of the (rectangular) co-ordinate axes, we infer that $\lambda\xi + \mu\eta + \nu\zeta$ is also an absolute invariant. When the latter invariant, but not the former, vanishes, the displacement is equivalent to a pure rotation.

If the small displacements of a rigid body be subject to one constraint, *e.g.* if a point of the body be restricted to lie on a given surface, the mathematical expression of this fact leads to a homogeneous linear equation between the infinitesimals $\xi, \eta, \zeta, \lambda, \mu, \nu$, say

$$A\xi + B\eta + C\zeta + F\lambda + G\mu + H\nu = 0. \tag{10}$$

The quantities ξ, η, ζ, λ, μ, ν are no longer independent, and the body has now only five degrees of freedom. Every additional constraint introduces an additional equation of the type (10) and reduces the number of degrees of freedom by one. In Sir R. S. Ball's *Theory of Screws* an analysis is made of the possible displacements of a body which has respectively two, three, four, five degrees of freedom. We will briefly notice the case of two degrees, which involves an interesting generalization of the method (already explained) of compounding rotations about intersecting axes. We assume that the body receives arbitrary twists about two given screws, and it is required to determine the character of the resultant displacement. We examine first the case where the axes of the two screws are at right angles and intersect. We take these as axes of x and y; then if ξ, η be the component rotations about them, we have

$$\lambda = h\xi,\ \mu = k\eta,\ \nu = 0, \tag{11}$$

where h, k, are the pitches of the two given screws. The equations (7) of the axis of the resultant screw then reduce to

$$x/\xi = y/\eta,\ z(\xi^2 + \eta^2) = (k - h)\xi\eta. \tag{12}$$

Hence, whatever the ratio $\xi : \eta$, the axis of the resultant screw lies on the conoidal surface

$$z(x^2 + y^2) = cxy \tag{13}$$

where $c = \frac{1}{2}(k - h)$. The co-ordinates of any point on (13) may be written

$$x = r\cos\theta,\quad y = r\sin\theta,\quad z = c\sin 2\theta; \tag{14}$$

hence if we imagine a curve of sines to be traced on a circular cylinder so that the circumference just includes two complete undulations, a straight line cutting the axis of the cylinder at right angles and meeting this curve will generate the surface. This is called a *cylindroid*. Again, the pitch of the resultant screw is

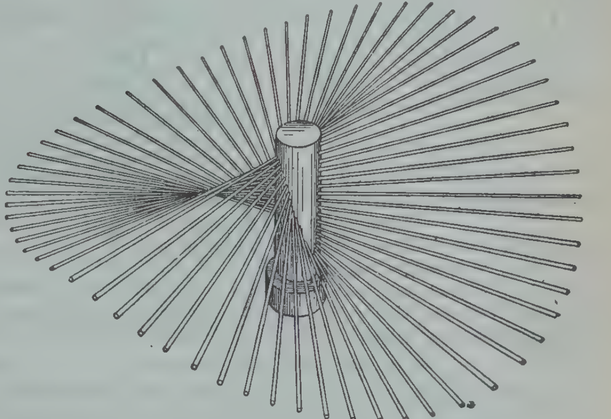
From Sir Robert S. Ball's *Theory of Screws*.

FIG. 41.

$$p = (\lambda\xi + \mu\eta)/(\xi^2 + \eta^2) = h\cos^2\theta + k\sin^2\theta. \tag{15}$$

The distribution of pitch among the various screws has therefore a simple relation to the *pitch-conic*

$$hx^2 + ky^2 = \text{const}; \tag{16}$$

viz. the pitch of any screw varies inversely as the square of that diameter of the conic which is parallel to its axis. It is to be noticed that the parameter c of the cylindroid is unaltered if the two pitches h, k be increased by equal amounts; the only change is that all the pitches are increased by the same amount. It remains to show that a system of screws of the above type can be constructed so as to contain any two given screws whatever. In the first place, a cylindroid can be constructed so as to have its axis coincident with the common perpendicular to the axes of the two given screws and to satisfy three other conditions, for the position of the centre, the parameter, and the orientation about the axis are still at our disposal. Hence we can adjust these so that the surface shall contain the axes of the two given screws as generators, and that the difference of the corresponding pitches shall have the proper value. It follows that when a body has two degrees of freedom it can twist about any one of a singly infinite system of screws whose axes lie on a certain cylindroid. In particular cases the cylindroid may degenerate into a plane, the pitches being then all equal.

§ 8. *Three-dimensional Statics.*—A system of parallel forces can be combined two and two until they are replaced by a single resultant equal to their sum, acting in a certain line. As special cases, the system may reduce to a couple, or it may be in equilibrium.

In general, however, a three-dimensional system of forces cannot be replaced by a single resultant force. But it may be reduced to simpler elements in a variety of ways. For example, it may be reduced to two forces in perpendicular skew lines. For consider any plane, and let each force, at its intersection with the plane, be resolved into two components, one (P) normal to the plane, the other (Q) in the plane. The assemblage of parallel forces P can be replaced in general by a single force, and the coplanar system of forces Q by another single force.

If the plane in question be chosen perpendicular to the direction of the vector-sum of the given forces, the vector-sum of the components Q is zero, and these components are therefore equivalent to a couple (§ 4). Hence any three-dimensional system can be reduced to a single force R acting in a certain line, together with a couple G in a plane perpendicular to the line. This theorem was first given by L. Poinsot, and the line of action of R was called by him the *central axis* of the system. The combination of a force and a couple in a perpendicular plane is termed by Sir R. S. Ball a *wrench*. Its type, as distinguished from its absolute magnitude, may be specified by a screw whose axis is the line of action of R, and whose pitch is the ratio G/R.

The case of two forces may be specially noticed. Let AB be the shortest distance between the lines of action, and let AA′, BB′ (fig. 42) represent the forces. Let α, β be the angles which AA′, BB′ make with the direction of the vector-sum, on opposite sides. Divide AB in O, so that

$$AA'.\cos\alpha.\ AO = BB'.\cos\beta.\ OB, \qquad (1)$$

and draw OC parallel to the vector-sum. Resolving AA′, BB′ each into two components parallel and perpendicular to OC, we see that the former components have a single resultant in OC, of amount

$$R = AA'\cos\alpha + BB'\cos\beta, \qquad (2)$$

whilst the latter components form a couple of moment

$$G = AA'.\ AB.\ \sin\alpha = BB'.\ AB.\ \sin\beta. \qquad (3)$$

Conversely it is seen that any wrench can be replaced in an infinite number of ways by two forces, and that the line of action of one of these may be chosen quite arbitrarily. Also, we find from (2) and (3) that

$$G.R = AA'.\ BB'.\ AB.\ \sin(\alpha+\beta). \qquad (4)$$

The right-hand expression is six times the volume of the tetrahedron of which the lines AA′, BB′ representing the forces are opposite edges; and we infer that, in whatever way the wrench be resolved into two forces, the volume of this tetrahedron is invariable.

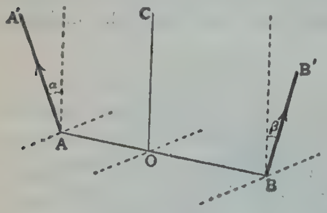

FIG. 42.

To define the *moment* of a force *about an axis* HK, we project the force orthogonally on a plane perpendicular to HK and take the moment of the projection about the intersection of HK with the plane (see § 4). Some convention as to sign is necessary; we shall reckon the moment to be positive when the tendency of the force is right-handed as regards the direction from H to K. Since two concurrent forces and their resultant obviously project into two concurrent forces and their resultant, we see that the sum of the moments of two concurrent forces about any axis HK is equal to the moment of their resultant. Parallel forces may be included in this statement as a limiting case. Hence, in whatever way one system of forces is by successive steps replaced by another, no change is made in the sum of the moments about any assigned axis. By means of this theorem we can show that the previous reduction of any system to a wrench is unique.

From the analogy of couples to translations which was pointed out in § 7, we may infer that a couple is sufficiently represented by a "free" (or non-localized) vector perpendicular to its plane. The length of the vector must be proportional to the moment of the couple, and its sense must be such that the sum of the moments of the two forces of the couple about it is positive. In particular, we infer that couples of the same moment in parallel planes are equivalent; and that couples in any two planes may be compounded by geometrical addition of the corresponding vectors. Independent statical proofs are of course easily given. Thus, let the plane of the paper be perpendicular to the planes of two couples, and therefore perpendicular to the line of intersection of these planes. By § 4, each couple can be replaced by two forces ± P (fig. 43) perpendicular to the plane of the paper, and so that one force of each couple is in the line of intersection (B); the arms (AB,BC) will then be proportional to the respective moments. The two forces at B will cancel, and we are left with a couple of moment P.AC in the plane AC. If we draw three vectors to represent these three couples, they will be perpendicular and proportional to the respective sides of the triangle ABC; hence the third vector is the geometric sum of the other two. Since, in this proof the magnitude of P is arbitrary, it follows incidentally that couples of the same moment in parallel planes, *e.g.* planes parallel to AC, are equivalent.

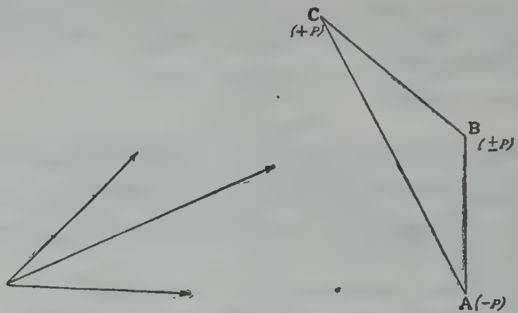

FIG. 43.

Hence a couple of moment G, whose axis has the direction (l, m, n) relative to a right-handed system of rectangular axes, is equivalent to three couples lG, mG, nG in the co-ordinate planes. The analytical reduction of a three-dimensional system can now be conducted as follows. Let (x_1, y_1, z_1) be the co-ordinates of a point P_1 on the line of action of one of the forces, whose components are (say) X_1, Y_1, Z_1. Draw P_1H normal to the plane zOx, and HK perpendicular to Oz. In KH introduce two equal and opposite forces $\pm X_1$. The force X_1 at P_1 with $-X_1$ in KH forms a couple about Oz, of moment $-y_1X_1$. Next, introduce along Ox two equal and opposite forces $\pm X_1$. The force X_1 in KH with $-X_1$ in Ox forms a couple about Oy, of moment z_1X_1. Hence the force X_1 can be transferred from P_1 to O, provided we introduce couples of moments z_1X_1 about Oy and $-y_1X_1$, about Oz. Dealing in the same way with the forces Y_1, Z_1 at P_1, we find that all three components of the force at P_1 can be transferred to O, provided we introduce three couples L_1, M_1, N_1 about Ox, Oy, Oz respectively, viz.

$$L_1 = y_1Z_1 - z_1Y_1, \quad M_1 = z_1X_1 - x_1Z_1, \quad N_1 = x_1Y_1 - y_1X_1. \qquad (5)$$

It is seen that L_1, M_1, N_1 are the moments of the original force at P_1 about the co-ordinate axes. Summing up for all the forces of the given system, we obtain a force R at O, whose components are

$$X = \Sigma(X_r), \quad Y = \Sigma(Y_r), \quad Z = \Sigma(Z_r), \qquad (6)$$

and a couple G whose components are

$$L = \Sigma(L_r), \quad M = \Sigma(M_r), \quad N = \Sigma(N_r), \qquad (7)$$

where $r = 1, 2, 3 \ldots$ Since $R^2 = X^2+Y^2+Z^2$, $G^2 = L^2+M^2+N^2$, it is necessary and sufficient for equilibrium that the six quantities X, Y, Z, L, M, N, should all vanish. In words: the sum of the projections of the forces on each of the co-ordinate axes must vanish; and, the sum of the moments of the forces about each of these axes must vanish.

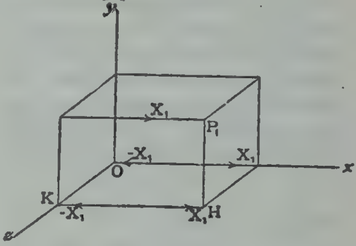

FIG. 44.

If any other point O′, whose co-ordinates are x, y, z, be chosen in place of O, as the point to which the forces are transferred, we have to write x_1-x, y_1-y, z_1-z for x_1, y_1, z_1, and so on, in the preceding process. The components of the resultant force R are unaltered, but the new components of couple are found to be

$$\left.\begin{aligned} L' &= L - yZ + zY, \\ M' &= M - zX + xZ, \\ N' &= N - xY + yX. \end{aligned}\right\} \qquad (8)$$

By properly choosing O′ we can make the plane of the couple perpendicular to the resultant force. The conditions for this are $L' : M' : N' = X : Y : Z$, or

$$\frac{L - yZ + zY}{X} = \frac{M - zX + xZ}{Y} = \frac{N - xY + yX}{Z}. \qquad (9)$$

These are the equations of the central axis. Since the moment of the resultant couple is now

$$G' = \frac{X}{R}L' + \frac{Y}{R}M' + \frac{Z}{R}N' = \frac{LX + MY + NZ}{R}, \qquad (10)$$

the pitch of the equivalent wrench is

$$(LX + MY + NZ)/(X^2 + Y^2 + Z^2).$$

It appears that $X^2+Y^2+Z^2$ and $LX+MY+NZ$ are absolute invariants (cf. § 7). When the latter invariant, but not the former, vanishes, the system reduces to a single force.

The analogy between the mathematical relations of infinitely small displacements on the one hand and those of force-systems on the other enables us immediately to convert any theorem in the one subject into a theorem in the other. For example, we can assert without further proof that any infinitely small displacement may be resolved into two rotations, and that the axis of one of these can be chosen arbitrarily. Again, that wrenches of arbitrary amounts about two given screws compound into a wrench the locus of whose axis is a cylindroid.

The mathematical properties of a twist or of a wrench have been the subject of many remarkable investigations, which are, however, of secondary importance from a physical point of view. In the "Null-System" of A. F. Möbius (1790–1868), a line such that the moment of a given wrench about it is zero is called a *null-line.* The triply infinite system of null-lines form what is called in line-geometry a "complex." As regards the configuration of this complex, consider a line whose shortest distance from the central axis is r, and whose inclination to the central axis is θ. The moment of the resultant force R of the wrench about this line is $-Rr\sin\theta$, and that of the couple G is $G\cos\theta$. Hence the line will be a null-line provided

$$\tan\theta = k/r, \qquad (11)$$

where k is the pitch of the wrench. The null-lines which are at a given distance r from a point O of the central axis will therefore form one system of generators of a hyperboloid of revolution; and by varying r we get a series of such hyperboloids with a common centre and axis. By moving O along the central axis we obtain the whole complex of null-lines. It appears also from (11) that the null-lines whose distance from the central axis is r are tangent lines to a system of helices of slope $\tan^{-1}(r/k)$; and it is to be noticed that these helices are left-handed if the given wrench is right-handed, and vice versa.

Since the given wrench can be replaced by a force acting through any assigned point P, and a couple, the locus of the null-lines through P is a plane, viz. a plane perpendicular to the vector which represents the couple. The complex is therefore of the type called "linear" (in relation to the degree of this locus). The plane in question is called the *null-plane* of P. If the null-plane of P pass through Q, the null-plane of Q will pass through P, since PQ is a null-line. Again, any plane ω is the locus of a system of null-lines meeting in a point, called the *null-point* of ω. If a plane revolve about a fixed straight line p in it, its null-point describes another straight line p', which is called the *conjugate line* of p. We have seen that the wrench may be replaced by two forces, one of which may act in any arbitrary line p. It is now evident that the second force must act in the conjugate line p', since every line meeting p, p' is a null-line. Again, since the shortest distance between any two conjugate lines cuts the central axis at right angles, the orthogonal projections of two conjugate lines on a plane perpendicular to the central axis will be parallel (fig. 42). This property was employed by L. Cremona to prove the existence under certain conditions of "reciprocal figures" in a plane (§ 5). If we take any polyhedron with plane faces, the null-planes of its vertices with respect to a given wrench will form another polyhedron, and the edges of the latter will be conjugate (in the above sense) to those of the former. Projecting orthogonally on a plane perpendicular to the central axis we obtain two reciprocal figures.

In the analogous theory of infinitely small displacements of a solid, a "null-line" is a line such that the lengthwise displacement of any point on it is zero.

Since a wrench is defined by six independent quantities, it can in general be replaced by any system of forces which involves six adjustable elements. For instance, it can in general be replaced by six forces acting in six given lines, *e.g.* in the six edges of a given tetrahedron. An exception to the general statement occurs when the six lines are such that they are possible lines of action of a system of six forces in equilibrium; they are then said to be *in involution.* The theory of forces in involution has been studied by A. Cayley, J. J. Sylvester and others. We have seen that a rigid structure may in general be rigidly connected with the earth by six links, and it now appears that any system of forces acting on the structure can in general be balanced by six determinate forces exerted by the links. If, however, the links are in involution, these forces become infinite or indeterminate. There is a corresponding kinematic peculiarity, in that the connexion is now not strictly rigid, an infinitely small relative displacement being possible. See § 9.

When parallel forces of given magnitudes act at given points, the resultant acts through a definite point, or *centre of parallel forces,* which is independent of the special direction of the forces. If P_r be the force at (x_r, y_r, z_r), acting in the direction (l, m, n), the formulae (6) and (7) reduce to

$$X = \Sigma(P).l,\ Y = \Sigma(P).m,\ Z = \Sigma(P).n, \qquad (12)$$

and

$$L = \Sigma(P).(n\bar{y} - m\bar{z}),\ M = \Sigma(P).(l\bar{z} - n\bar{x}),\ N = \Sigma(P).(m\bar{x} - l\bar{y}), \qquad (13)$$

provided
$$\bar{x} = \frac{\Sigma(Px)}{\Sigma(P)},\ \bar{y} = \frac{\Sigma(Py)}{\Sigma(P)},\ \bar{z} = \frac{\Sigma(Pz)}{\Sigma(P)}. \qquad (14)$$

These are the same as if we had a single force $\Sigma(P)$ acting at the point $(\bar{x}, \bar{y}, \bar{z})$, which is the same for all directions (l, m, n). We can hence derive the theory of the centre of gravity, as in § 4. An exceptional case occurs when $\Sigma(P) = 0$.

If we imagine a rigid body to be acted on at given points by forces of given magnitudes in directions (not all parallel) which are fixed in space, then as the body is turned about the resultant wrench will assume different configurations in the body, and will in certain positions reduce to a single force. The investigation of such questions forms the subject of "Astatics," which has been cultivated by Möbius, Minding, G. Darboux and others. As it has no physical bearing it is passed over here.

§ 9. *Work.*—The *work* done by a force acting on a particle, in any infinitely small displacement, is defined as the product of the force into the orthogonal projection of the displacement on the direction of the force; *i.e.* it is equal to $F.\delta s\cos\theta$, where F is the force, δs the displacement, and θ is the angle between the directions of F and δs. In the language of vector analysis (*q.v.*) it is the "scalar product" of the vector representing the force and the displacement. In the same way, the work done by a force acting on a rigid body in any infinitely small displacement of the body is the scalar product of the force into the displacement of any point on the line of action. This product is the same whatever point on the line of action be taken, since the lengthwise components of the displacements of any two points A, B on a line AB are equal, to the first order of small quantities. To see this, let A′, B′ be the displaced positions of A, B, and let ϕ be the infinitely small angle between AB and A′B′. Then if α, β be the orthogonal projections of A′, B′ on AB, we have

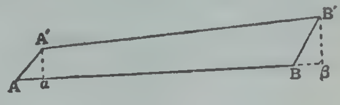

FIG. 45.

$$A\alpha - B\beta = AB - \alpha\beta = AB(1 - \cos\phi) = \tfrac{1}{2}AB.\phi^2,$$

ultimately. Since this is of the second order, the products $F.A\alpha$ and $F.B\beta$ are ultimately equal.

The total work done by two concurrent forces acting on a particle, or on a rigid body, in any infinitely small displacement, is equal to the work of their resultant. Let AB, AC (fig. 46) represent the forces, AD their resultant, and let AH be the direction of the displacement δs of the point A. The proposition follows at once from the fact that the sum of orthogonal projections of $\overrightarrow{AB}$, $\overrightarrow{AC}$ on AH is equal to the projection of $\overrightarrow{AD}$. It is to be noticed that AH need not be in the same plane with AB, AC.

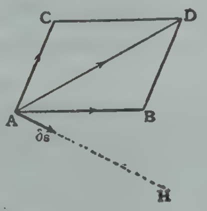

FIG. 46.

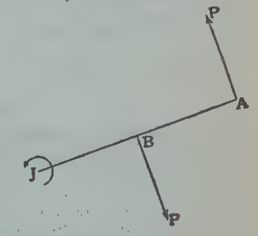

FIG. 47.

It follows from the preceding statements that any two systems of forces which are statically equivalent, according to the principles of §§ 4, 8, will (to the first order of small quantities) do the same amount of work in any infinitely small displacement of a rigid body to which they may be applied. It is also evident that the total work done in two or more successive infinitely small displacements is equal to the work done in the resultant displacement.

The work of a couple in any infinitely small rotation of a rigid body about an axis perpendicular to the plane of the couple is equal to the product of the moment of the couple into the angle of rotation, proper conventions as to sign being observed. Let the couple consist of two forces P, P (fig. 47) in the plane of the paper, and let J be the point where this plane is met by the axis of rotation. Draw JBA perpendicular to the lines of action, and let ϵ be the angle of rotation. The work of the couple is

$$\mathrm{P}.\,\mathrm{JA}.\,\epsilon-\mathrm{P}.\,\mathrm{JB}.\,\epsilon=\mathrm{P}.\,\mathrm{AB}.\,\epsilon=\mathrm{G}\epsilon,$$

if G be the moment of the couple.

The analytical calculation of the work done by a system of forces in any infinitesimal displacement is as follows. For a two-dimensional system we have, in the notation of §§ 3, 4,

$$\begin{aligned}\Sigma(\mathrm{X}\delta x+\mathrm{Y}\delta y)&=\Sigma\{\mathrm{X}(\lambda-y\epsilon)+\mathrm{Y}(\mu+x\epsilon)\}\\&=\Sigma(\mathrm{X}).\,\lambda+\Sigma(\mathrm{Y}).\,\mu+\Sigma(x\mathrm{Y}-y\mathrm{X})\epsilon\\&=\mathrm{X}\lambda+\mathrm{Y}\mu+\mathrm{N}\epsilon.\end{aligned}\tag{1}$$

Again, for a three-dimensional system, in the notation of §§ 7, 8,

$$\begin{aligned}&\Sigma(\mathrm{X}\delta x+\mathrm{Y}\delta y+\mathrm{Z}\delta z)\\&=\Sigma\{\mathrm{X}(\lambda+\eta z-\zeta y)+\mathrm{Y}(\mu+\zeta x-\xi x)+\mathrm{Z}(\nu+\xi y-\eta x)\}\\&=\Sigma(\mathrm{X}).\,\lambda+\Sigma(\mathrm{Y}).\,\mu+\Sigma(\mathrm{Z}).\,\nu+\Sigma(y\mathrm{Z}-z\mathrm{Y}).\,\xi+\Sigma(z\mathrm{X}-x\mathrm{Z}).\,\eta\\&\qquad+\Sigma(x\mathrm{Y}-y\mathrm{X}).\,\zeta\\&=\mathrm{X}\lambda+\mathrm{Y}\mu+\mathrm{Z}\nu+\mathrm{L}\xi+\mathrm{M}\eta+\mathrm{N}\zeta.\end{aligned}\tag{2}$$

This expression gives the work done by a given wrench when the body receives a given infinitely small twist; it must of course be an absolute invariant for all transformations of rectangular axes. The first three terms express the work done by the components of a force (X, Y, Z) acting at O, and the remaining three terms express the work of a couple (L, M, N).

The work done by a wrench about a given screw, when the body twists about a second given screw, may be calculated directly as follows. In fig. 48 let R, G be the force and couple of the wrench, ϵ,τ the rotation and translation in the twist. Let the axes of the wrench and the twist be inclined at an angle θ, and let h be the shortest distance between them. The displacement of the point H in the figure, resolved in the direction of R, is $\tau\cos\theta-\epsilon h\sin\theta$. The work is therefore

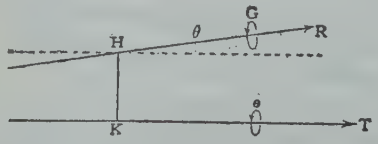

FIG. 48.

$$\begin{aligned}&\mathrm{R}(\tau\cos\theta-\epsilon h\sin\theta)+\mathrm{G}\cos\theta\\&=\mathrm{R}\epsilon\{(p+p')\cos\theta-h\sin\theta\},\end{aligned}\tag{3}$$

if $\mathrm{G}=p\mathrm{R}$, $\tau=p'\epsilon$, *i.e.* p, p' are the pitches of the two screws. The factor $(p+p')\cos\theta-h\sin\theta$ is called the *virtual coefficient* of the two screws which define the types of the wrench and twist, respectively.

A screw is determined by its axis and its pitch, and therefore involves five independent elements. These may be, for instance, the five ratios $\xi:\eta:\zeta:\lambda:\mu:\nu$ of the six quantities which specify an infinitesimal twist about the screw. If the twist is a pure rotation, these quantities are subject to the relation

$$\lambda\xi+\mu\eta+\nu\zeta=0.\tag{4}$$

In the analytical investigations of line geometry, these six quantities, supposed subject to the relation (4), are used to specify a line, and are called the six "co-ordinates" of the line; they are of course equivalent to only four independent quantities. If a line is a null-line with respect to the wrench (X, Y, Z, L, M, N), the work done in an infinitely small rotation about it is zero, and its co-ordinates are accordingly subject to the further relation

$$\mathrm{L}\xi+\mathrm{M}\eta+\mathrm{N}\zeta+\mathrm{X}\lambda+\mathrm{Y}\mu+\mathrm{Z}\nu=0,\tag{5}$$

where the coefficients are constant. This is the equation of a "linear complex" (cf. § 8).

Two screws are *reciprocal* when a wrench about one does no work on a body which twists about the other. The condition for this is

$$\lambda\xi'+\mu\eta'+\nu\zeta'+\lambda'\xi+\mu'\eta+\nu'\zeta=0,\tag{6}$$

if the screws be defined by the ratios $\xi:\eta:\zeta:\lambda:\mu:\nu$ and $\xi':\eta':\zeta':\lambda':\mu':\nu'$, respectively. The theory of the screw-systems which are reciprocal to one, two, three, four given screws respectively has been investigated by Sir R. S. Ball.

Considering a rigid body in any given position, we may contemplate the whole group of infinitesimal displacements which might be given to it. If the extraneous forces are in equilibrium the total work which they would perform in any such displacement would be zero, since they reduce to a zero force and a zero couple. This is (in part) the celebrated principle of *virtual velocities*, now often described as the principle of *virtual work*, enunciated by John Bernoulli (1667–1748). The word "virtual" is used because the displacements in question are not regarded as actually taking place, the body being in fact at rest. The "velocities" referred to are the velocities of the various points of the body in any imagined motion of the body through the position in question; they obviously bear to one another the same ratios as the corresponding infinitesimal displacements. Conversely, we can show that if the virtual work of the extraneous forces be zero for every infinitesimal displacement of the body as rigid, these forces must be in equilibrium. For by giving the body (in imagination) a displacement of translation we learn that the sum of the resolved parts of the forces in any assigned direction is zero, and by giving it a displacement of pure rotation we learn that the sum of the moments about any assigned axis is zero. The same thing follows of course from the analytical expression (2) for the virtual work. If this vanishes for all values of $\lambda,\mu,\nu,\xi,\eta,\zeta$ we must have $\mathrm{X},\mathrm{Y},\mathrm{Z},\mathrm{L},\mathrm{M},\mathrm{N}=0$, which are the conditions of equilibrium.

The principle can of course be extended to any system of particles or rigid bodies, connected together in any way, provided we take into account the internal stresses, or reactions, between the various parts. Each such reaction consists of two equal and opposite forces, both of which may contribute to the equation of virtual work.

The proper significance of the principle of virtual work, and of its converse, will appear more clearly when we come to kinetics (§ 16); for the present it may be regarded merely as a compact and (for many purposes) highly convenient summary of the laws of equilibrium. Its special value lies in this, that by a suitable adjustment of the hypothetical displacements we are often enabled to eliminate unknown reactions. For example, in the case of a particle lying on a smooth curve, or on a smooth surface, if it be displaced along the curve, or on the surface, the virtual work of the normal component of the pressure may be ignored, since it is of the second order. Again, if two bodies are connected by a string or rod, and if the hypothetical displacements be adjusted so that the distance between the points of attachment is unaltered, the corresponding stress may be ignored. This is evident from fig. 45; if AB, A′B′ represent the two positions of a string, and T be the tension, the virtual work of the two forces ± T at A,B is $\mathrm{T}(\mathrm{A}\alpha-\mathrm{B}\beta)$, which was shown to be of the second order. Again, the normal pressure between two surfaces disappears from the equation, provided the displacements be such that one of these surfaces merely slides relatively to the other. It is evident, in the first place, that in any displacement common to the two surfaces, the work of the two equal and opposite normal pressures will cancel; moreover if, one of the surfaces being fixed, an infinitely small displacement shifts the point of contact from A to B, and if A′ be the new position of that point of the sliding body which was at A, the projection of AA′ on the normal at A is of the second order. It is to be noticed, in this case, that the tangential reaction (if any) between the two surfaces is not eliminated. Again, if the displacements be such that one curved surface rolls without sliding on another, the reaction, whether normal or tangential, at the point of contact may be ignored. For the virtual work of two equal and opposite forces will cancel in any displacement which is common to the two surfaces; whilst, if one surface be fixed, the displacement of that point of the rolling surface which was in contact with the other is of the second order. We are thus able to imagine a great variety of mechanical systems to which the principle of virtual work can be applied without any regard to the internal stresses, provided the hypothetical displacements be such that none of the connexions of the system are violated.

If the system be subject to gravity, the corresponding part of the virtual work can be calculated from the displacement of the centre of gravity. If W_1, W_2, . . . be the weights of a system of particles, whose depths below a fixed horizontal plane of reference are z_1, z_2, . . . , respectively, the virtual work of gravity is

$$\begin{aligned} W_1\delta z_1 + W_2\delta z_2 + \dots &= \delta(W_1 z_1 + W_2 z_2 + \dots) \\ &= (W_1 + W_2 + \dots)\delta\bar{z}, \end{aligned} \tag{7}$$

where $\bar{z}$ is the depth of the centre of gravity (see § 8 (14) and § 11 (6)). This expression is the same as if the whole mass were concentrated at the centre of gravity, and displaced with this point. An important conclusion is that in any displacement of a system of bodies in equilibrium, such that the virtual work of all forces except gravity may be ignored, the depth of the centre of gravity is "stationary."

The question as to stability of equilibrium belongs essentially to kinetics; but we may state by anticipation that in cases where gravity is the only force which does work, the equilibrium of a body or system of bodies is stable only if the depth of the centre of gravity be a maximum.

Consider, for instance, the case of a bar resting with its ends on two smooth inclines (fig. 18). If the bar be displaced in a vertical plane so that its ends slide on the two inclines, the instantaneous centre is at the point J. The displacement of G is at right angles to JG; this shows that for equilibrium JG must be vertical. Again, the locus of G is an arc of an ellipse whose centre is in the intersection of the planes; since this arc is convex upwards the equilibrium is unstable. A general criterion for the case of a rigid body movable in two dimensions, with one degree of freedom, can be obtained as follows. We have seen (§ 3) that the sequence of possible positions is obtained if we imagine the "body-centrode" to roll on the "space-centrode." For equilibrium, the altitude of the centre of gravity G must be stationary; hence G must lie in the same vertical line with the point of contact J of the two curves. Further, it is known from the theory of "roulettes" that the locus of G will be concave or convex upwards according as

$$\frac{\cos\phi}{h} = \frac{1}{\rho} + \frac{1}{\rho'}, \tag{8}$$

where ρ, ρ' are the radii of curvature of the two curves at J, ϕ is the inclination of the common tangent at J to the horizontal, and h is the height of G above J. The signs of ρ, ρ' are to be taken positive when the curvatures are as in the standard case shown in fig. 49. Hence for stability the upper sign must obtain in (8). The same criterion may be arrived at in a more intuitive manner as follows. If the body be supposed to roll (say to the right) until the curves touch at J′, and if $JJ' = \delta s$, the angle through which the upper figure rotates is $\delta s/\rho + \delta s/\rho'$, and the horizontal displacement of G is equal to the product of this expression into h. If this displacement be less than the horizontal projection of JJ′, viz. $\delta s \cos\phi$, the vertical through the new position of G will fall to the left of J′ and gravity will tend to restore the body to its former position. It is here assumed that the remaining forces acting on the body in its displaced position have zero moment about J′; this is evidently the case, for instance, in the problem of "rocking stones."

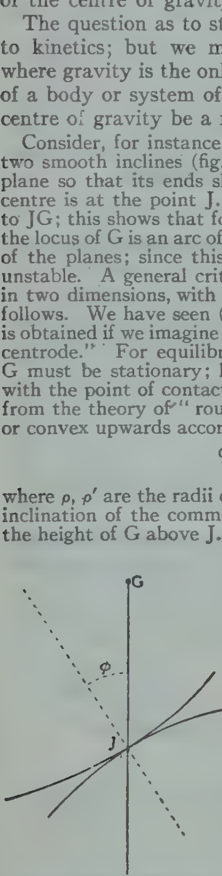

FIG. 49.

The principle of virtual work is specially convenient in the theory of frames (§ 6), since the reactions at smooth joints and the stresses in inextensible bars may be left out of account. In particular, in the case of a frame which is just rigid, the principle enables us to find the stress in any one bar independently of the rest. If we imagine the bar in question to be removed, equilibrium will still persist if we introduce two equal and opposite forces S, of suitable magnitude, at the joints which it connected. In any infinitely small deformation of the frame as thus modified, the virtual work of the forces S, together with that of the original extraneous forces, must vanish; this determines S.

As a simple example, take the case of a light frame, whose bars form the slides of a rhombus ABCD with the diagonal BD, suspended from A and carrying a weight W at C; and let it be required to find the stress in BD. If we remove the bar BD, and apply two equal and opposite forces S at B and D, the equation is

$$W . \delta(2l\cos\theta) + 2\,S . \delta(l\sin\theta) = 0,$$

where l is the length of a side of the rhombus, and θ its inclination to the vertical. Hence

$$S = W\tan\theta = W . BD/AC. \tag{8}$$

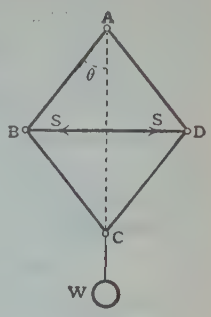

FIG. 50.

The method is specially appropriate when the frame, although just rigid, is not "simple" in the sense of § 6, and when accordingly the method of reciprocal figures is not immediately available. To avoid the intricate trigonometrical calculations which would often be necessary, graphical devices have been introduced by H. Müller-Breslau and others. For this purpose the infinitesimal displacements of the various joints are replaced by finite lengths proportional to them, and therefore proportional to the velocities of the joints in some imagined motion of the deformable frame through its actual configuration; this is really (it may be remarked) a reversion to the original notion of "virtual velocities." Let J be the instantaneous centre for any bar CD (fig. 12), and let s_1, s_2, represent the virtual velocities of C, D. If these lines be turned through a right angle in the same sense, they take up positions such as CC′, DD′, where C′, D′ are on JC, JD, respectively, and C′D′ is parallel to CD. Further, if F_1 (fig. 51) be any force acting on the joint C, its virtual work will be equal to the moment of F_1 about C′; the equation of virtual work is thus transformed into an equation of moments.

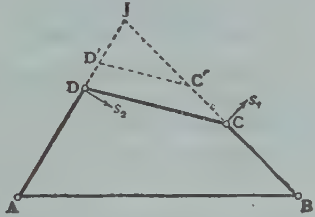

FIG. 12.

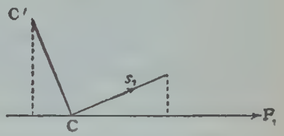

FIG. 51.

Consider, for example, a frame whose sides form the six sides of a hexagon ABCDEF and the three diagonals AD, BE, CF; and suppose that it is required to find the stress in CF due to a given system of extraneous forces in equilibrium, acting on the joints. Imagine the bar CF to be removed, and consider a deformation in which AB is fixed. The instantaneous centre of CD will be at the intersection of AD, BC, and if C′D′ be drawn parallel to CD, the lines CC′, DD′ may be taken to represent the virtual velocities of C, D turned each through a right angle. Moreover, if we draw D′E′ parallel to DE, and E′F′ parallel to EF, the lines CC′, DD′, EE′, FF′ will represent on the same scale the virtual velocities of the points C, D, E, F, respectively, turned each through a right angle. The equation of virtual work is then formed by taking moments about C′, D′, E′, F′ of the extraneous forces which act at C, D, E, F, respectively. Amongst these forces we must include the two equal and opposite forces S which take the place of the stress in the removed bar FC.

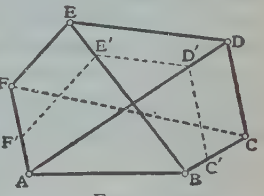

FIG. 52.

The above method lends itself naturally to the investigation of the *critical forms* of a frame whose general structure is given. We have seen that the stresses produced by an equilibrating system of extraneous forces in a frame which is just rigid, according to the criterion of § 6, are in general uniquely determinate; in particular, when there are no extraneous forces the bars are in general free from stress. It may however happen that owing to some special relation between the lengths of the bars the frame admits of an infinitesimal deformation. The simplest case is that of a frame of three bars, when the three joints A, B, C fall into a straight line; a small displacement of the joint B at right angles to AC would involve changes in the lengths of AB, BC which are only of the second order of small quantities. Another example is shown in fig. 53. The graphical method leads at once to the detection of such cases. Thus in the hexagonal frame of fig. 52, if an infinitesimal deformation is possible without removing the bar CF, the instantaneous centre of CF (when AB is fixed) will be at the intersection of AF and BC, and since CC′, FF′ represent the virtual velocities of the points C, F, turned each through a right angle, C′F′ must be parallel to CF. Conversely, if this condition be satisfied, an infinitesimal deformation is possible. The result may be generalized into the statement that a frame has a critical form whenever a frame of the same structure can be designed with corresponding bars parallel, but without complete geometric similarity. In the case of fig. 52 it may be shown that an equivalent condition is that the six points A, B, C, D, E, F should lie on a conic (M. W. Crofton). This is fulfilled when the opposite sides of the hexagon are parallel, and (as a still more special case) when the hexagon is regular.

When a frame has a critical form it may be in a state of stress independently of the action of extraneous forces; moreover, the stresses due to extraneous forces are indeterminate, and may be infinite. For suppose as before that one of the bars is removed. If there are no extraneous forces the equation of virtual work reduces to S . $\delta s = 0$, where S is the stress in the removed bar, and δs is the change in the distance between the joints which it connected. In a critical form we have $\delta s = 0$, and the equation is satisfied by an arbitrary value of S; a consistent system of stresses in the remaining bars can then be found by preceding rules. Again, when extraneous forces P act on the joints, the equation is

$$\Sigma(\mathrm{P}\,.\,\delta p)+\mathrm{S}\,.\,\delta s=0,$$

where δp is the displacement of any joint in the direction of the corresponding force P. If $\Sigma(\mathrm{P}\,.\,\delta p)=0$, the stresses are merely indeterminate as before; but if $\Sigma(\mathrm{P}\,.\,\delta p)$ does not vanish, the equation cannot be satisfied by any finite value of S, since $\delta s = 0$. This means that, if the material of the frame were absolutely unyielding, no finite stresses in the bars would enable it to withstand the extraneous forces. With actual materials, the frame would yield elastically, until its configuration is no longer "critical." The stresses in the bars would then be comparatively very great, although finite. The use of frames which approximate to a critical form is of course to be avoided in practice.

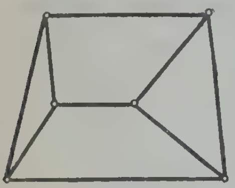

FIG. 53.

A brief reference must suffice to the theory of three dimensional frames. This is important from a technical point of view, since all structures are practically three-dimensional. We may note that a frame of n joints which is just rigid must have $3n-6$ bars; and that the stresses produced in such a frame by a given system of extraneous forces in equilibrium are statically determinate, subject to the exception of "critical forms."

§ 10. *Statics of Inextensible Chains.*—The theory of bodies or structures which are deformable in their smallest parts belongs properly to elasticity (*q.v.*). The case of inextensible strings or chains is, however, so simple that it is generally included in expositions of pure statics.

It is assumed that the form can be sufficiently represented by a plane curve, that the stress (tension) at any point P of the curve, between the two portions which meet there, is in the direction of the tangent at P, and that the forces on any linear element δs must satisfy the conditions of equilibrium laid down in § 1. It follows that the forces on any finite portion will satisfy the conditions of equilibrium which apply to the case of a rigid body (§ 4).

We will suppose in the first instance that the curve is plane. It is often convenient to resolve the forces on an element PQ ($=\delta s$) in the directions of the tangent and normal respectively. If T, T + δT be the tensions at P, Q, and $\delta\psi$ be the angle between the directions of the curve at these points, the components of the tensions along the tangent at P give $(\mathrm{T}+\delta\mathrm{T})\cos\psi-\mathrm{T}$, or δT, ultimately; whilst for the component along the normal at P we have $(\mathrm{T}+\delta\mathrm{T})\sin\delta\psi$, or $\mathrm{T}\delta\psi$, or $\mathrm{T}\delta s/\rho$, where ρ is the radius of curvature.

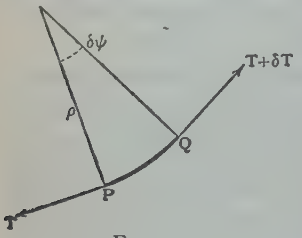

FIG. 54.

Suppose, for example, that we have a light string stretched over a smooth curve; and let Rδs denote the normal pressure (outwards from the centre of curvature) on δs. The two resolutions give $\delta\mathrm{T}=0$, $\mathrm{T}\delta\psi=\mathrm{R}\delta s$, or

$$\mathrm{T}=\text{const.},\ \mathrm{R}=\mathrm{T}/\rho. \tag{1}$$

The tension is constant, and the pressure per unit length varies as the curvature.

Next suppose that the curve is "rough"; and let Fδs be the tangential force of friction on δs. We have $\delta\mathrm{T}\pm\mathrm{F}\delta s=0$, $\mathrm{T}\delta\psi=\mathrm{R}\delta s$, where the upper or lower sign is to be taken according to the sense in which F acts. We assume that in limiting equilibrium we have $\mathrm{F}=\mu\mathrm{R}$, everywhere, where μ is the coefficient of friction. If the string be on the point of slipping in the direction in which ψ increases, the lower sign is to be taken; hence $\delta\mathrm{T}=\mathrm{F}\delta s=\mu\mathrm{T}\delta\psi$, whence

$$\mathrm{T}=\mathrm{T}_0e^{\mu\psi}, \tag{2}$$

if T_0 be the tension corresponding to $\psi=0$. This illustrates the resistance to dragging of a rope coiled round a post; *e.g.* if we put $\mu=\cdot 3$, $\psi=2\pi$, we find for the change of tension in one turn $\mathrm{T}/\mathrm{T}_0=6\cdot 5$. In two turns this ratio is squared, and so on.

Again, take the case of a string under gravity, in contact with a smooth curve in a vertical plane. Let ψ denote the inclination to the horizontal, and $w\delta s$ the weight of an element δs. The tangential and normal components of $w\delta s$ are $-w\delta s\sin\psi$ and $-w\delta s\cos\psi$. Hence

$$\delta\mathrm{T}=w\delta s\sin\psi,\ \mathrm{T}\delta\psi=w\delta s\cos\psi+\mathrm{R}\delta s. \tag{3}$$

If we take rectangular axes Ox, Oy, of which Oy is drawn vertically upwards, we have $\delta y=\sin\psi\,\delta s$, whence $\delta\mathrm{T}=w\delta y$. If the string be uniform, w is constant, and

$$\mathrm{T}=wy+\text{const.}=w(y-y_0), \tag{4}$$

say; hence the tension varies as the height above some fixed level (y_0). The pressure is then given by the formula

$$\mathrm{R}=\mathrm{T}\frac{d\psi}{ds}-w\cos\psi. \tag{5}$$

In the case of a chain hanging freely under gravity it is usually convenient to formulate the conditions of equilibrium of a finite portion PQ. The forces on this reduce to three, viz. the weight of PQ and the tensions at P, Q. Hence these three forces will be concurrent, and their ratios will be given by a triangle of forces. In particular, if we consider a length AP beginning at the lowest point A, then resolving horizontally and vertically we have

$$\mathrm{T}\cos\psi=\mathrm{T}_0,\ \mathrm{T}\sin\psi=\mathrm{W}, \tag{6}$$

where T_0 is the tension at A, and W is the weight of PA. The former equation expresses that the horizontal tension is constant.

If the chain be uniform we have $\mathrm{W}=ws$, where s is the arc AP: hence $ws=\mathrm{T}_0\tan\psi$. If we write $\mathrm{T}_0=wa$, so that a is the length of a portion of the chain whose weight would equal the horizontal tension, this becomes

$$s=a\tan\psi. \tag{7}$$

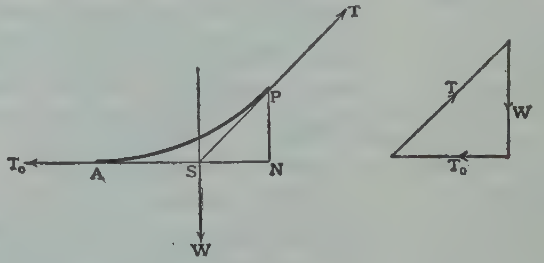

FIG. 55.

This is the "intrinsic" equation of the curve. If the axes of x and y be taken horizontal and vertical (upwards), we derive

$$x=a\log(\sec\psi+\tan\psi),\ y=a\sec\psi. \tag{8}$$

Eliminating ψ we obtain the Cartesian equation

$$y=a\cosh\frac{x}{a} \tag{9}$$

of the *common catenary*, as it is called (fig. 56). The omission of the additive arbitrary constants of integration in (8) is equivalent to a special choice of the origin O of co-ordinates; viz. O is at a distance a vertically below the lowest point ($\psi=0$) of the curve. The horizontal line through O is called the *directrix*. The relations

$$s=a\sinh\frac{x}{a},\ y^2=a^2+s^2,\ \mathrm{T}=\mathrm{T}_0\sec\psi=wy, \tag{10}$$

which are involved in the preceding formulae are also noteworthy. It is a classical problem in the calculus of variations to deduce the equation (9) from the condition that the depth of the centre of gravity of a chain of given length hanging between fixed points must be stationary (§ 9). The length a is called the *parameter* of the catenary; it determines the scale of the curve, all catenaries being geometrically similar. If weights be suspended from various points of a hanging chain, the intervening portions will form arcs of equal catenaries, since the horizontal tension (wa) is the same for all. Again, if a chain pass over a perfectly smooth peg, the catenaries in which it hangs on the two sides, though usually of different parameters, will have the same directrix, since by (10) y is the same for both at the peg.

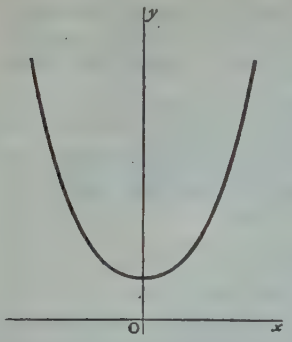

FIG. 56.

As an example of the use of the formulae we may determine the maximum span for a wire of given material. The condition is that the tension must not exceed the weight of a certain length λ of the wire. At the ends we shall have $y=\lambda$, or

$$\lambda=a\cosh\frac{x}{a}, \tag{11}$$

and the problem is to make x a maximum for variations of a. Differentiating (11) we find that, if $dx/da=0$,

$$\frac{x}{a}\tanh\frac{x}{a}=1. \tag{12}$$

It is easily seen graphically, or from a table of hyperbolic tangents, that the equation $u\tanh u=1$ has only one positive root ($u=1{\cdot}200$); the span is therefore

$$2x=2au=2\lambda/\sinh u=1{\cdot}326\,\lambda,$$

and the length of wire is

$$2s=2\lambda/u=1{\cdot}667\,\lambda.$$

The tangents at the ends meet on the directrix, and their inclination to the horizontal is 56° 30′.

The relation between the sag, the tension, and the span of a wire (*e.g.* a telegraph wire) stretched nearly straight between two points A, B at the same level is determined most simply from first principles. If T be the tension, W the total weight, k the sag in the middle, and ψ the inclination to the horizontal at A or B, we have $2T\psi=W$, $AB=2\rho\psi$, approximately, where ρ is the radius of curvature. Since $2k\rho=(\frac{1}{2}AB)^2$, ultimately, we have

$$k=\tfrac{1}{8}W\,.\,AB/T. \tag{13}$$

The same formula applies if A, B be at different levels, provided k be the sag, measured vertically, half way between A and B.

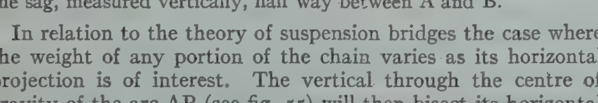

FIG. 57.

In relation to the theory of suspension bridges the case where the weight of any portion of the chain varies as its horizontal projection is of interest. The vertical through the centre of gravity of the arc AP (see fig. 55) will then bisect its horizontal projection AN; hence if PS be the tangent at P we shall have AS = SN. This property is characteristic of a parabola whose axis is vertical. If we take A as origin and AN as axis of x, the weight of AP may be denoted by wx, where w is the weight per unit length at A. Since PNS is a triangle of forces for the portion AP of the chain, we have $wx/T_0=PN/NS$, or

$$y=w\,.\,x^2/2T_0, \tag{14}$$

which is the equation of the parabola in question. The result might of course have been inferred from the theory of the parabolic funicular in § 2.

Finally, we may refer to the *catenary of uniform strength*, where the cross-section of the wire (or cable) is supposed to vary as the tension. Hence w, the weight per foot, varies as T, and we may write $T=w\lambda$, where λ is a constant length. Resolving along the normal the forces on an element δs, we find $T\delta\psi=w\delta s\cos\psi$, whence

$$\rho=\frac{ds}{d\psi}=\lambda\sec\psi. \tag{15}$$

From this we derive

$$x=\lambda\psi,\ y=\lambda\log\sec\frac{x}{\lambda}, \tag{16}$$

where the directions of x and y are horizontal and vertical, and the origin is taken at the lowest point. The curve (fig. 58) has two vertical asymptotes $x=\pm\frac{1}{2}\pi\lambda$; this shows that however the thickness of a cable be adjusted there is a limit $\pi\lambda$ to the horizontal span, where λ depends on the tensile strength of the material. For a uniform catenary the limit was found above to be $1{\cdot}326\lambda$.

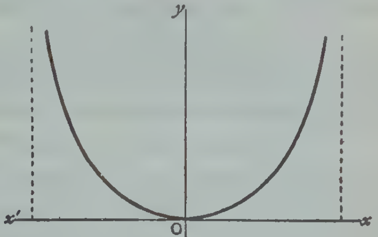

FIG. 58.

For investigations relating to the equilibrium of a string in three dimensions we must refer to the textbooks. In the case of a string stretched over a smooth surface, but in other respects free from extraneous force, the tensions at the ends of a small element δs must be balanced by the normal reaction of the surface. It follows that the osculating plane of the curve formed by the string must contain the normal to the surface, *i.e.* the curve must be a "geodesic," and that the normal pressure per unit length must vary as the principal curvature of the curve.

§ 11. *Theory of Mass-Systems.*—This is a purely geometrical subject. We consider a system of points $P_1, P_2 \ldots, P_n$, with which are associated certain co-efficients $m_1, m_2, \ldots m_n$, respectively. In the application to mechanics these coefficients are the masses of particles situate at the respective points, and are therefore all positive. We shall make this supposition in what follows, but it should be remarked that hardly any difference is made in the theory if some of the coefficients have a different sign from the rest, except in the special case where $\Sigma(m)=0$. This has a certain interest in magnetism.

In a given mass-system there exists one and only one point G such that

$$\Sigma(m\,.\overrightarrow{GP})=0. \tag{1}$$

For, take any point O, and construct the vector

$$\overrightarrow{OG}=\frac{\Sigma(m\,.\overrightarrow{OP})}{\Sigma(m)}. \tag{2}$$

Then

$$\Sigma(m\,.\overrightarrow{GP})=\Sigma\{m(\overrightarrow{GO}+\overrightarrow{OP})\}=\Sigma(m)\,.\overrightarrow{GO}+\Sigma(m)\,.\overrightarrow{OP}=0. \tag{3}$$

Also there cannot be a distinct point G′ such that $\Sigma(m.\,G'P)=0$, for we should have, by subtraction,

$$\Sigma\{m(\overrightarrow{GP}+\overrightarrow{PG'})\}=0,\ \text{or}\ \Sigma(m)\,.GG'=0; \tag{4}$$

i.e. G′ must coincide with G. The point G determined by (1) is called the *mass-centre* or *centre of inertia* of the given system. It is easily seen that, in the process of determining the mass-centre, any group of particles may be replaced by a single particle whose mass is equal to that of the group, situate at the mass-centre of the group.

If through $P_1, P_2, \ldots P_n$ we draw any system of parallel planes meeting a straight line OX in the points $M_1, M_2, \ldots M_n$, the collinear vectors $\overrightarrow{OM_1}, \overrightarrow{OM_2} \ldots \overrightarrow{OM_n}$ may be called the "projections" of $\overrightarrow{OP_1}, \overrightarrow{OP_2}, \ldots \overrightarrow{OP_n}$ on OX. Let these projections be denoted algebraically by $x_1, x_2, \ldots x_n$, the sign being positive or negative according as the direction is that of OX or the reverse. Since the projection of a vector-sum is the sum of the projections of the several vectors, the equation (2) gives

$$\bar{x}=\frac{\Sigma(mx)}{\Sigma(m)}, \tag{5}$$

if $\bar{x}$ be the projection of $\overrightarrow{OG}$. Hence if the Cartesian co-ordinates of $P_1, P_2, \ldots P_n$ relative to any axes, rectangular or oblique be $(x_1, y_1, z_1), (x_2, y_2, z_2), \ldots, (x_n, y_n, z_n)$, the mass-centre $(\bar{x}, \bar{y}, z)$ is determined by the formulae

$$\bar{x}=\frac{\Sigma(mx)}{\Sigma(m)},\ \bar{y}=\frac{\Sigma(my)}{\Sigma(m)},\ \bar{z}=\frac{\Sigma(mz)}{\Sigma(m)}. \tag{6}$$

If we write $x=\bar{x}+\xi$, $y=\bar{y}+\eta$, $z=\bar{z}+\zeta$, so that ξ, η, ζ denote co-ordinates relative to the mass-centre G, we have from (6)

$$\Sigma(m\xi)=0, \quad \Sigma(m\eta)=0, \quad \Sigma(m\zeta)=0. \tag{7}$$

One or two special cases may be noticed. If three masses α, β, γ be situate at the vertices of a triangle ABC, the mass-centre of β and γ is at a point A′ in BC, such that $\beta . BA'=\gamma . A'C$. The mass-centre (G) of α, β, γ will then divide AA′ so that $\alpha . AG=(\beta+\gamma)\ GA'$. It is easily proved that

$$\alpha : \beta : \gamma=\Delta BGA : \Delta GCA : \Delta GAB;$$

also, by giving suitable values (positive or negative) to the ratios $\alpha : \beta : \gamma$ we can make G assume any assigned position in the plane ABC. We have here the origin of the "barycentric co-ordinates" of Möbius, now usually known as "areal" co-ordinates. If $\alpha+\beta+\gamma=0$, G is at infinity; if $\alpha=\beta=\gamma$, G is at the intersection of the median lines of the triangle; if $\alpha : \beta : \gamma=a : b : c$, G is at the centre of the inscribed circle. Again, if G be the mass-centre of four particles $\alpha, \beta, \gamma, \delta$ situate at the vertices of a tetrahedron ABCD, we find

$$\alpha : \beta : \gamma : \delta=\text{tet}^{\text{n}}\ GBCD : \text{tet}^{\text{n}}\ GCDA : \text{tet}^{\text{n}}\ GDAB : \text{tet}^{\text{n}}\ GABC,$$

and by suitable determination of the ratios on the left hand we can make G assume any assigned position in space. If $\alpha+\beta+\gamma+\delta=0$, G is at infinity; if $\alpha=\beta=\gamma=\delta$, G bisects the lines joining the middle points of opposite edges of the tetrahedron ABCD; if $\alpha : \beta : \gamma : \delta=\Delta BCD : \Delta CDA : \Delta DAB : \Delta ABC$, G is at the centre of the inscribed sphere.

If we have a continuous distribution of matter, instead of a system of discrete particles, the summations in (6) are to be replaced by integrations. Examples will be found in textbooks of the calculus and of analytical statics. As particular cases: the mass-centre of a uniform thin triangular plate coincides with that of three equal particles at the corners; and that of a uniform solid tetrahedron coincides with that of four equal particles at the vertices. Again, the mass-centre of a uniform solid right circular cone divides the axis in the ratio 3 : 1; that of a uniform solid hemisphere divides the axial radius in the ratio 3 : 5.

It is easily seen from (6) that if the configuration of a system of particles be altered by "homogeneous strain" (see ELASTICITY) the new position of the mass-centre will be at that point of the strained figure which corresponds to the original mass-centre.

The formula (2) shows that a system of concurrent forces represented by $m_1 . \overrightarrow{OP_1}, m_2 . \overrightarrow{OP_2}, \ldots m_n . \overrightarrow{OP_n}$ will have a resultant represented by $\Sigma(m).\overrightarrow{OG}$. If we imagine O to recede to infinity in any direction we learn that a system of parallel forces proportional to $m_1, m_2, \ldots m_n$, acting at $P_1, P_2 \ldots P_n$ have a resultant proportional to $\Sigma(m)$ which acts always through a point G fixed relatively to the given mass-system. This contains the theory of the "centre of gravity" (§§ 4, 9). We may note also that if $P_1, P_2, \ldots P_n$, and $P_1', P_2', \ldots P_n'$ represent two configurations of the series of particles, then

$$\Sigma(m . \overrightarrow{PP'})=\Sigma(m).\overrightarrow{GG'}, \tag{8}$$

where G,G′ are the two positions of the mass-centre. The forces $m_1.\overrightarrow{P_1P_1'}, m_2.\overrightarrow{P_2P_2'}, \ldots m_n.\overrightarrow{P_nP_n'}$, considered as localized vectors, do not, however, as a rule reduce to a single resultant.

We proceed to the theory of the *plane*, *axial* and *polar quadratic moments* of the system. The axial moments have alone a dynamical significance, but the others are useful as subsidiary conceptions. If $h_1, h_2, \ldots h_n$ be the perpendicular distances of the particles from any fixed plane, the sum $\Sigma(mh^2)$ is the quadratic moment with respect to the plane. If $p_1, p_2, \ldots p_n$ be the perpendicular distances from any given axis, the sum $\Sigma(mp^2)$ is the quadratic moment with respect to the axis; it is also called the *moment of inertia* about the axis. If $r_1, r_2, \ldots r_n$ be the distances from a fixed point, the sum $\Sigma(mr^2)$ is the quadratic moment with respect to that point (or pole). If we divide any of the above quadratic moments by the total mass $\Sigma(m)$, the result is called the *mean square* of the distances of the particles from the respective plane, axis or pole. In the case of an axial moment, the square root of the resulting mean square is called the *radius of gyration* of the system about the axis in question. If we take rectangular axes through any point O, the quadratic moments with respect to the co-ordinate planes are

$$I_x=\Sigma(mx^2), \quad I_y=\Sigma(my^2), \quad I_z=\Sigma(mz^2); \tag{9}$$

those with respect to the co-ordinate axes are

$$I_{yz}=\Sigma\{m(y^2+z^2)\}, \quad I_{zx}=\Sigma\{m(z^2+x^2)\}, \quad I_{xy}=\Sigma\{m(x^2+y^2)\}; \tag{10}$$

whilst the polar quadratic moment with respect to O is

$$I_o=\Sigma\{m(x^2+y^2+z^2)\}. \tag{11}$$

We note that

$$I_{yz}=I_y+I_z, \quad I_{zx}=I_z+I_x, \quad I_{xy}=I_x+I_y, \tag{12}$$

and

$$I_o=I_x+I_y+I_z=\tfrac{1}{2}(I_{yz}+I_{zx}+I_{xy}). \tag{13}$$

In the case of continuous distributions of matter the summations in (9), (10), (11) are of course to be replaced by integrations. For a uniform thin circular plate, we find, taking the origin at its centre, and the axis of z normal to its plane, $I_o=\frac{1}{2}Ma^2$, where M is the mass and a the radius. Since $I_x=I_y$, $I_z=0$, we deduce $I_{zx}=\frac{1}{4}Ma^2$, $I_{xy}=\frac{1}{2}Ma^2$; hence the value of the squared radius of gyration is for a diameter $\frac{1}{4}a^2$, and for the axis of symmetry $\frac{1}{2}a^2$. Again, for a uniform solid sphere having its centre at the origin we find $I_o=\frac{3}{5}Ma^2$, $I_x=I_y=I_z=\frac{1}{5}Ma^2$, $I_{yz}=I_{zx}=I_{xy}=\frac{2}{5}Ma^2$; i. e. the square of the radius of gyration with respect to a diameter is $\frac{2}{5}a^2$. The method of homogeneous strain can be applied to deduce the corresponding results for an ellipsoid of semi-axes a, b, c. If the co-ordinate axes coincide with the principal axes, we find $I_x=\frac{1}{5}Ma^2$, $I_y=\frac{1}{5}Mb^2$, $I_z=\frac{1}{5}Mc^2$, whence $I_{yz}=\frac{1}{5}M(b^2+c^2)$, &c.

If $\phi(x, y, z)$ be any homogeneous quadratic function of x, y, z, we have

$$\begin{aligned}\Sigma\{m\phi(x, y, z)\}&=\Sigma\}m\phi(\bar{x}+\xi, \bar{y}+\eta, \bar{z}+\zeta)\}\\&=\Sigma\{m\phi(\bar{x}, y, z)\}+\Sigma\{m\phi(\xi, \eta, \zeta)\},\end{aligned} \tag{14}$$

since the terms which are bilinear in respect to $\bar{x}, \bar{y}, \bar{z}$, and ξ, η, ζ vanish, in virtue of the relations (7). Thus

$$I_x=I\xi+\Sigma(m)x^2, \tag{15}$$

$$I_{yz}=I\eta\zeta+\Sigma(m).(\bar{y}^2+\bar{z}^2), \tag{16}$$

with similar relations, and

$$I_O=I_G+\Sigma(m).\ OG^2. \tag{17}$$

The formula (16) expresses that the squared radius of gyration about any axis (Ox) exceeds the squared radius of gyration about a parallel axis through G by the square of the distance between the two axes. The formula (17) is due to J. L. Lagrange; it may be written

$$\frac{\Sigma(m . OP^2)}{\Sigma(m)}=\frac{\Sigma(m . GP^2)}{\Sigma(m)}+OG^2, \tag{18}$$

and expresses that the mean square of the distances of the particles from O exceeds the mean square of the distances from G by OG². The mass-centre is accordingly that point the mean square of whose distances from the several particles is least. If in (18) we make O coincide with $P_1, P_2, \ldots P_n$ in succession, we obtain

$$\left.\begin{array}{l} 0 \quad +m_2 . P_1P_2^2+\ldots+mn . P_1P_n^2=\Sigma(m . GP^2)+\Sigma(m) . GP_1^2,\\ m_1 . P_2P_1^2+\quad 0 \quad +\ldots+mn . P_2P_n^2=\Sigma(m . GP^2)+\Sigma(m) . GP_2^2,\\ \quad\cdot\qquad\cdot\qquad\cdot\qquad\cdot\qquad\cdot\qquad\cdot\\ m_1 . PnP_1^2+m_2 . PnP_2^2+\ldots+\quad 0 \quad=\Sigma(m . GP^2)+\Sigma(m) . GPn^2.\end{array}\right\} \tag{19}$$

If we multiply these equations by $m_1, m_2, \ldots m_n$, respectively, and add, we find

$$\Sigma\Sigma(m_rm_s . P_rP_s^2)=\Sigma(m) . \Sigma(m . GP^2), \tag{20}$$

provided the summation ΣΣ on the left hand be understood to include each pair of particles once only. This theorem, also due to Lagrange, enables us to express the mean square of the distances of the particles from the centre of mass in terms of the masses and mutual distances. For instance, considering four equal particles at the vertices of a regular tetrahedron, we can infer that the radius R of the circumscribing sphere is given by $R^2=\frac{3}{8}a^2$, if a be the length of an edge.

Another type of quadratic moment is supplied by the *deviation-moments*, or *products of inertia* of a distribution of matter. Thus the sum $\Sigma(m.yz)$ is called the "product of inertia" with respect to the planes $y=0$, $z=0$. This may be expressed in terms of the product of inertia with respect to parallel planes through G by means of the formula (14); viz.:—

$$\Sigma(m . yz)=\Sigma(m.\eta\zeta)+\Sigma(m) . \bar{y}\bar{z} \tag{21}$$

The quadratic moments with respect to different planes through a fixed point O are related to one another as follows. The moment with respect to the plane

$$\lambda x+\mu y+\nu z=0, \tag{22}$$

where λ, μ, ν are direction-cosines, is

$$\begin{aligned}\Sigma\{m(\lambda x+\mu y+\nu z)^2\}=\Sigma(mx^2)\,.\,\lambda^2+\Sigma(my^2)\,.\,\mu^2+\Sigma(mz^2)\,.\,\nu^2\\ +2\Sigma(myz)\,.\,\mu\nu+2\Sigma(mzx)\,.\,\nu\lambda+2\Sigma(mxy)\,.\,\lambda\mu,\end{aligned} \tag{23}$$

and therefore varies as the square of the perpendicular drawn from O to a tangent plane of a certain quadric surface, the tangent plane in question being parallel to (22). If the co-ordinate axes coincide with the principal axes of this quadric, we shall have

$$\Sigma(myz)=0,\quad \Sigma(mzx)=0,\quad \Sigma(mxy)=0; \tag{24}$$

and if we write

$$\Sigma(mx^2)=\mathrm{M}a^2,\quad \Sigma(my^2)=\mathrm{M}b^2,\quad \Sigma(mz^2)=\mathrm{M}c^2, \tag{25}$$

where $\mathrm{M}=\Sigma(m)$, the quadratic moment becomes $\mathrm{M}(a^2\lambda^2+b^2\mu^2+c^2\nu^2)$, or $\mathrm{M}p^2$, where p is the distance of the origin from that tangent plane of the ellipsoid

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1, \tag{26}$$

which is parallel to (22). It appears from (24) that through any assigned point O three rectangular axes can be drawn such that the product of inertia with respect to each pair of co-ordinate planes vanishes; these are called the *principal axes of inertia* at O. The ellipsoid (26) was first employed by J. Binet (1811), and may be called "Binet's Ellipsoid" for the point O. Evidently the quadratic moment for a variable plane through O will have a "stationary" value when, and only when, the plane coincides with a principal plane of (26). It may further be shown that if Binet's ellipsoid be referred to any system of conjugate diameters as co-ordinate axes, its equation will be

$$\frac{x'^2}{a'^2}+\frac{y'^2}{b'^2}+\frac{z'^2}{c'^2}=1, \tag{27}$$

provided

$$\Sigma(mx'^2)=\mathrm{M}a'^2,\quad \Sigma(my'^2)=\mathrm{M}b'^2,\quad \Sigma(mz'^2)=\mathrm{M}c'^2;$$

also that

$$\Sigma(my'z')=0,\ \Sigma(mz'x')=0,\ \Sigma(mx'y')=0. \tag{28}$$

Let us now take as co-ordinate axes the principal axes of inertia at the mass-centre G. If a, b, c be the semi-axes of the Binet's ellipsoid of G, the quadratic moment with respect to the plane $\lambda x+\mu y+\nu z=0$ will be $\mathrm{M}(a^2\lambda^2+b^2\mu^2+c^2\nu^2)$, and that with respect to a parallel plane

$$\lambda x+\mu y+\nu z=p \tag{29}$$

will be $\mathrm{M}(a^2\lambda^2+b^2\mu^2+c^2\nu^2+p^2)$, by (15). This will have a given value $\mathrm{M}k^2$, provided

$$p^2=(k^2-a^2)\lambda^2+(k^2-b^2)\mu^2+(k^2-c^2)\nu^2. \tag{30}$$

Hence the planes of constant quadratic moment $\mathrm{M}k^2$ will envelop the quadric

$$\frac{x^2}{k^2-a^2}+\frac{y^2}{k^2-b^2}+\frac{z^2}{k^2-c^2}=1, \tag{31}$$

and the quadrics corresponding to different values of k^2 will be confocal. If we write

$$\begin{gathered}k^2=a^2+b^2+c^2+\theta,\\ b^2+c^2=\alpha^2,\quad c^2+a^2=\beta^2,\quad a^2+b^2=\gamma^2\end{gathered} \tag{32}$$

the equation (31) becomes

$$\frac{x^2}{\alpha^2+\theta}+\frac{y^2}{\beta^2+\theta}+\frac{z^2}{\gamma^2+\theta}=1; \tag{33}$$

for different values of θ this represents a system of quadrics confocal with the ellipsoid

$$\frac{x^2}{\alpha^2}+\frac{y^2}{\beta^2}+\frac{z^2}{\gamma^2}=1, \tag{34}$$

which we shall meet with presently as the "ellipsoid of gyration" at G. Now consider the tangent plane ω at any point P of a confocal, the tangent plane ω′ at an adjacent point N′, and a plane ω″ through P parallel to ω′. The distance between the planes ω′ and ω″ will be of the second order of small quantities, and the quadratic moments with respect to ω′ and ω″ will therefore be equal, to the first order. Since the quadratic moments with respect to ω and ω′ are equal, it follows that ω is a plane of stationary quadratic moment at P, and therefore a principal plane of inertia at P. In other words, the principal axes of inertia at P are the normals to the three confocals of the system (33) which pass through P. Moreover if x, y, z be the co-ordinates of P, (33) is an equation to find the corresponding values of θ; and if θ_1, θ_2, θ_3 be the roots we find

$$\theta_1+\theta_2+\theta_3=r^2-\alpha^2-\beta^2-\gamma^2, \tag{35}$$

where $r^2=x^2+y^2+z^2$. The squares of the radii of gyration about the principal axes at P may be denoted by $k_2^2+k_3^2$, $k_3^2+k_1^2$, $k_1^2+k_2^2$; hence by (32) and (35) they are $r^2-\theta_1$, $r^2-\theta_2$, $r^2-\theta_3$, respectively.

To find the relations between the moments of inertia about different axes through any assigned point O, we take O as origin. Since the square of the distance of a point (x, y, z) from the axis

$$\frac{x}{\lambda}=\frac{y}{\mu}=\frac{z}{\nu} \tag{36}$$

is $x^2+y^2+z^2-(\lambda x+\mu y+\nu z)^2$, the moment of inertia about this axis is

$$\begin{aligned}\mathrm{I}&=\Sigma[m\{(\lambda^2+\mu^2+\nu^2)(x^2+y^2+z^2)-(\lambda x+\mu y+\nu z)^2\}]\\ &=\mathrm{A}\lambda^2+\mathrm{B}\mu^2+\mathrm{C}\nu^2-2\mathrm{F}\mu\nu-2\mathrm{G}\nu\lambda-2\mathrm{H}\lambda\mu,\end{aligned} \tag{37}$$

provided

$$\left.\begin{gathered}\mathrm{A}=\Sigma\{m(y^2+z^2)\},\quad \mathrm{B}=\Sigma\{m(z^2+x^2)\},\quad \mathrm{C}=\Sigma\{m(x^2+y^2)\},\\ \mathrm{F}=\Sigma(myz),\quad \mathrm{G}=\Sigma(mzx),\quad \mathrm{H}=\Sigma(mxy);\end{gathered}\right\} \tag{38}$$

i.e. A, B, C are the moments of inertia about the co-ordinate axes, and F, G, H are the products of inertia with respect to the pairs of co-ordinate planes. If we construct the quadric

$$\mathrm{A}x^2+\mathrm{B}y^2+\mathrm{C}z^2-2\mathrm{F}yz-2\mathrm{G}zx-2\mathrm{H}xy=\mathrm{M}\epsilon^4, \tag{39}$$

where ϵ is an arbitrary linear magnitude, the intercept r which it makes on a radius drawn in the direction λ, μ, ν is found by putting $x, y, z=\lambda r, \mu r, \nu r$. Hence, by comparison with (37),

$$\mathrm{I}=\mathrm{M}\epsilon^4/r^2. \tag{40}$$

The moment of inertia about any radius of the quadric (39) therefore varies inversely as the square of the length of this radius. When referred to its principal axes, the equation of the quadric takes the form

$$\mathrm{A}x^2+\mathrm{B}y^2+\mathrm{C}z^2=\mathrm{M}\epsilon^4. \tag{41}$$

The directions of these axes are determined by the property (24), and therefore coincide with those of the principal axes of inertia at O, as already defined in connexion with the theory of plane quadratic moments. The new A, B, C are called the *principal moments of inertia* at O. Since they are essentially positive the quadric is an ellipsoid; it is called the *momental ellipsoid* at O. Since, by (12), B+C>A, &c., the sum of the two lesser principal moments must exceed the greatest principal moment. A limitation is thus imposed on the possible forms of the momental ellipsoid; *e.g.* in the case of symmetry about an axis it appears that the ratio of the polar to the equatorial diameter of the ellipsoid cannot be less than $1/\sqrt{2}$.

If we write $\mathrm{A}=\mathrm{M}\alpha^2$, $\mathrm{B}=\mathrm{M}\beta^2$, $\mathrm{C}=\mathrm{M}\gamma^2$, the formula (37), when referred to the principal axes at O, becomes

$$\mathrm{I}=\mathrm{M}(\alpha^2\lambda^2+\beta^2\mu^2+\gamma^2\nu^2=\mathrm{M}p^2, \tag{42}$$

if p denotes the perpendicular drawn from O in the direction (λ, μ, ν) to a tangent plane of the ellipsoid

$$\frac{x^2}{\alpha^2}+\frac{y^2}{\beta^2}+\frac{z^2}{\gamma^2}=1 \tag{43}$$

This is called the *ellipsoid of gyration* at O; it was introduced into the theory by J. MacCullagh. The ellipsoids (41) and (43) are reciprocal polars with respect to a sphere having O as centre.

If A=B=C, the momental ellipsoid becomes a sphere; all axes through O are then principal axes, and the moment of inertia is the same for each. The mass-system is then said to possess kinetic symmetry about O.

If all the masses lie in a plane ($z=0$) we have, in the notation of (25), $c^2=0$, and therefore $\mathrm{A}=\mathrm{M}b^2$, $\mathrm{B}=\mathrm{M}a^2$, $\mathrm{C}=\mathrm{M}(a^2+b^2)$, so that the equation of the momental ellipsoid takes the form

$$b^2x^2+a^2\ y^2+(a^2+b^2)\ z^2=\epsilon^4. \tag{44}$$

The section of this by the plane $z=0$ is similar to

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1, \tag{45}$$

which may be called the *momental ellipse* at O. It possesses the property that the radius of gyration about any diameter is half the distance between the two tangents which are parallel to that diameter. In the case of a uniform triangular plate it may be shown that the momental ellipse at G is concentric, similar and similarly situated to the ellipse which touches the sides of the triangle at their middle points.

The graphical methods of determining the moment of inertia of a plane system of particles with respect to any line in its plane may be briefly noticed. It appears from § 5 (fig. 31) that the linear moment of each particle about the line may be found by means of a funicular polygon. If we replace the mass of each particle by its moment, as thus found, we can in like manner obtain the quadratic moment of the system with respect to the line. For if the line in question be the axis of y, the first process gives us the values of mx, and the second the value of $\Sigma(mx\,.\,x)$ or $\Sigma(mx^2)$. The construction of a second funicular may be dispensed with by the employment of a planimeter, as follows. In fig. 59 p is the line with respect to which moments are to be taken, and the masses of the respective particles are indicated by the corresponding segments of a line in the force-diagram, drawn parallel to p. The funicular ZABCD . . . corresponding to any pole O is constructed for a system of forces acting parallel to p through the positions of the particles and proportional to the respective masses; and its successive sides are produced to meet p in the points H, K, L, M, . . . As explained in § 5, the moment of the first particle is represented on a certain scale by HK, that of the second by KL, and so on. The quadratic moment of the first particle will then be represented by twice the area AHK, that of the second by twice the area BKL, and so on. The quadratic moment of the whole system is therefore represented by twice the area AHEDCBA. Since a quadratic moment is essentially positive, the various areas are to taken positive in all cases. If k be the radius of gyration about p we find

$$k^2 = 2 \times \text{area AHEDCBA} \times \text{ON} \div \alpha\beta,$$

where $\alpha\beta$ is the line in the force-diagram which represents the sum of the masses, and ON is the distance of the pole O from this line. If some of the particles lie on one side of p and some on the other, the quadratic moment of each set may be found, and the results added. This is illustrated in fig. 60, where the total quadratic moment is represented by the sum of the shaded areas. It is seen that for a given direction of p this moment is least when p passes through the intersection X of the first and last sides of the funicular; *i.e.* when p goes through the mass-centre of the given system; cf. equation (15).

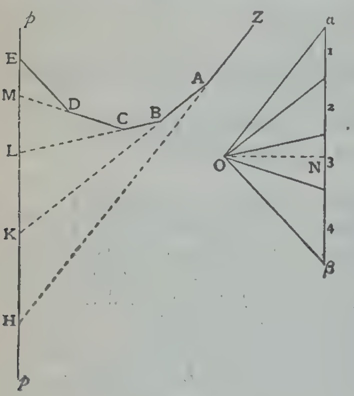

FIG. 59.

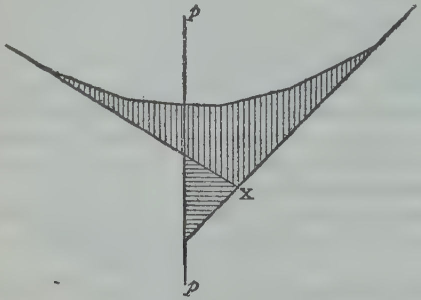

FIG. 60.

PART II.—KINETICS

§ 12. *Rectilinear Motion.*—Let x denote the distance OP of a moving point P at time t from a fixed origin O on the line of motion, this distance being reckoned positive or negative according as it lies to one side or the other of O. At time $t+\delta t$ let the point be at Q, and let OQ $= x+\delta x$. The *mean velocity* of the point in the interval δt is $\delta x/\delta t$. The limiting value of this when δt is infinitely small, viz. dx/dt, is adopted as the definition of the *velocity* at the instant t. Again, let u be the velocity at time t, $u+\delta u$ that at time $t+\delta t$. The mean rate of increase of velocity, or the *mean acceleration*, in the interval δt is then $\delta u/\delta t$. The limiting value of this when δt is infinitely small, viz., du/dt, is adopted as the definition of the *acceleration* at the instant t. Since $u = dx/dt$, the acceleration is also denoted by d^2x/dt^2. It is often convenient to use the "fluxional" notation for differential coefficients with respect to the time; thus the velocity may be represented by $\dot{x}$ and the acceleration by $\dot{u}$ or $\ddot{x}$. There is another formula for the acceleration, in which u is regarded as a function of the position; thus $\frac{du}{dt} = \frac{du}{dx}\frac{dx}{dt} = u\frac{du}{dx}$. The relation between x and t in any particular case may be illustrated by means of a curve constructed with t as abscissa and x as ordinate. This is called the *curve of positions* or *space-time curve*; its gradient represents the velocity. Such curves are often traced mechanically in acoustical and other experiments. A curve with t as abscissa and u as ordinate is called the *curve of velocities* or *velocity-time curve*. Its gradient represents the acceleration, and the area $(\int u dt)$ included between any two ordinates represents the space described in the interval between the corresponding instants (see fig. 62).

So far nothing has been said about the measurement of time. From the purely kinematic point of view, the t of our formulae may be any continuous independent variable, suggested (it may be) by some physical process. But from the dynamical standpoint it is obvious that equations which represent the facts correctly on one system of time-measurement might become seriously defective on another. It is found that for almost all purposes a system of measurement based ultimately on the earth's rotation is perfectly adequate. It is only when we come to consider such delicate questions as the influence of tidal friction that other standards become necessary.

The most important conception in kinetics is that of "inertia." It is a matter of ordinary observation that different bodies acted on by the same force, or what is judged to be the same force, undergo different changes of velocity in equal times. In our ideal representation of natural phenomena this is allowed for by endowing each material particle with a suitable *mass* or *inertia-coefficient m*. The product mu of the mass into the velocity is called the *momentum* or (in Newton's phrase) the *quantity of motion*. On the Newtonian system the motion of a particle entirely uninfluenced by other bodies, when referred to a suitable base, would be rectilinear, with constant velocity. If the velocity changes, this is attributed to the action of force; and if we agree to measure the force (X) by the rate of change of momentum which it produces, we have the equation

$$\frac{d}{dt}(mu) = \text{X}. \tag{1}$$

From this point of view the equation is a mere truism, its real importance resting on the fact that by attributing suitable values to the masses m, and by making simple assumptions as to the value of X in each case, we are able to frame adequate representations of whole classes of phenomena as they actually occur. The question remains, of course, as to how far the measurement of force here implied is practically consistent with the gravitational method usually adopted in statics; this will be referred to presently.

The practical unit or standard of mass must, from the nature of the case, be the mass of some particular body, *e.g.* the imperial pound, or the kilogramme. In the "C.G.S." system a subdivision of the latter, viz. the gramme, is adopted, and is associated with the centimetre as the unit of length, and the mean solar second as the unit of time. The unit of force implied in (1) is that which produces unit momentum in unit time. On the C.G.S. system it is that force which acting on one gramme for one second produces a velocity of one centimetre per second; this unit is known as the *dyne*. Units of this kind are called *absolute* on account of their fundamental and invariable character as contrasted with gravitational units, which (as we shall see presently) vary somewhat with the locality at which the measurements are supposed to be made.

If we integrate the equation (1) with respect to t between the limits t, t' we obtain

$$mu' - mu = \int_t^{t'} \text{X}\,dt. \tag{2}$$

The time-integral on the right hand is called the *impulse* of the force on the interval $t'-t$. The statement that the increase of momentum is equal to the impulse is (it may be remarked) equivalent to Newton's own formulation of his Second Law. The form (1) is deduced from it by putting $t'-t=\delta t$, and taking δt to be infinitely small. In problems of impact we have to deal with cases of practically instantaneous impulse, where a very great and rapidly varying force produces an appreciable change of momentum in an exceedingly minute interval of time.

In the case of a constant force, the acceleration $\dot{u}$ or $\ddot{x}$ is, according to (1), constant, and we have

$$\frac{d^2x}{dt^2}=a, \qquad (3)$$

say, the general solution of which is

$$x=\tfrac{1}{2}at^2+At+B. \qquad (4)$$

The "arbitrary constants" A, B enable us to represent the circumstances of any particular case; thus if the velocity $\dot{x}$ and the position x be given for any one value of t, we have two conditions to determine A, B. The curve of positions corresponding to (4) is a parabola, and that of velocities is a straight line. We may take it as an experimental result, although the best evidence is indirect, that a particle falling freely under gravity experiences a constant acceleration which at the same place is the same for all bodies. This acceleration is denoted by g; its value at Greenwich is about 981 centimetre-second units, or 32·2 feet per second. It increases somewhat with the latitude, the extreme variation from the equator to the pole being about $\frac{1}{2}$%. We infer that on our reckoning the force of gravity on a mass m is to be measured by mg, the momentum produced per second when this force acts alone. Since this is proportional to the mass, the relative masses to be attributed to various bodies can be determined practically by means of the balance. We learn also that on account of the variation of g with the locality a gravitational system of force-measurement is inapplicable when more than a moderate degree of accuracy is desired.

We take next the case of a particle attracted towards a fixed point O in the line of motion with a force varying as the distance from that point. If μ be the acceleration at unit distance, the equation of motion becomes

$$\frac{d^2x}{dt^2}=-\mu x, \qquad (5)$$

the solution of which may be written in either of the forms

$$x=A\cos\sigma t+B\sin\sigma t,\quad x=a\cos(\sigma t+\epsilon), \qquad (6)$$

where $\sigma=\sqrt{\mu}$, and the two constants A, B or a, ϵ are arbitrary. The particle oscillates between the two positions $x=\pm a$, and the same point is passed through in the same direction with the same velocity at equal intervals of time $2\pi/\sigma$. The type of motion represented by (6) is of fundamental importance in the theory of vibrations (§ 23); it is called a *simple-harmonic* or (shortly) a *simple* vibration. If we imagine a point Q to describe a circle of radius a with the angular velocity σ, its orthogonal projection P on a fixed diameter AA′ will execute a vibration of this character. The angle $\sigma t+\epsilon$ (or AOQ) is called the *phase*; the arbitrary elements a, ϵ are called the *amplitude* and *epoch* (or initial phase), respectively. In the case of very rapid vibrations it is usual to specify, not the *period* ($2\pi/\sigma$), but its reciprocal the *frequency*, *i.e.* the number of complete vibrations per unit time. Fig. 62 shows the curves of position and velocity; they both have the form of the "curve of sines." The numbers correspond to an amplitude of 10 centimetres and a period of two seconds.

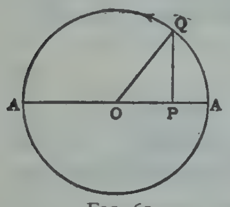

FIG. 61.

The vertical oscillations of a weight which hangs from a fixed point by a spiral spring come under this case. If M be the mass, and x the vertical displacement from the position of equilibrium, the equation of motion is of the form

$$M\frac{d^2x}{dt^2}=-Kx, \qquad (7)$$

provided the inertia of the spring itself be neglected. This becomes identical with (5) if we put $\mu=K/M$; and the period is therefore $2\pi\sqrt{(M/K)}$, the same for all amplitudes. The period is increased by an increase of the mass M, and diminished by an increase in the stiffness (K) of the spring. If c be the statical increase of length which is produced by the gravity of the mass M, we have $Kc=Mg$, and the period is $2\pi\sqrt{(c/g)}$.

The small oscillations of a simple pendulum in a vertical plane also come under equation (5). According to the principles of § 13, the horizontal motion of the bob is affected only by the horizontal component of the force acting upon it. If the inclination of the string to the vertical does not exceed a few degrees, the vertical displacement of the particle is of the second order, so that the vertical acceleration may be neglected, and the tension of the string may be equated to the gravity mg of the particle. Hence if l be the length of the string, and x the horizontal displacement of the bob from the equilibrium position, the horizontal component of gravity is mgx/l, whence

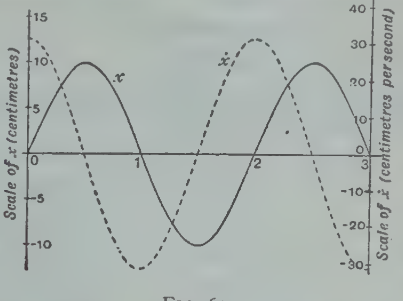

FIG. 62.

$$\frac{d^2x}{dt^2}=-\frac{gx}{l}, \qquad (8)$$

The motion is therefore simple-harmonic, of period $\tau=2\pi\sqrt{(l/g)}$. This indicates an experimental method of determining g with considerable accuracy, using the formula $g=4\pi^2l/\tau^2$.

In the case of a repulsive force varying as the distance from the origin, the equation of motion is of the type

$$\frac{d^2x}{dt^2}=\mu x, \qquad (9)$$

the solution of which is

$$x=Ae^{nt}+Be^{-nt}, \qquad (10)$$

where $n=\sqrt{\mu}$. Unless the initial conditions be adjusted so as to make $A=0$ exactly, x will ultimately increase indefinitely with t. The position $x=0$ is one of equilibrium, but it is unstable. This applies to the inverted pendulum, with $\mu=g/l$, but the equation (9) is then only approximate, and the solution therefore only serves to represent the initial stages of a motion in the neighbourhood of the position of unstable equilibrium.

In acoustics we meet with the case where a body is urged towards a fixed point by a force varying as the distance, and is also acted upon by an "extraneous" or "disturbing" force which is a given function of the time. The most important case is where this function is simple-harmonic, so that the equation (5) is replaced by

$$\frac{d^2x}{dt^2}+\mu x=f\cos(\sigma_1 t+\alpha), \qquad (11)$$

where σ_1 is prescribed. A particular solution is

$$x=\frac{f}{\mu-\sigma_1^2}\cos(\sigma_1 t+\alpha). \qquad (12)$$

This represents a *forced oscillation* whose period $2\pi/\sigma_1$, coincides with that of the disturbing force; and the phase agrees with that of the force, or is opposed to it, according as $\sigma_1^2<$or$>\mu$; *i.e.* according as the imposed period is greater or less than the natural period $2\pi/\sqrt{\mu}$. The solution fails when the two periods agree exactly; the formula (12) is then replaced by

$$x=\frac{ft}{2\sigma_1}\sin(\sigma_1 t+\alpha), \qquad (13)$$

which represents a vibration of continually increasing amplitude. Since the equation (12) is in practice generally only an approximation (as in the case of the pendulum), this solution can only be accepted as a representation of the initial stages of the forced oscillation. To obtain the complete solution of (11) we must of course superpose the free vibration (6) with its arbitrary constants in order to obtain a complete representation of the most general motion consequent on arbitrary initial conditions.

A simple mechanical illustration is afforded by the pendulum. If the point of suspension have an imposed simple vibration $\xi = a \cos \sigma t$ in a horizontal line, the equation of small motion of the bob is

$$m\ddot{x} = -mg\frac{x-\xi}{l},$$

or

$$\ddot{x} + \frac{gx}{l} = g\frac{\xi}{l}. \qquad (14)$$

This is the same as if the point of suspension were fixed, and a horizontal disturbing force $mg\xi/l$ were to act on the bob. The difference of phase of the forced vibration in the two cases is illustrated and explained in the annexed fig. 63, where the pendulum virtually oscillates about C as a fixed point of suspension. This illustration was given by T. Young in connexion with the kinetic theory of the tides, where the same point arises.

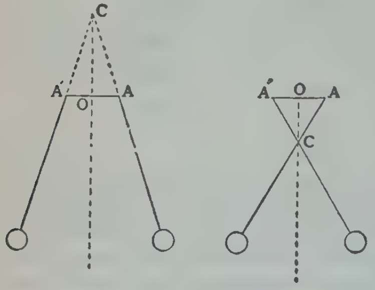

FIG. 63.

We may notice also the case of an attractive force varying inversely as the square of the distance from the origin. If μ be the acceleration at unit distance, we have

$$u\frac{du}{dx} = -\frac{\mu}{x^2} \qquad (15)$$

whence

$$u^2 = \frac{2\mu}{x} + C. \qquad (16)$$

In the case of a particle falling directly towards the earth from rest at a very great distance we have $C=0$ and, by Newton's Law of Gravitation, $\mu/a^2 = g$, where a is the earth's radius. The deviation of the earth's figure from sphericity, and the variation of g with latitude, are here ignored. We find that the velocity with which the particle would arrive at the earth's surface $(x=a)$ is $\sqrt{(2ga)}$. If we take as rough values $a = 21 \times 10^6$ feet, $g = 32$ foot-second units, we get a velocity of 36,500 feet, or about seven miles, per second. If the particles start from rest at a finite distance c, we have in (16), $C = -2\mu/c$, and therefore

$$\frac{dx}{dt} = u = -\sqrt{\left\{\frac{2\mu(c-x)}{cx}\right\}}, \qquad (17)$$

the minus sign indicating motion towards the origin. If we put $x = c\cos^2\frac{1}{2}\phi$, we find

$$t = \frac{c^{\frac{3}{2}}}{\sqrt{(8\mu)}}(\phi + \sin\phi), \qquad (18)$$

no additive constant being necessary if t be reckoned from the instant of starting, when $\phi = 0$. The time t of reaching the origin $(\phi = \pi)$ is

$$t_1 = \frac{\pi c^{\frac{3}{2}}}{\sqrt{(8\mu)}}. \qquad (19)$$

This may be compared with the period of revolution in a circular orbit of radius c about the same centre of force, viz. $2\pi c^{\frac{3}{2}}/\sqrt{\mu}$ (§14). We learn that if the orbital motion of a planet, or a satellite, were arrested, the body would fall into the sun, or into its primary, in the fraction 0·1768 of its actual periodic time. Thus the moon would reach the earth in about five days. It may be noticed that if the scales of x and t be properly adjusted, the curve of positions in the present problem is the portion of a cycloid extending from a vertex to a cusp.

In any case of rectilinear motion, if we integrate both sides of the equation

$$mu\frac{du}{dx} = X, \qquad (20)$$

which is equivalent to (1), with respect to x between the limits x_0, x_1, we obtain

$$\tfrac{1}{2}mu_1^2 - \tfrac{1}{2}mu_0^2 = \int_{x_0}^{x_1} X\,dx. \qquad (21)$$

We recognize the right-hand member as the *work* done by the force X on the particle as the latter moves from the position x_0 to the position x_1. If we construct a curve with x as abscissa and X as ordinate, this work is represented, as in J. Watt's "indicator-diagram," by the area cut off by the ordinates $x = x_0$, $x = x_1$. The product $\frac{1}{2}mu^2$ is called the *kinetic energy* of the particle, and the equation (21) is therefore equivalent to the statement that the increment of the kinetic energy is equal to the work done on the particle. If the force X be always the same in the same position, the particle may be regarded as moving in a certain invariable "field of force." The work which would have to be supplied by other forces, extraneous to the field, in order to bring the particle from rest in some standard position P_0 to rest in any assigned position P, will depend only on the position of P; it is called the *statical* or *potential energy* of the particle with respect to the field, in the position P. Denoting this by V, we have $\delta V - X\delta x = 0$, whence

$$X = -\frac{dV}{dx}. \qquad (22)$$

The equation (21) may now be written

$$\tfrac{1}{2}mu_1^2 + V_1 = \tfrac{1}{2}mu_0^2 + V_0, \qquad (23)$$

which asserts that when no extraneous forces act the sum of the kinetic and potential energies is constant. Thus in the case of a weight hanging by a spiral spring the work required to increase the length by x is $V = \int_0^x Kx\,dx = \frac{1}{2}Kx^2$, whence $\frac{1}{2}Mu^2 + \frac{1}{2}Kx^2 = \text{const.}$, as is easily verified from preceding results. It is easily seen that the effect of extraneous forces will be to increase the sum of the kinetic and potential energies by an amount equal to the work done by them. If this amount be negative the sum in question is diminished by a corresponding amount. It appears then that this sum is a measure of the total capacity for doing work against extraneous resistances which the particle possesses in virtue of its motion and its position; this is in fact the origin of the term "energy." The product mv^2 had been called by G. W. Leibnitz the "vis viva"; the name "energy" was substituted by T. Young; finally the name "actual energy" was appropriated to the expression $\frac{1}{2}mv^2$ by W. J. M. Rankine.

The laws which regulate the resistance of a medium such as air to the motion of bodies through it are only imperfectly known. We may briefly notice the case of resistance varying as the square of the velocity, which is mathematically simple. If the positive direction of x be downwards, the equation of motion of a falling particle will be of the form

$$\frac{du}{dt} = g - ku^2; \qquad (24)$$

this shows that the velocity u will send asymptotically to a certain limit V (called the *terminal velocity*) such that $kV^2 = g$. The solution is

$$u = V\tanh\frac{gt}{V},\quad x = \frac{V^2}{g}\log\cosh\frac{gt}{V}, \qquad (25)$$

if the particle start from rest in the position $x = 0$ at the instant $t = 0$. In the case of a particle projected vertically upwards we have

$$\frac{du}{dt} = -g - ku^2, \qquad (26)$$

the positive direction being now upwards. This leads to

$$\tan^{-1}\frac{u}{V} = \tan^{-1}\frac{u_0}{V} - \frac{gt}{V},\quad x = \frac{V^2}{2g}\log\frac{V^2 + u_0^2}{V^2 + u^2}, \qquad (27)$$

where u_0 is the velocity of projection. The particle comes to rest when

$$t = \frac{V}{g}\tan^{-1}\frac{u_0}{V},\quad x = \frac{V^2}{2g}\log\left(1 + \frac{u_0^2}{V^2}\right). \qquad (28)$$

For small velocities the resistance of the air is more nearly proportional to the first power of the velocity. The effect of forces of this type on small vibratory motions may be investigated as follows. The equation (5) when modified by the introduction of a frictional term becomes

$$\ddot{x} = -\mu x - k\dot{x}. \qquad (29)$$

If $k^2 < 4\mu$ the solution is

$$x = ae^{-t/\tau}\cos(\sigma t + \epsilon), \qquad (30)$$

where

$$\tau = 2/k,\quad \sigma = \sqrt{(\mu - \tfrac{1}{4}k^2)}, \qquad (31)$$

and the constants a, ϵ are arbitrary. This may be described as a simple harmonic oscillation whose amplitude diminishes asymptotically to zero according to the law $e^{-t/\tau}$. The constant τ is called the *modulus of decay* of the oscillations; if it is large compared with $2\pi/\sigma$ the effect of friction on the period is of the second order of small quantities and may in general be ignored. We have seen that a true simple-harmonic vibration may be regarded as the orthogonal projection of uniform circular motion; it was pointed out by P. G. Tait that a similar representation of the type (30) is obtained if we replace the circle by an equiangular spiral described, with a constant angular velocity about the pole, in the direction of diminishing radius vector. When $k^2 > 4\mu$, the solution of (29) is, in real form,

$$x = a_1 e^{-t/\tau_1} + a_2 e^{-t/\tau_2}, \tag{32}$$

where

$$1/\tau_1,\ 1/\tau_2 = \tfrac{1}{2}k \pm \sqrt{(\tfrac{1}{4}k^2 - \mu)}. \tag{33}$$

The body now passes once (at most) through its equilibrium position, and the vibration is therefore styled *aperiodic*.

To find the forced oscillation due to a periodic force we have

$$\ddot{x} + k\dot{x} + \mu x = f \cos(\sigma_1 t + \epsilon). \tag{34}$$

The solution is

$$x = \frac{f}{R} \cos(\sigma_1 t + \epsilon - \epsilon_1), \tag{35}$$

provided

$$R = \{(\mu - \sigma_1^2)^2 + k^2\sigma_1^2\}^{\frac{1}{2}},\ \tan \epsilon_1 = \frac{k\sigma_1}{\mu - \sigma_1^2}. \tag{36}$$

Hence the phase of the vibration lags behind that of the force by the amount ϵ_1, which lies between 0 and $\tfrac{1}{2}\pi$ or between $\tfrac{1}{2}\pi$ and π, according as $\sigma_1^2 \lesseqgtr \mu$. If the friction be comparatively slight the amplitude is greatest when the imposed period coincides with the free period, being then equal to $f/k\sigma_1$, and therefore very great compared with that due to a slowly varying force of the same average intensity. We have here, in principle, the explanation of the phenomenon of "resonance" in acoustics. The abnormal amplitude is greater, and is restricted to a narrower range of frequency, the smaller the friction. For a complete solution of (34) we must of course superpose the free vibration (30); but owing to the factor $e^{-t/\tau}$ the influence of the initial conditions gradually disappears.

For purposes of mathematical treatment a force which produces a finite change of velocity in a time too short to be appreciated is regarded as infinitely great, and the time of action as infinitely short. The whole effect is summed up in the value of the instantaneous impulse, which is the time-integral of the force. Thus if an instantaneous impulse ξ changes the velocity of a mass m from u to u' we have

$$mu' - mu = \xi. \tag{37}$$

The effect of ordinary finite forces during the infinitely short duration of this impulse is of course ignored.

We may apply this to the theory of impact. If two masses m_1, m_2 moving in the same straight line impinge, with the result that the velocities are changed from u_1, u_2, to u_1', u_2', then, since the impulses on the two bodies must be equal and opposite, the total momentum is unchanged, *i.e.*

$$m_1u_1' + m_2u_2' = m_1u_1 + m_2u_2. \tag{38}$$

The complete determination of the result of a collision under given circumstances is not a matter of abstract dynamics alone, but requires some auxiliary assumption. If we assume that there is no loss of apparent kinetic energy we have also

$$m_1u_1'^2 + m_2u_2'^2 = m_1u_1^2 + m_2u_2^2. \tag{39}$$

Hence, and from (38),

$$u_2' - u_1' = -(u_2 - u_1), \tag{40}$$

(*i.e.* the relative velocity of the two bodies is reversed in direction, but unaltered in magnitude. This appears to be the case very approximately with steel or glass balls; generally, however, there is some appreciable loss of apparent energy; this is accounted for by vibrations produced in the balls and imperfect elasticity of the materials. The usual empirical assumption is that

$$u_2' - u_1' = -e(u_2 - u_1), \tag{41}$$

where e is a proper fraction which is constant for the same two bodies. It follows from the formula § 15 (10) for the internal kinetic energy of a system of particles that as a result of the impact this energy is diminished by the amount

$$\tfrac{1}{2}(1 - e^2)\frac{m_1m_2}{m_1 + m_2}(u_1 - u_2)^2. \tag{42}$$

The further theoretical discussion of the subject belongs to ELASTICITY.

This is perhaps the most suitable place for a few remarks on the theory of "dimensions." (See also UNITS, DIMENSIONS OF.) In any absolute system of dynamical measurement the fundamental units are those of mass, length and time; we may denote them by the symbols M, L, T, respectively. They may be chosen quite arbitrarily, *e.g.* on the C.G.S. system they are the gramme, centimetre and second. All other units are derived from these. Thus the unit of velocity is that of a point describing the unit of length in the unit of time; it may be denoted by LT^{-1}, this symbol indicating that the magnitude of the unit in question varies directly as the unit of length and inversely as the unit of time. The unit of acceleration is the acceleration of a point which gains unit velocity in unit time; it is accordingly denoted by LT^{-2}. The unit of momentum is MLT^{-1}; the unit force generates unit momentum in unit time and is therefore denoted by MLT^{-2}. The unit of work on the same principles is ML^2T^{-2}, and it is to be noticed that this is identical with the unit of kinetic energy. Some of these derivative units have special names assigned to them; thus on the C.G.S. system the unit of force is called the *dyne*, and the unit of work or energy the *erg*. The number which expresses a physical quantity of any particular kind will of course vary inversely as the magnitude of the corresponding unit. In any general dynamical equation the dimensions of each term in the fundamental units must be the same, for a change of units would otherwise alter the various terms in different ratios. This principle is often useful as a check on the accuracy of an equation.

The theory of dimensions often enables us to forecast, to some extent, the manner in which the magnitudes involved in any particular problem will enter into the result. Thus, assuming that the period of a small oscillation of a given pendulum at a given place is a definite quantity, we see that it must vary as $\sqrt{(l/g)}$. For it can only depend on the mass m of the bob, the length l of the string, and the value of g at the place in question; and the above expression is the only combination of these symbols whose dimensions are those of a time, simply. Again, the time of falling from a distance a into a given centre of force varying inversely as the square of the distance will depend only on a and on the constant μ of equation (15). The dimensions of μ/x^2 are those of an acceleration; hence the dimensions of μ are L^3T^{-2}. Assuming that the time in question varies as $a^x\mu^y$, whose dimensions are $L^{x+3y}T^{-2y}$, we must have $x + 3y = 0$, $-2y = 1$, so that the time of falling will vary as $a^{\frac{3}{2}}/\sqrt{\mu}$, in agreement with (19).

The argument appears in a more demonstrative form in the theory of "similar" systems, or (more precisely) of the similar motion of similar systems. Thus, considering the equations

$$\frac{d^2x}{dt^2} = -\frac{\mu}{x^2},\quad \frac{d^2x'}{dt'^2} = -\frac{\mu'}{x'^2}, \tag{43}$$

which refer to two particles falling independently into two distinct centres of force, it is obvious that it is possible to have x in a constant ratio to x', and t in a constant ratio to t', provided that

$$\frac{x}{t^2} : \frac{x'}{t'^2} = \frac{\mu}{x^2} : \frac{\mu'}{x'^2}, \tag{44}$$

and that there is a suitable correspondence between the initial conditions. The relation (44) is equivalent to

$$t : t' = \frac{x^{\frac{3}{2}}}{\mu^{\frac{1}{2}}} : \frac{x'^{\frac{3}{2}}}{\mu'^{\frac{1}{2}}}, \tag{45}$$

where x, x' are any two corresponding distances; *e.g.* they may be the initial distances, both particles being supposed to start from rest. The consideration of dimensions was introduced by J. B. Fourier (1822) in connexion with the conduction of heat.

§ 13. *General Motion of a Particle.*—Let P, Q be the positions of a moving point at times t, $t + \delta t$ respectively. A vector $\overrightarrow{OU}$ drawn parallel to PQ, of length proportional to $PQ/\delta t$ on any convenient scale, will represent the *mean velocity* in the interval δt, *i.e.* a point moving with a constant velocity having the magnitude and direction indicated by this vector would experience the same resultant displacement $\overrightarrow{PQ}$ in the same time. As δt is indefinitely diminished, the vector $\overrightarrow{OU}$ will tend to a definite limit $\overrightarrow{OV}$; this is adopted as the definition

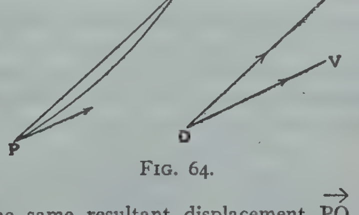

FIG. 64.

of the *velocity* of the moving point at the instant t. Obviously $\overrightarrow{OV}$ is parallel to the tangent to the path at P, and its magnitude is ds/dt, where s is the arc. If we project $\overrightarrow{OV}$ on the co-ordinate axes (rectangular or oblique) in the usual manner, the projections u, v, w are called the *component velocities* parallel to the axes. If x, y, z be the co-ordinates of P it is easily proved that

$$u = \frac{dx}{dt},\ v = \frac{dy}{dt},\ w = \frac{dz}{dt}. \tag{1}$$

The momentum of a particle is the vector obtained by multiplying the velocity by the mass m. The *impulse* of a force in any infinitely small interval of time δt is the product of the force into δt; it is to be regarded as a vector. The total impulse in any finite interval of time is the integral of the impulses corresponding to the infinitesimal elements δt into which the interval may be subdivided; the summation of which the integral is the limit is of course to be understood in the vectorial sense.

Newton's Second Law asserts that change of momentum is equal to the impulse; this is a statement as to equality of vectors and so implies identity of direction as well as of magnitude. If X, Y, Z are the components of force, then considering the changes in an infinitely short time δt we have, by projection on the co-ordinate axes, $\delta(mu) = \mathrm{X}\delta t$, and so on, or

$$m\frac{du}{dt} = \mathrm{X},\ m\frac{dv}{dt} = \mathrm{Y},\ m\frac{dw}{dt} = \mathrm{Z}. \tag{2}$$

For example, the path of a particle projected anyhow under gravity will obviously be confined to the vertical plane through the initial direction of motion. Taking this as the plane xy, with the axis of x drawn horizontally, and that of y vertically upwards, we have $\mathrm{X} = 0$, $\mathrm{Y} = -mg$; so that

$$\frac{d^2x}{dt^2} = 0,\ \frac{d^2y}{dt^2} = -g. \tag{3}$$

The solution is

$$x = \mathrm{A}t + \mathrm{B},\quad y = -\tfrac{1}{2}gt^2 + \mathrm{C}t + \mathrm{D}. \tag{4}$$

If the initial values of x, y, $\dot{x}$, $\dot{y}$ are given, we have four conditions to determine the four arbitrary constants A, B, C, D. Thus if the particle start at time $t = 0$ from the origin, with the component velocities u_0, v_0, we have

$$x = u_0 t,\quad y = v_0 t - \tfrac{1}{2}gt^2. \tag{5}$$

Eliminating t we have the equation of the path, viz.

$$y = \frac{v_0}{u_0}x - \frac{gx^2}{2u^2}. \tag{6}$$

This is a parabola with vertical axis, of latus-rectum $2u_0^2/g$. The range on a horizontal plane through O is got by putting $y = 0$, *viz.* it is $2u_0v_0/g$. If we denote the resultant velocity at any instant by $\dot{s}$ we have

$$\dot{s}^2 = \dot{x}^2 + \dot{y}^2 = \dot{s}_0^2 - 2gy. \tag{7}$$

Another important example is that of a particle subject to an acceleration which is directed always towards a fixed point O and is proportional to the distance from O. The motion will evidently be in one plane, which we take as the plane $z = 0$. If μ be the acceleration at unit distance, the component accelerations parallel to axes of x and y through O as origin will be $-\mu x$, $-\mu y$, whence

$$\frac{d^2x}{dt^2} = -\mu x,\ \frac{d^2y}{dt^2} = -\mu y. \tag{8}$$

The solution is

$$x = \mathrm{A}\cos nt + \mathrm{B}\sin nt,\quad y = \mathrm{C}\cos nt + \mathrm{D}\sin nt, \tag{9}$$

where $n = \sqrt{\mu}$. If P be the initial position of the particle, we may conveniently take OP as axis of x, and draw Oy parallel to the direction of motion at P. If $\mathrm{OP} = a$, and $\dot{s}_0$ be the velocity at P, we have, initially, $x = a$, $y = 0$, $\dot{x} = 0$, $\dot{y} = \dot{s}_0$; whence

$$x = a\cos nt,\quad y = b\sin nt, \tag{10}$$

if $b = \dot{s}_0/n$. The path is therefore an ellipse of which a, b are conjugate semi-diameters, and is described in the period $2\pi/\sqrt{\mu}$; moreover, the velocity at any point P is equal to $\sqrt{\mu}\cdot\mathrm{OD}$, where OD is the semi-diameter conjugate to OP. This type of motion is called *elliptic harmonic*. If the co-ordinate axes are the principal axes of the ellipse, the angle nt in (10) is identical with the "excentric angle." The motion of the bob of a "spherical pendulum," *i.e.* a simple pendulum whose oscillations are not confined to one vertical plane, is of this character, provided the extreme inclination of the string to the vertical be small. The acceleration is towards the vertical through the point of suspension, and is equal to gr/l, approximately, if r denote distance from this vertical. Hence the path is approximately an ellipse, and the period is $2\pi\sqrt{(l/g)}$.

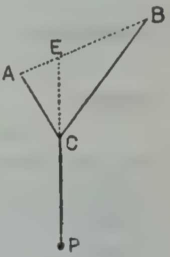

FIG. 65.

The above problem is identical with that of the oscillation of a particle in a smooth spherical bowl, in the neighbourhood of the lowest point. If the bowl has any other shape, the axes Ox, Oy may be taken tangential to the lines of curvature at the lowest point O; the equations of small motion then are

$$\frac{d^2x}{dt^2} = -g\frac{x}{\rho_1},\ \frac{d^2y}{dt^2} = -g\frac{y}{\rho_2}, \tag{11}$$

where ρ_1, ρ_2, are the principal radii of curvature at O. The motion is therefore the resultant of two simple vibrations in perpendicular directions, of periods $2\pi\sqrt{(\rho_1/g)}$, $2\pi\sqrt{(\rho_2/g)}$. The circumstances are realized in "Blackburn's pendulum," which consists of a weight P hanging from a point C of a string ACB whose ends A, B are fixed. If E be the point in which the line of the string meets AB, we have $\rho_1 = \mathrm{CP}$, $\rho_2 = \mathrm{EP}$. Many contrivances for actually drawing the resulting curves have been devised.

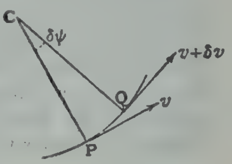

FIG. 66.

It is sometimes convenient to resolve the accelerations in directions having a more intrinsic relation to the path. Thus, in a plane path, let P, Q be two consecutive positions, corresponding to the times t, $t + \delta t$; and let the normals at P, Q meet in C, making an angle $\delta\psi$. Let v $(= \dot{s})$ be the velocity at P, $v + \delta v$ that at Q. In the time δt the velocity parallel to the tangent at P changes from v to $v + \delta v$, ultimately, and the tangential acceleration at P is therefore dv/dt or $\ddot{s}$. Again, the velocity parallel to the normal at P changes from 0 to $v\delta\psi$, ultimately, so that the normal acceleration is $v d\psi/dt$. Since

$$\frac{dv}{dt} = \frac{dv}{ds}\frac{ds}{dt} = v\frac{dv}{ds},\quad v\frac{d\psi}{dt} = v\frac{d\psi}{ds}\frac{ds}{dt} = \frac{v^2}{\rho}, \tag{12}$$

where ρ is the radius of curvature of the path at P, the tangential and normal accelerations are also expressed by $v\,dv/ds$ and v^2/ρ, respectively. Take, for example, the case of a particle moving on a smooth curve in a vertical plane, under the action of gravity and the pressure R of the curve. If the axes of x and y be drawn horizontal and vertical (upwards), and if ψ be the inclination of the tangent to the horizontal, we have

$$mv\frac{dv}{ds} = -mg\sin\psi = -mg\frac{dy}{ds},\quad \frac{mv^2}{\rho} = -mg\cos\psi + \mathrm{R}. \tag{13}$$

The former equation gives

$$v^2 = \mathrm{C} - 2gy, \tag{14}$$

and the latter then determines R.

In the case of the pendulum the tension of the string takes the place of the pressure of the curve. If l be the length of the string, ψ its inclination to the downward vertical, we have $\delta s = l\delta\psi$, so that $v = l d\psi/dt$. The tangential resolution then gives

$$l\frac{d^2\psi}{dt^2} = -g\sin\psi. \tag{15}$$

If we multiply by $2d\psi/dt$ and integrate, we obtain

$$\left(\frac{d\psi}{dt}\right)^2 = \frac{2g}{l}\cos\psi + \text{const.}, \tag{16}$$

which is seen to be equivalent to (14). If the pendulum oscillate between the limits $\psi = \pm\alpha$, we have

$$\left(\frac{\delta\psi}{dt}\right)^2 = \frac{2g}{l}(\cos\psi - \cos\alpha) = \frac{4g}{l}(\sin^2\tfrac{1}{2}\alpha - \sin^2\tfrac{1}{2}\psi); \tag{17}$$

and, putting $\sin\frac{1}{2}\psi = \sin\frac{1}{2}\alpha.\sin\phi$, we find for the period (τ) of a complete oscillation

$$\tau = 4\int_0^{\frac{1}{2}\pi}\frac{dt}{d\phi}d\phi = 4\sqrt{\frac{l}{g}}\cdot\int_0^{\frac{1}{2}\pi}\frac{d\phi}{\sqrt{(1 - \sin^2\frac{1}{2}\alpha.\sin^2\phi)}}$$

$$= 4\sqrt{\frac{l}{g}}\cdot\mathrm{F}_1(\sin\tfrac{1}{2}\alpha), \tag{18}$$

in the notation of elliptic integrals. The function F_1 (sin β) was tabulated by A. M. Legendre for values of β ranging from 0° to 90°. The following table gives the period, for various amplitudes α, in terms of that of oscillation in an infinitely small arc [viz. $2\pi\sqrt{(l/g)}$ as unit.

α/π	τ	α/π	τ
·1	1·0062	·6	1·2817
·2	1·0253	·7	1·4283
·3	1·0585	·8	1·6551
·4	1·1087	·9	2·0724
·5	1·1804	1·0	∞

The value of τ can also be obtained as an infinite series, by expanding the integrand in (18) by the binomial theorem, and integrating term by term. Thus

$$\tau=2\pi\sqrt{\frac{l}{g}}\cdot\left\{1+\frac{1^2}{2^2}\sin^2\tfrac{1}{2}\alpha+\frac{1^2\cdot3^2}{2^2\cdot4^2}\sin^4\tfrac{1}{2}\alpha+\ldots\right\}. \tag{19}$$

If α be small, an approximation (usually sufficient) is

$$\tau=2\pi\sqrt{(l/g)}\,.\,(1+\tfrac{1}{16}\alpha^2).$$

In the extreme case of $\alpha=\pi$, the equation (17) is immediately integrable; thus the time from the lowest position is

$$t=\sqrt{(l/g)}\,.\,\log\tan(\tfrac{1}{4}\pi+\tfrac{1}{2}\psi). \tag{20}$$

This becomes infinite for $\psi=\pi$, showing that the pendulum only tends asymptotically to the highest position.

The variation of period with amplitude was at one time a hindrance to the accurate performance of pendulum clocks, since the errors produced are cumulative. It was therefore sought to replace the circular pendulum by some other contrivance free from this defect. The equation of motion of a particle in any smooth path is

$$\frac{d^2s}{dt^2}=-g\sin\psi, \tag{21}$$

where ψ is the inclination of the tangent to the horizontal. If $\sin\psi$ were accurately and not merely approximately proportional to the arc s, say

$$s=k\sin\psi, \tag{22}$$

the equation (21) would assume the same form as § 12 (5). The motion along the arc would then be accurately simple-harmonic, and the period $2\pi\sqrt{(k/g)}$ would be the same for all amplitudes. Now equation (22) is the intrinsic equation of a cycloid; viz. the curve is that traced by a point on the circumference of a circle of radius $\frac{1}{4}k$ which rolls on the under side of a horizontal straight line. Since the evolute of a cycloid is an equal cycloid the object is attained by means of two metal cheeks, having the form of the evolute near the cusp, on which the string wraps itself alternately as the pendulum swings. The device has long been abandoned, the difficulty being met in other ways, but the problem, originally investigated by C. Huygens, is important in the history of mathematics.

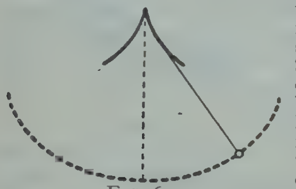

FIG. 67.

The component accelerations of a point describing a tortuous curve, in the directions of the tangent, the principal normal, and the binormal, respectively, are found as follows. If $\overrightarrow{OV}$, $\overrightarrow{OV'}$ be vectors representing the velocities at two consecutive points P, P′ of the path, the plane VOV′ is ultimately parallel to the osculating plane of the path at P; the resultant acceleration is therefore in the osculating plane. Also, the projections of $\overrightarrow{VV'}$ on OV and on a perpendicular to OV in the plane VOV′ are δv and $v\delta\epsilon$, where $\delta\epsilon$ is the angle between the directions of the tangents at P,P′. Since $\delta\epsilon=\delta s/\rho$, where $\delta s=\text{PP}'=v\delta t$ and ρ is the radius of principal curvature at P, the component accelerations along the tangent and principal normal are dv/dt and $vd\epsilon/dt$, respectively, or vdv/ds and v^2/ρ. For example, if a particle moves on a smooth surface, under no forces except the reaction of the surface, v is constant, and the principal normal to the path will coincide with the normal to the surface. Hence the path is a "geodesic" on the surface.

If we resolve along the tangent to the path (whether plane or tortuous), the equation of motion of a particle may be written

$$mv\frac{dv}{ds}=\mathfrak{T}, \tag{23}$$

where $\mathfrak{T}$ is the tangential component of the force. Integrating with respect to s we find

$$\tfrac{1}{2}mv_1^2-\tfrac{1}{2}mv_0^2=\int_{s_0}^{s_1}\mathfrak{T}ds; \tag{24}$$

i.e. the increase of kinetic energy between any two positions is equal to the work done by the forces. The result follows also from the Cartesian equations (2); viz. we have

$$m(\dot{x}\ddot{x}+\dot{y}\ddot{y}+\dot{z}\ddot{z})=\text{X}\dot{x}+\text{Y}\dot{y}+\text{Z}\dot{z}, \tag{25}$$

whence, on integration with respect to t,

$$\begin{aligned}\tfrac{1}{2}m(\dot{x}^2+\dot{y}^2+\dot{z}^2)&=\int(\text{X}\dot{x}+\text{Y}\dot{y}+\text{Z}\dot{z})dt+\text{const.}\\&=\int(\text{X}dx+\text{Y}dy+\text{Z}dz)+\text{const.}\end{aligned} \tag{26}$$

If the axes be rectangular, this has the same interpretation as (24).

Suppose now that we have a constant field of force; *i.e.* the force acting on the particle is always the same at the same place. The work which must be done by forces extraneous to the field in order to bring the particle from rest in some standard position A to rest in any other position P will not necessarily be the same for all paths between A and P. If it is different for different paths, then by bringing the particle from A to P by one path, and back again from P to A by another, we might secure a gain of work, and the process could be repeated indefinitely. If the work required is the same for all paths between A and P, and therefore zero for a closed circuit, the field is said to be *conservative*. In this case the work required to bring the particle from rest at A to rest at P is called the *potential energy* of the particle in the position P; we denote it by V. If PP′ be a linear element δs drawn in any direction from P, and S be the force due to the field, resolved in the direction PP′, we have $\delta\text{V}=-\text{S}\delta s$ or

$$\text{S}=-\frac{\partial\text{V}}{\partial s}. \tag{27}$$

In particular, by taking PP′ parallel to each of the (rectangular) co-ordinate axes in succession, we find

$$\text{X}=-\frac{\partial\text{V}}{\partial x},\ \text{Y}=-\frac{\partial\text{V}}{\partial y},\ \text{Z}=-\frac{\partial\text{V}}{\partial z}. \tag{28}$$

The equation (24) or (26) now gives

$$\tfrac{1}{2}mv_1^2+\text{V}_1=\tfrac{1}{2}mv_0^2+\text{V}_0; \tag{29}$$

i.e. the sum of the kinetic and potential energies is constant when no work is done by extraneous forces. For example, if the field be that due to gravity we have $\text{V}=\int mgdy=mgy+$ const., if the axis of y be drawn vertically upwards; hence

$$\tfrac{1}{2}mv^2+mgy=\text{const.} \tag{30}$$

This applies to motion on a smooth curve, as well as to the free motion of a projectile; cf. (7), (14). Again, in the case of a force Kr towards O, where r denotes distance from O we have $\text{V}=\int\text{K}rdr=\frac{1}{2}\text{K}r^2+$const., whence

$$\tfrac{1}{2}mv^2+\tfrac{1}{2}\text{K}r^2=\text{const.} \tag{31}$$

It has been seen that the orbit is in this case an ellipse; also that if we put $\mu=\text{K}/m$ the velocity at any point P is $v=\sqrt{\mu}.\,\text{OD}$, where OD is the semi-diameter conjugate to OP. Hence (31) is consistent with the known property of the ellipse that OP^2+OD^2 is constant.

The forms assumed by the dynamical equations when the axes of reference are themselves in motion will be considered in § 21. At present we take only the case where the rectangular axes Ox, Oy rotate in their own plane, with angular velocity ω about Oz, which is fixed. In the interval δt the projections of the line joining the origin to any point (x, y, z) on the directions of the co-ordinate axes at time t are changed from x, y, z to $(x+\delta x)\cos\omega\delta t-(y+\delta y)\sin\omega\delta t$, $(x+\delta x)\sin\omega\delta t+(y+\delta y)\cos\omega\delta t$, z respectively. Hence the component velocities parallel to the instantaneous positions of the co-ordinate axes at time t are

$$u=\dot{x}-\omega y,\ v=\dot{y}+\omega x,\ w=\dot{z}. \tag{32}$$

In the same way we find that the component accelerations are

$$\dot{u}-\omega v,\ \dot{v}+\omega u,\ \dot{w}. \tag{33}$$

Hence if ω be constant the equations of motion take the forms

$$m(\ddot{x}-2\omega\dot{y}-\omega^2x)=\text{X},\ m(\ddot{y}+2\omega\dot{x}-\omega^2y)=\text{Y},\ m\ddot{z}=\text{Z}. \tag{34}$$

These become identical with the equations of motion relative to fixed axes provided we introduce a fictitious force $m\omega^2r$ acting outwards from the axis of z, where $r=\sqrt{(x^2+y^2)}$, and a second fictitious force $2m\omega v$ at right angles to the path, where v is the component of the relative velocity parallel to the plane xy. The former force is called by French writers the *force centrifuge ordinaire*, and the latter the *force centrifuge composée*, or *force de Coriolis*. As an application of (34) we may take the case of a symmetrical Blackburn's pendulum hanging from a horizontal bar which is made to rotate about a vertical axis half-way between the points of attachment of the upper string. The equations of small motion are then of the type

$$\ddot{x}-2\omega\dot{y}-\omega^2x=-p^2x, \ddot{y}+2\omega\dot{x}-\omega^2y=-q^2y. \tag{35}$$

This is satisfied by

$$\ddot{x}=A\cos(\sigma t+\epsilon),\ y=B\sin(\sigma t+\epsilon), \tag{36}$$

provided

$$\left.\begin{aligned}(\sigma^2+\omega^2-p^2)A+2\sigma\omega B=0,\\ 2\sigma\omega A+(\sigma^2+\omega^2-q^2)B=0.\end{aligned}\right\} \tag{37}$$

Eliminating the ratio A:B we have

$$(\sigma^2+\omega^2-p^2)(\sigma^2+\omega^2-q^2)-4\sigma^2\omega^2=0. \tag{38}$$

It is easily proved that the roots of this quadratic in σ^2 are always real, and that they are moreover both positive unless ω^2 lies between p^2 and q^2. The ratio B/A is determined in each case by either of the equations (37); hence each root of the quadratic gives a solution of the type (36), with two arbitrary constants A, ϵ. Since the equations (35) are linear, these two solutions are to be superposed. If the quadratic (38) has a negative root, the trigonometrical functions in (36) are to be replaced by real exponentials, and the position $x=0$, $y=0$ is unstable. This occurs only when the period $(2\pi/\omega)$ of revolution of the arm lies between the two periods $(2\pi/p,\ 2\pi/q)$ of oscillation when the arm is fixed.

§ 14. *Central Forces. Hodograph.*—The motion of a particle subject to a force which passes always through a fixed point O is necessarily in a plane orbit. For its investigation we require two equations; these may be obtained in a variety of forms.

Since the impulse of the force in any element of time δt has zero moment about O, the same will be true of the additional momentum generated. Hence the moment of the momentum (considered as a localized vector) about O will be constant. In symbols, if v be the velocity and p the perpendicular from O to the tangent to the path,

$$pv=h, \tag{1}$$

where h is a constant. If δs be an element of the path, $p\delta s$ is twice the area enclosed by δs and the radii drawn to its extremities from O. Hence if δA be this area, we have $\delta A=\frac{1}{2}\ p\delta s=\frac{1}{2}\ h\delta t$, or

$$\frac{dA}{dt}=\tfrac{1}{2}h. \tag{2}$$

Hence equal areas are swept over by the radius vector in equal times.

If P be the acceleration towards O, we have

$$v\frac{dv}{ds}=-P\frac{dr}{ds}, \tag{3}$$

since dr/ds is the cosine of the angle between the directions of r and δs. We will suppose that P is a function of r only; then integrating (3) we find

$$\tfrac{1}{2}v^2=-\int P\,dr+\text{const.}, \tag{4}$$

which is recognized as the equation of energy. Combining this with (1) we have

$$\frac{h^2}{p^2}=C-2\int P\,dr, \tag{5}$$

which completely determines the path except as to its orientation with respect to O.

If the law of attraction be that of the inverse square of the distance, we have $P=\mu/r^2$, and

$$\frac{h^2}{p^2}=C+\frac{2\mu}{r}. \tag{6}$$

Now in a conic whose focus is at O we have

$$\frac{l}{p^2}=\frac{2}{r}\mp\frac{1}{a}, \tag{7}$$

where l is half the latus-rectum, a is half the major axis, and the upper or lower sign is to be taken according as the conic is an ellipse or hyperbola. In the intermediate case of the parabola we have $a=\infty$ and the last term disappears. The equations (6) and (7) are identified by putting

$$l=h^2/\mu,\ a=\mp\mu/C. \tag{8}$$

Since

$$v^2=\frac{h^2}{p^2}=\mu\left(\frac{2}{r}\mp\frac{1}{a}\right), \tag{9}$$

it appears that the orbit is an ellipse, parabola or hyperbola, according as v^2 is less than, equal to, or greater than $2\mu/r$. Now it appears from (6) that $2\mu/r$ is the square of the velocity which would be acquired by a particle falling from rest at infinity to the distance r. Hence the character of the orbit depends on whether the velocity at any point is less than, equal to, or greater than the *velocity from infinity*, as it is called. In an elliptic orbit the area πab is swept over in the time

$$\tau=\frac{\pi ab}{\frac{1}{2}h}=\frac{2\pi a^{\frac{3}{2}}}{\sqrt{\mu}}, \tag{10}$$

since $h=\mu^{\frac{1}{2}}l^{\frac{1}{2}}=\mu^{\frac{1}{2}}ba^{-\frac{1}{2}}$ by (8).

The converse problem, to determine the law of force under which a given orbit can be described about a given pole, is solved by differentiating (5) with respect to r; thus

$$P=\frac{h^2dp}{p^3dr}. \tag{11}$$

In the case of an ellipse described about the centre as pole we have

$$\frac{a^2b^2}{p^2}=a^2+b^2-r^2; \tag{12}$$

hence $P=\mu r$, if $\mu=h^2/a^2b^2$. This merely shows that a particular ellipse may be described under the law of the direct distance provided the circumstances of projection be suitably adjusted. But since an ellipse can always be constructed with a given centre so as to touch a given line at a given point, and to have a given value of $ab(=h/\sqrt{\mu})$ we infer that the orbit will be elliptic whatever the initial circumstances. Also the period is $2\pi ab/h=2\pi/\sqrt{\mu}$, as previously found.

Again, in the equiangular spiral we have $p=r\sin\alpha$, and therefore $P=\mu/r^3$, if $\mu=h^2/\sin^2\alpha$. But since an equiangular spiral having a given pole is completely determined by a given point and a given tangent, this type of orbit is not a general one for the law of the inverse cube. In order that the spiral may be described it is necessary that the velocity of projection should be adjusted to make $h=\sqrt{\mu}.\sin\alpha$. Similarly, in the case of a circle with the pole on the circumference we have $p^2=r^2/2a$, $P=\mu/r^5$, if $\mu=8h^2a^2$; but this orbit is not a general one for the law of the inverse fifth power.

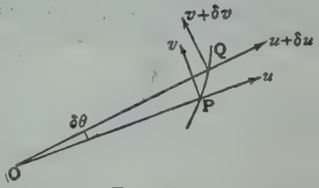

FIG. 68.

In astronomical and other investigations relating to central forces it is often convenient to use polar co-ordinates with the centre of force as pole. Let P, Q be the positions of a moving point at times t, $t+\delta t$, and write $OP=r$, $OQ=r+\delta r$, $\angle POQ=\delta\theta$, O being any fixed origin. If u, v be the component velocities at P along and perpendicular to OP (in the direction of θ increasing), we have

$$u=\lim.\frac{\delta r}{\delta t}=\frac{dr}{dt},\ v=\lim.\frac{r\delta\theta}{\delta t}=r\frac{d\theta}{dt}. \tag{13}$$

Again, the velocities parallel and perpendicular to OP change in the time δt from u, v to $u-v\delta\theta$, $v+u\delta\theta$, ultimately. The component accelerations at P in these directions are therefore

$$\left.\begin{aligned}\frac{du}{dt}-v\frac{d\theta}{dt}=\frac{d^2r}{dt^2}-r\left(\frac{d\theta}{dt}\right)^2,\\ \frac{dv}{dt}+u\frac{d\theta}{dt}=\frac{1}{r}\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right),\end{aligned}\right\} \tag{14}$$

respectively.

In the case of a central force, with O as pole, the transverse acceleration vanishes, so that

$$r^2d\theta/dt=h, \tag{15}$$

where h is constant; this shows (again) that the radius vector sweeps over equal areas in equal times. The radial resolution gives

$$\frac{d^2r}{dt^2}-r\left(\frac{d\theta}{dt}\right)^2=-P, \tag{16}$$

where P, as before, denotes the acceleration towards O. If in this we put $r=1/u$, and eliminate t by means of (15), we obtain the general differential equation of central orbits, viz.

$$\frac{d^2u}{d\theta^2}+u=\frac{P}{h^2u^2}. \tag{17}$$

If, for example, the law be that of the inverse square, we have $P=\mu u^2$, and the solution is of the form

$$u=\frac{\mu}{h^2}\{1+e\cos(\theta-\alpha)\}, \tag{18}$$

where e, α are arbitrary constants. This is recognized as the polar equation of a conic referred to the focus, the half latus-rectum being h^2/μ.

The law of the inverse cube $P=\mu u^3$ is interesting by way of contrast. The orbits may be divided into two classes according as $h^2 \gtrless \mu$, *i.e.* according as the transverse velocity (hu) is greater or less than the velocity $\sqrt{\mu}.u$ appropriate to a circular orbit at the same distance. In the former case the equation (17) takes the form

$$\frac{d^2u}{d\theta^2}+m^2u=0, \tag{19}$$

the solution of which is

$$au=\sin m\,(\theta-\alpha). \tag{20}$$

The orbit has therefore two asymptotes, inclined at an angle π/m. In the latter case the differential equation is of the form

$$\frac{d^2u}{d\theta^2}=m^2u, \tag{21}$$

so that

$$u=Ae^{m\theta}+Be^{-m\theta} \tag{22}$$

If A, B have the same sign, this is equivalent to

$$au=\cosh m\theta, \tag{23}$$

if the origin of θ be suitably adjusted; hence r has a maximum value a, and the particle ultimately approaches the pole asymptotically by an infinite number of convolutions. If A, B have opposite signs the form is

$$au=\sinh m\theta, \tag{24}$$

this has an asymptote parallel to $\theta=0$, but the path near the origin has the same general form as in the case of (23). If A or B vanish we have an equiangular spiral, and the velocity at infinity is zero. In the critical case of $h^2=\mu$, we have $d^2u/d\theta^2=0$, and

$$u=A\theta+B; \tag{25}$$

the orbit is therefore a "reciprocal spiral," except in the special case of $A=0$, when it is a circle. It will be seen that unless the conditions be exactly adjusted for a circular orbit the particle will either recede to infinity or approach the pole asymptotically. This problem was investigated by R. Cotes (1682–1716), and the various curves obtained are known as *Cotes's spirals.*

A point on a central orbit where the radial velocity (dr/dt) vanishes is called an *apse*, and the corresponding radius is called an *apse-line.* If the force is always the same at the same distance any apse-line will divide the orbit symmetrically, as is seen by imagining the velocity at the apse to be reversed. It follows that the angle between successive apse-lines is constant; it is called the *apsidal angle* of the orbit.

If in a central orbit the velocity is equal to the velocity from infinity, we have, from (5),

$$\frac{h^2}{p^2}=2\int_r^\infty P\,dr; \tag{26}$$

this determines the form of the *critical orbit*, as it is called. If $P=\mu/r^n$, its polar equation is

$$r^m \cos m\theta=a^m, \tag{27}$$

where $m=\frac{1}{2}(3-n)$, except in the case $n=3$, when the orbit is an equiangular spiral. The case $n=2$ gives the parabola as before.

If we eliminate $d\theta/dt$ between (15) and (16) we obtain

$$\frac{d^2r}{dt^2}-\frac{h^2}{r^3}=-P=-f(r),$$

say. We may apply this to the investigation of the stability of a circular orbit. Assuming that $r=a+x$, where x is small, we have, approximately,

$$\frac{d^2x}{dt^2}-\frac{h^2}{a^3}\left(1-\frac{3x}{a}\right)=-f(a)-xf'(a).$$

Hence if h and a be connected by the relation $h^2=a^3f(a)$ proper to a circular orbit, we have

$$\frac{d^2x}{dt^2}+\left\{f'(a)+\frac{3}{a}f(a)\right\}x=0. \tag{28}$$

If the coefficient of x be positive the variations of x are simple-harmonic, and x can remain permanently small; the circular orbit is then said to be stable. The condition for this may be written

$$\frac{d}{da}\{a^3f(a)\}>0, \tag{29}$$

i.e. the intensity of the force in the region for which $r=a$, nearly, must diminish with increasing distance less rapidly than according to the law of the inverse cube. Again, the half-period of x is $\pi/\sqrt{\{f'(a)+3a^{-1}f(a)\}}$, and since the angular velocity in the orbit is h/a^2, approximately, the apsidal angle is, ultimately,

$$\pi\sqrt{\left\{\frac{f(a)}{af'(a)+3f(a)}\right\}}, \tag{30}$$

or, in the case of $f(a)=\mu/r^n$, $\pi/\sqrt{(3-n)}$. This is in agreement with the known results for $n=2$, $n=-1$.

We have seen that under the law of the inverse square all finite orbits are elliptical. The question presents itself whether there then is any other law of force, giving a finite velocity from infinity, under which all finite orbits are necessarily closed curves. If this is the case, the apsidal angle must evidently be commensurable with π, and since it cannot vary discontinuously the apsidal angle in a nearly circular orbit must be constant. Equating the expression (30) to π/m, we find that $f(a)=C/a^n$, where $n=3-m^2$. The force must therefore vary as a power of the distance, and n must be less than 3. Moreover, the case $n=2$ is the only one in which the critical orbit (27) can be regarded as the limiting form of a closed curve. Hence the only law of force which satisfies the conditions is that of the inverse square.

At the beginning of § 13 the velocity of a moving point P was represented by a vector $\overrightarrow{OV}$ drawn from a fixed origin O. The locus of the point V is called the *hodograph* (*q.v.*); and it appears that the velocity of the point V along the hodograph represents in magnitude and in direction the acceleration in the original orbit. Thus in the case of a plane orbit, if v be the velocity of P, ψ the inclination of the direction of motion to some fixed direction, the polar co-ordinates of V may be taken to be v, ψ; hence the velocities of V along and perpendicular to OV will be dv/dt and $vd\psi/dt$. These expressions therefore give the tangential and normal accelerations of P; cf. § 13 (12).

In the motion of a projectile under gravity the hodograph is a vertical line described with constant velocity. In elliptic harmonic motion the velocity of P is parallel and proportional to the semi-diameter CD which is conjugate to the radius CP; the hodograph is therefore an ellipse similar to the actual orbit. In the case of a central orbit described under the law of the inverse square we have $v=h/SY=h.\,SZ/b^2$, where S is the centre of force, SY is the perpendicular to the tangent at P, and Z is the point where YS meets the auxiliary circle again. Hence the hodograph is similar and similarly situated to the locus of Z (the auxiliary circle) turned about S through a right angle. This applies to an elliptic or hyperbolic orbit; the case of the parabolic orbit may be examined separately or treated as a limiting case. The annexed fig. 70 exhibits the various cases, with the hodograph in its proper orientation. The pole O of the hodograph is inside on or outside the circle, according as the orbit is an ellipse, parabola or hyperbola. In any case of a central orbit the hodograph (when turned through a right angle) is similar and similarly situated to the "reciprocal polar" of the orbit with respect to the centre of force. Thus for a circular orbit with the centre of force at an excentric point, the hodograph is a conic with the pole as focus. In the case of a particle oscillating under gravity on a smooth cycloid from rest at the cusp the hodograph is a circle through the pole, described with constant velocity.

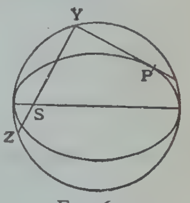

FIG. 69.

§ 15. *Kinetics of a System of Discrete Particles.*—The momenta of the several particles constitute a system of localized vectors which, for purposes of resolving and taking moments, may be reduced like a system of forces in statics (§ 8). Thus taking any point O as base, we have first a *linear momentum* whose components referred to rectangular axes through O are

$$\Sigma(m\dot{x}),\ \Sigma(m\dot{y}),\ \Sigma(m\dot{z}); \tag{1}$$

its representative vector is the same whatever point O be chosen. Secondly, we have an *angular momentum* whose components are

$$\Sigma\{m(y\dot{z}-z\dot{y})\},\ \Sigma\{m(z\dot{x}-x\dot{z})\},\ \Sigma\{m(x\dot{y}-y\dot{x})\}, \tag{2}$$

these being the sums of the moments of the momenta of the several particles about the respective axes. This is subject to the same relations as a couple in statics; it may be represented by a vector which will, however, in general vary with the position of O.

The linear momentum is the same as if the whole mass were concentrated at the centre of mass G, and endowed with the velocity of this point. This follows at once from equation (8) of § 11, if we imagine the two configurations of the system there referred to to be those corresponding to the instants t, $t+\delta t$. Thus

$$\Sigma\left(m.\frac{\overrightarrow{PP}}{\delta t}\right)=\Sigma(m)\cdot\frac{\overrightarrow{GG'}}{\delta t}. \tag{3}$$

Analytically we have

$$\Sigma(m\dot{x})=\frac{d}{dt}\Sigma(mx)=\Sigma(m)\cdot\frac{d\bar{x}}{dt}. \tag{4}$$

with two similar formulae.

Again, if the instantaneous position of G be taken as base, the angular momentum of the absolute motion is the same as the angular momentum of the motion relative to G. For the velocity of a particle m at P may be replaced by two components one of which ($\bar{v}$) is identical in magnitude and direction with the velocity of G, whilst the other (v) is the velocity relative to G.

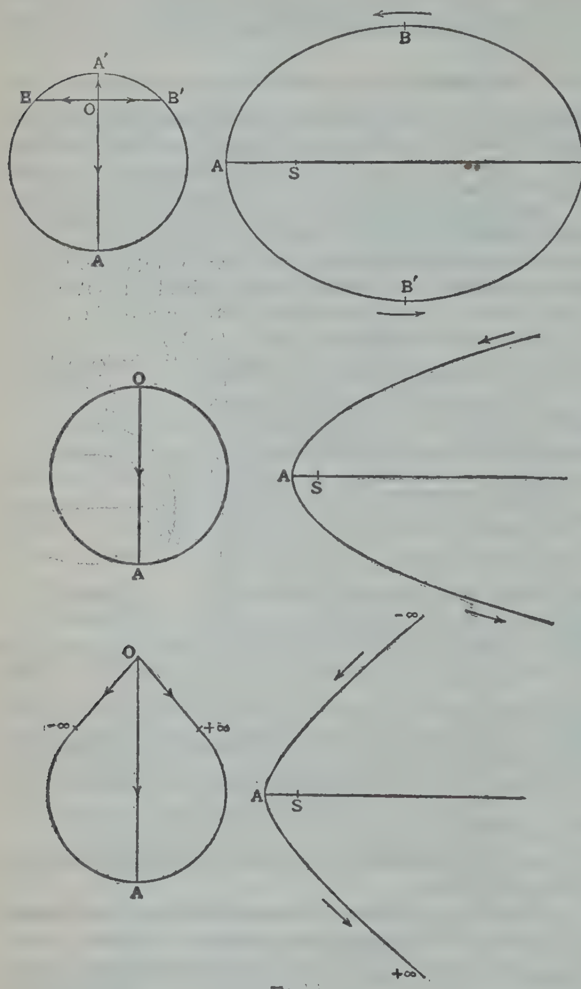

FIG. 70.

The aggregate of the components $m\bar{v}$ of momentum is equivalent to a single localized vector $\Sigma(m).\bar{v}$ in a line through G, and has therefore zero moment about any axis through G; hence in taking moments about such an axis we need only regard the velocities relative to G. In symbols, we have

$$\Sigma\{m(y\dot{z}-z\dot{y})\}=\Sigma(m).\left(\bar{y}\frac{d\bar{z}}{dt}-\bar{z}\frac{d\bar{y}}{dt}\right)+\Sigma\{m(\eta\dot{\zeta}-\zeta\dot{\eta})\}. \qquad (5)$$

since $\Sigma(m\xi)=0$, $\Sigma(m\dot{\xi})=0$, and so on, the notation being as in § 11. This expresses that the moment of momentum about any fixed axis (*e.g.* Ox) is equal to the moment of momentum of the motion relative to G about a parallel axis through G, together with the moment of momentum of the whole mass supposed concentrated at G and moving with this point. If in (5) we make O coincide with the instantaneous position of G, we have $\bar{x}, \bar{y}, \bar{z}=0$, and the theorem follows.

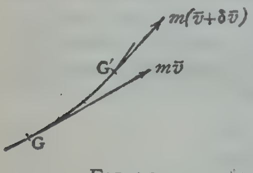

FIG. 71

Finally, the rates of change of the components of the angular momentum of the motion relative to G referred to G as a moving base, are equal to the rates of change of the corresponding components of angular momentum relative to a fixed base coincident with the instantaneous position of G. For let G′ be a consecutive position of G. At the instant $t+\delta t$ the momenta of the system are equivalent to a linear momentum represented by a localized vector $\Sigma(m).(\bar{v}+\delta\bar{v})$ in a line through G′ tangential to the path of G′, together with a certain angular momentum. Now the moment of this localized vector with respect to any axis through G is zero, to the first order of δt, since the perpendicular distance of G from the tangent line at G′ is of the order $(\delta t)^2$. Analytically we have from (5),

$$\frac{d}{dt}\Sigma\{m(y\dot{z}-z\dot{y})\}=\Sigma(m).\left(\bar{y}\frac{d^2\bar{z}}{dt^2}-\bar{z}\frac{d^2\bar{y}}{dt^2}\right)+\frac{d}{dt}\Sigma\{m(\eta\dot{\zeta}-\zeta\dot{\eta})\}. \qquad (6)$$

If we put $\bar{x}, \bar{y}, \bar{z}=0$, the theorem is proved as regards axes parallel to Ox.

Next consider the kinetic energy of the system. If from a fixed point O we draw vectors $\overrightarrow{OV_1}$, $\overrightarrow{OV_2}$ . . . to represent the velocities of the several particles m_1, m_2, . . . , and if we construct the vector

$$\overrightarrow{OK}=\frac{\Sigma(m.\overrightarrow{OV})}{\Sigma(m)} \qquad (7)$$

this will represent the velocity of the mass-centre, by (3). We find, exactly as in the proof of Lagrange's First Theorem (§ 11), that

$$\tfrac{1}{2}\Sigma(m.OV^2)=\tfrac{1}{2}\Sigma(m).OK^2+\tfrac{1}{2}\Sigma(m.KV^2); \qquad (8)$$

i.e. the total kinetic energy is equal to the kinetic energy of the whole mass supposed concentrated at G and moving with this point, together with the kinetic energy of the motion relative to G. The latter may be called the *internal kinetic energy* of the system. Analytically we have

$$\tfrac{1}{2}\Sigma\{m(\dot{x}^2+\dot{y}^2+\dot{z}^2)\}=\tfrac{1}{2}\Sigma(m)\cdot\left\{\left(\frac{d\bar{x}}{dt}\right)^2+\left(\frac{d\bar{y}}{dt}\right)^2+\left(\frac{d\bar{z}}{dt}\right)^2\right\}$$
$$+\tfrac{1}{2}\Sigma\{m(\dot{\xi}^2+\dot{\eta}^2+\dot{\zeta}^2)\}. \qquad (9)$$

There is also an analogue to Lagrange's Second Theorem, viz.

$$\tfrac{1}{2}\Sigma(m.KV^2)=\tfrac{1}{2}\frac{\Sigma\Sigma(m_p m_q.V_pV_q{}^2)}{\Sigma(m)}, \qquad (10)$$

which expresses the internal kinetic energy in terms of the relative velocities of the several pairs of particles. This formula is due to Möbius.

The preceding theorems are purely kinematical. We have now to consider the effect of the forces acting on the particles. These may be divided into two categories; we have first, the *extraneous forces* exerted on the various particles from without, and, secondly, the mutual or *internal forces* between the various pairs of particles. It is assumed that these latter are subject to the law of equality of action and reaction. If the equations of motion of each particle be formed separately, each such internal force will appear twice over, with opposite signs for its components, viz. as affecting the motion of each of the two particles between which it acts. The full working out is in general difficult, the comparatively simple problem of "three bodies," for instance, in gravitational astronomy being still unsolved, but some general theorems can be formulated.

The first of these may be called the *Principle of Linear Momentum.* If there are no extraneous forces, the resultant linear momentum is constant in every respect. For consider any two particles at P and Q, acting on one another with equal and opposite forces in the line PQ. In the time δt a certain impulse is given to the first particle in the direction (say) from P to Q, whilst an equal and opposite impulse is given to the second in the direction from Q to P. Since these impulses produce equal and opposite momenta in the two particles, the resultant linear momentum of the system is unaltered. If extraneous forces act, it is seen in like manner that the resultant linear momentum of the system is in any given time modified by the geometric addition of the total impulse of the extraneous forces. It follows, by the preceding kinematic theory, that the mass-centre G of the system will move exactly as if the whole mass were concentrated there and were acted on by the extraneous forces applied parallel to their original directions. For example, the mass-centre of a system free from extraneous force will describe a straight line with constant velocity. Again, the mass-centre of a chain of particles connected by strings, projected anyhow under gravity, will describe a parabola.

The second general result is the *Principle of Angular Momentum.* If there are no extraneous forces, the moment of momentum about any fixed axis is constant. For in time δt the mutual action between two particles at P and Q produces equal and opposite momenta in the line PQ, and these will have equal and opposite moments about the fixed axis. If extraneous forces act, the total angular momentum about any fixed axis is in time δt increased by the total extraneous impulse about that axis. The kinematical relations above explained now lead to the conclusion that in calculating the effect of extraneous forces in an infinitely short time δt we may take moments about an axis passing through the instantaneous position of G exactly as if G were fixed; moreover, the result will be the same whether in this process we employ the true velocities of the particles or merely their velocities relative to G. If there are no extraneous forces, or if the extraneous forces have zero moment about any axis through G, the vector which represents the resultant angular momentum relative to G is constant in every respect. A plane through G perpendicular to this vector has a fixed direction in space, and is called the *invariable plane*; it may sometimes be conveniently used as a plane of reference.

For example, if we have two particles connected by a string, the invariable plane passes through the string, and if ω be the angular velocity in this plane, the angular momentum relative to G is

$$m_1\omega_1 r_1 . r_1 + m_2\omega r_2 . r_2 = (m_1 r_1^2 + m_2 r_2^2)\omega,$$

where r_1, r_2 are the distances of m_1, m_2 from their mass-centre G. Hence if the extraneous forces (*e.g.* gravity) have zero moment about G, ω will be constant. Again, the tension R of the string is given by

$$\mathrm{R} = m_1\omega^2 r_1 = \frac{m_1 m_2}{m_1+m_2}\omega^2 a,$$

where $a = r_1 + r_2$. Also by (10) the internal kinetic energy is

$$\tfrac{1}{2}\frac{m_1 m_2}{m_1+m_2}\omega^2 a^2.$$

The increase of the kinetic energy of the system in any interval of time will of course be equal to the total work done by all the forces acting on the particles. In many questions relating to systems of discrete particles the internal force R_{pq} (which we will reckon positive when attractive) between any two particles m_p, m_q is a function only of the distance r_{pq} between them. In this case the work done by the internal forces will be represented by

$$-\Sigma\int \mathrm{R}_{pq}\,dr_{pq},$$

when the summation includes every pair of particles, and each integral is to be taken between the proper limits. If we write

$$\mathrm{V} = \Sigma\int \mathrm{R}_{pq}\,dr_{pq}, \qquad (11)$$

when r_{pq} ranges from its value in some standard configuration A of the system to its value in any other configuration P, it is plain that V represents the work which would have to be done in order to bring the system from rest in the configuration A to rest in the configuration P. Hence V is a definite function of the configuration P; it is called the *internal potential energy.* If T denote the kinetic energy, we may say then that the sum T + V is in any interval of time increased by an amount equal to the work done by the extraneous forces. In particular, if there are no extraneous forces T + V is constant. Again, if some of the extraneous forces are due to a conservative field of force, the work which they do may be reckoned as a diminution of the potential energy relative to the field as in § 13.

§ 16. *Kinetics of a Rigid Body. Fundamental Principles.*—When we pass from the consideration of discrete particles to that of continuous distributions of matter, we require some physical postulate over and above what is contained in the Laws of Motion, in their original formulation. This additional postulate may be introduced under various forms. One plan is to assume that any body whatever may be treated as if it were composed of material particles, *i.e.* mathematical points endowed with inertia coefficients, separated by finite intervals, and acting on one another with forces in the lines joining them subject to the law of equality of action and reaction. In the case of a rigid body we must suppose that those forces adjust themselves so as to preserve the mutual distances of the various particles unaltered. On this basis we can predicate the principles of linear and angular momentum, as in § 15.

An alternative procedure is to adopt the principle first formally enunciated by J. Le R. d'Alembert and since known by his name. If x, y, z be the rectangular co-ordinates of a mass-element m, the expressions $m\ddot{x}$, $m\ddot{y}$, $m\ddot{z}$ must be equal to the components of the total force on m, these forces being partly extraneous and partly forces exerted on m by other mass elements of the system. Hence $(m\ddot{x}, m\ddot{y}, m\ddot{z})$ is called the actual or *effective* force on m. According to d'Alembert's formulation, the extraneous forces together with the *effective forces reversed* fulfil the statical conditions of equilibrium. In other words, the whole assemblage of effective forces is statically equivalent to the extraneous forces. This leads, by the principles of § 8, to the equations

$$\left.\begin{aligned} \Sigma(m\ddot{x}) = \mathrm{X},\ \Sigma(m\ddot{y}) = \mathrm{Y},\ \Sigma(m\ddot{z}) = \mathrm{Z}, \\ \Sigma\{m(y\ddot{z}-z\ddot{y})\} = \mathrm{L},\ \Sigma\{m(z\ddot{x}-x\ddot{z})\} = \mathrm{M},\ \Sigma\{m(x\ddot{y}-y\ddot{x})\} = \mathrm{N}, \end{aligned}\right\} \qquad (1)$$

where (X, Y, Z) and (L, M, N) are the force—and couple—constituents of the system of extraneous forces, referred to O as base, and the summations extend over all the mass-elements of the system. These equations may be written

$$\left.\begin{aligned} \frac{d}{dt}\Sigma(m\dot{x}) = \mathrm{X},\ \frac{d}{dt}\Sigma(m\dot{y}) = \mathrm{Y},\ \frac{d}{dt}\Sigma(m\dot{z}) = \mathrm{Z}, \\ \frac{d}{dt}\Sigma\{m(y\dot{z}-z\dot{y})\} = \mathrm{L},\ \frac{d}{dt}\Sigma\{m(z\dot{x}-x\dot{z})\} = \mathrm{M},\ \frac{d}{dt}\Sigma\{m(x\dot{y}-y\dot{x})\} = \mathrm{N}, \end{aligned}\right\} \qquad (2)$$

and so express that the rate of change of the linear momentum in any fixed direction (*e.g.* that of Ox) is equal to the total extraneous force in that direction, and that the rate of change of the angular momentum about any fixed axis is equal to the moment of the extraneous forces about that axis. If we integrate with respect to t between fixed limits, we obtain the principles of linear and angular momentum in the form previously given. Hence, whichever form of postulate we adopt, we are led to the principles of linear and angular momentum, which form in fact the basis of all our subsequent work. It is to be noticed that the preceding statements are not intended to be restricted to rigid bodies; they are assumed to hold for all material systems whatever. The peculiar status of rigid bodies is that the principles in question are in most cases sufficient for the complete determination of the motion, the dynamical equations (1 or 2) being equal in number to the degrees of freedom (six) of a rigid solid, whereas in cases where the freedom is greater we have to invoke the aid of other supplementary physical hypotheses (cf. ELASTICITY; HYDROMECHANICS).

The increase of the kinetic energy of a rigid body in any interval of time is equal to the work done by the extraneous forces acting on the body. This is an immediate consequence of the fundamental postulate, in either of the forms above stated, since the internal forces do on the whole no work. The statement may be extended to a system of rigid bodies, provided the mutual reactions consist of the stresses in inextensible links, or the pressures between smooth surfaces, or the reactions at rolling contacts (§ 9).

§ 17. *Two-dimensional Problems.*—In the case of rotation about a fixed axis, the principles take a very simple form. The position of the body is specified by a single co-ordinate, viz. the angle θ through which some plane passing through the axis and fixed in the body has turned from a standard position in space. Then $d\theta/dt, = \omega$ say, is the *angular velocity* of the body. The angular momentum of a particle m at a distance r from the axis is $m\omega r.r$, and the total angular momentum is $\Sigma(mr^2) . \omega$, or Iω, if I denote the moment of inertia (§ 11) about the axis. Hence if N be the moment of the extraneous forces about the axis, we have

$$\frac{d}{dt}(\mathrm{I}\omega) = \mathrm{N}. \qquad (1)$$

This may be compared with the equation of rectilinear motion of a particle, viz. $d/dt.(\mathrm{M}u) = \mathrm{X}$; it shows that I measures the inertia of the body as regards rotation, just as M measures its inertia as regards translation. If N = 0, ω is constant.

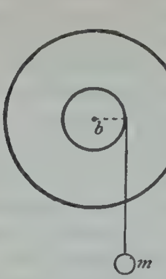

FIG. 72.

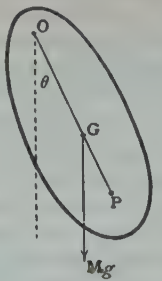

FIG. 73.

As a first example, suppose we have a flywheel free to rotate about a horizontal axis, and that a weight m hangs by a vertical string from the circumferences of an axle of radius b (fig. 72). Neglecting frictional resistance we have, if R be the tension of the string,

$$I\dot{\omega} = Rb, \quad m\dot{u} = mg - R,$$

whence

$$b\dot{\omega} = \frac{mb^2}{I + mb^2} g. \tag{2}$$

This gives the acceleration of m as modified by the inertia of the wheel.

A "compound pendulum" is a body of any form which is free to rotate about a fixed horizontal axis, the only extraneous force (other than the pressures of the axis) being that of gravity. If M be the total mass, k the radius of gyration (§ 11) about the axis, we have

$$\frac{d}{dt}\left(Mk^2\frac{d\theta}{dt}\right) = -Mgh \sin\theta, \tag{3}$$

where θ is the angle which the plane containing the axis and the centre of gravity G makes with the vertical, and h is the distance of G from the axis. This coincides with the equation of motion of a simple pendulum [§ 13 (15)] of length l, provided $l = k^2/h$. The plane of the diagram (fig. 73) is supposed to be a plane through G perpendicular to the axis, which it meets in O. If we produce OG to P, making $OP = l$, the point P is called the *centre of oscillation*; the bob of a simple pendulum of length OP suspended from O will keep step with the motion of P, if properly started. If κ be the radius of gyration about a parallel axis through G, we have $k^2 = \kappa^2 + h^2$ by § 11 (16), and therefore $l = h + \kappa^2/h$, whence

$$GO \,.\, GP = \kappa^2. \tag{4}$$

This shows that if the body were swung from a parallel axis through P the new centre of oscillation would be at O. For different parallel axes, the period of a small oscillation varies as $\sqrt{l}$, or $\sqrt{(GO+OP)}$; this is least, subject to the condition (4), when $GO = GP = \kappa$. The reciprocal relation between the centres of suspension and oscillation is the basis of Kater's method of determining g experimentally. A pendulum is constructed with two parallel knife-edges as nearly as possible in the same plane with G, the position of one of them being adjustable. If it could be arranged that the period of a small oscillation should be exactly the same about either edge, the two knife-edges would in general occupy the positions of conjugate centres of suspension and oscillation; and the distances between them would be the length l of the equivalent simple pendulum. For if $h_1 + \kappa^2/h_1 = h_2 + \kappa^2/h_2$, then unless $h_1 = h_2$, we must have $\kappa^2 = h_1 h_2$, $l = h_1 + h_2$. Exact equality of the two observed periods (τ_1, τ_2, say) cannot of course be secured in practice, and a modification is necessary. If we write $l_1 = h_1 + \kappa^2/h_1$, $l_2 = h_2 + \kappa^2/h_2$, we find, on elimination of κ,

$$\tfrac{1}{2}\,\frac{l_1 + l_2}{h_1 + h_2} + \tfrac{1}{2}\,\frac{l_1 - l_2}{h_1 - h_2} = 1,$$

whence

$$\frac{4\pi^2}{g} = \frac{\frac{1}{2}(\tau_1^2 + \tau_2^2)}{h_1 + h_2} + \frac{\frac{1}{2}(\tau_1^2 - \tau_2^2)}{h_1 - h_2}. \tag{5}$$

The distance $h_1 + h_2$, which occurs in the first term on the right hand can be measured directly. For the second term we require the values of h_1, h_2 separately, but if τ_1, τ_2 are nearly equal whilst h_1, h_2 are distinctly unequal this term will be relatively small, so that an approximate knowledge of h_1, h_2 is sufficient.

As a final example we may note the arrangement, often employed in physical measurements, where a body performs small oscillations about a vertical axis through its mass-centre G, under the influence of a couple whose moment varies as the angle of rotation from the equilibrium position. The equation of motion is of the type

$$I\ddot{\theta} = -K\theta, \tag{6}$$

and the period is therefore $\tau = 2\pi\sqrt{(I/K)}$. If by the attachment of another body of known moment of inertia I′, the period is altered from τ to τ', we have $\tau' = 2\pi\sqrt{\{(I+I')/K\}}$. We are thus enabled to determine both I and K, viz.

$$I/I' = \tau^2/(\tau'^2 - \tau^2), \quad K = 4\pi^2\tau^2 I/(\tau'^2 - \tau^2). \tag{7}$$

The couple may be due to the earth's magnetism, or to the torsion of a suspending wire, or to a "bifilar" suspension. In the latter case, the body hangs by two vertical threads of equal length l in a plane through G. The motion being assumed to be small, the tensions of the two strings may be taken to have their statical values $Mgb/(a+b)$, $Mga/(a+b)$, where a, b are the distances of G from the two threads. When the body is twisted through an angle θ the threads make angles $a\theta/l$, $b\theta/l$ with the vertical, and the moment of the tensions about the vertical through G is accordingly $-K\theta$, where $K = M\,gab/l$.

For the determination of the motion it has only been necessary to use one of the dynamical equations. The remaining equations serve to determine the reactions of the rotating body on its bearings. Suppose, for example, that there are no extraneous forces. Take rectangular axes, of which Oz coincides with the axis of rotation. The angular velocity being constant, the effective force on a particle m at a distance r from Oz is $m\omega^2 r$ towards this axis, and its components are accordingly $-\omega^2 mx$, $-\omega^2 my$, O. Since the reactions on the bearings must be statically equivalent to the whole system of effective forces, they will reduce to a force (X Y Z) at O and a couple (L M N) given by

$$X = -\omega^2\Sigma(mx) = -\omega^2\Sigma(m)\,\bar{x},\ Y = -\omega^2\Sigma(my) = -\omega^2\Sigma(m)\,\bar{y},\ Z = 0,$$
$$L = \omega^2\Sigma(myz),\ M = -\omega^2\Sigma(mzx),\ N = 0, \tag{8}$$

where $\bar{x}$, $\bar{y}$ refer to the mass-centre G. The reactions do not therefore reduce to a single force at O unless $\Sigma(myz) = 0$, $\Sigma(mzx) = 0$, *i.e.* unless the axis of rotation be a principal axis of inertia (§ 11) at O. In order that the force may vanish we must also have $\bar{x}, \bar{y} = 0$, *i.e.* the mass-centre must lie in the axis of rotation. These considerations are important in the "balancing" of machinery. We note further that if a body be free to turn about a fixed point O, there are three mutually perpendicular lines through this point about which it can rotate steadily, without further constraint. The theory of principal or "permanent" axes was first investigated from this point of view by J. A. Segner (1755). The origin of the name "deviation moment" sometimes applied to a product of inertia is also now apparent.

Proceeding to the general motion of a rigid body in two dimensions we may take as the three co-ordinates of the body the rectangular Cartesian co-ordinates x, y of the mass-centre G and the angle θ through which the body has turned from some standard position. The components of linear momentum are then $M\dot{x}$, $M\dot{y}$, and the angular momentum relative to G as base is $I\dot{\theta}$, where M is the mass and I the moment of inertia about G. If the extraneous forces be reduced to a force (X, Y) at G and a couple N, we have

$$M\ddot{x} = X,\ M\ddot{y} = Y,\ I\ddot{\theta} = N. \tag{9}$$

If the extraneous forces have zero moment about G the angular velocity $\dot{\theta}$ is constant. Thus a circular disk projected under gravity in a vertical plane spins with constant angular velocity, whilst its centre describes a parabola.

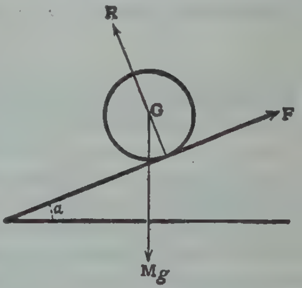

FIG. 74.

We may apply the equations (9) to the case of a solid of revolution rolling with its axis horizontal on a plane of inclination α. If the axis of x be taken parallel to the slope of the plane, with x increasing downwards, we have

$$M\ddot{x} = Mg\sin\alpha - F,\ 0 = Mg\cos\alpha - R,\ M\kappa^2\ddot{\theta} = Fa \tag{10}$$

where κ is the radius of gyration about the axis of symmetry, a is the constant distance of G from the plane, and R, F are the normal and tangential components of the reaction of the plane, as shown in fig. 74. We have also the kinematical relation $\dot{x} = a\dot{\theta}$. Hence

$$\ddot{x} = \frac{a^2}{\kappa^2 + a^2} g\sin\alpha,\ R = Mg\cos\alpha,\ F = \frac{\kappa^2}{\kappa^2 + a^2} Mg\sin\alpha. \tag{11}$$

The acceleration of G is therefore less than in the case of frictionless sliding in the ratio $a^2/(\kappa^2 + a^2)$. For a homogeneous sphere this ratio is $\frac{5}{7}$, for a uniform circular cylinder or disk $\frac{2}{3}$, for a circular hoop or a thin cylindrical shell $\frac{1}{2}$.

The equation of energy for a rigid body has already been stated (in effect) as a corollary from fundamental assumptions.

It may also be deduced from the principles of linear and angular momentum as embodied in the equations (9). We have

$$M(\dot{x}\ddot{x}+\dot{y}\ddot{y})+I\dot{\theta}\ddot{\theta}+X\dot{x}+Y\dot{y}+N\dot{\theta}, \qquad (12)$$

whence, integrating with respect to t,

$$\tfrac{1}{2}M(\dot{x}^2+\dot{y}^2)+\tfrac{1}{2}I\dot{\theta}^2=\int(Xdx+Ydy+Nd\theta)+\text{const.} \qquad (13)$$

The left-hand side is the kinetic energy of the whole mass, supposed concentrated at G and moving with this point, together with the kinetic energy of the motion relative to G (§ 15); and the right-hand member represents the integral work done by the extraneous forces in the successive infinitesimal displacements into which the motion may be resolved.

The formula (13) may be easily verified in the case of the compound pendulum, or of the solid rolling down an incline. As another example, suppose we have a circular cylinder whose mass-centre is at an excentric point, rolling on a horizontal plane. This includes the case of a compound pendulum in which the knife-edge is replaced by a cylindrical pin. If a be the radius of the cylinder, h the distance of G from its axis (O), κ the radius of gyration about a longitudinal axis through G, and θ the inclination of OG to the vertical, the kinetic energy is $\tfrac{1}{2}M\kappa^2\dot{\theta}^2+\tfrac{1}{2}M\,.\,CG^2\,.\,\dot{\theta}^2$, by § 3, since the body is turning about the line of contact (C) as instantaneous axis, and the potential energy is $-Mgh\cos\theta$. The equation of energy is therefore

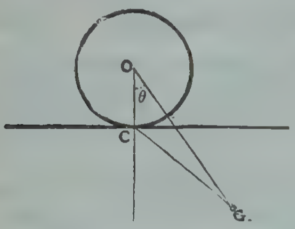

FIG. 75.

$$\tfrac{1}{2}M(\kappa^2+a^2+h^2-2\,ah\cos\theta)\,\dot{\theta}^2-Mgh\cos\theta-\text{const.} \qquad (14)$$

Whenever, as in the preceding examples, a body or a system of bodies, is subject to constraints which leave it virtually only one degree of freedom, the equation of energy is sufficient for the complete determination of the motion. If q be any variable co-ordinate defining the position or (in the case of a system of bodies) the configuration, the velocity of each particle at any instant will be proportional to $\dot{q}$, and the total kinetic energy may be expressed in the form $\tfrac{1}{2}A\dot{q}^2$, where A is in general a function of q [cf. equation (14)]. This coefficient A is called the *coefficient of inertia*, or the *reduced inertia* of the system, referred to the co-ordinate q.

Thus in the case of a railway truck travelling with velocity u the kinetic energy is $\tfrac{1}{2}(M+m\kappa^2/a^2)u^2$, where M is the total mass, a the radius and κ the radius of gyration of each wheel, and m is the sum of the masses of the wheels; the reduced inertia is therefore $M+m\kappa^2/a^2$. Again, take the system composed of the flywheel, connecting rod, and piston of a steam-engine. We have here a limiting case of three-bar motion (§ 3), and the instantaneous centre J of the connecting-rod PQ will have the position shown in the figure. The velocities of P and Q will be in the ratio of JP to JQ, or OR to OQ; the velocity of the piston is therefore $y\dot{\theta}$, where y=OR. Hence if, for simplicity, we neglect the inertia of the connecting-rod, the kinetic energy will be $\tfrac{1}{2}(I+My^2)\dot{\theta}^2$, where I is the moment of inertia of the flywheel, and M is the mass of the piston. The effect of the mass of the piston is therefore to increase the apparent moment of inertia of the flywheel by the variable amount My^2. If, on the other hand, we take OP ($=x$) as our variable, the kinetic energy is $\tfrac{1}{2}(M+I/y^2)\dot{x}^2$. We may also say, therefore, that the effect of the flywheel is to increase the apparent mass of the piston by the amount I/y^2; this becomes infinite at the "dead-points" where the crank is in line with the connecting-rod.

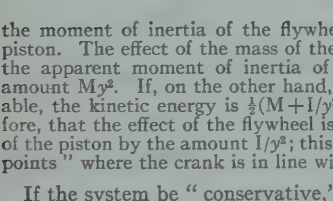

FIG. 76.

If the system be "conservative," we have

$$\tfrac{1}{2}A\dot{q}^2+V=\text{const.}, \qquad (15)$$

where V is the potential energy. If we differentiate this with respect to t, and divide out by $\dot{q}$, we obtain

$$A\ddot{q}+\tfrac{1}{2}\frac{dA}{dq}\dot{q}^2+\frac{dV}{dq}=0 \qquad (16)$$

as the equation of motion of the system with the unknown reactions (if any) eliminated. For equilibrium this must be satisfied by $\dot{q}=0$; this requires that $dV/dq=0$, *i.e.* the potential energy must be "stationary." To examine the effect of a small disturbance from equilibrium we put $V=f(q)$, and write $q=q_0+\eta$, where q_0 is a root of $f'(q_0)=0$ and η is small. Neglecting terms of the second order in η we have $dV/dq=f'(q)=f''(q_0).\eta$, and the equation (16) reduces to

$$A\ddot{\eta}+f''(q_0)\eta=0, \qquad (17)$$

where A may be supposed to be constant and to have the value corresponding to $q=q_0$. Hence if $f''(q_0)>0$, *i.e.* if V is a minimum in the configuration of equilibrium, the variation of η is simple-harmonic, and the period is $2\pi\sqrt{\{A/f''(q_0)\}}$. This depends only on the constitution of the system, whereas the amplitude and epoch will vary with the initial circumstances. If $f''(q_0)<0$, the solution of (17) will involve real exponentials, and η will in general increase until the neglect of the terms of the second order is no longer justified. The configuration $q=q_0$, is then unstable.

As an example of the method, we may take the problem to which equation (14) relates. If we differentiate, and divide by $\dot{\theta}$, and retain only the terms of the first order in θ, we obtain

$$\{\kappa^2+(h-a)^2\}\ddot{\theta}+gh\theta=0, \qquad (18)$$

as the equation of small oscillations about the position $\theta=0$. The length of the equivalent simple pendulum is $\{\kappa^2+(h-a)^2\}/h$.

The equations which express the change of motion (in two dimensions) due to an instantaneous impulse are of the forms

$$M(u'-u)=\xi,\quad M(v'-v)=\eta,\quad I(\omega'-\omega)=\nu. \qquad (19)$$

Here u', v' are the values of the component velocities of G just before, and u, v their values just after, the impulse, whilst ω', ω denote the corresponding angular velocities. Further, ξ, η are the time-integrals of the forces parallel to the co-ordinate axes, and ν is the time-integral of their moment about G. Suppose, for example, that a rigid lamina at rest, but free to move, is struck by an instantaneous impulse F in a given line. Evidently G will begin to move parallel to the line of F; let its initial velocity be u', and let ω' be the initial angular velocity. Then $Mu'=F$, $I\omega'=F.GP$, where GP is the perpendicular from G to the line of F. If PG be produced to any point C, the initial velocity of the point C of the lamina will be

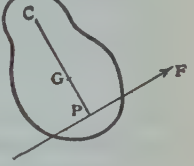

FIG. 77.

$$u'-\omega'.\,GC=(F/M).(1-GC.CP/\kappa^2),$$

where κ^2 is the radius of gyration about G. The initial centre of rotation will therefore be at C, provided $GC\,.\,GP=\kappa^2$. If this condition be satisfied there would be no impulsive reaction at C even if this point were fixed. The point P is therefore called the *centre of percussion* for the axis at C. It will be noted that the relation between C and P is the same as that which connects the centres of suspension and oscillation in the compound pendulum.

§ 18. *Equations of Motion in Three Dimensions.*—It was proved in § 7 that a body moving about a fixed point O can be brought from its position at time t to its position at time $t+\delta t$ by an infinitesimal rotation ϵ about some axis through O; and the limiting position of this axis, when δt is infinitely small, was called the "instantaneous axis." The limiting value of the ratio $\epsilon/\delta t$ is called the *angular velocity* of the body; we denote it by ω. If ξ, η, ζ are the components of ϵ about rectangular co-ordinate axes through O, the limiting values of $\xi/\delta t$, $\eta/\delta t$, $\zeta/\delta t$ are called the *component angular velocities*; we denote them by p, q, r. If l, m, n be the direction-cosines of the instantaneous axis we have

$$p=l\omega,\ q=m\omega,\ r=n\omega, \qquad (1)$$
$$p^2+q^2+r^2=\omega^2. \qquad (2)$$

If we draw a vector OJ to represent the angular velocity, then J traces out a certain curve in the body, called the *polhode*, and a certain curve in space, called the *herpolhode*. The cones generated by the instantaneous axis in the body and in space are called the polhode and herpolhode cones, respectively; in the actual motion the former cone rolls on the latter (§7).

The special case where both cones are right circular and ω is constant is important in astronomy and also in mechanism (theory of bevel wheels). The "precession of the equinoxes" is due to the fact that the earth performs a motion of this kind about its centre, and the whole class of such motions has therefore been termed *precessional*. In fig. 78, which shows the various cases, OZ is the axis of the fixed and OC that of the rolling cone, and J is the point of contact of the polhode and herpolhode, which are of course both circles. If α be the semi-angle of the rolling cone, β the constant inclination of OC to OZ, and $\dot\psi$ the angular velocity with which the plane ZOC revolves about OZ, then, considering the velocity of a point in OC at unit distance from O, we have

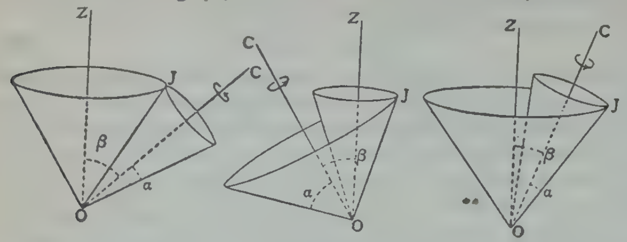

FIG. 78.

$$\omega \sin \alpha = \pm \dot\psi \sin \beta, \tag{3}$$

where the lower sign belongs to the third case. The earth's precessional motion is of this latter type, the angles being $\alpha = \cdot 0087''$, $\beta = 23° \; 28'$.

If m be the mass of a particle at P, and PN the perpendicular to the instantaneous axis, the kinetic energy T is given by

$$2\mathrm{T} = \Sigma\{m(\omega . \mathrm{PN})^2\} = \omega^2 . \Sigma(m . \mathrm{PN}^2) = \mathrm{I}\omega^2, \tag{4}$$

where I is the moment of inertia about the instantaneous axis. With the same notation for moments and products of inertia as in § 11 (38), we have

$$\mathrm{I} = \mathrm{A}l^2 + \mathrm{B}m^2 + \mathrm{C}n^2 - 2\mathrm{F}mn - 2\mathrm{G}nl - 2\mathrm{H}lm,$$

and therefore by (1),

$$2\mathrm{T} = \mathrm{A}p^2 + \mathrm{B}q^2 + \mathrm{C}r^2 - 2\mathrm{F}qr - 2\mathrm{G}rp - 2\mathrm{H}pq. \tag{5}$$

Again, if x, y, z be the co-ordinates of P, the component velocities of m are

$$qz - ry, \; rx - pz, \; py - qx, \tag{6}$$

by § 7 (5); hence, if λ, μ, ν be now used to denote the component angular momenta about the co-ordinate axes, we have $\lambda = \Sigma\{m(py - qx)y - m(rx - pz)z\}$, with two similar formulae, or

$$\left.\begin{aligned} \lambda &= \quad \mathrm{A}p - \mathrm{H}q - \mathrm{G}r = \frac{\partial \mathrm{T}}{\partial p}, \\ \mu &= -\mathrm{H}p + \mathrm{B}q - \mathrm{F}r = \frac{\partial \mathrm{T}}{\partial q}, \\ \nu &= -\mathrm{G}p - \mathrm{F}q + \mathrm{C}r = \frac{\partial \mathrm{T}}{\partial r}. \end{aligned}\right\} \tag{7}$$

If the co-ordinate axes be taken to coincide with the principal axes of inertia at O, at the instant under consideration, we have the simpler formulae

$$2\mathrm{T} = \mathrm{A}p^2 + \mathrm{B}q^2 + \mathrm{C}r^2, \tag{8}$$

$$\lambda = \mathrm{A}p, \; \mu = \mathrm{B}q, \; \nu = \mathrm{C}r. \tag{9}$$

It is to be carefully noticed that the axis of resultant angular momentum about O does not in general coincide with the instantaneous axis of rotation. The relation between these axes may be expressed by means of the momental ellipsoid at O. The equation of the latter, referred to its principal axes, being as in § 11 (41), the co-ordinates of the point J where it is met by the instantaneous axis are proportional to p, q, r, and the direction-cosines of the normal at J are therefore proportional to $\mathrm{A}p$, $\mathrm{B}q$, $\mathrm{C}r$, or λ, μ, ν. The axis of resultant angular momentum is therefore normal to the tangent plane at J, and does not coincide with OJ unless the latter be a principal axis. Again, if Γ be the resultant angular momentum, so that

$$\lambda^2 + \mu^2 + \nu^2 = \Gamma^2, \tag{10}$$

the length of the perpendicular OH on the tangent plane at J is

$$\mathrm{OH} = \frac{\mathrm{A}p}{\Gamma} \cdot \frac{p}{\omega}\rho + \frac{\mathrm{B}q}{\Gamma} \cdot \frac{q}{\omega}\rho + \frac{\mathrm{C}r}{\Gamma} \cdot \frac{r}{\omega}\rho = \frac{2\mathrm{T}}{\Gamma} \cdot \frac{\rho}{\omega}, \tag{11}$$

where $\rho = \mathrm{OJ}$. This relation will be of use to us presently (§ 19).

The motion of a rigid body in the most general case may be specified by means of the component velocities u, v, w of any point O of it which is taken as base, and the component angular velocities p, q, r. The component velocities of any point whose co-ordinates relative to O are x, y, z are then

$$u + qz - ry, \; v + rx - pz, \; w + py - qx \tag{12}$$

by § 7 (6). It is usually convenient to take as our base-point the mass-centre of the body. In this case the kinetic energy is given by

$$2\mathrm{T} = \mathrm{M}_0(u^2 + v^2 + w^2) + \mathrm{A}p^2 + \mathrm{B}q^2 + \mathrm{C}r^2 - 2\mathrm{F}qr - 2\mathrm{G}rp - 2\mathrm{H}pq, \tag{13}$$

where M_0 is the mass, and A, B, C, F, G, H are the moments and products of inertia with respect to the mass-centre; cf. § 15 (9).

The components ξ, η, ζ of linear momentum are

$$\xi = \mathrm{M}_0 u = \frac{\partial \mathrm{T}}{\partial u}, \; \eta = \mathrm{M}_0 v \frac{\partial \mathrm{T}}{\partial v}, \; \zeta = \mathrm{M}_0 w = \frac{\partial \mathrm{T}}{\partial w}, \tag{14}$$

whilst those of the relative angular momentum are given by (7). The preceding formulae are sufficient for the treatment of instantaneous impulses. Thus if an impulse $(\xi, \eta, \zeta, \lambda, \mu, \nu)$ change the motion from (u, v, w, p, q, r) to (u', v', w', p', q', r') we have

$$\left.\begin{aligned} \mathrm{M}_0(u' - u) = \xi, \quad \mathrm{M}_0(v' - v) = \eta, \quad \mathrm{M}_0(w' - w) = \zeta, \\ \mathrm{A}(p' - p) = \lambda, \quad \mathrm{B}(q' - q) = \mu, \quad \mathrm{C}(r' - r) = \nu, \end{aligned}\right\} \tag{15}$$

where, for simplicity, the co-ordinate axes are supposed to coincide with the principal axes at the mass-centre. Hence the change of kinetic energy is

$$\begin{aligned} \mathrm{T}' - \mathrm{T} = \xi . \tfrac{1}{2}(u + u') + \eta . \tfrac{1}{2}(v + v') + \zeta . \tfrac{1}{2}(w + w'), \\ + \lambda . \tfrac{1}{2}(p + p') + \mu . \tfrac{1}{2}(q + q') + \nu . \tfrac{1}{2}(r + r'). \end{aligned} \tag{16}$$

The factors of $\xi, \eta, \zeta, \lambda, \mu, \nu$ on the right-hand side are proportional to the constituents of a possible infinitesimal displacement of the solid, and the whole expression is proportional (on the same scale) to the work done by the given system of impulsive forces in such a displacement. As in § 9 this must be equal to the total work done in such a displacement by the several forces, whatever they are, which make up the impulse. We are thus led to the following statement: the change of kinetic energy due to any system of impulsive forces is equal to the sum of the products of the several forces into the semi-sum of the initial and final velocities of their respective points of application, resolved in the directions of the forces. Thus in the problem of fig. 77 the kinetic energy generated is $\tfrac{1}{2}\mathrm{M}(\kappa^2 + \mathrm{C}q^2)\omega'^2$, if C be the instantaneous centre; this is seen to be equal to $\tfrac{1}{2}\mathrm{F} . \omega' . \mathrm{CP}$, where $\omega' . \mathrm{CP}$ represents the initial velocity of P.

The equations of continuous motion of a solid are obtained by substituting the values of $\xi, \eta, \zeta, \lambda, \mu, \nu$ from (14) and (7) in the general equations

$$\left.\begin{aligned} \frac{d\xi}{dt} = \mathrm{X}, \; \frac{d\eta}{dt} = \mathrm{Y}, \; \frac{d\zeta}{dt} = \mathrm{Z}, \\ \frac{d\lambda}{dt} = \mathrm{L}, \; \frac{d\mu}{dt} = \mathrm{M}, \; \frac{d\nu}{dt} = \mathrm{N}, \end{aligned}\right\} \tag{17}$$

where (X, Y, Z, L, M, N) denotes the system of extraneous forces referred (like the momenta) to the mass-centre as base, the co-ordinate axes being of course fixed in direction. The resulting equations are not as a rule easy of application, owing to the fact that the moments and products of inertia A, B, C, F, G, H are not constants but vary in consequence of the changing orientation of the body with respect to the co-ordinate axes.

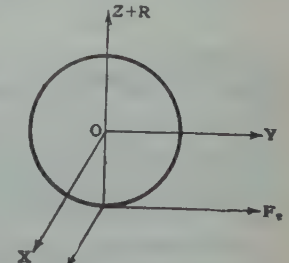

FIG. 79.

An exception occurs, however, in the case of a solid which is kinetically symmetrical (§ 11) about the mass-centre, *e.g.* a uniform sphere. The equations then take the forms

$$\begin{aligned} \mathrm{M}_0\dot u = \mathrm{X}, \; \mathrm{M}_0\dot v = \mathrm{Y}, \; \mathrm{M}_0\dot w = \mathrm{Z}, \\ \mathrm{C}\dot p = \mathrm{L}, \quad \mathrm{C}\dot q = \mathrm{M}, \quad \mathrm{C}\dot r = \mathrm{N}, \end{aligned} \tag{18}$$

where C is the constant moment of inertia about any axis through the mass-centre. Take, for example, the case of a sphere rolling on a plane; and let the axes Ox, Oy be drawn through the centre parallel to the plane, so that the equation of the latter is $z=-a$. We will suppose that the extraneous forces consist of a known force (X, Y, Z) at the centre, and of the reactions (F_1, F_2, R) at the point of contact. Hence

$$\left.\begin{aligned} M_0\dot{u}=X+F_1,\ M_0\dot{v}=Y+F_2,\quad 0=Z+R,\\ C\dot{p}=F_2a,\ C\dot{q}=-F_1a,\ C\dot{r}=0.\end{aligned}\right\}\tag{19}$$

The last equation shows that the angular velocity about the normal to the plane is constant. Again, since the point of the sphere which is in contact with the plane is instantaneously at rest, we have the geometrical relations

$$u+qa=0,\ v+pa=0,\ w=0,\tag{20}$$

by (12). Eliminating p, q, we get

$$(M_0+Ca^{-2})\dot{u}=X,\ (M_0+Ca^{-2})\dot{v}=Y.\tag{21}$$

The acceleration of the centre is therefore the same as if the plane were smooth and the mass of the sphere were increased by C/a^2. Thus the centre of a sphere rolling under gravity on a plane of inclination α describes a parabola with an acceleration

$$g \sin \alpha/(1+C/Ma^2)$$

parallel to the lines of greatest slope.

Take next the case of a sphere rolling on a fixed spherical surface. Let a be the radius of the rolling sphere, c that of the spherical surface which is the locus of its centre, and let x, y, z be the co-ordinates of this centre relative to axes through O, the centre of the fixed sphere. If the only extraneous forces are the reactions (P, Q, R) at the point of contact, we have

$$\left.\begin{aligned} M_0\ddot{x}=P,\ M_0\ddot{y}=Q,\ M_0\ddot{z}=R,\\ C\dot{p}=-\frac{a}{c}(yR-zQ),\ C\dot{q}=-\frac{a}{c}(zP-xR),\ C\dot{r}=-\frac{a}{c}(xQ-yP),\end{aligned}\right\}\tag{22}$$

the standard case being that where the rolling sphere is outside the fixed surface. The opposite case is obtained by reversing the sign of a. We have also the geometrical relations

$$\dot{x}=(a/c)(qz-ry),\ \dot{y}=(a/c)(rx-pz),\ \dot{z}=(a/c)(py-qx).\tag{23}$$

If we eliminate P, Q, R from (22), the resulting equations are integrable with respect to t; thus

$$p=-\frac{M_0a}{Cc}(y\dot{z}-z\dot{y})+\alpha,\ q=-\frac{M_0a}{Cc}(z\dot{x}-x\dot{z})+\beta,$$
$$r=-\frac{M_0a}{Cc}(x\dot{y}-y\dot{x})+\gamma,\tag{24}$$

where α, β, γ are arbitrary constants. Substituting in (23) we find

$$\left(1+\frac{M_0a^2}{C}\right)\dot{x}=\frac{a}{c}(\beta z-\gamma y),\ \left(1+\frac{M_0a^2}{C}\right)\dot{y}=\frac{a}{c}(\gamma x-\alpha z),$$
$$\left(1+\frac{M_0a^2}{C}\right)\dot{z}=\frac{a}{c}(\alpha y-\beta x).\tag{25}$$

Hence $\alpha\dot{x}+\beta\dot{y}+\gamma\dot{z}=0$, or

$$\alpha x+\beta y+\gamma z=\text{const.};\tag{26}$$

which shows that the centre of the rolling sphere describes a circle. If the axis of z be taken normal to the plane of this circle we have $\alpha=0$, $\beta=0$, and

$$\left(1+\frac{M_0a^2}{C}\right)\dot{x}=-\gamma\frac{a}{c}y,\quad \left(1+\frac{M_0a^2}{C}\right)\dot{y}=\gamma\frac{a}{c}x.\tag{27}$$

The solution of these equations is of the type

$$x=b\cos(\sigma t+\epsilon),\ y=b\sin(\sigma t+\epsilon),\tag{28}$$

where b, ϵ are arbitrary, and

$$\sigma=\frac{\gamma a/c}{1+M_0a^2/C}.\tag{29}$$

The circle is described with the constant angular velocity σ.

When the gravity of the rolling sphere is to be taken into account the preceding method is not in general convenient, unless the whole motion of G is small. As an example of this latter type, suppose that a sphere is placed on the highest point of a fixed sphere and set spinning about the vertical diameter with the angular velocity n; it will appear that under a certain condition the motion of G consequent on a slight disturbance will be oscillatory. If Oz be drawn vertically upwards, then in the beginning of the disturbed motion the quantities x, y, p, q, P, Q will all be small. Hence omitting terms of the second order, we find

$$\left.\begin{aligned} M_0\ddot{x}=P,\ M_0\ddot{y}=Q,\ R=M_0g,\\ C\dot{p}=-(M_0ga/c)y+aQ,\ C\dot{q}=(M_0ga/c)x-aP,\ C\dot{r}=0.\end{aligned}\right\}\tag{30}$$

The last equation shows that the component r of the angular velocity retains (to the first order) the constant value n. The geometrical relations reduce to

$$\dot{x}=aq-(na/c)y,\ \dot{y}=-ap+(na/c)x.\tag{31}$$

Eliminating p, q, P, Q, we obtain the equations

$$\left.\begin{aligned}(C+M_0a^2)\ddot{x}+(Cna/c)\dot{y}-(M_0ga^2/c)x=0,\\ (C+M_0a^2)\ddot{y}-(Cna/c)\dot{x}-(M_0ga^2/c)y=0,\end{aligned}\right\}\tag{32}$$

which are both contained in

$$\left\{(C+M_0a^2)\frac{d^2}{dt^2}-i\frac{Cna}{c}\frac{d}{dt}-\frac{M_0ga^2}{c}\right\}(x+iy)=0.\tag{33}$$

This has two solutions of the type $x+iy=\alpha e^{i(\sigma t+\epsilon)}$, where α, ϵ are arbitrary, and σ is a root of the quadratic

$$(C+M_0a^2)\sigma^2-(Cna/c)\sigma+M_0ga^2/c=0.\tag{34}$$

If

$$n^2>(4Mgc/C)\ (1+M_0a^2/C),\tag{35}$$

both roots are real, and have the same sign as n. The motion of G then consists of two superposed circular vibrations of the type

$$x=\alpha\cos(\sigma t+\epsilon),\ y=\alpha\sin(\sigma t+\epsilon),\tag{36}$$

in each of which the direction of revolution is the same as that of the initial spin of the sphere. It follows therefore that the original position is stable provided the spin n exceed the limit defined by (35). The case of a sphere spinning about a vertical axis at the lowest point of a spherical bowl is obtained by reversing the signs of a and c. It appears that this position is always stable.

It is to be remarked, however, that in the first form of the problem the stability above investigated is practically of a limited or temporary kind. The slightest frictional forces—such as the resistance of the air—even if they act in lines through the centre of the rolling sphere, and so do not directly affect its angular momentum, will cause the centre gradually to descend in an ever-widening spiral path.

§ 19. *Free Motion of a Solid.*—Before proceeding to further problems of motion under extraneous forces it is convenient to investigate the free motion of a solid relative to its mass-centre O, in the most general case. This is the same as the motion about a fixed point under the action of extraneous forces which have zero moment about that point. The question was first discussed by Euler (1750); the geometrical representation to be given is due to Poinsot (1851).

The kinetic energy T of the motion relative to O will be constant. Now $T=\frac{1}{2}I\omega^2$, where ω is the angular velocity and I is the moment of inertia about the instantaneous axis. If ρ be the radius-vector OJ of the momental ellipsoid

$$Ax^2+By^2+Cz^2=M\epsilon^4\tag{1}$$

drawn in the direction of the instantaneous axis, we have $I=M\epsilon^4/\rho^2$(§ 11); hence ω varies as ρ. The locus of J may therefore be taken as the "polhode" (§ 18). Again, the vector which represents the angular momentum with respect to O will be constant in every respect. We have seen (§ 18) that this vector coincides in direction with the perpendicular OH to the tangent plane of the momental ellipsoid at J; also that

$$OH=\frac{2T}{\Gamma}\cdot\frac{\rho}{\omega},\tag{2}$$

where Γ is the resultant angular momentum about O. Since ω varies as ρ, it follows that OH is constant, and the tangent plane at J is therefore fixed in space. The motion of the body relative to O is therefore completely represented if we imagine the momental ellipsoid at O to roll without sliding on a plane fixed in space, with an angular velocity proportional at each instant to the radius-vector of the point of contact. The fixed plane is parallel to the invariable plane at O, and the line OH is called the *invariable line*. The trace of the point of contact J on the fixed plane is the "herpolhode."

If p, q, r be the component angular velocities about the principal axes at O, we have

$$(A^2p^2+B^2q^2+C^2r^2)/\Gamma^2=(Ap^2+Bq^2+Cr^2)/2T,\tag{3}$$

each side being in fact equal to unity. At a point on the polhode cone $x:y:z=p:q:r$, and the equation of this cone is therefore

$$A^2\left(1-\frac{\Gamma^2}{2AT}\right)x^2+B^2\left(1-\frac{\Gamma^2}{2BT}\right)y^2+C^2\left(1-\frac{\Gamma^2}{2CT}\right)z^2=0.\tag{4}$$

Since $2AT-\Gamma^2=B(A-B)q^2+C(A-C)r^2$, it appears that if $A>B>C$ the coefficient of x^2 in (4) is positive, that of z^2 is negative, whilst that of y^2 is positive or negative according as $2BT \gtrless \Gamma^2$. Hence the polhode cone surrounds the axis of greatest or least moment according as $2BT \gtrless \Gamma^2$. In the critical case of $2BT=\Gamma^2$ it breaks up into two planes through the axis of mean moment (Oy). The herpolhode curve in the fixed plane is obviously confined between two concentric circles which it alternately touches; it is not in general a re-entrant curve. It has been shown by De Sparre that, owing to the limitation imposed on the possible forms of the momental ellipsoid by the relation $B+C>A$, the curve has no points of inflexion. The invariable line OH describes another cone in the body, called the *invariable cone.* At any point of this we have $x : y : z = \mathrm{A}p . \mathrm{B}q : \mathrm{C}r$, and the equation is therefore

$$\left(1-\frac{\Gamma^2}{2\mathrm{AT}}\right)x^2+\left(1-\frac{\Gamma^2}{2\mathrm{BT}}\right)y^2+\left(1-\frac{\Gamma^2}{2\mathrm{CT}}\right)z^2=0. \qquad (5)$$

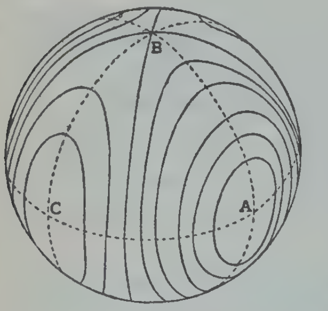

FIG. 80.

The signs of the coefficients follow the same rule as in the case of (4). The possible forms of the invariable cone are indicated in fig. 80 by means of the intersections with a concentric spherical surface. In the critical case of $2\mathrm{BT}=\Gamma^2$ the cone degenerates into two planes. It appears that if the body be sightly disturbed from a state of rotation about the principal axis of greatest or least moment, the invariable cone will closely surround this axis, which will therefore never deviate far from the invariable line. If, on the other hand, the body be slightly disturbed from a state of rotation about the mean axis a wide deviation will take place. Hence a rotation about the axis of greatest or least moment is reckoned as stable, a rotation about the mean axis as unstable. The question is greatly simplified when two of the principal moments are equal, say A=B. The polhode and herpolhode cones are then right circular, and the motion is "precessional" according to the definition of § 18. If α be the inclination of the instantaneous axis to the axis of symmetry, β the inclination of the latter axis to the invariable line, we have

$$\Gamma\cos\beta=\mathrm{C}\omega\cos\alpha,\quad \Gamma\sin\beta=\mathrm{A}\omega\sin\alpha, \qquad (6)$$

whence

$$\tan\beta=\frac{\mathrm{A}}{\mathrm{C}}\tan\alpha. \qquad (7)$$

Hence $\beta \gtreqless \alpha$, and the circumstances are therefore those of the first or second case in fig. 78, according as $\mathrm{A} \gtreqless \mathrm{C}$. If $\dot\psi$ be the rate at which the plane HOJ revolves about OH, we have

$$\dot\psi=\frac{\sin\alpha}{\sin\beta}\omega=\frac{\mathrm{C}\cos\alpha}{\mathrm{A}\cos\beta}\omega, \qquad (8)$$

by § 18 (3). Also if $\dot\chi$ be the rate at which J describes the polhode, we have $\dot\psi\sin(\beta-\alpha)=\dot\chi\sin\beta$, whence

$$\dot\chi=\frac{\sin(\alpha-\beta)}{\sin\alpha}\omega. \qquad (9)$$

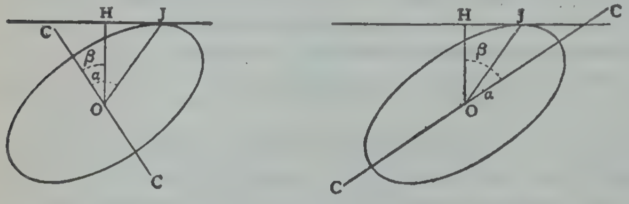

FIG. 81.

If the instantaneous axis only deviate slightly from the axis of symmetry the angles α, β are small, and $\dot\chi = (\mathrm{A}-\mathrm{C})\ \mathrm{A}\ .\omega$; the instantaneous axis therefore completes its revolution in the body in the period

$$\frac{2\pi}{\dot\chi}=\frac{\mathrm{A}-\mathrm{C}}{\mathrm{A}}\omega. \qquad (10)$$

In the case of the earth it is inferred from the independent phenomenon of luni-solar precession that (C-A)/A=·00313. Hence if the earth's axis of rotation deviates slightly from the axis of figure, it should describe a cone about the latter in 320 sidereal days. This would cause a periodic variation in the latitude of any place on the earth's surface, as determined by astronomical methods. There appears to be evidence of a slight periodic variation of latitude, but the period would seem to be about fourteen months. The discrepancy is attributed to a defect of rigidity in the earth. The phenomenon is known as the *Eulerian nutation,* since it is supposed to come under the free rotations first discussed by Euler.

§ 20. *Motion of a Solid of Revolution.*—In the case of a solid of revolution, or (more generally) whenever there is kinetic symmetry about an axis through the mass-centre, or through a fixed point O, a number of interesting problems can be treated almost directly from first principles. It frequently happens that the extraneous forces have zero moment about the axis of symmetry, as *e.g.* in the case of the flywheel of a gyroscope if we neglect the friction at the bearings. The angular velocity (r) about this axis is then constant. For we have seen that r is constant when there are no extraneous forces; and r is evidently not affected by an instantaneous impulse which leaves the angular momentum Cr, about the axis of symmetry, unaltered. And a continuous force may be regarded as the limit of a succession of infinitesimal instantaneous impulses.

Suppose, for example, that a flywheel is rotating with angular velocity n about its axis, which is (say) horizontal, and that this axis is made to rotate with the angular velocity $\dot\psi$ in the horizontal plane. The components of angular momentum about the axis of the flywheel and about the vertical will be Cn and A $\dot\psi$ respectively, where A is the moment of inertia about any axis through the mass-centre (or through the fixed point O) perpendicular to that of symmetry. If $\overrightarrow{\mathrm{OK}}$ be the vector representing the former component at time t, the vector which represents it at time $t+\delta t$ will be $\overrightarrow{\mathrm{OK}'}$, equal to $\overrightarrow{\mathrm{OK}}$ in magnitude and making with it an angle $\delta\psi$. Hence $\overrightarrow{\mathrm{KK}'}$ $(=\mathrm{C}n\delta\psi)$ will represent the change in this component due to the extraneous forces. Hence, so far as this component is concerned, the extraneous forces must supply a couple of moment $\mathrm{C}n\dot\psi$ in a vertical plane through the axis of the flywheel. If this couple be absent, the axis will be tilted out of the horizontal plane in such a sense that the direction of the spin n approximates to that of the azimuthal rotation $\dot\psi$. The remaining constituent of the extraneous forces is a couple $\mathrm{A}\ddot\psi$ about the vertical; this vanishes if $\dot\psi$ is constant. If the axis of the flywheel make an angle θ with the vertical, it is seen in like manner that the required couple in the vertical plane through the axis is $\mathrm{C}n\sin\theta\,\dot\psi$. This matter can be strikingly illustrated with an ordinary gyroscope, *e.g.* by making the larger movable ring in fig. 37 rotate about its vertical diameter.

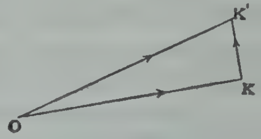

FIG. 82.

If the direction of the axis of kinetic symmetry be specified by means of the angular co-ordinates θ, ψ of § 7, then considering the component velocities of the point C in fig. 83, which are $\dot\theta$ and $\sin\theta\dot\psi$ along and perpendicular to the meridian ZC, we see that the component angular velocities about the lines OA′, OB′ are $-\sin\theta\,\dot\psi$ and $\dot\theta$ respectively. Hence if the principal moments of inertia at O be A, A, C, and if n be the constant angular velocity about the axis OC, the kinetic energy is given by

$$2\mathrm{T}=\mathrm{A}(\dot\theta^2+\sin^2\theta\,\dot\psi^2)+\mathrm{C}n^2. \qquad (1)$$

Again, the components of angular momentum about OC, OA′ are $\mathrm{C}n, -\mathrm{A}\sin\theta\,\dot\psi$, and therefore the angular momentum (μ, say) about OZ is

$$\mu=\mathrm{A}\sin^2\theta\,\dot\psi+\mathrm{C}n\cos\theta. \qquad (2)$$

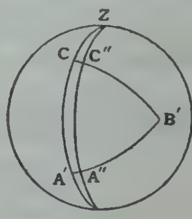

FIG. 83.

We can hence deduce the condition of steady precessional motion in a top. A solid of revolution is supposed to be free to turn about a fixed point O on its axis of symmetry, its mass-centre G being in this axis at a distance h from O. In fig. 83 OZ is supposed to be vertical, and OC is the axis of the solid drawn in the direction OG. If θ is constant the points C, A′ will in time δt come to positions C″, A″ such that $\mathrm{CC}''=\sin\theta\,\delta\psi$, $\mathrm{A}'\mathrm{A}''=\cos\theta\,\delta\psi$, and the angular momentum about OB′ will become $\mathrm{C}n\sin\theta\,\delta\psi-\mathrm{A}\sin\theta\,\dot\psi.\cos\theta\,\delta\psi$. Equating this to $\mathrm{M}gh\sin\theta\,\delta t$, and dividing out by $\sin\theta$, we obtain

$$\mathrm{A}\cos\theta\,\dot\psi^2-\mathrm{C}n\dot\psi+\mathrm{M}gh=0, \qquad (3)$$

as the condition in question. For given values of n and θ we have two possible values of $\dot\psi$ provided n exceed a certain limit. With a very rapid spin, or (more precisely) with Cn large in comparison with $\sqrt{(4\mathrm{AM}gh\cos\theta)}$, one value of $\dot\psi$ is small and the other large, viz. the two values are $\mathrm{M}gh/\mathrm{C}n$ and $\mathrm{C}n/\mathrm{A}\cos\theta$ approximately. The absence of g from the latter expression indicates that the circumstances of the rapid precession are very nearly those of a free Eulerian rotation (§ 19), gravity playing only a subordinate part.

Again, take the case of a circular disk rolling in steady motion on a horizontal plane. The centre O of the disk is supposed to describe a horizontal circle of radius c with the constant angular velocity $\dot\psi$, whilst its plane preserves a constant inclination θ to the horizontal. The components of the reaction of the horizontal lane will be $Mc\dot\psi^2$ at right angles to the tangent line at the point of contact and Mg vertically upwards, and the moment of these about the horizontal diameter of the disk, which corresponds to OB′ in fig. 83, is $Mc\dot\psi^2 . a \sin\theta - Mga \cos\theta$, where a is the radius of the disk. Equating this to the rate of increase of the angular momentum about OB′, investigated as above, we find

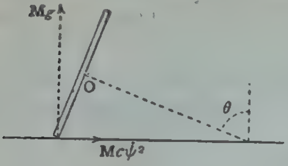

FIG. 84.

$$\left(C+Ma^2+A\frac{a}{c}\cos\theta\right)\dot\psi^2 = Mg\frac{a^2}{c}\cot\theta, \tag{4}$$

where use has been made of the obvious relation $na = c\dot\psi$. If c and θ be given this formula determines the value of $\dot\psi$ for which the motion will be steady.

In the case of the top, the equation of energy and the condition of constant angular momentum (μ) about the vertical OZ are sufficient to determine the motion of the axis. Thus, we have

$$\tfrac{1}{2}A(\dot\theta^2+\sin^2\theta\,\dot\psi^2) + \tfrac{1}{2}Cn^2 + Mgh\cos\theta = \text{const.}, \tag{5}$$

$$A\sin^2\theta\,\dot\psi + \nu\cos\theta = \mu, \tag{6}$$

where ν is written for Cn. From these $\dot\psi$ may be eliminated, and on differentiating the resulting equation with respect to t we obtain

$$A\ddot\theta - \frac{(\mu-\nu\cos\theta)(\mu\cos\theta-\nu)}{A\sin^3\theta} - Mgh\sin\theta = 0. \tag{7}$$

If we put $\ddot\theta = 0$ we get the condition of steady precessional motion in a form equivalent to (3). To find the small oscillation about a state of steady precession in which the axis makes a constant angle α with the vertical, we write $\theta = \alpha + \chi$, and neglect terms of the second order in χ. The result is of the form

$$\ddot\chi + \sigma^2\chi = 0, \tag{8}$$

where

$$\sigma^2 = \{(\mu-\nu\cos\alpha)^2 + 2(\mu-\nu\cos\alpha)(\mu\cos\alpha-\nu)\cos\alpha + (\mu\cos\alpha-\nu)^2\}/A^2\sin^4\alpha. \tag{9}$$

When ν is large we have, for the "slow" precession $\sigma = \nu/A$, and for the "rapid" precession $\sigma = A/\nu\cos\alpha = \dot\psi$, approximately. Further, on examining the small variation in $\dot\psi$, it appears that in a slightly disturbed slow precession the motion of any point of the axis consists of a rapid circular vibration superposed on the steady precession, so that the resultant path has a trochoidal character. This is a type of motion commonly observed in a top spun in the ordinary way, although the successive undulations of the trochoid may be too small to be easily observed. In a slightly disturbed rapid precession the superposed vibration is elliptic-harmonic, with a period equal to that of the precession itself. The ratio of the axes of the ellipse is sec α, the longer axis being in the plane of θ. The result is that the axis of the top describes a circular cone about a fixed line making a small angle with the vertical. This is, in fact, the "invariable line" of the free Eulerian rotation with which (as already remarked) we are here virtually concerned. For the more general discussion of the motion of a top see GYROSCOPE.

§ 21. *Moving Axes of Reference.*—For the more general treatment of the kinetics of a rigid body it is usually convenient to adopt a system of moving axes. In order that the moments and products of inertia with respect to these axes may be constant, it is in general necessary to suppose them fixed in the solid.

We will assume for the present that the origin O is fixed. The moving axes Ox, Oy, Oz form a rigid frame of reference whose motion at time t may be specified by the three component angular velocities p, q, r. The components of angular momentum about Ox, Oy, Oz will be denoted as usual by λ, μ, ν. Now consider a system of fixed axes Ox', Oy', Oz' chosen so as to coincide at the instant t with the moving system Ox, Oy, Oz. At the instant $t+\delta t$, Ox, Oy, Oz will no longer coincide with Ox', Oy', Oz'; in particular they will make with Ox' angles whose cosines are, to the first order, $1, -r\delta t, q\delta t$, respectively. Hence the altered angular momentum about Ox' will be $\lambda+\delta\lambda+(\mu+\delta\mu)(-r\delta t)+(\nu+\delta\nu)q\delta t$. If L, M, N be the moments of the extraneous forces about Ox, Oy, Oz this must be equal to $\lambda + L\delta t$. Hence, and by symmetry, we obtain

$$\left.\begin{aligned} \frac{d\lambda}{dt} - r\mu + q\nu &= L, \\ \frac{d\mu}{dt} - p\nu + r\lambda &= M, \\ \frac{d\nu}{dt} - q\lambda + p\mu &= N. \end{aligned}\right\} \tag{1}$$

These equations are applicable to any dynamical system whatever. If we now apply them to the case of a rigid body moving about a fixed point O, and make Ox, Oy, Oz coincide with the principal axes of inertia at O, we have $\lambda, \mu, \nu = Ap, Bq, Cr$, whence

$$\left.\begin{aligned} A\frac{dp}{dt} - (B-C)qr &= L, \\ B\frac{dq}{dt} - (C-A)rp &= M, \\ C\frac{dr}{dt} - (A-B)pq &= N. \end{aligned}\right\} \tag{2}$$

If we multiply these by p, q, r and add, we get

$$\frac{d}{dt}\cdot\tfrac{1}{2}(Ap^2+Bq^2+Cr^2) = Lp+Mq+Nr, \tag{3}$$

which is (virtually) the equation of energy.

As a first application of the equations (2) take the case of a solid constrained to rotate with constant angular velocity ω about a fixed axis (l, m, n). Since p, q, r are then constant, the requisite constraining couple is

$$L = (C-B)mn\omega^2,\quad M = (A-C)nl\omega^2,\quad N = (B-A)lm\omega^2. \tag{4}$$

If we reverse the signs, we get the "centrifugal couple" exerted by the solid on its bearings. This couple vanishes when the axis of rotation is a principal axis at O, and in no other case (cf. § 17).

If in (2) we put, L, M, N = O we get the case of free rotation; thus

$$\left.\begin{aligned} A\frac{dp}{dt} &= (B-C)qr, \\ B\frac{dq}{dt} &= (C-A)rp, \\ C\frac{dr}{dt} &= (A-B)pq. \end{aligned}\right\} \tag{5}$$

These equations are due to Euler, with whom the conception of moving axes, and the application to the problem of free rotation, originated. If we multiply them by p, q, r, respectively, or again by Ap, Bq, Cr respectively, and add, we verify that the expressions $Ap^2+Bq^2+Cr^2$ and $A^2p^2+B^2q^2+C^2r^2$ are both constant. The former is, in fact, equal to 2T, and the latter to Γ^2, where T is the kinetic energy and Γ the resultant angular momentum.

To complete the solution of (2) a third integral is required; this involves in general the use of elliptic functions. The problem has been the subject of numerous memoirs; we will here notice only the form of solution given by Rueb (1834), and at a later period by G. Kirchhoff (1875). If we write

$$u = \int_0^\phi \frac{d\phi}{\Delta\phi},\quad \Delta\phi = \sqrt{(1-k^2\sin^2\phi)},$$

we have, in the notation of elliptic functions, $\phi = \text{am } u$. If we assume

$$p = p_0\cos\text{am}(\sigma t+\epsilon),\quad q = q_0\sin\text{am}(\sigma t+\epsilon),\quad r = r_0\Delta\,\text{am}(\sigma t+\epsilon), \tag{7}$$

we find

$$\dot p = -\frac{\sigma p_0}{q_0 r_0}qr,\quad \dot q = \frac{\sigma q_0}{r_0 p_0}rp,\quad \dot r = -\frac{k^2\sigma r_0}{p_0 q_0}pq. \tag{8}$$

Hence (5) will be satisfied, provided

$$\frac{-\sigma p_0}{q_0 r_0} = \frac{B-C}{A},\quad \frac{\sigma q_0}{r_0 p_0} = \frac{C-A}{B},\quad \frac{-k^2\sigma r_0}{p_0 q_0} = \frac{A-B}{C}. \tag{9}$$

These equations, together with the arbitrary initial values of p, q, r, determine the six constants which we have denoted by $p_0, q_0, r_0, k^2, \sigma, \epsilon$. We will suppose that $A > B > C$. From the form of the polhode curves referred to in §19 it appears that the angular velocity q about the axis of mean moment must vanish periodically. If we adopt one of these epochs as the origin of t, we have $\epsilon = 0$, and p_0, r_0 will become identical with the initial values of p, r. The conditions (9) then lead to

$$q_0^2 = \frac{A(A-C)}{B(B-C)}p_0^2,\quad \sigma^2 = \frac{(A-C)(B-C)}{AB}r_0^2,\quad k^2 = \frac{A(A-B)}{C(B-C)}\cdot\frac{p_0^2}{r_0^2}. \tag{10}$$

For a real solution we must have $k^2 < 1$, which is equivalent to $2BT > \Gamma^2$. If the initial conditions are such as to make $2BT < \Gamma^2$, we must interchange the forms of p and r in (7). In the present case the instantaneous axis returns to its initial position in the body whenever ϕ increases by 2π, *i.e.* whenever t increases by $4K/\sigma$, when K is the "complete" elliptic integral of the first kind with respect to the modulus k.

The elliptic functions degenerate into simpler forms when $k^2=0$ or $k^2=1$. The former case arises when two of the principal moments are equal; this has been sufficiently dealt with in §19. If $k^2=1$, we must have $2BT=\Gamma^2$. We have seen that the alternative $2BT \lesseqgtr \Gamma^2$ determines whether the polhode cone surrounds the principal axis of least or greatest moment. The case of $2BT=\Gamma^2$, exactly, is therefore a critical case; it may be shown that the instantaneous axis either coincides permanently with the axis of mean moment or approaches it asymptotically.

When the origin of the moving axes is also in motion with a velocity whose components are u, v, w, the dynamical equations are

$$\frac{d\xi}{dt}-r\eta+q\zeta=X,\ \frac{d\eta}{dt}-p\zeta+r\xi=Y,\ \frac{d\zeta}{dt}-q\xi+p\eta=Z, \tag{11}$$

$$\left.\begin{array}{c}\dfrac{d\lambda}{dt}-r\mu+q\nu-w\eta+v\zeta=L,\ \dfrac{d\mu}{dt}-p\nu+r\lambda-u\zeta+w\xi=M,\\ \dfrac{d\nu}{dt}-q\lambda+p\mu-v\xi+u\eta=N.\end{array}\right\} \tag{12}$$

To prove these, we may take fixed axes $O'x'$, $O'y'$, $O'z'$ coincident with the moving axes at time t, and compare the linear and angular momenta $\xi+\delta\xi$, $\eta+\delta\eta$, $\zeta+\delta\zeta$, $\lambda+\delta\lambda$, $\mu+\delta\mu$, $\nu+\delta\nu$ relative to the new position of the axes, Ox, Oy, Oz at time $t+\delta t$ with the original momenta $\xi, \eta, \zeta, \lambda, \mu, \nu$ relative to $O'x'$, $O'y'$, $O'z'$ at time t. As in the case of (2), the equations are applicable to any dynamical system whatever. If the moving origin coincide always with the mass-centre, we have $\xi, \eta, \zeta = M_0u, M_0v, M_0w$, where M_0 is the total mass, and the equations simplify.

When, in any problem, the values of u, v, w, p, q, r have been determined as functions of t, it still remains to connect the moving axes with some fixed frame of reference. It will be sufficient to take the case of motion about a fixed point O; the angular co-ordinates θ, ϕ, ψ of Euler may then be used for the purpose. Referring to fig. 36 we see that the angular velocities p, q, r of the moving lines, OA, OB, OC about their instantaneous positions are

$$\left.\begin{array}{c}p=\dot\theta\sin\phi-\sin\theta\cos\phi\,\dot\psi,\ q=\dot\theta\cos\phi+\sin\theta\sin\phi\,\dot\psi,\\ r=\dot\phi+\cos\theta\dot\psi,\end{array}\right\} \tag{13}$$

by § 7 (3), (4). If OA, OB, OC be principal axes of inertia of a solid, and if A, B, C denote the corresponding moments of inertia, the kinetic energy is given by

$$\left.\begin{array}{c}2T=A(\dot\theta\sin\phi-\sin\theta\cos\phi\dot\psi)^2+B(\dot\theta\cos\phi+\sin\theta\sin\theta\dot\psi)^2\\ +C(\dot\phi+\cos\theta\,\dot\psi)^2.\end{array}\right\} \tag{14}$$

If A=B this reduces to

$$2T=A(\dot\theta^2+\sin^2\theta\,\dot\psi^2)+C(\dot\phi+\cos\theta\,\dot\psi)^2; \tag{15}$$

cf. § 20 (1).

§ 22. *Equations of Motion in Generalized Co-ordinates.*—Suppose we have a dynamical system composed of a finite number of material particles or rigid bodies, whether free or constrained in any way, which are subject to mutual forces and also to the action of any given extraneous forces. The configuration of such a system can be completely specified by means of a certain number (n) of independent quantities, called the generalized co-ordinates of the system. These co-ordinates may be chosen in an endless variety of ways, but their number is determinate, and expresses the number of *degrees of freedom* of the system. We denote these co-ordinates by $q_1, q_2, \ldots q_n$. It is implied in the above description of the system that the Cartesian co-ordinates x, y, z of any particle of the system are known functions of the q's, varying in form (of course) from particle to particle. Hence the kinetic energy T is given by

$$\begin{aligned}2T&=\Sigma\{m(\dot x^2+\dot y^2+\dot z^2)\}\\ &=a_{11}\dot q_1^2+a_{22}\dot q_2^2+\ldots+2a_{12}\dot q_1\dot q_2+\ldots,\end{aligned} \tag{1}$$

where

$$\left.\begin{array}{l}a_{rr}=\Sigma\left[m\left\{\left(\dfrac{\partial x}{\partial q_r}\right)^2+\left(\dfrac{\partial y}{\partial q_r}\right)^2+\left(\dfrac{\partial z}{\partial q_r}\right)^2\right\}\right],\\ a_{rs}=\Sigma\left\{m\left(\dfrac{\partial x}{\partial q_r}\dfrac{\partial x}{\partial q_s}+\dfrac{\partial y}{\partial q_r}\dfrac{\partial y}{\partial q_s}+\dfrac{\partial z}{\partial q_r}\dfrac{\partial z}{\partial q_s}\right)\right\}=a_{sr}.\end{array}\right\} \tag{2}$$

Thus T is expressed as a homogeneous quadratic function of the quantities $\dot q_1, \dot q_2, \ldots \dot q_n$, which are called the *generalized components of velocity*. The coefficients a_{rr}, a_{rs} are called the *coefficients of inertia*; they are not in general constants, being functions of the q's and so variable with the configuration. Again, if (X, Y, Z) be the force on m, the work done in an infinitesimal change of configuration is

$$\Sigma(X\delta x+Y\delta y+Z\delta z)=Q_1\delta q_1+Q_2\delta q_2+\ldots+Q_n\delta q_n, \tag{3}$$

where

$$Q_r=\Sigma\left(X\frac{\partial x}{\partial q_r}+Y\frac{\partial y}{\partial q_r}+Z\frac{\partial z}{\partial q_r}\right). \tag{4}$$

The quantities Q_r are called the *generalized components of force.*

The equations of motion of m being

$$m\ddot x=X,\ m\ddot y=Y,\ m\ddot z=Z, \tag{5}$$

we have

$$\Sigma\left\{m\left(\ddot x\frac{\partial x}{\partial q_r}+\ddot y\frac{\partial y}{\partial q_r}+\ddot z\frac{\partial z}{\partial q_r}\right)\right\}=Q_r. \tag{6}$$

Now

$$\dot x=\frac{\partial x}{\partial q_1}\dot q_1+\frac{\partial x}{\partial q_2}\dot q_2+\ldots+\frac{\partial x}{\partial q_n}\dot q_n, \tag{7}$$

whence

$$\frac{\partial\dot x}{\partial\dot q_r}=\frac{\partial x}{\partial q_r}. \tag{8}$$

Also

$$\frac{d}{dt}\left(\frac{\partial x}{\partial q_r}\right)=\frac{\partial^2x}{\partial q_1\partial q_r}\dot q_1+\frac{\partial^2x}{\partial q_2\partial q_r}\dot q_2+\ldots+\frac{\partial^2x}{\partial q_n\partial q_r}\dot q_r=\frac{\partial\dot x}{\partial q_r}. \tag{9}$$

Hence

$$\ddot x\frac{\partial x}{\partial q_r}=\frac{d}{dt}\left(\dot x\frac{\partial x}{\partial q_r}\right)-\dot x\frac{d}{dt}\left(\frac{\partial x}{\partial q_r}\right)=\frac{d}{dt}\left(\dot x\frac{\partial\dot x}{\partial\dot q_r}\right)-\dot x\frac{\partial\dot x}{\partial q_r}. \tag{10}$$

By these and the similar transformations relating to y and z the equation (6) takes the form

$$\frac{d}{dt}\left(\frac{\partial T}{\partial\dot q_r}\right)-\frac{\partial T}{\partial q_r}=Q_r. \tag{11}$$

If we put $r=1, 2, \ldots n$ in succession, we get the n independent equations of motion of the system. These equations are due to Lagrange, with whom indeed the first conception, as well as the establishment, of a general dynamical method applicable to all systems whatever appears to have originated. The above proof was given by Sir W. R. Hamilton (1835). Lagrange's own proof will be found under DYNAMICS, § *Analytical*. In a conservative system free from extraneous force we have

$$\Sigma(X\delta x+Y\delta y+Z\delta z)=-\delta V, \tag{12}$$

where V is the potential energy. Hence

$$Q_r=-\frac{\partial V}{\partial q_r}, \tag{13}$$

and

$$\frac{d}{dt}\left(\frac{\partial T}{\partial\dot q_r}\right)-\frac{\partial T}{\partial q_r}=-\frac{\partial V}{\partial q_r}. \tag{14}$$

If we imagine any given state of motion ($\dot q_1, \dot q_2, \ldots \dot q_n$) through the configuration ($q_1, q_2, \ldots q_n$) to be generated instantaneously from rest by the action of suitable impulsive forces, we find on integrating (11) with respect to t over the infinitely short duration of the impulse

$$\frac{\partial T}{\partial\dot q_r}=Q_r', \tag{15}$$

where Q_r' is the time integral of Q_r and so represents a *generalized component of impulse.* By an obvious analogy, the expressions $\partial T/\partial\dot q_r$ may be called the *generalized components of momentum*; they are usually denoted by p_r, thus

$$p_r=\partial T/\partial\dot q_r=a_{1r}\dot q_1+a_{2r}\dot q_2+\ldots+a_{nr}\dot q_n. \tag{16}$$

Since T is a homogeneous quadratic function of the velocities $\dot q_1, \dot q_2, \ldots \dot q_n$, we have

$$2T=\frac{\partial T}{\partial\dot q_1}\dot q_1+\frac{\partial T}{\partial\dot q_2}\dot q_2+\ldots+\frac{\partial T}{\partial\dot q_n}\dot q_n=p_1\dot q_2+p_2\dot q_2+\ldots+p_n\dot q_n. \tag{17}$$

Hence

$$\left.\begin{aligned}2\frac{dT}{dt}&=\dot p_1\dot q_1+\dot p_2\dot q_2+\ldots+p_n\dot q_n\\ &\quad+p_1\ddot q_1+p_2\ddot q_2+\ldots+p_n\ddot q_n\\ &=\left(\frac{\partial T}{\partial\dot q_1}+Q_1\right)\dot q_1+\left(\frac{\partial T}{\partial\dot q_2}+Q_2\right)\dot q_2+\ldots+\left(\frac{\partial T}{\partial\dot q_n}+Q_n\right)\dot q_n\\ &\quad+\frac{\partial T}{\partial\dot q_1}\ddot q_1+\frac{\partial T}{\partial\dot q_2}\ddot q_2+\ldots+\frac{\partial T}{\partial\dot q_n}\ddot q_n\\ &=\frac{dT}{dt}+Q_1\dot q_1+Q_2\dot q_2+\ldots+Q_n\dot q_n,\end{aligned}\right\} \tag{18}$$

or

$$\frac{dT}{dt}=Q_1\dot q_1+Q_2\dot q_2+\ldots+Q_n\dot q_n. \tag{19}$$

This equation expresses that the kinetic energy is increasing at a rate equal to that at which work is being done by the forces. In the case of a conservative system free from extraneous force it becomes the equation of energy

$$\frac{d}{dt}(\mathrm{T}+\mathrm{V})=0, \text{ or } \mathrm{T}+\mathrm{V}=\text{const.}, \tag{20}$$

in virtue of (13).

As a first application of Lagrange's formula (11) we may form the equations of motion of a particle in spherical polar co-ordinates. Let r be the distance of a point P from a fixed origin O, θ the angle which OP makes with a fixed direction OZ, ψ the azimuth of the plane ZOP relative to some fixed plane through OZ. The displacements of P due to small variations of these co-ordinates are δr along OP, $r\delta\theta$ perpendicular to OP in the plane ZOP, and $r\sin\theta\,\delta\psi$ perpendicular to this plane. The component velocities in these directions are therefore $\dot{r}$, $r\dot{\theta}$, $r\sin\theta\,\dot{\psi}$, and if m be the mass of a moving particle at P we have

$$2\mathrm{T}=m(\dot{r}^2+r^2\dot{\theta}^2+r^2\sin^2\theta\,\dot{\psi}^2). \tag{21}$$

Hence the formula (11) gives

$$\left.\begin{aligned} m(\ddot{r}-r\dot{\theta}^2-r\sin^2\theta\,\dot{\psi}^2)&=\mathrm{R},\\ \frac{d}{dt}(mr^2\dot{\theta})-mr^2\sin\theta\cos\theta\,\dot{\psi}^2&=\Theta,\\ \frac{d}{dt}(mr^2\sin^2\theta\,\dot{\psi})&=\Psi. \end{aligned}\right\} \tag{22}$$

The quantities R, Θ, Ψ are the coefficients in the expression $\mathrm{R}\delta r+\Theta\delta\theta+\Psi\delta\psi$ for the work done in an infinitely small displacement; viz. R is the radial component of force, Θ is the moment about a line through O perpendicular to the plane ZOP, and Ψ is the moment about OZ. In the case of the spherical pendulum we have $r=l$, $\Theta=-mgl\sin\theta$, $\Psi=0$, if OZ be drawn vertically downwards, and therefore

$$\left.\begin{aligned} \ddot{\theta}-\sin\theta\cos\theta\dot{\psi}^2&=-\frac{g}{l}\sin\theta,\\ \sin^2\theta\dot{\psi}&=h, \end{aligned}\right\} \tag{23}$$

where h is a constant. The latter equation expresses that the angular momentum $ml^2\sin^2\theta\dot{\psi}$ about the vertical OZ is constant. By elimination of $\dot{\psi}$ we obtain

$$\ddot{\theta}-h^2\cos^2\theta/\sin^3\theta=-\frac{g}{l}\sin\theta. \tag{24}$$

If the particle describes a horizontal circle of angular radius α with constant angular velocity Ω, we have $\ddot{\theta}=0$, $h=\Omega^2\sin\alpha$, and therefore

$$\Omega^2=\frac{g}{l}\cos\alpha, \tag{25}$$

as is otherwise evident from the elementary theory of uniform circular motion. To investigate the small oscillations about this state of steady motion we write $\theta=\alpha+\chi$ in (24) and neglect terms of the second order in χ. We find, after some reductions,

$$\ddot{\chi}+(1+3\cos^2\alpha)\,\Omega^2\chi=0; \tag{26}$$

this shows that the variation of χ is simple-harmonic, with the period

$$2\pi/\sqrt{(1+3\cos^2\alpha)}\,.\,\Omega$$

As regards the most general motion of a spherical pendulum, it is obvious that a particle moving under gravity on a smooth sphere cannot pass through the highest or lowest point unless it describes a vertical circle. In all other cases there must be an upper and a lower limit to the altitude. Again, a vertical plane passing through O and a point where the motion is horizontal is evidently a plane of symmetry as regards the path. Hence the path will be confined between two horizontal circles which it touches alternately, and the direction of motion is never horizontal except at these circles. In the case of disturbed steady motion, just considered, these circles are nearly coincident. When both are near the lowest point the horizontal projection of the path is approximately an ellipse, as shown in § 13; a closer investigation shows that the ellipse is to be regarded as revolving about its centre with the angular velocity $\frac{3}{8}ab\Omega/l^2$, where a, b are the semi-axes.

To apply the equations (11) to the case of the top we start with the expression (15) of § 21 for the kinetic energy, the simplified form (1) of § 20 being for the present purpose inadmissible, since it is essential that the generalized co-ordinates employed should be competent to specify the position of every particle. If λ, μ, ν be the components of momentum, we have

$$\left.\begin{aligned} \lambda&=\frac{\partial\mathrm{T}}{\partial\dot{\theta}}=\mathrm{A}\dot{\theta},\\ \mu&=\frac{\partial\mathrm{T}}{\partial\dot{\psi}}=\mathrm{A}\sin^2\theta\dot{\psi}+\mathrm{C}(\dot{\phi}+\cos\theta\dot{\psi})\cos\theta,\\ \nu&=\frac{\partial\mathrm{T}}{\partial\dot{\phi}}=\mathrm{C}(\dot{\phi}+\cos\theta\dot{\psi}). \end{aligned}\right\} \tag{27}$$

The meaning of these quantities is easily recognized; thus λ is the angular momentum about a horizontal axis normal to the plane of θ, μ is the angular momentum about the vertical OZ, and ν is the angular momentum about the axis of symmetry. If M be the total mass, the potential energy is $\mathrm{V}=\mathrm{M}gh\cos\theta$, if OZ be drawn vertically upwards. Hence the equations (11) become

$$\left.\begin{aligned} &\mathrm{A}\ddot{\theta}-\mathrm{A}\sin\theta\cos\theta\dot{\psi}^2+\mathrm{C}(\dot{\phi}+\cos\theta\dot{\psi})\dot{\psi}\sin\theta=\mathrm{M}gh\sin\theta,\\ &d/dt\,.\,\{\mathrm{A}\sin^2\theta\dot{\psi}+\mathrm{C}(\dot{\phi}+\cos\theta\dot{\psi})\cos\theta\}=0,\\ &d/dt\,.\,\{\mathrm{C}(\dot{\phi}+\cos\theta\dot{\psi})\}=0, \end{aligned}\right\} \tag{28}$$

of which the last two express the constancy of the momenta μ, ν. Hence

$$\left.\begin{aligned} \mathrm{A}\ddot{\theta}-\mathrm{A}\sin\theta\cos\theta\dot{\psi}^2+\nu\sin\theta\dot{\psi}&=\mathrm{M}gh\sin\theta,\\ \mathrm{A}\sin^2\theta\dot{\psi}+\nu\cos\theta&=\mu. \end{aligned}\right\} \tag{29}$$

If we eliminate $\dot{\psi}$ we obtain the equation (7) of § 20. The theory of disturbed precessional motion there outlined does not give a convenient view of the oscillations of the axis about the vertical position. If θ be small the equations (29) may be written

$$\left.\begin{aligned} \ddot{\theta}-\theta\dot{\omega}^2&=-\frac{\nu^2-4\mathrm{AM}gh}{4\mathrm{A}^2}\theta,\\ \theta^2\dot{\omega}&=\text{const.}, \end{aligned}\right\} \tag{30}$$

where

$$\omega=\psi-\frac{\nu}{2\mathrm{A}}t. \tag{31}$$

Since θ, ω are the polar co-ordinates (in a horizontal plane) of a point on the axis of symmetry, relative to an initial line which revolves with constant angular velocity $\nu/2\mathrm{A}$, we see by comparison with § 14 (15) (16) that the motion of such a point will be elliptic-harmonic superposed on a uniform rotation $\nu/2\mathrm{A}$, provided $\nu^2>4\mathrm{AM}gh$. This gives (in essentials) the theory of the "gyroscopic pendulum."

§ 23. *Stability of Equilibrium. Theory of Vibrations.*—If, in a conservative system, the configuration $(q_1, q_2, \ldots q_n)$ be one of equilibrium, the equations (14) of § 22 must be satisfied by $\dot{q}_1, \dot{q}_2, \ldots \dot{q}_n=0$, whence

$$\partial\mathrm{V}/\partial q_r=0. \tag{1}$$

A necessary and sufficient condition of equilibrium is therefore that the value of the potential energy should be stationary for infinitesimal variations of the co-ordinates. If, further, V be a minimum, the equilibrium is necessarily stable, as was shown by P. G. L. Dirichlet (1846). In the motion consequent on any slight disturbance the total energy T+V is constant, and since T is essentially positive it follows that V can never exceed its equilibrium value by more than a slight amount, depending on the energy of the disturbance. This implies, on the present hypothesis, that there is an upper limit to the deviation of each co-ordinate from its equilibrium value; moreover, this limit diminishes indefinitely with the energy of the original disturbance. No such simple proof is available to show without qualification that the above condition is *necessary*. If, however, we recognize the existence of dissipative forces called into play by any motion whatever of the system, the conclusion can be drawn as follows. However slight these forces may be, the total energy T+V must continually diminish so long as the velocities $\dot{q}_1, \dot{q}_2, \ldots \dot{q}_n$ differ from zero. Hence if the system be started from rest in a configuration for which V is less than in the equilibrium configuration considered, this quantity must still further decrease (since T cannot be negative), and it is evident that either the system will finally come to rest in some other equilibrium configuration, or V will in the long run diminish indefinitely. This argument is due to Lord Kelvin and P. G. Tait (1879).

In discussing the small oscillations of a system about a configuration of stable equilibrium it is convenient so to choose the generalized co-ordinates $q_1, q_2, \ldots q_n$ that they shall vanish in the configuration in question. The potential energy is then given with sufficient approximation by an expression of the form

$$2\mathrm{V}=c_{11}q_1{}^2+c_{22}q_2{}^2+\ldots+2c_{12}q_1q_2+\ldots, \tag{2}$$

a constant term being irrelevant, and the terms of the first order being absent since the equilibrium value of V is stationary. The coefficients c_{rr}, c_{rs} are called *coefficients of stability*. We may further treat the coefficients of inertia a_{rr}, a_{rs} of § 22 (1) as constants. The Lagrangian equations of motion are then of the type

$$a_1{}^r\ddot{q}_1+a_2{}^r\ddot{q}_2+\ \ldots\ +a_{nr}q_n+c_{1r}q_1+c_{2r}q_2+\ \ldots\ +c_{nr}q_n=\mathrm{Q}_r, \tag{3}$$

where Q_r now stands for a component of extraneous force. In a *free oscillation* we have $\mathrm{Q}_1, \mathrm{Q}_2, \ldots \mathrm{Q}_n=0$, and if we assume

$$q_r=\mathrm{A}_re^{i\sigma t}, \tag{4}$$

we obtain n equations of the type

$$(c_{1r}-\sigma^2a_{1r})\,\mathrm{A}_1+(c_{2r}-\sigma^2a_{2r})\,\mathrm{A}_2+\ \ldots\ +(c_{nr}-\sigma^2a_{nr})\,\mathrm{A}_n=0. \tag{5}$$

Eliminating the $n-1$ ratios $A_1:A_2:\ldots:A_n$ we obtain the determinantal equation

$$\Delta(\sigma^2)=0, \tag{6}$$

where

$$\Delta(\sigma^2)=\begin{vmatrix} c_{11}-\sigma^2 a_{11}, & c_{21}-\sigma^2 a_{21}, & \ldots, & c_{n1}-\sigma^2 a_{n1} \\ c_{12}-\sigma^2 a_{12}, & c_{22}-\sigma^2 a_{22}, & \ldots, & c_{n2}-\sigma^2 a_{n2} \\ \cdot & \cdot & \cdot\cdot & \cdot \\ \cdot & \cdot & \cdot\cdot & \cdot \\ c_{1n}-\sigma^2 a_{1n}, & c_{2n}-\sigma^2 a_{2n}, & \ldots, & c_{nn}-\sigma^2 a_{nn} \end{vmatrix} \tag{7}$$

The quadratic expression for T is essentially positive, and the same holds with regard to V in virtue of the assumed stability. It may be shown algebraically that under these conditions the n roots of the above equation in σ^2 are all real and positive. For any particular root, the equations (5) determine the ratios of the quantities $A_1, A_2, \ldots A_n$, the absolute values being alone arbitrary; these quantities are in fact proportional to the minors of any one row in the determinate $\Delta(\sigma^2)$. By combining the solutions corresponding to a pair of equal and opposite values of σ we obtain a solution in real form:

$$q_r=C\alpha_r\cos(\sigma t+\epsilon), \tag{8}$$

where $\alpha_1, \alpha_2 \ldots \alpha_r$ are a determinate series of quantites having to one another the above-mentioned ratios, whilst the constants C, ϵ are arbitrary. This solution, taken by itself, represents a motion in which each particle of the system (since its displacements parallel to Cartesian co-ordinate axes are linear functions of the q's) executes a simple vibration of period $2\pi/\sigma$. The amplitudes of oscillation of the various particles have definite ratios to one another, and the phases are in agreement, the absolute amplitude (depending on C) and the phase-constant (ϵ) being alone arbitrary. A vibration of this character is called a *normal mode* of vibration of the system; the number n of such modes is equal to that of the degrees of freedom possessed by the system. These statements require some modification when two or more of the roots of the equation (6) are equal. In the case of a multiple root the minors of $\Delta(\sigma^2)$ all vanish, and the basis for the determination of the quantities α_r disappears. Two or more normal modes then become to some extent indeterminate, and elliptic vibrations of the individual particles are possible. An example is furnished by the spherical pendulum (§ 13).

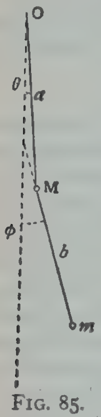

FIG. 85.

As an example of the method of determination of the normal modes we may take the "double pendulum." A mass M hangs from a fixed point by a string of length a, and a second mass m hangs from M by a string of length b. For simplicity we will suppose that the motion is confined to one vertical plane. If θ, ϕ be the inclinations of the two strings to the vertical, we have, approximately,

$$\left.\begin{aligned} 2T&=Ma^2\dot\theta^2+m(a\dot\theta+b\dot\phi)^2, \\ 2V&=Mga\theta^2+mg(a\theta^2+b\phi^2). \end{aligned}\right\} \tag{9}$$

The equations (3) take the forms

$$\left.\begin{aligned} a\ddot\theta+\mu b\ddot\phi+g\theta&=0, \\ a\ddot\theta+b\ddot\phi+g\phi&=0. \end{aligned}\right\} \tag{10}$$

where $\mu=m/(M+m)$. Hence

$$\left.\begin{aligned} (\sigma^2-g/a)a\theta+\mu\sigma^2 b\phi&=0, \\ \sigma^2 a\theta+(\sigma^2-g/b)b\phi&=0. \end{aligned}\right\} \tag{11}$$

The frequency equation is therefore

$$(\sigma^2-g/a)(\sigma^2-g/b)-\mu\sigma^4=0. \tag{12}$$

The roots of this quadratic in σ^2 are easily seen to be real and positive. If M be large compared with m, μ is small, and the roots are g/a and g/b, approximately. In the normal mode corresponding to the former root, M swings almost like the bob of a simple pendulum of length a, being comparatively uninfluenced by the presence of m, whilst m executes a "forced" vibration (§12) of the corresponding period. In the second mode, M is nearly at rest [as appears from the second of equations (11)], whilst m swings almost like the bob of a simple pendulum of length b. Whatever the ratio M/m, the two values of σ^2 can never be exactly equal, but they are approximately equal if a, b are nearly equal and μ is very small. A curious phenomenon is then to be observed; the motion of each particle, being made up (in general) of two superposed simple vibrations of nearly equal period, is seen to fluctuate greatly in extent, and if the amplitudes be equal we have periods of approximate rest, as in the case of "beats" in acoustics. The vibration then appears to be transferred alternately from m to M at regular intervals. If, on the other hand, M is small compared with m, μ is nearly equal to unity, and the roots of (12) are $\sigma^2=g/(a+b)$ and $\sigma^2=mg/M.(a+b)/ab$, approximately. The former root makes $\theta=\phi$, nearly; in the corresponding normal mode m oscillates like the bob of a simple pendulum of length $a+b$. In the second mode $a\theta+b\phi=0$, nearly, so that m is approximately at rest. The oscillation of M then resembles that of a particle at a distance a from one end of a string of length $a+b$ fixed at the ends and subject to a tension mg.

The motion of the system consequent on arbitrary initial conditions may be obtained by superposition of the n normal modes with suitable amplitudes and phases. We have then

$$q_r=\alpha_r\theta+\alpha_r'\theta'+\alpha_r''\theta''+\ldots, \tag{13}$$

where

$$\theta=C\cos(\sigma t+\epsilon),\ \theta'=C'\cos(\sigma' t+\epsilon),\ \theta''=C''\cos(\sigma'' t+\epsilon),\ \ldots \tag{14}$$

provided $\sigma^2, \sigma'^2, \sigma''^2, \ldots$ are the n roots of (6). The coefficients of θ, θ', θ'', ... in (13) satisfy the *conjugate* or *orthogonal* relations

$$a_{11}\alpha_1\alpha_1'+a_{22}\alpha_2\alpha_2'+\ldots+a_{12}(\alpha_1\alpha_2'+\alpha_2\alpha_1')+\ldots=0, \tag{15}$$

$$c_{11}\alpha_1\alpha_1'+c_{22}\alpha_2\alpha_2'+\ldots+c_{12}(\alpha_1\alpha_2'+\alpha_2\alpha_1')+\ldots=0, \tag{16}$$

provided the symbols α_r, α_r' correspond to two distinct roots σ^2, σ'^2 of (6). To prove these relations, we replace the symbols $A_1, A_2, \ldots A_n$ in (5) by $\alpha_1, \alpha_2, \ldots \alpha_n$ respectively, multiply the resulting equations by $\alpha_1', \alpha_2', \ldots \alpha_n'$, in order, and add. The result, owing to its symmetry, must still hold if we interchange accented and unaccented Greek letters, and by comparison we deduce (15) and (16), provided σ^2 and σ'^2 are unequal. The actual determination of C, C′, C″, ... and $\epsilon, \epsilon', \epsilon''$, ... in terms of the initial conditions is as follows. If we write

$$C\cos\epsilon=H, -C\sin\epsilon=K, \tag{17}$$

we must have

$$\left.\begin{aligned} \alpha_r H+\alpha_r' H'+\alpha_r'' H''+\ldots&=[q_r]_0, \\ \sigma\alpha_r H+\sigma'\alpha_r' H'+\sigma''\alpha_r'' H''+\ldots&=[\dot q_r]_0, \end{aligned}\right\} \tag{18}$$

where the zero suffix indicates initial values. These equations can be at once solved for H, H′, H″, ... and K, K′, K″, ... by means of the orthogonal relations (15).

By a suitable choice of the generalized co-ordinates it is possible to reduce T and V simultaneously to sums of squares. The transformation is in fact effected by the assumption (13), in virtue of the relations (15) (16), and we may write

$$\left.\begin{aligned} 2T&=a\dot\theta^2+a'\dot\theta'^2+a''\dot\theta''^2+\ldots, \\ 2V&=c\theta^2+c'\theta'^2+c''\theta''^2+\ldots. \end{aligned}\right\} \tag{19}$$

The new co-ordinates $\theta, \theta', \theta''$ ... are called the *normal* co-ordinates of the system; in a normal mode of vibration one of these varies alone. The physical characteristics of a normal mode are that an impulse of a particular normal type generates an initial velocity of that type only, and that a constant extraneous force of a particular normal type maintains a displacement of that type only. The normal modes are further distinguished by an important "stationary" property, as regards the frequency. If we imagine the system reduced by frictionless constraints to one degree of freedom, so that the co-ordinates $\theta, \theta', \theta''$, ... have prescribed ratios to one another, we have, from (19),

$$\sigma^2=\frac{c\theta^2+c'\theta'^2=c''\theta''^2+\ldots}{a\theta^2+a'\theta'^2+a''\theta''^2+\ldots}, \tag{20}$$

This shows that the value of σ^2 for the constrained mode is intermediate to the greatest and least of the values $c/a, c'/a', c''/a''$, ... proper to the several normal modes. Also that if the constrained mode differs little from a normal mode of free vibration (*e.g.* if θ', θ'', ... are small compared with θ), the change in the frequency is of the second order. This property can often be utilized to estimate the frequency of the gravest normal mode of a system, by means of an assumed approximate type, when the exact determination would be difficult. It also appears that an estimate thus obtained is necessarily too high.

From another point of view it is easily recognized that the equations (5) are exactly those to which we are led in the ordinary process of finding the stationary values of the function

$$\frac{V(q_1, q_2, \ldots q_n)}{T(q_1, q_2, \ldots q_n)},$$

where the denominator stands for the same homogeneous quadratic function of the q's that T is for the $\dot q$'s. It is easy to construct in this connexion a proof that the n values of σ^2 are all real and positive.

The case of three degrees of freedom is instructive on account of the geometrical analogies. With a view to these we may write

$$2\mathrm{T}=a\dot{x}^2+b\dot{y}^2+c\dot{z}^2+2f\dot{y}\dot{z}+2g\dot{z}\dot{x}+2h\dot{x}\dot{y},\qquad (21)$$
$$2\mathrm{V}=\mathrm{A}x^2+\mathrm{B}y^2+\mathrm{C}z^2+2\mathrm{F}yz+2\mathrm{G}zx+2\mathrm{H}xy.$$

It is obvious that the ratio

$$\frac{\mathrm{V}\ (x,v,z)}{\mathrm{T}\ (x,y,z)}\qquad (22)$$

must have a least value, which is moreover positive, since the numerator and denominator are both essentially positive. Denoting this value by σ_1^2, we have

$$\left.\begin{aligned}\mathrm{A}x_1+\mathrm{H}y_1+\mathrm{G}z_1&=\sigma_1^2(ax_1+hy_1+\partial gz_1),\\ \mathrm{H}x_1+\mathrm{B}y_1+\mathrm{F}z_1&=\sigma_1^2(hx_1+by_1+\ fz_1),\\ \mathrm{G}x_1+\mathrm{F}y_1+\mathrm{C}z_1&=\sigma_1^2(gx_1+fy_1+\ cz_1),\end{aligned}\right\}\qquad (23)$$

provided $x_1: y_1: z_1$ be the corresponding values of the ratios $x: y: z$. Again, the expression (22) will also have a least value when the ratios $x: y: z$ are subject to the condition

$$x_1\frac{\partial \mathrm{V}}{\partial x}+y_1\frac{\partial \mathrm{V}}{\partial y}+z_1\frac{\partial \mathrm{V}}{\partial z}=0;\qquad (24)$$

and if this be denoted by σ_2^2 we have a second system of equations similar to (23). The remaining value σ_3^2 is the value of (22) when $x: y: z$ are chosen so as to satisfy (24) and

$$x_2\frac{\partial \mathrm{V}}{\partial x}+y_2\frac{\partial \mathrm{V}}{\partial y}+z_2\frac{\partial \mathrm{V}}{\partial z}=0.\qquad (25)$$

The problem is identical with that of finding the common conjugate diameters of the ellipsoids $\mathrm{T}(x,\ y,\ z)=$const., $\mathrm{V}(x,\ y,\ z)=$const. If in (21) we imagine that x, y, z denote infinitesimal rotations of a solid free to turn about a fixed point in a given field of force, it appears that the three normal modes consist each of a rotation about one of the three diameters aforesaid, and that the values of σ are proportional to the ratios of the lengths of corresponding diameters of the two quadrics.

We proceed to the *forced vibrations* of the system. The typical case is where the extraneous forces are of the simple-harmonic type $\cos(\sigma t+\epsilon)$; the most general law of variation with time can be derived from this by superposition, in virtue of Fourier's theorem. Analytically, it is convenient to put Q_r equal to $e^{i\sigma t}$ multiplied by a complex coefficient; owing to the linearity of the equations the factor $e^{i\sigma t}$ will run through them all, and need not always be exhibited. For a system of one degree of freedom we have

$$a\ddot{q}+cq=\mathrm{Q},\qquad (26)$$

and therefore on the present supposition as to the nature of Q

$$q=\frac{\mathrm{Q}}{c-\sigma^2 a}.\qquad (27)$$

This solution has been discussed to some extent in § 12, in connexion with the forced oscillations of a pendulum. We may note further that when σ is small the displacement q has the "equilibrium value" Q/c, the same as would be produced by a steady force equal to the instantaneous value of the actual force, the inertia of the system being inoperative. On the other hand, when σ^2 is great q tends to the value $-\mathrm{Q}/\sigma^2 a$, the same as if the potential energy were ignored. When there are n degrees of freedom we have from (3)

$$(c_{1r}-\sigma^2 a_{2r})q_1+(c^2{}_r-\sigma^2 a_{2r})q_2+\ .\ .\ .\ +(c_{nr}-\sigma^2 a_{nr})q_n=\mathrm{Q}_r,\qquad (28)$$

and therefore

$$\Delta(\sigma^2)\,.\,q_r=\alpha_{1r}\mathrm{Q}_1+\alpha_{2r}\mathrm{Q}_2+\ldots+\alpha_{nr}\mathrm{Q}_n,\qquad (29)$$

where α_{1r}, α_{2r}, . . . α_{nr} are the minors of the rth row of the determinant (7). Every particle of the system executes in general a simple vibration of the imposed period $2\pi/\sigma$, and all the particles pass simultaneously through their equilibrium positions. The amplitude becomes very great when σ^2 approximates to a root of (6), *i.e.* when the imposed period nearly coincides with one of the free periods. Since $\alpha_{rs}=\alpha_{sr}$, the coefficient of Q_s in the expression for q_r is identical with that of Q_r in the expression for q_s. Various important "reciprocal theorems" formulated by H. Helmholtz and Lord Rayleigh are founded on this relation. Free vibrations must of course be superposed on the forced vibrations given by (29) in order to obtain the complete solution of the dynamical equations.

In practice the vibrations of a system are more or less affected by dissipative forces. In order to obtain at all events a qualitative representation of these it is usual to introduce into the equations frictional terms proportional to the velocities. Thus in the case of one degree of freedom we have, in place of (26),

$$a\ddot{q}+b\dot{q}+cq=\mathrm{Q},\qquad (30)$$

where a, b, c are positive. The solution of this has been sufficiently discussed in § 12. In the case of multiple freedom, the equations of small motion when modified by the introduction of terms proportional to the velocities are of the type

$$\frac{d}{dt}\frac{\partial \mathrm{T}}{\partial \dot{q}_r}+\mathrm{B}_{1r}\dot{q}_1+\mathrm{B}_{2r}\dot{q}_2+\ .\ .\ .\ +\mathrm{B}_{nr}\dot{q}_n+\frac{\partial \mathrm{V}}{\partial q_r}=\mathrm{Q}_r.\qquad (31)$$

If we put

$$b_{rs}=b_{sr}=\tfrac{1}{2}(\mathrm{B}_{rs}+\mathrm{B}_{sr}),\quad \beta_{rs}=-\beta_{sr}=\tfrac{1}{2}(\mathrm{B}_{rs}-\mathrm{B}_{sr}),\qquad (32)$$

this may be written

$$\frac{d}{dt}\frac{\partial \mathrm{T}}{\partial \dot{q}_r}+\frac{\partial \mathrm{F}}{\partial \dot{q}_r}+\beta_{1r}\dot{q}_1+\beta_{2r}\dot{q}_2+\ .\ .\ .\ +\beta_{nr}\dot{q}_n+\frac{\partial \mathrm{V}}{\partial q_r}=\mathrm{Q}_r,\qquad (33)$$

provided

$$2\mathrm{F}=b_{11}\dot{q}_1^2+b_{22}\dot{q}_2^2+\ .\ .\ .\ +\ 2b_{12}\dot{q}_1\dot{q}_2+\ .\ .\ .\qquad (34)$$

The terms due to F in (33) are such as would arise from frictional resistances proportional to the absolute velocities of the particles, or to mutual forces of resistance proportional to the relative velocities; they are therefore classed as *frictional* or *dissipative* forces. The terms affected with the coefficients β_{rs} on the other hand are such as occur in "cyclic" systems with latent motion (DYNAMICS, § *Analytical*); they are called the *gyrostatic terms.* If we multiply (33) by $\dot{q}_r$ and sum with respect to r from 1 to n, we obtain, in virtue of the relations $\beta_{rs}=-\beta_{sr}$, $\beta_{rr}=0$,

$$\frac{d}{dt}(\mathrm{T}+\mathrm{V})=2\mathrm{F}+\mathrm{Q}_1\dot{q}_1+\mathrm{Q}_2\dot{q}_2+\ .\ .\ .\ +\mathrm{Q}_n\dot{q}_n.\qquad (35)$$

This shows that mechanical energy is lost at the rate 2 F per unit time. The function F is therefore called by Lord Rayleigh the *dissipation function.*

If we omit the gyrostatic terms, and write $q_r=\mathrm{C}_r e^{\lambda t}$, we find, for a free vibration,

$$(a_{1r}\lambda^2+b_{1r}\lambda+c_{1r})\mathrm{C}_1+(a_{2r}\lambda^2+b_{2r}\lambda+c_{2r})\mathrm{C}_2+\ .\ .\ .$$
$$+(a_{nr}\lambda^2+b_{nr}\lambda+\mathrm{C}_{nr})\,\mathrm{C}_n=0.\qquad (36)$$

This leads to a determinantal equation in λ whose $2n$ roots are either real and negative, or complex with negative real parts, on the present hypothesis that the functions T, V, F are all essentially positive. If we combine the solutions corresponding to a pair of conjugate complex roots, we obtain, in real form,

$$q_r=\mathrm{C}\alpha_r e^{-t/\tau}\cos(\sigma t+\epsilon-\epsilon_r),\qquad (37)$$

where σ, τ, α_r, ϵ_r are determined by the constitution of the system, whilst C, ϵ are arbitrary, and independent of r. The n formulae of this type represent a normal mode of free vibration; the individual particles revolve as a rule in elliptic orbits which gradually contract according to the law indicated by the exponential factor. If the friction be relatively small, all the normal modes are of this character, and unless two or more values of σ are nearly equal the elliptic orbits are very elongated. The effect of friction on the period is moreover of the second order.

In a forced vibration of $e^{i\sigma t}$ the variation of each co-ordinate is simple-harmonic, with the prescribed period, but there is a retardation of phase as compared with the force. If the friction be small the amplitude becomes relatively very great if the imposed period approximate to a free period. The validity of the "reciprocal theorems" of Helmholtz and Lord Rayleigh, already referred to, is not affected by frictional forces of the kind here considered.

The most important applications of the theory of vibrations are to the case of continuous systems such as strings, bars, membranes, plates, columns of air, where the number of degrees of freedom is infinite. The series of equations of the type (3) is then replaced by a single linear partial differential equation, or by a set of two or three such equations, according to the number of dependent variables. These variables represent the whole assemblage of generalized co-ordinates q_r; they are continuous functions of the independent variables x, y, z whose range of variation corresponds to that of the index r, and of t. For example, in a one-dimensional system such as a string or a bar, we have one dependent variable, and two independent variables x and t. To determine the free oscillations we assume a time factor $e^{i\sigma t}$; the equations then become linear differential equations between the dependent variables of the problem and the independent variables x, or x, y, or x, y, z as the case may be. If the range of the independent variable or variables is unlimited, the value of σ is at our disposal, and the solution gives us the laws of wave-propagation (see WAVE). If, on the other hand, the body is finite, certain terminal conditions have to be satisfied. These limit the admissible values of σ, which are in general determined by a transcendental equation corresponding to the determinantal equation (6).

Numerous examples of this procedure, and of the corresponding treatment of forced oscillations, present themselves in theoretical acoustics. It must suffice here to consider the small oscillations of a chain hanging vertically from a fixed extremity. If x be measured upwards from the lower end, the horizontal component of the tension P at any point will be $P\partial y/\partial x$, approximately, if y denote the lateral displacement. Hence, forming the equation of motion of a mass-element, $\rho\delta x$, we have

$$\rho\delta x\,.\,\ddot{y}=\delta(\mathrm{P}\,.\,\partial y/\partial x). \qquad (38)$$

Neglecting the vertical acceleration we have $\mathrm{P}=g\rho x$, whence

$$\frac{\partial^2 y}{\partial t^2}=g\frac{\partial}{\partial x}\left(x\frac{\partial y}{\partial x}\right). \qquad (39)$$

Assuming that y varies as $e^{i\sigma t}$ we have

$$\frac{\partial}{\partial x}\left(x\frac{\partial y}{\partial x}\right)+ky=0. \qquad (40)$$

provided $k=\sigma^2/g$. The solution of (40) which is finite for $x=0$ is readily obtained in the form of a series, thus

$$y=\mathrm{C}\left(1-\frac{kx}{1^2}+\frac{k^2x^2}{1^2 2^2}-\dots\right)=\mathrm{CJ}_0(z), \qquad (41)$$

in the notation of Bessel's functions, if $z^2=4kx$. Since y must vanish at the upper end $(x=l)$, the admissible values of σ are determined by

$$\sigma^2=gz^2/4l,\quad \mathrm{J}_0(z)=0. \qquad (42)$$

The function $\mathrm{J}_0(z)$ has been tabulated; its lower roots are given by

$$z/\pi=\ \cdot 7655,\ 1\cdot 7571,\ 2\cdot 7546,\ \dots,$$

approximately, where the numbers tend to the form $s-\frac{1}{4}$. The frequency of the gravest mode is to that of a uniform bar in the ratio ·9815. That this ratio should be less than unity agrees with the theory of "constrained types" already given. In the higher normal modes there are *nodes* or points of rest $(y=0)$; thus in the second mode there is a node at a distance $\cdot 190l$ from the lower end.

Authorities.—For indications as to the earlier history of the subject see W. W. R. Ball, *Short Account of the History of Mathematics*; M. Cantor, *Geschichte der Mathematik* (Leipzig, 1880 . . .); J. Cox, *Mechanics* (Cambridge, 1904); E. Mach, *Die Mechanik in ihrer Entwickelung* (4th ed., Leipzig, 1901; Eng. trans.). Of the classical treatises which have had a notable influence on the development of the subject, and which may still be consulted with advantage, we may note particularly, Sir I. Newton, *Philosophiae naturalis Principia Mathematica* (1st ed., London, 1687); J. L. Lagrange, *Mécanique analytique* (2nd ed., Paris, 1811–1815); P. S. Laplace, *Mécanique céleste* (Paris, 1799–1825); A. F. Möbius, *Lehrbuch der Statik* (Leipzig, 1837), and *Mechanik des Himmels*; L. Poinsot, *Éléments de statique* (Paris, 1804), and *Théorie nouvelle de la rotation des corps* (Paris, 1834).

Of the more recent general treatises we may mention Sir W. Thomson (Lord Kelvin) and P. G. Tait, *Natural Philosophy* (2nd ed., Cambridge, 1879–1883); E. J. Routh, *Analytical Statics* (2nd. ed., Cambridge, 1896), *Dynamics of a Particle* (Cambridge, 1898), *Rigid Dynamics* (6th ed., Cambridge 1905); G. Minchin, *Statics* (4th ed., Oxford, 1888); A. E. H. Love, *Theoretical Mechanics* (2nd ed., Cambridge, 1909); A. G. Webster, *Dynamics of Particles*, &c. (1904); E. T. Whittaker, *Analytical Dynamics* (Cambridge, 1904); L. Arnal, *Traité de mécanique* (1888–1898); P. Appell, *Mécanique rationelle* (Paris, vols. i. and ii., 2nd ed., 1902 and 1904; vol. iii., 1st ed., 1896); G. Kirchhoff, *Vorlesungen über Mechanik* (Leipzig, 1896); H. Helmholtz, *Vorlesungen über theoretische Physik*, vol. i. (Leipzig, 1898); J. Somoff, *Theoretische Mechanik* (Leipzig, 1878–1879).

The literature of graphical statics and its technical applications is very extensive. We may mention K. Culmann, *Graphische Statik* (2nd ed., Zürich, 1895); A. Föppl, *Technische Mechanik*, vol. ii. (Leipzig, 1900); L. Henneberg, *Statik des starren Systems* (Darmstadt, 1886); M. Lévy, *La statique graphique* (2nd ed., Paris, 1886–1888); H. Müller-Breslau, *Graphische Statik* (3rd ed., Berlin, 1901). Sir R. S. Ball's highly original investigations in kinematics and dynamics were published in collected form under the title *Theory of Screws* (Cambridge, 1900).

Detailed accounts of the developments of the various branches of the subject from the beginning of the 19th century to the present time, with full bibliographical references, are given in the fourth volume (edited by Professor F. Klein) of the *Encyclopädie der mathematischen Wissenschaften* (Leipzig). There is a French translation of this work. (See also Dynamics.) (H. Lb.)

II.—Applied Mechanics[1]

§ 1. The practical application of mechanics may be divided into two classes, according as the assemblages of material objects to which they relate are intended to remain fixed or to move relatively to each other—the former class being comprehended under the term "Theory of Structures" and the latter under the term "Theory of Machines."

PART I.—OUTLINE OF THE THEORY OF STRUCTURES

§ 2. *Support of Structures.*—Every structure, as a whole, is maintained in equilibrium by the joint action of its own *weight*, of the *external load* or pressure applied to it from without and tending to displace it, and of the *resistance* of the material which supports it. A structure is supported either by resting on the solid crust of the earth, as buildings do, or by floating in a fluid, as ships do in water and balloons in air. The principles of the support of a floating structure form an important part of Hydromechanics (*q.v.*). The principles of the support, as a whole, of a structure resting on the land, are so far identical with those which regulate the equilibrium and stability of the several parts of that structure that the only principle which seems to require special mention here is one which comprehends in one statement the power both of liquids and of loose earth to support structures. This was first demonstrated in a paper "On the Stability of Loose Earth," read to the Royal Society on the 19th of June 1856 (Phil. *Trans.* 1856), as follows:—

Let E represent the weight of the portion of a horizontal stratum of earth which is displaced by the foundation of a structure, S the utmost weight of that structure consistently with the power of the earth to resist displacement, ϕ the angle of repose of the earth; then

$$\frac{\mathrm{S}}{\mathrm{E}}=\left(\frac{1+\sin\phi}{1-\sin\phi}\right)^2.$$

To apply this to liquids ϕ must be made zero, and then $\mathrm{S}/\mathrm{E}=1$, as is well known. For a proof of this expression see Rankine's *Applied Mechanics*, 17th ed., p. 219.

§ 3. *Composition of a Structure, and Connexion of its Pieces.*—A structure is composed of *pieces*,—such as the stones of a building in masonry, the beams of a timber frame-work, the bars, plates and bolts of an iron bridge. Those pieces are connected at their *joints* or surfaces of mutual contact, either by simple pressure and friction (as in masonry with moist mortar or without mortar), by pressure and adhesion (as in masonry with cement or with hardened mortar, and timber with glue), or by the resistance of *fastenings* of different kinds, whether made by means of the form of the joint (as dovetails, notches, mortices and tenons) or by separate fastening pieces (as trenails, pins, spikes, nails, holdfasts, screws, bolts, rivets, hoops, straps and sockets.

§ 4. *Stability, Stiffness and Strength.*—A structure may be damaged or destroyed in three ways:—first, by *displacement* of its pieces from their proper positions relatively to each other or to the earth; secondly by disfigurement of one or more of those pieces, owing to their being unable to preserve their proper shapes under the pressures to which they are subjected; thirdly, by *breaking* of one or more of those pieces. The power of resisting displacement constitutes stability, the power of each piece to resist disfigurement is its *stiffness*; and its power to resist breaking, its *strength*.

§ 5. *Conditions of Stability.*—The principles of the stability of a structure can be to a certain extent investigated independently of the stiffness and strength, by assuming, in the first instance, that each piece has strength sufficient to be safe against being broken, and stiffness sufficient to prevent its being disfigured to an extent inconsistent with the purposes of the structure, by the greatest forces which are to be applied to it. The condition that each piece of the structure is to be maintained in equilibrium by having its gross load, consisting of its own weight and of the external pressure applied to it, balanced by the *resistances* or pressures exerted between it and the contiguous pieces, furnishes the means of determining the magnitude, position and direction of the resistances required at each joint in order to produce equilibrium; and the *conditions of stability* are, first, that the *position*, and, secondly, that the *direction*, of the resistance required at each joint shall, under all the variations to which the load is subject, be such as the joint is capable of exerting—conditions which are fulfilled by suitably adjusting the figures and positions of the joints, and the *ratios* of the gross loads of the pieces. As for the *magnitude* of the resistance, it is limited by conditions, not of stability, but of strength and stiffness.

§ 6. *Principle of Least Resistance.*—Where more than one system of resistances are alike capable of balancing the same system of loads applied to a given structure, the *smallest* of those alternative systems, as was demonstrated by the Rev. Henry Moseley in his *Mechanics of Engineering and Architecture*, is that which will actually be exerted—

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[1] In view of the great authority of the author, the late Professor Macquorn Rankine, it has been thought desirable to retain the greater part of this article as it appeared in the 9th edition of the *Encyclopaedia Britannica*. Considerable additions, however, have been introduced in order to indicate subsequent developments of the subject; the new sections are numbered continuously with the old, but are distinguished by an asterisk. Also, two short chapters which concluded the original article have been omitted—ch. iii., "On Purposes and Effects of Machines," which was really a classification of machines, because the classification of Franz Reuleaux is now usually followed, and ch. iv., "Applied Energetics, or Theory of Prime Movers," because its subject matter is now treated in various special articles, *e.g.* Hydraulics, Steam Engine, Gas Engine, Oil Engine, and fully developed in Rankine's *The Steam Engine and Other Prime Movers* (London, 1902). (Ed. *E.B.*)

because the resistances to displacement are the effect of a strained state of the pieces, which strained state is the effect of the load, and when the load is applied the strained state and the resistances produced by it increase until the resistances acquire just those magnitudes which are sufficient to balance the load, after which they increase no further.

This principle of least resistance renders determinate many problems in the statics of structures which were formerly considered indeterminate.

§ 7. *Relations between Polygons of Loads and of Resistances.*—In a structure in which each piece is supported at two joints only, the well-known laws of statics show that the directions of the gross load on each piece and of the two resistances by which it is supported must lie in one plane, must either be parallel or meet in one point, and must bear to each other, if not parallel, the proportions of the sides of a triangle respectively parallel to their directions, and, if parallel, such proportions that each of the three forces shall be proportional to the distance between the other two,—all the three distances being measured along one direction.

Considering, in the first place, the case in which the load and the two resistances by which each piece is balanced meet in one point, which may be called the *centre of load*, there will be as many such points of intersection, or centres of load, as there are pieces in the structure; and the directions and positions of the resistances or mutual pressures exerted between the pieces will be represented by the sides of a polygon joining those points, as in fig. 86 where P_1, P_2, P_3, P_4 represent the centres of load in a structure of four pieces, and the sides of the *polygon of resistances* $P_1\ P_2\ P_3\ P_4$ represent respectively the directions and positions of the resistances exerted at the joints.

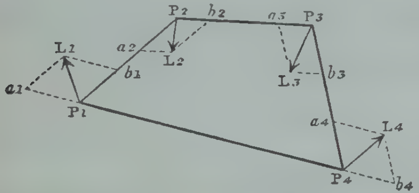

FIG. 86.

Further, at any one of the centres of load let PL represent the magnitude and direction of the gross load, and P*a*, P*b* the two resistances by which the piece to which that load is applied is supported; then will those three lines be respectively the diagonal and sides of a parallelogram; or, what is the same thing, they will be equal to the three sides of a triangle; and they must be in the same plane, although the sides of the polygon of resistances may be in different planes.

According to a well-known principle of statics, because the loads or external pressures P_1L_1, &c., balance each other, they must be proportional to the sides of a closed polygon drawn respectively parallel to their directions. In fig. 87 construct such a *polygon of loads* by drawing the lines L_1, &c., parallel and proportional to, and joined end to end in the order of, the gross loads on the pieces of the structure. Then from the proportionality and parallelism of the load and the two resistances applied to each piece of the structure to the three sides of a triangle, there results the following theorem (originally due to Rankine):—

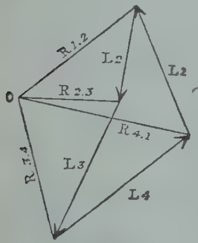

FIG. 87.

If from the angles of the polygon of loads there be drawn lines (R_1, R_2, &c.), *each of which is parallel to the resistance* (*as* P_1P_2, &c.) *exerted at the joint between the pieces to which the two loads represented by the contiguous sides of the polygon of loads* (*such as* L_1, L_2, &c.) *are applied; then will all those lines meet in one point* (O), *and their lengths, measured from that point to the angles of the polygon, will represent the magnitudes of the resistances to which they are respectively parallel.*

When the load on one of the pieces is parallel to the resistances which balance it, the polygon of resistances ceases to be closed, two of the sides becoming parallel to each other and to the load in question, and extending indefinitely. In the polygon of loads the direction of a load sustained by parallel resistances traverses the point O.[1]

§ 8. *How the Earth's Resistance is to be treated*...When the pressure exerted by a structure on the earth (to which the earth's resistance is equal and opposite) consists either of one pressure, which is necessarily the resultant of the weight of the structure and of all the other forces applied to it, or of two or more parallel vertical forces, whose amount can be determined at the outset of the investigation, the resistance of the earth can be treated as one or more *upward loads* applied to the structure. But in other cases the earth is to be treated as *one of the pieces of the structure*, loaded with a force equal and opposite in direction and position to the resultant of the weight of the structure and of the other pressures applied to it.

§ 9. *Partial Polygons of Resistance.*—In a structure in which there are pieces supported at more than two joints, let a polygon be constructed of lines connecting the centres of load of any continuous series of pieces. This may be called a *partial polygon of resistances.* In considering its properties, the *load* at each centre of load is to be held to *include* the resistances of those joints which are *not* comprehended in the partial polygon of resistances, to which the theorem of § 7 will then apply in every respect. By constructing several partial polygons, and computing the relations between the loads and resistances which are determined by the application of that theorem to each of them, with the aid, if necessary, of Moseley's principle of the least resistance, the whole of the relations amongst the loads and resistances may be found.

§ 10. *Line of Pressures—Centres and Line of Resistance.*—The *line of pressures* is a line to which the directions of all the resistances in one polygon are tangents. The *centre of resistance* at any joint is the point where the line representing the total resistance exerted at that joint intersects the joint. The *line of resistance* is a line traversing all the centres of resistance of a series of joints,—its form, in the positions intermediate between the actual joints of the structure, being determined by supposing the pieces and their loads to be subdivided by the introduction of intermediate joints *ad infinitum*, and finding the continuous line, curved or straight, in which the intermediate centres of resistance are all situated, however great their number. The difference between the line of resistance and the line of pressures was first pointed out by Moseley.

§ 11*. The principles of the two preceding sections may be illustrated by the consideration of a particular case of a buttress of blocks forming a continuous series of pieces (fig. 88), where *aa*, *bb*, *cc*, *dd* represent plane joints. Let the centre of pressure C at the first joint *aa* be known, and also the pressure P acting at C in direction and magnitude. Find R_1 the resultant of this pressure, the weight of the block *aabb* acting through its centre of gravity, and any other external force which may be acting on the block, and produce its line of action to cut the joint *bb* in C_1. C_1 is then the centre of pressure for the joint *bb*, and R_1 is the total force acting there. Repeating this process for each block in succession there will be found the centres of pressure C_2, C_3, &c., and also the resultant pressures R_2, R_3, &c., acting at these respective centres. The centres of pressure at the joints are also called *centres of resistance*, and the curve passing through these points is called a *line of resistance*. Let all the resultants acting at the several centres of resistance be produced until they cut one another in a series of points so as to form an unclosed polygon. This polygon is the *partial polygon of resistance.* A curve tangential to all the sides of the polygon is the *line of pressures*.

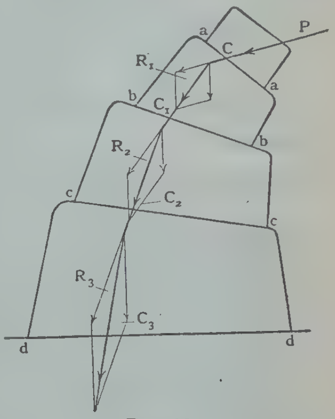

FIG. 88.

§ 12. *Stability of Position, and Stability of Friction.*—The resistances at the several joints having been determined by the principles set forth in §§ 6, 7, 8, 9 and 10, not only under the ordinary load of the structure, but under all the variations to which the load is subject as to amount and distribution, the joints are now to be placed and shaped so that the pieces shall not suffer relative displacement under any of those loads. The relative displacement of the two pieces which abut against each other at a joint may take place either by turning or by sliding. Safety against displacement by turning is called *stability of position*; safety against displacement by sliding, *stability of friction*.

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[1] Since the relation discussed in § 7 was enunciated by Rankine, an enormous development has taken place in the subject of Graphic Statics, the first comprehensive textbook on the subject being *Die Graphische Statik* by K. Culmann, published at Zürich in 1866. Many of the graphical methods therein given have now passed into the textbooks usually studied by engineers. One of the most beautiful graphical constructions regularly used by engineers and known as "the method of reciprocal figures" is that for finding the loads supported by the several members of a braced structure, having given a system of external loads. The method was discovered by Clerk Maxwell, and the complete theory is discussed and exemplified in a paper "On Reciprocal Figures, Frames and Diagrams of Forces," *Trans. Roy. Soc. Ed.*, vol. xxvi. (1870). Professor M. W. Crofton read a paper on "Stress-Diagrams in Warren and Lattice Girders" at the meeting of the Mathematical Society (April 13, 1871), and Professor O. Henrici illustrated the subject by a simple and ingenious notation. The application of the method of reciprocal figures was facilitated by a system of notation published in *Economics of Construction in relation to framed Structures*, by Robert H. Bow (London, 1873). A notable work on the general subject is that of Luigi Cremona, translated from the Italian by Professor T. H. Beare (Oxford, 1890), and a discussion of the subject of reciprocal figures from the special point of view of the engineering student is given in *Vectors and Rotors* by Henrici and Turner (London, 1903) See also above under "*Theoretical Mechanics*," Part I. § 5.

§ 13. *Condition of Stability of Position.*—If the materials of a structure were infinitely stiff and strong, stability of position at any joint would be insured simply by making the centre of resistance fall within the joint under all possible variations of load. In order to allow for the finite stiffness and strength of materials, the least distance of the centre of resistance inward from the nearest edge of the joint is made to bear a definite proportion to the depth of the joint measured in the same direction, which proportion is fixed, sometimes empirically, sometimes by theoretical deduction from the laws of the strength of materials. That least distance is called by Moseley the *modulus of stability*. The following are some of the ratios of the modulus of stability to the depth of the joint which occur in practice:—

Retaining walls, as designed by British engineers	1 : 8
Retaining walls, as designed by French engineers	1 : 5
Rectangular piers of bridges and other buildings, and arch-stones	1 : 3
Rectangular foundations, firm ground	1 : 3
Rectangular foundations, very soft ground	1 : 2
Rectangular foundations, intermediate kinds of ground 1 : 3 to	1 : 2
Thin, hollow towers (such as furnace chimneys exposed to high winds), square	1 : 6
Thin, hollow towers, circular	1 : 4
Frames of timber or metal, under their ordinary or average distribution of load	1 : 3
Frames of timber or metal, under the greatest irregularities of load	1 : 3

In the case of the towers, the *depth of the joint* is to be understood to mean the *diameter of the tower*.

§ 14. *Condition of Stability of Friction.*—If the resistance to be exerted at a joint is always perpendicular to the surfaces which abut at and form that joint, there is no tendency of the pieces to be displaced by sliding. If the resistance be oblique, let JK (fig. 89) be the joint, C its centre of resistance, CR a line representing the resistance, CN a perpendicular to the joint at the centre of resistance. The angle NCR is the *obliquity* of the resistance. From R draw RP parallel and RQ perpendicular to the joint; then, by the principles of statics, the component of the resistance *normal* to the joint is—

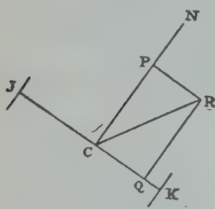

FIG. 89.

$$CP = CR \, . \cos PCR;$$

and the component *tangential* to the joint is—

$$CQ = CR \, . \sin PCR = CP \, . \tan PCR.$$

If the joint be provided either with projections and recesses, such as mortises and tenons, or with fastenings, such as pins or bolts, so as to resist displacement by sliding, the question of the utmost amount of the tangential resistance CQ which it is capable of exerting depends on the *strength* of such projections, recesses, or fastenings; and belongs to the subject of strength, and not to that of stability. In other cases the safety of the joint against displacement by sliding depends on its power of exerting friction, and that power depends on the law, known by experiment, that the friction between two surfaces bears a constant ratio, depending on the nature of the surfaces, to the force by which they are pressed together. In order that the surfaces which abut at the joint JK may be pressed together, the resistance required by the conditions of equilibrium CR, must be a *thrust* and not a *pull*; and in that case the force by which the surfaces are pressed together is equal and opposite to the normal component CP of the resistance. The condition of stability of friction is that the tangential component CQ of the resistance required shall not exceed the friction due to the normal component; that is, that

$$CQ \ngtr f \, . \, CP,$$

where f denotes the *coefficient of friction* for the surfaces in question. The angle whose tangent is the coefficient of friction is called *the angle of repose*, and is expressed symbolically by—

$$\phi = \tan^{-1} f.$$

$$\text{Now } CQ = CP \, . \tan PCR;$$

consequently the condition of stability of friction is fulfilled if the angle PCR is not greater than ϕ; that is to say, if *the obliquity of the resistance required at the joint does not exceed the angle of repose*; and this condition ought to be fulfilled under all possible variations of the load.

It is chiefly in masonry and earthwork that stability of friction is relied on.

§ 15. *Stability of Friction in Earth.*—The grains of a mass of loose earth are to be regarded as so many separate pieces abutting against each other at joints in all possible positions, and depending for their stability on friction. To determine whether a mass of earth is stable at a given point, conceive that point to be traversed by planes in all possible positions, and determine which position gives the greatest obliquity to the total pressure exerted between the portions of the mass which abut against each other at the plane. The condition of stability is that this obliquity shall not exceed the angle of repose of the earth. The consequences of this principle are developed in a paper, "On the Stability of Loose Earth," already cited in § 2.

§ 16. *Parallel Projections of Figures.*—If any figure be referred to a system of co-ordinates, rectangular or oblique, and if a second figure be constructed by means of a second system of co-ordinates, rectangular or oblique, and either agreeing with or differing from the first system in rectangularity or obliquity, but so related to the co-ordinates of the first figure that for each point in the first figure there shall be a corresponding point in the second figure, the lengths of whose co-ordinates shall bear respectively to the three corresponding co-ordinates of the corresponding point in the first figure three ratios which are the same for every pair of corresponding points in the two figures, these corresponding figures are called *parallel projections* of each other. The properties of parallel projections of most importance to the subject of the present article are the following:—

(1) A parallel projection of a straight line is a straight line.

(2) A parallel projection of a plane is a plane.

(3) A parallel projection of a straight line or a plane surface divided in a given ratio is a straight line or a plane surface divided in the same ratio.

(4) A parallel projection of a pair of equal and parallel straight lines, or plain surfaces, is a pair of equal and parallel straight lines, or plane surfaces; whence it follows

(5) That a parallel projection of a parallelogram is a parallelogram, and

(6) That a parallel projection of a parallelepiped is a parallelepiped.

(7) A parallel projection of a pair of solids having a given ratio is a pair of solids having the same ratio.

Though not essential for the purposes of the present article, the following consequence will serve to illustrate the principle of parallel projections:—

(8) A parallel projection of a curve, or of a surface of a given algebraical order, is a curve or a surface of the same order.

For example, all ellipsoids referred to co-ordinates parallel to any three conjugate diameters are parallel projections of each other and of a sphere referred to rectangular co-ordinates.

§ 17. *Parallel Projections of Systems of Forces.*—If a balanced system of forces be represented by a system of lines, then will every parallel projection of that system of lines represent a balanced system of forces.

For the condition of equilibrium of forces not parallel is that they shall be represented in direction and magnitude by the sides and diagonals of certain parallelograms, and of parallel forces that they shall divide certain straight lines in certain ratios; and the parallel projection of a parallelogram is a parallelogram, and that of a straight line divided in a given ratio is a straight line divided in the same ratio.

The resultant of a parallel projection of any system of forces is the projection of their resultant; and the centre of gravity of a parallel projection of a solid is the projection of the centre of gravity of the first solid.

§ 18. *Principle of the Transformation of Structures.*—Here we have the following theorem: If a structure of a given figure have stability of position under a system of forces represented by a given system of lines, then will any structure whose figure is a parallel projection of that of the first structure have stability of position under a system of forces represented by the corresponding projection of the first system of lines.

For in the second structure the weights, external pressures, and resistances will balance each other as in the first structure; the weights of the pieces and all other parallel systems of forces will have the same ratios as in the first structure; and the several centres of resistance will divide the depths of the joints in the same proportions as in the first structure.

If the first structure have stability of friction, the second structure will have stability of friction also, so long as the effect of the projection is not to increase the obliquity of the resistance at any joint beyond the angle of repose.

The lines representing the forces in the second figure show their *relative* directions and magnitudes. To find their *absolute* directions and magnitudes, a vertical line is to be drawn in the first figure, of such a length as to represent the weight of a particular portion of the structure. Then will the projection of that line in the projected figure indicate the vertical direction, and represent the weight of the part of the second structure corresponding to the before-mentioned portion of the first structure.

The foregoing "principle of the transformation of structures" was first announced, though in a somewhat less comprehensive form, to the Royal Society on the 6th of March 1856. It is useful in practice, by enabling the engineer easily to deduce the conditions of equilibrium and stability of structures of complex and unsymmetrical figures from those of structures of simple and symmetrical figures. By its aid, for example, the whole of the properties of elliptical arches, whether square or skew, whether level or sloping in their span, are at once deduced by projection from those of symmetrical circular arches, and the properties of ellipsoidal and ellipticconoidal domes from those of hemispherical and circular-conoidal domes; and the figures of arches fitted to resist the thrust of earth, which is less horizontally than vertically in a certain given ratio, can be deduced by a projection from those of arches fitted to resist the thrust of a liquid, which is of equal intensity, horizontally and vertically.

§ 19. *Conditions of Stiffness and Strength.*—After the arrangement of the pieces of a structure and the size and figure of their joints or surfaces of contact have been determined so as to fulfil the conditions of *stability*,—conditions which depend mainly on the position and direction of the *resultant* or *total* load on each piece, and the *relative* magnitude of the loads on the different pieces—the dimensions of each piece singly have to be adjusted so as to fulfil the conditions of *stiffness* and *strength*—conditions which depend not only on the *absolute* magnitude of the load on each piece, and of the resistances by which it is balanced, but also on the *mode of distribution* of the load over the piece, and of the resistances over the joints.

The effect of the pressures applied to a piece, consisting of the load and the supporting resistances, is to force the piece into a state of *strain* or disfigurement, which increases until the elasticity, or resistance to strain, of the material causes it to exert a *stress*, or effort to recover its figure, equal and opposite to the system of applied pressures. The condition of *stiffness* is that the strain or disfigurement shall not be greater than is consistent with the purposes of the structure; and the condition of *strength* is that the stress shall be within the limits of that which the material can bear with safety against breaking. The ratio in which the utmost stress before breaking exceeds the safe working stress is called the *factor of safety*, and is determined empirically. It varies from three to twelve for various materials and structures. (See STRENGTH OF MATERIALS.)

PART II. THEORY OF MACHINES

§ 20. *Parts of a Machine: Frame and Mechanism.*—The parts of a machine may be distinguished into two principal divisions,—the *frame*, or fixed parts, and the *mechanism*, or moving parts. The frame is a structure which supports the pieces of the mechanism, and to a certain extent determines the nature of their motions.

The form and arrangement of the pieces of the frame depend upon the arrangement and the motions of the mechanism; the dimensions of the pieces of the frame required in order to give it stability and strength are determined from the pressures applied to it by means of the mechanism. It appears therefore that in general the mechanism is to be designed first and the frame afterwards, and that the designing of the frame is regulated by the principles of the stability of structures and of the strength and stiffness of materials,—care being taken to adapt the frame to the most severe load which can be thrown upon it at any period of the action of the mechanism.

Each independent piece of the mechanism also is a structure, and its dimensions are to be adapted, according to the principles of the strength and stiffness of materials, to the most severe load to which it can be subjected during the action of the machine.

§ 21. *Definition and Division of the Theory of Machines.*—From what has been said in the last section it appears that the department of the art of designing machines which has reference to the stability of the frame and to the stiffness and strength of the frame and mechanism is a branch of the art of construction. It is therefore to be separated from the *theory of machines*, properly speaking, which has reference to the action of machines considered as moving. In the action of a machine the following three things take place:—

Firstly, Some natural source of energy communicates motion and force to a piece or pieces of the mechanism, called the *receiver of power* or *prime mover*.

Secondly, The motion and force are transmitted from the prime mover through the *train of mechanism* to the *working piece* or *pieces*, and during that transmission the motion and force are modified in amount and direction, so as to be rendered suitable for the purpose to which they are to be applied.

Thirdly, The working piece or pieces by their motion, or by their motion and force combined, produce some useful effect.

Such are the phenomena of the action of a machine, arranged in the order of *causation*. But in studying or treating of the theory of machines, the order of *simplicity* is the best; and in this order the first branch of the subject is the modification of motion and force by the train of mechanism; the next is the effect or purpose of the machine; and the last, or most complex, is the action of the prime mover.

The modification of motion and the modification of force take place together, and are connected by certain laws; but in the study of the theory of machines, as well as in that of pure mechanics, much advantage has been gained in point of clearness and simplicity by first considering alone the principles of the modification of motion, which are founded upon what is now known as Kinematics, and afterwards considering the principles of the combined modification of motion and force, which are founded both on geometry and on the laws of dynamics. The separation of kinematics from dynamics is due mainly to G. Monge. Ampère and R. Willis.

The theory of machines in the present article will be considered under the following heads:—

I. PURE MECHANISM, or APPLIED KINEMATICS; being the theory of machines considered simply as modifying motion.
II. APPLIED DYNAMICS; being the theory of machines considered as modifying both motion and force.

CHAP. I. ON PURE MECHANISM

§ 22. *Division of the Subject.*—Proceeding in the order of simplicity, the subject of Pure Mechanism, or Applied Kinematics, may be thus divided:—

Division 1.—Motion of a point.
Division 2.—Motion of the surface of a fluid.
Division 3.—Motion of a rigid solid.
Division 4.—Motions of a pair of connected pieces, or of an "elementary combination" in mechanism.
Division 5.—Motions of trains of pieces of mechanism.
Division 6.—Motions of sets of more than two connected pieces, or of "aggregate combinations."

A point is the boundary of a line, which is the boundary of a surface, which is the boundary of a volume. Points, lines and surfaces have no independent existence, and consequently those divisions of this chapter which relate to their motions are only preliminary to the subsequent divisions, which relate to the motions of bodies.

Division 1. *Motion of a Point.*

§ 23. *Comparative Motion.*—The comparative motion of two points is the relation which exists between their motions, without having regard to their absolute amounts. It consists of two elements,—the *velocity ratio*, which is the ratio of any two magnitudes bearing to each other the proportions of the respective velocities of the two points at a given instant, and the *directional relation*, which is the relation borne to each other by the respective directions of the motions of the two points at the same given instant.

It is obvious that the motions of a pair of points may be varied in any manner, whether by direct or by lateral deviation, and yet that their *comparative motion* may remain constant, in consequence of the deviations taking place in the same proportions, in the same directions and at the same instants for both points.

Robert Willis (1800–1875) has the merit of having been the first to simplify considerably the theory of pure mechanism, by pointing out that that branch of mechanics relates wholly to comparative motions.

The comparative motion of two points at a given instant is capable of being completely expressed by one of Sir William Hamilton's Quaternions,—the "tensor" expressing the velocity ratio, and the "versor" the directional relation.

Graphical methods of analysis founded on this way of representing velocity and acceleration were developed by R. H. Smith in a paper communicated to the Royal Society of Edinburgh in 1885, and illustrations of the method will be found below.

Division 2. *Motion of the Surface of a Fluid Mass.*

§ 24. *General Principle.*—A mass of fluid is used in mechanism to transmit motion and force between two or more movable portions (called *pistons* or *plungers*) of the solid envelope or vessel in which the fluid is contained; and, when such transmission is the sole action, or the only appreciable action of the fluid mass, its volume is either absolutely constant, by reason of its temperature and pressure being maintained constant, or not sensibly varied.

Let a represent the area of the section of a piston made by a plane perpendicular to its direction of motion, and v its velocity, which is to be considered as positive when outward, and negative when inward. Then the variation of the cubic contents of the vessel in a unit of time by reason of the motion of one piston is va. The condition that the volume of the fluid mass shall remain unchanged requires that there shall be more than one piston, and that the velocities and areas of the pistons shall be connected by the equation—

$$\Sigma . va = 0. \tag{1}$$

§ 25. *Comparative Motion of Two Pistons.*—If there be but two pistons, whose areas are a_1 and a_2, and their velocities v_1 and v_2, their comparative motion is expressed by the equation—

$$v_2/v_1 = -a_1a/_2; \tag{2}$$

that is to say, their velocities are opposite as to inwardness and outwardness and inversely proportional to their areas.

§ 26. *Applications: Hydraulic Press: Pneumatic Power-Transmitter.*—In the hydraulic press the vessel consists of two cylinders, viz. the pump-barrel and the press-barrel, each having its piston, and of a passage connecting them having a valve opening towards the press-barrel. The action of the enclosed water in transmitting motion takes place during the inward stroke of the pump-plunger, when the above-mentioned valve is open; and at that time the press-plunger moves outwards with a velocity which is less than the inward velocity of the pump-plunger, in the same ratio that the area of the pump-plunger is less than the area of the press-plunger. (See HYDRAULICS.)

In the pneumatic power-transmitter the motion of one piston is transmitted to another at a distance by means of a mass of air contained in two cylinders and an intervening tube. When the pressure and temperature of the air can be maintained constant, this machine fulfils equation (2), like the hydraulic press. The amount and effect of the variations of pressure and temperature undergone by the air depend on the principles of the mechanical action of heat, or THERMODYNAMICS (*q.v.*), and are foreign to the subject of pure mechanism.

Division 3. *Motion of a Rigid Solid.*

§ 27. *Motions Classed.*—In problems of mechanism, each solid piece of the machine is supposed to be so stiff and strong as not to undergo any sensible change of figure or dimensions by the forces applied to it—a supposition which is realized in practice if the machine is skilfully designed.

This being the case, the various possible motions of a rigid solid body may all be classed under the following heads: (1) *Shifting or Translation*; (2) *Turning or Rotation*; (3) *Motions compounded of Shifting and Turning.*

The most common forms for the paths of the points of a piece of mechanism, whose motion is simple shifting, are the straight line and the circle.

Shifting in a straight line is regulated either by straight fixed guides, in contact with which the moving piece slides, or by combinations of link-work, called *parallel motions*, which will be described in the sequel. Shifting in a straight line is usually *reciprocating*; that is to say, the piece, after shifting through a certain distance, returns to its original position by reversing its motion.

Circular shifting is regulated by attaching two or more points of the shifting piece to ends of equal and parallel rotating cranks, or by combinations of wheel-work to be afterwards described. As an example of circular shifting may be cited the motion of the coupling rod, by which the parallel and equal cranks upon two or more axles of a locomotive engine are connected and made to rotate simultaneously. The coupling rod remains always parallel to itself, and all its points describe equal and similar circles relatively to the frame of the engine, and move in parallel directions with equal velocities at the same instant.

§ 28. *Rotation about a Fixed Axis: Lever, Wheel and Axle.*—The fixed axis of a turning body is a line fixed relatively to the body and relatively to the fixed space in which the body turns. In mechanism it is usually the central line either of a rotating shaft or axle having journals, gudgeons, or pivots turning in fixed bearings, or of a fixed spindle or dead centre round which a rotating bush turns; but it may sometimes be entirely beyond the limits of the turning body. For example, if a sliding piece moves in circular fixed guides, that piece rotates about an ideal fixed axis traversing the centre of those guides.

Let the angular velocity of the rotation be denoted by $\alpha = d\theta/dt$, then the linear velocity of any point A at the distance r from the axis is αr; and the path of that point is a circle of the radius r described about the axis.

This is the principle of the modification of motion by the lever, which consists of a rigid body turning about a fixed axis called a fulcrum, and having two points at the same or different distances from that axis, and in the same or different directions, one of which receives motion and the other transmits motion, modified in direction and velocity according to the above law.

In the wheel and axle, motion is received and transmitted by two cylindrical surfaces of different radii described about their common fixed axis of turning, their velocity-ratio being that of their radii.

§ 29. *Velocity Ratio of Components of Motion.*—As the distance between any two points in a rigid body is invariable, the projections of their velocities upon the line joining them must be equal. Hence it follows that, if A in fig. 90 be a point in a rigid body CD, rotating round the fixed axis F, the component of the velocity of A in any direction AP parallel to the plane of rotation is equal to the total velocity of the point m, found by letting fall Fm perpendicular to AP; that is to say, is equal to

$$\alpha \cdot \mathrm{F}m.$$

Hence also the ratio of the components of the velocities of two points A and B in the directions AP and BW respectively, both in the plane of rotation, is equal to the ratio of the perpendiculars Fm and Fn.

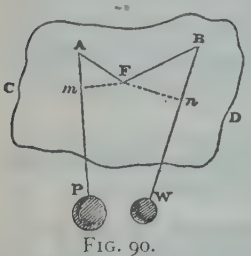

FIG. 90.

§ 30. *Instantaneous Axis of a Cylinder rolling on a Cylinder.*—Let a cylinder *bbb*, whose axis of figure is B and angular velocity γ, roll on a fixed cylinder *aaa*, whose axis of figure is A, either outside (as in fig. 91), when the rolling will be towards the same hand as the rotation, or inside (as in fig. 92), when the rolling will be towards the opposite hand; and at a given instant let T be the line of contact of the two cylindrical surfaces, which is at their common intersection with the plane AB traversing the two axes of figure.

The line T on the surface *bbb* has for the instant no velocity in a direction perpendicular to AB; because for the instant it touches, without sliding, the line T on the fixed surface *aaa*.

The line T on the surface *bbb* has also for the instant no velocity in the plane AB; for it has just ceased to move towards the fixed surface *aaa*, and is just about to begin to move away from that surface.

The line of contact T, therefore, on the surface of the cylinder *bbb*, is *for the instant* at rest, and is the "instantaneous axis" about which the cylinder *bbb* turns, together with any body rigidly attached to that cylinder.

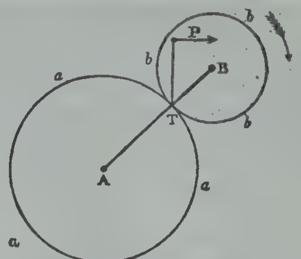

FIG. 91.

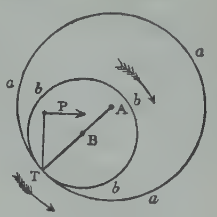

FIG. 92.

To find, then, the direction and velocity at the given instant of any point P, either in or rigidly attached to the rolling cylinder T, draw the plane PT; the direction of motion of P will be perpendicular to that plane, and towards the right or left hand according to the direction of the rotation of *bbb*; and the velocity of P will be

$$v_{\mathrm{P}} = \gamma \,.\, \mathrm{PT}, \tag{3}$$

PT denoting the perpendicular distance of P from T. The path of P is a curve of the kind called *epitrochoids*. If P is in the circumference of *bbb*, that path becomes an *epicycloid*.

The velocity of any point in the axis of figure B is

$$v_{\mathrm{B}} = \gamma \,.\, \mathrm{TB}; \tag{4}$$

and the path of such a point is a circle described about A with the radius AB, being for outside rolling the sum, and for inside rolling the difference, of the radii of the cylinders.

Let α denote the angular velocity with which the *plane of axes* AB rotates about the fixed axis A. Then it is evident that

$$v = \alpha \,.\, \mathrm{AB}, \tag{5}$$

and consequently that $\alpha = \gamma \,.\, \mathrm{TB}/\mathrm{AB}$ (6)

For internal rolling, as in fig. 92, AB is to be treated as negative, which will give a negative value to α, indicating that in this case the rotation of AB round A is contrary to that of the cylinder *bbb*.

The angular velocity of the rolling cylinder, *relatively to the plane of axes* AB, is obviously given by the equation—

$$\left.\begin{array}{r} \beta = \gamma - \alpha \\ \text{whence } \beta = \gamma \,.\, \mathrm{TA}/\mathrm{AB} \end{array}\right\}, \tag{7}$$

care being taken to attend to the sign of α, so that when that is negative the arithmetical values of γ and α are to be added in order to give that of β.

The whole of the foregoing reasonings are applicable, not merely when *aaa* and *bbb* are actual cylinders, but also when they are the osculating cylinders of a pair of cylindroidal surfaces of varying curvature, A and B being the axes of curvature of the parts of those surfaces which are in contact for the instant under consideration.

§ 31. *Instantaneous Axis of a Cone rolling on a Cone.*—Let O*aa* (fig. 93) be a fixed cone, OA its axis, O*bb* a cone rolling on it, OB the axis of the rolling cone, OT the line of contact of the two cones at the instant under consideration. By reasoning similar to that of § 30, it appears that OT is the instantaneous axis of rotation of the rolling cone.

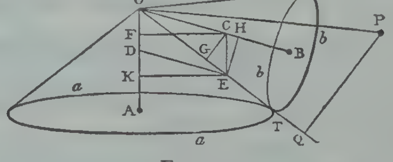

FIG. 93.

Let γ denote the total angular velocity of the rotation of the cone B about the instantaneous axis, β its angular velocity about the axis OB *relatively* to the plane AOB, and α the angular velocity with which the plane AOB turns round the axis OA. It is required to find the ratios of those angular velocities.

Solution.—In OT take any point E, from which draw EC parallel to OA, and ED parallel to OB, so as to construct the parallelogram OCED. Then

$$\mathrm{OD} : \mathrm{OC} : \mathrm{OE} : : \alpha : \beta : \gamma. \tag{8}$$

Or because of the proportionality of the sides of triangles to the sines of the opposite angles,

$$\sin \mathrm{TOB} : \sin \mathrm{TOA} : \sin \mathrm{AOB} : : \alpha : \beta : \gamma, \tag{8 A}$$

that is to say, the angular velocity about each axis is proportional to the sine of the angle between the other two.

Demonstration.—From C draw CF perpendicular to OA, and CG perpendicular to OE

$$\text{Then } CF = 2 \times \frac{\text{area ECO}}{CE},$$

$$\text{and } CG = 2 \times \frac{\text{area ECO}}{OE};$$

$$\therefore CG : CF :: CE = OD : OE.$$

Let v_c denote the linear velocity of the point C. Then

$$v_C = \alpha \,.\, CF = \gamma \,.\, CG$$

$$\therefore \gamma : \alpha :: CF : CG :: OE : OD,$$

which is one part of the solution above stated. From E draw EH perpendicular to OB, and EK to OA. Then it can be shown as before that

$$EK : EH :: OC : OD.$$

Let v_E be the linear velocity of the point E *fixed in the plane of axes* AOB. Then

$$v_E = \alpha \,.\, EK.$$

Now, as the line of contact OT is for the instant at rest on the rolling cone as well as on the fixed cone, the linear velocity of the point E fixed to the plane AOB relatively to the rolling cone is the same with its velocity relatively to the fixed cone. That is to say,

$$\beta \,.\, EH = v_E = \alpha \,.\, EK;$$

therefore $\alpha : \beta :: EH : EK :: OD : OC$,

which is the remainder of the solution.

The path of a point P in or attached to the rolling cone is a spherical epitrochoid traced on the surface of a sphere of the radius OP. From P draw PQ perpendicular to the instantaneous axis. Then the motion of P is perpendicular to the plane OPQ, and its velocity is

$$v_P = \gamma \,.\, PQ. \qquad (9)$$

The whole of the foregoing reasonings are applicable, not merely when A and B are actual regular cones, but also when they are the osculating regular cones of a pair of irregular conical surfaces, having a common apex at O.

§ 32. *Screw-like or Helical Motion.*—Since any displacement in a plane can be represented in general by a rotation, it follows that the only combination of translation and rotation, in which a complex movement which is not a mere rotation is produced, occurs when there is a translation *perpendicular to the plane and parallel to the axis* of rotation.

Such a complex motion is called *screw-like* or *helical* motion; for each point in the body describes a *helix* or *screw* round the axis of rotation, fixed or instantaneous as the case may be. To cause a body to move in this manner it is usually made of a helical or screw-like figure, and moves in a guide of a corresponding figure. Helical motion and screws adapted to it are said to be right- or left-handed according to the appearance presented by the rotation to an observer looking towards the direction of the translation. Thus the screw G in fig. 94 is right-handed.

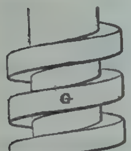

FIG. 94.

The translation of a body in helical motion is called its *advance.* Let v_x denote the velocity of advance at a given instant, which of course is common to all the particles of the body; α the angular velocity of the rotation at the same instant; $2\pi = 6{\cdot}2832$ nearly, the circumference of a circle of the radius unity. Then

$$T = 2\pi/\alpha \qquad (10)$$

is the time of one turn at the rate α; and

$$p = v_x T = 2\pi v_x/\alpha \qquad (11)$$

is the *pitch* or *advance per turn*—a length which expresses the *comparative motion* of the translation and the rotation.

The pitch of a screw is the distance, measured parallel to its axis, between two successive turns of the same *thread* or helical projection.

Let r denote the perpendicular distance of a point in a body moving helically from the axis. Then

$$v_r = \alpha r \qquad (12)$$

is the component of the velocity of that point in a plane perpendicular to the axis, and its total velocity is

$$v = \sqrt{\{v_x^2 + v_r^2\}}. \qquad (13)$$

The ratio of the two components of that velocity is

$$v_x/v_r = p/2\pi r = \tan\theta. \qquad (14)$$

where θ denotes the angle made by the helical path of the point with a plane perpendicular to the axis.

Division 4. Elementary Combinations in Mechanism

§ 33. *Definitions.*—An *elementary combination* in mechanism consists of two pieces whose kinds of motion are determined by their connexion with the frame, and their comparative motion by their connexion with each other—that connexion being effected either by direct contact of the pieces, or by a connecting piece, which is not connected with the frame, and whose motion depends entirely on the motions of the pieces which it connects.

The piece whose motion is the cause is called the *driver*; the piece whose motion is the effect, the *follower*.

The connexion of each of those two pieces with the frame is in general such as to determine the path of every point in it. In the investigation, therefore, of the comparative motion of the driver and follower, in an elementary combination, it is unnecessary to consider relations of angular direction, which are already fixed by the connexion of each piece with the frame; so that the inquiry is confined to the determination of the velocity ratio, and of the directional relation, so far only as it expresses the connexion between *forward* and *backward* movements of the driver and follower. When a continuous motion of the driver produces a continuous motion of the follower, forward or backward, and a reciprocating motion a motion reciprocating at the same instant, the directional relation is said to be *constant.* When a continuous motion produces a reciprocating motion, or vice versa, or when a reciprocating motion produces a motion not reciprocating at the same instant, the directional relation is said to be *variable.*

The *line of action* or *of connexion* of the driver and follower is a line traversing a pair of points in the driver and follower respectively, which are so connected that the component of their velocity relatively to each other, resolved along the line of connexion, is null. There may be several or an indefinite number of lines of connexion, or there may be but one; and a line of connexion may connect either the same pair of points or a succession of different pairs.

§ 34. *General Principle.*—From the definition of a line of connexion it follows that *the components of the velocities of a pair of connected points along their line of connexion are equal.* And from this, and from the property of a rigid body, already stated in § 29, it follows, that *the components along a line of connexion of all the points traversed by that line, whether in the driver or in the follower, are equal*; and consequently, *that the velocities of any pair of points traversed by a line of connexion are to each other inversely as the cosines, or directly as the secants, of the angles made by the paths of those points with the line of connexion.*

The general principle stated above in different forms serves to solve every problem in which—the mode of connexion of a pair of pieces being given—it is required to find their comparative motion at a given instant, or vice versa.

§ 35. *Application to a Pair of Shifting Pieces.*—In fig. 95, let P_1P_2 be the line of connexion of a pair of pieces, each of which has a motion of translation or shifting. Through any point T in that line draw TV_1, TV_2, respectively parallel to the simultaneous direction of motion of the pieces; through any other point A in the line of connexion draw a plane perpendicular to that line, cutting TV_1, TV_2 in V_1, V_2; then, velocity of piece 1 : velocity of piece 2 :: $TV_1 : TV_2$. Also TA represents the equal components of the velocities of the pieces parallel to their line of connexion, and the line V_1V_2 represents their velocity relatively to each other.

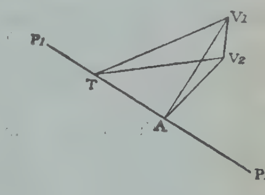

FIG. 95.

§ 36. *Application to a Pair of Turning Pieces.*—Let α_1, α_2 be the angular velocities of a pair of turning pieces; θ_1, θ_2 the angles which their line of connexion makes with their respective planes of rotation; r_1, r_2 the common perpendiculars let fall from the line of connexion upon the respective axes of rotation of the pieces. Then the equal components, along the line of connexion, of the velocities of the points where those perpendiculars meet that line are—

$$\alpha_1 r_1 \cos\theta_1 = \alpha_2 r_2 \cos\theta_2;$$

consequently, the comparative motion of the pieces is given by the equation

$$\frac{\alpha_2}{\alpha_1} = \frac{r_1 \cos\theta_1}{r_2 \cos\theta_2}. \qquad (15)$$

§ 37. *Application to a Shifting Piece and a Turning Piece.*—Let a shifting piece be connected with a turning piece, and at a given instant let α_1 be the angular velocity of the turning piece, r_1 the common perpendicular of its axis of rotation and the line of connexion, θ_1 the angle made by the line of connexion with the plane of rotation, θ_2 the angle made by the line of connexion with the direction of motion of the shifting piece, v_2 the linear velocity of that piece. Then

$$\alpha_1 r_1 \cos\theta_1 = v_2 \cos\theta_2; \qquad (16)$$

which equation expresses the comparative motion of the two pieces.

§ 38. *Classification of Elementary Combinations in Mechanism.*—The first systematic classification of elementary combinations in mechanism was that founded by Monge, and fully developed by Lanz and Bétancourt, which has been generally received, and has been adopted in most treatises on applied mechanics. But that classification is founded on the absolute instead of the comparative motions of the pieces, and is, for that reason, defective, as Willis pointed out in his admirable treatise *On the Principles of Mechanism.*

Willis's classification is founded, in the first place, on comparative motion, as expressed by velocity ratio and directional relation, and in the second place, on the mode of connexion of the driver and follower. He divides the elementary combinations in mechanism into three classes, of which the characters are as follows:—

Class A: Directional relation constant; velocity ratio constant.
Class B: Directional relation constant; velocity ratio varying.
Class C: Directional relation changing periodically; velocity ratio constant or varying.

Each of those classes is subdivided by Willis into five divisions, of which the characters are as follows:—

Division A: Connexion by rolling contact.
 „ B: „ „ sliding contact.
 „ C: „ „ wrapping connectors.
 „ D: „ „ link-work.
 „ E: „ „ reduplication.

In the Reuleaux system of analysis of mechanisms the principle of comparative motion is generalized, and mechanisms apparently very diverse in character are shown to be founded on the same sequence of elementary combinations forming a kinematic chain. A short description of this system is given in § 80, but in the present article the principle of Willis's classification is followed mainly. The arrangement is, however, modified by taking the *mode of connexion* as the basis of the primary classification, and by removing the subject of connexion by reduplication to the section of aggregate combinations. This modified arrangement is adopted as being better suited than the original arrangement to the limits of an article in an encyclopaedia; but it is not disputed that the original arrangement may be the best for a separate treatise.

§ 39. *Rolling Contact: Smooth Wheels and Racks.*—In order that two pieces may move in *rolling contact*, it is necessary that each pair of points in the two pieces which touch each other should at the instant of contact be moving in the same direction with the same velocity. In the case of two *shifting* pieces this would involve equal and parallel velocities for all the points of each piece, so that there could be no rolling, and, in fact, the two pieces would move like one; hence, in the case of rolling contact, either one or both of the pieces must rotate.

The direction of motion of a point in a turning piece being perpendicular to a plane passing through its axis, the condition that each pair of points in contact with each other must move in the same direction leads to the following consequences:—

I. That, when both pieces rotate, their axes, and all their points of contact, lie in the same plane.

II. That, when one piece rotates, and the other shifts, the axis of the rotating piece, and all the points of contact, lie in a plane perpendicular to the direction of motion of the shifting piece.

The condition that the velocity of each pair of points of contact must be equal leads to the following consequences:—

III. That the angular velocities of a pair of turning pieces in rolling contact must be inversely as the perpendicular distances of any pair of points of contact from the respective axes.

IV. That the linear velocity of a shifting piece in rolling contact with a turning piece is equal to the product of the angular velocity of the turning piece by the perpendicular distance from its axis to a pair of points of contact.

The *line of contact* is that line in which the points of contact are all situated. Respecting this line, the above Principles III. and IV. lead to the following conclusions:—

V. That for a pair of turning pieces with parallel axes, and for a turning piece and a shifting piece, the line of contact is straight, and parallel to the axes or axis; and hence that the rolling surfaces are either plane or cylindrical (the term "cylindrical" including all surfaces generated by the motion of a straight line parallel to itself).

VI. That for a pair of turning pieces with intersecting axes the line of contact is also straight, and traverses the point of intersection of the axes; and hence that the rolling surfaces are conical, with a common apex (the term "conical" including all surfaces generated by the motion of a straight line which traverses a fixed point).

Turning pieces in rolling contact are called *smooth* or *toothless wheels.* Shifting pieces in rolling contact with turning pieces may be called *smooth* or *toothless racks.*

VII. In a pair of pieces in rolling contact every straight line traversing the line of contact is a line of connexion.

§ 40. *Cylindrical Wheels and Smooth Racks.*—In designing cylindrical wheels and smooth racks, and determining their comparative motion, it is sufficient to consider a section of the pair of pieces made by a plane perpendicular to the axis or axes.

The points where axes intersect the plane of section are called *centres*; the point where the line of contact intersects it, the *point of contact*, or *pitch-point*; and the wheels are described as *circular*, *elliptical*, &c., according to the forms of their sections made by that plane.

When the point of contact of two wheels lies between their centres, they are said to be in *outside gearing*; when beyond their centres, in *inside gearing*, because the rolling surface of the larger wheel must in this case be turned inward or towards its centre.

From Principle III. of § 39 it appears that the angular velocity-ratio of a pair of wheels is the inverse ratio of the distances of the point of contact from the centres respectively.

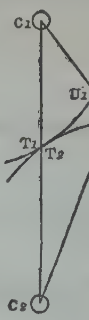

FIG. 96.

For outside gearing that ratio is *negative*, because the wheels turn contrary ways; for inside gearing it is *positive*, because they turn the same way.

If the velocity ratio is to be constant, as in Willis's Class A, the wheels must be circular; and this is the most common form for wheels.

If the velocity ratio is to be variable, as in Willis's Class B, the figures of the wheels are a pair of *rolling curves*, subject to the condition that the distance between their *poles* (which are the centres of rotation) shall be constant.

The following is the geometrical relation which must exist between such a pair of curves:—

Let C_1, C_2 (fig. 96) be the poles of a pair of rolling curves; T_1, T_2 any pair of points of contact; U_1, U_2 any other pair of points of contact. Then, for every possible pair of points of contact, the two following equations must be simultaneously fulfilled:—

$$\text{Sum of radii, } C_1U_1+C_2U_2=C_1T_1+C_2T_2 = \text{constant;}$$
$$\text{arc, } T_2U_2 = T_1U_1. \tag{17}$$

A condition equivalent to the above, and necessarily connected with it, is, that at each pair of points of contact the inclinations of the curves to their radii-vectores shall be equal and contrary; or, denoting by r_1, r_2 the radii-vectores at any given pair of points of contact, and s the length of the equal arcs measured from a certain fixed pair of points of contact—

$$dr_2/ds = -dr_1/ds; \tag{18}$$

which is the differential equation of a pair of rolling curves whose poles are at a constant distance apart.

For full details as to rolling curves, see Willis's work, already mentioned, and Clerk Maxwell's paper on Rolling Curves, *Trans. Roy. Soc. Edin.*, 1849.

A rack, to work with a circular wheel, must be straight. To work with a wheel of any other figure, its section must be a rolling curve, subject to the condition that the perpendicular distance from the pole or centre of the wheel to a straight line parallel to the direction of the motion of the rack shall be constant. Let r_1 be the radius-vector of a point of contact on the wheel, x_2 the ordinate from the straight line before mentioned to the corresponding point of contact on the rack. Then

$$dx_2/ds = -dr_1/ds \tag{19}$$

is the differential equation of the pair of rolling curves.

To illustrate this subject, it may be mentioned that an ellipse rotating about one focus rolls completely round in outside gearing with an equal and similar ellipse also rotating about one focus, the distance between the axes of rotation being equal to the major axis of the ellipses, and the velocity ratio varying from $\frac{1+\text{eccentricity}}{1-\text{eccentricity}}$ to $\frac{1-\text{eccentricity}}{1+\text{eccentricity}}$; an hyperbola rotating about its further focus rolls in inside gearing, through a limited arc, with an equal and similar hyperbola rotating about its nearer focus, the distance between the axes of rotation being equal to the axis of the hyperbolas, and the velocity ratio varying between $\frac{\text{eccentricity}+1}{\text{eccentricity}-1}$ and unity; and a parabola rotating about its focus rolls with an equal and similar parabola, shifting parallel to its directrix.

§ 41. *Conical or Bevel and Disk Wheels.*—From Principles III. and VI. of § 39 it appears that the angular velocities of a pair of wheels whose axes meet in a point are to each other inversely as the sines of the angles which the axes of the wheels make with the line of contact. Hence we have the following construction (figs. 97 and 98).—Let O be the apex or point of intersection of the two axes OC_1, OC_2. The angular velocity ratio being given, it is required to find the line of contact. On OC_1, OC_2 take lengths OA_1, OA_2, respectively proportional to the angular velocities of the pieces on whose axes they are taken. Complete the parallelogram OA_1EA_2; the diagonal OET will be the line of contact required.

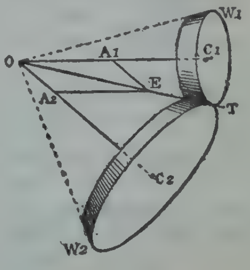

FIG. 97.

When the velocity ratio is variable, the line of contact will shift its position in the plane C_1OC_2, and the wheels will be cones, with eccentric or irregular bases. In every case which occurs in practice, however, the velocity ratio is constant; the line of contact is constant in position, and the rolling surfaces of the wheels are regular circular cones (when they are called *bevel wheels*); or one of a pair of wheels may have a flat disk for its rolling surface, as W_2 in fig. 98, in which case it is a *disk wheel.* The rolling surfaces of actual wheels consist of frusta or zones of the complete cones or disks, as shown by W_1, W_2 in figs. 97 and 98.

§ 42. *Sliding Contact (lateral): Skew-Bevel Wheels.*—An hyperboloid of revolution is a surface resembling a sheaf or a dice box, generated by the rotation of a straight line round an axis from which it is at a constant distance, and to which it is inclined at a constant angle. If two such hyperboloids E, F, equal or unequal, be placed in the closest possible contact, as in fig. 99, they will touch each other along one of the generating straight lines of each, which will form their line of contact, and will be inclined to the axes AG, BH in opposite directions. The axes will not be parallel, nor will they intersect each other.

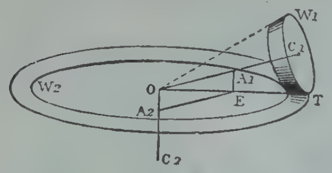

FIG. 98.

The motion of two such hyperboloids, turning in contact with each other, has hitherto been classed amongst cases of rolling contact; but that classification is not strictly correct, for, although the component velocities of a pair of points of contact in a direction at right angles to the line of contact are equal, still, as the axes are parallel neither to each other nor to the line of contact, the velocities of a pair of points of contact have components along the line of contact which are unequal, and their difference constitutes a *lateral sliding.*

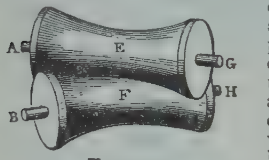

FIG. 99.

The directions and positions of the axes being given, and the required angular velocity ratio, the following construction serves to determine the line of contact, by whose rotation round the two axes respectively the hyperboloids are generated:—

In fig. 100, let B_1C_1, B_2C_2 be the two axes; B_1B_2 their common perpendicular. Through any point O in this common perpendicular draw OA_1 parallel to B_1C_1 and OA_2 parallel to B_2C_2; make those lines proportional to the angular velocities about the axes to which they are respectively parallel; complete the parallelogram OA_1EA_2, and draw the diagonal OE; divide B_1B_2 in D into two parts, *inversely* proportional to the angular velocities about the axes which they respectively adjoin; through D parallel to OE draw DT. This will be the line of contact.

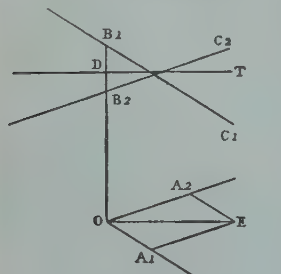

FIG. 100.

A pair of thin frusta of a pair of hyperboloids are used in practice to communicate motion between a pair of axes neither parallel nor intersecting, and are called *skew-bevel wheels.*

In skew-bevel wheels the properties of a line of connexion are not possessed by every line traversing the line of contact, but only by every line traversing the line of contact at right angles.

If the velocity ratio to be communicated were variable, the point D would alter its position, and the line DT its direction, at different periods of the motion, and the wheels would be hyperboloids of an eccentric or irregular cross-section; but forms of this kind are not used in practice.

§ 43. *Sliding Contact (circular): Grooved Wheels.*—As the adhesion or friction between a pair of smooth wheels is seldom sufficient to prevent their slipping on each other, contrivances are used to increase their mutual hold. One of those consists in forming the rim of each wheel into a series of alternate ridges and grooves parallel to the plane of rotation; it is applicable to cylindrical and bevel wheels, but not to skew-bevel wheels. The comparative motion of a pair of wheels so ridged and grooved is the same as that of a pair of smooth wheels in rolling contact, whose cylindrical or conical surfaces lie midway between the tops of the ridges and bottoms of the grooves, and those ideal smooth surfaces are called the *pitch surfaces* of the wheels.

The relative motion of the faces of contact of the ridges and grooves is a *rotatory sliding* or *grinding* motion, about the line of contact of the pitch-surfaces as an instantaneous axis.

Grooved wheels have hitherto been but little used.

§ 44. *Sliding Contact (direct): Teeth of Wheels, their Number and Pitch.*—The ordinary method of connecting a pair of wheels, or a wheel and a rack, and the only method which ensures the exact maintenance of a given numerical velocity ratio, is by means of a series of alternate ridges and hollows parallel or nearly parallel to the successive lines of contact of the ideal smooth wheels whose velocity ratio would be the same with that of the toothed wheels. The ridges are called *teeth*; the hollows, *spaces.* The teeth of the driver push those of the follower before them, and in so doing sliding takes place between them in a direction across their lines of contact.

The *pitch-surfaces* of a pair of toothed wheels are the ideal smooth surfaces which would have the same comparative motion by rolling contact that the actual wheels have by the sliding contact of their teeth. The *pitch-circles* of a pair of circular toothed wheels are sections of their pitch-surfaces, made for *spur-wheels* (that is, for wheels whose axes are parallel) by a plane at right angles to the axes, and for bevel wheels by a sphere described about the common apex. For a pair of skew-bevel wheels the pitch-circles are a pair of contiguous rectangular sections of the pitch-surfaces. The *pitch-point* is the point of contact of the pitch-circles.

The pitch-surface of a wheel lies intermediate between the points of the teeth and the bottoms of the hollows between them. That part of the acting surface of a tooth which projects beyond the pitch-surface is called the *face*; that part which lies within the pitch-surface, the *flank.*

Teeth, when not otherwise specified, are understood to be made in one piece with the wheel, the material being generally cast-iron, brass or bronze. Separate teeth, fixed into mortises in the rim of the wheel, are called *cogs.* A *pinion* is a small toothed wheel; a *trundle* is a pinion with cylindrical *staves* for teeth.

The radius of the pitch-circle of a wheel is called the *geometrical radius*; a circle touching the ends of the teeth is called the *addendum circle,* and its radius the *real radius*; the difference between these radii, being the projection of the teeth beyond the pitch-surface, is called the *addendum.*

The distance, measured along the pitch-circle, from the face of one tooth to the face of the next, is called the *pitch.* The pitch and the number of teeth in wheels are regulated by the following principles:—

I. In wheels which rotate continuously for one revolution or more, it is obviously necessary *that the pitch should be an aliquot part of the circumference.*

In wheels which reciprocate without performing a complete revolution this condition is not necessary. Such wheels are called *sectors.*

II. In order that a pair of wheels, or a wheel and a rack, may work correctly together, it is in all cases essential *that the pitch should be the same in each.*

III. Hence, in any pair of circular wheels which work together, the numbers of teeth in a complete circumference are directly as the radii and inversely as the angular velocities.

IV. Hence also, in any pair of circular wheels which rotate continuously for one revolution or more, the ratio of the numbers of teeth and its reciprocal the angular velocity ratio must be expressible in whole numbers.

From this principle arise problems of a kind which will be referred to in treating of *Trains of Mechanism.*

V. Let n, N be the respective numbers of teeth in a pair of wheels, N being the greater. Let t, T be a pair of teeth in the smaller and larger wheel respectively, which at a particular instant work together. It is required to find, first, how many pairs of teeth must pass the line of contact of the pitch-surfaces before t and T work together again (let this number be called a); and, secondly, with how many different teeth of the larger wheel the tooth t will work at different times (let this number be called b); thirdly, with how many different teeth of the smaller wheel the tooth T will work at different times (let this be called c)

CASE 1. If n is a divisor of N,

$$a = N;\ b = N/n;\ c = 1. \qquad (20)$$

CASE 2. If the greatest common divisor of N and n be d, a number less than n, so that $n = md$, $N = Md$; then

$$a = mN = Mn = Mmd;\ b = M;\ c = m. \qquad (21)$$

CASE 3. If N and n be prime to each other,

$$a = nN;\ b = N;\ c = n. \qquad (22)$$

It is considered desirable by millwrights, with a view to the preservation of the uniformity of shape of the teeth of a pair of wheels, that each given tooth in one wheel should work with as many different teeth in the other wheel as possible. They therefore study that the numbers of teeth in each pair of wheels which work together shall either be prime to each other, or shall have their greatest common divisor as small as is consistent with a velocity ratio suited for the purposes of the machine.

§ 45. *Sliding Contact: Forms of the Teeth of Spur-wheels and Racks.*—A line of connexion of two pieces in sliding contact is a line perpendicular to their surfaces at a point where they touch. Bearing this in mind, the principle of the comparative motion of a pair of teeth belonging to a pair of spur-wheels, or to a spur-wheel and a rack, is found by applying the principles stated generally in §§ 36 and 37 to the case of parallel axes for a pair of spur-wheels, and to the case of an axis perpendicular to the direction of shifting for a wheel and a rack.

In fig. 101, let C_1, C_2 be the centres of a pair of spur-wheels; B_1IB_1', B_2IB_2' portions of their pitch-circles, touching at I, the pitch-point. Let the wheel 1 be the driver, and the wheel 2 the follower.

Let $D_1TB_1A_1$, $D_2TB_2A_2$ be the positions, at a given instant, of the acting surfaces of a pair of teeth in the driver and follower respectively, touching each other at T; the line of connexion of those teeth is P_1P_2, perpendicular to their surfaces at T. Let C_1P_1, C_2P_2 be perpendiculars let fall from the centres of the wheels on the line of contact. Then, by § 36, the angular velocity-ratio is

$$a_2/a_1 = C_1P_1/C_2P_2. \qquad (23)$$

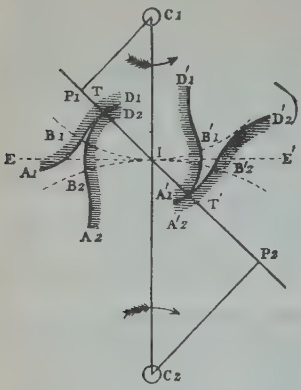

FIG. 101.

The following principles regulate the forms of the teeth and their relative motions:—

I. The angular velocity ratio due to the sliding contact of the teeth will be the same with that due to the rolling contact of the pitch-circles, if the line of connexion of the teeth cuts the line of centres at the pitch-point.

For, let P_1P_2 cut the line of centres at I; then, by similar triangles,

$$a_1 : a_2 :: C_2P_2 : C_1P_1 :: IC_2 :: IC_1; \qquad (24)$$

which is also the angular velocity ratio due to the rolling contact of the circles B_1IB_1', B_2IB_2'.

This principle determines the *forms* of all teeth of spur-wheels. It also determines the forms of the teeth of straight racks, if one of the centres be removed, and a straight line EIE′, parallel to the direction of motion of the rack, and perpendicular to C_1IC_2, be substituted for a pitch-circle.

II. The component of the velocity of the point of contact of the teeth T along the line of connexion is

$$a_1 . C_1P_1 = a_2 . C_2P_2. \qquad (25)$$

III. The relative velocity perpendicular to P_1P_2 of the teeth at their point of contact—that is, their *velocity of sliding* on each other—is found by supposing one of the wheels, such as 1, to be fixed, the line of centres C_1C_2 to rotate backwards round C_1 with the angular velocity a_1, and the wheel 2 to rotate round C_2 as before, with the angular velocity a_2 relatively to the line of centres C_1C_2, so as to have the same motion as if its pitch-circle *rolled* on the pitch-circle of the first wheel. Thus the *relative* motion of the wheels is unchanged; but 1 is considered as fixed, and 2 has the *total motion*, that is, a rotation about the instantaneous axis I, with the angular velocity $a_1 + a_2$. Hence the *velocity of sliding* is that due to this rotation about I, with the radius IT; that is to say, its value is

$$(a_1 + a_2) . IT; \qquad (26)$$

so that it is greater the farther the point of contact is from the line of centres; and at the instant when that point passes the line of centres, and coincides with the *pitch-point*, the velocity of sliding is null, and the action of the teeth is, for the instant, that of rolling contact.

IV. The *path of contact* is the line traversing the various positions of the point T. If the line of connexion preserves always the same position, the path of contact coincides with it, and is straight; in other cases the path of contact is curved.

It is divided by the pitch-point I into two parts—the *arc* or *line of approach* described by T in approaching the line of centres, and the *arc* or *line of recess* described by T after having passed the line of centres.

During the *approach*, the *flank* D_1B_1 of the driving tooth drives the *face* D_2B_2 of the following tooth, and the teeth are sliding *towards* each other. During the *recess* (in which the position of the teeth is exemplified in the figure by curves marked with accented letters), the *face* $B_1'A_1'$ of the driving tooth drives the *flank* $B_2'A_2'$ of the following tooth, and the teeth are sliding *from* each other.

The path of contact is bounded where the approach commences by the addendum-circle of the follower, and where the recess terminates by the addendum-circle of the driver. The length of the path of contact should be such that there shall always be at least one pair of teeth in contact; and it is better still to make it so long that there shall always be at least two pairs of teeth in contact.

V. The *obliquity* of the action of the teeth is the angle $EIT = IC_1P_1 = IC_2P_2$.

In practice it is found desirable that the mean value of the obliquity of action during the contact of teeth should not exceed 15°, nor the maximum value 30°.

It is unnecessary to give separate figures and demonstrations for inside gearing. The only modification required in the formulae is, that in equation (26) the *difference* of the angular velocities should be substituted for their sum.

§ 46. *Involute Teeth.*—The simplest form of tooth which fulfils the conditions of § 45 is obtained in the following manner (see fig. 102). Let C_1, C_2 be the centres of two wheels, B_1IB_1', B_2IB_2' their pitch-circles, I the pitch-point; let the obliquity of action of the teeth be constant, so that the same straight line P_1IP_2 shall represent at once the constant line of connexion of teeth and the path of contact. Draw C_1P_1, C_2P_2 perpendicular to P_1IP_2, and with those lines as radii describe about the centres of the wheels the circles D_1D_1', D_2D_2', called *base-circles*. It is evident that the radii of the base-circles bear to each other the same proportions as the radii of the pitch-circles, and also that

$$\left.\begin{array}{l} C_1P_1 = IC_1 . \cos \text{obliquity} \\ C_2P_2 = IC_2 . \cos \text{obliquity} \end{array}\right\} \qquad (27)$$

(The obliquity which is found to answer best in practice is about $14\frac{1}{2}°$; its cosine is about $\frac{31}{32}$, and its sine about $\frac{1}{4}$. These values though not absolutely exact, are near enough to the truth for practical purposes.)

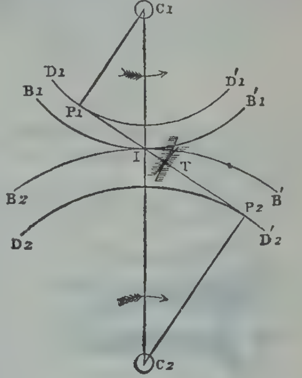

FIG. 102.

Suppose the base-circles to be a pair of circular pulleys connected by means of a cord whose course from pulley to pulley is P_1IP_2. As the line of connexion of those pulleys is the same as that of the proposed teeth, they will rotate with the required velocity ratio. Now, suppose a tracing point T to be fixed to the cord, so as to be carried along the path of contact P_1IP_2, that point will trace on a plane rotating along with the wheel 1 part of the involute of the base-circle D_1D_1', and on a plane rotating along with the wheel 2 part of the involute of the base-circle D_2D_2'; and the two curves so traced will always touch each other in the required point of contact T, and will therefore fulfil the condition required by Principle I. of § 45.

Consequently, one of the forms suitable for the teeth of wheels is the involute of a circle; and the obliquity of the action of such teeth is the angle whose cosine is the ratio of the radius of their base-circle to that of the pitch-circle of the wheel.

All involute teeth of the same pitch work smoothly together.

To find the length of the path of contact on either side of the pitch-point I, it is to be observed that the distance between the fronts of two successive teeth, as measured along P_1IP_2, is less than the pitch in the ratio of cos obliquity : 1; and consequently that, if distances equal to the pitch be marked off either way from I towards P_1 and P_2 respectively, as the extremities of the path of contact, and if, according to Principle IV. of § 45, the addendum-circles be described through the points so found, there will always be at least two pairs of teeth in action at once. In practice it is usual to make the path of contact somewhat longer, viz. about 2·4 times the pitch; and with this length of path, and the obliquity already mentioned of $14\frac{1}{2}°$, the addendum is about 3·1 of the pitch.

The teeth of a *rack*, to work correctly with wheels having involute teeth, should have plane surfaces perpendicular to the line of connexion, and consequently making with the direction of motion of the rack angles equal to the complement of the obliquity of action.

§ 47. *Teeth for a given Path of Contact: Sang's Method.*—In the preceding section the form of the teeth is found by assuming a figure for the path of contact, viz. the straight line. Any other convenient figure may be assumed for the path of contact, and the corresponding forms of the teeth found by determining what curves a point T, moving along the assumed path of contact, will trace on two disks rotating round the centres of the wheels with angular velocities bearing that relation to the component velocity of T along TI, which is given by Principle II. of § 45, and by equation (25). This method of finding the forms of the teeth of wheels forms the subject of an elaborate and most interesting treatise by Edward Sang.

All wheels having teeth of the same pitch, traced from the same path of contact, work correctly together, and are said to belong to the *same set*.

§ 48. *Teeth traced by Rolling Curves.*—If any curve R (fig. 103) be rolled on the inside of the pitch-circle BB of a wheel, it appears, from § 30, that the instantaneous axis of the rolling curve at any instant will be at the point I, where it touches the pitch-circle for the moment, and that consequently the line AT, traced by a tracing-point T, fixed to the rolling curve upon the plane of the wheel, will be everywhere perpendicular to the straight line TI; so that the traced curve AT will be suitable for the flank of a tooth, in which T is the point of contact corresponding to the position I of the pitch-point. If the

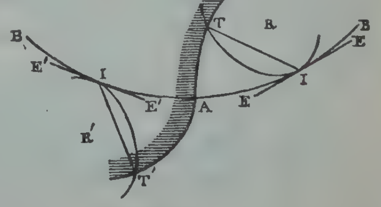

FIG. 103.

same rolling curve R, with the same tracing-point T, be rolled on the *outside* of any other pitch-circle, it will have the *face* of a tooth suitable to work with the *flank* AT.

In like manner, if either the same or any other rolling curve R′ be rolled the opposite way, on the *outside* of the pitch-circle BB, so that the tracing point T′ shall start from A, it will trace the *face* AT′ of a tooth suitable to work with a *flank* traced by rolling the same curve R′ with the same tracing-point T′ *inside* any other pitch-circle.

The figure of the *path of contact* is that traced on a fixed plane by the tracing-point, when the rolling curve is rotated in such a manner as always to touch a fixed straight line EIE (or E′I′E′, as the case may be) at a fixed point I (or I′).

If the same rolling curve and tracing-point be used to trace both the faces and the flanks of the teeth of a number of wheels of different sizes but of the same pitch, all those wheels will work correctly together, and will form a *set*. The teeth of a *rack*, of the same set, are traced by rolling the rolling curve on both sides of a straight line.

The teeth of wheels of any figure, as well as of circular wheels, may be traced by rolling curves on their pitch-surfaces; and all teeth of the same pitch, traced by the same rolling curve with the same tracing-point, will work together correctly if their pitch-surfaces are in rolling contact.

§ 49. *Epicycloidal Teeth.*—The most convenient rolling curve is the circle. The path of contact which it traces is identical with itself; and the flanks of the teeth are internal and their faces external epicycloids for wheels, and both flanks and faces are cycloids for a rack.

For a pitch-circle of twice the radius of the rolling or *describing* circle (as it is called) the internal epicycloid is a straight line, being, in fact, a diameter of the pitch-circle, so that the flanks of the teeth for such a pitch-circle are planes radiating from the axis. For a smaller pitch-circle the flanks would be convex and *incurved* or *under-cut*, which would be inconvenient; therefore the smallest wheel of a set should have its pitch-circle of twice the radius of the describing circle, so that the flanks may be either straight or concave.

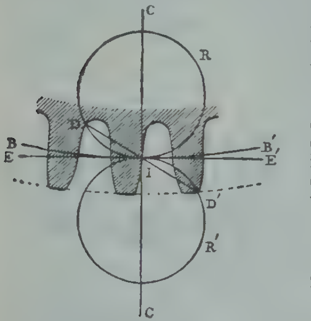

FIG. 104.

In fig. 104 let BB′ be part of the pitch-circle of a wheel with epicycloidal teeth; CIC′ the line of centres; I the pitch-point; EIE′ a straight tangent to the pitch-circle at that point; R the internal and R′ the equal external describing circles, so placed as to touch the pitch-circle and each other at I. Let DID′ be the path of contact, consisting of the arc of approach DI and the arc of recess ID′. In order that there may always be at least two pairs of teeth in action, each of those arcs should be equal to the pitch.

The obliquity of the action in passing the line of centres is nothing; the maximum obliquity is the angle EID = E′ID; and the mean obliquity is one-half of that angle.

It appears from experience that the mean obliquity should not exceed 15°; therefore the maximum obliquity should be about 30°; therefore the equal arcs DI and ID′ should each be one-sixth of a circumference; therefore the circumference of the describing circle should be *six times the pitch.*

It follows that the smallest pinion of a set in which pinion the flanks are straight should have twelve teeth.

§ 50. *Nearly Epicycloidal Teeth: Willis's Method.*—To facilitate the drawing of epicycloidal teeth in practice, Willis showed how to approximate to their figure by means of two circular arcs—one concave, for the flank, and the other convex, for the face—and each having for its radius the *mean* radius of curvature of the epicycloidal arc. Willis's formulae are founded on the following properties of epicycloids:—

Let R be the radius of the pitch-circle; r that of the describing circle; θ the angle made by the normal TI to the epicycloid at a given point T, with a tangent to the circle at I—that is, the obliquity of the action at T.

Then the radius of curvature of the epicycloid at T is—

$$\left.\begin{aligned}&\text{For an internal epicycloid, } \rho=4r\sin\theta\frac{\mathrm{R}-r}{\mathrm{R}-2r}\\&\text{For an external epicycloid, } \rho'=4r\sin\theta\frac{\mathrm{R}+r}{\mathrm{R}+2r}\end{aligned}\right\}\qquad(28)$$

Also, to find the position of the centres of curvature relatively to the pitch-circle, we have, denoting the chord of the describing circle TI by c, $c=2r\sin\theta$; and therefore

$$\left.\begin{aligned}&\text{For the flank, } \rho-c=2r\sin\theta\,\frac{\mathrm{R}}{\mathrm{R}-2r}\\&\text{For the face, } \rho'-c=2r\sin\theta\,\frac{\mathrm{R}}{\mathrm{R}+2r}\end{aligned}\right\}\qquad(29)$$

For the proportions approved of by Willis, $\sin\theta=\frac{1}{4}$ nearly; $r=p$ (the pitch) nearly; $c\doteq\frac{1}{2}p$ nearly; and, if N be the number of teeth in the wheel, $r/\mathrm{R}=6/\mathrm{N}$ nearly; therefore, approximately,

$$\left.\begin{aligned}\rho-c&=\frac{p}{2}\cdot\frac{\mathrm{N}}{\mathrm{N}-12}\\\rho'-c&=\frac{p}{2}\cdot\frac{\mathrm{N}}{\mathrm{N}+12}\end{aligned}\right\}\qquad(30)$$

Hence the following construction (fig. 105). Let BB be part of the pitch-circle, and a the point where a tooth is to cross it. Set off $ab=ac=\frac{1}{2}p$. Draw radii bd, ce; draw fb, cg, making angles of $75\frac{1}{2}°$ with those radii. Make $bf=\rho'-c$, $cg=\rho-c$. From f, with the radius fa, draw the circular arc ah; from g, with the radius ga, draw the circular arc ak. Then ah is the face and ak the flank of the tooth required.

To facilitate the application of this rule, Willis published tables of $\rho-c$ and $\rho'-c$, and invented an instrument called the "odontograph."

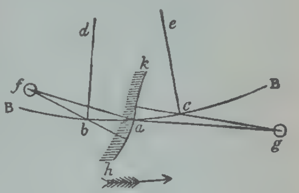

FIG. 105.

§ 51. *Trundles and Pin-Wheels.*—If a wheel or trundle have cylindrical pins or staves for teeth, the faces of the teeth of a wheel suitable for driving it are described by first tracing external epicycloids, by rolling the pitch-circle of the pin-wheel or trundle on the pitch-circle of the driving-wheel, with the centre of a stave for a tracing-point, and then drawing curves parallel to, and within the epicycloids, at a distance from them equal to the radius of a stave. Trundles having only six staves will work with large wheels.

§ 52. *Backs of Teeth and Spaces.*—Toothed wheels being in general intended to rotate either way, the *backs* of the teeth are made similar to the fronts. The *space* between two teeth, measured on the pitch-circle, is made about $\frac{1}{5}$th part wider than the thickness of the tooth on the pitch-circle—that is to say,

Thickness of tooth $=\frac{5}{11}$ pitch;
Width of space $=\frac{6}{11}$ pitch.

The difference of $\frac{1}{11}$ of the pitch is called the *back-lash.* The clearance allowed between the points of teeth and the bottoms of the spaces between the teeth of the other wheel is about one-tenth of the pitch.

§ 53. *Stepped and Helical Teeth.*—R. J. Hooke invented the making of the fronts of teeth in a series of steps with a view to increase the smoothness of action. A wheel thus formed resembles in shape a series of equal and similar toothed disks placed side by side, with the teeth of each a little behind those of the preceding disk. He also invented, with the same object, teeth whose fronts, instead of being parallel to the line of contact of the pitch-circles, cross it obliquely, so as to be of a screw-like or helical form. In wheelwork of this kind the contact of each pair of teeth commences at the foremost end of the helical front, and terminates at the aftermost end; and the helix is of such a pitch that the contact of one pair of teeth shall not terminate until that of the next pair has commenced.

Stepped and helical teeth have the desired effect of increasing the smoothness of motion, but they require more difficult and expensive workmanship than common teeth; and helical teeth are, besides, open to the objection that they exert a laterally oblique pressure, which tends to increase resistance, and unduly strain the machinery.

§ 54. *Teeth of Bevel-Wheels.*—The acting surfaces of the teeth of bevel-wheels are of the conical kind, generated by the motion of a line passing through the common apex of the pitch-cones, while its extremity is carried round the outlines of the cross section of the teeth made by a sphere described about that apex.

The operations of describing the exact figures of the teeth of bevel-wheels, whether by involutes or by rolling curves, are in every respect analogous to those for describing the figures of the teeth of spur-wheels, except that in the case of bevel-wheels all those operations are to be performed on the surface of a sphere described about the apex instead of on a plane, substituting *poles* for *centres*, and *great circles* for *straight lines.*

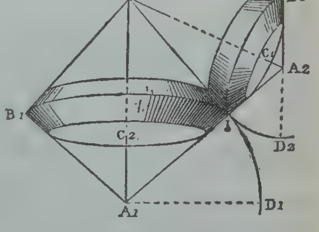

FIG. 106.

In consideration of the practical difficulty, especially in the case of large wheels, of obtaining an accurate spherical surface, and of drawing upon it when obtained, the following approximate method, proposed originally by Tredgold, is generally used:—

Let O (fig. 106) be the common apex of a pair of bevel-wheels; $\mathrm{OB_1I}$, $\mathrm{OB_2I}$ their pitch cones; $\mathrm{OC_1}$, $\mathrm{OC_2}$ their axes; OI their line of contact. Perpendicular to OI draw $\mathrm{A_1IA_2}$, cutting the axes in $\mathrm{A_1}$, $\mathrm{A_2}$; make the outer rims of the patterns and of the wheels portions of the cones A_1B_1I, A_2B_2I, of which the narrow zones occupied by the teeth will be sufficiently near to a spherical surface described about O for practical purposes. To find the figures of the teeth, draw on a flat surface circular arcs ID_1, ID_2, with the radii A_1I, A_2I; those arcs will be the *developments* of arcs of the pitch-circles B_1I, B_2I, when the conical surfaces A_1B_1I, A_2B_2I are spread out flat. Describe the figures of teeth for the developed arcs as for a pair of spur-wheels; then wrap the developed arcs on the cones, so as to make them coincide with the pitch-circles, and trace the teeth on the conical surfaces.

§ 55. *Teeth of Skew-Bevel Wheels.*—The crests of the teeth of a skew-bevel wheel are parallel to the generating straight line of the hyperboloidal pitch-surface; and the transverse sections of the teeth at a given pitch-circle are similar to those of the teeth of a bevel-wheel whose pitch surface is a cone touching the hyperboloidal surface at the given circle.

§ 56. *Cams.*—A *cam* is a single tooth, either rotating continuously or oscillating, and driving a sliding or turning piece either constantly or at intervals. All the principles which have been stated in § 45 as being applicable to teeth are applicable to cams; but in designing cams it is not usual to determine or take into consideration the form of the ideal pitch-surface, which would give the same comparative motion by rolling contact that the cam gives by sliding contact.

§ 57. *Screws.*—The figure of a screw is that of a convex or concave cylinder, with one or more helical projections, called *threads*, winding round it. Convex and concave screws are distinguished technically by the respective names of *male* and *female*; a short concave screw is called a *nut*; and when a *screw* is spoken of without qualification a *convex* screw is usually understood.

The relation between the *advance* and the *rotation*, which compose the motion of a screw working in contact with a fixed screw or helical guide, has already been demonstrated in § 32; and the same relation exists between the magnitudes of the rotation of a screw about a fixed axis and the advance of a shifting nut in which it rotates. The advance of the nut takes place in the opposite direction to that of the advance of the screw in the case in which the nut is fixed. The *pitch* or *axial pitch* of a screw has the meaning assigned to it in that section, viz. the distance, measured parallel to the axis, between the corresponding points in two successive turns of the *same thread*. If, therefore, the screw has several equidistant threads, the true pitch is equal to the *divided axial pitch*, as measured between two adjacent threads, multiplied by the number of threads.

If a helix be described round the screw, crossing each turn of the thread at right angles, the distance between two corresponding points on two successive turns of the same thread, measured along this *normal helix*, may be called the *normal pitch*; and when the screw has more than one thread the normal pitch from thread to thread may be called the *normal divided pitch*.

The distance from thread to thread, measured on a circle described about the axis of the screw, called the pitch-circle, may be called the *circumferential pitch*; for a screw of one thread it is one circumference; for a screw of n threads, $\dfrac{\text{one circumference}}{n}$.

Let r denote the radius of the pitch circle;
n the number of threads;
θ the obliquity of the threads to the pitch circle, and of the normal helix to the axis;

$$\left.\begin{array}{r} P_a \\ \dfrac{P_a}{n}=p_a \end{array}\right\}\text{ the axial }\left\{\begin{array}{l}\text{pitch,}\\ \text{divided pitch;}\end{array}\right.$$

$$\left.\begin{array}{r} P_n \\ \dfrac{P_n}{n}=p_n \end{array}\right\}\text{ the normal }\left\{\begin{array}{l}\text{pitch,}\\ \text{divided pitch;}\end{array}\right.$$

P_c the circumferential pitch;

then

$$\left.\begin{array}{l} p_c=p_a\cot\theta=p_n\cos\theta=\dfrac{2\pi r}{n},\\[2ex] p_a=p_n\sec\theta=p_c\tan\theta=\dfrac{2\pi r\tan\theta}{n},\\[2ex] p_n=p_c\sin\theta=p_a\cos\theta=\dfrac{2\pi r\sin\theta}{n}. \end{array}\right\} \qquad (31)$$

If a screw rotates, the number of threads which pass a fixed point in one revolution is the number of threads in the screw.

A pair of convex screws, each rotating about its axis, are used as an elementary combination to transmit motion by the sliding contact of their threads. Such screws are commonly called *endless screws*. At the point of contact of the screws their threads must be parallel; and their line of connexion is the common perpendicular to the acting surfaces of the threads at their point of contact. Hence the following principles:—

I. If the screws are both right-handed or both left-handed, the angle between the directions of their axes is the sum of their obliquities; if one is right-handed and the other left-handed, that angle is the difference of their obliquities.

II. The normal pitch for a screw of one thread, and the normal divided pitch for a screw of more than one thread, must be the same in each screw.

III. The angular velocities of the screws are inversely as their numbers of threads.

Hooke's wheels with oblique or helical teeth are in fact screws of many threads, and of large diameters as compared with their lengths.

The ordinary position of a pair of endless screws is with their axes at right angles to each other. When one is of considerably greater diameter than the other, the larger is commonly called in practice a *wheel*, the name *screw* being applied to the smaller only; but they are nevertheless both screws in fact.

To make the teeth of a pair of endless screws fit correctly and work smoothly, a hardened steel screw is made of the figure of the smaller screw, with its thread or threads notched so as to form a cutting tool; the larger screw, or "wheel," is cast approximately of the required figure; the larger screw and the steel screw are fitted up in their proper relative position, and made to rotate in contact with each other by turning the steel screw, which cuts the threads of the larger screw to their true figure.

§ 58. *Coupling of Parallel Axes—Oldham's Coupling.*—A *coupling* is a mode of connecting a pair of shafts so that they shall rotate in the same direction with the same mean angular velocity. If the axes of the shafts are in the same straight line, the coupling consists in so connecting their contiguous ends that they shall rotate as one piece; but if the axes are not in the same straight line combinations of mechanism are required. A coupling for parallel shafts which acts by *sliding contact* was invented by Oldham, and is represented in fig. 107. C_1, C_2 are the axes of the two parallel shafts; D_1, D_2 two disks facing each other, fixed on the ends of the two shafts respectively; E_1E_1 a bar sliding in a diametral groove in the face of D_1; E_2E_2 a bar sliding in a diametral groove in the face of D_2: those bars are fixed together at A, so as to form a rigid cross. The angular velocities of the two disks and of the cross are all equal at every instant; the middle point of the cross, at A, revolves in the dotted circle described upon the line of centres C_1C_2 as a diameter twice for each turn of the disks and cross; the instantaneous axis of rotation of the cross at any instant is at I, the point in the circle C_1C_2 diametrically opposite to A.

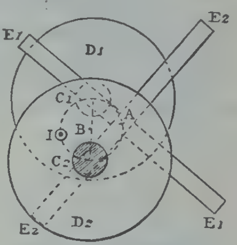

FIG. 107.

Oldham's coupling may be used with advantage where the axes of the shafts are intended to be as nearly in the same straight line as is possible, but where there is some doubt as to the practibility or permanency of their exact continuity.

§ 59. *Wrapping Connectors—Belts, Cords and Chains.*—Flat belts of leather or of gutta percha, round cords of catgut, hemp or other material, and metal chains are used as wrapping connectors to transmit rotatory motion between pairs of pulleys and drums.

Belts (the most frequently used of all wrapping connectors) require nearly cylindrical pulleys. A belt tends to move towards that part of a pulley whose radius is greatest; pulleys for belts, therefore, are slightly swelled in the middle, in order that the belt may remain on the pulley, unless forcibly shifted. A belt when in motion is shifted off a pulley, or from one pulley on to another of equal size alongside of it, by pressing against that part of the belt which is moving *towards* the pulley.

Cords require either cylindrical drums with ledges or grooved pulleys.

Chains require pulleys or drums, grooved, notched and toothed, so as to fit the links of the chain.

Wrapping connectors for communicating continuous motion are endless.

Wrapping connectors for communicating reciprocating motion have usually their ends made fast to the pulleys or drums which they connect, and which in this case may be sectors.

The line of connexion of two pieces connected by a wrapping connector is the centre line of the belt, cord or chain; and the comparative motions of the pieces are determined by the principles of § 36 if both pieces turn, and of § 37 if one turns and the other shifts, in which latter case the motion must be reciprocating.

The *pitch-line* of a pulley or drum is a curve to which the line of connexion is always a tangent—that is to say, it is a curve parallel to the acting surface of the pulley or drum, and distant from it by half the thickness of the wrapping connector.

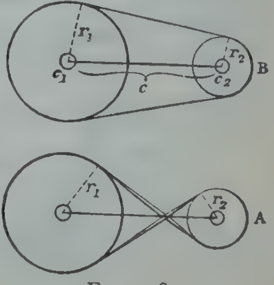

FIG. 108.

Pulleys and drums for communicating a constant velocity ratio are circular. The *effective radius*, or radius of the pitch-circle of a circular pulley or drum, is equal to the real radius added to half the thickness of the connector. The angular velocities of a pair of connected circular pulleys or drums are inversely as the effective radii.

A *crossed* belt, as in fig. 108, A, reverses the direction of the rotation communicated; an *uncrossed* belt, as in fig. 108, B, preserves that direction.

The *length* L of an endless belt connecting a pair of pulleys whose effective radii are r_1, r_2, with parallel axes whose distance apart is c, is given by the following formulae, in each of which the first term, containing the radical, expresses the length of the straight parts of the belt, and the remainder of the formula the length of the curved parts.

For a crossed belt:—

$$L = 2\sqrt{c^2 - (r_1 + r_2)^2} + (r_1 + r_2)\left(\pi - 2 \sin^{-1}\frac{r_1 + r_2}{c}\right); \qquad (32\text{ A})$$

and for an uncrossed belt:—

$$L = 2\sqrt{\{c^2 - (r_1 - r_2)^2\}} + \pi (r_1 + r_2 + 2 (r_1 - r_2) \sin^{-1}\frac{r_1 - r_2}{c}; \qquad (32\text{ B})$$

in which r_1 is the greater radius, and r_2 the less.

When the axes of a pair of pulleys are not parallel, the pulleys should be so placed that the part of the belt which is *approaching* each pulley shall be in the plane of the pulley.

§ 60. *Speed-Cones.*—A pair of speed-cones (fig. 109) is a contrivance for varying and adjusting the velocity ratio communicated between a pair of parallel shafts by means of a belt. The speed-cones are either continuous cones or conoids, as A, B, whose velocity ratio can be varied gradually while they are in motion by shifting the belt, or sets of pulleys whose radii vary by steps, as C, D, in which case the velocity ratio can be changed by shifting the belt from one pair of pulleys to another.

In order that the belt may fit accurately in every possible position on a pair of speed-cones, the quantity L must be constant, in equations (32 A) or (32 B), according as the belt is crossed or uncrossed.

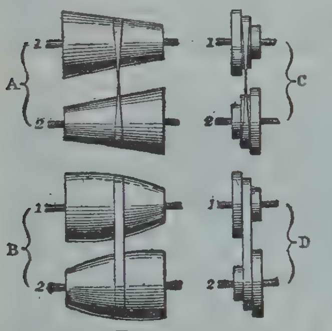

FIG. 109.

For a *crossed* belt, as in A and C, fig. 109, L depends solely on c and on $r_1 + r_2$. Now c is constant because the axes are parallel; therefore the *sum of the radii* of the pitch-circles connected in every position of the belt is to be constant. That condition is fulfilled by a pair of continuous cones generated by the revolution of two straight lines inclined opposite ways to their respective axes at equal angles.

For an uncrossed belt, the quantity L in equation (32 B) is to be made constant. The exact fulfilment of this condition requires the solution of a transcendental equation; but it may be fulfilled with accuracy sufficient for practical purposes by using, instead of (32 B) the following *approximate* equation:—

$$L \text{ nearly} = 2c + \pi(r_1 + r_2) + (r_1 - r_2)^2/c. \qquad (33)$$

The following is the most convenient practical rule for the application of this equation:—

Let the speed-cones be equal and similar conoids, as in B, fig. 109, but with their large and small ends turned opposite ways. Let r_1 be the radius of the large end of each, r_2 that of the small end, r_0 that of the middle; and let v be the *sagitta*, measured perpendicular to the axes, of the arc by whose revolution each of the conoids is generated, or, in other words, the *bulging* of the conoids in the middle of their length. Then

$$v = r_0 - (r_1 + r_2)/2 = (r_1 - r_2)^2/2\pi c. \qquad (34)$$

$2\pi = 6{\cdot}2832$; but 6 may be used in most practical cases without sensible error.

The radii at the middle and end being thus determined, make the generating curve an arc either of a circle or of a parabola.

§ 61. *Linkwork in General.*—The pieces which are connected by linkwork, if they rotate or oscillate, are usually called *cranks*, *beams* and *levers*. The *link* by which they are connected is a rigid rod or bar, which may be straight or of any other figure; the straight figure being the most favourable to strength, is always used when there is no special reason to the contrary. The link is known by various names in various circumstances, such as *coupling-rod*, *connecting-rod*, *crank-rod*, *eccentric-rod*, &c. It is attached to the pieces which it connects by two pins, about which it is free to turn. The effect of the link is to maintain the distance between the axes of those pins invariable; hence the common perpendicular of the axes of the pins is *the line of connexion*, and its extremities may be called the *connected points*. In a turning piece, the perpendicular let fall from its connected point upon its axis of rotation is the *arm* or *crank-arm*.

The axes of rotation of a pair of turning pieces connected by a link are almost always parallel, and perpendicular to the line of connexion in which case the angular velocity ratio at any instant is the reciprocal of the ratio of the common perpendiculars let fall from the line of connexion upon the respective axes of rotation.

If at any instant the direction of one of the crank-arms coincides with the line of connexion, the common perpendicular of the line of connexion and the axis of that crank-arm vanishes, and the directional relation of the motions becomes indeterminate. The position of the connected point of the crank-arm in question at such an instant is called a *dead-point*. The velocity of the other connected point at such an instant is null, unless it also reaches a dead-point at the same instant, so that the line of connexion is in the plane of the two axes of rotation, in which case the velocity ratio is indeterminate. Examples of dead-points, and of the means of preventing the inconvenience which they tend to occasion, will appear in the sequel.

§ 62. *Coupling of Parallel Axes.*—Two or more parallel shafts (such as those of a locomotive engine, with two or more pairs of driving wheels) are made to rotate with constantly equal angular velocities by having equal cranks, which are maintained parallel by a coupling-rod of such a length that the line of connexion is equal to the distance between the axes. The cranks pass their dead-points simultaneously. To obviate the unsteadiness of motion which this tends to cause, the shafts are provided with a second set of cranks at right angles to the first, connected by means of a similar coupling-rod, so that one set of cranks pass their dead points at the instant when the other set are farthest from theirs.

§ 63. *Comparative Motion of Connected Points.*—As the link is a rigid body, it is obvious that its action in communicating motion may be determined by finding the comparative motion of the connected points, and this is often the most convenient method of proceeding.

If a connected point belongs to a turning piece, the direction of its motion at a given instant is perpendicular to the plane containing the axis and crank-arm of the piece. If a connected point belongs to a shifting piece, the direction of its motion at any instant is given, and a plane can be drawn perpendicular to that direction.

The line of intersection of the planes perpendicular to the paths of the two connected points at a given instant is the *instantaneous axis of the link* at that instant; and the *velocities of the connected points are directly as their distances from that axis.*

In drawing on a plane surface, the two planes perpendicular to the paths of the connected points are represented by two lines (being their sections by a plane normal to them), and the instantaneous axis by a point (fig. 110); and, should the length of the two lines render it impracticable to produce them until they actually intersect, the velocity ratio of the connected points may be found by the principle that it is equal to the ratio of the segments which a line parallel to the line of connexion cuts off from any two lines drawn from a given point, perpendicular respectively to the paths of the connected points.

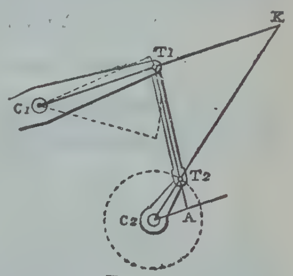

FIG. 110.

To illustrate this by one example. Let C_1 be the axis, and T_1 the connected point of the beam of a steam-engine; T_1T_2 the connecting or crank-rod; T_2 the other connected point, and the centre of the crank pin; C_2 the axis of the crank and its shaft. Let v_1 denote the velocity of T_1 at any given instant; v_2 that of T_2. To find the ratio of these velocities, produce C_1T_1, C_2T_2 till they intersect in K; K is the instantaneous axis of the connecting rod, and the velocity ratio is

$$v_1 : v_2 : : KT_1 : KT_2. \qquad (35)$$

Should K be inconveniently far off, draw any triangle with its sides respectively parallel to C_1T_1, C_2T_2 and T_1T_2; the ratio of the two sides first mentioned will be the velocity ratio required. For example, draw C_2A parallel to C_1T_1, cutting T_1T_2 in A; then

$$v_1 : v_2 : : C_2A : C_2T_2. \qquad (36)$$

§ 64. *Eccentric.*—An eccentric circular disk fixed on a shaft, and used to give a reciprocating motion to a rod, is in effect a crank-pin of sufficiently large diameter to surround the shaft, and so to avoid the weakening of the shaft which would arise from bending it so as to form an ordinary crank. The centre of the eccentric is its connected point; and its eccentricity, or the distance from that centre to the axis of the shaft, is its crank-arm.

An eccentric may be made capable of having its eccentricity altered by means of an adjusting screw, so as to vary the extent of the reciprocating motion which it communicates.

§ 65. *Reciprocating Pieces—Stroke—Dead-Points.*—The distance between the extremities of the path of the connected point in a reciprocating piece (such as the piston of a steam-engine) is called the *stroke* or *length of stroke* of that piece. When it is connected with a continuously turning piece (such as the crank of a steam-engine) the ends of the stroke of the reciprocating piece correspond to the *dead-points* of the path of the connected point of the turning piece, where the line of connexion is continuous with or coincides with the crank-arm.

Let S be the length of stroke of the reciprocating piece, L the length of the line of connexion, and R the crank-arm of the continuously turning piece. Then, if the two ends of the stroke be in one straight line with the axis of the crank,

$$S = 2R; \qquad (37)$$

and if these ends be not in one straight line with that axis, then S, L − R, and L+R, are the three sides of a triangle, having the angle opposite S at that axis; so that, if θ be the supplement of the arc between the dead-points,

$$\left.\begin{aligned} S^2 &= 2(L^2+R^2)-2(L^2-R^2)\cos\theta, \\ \cos\theta &= \frac{2L^2+2R^2-S^2}{2(L^2-R^2)}. \end{aligned}\right\} \qquad (38)$$

§ 66. *Coupling of Intersecting Axes—Hooke's Universal Joint.*—Intersecting axes are coupled by a contrivance of Hooke's, known as the "universal joint," which belongs to the class of linkwork (see fig. 111). Let O be the point of intersection of the axes OC_1, OC_2, and θ their angle of inclination to each other. The pair of shafts C_1, C_2 terminate in a pair of forks F_1, F_2 in bearings at the extremities of which turn the gudgeons at the ends of the arms of a rectangular cross, having its centre at O. This cross is the link; the connected points are the centres of the bearings F_1, F_2. At each instant each of those points moves at right angles to the central plane of its shaft and fork, therefore the line of intersection of the central planes of the two forks at any instant is the instantaneous axis of the cross, and the *velocity ratio* of the points F_1, F_2 (which, as the forks are equal, is also the *angular velocity ratio* of the shafts) is equal to the ratio of the distances of those points from that instantaneous axis. The *mean* value of that velocity ratio is that of equality, for each successive *quarter-turn* is made by both shafts in the same time; but its actual value fluctuates between the limits:—

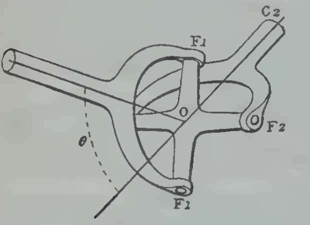

FIG. 111.

$$\left.\begin{aligned} &\frac{\alpha_2}{\alpha_1} = \frac{1}{\cos\theta} \text{ when } F_1 \text{ is the plane of } OC_1C_2 \\ \text{and } &\frac{\alpha_2}{\alpha_1} = \cos\theta \text{ when } F_2 \text{ is in that plane.} \end{aligned}\right\} \qquad (39)$$

Its value at intermediate instants is given by the following equations: let ϕ_1, ϕ_2 be the angles respectively made by the central planes of the forks and shafts with the plane OC_1C_2 at a given instant; then

$$\left.\begin{aligned} \cos\theta &= \tan\phi_1 \tan\phi_2, \\ \frac{\alpha_2}{\alpha_1} = -\frac{d\phi_2}{d\phi_1} &= \frac{\tan\phi_1+\cot\phi_1}{\tan\phi_2+\cot\phi_2}. \end{aligned}\right\} \qquad (40)$$

§ 67. *Intermittent Linkwork—Click and Ratchet.*—A *click* acting upon a ratchet-wheel or rack, which it pushes or pulls through a certain arc at each forward stroke and leaves at rest at each backward stroke, is an example of intermittent linkwork. During the forward stroke the action of the click is governed by the principles of linkwork; during the backward stroke that action ceases. A *catch* or *pall*, turning on a fixed axis, prevents the ratchet-wheel or rack from reversing its motion.

Division 5.—Trains of Mechanism.

§ 68. *General Principles.—A train of mechanism* consists of a series of pieces each of which is follower to that which drives it and driver to that which follows it.

The comparative motion of the first driver and last follower is obtained by combining the proportions expressing by their terms the velocity ratios and by their signs the directional relations of the several elementary combinations of which the train consists.

§ 69. *Trains of Wheelwork.*—Let A_1, A_2, A_3, &c., A_{m-1}, A_m denote a series of axes, and α_1, α_2, α_3, &c., α_{m-1}, α_m their angular velocities. Let the axis A_1 carry a wheel of N_1 teeth, driving a wheel of n_2 teeth on the axis A_2, which carries also a wheel of N_2 teeth, driving a wheel of n_3 teeth on the axis A_3, and so on; the numbers of teeth in drivers being denoted by N's, and in followers by n's, and the axes to which the wheels are fixed being denoted by numbers. Then the resulting velocity ratio is denoted by

$$\frac{\alpha_m}{\alpha_1} = \frac{\alpha_2}{\alpha_1} \cdot \frac{\alpha_3}{\alpha_2} \cdot \text{\&c.} \ldots \frac{\alpha_m}{\alpha_{m-1}} = \frac{N_1 \cdot N_2 \ldots \text{\&c.} \ldots N_{m-1}}{n_2 \cdot n_3 \ldots \text{\&c.} \ldots n_m}; \qquad (41)$$

that is to say, the velocity ratio of the last and first axes is the ratio of the product of the numbers of teeth in the drivers to the product of the numbers of teeth in the followers.

Supposing all the wheels to be in outside gearing, then, as each elementary combination reverses the direction of rotation, and as the number of elementary combinations $m-1$ is one less than the number of axes m, it is evident that if m is odd the direction of rotation is preserved, and if even reversed.

It is often a question of importance to determine the number of teeth in a train of wheels best suited for giving a determinate velocity ratio to two axes. It was shown by Young that, to do this with the *least total number of teeth*, the velocity ratio of each elementary combination should approximate as nearly as possible to 3·59. This would in many cases give too many axes; and, as a useful practical rule, it may be laid down that from 3 to 6 ought to be the limit of the velocity ratio of an elementary combination in wheelwork. The smallest number of teeth in a pinion for epicycloidal teeth ought to be *twelve* (see § 49)—but it is better, for smoothness of motion, not to go below *fifteen*; and for involute teeth the smallest number is about *twenty-four*.

Let B/C be the velocity ratio required, reduced to its least terms, and let B be greater than C. If B/C is not greater than 6, and C lies between the prescribed minimum number of teeth (which may be called t) and its double $2t$, then one pair of wheels will answer the purpose, and B and C will themselves be the numbers required. Should B and C be inconveniently large, they are, if possible, to be resolved into factors, and those factors (or if they are too small, multiples of them) used for the number of teeth. Should B or C, or both, be at once inconveniently large and prime, then, instead of the exact ratio B/C some ratio approximating to that ratio, and capable of resolution into convenient factors, is to be found by the method of continued fractions.

Should B/C be greater than 6, the best number of elementary combinations $m-1$ will lie between

$$\frac{\log B - \log C}{\log 6} \text{ and } \frac{\log B - \log C}{\log 3}.$$

Then, if possible, B and C themselves are to be resolved each into $m-1$ factors (counting 1 as a factor), which factors, or multiples of them, shall be not less than t nor greater than $6t$; or if B and C contain inconveniently large prime factors, an approximate velocity ratio, found by the method of continued fractions, is to be substituted for B/C as before.

So far as the resultant velocity ratio is concerned, the *order* of the drivers N and of the followers n is immaterial: but to secure equable wear of the teeth, as explained in § 44, the wheels ought to be so arranged that, for each elementary combination, the greatest common divisor of N and n shall be either 1, or as small as possible.

§ 70. *Double Hooke's Coupling.*—It has been shown in § 66 that the velocity ratio of a pair of shafts coupled by a universal joint fluctuates between the limits $\cos\theta$ and $1/\cos\theta$. Hence one or both of the shafts must have a vibratory and unsteady motion, injurious to the mechanism and framework. To obviate this evil a short intermediate shaft is introduced, making equal angles with the first and last shaft, coupled with each of them by a Hooke's joint, and having its own two forks in the same plane. Let α_1, α_2, α_3 be the angular velocities of the first, intermediate, and last shaft in this *train of two Hooke's couplings*. Then, from the principles of § 60 it is evident that at each instant $\alpha_2/\alpha_1 = \alpha_2/\alpha_3$, and consequently that $\alpha_3 = \alpha_1$; so that the fluctuations of angular velocity ratio caused by the first coupling are exactly neutralized by the second, and the first and last shafts have equal angular velocities at each instant.

§ 71. *Converging and Diverging Trains of Mechanism.*—Two or more trains of mechanism may *converge* into one—as when the two pistons of a pair of steam-engines, each through its own connecting-rod, act upon one crank-shaft. One train of mechanism may *diverge* into two or more—as when a single shaft, driven by a prime mover, carries several pulleys, each of which drives a different machine. The principles of comparative motion in such converging and diverging trains are the same as in simple trains.

Division 6.—Aggregate Combinations.

§ 72. *General Principles.*—Willis designated as "aggregate combinations" those assemblages of pieces of mechanism in which the motion of one follower is the *resultant* of component motions impressed on it by more than one driver. Two classes of aggregate combinations may be distinguished which, though not different in their actual nature, differ in the *data* which they present to the designer, and in the method of solution to be followed in questions respecting them.

Class I. comprises those cases in which a piece A is not carried directly by the frame C, but by another piece B. *relatively* to which the motion of A is given—the motion of the piece B relatively to the frame C being also given. Then the motion of A relatively to the frame C is the *resultant* of the motion of A relatively to B and of B relatively to C; and that resultant is to be found by the principles already explained in Division 3 of this Chapter §§ 27–32.

Class II. comprises those cases in which the motions of three points in one follower are determined by their connexions with two or with three different drivers.

This classification is founded on the kinds of problems arising from the combinations. Willis adopts another classification founded on the *objects* of the combinations, which objects he divides into two classes, viz. (1) to produce *aggregate velocity*, or a velocity which is the resultant of two or more components in the same path, and (2) to produce *an aggregate path*—that is, to make a given point in a rigid body move in an assigned path by communicating certain motions to other points in that body.

It is seldom that one of these effects is produced without at the same time producing the other; but the classification of Willis depends upon which of those two effects, even supposing them to occur together, is the practical object of the mechanism.

§ 73. *Differential Windlass.*—The axis C (fig. 112) carries a larger barrel AE and a smaller barrel DB, rotating as one piece with the angular velocity α_1 in the direction AE. The pulley or *sheave* FG has a weight W hung to its centre. A cord has one end made fast to and wrapped round the barrel AE; it passes from A under the sheave FG, and has the other end wrapped round and made fast to the barrel BD. Required the relation between the velocity of translation v_2 of W and the angular velocity α_1 of the *differential barrel.*

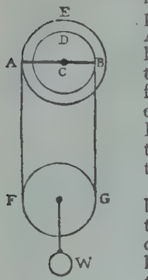

FIG. 112.

In this case v_2 is an *aggregate velocity*, produced by the joint action of the two drivers AE and BD, transmitted by wrapping connectors to FG, and combined by that sheave so as to act on the follower W, whose motion is the same with that of the centre of FG.

The velocity of the point F is $\alpha_1 \, . \, AC$, *upward* motion being considered positive. The velocity of the point G is $-\alpha_1 \, . \, CB$, *downward* motion being negative. Hence the instantaneous axis of the sheave FG is in the diameter FG, at the distance

$$\frac{FG}{2}\cdot\frac{AC-BC}{AC+BC}$$

from the centre towards G; the angular velocity of the sheave is

$$\alpha_2=\alpha_1\cdot\frac{AC+BC}{FG};$$

and, consequently, the velocity of its centre is

$$v_2=\alpha_2\cdot\frac{FG}{2}\cdot\frac{AC-BC}{AC+BC}=\frac{\alpha_1(AC-BC)}{2}, \qquad (42)$$

or the *mean between the velocities of the two vertical parts of the cord.*

If the cord be fixed to the framework at the point B, instead of being wound on a barrel, the velocity of W is half that of AF.

A case containing several sheaves is called a *block.* A *fall-block* is attached to a fixed point; a *running-block* is movable to and from a fall-block, with which it is connected by two or more plies of a rope. The whole combination constitutes a *tackle* or *purchase.* (See PULLEYS for practical applications of these principles.)

§ 74. *Differential Screw.*—On the same axis let there be two screws of the respective pitches p_1 and p_2, made in one piece, and rotating with the angular velocity α. Let this piece be called B. Let the first screw turn in a fixed nut C, and the second in a sliding nut A. The velocity of advance of B relatively to C is (according to § 32) αp_1, and of A relatively to B (according to § 57) $-\alpha p_2$; hence the velocity of A relatively to C is

$$\alpha(p_1-p_2), \qquad (46)$$

being the same with the velocity of advance of a screw of the pitch p_1-p_2. This combination, called *Hunter's* or the *differential screw,* combines the strength of a large thread with the slowness of motion due to a small one.

§ 75. *Epicyclic Trains.*—The term *epicyclic train* is used by Willis to denote a train of wheels carried by an arm, and having certain rotations relatively to that arm, which itself rotates. The arm may either be driven by the wheels or assist in driving them. The comparative motions of the wheels and of the arm, and the *aggregate paths* traced by points in the wheels, are determined by the principles of the composition of rotations, and of the description of rolling curves, explained in §§ 30, 31.

§ 76. *Link Motion.*—A slide valve operated by a link motion receives an aggregate motion from the mechanism driving it. (See STEAM-ENGINE for a description of this and other types of mechanism of this class.)

§ 77. *Parallel Motions.*—A *parallel motion* is a combination of turning pieces in mechanism designed to guide the motion of a reciprocating piece either exactly or approximately in a straight line, so as to avoid the friction which arises from the use of straight guides for that purpose.

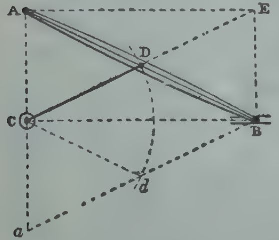

FIG 113.

Fig. 113 represents an exact parallel motion, first proposed, it is believed, by Scott Russell. The arm CD turns on the axis C, and is jointed at D to the middle of the bar ADB, whose length is double of that of CD, and one of whose ends B is jointed to a slider, sliding in straight guides along the line CB. Draw BE perpendicular to CB, cutting CD produced in E, then E is the instantaneous axis of the bar ADB; and the direction of motion of A is at every instant perpendicular to EA—that is, along the straight line AC*a*. While the stroke of A is AC*a*, extending to equal distances on either side of C, and equal to twice the chord of the arc D*d*, the stroke of B is only equal to twice the sagitta; and thus A is guided through a comparatively long stroke by the sliding of B through a comparatively short stroke, and by rotatory motions at the joints C, D, B.

§ 78.* An example of an approximate straight-line motion composed of three bars fixed to a frame is shown in fig. 114. It is due to P. L. Tchebichev of St Petersburg. The links AB and CD are equal in length and are centred respectively at A and C. The ends D and B are joined by a link DB. If the respective lengths are made in the proportions AC:CD:DB=1:1·3:0·4 the middle point P of DB will describe an approximately straight line parallel to AC within limits of length about equal to AC. C. N. Peaucellier, a French engineer officer, was the first, in 1864, to invent a linkwork with which an exact straight line could be drawn. The linkwork is shown in fig. 115, from which it will be seen that it consists of a rhombus of four equal bars ABCD, jointed at opposite corners with two equal bars BE and DE. The seventh link AF is equal in length to half the distance EA when the mechanism is in its central position. The points E and F are fixed. It can be proved that the point C always moves in a straight line at right angles to the line EF. The more general property of the mechanism corresponding to proportions between the lengths FA and EF other than that of equality is that the curve described by the point C is the inverse of the curve described by A. There are other arrangements of bars giving straight-line motions, and these arrangements together with the general properties of mechanisms of this kind are discussed in *How to Draw a Straight Line* by A. B. Kempe (London, 1877).

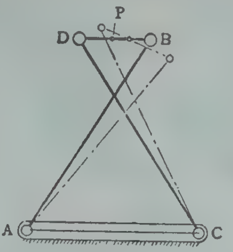

FIG. 114.

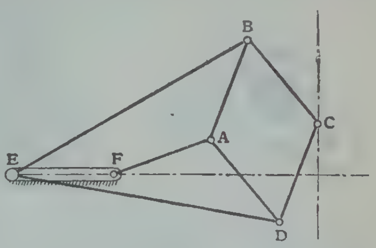

FIG. 115.

§ 79.* *The Pantograph.*—If a parallelogram of links (fig. 116), be fixed at any one point *a* in any one of the links produced in either direction, and if any straight line be drawn from this point to cut the links in the points *b* and *c*, then the points *a, b, c* will be in a straight line for all positions of the mechanism, and if the point *b* be guided in any curve whatever, the point *c* will trace a similar curve to a scale enlarged in the ratio *ab* : *ac*. This property of the parallelogram is utilized in the construction of the pantograph, an instrument used for obtaining a copy of a map or drawing on a different scale. Professor J. J. Sylvester discovered that this property of the parallelogram is not confined to points lying in one line with the fixed point. Thus if *b* (fig. 117) be any point on the link CD, and if a point *c* be taken on the link DE such that the triangles C*b*D and D*c*E are similar and similarly situated with regard to their respective links, then the ratio of the distances *ab* and *ac* is constant, and the angle *bac* is constant for all positions of the mechanism; so that, if *b* is guided in any curve, the point *c* will describe a similar curve turned through an angle *bac*, the scales of the curves being in the ratio *ab* to *ac*. Sylvester called an instrument based on this property a plagiograph or a skew pantograph.

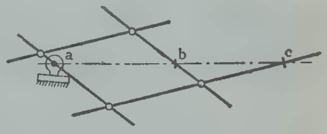

FIG. 116.

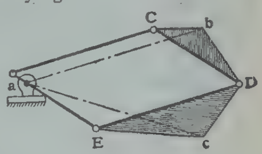

FIG. 117.

The combination of the parallelogram with a straight-line motion, for guiding one of the points in a straight line, is illustrated in Watt's parallel motion for steam-engines. (See STEAM-ENGINE.)

§ 80.* *The Reuleaux System of Analysis.*—If two pieces, A and B. (fig. 118) are jointed together by a pin, the pin being fixed, say, to A, the only relative motion possible between the pieces is one of turning about the axis of the pin. Whatever motion the pair of pieces may have as a whole each separate piece shares in common, and this common motion in no way affects the relative motion of A and B. The motion of one piece is said to be completely constrained relatively to the other piece. Again, the pieces A and B (fig. 119) are paired together as a slide, and the only relative motion possible between them now is that of sliding, and therefore the motion of one relatively to the other is completely constrained. The pieces may be paired together as a screw and nut, in which case the relative motion is compounded of turning with sliding.

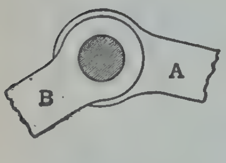

FIG. 118.

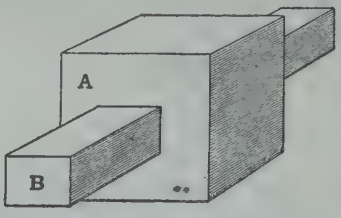

FIG. 119.

These combinations of pieces are known individually as *kinematic pairs of elements*, or briefly *kinematic pairs*. The three pairs mentioned above have each the peculiarity that contact between the two pieces forming the pair is distributed over a surface. Kinematic pairs which have surface contact are classified as *lower pairs*. Kinematic pairs in which contact takes place along a line only are classified as *higher pairs*. A pair of spur wheels in gear is an example of a higher pair, because the wheels have contact between their teeth along lines only.

A *kinematic link* of the simplest form is made by joining up the halves of two kinematic pairs by means of a rigid link. Thus if A_1B_1 represent a turning pair, and A_2B_2 a second turning pair, the rigid link formed by joining B_1 to B_2 is a kinematic link. Four links of this kind are shown in fig. 120 joined up to form a *closed kinematic chain*.

In order that a kinematic chain may be made the basis of a mechanism, every point in any link of it must be completely constrained with regard to every other link. Thus in fig. 120 the motion of a point *a* in the link A_1A_2 is completely constrained with regard to the link B_1B_4 by the turning pair A_1B_1, and it can be proved that the motion of *a* relatively to the non-adjacent link A_3A_4 is completely constrained, and therefore the four-bar chain, as it is called, can be and is used as the basis of many mechanisms. Another way of considering the question of constraint is to imagine any one link of the chain fixed; then, however the chain be moved, the path of a point, as *a*, will always remain the same. In a five-bar chain, if *a* is a point in a link non-adjacent to a fixed link, its path is indeterminate. Still another way of stating the matter is to say that, if any one link in the chain be fixed, any point in the chain must have only one degree of freedom. In a five-bar chain a point, as *a*, in a link non-adjacent to the fixed link has two degrees of freedom and the chain cannot therefore be used for a mechanism. These principles may be applied to examine any possible combination of links forming a kinematic chain in order to test its suitability for use as a mechanism. Compound chains are formed by the super-position of two or more simple chains, and in these more complex chains links will be found carrying three, or even more, halves of kinematic pairs. The Joy valve gear mechanism is a good example of a compound kinematic chain.

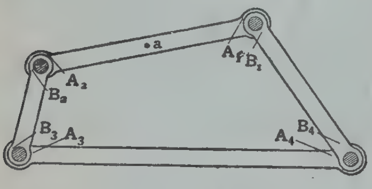

FIG. 120.

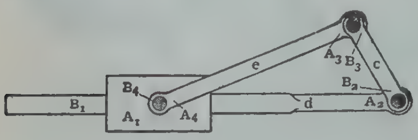

FIG. 121.

A chain built up of three turning pairs and one sliding pair, and known as the *slider crank chain*, is shown in fig. 121. It will be seen that the piece A_1 can only slide relatively to the piece B_1, and these two pieces therefore form the sliding pair. The piece A_1 carries the pin B_4, which is one half of the turning pair A_4 B_4. The piece A_1 together with the pin B_4 therefore form a kinematic link A_1B_4. The other links of the chain are, B_1A_2, B_2B_3, A_3A_4. In order to convert a chain into a mechanism it is necessary to fix one link in it. Any one of the links may be fixed. It follows therefore that there are as many possible mechanisms as there are links in the chain. For example, there is a well-known mechanism corresponding to the fixing of three of the four links of the slider crank chain (fig. 121). If the link *d* is fixed the chain at once becomes the mechanism of the ordinary steam engine; if the link *e* is fixed the mechanism obtained is that of the oscillating cylinder steam engine; if the link *c* is fixed the mechanism becomes either the Whitworth quick-return motion or the slot-bar motion, depending upon the proportion between the lengths of the links *c* and *e*. These different mechanisms are called *inversions* of the slider crank chain. What was the fixed framework of the mechanism in one case becomes a moving link in an inversion.

The Reuleaux system, therefore, consists essentially of the analysis of every mechanism into a kinematic chain, and since each link of the chain may be the fixed frame of a mechanism quite diverse mechanisms are found to be merely inversions of the same kinematic chain. Franz Reuleaux's *Kinematics of Machinery*, translated by Sir A. B. W. Kennedy (London, 1876), is the book in which the system is set forth in all its completeness. In *Mechanics of Machinery*, by Sir A. B. W. Kennedy (London, 1886), the system was used for the first time in an English textbook, and now it has found its way into most modern textbooks relating to the subject of mechanism.

§ 81.* *Centrodes, Instantaneous Centres, Velocity Image, Velocity Diagram.*—Problems concerning the relative motion of the several parts of a kinematic chain may be considered in two ways, in addition to the way hitherto used in this article and based on the principle of § 34. The first is by the method of instantaneous centres, already exemplified in § 63, and rolling centroids, developed by Reuleaux in connexion with his method of analysis. The second is by means of Professor R. H. Smith's method already referred to in § 23.

Method 1.—By reference to § 30 it will be seen that the motion of a cylinder rolling on a fixed cylinder is one of rotation about an instantaneous axis T, and that the velocity both as regards direction and magnitude is the same as if the rolling piece B were for the instant turning about a fixed axis coincident with the instantaneous axis. If the rolling cylinder B and its path A now be assumed to receive a common plane motion, what was before the velocity of the point P becomes the velocity of P relatively to the cylinder A, since the motion of B relatively to A still takes place about the instantaneous axis T. If B stops rolling, then the two cylinders continue to move as though they were parts of a rigid body. Notice that the shape of either rolling curve (fig. 91 or 92) may be found by considering each fixed in turn and then tracing out the locus of the instantaneous axis. These rolling cylinders are sometimes called axodes, and a section of an axode in a plane parallel to the plane of motion is called a centrode. The axode is hence the locus of the instantaneous axis, whilst the centrode is the locus of the instantaneous centre in any plane parallel to the plane of motion. There is no restriction on the shape of these rolling axodes; they may have any shape consistent with rolling (that is, no slipping is permitted), and the relative velocity of a point P is still found by considering it with regard to the instantaneous centre.

Reuleaux has shown that the relative motion of any pair of non-adjacent links of a kinematic chain is determined by the rolling together of two ideal cylindrical surfaces (cylindrical being used here in the general sense), each of which may be assumed to be formed by the extension of the material of the link to which it corresponds. These surfaces have contact at the instantaneous axis, which is now called the instantaneous axis of the two links concerned. To find the form of these surfaces corresponding to a particular pair of non-adjacent links, consider each link of the pair fixed in turn, then the locus of the instantaneous axis is the axode corresponding to the fixed link, or, considering a plane of motion only, the locus of the instantaneous centre is the centrode corresponding to the fixed link.

To find the instantaneous centre for a particular link corresponding to any given configuration of the kinematic chain, it is only necessary to know the direction of motion of any two points in the link, since lines through these points respectively at right angles to their directions of motion intersect in the instantaneous centre.

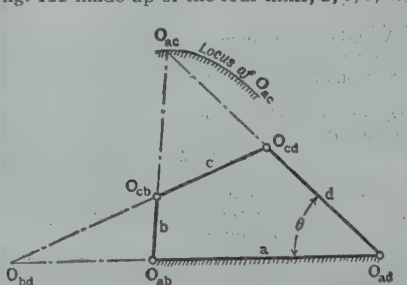

FIG. 122.

To illustrate this principle, consider the four-bar chain shown in fig. 122 made up of the four links, *a*, *b*, *c*, *d*. Let *a* be the fixed link, and consider the link *c*. Its extremities are moving respectively in directions at right angles to the links *b* and *d*; hence produce the links *b* and *d* to meet in the point O_{ac}. This point is the instantaneous centre of the motion of the link *c* relatively to the fixed link *a*, a fact indicated by the suffix *ac* placed after the letter O. The process being repeated for different values of the angle θ the curve through the several points O_{ac} is the centroid which may be imagined as formed by an extension of the material of the link *a*. To find the corresponding centroid for the link *c*, fix *c* and repeat the process. Again, imagine *d* fixed, then the instantaneous centre O_{bd} of *b* with regard to *d* is found by producing the links *c* and *a* to intersect in O_{bd}, and the shapes of the centroids belonging respectively to the links *b* and *d* can be found as before. The axis about which a pair of adjacent links turn is a permanent axis, and is of course the axis of the pin which forms the point. Adding the centres corresponding to these several axes to the figure, it will be seen that there are six centres in connexion with the four-bar chain of which four are permanent and two are instantaneous or virtual centres; and, further, that whatever be the configuration of the chain these centres group themselves into three sets of three, each set lying on a straight line. This peculiarity is not an accident or a special property of the four-bar chain, but is an illustration of a general law regarding the subject discovered by Aronhold and Sir A. B. W. Kennedy independently, which may be thus stated: If any three bodies, *a*, *b*, *c*, have plane motion their three virtual centres, O_{ab}, O_{bc}, O_{ac}, are three points on one straight line. A proof of this will be found in *The Mechanics of Machinery* quoted above. Having obtained the set of instantaneous centres for a chain, suppose *a* is the fixed link of the chain and *c* any other link; then O_{ac} is the instantaneous centre of the two links and may be considered for the instant as the trace of an axis fixed to an extension of the link *a* about which *c* is turning, and thus problems of instantaneous velocity concerning the link *c* are solved as though the link *c* were merely rotating for the instant about a fixed axis coincident with the instantaneous axis.

Method 2.—The second method is based upon the vector representation of velocity, and may be illustrated by applying it to the four-bar chain. Let AD (fig. 123) be the fixed link. Consider the link BC, and let it be required to find the velocity of the point B having given the velocity of the point C. The principle upon which the solution is based is that the only motion which B can have relatively to an axis through C fixed to the link CD is one of turning about C. Choose any pole O (fig. 124). From this pole set out O*c* to represent the velocity of the point C. The direction of this must be at right angles to the line CD, because this is the only direction possible to the point C. If the link BC moves without turning, O*c* will also represent the velocity of the point B; but, if the link is turning, B can only move about the axis C, and its direction of motion is therefore at right angles to the line CB. Hence set out the possible direction of B's motion in the velocity diagram, namely cb_1, at right angles to CB. But the point B must also move at right angles to AB in the case under consideration. Hence draw a line through O in the velocity diagram at right angles to AB to cut cb_1 in *b*. Then O*b* is the velocity of the point *b* in magnitude and direction, and *cb* is the tangential velocity of B relatively to C. Moreover, whatever be the actual magnitudes of the velocities, the instantaneous velocity ratio of the points C and B is given by the ratio O*c*/O*b*.

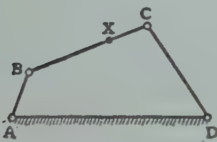

FIG. 123.

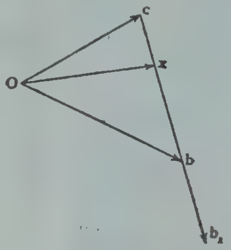

FIG. 124.

A most important property of the diagram (figs. 123 and 124) is the following: If points X and *x* are taken dividing the link BC and the tangential velocity *cb*, so that $cx : xb = \text{CX} : \text{XB}$, then O*x* represents the velocity of the point X in magnitude and direction. The line *cb* has been called the *velocity image* of the rod, since it may be looked upon as a scale drawing of the rod turned through 90° from the actual rod. Or, put in another way, if the link CB is drawn to scale on the new length *cb* in the velocity diagram (fig. 124), then a vector drawn from O to any point on the new drawing of the rod will represent the velocity of that point of the actual rod in magnitude and direction. It will be understood that there is a new velocity diagram for every new configuration of the mechanism, and that in each new diagram the image of the rod will be different in scale. Following the method indicated above for a kinematic chain in general, there will be obtained a velocity diagram similar to that of fig. 124 for each configuration of the mechanism, a diagram in which the velocity of the several points in the chain utilized for drawing the diagram will appear to the same scale, all radiating from the pole O. The lines joining the ends of these several velocities are the several tangential velocities, each being the velocity image of a link in the chain. These several images are not to the same scale, so that although the images may be considered to form collectively an image of the chain itself, the several members of this chain-image are to different scales in any one velocity diagram, and thus the chain-image is distorted from the actual proportions of the mechanism which it represents.

§ 82.* *Acceleration Diagram. Acceleration Image.*—Although it is possible to obtain the acceleration of points in a kinematic chain with one link fixed by methods which utilize the instantaneous centres of the chain, the vector method more readily lends itself to this purpose. It should be understood that the instantaneous centre considered in the preceding paragraphs is available only for estimating relative velocities; it cannot be used in a similar manner for questions regarding acceleration. That is to say, although the instantaneous centre is a centre of no velocity for the instant, it is not a centre of no acceleration, and in fact the centre of no acceleration is in general a quite different point. The general principle on which the method of drawing an acceleration diagram depends is that if a link CB (fig. 125) have plane motion and the acceleration of any point C be given in magnitude and direction, the acceleration of any other point B is the vector sum of the acceleration of C, the radial acceleration of B about C and the tangential acceleration of B about C. Let A be any origin, and let A*c* represent the acceleration of the point C, *ct* the radial acceleration of B about C which must be in a direction parallel to BC, and *tb* the tangential acceleration of B about C, which must of course be at right angles to *ct*; then the vector sum of these three magnitudes is A*b*, and this vector represents the acceleration of the point B. The directions of the radial and tangential accelerations of the point B are always known when the position of the link is assigned, since these are to be drawn respectively parallel to and at right angles to the link itself. The magnitude of the radial acceleration is given by the expression v^2/BC, *v* being the velocity of the point B about the point C. This velocity can always be found from the velocity diagram of the chain of which the link forms a part. If $d\omega/dt$ is the angular acceleration of the link, $d\omega/dt \times \text{CB}$ is the tangential acceleration of the point B about the point C. Generally this tangential acceleration is unknown in magnitude, and it becomes part of the problem to find it. An important property of the diagram is that if points X and *x* are taken dividing the link CB and the whole acceleration of B about C, namely, *cb* in the same ratio, then A*x* represents the acceleration of the point X in magnitude and direction; *cb* is called the acceleration image of the rod. In applying this principle to the drawing of an acceleration diagram for a mechanism, the velocity diagram of the mechanism must be first drawn in order to afford the means of calculating the several radial accelerations of the links. Then assuming that the acceleration of one point of a particular link of the mechanism is known together with the corresponding configuration of the mechanism, the two vectors *Ac* and *ct* can be drawn. The direction of *tb*, the third vector in the diagram, is also known, so that the problem is reduced to the condition that *b* is somewhere on the line *tb*. Then other conditions consequent upon the fact that the link forms part of a kinematic chain operate to enable *b* to be fixed. These methods are set forth and exemplified in *Graphics*, by R. H. Smith (London, 1889). Examples, completely worked out, of velocity and acceleration diagrams for the slider crank chain, the four-bar chain, and the mechanism of the Joy valve gear will be found in ch. ix. of *Valves and Valve Gear Mechanism*, by W. E. Dalby (London, 1906).

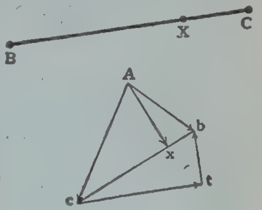

FIG. 125.

CHAPTER II. ON APPLIED DYNAMICS

§ 83. *Laws of Motion.*—The action of a machine in transmitting *force* and *motion* simultaneously, or performing *work*, is governed, in common with the phenomena of moving bodies in general, by two "laws of motion."

Division 1. *Balanced Forces in Machines of Uniform Velocity.*

§ 84. *Application of Force to Mechanism.*—Forces are applied in units of weight; and the unit most commonly employed in Britain is the *pound avoirdupois*. The action of a force applied to a body is always in reality distributed over some definite space, either a volume of three dimensions or a surface of two. An example of a force distributed throughout a volume is the *weight* of the body itself, which acts on every particle, however small. The *pressure* exerted between two bodies at their surface of contact, or between the two parts of one body on either side of an ideal surface of separation, is an example of a force distributed over a surface. The mode of distribution of a force applied to a solid body requires to be considered when its stiffness and strength are treated of; but, in questions respecting the action of a force upon a rigid body considered as a whole, the *resultant* of the distributed force, determined according to the principles of statics, and considered as acting in a *single line* and applied at a *single point*, may, for the occasion, be substituted for the force as really distributed. Thus, the weight of each separate piece in a machine is treated as acting wholly at its *centre of gravity*, and each pressure applied to it as acting at a point called the *centre of pressure* of the surface to which the pressure is really applied.

§ 85. *Forces applied to Mechanism Classed.*—If θ be the *obliquity* of a force F applied to a piece of a machine—that is, the angle made by the direction of the force with the direction of motion of its point of application—then by the principles of statics, F may be resolved into two rectangular components, viz.:—

$$\left.\begin{array}{l}\text{Along the direction of motion, } \mathrm{P}=\mathrm{F}\cos\theta\\ \text{Across the direction of motion, } \mathrm{Q}=\mathrm{F}\sin\theta\end{array}\right\}\qquad(49)$$

If the component along the direction of motion acts *with* the motion, it is called an *effort*; if *against* the motion, a *resistance.* The component *across* the direction of motion is a *lateral pressure*; the unbalanced lateral pressure on any piece, or part of a piece, is *deflecting force.* A lateral pressure may increase resistance by causing friction; the friction so caused acts against the motion, and is a resistance, but the lateral pressure causing it is not a resistance. Resistances are distinguished into *useful* and *prejudicial*, according as they arise from the useful effect produced by the machine or from other causes.

§ 86. *Work.—Work* consists in moving against resistance. The work is said to be *performed*, and the resistance *overcome.* Work is measured by the product of the resistance into the distance through which its point of application is moved. The *unit of work* commonly used in Britain is a resistance of one pound overcome through a distance of one foot, and is called a *foot-pound.*

Work is distinguished into *useful work* and *prejudicial* or *lost work*, according as it is performed in producing the useful effect of the machine, or in overcoming prejudicial resistance.

§ 87. *Energy: Potential Energy.—Energy* means *capacity for performing work.* The *energy of an effort*, or *potential energy*, is measured by the product of the effort into the distance through which its point of application is *capable* of being moved. The unit of energy is the same with the unit of work.

When the point of application of an effort *has been moved* through a given distance, energy is said to have been *exerted* to an amount expressed by the product of the effort into the distance through which its point of application has been moved.

§ 88. *Variable Effort and Resistance.*—If an effort has different magnitudes during different portions of the motion of its point of application through a given distance, let each different magnitude of the effort P be multiplied by the length Δs of the corresponding portion of the path of the point of application; the sum

$$\Sigma\,.\,\mathrm{P}\Delta s \tag{50}$$

is the whole energy exerted. If the effort varies by insensible gradations, the energy exerted is the integral or limit towards which that sum approaches continually as the divisions of the path are made smaller and more numerous, and is expressed by

$$\int \mathrm{P}ds. \tag{51}$$

Similar processes are applicable to the finding of the work performed in overcoming a varying resistance.

The work done by a machine can be actually measured by means of a dynamometer (*q.v.*).

§ 89. *Principle of the Equality of Energy and Work.*—From the first law of motion it follows that in a machine whose pieces move with uniform velocities the efforts and resistances must balance each other. Now from the laws of statics it is known that, in order that a system of forces applied to a system of connected points may be in equilibrium, it is necessary that the sum formed by putting together the products of the forces by the respective distances through which their points of application are capable of moving simultaneously, each along the direction of the force applied to it, shall be zero,—products being considered positive or negative according as the direction of the forces and the possible motions of their points of application are the same or opposite.

In other words, the sum of the negative products is equal to the sum of the positive products. This principle, applied to a machine whose parts move with uniform velocities, is equivalent to saying that in any given interval of time *the energy exerted is equal to the work performed.*

The symbolical expression of this law is as follows: let efforts be applied to one or any number of points of a machine; let any one of these efforts be represented by P, and the distance traversed by its point of application in a given interval of time by ds; let resistances be overcome at one or any number of points of the same machine; let any one of these resistances be denoted by R, and the distance traversed by its point of application in the given interval of time by ds'; then

$$\Sigma\,.\,\mathrm{P}ds = \Sigma\,.\,\mathrm{R}ds'. \tag{52}$$

The lengths ds, ds' are proportional to the velocities of the points to whose paths they belong, and the proportions of those velocities to each other are deducible from the construction of the machine by the principles of pure mechanism explained in Chapter I.

§ 90.* *Static Equilibrium of Mechanisms.*—The principle stated in the preceding section, namely, that the energy exerted is equal to the work performed, enables the ratio of the components of the forces acting in the respective directions of motion at two points of a mechanism, one being the point of application of the effort, and the other the point of application of the resistance, to be readily found. Removing the summation signs in equation (52) in order to restrict its application to two points and dividing by the common time interval during which the respective small displacements ds and ds' were made, it becomes $\mathrm{P}ds/dt = \mathrm{R}ds'/dt$, that is, $\mathrm{P}v = \mathrm{R}v'$, which shows that the force ratio is the inverse of the velocity ratio. It follows at once that any method which may be available for the determination of the velocity ratio is equally available for the determination of the force ratio, it being clearly understood that the forces involved are the components of the actual forces resolved in the direction of motion of the points. The relation between the effort and the resistance may be found by means of this principle for all kinds of mechanisms, when the friction produced by the components of the forces across the direction of motion of the two points is neglected. Consider the following example:—

A four-bar chain having the configuration shown in fig. 126 supports a load P at the point x. What load is required at the point y to maintain the configuration shown, both loads being supposed to act vertically? Find the instantaneous centre O_{bd}, and resolve each load in the respective directions of motion of the points x and y; thus there are obtained the components P cos θ and R cos ϕ. Let the mechanism have a small motion; then, for the instant, the link b is turning about its instantaneous centre O_{bd}, and, if ω is its instantaneous angular velocity, the velocity of the point x is ωr, and the velocity of the point y is ωs. Hence, by the principle just stated, $\mathrm{P}\cos\theta\times\omega r = \mathrm{R}\cos\phi\times\omega s$. But, p and q being respectively the perpendiculars to the lines of action of the forces, this equation reduces to $\mathrm{P}p = \mathrm{R}q$, which shows that the ratio of the two forces may be found by taking moments about the instantaneous centre of the link on which they act.

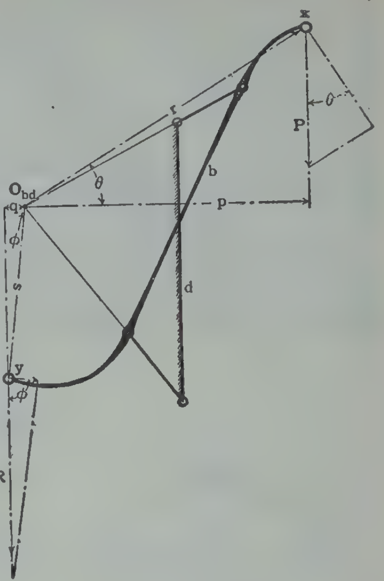

FIG. 126.

The forces P and R may, however, act on different links. The general problem may then be thus stated: Given a mechanism of which r is the fixed link, and s and t any other two links, given also a force f_s acting on the link s, to find the force f_t acting in a given direction on the link t, which will keep the mechanism in static equilibrium. The graphic solution of this problem may be effected thus:—

1. Find the three virtual centres O_{rs}, O_{rt}, O_{st}, which must be three points in a line.
2. Resolve f_s into two components, one of which, namely, f_q, passes through O_{rs}, and may be neglected, and the other f_p passes through O_{st}.
3. Find the point M, where f_p joins the given direction of f_t, and resolve f_p into two components, of which one is in the direction MO_{rt} and may be neglected because it passes through O_{rt}, and the other is in the given direction of f_t and is therefore the force required.

This statement of the problem and the solution is due to Sir A. B. W. Kennedy, and is given in ch. 8 of his *Mechanics of Machinery.* Another general solution of the problem is given in the *Proc. Lond. Math. Soc.* (1878–1879), by the same author. An example of the method of solution stated above, and taken from the *Mechanics of Machinery*, is illustrated by the mechanism fig. 127, which is an epicyclic train of three wheels with the first wheel r fixed. Let it be required to find the vertical force which must act at the pitch radius of the last wheel t to balance exactly a force f_s acting vertically downwards on the arm at the point indicated in the figure. The two links concerned are the last wheel t and the arm s, the wheel r being the fixed link of the mechanism. The virtual centres O_{rs}, O_{st} are at the respective axes of the wheels r and t, and the centre O_{rt} divides the line through these two points externally in the ratio of the train of wheels. The figure sufficiently indicates the various steps of the solution.

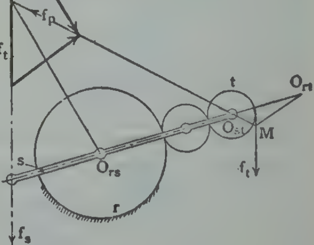

FIG. 127.

The relation between the effort and the resistance in a machine to include the effect of friction at the joints has been investigated in a paper by Professor Fleeming Jenkin, "On the application of graphic methods to the determination of the efficiency of machinery"

(*Trans. Roy. Soc. Ed.*, vol. 28). It is shown that a machine may at any instant be represented by a frame of links the stresses in which are identical with the pressures at the joints of the mechanism. This self-strained frame is called the *dynamic frame* of the machine. The driving and resisting efforts are represented by elastic links in the dynamic frame, and when the frame with its elastic links is drawn the stresses in the several members of it may be determined by means of reciprocal figures. Incidentally the method gives the pressures at every joint of the mechanism.

§ 91. *Efficiency.*—The *efficiency* of a machine is the ratio of the *useful* work to the *total* work—that is, to the energy exerted—and is represented by

$$\frac{\Sigma\,.\,R_u ds'}{\Sigma\,.\,R ds'} = \frac{\Sigma\,.\,R_u ds'}{\Sigma\,.\,R_u ds' + \Sigma\,.\,R_p ds'} = \frac{\Sigma\,.\,R_u ds'}{\Sigma\,.\,P ds} = \frac{U}{E}. \tag{53}$$

R_u being taken to represent useful and R_p prejudicial resistances. The more nearly the efficiency of a machine approaches to unity the better is the machine.

§ 92. *Power and Effect.*—The *power* of a machine is the energy exerted, and the *effect* the useful work performed, in some interval of time of definite length, such as a second, an hour, or a day.

The unit of power, called conventionally a *horse-power*, is 550 foot-pounds per second, or 33,000 foot-pounds per minute, or 1,980,000 foot-pounds per hour.

§ 93. *Modulus of a Machine.*—In the investigation of the properties of a machine, the useful resistances to be overcome and the useful work to be performed are usually given. The prejudicial resistances are generally functions of the useful resistances of the weights of the pieces of the mechanism, and of their form and arrangement; and, having been determined, they serve for the computation of the *lost* work, which, being added to the useful work, gives the expenditure of energy required. The result of this investigation, expressed in the form of an equation between this energy and the useful work, is called by Moseley the *modulus* of the machine. The general form of the modulus may be expressed thus—

$$E = U + \phi(U, A) + \psi(A), \tag{54}$$

where A denotes some quantity or set of quantities depending on the form, arrangement, weight and other properties of the mechanism. Moseley, however, has pointed out that in most cases this equation takes the much more simple form of

$$E = (1 + A)U + B, \tag{55}$$

where A and B are *constants*, depending on the form, arrangement and weight of the mechanism. The efficiency corresponding to the last equation is

$$\frac{U}{E} = \frac{1}{1 + A + B/U}. \tag{56}$$

§ 94. *Trains of Mechanism.*—In applying the preceding principles to a train of mechanism, it may either be treated as a whole, or it may be considered in sections consisting of single pieces, or of any convenient portion of the train—each section being treated as a machine driven by the effort applied to it and energy exerted upon it through its line of connexion with the preceding section, performing useful work by driving the following section, and losing work by overcoming its own prejudicial resistances. It is evident that *the efficiency of the whole train is the product of the efficiencies of its sections.*

§ 95. *Rotating Pieces: Couples of Forces.*—It is often convenient to express the energy exerted upon and the work performed by a turning piece in a machine in terms of the *moment* of the *couples of forces* acting on it, and of the angular velocity. The ordinary British unit of moment is a *foot-pound*; but it is to be remembered that this is a foot-pound of a different sort from the unit of energy and work.

If a force be applied to a turning piece in a line not passing through its axis, the axis will press against its bearings with an equal and parallel force, and the equal and opposite reaction of the bearings will constitute, together with the first-mentioned force, a couple whose arm is the perpendicular distance from the axis to the line of action of the first force.

A couple is said to be *right* or *left handed* with reference to the observer, according to the direction in which it tends to turn the body, and is a *driving* couple or a *resisting* couple according as its tendency is with or against that of the actual rotation.

Let dt be an interval of time, a the angular velocity of the piece; then adt is the angle through which it turns in the interval dt, and $ds = vdt = radt$ is the distance through which the point of application of the force moves. Let P represent an effort, so that Pr is a driving couple, then

$$Pds = Pvdt = Pradt = Madt \tag{57}$$

is the energy exerted by the couple M in the interval dt; and a similar equation gives the work performed in overcoming a resisting couple. When several couples act on one piece, the resultant of their moments is to be multiplied by the common angular velocity of the whole piece.

§ 96. *Reduction of Forces to a given Point, and of Couples to the Axis of a given Piece.*—In computations respecting machines it is often convenient to substitute for a force applied to a given point, or a couple applied to a given piece, the *equivalent* force or couple applied to some other point or piece; that is to say, the force or couple, which, if applied to the other point or piece, would exert equal energy or employ equal work. The principles of this reduction are that the ratio of the given to the equivalent force is the reciprocal of the ratio of the velocities of their points of application, and the ratio of the given to the equivalent couple is the reciprocal of the ratio of the angular velocities of the pieces to which they are applied.

These velocity ratios are known by the construction of the mechanism, and are independent of the absolute speed.

§ 97. *Balanced Lateral Pressure of Guides and Bearings.*—The most important part of the lateral pressure on a piece of mechanism is the reaction of its guides, if it is a sliding piece, or of the bearings of its axis, if it is a turning piece; and the balanced portion of this reaction is equal and opposite to the resultant of all the other forces applied to the piece, its own weight included. There may be or may not be an unbalanced component in this pressure, due to the deviated motion. Its laws will be considered in the sequel.

§ 98. *Friction. Unguents.*—The most important kind of resistance in machines is the *friction* or *rubbing resistance* of surfaces which slide over each other. The *direction* of the resistance of friction is opposite to that in which the sliding takes place. Its *magnitude* is the product of the *normal pressure* or force which presses the rubbing surfaces together in a direction perpendicular to themselves into a specific constant already mentioned in § 14, as the *coefficient of friction*, which depends on the nature and condition of the surfaces of the unguent, if any, with which they are covered. The *total pressure* exerted between the rubbing surfaces is the resultant of the normal pressure and of the friction, and its *obliquity*, or inclination to the common perpendicular of the surfaces, is the *angle of repose* formerly mentioned in § 14, whose tangent is the coefficient of friction. Thus, let N be the normal pressure, R the friction, T the total pressure, f the coefficient of friction, and ϕ the angle of repose; then

$$\left.\begin{array}{c} f = \tan\phi \\ R = fN = N\tan\phi = T\sin\phi \end{array}\right\} \tag{58}$$

Experiments on friction have been made by Coulomb, Samuel Vince, John Rennie, James Wood, D. Rankine and others. The most complete and elaborate experiments are those of Morin, published in his *Notions fondamentales de mécanique*, and republished in Britain in the works of Moseley and Gordon.

The experiments of Beauchamp Tower ("Report of Friction Experiments," *Proc. Inst. Mech. Eng.*, 1883) showed that when oil is supplied to a journal by means of an oil bath the coefficient of friction varies nearly inversely as the load on the bearing, thus making the product of the load on the bearing and the coefficient of friction a constant. Mr Tower's experiments were carried out at nearly constant temperature. The more recent experiments of Lasche (*Zeitsch, Verein Deutsche Ingen.*, 1902, 46, 1881) show that the product of the coefficient of friction, the load on the bearing, and the temperature is approximately constant. For further information on this point and on Osborne Reynolds's theory of lubrication see BEARINGS and LUBRICATION.

§ 99. *Work of Friction. Moment of Friction.*—The work performed in a unit of time in overcoming the friction of a pair of surfaces is the product of the friction by the velocity of sliding of the surfaces over each other, if that is the same throughout the whole extent of the rubbing surfaces. If that velocity is different for different portions of the rubbing surfaces, the velocity of each portion is to be multiplied by the friction of that portion, and the results summed or integrated.

When the relative motion of the rubbing surfaces is one of rotation, the work of friction in a unit of time, for a portion of the rubbing surfaces at a given distance from the axis of rotation, may be found by multiplying together the friction of that portion, its distance from the axis, and the angular velocity. The product of the force of friction by the distance at which it acts from the axis of rotation is called the *moment of friction*. The total moment of friction of a pair of rotating rubbing surfaces is the sum or integral of the moments of friction of their several portions.

To express this symbolically, let du represent the area of a portion of a pair of rubbing surfaces at a distance r from the axis of their relative rotation; p the intensity of the normal pressure at du per unit of area; and f the coefficient of friction. Then the moment of friction of du is $fprdu$;

$$\left.\begin{array}{l} \text{the total moment of friction is } f\int pr.\,du\,; \\ \text{and the work performed in a unit of time in overcoming} \\ \text{friction, when the angular velocity is } a\text{, is } af\int pr.\,du. \end{array}\right\} \tag{59}$$

It is evident that the moment of friction, and the work lost by being performed in overcoming friction, are less in a rotating piece as the bearings are of smaller radius. But a limit is put to the diminution of the radii of journals and pivots by the conditions of durability and of proper lubrication, and also by conditions of strength and stiffness.

§ 100. *Total Pressure between Journal and Bearing.*—A single piece rotating with a uniform velocity has four mutually balanced forces applied to it: (1) the effort exerted on it by the piece which drives it; (2) the resistance of the piece which follows it—which may be considered for the purposes of the present question as useful resistance; (3) its weight; and (4) the reaction of its own cylindrical bearings. There are given the following data:—

The direction of the effort.
The direction of the useful resistance.
The weight of the piece and the direction in which it acts.
The magnitude of the useful resistance.
The radius of the bearing *r*.
The angle of repose ϕ, corresponding to the friction of the journal on the bearing.

And there are required the following:—
The direction of the reaction of the bearing.
The magnitude of that reaction.
The magnitude of the effort.

Let the useful resistance and the weight of the piece be compounded by the principles of statics into one force, and let this be called *the given force*.

The directions of the effort and of the given force are either parallel or meet in a point. If they are parallel, the direction of the reaction of the bearing is also parallel to them; if they meet in a point, the direction of the reaction traverses the same point.

Also, let AAA, fig. 128, be a section of the bearing, and C its axis; then the direction of the reaction, at the point where it intersects the circle AAA, must make the angle ϕ with the radius of that circle; that is to say, it must be a line such as PT touching the smaller circle BB, whose radius is $r.\ \sin\phi$. The side on which it touches that circle is determined by the fact that the obliquity of the reaction is such as to oppose the rotation.

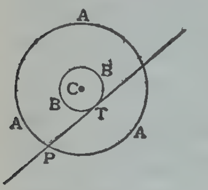

FIG. 128.

Thus is determined the direction of the reaction of the bearing; and the magnitude of that reaction and of the effort are then found by the principles of the equilibrium of three forces already stated in § 7.

The work lost in overcoming the friction of the bearing is the same as that which would be performed in overcoming at the circumference of the small circle BB a resistance equal to the whole pressure between the journal and bearing.

In order to diminish that pressure to the smallest possible amount, the effort, and the resultant of the useful resistance, and the weight of the piece (called above the "given force") ought to be opposed to each other as directly as is practicable consistently with the purposes of the machine.

An investigation of the forces acting on a bearing and journal lubricated by an oil bath will be found in a paper by Osborne Reynolds in the *Phil. Trans.*, pt. i. (1886). (See also BEARINGS.)

§ 101. *Friction of Pivots and Collars.*—When a shaft is acted upon by a force tending to shift it lengthways, that force must be balanced by the reaction of a bearing against a *pivot* at the end of the shaft; or, if that be impossible, against one or more *collars*, or rings *projecting* from the body of the shaft. The bearing of the pivot is called a *step* or *footstep*. Pivots require great hardness, and are usually made of steel. The *flat* pivot is a cylinder of steel having a plane circular end as a rubbing surface. Let N be the total pressure sustained by a flat pivot of the radius *r*; if that pressure be uniformly distributed, which is the case when the rubbing surfaces of the pivot and its step are both true planes, the *intensity* of the pressure is

$$p = \mathrm{N}/\pi r^2; \qquad (60)$$

and, introducing this value into equation 59, the *moment of friction of the flat pivot* is found to be

$$\tfrac{2}{3}f\mathrm{N}r \qquad (61)$$

or two-thirds of that of a cylindrical journal of the same radius under the same normal pressure.

The friction of a *conical* pivot exceeds that of a flat pivot of the same radius, and under the same pressure, in the proportion of the side of the cone to the radius of its base.

The moment of friction of a *collar* is given by the formula—

$$\tfrac{2}{3}f\mathrm{N}\frac{r^3 - r'^3}{r^2 - r'^2}, \qquad (62)$$

where *r* is the external and *r′* the internal radius.

In the *cup and ball* pivot the end of the shaft and the step present two recesses facing each other, into which are fitted two shallow cups of steel or hard bronze. Between the concave spherical surfaces of those cups is placed a steel ball, being either a complete sphere or a lens having convex surfaces of a somewhat less radius than the concave surfaces of the cups. The moment of friction of this pivot is at first almost inappreciable from the extreme smallness of the radius of the circles of contact of the ball and cups, but, as they wear, that radius and the moment of friction increase.

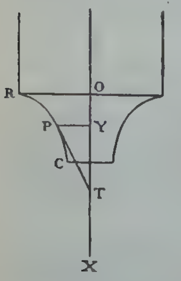

FIG. 129.

It appears that the rapidity with which a rubbing surface wears away is proportional to the friction and to the velocity jointly, or nearly so. Hence the pivots already mentioned wear unequally at different points, and tend to alter their figures. Schiele has invented a pivot which preserves its original figure by wearing equally at all points in a direction parallel to its axis. The following are the principles on which this equality of wear depends:—

The rapidity of wear of a surface measured in an *oblique* direction is to the rapidity of wear measured normally as the secant of the obliquity is to unity. Let OX (fig. 129) be the axis of a pivot, and let RPC be a portion of a curve such that at any point P the secant of the obliquity to the normal of the curve of a line parallel to the axis is inversely proportional to the ordinate PY, to which the velocity of P is proportional. The rotation of that curve round OX will generate the form of pivot required. Now let PT be a tangent to the curve at P, cutting OX in T; PT = PY × *secant obliquity*, and this is to be a constant quantity; hence the curve is that known as the *tractory* of the straight line OX, in which PT = OR = constant. This curve is described by having a fixed straight edge parallel to OX, along which slides a slider carrying a pin whose centre is T. On that pin turns an arm, carrying at a point P a tracing-point, pencil or pen. Should the pen have a nib of two jaws, like those of an ordinary drawing-pen, the plane of the jaws must pass through PT. Then, while T is slid along the axis from O towards X, P will be drawn after it from R towards C along the tractory. This curve, being an asymptote to its axis, is capable of being indefinitely prolonged towards X; but in designing pivots it should stop before the angle PTY becomes less than the angle of repose of the rubbing surfaces, otherwise the pivot will be liable to stick in its bearing. The moment of friction of "Schiele's anti-friction pivot," as it is called, is equal to that of a cylindrical journal of the radius OR = PT the constant tangent, under the same pressure.

Records of experiments on the friction of a pivot bearing will be found in the *Proc. Inst. Mech. Eng.* (1891), and on the friction of a collar bearing *ib.* May 1888.

§ 102. *Friction of Teeth.*—Let N be the normal pressure exerted between a pair of teeth of a pair of wheels; *s* the total distance through which they slide upon each other; *n* the number of pairs of teeth which pass the plane of axis in a unit of time; then

$$nf\mathrm{N}s \qquad (63)$$

is the work lost in unity of time by the friction of the teeth. The sliding *s* is composed of two parts, which take place during the approach and recess respectively. Let those be denoted by s_1 and s_2, so that $s = s_1 + s_2$. In § 45 the *velocity* of sliding at any instant has been given, viz. $u = c\cdot(\alpha_1 + \alpha_2)$, where *u* is that velocity, *c* the distance TI at any instant from the point of contact of the teeth to the pitch-point, and α_1, α_2 the respective angular velocities of the wheels.

Let *v* be the common velocity of the two pitch-circles, r_1, r_2, their radii; then the above equation becomes

$$u = cv\left(\frac{1}{r_1} + \frac{1}{r_2}\right).$$

To apply this to involute teeth, let c_1 be the length of the approach, c_2 that of the recess, u_1, the *mean* volocity of sliding during the approach, u_2 that during the recess; then

$$u_1 = \frac{c_1 v}{2}\left(\frac{1}{r_1} + \frac{1}{r_2}\right); \quad u_2 = \frac{c_2 v}{2}\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$

also, let θ be the obliquity of the action; then the times occupied by the approach and recess are respectively

$$\frac{c_1}{v\cos\theta}, \quad \frac{c_2}{v\cos\theta};$$

giving, finally, for the length of sliding between each pair of teeth,

$$s = s_1 + s_2 = \frac{c_1{}^2 + c_2{}^2}{2\cos\theta}\left(\frac{1}{r_1} + \frac{1}{r_2}\right) \qquad (64)$$

which, substituted in equation (63), gives the work lost in a unit of time by the friction of involute teeth. This result, which is exact for involute teeth, is approximately true for teeth of any figure.

For inside gearing, if r_1 be the less radius and r_2 the greater, $\frac{1}{r_1} - \frac{1}{r_2}$ is to be substituted for $\frac{1}{r_1} + \frac{1}{r_2}$.

§ 103. *Friction of Cords and Belts.*—A flexible band, such as a cord, rope, belt or strap, may be used either to exert an effort or a resistance upon a pulley round which it wraps. In either case the tangential force, whether effort or resistance, exerted between the band and the pulley is their mutual friction, caused by and proportional to the normal pressure between them.

Let T_1 be the tension of the free part of the band at that side *towards* which it tends to draw the pulley, or *from* which the pulley tends to draw it; T_2 the tension of the free part at the other side; T the tension of the band at any intermediate point of its arc of contact with the pulley; θ the ratio of the length of that arc to the radius of the pulley; $d\theta$ the ratio of an indefinitely small element of that arc to the radius; $\mathrm{F} = \mathrm{T}_1 - \mathrm{T}_2$ the total friction between the band and the pulley; $d\mathrm{F}$ the elementary portion of that friction due to the elementary arc $d\theta$; *f* the coefficient of friction between the materials of the band and pulley.

Then, according to a well-known principle in statics, the normal pressure at the elementary arc $d\theta$ is $\mathrm{T}d\theta$, T being the mean tension of the band at that elementary arc; consequently the friction on that arc is $d\mathrm{F} = f\mathrm{T}d\theta$. Now that friction is also the difference between the tensions of the band at the two ends of the elementary arc, or $dT = dF = fTd\theta$; which equation, being integrated throughout the entire arc of contact, gives the following formulae:—

$$\left.\begin{array}{l} \text{hyp log.}\ \dfrac{T_1}{T_2} = f\theta \\ \dfrac{T_1}{T_2} = e^{f\theta} \\ F = T_1 - T_2 = T_1(1 - e^{-f\theta}) = T_2(e^{f\theta} - 1) \end{array}\right\} \quad (65)$$

When a belt connecting a pair of pulleys has the tensions of its two sides originally equal, the pulleys being at rest, and when the pulleys are next set in motion, so that one of them drives the other by means of the belt, it is found that the advancing side of the belt is exactly as much tightened as the returning side is slackened, so that the *mean* tension remains unchanged. Its value is given by this formula—

$$\frac{T_1 + T_2}{2} = \frac{e^{f\theta} + 1}{2(e^{f\theta} - 1)} \quad (66)$$

which is useful in determining the original tension required to enable a belt to transmit a given force between two pulleys.

The equations 65 and 66 are applicable to a kind of *brake* called a *friction-strap*, used to stop or moderate the velocity of machines by being tightened round a pulley. The strap is usually of iron, and the pulley of hard wood.

Let a denote the arc of contact expressed in *turns and fractions of a turn*; then

$$\left.\begin{array}{r} \theta = 6{\cdot}2832a \\ e^{f\theta} = \text{number whose common logarithm is } 2{\cdot}7288fa \end{array}\right\} \quad (67)$$

See also DYNAMOMETER for illustrations of the use of what are essentially friction-straps of different forms for the measurement of the brake horse-power of an engine or motor.

§ 104. *Stiffness of Ropes.*—Ropes offer a resistance to being bent, and, when bent, to being straightened again, which arises from the mutual friction of their fibres. It increases with the sectional area of the rope, and is inversely proportional to the radius of the curve into which it is bent.

The *work lost* in pulling a given length of rope over a pulley is found by multiplying the length of the rope in feet by its stiffness in pounds, that stiffness being the excess of the tension at the leading side of the rope above that at the following side, which is necessary to bend it into a curve fitting the pulley, and then to straighten it again.

The following empirical formulae for the stiffness of hempen ropes have been deduced by Morin from the experiments of Coulomb:—

Let F be the stiffness in pounds avoirdupois; d the diameter of the rope in inches, $n = 48d^2$ for white ropes and $35d^2$ for tarred ropes; r the *effective* radius of the pulley in inches; T the tension in pounds. Then

$$\left.\begin{array}{l} \text{For white ropes, } F = \dfrac{n}{r}(0{\cdot}0012 + 0{\cdot}001026n + 0{\cdot}0012T \\ \text{For tarred ropes, } F = \dfrac{n}{r}(0{\cdot}006 + 0{\cdot}001392n + 0{\cdot}00168T \end{array}\right\} \quad (68)$$

§ 105. *Friction-Couplings.*—Friction is useful as a means of communicating motion where sudden changes either of force or velocity take place, because, being limited in amount, it may be so adjusted as to limit the forces which strain the pieces of the mechanism within the bounds of safety. Amongst contrivances for effecting this object are *friction-cones.* A rotating shaft carries upon a cylindrical portion of its figure a wheel or pulley turning loosely on it, and consequently capable of remaining at rest when the shaft is in motion. This pulley has fixed to one side, and concentric with it, a short frustum of a hollow cone. At a small distance from the pulley the shaft carries a short frustum of a solid cone accurately turned to fit the hollow cone. This frustum is made always to turn along with the shaft by being fitted on a square portion of it, or by means of a rib and groove, or otherwise, but is capable of a slight longitudinal motion, so as to be pressed into, or withdrawn from, the hollow cone by means of a lever. When the cones are pressed together or engaged, their friction causes the pulley to rotate along with the shaft; when they are disengaged, the pulley is free to stand still. The angle made by the sides of the cones with the axis should not be less than the angle of repose. In the *friction-clutch*, a pulley loose on a shaft has a hoop or gland made to embrace it more or less tightly by means of a screw; this hoop has short projecting arms or ears. A fork or *clutch* rotates along with the shaft, and is capable of being moved longitudinally by a handle. When the clutch is moved towards the hoop, its arms catch those of the hoop, and cause the hoop to rotate and to communicate its rotation to the pulley by friction. There are many other contrivances of the same class, but the two just mentioned may serve for examples.

§ 106. *Heat of Friction: Unguents.*—The work lost in friction is employed in producing heat. This fact is very obvious, and has been known from a remote period; but the *exact* determination of the proportion of the work lost to the heat produced, and the experimental proof that that proportion is the same under all circumstances and with all materials, solid, liquid and gaseous, are comparatively recent achievements of J. P. Joule. The quantity of work which produces a British unit of heat (or so much heat as elevates the temperature of one pound of pure water, at or near ordinary atmospheric temperatures, by 1° F.) is 772 foot-pounds. This constant, now designated as "Joule's equivalent," is the principal experimental datum of the science of thermodynamics.

A more recent determination (*Phil. Trans.*, 1897), by Osborne Reynolds and W. M. Moorby, gives 778 as the mean value of Joule's equivalent through the range of 32° to 212° F. See also the papers of Rowland in the *Proc. Amer. Acad.* (1879), and Griffiths, *Phil. Trans.* (1893).

The heat produced by friction, when moderate in amount, is useful in softening and liquefying thick unguents; but when excessive it is prejudicial, by decomposing the unguents, and sometimes even by softening the metal of the bearings, and raising their temperature so high as to set fire to neighbouring combustible matters.

Excessive heating is prevented by a constant and copious supply of a good unguent. The elevation of temperature produced by the friction of a journal is sometimes used as an experimental test of the quality of unguents. For modern methods of forced lubrication see BEARINGS.

§ 107. *Rolling Resistance.*—By the rolling of two surfaces over each other without sliding a resistance is caused which is called sometimes "rolling friction," but more correctly *rolling resistance.* It is of the nature of a *couple*, resisting rotation. Its *moment* is found by multiplying the normal pressure between the rolling surfaces by an *arm*, whose length depends on the nature of the rolling surfaces, and the work lost in a unit of time in overcoming it is the product of its moment by the *angular velocity* of the rolling surfaces relatively to each other. The following are approximate values of the arm in decimals of a foot:—

Oak upon oak	0·006 (Coulomb).
Lignum vitae on oak	0·004 "
Cast iron on cast iron	0·002 (Tredgold).

§ 108. *Reciprocating Forces: Stored and Restored Energy.*—When a force acts on a machine alternately as an effort and as a resistance, it may be called a *reciprocating force.* Of this kind is the weight of any piece in the mechanism whose centre of gravity alternately rises and falls; for during the rise of the centre of gravity that weight acts as a resistance, and energy is employed in lifting it to an amount expressed by the product of the weight into the vertical height of its rise; and during the fall of the centre of gravity the weight acts as an effort, and exerts in assisting to perform the work of the machine an amount of energy exactly equal to that which had previously been employed in lifting it. Thus that amount of energy is not lost, but has its operation deferred; and it is said to be *stored* when the weight is lifted, and *restored* when it falls.

In a machine of which each piece is to move with a uniform velocity, if the effort and the resistance be constant, the weight of each piece must be balanced on its axis, so that it may produce lateral pressure only, and not act as a reciprocating force. But if the effort and the resistance be alternately in excess, the uniformity of speed may still be preserved by so adjusting some moving weight in the mechanism that when the effort is in excess it may be lifted, and so balance and employ the excess of effort, and that when the resistance is in excess it may fall, and so balance and overcome the excess of resistance—thus *storing* the periodical excess of energy and *restoring* that energy to perform the periodical excess of work.

Other forces besides gravity may be used as reciprocating forces for storing and restoring energy—for example, the elasticity of a spring or of a mass of air.

In most of the delusive machines commonly called "perpetual motions," of which so many are patented in each year, and which are expected by their inventors to perform work without receiving energy, the fundamental fallacy consists in an expectation that some reciprocating force shall restore more energy than it has been the means of storing.

Division 2. Deflecting Forces.

§ 109. *Deflecting Force for Translation in a Curved Path.*—In machinery, deflecting force is supplied by the tenacity of some piece, such as a crank, which guides the deflected body in its curved path, and is *unbalanced*, being employed in producing deflexion, and not in balancing another force.

§ 110. *Centrifugal Force of a Rotating Body.—The centrifugal force exerted by a rotating body on its axis of rotation is the same in magnitude as if the mass of the body were concentrated at its centre of gravity, and acts in a plane passing through the axis of rotation and the centre of gravity of the body.*

The particles of a rotating body exert centrifugal forces on each other, which strain the body, and tend to tear it asunder, but these forces balance each other, and do not affect the resultant centrifugal force exerted on the axis of rotation.[1]

If the axis of rotation traverses the centre of gravity of the body, the centrifugal force exerted on that axis is nothing.

Hence, unless there be some reason to the contrary, each piece of a machine should be balanced on its axis of rotation; otherwise the centrifugal force will cause strains, vibration and increased friction, and a tendency of the shafts to jump out of their bearings.

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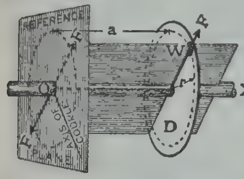
[1] This is a particular case of a more general principle, that *the motion of the centre of gravity of a body is not affected by the mutual actions of its parts.*

§ 111. *Centrifugal Couples of a Rotating Body.*—Besides the tendency (if any) of the combined centrifugal forces of the particles of a rotating body to *shift* the axis of rotation, they may also tend to *turn* it out of its original direction. The latter tendency is called *a centrifugal couple*, and vanishes for rotation about a principal axis.

It is essential to the steady motion of every rapidly rotating piece in a machine that its axis of rotation should not merely traverse its centre of gravity, but should be a permanent axis; for otherwise the centrifugal couples will increase friction, produce oscillation of the shaft and tend to make it leave its bearings.

The principles of this and the preceding section are those which regulate the adjustment of the weight and position of the *counterpoises* which are placed between the spokes of the driving-wheels of locomotive engines.



(From *Balancing of Engines*, by permission of Edward Arnold.)

FIG. 130.

§ 112.* *Method of computing the position and magnitudes of balance weights which must be added to a given system of arbitrarily chosen rotating masses in order to make the common axis of rotation a permanent axis.*—The method here briefly explained is taken from a paper by W. E. Dalby, "The Balancing of Engines with special reference to Marine Work," *Trans. Inst. Nav. Arch.* (1899). Let the weight (fig. 130), attached to a truly turned disk, be rotated by the shaft OX, and conceive that the shaft is held in a bearing at one point, O. The force required to constrain the weight to move in a circle, that is the deviating force, produces an equal and opposite reaction on the shaft, whose amount F is equal to the centrifugal force $W\alpha^2 r/g$ lb, where r is the radius of the mass centre of the weight, and α is its angular velocity in radians per second. Transferring this force to the point O, it is equivalent to, (1) a force at O equal and parallel to F, and, (2) a centrifugal couple of Fa foot-pounds. In order that OX may be a permanent axis it is necessary that there should be a sufficient number of weights attached to the shaft and so distributed that when each is referred to the point O

$$\left.\begin{array}{ll}(1)\ \Sigma F & =0\\ (2)\ \Sigma Fa & =0\end{array}\right\}\qquad (a)$$

The plane through O to which the shaft is perpendicular is called the *reference plane*, because all the transferred forces act in that plane at the point O. The plane through the radius of the weight containing the axis OX is called the *axial plane* because it contains the forces forming the couple due to the transference of F to the reference plane. Substituting the values of F in (*a*) the two conditions become

$$\begin{array}{ll}(1)\ (W_1r_1+W_2r_2+W_3r_3+\ldots)\dfrac{\alpha^2}{g}=0 & \\ & (b)\\ (2)\ (W_1a_1r_1+W_2a_2r_2+\ldots)\dfrac{\alpha^2}{g}=0 & \end{array}$$

In order that these conditions may obtain, the quantities in the brackets must be zero, since the factor α^2/g is not zero. Hence finally the conditions which must be satisfied by the system of weights in order that the axis of rotation may be a permanent axis is

$$\begin{array}{l}(1)\ (W_1r_1+W_2r_2+W_3r_3)=0\\ (2)\ (W_1a_1r_1+W_2a_2r_2+)=0\end{array}\qquad (c)$$

It must be remembered that these are all directed quantities, and that their respective sums are to be taken by drawing vector polygons. In drawing these polygons the magnitude of the vector of the type Wr is the product Wr, and the direction of the vector is from the shaft outwards towards the weight W, parallel to the radius r. For the vector representing a couple of the type War, if the masses are all on the same side of the reference plane, the direction of drawing is from the axis outwards; if the masses are some on one side of the reference plane and some on the other side, the direction of drawing is from the axis outwards towards the weight for all masses on the one side, and from the mass inwards towards the axis for all weights on the other side, drawing always parallel to the direction defined by the radius r. The magnitude of the vector is the product War. The conditions (*c*) may thus be expressed: first, that the sum of the vectors Wr must form a closed polygon, and, second, that the sum of the vectors War must form a closed polygon. The general problem in practice is, given a system of weights attached to a shaft, to find the respective weights and positions of two balance weights or counterpoises which must be added to the system in order to make the shaft a permanent axis, the planes in which the balance weights are to revolve also being given. To solve this the reference plane must be chosen so that it coincides with the plane of revolution of one of the as yet unknown balance weights. The balance weight in this plane has therefore no couple corresponding to it. Hence by drawing a couple polygon for the given weights the vector which is required to close the polygon is at once found and from it the magnitude and position of the balance weight which must be added to the system to balance the couples follow at once. Then, transferring the product Wr corresponding with this balance weight to the reference plane, proceed to draw the force polygon. The vector required to close it will determine the second balance weight, the work may be checked by taking the reference plane to coincide with the plane of revolution of the second balance weight and then re-determining them, or by taking a reference plane anywhere and including the two balance weights trying if condition (*c*) is satisfied.

When a weight is reciprocated, the equal and opposite force required for its acceleration at any instant appears as an unbalanced force on the frame of the machine to which the weight belongs. In the particular case where the motion is of the kind known as "simple harmonic" the disturbing force on the frame due to the reciprocation of the weight is equal to the component of the centrifugal force in the line of stroke due to a weight equal to the reciprocated weight supposed concentrated at the crank pin. Using this principle the method of finding the balance weights to be added to a given system of reciprocating weights in order to produce a system of forces on the frame continuously in equilibrium is exactly the same as that just explained for a system of revolving weights, because for the purpose of finding the balance weights each reciprocating weight may be supposed attached to the crank pin which operates it, thus forming an equivalent revolving system. The balance weights found as part of the equivalent revolving system when reciprocated by their respective crank pins form the balance weights for the given reciprocating system. These conditions may be exactly realized by a system of weights reciprocated by slotted bars, the crank shaft driving the slotted bars rotating uniformly. In practice reciprocation is usually effected through a connecting rod, as in the case of steam engines. In balancing the mechanism of a steam engine it is often sufficiently accurate to consider the motion of the pistons as simple harmonic, and the effect on the framework of the acceleration of the connecting rod may be approximately allowed for by distributing the weight of the rod between the crank pin and the piston inversely as the centre of gravity of the rod divides the distance between the centre of the cross head pin and the centre of the crank pin. The moving parts of the engine are then divided into two complete and independent systems, namely, one system of revolving weights consisting of crank pins, crank arms, &c., attached to and revolving with the crank shaft, and a second system of reciprocating weights consisting of the pistons, cross-heads, &c., supposed to be moving each in its line of stroke with simple harmonic motion. The balance weights are to be separately calculated for each system, the one set being added to the crank shaft as revolving weights, and the second set being included with the reciprocating weights and operated by a properly placed crank on the crank shaft. Balance weights added in this way to a set of reciprocating weights are sometimes called bob-weights. In the case of locomotives the balance weights required to balance the pistons are added as revolving weights to the crank shaft system, and in fact are generally combined with the weights required to balance the revolving system so as to form one weight, the counterpoise referred to in the preceding section, which is seen between the spokes of the wheels of a locomotive. Although this method balances the pistons in the horizontal plane, and thus allows the pull of the engine on the train to be exerted without the variation due to the reciprocation of the pistons, yet the force balanced horizontally is introduced vertically and appears as a variation of pressure on the rail. In practice about two-thirds of the reciprocating weight is balanced in order to keep this variation of rail pressure within safe limits. The assumption that the pistons of an engine move with simple harmonic motion is increasingly erroneous as the ratio of the length of the crank r, to the length of the connecting rod l increases. A more accurate though still approximate expression for the force on the frame due to the acceleration of the piston whose weight is W is given by

$$\frac{W}{g}\,\omega^2 r\left\{\cos\theta+\frac{r}{l}\cos 2\theta\right\}$$

The conditions regulating the balancing of a system of weights reciprocating under the action of accelerating forces given by the above expression are investigated in a paper by Otto Schlick, "On Balancing of Steam Engines," *Trans. Inst. Nav. Arch.* (1900), and in a paper by W. E. Dalby, "On the Balancing of the Reciprocating Parts of Engines, including the Effect of the Connecting Rod" (*ibid.*, 1901). A still more accurate expression than the above is obtained by expansion in a Fourier series, regarding which and its bearing on balancing engines see a paper by J. H. Macalpine, "A Solution of the Vibration Problem" (*ibid.*, 1901). The whole subject is dealt with in a treatise, *The Balancing of Engines*, by W. E. Dalby (London, 1906). Most of the original papers on this subject of engine balancing are to be found in the *Transactions* of the Institution of Naval Architects.

§ 113.* *Centrifugal Whirling of Shafts.*—When a system of revolving masses is balanced so that the conditions of the preceding section are fulfilled, the centre of gravity of the system lies on the axis of revolution. If there is the slightest displacement of the centre of gravity of the system from the axis of revolution a force acts on the shaft tending to deflect it, and varies as the deflexion and as the square of the speed. If the shaft is therefore to revolve stably, this force must be balanced at any instant by the elastic resistance of the shaft to deflexion. To take a simple case, suppose a shaft, supported on two bearings to carry a disk of weight W at its centre, and let the centre of gravity of the disk be at a distance e from the axis of rotation, this small distance being due to imperfections of material or faulty construction. Neglecting the mass of the shaft itself, when the shaft rotates with an angular velocity a, the centrifugal force $\mathrm{W}a^2e/g$ will act upon the shaft and cause its axis to deflect from the axis of rotation a distance, y say. The elastic resistance evoked by this deflexion is proportional to the deflexion, so that if c is a constant depending upon the form, material and method of support of the shaft, the following equality must hold if the shaft is to rotate stably at the stated speed—

$$\frac{\mathrm{W}}{g}(y+e)a^2 \doteq cy,$$

from which $y=\mathrm{W}a^2e/(gc-\mathrm{W}a^2)$.

This expression shows that as a increases y increases until when $\mathrm{W}a^2=gc$, y becomes infinitely large. The corresponding value of a, namely $\sqrt{gc/\mathrm{W}}$, is called the *critical velocity* of the shaft, and is the speed at which the shaft ceases to rotate stably and at which centrifugal whirling begins. The general problem is to find the value of a corresponding to all kinds of loadings on shafts supported in any manner. The question was investigated by Rankine in an article in the *Engineer* (April 9, 1869). Professor A. G. Greenhill treated the problem of the centrifugal whirling of an unloaded shaft with different supporting conditions in a paper "On the Strength of Shafting exposed both to torsion and to end thrust," *Proc. Inst. Mech. Eng.* (1883). Professor S. Dunkerley ("On the Whirling and Vibration of Shafts," *Phil. Trans.*, 1894) investigated the question for the cases of loaded and unloaded shafts, and, owing to the complication arising from the application of the general theory to the cases of loaded shafts, devised empirical formulae for the critical speeds of shafts loaded with heavy pulleys, based generally upon the following assumption, which is stated for the case of a shaft carrying one pulley: If N_1, N_2 be the separate speeds of whirl of the shaft and pulley on the assumption that the effect of one is neglected when that of the other is under consideration, then the resulting speed of whirl due to both causes combined may be taken to be of the form $\mathrm{N}_1\mathrm{N}_2\sqrt{(\mathrm{N}^2_1+\mathrm{N}_2{}^2)}$ where N means revolutions per minute. This form is extended to include the cases of several pulleys on the same shaft. The interesting and important part of the investigation is that a number of experiments were made on small shafts arranged in different ways and loaded in different ways, and the speed at which whirling actually occurred was compared with the speed calculated from formulae of the general type indicated above. The agreement between the observed and calculated values of the critical speeds was in most cases quite remarkable. In a paper by Dr C. Chree, "The Whirling and Transverse Vibrations of Rotating Shafts," *Proc. Phys. Soc. Lon.*, vol. 19 (1904); also *Phil. Mag.*, vol. 7 (1904), the question is investigated from a new mathematical point of view, and expressions for the whirling of loaded shafts are obtained without the necessity of any assumption of the kind stated above. An elementary presentation of the problem from a practical point of view will be found in *Steam Turbines*, by Dr A. Stodola (London, 1905).

§ 114. *Revolving Pendulum. Governors.*—In fig. 131 AO represents an upright axis or spindle; B a weight called a *bob*, suspended by rod OB from a horizontal axis at O, carried by the vertical axis. When the spindle is at rest the bob hangs close to it; when the spindle rotates, the bob, being made to revolve round it, diverges until the resultant of the centrifugal force and the weight of the bob is a force acting at O in the direction OB, and then it revolves steadily in a circle. This combination is called a *revolving, centrifugal,* or *conical pendulum.* Revolving pendulums are usually constructed with *pairs* of rods and bobs, as OB, Ob, hung at opposite sides of the spindle, that the centrifugal forces exerted at the point O may balance each other.

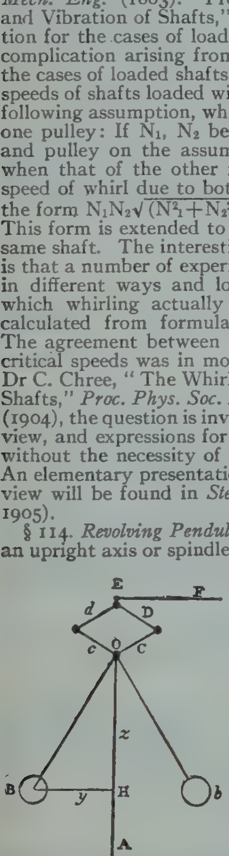


FIG. 131.

In finding the position in which the bob will revolve with a given angular velocity, a, for most practical cases connected with machinery the mass of the rod may be considered as insensible compared with that of the bob. Let the bob be a sphere, and from the centre of that sphere draw $\mathrm{BH}=y$ perpendicular to OA. Let $\mathrm{OH}=z$; let W be the weight of the bob, F its centrifugal force. Then the condition of its steady revolution is $\mathrm{W}:\mathrm{F}::z:y$; that is to say, $y/z=\mathrm{F}/\mathrm{W}=ya^2/g$; consequently

$$z=g/a^2 \tag{69}$$

Or, if $n=a/2\pi=a/6\cdot2832$ be the number of turns or fractions of a turn in a second,

$$\left.=\frac{g}{4\pi^2n^2}=\frac{0\cdot8165\text{ ft.}}{n^2}=\frac{9\cdot79771\text{ in.}}{n^2}\right\} \tag{70}$$

z is called the *altitude of the pendulum.*

If the rod of a revolving pendulum be jointed, as in fig. 132, not to a point in the vertical axis, but to the end of a projecting arm C, the position in which the bob will revolve will be the same as if the rod were jointed to the point O, where its prolongation cuts the vertical axis.

A revolving pendulum is an essential part of most of the contrivances called *governors*, for regulating the speed of prime movers, for further particulars of which see STEAM ENGINE.

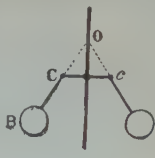


FIG. 132.

Division 3. Working of Machines of Varying Velocity.

§ 115. *General Principles.*—In order that the velocity of every piece of a machine may be uniform, it is necessary that the forces acting on each piece should be always exactly balanced. Also, in order that the forces acting on each piece of a machine may be always exactly balanced, it is necessary that the velocity of that piece should be uniform.

An excess of the effort exerted on any piece, above that which is necessary to balance the resistance, is accompanied with acceleration; a deficiency of the effort, with retardation.

When a machine is being started from a state of rest, and brought by degrees up to its proper speed, the effort must be in excess; when it is being retarded for the purpose of stopping it, the resistance must be in excess.

An excess of effort above resistance involves an excess of energy exerted above work performed; that excess of energy is employed in producing acceleration.

An excess of resistance above effort involves an excess of work performed above energy expended; that excess of work is performed by means of the retardation of the machinery.

When a machine undergoes alternate acceleration and retardation, so that at certain instants of time, occurring at the end of intervals called *periods* or *cycles*, it returns to its original speed, then in each of those periods or cycles the alternate excesses of energy and of work neutralize each other; and at the end of each cycle the principle of the equality of energy and work stated in § 87, with all its consequences, is verified exactly as in the case of machines of uniform speed.

At intermediate instants, however, other principles have also to be taken into account, which are deduced from the second law of motion, as applied to *direct deviation*, or acceleration and retardation.

§ 116. *Energy of Acceleration and Work of Retardation for a Shifting Body.*—Let w be the weight of a body which has a motion of translation in any path, and in the course of the interval of time Δt let its velocity be increased at a uniform rate of acceleration from v_1 to v_2. The rate of acceleration will be

$$dv/dt=\text{const.}=(v_2-v_1)\,\Delta t;$$

and to produce this acceleration a uniform effort will be required, expressed by

$$\mathrm{P}=w(v_2-v_1)g\Delta t \tag{71}$$

(The product wv/g of the mass of a body by its velocity is called its *momentum*; so that the effort required is found by dividing the increase of momentum by the time in which it is produced.)

To find the *energy* which has to be exerted to produce the acceleration from v_1 to v_2, it is to be observed that the *distance* through which the effort P acts during the acceleration is

$$\Delta s=(v_2+v_1)\Delta t/2;$$

consequently, the *energy of acceleration* is

$$\mathrm{P}\Delta s=w(v_2-v_1)(v_2+v_1)/2g=w(v_2{}^2-v_1{}^2)2g, \tag{72}$$

being proportional to the increase in the square of the velocity, and *independent of the time.*

In order to produce a *retardation* from the greater velocity v_2 to the less velocity v_1, it is necessary to apply to the body a *resistance* connected with the retardation and the time by an equation identical in every respect with equation (71), except by the substitution of a resistance for an effort; and in overcoming that resistance the body *performs work* to an amount determined by equation (72), putting Rds for Pas.

§ 117. *Energy Stored and Restored by Deviations of Velocity.*—Thus a body alternately accelerated and retarded, so as to be brought back to its original speed, performs work during its retardation exactly equal in amount to the energy exerted upon it during its acceleration; so that that energy may be considered as *stored* during the acceleration, and *restored* during the retardation. in a manner analogous to the operation of a reciprocating force (§ 108).

Let there be given the mean velocity $\mathrm{V}=\frac{1}{2}(v_2+v_1)$ of a body whose weight is w, and let it be required to determine the fluctuation of velocity v_2-v_1, and the extreme velocities v_1, v_2, which that body must have, in order alternately to store and restore an amount of energy E. By equation (72) we have

$$\mathrm{E}=w(v_2{}^2-v_1{}^2)/2g$$

which, being divided by $\mathrm{V}=\frac{1}{2}(v_2+v_1)$, gives

$$\mathrm{E}/\mathrm{V}=w(v_2-v_1)/g;$$

and consequently

$$v_2-v_1=g\mathrm{E}/\mathrm{V}w \tag{73}$$

The ratio of this fluctuation to the mean velocity, sometimes called the *unsteadiness* of the motion of the body, is

$$(v_2-v_1)\mathrm{V}=g\mathrm{E}/\mathrm{V}^2w. \tag{74}$$

§ 118. *Actual Energy of a Shifting Body.*—The energy which must be exerted on a body of the weight w, to accelerate it from a state of rest up to a given velocity of translation v, and the equal amount of work which that body is capable of performing by overcoming resistance while being retarded from the same velocity of translation v to a state of rest, is

$$wv^2/2g. \tag{75}$$

This is called the *actual energy* of the motion of the body, and is half the quantity which in some treatises is called *vis viva.*

The energy stored or restored, as the case may be, by the deviations of velocity of a body or a system of bodies, is the amount by which the actual energy is increased or diminished.

§ 119. *Principle of the Conservation of Energy in Machines.*—The following principle, expressing the general law of the action of machines with a velocity uniform or varying, includes the law of the equality of energy and work stated in § 89 for machines of uniform speed.

In any given interval during the working of a machine, the energy exerted added to the energy restored is equal to the energy stored added to the work performed.

§ 120. *Actual Energy of Circular Translation—Moment of Inertia.*—Let a small body of the weight w undergo translation in a circular path of the radius ρ, with the angular velocity of deflexion α, so that the common linear velocity of all its particles is $v=\alpha\rho$. Then the actual energy of that body is

$$wv^2/2g=w\alpha^2\rho^2/2g. \tag{76}$$

By comparing this with the expression for the centrifugal force $(w\alpha^2\rho/g)$, it appears that the actual energy of a revolving body is equal to the potential energy $\mathrm{F}\rho/2$ due to the action of the deflecting force along one-half of the radius of curvature of the path of the body.

The product $w\rho^2/g$, by which the half-square of the angular velocity is multiplied, is called the *moment of inertia* of the revolving body.

§ 121. *Flywheels.*—A flywheel is a rotating piece in a machine, generally shaped like a wheel (that is to say, consisting of a rim with spokes), and suited to store and restore energy by the periodical variations in its angular velocity.

The principles according to which variations of angular velocity store and restore energy are the same as those of § 117, only substituting *moment of inertia* for *mass*, and *angular* for *linear* velocity.

Let W be the weight of a flywheel, R its radius of gyration, α_2 its maximum, α_1 its minimum, and $\mathrm{A}=\frac{1}{2}(\alpha_2+\alpha_1)$ its mean angular velocity. Let

$$1/\mathrm{S}=(\alpha_2-\alpha_2)/\mathrm{A}$$

denote the *unsteadiness* of the motion of the flywheel; the denominator S of this fraction is called the *steadiness.* Let e denote the quantity by which the energy exerted in each cycle of the working of the machine alternately exceeds and falls short of the work performed, and which has consequently to be alternately stored by acceleration and restored by retardation of the flywheel. The value of this *periodical excess* is—

$$e=\mathrm{R}^2\mathrm{W}(\alpha_2{}^2-\alpha_1{}^2),\ 2g, \tag{77}$$

from which, dividing both sides by A^2, we obtain the following equations:—

$$\left.\begin{array}{r}e/\mathrm{A}^2=\mathrm{R}^2\mathrm{W}/g\mathrm{S}\\ \mathrm{R}^2\mathrm{WA}^2/2g=\mathrm{S}e/2\end{array}\right\}. \tag{78}$$

The latter of these equations may be thus expressed in words: *The actual energy due to the rotation of the fly, with its mean angular velocity, is equal to one-half of the periodical excess of energy multiplied by the steadiness.*

In ordinary machinery S = about 32; in machinery for fine purposes S = from 50 to 60; and when great steadiness is required S = from 100 to 150.

The periodical excess e may arise either from variations in the effort exerted by the prime mover, or from variations in the resistance of the work, or from both these causes combined. When but one flywheel is used, it should be placed in as direct connexion as possible with that part of the mechanism where the greatest amount of the periodical excess originates; but when it originates at two or more points, it is best to have a flywheel in connexion with each of these points. For example, in a machine-work, the steam-engine, which is the prime mover of the various tools, has a flywheel on the crank-shaft to store and restore the periodical excess of energy arising from the variations in the effort exerted by the connecting-rod upon the crank; and each of the slotting machines, punching machines, riveting machines, and other tools has a flywheel of its own to store and restore energy, so as to enable the very different resistances opposed to those tools at different times to be overcome without too great unsteadiness of motion. For tools performing useful work at intervals, and having only their own friction to overcome during the intermediate intervals, e should be assumed equal to the whole work performed at each separate operation.

§ 122. *Brakes.*—A brake is an apparatus for stopping and diminishing the velocity of a machine by friction, such as the friction-strap already referred to in § 103. To find the distance s through which a brake, exerting the friction F, must rub in order to stop a machine having the total actual energy E at the moment when the brake begins to act, reduce, by the principles of § 96, the various efforts and other resistances of the machine which act at the same time with the friction of the brake to the rubbing surface of the brake, and let R be their resultant—*positive* if resistance, *negative* if effort preponderates. Then

$$s=\mathrm{E}/(\mathrm{F}+\mathrm{R}). \tag{79}$$

§ 123. *Energy distributed between two Bodies: Projection and Propulsion.*—Hitherto the effort by which a machine is moved has been treated as a force exerted between a movable body and a fixed body, so that the whole energy exerted by it is employed upon the movable body, and none upon the fixed body. This conception is sensibly realized in practice when one of the two bodies between which the effort acts is either so heavy as compared with the other, or has so great a resistance opposed to its motion, that it may, without sensible error, be treated as fixed. But there are cases in which the motions of both bodies are appreciable, and must be taken into account—such as the projection of projectiles, where the velocity of the *recoil* or backward motion of the gun bears an appreciable proportion to the forward motion of the projectile; and such as the propulsion of vessels, where the velocity of the water thrown backward by the paddle, screw or other propeller bears a very considerable proportion to the velocity of the water moved forwards and sideways by the ship. In cases of this kind the energy exerted by the effort is *distributed* between the two bodies between which the effort is exerted in shares proportional to the velocities of the two bodies during the action of the effort; and those velocities are to each other directly as the portions of the effort unbalanced by resistance on the respective bodies, and inversely as the weights of the bodies.

To express this symbolically, let W_1, W_2 be the weights of the bodies; P the effort exerted between them; S the distance through which it acts; R_1, R_2 the resistances opposed to the effort overcome by W_1, W_2 respectively; E_1, E_2 the shares of the whole energy E exerted upon W_1, W_2 respectively. Then

$$\left.\begin{array}{c}\mathrm{E} \quad : \quad \mathrm{E}_1 \quad : \quad \mathrm{E}_2\\ ::\dfrac{\mathrm{W}_2(\mathrm{P}-\mathrm{R}_1)+\mathrm{W}_1(\mathrm{P}-\mathrm{R}_2)}{\mathrm{W}_1\mathrm{W}_2}:\dfrac{\mathrm{P}-\mathrm{R}_1}{\mathrm{W}_1}:\dfrac{\mathrm{P}-\mathrm{R}_2}{\mathrm{W}_2}\end{array}\right\}. \tag{80}$$

If $\mathrm{R}_1=\mathrm{R}_2$, which is the case when the resistance, as well as the effort, arises from the mutual actions of the two bodies, the above becomes,

$$\left.\begin{array}{c}\mathrm{E} : \mathrm{E}_1 : \mathrm{E}_2\\ ::\mathrm{W}_1+\mathrm{W}_2:\mathrm{W}_2:\mathrm{W}_1\end{array}\right\}, \tag{81}$$

that is to say, the energy is exerted on the bodies in shares inversely proportional to their weights; and they receive accelerations inversely proportional to their weights, according to the principle of dynamics, already quoted in a note to § 110, that the mutual actions of a system of bodies do not affect the motion of their common centre of gravity.

For example, if the weight of a gun be 160 times that of its ball $\frac{160}{161}$ of the energy exerted by the powder in exploding will be employed in propelling the ball, and $\frac{1}{161}$ in producing the recoil of the gun, provided the gun up to the instant of the ball's quitting the muzzle meets with no resistance to its recoil except the friction of the ball.

§ 124. *Centre of Percussion.*—It is obviously desirable that the deviations or changes of motion of oscillating pieces in machinery should, as far as possible, be effected by forces applied at their centres of percussion.

If the deviation be a *translation*—that is, an equal change of motion of all the particles of the body—the centre of percussion is obviously the centre of gravity itself; and, according to the second law of motion, if dv be the deviation of velocity to be produced in the interval dt, and W the weight of the body, then

$$\mathrm{P}=\frac{\mathrm{W}}{g}\cdot\frac{dv}{dt} \tag{82}$$

is the unbalanced effort required.

If the deviation be a rotation about an axis traversing the centre of gravity, there is no centre of percussion; for such a deviation can only be produced by a *couple* of forces, and not by any single force. Let $d\alpha$ be the deviation of angular velocity to be produced in the interval dt, and I the moment of the inertia of the body about an axis through its centre of gravity; then $\frac{1}{2}\mathrm{I}d(\alpha^2)=\mathrm{I}\alpha d\alpha$ is the variation of the body's actual energy. Let M be the moment of the unbalanced couple required to produce the deviation; then by equation 57, § 104, the energy exerted by this couple in the interval dt is $\mathrm{M}\alpha dt$, which, being equated to the variation of energy, gives

$$\mathrm{M}=\mathrm{I}\frac{d\alpha}{dt}=\frac{\mathrm{R}^2\mathrm{W}}{g}\cdot\frac{d\alpha}{dt}. \tag{83}$$

R is called the radius of gyration of the body with regard to an axis through its centre of gravity.

Now (fig. 133) let the required deviation be a rotation of the body BB about an axis O, not traversing the centre of gravity G, $d\alpha$

being, as before, the deviation of angular velocity to be produced in the interval dt. A rotation with the angular velocity α about an axis O may be considered as compounded of a rotation with the same angular velocity about an axis drawn through G parallel to O and a translation with the velocity α. OG, OG being the perpendicular distance between the two axes. Hence the required deviation may be regarded as compounded of a deviation of translation $dv = \text{OG}.\ d\alpha$, to produce which there would be required, according to equation (82), a force applied at G perpendicular to the plane OG—

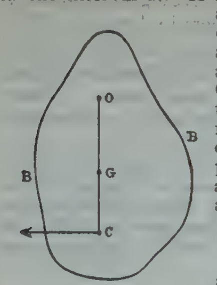


FIG. 133.

$$P = \frac{W}{g}\ .\ \text{OG}\ .\ \frac{d\alpha}{dt} \qquad (84)$$

and a deviation $d\alpha$ of rotation about an axis drawn through G parallel to O, to produce which there would be required a couple of the moment M given by equation (83). According to the principles of statics, the resultant of the force P, applied at G perpendicular to the plane OG, and the couple M is a force equal and parallel to P, but applied at a distance GC from G, in the prolongation of the perpendicular OG, whose value is

$$\text{GC} = M/P = R^2/\text{OG}. \qquad (85)$$

Thus is determined the position of the centre of percussion C, corresponding to the axis of rotation O. It is obvious from this equation that, for an axis of rotation parallel to O traversing C, the centre of percussion is at the point where the perpendicular OG meets O.

§ 125.* *To find the moment of inertia of a body about an axis through its centre of gravity experimentally.*—Suspend the body from any conveniently selected axis O (fig. 48) and hang near it a small plumb bob. Adjust the length of the plumb-line until it and the body oscillate together in unison. The length of the plumb-line, measured from its point of suspension to the centre of the bob, is for all practical purposes equal to the length OC, C being therefore the centre of percussion corresponding to the selected axis O. From equation (85)

$$R^2 = \text{CG} \times \text{OG} = (\text{OC} - \text{OG})\text{OG}.$$

The position of G can be found experimentally; hence OG is known, and the quantity R^2 can be calculated, from which and the ascertained weight W of the body the moment of inertia about an axis through G, namely, $W/g \times R^2$, can be computed.

§ 126.* *To find the force competent to produce the instantaneous acceleration of any link of a mechanism.*—In many practical problems it is necessary to know the magnitude and position of the forces acting to produce the accelerations of the several links of a mechanism. For a given link, this force is the resultant of all the accelerating forces distributed through the substance of the material of the link required to produce the requisite acceleration of each particle. and the determination of this force depends upon the principles of the two preceding sections. The investigation of the distribution of the forces through the material and the stress consequently produced belongs to the subject of the STRENGTH OF MATERIALS (*q. v.*). Let BK (fig. 134) be any link moving in any manner in a plane, and let G be its centre of gravity. Then its motion may be analysed into (1) a translation of its centre of gravity; and (2) a rotation about an axis through its centre of gravity perpendicular to its plane of motion. Let a be the acceleration of the centre of gravity and let A be the angular acceleration about the axis through the centre of gravity; then the force required to produce the translation of the centre of gravity is $F = Wa/g$, and the couple required to produce the angular acceleration about the centre of gravity is $M = IA/g$, W and I being respectively the weight and the moment of inertia of the link about the axis through the centre of gravity. The couple M may be produced by shifting the force F parallel to itself through a distance x, such that $Fx = M$. When the link forms part of a mechanism the respective accelerations of two points in the link can be determined by means of the velocity and acceleration diagrams described in § 82, it being understood that the motion of one link in the mechanism is prescribed, for instance, in the steam-engine's mechanism that the crank shall revolve uniformly. Let the acceleration of the two points B and K therefore be supposed known. The problem is now to find the acceleration a and A. Take any pole O (fig. 49), and set out Ob equal to the acceleration of B and Ok equal to the acceleration of K. Join bk and take the point g so that KG: GB = kg:gb. Og is then the acceleration of the centre of gravity and the force F can therefore be immediately calculated. To find the angular acceleration A, draw kt, bt respectively parallel to and at right angles to the link KB. Then tb represents the angular acceleration of the point B relatively to the point K and hence tb/KB is the value of A, the angular acceleration of the link. Its moment of inertia about G can be found experimentally by the method explained in § 125, and then the value of the couple M can be computed. The value of x is found immediately from the quotient M/F. Hence the magnitude F and the position of F relatively to the centre of gravity of the link, necessary to give rise to the couple M, are known, and this force is therefore the resultant force required.

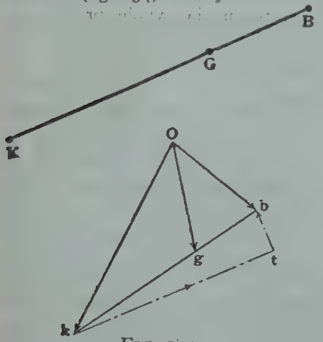


FIG. 134.

§ 127.* *Alternative construction for finding the position of F relatively to the centre of gravity of the link.*—Let B and K be any two points in the link which for greater generality are taken in fig. 135, so that the centre of gravity G is not in the line joining them. First find the value of R experimentally. Then produce the given directions of acceleration of B and K to meet in O; draw a circle through the three points B, K and O; produce the line joining O and G to cut the circle in Y; and take a point Z on the line OY so that $\text{YG} \times \text{GZ} = R^2$. Then Z is a point in the line of action of the force F. This useful theorem is due to G. T. Bennett, of Emmanuel College, Cambridge. A proof of it and three corollaries are given in appendix 4 of the second edition of Dalby's *Balancing of Engines* (London, 1906). It is to be noticed that only the directions of the accelerations of two points are required to find the point Z.

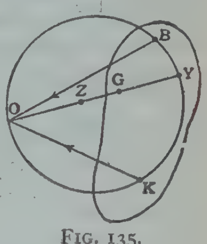


FIG. 135.

For an example of the application of the principles of the two preceding sections to a practical problem see *Valve and Valve Gear Mechanisms*, by W. E. Dalby (London, 1906), where the inertia stresses brought upon the several links of a Joy valve gear, belonging to an express passenger engine of the Lancashire & Yorkshire railway, are investigated for an engine-speed of 68 m. an hour.

§ 128.* *The Connecting Rod Problem.*—A particular problem of practical importance is the determination of the force producing the motion of the connecting rod of a steam-engine mechanism of the usual type. The methods of the two preceding sections may be used when the acceleration of two points in the rod are known. In this problem it is usually assumed that the crank pin K (fig. 136) moves with uniform velocity, so that if α is its angular velocity and r its radius, the acceleration is $\alpha^2 r$ in a direction along the crank arm from the crank pin to the centre of the shaft. Thus the acceleration of one point K is known completely. The acceleration of a second point, usually taken at the centre of the crosshead pin, can be found by the principles of § 82, but several special geometrical constructions have been devised for this purpose, notably the construction of Klein,[1] discovered also independently by Kirsch.[2] But probably the most convenient is the construction due to G. T. Bennett[3] which is as follows: Let OK be the crank and KB the connecting rod. On the connecting rod take a point L such that $\text{KL} \times \text{KB} = \text{KO}^2$. Then, the crank standing at any angle with the line of stroke, draw LP at right angles to the connecting rod, PN at right angles to the line of stroke OB and NA at right angles to the connecting rod; then AO is the acceleration of the point B to the scale on which KO represents the acceleration of the point K. The proof of this construction is given in *The Balancing of Engines*.

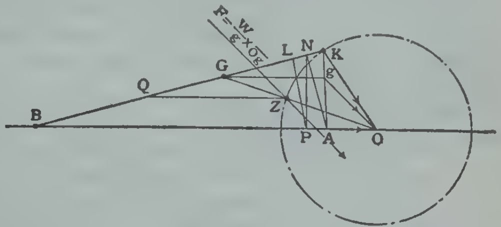


FIG. 136.

The finding of F may be continued thus: join AK, then AK is the acceleration image of the rod, OKA being the acceleration diagram. Through G, the centre of gravity of the rod, draw Gg parallel to the line of stroke, thus dividing the image at g in the proportion that the connecting rod is divided by G. Hence Og represents the acceleration of the centre of gravity and, the weight of the connecting rod being ascertained, F can be immediately calculated. To find a point in its line of action, take a point Q on the rod such that $KG \times GQ = R^2$, R having been determined experimentally by the method of § 125; join G with O and through Q draw a line parallel to BO to cut GO in Z. Z is a point in the line of action of the resultant force F; hence through Z draw a line parallel to Og. The force F acts in this line, and thus the problem is completely solved. The above construction for Z is a corollary of the general theorem given in § 127.

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[1] J. F. Klein, "New Constructions of the Force of Inertia of Connecting Rods and Couplers and Constructions of the Pressures on their Pins," *Journ. Franklin Inst.*, vol. 132 (Sept. and Oct., 1891).

[2] Prof. Kirsch, "Über die graphische Bestimmung der Kolbenbeschleunigung," *Zeitsch. Verein deutsche Ingen.* (1890), p. 1320.

[3] Dalby, *The Balancing of Engines* (London, 1906), app. 1.

§ 129. *Impact.* Impact or collision is a pressure of short duration exerted between two bodies.

The effects of impact are sometimes an alteration of the distribution of actual energy between the two bodies, and always a loss of a portion of that energy, depending on the imperfection of the elasticity of the bodies, in permanently altering their figures, and producing heat. The determination of the distribution of the actual energy after collision and of the loss of energy is effected by means of the following principles:—

I. The motion of the common centre of gravity of the two bodies is unchanged by the collision.

II. The loss of energy consists of a certain proportion of that part of the actual energy of the bodies which is due to their motion relatively to their common centre of gravity.

Unless there is some special reason for using impact in machines, it ought to be avoided, on account not only of the waste of energy which it causes, but from the damage which it occasions to the frame and mechanism. (W. J. M. R.; W. E. D.)

MECHANICVILLE, a village of Saratoga county, New York, U.S.A., on the west bank of the Hudson River, about 20 m. N. of Albany; on the Delaware & Hudson and Boston & Maine railways. Pop. (1900), 4695 (702 foreign-born); (1905, state census), 5877; (1910) 6,634. It lies partly within Stillwater and partly within Half-Moon townships, in the bottom-lands at the mouth of the Anthony Kill, about 1½ m. S. of the mouth of the Hoosick River. On the north and south are hills reaching a maximum height of 200 ft. There is ample water power, and there are manufactures of paper, sash and blinds, fibre, &c. From a dam here power is derived for the General Electric Company at Schenectady. The first settlement in this vicinity was made in what is now Half-Moon township about 1680. Mechanicville (originally called Burrow) was chartered by the county court in 1859, and incorporated as a village in 1870. It was the birthplace of Colonel Ephraim Elmer Ellsworth (1837–1861), the first Federal officer to lose his life in the Civil War.

MECHITHARISTS, a congregation of Armenian monks in communion with the Church of Rome. The founder, Mechithar, was born at Sebaste in Armenia, 1676. He entered a monastery, but under the influence of Western missionaries he became possessed with the idea of propagating Western ideas and culture in Armenia, and of converting the Armenian Church from its monophysitism and uniting it to the Latin Church. Mechithar set out for Rome in 1695 to make his ecclesiastical studies there, but he was compelled by illness to abandon the journey and return to Armenia. In 1696 he was ordained priest and for four years worked among his people. In 1700 he went to Constantinople and began to gather disciples around him. Mechithar formally joined the Latin Church, and in 1701, with sixteen companions, he formed a definitely religious institute of which he became the superior. Their Uniat propaganda encountered the opposition of the Armenians and they were compelled to move to the Morea, at that time Venetian territory, and there built a monastery, 1706. On the outbreak of hostilities between the Turks and Venetians they migrated to Venice, and the island of St Lazzaro was bestowed on them, 1717. This has since been the headquarters of the congregation, and here Mechithar died in 1749, leaving his institute firmly established. The rule followed at first was that attributed to St Anthony; but when they settled in the West modifications from the Benedictine rule were introduced, and the Mechitharists are numbered among the lesser orders affiliated to the Benedictines. They have ever been faithful to their founder's programme. Their work has been fourfold: (1) they have brought out editions of important patristic works, some Armenian, others translated into Armenian from Greek and Syriac originals no longer extant; (2) they print and circulate Armenian literature among the Armenians, and thereby exercise a powerful educational influence; (3) they carry on schools both in Europe and Asia, in which Uniat Armenian boys receive a good secondary education; (4) they work as Uniat missioners in Armenia. The congregation is divided into two branches, the head houses being at St Lazzaro and Vienna. They have fifteen establishments in various places in Asia Minor and Europe. There are some 150 monks, all Armenians; they use the Armenian language and rite in the liturgy.

See *Vita del servo di Dio Mechitar* (Venice, 1901); E. Boré, *Saint-Lazare* (1835); Max Heimbucher, *Orden u. Kongregationen* (1907) I. § 37; and the articles in Wetzer u. Welte, *Kirchenlexicon* (ed. 2) and Herzog, *Realencyklopädie* (ed. 3), also articles by Sargisean, a Mechitharist, in *Rivista storica benedettina* (1906), "La Congregazione Mechitarista." (E. C. B.)

MECKLENBURG, a territory in northern Germany, on the Baltic Sea, extending from 53° 4′ to 54° 22′ N. and from 10° 35′ to 13° 57′ E., unequally divided into the two grand duchies of Mecklenburg-Schwerin and Mecklenburg-Strelitz.

MECKLENBURG-SCHWERIN is bounded N. by the Baltic Sea, W. by the principality of Ratzeburg and Schleswig-Holstein, S. by Brandenburg and Hanover, and E. by Pomerania and Mecklenburg-Strelitz. It embraces the duchies of Schwerin and Güstrow, the district of Rostock, the principality of Schwerin, and the barony of Wismar, besides several small enclaves (Ahrensberg, Rosson, Tretzeband, &c.) in the adjacent territories. Its area is 5080 sq. m. Pop. (1905), 625,045.

MECKLENBURG-STRELITZ consists of two detached parts, the duchy of Strelitz on the E. of Mecklenburg-Schwerin, and the principality of Ratzeburg on the W. The first is bounded by Mecklenburg-Schwerin, Pomerania and Brandenburg, the second by Mecklenburg-Schwerin, Lauenburg, and the territory of the free town of Lübeck. Their joint area is 1130 sq. m. Pop. (1905), 103,451.

Mecklenburg lies wholly within the great North-European plain, and its flat surface is interrupted only by one range of low hills, intersecting the country from south-east to north-west, and forming the watershed between the Baltic Sea and the Elbe. Its highest point, the Helpter Berg, is 587 ft. above sea-level. The coast-line runs for 65 m. along the Baltic (without including indentations), for the most part in flat sandy stretches covered with dunes. The chief inlets are Wismar Bay, the Salzhaff, and the roads of Warnemünde. The rivers are numerous though small; most of them are affluents of the Elbe, which traverses a small portion of Mecklenburg. Several are navigable, and the facilities for inland water traffic are increased by canals. Lakes are numerous; about four hundred, covering an area of 500 sq. m., are reckoned in the two duchies. The largest is Lake Müritz, 52 sq. m. in extent. The climate resembles that of Great Britain, but the winters are generally more severe; the mean annual temperature is 48° F., and the annual rainfall is about 28 in. Although there are long stretches of marshy moorland along the coast, the soil is on the whole productive. About 57% of the total area of Mecklenburg-Schwerin consists of cultivated land, 18% of forest, and 13% of heath and pasture. In Mecklenburg-Strelitz the corresponding figures are 47, 21 and 10%. Agriculture is by far the most important industry in both duchies. The chief crops are rye, oats, wheat, potatoes and hay. Smaller areas are devoted to maize, buckwheat, pease, rape, hemp, flax, hops and tobacco. The extensive pastures support large herds of sheep and cattle, including a noteworthy breed of merino sheep. The horses of Mecklenburg are of a fine sturdy quality and highly esteemed. Red deer, wild swine and various other game are found in the forests. The industrial establishments include a few iron-foundries, wool-spinning mills, carriage and machine factories, dye-works, tanneries, brick-fields, soap-works, breweries, distilleries, numerous limekilns and tar-boiling works, tobacco and cigar factories, and numerous mills of various kinds. Mining is insignificant, though a fair variety of minerals is represented in the district. Amber is found on and near the Baltic coast. Rostock, Warnemünde and Wismar are the principal commercial centres. The chief exports are grain and other agricultural produce, live stock, spirits, wood and wool; the chief imports are colonial produce, iron, coal, salt, wine, beer and tobacco. The horse and wool markets of Mecklenburg are largely attended by buyers from various parts of Germany. Fishing is carried on extensively in the numerous inland lakes.

In 1907 the grand dukes of both duchies promised a constitution to their subjects. The duchies had always been under a government of feudal character, the grand dukes having the executive entirely in their hands (though acting through ministers), while the duchies shared a diet (*Landtag*), meeting for a short session each year, and at other times represented by a committee, and consisting of the proprietors of knights' estates (*Rittergüter*), known as the *Ritterschaft*, and the *Landschaft* or burgomasters of certain towns.

Mecklenburg-Schwerin returns six members to the Reichstag and Mecklenburg-Strelitz one member.

In Mecklenburg-Schwerin the chief towns are Rostock (with a university), Schwerin, and Wismar the capital. The capital of Mecklenburg-Strelitz is Neu-Strelitz. The peasantry of Mecklenburg retain traces of their Slavonic origin, especially in speech, but their peculiarities have been much modified by amalgamation with German colonists. The townspeople and nobility are almost wholly of Saxon strain. The slowness of the increase in population is chiefly accounted for by emigration.

History.—The Teutonic peoples, who in the time of Tacitus occupied the region now known as Mecklenburg, were succeeded in the 6th century by some Salvonic tribes, one of these being the Obotrites, whose chief fortress was Michilenburg, the modern Mecklenburg, near Wismar; hence the name of the country. Though partly subdued by Charlemagne towards the close of the 8th century, they soon regained their independence, and until the 10th century no serious effort was made by their Christian neighbours to subject them. Then the German king, Henry the Fowler, reduced the Slavs of Mecklenburg to obedience and introduced Christianity among them. During the period of weakness through which the German kingdom passed under the later Ottos, however, they wrenched themselves free from this bondage; the 11th and the early part of the 12th century saw the ebb and flow of the tide of conquest, and then came the effective subjugation of Mecklenburg by Henry the Lion, duke of Saxony. The Obotrite prince Niklot was killed in battle in 1160 whilst resisting the Saxons, but his son Pribislaus (d. 1178) submitted to Henry the Lion, married his daughter to the son of the duke, embraced Christianity, and was permitted to retain his office. His descendants and successors, the present grand dukes of Mecklenburg, are the only ruling princes of Slavonic origin in Germany. Henry the Lion introduced German settlers and restored the bishoprics of Ratzeburg and Schwerin; in 1170 the emperor Frederick I. made Pribislaus a prince of the empire. From 1214 to 1227 Mecklenburg was under the supremacy of Denmark; then, in 1229, after it had been regained by the Germans, there took place the first of the many divisions of territory which with subsequent reunions constitute much of its complicated history. At this time the country was divided between four princes, grandsons of duke Henry Borwin, who had died two years previously. But in less than a century the families of two of these princes became extinct, and after dividing into three branches a third family suffered the same fate in 1436. There then remained only the line ruling in Mecklenburg proper, and the princes of this family, in addition to inheriting the lands of their dead kinsmen, made many additions to their territory, including the counties of Schwerin and of Strelitz. In 1352 the two princes of this family made a division of their lands, Stargard being separated from the rest of the country to form a principality for John (d. 1393), but on the extinction of his line in 1471 the whole of Mecklenburg was again united under a single ruler. One member of this family, Albert (*c.* 1338–1412), was king of Sweden from 1364 to 1389. In 1348 the emperor Charles IV. had raised Mecklenburg to the rank of a duchy, and in 1418 the university of Rostock was founded.

The troubles which arose from the rivalry and jealousy of two or more joint rulers incited the prelates, the nobles and the burghers to form a union among themselves, and the results of this are still visible in the existence of the *Landesunion* for the whole country which was established in 1523. About the same time the teaching of Luther and the reformers was welcomed in Mecklenburg, although Duke Albert (d. 1547) soon reverted to the Catholic faith; in 1549 Lutheranism was recognized as the state religion; a little later the churches and schools were reformed and most of the monasteries were suppressed. A division of the land which took place in 1555 was of short duration, but a more important one was effected in 1611, although Duke John Albert I. (d. 1576) had introduced the principle of primogeniture and had forbidden all further divisions of territory. By this partition John Albert's grandson Adolphus Frederick I. (d. 1658) received Schwerin, and another grandson John Albert II. (d. 1636) received Güstrow. The town of Rostock "with its university and high court of justice" was declared to be common property, while the Diet or *Landtag* also retained its joint character, its meetings being held alternately at Sternberg and at Malchin.

During the early part of the Thirty Years' War the dukes of Mecklenburg-Schwerin and Mecklenburg-Güstrow were on the Protestant side, but about 1627 they submitted to the emperor Ferdinand II. This did not prevent Ferdinand from promising their land to Wallenstein, who, having driven out the dukes, was invested with the duchies in 1629 and ruled them until 1631. In this year the former rulers were restored by Gustavus Adolphus of Sweden, and in 1635 they came to terms with the emperor and signed the peace of Prague, but their land continued to be ravaged by both sides until the conclusion of the war. In 1648 by the Treaty of Westphalia, Wismar and some other parts of Mecklenburg were surrendered to Sweden, the recompense assigned to the duchies including the secularized bishoprics of Schwerin and of Ratzeburg. The sufferings of the peasants in Mecklenburg during the Thirty Years' War were not exceeded by those of their class in any other part of Germany; most of them were reduced to a state of serfdom and in some cases whole villages vanished. Christian Louis who ruled Mecklenburg-Schwerin from 1658 until his death in 1692 was, like his father Adolphus Frederick, frequently at variance with the estates of the land and with members of his family. He was a Roman Catholic and a supporter of Louis XIV., and his country suffered severely during the wars waged by France and her allies in Germany.

In June 1692 when Christian Louis died in exile and without sons, a dispute arose about the succession to his duchy between his brother Adolphus Frederick and his nephew Frederick William. The emperor and the rulers of Sweden and of Brandenburg took part in this struggle which was intensified when, three years later, on the death of Duke Gustavus Adolphus, the family ruling over Mecklenburg-Güstrow became extinct. At length the partition Treaty of Hamburg was signed on the 8th of March 1701, and a new division of the country was made. Mecklenburg was divided between the two claimants, the shares given to each being represented by the existing duchies of Mecklenburg-Schwerin, the part which fell to Frederick William, and Mecklenburg-Strelitz, the share of Adolphus Frederick. At the same time the principle of primogeniture was again asserted, and the right of summoning the joint *Landtag* was reserved to the ruler of Mecklenburg-Schwerin.

Mecklenburg-Schwerin began its existence by a series of constitutional struggles between the duke and the nobles. The heavy debt incurred by Duke Charles Leopold (d. 1747), who had joined Russia in a war against Sweden, brought matters to a crisis; the emperor Charles VI. interfered and in 1728 the imperial court of justice declared the duke incapable of governing and his brother Christian Louis was appointed administrator of the duchy. Under this prince, who became ruler *de jure* in 1747, there was signed in April 1755 the convention of Rostock by which a new constitution was framed for the duchy. By this instrument all power was in the hands of the duke, the nobles and the upper classes generally, the lower classes being entirely unrepresented. During the Seven Years' War Duke Frederick (d. 1785) took up a hostile attitude towards Frederick the Great, and in consequence Mecklenburg was occupied by Prussian troops, but in other ways his rule was beneficial to the country. In the early years of the French revolutionary wars Duke Frederick Francis I. (1756–1837) remained neutral, and in 1803 he regained Wismar from Sweden, but in 1806 his land was overrun by the French and in 1808 he joined the Confederation of the Rhine. He was the first member of the confederation to abandon Napoleon, to whose armies he had sent a contingent, and in 1813–1814 he fought against France. In 1815 he joined the Germanic Confederation (Bund) and took the title of grand duke. In 1819 serfdom was abolished in his dominions. During the movement of 1848 the duchy witnessed a considerable agitation in favour of a more liberal constitution, but in the subsequent reaction all the concessions which had been made to the democracy were withdrawn and further restrictive measures were introduced in 1851 and 1852.

Mecklenburg-Strelitz adopted the constitution of the sister duchy by an act of September 1755. In 1806 it was spared the infliction of a French occupation through the good offices of the king of Bavaria; in 1808 its duke, Charles (d. 1816), joined the confederation of the Rhine, but in 1813 he withdrew therefrom. Having been a member of the alliance against Napoleon he joined the Germanic confederation in 1815 and assumed the title of grand duke.

In 1866 both the grand dukes of Mecklenburg joined the North German confederation and the *Zollverein*, and began to pass more and more under the influence of Prussia, who in the war with Austria had been aided by the soldiers of Mecklenburg-Schwerin. In the Franco-German War also Prussia received valuable assistance from Mecklenburg, Duke Frederick Francis II. (1823–1883), an ardent advocate of German unity, holding a high command in her armies. In 1871 the two grand duchies became states of the German Empire. There was now a renewal of the agitation for a more democratic constitution, and the German Reichstag gave some countenance to this movement. In 1897 Frederick Francis IV. (b. 1882) succeeded his father Frederick Francis III. (1851–1897) as grand duke of Mecklenburg-Schwerin, and in 1904 Adolphus Frederick (b. 1848) a son of the grand duke Frederick William (1819–1904) and his wife Augusta Carolina, daughter of Adolphus Frederick, duke of Cambridge, became grand duke of Mecklenburg-Strelitz. The grand dukes still style themselves princes of the Wends.

See F. A. Rudloff, *Pragmatisches Handbuch der mecklenburgischen Geschichte* (Schwerin, 1780–1822); C. C. F. von Lützow, *Versuch einer pragmatischen Geschichte von Mecklenburg* (Berlin, 1827–1835); *Mecklenburgische Geschichte in Einzeldarstellungen*, edited by R. Beltz, C. Beyer, W. P. Graff and others; C. Hegel, *Geschichte der mecklenburgischen Landstände bis 1555* (Rostock, 1856); A. Mayer, *Geschichte des Grossherzogtums Mecklenburg-Strelitz 1816–1890* (New Strelitz, 1890); Tolzien, *Die Grossherzöge von Mecklenburg-Schwerin* (Wismar, 1904); Lehsten, *Der Adel Mecklenburgs seit dem landesgrundgesetzlichen Erbvergleich* (Rostock, 1864); the *Mecklenburgisches Urkundenbuch* in 21 vols. (Schwerin, 1873–1903); the *Jahrbücher des Vereins für mecklenburgische Geschichte und Altertumskunde* (Schwerin, 1836 fol.); and W. Raabe, *Mecklenburgische Vaterlandskunde* (Wismar, 1894–1896); von Hirschfeld, *Friedrich Franz II., Grossherzog von Mecklenburg-Schwerin und seine Vorgänger* (Leipzig, 1891); Volz, *Friedrich Franz II.* (Wismar, 1893); C. Schröder, *Friedrich Franz III.* (Schwerin, 1898); Bartold, *Friedrich Wilhelm, Grossherzog von Mecklenburg-Strelitz und Augusta Carolina* (New Strelitz, 1893); and H. Sachsse, *Mecklenburgische Urkunden und Daten* (Rostock, 1900).

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A. J. G.	Rev. Alexander James Grieve, M.A., B.D. Professor of New Testament and Church History at the United Independent College, Bradford. Sometime Registrar of Madras University and Member of Mysore Educational Service.	**Missions** (*in part*).
A. J. L.	Andrew Jackson Lamoureux. Librarian, College of Agriculture, Cornell University. Formerly Editor of the *Rio News*, Rio de Janeiro.	**Mexico:** ***Geography.***
A. L.	Andrew Lang. See the biographical article, Lang, Andrew.	**Molière.**
A. M. C.	Agnes Mary Clerke. See the biographical article, Clerke, A. M.	**Mouchez.**
A. N.	Alfred Newton, F.R.S. See the biographical article, Newton, Alfred.	**Megapode; Merganser;** **Mocking Bird;** **Moor-Hen; Morillon;** **Motmot; Mouse-Bird.**
A. Se.*	Adam Sedgwick, M.A., F.R.S. Professor of Zoology at the Imperial College of Science and Technology, London. Fellow, and formerly Tutor, of Trinity College, Cambridge. Professor of Zoology in the University of Cambridge, 1907–1909.	**Metamorphosis.**
A. v. G.	Baron Alfred von Gutschmid. See the biographical article, Gutschmid, Alfred, Baron von.	**Moses of Chorene** (*in part*).
A. Wa.	Arthur Waugh, M.A. New College, Oxford. Newdigate Prize, 1888. Author of *Gordon in Africa*; *Alfred, Lord Tennyson.* Editor of Johnson's *Lives of the Poets*; editions of *Dickens, Tennyson, Arnold, Lamb*; &c.	**Morris, William.**

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B. M.*	Budgett Meakin (1866–1906). Formerly Editor of the *Times of Morocco*. Author of *The Land of the Moors*; *The Moorish Empire*; *Life in Morocco*; &c.	**Morocco** (*in part*).
C. A.	Cleveland Abbe, A.M., LL.D. Professor of Meteorology, U.S. Weather Bureau, Washington. Director of the Cincinnati Observatory, 1863–1873. Editor of *Monthly Weather Review*; and *Bulletin of Mount Weather Observatory*. Author of *Meteorological Apparatus and Methods*; &c.	**Meteorology.**
C. B. W.*	Charles Bertie Wedd, F.G.S. Joint-author of various memoirs and maps of the Geological Survey.	**Millstone Grit; Miocene.**
C. C.	Charles Creighton, M.A., M.D. King's College, Cambridge. Author of *A History of Epidemics in Britain*; *Jenner and Vaccination*; *Plague in India*; &c.	**Monster** (*in part*); **Morgagni.**
C. El.	Sir Charles Norton Edgcumbe Eliot, K.C.M.G., C.B., M.A., LL.D., D.C.L. Vice-Chancellor of Sheffield University. Formerly Fellow of Trinity College, Oxford. H.M.'s Commissioner and Commander-in-Chief for the British East Africa Protectorate; Agent and Consul-general at Zanzibar; and Consul-general for German East Africa, 1900–1904.	**Mordvinians.**
C. F. A.	Charles Francis Atkinson. Formerly Scholar of Queen's College, Oxford. Captain, 1st City of London (Royal Fusiliers). Author of *The Wilderness and Cold Harbour*.	**Medal:** *War Decoration* (*in part*).
C. F. B.	Charles Francis Bastable, M.A., LL.D. Regius Professor of Laws and Professor of Political Economy in the University of Dublin. Author of *Public Finance*; *Commerce of Nations*; *Theory of International Trade*; &c.	**Monetary Conferences;** **Money.**
C. G. Ala.	Chaloner Grenville Alabaster. Barrister-at-Law, Inner Temple.	**Money-Lending.**
C. J. B.	Charles Jasper Blunt, A.O.D. Major, Royal Artillery. Chief Ordnance Officer, Singapore. Served through Chitral Campaign.	**Mohmand Campaign.**
C. J. F.*	Constance Jocelyn Ffoulkes. Translator of Morelli's *Italian Painters*; &c.	**Morelli.**
C. J. L.	Sir Charles James Lyall, K.C.S.I., C.I.E., LL.D. (Edin.). Secretary, Judicial and Public Department, India Office. Fellow of King's College, London. Secretary to Government of India in Home Department, 1889–1894, Chief Commissioner, Central Provinces, India, 1895–1898. Author of *Translations of Ancient Arabic Poetry*; &c.	**Mofaḍḍalīyāt.**
C. Mi.	Chedomille Mijatovich. Senator of the Kingdom of Servia. Envoy Extraordinary and Minister Plenipotentiary of the King of Servia to the Court of St James's, 1895–1900, and 1902–1903.	**Michael Obrenovich III.;** **Milosh Obrenovich I.**
C. Mo.	William Cosmo Monkhouse. See the biographical article, Monkhouse, William Cosmo.	**Millais.**
C. Pf.	Christian Pfister, D-ès.-L. Professor at the Sorbonne, Paris. Chevalier of the Legion of Honour. Author of *Études sur le règne de Robert le Pieux*.	**Merovingians.**
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C. R. W. B.	C. R. W. Biggar, M.A., K.C.	**Mowat, Sir Oliver.**
C. S. R.	Hon. Charles Stewart Rolls, M.A., F.R.G.S. (1877–1910). Trinity College, Cambridge. British Pioneer of Motoring and Aviation. Formerly Managing Director of Rolls-Royce, Ltd.	**Motor Vehicles:** *Light Vehicles*.
C. We.	Cecil Weatherly. Formerly Scholar of Queen's College, Oxford. Barrister-at-Law.	**Monument.**
D. B. Ma.	Duncan Black Macdonald, M.A., D.D. Professor of Semitic Languages, Hartford Theological Seminary, U.S.A. Author of *Development of Muslim Theology, Jurisprudence and Constitutional Theory*; *Selections from Ibn Khaldun*; *Religious Attitude and Life in Islam*; &c.	**Mufti.**
D. F. T.	Donald Francis Tovey. Author of *Essays in Musical Analysis*: comprising *The Classical Concerto, The Goldberg Variations*, and analyses of many other classical works.	**Melody;** **Mendelssohn-Bartholdy** (*in part*); **Motet; Mozart** (*in part*).
D. Gi.	Sir David Gill, K.C.B., LL.D., F.R.S., F.R.A.S., D.Sc. H.M. Astronomer at Cape of Good Hope, 1879–1907. Served on Geodetic Survey of Egypt, and on the expedition to Ascension Island to determine the Solar Parallax by observations of Mars. Directed Geodetic Survey of Natal, Cape Colony, and Rhodesia. Author of *Geodetic Survey of South Africa*; *Catalogues of Stars for the Equinoxes, 1850, 1860, 1885, 1890, 1900*; &c.	**Micrometer.**

D. G. H.	DAVID GEORGE HOGARTH, M.A. Keeper of the Ashmolean Museum, Oxford. Fellow of Magdalen College, Oxford. Fellow of the British Academy. Excavated at Paphos, 1888; Naucratis 1899 and 1903; Ephesus, 1904–1905; Assiut, 1906–1907. Director, British School at Athens, 1897–1900. Director, Cretan Exploration Fund, 1899.	**Mersina; Miletus.**
D. H.	DAVID HANNAY. Formerly British Vice-Consul at Barcelona. Author of *Short History of the Royal Navy*; *Life of Emilio Castelar*; &c.	**Meloria; Mina.**
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E. A. M.	EDWARD ALFRED MINCHIN, M.A., F.Z.S., Professor of Protozoology in the University of London. Formerly Fellow of Merton College, Oxford.	**Medusa.**
E. B. T.	EDWARD BURNETT TYLOR, D.C.L., LL.D. See the biographical article, TYLOR, EDWARD BURNETT.	**Mexico:** *Ancient History* (*in part*).
E. C. B.	RIGHT REV. EDWARD CUTHBERT BUTLER, O.S.B., D.LITT. Abbot of Downside Abbey, Bath. Author of "The Lausiac History of Palladius" in *Cambridge Texts and Studies*, vol. vi.	**Mendicant Movement and Orders;** **Monasticism;** **Monte Cassino.**
E. E. A.	ERNEST E. AUSTEN. Assistant in Department of Zoology, Natural History Museum, South Kensington.	**Mosquito.**
E. F. S. D.	LADY DILKE. See the biographical article, DILKE, SIR C. W., BART.	**Millet, Jean François.**
E. Gr.	ERNEST ARTHUR GARDNER, M.A. See the biographical article, GARDNER, PERCY.	**Megalopolis;** **Megara** (*in part*); **Melos.**
E. H. B.	SIR EDWARD HERBERT BUNBURY, BART., M.A., F.R.G.S.(d. 1895). M.P. for Bury St Edmunds, 1847–1852. Author of *A History of Ancient Geography*; &c.	**Mela, Pomponius** (*in part*).
E. H. M.	ELLIS HOVELL MINNS, M.A. University Lecturer in Palaeography, Cambridge. Lecturer and Assistant Librarian at Pembroke College, Cambridge. Formerly Fellow of Pembroke College.	**Melanchlaeni.**
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Ed. M.	EDUARD MEYER, PH.D., D.LITT. (Oxon.), LL.D. Professor of Ancient History in the University of Berlin. Author of *Geschichte des Alterthums*; *Geschichte des alten Aegyptens*; *Die Israeliten und ihre Nachbarstämme*.	**Media;** **Memnon of Rhodes;** **Menander** (MILINDA) (*in part*); **Mentor of Rhodes;** **Mithradates.**
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E. R. L.	Sir Edwin Ray Lankester, K.C.B., F.R.S., M.A., D.Sc., LL.D. Hon. Fellow of Exeter College, Oxford. President of the British Association, 1906. Professor of Zoology and Comparative Anatomy in University College, London, 1874–1890. Linacre Professor of Comparative Anatomy at Oxford, 1891–1898. Director of the Natural History Departments of the British Museum, 1898–1907. Vice-President of the Royal Society, 1896. Romanes Lecturer at Oxford, 1905. Author of *Degeneration*; *The Advancement of Science*; *The Kingdom of Man*; &c.	**Metamerism;** **Mollusca** (*in part*).
E. St.	Eugene Stock. Formerly Editorial Secretary of the Church Missionary Society.	**Missions** (*in part*).
E. S. S.	Edward Shrapnell Smith. Editor of *The Commercial Motor*. Hon. Treasurer of the Commercial Motor Users Association. Organiser of the Lancashire Heavy Motor Trials of 1898, 1899–1901.	**Motor Vehicles:** *Heavy Commercial Vehicles.*
F. C. C.	Frederick Cornwallis Conybeare, M.A., D.Th. (Giessen). Fellow of the British Academy. Formerly Fellow of University College, Oxford. Editor of *The Ancient Armenian Texts of Aristotle*. Author of *Myth, Magic and Morals*; &c.	**Moses of Chorene** (*in part*).
F. G. M. B.	Frederick George Meeson Beck, M.A. Fellow and Lecturer of Clare College, Cambridge.	**Mercia.**
F. G. P.	Frederick Gymer Parsons, F.R.C.S., F.Z.S., F.R.Anthrop.Inst. Vice-President, Anatomical Society of Great Britain and Ireland. Lecturer on Anatomy at St Thomas's Hospital and the London School of Medicine for Women, London. Formerly Hunterian Professor at the Royal College of Surgeons.	**Mouth and Salivary Glands.**
F. H. Ne.	Francis Henry Neville, M.A., F.R.S. Fellow and Lecturer in Natural Science, Sidney Sussex College, Cambridge.	**Metallography** (*in part*).
F. J. H.	Francis John Haverfield, M.A., LL.D., F.S.A. Camden Professor of Ancient History in the University of Oxford. Fellow of Brasenose College. Fellow of the British Academy. Author of Monographs on Roman History, especially Roman Britain; &c.	**Mona.**
F. Ll. G.	Francis Llewellyn Griffith, M.A., Ph.D., F.S.A. Reader in Egyptology, Oxford University. Editor of the Archaeological Survey and Archaeological Reports of the Egypt Exploration Fund. Fellow of Imperial German Archaeological Institute.	**Memphis; Menes;** **Moeris, Lake of;** **Mummy.**
F. N. M.	Colonel Frederic Natusch Maude, C.B. Lecturer in Military History, Manchester University. Author of *War and the World's Policy*; *The Leipzig Campaign*; *The Jena Campaign*.	**Metz.**
F. O. B.	Frederick Orpen Bower, M.A., D.Sc., F.R.S. Regius Professor of Botany in the University of Glasgow. Author of *Practical Botany for Beginners*; &c.	**Mohl, Hugo von.**
F. We.	Frederick Wedmore. See the biographical article, Wedmore, Frederick.	**Méryon.**
F. W. R.*	Frederick William Rudler, I.S.O., F.G.S. Curator and Librarian of the Museum of Practical Geology, London, 1879–1902. President of the Geologists' Association, 1887–1889.	**Moldavite.**
G. A. B.	George A. Boulenger, D.Sc., Ph.D., F.R.S. In charge of the collections of Reptiles and Fishes, Department of Zoology, British Museum. Vice-President of the Zoological Society of London.	**Mormyr.**
G. C. W.	George Charles Williamson, Litt.D. Chevalier of the Legion of Honour. Author of *Portrait Miniatures*; *Life of Richard Cosway, R.A.*; *George Engleheart*; *Portrait Drawings*; &c. Editor of new edition of Bryan's *Dictionary of Painters and Engravers*.	**Miniature;** **Morland, George.**
G. E. D.	Surgeon-Major George Edward Dobson, M.A., M.B., F.Z.S., F.R.S. (1848–1895). Army Medical Department, 1868–1888. Formerly Curator of the Royal Victoria Museum, Netley. Author of *Monograph of the Asiatic Chiroptera, &c.*; *A Monograph of the Insectivora, Systematic and Anatomical*.	**Mole** (*in part*).
G. F. B.	George F. Barwick. Assistant Keeper of Printed Books and Superintendent of Reading-room, British Museum.	**Midhat Pasha.**
G. G. S.	George Gregory Smith, M.A. Professor of English Literature, Queen's University, Belfast. Author of *The Days of James IV.*; *The Transition Period*; *Specimens of Middle Scots*; &c.	**Montgomerie.**
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G. P. R.	Gerald Philip Robinson. President of the Society of Mezzotint Engravers. Mezzotint Engraver to Queen Victoria and to King Edward VII.	**Mezzotint.**
G. Sa.	George Saintsbury, LL.D., D.C.L. See the biographical article, Saintsbury, G.	**Mérimée; Michelet, Jules;** **Montaigne; Montesquieu;** **Montpensier, Duchesse de.**
G. Sn.	Grant Showerman, A.M., Ph.D. Professor of Latin in the University of Wisconsin. Member of the Archaeological Institute of America. Member of American Philological Association. Author of *With the Professor*; *The Great Mother of the Gods*; &c.	**Mithras.**

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H. B. Wo.	Horace Bolingbroke Woodward, F.R.S., F.G.S. Formerly Assistant Director of the Geological Survey of England and Wales. President, Geologists' Association, 1893–1894. Wollaston Medallist, 1908.	**Miller, Hugh.**
H. Ch.	Hugh Chisholm, M.A. Formerly Scholar of Corpus Christi College, Oxford. Editor of the 11th edition of the *Encyclopaedia Britannica*. Co-editor of the 10th edition.	**Meredith, George;** **Milan Obrenovitch IV.;** **Morley, Viscount.**
H. E.	Karl Hermann Ethé, M.A., Ph.D. Professor of Oriental Languages, University College, Aberystwyth (University of Wales). Author of *Catalogue of Persian Manuscripts in the India Office Library, London* (Clarendon Press); &c.	**Mirkhond.**
H. Fr.	Henri Frantz. Art Critic, *Gazette des beaux arts*, Paris.	**Meissonier.**
H. F. B.	Horatio Robert Forbes Brown, LL.D. Editor of the *Calendar of Venetian State Papers*, for the Public Record Office. Author of *Life on the Lagoons*; *Venetian Studies*; *John Addington Symonds, a Biography*; &c.	**Milan** (*in part*).
H. F. G.	Hans Friedrich Gadow, F.R.S., Ph.D. Strickland Curator and Lecturer on Zoology in the University of Cambridge. Author of "Amphibia and Reptiles," in the *Cambridge Natural History*.	**Migration:** *Zoology*; **Moa.**
H. H. L.	Henry Harvey Littlejohn, M.A., M.B., C.M., F.R.C.S. (Edin.), F.R.S. (Edin.) Professor of Forensic Medicine in the University of Edinburgh.	**Medical Jurisprudence** (*in part*).
H. L. H.	Harriet L. Hennessy, M.D. (Brux.), L.R.C.P.I., L.R.C.S.I.	**Medical Education, U.S.A.** (*in part*).
H. L. S.	H. Lawrence Swinburne (d. 1907).	**Medal:** *War Decorations* (*in part*).
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H. S. M.	Henry Smith Munroe, D.Sc., Ph.D. Professor of Mining, Columbia University, New York.	**Mining.**
H. S. W.	Henry Spenser Wilkinson, M.A. Chichele Professor of Military History, University of Oxford. Fellow of All Souls' College. Author of *The Brain of an Army*; &c.	**Moltke, Count von.**
H. T. A.	Rev. Herbert Thomas Andrews. Professor of New Testament Exegesis, New College, London. Author of "The Commentary on Acts" in the *Westminster New Testament*; *Handbook on the Apocryphal Books* in the "Century" Bible.	**Missions** (*in part*).
H. W. H.	Hope W. Hogg, M.A. Professor of Semitic Languages and Literatures in the University of Manchester.	**Mesopotamia.**
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J. A. C.	Sir Joseph Archer Crowe, K.C.M.G. See the biographical article, Crowe, Sir J. A.	**Memline** (*in part*).

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J. A. S.	John Addington Symonds, LL.D. See the biographical article, Symonds, John Addington.	**Metastasio.**
J. A. V.	Rev. J. A. Vanes. Professor of New Testament Exegesis, Wesleyan College, Richmond.	**Methodism** *(in part).*
J. Bt.	James Bartlett. Lecturer on Construction, Architecture, Sanitation, Quantities, &c., at King's College, London. Member of Society of Architects. Member of Institute of Junior Engineers.	**Mortar.**
J. B. T.	Sir John Batty Tuke, M.D., F.R.S. (Edin.), D.Sc., LL.D. President of the Neurological Society of the United Kingdom. Medical Director of New Saughton Hall Asylum, Edinburgh. M.P. for the Universities of Edinburgh and St Andrews, 1900–1910.	**Medical Education.**
J. D. B.	James David Bourchier, M.A., F.R.G.S. King's College, Cambridge. Correspondent of *The Times* in South-Eastern Europe. Commander of the Orders of Prince Danilo of Montenegro and of the Saviour of Greece, and Officer of the Order of St Alexander of Bulgaria.	**Montenegro.**
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J. G. H.	Joseph G. Horner, A.M.I.Mech.E. Author of *Plating and Boiler Making*; *Practical Metal Turning*; &c.	**Metal-Work:** *Industrial.*
J. G. R.	John George Robertson, M.A., Ph.D. Professor of German at the University of London. Formerly Lecturer on the English Language, Strassburg University. Author of *History of German Literature*; &c.	**Meistersinger.**
J. G. Sc.	Sir James George Scott, K.C.I.E. Superintendent and Political Officer, Southern Shan States. Author of *Burma*; *The Upper Burma Gazetteer.*	**Mekong; Minbu.**
J. H. F.	John Henry Freese, M.A. Formerly Fellow of St John's College, Cambridge.	**Menander;** **Mirror:** *Ancient*; **Moesia.**
J. H. Je.	James Hopwood Jeans, M.A., F.R.S. Stokes Lecturer in the University of Cambridge. Formerly Fellow of Trinity College. Author of *Mathematical Theory of Electricity and Magnetism*; &c.	**Molecule.**
J. H. M.	John Henry Middleton, M.A., Litt.D., F.S.A., D.C.L. (1846–1896). Slade Professor of Fine Art in the University of Cambridge, 1886–1895. Director of the Fitzwilliam Museum, Cambridge, 1889–1892. Art Director of the South Kensington Museum, 1892–1896. Author of *The Engraved Gems of Classical Times*; *Illuminated Manuscripts in Classical and Mediaeval Times.*	**Metal-Work:** *Art* *(in part)*; **Monreale;** **Mosaic:** *Ancient* *(in part).*
J. H. R.	John Horace Round, M.A., LL.D. Author of *Feudal England*; *Studies in Peerage and Family History*; *Peerage and Pedigree.*	**Mortain;** **Mowbray:** *Family.*
J. Hl. R.	John Holland Rose, M.A., Litt.D. Lecturer on Modern History to the Cambridge University Local Lectures Syndicate. Author of *Life of Napoleon I.*; *Napoleonic Studies*; *The Development of the European Nations*; *The Life of Pitt*; &c.	**Mollien, Count;** **Montholon, Marquis de.**
J. Le.	Rev. James Legge, D.D. See the biographical article, Legge, James.	**Mencius.**
J. L. W.	Jessie Laidlay Weston. Author of *Arthurian Romances unrepresented in Malory.*	**Merlin.**
J. M. Bu.	Rev. James Monroe Buckley, D.D., LL.D. Editor of the *Christian Advocate*, New York. Author of *History of Methodism in the United States*; &c.	**Methodism:** *United States.*
J. M. M.	John Malcolm Mitchell. Sometime Scholar of Queen's College, Oxford. Lecturer in Classics, East London College (University of London). Joint-editor of Grote's *History of Greece.*	**Mill, John Stuart** *(in part)*; **Miltiades; Mnemonics.**
Jno. S.	Sir John Scott, K.C.M.G., M.A., D.C.L. Formerly Deputy Judge-Advocate-General to His Majesty's Forces. Judge, afterwards Vice-President, International Court of Appeal in Egypt. 1874–1882. Judge of High Court, Bombay, 1882–1890. Judicial Adviser to the Khedive of Egypt, 1890–1898. Vice-President, International Law Association.	**Military Law.**

J. S. Bl.	John Sutherland Black, M.A., LL.D. Assistant Editor, 9th edition, *Encyclopaedia Britannica.* Joint-editor of the *Encyclopaedia Biblica.*	**Missal.**
J. S. F.	John Smith Flett, D.Sc., F.G.S. Petrographer to the Geological Survey. Formerly Lecturer on Petrology in Edinburgh University. Neill Medallist of the Royal Society of Edinburgh. Bigsby Medallist of the Geological Society of London.	**Metamorphism;** **Metasomatism;** **Mica-Schist;** **Micropegmatite;** **Monzonite.**
J. S. G.	John Starkie Gardner, F.S.A. Expert Metal Worker. Author of *Armour in England; Ironwork* (for the Educational Department); &c.	**Metal Work:** *Modern Art.*
J. S. Ma.	James Saumarez Mann, M.A. Formerly Fellow and Lecturer of Trinity College, Oxford. Professor of Greek at Bedford College, London. Joint-editor of *Social England.*	**Mexico:** *Modern History.*
J. T. Be.	John Thomas Bealby. Joint-author of Stanford's *Europe.* Formerly Editor of the *Scottish Geographical Magazine.* Translator of Sven Hedin's *Through Asia, Central Asia and Tibet*; &c.	**Merv; Minsk**(*in part*); **Moscow**(*in part*).
J. T. C.	Joseph Thomas Cunningham, M.A., F.Z.S. Lecturer on Zoology at the South-Western Polytechnic, London. Formerly Fellow of University College, Oxford. Assistant Professor of Natural History in the University of Edinburgh. Naturalist to the Marine Biological Association.	**Mollusca** (*in part*); **Mullet.**
J. T. S.*	James Thomson Shotwell, Ph.D. Professor of History in Columbia University, New York City.	**Middle Ages.**
K. A. M.*	Kate A. Meakin (Mrs Budgett Meakin).	**Morocco** (*in part*).
K. S.	Kathleen Schlesinger. Editor of the *Portfolio of Musical Archaeology.* Author of *The Instruments of the Orchestra.*	**Monochord; Mouthpiece.**
L. Bl.	Louis Bell, Ph.D. Consulting Engineer, Boston, U.S.A. Chief Engineer, Electric Power Transmission Department, General Electric Co., Boston. Formerly Editor of *Electrical World,* New York. Author of *Electric Power Transmission*; &c.	**Motors, Electric.**
L. Bo.	Ludwig Boltzmann (1844–1906). Formerly Professor of Theoretical Physics, Universities of Munich, Vienna and Leipzig. Author of *Lectures on the Theory of Gas*; *Lectures on Maxwell's Theory of Electricity and Light.*	**Model.**
L. F.	Lazarus Fletcher, M.A., F.R.S. Director of Natural History Departments of the British Museum. Keeper of Minerals, British Museum, 1880–1909. Secretary to the Mineralogical Society. Formerly Fellow of University College, Oxford. Author of *Introduction to the Study of Meteorites*; &c.	**Meteorite.**
L. J. S.	Leonard James Spencer, M.A. Assistant in Department of Mineralogy, British Museum. Formerly Scholar of Sidney Sussex College, Cambridge, and Harkness Scholar. Editor of the *Mineralogical Magazine.*	**Melaconite; Mica;** **Microcline; Millerite;** **Mimetite; Mineralogy;** **Mispickel; Molybdenite;** **Monazite.**
M. H. C.	Montague Hughes Crackanthorpe, M.A., D.C.L., K.C. Honorary Fellow, St John's College, Oxford. Bencher of Lincoln's Inn. Formerly Member of the General Council of the Bar and of the Council of Legal Education, and Standing Counsel to the University of Oxford. President of the Eugenics Education Society.	**Mediation.**
M. H. S.	Marion H. Spielmann, F.S.A. Formerly Editor of the *Magazine of Art.* Member of Fine Art Committee of International Exhibitions of Brussels, Paris, Buenos Aires, Rome, and the Franco-British Exhibition, London. Author of *History of "Punch"*; *British Portrait Painting to the opening of the Nineteenth Century*; *Works of G. F. Watts, R.A.*; *British Sculpture and Sculptors of To-Day*; *Henriette Ronner*; &c.	**Medal** (*in part*).
M. N. T.	Marcus Niebuhr Tod, M.A. Fellow and Tutor of Oriel College, Oxford. University Lecturer in Epigraphy. Joint-author of *Catalogue of the Sparta Museum.*	**Messene; Messenia.**
M. O. B. C.	Maximilian Otto Bismarck Caspari, M.A. Reader in Ancient History at London University. Lecturer in Greek at Birmingham University, 1905–1908.	**Megara** (*in part*).
M. P.	Rev. Mark Pattison. See the biographical article, Pattison, Mark.	**More, Sir Thomas.**
N. W. T.	Northcote Whitridge Thomas, M.A. Government Anthropologist to Southern Nigeria. Corresponding Member of the Société d'Anthropologie de Paris. Author of *Thought Transference*; *Kinship and Marriage in Australia*; &c.	**Medium.**
O. Ba.	Oswald Barron, F.S.A. Editor of *The Ancestor*, 1902–1905. Hon. Genealogist to Standing Council of the Honourable Society of the Baronetage.	**Montagu** (*Family*). **Mortimer**(*Family*).
O. C. W.	Owen Charles Whitehouse, M.A., D.D. Theological Tutor and Lecturer in Hebrew, Cheshunt College, Cambridge.	**Messiah** (*in part*).

O. Hr.	Otto Henker, Ph.D. On the Staff of the Carl Zeiss Factory, Jena, Germany.	**Microscope.**
P. A. K.	Prince Peter Alexeivitch Kropotkin. See the biographical article, Kropotkin, Prince P. A.	**Minsk** (*in part*); **Mongolia; Moscow.**
P. C. M.	Peter Chalmers Mitchell, M.A., F.R.S., F.Z.S., D.Sc., LL.D. Secretary to the Zoological Society of London. University Demonstrator in Comparative Anatomy and Assistant to Linacre Professor at Oxford, 1888–1891. Author of *Outlines of Biology*; &c.	**Monster** (*in part*); **Morphology** (*in part*).
P. Ge.	Patrick Geddes, F.R.S. (Edin.). Professor of Botany, University College, Dundee. Formerly Lecturer on Natural History in School of Medicine, Edinburgh. Part-author of *Evolution of Sex*. Author of *Chapters in Modern Botany.*	**Morphology** (*in part*).
P. G. K.	Paul George Konody. Art Critic of the *Observer* and the *Daily Mail.* Formerly Editor of *The Artist.* Author of *The Art of Walter Crane*; *Velasquez, Life and Work*; &c.	**Memlinc** (*in part*).
P. La.	Philip Lake, M.A., F.G.S. Lecturer on Physical and Regional Geography in Cambridge University. Formerly of the Geological Survey of India. Author of *Monograph of British Cambrian Trilobites.* Translator and Editor of Keyser's *Comparative Geology.*	**Mexico:** *Geology.*
P. V.	Pasquale Villari. See the biographical article, Villari, Pasquale.	**Medici** (*Family*).
R. A. S. M.	Robert Alexander Stewart Macalister, M.A., F.S.A. St John's College, Cambridge. Director of Excavations for the Palestine Exploration Fund.	**Michmash; Mizpah;** **Moriah.**
R. C. P.	Reginald Crundall Punnett, M.A. Professor of Biology in the University of Cambridge. Fellow of Gonville and Caius College. Superintendent of the Museum of Zoology.	**Mendelism.**
R. H. C.	Rev. Robert Henry Charles, M.A., D.D., D.Litt. Grinfield Lecturer, and Lecturer in Biblical Studies, Oxford. Fellow of the British Academy. Formerly Professor of Biblical Greek, Trinity College, Dublin. Author of *Critical History of the Doctrine of a Future Life*; *Book of Jubilees*; &c.	**Moses, Assumption of.**
R. I. P.	Reginald Innes Pocock, F.Z.S. Superintendent of the Zoological Gardens, London.	**Millipede; Mimicry;** **Mite.**
R. K. D.	Sir Robert Kennaway Douglas. Formerly Keeper of Oriental Printed Books and MSS. at the British Museum; and Professor of Chinese, King's College, London. Author of *The Language and Literature of China*; &c.	**Mongols.**
R. L.*	Richard Lydekker, M.A., F.R.S., F.G.S., F.Z.S. Member of the Staff of the Geological Survey of India, 1874–1882. Author of *Catalogues of Fossil Mammals, Reptiles and Birds in British Museum*; *The Deer of All Lands*; *The Game Animals of Africa*; &c.	**Megatherium; Mole** (*in part*); **Monodelphia;** **Monotremata; Mouse;** **Multituberculata.**
R. M.-S.	Richmond Mayo-Smith, Ph.D. See the biographical article, Mayo-Smith, Richmond.	**Migration** (*in part*).
R. N. B.	Robert Nisbet Bain (d. 1909). Assistant Librarian, British Museum, 1883–1909. Author of *Scandinavia, the Political History of Denmark, Norway and Sweden, 1513–1900*; *The First Romanovs, 1613–1725*; *Slavonic Europe, the Political History of Poland and Russia from 1469 to 1796*; &c.	**Menshikov;** **Michael, Tsar;** **Moltke, Count A. G.;** **Moltke, Count A. W.**
R. P. S.	R. Phené Spiers, F.S.A., F.R.I.B.A. Formerly Master of the Architectural School, Royal Academy, London. Past President of Architectural Association. Associate and Fellow of King's College, London. Corresponding Member of the Institute of France. Editor of *Fergusson's History of Architecture.* Author of *Architecture: East and West*; &c.	**Mosque; Mouldings.**
R. S. C.	Robert Seymour Conway, M.A., D.Litt. (Cantab.). Professor of Latin and Indo-European Philology in the University of Manchester. Formerly Professor of Latin in University College, Cardiff; and Fellow of Gonville and Caius College, Cambridge. Author of *The Italic Dialects.*	**Messapii.**
S. A. C.	Stanley Arthur Cook, M.A. Lecturer in Hebrew and Syriac, and formerly Fellow, Gonville and Caius College, Cambridge. Editor for the Palestine Exploration Fund. Examiner in Hebrew and Aramaic, London University, 1904–1908. Council of Royal Asiatic Society, 1904–1905. Author of *Glossary of Aramaic Inscriptions*; *The Law of Moses and the Code of Hammurabi*; *Critical Notes on Old Testament History*; *Religion of Ancient Palestine*; &c.	**Melchizedek** (*in part*); **Menahem; Midrash;** **Mizraim; Moab;** **Moloch** (*in part*); **Moses.**
S. C.	Sidney Colvin, LL.D. See the biographical article, Colvin, Sidney.	**Michelangelo.**
St. C.	Viscount St. Cyres. See the biographical article, Iddesleigh, 1st Earl of.	**Molinos.**
S. N.	Simon Newcomb, D.Sc., LL.D. See the biographical article, Newcomb, Simon.	**Mercury; Moon.**

T. As.	Thomas Ashby, M.A., D.Litt. (Oxon.). Director of British School of Archaeology at Rome. Formerly Scholar of Christ Church, Oxford. Craven Fellow, 1897. Conington Prizeman, 1906. Member of the Imperial German Archaeological Institute. Author of *The Classical Topography of the Roman Campagna.*	**Mediolanum;** **Megara Hyblaea;** **Messina; Metapontum;** **Milan** (*in part*); **Minturnae; Misenum;** **Monreale** (*in part*); **Monteleone Calabro;** **Motya; Monument:** *Italy.*
T. A. I.	Thomas Allan Ingram, M.A., LL.D. Trinity College, Dublin.	**Medical Jurisprudence** (*in part*); **Midwife;** **Migration** (*in part*).
T. Ca.	Thomas Case, M.A. President of Corpus Christi College, Oxford. Formerly Waynflete Professor of Moral and Metaphysical Philosophy in the University of Oxford, and Fellow of Magdalen College.	**Metaphysics.**
T. C. A.	Sir Thomas Clifford Allbutt, K.C.B., M.A., M.D., D.Sc., LL.D., F.R.S. Regius Professor of Physic in the University of Cambridge. Physician to Addenbrooke's Hospital, Cambridge. Fellow of Gonville and Caius College, Cambridge. Editor of *Systems of Medicine.*	**Medicine:** *Modern Progress.*
T. H. H.*	Colonel Sir Thomas Hungerford Holdich, K.C.M.G., K.C.I.E., D.Sc. Superintendent Frontier Surveys, India, 1892–1898. Gold Medallist, R.G.S. (London), 1887. Author of *The Indian Borderland*; *The Countries of the King's Award*; *India*; *Tibet*; &c.	**Mohmand.**
T. K. R.	Thomas Kirke Rose, D.Sc. Chemist and Assayer, The Royal Mint, London. Author of *Metallurgy of Gold*; *The Precious Metals*; &c.	**Mint.**
Th. N.	Theodor Nöldeke, Ph.D. See the biographical article, Nöldeke, Theodor.	**Moʿallakāt.**
T. S. W.	Theodore Salisbury Woolsey, LL.D. Professor of International Law, Yale University. Editor of Woolsey's *International Law.* Author of *America's Foreign Policy*; &c.	**Monroe Doctrine.**
T. W. R. D	Thomas William Rhys Davids, LL.D., Ph.D. Professor of Comparative Religion, Manchester University. President of the Pali Text Society. Fellow of the British Academy. Secretary and Librarian of Royal Asiatic Society, 1885–1902. Author of *Buddhism*; *Sacred Books of the Buddhists*; *Early Buddhism*; *Buddhist India*; *Dialogues of the Buddha*; &c.	**Medhankara;** **Menander** (*Milinda*).
W. A. B. C.	Rev. William Augustus Brevoort Coolidge, M.A., F.R.G.S., Ph.D.(Bern). Fellow of Magdalen College, Oxford. Professor of English History, St David's College, Lampeter, 1880–1881. Author of *Guide du Haut Dauphiné*; *The Range of the Tödi*; *Guide to Grindelwald*; *Guide to Switzerland*; *The Alps in Nature and in History*; &c. Editor of *The Alpine Journal*, 1880–1881; &c.	**Meiringen; Meran;** **Merian; Mont Cenis;** **Morat;** **Müller, Johannes von.**
W. A. P.	Walter Alison Phillips, M.A. Formerly Exhibitioner of Merton College and Senior Scholar of St John's College, Oxford. Author of *Modern Europe*; &c.	**Mehemet Ali;** **Mephistopheles;** **Metternich; Minister;** **Mitre.**
W. B. Ri.	Sir William Blake Richmond, K.C.B. See the biographical article, Richmond, Sir William Blake.	**Mosaic:** *Modern.*
W. B. S.*	William Barclay Squire, M.A. Assistant in Charge of Printed Music, British Museum.	**Morley, Thomas.**
W. C. R.-A.	Sir William Chandler Roberts-Austen, K.C.B., D.C.L., F.R.S. See the biographical article, Roberts-Austen, Sir W. C.	**Metallography** (*in part*).
W. F. C.	William Feilden Craies, M.A. Barrister-at-Law, Inner Temple. Lecturer on Criminal Law, King's College, London. Editor of Archbold's *Criminal Pleading* (23rd edition).	**Misdemeanour.**
W. F. D.	William Frederick Denning, F.R.A.S. Gold Medallist, R.A.S. President, Liverpool Astronomical Society, 1877–1878. Author of *Telescopic Work for Starlight Evenings*; *The Great Meteoric Shower*; &c.	**Meteor.**
W. F. Sh.	William Fleetwood Sheppard, M.A. Senior Examiner in the Board of Education. Formerly Fellow of Trinity College, Cambridge. Senior Wrangler, 1884.	**Mensuration.**
W. H. F.	Sir William Henry Flower, F.R.S. See the biographical article, Flower, Sir W. H.	**Mink.**
W. H. H.	William Henry Howell, M.D., Ph.D., LL.D. Dean of the Medical Faculty and Professor of Physiology, Johns Hopkins University, Baltimore. President of the American Physiological Association. Associate-editor of *American Journal of Physiology.*	**Medical Education, U.S.A** (*in part*).
W. H. M.	William Herrick Macaulay, M.A. Fellow and Tutor of King's College, Cambridge.	**Motion, Laws of.**
W. L.*	Walter Lehmann, D.M. Directorial Assistant, Royal Ethnographical Museum, Munich. Author of *Methods and Results in Mexican Research*; &c.	**Mexico:** *Ancient History* (*in part*).

W. M.	William Minto, LL.D. See the biographical article, Minto, William.	**Mill, John Stuart** (*in part*).
W. M. C.	Sir W. Martin Conway. See the biographical article, Conway, Sir W. M.	**Mountaineering.**
W. M. R.	William Michael Rossetti. See the biographical article, Rossetti, Dante, G.	**Moroni.**
W. P. A.	Lieut.-Colonel William Patrick Anderson, M.Inst.C.E., F.R.G.S. Chief Engineer, Department of Marine and Fisheries of Canada. Member of the Geographic Board of Canada. Past President of Canadian Society of Civil Engineers.	**Michigan, Lake.**
W. R. M.	William Richard Morfill, M.A. (d. 1910). Formerly Professor of Russian and the other Slavonic Languages in the University of Oxford. Curator of the Taylorian Institution Oxford. Author of *Russia; Slavonic Literature*; &c.	**Mickiewicz, Adam.**
W. R. S.	William Robertson Smith, LL.D. See the biographical article, Smith, William Robertson.	**Medina;** **Melchizedek** (*in part*); **Messiah** (*in part*); **Micah** (*in part*); **Moloch** (*in part*).
W. R. S.*	William Roy Smith, M.A., Ph.D. Associate Professor of History, Bryn Mawr College, Pennsylvania. Author of *Sectionalism in Pennsylvania during the Revolution*; &c.	**Missouri Compromise.**
W. S. R.	William Smyth Rockstro. Author of *A General History of Music from the Infancy of the Greek Drama to the Present Period*; and other works on the history of music.	**Mendelssohn-Bartholdy** (*in part*); **Mozart** (*in part*).

PRINCIPAL UNSIGNED ARTICLES

Melbourne.
Melon.
Meningitis.
Mercantile System.
Mercury (Chemistry).
Mermaids.
Metal.
Metallurgy.
Michigan.
Micronesia.
Militia.
Milk.
Mineral Waters.
Ministry.
Minnesingers.
Minnesota.
Mississippi.
Mississippi River.
Missouri.
Monaco.
Monmouthshire.
Monopoly.
Montana.
Moors.
Moravia.
Mormons.
Morphine.
Mortgage.
Mounted Infantry.

THE
ENCYCLOPÆDIA BRITANNICA

VOLUME 18

MEDAL TO MUMPS

MEDAL (Fr. *médaille*, from Lat. *metallum*), strictly the term given to a memorial piece, originally of metal, and generally in the shape of a coin, used however not as currency but as an artistic product. "Medallion" is a similar term for a large medal, but is now usually restricted to a form of bas-relief in sculpture. The term "medal" is, artistically, extended by analogy to pieces of the same character not necessarily shaped like coins. The history of coins and medals is inseparable, and is treated under the general heading of NUMISMATICS. That article may be supplemented here by an account of (1) the more recent progress in the art of the medallist, and (2) the use of medals for war decorations.

1. The medal—as it is understood to-day—enjoys a life entirely independent of the coin on the one hand, and, on the other, of the sculptured medallion, or bas-relief; and its renaissance is one of the chief phenomena in art during the period since about 1870. It is in France that it has risen to the greatest perfection. Its popularity there is well-nigh universal; it is esteemed not only for memorials of popular events and of public men, but also for private celebrations of all kinds. No other nation approaches in excellence—in artistic feeling, treatment, and sensitiveness of execution—the artists and the achievements of France. In England, although the Royal Academy seeks to encourage its students to practise the art, the prize it offers commonly induces no competition. The art of the medallist is not properly appreciated or understood, and receives little or no support. The prevailing notion concerning it is that it consists in stamping cheap tokens out of white metal or bronze, on which a design, more or less vulgar, stands out in frosty relief from a dazzling, glittering background. These works, even the majority of military and civic medals, demonstrate how the exquisite art of the Renaissance had been degraded in England—almost without protest or even recognition—so that they are, to a work of Roty or Chaplain, what a nameless daub would be to a picture by Rembrandt or Velasquez.

It is probable that Jacques Wiener (d. 1899), of Belgium, was the last of the medallists of note who habitually cut his steel dies entirely with his own hand without assistance, though others in some measure do so still. Although most modern workers, exclusively medallists, have themselves cut dies, they now take advantage of the newest methods; and the *graveur en médailles* has become simply a *médailleur*. His knowledge of effect is the same—though the effect sought is different: in earlier times the artist thought chiefly of his *shadows*; now he mainly regards his *planes*. Otherwise his aims are not dissimilar. At the present day the medallist, after making conscientious studies from life (as if he were about to paint a picture), commonly works out his design in wax, or similar substance, upon a disk of plaster about 12 or 14 inches in diameter. From that advanced model a simple mould, or matrix, is made, and a plaster cast is taken, whereupon the artist can complete his work in the utmost perfection. Then, if a struck medal is required, a steel cast is made, and from that a reduction to the size required for the final work is produced by means of the machine—the *tour à réduire*. It is this machine which has made possible the modern revival, and has revolutionized the taste of designers and public alike. It was invented by Contamin, who based it upon that *tour à portrait* which Houlot produced in 1766, and which helped to fame several engravers now celebrated. This machine was first exhibited in Paris in 1839, and was sold to the Munich Mint; while a similar invention, devised at the same time by the English engraver Hill, was acquired by Wyon for £2000, and was ultimately disposed of to a private mint in Paris. From that city comes the machine, based by the French inventor M. Ledru upon the two already referred to, now in use at the Royal Mint in London. A well-served medallist, therefore, need trouble himself nowadays about little beyond the primary modelling and the final result, correcting with his own hand only the slightest touches—refining, perfecting—but sometimes merely confining himself to giving his directions to the professional engraver.[1]

The great majority of the artistic medals at present in the world (in the great collection of France there is a total of not fewer than 200,000 medals) are cast, not struck. There is in them a charm of surface, of patina, of the metal itself, which the struck medal, with all the added beauties which it allows of delicate finish and exquisite detail, can hardly give. But the production of the cast medal is much slower, much more uncertain, and the number of fine copies that can be produced is infinitely smaller. All the early medals were cast, being first modelled in wax, and then cast by the *cire perdue* (waste wax) process, and were usually worked over by the chaser afterwards; indeed, it was not until the beginning of the 16th century that dies, hitherto used only for coins executed in low relief, were employed for larger and bolder work. The medallists of those days always cast in bronze or lead, and only proceeded to use silver and gold as a luxurious taste began to demand the more precious metals. There is little doubt that the material to be preferred is dull silver (*mat* or *sablé*—sand-blasted), as the work, with all its variations of light and shade, can be better seen in the delicate grey of the surface.

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[1] The method of preparing the dies, &c., is the same for medals as for coins, save that for larger and heavier work more strokes are required, as in the case of L. Coudray's popular "Orphée"—rather a sculpture-relief than a medal. The dies are capable of a great yield before becoming quite worn-out; it is said that no fewer than three million copies were struck of Professor J. Tautenhayn's Austrian jubilee medal of the Emperor Francis Joseph. In France, Thonelier's perfected machine, substituting the lever for the screw, has been in use for coins since 1844; but for the striking of medals the same old fashioned screw-press is retained which had till then been employed both for coins and medals since the time of Louis XIV. In its present form the machine consists of an iron or bronze frame, of which the upper part is fitted with a hollow screw wherein works an inner screw. This screw, moved by steam or electricity, drives the dies, set in iron collars, so that they strike the blank placed between them. This machine can deliver a strong blow to produce a high relief, or a delicate touch to add the finest finish. In the Paris Mint large medals can be struck with comparative ease and rapidity. A hydraulic press of nearly two million pounds pressure is utilized for testing the dies

The medal, properly considered, is not sculpture. Vasari was happy in his definition when he described the medallic art as the link between sculpture and painting—that is to say, painting in the round with the colour left out. Less severe than sculpture, it need not be less dignified; it is bound down by the conventions of low relief, and by compulsions of composition and design, dependent on shape, from which sculpture, even when the relief is the lowest, is in a great measure free. In the medal, otherwise than in sculpture, elaborate perspective and receding planes are not out of place. The genius of the modern Frenchman rebelled against the rule that commonly governed the medal during the decadence, and has triumphed in his revolt, justifying the practice by his success. The modern medal and the *plaquette* aim at being decorative yet vigorous, reticent and dignified, delicate and tender, graceful and pure; it may be, and often is, all these in turn. Imagination, fancy, symbolism, may always be brought into play, allied to a sense of form and colour, of arrangement and execution. By the demonstration of these qualities the artist is to be differentiated from the skilful, mechanical die-sinker, who spreads over the art the blight of his heavy and insensitive hand and brain. So with portraiture. Accurate likeness of feature as well as character and expression are now to be found in all fine works, such as are seized only by an artist of keenly sensitive temperament. It is thus that he casts the events and the actions of to-day into metallic history, beautifully seen and exquisitely recorded; thus that the figure on the medal is no longer a mere sculpturesque symbol, but a thing of flesh and blood, suave and graceful in composition, and as pleasing in its purely decorative design as imagination can inspire or example suggest. It is thus that the art, while offering easy means of permanent memorial, has afforded to men of restricted means the eagerly seized opportunity of forming small collections of masterpieces of art at a small outlay.

France.—In France the example of Oudiné, coming after that of David d'Angers, did much to revolutionize the spirit animating the modern medallist, but Chapu, by his essentially modern treatment, did more. To Ponscarme (pupil of Oudiné) is chiefly due the idea of rendering *mat* the ground as well as the subject on the medal, the suppression of the raised rim, and the abandonment of the typographic lettering hitherto in vogue, together with the mechanical regularity of its arrangement. Degeorge, with his semi-pictorial treatment, was followed by Daniel Dupuis, whose delicate and playful fancy, almost entirely pictorial, makes us forget alike the material and the die. J. C. Chaplain is unsurpassed as a modeller of noble heads, including those of four presidents of the French Republic—Macmahon, Casimir-Perier, Faure and Loubet—and his allegorical designs are finely imagined and admirably worked out (see Plate); but L. Oscar Roty (pupil of Ponscarme) is at the head of the whole modern school, not only by virtue of absolute mastery of the technique of his art, but also of his originality of arrangement, of the poetic charm of his symbolism and his allegories, the delicate fancy, the exquisite touch, the chasteness and purity of taste—wedding a modern sentiment to an obvious feeling for the Greek. Though expressly less virile than Chaplain, Roty is never effeminate. To Roty belongs the credit of having first revived the form of the *plaquette*, or rectangular medal, which had been abandoned and forgotten along with many other traditions of the Renaissance (see Plate). Alphée Dubois, Lagrange, and Borrel must be mentioned among those who are understood to engrave their own dies. Followers are to be found in Mouchon, Lechevrel, Vernon, Henri Dubois, Patey, Bottée (see Plate)—all sterling artists if not innovators. Medallists of more striking originality but less finish, and of far less elegance are Michel Cazin, Levillain (who loves as much as Bandinelli to make over-display of his knowledge of muscular anatomy), Charpentier, and their school, who aim at a manner which makes less demand of highly educated artistry such as that of Roty or of Chaplain. It is learned and accomplished in its way, but lumpy in its result; breadth is gained, but refinement and distinction are in a great measure lost. It may be added—to give some idea of the industry of the modern medallist, and the encouragement accorded to him—that between 1879 and 1900 M. Roty executed more than 150 pieces, each having an obverse and a reverse.

Austria.—The two leading medallists of the Austrian school are Josef Tautenhayn (see Plate) and Anton Scharff, both highly accomplished, yet neither displaying the highest qualities of taste, ability and "keeping," which distinguishes the French masters. About 330 pieces have come from the hand of Anton Scharff. Stefan Schwartz, Franz Pawlik, Staniek, Marschall and J. Tautenhayn, junior, are the only other artists who have risen to eminence.

Germany.—A characteristically florid style is here cultivated, such as lends itself to the elaborate treatment of costume, armorial bearings, and the like; but delicacy, distinction, and the highest excellence in modelling and draughtsmanship—qualities which should accompany even the most vigorous or elaborate designs—are lacking in a great degree. Professors Hildebrand and Kowarzik have wrought some of the most artistic works there produced.

Belgium.—Although sculpture so greatly flourishes in Belgium, medal work shows little promise of rivalling that of France. The influence of the three brothers Wiener (Jacques, Léopold and Charles)—good medallists of the old school—has not yet been shaken off. The remarkable architectural series by the first-named, and the coinage of the second, have little affinity with the spirit of the modern medal. Lemaire has perhaps done as well as any, followed by Paul Dubois, J. Dillens (a follower of the French), G. Devreese and Vinçotte (see Plate)—whose *plaquette* for the Brussels Exhibition award (1887) is original, but more admirable in design than in finish.

Holland.—In Holland not very much has been done. Patriotism has called forth many medals of Queen Wilhelmina, and the best of them are doubtless those of Bart van Hove and Wortman. Baars is a more virile artist, who follows Chaplain at a distance. Wienecke is interesting for the sake of his early Netherlandic manner; the incongruity is not unpleasant.

Switzerland.—The medal is also popular in Switzerland. Here Bovy is the leader of the French tradition and Hans Frei of a more national sentiment. The last-named, however, is more remarkable as a revivalist than as an original artist.

Great Britain.—In England only two medallists of repute can be counted who practically confine themselves to their art—G. W. de Saulles, of the Royal Mint, best known by the Diamond Jubilee medal of Queen Victoria and by his medal of Sir Gabriel Stokes, and Frank Bowcher (see Plate) by that of Thomas Huxley. These artists both cut their own dies when necessary. Emil Fuchs, working in England in the manner of the French medallists, but with greater freedom than is the wont of the older school, has produced several examples of the art: the medals commemorative of the South African War and of Queen Victoria (two versions), all of 1900; and many portrait medals and *plaquettes* of small size have come from the same hand. Besides these, the leading English sculptors have produced medals—Lord Leighton, Sir Edward Poynter, Hamo Thornycroft, T. Brock, Onslow Ford, G. Frampton and Goscombe John; but, practising more continually in sculpture, they do not claim rank as medallists, nor have they sought to acquire that class of dexterity which constant habit alone can give. Alphonse Legros, who has cast a certain number of portrait medals, is usually included in the French school.

United States.—Among American medallists Augustus St Gaudens (see Plate) is perhaps the most prominent; but he is not, strictly speaking, a medallist, but a sculptor who can model in the flat.

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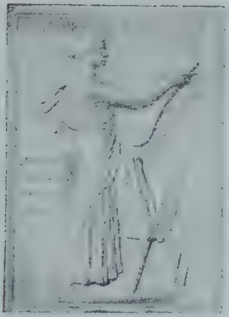
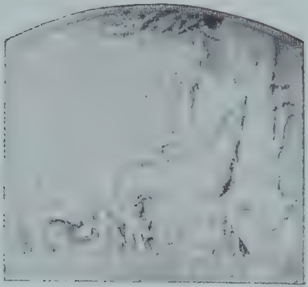
(M. H. S.)

MEDALS AS WAR DECORATIONS

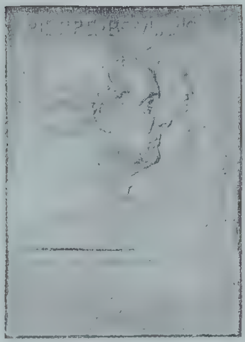
Although the striking of medals to commemorate important events is a practice of considerable antiquity, yet the custom of using the medal as a decoration, and especially as a decoration to do honour to those who have rendered service to the state



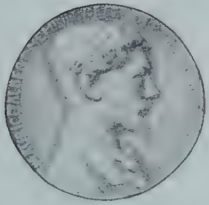
DUPLESSIS PLAQUETTE.
Roty.



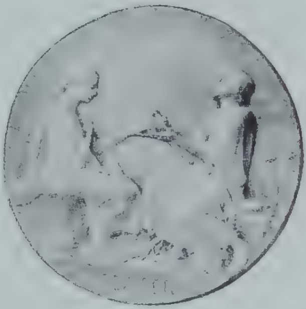
STUDY.
Roty.



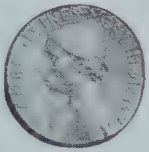
BOULANGER PLAQUETTE.
Roty.



MAURICE ALBERT
PORTRAIT.
Roty.



WEDDING MEDAL.
Roty.

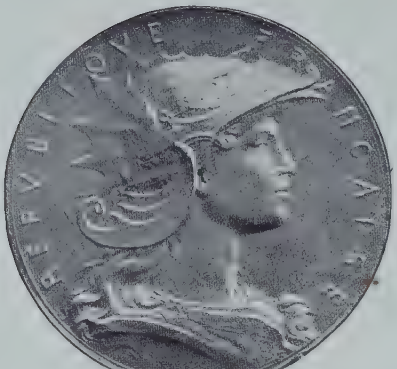


AMBROISINE MERLIN
From the Medal by
Michel Cazin.

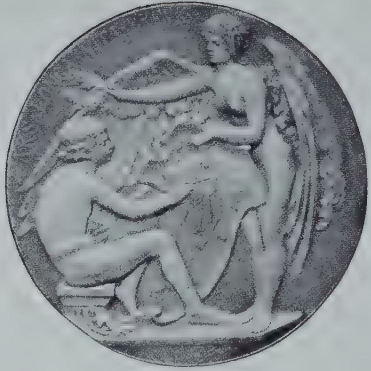
MEDALS AND PLAQUETTES.
Jules Chaplain.

PLATE II.

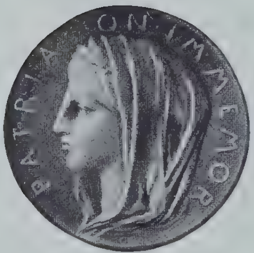
MEDAL


REPUBLIQUE FRANÇAISE

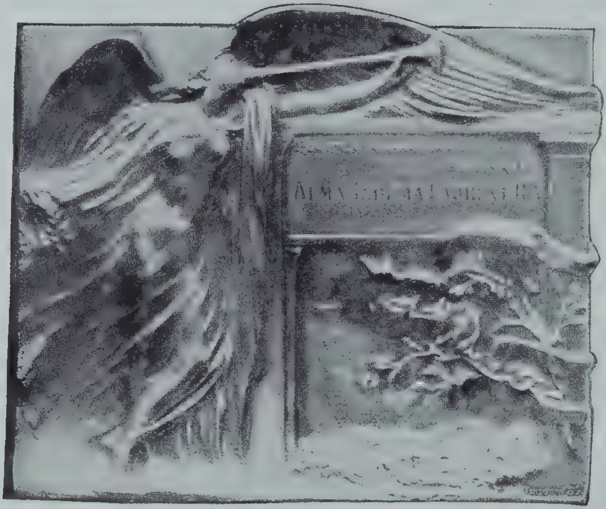
HENRI DUBOIS.



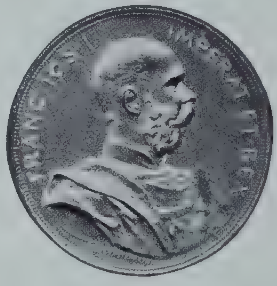
MEDAL OF AWARD FOR THE COPE AND NICOL SCHOOL OF PAINTING.
F. BOWCHER.


PATRIA NON IMMEMOR

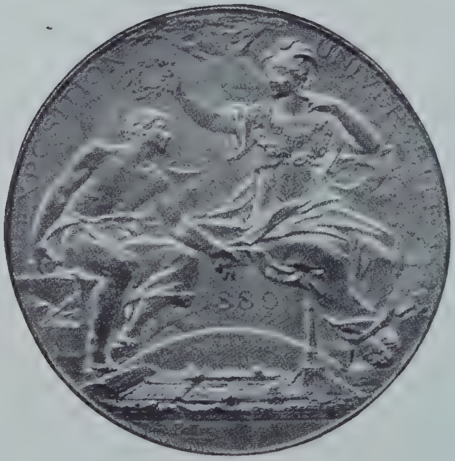
FRANCE, 1870.
ROTY.



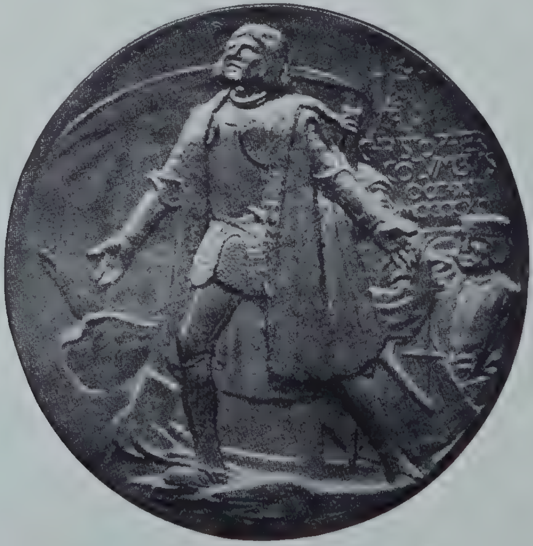
GREAT GOLD MEDAL, BRUSSELS, 1898.
Designed by P. WOLFERS. Engraved by VINÇOTTE.



GOLD MEDAL, VIENNA, 1894.
By JOSEPH TAUTENHAYN.



PARIS UNIVERSAL EXHIBITION, 1889.
By LOUIS BOTTÉE.



INTERNATIONAL EXHIBITION, CHICAGO, 1893.
By AUGUSTUS ST GAUDENS.

in time of war, is comparatively modern. It has been supposed that the circular ornaments on the Roman standards had medals in their centres, but there is no evidence to show that this was the case, and the standards shown on the column of Trajan appear only to have had plain bosses in their centres. It is true that the Chinese are said to have used military medals during the Han dynasty (1st century A.D.), but, as far as the West is concerned, we have to come to the 16th century before we find the custom of wearing medals as decorations of honour a recognized institution.

The wearing of decorative medals was common in England in the reign of Henry VIII., but the first medals commemorating a particular event that were evidently intended as a personal decoration, and were in all probability (though there is no absolute proof) bestowed as reward for military services rendered to the Crown, are the "Armada" medals of Queen Elizabeth, 1588–1589. Of these there are two. The earliest, generally styled the "Ark in flood" medal, is a large oval medal of silver (2 by 1·75 in.), and bears on the obverse a profile bust of the queen surrounded by the inscription, ELIZABETH D. G. ANGLIAE. F. ET HI. REG. On the reverse is an ark on waves, with above the rays of the sun, and around the legend, SAEVAS TRANQVILLA PER VNDAS. This medal dates from 1588, and in the following year there was given another medal, a little larger (2·3 by 2·1 in.) and struck in gold, silver and copper. The obverse of this second medal bore a full-face bust of Elizabeth, with the legend, characteristic both of the monarch and the period, DITIOR IN TOTO NON ALTER CIRCULUS ORBE. The reverse has an island around which ships are sailing and sea-monsters swimming, and on the island there are houses, a flourishing bay-tree, standing uninjured by a storm of wind, and lightning emerging from heavy clouds above. The island is inscribed NON IPSA PERICVLA TANGVNT. These medals are of special interest as demonstrating thus early the existence of a doctrine of sea-power. In fact, in the medals of James I. (1603–1625), none of which have a distinct reference to war services, the "ark in flood" design was again reproduced on the reverse, this time with the legend slightly altered, viz. STET SALVVS IN VNDIS.

Other European nationalities were also about this period conferring decorative medals as a reward for war services, as for example, the "Medal to Volunteers" issued in Holland in 1622–1623 and the "Military Medal of Gustavus Adolphus" issued in Sweden in 1630. Here it may be noted that in following the history of medals as used as a decoration to reward military services, only those of British origin need be dealt with in detail, since Great Britain has utilized them in a much greater degree than any other nationality. The countless minor wars of the 19th century, waged by the forces of the Crown of every class, navy, army and auxiliary, have no equivalent in the history of other states, even in that of France, the United States and Russia. The great wars of the 19th century were divided by long intervals of peace, and the result is that with most of the great military powers the issue of campaign medals has been on a small scale, and in the main decorations have taken the form of "Orders" (see KNIGHTHOOD AND CHIVALRY: *Orders*), or purely personal decorations for some meritorious or exemplary service.

During the reign of Charles I. (1625–1649), we come across numerous medals and badges; a considerable number of these were undoubtedly associated with, and given, even systematically given, as rewards for war services; for a royal warrant "given at our Court of Oxford, the eighteenth day of May, 1643," which directed "Sir William Parkhurst, Knight, and Thomas Bushell, Esquire, Wardens of our Mint, to provide from time to time certain Badges of silver, containing our Royal image, and that of our dearest son, Prince Charles, to be delivered to wear on the breast of every man who shall be certified under the hands of their Commanders-in-Chief to have done us faithful service in the Forlorn-hope."

From the foregoing it must not be deduced that this medal was in any way intended to reward special valour. In those days "forlorn-hopes" were not volunteers for some desperate enterprise, as to-day, but a tactical advanced guard which naturally varied, both in numbers and arm of the service, according to ground and circumstances. That a very free distribution of the award was contemplated is evident from the fact that "soldiers" alone were specified as recipients and that a clause was inserted in the warrant strictly forbidding the sale of the medal. This letter ran:—

> "And we do, therefore, most straitly command, that no soldier at any time do sell, nor any of our subjects presume to buy, or wear, any of these said Badges, other than they to whom we shall give the same, and that under such pain and punishment as our Council of War shall think fit to inflict, if any shall presume to offend against this our Royal command."

As there are in existence several medals of this period which bear the effigies of both the king and Prince Charles, it is uncertain which in particular was used for the "forlorn-hope" award. Very probably it is one, an oval silver-gilt medal (1·7 by 1·3 in.) which bears on the obverse a three-quarters (r.) bust of Charles I., and on the reverse a profile (l.) bust of Prince Charles (see Mayo, *Medals and Decorations of the British Army and Navy*, vol. 1. No. 16, Plate 5, No. 3). During the Commonwealth (1649–1660), parliament was lavish in the award of medals in recognition of war services, and for the first time we find statutory provision made for their bestowal as naval awards, in the shape of acts of parliament passed Feb. 22, 1648 and April 7, 1649 (cap. 12, 1648 and cap. 21, 1649), and Orders in Council of May 8 and Nov. 19 and 21, 1649, and Dec. 20, 1652. There is no doubt whatever that there was a "Medal of the Parliament" for sea service issued in 1649. This medal, oval (·95 by ·85 in.) and struck in gold and silver, had on the obverse an anchor, from the stock of which are suspended two shields, one bearing the cross of St George, and the other the Irish harp. The motto is MERVISTI. On the anchor stock, T. S.[1] The reverse has on it the House of Commons with the Speaker in the chair. This medal is referred to in a minute of the Council of State of Nov. 15, 1649:—

> "(5) That the Formes of the medalls which are now brought in to be given to the severall Mariners who have done good service this last Sum̄er be approved off, viz^{t}: the Armes of the Com̄on wealth on one side with *Meruisti* written above it, and the picture of the House of Com̄ons on the other."

That there was a "Medal of the Parliament" for land service as well, is proved by the following extract from the Journals of the House of Commons (vii. 6, 7):—

> "*Resolved*, That a Chain of Gold, with the Medal of the Parliament, to the Value of One Hundred Pounds, be sent to Colonel Mackworth, Governor of Shrewsbury, as a mark of the Parliament's Favour, and good acceptance of his fidelity: And that the Council of State do take care for the providing the same, and sending it forthwith."

This order was duly carried out, as is shown in the minutes of the Council of State, June 2 and July 30, 1652, but there is no trace to-day of either medal or chain. It is not unlikely that this medal is one figured at page 117 of Evelyn's *Numismata* (the engraving, unnumbered, is placed between Nos. 39 and 40, and there is no allusion to it in the text), which has on the obverse a representation of the parliament, and on the reverse a bust of the Protector with a camp and troops in the background.

The most splendid of all the naval awards of this period were those given for the three victories over the Dutch in 1653, namely:—

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[1] Thomas Simon, master and chief graver of the mint. Most of the medals of this period were his work, and they are considered to be amongst the best specimens of the medallic art that have been produced in the country.

1. The fight of Feb. 18/20, when Blake, Deane and Monk defeated Van Tromp and De Ruyter, the battle beginning off Portland and ending near Calais; (2) the fight of June 2 and 3, off the Essex coast, when Monk, Deane (killed), Penn and Blake, again defeated Van Tromp and De Ruyter; (3) the fight of 31st of July off the Texel, in which Monk, Penn and Lawson beat Van Tromp in what was the decisive action of the war. The authorization for these awards will be found recorded in the Journals of the House of Commons (vii. 296, 297), under date Aug. 8, 1653. The medals, all oval, and in gold, were given in three sizes, as described below:—

A (2·2 by 2 in.). Only four of these medals were issued, to Admirals Blake and Monk, each with a gold chain of the value of £300, and to Vice-Admiral Penn and Rear-Admiral Lawson, each with a gold chain of the value of £100. On the obverse is an anchor, from the stock of which are suspended three shields, bearing respectively St George's cross, the saltire of St Andrew, and the Irish harp, the whole encircled by the cable of the anchor. On the reverse is depicted a naval battle with, in the foreground, a sinking ship. Both obverse and reverse have broad, and very handsome, borders of naval trophies, and on the obverse side this border has imposed upon it the arms of Holland and Zeeland. Of these four medals three are known to be in existence. One, lent by the warden and fellows of Wadham College, Oxford (Blake, it may be noted, was a member of Wadham College) was exhibited at the Royal Naval Exhibition of 1891. A second is in the royal collection at Windsor Castle. The third, with its chain, is in the possession of the family of Stuart of Tempsford House, Bedfordshire. This latter medal is known to have been the one given to Vice-Admiral Penn, an ancestor of the Stuart family. The one at Windsor is presumably Blake's, as Tancred states "the medal given to Blake was purchased for William IV. at the price of 150 guineas (Tancred, *Historical Records of Medals*, p. 30). The medal at Wadham was formerly in Captain Hamilton's collection. He purchased it at a low figure, but secrecy was kept as to the owner, and the original chain that was with it went into the melting-pot: there is therefore nothing to show whether it was Monk's or Lawson's, as the chain would have done. It was sold at Sotheby's in May 1882 for £305.

B (2 by 1·8 in.). Four of these medals were issued, each with a gold chain of the value of £40, to the "Flag Officers," *i.e.* to the flag captains who commanded the four flag-ships. The obverse and reverse of this medal are, with the exception of the borders, precisely as in (A). The borders on both sides are a little narrower than those of (A), and of laurel instead of trophies. One of these medals—that given to Captain William Haddock, who was probably Monk's flag-captain in the "Vanguard," in the February fight, as he had been in that ship in the previous year, and who commanded the "Hannibal," (44) in the June battle—is now (1909) in the possession of Mr C. D. Holworthy, who is maternally descended from Captain Haddock.

C (1·6 by 1·4 in.). This medal is precisely the same as (B). but has no border of any kind, and also was issued without the gold chains. It was in all probability one that was issued in some numbers to the captains and other senior officers of the fleet.

Some of these medals have in the plate of the reverse an inscription: FOR EMINENT SERVICE IN SAVING Y TRIUMPH FIERED IN FIGHT WH Y DVCH IN JULY 1653. The medal so inscribed was given only to those who served in the "Triumph," and commemorates a special service. Blake, incapacitated by wounds received in the fight of February, took no part in this action, but his historic flag-ship, the "Triumph," formed part of the fleet, and early in the battle was fired by the Dutch fire-ships. Many of the crew threw themselves overboard in a panic, but those who remained on board succeeded by the most indomitable and heroic efforts in subduing the flames, and so saving the vessel.

But undoubtedly the most interesting of all the medals of the Commonwealth period, is that known as the "Dunbar Medal," authorized by parliament, Sept. 10, 1650, in a resolution of which the following is an extract:—

> "*Ordered*, that it be referred to the Committee of the Army, to consider what Medals may be prepared, both for Officers and Soldiers, that were in this Service in Scotland; and set the Proportions and Values of them, and their number; and present the Estimate of them to the House. (*Journals of the House of Commons*, vi. 464–465.)

So came into being, what, in a degree, may be regarded as the prototype of the "war medal" as we know it to-day, for the "Dunbar Medal" is the very earliest that we know was issued to all ranks alike, to the humblest soldiers as well as to the commander-in-chief. It differed however in one very material point from the war medal of to-day—in that it was issued in two sizes, and in several different metals. There is no evidence to show what was the method that governed the issue of this medal; but the medal itself undoubtedly varied in size or metal, or both, according to the rank of the recipient. Of the two sizes in which the medal was issued the smaller, 1 by ·85 in. was apparently intended for seniors in the respective grades, for it was struck in gold, silver and copper. The larger, 1·35 by 1·15 in. was struck in silver, copper and lead (see Mayo. *op. cit.* i. 20–21).[1] On the obverse of both issues of the "Dunbar Medal" is a left profile bust of Oliver Cromwell, with, in the distance, a battle. The reverse of the larger medal has the parliament assembled in one House with the Speaker; and, on the left, a member standing addressing the chair. The reverse of the smaller medal is the same as that of the larger, except that the member addressing the House is omitted. Cromwell himself expressed a wish to the "Committee of the Army, at London," in a letter dated the 4th of February 1650/51, that his likeness, to procure which accurately the committee had sent Mr Simon to Scotland, should not appear on the medal. He writes:—

> "If my poor opinion may not be rejected by you, I have to offer to which I think the most noble end, to witt, The Commemoracon of that great Mercie att Dunbar, and the Gratuitie to the Army, which might be better expressed upon the Medall, by engraving, as on the one side the Parliament which I hear was intended and will do singularly well, so on the other side an Army, with this inscription over the head of it, The Lord of Hosts which was our Word that day. Wherefore, if I may beg it as a favour from you, I most earnestly beseech you, if I may do it without offence, that it may be soe. And if you think not fitt to have it as I offer, you may alter it as you see cause; only I doe think I may truly say, it will be very thankfully acknowledged by me, if you will spare the having my Effigies in it."

In spite of this request Cromwell's "Effigies" is made the prominent feature of the obverse of the medal, to which the representation of the "Army" is entirely subordinated. His wish that the "word" for the day should be commemorated is, however, observed in the legend on the obverse, as is also, on the reverse, his suggestion that on one side of the medal there should be a representation of the parliament.

During the reign of Charles II. the issue of medals was numerous, and though we have it on the authority of Evelyn that many of these were bestowed as "gratuities of respect," yet many were given as naval awards; and, for the first time, there appears official authorization for the conferring of particular awards on those who had succeeded in the very hazardous service of destroying an enemy's vessel by the use of fire-ships. In what are probably the earliest "Fighting Instructions" issued—those of Sir William Penn, in 1653, and again in an abridged form in 1655—no allusion to these awards is made, but that the custom of rewarding this special service prevailed, there is a piece of strong indirect evidence to show, in the shape of an amusing letter from a certain Captain Cranwill, of "ye Hare Pinke," to the Admiralty Committee, dated Feb. 4, 1655:—

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[1] An excellent reproduction of this medal, both obverse and reverse, is given in Plate 8, figs. 4 and 5, of the same work, and on Plate 9 will be found equally well reproduced facsimiles of the three medals for "Victories over the Dutch, 1653," figs. 1, 2 and 3 and of the "Medal of the Parliament, for Sea Service, 1649," fig. 1.

" As for ye Pay yor Honrs were please to order mee for my service in ye Hare Pinke, I return most humble thankes, and am ready to serve yor Honrs and my Country for ye future

. . . .

For though ye Hare be mewsed in ye sand
yet Cranwell at your mercy still doth stand
A fire Ship now doth hee Crave,
And the Fox fain would he Have,
then has hee had both Fox and Hare,
then Spanish Admirall stand you cleare,
For Cranwell means ye Chaine of goold to ware;
Sett penn to paper it is done,
for Cranwell still will be your man,"

all of which goes to show that it had not been unusual to bestow gold chains, with or without medals, on the captains of fire-ships. By the "Fighting Instructions" issued 20th of April, 1665, by James, duke of York, lord high admiral, it was provided as follows. In the case of the destruction of an enemy's vessel of forty guns or more, each person remaining on board the fire-ship till the service was performed was to receive £10, "on board ye Admirall imediately after ye service done," and the captain a gold medal and "shuth other future encouragement by preferment and commande as shall be fitt both to reward him and induce others to perform ye like Service." If it was a flag-ship that was fired "ye Recompense in money shall be doubled to each man performing itt, and ye medall to ye Commander shall be shuth as shall particularly ezpress ye Eminensye of ye Service, and his with ye other officers preferement shalbe suitable to ye meritt of itt." This was followed by an "Oder of the King in Council" dated Whitehall 12th of January 1669–1670, in which the lord high admiral is authorized "to distribute a Medall and Chaine to such Captaines of Fire Shipps as in the last Dutch Warr have burnt any Man of Warr, as also to any of them that shall perform any such service in the present Warr with Algiers. Which Medalls and Chaines are to be of the price of Thirty Pounds each or thereabouts"

To complete the story of fire-ship awards, it may here be noted (though out of chronological order) that in 1703 revised "Fighting Instructions" were issued by Admiral Sir George Rocke, in which it was provided that the captain was to have his choice between a gratuity of £100, or a gold medal and chain of that value. Lastly an order of the king in council, dated, St James's, 16th of December, 1742, ordered that all lieutenants of fire-ships (which originally carried no officers of this rank) should be entitled to a gratuity of £50 "in all cases where the Captain is entituled to the Reward of £100." Though probably others were conferred, so thorough an investigator as the late John Horsley Mayo, for many years assistant military secretary at the India office, who had special opportunities of access to official records, traced but three authenticated fire-ship awards. Those were: (1) to Captain John Guy, who blew up his fire-ship the "Vesuvius" under the walls of St Malo in 1693; (2) to Captain Smith Callis who, with his fire-ship the "Duke," in 1742, destroyed five Spanish galleys which had put into St Tropez, to the eastward of Marseilles; (3) to Captain James Wooldridge, who commanded the British fire-ships in Aix Roads on the 11th of April 1809, when four French sail of the line were burnt. This latter is believed to be the last award of the kind that was issued. Fire-ships awards are of special interest as affording a precedent, in future naval wars, for the award of special decorations for torpedo services.

It is in this reign also that we first find a case of medals being granted by the Honourable East India Company. The earliest of these would appear to have been a gold medal of the value of £20, conferred on Sir George Oxinden, president at Surat, 1622–1669, in 1668, for considerable civil and military services. Surat was then and until 1687, when Bombay took its place, the seat of government of the Western Presidency, and the most eminent of Sir George's services was the defence of the Company's treasures and possessions at that place against Sivajee and the Mahrattas in 1664. It is not known what has become of this medal, but there is indirect evidence to show that it was a circular medal, three inches in diameter. On the obverse the "Arms of the Governor and Company of Merchants of London trading to the East Indies, with creast, supporters, and mottoes," and around the legend NON MINOR EST VIRTVS QUAM QVAERERE PARTA TVERI. The reverse was probably blank to admit of an inscription. This award was the forerunner of many given by the H.E.I. Co., several of which were "general distributions" of the very highest interest, which will be dealt with together later on.

The awards made in the reigns of James II., William and Mary, William III., Anne, George I., George II., may be very briefly dealt with. Almost without an exception they were either naval or conferred by the Hon. East India Company, and with only perhaps one or two exceptions, they were "personal" as distinct from "general" awards. Of the very few medals awarded by James II., one was an undoubted military award, though curiously enough the recipient was a bishop. This was Peter Mew, who had been made bishop of Bath and Wells in 1672, was translated to Winchester 1684, "and next year was commanded by the king, in compliance with the request of the gentry of Somerset, to go against Monmouth, and did eminent service at the battle of Sedgmoor, where he managed the artillery; for which he was rewarded with a rich medal" (Hutchins's *History of Dorset*, 3rd ed., vol. iv. p. 149).

The possible exceptions in the way of a "general" distribution of a medal during the reigns under review are the cases of the medals struck after the battles of La Hogue, 1692, and Culloden, 1746. By an act of parliament passed in 1692 (4 Gul. and Mar. c. 25), it was enacted that a tenth part of the prize money taken by the navy should be set apart "for Medalls and other Rewards for Officers, Mariners, and Seamen in their Majesties Service at Sea who shall be found to have done any signal or extraordinary service." (Later a Royal Declaration of Queen Anne, the 1st of June 1702, provided that all medal and monetary awards "shall be also paid out of Her Majesties Shares of Prizes.") This is the first case in naval records authorizing the issue of medals to men as well as to officers, and the conferring of the "La Hogue" medal was the first case in which the enactment was carried into effect, at any rate as far as admirals and officers are concerned. Seamen and soldiers had a more substantial reward, for the queen sent £30,000 to be distributed amongst them, whilst gold and silver medals were struck for the admirals and officers. The medal, which was circular, 1·95 in. in diameter, had on the obverse the busts conjoined of William and Mary, r., with around GVL ET MAR D G M B F ET H REX ET REGINA. On the reverse was a representation of the fight, showing the French flag-ship, "Le Soleil Royal," in flames, with above the legend, NOX NVLLA SECVTA EST, and, in the exergue, PVGN. NAV. INT. ANG ET FR 21 MAY 1692.

As regards the medal struck after Culloden, fought on the 16th of April 1746, and in which the adherents of the young Pretender were completely routed, there is nothing even to show that it was issued even by the authority of the government, though it was undoubtedly worn, and (if a contemporary portrait is to be relied upon, that of an ancestor of Mr W. Chandos-Pole of Radbourne Hall in Derbyshire) around the neck attached to a crimson ribbon with a green edge. There is no doubt it was struck in gold, silver and copper, but how it was awarded there is no proof, probably only to officers. The obverse had an r., bust of the duke of Cumberland, with above CUMBERLAND, below YEO f (Richard Yeo *fecit*), and, on the reverse, an Apollo, laureate, leaning upon his bow and pointing to a dragon wounded by his arrow. The reverse legend was ACTUM EST ILICET PERIIT, and, in the exergue PROEL COLOD AP XVI MDCCXLVI. The medal is a strikingly handsome one, with an ornamental border and ring for suspension, oval, 1·75 by 1·45 in., but very few specimens are known to exist. Those in gold were probably only given to officers commanding regiments and a very fine specimen of these, originally conferred on Brigadier-General Fleming (at one time in command of the 36th Foot) is now in the collection of Major-General Lord

Cheylesmore. In his monograph, *Naval and Military Medals*, Lord Cheylesmore mentions another "Culloden" medal in his collection, "a slightly larger one in white metal, which leads one to suppose that it was given in inferior metal to the more junior branches, probably officers; but whether this was the case or no I am unable authoritatively to state." However, one thing is fairly certain, that the issue of the "Culloden" medal was in no sense "general," as we now understand the term, nor as were the issues for "Dunbar" or the issues of the Honourable East India Company, which will next be dealt with.

No medal awards were made to either the naval or military services for the Seven Years' War, and the American War of Independence. In fact George III. had been more than thirty years on the throne when the first medal award by the Crown was given, in the shape of the navy gold medals, first issued in 1794. It will however be more convenient to deal later with these medals and the army gold medals and crosses given for services in the long and arduous struggle of 1793–1815, and to describe here in sequence those medals which were issued by the Honourable East India Company, the issue of which was, with certain limitations, "general," thus reverting to the precedent first established in the "Dunbar" award, namely an issue to all ranks. They are nine in number, and are described below in the chronological order of the military operations for which they were awarded.

1. The "DECCAN" medal. Authorized, first in 1784, and again 1785. Obverse: Figure of Britannia seated on a military trophy, with her right hand holding a wreath of laurel and extended towards a fortress over which the British flag flies. Reverse: Persian inscriptions—In centre, "Presented by the Calcutta Government in memory of good service and intrepid valour, A.D. 1784, A.H. 1199;" around, "Like this coin may it endure in the world, and the exertions of those lion-hearted Englishmen of great name, victorious from Hindostan to the Deccan, become exalted." This medal was issued in two sizes, diameters 1·6 and 1·25 in. The larger medal was struck both in gold and silver, the smaller in silver only, and both were worn round the neck suspended from a yellow cord. This medal was awarded to two large detachments of the Bengal army, denominated the "Bombay Detachment" (authorized 1784), and the "Carnatic Detachment" (authorized 1785), which respectively fought in the west of India and Guzerat, 1778–84, and in the south of India, 1780–84. The medal was not given to any Europeans, only to natives; the larger medal in gold to Subadars, and in silver to Jemadars; the smaller silver medal to non-commissioned officers and sepoys. By a minute of council, dated the 15th of July 1784, a further boon was granted to the "Bombay Detachment," inasmuch as it exempted all Hindus of that detachment from payment of the duties levied by the authorities on pilgrims to Coya in Behar. As the large majority of the troops were high caste Hindus, and Coya was, and is the Mecca of Hinduism, this favour must have been much appreciated by the recipients of the medal. This is the earliest Anglo-Indian example of a medal issued alike to all ranks.

2. The "MYSORE" medal. Authorized, 1793. Obverse: A sepoy holding in his right hand the British colours, in his left an enemy's standard reversed, whilst his left foot rests on a dismounted cannon. A fortified town is in the background. Reverse: Within a wreath; "For Services in Mysore, A.D. 1791–1792." Between wreath and rim is an inscription in Persian: "A memorial of devoted services to the English government at the war of Mysore. Christian Era, 1791–1792, equivalent to the Mahomedan Era, 1205–1206." Like the "Deccan" this medal was in two sizes, diameters 1·7 in. and 1·5 in., the larger being struck both in gold and silver, the smaller in silver only, and both were worn suspended from the neck by a yellow cord. The medal was awarded for the operations against Tippoo Sultan, and was bestowed on the "Native Officers and Sepoys of the Infantry and Cavalry, and on the Artillery Lascars, who either marched by land, or proceeded by sea to the Carnatic and returned to Bengal." The large gold medals were given to Subadars, the large silver to "Jemadars and Serangs," the small silver medals to "Havildars, Naicks, Tindals, Sepoys and Lascars." The award therefore, followed precisely the precedent set in the "Deccan" medal. One of the very rare gold specimens of this medal is in the collection of Captain Whitaker, late 5th Fusiliers, whose collection, and that of Lord Cheylesmore, are probably the two finest that have as yet been brought together.

3. The "CEYLON" medal. Authorized, 1807. Obverse: An English inscription: "For Services on the Island of Ceylon, A.D. 1795–6." Reverse: A Persian inscription: "This Medal was presented to commemorate good services in Ceylon during the years of the Hegira 1209–10." This medal was issued in only one size, 2 in. diameter, and was awarded to a small force of Bengal native artillery which formed a fraction of a large body of British and native troops (the rest did not receive the medal) which captured Ceylon from the Dutch in 1795–96. It is the only instance of a war medal that has merely a verbal design on both obverse and reverse, and moreover it sets a precedent that was destined to be followed only too often in that it was only granted twelve years after the services that had earned it had been rendered. Only 123 medals were struck, two in gold for native officers, and 121 in silver for other ranks. Like the two preceding, it was worn from the neck suspended from a yellow cord.

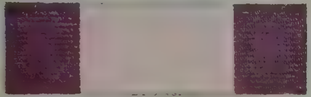
4. The "SERINGAPATAM" medal. Authorized, 1799, for services in Lord Harris's campaign of that year, and the storm of Seringapatam. Obverse: A representation of the storming of the breach at Seringapatam, with the meridian sun denoting the time of the storm. In the exergue is a Persian inscription: "The Fort of Seringapatam, the gift of God, the 4th May 1799." Reverse: A British lion overcoming a tiger, the emblem of Tippoo Sultan. Above is a standard, with, in the innermost part of the hoist immediately contiguous to the staff, the Union badge, and, in the fly, an Arabic legend signifying "The Lion of God is the Conqueror." In the exergue: IV. MAY, MDCCXCIX. (the date of the assault). It was in one size, 1·9 in. but of five different kinds. Although the medal was authorized in 1799, it was 1801 before orders for the preparation of 30 gold medals, 185 silver-gilt, 850 silver, 5000 copper bronzed, and 45,000 pure tin, were given, the artist being C. H. Kuchler, and the medals made by Matthew Boulton at the Soho Mint, Birmingham. It was 1808 before they came out to India for distribution, and it was not till 1815 that the Company's European officers had the prince regent's sanction to wearing them on public occasions. For the first time the issue was absolutely "general," to Europeans as well as natives, to Crown troops as well as to those of the H.E.I. Co., but it was not till 1851, when the First India G.S. Medal was awarded, that official sanction was given to their being worn by Europeans in uniform. The medal was given in gold to general officers, in silver-gilt to field officers, in silver to captains and subalterns, in copper bronzed to non-commissioned officers, and in pure grain tin to privates and sepoys. With regard to this medal there is an incident that is worth recording. The bulk of the troops engaged at Seringapatam were Crown forces, or belonged to the Madras and Bombay presidencies; the only Bengal troops taking part being five battalions of infantry, and artillery detachments. On their return to Bengal no steps were taken with regard to medals till 1807, when medals copied from the Soho Mint one, but 1·8 in. only in diameter, were made at the Calcutta Mint. Following the Bengal precedents as set in the "Deccan," "Mysore" and "Ceylon" medals, the medals were struck in gold for officers, and in silver for the other ranks. A Bengal native officer therefore wore just the same medal as a general officer of any of the other forces, and similarly a Bengal sepoy wore the same medal as a British captain or subaltern of the Crown. The Bengal medal can easily be distinguished from the others, for in the reverse the artist's initials C.H.K. are rendered "C.ꓘ.H." Some officers, amongst them Lord Harris himself and his second-in-command Sir David Baird, wore the medal with the red, blue-bordered ribbon, which is the same as that worn with the Army Gold Medal (see below) and was in fact the only authorized military ribbon then in use; but though no ribbon was issued with the medal, recipients were given to understand that the ribbon would be of a deep maize colour and watered, the shading on the ribbon symbolizing the stripes in the fur of the tiger, Tippoo Sultan's favourite emblem. The duke of Wellington's medal (silver gilt), has the maize (or yellow as it is often termed) ribbon, and the medal was undoubtedly more generally worn with this ribbon than with the red and blue one. There are also apparently occasional instances of it having been worn with a plain red ribbon.

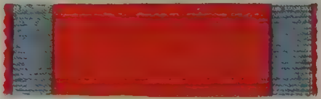
5. The "EGYPT" medal. Authorized, 1802. Obverse: A Sepoy holding the Union Flag in his right hand; in the background a camp. In exergue, in Persian: "This medal has been presented in commemoration of the defeat of the French Army in Egypt by the victorious and brave English Army." Reverse: A British ship sailing towards the coast of Egypt. In the background, an obelisk and four pyramids. In the exergue, MDCCCI. This medal was only awarded to native officers and men of the small force of Bengal and Bombay troops which formed part of the expeditionary force from India, that co-operated in Sir Ralph Abercromby's descent on Egypt in 1801 (see BAIRD, SIR DAVID). This was another case of a belated issue (1811 for the Bengal troops and two years later for the Bombay troops). The medal was issued in only one size, 1·9 in. in diameter. For the Bengal troops 776 medals were struck, 16 in gold for commissioned officers, 760 in silver for other ranks. The Bombay government obtained the approval of the court of directors for the issue of the medal to their troops in 1803, but apparently did nothing till 1812, when they asked the Calcutta Mint for a copy of the medal to enable them to prepare similar ones. The Bombay Mint would not however appear to have been equal to the occasion, for the sample was returned to Calcutta with the request that 1439 medals might be struck there. This was accordingly done, but all of these medals were made of silver, and so the medal went to the Bombay troops in all ranks alike. As in the case of the "Deccan" medal, Hindu sepoys, who had volunteered for Egypt, were exempted from the duties levied on pilgrims. This medal was worn suspended from the neck by a yellow cord.

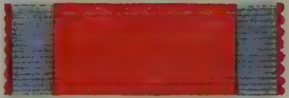
MEDALS AND DECORATIONS

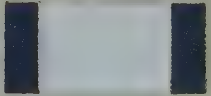
PLATE I.

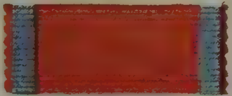
WARS OF THE FRENCH REVOLUTION AND NAPOLEON ERAS


Navy Gold Medal, 1794.
1794-1815.

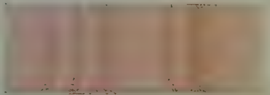

Army Gold Medal and Cross, 1810.
1808-14.

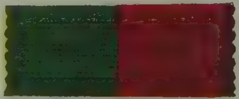

Waterloo, 1815.
1815.


Navy General Service, 1848.
1793-1840.
Medal dated 1848 but authorized 1847.


Army General Service, 1848.
1793-1814.
Medal dated 1848 but authorized 1847. Exergue date 1793-1814, but first operations for which awarded took place 1801.

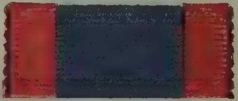
INDIA. AWARDS BY THE HON. EAST INDIA COMPANY

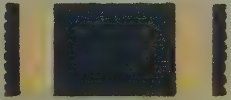

Seringapatam, 1801.
1799.


Ghazni, 1841.
1839.
Shah Soojah's original award of 1839 was, after his death, carried out by H. E. I. Co., in 1841.

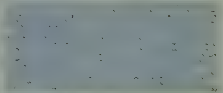
Military Ribbon of India, 1842.
1842-43, 1880.
The Medals worn with this Ribbon are "Jellahabad," 1842; "Kilat-i-Ghilzie," 1842; "Afghanistan" (first Afghan War), 1842; "Sinde," 1843; "Maharajpoor-Punniar" Stars (Gwalior Campaign, 1843); "Kabul-Kandahar" Star, 1880 (second Afghan War).

FIRST AND SECOND SIKH WARS

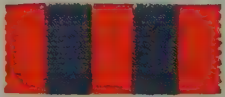

Sutlej, 1845.
1845-46.

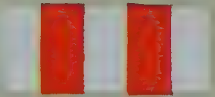

Punjab, 1849.
1840-49.

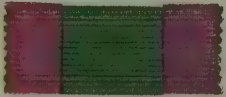
INDIA. AWARD H. E. I. CO.

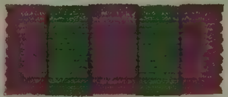

First India G.S., 1851.
1799-1826.
Date given is as in exergue, but the first action for which the Medal was awarded did not take place until 1803. This Medal is often termed "Army of India" Medal.

INDIA. AWARDS BY THE CROWN


Second India G.S., 1854.
1852-1895

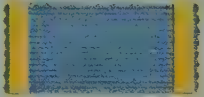

Indian Mutiny, 1858.
1857-58.

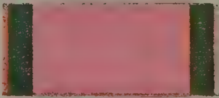

Afghanistan, 1879.
1878-80.
Second Afghan War.

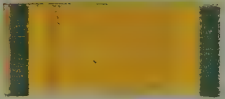

Third India G.S., 1895.
Since 1895.
The award of March 1903 made the 7th Clasp.

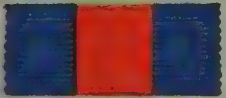
China, 1842.
1841-42, 1857-60, 1900.

RUSSIAN WAR

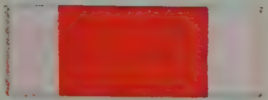

Crimea, 1854.
1854-56.


Turkish Crimea, 1855.
1854-56.


Baltic, 1856.
1854-55.


New Zealand, 1869.
1845-47, 1860-66.

NORTHERN AFRICA

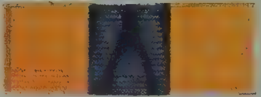

Abyssinia, 1868.
1867-68.

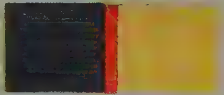
EGYPT AND THE SUDAN

Egypt, 1882.
1882-89.

Khedive's Star, 1883.
1882-90.

RECONQUEST OF THE SUDAN


Khedive's Sudan, 1897.
1896-98, and since.
Since the reconquest of the Sudan this Medal has become a G.S. one for the Egyptian Army. Last award Dec. 1906, making the 13th Clasp.


Queen's Sudan, 1899.
1896-98.

NOTE.—Date following Title is that of authorization of first award, those under Titles are the year, or years, in which the operations for which the Medal was awarded took place.

6. The "RODRIGUES, BOURBON AND MAURITIUS" medal. Authorized, 1811. Obverse: A sepoy, holding in his right hand the British flag, in his left a musket with bayonet fixed, stands with his left foot trampling a French eagle and standard; beside the figure a cannon, and, in the background the sea and ships. Reverse: Within a wreath, in Persian: "This medal was conferred in commemoration of the bravery and devotion exhibited by the Sepoys of the English Company in the capture of the Islands of Rodrigues, Bourbon, and Mauritius, in the year of the Hegira 1226." In the circumference, in English: RODRIGUES VI. JULY MDCCCIX. BOURBON VIII. JULY AND ISLE OF FRANCE III. DEC. MDCCCX. This medal was awarded to the native troops of the Bengal Presidency that formed part of the combined naval and military forces that effected the reduction of these islands in 1809–10. The government of Bengal also suggested "for the consideration of the governments of Fort St George and Bombay, that corresponding Medals shall be conferred on the native troops from those Establishments;" but those governments do not appear to have complied with the suggestion, a distinct injustice to the Madras and Bombay troops employed. The medals, struck at the Calcutta Mint for the Bengal troops, were 1·9 in. in diameter, and in gold and silver, 45 gold for native officers, 2156 silver for all other ranks. They were worn as was customary in so many cases with yellow silk cord suspended from the neck.

7. The "JAVA" medal. Authorized, 1812. Obverse: A representation of the storming of Fort Cornelis. On a flag-staff the British flag is shown flying above a Dutch one, and over all is the word Cornelis. Reverse: In Persian: "This medal was conferred in commemoration of the bravery and courage exhibited by the Sepoys of the English Company in the capture of Java, 1228, Hegira." In circumference, in English: "JAVA CONQUERED XXVI. AUGUST MDCCCXI." This medal was awarded to the native troops of the Honourable East India Company (all Bengal), which took part in the expedition under Lieut.-General Sir Samuel Auchmuty which effected the capture of Java from the Dutch in 1811. The medal, 1·9 in. in diameter, was struck in gold and silver, 133 in the former metal for native officers, and 6519 in silver for other ranks, and was worn in the usual manner with a yellow silk cord.

8. The "NEPAL" medal. Authorized, 1816. Obverse: Hills crowned with stockades. In right foreground the colours and bayonets of an attacking force, to the left a cannon. Reverse: In Persian: "This Medal was conferred by the Nawab Governor-General Bahadur in testimony of the energy, good service, skill and intrepidity, which were displayed in the Hills in the years of the Hegira 1229 and 1230." This was awarded to the native troops of the East India Company who took part in the arduous operations in Nepal in 1814–16. This medal, 2 in. in diameter, marks a very interesting new departure, for it was struck only in silver, and given to all ranks precisely alike, whether the recipient was commissioned or not. It was worn from the usual yellow silk cord.

9. The "BURMAH" medal. Authorized, 1826. Obverse: Representation of the storming of the great pagoda at Rangoon; on the left, a palm tree under which the general and staff, and the river with steamer and boats of the Irrawaddy flotilla joining in the attack. In exergue, in Persian: "The Standard of the victorious Army of England upon Ava." Reverse: The White Elephant of Burma crouching in submission before the British Lion; behind the lion, the British flag flying broad, behind the elephant, the Burma flag drooping and between the two flags palm trees. In the exergue, in Persian: "The elephant of Ava submits to the lion of England, year 1826." This, one of the most beautiful of all war medals, was designed by W. Daniell, R.A., and executed by W. Wyon; and was awarded to all the Company's native troops, that participated in the First Burmese War, 1824–26. The medal, 1·5 in. diameter, was issued in gold to native officers, in silver to other ranks. In all there were struck; for Bengal troops, 308 gold, 13,108 silver; and for those of Madras, 450 gold and 20,025 silver. Of the Madras medals however nearly half were still unclaimed in 1840. It is with this medal that we first find, as regards Indian medals, definite instructions as to the use of a ribbon, and the manner in which medals should be worn. In 1831, it was officially ordered that the colour should be red with blue edges—it was in fact precisely similar to the Waterloo ribbon (for which see Plate I.)—and the instructions were that the medal "be worn perfectly square upon the centre of the left breast, the upper edge of the ribbon being even with the first button for ranks wearing Sword Belts only, and even with the second button for ranks wearing Cross Belts." Like the Waterloo medal also, it was mounted on a steel clip and ring, and the medals were struck at the Royal Mint instead of, as heretofore, in India.[1]

This closes the list of the Indian medals, which, with the exception of that for Seringapatam, were issued only to the native troops of the Honourable East India Company. All are now very rare and very highly valued by collectors.

As has already been stated, the first war medals awarded by the Crown in the reign of George III., were the navy gold medals, instituted on the occasion of Lord Howe's great victory over the French fleet on the 1st of June 1794. On the 26th of that month the king and queen visited Portsmouth, and, on the deck of the "Queen Charlotte," Lord Howe's flag-ship, presented the victorious admiral with a diamond-hilted sword of the value of three thousand guineas. Gold chains, from which the medals were afterwards to be suspended, were also conferred on Admiral Lord Howe; Vice-Admirals Graves and Sir Alexander Hood; Rear-Admirals Gardner, Bowyer and Pasley; and Captain of the Fleet Sir Roger Curtis. At the same time the king announced his intention of conferring gold medals on each of the officers named, and similar, but smaller medals on the captains. The medals were delivered in 1796, the Admiralty ordering "The Admirals to wear the Medal suspended by a ribband round their necks. The Captains to wear the Medal suspended to a ribband, but fastened through the third or fourth button-hole on the left side. The colour of the ribband, blue and white."

The ribbon, which is white with broad blue borders (see Plate I.), did not of course supersede the gold chain in the case of those officers on whom chains had been conferred. They wore their chain with the ribbon, and the medal of Admiral Bowyer (now in the collection of Lord Cheylesmore) is so suspended. The same splendid and intensely interesting medal was later conferred for various fleet and ship actions deemed worthy of special acknowledgment; and so came into being the first "regulation" medal for naval officers.

The two medals are, with but one slight distinction, identical in design, the larger being 2, and the smaller 1·3, in. in diameter. The design is:—

Obverse: The fore part of an antique galley, on the prow of which rests a figure of Victory who is placing a wreath on the head of Britannia who stands on the deck of the galley, her right foot resting upon a helmet, her left hand holding a spear. Behind Britannia is a "union" shield, charged with the Cross of St George and the Saltire of St Andrew. (Ireland had not then been added to the Union). Reverse: Within a wreath of oak and laurel, the name of the recipient, the event for which the medal was conferred, and the date. (In the smaller medal the wreath is omitted.)

In all, eighteen actions were recognized by this medal, the complete list of which is as follows:—

The "Glorious First of June" (7 large and 18 small medals); St Vincent (Feb. 14, 1787) (6 large and 15 small medals); Camperdown Oct. 11, 1797) (2 large, 15 small medals); The Nile (Aug. 1, 1798) (1 large and 14 small medals); Re-capture of the frigate "Hermione" from the Spaniards by the boats of H.M.S. "Surprise" at Porto Cavallo (Oct. 25, 1799) (1 small medal); Trafalgar (Oct. 21, 1805) (3 large and 27 small medals); Action off Ferrol (Nov. 4, 1805) (4 small medals); Action off St Domingo (Feb. 5, 1806) (3 large and 7 small medals); Capture of Curaçoa (Jan. 1, 1807) (4 small medals); Capture of the Turkish frigate "Badere Zaffer" by H.M.S. "Seahorse" (July 6, 1808) (1 small medal); Capture of the French frigate "Thetis" by H.M.S. "Amethyst" (Nov. 10, 1808) (1 small medal); Capture of the French frigate "Furieuse" by H.M. ship-sloop "Bonne Citoyenne" July 6, 1809 (1 small medal); Capture of the Island of Banda Neira (Aug. 9, 1810) (1 small medal); Captain W. Hoste's action off Lissa (March 13, 1811) (4 small medals); Capture of the French 74-gun ship "Rivoli" by H.M.S. "Victorious" (Feb. 22, 1812) (1 small medal); The "Chesapeake" and "Shannon" (June 1, 1813) (1 small medal); Capture of the French frigate "Étoile" by H.M.S. "Hebrus" (March 27, 1814) (1 small medal); Capture of the American frigate "President" by H.M.S. "Endymion" (Jan. 15, 1815) (1 small medal).

In all 22 large medals, and 117 small, were awarded; but this does not say that all who were entitled to the medal received it. This is most notably the case with regard to the "Glorious First of June." When the issue was made, in 1796, the medals were given only to those flag officers who had received gold chains, and to such captains as were specially mentioned in Lord Howe's despatch of the 21st of June, despite the fact that the admiral specially put it on record that the selection therein made, "should not be construed to the disadvantage of the other commanders, who may have been equally deserving of the approbation of the Lords Commissioners of the Admiralty, although I am not enabled to make a particular statement of their merits." For this reason the medal was never awarded to Rear-Admiral B. Caldwell, fifth in command on the great day, to his flag-captain, Captain G. B. Westcott, and to seven other captains of line of battle ships engaged. One captain however, who was not mentioned in despatches, succeeded in gaining the medal, by a *tour de force* eminently characteristic of the superb breed of naval officers that the great wars had brought into being. This was Collingwood, who had been flag-captain to Bowyer in the "Barfleur." When Collingwood was awarded the medal for St Vincent, where he commanded the "Excellent," he flatly refused to receive it unless that for the First of June was also conferred upon him, which was done. For St Vincent, the Nile and Trafalgar, all flag officers and captains engaged received the medal. At the Nile, Troubridge's ship, the "Culloden," grounded in entering the bay, and so, strictly speaking, he was never engaged in the action; but the king specially included him in the award, "for his services both before and since, and for the great and wonderful exertions he made at the time of the action, in saving and getting off his ship."

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[1] Most of the authorities on medals, including Mr Thomas Carter and Captain Tancred, style as the reverse of the medal what above is styled the obverse and vice versa. We, however, prefer to agree with the description of the medal as given by Mayo and for this reason. The side of the medal which is described above as the obverse depicts a chief incident of the war; the allegorical representation on the other side is after all but the pictorial equivalent of a verbal inscription, and so is properly the reverse of the medal.

For Camperdown, one captain, afterwards found guilty by court-martial of failure in duty, did not receive the medal. Several posthumous awards of the smaller medals were made to the relatives of officers who were either killed in action or died of wounds. These were: on the first of June, Captains Hutt ("Queen"), Montagu ("Montagu"), Harvey ("Brunswick"); at Camperdown, Captain Burgess ("Ardent"); at the Nile, Captain Westcott ("Majestic"); at Trafalgar, Captains Duff ("Mars") and Cooke ("Bellerophon"). Captain Westcott was doubly unfortunate, for he was one of the First of June captains who should have received the medal but did not. Captain Miller of the "Theseus" also did not receive his medal for the Nile, for, though not killed in the action, he perished at Acre in an accidental powder explosion the May following, the medal arriving after his death, and being returned to the Admiralty. In only two cases were large medals conferred on officers below flag rank, these being Sir R. Curtis, captain of the fleet to Lord Howe on the First of June, and Nelson, who only flew a commodore's broad pendant at St Vincent. Following this latter precedent Sir R. Strachan should have had the large medal for the action of the 4th of November 1805, for he also was a commodore, but it was denied him for what seems quite an inadequate reason, namely that he was junior in rank to Captain Hervey of the "Temeraire," who was the senior of the Trafalgar captains. Hervey was promoted to rear-admiral for Trafalgar on the 9th of November, and Strachan to the same rank on the following day.

The small medal too was conferred in only three cases on officers below the rank of post captain. These were Commander Mounsey of the "Bonne Citoyenne," for the capture of the "Furieuse" and Lieuts. Pilfold and Stockham, who at Trafalgar commanded respectively the "Ajax" and the "Thunderer," the captains of those two ships being at the time of the action in England giving evidence at the court-martial of Sir Robert Calder. In all, of the eighteen awards of the Navy Gold Medal, eight were for fleet actions (one of which was between squadrons of frigates), seven for single ship actions, one between line of battleships, six in which frigates were engaged, two for shore operations (in both cases the taking of islands from the Dutch), and lastly the re-capture of the "Hermione" by the "Surprise." This last mentioned award is one particularly memorable, not only because it was the first time that the medal was awarded to a frigate captain, but also because it is the only case in which the medal was awarded for boat service pure and simple.

Nelson's two great victories, the Nile and Trafalgar, also earned a medal for all ranks that participated in them, but these awards were not made by the Crown but by the generosity of two private individuals, though of course with the king's approval and permission. The first of these is "Davison's Nile Medal," which Mr Alexander Davison, Nelson's prize agent and a valued friend, caused to be struck at a cost of near £2000, and one of which was presented to every officer and man engaged at the Nile. The medal, 1·85 in. in diameter, was given in gold to Nelson and his captains, in silver to lieutenants and officers of corresponding rank, in copper gilt to warrant and petty officers, and in copper bronze to seamen and marines:—

Obverse: Hope, standing on a rock in the sea, holding in her right hand an olive branch, and supporting with her left side a shield on which is the bust of Nelson surrounded by the legend: "EUROPE'S HOPE AND BRITAIN'S GLORY." Behind the figure and shield is an anchor, whilst around all is inscribed: "REAR-ADMIRAL LORD NELSON OF THE NILE." Reverse: The French fleet at anchor in Aboukir Bay, the British fleet advancing to the attack: a setting sun denotes the time of the action. Around: "ALMIGHTY GOD HAS BLESSED HIS MAJESTY'S ARMS"; and, in exergue: "VICTORY OF THE NILE AUGUST 1 1798." In the reverse the engraver when sinking the die forgot to transpose the position of the objects, and so the sun is made to set in the east instead of in the west, and the land which is shown on the right should properly be on the left.

Davison's Nile medal was struck at the Soho Mint, Birmingham, by Boulton, and it was this that probably inspired the latter to present a medal to all who took part in the battle of Trafalgar. "Boulton's Trafalgar Medal" was 1·9 in. in diameter, and given in gold to the three admirals, in silver to captains and first-lieutenants, and in pewter to other ranks. In a very considerable number of cases the pewter medals were either returned, or thrown overboard, the recipients being disgusted at what they deemed the paltriness of the reward. Obverse: A bust of Lord Nelson in uniform with around: HORATIO, VISCOUNT NELSON, K.B. DUKE OF BRONTE, &c. Reverse: A representation of the battle, with around on a scroll: ENGLAND EXPECTS EVERY MAN WILL DO HIS DUTY. In exergue: TRAFALGAR OCTR. 21 1805.

Both the Davison and the Boulton medals were worn suspended from a blue ribbon. These are the only two cases in which officers and men of the navy and army have accepted and worn medals presented by a private individual.

The Gold Medal given by George III. to the superior officers in command at the battle of Maida, in Sicily, on the 4th of July 1806, is an award of special interest, for not only was it the first military award made by the Crown during the reign, but it was moreover the prototype of the superb army gold medals and crosses which were so widely distributed during the years that followed. A general order of the duke of York, commander-in-chief, dated Horse Guards, 22nd of February 1808, awarded a gold medal for Maida to Sir John Stuart, K.B., his three brigadiers, and nine other officers. Subsequently four other officers received it, so in all seventeen officers received the award. It was prescribed that the medal "should be worn suspended by a Ribband of the colour of the Sash, with a blue edge, from a button of the coat on the left side." It was in fact to be worn in the same way as the small Navy Gold Medal, and as this grant established blue and white as the specific navy ribbon, so did the Maida award establish red with a blue border as the regulation military ribbon. The Maida ribbon is in fact precisely the same as the Waterloo ribbon shown in Plate I. The Maida medal was 1·5 in. in diameter and struck in gold only. It was issued precisely alike, quite irrespective of rank, to each of its seventeen recipients.

Obverse: Head of George III., laureated and facing left, with below the legend: GEORGIUS TERTIUS REX. Reverse: Britannia casting a spear with her right hand, and on her left arm the Union shield, above, and approaching her is a Flying Victory holding out a wreath. In front of Britannia in four lines, is MAI/DA/IVL IV/MDCCCVI/; behind her the triquetra or trinacria, the symbol of the Island of Sicily. In the exergue are crossed spears.

Two and a half years after the Maida award the king authorized the "Army Gold Medal," the first grant of which was notified by the commander-in-chief, in a Horse Guards general order dated the 9th of September 1810. This authorized the bestowal of the medal on 107 senior officers mentioned by name. The battles commemorated were Roleia, Vimiera (1808), the cavalry actions of Sahagun and Benevente (1808), Corunna and Talavera (1809). The Army Gold Medal so awarded was in two sizes, large, 2·1 in. in diameter, for general officers, small, 1·3 in. in diameter, for officers of lower rank: and the regulations provided that it should be worn from a red ribbon edged with blue, the larger round the neck, the smaller on the left breast from a button-hole of the uniform. The ribbon was the same width, 1¾ for both ribbons, and precisely the same later on for the Gold Cross. Both large and small medals were of identical design, in fact there was no difference, either in medals or in ribbons, except in size and the style in which they were worn:—

Obverse: Britannia seated on a globe, holding in her right hand a laurel wreath, and in her left, which rests upon a Union shield resting against the globe, a palm leaf; at her feet to her right, a lion. Reverse: A wreath of laurel, encircling the name of the battle or operations for which the medal was granted.

In the following years subsequent orders similar to the original grant extended the award of the Army Gold Medal, until eventually twenty-four distinct awards were made, commemorating twenty-six actions, or series of operations, which took place not only in the Peninsula, but also in North America, and both the East and the West Indies.

The Peninsula medals were for Roleia and Vimiera, Sahagun and Benevente, Corunna, Talavera, Busaco, Barrosa, Fuentes d'Onor, Albuera, Ciudad Rodrigo (1812), Badajoz (1812), Salamanca, Vittoria, Pyrenees, St Sebastian, Nivelle, Nive, Orthes, Toulouse. The West Indies medals were for Martinique (Feb. 1809) and Gaudaloupe (Jan.–Feb. 1810), the North American for Fort Detroit (Aug. 16, 1812), Chateauguay (Oct. 26, 1813) and Chrystler's Farm (Nov. 11, 1813), and there was, lastly, a medal awarded for Java (Aug.–Sept. 1811).

From the above it will be seen that as time went on many officers became entitled to two, three and even more medals, and as this was found inconvenient, the method of granting the award was very materially amended as notified by the commander-in-chief, in a general order, dated Horse Guards, October 7, 1813. This order formulated regulations which were as follows:—

1. That one medal only was to be borne by each officer recommended for the distinction.

2. That for a second and a third action a gold clasp was to be attached to the ribbon from which the medal was suspended inscribed with the name of the action.

3. When a fourth distinction was earned, the medal and two clasps were to be replaced by a Gold Cross having the four actions for which it was awarded inscribed upon it, one upon each arm.

4. On every occasion the recipient was awarded the decoration after the fourth a Gold Clasp worn on the ribband was added to the Cross.

The regulations further laid down that only officers should be recommended who had been "personally and particularly engaged" on the occasion, and that officers were to be named by "special selection and report of the Commander of the Forces upon the spot, as having merited the distinction by conspicuous service Further, the Commander of the Forces was restricted in his selection to General Officers, C.Os. of Brigades, C.Os. of Artillery or Engineers, and certain staff officers holding field rank, and Commanding Officers of Units, and Officers succeeding to such command during an engagement.[1] It was also ordered that awards earned by deceased officers should be transmitted "to their respective families." The Gold Cross that was, under these regulations, instituted is as follows:—

A Maltese Cross, 1½ inches square, with an ornamental border; in the centre, a lion, facing right; in each limb of the cross the name of one of the actions for which it was conferred. The back of the cross is the same as the front. The cross was precisely the same irrespective of whether it replaced a large or a small medal.

The clasps were all of the same pattern, whether worn with the cross, the large gold medal, or the small gold medal. They are 2 in. in length by ⅓ in. in width, and bear, within a border of laurel, the name of the action for which they were conferred. At the close of the war in the Peninsula the issue of this handsome and much coveted decoration was discontinued, the enlargement of the Order of the Bath (January 1815) affording another method of reward which the Crown deemed more appropriate. On the occasion of this extension all officers who had obtained the cross with one clasp, *i.e.* who had been decorated for five or more actions, were made Knights Commander of the Bath. In all 847 awards of this superb decoration were made. The medal alone went to 469 officers, whilst 143 received it with one clasp, and 72 with two clasps. The cross was issued singly in 61 cases, with one clasp in 46, with two in 18, with three in 17, with four in 8, and with five clasps in 7 cases. The cross with six clasps was gained by Sir Colin Campbell (Lord Clyde), Sir Alexander Dickson (d. 1840) and Sir George Murray (d. 1846). Two officers, Viscount Beresford and Sir Denis Pack (d. 1823) received it with seven clasps. The duke of Wellington's had nine, the decoration thus commemorating fourteen out of the twenty-six battles, sieges or operations for which the Gold Medals, Cross and Clasps were awarded. On the limbs of this cross are, ROLEIA AND VIMIERA, TALAVERA, BUSACO, FUENTES DE ONOR. The clasps are for CIUDAD RODRIGO, BADAJOZ, SALAMANCA, VITTORIA, PYRENEES, NIVELLE, NIVE, ORTHES and TOULOUSE. Not until after the close of the Great War, however, do we meet with the real prototype of the war medal as we know it to-day; for the Waterloo Medal of 1815 is the first actual "general" medal that was ever issued, because it was issued precisely alike to all ranks. In the twelve cases in which we have seen that a medal was given to all ranks, the medals differed either in size or in metal, or in both, according to the rank of the recipient, and in eight out of the nine issued by the Hon. East India Company the award was withheld from the British officers and men employed. Again in none of the cases quoted were the awards made by the Crown. The "Dunbar" medal was awarded by the Commonwealth parliament. The men of the Nile and Trafalgar wore their medals through the generosity of private individuals. In the other nine cases the award was made by the directors of the Hon. East India Company. It was with the issue of the Waterloo Medal that all this was changed and for this well-merited and much prized boon the Services owe all gratitude to the duke of Wellington. Writing from Orville on June 28, 1815, to H.R.H. the duke of York, he says:—

> "I would likewise beg leave to suggest to your Royal Highness (the then Commander-in-chief) the expediency of giving to the non-commissioned officers and soldiers engaged in the battle of Waterloo, a medal. I am convinced it would have the best effect in the army; and, if that battle should settle our concerns, they will well deserve it."

Again, writing from Paris, Sept. 17, 1815, to Lord Bathurst, then war secretary:—

> "I have long intended to write to you about the medal for Waterloo. I recommend that we should all have the same medal, hung to the same ribband as that now used with the medals."

(*i.e.* the army gold medals and crosses). It is also fair to point out that in his place in the House of Commons, and on the day after the duke's letter to the commander-in-chief had been penned, William Watkins Wynn urged that medals should be given to the survivors of Waterloo, and that they should be the same for both officers and men, "so that they who had been fellows in danger might bear the same badge of honour." And so came into being that type of "general" medal, which beginning with Waterloo has continued down to the present.

The description of these later medals, and the points of interest about them, will now be given as fully as exigencies of space will allow.

1. *Waterloo*, 1815.—Awarded by the Prince Regent, 1816. Obverse: Bust of the Prince Regent. Leg. GEORGE P. REGENT. Reverse: Figure of Victory seated; in her right hand, a palm branch; in her left, an olive branch. Above, WELLINGTON; below, WATERLOO, JUNE 18, 1815. Ribbon: Crimson with blue borders (Plate I.). Clasps: Nil.

The notification of this award was made in a memorandum by H.R.H. the commander-in-chief, dated Horse Guards, March 10, 1816, and it is worth noting that the prince regent commanded that the ribbon "shall never be worn but with the medal suspended to it." The medal was conferred on all the British troops, including the King's German Legion, present on the 16th June at Quatre Bras, on the 17th in the fighting that took place during the retirement through Genappe to Waterloo, and on the 18th at Waterloo. It was also given to four regiments, 2nd Batt. 35th, 1st Batt. 54th, 2nd Batt. 59th, and 1st Batt. 91st Regiments of Foot, which formed Sir Charles Colville's Brigade, which was detached. The reverse of this medal would appear to have been copied from the Greek Coin of Elis, about 450 B.C., a specimen of which is in the British Museum. The medals most prized by collectors are those of the 1st, 2nd, and 6th Dragoons (the "Union Brigade"), and the 28th and 42nd Regiments of Foot, as those regiments suffered very severely and consequently fewer survivors received the medal than in other corps.

2. *Ghuznee*, 1839.—Awarded by the Government of India, 1842. Obverse: The Gateway of the Fortress. Below, GHUZNEE. Reverse: In centre a space for name of recipient; above, 23rd July; below, a mural crown with underneath it 1839; the whole within a wreath of laurel. Ribbon: Particoloured, crimson and green (Plate I.). Clasps: Nil.

This medal originated with Shah Soojah, whose part the Indian government took in the Afghan troubles of the time. His downfall and death having taken place before the medals were ready, the actual award was made by the Government of India. It was originally ordered (Bengal Military Proceedings, May 27, 1842; Nos. 151 and 152) that the ribbon should be green and yellow, and it was undoubtedly so worn by some recipients; but there is no official record to show why the colours were altered to green and crimson.

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[1] Captain Sayers of the royal navy, who commanded the "Leda" 36, and landed in command of the 500 seamen who erected and manned the batteries for the attack of Fort Cornelis, received the small medal for Java. This is the only case of the Army Gold Medal having been conferred on a naval officer.

The medal was awarded to all troops both of the Crown and of the Company that were actually present at the siege and capture of the fortress, July 21, 22, and 23, 1839.

3. *Syria*, 1840.—Awarded by the Sultan of Turkey, 1841. Obverse: A fortress on which the Turkish flag is flying, and above six stars; below, in Turkish, "The People of Syria; and the Citadel of Acre, A.H. 1258." Reverse: Cypher of the Sultan, within a laurel wreath. Ribbon: Red with white edges. Clasps: Nil.

The St Jean d'Acre medal, as it is commonly called, was awarded to the officers and men of the British fleet that were engaged in the operations off the coast of Syria, against Mehemet Ali, which culminated in the bombardment and capture of St Jean d'Acre, Nov. 3, 1840. The medal, $1\frac{1}{8}$ in. in diameter, is purely a naval medal therefore, although a few artillery and engineer officers doing duty in the fleet received it. It was given in gold to officers of flag rank and captains (or field officers), in silver to quarter-deck and warrant officers, and in copper to other ranks. This is the only instance of there being a difference made according to the rank of the recipient since the "Burma" medal.

4. *China*, 1840–42 (1st Medal); *China*, 1857–60 (2nd Medal). —Awarded by Queen Victoria, 1842, 1861. Obverse: Head of Queen Victoria, diademed, l. Leg. VICTORIA REGINA. Reverse: Naval and military trophy, with behind a palm tree, and in front a shield of the Royal Arms. Above, ARMIS EXPOSCERE PACEM. In exergue, CHINA 1842.[1] Ribbon: Red with yellow borders (Plate I.). Clasps: 1st medal, nil; 2nd medal, six— CHINA 1842; FATSHAN 1857[2]; CANTON 1857; TAKU FORTS 1858[2]; TAKU FORTS 1860; PEKIN 1860.

The first China medal was awarded to all the naval and military forces, both of the Crown and of the Hon. East India Company, that took part in the first China War, 1840–42. Another medal was struck, and is to be found in proof, but it was never issued as it was deemed it might give offence to China. Of this the obverse is the same as that described above; but the reverse had, under the same motto, the British lion trampling upon the Chinese dragon, and in the exergue, NANKING 1842. The second China medal was similarly awarded to both the naval and military forces, British and Indian, that took part in the second China war, 1857–60. To those, however, who were already in possession of the first China medal the second medal was not awarded, they receiving a clasp CHINA 1842 to go on their original medal, together of course with the clasps to which their services in the second war had entitled them. The second medal was in fact not a new decoration but a re-issue. The first China medal was the first to be issued with the effigy of Queen Victoria upon it. The first medal with clasps for the second China war is very rare, and in almost every case would probably be found to be a naval medal. Of the second medal only one was issued with all the five new clasps. This was to a Royal Marine Artilleryman, and it is now in the Cheylesmore collection. Medals specially valued by collectors are those given to the 1st Dragoon Guards with the two clasps TAKU FORTS 1860 and PEKIN 1860, as only two squadrons of the regiment were present. In a G.O. by Lord Ellenborough, governor-general of India, dated Simla, Oct. 14, 1842, it was intimated that the Government of India would present to the Indian Army a medal, the design of which was indicated in the order, but this idea was of course abandoned when the queen intimated her intention of making the award.

5. *Jellalabad*, 1842.—Awarded by the Government of India, 1842. First medal—Obverse: A mural crown; above, JELLALABAD. Reverse: VII April 1842. Second medal—Obverse: Head of Queen Victoria as in China medal, but legend, VICTORIA VINDEX. Reverse: Figure of Victory flying, in her right hand two wreaths, in her left the British flag. Beneath, the town of Jellalabad. Above, JELLALABAD VII APRIL: in exergue, MDCCCXLII. Ribbon (both medals): Military ribbon of India (Plate I.). Clasps: Nil.

In a G.O., dated Allahabad, April 30, 1842, Lord Ellenborough announced that the Government of India would present a medal to the Company's troops, and with the consent of Her Majesty, to those of the Crown, that held Jellalabad, under Sir Robert Sale (Nov. 12, 1842—April 7, 1842). The queen's consent to her troops (13th Foot, now Somersetshire Light Infantry) receiving the medal was granted in August. The governor-general being dissatisfied with the first medal, made at the Calcutta Mint, the second (generally known as the "Flying Victory") was ordered in England, and it was notified that on their arrival the first medals, all of which had been distributed, could be exchanged for the second. The new issue was ready by March 13, 1845, but the recipients apparently preferred the original medals, for very few were exchanged. Both are very rare, for only 2596 medals were issued. The "military ribbon of India" is a tri-colour composed of the three primary colours shading into one another. It was designed by Lord Ellenborough, and is intended to symbolize an Oriental sunrise.

6. *Afghanistan*, 1842 (1st Afghan).—Awarded by Government of India, 1842. Obverse: Head of Queen Victoria as on First China Medal. Reverse: No. 1. CANDAHAR 1842 within a laurel wreath; above, a crown. No. 2. GHUZNEE CABUL each within a laurel wreath; above, a crown; below, 1842. No. 3. CANDAHAR GHUZNEE CABUL 1842 all within a laurel wreath; above, a crown No. 4. CABUL 1842 within a laurel wreath; above, a crown. Ribbon: Military ribbon of India (Plate I.). Clasps: Nil.

The authority for this medal is a G.O. of the governor-general dated October 4, 1842. It was awarded to all troops, both of the Crown and the Hon. East India Company, who took part in the operations in Afghanistan in 1842, that is to say the second phase of the First Afghan War. The medal, with reverses 1, 2 and 3, was awarded to those troops that were with Major-General Sir William Nott in Candahar, and took part in the operations around that place, recaptured Ghuznee, and then joined hands with the column under Major-General Pollock at Cabul. The medal with reverse 4 was awarded to the column which advanced from Peshawur on Cabul, being joined *en route* by the victorious garrison at Jellalabad. This is the first of the four occasions on which the reverse of a medal has been used to denote the actual part taken in the operations by the recipient, in the manner that is now done by clasps. Of these medals the one with the No. 1 reverse is the rarest, as its issue was confined to the small portion of his army that Major-General Nott left behind him in Candahar. The medal with the No. 2 reverse is also rare, as its distribution was very limited.

7. *Kelat-i-Ghilzie*, 1842.—Awarded by Government of India, 1842. Obverse: A shield inscribed KELAT I GHILZIE encircled by a laurel wreath, and surmounted by a mural crown. Reverse: A military trophy, beneath, on a tablet, INVICTA MDCCCXLII. Ribbon: Military ribbon of India (Plate I.). Clasps: Nil.

The authority for this medal is the same as that for the First Afghan Medal, and the medal itself was awarded to the troops of the Hon. East India Company, which defended this hill fortress for several months, and finally, before they were eventually relieved from Candahar utterly routed and drove off a force of four thousand men. As the medal was given only to 950 in all (forty being European artillerymen, the remainder native troops), it is naturally very scarce.

8. *Sinde*, 1843.—Awarded by Queen Victoria to the forces of the Crown, and by the Government of India to the troops of the Company. Obverse: Head of Queen Victoria as on First China Medal. Reverse: 1. MEEANEE 1843. 2. HYDERABAD 1843. 3. MEEANEE HYDERABAD 1843. In each case the inscription is surrounded by a laurel wreath, and surmounted by a crown. Ribbon: Military ribbon of India (Plate I.). Clasps: Nil.

The award of a medal for Sir Charles Napier's conquest of Sinde was first notified, as far as the troops of the Crown were concerned, by a letter from Lord Stanley, then war secretary, to the president of the India Board, dated July 18, 1843, and it is worth noting that this is the only instance of any medals for Indian service being paid for by the Crown. The notification of a similar award by the Government of India to their own troops, followed in a G.O. by the governor-general, dated September 22, 1843. The award was confined to those who had been present at either Meeanee or Hyderabad, and the medals were issued according as to which actions the recipient had been present, no one of course receiving more than one medal for the campaign. In addition to the land forces of the Hon. East India Company, the medal was also given to the naval officers and crews of the Company's flotilla on the Indus. The only Crown regiment that received this medal was the 22nd Foot.

9. *Gwalior*, 1843 ("Maharajpoor" and "Punniar" Stars).—Awarded by the Government of India, 1844. This decoration took the form of a bronze star of six points, 2 in. in diameter. Obverse: In centre a silver star, $1\frac{1}{8}$ in. in diameter, around the centre of which is a circle in which is inscribed either MAHARAJPOOR 1843 or PUNNIAR 1843, and in centre of circle the date 29th DECR. Reverse: Plain for name and regiment, or corps, of recipient. Ribbon: Military ribbon of India (Plate I.). Clasps: Nil.

The award of a medal to the troops of the Crown and the Hon. East India Company engaged in the Gwalior Campaign of 1843 was first notified in governor-general's G.O., dated Camp, Gwalior Residency, January 4, 1844; and the queen's permission for it to be worn by Crown troops given June 26, 1844. The force moved in two columns, the main and larger under Sir Hugh (Viscount) Gough, the smaller under Major-General Gray. Each force fought an action on the same day, December 29, 1843, the former at Maharajpoor, the latter at Punniar, and the star was inscribed according to which action the recipient was engaged. The stars were manufactured from the metal of the captured guns. The star given to Sir Hugh Gough had in the centre a silver elephant in lieu of a silver star, and it was originally intended that all should be the same, but the silver star was substituted for reasons of economy. As there were fewer troops at Punniar that star is of course the more uncommon.

10. *Sutlej*, 1845–46 (1st Sikh War).—Awarded by Government of India, 1845. Obverse: Head of Queen Victoria as on First China Medal. Reverse: Figure of Victory, standing, with in right hand outstretched a wreath, in left a palm branch; at her feet a trophy of captured Sikh weapons and armour. In exergue, name and year of the first battle of the war in which recipient was engaged. These inscriptions are four, viz. MOODKEE 1845, FEROZESHUHUR 1845, ALIWAL 1846, SOBRAON 1846. Ribbon: Blue with crimson borders (Plate I.). Clasps: FEROZESHUHUR, ALIWAL, SOBRAON.

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[1] The second medal has no date.

[2] Royal Navy and Royal Marines only.

This award, given to all the troops, both Crown and Hon. East India Company engaged in the First Sikh War, was first notified in governor-general's G.O., dated Camp, Ferozepore, December 25, 1845, the queen's consent for Crown troops to receive the medal being given six months later. As there was a considerable number of troops engaged in this campaign, the medal is not a very rare one, but a very rare combination is the medal with Ferozeshuhur in the exergue and the clasp for Aliwal, as only half a company of native artillery was present in these two battles and in no other. This is a specially noticeable medal, for it is the first time that "clasps" were issued with a "general" medal, the precedent followed being that of the Army Gold Medal. For every action after his first battle, which was inscribed on the medal itself, the recipient received a clasp. Thus a medal with "Moodkee" in the exergue might carry one, two or three clasps; a "Sobraon" medal could have no clasps. This and the "Punjab" medal, to be described later, are generally considered to be the two finest pieces of medal work by W. Wyon, R.A.

11. *Navy General Service*, 1793–1840.—Awarded by Queen Victoria, 1847. Obverse: Head of Queen Victoria as on First China Medal; under head, 1848. Reverse: Britannia seated on a sea horse; in her right hand, a trident; in her left, a laurel branch. Ribbon: White, with dark blue borders (Plate I.). Clasps: 231 clasps in all were granted, of which 55 were for "Boat Service."

An Admiralty memorandum dated June 1, 1847, notified the grant of this award to commemorate the services of the fleet "during the wars commencing in 1793 and ending in 1815," and this practically confined the award to those operations for which the Navy Gold Medal (see *ante*) had been conferred. Subsequently, however, a board of admirals was appointed to consider claims, and on their recommendation an Admiralty memorandum dated June 7, 1848, extended the grant. Clasps were to be given for: (1) All Gold Medal actions or operations. (2) All actions in which first lieutenants or commanders were promoted, as had been customary after important and meritorious engagements. (3) All "Boat Service" operations in which the officer conducting the operations was promoted. (4) For, in co-operation with the land forces, the siege and capture of Martinique, 1809, Guadaloupe, 1810, Java, 1811, and St Sebastian, 1813, for all of which operations the Army Gold Medal had been awarded; and (5) The Bombardment of Algiers, 1816; the Battle of Navarino, 1827; and operations on the coast of Syria, 1840.

Although the medal is purely a naval one, yet it was conferred on a few soldiers who had done duty in the fleet in actions or operations, for which the medal was granted. Forty military officers in all received the Navy G.S. medal, one, Captain Caleb Chute, 69th Foot, with two clasps, viz. "14th March, 1795" and "St Vincent." It is very difficult to compile an absolutely accurate list of all the clasps issued, for in several cases more than one clasp was given for the same action, and there were moreover nine or ten clasps allowed for which no claims appear to have been made good. The combination of the clasps is endless, but it is curious to note that medals with more than one, or two clasps are rare; with four or five clasps, very rare; and the highest number of clasps issued with any one medal is six. Amongst very rare clasps the following may be mentioned. One survivor only, Lieut. Baugh, the officer in command, was alive to claim the clasp "Rapid, 24th April, 1808." Only two claims were proved for "Surly, 24th April, 1810"; six for "Castor, 17th June, 1809"; seven for "Amazon, 13th January, 1797"; eight for "Confiance, 14th January, 1809"; and ten for "Acheron, 3rd February, 1805." Of "Boat Service" clasps only three were claimed for "20th December, 1799"; four for "9th June, 1799"; and eight for "10th July, 1799." (All "Boat Service" clasps are inscribed "Boat Service" with the day and month on the left, and the year on the right.) In all nearly thirty thousand claims were proved for the medal.

12. *Army General Service*, 1793–1814.—Awarded by Queen Victoria, 1847. Obverse: Head of Queen Victoria as on First China Medal; under head, 1848. Reverse: Queen Victoria on a daïs is placing a wreath on the head of the duke of Wellington, who kneels on his left knee before her, holding in his right hand the baton of a Field Marshal; at the side of the daïs is a lion dormant. Legend: TO THE BRITISH ARMY. In exergue: 1793–1814. Ribbon: Crimson with blue borders (Plate I.). Clasps: EGYPT, MAIDA, ROLEIA, VIMIERA, SAHAGUN,[1] BENEVENTE,[1] SAHAGUN-BENEVENTE,[1] CORUNNA, MARTINIQUE,[2] TALAVERA, GUADALOUPE,[2] BUSACO, BARROSA, FUENTES D'ONOR, ALBUHERA, JAVA,[2] CIUDAD RODRIGO, BADAJOZ, SALAMANCA, FORT DETROIT, CHATEAUGUAY, CHRYSTLER'S FARM, VITTORIA, PYRENEES, ST SEBASTIAN,[2] NIVELLE, NIVE, ORTHES, TOULOUSE.

This medal, frequently erroneously termed the "Peninsular War" medal, was awarded to the survivors of the military forces of the Crown that had taken part in the Peninsular War, and in contemporaneous operations in other parts of the world; it was also given with the clasp "Java" to the European troops of the Hon. East India Company; with the clasps "Martinique" and "Guadaloupe" to certain local West Indian Corps; and with the clasps "Fort Detroit," "Chateauguay," and "Chrystler's Farm," to some Canadian militia and local levies, as well as to some Indian auxiliaries. The award of the medal, and all the clasps except "Egypt," bear date June 1, 1847, but the clasp "Egypt" was not granted till February 12, 1850. Although the medal is supposed to commemorate services "during the wars commencing in 1793, and ending in 1814," the earliest operations for which the medal was awarded did not take place until 1801. No medal was issued without a clasp, and as will be seen the medal was awarded only for those actions or operations for which the Army Gold Medals (including that for Maida) had been awarded; and in addition for the operations in Egypt in 1801. The combination of clasps is endless but only two medals were issued with fifteen clasps, though several survivors proved their claim to fourteen clasps. In fact medals with seven, eight or nine clasps are not common, those with ten, or more, distinctly rare. For example, taking only medals issued to officers (including those of the King's German Legion), three were issued with 14 clasps, three with 13, nine with 12, twelve with 11, thirty-six with 10, fifty-eight with 9, ninety with 8, and one hundred and fourteen with 7. By far the rarest of all clasps is "Benevente," as according to the War Office lists only three would appear to have been issued, viz. to Captain Evelegh, R.H.A., Pte. G. Barrett, 10th Hussars, and Pte. M. Gilmour, 18th Hussars, although a medal with this clasp having every appearance of being genuine and issued to Pte. William Lyne, 7th Hussars, was in the collection of Colonel Murray of Polmaise. Sahagun also is a very rare clasp, as it was received only by fifteen men of the 15th Hussars and a few others. The three North American clasps are also very rare, especially Chateauguay. Leaving out awards to Indian warriors, the statistics regarding the issue of the North American clasps are approximately as follows. At Chateauguay some 300 men fought, and 132 survivors proved for the clasp, of which all except three of the Royal Artillery were Canadians. For Chrystler's Farm, the next rarest clasp, out of about 800 engaged 176 claims were proved: viz. 79 of the 89th Foot, 59 Canadians, 44 of the 49th Foot, and 4 Royal Artillery. At Fort Detroit, 1330 men were engaged, and those who proved for the clasp included 210 Canadians, 52 of the 41st Foot, 5 Royal Artillery, and one man of the 41st Foot (who also got the clasp for Chrystler's Farm). One man proved for all three clasps, another for "Fort Detroit" and "Chateauguay," a third for "Chateauguay" and "Chrystler's Farm." The former medal is said to be in the cabinet of a New York collector. Two "regulars" also proved for the medal with clasps for "Fort Detroit" and "Chrystler's Farm," the one belonging to the Royal Artillery, the other to the 49th Foot. The medal of the former sold at the Greg sale, in 1887, for £25 10s.

13. *Punjab*, 1848–49 (2nd Sikh War).—Awarded by Government of India, 1849. Obverse: Head of Queen Victoria as in First China Medal. Reverse: Sikh chiefs delivering up their arms to Sir Walter Raleigh Gilbert, near Rawal Pindi, March 14, 1849. Above, TO THE ARMY OF THE PUNJAB. In exergue, MDCCCXLIX. Ribbon: Blue with yellow stripes at side (Plate I.). Clasps: MOOLTAN, CHILIANWALA, GOOJERAT.

The award of this medal was first notified by a G.O. of the governor-general, dated Camp, Ferozepore, April 2, 1849. The medal is one of special interest, for it establishes the principle that now rules, viz. that every one participating in a campaign (including for the first time civilians) was entitled to receive the medal, apart from those who received the medal together with a clasp for a specific action. The medal in fact was granted "to every officer and soldier who has been employed *within the Punjab* in this campaign to the date of the occupation of Peshawur." In other words it was granted to all who had served "during this campaign within the territories of Maharajah Duleep Sing," irrespective of whether they had qualified for any of the clasps. A very large number of medals was therefore issued without clasps. Another interesting point about this award is that after its grant it was laid down that in future no medals were to be issued by the Government of India without the consent of the Crown. As a matter of fact the Government of India was for the future only concerned in the grant of the two medals that followed, namely the First and Second India General Service Medals. No medals were issued with more than two of the three clasps, the combination being either "Mooltan" and "Goojerat" or "Chilianwala" and "Goojerat." Very rare medals are those of the 24th Foot with the clasp for "Chilianwala," as in that action they lost more than half their strength, their casualties amounting to 497, of whom 250 were killed or died of wounds. Another rare medal is that given without a clasp to the officers and men of the Indian Marine that manned the Indus Flotilla: and more rare still is the same medal with the "Mooltan" clasp which was given to a naval brigade landed from the same flotilla.

14. *India*, 1799–1826 (1st India G.S., officially styled "India, 1851").—Awarded by the Government of India, 1851. Obverse: Head of Queen Victoria as in First China Medal. Reverse: Victory seated, in her right hand a laurel branch, in her left a wreath; on the ground beside her a lotus flower, and in the left background a palm tree and trophy of Eastern arms. Above, TO THE ARMY OF INDIA. In exergue, 1799–1826. Ribbon: Sky blue (Plate I.). Clasps: ALLIGHUR, BATTLE OF DELHI, ASSYE, ASSEERGHUR, LASWARREE, ARGAUM, GAWILGHUR, DEFENCE OF DELHI, BATTLE OF DEIG, CAPTURE OF

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[1] Whether in one or both actions, only one clasp awarded.

[2] A similar clasp was given with the Navy G.S. medal.

DEIG, NEPAUL, KIRKEE,[1] POONA,[1] KIRKEE-POONA,[1] SEETABULDEE,[1] NAGPORE,[1] SEETABULDEE-NAGPORE,[1] MAHEIDPOOR, CORYGAUM, AVA, BHURTPOOR.

This medal was awarded "to the surviving officers and soldiers of the Crown and of the East India Company" who took part in any one of seventeen specified actions and operations which occurred in India, Nepaul and Burma, during the first twenty-five years of the 19th century, "including the officers and seamen of the Royal Navy and the Company's Marine who took part in the first Burmese War." The queen's consent to the grant of this medal was announced in the London Gazette by a Notice of the Court of Directors, dated March 21, 1851. It was subsequently notified to the British Army by a Horse Guards G.O., dated March 21, 1851; to the Royal Navy by an Admiralty memorandum of the same date; and to the Army in India by a governor-general's G.O., dated April 14, 1851. In this medal again there is a discrepancy in dating, for though it is dated 1799–1826, the first action for which it was awarded, the storming of Allighur, took place on September 24, 1803. No medals were issued without clasps, the largest combination of clasps known being five. According to the India Office records there were apparently men entitled to as many as seven clasps, but whether any medal was issued with more than five is very doubtful. That awarded to the duke of Wellington had three clasps, "Assye," "Argaum" and "Gawilghur." With the exception of medals issued with the Ava and Bhurtpore clasps, this medal is a rare one, and with a large number of the clasps, all except perhaps those for Nepaul and Maheidpore, an extremely rare one. The rarest of all is "Seetabuldee," as only two Europeans and two natives are known to have received it. "Defence of Delhi" is also a very rare clasp, as the garrison only comprised two weak battalions of native infantry; as is also "Corygaum," which was issued to only two Europeans, "both officers," and seventy-five natives. The only European troops present at Corygaum were an officer and twenty-six men of the Madras Artillery, of whom the officer and twelve men were killed and eight wounded. As the "Burma" medal had already been given to the Company's native officers and soldiers for the First Burmese War, only the European officers and men of the Company's service received the medal with "Ava" clasp; but as the "Nepaul" medal had not been given to all the native troops who actually served "within the hills," the medal with clasp "Nepaul" was granted to those native troops who had not received the Nepaul medal, as well as to all the Company's European officers and men.

15. *India*, 1852–95 (2nd India G.S., officially styled "India, 1854").—Awarded by the Government of India as far as the first two issues with their clasps are concerned, all subsequent issues and clasps, with the exception of the last two, by Queen Victoria; the last two issues and clasps by King Edward VII. Obverse: Head of Queen Victoria as in First China Medal. Reverse: Victory standing, crowning a naked warrior sitting. In exergue, a lotus flower and leaves, symbolizing the connexion of the medal with India. Ribbon: Red, with two blue stripes, forming five ¼-inch stripes (Plate I.). Clasps: PEGU,[2] PERSIA,[2] NORTH-WEST FRONTIER, UMBEYLA, BHOOTAN, LOOSHAI, PERAK 1875–76,[2] JOWAKI 1877–78, NAGA 1879–80, BURMA 1885–87,[2] SIKKIM 1888, HAZARA 1888, BURMA 1887–89, CHIN-LOOSHAI 1889–90, SAMANA 1891, HAZARA 1891, N.E. FRONTIER 1891, HUNZA 1891, BURMA 1889–92, LUSHAI 1889–92, WAZIRISTAN 1894–95, CHIN HILLS 1892–93, KACHIN HILLS 1892–93.

The queen's assent to this award, to those of H.M.'s Sea and Land Forces, as well as those belonging to the East India Company's Establishment engaged in the Second Burmese War, was first made known to the Government of India in a letter from the Court of Directors, April 6, 1853. In a Minute by Lord Dalhousie, the governor-general, December 9, 1852, it had been suggested "whether it would not be better for the future, instead of issuing a separate Medal for each campaign, to have one Medal, such as the 'Indian Medal' (*i.e.* the 'India, 1851' Medal), which should be issued once to each individual entitled: the particular service for which it is granted being recorded upon a Bar, and every subsequent service which may be thought to deserve distinction being recorded by an additional Bar. This plan would avoid the multiplication of Medals, which has accumulated of late years, which I humbly think is undesirable." In another letter from the Court of Directors to the Government of India, March 1, 1854, this suggestion is approved, and it was ordered that after "a suitable design" had been procured (L. C. Wyon designed the reverse), "the Medal to be now struck shall be of a general character, the particular service for which it is now granted, viz. 'Pegu,' being recorded on a Bar. In the event of the same soldiers being entitled hereafter to another similar distinction, the service will be recorded by an additional Bar to the same Medal." Occasional mistakes have however been made, for, since the issue with the clasp for the Perak campaign, from which time it has become customary to date the clasp, many instances have occurred of men having received two medals with clasps for different campaigns. The issue to the Persian Expeditionary Force (1856–1857), with the clasp "Persia," was awarded by the Court of Directors January 19, 1858, and sanctioned by the queen in the same month. The first issue of the medal by the Crown was authorized April 15, 1859, with the clasps "North-West Frontier" and "Umbeyla," the former covering various expeditions between 1849 and 1863, the latter the hard-fought Umbeyla Campaign of the latter mentioned year. All subsequent issues of the award were made by Queen Victoria, with the exception of those that carried with them the clasps "Chin Hill 1892–93," and "Kachin Hills 1892–93," which were only awarded ten years afterwards by King Edward VII., and notified in Army Order 9 of January 1903; the medal, which had meantime been superseded by the Third India G.S. medal described below, being re-issued with these last two clasps. The combination of clasps with this medal is very numerous, but medals with more than two or three clasps are rare. Seven is probably the greatest number awarded with any one medal, and a medal with this number, viz. "Umbeyla," "North-West Frontier," "Jowaki 1877–78," "Burma 1885–87," "Hazara 1888," "Samana 1891," and "Hunza 1891," was granted to Bhanga Singh, Sardar Bahadur, who retired as Subadar-Major of No. 4 (Derajat) Mountain Battery. Sir William Lockhart (*q.v.*) had the medal with six clasps. The rarest of all the clasps is probably "Hunza 1891," as less than a thousand men were employed, and the majority of these were Cashmere Imperial Service Troops. No European troops received the clasps, "Looshai," "Naga 1879–80," or "Hunza 1891." "Sikkim 1888" is also a rare clasp as only some 2000 troops were employed, the only Europeans being two companies of the 2nd Derbyshire Regiment. So also is "N.E. Frontier 1891," for in the Manipur expedition for which this clasp was given about 3000 men were employed, the only Europeans being four companies of the King's Royal Rifle Corps. It was with the issue of this medal with the clasp "Burma 1885–87," that the precedent was set of awarding the medal and clasp in bronze to "all authorized followers," a precedent that was followed in all subsequent issues.

16. *South Africa*, 1834–35, 1846–47, 1850–53.—Awarded by Queen Victoria, 1854. (South Africa, 1877–79. Re-issue of first medal. Awarded by Queen Victoria, 1880.) Obverse: Head of Queen Victoria as in First China Medal. Reverse: A lion crouching behind a sugar bush (*Protea mellifera*). Above, SOUTH AFRICA. In exergue, 1853. In the exergue of the re-issued medal, the place of the date is taken by a trophy of four assegais and a Zulu shield. Ribbon: Orange watered, with two broad and two narrow blue stripes (Plate II.). Clasps: 1877–78–79, 1878–79, 1877–78, 1878, 1877, 1879.

The command of the queen that a medal should be awarded to the survivors of the forces that had been engaged in the first, second and third Kaffir Wars (1834–35, 1846–47, and 1850–53) was notified by Viscount Hardinge, the commander-in-chief, in a G.O., dated Horse Guards, November 22, 1854. No clasps were issued with this medal. The medal was accorded only to the "regular forces" (including the Cape Mounted Rifles), so local levies did not receive it. In the third Kaffir War a small Naval Brigade and a detachment of Royal Marines took part in the operations, and the survivors received the medal. The award of the re-issue was notified in a G.O. by the duke of Cambridge, commander-in-chief, August 1, 1880. It was to "be granted to Her Majesty's Imperial Forces, and to such of Her Majesty's Colonial Forces, European or Native, as were regularly organized and disciplined as combatants, whether raised by the Colonial Government or by the General Officer Commanding." The operations for which it was given were against the Galekas and Gaikas 1877–78, the Griquas 1878, Basutos 1879, Zulus 1879, and Sekukuni 1878–79. In both the operations against the Galekas and Gaikas, and in the Zulu War of 1879, the Royal Navy and Royal Marines took part and received the medal. The clasps issued with this medal were as noted above and record the year, or years, of service covering all the operations in which the recipient was engaged. No one received a medal with more than one clasp. The medal without a clasp was issued to such troops as were employed in Natal from January to September 1879, but never crossed the border into Zululand.

17. *Crimea*, 1854–56.—Awarded by Queen Victoria in 1854. Obverse: Head of Queen Victoria as in First China Medal; below, 1854. Reverse: Victory crowning a Roman soldier, who holds a sword in his right hand, and bears on his left arm a shield on which is the figure of a lion. On the left, CRIMEA. Ribbon: Light blue, with narrow yellow borders (Plate I.). Clasps: ALMA, BALAKLAVA, INKERMANN, SEBASTOPOL, AZOFF.[3]

This medal, awarded to both Services, was first notified by a commander-in-chief's G.O., dated December 15, 1854. The grant was limited to all troops landing in the Crimea up to September 9, 1855—the day on which Sevastopol fell—"unless they shall have been engaged *after that date* in some expedition or operation against the enemy." This latter proviso applied in the main to the naval clasp "AZOFF," the period for which award was extended to the 22nd of November. The clasps for this medal are very ornamental, being in the shape of oak leaves, ornamented with acorns. The Royal Navy and Royal Marines, besides the "Azoff" clasp, received the clasps "Balaklava," "Inkermann," "Sebastopol." The largest number of clasps to any one medal is four. Certain non-combatants received the medal without a clasp.

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[1] Whether in one or both actions, only one clasp awarded.

[2] The Royal Navy or Indian Marine, or both, received the medal with these clasps.

[3] Royal Navy and Royal Marines.

18. *Baltic*, 1854–55.—Awarded by Queen Victoria, 1856. Obverse: Head of Queen Victoria as in First China Medal. Reverse: Britannia seated and holding a trident in her right hand. In the background forts. Above, BALTIC. In exergue, 1854–1855. Ribbon: Yellow, with pale blue borders (Plate I.). Clasps: Nil.

This award, notified by Admiralty Order, June 5, 1856, was granted "to the officers and crews of Her Majesty's ships, as well as to such officers and Men of Her Majesty's Army as were employed in the operations in the Baltic in the years 1854 and 1855." The medal is, of course, practically a naval one, but two officers and ninety-nine men of the Royal Engineers were employed in the expedition, especially at Bomarsund, and received it.

19. *Turkish Crimea Medal*.—Awarded by the Sultan, 1856. Obverse: A trophy composed of a field piece, a mortar, and an anchor, the field piece standing on the Russian Imperial Standard, and having a map of the Crimea spread over the wheel and breech. Behind are the Turkish, British, French and Sardinian flags. The flag of the nation to which the recipient belonged is in the front with that of Turkey, the flags of the other two nationalities behind. In exergue, "Crimea 1855," "La Crimée 1855," or "La Crimea 1855," according as to whether the medal was intended for British, French or Sardinian recipients. Reverse: The Sultan's cypher, below, in Turkish, "Crimea," and the year of the Hegira, 1271. Ribbon: Crimson watered, with bright green edges (Plate I.). Clasps: Nil.

This medal was distributed to all of the Allied Forces, both naval and military, which shared in the operations in the Black Sea and the Crimea. As the ship that conveyed a majority of the English medals was sunk, the remainder were issued indiscriminately, and a large number of the British received medals which were originally intended either for the French or Sardinians.[1]

20. *Arctic*, 1818–1855 (First Arctic).—Awarded by Queen Victoria, 1857. Obverse: Head of Queen Victoria, wearing a tiara. Legend, VICTORIA REGINA. Reverse: A ship blocked in the ice, icebergs to right and left, and in foreground a sledging party. Above, FOR ARCTIC DISCOVERIES. In exergue, 1818–1855. Ribbon: White (Plate II.). Clasps: Nil.

This award was first notified in an Admiralty Notice dated, January 30, 1857. It was given to the crews of Her Majesty's ships employed in Arctic exploration, and also "to the officers of the French Navy, and to such volunteers as accompanied those expeditions"; also to those engaged in expeditions "equipped by the government and citizens of the United States": also to the "commanders and crews of the several expeditions which originated in the zeal and humanity of Her Majesty's subjects": and finally to those who served "in the several land expeditions, whether equipped by Her Majesty's government, by the Hudson's Bay Company, or from private resources." The medal is worn on the left breast and takes rank as a war medal. It is octagonal in shape, 1·3 in., and has affixed to the upper edge a five-pointed star to which is attached a ring for suspension. The head of the queen, which is the work of L. C. Wyon, has never been reproduced on any other medal.

21. *Indian Mutiny*, 1857–58.—Awarded by the Government of India, 1858. Obverse: Head of Queen Victoria as on First China Medal. Reverse: Britannia standing facing left with a lion on her right side; her right arm is extended holding out a wreath; on her left arm is the Union shield, and in her left hand a wreath. Above, INDIA. In exergue, 1857–1858. Ribbon: White, with two red stripes, forming five $\frac{1}{4}$-inch stripes (Plate I.). Clasps: DELHI (May 30 to Sep. 14, 1857); DEFENCE OF LUCKNOW (June 29 to Sep. 25, 1857); RELIEF OF LUCKNOW (Nov., 1857); LUCKNOW (March 2 to 21, 1858); CENTRAL INDIA (Jan. to June 1858).

The grant of this award was first notified in a despatch from the Court of Directors to the Government which stated that "the Queen has been graciously pleased to command that a Medal shall be granted to the troops in the Service of Her Majesty, and of the East India Company, who have been, or may be, employed in the suppression of the Mutiny in India." This is the last medal given by the Honourable East India Company. The medal without clasp was awarded to all, including civilians, who had taken part in operations against the mutineers or rebels, and with the clasps enumerated above to those who shared in the operations specified. Some two or three artillery men are known to have received the medal with the clasps "Delhi," "Relief of Lucknow," "Lucknow" and "Central India." The medal with three clasps, viz. "Delhi," "Relief of Lucknow" and "Lucknow" was given only to the 9th Lancers and the Bengal Horse Artillery, and of course various officers who served on the staff, as, for example, Field Marshals Earl Roberts and Sir Henry Norman. With regard to the Royal Navy and Royal Marines, the "Shannon's" brigade, under Captain Peel, received the medal with one, or both, of the clasps "Relief of Lucknow," "Lucknow," the "Pearl's" brigade, under Captain Sotheby received the medal without clasp. This is the last medal that had on it the beautiful head of Queen Victoria which was first used for the China Medal of 1842, and of which W. Wyon, R.A., was the artist.

22. *Abyssinia*, 1867–68.—Awarded by Queen Victoria, 1868. Obverse: Bust of Queen Victoria, with diadem and veil; around an indented border, between the nine points of which are the letters A.B.Y.S.S.I.N.I.A. Reverse: Within a beaded circle the name of recipient, his corps, regiment or ship, the whole surrounded with a wreath of laurel. Ribbon: Red, with broad white borders Plate I.). Clasps: Nil.

The sanction of this award is to be found in a letter from Sir J. S. Pakington, secretary of state for war, to H.R.H. the duke of Cambridge, field-marshal commanding-in-chief, which notifies the queen's pleasure "that a medal be granted to all Her Majesty's Forces and Indian Forces, Naval and Military, employed in the operations in Abyssinia, which resulted in the capture of Magdala." In all 20,000 medals were struck. The medal is smaller than the usual, $1\frac{1}{2}$ in. in diameter, and it is surmounted by an Imperial Crown, and a large silver ring for suspension. It is altogether an unusual type of medal, and in the use of an indented border it follows a very old precedent, that of a medal commemorating the victory of Valens over Procopius, A. D. 365. (See *Les Médaillons de l'empire romain*, by W. Froehner, Paris, 1878). The artists responsible for this medal are Joseph S. Wyon and Alfred B. Wyon, and this bust of the queen is reproduced on only one other medal, the New Zealand.

23. *New Zealand*, 1845–47, 1860–66.—Awarded by Queen Victoria, 1869. Obverse: Bust of Queen Victoria as on Abyssinia medal, but larger. Legend: VICTORIA D:G:BRITT: REG:F:D: Reverse: Dated, within a wreath of laurel, according to the period in which the recipient served. Above, NEW ZEALAND; below, VIRTUTIS HONOR. Ribbon: Blue, with a broad red stripe down centre (Plate I.). Clasps: Nil.

The grant of this award to the Army was notified in an Army Order, dated March 1, 1869, and its extension to the Royal Navy and Royal Marines by an Admiralty Order, dated June 3, 1869. Owing to incompleteness in the returns many medals were issued undated. The dates on the reverse, in those issued dated, varied considerably; for the First Maori War, the medal was issued to the Army with one, and to the Navy with five different dates; for the Second Maori War, the medal was issued to the Army with twenty-one, and to the Navy with five different dates. No medal was dated 1862, though many of the Army medals bore date of a period covering that year, although no naval medals did.

24. *West Africa*, 1873–1900.—Awarded (originally as the "Ashantee" medal) by Queen Victoria in 1874, with the exception of the last issue, with clasp "1900," which was awarded by H.M. King Edward VII. Obverse: Head of Queen Victoria, with diadem, and veil behind, by L. C. Wyon. Legend: VICTORIA REGINA. Reverse: British soldiers fighting savages in thick bush, by Sir E. J. Poynter. Ribbon: Yellow, with black borders, and two narrow black stripes (Plate II.). Clasps: COOMASSIE, 1887–8, 1891–2, 1892, 1893–94; WITU, 1890;[3] LIWONDI, 1893;[2] WITU, August 1893;[3] JUBA RIVER, 1893;[3] LAKE NYASSA, 1893;[2] GAMBIA, 1894;[2] BENIN RIVER, 1894;[3] BRASS RIVER, 1895;[3] MWELE, 1895;[3] [4] NIGER, 1897; BENIN, 1897;[3] SIERRA LEONE, 1898–99; 1896–98, 1897–98, 1898, 1899, 1900.

This medal was first awarded by Army Order 43, dated June 1, 1874, to "all of Her Majesty's Forces who have been employed on the Gold Coast during the operations against the King of Ashantee," and in addition a clasp, "Coomassie," "in the case of those who were present at Amoaful and the actions between that place and Coomassie (including the capture of the capital), and of those who, during the five days of those actions, were engaged on the north of the Prah in maintaining and protecting the communications of the main army." In all, with and without the clasp, 11,000 medals were issued for the Ashantee campaign to both Services. Over eighteen years later this same medal was re-issued as a "general service" medal, the award being for operations in Central Africa, and on the East and West Coasts, during the period 1887–92, which were covered by the dated clasps "1887–8," "1891–2," and "1892." As such the issue was continued for operations down to the year 1900, although the official title "West

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[1] In addition to this award the French emperor sent five hundred of the French "Military Medal," to be distributed amongst specially selected non-commissioned officers and men of the army and Royal Marines, and petty officers and seamen of the Royal Navy. Only two of these medals were given to officers, viz. the duke of Cambridge and Sir William Codrington, the latter being presented by Pélissier with his own medal. The king of Sardinia also distributed 450 medals to the British forces, of which 50 were given to the Royal Navy and Royal Marines, and 243 to officers and 157 to non-commissioned officers and privates of the army.

[2] These clasps were all naval awards, but two companies of the West India Regiment took part in the operations for which the clasp "Gambia, 1894," was awarded.

[3] Were awarded by the Admiralty to certain local forces which co-operated with the Naval Brigades.

[4] "Mwele, 1895," is not strictly speaking a clasp, as it is engraved on the edge of the medal. Recipients already in possession of the medal were entitled to have the action and date engraved thereon. It corresponds, however, to a clasp in that it commemorates a particular service, and so has been included.

Africa Medal" (see Army Order 253, of Dec. 1894) is somewhat of a misnomer, for very frequently the medal has been granted for services in Central Africa and in the Hinterland of the East Coast as for services on the West Coast. In all issues since the original "Ashantee" medal, the clasp only was given to those who already had the medal, so subsequent issues do not make it a new award. As will be seen later, the same medal was subsequently issued with a different ribbon, and so constituted as an entirely new decoration, that could be worn in conjunction with the older one. With the exception of those issued with "Mwele, 1895" engraved on the medal, none of these medals have been issued without a clasp since the original issue for the campaign of 1873–74; and the clasp "Coomassie" that accompanied the first issue is the only one that has been issued to regimental units of the British Army as apart from the West India Regiment and local troops. The duke of Edinburgh was married in January of the year in which this medal was first awarded, and it is said that yellow and black (the Imperial Russian colours) were chosen as the colours of the ribbon, in compliment to his consort the grand duchess Marie of Russia.

25. *Arctic*, 1876 (2nd Arctic Medal).—Awarded by Queen Victoria, 1876. Obverse: Bust of Queen Victoria, crowned and with veil by G. G. Adams. Legend: VICTORIA REGINA; underneath bust, 1876. Reverse: A ship packed in floe ice; above, an Arctic sky with fleecy clouds in a clear horizon. Ribbon: White (Plate II.). Clasps: Nil.

The award of this grant was notified in an Admiralty Order, dated Nov. 28, 1876, and the award is specified "to all persons, of every rank and class, who were serving on board Her Majesty's ships 'Alert' and 'Discovery' during the Arctic Expedition of 1875–1876, and on board the yacht 'Pandora,' in her voyage to the Arctic Regions in 1876." The 'Pandora' was owned and sailed by Commander (Sir Allen) Young, R.N.R., whose officers and crew rendered valuable services to Her Majesty's ships when in the Polar seas. Sixty-three medals were given on board the "Alert," fifty-seven on board the "Discovery." The bust on the obverse of this medal has not been reproduced on any other. The reverse (by L. C. Wyon) is copied from a photograph taken during the expedition of the "Alert" and "Discovery" under Sir George Nares, K.C.B.

26. *Afghanistan*, 1878–80 (2nd Afghan). Awarded by Queen Victoria, 1880. Obverse: Bust of Queen Victoria, crowned and with veil, by J. E. Boehm. This is the first war medal bearing the imperial title. Legend: VICTORIA REGINA ET IMPERATRIX. Reverse: A column of troops emerging from a mountain-pass, headed by a heavy battery elephant carrying a gun; behind, mounted troops. Above, AFGHANISTAN. In exergue, 1878–79–80. Ribbon: Green, with crimson borders (Plate I.). Clasps: ALI MUSJID, PEIWAR KOTAL, CHARASIA, KABUL, AHMED KHEL, KANDAHAR.

At the conclusion of the first phase of the Second Afghan War, it was proposed that the (Second) India G.S. Medal should be issued for this campaign with clasps "Afghanistan," "Ali Musjid," "Peiwar Kotal," but, after the massacre of Sir P. L. N. Cavagnari and the members and escort of the Embassy at Kabul, Sep. 3, 1879, and the consequent renewal of the war, it was decided to grant a separate medal. The first official intimation of the award is in a telegram from the secretary of state for India to the viceroy, dated Aug. 7, 1880. The award, with the regulations to govern the issue, was promulgated in a G.O. by the governor-general, Dec. 10, 1880, and subsequent G.O.'s. The medal without clasp was awarded to all who had served across the frontier between Nov. 22, 1878, and May 26, 1879 (first phase of the war), and between Sep. 1879, and Aug. 15, 1880 for the Khyber and Kurram Lines, and Sep. 20, 1880, for Southern Afghanistan (second phase of the war). The "Kabul" clasp was awarded to all who had shared in the operations "at and near that place from the 10th to the 23rd Dec., 1879, including the column under the command of Brigadier-General C. J. S. Gough, C.B., which joined Sir Frederick Roberts on the 24th Dec., 1879." The clasp for "Kandahar" did not include the whole garrison of the beleaguered city, but only the troops that were actually "engaged in the action fought under Sir Frederick Roberts' command against Sirdar Mahomed Ayub Khan on the 1st Sep., 1880." The greatest number of clasps with which the medal was issued was four, and the units to which such medals were issued are the 72nd Highlanders, 5th Ghoorkas, 5th Punjab Infantry and 23rd Punjab Pioneers. The bust of the Queen by Sir Edgar Boehm, R.A., has not been reproduced on other war medals.

27. *Kabul to Kandahar*, 1880.—Awarded by Queen Victoria, 1880. This decoration took the form of a five-pointed star, 1·9 in. across from point to point, with a ball between the points; between the two topmost points of the star is an Imperial Crown and ring for suspension. Obverse: In the centre the imperial monogram V.R.I., surrounded by a band inscribed KABUL TO KANDAHAR, 1880. Reverse: Plain, with a hollow centre, round which the recipient's name and regiment are indented in capital letters. The old rainbow-coloured military ribbon is worn with this star.

The grant of this award was first notified in a despatch from the secretary of state for India to the viceroy, dated Nov. 30, 1880. This awarded the decoration "to the force which marched from Kabul to Kandahar," and later, Aug. 26, 1881, a G.O. by the Governor-General extended the grant "to the troops which then composed the garrison of Kelat-i-Ghilzai, and accompanied the force under the command of Lieutenant-General Sir F. S. Roberts, G.C.B., V.C., from that place to Kandahar."

28. *Egypt*, 1882–1889.—Awarded by Queen Victoria, 1882. Obverse: Head of Queen Victoria as in the West African Medal. Legend: VICTORIA REGINA ET IMPERATRIX. Reverse: A Sphinx; above, EGYPT; below, 1882. Ribbon: Blue, with two white stripes, forming five $\frac{1}{4}$-inch stripes (Plate I.). Clasps: ALEXANDRIA, 11th July[1]; TEL-EL-KEBIR, SUAKIN, 1884; EL-TEB, TAMAAI, EL-TEB-TAMAAI,[2] THE NILE, 1884–85; ABU KLEA, KIRBEKAN, SUAKIN, 1885; TOFREK, GEMAIZAH, 1888; TOSKI, 1889.[3] This medal was first awarded (Admiralty Circular, Oct. 1882; G.O. by the commander-in-chief, Oct. 17, 1882; and G.O. by governor-general of India, Oct. 27, 1882); to all the Forces, naval and military, present and serving in Egypt between July 16, and Sep. 14, 1882. The first two clasps were also given with this issue. One military officer (Major-General Sir A. B. Tulloch, then of the Welsh Regiment) received the clasp "Alexandria, 11th July," as he was serving in the fleet as military adviser to Admiral Sir Beauchamp Seymour. A second issue was made in 1884, and with it the next four clasps were given; "Suakin, 1884," for those who landed at Suakin or Trinkitat between Feb. 19 and March 26, 1884, was, however, only given to those with the 1882 medal, those not so possessed receiving the medal without a clasp. A third issue was made in 1885, the next five clasps accompanying it. "The Nile, 1884–85," was given to those who served south of Assouan on or before March 7, 1885; "Suakin, 1885," to those who were engaged in the operations at Suakin between March and May 14, 1885; but the former clasp was only to go to those already possessed of the medal, others received the medal only. The medal alone was also given to all on duty at Suakin between March 27, 1884, and May 14, 1885. No medals were issued with single clasps for "Tofrek," recipients of which also got clasp "Suakin, 1885," or "Abu Klea" and "Kirbekan," recipients of which got also clasp "The Nile, 1884–85." In 1886, the medal without was issued to those who had not previously received it and had served at, and south of Wady Halfa, between Nov. 30, 1885 and Jan. 11, 1886, but no clasps went with this issue, although the operations included the battle of Ginnis. The last issue was made in 1890. The medal with clasp "Gemaizah, 1888," to all who were present at that action near Suakin, Dec. 20, 1888; the medal alone to all employed on the Nile at, and south of Korosko, on Aug. 3, 1889, and with clasp "Toski, 1889," to all present at that action, Aug. 3, 1889. Besides those already enumerated who received the medal without clasp, it was given to officers of hired transports of the mercantile marine, to some civilians, native and European, to the Australian contingent that landed at Suakin, and to the Canadian boatmen employed on the Nile. In fact, not far short of fifty thousand of these medals have been struck, and the numbers issued have exceeded that of any other medal with the exception of that given for the South African War. Seven clasps: "Tel-el-Kebir," "Suakin, 1884"; "El-Teb-Tamaai"; "The Nile, 1884–85"; "Abu Klea"; "Gemaizah, 1888"; and "Toski, 1889," were awarded to one officer, Major Beech, late 20th Hussars, who also received the Bronze Star with the clasp "Tokar, 1890." The medal with six clasps was earned by four men of the 19th Hussars who were Lord Wolseley's orderlies, and who after having earned the first five clasps enumerated in Major Beech's medal, went with Lord Wolseley to Suakin and so got the "Suakin, 1885" clasp.

29. *Egypt Bronze Star*, 1882–93.—Awarded by the Khedive 1883. This decoration is in the shape of a five-pointed star (1·9 in. diameter) connected by a small star and crescent to a laureated bar to which the ribbon is attached. Obverse: A front view of the Sphinx, with the desert and pyramids in the rear. Around a double band, upon which are, above, EGYPT, 1882, and below, in Arabic, "Khedive of Egypt, 1299" (the Hegira date). In the second and third issues the dates are respectively altered to 1884, 1301 and 1884–86 and 1301–4; the fourth and fifth issues are dateless. Reverse: A large raised circle inside which is the Khedivial monogram, T. M. (Tewfik Mahomed), surmounted by a Crown and Crescent and Star. Ribbon: Dark blue (Plate I.). Clasps: TOKAR, 1890.

This star was awarded for the same operations as was the British Egyptian medal above described, but, except for a few officers and men of the Royal Navy, the issue of the clasp TOKAR was confined to British and native officers and men of the Egyptian service. (H. L. S.)

30. *Canada*, 1885.—Awarded by Queen Victoria, 1885. Obverse: Head of Queen Victoria as on the West African ("Ashantee") Medal. Reverse: NORTH WEST CANADA and date, within a maple leaf. Ribbon: Blue-grey, with a crimson stripe on each side (Plate II.). Clasp: SASKATCHEWAN.

This medal, commemorative of services in the Riel Rebellion, was awarded to Canadian forces only.

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[1] Issued to the Royal Navy and Royal Marines only.

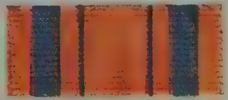
[2] For combatants present at both actions.

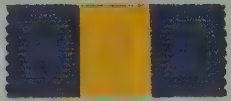
[3] Only clasp not issued to Royal Navy and Royal Marines.

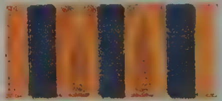
MEDALS AND DECORATIONS

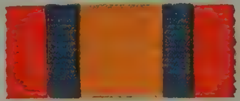
PLATE II.

SOUTH AFRICA


South Africa, 1853.
1834-35, 1846-47, 1850-53, 1877-79.
1853 in exergue, but Medal actually authorized 1854.


Cape Colony General Service, 1900.
1880-81, 1896-97.

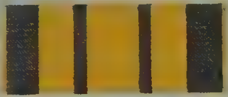

British South Africa Co., 1893.
1893, 1896, 1897.
Frequently termed "Rhodesia" or "Matabeleland" Medal.

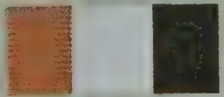

Queen Victoria Medal.

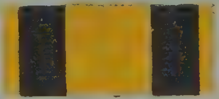
King Edward VII. Medal.

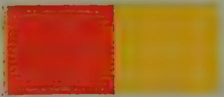
South Africa, 1901.
1899-1902.
Boer War Medals.

WEST, EAST, AND CENTRAL AFRICA

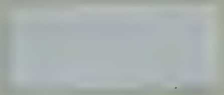

West Africa, 1874.
1873-1900.
Originally issued as "Ashanti, 1874," for campaign of 1873-74, and afterwards became a West African G.S. Medal.


East and Central Africa, 1895.
1891-1898.
Medal the same as West African, but the different Ribbon constitutes it a separate decoration, and both are worn together by a recipient. This Medal is often termed the "Central Africa" Medal.

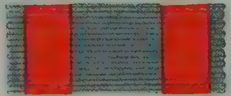

Ashanti Star.
1896.

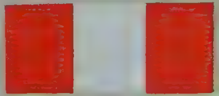

East and Central Africa, 1899.
1897-99.
Frequently termed the "Uganda" Medal

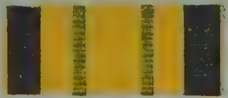
Ashanti.
1900.

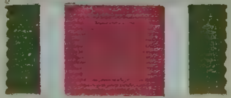

Arctic Medal of 1857.
Arctic Medal of 1876.
Polar Medal of 1905.

CANADA

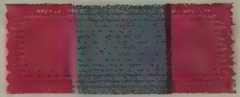

Canada.
1885.
Suppression of Riel's Rebellion in the North-West.

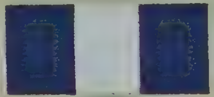

Canada General Service, 1899.
1866, 1870.

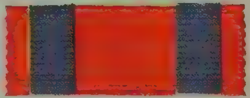

Africa General Service, 1902.
Since 1901.
The award of Nov. 1907 made the 26th Clasp to this Medal.

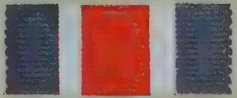

Tibet, 1905
1903-04.

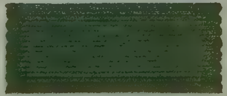
FOR PERSONAL GALLANTRY


Distinguished Conduct in the Field.
Army, 1862.

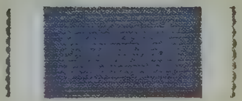

Conspicuous Gallantry.
Navy, 1874.

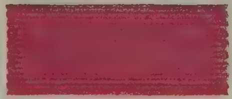

Transport Service, 1902
For Officers of the Mercantile Marine
Up to 1908 two awards had been made, one for South Africa and one for China.

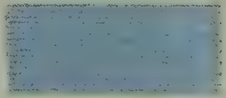

Naval Gunnery, 1903.
For best shot in ship during year with each nature of gun.

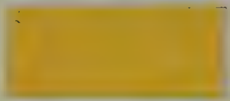

Volunteer Forces.
Long Service Medal.
1894.

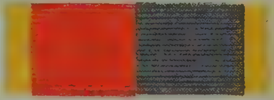
LONG SERVICE AND GOOD CONDUCT


Navy and Royal Marines.
1831.


Army.
1833.
The "Meritorious Service" Medal is worn with a similar Ribbon.


Militia.
1904.


Imperial Yeomanry.
1904.


Hon. Artillery Company.
Long Service Medal.
1906.

NOTE.—Date following Title is that of authorization of first award, those under Titles are the year, or years, in which the operations for which the Medal was awarded took place.

31. *Canada* (*General Service*).—Awarded, 1899. Obverse: Head of Queen Victoria, as in Third India G. S. Medal. Reverse: Within a maple wreath, the Dominion flag, above, CANADA. Ribbon: Red, with white centre (Plate II.). Clasps: FENIAN RAID, 1866; FENIAN RAID, 1870; RED RIVER, 1870. One battalion of the King's Royal Rifles received this medal with the Red River Clasp. Otherwise issue confined to Canadian forces.

32. "*Queen's*" *Sudan*, 1896–1898.—Awarded by Queen Victoria, 1899. Obverse: Half-length effigy of Queen Victoria holding sceptre, by De Saulles, as in "Uganda" medal described below. Reverse: A winged Victory, seated, with, on either hand, the Union Jack and the Egyptian flag. The left hand holds a laurel wreath, the right a palm branch. On a tablet below, SUDAN, and below this lotus leaves. Ribbon: Half black, half yellow, divided by a narrow red stripe (Plate I.). Clasps: none.

Given for the operations under the command of Sir Herbert (Lord) Kitchener, which led to the reconquest of the Sudan, 1898; issued in bronze to followers.

33. "*Khedive's*" *Sudan*, 1896–1900.—Awarded by the khedive in 1897. Obverse: "Abbas Hilmi II." and date, in Arabic. Reverse: A trophy of arms with a shield in the centre, on a tablet below "Recovery of the Sudan," in Arabic. Ribbon: Yellow, with blue centre (Plate I.). Clasps: FIRKET, HAFIR, SUDAN, 1897; SUDAN, 1898; ABU HAMED, THE ATBARA, KHARTOUM GEDAREF,[1] SUDAN, 1899;[1] SUDAN, 1900;[1] CEDID,[1] BAHR-EL-GHAZAL, 1900–1902;[1] TEROK,[1] NYAM NYAM,[1] TALODI.[1]

This medal was awarded to officers and men of the British Navy and Army, to the Egyptian Army engaged in the reconquest of the Sudan and (in bronze without clasps) to followers.

34. *Cape Colony General Service*, 1900.—Awarded by the government of Cape Colony. Obverse: Bust of Queen Victoria as on the Volunteer Long Service Medal. Reverse: Arms of Cape Colony. Ribbon: Dark blue, with yellow centre (Plate II.). Clasps: BASUTOLAND, TRANSKEI, BECHUANALAND. Issued to Colonial troops only, for services in various minor campaigns.

35. *Matabeleland*, 1893 (called the *Rhodesia Medal*).—Awarded by the British South Africa Company, 1896. Obverse: Bust of Queen Victoria. Reverse: A fighting lion. Ribbon: Orange, with three dark blue stripes (Plate II.). Clasps: RHODESIA and MASHONALAND, with dates.

This is the first war medal issued by a chartered company since the close of the Company's rule in India. It was awarded to British officers and men of the British service, to the Cape Mounted Rifles, Bechuanaland police, and the Chartered Company's own forces, engaged in the Matabeleland and Mashonaland Campaigns 1893, 1896 and 1897.

36. *East and Central Africa*, 1891–98.—Awarded by Queen Victoria in 1895. Obverse and Reverse: as in West African (or original Ashantee) Medal described above. Ribbon: Terra-cotta, white and black stripes (Plate II.). Clasps: CENTRAL AFRICA, 1894–96; CENTRAL AFRICA, 1899.

This medal only differs from the West African in that it has a different ribbon. It is suspended by a ring. Practically only the local forces (and of course their British officers) received this medal. But a few officers and men of the Indian Army and of the Royal Navy have also received it.

37. *East and Central Africa*, 1899 (*the* "*Uganda*" *Medal*).—Awarded by Queen Victoria in 1899. Obverse: Half-length effigy of Queen Victoria, by De Saulles. Reverse: Britannia with lion, gazing over a desert towards a rising sun. Ribbon: Half red, half yellow (Plate II.). Clasps: LUBWA'S, UGANDA, 1897–98; UGANDA, 1899; UGANDA, 1900.

This medal was awarded to the local forces and also to officers and men of the Indian Army and Royal Navy.

38. *Ashanti Star*, 1896.—Awarded by Queen Victoria in 1896. Obverse: An imperial crown with "Ashanti, 1896" round it. Reverse: Inscribed "from the Queen." The star is four-pointed, and is crossed by a saltire or St Andrew's cross. Ribbon: Yellow with black stripes (Plate II.).

This medal was issued for the expedition against Prempeh in 1896. As there was no actual fighting, no medal was given, but sickness claimed many victims, amongst them Prince Henry of Battenberg. The decoration was issued to officers and men of the British Army, Royal Navy and local troops.

39. *Ashanti Medal*, 1900.—Awarded by King Edward VII. in 1901. Obverse: Head and bust of King Edward VII. in the uniform of a field-marshal, by De Saulles. Reverse: a lion standing on a cliff, in the background the rising sun. Ribbon: Green with black edges and black central stripe (Plate II.). Clasp: KUMASSI.

This medal was the first which was issued with an effigy of King Edward VII. It was given only to local forces, and the British officers employed on the staff or in commands.

40. *Africa General Service*, 1899– .—Awarded by King Edward VII. in 1902. Obverse: As in Ashanti Medal of 1900. Reverse: As in "Uganda" Medal above described. Ribbon: Yellow, with black edges and two narrow green stripes (Plate II.). Clasps: N. NIGERIA, with various dates; S. NIGERIA, with various dates; UGANDA, 1900; JUBALAND, GAMBIA, LANGO, 1901 and 1902; JIDBALLI, KISSI, 1905; SOMALILAND, 1901 and 1902–04; BRITISH CENTRAL AFRICA, 1899–1900; ARO, 1901–02.

This medal represents an almost incessant warfare of a minor, but exacting, nature. In the first eighteen months, eleven clasps were awarded, some awards being of course retrospective. The clasp "Jubaland" is chiefly a naval award, but all the rest are almost exclusively earned by the West African Frontier Force and the King's African Rifles. It is worthy of remembrance, however, that a contingent of Boer mounted riflemen took part in the Somaliland Campaign, within one year of the peace of Vereeniging, and received the medal and clasp. The "Somaliland, 1902–1904" clasp represents indeed a considerable campaign in which contingents from Great Britain and India took part.

41. "*Queen's*" *South African*, 1899–1902.—Awarded by King Edward VII. in 1901 shortly after Queen Victoria's death. Obverse: Bust of Queen Victoria, by De Saulles. Reverse: Britannia holding an outstretched laurel wreath towards a body of troops, in the background a coast line, the sea and war-ships. Ribbon: Centre orange bordered with blue, outside edges red (Plate II.). Clasps; see below.

The "Queen's" medal for troops engaged in the South African War was authorized, shortly after Queen Victoria's death, by Army Order 94 of 1901. It was given "to all officers, warrant officers, non-commissioned officers and men, of the British, Indian and Colonial forces, and to all Nurses and Nursing Sisters, who actually served in South Africa between 11th of October 1899, and a date to be fixed hereafter" (the war not being concluded) "to all troops stationed in Cape Colony and Natal at the outbreak of hostilities, and to troops stationed at St Helena between the 14th of April 1900, and a date to be fixed hereafter." The last provision shows a widening of the signification hitherto attaching to "war service," for the troops at St Helena were employed in guarding Boer prisoners. The A.O. referred to was supplemented by others in 1901 and 1902. Clasps were authorized as follows: BELMONT (Nov. 23, 1899); MODDER RIVER (Nov. 28, 1899); PAARDEBERG (Feb. 17–26, 1900); DREIFONTEIN (March 10, 1900); WEPENER (April 9–25, 1900); JOHANNESBURG (May 29, 1900); DIAMOND HILL (June 11–12, 1900); BELFAST (Aug. 26–27, 1900); WITTEBERGEN (July 1–29, 1900); DEFENCE OF KIMBERLEY (Oct. 14, 1899, Feb. 15, 1900); RELIEF OF KIMBERLEY (Feb. 15, 1900); DEFENCE OF MAFEKING (Oct. 13, 1899—May 17, 1900); RELIEF OF MAFEKING (May 17, 1900); TALANA (Oct. 20, 1899); ELANDSLAAGTE (Oct. 21, 1899); DEFENCE OF LADYSMITH (Nov. 3, 1899—Feb. 28, 1900); TUGELA HEIGHTS (Feb. 14–27, 1900); RELIEF OF LADYSMITH (Dec. 15, 1899—Feb. 28, 1900); LAING'S NEK (June 2–9, 1900). Clasps: for CAPE COLONY, NATAL, ORANGE FREE STATE and RHODESIA, were given to troops who served within the limits of the respective colonies and states named during the war, without being present at any action, fought inside those limits, for which a clasp was awarded. Non-enlisted men, of whatever nationality, who drew military pay, were awarded the medal in bronze instead of silver and without clasps. Militia units which volunteered and were sent to Mediterranean stations to release the regulars for field service were awarded (Feb. 1902) the medal without clasp, "Mediterranean" being substituted for "South Africa" on the reverse. This was not, of course, issued to any one entitled to the Queen's Medal for South Africa.

43. The "*King's*" *South African Medal* was awarded by King Edward VII. in 1902, to be worn in addition to the "Queen's" by those who completed eighteen months' service in South Africa during the war. On the obverse of the medal is the effigy of King Edward, by De Saulles (as on the "Ashanti, 1900," Medal); the reverse is the same as that of the "Queen's" Medal. Ribbon: Green, white and orange (Plate II.). The two clasps awarded were, in accordance with the terms of the award, general in character, to wit, SOUTH AFRICA, 1901 and SOUTH AFRICA, 1902.

44. *China*, 1900.—Awarded by King Edward VII., 1902. Obverse: Bust of Queen Victoria as on "Queen's" South African Medal. Reverse: As on first China Medal, but with date altered. Ribbon: As in first China Medal (Plate I.). Clasps: DEFENCE OF LEGATIONS, RELIEF OF PEKIN, TAKU FORTS.

This medal was issued to the Royal Navy (including some Naval volunteers), British and Indian Armies, and the (Wei-hai-Wei) Chinese Regiment, for operations during the Boxer rebellion. This was the last war medal, as the "First China" was the first to bear Queen Victoria's effigy. Sir E. H. Seymour, the commander of the Tientsin relieving column, who had taken part in the former China War, received the new medal as well as the old.

45. *India*, 1895 (*Third India General Service*).—Awarded by Queen Victoria in 1896. Obverse: Bust of Queen Victoria, by T. Brock, R.A. Reverse: A British and Indian soldier supporting a standard; below, INDIA, 1895. Ribbon: Three red and two green stripes of equal width (Plate I.). Clasps: DEFENCE OF CHITRAL, 1895; RELIEF OF CHITRAL, 1895; MALAKAND, 1898; PUNJAB FRONTIER, 1898; TIRAH, 1897; TIRAH, 1898; WAZIRISTAN, 1901–02.

The ribbon of this medal is perhaps more frequently seen than that of any other British war medal except those for South Africa. In 1903 the medal was re-issued with the military effigy of King Edward VII. (as on the Ashanti, 1900, medal) on the obverse, and the date was omitted from the reverse. The medal is issued in bronze, without clasps, to followers.

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[1] Awarded to Egyptian Army only.

46. *Tibet*, 1903–04.—Awarded by King Edward VII in 1905. Obverse: Military effigy of the king as on Ashanti, 1900, medal. Reverse: a representation of the Potala at Lhasa. Ribbon: Purple-red, edged with green and white stripes (Plate II.). Clasp: GYANTSE.

47. *India*, 1908.—A new India General Service Medal was authorized in 1908, to take the place of the medal granted by A.O. 43 of 1903. This was to be issued in silver to officers and men, and in bronze to non-enlisted men of all sorts. This medal with clasp bearing the name and date was given to the troops which took part in the North Western Frontier Expedition of 1908. The ribbon is dark blue edged with green.

48. *Transport Medal.*—Awarded by King Edward VII. in 1902. Obverse: Head and bust of the king in naval uniform, by De Saulles. Reverse; A steamer at sea, and the five continents. Ribbon: red, with two thin stripes near the edge (Plate II.). Clasps: SOUTH AFRICA, 1899–1902; CHINA, 1900. This medal is restricted to officers of the mercantile marine serving in chartered troop-ships. It is a sort of general service medal, clasps being added as earned. Up to 1910 only the above clasps had been authorized.

49. *Polar Medal* (or *Antarctic Medal*).—Awarded by King Edward VII., 1904. Obverse: Naval effigy of the king as on Transport Medal. Reverse: In the foreground a sledge and travellers, in the background the steamer "Discovery" (Capt. R. F. Scott's Expedition, 1904). Ribbon: As for 1st and 2nd Arctic Medals, white (Plate I.). The medal, like the 1st Arctic Medal, is octagonal. First awarded to officers and men of the "Discovery," whether belonging to the Royal Navy or not. It is given with a dated clasp for Antarctic exploration service.

Other Medals and Decorations.—The above forty-nine medals are given as rewards for participating in the operations they commemorate, and issued generally to all concerned, irrespective of individual distinction or bravery. There are other classes of medals and decorations, civil as well as military, which must be grouped with them, as being allied in character. These are either (i.) awards personal to the recipient, being an acknowledgment of or reward for special individual services or good conduct (these are civil as well as military in respect of awards for bravery), or (ii.) awards that are simply of a commemorative kind, though worn as war medals and for the most part given to officers and soldiers. The more important of these two classes will be named. *Orders* given for service are dealt with, for the most part in the article KNIGHTHOOD; but particulars are given here of certain distinctively military orders that have no knighthood rights and duties, and indeed little meaning apart from the deeds or services which led to the award—being so to speak, records of the past, rather than badges of a present membership. Individual decorations for services may be classed as (i.) for gallantry, (ii.) for special merit, and (iii.) for long service and good conduct.

1. *Indian Order of Merit.*—Awarded by H.E.I. Company and notified by G.O. of governor-general, April 17, 1837. Obverse: 1st Class—A Gold Star, 1½ in. diameter; in the centre, in gold on a ground of dark blue enamel, crossed swords within a circle around which is the legend, REWARD OF VALOUR, the whole encircled by a gold laurel wreath. 2nd Class—Star similar to that of 1st Class, but in silver. Wreath and centre as in 1st Class. 3rd Class—Star exactly similar to that of 2nd Class, but the wreath and centre in silver, and dark blue enamel and silver, respectively. Reverse: Engraved 1st, 2nd and 3rd Class Order of Merit, respectively, but the name of the recipient is not engraved on the decoration when issued. Ribbon: Dark blue, with red edges. This decoration is to be obtained only by a "conspicuous act of individual gallantry" in the field or in the attack or defence of fortified places. It is open to all native officers or soldiers of the Indian Army, "without distinction of rank or grade." The 3rd Class is bestowed for the first act of gallantry for which the recipient is recommended. The 2nd Class is given only to those who possess the third, and for a second act of conspicuous gallantry. The 1st Class is given only to those who hold the 2nd, and for a third act of bravery. A recipient of the decoration receives an additional allowance equivalent in the 3rd Class to one-third, in the 2nd to two-thirds, and in the 1st to the whole of the ordinary pay of his rank, over and above that pay or his pension. The widow (in the case of plurality of wives, the first married) receives the pension of the Order for three years after her husband's death.

2. *Victoria Cross.*—Instituted by Royal Warrant, January 29, 1856. A bronze Maltese Cross, 1½ in. diameter, with, in the centre, the Royal Crest (lion and crown), and below it a scroll inscribed "FOR VALOUR." There is a bronze laureated bar for suspension, connected with the cross by a V. The reverse is plain, but the name, rank and corps of the recipient are engraved on the back of the laureated bar. Ribbon: Red for the army; blue for the navy. Clasp: For every additional act of bravery a clasp, bearing the date of such act, may be awarded.

Nothing save "the merit of conspicuous bravery" gives claim for the decoration, and it must be evinced by "some signal act of valour or devotion to their country" performed "*in the presence of the enemy.*" (The regulation italicized was for a short time abrogated, but soon restored to force.) The original Royal Warrant has been supplemented by various Royal Warrants (Oct. 1857, Aug. and Dec. 1858, Jan, 1867, April and Aug. 1881), and now every grade and rank of all ranks of all branches of His Majesty's Forces, British and Colonial, are eligible, with the single exception of native ranks of the Indian army, who have an equivalent decoration in their own Order of Merit. In the case of recipients who are not of commissioned rank, the Cross carries with it a pension of £10 a year, and an additional £5 a year for each clasp. A larger grant is sometimes given to holders of the V.C. who are in need of monetary help. In all, up to 1904, the Cross was awarded to 521 recipients (including 15 posthumous awards).

3. *Distinguished Conduct in the Field* (*Army*).—Instituted by Royal Warrant, September 30, 1862. Obverse: A military trophy, with, in the centre, the Royal Arms (as in the Long Service and Good Conduct Medals). Reverse: inscribed "FOR DISTINGUISHED CONDUCT IN THE FIELD." Ribbon: Three stripes equal width, outside red, centre blue (Plate II.). Clasp: Royal Warrant, 7th of February 1881, authorized award of clasps for subsequent acts of gallantry.

"Individual acts of distinguished conduct in the field in any part of the world" entitle to this medal, and only non-commissioned officers and men of the British forces are eligible for the award. Prior to its institution, distinguished gallantry was rewarded by the "Meritorious Service" medal. Single clasps have been constantly conferred, and there is more than one case of a recipient having earned two clasps to his medal.

4. *Albert Medal* (for saving life at sea).—Instituted by Royal Warrant, 7th of March 1866. Gold oval badge, enamelled in dark blue, with a monogram composed of the letters V and A, interlaced with an anchor erect, all in gold, surrounded with a garter in bronze, inscribed in raised letters of gold "FOR GALLANTRY IN SAVING LIFE AT SEA," and surmounted by a representation of the crown of the prince consort, the whole edged with gold. Ribbon: dark blue, with two white stripes. Clasps are awarded for any subsequent acts of bravery. By a subsequent Royal Warrant of the 12th of April 1867, the decoration was re-constituted in two classes, as follows. 1st Class—Badge precisely as already described. Ribbon: Dark blue, with *four* white stripes (1⅜ in. wide). Clasps: As authorized in original warrant. 2nd Class—Badge exactly similar to that of the 1st Class, except that it is entirely worked in bronze, instead of gold and bronze. Ribbon: Dark blue, with *two* white stripes. Clasps: As authorized for 1st Class.

The decoration is awarded only to those who "have, in saving or endeavouring to save the lives of others from shipwreck or other peril of the sea, endangered their own lives." The 1st Class is confined "to cases of extreme and heroic daring"; the 2nd for acts which, though great courage may be shown, "are not sufficiently distinguished to deserve" the 1st Class of the decoration.

5. *New Zealand Cross.*—Instituted by an Order of the governor of New Zealand in council, 10th of March, 1869. Silver Maltese Cross with gold star on each of the four limbs and in the centre, in a circle within a gold laurel wreath, NEW ZEALAND. Above the Cross a crown in gold, and connected at the top by a V, to a silver bar ornamented with laurel in gold. The name of recipient is engraved on reverse. Width of Cross, 1½ in. Ribbon: Crimson. Clasps: Authorized for subsequent acts of valour. In authorizing this decoration Sir G. F. Bowen, the then governor, went outside his authority, but the queen ratified the colonial order in council, and intimated "Her gracious desire that the arrangements made by it may be considered as established from that date by Her direct authority." It was, however, stipulated that the occasion was in no way to form a precedent. The award was to be for those "who may particularly distinguish themselves by their bravery in action, or devotion to their duty while on service," and only local "Militia, Volunteers or Armed Constabulary" were to be eligible. In all only nineteen of these decorations were awarded. No clasps were awarded.

6. *Conspicuous Gallantry* (*Navy*).—Instituted by an Order of the queen in Council, 7th of July, 1874. Obverse: Head of Queen Victoria, by W. Wyon, R.A. (as on China Medal).[1] Reverse: A laurel wreath, and within FOR CONSPICUOUS GALLANTRY. Above, a crown. Ribbon: Three stripes of equal width, outside blue, centre white (Plate II.). Clasps: none authorized.

To reward "acts of pre-eminent bravery in Action with the Enemy." Only petty officers and seamen of the Royal Navy, and non-commissioned officers and privates of the Royal Marines, are eligible for this decoration. Prior to the institution of this decoration, acts of gallantry by sailors and marines were rewarded by the same medal as that given to the army before the "medal for distinguished conduct in the field" was instituted, viz. the "Meritorious Service" medal. If the holder be a Chief or First Class Petty Officer, or a Sergeant of Marines, the award carries with it an annuity of £20 per annum; and if a recipient's service ends before his reaching one of those ranks, he may receive a gratuity of £20 on discharge.

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[1] Now naval effigy of King Edward VII., as on Transport Service Medal.

7. *Albert Medal* (for saving life on land).—Instituted by Royal Warrant, 30th of April 1877. 1st Class—Similar to that of the 1st Class for saving life at sea, but the enamelling is in red instead of blue, and there is no anchor interlaced with the monogram V.A. Ribbon: Crimson, with four white stripes. Clasps: for subsequent acts of same character. 2nd Class—Badge similar to that of the 2nd Class for saving life at sea, but the enamelling is in red instead of blue, and there is no anchor interlaced with the monogram V.A. Ribbon: Crimson, with two white stripes. Clasps: As authorized for 1st Class.

The conditions governing the award of this decoration are the same that govern the award for saving life at sea. Originally the award was restricted to acts of gallantry performed within British dominions, but this restriction was removed by Royal Warrant, 5th of June 1905.

8. *Distinguished Conduct in the Field* (*Colonial*).—Instituted by a Royal Warrant, 24th of May 1894, which was later cancelled and superseded by Royal Warrant, 31st of May 1895. Obverse: same as "Distinguished Conduct in the Field" (Army). Reverse: same as "Army" medal, but with the name of the colony inscribed above the words "For Distinguished Conduct in the Field." Ribbon: Crimson, with a line of the colonial colour in the centre. Clasps: Authorized for subsequent acts of valour. Every colony or protectorate, having permanently embodied forces, draws up regulations to govern the issue of these medals as suit its own particular requirements, but in all essentials these regulations are modelled on those that govern the award of the Distinguished Conduct in the Field (Army).

9. *Conspicuous Service Cross.*—Instituted by an Order in Council, 15th of June 1901. Silver cross, with the reverse side plain; on the obverse, in the centre, the Imperial and Royal Cypher, E.R.I., surmounted by the imperial crown. Ribbon: Three stripes equal width, outside white, centre blue. Clasps: none authorized.

This award is to recognize "Distinguished Service before the Enemy." Its grant is confined to "Warrant Officers or Subordinate Officers" of the Royal Navy. Such, not being of "lower-deck rating," are not eligible for the "Conspicuous Gallantry" medal; also, they, "by reason of not holding a commission in the Royal Navy, are not eligible to any existing Order or Decoration."

10. *Edward Medal.*—Founded in 1907 to reward acts of courage in saving life in mines; this medal was extended in 1909 (R.W. Dec. 3) so as to be awarded "to those who in course of industrial employment endanger their own lives in saving or endeavouring to save the lives of others from perils incurred in connexion with such industrial employment."

Certain important medals and decorations for saving life are not the gift of the Crown. These are allowed to be worn in uniform on the right breast. They are the medals of the Royal Humane Society, those given by the Board of Trade for gallantry in saving life at sea, the medals of the Royal National Lifeboat Institution, those of the Shipwrecked Fishermen and Mariners' Royal Benevolent Society, Lloyd's Honorary Silver Medal, Liverpool Shipwrecked and Humane Society's Medals, and the Stanhope Gold Medal.

All these are suspended from a dark blue ribbon with the exception of the medals of the S.F. and M. Royal Benevolent Society, which has a light blue ribbon, and the Stanhope Gold Medal which has a broad dark blue centre, edged with yellow, and black borders. These medals are usually struck in silver or bronze, but occasionally gold medals are awarded. The Stanhope Gold Medal is annually awarded for the most gallant of all the acts of rescue for which the society have awarded medals during the year. This award has been frequently earned by officers or men of the Royal Navy. It is, in fact, the "Victoria Cross" of awards of this character.

The following are decorations for special merit:—

1. *Order of British India.*—Instituted by General Order of Governor-General of India, 17th of April 1837. 1st Class—A gold star of eight points radiated, $1\frac{5}{8}$ in. in diameter, between the two top points the crown of England. In the centre, on a ground of light blue enamel, a gold lion statant, within a band of dark blue enamel, containing in gold letters ORDER OF BRITISH INDIA, the whole encircled by a gold laurel wreath. The whole hangs from the ribbon by a gold loop attached by a ring to the top of the crown, and is worn round the neck, outside the uniform. Ribbon: originally sky-blue, changed to crimson 1838. 2nd Class—Gold star similar to that of the 1st Class, but smaller, $1\frac{1}{2}$ in. diameter, and without the crown. The centre also is similar to that of the 1st Class star, but the enamelling is all dark blue. Suspended and worn as in the 1st Class. Ribbon: As in 1st Class.

This, the highest military distinction to which in the ordinary course native officers of the Indian Army can attain, and confined to them, is a reward for long, honourable and specially meritorious service. The 1st Class is composed exclusively of officers of and above the rank of Subadar in the artillery and infantry, or of a corresponding rank in the other branches of the service. The 2nd Class is open to all native commissioned officers, irrespective of their rank. Originally the order was limited to 100 in the 1st Class and the same number in the 2nd, but it now comprises 215 in the 1st Class and 324 in the 2nd Class. Officers in the 1st Class are entitled to the title of "Sirdar Bahadur," and receive a daily allowance of two rupees in addition to the pay, allowances or pension of their rank, while those of the 2nd Class are styled "Bahadur," and receive an extra one rupee per diem.

2. *Ability and Good Conduct.*—Instituted in 1842. Obverse: A paddle-wheel steamship. Reverse: Crown and anchor, and inscribed, FOR ABILITY AND GOOD CONDUCT. Ribbon: None authorized.

No official documents as regards the institution of this decoration are now to be found at the Admiralty, but only engineers were eligible for the award, and it carried no gratuity or annuity. Only six were ever awarded. When, in 1847, engineers were raised to the rank of warrant officers, the issue of this decoration was discontinued. It had a ring for suspension, and was probably worn with the narrow navy blue ribbon of the "Long Service and Good Conduct" medal of the period.

3. *Meritorious Service* (*Army and Royal Marines*).—Instituted by Royal Warrant, 19th December 1845, for army only; grant extended to Royal Marines by Order in Council, 15th January 1849. Obverse: Head of Queen Victoria as on China medal.[1] Reverse: FOR MERITORIOUS SERVICE, within a laurel wreath. Ribbon: Crimson for army (Plate II.); navy blue for Royal Marines. Only non-commissioned officers of or above the rank of sergeant are eligible for this decoration. It carries with it an annuity not exceeding £20 per annum; but, as the total sum available is strictly limited, the number of these medals that is issued is small, and a non-commissioned officer who is recommended may have to wait many years before his turn comes and he receives the award. The qualification for recommendation is long, efficient and meritorious service, and need not necessarily, although in many cases it does, include any special display of personal gallantry in action. For many years the "meritorious service" medal was considered to cancel the "long service and good conduct" medal, but by A.O. 250 of 1902 both medals can be worn together.[2]

4. The *Distinguished Service Order* (see KNIGHTHOOD) is given only to officers (and naval and military officials of officer rank, not including Indian native officers) for services in war. Often it is the reward of actual conspicuous gallantry under fire, but its purpose, as defined in the Royal Warrant instituting the order, is to reward "individual instances of meritorious or distinguished service in war;" and the same document declares that only those shall be eligible who have been mentioned "in despatches for meritorious or distinguished service in the field, or before the enemy." In the main, therefore, it is awarded for special services in war, and not necessarily under fire; and although the services rewarded are as a fact generally rendered in action, the order is in no sense a sort of second class of the Victoria Cross. Like the latter, the Distinguished Service Order is generally referred to by its initials.

5. The *Royal Red Cross* is also an Order. Membership is restricted to women (not necessarily British subjects), and is given as a reward for naval or military nursing service. Instituted 1883.

6. The *Kaisar-i-Hind Medal* is given for public services in India.

7. The *Volunteer Officers' Decoration.*—Instituted in 1892. An oval of silver, crossed at intervals with gold, in the centre the monogram V.R. and crown in gold. Worn from a ring. Ribbon: Dark green.

This decoration was instituted in 1892, and is the reward of twenty years' service in the commissioned ranks of the volunteer force. It is generally called the "V.D." Since the conversion of the Volunteer into the Territorial Force (1908) it has been replaced by THE TERRITORIAL OFFICERS' DECORATION. Officers of the Royal Naval Reserve and of the Royal Naval Volunteer Reserve are eligible for a similar decoration (1910).

8. The *Long Service and Good Conduct* (*Army*) *Medal* was instituted in 1833. Obverse: A trophy of arms.[3] Reverse: FOR LONG SERVICE AND GOOD CONDUCT. Ribbon: Crimson, as for "Meritorious Service" medal (Plate II.).

This is a reward for "long service with irreproachable character and conduct," the qualifying period of service being 18 years.

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[1] Now naval effigy of King Edward VII., as on Transport Service medal.

[2] Other "Meritorious" or "Long Service" medals worn with a crimson ribbon are the former Long Service medal of the H.E.I. Company's European troops and the Meritorious and Long Service medals of the Indian Native Army.

[3] Now replaced by military effigy of King Edward VII.

9. The *Long Service and Good Conduct (Navy) Medal* was instituted in 1831. Ribbon: Blue, with white edges (Plate II.).

10. The *Volunteer Long Service Medal.*—Instituted in 1894 Has a green ribbon. Obverse: Effigy of Queen Victoria. Reverse: A scroll within a wreath, inscribed FOR LONG SERVICE IN THE VOLUNTEER FORCE. Replaced by the *Territorial Long Service Medal* (1908), of which the ribbon is green with a yellow centre; and the obverse a bust of the king. The *Militia Long Service Medal* (1904) has a light blue ribbon, the *Imperial Yeomanry Long Service Medal* a yellow ribbon, the *Honourable Artillery Company's Medal* a black, red and yellow ribbon. All these are shown on Plate II.[1]

11. The Medal for the *Best Shot in the Army* was instituted in 1869 Obverse: Bust of Queen Victoria (now effigy of King Edward VII.). Reverse: A winged Victory crowning a warrior. Ribbon: Red, with two narrow black stripes on each edge, the two black stripes being divided by a narrow white one. There is also a "Best Shot" Medal for the Indian Native Army, which has an orange ribbon.

12. The Medal for *Naval Gunnery* was instituted in 1903. Ribbon: Red centre, flanked by two narrow white stripes, two broad blue stripes at edges (Plate II.).

Amongst medals of the last class may be mentioned the *Jubilee Medals* of 1887 and 1897, the *Coronation Medal* of 1902, the *Royal Victorian Medal* (this, however, is a sort of sixth class of the Royal Victorian Order, for which see KNIGHTHOOD) and the medals awarded for Durbars.

United States.—The war medals and decorations of the United States, although few in number, are interesting, as they follow a peculiar system in the colours of the ribbons.

The principal military decoration of the United States is the "Medal of Honor," which was founded for the reward of unusual bravery or special good conduct during the Civil War. In its present form it is a five-pointed star, with a medallion in the centre bearing a head of Minerva and round it UNITED STATES OF AMERICA in relief. On each ray of the star is an oak-leaf, and the points themselves are trefoil shaped. A laurel wreath, in green enamel, encircles the whole, and this wreath is surmounted by VALOR, which in turn is surmounted by an eagle that attaches the decoration to its ribbon. This last is blue, with thirteen white stars worked on it in silk. Accompanying this decoration there is a badge or lapel button, hexagonal, and made of blue silk with the thirteen stars in white.

The original form of the decoration had no encircling wreath; on the rays, instead of the oak-leaves, were small wreaths of laurel and oak, and the design in the central medallion was a figure of Minerva standing, with her left hand resting upon a consul's *fasces* and her right warding off with a shield the figure of Discord. The background was formed by thirty-four stars. The decoration was surmounted by a trophy of crossed guns, swords, &c., with eagle above, and the ribbon was designed of the national colours, as follows: thirteen alternate red and white stripes, and across the ribbon at the top a broad band of blue (palewise gules and argent and a chief azure). The ribbon was attached to the coat by a clasp badge bearing two cornucopias and the arms of the U.S. The present decoration does not have this badge, but is suspended from a concealed bar brooch.

Another special decoration is the "Merit" Medal. This bears on the obverse an eagle, surrounded by the inscription VIRTVTIS ET AVDACIAE MONVMENTVM ET PRAEMIVM, and on the reverse the inscription FOR MERIT, surrounded by an oak-leaf wreath; in the upper part of the exergue is UNITED STATES ARMY, in the lower thirteen stars. The ribbon is red, white and blue, in six stripes, two red stripes divided by a fine white line in the centre, two white on either side of the red and two blue forming the two outer edges.

We come now to the war medals proper, issued generally to all those who took part in the events commemorated.

The Civil War Medal bears on the obverse the portrait of Lincoln, surrounded by an inscription taken from his famous Second Inaugural—WITH MALICE TOWARDS NONE, WITH CHARITY FOR ALL. On the reverse is the inscription THE CIVIL WAR, 1861–1865 surrounded by a wreath of oak leaves and olive branches. The ribbon is somewhat similar to that last described; the blue stripe, however, is in the centre, divided as before by a white line, and the red stripes form the outer edges.

The "Indian Wars" Medal is interesting from the fact that its reverse was copied on other medals, this making it, in a sense, a "general service" medal. On the obverse is a mounted Indian in war costume bearing a spear, in the upper part of the exergue INDIAN WARS, in the lower a buffalo's skull with arrow-heads on either side. What we have called the "general service" design on the reverse is composed of (*a*) an eagle perched on a cannon, supported by five standards (typifying the five great wars of the United States), rifles, Indian shield, spear and arrows, Filipino dagger and Cuban machete; (*b*) below this trophy the words FOR SERVICE; (*c*) in exergue, above, UNITED STATES ARMY, below, thirteen stars.

Ribbon of the Indian Medal, vermilion, with deep red edges.

The "War with Spain" Medal bears on the obverse a castle with two flanking towers; in exergue, above, WAR WITH SPAIN, below, the date 1898, with, on one side of it, a branch of the tobacco-plant, and on the other a sugar-cane. Reverse: As for "Indian Wars" Medal. Ribbon: Centre golden-yellow, with two red stripes close to the edges, the edges themselves being narrow stripes of blue.

The "Philippine Insurrection" Medal bears on the obverse a coco-nut palm tree, with, on the left of it, a lamp (typifying Enlightenment), and on the right a balance (representing Justice). This is encircled by the inscription PHILIPPINE INSURRECTION 1899. The ribbon is blue, with two red stripes near the edges. Reverse: As in "Indian Wars" Medal.

Another medal connected with the Filipino insurrection is the so-called "Congressional" Medal, which was designed to commemorate the participation in the war of regulars and volunteers, Northerners and Southerners, side by side. On the obverse is a colour-party of infantry with the national flag, the fly of the flag extending almost to the edge of the medal. Below is the date, 1899, and above, in a semicircle, PHILIPPINE INSURRECTION. The reverse has the inscription FOR PATRIOTISM, FORTITUDE AND LOYALTY, surrounded by a wreath of oak-leaves (typifying the North) and palm branches (typifying the South). The ribbon is blue, edged by narrow stripes of the national colours, the blue being nearest the edge and the red nearest the centre.

The "China Relief" Medal bears on the obverse a Chinese dragon, surrounded by the inscription CHINA RELIEF EXPEDITION, and at bottom, the date 1900–1. Reverse: As for "Indian Wars" medal. Ribbon: Lemon-yellow, with narrow blue edges.

It is interesting to note that in the case of two of these medals the national colours of the enemy (Spain and China) furnish those of the ribbon. The national colours adopted by the Filipinos were red and blue, and these also figure, in spite of their similarity to the U.S. national colours, on the ribbons of the "Filipino" and "Congressional" Medals. The Indian ribbon is, similarly, of the colour of the enemy's war paint—vermilion. See, for illustrations and further details of all these medals and decorations, *Journal of the* [*U.S.*] *Military Service Institution*, May–June 1909. Some of the badges of membership of associations of veterans, such as the Loyal Legion, are allowed to be worn as war medals in uniform. The "Rescue" Medal, in gold or silver, is awarded for bravery in saving life by land or sea.

Other Countries.—As has been mentioned above, foreign decorations for military service usually take the form of Orders in many classes. There are, however, numerous long service decorations, which need not be specified. The most famous of the European war and service decorations are the Prussian Iron Cross, the French *Médaille Militaire*, and the Russian St George's Cross; all these are individual decorations.

The *Iron Cross* is given to officers and soldiers for distinguished service in war. It was founded, in the enthusiasm of the War of Liberation movement, on the 10th of March 1813, and revived at the outbreak of the "War for Unity" against France, 19th of July 1870. The cross is a Maltese cross of cast iron edged with silver. The 1813–15 crosses have the initials F. W. (Friedrich Wilhelm) in the centre, a crown in the upper limb of the cross, and the date in the lower. Those of 1870 have W. (Wilhelm) in the centre, crown on the upper and date on the lower limb of the cross. There are certain distinctions between the Grand Cross, which is worn at the neck, the 1st Class Cross which is worn as an Order suspended from a ribbon, and the 2nd Class Cross, which is worn on the breast. In 1870 war medals were given, bearing on the obverse a Maltese cross superposed on a many-pointed star, and having in its centre 1870–1871 within a wreath. The reverse has W. and a crown, with, for combatants the inscription *Dem siegreichen Heere*, and for non-combatants *Für Pflichttreue im Kriege*, in each case surrounded by the words *Gott war mit uns Ihm sei die Ehre*. The award of the Iron Cross to the rank and file carries with it an allowance of 3–6 marks monthly. (H. L. S.; C. F. A.)

MEDEA (Gr. Μήδεια), in Greek legend, a famous sorceress, daughter of Aeetes, king of Colchis. Having been thrown into prison by her father, who was afraid of being injured by her witchcraft, she escaped by means of her art and fled to the temple of Helios the Sun-god, her reputed grandfather. She fell in love with Jason the Argonaut, who reached Colchis at this time, and exacted a terrible revenge for his faithlessness (see ARGONAUTS and JASON). After the murder of Jason's second wife and her own children, she fled from Corinth in her car drawn by dragons, the gift of Helios, to Athens, where she married king Aegeus, by whom she had a son, Medus. But the discovery of an attempt on the life of Theseus, the son of Aegeus, forced her to leave Athens (Apollodorus i. 9, 28; Pausanias ii. 3, 6–11; Diod. Sic. iv. 45, 46, 54–56). Accompanied by her son, she returned to Colchis, and restored her father to the throne, of which he had been deprived by his own brother Perses. Medus was regarded as the eponymous hero and progenitor of the Medes. Medea was honoured as a goddess at Corinth, and was said to have become the wife of Achilles in the Elysian fields. The chief seat of her cult, however, was Thessaly, which was always regarded as the home of magic. As time went on her character was less favourably described. In the case of Jason and the Argonauts, she plays the part of a kindly, good-natured fairy; Euripides, however, makes her a barbarous priestess of Hecate, while the Alexandrian writers depicted her in still darker colours. Some authorities regard Medea as a lunar divinity, but the ancient conception of her as a Thessalian sorceress is probably correct. The popularity of the story of Jason and Medea in antiquity is shown by the large amount of literature on the subject. The original story was probably contained in an old epic poem called Μινυὰς ποίησις, the authorship of which was ascribed to Prodicus of Phocaea. It is given at some length in the fourth Pythian ode of Pindar, and forms the subject of the *Argonautica* of Apollonius Rhodius. There is a touching epistle (*Medea to Jason*) in the *Heroides* of Ovid. Medea is the heroine of extant tragedies of Euripides and Seneca; those of Aeschylus and Ennius (adapted from Euripides) are lost. Neophron of Sicyon and Melanthius wrote plays of the same name. Among modern writers on the same theme may be mentioned T. Corneille, F. Grillparzer and M. Cherubini (opera).

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[1] By Royal Warrant of 31st of May 1895, medals both for distinguished conduct in the field and for long service were authorized to be awarded by the various colonies possessing regular or volunteer troops, "under regulations similar, as far as circumstances permit, to those now ranking for Our Regular and Auxiliary Forces."

The death of Glauce and the murder of her children by Medea was frequently represented in ancient art. In the famous picture of Tomomachus of Byzantium Medea is deliberating whether or not she shall kill her children; there are copies of this painting in the mural decorations of Herculaneum and Pompeii.

See Léon Mallinger, *Médée: étude sur la littérature comparée*, an account of Medea in Greek, Roman, middle age and modern literature (1898); and the articles in Daremberg and Saglio's *Dictionnaire des antiquités* and Roscher's *Lexikon der Mythologie*.

MEDELLIN, a city of Colombia and capital of the department of Antioquia, 150 m. N.W. of Bogota, on a plateau of the Central Cordillera, 4823 ft. above sea-level. Pop. (1906 estimate), 50,000. Medellin, the foundation of which dates from 1674, stands in the valley of the Porce, a tributary of the Cauca, and is reputed to be one of the healthiest as well as one of the most attractive cities of the republic. It has a university, national college, school of mines and other educational institutions, assaying and refining laboratories, a public library and a mint. The principal industry of the surrounding country is mining, and gold and silver are exported in considerable quantities. Coffee and hides are also exported, but the trade of the city has been greatly impeded by difficulties of transportation. A railway from Puerto Berrio, on the Magdalena, was begun many years before the end of the 19th century, but political and financial difficulties interposed and work was suspended when only 43 m. were finished. The completion of the remaining 80 m. was part of a larger scheme proposed in 1906 for bringing the Cauca Valley into railway communication with the national capital.

MEDEMBLIK, a seaport of Holland, on the Zuider Zee, the terminus of a branch railway from Hoorn, 10½ m. S. Pop. (1903), 3012. Once the capital of West Friesland and a prosperous town, many of its streets and quays are now deserted, though the docks and basins constructed at the end of the 16th and beginning of the 17th centuries could still afford excellent accommodation for many ships. Close to the harbour entrance stands the castle built by Florens V., count of Holland, in 1285. It has been restored, and is used as a court of justice. The West church, formerly called after St Boniface, the apostle of Germany, was once the richest in Friesland, and belonged from an early date to the cathedral chapter at Utrecht, where, until the Reformation, the pastor of Medemblik had a seat in the cathedral. It contains the tomb of Lord George Murray (*q.v.*). Among the public buildings are the town-hall (17th century), weigh-house, orphanage, the old almshouse, the house (1613) of the Water Commissioners, and a large building formerly belonging to the admiralty and now used as a state lunatic asylum. There are many interesting brick houses, dating chiefly from the first half of the 17th century, with curious gables and picturesque ornamentation, carvings and inscriptions.

MEDFORD, a city, including several villages, of Middlesex county, Massachusetts, U.S.A., on the Mystic river and Lakes, 5 m. N. by W. of Boston. Pop. (1900), 18,244, of whom 4327 were foreign-born; (1910 census) 23,150. The city is served by the Southern Division and a branch of the Western Division of the Boston & Maine railroad, and is connected with Boston and neighbouring cities by electric railways. The Mystic River, a tidewater stream, is navigable for small craft as far as the centre of the city. There are manufactures of considerable importance, including bricks and tiles, woollen goods, carriages and wagons, food products, iron and steel building materials and machinery. The city covers a land area of about 8 sq. m., along the Mystic river, and extending to the hills. The western portion borders the Upper and Lower Mystic Lakes, which are centres for boating. In the north-west portion of Medford is a part of the Middlesex Fells, a heavily wooded reserve belonging to the extensive Metropolitan Park System maintained by the state. The broad parkways of this system also skirt the Mystic Lakes, and here is the greater part (1907, 267 out of 291 acres) of the Mystic River Reservation of the Metropolitan System. Among the city parks are Hastings, Brooks, Logan, Tufts and Magoun. Within the city limits are some of the oldest and most interesting examples of colonial domestic architecture in America, including the so-called "Cradock House" (actually the Peter Tufts house, built in 1677–1680), the "Wellington House," built in 1657, and the "Royall House." The last was built originally by Governor John Winthrop for the tenants of his Ten Hills Farm, and was subsequently enlarged and occupied by Lieut.-Governor John Usher, and by Isaac Royall[1] (*c.* 1720–1781) and his son, Isaac Royall, Jun.

Medford has a public library of about 35,200 volumes, housed in the colonial residence (reconstructed) of Thatcher Magoun. The city has also a city hall, a high school and manual training school, an opera house, and one of the handsomest armory buildings in the country (the home of the Lawrence Light Guard), presented by General Samuel C. Lawrence (b. 1832), a liberal benefactor of Medford institutions and the first mayor of the city (1892–1894). The Salem St. Burying Ground, dating from 1689, is one of the oldest burial places in America. The Medford Historical Society maintains a library and museum in the birthplace of Lydia Maria Child. Medford is the seat of Tufts College, planned and founded as a Universalist institution in 1852 by Hosea Ballou, its first president, and others, and named in honour of Charles Tufts (1781–1876), a successful manufacturer, who gave the land on which it stands. The college, which had 1120 students and 217 instructors in 1909, comprises a college of letters, a divinity school, and a school of engineering (all in Medford), and medical and dental schools in Boston; it is now undenominational. Among the twenty college buildings, the Barnum Museum of Natural History (1885) founded by Phineas T. Barnum, and the Eaton Memorial Library (1907), presented by Mrs Andrew Carnegie in memory of her pastor, are noteworthy. The college endowment amounted in 1908 to $2,300,000.

Medford was first settled in 1630. A considerable portion of its area formed the plantation of Matthew Cradock (d. 1641), first governor of the Massachusetts Bay Company, who in 1630 sent out agents to settle his lands. John Winthrop's "Ten Hills Farm," partly within the present limits of Medford, was settled soon afterwards. One of the earliest industries was ship-building, John Winthrop's "Blessing of the Bay," built on the Mystic in 1631–1632, being one of the first keels laid on the continent. In 1802 Thatcher Magoun began building sea-going vessels, and many of the famous privateers of the War of 1812 were constructed here. By 1845 Medford employed fully a quarter of all the shipwrights of the state. The industry gradually lost its importance after the introduction of steamships, and the last keel was laid in 1873. Another early industry was the distilling of rum; this was carried on for two centuries, especially by the Hall family and, after about 1830, by the Lawrence family, but was discontinued in 1905. The manufacture of brick and tile was an important industry in the 17th century. The Cradock bridge, the first toll-bridge in New England, was built across the Mystic in 1638; over it for 150 years ran the principal thoroughfare, from Boston to Maine and New Hampshire. The course of Paul Revere's ride lay through Medford Square and High Street, and within a half-hour of his passage the Medford minute men were on their way to Lexington and Concord, where they took part in the engagements with the British. After the Battle of Saratoga many of Burgoyne's officers were quartered here for the winter. The Middlesex Canal was opened through Medford in 1803, and the Boston & Lowell railroad (now the southern division of the Boston & Maine) in 1831. Medford was chartered as a city in 1892.

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[1] A prominent Loyalist, whose estate was seized during the War of Independence, but was restored to his heirs about 1800. He endowed the first professorship of law in America—at Harvard College.

See Charles Brooks, *History of the Town of Medford* (Boston, 1855; enlarged by J. M. Usher, Boston, 1886); *Historical Register* of the Medford Historical Society (1898 et seq.); *Proceedings of the 275th Anniversary of the Settlement of Medford* (Medford, 1905); S. A. Drake, *History of Middlesex County* (2 vols., Boston, 1880) and Helen Tilden Wild, *Medford in the Revolution* (Medford, 1903).

MEDHANKARA, the name of several distinguished members, in medieval times, of the Buddhist order. The oldest flourished about A.D. 1200, and was the author of the *Vinaya Artha Samuccaya*, a work in the Sinhalese language on Buddhist canon law. Next to him came Araññaka Medhankara, who presided over the Buddhist council held at Polonnaruwa, then the capital of Ceylon, in 1250. The third Vanaratana Medhankara, flourished in 1280, and wrote a poem in Pali, *Jina Carita*, on the life of the Buddha. He also wrote the *Payoga Siddhi*. The fourth was the celebrated scholar to whom King Parākrama Bāhu IV. of Ceylon entrusted in 1307 the translation from Pali into Sinhalese of the *Jātaka* book, the most voluminous extant work in Sinhalese. The fifth, a Burmese, was called the Sangharāja Nava Medhankara, and wrote in Pali a work entitled the *Loka Padīpa Sāra*, on cosmogony and allied subjects.

See the *Journal of the Pali Text Society*, 1882, p. 126; 1886, pp. 62, 67, 72; 1890, p. 63; 1896, p. 43; *Mahāvaṃsa*, ch. xl., verse 85.

(T. W. R. D.)

MEDHURST, WALTER HENRY (1796–1857), English Congregationalist missionary to China, was born in London and educated at St Paul's school. He learned the business of a printer, and having become interested in Christian missions he sailed in 1816 for the London Missionary Society's station at Malacca, which was intended to be a great printing-centre. He became proficient in Malay, in a knowledge of the written characters of Chinese, and in the colloquial use of more than one of its dialects. He was ordained at Malacca in 1819, and engaged in missionary labours, first at Penang, then at Batavia, and finally, when peace was concluded with China in 1842, at Shanghai. There he continued till 1856, laying the foundations of a successful mission. His principal labour for several years, as one of a committee of delegates, was in the revision of existing Chinese versions of the Bible. The result was a version (in High Wen-li) marvellously correct and faithful to the original. With John Stronach he also translated the New Testament into the Mandarin dialect of Nanking. His Chinese-English and English-Chinese dictionaries (each in 2 vols.) are still valuable, and to him the British public owed its understanding of the teaching of Hung-Sew-Tseuen, the leader of the Tai-ping rising (1851–64). The university of New York conferred upon him in 1843 the degree of D.D. Medhurst left Shanghai in 1856 in failing health, and died two days after reaching London, on the 24th of January 1857. His son, Sir Walter Henry Medhurst (1822–1885), was British consul at Hankow and afterwards at Shanghai.

MEDIA, the ancient name of the north-western part of Iran, the country of the Medes, corresponding to the modern provinces of Azerbaijan, Ardelan, Irak Ajemi, and parts of Kurdistan. It is separated from Armenia and the lowlands on the Tigris (Assyria) by the mighty ranges of the Zagros (mountains of Kurdistan; in its northern parts probably called Choatras, Plin. v. 98), and in the north by the valley of the Araxes (Aras). In the east it extends towards the Caspian Sea; but the high chains of mountains which surround the Caspian Sea (the Parachoathras of the ancients and the Elburz, separate it from the coast, and the narrow plains on the border of the sea (Gilan, the country of the Gelae and Amardi, and Mazandaran, in ancient times inhabited by the Tapuri) cannot be reckoned as part of Media proper. The greater part of Media is a mountainous plateau, about 3000–5000 ft. above the sea; but it contains some fertile plains. The climate is temperate, with cold winters, in strong contrast to the damp and unwholesome air of the shores of the Caspian, where the mountains are covered with a rich vegetation. Media contains only one river, which reaches the sea, the Sefid Rud (Amardus), which flows into the Caspian; but a great many streams are exhausted after a short course, and in the north-west is a large lake, the lake of Urumiah or Urmia.[1] From the mountains in the west spring some great tributaries of the Tigris, viz. the Diyala (Gyndes) and the Kerkheh (Choaspes). Towards the south-east Media passes into the great central desert of Iran, which eastwards of Rhagae (mod. Rai, near Teheran), in the region of the "Caspian gates," reaches to the foot of the Elburz chain. On a tract of about 150 m. the western part of Iran is connected with the east (Khorasan, Parthyaea) only by a narrow district (Choarene and Comisene), where human dwellings and small villages can exist.

The people of the Mada, Medes (the Greek form *Μῆδοι* is Ionian for *Μᾶδοι*) appear in history first in 836 B.C., when the Assyrian conqueror Shalmaneser II. in his wars against the tribes of the Zagros received the tribute of the Amadai (this form, with prosthetic *a*-, which occurs only here, has many analogies in the names of Iranian tribes). His successors undertook many expeditions against the Medes (Madai). Sargon in 715 and 713 subjected them "to the far mountain Bikni," *i.e.* the Elburz (Demavend) and the borders of the desert. They were divided into many districts and towns, under petty local chieftains; from the names which the Assyrian inscriptions mention, we learn that they were an Iranian tribe and that they had already adopted the religion of Zoroaster. In spite of different attempts of some chieftains to shake off the Assyrian yoke (cf. the information obtained from prayers to the Sun-god for oracles against these rebels: Knudtzon, *Assyrische Gebete an den Sonnengott*), Media remained tributary to Assyria under Sargon's successors, Sennacherib, Esar-haddon and Assur-bani-pal.

Herodotus, i. 101, gives a list of six Median tribes (γένεα), among them the Paraetaceni, the inhabitants of the mountainous highland of Paraetacene, the district of Isfahan, and the Magoi, *i.e.* the Magians, the hereditary caste of the priests, who in Media took the place of the "fire-kindlers" (*athravan*) of the Zoroastrian religion, and who spread from Media to Persia and to the west. But the Iranian Medes were not the only inhabitants of the country. The names in the Assyrian inscriptions prove that the tribes in the Zagros and the northern parts of Media were not Iranians nor Indo-Europeans, but an aboriginal population, like the early inhabitants of Armenia, perhaps connected with the numerous tribes of the Caucasus.

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[1] Anc. Mantiane, Strabo xi. 529; Martiane, Ptol. vi. 2, 5, probably identical with the name Matiane, Matiene, by which Herodotus i. 189, 202, iii. 94, v. 49, 52 (in i. 72 and vii. 72 they seem to be a different people in Asia Minor); Polyb. v. 44, 9; Strabo i. 49, ii. 73, xi. 509, 514, 523, 525; Plin vi. 48, designate the northern part of Media.

We can see how the Iranian element gradually became dominant: princes with Iranian names occasionally occur as rulers of these tribes. But the Gelae, Tapuri, Cadusii, Amardi, Utii and other tribes in northern Media and on the shores of the Caspian were not Iranians. With them Polybius v. 44, 9, Strabo xi. 507, 508, 514, and Pliny vi. 46, mention the Anariaci, whom they consider as a particular tribe; but in reality their name, the "Not-Arians," is the comprehensive designation of all these small tribes.

In the second half of the 7th century the Medians gained their independence and were united by a dynasty, which, if we may trust Herodotus, derived its origin from Deioces (*q.v.*); a Median chieftain in the Zagros, who was, with his kinsmen, transported by Sargon to Hamath (Hamah) in Syria in 715 B.C. The kings, who created the Median Empire, were Phraortes and his son Cyaxares. Probably they were chieftains of a nomadic Median tribe in the desert, the Manda, mentioned by Sargon; for the Babylonian king Nabonidus designates the Medians and their kings always as Manda. The origin and history of the Median Empire is quite obscure, as we possess almost no contemporary information, and not a single monument or inscription from Media itself. Our principal source is Herodotus, who wrongly makes Deioces the first king and uniter of the whole nation, and dates their independence from *c.* 710—*i.e.* from the time when the Assyrian supremacy was at its height. But his account contains real historical elements, whereas the story which Ctesias gave (a list of nine kings, beginning with Arbaces, who is said to have destroyed Nineveh about 880 B.C., preserved in Diod. ii. 32 sqq. and copied by many later authors) has no historical value whatever, although some of his names may be derived from local traditions. According to Herodotus, the conquests of Cyaxares were interrupted by an invasion of the Scythians, who founded an empire in western Asia, which lasted twenty-eight years. From the Assyrian prayers to the Sun-god, mentioned above, we learn that the Median dynasts, who tried rebellions against the Assyrians in the time of Esar-haddon and Assur-bani-pal, were allied with chieftains of the Cimmerians (who had come from the northern shore of the Black Sea and invaded Armenia and Asia Minor), of the Saparda, Ashguza and other tribes; and from Jeremiah and Zephaniah we know that a great invasion of Syria and Palestine by northern barbarians really took place in 626 B.C. With these facts the traditions of Herodotus must in some way be connected; but at present it is impossible to regain the history of these times. The only certain facts are that in 606 Cyaxares succeeded in destroying Nineveh and the other cities of Assyria (see Phraortes and Deioces).

From then the Median king ruled over the greatest part of Iran, Assyria and northern Mesopotamia, Armenia and Cappadocia. His power was very dangerous to their neighbours, and the exiled Jews expected the destruction of Babylonia by the Medes (Isa. xiii., xiv., xxi.; Jerem. l. li.). When Cyaxares attacked Lydia, the kings of Cilicia and Babylon intervened and negotiated a peace in 585, by which the Halys was established as the boundary. Nebuchadrezzar married a daughter of Cyaxares, and an equilibrium of the great powers was maintained till the rise of Cyrus.

About the internal organization of the Median Empire we know only that the Greeks derive a great part of the ceremonial of the Persian court, the costume of the king, &c., from Media. But it is certain that the national union of the Median clans was the work of their kings; and probably the capital Ecbatana (*q.v.*) was created by them.

By the rebellion of Cyrus, king of Persia, against his suzerain Astyages, the son of Cyaxares, in 553, and his victory in 550, the Medes were subjected to the Persians. In the new empire they retained a prominent position; in honour and war they stood next to the Persians; the ceremonial of their court was adopted by the new sovereigns who in the summer months resided in Ecbatana, and many noble Medes were employed as officials, satraps and generals. After the assassination of the usurper Smerdis, a Mede Fravartish (Phraortes), who pretended to be of the race of Cyaxares, tried to restore the Median kingdom, but was defeated by the Persian generals and executed in Ecbatana (Darius in the Behistun inscr.). Another rebellion, in 409, against Darius II. (Xenophon, *Hellen.* i. 2, 19) was of short duration. But the non-Aryan tribes of the north, especially the Cadusians, were always troublesome; many abortive expeditions of the later kings against them are mentioned.

Under the Persian rule the country was divided into two satrapies. The south, with Ecbatana and Rhagae (Rai), Media proper, or "Great Media," as it is often called, formed in Darius' organization the eleventh satrapy (Herodotus iii. 92), together with the Paricanians and Orthocorybantians; the north, the district of Matiane (see above), together with the mountainous districts of the Zagros and Assyria proper (east of the Tigris) was united with the Alarodians and Saspirians in eastern Armenia, and formed the eighteenth satrapy (Herod. iii. 94; cf. v. 49, 52, vii. 72). When the empire decayed and the Carduchi and other mountainous tribes made themselves independent, eastern Armenia became a special satrapy, while Assyria seems to have been united with Media; therefore Xenophon in the *Anabasis* ii. 4, 27; iii. 5, 15; vii. 8, 25; cf. iii. 4, 8 sqq. always designates Assyria by the name of Media.

Alexander occupied Media in the summer of 330; in 328 he appointed Atropates, a former general of Darius (Arrian iii. 8, 4), as satrap (iv. 18, 3, vi. 29, 3), whose daughter was married to Perdiccas in 324 (Arrian vii. 4, 5). In the partition of his empire, southern Media was given to the Macedonian Peithon; but the north, which lay far off and was of little importance for the generals who fought for the inheritance of Alexander, was left to Atropates. While southern Media with Ecbatana passed to the rule of Antigonus, and afterwards (about 310) to Seleucus I.; Atropates maintained himself in his satrapy and succeeded in founding an independent kingdom. Thus the partition of the country, which the Persian had introduced, became lasting; the north was named Atropatene (in Plin. vi. 42, Atrapatene; in Ptolem. vi. 2, 5, Tropatene; in Polyb. v. 44 and 55 corrupted in *τὰ σατραπεῖα καλούμενα*), after the founder of the dynasty, a name which is preserved in the modern Azerbaïjan; cf. Nöldeke, "Atropatene," in *Zeitschrift der deutschen morgenl. Gesellschaft*, 34, 692 sqq. and Marquart, *Eranshahr*, p. 108 sqq. The capital was Gazaca in the central plain, and the strong castle Phraaspa (Dio Cass. xlix. 26; Plut. *Anton.* 38; Ptol. vi. 2, 10) or Vera (Strabo xi. 523), probably identical with the great ruin Takhti Suleiman, with remains of Sassanid fire-altars and of a later palace. The kings had a strong and warlike army, especially cavalry (Polyb. v. 55; Strabo xi. 253). Nevertheless, King Artabazanes was forced by Antiochus the Great in 220 to conclude a disadvantageous treaty (Polyb. v. 55), and in later times the rulers became in turn dependent on the Parthians, on Tigranes of Armenia, and in the time of Pompey who defeated their king Darius (Appian, *Mithr.* 108), on Antonius (who invaded Atropatene) and on Augustus of Rome. In the time of Strabo (A.D. 17), the dynasty existed still (p. 523); in later times the country seems to have become a Parthian province.

Atropatene is that country of western Asia which was least of all influenced by Hellenism; there exists not even a single coin of its rulers. But the opinion of modern authors—that it had been a special refuge of Zoroastrianism—is based upon a wrong etymology of the name (which is falsely explained as "country of fire-worship"), and has no foundation whatever. There can be no doubt that the kings adhered to the Persian religion; but it is not probable that it was deeply rooted among their subjects, especially among the non-Aryan tribes.

Southern Media remained a province of the Seleucid Empire for a century and a half, and Hellenism was introduced everywhere. "Media is surrounded everywhere by Greek towns, in pursuance of the plan of Alexander, which protect it against the neighbouring barbarians," says Polybius (x. 27). Only Ecbatana retained its old character. But Rhagae became a Greek town, Europus; and with it Strabo (xi. 524) names Laodicea, Apamea, Heraclea or Achais (cf. Plin. vi. 48). Most of them were founded by Seleucus I. and his son Antiochus I. In 221, the satrap Molon tried to make himself independent (there exist bronze coins with his name and the royal title), together with his brother Alexander, satrap of Persis, but they were defeated and killed by Antiochus the Great. In the same way, in 161, the Median satrap Timarchus took the diadem and conquered Babylonia; on his coins he calls himself "the great king Timarchus"; but this time again the legitimate king, Demetrius I., succeeded in subduing the rebellion, and Timarchus was slain. But with Demetrius I. the dissolution of the Seleucid Empire begins, which was brought on chiefly by the intrigues of the Romans, and shortly afterwards, about 150, the Parthian king, Mithradates I. (*q.v.*), conquered Media (Justin xli. 6). From this time Media remained subject to the Arsacids, who changed the name of Rhagae, or Europus, into Arsacia (Strabo xi. 524), and divided the country into five small provinces (Isidorus Charac.). From the Arsacids or Parthians, it passed in A.D. 226 to the Sassanids, together with Atropatene. By this time the old tribes of Aryan Iran had lost their character and had been amalgamated into the one nation of the Iranians. The revival of Zoroastrianism, which was enforced everywhere by the Sassanids, completed this development. It was only then that Atropatene became a principal seat of fire-worship, with many fire-altars. Rhagae now became the most sacred city of the empire and the seat of the head of the Zoroastrian hierarchy; the Sassanid *Avesta* and the tradition of the Parsees therefore consider Rhagae as the home of the family of the Prophet. Henceforth the name of Media is used only as a geographical term and begins to disappear from the living language; in Persian traditions it occurs under the modern form *Māh* (Armen. *Mai*; in Syriac the old name *Madai* is preserved; cf. Marquart, *Eranshahr*, 18 seq.).

For Mahommedan history see CALIPHATE; for later history SELJUKS and PERSIA. (ED. M.)

MEDIATION (Lat. *medius*, middle), in the international sense, the intervention of a third power, on the invitation or with the consent of two other powers, for the purpose of arranging differences between the latter without recourse to war. Mediation may also take place after war has broken out, with a view to putting an end to it on terms. In either case the mediating power negotiates on behalf of the parties who invoke or accept its aid, but does not go farther. Unlike an arbitrating power the mediator limits his intervention to suggestion and advice. His action is liable to be arrested at any time at the will of either party unless otherwise agreed, in which case to arrest it prematurely would be a breach of good faith. The difference between mediation and arbitration may be stated in the words of the Digest (lib. iv. tit. 8, § 13): "Recepisse autem arbitrium videtur, ut ait Pedius, qui judicis partes suscepit finemque se sua sententia controversiis impositurum pollicetur. Quod si hactenus intervenit ut experiretur an concilio suo vel auctoritate discuti litem paterentur, non videtur arbitrium recepisse."

Some writers distinguish mediation from "good offices," but the distinction is of little practical value. We may, if we please, regard "good offices" as inchoate mediation, and "mediation" as good offices brought to the birth. Thus we may say that a third power renders "good offices" when it brings the parties together so as to make diplomatic negotiations between them possible; whilst if it takes an active part in those negotiations it becomes for the time being a mediator. The spontaneous yet successful effort made by President Roosevelt in 1905 to bring together the Russian and Japanese governments, and to secure their appointing delegates to discuss terms of peace, although not strictly mediation, was closely akin to it.

Of successful mediation in the strict sense there have been many instances: that of Great Britain, in 1825, between Portugal and Brazil; of France, in 1849–1850, when differences arose between Great Britain and Greece; of the Great Powers, in 1868–1869, when the relations of Greece and Turkey were strained to breaking-point by reason of the insurrection in Crete; of Pope Leo XIII., in 1885, between Germany and Spain in the matter of the Caroline Islands. In these cases mediation averted war. The Austro-Prussian War of 1866, the war between Chile and Peru in 1882, and that between Greece and Turkey in 1897, are instances of wars brought to a close through the mediation of neutral powers. Mediation has also been occasionally employed where differences have arisen as to the interpretation of treaties or as to the mode in which they ought to be carried out: as when Great Britain mediated between France and the United States with regard to the Treaty of Paris of the 4th of July 1830. In one case at least mediation has been successful after a proposal for arbitration had failed. In 1844, when war between Spain and Morocco was threatened by reason of the frequent raids by the inhabitants of the Rif on the Spanish settlement of Ceuta, Spain declined arbitration on the ground that her rights were too clear for argument. But both she and Morocco subsequently accepted joint mediation at the hands of Great Britain and France.

The cause of mediation was considerably advanced by the Declaration of Paris of 1856. The plenipotentiaries of Great Britain, France, Austria, Russia, Sardinia and Turkey recorded in a protocol, at the instance of Lord Clarendon, their joint wish that "states between which any misunderstanding might arise should, before appealing to arms, have recourse so far as circumstances might allow (*en tant que les circonstances l'admettraient*) to the good offices of a friendly power." Article 8 of the Treaty of Paris, concluded in the same year, stipulated that "if there should arise between the Sublime Porte and one or more of the other signing powers any misunderstanding which might endanger the maintenance of their relations, the Porte and each of such powers, before having recourse to the use of force, shall afford the other contracting parties the opportunity of preventing such as extremity by means of mediation." These precedents (in which it will be seen that "good offices" and "mediation" are used interchangeably) were followed in the general act agreed to at the Conference held at Berlin in 1884–1885 the object of which was to secure religious and commercial liberty and to limit warlike operations in the Congo basin.

A special form of mediation was proposed by a delegate from the United States at the Peace Conference held at the Hague in 1899, and was approved by the representatives of the powers there assembled. The clause in which this proposal was embodied provided in effect that, whenever there is danger of a rupture between two powers, each of them shall choose a third power to which these differences shall be referred, and that, pending such reference, for a period not exceeding thirty days (unless the time is extended by agreement) the powers at issue shall cease to negotiate with each other and leave the dispute entirely in the hands of the mediating powers. The powers thus appealed to occupy a position analogous to that of seconds in a duel, who are authorized to arrange an "affair of honour" between their principals. This novel device has the advantage of toning down, if not of eliminating, personal and national prejudices by which controversy is frequently embittered. It also gets over the difficulty, often met with in arbitration, of choosing a referee satisfactory to both parties. The closer the relations between states become, the more their commercial interests are intertwined, the larger the part which mediation seems destined to play. It is true that states which have accepted the intervention of a mediator remain free to adopt or reject any advice he may give, but the advice of a disinterested power must always add considerable moral weight to the side towards which it inclines. (M. H. C.)

MEDIATIZATION (Ger. *Mediatisierung*, from Lat. *mediatus*, mediate, middle), the process by which at the beginning of the 19th century, a number of German princes, hitherto sovereign as holding *immediately* of the emperor, were deprived of their sovereignty and *mediatized* by being placed under that of other sovereigns. This was first done on a large scale in 1803, when by a recess of the imperial diet many of the smaller fiefs were mediatized, in order to compensate those German princes who had been forced to cede their territories on the left bank of the

Rhine to France. In 1806 the formation of the Confederation of the Rhine involved an extension of this mediatizing process, though the abolition of the empire itself deprived the word "mediatization" of its essential meaning. After the downfall of Napoleon the powers were besieged with petitions from the mediatized princes for the restoration of their "liberties"; but the congress of Vienna (1815) further extended the process of mediatization by deciding that certain houses hitherto *immediate* (*i.e.* Salm, Isenburg, Leyen) should only be represented mediately in the diet of the new Confederation. On the other hand, at Aix-la-Chapelle (1818) the powers, in response to the representations of the aggrieved parties, admonished the German sovereigns to respect the rights of the mediatized princes subject to them. Of these rights, which included the hereditary right to a seat in the estates, the most valued is that of *Ebenbürtigkeit* (equality of birth), which, for purposes of matrimonial alliance, ranks the mediatized princes with the royal houses of Europe.

See August Wilhelm Heffter, *Die Sonderrechte der Souveränen und der Mediatisirten, vormals reichsständischen Häuser Deutschlands* (Berlin, 1871). The mediatized families are included in the *Almanach de Gotha*.

MEDICAL EDUCATION. Up to 1858 each University, Royal College of Physicians or of Surgeons, and Apothecaries' Hall in Great Britain and Ireland laid down its own regulations for study and examination, and granted its degree or licence without any State supervision. In that year, pursuant to the Medical Act, 21 & 22 Vict. c. 90, the General Medical Council of Medical Education and Registration was established, consisting of twenty-three members, of whom seventeen were appointed by the various licensing bodies and six by the Crown. This number was increased by the amended act of 1886 to twenty-nine, three of the six additional members being elected by the profession as "direct" representatives. The object of the act was "to enable persons requiring medical aid to distinguish qualified from unqualified practitioners." To this end the "Medical Register" was established, on which no person's name could be inscribed who did not hold a diploma or licence from one or more of the licensing bodies after examination. By the 1886 act a qualifying examination was defined as "an examination in medicine, surgery, and midwifery," conducted by universities or by medical corporations, of which one must be capable of granting a diploma in medicine, and one in surgery. The Council is authorized to require from the licensing bodies information as to courses of study and examinations, and generally as to the requisites for obtaining qualifications; and to visit and inspect examinations either personally or by deputy. If the visitors think the course of study and examination of any licensing body is not sufficient to ensure that candidates obtaining its qualification possess the requisite knowledge and skill for the efficient practice of their profession the Council, on a report being made, may represent the same to the Privy Council. The Privy Council may, if it sees fit, deprive the accused body of its power to grant registrable qualifications. From this statement it will be seen that the powers of the Council are limited; nevertheless, by their cautious application, and by the loyal manner in which the licensing bodies have acted on the recommendations and suggestions which have from time to time been made, the condition of medical education has been improved; and although there is not a uniform standard of examination throughout the United Kingdom, the Council has ensured that the minimum requirements of any licensing body shall be sufficient for the production of trustworthy practitioners.

Great Britain and Ireland.

One of the first subjects to which the Council applied itself was the establishment of a system of examinations in general knowledge. Such examinations have to be passed before beginning medical study. On presentation of a certificate to the registrars of the Council, and on evidence being produced that the candidate is sixteen years of age, his name is inscribed on the "Students' Register." The subjects of examinations are: (*a*) English language, including grammar and composition (marks not exceeding 5% of the total obtainable in this section may be assigned to candidates who show a competent knowledge of shorthand); (*b*) Latin, including grammar, translation from specified authors, and translation of easy passages not taken from such authors; (*c*) mathematics, comprising arithmetic; algebra, as far as simple equations inclusive; geometry, the subject-matter of Euclid, Books I., II. and III., with easy deductions; (*d*) one of the following optional subjects—Greek, French, German, Italian or any other modern language. Certificates are accepted from all the universities of Great Britain and Ireland, from the leading Indian and colonial universities, from government examination boards, and from certain chartered bodies. The German Abiturienten Examen of the gymnasia and *real*-gymnasia, the French diplomas of Bachelier ès Lettres and Bachelier ès Sciences, and corresponding entrance examinations to other continental universities are also accepted.

As regards professional education, the Council divided its resolutions into "requirements" and "recommendations"; the former consisting of demands on the licensing bodies, non-compliance with which renders them liable to be reported to the Privy Council; the latter are regarded merely as suggestions for the general conduct of education and examination. The requirements may be summarized as follows: (*a*) Registration as a medical student. (*b*) Five years of bona-fide study between the date of registration and the date of the final examination for any diploma entitling the holder to be registered under the Medical Acts. (*c*) In every course of professional study and examination the following subjects must be contained, the Council offering no opinion as to the manner in which they should be distributed or combined for the purposes of teaching or examination, this being left to the discretion of the bodies or of the student—(i.) physics, including the elementary mechanics of solids and fluids, and the rudiments of heat, light and electricity; (ii.) chemistry, including the principles of the science, and the details which bear on the study of medicine; (iii.) elementary biology; (iv.) anatomy; (v.) physiology; (vi.) materia medica and pharmacy; (vii.) pathology; (viii.) therapeutics; (ix.) medicine, including medical anatomy and clinical medicine; (x.) surgery, including surgical anatomy and clinical surgery; (xi.) midwifery, including diseases peculiar to women and to new-born children; (xii.) theory and practice of vaccination; (xiii.) forensic medicine; (xiv.) hygiene; (xv.) mental disease. (*d*) The first of the four years must be passed at a school or schools of medicine recognized by any of the licensing bodies; provided that the first year may be passed at a university or teaching institution where the subjects of physics, chemistry and biology are taught; and that graduates in arts or science of any university recognized by the Council, who shall have spent a year in the study of these subjects, and have passed in them, shall be held to have completed the first of the five years of medical study. (*e*) The study of midwifery practice must consist of three months' attendance on the indoor practice of a lying-in hospital, or the student must have been present at not less than twenty labours, five of which shall have been conducted throughout under the direct supervision of a registered practitioner.

The fifth year of study is intended to be devoted to clinical work and may be passed at any one or more public hospitals or dispensaries, British or foreign, recognized by the licensing authorities; six months of this year may be passed as a pupil to a practitioner possessing such opportunities of imparting practical knowledge as shall be satisfactory to the medical authorities. This latter method is rarely employed.

The "recommendations" of the Council contain suggestions which may or may not be acted on by the bodies. For the most part they are complied with in connexion with the system of practical and clinical teaching.

The Council satisfies itself that its requirements are acted on, and that the examinations are "sufficient," by cycles of inspection about every five years. The examination of each licensing body is visited by an inspector, who forwards his report to the Council, which sends each report to the body for its information and remarks. As yet it has never been the duty of the Council to report to the Privy Council that any examination has not been found sufficient.

Most universities exact attendance at more classes than the colleges and halls; for instance, botany and natural history are taught to their students, who are also examined in them. But with these exceptions the system of professional education is fairly uniform. Since 1875 attendance on "practical" classes has been called for in all subjects. Under this system the larger classes in which the subjects are taught systematically are broken up, and the students are taught the use of apparatus and the employment of methods of investigation and observation. Tutorial instruction is superimposed on teaching by lecture. Much the same plan is adopted in respect of clinical instruction: not only is the student taught at the bedside by the lecturer, but he receives, either from the house-surgeon or house-physician or from a specially appointed clinical tutor, an insight into methods of examination of diseases, and learns practically the use of the stethoscope and other aids to diagnosis, and of surgical and obstetrical instruments. In fact, it may be said that each subject of instruction is duplicated. If this is taken into account, it must be evident that the time of the student is fully occupied, and the belief is rapidly growing that five years is too short a period of study. As a matter of fact, the average time taken to obtain a British licence to practise is upwards of six years. The probability is that the solution of the difficulty will be found in the inclusion of such subjects as physics, biology and chemistry in a "preliminary scientific" examination, which may have to be undertaken before registration as a medical student, thus leaving the whole five years to be devoted to purely professional study.

Germany.

The German regulations in regard to professional study are few. They are those for the *Staats Examen*, for which the university degree is no longer necessary. The regulations for the admission of candidates to the *Staats Examen* are contained in the royal proclamations of the 22nd of June 1883. They comprise: (*a*) Certificate of a course of study at a classical gymnasium of the German Empire. In exceptional cases, the same from a classical gymnasium outside the German empire may be considered sufficient. (For details of the course of study and examinations, see *Minutes of the General Medical Council*, vol. xxvii. appendix 3.) (*b*) Certificate from a university, certifying a course of medical study of at least nine half-years at a university of the German empire. (*c*) Certificate that the candidate has passed, entirely at a German university, the medical *Vorprüfung*, and thereafter has attended for at least four half-years the medical studies of a university. (*d*) The special testimony of the clinical directors bearing witness that the candidate has taken part as *Praktikant* (clerk or dresser) during two half-years at the medical, surgical, and gynaecological clinics; has himself delivered two cases of labour in the presence of his teachers or assistant physicians; and has attended for a half-year as *Praktikant* the clinic for diseases of the eye.

The medical *Vorprüfung* referred to is necessary alike for the *Staats Examen* and the degree of Doctor of Medicine. It takes place at the end of the second year (fourth *semestre*), and includes the subjects of experimental physics, chemistry, botany, zoology, anatomy and physiology. It is conducted by a board appointed yearly by the Minister of Education.

France.

No one can practise medicine in France who does not possess the diploma of Doctor of Medicine of a French university. The qualification of *Officier de santé* is no longer granted. Before he can inscribe as a student of medicine the applicant must have obtained the diplomas of *Bachelier ès lettres* and *Bachelier ès sciences*. Although the course of professional study may be completed in four years, a longer time is generally taken before the student proceeds to the final examination for the doctor's degree. Each year is divided into four *trimestres*; at each *trimestre* the student must make a new inscription. The *trimestres* are (1) November and December, 56 days; (2) January, February, March, 86 days; (3) April, May, June, 86 days; (4) July, August, 56 days. Practically there are no regulations determining the division of the various subjects, or the number of lectures in each course, or requiring the student to attend the courses. The medical faculty of each university puts before the student a scheme recommending a certain order of studies (*Division des études*) for each of the four years of the medical course, and, as a matter of fact, this order of study is enforced by the system of intermediate examinations (*Examens du fin d'année*). All the lecture courses are free, as also are the clinics and the hospital service, and there is no system of ascertaining the regularity of attendance at lectures, or of certificate of attendance. If, however, the student fails to pass the *Examen du fin d'année* he is debarred from making the next trimestral inscription, and thus loses three months. The lectures are, however, closely attended. In contrast to the freedom in regard to attendance on systematic lectures, there are strict direction and control in regard to hospital attendance and practical courses. The student is required to sign a register *ad hoc* each time he goes in and out. From the beginning of the third year, *e.g.* from the ninth quarterly inscription, hospital attendance is enforced till the end of the fourth year. No one can renew his trimestral inscription without producing a schedule of his last trimestral stage, showing that during it he had not absented himself more than five times without explanation. Practical work is obligatory during each of the four years.

Besides systematic courses of lectures, *Conférences* are held by the assistant-professors (*agrégés*) in natural history, physiology, general pathology, internal pathology, external pathology. At the end of the first year the student is examined in osteology, myology and the elements of physiology; at the end of the second year, in anatomy and physiology in all their branches; at the end of the third year, in medicine and surgery; at the end of the fourth year, an examination is held over the whole field of study.

Denmark.

No one is allowed to enter on the study of medicine without passing the *Artium examen* of a secondary school. This is the equivalent of the German Abiturienten Examen of a classical gymnasium. After study for two *semestres* an examination must be passed in psychology, logic and history. The special professional examinations consist of (1) preliminary scientific, in botany, zoology, physics, chemistry; (2) first special or professional, anatomy (orally and by dissections), physiology, and pharmacology; (3) second special or professional, written examinations in medicine, surgery, medical jurisprudence; practical and oral in operative surgery, in clinical medicine, and clinical surgery; and oral in pathological anatomy, medicine, surgery; and midwifery. The completion of the full medical course takes six years, of which the first two are devoted to the study of the natural sciences.

Authorities.—The history of the development of medical education from the earliest times down to 1894 will be found treated of generally in Puschmann's *Geschichte des medicinischen Unterrichts* (Leipzig, 1889–1905) translated by E. H. Hare (London, 1891). Those desiring more special information on the subject in regard to the details of British institutions should consult the annals of the various universities and colleges of Great Britain and Ireland. The following works supply much interesting information regarding the gradual rise and development of teaching and examination: *Annals of the Barber Surgeons*, by Sydney Young (1890); *History of the Royal College of Surgeons of Ireland*, by Cameron (1886); *Early Days of the Royal College of Physicians of Edinburgh*, by Peel Ritchie (1899); *Historical Sketch of the Royal College of Surgeons of Edinburgh*, by Gairdner (1860); *Memorials of the Faculty of Physicians and Surgeons of Glasgow*, by Duncan (1896); *The Story of the University of Edinburgh*, by Sir A. Grant (1884); *University of Glasgow*, by Stewart (1891). (J. B. T.)

United States.

As late as 1880 medical education in the United States was in a deplorable condition. In the early history of the country, before and shortly after the beginning of the 19th century, the few medical colleges had shown a disposition to require a liberal education on the part of those who entered upon their courses, and some effort was made, through the agency of state boards, to control the licence to practise. But as the country increased in population and wealth preliminary requirements were practically abolished, the length of the courses given each year was shortened to four or five months or less, and in the second and final year there was simply a repetition of the courses given during the first year. This is to be attributed mainly to the fact that there was no general national or state supervision of medical training. Medical colleges could obtain incorporation under state laws without difficulty, and brought considerable advantages in the way of prestige and increased practice to those concerned. That the existence of a college depended solely upon the fees of the students encouraged the tendency to make both entrance and graduation requirements as easy as possible, especially as there was no state supervision, and the mere possession of a diploma entitled the holder to practise. Fortunately, during this period the practical character of the clinical instruction given in the better colleges fitted the graduates in some measure for the actual necessities of practice, while the good traditions of medicine as a learned profession stimulated those who adopted it as a career, so that in the main the body of practitioners deserved and held the confidence and respect of the community. From the middle of the 19th century there has been constant agitation on the part of the physicians themselves for an improvement in medical education. The first notable result was an increase in the time of instruction from two to three years (Chicago Medical College, 1859; Harvard Medical School, 1871), the lengthening of each session to six months or more, and the introduction of graded courses instead of a repetition of the same lectures every year. The improvement thus begun became marked during the decade 1890–1900, amounting almost to a revolution in the rapidity with which the course of instruction was amplified. Many factors co-operated to produce this result: the general development of scientific instruction in the colleges and secondary schools, the influence of the large number of medical graduates who completed their training by study in European schools, the adoption by many states of stringent regulations regarding the licence to practise within their borders, the good examples set by many leading schools in voluntarily raising their requirements for entrance and graduation, and, perhaps above all in its general effect, the agitation continually maintained by several national or state associations which in a measure have exerted the general regulating control that in other countries has been enforced by national legislation. Among the most influential of these associations are the American Medical Association, the American Academy of Medicine, the Association of American Medical Colleges, the Illinois State Board of Health, and the University of the State of New York.

The different states make their own general regulations as to the practice of medicine within their borders. Certain states recognize the medical diplomas granted by other states having equivalent standards of examination. Such certificates are generally required to be (*a*) of graduation from a "reputable medical school," (*b*) certificates of moral character, (*c*) the applicant must be at least twenty-one years of age. These enable the candidate to present himself before the state board for the state examination. In many states the applicant must satisfy the board not only as to his professional, but as to his general education. The standing of the various medical schools is usually left to the state boards, each one determining the matter for its own state, consequently a school may confer a degree recognized as reputable in several states but not in others. Only three or four states regulate the chartering of institutions. In other states any body of men may secure articles of incorporation of a college or school by paying the necessary state fee, without question as to the ability of the incorporator to furnish an education. So strong, however, has been the growth of American public opinion that a four-years' course of medical training has become the standard in medical schools, and in the majority this is in addition to one or two years' training in the natural sciences. There are some sixty-five state boards, and many have adopted strong medical practice acts.

The standard of preliminary requirements for entrance to the medical schools is being gradually raised, and a large number of the states demand a certificate of a high school education, while the colleges comprising the Association of Medical Colleges, which numbers more than half the American medical schools, accept as an entrance standard a certificate of at least one year's study at a high school. In the report for 1908 of the United States bureau of education of 71 schools, which report the number of their students having an arts degree, it is stated that a degree was held by only 15 % of the candidates in medicine. These students were mostly distributed between the Johns Hopkins Medical School (which from the date of its foundation in 1893 has only admitted college graduates, and has in addition stipulated that candidates shall have a knowledge of French and German and have already completed a year's training in the natural sciences), Harvard Medical School and Columbia University, and the medical departments of the universities of California, Michigan and Chicago (Rush Medical College) require on entrance the equivalent of a two-years' college course, which must include French and German, together with physics, chemistry and biology. This tendency is in accordance with the recommended standard of medical education suggested by the Council of Medical Education and adopted by the House of Delegates of the American Medical Association, of which the following is a summary:—

1. (*a*) The preliminary of a four-years' high school education or an examination such as would admit to a recognized university. (*b*) In addition a year of not less than nine months devoted to chemistry, physics and biology and one language (preferably French or German) to be taken at a college of the liberal arts.

2. Previous to entering a medical college every student should receive from the state board a "medical student's entrance certificate" to be given on the production of credentials of training as above.

3. Four years of study in a medical college having a minimum of a 30-weeks' course each year, with not less than 30 hours' work per week.

4. Graduation from college to entitle a candidate to present himself for examination before a state board.

5. A satisfactory examination to be passed before the state board.

Practically all medical schools admit women, but there are three separate schools of medicine for women: The Women's Medical College of Philadelphia, Pennsylvania; Women's Medical College, Baltimore, Maryland; New York Medical College and Hospital for Women—the last being one of the eighteen homoeopathic colleges of the United States.

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MEDICAL JURISPRUDENCE, or FORENSIC MEDICINE, that branch of state medicine which treats of the application of medical knowledge to certain questions of civil and criminal law. The term "medical jurisprudence," though sanctioned by long usage, is not really appropriate, since the subject is strictly a branch of medicine rather than of jurisprudence; it does not properly include sanitation or hygiene, both this and medical jurisprudence proper being distinct branches of state medicine. The connexion between medicine and the law was perceived long before medical jurisprudence was recognized, or had obtained a distinct appellation. It first took its rise in Germany, and more tardily received recognition in Great Britain. Forensic medicine, or medical jurisprudence proper as distinguished from hygiene, embraces all questions which bring the medical man into contact with the law, and embraces (1) questions affecting the civil rights of individuals, and (2) injuries to the person.

I.—QUESTIONS AFFECTING THE CIVIL OR SOCIAL RIGHTS OF INDIVIDUALS

1. *Development of the Human Frame.*—The development of the physical and mental powers of the human being is a factor of great consequence in determining criminal responsibility, civil responsibility, or the power of giving validity to civil contracts, and in determining the personal identity of a living person or of a corpse. Human life is usually divided into the five periods of *infancy*, *childhood*, *youth*, *manhood* and *old age*. Some writers increase the number of these unnecessarily to seven periods.

Infancy is the period from birth till the first or milk set of teeth begin to be shed—usually about the seventh year. During this period the body increases in size and stature more, relatively, than at any other period of existence; and the mental faculties undergo great development. The milk teeth, twenty in number, are evolved in a definite order, beginning with the central incisors at about six months, and ending with the second molars about the termination of the second year. From the size and stature of the body, the development of the teeth, and the more or less advanced state of ossification or solidification of the bony skeleton, conclusions may be drawn as to the probable age of the infant.

Childhood extends from the commencement of the shedding of the milk teeth to the age of puberty—usually from the seventh to the fourteenth or fifteenth year. During this period the body expands, as well as the bony structures, without any clearly marked difference in structure being observable between the sexes except as regards the genitals, so that it is impossible to distinguish absolutely between the male and the female skeleton during this period. The milk teeth are shed, and are replaced by the second or permanent set, thirty-two in number, though these do not usually all make their appearance during childhood. Marked differences between the proclivities of the sexes are noticeable even at an early period of childhood, and long before the characteristic functions begin to be developed.

Youth is marked at its commencement by the changes which occur at puberty—the development of the genitals in both sexes, the appearance of hair on the genitals, the appearance of a beard in the male, the development of the breasts in the female, the appearance of the monthly flow in the female, and the ability to secrete semen in the male. Marked mental changes now occur, and the generative functions are perfected. Youth terminates at the age of legal majority, twenty-one years, or perhaps the period ought to be extended to twenty-five years of age, as it is with some nations.

Manhood (or *Womanhood*) is the period of perfection of all the bodily and mental powers. It ceases in woman with the cessation of the monthly flow at about forty-five years of age; but in man it often extends to a much later period of life.

Old Age begins with the decay of the bodily and mental faculties, and is characterized by wrinkling of the skin, loss of the teeth, whitening of the hair, and feebleness of the limbs. In its later stages decay of the mental faculties, deafness, obscurity or loss of vision, and bowing of the spine are added.

2. *Duration of Human Life.*—The chances of human life form an important subject of inquiry, and on deductions from comparisons of birth and death rates is founded the system of annuities, insurance against loss in sickness, and the insurance of lives. Since the establishment of compulsory registration of deaths, our knowledge of the ordinary and extraordinary chances of human life has been extended, and surer data are available for calculations of probabilities of life, of survivorships, and of the payments which ought to be made in benefit clubs (see INSURANCE).

3. *Personal Identity.*—Where the identity has to be established or disproved after long absence, exposure to foreign climates and hardships, wounds, &c., the problem has often been extremely difficult. The data for identifying a person are individual and family likeness, stature, the colour of the eyes, peculiarities of garb and manner, recollection of antecedent events, but more especially marks on the persons either congenital or acquired. Such are *naevi* or mother's marks, scars, and disunited or badly united fractures, known to have existed upon the missing person (see IDENTIFICATION). In the case of the living, identification is more often a matter for the police officer than for the medical man. Bertillon and Galton have each devised methods for the identification of criminals (see ANTHROPOMETRY, and FINGER-PRINTS).

4. *Marriage.*—Under this head the medical jurist has to deal principally with the nubile age, viewed in the light of nature and according to legislative enactments, and with such physical circumstances as affect the legality of marriages, or justify divorce.

In Great Britain the age at which the sexes are first capable of propagating the species is later than in more southern climes. Ordinarily it does not occur before fifteen years of age for the male and fourteen for the female; exceptionally it occurs at the ages of thirteen and of twelve (or even less) respectively in the male and female. By law, nevertheless, parents and guardians may, in England at all events, forbid the marriage of young people till the age of legal majority. The only physical circumstances which in Great Britain form a bar to marriage are physical inability to consummate, and the insanity of one of the parties at the time of marriage. Both those circumstances have been pleaded and sustained in the law courts. In other countries minor physical circumstances, as disease, are held to invalidate marriage.

5. *Impotence and Sterility.*—These are of importance in connexion with legitimacy, divorce and criminal assaults. Impotence and sterility may arise from organic or from functional causes, and may be curable or incurable. Impotence (*q.v.*) is taken cognisance of by the law courts as a ground of divorce, and might, of course, be urged as a defence in a case of rape. Sterility is not a ground of divorce, but might be a question of importance in cases of legitimacy.

6. *Pregnancy.*—This subject presents one of the widest fields for medico-legal evidence. The limits of age between which it is possible, the limits of utero-gestation, and the signs of pregnancy may all in turn be the subjects of investigation.

The limits of age between which pregnancy is possible are usually fixed by the appearance and cessation of the monthly flow; and these ordinarily begin about fourteen and cease at forty-five years of age. Exceptionally they appear as early as the tenth year, and may not cease till the end of the fifth decade of life. Cases, however, have occurred where a woman has conceived before menstruating; and a few doubtful cases of conception are recorded in women upwards of fifty or even sixty years of age. The general fact of pregnancy being limited by the age of puberty on the one hand and the cessation of the monthly flow—or fifty-three or fifty-four years as the extreme limit of age—must be accepted as the safest guide in practice.

The limits of utero-gestation are not in England fixed by legislation. The French code fixes the extreme limit of three hundred days. The ordinary period is forty weeks and a half, or two hundred and eighty-three days from the cessation of the last monthly flux. The limit of three hundred days, as fixed by the French code, is perhaps never exceeded, if ever reached. The uncertainty of females in fixing the exact date of conception has given rise to the discrepant opinions of physiologists on the subject. It is well known, however, that among the higher animals the period is not precise; and impregnation and conception need not necessarily be coincident.

The signs of pregnancy are of the utmost importance to the medical jurist. He may be called upon to pronounce upon the virtue of a female, to sustain or rebut a plea for divorce, to determine whether a capital sentence shall be carried out, or to determine whether it is probable that an heir will be born to an estate. Medical jurists classify the signs of pregnancy as uncertain or certain; it is the former which are most regarded by the public, but the latter are alone of probative value to the jurist. The usual and uncertain signs are the cessation of the monthly flow, nausea, sickness, a darkening of the areola and the formation of a secondary areola around the nipple, enlargement of the breasts, increased size of the abdomen, the formation of a tumour in the womb, quickening, and the motions of the foetus. Also uncertain are the uterine souffle, which is a peculiar soft sound heard over the abdomen and synchronous with the maternal pulse and ballottement or the examination for a floating tumour in the abdomen between the fifth and eighth months of pregnancy. The certain signs of pregnancy are the foetal limbs palpated through the abdomen by the physician, the pulsations of the foetal heart heard by means of the stethoscope, the pulsations being much quicker and not synchronous with the maternal pulse. This latter is inapplicable before the fourth month of gestation.

7. *Parturition.*—The *imminence* of the process of parturition is of comparatively little interest to the medical jurist; but the *signs of recent delivery* are all-important. These signs are the bruised, swollen, and lacerated state of the external genitals, relaxation and dilatation of the vagina and womb, the existence of a peculiar vaginal discharge known as the lochia, a relaxed and fissured condition of the abdominal walls, a peculiar aspect of the countenance, and the distended state of the breasts due to the secretion of milk. The lochial discharge is the most characteristic sign. All the signs may disappear within ten days of delivery, though this is not usual.

Connected with parturition, the question of *viability* (potentiality for life) of the child is not unimportant. After the intra-uterine age of seven months is reached a child is certainly viable. The period at which the foetus becomes viable cannot be stated with certainty; but five calendar months, or one hundred and fifty days, is perhaps the nearest approximation. The viability of a child is judged by its size and weight, its general state of development; the state of the skin, hair, and nails; its strength or feebleness, the ability to cry, and its power of taking maternal nourishment. The question of viability has important bearings upon the crime of infanticide. In the case of succession to property the meaning of "born alive" is different from the meaning of the same expression as used respecting infanticide. In questions of tenancy by the curtesy (*q.v.*) it has been decided that any kind of motion of the child, as a twitching and tremulous motion of the lips, is sufficient evidence of live-birth. By the French code, however, no child that is born alive can inherit, unless it is born viable. As regards infanticide, proof of a conclusive separate existence of the child is demanded before live-birth is admitted.

The subject of *superfoetation* and *superfecundation*, or the possibility of two conceptions having occurred resulting in the birth of twins with a considerable intervening interval, is obscure and has given rise to much controversy. There is much, however (*e.g.* the existence of a double or bifid uterus), to countenance the view that a double conception is possible.

8. *Monsters and Hermaphrodites.*—To destroy any living human birth, however unlike a human creature it may be, is to commit a crime. Blackstone states that a monster which hath not the shape of mankind hath no inheritable blood; but the law has not defined a monster, nor what constitutes a human form. The same author states that if, in spite of deformity, the product of birth has human shape, it may be an heir. Hermaphrodites are beings with malformations of the sexual organs, simulating a double sex. Physiologists do not admit, however, the existence of true hermaphrodites with double perfect organs, capable of performing the functions of both sexes.

9. *Paternity and Affiliation.*—These are often matters of great doubt. A considerable time may elapse between the absence or death of a father and the birth of his reputed child. As has already been said, three hundred days is the utmost limit to which physiologists would extend the period of utero-gestation. This subject involves questions respecting children born during a second marriage of the mother, posthumous children, bastardy, and alleged cases of posthumous children.

10. *Presumption of Survivorship.*—When two or more persons perish by a common accident, when a mother and her new-born child are found dead, and in a few analogous cases, important civil rights may depend upon the question which lived the longest; and great ingenuity has been displayed in elucidating the disputes which have arisen in the law courts in such cases.

11. *Maladies exempting from Discharge of Public Duties* frequently demand the attention of the medical man. He may be called upon to decide whether a man is able to undertake military or naval service, to act as a juryman without serious risk to life or health, or to attend as a witness at a trial.

12. *Feigned and Simulated Diseases* often require much skill and caution in order to detect the imposture.

13. *The Signs of Death.*—The determination of the actual existence of death assumes a certain importance in tropical countries, where the necessity for speedy interment may involve a risk of burial alive. Such an accident cannot well occur where a medical man confirms the existence of death, and in the United Kingdom, where burial rarely takes place before the lapse of forty-eight hours, such changes usually occur in the body as to render any error practically impossible. Within a varying period, usually not more than twelve hours, the body becomes rigid, owing to the development of *rigor mortis* or post mortem rigidity. The blood, which during life is equally distributed throughout the body, gravitates to the most dependent parts and develops a discoloration of the skin which is known as post mortem lividity or post mortem staining. At a variable period of time, dependent on the cause of death, also the temperature and moisture of the air to which the body is exposed, decomposition or putrefaction sets in. These changes after death are of great importance, not only as affording certain proof of death, but also because they furnish valuable information as to the probable time at which it occurred, and from the fact that they may alter or destroy evidence as to the cause of death.

14. *Insanity or Mental Alienation.*—A medical man may be required to give evidence in any of the law courts, civil, criminal or ecclesiastical, before commissions *de lunatico inquirendo*, or before a magistrate, as to the sanity or insanity of an individual; and he may have to sign certificates of unsoundness of mind with the view of providing for the safe custody and proper treatment of a lunatic. Hence he must be familiar with the chief forms of insanity (see INSANITY), and be able to distinguish and treat each of these. He will also be required to detect feigned insanity, and to examine persons charged with crime with the view of preventing real lunatics from being treated as criminals.

II.—INJURIES TO THE PERSON

1. *Defloration.*—The signs of defloration are obscure and uncertain; and it is rather by the coexistence of several of the usual marks than the existence of any one sign, that any just conclusion can be arrived at.

2. *Rape.*—This crime consists in the carnal knowledge of a woman forcibly and against her will. The proofs of rape apart from the consistency of the woman's story, mainly depend on the presence of marks of violence, stains, &c. In all charges of rape, the woman and her assailant should be examined as soon as possible by a medical man, but such examination, it is important to remember, can only be carried out with the free consent of the party to be examined. It is to be noted that according to English law the slightest degree of penetration is sufficient to constitute the crime of rape.

3. *Mutilation.*—This may consist in the cutting or maiming of any member; castration is the most important, and perhaps but rarely effected as a crime. Self-mutilation, giving rise to false accusations, is occasionally resorted to.

4. *Criminal Abortion.*—This crime consists in unlawfully procuring the expulsion of the contents of the gravid uterus at any period short of full term. It must be noted that while this definition may be held to recognize the induction of premature labour by medical men in certain circumstances, yet, when the operation is necessary, a medical man should always protect himself from possible misconstruction of his action (*i.e.* criminal intent) by having a consultation with another practitioner. The means employed in criminal abortion to procure the desired result may be classed under three heads: (1) general violence to the body, (2) administration of drugs supposed to have abortifacient qualities, (3) instrumental interference with the contents of the uterus. Among the drugs frequently employed for the purpose, although by no means always successfully, are ergot, strong purgatives, iron, rue, pennyroyal, savin.

5. *Homicide.*—The legal sense of the term homicide excludes such injuries as are the result of either accident or of suicide. It embraces murder or wilful homicide, manslaughter or culpable homicide, casual homicide, and justifiable homicide.

Ordinary *homicide* may be accomplished by several modes that may sometimes be ascertained by examination of the body, *e.g.* poison.

As a preliminary in all cases of homicide, it is the duty of the medical jurist in the first place to ascertain the fact of death, and to distinguish between real and apparent death; and then to determine, if possible, the period at which death took place.

Infanticide, or child murder, is by the British law treated with the same severity as the murder of an adult. Indeed infanticide as a crime distinct from murder has no legal recognition. Practically this severity defeats itself, and hence an alternative charge of concealment of birth in England, or concealment of pregnancy in Scotland, is usually preferred in such cases.

The iniquity of the old law which threw the onus of proof of still-birth on the mother now no longer exists, and the law demands strict proof of live-birth at the hands of the prosecution. Hence the subject involves nice points of forensic medicine. The child must be proved to have arrived at the period when there was a probability of its living (proof of viability); and as the establishment of respiration is necessary to prove live-birth the evidences of this act must be carefully investigated. The size and position of the lungs, and the state of the vessels concerned in foetal circulation, must be carefully noted. The foetal lungs are dark, dense and liver-like in appearance and consistence, and sink when immersed in water; whilst the fully respired lungs are rosy, marbled, and soft and crepitant when handled. Minor degrees of respiration are recognized by the appearance of little groups of dilated air-vesicles, and by the fact that, although the lungs as a whole may sink in water, certain portions of them, into which respired air has penetrated, float in water even after subjection to firm pressure in the hand. Care must be taken, nevertheless, to exclude buoyancy of the lung due to putrefaction; in this case the air may be expelled by gentle pressure, and the previously buoyant portion of lung now sinks in water. It is impossible, however, to distinguish certainly between a lung naturally inflated and one artificially insufflated.

It must be borne in mind that, although live-birth cannot be affirmed in the absence of signs of respiration, the presence of these signs is not proof of live-birth in the legal sense of the term. The law demands for live-birth a separate existence of the child after delivery; and breathing may take place whilst the child is still either wholly or partially within the maternal passages, and in some special cases whilst still within the uterus itself.

When proofs of respiration—it may be to such an extent as to leave no doubt as to live-birth—have been found, the cause of death is then to be investigated. Wounds, and other forms of injury, must be sought for. There may be signs of strangulation, suffocation, puncture of the fontanelles and consequent injury to the brain, the administration of a poison, or other means of procuring death. It must be borne in mind that some of these causes may be brought about by omission, or even by accident. Thus strangulation may arise from natural and unrelieved pressure of the navel-string on the neck of the child; suffocation from immersion of the face of the child in the maternal discharges, or by pressure of clothes on the mouth. Death may result from haemorrhage through neglect to tie the navel-string, or the infant may perish from exposure to cold.

In the case of exposed infants it is important to ascertain the real mother. As such exposure usually takes place soon after birth, comparison of the age of the infant with the signs of recent delivery in the suspected mother is the best method of proving the relation.

Death from Asphyxia.—Among the forms of violent death due to this cause are drowning, hanging, strangulation, garotting, smothering, suffocation from choking, mechanical interference with the expansion of the chest walls, as when persons are crushed together during a panic in a fire, breathing poisonous gases, such as carbonic acid or carbonic oxide. Suicide and accidental death from these causes are still more common.

Drowning is thought to produce death occasionally by the suddenness of the shock causing suspension of the functions of circulation and respiration—by shock without a struggle. The usual mode of death appears, however, to be by the circulation of unoxygenated blood through the brain acting as a poison upon that organ; and this is attended with all the phenomena of asphyxia, as in suffocation. The phenomena attending asphyxia are as follows. As soon as the oxygen in the arterial blood, through exclusion of air, sinks below the normal, the respiratory movements grow deeper and at the same time more frequent; both the inspiratory and expiratory phases are exaggerated, the supplementary respiratory muscles are brought into play, and the breathing becomes hurried. As the blood becomes more and more venous, the respiratory movements continue to increase both in force and frequency. Very soon the expiratory movements become more marked than the inspiratory, and every muscle which can in any way assist in expiration is brought into play. The orderly expiratory movements culminate in expiratory convulsions; these violent efforts speedily exhaust the nervous system, and the convulsions suddenly cease and are followed by a period of calm. The calm is one of exhaustion; all expiratory active movements have ceased, and all the muscles of the body are flaccid and quiet. But at long intervals lengthened deep inspiratory movements take place; then these movements become less frequent; the rhythm becomes irregular, so that each breath becomes a more and more prolonged gasp, which becomes at last a convulsive stretching of the whole body; and with extended limbs and a straightened trunk, with the head thrown back, the mouth widely open, the face drawn and the nostrils dilated, the last breath is taken. The above phenomena are not all observed except in cases of sudden and entire exclusion of air from the lungs. In slow asphyxia, where the supply of air is gradually diminished (*e.g.* in drowning), the phenomena are fundamentally the same, but with minor differences. The appearances of the body after death from drowning are various. There may be pallor of the countenance, or this may be livid and swollen. The air passages are filled with frothy mucus, and there may be water in the stomach. The ends of the fingers are often excoriated from grasping at objects; and weeds, &c., are sometimes found grasped in the hands. The distinction between murder and suicide by drowning can rarely be made out by examination of the body alone, and is usually decided from collateral circumstances or marks of a struggle. Attention must also be paid to the existence of wounds on the body, marks of strangulation on the neck, and the like.

Hanging may result in death from asphyxia, or, as is more particularly the case in judicial hanging, some injury is inflicted on the upper portion of the spinal cord, resulting in instant death. The ordinary appearances of death from asphyxia may be found: dark fluid blood, congestion of the brain, intensely congested lungs, the right cavities of the heart full, and the left comparatively empty of blood, and general engorgement of the viscera. Ecchymosis may be found beneath the site of the cord, or a mere parchmenty appearance. There may even be no mark of the cord visible. The mark, when present, usually follows an oblique course, and is high up the neck. The fact that a body may be suspended after death, and that if this be done speedily whilst the body is still warm there may be a post-mortem mark undistinguishable from the mark observed in death from hanging, must not be forgotten.

Suffocation may occur from the impaction of any substance in the glottis, or by covering up the mouth and nose. It is frequently of accidental origin, as when substances become accidentally impacted in the throat, and when infants are overlaid. The phenomena are those of pure asphyxia, which have already been detailed. On post-mortem examination the surface of the lungs is found covered with minute extravasations of blood, known as punctated ecchymosis.

Strangulation may be accomplished by drawing a cord tightly round the neck, or by forcibly compressing the windpipe (throttling). Hence there may be either a circular mark round the neck, not so oblique as after hanging, or the marks of the fingers may be found about the region of the larynx. The cartilaginous structures of the larynx and windpipe may be broken. The mark of the ligature is often low down in the neck. The signs of asphyxia are present in a marked degree.

Mephitism.—In the United Kingdom this last form of death usually results accidentally from an escape of lighting gas, the danger has been much increased in many towns owing to the addition of carburetted water-gas to the ordinary supply. Carbonic oxide gas is contained in ordinary lighting gas to the extent of about 6 to 8 %, and is extremely fatal when inhaled. Carburetted water-gas contains about 28 %, and when mixed with ordinary lighting gas the percentage of carbonic oxide is thus very much increased. As a mode of assassination it is seldom employed, but is frequently resorted to on the continent of Europe by suicides, charcoal fumes being commonly used for the purpose.

6. *Death from Starvation.*—Cases occur in which it is important to distinguish this from other modes of death. In such cases the skin becomes harsh and dry, and may acquire a peculiar odour; the subcutaneous fat disappears; the gums shrink away from the teeth; the tongue and mouth become dark-coloured and dry; the eyes are bloodshot; the intestines become thin and their coats translucent; the gall-bladder is distended. The period of total abstinence from food required to kill an adult is unknown, and greatly depends upon whether there be access to liquid. In some cases persons have been able to subsist on little or no nourishment for long periods, the body being in a state of quasi-hibernation.

7. *Death from Extremes of Temperature.*—(1) Death from cold is not often observed in the British Isles. A portion only of the body, as the extremity of a limb, may perish from extreme cold. After the first sensation of tingling experienced on exposure to severe cold, loss of sensation supervenes, with languor and an irresistible propensity to sleep. The tendency to this forms an extreme danger in such cases. (2) Death from extreme heat usually occurs in the form of burning and scalding, attended with destruction of a large portion of the cutaneous structures. Here the cause of death is obvious. The human body is capable of exposure to very hot air—as is seen in Turkish baths—for a considerable period with impunity. Sunstroke is a cerebral affection brought on by too great exposure to a hot atmosphere, especially whilst undergoing fatigue.

8. *Death by Lightning.*—Lightning or an electric current may cause instant death. No visible marks of the effects of the electric current may be left, or the body may be singed or discoloured, or the skin may be perforated at one or two spots.

9. *Injuries or Wounds.*—These include in a medico-legal sense not only those characterized as incised, punctured, contused, lacerated, stab wounds, but also burns, injuries produced by firearms, fractures, dislocations, &c. One of the chief questions which have to be decided in all forms of violent death is whether it was the result of accident, suicide or murder. In cases of fatal wounding, among the points to be noted, which will help to decide the question, are the situation, direction and extent of the wound, the position in which the body and any weapon may be found, together with the presence and distribution of any blood marks and the signs of a struggle. In wounds caused by firearms the injury, if suicidal, is usually situated in a vital and accessible part of the body, the temple, mouth, and chest being the favourite situations; but such an injury also presents, as a rule, the characteristic appearances resulting from the discharge of the weapon close to the body, viz. besides the wound of entrance of the bullet, there are singeing of the cuticle and hair, and blackening of the area immediately surrounding the wound, from particles of unconsumed powder being driven into the skin and from the smoke of the discharge. These effects are naturally not produced when the weapon is discharged at a distance exceeding 2 or 3 ft., as usually happens in cases of homicidal shooting. They may also be wanting in undoubted suicidal wounds produced by revolvers and cartridges filled with amberite or other smokeless powders. Death from burning is generally accidental, very rarely suicidal, and when homicidal is usually employed to conceal traces of other violence inflicted upon the body. In large conflagrations death is not always due to burning. Charred bodies may be found presenting various injuries due to the fall of beams, crushing, the trampling of others trying to escape, &c., or fractures and lacerations may be due simply to the action of the heat. Death may result from such injuries, or from suffocation by the gases of combustion, before the victim is affected by the actual fire. Spontaneous combustion of the body has been stated to occur, but the evidence upon which the cases rest is not well authenticated.

Punctured wounds or stabs require minute attention; for there have been instances in which death has been produced by an instrument so small as a pin thrust into a vital part. *Wounds of the head* are always dangerous, especially if the blow has been severe. The person so wounded may die without division of the skin, or fracture of the bones, as happens in what is known as *concussion* of the brain. Contusions which do not divide the skin may fracture the skull; or the inner table of the skull may be fractured without the outer being broken or depressed. Even wounds of the scalp may prove fatal, from inflammation extending towards the brain. Punctured wounds of the head are more dangerous than cuts, as more likely to excite fatal inflammation. When the brain and its membranes are injured, all such wounds are generally fatal. Wounds of the face or organs of sense are often dangerous, always disfiguring, and productive of serious inconvenience. *Wounds of the neck* are always serious whenever more than the skin is divided. The danger of opening large blood-vessels, or wounding important nerves, is imminent; even the division of a large vein in the neck has proved immediately fatal, from the entrance of air into the vessel, and its speedy conveyance to the heart. A blow on the neck has instantly proved fatal, from injury to an important nerve, generally the pneumogastric or the sympathetic. Dislocations and fractures of the bones of the neck prove instantly fatal. *Wounds of the chest* are always serious when the cavity is penetrated, though persons may recover from wounds of the lungs, and have even survived for some time considerable wounds of the heart. This last is an important fact; because we are not always to consider the spot where the body of a person killed by a wound of the heart, and apparently remaining where he fell, is found as that in which the fatal wound was inflicted. Instances have occurred of persons surviving severe wounds of the heart for several days. Broken ribs are never without danger; and the same may be said of severe contusions of the chest, from the chance of inflammation extending inwards. Wounds penetrating both sides of the chest are generally considered as fatal; but possibly there may be recovery from such. *Wounds of the abdomen*, when they do not completely penetrate, may be considered as simple wounds, unless when inflicted with great force, so as to bruise the contents of the abdominal cavity; in that case they may produce death without breach of surface, from rupture of some viscus, as sometimes happens from blows or kicks upon the belly. Wounds injuring the peritoneum are highly perilous, from the risk of severe inflammation. Wounds of the stomach or intestines, or of the gall-bladder, generally prove mortal, from the effusion of their contents into the peritoneal cavity producing fatal inflammation. Wounds of the liver, spleen or kidneys are generally soon mortal, from the great vascularity of those organs. Wounds of the extremities, when fatal, may generally be considered so from excessive haemorrhage, from the consequences of inflammation and gangrene, or from the shock to the system when large portions of the limb are forcibly removed, as in accidents from machinery, and in wounds from firearms.

Blood Stains.—The examination of blood stains is a frequent and important operation in criminal charges. Blood stains when fresh and abundant can be recognized without difficulty, but when old, or after being acted upon by certain substances, their identity is not readily determined.

The tests which may be applied to a suspected stain consist of: (1) *The microscopic test.* A portion of the stain is soaked in a drop of some fluid which will soften and cause separation of the dried blood corpuscles without altering their characteristic appearance. Such fluids are solutions of glycerine and water of a specific gravity of 1028 or 30% caustic potash. The recognition of blood corpuscles affords evidence of the nature of the stain. (2) *Chemical tests.* (*a*) Heat applied to a solution obtained by soaking some of the stained fabric in cold water. A blood solution is red, and loses its red colour on application of heat, while at the same time a buff-coloured precipitate is formed. (*b*) On applying a drop of freshly prepared tincture of guaiacum and then some ozonic ether or peroxide of hydrogen to the stain, a blue colour is obtained if blood be present. Many other substances, however, give the same reaction. (*c*) If, even to the smallest particle of dried blood, a fragment of common salt and some glacial acetic acid be added, and the latter is then heated to ebullition and allowed to evaporate away, small brown rhomboid crystals—haemin crystals—will be found to have formed, and they can be recognized under the microscope. (3) *Spectroscopic test.* A solution of blood obtained from a stain will show a spectrum having two dark bands between Fraunhofer's lines D and E (oxy-haemoglobin). On adding ammonium sulphide to the solution the haemoglobin is reduced and only one broad dark band is seen (reduced haemoglobin). On adding caustic potash to a solution of blood, alkaline haematin is formed, and this again is transformed on the further addition of ammonium sulphide into reduced haematin or haemochromogen, which gives a very characteristic spectrum of two dark bands situated in the yellow part of the spectrum. The production of these three different spectra from a red-coloured solution is characteristic of blood. Old blood stains are insoluble in water, whereas recent stains are readily soluble in cold water, yielding a red solution. The application of hot water or washing with soap tends to fix or render blood stains insoluble. Vegetable dyes may likewise give red solutions, but they may be distinguished from blood by the addition of ammonia, which alters the colour of the former, but rather intensifies the red colour of a blood solution.

The differentiation between human blood stains and those produced by the blood of other animals, more especially domestic animals, is a matter of great importance to the medical jurist. When the blood stain is fresh, measurement of the corpuscles may decide the question, but in the case of dry and old stains it is impossible to make the distinction. A method has been discovered, however, which enables the distinction to be made not only between human blood and that of other animals (with the exception of *Simiidae*), but also between the bloods of different animals. The method depends upon the fact that if an animal (A), such as a dog or rabbit, is inoculated with the blood or serum of another animal (B), then the blood or serum of A is found to produce a specific reaction (namely, the production of a cloudiness or precipitate) when added to a solution of the blood of a similar animal to B, and that species of animal only. If, therefore, human blood serum is injected into an animal, its blood after a time affords an "anti-serum" which produces the specific reaction only in human blood solutions and not in those formed from the blood of other animals.

10. *Poisoning.*—There is no exact definition of a poison (*q.v.*). Popularly, substances which destroy or endanger life when swallowed in small quantity are called poisons, but a scientific definition would also include many substances which are injurious to health in large doses or only after repeated administration, and which act not only when swallowed, but also when taken into the system through other channels, *e.g.* the skin or the lungs. The branch of science which relates to poisons, their nature, methods of detection, the symptoms produced by them, and treatment of poisoning, is called Toxicology, and is one of the most important subjects included under the term Medical Jurisprudence.

The medical evidence in cases of poisoning rests upon—(1) the symptoms produced during life; (2) the post mortem appearances; (3) the chemical analysis and detection of the substance in the body, or in the excretions and vomited matters, or in articles of food; (4) experiments on animals in the case of certain poisons where other conclusive evidence is difficult to obtain. The treatment of cases of poisoning will vary according to the substance taken, but the general principles which should be followed are: (*a*) to get rid of the poison by means of the stomach-pump, or by washing out the stomach with water through a soft rubber tube, or by giving an emetic such as mustard, sulphate of zinc, ipecacuanha; (*b*) to neutralize the poison by giving a substance which will form with it an innocuous compound (*e.g.* in the case of the strong acids by administering magnesia or common whiting), or which has an opposite physiological action (*e.g.* atropine in opium poisoning); (*c*) to promote the elimination from the body of the poison which has been already absorbed; (*d*) general treatment of any dangerous symptoms which appear, as by stimulation in collapse or artificial respiration in asphyxia.

Food Poisoning (see also ADULTERATION).—Foods may prove noxious from a variety of causes: (1) The presence of metallic poisons, as in peas artificially coloured with copper salts, in tinned foods from dissolved tin salts, &c. (2) The contamination of any food with the specific germs of disease, as for example, milk infected with the germ of enteric fever. (3) The presence in meat of parasites, such as the *Trichina spiralis*, or of disease in animals, capable of transmission to man, such as tuberculosis, or the presence of poison in the flesh of animals which have fed on substances harmless to them but poisonous to human beings. Grain may be infected with parasitic fungi of a poisonous character, as for example *Claviceps purpurea*, causing epidemics of ergotism. (4) Foods of various kinds may contain saprophytic bacteria which elaborate certain poisons, either before or after the food is taken. It is chiefly in relation to food-poisoning from the last-mentioned cause that our knowledge has been increased in recent years.

Many cases of food-poisoning, previously of mysterious origin, can now be explained by the action of bacteria and the products which they give rise to—tox-albumoses, ptomaines, toxins—by splitting up proteid substances. It is not necessary that the food should show evident signs of putrefaction. It may not do so, and yet on being eaten produce violent symptoms of gastro-intestinal irritation almost immediately, followed by various nervous symptoms. In such cases a chemical poison, developed by putrefactive bacteria before the food was eaten, quickly acts upon the system. On the other hand, symptoms may not appear for many hours after ingestion of the food, and then come on suddenly and with great severity—there has been a period of incubation. In such cases the food when swallowed has contained the bacteria, but the poisonous toxin has been elaborated by them afterwards in the system during the period preceding the onset of symptoms. In both varieties of poisoning the symptoms are similar, consisting of gastro-intestinal irritation—vomiting, purging and pain in the abdomen—together with great prostration, fever, muscular twitchings, disturbances of vision, delirium and coma. The varieties of meat which have most frequently given rise to poisoning (Botulismus) are pork, ham, veal, sausages, brawn, various kinds of meat pies and potted meats. Pig flesh appears to be specially liable to become infected. A point of considerable interest, which has sometimes given rise to doubt as to the poisonous character of meat in certain instances, is, that the same food may be poisonous at one time and not at another. Thus it may be harmless when freshly prepared, cause fatal effects if eaten a day or two afterwards, and shortly after that again prove perfectly innocuous. This is explained by the fact that the toxic substances take some time to develop, and after development are still further split up by the bacteria into other bodies of a harmless nature.

In some fish—*e.g. Trachinus draco*, or sea weaver—the poison is a physiological product of certain glands. In others the poison is not known, as in the family *Scombridae*, to which the disease Kakkè has been attributed. In the United Kingdom the poisonous effects produced by fish are due to bacterial agency after death, and instances have occurred from the eating of herrings, mackerel, dried salt codfish, caviare, tinned salmon and tinned sardines. Shellfish may produce poisonous effects from putrefactive changes or from the development in them (oysters and mussels) of ptomaines. Brieger discovered a ptomaine in poisonous mussels to which he gave the name mytilotoxin. It is now fully proved that oysters and mussels may become contaminated with the organism of typhoid fever if placed in specifically polluted water, and thus transmit the disease to human beings. Milk, as already stated, may be contaminated and convey the infection of scarlet fever and other diseases. It may also contain substances of bacterial origin, which are possibly the cause of infantile diarrhoea, and others, having a fatal effect upon adults. Cheese has frequently caused poisoning. Vaughan discovered a toxic substance in milk and cheese—tyrotoxicon—but there are other toxic substances of bacterial origin sometimes present in cheese to which poisonous effects have probably been due. Mushroom-poisoning results from the eating of poisonous fungi in mistake for the edible mushroom. The poisonous element in most cases is either muscarin contained in the fungus *Amanita muscaria*, or phallin in *Amanita phalloides*.

History of Forensic Medicine

The true origin of medical jurisprudence is of comparatively recent date, although traces of its principles may be perceived in remote times. Among the ancient Greeks the principles of medical science appear only to have been applied to legislation in certain questions relating to legitimacy. In the writings of Galen we find, however, remarks on the differences between the foetal and the adult lungs; he also treats of the legitimacy of seven months' children, and discusses feigned diseases. Turning to Rome, we find that the laws of the Twelve Tables fix three hundred days as the extreme duration of utero-gestation. It is doubtful whether the Roman law authorized medical inspections of dead bodies. In the code of Justinian we find *De statu hominum; De poenis et manumissis; De sicariis; De inspiciendo ventre custodiendoque partu; De muliere quae peperit undecimo mense; De impotentia; De hermaphroditis*—titles which show obvious traces of a recognized connexion between medicine and law. It was not, however, by the testimony of living medical witnesses that such questions were to be settled, but on the authority of Hippocrates.

Medical jurisprudence, as a science, dates only from the 16th century. In 1507 the bishop of Bamberg introduced a penal code in which the necessity of medical evidence in certain cases was recognized; and in 1532 the emperor Charles V. persuaded the Diet of Ratisbon to adopt a uniform code of German penal jurisprudence, in which the civil magistrate was enjoined in all cases of doubt or difficulty to obtain the evidence of medical witnesses,—as in cases of personal injuries, infanticide, pretended pregnancy, simulated diseases, and poisoning. The true dawn of forensic medicine dates, however, from the publication in 1553 of the *Constitutio criminalis carolina* in Germany. A few years later Weiher, a physician, having undertaken to prove that witches and demoniacs are, in fact, persons subject to hypochondriasis and hysteria, and should not be punished, aroused popular indignation, and was with difficulty rescued from the flames by his patron, William duke of Cleves.

At the close of the 16th century Ambrose Paré wrote on monsters, on simulated diseases, and on the art of drawing up medico-legal reports; Pineau also published his treatise on virginity and defloration. About the same time as these stimuli to the study of forensic medicine were being made known in Paris, the first systematic treatise on the science appeared in Sicily in the form of a treatise *De relationibus medicorum* by Fidele. Paulo Zacchia, the illustrious Roman medical jurist, moreover, published from 1621 to 1635 a work entitled *Quaestiones medico-legales*, which marks a new era in the history of the science—a work which displays an immense amount of learning and sagacity in an age when chemistry was in its infancy, and physiology very imperfectly understood. The discovery of the circulation of the blood by Harvey soon followed, and gave a new impetus to the study of those branches of forensic medicine having direct relations to physiology; and to Harvey we owe the idea how to apply Galen's observations on the differences between the foetal and the adult lungs to the elucidation of cases of supposed infanticide. About this time, too, Sebiz published two treatises, on the signs of virginity and on the examination of wounds respectively. In the former he contended that the hymen was the real mark of virginity; but this was denied by Augenio and Gassendi. In 1663 Thomas Bartholin investigated the period of human uterine gestation, a subject which had engaged the attention of Aristotle. He also proposed the "hydrostatic test" for the determination of live-birth—a test still in use, and applied by observing whether the lungs of an infant float or sink in water. J. Swammerdam explained the rationale of the process in 1677; but it was not till 1682 that it was first practically applied by Jan Schreyer.

Germany, ever the leader in questions of forensic medicine, introduced the first public lectures on medical jurisprudence. Michaelis gave the first course about the middle of the 17th century in the university of Leipzig; and these were followed by the lectures of Bohn, who also published *De renunciatione vulnerum; cui accesserunt dissertationes binae de partu enecato, et an quis vivus mortuusve aquis submersus, strangulatus, aut vulneratus fuerit*, and *De officiis medici duplicis, clinici et forensis*. Welsch and Amman wrote on the fatality of wounds, and Licetus on monsters.

From the time of Ambrose Paré the mode of conducting investigations in forensic medicine had attracted attention in France; and in 1603 Henry IV. authorized his physician to appoint persons skilled in medicine and surgery to make medico-legal inspections and reports in all cities and royal jurisdictions; in 1692, difficulties having arisen, Louis XIV. created hereditary royal physicians and surgeons for the performance of like duties. These, having become a corrupt and venal body, were suppressed in 1790. The only works on forensic medicine which appeared in France during the 17th century, however, were Gendry's *Sur les moyens de bien rapporter à justice* and Blégny's *Doctrine des rapports en chirurgie*. At the beginning of the 18th century the latter was superseded as a text-book by Devaux's *L'Art de faire des rapports en chirurgie*. Valentini followed with two works, which were finally incorporated in his *Corpus juris medico-legale* which appeared in 1722. This work is a vast storehouse of medico-legal information, and a summary of the knowledge of the time.

Professorships for teaching the subject were founded in the German universities early in the 18th century, and numerous treatises on forensic medicine were published. Teichmeyer's *Institutiones medicinae legalis* long formed the text-book of the subject; and Alberti, professor of legal medicine at Halle, in his *Systema* gave to the world a most complete and laborious treatise on the science. His industrious collection of facts renders his works a precious mine of information. Indeed towards the close of the 18th century the Germans were almost the only cultivators of legal medicine. But in France the celebrated case of Villeblanche attracted attention to the subject, and called forth Louis, who in a memoir on utero-gestation attacked with powerful arguments the pretended instances of protracted pregnancy, and paved the way for the adoption in the *Code Napoléon* of three hundred days as the limit of utero-gestation, a period in precise accordance with the ancient Roman law of the Twelve Tables. Louis also wrote on death from hanging, and pointed out the mode by which we may distinguish murder from suicide under such circumstances. It is he who is credited with having been the first in France to publicly teach the just application of medical knowledge to jurisprudence. Foderé's celebrated *Traité de médecine légale* appeared in 1798, and marks a new era in the annals of legal medicine.

No British author wrote systematically on forensic medicine till 1788, when Dr Samuel Farr published a short treatise on the *Elements of Medical Jurisprudence*; but this was merely an abridgment of an earlier work of Fazelius. Previous writers—as Mead, Munro, Denman, Percival and the two Hunters—had, however, dealt with fragments of the subject; nevertheless the science as a whole was little appreciated or recognized in this country during the 18th century.

In the 19th century France took the lead; and the institution of three professorships of forensic medicine at the end of the 18th century produced excellent fruits. In 1814 Orfila, a Spaniard by birth, but naturalized in France, published his *Toxicologie*, a work which revolutionized this branch of medical jurisprudence, and first placed the knowledge of poisons upon a scientific basis. Since the time of Orfila, France has never ceased to have one or more living medical jurists, among the most recent of whom we must enumerate Tardieu, whose treatises on abortion, on poisons, on wounds, &c., are justly celebrated. Germany too industriously pursued the subject, and Casper's great work on forensic medicine will ever remain a classic in the science. In Russia Dragendorff greatly contributed to our knowledge of poisons.

Though forensic medicine may be said to have been entirely neglected in England till the beginning of the 19th century, its progress has since been by no means slow or unimportant; and the subject now forms a recognized and obligatory portion of medical study. The first lectures delivered in Great Britain were given in the university of Edinburgh in 1801 by the elder Dr Duncan; and the first professorship was held by his son in 1803. Dr Alfred Swaine Taylor gave the first course of lectures delivered in England, at Guy's Hospital in 1831; and in 1863 the university of London made forensic medicine a separate subject for examination and honours for medical graduates. In 1822 there was not in the English language any treatise of authority either on medical jurisprudence or on any important division of the subject; for it was not till the following year that the useful compendium of Paris and Fonblanque was published; and even in the middle of the 19th century medical jurisprudence may be said to have been almost in its infancy as compared with what it is now. From 1829 Great Britain produced an abundant crop of literature on forensic medicine. Sir Robert Christison's admirable treatise on *Toxicology*, Dr A. S. Taylor's *Principles and Practice of Medical Jurisprudence* (1905 edition, by F. J. Smith), the same author's *Elements of Medical Jurisprudence*, Dr Guy's *Forensic Medicine*, and Ogston's *Lectures on Medical Jurisprudence* have become well-known and widely circulated works. The separate memoirs of Taylor, Christison, Guy and others are also storehouses of facts and deductions in the science. America, too, has not been behindhand in the race. F. Wharton and M. Stillé's *Manual*, Wormley's *Toxicology*, and the works of Beck and Reese have furthered the study of the science.

See also Dixon Mann, *Forensic Medicine and Toxicology* (London, 1902); Wynter Blyth, *Poisons: their Effects and Detection* (London, 1895); Allbutt and Rolleston, *A System of Medicine*, vol. ii. "Intoxications" (London, 1909); Vaughan, *Twentieth Century Practice of Medicine*, vol. xiii. article "Ptomaines, Toxins and Leucomaines" (London, 1898); Maschka, *Handbuch der gerichtlichen Medicin* (Tübingen, 1881–1882); Hofmann, *Lehrbuch der gerichtlichen Medicin* (Wien, 1898); Strassmann, *Lehrbuch der gerichtlichen Medicin* (Stuttgart, 1895); Kunkel, *Handbuch der Toxikologie* (Jena, 1899); Brouardel, *L'Infanticide, La Pendaison, &c.* (Paris, 1897). (H. H. L.; T. A. I.)

MEDICI, the name of a family renowned in Italian history for the extraordinary number of statesmen to whom it gave birth, and for its magnificent patronage of letters and art. They emerged from private life and rose to power by means of a very subtle policy that was persistently pursued from generation to generation. The origin of the family is buried in obscurity. Some court historians indeed declare it to have been founded by Perseus, and assert that Benvenuto Cellini's bronze Perseus holding on high the head of Medusa was executed and placed in the Loggia dei Lanzi at Florence to symbolize the victory of the Medici over the republic. But this only proves that the real origin of the family is unknown, and equally unknown is the precise signification of the Medicean arms—six red balls on a field of gold.

Early Bearers of the Name.

Salvestro.

The name appears in Florentine chronicles as early as the close of the 12th century, although only casually mentioned in connexion with various offices of the republic. The first of the family to be a distinct figure in history was Salvestro dei Medici, who, in 1378, took an active part in the revolt of the Ciompi—so called because it was led by a wool-carder (*ciompo*), one Michele di Lando, and because the chief share in it was taken by the populace, who held the reins of government for some time, and sought to obtain extended political rights. Although Michele di Lando was the nominal chief of the revolt, Salvestro dei Medici was its real leader. The latter, although a member of the greater gilds, had joined the lesser and sought to be at their head, in order to lay the foundation of his own power and that of his kindred by attacking the Albizzi, who were the leading men of the greater gilds. The victory of the Ciompi, however, was brief, for the excesses of the lower classes brought about a reaction, in which they were crushed, and Michele di Lando sent into banishment. Nevertheless the lesser gilds had gained some ground by this riot, and Salvestro dei Medici the great popularity at which he had aimed. His policy during that period had traced the sole possible road to power in liberty-loving Florence. This was the road henceforth pursued by the Medici.

Giovanni.

On Salvestro's death in 1388 the Albizzi repossessed themselves of the government, and conducted the wars of the republic. Vieri dei Medici, who seems to have been the next head of the family, understanding the temper of the times, abstained from becoming a popular leader, and left it to his successors to prosecute the task under easier conditions. Then, in the person of Giovanni, son of Averardo Bicci dei Medici (1360–1429), another branch of the family arose, and became its representative branch. Indeed this Giovanni may be considered the actual founder of Medicean greatness. He took little part in political affairs, but realized an immense fortune by trade—establishing banks in Italy and abroad, which in his successor's hands became the most efficient engines of political power. The Council of Constance (1414–1418) enabled Giovanni dei Medici to realize enormous profits. Besides, like his ancestor Salvestro, he was a constant supporter of the lesser gilds in Florence. Historians record his frequent resistance to the Albizzi when they sought to oppress the people with heavier taxation, and his endeavours to cause the chief weight to fall upon the richer classes. For this reason he was in favour of the so-called law of *catasto*, which, by assessing the property of every citizen, prevented those in power from arbitrarily imposing taxes that unjustly burdened the people. In this way, and by liberal loans of money to all who were in need of it, he gained a reputation that was practically the foundation-stone of the grand family edifice. Giovanni dei Medici died in 1429 leaving two sons, Cosimo (1389–1464) and Lorenzo (1395–1440). From the former proceeded the branch that held absolute sway for many generations over the nominal republic of Florence, and gave to Italy popes like Leo X. and Clement VII. On the extinction of this elder line in the 16th century, the younger branch derived from Lorenzo, Cosimo's brother, seemed to acquire new life, and for two centuries supplied grand-dukes to Tuscany.

Cosimo the Elder.

Cosimo, surnamed Cosimo the Elder, to distinguish him from the many others bearing the same name, and honoured after his death by the title of *pater patriae*, first succeeded in solving the strange problem of becoming absolute ruler of a republic keenly jealous of its liberty, without holding any fixed office, without suppressing any previous form of government, and always preserving the appearance and demeanour of a private citizen. Born in 1389, he had reached the age of forty at the time of his father's death. He had a certain amount of literary culture, and throughout his life showed much taste and an earnest love both for letters and art. But his father had mainly trained him to commerce, for which he had a special liking and aptitude. He was devoted to business to the day of his death, and like his forefathers derived pecuniary advantage from his friendly relations with the papal court. He accompanied Pope John XXIII. to the Council of Constance, transacted a vast amount of business in that city, and made very large gains. He then travelled in Germany, and after his return to Florence discharged several ambassadorial missions. At the death of his father he was possessed of a vast fortune and an extended experience, and inherited the leadership of the opposition to the then dominant party of the greater gilds headed by Rinaldo degli Albizzi, Palla Strozzi and Niccolò da Uzzano. Of gentle and kindly manners, generous in lending and even in giving money whenever he could gain popularity by that means, at critical moments he frequently came to the succour of the government itself. He was very dexterous in turning his private liberalities to account for the increase of his political prestige, and showed no less acumen and still fewer scruples in making use of his political prestige for purposes of pecuniary profit. Indeed, whenever his own interests were at stake, he showed himself capable of positive villainy, although this was always tempered by calculation. Cosimo proved his skill in these knavish arts during the war between Florence and Lucca. He had joined the Albizzi in urging on this war, and many writers assert that he turned it to much pecuniary advantage by means of loans to the government and other banking operations. When, however, military affairs went badly, Cosimo joined the discontented populace in invectives against the war and those who had conducted it. This won him an enormous increase of popularity, but the hatred of the Albizzi and their friends augmented in equal degree, and a conflict became inevitable. The Albizzi, who were far more impetuous and impatient than Cosimo, were now bent upon revenge. In 1433 one of their friends, Bernardo Guadagni, was elected gonfalonier, and thereupon Cosimo dei Medici was called to the palace and summarily imprisoned in the tower. A general assembly of the people was convoked and a *balìa* chosen, which changed the government and sent Cosimo into exile. Undoubtedly the Albizzi party would have preferred a heavier sentence, but they did not dare to attempt their enemy's life, being well aware of the great number of his adherents. Cosimo had some apprehension that he might be poisoned in prison, but Federigo dei Malavolti, captain of the palace guard, showed him the utmost kindness, and, to soothe his fears, voluntarily shared his meals. On the 3rd of October the prisoner was sent to Padua, his allotted place of exile.

The Albizzi speedily saw that they had done either too much or too little. While seeking to keep the government entirely in their own hands, they beheld the continual growth of the Medici party. When it was necessary to make a campaign in Romagna against the mercenary captains commanding the forces of the duke of Milan, it was plainly seen that in banishing Cosimo the republic had lost the only citizen banker in a position to assist it with considerable loans. The Florentines were defeated by Piccinino in 1434, and this event greatly increased the public exasperation against the Albizzi. Meanwhile Cosimo, who had gone to Padua as a private individual, was entertained there like a prince. Then, being permitted to transfer his residence to Venice, he entered on a course of lavish expenditure. He was overwhelmed with letters and appeals from Florence. Finally, on the 1st of September 1434, a signory was elected composed of his friends, and his recall was decreed. Rinaldo degli Albizzi determined to oppose it by force, and rushed to the Piazza with a band of armed men; but his attempt failed, and he left the country to return no more. The Medici were now reinstated in all their former dignities and honours, and Cosimo, on the evening of the 6th of September, rode past the deserted mansions of the Albizzi and re-entered his own dwelling after an exile of a year. For three centuries, dating from that moment, the whole history of Florence was connected with that of the house of Medici.

The Government of Florence.

Cosimo's first thought was to secure himself against all future risk of removal from Florence, and accordingly he drove the most powerful citizens into exile to all parts of Italy. Nor did he spare even his former political adversary, Palla Strozzi, although the latter had been favourable to him during the recent changes. His rigour in this particular case was universally censured, but Cosimo would tolerate no rivals in the city, and was resolved to abase the great families and establish his power by the support of the lower classes. He was accustomed to say that states could not be ruled by paternosters. Still, when cruelty seemed requisite, he always contrived that the chief odium of it should fall upon others. When Neri Capponi, the valiant soldier and able diplomatist, gained great public favour by his military prowess, and his influence was further increased by the friendship of Baldaccio d'Anghiari, captain of the infantry, Cosimo resolved to weaken his position by indirect means. Accordingly, when in 1441 a partisan of the Medici was elected gonfalonier, Baldaccio was instantly summoned to the palace, imprisoned, murdered, and his body hurled from the window. No one could actually fix this crime upon Cosimo, but the majority believed that he had thus contrived to rid himself of one enemy and cripple another without showing his hand. It was impossible for Cosimo openly to assume the position of tyrant of Florence, nor was it worth his while to become gonfalonier, since the term of office only lasted two months. It was necessary to discover some other way without resorting to violence; he accordingly employed what were then designated "civil methods." He managed to attain his object by means of the *balìe*. These magistracies, which were generally renewed every five years, placed in the ballot-bags the names of the candidates from whom the signory and other chief magistrates were to be chosen. As soon as a *balìa* favourable to Cosimo was formed, he was assured for five years of having the government in the hands of men devoted to his interests. He had comprehended that the art of politics depended rather upon individuals than institutions, and that he who ruled men could also dictate laws. His foreign policy was no less astute. His great wealth enabled him to supply money not only to private individuals, but even to foreign potentates. Philippe de Comines tells us that Cosimo frequently furnished Edward IV. of England with sums amounting to many hundred thousand florins. When Tommaso Parentucelli was still a cardinal, and in needy circumstances, Cosimo made him considerable loans without demanding guarantees of payment. On the cardinal's accession to the tiara as Nicholas V. he was naturally very well disposed towards Cosimo, and employed the Medici bank in Rome in all the affairs of the curia. At the time when Francesco Sforza was striving for the lordship of Milan, Cosimo foresaw his approaching triumph, showed him great friendship, and aided him with large sums of money. Accordingly, when Sforza became lord of Milan, Cosimo's power was doubled.

Cosimo's Patronage of Art.

Without the title of prince, this merchant showed royal generosity in his expenditure for the promotion of letters and the fine arts. Besides his palace in the city, he constructed noble villas at Careggi, Fiesole and other places. He built the basilica of Fiesole, and that of St Lorenzo in Florence, and enlarged the church and monastery of St Mark. Even in distant Jerusalem he endowed a hospice for the use of pilgrims. The artists of the day comprised men like Donatello, Brunelleschi, Ghiberti, Luca della Robbia, and many others, and Cosimo's magnificent commissions not only developed their powers but stimulated other men of wealth to the patronage of art. Without being a scholar, Cosimo had a genuine taste for letters. He purchased many Greek and Latin manuscripts; he opened the first public library at St Mark's at his own expense, and founded another in the abbey of Fiesole. The Greek refugees from Constantinople found a constant welcome in his palace. During the Council of Florence (1439–1442), Gemistus Pletho spoke to him with enthusiasm of the Platonic philosophy. Cosimo was so deeply attracted by the theme that he decided to have the young Marsilio Ficino trained in philosophy and Greek learning in order to make a Latin translation of the complete works of Plato. And thus a version was produced that is still considered one of the best extant, and that Platonic academy was founded which led to such important results in the history of Italian philosophy and letters. On the 1st of August 1464 Cosimo breathed his last, at the age of seventy-five, while engaged in listening to one of Plato's dialogues.

The concluding years of his life had been years of little happiness for Florence. Being old and infirm, he had left the government to the management of his friends, among whom Luca Pitti was one of the most powerful, and they had ruled with disorder, corruption and cruelty. The lordship of Florence accordingly did not pass without some difficulty and danger into the hands of Piero, surnamed the Gouty, Cosimo's only surviving legitimate son. Afflicted by gout, and so terribly crippled that he was often only able to use his tongue, the new ruler soon discovered that a plot was on foot to overthrow his power. However, showing far more courage than he was supposed to possess, he had himself borne on a litter from his villa to Florence, defeated his enemies' designs, and firmly re-established his authority. But his success may be mainly attributed to the enormous prestige bequeathed by Cosimo to his posterity. Piero died at the end of five years' reign, on the 3rd of December 1469, leaving two sons, Lorenzo (1449–1492) and Giuliano (1453–1478). The younger, the gentler and less ambitious of the pair, was quickly removed from the world. Lorenzo, on the contrary, at once seized the reins of state with a firm grasp, and was, chronologically, the second of the great men bestowed upon Italy by the house of Medici. In literary talent he was immensely superior to Cosimo, but greatly his inferior in the conduct of the commercial affairs of the house. In politics he had nobler conceptions and higher ambitions, but he was more easily carried away by his passions, less prudent in his revenge, and more disposed to tyranny. He had studied letters from his earliest years under the guidance of Ficino and other leading litterati of the day. At the age of eighteen he visited the different courts of Italy. At his father's death he was only twenty-one years old, but instantly showed his determination to govern Florence with greater despotism than his father or grandfather. He speedily resorted to the system of the *balie*, and was very dexterous in causing the first to be chosen to suit his purpose. He then proceeded to humiliate the great families and exalt those of little account, and this was the policy he constantly pursued. His younger brother Giuliano, being of a mild and yielding disposition, had only a nominal share in the government.

Piero the Gouty.

Lorenzo.

Lorenzo's policy, although prosecuted with less caution, was still the old astute and fortunate policy initiated by Cosimo. But the grandson bestowed no care upon his commercial interests, although squandering his fortune with far greater lavishness. Accordingly he was sometimes driven to help himself from the public purse without ever being able to assist it as Cosimo had done. All this excited blame and enmity against him, while his greed in the matter of the alum mines of Volterra, and the subsequent sack of that unhappy city, were crimes for which there was no excuse. Among his worst enemies were the Pazzi, and, as they formed a very powerful clan, he sought their ruin by competing with them even in business transactions. They were on the point of inheriting the large property of Giovanni Borromeo when Lorenzo hurriedly caused a law to be passed that altered the right of succession. The hatred of the Pazzi was thereby exasperated to fury. And in addition to these things there ensued a desperate quarrel with Pope Sixtus IV., a man of very impetuous temper, who, on endeavouring to erect a state on the frontiers of the Florentine republic for the benefit of his nephews, found a determined and successful opponent in Lorenzo. Consequently the Pazzi and Archbishop Salviati, another enemy of Lorenzo, aided by the nephews of the pontiff, who was himself acquainted with the whole matter, determined to put an end to the family. On the 26th of April 1478, while Giuliano and Lorenzo were attending high mass in the cathedral of Florence, the former was mortally stabbed by conspirators, but the latter was able to beat back his assailants and escape into the sacristy. His life preserved, and no longer having to share the government with a brother, Lorenzo profited by the opportunity to wreak cruel vengeance upon his foes. Several of the Pazzi and their followers were hanged from the palace windows; others were hacked to pieces, dragged through the streets, and cast into the Arno, while a great many more were condemned to death or sent into exile. Lorenzo seemed willing and able to become a tyrant. But he stopped short of this point. He knew the temper of the city, and had also to look to fresh dangers threatening him from without. The pope had excommunicated him, put Florence under an interdict, and, being seconded by the Neapolitan king, made furious war against the republic. The Florentines began to tire of submitting to so many hardships in order to support the yoke of a fellow-citizen. Lorenzo's hold over Florence seemed endangered. But he rose superior to the difficulties by which he was encompassed. He boldly journeyed to Naples, to the court of King Ferdinand of Aragon, who was reputed to be as treacherous as he was cruel, and succeeded in obtaining from him an honourable peace, that soon led to a reconciliation with Sixtus. Thus at last Lorenzo found himself complete master of Florence. But, as the *balie* changed every five years, it was always requisite, in order to retain his supremacy, that he should be prepared to renew the usual manœuvre at the close of that term and have another elected equally favourable to his aims. This was often a difficult achievement, and Lorenzo showed much dexterity in overcoming all obstacles. In 1480 he compassed the institution of a new council of seventy, which was practically a permanent *balìa* with extended powers, inasmuch as it not only elected the chief magistrates, but had also the administration of numerous state affairs. This permanent council of devoted adherents once formed, his security was firmly established. By this means, the chroniclers tell us, "liberty was buried," but the chief affairs of the state were always conducted by intelligent and experienced men, who promoted the public prosperity. Florence was still called a republic; the old institutions were still preserved, if only in name. Lorenzo was absolute lord of all, and virtually a tyrant. His immorality was scandalous; he kept an army of spies; he frequently meddled in the citizens' most private affairs, and exalted men of the lowest condition to important offices of the state. Yet, as Guicciardini remarks, "if Florence was to have a tyrant, she could never have found a better or more pleasant one." In fact all industry, commerce and public works made enormous progress. The civil equality of modern states, which was quite unknown to the middle ages, was more developed in Florence than in any other city of the world. Even the condition of the peasantry was far more prosperous than elsewhere. Lorenzo's authority was not confined to Tuscany, but was also very great throughout the whole of Italy. He was on the friendliest terms with Pope Innocent VIII., from whom he obtained the exaltation of his son Giovanni to the cardinalate at the age of fourteen. This boy-cardinal was afterwards Pope Leo X. From the moment of the decease of Sixtus IV., the union of Florence and Rome became the basis of Lorenzo's foreign policy. By its means he was able to prevent the hatreds and jealousies of the Sforzas of Milan and the Aragonese of Naples from bursting into the open conflict that long threatened, and after his death actually caused, the beginning of new and irreparable calamities. Hence Lorenzo was styled the needle of the Italian compass.

But the events we have narrated cannot suffice for the full comprehension of this complex character, unless we add the record of his deeds as a patron of letters and his achievements as a writer. His palace was the school and resort of illustrious men. Within its walls were trained the two young Medici afterwards known to the world as Leo X. and Clement VII. Ficino, Poliziano, Pico della Mirandola and all members of the Platonic academy were its constant habitués. It was here that Pulci gave readings of his *Morgante*, and Michelangelo essayed the first strokes of his chisel. Lorenzo's intellectual powers were of exceptional strength and versatility. He could speak with

Lorenzo as a Man of Letters.

equal fluency on painting, sculpture, music, philosophy and poetry. But his crowning superiority over every other Maecenas known to history lay in his active participation in the intellectual labours that he promoted. Indeed at certain moments he was positively the leading spirit among the litterati of his time. He was an elegant prose writer, and was likewise a poet of real originality. At that period Italians were forsaking erudition in order to forward the revival of the national literature by recurring to the primitive sources of the spoken tongue and popular verse. It is Lorenzo's lasting glory to have been the initiator of this movement. Without being—as some have maintained—a poet of genius, he was certainly a writer of much finish and eloquence, and one of the first to raise popular poetry to the dignity of art. In his *Ambra*, his *Caccia del falcone* and his *Nencia da Barberino*, he gives descriptions of nature and of the rural life that he loved, with the graphic power of an acute and tasteful observer, joined to an ease of style that occasionally sins by excess of homeliness. Both in his art and in his politics he leant upon the people. The more oppressive his government, the more did he seek in his verses to incite the public to festivities and lull it to slumber by sensual enjoyments. In his *Ballate*, or songs for dancing, and more especially in his carnival songs, a kind of verse invented by himself, Lorenzo displayed all the best qualities and worst defects of his muse. Marvellously and spontaneously elegant, very truthful and fresh in style, fertile in fancy and rich in colour, they are often of a most revolting indecency. And these compositions of one filling a princely station in the city were often sung by their author in the public streets, in the midst of the populace.

Pietro.

Lorenzo left three sons—Pietro (1471–1503), Giovanni (1475–1521) and Giuliano (1479–1516). He was succeeded by Pietro, whose rule lasted but for two years. During this brief term he performed no good deeds, and only displayed inordinate vanity and frivolity. His conduct greatly helped to foment the hatred between Lodovico Sforza and Ferdinand of Naples, which hastened the coming of the French under Charles VIII., and the renewal of foreign invasions. No sooner did the French approach the frontiers of Tuscany than Pietro, crazed with fear, hastened to meet them, and, basely yielding to every demand, accepted terms equally humiliating to himself and the state. But, returning to Florence, he found that the enraged citizens had already decreed his deposition, in order to reconstitute the republic, and was therefore compelled to escape to Venice. His various plots to reinstate himself in Florence were all unsuccessful. At last he went to the south of Italy with the French, was drowned at the passage of the Garigliano in 1503, and was buried in the cloister of Monte Cassino.

Cardinal Giovanni (Leo X.), Giuliano, Lorenzo.

The ensuing period was adverse to the Medici, for a republican government was maintained in Florence from 1494 to 1512, and the city remained faithful to its alliance with the French, who were all-powerful in Italy. Cardinal Giovanni, the head of the family, resided in Rome, playing the patron to a circle of litterati, artists and friends, seeking to increase his popularity, and calmly waiting for better days. The battle of Ravenna wrought the downfall of the fortunes of France in Italy, and led to the rise of those of Spain, whose troops entered Florence to destroy the republic and reinstate the Medici. Pietro had now been dead for some time, leaving a young son, Lorenzo (1492–1519), who was afterwards duke of Urbino. The following year (1513) Cardinal Giovanni was elected pope, and assumed the name of Leo X. He accordingly removed to Rome, leaving his brother Giuliano with his nephew Lorenzo in Florence, and accompanied by his cousin Giulio, who was a natural son of the Giuliano murdered in the conspiracy of the Pazzi, and was soon destined to be a cardinal and ultimately a pope. Meanwhile his kinsmen in Florence continued to govern that city by means of a *balia*. And thus, being masters of the whole of central Italy, the Medici enjoyed great authority throughout the country and their ambition plumed itself for still higher flights. This was the moment when Niccolò Machiavelli, in his treatise *The Prince*, counselled them to accomplish the unity of Italy by arming the whole nation, and expelling its foreign invaders.

Leo X., who is only indirectly connected with the history of Florence, gave his name to the age in which he lived in consequence of his magnificent patronage of art and letters in Rome. But he was merely a clever amateur, and had not the literary gifts of his father Lorenzo. He surrounded himself with versifiers and inferior writers, who enlivened his board and accompanied him wherever he went. He liked to lead a gay and untroubled life, was fond of theatrical performances, satires and other intellectual diversions. His patronage of the fine arts, his genuine affection for Raphael, and the numerous works he caused to be executed by him and other artists, have served to confer an exaggerated glory on his name. He had not the remotest idea of the grave importance of the Reformation, which indeed he unconsciously promoted by his reckless and shameless sale of indulgences. The whole policy of Pope Leo X. consisted in oscillating between France and Spain, in always playing fast and loose, and deceiving both powers in turn. Yet the evil results of this contemptible policy never seemed to disturb his mind. He finally joined the side of the emperor Charles V., and in 1521, at the time of the defeat of the French by the Spanish troops on the river Adda, he ceased to breathe at his favourite villa of Magliana.

Giuliano dei Medici had died during Leo's reign, in 1516, without having ever done anything worthy of record. He was the husband of Philiberta of Savoy, was duke of Nemours, and left a natural son, Ippolito dei Medici (1511–1535), who afterwards became a cardinal. Lorenzo, being of more ambitious temper, was by no means content to remain at the head of the Florence government hampered by many restrictions imposed by republican institutions, and subject to the incessant control of the pope. In his eagerness to aggrandize his kinsmen, the latter had further decided to give Lorenzo the duchy of Urbino, and formally invested him in its rights, after expelling on false pretences its legitimate lord, Francesco Maria della Rovere. This prince, however, soon returned to Urbino, where he was joyously welcomed by his subjects, and Lorenzo regained possession only by a war of several months, in which he was wounded. In 1519 he also died, worn out by disease and excess. By his marriage with Madeleine de la Tour d'Auvergne, he had one daughter, Caterina dei Medici (1519–1589), married in 1533 to Henry, duke of Orleans, afterwards king of France. She played a long and sinister part in the history of that country. Lorenzo also left a natural son named Alessandro, inheriting the frizzled hair and projecting lips of the negro or mulatto slave who had given him birth. His miserable death will be presently related. Thus the only three surviving representatives of the chief branch of the Medici, Cardinal Giulio, Ippolito and Alessandro were all of illegitimate birth, and left no legitimate heirs.

Cardinal Giulio (Clement VII.).

Cardinal Giulio, who had laboured successfully for the reinstatement of his family in Florence in 1512, had been long attached to the person of Leo X. as his trusted factotum and companion. He had been generally regarded as the mentor of the pope, who had no liking for hard work. But in fact, his frivolity notwithstanding, Leo X. always followed his own inclinations. He had much aptitude for command, and pursued his shuffling policy without any mental anxiety. Giulio, on the contrary, shrank from all responsibility, muddled his brains in weighing the reasons for and against every possible decision, and was therefore a better tool of government in others' hands than he was fit to govern on his own account. When Giuliano and Lorenzo died, the pope appointed the cardinal to the government of Florence. In that post, restricted within the limits imposed by republican institutions, and acting under the continual direction of Rome, he performed his duties fairly well. He caressed the citizens with hopes of extended liberties, which, although never destined to be fulfilled, long served to keep men's minds in a pleasant flutter of expectation; and when the more impatient spirits attempted to raise a rebellion he speedily quenched it in blood. When, after the death of Leo X. and the very brief pontificate of Adrian VI., he was elected pope (1523) under the name of Clement VII., he entrusted the government of Florence to Cardinal Silvio Passerini conjointly with Alessandro and Ippolito, who were still too young to do much on their own account.

The pontificate of Leo X. had been a time of felicity to himself if of disaster to Italy and the Church. The reign of Clement, on the contrary, was fatal to himself as well. His policy, like that of Leo X., consisted in perpetual oscillation between France and Spain. By his endeavours to trick all the world, he frequently ended in being tricked himself. In 1525 he was the ally of the French, who then suffered a terrible defeat at Pavia, where their king Francis I. was taken prisoner. The armies of Charles V. triumphantly advanced, without Clement being able to oppose any effectual resistance. Both Rome and Florence were threatened with a fearful catastrophe.

Thus far we have had no occasion to speak of the younger branch of the Medici, descended from Lorenzo, brother to Cosimo the elder. Always in obscurity, and hitherto held in check by the elder line, it first entered the arena of history when the other was on the point of extinction. In fact the most valiant captain of the papal forces was Giovanni dei Medici, afterwards known by the name of Giovanni delle Bande Nere. His father was Giovanni, son of Pier Francesco, who was the son of Lorenzo, the brother of Cosimo dei Medici. History has little to tell of the elder Giovanni; but his wife Caterina Sforza, of whom he was the third husband, was a woman of more than masculine vigour. Giovanni dei Medici married her in 1497, but died in 1498, leaving her with one son who was christened Lodovico, but afterwards took his father's name of Giovanni (1498–1526). Trained to arms from his earliest years, this youth inherited all the energy of his mother, whose Sforza blood seemed to infuse new life into the younger branch of the Medici. Notwithstanding his extreme youth, he had already achieved the title of the best captain in Italy. He had always fought with immense dash and daring, and was devotedly loved and obeyed by his soldiery. He was the only leader who opposed a determined resistance to the imperial forces. He was seriously wounded at Pavia when fighting on the French side. On his recovery he joined the army of the League, and was much enraged by finding that the duke of Urbino, commander of the Venetian and papal forces, would never decide on attacking. When the imperial troops were struggling through the marshes of Mantua, surrounded on every side, and without stores or ammunition, Giovanni could not resign himself to inactivity like his colleagues in command. He was ignorant that the imperialists had just received supplies and artillery from the duke of Ferrara, and therefore daringly attacked them with a small body of men without taking any precautions for defence. One of the first shots fired by the enemy injured him so fatally that he died a few days after. He was married to Maria Salviati, by whom he had one son, Cosimo (1519–1574), who became the first grand duke of Tuscany, and indeed the founder of the grand duchy and the new dynasty.

Giovanni delle Bande Nere.

Meanwhile the imperial army pursued its march upon Rome, captured the Eternal City after a few hours' combat, and cruelly sacked it during many days (1527). Thanks to his perpetual shuffling and excessive avarice, the pope found himself utterly forsaken, and was obliged to seek refuge in the castle of St Angelo, whence he only effected his escape after some months. He then signed a treaty of alliance with the emperor (1529), who sent an army to besiege Florence and restore the Medici, whom the people had expelled in 1527 on the re-establishment of the republic. After an heroic defence, the city was forced to surrender (1530); and, although it was expressly stipulated that the ancient liberties of Florence should be respected, every one foresaw that the conditions would be violated. In fact, pope and emperor immediately began to dispute as to which should be the new lord of the city. Clement VII. had inherited the traditional family dislike for the younger branch of his kin, and so the choice lay between the two bastards Ippolito and Alessandro. The former being a cardinal, the latter was chosen. Alessandro, who already bore the title of duke of Città di Penna, came to Florence in 1531, and by imperial patent was nominated head of the republic. According to the terms of this patent, the former liberty enjoyed under the Medicean rule was to remain intact. But no previous ruler of the city had enjoyed hereditary power confirmed by imperial patent, and such power was incompatible with the existence of a republic. Moreover, Clement VII. showed dissatisfaction with the uncertainty of the power conferred upon his kinsman, and finally succeeded in obtaining additional privileges. On the 4th of April 1532 a parliament was convoked for the last time in Florence, and, as usual, approved every measure proposed for acceptance. Accordingly a new council was formed of two hundred citizens elected for life, forty-eight of which number were to constitute a senate. Alessandro, as duke of the republic, filled the post of gonfalonier, and carried on the government with the assistance of three senators, changed every three months, who took the place of the suppressed signory.

Duke Alessandro.

The duke's chief advisers, and the contrivers of all these arrangements were Baccio Valori, Francesco Vettori and above all Francesco Guicciardini—men, especially the latter two, of lofty political gifts and extensive influence. The mind and character of Duke Alessandro were as yet comparatively unknown. At first he seemed disposed to rule with justice and prudence. But encountering difficulties that he was unable to overcome, he began to neglect the business of the state, and acted as if the sole function of government consisted in lulling the people by festivities and corrupting it by the dissolute life of which he set the example. The question of the moment was the transformation of the old republican régime into a princedom; as an unavoidable result of this change it followed that Florence was no longer to be the ruling city to whose inhabitants alone belonged the monopoly of political office. When the leading Florentine families realized not only that the republic was destroyed, but that they were reduced to equality with those whom they had hitherto regarded as their inferiors and subjects, their rage was indescribable, and hardly a day passed without the departure of influential citizens who were resolved to achieve the overthrow of their new ruler. They found a leader in Cardinal Ippolito dei Medici, who was then in Rome, embittered by the preference given to Alessandro, and anxious to become his successor with the least possible delay. Under the pressure of terror the duke at once became a tyrant. He garrisoned the different cities, and began the erection in Florence of the Fortezza da Basso, built chiefly at the expense of Filippo Strozzi, who afterwards met his death within its walls.

Cardinal Ippolito.

In 1534 Clement VII. died, and the election fell on Paul III., from whom Cardinal Ippolito hoped to obtain assistance. Accordingly the principal Florentine exiles were despatched to Charles V. with complaints of Alessandro's tyranny and his shameless violation of the terms upon which the city had surrendered. Cardinal Ippoloto also represented his own willingness to carry on the government of Florence in a more equitable manner, and promised the emperor a large sum of money. Reply being delayed by the emperor's absence, he became so impatient that he set out to meet Charles in Tunis, but on the 10th of August 1535 died suddenly at Itri, poisoned by order of Alessandro. Such at least was the general belief, and it was confirmed by the same fate befalling other enemies of the duke about the same time. On the emperor's return from Africa, the exiles presented themselves to him in Naples, and the venerable patriot Jacopo Nardi pleaded their cause. Duke Alessandro, being cited to appear, came to Naples accompanied by Francesco Guicciardini, who by speaking in his defence rendered himself odious to all friends of liberty, and irretrievably tarnished his illustrious name. The cardinal being dead, it was hard to find a successor to Alessandro. On this account, and perhaps to some extent through the emperor's personal liking for the duke, the latter rose higher than before in the imperial favour, married Margaret of Austria, the natural daughter of Charles, and returned to Florence with increased power. And now Alessandro indulged unchecked in the lowest excesses of tyranny, and although so recently a bridegroom gave way to increased libertinism. His whole time was passed in vicious haunts and in scandalous adventures. In order to conceal the obscurity of his birth, he left his mother to starve, and it was even asserted that he finally got rid of her by poison.

Lorenzino dei Medici.

His constant associate in this disgraceful routine was his distant kinsman Lorenzo, generally known as Lorenzino dei Medici. Of the younger branch of the Medici, the latter was second cousin of the Cosimo already mentioned as the son of Giovanni delle Bande Nere. He had much culture and literary talent, but led an irregular life, sometimes acting like a madman and sometimes like a villain. He was a writer of considerable elegance, the author of several plays, one of which, the *Aridosio*, was held to be among the best of his age, and he was a worshipper of antiquity. Notwithstanding these tastes, when in Rome he knocked off the heads of some of the finest statues of the age of Adrian, an act by which Clement VII. was so incensed that he threatened to have him hanged. Thereupon Lorenzino fled to Florence, where he became the friend of Duke Alessandro, and his partner in the most licentious excesses. They went together to houses of ill-fame, and violated private dwellings and convents. They often showed themselves in public mounted on the same horse. All Florence eyed them with disgust, but no one foresaw the tragedy that was soon to take place.

Assassination of Alessandro.

On the evening of the 5th of January 1537, after a day passed in the usual excesses, Lorenzino led the duke to his own lodging, and left him there, promising shortly to return with the wife of Leonardo Ginori. Alessandro, worn out by the exertions of the day, fell asleep on the couch while awaiting Lorenzino's return. Before long the latter came accompanied by a desperado known as the Scoronconcolo, who aided him in falling on the sleeper. Roused by their first thrusts, the duke fought for his life, and was only despatched after a violent struggle. The murderers then lifted the body into a bed, hid it beneath the clothes, and, Lorenzino having attached a paper to it bearing the words *vincit amor patriae, laudumque immensa cupido*, they both fled to Venice. In that city Lorenzino was assassinated some ten years later, in 1548, at the age of thirty-two, by order of Alessandro's successor. He wrote an *Apologia*, in which he defended himself with great skill and eloquence, saying that he had been urged to the deed solely by love of liberty. For this reason alone he had followed the example of Brutus and played the part of friend and courtier. The tone of this *Apologia* is so straightforward, sometimes even so eloquent and lofty, that we should be tempted to give it credence were it possible to believe the assertions of one who not only by his crime but by the infamy of his previous and subsequent career completely gave the lie to his vaunted nobility of purpose. By Alessandro's death the elder branch of the Medici became extinct, and thus the appearance of the younger line was heralded by a bloody crime.

Cosimo I.

When the duke's absence from his own palace was discovered on the morning of the 6th of January he was at first supposed to have spent the night with one of his mistresses; but soon, some alarm being felt, search was made, and Cardinal Cybo was the first to discover the murder. Enjoining the strictest secrecy, he kept the corpse concealed for three days, and then had it interred in the sacristy of San Lorenzo. Meanwhile he had hastily summoned Alessandro Vitelli and the other captains, so that, by the time Alessandro's death was made public, the city was already filled with troops. The cardinal then convoked the council of forty-eight to decide upon a successor. Alessandro's only issue was a natural son named Giulio, aged five. The cardinal favoured his election, in the hope of keeping the real sovereignty in his own hands. But he speedily saw the impossibility of carrying out a design that was ridiculed by all. Guicciardini, Vettori and others of the leading citizens favoured the choice of Cosimo, the son of Giovanni delle Bande Nere. He was already in Florence, was aged seventeen, was keen-witted and aspiring, strong and handsome in person, heir to the enormous wealth of the Medici, and, by the terms of the imperial patent, was Alessandro's lawful successor. Charles V. approved the nomination of Cosimo, who without delay seized the reins of government with a firm grasp. Like Alessandro, he was named head of the republic; and Guicciardini and others who had worked hardest in his cause hoped to direct him and keep him under their control. But Cosimo soon proved that, his youth notwithstanding, he was resolved to rule unshackled by republican forms and unhampered by advisers disposed to act as mentors. The Florentines had now an absolute prince who was likewise a statesman of eminent ability.

On learning the death of Alessandro and the election of Cosimo, the exiles appreciated the necessity for prompt action, as delay would be fatal to the overthrow of the Medicean rule. They had received money and promises from France; they were strengthened by the adhesion of Filippo Strozzi and Baccio Valori, who had both become hostile to the Medici through the infamous conduct and mad tyranny of Alessandro; and Strozzi brought them the help of his enormous fortune and the prowess of that very distinguished captain, his son Piero. The exiles assembled their forces at Mirandola. They had about four thousand infantry and three hundred horse; among them were members of all the principal Florentine families; and their leaders were Bernardo Salviati and Piero Strozzi. They marched rapidly, and entered Tuscany towards the end of July 1537. Cosimo on this occasion displayed signal capacity and presence of mind. Informed of the exiles' movements by his spies, he no sooner learned their approach than he ordered Alessandro Vitelli to collect the best German, Spanish and Italian infantry at his disposal, and advance against the enemy without delay. On the evening of the 31st of July Vitelli marched towards Prato with seven hundred picked infantry and a band of one hundred horse, and on the way fell in with other Spanish foot soldiers who joined the expedition. At early dawn the following morning he made a sudden attack on the exiles' advanced guard close to Montemurlo, an old fortress converted into a villa belonging to the Nerli. Having utterly routed them, he proceeded to storm Montemurlo, where Filippo Strozzi and a few of his young comrades had taken refuge. They made a desperate resistance for some hours, and then, overwhelmed by superior numbers, were obliged to yield themselves prisoners. The main body of the army was still at some distance, having been detained in the mountains by heavy rains and difficult passes, and, on learning the defeat at Montemurlo, its leader turned back by the way he had come. Alessandro Vitelli re-entered Florence with his victorious army and his fettered captives. Cosimo had achieved his first triumph.

All the prisoners, who were members of great families, were brought before Cosimo, and were received by him with courteous coldness. Soon, however, a scaffold was erected in the Piazza, and on four mornings in succession four of the prisoners were beheaded. Then the duke saw fit to stay the executions. Baccio Valori, however, and his son and nephew were beheaded on the 20th of August in the courtyard of the Bargello. Filippo Strozzi still survived, confined in the Fortezza da Basso, that had been built at his expense. His family was illustrious, he had numerous adherents, and he enjoyed the protection of the French king. Nevertheless Cosimo only awaited some plausible pretext to rid himself of this dreaded enemy. He brought him to trial and had him put to the question. But this cruelty led to nothing, for Strozzi denied every accusation and bore the torture with much fortitude. On the 18th of December he was found dead in his prison, with a blood-stained sword by his side, and a slip of paper bearing these words: *exoriare aliquis nostris ex ossibus ultor*. It was believed that, having renounced all hope of his life being spared, Strozzi had preferred suicide to death at the hands of the executioner. Some, however, thought that Cosimo had caused him to be murdered, and adopted this mode of concealing the crime. The young prince's cold-blooded massacre of his captives cast an enduring shadow upon his reign and dynasty. But it was henceforward plain to all that he was a man of stern resolve, who went straight to his end without scruples or half-measures. Before long he was regarded by many as the incarnation of Machiavelli's *Prince*, "inasmuch as he joined daring to talent and prudence, was capable of great cruelty, and yet could practise mercy in due season." Guicciardini, who still pretended to act as mentor, and who on account of his many services had a certain influence over him, was obliged to withdraw from public life and busy himself with writing his *History* at his villa of Arcetri. He died in this retreat in 1540, and it was immediately rumoured that the duke had caused him to be poisoned. This shows the estimation in which Cosimo was now held. He punished with death all who dared to resist his will. By 1540 sentence of death had been pronounced against four hundred and thirty contumacious fugitives, and during his reign one hundred and forty men and six women actually ascended the scaffold, without counting those who perished in foreign lands by the daggers of his assassins. He reduced the old republican institutions to empty forms, by making the magistrates mere creatures of his will. He issued the sternest edicts against the rebels, particularly by the law known as the "Polverina," from the name of its proposer Jacopo Polverini. This law decreed not only the confiscation of the property of exiles, but likewise that of their heirs, even if personally acquired by the latter. Cosimo ruled like the independent sovereign of a great state, and always showed the capacity, firmness and courage demanded by that station. Only, his state being small and weak, he was forced to rely chiefly upon his personal talent and wealth. It was necessary for him to make heavy loans to the different European sovereigns, especially to Charles V., the most rapacious of them all, and to give enormous bribes to their ambassadors. Besides, he had to carry on wars for the extension of his dominions; and neither his inherited wealth nor the large sums gained by confiscating the estates of rebellious subjects sufficed for all this outlay. He was accordingly compelled to burden the people with taxes, and thus begin at once to diminish its strength.

Lucca and Siena seized.

Cosimo bore a special grudge against the neighbouring republics of Siena and Lucca. Although the latter was small and weak, and the former garrisoned by Spaniards, yet the spectacle of free institutions at the frontiers of his own state served as a continual incitement to subjects disaffected to the new régime. In fact Francesco Burlamacchi, a zealous Lucchese patriot, had conceived the design of re-establishing republican government in all the cities of Tuscany. Cosimo, with the emperor's help, succeeded in having him put to death. Lucca, however, was an insignificant state making no pretence of rivalry, whereas Siena was an old and formidable foe to Florence, and had always given protection to the Florentine exiles. It was now very reluctantly submitting to the presence of a Spanish garrison, and, being stimulated by promises of prompt and efficacious assistance from France, rose in rebellion and expelled the Spaniards in 1552. Cosimo instantly wrote to the emperor in terms that appealed to his pride, asked leave to attack Siena, and begged for troops to ensure the success of his enterprise. As no immediate answer arrived, he feigned to begin negotiations with Henry II. of France, and, by thus arousing the imperial jealousy, obtained a contingent of German and Spanish infantry. Siena was besieged for fifteen months, and its inhabitants, aided by the valour of Piero Strozzi, who fought under the French flag, made a most heroic resistance, even women and children helping on the walls. But fortune was against them. Piero Strozzi sustained several defeats, and finally the Sienese, having exhausted their ammunition and being decimated by famine and the sword, were obliged to capitulate on honourable terms that were shamelessly violated. By the varied disasters of the siege and the number of fugitives the population was reduced from forty to eight thousand inhabitants. The republicans, still eager to resist, withdrew to Montalcino. Cosimo now ruled the city and territory of Siena in the name of Charles V., who always refused him its absolute possession. After the emperor's abdication, and the succession of Philip II. to the Spanish throne, Cosimo at last obtained Siena and Porto Ferraio by giving up his claim to a sum of 200,000 ducats that he was to have received from Charles V.

Grand-Duchy of Tuscany formed.

In 1559 Cosimo also captured Montalcino, and thus formed the grand-duchy of Tuscany, but he continued to govern the new state—*i.e.* Siena and its territories—separately from the old. His rule was intelligent, skilful and despotic; but his enormous expenses drove him to raise large sums of money by special contrivances unsuited to the country and the people. Hence, notwithstanding the genius of its founder, the grand-duchy held from the first the elements of its future decay. Cosimo preferred to confer office upon men of humble origin in order to have pliable tools, but he also liked to be surrounded by a courtier aristocracy on the Spanish and French pattern. As no Tuscan aristocracy any longer existed, he created new nobles, and tempted foreign ones to come by the concession of various feudal privileges; and, to turn this artificial aristocracy to some account, he founded the knightly order of St Stephen, charged with the defence of the coast against pirates, which in course of time won much honour by its prowess. He also established a small standing army for the protection of his frontiers; but he generally employed German and Spanish troops for his wars, and always had a foreign bodyguard. At the commencement of his reign he opposed the popes in order to maintain the independence of his own state; but later, to obtain help, he truckled to them in many ways, even to the extent of giving up to the Inquisition his own confidant, Piero Carnesecchi, who, being accused of heresy, was beheaded and burnt in 1567. In reward for these acts of submission, the popes showed him friendship, and Pius V. granted him the title of grand-duke, conferring the patent and crown upon him in Rome, although the emperor had always withheld his consent. The measure most injurious to Tuscany was the fiscal system of taxes, of which the sole aim was to extort the greatest possible amount of money. The consequent damage to industry, commerce and agriculture was immense, and, added to the devastations caused by the Sienese War, led to their utter ruin. Otherwise Cosimo did not neglect useful measures for the interior prosperity of his state. He was no Maecenas; nevertheless he restored the Pisan university, enlarged that of Siena, had the public records classified, and also executed public works like the Santa Trinità bridge. During the great inundations of 1557 he turned his whole energy to the relief of the sufferers.

In 1539 he had espoused Eleonora of Toledo, daughter of the viceroy of Naples, by whom he had several children. Two died in 1562, and their mother soon followed them to the grave. It was said that one of these boys, Don Garcia, had murdered the other, and then been killed by the enraged father. Indeed, Cosimo was further accused of having put his own wife to death: but neither rumour had any foundation. He now showed signs of illness and failure of strength. He was not old, but worn by the cares of state and self-indulgence. Accordingly in 1564 he resigned the government to his eldest son, who was to act as his lieutenant, since he wished to have power to resume the sceptre on any emergency. In 1570, by the advice of Pope Pius V., he married Camilla Martelli, a young lady of whom he had been long enamoured. In 1574 he died, at the age of fifty-four years and ten months, after a reign of thirty-seven years, leaving three sons and one daughter besides natural children. These sons were Francesco, his successor, who was already at the head of the government, Cardinal Ferdinand, and Piero.

Francesco I.

Francesco I., born in 1541, began to govern as his father's lieutenant in 1564, and was married in 1565 to the archduchess Giovanna of Austria. On beginning to reign on his own account in 1574, he speedily manifested his real character. His training in the hands of a Spanish mother had made him suspicious, false and despotic. Holding every one aloof, he carried on the government with the assistance of a few devoted ministers. He compelled his step-mother to retire to a convent, and kept his brothers at a distance from Florence. He loved the privileges of power without its burdens. Cosimo had known how to maintain his independence, but Francesco cast himself like a vassal at Austria's feet. He reaped his reward by obtaining from Maximilian II. the title of grand-duke, for which Cosimo had never been able to win the imperial sanction, but he forfeited all independence. Towards Philip II. he showed even greater submissiveness, supplying him with large sums of money wrung from his overtaxed people. He held entirely aloof from France, in order not to awake the suspicions of his protectors. He traded on his own account, thus creating a monopoly that was ruinous to the country. He raised the tax upon corn to so high a rate that few continued to find any profit in growing it, and thus the Maremme, already partly devastated during the war with Siena, were converted into a desert. Even industry declined under this system of government; and, although Francesco founded porcelain manufactories and pietra dura works, they did not rise to any prosperity until after his death. His love of science and letters was the only Medicean virtue that he possessed. He had an absolute passion for chemistry, and passed much of his time in his laboratory. Sometimes indeed he gave audience to his secretaries of state standing before a furnace, bellows in hand. He took some useful measures to promote the rise of a new city at Leghorn, which at that time had only a natural and ill-sheltered harbour. The improvement of Leghorn had been first projected by Cosimo I., and was carried on by all the succeeding Medici. Francesco was a slave to his passions, and was led by them to scandalous excesses and deeds of bloodshed. His example and neglect of the affairs of the state soon caused a vast increase of crime even among the people, and, during the first eighteen months of his reign, there occurred no fewer than one hundred and sixty-eight murders.

In default of public events, the historians of this period enlarge upon private incidents, generally of a scandalous or sanguinary kind. In 1575 Orazio Pucci, wishing to avenge his father, whom Cosimo had hanged, determined to get up a conspiracy, but, soon recognizing how firmly the Medicean rule had taken root in the country, desisted from the attempt. But the grand-duke, on hearing of the already abandoned plot, immediately caused Pucci to be hanged from the same window of the Palazzo Vecchio, and even from the same iron stanchion, from which his father before him had hung. His companions, who had fled to France and England, were pursued and murdered by the ducal emissaries. Their possessions were confiscated, and the "Polverina" law applied, so that the conspirators' heirs were reduced to penury, and the grand-duke gained more than 300,000 ducats.

Next year Isabella dei Medici, Francesco's sister, was strangled in her nuptial bed by her husband, Paolo Giordano Orsini, whom she had betrayed. Piero dei Medici, Francesco's brother, murdered his wife Eleonora of Toledo from the same motive. Still louder scandal was caused by the duke's own conduct. He was already a married man, when, passing one day through the Piazza of St Mark in Florence, he saw an exceedingly beautiful woman at the window of a mean dwelling, and at once conceived a passion for her. She was the famous Bianca Cappello, a Venetian of noble birth, who had eloped with a young Florentine named Pietro Buonaventuri, to whom she was married at the time that she attracted the duke's gaze. He made her acquaintance, and, in order to see her frequently, nominated her husband to a post at court. Upon this, Buonaventuri behaved with so much insolence, even to the nobility, that one evening he was found murdered in the street. Thus the grand-duke, who was thought to have sanctioned the crime, was able to indulge his passion unchecked. On the death of the grand-duchess in 1578 he was privately united to Bianca, and afterwards married her publicly. But she had no children, and this served to poison her happiness, since the next in succession was her bitter enemy, the cardinal Ferdinand. The latter came to Florence in 1587, and was ostentatiously welcomed by Bianca, who was most anxious to conciliate him. On the 18th of October of the same year the grand-duke died at his villa of Poggio a Caiano, of a fever caught on a shooting excursion in the Maremme, and the next day Bianca also expired, having ruined her health by drugs taken to cure her sterility. But rumour asserted that she had prepared a poisoned tart for the cardinal, and that, when he suspiciously insisted on the grand-duke tasting it first, Bianca desperately swallowed a slice and followed her husband to the tomb.

Such was the life of Francesco dei Medici, and all that can be said in his praise is that he gave liberal encouragement to a few artists, including de Giovanni Bologna (*q.v.*). He was the founder of the Uffizi gallery, of the Medici theatre, and the villa of Pratolino; and during his reign the Della Cruscan academy was instituted.

Ferdinand I.

Ferdinand I. was thirty-eight years of age when, in 1587, he succeeded his brother on the throne. A cardinal from the age of fourteen, he had never taken holy orders. He showed much tact and experience in the management of ecclesiastical affairs. He was the founder of the Villa Medici at Rome, and the purchaser of many priceless works of art, such as the Niobe group and many other statues afterwards transported by him to Florence. After his accession he retained the cardinal's purple until the time of his marriage. He was in all respects his brother's opposite. Affable in his manners and generous with his purse, he chose a crest typical of the proposed mildness of his rule—a swarm of bees with the motto *Majestate tantum.* He instantly pardoned all who had opposed him, and left his kinsmen at liberty to choose their own place of residence. Occasionally, for political reasons, he committed acts unworthy of his character; but he re-established the administration of justice, and sedulously attended to the business of the state and the welfare of his subjects. Accordingly Tuscany revived under his rule and regained the independence and political dignity that his brother had sacrificed to love of ease and personal indulgence. He favoured commerce, and effectually ensured the prosperity of Leghorn, by an edict enjoining toleration towards Jews and heretics, which led to the settlement of many foreigners in that city. He also improved the harbour and facilitated communication with Pisa by means of the Naviglio, a canal into which a portion of the water of the Arno was turned. He nevertheless retained the reprehensible custom of trading on his own account, keeping banks in many cities of Europe. He successfully accomplished the draining of the Val di Chiana, cultivated the plains of Pisa, Fucecchio and Val di Nievole, and executed other works of public utility at Siena and Pisa. But his best energies were devoted to the foreign policy by which he sought to emancipate himself from subjection to Spain. On the assassination (1589) of Henry III. of France Ferdinand supported the claims of the king of Navarre, undeterred by the opposition of Spain and the Catholic League, who were dismayed by the prospect of a Huguenot succeeding to the throne of France. He lent money to Henry IV., and strongly urged his conversion to Catholicism; he helped to persuade the pope to accept Henry's abjuration, and pursued this policy with marvellous persistence until his efforts were crowned with success. Henry IV. showed faint gratitude for the benefits conferred upon him, and paid no attention to the expostulations of the grand-duke, who then began to slacken his relations with France, and showed that he could guard his independence by other alliances. He gave liberal assistance to Philip III. for the campaign in Algiers, and to the emperor for the war with the Turks. Hence he was compelled to burden his subjects with enormous taxes, forgetting that while guaranteeing the independence of Tuscany by his loans to foreign powers he was increasingly sapping the strength of future generations. He at last succeeded in obtaining the formal investiture of Siena, which Spain had always considered a fief of her own.

During this grand-duke's reign the Tuscan navy was notably increased, and did itself much honour on the Mediterranean. The war-galleys of the knights of St Stephen were despatched to the coast of Barbary to attack Bona, the headquarters of the corsairs, and they captured the town with much dash and bravery. In the following year (1608) the same galleys achieved their most brilliant victory in the archipelago over the stronger fleet of the Turks, by taking nine of their vessels, seven hundred prisoners, and jewels of the value of 2,000,000 ducats.

Cosimo II.

Ferdinand I. died in 1609, leaving four sons, of whom the eldest, Cosimo II., succeeded to the throne at the age of nineteen. He was at first assisted in the government by his mother and a council of regency. He had a good disposition, and the fortune to reign during a period when Europe was at peace and Tuscany blessed with abundant harvests. Of his rule there is little to relate. His chief care was given to the galleys of St Stephen, and he sent them to assist the Druses against the Porte. On one occasion he was involved in a quarrel with France. Concino Concini, the Marshal d'Ancre, being assassinated in 1617, Louis XIII. claimed the right of transferring the property of the murdered man to De Luynes. Cosimo, refusing to recognize the confiscation decreed by the French tribunals, demanded that Concini's son should be allowed to inherit. Hence followed much ill-feeling and mutual reprisals between the two countries, finally brought to an end by the intervention of the duke of Lorraine.

Like his predecessors, Cosimo II. studied to promote the prosperity of Leghorn, and he deserves honour for abandoning all commerce on his own account. But it was no praiseworthy act to pass a law depriving women of almost all rights of inheritance. By this means many daughters of the nobility were driven into convents against their will. He gave scanty attention to the general affairs of the state. He was fond of luxury, spent freely on public festivities and detested trouble. Tuscany was apparently tranquil and prosperous; but the decay of which the seeds were sown under Cosimo I. and Ferdinand I. was rapidly spreading, and became before long patent to all and beyond all hope of remedy. The best deed done by Cosimo II. was the protection accorded by him to Galileo Galilei, who had removed to Padua, and there made some of his grandest discoveries. The grand duke recalled him to Florence in 1610, and nominated him court mathematician and philosopher. Cosimo died in February 1621. Feeling his end draw near, when he was only aged thirty and all his sons were still in their childhood, he hastened to arrange his family affairs. His mother, Cristina of Lorraine, and his wife, Maddalena of Austria, were nominated regents and guardians to his eldest son Ferdinand II., a boy of ten, and a council of four appointed, whose functions were regulated by law. After Cosimo's death, the young Ferdinand was sent to Rome and Vienna to complete his education, and the government of Tuscany remained in the hands of two jealous and quarrelsome women. Thus the administration of justice and finance speedily went to ruin. Out of submissiveness to the pope, the regents did not dare to maintain their legitimate right to inherit the duchy of Urbino. They conferred exaggerated privileges on the new Tuscan nobility, which became increasingly insolent and worthless. They resumed the practice of trading on their own account, and, without reaping much benefit thereby, did the utmost damage to private enterprise.

Ferdinand II.

In 1627 Ferdinand II., then aged seventeen, returned to Italy and assumed the reins of government; but, being of a very gentle disposition, he decided on sharing his power with the regents and his brothers, and arranged matters in such wise that each was almost independent of the other. He gained the love of his subjects by his great goodness; and, when Florence and Tuscany were ravaged by the plague in 1630, he showed admirable courage and carried out many useful measures. But he was totally incapable of energy as a statesman. When the pope made bitter complaints because the board of health had dared to subject certain monks and priests to the necessary quarantine, the grand-duke insisted on his officers asking pardon on their knees for having done their duty. On the death in 1631 of the last duke of Urbino, the pope was allowed to seize the duchy without the slighest opposition on the part of Tuscany. As a natural consequence the pretensions of the Roman curia became increasingly exorbitant; ecclesiastics usurped the functions of the state; and the ancient laws of the republic, together with the regulations decreed by Cosimo I. as a check upon similar abuses, were allowed to become obsolete. On the extinction of the line of the Gonzagas at Mantua in 1627, war broke out between France on the one side and Spain, Germany and Savoy on the other. The grand duke, uncertain of his policy, trimmed his sails according to events. Fortunately peace was re-established in 1631. Mantua and Monferrato fell to the duke of Nevers, as France had always desired. But Europe was again in arms for the Thirty Years' War, and Italy was not at peace. Urban VIII. wished to aggrandize his nephews, the Barberini, by wresting Castro and Ronciglione from Odoardo Farnese, duke of Parma and brother-in-law to Ferdinand. Farnese marched his army through Tuscany into the territories of the pope, who was greatly alarmed by the attack. The grand-duke was drawn into the war to defend his own state and his kinsman. His military operations, however, were of the feeblest and often the most laughable character. At last, by means of the French intervention, peace was made in 1644. But, although the pope was forced to yield, he resigned none of his ecclesiastical pretensions in Tuscany. It was during Ferdinand's reign that the septuagenarian Galileo was obliged to appear before the Inquisition in Rome, which treated him with infamous cruelty. On the death of this great and unfortunate man, the grand-duke wished to erect a monument to him, but was withheld by fear of the opposition of the clergy. The dynasty as well as the country now seemed on the brink of decay. Two of the grand-duke's brothers had already died childless, and Ippolito, the sole survivor, was a cardinal. The only remaining heir was his son Cosimo, born in 1642.

Like nearly all his predecessors, Ferdinand II. gave liberal patronage to science and letters, greatly aided therein by his brother Leopold, who had been trained by Galileo Galilei, and who joined with men of learning in founding the celebrated academy *Del Cimento*, of which he was named president. This academy took for its motto the words *Provando e riprovando*, and followed the experimental method of Galileo. Formed in 1657, it was dissolved in 1667 in consequence of the jealousies and dissensions of its members, but during its brief existence won renown by the number and importance of its works.

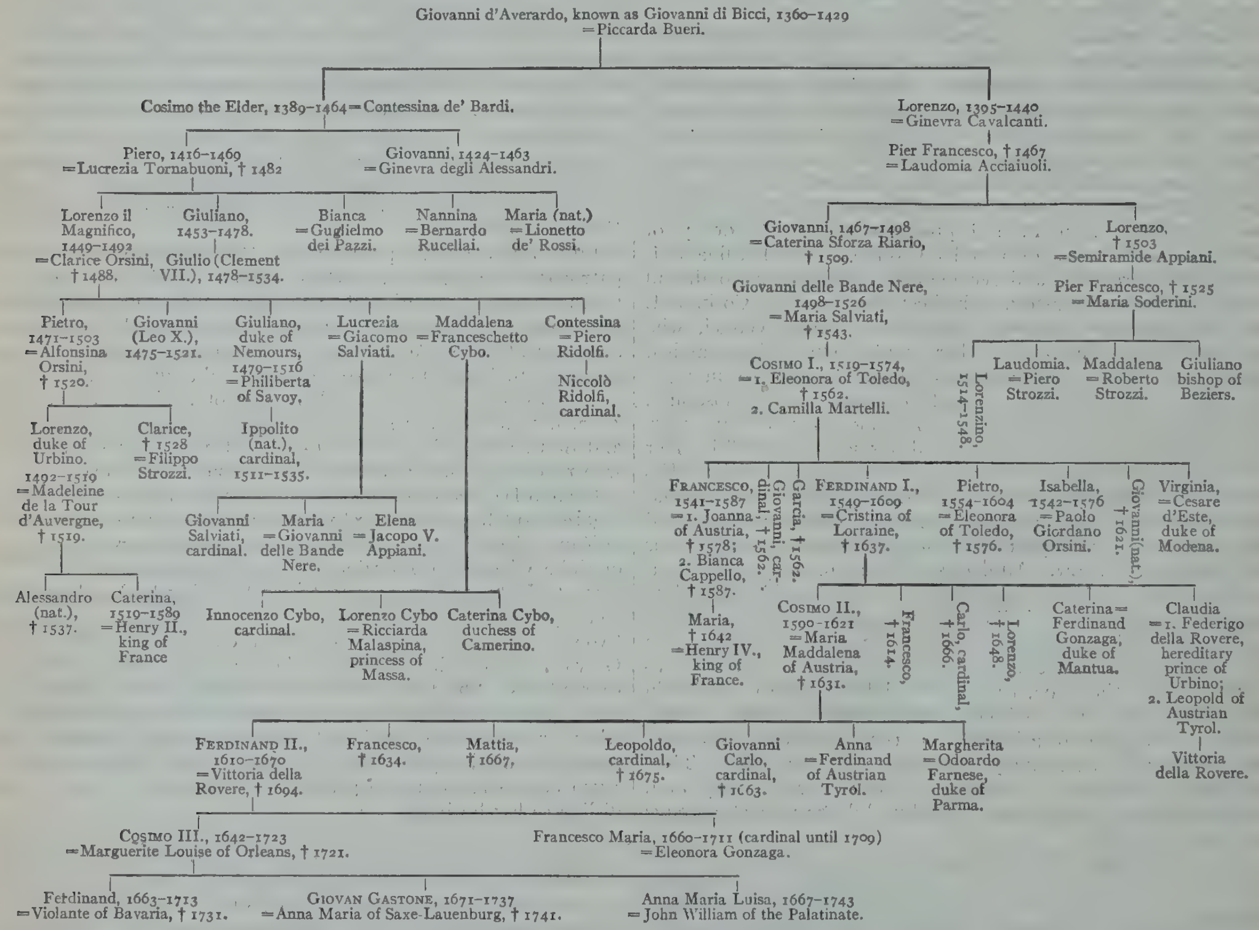
Cosimo III.

Cosimo III. succeeded his father in 1670. He was weak, vain, bigoted and hypocritical. In 1661 he had espoused Louise of Orléans, niece of Louis XIV., who, being enamoured of duke Charles of Lorraine, was very reluctant to come to Italy, and speedily detested both her husband and his country, of which she refused to learn the language. She had two sons and one daughter, but after the birth of her third child, Giovan Gastone, her hatred for her husband increased almost to madness. She first withdrew to Poggio a Caiano, and then, being unable to get her marriage annulled, returned to France, where, although supposed to live in conventual seclusion, she passed the greater part of her time as a welcome visitor at court. Even her testamentary dispositions attested the violence of her dislike to her husband.

Cosimo's hypocritical zeal for religion compelled his subjects to multiply services and processions that greatly infringed upon their working hours. He wasted enormous sums in pensioning converts—even those from other countries—and in giving rich endowments to sanctuaries. Meanwhile funds often failed for the payment of government clerks and soldiers. His court was composed of bigots and parasites; he ransacked the world for dainties for his table, adorned his palace with costly foreign hangings, had foreign servants, and filled his gardens with exotic plants. He purchased from the emperor the title of "Highness" in order to be the equal of the duke of Savoy. He remained neutral during the Franco-Spanish War, and submitted to every humiliation and requisition exacted by the emperor. He had vague notions of promoting agriculture, but accomplished no results. At one time he caused eight hundred families to be brought over from the Morea for the cultivation of the Maremme, where all of them died of fever. But when, after the revocation of the Edict of Nantes, French Huguenots offered to apply their labour and capital to the same purpose, the grand duke's religious scruples refused them refuge. So ruin fell upon Tuscany. Crime and misery increased, and the poor, who only asked for work, were given alms and sent oftener to church. This period witnessed the rise of many charitable institutions of a religious character under the patronage of the grand-duke, as for instance the congregation of San Giovanni Battista. But these could not remedy the general decay.

Cosimo's dominant anxiety regarded the succession to the throne. His eldest son Ferdinand died childless in 1713. The pleasure-loving Giovan Gastone was married to Anna Maria of Saxe-Lauenburg, widow of a German prince, a wealthy, coarse woman wholly immersed in domestic occupations. After living with her for some time in a Bohemian village, Giovan Gastone yielded to his dislike to his wife and her country, withdrew to France, and ruined his health by his excesses. After a brief return to Bohemia he finally separated from his wife, by whom he had no family. Thus the dynasty was doomed to extinction.

GENEALOGICAL TABLE OF THE MEDICI


Giovanni d'Averardo, known as Giovanni di Bicci, 1360–1429 =Piccarda Bueri.
Cosimo the Elder, 1389–1464=Contessina de' Bardi.
Lorenzo, 1395–1440 =Ginevra Cavalcanti.
Piero, 1416–1469 =Lucrezia Tornabuoni, † 1482
Giovanni, 1424–1463 =Ginevra degli Alessandri.
Pier Francesco, † 1467 =Laudomia Acciaiuoli.
Lorenzo il Magnifico, 1449–1492 =Clarice Orsini, † 1488.
Giuliano, 1453–1478.
Giulio (Clement VII.), 1478–1534.
Bianca =Guglielmo dei Pazzi.
Nannina =Bernardo Rucellai.
Maria (nat.) =Lionetto de' Rossi.
Giovanni, 1467–1498 =Caterina Sforza Riario, † 1509.
Lorenzo, † 1503 =Semiramide Appiani.
Giovanni delle Bande Nere, 1498–1526 =Maria Salviati, † 1543.
Pier Francesco, † 1525 =Maria Soderini.
Pietro, 1471–1503 =Alfonsina Orsini, † 1520.
Giovanni (Leo X.), 1475–1521.
Giuliano, duke of Nemours, 1479–1516 =Philiberta of Savoy.
Lucrezia =Giacomo Salviati.
Maddalena =Franceschetto Cybo.
Contessina =Piero Ridolfi.
Niccolò Ridolfi, cardinal.
Cosimo I., 1519–1574, =1. Eleonora of Toledo, † 1562. 2. Camilla Martelli.
Lorenzino, 1514–1548.
Laudomia. =Piero Strozzi.
Maddalena =Roberto Strozzi.
Giuliano bishop of Beziers.
Lorenzo, duke of Urbino. 1492–1519 =Madeleine de la Tour d'Auvergne, † 1519.
Clarice, † 1528 =Filippo Strozzi.
Ippolito (nat.), cardinal, 1511–1535.
Giovanni Salviati, cardinal.
Maria =Giovanni delle Bande Nere.
Elena =Jacopo V. Appiani.
Francesco, 1541–1587 =1. Joanna of Austria, † 1578; 2. Bianca Cappello, † 1587.
Giovanni, cardinal, † 1562.
Garcia, † 1562.
Ferdinand I., 1549–1609 =Cristina of Lorraine, † 1637.
Pietro, 1554–1604 =Eleonora of Toledo, † 1576.
Isabella, 1542–1576 =Paolo Giordano Orsini.
Giovanni (nat.), † 1621.
Virginia, =Cesare d'Este, duke of Modena.
Alessandro (nat.), † 1537.
Caterina, 1519–1589 =Henry II., king of France
Innocenzo Cybo, cardinal.
Lorenzo Cybo =Ricciarda Malaspina, princess of Massa.
Caterina Cybo, duchess of Camerino.
Maria, † 1642 =Henry IV., king of France.
Cosimo II., 1590–1621 =Maria Maddalena of Austria, † 1631.
Francesco, † 1614.
Carlo, cardinal, † 1666.
Lorenzo, † 1648.
Caterina=Ferdinand Gonzaga, duke of Mantua.
Claudia =1. Federigo della Rovere, hereditary prince of Urbino; 2. Leopold of Austrian Tyrol.
Ferdinand II., 1610–1670 =Vittoria della Rovere, † 1694.
Francesco, † 1634.
Mattia, † 1667,
Leopoldo, cardinal, † 1675.
Giovanni Carlo, cardinal, † 1663.
Anna =Ferdinand of Austrian Tyrol.
Margherita =Odoardo Farnese, duke of Parma.
Vittoria della Rovere.
Cosimo III., 1642–1723 =Marguerite Louise of Orleans, † 1721.
Francesco Maria, 1660–1711 (cardinal until 1709) =Eleonora Gonzaga.
Ferdinand, 1663–1713 =Violante of Bavaria, † 1731.
Giovan Gastone, 1671–1737 =Anna Maria of Saxe-Lauenburg, † 1741.
Anna Maria Luisa, 1667–1743 =John William of the Palatinate.

Cosimo had a passing idea of reconstituting the Florentine republic, but, this design being discountenanced by the European powers, he determined to transfer the succession, after the death of Giovan Gastone, to his sister Anna Maria Louisa, who in fact survived him. For this purpose he proposed to annul the patent of Charles V., but the powers objected to this arrangement also, and by the treaty of 1718 the quadruple alliance of Germany, France, England and Holland decided that Parma and Tuscany should descend to the Spanish Infante Don Carlos. The grand-duke made energetic but fruitless protests.

Giovan Gastone.

Cosimo III. had passed his eightieth year at the time of his decease in October 1723, and was succeeded by his son Giovan Gastone, then aged fifty-three. The new sovereign was in bad health, worn out by dissipation, and had neither ambition nor aptitude for rule. His throne was already at the disposal of foreign powers, and his only thought on ascending it was to regain strength enough to pass the remainder of his days in enjoyment. He dismissed the spies, parasites and bigots that had formed his father's court, abolished the pensions given to converts, suppressed several taxes, and prohibited the organized espionage established in the family circle. He wished to live and let live, and liked the people to be amused. Everything in fact bore a freer and gayer aspect under his reign, and the Tuscans seemed to feel renewed attachment for the dynasty as the moment of its extinction drew near. But the grand-duke was too feeble and incapable to accomplish any real improvement. Surrounded by gay and dissipated young men, he entrusted all the cares of government to a certain Giuliano Dami, who drove a profitable trade by the sale of offices and privileges. In this way all things were in the hands of corrupt individuals; while the grand-duke, compelled to pass the greater part of his time in bed, vainly sought diversion in the company of buffoons, and was only tormented by perceiving that all the world disposed of his throne without even asking his advice. And when, after prolonged opposition, he had resigned himself to accept Don Carlos as his successor, the latter led a Spanish army to the conquest of Naples, an event afterwards leading to the peace of 1735, by which the Tuscan succession was transferred to Francesco II., duke of Lorraine, and husband of Maria Theresa. Giovan Gastone was finally obliged to submit even to this. Spain withdrew her garrisons from Tuscany, and Austrian soldiers took their place and swore fealty to the grand-duke on the 5th of February 1737. He expired on the 9th of July of the same year. Such was the end of the younger branch of the Medici, which had found Tuscany a prosperous country, where art, letters, commerce, industry and agriculture flourished, and left her poor and decayed in all ways, drained by taxation, and oppressed by laws contrary to every principle of sound economy, downtrodden by the clergy, and burdened by a weak and vicious aristocracy.

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MEDICI, GIACOMO (1817–1882), Italian patriot and soldier, was born at Milan in January 1817. Exiled in 1836, he fought in Spain against the Carlists between 1836 and 1840, and in 1846 joined Garibaldi at Montevideo. Returning to Italy with Garibaldi in 1848, he raised a company of volunteers to fight against Austria, and commanded the volunteer vanguard in Lombardy, proceeding thence to Rome, where he gained distinction by defending the "Vascello," a position near the Porta San Pancrazio, against the French. During the siege of Rome he himself was wounded. In the war of 1859 he commanded a volunteer regiment, and was sent by Cavour into Tirol. In 1860 he tried in vain to dissuade Garibaldi from the Marsala expedition, but, after his chief's departure, he sailed for Sicily with the second expedition, taking part in the whole campaign, during which he forced Messina to capitulate after an eight days' siege. Joining the regular army, he was appointed military commandant of Palermo, in which capacity he facilitated the abortive campaign of Garibaldi in 1862. In 1866 he commanded the division which invaded Tirol, but the effect of his victories was neutralized by the conclusion of peace. Returning to Palermo he did good work in restoring order in Sicily. He became a senator in 1870, and marquis of the "Vascello" and first aide-de-camp to the king in 1876. He died on the 9th of March 1882.

MEDICINE.—The science of medicine, as we understand it, has for its province the treatment of disease. The word "medicine" (Lat. *medicina:* sc. *ars*, art of healing, from *mederi*, to heal) may be used very widely, to include *Pathology* (*q.v.*), the theory of the causation of disease, or, very narrowly, to mean only the drug or form of remedy prescribed by the physician—this being more properly the subject of *Therapeutics* (*q.v.*) and *Pharmacology* (*q.v.*). But it is necessary in practice, for historical comprehensiveness, to keep the wider meaning in view.

Disease (see PATHOLOGY) is the correlative of health, and the word is not capable of a more penetrating definition. From the time of Galen, however, it has been usual to speak of the life of the body either as proceeding in accordance with nature (*κατὰ φύσιν*, *secundum naturam*) or as overstepping the bounds of nature (*παρὰ φύσιν*, *praeter naturam*). Taking disease to be a deflexion from the line of health, the first requisite of medicine is an extensive and intimate acquaintance with the norm of the body. The structure and functions of the body form the subject of *Anatomy* (*q.v.*) and *Physiology* (*q.v.*).

The medical art (*ars medendi*) divides itself into departments and subdepartments. The most fundamental division is into internal and external medicine, or into medicine proper and surgery (*q.v.*). The treatment of wounds, injuries and deformities, with operative interference in general, is the special department of surgical practice (the corresponding parts of pathology, including inflammation, repair, and removable tumours, are sometimes grouped together as surgical pathology); and where the work of the profession is highly subdivided, surgery becomes the exclusive province of the surgeon, while internal medicine remains to the physician. A third great department of practice is formed by obstetric medicine or midwifery (see OBSTETRICS); and dentistry (*q.v.*), or dental surgery, is given up to a distinct branch of the profession.

A state of war, actual or contingent, gives occasion to special developments of medical and surgical practice (military hygiene and military surgery). Wounds caused by projectiles, sabres, &c., are the special subject of naval and military surgery; while under the head of military hygiene we may include the general subject of ambulances, the sanitary arrangements of camps, and the various forms of epidemic camp sickness.

The administration of the civil and criminal law involves frequent relations with medicine, and the professional subjects most likely to arise in that connexion, together with a summary of *causes célèbres*, are formed into the department of MEDICAL JURISPRUDENCE (*q.v.*).

In preserving the public health, the medical profession is again brought into direct relation with the state, through the public medical officers.

HISTORY OF MEDICINE

Medicine as Portrayed in the Homeric Poems.—In the state of society pictured by Homer it is clear that medicine has already had a history. We find a distinct and organized profession; we find a system of treatment, especially in regard to injuries, which it must have been the work of long experience to frame; we meet with a nomenclature of parts of the body substantially the same (according to Daremberg) as that employed long afterwards in the writings of Hippocrates; in short, we find a science and an organization which, however imperfect as compared with those of later times, are yet very far from being in their beginning. The Homeric heroes themselves are represented as having considerable skill in surgery, and as able to attend to ordinary wounds and injuries, but there is also a professional class, represented by Machaon and Podalirius, the two sons of Asclepius, who are treated with great respect. It would appear, too, from the *Aethiopis* of Archinus (quoted by Welcker and Häser) that the duties of these two were not precisely the same. Machaon's task was more especially to heal injuries, while Podalirius had received from his father the gift of "recognizing what was not visible to the eye, and tending what could not be healed." In other words, a rough indication is seen of the separation of medicine and surgery. Asclepius appears in Homer as a Thessalian king, not as a god, though in later times divine honours were paid to him. There is no sign in the Homeric poems of the subordination of medicine to religion which is seen in ancient Egypt and India, nor are priests charged, as they were in those countries, with medical functions—all circumstances which throw grave doubts on the commonly received opinion that medicine derived its origin in all countries from religious observances.

Although the actual organization of medicine among the Homeric Greeks was thus quite distinct from religion, the worship of Asclepius (or Aesculapius) as the god of healing demands some notice. This cult spread very widely among the Greeks; it had great civil importance, and lasted even into Christian times; but there is no reason to attribute to it any special connexion with the development of the science or profession of medicine. Sick persons repaired, or were conveyed, to the temples of Asclepius in order to be healed, just as in modern times relief is sought by a devotional pilgrimage or from the waters of some sacred spring, and then as now the healing influence was sometimes sought by deputy. The sick person, or his representative, after ablution, prayer and sacrifice, was made to sleep on the hide of the sacrificed animal, or at the feet of the statue of the god, while sacred rites were performed. In his sleep (incubatio, ἐγκοίμησις) the appropriate remedy was indicated by a dream. Moral or dietetic remedies were more often prescribed than drugs. The record of the cure was inscribed on the columns or walls of the temple; and it has been thought that in this way was introduced the custom of "recording cases," and that the physicians of the Hippocratic school thus learnt to accumulate clinical experience. But the priests of Asclepius were not physicians. Although the latter were often called Asclepiads, this was in the first place to indicate their real or supposed descent from Asclepius, and in the second place as a complimentary title. No medical writing of antiquity speaks of the worship of Asclepius in such a way as to imply any connexion with the ordinary art of healing. The two systems appear to have existed side by side, but to have been distinct, and if they were ever united it must have been before the times of which we have any record. The theory of a development of Greek medicine from the rites of Asclepius, though defended by eminent names, must accordingly be rejected.

Development of Medicine in Greece.—It is only from non-medical writers that anything is known of the development of medicine in Greece before the age of Hippocrates. The elaborate collections made by Daremberg of medical notices in the poets and historians illustrate the relations of the profession to society, but do little to prepare us for the Hippocratic period. Nor is much importance to be attached to the influence of the philosophical sects on medicine except as regards the school of Pythagoras. That philosopher and several of his successors were physicians, but we do not know in what relation they stood to later medical schools. We must therefore hasten onward to the age of Pericles, in which Hippocrates, already called "the Great," was in medicine as complete a representative of the highest efforts of the Greek intellect as were his contemporaries the great philosophers, orators and tragedians. The medical art as we now practise it, the character of the physician as we now understand it, both date for us from Hippocrates. The justification of this statement is found in the literary collection of writings known by his name. Of these certainly many are falsely ascribed to the historical Hippocrates of Cos; others are almost as certainly rightly so ascribed; others again are clearly works of his school, whether from his hand or not. But which are to be regarded as the "genuine works" is still uncertain, and authorities are conflicting. There are clearly two schools represented in the collection—that of Cnidus in a small proportion, and that of Cos in far the larger number of the works. The latter was that to which Hippocrates belonged, and where he gave instruction; and accordingly it may be taken that works of this school, when not obviously of a different date, are Hippocratic in doctrine if not in actual authorship.

Hippocratic Medicine.—The first grand characteristic of Hippocratic medicine is the high conception of the duties and status of the physician, shown in the celebrated "Oath of Hippocrates" and elsewhere—equally free from the mysticism of a priesthood and the vulgar pretensions of a mercenary craft. So matured a professional sentiment may perhaps have been more the growth of time and organization than the work of an individual genius, but certainly corresponds with the character universally attributed to Hippocrates himself. The second great quality is the singular artistic skill and balance with which the Hippocratic physician used such materials and tools as he possessed. Here we recognize the true Greek *σωφροσύνη*. But this artistic completeness was closely connected with the third cardinal virtue of Hippocratic medicine—the clear recognition of disease as being equally with life a process governed by what we should now call natural laws, which could be known by observation, and which indicated the spontaneous and normal direction of recovery, by following which alone could the physician succeed. In the fourth place, these views of the "natural history of disease" (in modern language) led to habits of minute observation and accurate interpretation of symptoms, in which the Hippocratic school was unrivalled in antiquity, and has been the model for all succeeding ages, so that even in these days, with our enormous advances in knowledge, the true method of clinical medicine may be said to be the method of Hippocrates.

The actual science of the Hippocratic school was of course very limited. In anatomy and physiology little advance had been made, and so of pathology in the sense of an explanation of morbid processes or knowledge of diseased structures there could be very little. The most valuable intellectual possession was a large mass of recorded observations in individual cases and epidemics of disease. Whether these observations were systematic or individual, and how they were recorded, are points of which we are quite ignorant, as the theory that the votive tablets in the temples supplied such materials must be abandoned.

Though the Hippocratic medicine was so largely founded on observation, it would be an error to suppose that dogma or theory had no place. The dominating theory of disease was the *humoral*, which has never since ceased to influence medical thought and practice. According to this celebrated theory, the body contains four humours—blood, phlegm, yellow bile and black bile, a right proportion and mixture of which constitute health; improper proportions or irregular distribution, disease. It is doubtful whether the treatise in which this theory is fully expounded (*περὶ φύσιος ἀνθρώπου*) is as old as Hippocrates himself; but it was regarded as a Hippocratic doctrine, and, when taken up and expanded by Galen, its terms not only became the common property of the profession, but passed into general literature and common language. Another Hippocratic doctrine, the influence of which is not even yet exhausted, is that of the healing power of nature. Not that Hippocrates taught, as he was afterwards reproached with teaching, that nature is sufficient for the cure of diseases; for he held strongly the efficacy of art. But he recognized, at least in acute diseases, a natural process which the humours went through—being first of all *crude*, then passing through *coction* or digestion, and finally being expelled by resolution or *crisis* through one of the natural channels of the body. The duty of the physician was to foresee these changes, "to assist or not to hinder them," so that "the sick man might conquer the disease with the help of the physician." The times at which crises were to be expected were naturally looked for with anxiety; and it was a cardinal point in the Hippocratic system to foretell them with precision. Hippocrates, influenced as is thought by the Pythagorean doctrines of number, taught that they were to be expected on days fixed by certain numerical rules, in some cases on odd, in others on even numbers—the celebrated doctrine of "critical days." This false precision can have had no practical value, but may have enforced habits of minute observation. It follows from what has been said that *prognosis*, or the art of foretelling the course and event of the *disease*, was a strong point with the Hippocratic physicians. In this they have perhaps never been excelled. Diagnosis, or recognition of the disease, must have been necessarily imperfect, when no scientific nosology or system of disease existed, and the knowledge of anatomy was quite inadequate to allow of a precise determination of the seat of disease; but symptoms were no doubt observed and interpreted skilfully. The pulse is not spoken of in any of the works now attributed to Hippocrates himself, though it is mentioned in other works of the collection.

In the treatment of disease, the Hippocratic school attached great importance to diet, the variations necessary in different diseases being minutely defined. Medicines were regarded as of secondary importance, but not neglected, two hundred and sixty-five drugs being mentioned at different places in the Hippocratic works. Blood-letting was known, but not greatly practised. The highest importance was attached to applying all remedies at the right moment, and the general principle enforced of making all influences—internal and external—co-operate for the relief of the patient. The principles of treatment just mentioned apply more especially to the cure of acute diseases; but they are the most salient characteristics of the Hippocratic school. In chronic cases diet, exercise and natural methods were chiefly relied upon.

The school of Cnidus, as distinguished from that of Cos, of which Hippocrates is the representative, appears to have differed in attaching more importance to the differences of special diseases, and to have made more use of drugs. A treatise on the diseases of women, contained in the Hippocratic collection, and of remarkable practical value, is attributed to this school.

The above sketch of Hippocratic medicine will make it less necessary to dwell upon the details relating to subsequent medical schools or sects in ancient times. The general conception of the physician's aim and task remained the same, though, as knowledge increased, there was much divergence both in theory and practice—even opposing schools were found to be developing some part of the Hippocratic system. Direct opponents or repudiators of the authority of Hippocrates were rare, all generally appealing to his authority. But, insensibly, the least valuable part of the Hippocratic work, the theory, was made permanent; the most valuable, the practical, neglected.

Post-Hippocratic Medicine.—After Hippocrates the progress of medicine in Greece does not call for any special remark in such a sketch as this, but mention must be made of one great name. Though none of Aristotle's writings are strictly medical, he has by his researches in anatomy and physiology contributed greatly to the progress of medicine. It should also be remembered that he was of an Asclepiad family, and received that partly medical education which was traditional in such families, and also himself is said to have practised medicine as an amateur. Moreover, his works on natural history doubtless furthered the progress among the Greeks of sciences tributary to medicine, though the only specimens of such works which have come down to us from the Peripatetic school are those of Theophrastus, who may be considered the founder of the scientific study of botany. Among his encyclopaedic writings were some on medical subjects, of which fragments only have been preserved. The Peripatetic school may have been more favourable to the development of medicine, as of other departments of natural knowledge, than any other; but there is no evidence that any of the philosophical schools had important influence on the progress of medicine. The fruit of Aristotle's teaching and example was seen later on in the schools of Alexandria.

The century after the death of Hippocrates is a time almost blank in medical annals. It is probable that the science, like others, shared in the general intellectual decline of Greece after the Macedonian supremacy; but the works of physicians of the period are almost entirely lost, and were so even in the time of Galen. Galen classes them all as of the dogmatic school; but, whatever may have been their characteristics, they are of no importance in the history of the science.

Alexandrian School of Medicine.—The dispersion of Greek science and intellectual activity through the world by the conquests of Alexander and his successors led to the formation of more than one learned centre, in which medicine among other sciences was represented. Pergamum was early distinguished for its medical school; but in this as in other respects its reputation was ultimately effaced by the more brilliant fame of Alexandria. It is here that the real continuation and development of Hippocratic medicine can be traced.

In one department the Alexandrian school rapidly surpassed its Greek original—namely, in the study of anatomy. The dissection of the human body, of which some doubtful traces or hints only are found in Greek times, was assiduously carried out, being favoured or even suggested perhaps by the Egyptian custom of disembowelling and embalming the bodies of the dead. There is no doubt that the organs were also examined by opening the bodies of living persons—criminals condemned to death being given over to the anatomists for this purpose.

Two eminent names stand in the first rank as leaders of the two earliest schools of medicine which arose in Alexandria, Herophilus and Erasistratus.

Herophilus (335–280 B.C.) was a Greek of Chalcedon, a pupil of the schools both of Cos and of Cnidus. He was especially noted for his profound researches in anatomy (see i. 802), and in the knowledge and practice of medicine he appears to have been equally renowned. He professed himself a close adherent of Hippocrates, and adopted his theory of the humours. He also made extensive use of drugs and of bleeding. The reputation of Herophilus is attested by the fact that four considerable physicians wrote works about him and his writings, and he is further spoken of with the highest respect by Galen and Celsus. By the general voice of the medical world of antiquity he was placed only second to Hippocrates.

Erasistratus (d. 280 B.C.) was the contemporary and rival of Herophilus. Little is known of his life, except that he spent some time at the court of Seleucus Nicator at Antioch before coming to Alexandria, and that he cultivated anatomy late in life, after he had taken up his abode in the latter city. His numerous works are also almost entirely lost, fragments only being preserved by Galen and others. Erasistratus, instead of following Hippocrates as Herophilus did, depreciated him, and seems to have been rather aggressive and independent in his views. He appears to have leaned to mechanical explanations of the symptoms of disease, as was especially the case with inflammation, of which he gave the first rational, though necessarily inadequate, theory.

The two schools composed of the followers of Herophilus and Erasistratus respectively long divided between them the medical world of Alexandria. The names of many prominent members of both sects have been preserved, but it would be useless to repeat them. The Herophilists still reverenced the memory of Hippocrates, and wrote numerous commentaries on his works. They produced many eminent anatomists, but in the end seem to have become lost in theoretical subtleties, and to have maintained too high a standard of literary cultivation. The school of Erasistratus was less distinguished in anatomy than that of Herophilus, but paid more attention to the special symptoms of diseases, and employed a great variety of drugs. It was longer-lived than that of Herophilus, for it still numbered many adherents in the 2nd century after Christ, a century after the latter had become extinct.

The Erasistrateans paved the way for what was in some respects the most important school which Alexandria produced, that known as the empiric, which, though it recognized no master by name, may be considered to have been founded by Philinus of Cos (280 B.C.), a pupil of Herophilus; but Serapion, a great name in antiquity, and Glaucias of Tarentum, who traced the empirical doctrine back to the writings of Hippocrates, are also named among its founders. The most striking peculiarity of the empirics was that they rejected anatomy, regarding it as useless to inquire into the causes of things, and thus, as they contended, being the more minute in their observation of the actual phenomena of disease. They professed that their whole practice was based upon experience, to which word they gave a special meaning. Three sources, and three only, could experience draw from: observation, history (*i.e.* recorded observation), and judgment by analogy. These three bases of knowledge were known as the "tripod" of the empirics. It should not, however, be forgotten that the empirics read and industriously commented on the works of Hippocrates. They were extremely successful in practical matters, especially in surgery and in the use of drugs, and a large part of the routine knowledge of diseases and remedies which became traditional in the times of the Roman empire is believed to have been derived from them. In the 2nd century the school became closely connected with the philosophical sect of the Sceptics, whose leader, Sextus (200 B.C.), was an empirical physician. It lived and flourished far beyond this time, when transplanted to Rome, not less than in its native Alexandria, and appears to be recognizable even up to the beginning of the middle ages.

If we look at the work of the Alexandrian schools in medicine as a whole, we must admit that the progress made was great and permanent. The greatest service rendered to medicine was undoubtedly the systematic study of anatomy. It is clear that the knowledge of function (physiology) did not by any means keep pace with the knowledge of structure, and this was probably the reason why the important sect of the empirics were able entirely to dispense with anatomical knowledge. The doctrines of Hippocrates, though lightly thought of by the Erasistrateans, still were no doubt very widely accepted, but the practice of the Hippocratic school had been greatly improved in almost every department—surgery and obstetrics being probably those in which the Alexandrian practitioners could compare most favourably with those of modern times. We have now to trace the fortunes of this body of medical doctrine and practice when transplanted to Rome, and ultimately to the whole Roman world.

Roman Medicine.—The Romans cannot be said to have at any time originated or possessed an independent school of medicine. They had from early times a very complicated system of superstitious medicine, or religion, related to disease and the cure of disease, borrowed, as is thought, from the Etruscans; and, though the saying of Pliny that the Roman people got on for six hundred years without doctors was doubtless an exaggeration, and not, literally speaking, exact, it must be accepted for the broad truth which it contains. When a medical profession appears, it is, so far as we are able to trace it, as an importation from Greece.

The first Greek physician whose name is preserved as having migrated to Rome was Archagathus, who came over from the Peloponnesus in 218 B.C.; but there were probably others before him. When Greece was made a Roman province, the number of such physicians who sought their fortunes in Rome must have been very large. The bitter words of M. Porcius Cato, who disliked them as he did other representatives of Greek culture, are evidence of this. The most eminent of these earlier Greek physicians at Rome was Asclepiades, the friend of Cicero (born 124 B.C. at Prusa in Bithynia). He came to Rome as a young man, and soon became distinguished both for his medical skill and his oratorical power. He introduced a system which, so far as we know, was his own, though founded upon the Epicurean philosophical creed; on the practical side it conformed pretty closely to the Stoic rule of life, thus adapting itself to the leanings of the better stamp of Romans in the later times of the republic. According to Asclepiades all diseases depended upon alterations in the size, number, arrangement or movement of the "atoms," of which, according to the doctrine of Epicurus, the body consisted. These atoms were united into passages (*πόροι*) through which the juices of the body were conveyed. This doctrine, of which the developments need not further be followed, was important chiefly in so far that it was perfectly distinct from, and opposed to, the humoral pathology of Hippocrates. In the treatment of disease Asclepiades attached most importance to diet, exercise, passive movements or frictions, and the external use of cold water—in short, to a modified athletic training. He rejected the *vis medicatrix naturae*, pointing out that nature in many cases not only did not help but marred the cure. His knowledge of disease and surgical skill were, as appears from the accounts given by Celsus and Caelius Aurelianus, very considerable. Asclepiades had many pupils who adhered more or less closely to his doctrines, but it was especially one of them, Themison, who gave permanence to the teachings of his master by framing out of them, with some modifications, a new system of medical doctrine, and founding on this basis a school which lasted for some centuries in successful rivalry with the Hippocratic tradition, which, as we have seen, was up to that time the prevailing influence in medicine.

This system was known as methodism, its adherents as the methodici or methodists. Its main principles were that it was useless to consider the causes of a disease, or even the organ affected by the disease, and that it was sufficient to know what was common to all diseases, viz. their common qualities (communitates, *κοινότητες*). Of these there were three possible forms—(1) relaxation, (2) contraction of the minute passages or *πόροι*, and (3) a mixed state, partly lax, partly constricted. The signs of these morbid states were to be found in the general constitution of the body, especially in the excretions. Besides this it was important only to consider whether the disease was acute or chronic, whether it was increasing, declining or stationary. Treatment of disease was directed not to any special organ, nor to producing the crises and critical discharges of the Hippocratic school, but to correcting the morbid common condition or "community," relaxing the body if it was constricted, causing contraction if it was too lax, and in the "mixed state" acting according to the predominant condition. This simple rule of treatment was the system or "method" from which the school took its name.

The methodists agreed with the empirics in one point, in their contempt for anatomy; but, strictly speaking, they were dogmatists, though with a dogma different from that of the Hippocratic school. Besides Themison, its systematic founder, the school boasted many physicians eminent in their day, among whom Thessalus of Tralles, a half-educated and boastful pretender, was one of the most popular. He reversed the Hippocratic maxim "art is long," promising his scholars to teach them the whole of medicine in six months, and had inscribed upon his tomb *ἰατρονίκης*, as being superior to all living and bygone physicians.

In the 2nd century a much greater name appears among the methodists, that of Soranus of Ephesus, a physician mentioned with praise even by Tertullian and Augustine, who practised at Rome in the reigns of Trajan and Hadrian. Soranus is known by a work, still extant in the Greek original, on the diseases of women, and also by the Latin work of Caelius Aurelianus, three centuries later, on acute and chronic diseases, which is based upon, if not, as some think, an actual translation of, the chief work of Soranus, and which is the principal source of our knowledge of the methodic school. The work on diseases of women is the only complete work on that subject which has come down to us from antiquity, and shows remarkable fullness of practical knowledge in relation to its subject. It is notable that an important instrument of research, the speculum, which has been reinvented in modern times, was used by Soranus; and specimens of still earlier date, showing great mechanical perfection, have been found among the ruins of Pompeii. The work on acute and chronic diseases is also full of practical knowledge, but penetrated with the theories of the methodists.

The methodic school lasted certainly for some centuries, and influenced the revival of medical science in the middle ages, though overshadowed by the greater reputation of Galen. It was the first definite product of Greek medicine on Roman soil, but was destined to be followed by others, which kept up a more or less successful rivalry with it, and with the Hippocratic tradition.

The so-called pneumatic school was founded by Athenaeus, in the 1st century after Christ. According to its doctrines the normal as well as diseased actions of the body were to be referred to the operation of the pneuma or universal soul. This doctrine, crudely transferred from philosophical speculation, was intended to reconcile the humoral (or Hippocratic) and solidist (or methodic) schools; but the methodists seem to have claimed Athenaeus as one of themselves.

The conflicts of the opposing schools, and the obvious deficiencies of each, led many physicians to try and combine the valuable parts of each system, and to call themselves eclectics. Among these were found many of the most eminent physicians of Graeco-Roman times. It may be sufficient to name Rufus or Ephesus (2nd century A.D.), and Archigenes (*fl.* A.D. 90), who is mentioned by Juvenal.

Although no system or important doctrine of medicine was originated by the Roman intellect, and though the practice of the profession was probably almost entirely in the hands of the Greeks, the most complete picture which we have of medical thought and activity in Roman times is due to a Latin pen, and to one who was, in all probability, not a physician. A. Cornelius Celsus, a Roman patrician, who lived probably in the 1st century, appears to have studied medicine as a branch of general knowledge. Whether he was a practising physician or not has been a matter of controversy. The conclusion supported by most evidence seems to be that he practised on his friends and dependants, but not as a remunerative profession. His well-known work, *De medicina*, was one of a series of treatises intended to embrace all knowledge proper for a man of the world. It was not meant for the physicians, and was certainly little read by them, as Celsus is quoted by no medical writer, and when referred to by Pliny, is spoken of as an author not a physician. There is no doubt that his work is chiefly a compilation; and Daremberg, with other scholars, has traced a large number of passages of the Latin text to the Greek originals from which they were translated. In the description of surgical operations the vagueness of the language seems sometimes to show that the author had not performed such himself; but in other parts, and especially in his historical introduction, he speaks with more confidence; and everywhere he compares and criticizes with learning and judgment. The whole body of medical literature belonging to the Hippocratic and Alexandrian times is ably summarized, and a knowledge of the state of medical science up to and during the times of the author is thus conveyed to us which can be obtained from no other source. The work of Celsus is thus for us only second in importance to the Hippocratic writings and the works of Galen; but it is valuable rather as a part of the history of medicine than as the subject of that history. It forms no link in the general chain of medical tradition, for the simple reason that the influence of Celsus (putting aside a few scanty allusions in medieval times) commenced in the 15th century, when his works were first discovered in manuscript or committed to the press. Since then, however, he has been almost up to our own times the most popular and widely read of all medical classics, partly for the qualities already indicated, partly because he was one of the few of those classics accessible to readers of Latin, and partly also because of the purity and classical perfection of his language.

Of Pliny, another encyclopaedic writer, a few words must be said, though he was not a physician. In his *Natural History* we find as complete a summary of the popular medicine of his time as Celsus gives of the scientific medicine. Pliny disliked doctors, and lost no opportunity of depreciating regular medicine; nevertheless he has left many quotations from, and many details about, medical authors which are of the highest value. He is useful to us for what he wrote about the history of medicine, not for what he contributed. Like Celsus, he had little influence on succeeding medical literature or practice.

We now come to the writer who, above all others, gathered up into himself the divergent and scattered threads of ancient medicine, and out of whom again the greater part of modern European medicine has flowed. Galen was a man furnished with all the anatomical, medical and philosophical knowledge of his time; he had studied all kinds of natural curiosities, and had stood in near relation to important political events; he possessed enormous industry, great practical sagacity and unbounded literary fluency. He had, in fact, every quality necessary for an encyclopaedic writer, or even for a literary and professional autocrat. He found the medical profession of his time split up into a number of sects, medical science confounded under a multitude of dogmatic systems, the social status and moral integrity of physicians degraded. He appears to have made it his object to reform these evils, to reconcile scientific acquirements and practical skill, to bring back the unity of medicine as it had been understood by Hippocrates, and at the same time to raise the dignity of medical practitioners.

Galen was as devoted to anatomical and, so far as then understood, physiological research as to practical medicine. He worked enthusiastically at dissection, though, the liberty of the Alexandrian schools no longer existing, he could dissect only animals, not the human body. In his anatomical studies Galen had a twofold object—a philosophical, to show the wisdom of the Creator in making everything fit to serve its purpose; and a practical, to aid the diagnosis, or recognition, of disease. The first led him into a teleological system so minute and overstrained as to defeat its own end; the second was successfully attained by giving greater precision and certainty to medical and surgical practice in difficult cases. His general physiology was essentially founded upon the Hippocratic theory of the four elements, with which he combined the notion of spirit (pneuma) penetrating all parts, and mingled with the humours in different proportions. It was on this field that he most vehemently attacked the prevailing atomistic and materialistic views of the methodic school, and his conception of the pneuma became in some respects half metaphysical. His own researches in special branches of physiology were important, but do not strictly belong to our present subject.

The application of physiology to the explanation of diseases, and thus to practice, was chiefly by the theory of the temperaments or mixtures which Galen founded upon the Hippocratic doctrine of humours, but developed with marvellous and fatal ingenuity. The normal condition or temperament of the body depended upon a proper mixture or proportion of the four elements—hot, cold, wet and dry. From faulty proportions of the same arose the *intemperies* ("distempers"), which, though not diseases, were the occasions of disease. Equal importance attached to faulty mixtures or dyscrasiae of the blood. By a combination of these morbid predispositions with the action of deleterious influences from without all diseases were produced. Galen showed extreme ingenuity in explaining all symptoms and all diseases on his system. No phenomenon was without a name, no problem without a solution. And, though it was precisely in his fine-spun subtlety that he departed furthest from scientific method and practical utility, it was this very quality which seems in the end to have secured his popularity and established his pre-eminence in the medical world.

Galen's use of drugs was influenced largely by the same theories. In drugs were to be recognized the same elementary qualities—hot, cold, moist, dry, &c.—as in the human body; and, on the principle of curing by contraries, the use of one or other was indicated. The writings of Galen contain less of simple objective observations than those of several other ancient physicians, all being swept into the current of dogmatic exposition. But there is enough to show the thoroughness and extent of his practical knowledge. Unfortunately it was neither this nor his zeal for research that chiefly won him followers, but the completeness of his theoretical explanations, which fell in with the mental habits of succeeding centuries, and were such as have flattered the intellectual indolence of all ages. But the reputation of Galen grew slowly; he does not appear to have enjoyed any pre-eminence over other physicians of his time, to most of whom he was strongly opposed in opinion. In the next generation he began to be esteemed only as a philosopher; gradually his system was implicitly accepted, and it enjoyed a great though not exclusive predominance till the fall of Roman civilization. When the Arabs possessed themselves of the scattered remains of Greek culture, the works of Galen were more highly esteemed than any others except those of Aristotle. Through the Arabs the Galenical system found its way back again to western Europe. Even when Arabian medicine gave way before the direct teaching of the Greek authors rescued from neglect, the authority of Galen was increased instead of being diminished; and he assumed a position of autocracy in medical science which was only slowly undermined by the growth of modern science in the 17th and 18th centuries.

The history of medicine in Roman times is by no means the same thing as the history of the fate of the works of Galen. For some centuries the methodic school was popular at Rome, and produced one physician, Caelius Aurelianus, who must be pronounced, next to Celsus, the most considerable of the Latin medical writers. His date was in all probability the end of the 4th or the beginning of the 5th century. The works bearing his name are, as has been said, entirely based upon the Greek of Soranus, but are important both because their Greek originals are lost, and because they are evidence of the state of medical practice in his own time. The popularity of Caelius is evidenced by the fact that in the 6th century an abridgment of his larger work was recommended by Cassiodorus to the Benedictine monks for the study of medicine.

Before quitting this period the name of Aretaeus of Cappadocia must be mentioned. So little is known about him that even his date cannot be fixed more closely than as being between the second half of the 1st century and the beginning of the 3rd. His works have been much admired for the purity of the Greek style, and his accurate descriptions of disease; but, as he quotes no medical author, and is quoted by none before Alexander of Aphrodisias at the beginning of the 3rd century, it is clear that he belonged to no school and founded none, and thus his position in the chain of medical tradition is quite uncertain. Alexander of Aphrodisias, who lived and wrote at Athens in the time of Septimius Severus, is best known by his commentaries on Aristotle, but also wrote a treatise on fevers, still extant.

Ancient Medicine after Galen.—The Byzantine school of medicine, which closely corresponds to the Byzantine literary and historical schools, followed closely in Galen's footsteps, and its writers were chiefly compilers and encyclopaedists. The earliest is Oribasius (326–403), whose date and position are fixed by his being the friend and court physician of Julian the Apostate. He was a Greek of Pergamum, educated in Alexandria, and long resident in Byzantium. His great work *Συνάγωγαὶ ἰατρικαί*, of which only about one-third has been preserved, was a medical encyclopaedia founded on extracts from Hippocrates, Galen, Dioscorides (*fl.* A.D. 50) and certain Greek writers who are otherwise very imperfectly known. The work is thus one of great historical value but of no originality. The next name which requires to be mentioned is that of Aetius (A.D. 550), a compiler who closely followed Oribasius, but with inferior powers, and whose work also has an historical but no original value. A higher rank among medical writers is assigned to Alexander of Tralles (525–605), whose doctrine was that of an eclectic. His practical and therapeutical rules are evidently the fruit of his own experience, though it would be difficult to attribute to him any decided advance in medical knowledge. But the most prominent figure in Byzantine medicine is that of Paul of Aegina (Paulus Aegineta), who lived probably in the early part of the 7th century. His skill, especially in surgery, must have been considerable, and his *Ἰατρικά* gives a very complete picture of the achievements of the Greeks in this department. Another work, on obstetrics, now lost, was equally famous, and procured for him, among the Arabs, the name of "the Obstetrician." His reputation lasted through the middle ages, and was not less in the Arabian schools than in the West. In this respect Paulus is a most important influence in the development of medicine. His great work on surgery was early translated into Arabic, and became the foundation of the surgery of Abulcasis, which in turn (to anticipate) was one of the chief sources of surgical knowledge to Europe in the middle ages. The succeeding period of Byzantine history was so little favourable to science that no name worthy of note occurs again (though many medical works of this period are still extant) till the 13th century, when we meet with a group of writers. Demetrius Pepagomenus, Nicolaus Myrepsus and Johannes, called Actuarius, who flourished under the protection of the Palaeologi. The work of the last has some independent merit; but all are interesting as showing a fusion of Greek and Arabian medicine, the latter having begun to exercise even in the 11th century a reflex influence on the schools of Byzantium. Something was borrowed even from the school of Salerno, and thus the close of Byzantine medicine is brought into connexion with the dawn of science in modern Europe.

In the West the period after Galen affords little evidence of anything but a gradual though unvarying decline in Roman medicine. Caelius Aurelianus, already referred to as the follower of Soranus, must be mentioned as showing the persistence of the methodic school. An abridgment of one of his writings, with the title of *Aurelius*, became the most popular of all Latin medical works. As a writer he was worthy of a better period of medical literature. Little else was produced in these times but compilations, of the most meagre kind, chiefly of the nature of herbals, or domestic receipt-books; among the authors of which it may be sufficient to name Serenus Sammonicus (3rd century), Gargilius Martialis (3rd century) and Marcellus Empiricus (5th century). Certain compilations still extant bear the falsely-assumed names of eminent writers, such as Pliny and Hippocrates. A writer with the (perhaps assumed) name of Apuleius Platonicus produced a herbal which held its ground till the 15th century at least, and was in the 9th translated into Anglo-Saxon. These poor compilations, together with Latin translations of certain works of Galen and Hippocrates, formed a medical literature, meagre and unprogressive indeed, but of which a great part survived through the middle ages till the discovery of printing and revival of learning. It is important to remember that this obscure stream of tradition flowed on, only partially affected by the influx of Arabian, or even the early revival of purer classical learning.

Arabian Medicine.—The rise of the Mahommedan Empire, which influenced Europe so deeply both politically and intellectually, made its mark also in the history of medicine. As in the parallel case of the Roman conquest of Greece, the superior culture of the conquered race asserted its supremacy over their Arab conquerors. After the Mahommedan conquests became consolidated, and learning began to flourish, schools of medicine, often connected with hospitals and schools of pharmacy, arose in all the chief seats of Moslem power. At Damascus Greek medicine was zealously cultivated with the aid of Jewish and Christian teachers. In Bagdad, under the rule of Hārūn el Rashīd and his successors, a still more flourishing school arose, where numerous translations of Greek medical works were made. The names of Mesua, or Yaḥyā ibn Māsawaih (d. A.D. 857–858), celebrated for his knowledge of drugs, and Ḥonein ibn Isḥaq el 'Ibādī (d. 873) or Joannitius, the translator and commentator of Hippocrates and Galen, belong to this period. Certain writings of Joannitius, translated into Latin, were popular in the middle ages in Europe, and were printed in the 16th century. At the same time the Arabs became acquainted with Indian medicine, and Indian physicians lived at the court of Bagdad. The Islamite rulers in Spain were not long behind those of the East in encouraging learning and medical science, and developed culture to a still higher degree of perfection. In that country much was due to the Jews, who had already established schools in places which were afterwards the seats of Moslem dominion. From the 10th to the 13th century was the brilliant period of Arabian medicine in Spain.[1]

The classical period of Arabian medicine begins with Rhazes (Abū Bakr Muḥammad ibn Zakarīyā el-Rāzī, A.D. 925–926), a native of Raī in the province of Dailam (Persia), who practised with distinction at Bagdad; he followed the doctrines of Galen, but learnt much from Hippocrates. He was the first of the Arabs to treat medicine in a comprehensive and encyclopaedic manner, surpassing probably in voluminousness Galen himself, though but a small proportion of his works are extant. Rhazes is deservedly remembered as having first described small-pox and measles in an accurate manner. Hali, *i.e.* 'Ali ibn el-'Abbās, a Persian, wrote a medical textbook, known as the "Royal Book," which was the standard authority among the Arabs up to the time of Avicenna (A.D. 980–1037) and was more than once translated into Latin and printed. Other writers of this century need not be mentioned here; but the next, the 11th century, is given as the probable though uncertain date of a writer who had a great influence on European medicine, Mesua the younger of Damascus, whose personality is obscure, and of whose very existence some historians have doubted, thinking that the name was assumed by some medieval Latin writer. The work *De simplicibus*, which bears his name, was for centuries a standard authority on what would now be called materia medica, was printed in twenty-six editions in the 15th century and later, and was used in the formation of the first London pharmacopoeia, issued by the College of Physicians in the reign of James I. Either to the 10th or the 11th century must be referred the name of another Arabian physician who has also attained the position of a classic, Abu'l Qāsim or Abulcasis, of El-Zahra, near Cordova, in Spain. His great work, *Altaṣrif*, a medical encyclopaedia, is chiefly valued for its surgical portion (already mentioned), which was translated into Latin in the 16th century, and was for some centuries a standard if not the standard authority on surgery in Europe. Among his own countrymen the fame and position of Abulcasis were soon eclipsed by the greater name of Avicenna.

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[1] See Dozy, *Cat. Cod. Or. Lug. Bat.* ii. 296.

Avicenna has always been regarded as the chief representative of Arabian medicine. He wrote on philosophy also, and in both subjects acquired the highest reputation through the whole of eastern Islam. In Mahommedan Spain he was less regarded, but in Europe his works even eclipsed and superseded those of Hippocrates and Galen. His style and expository power are highly praised, but the subject-matter shows little originality. The work by which he is chiefly known, the celebrated "canon," is an encyclopaedia of medical and surgical knowledge, founded upon Galen, Aristotle, the later Greek physicians, and the earlier Arabian writers, singularly complete and systematic, but is thought not to show the practical experience of its author. As in the case of Galen, the formal and encyclopaedic character of Avicenna's works was the chief cause of his popularity and ascendancy, though in modern times these very qualities in a scientific or medical writer would rather cause him to become more speedily antiquated.

In the long list of Arabian medical writers none can here be mentioned except the great names of the Hispano-Moorish school, a school both philosophically and medically antagonistic to that of Avicenna. Of these the earliest is AVENZOAR or Abumeron, that is, Abū Merwān 'Abd al-Malik Ibn Zuhr (beginning of 12th century), a member of a family which gave several distinguished members to the medical profession. His chief work, *Al-Teysīr* (facilitatio), is thought to show more practical experience than the writings of Avicenna, and to be less based upon dialectical subtleties. It was translated into Latin, and more than once printed, as were some of his lesser works, which thus formed a part of the contribution made by the Arabians to European medicine. His friend and pupil AVERROES of Cordova (*q.v.*), so well known for his philosophical writings, was also an author in medical subjects, and as such widely read in Latin. The famous Rabbi MAIMONIDES (A.D. 1135–1204) (*q.v.*) closes for us the roll of medical writers of the Arabian school. His works exist chiefly in the original Arabic or in Hebrew translations; only some smaller treatises have been translated into Latin, so that no definite opinion can be formed as to their medical value. But, so far as is known, the independent and rationalistic spirit which the two last-named writers showed in philosophy did not lead them to take any original point of view in medicine.

The works of the Arabian medical writers who have now been mentioned form a very small fraction of the existing literature. Three hundred medical writers in Arabic are enumerated by Ferdinand Wüstenfeld (1808–1899), and other historians have enlarged the list (Häser), but only three have been printed in the original; a certain number more are known through old Latin translations, and the great majority still exist in manuscript. It is thus evident that the circumstance of having been translated (which may have been in some cases almost an accident) is what has chiefly determined the influence of particular writers on Western medicine. But it is improbable that further research will alter the general estimate of the value of Arabian medicine. There can be no doubt that it was in the main Greek medicine, modified to suit other climates, habits and national tastes, and with some important additions from Oriental sources. The greater part is taken from Hippocrates, Galen, Dioscorides and later Greek writers. The Latin medical writers were necessarily unknown to the Arabs; and this was partly the cause that even in Europe Galenic medicine assumed such a preponderance, the methodic school and Celsus being forgotten or neglected. In anatomy and physiology the Arabians distinctly went back; in surgery they showed no advance upon the Greeks; in practical medicine nothing new can be traced, except the description of certain diseases (*e.g.* small-pox and measles) unknown or imperfectly known to the Greeks; the only real advance was in pharmacy and the therapeutical use of drugs. By their relations with the farther East, the Arabs became acquainted with valuable new remedies which have held their ground till modern times; and their skill in chemistry enabled them to prepare new chemical remedies, and form many combinations of those already in use. They produced the first pharmacopoeia, and established the first apothecaries' shops. Many of the names and many forms of medicines now used, and in fact the general outline of modern pharmacy, except so far as modified by modern chemistry, started with the Arabs. Thus does Arabian medicine appear as judged from a modern standpoint; but to medieval Europe, when little but a tradition remained of the great ancient schools, it was invested with a far higher degree of originality and importance.

It is now necessary to consider what was the state of medicine in Europe after the fall of the Western Empire and before the influence of Arabian science and literature began to be felt. This we may call the pre-Arabian or Salernitan period.

Medicine in the Early Middle Ages: School of Salerno.—In medical as in civil history there is no real break. A continuous thread of learning and practice must have connected the last period of Roman medicine already mentioned with the dawn of science in the middle ages. But the intellectual thread is naturally traced with greater difficulty than that which is the theme of civil history; and in periods such as that from the 5th to the 10th century in Europe it is almost lost. The chief homes of medical as of other learning in these disturbed times were the monasteries. Though the science was certainly not advanced by their labours, it was saved from total oblivion, and many ancient medical works were preserved either in Latin or vernacular versions. The Anglo-Saxon Leechdoms[1] of the 11th century, published in the Rolls series of medieval chronicles and memorials, admirably illustrate the mixture of magic and superstition with the relics of ancient science which constituted monastic medicine. Similar works, in Latin or other languages, exist in manuscript in all the great European libraries. It was among the Benedictines that the monastic study of medicine first received a new direction, and aimed at a higher standard. The study of Hippocrates, Galen, and other classics was recommended by Cassiodorus (6th century), and in the original mother-abbey of Monte Cassino medicine was studied; but there was not there what could be called a medical school; nor had this foundation any connexion (as has been supposed) with the famous school of Salerno.

The origin of this, the most important source of medical knowledge in Europe in the early middle ages, is involved in obscurity. It is known that Salerno, a Roman colony, in a situation noted in ancient times for its salubrity, was in the 6th century at least the seat of a bishopric, and at the end of the 7th century of a Benedictine monastery, and that some of the prelates and higher clergy were distinguished for learning, and even for medical acquirements. But it has by recent researches been clearly established that the celebrated *Schola salernitana* was a purely secular institution. All that can with certainty be said is that a school or collection of schools gradually grew up in which especially medicine, but also, in a subordinate degree, law and philosophy were taught. In the 9th century Salernitan physicians were already spoken of, and the city was known as *Civitas hippocratica*. A little later we find great and royal personages resorting to Salerno for the restoration of their health, among whom was William of Normandy, afterwards the Conqueror. The number of students of medicine must at one time have been considerable, and in a corresponding degree the number of teachers. Among the latter many were married, and their wives and daughters appear also in the lists of professors. The most noted female professor was the celebrated Trotula in the 11th century. The Jewish element appears to have been important among the students, and possibly among the professors. The reputation of the school was great till the 12th or 13th century, when the introduction of the Arab medicine was gradually fatal to it. The foundation of the university of Naples, and the rise of Montpellier, also contributed to its decline.

The teachings of the Salernitan doctors are pretty well known through existing works, some of which have only recently been discovered and published. The best-known is the rhyming Latin poem on health by Joannes de Meditano, *Regimen sanitatis Salerni*, professedly written for the use of the "king of England," supposed to mean William the Conqueror; it had an immense reputation in the middle ages, and was afterwards many times printed, and translated into most European languages. This was a popular work intended for the laity; but there are others strictly professional.

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[1] Derived from the Anglo-Saxon *laece*, a physician, and *dom*, a law.

Among the writers it may be sufficient to mention here Gariopontus; Copho, who wrote the *Anatome porci*, a well-known medieval book; Joannes Platearius, first of a family of physicians bearing the same name, whose *Practica*, or medical compendium, was afterwards several times printed; and Trotula, believed to be the wife of the last-named. All of these fall into the first period before the advent of Arabian medicine. In the transitional period, when the Arabian school began to influence European medicine, but before the Salernitans were superseded, comes Nicolaus Praepositus, who wrote the *Antidotarium*, a collection of formulae for compound medicines, which became the standard work on the subject, and the foundation of many later compilations. An equally popular writer was Gilles de Corbeil (Aegidius Corboliensis), at one time a teacher at Salerno, afterwards court physician to Philip Augustus of France, who composed several poems in Latin hexameters on medical subjects. Two of them, on the urine and the pulse respectively, attained the position of medical classics.

None of these Salernitan works rise much above the rank of compilations, being founded on Hippocrates, Galen and later Greek writers, with an unmistakable mixture of the doctrines of the methodists. But they often show much practical experience, and exhibit the naturalistic method of the Hippocratic school. The general plan of treatment is dietetic rather than pharmaceutical, though the art of preparing drugs had reached a high degree of complexity at Salerno. Anatomy was as little regarded as it was in the later ancient schools, the empiric and methodic, but demonstrations of the parts of the body were given on swine. Although it cannot be said that the science of medicine was advanced at Salerno, still its decline was arrested at a time when every other branch of learning was rapidly falling into decay; and there can be no doubt that the observation of patients in hospitals, and probably clinical instruction, were made use of in learning and teaching. The school of Salerno thus forms a bridge between the ancient and the modern medicine, more direct though less conspicuous than that circuitous route, through Byzantium, Bagdad and Cordova, by which Hippocrates and Galen, in Arabian dress, again entered the European world. Though the glory of Salerno had departed, the school actually existed till it was finally dissolved by an edict of the emperor Napoleon I. in the year 1811.

Introduction of Arabian Medicine: The Scholastic Period.—About the middle of the 11th century the Arabian medical writers began to be known by Latin translations in the Western world. Constantinus Africanus, a monk, was the author of the earliest of such versions (A.D. 1050); his labours were directed chiefly to the less important and less bulky Arabian authors, of whom Haly was the most noted; the real classics were not introduced till later. For some time the Salernitan medicine held its ground, and it was not till the conquest of Toledo by Alphonso of Castile that any large number of Western scholars came in contact with the learning of the Spanish Moors, and systematic efforts were made to translate their philosophical and medical works. Jewish scholars, often under the patronage of Christian bishops, were especially active in the work. In Sicily also the Oriental tendencies of Frederick Barbarossa and Frederick II. worked in the same direction. Gerard of Cremona, a physician of Toledo (1114–1187), made translations, it is said by command of Barbarossa, from Avicenna and others. It is needless to point out the influence of the crusades in making Eastern ideas known in the Western world. The influence of Arabian medicine soon began to be felt even in the Hippocratic city of Salerno, and in the 13th century is said to have held an even balance with the older medicine. After this time the foreign influence predominated; and by the time that the Aristotelian dialectic, in the introduction of which the Arabs had so large a share, prevailed in the schools of Europe, the Arabian version of Greek medicine reigned supreme in the medical world. That this movement coincided with the establishment of some of the older European universities is well known. The history of medicine in the period now opening is closely combined with the history of scholastic philosophy. Both were infected with the same dialectical subtlety, which was, from the nature of the subject, especially injurious to medicine.

At the same time, through the rise of the universities, medical learning was much more widely diffused, and the first definite forward movement was seen in the school of Montpellier, where a medical faculty existed early in the 12th century, afterwards united with faculties of law and philosophy. The medical school owed its foundation largely to Jewish teachers, themselves educated in the Moorish schools of Spain, and imbued with the intellectual independence of the Averroists. Its rising prosperity coincided with the decline of the school of Salerno. Montpellier became distinguished for the practical and empirical spirit of its medicine, as contrasted with the dogmatic and scholastic teaching of Paris and other universities. In Italy, Bologna and Padua were earliest distinguished for medical studies—the former preserving more of the Galenical tradition, the latter being more progressive and Averroist. The northern universities contributed little—the reputation even of Paris being of later growth.

The supremacy of Arabian medicine lasted till the revival of learning, when the study of the medical classics in their original language worked another revolution. The medical writers of this period, who chiefly drew from Arabian sources, have been called Arabists (though it is difficult to give any clear meaning to this term), and were afterwards known as the neoterics.

The medical literature of this period is extremely voluminous, but essentially second-hand, consisting mainly of commentaries on Hippocrates, Galen, Avicenna and others, or of compilations and *compendia* still less original than commentaries. Among these may be mentioned the *Conciliator* of Peter of Abano (1250–1315), the *Aggregator* of Jacob de Dondi (1298–1359), both of the school of Padua, and the *Pandectae medicinae* of the Salernitan Matthaeus Sylvaticus (d. 1342), a sort of medical glossary and dictionary. But for us the most interesting fact is the first appearance of Englishmen as authors of medical works, having a European reputation, distinguished, according to the testimony of Häser, by a practical tendency characteristic of the British race, and fostered in the school of Montpellier.

The first of these works is the *Compendium medicinae*, also called *Laurea* or *Rosa anglicana*, of Gilbert (Gilbertus Anglicus, about 1290), said to contain good observations on leprosy. A more important work, the *Practica seu lilium medicinae*, of Bernard Gordon, a Scottish professor at Montpellier (written in the year 1307), was more widely spread, being translated into French and Hebrew, and printed in several editions. Of these two physicians the first probably, the latter certainly, was educated and practised abroad, but John Gaddesden (1280?–1361), the author of *Rosa anglica seu practica medicinae* (between 1305 and 1317), was a graduate in medicine of Merton College, Oxford, and court physician. His compendium is entirely wanting in originality, and perhaps unusually destitute of common sense, but it became so popular as to be reprinted up to the end of the 16th century. Works of this kind became still more abundant in the 14th and in the first half of the 15th century, till the wider distribution of the medical classics in the original put them out of fashion.

In surgery this period was far more productive than in medicine, especially in Italy and France, but the limits of our subject only permit us to mention Gulielmus de Saliceto of Piacenza (about 1275), Lanfranchi of Milan (died about 1306), the French surgeon, Guy de Chauliac (about 1350) and the Englishman, John Ardern (about 1350). In anatomy also the beginning of a new epoch was made by Mondino de Liucci or Mundinus (1275–1326), and his followers. The medical writings of Arnald de Villanova (*c.* 1235–1313) (if the *Breviarium practicae* be rightly ascribed to him) rise above the rank of compilations. Finally, in the 13th and especially the 14th century we find, under the name of *consilia*, the first medieval reports of medical cases which are preserved in such a form as to be intelligible. Collections of *consilia* were published, among others, by Gentilis Fulgineus before 1348, by Bartolomeo Montagnana (d. 1470), and by Baverius de Baveriis of Imola (about 1450). The last-named contains much that is interesting and readable.

Period of the Revival of Learning.—The impulse which all departments of intellectual activity received from the revival of Greek literature in Europe was felt by medicine among the rest. Not that the spirit of the science, or of its corresponding practice, was at once changed. The basis of medicine through the middle ages had been literary and dogmatic, and it was literary and dogmatic still; but the medical literature now brought to light—including as it did the more important works of Hippocrates and Galen, many of them hitherto unknown, and in addition the forgotten element of Latin medicine, especially the work of Celsus—was in itself far superior to the second-hand compilations and incorrect versions which had formerly been accepted as standards. The classical works, though still regarded with unreasoning reverence, were found to have a germinative and vivifying power that carried the mind out of the region of dogma, and prepared the way for the scientific movement which has been growing in strength up to our own day.

Two of the most important results of the revival of learning were indeed such as are excluded from the scope of this brief sketch—namely, the reawakening of anatomy, which to a large extent grew out of the study of the works of Galen, and the investigation of medicinal plants, to which a fresh impulse was given by the revival of Dioscorides (A.D. 50) and other ancient naturalists. The former brought with it necessarily a more accurate conception of physiology, and thus led up to the great discovery of Harvey, which was the turning-point in modern medicine. The latter gave rise, on the one hand, to the modern science of botany, on the other to a more rational knowledge of drugs and their uses. At the same time, the discovery of America, and increased intercourse with the East, by introducing a variety of new plants, greatly accelerated the progress both of botany and pharmacology.

But it was not in these directions that improvement was first looked for. It was at first very naturally imagined that the simple revival of classical and especially of Greek literature would at once produce the same brilliant results in medicine as in literature and philosophy. The movement of reform started, of necessity, with scholars rather than practising physicians—more precisely with a group of learned men, whom we may be permitted, for the sake of a name, to call the medical humanists, equally enthusiastic in the cause of letters and of medicine. From both fields they hoped to expel the evils which were summed up in the word barbarism. Nearly all medieval medical literature was condemned under this name; and for it the humanists proposed to substitute the originals of Hippocrates and Galen, thus leading back medicine to its fountain-head. Since a knowledge of Greek was still confined to a small body of scholars, and a still smaller proportion of physicians, the first task was to translate the Greek classics into Latin. To this work several learned physicians, chiefly Italians, applied themselves with great ardour. Among the earliest were Nicolaus Leonicenus of Vicenza (1428–1524), Giovanni de Monte or Montanus (1498–1552), and many others in Italy. In northern Europe should be mentioned Gulielmus Copus (1471–1532) and Günther of Andernach (1487–1584), better known as Guinterius Andernacensis, both for a time professors at Paris; and, among the greatest, Thomas Linacre (about 1460–1524; see LINACRE). A little later Janus Cornarius or Hagenbut (1500–1558) and Leonhard Fuchs (1501–1566) in Germany, and John Kaye of Caius (1510–1572) in England, carried on the work. Symphorien Champier (Champerius or Campegius) of Lyons (1472–1539), a contemporary of Rabelais, and the patron of Servetus, wrote with fantastic enthusiasm on the superiority of the Greek to the Arabian physicians, and possibly did something to enlist in the same cause the two far greater men just mentioned. Rabelais not only lectured on Galen and Hippocrates, but edited some works of the latter; and Michael Servetus (1511–1553), in a little tract *Syruporum universa ratio*, defended the practice of Galen as compared with that of the Arabians. The great Aldine Press made an important contribution to the work, by *editiones principes* of Hippocrates and Galen in the original. Thus was the campaign opened against the medieval and Arabian writers, till finally Greek medicine assumed a predominant position, and Galen took the place of Avicenna. The result was recorded in a formal manner by the Florentine Academy, sometime shortly before 1535: "Quae, excusso. Arabicae et barbarae servitutis medicae jugo, ex professo se Galenicam appellavit et profligato barbarorum exercitu unum totum et solum Galenum, ut optimum artis medicae authorem, in omnibus se sequuturam pollicita est." Janus Cornarius, from whom this is quoted, laments, however, that the Arabians still reigned in most of the schools of medicine, and that the Italian and French authors of works called *Practica* were still in high repute. The triumph of Galenism was therefore not complete by the middle of the 16th century. It was probably most so, and earliest, in the schools of Italy and in those of England, where the London College of Physicians might be regarded as an offshoot of the Italian schools. Paris was the stronghold of conservatism, and Germany was stirred by the teachings of one who must be considered apart from all schools—Paracelsus. The nature of the struggle between the rival systems may be well illustrated by a formidable controversy about the rules for bleeding in acute diseases. This operation, according to the Arabian practice, was always performed on a vein at a distance from the organ affected. The Hippocratic and also Galenic rule, to let blood from, or near to, the diseased organ, was revived by Pierre Brissot (1470–1522), a professor in the university of Paris. His attempt at reform, which was taken to be, as in effect it was, a revolt against the authority of the Arabian masters, led to his expulsion from Paris, and the formal prohibition by the parliament of his method. Upon this apparently trifling question arose a controversy which lasted many years, occupied several universities, and led to the interposition of personages no less important than the pope and the emperor, but which is thought to have largely contributed to the final downfall of the Arabian medicine.

Paracelsus and Chemical Medicine.—Contemporary with the school of medical humanists, but little influenced by them, lived in Germany a man of strange genius, of whose character and importance the most opposite opinions have been expressed. The first noticeable quality in Paracelsus (*c.* 1490–1541) is his revolutionary independence of thought, which was supported by his immense personal arrogance. Himself well trained in the learning and medical science of the day, he despised and trampled upon all traditional and authoritative teachings. He began his lectures at Basel by burning the books of Avicenna and others; he afterwards boasted of having read no books for ten years; he protested that his shoe-buckles were more learned than Galen and Avicenna. On the other hand, he spoke with respect of Hippocrates, and wrote a commentary on his *Aphorisms*. In this we see a spirit very different from the enthusiasm of the humanists for a purer and nobler philosophy than the scholastic and Arabian versions of Greek thought. There is no record of Paracelsus' knowledge of Greek, and as, at least in his student days, the most important works of Greek medicine were very imperfectly known, it is probable he had little first hand acquaintance with Galen or Hippocrates, while his breach with the humanists is the more conspicuous from his lecturing and writing chiefly in his native German.

Having thus made a clean sweep of nearly the whole of the dogmatic medicine, what did Paracelsus put in its place? Certainly not pure empiricism, or habits of objective observation. He had a dogma of his own—one founded, according to his German expositors, on the views of the Neoplatonists, of which a few disjointed specimens must here suffice. The human body was a "microcosm" which corresponded to the "macrocosm," and contained in itself all parts of visible nature,—sun, moon, stars and the poles of heaven. To know the nature of man and how to deal with it, the physician should study, not anatomy, which Paracelsus utterly rejected, but all parts of external nature. Life was a perpetual germinative process controlled by the indwelling spirit or Archeus; and diseases, according to the mystical conception of Paracelsus, were not natural but spiritual. Nature was sufficient for the cure of most diseases; art had only to interfere when the internal physician, the man himself, was tired or incapable. Then some remedy had to be introduced which should be antagonistic, not to the disease in a physical sense, but to the spiritual seed of the disease. These remedies were *arcana*—a word corresponding partly to what we now call specific remedies, but implying a mysterious connexion between the remedy and the "essence" of the disease. Arcana were often shown to be such by their physical properties, not only by such as heat, cold, &c., but by fortuitous resemblances to certain parts of the body; thus arose the famous doctrine of "signatures," or signs indicating the virtues and uses of natural objects, which was afterwards developed into great complexity. Great importance was also attached to chemically prepared remedies as containing the essence or spiritual quality of the material from which they were derived. The actual therapeutical resources of Paracelsus included a large number of metallic preparations, in the introduction of some of which he did good service, and, among vegetable preparations, the tincture of opium, still known by the name he gave it, laudanum. In this doubtless he derived much advantage from his knowledge of chemistry, though the science was as yet not disentangled from the secret traditions of alchemy, and was often mixed up with imposture.

German historians of medicine attach great importance to the revolt of Paracelsus against the prevailing systems, and trace in his writings anticipations of many scientific truths of later times. That his personality was influential, and his intrepid originality of great value as an example in his own country, is undeniable. As a national reformer he has been not inaptly compared to Luther. But his importance in the universal history of medicine we cannot estimate so highly. The chief immediate result we can trace is the introduction of certain mineral remedies, especially antimony, the use of which became a kind of badge of the disciples of Paracelsus. The use of these remedies was not, however, necessarily connected with a belief in his system, which seems to have spread little beyond his own country. Of the followers of Paracelsus some became mere mystical quacks and impostors. Others, of more learning and better repute, were distinguished from the regular physicians chiefly by their use of chemical remedies. In France the introduction of antimony gave rise to a bitter controversy which lasted into the 17th century, and led to the expulsion of some men of mark from the Paris faculty. In England "chemical medicine" is first heard of in the reign of Elizabeth, and was in like manner contemned and assailed by the College of Physicians and the Society of Apothecaries. But it should be remembered that all the chemical physicians did not call Paracelsus master. The most notorious of that school in England, Francis Anthony (1550–1623), never quotes Paracelsus, but relies upon Arnald de Villanova and Raimon Lull. From this time, however, it is always possible to trace a school of chemical practitioners, who, though condemned by the orthodox Galenists, held their ground, till in the 17th century a successor of Paracelsus arose in the celebrated J. B. Van Helmont.

Consequences of the Revival of Ancient Medicine.—The revival of Galenic and Hippocratic medicine, though ultimately it conferred the greatest benefits on medical sciences, did not immediately produce any important or salutary reform in practical medicine. The standard of excellence in the ancient writers was indeed far above the level of the 16th century; but the fatal habit of taking at second hand what should have been acquired by direct observation retarded progress more than the possession of better models assisted it, so that the fundamental faults of medieval science remained uncorrected.

Nevertheless some progress has to be recorded, even if not due directly to the study of ancient medicine. In the first place the 15th and 16th centuries were notable for the outbreak of certain epidemic diseases, which were unknown to the old physicians. Of these the chief was the "sweating sickness" or "English sweat," especially prevalent in, though not confined to, the country whence it is named. Among many descriptions of this disease, that by John Kaye or Caius, already referred to, was one of the best, and of great importance as showing that the works of Galen did not comprise all that could be known in medicine. The spread of syphilis, a disease equally unknown to the ancients, and the failure of Galen's remedies to cure it, had a similar effect.

In another direction the foundations of modern medicine were being laid during the 16th century—namely, by the introduction of clinical instruction in hospitals. In this Italy, and especially the renowned school of Padua, took the first step, where Giovanni De Monte (Montanus), (1498–1552), already mentioned as a humanist, gave clinical lectures on the patients in the hospital of St Francis, which may still be read with interest. Pupils flocked to him from all European countries; Germans are especially mentioned; a Polish student reported and published some of his lectures; and the Englishman Kaye was a zealous disciple, who does not, however, seem to have done anything towards transplanting this method of instruction to his own country. Inspections of the dead, to ascertain the nature of the disease, were made, though not without difficulty, and thus the modern period of the science of morbid anatomy was ushered in.

Medicine in the 17th Century.—The medicine of the early 17th century presents no features to distinguish it from that of the preceding century. The practice and theory of medicine were mainly founded upon Hippocrates and Galen, with ever-increasing additions from the chemical school. But the development of mathematical and physical science soon introduced a fundamental change in the habits of thought with respect to medical doctrine.

These discoveries not only weakened or destroyed the respect for authority in matters of science, but brought about a marked tendency to mechanical explanations of life and disease. When William Harvey by his discovery of the circulation furnished an explanation of many vital processes which was reconcilable with the ordinary laws of mechanics, the efforts of medical theorists were naturally directed to bringing all the departments of medicine under similar laws. It is often assumed that the writings and influence of Bacon did much towards introducing a more scientific method into medicine and physiology. But, without discussing the general philosophical position or historical importance of Bacon, it may safely be said that his direct influence can be little traced in medical writings of the first half of the 17th century. Harvey, as is well known, spoke slightingly of the great chancellor, and it is not till the rapid development of physical science in England and Holland in the latter part of the century, that we find Baconian principles explicitly recognized.

The dominant factors in the 17th-century medicine were the discovery of the circulation by William Harvey (published in 1628), the mechanical philosophy of Descartes and the contemporary progress of physics, the teaching of Van Helmont and the introduction of chemical explanations of morbid processes, and finally, combined of all these, and inspiring them, the rise of the spirit of inquiry and innovation, which may be called the scientific movement. Before speaking in detail of these, we may note that by other influences quite independent of theories, important additions were made to practical medicine. The method of clinical instruction in hospitals, commenced by the Italians, was introduced into Holland, where it was greatly developed, especially at Leiden, in the hands of Francis de la Boë, called Sylvius (1641–1672). It is noteworthy that concurrently with the rise of clinical study the works of Hippocrates were more and more valued, while Galen began to sink into the background.

At the same time the discovery of new diseases, unknown to the ancients, and the keener attention which the great epidemics of plague caused to be paid to those already known, led to more minute study of the natural history of disease. The most important disease hitherto undescribed was rickets, first made known by Arnold de Boot, a Frisian who practised in Ireland, in 1649, and afterwards more fully in the celebrated work of Francis Glisson (1597–1677) in 1651. The plague was carefully studied by Isbrand de Diemerbroek, in his *De Peste* (1646), and others. Nathaniel Hodges of London (1629–1688) in 1665 seems to have been the first who had the courage to make a post mortem inspection of a plague patient. Christopher Bennet (1617–1655) wrote an important work on consumption in 1654. During the same period many new remedies were introduced, the most important being cinchona-bark, brought to Spain in the year 1640. The progress of pharmacy was shown by the publication of *Dispensatories* or *Pharmacopoeiae*—such as that of the Royal College of Physicians of London in 1618. This, like the earlier German works of the same kind (on which it was partly founded), contains both the traditional (Galenical) and the modern or chemical remedies.

Van Helmont.—The medicine of the 17th century was especially distinguished by the rise of sytems; and we must first speak of an eccentric genius who endeavoured to construct a system for himself, as original and opposed to tradition as that of Paracelsus. J. B. Van Helmont (1578–1644) was a man of noble family in Brussels, who, after mastering all other branches of learning as then understood, devoted himself with enthusiasm to medicine and chemistry. By education and position a little out of the regular lines of the profession, he took up in medicine an independent attitude. Well acquainted with the doctrines of Galen, he rejected them as thoroughly as Paracelsus did, and borrowed from the latter some definite ideas as well as his revolutionary spirit. The archeus of Paracelsus appears again, but with still further complications—the whole body being controlled by the *archeus influus*, and the organ of the soul and its various parts by the *archei insiti*, which are subject to the central archeus. Many of the symptoms of diseases were caused by the passions and perturbations of the archeus, and medicines acted by modifying the *ideas* of the same archeus. These and other notions cannot be here stated at sufficient length to be intelligible. It is enough to say that on this fantastic basis Helmont constructed a medical system which had some practical merits, that his therapeutical methods were mild and in many respects happy, and that he did service by applying newer chemical methods to the preparation of drugs. He thus had some share, though a share not generally recognized, in the foundation of the iatro-chemical school, now to be spoken of. But his avowed followers formed a small and discredited sect, which, in England at least, can be clearly traced in the latter part of the century.

Discovery of the Circulation of the Blood.—The influence of Harvey's discovery began to be felt before the middle of the century. Its merits were recognized by Descartes, among the first, nine years after its publication. For the history of the discovery, and its consequences in anatomy and physiology, we must refer to the article HARVEY. In respect of practical medicine, much less effect was at first noticeable. But this example, combined with the Cartesian principles, set many active and ingenious spirits to work to reconstruct the whole of medicine on a physiological or even a mechanical basis—to endeavour to form what we should now call physiological or scientific medicine. The result of this was not to eliminate dogma from medicine, though it weakened the authority of the old dogma. The movement led rather to the formation of schools or systems of thought, which under various names lasted on into the 18th century, while the belief in the utility or necessity of schools and systems lasted much longer. The most important of these were the so-called iatro-physical or mechanical and the iatro-chemical schools.

Iatro-Physical School.—The iatro-physical school of medicine grew out of physiological theories. Its founder is held to have been G. A. Borelli (1608–1679), whose treatise *De motu animalium*, published in 1680, is regarded as marking an epoch in physiology. The tendency of the school was to explain the actions and functions of the body on physical, and especially on mechanical, principles. The movements of bones and muscles were referred to the theory of levers; the process of digestion was regarded as essentially a process of trituration; nutrition and secretion were shown to be dependent upon the tension of the vessels, and so forth. The developments of this school belong rather to the history of physiology, where they appear, seen in the light of modern science, as excellent though premature endeavours in a scientific direction. But the influence of these theories on practical medicine was not great. The more judicious of the mechanical or physical school refrained, as a judicious modern physiologist does, from too immediate an application of their principles to daily practice. Mechanical theories were introduced into pathology, in explanation of the processes of fever and the like, but had little or no influence on therapeutics. The most important men in this school after Borelli were Nicolaus Stensen (Steno), (1638–1686), Giorgio Baglivi (1669–1707) and Lorenzo Bellini (1643–1704). An English physician, William Cole (1635–1716), is also usually ranked with them. One of the most elaborate developments of the system was that of Archibald Pitcairne (1652–1713), a Scottish physician who became professor at Leiden, to be spoken of hereafter.

Iatro-Chemical School.—The so-called iatro-chemical school stood in a much closer relation to practical medicine than the iatro-physical. The principle which mainly distinguished it was not merely the use of chemical medicines in addition to the traditional, or, as they were called in distinction, "Galenical" remedies, but a theory of pathology or causation of disease entirely different from the prevailing "humoral" pathology. Its chief aim was to reconcile the new views in physiology and chemistry with practical medicine. In some theoretical views, and in the use of certain remedies, the school owed something to Van Helmont and Paracelsus, but took in the main an independent position. The founder of the iatro-chemical school was Sylvius (1614–1672), who belonged to a French family settled in Holland, and was for fourteen years professor of medicine at Leiden, where he attracted students from all quarters of Europe. He made a resolute attempt to reconstruct medicine on the two bases of the doctrine of the circulation of the blood and the new views of chemistry. Fermentation, which was supposed to take place in the stomach, played an important part in the vital processes. Chemical disturbances of these processes, called *acridities*, &c., were the cause of fevers and other diseases. Sometimes acid sometimes alkaline properties predominated in the juices and secretions of the body, and produced corresponding disturbances. In nervous diseases disturbances of the vital "spirits" were most important. Still in some parts of his system Sylvius shows an anxiety to base his pathology on anatomical changes. The remedies he employed were partly galenical, partly chemical. He was very moderate in the use of bleeding.

The doctrines of Sylvius became widely spread in Holland and Germany; less so in France and Italy. In England they were not generally accepted till adopted with some modifications by Thomas Willis the great anatomist (1621–1675), who is the chief English representative of the chemical school. Willis was as thorough-going a chemist as Sylvius. He regarded all bodies, organic and inorganic, as composed of the three elements—spirit, sulphur and salt, the first being only found abundantly in animal bodies. The "intestine movement of particles" in every body, or fermentation, was the explanation of many of the processes of life and disease. The sensible properties and physical alterations of animal fluids and solids depended upon different proportions, movements and combinations of these particles. The elaborate work *Pharmaceutice rationalis* (1674), based on these materials, had much influence in its time, though it was soon forgotten. But some parts of Willis's works, such as his descriptions of nervous diseases, and his account (the earliest) of diabetes, are classical contributions to scientific medicine. In the application of chemistry to the examination of secretions Willis made some important steps. The chemical school met with violent opposition, partly from the adherents of the ancient medicine, partly from the iatro-mechanical school. Towards the end of the 17th century appeared an English medical reformer who sided with none of these schools, but may be said in some respects to have surpassed and dispensed with them.

Sydenham and Locke.—Thomas Sydenham (1624–1689) was educated at Oxford and at Montpellier. He was well acquainted with the works of the ancient physicians, and probably fairly so with chemistry. Of his knowledge of anatomy nothing definite can be said, as he seldom refers to it. His main avowed principle was to do without hypothesis, and study the actual diseases in an unbiassed manner. As his model in medical methods, Sydenham repeatedly and pointedly refers to Hippocrates, and he has not unfairly been called the English Hippocrates. He resembled his Greek master in the high value he set on the study of the "natural history of disease"; in the importance he attached to "epidemic constitution"—that is, to the influence of weather and other natural causes in modifying disease; and further in his conception of the healing power of nature in disease, a doctrine which he even expanded beyond the teaching of Hippocrates. According to Sydenham, a disease is nothing more than an effort of nature to restore the health of the patient by the elimination of the morbific matter. The extent to which his practice was influenced by this and other a priori conceptions prevents us from classing Sydenham as a pure empiric; but he had the rare merit of never permitting himself to be enslaved even by his own theories. Still less was his mind warped by either of the two great systems, the classical and the chemical, which then divided the medical world. Sydenham's influence on European medicine was very great. His principles were welcomed as a return to nature by those who were weary of theoretical disputes. He introduced a milder and better way of treating fevers—especially small-pox, and gave strong support to the use of specific medicines—especially Peruvian bark. He was an advocate of bleeding, and often carried it to excess. Another important point in Sydenham's doctrine is his clear recognition of many diseases as being what would be now called *specific*, and not due merely to an alteration in the primary qualities or humours of the older schools. From this springs his high appreciation of specific medicines.

One name should always be mentioned along with Sydenham—that of his friend John Locke. The great sensational philosopher was a thoroughly trained physician, and practised privately. He shared and defended many of Sydenham's principles, and in the few medical observations he has left shows himself to be even more thorough-going than the "English Hippocrates." It is deeply to be regretted in the interests of medicine that he did not write more. It is, however, reasonable to suppose that his commanding intellect often makes itself felt in the words of Sydenham. One sentence of Locke's, in a letter to William Molyneux, sums up the practical side of Sydenham's teaching:—

"You cannot imagine how far a little observation carefully made by a man not tied up to the four humours [Galen], or sal, sulphur and mercury [Paracelsus], or to acid and alcali [Sylvius and Willis] which has of late prevailed, will carry a man in the curing of diseases though very stubborn and dangerous; and that with very little and common things, and almost no medicine at all."

We thus see that, while the great anatomists, physicists and chemists—men of the type of Willis, Borelli and Boyle—were laying foundations which were later on built up into the fabric of scientific medicine, little good was done by the premature application of their half-understood principles to practice. The reform of practical medicine was effected by men who aimed at, and partly succeeded in, rejecting all hypothesis and returning to the unbiassed study of natural processes, as shown in health and disease.

Sydenham showed that these processes might be profitably studied and dealt with without explaining them; and, by turning men's minds away from explanations and fixing them on facts, he enriched medicine with a *method* more fruitful than any discoveries in detail. From this time forth the reign of canonical authority in medicine was at an end, though the dogmatic spirit long survived.

The 18th Century.—The medicine of the 18th century is notable, like that of the latter part of the 17th, for the striving after complete theoretical systems. The influence of the iatro-physical school was by no means exhausted; and in England, especially through the indirect influence of Sir Isaac Newton's (1642–1727) great astronomical generalizations, it took on a mathematical aspect, and is sometimes known as iatro-mathematical. This phase is most clearly developed in Archibald Pitcairne (1652–1713), who, though a determined opponent of metaphysical explanations, and of the chemical doctrines, gave to his own rude mechanical explanations of life and disease almost the dogmatic completeness of a theological system. His countryman and pupil, George Cheyne (1671–1743), who lived some years at Bath, published a new theory of fevers on the mechanical system, which had a great reputation. Their English contemporaries and successors, John Freind, William Cole, and Richard Mead, leaned also to mechanical explanations, but with a distrust of systematic theoretical completeness, which was perhaps partly a national characteristic, partly the result of the teaching of Sydenham and Locke. Freind (1675–1728) in his *Emmenologia* gave a mechanical explanation of the phenomena of menstruation. He is also one of the most distinguished writers on the history of medicine. Cole (1635–1716) (see above) published mechanical hypotheses concerning the causation of fevers which closely agree with those of the Italian iatro-mechanical school. More distinguished in his own day than any of these was Mead (1673–1754), one of the most accomplished and socially successful physicians of modern times. Mead was the pupil of the equally popular and successful John Radcliffe (1650–1714), who had acquired from Sydenham a contempt for book-learning, and belonged to no school in medicine but the school of common sense. Radcliffe left, however, no work requiring mention in a history of medicine. Mead, a man of great learning and intellectual activity, was an ardent advocate of the mathematical doctrines. "It is very evident," he says, "that all other means of improving medicine have been found ineffectual, by the stand it was at for two thousand years, and that, since mathematicians have set themselves to the study of it, men already begin to talk so intelligibly and comprehensibly, even about abstruse matters, that it is to be hoped that mathematical learning will be the distinguishing mark of a physician and a quack." His *Mechanical Account of Poisons*, in the first edition (1702), gave an explanation of the effects of poisons, as acting only on the blood. Afterwards he modified his hypothesis, and referred the disturbances produced to the "nervous liquor," which he supposed to be a quantity of the "universal elastic matter" diffused through the universe, by which Newton explained the phenomena of light—*i.e.* what was afterwards called the luminiferous ether. Mead's treatise on *The Power of the Sun and Moon over Human Bodies* (1704), equally inspired by Newton's discoveries, was a premature attempt to assign the influence of atmospheric pressure and other cosmical causes in producing disease. His works contain, however, many original experiments, and excellent practical observations. James Keill (1673–1719) applied Newtonian and mechanical principles to the explanation of bodily functions with still greater accuracy and completeness; but his researches have more importance for physiology than for practical medicine.

Boerhaave.—None of these men founded a school—a result due in part to their intellectual character, in part to the absence in England of medical schools equivalent in position and importance to the universities of the Continent. An important academical position was, on the other hand, one of the reasons why a physician not very different in his way of thinking from the English physicians of the age of Queen Anne was able to take a far more predominant position in the medical world. Hermann Boerhaave (1668–1738) was emphatically a great teacher. He was for many years professor of medicine at Leiden, where he lectured five hours a day, and excelled in influence and reputation not only his greatest forerunners, Montanus of Padua and Sylvius of Leiden, but probably every subsequent teacher. The hospital of Leiden, though with only twelve beds available for teaching, became the centre of medical influence in Europe. Many of the leading English physicians of the 18th century studied there; Gerard Van Swieten (1700–1772), a pupil of Boerhaave, transplanted the latter's method of teaching to Vienna, and founded the noted Vienna school of medicine. As the organizer, and almost the constructor, of the modern method of clinical instruction, the services of Boerhaave to the progress of medicine were immense, and can hardly be overrated. In his teaching, as in his practice, he avowedly followed the method of Hippocrates and Sydenham, both of whom he enthusiastically admired. In his medical doctrines he must be pronounced an eclectic, though taking his stand mainly on the iatro-mechanical school. The best-known parts of Boerhaave's system are his doctrines of inflammation, obstruction and "plethora." By the last named especially he was long remembered. His object was to make all the anatomical and physiological acquisitions of his age, even microscopical anatomy, which he diligently studied, available for use in the practice of medicine. He thus differed from Sydenham, who took almost as little account of modern science as of ancient dogma. Boerhaave may be in some respects compared to Galen, but again differed from him in that he always abstained from attempting to reduce his knowledge to a uniform and coherent system. Boerhaave attached great importance to the study of the medical classics, but rather treated them historically than quoted them as canonical authorities. It almost follows from the nature of the case that the great task of Boerhaave's life, a synthesis of ancient and modern medicine, and the work in which this is chiefly contained, his celebrated *Institutions*, could not have any great permanent value. Nearly the same thing is true even of the *Aphorisms*, in which, following the example of Hippocrates, he endeavoured to sum up the results of his long experience.

Hoffmann and Stahl.—We have now to speak of two writers in whom the systematic tendency of the 18th century showed itself most completely.

Friedrich Hoffmann (1660–1742), like Boerhaave, owed his influence, and perhaps partly his intellectual characteristics, to his academical position. He was in 1693 appointed the first professor of medicine in the university of Halle, then just founded by the elector Frederick III. Here he became, as did his contemporary and rival Stahl, a popular and influential teacher, though their university had not the European importance of Leiden. Hoffmann's "system" was apparently intended to reconcile the opposing "spiritual" and "materialistic" views of nature, and is thought to have been much influenced by the philosophy of Leibnitz. His medical theories rest upon a complete theory of the universe. Life depended upon a universally diffused ether, which animals breathe in from the atmosphere, and which is contained in all parts of the body. It accumulates in the brain, and there generates the "nervous fluid" or *pneuma*—a theory closely resembling that of Mead on the "nervous liquor," unless indeed Mead borrowed it from Hoffmann. On this system are explained all the phenomena of life and disease. Health depends on the maintenance of a proper "tone" in the body—some diseases being produced by excess of tone, or "spasm"; others by "atony," or want of tone. But it is impossible here to follow its further developments. Independently of his system, which has long ceased to exert any influence, Hoffmann made some contributions to practical medicine; and his great knowledge of chemistry enabled him to investigate the subject of mineral waters. He was equally skilful in pharmacy, but lowered his position by the practice, which would be unpardonable in a modern physician, of trafficking in secret remedies.

George Ernest Stahl (1660–1734) was for more than twenty years professor of medicine at Halle, and thus a colleague of Hoffmann, whom he resembled in constructing a complete theoretical system, though their systems had little or nothing in common. Stahl's chief aim was to oppose materialism. For mechanical conceptions he substituted the theory of "animism"—attributing to the soul the functions of ordinary animal life in man, while the life of other creatures was left to mechanical laws. The symptoms of disease were explained as efforts of the soul to rid itself from morbid influences, the soul acting reasonably with respect to the end of self-preservation. The anima thus corresponds partly to the "nature" of Sydenham, while in other respects it resembles the archeus of Van Helmont. Animism in its completeness met with little acceptance during the lifetime of its author, but influenced some of the iatro-physical school. Stahl was the author of the theory of "phlogiston" in chemistry, which in its day had great importance.

Haller and Morgagni.—From the subtleties of rival systems it is a satisfaction to turn to two movements in the medicine of the 18th century which, though they did not extinguish the spirit of system-making, opened up paths of investigation by which the systems were ultimately superseded. These are physiology in the modern sense, as dating from Haller, and pathological anatomy, as dating from Morgagni.

Albrecht von Haller (1708–1777) was a man of even more encyclopaedic attainments than Boerhaave. He advanced chemistry, botany, anatomy, as well as physiology, and was incessantly occupied in endeavouring to apply his scientific studies to practical medicine, thus continuing the work of his great teacher Boerhaave. Besides all this he was probably more profoundly acquainted with the literature and bibliography of medicine than any one before or since. Haller occupied in the new university of Göttingen (founded 1737) a position corresponding to that of Boerhaave at Leiden, and in like manner influenced a very large circle of pupils

The appreciation of his work in physiology belongs to the history of that science; we are only concerned here with its influence on medicine. Haller's definition of irritability as a property of muscular tissue, and its distinction from sensibility as a property of nerves, struck at the root of the prevailing hypothesis respecting animal activity. It was no longer necessary to suppose that a half-conscious "anima" was directing every movement. Moreover, Haller's views did not rest on a priori speculation, but on numerous experiments. He was among the first to investigate the action of medicines on healthy persons. Unfortunately the lesson which his contemporaries learnt was not the importance of experiment, but only the need of contriving other "systems" less open to objection; and thus the influence of Haller led directly to the theoretical subtleties of William Cullen and John Brown, and only indirectly and later on to the general anatomy of M. F. X. Bichat. The great name of Haller does not therefore occupy a very prominent place in the history of practical medicine.

The work of Giovanni Battista Morgagni (1682–1771) had and still preserves a permanent importance beyond that of all the contemporary theorists. In a series of letters, *De sedibus et causis morborum per anatomen indagatis*, published when he was in his eightieth year, he describes the appearances met with at the post mortem examination as well as the symptoms during life in a number of cases of various diseases. It was not the first work of the kind. The Swiss physician, Théophile Bonet (1620–1689) had published his *Sepulcretum* in 1679; and observations of post mortem appearances had been made by Montanus, P. Tulp, Raymond Vieussens, A.M. Valsalva, G. M. Lancisi, Haller and others. But never before was so large a collection of cases brought together, described with such accuracy, or illustrated with equal anatomical and medical knowledge. Morgagni's work at once made an epoch in the science. Morbid anatomy now became a recognized branch of medical research, and the movement was started which has lasted till our own day.

The contribution of Morgagni to medical science must be regarded as in some respects the counterpart of Sydenham's. The latter had, in neglecting anatomy, neglected the most solid basis for studying the natural history of disease; though perhaps it was less from choice than because his practice, as he was not attached to a hospital, gave him no opportunities. But it is on the combination of the two methods—that of Sydenham and of Morgagni—that modern medicine rests; and it is through these that it has been able to make steady progress in its own field, independently of the advance of physiology or other sciences.

The method of Morgagni found many imitators, both in his own country and in others. In England the first important name in this field is at the same time that of the first writer of a systematic work in any language on morbid anatomy, Matthew Baillie (1761–1823), a nephew of John and William Hunter, who published his treatise in 1795.

Cullen and Brown.—It remains to speak of two systematic writers on medicine in the 18th century, whose great reputation prevents them from being passed over, though their real contribution to the progress of medicine was not great—Cullen and Brown.

William Cullen (1710–1790) was a most eminent and popular professor of medicine at Edinburgh. The same academical influences as surrounded the Dutch and German founders of systems were doubtless partly concerned in leading him to form the plan of a comprehensive system of medicine. Cullen's system was largely based on the new physiological doctrine of irritability, but is especially noticeable for the importance attached to nervous action. Thus even gout was regarded as a "neurosis." These pathological principles of Cullen are contained in his *First Lines of the Practice of Physic*, an extremely popular book, often reprinted and translated. More importance is to be attached to his *Nosology or Classification of Diseases.* The attempt to classify diseases on a natural-history plan was not new, having been commenced by Sauvages and others, and is perhaps not a task of the highest importance. Cullen drew out a classification of great and needless complexity, the chief part of which is now forgotten, but several of his main divisions are still preserved.

It is difficult to form a clear estimate of the importance of the last systematizer of medicine—John Brown (1735–1788)—for, though in England he has been but little regarded, the wide though short-lived popularity of his system on the Continent shows that it must have contained some elements of brilliancy, if not originality. His theory of medicine professed to explain the processes of life and disease, and the methods of cure, upon one simple principle—that of the property of "excitability," in virtue of which the "exciting powers," defined as being (1) external forces and (2) the functions of the system itself, call forth the vital phenomena "sense, motion, mental function and passion." All exciting powers are stimulant, the apparent debilitating or sedative effect of some being due to a deficiency in the degree of stimulus; so that the final conclusion is that "the whole phenomena of life, health as well as disease, consist in stimulus and nothing else." Brown recognized some diseases as *sthenic*, others as *asthenic*, the latter requiring stimulating treatment, the former the reverse; but his practical conclusion was that 97% of all diseases required a "stimulating" treatment. In this he claimed to have made the most salutary reform because all physicians from Hippocrates had treated diseases by depletion and debilitating measures with the object of curing by elimination. It would be unprofitable to attempt a complete analysis of the Brunonian system; and it is difficult now to understand why it attracted so much attention in its day. To us at the present time it seems merely a dialectical construction, having its beginning and end in definitions: the words power, stimulus, &c., being used in such a way as not to correspond to any precise physical conceptions, still less to definite material objects or forces. One recommendation of the system was that it favoured a milder system of treatment than was at that time in vogue; Brown may be said to have been the first advocate of the modern stimulant or feeding treatment of fevers. He advocated the use of "animal soups" or beef-tea. Further, he had the discernment to see that certain symptoms—such as convulsions and delirium, which were then commonly held always to indicate inflammation—were often really signs of weakness.

The fortunes of Brown's system (called, from having been originally written in Latin, the Brunonian) form one of the strangest chapters in the history of medicine. In Scotland, Brown so far won the sympathy of the students that riotous conflicts took place between his partisans and opponents. In England his system took little root. In Italy, on the other hand, it received enthusiastic support, and, naturally, a corresponding degree of opposition. The most important adherent to Brown's system was J. Rasori (1763–1837), who taught it as professor at Pavia, but afterwards substituted his own system of contra-stimulus. The theoretical differences between this and the "stimulus" theory need not be expounded. The practical difference in the corresponding treatment was very great, as Rasori advocated a copious use of bleeding and of depressing remedies, such as antimony. Joseph Frank (1774–1841), a German professor at Pavia, afterwards of Vienna, the author of an encyclopaedic work on medicine now forgotten, embraced the Brunonian system, though he afterwards introduced some modifications, and transplanted it to Vienna. Many names are quoted as partisans or opponents of the Brunonian system in Italy, but scarcely one of them has any other claim to be remembered. In Germany the new system called forth, a little later, no less enthusiasm and controversial heat. C. Girtanner (1760–1800) first began to spread the new ideas (though giving them out as his own), but Weikard was the first avowed advocate of the system. Röschlaub (1768–1835) modified Brown's system into the theory of excitement (*Erregungstheorie*), which for a time was extremely popular in Germany. The enthusiasm of the younger Brunonians in Germany was as great as in Edinburgh or in Italy, and led to serious riots in the university of Göttingen. In America the system was enthusiastically adopted by a noted physician, Benjamin Rush (1745–1813), of Philadelphia, who was followed by a considerable school. France was not more influenced by the new school than England. In both countries the tendency towards positive science and progress by objective investigation was too marked for any theoretical system to have more than a passing influence. In France, however, the influence of Brown's theories is very clearly seen in the writings of François J. V. Broussais, who, though not rightly classed with the system-makers, since his conclusions were partly based upon anatomical investigation, resembled them in his attempt to unite theory and practice in one comprehensive synthesis. The explanation of the meteoric splendour of the Brunonian system in other countries seems to be as follows. In Italy the period of intellectual decadence had set in, and no serious scientific ardour remained to withstand the novelties of abstract theory. In Germany the case was somewhat different. Intellectual activity was not wanting, but the great achievements of the 18th century in philosophy and the moral sciences had fostered a love of abstract speculation; and some sort of cosmical or general system was thought indispensable in every department of special science. Hence another generation had to pass away before Germany found herself on the level, in scientific investigation, of France and England.

Before the theoretic tendency of the 18th century was quite exhausted, it displayed itself in a system which, though in some respects isolated in the history of medicine, stands nearest to that of Brown—that, namely, of Hahnemann (see HOMOEOPATHY). S. C. F. Hahnemann (1753–1844) was in conception as revolutionary a reformer of medicine as Paracelsus. He professed to base medicine entirely on a knowledge of symptoms, regarding all investigation of the causes of symptoms as useless. While thus rejecting all the lessons of morbid anatomy and pathology, he put forward views respecting the causes of disease which hardly bear to be seriously stated. All chronic maladies result either from three diseases—psora (the itch), syphilis or sycosis (a skin disease), or else are maladies produced by medicines. Seven-eighths of all chronic diseases are produced by itch driven inwards.[1] (It is fair to say that these views were published in one of his later works.) In treatment of disease Hahnemann rejected entirely the notion of a *vis medicatrix naturae*, and was guided by his well-known principle

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[1] The itch (*scabies*) is really an affection produced by the presence in the skin of a species of mite (*Acarus scabiei*), and when this is destroyed or removed the disease is at an end.

"similia similibus curantur," which he explained as depending on the law that in order to get rid of a disease some remedy must be given which should substitute for the disease an action dynamically similar, but weaker. The original malady being thus got rid of, the vital force would easily be able to cope with and extinguish the slighter disturbance caused by the remedy. Something very similar was held by Brown, who taught that "indirect debility" was to be cured by a lesser degree of the same stimulus as had caused the original disturbance. Generally, however, Hahnemann's views contradict those of Brown, though moving somewhat in the same plane. In order to select remedies which should fulfil the indication of producing symptoms like those of the disease, Hahnemann made many observations of the action of drugs on healthy persons. He did not originate this line of research, for it had been pursued, if not originated, by Haller, and cultivated systematically by Tommasini, an Italian "contra-stimulist"; but he carried it out with much elaboration. His results, nevertheless, were vitiated by being obtained in the interest of a theory, and by singular want of discrimination. In his second period he developed the theory of "potentiality" or dynamization—namely, that medicines gained in strength by being diluted, if the dilution was accompanied by shaking or pounding, which was supposed to "potentialize" or increase the potency of the medicine. On this principle Hahnemann ordered his original tinctures to be reduced in strength to one-fiftieth; these first dilutions again to one-fiftieth; and so on, even till the thirtieth dilution, which he himself used by preference, and to which he ascribed the highest "potentiality." From a theoretical point of view Hahnemann's is one of the abstract systems, pretending to universality, which modern medicine neither accepts nor finds it worth while to controvert. In the treatment of disease his practical innovations came at a fortunate time, when the excesses of the depletory system had only partially been superseded by the equally injurious opposite extreme of Brown's stimulant treatment. Hahnemann's use of mild and often quite inert remedies contrasted favourably with both of these. Further, he did good by insisting upon simplicity in prescribing, when it was the custom to give a number of drugs, often heterogeneous and inconsistent, in the same prescription. But these indirect benefits were quite independent of the truth or falsity of his theoretical system.

Positive Progress in the 18th Century.—In looking back on the repeated attempts in the 18th century to construct a universal system of medicine, it is impossible not to regret the waste of brilliant gifts and profound acquirements which they involved. It was fortunate, however, that the accumulation of positive knowledge in medicine did not cease. While Germany and Scotland, as the chief homes of abstract speculation, gave birth to most of the theories, progress in objective science was most marked in other countries—in Italy first, and afterwards in England and France. We must retrace our steps a little to enumerate several distinguished names which, from the nature of the case, hardly admit of classification.

In Italy the tradition of the great anatomists and physiologists of the 17th century produced a series of accurate observers and practitioners. Among the first of these were Antonio Maria Valsalva (1666–1723), still better known as an anatomist; Giovanni Maria Lancisi (1654–1720), also an anatomist, the author of a classical work on the diseases of the heart and aneurisms; and Ippolito Francisco Albertini (1662–1738), whose researches on the same class of diseases were no less important.

In France, Jean Baptiste Sénac (1693–1770) wrote also an important work on the affections of the heart. Sauvages, otherwise F. B. de Lacroix (1706–1767), gave, under the title *Nosologia methodica*, a natural-history classification of diseases; Jean Astruc (1684–1766) contributed to the knowledge of general diseases. But the state of medicine in that country till the end of the 18th century was unsatisfactory as compared with some other parts of Europe.

In England the brilliancy of the early part of the century in practical medicine was hardly maintained to the end, and presented, indeed, a certain contrast with the remarkable and unflagging progress of surgery in the same period. The roll of the College of Physicians does not furnish many distinguished names. Among these should be mentioned John Fothergill (1712–1780), who investigated the "putrid sore throat" now called diphtheria, and the form of neuralgia popularly known as tic douloureux. A physician of Plymouth, John Huxham (1694–1768), made researches on epidemic fevers, in the spirit of Sydenham and Hippocrates, which are of the highest importance. William Heberden (1710–1801), a London physician, called by Samuel Johnson *ultimus Romanorum*, "the last of our learned physicians," left a rich legacy of practical observations in the *Commentaries* published after his death. More important in their results than any of these works were the discoveries of EDWARD JENNER (*q.v.*), respecting the prevention of small-pox by vaccination, in which he superseded the partially useful but dangerous practice of inoculation, which had been introduced into England in 1721. The history of this discovery need not be told here, but it may be pointed out that, apart from its practical importance, it has had great influence on the scientific study of infectious diseases. The name of John Pringle (1707–1782) should also be mentioned as one of the first to study epidemics of fevers occurring in prisons and camps. His work, entitled *Observations on the Diseases of an Army*, was translated into many European languages and became the standard authority on the subject.

In Germany the only important school of practical medicine was that of Vienna, as revived by Gerard van Swieten (1700–1772), a pupil of Boerhaave, under the patronage of Maria Theresa. Van Swieten's commentaries on the aphorisms of Boerhaave are thought more valuable than the original text. Other eminent names of the same school are Anton de Haën (1704–1776), Anton Störck (1731–1803), Maximilian Stoll (1742–1788), and John Peter Frank (1745–1821), father of Joseph Frank, before mentioned as an adherent of the Brownian system, and like his son carried away for a time by the new doctrines. This, the old "Vienna School," was not distinguished for any notable discoveries, but for success in clinical teaching, and for its sound method of studying the actual facts of disease during life and after death, which largely contributed to the establishment of the "positive medicine" of the 19th century.

One novelty, however, of the first importance is due to a Vienna physician of the period, Leopold Auenbrugger (1722–1809), the inventor of the method of recognizing diseases of the chest by percussion. Auenbrugger's method was that of *direct* percussion with the tips of the fingers, not that which is now used, of *mediate* percussion with the intervention of a finger or plessimeter; but the results of his method were the same and its value nearly as great. Auenbrugger's great work, the *Inventum novum*, was published in 1761. The new practice was received at first with contempt and even ridicule, and afterwards by Stoll and Peter Frank with only grudging approval. It did not receive due recognition till 1808, when J. N. Corvisart translated the *Inventum novum* into French, and Auenbrugger's method rapidly attained a European reputation. Surpassed, but not eclipsed, by the still more important art of auscultation introduced by R. T. H. Laennec, it is hardly too much to say that this simple and purely mechanical invention has had more influence on the development of modern medicine than all the "systems" evolved by the most brilliant intellects of the 18th century.

Rise of the Positive School in France.—The reform of medicine in France must be dated from the great intellectual awakening caused by the Revolution, but more definitely starts with the researches in anatomy and physiology of Marie François Xavier Bichat (1771–1802). The importance in science of Bichat's classical works, especially of the *Anatomie générale*, cannot be estimated here; we can only point out their value as supplying a new basis for pathology or the science of disease. Among the most ardent of his followers was François Joseph Victor Broussais (1772–1838), whose theoretical views, partly founded on those of Brown and partly on the so-called vitalist school of Théophile Bordeu (1722–1776) and Paul Joseph Barthez (1734–1806), differed from these essentially in being avowedly based on anatomical observations. Broussais's chief aim was to find an anatomical basis for all diseases, but he is especially known for his attempt to explain all fevers as a consequence of irritation or inflammation of the intestinal canal (gastro-entérite). A number of other maladies, especially general diseases and those commonly regarded as nervous, were attributed to the same cause. It would be impossible now to trace the steps which led to this wild and long since exploded theory. It led, among other consequences, to an enormous misuse of bleeding. Leeches were his favourite instruments; and so much so that he is said to have used 100,000 in his own hospital wards during one year. He was equalled if not surpassed in this excess by his follower Jean Bouillaud (1796–1881), known for his important work on heart diseases. Broussais's system, to which he gave the name of "Médecine physiologique," did much indirect good, in fixing attention upon morbid changes in the organs, and thus led to the rise of the strongly opposed anatomical and pathological school of Corvisart, Laennec and Bayle.

Jean Nicolas Corvisart (1755–1821) has already been mentioned as the translator and introducer into France of Auenbrugger's work on percussion. He introduced some improvements in the method, but the only real advance was the introduction of mediate percussion by Pierre Adolphe Piorry (1794–1879) in 1828. The discovery had, however, yet to be completed by that of auscultation, or listening to sounds produced in the chest by breathing, the movements of the heart, &c. The combination of these methods constitutes what is now known as *physical diagnosis*. René Théophile Hyacinthe Laennec (1781–1826) was the inventor of this most important perhaps of all methods of medical research. Except for some trifling notices of sounds heard in certain diseases, this method was entirely new. It was definitely expounded in an almost complete form in his work *De l'auscultation médiate*, published in 1819. Laennec attached undue importance to the use of the stethoscope, and laid too much weight on specific signs of specific diseases; otherwise his method in its main features has remained unchanged. The result of his discovery was an entire revolution in the knowledge of diseases of the chest; but it would be a mistake to forget that an essential factor in this revolution was the simultaneous study of the condition of the diseased organs as seen after death. Without the latter, it is difficult to see how the information conveyed by sounds could ever have been verified. This increase of knowledge is therefore due, not to auscultation alone, but to auscultation combined with morbid anatomy. In the case of Laennec himself this qualification takes nothing from his fame, for he studied so minutely the relations of post-mortem appearances to symptoms during life that, had he not discovered auscultation, his researches in morbid anatomy would have made him famous. The pathologico-anatomical method was also followed with great zeal and success by Gaspard Laurent Bayle (1774–1816), whose researches on tubercle, and the changes of the lungs and other organs in consumption, are the foundation of most that has been done since his time. It was of course antecedent to the discovery of auscultation. Starting from these men arose a school of physicians who endeavoured to give to the study of symptoms the same precision as belonged to anatomical observations, and by the combination of both methods made a new era in clinical medicine. Among these were Auguste François Chomel (1788–1858), Pierre Charles Alexandre Louis (1787–1872), Jean Cruveilhier (1791–1874) and Gabriel Andral (1797–1876). Louis, by his researches on pulmonary consumption and typhoid fever, had the chief merit of refuting the doctrines of Broussais. In another respect also he aided in establishing an exact science of medicine by the introduction of the numerical or statistical method. By this method only can the fallacies which are attendant on drawing conclusions from isolated cases be avoided; and thus the chief objection which has been made to regarding medicine as an inductive science has been removed. Louis's method was improved and systematized by Louis Denis Jules Gavarret (1809–1890); and its utility is now universally recognized. During this brilliant period of French medicine the superiority of the school of Paris could hardly be contested. We can only mention the names of Pierre Bretonneau (1771–1862), Louis Léon Rostan (1790–1866), Jean Louis D'Alibert (1766–1837), Pierre François Olive Rayer (1793–1867) and Armand Trousseau (1801–1866), the eloquent and popular teacher.

English Medicine from 1800 to 1840.—The progress of medicine in England during this period displays the same characteristics as at other times, viz. a gradual and uninterrupted development, without startling changes such as are caused by the sudden rise or fall of a new school. Hardly any theoretical system is of English birth; Erasmus Darwin (1731–1802), the grandfather of the great Charles Darwin, alone makes an exception. In his *Zoonomia* (1794) he expounded a theory of life and disease which had some resemblance to that of Brown, though arrived at (he says) by a different chain of reasoning.

Darwin's work shows, however, the tendency to connect medicine with physical science, which was an immediate consequence of the scientific discoveries of the end of the 18th century, when Priestley and Cavendish in England exercised the same influence as Lavoisier in France. The English school of medicine was also profoundly stirred by the teachings of the two brothers William and John Hunter, especially the latter—who must therefore be briefly mentioned, though their own researches were chiefly concerned with subjects lying a little outside the limits of this sketch. William Hunter (1718–1783) was known in London as a brilliant teacher of anatomy and successful obstetric physician; his younger brother and pupil, John Hunter (1728–1793), was also a teacher of anatomy, and practised as a surgeon. His immense contributions to anatomy and pathology cannot be estimated here, but his services in stimulating research and training investigators belong to the history of general medicine. They are sufficiently evidenced by the fact that Edward Jenner and Matthew Baillie were his pupils.

The same scientific bent is seen in the greater attention paid to morbid anatomy (which dates from Baillie) and the more scientific method of studying diseases. An instance of the latter is the work of Robert Willan (1757–1812) on diseases of the skin—a department of medicine in which abstract and hypothetical views had been especially injurious. Willan, by following the natural-history method of Sydenham, at once put the study on a sound basis; and his work has been the starting-point of the most important modern researches. About the same time William Charles Wells (1757–1817), a scientific investigator of remarkable power, and the author of a celebrated essay on dew, published observations on alterations in the urine, which, though little noticed at the time, were of great value as assisting in the important discovery made some years afterwards by Richard Bright.

These observers, and others who cannot be mentioned here, belong to the period when English medicine was still little influenced by the French school. Shortly after 1815, however, when the continent of Europe was again open to English travellers, many English doctors studied in Paris, and the discoveries of their great French contemporaries began to be known. The method of auscultation was soon introduced into England by pupils of Laennec. John Forbes (1787–1861) in 1824, and William Stokes (1804–1878) of Dublin in 1825, published treatises on the use of the stethoscope. Forbes also translated the works of Laennec and Auenbrugger, and an entire revolution was soon effected in the knowledge of diseases of the chest. James Hope (1801–1841) and Peter Mere Latham (1789–1875) further developed this subject, and the former was also known for his researches in morbid anatomy. The combination of clinical and anatomical research led, as in the hands of the great French physicians, to important discoveries by English investigators. The discovery by Richard Bright (1789–1858) of the disease of the kidneys known by his name proved to be one of the most momentous of the century. It was published in *Reports of Medical Cases 1827–1831*. Thomas Addison (1793–1860) takes, somewhat later, a scarcely inferior place. The remarkable physiological discoveries of Sir Charles Bell (1774–1842) and Marshall Hall (1790–1857) for the first time rendered possible the discrimination of diseases of the spinal cord. Several of these physicians were also eminent for their clinical teaching—an art in which Englishmen had up till then been greatly deficient.

Although many names of scarcely less note might be mentioned among the London physicians of the early part of the century, we must pass them over to consider the progress of medicine in Scotland and Ireland. In Edinburgh the admirable teaching of Cullen had raised the medical faculty to a height of prosperity of which his successor, James Gregory (1758–1821), was not unworthy. His nephew, William Pulteney Alison (1790–1859), was even more widely known. These great teachers maintained in the northern university a continuous tradition of successful teaching, which the difference in academical and other circumstances rendered hardly possible in London. Nor was the northern school wanting in special investigators, such as John Abercrombie (1780–1844), known for his work on diseases of the brain and spinal cord, published in 1828, and many others. Turning to Ireland, it should be said that the Dublin school in this period produced two physicians of the highest distinction. Robert James Graves (1796–1853) was a most eminent clinical teacher and observer, whose lectures are regarded as the model of clinical teaching, and indeed served as such to the most popular teacher of the Paris school in the middle of this century, Trousseau. William Stokes (1804–1878) was especially known for his works on diseases of the chest and of the heart, and for his clinical teaching.

German Medicine from 1800 to 1840.—Of the other countries of Europe, it is now only necessary to mention Germany. Here the chief home of positive medicine was still for a long time Vienna, where the "new Vienna school" continued and surpassed the glory of the old. Joseph Skoda (1805–1881) extended, and in some respects corrected, the art of auscultation as left by Laennec. Karl Rokitansky (1804–1878), by his colossal labours, placed the science of morbid anatomy on a permanent basis, and enriched it by numerous discoveries of detail. Most of the ardent cultivators of this science in Germany in the next generation were his pupils. In the other German schools, though some great names might be found, as Moritz Heinrich Romberg (1795–1873), the founder of the modern era in the study of nervous diseases, the general spirit was scholastic and the result barren till the teaching of one man, whom the modern German physicians generally regard as the regenerator of scientific medicine in their country, made itself felt. Johann Lucas Schönlein (1793–1864) was first professor at Würzburg, afterwards at Zürich, and for twenty years at Berlin (from 1839–1859). Schönlein's positive contributions to medical science were not large; but he made in 1839 one discovery, apparently small, but in reality most suggestive, namely, that the contagious disease of the head called favus is produced by the growth in the hair of a parasitic fungus. In this may be found the germ of the startling modern discoveries in parasitic diseases. His systematic doctrines founded the so-called "natural history school"; but his real merit was that of the founder or introducer of a method. In the words of H. Häser: "Schönlein has the incontestable merit of having been the first to establish in Germany the exact method of the French and the English, and to impregnate this method with the vivifying spirit of German research." (J. F. P.)

Modern Progress.—In recent times the positive bent of modern knowledge and methods in other spheres of science and thought, and especially in biology, has influenced medicine profoundly. Minuter accuracy of observation was inculcated by the labours and teaching of the great anatomists of the 17th century; and, for modern times, experimental physiology was instituted by Harvey, anatomy having done little to interpret life in its dynamic aspects. For medicine in England Harvey did what William Gilbert did for physics and Robert Boyle for chemistry: he insisted upon direct interrogation of natural processes, and thereby annihilated the ascendancy of mere authority, which, while nations were in the making, was an essential principle in the welding together of heterogeneous and turbulent peoples. The degradation of medicine between Galen and Harvey, if in part it consisted in the blind following of the authority of the former physician, was primarily due to other causes; and its new development was not due to the discovery of the experimental method alone: social and political causes also are concerned in the advance even of the exact sciences. Among such contributory causes is the more familiar intercourse of settled nations which we enjoy in our own day; the ideas of one nation rapidly permeate neighbouring nations, and by the means of printed books penetrate into remoter provinces and into distant lands. Hence the description of the advance of medicine in western Europe and America may for the latest stage be taken as a whole, without that separate treatment, nation by nation, which in the history of earlier times was necessary. Italy lost the leading place she had taken in the new development of science. The several influences of modern Germany, France and America became of the first importance to English medicine; but these tides, instead of pursuing their courses as independent streams, have become confluent. The work of Theodor Schwann (1810–1882), Johannes Müller (1809–1875), Rudolph Virchow and Karl Ludwig (1816–1805) in Germany, of R. T. H. Laennec and Claude Bernard in France, was accepted in England, as that of Matthew Baillie, Charles Bell, Bright, Graves and others of the British school, quickly made itself felt abroad.

Experimental Method recognized.

The character of modern medicine cannot be summed in a word, as, with more or less aptness, that of some previous periods may be. Modern medicine, like modern science, is as boldly speculative as it has been in any age, and yet it is as observant as in any naturalistic period; its success lies in the addition to these qualities of the method of verification; the fault of previous times being not the activity of the speculative faculty, without which no science can be fertile, but the lack of methodical reference of all and sundry propositions, and parts of propositions, to the test of experiment. In no department is the experimental method more continually justified than in that of the natural history of disease, which at first sight would seem to have a certain independence of it and a somewhat exclusive value of its own. Hippocrates had no opportunity of verification by necropsy, and Sydenham ignored pathology; yet the clinical features of many but recently described diseases, such, for example, as that named after Graves, and myxoedema, both associated with perversions of the thyroid gland, lay as open to the eye of physicians in the past as to our own. Again, to the naturalist the symptoms of tabes dorsalis were distinctive enough, had he noted them. No aid to the trained eye was necessary for such observations, and for many other such; yet, if we take Sir Thomas Watson (1792–1882) as a modern Sydenham, we may find in his lectures no suspicion that there may be a palsy of muscular co-ordination apart from deprivation of strength. Indeed, it does not seem to have occurred to any one to compare the muscular strength in the various kinds of paraplegia. Thus it was, partly because the habit of acceptance of authority, waning but far from extirpated, dictated to the clinical observer what he should see; partly because the eye of the clinical observer lacked that special training which the habit and influence of experimental verification alone can give, that physicians, even acute and practised physicians, failed to see many and many a symptomatic series which went through its evolutions conspicuously enough, and needed for its appreciation no unknown aids or methods of research, nor any further advances of pathology. We see now that the practice of the experimental method endows with a new vision both the experimenter himself and, through his influence, those who are associated with him in medical science, even if these be not themselves actually engaged in experiment; a new discipline is imposed upon old faculties, as is seen as well in other sciences as in those on which medicine more directly depends. And it is not only the perceptions of eye or ear which tell, but also the association of concepts behind these adits of the mind. It was the concepts derived from the experimental methods of Harvey, Lavoisier, Liebig, Claude Bernard, Helmholtz, Darwin, Pasteur, Lister and others which, directly or indirectly, trained the eyes of clinicians to observe more closely and accurately; and not of clinicians only, but also of pathologists, such as Matthew Baillie, Cruveilhier, Rokitansky, Bright, Virchow—to name but a few of those who, with (as must be admitted) new facilities for necropsies, began to pile upon us discoveries in morbid anatomy and histology. If at first in the 18th century, and in the earlier 19th, the discoveries in this branch of medical knowledge had a certain isolation, due perhaps to the prepossessions of the school of Sydenham, they soon became the property of the physician, and were brought into co-ordination with the clinical phenomena of disease. The great Morgagni, the founder of morbid anatomy, himself set the example of carrying on this study parallel with clinical observation; and always insisted that the clinical story of the case should be brought side by side with the revelations of the necropsy. In pathology, indeed, Virchow's (1821–1902) influence in the transfiguration of this branch of science may almost be compared to that of Darwin and Pasteur in their respective domains. In the last quarter of the 19th century the conception grew clearer that morbid anatomy for the most part demonstrates disease in its static aspects only, and also for the most part in the particular aspect of final demolition; and it became manifest, as pathology and clinical medicine became more and more thoroughly integrated, that the processes which initiate and are concerned in this dissolution were not revealed by the scalpel.

Again, the physician as naturalist, though stimulated by the pathologist to delineate disease in its fuller manifestations, yet was hampered in a measure by the didactic method of constructing "types" which should command the attention of the disciple and rivet themselves on his memory; thus too often those incipient and transitory phases which initiate the paths of dissolution were missed. Not only so, but the physician, thus fascinated by "types," and impressed by the silent monuments of the pathological museum, was led to localize disease too much, to isolate the acts of nature, and to forget not only the continuity of the phases which lead up to the exemplary forms, or link them together, but to forget also that even between the types themselves relations of affinity must exist—and these oftentimes none the less intimate for apparent diversities of form, for types of widely different form may be, and indeed often are, more closely allied than types which have more superficial resemblance—and to forget, moreover, how largely negative is the process of abstraction by which types are imagined. Upon this too static a view, both of clinical type and of post-mortem-room pathology, came a despairing spirit, almost of fatalism, which in the contemplation of organic ruins lost the hope of cure of organic diseases. So prognosis became pessimistic, and the therapeutics of the abler men negative, until fresh hopes arose of stemming the tides of evil at their earliest flow.

Influence of Darwin.

Such was medicine, statically ordered in pathology, statically ordered in its clinical concepts, when, on the 24th of November 1859, the *Origin of Species* was published. It is no exaggeration to say that this epoch-making work brought to birth a world of conceptions as new as the work of Copernicus. For the natural philosopher the whole point of view of things was changed; in biology not only had the anthropocentric point of view been banished, but the ancient concept of perpetual flux was brought home to ordinary men, and entered for good into the framework of thought. The study of comparative pathology, yet in an inchoate stage, and of embryology, illuminated and enlarged biological conceptions, both normal and abnormal; and the *ens reale subsistens in corpore* disappeared for ever—at any rate from physiology and medicine. Before Darwin—if the name of Darwin may be used to signify the transformation of thought of which he was the chief artificer—natural objects were regarded, not in medicine and pathology only, as a set of hidebound events; and natural operations as moving in fixed grooves, after a fashion which it is now difficult for us to realize. With the melting of the ice the more daring spirits dashed into the new current with such ardour that for them all traditions, all institutions, were thrown into hotchpot; even elderly and sober physicians took enough of the infection to liberate their minds, and, in the field of the several diseases and in that of post-mortem pathology, the hollowness of classification by superficial resemblance, the transitoriness of forms, and the flow of processes, broke upon the view. Thus it came about not only that classifications of disease based on superficial likeness—such as jaundice, dropsy, inflammation—were broken up, and their parts redistributed, but also that even more set diseases began to lose their settlements, and were recognized as terms of series, as transitory or culminating phases of perturbations which might be traced to their origins, and in their earlier stages perhaps withstood.

The doctrine of heredity in disease thus took a larger aspect; the view of morbid series was no longer bounded even by the life of the individual; and the propagation of taints, and of morbid varieties of man, from generation to generation proved to be no mere repetition of fixed features but, even more frequently, to be modes of development or of dissolution betraying themselves often in widely dissimilar forms, in series often extending over many lives, the terms of which at first sight had seemed wholly disparate. Thus, for example, as generations succeed one another, nervous disorders appear in various guise; epilepsy, megrim, insanity, asthma, hysteria, neurasthenia, a motley array at first sight, seemed to reveal themselves as terms of a morbid series; not only so, but certain disorders of other systems also might be members of the series, such as certain diseases of the skin, and even peculiar susceptibilities or immunities in respect of infections from without. On the other hand, not a few disorders proved to be alien to classes to which narrower views of causation had referred them; of such are tabes dorsalis, neuritis, infantile palsy or tetanus, now removed from the category of primary nervous diseases and placed in one or other of the class of infections; or, conversely, certain forms of disease of the joints are now regarded with some certainty as members of more than one series of diseases chiefly manifest in the nervous system. In the effects of simpler poisons the recognition of unity in diversity, as in the affiliation of a peripheral neuritis to arsenic, illustrated more definitely this serial or etiological method of classifying diseases. On the other hand, inheritance was dismissed, or survived only as a "susceptibility," in the cases of tubercle, leprosy and some other maladies now recognized as infectious; while in others, as in syphilis, it was seen to consist in a translation of the infectious element from parent to offspring. These new conceptions of the multiplicity in unity of disease, and of the fluidity and continuity of morbid processes, might have led to vagueness and over-boldness in speculation and reconstruction, had not the experimental method been at hand with clues and tests for the several series. Of this method the rise and wonderful extension of the science of bacteriology also furnished no inconsiderable part.

Bacteriology.

In the disease of the scalp called favus, Schönlein had discovered a minute mycelial fungus; a remarkable discovery, for it was the first conspicuous step in the attribution of diseases to the action of minute parasites. Schönlein thus did something to introduce new and positive conceptions and exacter methods into Germany; but unfortunately his own mind retained the abstract habit of his country, and his abilities were dissipated in the mere speculations of Schelling. Similarly Karl Hoffmann of Würzburg wasted his appreciations of the newer schools of developmental biology in fanciful notions of human diseases as reversions to normal stages of lower animals; scrofula being for him a reversion to the insect, rickets to the mollusc, epilepsy to the oscillaria, and so forth. Even that distinguished physiologist Johannes Müller remained a staunch vitalist. Fortunately Germany, which at the beginning of the century was delivered over to Brownism and vitalism and was deaf to Bichat, was rescued from this sort of barrenness by the brilliant experimental work of Claude Bernard and Pasteur in France—work which, as regards the attenuated virus, was a development of that of Edward Jenner, and indeed of Schwann, Robert Koch worthily following Pasteur with his work on the bacillus of anthrax and with his discovery of that of tuberculosis; and by the cellular doctrine and abundant labours in pathology of Virchow. Ludwig Brieger then discovered the toxins of certain infections; and Emil A. von Behring completed the sphere of the new study by his discovery of the antitoxins of diphtheria and tetanus. In practical medicine the subsequent results of Behring and his followers have in diphtheria attained a signal therapeutical success. If the striking conceptions of Paul Ehrlich and Emil Fischer continue to prove as fertile in inspiring and directing research as at present they seem to be, another wide sphere of conceptions will be opened out, not in bacteriology only, but also in biological chemistry and in molecular physics. Again, besides giving us the clue to the nature of many diseases and to the continuity of many morbid series, by bacteriology certain diseases, such as actinomycosis, have been recognized for the first time.

As the prevalence of the conceptions signified and inspired by the word "phlogiston" kept alive ontological notions of disease, so the dissipation of vitalistic conceptions in the field of physics prepared men's minds in pathology for the new

Fevers and Inflammations.

views opened by the discoveries of Pasteur on the side of pathogeny, and of J. F. Cohnheim (1839–1884) and of Iliya Metchnikoff on the dynamical side of histology. Of the older ontological notions of disease the strongest were those of the essence of fever and of the essence of inflammation. Broussais had done much to destroy the notion of fever as an entity, but by extravagances in other directions he had discredited the value of his main propositions. Yet, although, as Andral and other French physicians proved, it was extravagant to say that all fevers take their origin from some local inflammation, it was true and most useful to insist, as Broussais vehemently insisted, that "fever" is no substance, but a generalization drawn from symptoms common to many and various diseases springing from many various and often local causes; from causes agreeing perhaps only in the factor of elevation of the temperature of the body. To the establishment of this new conception the improvement and general use of the *clinical thermometer* gave invaluable advantages. This instrument, now indispensable in our daily work at the bedside, had indeed long been known both to physiologists (Haller) and to clinicians. In the 18th century A. de Haën, and, in the United Kingdom, George Cleghorn (1716–1789) of Dublin and James Currie (1756–1805), carried on the use of the thermometer in fevers; and on the continent of Europe in later years F. G. F. von Bärensprung (1822–1865) and Ludwig Traube (1818–1876) did the same service; but it is to the work of Karl August Wunderlich (1815–1877) that we owe the establishment of this means of precision as a method of regular observation both in pathology and in clinical medicine. By his almost exhaustive comparison of febrile movements as symptomatic processes Wunderlich dealt the last blow to the expiring doctrine of the "entity" of "fever"; while on the clinical side Bretonneau and Louis, in 1862–1872, by their careful clinical and pathological studies of forms of fever, relieved the new doctrine of the extravagances of Broussais, and prepared the way for the important distinction of enteric from typhus fever by A. P. Stewart (1813–1883), William Jenner, William Budd (1811–1880), Charles Murchison (1830–1879), J. H. F. Autenrieth (1772–1835), Heinrich Gustav Magnus (1802–1870), Huss and others. By the learned and accomplished Armand Trousseau British and German influences were carried into France.

Meanwhile, Cohnheim and Metchnikoff were engaged in destroying the ontological conception not of fever only, but also of inflammation, of which, as a local event, an ontological conception was no less strongly implanted. By his researches on the migration of the white corpuscles of the blood Cohnheim, on the bases laid by Virchow, brought the processes of inflammation within the scope of the normal, seeing in them but a modification of normal processes under perturbations of relatively external incidence; even the formation of abscess was thus brought by him within the limits of perversion of processes not differing essentially from those of health; and "new formations," "plastic exudations," and other discontinuous origins of an "essential" pathology, fell into oblivion. And it is not alien from the present point of view to turn for a moment to the light thrown on the cardio-arterial pulse and the measurement of its motions by the more intimate researches into the phenomena of the circulation by many observers, among whom in the 19th century James Hope, E. J. Marey (1830–1904) and C. F. W. Ludwig will always take a leading place. By them the demonstration of Harvey that the circulation of the blood is in large part a mechanical process, and nowhere independent of mechanical laws, was considerably enlarged and extended. In particular the fluctuations of the pulse in fevers and inflammations were better understood, and accurately registered; and we can scarcely realize now that before Harvey the time of the pulse seems not to have been counted by the watch. Discovery in these various directions then led physicians to regard fever and inflammation not as separable entities, but as fluctuating symptom-groups, due to swervings of function from the normal balance under contingent forces.

New Conceptions of Etiology.

As to such reforms in our conceptions of disease the advances of bacteriology profoundly contributed, so under the stress of consequent discoveries, almost prodigious in their extent and revolutionary effect, the conceptions of the etiology of disease underwent no less a transformation than the conceptions of disease itself. It is proper to point out here how intimately a pathology thus regenerated modified current conceptions of disease, in the linking of disease to oscillations of health, and the regarding many diseases as modifications of the normal set up by the impingement of external causes; not a few of which indeed may be generated within the body itself—"autogenetic poisoning." The appreciation of such modifications, and of the working of such causes, has been facilitated greatly by the light thrown upon normal processes by advances in physiology; so dependent is each branch of knowledge upon the advances of contiguous and incident studies. To biological chemistry we have been deeply indebted during the latter half of the 19th century. In 1872, Hoppe-Seyler (1825–1895) gave a new beginning to our knowledge of the chemistry of secretion and of excretion; and later students have increased the range of physiological and pathological chemistry by investigations not only into the several stages of albuminoid material and the transitions which all foodstuffs undergo in digestion, but even into the structure of protoplasm itself. Digestion, regarded not long ago as little more than a trituration and "coction" of ingesta to fit them for absorption and transfer them to the tissues, now appears as an elaboration of peptones and kindred intermediate products which, so far from being always bland, and mere bricks and mortar for repair or fuel for combustion, pass through phases of change during which they become so unfit for assimilation as to be positively poisonous. The formation of prussic acid at a certain period of the vital processes of certain plants may be given as an example of such phases; and poisons akin to muscarin seem to arise frequently in development or regression, both in animals and plants. Thus the digestive function, in its largest sense, is now seen to consist, not only in preparation and supply, but in no small measure also of protective and antidotal conversions of the matters submitted to it; coincidently with agents of digestion proper are found in the circuit of normal digestion "anti-substances" which neutralize or convert peptones in their poisonous phases; an autochthonous ferment, such as rennet for instance, calling forth an anti-rennet, and so on. Now as our own bodies thus manipulate substances poisonous and antidotal, if in every hour of health we are averting self-intoxication, so likewise are we concerned with the various intruding organisms, whose processes of digestion are as dangerous as our own; if these destructive agents, which no doubt are incessantly gaining admission to our bodies, do not meet within us each its appropriate compensatory defensive agent, dissolution will begin. Thus, much of infection and immunity are proving to be but special cases of digestion, and teleological conceptions of protective processes are modified.

Natural Resistance.

Under the name of chemotaxis (W. Pfeffer) are designated certain of the regulative adaptations by which such ends are attained. By chemical warnings the defensive processes seem to be awakened, or summoned; and when we think of the infinite variety of such possible phases, and of the multitude of corresponding defensive agents, we may form some dim notion of the complexity of the animal blood and tissues, and within them of the organic molecules. Even in normal circumstances their play and counterplay, attractive and repellent, must be manifold almost beyond conception; for the body may be regarded as a collective organization consisting of a huge colony of micro-organisms become capable of a common life by common and mutual arrangement and differentiation of function, and by toleration and utilization of each other's peculiar products; some organs, such as the liver, for example, being credited with a special power of neutralizing poisons, whether generated under normal conditions or under abnormal, which gain entrance from the intestinal tract. As a part of these discoveries has arisen another but kindred doctrine that of hormones (Starling), juices prepared, not for excretion, not even for partial excretion, but for the fulfilment of physiological equilibrium. Thus the reciprocity of the various organs, maintained throughout the divisions of physiological labour, is not merely a mechanical stability; it is also a mutual equilibration in functions incessantly at work on chemical levels, and on those levels of still higher complexity which seem to rise as far beyond chemistry as chemistry beyond physics. Not only are the secreted juices of specialized cells thus set one against another in the body, whereby the various organs of the body maintain a mutual play, but the blood itself also in its cellular and fluid parts contains elements potent in the destruction of bacteria and of their secretions. Thus endowed, the blood, unless overwhelmed by extraordinary invasions, does not fail in stability and self-purification. So various are the conditions of self-regulation in various animals, both in respect of their peculiar and several modes of assimilating different foods, and of protecting themselves against particular dangers from without, that, as we might have expected, the bloods taken from different species, or even perhaps from different individuals, are found to be so divergent that the healthy serum of one species may be, and often is, poisonous to another; not so much in respect of adventitious substances, as because the phases of physiological change in different species do not harmonize; each by its peculiar needs has been modified until, in their several conditions of life, they vary so much about the mean as to have become almost if not quite alien one to another.

In the preservation of immunity then, in its various degrees and kinds, not only is the chemistry of the blood to be studied, but also its histology. By his eminent labours in cellular pathology, Virchow, and Metchnikoff later, gave the last blow to the mere humoral pathology which, after an almost unchallenged prevalence for some two thousand years, now finds a resting-place only in our nurseries. Now the cellular pathology of the blood, investigated by the aid of modern staining methods, is as important as that of the solid organs; no clinical investigator—indeed, apart from research, no practitioner at this day—can dispense with examination of the blood for purposes of diagnosis; its coagulability and the kinds and the variations of the cells it contains being evidence of many definitely morbid states of the body. Again, not only in certain diseases may strange cells be found in the blood (*e.g.* in myelogenic leucaemia), but parasites also, both in man, as those of malaria, of sleeping sickness, of kala-azar, and in animals, as redwater, yellow fever, n'gana have been discovered, to the great advantage of preventive medicine. For some of these, as redwater (pyrosoma), antidotes are already found; for others, as for yellow fever—of which the parasite is unknown, but the mode of its transmission, by the mosquito, discovered (Finlay-Reed)—preventive measures are reducing the prevalence.

Specialism.

It is obvious that the results of such advances prescribe for the clinical physician methods which cannot be pursued without expert assistance; a physician engaged in busy practice cannot himself undertake even the verifications required in the conduct of individual cases. Skill in modern laboratory work is as far out of the reach of the untaught as performance on a musical instrument. In spite, therefore, of the encyclopaedic tradition which has persisted from Aristotle through the Arab and medieval schools down to Herbert Spencer, it is forced upon us in our own day that in a pursuit so many-sided as medicine, whether in its scientific or in its practical aspect, we have to submit more and more to that division of labour which has been a condition of advance in all other walks of life. It is now fully recognized that diseases of infants and children, of the insane, of the generative organs of women, of the larynx, of the eye, have been brought successively into the light of modern knowledge by "specialists," and by them distributed to the profession; and that in no other way could this end have been attained. That the division of labour, which may seem to disintegrate the calling of the physician, really unites it, is well seen in the clinical laboratories which were initiated in the later 19th century, and which are destined to a great future. By the approach of skilled pathologists to the clinical wards, a link is forged between practitioners and the men of science who pursue pathology disinterestedly. The first clinical laboratory seems to have been that of Von Ziemssen (1829–1902) at Munich, founded in 1885; and, although his example has not yet been followed as it ought to have been, enough has been done in this way, at Johns Hopkins University and elsewhere, to prove the vital importance of the system to the progress of modern medicine. At the same time provision must be made for the integration of knowledge as well as for the winning of it by several adits. A conspicuous example of the incalculable evil wrought by lack of integration is well seen in the radical divorce of surgery from medicine, which is one of the most mischievous legacies of the middle ages—one whose mischief is scarcely yet fully recognized, and yet which is so deeply rooted in our institutions, in the United Kingdom at any rate, as to be hard to obliterate. That the methods and the subject-matter of surgery and of medicine are substantially the same, and that the advance of one is the advance of the other, the division being purely artificial and founded merely on accidents of personal bent and skill, must be insisted upon at this time of our history. The distinction was never a scientific one, even in the sense in which the word science can be used of the middle ages; it originated in social conceits and in the contempt for mechanical arts which came of the cultivation of "ideas" as opposed to converse with "matter," and which, in the dawn of modern methods, led to the derision of Boyle by Oxford humanists as one given up to "base and mechanical pursuits." Had physicians been brought into contact with facts as hard as those faced by the surgeons of the 16th century (cf. Ambrose Paré), their art would not have lain so long in degradation. It is under this closer occupation with mechanical conditions that surgery to-day is said—not without excuse, but with no more than superficial truth—to have made more progress than medicine. Medicine and surgery are but two aspects of one art; Pasteur shed light on both surgery and medicine, and when Lister, his disciple, penetrated into the secrets of wound fevers and septicaemia, he illuminated surgery and medicine alike, and, in the one sphere as in the other, co-operated in the destruction of the idea of "essential fevers" and of inflammation as an "entity." Together, then, with the necessary multiplication of specialism, one of the chief lessons of the latter moiety of the 19th century was the unity of medicine in all its branches—a unity strengthened rather than weakened by special researches, such as those into "medical" and "surgical" pathology, which are daily making more manifest the absurdity of the distinction. Surgeons, physicians, oculists, laryngologists, gynaecologists, neurologists and the rest, all are working in allotments of the same field, and combining to a common harvest.

Medical Training.

While pathology then, which is especially the "science of medicine," was winning territory on one side from physiology, of which in a sense it is but an aspect, and on another by making ground of its own in the post mortem room and museum of morbid anatomy, and was fusing these gains in the laboratory so as to claim for itself, as a special branch of science by virtue of peculiar concepts, its due place and provision—provision in the establishment of chairs and of special laboratories for its chemical and biological subdivisions—clinical medicine, by the formal provision of disciplinary classes, was illustrating the truth of the experience that teaching and research must go hand-in-hand, the one reinforcing the other: that no teacher can be efficient unless he be engaged in research also; nay, that for the most part even the investigator needs the encouragement of disciples. Yet it was scarcely until the last quarter of the 19th century that the apprenticeship system, which was a mere initiation into the art and mystery of a craft, was recognized as antiquated and, in its virtual exclusion of academic study, even mischievous. In place of it, systematic clinical classes have become part of the scheme of every efficient school of medicine. A condition of this reform was the need of a preliminary training of the mind of the pupil in pure science, even in physics and chemistry; that is to say, before introduction into his professional studies. The founding of new teaching universities, in which England, and even France, had been at some disadvantage as compared with Scotland and Germany, strengthened the movement in favour of enlarging and liberalizing technical training, and of anticipating technical instruction by some broader scientific discipline; though, as in all times of transition, something was lost temporarily by a departure from the old discipline of the grammar school before a new scheme of training the mind in scientific habits and conceptions was established or fully apprehended. Yet on the whole, even from the beginning, the revolt was useful in that it shook the position of the "learned physician," who took a literary, fastidious and meditative rather than an experimental interest in his profession, and, as in great part a descendant of the humanists, was never in full sympathy with experimental science. At the risk no doubt of some defects of culture, the newer education cleared the way for a more positive temper, awoke a new sense of accuracy and of verification, and created a sceptical attitude towards all conventions, whether of argument or of practice. Among the drawbacks of this temper, which on the whole made for progress, was the rise of a school of excessive scepticism, which, forgetting the value of the accumulated stores of empiricism, despised those degrees of moral certainty that, in so complex a study and so tentative a practice as medicine, must be our portion for the present, and even for a long future, however great the triumphs of medicine may become. This scepticism took form in the school, most active between 1860 and 1880, known as the school of "Expectant Medicine." These teachers, genuinely touched with a sense of the scantiness of our knowledge, of our confidence in abstract terms, of the insecurity of our alleged "facts," case-histories and observations, alienated from traditional dogmatisms and disgusted by meddlesome polypharmacy—enlightened, moreover, by the issue of cases treated by means such as the homoeopathic, which were practically "expectant"—urged that the only course open to the physician, duly conscious of his own ignorance and of the mystery of nature, is to put his patient under diet and nursing, and, relying on the tendency of all equilibriums to recover themselves under perturbation, to await events (*Vis medicatrix naturae*). Those physicians who had occupied themselves in the study of the exacter sciences, or more closely or more exclusively of the wreckage of the post mortem room, were the strongest men of this school, whether in England or abroad.

Therapeutics.

But to sit down helpless before human suffering is an unendurable attitude. Moreover, the insight into origins, into initial morbid processes revealed by the pathologists, awoke more and more the hope of dealing with the elements of disease, with its first beginnings; and in the field of therapeutics, chemical and biological experiment, as in the case of digitalis, mercury and the iodides, was rapidly simplifying remedies and defining their virtues, so that these agents could be used at the bedside with more precision. Furthermore, the aversion from drugging had the advantage of directing men's minds to remedies taken from the region of the physical forces, of electricity (G. B. Duchenne, 1806–1875), of gymnastics (Ling, 1776–1839), of hydropathy (V. Priessnitz), of massage (Weir Mitchell), of climate (James Clarke), of diet (R. B. Todd, King Chambers, &c.), and even of hypnotism (James Braid 1795?–1860), while with the improvement of the means of locomotion came the renewal of the old faith and the establishment of new methods in the use of mineral springs. These and such means, often in combination, took much of the place formerly given to the use of drugs.

Hygiene.

Again, a like spirit dictated the use of the physical or "natural" methods on a larger scale in the field of prevention. From the new regard given by physiologists and pathologists to the study of origins, and in the new hopes of thus dealing with disease at its springs, not in individuals only but in cities and nations, issued the great school of Preventive Medicine, initiated in England—E. A. Parkes (1819–1876), J. Simon, Sir B. W. Richardson (1828–1896), Sir H. W. Acland (1815–1900), Sir G. Buchanan (1831–1895), and forwarded in Germany by Max von Pettenkofer (1818–1901). Hygiene became for pathology what "milieu" is for physiology. By the modification of physical conditions on a national scale a prodigious advance was made in the art of preventing disease. The ghastly roll of infantile mortality was quickly purged of its darkest features (Ballard and others); aided by bacteriology, sanitary measures attained some considerable degree of exactness; public medicine gained such an ascendancy that special training and diplomas were offered at universities; and in 1875 a consolidated act was passed for the United Kingdom establishing medical officers of health, and responsible lay sanitary authorities, with no inconsiderable powers of enforcing the means of public health in rural, urban, port and other jurisdictions, with summary methods of procedure. A department of public health was formed within the precincts of the Local Government Board; government laboratories were established, and machinery was devised for the notification of infectious diseases. The enormous growth of towns during the second half of the 19th century was thus attended with comparative safety to these great aggregates of mankind; and the death-rates, so far from being increased, relatively decreased in substantial proportions. In 1878 an act was passed giving like powers in the case of the infectious diseases of animals. The establishment in England of the Register of qualified practitioners and of the General Medical Council (in 1858) did something, however imperfectly, to give unity to the profession, unhappily bisected by "the two colleges"; and did much to organize, to strengthen and to purify medical education and qualification. In 1876 women were admitted to the Register kept by the Council. In 1871 the Anatomical Act of 1832 was amended; and in 1876 the Vivisection Act was passed, a measure which investigators engaged in the medical sciences of physiology and pathology resented as likely to prevent in England the advance of knowledge of living function, both in its normal balance and in its aberrancies, and moreover to slacken that habit of incessant reference of propositions to verification which is as necessary to the clinical observer as to the experimentalist. However the opinion of later generations may stand in respect of the Vivisection Act, it will surely appear to them that the other acts, largely based upon the results of experimental methods, strengthening and consolidating the medical profession, and fortifying the advance of medical education, led directly to a fundamental change in the circumstances of the people in respect of health. The intelligent classes have become far better educated in the laws of health, and less disposed to quackery; the less intelligent are better cared for and protected by municipal and central authority. Thus the housing of the poor has been improved, though this difficult problem is yet far from solution; not the large towns only, but the larger villages also, are cleansed and drained; food has been submitted to inspection by skilled officers; water supplies have been undertaken on a vast scale; personal cleanliness has been encouraged, and with wonderful success efforts have been made to bring civilized Europe back from the effects of a long wave of Oriental asceticism, which in its neglect and contempt of the body led men to regard filth even as a virtue, to its pristine cleanliness under the Greeks and Romans. During the latter half of the 19th century the death-rate of many towns was reduced by something like 50%. Some plagues, such as typhus fever, have been dispelled; others, such as enteric fever, have been almost banished from large areas; and there is much reason to hope that cholera and plague, if introduced, could not get a footing in western Europe, or in any case could be combated on scientific principles, and greatly reduced. Temperance in the use of alcohol has followed the demonstration not only of its unimportance as a food or tonic, but also of its harmfulness, save in very small quantities. In the earlier part of the 19th century, and in remoter districts even in its later years, the use of alcohol was regarded not as a mere indulgence, but as essential to health; the example of teetotallers, as seen in private life and in the returns of the insurance offices, has undermined this prepossession. From the time of Plato medicine has been accused of ministering to the survival of unfit persons, and to their propagation of children. But bodily defect is largely a result of evil circumstances, in the prevention of which the physician is not unsuccessfully engaged, and the growth of sympathy means a stronger cement of the social structure. At any rate the mean standard of health will be raised, perhaps enormously.

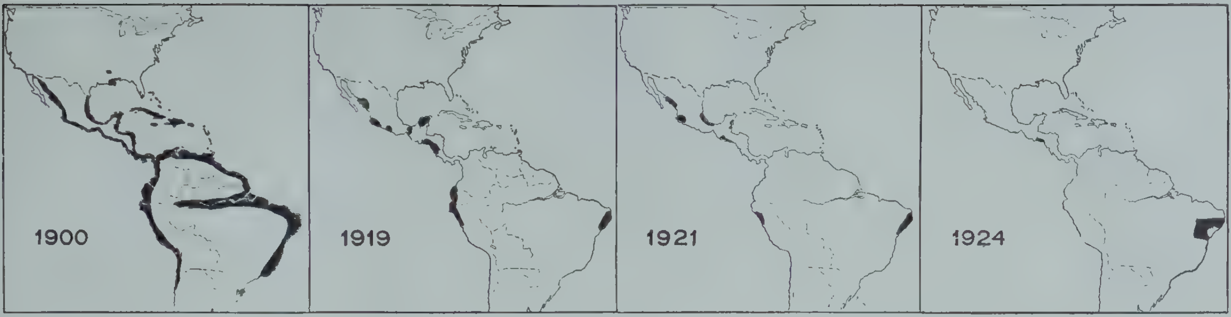
In the tropics, as well as in Europe, such methods and such researches threw new light upon the causes and paths of the terrible infections of these climates. In 1880, two years before Koch discovered the bacillus of tubercle, C. L. A. Laveran (b. 1845) discovered the parasite of malaria, and truly conceived its relations to the disease; thus within two years were made two discoveries either of which was sufficient to make the honour of a century. Before the end of the 19th century this discovery of the blood parasite of malaria was crowned by the hypothesis of Patrick Manson, proved by Ronald Ross, that malaria is propagated by a certain genus of gnat, which acts as an intermediate host of the parasite. Cholera (Haffkine) and yellow fever are yielding up their secrets, and falling under some control. The 20th century, by means of this illumination of one of the darkest regions of disease, may diminish human suffering enormously, and may make habitable rich and beautiful regions of the earth's surface now, so far as man's work is concerned, condemned to sterility. Moreover, freedom of trade and of travel has been promoted by a reform of the antiquated, cumbrous, and too often futile methods of quarantine—a reform as yet very far from complete, but founded upon a better understanding of the nature and propagation of disease.

Infections.

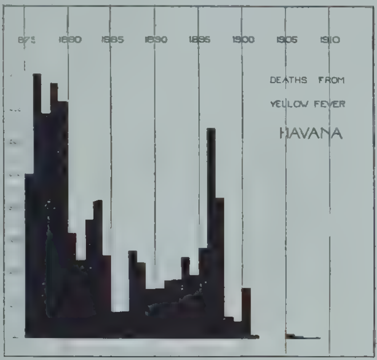
Special Departments.—Hitherto we have presented a survey of the progress of the science and practice of medicine on general lines; it remains to give some indication of the advance of these subjects of study and practice in particular departments. As regards infections, it is not to be supposed that our knowledge of these maladies has been advanced by pathology and bacteriology only. In the clinical field also it has received a great enlargement. Diphtheria, long no doubt a plague among mankind, was not carefully described until by Pierre Bretonneau in 1826; and since his time our conception of this disease has been extended by the study of later, secondary and incidental phases of it, such as neuritis, which had always formed part of the diphtheritic series, though the connexion had not been detected. Influenza, again, was well known to us in 1836–1840, yet clinical observers had not traced out those sequels which, in the form of neuritis and mental disorder, have impressed upon our minds the persistent virulence of this infection, and the manifold forms of its activity. By the discovery of the bacillus of tubercle, the physician has been enabled to piece together a long and varied list of maladies under several names, such as scrofula and lupus, many of them long suspected to be tuberculous, but now known to belong to the series. It is on clinical grounds that beriberi, scarlet fever, measles, &c., are recognized as belonging to the same class, and evolving in phases which differ not in intimate nature but in the more superficial and inessential characters of time, rate and polymorphism; and the impression is gaining strength that acute rheumatism belongs to the group of the infections, certain sore throats, chorea and other apparently distinct maladies being terms of this series. Thus the field of disease arising not from essential defect in the body, but from external contingencies, is vastly enlarging; while on the other hand the great variability of individuals in susceptibility explains the very variable results of such extrinsic causes. Coincidently therewith, the hope of neutralizing infections by fortifying individual immunity has grown brighter, for it appears that immunity is not a very radical character, but one which, as in the case of vaccination, admits of modification and accurate adjustment in the individual, in no long time and by no very tedious methods. Evidence is accumulating which may end in the explanation and perhaps in the prevention of the direst of human woes—cancer itself, though at present inquiry is being directed rather to intrinsic than to extrinsic causes.

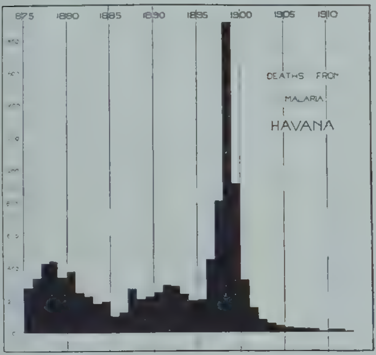
Neurology.

When, leaving the infections, we look for evidence of progress in our knowledge of more or less local diseases, we may begin with the nervous system. It is in this department, from its abstruseness and complexity, that we should expect the advance of anatomy and physiology—normal and morbid—to be most delayed. If we consult the medical works even of the middle of the 19th century we shall find that, in the light of the present time, accurate knowledge in this sphere, whether clinical, pathological or therapeutical, could scarcely be said to exist. Even in the hands of J. A. Lockhart Clarke (1817–1880), one of the earliest investigators of nervous pathology, the improvement of the compound microscope had not attained the achromatism, the penetration and the magnification which have since enabled J. L. C. Schroeder-van der Kolk (1797–1862), Albert von Kölliker, Santiago Ramon y Cajal, C. Golgi (b. 1844) and others to reveal the minute anatomy of the nervous centres; while the discrimination of tissues and morbid products by stains, as in the silver and osmic acid methods, and in those known by the names of Carl Weigert or Marchi, had scarcely begun. In England the Hospital for the Paralysed and Epileptic was founded in 1859, where Charles E. Brown-Séquard (1817–1894), J. Hughlings-Jackson, Thomas Buzzard, Henry C. Bastian (b. 1837), Sir W. R. Gowers and David Ferrier (b. 1843) found an adequate field for the clinical and pathological parts of their work. In France, in the wards of the Hôtel Dieu, Guillaume Benjamin Duchenne (1806–1875), in association with Trousseau and in his private clinic, pursued his memorable clinical and therapeutical researches into the diseases of the nervous system; and Jean M. Charcot (1825–1893) in that great asylum for the wreckage of humanity—the Salpêtrière—discovered an unworked mine of chronic nervous disease. M. H. Romberg (1795–1873) and Theodor Meynert (1833–1892) also were pioneers in the study of nervous diseases, but it was not till later in the century that Germany took a high place in this department of medicine. The discoveries of the separate paths of sensory and motor impulses in the spinal cord, and consequently of the laws of reflex action, by Charles Bell and Marshall Hall respectively, in their illumination of the phenomena of nervous function, may be compared with the discovery in the region of the vascular system of the circulation of the blood; for therein a key to large classes of normal and aberrant functions and a fertile principle of interpretation were obtained. Nor was the theory of reflex action confined to the more "mechanical" functions. By G. H. Lewes and others the doctrine of "cerebral reflex" was suggested, whereby actions, at first achieved only by incessant attention, became organized as conscious or subconscious habits; as for instance in the playing on musical or other instruments, when acts even of a very elaborate kind may directly follow the impulses of sensations, conscious adaptation and the deliberate choice of means being thus economized. This law has important ethical and political bearings; but in the province of disease this advance of what may be compared to the interlocking of points and signals has had wide influence not only in altering our conceptions of disease, but also in enlarging our views of all perturbations of function. The grouping of reflex "units," and the paths wherein impulses travel and become associated, have been made out by the physiologist (Sherrington and others) working on the healthy animal, as well as by the record of disease; and not of spontaneous disease alone, for the artificial institution of morbid processes in animals has led to many of these discoveries, as in the method of A. V. Waller (1816–1870), who tracked the line of nervous strands by experimental sections, and showed that when particular strands are cut off from their nutritive centres the consequent degeneration follows the line of the separated strands. By similar methods nature, unassisted, betrays herself but too often; in many instances—probably originating primarily in the nervous tissues themselves—the course of disease is observed to follow certain paths with remarkable consistency, as for instance in diseases of particular tracts of the spinal cord. In such cases the paths of degeneration are so neatly defined that, when the tissues are prepared after death by modern methods, they are plainly to be seen running along certain columns, the subdivisions



CONQUEST OF MOSQUITO BORNE DISEASE IN HAVANA





Yellow Fever is steadily retreating before the attacks of the scientist, as is shown by the decreasing blackened areas on these maps.

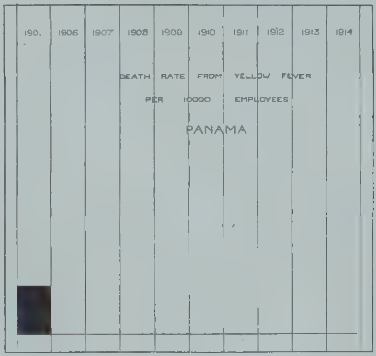
Yellow Fever claimed over 13,000 victims in the Mississippi Valley alone, as late as 1878. As soon as its connection with mosquitoes was discovered, organised effort on scientific lines was instigated, as a consequence of which, Yellow Fever soon nearly disappeared.

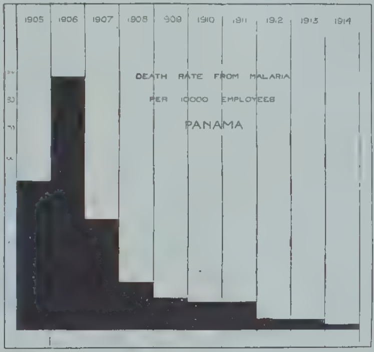
Malaria, perhaps as injurious, has also been brought under control by the elimination of the mosquito.

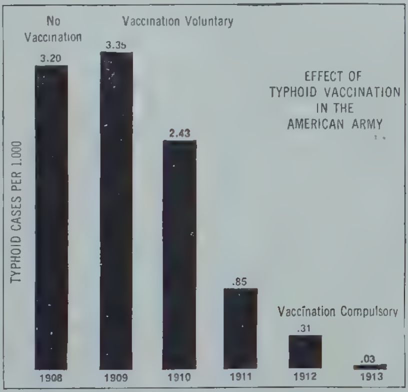
Typhoid also has diminished since its connection with the common housefly was established.

The latest authoritative information on these and kindred subjects is to be found in the articles MALARIA (VOL. 30), MEDICAL RESEARCH (VOL. 30), MEDICAL SERVICE (VOL. 30), TROPICAL MEDICINE (VOL. 31) and YELLOW FEVER (VOL. 31).

CONQUEST OF MOSQUITO BORNE DISEASE IN PANAMA







At left—the Yellow Fever Mosquito, the only known transmitter of Yellow Fever. The female alone bites. (From the large glass model.) At right—the Malaria Mosquito. Malaria is transmitted to man only by the bite of infected female anopheles mosquitoes. (From the large glass model—the left side cut away to show internal structure.)

(Maps, courtesy of the Rockefeller Institute; other figures, courtesy of the American Museum of Natural History.)

of which in the normal state may hardly be distinguishable one from another: some run in strips along the periphery of the spinal cord, at its anterior, middle or posterior segments, as the case may be; in other cases such strips occur within its substance, whether along columns of cells or of white matter. It is needless to point out how such paths of disease, in their association with characteristic symptoms, have illuminated the clinical features of disease as well as the processes of normal function.

Not, however, all diseases of the nervous system conduct themselves on these definite paths, for some of them pay no attention to the geography of structure, but, as one may say, blunder indiscriminately among the several parts; others, again, pick out particular parts definitely enough, but not parts immediately continuous, or even contiguous. Diseases of the latter kind are especially interesting, as in them we see that parts of the nervous structure, separated in space, may nevertheless be associated in function; for instance, wasting of a group of muscles associated in function may depend on a set of central degenerations concurring in parts whose connexion, in spite of dissociation in space, we thus perceive. The undiscriminating diseases, on the other hand, we suspect not to be primarily of nervous origin, but to depend rather on the agency of other constituent tissues of this system, as of the blood-vessels or the connective elements. Thus, arguing inversely, we may learn something of the respective natures of these influences and of the way in which the nervous system is affected secondarily.

Anchorage of Molecules.

Yet even the distribution of toxic matters by the blood is not necessarily followed by general and indiscriminate injury to the nervous elements. In infantile palsy, for example, and in tabes dorsalis, there is good reason to believe that, definitely as the traces of the disease are found in certain physiologically distinct nervous elements, they are due nevertheless to toxic agents arriving by way of the blood. Here we enter upon one of the most interesting chapters of disorders and modes of disorder of this and of other systems. It has come out more and more clearly of late years that poisons do not betray even an approximately indifferent affinity for all tissues, which indeed a little reflection would tell us to be a priori improbable, but that each tends to fix itself to this cell group or to that, picking out parts for which they severally have affinities. Chemical, physiological and pathological research is exploring the secret of these more refined kinds of "anchorage" of molecules. In 1868 Drs A. Crum Brown and T. R. Fraser proved that by substitution of molecules in certain compounds a stimulant could be converted into a sedative action; thus by the addition of the methyl group CH_2 to the molecule of strychnine, thebaine or brucine, the tetanizing action of these drugs is converted into a paralysing action. The number of these instances, and the variety of them, are now known to be very large; and it is supposed that what is true of these simpler agents is true also of far more elaborate phases of vital metabolism. Now, what is remarkable in these and many other reactions is not only that effects apparently very opposite may result from minute differences of molecular construction, but also that, whatever the construction, agents, not wholly indifferent to the body or part, tend to anchor themselves to organic molecules in some way akin to them. Highly complex as are all animal tissues, or nearly all, yet in this category of high complexity are degrees higher and higher again of which we can form little conception, so elaborate they are, so peculiar in their respective properties, and probably so fugitive. It is this wide range of dynamic peculiarities above the common range of known physical and chemical molecules which excites our wonder; and a reflection of these peculiar properties is seen in their affinities for this or that toxic or constructive agent, whereby the peculiarity, for example, of a particular kind of nerve cell may be altered, antagonized, reinforced or converted. On the other hand, the reagents by which such modifications are apt to be produced are not necessarily simple; many of them likewise are known to be of very high degrees of complexity, approaching perhaps in complexity the molecules to which they are akin. Of such probably are the toxins and antitoxins of certain infections, which, anchoring themselves not by any means indiscriminately, but to particular and concerted molecules, by such anchorage antagonize them or turn them to favourable or unfavourable issues. Toxins may thus become so closely keyed into their corresponding atom groups, as for instance in tetanus, that they are no longer free to combine with the antitoxin; or, again, an antitoxin injected before a toxin may anticipate it and, preventing its mischievous adhesion, dismiss it for excretion. In the mutual behaviour of such cells, toxins, and antitoxins, and again of microbes themselves, we may demonstrate even on the field of the microscope some of the modes of such actions, which seem to partake in great measure at any rate of a chemical quality (agglutinins, coagulins, chemotaxis). It is convenient here to add that such reactions and modifications, if more conspicuous in the nervous system, are of course not confined to it, but are concerned in their degree in all the processes of metabolism, being most readily traced by us in the blood.

Many other diseases formerly regarded as primarily diseases of the nervous system are not such; but, by means of agents either introduced into the body or modified there, establish themselves after the affinities of these in contiguous associated parts of the structure, as in vascular, membranous or connective elements, or again in distant and peripheral parts; the perturbations of nervous function being secondary and consequential. Of such are tetanus and diphtheria, now known to be due to the establishment from without of a local microbic infection, from which focus a toxin is diffused to the nervous matter. The terrible nervous sequels of some forms of inflammation of the membranes of the brain, again, are due primarily to microbic invasion rather of the membranes than of their nervous contents; and many other diseases may be added to this list. The grave palsies in such diseases as influenza, diphtheria, beriberi, or ensuing on the absorption of lead, are in the main not central, but due to a symmetrical peripheral neuritis.

Individual Forms of Disease.

Among diseases not primarily nervous, but exhibited in certain phenomena of nervous disorder, are *diseases of the blood-vessels*. Much light has been thrown upon the variations of arterial and venous blood pressures by Karl Ludwig (1816–1895) and his many followers: by them not only the diseases of the circulatory system itself are elucidated, but also those of other systems—the nervous, for instance—which depend intimately on the mechanical integrity of the circulation of the blood as well as on the chemical integrity of the blood itself. With changes of the pressures of the blood in arteries, veins or capillaries, and in the heart itself and its respective chambers, static changes are apt to follow in these parts; such as degeneration of the coats of the arteries, due either to the silent tooth of time, to persistent high blood pressures, or to the action of poisons such as lead or syphilis. Syphilitic lesion of the arteries, and likewise of other fibrous tissues, often involves grave consequential damage to nervous structures fed or supported by such parts. Some of the most successful of the advances of medicine as a healing art have followed the detection of syphilitic disease of the vessels, or of the supporting tissues of nervous centres and of the peripheral nerves; so that by specific medication, the treatment of paralytic, convulsive, and other terrible manifestations of nervous disease thus secondarily induced is now undertaken in early stages with definite prospect of cure.

Not of less importance in this respect, and in other disorders many of them of grave incidence, is the knowledge of the phenomena of *embolism* and of *thrombosis*, also gained during the latter half of the 19th century—W. S. Kirkes (1823–1864), R. Virchow. By embolism is meant the more or less sudden stoppage of a vessel by a plug of solid matter carried thither by the current of the blood; be it a little clot from the heart or, what is far more pernicious, an infective fragment from some focus of infection in the body, by which messengers new foci of infection may be scattered about the body. Thrombosis is an accident of not dissimilar character, whereby a vessel is blocked not by a travelling particle, but by a clotting of the blood *in situ*, probably on the occasion of some harm to the epithelial lining of the vessel. Such injuries are apt to occur in syphilitic endarteritis, or senile arterial decay, whereby an artery may be blocked permanently, as if with an embolus, and the area supplied by it, in so far as it was dependent upon this vessel, deprived of nutrition. These events, although far more mischievous in the brain, the functions of which are far-reaching, and the collateral circulation of which is ill-provided, are seen very commonly in other parts.

It is in the structure of the brain itself that modern research has attained the most remarkable success. In 1861 an alleged "centre" of speech was detected, by a combination of clinical and pathological researches, by Paul Broca (1824–1880). By these means also, in the hands of Hughlings-Jackson, and more conclusively by experimental research initiated by G. T. Fritsch (b. 1838) and T. E. Hitzig (b. 1838), but pursued independently and far more systematically and thoroughly by David Ferrier (b. 1843) and his disciples, it was proved that the cerebrum is occupied by many such centres or exchanges, which preside over the formulation of sensations into purposive groups of motions—kinaesthesis of H. Charlton Bastian (b. 1837). The results of these experimental researches by many inquirers into the constitution of the brain have transformed our conceptions of cerebral physiology, and thrown a flood of light on the diseases of the brain. Not only so, but this mapping of the brain in areas of function now often enables the clinical physician to determine the position of disease; in a certain few cases of tumour or abscess, so precisely that he may be enabled to open the skull above the part affected and to extirpate it—operations which are surely a triumph of science and technical skill (Lister, W. MacEwen, V. Horsley).

The remarkable discovery of the dual nature of the nervous system, of its duplex development as a lower and upper system of "neurons," has shed much light upon the problems of practical medicine, but this construction is described under BRAIN; NEUROPATHOLOGY; MUSCLE AND NERVE, &c.

In *mental diseases* little of first-rate importance has been done. The chief work has been the detection of chronic changes in the cortex of the brain, by staining and other histological methods, in degenerative affections of this organ—Theodor Meynert (1833–1892), W. Griesinger (1817–1868), Bevan Lewis—and in the separation from insanity due to primary disease or defect of nerve elements of such diseases as general paralysis of the insane, which probably arise, as we have said, by the action of poisons on contiguous structures—such as blood-vessels and connective elements—and invade the nervous matter secondarily. Some infections, however, seem to attack the mental fabric directly; intrinsic toxic processes which may be suspected on the detection of neurin and cholin in the fluids of the brain (F. W. Mott). Truer conceptions of normal psychology have transformed for us those of the morbid—P. Pinel (1745–1826), Griesinger, Henry Maudsley (b. 1835), Mercier, Kräpelin, Rivers—and indicated more truly the relations of sanity to insanity. In the treatment of insanity little has been done but to complete the non-restraint system which in principle belongs to the earlier part of the 19th century (Pinel, Tuke, R. G. Hill, J. Conolly). An enormous accumulation of lunatics of all sorts and degrees seems to have paralysed public authorities, who, at vast expense in buildings, mass them more or less indiscriminately in barracks, and expect that their sundry and difficult disorders can be properly studied and treated by a medical superintendent charged with the whole domestic establishment, with a few young assistants under him. The life of these insane patients is as bright, and the treatment as humane, as a barrack life can be; but of science, whether in pathology or medicine, there can be little. A considerable step in advance is the establishment by the London County Council of a central laboratory for its asylums, with an eminent pathologist at its head: from this laboratory valuable reports are in course of issue. Provision for the reception and treatment of insanity in its earliest and more curable stages can scarcely be said to exist. Sufferers from mental disease are still regarded too much as troublesome persons to be hidden away in humane keeping, rather than as cases of manifold and obscure disease, to be studied and treated by the undivided attention of physicians of the highest skill. The care and education of idiots, initiated by Guggenbuhl and others, is making way in England, and if as yet insufficient, is good of its kind.

By the genius of René Théophile Laennec (1781–1826), *diseases of the lungs and heart* were laid on a foundation so broad that his successors have been occupied in detail and refinement rather than in reconstruction. In heart disease the chief work of the latter half of the 19th century was, in the first quarter, such clinical work as that of William Stokes and Peter Mere Latham (1789–1875); and in the second quarter the fuller comprehension of the vascular system, central and peripheral, with its cycles and variations of blood pressure, venous and arterial. Moreover, the intricacies of structure and function within the heart itself have been more fully discriminated (W. H. Gaskell, Aschoff, A. Keith, Wenkebach, J. Mackenzie). By the greater thoroughness of our knowledge of the physics of the circulation— Étienne Marey (b. 1830), Karl Ludwig (1816–1895), Leonard Hill—we have attained to a better conception of such events as arterial disease, apoplexy, "shock," and so forth; and pharmacologists have defined more precisely the virtues of curative drugs. To the discovery of the parts played in disease by thrombosis and embolism we have referred above. With this broader and more accurate knowledge of the conditions of the health of the circulation a corresponding efficiency has been gained in the manipulation of certain remedies and new methods of treatment of heart diseases, especially by baths and exercises.

As regards pulmonary disease, pneumonia has passed more and more definitely into the category of the infections: the modes of invasion of the lungs and pleura by tuberculosis has been more and more accurately followed; and the treatment of these diseases, in the spheres both of prevention and of cure, has undergone a radical change. Instead of the close protection from the outer air, the respirators, and the fancy diets of our fathers, the modern *poitrinaire* camps out in the open air in all weathers, is fed with solid food, and in his exercise and otherwise is ruled with minute particularity according to the indications of the clinical thermometer and other symptoms. The almost reckless reliance on climate, which, at Davos for instance, marked the transition from the older to the modern methods, has of late been sobered, and supplemented by more systematic attention to all that concerns the mode of life of the invalid. The result is that, both in physicians and in the public, a more hopeful attitude in respect of the cure of phthisis has led to a more earnest grappling with the infection in its earliest stages and in every phase, with a correspondingly large improvement in prevention and treatment. Indeed, in such early stages, and in patients who are enabled to command the means of an expensive method of cure, phthisis is no longer regarded as desperate; while steps are being taken to provide for those who of their own means are unable to obtain these advantages, by the erection of special sanatoriums on a more or less charitable basis. Perhaps no advance in medicine has done so much as the study of tuberculosis to educate the public in the methods and value of research in medical subjects, for the results, and even the methods, of such labours have been brought home not only to patients and their friends, but also to the farmer, the dairyman, the butcher, the public carrier, and, indeed, to every home in the land.

It was in the management of pleurisies that the aid of surgical means first became eminent in inward disease. In the treatment of effusions into the pleura and, though with less advantage, of pericardial effusions, direct mechanical interference was practised by one physician and another, till these means of attaining rapid and complete cure took their places as indispensable, and were extended from thoracic diseases to those of the abdominal and other inner parts formerly beyond the reach of direct therapeutics. Lord Lister's discoveries brought these new methods to bear with a certainty and a celerity previously undreamed of; and many visceral maladies, such as visceral ulcers, disease of the pancreas, stone of the kidney or gall-bladder, perityphlitis, ovarian dropsy, which in the earlier part of the 19th century were either fatal or crippling, are now taken promptly and safely in hand, and dealt with successfully. Even for internal cancer cure or substantial relief is not infrequently obtained. We have said that this advance is often quoted, not very wisely, to signify that in modern progress " medicine " has fallen behind surgery—as if the art of the physician were not one and indivisible. That certain Fellows of the College of Physicians (especially in gynaecology) have personally taken operative procedures in hand is some good omen that in time the unreal and mischievous schism between medicine and surgery may be bridged over.

In the department of *abdominal disease* progress has been made, not only in this enormous extension of means of cure by operative methods, but also in the verification of diagnosis. The first recognition of a disease may be at a necropsy, but then usually by irresponsible pathologists; it is another matter when the physician himself comes under rebuke for failing to seize a way to cure, while the chance remained to him, by section of the abdomen during life. The abdomen is still " full of surprises "; and he who has most experience of this deceptive region will have least confidence in expressing positive opinions in particular cases of disease without operative investigation. Besides the attainments mentioned above, in respect of operative progress, many important revisions of older rule-of-thumb knowledge have come about, and not a few other substantial discoveries. Among the revisions may be adduced some addition to our knowledge of dyspepsia, attained by analytic investigations into the contents of the stomach at various stages of digestion, and by examining the passage of opaque substances through the *primae viae* by the Röntgen rays. Thus the defects, whether of this secretion or of that, and again of motor activity, the state of the valvular junctions, the volume of the cavities, and their position in the abdomen, may be ascertained, and dealt with as far as may be; so that, although the fluctuations of chemical digestion are still very obscure, the application of remedies after a mere traditional routine is no longer excusable. In our conceptions of the later stages of assimilation and of excretion, with the generation of poisons (auto-intoxication) in the intestinal tract, there is still much obscurity and much guess-work; yet in some directions positive knowledge has been gained, partly by the physiologist, partly by the physician himself. Of such are the better understanding of the functions of the liver in normal catabolism, in the neutralization of poisons absorbed from the intestines or elsewhere, in the causation of jaundice, and in diabetes [Bernhardt Naunyn (b. 1839) and F. W. Pavy]. Nor must we forget the unfolding of a new chapter of disease, in the nosology of the pancreas. In diabetes this organ seems to play a part which is not yet precisely determined; and one fell disease at least has been traced to a violent access of inflammation of this organ, caused perhaps by entry of foreign matters into its duct. The part of the pancreas in digestion also is better understood. The part of the spleen in the motley group of dyspepsias and anaemias, conspicuous as it often is, still remains very enigmatic.

The peritoneum is no longer regarded with awe as inviolable; by modern methods, if not as manageable as other lymphatic sacs, it is at any rate accessible enough without considerable risk to life. Not only in its bacteriological relations are the conditions of peritonitis recognized in its various kinds, but also the state known as " shock " turns out to be quasi-mechanical, and avoidable by measures belonging in considerable part to this category. Thus, by the avoidance both of toxaemia and of shock, peritonitis and other dangers of the abdomen, such as strangulations or intussusceptions of the bowels, formerly desperate, can in many cases be dealt with safely and effectively.

Our knowledge of diseases of the kidneys has made no great advance since the time of Richard Bright. In the sphere of physiology and in the interpretation of associated arterial diseases much obscurity still remains; as, for instance, concerning the nature of the toxic substances which produce those bilateral changes in the kidneys which we call Bright's disease, and bring about the " uraemia " which is characteristic of it. Lardaceous disease, however, here and in other regions, now appears to be due to the specific toxins of pyogenetic micro-organisms. In stone of the kidney a great advance has been made in treatment by operative means, and the formation of these stones seems to recent observers to depend less upon constitutional bent (gout) than upon unhealthy local conditions of the passages, which in their turn again may be due to the action of micro-organisms.

To Thomas Addison's descriptions of certain anaemias, and of the disease of the suprarenal capsules which bears his name, something has been added; and W. Hunter's researches on the severer anaemias are doing much to elucidate these subtle maladies. And on the influence of these inconspicuous bodies and of the pituitary body in sustaining arterial blood pressures physiologists have thrown some important light.

The secret of the terrible puerperal septicaemia was read by J. P. Semmelweiss (*q.v.*), wherein he proved himself to be the greatest of Lister's forerunners (see LISTER).

The *diseases peculiar to women* (see GYNAECOLOGY) have received attention from early times, but little progress had been made in their interpretation till the 19th century. In the middle part of the century, by a natural exaggeration of the importance of newly-discovered local changes in the pelvic organs, much harm was done to women by too narrow an attention to the site, characters and treatment of these; the meddlesomeness of the physician becoming in the temperament of woman a morbid obsession. To James Matthews Duncan (1826–1890) we chiefly owe a saner and broader comprehension of the relative importance of the local and the general conditions which enter into the causation of uterine and ovarian disorders. In operations for diseases of the pelvis, ovarian dropsy, cancer of the uterus, and other grave diseases of the region, success has been stupendous.

In the subject of *diseases of the skin* much has been done, in the minuter observation of their forms, in the description of forms previously unrecognized, and in respect of bacterial and other causation and of treatment. The comparison of observations in various climates and peoples has had some weight; while in the better knowledge of their causes their treatment has found permanent advantage. Not only is the influence of bacteria in the causation of many of them newly revealed, but it is now recognized also that, even in skin diseases not initiated by microbic action, microbes play a considerable and often a determining part in their perpetuation; and that the rules of modern aseptic surgery are applicable with no little success to skin therapeutics. We have learned that " constitutional " causes play a smaller part in them than was supposed, that a large number of diseases of the skin, even if initiated by general disorder, are or soon become local diseases, being, if not initiated by local infection yet perpetuated thereby, so that, generally speaking, they are to be cured by local means.

The *diseases of children* have not lacked the renewed attention, the successful investigation, and the valuable new lights which have been given to other departments of medicine. That infantile paralysis is an infection, and that its unhappy sequels are now treated with more hope of restoration, has been indicated already. Infantile diarrhoea has also been recognized as a common infection (Ballard), and the means of its avoidance and cure ascertained. The conditions of diet and digestion in children are now far better understood, and many of their maladies, formerly regarded as organic or incomprehensible, are cured or prevented by dietetic rules. Rickets, scurvy and " marasmus " may be instanced as diet diseases in children. Acute inflammation of the ear, with its alarming extensions to the cerebral cavity, is now dealt with successfully by surgical means, and infected sinuses or even encephalic abscesses are reached and cleansed. The origins, kinds and processes of meningitis are more clearly distinguished, and referred each to its proper cause —for the most part bacterial.

As by the discovery of stethoscopy by Laennec a new field of medical science and art was opened up, so, more recently, inventions of other new methods of investigation in medicine

Diagnosis.

have opened to us other fields of little less interest and importance. Of such is the ophthalmoscope, invented by H. von Helmholtz in 1851. By the revelations of this instrument not only have the diseases of the eye been illuminated, but much light has been thrown also upon the part of the eye in more general maladies; as, for instance, in syphilis, in diabetes, in kidney diseases, and in diseases of the brain—F. C. Donders (1818–1889), Alfred von Gräfe (1830–1899) and others. A remarkable help to the cure of headaches and wider nervous disorders has come out of the better appreciation and correction of errors of refraction in the eye. Radiography has done great things for surgery; for medicine its services are already appreciable, and may prove more and more valuable hereafter. In 1879 the use of the spectroscope in medicine was pointed out by Dr Charles A. MacMunn (b. 1852). By E. du Bois-Reymond, Robert Remak (1815–1865), Carlo Matteucci (1811–1868), Guillaume Duchenne (1806–1875), the value of electricity in medicine, greater in diagnosis perhaps than in therapeutics, was demonstrated. By the sphygmograph (E. J. Marey, 1863) attention was drawn to the physical features of the circulation, to the signs of degeneration of the arterial tree, and less definitely to the fluctuations of blood pressure; but as we have said under the consideration of diseases of the heart, the kymographs of Ludwig and his pupils brought out these fluctuations far more accurately and completely. By these, and other instruments of precision, such as the thermometer, of which we have already spoken, the eminently scientific discipline of the measurement of functional movements, so difficult in the complex science of biology, has been cultivated. By the laryngoscope, invented about 1850 by Manuel Garcia the celebrated singing-master, and perfected by Johann Czermak (1828–1873) and others, the diseases of the larynx also have been brought into the general light which has been shed on all fields of disease; and many of them, previously known more or less empirically, submitted to precise definition and cure. Of such we may cite tuberculosis of the larynx, formerly as incurable as distressing; and " adenoids "—a disease revealed by intrascopic methods—which used grievously to thwart and stifle the growth both of mind and body in children, are now promptly removed, to the infinite advantage of the rising generation. To the value of stains in clinical diagnosis, especially in investigation of perversions of the blood in many maladies, we have already made some reference. The discovery of the Röntgen rays has also extended the physician's power of vision, as in cases of aortic aneurysm, and other thoracic diseases.

By photography and diagrammatic records the clinical work of hospital wards has been brought into some better definition, and teaching made more accurate and more impressive. The separation of the alkaloids belongs rather to the earlier part of the 19th century, but the administration of these more accurate medications by means of hypodermic injection (see THERAPEUTICS) belongs to the latter. The ancient practice of transfusion has been placed on a more intelligible footing, and by the method of saline injections made more manageable as a means of relief or even of cure. Finally, calculation by statistics (William Farr, Karl Pearson, and others) has been brought into line with other scientific methods: the method is a difficult one, and one full of pitfalls for the unwary, yet when by co-operation of physician and mathematician its applications have been perfected its services will appear more and more indispensable.

Among the achievements of the medicine of the 19th century the growth of the medical press must not be forgotten. In England, by the boldness of the *Lancet* (founded in 1823), the tyranny of prescription, inveterate custom, and privilege abused was defied and broken down; freedom of learning was regained, and promotion thrown open to the competent, independently of family, gild and professional status. For the record and diffusion of rapidly growing knowledge, learned societies, universities and laboratories, greatly increased in number and activity, issue their transactions in various fields; and by means of year-books and central news-sheets the accumulation of knowledge is organized and made accessible.

It is interesting to find that, with all this activity in the present reformed methods of research and verification are not confined to the work of the passing day; in the brilliant achievements of modern research and reconstruction the maxim that " Truth is the daughter of Time " has not been forgotten. In the field of the History of Medicine the work of scholars such as Francis Adams of Banchory (1796–1861), William A. Greenhill (1814–1894) and C. Creighton in England, Maximilien P. Littré (1801–1881) and Charles V. Daremberg (1817–1872) in France, and Heinrich Häser (1811–1888) and August Hirsch, Diels, Weltmann and Julius Pagel in Germany, will prove to our children that tradition was as safe in our hands as progress itself.

(T. C. A.)

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MEDINA, JOSE TORIBIO (1852–   ), Chilean bibliographer, was born at Santiago, and was educated for the bar. His first publication, when a very young man, was a metrical translation of Longfellow's *Evangeline*. When twenty-two he was appointed secretary to the legation at Lima. After his return he published a history of Chilean literature (1878), and a work upon the aboriginal tribes (1884). In this latter year he was appointed secretary of legation in Spain, and availed himself of the opportunity of examining the treasures of the old Spanish libraries. These researches, repeated on subsequent visits to Spain, and also to France and England, enriched him with a mass of historical and bibliographical material. Among his publications may be mentioned the *Biblioteca hispano-americana*, a catalogue of all books and pamphlets relating to Spanish America printed in Spain; the *Biblioteca hispano-chilena*, a similar work, commenced in 1897; the standard and magnificent history of printing in the La Plata countries (1892); comprehensive works on the Inquisition in Chile, Peru and the Philippines; and the standard treatise on South American medals (1899). In addition, Señor Medina produced the fullest bibliographies yet attainable of books printed at Lima, Mexico and Manila, and a number of memoirs and other minor writings. No other man had rendered anything like the same amount of service to the literary history and bibliography of the Spanish colonies.

MEDINA, or rather AL-MEDINA (the city), or MEDINAT RASUL ALLAH (the city of the apostle of God), a town of the Hejaz in Arabia, about 820 m. by rail S.S.E. of Damascus, in 25° N., 40° E.,[1] the refuge of Mahomet on his emigration from Mecca, and a renowned place of Moslem pilgrimage, consecrated by the possession of his tomb. The name Medina goes back to the Koran (*sur.* xxxiii. 60); the old name was Yathrib, the Lathrippa of Ptolemy and Iathrippa of Stephanus Byzantius.

Medina stands in a basin at the northern extremity of an elevated plain, on the western skirt of the mountain range which divides the Red Sea coast-lands from the central plateau of Arabia. At an hour's distance to the north it is dominated by Mount Ohod, an outlying spur of the great mountains, the scene of the well-known battle (see MAHOMET), and the site of the tomb and mosque of the Prophet's uncle Hamza. To the east the plain is bounded by a long line of hills eight or ten hours distant, over which the Nejd road runs. A number of torrent courses (of which Wadi Kanat to the north, at the foot of Mount Ohod, and W. Akik, some miles to the south, are the most important) descend from the mountains, and converge in the neighbourhood of the town to unite farther west at a place called Zaghaba, whence they descend to the sea through the " mountains of the Tehama "—the rough country between Medina and its port of Yambu—under the name of W. Idam. Southwards from Medina the plain extends unbroken, but with a slight rise, as far as the eye can reach. The convergence of torrent-courses in the neighbourhood of Medina makes this one of the best-watered spots in northern Arabia. The city lies close to one of the great volcanic centres of the peninsula, which was in violent eruption as late as A.D. 1266, when the lava stream approached within an hour's distance of the walls, and dammed up W. Kanat. The result of this and older prehistoric eruptions has been to confine the underground water, so important in Arabian tillage, which can be reached at any point of the oasis by sinking deep wells. Many of the wells are brackish, and the natural fertility of the volcanic soil is in many places impaired by the salt with which it is impregnated; but the date-palm grows well everywhere, and the groves, interspersed with gardens and cornfields, which surround the city on all sides except the west, have been famous from the time of the Prophet. Thus situated, Medina was originally a city of agriculturists, not like Mecca a city of merchants; nor, apart from the indispensable trade in provisions, has it ever acquired commercial importance like that which Mecca owes to the pilgrimage.[1] Landowners and cultivators are still a chief element in the population of the city and suburbs. The latter, who are called Nakhāwila, and more or less openly profess the Shīʽa opinions, marry only among themselves. The townsmen proper, on the other hand, are a very motley race.[2] New settlers remain behind with each pilgrimage; attracted by the many offices of profit connected with the mosque, the stipends paid by the sultan to every inhabitant, and the gains to be derived by pilgrim-cicerones (*Muzawwirs*) or by those who make it a business to say prayers at the Prophet's mosque for persons who send a fee from a distance, as well as the alms which the citizens are accustomed to collect when they go abroad, especially in Turkey. The population of the city and suburbs may be from 16,000 to 20,000.

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[1] This is a very rough estimate. The road from Yambu on the Red Sea, which runs somewhat north of east, is by Burton's estimate 132 m. From Medina to Mecca by the inland or high road he makes 248 m. The usual road near the coast by Rabigh and Khulesa and thence to W. Fatima cannot be very different in length. Caravans traverse it in about ten or eleven days.

The city proper is surrounded by a solid stone wall,[3] with towers and four massive gateways of good architecture, forming an irregular oval running to a kind of angle at the north-west, where stands the castle, held by a Turkish garrison. The houses are good stone buildings similar in style to those of Mecca; the streets are narrow but clean, and in part paved.[4] There is a copious supply of water conducted from a tepid source (ez-Zarkā) at the village of Kuba, 2 m. south, and distributed in underground cisterns in each quarter.[5] The glory of Medina, and the only important building, is the mosque of the Prophet, in the eastern part of the city, a spacious enclosed court between 400 and 500 ft. in length from north to south, and two-thirds as much in breadth. The minarets and the lofty dome above the sacred graves are imposing features; but the circuit is hemmed in by houses or narrow lanes, and is not remarkable except for the principal gate (Bab al-Salam) at the southern end of the west front, facing the sacred graves, which is richly inlaid with marbles and fine tiles, and adorned with golden inscriptions. This gate leads into a deep portico, with ten rows of pillars, running along the southern wall. Near the farther end of the portico, but not adjoining the walls, is a sort of doorless house or chamber hung with rich curtains, which is supposed to contain the graves of Mahomet, Abu Bekr and Omar. To the north of this is a smaller chamber of the same kind, draped in black, which is said to represent the tomb of Fatima. Both are enclosed with an iron railing, so closely interwoven with brass wire-work that a glimpse of the so-called tombs can only be got through certain apertures, where intercessory prayer is addressed to the prophet, and pious salutations are paid to the other saints.[6] The portico in front of the railing is not ineffective, at least by nightlight. It is paved with marble, and in the eastern part with mosaic, laid with rich carpets; the southern wall is clothed with marble pierced with windows of good stained glass, and the great railing has a striking aspect; but an air of tawdriness is imparted by the vulgar painting of the columns, especially in the space between the tomb and the pulpit, which has received, in accordance with a tradition of the Prophet, the name of the Garden (*rauḍa*), and is decorated with barbaric attempts to carry out this idea in colour.[7] The throng of visitors passing along the south wall from the Bab al-Salam to salute the tombs is separated from the Garden by an iron railing. The other three sides of the interior court have porticoes of less depth and mean aspect, with three or four rows of pillars. Within the court are the well of the Prophet, and some palm-trees said to have been planted by Fatima; this "grove" is separated from the rest of the court by a wooden partition.

The original mosque was a low building of brick, roofed with palm-branches, and much smaller than the present structure. The wooden pulpit from which Mahomet preached appears to have stood on the same place with the present pulpit in the middle of the south portico. The dwelling of the Prophet and the huts of his women adjoined the mosque. Mahomet died in the hut of Ayesha and was buried where he died; Abu Bekr and Omar were afterwards buried beside him. In A.D. 711 the mosque, which had previously been enlarged by Omar and Othman, was entirely reconstructed on a grander scale and in Byzantine style by Greek and Coptic artificers at the command of the caliph Walid and under the direction of Omar Ibn Abd-al-Aziz. The enlarged plan included the huts above named, which were pulled down. Thus the place of the Prophet's burial was brought within the mosque; but the recorded discontent of the city at this step shows that the feeling which regards the tomb as the great glory of the mosque, and the pilgrimage to it as the most meritorious that can be undertaken except that to Mecca, was still quite unknown. It is not even certain what was done at this time to mark off the graves. Ibn ʽAbd Rabbih, in the beginning of the 10th century (*ʽIḳd*, Cairo ed., iii. 366), describes the enclosure as a hexagonal wall, rising within three cubits of the ceiling of the portico, clothed in marble for more than a man's height, and above that height daubed with the unguent called *khalūk*. This may be supplemented from Iṣṭakhrī, who calls it a lofty house without a door. That there are no gravestones or visible tombs within is certain from what is recorded of occasions when the place was opened up for repairs. Ibn Jubair (p. 193 seq.) and Samhūdī speak of a small casket adorned with silver, fixed in the eastern wall, which was supposed to be opposite the head of the Prophet, while a silver nail in the south wall indicated the point to which the corpse faced, and from which the salutation of worshippers was to be addressed (Burton misquotes). The European fable (mentioned and refuted, *e.g.* in *Histoire des Arabes par l'abbé de Marigny*, t. i. p. 46, Paris, 1750) of the coffin suspended by magnets is totally unknown to Moslem tradition. The smaller chamber of Fatima is comparatively modern. In the time of Ibn Jubair and of Ibn Batuta (unless the latter, as is so often the case, is merely copying his predecessor) there was only a small marble trough north of the rauḍa (or grave) which "is said to be the house of Fatima or her grave, but God only knows." It is more probable that Fatima was buried in the Baḳī, where her tomb was also shown in the 12th century (Ibn Jubair, pp. 198 seq.).

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[1] The pilgrimage to Medina, though highly meritorious, is not obligatory, and it is not tied to a single season: so that there is no general concourse at one time, and no fair like that of Mecca.

[2] A small number of families in Medina still claim to represent the ancient *Ansar*, the "defenders" of Mahomet; there are also some *Siddiqiyah*, claiming descent from Abu Bekr. But in fact the old population emigrated *en masse* after the sack of Medina by Moslim in 683, and passed into Spain in the armies of Musa. In the 13th century one old man of the Khazraj and one old woman of the Aus tribe were all that remained of the old stock in Medina (Maqqarī, i. 187; Dozy, *Mus. d'Espagne*, i. 111). The aristocratic family of the Benī Hosain, who claim descent from the martyr of Kerbela, and so from the Prophet, have apparently a better established pedigree.

[3] According to Ibn Khallikan (Slane's trans. iii. 927) the walls are of the 12th century, the work of Jamāl ud-Dīn al-Ispahānī.

[4] The Balāt or great paved street of Medina, a very unusual feature in an Eastern town, dates from the 1st century of Islām. (See Wüstenfeld's abstract of Samhūdī, p. 115.)

[5] Kubā is famous as the place where the Prophet lived before he entered Medina, and the site of the first mosque in which he prayed. It lies amidst orchards in the richest part of the oasis.

[6] The space between the railing and the tomb is seldom entered except by the servants of the mosque. It contains the treasures of the mosque in jewels and plate, which were once very considerable, but have been repeatedly plundered, last of all by the Wahhābīs in the beginning of the 19th century.

[7] The word *rauḍa* also means a mausoleum, and is applied by Ibn Jubair to the tomb itself. Thus the tradition that the space between the pulpit and the tomb was called by the Prophet one of the gardens of Paradise probably arose from a mistake.

The mosque was again extended by the caliph Mahdī (A.D. 781) and was burned down in 1256. Of its appearance before the fire we have two authentic accounts by Ibn ‘Abd Rabbih early in the 10th century, and by Ibn Jubair, who visited it in 1184. The old mosque had a much finer and more regular appearance than the present one; the interior walls were richly adorned with marble and mosaic arabesques of trees and the like, and the outer walls with stone marquetry; the pillars of the south portico (seventeen in each row) were in white plaster with gilt capitals, the other pillars were of marble. Ibn ‘Abd Rabbih speaks of eighteen gates, of which in Ibn Jubair's time, as at present, all but four were walled up. There were then three minarets. After the fire which took place just at the time of the fall of the caliphate, the mosque long lay in a miserable condition. Its repair was chiefly due to the Egyptian sultans, especially to Ḳāit Bey, whose restoration after a second fire in 1481 amounted almost to a complete reconstruction. Of the old building nothing seems to have remained but some of the columns and part of the walls. The minarets have also been rebuilt and two new ones added. The great dome above the tomb, the railing round it, and the pulpit, all date from Ḳāit Bey's restoration.

The suburbs, which occupy as much space as the city proper, and are partly walled in, lie south-west of the town, from which they are separated by an open space, the halting-place of caravans. Through the suburbs runs the watercourse called Wadi Buthan, a tributary of W. Ḳanāt, which the Yanbu‘ road crosses by a stone bridge. The suburbs are the quarter of the peasants. Thirty or forty families with their cattle occupy a single courtyard (*ḥōsh*), and form a kind of community often at feud with its neighbours. The several clans of Medina must have lived in much the same way at the time of the Prophet. The famous cemetery called Baḳī‘ el-Gharḳad, the resting-place of a multitude of the "companions" of the Prophet, lies immediately to the west of the city. It once contained many monuments, the chief of which are described by Ibn Jubair. Burckhardt in 1815 found it a mere waste, but some of the mosques have since been rebuilt.

History.—The story of the Amalekites in Yathrib and of their conquest by the Hebrews in the time of Moses is purely fabulous (see Nöldeke, *Über die Amalekiter*, 1864, p. 36). The oasis, when it first comes into the light of history, was held by Jews, among whom emigrants from Yemen afterwards settled. From the time of the emigration of Mahomet (A.D. 622) till the Omayyads removed the seat of empire from Medina to Damascus, the town springs into historic prominence as the capital of the new power that so rapidly changed the fate of the East. Its fall was not less rapid and complete, and since the battle of Harra and the sack of the city in 683 it has never regained political importance (see CALIPHATE, B. §§ 1, 2, &c.). Mahomet invested the country round Medina with an inviolable character like that of the Haram round Mecca; but this provision has never been observed with strictness. After the fall of the caliphs, who maintained a governor in Medina, the native amīrs enjoyed a fluctuating measure of independence, interrupted by the aggressions of the sherīfs of Mecca, or controlled by an intermittent Egyptian protectorate. The Turks after the conquest of Egypt held Medina for a time with a firmer hand; but their rule grew weak, and was almost nominal long before the Wahhābīs took the city in 1804. A Turko-Egyptian force retook it in 1812, and the Turks now maintain a pasha with a military establishment, while the cadi and chief agha of the mosque (a eunuch) are sent from Constantinople. In late years the influence of the Turkish government has been much strengthened, an important factor in its consideration being the construction of the railway from Syria to the Hejaz. Railway communication between Damascus and Medina was effected in 1908.

AUTHORITIES.—Medina has been described from personal observation by Burckhardt, who visited it in 1815, and Burton, who made the pilgrimage in 1853. Sadlier on his journey from Katif to Yambu (1819) was not allowed to enter the holy city. Burckhardt was prevented by ill-health from examining the city and country with his usual thoroughness. Little is added to our information by the report of ‘Abd el-Razzāq, who performed the pilgrimage in 1878, on a medical commission from the English government. The chief Arabic authority besides Ibn ‘Abd Rabbih and Ibn Jubair is Samhūdī, of whose history Wüstenfeld published an abstract in the Göttingen *Abhandlungen*, vol. ix. (1861). It goes down to the end of the 15th century. The topography of the country about Medina is interesting both historically and geographically; Bakrī, Yāqūt and other Arabic geographers supply much material on this topic. Some good information concerning Medina is contained in the 2nd volume of Doughty's *Travels in Arabia Deserta*.

(W. R. S.)

MEDINA, a village of Orleans county, in north-west New York, U.S.A., about 40 m. N.E. of Buffalo, and on Oak Orchard Creek. Pop. (1900), 4716 (857 foreign-born); (1905, state census), 5114; (1910) 5683. It is served by the New York Central & Hudson River railroad, by the Buffalo, Lockport & Rochester (interurban) railway, and by the Erie Canal. On Oak Orchard Creek and near the city are electric power plants, at the Medina Falls and at a large storage dam (60 ft. high) for water power, built in 1902. In the neighbourhood are extensive apple, peach and pear orchards; and vegetables, especially beans, are grown. There are valuable quarries of Medina sandstone, a good building-, paving- and flag-stone, varying in colour from light grey to brownish red, readily shaped and split, and less likely than limestone to crack or than granite to wear slippery; it was first found at Medina in 1837. There was a saw-mill on the creek near here in 1805, but the place was little settled before 1824, and its growth was due to the Erie Canal. It was incorporated in 1832.

MEDINA SIDONIA, DON ALONSO PEREZ DE GUZMAN EL BUENO, 7TH DUKE OF (1550–1615), the commander-in-chief of the Spanish Armada, was born on the 10th of September 1550. He was the son of Don Juan Claros de Guzman, eldest son of the 6th duke, and of his wife Doña Leonor Manrique de Zuñiga y Sotomayor. His father died in 1555, and Don Alonso became duke, and master of one of the greatest fortunes in Europe, on the death of his grandfather in 1539. The family of Guzman was originally lords of Abiados, on the southern slope of the Picos de Europa in the hill country of Leon. The name is believed to be a contraction or corruption of Gundamaris, *i.e.* son of Gundamar. An early family tradition represents them as having come from Britain, and they may have descended from one of the Scandinavian invaders who attacked the north coast of Spain in the 10th century. It is in the 10th century that they first appear, and they grew great by the reconquest of the country from the Mahommedans. The branch to which the dukes of Medina Sidonia belonged was founded by Alonso Perez de Guzman (1256–1309), surnamed El Bueno, the good, in the sense of good at need, or stout-hearted. In 1296 he defended the town of Tarifa on behalf of Sancho IV., and when the besiegers threatened to murder one of his sons whom they held as a prisoner if he did not surrender, he allowed the boy to be killed. He was rewarded by great grants of crown land. The duchy of Medina Sidonia, the oldest in Spain, was conferred by John II. in 1445 on one of his descendants, Juan Alonzo de Guzman, count of Niebla. The addition "El Bueno" to the family name of Guzman was used by several of the house, which included many statesmen, generals and colonial viceroys.[1] The 7th duke was betrothed in 1565 to Ana de Silva y Mendoza, who was then four years of age, the daughter of the prince of Eboli. In 1572 when the duchess was a little more than ten years of age, the pope granted a dispensation for the consummation of the marriage. The scandal of the time, for which there appears to be no foundation, accused Philip II. of a love intrigue with the princess of Eboli. The unvarying and unmerited favour he showed the duke has been accounted for on the ground that he took a paternal interest in the duchess. Don Alonso, though he bore the name of El Bueno, was a man of mean spirit. He made no serious effort to save his mother-in-law from the persecution she suffered at the hands of Philip II. His correspondence is full of whining complaints of poverty, and appeals to the king for pecuniary favours. In 1581 he was created a knight of the Golden Fleece, and was named captain-general of Lombardy. By pressing supplications to the king he got himself exempted on the ground of poverty and poor health. Yet when the marquess of Santa Cruz (*q.v.*) died, on the 9th of February 1588, Philip insisted on appointing him to the command of the Armada. He was chosen even before Santa Cruz was actually dead, and was forced to go in spite of his piteous declarations that he had neither experience nor capacity, and was always sick at sea. His conduct of the Armada justified his plea. He was even accused of showing want of personal courage, and was completely broken by the sufferings of the campaign, which turned his hair grey. The duke retained his posts of "admiral of the ocean" and captain-general of Andalusia in spite of the contempt openly expressed for him by the whole nation. When an English and Dutch armament assailed Cadiz in 1596 his sloth and timidity were largely responsible for the loss of the place. He was held up to ridicule by Cervantes in a sonnet. Yet the royal favour continued unabated even under the successor of Philip II. In 1606 the obstinacy and folly of the duke caused the loss of a squadron which was destroyed near Gibraltar by the Dutch. He died in 1615.

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[1] The titles and grandeeship passed, in accordance with Castilian law, by marriage of a daughter and heiress in 1777, to the marquess of Villafranca, and have since remained in that house.

See Cesario Duro, *La Armada invincible* (Madrid, 1884), which gives numerous references to authorities.

MEDINA SIDONIA, or MEDINASIDONIA, a town of southern Spain, in the province of Cadiz, 21 m. by road E.S.E. of Cadiz. Pop. (1900), 11,040. Medina Sidonia is built on an isolated hill surrounded by a cultivated plain. It contains a fine Gothic church, several convents, and the ancestral palace of the dukes of Medina Sidonia. It has a small agricultural trade, chiefly in wheat, olives and oats.

Medina Sidonia has been identified by some with the *Asido* of Pliny, but this is uncertain. Under the Visigoths the place was erected into a bishopric (*Assidonia*), and attained some importance; in the beginning of the 8th century it was taken by Tariq. In the time of Idrisi (12th century) the province of *Shadūna* or *Shidona* included, among other towns, Seville and Carmona; later Arab geographers place *Shadūna* in the province of Seville.

MEDIOLANUM, or MEDIOLANIUM (mod. Milan, *q.v.*), an ancient city of Italy, and the most important in Gallia Transpadana. Livy attributes its foundation to the Galli Insubres under Bellovesus after their defeat of the Etruscans, in the time of the older Tarquin. According to other authorities, the Etruscan city of Melpum which preceded it was destroyed in 396 B.C. Objects of the Bronze age have been found outside the city on the south. The name itself is Celtic. The Romans defeated the Insubres in 225–222 B.C., and stormed Mediolanum itself in the latter year. Its inhabitants rebelled some twenty years later in the Hannibalic War, but were defeated and finally reduced to obedience in 196 B.C. They probably acquired Latin rights in 89, and full civic rights in 49 B.C., as did those of the other towns of Gallia Transpadana. It appears later on (but not before the 2nd century A.D.) to have become a colony. It acquired a certain amount of literary eminence, for we hear of youths going from Comum to Mediolanum to study. In Strabo's time it was on an equality with Verona, but smaller than Patavium, but in the later times of the empire its importance increased. At the end of the 3rd century it became the seat of the governor of Aemilia and Liguria (which then included Gallia Transpadana also, thus consisting of the 9th and 11th regions of Augustus), and at the end of the 4th, of the governor of Liguria only, Aemilia having one of its own thenceforth. From Diocletian's time onwards the *praefectus praetorio* and the imperial vicar of Italy also had their seat here: and it became one of the principal mints of the empire. The emperors of the West resided at Mediolanum during the 4th century, until Honorius preferred Ravenna, and in 402 transferred his court there. Its importance, described in the poems of Ausonius, is demonstrated by its many inscriptions, and the interest and variety of their contents. In these the rarity of the mention of its chief magistrates is surprising: and it is not impossible that owing to its very importance the right of appointing them had been taken from it (as Mommsen thinks). The case of Ravenna is not dissimilar. The inscriptions indicate a strong Celtic character in the population. Procopius speaks of it as the first city of the West, after Rome, and says that when it was captured by the Goths in 539, 300,000 of the inhabitants were killed. It was an important centre of traffic, from which roads radiated in several directions—as railways do to-day—to Comum, to the foot of the Lacus Verbanus (Lago Maggiore), to Novaria and Vercellae, to Ticinum, to Laus Pompeia and thence to Placentia and Cremona, and to Bergomum. None of these roads had an individual name, so far as we know. To its secular power corresponds the independent position which its Church took in the time of St Ambrose (*q.v.*), bishop of Milan in 374–397, who founded the church which bears his name, and here baptized St Augustine in A.D. 387, and whose rite is still in use throughout the diocese. Theodosius indeed did penance here at Ambrose's bidding for his slaughter of the people of Thessalonica. After his death the period of invasions begins; and Milan felt the power of the Huns under Attila (452), of the Heruli under Odoacer (476) and of the Goths under Theodoric (493). When Belisarius was sent by Justinian to recover Italy, Datius, the archbishop of Milan, joined him, and the Goths were expelled from the city. But Uraia, nephew of Vitigis the Gothic king, subsequently assaulted and retook the town, after a brave resistance. Uraia destroyed the whole of Milan in 539; and hence it is that this city, once so important a centre of Roman civilization, possesses so few remains of antiquity. Narses, in his campaigns against the Goths, had invited the Lombards to his aid. They came in a body under Alboin, their king, in 568, and were soon masters of north Italy. They entered Milan in the next year, but Pavia became the Lombard capital.

Of Roman remains little is to be seen above ground, but a portico of sixteen Corinthian columns near S. Lorenzo, which may belong to the baths of Hercules, mentioned by Ausonius, or to the palace of Maximian. Close to the Torre del Carrobio remains of an ancient bridge and (possibly) of the walls of Maximian were found: and many remains of ancient buildings, including a theatre, have been discovered below ground-level. The objects found are preserved in the archaeological museum in the Castello Sforzesco. (See MILAN.)

See Th. Mommsen in *Corp. inscript. Latin.* (Berlin, 1883), v. 617 sqq. (with full bibliography); *Notizie degli Scavi, passim.*

(T. As.)

MEDITERRANEAN SEA. The Mediterranean is all that remains of a great ocean which at an early geological epoch, before the formation of the Atlantic, encircled half the globe along a line of latitude. This ocean, already diminished in area, retreated after Oligocene times from the Iranian plateau, Turkestan, Asia Minor and the region of the north-west Alps. Next the plains of eastern Europe were lost, then the Aralo-Caspian region, southern Russia and finally the valley of the Danube. The "Mediterranean region," as a geographical unit, includes all this area; the Black Sea and the Sea of Marmora are within its submerged portion, and the climate of the whole is controlled by the oceanic influences of the Mediterranean Sea. Professor Suess, to whom the above description is due, finds that the Mediterranean forms no exception to the rule in affording no evidence of elevation or depression within historic times; but it is noteworthy that its present basin is remarkable in Europe for its volcanic and seismic activity. Submarine earthquakes are in some parts sufficiently frequent and violent as seriously to interfere with the working of telegraph cables. Suess divides the Mediterranean basin into four physical regions, which afford probably the best means of description: (1) The western Mediterranean, from Gibraltar to Malta and Sicily, enclosed by the Apennines, the mountains of northern Africa, and of southern and south-eastern Spain (*Cordillère bétique*). (2) The Adriatic, occupying the space between the Apennines and the Dinaric group (Suess compares the Adriatic to the valley of the Brahmaputra). (3) A part surrounded by the fragments of the Dinaro-Taurus arch, especially by Crete and Cyprus. This includes the Aegean and the Black Sea, and its margin skirts the south coast of Asia Minor. These three parts belong strictly to Eurasia. (4) Part of the coastal region of Indo-Africa, terraced downwards in successive horizontal planes from the Shot, reaching the sea in the Little Syrte, and continuing to the southern depressions of Syria. Malta and Gozo are the only islands of the Mediterranean which can be associated with this section, and, *per contra*, the mountain chain of north-west Africa belongs to Eurasia. Murray (1888) estimates the total area of the Mediterranean at 813,000 sq. m. Karstens (1894) breaks it up into parts as follows:—

Western Mediterranean	841,593 sq. km.
Sicilian-Ionian basin	767,658 ,,
Greece and Levant basin	769,652 ,,
Adriatic Sea	130,656 ,,
Total	2,509,559 ,,

A more recent calculation by Krümmel gives the total area as 2,967,570 sq. km. or 1,145,830 sq. m. (See OCEAN.) Murray estimates the total surface of the Mediterranean drainage area, with which must be included the Black Sea, at 2,934,500 sq. m., of which 1,420,800 are Eurasian and 1,513,800 are African. The principal rivers entering the Mediterranean directly are the Nile from Africa, and the Po, Rhone and Ebro from Europe.

The physical divisions of the Mediterranean given above hold good in describing the form of the sea-bed. The western Mediterranean is cut off by a bank crossing the narrow strait between Sicily and Cape Bon, usually known as the Adventure Bank, on which the depth is nowhere 200 fathoms. The mean depth of the western basin is estimated at 881 fathoms, and the deepest sounding recorded is 2040 fathoms. In the eastern Mediterranean the mean depth is nearly the same as in the western basin. The Sicilian-Ionian basin has a mean depth of 885 fathoms, and the Levant basin, 793 fathoms. Deep water is found close up to the coast of Sicily, Greece, Crete and the edge of the African plateau. The steepest slope observed occurs off the island of Sapienza, near Navarino, where 1720 fathoms has been obtained only 10 miles from land. In 1897 the ship "Washington" obtained depths of 2220 fathoms in the middle of the eastern Mediterranean; and the Austrian expeditions in the "Pola" discovered in the "Pola Deep" (35° 44′ N., 21° 45′ E.), south-west of Cape Matapan, a maximum depth of 2046 fathoms. Between these two deep areas a ridge runs in a north-westerly direction 550 fathoms from the surface—possibly a projection from the African plateau. Another bank 1100 fathoms from the surface runs south from the east end of Crete, separating the Pola Deep from the depths of the Levant basin, in which a depth of 1960 fathoms was recorded near Makri on the coast of Asia Minor. The later expedition of the "Pola" discovered the "Rhodes Deep" (36° 5′ N., 28° 36′ E.), with a maximum depth of 2110 fathoms: this deep is closed to the south-east by a ridge running south-east, over which the depth is 1050 fathoms. Off the coast of Syria the "Pola" obtained four soundings of more than 1100 fathoms, and between Cyprus and the coast of Asia Minor only two over 550 fathoms. Murray gives the following figures for the areas and volumes of the Mediterranean at different depths:—

Depth. Fathoms.	Area. Sq. Miles.	Volume. Cub. Miles.
0– 100	201,300	80,950
100– 500	251,650	220,850
500–1000	81,300	189,200
1000–2000	263,250	217,050
Over 2000	15,500	1,750
	813,000	709,800

which gives a mean depth over all of 768 fathoms. The following table is due to Karstens:—

	Volume. Cub. Km.	Mean Depth. Fathoms.
Western Mediterranean	1,356,512	881
Sicilian-Ionian basin	1,242,549	885
Levant	1,116,599	793
Adriatic Sea	31,844	133

Krümmel gives the total volume of the basin as 4,249,020 cubic kilometres or 1,019,400 cubic statute miles, and the mean depth as 782 fathoms. (See OCEAN.)

Meteorology.—As already stated, the "Mediterranean region" forms a distinct climatic unit, chiefly due to the form and position of the Mediterranean Sea. The prevailing winds in this region, which the sea traverses longitudinally, are westerly, but the sea itself causes the formation of bands of low barometric pressure during the winter season, within which cyclonic disturbances frequently develop, while in summer the region comes under the influence of the polar margin of the tropical high pressure belt. Hence the Mediterranean region is characteristically one of winter rains, the distinctive feature becoming less sharply defined from south to north, and the amount of total annual fall increasing in the same direction. The climate becomes more continental in type from west to east, but there are great local irregularities—the elevated plateaus of Algeria and Spain cause a rise of pressure in winter and delay the rainy seasons: the rains set in earlier in the west than in the east, and the total fall is greater. Temperature varies greatly, the annual mean varying from 56° F. to 77° F. In the west the Atlantic influence limits the mean annual range to about 10°–12° F., but in the east this increases to 36° and even 40°. Autumn is warmer than spring, especially in the coastal regions, and this is exaggerated in the eastern region by local land winds, which replace the cool sea-breezes of summer: overcoats are ordinarily worn in Spain and Italy till July, and are then put aside till October. Local winds form an important feature in nearly all the coast climates of the Mediterranean, especially in winter, where they are primarily caused by the rapid change of temperature from the sea to the snow-clad hinterlands. Cold dry winds, often of great violence, occur in the Rhone valley (the Mistral), in Istria, and Dalmatia (the Bora), and in the western Caucasus. In summer a north-west "trade" wind, the Maestro, occurs in the Adriatic. The Sirocco is a cyclonic wind characteristic of the winter rainy season; in the Adriatic it is usually accompanied by cloud and moisture, often by rain. In Sicily and southern Italy the Sirocco occurs at all seasons; it is a dry, dusty wind from south-east or south-west. The dust is chiefly of local origin, but partly comes from the Sahara. Similar winds are met with in Spain (the Leveche), but they reach their greatest development in the Simooms of Algeria and Syria, and the Khamsin of Egypt.

Temperature.—The mean surface temperature of the waters of the Mediterranean falls from south-east, where it is over 70° F., to north-west, the average at the coast of the Gulf of Lyons being 60°. The isothermal of 65° runs from Gibraltar to the north of Sardinia, and thence by the Strait of Messina to the Gulf of Corinth. A similar distribution is found 100 fathoms from the surface, temperature falling from 60° in the Levant to 55° east of Gibraltar. At 200 fathoms temperature falls in the same way from 58° to 55°, but below 250 fathoms temperatures are practically uniform to the bottom, 55·5° in the western basin and 56·5° in the eastern. The bottom temperature observed in the Pola Deep was 56·3°.

Salinity.—In the extreme west the salinity of the surface water is about 36·3 per mille, and it increases eastwards to 37·6 east of Sardinia and 39·0 and upwards in the Levant. Observations of salinity in the depths of the western Mediterranean are very deficient, but the average is probably between 38·0 and 38·5. In the eastern basin the "Pola" expedition observed salinities of 38·7 to 39·0 to the east of a line joining Cape Matapan with Alexandria, and 38·2 to 38·7 to the west of it. The salter waters apparently tend to make their way westwards close to the African coast, and at the bottom the highest salinities have been observed south of Crete. Evnitzki states that the saltest water of the whole basin occurs in the Aegean Sea.

Circulation.—There is little definite circulation of water within the Mediterranean itself. In the straits joining it with the Atlantic and the Black Sea the fresher surface waters of these seas flow inwards to assist in making good the loss by evaporation at the surface of the Mediterranean, and in both cases dense water makes its way outwards along the bottom of the channels, the outflowing currents being less in volume and delivery than the inflowing. Elsewhere local surface currents are developed, either drifts due to the direct action of the winds, or streams produced by wind action heaping water up against the land; but these nowhere rise to the dignity of a distinct current system, although they are often sufficient to obliterate the feeble tidal action characteristic of the Mediterranean. Dr Natterer, the chemist of the "Pola" expeditions, has expressed the opinion that the poverty of the pelagic fauna is solely due to the want of circulation in the depths.

Deposits.—A great part of the bottom of the Mediterranean is covered with blue muds, frequently with a yellow upper layer containing a considerable proportion of carbonate of lime, chiefly shells of pelagic Foraminifera. In many parts, particularly in the eastern basin, a calcareous or siliceous crust, from half an inch to three inches in thickness, is met with; and Natterer suggested that the formation of this crust may be due to the production of carbonate of ammonium where deposits containing organic matter are undergoing oxidation, and the consequent precipitation of carbonate of lime and other substances from the waters nearer the surface. This view, however, has not met with general acceptance. (H. N. D.)

MEDIUM, primarily a person through whom, as an intermediate, communication is deemed to be carried on between living men and spirits of the departed, according to the spiritistic hypothesis; such a person is better termed sensitive or automatist. The phenomena of mediumship fall into two classes, (1) "physical phenomena" (*q.v.*) and (2) trance and automatic phenomena (utterances, script, &c.); both these may be manifested by the same person, as in the case of D. D. Home and Stainton Moses, but are often independent.

I. No sufficient mass of observations is to hand to enable us to distinguish between the results of trickery or hallucination on the one hand, and genuine supernormal phenomena on the other; but the evidence for raps and lights is good; competent observers have witnessed supposed materializations and there is respectable evidence for movements of objects.

Mediumship in the modern sense of the term may be said to have originated with the Rochester rappings of 1848 (see Spiritualism); but similar phenomena had been reported by such authors as Apollonius of Tyana; they figure frequently in the lives of the saints; and the magician in the lower stages of culture is in many respects a counterpart of the white medium. Among physical mediums who have attained celebrity may be mentioned D. D. Home (*q.v.*), Stainton Moses and Eusapia Palladino; the last has admittedly been fraudulent at times, but no deceit was ever proved of Home; Stainton Moses sat in a private circle and no suspicion of his good faith was ever aroused.

W. Stainton Moses (1839–1892) was a man of university education, a clergyman and a schoolmaster. In 1872 he became interested in spiritualism and soon began to manifest mediumistic phenomena, which continued for some ten years. These included, besides trance communications, raps, telekinesis, levitation, production of lights, perfumes and musical sounds, apports and materialized hands. But the conditions under which the experiments were tried were not sufficiently rigid to exclude the possibility of normal causes being at work; for no amount of evidence that the normal life is marked by no lapse from rectitude affords a presumption that uprightness will characterize states of secondary personality.

Eusapia Palladino has been observed by Sir O. Lodge, Professor Richet, F. W. H. Myers, and other eminent investigators; the first named reported that none of the phenomena in his presence went beyond what could be accomplished in a normal manner by a free and uncontrolled person; but he was convinced that movements were produced without apparent contact. Among other phenomena asserted to characterize the mediumship of Eusapia are the production of temporary prolongations from the medium's body; these have been seen in a good light by competent witnesses. It was shown in some sittings held at Cambridge in 1895 that Eusapia produced phenomena by fraudulent means: but though the evidence of this is conclusive it has not been shown that her mediumship is entirely fraudulent. Automatic records of seances can alone solve the problems raised by physical mediumship. It has been shown in the Davey-Hodgson experiments that continuous observation, even for a short period, is impossible, and that in the process of recording the observations many omissions and errors are inevitable. Even were it otherwise, no care could provide against the possibility of hallucination.

II. The genuineness of trance mediumship can no longer be called in question. The problem for solution is the source of the information. The best observed case is that of Mrs Piper of Boston; at the outset of her career, in 1884, she did not differ from the ordinary American trance medium. In 1885 the attention of Professor William James of Harvard was attracted to her; and for twenty years she remained under the supervision of the Society for Psychical Research. During that period three phases may be distinguished: (1) 1884–1891, trance utterances of a "control" calling himself Dr Phinuit, a French physician, of whose existence in the body no trace can be found; (2) 1892–1896, automatic writing by a "control" known as "George Pelham," the pseudonym of a young American author; (3) 1896 onwards, supervision by "controls" purporting to be identical with those associated with Stainton Moses. There is no evidence for regarding Mrs Piper as anything but absolutely honest. Much of the Piper material remains unpublished, partly on account of its intimate character. Many of those to whom the communications were made have been convinced that the "controls" are none other than discarnate spirits. Probably no absolute proof of identity can be given, though the reading of sealed letters would come near it; these have been left by more than one prominent psychical researcher, but so far the "controls" who claim to be the writers of them have failed to give their contents, even approximately.

Professor Flournoy has investigated a medium of very different type, known as Hélène Smith; against her good faith nothing can be urged, but her phenomena—trance utterance and glossolalia—have undoubtedly been produced by her own mind. These represent her to be the reincarnation of a Hindu princess, and of Marie Antoinette among others, but no evidence of identity has been produced. The most striking phenomenon of her trance was the so-called Martian language, eventually shown by analysis to be a derivative of French, comparable to the languages invented by children in the nursery, but more elaborate.

Authorities.—F. W. H. Myers, *Human Personality*; F. Podmore, *Modern Spiritualism*; the *Proceedings and Journal of the Society for Psychical Research*, *passim*; for a convenient survey of the Piper case, see F. Sage, *Madame Piper*; J. Maxwell, *Les Phénomènes psychiques* (1903; Eng. trans. 1905); Th. Flournoy, *Des Indes à la planète Mars*. For fraudulent methods, see *Confessions of a Medium* (London, 1882); Truesdell, *Bottom Facts of Spiritualism*, and works cited by Myers, II., 502–503. (N. W. T.)

MEDJIDIE, or Mejidie, the name of a military and knightly order of the Turkish Empire, and also of a silver Turkish coin, worth twenty piastres. The coin was first struck in 1844, and the order was instituted in 1852 by the sultan Abd-ul-Mejid, whose name was therefore given to them. (See Knighthood and Chivalry: § *Orders of Knighthood*.)

MEDLAR, *Mespilus germanica*, a tree of the tribe *Pomeae* of the order *Rosaceae*, closely allied to the genus *Pyrus*, in which it is sometimes included; it is a native of European woods, &c., from Holland southwards, and of western Asia. It occurs in hedges, &c., in middle and south England, as a small, much-branched, deciduous, spinous tree, but is not indigenous. The medlar was well known to the ancients. Pickering (*Chron. Hist. Pl.* p. 201) identifies it with a tree mentioned in a Siao-ya ode (*She-King*, ii. 1, 2), 827 B.C. It is the *μεσπίλη* of Theophrastus and *Mespilus* of Pliny. The Latin *mespilus* or *mespilum* became in Old French *mesle* or *medle*, "the fruit," *meslier*, *medlier*, "the tree." The modern French *nèfle* is from a corruption *nespilum* of the Latin. The German Mispel preserves the original more closely. The well-known fruit is globular, but depressed above, with leafy persistent sepals, and contains stones of a hemispherical shape. It is not fit to eat until it begins to decay and becomes "bletted," when it has an agreeable acid and somewhat astringent flavour. Several varieties are known in cultivation. The large Dutch medlar, which is very widely cultivated, has a naturally crooked growth; the large, much-flattened fruit is inferior in quality to the Nottingham, which is a tree of upright habit with fruits of about 1 in. diameter, superior to any other variety. There is also a stoneless variety with still smaller fruits, but the quality is not so good.

The medlar is propagated by budding or grafting upon the white-thorn, which is most suitable if the soil is dry and sandy, or on the quince if the soil is moist; the pear stock also succeeds well on ordinary soils. It produces the best fruit in rich, loamy, somewhat moist ground. The tree may be grown as a standard, and chiefly requires pruning to prevent the branches from rubbing each other. The fruit should be gathered in November, on a dry day, and laid out upon shelves. It becomes "bletted" and fit for use in two or three weeks. The Japanese medlar is *Eriobotrya japonica* (see LOQUAT), a genus of the same tribe of Rosaceae.

MÉDOC, a district in France adjoining the left bank of the Gironde from Blanquefort (N. of Bordeaux) to the mouth of the Gironde. Its length is about 50 m., its breadth averages between 6 and 7 m. It is formed by a number of low hills, which separate the Landes from the Gironde, and is traversed only by small streams; the Gironde itself is muddy, and often enveloped in fog, and the region as a whole is far from picturesque. Large areas of its soil are occupied by vineyards, the products of which form the finest growths of Bordeaux. (See WINE.)

MEDUSA, the name given by zoologists to the familiar marine animals known popularly as jelly-fishes; or, to be more accurate, to those jelly-fishes[1] in which the form of the body resembles that of an umbrella, bell or parachute. The name medusa is suggested by the tentacles, usually long and often numerous, implanted on the edge of the umbrella and bear the stinging organs of which sea-bathers are often disagreeably aware. The tentacles serve for the capture of prey and are very contractile, being often protruded to a great length or, on the other hand, retracted and forming corkscrew-like curls. Hence the animals have suggested to vivid imaginations the head of the fabled Gorgon or Medusa with her *chevelure* of writhing snakes.

The medusa occurs as one type of individual in the class Hydrozoa (*q.v.*), the other type being the polyp (*q.v.*). In a typical medusa we can distinguish the following parts. The umbrella-like body bears a circle of tentacles at the edge, whereby the body can be divided into a convex *exumbrella* or exumbral surface and a concave *subumbrella* or subumbral surface. The vast majority of jelly-fish float in the sea, with the exumbrella upwards, the subumbrella downwards. A few species, however, attach themselves temporarily or permanently to some firm object by the exumbral surface of the body, and then the subumbral surface is directed upwards. From the centre of the subumbral surface hangs down the *manubrium*, like the handle of an umbrella or the clapper of a bell, bearing the mouth at its extremity. In addition to the tentacles, the margin of the umbrella bears sense-organs, which may be of several kinds and may attain a high degree of complexity.

Medusae capture their prey, consisting of small organisms of various kinds, especially Crustacea, by means of the tentacles which hang out like fishing-lines in all directions. When the prey comes into contact with the tentacles it is paralysed, and at the same time held firmly, by the barbed threads shot out from the stinging organs or nematocysts. Then by contraction of the tentacles the prey is drawn into the mouth. Medusae thus form an important constituent of the plankton or floating fauna of the ocean, and compete with fish and other animals for the food-supply furnished by minuter forms of life.

A medusa has a layer of muscles, more or less strongly developed, running in a circular direction on the surface of the subumbrella, the contractions of which are antagonized by the elasticity of the gelatinous substance of the body. By the contraction of the subumbral circular muscles the concavity of the subumbrella is increased, and as water is thereby forced out of the subumbral cavity the animal is jerked upwards. In this way jelly-fish progress feebly by the pumping movements of the umbrella. Besides the circular subumbral muscles, there may be others running in a radial direction, chiefly developed as the longitudinal retractor muscles of the manubrium. In some cases the circular subumbral muscles form a rim known as the *velum* (*v.*, see fig. 1), projecting into the subumbral cavity just within the ring of marginal tentacles. The two principal divisions of the medusae are characterized by the presence or absence of a velum.

Correlated with the well-developed muscular system and sense-organs of the medusa, we find also a distinct nervous system, either, when there is no velum, in the form of concentrations of nervous matter in the vicinity of each sense-organ, or, when a velum is present, as two continuous rings running round the margin of the umbrella, one external to the velum (exumbral nerve-ring, $n.r^1$, see fig. 1), the other internal to it (subumbral nerve-ring, $n.r^2$.). The exumbral nerve-ring is the larger and supplies the tentacles; the subumbral ring supplies the velum.

Every possible variety of body-form compatible with the foregoing description may be exhibited by different species of medusae. The body may show modifications of form which can be compared to a shallow saucer, a cup, a bell or a thimble. The marginal tentacles may be very numerous or may be few in number or even absent altogether; and they may be simple filaments, or branched in a complicated manner. The manubrium may be excessively long or very short, and in rare cases absent, the mouth then being flush with the subumbral surface. The mouth may be circular or four-cornered, and in the latter case the manubrium at the angles of the mouth may become drawn out into four lappets, the oral arms, each with a groove on its inner side continuous with the corner of the mouth. The oral arms are the starting-point of a further series of variations; they may be simple flaps, crinkled and folded in various ways, or they may be subdivided, and then the branches may simulate tentacles in appearance. In the genus *Rhizostoma*, common on the British coasts and conspicuous on account of its large size, the oral arms, originally distinct and four in number, undergo concrescence, so that the entrance to the mouth is reduced to numerous fine pores and canals.[2]

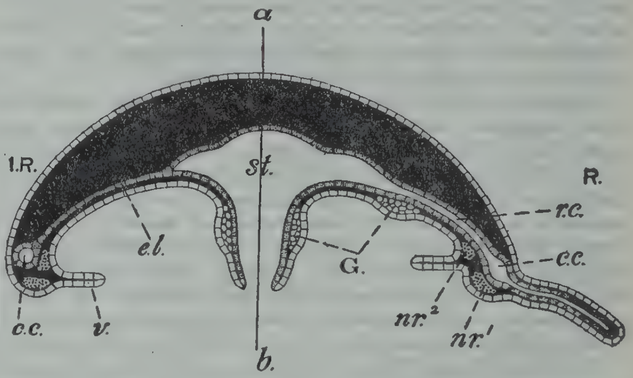

FIG. 1.

Diagram of the structure of a medusa; the ectoderm is left clear, the endoderm is dotted, the mesogloea is shaded black; *a-b*, principal axis (see HYDROZOA); to the left of this line the section is supposed to pass through an inter-radius (I.R.); to the right through a radius (R). The exumbral surface is uppermost, the subumbral surface, with the manubrium and mouth, is facing downwards.

St.	Stomach.	G.	Gonads.
r.c.	Radial canal.	*n.r.*¹	Exumbral (so-called upper) nerve-ring.
c.c.	Circular or ring-canal.		
e.l.	Endoderm-lamella.	*n.r.*²	Subumbral (so-called lower) nerve-ring.
v.	Velum.		

(For other figures of medusae see HYDROZOA.)

Like the external structure, the internal anatomy of the medusa shows a complete radial symmetry, and is simple in plan but often complicated in detail (see fig. 1). As in all Hydrozoa (*q.v.*) the body wall is composed of two cell-layers, the ectoderm and endoderm, between which is a structureless gelatinous secreted layer, the mesogloea. As the name jelly-fish implies, the mesogloea is greatly developed and abundant in quantity. It may be traversed by processes of the cells of the ectoderm and endoderm, or it may contain cells which have migrated into it from these two layers. The ectoderm covers the whole external surface of the animal, while the endoderm lines the coelenteron or gastrovascular space; the two layers meet each other, and become continuous, at the edge of the mouth.

The mouth leads at once into the true digestive cavity, divisible into an oesophageal region in the manubrium and a more dilated cavity, the stomach (*st.*), occupying the centre of the umbrella. From the stomach, canals arise termed the radial canals (*r.c.*); typically four in number, they run in a radial direction to the edge of the umbrella. There the radial canals are joined by a ring-canal (*c.c.*) which runs round the margin of the umbrella. From the ring-canal are given off tentacle-canals which run down the axis of each tentacle; in many cases, however, the cavity of the tentacle is obliterated and instead of a canal the tentacle contains a solid core of endoderm. Oesophagus, stomach, radial canals, ring-canal and tentacle-canals, constitute together the gastrovascular system and are lined throughout by endoderm, which forms also a flat sheet of cells connecting the radial canals and ring canal together like a web; this is the so-called *endoderm-lamella* (*e.l.*), a most important feature of medusan morphology, the nature of which will be apparent when the development is described. As a general rule the mouth is the only aperture of the gastrovascular system; in a few cases, however, excretory pores are found on the ring-canal, but there is never any anal opening.

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[1] The gooseberry-like or band-shaped jelly-fishes belong to the class Ctenophora (*q.v.*).

[2] For other variations of the medusa, often of importance for systematic classification, see HYDROMEDUSAE and SCYPHOMEDUSAE.

The sense-organs of medusae are of two classes: (1) pigment spots, sensitive to light, termed *ocelli*, which may become elaborated into eye-like structures with lens, retina and vitreous body; (2) organs of the sense of balance or orientation, commonly termed *otocysts* or *statocysts*. The sense-organs are always situated at the margin of the unbrella and may be distinguished from the morphological point of view into two categories, according as they are, or are not, derived from modifications of tentacles; in the former case they are termed *tentaculocysts*. (For fuller information upon the sense-organs see HYDROMEDUSAE.)

Medusae are nearly always of separate sexes, and instances of hermaphroditism are rare. The gonads or generative organs may be produced either in the ectoderm or the endoderm. When the gonads are endodermal, they are formed on the floor of the stomach; when ectodermal (G, see fig. 1), they are formed on the subumbral surface, either on the manubrium or under the stomach or under the radial canals, or in more than one of these regions. Medusae often have the power of budding, and the buds are formed either on the manubrium, or at the margin of the umbrella, or on an outgrowth or "stolon" produced from the exumbral surface.

The internal anatomy of the medusa is as variable as its external features. The mouth may lead directly into the stomach, without any oesophagus. The stomach may be situated in the disk, or may be drawn out into the base of the manubrium, so that the disk is occupied only by the radial canals. On the other hand the stomach may have lobes extending to the ring-canal, so that radial canals may be very short or absent. The radial canals may be four, rarely six, or a multiple of these numbers, and may be very numerous. They may be simple or branched. (For other anatomical variations see HYDROMEDUSAE and SCYPHOMEDUSAE.)

In development the medusa can be derived easily by a process of differential growth, combined with concrescence of cell-layers, from the actinula-larva. (For figures see HYDROZOA.) The actinula is polyp-like, with a sack-like or rounded body; a crown of tentacles surrounds a wide peristome, in the centre of which is the mouth, usually raised on a conical process termed the hypostome. To produce a medusa the actinula grows greatly along a plane at right angles to the vertical axis of the body, whereby the aboral surface of the actinula becomes the exumbrella, and the peristome becomes the subumbrella. The crown of tentacles thus comes to form a fringe to the margin of the body, and the hypostome becomes the manubrium. As a result of this change of form the gastric cavity or coelenteron becomes of compressed lenticular form, and the endoderm lining it can be distinguished as an upper or exumbral layer and a lower or subumbral layer. The next event is a great growth in thickness of the gelatinous mesogloea, especially on the exumbral side; as a result the flattened coelenteron is still further compressed so that in certain spots its cavity is obliterated, and its exumbral and subumbral layers of endoderm come into contact and undergo concrescence. As a rule four such areas of concrescence or *cathammata* (E. Haeckel) are formed. The cathammal areas may remain very small, mere wedge-shaped partitions dividing up the coelenteron into a four-lobed stomach, the lobes of which communicate at the periphery of the body by a spacious ring-canal. More usually each cathamma is a wide triangular area, reducing the peripheral portion of the coelenteron to the four narrow radial canals and the ring-canal above described. The two apposed layers of endoderm in the cathammal area undergo complete fusion to form a single layer of epithelium, the endoderm-lamella of the adult medusa.

Medusae, when they reproduce themselves by budding, always produce medusae, but when they reproduce by the sexual method the embryos produced from the egg grow into medusae in some cases, in other cases into polyps which bud medusae in their turn. In this way complicated cycles of alternating generations arise, which are described fully in HYDROMEDUSAE and SCYPHOMEDUSAE.

Medusae are exclusively aquatic animals and for the most part marine, but at least two fresh-water species are known.[1] *Limnocodium sowerbyi* was first discovered swimming in the tank in which the water-lily, *Victoria regia*, is cultivated in Kew Gardens, and has since been found sporadically in a similar situation in other botanical gardens, its most recent appearance being at Lille. These jelly-fishes are probably budded from a minute polyp-stock introduced with the roots of the lily. Another fresh-water form is *Limnocnida tanganyicae*, discovered first in lake Tanganyika, and now known to occur also in the Victoria Nyanza and in the Niger. A medusa with a remarkable habit of life is *Mnestra parasites*, which is parasitic on the pelagic mollusc *Phyllirrhoe*, attaching itself to the host by its subumbral surface; its tentacles, no longer required for obtaining food, have become rudimentary. A parasitic mode of life is also seen in medusae of the genus *Cunina* during the larval condition, but the habit is abandoned, in this case, when the medusae become adult.

For figures of medusae see (1) E. Haeckel, "Das System der Medusen," *Denkschriften med-natwiss. Ges. Jena* (1879, 2 vols.); (2) Id., "Deep-Sea Medusae," *Challenger Reports, Zoology*, IV. pt. ii. (1882); (3) O. Maas, "Die craspedoten Medusen," *Ergebn. Plankton-Expedition*, II. (1893); (4) id., "Die Medusen," *Mem. Mus. Comp. Zool. Harvard*, XXIII. (1897); (5) G. J. Allman, "A Monograph of the Gymnoblastic or Tubularian Hydroids," *Ray. Soc.* (1871–1872). (E. A. M.)

MEDWAY, a river in the south-east of England. It rises in the Forest Ridges, S.W. of East Grinstead in Sussex, and, increased by many feeders from these picturesque hills, has an easterly course to the county boundary, which it forms, turning northward for a short distance. Entering Kent near Ashurst, its course becomes north-easterly, and this direction is generally maintained to the mouth. The river passes Tonbridge, receiving the Eden from the west, and later the Teise and Beult from the south and east, all these streams watering the rich Weald (*q.v.*) to the south of the North Downs. These hills are breached by the Medway in a beautiful valley, in which lies Maidstone, generally much narrower than the upper valley. The characteristic structure of this part of the valley is considered under the heading DOWNS. Below Maidstone the valley forms a perfect basin, the hills descending upon it closely above Rochester. Below this city the river enters a broad, winding estuary, passing Chatham, and at Sheerness joining that of the Thames, so that the Medway may be considered a tributary, and its drainage area of 680 sq. m. reckoned as part of that of the greater river. The length of the Medway is about 60 m., excluding its many lesser windings. The estuary is navigable for sea-going vessels drawing 24 ft. up to Rochester Bridge. A considerable traffic is carried on by small vessels up to Maidstone, and by barges up to Tonbridge, the total length of the navigation being 43 m. The marshy lowlands along the course of the river have yielded extensive remains of Roman pottery, a plain ware of dark slate-colour.

MEEANEE, or MIANI, a village in Sind, India, on the Indus 6 m. N. of Hyderabad. Pop. (1901), 962. It is famous as the scene of the battle in which Sir Charles Napier, with only 2800 men, broke the power of the mirs of Sind on the 17th of February 1843. The result of this victory was the conquest and annexation of Sind.

MEEK, FIELDING BRADFORD (1817–1876), American geologist and palaeontologist, the son of a lawyer, was born at Madison, Indiana, on the 10th of December 1817. In early life he was in business as a merchant, but his leisure hours were devoted to collecting fossils and studying the rocks of the neighbourhood of Madison. Being unsuccessful in business he turned his whole attention to science, and in 1848 he gained employment on the U.S. Geological Survey in Iowa, and subsequently in Wisconsin and Minnesota. In 1852 he became assistant to Professor James Hall at Albany, and worked at palaeontology with him until 1858. Meanwhile in 1853 he accompanied Dr F. V. Hayden in an exploration of the "Bad Lands" of Dakota, and brought back valuable collections of fossils. In 1858 he went to Washington, where he devoted his time to the palaeontological work of the United States geological and geographical surveys, his work bearing "the stamp of the most faithful and conscientious research," and raising him to the highest rank as a palaeontologist. Besides many separate contributions to science, he prepared with W. M. Gabb (1839–1878), two volumes on the palaeontology of California (1864–1869); and also a *Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country* (1876). He died at Washington, on the 22nd of December 1876.

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[1] C. L. Boulenger (*Proc. Zool. Soc. of London*, 1907, p. 516) recorded the discovery of a third species by himself and W. A. Cunnington, in the brackish water of lake Birket el Kerun in the Egyptian Fayum.

MEER, JAN VAN DER (1632–1675), more often called Vermeer of Delft—not to be confounded with the elder (1628–1691) or younger (1656–1705) Van der Meer of Haarlem, or with Van der Meer of Utrecht—is one of the excellent Dutch painters about whom the Dutch biographers give us little information.[1] Van der Meer, or Vermeer, was born in Delft, and was a pupil of Carel Fabritius, whose junior he was by only eight years. The works by Fabritius are few, but his contemporaries speak of him as a man of remarkable power, and the paintings now ascertained to be from his hand, and formerly ascribed to Rembrandt, prove him to have been deeply imbued with the spirit and manner of that master. Whether Van der Meer had ever any closer relation to Rembrandt than through companionship with Fabritius remains uncertain. In 1653 he married Catherine Bolenes, and in the same year he entered the gild of St Luke of Delft, becoming one of the heads of the gild in 1662 and again in 1670. He died at Delft in 1675, leaving a widow and eight children. His circumstances cannot have been flourishing, for at his death he left twenty-six pictures undisposed of, and his widow had to apply to the court of insolvency to be placed under a curator, who was Leeuwenhoek, the naturalist.

For more than two centuries Van der Meer was almost completely forgotten, and his pictures were sold under the names and forged signatures of the more popular De Hooch, Metsu, Ter Borch, and even of Rembrandt. The attention of the art-world was first recalled to this most original painter by Thoré, an exiled Frenchman, who described his then known works in *Musées de la Hollande* (1858–1860), published under the assumed name of W. Bürger. The result of his researches, continued in his *Galerie Suermondt* and *Galerie d'Arenberg*, was afterwards given by him in a charming, though incomplete, monograph (*Gazette des beaux-arts*, 1866, pp. 297, 458, 542). The task was prosecuted with success by Havard (*Les Artistes hollandais*), and by Obreen (*Nederlandsche Kunstgeschiedenis*, Dl. iv.), and we are now in a position to refer to Van der Meer's works. His pictures are rarely dated, but one of the most important, in the Dresden Gallery, bears the date 1656, and thus gives us a key to his styles. With the exception of the "Christ with Martha and Mary" in the Coats collection at Glasgow, it is perhaps the only one, hitherto recognized, that has figures of life size, though his authorship is claimed for several others. The Dresden picture of a "Woman and Soldier," with other two figures, is painted with remarkable power and boldness, with great command over the resources of colour, and with wonderful expression of life. For strength and colour it more than holds its own beside the neighbouring Rembrandts. To this early period of his career belong, from internal evidence, the "Reading Girl" of the same gallery, the luminous and masterly "View of Delft" in the museum of the Hague, the "Milk-Woman" and the small street view, both identified with the Six collection at Amsterdam, the former now in the Rijksmuseum; the magnificent "The Letter" also at Amsterdam, "Diana and the Nymphs" (formerly ascribed to Vermeer of Utrecht) at the Hague Gallery, and others. In all these we find the same brilliant style and vigorous work, a solid impasto, and a crisp, sparkling touch. His first manner seems to have been influenced by the pleiad of painters circling round Rembrandt, a school which lost favour in Holland in the last quarter of the century. During the final ten or twelve years of his life Van der Meer adopted a second manner. We now find his painting smooth and thin, and his colours paler and softer. Instead of masculine vigour we have refined delicacy and subtlety, but in both styles beauty of tone and perfect harmony are conspicuous. Through all his work may be traced his love of lemon-yellow and of blue of all shades. Of his second style typical examples are to be seen in "The Coquette" of the Brunswick Gallery, in the "Woman Reading" in the Van der Hoop collection now at the Rijksmuseum at Amsterdam, in the "Lady at a Casement" belonging to Lord Powerscourt (exhibited at the Royal Academy, 1878) and in the "Music Master and Pupil" belonging to the King (exhibited at the Royal Academy, 1876).

Van der Meer's authentic pictures in public and private collections amount to about thirty. There is but one in the Louvre, the "Lace Maker"; Dresden has the two aforementioned, while Berlin has three, all acquired in the Suermondt collection, and the Czernin Gallery of Vienna is fortunate in possessing a fine picture, believed to represent the artist in his studio. In the Arenberg Gallery at Brussels there is a remarkable head of a girl, half the size of life, which seems to be intermediate between his two styles. Several of his paintings are in private foreign collections. In all his work there is a singular completeness and charm. His tone is usually silvery with pearly shadows, and the lighting of his interiors is equal and natural. In all cases his figures seem to move in light and air, and in this respect he resembles greatly his fellow-worker De Hooch. It is curious to read that, at one of the auctions in Amsterdam about the middle of the 18th century, a De Hooch is praised as being "nearly equal to the famous Van der Meer of Delft."

See also Havard, *Van der Meer* (Paris, 1888); Vanzype, *Vermeer de Delft* (Brussels, 1908), and Hofstede de Groot, *Jan Vermeer von Delft* (Leipzig, 1909).

MEERANE, a town in the kingdom of Saxony, 9 m. N. of Zwickau and 37 S. of Leipzig by rail. Pop. (1905), 26,005. It contains a fine medieval church (Evangelical). It is one of the most important industrial centres of Germany for the manufacture of woollen and mixed cloths, and in these products has a large export trade, especially to America and the Far East. There are also extensive dyeworks, tanneries and machine factories.

See Leopold, *Chronik und Beschreibung der Fabrik- und Handelstadt Meerane* (1863).

MEERSCHAUM, a German word designating a soft white mineral sometimes found floating on the Black Sea, and rather suggestive of sea-foam (*Meerschaum*), whence also the French name for the same substance, *écume de mer*. It was termed by E. F. Glocker sepiolite, in allusion to its remote resemblance to the "bone" of the sepia or cuttle-fish. Meerschaum is an opaque mineral of white, grey or cream colour, breaking with a conchoidal or fine earthy fracture, and occasionally though rarely, fibrous in texture. It can be readily scratched with the nail, its hardness being about 2. The specific gravity varies from 0·988 to 1·279, but the porosity of the mineral may lead to error. Meerschaum is a hydrous magnesium silicate, with the formula $H_4Mg_2Si_3O_{10}$, or $Mg_2Si_3O_8 \cdot 2H_2O$.

Most of the meerschaum of commerce is obtained from Asia Minor, chiefly from the plain of Eski-Shehr, on the Haidar Pasha-Angora railway, where it occurs in irregular nodular masses, in alluvial deposits, which are extensively worked for its extraction. It is said that in this district there are 4000 shafts leading to horizontal galleries for extraction of the meerschaum. The principal workings are at Sepetdji-Odjaghi and Kemikdji-Odjaghi, about 20 m. S.E. of Eski-Shehr. The mineral is associated with magnesite (magnesium carbonate), the primitive source of both minerals being a serpentine. When first extracted the meerschaum is soft, but it hardens on exposure to solar heat or when dried in a warm room. Meerschaum is found also, though less abundantly, in Greece, as at Thebes, and in the islands of Euboea and Samos; it occurs also in serpentine at Hrubschitz near Kromau in Moravia. It is found to a limited extent at certain localities in France and Spain, and is known in Morocco. In the United States it occurs in serpentine in Pennsylvania (as at Nottingham, Chester county) and in South Carolina and Utah.

Meerschaum has occasionally been used as a substitute for soap and fuller's earth, and it is said also as a building material; but its chief use is for tobacco-pipes and cigar-holders. The natural nodules are first scraped to remove the red earthy matrix, then dried, again scraped and polished with wax. The rudely shaped masses thus prepared are sent from the East to Vienna and other manufacturing centres, where they are turned and carved, smoothed with glass-paper and Dutch rushes, heated in wax or stearine, and finally polished with bone-ash, &c. Imitations are made in plaster of Paris and other preparations.

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[1] This undeserved neglect seems to have fallen on him at an early period, for Houbraken (*Groote Schouburgh*, 1718), writing little more than forty years after his death, does not even mention him. The only definite information we have from a contemporary is given by Bleyswijck (*Beschrijving der Stad Delft*, 1687), who tells us that he was born in 1632, and that he worked with Carel Fabritius, an able disciple of Rembrandt, who lost his life by an explosion of a powder magazine in Delft in 1654. It is to the patient researches of W. Bürger (Th. Thoré), Havard, Obreen, Soutendam, and others, that we owe our knowledge of the main facts of his life, discovered in the archives of his native town.

The soft, white, earthy mineral from Långbanshyttan, in Vermland, Sweden, known as aphrodite (ἀφρός, foam), is closely related to meerschaum. It may be noted that meerschaum has sometimes been called magnesite (*q.v.*).

MEERUT, a city, district and division of British India, in the United Provinces. The city is half-way between the Ganges and the Jumna, and has two stations on the North-Western railway, 37 m. N.E. from Delhi. Pop. (1901), 118,129. The city proper lies south of the cantonments, and although dating back to the days of the Buddhist emperor Asoka (*c.* 250 B.C.) Meerut owes its modern importance to its selection by the British government as the site of a great military station. In 1805 it is mentioned as "a ruined, depopulated town." The cantonment was established in 1806, and the population rose to 29,014 in 1847, and 82,035 in 1853. The town is an important centre of the cotton-trade. It is the headquarters of the 7th division of the northern army, with accommodation for horse and field artillery, British and native cavalry and infantry. It was here that the first outbreak of the Mutiny of 1857 took place. (See INDIAN MUTINY.)

The DISTRICT OF MEERUT forms part of the upper Doab, or tract between the Ganges and the Jumna, extending from river to river. Area, 2354 sq. m. Though well wooded in places and abundantly supplied with mango groves, it has but few patches of jungle or waste land. Sandy ridges run along the low watersheds which separate the minor channels, but with this exception the whole district is one continuous expanse of careful and prosperous tillage. Its fertility is largely due to the system of irrigation canals. The Eastern Jumna canal runs through the whole length of the district, and supplies the rich tract between the Jumna and the Hindan with a network of distributary streams. The main branch of the Ganges canal passes across the centre of the plateau in a sweeping curve and waters the midland tract. The Anūpshahr branch supplies irrigation to the Ganges slope, and the Agra canal passes through the southern corner of Loni pargana from the Hindan to the Jumna. Besides these natural and artificial channels, the country is everywhere cut up by small water-courses. The Burh Ganga, or ancient bed of the Ganges, lies at some distance from the modern stream; and on its bank stood the abandoned city of Hastinapur, the legendary capital of the Pandavas at the period of the *Mahābhārata*, said to have been deserted many centuries before the Christian era, owing to the encroachments of the river.

The comparatively high latitude and elevated position of Meerut make it one of the healthiest districts in the plains of India. The average temperature varies from 57° F. in January to 87° in June. The rainfall is small, less than 30 in. annually. The only endemic disease in the district is malarial fever; but small-pox and cholera occasionally visit it as epidemics. The population in 1901 was 1,540,175, showing an increase of 10·6% in the decade. The principal crops are wheat, pulse, millet, sugar-cane, cotton and indigo, but this last crop has declined of late years almost to extinction. The district is traversed by the North-Western railway, and also contains Ghaziabad, the terminus of the East Indian system, whence a branch runs to Delhi, while a branch of the Oudh & Rohilkhand railway from Moradabad to Ghaziabad was opened in 1900.

The authentic history of the district begins with the Moslem invasions. The first undoubted Mahommedan invasion was that of Kutbeddin in 1191, when Meerut town was taken and all the Hindu temples turned into mosques. In 1398 Timūr captured the fort of Loni after a desperate resistance, and put all his Hindu prisoners to death. He then proceeded to Delhi, and after his memorable sack of that city returned to Meerut, captured the town, razed all the fortifications and houses of the Hindus, and put the male inhabitants to the sword. The establishment of the great Mogul dynasty in the 16th century, under Baber and his successors, gave Meerut a period of internal tranquillity and royal favour. After the death of Aurangzeb, however, it was exposed to alternate Sikh and Mahrattā invasions. From 1707 till 1775 the country was the scene of perpetual strife, and was only rescued from anarchy by the exertions of the military adventurer Walter Reinhardt, afterwards the husband of the celebrated Begum Samru, who established himself at Sardhāna in the north, and ruled a large estate. The southern tract, however, remained in its anarchic condition under Mahrattā exactions until the fall of Delhi in 1803, when the whole of the country between the Jumna and the Ganges was ceded by Sindhia to the British. It was formed into a separate district in 1818. In the British period it has become memorable for its connexion with the Mutiny of 1857.

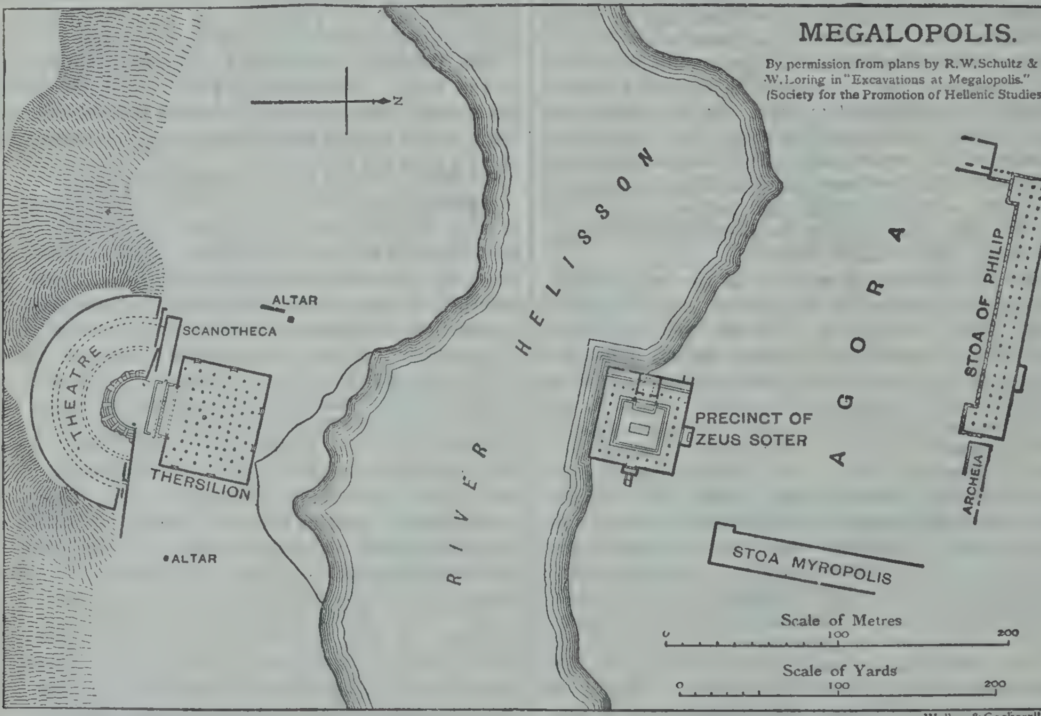
The DIVISION OF MEERUT comprises the northern portion of the Doab. It consists of the six districts of Dehra Dun, Saharanpur, Muzaffarnagar, Meerut, Bulandshahr and Aligarh. Area, 11,302 sq. m.; pop. (1901), 5,979,711, showing an increase of 12·3% in the decade.

See *Meerut District Gazetteer* (Allahabad, 1904).

MEETING (from "to meet," to come together, assemble, O. Eng. *mētan* ; cf. Du. *moeten*, Swed. *möta*, Goth. *gamotjan*, &c. derivatives of the Teut. word for a meeting, seen in O. Eng. *mōt* moot, an assembly of the people; cf. *witanagemot*), a gathering together of persons for the purpose of discussion or for the transaction of business. Public meetings may be either those of statutory bodies or assemblies of persons called together for social, political or other purposes. In the case of statutory bodies, by-laws usually fix the quorum necessary to constitute a legal meeting. That of limited companies may be either by reference to the capital held, or by a fixed quorum or one in proportion to the number of shareholders. It has been held that in the case of a company it takes at least two persons to constitute a meeting (*Sharp* v. *Daws*, 1886, 2 Q.B.D. 26). In the case of public meetings for social, political or other purposes no quorum is necessary. They may be held, if they are for a lawful purpose, in any place, on any day and at any hour, provided they satisfy certain statutory provisions or by-laws made under the authority of a statute for the safety of persons attending such meetings. If, however, a meeting is held in the street and it causes an obstruction those convening the meeting may be proceeded against for obstructing the highway. The control of a meeting and the subjects to be discussed are entirely within the discretion of those convening it, and whether the meeting is open to the public without payment, or subject to a charge or to membership of a specified body or society, those present are there merely by virtue of a licence of the conveners, which licence may be revoked at any time. The person whose licence is revoked may be requested to withdraw from the meeting, and on his refusal may be ejected with such force as is necessary. If he employs violence to those removing him he commits a breach of the peace for which he may be given into custody. An important English act has dealt for the first time with the disturbance of a public meeting. The Public Meeting Act 1908 enacted that any person who at a lawful public meeting acts in a disorderly manner for the purpose of preventing the transaction of the business for which the meeting was called together shall be guilty of an offence, and if the offence is committed at a political meeting held in any parliamentary constituency between the issue and return of a writ, the offence is made an illegal practice within the meaning of the Corrupt and Illegal Practices Prevention Act 1883. Any person who incites another to commit the offence is equally guilty. A public meeting is usually controlled by a chairman, who may be appointed by the conveners or elected by the meeting itself. On the chairman falls the duty of preserving order, of calling on persons to speak, deciding points of order, of putting questions to the meeting for decision, and declaring the result and other incidental matters.

In England it is illegal, by a statute of George III. (Seditious Meetings Act 1817), to hold a public meeting in the open air within 1 m. of Westminster Hall during the sitting of Parliament.

See C. P. Blackwell's *Law of Meetings* (1910).



Walker & Cockerell sc.

MEGALOPOLIS, an ancient city of Arcadia, Greece, situated in a plain about 20 m. S.W. of Tegea, on both banks of the Helisson, about $2\frac{1}{2}$ m. above its junction with the Alpheus. Like Messene, it owed its origin to the Theban general Epaminondas, and was founded in 370 B.C., the year after the battle of Leuctra, as a bulwark for the southern Arcadians against Sparta, and as the seat of the Arcadian Federal Diet, which consisted of ten thousand men. The builders were protected by a Theban force, and directed by ten native oecists (official "founders"), who likewise attended to the peopling of the new city, which apparently drew inhabitants from all parts of Arcadia, but especially from the neighbouring districts of Maenalia and Parrhasia. Forty townships are mentioned by Pausanias (viii. 27, 3–5) as having been incorporated in it. It was 50 stadia in circumference, and was surrounded with strong walls. Its territory was the largest in Arcadia, extending northward 24 m. The city was built on a magnificent scale, and adorned with many handsome buildings, both public and private. Its temples contained many ancient statues brought from the towns incorporated in it. After the departure of Epaminondas, Lycomedes of Mantineia succeeded in drawing the Arcadian federation away from its alliance with Thebes, and it was consequently obliged to make common cause with Athens. An attempt on the part of the federation to use the treasures of the temple of Zeus at Olympia led to internal dissensions, so that in the battle of Mantineia (362) one half of the Arcadians fought on the side of the Spartans, the other on that of the Thebans. After this battle many of the inhabitants of Megalopolis sought to return to their former homes, and it was only by the assistance of three thousand Thebans under Pammenes that the authorities were able to prevent them from doing so. In 353, when Thebes had her hands full with the so-called Sacred War, the Spartans made an attempt to reduce Megalopolis; but the Thebans sent assistance and the city was rescued. Not sure of this assistance, the Megalopolitans had appealed to Athens, an appeal which gave occasion to the oration of Demosthenes, Περὶ Μεγαλοπολιτῶν. The Spartans were now obliged to conclude peace with Megalopolis and acknowledge her autonomy. Nevertheless their feeling of hostility did not cease, and Megalopolis consequently entered into friendly relations with Philip of Macedon. Twenty years later, when the Spartans and their allies rebelled against the power of Macedon, Megalopolis remained firm in its allegiance, and was subjected to a long siege. After the death of Alexander, Megalopolis was governed by native tyrants. In the war between Cassander and Polyperchon it took part with the former and was besieged by the latter. On this occasion it was able to send into the field an army of fifteen thousand. In 234 B.C. Lydiades, the last tyrant of Megalopolis, voluntarily resigned his power, and the city joined the Achaean League. In consequence of this it was again exposed to the hatred of Sparta. In 222 Cleomenes plundered it and killed or dispersed its inhabitants, but in the year following it was restored and its inhabitants reinstated by Philopoemen, a native of the city. After this, however, it gradually sank into insignificance. The only great men whom it produced were Philopoemen and Polybius the historian. Lycortas, the father of the latter, may be accounted a third. In the time of Pausanias the city was mostly in ruins.

The site of Megalopolis was excavated by members of the British School at Athens in the years 1890–1892. The description of Pausanias is so clear that it enabled Curtius, in his *Peloponnesos*, to give a conjectural plan that was found to tally in most respects with the reality. The town was divided into two approximately equal parts by the river Helisson, which flows through it from east to west. The line of the walls may be traced, partly by remains, partly by the contours it must have followed, and confirms the estimate of Polybius that they had a circuit of 50 stades, or about $5\frac{1}{2}$ m. It is difficult to see how the river bed, now a broad and shingly waste, was dealt with in ancient times; it must have been embanked in some way, but there are no remains to show whether the fortification wall was carried across the river at either end or along the parallel embankments so as to make two separate enclosures. There must have been, in all probability, a bridge to connect the two halves of the city, but the foundations seen by Leake and others, and commonly supposed to belong to such a bridge, proved to be only the substructures of the precinct of Zeus Soter. The buildings north of the river were municipal and were grouped round the square agora. One, of which the complete plan has been recovered, is the portico of Philip, a splendid building, which bounded the agora on the north; it was 300 ft. long, with three rows of columns running its whole length, three in the outer line to each one in the two inner lines; it had a slightly projecting wing at either end. At the south-west of the agora was found the precinct of Zeus Soter: it consists of a square court surrounded by a double colonnade, and faced on the west side by a small temple; on the east side was an entrance or propylaeum approached by a ramp. In the midst of the court was a substructure which has been variously interpreted as an altar or as the base of the great group of Zeus and Megalopolis, which is recorded to have stood here. North of this was the Stoa Myropolis, forming the east boundary of the agora, and, between this and the Stoa of Philip, the Archeia or municipal offices. These buildings were of various dates, but seem all to fit into an harmonious plan. The buildings on the south and west of the agora have been almost entirely destroyed by the Helisson and a tributary brook. On the south bank of the river were the chief federal buildings, the theatre (noted by Pausanias as the largest in Greece), and the Thersilion or parliament hall of the ten thousand Arcadians. These two buildings form part of a common design, the great portico of the Thersilion facing the orchestra of the theatre. As a consequence of this arrangement, the plan of the theatre is abnormal. The auditorium has as its lowest row of seats a set of "thrones" or ornamental benches, which, as well as the gutter in front, were dedicated by a certain Antiochus; the orchestra is about 100 ft. in diameter; and in place of the western parados is a closed room called the Scanotheca. The chief peculiarity, however, lies in the great portico already mentioned, which has its base about 4 ft. 6 in. above the level of the orchestra. It was much too lofty to serve as a proscenium; yet, if a proscenium of the ordinary Greek type were erected in front, it would hide the lower part of the columns. Such a proscenium was actually erected in later times; and beneath it were the foundations for an earlier wooden proscenium, which was probably erected only when required. In later times steps were added, leading from the base of the portico to the level of the orchestra. The theatre was probably used, like the theatre at Athens, for political assemblies; but the adjoining Thersilion provided covered accommodation for the Arcadian ten thousand in wet weather. It is a building unique in plan, sloping up from the centre towards all sides like a theatre. The roof was supported by columns that were placed in lines radiating from the centre, so as to obscure as little as possible the view of an orator in this position from all parts of the building; there were two entrances in each side.

See *Excavations at Megalopolis* (E. A. Gardner, W. Loring, G. C. Richards, W. J. Woodhouse; Architecture, by R. W. Schultz); Supplementary Paper issued by the Society for the Promotion of Hellenic Studies, 1892; *Journal of Hellenic Studies*, xiii. 328, A. G. Bather; p. 319, E. F. Benson ("Thersilion"); 1898, p. 15, J. B. Bury ("Double City"); W. Dörpfeld ("Das griechische Theater"); O. Puchstein, "Griechische Bühne" (Theatre). (E. Gr.)

MEGANUCLEUS (also called Macronucleus), in Infusoria (*q.v.*)., the large nucleus which undergoes direct (amitotic) division in fission, and is lost during conjugation, to be replaced by a nucleus, the result of the karyogamy of the micronuclei.

MEGAPODE (Gr. μέγας, great and πούς, foot), the name given generally to a small but remarkable family of birds, characteristic of some parts of the Australian region, to which it is almost peculiar. The *Megapodiidae*, with the *Cracidae* and *Phasianidae*, form that division of the sub-order *Galli* named by Huxley *Peristeropodes* (*Proc. Zool. Soc.*, 1868, p. 296). Their most remarkable habit is that of leaving their eggs to be hatched without incubation, burying them in the ground (as many reptiles do), or in a mound of earth, leaves and rotten wood which they scratch up. This habit attracted attention nearly four hundred years ago,[1] but the accounts given of it by various travellers were generally discredited, and as examples of the birds, probably from their unattractive plumage, appear not to have been brought to Europe, no one of them was seen by any ornithologist or scientifically described until near the end of the first quarter of the 19th century. The first member of the family to receive authoritative recognition was one of the largest, inhabiting the continent of Australia, where it is known as the brush-turkey, and was originally described by J. Latham in 1821 under the misleading name of the New Holland vulture. It is the *Catheturus lathami* of modern ornithologists, and is nearly the size of a hen turkey. This East Australian bird is of a sooty-brown colour, relieved beneath by the lighter edging of some of the feathers, but the head and neck are nearly bare, beset with fine bristles, the skin being of a deep pinkish-red, passing above the breast into a large wattle of bright yellow. The tail is commonly carried upright and partly folded, something like that of a domestic fowl. Allied to it are three or four species of *Talegallus*, from New Guinea and adjacent islands.

Another form, an inhabitant of South and West Australia, commonly known in England as the mallee-bird, but to the colonists as the "native pheasant"—the *Lipoa ocellata*, as described by J. Gould in the *Proc. Zool. Soc.* (1840), p. 126, has much shorter tarsi and toes, the head entirely clothed, and the tail expanded. Its plumage presents a combination of greys and browns of various tints, interspersed with black, white and buff, the wing-coverts and feathers of the back bearing each near the tip an oval or subcircular patch, whence the scientific name of the bird is given, while a stripe of black feathers with a median line of white extends down the front of the throat from the chin to the breast. There is but one species of this genus known, as is also the case with the next to be mentioned, a bird long known to inhabit Celebes, but not fully

[1] Antonio Pigafetta, one of the survivors of Magellan's voyage, records in his journal, under date of April 1521, among the peculiarities of the Philippine Islands, then first discovered by Europeans, the existence of a bird there, about the size of a fowl, which laid its eggs, as big as a duck's, in the sand, and left them to be hatched by the heat of the sun (*Premier voyage autour du monde*, ed. Amoretti, Paris, A.R. ix. 88). More than a hundred years later the Jesuit Nieremberg, in his *Historia naturae*, published at Antwerp in 1635, described (p. 207) a bird called "Daie," and by the natives named "Tapun," not larger than a dove, which, with its tail (!) and feet excavated a nest in sandy places and laid therein eggs bigger than those of a goose. The publication at Rome in 1651 of Hernandez's *Hist. avium novae Hispaniae* shows that his papers must have been accessible to Nieremberg, who took from them the passage just mentioned, but, as not unusual with him, misprinted the names which stand in Hernandez's work (p. 56, cap. 220) "Daic" and "Tapum" respectively, and omitted his predecessor's important addition "Viuit in Philippicis." Not long after, the Dominican Navarrete, a missionary to China, made a considerable stay in the Philippines, and returning to Europe in 1673 wrote an account of the Chinese empire, of which Churchill (*Collection of Voyages and Travels*, vol. i.) gave an English translation in 1704. It is therein stated (p. 45) that in many of the islands of the Malay Archipelago "there is a very singular bird call'd *Tabon*," and that "What I and many more admire is, that it being no bigger in body than an ordinary chicken, tho' long legg'd, yet it lays an egg larger than a gooses, so that the egg is bigger than the bird itself. . . . In order to lay its eggs, it digs in the sand above a yard in depth; after laying, it fills up the hole and makes it even with the rest; there the eggs hatch with the heat of the sun and sand." Gemelli Careri, who travelled from 1663 to 1699, and in the latter year published an account of his voyage round the world, gives similar evidence respecting this bird, which he calls "tavon," in the Philippine Islands (*Voy. du tour du monde*, ed. Paris, 1727, v. 157, 158). The megapode of Luzon is fairly described by Camel or Camelli in his observations on the birds of the Philippines communicated by Petiver to the Royal Society in 1703 (*Phil. Trans.* xxiii. 1398). In 1726 Valentyn published his elaborate work on the East Indies, wherein (deel iii. bk. v. p. 320) he correctly describes the megapode of Amboina under the name of "malleloe," and also a larger kind found in Celebes.

described until 1846,[1] when it received from Salomon Müller (*Arch. f. Naturgeschichte*, xii. pt. 1, p. 116) the name of *Macrocephalon maleo*, but, being shortly afterwards figured by Gray and Mitchell (*Gen. Birds*, iii. pl. 123) under the generic term of *Megacephalon*, has since commonly borne the latter appellation. This bird bears a helmet-like protuberance on the back of its head, all of which, as well as the neck, is bare and of a bright red colour; the plumage of the body is glossy black above, and beneath roseate-white.

Of the megapodes proper, constituting the genus *Megapodius*, about fifteen species are admitted. The birds of this genus range from the Samoa Islands in the east, through the Tonga group, to the New Hebrides, the northern part of Australia, New Guinea and its neighbouring islands, Celebes, the Pelew Islands and the Ladrones, and have also outliers in detached portions of the Indian Region, as the Philippines (where indeed they were first discovered by Europeans), Labuan, and even the Nicobars—though none is known from the intervening islands of Borneo, Java or Sumatra. Within what may be deemed their proper area they are found, says A. R. Wallace (*Geogr. Distr. Animals*, ii. 341), "on the smallest islands and sandbanks, and can evidently pass over a few miles of sea with ease." Indeed, proof of their roaming disposition is afforded by the fact that the bird described by Lesson (*Voy. Coquille: Zoologie*, p. 703) as *Alecthelia urvillii*, but now considered to be the young of *Megapodius freycineti*, flew on board his ship when more than 2 m. from the nearest land (Guebé), in an exhausted state, it is true, but that may be attributed to its youth. The species of *Megapodius* are about the size of small fowls, the head generally crested, the tail very short, the feet enormous, and, with the exception of *M. wallacii* (*Proc. Zool. Soc.*, 1860, *Aves*, pl. 171), from the Moluccas, all have a sombre plumage.

Megapodes are shy terrestrial birds, of heavy flight, and omnivorous diet. In some islands they are semi-domesticated, although the flesh is dark and generally unpalatable. (A. N.)

MEGARA, an ancient Greek town on the road from Attica to Corinth. The country which belonged to the city was called Μεγαρίς or ἡ Μεγαρική; it occupied the broader part of the isthmus between Attica, Boeotia, Corinth, and the two gulfs, and its whole area is estimated by Clinton at 143 sq. m. The range of Mount Geraneia extends across the country from east to west, forming a barrier between continental Greece and the Peloponnesus. The shortest road across this range passes along the eastern side of the mountains, and the most difficult part is the celebrated Scironian rocks, the mythic home of the robber Sciron. The only plain in the rugged little country was the White Plain, in which was situated the only important town, Megara. The modern town of Megara is situated on two low hills which formed part of the ancient site; it is the chief town of the eparchy of Megaris; pop. about 6400. It contains few remains of antiquity, except of the aqueduct and basin, said to have been made by the architect Eupalinus for the tyrant Theagenes. (E. Gr.)

From the somewhat conflicting evidence of mythology it may be gathered that in prehistoric days Megara had maritime intercourse with the southern Aegean. The early inhabitants, whose race is unknown, were extirpated or absorbed in the Dorian migration, for in historic times the city had a homogeneous Dorian population. Favoured by its proximity to two great waterways and by its two ports, Nisaea on the Saronic and Pegae on the Corinthian Gulf, Megara took a prominent part in the commercial expansion of Greece from the 8th century onwards, and for two hundred years enjoyed prosperity out of proportion to the slight resources of its narrow territory. Its trade was mainly directed towards Sicily, where Megarian colonies were established at Hybla (Megara Hyblaea) and Selinus, and towards the Black Sea, in which region the Megarians were probably pioneers of Greek commerce. In the Sea of Marmora they had to face the competition of the Samians, with whom they waged a war concerning the town of Perinthus, and of Miletus; but on the Bosporus they established themselves by means of settlements at Chalcedon and, above all, Byzantium (founded, according to tradition, 675 and 658 respectively). In the Black Sea they exploited the shores of Pontus and Scythia, whose products they exchanged for textiles spun from the wool of their own country. Their chief colonies in this sea were Astacus and Heraclea in Bithynia, and another Heraclea in the Crimea. In the later 7th century this current of trade dwindled in face of the great commercial and colonizing activity of Miletus; it probably received further injury through the subsequent interference of Athens on the Hellespont. Simultaneously Megarian commerce in Sicily began to be supplanted by Corinth and Corcyra.

Megara's economic development entailed a change in the distribution of wealth, and consequently of political power, which is commented upon in the elegies of Theognis (*q.v.*). The original land-holding aristocracy, which had probably initiated and for a time monopolized commerce, was partly supplanted by prosperous upstarts, and with the general increase of prosperity began to lose its hold upon the community of artisans. In the ensuing party struggles the city passed under a tyrant, Theagenes (about 640), whose rule was too brief to produce great changes. The power of the nobles would seem to have been more effectively broken in a war with Athens, in which Megara ultimately lost the island of Salamis (about 570, see SOLON), for shortly afterwards the constitution was changed to a democracy, and eventually was fixed as an oligarchy of a moderate type.

During the Persian wars the state, which had recently joined the Peloponnesian League, could still muster 3000 hoplites. But the subsequent expansion of Athens ruined the commerce of Megara, and the town itself was threatened with absorption by some powerful neighbour. In 459 an attack by Corinth, which had always coveted Megara's territory, induced the people to summon the aid of the Athenians, who secured Megara in battle and by the construction of long walls between the capital and its port Nisaea. In 445 a revulsion of feeling led the Megarians to massacre their Athenian garrison. The Athenians retaliated by placing an embargo upon Megarian trade throughout their empire (432), and in the Peloponnesian War, which the Megarians had consequently striven to hasten on, reduced their neighbours to misery by blockade and devastations. In 424 they nearly captured Megara, in collusion with a democratic party within the town, and succeeded in securing Nisaea, which they held till 410. In the 4th century Megara recovered some measure of prosperity, but played an insignificant part in politics, its only notable move being the participation in the final conflict against Philip II. of Macedon (338). During the Macedonian supremacy the town passed in turn from Cassander and Demetrius Poliorcetes to Antigonus Gonatas, and finally was incorporated in the Achaean League. Megara suffered severely during the Civil War of 48 B.C., but seems at some later period to have received new settlers. It maintained itself as a place of some size in subsequent centuries, but was depopulated by the Venetians in A.D. 1500. The inhabitants of the modern village are mostly of Albanian origin.

In literature Megara figures as the reputed home of the comedian Susarion, and in the 4th century gave its name to a school of philosophy founded by Euclid.

See Strabo ix. 391–395; Theognis; Thucydides i.–iv.; Aristophanes, *Acharnians*, 729–835; F. Cauer, *Parteien und Politiker in Megara und Athen* (Stuttgart, 1890), pp. 1–44; B. V. Head, *Historia numorum* (Oxford, 1887), pp. 329–330; R. Delbrück and K. G. Vollmöller, "Das Brunnenhaus des Theagenes," in *Mitteil. d. deutsch. Inst. Athen.* XXV. (1900). (M. O. B. C.)

MEGARA HYBLAEA (perhaps identical with HYBLA MAJOR), an ancient city of Sicily, on the E. coast, 12 m. N.N.W. of Syracuse, founded in 728 B.C. by Megarean colonists, who had previously settled successively at Trotilon, Leontini and Thapsus. A hundred years later it founded Selinus, apparently because it had no room for development. It never seems to have been a town of great importance, and had no advantages of position. It was destroyed by Gelon about 481 B.C., and its walls seem to have been razed to the ground. In the Athenian expedition against Syracuse (415–413) Lamachus proposed (it being then deserted) to make it the Athenian base of operations; but his advice was not taken, and in the next spring the Syracusans fortified it. In 309 it was still fortified; but, after Marcellus captured it, in 214, we hear little more of it. Excavations carried on in 1891 led to the discovery of the northern portion of the western town wall, which in one section served at the same time as an embankment against floods (it was apparently more conspicuous in the time of P. Cluver, *Sicilia*, p. 133), of an extensive necropolis, about 1000 tombs of which have been explored, and of a deposit of votive objects from a temple. The harbour lay to the north of the town.

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[1] As we have seen, it was mentioned in 1726 by Valentyn, and a young example, was in 1830 described and figured by Quoy and Gaimard (*Voy. de l'Astrolabe: Oiseaux*, p. 239, pl. 25) as the *Megapodius rubripes* of Temminck, a wholly different bird.

See P. Orsi in *Monumenti dei Lincei* (1891), i. 689–950; and *Atti del congresso delle scienze storiche*, v. 181 (Rome, 1904). (T. As.)

MEGARIAN SCHOOL OF PHILOSOPHY. This school was founded by Euclides of Megara, one of the pupils of Socrates. Two main elements went to make up the Megarian doctrine. Like the Cynics and the Cyrenaics, Euclides started from the Socratic principle that virtue is knowledge. But into combination with this he brought the Eleatic doctrine of Unity. Perceiving the difficulty of the Socratic dictum he endeavoured to give to the word " knowledge " a definite content by divorcing it absolutely from the sphere of sense and experience, and confining it to a sort of transcendental dialectic or logic. The Eleatic unity is Goodness, and is beyond the sphere of sensible apprehension. This goodness, therefore, alone exists; matter, motion, growth and decay are figments of the senses; they have no existence for Reason. " Whatever is, is!" Knowledge is of ideas and is in conformity with the necessary laws of thought. Hence Plato in the *Sophist* describes the Megarians as " the friends of ideas." Yet the Megarians were by no means in agreement with the Platonic idealism. For they held that ideas, though eternal and immovable, have neither life nor action nor movement.

This dialectic, initiated by Euclides, became more and more opposed to the testimony of experience; in the hands of Eubulides and Alexinus it degenerated into hairsplitting, mainly in the form of the *reductio ad absurdum*. The strength of these men lay in destructive criticism rather than in construction: as dialecticians they were successful, but they contributed little to ethical speculation. They spent their energy in attacking Plato and Aristotle, and hence earned the opprobrious epithet of *Eristic*. They used their dialectic subtlety to disprove the possibility of motion and decay; unity is the negation of change, increase and decrease, birth and death. None the less, in ancient times they received great respect owing to their intellectual pre-eminence. Cicero (*Academics*, ii. 42) describes their doctrine as a " nobilis disciplina," and identifies them closely with Parmenides and Zeno. But their most immediate influence was upon the Stoics (*q.v.*), whose founder, Zeno, studied under Stilpo. This philosopher, a man of striking and attractive personality, succeeded in fusing the Megarian dialectic with Cynic naturalism. The result of the combination was in fact a juxtaposition rather than a compound; it is manifestly impossible to find an organic connexion between a practical code like Cynicism and the transcendental logic of the Megarians. But it served as a powerful stimulus to Zeno, who by descent was imbued with oriental mysticism.

For bibliographical information about the Megarians, see Euclides; Eubulides; Diodorus Cronus; Stilpo. See also Eleatic School; Cynics; Stoics; and, for the connexion between the Megarians and the Eretrians, Menedemus and Phaedo. Also Zeller, *Socrates and the Socratic Schools*; Dyeck, *De Megaricorum doctrina* (Bonn, 1827); Mallet, *Histoire de l'école de Mégare* (Paris, 1845); Ritter, *Über die Philosophie der meg. Schule*; Prantl, *Geschichte der Logik*, i. 32; Henne, *L'école de Mégare* (Paris, 1843); Gomperz, *Greek Thinkers* (Eng. trans. 1905), ii. 170 seq.

MEGARON, the principal hall of the ancient Greek palace, situated in the andron or men's quarter. Examples have been found at Tiryns and Mycenae, and references are made to it in the *Iliad* and the *Odyssey*.

MEGATHERIUM (properly *Megalotherium*), a huge extinct edentate mammal from the Pleistocene deposits of Buenos Aires, typifying the family *Megatheriidae* (or *Megalotheriidae*), and by far the largest representative of the Edentata. Except, indeed, for its relatively shorter limbs *Megatherium americanum* rivalled an elephant in bulk, the total length of the skeleton being 18 feet, five of which are taken up by the tail. The *Megatheriidae*, which include a number of genera, are collectively known as ground-sloths, and occupy a position intermediate between the sloths and the ant-eater: their skulls being of the type of the former, while their limbs and vertebrae conform in structure to those of the latter. As in the other typical South American edentates, there are no teeth in the front of the jaws, while those of the cheek-series usually comprise five pairs in the upper and four in the lower. In nearly all the other Pleistocene forms these teeth were subcylindrical in shape, with the summit of the crown (except sometimes in the first pair) forming a cup-like depression; enamel being in all cases absent. From all these *Megatherium* differs in the form and structure of the teeth.

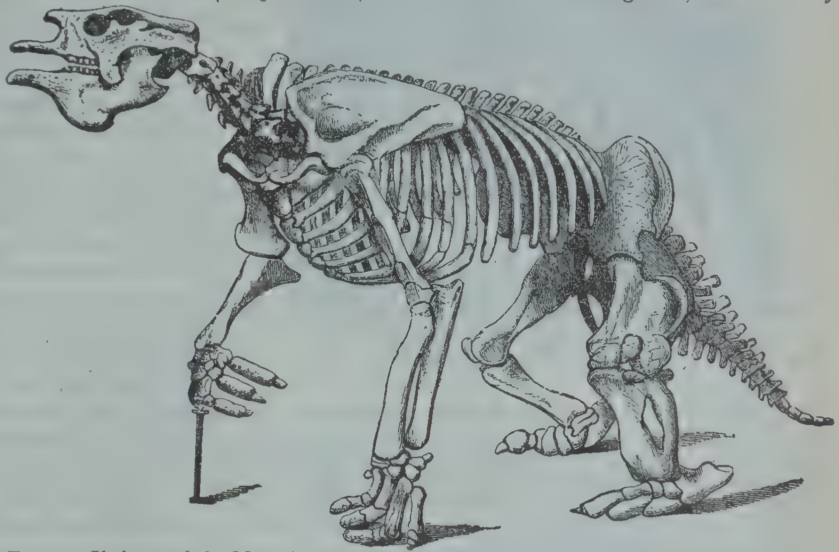
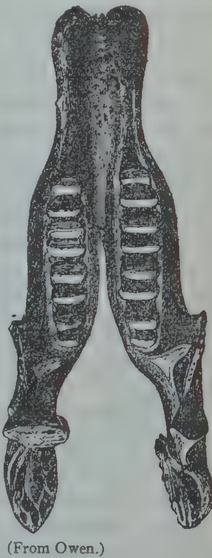


Fig. 1.—Skeleton of the Megatherium, from the specimen in the Museum of the Royal College of Surgeons of England.

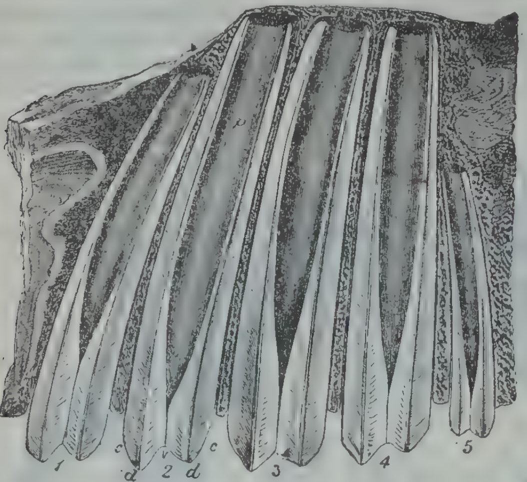
In form, as shown in fig. 2, the teeth are quadrangular prisms, each of which is surmounted by a pair of transverse ridges. They grew apparently throughout life, and were implanted to a great depth in the jaws, being 7 or 8 in. in length, with a cross-section of at least an inch and a half. The ridges on the crown are due to the arrangement of the vertical layers of hard dentine (fig. 3, *d*), softer vasodentine (*v*) and cement (*c*). The skull is relatively small, with the lower jaw very deep in its central portion, and produced in part into a long snout-like symphysis for the reception, doubtless, of a large and fleshy tongue (fig. 2). Unlike sloths, the megatherium has seven cervical vertebrae; and the spines of all the trunk-vertebrae incline backwards. The pelvis and hind-limbs are much more powerful than the fore-quarters; thereby enabling these animals, in all probability, to rear themselves on their hind-quarters, and thus pull down the branches of trees: if not, indeed, in some cases to bodily uproot the trees themselves. Large chevron-bones are suspended to the vertebrae of the tail, which was massive, and probably afforded a support when the monster was sitting up. The humerus has no foramen, and the



(From Owen.)

Fig. 2.—Lower Jaw and Teeth of *Megatherium*.

whole fore-limb was very mobile. The first front toe was rudimentary, having no phalanges, but the fifth was rather less aborted, although clawless; the other three carried enormous claws, protected by reflected sheaths. The hind-foot is remarkable for the great backward projection of the calcaneum, and likewise for the peculiar shape of the astragalus; the middle toe alone carries a claw, this being of huge size, and ensheathed like those of the fore foot. No trace of a bony armour in the skin has been detected; but, from the evidence of other genera, it may be assumed that the body was clothed in a coat of long, coarse hair. Although similar teeth occur in the phosphorite beds of South Carolina, which may have been transported from elsewhere, no undoubted remains of *Megatherium* are known from North America.



(From Owen.)

FIG. 3.—Section of Upper Molar Teeth of *Megatherium*.

The typical species ranged from Argentina and Chili to Brazil. For certain small ground-sloths from Patagonia with *Megatherium*-like teeth, see MYLODON. (R. L.*)

MEGHNA, a river of India. It forms, in the lower part of its course, the great estuary of the Bengal delta, which conveys to the sea the main body of the waters of the Ganges and the Brahmaputra, which unite at Goalanda in Faridpur district. The united waters, turbid and of great depth, are sometimes split into half a dozen channels by sand-banks, sometimes spread into a wide sheet of water. The river enters the sea by four principal mouths, enclosing the three large islands of Dakshin Shahbazpur, Hatia and Sandwip. It is navigable by native boats and river steamers all the year; but the navigation is difficult and sometimes dangerous on account of shifting sand-banks and snags, and boisterous weather when the monsoon is blowing. The most favourable season is between November and February. Alluvion and diluvion are constantly taking place, especially along the seaboard, and in Noakhali district the land is said to have made rapid advance on the sea; while the islands fringing the mouth are annually being cut away and redeposited in fresh shapes. The regular rise of the tide is from 10 to 18 ft., and at springs the sea rushes up in a dangerous bore. It is greatest at the time of the biennial equinoxes, when navigation is sometimes impeded for days together. The tidal wave advances like a wall topped with foam of the height of nearly 20 ft., and at the rate of 15 m. an hour; in a few minutes it is past, and the river has changed from ebb to flood tide. A still greater danger is the "storm wave" which occasionally sweeps up the Meghna under a cyclone.

MEHÁDIA, a market town of Hungary, in the county of Krassó-Szörény, 287 m. S.E. of Budapest by rail. Pop. (1900), 2492. The town is the site of the ancient Roman colony *Ad Mediam*, near which passed the Roman road from the Danube to Dacia. It contains the ruins of a fortress, and other Roman remains. In its neighbourhood are the famous Hercules baths (Hungarian, *Herkulesfürdö*). These are situated in a narrow rocky ravine in the valley of the Cserna, where there are 22 hot springs, of which nine are in use, the most powerful being the Hercules spring. The springs are all strongly impregnated with salts of sulphur, iodine, bromine and chlorine, and their average temperature is 70° to 145° F. They were famous in the Roman period under the name of *Thermae Herculis* or *Fontes Herculis*. Their popularity is attested by numerous inscriptions and relics. After the fall of the Roman Empire they fell into disuse until 1735, but in modern times they have been much frequented.

MEHEMET ALI (1769–1849), pasha and afterwards viceroy of Egypt, was born at Kavala, a small seaport on the frontier of Thrace and Macedonia. His father, an Albanian, was an *aga*, a small yeoman farmer, and he himself lived in his native town for many years as a petty official and trader in tobacco. In 1798 he became second in command of a regiment of bashi-bazouks, or volunteers, recruited in his neighbourhood to serve against Napoleon in Egypt. He took part in the battle of Aboukir (July 25, 1799), was driven into the sea with the routed Turks, and was saved from drowning by the gig of the British admiral, Sir Sidney Smith. In 1801 he returned to Egypt, in command of his regiment, and on the 9th of May distinguished himself by heading a bold cavalry charge at the battle of Rahmanieh. In the troubled years that followed, Mehemet Ali, leader of a compact body of Albanian clansmen, was in the best position to draw advantage from the struggle for power between the Mamelukes and the representatives of the Porte. In 1803 he cast in his lot with the former; in 1804 he turned against them and proclaimed his loyalty to the sultan; in 1805 the sheiks of Cairo, in the hope of putting a stop to the intolerable anarchy, elected him pasha, and a year later an imperial firman confirmed their choice. The disastrous British expedition of 1807 followed; and while at Constantinople the prestige of the sultan was being undermined by the series of revolutions which in 1808 brought Mahmud II. to the throne, that of Mehemet Ali was enhanced by the exhibition at Cairo of British prisoners and an avenue of stakes decorated with the heads of British slain.

The situation revealed to the astute Albanian boundless possibilities for gratifying his ambition. In spite of his chance victories, he was too shrewd an observer not to recognize the superiority of European methods of warfare; and as the first step towards the empire of which he dreamed he determined to create an army and a fleet on the European model. In 1808 the building and organization of the navy was begun with the aid of French officers and engineers. In 1811 the massacre of the Mamelukes left Mehemet Ali without a rival in Egypt, while the foundations of his empire beyond were laid by the war against the Wahhābīs and the conquest of the holy cities of Mecca and Medina. The Wahhābī War, indeed, dragged on till 1818, when Ibrahim (*q.v.*), the pasha's son, who in 1816 had driven the remnant of the Mamelukes into Nubia, brought it to an end. This done, the pasha turned his attention southward to the vast country watered by the Upper Nile. In 1820 the oasis of Siwa was subdued by his arms; in 1823 he laid the foundations of Khartum.

By this time Mehemet Ali was the possessor of a powerful fleet and of an army of veterans disciplined and drilled by European officers. To obtain these money had been necessary; and to raise money the pasha had instituted those internal "reforms"—the bizarre system of state monopolies and the showy experiments in new native industries which are described in the article Egypt (*q.v.*). The inherent viciousness of these expedients had, however, not as yet been revealed by their inevitable results, and Mehemet Ali in the eyes of the world was at once the most enlightened and the most powerful of the sultan's valis. To Mahmud II., whose whole policy was directed to strengthening the authority of the central power, this fact would have sufficed to make him distrust the pasha and desire his overthrow; and it was sorely against his will that, in 1822, the ill-success of his arms against the insurgent Greeks forced him to summon Mehemet Ali to his aid. The immediate price was the pashalik of Crete; in the event of the victory of the Egyptian arms the pashaliks of Syria and Damascus were to fall to Mehemet Ali, that of the Morea to his son Ibrahim. The part played by Mehemet Ali in the Greek War is described elsewhere (see TURKEY: *History*; GREECE: *History*; GREEK INDEPENDENCE, WAR OF;

Ibrahim). The intervention of the powers, culminating in the shattering of the Egyptian fleet at Navarino (*q.v.*), robbed him of his reward so far as Greece was concerned; the failure of his arms in face of this intervention gave Sultan Mahmud the excuse he desired for withholding the rest of the stipulated price of his assistance.

This disappointment of his ambition would not perhaps in itself have sufficed to stir Mehemet Ali to revolt against his master; but it was ominous of perils to come, which the astute pasha thought it wise to forestall. The sultan's policy had been consistently directed to crushing the overgrown power of his vassals; in the spring of 1831 two rebellious pashas, Hussein of Bosnia and Mustafa of Scutari, had succumbed to his arms; and, since he was surrounded and counselled by the personal enemies of the pasha of Egypt, it was likely that, so soon as he should feel himself strong enough, he would deal in like manner with Mehemet Ali. It was to anticipate this peril that Mehemet Ali determined himself to open the struggle: on the 1st of November 1831 a force of 9000 Egyptian infantry and 2000 cavalry crossed the frontier into Syria and met at Jaffa the fleet which brought Ibrahim as commander-in-chief. The combined forces at once laid siege to St Jean d'Acre.

The stubborn resistance of the garrison delayed Ibrahim's progress; and, meanwhile, wild rumours went abroad as to Mehemet Ali's intentions. He was master of the holy cities, and the official *Moniteur Ottoman* denounced his supposed plan of aiming at the caliphate in collusion with the sherif of Mecca. As for the pasha himself, he loudly disclaimed any such disloyal pretensions; his aim was to chastise Abdulla, pasha of Acre, who had harboured refugees from his " reforms "; to overthrow Khusrev, who had encouraged him in his refusal to surrender them; to secure the fulfilment of the sultan's promise with regard to Syria and Damascus. Mahmud, on the other hand, was torn between hatred of the pasha and hatred of the Christian powers which had forced him to make concessions to the Greeks. Voices urged him to come to terms with Mehemet Ali, secure peace in Islam, and turn a united face of defiance against Europe; and for a while he harboured the idea. He was conscious of his own intense unpopularity, the outcome of his efforts at reform; he knew that in popular opinion Mehemet Ali was the champion of Islam against the infidel caliph, and that the issue of a struggle with him was more than doubtful. He was hampered by the unpaid debt to Russia; by unrest in Bosnia and Albania; above all, by the revolt of the Greek Islands, which had left his navy, deprived of its best sailors, in no condition to dispute the Egyptian command of the sea. In the end, however, his pride prevailed; in April 1833 the Turkish commander-in-chief Hussein Pasha left Constantinople for the front; and in the third week in May the ban of outlawry was launched against Mehemet Ali.

Meanwhile, Ibrahim had occupied Gaza and Jerusalem as well as Jaffa; on the 27th of May, a few days after the publication of the ban, Acre was stormed; on the 15th of June the Egyptians occupied Damascus. Ibrahim pressed on with characteristic rapidity, his rapid advance being favoured by the friendly attitude of the various sections of the Syrian population, whom he had been at pains to conciliate. He defeated the Ottoman advance-guard at Homs on the 9th of July and at Hamah on the 11th, entered Aleppo on the 17th, and on the 29th inflicted a crushing defeat on the main Turkish army under Hussein Pasha at the pass of Beilan. All Syria was lost to the sultan, and the Egyptian advance-guard passed the mountain defiles into Adana in Asia Minor.

Mahmud, in desperation, now turned for help to the powers. Russian aid, though promptly offered, was too double-edged a weapon to be used save at the last extremity. Austrian diplomacy was, for the moment, that of Russia. France had broken her long tradition of friendship for Turkey by the occupation of Algiers. Great Britain, prodigal of protestations of goodwill, alone remained; and to her Mahmud turned with a definite offer of an offensive and defensive alliance. Stratford Canning, who was at Constantinople for the purpose of superintending the negotiations for the delimitation of the frontiers of Greece, wrote home urging the government to accept, and suggesting a settlement of the Egyptian question which foreshadowed that of 1841. Palmerston, however, did not share Canning's belief in the possible regeneration of Turkey; he held that an isolated intervention of Great Britain would mortally offend not only Russia but France, and that Mehemet Ali, disappointed of his ambitions, would find in France a support that would make him doubly dangerous.[1]

In the autumn Sultan Mahmud, as a last independent effort, despatched against Ibrahim the army which, under Reshid Pasha, had been engaged in pacifying Albania. The result was the crowning victory of the Egyptians at Konia (Dec. 21). The news reached Constantinople at the same time as Count Muraviev arrived on a special mission from the tsar. The Russian offers were at once renewed of a squadron of battleships and of a land force for the protection of the capital. Efforts were made to escape the necessity of accepting the perilous aid. Ottoman agents, backed by letters from the French chargé d'affaires, were sent to Mehemet Ali and to Ibrahim, to point out the imminence of Russian intervention and to offer modified terms. Muraviev himself went to Alexandria, where, backed by the Austrian agent, Count Prokesch-Osten, he announced to the pasha the tsar's immutable hatred of rebels. Mehemet Ali merely protested the complete loyalty of his intentions; Ibrahim, declaring that as a soldier he had no choice but to obey his father's orders, advanced to Afium-Karahissar and Kutaiah, whence he wrote to the sultan asking his gracious permission to advance to Brusa. He was at the head of 100,000 men, well organized and flushed with victory; the Ottoman army survived only as demoralized rabble. Panic seized the Seraglio; and at the beginning of February the assistance of Russia was formally demanded. The representatives of France and Great Britain made every effort to secure a reversal of this fatal step; but, while they were threatening and promising, Russia was acting, and on the 20th of February a Russian squadron entered the Bosporus.

In view of this it became necessary for the objecting powers to take a new line. The new French ambassador, Admiral Roussin, had arrived on the 17th; he now, with the full concurrence of Mandeville, the British chargé d'affaires, persuaded the Porte to invite the Russians to withdraw, undertaking that France would secure the acceptance by Mehemet Ali of the sultan's terms. A period of suspense followed. The Russian squadron was detained by contrary winds, and before it could sail peremptory orders arrived from the tsar for it to remain until Ibrahim should have repassed the Taurus mountains. Meanwhile, Mehemet Ali had scornfully rejected the offers of the Porte; he would be content with nothing but the concession of his full demands—Syria, Icheli, Aleppo, Damascus and Adana. France and Great Britain now urged the sultan to yield, and in March a Turkish agent was sent to Ibrahim to offer the pashaliks of Syria, Aleppo and Damascus. The crisis was precipitated by the arrival on the 5th of April of a second division of the Russian fleet in the Bosporus, and of a Russian force of 6000 men, which landed on the Asiatic shore. The Porte now tried once more to modify its terms; but the Western powers were now intent on getting rid of the Russians at all costs, and as a result of the pressure they brought to bear on both parties the preliminary convention of Kutaiah, conceding all the Egyptian demands, was signed on the 8th of April, and Ibrahim began his withdrawal. The convention stipulated for the bestowal of the pashalik of Adana on Ibrahim; but when on the 16th he received the official list of appointments, he found that Adana had been expressly reserved by the sultan. He at once arrested his march; but the pressure of famine in the capital, caused by the cutting off of supplies from Asia and the presence of the large Russian force, compelled Mahmud to yield, and on the 3rd of May a firman ceded Adana to Ibrahim under the pretext of appointing him *muhassil*, or collector of the revenue.

When Lord Ponsonby, the new British ambassador, arrived at

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[1] Canning's original memorandum is in the Foreign Office Records in the volume marked *F.O., Turkey: From Sir Stratford Canning* (August to December, 1832). It bears elaborate pencil notes in Palmerston's handwriting, in part already obliterated.

Constantinople on the 1st of May he found Russia practically in possession. Sultan Mahmud was to the last degree embittered against the powers which, with lively protestations of friendship, had forced him to humiliate himself before his hated vassal. Russia had given him deeds, not words; and to Russia he committed himself. A further contingent of six or seven thousand Russians had arrived on the 22nd of April; Russian engineers were busy with the fortifications along the Straits; Russian agents alone were admitted to the sultan's presence. "It is manifest," wrote Lord Ponsonby, "that the Porte stands in the relation of vassal to the Russian government."[1] The relation was soon to be yet more manifest. Before, on the 9th of July, the Russian fleet, with the Russian troops on board, weighed anchor for the Black Sea, there was signed at the palace of Unkiar Skelassi the famous treaty (July 8, 1833) which, under the guise of an offensive and defensive alliance, practically made Russia the custodian of the gates of the Black Sea. (See TURKEY: *History*.)

Mehemet Ali had triumphed, but he was well aware that he held the fruits of his victory by a precarious tenure. He was still but a vali among the rest, holding his many pashaliks nominally by the sultan's will and subject to annual reappointment; and he knew that both his power and his life would be forfeit so soon as the sultan should be strong enough to deprive him of them. To achieve this one end had, indeed, become the overmastering passion of Mahmud's life, to defeat it the object of all Mehemet Ali's policy. So early as 1834 it seemed as though the struggle would be renewed; for Mehemet Ali had extended to his new pashaliks his system of monopolies and conscription, and the Syrians, finding that they had exchanged Turkish whips for Egyptian scorpions, rose in a passion of revolt. It needed the intervention of Mehemet Ali in person before, in the following year, they were finally subdued. Meanwhile it had needed all the diplomatic armoury of the powers to prevent Mahmud hastening to the assistance of his "oppressed subjects." The threats of Great Britain and France, the failure of Russia to back him up, induced him to refrain; but sooner or later a renewal of the war was inevitable; for the sultan, with but one end in view, was reorganizing his army, and Mehemet Ali, who in the autumn of 1834 had assumed the style of viceroy and sounded the powers as to their attitude in the event of his declaring his complete independence, refused to continue to pay tribute which he knew would be used against himself.

The crisis came in 1838. In March the Egyptians were severely defeated by the revolted Arabs of the Hauran; and the Porte, though diplomatic pressure kept it quiet, hurried on preparations for war. Mehemet Ali, too, had small reason for postponing the conflict. The work of Moltke, who with other German officers who had been engaged in organizing the Turkish army, threatened to destroy his superiority in the field; the commercial treaty signed by the Ottoman government with Great Britain (Aug. 16), which applied equally to all the territories under his rule, threatened to destroy at a blow the lucrative monopolies which supplied him with the sinews of war. Months of suspense followed; for the powers had threatened to cast their weight into the scale against whichever side should prove the aggressor, and Mehemet Ali was too astute to make the first move. In the end Mahmud's passion played into his hands. The old sultan thirsted to crush his rebellious vassal, at any cost; and on the 21st of April 1839 the Ottoman army, stationed at Bir on the Euphrates, crossed the stream and invaded Syria. On the 23rd of June it was attacked and utterly routed by Ibrahim at Nezib. On the 1st of July the old sultan died, unconscious of the fatal news, leaving his throne to Abdul-Mejid, a lad of sixteen. To complete the desperateness of the situation the news reached the capital that Ahmed Pasha, the Ottoman admiral-in-chief, had sailed to Alexandria and surrendered his fleet to Mehemet Ali, on the pretext that the sultan's advisers were sold to the Russians.

So far as the forces of the Ottoman Empire were concerned, Mehemet Ali was now absolute master of the situation. The grand vizier, in the sultan's name, wrote beseeching him to avoid the further shedding of Mussulman blood, offering him a free pardon, the highest honours of the state, the hereditary pashalik of Egypt for himself, and Syria for Ibrahim until he should succeed his father in Egypt. Mehemet Ali replied diplomatically; for, though these offers fell far short of his ambitions, a studious moderation was essential in view of the doubtful attitude of the European powers.

On the 27th of July the ambassadors of the five powers presented to the Porte a joint note, in which they declared that an agreement on the Eastern Question had been reached by the five Great Powers, and urged it "to suspend all definite decision made without their concurrence, pending the effect of their interest in its welfare." The necessity for showing a united front justified the diplomatic inexactitude; but the powers were agreed on little except the need for agreement. Especially was this need realized by the British government, which feared that Russia would seize the occasion for an isolated intervention under the treaty of Unkiar Skelessi. On the 1st of August Palmerston wrote to Ponsonby impressing upon him that the representatives of the powers, in their communications with the Porte, "should act not only simultaneously in point of time, *but identically in point of manner*"—a principle important in view of later developments. Yet it was a task all but impossible to preserve this appearance of unanimity in view of the divergent views within the concert. France and Great Britain had hitherto acted together through common opposition to the supposed designs of Russia. Austria, too, now that the revolutionary spectres of 1830 had been laid, was reverting to her traditional opposition to Russia in the affairs of the Near East, and Metternich supported Palmerston's proposal of an international conference at Vienna. Everything depended on the attitude of the emperor Nicholas. This was ultimately determined by his growing distrust of Austria and his perennial hatred of the democratic régime of France. The first caused him to reject the idea of a conference of which the activities would have been primarily directed against Russia; the second led him to drive a wedge into the Anglo-French *entente* by making direct overtures to Great Britain. Palmerston listened to the tsar's proposals, conveyed through Baron Brunnow, "with surprise and admiration." The emperor Nicholas was prepared to accept the views of Great Britain on the Turco-Egyptian question; to allow the Treaty of Unkiar Skelessi to lapse; to act henceforth in the Ottoman Empire only in concert with the other powers, in return for an agreement closing the Dardanelles to the war-ships of all nations and to extend the same principle to the Bosporus. Finally, Brunnow was empowered to arrange a coalition of the great powers with a view to the settlement of the Egyptian question; and in this coalition the tsar was willing, for political reasons, that France should be included, though he stated his personal preference for her exclusion.

To these views Austria and, as a natural consequence, Prussia acceded without difficulty. The attitude of France was a more doubtful quantity. In France Mehemet Ali had become a popular hero; under him French civilization had gained a foothold in Egypt; he was regarded as invincible; and it was hoped that in alliance with him French influence in the Mediterranean would be supreme. Palmerston, on the other hand, believed that the Ottoman empire would never be secure until "the desert had been placed between" the pasha of Egypt and the sultan; and the view that the coalition should be directed against Mehemet Ali was shared by the other powers. In the circumstances France should either have loyally accepted the decision of the majority of the concert, to which she had committed herself by signing the joint note of the 27th of July, or should have frankly stated her intention of taking up a position outside. The fact that she did neither led to a crisis that for a moment threatened to plunge Europe into war.

For nearly a year the diplomatic *pourparlers* continued without an agreement being reached; France insisted on Mehemet Ali's receiving the hereditary pashalik of Syria as well as that of

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[1] From Lord Ponsonby, *F.O.*, *Turkey*, May 22, 1833.

Egypt, a proposition to which Palmerston, though sincerely anxious to preserve the Anglo-French *entente*, refused to agree. The tension of the situation was increased when, on the 20th of February 1840, Thiers came into power. The diplomacy of Guizot, backed now by Austria and Prussia, had succeeded in persuading Palmerston to concede the principle of allowing Mehemet Ali to receive, besides Egypt, the pashalik of Acre as far as the frontiers of Tripoli and Damascus (May 7). Thiers, however, refused to listen to any suggestion for depriving him of any part of Syria; but, instead of breaking off the correspondence and leaving the concert, he continued the negotiations, and before long circumstances came to the knowledge of the British government which seemed to prove that he was only doing so with a view to gaining time in order to secure a separate settlement in accordance with French views.

The opportunity for this arose from a change in the situation at Constantinople, where the dismissal of Khusrev Pasha had, in Mehemet Ali's view, removed the main obstacle to his reconciliation with the sultan. He proposed to the French consul-general at Alexandria to make advances to the Porte, and suggested sending back the Ottoman fleet as an earnest of his good intentions, a course which, it was hoped, " would lead to a *direct* and amicable arrangement of the Turco-Egyptian question." On the 21st of June his envoy, Sami Bey, actually arrived at Constantinople, ostensibly to congratulate the sultan on the birth of a daughter, really to make use of the French influence now supreme at the Porte in order to effect a settlement. In the circumstances the proper course for Thiers to have pursued would have been to have communicated to the powers, to whom he was bound by the moral engagement of the 27th of July 1839, the new conditions arising out of Mehemet Ali's offer. Instead he wrote to Guizot, on the 30th of June, saying that the situation argued strongly in favour of postponing any decision in London, adding: " I have written to Alexandria and Constantinople to counsel moderation on both sides; but I have been careful to forbid the agents to enter on their own account, and as a French undertaking, on a negotiation of which the avowed aim is a direct arrangement. If such an enterprise is imputed to us, you will be in a position to deny it."

The discovery of what seemed an underhand intrigue on the part of France produced upon the powers exactly the effect that Thiers had foreseen and deprecated. They regarded it as an attempt to ruin the work of the concert and to secure for France a " complete individual triumph " at Alexandria and Constantinople, and their countermove was to sign at London on the 15th of July, without the concurrence of France, a convention with the Porte for the settlement of the affairs of the Levant. By this instrument it was agreed that the terms to be offered to Mehemet Ali having been concerted with the Porte, the signatory powers would unite their forces in order to compel the pasha to accept the settlement. As to the terms to be offered, it was arranged that, in the event of Mehemet Ali yielding within ten days, he should receive the hereditary pashalik of Egypt and the administration for life of southern Syria, with the title of Pasha of Acre and the possession of the fortress of St Jean d'Acre. At the end of ten days, should he remain obdurate, the offer of Syria and Acre would be withdrawn; and if at the end of another ten days he was still defiant, the sultan would hold himself at liberty to withdraw the whole offer and to take such measures as his own interests and the counsels of his allies might suggest to him.

The news of this " mortal affront " to the honour of France caused immense excitement in Paris. The whole press was clamorous for war; Thiers declared that the alliance with Great Britain was shattered, and pressed on warlike preparations; even Louis Philippe was carried away by the fever. The immediate effect was that Mehemet Ali, confident of French assistance, maintained a defiant attitude. The situation, however, was rapidly changed by the unexpected results of the armed intervention of the Allies. The appearance of the combined British, Austrian and Russian fleets, under Sir Charles Napier, off Beirut (Aug. 11) was the signal for a general rising of the Syrians against Ibrahim's tyranny. On the 11th of September, Suleiman Pasha not having obeyed the summons to evacuate the town, the bombardment was begun, and Ottoman troops were landed to co-operate with the rebels. On the 3rd of October Beirut fell; and Ibrahim, cut off from his communications by sea, and surrounded by a hostile population, began a hurried retreat southward. On the 3rd of November Acre surrendered to the allied fleet. Mehemet Ali's power in Syria had collapsed like a pricked bubble; and with it had gone for ever the myth of his humane and enlightened rule. The sole question now was whether he should be allowed to retain Egypt itself.

On the 15th of September the sultan, who had broken off all negotiations with Mehemet Ali on receipt of the news of the Syrian revolt, acting on the advice of Lord Ponsonby, declared the pasha deposed, on the ground that the term allowed by the Convention of London had expired, and nominated his successor. Mehemet Ali received the news with his accustomed *sang-froid*, observing to the consuls of the four powers, who had come to notify their own removal, that " such denunciations were nothing new to him; that this was the fourth, and that he hoped to get over it as well as he had done the other three, with the help of God and the Prophet." In the end his confidence proved to be justified. The news of the events in Syria and especially of the deprivation of Mehemet Ali had produced in France what appeared to be an exceedingly dangerous temper; the French government declared that it regarded the maintenance of Mehemet Ali in Egypt as essential to the European balance of power; and Louis Philippe sought to make it clear to the British government, through the king of the Belgians, that, whatever might be his own desire to maintain peace, in certain events to do so would be to risk his throne. Palmerston, indeed, who did not believe that under the Bourgeois Monarchy France would translate her brave words into action, was in favour of settling the Turco-Egyptian question once for all by depriving Mehemet Ali of Egypt as well. The influences against him, however, were too powerful. Metternich protested against a course which would result, in his opinion, either in a war or a revolution in France; King Leopold enlarged on the wickedness and absurdity of risking a European war for the sake of putting an end to the power of an old man who could have but few years to live; Queen Victoria urged her ministers to come to terms with France and relieve the embarrassments of the " dear King "; and Lord Melbourne, with the majority of the cabinet, was in favour of compromise. When therefore, on the 8th of October, Guizot, in an interview with Palmerston, presented what was practically an ultimatum on the part of France, " it was determined that this intimation should be met in a friendly spirit, and that Lord Palmerston should see the Ministers of the other powers and agree with them to acquaint the French that they with England would use their good offices to induce the Porte not to insist on the deprivation of Mehemet Ali so far as Egypt is concerned." In accordance with this Palmerston instructed Ponsonby to press upon the sultan, in the event of Mehemet Ali's speedy submission, not only to withdraw the sentence of deprivation but to confer upon him the hereditary pashalik of Egypt.

For a while it seemed that even this would not avert a European war. Thiers still maintained his warlike tone, and the king's speech prepared by him for the opening of the Chambers on the 28th of October was in effect a declaration of defiance to Europe. Louis Philippe himself, however, was not prepared to use this language; whereupon Thiers resigned, and a new cabinet was formed under Marshal Soult, with Guizot as foreign secretary. The equivocal tone of the new speech from the Throne raised a storm of protest in the Chambers and the country. It was, however, soon clear that Palmerston's diagnosis of the temper of the French *bourgeois* was correct; the clamour for war subsided; on the 4th of December the address on the Egyptian Question proposed by the government was carried, and peace was assured. Nine days earlier Sir Charles Napier had appeared with a British squadron off Alexandria and, partly by persuasion, partly by threats, had induced Mehemet Ali to submit to the sultan and to send back the Ottoman fleet, in return for a guarantee of the hereditary pashalik of Egypt. This arrangement was ratified by Palmerston; and all four powers now combined to press it on the reluctant Porte, pointing out, in a joint note of the 30th of January 1841, that "they were not conscious of advising a course out of harmony with the sovereignty and legitimate rights of the sultan, or contrary to the duties imposed on the Pasha of Egypt as a subject appointed by His Highness to govern a province of the Ottoman Empire." This principle was elaborated in the firman, issued on the 13th of February, by which the sultan conferred on Mehemet Ali and his heirs by direct descent the pashalik of Egypt, the greatest care being taken not to bestow any rank and authority greater than that enjoyed by other viziers of the empire. By a second firman of the same date Mehemet Ali was invested with the government of Nubia, Darfur, Khordofan and Sennaar, with their dependencies. On the 10th of June the firman was solemnly promulgated at Alexandria.

Thus ended the phase of the Egyptian Question with which the name of Mehemet Ali is specially bound up. The threatened European conflict had been averted, and presently the wounded susceptibilities of France were healed by the invitation extended to her to take part in the Straits Convention. As for Mehemet Ali himself, he now passes off the stage of history. He was an old man; his mind was soon to give way; and for some time before his death on the 2nd of August 1849 the reins of power were held by his son and successor Ibrahim.

Probably no Oriental ruler, not even excepting Ali of Iannina, has ever stirred up so much interest among his contemporaries as Mehemet Ali. The spectacle of an Eastern despot apparently advancing on the lines of European progress was in itself as astonishing as new. Men thought they were witnessing the dawn of a new era in the East; Mehemet Ali was hailed as the most beneficent and enlightened of princes; and political philosophers like Jeremy Bentham, who sent him elaborate letters of good advice, thought to find in him the means for developing their theories in virgin soil. In fact the pasha was an illiterate barbarian, of the same type as his countryman Ali of Iannina, courageous, cruel, astute, full of wiles, avaricious and boundlessly ambitious. He never learned to read or write, though late in life he mastered colloquial Arabic; yet those Europeans who were brought into contact with him praised alike the dignity and charm of his address, his ready wit, and the astonishing perspicacity which enabled him to read the motives of men and of governments and to deal effectively with each situation as it arose.

The latest account of Mehemet Ali and the European crisis arising out of his revolt is that by W. Alison Phillips in vol. x. ch. xvii. of the *Cambridge Modern History* (1907). The bibliography attached to this chapter (p. 852) gives a list of all the principal published documents and works, together with some analysis of the unpublished Foreign Office records bearing on the subject. Of the works mentioned C. de Freycinet's *La Question d'Égypte* (Paris, 1905) gives the most authoritative account of the diplomatic developments. (W. A. P.)

MEHIDPUR, or Mahidpur, a town of India, in Indore state of Central India, on the right bank of the Sipra, 1543 ft. above the sea, and 24 m. N. of Ujjain. Pop. (1901), 6681. Though of some antiquity and frequented by Hindu pilgrims, it is best known for the battle fought in the neighbourhood on the 20th of December 1817, in which Sir John Malcolm defeated the army of Holkar. The result was the Treaty of Mandasor and the pacification of Malwa. Mehidpur was again the scene of some sharp fighting during the Mutiny. The British cantonment, placed here in 1817, was removed in 1882.

MÉHUL, ÉTIENNE HENRI (or Étienne Nicolas) (1763–1817), French composer, was born at Givet in Ardennes, on the 24th of June 1763. His father being too poor to give him a regular musical education, his first ideas of art were derived from a poor blind organist of Givet; yet such was his aptitude that, when ten years old, he was appointed organist of the convent of the Récollets. In 1775 an able German musician and organist, Wilhelm Hauser, was engaged for the monastery of Lavaldieu, a few miles from Givet, and Méhul became his occasional pupil. In 1778 he was taken to Paris by a military officer, and placed himself under Edelmann, a good musician and harpsichord player. His first attempts at instrumental composition in 1781 did not succeed, and he therefore turned his attention to sacred and dramatic music. Gluck gave him advice in his studies. After various disappointments during his efforts for six years to obtain, at the Grand Opéra, a representation of his *Cora et Alonzo*, he offered to the Opéra Comique his *Euphrosine et Coradin*, which, being accepted and performed in 1790, at once fixed his reputation. His opera of *Stratonice* was also received with enthusiasm in 1792. After several unsuccessful operas, his *Adrien* appeared, and added much to his fame, which was further increased by his three best works, *Le Jeune Henri*, *Uthal* and *Joseph*, the finest of the series. *Uthal* was written for an orchestra without violins. Méhul held a post as one of the four inspectors of the Paris Conservatoire, but this office made him feel continually the insufficiency of his early studies, a want which he endeavoured to remedy by incessant application. *Timoléon*, *Ariodant* and *Bion* followed. *Epicure* was composed by Méhul and Cherubini jointly; but the superiority of the latter was evident. Méhul's next opera, *L'Irato*, failed. After writing forty-two operas, besides a number of songs for the festivals of the republic, cantatas, and orchestral pieces of various kinds, his health gave way, from an affection of the chest, and he died on the 18th of October 1817 in Paris.

See Lives by Pougin (1889), Viellard (1859), and Quatremère de Quincey (1818).

MEIBOM, HEINRICH (1555–1625), German historian and poet, was born at Lemgo on the 4th of December 1555, and died on the 20th of September 1625, at Helmstedt, where he had held the chair of history and poetry since 1583. He was a writer of Latin verses (*Parodiarum horatianarum libri III. et sylvarum libri II.*, 1588); and his talents in this direction were recognized by the emperor Rudolph II., who ennobled him; but his claim to be remembered rests on his services in elucidating the medieval history of Germany.

His *Opuscula historica ad res germanicas spectantia* was edited and published in 1660 by his grandson, Heinrich Meibom (1638–1700), who was professor of medicine and then of history and poetry at Helmstedt, and incorporated his grandfather's work with his own *Rerum germanicarum scriptores* (1688).

MEIDERICH, a town of Germany, in the Prussian Rhine province, 2½ m. by rail N.E. of Ruhrort, whose river harbour is in great part within its confines. Pop. (1905), 40,822. Iron and steel works, coal-mines, saw-mills, brickworks, and machine-shops furnish the principal occupations of the inhabitants. Meiderich, which is first mentioned in 874, was united with Duisburg in 1905.

See Graeber, *Tausendjährige Geschichte von Meiderich* (1893).

MEIKTILA, a district and division in Upper Burma. The district is the most easterly of the districts in the dry zone, and has an area of 2183 sq. m. It lies between Kyauksē, Myingyan, Yamēthin, and on the east touches the Shan States. It is a slightly undulating plain, the gentle slopes of which are composed of black "cotton" soil and are somewhat arid. The only hills above 300 ft. are on the slopes of the Shan hills. The lake is the chief feature of the district. It is artificial, and according to Burmese legend was begun 2400 years ago by the grandfather of Gautama Buddha. It is 7 m. long, averages half a mile broad, and covers an area of 3½ sq. m. With the Minhla and other connected lakes it irrigates a large extent of country.

There are small forest reserves, chiefly of cutch. Large numbers of cattle are bred. The chief agricultural products are rice, sesamum, cotton, peas, maize, millet and gram. Pop. (1901), 252,305. Famines in 1891, 1895 and 1896 led to considerable emigration. The climate is healthy except in the submontane townships. The temperature rises to 100° F. and over between the months of March and June, and the mean minimum in January is about 61°. The rainfall is uncertain (36·79 in. in 1893, 25·59 in 1891). The vast majority of the population are Buddhists. The headquarters town, Meiktila, stands on the banks of the lake, which supplies good drinking water. Pop. (1901), 7203. A wing of a British regiment is stationed here. A branch railway connects it at Thazi station with the Rangoon-Mandalay line, and continues westward to its terminus on the Irrawaddy at Myingyan.

The division includes the districts of Meiktila, Kyauksē, Yamēthin and Myingyan, with a total area of 10,852 sq. m., and a population (1901) of 992,807, showing an increase of 10·2% in the preceding decade, and giving a density of 91 inhabitants to the square mile. All but a small portion of the division lies in the dry zone, and cultivation is mainly dependent on irrigation.

MEILHAC, HENRI (1831–1897), French dramatist, was born in Paris on the 21st of February 1831, and while a young man began writing fanciful articles for the newspapers and *vaudevilles* for the theatres, in a vivacious *boulevardier* spirit which brought him to the front. About 1860 he met Ludovic Halévy, and the two began a collaboration in writing for the stage which lasted for twenty years. An account of their work is given under Halévy. Meilhac wrote a few pieces with lesser collaborators. In 1888 he was elected to the Academy. He died at Paris in 1897.

MEINBERG, a village and watering-place of Germany, in the principality of Lippe Detmold, situated in a pleasant valley under the Teutoburger Wald, 12 m. S.E. from Detmold by the railway to Altenbeken. Pop. (1905), 1300. The waters of Meinberg, which attract annually about 1200 visitors, are sulphur springs, and are used for drinking, bathing and inhalation. They became known in the 18th century.

See Gilbert and Meissner, *Bad Meinberg und seine Kurmittel* (Berlin, 1902).

MEINEKE, JOHANN ALBRECHT FRIEDRICH AUGUST (1790–1870), German classical scholar, was born at Soest in Westphalia on the 8th of December 1790. After holding educational posts at Jenkau and Danzig, he was director of the Joachimsthal gymnasium in Berlin from 1826 to 1856. He died at Berlin on the 12th of December 1870. He was distinguished in conjectural criticism, the comic writers and Alexandrine poets being his favourite authors.

His most important works are: *Graecorum comicorum fragmenta* (1839–1857, the first volume of which contains an essay on the development of Greek comedy and an account of its chief representatives); Aristophanes (1860); *Analecta alexandrina* (1843, containing the fragments of Rhianus, Euphorion, Alexander of Aetolia, and Parthenius); Callimachus (1861); Theocritus, Bion, Moschus (3rd ed., 1856); Alciphron (1853); Strabo (2nd ed., 1866) and *Vindiciae strabonianae* (1852); Stobaeus (1855–1863); Athenaeus (1858–1867). See monographs by F. Ranke (1871), H. Sauppe (1872), and E. Förstemann in *Allgemeine deutsche Biographie*, XXI. (1885); also Sandys, *Hist. Class. Schol.* (1908), iii. 117.

MEININGEN, a town of Germany, capital of the duchy of Saxe-Meiningen, romantically situated in forests on the right bank of the Werra, 40 m. S. of Eisenach by rail. Pop. (1905), 15,989. It consists of an old town and several handsome suburbs, but much of the former has been rebuilt since a fire in 1874. The chief building is the Elisabethenburg, or the old ducal palace, containing several collections; it was built mainly about 1680, although part of it is much older. Other buildings are the Henneberger Haus with a collection of antiquities, and the town church, with twin towers, built by the emperor Henry II. in the 11th century. The theatre enjoyed for many years (1875–1890) a European reputation for its actors and scenic effects. The English garden, a beautiful public park, contains the ducal mortuary chapel and several monuments, including busts of Brahms and Jean Paul Richter.

Meiningen, which was subject to the bishops of Würzburg (1000–1542), came into the possession of the duke of Saxony in 1583, having in the meantime belonged to the counts of Henneberg. At the partition of 1660 it fell to the share of Saxe-Altenburg, and in 1680 became the capital of Saxe-Meiningen.

See E. Döbner, *Bausteine zu einer Geschichte der Stadt Meiningen* (Meiningen, 1902).

MEÏR, Jewish rabbi of the 2nd century, was born in Asia Minor and according to legend was a descendant of the family of Nero. He was the most notable of the disciples of Aqiba (*q.v.*), and after the Hadrianic repressions of A.D. 135 was instrumental in refounding the Palestinian schools at Usha. Among his teachers was also Elisha ben Abuya (*q.v.*), and Meïr continued his devotion to Elisha after the latter's apostasy He is said to have visited Rome to rescue his wife's sister. His wife, Beruriah, is often cited in the Talmud as an exemplar of generosity and faith. She was a daughter of the martyr Ḥananiah ben Teradion. On one occasion Meïr, who had been frequently troubled by his ungodly neighbours, uttered a prayer for their extinction. "Nay," said Beruriah, "it is written (Ps. civ. 35) let *sins* be blotted out, not sinners"; whereupon Meïr prayed for the evildoers' conversion. But she is best known for her conduct at the sudden death of her two sons. It was the Sabbath, and Meïr returned home towards sunset. He repeatedly asked for the children, and Beruriah, after parrying his question, said: "Some time ago a precious thing was left with me on trust, and now the owner demands its return. Must I give it back?" "How can you question it?" rejoined her husband. Beruriah then led him to the bed whereon were stretched the bodies of the children. Meïr burst into tears. But the wife explained that *this* was the treasure of which she had spoken, adding the text from Job: "The Lord gave and the Lord hath taken away; blessed be the name of the Lord." Meïr himself was the author of many famous sayings: "Look not to the flask, but to its contents. Many a new vessel contains old wine, but there are old casks which do not contain even new wine." "Condole not with a mourner while his dead is laid out before him." "Man cometh into the world with closed hands as though claiming the ownership of all things; but he departeth hence with hands open and limp, as if to show that he taketh naught with him." "What God does is well done." "The tree itself supplies the handle of the axe which cuts it down." His wisdom was proverbial, and to him was in particular assigned an intimate acquaintance with fables, and he is reported to have known 300 Fox-Fables. "With the death of Rabbi Meïr," says the Mishnah (*Sota* ix. 15), "Fabulists ceased to be."

Meïr's wide sympathies were shown in his inclusion of all mankind in the hopes of salvation (Sifra to Leviticus xviii. 5). He was certainly on friendly terms with heathen scholars. Meïr contributed largely to the material from which finally emerged the Mishnah. His dialectic skill was excessive, and it was said jestingly of him that he could give 150 reasons to prove a thing clean, and as many more to prove it unclean. His balanced judgment fitted him to carry on Aqiba's work, sifting and arranging the oral traditions, and thus preparing the ground for the Mishnaic Code.

Meïr left Palestine some time before his death, owing to disagreements between him and the Patriarch. He died in Asia Minor, but his love for the Holy Land remained dominant to the last. "Bury me," he said, "by the shore, so that the sea which washes the land of my fathers may touch also my bones." The tomb shown as that of Meïr at Tiberias is inauthentic.

See Bacher, *Agada der Tannaiten*, vol. II. ch. i.; Graetz, *History of the Jews* (Eng. trans.), vol. II. ch. xvi.; *Jewish Encyclopedia* (whence some of the above cited sayings are quoted), viii. 432–435. On Meïr's place in the history of the fable, see J. Jacobs, *The Fables of Aesop*, i. 111, &c. (see Index *s.v.*). (I. A.)

MEIR OF ROTHENBURG (*c.* 1215–1293), German rabbi and poet, was born in Worms *c.* 1215. He played a great part in organizing the Jewish communal life of the middle ages. In 1286 for some unknown reason he was thrown into prison in Alsace, where he remained until his death in 1293. His friends offered to find a ransom, but he declined the suggestion, fearing that the precedent would lead to extortion in other cases. He wrote glosses to the Talmud (*tosaphot*) and many *Responsa* of the utmost value for historical research. Through his disciples Asher ben Yeḥiel and Mordecai ben Hillel, Meir exercised much influence on subsequent developments of Judaism. He was also a liturgical poet of considerable merit. One of his finest elegies is translated into English in Nina Davis's *Songs of Exile.*

See L. Ginzberg, *Jewish Encyclopedia*, viii. 437–440. (I. A.)

MEIRINGEN, the principal village on the Hasle (or the upper Aar) valley in the Swiss canton of Bern. It is built at a height of 1969 ft. on the right bank of the Aar and on the level floor of the valley, but is much exposed to the south wind (or *Föhn*), and has several times been in great part destroyed by fire (1632, 1879 and 1891). It has 3077 inhabitants, all German-speaking and Protestants. The parish church is ancient, and above it are the ruins of the medieval castle of Resti. Meiringen is frequented by travellers in summer, as it is the meeting-point of many routes: from Interlaken by the lake of Brienz and Brienz, from Lucerne by the Brünig railway (28 m.), from Engelberg by the Joch Pass (7267 ft.), from the upper Valais by the Grimsel Pass (7100 ft.), and from Grindelwald by the Great Scheidegg Pass (6434 ft.). Many waterfalls descend the hill-sides, the best known being the Reichenbach and the Alpbach, while the great gorge pierced by the Aar through the limestone barrier of the Kirchet is remarkable. The village and valley belonged of old to the emperor, who in 1234 gave the advowson to the Knights of St Lazarus, by whom it was sold in 1272 to the Austin Canons of Interlaken, on the suppression of whom in 1528 it passed to the state. In 1310 the emperor mortgaged the valley to the lords of Weissenburg, who sold it in 1334 to the town of Bern. (W. A. B. C.)

MEISSEN, a town of Germany, in the kingdom of Saxony, on both banks of the Elbe, 15 m. N.W. from Dresden, on the railway to Leipzig via Döbeln. Pop. (1905), 32,336. The old town lies on the left bank of the river, between the streams Meisse and Triebisch, and its irregular hilly site and numerous fine old buildings make it picturesque. Most of its streets are narrow and uneven. The cathedral, one of the finest early Gothic buildings in Germany, stands on the Schlossberg, 160 ft. above the town. It is said to have been founded by the emperor Otto the Great, but the present building was begun in the 13th century and was completed about 1450. Here are tombs of several rulers and princes of Saxony, including those of Albert and Ernest, the founders of the two existing branches of the Saxon house. The cathedral also contains works by Peter Vischer and Lucas Cranach and several other interesting monuments. A restoration, including the rebuilding of the two towers, was carried out in 1903–1908. Adjoining the cathedral is the castle, dating from 1471–1483, but restored and named the Albrechtsburg about 1676. Another restoration was undertaken after 1860, when a series of historical frescoes was painted upon its walls. A stone building of the 13th century connects the Schlossberg with the Afraberg, which owes its name to the old convent of St Afra. The convent was suppressed by Duke Maurice in 1543, and was by him converted into a school (the Fürsten Schule), one of the most renowned classical schools in Germany, which counts Lessing and Gellert among its former pupils. Other public buildings of interest are the town-hall, built in 1479 and restored in 1875; the fine town church, called the Frauenkirche or Marienkirche; the Nikolaikirche and the Afrakirche. The Franciscan church is now used as a museum of objects connected with the history of Meissen. Since 1710 Meissen has been the seat of the manufacture of Dresden china. Till 1860 the royal porcelain factory was in the Albrechtsburg, but in that year it was transferred to a large new building in the Triebischtal, near the town. Meissen also contains iron foundries, factories for making earthenware stoves and pottery, sugar refineries, breweries and tanneries. A considerable trade is carried on in the wine produced in the surrounding vineyards, and other industries are spinning and weaving.

Meissen was founded about 920 by Henry the Fowler (see MEISSEN, Margraviate). From 968 to 1581 Meissen was the seat of a line of bishops, who ranked as princes of the empire. During the 15th century the town suffered greatly from the Hussites, and it was captured by the imperial troops during the war of the league of Schmalkalden, and again in the Thirty Years' War. In 1637 it suffered much from the Swedes, and in 1745 it fell into the hands of the Prussians. The bridge over the Elbe was destroyed by the French in 1813, and again by the Saxons in June 1866 in order to impede the march of the Prussians on Dresden. Cölln on the right bank of the Elbe was incorporated with Meissen in 1901.

See Reinhard, *Die Stadt Meissen, ihre Merkwürdigkeiten* (Meissen, 1829); Loose, *Alt-Meissen in Bildern* (Meissen, 1889); Jäschke, *Meissen und seine Kirchen* (Leipzig, 1902); and Gersdorf, *Urkundenbuch der Stadt Meissen* (Leipzig, 1873).

MEISSEN, a German margraviate now merged in the kingdom of Saxony. The mark of Meissen was originally a district centring round the castle of Meissen or Misnia on the Middle Elbe, which was built about 920 by the German king Henry I., the Fowler, as a defence against the Slavs. After the death of Gero, margrave of the Saxon east mark, in 965, his territory was divided into five marks, one of which was called Meissen. In 985 the emperor Otto III. bestowed the office of margrave upon Ekkard I., margrave of Merseburg, and the district comprising the marks of Meissen, Merseburg and Zeitz was generally known as the mark of Meissen. In 1002 Ekkard was succeeded by his brother Gunzelin, and then by his sons Hermann I. and Ekkard II. Under these margraves the area of the mark was further increased, but when Ekkard II. died in 1046 it was divided, and Meissen proper was given successively to William and Otto, counts of Weimar, and Egbert II., count of Brunswick. Egbert was a rival of the emperor Henry IV. and died under the imperial ban in 1089, when Meissen was bestowed upon Henry I., count of Wettin, whose mother was a sister of the margrave Ekkard II. Henry, who already ruled lower Lusatia and the new and smaller Saxon east mark, was succeeded in 1103 by his cousin Thimo, and in 1104 by his son Henry II., whose claim on the mark was contested by Thimo's son Conrad. When Henry died without issue in 1123 Meissen was given by the emperor Henry V. to Hermann II., count of Wintzenburg; but, renewing his claim, Conrad won the support of Lothair, duke of Saxony, afterwards the emperor Lothair II., and obtained possession in 1130. Conrad, called the Great, extended the boundaries of Meissen before abdicating in 1156 in favour of his son Otto, known as the Rich. Otto appointed his younger son Dietrich as his successor and was attacked and taken prisoner by his elder son Albert; but, after obtaining his release by order of the emperor Frederick I., he had only just renewed the war when he died in 1190. During his reign silver mines were opened in the Harz Mountains, towns were founded, roads were made, and the general condition of the country was improved. Otto was succeeded by his son Albert, called the Proud, who was engaged in warfare with his brother Dietrich until his death in 1195. As Albert left no children, Meissen was seized by the emperor Henry VI. as a vacant fief of the empire; but Dietrich, called the Oppressed, secured the mark after Henry's death in 1197. Dietrich married Jutta, daughter of Hermann I., landgrave of Thuringia, and was succeeded in 1221 by his infant son Henry, surnamed the Illustrious; who on arriving at maturity obtained as reward for supporting the emperor Frederick II. against the pope a promise to succeed his uncle, Henry Raspe IV., as landgrave of Thuringia. In 1243 Henry's son Albert was betrothed to Margaret, daughter of Frederick II.; and Pleissnerland, a district west of Meissen, was added to his possessions. Having gained Thuringia and the Saxon palatinate on his uncle's death in 1247, he granted sections of his lands to his three sons in 1265, but retained Meissen. A series of family feuds followed. His second son Dietrich died in 1285, and on Henry's own death in 1288 Meissen was divided between his two remaining sons, Albert (called the Degenerate) and Frederick, and his grandson Frederick Tutta, the son of Dietrich. Albert was engaged in struggles with his three sons, who took him prisoner in 1288; but he was released the following year by order of the German king Rudolph I. About this time he sold his portion of Meissen to his nephew Frederick Tutta, who held the title of margrave and ruled the greater part of the mark until his death in 1291. Albert's two remaining sons, Frederick and Dietrich or Diezmann, then claimed Meissen; but it was seized by King Adolph of Nassau as a vacant fief of the empire, and was for some time retained by him and his successor King Albert I. In the course of constant efforts to secure the mark the brothers Frederick and Dietrich defeated the troops of King Albert at Lucka in May 1307 and secured partial possession of their lands. In this year Dietrich died and Frederick became reconciled with his father, who, after renouncing his claim on Meissen for a yearly payment, died in 1314. Having obtained possession of the greater part of the mark, Frederick was invested with it by the German king Henry VII. in 1310. During these years the part of Meissen around Dresden had been in the possession of Frederick, youngest son of the margrave Henry the Illustrious, and when he died in 1316 it came to his nephew Frederick. About 1312 Frederick, who had become involved in a dispute with Waldemar, margrave of Brandenburg, over the possession of lower Lusatia, was taken prisoner. Surrendering lower Lusatia he was released, but it was only after Waldemar's death in 1319 that he obtained undisputed possession of Meissen. Frederick, who was surnamed the Peaceful, died in 1323 and was followed as margrave by his son Frederick II., called the Grave, who added several counties to his inheritance. From this latter Frederick's death in 1349 until 1381 the lands of the family were ruled by his three sons jointly; but after the death of his eldest son Frederick III. in 1381 a division was made by which Meissen fell to his youngest son William I. In 1407 William was succeeded by his nephew Frederick, called the Warlike, who in 1423 received from the emperor Sigismund the electoral duchy of Saxe-Wittenberg. The mark then became merged in the duchy of Saxony, and at the partition of 1485 fell to the Albertine line. As Meissen was relieved from the attacks of the Slavs by the movement of the German boundary to the east, its prosperity increased. Many towns were founded, among which were Dresden, Leipzig and Freiburg; Chemnitz began its textile industry; and although the condition of the peasants was wretched, that of the townsmen was improving. The discoveries of silver brought great wealth to the margraves, but they resorted at times to *bedes*, which were contributions from the nobles and ecclesiastics who met in a kind of diet. During this period the mark of Meissen lay on both banks of the Elbe, and stretched from Bohemia to the duchy of Saxe-Wittenberg, embracing an area of about 3000 sq. m.

See O. Posse, *Die Markgrafen von Meissen und das Haus Wettin* (Leipzig, 1881); F. W. Tittmann, *Geschichte Heinrichs des erlauchten Markgrafen zu Meissen* (Dresden, 1845–1846); C. F. von Posern-Klett. *Zur Geschichte der Verfassung der Markgrafschaft Meissen im 13. Jahrhundert* (Leipzig, 1863). See also *Urkunden der Markgrafen von Meissen und Landgrafen von Thüringen*, edited by E. G. Gersdorf (Leipzig, 1864); and H. B. Meyer, *Hof- und Zentralverwaltung der Wettiner* (Leipzig, 1902).

MEISSONIER, JEAN LOUIS ERNEST (1815–1891), French painter, was born at Lyons on the 21st of February 1815. From his schooldays he showed a taste for painting, to which some early sketches, dated 1823, bear witness. After being placed with a druggist, he obtained leave from his parents to become an artist, and, owing to the recommendation of a painter named Potier, himself a second class Prix de Rome, he was admitted to Léon Cogniet's studio. He paid short visits to Rome and to Switzerland, and exhibited in the Salon of 1831 a picture then called "Les Bourgeois Flamands" ("Dutch Burghers"), but also known as "The Visit to the Burgomaster," subsequently purchased by Sir Richard Wallace, in whose collection (at Hertford House, London) it is, with fifteen other examples of this painter. It was the first attempt in France in the particular *genre* which was destined to make Meissonier famous: microscopic painting—miniature in oils. Working hard for daily bread at illustrations for the publishers—Curmer, Hetzel and Dubocher—he also exhibited at the Salon of 1836 the "Chess Player" and the "Errand Boy." After some not very happy attempts at religious painting, he returned, under the influence of Chenavard, to the class of work he was born to excel in, and exhibited with much success the "Game of Chess" (1841), the "Young Man playing the 'Cello" (1842), "The Painter in his Studio" (1843), "The Guard Room," the "Young Man looking at Drawings," the "Game of Piquet" (1845), and the "Game of Bowls"—works which show the finish and certainty of his technique, and assured his success. After his "Soldiers" (1848) he began "A Day in June," which was never finished, and exhibited "A Smoker" (1849) and "Bravos" ("Les Bravi," 1852). In 1855 he touched the highest mark of his achievement with "The Gamblers" and "The Quarrel" ("La Rixe"), which was presented by Napoleon III. to the English Court. His triumph was sustained at the Salon of 1857, when he exhibited nine pictures, and drawings; among them the "Young Man of the Time of the Regency," "The Painter," "The Shoeing Smith," "The Musician," and "A Reading at Diderot's." To the Salon of 1861 he sent "The Emperor at Solferino," "A Shoeing Smith," "A Musician," "A Painter," and "M. Louis Fould"; to that of 1864 another version of "The Emperor at Solferino," and "1814." He subsequently exhibited "A Gamblers' Quarrel" (1865), and "Desaix and the Army of the Rhine" (1867). Meissonier worked with elaborate care and a scrupulous observation of nature. Some of his works, as for instance his "1807," remained ten years in course of execution. To the great Exhibition of 1878 he contributed sixteen pictures: the portrait of Alexandre Dumas which had been seen at the Salon of 1877, "Cuirassiers of 1805," "A Venetian Painter," "Moreau and his Staff before Hohenlinden," a "Portrait of a Lady," the "Road to La Salice," "The Two Friends," "The Outpost of the Grand Guard," "A Scout," and "Dictating his Memoirs." Thenceforward he exhibited less in the Salons, and sent his work to smaller exhibitions. Being chosen president of the Great National Exhibition in 1883, he was represented there by such works as "The Pioneer," "The Army of the Rhine," "The Arrival of the Guests," and "Saint Mark." On the 24th of May 1884 an exhibition was opened at the Petit Gallery of Meissonier's collected works, including 146 examples. As president of the jury on painting at the Exhibition of 1889 he contributed some new pictures. In the following year the New Salon was formed (the National Society of Fine Arts), and Meissonier was president. He exhibited there in 1890 his picture "1807"; and in 1891, shortly after his death, his "Barricade" was displayed there. A less well-known class of work than his painting is a series of etchings: "The Last Supper," "The Skill of Vuillaume the Lute Player," "The Little Smoker," "The Old Smoker," the "Preparations for a Duel," "Anglers," "Troopers," "The Reporting Sergeant," and "Polichinelle," in the Hertford House collection. He also tried lithography, but the prints are now scarcely to be found. Of all the painters of the century, Meissonier was one of the most fortunate in the matter of payments. His "Cuirassiers," now in the late duc d'Aumale's collection at Chantilly, was bought from the artist for £10,000, sold at Brussels for £11,000, and finally resold for £16,000. Besides his genre portraits, he painted some others: those of "Doctor Lefevre," of "Chenavard," of "Vanderbilt," of "Doctor Guyon," and of "Stanford." He also collaborated with the painter Français in a picture of "The Park at St Cloud." In 1838 Meissonier married the sister of M. Steinheil, a painter. Meissonier was attached by Napoleon III. to the imperial staff, and accompanied him during the campaign in Italy and at the beginning of the war in 1870. During the siege of Paris in 1871 he was colonel of a marching regiment. In 1840 he was awarded a third-class medal, a second-class medal in 1841, first-class medals in 1843 and 1844 and medals of honour at the great exhibitions. In 1846 he was appointed knight of the Legion of Honour and promoted to the higher grades in 1856, 1867 (June 29), and 1880 (July 12), receiving the Grand Cross in 1889 (Oct. 29). He nevertheless cherished certain ambitions which remained unfulfilled. He hoped to become a professor at the École des Beaux Arts, but the appointment he desired was never given to him. On various occasions, too, he aspired to be chosen deputy or made senator, but he was not elected. In 1861 he succeeded Abel de Pujol as member of the Academy of Fine Arts. On the occasion of the centenary festival in honour of Michelangelo in 1875 he was the delegate of the Institute of France to Florence, and spoke as its representative. Meissonier was an admirable draughtsman upon wood, his illustrations to *Les Contes Rémois* (engraved by Lavoignat), to Lamartine's *Fall of an Angel*, to *Paul and Virginia*, and to *The French Painted by Themselves* being among the best known. The leading engravers and etchers of France have been engaged upon plates from the works of Meissonier, and many of these plates command the highest esteem of collectors. Meissonier died in Paris on the 21st of January 1891. His son, Jean Charles Meissonier, also a painter, was his father's pupil, and was admitted to the Legion of Honour in 1889.

See Alexandre, *Histoire de la peinture militaire en France* (Paris, 1891); Laurens, *Notice sur Meissonier* (Paris, 1892); Gréard, *Meissonier* (Paris and London, 1897); T. G. Dumas, *Maîtres modernes* (Paris, 1884); Ch. Formentin, *Meissonier, sa vie—son œuvre* (Paris, 1901); J. W. Mollett, *Illustrated Biographies of Modern Artists: Meissonier* (London, 1882). (H. Fr.)

MEISSONIER, JUSTE AURÈLE (1695–1750), French goldsmith, sculptor, painter, architect, and furniture designer, was born at Turin, but became known as a worker in Paris, where he died. His Italian origin and training were probably responsible for the extravagance of his decorative style. He shared, and perhaps distanced, the meretricious triumphs of Oppenard and Germain, since he dealt with the Baroque in its most daring and flamboyant developments. Rarely does he leave a foot or two of undecorated space; the effect of the whole is futile and fatiguing. It was because Meissonier carried the style of his day to its extreme that he acquired so vast a popularity. Like the English brothers Adam at a later day he not only as architect built houses, but as painter and decorator covered their internal walls; he designed the furniture and the candlesticks, the silver and the decanters for the table; he was as ready to produce a snuff-box as a watch case or a sword hilt. Not only in France, but for the nobility of Poland, Portugal and other countries who took their fashions and their taste from Paris, he made designs, which did nothing to improve European taste. Yet his achievement was not wholly without merit. His work in gold and silver-plate was often graceful and sometimes bold and original. He was least successful in furniture, where his twirls and convolutions, his floral and rocaille motives were conspicuously offensive. He was appointed by Louis XV. *Dessinateur de la chambre et du cabinet du roi*; the post of designer *pour les pompes funèbres et galantes* was also held along with that of *Orfèvre du roi*.

For our knowledge of his work we are considerably indebted to his own books of design: *Livre d'ornements en trente pièces*; *Livre d'orfèvrerie d'église en six pièces*, and *Ornements de la carte chronologique*.

MEISTERSINGER (Ger. for "master-singer"), the name given to the German lyric poets of the 14th, 15th and 16th centuries, who carried on and developed the traditions of the medieval Minnesingers (*q.v.*). These singers, who, for the most part, belonged to the artisan and trading classes of the German towns, regarded as their masters and the founders of their gild twelve poets of the Middle High German period, among whom were Wolfram von Eschenbach, Konrad von Würzburg, Reinmar von Zweter and Frauenlob. The last mentioned of these, Frauenlob, is said to have established the earliest Meistersinger school at Mainz, early in the 14th century. This is only a tradition, but the institution of such schools originated undoubtedly in the upper Rhine district. In the 14th century there were schools at Mainz, Strassburg, Frankfort, Würzburg, Zürich and Prague; in the 15th at Augsburg and Nuremberg, the last becoming in the following century, under Hans Sachs, the most famous of all. By this time the Meistersinger schools had spread all over south and central Germany; and isolated gilds were to be found farther north, at Magdeburg, Breslau, Görlitz and Danzig.

Each gild numbered various classes of members, ranging from beginners, or *Schüler* (corresponding to trade-apprentices), and *Schulfreunde* (who were equivalent to *Gesellen* or journeymen), to *Meister*, a *Meister* being a poet who was not merely able to write new verses to existing melodies but had himself invented a new melody. The poem was technically known as a *Bar* or *Gesetz*, the melody as a *Ton* or *Weis*. The songs were all sung in the schools without accompaniment. The rules of the art were set down in the so-called *Tabulatur* or law-book of the gild. The meetings took place either in the Rathaus, or town hall, or, when they were held—as was usually the case—on Sunday, in the church; and three times a year, at Easter, Whitsuntide and Christmas, special festivals and singing competitions were instituted. At such competitions or *Schulsingen* judges were appointed, the so-called *Merker*, whose duty it was to criticize the competitors and note their offences against the rules of the *Tabulatur*.

The literary value of the Meistersinger poetry was hardly in proportion to the large part it played in the life of the German towns of the 15th and 16th centuries. As the medieval lyric decayed, more and more attention was given to the externals of poetic composition, the form, the number of syllables, the melody; and it was such externals that attracted the interest of these burgher-poets. Poetry was to them a mechanical art that could be learned by diligent application, and the prizes they had to bestow were the rewards of ingenuity, not of genius or inspiration. Consequently we find an extraordinary development of strophic forms corresponding to the many new "tones" which every Meistersinger regarded it as his duty to invent—tones which bore the most remarkable and often ridiculous names, such as *Gestreiftsafranblümleinweis*, *Fettdachsweis*, *Vielfrassweis*, *geblümte Paradiesweis*, &c. The verses were adapted to the musical strophes by a merely mechanical counting of syllables, regardless of rhythm or sense. The meaning, the sentiment, the thought, were the last things to which the Meistersingers gave heed. At the same time there was a certain healthy aspect in the cultivation of the Meistergesang among the German middle classes of the 15th and 16th centuries; the Meistersinger poetry, if not great or even real poetry, had —especially in the hands of a poet like Hans Sachs—many germs of promise for the future. It reflected without exaggeration or literary veneer the faith of the German burgher, his blunt good sense and honesty of purpose. In this respect it was an important factor in the rise of that middle-class literature which found its most virile expression in the period of the Reformation. The Meistergesang reached its highest point in the 16th century; and it can hardly be said to have outlived that epoch, although the traditions of the Meistersinger schools lingered in south German towns even as late as the 19th century.

Specimens of Meistersinger poetry will be found in various collections, such as J. J. Görres, *Altdeutsche Volks- und Meisterlieder* (1817); K. Bartsch, *Meisterlieder der Kolmarer Handschrift* (Publ. of the Stuttgart *Literarischer Verein*, vol. lxviii.; 1862). Of the older sources of information about the Meistersinger the most important are Adam Puschmann, *Gründlicher Bericht des deutschen Meistergesangs zusamt der Tabulatur* (1571; reprinted in W. Braune's *Neudrucke deutscher Literaturwerke des 16. und 17. Jahrh.*, 73, 1888), and J. C. Wagenseil, *De civitate Noribergensi* (1697). See further J. Grimm, *Über den altdeutschen Meistergesang* (1811); F. Schnorr von Carolsfeld, *Zur Geschichte des deutschen Meistergesangs* (1872); R. von Liliencron, *Über den Inhalt der allgemeinen Bildung in der Zeit der Scholastik* (1876); G. Jacobsthal, "Die musikalische Bildung der Meistersinger" (*Zeitschrift für deut. Altertum*, xx., 1876); O. Lyon, *Minne- und Meistergesang* (1882); K. Mey, *Der Meistergesang in Geschichte und Kunst* (1892). The art of the Meistersingers has been immortalized by Richard Wagner in his music drama, *Die Meistersinger* (1868). (J. G. R.)

MEKONG, or Me Nam Kong (pronounced *Kawng*), sometimes known as the Cambodia River, the great river of Indo-China, having its origin in the Tibetan highlands. It is the third or fourth longest river in Asia and the seventh or eighth in the world. It is about 2800 m. in length, of which 1200 flow through portions of the Chinese Empire and Tibet and 1600 through French territory. Its sources are not definitely settled, but it is supposed to rise on the slopes of Dza-Nag-Lung-Mung in about

33° N., 93° E., at an altitude of 16,700 ft. above sea-level. Throughout the greater part of its course in Tibet, where it is called the Dza-Chu, it flows south-eastwards to Chiamdo, on the great east and west caravan route from China to Lhasa. At this point it is about 10,000 ft. above sea-level. From here it flows southwards through little-known mountain wastes. Below Dayul in lat. 29° it is known by the Chinese name of Lantsan Kiang. For the next 300 m. of its course the Lantsan Kiang, or, as it soon becomes known among the Thai peoples inhabiting its rugged valley, the Mekong, is very little known to us. The river flows beneath bare and rocky walls. A few scattered villages of Lusus and Mossos exist in this region; there is no trade from north to south. In 25° 18′ N. the Tali-Bhamo caravan route, described by Colborne Baker, crosses the river by one of those iron suspension bridges which are a feature of Yun-nan, at a height of 4700 ft. above sea-level. From this point to Chieng or Keng Hung, the head of the old confederacy of the Sibsawng Punna or Twelve States, it is little known; the fact that it falls some 900 ft. for each degree of latitude indicates the character of the river. Under the provisions of the Anglo-French agreement of January 1896, from the Chinese frontier southwards to the mouth of the Nam Hok the Mekong forms the frontier between the British Shan States on the west and the territories acquired from Siam by France in 1893. By the treaty of 1893, from that point southwards to about 13° 30′ N. it is also the frontier between French Indo-China and Siam, and a zone extended 25 kilometres inland from the right bank, within which the Siamese government agreed not to construct any fortified port or maintain any armed force. This 25 kilometre neutral zone was abolished in 1905 when France surrendered Chantabun to the Siamese, who in their turn ceded the port of Krat and the provinces of Melupre and Bassac, together with various trading concessions to France on the right bank of the Mekong. Below the Siamese Shan town of Chieng Sen the river takes its first great easterly bend to Luang Prabang, being joined by some important tributaries. This portion is obstructed by rapids. The country is mountainous, and the vegetation of the lower heights begins to assume a tropical aspect. From Luang Prabang the river cuts its way southwards for two degrees through a lonely jungle country among receding hills of low elevation. From Chieng Khan the river again turns eastwards along the 18th parallel, forcing its way through its most serious rapid-barrier, and receiving some important tributaries from the highlands of Tung Chieng Kum and Chieng Kwang, the finest country in Indo-China. In 104° E. the river resumes a southerly course through a country thinly peopled. At Kemarat (16° N.) the fourth serious rapid-barrier occurs, some 60 m. in length, and the last at Khong in 14° N. From here to its outfall in the China Sea the river winds for some 400 m. through the French territories of Cambodia and Cochin China, and to its annual overflow these countries owe their extraordinary fertility. The French have done much to render the river navigable. Steamers ply regularly from Saigon through Mytho to Pnompenh, and launches proceed from this place, the capital of Cambodia, to the Preapatano rapids, and beyond this a considerable portion of the distance to Luang Prabang, the journey being finished in native boats. (J. G. Sc.)

MELA, POMPONIUS (*fl.* c. A.D. 43), the earliest Roman geographer. His little work (*De situ orbis libri III.*) is a mere compendium, occupying less than one hundred pages of ordinary print, dry in style and deficient in method, but of pure Latinity, and occasionally relieved by pleasing word-pictures. Excepting the geographical parts of Pliny's *Historia naturalis* (where Mela is cited as an important authority) the *De situ orbis* is the only formal treatise on the subject in classical Latin. Nothing is known of the author except his name and birthplace—the small town of Tingentera or Cingentera in southern Spain, on Algeciras Bay (Mela ii. 6, § 96; but the text is here corrupt). The date of his writing may be approximately fixed by his allusion (iii. 6 § 49) to a proposed British expedition of the reigning emperor, almost certainly that of Claudius in A.D. 43. That this passage cannot refer to Julius Caesar is proved by several references to events of Augustus's reign, especially to certain new names given to Spanish towns. Mela has been without probability identified by some with L. Annaeus Mela of Corduba, son of Seneca the rhetorician, and brother of the great Seneca.

The general views of the *De situ orbis* mainly agree with those current among Greek writers from Eratosthenes to Strabo; the latter was probably unknown to Mela. But Pomponius is unique among ancient geographers in that, after dividing the earth into five zones, of which two only were habitable, he asserts the existence of *antichthones*, inhabiting the southern temperate zone inaccessible to the folk of the northern temperate regions from the unbearable heat of the intervening torrid belt. On the divisions and boundaries of Europe, Asia and Africa, he repeats Eratosthenes; like all classical geographers from Alexander the Great (except Ptolemy) he regards the Caspian Sea as an inlet of the Northern Ocean, corresponding to the Persian and Arabian (Red Sea) gulfs on the south. His Indian conceptions are inferior to those of some earlier Greek writers; he follows Eratosthenes in supposing that country to occupy the south-eastern angle of Asia, whence the coast trended northwards to Scythia, and then swept round westward to the Caspian Sea. As usual, he places the Rhipaean Mountains and the Hyperboreans near the Scythian Ocean. In western Europe his knowledge (as was natural in a Spanish subject of Imperial Rome) was somewhat in advance of the Greek geographers. He defines the western coast-line of Spain and Gaul and its indentation by the Bay of Biscay more accurately than Eratosthenes or Strabo, his ideas of the British Isles and their position are also clearer than his predecessors'. He is the first to name the Orcades or Orkneys, which he defines and locates pretty correctly. Of northern Europe his knowledge was imperfect, but he speaks vaguely of a great bay ("Codanus sinus") to the north of Germany, among whose many islands was one, "Codanovia," of pre-eminent size; this name reappears in Pliny as "Scandinavia." Mela's descriptive method is peculiar and inconvenient. Instead of treating each continent separately he begins at the Straits of Gibraltar, and describes the countries adjoining the south coast of the Mediterranean; then he moves round by Syria and Asia Minor to the Black Sea, and so returns to Spain along the north shore of the Euxine, Propontis, &c. After treating the Mediterranean islands, he next takes the ocean littoral—to west, north, east and south successively—from Spain and Gaul round to India, from India to Persia, Arabia and Ethiopia; and so again works back to Spain round South Africa. Like most classical geographers he conceives the Dark Continent as surrounded by sea and not extending very far south.

The first edition of Mela was published at Milan in 1471; the first good edition was by Vadianus (Basel, 1522), superseded by those of Voss (1658), J. Gronovius (1685 and 1696), A. Gronovius (1722 and 1728), and Tzschucke (1806–1807), in seven parts (Leipzig; the most elaborate of all); G. Parthey's (Berlin, 1867), gives the best text. The English trans. by Arthur Golding (1585), is famous; see also E. H. Bunbury, *Ancient Geography*, ii. 352–368, and D. Detlefsen, *Quellen und Forschungen zur alten Gesch. und Geog.* (1908). (E. H. B.; C. R. B.)

MELACONITE, a mineral consisting of cupric oxide, CuO, and known also as black copper ore. In appearance it is strikingly different from cuprite (*q.v.*) or red copper ore, which is cuprous oxide. Crystals are rare; they belong to the monoclinic, or possibly to the anorthic system, and have the form of thin triangular or hexagonal scales with a steel-grey colour and brilliant metallic lustre. More often the mineral is massive, earthy or pulverulent, and has a dull iron-black colour. Hence the name melaconite, from the Greek μέλας, black and κόνις, dust, which was originally given by F. S. Beudant in 1832 in the form melaconise. The crystallized Vesuvian mineral was later named tenorite, a name commonly adopted for the species. The hardness of the crystals is 3–4, but the earthy and powdery forms readily soil the fingers; the spec. grav. is 5·9. Crystals have been found only at Mt Vesuvius, where they encrust lava, and in Cornwall. The other forms of the mineral, however, are common in copper mines, and have resulted by the alteration of chalcocite, chalcopyrite and other copper ores, on which they often form a superficial coating. (L. J. S.)

MELAMPUS, in Greek legend, a celebrated seer and physician, son of Amythaon and Eidomene, brother of Bias, mythical eponymous hero of the family of the Melampodidae. Two young serpents, whose life he had saved, licked his ears while he slept, and from that time he understood the language of birds and beasts. In the art of divination he received instruction from Apollo himself. To gain the consent of Neleus, king of Pylos, to the marriage of his daughter Pero with Bias, Melampus undertook to obtain possession of the oxen of the Thessalian prince Iphiclus. As Melampus had foretold, he was caught and imprisoned, but was released by Phylacus (the father of Iphiclus) on giving proof of his powers of divination, and was finally presented with the oxen as a reward for having restored the virility of the son. Melampus subsequently obtained a share in the kingdom of Argos in return for having cured the daughters of its king Proetus, who had been driven mad for offering resistance to the worship of Dionysus or for stealing the gold from the statue of Hera. At Aegosthena in Megara there was a sanctuary of Melampus, and an annual festival was held in his honour. According to Herodotus, he introduced the cult of Dionysus into Greece from Egypt, and his name (" black foot ") is probably " a symbolical expression of his character as a Bacchic propitiatory priest and seer " (Preller). According to the traditional explanation, he was so called from his foot having been tanned by exposure to the sun when a boy. In his character of physician, he was the reputed discoverer of the herb melampodium, a kind of hellebore. Melampus and Bias are symbolical representatives of cunning and force.

See Apollodorus i. 9, 11, 12; ii. 2, 2; *Odyssey*, xv. 225–240; Diod. Sic. iv. 68; Herodotus ii. 49; ix. 34; Pausanias ii. 18, 4; iv. 36, 3; scholiast on Theocritus iii. 43; Ovid, *Metam.* xv. 325; C. Eckermann, *Melampus und sein Geschlecht* (1840).

Melampus is also the name of the author of a short extant treatise of little value on Divination by means of Palpitation (Παλμῶν) and Birthmarks ('Ελαιῶν). It probably dates from the time of Ptolemy Philadelphus (3rd cent. B.C.). Edition by J. G. Franz in *Scriptores physiognomiae veteres* (1780).

MELANCHLAENI (from Gr. *μέλας*, and *χλαῖνα*, " Black-cloaks "), an ancient tribe to the north of Scythia, probably about the modern Ryazan and Tambov (Herodotus iv. 106). They have been identified with the Finnish tribes Merja (now extinct) and Cheremis, now driven north-east on to the middle Volga. These, till recently, wore black. There has been confusion between this tribe and another of the same name mentioned by Pliny (*N. H.* vi. 15), and Ptolemy in the Caucasus. (E. H. M.)

MELANCHOLY (Gr. *μελαγχολία*, from *μέλας*, black, and *χολή*, bile), originally a condition of the mind or body due to a supposed excess of black bile, also this black bile itself, one of the chief " humours " of the body, which were, according to medieval physiology, blood, phlegm, choler and melancholy (see HUMOUR); now a vague term for desponding grief. From the 17th century the name was used of the mental disease now known as " melancholia " (see INSANITY), but without any reference to the supposed cause of it.

MELANCHTHON, PHILIPP (1497–1560), German theologian and reformer, was born at Bretten in Baden on the 16th of February 1497. His father, George Schwartzerd, was an armourer under the Palatinate princes. His mother, Barbara Reuter, a niece of Johann Reuchlin, was shrewd, thrifty and affectionate.[1] Her father, Johann Reuter, long burgomaster of Bretten, supervised the education of Philipp, who was taught first by Johannes Hungarus and then by Georg Simler at the academy of Pfortzheim. Reuchlin took an interest in him, and, following a contemporary custom, named him Melanchthon (the Greek form of Schwartzerd, black earth). In October 1509 he went to Heidelberg, where he took the B.A. degree, afterwards proceeding M.A. at Tübingen. The only other academic distinction he accepted was the B.D. of Wittenberg (1519). He would never consent to become a " doctor," because he thought the title carried with it responsibilities to which he felt himself unequal. At Tübingen he lived as student and teacher for six years, until on Reuchlin's advice, the elector of Saxony called him to Wittenberg as professor of Greek in 1518. This appointment marked an epoch in German university education; Wittenberg became the school of the nation; the scholastic methods of instruction were set aside, and in a *Discourse on Reforming the Studies of Youth* Melanchthon gave proof, not only that he had caught the Renaissance spirit, but that he was fitted to become one of its foremost leaders. He began to lecture on Homer and the Epistle to Titus, and in connexion with the former he announced that, like Solomon, he sought Tyrian brass and gems for the adornment of God's Temple. Luther received a fresh impulse towards the study of Greek, and his translation of the Scriptures, begun as early as 1517, now made rapid progress, Melanchthon helping to collate the Greek versions and revising Luther's translation. Melanchthon felt the spell of Luther's personality and spiritual depth, and seems to have been prepared on his first arrival at Wittenberg to accept the new theology, which as yet existed mainly in subjective form in the person of Luther. To reduce it to an objective system, to exhibit it dialectically, the calmer mind of Melanchthon was requisite.

Melanchthon was first drawn into the arena of the Reformation controversy through the Leipzig Disputation (June 27–July 8, 1519), at which he was present. He had been reproved by Johann Eck for giving aid to Carlstadt (" Tace tu, Philippe, ac tua studia cura nec me perturba "), and he was shortly afterwards himself attacked by the great papal champion. Melanchthon replied in a brief and moderately worded treatise, setting forth Luther's first principle of the supreme authority of Scripture in opposition to the patristic writings on which Eck relied. His marriage in 1520 to Catharine Krapp of Wittenberg gave a domestic centre to the Reformation. In 1521, during Luther's confinement in the Wartburg, Melanchthon was leader of the Reformation cause at the university. He defended the action of Carlstadt, when he dispensed the Eucharist in an " evangelical fashion."[2]

With the arrival of the Anabaptist enthusiasts of Zwickau, he had a more difficult task, and appears to have been irresolute. Their attacks on infant baptism seemed to him not altogether irrational, and in regard to their claim to personal inspiration he said " Luther alone can decide; on the one hand let us beware of quenching the Spirit of God, and on the other of being led astray by the spirit of Satan." In the same year, 1521, he published his *Loci communes rerum theologicarum*, the first systematized presentation of the reformed theology. From 1522 to 1524 he was busy with the translation of the Bible and in publishing commentaries. In 1524 he went for reasons of health into southern Germany and was urged by the papal legate Campegio to renounce the new doctrines. He refused, and maintained his refusal by publishing his *Summa doctrinae Lutheri*.

After the first Diet of Spires (1526), where a precarious peace was patched up for the reformed faith, Melanchthon was deputed as one of twenty-eight commissioners to visit the reformed states and regulate the constitution of churches, he having just published a famous treatise called the *Libellus visitatorius*, a directory for the use of the commissioners. At the Marburg conference (1529) between the German and Swiss reformers, Luther was pitted against Oecolampadius and Melanchthon against Zwingli in the discussion regarding the real presence in the sacrament. How far the normally conciliatory spirit of Melanchthon was here biased by Luther's intolerance is evident from the exaggerated accounts of the conference written by the former to the elector of Saxony. He was at this time even more embittered than Luther against the Zwinglians. At the Diet of Augsburg (1530) Melanchthon was the leading representative of the reformation, and it was he who prepared for that diet the seventeen articles of the Evangelical faith, which are known as the " Augsburg Confession." He held conferences with Roman divines appointed to adjust differences, and afterwards wrote an *Apology for the Augsburg Confession*. After the Augsburg conference further attempts were made to settle the Reformation controversy by a compromise, and Melanchthon, from his conciliatory spirit and facility of access, appeared to the defenders of the old faith the fittest of the reformers to deal with. His historical instinct led him ever to revert to the original unity of the church, and to regard subsequent errors as excrescences rather than proofs of an essentially anti-Christian system. He was weary of the *rabies theologorum*, and dreamed that the evangelical leaven, if tolerated, would purify the church's life and doctrine. In 1537, when the Protestant divines signed the Lutheran Articles of Schmalkalden, Melanchthon appended to his signature the reservation that he would admit of a pope provided he allowed the gospel and did not claim to rule by divine right.

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[1] Her character is evidenced by the familiar proverb—

> Wer mehr will verzehren
> Denn sein Pflug kann erehren,
> Der muss zuletzt verderben
> Und vielleicht am Galgen sterben—

of which Melanchthon said to his students " Didici hoc a mea matre, vos etiam observate." (For Melanchthon's Latin version of the saying see *Corpus reformatorum*, x. 469.)

[2] He read the usual service, but omitted everything that taught a propitiatory sacrifice; he did not elevate the Host, and he gave both the bread and the cup into the hands of every communicant.

The year after Luther's death, when the battle of Mühlberg (1547) had given a seemingly crushing blow to the Protestant cause, an attempt was made to weld together the evangelical and the papal doctrines, which resulted in the compilation by Pflug, Sidonius and Agricola of the Augsburg "Interim." This was proposed to the two parties in Germany as a provisional ground of agreement till the decision of the Council of Trent. Melanchthon, on being referred to, declared that, though the Interim was inadmissible, yet so far as matters of indifference (*adiaphora*) were concerned it might be received. Hence arose that "adiaphoristic" controversy in connexion with which he has been misrepresented as holding among matters of indifference such cardinal doctrines as justification by faith, the number of the sacraments, as well as the dominion of the pope, feast-days, and so on. The fact is that Melanchthon sought, not to minimize differences, but to veil them under an intentional obscurity of expression. Thus he allowed the necessity of good works to salvation, but not in the old sense; proposed to allow the seven sacraments, but only as rites which had no inherent efficacy to salvation, and so on. He afterwards retracted his compliance with the adiaphora, and never really swerved from the views set forth in the *Loci communes*; but he regarded the surrender of more perfect for less perfect forms of truth or of expression as a painful sacrifice rendered to the weakness of erring brethren. Luther, though he had probably uttered in private certain expressions of dissatisfaction with Melanchthon, maintained unbroken friendship with him; but after Luther's death certain smaller men formed a party emphasizing the extremest points of his doctrine.[1] Hence the later years of Melanchthon were occupied with controversies within the Evangelical church, and fruitless conferences with his Romanist adversaries. He died in his sixty-third year, on the 19th of April 1560, and his body was laid beside that of Martin Luther in the Schlosskirche at Wittenberg.

His ready pen, clear thought and elegant style, made him the scribe of the Reformation, most public documents on that side being drawn up by him. He never attained entire independence of Luther, though he gradually modified some of his positions from those of the pure Lutherism with which he set out. His development is chiefly noteworthy in regard to these two leading points—the relation of the *evangelium* or doctrine of free grace (1) to free will and moral ability, and (2) to the law and *poenitentia* or the good works connected with repentance. At first Luther's cardinal doctrine of grace appeared to Melanchthon inconsistent with any view of free will; and, following Luther, he renounced Aristotle and philosophy in general, since "philosophers attribute everything to human power, while the sacred writings represent all moral power as lost by the fall." In the first edition of the *Loci* (1521) he held, to the length of fatalism, the Augustinian doctrine of irresistible grace, working according to God's immutable decrees, and denied freedom of will in matters civil and religious alike. In the Augsburg Confession (1530), which was largely due to him, freedom is claimed for the will in non-religious matters, and in the *Loci* of 1533 he calls the denial of freedom Stoicism, and holds that in justification there is a certain causality, though not worthiness, in the recipient, subordinate to the Divine causality. In 1535, combating Laurentius Valla, he did not deny the spiritual incapacity of the will *per se*, but held that this is strengthened by the word of God, to which it can cleave. The will co-operates with the word and the Holy Spirit. Finally, in 1543, he says that the cause of the difference of final destiny among men lies in the different method of treating grace which is possible to believers as to others. Man may pray for help and reject grace. This he calls free will, as the power of laying hold of grace. Melanchthon's doctrine of the three concurrent causes in conversion, viz. the Holy Spirit, the word, and the human will, suggested the semi-Pelagian position called Synergism, which was held by some of his immediate followers.

In regard to the relation of grace to repentance and good works, Luther was disposed to make faith itself the principle of sanctification. Melanchthon, however, for whom ethics possessed a special interest, laid more stress on the law. He began to do this in 1527 in the *Libellus visitatorius*, which urges pastors to instruct their people in the necessity of repentance, and to bring the threatenings of the law to bear upon men in order to faith. This brought down upon him the opposition of the Antinomian Johannes Agricola. In the *Loci* of 1535 Melanchthon sought to put the fact of the co-existence of justification and good works in the believer on a secure basis by declaring the latter necessary to eternal life, though the believer's destiny thereto is already fully guaranteed in his justification. In the *Loci* of 1543 he did not retain the doctrine of the necessity of good works in order to salvation, and to this he added, in the Leipzig Interim, "that this in no way countenances the error that eternal life is merited by the worthiness of our own works." Melanchthon was led to lay more and more stress upon the law and moral ideas; but the basis of the relation of faith and good works was never clearly brought out by him, and he at length fell back on his original position, that we have justification and inheritance of bliss in and by Christ alone, and that good works are necessary by reason of immutable Divine command.

Bibliography.—The principal works of Melanchthon, with the bulk of his correspondence, are contained in the *Corpus reformatorum* (vols. i.–xxviii.; Halle, 1834–1850), edited by Bretschneider and Bindseil, to which must be added Bindseil's *Supplementa* (Halle, 1874). Melanchthon's earliest and best biographer was his friend Joachim Camerarius (1566), a new annotated edition of which is much needed. The best modern life is that by Georg Ellinger (Berlin, 1902); next is that of Karl Schmidt (Elberfeld, 1861). The celebration in 1897 of the 400th anniversary of Melanchthon's birth produced many short biographies and *Festreden*, among them works by J. W. Richard (New York and London, 1898); George Wilson (London, 1897); Karl Sell (Halle, 1897); Ferdinand Cohrs (Halle, 1897); Beyschlag and Harnack (1897). Richard Rothe's *Festrede* (1860) also is good. The most learned of modern Melanchthon scholars was probably Karl Hartfelder, who wrote *Philipp Melanchthon als Praeceptor Germaniae* (Berlin, 1899); *Melanchthoniana paedagogica* (Leipzig, 1892), giving in the first named two full bibliographies, one of all works written on Melanchthon, the other of all works written by him (in chronological order). Hartfelder believed that a good deal of unpublished material is still left in German and foreign libraries. Thus three long unknown letters are published in the *Quellen und Forschungen* of the Königl. Preuss. Inst. Hist. at Rome, vol. ii. Two are to the Cardinal of Augsburg and one to Lazarus von Schwendi. Melanchthon was on his way to the Council of Trent as delegate of the elector of Saxony and the cardinal had offered to meet him at Dillingen. He writes "ingeminating peace," deploring that the council was not a national synod, which would have been a better means of arriving at the truth.

MELANESIA, one of the three great divisions of the oceanic islands in the central and western Pacific. It embraces the Bismarck Archipelago, N.E. of New Guinea, the Louisiade, Solomon, Santa Cruz, New Hebrides and Loyalty islands, New Caledonia, Fiji and intervening small groups. The name (Gr. *μέλας*, black, and *νῆσος*, island) is derived from the black colour of the prevailing native race, the Papuan and its allied tribes. Many of these differ widely from the parent race, but all the Melanesian peoples have certain common characteristics which distinguish them sharply from the inhabitants of Polynesia and Micronesia. Their civilization is lower. The Melanesians are mostly "negroid," nearly black, with crisp, curly hair elaborately dressed; their women hold a much lower position than among the Polynesians; their institutions, social, political and religious, are simpler, their manners ruder; they have few or no traditions; cannibalism, in different degrees, is almost universal; but their artistic skill and taste, as with some of the lower African negroes, are remarkable, and they are amenable to discipline and fair treatment. Their languages, which exhibit considerable difference among themselves, have features which mark them off clearly from the Polynesian, notwithstanding certain fundamental relations with the latter.

See R. H. Codrington, *The Melanesian Languages* (Oxford, 1885) and *The Melanesians* (Oxford, 1891); the articles Papuans and Pacific Ocean; also those on the several island-groups, &c.

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[1] It must be admitted, however, that Matthias Flacius saved the Reformation.

MELANTHIUS, a noted Greek painter of the 4th century B.C. He belonged to the school of Sicyon, which was noted for fine drawing.

MELBA [NELLIE PORTER ARMSTRONG] (1859–), British operatic soprano, *née* Nellie Porter Mitchell, was born at Burnley, near Melbourne, Australia, her father being a contractor, of Scottish blood. She sang at a local concert when six years old, and was given a good musical education. In 1882 she married Captain Charles Armstrong, and in 1886 went to study singing in Paris under the famous teacher, Madame Mathilde Marchesi, whose daughter, Madame Blanche Marchesi, also a famous singer, was associated with her. In 1887 she made her début in opera at Brussels, taking the stage-name of Madame Melba from her connexion with Melbourne. In the next year she sang the part of Lucia, which remained one of her famous rôles, at Covent Garden, London; and, though critics complained of her coldness as an actress, her liquid voice and brilliant execution henceforth made her famous as the greatest successor to Patti, in pure vocalization, on the operatic stage. She maintained this position for over twenty years, her triumphs being celebrated in every country.

See the "authorized" biography by Agnes G. Murphy (1909).

MELBOURNE, WILLIAM LAMB, 2ND VISCOUNT (1779–1848), English statesman, second son of the 1st Viscount Melbourne, by his marriage with the daughter of Sir Ralph Milbanke, bart., was born on the 15th of March 1779. His father, Peniston Lamb (1748–1829), was the son of Sir Matthew Lamb, bart. (d. 1768), who made a large fortune out of the law, and married Miss Coke of Melbourne Hall; in 1770 he was made baron and in 1781 Viscount Melbourne in the Irish peerage, and in 1815 was created an English peer. After completing his course at Trinity College, Cambridge, William Lamb studied law at the university of Glasgow, and was called to the bar in 1804. In 1805 he married Lady Caroline Ponsonby (1785–1828), daughter of the 3rd earl of Bessborough. She was, however, separated from him in 1825. Lady Caroline Lamb acquired some fame as a novelist by her romance of *Glenarvon*, which was published anonymously in 1816 and was afterwards (1865) re-issued under the title of *The Fatal Passion*. On entering parliament in 1806 the Hon. William Lamb (as Lord Melbourne then was) joined the opposition under Fox, of whom he was an ardent admirer; but his Liberal tendencies were never decided, and he not infrequently supported Lord Liverpool during that statesman's long tenure of office. During the short ministry of Canning in 1827 he was chief secretary for Ireland, but he afterwards for a time adhered to the small remnant of the party who supported the duke of Wellington. The influence of Melbourne as a politician dates from his succeeding to the peerage in 1829. Disagreeing with the duke of Wellington on the question of parliamentary reform, he entered the ministry of Grey as home secretary in 1830. For the duties of this office at such a critical time he was deficient in insight and energy, but his political success was independent of his official capacity; and when the ministry of Grey was wrecked on the Irish question in July 1834 Melbourne was chosen to succeed him as prime minister. In November following he had to give place to a Conservative ministry under Peel; but he resumed office in April 1835, and remained prime minister till 1841. He died at Melbourne House, Derbyshire, on the 24th of November 1848.

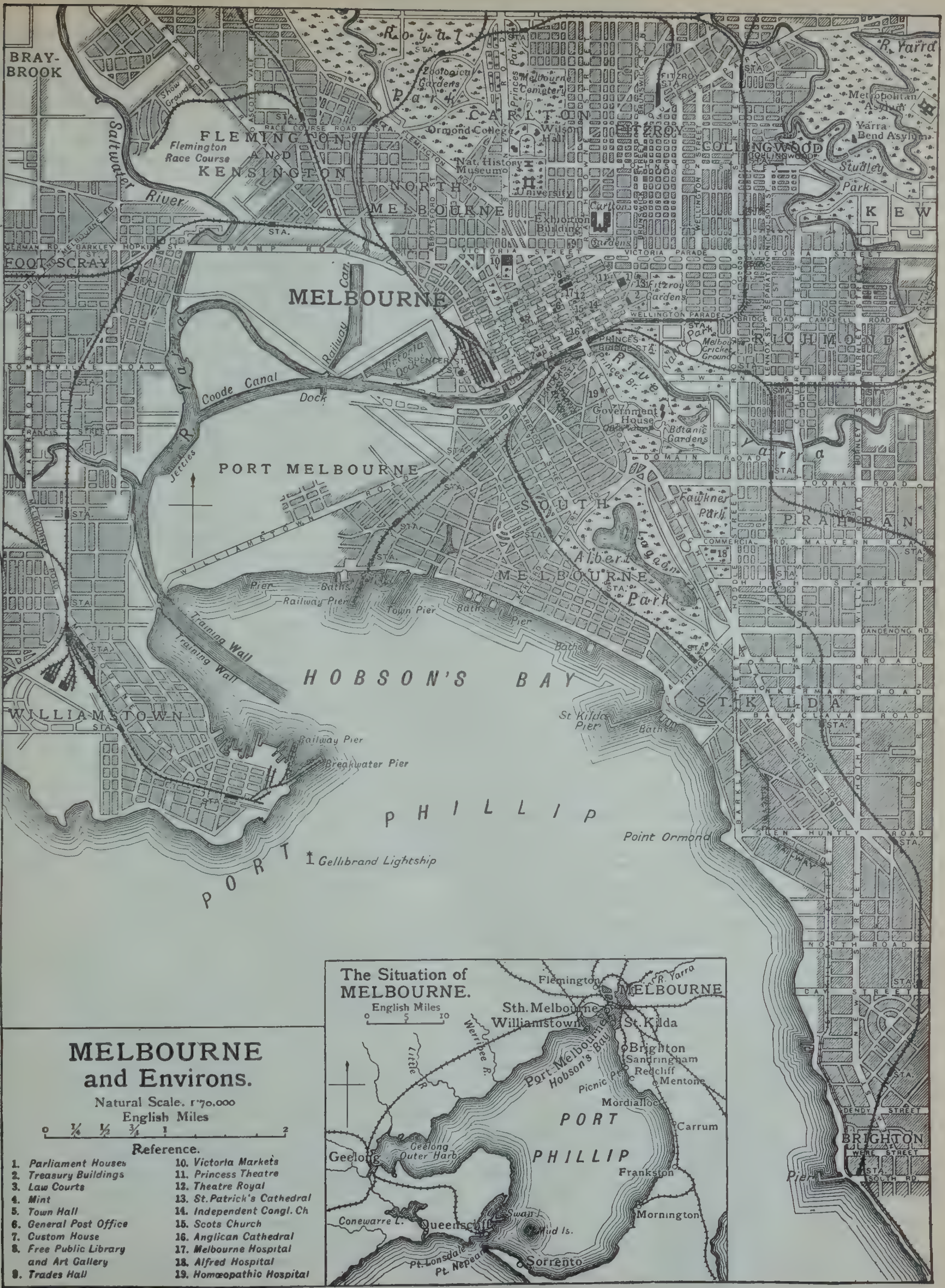
Lord Melbourne was without the qualification of attention to details, and he never displayed those brilliant talents which often form a substitute for more solid acquirements. Though he possessed a fine and flexible voice, his manner as a speaker was ineffective, and his speeches were generally ill-arranged and destitute of oratorical point. His political advancement was due to his personal popularity. He had a thorough knowledge of the private and indirect motives which influence politicians, and his genial attractive manner, easy temper and vivacious, if occasionally coarse, wit helped to confer on him a social distinction which led many to take for granted his eminence as a statesman. His favourite dictum in politics was, "Why not leave it alone?" His relations with women gave opportunity for criticism though not open scandal; but the action brought against him in 1836 by Mr George Chapple Norton in regard to the famous Mrs Caroline Norton (*q.v.*) was deservedly unsuccessful. The most notable and estimable feature of his political conduct was his relation to Queen Victoria (*q.v.*), whom he initiated into the duties of sovereign with the most delicate tact and the most paternal and conscientious care.

Melbourne was succeeded as 3rd viscount by his brother, Frederick James Lamb (1782–1853), who was British ambassador to Vienna from 1831 to 1841. On the 3rd viscount's death the titles became extinct, but the estates passed to his sister Emily Mary (1787–1869), the wife of Lord Palmerston.

See W. McC. Torrens, *Memoirs of Lord Melbourne* (1878); Lloyd Sanders, *Lord Melbourne's Papers* (1889); A. Hayward's essay (from the *Quarterly Review*, 1878) in "Eminent Statesmen" (1880).

MELBOURNE, the capital of Victoria, and the most populous city in Australia. It is situated on Hobson's Bay, a northern bend of the great harbour of Port Phillip, in Bourke county, about 500 m. S.W. of Sydney. The suburbs extend along the shores of the bay for more than 10 m., but the part distinctively known as the "city" occupies a site about 3 m inland on the north bank of the Yarra river. The appearance of Melbourne from the sea is by no means picturesque. The busy shipping suburbs of Port Melbourne and Williamstown occupy the flat alluvial land at the mouth of the Yarra. But the city itself has a different aspect; its situation is relieved by numerous gentle hills, which show up its fine public buildings to great advantage; its main streets are wide and well kept, and it has an air of prosperity, activity and comfort. The part especially known as the "city" occupies two hills, and along the valley between them runs the thoroughfare of Elizabeth Street. Parallel to this is Swanston Street, and at right angles to these, parallel to the river, are Bourke Street, Collins Street and Flinders Street—the first being the busiest in Melbourne, the second the most fashionable with the best shops, and the third, which faces the river, given up to the maritime trade. These streets are an eighth of a mile apart, and between each is a narrower street bearing the name of the wider, with the prefix "Little." The original plan seems to have been to construct these narrow streets to give access to the great business houses which, it was foreseen, would be built on the frontage of the main streets. This plan, however, miscarried, for space grew so valuable that large warehouses and business establishments have been erected in these lanes. Little Flinders Street, in which the great importers' warehouses are mainly situated, is locally known as "the Lane." In the centre of the city some of the office buildings are ten, twelve or even fourteen storeys high. The main streets are 99 ft. wide, and the lanes somewhat less than half that width. Round the city lies a circle of populous suburbs—to the north-east Fitzroy (pop. 31,687) and Collingwood (32,749), to the east Richmond (37,824), to the south-east Prahran (40,441), to the south South Melbourne (40,619), to the south-west Port Melbourne (12,176), and to the north-west North Melbourne (18,120). All these suburbs lie within 3 m. of the general post office in Elizabeth Street; but outside them and within the 5 m. radius is another circle—to the east Kew (9469) and Hawthorne (21,430), to the south-east St Kilda (20,542) and Brighton (10,047), to the south-west Williamstown (14,052) and Footscray (18,318), to the north-west Essenden (17,426), and Flemington and Kensington (10,946), and to the north Brunswick (24,141). Numerous small suburbs fill the space between the two circles, the chief being Northcote, Preston, Camberwell, Toorak, Caulfield, Elsternwick and Coburg. Some of these suburbs are independent cities, others separate municipalities. In spite of the value of land, Melbourne is not a crowded city.

The Parliament House, standing on the crown of the eastern hill, is a massive square brick building with a pillared freestone façade approached by a broad flight of steps. The interior is lavishly decorated and contains, besides the legislative chambers, a magnificent library of over 52,000 volumes. At the top of


BRAY-BROOK
Royal Park
Zoological Gardens
Melbourne Cemetery
Princes Park
Show Ground
Flemington Race Course
FLEMINGTON AND KENSINGTON
CARLTON
Ormond College
Wilson Hall
FITZROY
COLLINGWOOD
Metropolitan Asylum
Yarra Bend Asylum
R. Yarra
Studley Park
KEW
Nat. History Museum
University
NORTH MELBOURNE
Exhibition Building
Carlton Gardens
Saltwater River
FOOTSCRAY
Swamp Road
Victoria Street
Victoria Parade
MELBOURNE
Fitzroy Gardens
Wellington Parade
Bridge Road
RICHMOND
Railway Can.
Victoria Dock
Spencer St.
Princes Bridge Sta.
Yarra Park
Melbourne Cricket Ground
Coode Canal
Dock
R. Yarra
Somerville Road
Francis Street
Government House
Botanic Gardens
Domain Road
Toorak Road
PORT MELBOURNE
Jetties
SOUTH MELBOURNE
Fawkner Park
PRAHRAN
Commercial Rd.
Malvern Road
Williamstown Road
Albert Park Lagoon
Albert Park
High Street
Pier
Baths
Railway Pier
Town Pier
Training Wall
Dandenong Rd.
HOBSON'S BAY
Fitzroy St.
Inkerman Road
Balaclava Road
ST. KILDA
WILLIAMSTOWN
St Kilda Pier
Railway Pier
Breakwater Pier
PORT PHILLIP
Point Ormond
Gellibrand Lightship
Glen Huntly Road
North Road
Hotham Street
Brighton Road
Cay Street
Dendy Street
BRIGHTON
Were Street
South Rd.
Pier
STA.
The Situation of MELBOURNE
English Miles
0 5 10
Flemington
R. Yarra
MELBOURNE
Sth. Melbourne
Williamstown
St. Kilda
Port Melbourne
Hobson's Bay
Werribee R.
Little R.
Brighton
Sandringham
Redcliff
Mentone
Picnic Pt.
Mordialloc
PORT PHILLIP
Carrum
Geelong
Geelong Outer Harb.
Frankston
Conewarre L.
Queenscliff
Swan I.
Mud Is.
Mornington
Pt. Lonsdale
Pt. Nepean
Sorrento

MELBOURNE and Environs.

Natural Scale, 1:70,000

English Miles

0 ¼ ½ ¾ 1 2

Reference.

1. *Parliament Houses*
2. *Treasury Buildings*
3. *Law Courts*
4. *Mint*
5. *Town Hall*
6. *General Post Office*
7. *Custom House*
8. *Free Public Library and Art Gallery*
9. *Trades Hall*
10. *Victoria Markets*
11. *Princess Theatre*
12. *Theatre Royal*
13. *St. Patrick's Cathedral*
14. *Independent Congl. Ch*
15. *Scots Church*
16. *Anglican Cathedral*
17. *Melbourne Hospital*
18. *Alfred Hospital*
19. *Homœopathic Hospital*

Collins Street a building in brown freestone is occupied by the Treasury, behind which and fronting the Treasury Park another palatial building houses the government offices. A little further on is St Patrick's Roman Catholic cathedral, the seat of the archbishop of Melbourne, a building of somewhat sombre bluestone. Two striking churches face each other in Collins Street, the Scots church, a Gothic edifice with a lofty spire, and the Independent church, a fine Saracenic building with a massive campanile. The seat of the Anglican bishop, St Paul's cathedral, has an elegant exterior and a wealth of elaborate workmanship within, but stands low and is obscured by surrounding warehouses. On the western hill are the law courts, a fine block of buildings in classic style surmounted by a central dome. In Swanston Street there is a large building where under one roof are found the public library of over 100,000 volumes, the museum of sculpture, the art gallery, and the museums of ethnology and technology. In connexion with the art gallery there is a travelling scholarship for art students, endowed by the state. The Exhibition Buildings are situated on a hill in Carlton Gardens; they consist of a large cruciform hall surmounted by a dome and flanked by two annexes. Here on the 9th of May 1901 the first federal parliament of the Australian commonwealth was opened by King George V. (as duke of Cornwall and York). The Trades Hall at Carlton is the meeting-place of the trades-union societies of Victoria, and is the focus of much political influence. The Melbourne town hall contains a central chamber capable of accommodating 3000 people. The suburban cities and towns have each a town hall. The residence of the governor of the colony is in South Melbourne, and is surrounded by an extensive domain. The university is a picturesque mass of buildings in large grounds about a mile from the heart of the city. It comprises the university buildings proper, the medical school, the natural history museum, the Wilson Hall, a magnificent building in the Perpendicular style, and the three affiliated colleges, Trinity College (Anglican), Ormond College (Presbyterian) and Queen's College (Wesleyan). The university, established in 1855, is undenominational, and grants degrees in the faculties of arts, law, medicine, science, civil engineering and music; instruction in theology is left to the affiliated colleges. Melbourne has numerous state schools, and ample provision is made for secondary education by the various denominations and by private enterprise. Of theatres, the Princess and the Theatre Royal are the most important. Other public buildings include the mint, the observatory, the Victoria markets, the Melbourne hospital, the general post office, the homoeopathic hospital, the custom house and the Alfred hospital. Many of the commercial buildings are of architectural merit, notably the banks, of which the bank of Australasia, a massive edifice of the Doric order, and the Gothic Australian bank are the finest examples.

The public gardens and parks of Melbourne are extensive. Within the city proper the Fitzroy Gardens are a network of avenues bordered with oak, elm and plane, with a "ferntree gully" in the centre; they are ornamented with casts of famous statues, and ponds, fountains and classic temples. The Treasury, Flagstaff and Carlton Gardens are of the same class. Around the city lie five great parks—Royal Park, in which are excellent zoological gardens; Yarra Park, which contains the leading cricket grounds; the Botanical Gardens, sloping down to the banks of the river; Albert Park, in which is situated a lake much used for boating; and Studley Park on the Yarra river, a favourite resort which has been left in a natural state. Besides these parks, each suburb has its public gardens, and at Flemington there is a fine race-course, on which the Melbourne cup races are run every November, an event which brings in a large influx of visitors from all parts of Australia. Melbourne has a complete tramway system; all the chief suburbs are connected with the city by cable trams. The tramways are controlled by a trust, representing twelve of the metropolitan municipalities. The chief monuments and statues of the city are the statue of Queen Victoria in the vestibule of the Houses of Parliament, and a colossal group commemorating the explorers Robert O'Hara Bourke (b. 1820) and William John Wills (b. 1834), who died of starvation in 1861 on an expedition for the crossing of Australia from south to north. There are also the statue to Sir Redmond Barry, first chancellor of the university, outside the public library, the Gordon statue in Spring Street, a replica of that in Trafalgar Square, London, and a statue of Daniel O'Connell, outside St Patrick's cathedral.

Port Melbourne, originally called Sandridge, is about 2½ m. distant from the city, with which it is connected by rail and tramway. It has two large piers, alongside of which vessels of almost any tonnage can lie. One of these piers is served by the railway, and here most of the great liners are berthed. Vessels drawing 22 ft. of water can ascend the river Yarra to the heart of the city. There are 2 m. of wharves along each bank of the river, with two large dry-docks and ship-repairing yards and foundries. Below Queen's Bridge is an expansion of the river known as the Pool, in which the largest ships using the river can turn with ease. Leading from a point opposite the docks is the Coode canal, by means of which the journey from the city to the mouth of the river is shortened by over a mile. As a port Melbourne takes the first place in Australia as regards tonnage. It is also a great manufacturing centre, and both city and suburbs have their distinctive industries. The chief are tanning, fellmongery, wool-washing, bacon-curing, flour milling, brewing, iron-founding, brick-making, soap-boiling, the manufacture of pottery, candles, cheese, cigars, snuff, jams, biscuits, jewelry, furniture, boots, clothing and leather and woollen goods.

The climate of Melbourne is exceptionally fine; occasionally hot winds blow from the north for two or three days at a time, but the proportion of days when the sky is clear and the air dry and mild is large. Snow is unknown, and the average annual rainfall is 25·58 in. The mean annual temperature is 57·3° F., corresponding to that of Washington in the United States, and to Lisbon and Messina in Europe. The city is supplied with water from the Yan Yean works, an artificial lake at the foot of the Plenty Range, nearly 19 m. distant.

The little settlement of the year 1835, out of which Melbourne grew, at first bore the native name of Dootigala, but it was presently renamed after Viscount Melbourne, premier of Great Britain at the time of its foundation. In June 1836 it consisted of only thirteen buildings, eight of which were turf huts. For two years after that date a constant stream of squatters with their sheep flowed in from around Sydney and Tasmania to settle in the Port Phillip district, and by 1841 the population of the town had grown to 11,000. The discovery of gold at Ballarat in 1851 brought another influx of population to the district, and the town grew from 30,000 to 100,000 in the course of two or three years. In 1842 Melbourne was incorporated and first sent members to the New South Wales parliament. A strong popular agitation caused the Port Phillip district to be separated from New South Wales in 1851, and a new colony was formed with the name of Victoria, Melbourne becoming its capital. In 1901 Melbourne became the temporary capital of the Australian commonwealth pending the selection of the permanent capital in New South Wales. The population of the city proper in 1901 was 68,374, and that of "greater Melbourne" was 496,079.

MELBOURNE, a market town in the southern parliamentary division of Derbyshire, England, 8 m. S.S.E. of Derby, on the Midland railway. Pop. (1901), 3580. It lies in an undulating district on a small southern tributary of the Trent, from which it is about 2 m. distant. The church of St Michael is a fine example of Norman work, with certain late details, having clerestoried nave, chancel and aisles, with central and two western towers. Melbourne Hall, a building of the time of William III., surrounded by formal Dutch gardens, stands in a domain owned at an early date by the bishops of Carlisle, whose tithe barn remains near the church. They obtained the manor in 1133. In 1311 Robert de Holland fortified a mansion here, and in 1327 this castle belonged to Henry, earl of Lancaster; but it was dismantled in 1460, and little more than the site is now traceable. The title of Viscount Melbourne was taken from this town. There are manufactures of silk, and boots and shoes.

MELCHERS, (JULIUS) GARI (1860–), American artist, was born at Detroit, Michigan, on the 11th of August 1860. The son of a sculptor, at seventeen he was sent to Düsseldorf to study art under von Gebhardt, and after three years went to Paris, where he worked at the Académie Julien and the École des Beaux Arts. Attracted by the pictorial side of Holland, he settled at Egmond. His first important Dutch picture, "The Sermon," brought him honourable mention at the Paris Salon of 1886. He became a member of the National Academy of Design, New York; the Royal Academy of Berlin; Société Nationale des Beaux Arts, Paris; International Society of Painters, Sculptors and Engravers, London, and the Secession Society, Munich; and, besides receiving a number of medals, his decorations include the Legion of Honour, France; the order of the Red Eagle, Germany; and knight of the Order of St Michael, Bavaria. Besides portraits, his chief works are: "The Supper at Emmaus," in the Krupp collection at Essen; "The Family," National Gallery, Berlin; "Mother and Child," Luxembourg; and the decoration, at the Congressional Library, Washington, "Peace and War."

MELCHIADES, or MILTIADES (other forms of the name being Meltiades, Melciades, Milciades and Miltides), pope from the 2nd of July 310, to the 11th January 314. He appears to have been an African by birth, but of his personal history nothing is known. The toleration edicts of Galerius and of Constantine and Licinius were published during his pontificate, which was also marked by the holding of the Lateran synod in Rome (313) at which Caecilianus, bishop of Carthage, was acquitted of the charges brought against him and Donatus condemned. Melchiades was preceded and followed by Eusebius and Silvester I. respectively.

MELCHITES (lit. Royalists, from Syriac *melcha*, a king), the name given in the 5th century to those Christians who adhered to the creed supported by the authority of the Byzantine emperor. The Melchites therefore are those who accept the decrees of Ephesus and Chalcedon as distinguished from the Nestorians and Jacobite Church (*qq.v.*). They follow the Orthodox Eastern liturgy, ceremonial and calendar, but acknowledge the papal and doctrinal authority of Rome. They number about 80,000, are found in Syria, Palestine and Egypt, and are under the immediate rule of the patriarch of Damascus and twelve bishops.

MELCHIZEDEK (Heb. for "king of righteousness"; or, since Ṣedeḳ is probably the name of a god, "Ṣedeḳ is my king"),[1] king of Salem and priest of "supreme El" (*El ʿelyon*), in the Bible. He brought forth bread and wine to Abraham on his return from the expedition against Chedorlaomer, and blessed him in the name of the supreme God, possessor (or maker) of heaven and earth; and Abraham gave him tithes of all his booty (Gen. xiv. 18–20). Biblical tradition tells us nothing more about Melchizedek (cf. Heb. vii. 3); but the majestic figure of the king-priest, prior to the priesthood of the law, to whom even the father of all Israel paid tithes (cf. Jacob at Bethel, Gen. xxviii. 22), suggested a figurative or typical application, first in Psalm cx. to the vicegerent of Yahweh, seated on the throne of Zion, the king of Israel who is also priest after the order of Melchizedek, and then, after the Gospel had ensured the Messianic interpretation of the Psalm (Matt. xxii. 42 seq.), to the kingly priesthood of Jesus, as that idea is worked out at length in the Epistle to the Hebrews.

The theological interest which attaches to the idea of the pre-Aaronic king-priest in these typical applications is practically independent of the historical questions suggested by the narrative of Gen. xiv. The episode of Melchizedek, though connected with the main narrative by the epithets given to Yahweh in Gen. xiv. 22, breaks the natural connexion of verses 17 and 21, and may perhaps have come originally from a separate source. As the narrative now stands Salem must be sought in the vicinity of "the king's dale," which from 2 Sam. xviii. 18, probably, but not necessarily, lay near Jerusalem. That Salem is Jerusalem, as in Psalm lxxvi. 2, is the ancient and common view; but even in the 15th century B.C. Jerusalem was known as Uru-salim. Jerome and others have identified Salim with one or other of the various places which bear that name, *e.g.* the Σαλείμ of John iii. 23, 8 m. south of Beth-shean. In a genuine record of extreme antiquity the union of king and priest in one person, the worship of El as the supreme deity by a Canaanite,[2] and the widespread practice of the consecration of a tithe of booty can present no difficulty; but, if the historical character of the narrative is denied, the date of the conception must be placed as late as the rise of the temporal authority of the high priests after the exile. So far no evidence has been found in the cuneiform inscriptions or elsewhere in support either of the genuineness of the episode in its present form, or of the antiquity which is attributed to it (see further, J. Skinner, *Genesis*, pp. 269 sqq.). An ancient legend identifies Melchizedek with Shem (Palestinian Targum, Jerome on Isa. xli., Ephraem Syrus *in loco*).

See further the literature on Gen. xiv., and the articles ABRAHAM, GENESIS. (W. R. S.; S. A. C.)

MELCOMBE, GEORGE BUBB DODDINGTON, BARON (1691–1762), English politician. His father's name was Bubb, but the son took the name of Doddington on inheriting a large property by the death of an uncle of that name (1720). He was educated at Oxford. In 1715 he was returned to parliament as member for Winchelsea, and was sent as envoy extraordinary to Spain. He carried on a scandalous traffic in the five or six parliamentary votes which he controlled, his tergiversation and venality furnishing food for the political satirists and caricaturists of the day. His most estimable political action was his defence of Admiral Byng in the House of Commons (1757). From 1722 to 1754 he sat in parliament for Bridgewater; from 1724 to 1740 was a lord of the treasury; and, in 1744, became treasurer of the navy under Henry Pelham, and, again in 1755, under Newcastle and Fox. In April 1761 he was raised to the peerage as Baron Melcombe of Melcombe Regis in Dorsetshire. He died at La Trappe, his Hammersmith house, on the 28th of July 1762. His wife, acknowledged only after the death of another lady to whom he had given a bond that he would marry no one else, died without issue. He was a wit and a friend of wits, a good scholar, and something of a Maecenas; Thomson's "Summer" was dedicated to him, Fielding addressed to him an epistle and Edward Young a satire. He was a leading spirit of the "Hell-fire" Club, whose members, called "Franciscans," from their founder Sir Francis Dashwood (d. 1781), held their revels in the ruined Cistercian abbey of Medmenham, Bucks.

His diary, published in 1784, reveals him in his character of place-hunter and throws a curious light on the political methods of the time.

MELEAGER (Gk. Μελέαγρος), in Greek legend, the son of Oeneus, king of Calydon, and Althaea. His father having neglected to sacrifice to Artemis, she sent a wild boar to ravage the land, which was eventually slain by Meleager. A war broke out between the Calydonians and Curetes (led by Althaea's brothers) about the disposal of the head and skin, which Meleager awarded as a prize to Atalanta, who had inflicted the first wound; the brothers of Althaea lay in wait for Atalanta and robbed her of the spoils, but were slain by Meleager. When Althaea heard this, she cursed Meleager, who withdrew, and refused to fight until the Curetes were on the point of capturing the city of Calydon. Then, yielding to his wife's entreaties, he sallied forth and defeated the enemy, but was never seen again, having been carried off by the Erinyes, who had heard his mother's curse (or he was slain by Apollo in battle). According to a later tradition, not known to Homer, the Moerae appeared to Althaea when Meleager was seven days old, and announced that the child would only live as long as the log blazing on the hearth remained unconsumed. Althaea thereupon seized the log, extinguished the flames, and hid it in a box. But, after her brothers' death, she relighted the log, and let it burn away until Meleager died.[3] Then, horrified at what she had done, she hanged herself, or died of grief. The sisters of Meleager were changed by Artemis out of compassion into guinea fowls and removed to the island of Leros, where they mourned part of the year for their brother. The life and adventures of Meleager were a favourite subject in ancient literature and art. Meleager is represented as a tall, vigorous youth with curly hair, holding a javelin or a boar's head, and accompanied by a dog.

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[1] It is to be noted also that the name is of the same form as Adoni-zedek, king of Jerusalem (Josh. x. 1), and that the un-Hebraic Araunah of 2 Sam. xxiv. 16 is probably a corruption of the similar compound Adonijah (so Cheyne, *Ency. Bib.* col. 290).

[2] The god Ἐλιοῦν was also Phoenician; see Driver, *Genesis*, p. 165; Lagrange, *Religions Sémitiques*, Index, *s.v.*

[3] On the torch as representing the light of life, see E. Kuhnert in *Rheinisches Museum*, xlix., 1894, and J. Grimm, *Teutonic Mythology* (Eng. trans. by J. Stallybrass, 1880), ii. 853.

See R. Kekulé, *De fabula meleagrea dissertatio* (1861); Surber, *Die Meleagersage* (Zürich, 1880); articles on "Meleager" and "Meleagrides" in Roscher's *Lexikon der Mythologie*; L. Preller, *Griechische Mythologie*; Apollodorus i. 8; Homer, *Iliad*, ix. 527; Diod. Sic. iv. 34; Dio Chrysostom, *Or.* 67; Hyginus, *Fab.* 171; Ovid, *Metam.* viii. 260–545. In the article GREEK ART (fig. 41) the hunting of the Calydonian boar is represented on a fragment of a frieze from a heroum.

MELEDA (Serbo-Croatian, *Mljet*; Lat. *Melita*), the most southerly and easterly of the larger Adriatic islands of the Austrian province of Dalmatia. Pop. (1900), 1617. Meleda lies south of the Sabioncello promontory, from which it is divided by the Meleda Channel. Its length is 23 m.; its average breadth 2 m. It is of volcanic origin, with numerous chasms and gorges, of which the longest, the Babinopolje, connects the north and south of the island. Port Palazzo, the principal harbour, on the north, is a port of call for tourist steamers. Meleda has been regarded as the Melita on which St Paul was shipwrecked, this view being first expounded, in the 10th century, by Constantine Porphyrogenitus. As at Malta, a "St Paul's Bay" is still shown.

MELEGNANO (formerly *Marignano*), a town of Lombardy, Italy, in the province of Milan, 11 m. S.E. of that city by the railway to Piacenza, 289 ft. above sea-level. Pop. (1901), 6782. There are remains of a castle of the Visconti. Its military importance is due to its position at the crossing of the river Lambro. It was a stronghold of Milan in her great struggle against Lodi, and is famous for the victory of Francis I. of France over the Swiss in 1515, known as the battle of Marignan, and for the action between the French and Austrians in 1859.

MELENDEZ VALDÉS, JUAN (1754–1817), Spanish poet, was born at Ribera del Fresno, Badajoz, on the 11th of March 1754. Destined by his parents for the priesthood, he graduated in law at Salamanca, where he became indoctrinated with the ideas of the French philosophical school. In 1780 with *Batilo*, a pastoral in the manner of Garcilaso de la Vega, he won a prize offered by the Spanish academy; next year he was introduced to Jovellanos, through whose influence he was appointed to a professorship at Salamanca in 1783. The pastoral scenes in *Las Bodas de Camacho* (1784) do not compensate for its undramatic nature, but it gained a prize from the municipality of Madrid. A volume of verses, lyrical and pastoral, published in 1785, caused Melendez Valdés to be hailed as the first Spanish poet of his time. This success induced him to resign his chair at Salamanca, and try his fortune in politics. Once more the friendship of Jovellanos obtained for him in 1789 a judgeship at Saragossa, whence he was transferred two years later to a post in the chancery court at Valladolid. In 1797 he dedicated to Godoy an enlarged edition of his poems, the new matter consisting principally of unsuccessful imitations of Milton and Thomson; but the poet was rewarded by promotion to a high post in the treasury at Madrid. On the fall of Jovellanos in 1798 Melendez Valdés was dismissed and exiled from the capital; he returned in 1808 and accepted office under Joseph Bonaparte. He had previously denounced the French usurper in his verses. He now outraged the feelings of his countrymen by the grossest flattery of his foreign master, and in 1813 he fled to Alais. Four years later he died in poverty at Montpellier. His remains were removed to Spain in 1900. In natural talent and in acquired accomplishment Melendez Valdés was not surpassed by any contemporary Spaniard; he failed from want of character, and his profound insincerity affects his poems. Yet he has fine moments in various veins, and his imitation of Jean Second's *Basia* is notable.

MELETIUS OF ANTIOCH (d. 381), Catholic bishop and saint, was born at Melitene in Lesser Armenia of wealthy and noble parents. He first appears (*c.* 357) as a supporter of Acacius, bishop of Caesarea, the leader of that party in the episcopate which supported the *Homoean* formula by which the emperor Constantius sought to effect a compromise between the Homoeusians and the Homousians. Meletius thus makes his début as an ecclesiastic of the court party, and as such became bishop of Sebaste in succession to Eustathius, deposed as an Homousian heretic by the synod of Melitene. The appointment was resented by the Homoeusian clergy, and Meletius retired to Beroea. According to Socrates he attended the synod of Seleucia in the autumn of 359, and then subscribed the Acacian formula. Early in 360 he became bishop of Antioch, in succession to Eudoxius, who had been raised to the see of Constantinople. Early in the following year he was in exile. According to an old tradition, supported by evidence drawn from Epiphanius and Chrysostom, this was due to a sermon preached before the emperor Constantius, in which he revealed Homousian views. This explanation, however, is rejected by Loofs; the sermon contains nothing inconsistent with the Acacian position favoured by the court party; on the other hand, there is evidence of conflicts with the clergy, quite apart from any questions of orthodoxy, which may have led to the bishop's deposition.

The successor of Meletius was Euzoeus, who had fallen with Arius under the ban of Athanasius; and Loofs explains the *subita fidei mutatio* which St Jerome (*ann. Abr.* 2376) ascribes to Meletius to the dogmatic opposition of the deposed bishop to his successor. In Antioch itself Meletius continued to have adherents, who held separate services in the "Apostolic" church in the old town. The Meletian schism was complicated, moreover, by the presence in the city of another anti-Arian sect, stricter adherents of the Homousian formula, maintaining the tradition of the deposed bishop Eustathius and governed at this time by the presbyter Paulinus. The synod of Alexandria sent deputies to attempt an arrangement between the two anti-Arian Churches; but before they arrived Paulinus had been consecrated bishop by Lucifer of Calaris, and when Meletius—free to return in consequence of the emperor Julian's contemptuous policy—reached the city, he found himself one of three rival bishops. Meletius was now between two stools. The orthodox Nicene party, notably Athanasius himself, held communion with Paulinus only; twice, in 365 and 371 or 372, Meletius was exiled by decree of the Arian emperor Valens. A further complication was added when, in 375, Vitalius, one of Meletius's presbyters, was consecrated bishop by the heretical bishop Apollinaris of Laodicea.

Meanwhile, under the influence of his situation, Meletius had been more and more approximating to the views of the newer school of Nicene orthodoxy. Basil of Caesarea, throwing over the cause of Eustathius, championed that of Meletius who, when after the death of Valens he returned in triumph to Antioch, was hailed as the leader of Eastern orthodoxy. As such he presided, in October 379, over the great synod of Antioch, in which the dogmatic agreement of East and West was established; it was he who helped Gregory of Nazianzus to the see of Constantinople and consecrated him; it was he who presided over the second oecumenical council at Constantinople in 381. He died soon after the opening of the council, and the emperor Theodosius, who had received him with especial distinction, caused his body to be carried to Antioch and buried with the honours of a saint. The Meletian schism, however, did not end with his death. In spite of the advice of Gregory of Nazianzus and of the Western Church, the recognition of Paulinus's sole episcopate was refused, Flavian being consecrated as Meletius's successor. The Eustathians, on the other hand, elected Evagrius as bishop on Paulinus's death, and it was not till 415 that Flavian succeeded in re-uniting them to the Church.

Meletius was a holy man, whose ascetic life was all the more remarkable in view of his great private wealth. He was also a man of learning and culture, and widely esteemed for his honourable, kindly and straightforward character. He is venerated as a saint and confessor in both the Roman Catholic and Orthodox Eastern Churches.

See the article G. F. Loofs in Herzog-Hauck, *Realencyklopädie* (ed. 1897, Leipzig), xii. 552, and authorities there cited.

MELETIUS OF LYCOPOLIS (4th century), founder of the sect known after him as the "Meletians," or as the "Church of the Martyrs," in the district of Thebes in Egypt. With Peter, archbishop of Alexandria, he was thrown into prison during the persecution under Diocletian. His importance is due to his refusal to receive, at least until the persecution had ceased, those Christians who during the persecutions had renounced their faith, and then repented. This refusal led to a breach with Peter, and other Egyptian bishops who were willing to grant absolution to those who were willing to do penance for their infidelity. Meletius, after regaining his freedom, held his ground and drew around him many supporters, extending his influence even so far away as Palestine. He ordained 29 bishops and encroached upon Peter's jurisdiction. The Council of Nicaea in 325 upheld the bishops, but Meletius was allowed to remain bishop of Lycopolis though with merely nominal authority. His death followed soon after. His followers, however, took part with the Arians in the controversy with Athanasius and existed as a separate sect till the 5th century.

See Achelis in Herzog-Hauck, *Realencyk.* xii. (1903) 558, with the authorities there quoted, and works on Church History.

MELFI, a city and episcopal see of Basilicata, Italy, in the province of Potenza, 30 m. by rail N. of the town of that name. Melfi is picturesquely situated on the lower slopes of Monte Vulture, 1591 ft. above sea-level. Pop. (1901), 14,547. The castle was originally erected by Robert Guiscard, but as it now stands it is mainly the work of the Doria family, who have possessed it since the time of Charles V.; and the noble cathedral which was founded in 1153 by Robert's son and successor, Roger, has had a modern restoration (though it retains its campaniles) in consequence of the earthquake of 1851, when the town was ruined, over one thousand of the inhabitants perishing. It is the centre of an agricultural district which produces oil and wine. In the town hall is a fine Roman sarcophagus found 6 m. W. of Venosa.

Melfi does not seem to occupy an ancient site, and its origin is uncertain. By the Normans it was made the capital of Apulia in 1041, and fortified. The council held by Nicholas I. in 1059, that of Urban II. in 1089, the rebellion against Roger in 1133 and the subsequent punishment, the plunder of the town by Barbarossa in 1167, the attack by Richard, count of Acerra in 1190, and the parliament of 1223, in which Frederick II. established the constitution of the kingdom of Naples, form the principal points of interest in the annals of Melfi. In 1348 Joanna I. of Naples bestowed the city on Niccolo Acciajuoli; but it was shortly afterwards captured, after a six months' siege, by the king of Hungary, who transferred it to Conrad the Wolf. In 1392 Goffredo Marzano was made count of Melfi; but Joanna II. granted the lordship to the Caracciolo family, and they retained it for one hundred and seven years till the time of Charles V. An obstinate resistance was offered by the city to Lautrec de Foix in 1528; and his entrance within its walls was followed by the massacre, it is said, of 18,000 of its citizens.

See G. de Lorenzo, *Venosa e la regione del Vulture* (Bergamo, 1906).

MELICERTES, in Greek legend, the son of the Boeotian prince Athamas and Ino, daughter of Cadmus. Ino, pursued by her husband, who had been driven mad by Hera because Ino had brought up the infant Dionysus, threw herself and Melicertes into the sea from a high rock between Megara and Corinth. Both were changed into marine deities—Ino as Leucothea, Melicertes as Palaemon. The body of the latter was carried by a dolphin to the Isthmus of Corinth and deposited under a pine tree. Here it was found by his uncle Sisyphus, who had it removed to Corinth, and by command of the Nereids instituted the Isthmian games and sacrifices in his honour. There seems little doubt that the cult of Melicertes was of foreign, probably Phoenician, origin, and introduced by Phoenician navigators on the coasts and islands of the Aegean and Mediterranean. He is a native of Boeotia, where Phoenician influences were strong; at Tenedos he was propitiated by the sacrifice of children, which seems to point to his identity with Melkart. The premature death of the child in the Greek form of the legend is probably an allusion to this.

The Romans identified Palaemon with Portunus (the harbour god). No satisfactory origin of the name Palaemon has been given. It has been suggested that it means the "wrestler" or "struggler" (παλαίω) and is an epithet of Heracles, who is often identified with Melkart, but there does not appear to be any traditional connexion between Heracles and Palaemon. Melicertes being Phoenician, Palaemon also has been explained as the "burning lord" (Baal-haman), but there seems little in common between a god of the sea and a god of fire.

See Apollodorus iii. 4, 3; Ovid, *Metam.* iv. 416–542, *Fasti*, vi. 485; Hyginus, *Fab.* 2; Pausanias i. 44, ii. 1; Philostratus, *Icones*, ii. 16; articles by Toutain in Daremberg and Saglio's *Dictionnaire des antiquités* and by Stoll in Roscher's *Lexikon der Mythologie*; L. Preller, *Griechische Mythologie*; R. Brown, *Semitic Influence in Hellenic Mythology* (1898).

MELILLA, a Spanish fortified station and penal settlement on the north coast of Morocco, south of Cape Tres Forcas and 135 m. E.S.E. of Ceuta. Pop. about 9000. The town is built on a huge rock connected with the mainland by a rocky isthmus. There is a harbour, only accessible to small vessels; the roadstead outside is safe and has deep water a mile to the east of the fortress. From the landing-place, where a mole is cut out of the rock, there is a steep ascent to the upper town, characteristically Spanish in appearance. The town is walled, and the isthmus protected by a chain of small forts. A Moorish custom-house is placed on the Spanish border beyond the fort of Santa Isabel, and is the only authorized centre of trade on the Riff coast between Tetuan and the Algerian frontier. It thus forms the entrepôt for the commerce of the Riff district and its hinterland. Goat skins, eggs and beeswax are the principal exports, cotton goods, tea, sugar and candles being the chief imports. For the period 1900–1905 the annual value of the trade was about £200,000. Melilla, the first place captured by Spain on the African mainland, was seized from the Moors in 1490. The Spaniards have had much trouble with the neighbouring tribes—turbulent Riffians, hardly subject to the sultan of Morocco. The limits of the Spanish territory round the fortress were fixed by treaties with Morocco in 1859, 1860, 1861 and 1894. In 1893 the Riffians besieged Melilla and 25,000 men had to be despatched against them. In 1908 two companies, under the protection of El Roghi, a chieftain then ruling the Riff region, started mining lead and iron some 15 m. from Melilla and a railway to the mines was begun. In October of that year the Riffians revolted from the Roghi and raided the mines, which remained closed until June 1909. On the 9th of July the workmen were again attacked and several of them killed. Severe fighting between the Spaniards and the tribesmen followed. The Riffians having submitted, the Spaniards, in 1910, restarted the mines and undertook harbour works at Mar Chica.

See Budgett Meakin, *The Land of the Moors* (London, 1901), ch. xix., and the authorities there cited; P. Barré, "Melilla et les présides espagnols," *Rev. française* (1908).

MÉLINE, FÉLIX JULES (1838–), French statesman, was born at Remiremont on the 20th of May 1838. Having adopted the law as his profession, he was chosen a deputy in 1872, and in 1879 he was for a short time under-secretary to the minister of the interior. In 1880 he came to the front as the leading spokesman of the party which favoured the protection of French industries, and he had a considerable share in fashioning the protectionist legislation of the years 1890–1902. From 1883 to 1885 Méline was minister for agriculture, and in 1888–1889 he was president of the Chamber of Deputies. In 1896 he became premier (*président du conseil*) and minister for agriculture, offices which he vacated in 1898. At one time he edited *La République française*, and after his retirement from public life he wrote *Le Retour à la terre et la surproduction industrielle, tout en faveur de l'agriculture* (1905).

MÉLINGUE, ÉTIENNE MARIN (1808–1875), French actor and sculptor, was born in Caen, the son of a volunteer of 1792. He early went to Paris and obtained work as a sculptor on the church of the Madeleine, but his passion for the stage soon led him to join a strolling company of comedians. Finally chance gave him an opportunity to show his talents, and at the Porte Saint Martin he became the popular interpreter of romantic drama of the Alexandre Dumas type. One of his greatest successes was as Benvenuto Cellini, in which he displayed his ability both as an actor and as a sculptor, really modelling before the eyes of the audience a statue of Hebe. He sent a number of statuettes to the various exhibitions, notably one of Gilbert Louis Duprez as William Tell. Melingue's wife, Théodorine Thiesset (1813–1886), was the actress selected by Victor Hugo to create the part of Guanhumara in *Burgraves* at the Comédie Française, where she remained ten years.

See Dumas, *Une Vie d'artiste* (1854).

MELIORISM (Lat. *melior*, better), in philosophy, a term given to that view of the world which believes that at present the sum of good exceeds the sum of evil and that, in the future, good will continually gain upon evil. The term is said to have been invented by George Eliot to express a theory mediating between optimism and pessimism. The pragmatic movement in philosophy which puts stress upon the duty and value of effort is naturally favourable to the melioristic view: the best things that have been said recently in favour of it are found in books such as William James's *Pragmatism*.

MELISSUS OF SAMOS, Greek philosopher of the Eleatic School (*q.v.*), was born probably not later than 470 B.C. According to Diogenes Laërtius, ix. 24, he was not only a thinker, but also a political leader in his native town, and was in command of the fleet which defeated the Athenians in 442. The same authority says he was a pupil of Parmenides and of Heraclitus, but the statement is improbable, owing to discrepancy in dates. His works, fragments of which are preserved by Simplicius and attested by the evidence of Aristotle, are devoted to the defence of Parmenides' doctrine. They were written in Ionic and consist of long series of argument. Being, he says, is eternal. It cannot have had a beginning because it cannot have begun from not-being (cf. *ex nihilo nihil*), nor from being (*εἴη γὰρ ἂν οὕτω καὶ οὐ γένοιτο*). It cannot suffer destruction; it is impossible for being to become not being, and if it became another being, there would be no destruction. According to Simplicius (*Physica*, f. 22b), he differed here from Parmenides in distinguishing being and absolute being (*τὸ ἁπλῶς ἐόν*). He goes on to show that eternal being must also be unlimited in magnitude, and, therefore, one and unchangeable. Any change whether from internal or external source, he says, is unthinkable; the One is unvarying in quantity and in kind. There can be no division inside this unity, for any such division implies space or void; but void is nothing, and, therefore, is not. It follows further that being is incorporeal, inasmuch as all body has size and parts. The fundamental difficulty underlying this logic is the paradox more clearly expressed by Zeno and to a large extent represented in almost all modern discussion, namely that the evidence of the senses contradicts the intellect. Abstract argument has shown that change in the unity is impossible; yet the senses tell us that hot becomes cold, hard becomes soft, the living dies, and so on. From a comparison of Melissus with Zeno of Elea, it appears that the spirit of dialectic was already tentatively at work, though it was not conscious of its own power. Neither Melissus nor Zeno seems to have observed that the application of these destructive methods struck at the root not only of multiplicity but also of the One whose existence they maintained. The weapons which they forged in the interests of Parmenides were to be used with equal effect against themselves.

See Ritter and Preller, §§ 159–166; Brandis, *Commentationum eleaticarum*, pt. 1, p. 185; Mullach, *Aristotelis de Melisso, Xenophane, Gorgia*; Pabst, *De Melissi samii fragmentis* (Bonn, 1889), and histories of philosophy.

MELITO, bishop of Sardis, a Christian writer of the 2nd century, mentioned by Eusebius (*Hist. Eccl.* iv. 21) along with Hegesippus, Dionysius of Corinth, Apollinaris of Hierapolis, Irenaeus, and others, his contemporaries, as a champion of orthodoxy and upholder of apostolic tradition. Of his personal history nothing is known, and of his numerous works (which are enumerated—with quotations—by Eusebius) only a few fragments are extant. They included an *Apologia* addressed to Antoninus some time between A.D. 169 and 180, two books relating to the paschal controversy, and a work entitled *Ἐκλογαί* (selections from the Old Testament), which contained the first Christian list of "the books of the Old Covenant." It excludes Esther, Nehemiah and the Apocrypha. The fragments have been edited with valuable notes by Routh (*Reliquiae sacrae*, vol. i., 1814). These are sufficient to show that Melito was an important figure in Asia Minor and took much part in the paschal, Marcionite and Montanist controversies.

It seems more than doubtful whether the *Apologia* of Melito "the Philosopher," discovered in a Syriac translation by Henry Tattam (1789–1868), and subsequently edited by W. Cureton and by Pitra-Renan, ought to be attributed to this writer and not to another of the same name. The *Κλεὶς* (clavis), edited by Pitra-Renan, is a much later Latin collection of mystical explanations of Scripture.

See A. Harnack, *Texte und Untersuchungen*, i. 240–278 (Leipzig, 1882); Erwin Preuschen, *s.v.* "Melito" in Herzog-Hauck, *Realencyklopädie*, xii., 1903, giving full list of works and bibliography.

MELKSHAM, a market town in the Westbury parliamentary division of Wiltshire, England, $95\frac{1}{4}$ m. W. of London by the Great Western railway. Pop. of urban district (1901), 2450. It lies in a valley sheltered by steep chalk hills on the east, its old-fashioned stone houses lining a single broad street, which crosses the Upper Avon by a bridge of four arches. The church preserves some remnants of Norman work and a Perpendicular south chapel of rare beauty. Melksham possesses cloth-mills where coco-nut fibre and hair cloth are woven, flour-mills and dye-works. On the discovery of a saline spring in 1816, baths and a pump-room were opened, but although two other springs were found later, the attempt to create a fashionable health resort failed. The surrounding deer-forest was often visited by Edward I. Lacock Abbey, 3 m. distant, was founded in 1232 for Austin canonesses, and dissolved in 1539. Portions of the monastic buildings remain as picturesque fragments in and near the modern mansion called Lacock Abbey.

MELLE, a town of western France, capital of an arrondissement in the department of Deux-Sèvres, on the left bank of the Béronne, 21 m. E.S.E. of Niort by rail. Pop. (1906), 2231. Melle has two churches in the Romanesque style of Poitou, St Pierre and St Hilaire, the latter ornamented with sculptured arcading. The hospital has a richly carved doorway of the 17th century. The church of St Savinien (11th century) serves as a prison. The town has trade in farm-produce, mules and other live stock; distilling is carried on. Melle (*Metallum*) derives its name from the lead mine worked here during the Roman occupation and in the early middle ages. At the latter period it had a mint. In later times it was a possession of the counts of Maine.

MELLITIC ACID (benzene hexacarboxylic acid), $C_6(COOH)_6$, was first discovered in 1799 by M. H. Klaproth in the mineral honeystone, which is the aluminium salt of the acid. The acid may be prepared by warming honeystone with ammonium carbonate, boiling off the excess of the ammonium salt and adding ammonia to the solution. The precipitated alumina is filtered off, the filtrate evaporated and the ammonium salt of the acid purified by recrystallization. The ammonium salt is then converted into the lead salt by precipitation with lead acetate and the lead salt decomposed by sulphuretted hydrogen.

The acid may also be prepared by the oxidation of pure carbon, or of hexamethyl benzene, in the cold, by alkaline potassium permanganate (F. Schulze, *Ber.*, 1871, 4, p. 802; C. Friedel and J. M. Crafts, *Ann. chim. phys.*, 1884 [6], 1, p. 470). It crystallizes in fine silky needles and is soluble in water and alcohol. It is a very stable compound, chlorine, concentrated nitric acid and hydriodic acid having no action upon it. It is decomposed, on dry distillation, into carbon dioxide and pyromellitic acid, $C_{10}H_6O_8$; when distilled with lime it gives carbon dioxide and benzene. Long digestion of the acid with excess of phosphorus pentachloride results in the formation of the acid chloride, $C_6(COCl)_6$, which crystallizes in needles, melting at 190° C. By heating the ammonium salt of the acid to 150–160° C. as long as ammonia is evolved, a mixture of *paramide* (mellimide), $C_6\left(\begin{matrix}\mathrm{CO}\\ \mathrm{CO}\end{matrix}>\mathrm{NH}\right)_3$, and ammonium euchroate is obtained. The mixture may be separated by dissolving out the ammonium euchroate with water. Paramide is a white amorphous powder, insoluble in water and alcohol.

MELLITUS (d. 624), bishop of London and archbishop of Canterbury, was sent to England by Pope Gregory the Great in 601. He was consecrated by St Augustine before 604, and a church was built for him in London by Aethelberht, king of Kent; this church was dedicated to St Paul, and Mellitus became first bishop of London. About ten years later the East Saxons reverted to heathenism and the bishop was driven from his see. He took refuge in Kent and then in Gaul, but soon returned to England, and in 619 became archbishop of Canterbury in succession to Laurentius. He died on the 24th of April 624.

MELLONI, MACEDONIO (1798–1854), Italian physicist, was born at Parma on the 11th of April 1798. From 1824 to 1831 he was professor at Parma, but in the latter year he was compelled to escape to France, having taken part in the revolution. In 1839 he went to Naples and was soon appointed director of the Vesuvius observatory, a post which he held until 1848. Melloni received the Rumford medal of the Royal Society in 1834. In 1835 he was elected correspondent of the Paris Academy, and in 1839 a foreign member of the Royal Society. He died at Portici near Naples of cholera on the 11th of August 1854. Melloni's reputation as a physicist rests especially on his discoveries in radiant heat, made with the aid of the thermomultiplier or combination of thermopile and galvanometer, which, soon after the discovery of thermoelectricity by T. J. Seebeck, was employed by him jointly with L. Nobili in 1831. His experiments were especially concerned with the power of transmitting dark heat possessed by various substances and with the changes produced in the heat rays by passage through different materials. Substances which were comparatively transparent to heat he designated by the adjective "diathermane," the property being "diathermanéïté," while for the heat-tint or heat-coloration produced by passage through different materials he coined the word "diathermansie." In English, however, the terms were not well understood, and "diathermancy," was generally used as the equivalent of "diathermanéïté." In consequence Melloni about 1841 began to use "diathermique" in place of "diathermane," "diathermasie" in place of "diathermanéïté," and "thermocrose" for "diathermansie." His most important book, *La thermocrose ou la coloration calorifique* (vol. i., Naples, 1850), was unfinished at his death. He studied the reflection and polarization of radiant heat, the magnetism of rocks, electrostatic induction, daguerrotypy, &c.

MELODRAMA (a coined word from Gr. μέλος, music, and δρᾶμα, action), the name of several species of dramatic composition. As the word implies, "melodrama" is properly a dramatic mixture of music and action, and was first applied to a form of dramatic musical composition in which music accompanied the spoken words and the action, but in which there was no singing. The first example of such a work has generally been taken to be the *Pygmalion* of J. J. Rousseau, produced in 1775. This is the source of romantic dramas depending on sensational incident with exaggerated appeals to conventional sentiment rather than on play of character, and in which *dramatis personae* follow conventional types—the villain, the hero wrongfully charged with crime, the persecuted heroine, the adventuress, &c. At first the music was of some importance, forming practically a running accompaniment suitable to the situations—but this has gradually disappeared, and, if it remains, is used mainly to emphasize particularly strong situations, or to bring on or off the stage the various principal characters. Such plays first became popular in France at the beginning of the 19th century. One of the most prolific writers of melodramas at that period was R. C. G. de Pixericourt (1773–1844). The titles of some of his plays give a sufficient indication of their character; *e.g. Victor, ou l'enfant de la forêt* (1797); *Carlina, ou l'enfant du mystère* (1801); *Le Monastère abandonné, ou la malédiction paternelle* (1816). Another form of melodrama came from the same source, but developed on lines which laid more emphasis on the music, and is of some importance in the history of opera. Probably the first of this type is to be found in Georg Benda's *Ariadne auf Naxos* (1774). The most familiar of such melodramas is Gay's *Beggar's Opera.* In these the dialogue is entirely spoken. In true opera the spoken dialogue was replaced by recitative. It may be noticed that the speaking of some parts of the dialogue is not sufficient to class an opera as a "melodrama" in this sense, as is proved by the spoken grave-digging scene, accompanied by music, in *Fidelio*, and the incantation scene in *Der Freischütz.* To this the English term "declamation" is usually applied; the Germans use *Melodram.* But see OPERA.

MELODY (Gr. μελῳδία, a choral song, from μέλος, tune, and ᾠδή, song). In musical philosophy and history the word "melody" must be used in a very abstract sense, as that aspect of music which is concerned only with the pitch of successive notes. Thus a "melodic scale" is a scale of a kind of music that is not based on an harmonic system; and thus we call ancient Greek music "melodic." The popular conception of melody is that of "air" or "tune," and this is so far from being a primitive conception that there are few instances of such melody in recorded music before the 17th century; and even folk-songs, unless they are of recent origin, deviate markedly from the criteria of tunefulness. The modern conception of melody is based on the interaction of every musical category. For us a melody is the surface of a series of harmonies, and an unaccompanied melody so far implies harmony that if it so behaves that simple harmonies expressing clear key-relationships would be difficult to find for it, we feel it to be strange and vague. Again, we do not feel music as melodious unless its rhythm is symmetrical; and this, taken together with the harmonic rationality of modern melody, brings about an equally intimate connexion between melody on a large scale and form on a small scale. In the article on SONATA FORMS it is shown that there are gradations between the form of some kinds of single melody like "Barbara Allen" (see Ex. 1) and the larger dance forms of the suite, and then, again, gradations between these and the true sonata forms with their immense range of expression and development. Lastly, the element that appears at first sight most strictly melodic, namely, the rise and fall of the pitch, is intimately connected by origin with the nature of the human voice, and in later forms is enlarged fully as much by the characteristics of instruments as by parallel developments in rhythm, harmony and form. Thus modern melody is the musical surface of rhythm, harmony, form and instrumentation; and, if we take Wagnerian *Leitmotif* into account, we may as well add drama to the list. In short, melody is the surface of music.

We may here define a few technicalities which may be said to come more definitely under the head of melody than any other; but see also HARMONY and RHYTHM.

1. A *theme* is a melody, not necessarily or even usually complete, except when designed for a set of *variations* (*q.v.*), but of sufficient independent coherence to be, so to speak, an intelligible musical sentence. Thus a fugue-subject is a theme, and the first and second subjects in sonata form are more or less complex groups of themes.

2. A *figure* is the smallest fragment of a theme that can be recognized when transformed or detached from its surroundings. The grouping of figures into new melodies is the most obvious resource of "development" or "working-out" in the sonata-forms (see Ex. 2–7), besides being the main resource by which fugues are carried on at those moments in which the subjects and counter-subjects are not present as wholes. In 16th-century polyphony melody consists mainly of figures thus broken off from a *canto fermo* (see CONTRAPUNTAL FORMS).

3. *Polyphony* is simultaneous multiple melody. In 16th-century music and in fugue-writing every part is as melodious as every other. The popular cry for melody as an antidote to polyphony is thus really a curious perversion of the complaint that one may have too much of a good thing. Several well-known classical melodies are polyphonically composite, being formed by an inner melody appearing as it were through transparent places in the outer melody, which it thus completes. This is especially common in music for the pianoforte, where the tone of long notes rapidly fades; and the works of Chopin are full of examples. In Bach's works for keyed instruments figures frequently have a double meaning on this principle, as, for instance, in the peculiar kind of counter-subject in the 15th fugue of the 2nd book of the *Wohltemperirtes Klavier.* A good familiar example of a simple melody which, as written by the composer, would need two voices to sing it, is that

which begins the second subject of Beethoven's *Waldstein Sonata* (Op. 53, first movement, bars 35–42, where at the third bar of the melody a lower voice enters and finishes the phrase).

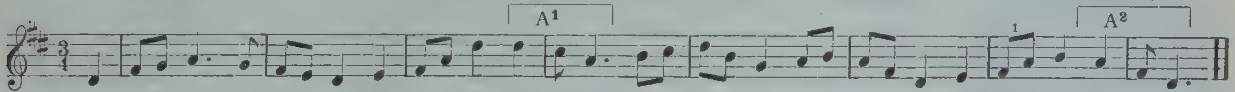
4 (*a*) *Conjunct movement* is the movement of melody along adjacent degrees of the scale. A large proportion of Beethoven's melodies are conjunct (see Ex. 2, fig. B).

4 (*b*) *Disjunct movement*, the opposite of conjunct, tends, though by no means always, to produce *arpeggio* types of melody, *i.e.* melodies which move up and down the notes of a chord. Certain types of such melody are highly characteristic of Brahms; and Wagner, whose melodies are almost always of instrumental origin, is generally disjunct in diatonic melody and conjunct in chromatic (Ex. 2, fig. C, is a disjunct figure not forming an arpeggio).

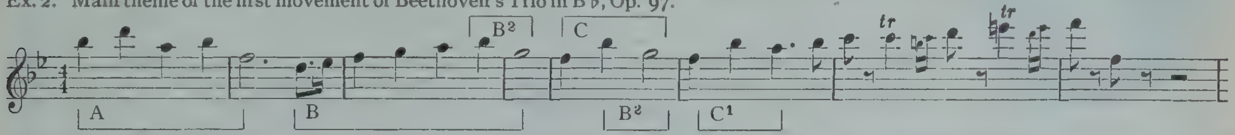
For various other melodic devices, such as inversion, augmentation and diminution, see CONTRAPUNTAL FORMS.

We subjoin some musical illustrations showing the treatment of figures in melody as a means of symmetry (Ex. 1), and development (Ex. 2–7), and (Ex. 8–13) some modern melodic transformations, differing from earlier methods in being immediate instead of gradual. (D. F. T.)

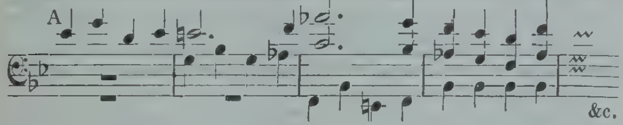
Ex. 1. "*Barbara Allen*" (showing the germ of binary form in the balance between A^1 on the dominant and A^2 on the tonic).



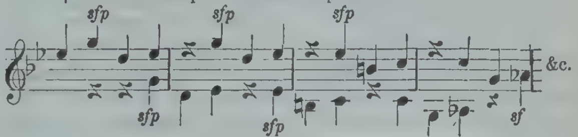
Ex. 2. Main theme of the first movement of Beethoven's Trio in B♭, Op. 97.



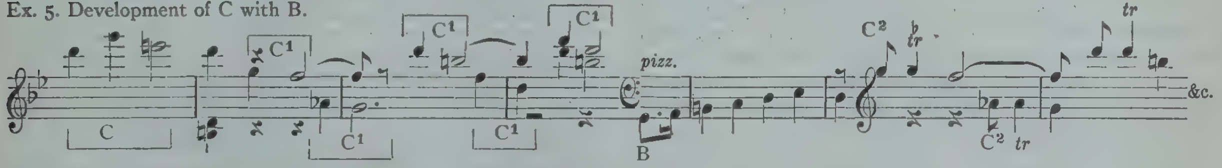
Ex. 3. Figure A of above developed in a new polyphonic 4-bar phrase.



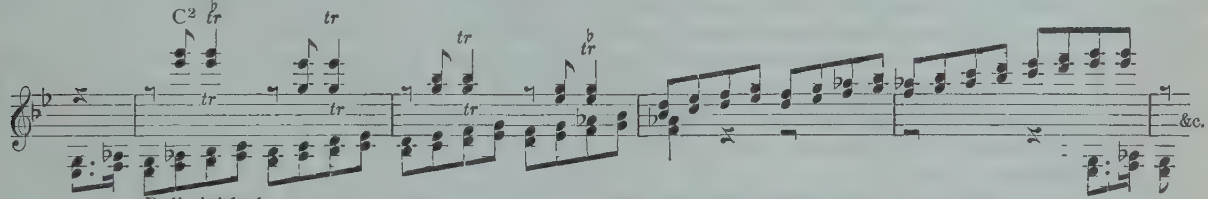
Ex. 4. Further sequential developments of A.



Ex. 5. Development of C with B.

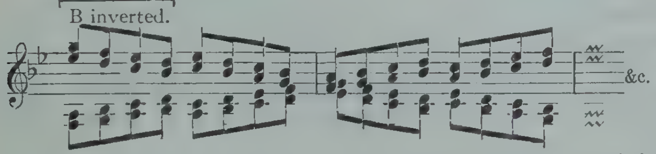


Ex. 6. Further development of B by diminution, in combination with the trills derived from C.

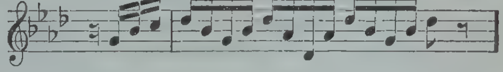


B diminished.

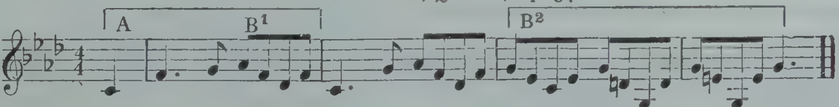
Ex. 7. Further development of B by diminution and contrary motion (inversion).



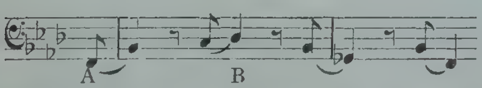
Ex. 9. A and B^2 diminished.



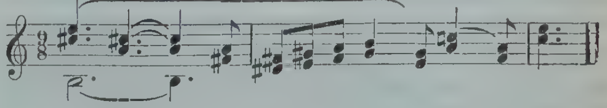
Ex. 8. BRAHMS, Quintet, Op. 34.



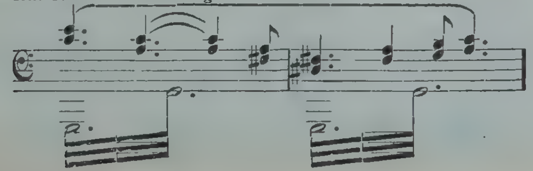
Ex. 10.



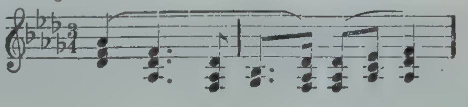
Ex. 11. *The Rheindaughter's Toy.* Wagner, Das *Rheingold.*



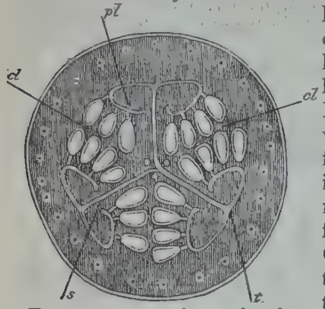
Ex. 12. *The Nibelung's Talisman.*



Ex. 13. *Walhalla.*



MELON (Late Lat. *melo*, shortened form of Gr. μηλοπέπων, a kind of gourd; μῆλον, apple, and πέπων, ripe), *Cucumis melo*, a polymorphic species of the order Cucurbitaceae, including numerous varieties.[1] The melon is an annual trailing herb with palmately-lobed leaves, and bears tendrils by means of which it is readily trained over trellises, &c. It is monoecious, having male and female flowers on the same plant; the flowers have deeply five-lobed campanulate corollas and three stamens. Naudin observed that in some varieties (*e.g.* of Cantaloups) fertile stamens sometimes occur in the female flowers. It is a native of south Asia "from the foot of the Himalayas to Cape Comorin,"[2] where it grows spontaneously, but is cultivated in the temperate and warm regions of the whole world. It is variable both in diversity of foliage and habit, but much more so in the fruit, which in some varieties is no larger than an olive, while in others it rivals the gourd (*Cucurbita maxima*). The fruit is globular, ovoid, spindle-shaped, or serpent-like, netted or smooth-skinned, ribbed or furrowed, variously coloured externally, with white, green, or orange flesh when ripe, scented or scentless, sweet or insipid, bitter or even nauseous, &c. Like the gourd, the melon undergoes strange metamorphoses by crossing its varieties, though the latter preserve their characters when alone. The offspring of all crossings are fertile. As remarkable cases of sudden changes produced by artificially crossing races, M. Naudin records that in 1859 the offspring of the wild melons *m. sauvage de l'Inde* (*C. melo agrestis*) and *m. s. d'Afrique, le petit m. de Figari* bore different fruits from their parents, the former being ten to twelve times their size, ovoid, white-skinned, more or less scented, and with reddish flesh; though another individual bore fruits no larger than a nut. The offspring of *m. de Figari* after being crossed bore fruits of the serpent-melon. On the other hand, the serpent-melon was made to bear ovoid and reticulated fruit.



Transverse section of the fruit of the melon (*Cucumis melo*), showing the placentas (*pl*), with the seeds attached to them. The three carpels forming the pepo are separated by partitions (*cl*). From the centre, processes (*s*) go to circumference (*t*), ending in curved placentaries bearing the ovules.

Naudin thinks it is probable that the culture of the melon in Asia is as ancient as that of all other alimentary vegetables. The Egyptians grew it, or at least inferior races of melon, which were either indigenous or introduced from Asia. The Romans and doubtless the Greeks were familiar with it, though some forms may have been described as cucumbers. Columella seems to refer to the serpent-melon in the phrase *ut coluber . . . ventre cubat flexo.* Pliny describes them as *pepones* (xix. 23 to xx. 6) and Columella as *melones* (xi. 2, 53). The melon began to be extensively cultivated in France in 1629, according to Olivier de Serres. Gerard (*Herball*, 772) figured and described in 1597 several kinds of melons or pompions, but he has included gourds under the same name.

The origin of some of the chief modern races, such as "Cantaloups," "Dudaim," and probably the netted sorts, is due to Persia and the neighbouring Caucasian regions. The first of these was brought to Rome from Armenia in the 16th century, and supplies the chief sorts grown for the French markets; but many others are doubtless artificial productions of west Europe.

The water-melon (*Citrullus vulgaris*) is a member of a different genus of the same order. It has been cultivated for its cool refreshing fruit since the earliest times in Egypt and the Orient, and was known before the Christian era in southern Europe and Asia.

The melon requires artificial heat to grow it to perfection, the rock and cantaloup varieties succeeding with a bottom heat of 70° and an atmospheric temperature of 75°, rising with sun heat to 80°, and the Persian varieties requiring a bottom heat of 75°, gradually increasing to 80°, and an atmospheric temperature ranging from 75° to 80° when the fruit is swelling, as much sun heat as the plants can bear being allowed at all times. The melon grows best in rich turfy loam, somewhat heavy, with which a little well-rotted dung, especially that of pigeons or fowls, should be used, in the proportion of one-fifth mixed in the compost of loam. Melons are grown on hotbeds of fermenting manure, when the soil should be about a foot in thickness, or in pits heated either by hot water or fermenting matter, or in houses heated by hot water, in which case the soil bed should be 15 or 18 in. thick. The fermenting materials should be well prepared, and, since the heat has to be kept up by linings, it is a good plan to introduce one or two layers of faggots in building up the bed. A mixture of dung and leaves gives a more subdued but more durable heat.

For all ordinary purposes February is early enough for sowing the first crop, as well-flavoured fruits can scarcely be looked for before May. The seeds may be sown singly in 3-in. pots in a mixture of leaf-mould with a little loam, the pots being plunged in a bottom heat of 75° to 80°, and as near the glass as possible, in order that the young plants may not be drawn up. The hill or ridge of soil should be about a foot in thickness, the rest of the surface being afterwards made up nearly to the same level. If the fruiting-bed is not ready when the roots have nearly filled the pots, they must be shifted into 4-inch pots, for they must not get starved or pot-bound. Two or three plants are usually planted in a mound or ridge of soil placed in the centre of each light, and the rest of the surface is covered over to a similar depth as soon as the roots have made their way through the mound.

The melon being one of those plants which produce distinct male and female flowers, it is necessary to its fertility that both should be produced, and that the pollen of the male flower should, either naturally by insect agency, or artificially by the cultivator's manipulation, be conveyed to the stigma of the female flower; this setting of the fruit is often done by stripping a male flower of its corolla, and inverting it in the centre of the fruit-bearing flower. After the fruit has set and has grown to the size of an egg, it should be preserved from contact with the soil by placing it on a piece of tile or slate; or if grown on a trellis by a little swinging wooden shelf, just large enough to hold it. In either case the material used should be tilted a little to one side, so as to permit water to drain away. Before the process of ripening commences, the roots should have a sufficient supply of moisture, so that none may be required from that time until the fruit is cut.

When the melon is grown in a house there should be a good depth of drainage over the tank or other source of bottom heat, and on this should be placed turfs, grass side downwards, below the soil, which should not be less than 15 and need not be more than 18 in. in thickness. The compost should be made moderately firm, and only half the bed should be made up at first, the rest being added as the roots require it. The melon may also be grown in large pots, supplied with artificial manure or manure water. The stems may be trained up the trellis in the usual way, or the rafters of a pine stove may be utilized for the purpose. If the trellis is constructed in panels about the width of the lights, it can be taken down and conveniently stowed away when not in use.

The presence of too much moisture either in the atmosphere or in the soil is apt to cause the plants to damp off at the neck, but the evil may be checked by applying a little fresh-slaked lime round the stem of the plant.

Melons are liable to the attack of red spider, which are best removed by syringing with rain-water, and prevented by keeping a fairly humid atmosphere; green or black fly should also be watched for and removed by fumigation with tobacco smoke or by "vaporizing."

The varieties of melon are continually receiving additions, and as newer varieties spring into favour, so the older ones drop out of cultivation. A great deal depends on getting the varieties true to name, as they are very liable to get cross-fertilized by insect agency. Some of the best at present are:

Scarlet-fleshed.—Blenheim Orange, Frogmore Orange, Invincible, Sutton's Scarlet, and Triumph.

White-fleshed.—Golden Orange, Hero of Lockinge, Longleat Perfection, Royal Favourite.

Green-fleshed.—British Queen, Epicure, Exquisite, Monarch, Ringleader.

The market-gardeners round Paris and other parts of France chiefly cultivate varieties of Cantaloup melon known as the Prescott hâtif à chassis and Prescott fond blanc—both excellent in flavour. The plants are grown in frames on hotbeds, and only one large fruit is allowed to mature on each plant. If secured early in the season—say in June—from 25 to 35 francs can be obtained for each fruit in the Paris markets; later fruits, however, drop down to 2 francs each, or even less when there is a glut (see J. Weathers, *French Market-Gardening*).

MELORIA, a rocky islet, surrounded by a shoal, almost opposite Leghorn. It was the scene of two naval battles of the middle ages. The first, on the 3rd of May 1241, was fought between the fleet of the emperor Frederick II. Hohenstaufen, surnamed Stupor Mundi, in alliance with Pisa, against a Genoese squadron bringing a number of English, French and Spanish prelates to attend the council summoned to meet at the Lateran by Gregory IX. Three Genoese galleys were sunk and twenty-two taken. Several of the prelates perished, and many were carried prisoners to the camp of the emperor. The second, fought on Sunday the 6th of August 1284, was of higher historical importance. It was a typical medieval sea-fight, and accomplished the ruin of Pisa as a naval power. The long rivalry of that city and of Genoa had broken out for the last time in 1282, the immediate cause being the incompatible claims of the two cities to sovereignty over the islands of Sardinia and Corsica. The earlier conflicts of the war in 1282, 1283 and the spring of 1284, had been unfavourable to Pisa. Though the city was united with the Catalans and with Venice in hostility to Genoa, and though it had chosen a Venetian, Alberto Morosini, as its Podestà, it received no help from either. The Genoese, who had the larger and more efficient fleet, sent their whole power against their enemy. When the Genoese appeared off Meloria the Pisans were lying in the river Arno at the mouth of which lay Porto Pisano the port of the city. The Pisan fleet represented the whole power of the city, and carried members of every family of mark and most of the great officers of state. The Genoese, desiring to draw their enemy out to battle, and to make the action decisive, arranged their fleet in two lines abreast. The first was composed according to Agostino Giustiniani of fifty-eight galleys, and eight *panfili*, a class of light galleys of eastern origin named after the province of Pamphylia. Uberto Doria, the Genoese admiral, was stationed in the centre and in advance of his line. To the right were the galleys of the Spinola family, and of four of the eight "companies" into which Genoa was divided—Castello, Piazzalunga, Macagnana and Son Lorenzo. To the left were the galleys of the Dorias, and of the other four companies, Porta, Soziglia, Porta Nuova and Il Borgo. The second line of twenty galleys, under the command of Benedetto Giacaria (or Zaccharie), was placed so far behind the first that the Pisans could not see whether it was made up of war-vessels or of small craft meant to act as tenders to the others. Yet it was near enough to strike in and decide the battle when the action had begun. The Pisans, commanded by the Podestà Morosini and his lieutenants Ugolino della Gherardescha and Andreotto Saraceno, came out in a single body. It is said that while the archbishop was blessing the fleet the silver cross of his archiepiscopal staff fell off, but that the omen was disregarded by the irreverence of the Pisans, who declared that if they had the wind they could do without divine help. They advanced in line abreast to meet the first line of the Genoese, fighting according to the medieval custom to ram and board. The victory was decided for Genoa by the squadron of Giacaria which fell on the flank of the Pisans. Their fleet was nearly annihilated, the Podestà was taken, and Ugolino fled with a few vessels. As Pisa was also attacked by Florence and Lucca it could never recover the disaster. Two years later Genoa took Porto Pisano, and filled up the harbour. The count Ugolino was afterwards starved to death with several of his sons and grandsons in the manner made familiar by the 32nd canto of Dante's *Inferno*.

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[1] For a full account of the species of *Cucumis* and of the varieties of melon by Charles Naudin, see *Annales des sciences naturelles*, ser 4, vol. xi. p. 34 (1859).

[2] Naudin, *loc. cit.* pp. 39, 76.

See *Annali della republica di Genova*, by Agostino Giustiniani (ed. Canepa, Genoa, 1854). (D. H.)

MELOS (mod. *Milo*), an island of the Aegean Sea (Cyclades group), at the S.W. corner of the archipelago, 75 m. due E. from the coast of Laconia. From E. to W. it measures about 14 m., from N. to S. 8 m., and its area is estimated at 52 sq. m. The greater portion is rugged and hilly, culminating in Mount Elias in the west (2538 ft.). Like the rest of the cluster, the island is of volcanic origin, with tuff, trachyte and obsidian among its ordinary rocks. The natural harbour, which, with a depth diminishing from 70 to 30 fathoms, strikes in from the north-west so as to cut the island into two fairly equal portions, with an isthmus not more than 1½ m. broad, is the hollow of the principal crater. In one of the caves on the south coast the heat is still great, and on the eastern shore of the harbour there are hot sulphurous springs. Sulphur is found in abundance on the top of Mount Kalamo and elsewhere. In ancient times the alum of Melos was reckoned next to that of Egypt (Pliny xxxv. 15 [52]), and millstones, salt (from a marsh at the east end of the harbour), and gypsum are still exported. The Melian earth (γῆ Μηλιάς) was employed as a pigment by ancient artists. Orange, olive, cypress and arbutus trees grow throughout the island, which, however, is too dry to have any profusion of vegetation. The vine, the cotton plant and barley are the main objects of cultivation. Pop. (1907), 4864 (commune), 12,774 (province).

The harbour town is Adamanta; from this there is an ascent to the plateau above the harbour, on which are situated Plaka, the chief town, and Kastro, rising on a hill above it, and other villages. The ancient town of Melos was nearer to the entrance of the harbour than Adamanta, and occupied the slope between the village of Trypete and the landing-place at Klima. Here is a theatre of Roman date and some remains of town walls and other buildings, one with a fine mosaic excavated by the British school at Athens in 1896. Numerous fine works of art have been found on this site, notably the Aphrodite of Melos in the Louvre, the Asclepius in the British Museum, and the Poseidon and an archaic Apollo in Athens. The position of Melos, between Greece and Crete, and its possession of obsidian, made it an important centre of early Aegean civilization. At this time the chief settlement was at the place now called Phylakopi, on the north-east coast. Here the excavations of the British school cleared many houses, including a palace of "Mycenaean" type; there is also a town wall. Part of the site has been washed away by the sea. The antiquities found were of three main periods, all preceding the Mycenean age of Greece. Much pottery was found, including examples of a peculiar style, with decorative designs, mostly floral, and also considerable deposits of obsidian. There are some traditions of a Phoenician occupation of Melos. In historical times the island was occupied by Dorians from Laconia. In the 6th century it again produced a remarkable series of vases, of large size, with mythological subjects and orientalizing ornamentation (see GREEK ART, fig. 9), and also a series of terra-cotta reliefs.

Though Melos inhabitants sent a contingent to the Greek fleet at Salamis, it held aloof from the Attic league, and sought to remain neutral during the Peloponnesian War. But in 416 B.C. the Athenians, having attacked the island and compelled the Melians to surrender, slew all the men capable of bearing arms, made slaves of the women and children, and introduced 500 Athenian colonists. Lysander restored the island to its Dorian possessors, but it never recovered its former prosperity. There were many Jewish settlers in Melos in the beginning of the Christian era, and Christianity was early introduced. During the "Frankish" period the island formed part of the duchy of Naxos, except for the few years (1341–1383) when it was a separate lordship under Marco Sanudo and his daughter.

Antimelos or *Antimilo*, 5½ m. north-west of Milo, is an uninhabited mass of trachyte, often called Eremomilo or Desert Melos. *Kimolos*, or *Argentiera*, less than 1 m. to the north-east, was famous in antiquity for its figs and fuller's earth (Κιμωλία γῆ), and contained a considerable city, the remains of which cover the cliff of St Andrews. *Polinos*, *Polybos* or *Polivo* (anc. *Polyaegos*) lies rather more than a mile south-east of Kimolos. It was the subject of dispute between the Melians and Kimolians. It has long been almost uninhabited.

See Leycester, "The Volcanic Group of Milo, Anti-Milo, &c.," in *Jour. Roy. Geog. Soc.* (1852); Tournefort, *Voyage*; Leake, *Northern Greece*, iii.; Prokesch von Osten, *Denkwürdigkeiten*, &c.; Bursian, *Geog. von Griechenland*, ii.; *Journ. Hell. Stud.* xvi., xvii., xviii.; *Excavations at Phylakopi*; *Inscr. graec.* xii. iii. 197 sqq.; on coins found in 1909, see Jameson in *Rev. Num.* 1909, 188 sqq. (E. GR.)

MELOZZO DA FORLÌ (*c.* 1438–1494), Italian painter, the first who practised foreshortening with much success, was born at Forlì about 1438; he came, it is supposed, of a wealthy family named Ambrosi. In all probability, Melozzo studied painting under Piero de' Franceschi, of Borgo St Sepolcro; he seems also to have been well acquainted with Giovanni Santi, the father of

Raphael. It has been said that he became a journeyman and colour-grinder to some of the best masters, in order to prosecute his studies; this lacks confirmation. Only three works are extant which can safely be assigned to Melozzo: those in the Louvre, the National Gallery, London, and the Barberini Palace, Rome, are disputable. (1) He painted in 1472 the vault of the chief chapel in the church of the Apostoli in Rome, his subject being the "Ascension of Christ"; the figure of Christ is so boldly and effectively foreshortened that it seems to "burst through the vaulting"; this fresco was taken down in 1711, and the figure of Christ is now in the Quirinal Palace, not worthy of special admiration save in its perspective quality; while some of the other portions, almost Raphaelesque in merit, are in the sacristy of St Peter's. (2) Between 1475 and 1480 he executed a fresco, now transferred to canvas, and placed in the Vatican picture-gallery, representing the appointment of Platina by Pope Sixtus IV. as librarian of the restored Vatican library. (3) In the Collegio at Forlì is a fresco by Melozzo, termed the "Pestapepe," or Pepper-grinder, originally painted as a grocer's sign; it is an energetic specimen of rather coarse realism, now much damaged. Melozzo also painted the cupola of the Capuchin church at Forlì, destroyed in 1651; and it has been said that he executed at Urbino some of the portraits of great men (Plato, Dante, Sixtus IV., &c.) which are now divided between the Barberini Palace and the Campana collection in Paris; this, however, is doubtful, and it is even questionable whether Melozzo was ever at Urbino. In Rome he was one of the original members of the academy of St Luke, founded by Sixtus IV. He returned to Forlì, probably towards 1480, and died in November 1494. He contributed sensibly to the progress of pictorial art; and, without being remarkable as a colourist, gave well graded lights, with general care and finish, and fine dignified figures. His works bear a certain resemblance to those of his contemporary Mantegna. Marco Palmezzano was his pupil; and the signature "Marcus de Melotius" on some of Palmezzano's works, along with the general affinity of style, has led to their being ascribed to Melozzo, who has hence been incorrectly called "Marco Melozzo."

MELROSE, a city of Middlesex county, Massachusetts, U.S.A., about 7 m. N. of Boston. Pop. (1890), 8519; (1900), 12,962, of whom 2924 were foreign-born and 130 were negroes; (1910 census) 15,715. It is served by the Boston & Maine railroad, and by inter-urban electric railways. The city covers 4·8 sq. m. of broken, hilly country, in which is a part of the state park of Middlesex Fells; it includes the villages of Melrose, Melrose Highlands, Wyoming and Fells. In 1905 the total factory product was valued at $9,450,929 (an increase of 176·6% over the value of the factory product in 1900). The principal products are rubber shoes (at the village of Fells), skirts (at the village of Wyoming), and leather and silverware (at Melrose Highlands). The water supply of Melrose, like that of Stoneham and of Medford, is derived from the metropolitan reservoir called Spot Pond in Stoneham, immediately west of Melrose. The city was the home of Samuel Adams Drake (1833–1905), American historian, whose *History of Middlesex County* (Boston, 1880; vol. 2, "Melrose," by E. H. Goss) should be consulted; and of William Frederick Poole (1821–1894), the librarian and the originator of indexes of periodical literature. Melrose was settled about 1633, and was a part of Charlestown until 1649, and of Malden until 1850. The eastern part of Stoneham was annexed to it in 1853. In 1899 it was chartered as a city; the charter came into effect in 1900. The name is said to be due to a resemblance of the scenery to that of Melrose, Scotland.

MELROSE, a police burgh of Roxburghshire, Scotland. Pop. (1901), 2195. It lies on the right bank of the Tweed, 37¼ m. S.E. of Edinburgh, and 19 m. N.W. of Jedburgh, via St Boswells and Roxburgh, by the North British railway. The name—which Bede (730) wrote Mailros and Simeon of Durham (1130) Melros—is derived from the Celtic *maol ros*, "bare moor," and the town figures in Sir Walter Scott's *Abbot* and *Monastery* as "Kennaquhair." In consequence of the beauty of its situation between the Eildons and the Tweed, the literary and historical associations of the district, and the famous ruin of Melrose Abbey, the town has become residential and a holiday resort. There is a hydropathic establishment on Skirmish Hill, the name commemorating the faction fight on the 25th of July 1526, in which the Scotts defeated the Douglases and Kers. Trade is almost wholly agricultural. The main streets run from the angles of the triangular market-place, in which stands the market cross, dated 1642, but probably much older. Across the river are Gattonside, with numerous orchards, and Allerly, the home of Sir David Brewster from 1827 till his death in 1868.

The original Columban monastery was founded in the 7th century at Old Melrose, about 2½ m. to the east, in the loop of a great bend of the Tweed. It was colonized from Lindisfarne, Eata, a disciple of Aidan, being the first abbot (651), and Boisil and Cuthbert being priors here. It was burned by Kenneth Macalpine in 839 during the wars between Scot and Saxon, and, though rebuilt, was deserted in the middle of the 11th century. The chapel, dedicated to St Cuthbert, continued for a period to attract many pilgrims, but this usage gradually declined and the building was finally destroyed by English invaders. Meanwhile in 1136 David I. and founded an abbey dedicated to the Virgin, a little higher up the Tweed, the first Cistercian settlement in Scotland, with monks from Rievaulx in Yorkshire. Lying in the direct road from England, the abbey was frequently assaulted and in 1322 was destroyed by Edward II. Rebuilt, largely by means of a gift of Robert Bruce, it was nearly burned down in 1385 by Richard II. Erected once more, it was reduced to ruin by the earl of Hertford (afterwards the Protector Somerset) in 1545. Later the Reformers dismantled much of what was left. The adaptation of part of the nave to the purposes of a parish church and the use of the building as a quarry did further damage. The ruins, however, now the property of the duke of Buccleuch, are carefully preserved. Of the conventual buildings apart from the church nothing has survived but a fragment of the cloister with a richly-carved round-headed doorway and some fine arcading. The abbey, cruciform, is in the Decorated and Perpendicular styles, with pronounced French influence, due probably to the master mason John Morow, or Morreau, who, according to an inscription on the south transept wall, was born in Paris. The south front is still beautiful. The west front and a large portion of the north half of the nave and aisle have perished, but the remains include the rest of the nave, the two transepts, the chancel and choir, the two western piers of the tower and the sculptured roof of the east end. From east to west it measured 258 ft., the nave is 69 ft. wide and the width of the transepts from north to south is 115½ ft. The nave had an aisle on each side, the north noticeably the narrower, the south furnished with eight chapels, one in each bay. Both transepts contained an eastern aisle, and the chancel a square chapel at its west end on each side. Over the south transept aisle, which was the chapel of St Bridget, is the clerestory passage, which ran all round the church. The choir extended westwards for three bays beyond the tower and terminated in a stone rood-screen. Sir Walter Scott has immortalized the east window, in *The Lay of the Last Minstrel*, but the south window with its flowing tracery is even finer. In the carving of windows, aisles, cloister, capitals, bosses and doorheads no design is repeated. The heart of Robert Bruce was buried at the high altar, and in the chancel are the tombs of Sir William Douglas, the Knight of Liddesdale (1300–1353), James 2nd earl of Douglas (1358–1388), the victor of Otterburn; Alexander II.; and Michael Scot "the Wizard" (1175–1234)—though some authorities say that this is the tomb of Sir Brian Layton, who fell in the battle of Ancrum Moor (1544). At the door leading from the north transept to the sacristy is the grave of Joanna (d. 1238), queen of Alexander II.

The muniments of the abbacy, preserved in the archives of the earl of Morton, were edited by Cosmo Innes for the Bannatyne Club and published in 1837 under the title of *Liber sancte Marie de Melros*. Among the documents is one of the earliest specimens of the Scots dialect. The *Chronica de Mailros*, preserved among the Cotton MSS., was printed at Oxford in 1684 by William Fulman and by the Bannatyne Club in 1835 under the editorship of John Stevenson.

MELTON MOWBRAY, a market town in the Melton parliamentary division of Leicestershire, England, pleasantly situated in a fertile vale, at the confluence of the Wreake and the Eye. Pop. of urban district (1901), 7454. It is 105 m. N.N.W. from London by the Midland railway, and is served by a joint branch of the London & North Western and Great Northern railways. The church of St Mary, a fine cruciform structure, Early English and later, with a lofty and richly ornamented central tower, was enlarged in the reign of Elizabeth. Melton is the centre of a celebrated hunting district, in connexion with which there are large stables in the town. It is known for its pork pies, and has a trade in Stilton cheese. There are breweries and tanneries and an important cattle market. There are blast furnaces in the neighbouring parish of Asfordby for the smelting of the abundant supply of iron ore in the district. During the Civil War Melton was in February 1644 the scene of a defeat of the parliamentary forces by the royalists. It is the birthplace of John Henley the orator (1692–1759).

MELUN, a town of northern France, capital of the department of Seine-et-Marne, situated north of the forest of Fontainebleau, 28 m. S.S.E. of Paris by rail. Pop. (1906), 11,219. The town is divided into three parts by the Seine. The principal portion lies on the slope of a hill on the right bank; on the left bank is the most modern quarter, while the old Roman town occupies an island in the river. On the island stands the Romanesque church of Notre-Dame (11th and 12th centuries), formerly part of a nunnery, the site of which is occupied by a prison. The other public buildings are on the right bank of the river. Of these, the most striking is the church of St Aspais, an irregularly shaped structure of the 15th and 16th centuries, on the apse of which may be seen a modern medallion in bronze, the work of the sculptor H. Chapu, representing Joan of Arc as the liberator of Melun. The hôtel-de-ville (1847)—in the construction of which an old mansion and turret have been utilized—and the tower of St Bartholomew of the 16th and 18th centuries are also of interest. In the courtyard of the former there is a monument to Jacques Amyot, the translator of Plutarch, who was born at Melun in 1513. Among the rich estates in the neighbourhood the most remarkable is the magnificent château of Vaux-le-Vicomte, which belonged to Nicholas Fouquet, intendant of finances under Louis XIV. Melun is a market for grain and farm produce, and its industries include brewing, tanning, distilling, sawing and the manufacture of agricultural implements, clogs, fur garments, lime, cement and plaster.

In Caesar's Gallic wars Melun (*Melodunum*) was taken by his lieutenant Labienus, in order to facilitate the attack of Lutetia by the right bank of the Seine. It was pillaged by the Normans, and afterwards became the favourite residence of the first kings of the race of Capet; Robert and Philip I. both died here. In 1359 Melun was given up by Jeanne of Navarre to her brother, Charles the Bad, but was retaken by the dauphin Charles and Bertrand Duguesclin. In 1420 it made an heroic defence against Henry V. of England and his ally the duke of Burgundy. Ten years later the people of Melun, with the help of Joan of Arc, drove out the English. It was occupied by the League in 1589, and retaken by Henry IV. in the following year.

MÉLUSINE, the tutelary fairy of the house of Lusignan, was the eldest daughter of the fairy Pressine, to avenge whose wrongs she shut up her father in a mountain in Northumberland. For this she was condemned to be metamorphosed every Saturday into a woman-serpent—that is, to be a serpent from the hips downwards. She might, however, be eventually saved from this punishment if she could find a husband who would never see her on a Saturday. Such a husband was found in Raymond, nephew of the count of Poitiers, who became rich and powerful through the machinations of his wife. She built the castle of Lusignan and many other of the family fortresses. When at length her husband gave way to his curiosity, and saw her taking the bath of purification on a Saturday she flew from the castle in the form of a serpent. Thenceforward the death of a member of the house of Lusignan was heralded by the cries of the fairy serpent. "*Pousser des cris de Mélusine*" is still a popular saying.

This history is related at length, with the adventures of Mélusine's numerous progeny, by Jean d'Arras, in his *Chronique de la princesse*, written in 1387 at the desire of John, duke of Berry, for the amusement of the duke and of his sister Marie of France, duchess of Bar. It is one of the most charming of the old prose romances in manner and style, and is natural in spite of the free use of the marvellous. An attempt has been made by Jules Baudot in *Les Princesses Yolande et les ducs de Bar* (Paris, 1900) to make it a *roman à clé* and to identify the personages. Mélusine, Mellusine or Merlusine is, however, simply the spirit of the fountain of Lusignan, and the local Poitevin myth is attached to the origin of the noble house. The etymology of the word has been variously and fancifully given. Some writers have supposed Merlusine to be a corruption of mère Lucine (*mater Lucina*), the deity invoked in child-birth. She has been identified with Mélisende, widow of a king of Jerusalem, and with Mervant, wife of Geoffroi de Lusignan.

The *Mélusine* of Jean d'Arras was printed by Adam Steinschaber at Geneva in 1478, and was reprinted many times in the 15th and 16th centuries. It has been translated into Spanish, English, German and Flemish. Modern editions are by J. C. Brunet (Paris, 1854), and by E. Lecesne for the Academy of Arras (Arras, 1888). The English translation was edited from a unique MS. in the British Museum by A. K. Donald for the E.E.T.S. (1895). The tale was versified in the 14th century by a poet called Couldrette, whose poem was published in 1854 by Francisque Michel. See further J. C. Dunlop, *Hist. of Fiction*, ii. 491-493 (new ed., 1888); S. Baring-Gould, *Curious Myths of the Middle Ages*, pp. 470 seq. (new ed., 1881); and J. C. Brunet, *Manuel du libraire* (vol. iii., 1862, *s.v.* Jean d'Arras).

MELVILLE, ANDREW (1545–1622), Scottish scholar, theologian and religious reformer, was the youngest son of Richard Melville (brother to Melville of Dysart), proprietor of Baldovy near Montrose, at which place Andrew was born on the 1st of August 1545. His father fell at the battle of Pinkie (1547), fighting in the van of the Scottish army, and, his wife having died soon after, the orphan was cared for by his eldest brother Richard (1522–1575). At an early age Melville began to show a taste for learning, and his brother did everything in his power to give him the best education. The rudiments of Latin he obtained at the grammar school of Montrose, after leaving which he learned Greek for two years under Pierre de Marsilliers, a Frenchman whom John Erskine of Dun had induced to settle at Montrose; and such was Melville's proficiency that on going to the university of St Andrews he excited the astonishment of the professors by using the Greek text of Aristotle, which no one else there understood. On completing his course, Melville left St Andrews with the reputation of "the best poet, philosopher, and Grecian of any young master in the land." He then, in 1564, being nineteen years of age, set out for France to perfect his education at the university of Paris. He there applied himself to Oriental languages, but also attended the last course of lectures delivered by Turnebus in the Greek chair, as well as those of Peter Ramus, whose philosophical method and plan of teaching he afterwards introduced into the universities of Scotland. From Paris he proceeded to Poitiers (1566) to study civil law, and though only twenty-one he was apparently at once made a regent in the college of St Marceon. After a residence of three years, however, political troubles compelled him to leave France, and he went to Geneva, where he was welcomed by Theodore Beza, at whose instigation he was appointed to the chair of humanity in the academy of Geneva. In addition to his teaching, however, he also applied himself to studies in Oriental literature, and in particular acquired from Cornelius Bertram, one of his brother professors, a knowledge of Syriac. While he resided at Geneva the massacre of St Bartholomew in 1572 drove an immense number of Protestant refugees to that city, including several of the most distinguished French men of letters of the time. Among these were several men learned in civil law and political science, and their society increased Melville's knowledge of the world and enlarged his ideas of civil and ecclesiastical liberty. In 1574 Melville returned to Scotland, and almost immediately received the appointment of principal of Glasgow University, which had fallen into an almost ruinous state, the college having been shut and the students dispersed. Melville, however, set himself to establish a good educational system. He enlarged the curriculum at the college, and established chairs in languages, science, philosophy and divinity, which were confirmed by charter in 1577. His fame spread through the kingdom, and students flocked from all parts of Scotland and even beyond, till the class-rooms could not contain those who came for admission. He assisted in the reconstruction of Aberdeen University in 1575, and in order that he might do for St Andrews what he had done for Glasgow, he was appointed principal of St Mary's College, St Andrews, in 1580. His duties there comprehended the teaching, not only of theology, but of the Hebrew, Chaldee, Syriac and Rabbinical languages. The ability of his lectures was universally acknowledged, and he created a taste for the study of Greek literature. The reforms, however, which his new modes of teaching involved, and even some of his new doctrines, such as the non-infallibility of Aristotle, brought him into collision with other teachers in the university. He was moderator of the General Assembly in 1582, and took part in the organization of the Church and the Presbyterian method. Troubles arose from the attempts of the court to force a system of Episcopacy upon the Church of Scotland (see SCOTLAND, CHURCH OF), and Melville prosecuted one of the "tulchan" bishops (Robert Montgomery, d. 1609). In consequence of this he was summoned before the Privy Council in February 1584, and had to flee into England in order to escape an absurd charge of treason which threatened imprisonment and not improbably his life. After an absence of twenty months he returned to Scotland in November 1585, and in March 1586 resumed his lectures in St Andrews, where he continued for twenty years; he became rector of the university in 1590. During the whole time he protected the liberties of the Scottish Church against all encroachments of the government. That in the main he and his coadjutors were fighting for the constitutionally guaranteed rights of the Church is admitted by all candid inquirers (see in particular *The History of England from 1603 to 1616*, by S. R. Gardiner, vol. i. chap. ix.). The chief charge against Melville is that his fervour often led him to forget the reverence due to an "anointed monarch." Of this, however, it is not easy to judge. Manners at that time were rougher than at present. When the king acted in an arbitrary and illegal manner he needed the reminder that though he was king over men he was only "God's silly vassal." Melville's rudeness (if it is to be called so) was the outburst of just indignation from a man zealous for the purity of religion and regardless of consequences to himself. In 1599 he was deprived of the rectorship, but was made dean of the faculty of theology. The close of Melville's career in Scotland was at length brought about by James in characteristic fashion. In 1606 Melville and seven other clergymen of the Church of Scotland were summoned to London in order "that his majesty might treat with them of such things as would tend to settle the peace of the Church." The contention of the whole of these faithful men was that the only way to accomplish that purpose was a free Assembly. Melville delivered his opinion to that effect in two long speeches with his accustomed freedom, and, having shortly afterwards written a sarcastic Latin epigram on some of the ritual practised in the chapel of Hampton Court, and some eavesdropper having conveyed the lines to the king, he was committed to the tower, and detained there for four years. On regaining his liberty, and being refused permission to return to his own country, he was invited to fill a professor's chair in the university of Sedan, and there he spent the last eleven years of his life. He died at Sedan in 1622, at the age of seventy-seven.

See McCries, *Andrew Melville* (ed. 1819); Andrew Lang, *History of Scotland* (1902). (D. MN.)

MELVILLE, ARTHUR (1858-1904), British painter, was born in Scotland, in a village of Haddingtonshire. He took up painting at an early age, and though he attended a night-school and studied afterwards in Paris and Grez, he learnt more from practice and personal observation than from school training. The remarkable colour-sense which is so notable a feature of his work, whether in oils or in water-colour, came to him during his travels in Persia, Egypt and India. Melville, though comparatively little known during his lifetime, was one of the most powerful influences in contemporary art, especially in his broad decorative treatment with water-colour. Though his vivid impressions of colour and movement are apparently recorded with feverish haste, they are the result of careful deliberation and selection. He was at his best in his water-colours of Eastern life and colour and his Venetian scenes, but he also painted several striking portraits in oils and a powerful colossal composition of "The Return from the Crucifixion" which remained unfinished at his death in 1904. At the Victoria and Albert Museum is one of his water-colours, "The Little Bull-Fight—Bravo, Toro!" and another, "An Oriental Goatherd," is in the Weimar Museum. But the majority of his pictures have been absorbed by private collectors.

A comprehensive memorial exhibition of Melville's works was held at the Royal Institute Galleries in London in 1906.

MELVILLE, HENRY DUNDAS, 1ST VISCOUNT (1742-1811), British statesman, fourth son of Robert Dundas (1685-1753), lord president of the Scottish court of session, was born at Edinburgh in 1742, and was educated at the high school and university there. Becoming a member of the faculty of advocates in 1763, he soon acquired a leading position at the bar; and he had the advantage of the success of his half-brother Robert (1713-1787), who had become lord president of the court of session in 1760. He became solicitor-general to Scotland in 1766; but after his appointment as lord-advocate in 1775, he gradually relinquished his legal practice to devote his attention more exclusively to public business. In 1774 he was returned to parliament for Midlothian, and joined the party of Lord North; and notwithstanding his provincial dialect and ungraceful manner, he soon distinguished himself by his clear and argumentative speeches. After holding subordinate offices under the marquess of Lansdowne and Pitt, he entered the cabinet in 1791 as home secretary. From 1794 to 1801 he was secretary at war under Pitt, who conceived for him a special friendship. In 1802 he was elevated to the peerage as Viscount Melville and Baron Dunira. Under Pitt in 1804 he again entered office as first lord of the admiralty, when he introduced numerous improvements in the details of the department. Suspicion had arisen, however, as to the financial management of the admiralty, of which Dundas had been treasurer between 1782 and 1800; in 1802 a commission of inquiry was appointed, which reported in 1805. The result was the impeachment of Lord Melville in 1806, on the initiative of Samuel Whitbread, for the misappropriation of public money; and though it ended in an acquittal, and nothing more than formal negligence lay against him, he never again held office. An earldom was offered in 1809 but declined; and he died on the 28th of May 1811.

His son ROBERT, 2nd Viscount Melville (1771-1851), filled various political offices and was first lord of the admiralty from 1812 to 1827 and from 1828 to 1830; his name is perpetuated by that of Melville Sound, because of his interest in Arctic exploration. His eldest son, HENRY DUNDAS, 3rd Viscount (1801-1876), a general in the army, played a distinguished part in the second Sikh War.

See Hon. J. W. Fortescue, *History of the British Army*, vol. iv. (1907).

MELVILLE, HERMAN (1819-1891), American author, was born in New York City on the 1st of August 1819. He shipped as a cabin-boy at the age of eighteen, thus being enabled to make his first visit to England, and at twenty-two sailed for a long whaling cruise in the Pacific. After a year and a half he deserted his ship at the Marquesas Islands, on account of the cruelty of the captain; was captured by cannibals on the island of Nukahiva, and detained, without hardship, four months; was rescued by the crew of an Australian vessel, which he joined, and two years later reached New York. Thereafter, with the exception of a passenger voyage around the world in 1860, Melville remained in the United States, devoting himself to literature—though for a considerable period (1866-1885) he held a post in the New York custom-house—and being perhaps Hawthorne's most intimate friend among the literary men of America. His writings are numerous, and of varying merit; his verse, patriotic and other, is forgotten; and his works of fiction and of travel are of irregular execution. Nevertheless, few authors have been enabled so freely to introduce romantic personal experiences into their books: in his first work, *Typee: A Peep at Polynesian Life, or Four Months' Residence in a Valley of the Marquesas* (1846), he described his escape from the cannibals; while in *Omoo, a Narrative of Adventures in the South Seas* (1847), *White Jacket, or The World in a Man-of-War* (1850), and especially *Moby Dick, or The Whale* (1851), he portrayed seafaring life and character with vigour and originality, and from a personal knowledge equal to that of Cooper, Marryat or Clark Russell. But these records of adventure were followed by other tales so turgid, eccentric, opinionative, and loosely written as to seem the work of another author. Melville was the product of a period in American literature when the fiction written by writers below Irving, Poe and Hawthorne was measured by humble artistic standards. He died in New York on the 28th of September 1891.

MELVILLE, JAMES (1556–1614), Scottish reformer, nephew of Andrew Melville (*q.v.*), was born on the 26th of July 1556. He was educated at Montrose and St Leonard's College, St Andrews. In 1574 he proceeded to the university of Glasgow, of which his uncle was principal, and within a year became one of the regents. When his uncle was appointed, in 1580, principal of the New (later, St Mary's) College, St Andrews, he was transferred to the chair of Oriental languages there. For three and a half years he lectured in the university, chiefly on Hebrew, but he had to flee to Berwick in May 1584 (a few months after his uncle's exile) to escape the attacks of his ecclesiastical enemy, Bishop Adamson. After a short stay there and at Newcastle-on-Tyne, and again at Berwick, he proceeded to London, where he joined some of the leaders of the Scottish Presbyterian party. The taking of Stirling Castle in 1585 having changed the political and ecclesiastical positions in the north, he returned to Scotland in November of that year, and was restored to his office at St Andrews. From 1586 to his death he took an active part in Church controversy. In 1589 he was moderator of the General Assembly and on several occasions represented his party in conferences with the court. Despite his antagonism to James's episcopal schemes, he appears to have won the king's respect. He answered, with his uncle, a royal summons to London in 1606 for the discussion of Church policy. The uncompromising attitude of the kinsmen, though it was made the excuse for sending the elder to the Tower, brought no further punishment to James than easy detention within ten miles of Newcastle-on-Tyne. During his residence there it was made clear to him by the king's agents that he would receive high reward if he supported the royal plans. In 1613 negotiations were begun for his return to Scotland, but his health was broken, and he died at Berwick in January 1614.

Melville has left ample materials for the history of his time from the Presbyterian standpoint, in (*a*) correspondence with his uncle Andrew Melville (MS. in the library of the university of Edinburgh), and (*b*) a diary (MS. in the Advocates' Library, Edinburgh). The latter is written in a vigorous, fresh style, and is especially direct in its descriptions of contemporaries. His sketch of John Knox at St Andrews is one of his best passages.

As a writer of verse he compares unfavourably with his uncle. All his pieces, with the exception of a "*libellus supplex*" to King James, are written in Scots. He translated a portion of the *Zodiacus vitae* of Palingenius, and adapted some passages from Scaliger under the title of *Description of the Spainyarts naturall*. His *Spiritual Propine of a Pastour to his People* (1598), *The Black Bastill*, a lamentation for the kirk (1611), *Thrie may keip Counsell, give Twa be away, The Beliefe of the Singing Soul, David's Tragique Fall*, and a number of *Sonnets* show no originality and indifferent technical ability.

The *Diary* was printed by the Bannatyne Club in 1829, and by the Wodrow Society in 1842. Large portions of it are incorporated in David Calderwood's (1575–1650) *History of the Kirk of Scotland* (first printed in 1678). For the life and times, see Thomas M'Crie's *Life of Andrew Melville*.

MELVILLE, SIR JAMES (1535–1617), Scottish diplomatist and memoir writer, was the third son of Sir John Melville, laird of Raith in the county of Fife, who was executed for treason in 1548. One of his brothers was Robert, 1st Baron Melville of Monimail (1527–1621). James Melville in 1549 went to France to become page to Mary Queen of Scots. Serving on the French side at the battle of St Quentin in 1557 Melville was wounded and taken prisoner. He subsequently carried out a number of diplomatic missions for Henry II. of France. On Mary's return to Scotland in 1561 she gave Melville a pension and an appointment in her household, and she employed him as special emissary to reconcile Queen Elizabeth to her marriage with Darnley. After the murder of Darnley in February 1567, Melville joined Lord Herries in boldly warning Mary of the danger and disgrace of her projected marriage with Bothwell, and was only saved from the latter's vengeance in consequence by the courageous resolution of the queen. During the troubled times following Mary's imprisonment and abdication Melville conducted several diplomatic missions of importance, and won the confidence of James VI. when the king took the government into his own hands. Having been adopted as his heir by the reformer Henry Balnaves, he inherited from him, at his death in 1579, the estate of Halhill in Fife; and he retired thither in 1603, refusing the request of James to accompany him to London on his accession to the English throne. At Halhill Melville wrote the *Memoirs of my own Life*, a valuable authority for the history of the period, first published by his grandson, George Scott, in 1683. Sir James Melville died at Halhill on the 13th of November 1617. By his wife, Christina Boswell, he had one son and two daughters; the elder of these, Elizabeth, who married John Colville, *de jure* 3rd Baron Colville of Culross, has been identified with the authoress of a poem published in 1603, entitled *Ane Godlie Dreame*.

See the *Memoirs* mentioned above, of which the most modern edition is that prepared by T. Thompson for the Bannatyne Club (Edinburgh, 1827).

MELVILL VAN CARNBEE, PIETER, Baron (1816–1856), Dutch geographer, was born at the Hague on the 20th of May 1816. He traced his descent from an old Scottish family, originally, it is said, of Hungarian extraction. Destined for the navy, in which his grandfather Pieter Melvill van Carnbee (1743–1810) had been admiral, he imbibed a taste for hydrography and cartography as a student in the college of Medemblik, and he showed his capacity as a surveyor on his first voyage to the Dutch Indies (1835). In 1839 he was again in the East, and was attached to the hydrographical bureau at Batavia. With the assistance of documents collected by the old East India Company, he completed a map of Java in five sheets, accompanied by sailing directions (Amsterdam, 1842). He remained in the East till 1845 collecting materials for a chart of the waters between Sumatra and Borneo (two sheets, 1845 and 1846). On his return to Holland he was attached to the naval department with the charge of studying the history of the hydrography of the Dutch East Indies. He also undertook, in connexion with P. F. von Siebold, the publication of the *Moniteur des Indes*, a valuable series of scientific papers, mainly from his own pen, on the foreign possessions of Holland, which was continued for three years. In 1850 Melvill returned to India as lieutenant of the first class and adjutant to Vice-Admiral van den Bosch; and after the premature death of this commander he was again appointed keeper of the charts at Batavia. In 1853 he obtained exemption from active naval service that he might devote himself to a general atlas of the Dutch Indies. But in 1856 he fell a victim to climate, dying at Batavia on the 24th of October. In spite of delays in engraving, twenty-five sheets of the atlas were already finished, but it was not till 1862 that the whole plan, embracing sixty sheets, was completed by Lieut.-Colonel W. F. Versteeg. In 1843 Melvill received the decoration of the Netherlands Lion, in 1849 that of the Legion of Honour.

MEMBRANELLE, an organ in Ciliate Infusoria (*q.v.*), a flattened assemblage of adherent cilia, like the plates of Ctenophora (*q.v.*): such are arranged in a series in the adoral wreath of the Heterothrichaceae Oligotrichaceae and Hypotrichaceae and constitute the posterior girdle of Peritricha.

MEMEL, a town of Germany, in the kingdom of Prussia, the most northerly town of the German empire, 91 m. by rail N.E. of Königsberg, at the mouth of the Dange, and on the bank of a sound, called the Memeler Tief, which connects the Kurische Haff with the Baltic. Pop. (1905), 20,687. On the side next the sea the town is defended by a citadel and other fortifications, and the entrance to the harbour is protected by a lighthouse. Memel has been largely rebuilt since a destructive fire in 1854. It possesses iron-foundries, shipbuilding yards, breweries, distilleries, and manufactories of chemicals, soap and amber wares. By far the most important interest of the town, however, is its transit trade in timber and the grain and other agricultural products of Lithuania, and also herrings and other kinds of fish. The timber is brought by river from the forests of Russia, and is prepared for export in numerous saw-mills. The annual value of timber exported is above £1,000,000. A Prussian national memorial was unveiled here in the presence of the emperor William II. in September 1907.

Memel was founded in 1252 by Poppo von Osterna, grand master of the Teutonic order, and was at first called New Dortmund and afterwards Memelburg. It soon acquired a considerable trade, and joined the Hanseatic League. During the 13th, 14th and 15th centuries it was repeatedly burned by its hostile neighbours, the Lithuanians and Poles, and in the 17th century it remained for some time in the possession of Sweden. In 1757, and again in 1813, it was occupied by Russian troops. After the battle of Jena, King Frederick William III. retired to Memel; and here, in 1807, a treaty was concluded between England and Prussia. The poet Simon Dach was a native of Memel.

See J. Sembritzki, *Geschichte der königlich preussischen See- und Handelsstadt Memel* (Memel, 1900); and *Memel in 19 Jahrhundert* (Memel, 1902).

MEMEL, or NIEMEN, a river of Russia and Prussia, rising in the middle of the Russian government of Minsk at an altitude of 580 ft. and flowing generally west as far as Grodno. Thence it runs north to Kovno, separating Poland from Russia, and at Kovno it turns west again, still dividing Poland from Russia, until it enters the Prussian province of East Prussia, through which it flows west and north-west past Tilsit for a distance of 70 m. and finally enters the Kurisches Haff by several arms. Of these, those principally used for navigation are the Russ, and its chief branch the Atmat. The Russ is connected with the outlet of the Kurisches Haff at Memel by a canal, while another canal links the Gilge arm southward with the Pregel. Considerable quantities of timber are floated down the Memel, and large amounts of corn shipped down it and its navigable tributary the Viliya. The lowlands of Tilsit are protected against inundation by dikes. Total length of the river, 490 m.; area of its basin, 34,950 sq. m. It is navigable for large vessels as far as Grodno.

See H. Keller, *Memel, Pregel und Weichselstrom* (2 vols., Berlin, 1900); and Schickert, *Wasserwege und Deichwesen in der Memelniederung* (Königsberg, 1901).

MEMLINC, HANS (*c.* 1430–1494), Flemish painter, whose art gave lustre to Bruges in the period of its political and commercial decline. Though much has been written respecting the rise and fall of the school which made this city famous, it remains a moot question whether that school ever truly existed. Like Rome or Naples, Bruges absorbed the talents which were formed and developed in humbler centres. Jan Van Eyck first gained repute at Ghent and the Hague before he acquired a domicile elsewhere, and Memlinc, we have reason to think, was a skilled artist before he settled at Bruges. The annals of the city are silent as to the birth and education of a painter whose name was inaccurately spelt by different authors, and whose identity was lost under the various appellations of Hans and Hausse, or Hemling, Memling, and Memlinc. But W. H. J. Weale mentions a contemporary document discovered in 1889, according to which Memlinc "drew his origin from the ecclesiastical principality of Mayence," and died at Bruges on the 11th of August 1494. He probably served his apprenticeship at Mayence or Cologne, and later worked under Rogier van der Weyden. He did not come to Bruges until about 1467, and certainly not as a wounded fugitive from the field of Nancy. The story is fiction, as is also the report that he was sheltered and cured by the Hospitallers at Bruges, and, to show his gratitude, refused payment for a picture he had painted. Memlinc did indeed paint for the Hospitallers, but he painted not one but many pictures, and he did so in 1479 and 1480, being probably known to his patrons of St John by many masterpieces even before the battle of Nancy.

Memlinc is only connected with military operations in a mediate and distant sense. His name appears on a list of subscribers to the loan which was raised by Maximilian of Austria to push hostilities against France in the year 1480. In 1477, when he is falsely said to have fallen, and when Charles the Bold was killed, he was under contract to furnish an altarpiece for the gild-chapel of the booksellers of Bruges; and this altarpiece, now preserved, under the name of the "Seven Griefs of Mary," in the gallery of Turin, is one of the fine creations of his riper age, and not inferior in any way to those of 1479 in the hospital of St John, which for their part are hardly less interesting as illustrative of the master's power than the "Last Judgment" in the cathedral of Danzig. Critical opinion has been unanimous in assigning the altarpiece of Danzig to Memlinc; and by this it affirms that Memlinc was a resident and a skilled artist at Bruges in 1473; for there is no doubt that the "Last Judgment" was painted and sold to a merchant at Bruges, who shipped it there on board of a vessel bound to the Mediterranean, which was captured by a Danzig privateer in that very year. But, in order that Memlinc's repute should be so fair as to make his pictures purchasable, as this had been, by an agent of the Medici at Bruges, it is incumbent on us to acknowledge that he had furnished sufficient proofs before that time of the skill which excited the wonder of such highly cultivated patrons.

It is characteristic that the oldest allusions to pictures connected with Memlinc's name are those which point to relations with the Burgundian court. The inventories of Margaret of Austria, drawn up in 1524, allude to a triptych of the "God of Pity" by Rogier van der Weyden, of which the wings containing angels were by "Master Hans." But this entry is less important as affording testimony in favour of the preservation of Memlinc's work than as showing his connexion with an older Flemish craftsman. For ages Rogier van der Weyden was acknowledged as an artist of the school of Bruges, until records of undisputed authenticity demonstrated that he was bred at Tournai and settled at Brussels. Nothing seems more natural than the conjunction of his name with that of Memlinc as the author of an altarpiece, since, though Memlinc's youth remains obscure, it is clear from the style of his manhood that he was taught in the painting-room of Van der Weyden. Nor is it beyond the limits of probability that it was Van der Weyden who received commissions at a distance from Brussels, and first took his pupil to Bruges, where he afterwards dwelt. The clearest evidence of the connexion of the two masters is that afforded by pictures, particularly an altarpiece, which has alternately been assigned to each of them, and which may possibly be due to their joint labours. In this altarpiece, which is a triptych ordered for a patron of the house of Sforza, we find the style of Van der Weyden in the central panel of the Crucifixion, and that of Memlinc in the episodes on the wings. Yet the whole piece was assigned to the former in the Zambeccari collection at Bologna, whilst it was attributed to the latter at the Middleton sale in London in 1872. At first, we may think, a closer resemblance might be traced between the two artists than that disclosed in later works of Memlinc, but the delicate organization of the younger painter, perhaps also a milder appreciation of the duties of a Christian artist, may have led Memlinc to realise a sweet and perfect ideal, without losing, on that account, the feeling of his master. He certainly exchanged the asceticism of Van der Weyden for a sentiment of less energetic concentration. He softened his teacher's asperities and bitter hardness of expression.

In the oldest form in which Memlinc's style is displayed, or rather in that example which represents the Baptist in the gallery of Munich, we are supposed to contemplate an effort of the year 1470. The finish of this piece is scarcely surpassed, though the subject is more important, by that of the "Last Judgment" of Danzig

But the latter is more interesting than the former, because it tells how Memlinc, long after Rogier's death and his own settlement at Bruges, preserved the traditions of sacred art which had been applied in the first part of the century by Rogier van der Weyden to the "Last Judgment" of Beaune. All that Memlinc did was to purge his master's manner of excessive stringency, and add to his other qualities a velvet softness of pigment, a delicate transparence of colours, and yielding grace of slender forms. That such a beautiful work as the "Last Judgment" of Danzig should have been bought for the Italian market is not surprising when we recollect that picture-fanciers in that country were familiar with the beauties of Memlinc's compositions, as shown in the preference given to them by such purchasers as Cardinal Grimari and Cardinal Bembo at Venice, and the heads of the house of Medici at Florence. But Memlinc's reputation was not confined to Italy or Flanders. The "Madonna and Saints" which passed out of the Duchatel collection into the gallery of the Louvre, the "Virgin and Child" painted for Sir John Donne and now at Chatsworth, and other noble specimens in English and Continental private houses, show that his work was as widely known and appreciated as it could be in the state of civilization of the 16th century. It was perhaps not their sole attraction that they gave the most tender and delicate possible impersonations of the "Mother of Christ" that could suit the taste of that age in any European country. But the portraits of the donors, with which they were mostly combined, were more characteristic, and probably more remarkable as likenesses, than any that Memlinc's contemporaries could produce. Nor is it unreasonable to think that his success as a portrait painter, which is manifested in isolated busts as well as in altarpieces, was of a kind to react with effect on the Venetian school, which undoubtedly was affected by the partiality of Antonello da Messina for trans-Alpine types studied in Flanders in Memlinc's time. The portraits of Sir John Donne and his wife and children in the Chatsworth altarpiece are not less remarkable as models of drawing and finish than as refined presentations of persons of distinction; nor is any difference in this respect to be found in the splendid groups of father, mother, and children which fill the noble altarpiece of the Louvre. As single portraits, the busts of Burgomaster Moreel and his wife in the museum of Brussels, and their daughter the "Sibyl Zambetha" (according to the added description) in the hospital at Bruges, are the finest and most interesting of specimens. The "Seven Griefs of Mary" in the gallery of Turin, to which we may add the "Seven Joys of Mary" in the Pinakothek of Munich, are illustrations of the habit which clung to the art of Flanders of representing a cycle of subjects on the different planes of a single picture, where a wide expanse of ground is covered with incidents from the Passion in the form common to the action of sacred plays.

The masterpiece of Memlinc's later years, a shrine containing relics of St Ursula in the museum of the hospital of Bruges, is fairly supposed to have been ordered and finished in 1480. The delicacy of finish in its miniature figures, the variety of its landscapes and costume, the marvellous patience with which its details are given, are all matters of enjoyment to the spectator. There is later work of the master in the "St Christopher and Saints" of 1484 in the academy, or the Newenhoven "Madonna" in the hospital of Bruges, or a large "Crucifixion," with scenes from the Passion, of 1491 in the cathedral of Lübeck. But as we near the close of Memlinc's career we observe that his practice has become larger than he can compass alone; and, as usual in such cases, the labour of disciples is substituted for his own. The registers of the painters' corporation at Bruges give the names of two apprentices who served their time with Memlinc and paid dues on admission to the gild in 1480 and 1486. These subordinates remained obscure.

The trustees of his will appeared before the court of wards at Bruges on the 10th of December 1495, and we gather from records of that date and place that Memlinc left behind several children and a considerable property.

AUTHORITIES.—A. Michiels, *Memlinc: sa vie et ses ouvrages* (Verviers, 1881); T. Gaedertz, *Hans Memling und dessen Altarschrein im Dom zu Lübeck* (Leipzig, 1883); Jules du Jardin, *L'École de Bruges. Hans Memling, son temps, sa vie et son œuvre* (Antwerp, 1897); Ludwig Kämmerer, *Memling* (Leipzig, 1899); W. H. J. Weale, *Hans Memlinc* (London, 1901), *Hans Memlinc*: Biography (Bruges, 1901).

(J. A. C.; P. G. K.)

MEMMINGEN, a town of Germany, in the kingdom of Bavaria, on the Ach, a tributary of the Iller, 35 m. S.W. of Augsburg on the railway to Ulm. Pop. (1905), 11,618. It is partly surrounded with walls, and has some interesting old gates and houses. It contains the fine Gothic church of St Martin, which contains 67 beautifully carved choir-stalls, and a town hall dating from about 1580. Its industrial products are yarn, calico, woollen goods, thread. A considerable trade is carried on in hops, which are extensively cultivated in the neighbourhood, and in cattle, wool, leather and grain.

Memmingen, first mentioned in a document of 1010, belonged originally to the Guelf family, and later to the Hohenstaufens. In 1286 it became a free city of the empire, a position which it maintained down to 1802, when it was allotted to Bavaria. In 1331 it was a member of the league of Swabian towns; in 1530 it was one of the four towns which presented the *Confessio Tetrapolitana* to the emperor Ferdinand I.; and a few years later it joined the league of Schmalkalden. During the Thirty Years' War it was alternately occupied by the Swedes and the Imperialists. In May 1800 the French gained a victory over the Austrians near Memmingen.

See Dobel, *Memmingen im Reformationszeitalter* (Augsburg, 1877–1878), and Clauss, *Memmingen Chronik*, 1826–1892 (Memmingen, 1894).

MEMMIUS, GAIUS (incorrectly called *Gemellus*, "The Twin"), Roman orator and poet, tribune of the people (66 B.C.), friend of Lucretius and Catullus. At first a strong supporter of Pompey, he quarrelled with him, and went over to Caesar, whom he had previously attacked. In 54, as candidate for the consulship, he lost Caesar's support by revealing a scandalous transaction in which he and his fellow candidate had been implicated (Cic. *Ad Att.* iv. 15–18). Being subsequently condemned for illegal practices at the election, he withdrew to Athens, and afterwards to Mytilene. He died about the year 49. He is remembered chiefly because it was to him that Lucretius addressed the *De rerum natura*, perhaps with the idea of making him a convert to the doctrines of Epicurus. It appears from Cicero (*Ad Fam.* xiii. 1) that he possessed an estate on which were the ruins of Epicurus' house, and that he had determined to build on the site a house for himself. According to Ovid (*Trist.* ii. 433) he was the author of erotic poems. He possessed considerable oratorical abilities, but his contempt for Latin letters and preference for Greek models impaired his efficiency as an advocate (Cic. *Brut.* 70).

Another GAIUS MEMMIUS, tribune in 111 B.C., attacked the aristocrats on a charge of corrupt relations with Jugurtha. Memmius subsequently stood for the consulship in 99, but was slain in a riot stirred up by his rival the praetor Glaucia. Sallust describes him as an orator, but Cicero (*De oratore*, ii. 59, 70) had a poor opinion of him.

MEMNON, in Greek mythology, son of Tithonus and Eos (Dawn), king of the Aethiopians. Although mentioned in Hesiod and the *Odyssey*, he is rather a post-Homeric hero. After the death of Hector he went to assist his uncle Priam against the Greeks. He performed prodigies of valour, but was slain by Achilles, after he had himself killed Antilochus, the son of Nestor and the friend of Achilles. His mother, Eos, removed his body from the field of battle, and it was said that Zeus, moved by her tears, bestowed immortality upon him. According to another account, Memnon was engaged in single combat with Ajax Telamonius, when Achilles slew him before his warriors had time to come to his aid (Dictys Cretensis iv. 6; Quintus Smyrnaeus ii.; Pindar, *Pythia*, vi. 31). His mother wept for him every morning, and the early dew-drops were said to be her tears. His companions were changed into birds, called Memnonides, which came every year to fight and lament over his grave, which was variously located (Ovid, *Metam.* xiii. 576–622; Pausanias x. 31). The story of Memnon was the subject of the lost *Aethiopis* of Arctinus of Miletus; the chief source from which our knowledge of him is derived is the second book of the *Posthomerica* of Quintus Smyrnaeus (itself probably an adaptation of the works of Arctinus and Lesches), where his exploits and death are described at length. As an Aethiopian, Memnon was described as black, but was noted for his beauty. The fight between Achilles and Memnon was often represented by Greek artists, as on the chest of Cypselus, and more than one Greek play was written bearing his name as a title. In later times the tendency was to regard Memnon as a real historical figure. He was said to have built the royal citadel of Susa, called after him the Memnonion, and to have been sent by Teutamus, king of Assyria, to the assistance of his vassal Priam (Diod. Sic. ii. 22). In Egypt, the name of Memnon was connected with the colossal statues of Amenophis (Amenhotep) III. near Thebes, two of which still remain. The more northerly of these was partly destroyed by an earthquake (27 B.C.) and the upper part thrown down. A curious phenomenon then occurred. Every morning, when the rays of the rising sun touched the statue, it gave forth musical sounds, like the moaning noise or the sharp twang of a harp-string. This was supposed to be the voice of Memnon responding to the greeting of his mother Eos. After the restoration of the statue by Septimius Severus (A.D. 170) the sounds ceased. The sound, which has been heard by modern travellers, is generally attributed to the passage of the air through the pores of the stone, chiefly due to the change of temperature at sunrise. Others have held that it was a device of the priests. Strabo (xvii. 816), the first to mention the sound, declares that he himself heard it, and Pausanias (i. 42, 3) says "one would compare the sound most nearly to the broken chord of a harp or a lute" (Juvenal xv. 5, with Mayor's note; Tacitus, *Annals*, ii. 61).

The supporters of the solar theory look upon Memnon as the son of the dawn, who, though he might vanish from sight for a time, could not be destroyed; hence the immortality bestowed upon him by Zeus. He comes from the east, that is, the land of the rising sun. On early Greek vases he is represented as borne through the air; this is the sun making his way to his place of departure in the west. Both Susa and Egyptian Thebes, where there was a Memnonion or temple in honour of the hero, were centres of sun-worship. "Eos, the mother of Memnon, is so transparently the morning, that her child must rise again as surely as the sun reappears to run his daily course across the heavens" (G. W. Cox, *Mythology and Folklore*, p. 267).

See J. A. Letronne, *La Statue vocale de Memnon* (1833); C. R. Lepsius, *Briefe aus Ägypten* (1852); "The Voice of Memnon" in *Edinburgh Review* (July 1886); article by R. Holland in Roscher's *Lexikon der mythologie*.

MEMNON OF RHODES, brother of Mentor (*q.v.*), with whom he entered the services of the rebellious satrap Artabazus of Phrygia, who married his sister. Mentor after the conquest of Egypt rose high in the favour of the king, and Memnon, who had taken refuge with Artabazus at the Macedonian court, became a zealous adherent of the Persian king; he assisted Mentor in subduing the rebellious satraps and dynasts in Asia Minor, and succeeded him as general of the Persian troops. In the pseudo-Aristotelian *Oeconomica*, ii. 28, stories are told of his methods of obtaining money and evading his obligations; thus he extorted a large sum of money from the conquered inhabitants of Lampsacus and cheated his soldiers out of a part of their pay. He owned a large territory in eastern Troas (Arrian i. 17, 8; Strabo xiii. 587). He gained some successes against Philip II. of Macedon in 336 (Diod. xvii. 6; Polyaen. v. 44, 4, 5) and commanded the Persian army against Alexander's invasion. Convinced that it was impossible to meet Alexander in a pitched battle, his plan was to lay waste the country and retire into the interior, meanwhile organizing resistance on sea (where the Persians were far superior to the Macedonians) and carrying the war into Greece. But his advice was overridden by the Persian satraps, who forced him to fight at the Granicus. After his defeat he tried to organize the maritime war and occupied the Greek islands, but in the beginning of 333 he fell ill and died (Arrian ii. 1, 1). (ED. M.)

MEMORANDUM OF ASSOCIATION, in English company law, a document subscribed to by seven or more persons associated for any lawful purpose, by subscribing to which, and otherwise complying with the requisitions of the Companies Acts in respect of registration, they may form themselves into an incorporated company, with or without limited liability (see COMPANY).

MEMORIAL DAY (or DECORATION DAY), a holiday observed in the northern states of the United States on the 30th of May, in honour of soldiers killed in the American Civil War, and especially for the decoration of their graves with flags and flowers. Before the close of the Civil War the 30th of May was thus celebrated in several of the southern states; in the North there was no fixed day commonly celebrated until 1868, when (on the 5th of May) Commander-in-Chief John A. Logan, of the Grand Army of the Republic, issued a general order designating the 30th of May 1868 "for the purpose of strewing with flowers or otherwise decorating the graves of comrades who died in defense of their country during the late rebellion"; Logan did this "with the hope that it will be kept up from year to year." In 1882 the Grand Army urged that the "proper designation of May 30 is Memorial Day"—not Decoration Day. Rhode Island made it a legal holiday in 1874, Vermont in 1876, and New Hampshire in 1877; and by 1910 it was a legal holiday in all the states and territories save Alabama, Alaska, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina and Texas. In Virginia the 30th of May is observed as a Confederate Memorial Day. The 3rd of June (the birthday of Jefferson Davis) is observed as Confederate Memorial Day in Louisiana and Tennessee; the 26th of April in Alabama, Florida, Georgia and Mississippi; and the 10th of May in North Carolina and South Carolina.

MEMPHIS, the capital of Egypt through most of its early history, now represented by the rubbish mounds at Bedreshēn on the W. bank of the Nile 14 m. S. of Cairo. As the chief seat of the worship of Ptah, the artisan god (Hephaestus), Memphis must have existed from a very remote time. But its greatness probably began with Menes (*q.v.*), who united the kingdoms of Upper and Lower Egypt, and is said to have secured the site for his capital near the border of the two lands by diverting the course of the river eastward. Memphis was the chief city of the 1st nome of Lower Egypt; in its early days it was known as "the white walls" or the "white wall," a name which clung to its citadel down to Herodotus's day. The residence here of Pepi I. of the VIth Dynasty, as well as his pyramid in the necropolis, was named *Mn-nfr*, and this gradually became the usual designation of the whole city, becoming Menfi, Membi in late Egyptian, *i.e.* Memphis. It was also called Hakeptah, "Residence of the *ka* of Ptah," and this name furnishes a possible origin for that of Egypt (Αἴγυπτος). Various dynasties had their ancestral seats elsewhere and individual kings built their palaces and pyramids at some distance up or down the valley, but Memphis must have been generally the centre of the government and the largest city in Egypt until the New Empire (Dyns. XVIII.–XX.), when Thebes took the lead. In the succeeding period it regained its ancient position. The government of the Persian satrap was seated in Memphis. After the conquest of Alexander the city quickly lost its supremacy to his new foundation, and although it remained the greatest native centre, its population was less than that of Alexandria. In the time of Strabo (xvii. 807) it was the second city of Egypt, inferior only to Alexandria, and with a mixed population like the latter. Memphis was still important though declining at the time of the Moslem conquest. Its final fall was due to the rise of the Arabic city of Fostāt on the right bank of the Nile almost opposite the northern end of the old capital; and its ruins, so far as they still lay above ground, gradually disappeared, being used as a quarry for the new city, and afterwards for Cairo. The remains of "Menf" were still imposing late in the 12th century, when they were described by ʿAbdallatif. Now the ruins of the city, the great temple of Ptah, the dwelling of Apis, and the palaces of the kings, are traceable only by a few stones among the palm trees and fields and heaps of rubbish. But the necropolis has been to a great extent protected by the accumulations of blown sand. Pyramids of the Old and Middle kingdoms form a chain 20 m. long upon the edge of the valley from Giza to Dahshur. At Saqqara, opposite Memphis itself, the step-pyramid of Zoser of the IIIrd Dynasty, several pyramids of the Vth and VIth Dynasties, and innumerable mastaba-tombs of the Old Kingdom, are crowded together in the cemetery. Later tombs are piled upon and cut through the old ones. One of the chief monuments is the Serapeum or sepulchre of the Apis bulls, discovered by Mariette in 1851. From 1905 J. E. Quibell was charged by the Service des Antiquités solely with the excavations in this vast necropolis. His principal discovery has been the extensive remains of the Coptic monastery of St Jeremias, with remarkable sculptures and frescoes. Flinders Petrie began the systematic exploration of the ruins of Bedreshēn, and in three seasons cleared up much of the topography of the ancient city, identifying the mound of the citadel and palace, a foreign quarter, &c. Among his finds not the least interesting is a large series of terra-cotta heads representing the characteristic features of the foreigners who thronged the bazaars of Memphis. They date from the Persian rule down to the Ptolemaic period and are evidently modelled by Greek workmen. In the Old Testament Memphis is mentioned under the names of Moph (Hos. ix. 6) and Noph (Isa. xix. 13; Jer. ii. 16; Ezek. xxx. 13, 16).

See J. de Morgan, *Carte de la nécropole memphite* (Cairo, 1897); Baedeker's *Egypt*; J. E. Quibell, *Excavations at Saqqara* (2 vols., Cairo, 1908–1909); W. M. Flinders Petrie, *Memphis I.* and *The Palace of Apries* (*Memphis II.*) (London, 1909). (F. Ll. G.)

MEMPHIS, a port of entry and the largest city of Tennessee, U.S.A., and the county-seat of Shelby county, on the Mississippi river, in the S.W. corner of the state. Pop. (1860), 22,623; (1870), 40,226; (1880), 33,592; (1890), 64,495; (1900), 102,320, of whom 5110 were foreign-born and 49,910 were negroes; (1910 census) 131,105. It is served by the Chicago, Rock Island & Pacific, the St Louis & San Francisco, the Illinois Central, the Southern, the Louisville & Nashville, the Nashville, Chattanooga & St Louis, the St Louis South-Western, the St Louis, Iron Mountain & Southern and the Yazoo & Mississippi Valley railways, and by steamboats on the Mississippi. The river is spanned here by a cantilever railway bridge 1895 ft. long, completed in 1892. The city is finely situated on the fourth Chickasaw Bluffs, more than 40 ft. above high water; the streets are broad, well paved and pleasantly shaded; and a broad levee overlooks the river. In Court Square, in the heart of the city, are many fine old trees and a bust of President Andrew Jackson. In 1909 the city had about 1000 acres of parks and 11½ m. of parkways, besides two race-courses. Overton Park has beautiful playgrounds and a good zoological collection. Five miles from Memphis is a National Cemetery. Among the prominent buildings are the United States Government building, the county Court house, Cotton Exchange, Business Men's Club, Goodwyn Institute, containing an auditorium and the public library, the Cossett Free Library, Grand Opera House, Lyceum Theatre, Auditorium, Gayoso Hotel, Memphis Evening Scimitar building, the Union and Planters' Bank and Trust Company building, Equitable building, Memphis Trust building, Tennessee Trust building, the Bank of Commerce, Woman's building (containing offices for business women), Masonic Temple, Odd Fellows' building and the Commercial Appeal building. Among educational institutions are the College of Christian Brothers (Roman Catholic, opened in 1871), Memphis Hospital Medical College, College of Physicians and Surgeons, Hannibal Medical College for negroes and Le Moyne Normal Institute, also for negroes. Memphis is the see of a Protestant Episcopal bishopric. The city is supplied with water from more than eighty artesian wells, having an average depth of about 400 ft.

Owing to its situation at the head of deep water navigation on the Mississippi, Memphis has become a leading commercial city of the southern states; its trade in cotton, lumber, groceries, mules and horses is especially large. The city also manufactures large quantities of cotton-seed oil and cake, lumber, flour and grist-mill products, foundry and machine-shop products, confectionery, carriages and wagons, paints, furniture, bricks, cigars, &c. The Illinois Central and the St Louis & San Francisco railways have workshops here. The total value of the city's manufactures increased from $13,244,538 in 1890 to $17,923,059 ($14,233,483 being factory product) in 1900, and to $21,346,817 (factory product) in 1905, an increase of 50% over the value of the factory product in 1900.

Chickasaw Bluffs were named from the Chickasaw Indians, who were in possession when white men first came to the vicinity. Late in the 17th century the French built a fort on the site of Memphis, and during most of the 18th century this site was held either by the French or the Spanish. In 1797 it passed into the possession of the United States. By a treaty of the 19th of October 1818, negotiated by General Andrew Jackson and General Isaac Shelby, the Chickasaws ceded all their claims east of the Mississippi, and early in 1819 Memphis was laid out in accordance with an agreement entered into by John Overton (1766–1833), Andrew Jackson and James Winchester (1752–1826), the proprietors of the land. Its name was suggested from the similarity of its situation on the Mississippi to that of the Egyptian city on the Nile. Memphis was incorporated as a town in 1827, and in 1849 was chartered as a city. Near Memphis, on the 6th of June 1862, a Union fleet of 9 vessels and 68 guns, under Commander Charles Henry Davis (1807–77), defeated a Confederate fleet of 8 vessels and 28 guns under Commander J. E. Montgomery after a contest of little more than one hour, three of the Confederate vessels being destroyed and four of them captured, and from this victory until the close of the war the city was in possession of the Union forces. In August 1864, however, a Confederate force under General N. B. Forrest raided it and captured several hundred prisoners. The decrease of population between 1870 and 1880 was due to the ravages of yellow fever in 1873, 1878 and 1879. The epidemic of 1873 resulted in over two thousand deaths, and that of 1878 in a total of 5150, of whom 4250 were whites and 900 negroes. At the return of the fever in 1879 better care and strict quarantine arrangements prevailed, but there were 497 deaths. During the epidemics of 1878 and 1879 fully two-thirds of the population fled from the city, many of whom died of the fever at other places, and a still larger number did not return. For three months during each year business was suspended, and all ingress or egress except for the most necessary purposes was forbidden. The city was left almost bankrupt, and as a means of relief the legislature of the state in January 1879 repealed the city's charter, and, assuming exclusive control of its taxation and finances, constituted it simply a "taxing district," placing its government in the hands of a "legislative council." This anomalous proceeding was declared constitutional by the supreme court of Tennessee. Subsequently the streets were cleansed and repaved, an improved sewer system was put in operation, and the water supply was obtained from artesian wells. In 1891 a new city charter was obtained, and in 1907 the "Houston plan" (see Houston, Texas) was adopted for Memphis by the state legislature. The act, however, was declared unconstitutional by the state supreme court, on the ground that it would force elected officers out of office before the expiration of their constitutional terms; and in 1909 a new charter on the Houston plan was adopted by the legislature, to become effective on the 1st of January 1910, providing for a government by five commissioners, each having charge of a separate department.

See J. M. Keating, *History of the City of Memphis and Shelby County, Tennessee* (Syracuse, 1888); James Phelan, *History of Tennessee* (Boston, 1889).

MENA, JUAN DE (1411–1456), Spanish poet, was born at Córdova in 1411. In his twenty-fourth year he matriculated at the university of Salamanca, and studied later at Rome. His scholarship obtained for him the post of Latin secretary at the court of Castille; subsequently he became historiographer to John II. and magistrate at Córdova. According to the *Epicedio* of Valerio Francisco Romero, Mena died from natural causes in 1456; popular tradition, however, ascribes his death to a fall from his mule. Though nominally the king's chronicler, Mena had no share in the *Crónica de Don Juan II.*; the statement that he wrote the first act of the *Celestina* (*q.v.*) is rejected; but three authentic specimens of his cumbrous prose exist in the commentary to his dull poem entitled *La Coronacion* or *Calamacileos*, in the *Iliada en romance* (an abridged version of Homer), and in the unpublished *Memorias de algunos linajes antiguas é nobles de Castilla*. He is conjectured to be the author of the satirical *Coplas de la panadera*; but, apart from the fact that these verses are ascribed by Argote de Molina to Iñigo Ortiz de Zúñiga, they are instinct with a tart humour of which Mena was destitute. His principal work is his allegorical poem, *El Laberinto de Fortuna*, dedicated to John II.; in the oldest manuscripts it consists of 297 stanzas, but three more stanzas were added to it later, and hence the alternative, popular title of *Las Trezientas*. The *Laberinto* is modelled on Dante, and further contains reminiscences of the *Roman de la rose*, as well as episodes borrowed from Virgil and Lucan. It is marred by excessive emphasis and pedantic diction, and the *arte mayor* measure in which it is written is monotonous; but many octaves are of such excellence that the *arte mayor* metre continued in fashion for nearly a century. The poem, as a whole, is tedious; yet its dignified expression of patriotic spirit has won the admiration of Spaniards from Cervantes' time to our own.

A critical edition of the *Laberinto* has been issued by R. Foulché-Delbosc (Mâcon, 1904).

MENA, PEDRO DE (*d.* 1693), Spanish sculptor, was born in Adra. He was a pupil of his father as well as of Alonzo Cano. His first conspicuous success was achieved in work for the convent El Angel at Granada, including figures of St Joseph, St Antony of Padua, St Diego, St Pedro Meántara, St Franciscus and Santa Clara. In 1658 he signed a contract for sculptural work on the choir stalls of the cathedral at Malaga—this work extending over four years. Other works are, statues of the Madonna and child and of St Joseph in Madrid, the polychromatic figures in the church of St Isodoro, the Magdalena and the Gertrudis in the church of St Martin (Madrid), the crucifixion in the Nuestra Señora de Gracia (Madrid), the statuette of St Francis of Assisi in Toledo, and of St Joseph in the St Nicholas church in Murcia. Between 1673 and 1679 Mena worked at Cordova. About 1680 he was in Granada, where he executed a half-length Madonna and child (seated) for St Dominicos. Mena died in Malaga in 1693. He and Mora (*q.v.*) may be regarded as artistic descendants of Montañes and Alonzo Cano, but in technical skill and the expression of religious motive his statues are unsurpassed in the sculpture of Spain. His feeling for the nude was remarkable. Like his immediate predecessors he excelled in the portrayal of contemplative figures and scenes; Mena's drawing of Santiago leaping upon his charger is good, and the carving admirable, but the necessary movement for so spirited an action is lacking.

See B. Haendcke, *Studien zur Geschichte der spanischen Plastik* (Strassburg, 1900).

MENABREA, LUIGI FEDERICO, Marquis of Valdora (1809–1896), Italian general and statesman, was born at Chambéry on the 4th of September 1809. He was educated at the university of Turin, where he qualified as an engineer and became a doctor of mathematics. As an officer of engineers he replaced Cavour in 1831 at the fortress of Bardo. He then became professor of mechanics and construction at the military academy and at the university of Turin. King Charles Albert sent him in 1848 on diplomatic missions to secure the adhesion of Modena and Parma to Sardinia. He entered the Piedmontese parliament, and was attached successively to the Ministries of War and Foreign Affairs. He belonged to the right centre, and until the events of 1859 he believed in the possibility of a compromise between the Vatican and the state. He was major-general and commander-in-chief of the engineers in the Lombard campaign of 1859. He superintended the siege works against Peschiera, was present at Palestro and Solferino, and repaired the fortifications of some of the northern fortresses. In 1860 he became lieutenant-general and conducted the siege of Gaeta. He was appointed senator and received the title of count. Entering the Ricasoli cabinet of 1861 as minister of marine, he held the portfolio of public works until 1864 in the succeeding Farini and Minghetti cabinets. After the war of 1866 he was chosen as Italian plenipotentiary for the negotiation of the treaty of Prague and for the transfer of Venetia to Italy. In October 1867 he succeeded Rattazzi in the premiership, and was called upon to deal with the difficult situation created by Garibaldi's invasion of the Papal States and by the catastrophe of Mentana. Menabrea disavowed Garibaldi and instituted judicial proceedings against him; but in negotiations with the French government he protested against the retention of the temporal power by the pope and insisted on the Italian right of interference in Rome. He was in the secret of the direct negotiations between Victor Emanuel and Napoleon III. in June 1869, and refused to entertain the idea of a French alliance unless Italy were allowed to occupy the Papal States, and, on occasion, Rome itself. On the eve of the assembly of the Oecumenical Council at Rome Menabrea reserved to the Italian government its right in respect of any measures directed against Italian institutions. He withdrew from seminary students in 1869 the exemption from military service which they had hitherto enjoyed. Throughout his term of office he was supported by the finance minister Count Cambray Digny, who forced through parliament the grist tax proposed by Quintino Sella, though in an altered form from the earlier proposal. After a series of changes in the cabinet, and many crises, Menabrea resigned in December 1869 on the election of a new chamber in which he did not command a majority. He was made marquis of Valdora in 1875. His successor in the premiership, Giovanni Lanza, in order to remove him from his influential position as aide-de-camp to the king, sent him to London as ambassador, where he remained until in 1882 he replaced General Cialdini at the Paris Embassy. Ten years later he withdrew from public life, and died at Saint Capin on the 24th of May 1896.

MÉNAGE, GILLES (1613–1692), French scholar, son of Guillaume Ménage, king's advocate at Angers, was born in that city on the 15th of August 1613. A tenacious memory and an early enthusiasm for learning carried him speedily through his literary and professional studies, and he practised at the bar at Angers as early as 1632. In the same year he pleaded several causes before the parlement of Paris, but illness induced him to abandon the legal profession for the church. He became prior of Montdidier without taking holy orders, and lived for some years in the household of Cardinal de Retz (then coadjutor to the archbishop of Paris), where he had leisure for literary pursuits. Some time after 1648 he quarrelled with his patron and withdrew to a house in the cloister of Notre-Dame, where he gathered round him on Wednesday evenings those literary assemblies which he called "*Mercuriales.*" Chapelain, Pellisson, Conrart, Sarrazin and Du Bos were among the *habitués.* He was admitted to the Della Cruscan Academy of Florence, but his caustic sarcasm led to his exclusion from the French Academy. Ménage made many enemies and suffered under the satire of Boileau and of Molière. Molière immortalized him as the pedant Vadius in *Les Femmes savantes*, a portrait Ménage pretended to ignore. He died in Paris on the 23rd of July 1692.

Of his works the following may be mentioned: *Poemata latina, gallica, graeca, et italica* (1656); *Origini della lingua italiana* (1669); *Dictionnaire étymologique* (1650 and 1670); *Observations sur la langue française* (1672–1676), and *Anti-Baillet* (1690).

MENAGERIE, a collection of wild animals kept for show or exhibition. The word is particularly applied to travelling exhibitions of wild animals, attached to a circus or other show, "zoological gardens" (*q.v.*) being the term generally applied to large stationary and permanent exhibitions, arranged on a scientific system. The French *ménagerie* (from *ménage*, O. Fr. *mesnage*, Lat. *mansionaticum*, *mansio*, house, cf. "manage") originally meant the administration of a household or farm, with special reference to the live stock.

MENAHEM (Hebrew for "consoler"), a king of Israel. He was the son of Gadi (*i.e.* perhaps, a man of Gad), and during the disturbances at the death of Jeroboam II. seized the throne and reigned ten years (2 Kings xv. 14–18). The scene of his revolt was Tirzah, the old seat of the kings of Israel between Jeroboam I. and Omri (which period the present closely resembles), and it was only after perpetrating nameless cruelties at Tappuah[1] on the border of Ephraim and Mannasseh that the counter revolt of Shallum, son of Jabesh (perhaps a Gileadite), was suppressed. Towards the end of his reign Tiglath-Pileser IV. marched against north Syria, and among his tributaries mentions Menahem[2] together with Rezin of Damascus, and kings of Tyre, Gebal, &c. (*c.* 738 B.C.). According to the Old Testament account the Assyrian king even advanced against Israel, and only withdrew in consideration of a tribute amounting to about £400,000. A thousand talents (*i.e.* about 3,000,000 shekels) was raised by assessing every wealthy person at 50 shekels. The act was hardly popular, and the internal troubles which he had quelled broke out again at or shortly after his death. The Gileadites again conspired, and having slain his son Pekahiah set up Pekah the son of Remaliah in his place.[1] This meant a return to an anti-Assyrian policy. (See AHAZ.) (S. A. C.)

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[1] Scarcely Tiphsah (2 Kings xv. 16) on the Euphrates.

[2] The identification of the Israelite king with Me-ni-hi-(im)-mi of Sa-me-ri-na-ai on the Ass. inscription has been unnecessarily doubted.

MENAI STRAITS, a channel of the Irish Sea, separating Anglesea from Carnarvonshire, N. Wales, extending 14 m. from Beaumaris to Abermenai, and varying in breadth from 200 yds. to 2 m. It is famous for the suspension and tubular bridges which cross it. The suspension bridge carries the Holyhead road from Bangor. Designs were prepared by T. Telford. It was begun in 1819; the first chain carried over in April 1825; the last in July of the same year, and the bridge opened to the public the 30th of January 1826. The cost was £120,000. The length of the chains (from rock-fastenings) is 1715 ft., and between the piers 590 ft.; the length of the roadway between the piers is 550 ft. and the total roadway length 1000 ft.; the height of the roadway from the spring tide high-water level is 100 ft.; the breadth of the roadway including two carriage-ways and a footpath is 30 ft. The sixteen suspending chains are carried 60 ft. through rock. Their sustaining power has been calculated at 2016 tons, while the whole weight of the suspended part of the bridge is only 489 tons. During a gale a slight oscillation is noticeable on the bridge itself and from the shore. The tubular bridge carries the London & North Western railway. Here the channel is about 1100 ft. wide, and divided in the middle by the Britannia Rock, bare at low water. The tide generally rises 20 ft., with great velocity. The principal measurements are: each abutment 176 ft.; from abutment to side tower, 230 ft.; from side tower to central tower, 460 ft.; breadth of each side tower at road-level, 32 ft.; breadth of centre tower, 45 ft. 5 in. The total length of the roadway is 1841 ft. 5 in. The Britannia tower measures at its base 62 by 52½ ft.; with a total height of 230 ft. There are 101 ft. between the sea at high tide and the bridge roadway bottom. The limestone used is from Penmon, 4 m. from Beaumaris. Four stone lions couchant guard the approaches to the bridge. The first tube of the tubular bridge was deposited in its place on the 9th of November 1849, the last on the 13th of September 1850. The total cost was £621,865. The engineer of the tubular bridge was Robert Stephenson, who was assisted by Sir William Fairbairn and Eaton Hodgkinson.

MENAM, or ME NAM (literally the "mother water" or "main river"), a river of Siam, the chief highway of the interior, on whose yearly rise and fall depends the rice crop of Lower Siam. Rising in the Lao or Siamese Shan state of Nan, at a height of 1400 ft. upon the shoulders of the mountain mass of Doi Luang, it is first known as the Nam Ngob, after a village of that name. As the Nam Nan, still a mountain stream, it flows southward through the state so named between high forested ranges, and, notwithstanding the frequent rapids along its course, the natives use it in dug-outs for the transport of hill produce. From Utaradit, where it leaves the hills of the Lao country, it flows southward through the plain of Lower Siam, and is navigable for flat-bottomed native craft of considerable capacity. It is here known as the Nam, or Menam Pichai. Below Pichai the river flows through forest and swamp, the latter providing vast overflow basins for the yearly floods. Thousands of tons of fish are caught and cured here during the fall of the river after the rains. Below Pitsunalok the waters of the Menam Yom, the historic river of Siam, upon which two of its ancient capitals, Sawankalok and Sukotai, were situated, meander by more than one tortuous clayey channel to the main river, and combine to form the Nam Po. At Paknam Po the main western tributary comes in, the shallow Me Ping, the river of Raheng and Chieng Mai, bringing with it the waters of the Me Wang. As the chief duty-station for teak, which is floated in large quantities down all the upper branches of the river and as a place of transshipment for boats, Paknam Po is an important and growing town. From this point southwards the river winds by many channels through the richest and most densely populated portion of Siam. About Chainat the Tachin branches off, forming the main western branch of the Menam, and falling into the gulf at a point about 24 m. west of the bar of the main or Bangkok river. At Ayuthia, another of the ancient capitals of Siam, the Nam Sak flows in from the north-east, an important stream affording communication with the rich tobacco district of Pechabun, and draining the western slopes of the Korat escarpment.

MENANDER (342–291 B.C.), Greek dramatist, the chief representative of the New comedy, was born at Athens. He was the son of well-to-do parents; his father Diopeithes is identified by some with the Athenian general and governor of the Thracian Chersonese known from the speech of Demosthenes *De Chersoneso*. He doubtless derived his taste for the comic drama from his uncle Alexis (*q.v.*). He was the friend and associate, if not the pupil, of Theophrastus, and was on intimate terms with Demetrius of Phalerum. He also enjoyed the patronage of Ptolemy Soter, the son of Lagus, who invited him to his court. But Menander, preferring independence and the company of his mistress Glycera in his villa in the Peiraeus, refused. According to the note of a scholiast on the *Ibis* of Ovid, he was drowned while bathing; his countrymen built him a tomb on the road leading to Athens, where it was seen by Pausanias. A well-known statue in the Vatican, formerly thought to represent Marius, is now generally supposed to be Menander (although some distinguished archaeologists dispute this), and has been identified with his statue in the theatre at Athens, also mentioned by Pausanias.

Menander was the author of more than a hundred comedies, but only gained the prize eight times. His rival in dramatic art and also in the affections of Glycera was Philemon (*q.v.*), who appears to have been more popular. Menander, however, believed himself to be the better dramatist, and, according to Aulus Gellius, used to ask Philemon: "Don't you feel ashamed whenever you gain a victory over me?" According to Caecilius of Calacte (Porphyry in Eusebius, *Praep. evan.* x. 3, 13) he was guilty of plagiarism, his Δεισιδαίμων being taken bodily from the Οἰωνιστής of Antiphanes. But, although he attained only moderate success during his lifetime, he subsequently became the favourite writer of antiquity. Copies of his plays were known to Suïdas and Eustathius (10th and 11th centuries), and twenty-three of them, with commentary by Psellus, were said to have been in existence at Constantinople in the 16th century. He is praised by Plutarch (*Comparison of Menander and Aristophanes*) and Quintilian (*Instit.* x. l. 69), who accepted the tradition that he was the author of the speeches published under the name of the Attic orator Charisius. A great admirer and imitator of Euripides, he resembles him in his keen observation of practical life, his analysis of the emotions, and his fondness for moral maxims, many of which have become proverbial: "The property of friends is common," "Whom the gods love die young," "Evil communications corrupt good manners" (from the *Thaïs*, quoted in 1 Cor. xv. 33). These maxims (chiefly monostichs) were afterwards collected, and, with additions from other sources, were edited as Μενάνδρου γνῶμαι μονόστιχοι, a kind of moral textbook for the use of schools.

Menander found many Roman imitators. The *Eunuchus*, *Andria*, *Heautontimorumenos* and *Adelphi* of Terence (called by Caesar "dimidiatus Menander") were avowedly taken from Menander, but some of them appear to be adaptations and combinations of more than one play; thus, in the *Andria* were combined Menander's 'Ανδρία and Περινθία, in the *Eunuchus* the Εὐνοῦχος and Κόλαξ, while the *Adelphi* was compiled partly from Menander and partly from Diphilus. The original of Terence's *Hecyra* (as of the *Phormio*) is generally supposed to be, not Menander, but Apollodorus of Carystus. The *Bacchides* and *Stichus* of Plautus were probably based upon Menander's Δὶς 'Εξαπατῶν and Φιλάδελφοι, but the *Poenulus* does not seem to be from the Καρχηδόνιος, nor the *Mostellaria* from the Φάσμα, in spite of the similarity of titles. Caecilius Statius, Luscius Lavinius, Turpilius and Atilius also imitated Menander. He was further credited with the authorship of some epigrams of doubtful authenticity; the letters addressed to Ptolemy Soter and the discourses in prose on various subjects mentioned by Suïdas are probably spurious.

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[1] The chronology in xv. 2, 23, 32, appears to confuse Pekah and Pekahiah, and the view has been held that they were originally one and the same; cf. Cheyne, *Ency. Bib.*, col. 3643.

Till the end of the 19th century, all that was known of Menander were the fragments collected by A. Meineke (1855) and T. Kock, *Comicorum atticorum fragmenta*, iii. (1888). They consist of some 1650 verses or parts of verses, in addition to a considerable number of words quoted expressly as from Menander by the old lexicographers. From 1897 to 1907 papyri were discovered in different parts of Egypt, containing fragments of considerable length, amounting to some 1400 lines. In 1897, about eighty lines of the Γεωργός; in 1899, fifty lines of the Περικειρομένη; in 1903, one hundred lines (half in a very mutilated condition) from the Κόλαξ; in 1906, two hundred lines from the middle of the Περικειρομένη, the part previously discovered containing the *dénouement*; five hundred lines from the 'Επιτρέποντες, generally well preserved; sixty-three lines (the prologue, list of characters, and the first scene), from the Ἥρως; three hundred and forty lines from the Σαμία (the identification of the two last plays is not considered absolutely certain); and twenty lines from an unknown comedy. Subsequently, part of a third copy of the Περικειρομένη was found in Egypt, some one hundred and forty lines, half of which were already known, while the remainder were new (*Abhandlungen der königl.-sächsischen Gesellschaft der Wissenschaften*, Leipzig), 1908.

It is doubtful whether these fragments, which are of sufficient length to afford a basis for the consideration of the merits of Menander as a writer of comedies, justify the great reputation enjoyed by him in ancient times. With the exception of a scene in the 'Επιτρέποντες, which would appeal to the litigious Athenians, they contain little that is witty or humorous; there is little variety in the characters, the situations are conventional, and the plots, not of a highly edifying character, are lacking in originality. Menander's chief excellences seem to be facility of language, accurate portrayal of manners, and naturalness of the sentiments which he puts into the mouth of his dramatis personae. It is remarkable that the maxims, which form the chief part of the earlier collections of fragments, are few in the later.

On Menander generally see monographs by C. Benoît (1854) and G. Guizot (1855); J. Geffcken, *Studia zu Menander* (1898); H. Lübke, *Menander und seine Kunst* (1892); J. Denis, *La Comédie grecque* (1886), vol. ii.; H. Weil, *Études sur l'antiquité grecque* (1900). Editions of the fragments: Γεωργός, by J. Nicole, with translation and notes (1898) and by B. P. Grenfell and A. S. Hunt, with revised text and translation (1898); the Ἥρως, 'Επιτρέποντες, Περικειρομένη, Σαμία, by G. Lefebvre and M. Croiset, with introduction, notes and translation (Cairo, 1907); J. van Leeuwen, with Latin notes (2nd ed., 1908); L. Bodin and P. Mazon, *Extraits de Ménandre* (*Samia* and *Epitrepontes*, 1908); E. Croiset, *L'Arbitrage*, critical ed. and translation (1908); C. Robert, *Der neue Menander* (text reconstructed, 1908); Wilamowitz-Möllendorff, "Der Menander von Kairo" in *Neue Jahrbücher für das klassische Altertum* (1908), pp. 34–62; German trans. by C. Robert, *Szenen aus Menander* (1908); English by Unus Multorum (1909). See also Wilamowitz-Möllendorff, "Der Landmann des Menandros" in *Neue Jahrbücher* (1899), p. 513; C. Dziatzko, "Der Inhalt des Georgos von Menander," in *Rhein. Mus.* liv. 497, lv. 104; F. Leo, "Der Neue Menander" in *Hermes*, xliii. 120; E. Capps, "The Plot of Menander's *Epitrepontes*" in *Amer. Journ. of Philology* (1908), p. 410; A. Kretschmar, *De Menandri reliquiis nuper repertis* (1906); F. G. Kenyon in *Quarterly Review* (April, 1908); *The Times Literary Supplement* (Sept. 20, 1907); *Athenaeum* (Oct. 23, 1897; Aug. 1, 1908; Oct. 24, 1908); and list of articles in periodicals in Van Leeuwen's edition. (J. H. F.)

MENANDER (MILINDA), a Graeco-Indian dynast. When the Graeco-Indian king Demetrius had been beaten by Eucratides of Bactria, about 160 B.C., and the kingdom of Eucratides (*q.v.*) dissolved after his assassination (*c.* 150 B.C.), a Greek dynasty maintained itself in the Kabul Valley and the Punjab. The only two kings of this dynasty mentioned by classical authors are Apollodotus and Menander, who conquered a great part of India. Trogus Pompeius described in his forty-first book (see the prologue) "the Indian history of these kings, Apollodotus and Menander," and Strabo, xi. 516, mentions from Apollodotus of Artemita, the historian of the Parthians, that Menander "conquered more tribes than Alexander, as he crossed the Hypanis to the east and advanced to the Isamus; he and other kings (especially Demetrius) occupied also Patalene (the district of Patala near Hyderabad on the head of the delta of the Indus) and the coast which is called the district of Saraostes (*i.e.* Syrastene, in mod. Gujarat, Brahman *Saurashtra*) and the kingdom of Sigerdis (not otherwise known); and they extended their dominion to the Seres (*i.e.* the Chinese) and Phryni (?)." The last statement is an exaggeration, probably based upon the fact that from the mouth of the Indus trade went as far as China. That the old coins of Apollodotus and Menander, with Greek legends, were still in currency in Barygaza (mod. Broach), the great port of Gujarat, about A.D. 70 we are told by the *Periplus maris Erythraei*, 48. We possess many of these coins, which follow the Indian standard and are artistically degenerate as compared with the earlier Graeco-Bactrian and Graeco-Indian coins, with bilingual legends (Greek and Kharoshti, see BACTRIA). Apollodotus, who must have been the earlier of the two kings, bears the titles *Soter*, *Philopator*, and "Great King"; Menander, who must have reigned a long time, as his portrait is young on some coins and old on others, calls himself *Soter* and "Just" (δίκαιος). Their reigns may be placed about 140–80 B.C. Menander appears in Indian traditions as Milinda; he is praised by the Buddhists, whose religion he is said to have adopted, and who in the *Milindapanha* or *Milinda Pañho* (see below), "the questions of Milinda" (Rhys Davids, *Sacred Books of the East*, xxxv., xxxvi.) relate his discourses with the wise Nāgasena. According to the Indians, the Greeks conquered Ayodhya and Pataliputra (Palimbothra, mod. Patna); so the conjecture of Cunningham that the river Isamus of Strabo is the Son, the great southern tributary of the Ganges (near Patna), may be true. The Buddhists praise the power and military force, the energy and wisdom of "Milinda"; and a Greek tradition preserved by Plutarch (*Praec. reip. ger.* 28, 6) relates that "when Menander, one of the Bactrian kings, died on a campaign after a mild rule, all the subject towns disputed about the honour of his burial, till at last his ashes were divided between them in equal parts." (The Buddhist tradition relates a similar story of the relics of Buddha.) Besides Apollodotus and Menander, we know from the coins a great many other Greek kings of western India, among whom two with the name of Straton are most conspicuous. The last of them, with degenerate coins, seems to have been Hermaeus Soter. These Greek dynasts may have maintained themselves in some part of India till about 40 B.C. But at this time the west, Kabul and the Punjab were already in the hands of a barbarous dynasty, most of whom have Iranian (Parthian) names, and who seem therefore to have been of Arsacid origin (cf. Vincent A. Smith, "The Indo-Parthian Dynasties from about 120 B.C. to A.D. 100," in *Zeitschrift der deutschen morgenländischen Gesellschaft*, 1906, lx. 69 sqq.). Among them Manes, two kings named Azes, Vonones and especially Gondophares or Hyndophares are the most conspicuous. The latter, whose date is fixed by an inscription from the Kabul Valley dated from the year 103 of the Samvat era (= A.D. 46), is famous by the legend of St Thomas, where he occurs as king of India under the name of Gundaphar. Soon afterwards the Mongolian Scyths (called Saka by the Indians), who had conquered Bactria in 139 B.C., invaded India and founded the great Indo-Scythian kingdom of the Kushan dynasty. (See BACTRIA; and PERSIA: *Ancient History*.) (ED. M.)

The *Milinda Pañho* is preserved in Pali, in Ceylon, Burma and Siam, but was probably composed originally in the extreme north-west of India, and in a dialect spoken in that region. Neither date nor author is known; but the approximate date must have been about the 2nd century of our era. The work is entitled *Milinda Pañho*—that is, *The Questions of King Milinda*. In it the king is represented as propounding to a Buddhist Bhikshu named Nāgasena a number of problems, puzzles or questions in religion and philosophy; and as receiving, in each case, a convincing reply. It is a matter of very little importance whether a tradition of some such conversations having really taken place had survived to the time when the author wrote his book. In any case he composed both problems and answers; and his work is an historical romance, written to discuss certain points in the faith, and to invest the discussion with the interest arising from the story in which it is set. This plan is carried out with great skill. An introduction, giving the past and present lives of Milinda and Nāgasena, is admirably adapted to fill the reader with the idea of the great ability and distinction of the two disputants. The questions chosen are just those which would appeal most strongly to the intellectual taste of the India of that age. And the style of the book is very attractive. Each particular point is kept within easy limits of space, and is treated in a popular way. But the earnestness of the author is not concealed; and he occasionally rises into a very real eloquence. The work is several times quoted as authority by Buddhaghosa, who wrote about A.D. 450, and it is the only work, not in the canon, which receives this honour.

The Milinda has been edited in Pali by V. Trenckner, and translated into English by the present writer, with introductions in which the historical and critical points made in this article are discussed in detail. There is space here to mention only one further fact. M. Sylvain Lévy, working in collaboration with M. Specht, has shown that there are two, if not three, Chinese works, written between the 5th and 7th centuries, on the Questions of Milinda. They purport to be translations of Indian works. They are not, however, translations of the Pali text. They give, with alterations and additions, the substance of the earlier part of the Pali work; and are probably derived from a recension that may be older than the Pali.

AUTHORITIES.—V. Trenckner, *Milinda-pañho* (London, 1880); Rhys Davids, *Questions of King Milinda* (2 vols., Oxford, 1890–1894); R. Garbe, *Beiträge zur indischen Kulturgeschichte* (Berlin, 1903, ch. 3, *Der Milinda-pañha*); *Milinda Prashṇaya*, in Sinhalese, (Colombo, 1877); R. Morris, in the *Academy* (Jan. 11, 1881); Sylvain Lévy, *Proceedings of the 9th International Congress of Orientalists* (London, 1892), i. 518–529, and *Journal of the Royal Asiatic Society* (1891), p. 476. (T. W. R. D.)

MENANDER, of Laodicea on the Lycus, Greek rhetorician and commentator. Two incomplete treatises on epideictic (or show) speeches have been preserved under his name, but it is generally considered that they cannot be by the same author. Bursian attributes the first to Menander, whom he placed in the 4th century, and the second to an anonymous rhetorician of Alexandria Troas, who possibly lived in the time of Diocletian. Others, from the superscription of the Paris MS., assign the first to Genethlius of Petrae in Palestine. In view of the general tradition of antiquity, that both treatises were the work of Menander, it is possible that the author of the second was not identical with the Menander mentioned by Suïdas, since the name is of frequent occurrence in later Greek literature. The first treatise, entitled Διαίρεσις τῶν ἐπιδεικτικῶν, discusses the different kinds of epideictic speeches; the second, Περὶ ἐπιδεικτικῶν, has special titles for each chapter.

Text in L. Spengel's *Rhetores graeci*, iii. 329–446, and in C. Bursian's "Der Rhetor Menandros und seine Schriften" in *Abhandl. der bayer. Akad. der Wissenschaften*, xvi. (1882); see also W. Nitsche, *Der Rhetor M. und die Scholien zu Demosthenes*; J. E. Sandys, *Hist. of Classical Scholarship* (1906), i. 338; W. Christ, *Gesch. der griechischen Litteratur* (1898), § 550.

MENANDER PROTECTOR (Προτίκτωρ, *i.e.* one of the imperial bodyguards), Byzantine historian, was born in Constantinople in the middle of the 6th century A.D. The little that is known of his life is contained in the account of himself quoted by Suïdas. He at first took up the study of law, but abandoned it for a life of pleasure. When his fortunes were low, the patronage accorded to literature by the emperor Maurice (582) encouraged him to try writing history. He took as his model Agathias (*q.v.*), who like him had been a jurist, and his history begins at the point where Agathias leaves off. It embraces the period from the arrival of the Cotriguri Hunni in Thrace during the reign of Justinian in 558 down to the death of the emperor Tiberius in 582. Considerable fragments of the work are preserved in the excerpts of Constantine Porphyrogenitus and in Suïdas. Although the style is sometimes bombastic, he is considered trustworthy and is one of the most valuable authorities for the history of the 6th century, especially on geographical and ethnographical matters. He was an eye-witness of some of the events he describes. Like Agathias, he wrote epigrams, one of which, on a Persian *magus*, who became a convert to Christianity and died the death of a martyr, is preserved in the Greek anthology (*Anth. Pal.* i. 101).

The fragments will be found in C. W. Müller, *Frag. hist. graec.* iv. 200; J. P. Migne, *Patrologia graeca*, cxiii., and L. Dindorf, *Historici graeci minores*, ii.; see also C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897).

MENANGKABOS, the most civilized of all the true Malays of Sumatra, inhabiting the mountains above Padang. Their district is regarded as the cradle of the Malay race, and thence began, about 1160, those migrations which ended in the true Malays becoming the dominant race throughout the peninsula and the Malay Archipelago. The Menangkabos are said to be the original conquerors of the island, and the real form of the word is *Menang-Karbau* ("victory of the buffalo"), in reference to a local legend of a fight between a Sumatran and Javanese buffalo, ending in victory for the former. Though converts to Islam, the ancient confederate village communes and the matriarchal system still exist. The people are divided into clans, the chiefs together forming the district council. Early in the 19th century a religious sect was founded among the Manangkabos, known as "Padris" from its zealous proselytism, or *Orang puti* (white men) from the converts being dressed in white. The tendency was towards asceticism, the chief tenet being the prohibition of opium, the use of which was made a capital offence. The sect brought a large portion of the interior of Sumatra under its rule, but the neighbouring tribes asked the Dutch to protect them, and this led to the Netherlands government acquiring the Menangkabo territory.

MÉNANT, JOACHIM (1820–1899), French magistrate and orientalist, was born at Cherbourg on the 16th of April 1820. He was educated for the law, and became vice-president of the civil tribunal of Rouen in 1878, and a member of the *cour d'appel* three years later. But he became best known by his studies on the cuneiform inscriptions. Among his works on the subject of Assyriology are: *Recueil d'alphabets des écritures cunéiformes* (1860); *Exposé des éléments de la grammaire assyrienne* (1868); *Le Syllabaire assyrien* (2 vols., 1869–1873); *Les Langues perdues de la Perse et de l'Assyrie* (2 vols., 1885–1886); *Les Pierres gravées de la Haute-Asie* (2 vols., 1883–1886). He also collaborated with Julius Oppert. He was admitted to the Academy of Inscriptions in 1887, and died in Paris on the 30th of August 1899.

His daughter DELPHINE (b. 1850) received a prize from the Academy for her *Les Parsis, histoire des communautés zoroastriennes de l'Inde* (1898), and was sent in 1900–1901 to British India on a scientific mission, of which she published a report in 1903.

MÉNARD, LOUIS NICOLAS (1822–1901), French man of letters, was born in Paris on the 19th of October 1822. His versatile genius occupied itself in turn with chemistry, poetry, painting and history. In 1843 he published, under the pseudonym of L. de Senneville, a translation of *Prométhée délivré*. Turning to chemistry, he discovered collodion in 1846, but its value was not recognized at the time; and its application later to surgery and photography brought him no advantage. Louis Ménard was a socialist, always in advance of the reform movements of his time. After 1848 he was condemned to imprisonment for his *Prologue d'une révolution*. He escaped to London, returning to Paris only in 1852. Until 1860 he occupied himself with classical studies, the fruits of which are to be seen in his *Poèmes* (1855), *Polythéisme hellénique* (1863), and two academic theses, *De sacra poesi graecorum* and *La Morale avant les philosophes* (1860). The next ten years Ménard spent chiefly among the Barbizon artists, and he exhibited several pictures. He was in London at the time of the Commune, and defended it with his pen. In 1887 he became professor at the École des Arts décoratifs, and in 1895 professor of universal history at the Hôtel de Ville in Paris. His *Rêveries d'un païen mystique* (1876), which contained sonnets, philosophical dialogues and some stories, was followed in 1896 by *Poëmes et rêveries d'un païen mystique*. Ménard died in Paris on the 12th of February 1901.

His works include: *Histoire des anciens peuples de l'Orient* (1882); *Histoire des Israélites d'après l'exégèse biblique* (1883), and *Histoire des Grecs* (1884–1886). There is an appreciation of Ménard in the opening chapter of Maurice Barrès's *Voyage de Sparte*.

MENASHA (an Indian word meaning "thorn" or "island"), a city of Winnebago county, Wisconsin, U.S.A., 88 m. N. of Milwaukee, and 14 m. N. of Oshkosh, attractively situated at the N. extremity of Lake Winnebago at its outlet into the Fox river. Pop. (1890), 4581; (1900), 5589 (1535 foreign-born); (1905, state census), 5960; (1910), 6081. Menasha is served by the Minneapolis, St Paul & Sault Ste Marie, the Chicago, Milwaukee & St Paul, and the Chicago & North-Western railways, and by an inter-urban electric railway system. Several bridges across the Fox River connect Menasha with Neenah, with which it really forms one community industrially. Doty Island, at the mouth of the river and divided about equally between the cities, is a picturesque and popular summer resort.

Menasha had good water power and among its manufactures are paper and sulphite pulp, lumber, wooden-ware and cooperage products, woollen and knit goods, leather, boats and bricks. The first white man to visit the site of Menasha was probably Jean Nicolet, who seems to have come in the winter of 1634–1635 and to have found here villages of Fox and Winnebago Indians. Subsequently there were French and English trading posts here. The city was settled permanently in 1848, and was chartered in 1874.

MENASSEH BEN ISRAEL (*c.* 1604–1657), Jewish leader, was born in Lisbon about 1604, and was brought up in Amsterdam. His family had suffered under the Inquisition, but found an asylum first in La Rochelle and later in Holland. Here Menasseh rose to eminence not only as a rabbi and an author, but also as a printer. He established the first Hebrew press in Holland. One of his earliest works *El Conciliador* won immediate reputation. It was an attempt at reconciliation between apparent discrepancies in various parts of the Old Testament. Among his correspondents were Vossius, Grotius and Huet. In 1638 he decided to settle in Brazil, as he still found it difficult to provide in Amsterdam for his wife and family, but this step was rendered unnecessary by his appointment to direct a college founded by the Pereiras.

In 1644 Menasseh met Antonio de Montesinos, who persuaded him that the North-American Indians were the descendants of the lost ten tribes of Israel. This supposed discovery gave a new impulse to Menasseh's Messianic hopes. But he was convinced that the Messianic age needed as its certain precursor the settlement of Jews in all parts of the known world. Filled with this idea, he turned his attention to England, whence the Jews had been expelled since 1290. He found much Christian support in England. During the Commonwealth the question of the readmission of the Jews was often mooted under the growing desire for religious liberty. Besides this, Messianic and other mystic hopes were current in England. In 1650 appeared an English version of the *Hope of Israel*, a tract which deeply impressed public opinion. Cromwell had been moved to sympathy with the Jewish cause partly by his tolerant leanings, but chiefly because he foresaw the importance for English commerce of the presence of the Jewish merchant princes, some of whom had already found their way to London. At this juncture Jews received full rights in the colony of Surinam, which had been English since 1650. In 1655 Menasseh arrived in London. It was during his absence that the Amsterdam Rabbis excommunicated Spinoza, a catastrophe which would probably have been avoided had Menasseh—Spinoza's teacher—been on the spot. One of his first acts on reaching London was the issue of his *Humble Addresses* to the Lord Protector, but its effect was weakened by the issue of Prynne's able but unfair *Short Demurrer*. Cromwell summoned the Whitehall Conference in December of the same year. To this conference were summoned some of the most notable statesmen, lawyers and theologians of the day. The chief practical result was the declaration of Judges Glynne and Steele that "there was no law which forbade the Jews' return to England." Though, therefore, nothing was done to regularize the position of the Jews, the door was opened to their gradual return. Hence John Evelyn was able to enter in his *Diary* under the date Dec. 14, 1655, "Now were the Jews admitted." But the attack on the Jews by Prynne and others could not go unanswered. Menasseh replied in the finest of his works, *Vindiciae judaeorum* (1656). "The best tribute to its value is afforded by the fact that it has since been frequently reprinted in all parts of Europe when the calumnies it denounced have been revived" (L. Wolf). Among those who used in this way Menasseh's *Vindiciae* was Moses Mendelssohn (*q.v.*). Soon after Menasseh left London Cromwell granted him a pension, but he died before he could enjoy it. Death overtook him at Middleburg, as he was conveying the body of his son Samuel home for burial.

Menasseh ben Israel was the author of many works, but his English tracts remain the only ones of importance. His *De termino vitae* was translated into English by Pococke, and his *Conciliator* by G. H. Lindo. Among his other works were a ritual compendium *Tesoro dos dinim*, and a treatise in Hebrew on immortality (*Nishmath ḥayim*). He was a friend of Rembrandt, who painted his portrait and engraved four etchings to illustrate his *Piedra gloriosa*. These are preserved in the British Museum.

See Graetz, *History of the Jews*, vol. v. ch. ii.; Lucien Wolf, *Menasseh ben Israel's Mission to Oliver Cromwell*, with a reprint of the English pamphlets (London, 1901); H. Adler, "A Homage to Menasseh ben Israel," in *Transactions of the Jewish Historical Society of England*, i. 25–54. (I. A.)

MENCIUS, the latinized form of Măng-tsze, "Mr Măng," or "Măng the philosopher," a Chinese moral teacher whose name stands second only to that of Confucius. His statue or spirit-tablet (as the case may be) has occupied, in the temples of the sage, since our 11th century, a place among "the four assessors," and since A.D. 1530 his title has been "the philosopher Măng, sage of the second degree."

The Măngs or Măng-suns had been in the time of Confucius one of the three great clans of Lû (all descended from the marquis Hwan, 711–694 B.C.), which he had endeavoured to curb. Their power had subsequently been broken, and the branch to which Mencius belonged had settled in Tsâu, a small adjacent principality, the name of which remains in Tsâu hsien, a district of Yenchâu Shan-tung. A magnificent temple to Mencius is the chief attraction of the district city. The large marble statue of Mencius in the courtyard shows much artistic skill, and gives the impression of a man strong in body and mind, thoughtful and fearless. His lineal representative lives in the city, and thousands of Măngs are to be found in the neighbourhood.

Mencius, who died in the year 289 B.C., had lived to a great age—some say to his eighty-fourth year, placing his birth in 372 B.C., and others to his ninety-seventh, placing it in 385. All that we are told of his father is that he died in the third year of the child, who was thus left to the care of his mother. Her virtues and dealings with her son were celebrated by a great writer in the 1st century before our era, and for two thousand years she has been the model mother of China.

Mencius is more than forty years old when he comes before us as a public character. He must have spent much time in study, investigating questions as to the fundamental principles of morals and society, and brooding over the condition of the country. The history, the poetry, the institutions and the great men of the past had received his attention. He intimates that he had been in communication with men who had been disciples of Confucius. That sage had become to him the chief of mortal men, the object of his untiring admiration; and in the doctrines which he had taught Mencius recognized the truth for want of an appreciation of which the bonds of order all round him were being relaxed, and the kingdom hastening to anarchy.

When he first comes forth from Tsâu, he is accompanied by several eminent disciples. He had probably imitated Confucius in becoming the master of a school, and encouraging the resort to it of inquiring minds that he might resolve their doubts and unfold to them the right methods of government. One of his sayings is that it would be a greater delight to the superior man to get the youth of brightest promise around him and to teach and train them than to enjoy the revenues of the kingdom. His intercourse with his followers was not so intimate as that of Confucius had been with the members of his selected circle; and, while he maintained his dignity among them, he was not able to secure from them the same homage and reverent admiration.

More than a century had elapsed since the death of Confucius, and during that period the feudal kingdom of Châu had been showing more and more of the signs of dissolution, and portentous errors that threatened to upset all social order were widely disseminated. The sentiment of loyalty to the dynasty had disappeared. Several of the marquesses and other feudal princes of earlier times had usurped the title of king. The smaller fiefs had been absorbed by the larger ones, or reduced to helpless dependence on them. Tsin, after greatly extending its territory, had broken up into three powerful kingdoms, each about as large as England. Mencius found the nation nominally one, and with the traditions of two thousand years affirming its essential unity, but actually divided into seven monarchies, each seeking to subdue the others under itself. The consequences were constant warfare and chronic misery.

In Confucius's time we meet with recluses who had withdrawn in disgust from the world and its turmoil; but these had now given place to a class of men who came forth from their retirements provided with arts of war or schemes of policy which they recommended to the contending chiefs, ever ready to change their allegiance as they were moved by whim or interest. Mencius was once asked about two of them, "Are they not really great men? Let them be angry, and all the princes are afraid. Let them live quietly, and the flames of trouble are everywhere extinguished." He looked on them as little men, and delighted to proclaim his idea of the great man in such language as the following:—

> "To dwell in love, the wide house of the world, to stand in propriety, the correct seat of the world, and to walk in righteousness, the great path of the world; when he obtains his desire for office, to practise his principles for the good of the people, and when that desire is disappointed, to practise them alone; to be above the power of riches and honours to make dissipated, of poverty and mean condition to make swerve from the right, and of power and force to make bend—these characteristics constitute the great man."

Most vivid are the pictures which Mencius gives of the condition of the people in consequence of the wars of the states. "The royal ordinances were violated; the multitudes were oppressed; the supplies of food and drink flowed away like water." It is not wonderful that, when the foundations of government were thus overthrown, speculations should have arisen that threatened to overthrow what he considered to be the foundations of truth and all social order. "A shrill-tongued barbarian from the south," as Mencius called him, proclaimed the dissolution of ranks, and advocated a return to primitive simplicity. He and his followers maintained that learning was quackery, and statesmanship craft and oppression, that prince and peasant should be on the same level, and every man do everything for himself. Another, called Yang-chû, denied the difference between virtue and vice, glory and shame. It was the same with all at death. The conclusion therefore was: "Let us eat and drink; let us gratify the ears and eyes, get servants and maidens, beauty, music, wine; when the day is insufficient, carry it on through the night. Each one for himself." Against a third heresiarch, of a very different stamp, Mencius felt no less indignation. This was Mo Tî, who found the source of all the evils of the time and of all time in the want of mutual love. He taught, therefore, that men should love others as themselves; princes, the states of other princes as much as their own; children, the parents of others as much as their own. Mo, in his gropings, had got hold of a noble principle, but he did not apprehend it distinctly nor set it forth with discrimination. To our philosopher the doctrine appeared contrary to the Confucian orthodoxy about the five relations of society; and he attacked it without mercy and with an equal confusion of thought. "Yang's principle," he said, "is 'each one for himself,' which does not acknowledge the claims of the sovereign. Mo's is 'to love all equally,' which does not acknowledge the peculiar affection due to a father. But to acknowledge neither king nor father is to be in the state of a beast. The way of benevolence and righteousness is stopped up."

On this ocean of lawlessness, wickedness, heresies and misery Mencius looked out from the quiet of his school, and his spirit was stirred to attempt the rescue of the people from misrule and error. "If Heaven," he said, "wishes that the kingdom should enjoy tranquillity and good order, who is there besides me to bring it about?" He formed his plan, and proceeded to put it in execution. He would go about among the different kings till he should find one among them who would follow his counsels and commit to him the entire administration of his government. That obtained, he did not doubt that in a few years there would be a kingdom so strong and so good that all rulers would acknowledge its superiority, and the people hasten from all quarters to crown its sovereign as monarch of the whole of China. This plan was much the same as that of Confucius had been; but, with the bolder character that belonged to him, Mencius took in one respect a position from which "the master" would have shrunk. The former was always loyal to Châu, and thought he could save the country by a reformation; the latter saw the day of Châu was past, and the time was come for a revolution. Mencius's view was the more correct, but he was not wiser than the sage in forecasting for the future. They could think only of a reformed dynasty or of a changed dynasty, ruling according to the model principles of a feudal constitution, which they described in glowing language. They desired a repetition of the golden age in the remote past; but soon after Mencius disappeared from the stage of life there came the sovereign of Ch'in, and solved the question with fire and sword, introducing the despotic empire which has since prevailed.

The question may be asked, "How, in the execution of his plan, was Mencius, a scholar, without wealth or station, to find admission to the courts of lawless and unprincipled kings, and acquire the influence over them which he expected?" The answer can only be found by bearing in mind the position accorded from the earliest times in China to men of virtue and ability. The same written character denotes both scholars and officers. They are at the top of the social scale—the first of the four classes into which the population has always been divided. This appreciation of learning or culture has exercised a powerful influence over the government under both conditions of its existence; and out of it grew the system of making literary merit the passport to official employment. The ancient doctrine was that the scholar's privilege was from Heaven as much as the sovereign's right; the modern system is a device of the despotic rule to put itself in Heaven's place, and have the making of the scholar in its own hands. The feeling and conviction out of which the system grew prevailed in the time of Mencius. The dynasties that had successively ruled over the kingdom had owed their establishment not more to the military genius of their founders than to the wisdom and organizing ability of the learned men, the statesmen, who were their bosom friends and trusted counsellors. Why should not he become to one of the princes of his day what Î Yin had been to Thang, and Thâi-kung Wang to King Wân, and the duke of Châu to Wû and Ch'ăng? But, though Mencius might be the equal of any of those worthies, he knew of no prince like Thang and the others, of noble aim and soul, who would adopt his lessons. In his eagerness he overlooked this condition of success for his enterprise. He might meet with such a ruler as he looked for, or he might reform a bad one, and make him the coadjutor that he required. On the strength of these peradventures, and attended by several of his disciples, Mencius went for more than twenty years from one court to another, always baffled, and always ready to try again. He was received with great respect by kings and princes. He would not enter into the service of any of them, but he occasionally accepted honorary offices of distinction; and he did not scruple to receive large gifts which enabled him to live and move about as a man of wealth. In delivering his message he was as fearless and outspoken as John Knox. He lectured great men, and ridiculed them. He unfolded the ways of the old sage kings, and pointed out the path to universal sway; but it was all in vain. He could not stir any one to honourable action. He confronted heresy with strong arguments and exposed it with withering sarcasm; but he could work no deliverance in the earth. The last court at which we find him was that of Lû, probably in 310 B.C. The marquis of that state had given office to Yo-chăng, one of Mencius's disciples, and he hoped that this might be the means of a favourable hearing for himself. So it had nearly happened. On the suggestion of Yo-chăng the marquis had ordered his carriage to be yoked, and was about to step into it and proceed to bring Mencius to his palace, when an unworthy favourite stepped in and diverted him from his purpose. The disciple told his master what had occurred, reproaching the favourite for his ill-timed intervention; Mencius, however, said to him, "A man's advancement or the arresting of it may seem to be effected by others, but is really beyond their power. My not finding in the marquis of Lû a ruler who would confide in me and put my lessons in practice is from Heaven."

Mencius accepted this incident as a final intimation to him of the will of Heaven. He had striven long against adverse circumstances, but now he bowed in submission. He withdrew from courts and the public arena. According to tradition he passed the last twenty years of his life in the society of his disciples, discoursing to them, and giving the finishing touches to the record of his conversations and opinions, which were afterwards edited by them, and constitute his works. Mencius was not so oracular, nor so self-contained, as Confucius; but his teachings have a vivacity and sparkle all their own.

Mencius held with Confucius—and it was a doctrine which had descended to them both from the remotest antiquity—that royal government is an institution of God. An ancient sovereign had said that "Heaven, having produced the people, appointed for them rulers, and appointed for them teachers, who should be assisting to God." Our philosopher, adopting this doctrine, was led by the manifest incompetency of all the rulers of his time to ask how it could be known on what individual the appointment of Heaven had fallen or ought to fall, and he concluded that this could be ascertained only from his personal character and his conduct of affairs. The people must find out the will of Heaven as to who should be their ruler for themselves. There was another old saying which delighted Mencius—"Heaven sees as the people see; Heaven hears as the people hear." He taught accordingly that, while government is from God, the governors are from the people;—*vox populi vox Dei.* No claim then of a "divine right" should be allowed to a sovereign if he were not exercising a rule for the good of the people. "The people are the most important element in a nation; the altars to the spirits of the land and grain are the second; the sovereign is the lightest." Mencius was not afraid to follow this utterance to its consequences. The monarch whose rule is injurious to the people, and who is deaf to remonstrance and counsel, should be dethroned. In such a case "killing is no murder." But who is to remove the sovereign that thus ought to be removed? Mencius had three answers to this difficult question. First, he would have the members of the royal house perform the task. Let them disown their unworthy head, and appoint some better individual of their number in his room. If they could not or would not do this, he thought, secondly, that any high minister, though not allied to the royal house, might take summary measures with the sovereign, assuming that he acted purely with a view to the public weal. His third and grand device was what he called "the minister of Heaven." When the sovereign had become a pest instead of a blessing, he believed that Heaven would raise up some one for the help of the people, some one who should so conduct himself in his original subordinate position as to draw all eyes and hearts to himself. Let him then raise the standard not of rebellion but of righteousness, and he could not help attaining to the highest dignity. Mencius hoped to find one among the rulers of his day who might be made into such a minister, and he counselled one and another to adopt measures with that object. It was in fact counselling rebellion, but he held that the house of Châu had forfeited its title to the throne.

A good government according to his ideal must be animated by a spirit of benevolence, and ever pursue a policy of righteousness. Its aims must be, first, to make the people well off, and next, to educate them. No one was fit to occupy the throne who could be happy while any of the people were miserable, who delighted in war, who could indulge in palaces and parks which the poorest did not in a measure share with him. Game laws received his emphatic condemnation. Taxes should be light, and all the regulations for agriculture and commerce of a character to promote and encourage them. The rules which he suggested to secure those objects had reference to the existing condition of his country, but they are susceptible of wide application. They carry in them schemes of drainage and irrigation for land, and of free trade for commerce. But it must be, he contended, that a sufficient and certain livelihood be secured for all the people. Without this their minds would be unsettled, and they would proceed to every form of wild licence. They would break the laws, and the ruler would punish them—punish those whom his neglect of his own duties had plunged into poverty, of which crime was the consequence. He would be, not their ruler, but their "trapper."

Supposing the people to be made well off, Mencius taught that education should be provided for them all. He gave the marquis of Thang a programme of four kinds of educational institutions, which he wished him to establish in his state—in the villages and the towns, for the poor as well as the rich, so that none might be ignorant of his duties in the various relations of society. But after all, unless the people could get food and clothing by their labour, he had not much faith in the power of education to make them virtuous. Give him, however, a government fulfilling the conditions that he laid down, and he was confident there would soon be a people, all contented, all virtuous. And he saw nothing to prevent the realization of such a government. Any ruler might become, *if he would,* "the minister of Heaven," who was his ideal, and the influence of his example and administration would be all-powerful. The people would flock to him as their parent, and help him to do justice on the foes of truth and happiness. Pulse and grain would be abundant as water and fire, and the multitudes, well clothed, and well principled, would sit under the shade of their mulberry trees, and hail the ruler "king by the grace of Heaven."

Opinions were much divided among his contemporaries on the subject of human nature. Some held that the nature of man is neither good nor bad; he may be made to do good and also to do evil. Others held that the nature of some men is good, and that of others bad; thus it is that the best of men sometimes have bad sons, and the worst of men good sons. It was also maintained that the nature of man is evil, and whatever good appears in it is the result of cultivation. In opposition to all these views Mencius contended that the nature of man is good. "Water," he said, "will flow indifferently to the east or west; but will it flow indifferently up or down? The tendency of man's nature to goodness is like the tendency of water to flow downwards. By striking water you may make it leap over your forehead; and by damming and leading it you may make it go up a hill. But such movements are not according to the nature of water; it is the force applied which causes them. When men do what is not good, their nature has been dealt with in this way." With various, but equally felicitous, illustration he replied to his different opponents. Sometimes he may seem to express himself too strongly, but an attentive study of his writings shows that he is speaking of our nature in its ideal, and not as it actually is—as we may ascertain, by an analysis of it, that it was intended to be, and not as it has been made to become.

Mencius insists on the constituents of human nature, dwelling especially on the principles of benevolence, righteousness, propriety, and wisdom or knowledge, the last including the judgment of conscience. "These," said he, "are not infused into us from without. Men have these four principles just as they have their four limbs." But man has also instincts and appetites which seek their own gratification without reference to righteousness or any other control. He met this difficulty by contending that human nature is a constitution, in which the higher principles are designed to rule the lower. "Some constituents of it are noble and some ignoble, some great and some small. The great must not be injured for the small, nor the noble for the ignoble."

One of his most vigorous vindications of his doctrine is the following: "For the mouth to desire flavours, the eye colours, the ear sounds, and the four limbs ease and rest belong to man's nature. An individual's lot may restrict him from the gratification of them; and in such a case the superior man will not say, 'My nature demands that pleasure, and I *will* get it.' On the other hand, there are love between father and son, righteousness between ruler and minister, the rules of ceremony between host and guest, and knowledge seen in recognizing the able and virtuous, and in the sage's fulfilling the heavenly course;—these are appointed (by Heaven). But they also belong to our nature, and the superior man will not say, 'The circumstances of my lot relieve me from them.'"

When he proceeded from his ideal of human nature to account for the actual phenomena of conduct, he was necessarily less successful. "There is nothing good," he said, "that a man cannot do; he only does not do it." But why does he not do it? Against the stubborn fact Mencius beats his wings and shatters his weapons—all in vain. He mentions a few ancient worthies who, he conceived, had always been, or who had become, perfectly virtuous. Above them all he extols Confucius, taking no notice of that sage's confession that he had not attained to conformity to his own rule of doing to others as he would have them do to him. No such acknowledgment about himself ever came from Mencius. Therein he was inferior to his predecessor: he had a subtler faculty of thought, and a much more vivid imagination; but he did not know himself nor his special subject of human nature so well.

A few passages illustrative of his style and general teachings will complete all that can be said of him here. His thoughts, indeed, were seldom condensed like those of "the master" into aphorisms, and should be read in their connexion; but we have from him many words of wisdom that have been as goads to millions for more than two thousand years. For instance:—

"Though a man may be wicked, yet, if he adjust his thoughts, fast, and bathe, he may sacrifice to God."

"When Heaven is about to confer a great office on any man, it first exercises his mind with suffering, and his sinews and bones with toil. It exposes his body to hunger, subjects him to extreme poverty, and confounds his undertakings. In all these ways it stimulates his mind, strengthens his nature, and supplies his incompetencies."

"The great man is he who does not lose his child-heart."

"The sense of shame is to a man of great importance. When one is ashamed of having been without shame, he will afterwards not have occasion for shame."

"To nourish the heart there is nothing better than to keep the desires few. Here is a man whose desires are few; in some things he may not be able to keep his heart, but they will be few. Here is a man whose desires are many; in some things he may be able to keep his heart, but they will be few."

"Benevolence is the distinguishing characteristic of man. As embodied in his conduct, it may be called the path of duty."

"There is an ordination for everything; and a man should receive submissively what may be correctly ascribed thereto. He who has the correct idea of what Heaven's ordination is will not stand beneath a tottering wall. Death sustained in the discharge of one's duties may be correctly ascribed to Heaven. Death under handcuffs and fetters cannot be correctly so ascribed."

"When one by force subdues men, they do not submit to him in heart. When he subdues them by virtue, in their hearts' core they are pleased, and sincerely submit."

Two translations of the works of Mencius are within the reach of European readers: that by Stanislaus Julien, in Latin (Paris, 1824–1829); and that forming the second volume of Legge's *Chinese Classics* (Hong-Kong, 1862). The latter has been published at London (1875) without the Chinese text. See also E. Faber, *The Mind of Mencius, or Political Economy founded on Moral Philosophy*, translated from the German by A. B. Hutchinson (London, 1882). (J. Le.)

MENDE, a town of south-eastern France, capital of the department of Lozère, 59 m. N.N.E. of Millau by rail. Pop. (1906), town 5246; commune 7007. Mende is picturesquely situated on the left bank of the Lot, and at the foot of the Mimat cliff, which rises 1000 ft. above the town, and terminates the Causse de Mende. The town is the seat of a bishopric. Its cathedral of St Peter was founded in the 14th century by Pope Urban V., a native of the district, but the two towers, respectively 280 and 210 ft. high, were added by Bishop François de la Rovère in the early part of the 16th century. Partly destroyed during the devastation of the town by the Protestants in 1579 and 1580, it was rebuilt in the 17th century, and in 1874 a statue of Urban V. was erected in front of it. A Renaissance tower of the ancient citadel now serves as the belfry of the church of the Penitents, and a 14th-century bridge crosses the Lot. The town is a convenient centre for visitors to the gorges of the Tarn. It is the seat of a prefect and a court of assizes, and has a tribunal of first instance and a chamber of commerce. The chief industry is the manufacture of serges and shalloons, known as Mende stuffs, exported to Spain, Italy and Germany.

Mende (Mimate) grew up around the hermitage, partly excavated in the side of the Mimat cliff, to which St Privat, bishop of Javols, retreated after the destruction of that town, and where he was subsequently slain by the Vandals, who had pursued him thither, about 408. In the 14th century the new town became the civil, as it had previously been the ecclesiastical, capital of the Gévaudan district.

MENDELÉEFF, DMITRI IVANOVICH (1834–1907), Russian chemist, the youngest of a family of seventeen, was born at Tobolsk, Siberia, on the 7th of February (N.S.) 1834. After attending the gymnasium of his native place, he went to study natural science at St Petersburg, where he graduated in chemistry in 1856, subsequently becoming *privatdozent*. In 1860 he went to Heidelberg, where he started a laboratory of his own, but returning to St Petersburg in 1861, he became professor of chemistry in the technological institute there in 1863, and three years later succeeded to the same chair in the university. In 1890 he resigned the professorship, and in 1893 he was appointed director of the Bureau of Weights and Measures, a post which he occupied till his death.

Mendeléeff's original work covered a wide range, from questions in applied chemistry to the most general problems of chemical and physical theory. His name is best known for his work on the Periodic Law. Various chemists had traced numerical sequences among the atomic weights of some of the elements and noted connexions between them and the properties of the different substances; but it was left to him to give a full expression to the generalization, and to treat it not merely as a system of classifying the elements according to certan observed facts, but as a "law of nature" which could be relied upon to predict new facts and to disclose errors in what were supposed to be old facts. Thus in 1871 he was led by certain gaps in his tables to assert the existence of three new elements so far unknown to the chemist, and to assign them definite properties. These three he called ekaboron, ekaaluminium, and ekasilicon; and his prophecy was completely vindicated within fifteen years by the discovery of gallium in 1871, scandium in 1879, and germanium in 1886. Again, in several cases he ventured to question the correctness of the "accepted atomic weights," on the ground that they did not correspond with the Periodic Law, and here also he was justified by subsequent investigation. In 1902, in an "attempt at a chemical conception of the ether," he put forward the hypothesis that there are in existence two elements of smaller atomic weight than hydrogen, and that the lighter of these is a chemically inert, exceedingly mobile, all-penetrating and all-pervading gas, which constitutes the aether. Mendeléeff also devoted much study to the nature of such "indefinite" compounds as solutions, which he looked upon as homogeneous liquid systems of unstable dissociating compounds of the solvent with the substance dissolved, holding the opinion that they are merely an instance of ordinary definite or atomic compounds, subject to Dalton's laws. In another department of physical chemistry he investigated the expansion of liquids with heat, and devised a formula for its expression similar to Gay-Lussac's law of the uniformity of the expansion of gases, while so far back as 1861 he anticipated T. Andrews's conception of the critical temperature of gases by defining the absolute boiling-point of a substance as the temperature at which cohesion and heat of vaporization become equal to zero and the liquid changes to vapour, irrespective of the pressure and volume. Mendeléeff wrote largely on chemical topics, his most widely known book probably being *The Principles of Chemistry*, which was written in 1868–1870, and has gone through many subsequent editions in various languages. For his work on the Periodic Law he was awarded in 1882, at the same time as L. Meyer, the Davy medal of the Royal Society, and in 1905 he received its Copley medal. He died at St Petersburg on the 2nd of February 1907.

See W. A. Tilden, "Mendeléeff Memorial Lecture," *Jour. Chem. Soc.*, 95, p. 2077.

MENDELISM. To define what some biologists call Mendelism briefly is not possible. Within recent years there has come to biologists a new idea of the nature of living things, a new conception of their potentialities and of their limitations; and for this we are primarily indebted to the work of Gregor Mendel. Peasant boy, monk, and abbot of Brünn, this remarkable man at one time interested himself in the workings of heredity, and the experiments devised by him and carried out in his cloister garden are to-day the foundation of that exact knowledge of the physiological process of heredity which biologists are rapidly extending in various directions. This extension Mendel never saw. Born in 1822 he published the account of his experiments in 1865, but it was not until 1900, eighteen years after his death, that biologists came to appreciate what he had accomplished. That year marked the simultaneous rediscovery of his work by three distinguished botanists: Hugo de Vries, C. Correns and E. Tschermak. Thenceforward Mendel's ideas have steadily gained ground, and, as the already strong body of evidence in their favour grows, they must come to exert upon biological conceptions an influence not less than those associated with the name of Darwin.

Dominant and Recessive.—Mendel chose the common pea (*Pisum sativum*) as a subject for experiment, and investigated the effects of crossing different varieties. In his method he differed from previous investigators in concentrating his attention on the mode of inheritance of a single pair of alternative characters at a time. Thus on crossing a tall with a dwarf and paying attention to this pair of characters alone, he found that the hybrids (or F_1 generation) were all tall and that no intermediates appeared. Accordingly he termed the tall character *dominant* and the dwarf character *recessive*. On allowing these hybrids to fertilize themselves in the ordinary way he obtained a further generation which on the average was composed of three talls to one dwarf. Subsequent experiment showed that the dwarfs always bred true, as did also one out of every three talls; the two remaining talls behaved as the original hybrids in giving three talls to one dwarf. Having regard to the characters, tallness and dwarfness, three and only three kinds of peas exist, viz. dwarfs which breed true, talls which breed true, and talls which give a fixed proportion of talls and dwarfs. The relation between these three forms may be briefly summarized in the subjoined scheme, in which pure tall and dwarf are represented by T and D respectively, while [T] denotes the talls which do not breed true. Experiments were also made with several other pairs of characters, and the same mode of inheritance was shown to hold good throughout.

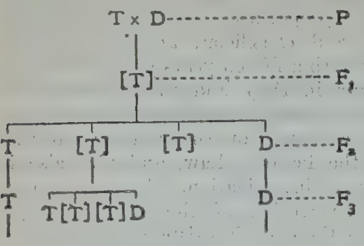


FIG. 1.

Unit-Characters.—As Mendel clearly perceived, these definite results lead inevitably to a precise conception of the constitution of the reproductive cells, or gametes; and to appreciate fully the change wrought in our point of view necessitates a brief digression into the essential features of the reproductive process. A sexual process (see SEX) is almost universal among animals and plants, and consists essentially of the union of two gametes, of which one is produced by either parent. Every gamete contains small definite bodies known as chromosomes, and the number of these is, with few known exceptions, constant for the gametes of a given species. On the fusion of two gametes the resulting cell or zygote has therefore a double structure, for it contains an equal number of chromosomes brought in by the paternal and by the maternal gamete—in the case of a plant by the pollen grain as well as by the ovule. By a process of repeated division the zygote gives rise to a plant (or an animal) whose cells apparently retain the double structure throughout. Certain of the cells of such a zygote become the germ cells and are set apart, as it were, for the formation of gametes. Histology has shown that when this occurs the cells lose the double structure which they had hitherto possessed, and that as the result of a process known as the reduction division gametes are formed in which the number of chromosomes is one half of that which characterizes the cells of the zygote. It is generally acknowledged that the chromosomes play an important part in the hereditary process, and it is possible that the divisions which they undergo in gametogenesis are connected with the observed inheritance of characters. We shall refer later to the few observations which seem to connect the two sets of phenomena.

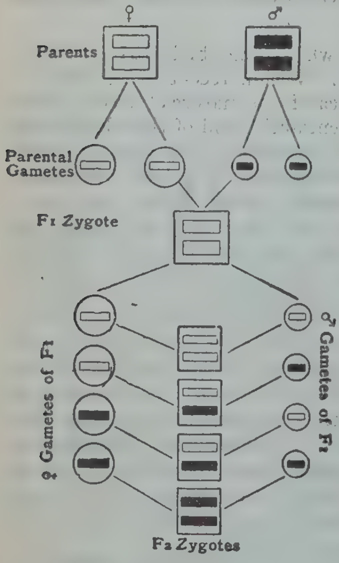


FIG. 2.

Our conception of what occurs when a cross is made between two individuals may be illustrated by the diagram which forms fig. 2. Zygotes are here represented by squares and gametes by circles. The dominant and recessive characters are indicated by small plain and black rectangles. Each zygote must contain two and each gamete but one of these unit-characters. Zygotes such as the original parents which breed true to a given character are said to be homozygous for that character, and from their nature such homozygotes must produce identical gametes. Consequently when a cross is made only one kind of zygote can be formed, viz. that containing both the dominant and recessive unit-characters. When the germ-cells of such a heterozygote split to form gametes, these, as indicated in fig. 2, will be of two sorts containing the dominant and recessive characters respectively, and will be produced in equal numbers. If we are dealing with a hermaphrodite plant such as the pea the ovules will consist of one half bearing only the dominant character and one half bearing only the recessive character; and this will be true also of the pollen grains. Consequently each dominant ovule has an equal chance of being fertilized by a dominant or by a recessive pollen grain, and the dominant ovules must therefore give rise to equal numbers of dominant homozygous and of heterozygous plants. Similarly the recessive ovules must give rise to equal numbers of recessive homozygotes and of heterozygotes. Hence of the total offspring of such a plant one quarter will be pure dominants, one quarter recessives, and one half heterozygotes as indicated in fig. 2. Where one character is completely dominant over the other, heterozygotes will be indistinguishable in appearance from the homozygous dominant, and the F_2 generation will be composed of three plants of the dominant form to each recessive. These are the proportions actually found by Mendel in the pea and by many other more recent observers in a number of plants and animals. The experimental facts are in accordance with the conception of unit-characters and their transmission from zygote to gamete in the way outlined above; and the numerical results of breeding experiments are to be regarded as proving that in the formation of gametes from the heterozygote the unit-characters are treated as unblending entities separating cleanly, or *segregating*, from one another. From this it follows that any gamete can carry but one of a pair of unit-characters and must therefore be pure for that character. The principle of the segregation of characters in gametogenesis with its natural corollary, the purity of the gametes, is the essential part of Mendel's discoveries. The quite distinct phenomenon of dominance observed by him in *Pisum* occurs in many other cases, but, as will appear below, is by no means universal.

Illustrations.—Mendelian inheritance in its simplest form, *i.e.* for a single pair of characters, has already been shown to occur in many species of animals and plants, and for many very diverse characters. In some cases complete dominance of one of the pair of unit-characters occurs; in others the form of heterozygote is more or less intermediate. Fresh cases are continually being recorded and the following short list can but serve to give some idea of the variety of characters in which Mendelian inheritance has been demonstrated.

A. Dominance nearly or quite complete. (The dominant character is given first).
Tall and dwarf habit (pea, sweet pea).
Round seed and wrinkled seed (pea).
Long pollen and round pollen (sweet pea).
Starch and sugar endosperm (maize).
Hoariness and absence of hairs (stocks, *Lychnis*).
Beardless and bearded condition (wheat).
Prickliness and smoothness of fruits (*Datura*).
Palm and fern leaf (*Primula*).
Purple and red flowers (sweet pea, stocks, &c.).
Fertility and sterility of anthers (sweet pea).
Susceptibility and immunity to rust (wheat).
Rose comb and single comb (fowls).
Black and white plumage (Rosecomb bantams).
Grey and black coat colour (rabbits, mice).
Bay and chestnut coat colour (horses).
Pigmentation and albinism (rabbits, rats, mice).
Polled and horned condition (cattle).
Short and long "Angora" coat (rabbits).
Normal and waltzing habit (mice).
Deformed hand with but two phalanges in digits and normal hand (man).

B. Absence of dominance, the heterozygote being more or less intermediate in form.
Black and white splashed plumage (Andalusian fowls).
Lax and dense ears (wheat).
Six rowed and two rowed ears (barley).

Dominance.—The meaning of this phenomenon is at present obscure, and we can make no suggestion as to why it should be complete in one case, partial in another, and entirely absent in a third. When found it is as a rule definite and orderly, but there are cases known where irregularity exists. The extra toe characteristic of certain breeds of fowls, such as Dorkings, behaves generally as a dominant character, but in certain cases it has been ascertained that a fowl without an extra toe may yet carry the extra toe character. It is possible that in some cases dominance may be conditioned by the presence of other features, and certain crosses in sheep lend colour to the supposition that sex may be such a feature. A cross between the polled Suffolk and the horned Dorset breeds results in horned rams and polled ewes only, though in the F_2 generation both sexes appear with and without horns. At present the simplest hypothesis which fits the facts is that horns are dominant in the male and recessive in the female. It is important not to confuse cases of apparent reversal of dominance such as the above with cases in which a given visible character may be the result of two entirely different causes. One white hen may give only colour chicks by a coloured cock, whilst the same cock with another white hen, indistinguishable in appearance from the former, will give only white chickens containing a few dark ticks. There is here no reversal of dominance, but, as has been abundantly proved by experiment, there are two entirely distinct classes of white fowls, of which one is dominant and the other recessive to colour.

The Presence and Absence Hypothesis.—Whether the phenomenon of dominance occur or not, the unit-characters exist in pairs, of which the members are seemingly interchangeable. In virtue of this behaviour the unit-characters forming such a pair have been termed allelomorphic to one another, and the question arises as to what is the nature of the relation between two allelomorphs. The fact that such cases of heredity as have been fully worked out can all be formulated in terms of allelomorphic pairs is suggestive, and has led to what may be called the "presence and absence" hypothesis. An allelomorphic pair represents the only two possible states of any given unit-character in its relation to the gamete, viz. its presence or its absence. When the unit-character is present the quality for which it stands is manifested in the zygote: when it is absent some other quality previously concealed is able to appear. When the unit-character for yellowness is present in a pea the seeds are yellow, when it is absent the seeds are green. The green character is underlying in all yellow seeds, but can only appear in the absence of the unit-character for yellowness, and greenness is allelomorphic to yellowness because it is the expression of absence of yellowness.

Dihybridism.—The instances hitherto considered are all simple cases in which the individuals crossed differ only in one pair of unit-characters. Mendel himself worked out cases in which the parents differed in more than one allelomorphic pair, and he pointed out that the principles involved were capable of indefinite extension. The inheritance of the various allelomorphic pairs is to be regarded as entirely independent. For example, when two individuals AA and aa are crossed the composition of the F_2 generation must be $AA + 2Aa + aa$. If we suppose that the two parents differ also in the allelomorphic pair B–b, the composition of the F_2 generation for this pair will be $BB + 2Bb + bb$. Hence of the zygotes which are homozygous for AA one quarter will carry also BB, one quarter bb, and one half Bb. And similarly for the zygotes which carry Aa or aa. The various combinations possible together with the relative frequencies of their occurrence may be gathered from fig. 3. Of the 16 zygotes there are:—

9 containing A and B 3 containing B but not A
3 ,, A but not B 1 ,, neither A nor B

In a case of dihybridism the F_1 zygote must be heterozygous for the two allelomorphic pairs, *i.e.* must be of the constitution $Aa\ Bb$. It is obvious that such a result may be produced in two ways, either by the union of two gametes, Ab and aB, or of two gametes AB and ab. In the former case each parent must be homozygous for one dominant and one recessive character; in the latter case one parent must be homozygous for both the dominant and the other for both recessive characters. The results of a cross involving dihybridism may be complicated in several ways by the reaction upon one another of the unit-characters belonging to the separate allelomorphic pairs, and it will be convenient to consider the various possibilities apart.

AA BB	AA Bb	Aa BB	Aa Bb
AA bB	AA bb	Aa bB	Aa bb
aA BB	aA Bb	aa BB	aa Bb
aA bB	aA bb	aa bB	aa bb

FIG. 3.

1. The simplest case is that in which the two allelomorphic pairs affect entirely distinct characters. In the pea tallness is dominant to dwarfness and yellow seeds are dominant to green. When a yellow tall is crossed with a green dwarf the F_1 generation consists entirely of tall yellows. Precisely the same result is obtained by crossing a tall green with a dwarf yellow. In either case all the four characters involved are visible in one or other of the parents. Of every 16 plants produced by the tall yellow F_1, 9 are tall yellows, 3 are tall greens, 3 are dwarf yellows, and 1 is a dwarf green. If we denote the tall and dwarf characters by A and a, and the yellow and green seed characters by B and b respectively, then the constitution of the F_2 generation can be readily gathered from fig. 3.

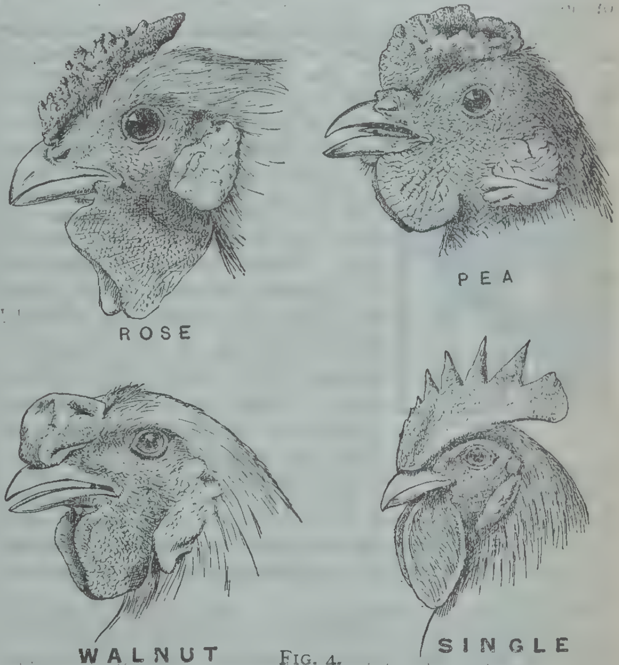


FIG. 4.

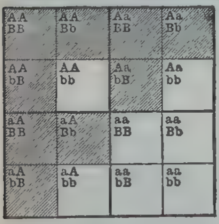
The four types of comb referred to in the text are shown here. All the drawings were made from male birds. In the hens the combs are smaller. All four types of comb are liable to a certain amount of minor variation, and the walnut especially so. The presence of minute bristles on its posterior portion, however, serves at once to distinguish it from any other comb.

2. When the two allelomorphic pairs affect the same structure we may get the phenomenon of novelties appearing in F_1 and F_2. Certain breeds of fowls have a "rose" and others a "pea" comb (fig. 4). On crossing the two a "walnut" comb results, and the offspring of such walnuts bred together consist of 9 walnuts, 3 roses, 3 peas, and 1 single comb in every 16 birds. This case may be brought into line with the scheme in fig. 3 if we consider the allelomorphic pairs concerned to

be rose (*A*) and absence of rose (*a*), and pea (*B*) and absence of pea (*b*). The zygotic constitution of a rose is therefore *AAbb*, and of a pea *aaBB*. A zygote containing both rose and pea is a walnut: a zygote containing neither rose nor pea is a single. The peculiar feature of such a case lies in the fact that absence of rose and absence of pea are the same thing, *i.e.* single; and this is doubtless owing to the fact that the characters rose and pea both affect the same structure, the comb.

3. Cases exist in which the characters due to one allelomorphic pair can only become manifest in the presence of a particular member of the other pair. If in fig. 3 the characters due to *B–b* can only manifest themselves in the presence of *A*, it is obvious that this can happen in twelve cases out of sixteen, but not in the remaining four, which are homozygous for *aa*. An example of this is to be found in the inheritance of coat colour in rabbits, rats and mice where the allelomorphic pairs concerned are wild grey colour (*B*) dominant to black (*b*) and pigmentation (*A*) dominant to albinism (*a*). Certain albinos (*aaBB*) crossed with blacks (*AAbb*) give only greys (*AaBb*), and when these are bred together they give 9 greys, 3 blacks and 4 albinos. Of the 4 albinos 3 carry the grey character and 1 does not, but in the absence of the pigmentation factor (*A*) this is not visible. The ratio 9 : 3 : 4 must be regarded as a 9 : 3 : 3 : 1 ratio, in which the last two terms are visibly indistinguishable owing to the impossibility of telling by the eye whether an albino carries the character for grey or not.

4. The appearance of a zygotic character may depend upon the coexistence in the zygote of two unit-characters belonging to different allelomorphic pairs. If in the scheme shown in fig. 3 the manifestation of a given character depends upon the simultaneous presence of *A* and *B*, it is obvious that 9 of the 16 zygotes will present this character, whilst the remaining 7 will be without it. This is shown graphically in fig. 5, where the 9 squares have been shaded and the 7 left plain. The sweet pea offers an example of this phenomenon. White sweet peas breed true to whiteness, but when certain strains of whites are crossed the offspring are all coloured. In the next generation (F_2) these F_1 plants give rise to 9 coloured and 7 whites in every 16 plants. Colour here is a compound character whose manifestation depends upon the co-existence of two factors in the zygote, and each of the original parents was homozygous for one of the two factors necessary to the production of colour. The ratio 9 : 7 is in reality a 9 : 3 : 3 : 1 ratio in which, owing to special conditions, the zygotes represented by the last three terms are indistinguishable from one another by the eye.

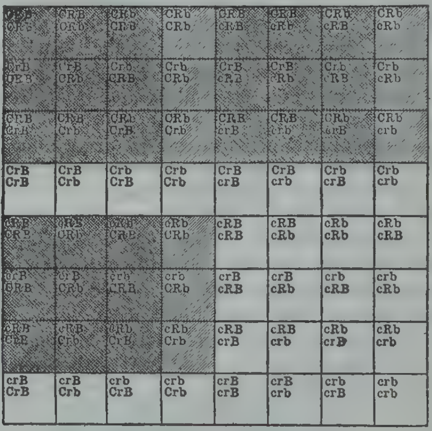


AA BB	AA Bb	Aa BB	Aa Bb
AA bB	AA bb	Aa bB	Aa bb
aA BB	aA Bb	aa BB	aa Bb
aA bB	aA bb	aa bB	aa bb

FIG. 5.

The phenomena of dihybridism, as illustrated by the four examples given above, have been worked out in many other cases for plants and animals. Emphasis must be laid upon the fact that, although the unit-characters belonging to two pairs may react upon one another in the zygote and affect its character, their inheritance is yet entirely independent. Neither grey nor black can appear in the rabbit unless the pigmentation factor is also present; nevertheless, gametic segregation of this pair of characters takes place in the normal way among albino rabbits, though its effects are never visible until a suitable cross is made. In cases of trihybridism the Mendelian ratio for the forms appearing in F_2 is 27 : 9 : 9 : 9: 3 : 3 : 3 : 1, *i.e.* 27 showing dominance of three characters, three groups of 9 each showing dominance of two characters, three groups of 3 each showing dominance of one character, and a single individual out of 64 which is homozygous for all three recessive characters. It is obvious that the system can be indefinitely extended to embrace any number of allelomorphic pairs.

Reversion.—Facts such as those just dealt with in connexion with certain cases of dihybridism throw an entirely new light upon the phenomenon known as reversion on crossing. This is now seen to consist in the meeting of factors which had in some way or other become separated in phylogeny. The albino rabbit when crossed with the black "reverts" to the wild grey colour, because each parent supplies one of the two factors upon which the manifestation of the wild colour depends. So also the wild purple sweet pea may come as a reversion on crossing two whites. In such cases the reversion appears in the F_1 generation, because the two factors upon which it depends are the dominants of their respective allelomorphic pairs. Where the reversion depends upon the simultaneous absence of two characters it cannot appear until the F_2 generation. When fowls with rose and pea combs are crossed the reversionary single comb characteristic of the wild *Gallus bankiva* first appears in the F_2 generation.



CRB CRB	CRB CRb	CRb CRB	CRb CRb	CRB cRB	CRB cRb	CRb cRB	CRb cRb
CrB CRB	CrB CRb	Crb CRB	Crb CRb	CrB cRB	CrB cRb	Crb cRB	Crb cRb
CRB CrB	CRB Crb	CRb CrB	CRb Crb	CRB crB	CRB crb	CRb crB	CRb crb
CrB CrB	CrB Crb	Crb CrB	Crb Crb	CrB crB	CrB crb	Crb crB	Crb crb
cRB CRB	cRB CRb	cRb CRB	cRb CRb	cRB cRB	cRB cRb	cRb cRb	cRb cRB
crB CRB	crB CRb	crb CRB	crb CRb	crB cRB	crB cRb	crb cRB	crb cRb
cRB CrB	cRB Crb	cRb CrB	cRb Crb	cRB crB	cRB crb	cRb crB	cRb crb
crB CrB	crB Crb	crb CrB	crb Crb	crB crB	crB crb	crb crB	crb crb

FIG. 6.

Gametic Coupling.—In certain cases the distribution of characters in heredity is complicated by the fact that particular unit-characters tend to become associated or coupled together during gametogenesis. In no case have we yet a complete explanation of the phenomenon, but in view of the important bearing which these facts must eventually have on our ideas of the gametogenic process an illustration may be given. The case in which two white sweet peas gave a coloured on crossing has already been described, and it was seen that the production of colour was dependent upon the meeting of two factors, of which one was brought in by each parent. If the allelomorphic pairs be denoted by *C–c* and *R–r*, then the zygotic constitution of the two parents must have been *CCrr* and *ccRR* respectively. The F_1 plant may be either purple or red, two characters which form an allelomorphic pair in which the former is dominant, and which may be denoted by the letters *B–b*. If *B* is brought in by one parent only the F_1 plant will be heterozygous for all three allelomorphic pairs, and therefore of the constitution *Cc Rr Bb*. In the F_2 generation the ratio of coloured to white must be 9 : 7, and of purple to red 3 : 1; and experiment has shown that this generation is composed on the average of 27 purples, 9 reds and 28 whites out of every 64 plants. The exact composition of such a family may be gathered from the accompanying table (fig. 6). So far the case is perfectly smooth, and it is only on the introduction of another character that the phenomenon of partial coupling is witnessed. Two kinds of pollen grain occur in the sweet pea. In some plants they are oblong in shape, whilst in others they are round, the latter condition being recessive to the former. If the original white parents were homozygous for long and round respectively the F_1 purple must be heterozygous, and in the F_2 generation, as experiment has shown, the ratio of longs to rounds for the whole family is 3 : 1. But among the purples there are about twelve longs to each round, the excess of longs here being balanced by the reds, where the proportion is 1 long to about 3·5 rounds. There is partial coupling of long pollen with the purple colour and a complementary coupling of the red colour with round pollen. This result would be brought about if it were supposed that seven out of every eight purple gametes produced by the F_1 plant carried the long pollen character, and that seven out of every eight red gametes carried the round pollen character. The facts observed fit in with the supposition that the gametes are produced in series of sixteen, but how such result could be brought about is a question which for the present must remain open.

Spurious Allelomorphism.—Instances of association between characters are known in which the connection is between the dominant member of one pair and the recessive of another. In many sweet peas the standard folds over towards the wings, and the flower is said to be hooded. This "hooding" behaves as a recessive towards the erect standard. Red sap colour is also recessive to purple. In families where purples and reds as well as erect and hooded standards occur it has been found, as might be expected, that erect standards are to hooded ones, and that purples are to reds as 3:1. Were the case one of simple dihybridism the F_2 generation should be composed of 9 erect purples, 3 hooded purples, 3 erect reds and 1 hooded red in every 16. Actually it is composed of 8 erect purples, 4 hooded purples and 4 erect reds. The hood will not associate with the red, but occurs only on the purples. Cases like this are best interpreted on the assumption that during gametogenesis there is some form of repulsion between the members of the different pairs—in the present instance between the factor for purple and that for the erect standard—so that all the gametes which contain the purple factor are free from the factor for the erect standard. To the process involved in this assumption the term *spurious allelomorphism* has been applied.

Sex.—On the existing evidence it is probable that the inheritance of sex runs upon the same determinate lines as that of other characters. Indeed, there occurs in the sweet pea what may be regarded as an instance of sex inheritance of the simplest kind. Most sweet peas are hermaphrodite, but some are found in which the anthers are sterile and the plants function only as females. This latter condition is recessive to the hermaphrodite one and segregates from it in the ordinary way. Most cases of sex inheritance, however, are complicated, and it is further possible that the phenomena may be of a different order in plants and animals. Instructive in this connexion are certain cases in which one of the characters of an allelomorphic pair may be coupled with a particular sex. The pale *lacticolor* variety of the currant moth (*Abraxas grossulariata*) is recessive to the normal form, and in families produced by heterozygous parents one quarter of the offspring are of the variety. Though the sexes occur in approximately equal numbers, all the *lacticolor* in such families are females; and the association of sex with a character exhibiting normal segregation is strongly suggestive of a similar process obtaining for sex also. Castle has worked out similar cases in other Lepidoptera and has put forward an hypothesis of sex inheritance on the basis of the Mendelian segregation of sex determinants. An ovum or spermatozoon can carry either the male or the female character, but it is essential to Castle's hypothesis that a male spermatozoon should fertilize only a female ovum and vice versa, and consequently on his view all zygotes are heterozygous in respect of sex. Whether any such gametic selection as that postulated by Castle occurs here or elsewhere must for the present remain unanswered. Little evidence exists for it at present, but the possibility of its occurrence should not be ignored.

More recently evidence has been brought forward by Bateson and others (3) which supports the view that the inheritance of sex is on Mendelian lines. The analysis of cases where there is a closer association between a Mendelian character and a particular sex has suggested that femaleness is here dominant to maleness, and that the latter sex is homozygous while the former is heterozygous.

Chromosomes and Unit-Characters.—Breeding experiments have established the conception of definite unit-characters existing in the cells of an organism: in the cell histology has demonstrated the existence of small definite bodies—the chromosomes. During gametogenesis there takes place what many histologists regard as a differentiating division of the chromosomes: at the same period occurs the segregation of the unit-characters. Is there a relation between the postulated unit-character and the visible chromosome, and if so what is this relation? The researches of E. B. Wilson and others have shown that in certain Hemiptera the character of sex is definitely associated with a particular chromosome. The males of *Protenor* possess thirteen chromosomes, and the qualitative division on gametogenesis results in the production of equal numbers of spermatozoa having six and seven chromosomes. The somatic number of chromosomes in the female is fourteen, and consequently all the mature ova have seven chromosomes. When a spermatozoon with seven chromosomes meets an ovum the resulting zygote has fourteen chromosomes and is a female; when a spermatozoon with six chromosomes meets an ovum the resulting zygote has thirteen chromosomes and is a male. In no other instance has any such definite relation been established, and in many cases at any rate it is certain that it could not be a simple one. The gametic number of chromosomes in wheat is eight, whereas the work of R. H. Biffen and others has shown that the number of unit-characters in this species is considerably greater. If therefore there exists a definite relation between the two it must be supposed that a chromosome can carry more than a single unit-character. It is not impossible that future work on gametic coupling may throw light upon the matter.

Heredity and Variation.—It has long been realized that the problems of heredity and variation are closely interwoven, and that whatever throws light upon the one may be expected to illuminate the other. Recent as has been the rise of the study of genetics, it has, nevertheless, profoundly influenced our views as to the nature of these phenomena. Heredity we now perceive to be a method of analysis, and the facts of heredity constitute a series of reactions which enable us to argue towards the constitution of living matter. And essential to any method of analysis is the recognition of the individuality of the individual. Constitutional differences of a radical nature may be concealed beneath apparent identity of external form. Purple sweet peas from the same pod, indistinguishable in appearance and of identical ancestry, may yet be fundamentally different in their constitution. From one may come purples, reds and whites, from another only purples and reds, from another purples and whites alone, whilst a fourth will breed true to purple. Any method of investigation which fails to take account of the radical differences in constitution which may underlie external similarity must necessarily be doomed to failure. Conversely, we realize to-day that individuals identical in constitution may yet have an entirely different ancestral history. From the cross between two fowls with rose and pea combs, each of irreproachable pedigree for generations, come single combs in the second generation, and these singles are precisely similar in their behaviour to singles bred from strains of unblemished ancestry. In the ancestry of the one is to be found no single over a long series of years, in the ancestry of the other nothing but singles occurred. The creature of given constitution may often be built up in many ways, but once formed it will behave like others of the same constitution. The one sure test of the constitution of a living thing lies in the nature of the gametes which it carries, and it is the analysis of these gametes which forms the province of heredity.

The clear cut and definite mode of transmission of characters first revealed by Mendel leads inevitably to the conception of a definite and clear-cut basis for those characters. Upon this structural basis, the unit-character, are grounded certain of the phenomena now termed variation. Varieties exist as such in virtue of differing in one or more unit-characters from what is conventionally termed the type; and since these unit-characters must from their behaviour in transmission be regarded as discontinuous in their nature, it follows that the variation must be discontinuous also. A present tendency of thought is to regard the discontinuous variation or mutation as the material upon which natural selection works, and to consider that the process of evolution takes place by definite steps. Darwin's opposition to this view rested partly upon the idea that the discontinuous variation or sport would, from the rarity of its occurrence, be unable to maintain itself against the swamping effects of intercrossing with the normal form. Mendel's work has shown that this objection is not valid, and the precision of the mode of inheritance of the discontinuous variation leads us to inquire if the small or fluctuating variation can be shown to have an equally definite physiological basis before it is admitted to play any part in the production of species. Until this has been shown it is possible to consider the discontinuous variation as the unit in all evolutionary change, and to regard the fluctuating variation as the uninherited effect of environmental accident.

The Human Aspect.—In conclusion we may briefly allude to certain practical aspects of Mendel's discovery. Increased knowledge of heredity means increased power of control over the living thing, and as we come to understand more and more the architecture of the plant or animal we realize what can and what cannot be done towards modification or improvement. The experiments of Biffen on the cereals have demonstrated what may be done with our present knowledge in establishing new, stable and more profitable varieties of wheat and barley, and it is impossible to doubt that as this knowledge becomes more widely disseminated it will lead to considerable improvements in the methods of breeding animals and plants.

It is not, however, in the economic field, important as this may be, that Mendel's discovery is likely to have most meaning for us: rather it is in the new light in which man will come to view himself and his fellow creatures. To-day we are almost entirely ignorant of the unit-characters that go to make the difference between one man and another. A few diseases, such as alcaptonuria and congenital cataract, a digital malformation, and probably eye colour, are as yet the only cases in which inheritance has been shown to run upon Mendelian lines. The complexity of the subject must render investigation at once difficult and slow; but the little that we know to-day offers the hope of a great extension in our knowledge at no very distant time. If this hope is borne out, if it is shown that the qualities of man, his body and his intellect, his immunities and his diseases, even his very virtues and vices, are dependent upon the ascertainable presence or absence of definite unit-characters whose mode of transmission follows fixed laws, and if also man decides that his life shall be ordered in the light of this knowledge, it is obvious that the social system will have to undergo considerable changes.

BIBLIOGRAPHY.—In the following short list are given the titles of papers dealing with experiments directly referred to in this article. References to most of the literature will be found in (11), and a complete list to the date of publication in (3).

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MENDELSSOHN, MOSES (1729–1786), Jewish philosopher, was born in Dessau in 1729. His father's name was Mendel, and he was later on surnamed Mendelssohn (=son of Mendel). He was the foremost Jewish figure of the 18th century, and to him is attributable the renaissance of the House of Israel. With this third Moses (the other two being the Biblical lawgiver and Moses Maimonides) a new era opens in the history of the Jewish people. Mendel Dessau was a poor scribe—a writer of scrolls—and his son Moses in his boyhood developed curvature of the spine. His early education was cared for by his father and by the local rabbi, David Fränkel. The latter, besides teaching him the Bible and Talmud, introduced to him the philosophy of Maimonides (*q.v.*). Fränkel received a call to Berlin in 1743. Not many months later a weakly lad knocked at one of the gates of Berlin. He was admitted after an altercation, and found a warm welcome at the hands of his former teacher. His life at this period was a struggle against crushing poverty, but his scholarly ambition was never relaxed. A refugee Pole, Zamosz, taught him mathematics, and a young Jewish physician was his tutor in Latin. He was, however, mainly self-taught. "He learned to spell and to philosophize at the same time" (Graetz). With his scanty earnings he bought a Latin copy of Locke's *Essay concerning the Human Understanding*, and mastered it with the aid of a Latin dictionary. He then made the acquaintance of Aaron Solomon Gumperz, who taught him the elements of French and English. In 1750 he was appointed by a wealthy silk-merchant, Isaac Bernhard, as teacher to his children. Mendelssohn soon won the confidence of Bernhard, who made the young student successively his book-keeper and his partner.

Gumperz or Hess rendered a conspicuous service to Mendelssohn and to the cause of enlightenment in 1754 by introducing him to Lessing. Just as the latter afterwards makes Nathan the Wise and Saladin meet over the chess-board, so did Lessing and Mendelssohn actually come together as lovers of the game. The Berlin of the day—the day of Frederick the Great—was in a moral and intellectual ferment. Lessing was the great liberator of the German mind. He had already begun his work of toleration, for he had recently produced a drama (*Die Juden*, 1749), the motive of which was to prove that a Jew can be possessed of nobility of character. This notion was being generally ridiculed as untrue, when Lessing found in Mendelssohn the realization of his dream. Within a few months of the same age, the two became brothers in intellectual and artistic cameraderie. Mendelssohn owed his first introduction to the public to Lessing's admiration. The former had written in lucid German an attack on the national neglect of native philosophers (principally Leibnitz), and lent the manuscript to Lessing. Without consulting the author, Lessing published anonymously Mendelssohn's *Philosophical Conversations* (*Philosophische Gespräche*) in 1755. In the same year there appeared in Danzig an anonymous satire, *Pope a Metaphysician* (*Pope ein Metaphysiker*), the authorship of which soon transpired. It was the joint work of Lessing and Mendelssohn. From this time Mendelssohn's career was one of ever-increasing brilliance. He became (1756–1759) the leading spirit of Nicolai's important literary undertakings, the *Bibliothek* and the *Literaturbriefe*, and ran some risk (which Frederick's good nature obviated) by somewhat freely criticizing the poems of the king of Prussia. In 1762 he married. His wife was Fromet Gugenheim, who survived him by twenty-six years. In the year following his marriage Mendelssohn won the prize offered by the Berlin Academy for an essay on the application of mathematical proofs to metaphysics, although among the competitors were Abbt and Kant. In October 1763 the king granted Mendelssohn the privilege of Protected Jew (*Schutz-Jude*)—which assured his right to undisturbed residence in Berlin.

As a result of his correspondence with Abbt, Mendelssohn resolved to write on the Immortality of the Soul. Materialistic views were at the time rampant and fashionable, and faith in immortality was at a low ebb. At this favourable juncture appeared the *Phädon* (1767). Modelled on Plato's dialogue of the same name, Mendelssohn's work possessed some of the charm of its Greek exemplar. What most impressed the German world was its beauty and lucidity of style—features to which Mendelssohn still owes his popularity as a writer. The *Phädon* was an immediate success, and besides being often reprinted in German was speedily translated into nearly all the European languages, including English. The author was hailed as the "German Plato," or the "German Socrates"; royal and other aristocratic friends showered attentions on him, and it is no exaggeration to assert with Kayserling that "no stranger who came to Berlin failed to pay his personal respects to the German Socrates."

So far, Mendelssohn had devoted his talents to philosophy and criticism; now, however, an incident turned the current of his life in the direction of the cause of Judaism. Lavater was one of the most ardent admirers of Mendelssohn. He described him as "a companionable, brilliant soul, with piercing eyes, the body of an Aesop—a man of keen insight, exquisite taste and wide erudition . . . frank and open-hearted." Lavater was fired with the ambition to convert his friend to Christianity. In the preface to a German translation of Bonnet's essay on Christian Evidences, Lavater publicly challenged Mendelssohn to refute Bonnet or if he could not then to "do what wisdom, the love of truth and honesty must bid him, what a Socrates would have done if he had read the book and found it unanswerable." This appeal produced a painful impression. Bonnet resented Lavater's action, but Mendelssohn was bound to reply, though opposed to religious controversy. As he put it: "Suppose there were living among my contemporaries a Confucius or a Solon, I could, according to the principles of my faith, love and admire the great man without falling into the ridiculous idea that I must convert a Solon or a Confucius."

Here we see the germs of Mendelssohn's Pragmatism, to use the now current term. He shared this with Lessing; in this case, at all events, it is probable that the latter was indebted to Mendelssohn. But before discussing this matter, we must follow out the consequences of Lavater's intrusion into Mendelssohn's affairs. The latter resolved to devote the rest of his life to the emancipation of the Jews. Among them secular studies had been neglected, and Mendelssohn saw that he could best remedy the defect by attacking it on the religious side. A great chapter in the history of culture is filled by the influence of translations of the Bible. Mendelssohn added a new section to this chapter by his German translation of the Pentateuch and other parts of the Bible. This work (1783) constituted Mendelssohn the Luther of the German Jews. From it, the Jews learned the German language; from it they imbibed culture; with it there was born a new desire for German nationality; as a result of its popularity was inaugurated a new system of Jewish education. Some of the conservatives among the Jews opposed these innovations, but the current of progress was too strong for them. Mendelssohn was the first great champion of Jewish emancipation in the 18th century. He it was who induced C. W. Dohm to publish in 1781 his epoch-making work, *On the Civil Amelioration of the Condition of the Jews*, a memorial which played a great part in the triumph of tolerance. Mendelssohn himself published a German translation of the *Vindiciae judaeorum* by Menasseh ben Israel. The excitement caused by these proceedings led Mendelssohn to publish his most important contribution to the problems connected with the position of Judaism in relation to the general life.

This work was the *Jerusalem* (1783; Eng. trans. 1838 and 1852). It is a forcible plea for freedom of conscience. Kant described it as "an irrefutable book." Its basic idea is that the state had no right to interfere with the religion of its citizens. As Kant put it, this was "the proclamation of a great reform, which, however, will be slow in manifestation and in progress, and which will affect not only your people but others as well." Mendelssohn asserted the pragmatic principle of the possible plurality of truths: that just as various nations need different constitutions—to one a monarchy, to another a republic, may be the most congenial to the national genius—so individuals may need different religions. The test of religion is its effect on conduct. This is the moral of Lessing's *Nathan the Wise*, the hero of which is undoubtedly Mendelssohn. The parable of the three rings is the epitome of the pragmatic position. One direct result of this pragmatism was unexpected. Having been taught that there is no absolutely true religion, Mendelssohn's own descendants—a brilliant circle, of which the musician Felix was the most noted—left the Synagogue for the Church. But despite this, Mendelssohn's theory was found to be a strengthening bond in Judaism. For he maintained that Judaism was less a "divine need, than a revealed life." In the first part of the 19th century, the criticism of Jewish dogmas and traditions was associated with a firm adhesion to the older Jewish mode of living. Reason was applied to beliefs, the historic consciousness to life. Modern reform in Judaism is parting to some extent from this conception, but it still holds good even among the liberals.

Of Mendelssohn's remaining years it must suffice to say that he progressed in fame numbering among his friends more and more of the greatest men of the age. His *Morgenstunden* appeared in 1785, and he died as the result of a cold contracted while carrying to his publishers in 1786 the manuscript of a vindication of his friend Lessing, who had predeceased him by five years.

Mendelssohn had six children. His sons were: Joseph (founder of the Mendelssohn banking house, and a friend and benefactor of Alexander Humboldt), whose son Alexander (d. 1871) was the last *Jewish* descendant of the philosopher; Abraham (who married Leah Bartholdy and was the father of Fanny Hensel and J. L. Felix Mendelssohn-Bartholdy); and Nathan (a mechanical engineer of considerable repute). His daughters were Dorothea, Recha and Henriette, all brilliantly gifted women.

BIBLIOGRAPHY.—An edition of Mendelssohn's works was published in 1843–1845, with a biography by his son Joseph; another edition of his *Schriften zur Philosophie, Aesthetik und Apologetik*, appeared (ed. Brasch) in 2 vols. in 1880. For Mendelssohn's biography the chief sources are Graetz, *History of the Jews*, vol. v., and Kayserling's *M. Mendelssohn's Leben und Wirken* (1887). Much interesting material on the Mendelssohn family is given in Hensel's *Die Familie Mendelssohn* (translated into English, 1881). Much general comment on Moses Mendelssohn appeared in the press of the world on occasion of the centenary of the birth of the composer Mendelssohn in 1909. (I. A.)

MENDELSSOHN-BARTHOLDY, JAKOB LUDWIG FELIX (1809–1847), German composer, grandson of Moses Mendelssohn (*q.v.*), was born in Hamburg on the 3rd of February 1809. In consequence of the troubles caused by the French occupation of Hamburg, Abraham Mendelssohn, his father, migrated in 1811 to Berlin, where his grandmother Fromet, then in the twenty-fifth year of her widowhood, received the whole family into her house, No. 7 Neue Promenade. Here Felix and his sister Fanny received their first instruction in music from their mother, under whose care they progressed so rapidly that their exceptional talent soon became apparent. Their next teacher was Madame Bigot, who, during the temporary residence of the family in Paris in 1816, gave them valuable instruction. On their return to Berlin they took lessons in thoroughbass and composition from Zelter, in pianoforte-playing from Ludwig Berger, and in violin-playing from Henning—the care of their general education being entrusted to the father of the novelist Paul Heyse.

Felix first played in public on the 24th of October 1818, taking the pianoforte part in a trio by Woelfl. On the 11th of April 1819 he entered the Berlin Singakademie as an alto, and in the following year began to compose with extraordinary rapidity. His earliest dated work is a cantata, *In rührend feierlichen Tönen*, completed on the 13th of January 1820. During that year alone he produced nearly sixty movements, including songs, pianoforte sonatas, a trio for pianoforte, violin and violoncello, a sonata for violin and pianoforte, pieces for the organ, and even a little dramatic piece in three scenes. In 1821 he wrote five symphonies for stringed instruments, each in three movements; motets for four voices, an opera, in one act, called *Soldatenliebschaft*; another, called *Die beiden Pädagogen*; part of a third, called *Die wandernden Comödianten*; and an immense quantity of other music of different kinds, all showing the precocity of his genius. The original autograph copies of these early productions are preserved in the Berlin Library, where they form part of a collection which fills forty-four large volumes, all written with infinite neatness, and for the most part carefully dated—a sufficient proof that the methodical habits which distinguished his later life were formed in early childhood.

In 1821 Mendelssohn paid his first visit to Goethe, with whom he spent sixteen days at Weimar, in company with Zelter. From this year also dates his first acquaintance with Weber, who was then in Berlin superintending the production of *Der Freischütz*; and from the summer of 1822 his introduction, at Cassel, to another of the greatest of his contemporaries, Ludwig Spohr. During this year his pen was even more prolific, producing, among other works, an opera, in three acts, entitled *Die beiden Neffen, oder der Onkel aus Boston*, and a pianoforte concerto, which he played in public at a concert given by Frau Anna Milder.

It had long been a custom with the Mendelssohn family to give musical performances on alternate Sunday mornings in their dining-room, with a small orchestra, which Felix always conducted, even when he was not tall enough to be seen without standing upon a stool. For each of these occasions he produced some new work—playing the pianoforte pieces himself, or entrusting them to Fanny, while his sister Rebecka sang, and his brother Paul played the violoncello. In this way *Die beiden Neffen* was first privately performed, on the fifteenth anniversary of his birthday, the 3rd of February 1824. Between the 3rd and the 31st of March in this year he composed his fine symphony in C minor, now known as Op. 10, and soon afterwards the quartet in B minor, Op. 3, and the (posthumous) pianoforte sestet, Op. 110. In this year also began his lifelong friendship with Moscheles, who, when asked to receive him as a pupil, said, "If he wishes to take a hint from me, as to anything new to him, he can easily do so; but he stands in no need of lessons."

In 1825 Abraham Mendelssohn took Felix to Paris, where among other musicians then resident in the French capital he met the two most popular dramatic composers of the age, Rossini and Meyerbeer, and lived on terms of intimacy with Hummel, Kalkbrenner, Rode, Baillot, Herz, and many other artists of European celebrity. On this occasion also he made his first acquaintance with Cherubini, who, though he rarely praised any one, expressed a high opinion of his talent, and recommended him to write a *Kyrie*, for five voices, with full orchestral accompaniments, which he himself described as "exceeding in thickness" anything he had attempted. From letters written at this period we learn that Felix's estimate of the French school of music was far from flattering; but he formed some friendships in Paris, which were renewed on later occasions. He returned to Berlin with his father in May 1825, taking leave of his Parisian friends on the 19th of the month, and interrupting his journey at Weimar for the purpose of paying a second visit to Goethe, to whom he dedicated his quartet in B minor. On reaching home he must have worked with greater zeal than ever; for on the 10th of August in this same year he completed an opera, in two acts, called *Die Hochzeit des Camacho*, a work of considerable importance.

No ordinary boy could have escaped uninjured from the snares attendant upon such a life as that which Mendelssohn now lived. Notwithstanding his overwhelming passion for music, his general education had been so well cared for that he was able to hold his own, in the society of his seniors, with the grace of an accomplished man of the world. He was already recognized as a leading spirit by the artists with whom he associated, and these artists were men of acknowledged talent and position. The temptations to egoism by which he was surrounded would have rendered most clever students intolerable. But the natural amiability of his disposition, and the healthy influence of his happy home-life, counteracted all tendencies towards self-assertion.

Soon after his return from Paris, Abraham Mendelssohn removed from his mother's residence to No. 3 Leipziger Strasse, a roomy, old-fashioned house, containing an excellent music-room, and in the grounds adjoining a "Gartenhaus" capable of accommodating several hundred persons at the Sunday performances.[1] In the autumn of the following year this "garden-house" witnessed a memorable private performance of the work by means of which the greatness of Mendelssohn's genius was first revealed to the outer world—the overture to Shakespeare's *Midsummer Night's Dream*. The finished score of this famous composition is dated "Berlin, August 6, 1826"—its author was only seventeen and a half years old. Yet in no later work does he exhibit more originality of thought, more freshness of conception, or more perfect mastery over the details of technical construction, than in this delightful inspiration. The overture was first publicly performed at Stettin, in February 1827, under the direction of the young composer, who was at once accepted as the leader of a new and highly characteristic manifestation of the spirit of progress. Henceforth we must speak of him, not as a student, but as a mature and experienced artist.

Meanwhile *Camacho's Wedding* had been submitted to Spontini, with a view to its production at the opera. The libretto, founded upon an episode in the history of Don Quixote, was written by Klingemann, and Mendelssohn threw himself into the spirit of the romance with a keen perception of its peculiar humour. The work was put into rehearsal soon after the composer's return from Stettin, produced on the 29th of April 1827, and received with great apparent enthusiasm; but a cabal was formed against it, and it never reached a second performance. The critics abused it mercilessly; yet it exhibits merits of a very high order. The solemn passage for the trombones, which heralds the first appearance of the knight of La Mancha, is conceived in a spirit of reverent appreciation of the idea of Cervantes, which would have done honour to a composer of lifelong experience.

Mendelssohn was annoyed at this injustice, and some time elapsed before his mind recovered its usual bright tone; but he continued to work diligently. Among other serious undertakings, he formed a choir for the study of the choral works of Sebastian Bach, then unknown to the public; and, in spite of Zelter's opposition, he succeeded, in 1829, in inducing the Berlin Singakademie to give a public performance of the *Passion according to St Matthew*, under his direction, with a chorus of between three and four hundred voices. The scheme succeeded beyond his warmest hopes, and proved the means of restoring to the world great compositions which had never been heard since the death of Bach. But the obstructive party were offended; and at this period Mendelssohn was far from popular among the musicians of Berlin.

In April 1829 Mendelssohn paid his first visit to London. His reception was enthusiastic. He made his first appearance before an English audience at one of the Philharmonic Society's concerts—then held in the Argyll Rooms—on the 25th of May, conducting his symphony in C minor from the pianoforte, to which he was led by John Cramer. On the 30th he played Weber's *Concertstück*, from memory, a proceeding at that time extremely unusual. At a concert given by Drouet, on the 24th of June, he played Beethoven's pianoforte concerto in E flat, which had never before been heard in the country; and the overture to *A Midsummer Night's Dream* was also, for the first time, presented to a London audience. On returning home from the concert, Attwood, then organist of St Paul's Cathedral, left the score of the overture in a hackney coach, whereupon Mendelssohn wrote out another, from memory, without an error. At another concert he played, with Moscheles, his still unpublished concerto in E, for two pianofortes and orchestra. After the close of the London season he started with Klingemann on a tour through Scotland, where he was inspired with the first idea of his overture to *The Isles of Fingal*, returning to Berlin at the end of November. Except for an accident to his knee, which lamed him for some time, his visit was highly successful and laid the foundation of many friendships and prosperous negotiations.

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[1] After Mendelssohn's death this house was sold to the Prussian government; and the "Herrenhaus" now stands on the site of the garden-house.

The visit to England formed the first division of a great scheme of travel which his father wished him to extend to all the most important art centres in Europe. After refusing the offer of a professorship at Berlin, he started again, in May 1830, for Italy, pausing on his way at Weimar, where he spent a fortnight with Goethe, and reaching Rome, after many pleasant interruptions, on the 1st of November. No excitement prevented him from devoting a certain time every day to composition; but he lost no opportunity of studying either the countless treasures which form the chief glory of the great city or the manners and customs of modern Romans. He attended, with insatiable curiosity, the services in the Sistine Chapel; and his keen power of observation enabled him to throw much interesting light upon them. His letters on this subject, however, lose much of their value through his incapacity to comprehend the close relation existing between the music of Palestrina and his contemporaries and the ritual of the Roman Church. His Lutheran education kept him in ignorance even of the first principles of ordinary chanting; and it is amusing to find him describing as enormities peculiar to the papal choir customs familiar to every village singer in England, and as closely connected with the structure of the "Anglican chant" as with that of "Gregorian music." Still, though he could not agree in all points with Baini, the greatest ecclesiastical musician then living, he shared his admiration for the *Improperiæ*, the *Miserere*, and the *cantus planus* of the *Lamentationes* and the *Exultet*, the musical beauty of which he could understand, apart from their ritual significance.

In passing through Munich on his return in October 1831 he composed and played his pianoforte concerto in G minor, and accepted a commission (never fulfilled) to compose an opera for the Munich theatre. Pausing for a time at Stuttgart, Frankfort and Düsseldorf he arrived in Paris in December, and passed four pleasant months in the renewal of acquaintances formed in 1825, and in close intercourse with Liszt and Chopin. On the 19th of February 1832 the overture to *A Midsummer Night's Dream* was played at the conservatoire, and many of his other compositions were brought before the public; but he did not escape disappointments with regard to some of them, especially the Reformation symphony, and the visit was brought to a premature close in March by an attack of cholera, from which, however, he rapidly recovered.

On the 23rd of April 1832 he was again in London, where he twice played his G minor concerto at the Philharmonic concerts, gave a performance on the organ at St Paul's, and published his first book of *Lieder ohne Worte*. He returned to Berlin in July, and during the winter he gave public performances of his Reformation symphony, his concerto in G minor, and his *Walpurgisnacht*. In the following spring he paid a third visit to London for the purpose of conducting his Italian symphony, which was played for the first time, by the Philharmonic Society, on the 13th of May 1833. On the 26th of the same month he conducted the performances at the Lower Rhine festival at Düsseldorf with such brilliant effect that he was at once offered, and accepted, the appointment of general-music-director to the town, an office which included the management of the music in the principal churches, at the theatre, and at the rooms of two musical associations.

Before entering upon his new duties, Mendelssohn paid a fourth visit to London, with his father, returning to Düsseldorf on the 27th of September 1833. His influence produced an excellent effect upon the church music and in the concert-room; but his relations with the management of the theatre were not altogether pleasant; and it was probably this circumstance which first led him to forsake the cultivation of the opera for that of sacred music. At Düsseldorf he first designed his famous oratorio *St Paul*, in response to an application from the Cäcilien-Verein at Frankfort, composed his overture to *Die schöne Melusine*, and planned some other works of importance. He liked his appointment, and would probably have retained it much longer had he not been invited to undertake the permanent direction of the Gewandhaus concerts at Leipzig, and thus raised to the highest position attainable in the German musical world. To this new sphere of labour he removed in August 1835, opening the first concert at the Gewandhaus, on the 4th of October, with his overture *Die Meeresstille*, a work possessing great attractions, though by no means on a level with the *Midsummer Night's Dream*, *The Isles of Fingal*, or *Melusine*.

Mendelssohn's reception in Leipzig was most enthusiastic; and under their new director the Gewandhaus concerts prospered exceedingly. Meanwhile *St Paul* steadily progressed, and was first produced, with triumphant success, at the Lower Rhine festival at Düsseldorf, on the 22nd of May 1836. On the 3rd of October it was first sung in English, at Liverpool, under the direction of Sir George Smart; and on the 16th of March 1837 Mendelssohn again directed it at Leipzig.

The next great event in Mendelssohn's life was his happy marriage, on the 28th of March 1837, to Cecile Charlotte Sophie Jeanrenaud. The honeymoon was scarcely over before he was again summoned to England to conduct *St Paul*, at the Birmingham festival, on the 20th of September. During this visit he played on the organ at St Paul's and at Christ Church, Newgate Street, with an effect which exercised a lasting influence upon English organists. It was here also that he first contemplated the production of his second oratorio, *Elijah*.

Passing over the composition of the *Lobgesang* in 1840, a sixth visit to England in the same year, and his inauguration of a scheme for the erection of a monument to Sebastian Bach, we find Mendelssohn in 1841 recalled to Berlin by the king of Prussia, with the title of Kapellmeister. Though his appointment resulted in the production of *Antigone*, *Oedipus Coloneus*, *Athalie*, the incidental music to the *Midsummer Night's Dream*, and other great works, it proved an endless source of vexation, and certainly helped to shorten the composer's life. In 1842 he came to England for the seventh time, accompanied by his wife, conducted his Scotch symphony at the Philharmonic, again played the organ at St Peter's, Cornhill, and Christ Church, Newgate Street, and was received with honour by the queen and the prince consort. He did not, however, permit his new engagements to interfere with the direction of the Gewandhaus concerts; and in 1843 he founded in Leipzig the great conservatoire which soon became the best musical college in Europe, opening it on the 3rd of April in the buildings of the Gewandhaus. In 1844 he conducted six of the Philharmonic concerts in London, producing his new *Midsummer Night's Dream* music, and playing Beethoven's pianoforte concerto in G with extraordinary effect. He returned to his duties at Berlin in September, but succeeded in persuading the king to free him from his most onerous engagements.

After a brief residence in Franfort, Mendelssohn returned to Leipzig in September 1845, resuming his old duties at the Gewandhaus, and teaching regularly in the conservatoire. Here he remained, with little interruption, during the winter—introducing his friend Jenny Lind, then at the height of her popularity, to the critical frequenters of the Gewandhaus, and steadily working at *Elijah*, the first performance of which he conducted at the Birmingham festival, on the 26th of August 1846. The reception of this great work was enthusiastic. Unhappily, the excitement attendant upon its production, added to the irritating effect of the worries at Berlin, made a serious inroad upon the composer's health. On his return to Leipzig he worked on as usual, but it was clear that his health was seriously impaired. In 1847 he visited England for the tenth and last time, to conduct four performances of *Elijah* at Exeter Hall, on the 16th, 23rd, 28th and 30th of April, one at Manchester on the 20th, and one at Birmingham on the 27th.

But the exertion was beyond his strength. He witnessed Jenny Lind's first appearance at Her Majesty's Theatre, on the 4th of May, and left England on the 9th, little anticipating the trial that awaited him in the tidings of the sudden death of his sister Fanny, which reached him only a few days after his arrival in Frankfort. The loss of his mother in 1842 had shaken him much, but the suddenness with which this last intelligence was communicated broke him down. He fell to the ground insensible, and never fully recovered. In June he was so far himself again that he was able to travel, with his family, by short stages, to Interlaken, where he stayed for some time, illustrating the journey by a series of water-colour drawings, but making no attempt at composition for many weeks. He returned to Leipzig in September, bringing with him fragments of *Christus*, *Loreley*, and some other unfinished works, taking no part in the concerts, and living in privacy. On the 9th of October he called on Madame Frege, and asked her to sing his latest set of songs. She left the room for lights, and on her return found him in violent pain and almost insensible. He lingered for four weeks, and on the 4th of November he passed away, in the presence of his wife, his brother, and his three friends, Moscheles, Schleinitz, and Ferdinand David. A cross marks the site of his grave, in the Alte Dreifaltigkeits Kirchhof, at Berlin.

Mendelssohn's title to a place among the great composers of the century is incontestable. His style, though differing little in technical arrangement from that of his classical predecessors, is characterized by a vein of melody peculiarly his own, and easily distinguishable by those who have studied his works, not only from the genuine effusions of contemporary writers, but from the most successful of the servile imitations with which, even during his lifetime, the music-shops were deluged. In less judicious hands the rigid symmetry of his phrasing might, perhaps, have palled upon the ear; but under his skilful management it serves only to impart an additional charm to thoughts which derive their chief beauty from the evident spontaneity of their conception. In this, as in all other matters of a purely technical character, he regarded the accepted laws of art as the medium by which he might most certainly attain the ends dictated by the inspiration of his genius. Though caring nothing for rules, except as means for producing a good effect, he scarcely ever violated them, and was never weary of impressing their value upon the minds of his pupils. His method of counterpoint was modelled in close accordance with that practised by Sebastian Bach. This he used in combination with an elastic development of the sonata-form, similar to that engrafted by Beethoven upon the lines laid down by Haydn. The principles involved in this arrangement were strictly conservative; yet they enabled him, at the very outset of his career, to invent a new style no less original than that of Schubert or Weber, and no less remarkable as the embodiment of canons already consecrated by classical authority than as a special manifestation of individual genius. It is thus that Mendelssohn stands before us as at the same time a champion of conservatism and an apostle of progress; and it is chiefly by virtue of these two apparently incongruous though really compatible phases of his artistic character that his influence and example availed, for so many years, to hold in check the violence of reactionary opinion which injudicious partisanship afterwards fanned into revolutionary fury.

Concerning Mendelssohn's private character there have never been two opinions. As a man of the world he was more than ordinarily accomplished—brilliant in conversation, and in his lighter moments overflowing with sparkling humour and ready pleasantry, loyal and unselfish in the more serious business of life, and never weary of working for the general good. As a friend he was unvaryingly kind, sympathetic and true. His earnestness as a Christian needs no stronger testimony than that afforded by his own delineation of the character of St Paul; but it is not too much to say that his heart and life were pure as those of a little child. (W. S. R.)

This article has the unique value of being the record of an eminent musical scholar who was an actual pupil of Mendelssohn. No change of reputation can alter the value of such a record of a man whom even his contemporaries knew to be greater than his works. Mendelssohn's aristocratic horror of self-advertisement unfitted him for triumph in a period of revolution; he died, most inopportunely, when his own powers, like Handel's at the same age, were being wasted on pseudo-classical forms; the new art was not yet ripe; and in the early Wagner-Liszt reign of terror his was the first reputation to be assassinated. That of the too modest and gentle "Romantic" pioneer Schumann soon followed; but, as being more difficult to explain away, and more embarrassing to irreverence and conceit, it remains a subject of controversy. Meanwhile Mendelssohn's reputation, except as the composer of a few inexplicably beautiful and original orchestral pieces, has vanished and been replaced by a pure fiction known as the "Mendelssohn tradition" of orchestral conducting. This fiction is traceable to some characteristic remarks made by Wagner on his experiences of English orchestral playing, remarks which, though not very good-natured, do not bear the full construction popularly imputed to them. If Beethoven had come and conducted in England, Mendelssohn's expostulations with careless players would have been met by references to the "Beethoven tradition"; and, if Wagner had shared Mendelssohn's reluctance to putting on record remarks likely to wound individual, professional and national sensibilities, it might not have been impossible that reproaches against slipshod and mechanical playing might nowadays be met by references to the "Wagner tradition," for Wagner also found himself compelled to concentrate his care on the main items in the overloaded English orchestral programmes, to the detriment of the rest.

Mendelssohn's influence on the early career of Joachim is, next to his work in the rediscovery of Bach, his greatest bequest to later musical history. Those many profound and sincere admirers to Joachim to whom the name of Mendelssohn calls up only the Widow in *Elijah* and the weaker *Songs without Words*, may find the idea strange; but there is no doubt that Joachim regarded the continuation of a true Mendelssohn tradition as identical with his own efforts to "uphold the dignity of art." (D. F. T.)

MENDÈS, CATULLE (1841–1909), French poet and man of letters, of Jewish extraction, was born at Bordeaux on the 22nd of May 1841. He early established himself in Paris, attaining speedy notoriety by the publication in the *Revue fantaisiste* (1861) of his "Roman d'une nuit," for which he was condemned to a month's imprisonment and a fine of 500 francs. He was allied with the Parnassians from the beginning of the movement, and displayed extraordinary metrical skill in his first volume of poems, *Philoméla* (1863). In later volumes—*Poésies, Ière série* (1876), which includes much of his earlier verse, "*Soirs moroses*," *Contes épiques*, *Philoméla*, &c; *Poésies* (7 vols., 1885), a new edition largely augmented; *Les Poésies de Catulle Mendès* (3 vols., 1892); *La Grive des vignes* (1895), &c.—his critics have noted that the elegant verse is distinguished rather by dexterous imitation of different writers than by any marked originality. The versatility and fecundity of Mendès's talent is shown in a series of his critical and dramatic writings, and of novels and short stories, in the latter of which he continues the French tradition of the licentious *conte*. For the theatre he wrote: *La Part du roi* (1872), a one-act verse comedy; *Les Frères d'armes* (1873), drama; *Justice* (1877), in three acts, characterized by a hostile critic as a hymn in praise of suicide; the libretto of a light opera, *Le Capitaine Fracasse* (1878), founded on Théophile Gautier's novel; *La Femme de Tabarin* (1887); *Médée* (1898), in three acts and in verse; *La Reine Fiammette* (1898), a *conte dramatique* in six acts and in verse, the scene of which is laid in the Italy of the Renaissance; *Le Fils de l'étoile* (1904), the hero of which is Bar-Cochebas, the Syrian pseudo-Messiah, for the music of C. Erlanger; *Scarron* (1905); *Ariane* (1906), for the music of Massenet; and *Glatigny* (1906). His critical work includes: *Richard Wagner* (1886); *L'Art au théâtre* (3 vols., 1896–1900), a series of dramatic criticisms reprinted from newspapers; and a report addressed to the minister of public instruction and of the fine arts on *Le Mouvement poétique français de 1867 à 1900* (new ed., 1903), which includes a bibliographical and critical dictionary of the French poets of the 19th century. Perhaps the most famous of his novels are: *Le Roi vierge* (1880) in which he introduces Louis II. of Bavaria and Richard Wagner; *La Maison de la vielle* (1894), and *Gog* (1897). He married in 1866 Mlle Judith Gautier, younger daughter of the poet, from whom he was subsequently separated.

On the 9th of February 1909, early in the morning, his dead body was discovered in the railway tunnel of Saint Germain. He had left Paris by the midnight train on the 7th, and it is supposed that, thinking he had arrived at the station, he had opened the door of his compartment while still in the tunnel.

MENDICANCY (from Lat. *mendicus*, in a condition of beggary, a word of unknown origin), a state or condition of being a beggar, the practice of obtaining a livelihood by asking alms. The word "mendicant," also found in the French form "mendiant," appears to have come into use through the begging friars.

MENDICANT MOVEMENT AND ORDERS. The facts concerning the rise of the Orders of Mendicant Friars are related in the articles on the several orders (FRANCISCANS, DOMINICANS, CARMELITES, AUGUSTINIAN HERMITS), and in that on MONASTICISM (§ 11), where the difference between friars and monks is explained. The purpose of this article is to characterize the movement as a whole, and to indicate the circumstances that produced it. The most striking phenomenon in connexion with the beginnings of the mendicant orders is the rapidity with which the movement spread. Within a generation of the death of the two great founders, Dominic (1221) and Francis (1226), their institutes had spread all over Europe and into Asia, and their friars could be numbered by tens of thousands. In all the great cities of Western Europe friaries were established, and in the universities theological chairs were held by Dominicans and Franciscans. And when at the middle of the century the other great mendicant orders of Carmelites and Austin Friars, and also Servites (*q.v.*) arose their propagation showed that the possibilities of the mendicant movement had not been exhausted by the Dominicans and Franciscans. Lesser mendicant orders sprang up in all directions—Gasquet mentions half a dozen such that found their way into England (*English Monastic Life*, p. 241)—in such numbers that the Council of Lyons in 1274 found it necessary to suppress all except the orders already named. Moreover, besides the various orders of friars, there were the lay Tertiaries that arose and spread far and wide in connexion with the Franciscans and other mendicants, and the similar institute of the Humiliati (see TERTIARIES). These facts clearly show that the Mendicant Movement responded to widely spread and deeply felt needs of the time. These needs found expression not only in the Mendicant orders within the Church, but also in a number of more or less heretical and revolutionary religious sects. There was this in common among the Cathari, Waldenses, Albigenses and other heretical bodies that overran so many parts of Western Europe in the second half of the 12th century and the beginning of the 13th, that they all inveighed against the wealth of the clergy, and preached the practice of austere poverty and a return to the simple life of Christ and the Apostles. Thus the sectaries no less than the Mendicant orders bear witness to the existence of spiritual needs in Western Christendom, which the Mendicant orders went a long way towards satisfying. Probably the most crying need was that of priests to minister to the great city populations, at that time growing up with such rapidity, especially in Italy. During the 10th, 11th and 12th centuries the Church had been organized on the lines of the prevailing feudal system—the bishops and abbots were feudal barons, and the effects of the system were felt throughout the ranks of the lower clergy. The social fabric was built up not on the towns, but on the great landlords; and when the centre of gravity began to move, first of all in Italy, to the towns, and crowded populations began to be massed together in them, the parochial systems broke down under the weight of the new conditions, and the people were in a state of spiritual and moral no less than physical destitution. So, when the friars came and established themselves in the poorest localities of the towns, and brought religion to the destitute and the outcasts of society, assimilating themselves to the conditions of life of those among whom they worked, they supplied a need with which the parochial clergy were unable to cope.

The friars responded not only to the new needs of the age, but to its new ideas—religious, intellectual, social, artistic. It was a period of religious revival, and of reaction against abuses that followed in the wake of the feudal system; and this religious movement was informed by a new mysticism—a mysticism that fixed its attention mainly on the humanity of Christ and found its practical expression in the imitation of His life. A new intellectual wave was breaking over Western Europe, symbolized by the university and the scholastic movements; and a new spirit of democratic freedom was making itself felt in the growing commercial towns of Italy and Germany. There is no need to labour the point that the Mendicants responded to all these needs and interpreted them within the pale of Catholic Christianity, for the fact lies upon the surface of history. But a few words are necessary on the central idea from which the Mendicants received their name—the idea of poverty. This was St Francis's root idea, and there is no doubt—though it has been disputed—that it was borrowed from him by St Dominic and the other Mendicant founders. St Francis did not intend that begging and alms should be the normal means of sustenance for his friars; on the contrary, he intended them to live by the work of their hands, and only to have recourse to begging when they could not earn their livelihood by work. But as the friars soon came nearly all to be priests devoted to spiritual ministrations, and the communities grew larger, it became increasingly difficult for them to support themselves by personal work; and so the begging came to play a greater rôle than had been contemplated by St Francis. But his idea certainly was that his friars should not only practise the utmost personal poverty and simplicity in their life, but that they should have the minimum of possessions—no lands, no funded property, no fixed sources of income. The maintaining of this ideal has proved unworkable in practice. In the Dominican Order and the others that started as mendicant it has been mitigated or even abrogated. Among the Franciscans themselves it has been the occasion of endless strife, and has been kept alive only by dint of successive reforms and fresh starts, each successful for a time, but doomed always, sooner or later, to yield to the inexorable logic of facts. The Capuchins (*q.v.*) have made the most permanently successful effort to maintain St Francis's ideal; but even among them mitigations have had to be admitted. In spite, however, of all mitigations the Franciscans have nearly always presented to the world an object lesson in evangelical poverty by the poorness and simplicity of their lives and surroundings.

On the subject-matter of this article the best thing in English is the Introductory Essay by the Capuchin Fr. Cuthbert on "The Spirit and Genius of the Franciscan Friars," in *The Friars and how they came to England* (1903); see also the earlier chapters of Emil Gebhard's *Italie mystique* (1899). (E. C. B.)

MENDIP HILLS, a range in the north of Somersetshire, England. Using the name in its widest application, the eastern boundary of the range may be taken to be formed by the upper valleys of the rivers Frome and Brue, and the depression between them. The range extends from these north-westward with a major axis of about 23 m., while the outliers of Wavering Down and Bleadon Hill continue it towards the shore of the Bristol Channel. The range is generally about 6 m. in width, and its total area about 130 sq. m. Its south-western face descends to the low "moors" or marshes drained by the Axe and other streams, the small towns of Axbridge, Cheddar and Wells lying at the foot of the hills. Towards the north-east its limits are less clearly defined, for high ground, intersected by narrow vales, extends as far as the valley of the Avon. A depression, followed by the road between Radstock and Wells, strikes across the range about its centre; the principal elevations lie west of this, and to the area thus defined the name of the Mendips is sometimes restricted. The summit of the hills is a gently swelling plateau, which reaches its extreme height in the north—1068 ft. The Mendips consist principally of Carboniferous Limestone. Fine cliffs and scars occur on the flanks of the plateau, as in the gorge of Cheddar, and there is a wonderful series of caverns, the result of water action. The surface of the plateau is often broken by deep holes ("swallets") into which streams flow. Some of the caves, such as those at Cheddar, are easy of access, and attract many visitors owing to the beauty of the stalactitic formations; others, of greater extent and grandeur, have only been explored, or partly explored, with great difficulty. Some caves have yielded large quantities of animal remains (hyaenas, bears and others) together with traces of prehistoric human occupation. Among such Wookey Hole, where the river Axe issues from the foot of a cliff, may be mentioned. Lead was worked among the Mendips at a very early period. Some of the Roman workings, especially in the neighbourhood of Charterhouse-on-Mendip, have yielded pigs of lead inscribed with the names of emperors of the 1st and 2nd centuries A.D., together with an abundance of smaller objects.

See E. Baker and H. Balch, *The Netherworld of Mendip* (Clifton, 1907).

MENDOZA, ANTONIO HURTADO DE (1593?–1644), Spanish dramatist, was born about the end of the 16th century in the province of Asturias, became page to the count de Saldaña (son of the duke de Lerma), and was recognized as a rising poet by Cervantes in the *Viaje del Parnaso* (1614). He rose rapidly into favour under Philip IV., who appointed him private secretary, commissioned from him *comedias palaciegas* for the royal theatre at Aranjuez, and in 1623 conferred on him the orders of Santiago and Calatrava. Most of his contemporaries and rivals paid court to "*el discreto de palacio*," and Mendoza seems to have lived on the friendliest terms with all his brother-dramatists except Ruiz de Alarcón. He is said to have been involved in the fall of Olivares, and died unexpectedly at Saragossa on the 19th of September 1644. Only one of his plays, *Querer por sólo querer*, was published with his consent; it is included in a volume (1623) containing his semi-official account of the performances at Aranjuez in 1622. The best edition of Mendoza's plays and verses bears the title of *Obras líricas y cómicas, divinas y humanas* (1728). Much of his work does not rise above the level of graceful and accomplished verse; but that he had higher qualities is shown by *El Marido hace mujer*, a brilliant comedy of manners, which forms the chief source of Molière's *École des maris*.

The *Fiesta que se hizo en Aranjuez* and *Querer por sólo querer* were translated into English by Sir Richard Fanshawe, afterwards ambassador at Madrid, in a posthumous volume published in 1671.

MENDOZA, DIEGO HURTADO DE (1503–1575), Spanish novelist, poet, diplomatist and historian, a younger son of the count of Tendillas, governor of Granada, was born in that city in 1503. The celebrated marquis of Santillana was his great-grandfather. On leaving the university of Salamanca, Mendoza abandoned his intention of taking orders, served under Charles V. in Italy, and attended lectures at the universities of Bologna, Padua and Rome. In 1537 he was sent to England to arrange a marriage between Henry VIII. and the duchess of Milan, as well as a marriage between Prince Louis of Portugal and Mary Tudor. Despite the failure of his mission, he preserved the confidence of the emperor, and in 1539 was appointed ambassador at Venice; there he patronized the Aldi, procured copies of the Greek manuscripts belonging to Cardinal Bessarion, and acquired other rare codices from the monastery of Mount Athos. The first edition of Josephus was printed (1544) from the texts in Mendoza's collection. He acted for some time as military governor of Siena, represented Spain diplomatically at the council of Trent, and in 1547 was nominated special plenipotentiary at Rome, where he remained till 1554. He was never a favourite with Philip II., and a quarrel with a courtier resulted in his banishment from court (June 1568). The remaining years of his life, which were spent at Granada, he devoted to the study of Arabic, to poetry, and to his history of the Moorish insurrection of 1568–1570. He died in 1575. His *Guerra de Granada* was published at Lisbon by Luis Tribaldos de Toledo in 1627; the delay was doubtless due to Mendoza's severe criticism of contemporaries who survived him. In some passages the author deliberately imitates Sallust and Tacitus; his style is, on the whole, vivid and trenchant, his information is exact, and in critical insight he is not inferior to Mariana. The attribution to Mendoza of *Lazarillo de Tormes* is rejected by all competent scholars, but that he excelled in picaresque malice is proved by his indecorous verses written in the old Castilian metres and in the more elaborate measures imported from Italy. Mendoza is believed to be the author of the letters to Feliciano de Silva and to Captain Salazar, published by Antonio Paz y Melia in *Sales Españolas* (Madrid, 1900).

See A. Senán y Alonso, *D. Diego Hurtado de Mendoza, apuntes biográfico-críticos* (Granada, 1886); *Calendar of Letters and Papers foreign and domestic, Henry VIII.*, vols. xii. and xiii.; C. Graux, *Essai sur l'origine du fonds grec de l'Escurial* (Paris, 1880); R. Foulché-Delbosc, "Étude sur la Guerra de Granada" in the *Revue hispanique* (Paris, 1894), vol. i.

MENDOZA, PEDRO GONZALEZ DE (1428–1495), Spanish cardinal and statesman, was the fourth son of Iñigo Lopez de Mendoza, marquess of Santillana, and duke of Infantado. He was born at Guadalajara in New Castile, the chief lordship of his family, on the 3rd of May 1428. The house of Mendoza claimed to descend from the lords of Llodio in Alava, and to have been settled in Old Castile, in the 11th century. One chief of the house had been greatly distinguished at the battle of the Navas de Tolosa in 1212. Another had been Admiral of Castile in the reign of Alphonso the Wise. Peter the Cruel had endowed them with the lordships of Hita and Buitrago. The greatness of the Mendozas was completed by Pedro Gonzalez, who sacrificed his life to save King John I. at the battle of Aljubarrota in 1385. The cardinal's father, the marquis of Santillana—to use the title he bore for the greater part of his life—was a poet, and was conspicuous during the troubled reign of John II. Loyalty to the Crown was the traditional and prevailing policy of the family. Pedro Gonzalez, the future cardinal, was sent into the Church mainly because he was a younger son and that he might be handsomely provided for. He had no vocation, and was an example of the worldly, political and martial prelates of the 15th century. In 1452 at the age of twenty-four, he was chosen by the king John II. to be bishop of Calahorra, but did not receive the pope's bull till 1454. As bishop of Calahorra he was also *señor*, or civil and military ruler, of the town and its dependent district. In his secular capacity he led the levies of Calahorra in the civil wars of the reign of Henry IV. He fought for the king at the second battle of Olmedo on the 20th of August 1467, and was wounded in the arm. During these years he became attached to Doña Mencia de Lemus, a Portuguese lady-in-waiting of the queen. She bore him two sons, Rodrigo, who was once selected to be the husband of Lucrezia Borgia, and Diego, who was the grandfather of the princess of Eboli of the reign of Philip II (see PEREZ, ANTONIO.) By another lady of a Valladolid family he had a third son who afterwards emigrated to France. In 1468 he became bishop of Siguenza. In 1473 he was created cardinal, was promoted to the archbishopric of Seville and named chancellor of Castile. During the last years of the reign of King Henry IV. he was the partisan of the Princess Isabella, afterwards queen. He fought for her at the battle of Toro on the 1st of March 1476; had a prominent part in placing her on the throne; and served her indefatigably in her efforts to suppress the disorderly nobles of Castile. In 1482 he became archbishop of Toledo. During the conquest of Granada he contributed largely to the maintenance of the army. On the 2nd of January 1492 he occupied the town in the name of the Catholic sovereigns. Though his life was worldly, and though he was more soldier and statesman than priest, the "Great Cardinal," as he was commonly called, did not neglect his duty as a bishop. He used his influence with the queen and also at Rome to arrange a settlement of the disputes between the Spanish sovereigns and the papacy. Though he maintained a splendid household as archbishop of Toledo, and provided handsomely for his children, he devoted part of his revenue to charity, and with part he endowed the college of Santa Cruz at Valladolid. His health broke down at the close of 1493. Queen Isabella visited and nursed him on his deathbed. It is said that he recommended her to choose as his successor the Franciscan Jimenez de Cisneros, a man who had no likeness to himself save in political faculty and devotion to the authority of the Crown. He died at Guadalajara on the 11th of January 1495.

The life of the cardinal, by Salazar de Mendoza, *Cronica del gran cardinal Don Pedro Gonzalez de Mendoza* (Toledo, 1625), is discursive and garrulous but valuable. See also Prescott, *History of Ferdinand and Isabella*.

MENDOZA, a province of western Argentina, bounded N. by San Juan, E. by San Luis and the territory of La Pampa, S. by the territories of La Pampa and Neuquen, and W. by the republic of Chile. Area, 56,502 sq. m.; pop. (1895), 116,136; (1904, estimate), 159,780. The Andes form the western boundary, and a considerable part of the territory is covered by the great Cordillera, its foothills and flanking ranges. The eastern part is an arid, sandy, level plain, with extensive saline basins, having no vegetation other than coarse grasses and thickets of low, spiny mimosas and "chañar" (*Gourliaea decorticans*). The fertile, populated districts of the province border on the Cordillera, particularly in the north where numerous streams from the snow-clad summits supply water for irrigation. The secondary ranges in this part of Mendoza are the Sierra de los Paramillos, which encloses the Uspallata Valley, and the Sierra del Tunuyán, which encloses a number of populous valleys drained by the Tunuyán river and its tributaries. One of the largest of these is the Yuco Valley. Farther south the country becomes more arid and sparsely populated, and unsubdued tribes of Indians for a long time prevented its exploration. In this region the Sierra de Payén and Sierra del Nevado (otherwise known as the Sierra Quero Matro Pellon) extend in a north-easterly direction. With the exception of the Rio Grande in the south-west part of the province, which forms the principal source of the Colorado, all the rivers of the province flow easterly and southerly into the great saline depression of western Argentina, which includes a great part of Mendoza, San Luis and La Pampa. The Andean streams rise in the higher snow-clad elevations, but their waters become impregnated with saline matter soon after reaching the plain, and are eventually lost in the saline marshes and lagoons of southern Mendoza and La Pampa. These Andean rivers are the Mendoza, Tunuyán, Diamante and Atuel, with their numerous tributaries, all of which discharge into the sluggish river which flows from the Huanacache lagoons, on the San Juan frontier, southward to the marshes and lagoons of La Pampa. The upper part of this brackish, swampy stream is called the Desaguadero, and the lower the Salado. It forms the eastern boundary line of the province down to the 36th parallel. With the exception of the elevated districts of the Andes, the climate of Mendoza is hot and dry. On the plains the rainfall is insignificant, but on the slopes of the Cordillera rains are frequent and winter cold is severe. Agriculture is the principal occupation where irrigation can be used, the province having a high reputation for its raisins and wines. Alfalfa is an important product, being grown for fattening the cattle driven through the province to the Chilean markets. The mineral resources of the province are said to be good, but receive little attention. Petroleum is found in the vicinity of San Rafael, on the Diamante river, and it is claimed that coal exists in the same region. Although Mendoza was settled by Spanish colonists from Chile as far back as 1559, its development has been hindered by its isolated position. This isolation was broken in 1884 by the completion of the Argentine Great Western railway to the provincial capital. Since then a railway has been built northward to San Juan, and another line was in 1908 under construction through the Andes to connect with the Chilean railway system. In addition to Mendoza, the capital of the province, the principal towns (hardly more than villages) are Guaymallén, Maipú, San Martin, Lujan and San Rafael. The provinces of Mendoza, San Juan and San Luis, which were settled from Chile and were for a long time governed from Santiago, were at first called the province of Cuyo, and are still spoken of as the "Cuyo provinces."

MENDOZA, a city of Argentina, capital of Mendoza province, 632 m. by rail W.N.W. of Buenos Aires. Pop. (1904, estimate), 32,000. It stands on a plain near the foot of a secondary Andean range called the Sierra de los Paramillos, at an elevation of 2320 ft. The surrounding district is arid, but has been irrigated and is covered with gardens, orchards and cultivated fields. The city is about 15 m. N. of the Mendoza, or Lujan river, whose waters are utilized for irrigation and for the requirements of the city by means of a channel which leaves the main river a little above the town of Lujan and runs to the Tulumaya river and the lagoons of Huanacache. This channel is called El Zanjón, and is believed to have been opened by Guaymallén, the chief of the Guarpès who inhabited this district at the time of the Spanish conquest, but it is more probably natural. The city is laid out in a regular manner with broad well-paved streets and numerous public squares. The Zanjón and another stream called the Guaymallén traverse the city, and the principal streets have water flowing through them and are shaded by poplars. Because of earthquake risks, the public buildings are neither costly nor imposing. The private residences are commonly of one storey, built with wooden frames filled in with *adobes*. The climate is hot, dry and enervating, notwithstanding the elevation and the proximity of the Andes. The surrounding districts produce fruit, vegetables, alfalfa and cereals. The vineyard industry is prominent, and raisins and wine are exported. The position on the main route across the Andes into Chile, by way of the Uspallata, or Cumbre pass (highest point 12,870 ft.), has given the city commercial importance. It has railway connexion with the principal cities of the republic, including the ports of Rosario, Buenos Aires and Bahia Blanca, and also with the capital of San Juan.

Mendoza was founded by Captain Pedro del Castillo, who had been sent from Santiago across the Andes in 1559 by Garcia Hurtado de Mendoza, the governor of Chile, to conquer and annex the territory extending N.E. to Tucuman. The city was named after Mendoza. It was made the capital of the province of Cuyo, and belonged to Chile down to 1776, when the province was transferred to the newly created viceroyalty of La Plata. It was the headquarters of General San Martin while he was organizing an army for the liberation of Chile, and greatly assisted him with men and money. Under republican administration Mendoza suffered much from revolutions. Moreover, on the 20th of March 1861, the city was destroyed by an earthquake and a fire which followed. Not a building was left standing, and the loss of life was estimated at 10,000 to 12,000. The French geologist Bravard, who had predicted the catastrophe, was one of its victims. The poplars in the streets, together with some species of fruit-trees, were first planted in Mendoza by a Spaniard, Juan Cobos, in 1809, who thus became one of its greatest benefactors.

MENEDEMUS, Greek philosopher, and founder of the Eretrian school of thought, was born at Eretria about 350 and died between 278 and 275 B.C. Though of noble birth, he worked as builder and tentmaker until he was sent with a military expedition to Megara, where, according to Diogenes Laertius, he heard Plato and resolved to devote himself to philosophy. It is more likely that he heard one of Plato's followers, inasmuch as Plato died when he was only four years old, if the above dates are correct. At Megara he formed a life-long friendship with Asclepiades, with whom he toiled in the night that he might study philosophy by day. He was subsequently a pupil first of Stilpo and then of Phaedo of Elis, whose school he transferred to Eretria, by which name it was afterwards known. In addition to his philosophical work, he took a leading part in the political affairs of his city from the time of the Diadochi until his death, and obtained a remission of the tribute to Demetrius. His friendship with Antigonus Gonatas seems to have roused suspicion as to his loyalty, and he sought safety first in the temple of Amphiaraus at Oropus, and later with Antigonus, at whose court he is said to have died of grief. Other accounts say that he starved himself to death on failing to induce Antigonus to free his native city. His philosophical views are known only in part. Athenaeus quotes Epicrates as stating that he was a Platonist, but other accounts credit him with having preferred Stilpo to Plato. Diogenes Laërtius (ii. 134 and 135) says that he declined to identify the Good with the Useful, and that he denied the value of the negative proposition on the ground that affirmation alone can express truth. He probably meant to imply that qualities have no existence apart from the subject to which they belong. In ethics we learn from Plutarch (*De virt. mor.* 2) and from Cicero (*Acad.* ii. 42) that he regarded Virtue as one, by whatever name it be called, and maintained that it is intellectual. Cicero's evidence is the less valuable in that he always assumed that Menedemus was a follower of the Megarians. Diogenes says that he left no writings, and the Eretrian school disappeared after a short and unobtrusive existence.

Beside the ancient sources quoted above, see H. Mallett, *Histoire de l'école de Mégare et des écoles d'Elis et d'Erétrie* (1845). Also the articles MEGARIAN SCHOOL; PHAEDO; STILPO.

MENELAUS, in Greek legend, son of Atreus (or Pleisthenes), king of Sparta, brother of Agamemnon and husband of Helen. He was one of the Greeks who entered Troy concealed in the wooden horse (Virgil, *Aeneid*, ii. 264) and recovered his wife at the sack of the city. On the voyage homewards his fleet was scattered off Cape Malea by a storm, which drove him to Egypt. After eight years' wandering in the east, he landed on the island of Pharos, where Proteus revealed to him the means of appeasing the gods and securing his return. He reached Sparta on the day on which Orestes was holding the funeral feast over Aegisthus and Clytaemnestra. After a long and happy life in Lacedaemon, Menelaus, as the son-in-law of Zeus, did not die but was translated to Elysium (Homer, *Odyssey*, iii. iv.). His grave and that of Helen were shown at Therapnae, where he was worshipped as a god (Pausanias iii. 19, 9). He was represented in works of art as carrying off the body of the dead Patroclus or lifting up his hand to slay Helen.

MENELEK II. (SAHALA MARIEM), emperor of Abyssinia, officially negus negusti (king of kings) of Ethiopia (1844–), son of Haeli Melicoth, king of Shoa, was born in 1844, and claimed to be a direct descendant of Solomon by the queen of Sheba. On the death of his father in 1855 he was kept a prisoner at Gondar by Kassai, the governor, who had seized the throne under the title of Theodore III. But having succeeded in effecting his escape he was acknowledged king of Shoa, and at once attacked the usurper. These campaigns were unsuccessful, and he turned his arms to the west, east and south, and annexed much territory to his kingdom, still, however, maintaining his divine right to the crown of Ethiopia. After the death of Theodore in 1888 he continued to struggle against his successor, the emperor Johannes (better known to Europeans as King John of Abyssinia). Being again unsuccessful, he resolved to await a more propitious occasion; so, acknowledging the supremacy of Johannes, in 1886 he married his daughter Zeodita (b. 1876) to the emperor's son, the Ras Area; he was thereupon declared heir to the empire, and on his side acknowledged the Ras Area as his successor. Ras Area died in May 1888, and the emperor Johannes was killed in a war against the dervishes at the battle of Gallabat (Matemma) on the 10th of March 1889. The succession now lay between the late emperor's natural son, the Ras Mangasha, and Menelek, but the latter was elected by a large majority on the 4th of November, and consecrated shortly afterwards. Menelek had married in 1883 Taïtu (b. 1854) a princess of Tigré, a lady who had been married four times previously and who exercised considerable influence. Menelek's clemency to Mangasha, whom he compelled to submit and then made viceroy of Tigré, was ill repaid by a long series of revolts. In 1889, at the time when he was claiming the throne against Mangasha, Menelek signed at Uccialli a treaty with Italy acknowledging Italian claims to the Asmara district. Finding, however, that according to the Italian view of one of its articles the treaty placed his empire under Italian domination, Menelek denounced it; and after defeating the Italians at Amba-Alagi, he compelled them to capitulate at Adowa in February 1896, and a treaty was signed recognizing the absolute independence of Abyssinia. His French sympathies were shown in a reported official offer of treasure towards payment of the indemnity at the close of the Franco-Prussian War, and in February 1897 he concluded a commercial treaty with France on very favourable terms. He also gave assistance to French officers who sought to reach the upper Nile from Abyssinia, there to join forces with the Marchand Mission; and Abyssinian armies were sent Nilewards. A British mission under Sir Rennell Rodd in May 1897, however, was cordially received, and Menelek agreed to a settlement of the Somali boundaries, to keep open to British commerce the caravan route between Zaila and Harrar, and to prevent the transit of munitions of war to the Mahdists, whom he proclaimed enemies of Abyssinia. In the following year the Sudan was reconquered by an Anglo-Egyptian army and thereafter cordial relations between Menelek and the British authorities were established. In 1889 and subsequent years, Menelek sent forces to co-operate with the British troops engaged against the Somali mullah, Mahommed Abdullah. Menelek had in 1898 crushed a rebellion by Ras Mangasha (who died in 1906) and he directed his efforts henceforth to the consolidation of his authority, and in a certain degree, to the opening up of his country to western civilization. He had granted in 1894 a concession for the building of a railway to his capital from the French port of Jibuti, but, alarmed by a claim made by France in 1902 to the control of the line in Abyssinian territory, he stopped for four years the extension of the railway beyond Dire Dawa. When in 1906 France, Great Britain and Italy came to an agreement on the subject, Menelek officially reiterated his full sovereign rights over the whole of his empire. In May 1909 the emperor's grandson Lij Yasu, or Jeassu, then a lad of thirteen, was married to Romanie (b. 1902), granddaughter of the negus Johannes. Two days later Yasu was publicly proclaimed at Adis Ababa as Menelek's successor. At that time the emperor was seriously ill and as his ill-health continued, a council of regency—from which the emperor was excluded—was formed in March 1910. (See also ABYSSINIA.)

MENÉNDEZ Y PELAYO, MARCELINO (1856–), Spanish scholar and critic, was born at Santander on the 3rd of November 1856. In 1871–1872 he studied under Milá y Fontanals at the university of Barcelona, whence he proceeded to the central university of Madrid. His academic successes had never been surpassed; a special law was passed by the Cortes to enable him to become a professor at the age of twenty-two, and three years later he was elected a member of the Spanish Academy. But before this date (1882) he was well known throughout Spain. His first volume, *Estudios críticos sobre escritores montañeses* (1876), had attracted little notice, and his scholarly *Horacio en España* (1877) appealed only to students. He became famous through his *Ciencia española* (1878), a collection of polemical essays defending the national tradition against the attacks of political and religious reformers. The unbending orthodoxy of this work is, if possible, still more pronounced in the *Historia de los heterodoxos españoles* (1880–1886), and the writer was hailed as the champion of the ultramontane party. His lectures (1881) on Calderón established his reputation as a literary critic; and his work as an historian of Spanish literature was continued in his *Historia de las ideas estéticas en España* (1881–1891), his edition (1890–1903) of Lope de Vega, his *Antología de poetas líricos castellanos* (1890–1906), and his *Orígenes de la novela* (1905).

MENENIUS LANATUS, AGRIPPA, Roman patrician and statesman, consul 503 B.C. On the occasion of the first secession of the people to the Sacred Mount, Agrippa, who was known to be a man of moderate views, was one of the commissioners empowered by the senate to treat with the seceders. On this occasion he recited the well-known fable of the belly and the members.

Livy ii. 16, 32, 33; Dion. *Halic.* v. 44–47; vi. 49–88, 96; Val. *Max.* iv. 4, 2.

MENES, the name of the founder of the 1st Dynasty of historical kings of Egypt. He appears at the head of the lists not only in Herodotus and Manetho, but also in the native Turin Papyrus of Kings and the lists of Abydos, while the list of Sakkara begins with the sixth king of the 1st Dynasty, a fact which may throw some doubt on the supposed foundation of Memphis by Menes. Until recently he was looked upon as semi-mythical, but the discovery of the tombs of many kings of the 1st Dynasty including probably that of Menes himself, as well as an abundance of remains of still earlier ages in Egypt has given him a personality. He was probably ruler of Upper Egypt and conquered the separate kingdom of Lower Egypt.

See EGYPT; K. Sethe, "Menes und die Grundung von Memphis," in his *Untersuchungen zur Geschichte und Alterthumskunde Aegyptens*, iii. 121. (F. LL. G.)

MENGS, ANTONY RAPHAEL (1728–1779), German painter, was born in 1728 at Aussig in Bohemia, but his father, Ismael Mengs, a Danish painter, established himself finally at Dresden, whence in 1741 he took his son to Rome. The appointment of Mengs in 1749 as first painter to the elector of Saxony did not prevent his spending much time in Rome, where he had married in 1748, and abjured the Protestant faith, and where he became in 1754 director of the Vatican school of painting, nor did this hinder him on two occasions from obeying the call of Charles III. of Spain to Madrid. There Mengs produced some of his best work, and specially the ceiling of the banqueting-hall, the subject of which was the Triumph of Trajan and the Temple of Glory. After the completion of this work in 1777, Mengs returned to Rome, and there he died, two years later, in poor circumstances, leaving twenty children, seven of whom were pensioned by the king of Spain. Besides numerous paintings in the Madrid gallery, the Ascension at Dresden, Perseus and Andromeda at St Petersburg, and the ceiling of the Villa Albani must be mentioned among his chief works. In England, the duke of Northumberland possesses a Holy Family, and the colleges of All Souls and Magdalen, at Oxford, have altar-pieces by his hand. In his writings, in Spanish, Italian and German, Mengs has put forth his eclectic theory of art, which treats of perfection as attainable by a well-schemed combination of diverse excellences—Greek design, with the expression of Raphael, the chiaroscuro of Correggio, and the colour of Titian. His intimacy with Winckelmann—who constantly wrote at his dictation—has enhanced his historical importance, for he formed no scholars, and the critic must now concur in Goethe's judgment of Mengs in *Winckelmann und sein Jahrhundert*; he must deplore that so much learning should have been allied to a total want of initiative and poverty of invention, and embodied with a strained and artificial mannerism.

See *Opere di Antonio Raffaello Mengs* (Parma, 1780); *Mengs Werke, übersetzt v. G. F. Prange* (1786); *Zeitschrift für bildende Kunst* (1880); Bianconi, *Elogio storico di Mengs* (Milan, 1780); Woermann, *Ismael und Raphael Mengs* (Leipzig, 1893).

MENGTSZE, a city in the S.E. of the province of Yunnan, China. Pop. about 12,000. It was selected by the French convention of 1886 as the seat of the overland trade between Tongking and Yunnan, and opened two years later. It is beautifully situated in the centre of a valley basin on a plateau 3500 ft. above sea-level. The country round is fertile and well cultivated, and the place must have been one of considerable wealth before the T'aip'ing rebellion, as the ruins of many fine temples attest. A considerable overland trade has sprung up since the opening of Mengtsze. Of the import trade Hong-Kong supplied 86%, and of the export trade 70%, Cochin-China, Tongking and Annam claiming the remainder. Tin (68%) and opium (27·8%) are the principal exports, and textiles (71%), mostly cottons, and tobacco (4%) are the chief imports. On the Tongking side this trade follows the Red River route as far as Manhao, which is distant from Mengtsze about 40 m., though the navigation of the river is difficult. From Manhao the transit is by coolies or pack animals. Concessions have been obtained by the French government to build a line of railway from the Tongking frontier at the town of Laokay via Mengtsze to Yunnan-fu. The climate is equable and healthy.

MENHADEN, economically one of the most important fishes of the United States, known by a great number of local names, "menhaden" and "mossbunker" being those most generally in use. The Indians and white settlers used it as a manure, and the name is Narragansett for "fertilizer." Its scientific name is *Clupea* (or *Alosa*) *menhaden* and *Brevoortia tyrannus*. It is allied to the European species of shad and pilchard, and, like the latter, approaches the coast in immense shoals, which are found throughout the year in some part of the littoral waters between Maine and Florida, the northern shoals retiring into deeper water or to more southern latitudes with the approach of cold weather. The average size of the menhaden is about 12 in. It is too bony and oily for a table-fish, but is used as bait for cod and mackerel. A large fleet is engaged in the fishery; and a great number of factories extract the oil for tanning and currying, and for adulterating other more expensive oils, and manufacture the refuse into a valuable guano.

MENIAL, that which belongs to household or domestic service, hence, particularly, a domestic servant. The idea of such service being derogatory has made the term one of contempt. The word is derived from an obsolete *meinie* or *meyney*, the company of household servants or retainers; a Scottish form is *menzie*. The origin is to be found in the O.Fr. *mesnie*, popular Lat. *mansionata*, from *mansio*, mansion, from which comes Fr. *maison*, house.

MÉNIER, EMILE JUSTIN (1826–1881), French manufacturer and politician, was born at Paris in 1826. In 1853, on the death of his father, Antoine Brutus Ménier, he became proprietor of a large drug factory, founded in 1815 by the latter at Saint Denis, Paris, and in 1825 at Noisiel-sur-Marne. Antoine Brutus Ménier had also manufactured chocolate in a small way, but Emile Justin from the first devoted himself specially to chocolate. He purchased cocoa-growing estates in Nicaragua and beet-fields in France, erected a sugar-mill, and equipped himself in other ways for the production of chocolate on a large scale. In 1864 he sold his interest in the drug-manufacturing business, and thenceforth confined himself to chocolate, building up an immense trade. Ménier was a keen politician, and from 1876 till his death had a seat in the French Chamber, his general views being strongly Republican, while he consistently opposed protection. He was the author of several works on fiscal and economic questions, notably *L'Impôt sur le capital* (1872), *La Réforme fiscale* (1872), *Économie rurale* (1875), *L'Avenir économique* (1875–1878), *Atlas de la production de la richesse* (1878). He died at Noisiel-sur-Marne in 1881, his sons succeeding to the business.

MÉNIÈRE'S DISEASE, a form of auditory vertigo, first described by a French physician, Emile Antoine Ménière, in 1861. It usually attacks persons of middle age whose hearing has been previously normal. A. Politzer gives the following as the principal causes: intense heat and exposure to the sun, rheumatism, influenza, venereal diseases, anaemia and leukaemia. The disease presents itself in various forms, but the most usual is the apoplectoform, due to haemorrhage into the labyrinth, followed by more or less complete deafness in either or both ears. The attack usually sets in with dizziness, noises in the ears, nausea, vomiting and staggering gait, and the patient may suddently fall down with loss of consciousness. The seizures are usually paroxysmal, occurring at irregular intervals of days or weeks. Between the attacks the equilibrium may be disturbed, there being marked nystagmus and unsteadiness of gait. The attacks of vertigo tend to become less frequent and may entirely pass away, but the deafness may remain permanent. The treatment is directed towards relieving the troublesome head symptoms by the application of cold compresses. The drug that has proved most serviceable in diminishing the dizziness is potassium iodide, administered daily for at least a month. Politzer considers that the attacks may be averted by producing rarefaction of the air in the external meatus of the ear by means of a specially devised aspirating tube.

MENIN (Flemish *Meenen*), a town of Belgium in the province of West Flanders situated on the Lys 7 m. S. of Courtrai. Pop. (1904), 19,377. It manufactures linen and flannel, and in the neighbourhood are extensive tobacco plantations. It was first fortified in 1578, and in 1685 Vauban made it one of the strongest places on the French frontier, but the fortifications were razed in 1748 by the treaty of Aix-la-Chapelle.

MENINGITIS (from Gr. μῆνιγξ, a membrane), a term in medicine applied to inflammation affecting the membranes of the brain (cerebral meningitis) or spinal cord (spinal meningitis) or both.

Tubercular cerebral meningitis (or *Acute Hydrocephalus*) is a disease due to inflammation of the meninges of the brain produced by the presence of a tubercle bacillus. This disease is most common in children under ten years of age, but may affect adults. The tubercular constitution is an important factor in this malady. In numerous cases it is manifestly connected with bad hygienic conditions, with insufficient or improper feeding, or with over exercise of the mental powers, all of which will doubtless more readily exert their influence where an inherited liability exists, and the same may be said regarding its occasional occurrence as one of the after consequences of certain of the diseases of childhood, especially measles and whooping-cough.

There are certain typical features characterizing the disease in each of its stages. The premonitory symptoms are mostly such as relate to the general nutrition. A falling off in flesh and failure of strength are often observed for a considerable time before the characteristic phenomena of the disease appear. The patient, if a child, becomes listless and easily fatigued, loses appetite, and is restless at night. There is headache after exertion, and the child becomes unusually irritable. These symptoms may persist during many weeks; but on the other hand such premonitory indications may be entirely wanting, and the disease be developed to all appearance suddenly.

The onset is in most instances marked by the occurrence of vomiting, often severe, but sometimes only slight, and there is in general obstinate constipation. In not a few cases the first symptoms are convulsions, which, however, may in this early stage subside, and remain absent, or reappear at a later period. Headache is one of the most constant of the earlier symptoms, and is generally intense and accompanied with sharper paroxysms, which cause the patient to scream, with a peculiar and characteristic cry. There is great intolerance of light and sound, and general nervous sensitiveness. Fever is present to a greater or less extent, the temperature ranging from 100° to 103° F.; yet the pulse is not quickened in proportion, being on the contrary rather slow, but exhibiting a tendency to irregularity, and liable to become rapid on slight exertion. The breathing, too, is somewhat irregular. Symptoms of this character, constituting the stage of excitement, continue for a period varying from one to two weeks, when they are succeeded by the stage of depression. There is now a marked change in the symptoms, which is apt to lead to the belief that a favourable turn has taken place. The patient becomes quieter and inclines to sleep, but it will be found on careful watching that this quietness is but a condition of apathy or partial stupor into which the child has sunk. The vomiting has ceased, and there is less fever; the pulse is slower, and shows a still greater tendency to irregularity than before, while the breathing is of markedly unequal character, being rapid and shallow at one time, and long drawn out and sinking away at another. There is manifestly little suffering, although the peculiar cry may still be uttered, and the patient lies prostrate, occasionally rolling the head uneasily upon the pillow, or picking at the bedclothes or at his face with his fingers. He does not ask for food, but readily swallows what is offered. The countenance is pale, but is apt to flush up suddenly for a time. The eyes present important alterations, the pupils being dilated or unequal, and scarcely responding to light. There may be double vision, or partial or complete blindness. Squinting is common in this stage, and there may also be drooping of an eyelid, due to paralysis of the part, and one or more limbs may be likewise paralysed.

To this succeeds the third or final stage, in which certain of the former symptoms recur, while others become intensified. There is generally a return of the fever, the temperature rising sometimes very high. The pulse becomes feeble, rapid, and exceedingly irregular, as is also the case with the breathing. Coma is profound, but yet the patient may still be got to swallow nourishment, though not so readily as before. Convulsions are apt to occur, while paralysis, more or less extensive, affects portions of the body or groups of muscles. The pupils are now widely dilated, and there is generally complete blindness and often deafness. In this condition the patient's strength undergoes rapid decline, and the body becomes markedly emaciated. Death takes place either suddenly in a fit, or more gradually from exhaustion. Shortly before death it is not uncommon for the patient, who, it may be for many days previously, lay in a state of profound stupor, to awake up, ask for food, and talk to those around. The duration of a case varies somewhat, but in general death takes place within three weeks from the onset of the symptoms. The disease may be said to be almost invariably fatal, yet cases presenting all the principal symptoms occasionally recover.

Much may be done in the way of prevention of this disease, and, in its earlier stages, even in the way of cure. It is most important in families where the history indicates a tuberculous or scrofulous tendency, and particularly where acute hydrocephalus has already occurred, that every effort should be used to fortify the system and avoid the causes already alluded to as favouring the development of the disease during that period in which children are liable to suffer from it. With this view wholesome food, warm clothing, cleanliness, regularity, and the avoidance of over-exertion, physical and mental, are of the utmost consequence.

Timely use of remedies may mitigate and even occasionally remove the symptoms when they arise. The maintenance of the patient's strength by light nourishment and the use of sedatives to compose the nervous system are the measures most likely to be attended with success. Bromide, combined with iodide of potassium, is the medicinal agent of most value for this purpose. Should convulsions occur, they are best treated by chloral or chloroform.

In what is known as *suppurative*, or *simple acute meningitis* (non-tubercular), the disease arises from various causes, and the symptoms are similar to those described above.

In *posterior-basic meningitis*, inflammation of the membranes investing the posterior basic spinal cord, the chief symptoms are fever, with severe pain in the back or loins shooting downwards into the limbs (which are the seat of frequent painful involuntary startings), accompanied with a feeling of tightness round the body.

The local symptoms bear reference to the portion of the cord the membranes of which are involved. Thus when the inflammation is located in the cervical portion the muscles of the arms and chest are spasmodically contracted, and there may be difficulty of swallowing or breathing, or embarrassed heart's action, while when the disease is seated in the lower portion, the lower limbs and the bladder and rectum are the parts affected in this way. At first there is excited sensibility (hyperaesthesia) in the parts of the surface of the body in relation with the portion of cord affected. As the disease advances these symptoms give place to those of partial loss of power in the affected muscles, and also partial anaesthesia. These various phenomena may entirely pass away, and the patient after some weeks or months recover; or, on the other hand, they may increase, and end in permanent paralysis.

Some observers regard these forms as sporadic cases of cerebro-spinal fever; and Still, William Hunter and George Nuttall have isolated an organism similar to the diplococcus intracellularis, while Henry Koplik in New York found cases of typical posterior-basic meningitis due to the diplococcus intracellularis.

The treatment is directed to allaying the pain and inflammatory action by opiates. Ergot is recommended by many physicians. The patient should have perfect rest in the recumbent, or better still in the prone, position. Cold applications to the spine may be of use, while attention to the functions of the bladder and bowels, and to the condition of the skin with the view of preventing bed-sores, is all-important.

Cerebro-spinal fever or *epidemic cerebro-spinal meningitis*, popularly called "spotted fever," is an infectious disease occurring sporadically or in epidemics, and due to the diplococcus intracellularis discovered by Weichselbaum in 1887. This disease was not recognized until the 19th century. It was first described at Geneva in 1805 and small outbreaks followed in Paris (1814), Metz and Genoa (1815), and Westphalia (1822), but in the United States there was a widespread epidemic, including New England and spreading as far as Kentucky and Ohio. Fresh outbreaks in Europe took place between 1837 and 1850. In 1837 it prevailed in the south of France chiefly amongst troops in garrison, and fresh outbreaks continued throughout France in 1846 with epidemics in Algiers, Italy and Sicily. In Great Britain it first showed itself in the Irish workhouses in 1846, where it was known as "the black death" or "malignant purpuric fever." After 1866 except for sporadic cases it disappeared from Great Britain, but small outbreaks took place in 1885 to 1900 in Dublin. In 1905 there was an extensive epidemic in New York, followed by an outbreak in Scotland in 1906, and in Scotland and Ireland in 1907–1908. The registrar-general's returns for 1907 give 1018 deaths in Scotland due to the disease, of which 711 were at Glasgow and 148 at Edinburgh. In the same year Belfast was visited by a severe epidemic, 495 deaths out of the total death-rate of 631 taking place in that district.

The mode of infection is obscure, but the organism is thought to gain access to the circulation through the mucous membrane of the nose and conjunctiva, as the organism has been isolated from the mucous membrane of the nose, not only of those suffering from the disease but from healthy persons who have been in contact with cases. Cerebro-spinal fever has an undoubted tendency to follow bad sanitary conditions and to prevail in damp, sunless houses. It is a disease of temperate climates, and the outbreaks usually take place in the spring of the year. The victims are mostly children and young adults, and Koplik states that few recoveries take place in children under two years of age.

The onset of symptoms is sudden, as contrasted with tubercular meningitis, in which the onset is gradual. The attack comes on sharply with intense headache, rigors and vomiting. The pain soon localizes itself in the back of the neck and occiput, and may thence radiate down the spine, limbs and abdomen. The pain is soon followed by a characteristic symptom, namely retraction of the head. The head is drawn back and rigidly fixed, the spine arched and the limbs drawn up, and muscular spasms may take place. There is general hyperaesthaesia, the slightest contact producing pain. More or less fever is present, but the temperature is not characteristic. The headache continues with great severity and restlessness and delirium supervene, or there may be long periods when the patient is comatose. Twitching of the limbs and general convulsions may occur and facial paralysis is frequent. Paralysis of the ocular nerves causing squint, dilatations and contractions of the pupil are common as in other varieties of meningitis.

Some of the most striking symptoms are the rashes. These usually occur about the fourth day of illness and vary widely in character, resembling erythema, urticaria, rose spots or purpuric spots. The rashes have usually no relation to the gravity of the disease, but severe cutaneous haemorrhages usually indicate a severe form of illness. Should the patient survive the first shock of the attack serious complications may arise; the eyes may be attacked by severe conjunctivitis, iritis or keratitis or inflammation of the deeper parts may take place leading to detachment of the retina. More frequent even is disease of the auditory apparatus, and purulent otitis media or disease of the labyrinth may lead to permanent deafness. Serous effusion may take place into joints which are painful, red and swollen as in acute rheumatism.

Certain forms of the disease are rapidly fatal, these are known as the fulminant type, and death may take place within 12 to 24 hours of the onset. Death usually occurs between the fifth and the eighth day, but many cases drag on for weeks with rapid and progressive emaciation, and recovery is slow. The mortality has varied in different epidemics. Hirsch's tables of forty-one epidemics give a mortality of from 25 to 75 %, and Koplik rates it at 48 to 90 %. During 1907, 623 cases of cerebro-spinal fever were notified in Belfast, and the deaths numbered 495. During that year the disease was made notifiable in 48 Irish urban and 55 rural districts. The mortality in Dublin was 75 %. Osler states that in children under one year (in New York) the mortality reached 87·6 %.

The changes found after death from cerebro-spinal fever are an acute inflammation of the pia-arachnoid membrane both of the brain and spinal cord, with effusion of serum or pus into the ventricular and subarachnoid spaces. With such rapidity may the effusion become purulent that it has been found purulent in a case where death took place within five hours from the apparent onset. The operation of lumbar puncture (or puncture of the spinal canal between the lumbar vertebrae) has enabled the physician to make an accurate diagnosis by bacteriological examination of the contents of the spinal fluid. Lumbar puncture too has been found to be of eminent service in many cases, the withdrawal of from 30 to 50 cc. of the spinal fluid serving to relieve pressure and at least temporarily ameliorate the symptoms.

Up to a few years ago it may be said that there was no effective treatment for cerebro-spinal fever but that of endeavouring to alleviate pain by the administration of opium, but with the recent introduction of serum therapy the future is full of hope. In the epidemic in New York (1905) the serum of Flexner and Jobling was used, and the most striking results were seen in young patients, the death-rate where the serum was used sinking to 46·3 % as against 90 % without. Like other serum treatments, to get the best results the serum must be administered early in the disease. Of 221 patients injected during the first week of illness the mortality was only 18 %, while of 107 others injected after the first week of the disease the mortality was double that amount. When given subcutaneously, as in diphtheria, the serum has little or no effect, and to obtain good results it must be injected directly into the spinal canal after the removal of a certain amount of the spinal fluid. The injections are then continued daily as required according to the severity of the case. Dr Robb of Belfast reports that during the epidemic there, of 275 cases treated by ordinary means, the death-rate was 72·3 %, but in 90 cases treated with injections of Flexner and Jobling's serum the death-rate was only 30 %. Dr Ivy McKenzie and Dr W. B. Martin of Glasgow have published a series of cases treated with the highly immune serum of patients who have recovered from the disease with encouraging results.

MENIPPUS, of Gadara in Coele-Syria, Greek cynic and satirist, lived during the 3rd century B.C. According to Diogenes Laërtius (vi. 8) he was originally a slave, amassed a fortune as a money-lender, lost it, and committed suicide through grief. His works (written in a mixture of prose and verse) are all lost. He discussed serious subjects in a spirit of raillery, and especially delighted in attacking the Epicureans and Stoics. His writings exercised considerable influence upon later literature. One of the dialogues attributed to Lucian, his avowed imitator, who frequently mentions him, is called *Menippus*. But this dialogue is regarded with suspicion, and since the sub-title (" The Oracle of the Dead ") resembles that of a work ascribed to Menippus by Diogenes Laërtius, it has been suggested that it is really the work of Menippus himself, or at any rate imitated from his Νέκυια by the author, whether Lucian or another. It is well known that the Menippean satires of M. Terentius Varro, the fragments of which give an idea of this kind of composition, were called after Menippus of Gadara (see Teuffel-Schwabe, *Hist. of Roman Literature*, § 165, 3).

BIBLIOGRAPHY.—F. Ley, *De vita scriptisque Menippi cynici* (Cologne, 1843); R. Helm, *Lucian und Menipp* (1906); C. Wachsmuth, *Sillographorum graecorum reliquiae* (1885), with an account of Menippus and similar writers. Menippus found an imitator in later times in Justus Lipsius, author of a *Satyra menippaea* (1637) in which he ridiculed certain literary men of his age, especially the poet laureate; and in the authors of the famous *Satyre Menippée* (1593; latest editions by C. Marcilly, Paris, 1882; J. Frank, Oppeln, 1884), written against the Holy League during the reign of Henri IV.

MENIUS, JUSTUS (1499–1558), Lutheran theologian, whose name is Latinized from Jost or Just (*i.e.* Jodocus) Menig, was born at Fulda, of poor but respectable parents, on the 13th of December 1499. Entering the university of Erfurt in 1514, he took the bachelor's degree in 1515, the master's in 1516. At this time, in association with the keen humanists Conrad Mutian, Crotus Rubeanus and Eoban Hess, he was of sceptical tendency; moving to Wittenberg in 1519, he became evangelical under the teaching of Melanchthon and the preaching of Luther. After travel in Italy (1521–1522) he was appointed (1523) town's preacher at Wittenberg, but was soon transferred to the charge of Mühlberg, under Erfurt. Here he published his commentary on Acts (1524) and married. He resigned his charge (1525) and opened a school at Erfurt, but the town council insisted on his resuming his ministry, appointing him preacher in St Thomas', Erfurt. He worked in conjunction with Luther's friend, John Lange, and was opposed by the Franciscans under Conrad Kling. Hence he left for Gotha (1528), resumed teaching, and enjoyed the friendship of Friedrich Myconius. Duke John of Saxony had placed him on the commission for church visitation in Thuringia, and in 1529 appointed him pastor and superintendent at Eisenach, where for eighteen years he administered church affairs with tact, and fostered the spread of education. In 1529 he brought out his *Oeconomia christiana* (a treatise in German, on the right ordering of a Christian household) with a dedication to the duchess Sybil of Saxony and a preface by Luther. His tractate, written in concert with Myconius, controverting *Der Wiedertäufer Lehre und Geheimniss* (1530) was also prefaced by Luther. The reversion to the Roman communion of his old friend Crotus led to his mordant *Responsio amici* (1532, anon.) to the *Apologia* (1531) of Crotus. He took his part in the theological disputations of the time, at Marburg (1529), the Concordia at Wittenberg (1536), the Convention at Schmalkalden (1537), the discussions at Hagenau and Worms (1540). His tractate (1542) against the permission of bigamy in the case of Philip of Hesse was not allowed to be printed (the manuscript is in the Heidelberg university library). In 1542 he removed to Mühlhausen, being appointed by Duke Henry of Saxony for the ordering of the church there. On the death of Myconius (1546) he was entrusted with the oversight of Gotha, in addition to that of Eisenach; to Gotha he returned in 1547. The remainder of his life was not happy. He was against the Leipzig *Interim* (1548) with its compromise on some Catholic usages, and was involved in controversies and quarrels; with Georgius Merula, against whom he maintained the need of exorcism in baptism; with Osiander's adherents in the matter of justification; with his colleague, Nicholas von Amsdorf, to whom he had resigned the Eisenach superintendency; with Flacius Illyricus, and others. He lost favour with Duke John Frederic of Saxony, fell into bad health, was deposed (1555) from his offices, and was disappointed in his hopes of being reinstated, after the colloquy at Eisenach (1556). He died at Leipzig on the 11th of August 1558. He was twice married, and had several sons, of whom Eusebius held a chair of philosophy at Wittenberg, and married Melanchthon's grand-daughter, Anna Sabinus. Schmidt gives a full bibliography of the numerous writings of Menius, who translated several of Luther's biblical commentaries into German. His *Oeconomia* was reprinted in 1855.

See G. L. Schmidt, *Justus Menius, der Reformator Thüringens* (1867); Wagenmann, in *Allgemeine deutsche Biog.* (1885); G. Kawerau, in Hauck's *Realencyklopädie* (1903). (A. Go.*)

MENKEN, ADAH ISAACS (1835–1868), American actress, was born in New Orleans, the daughter of a Spanish Jew, her name being Dolores Adios Fuertes. Left in poverty at the age of thirteen, she made her first appearance as a dancer in her native city. She had a great success there and in other southern cities, including Havana, and she afterwards aspired to act in serious parts. In 1856 she married John Isaacs Menken, translated Adios to Adah, and thus took the name she thereafter bore through various matrimonial ventures. In 1864 she appeared at Astley's in London as Mazeppa, a performance of an athletic dramatic type suited to her fine physique. In England and France she became intimate with many literary men—Swinburne, Charles Reade, Dickens (to whom she dedicated in 1868 a volume of verse, *Infelicia*), Gautier and Dumas the elder. Paris saw her for a hundred nights in *Les Pirates de la Savane*, and she also played in Vienna and again in London. She died in Paris on the 10th of August 1868.

MENNONITES, a body of religionists who take their name from Menno Simons (see below), the most valued exponent of their principles. They maintain a form of Christianity which, discarding the sacerdotal idea, owns no authority outside the Bible and the enlightened conscience, limits baptism to the believer, and lays stress on those precepts which vindicate the sanctity of human life and of a man's word. The place of origin of the views afterwards called Mennonite (see BAPTISTS) was Zürich, where in 1523 a small community left the state church and (from Jan. 18, 1525) adopted the tenet of believers' baptism. Unlike other Reformers, they denied at once the Christian character of the existing church and of the civil authority, though, in common with the first Christians, it was their duty to obey all lawful requirements of an alien power. By Protestants as much as by Catholics this position was not unnaturally regarded as subversive of the established foundations of society. Hence the bitter persecutions which, when the safety of toleration was not imagined, made martyrs of these humble folk, who simply wished to cultivate the religious life apart from the world. There was something in this ideal which answered to that medieval conception of separation from the world which had leavened all middle-class society in Europe; and the revolt from Rome had prepared many minds to accept the further idea of separation from the church, for the pursuit of holiness in a society pledged to primitive discipline. Hence the new teaching and praxis spread rapidly from Switzerland to Germany, Holland and France. While the horrors of the Münster fanaticism, which culminated in 1534, made Anabaptism a byword, and increased the severity of a persecution directed against all Baptists indiscriminately, the reaction against the fatal errors of the Münster experiment increased also the adherents of communities which discarded the sword; thus Menno was brought into their ranks. Each community was independent, united with others only by the bond of love. There was no hierarchy (as with the Familists), but "exhorters" chosen by the members, among them "elders" for administering baptism and the Lord's Supper; an arrangement so readily renewed that the sure way of putting down such a body was the execution of all its constituents, often by drowning, an appropriate end, according to Zwingli's quip. The remnant of the Swiss Mennonites (not tolerated till 1710) broke in 1620 into two parties, the Uplanders (or Amish, from their leader Jacob Amen) holding against the Lowlanders that excommunication of husband or wife dissolved marriage, and that razors and buttons were unlawful. In Holland the Mennonites have always been numerous. An offshoot from them at Rhijnsburg in 1619, founded by the four brothers, farmers, Van der Kodde, and named Collegianten from their meetings, termed *collegia* (thus, as not churches, escaping the penal laws), has been compared to the Plymouth Brethren, but differed in so far as they required no conformity of religious opinion, and recognized no office of teacher. With them, as Martineau notes, Spinoza had "an intense fellow-feeling." Later, the exiled Socinians from Poland (1660) were in many cases received into membership. There had previously been overtures, more than once, for union with Mennonites on the part of Polish Socinians, who agreed with them in the rejection of oaths, the refusal to take human life, the consequent abstinence from military service and magisterial office, and in the Biblical basis of doctrine; differences of doctrinal interpretation precluded any fusion. In Holland the Mennonites were exempted from military service in 1575, from oath-taking in 1585, from public office in 1617. In Zeeland exemption from military service and oaths was granted in 1577; afterwards, as in Friesland, a heavy poll tax was the price of exemption from military service; but since 1795 they have enjoyed a legal exemption from oath-taking. In France the Mennonites of the Vosges were exempted from military service in 1793, an exemption confirmed by Napoleon, who employed them in hospital service on his campaigns. That he did not exempt the Dutch Mennonites is due to the fact that "they had ceased to present a united front of resistance to military claims" (Martineau); in fact they sent a large band of volunteers to Waterloo (Barclay). While in Germany the Mennonites exist in considerable numbers, more important are the German Mennonite colonies in southern Russia, brought there in 1786 by Catherine II., and freed, by the grant of complete religious liberty, from the hardships imposed by Prussian military law. These colonies have sent many emigrants to America, where their oldest community was settled (1683) at Germantown, Pennsylvania. Their settlement in Canada dates from 1786. Among the American Mennonites there are three sections, and a progressive party, known as New School Mennonites.

S. Cramer gives (1903) the following statistics: in all, some 250,000 members, of whom over 80,000 are in the United States, 70,000 in Russia, 60,000 in Holland, 20,000 in Canada, 18,000 in Germany, 1500 in Switzerland, 800 in France, and the same number in Poland and Galicia. (A. Go.*)

MENNO SIMONS (1492–1559), religious leader, was born in 1492 at Witmarsum in Friesland. Of his parentage (apart from his patronymic) and education nothing is known. He was not a man of learning, nor had he many books; for his knowledge of early Christian writers he was partly indebted to the *Chronica* or compilations of Sebastian Franck. At the age of twenty-four he entered the priesthood, becoming one of two curates under the incumbent of Pingjum, a village near his birthplace. He accused himself, with the other clergy, of lax and self-indulgent living. Doubts about transubstantiation made him uneasy; some of Luther's tracts fell in his way, and he was comforted by Luther's dictum that salvation does not depend on human dogmata. Hence he began to study the New Testament. The question as to the right age for baptism came up; he found this an open matter in the early church. Then the execution, in March 1531, at Leeuwarden, of the tailor Sicke Freerks, who had been rebaptized in the previous December at Emden, introduced further questions. Menno was not satisfied with the inconsistent answers which he got from Luther, Bucer and Bullinger; he resolved to rely on Scripture alone, and from this time describes his preaching as evangelical, not sacramental. In 1532 he exchanged his curacy for a living at Witmarsum, in response to a popular call. Anabaptism of the Münster type repelled him. His first tractate (1535, first printed 1627) is directed against the "horrible and gross blasphemy of John of Leiden"—though the genuineness of this tract has been doubted. A brother of Menno joined the insurgent followers of John Matthyszoon, and was killed at Bolsward (April 1535). Blaming the leaders by whom these poor people had been misled, Menno blamed himself for not having shown them a straight course. Accordingly on the 12th of January 1536, he left the Roman communion. There were now among the so-called Anabaptists four parties, the favourers of the Münster faction, the Batenburgers, extremists, the Melchiorites and the Obbenites. For a time Menno remained aloof from both Melchior Hofman and Obbe Philipsz. Before the year was out, yielding to the prayer of six or eight persons who had freed themselves from the Münster spell, he agreed to become their minister, and was set apart (January 1537) to the eldership at Groningen, with imposition of hands by Obbe Philipsz, who is regarded as the actual founder of the Mennonite body. In fact, Obbe left the body and is stigmatized as its Demas. Menno repudiated the formation of a sect; those who had experienced the "new birth" were to him the true Christian church, which was limited by no decree of reprobation. His Christology was in the main orthodox, though he rejected terms (such as Trinity) which he could not find in Scripture, and held a Valentinian doctrine of the celestial origin of the flesh of Christ. His church discipline was drawn from the Swiss Baptists. Silent prayer was a feature of the worship; sermons were without texts. Neither baptism (by pouring on the head) nor the Lord's Supper (with the accompaniment of feet-washing) conferred grace; they were divine ordinances which reflected the believer's inward state. Marriage with outsiders was prohibited; women had no part in church government. Oaths and the taking of life were absolutely forbidden; hence the magistracy and the army were for the Mennonite unlawful callings; but magistrates were to be obeyed in all things not prohibited by Scripture. The subsequent career of Menno was that of an active missioner; his changes of place, often compulsory, are difficult to trace. He was apparently much in East Friesland till 1541; in North Holland, with Amsterdam as centre, from 1541 to 1543; again till 1545 in East Friesland (where he held a disputation at Emden with John à Lasco in January 1544); till 1547 in South Holland; next, about Lübeck; at Wismar in 1553–1554 (he held two disputations with Martin Micronius at Norden in February 1554); lastly at Wüstenfelde, a village near Oldesloo, between Hamburg and Lübeck, where he died on the 13th of January 1559. He had married one Gertrude at Groningen, and left a daughter, by whom the dates of his birth and death were communicated to P. J. Twisch, for his *Chronyk* (1619).

Menno's writings in Plattdeutsch, printed at various places, are numerous, with much sameness, and what an unfriendly critic would call wool-gathering; through them shines a character attractive by the sincerity of its simple and warm spirituality, the secret of Menno's influence. The collection of his *Opera Omnia Theologica* (Amsterdam, 1681), folio, in a Dutch version, comprises twenty-three tractates, with reference to nine unprinted. His main principles will be found in his *Dat Fundament des Christelycken Leers* (1539, 8vo). A selection (*Gedenkblätter*) from his writings, in a German version, in honour of the (supposed) tercentennial of his death was edited by J. Mannhardt (Danzig, 1861) with an appendix from the writings of Dirk Philipsz (1504–1570), brother of Obbe, and Menno's henchman. His writings are published in English at Elkhart, Indiana.

Since the publication of the *Leven* (1837) by A. M. Cramer, light has been thrown on the period by the researches of de Hoop Scheffer; see Van der Aa, *Biographisch woordenboek der Nederlanden* (1869); R. Barclay, *Inner Life of Religious Societies of the Commonwealth* (1876) for a good account of Mennonite anticipations of Quaker views and practices; F. C. Fleischer, *Menno Simons, eene Levensschets* (1892); V. M. Reimann, *Mennonis Simonis qualis fuerit vita* (1894); S. Cramer, in Hauck's *Realencyklopädie* (1903); a separate article in the same, *Mennoniten*, by S. Cramer, gives a survey of the origin and ramifications of the movement in Europe and America. (A. Go.*)

MENOMINEE, a city and the county-seat of Menominee county, Michigan, U.S.A., on Green Bay, at the mouth of the Menominee river, opposite Marinette, Wisconsin, at the southern extremity of the upper peninsula. Pop. (1890), 10,630; (1900), 12,818, of whom 4186 were foreign-born; (1910 census), 10,507. It is served by the Chicago & North-Western, the Chicago, Milwaukee & St Paul, the Wisconsin & Michigan, and the Ann Arbor railways, and is connected by five bridges with Marinette, Wisconsin. Menominee has several parks, and harbour and dock facilities for the heaviest lake vessels. It is one of the largest lumber centres in the United States; it has excellent water power, and there are manufactures of wire, steel, electrical appliances, mill and mining machinery, shoes, beet sugar and paper. The use of beet-pulp instead of Indian corn ensilage for dairy cows has promoted the dairying industry in the city.

A trading post was established here in 1799, but settlement was not begun until 1833. Menominee became the county-seat in 1874, was chartered as a city in 1883, and in 1891 and in 1901 it was re-chartered; in 1903 an amendment to the charter created a municipal court. The city is named after the Menominee Indians,[1] an Algonquian tribe formerly ranging over a considerable territory in Wisconsin and Michigan, who seem to have been first visited by whites in 1634, when Nicolet found them at the mouth of the Menominee river, and now number about 1600, most of them being under the Green Bay school superintendency, Wisconsin. The name is the Chippewa word for wild rice, which formed part of the food of the tribe.

MENOMONIE, a city and the county-seat of Dunn county, Wisconsin, U.S.A., about 64 m. E. of St Paul, Minnesota, on the Red Cedar river. Pop. (1890), 5491; (1900), 5655, of whom 1772 were foreign-born; (1905), 5473; (1910), 5036. It is served by the Chicago, Milwaukee & St. Paul, and the Chicago, St Paul, Minneapolis & Omaha railways. The city is widely known for its institutions, for the most part founded or supported by James Huff Stout (1848–1910), a prominent local lumberman. Among them are the Mabel Tainter Memorial Library, the Dunn County School of Agriculture, the Dunn County Normal Training School, the Stout Institute for the training of teachers of domestic science &c., institutions in which public school children receive physical training. The city has grain elevators, and manufactures of bricks and tiles, foundry and machine shop products, carriages and wagons and flour. Menomonie is an important market for dairy products and livestock. Menomonie was settled about 1846 and was chartered as a city in 1882. The first free travelling library in the state was established here in 1896 by James Huff Stout.

MENSA and **MAREA,** semi-nomad pastoral tribes of Africans occupying part of the Abyssinian highlands included in the Italian colony of Eritrea, and the adjacent coast plains of the Red Sea. They have for neighbours the Habab and Beni-Amer tribes, as well as Abyssinians. The Marea are found chiefly in the valley of the Khor Anseba, the Mensa dwelling farther north. These tribes claim Arab origin, tracing their descent from an uncle of the Prophet. Under Abyssinian rule they were Christians, but became Mahommedans in the 19th century. They speak a dialect of Tigrin (Abyssinian). On the death of a Marea the head of every dependent *tigré* or slave family must give his heirs a cow. The tribes avenge an illegitimate birth by putting parents and child to death.

MENSHIKOV, ALEXANDER DANILOVICH, PRINCE (1663?–1729), Russian statesman, was born not earlier than 1660 nor later than 1663. It is disputed whether his father was an ostler or a bargee. At the age of twenty he was gaining his livelihood in the streets of Moscow as a vendor of meat-pies. His handsome looks and smart sallies attracted the attention of François Lefort, Peter's first favourite, who took him into his service and finally transferred him to the tsar. On the death of Lefort in 1699, Menshikov succeeded him as prime favourite. Ignorant, brutal, grasping and corrupt as he was, he deserved the confidence of his master. He could drill a regiment, build a frigate, administer a province, and decapitate a rebel with equal facility. During the tsar's first foreign tour, Menshikov worked by his side in the dockyards of Amsterdam, and acquired a thorough knowledge of colloquial Dutch and German. He took an active part in the Azov campaigns (1695–96), and superseded Ogilvie as commander-in-chief during the retreat before Charles XII. in 1708, subsequently participating in the battle of Holowczyn, the reduction of Mazepa, and the crowning victory of Poltava (June 26, 1709), where he won his marshal's bâton. From 1709 to 1714 he served during the Courland, Holstein and Pomeranian campaigns, but then, as governor-general of Ingria, with almost unlimited powers, was entrusted with a leading part in the civil administration. Menshikov understood perfectly the principles on which Peter's reforms were conducted, and was the right hand of the tsar in all his gigantic undertakings. But he abused his omnipotent position, and his depredations frequently brought him to the verge of ruin. Every time the tsar returned to Russia he received fresh accusations of peculation against "his Serene Highness." Peter's first serious outburst of indignation (March 1711) was due to the prince's looting in Poland. On his return to Russia in 1712, Peter discovered that Menshikov had winked at wholesale corruptions in his own governor-generalship. Peter warned him "for the last time" to change his ways. Yet, in 1713, he was implicated in the famous Solov'ey process, in the course of which it was demonstrated that he had defrauded the government of 100,000 roubles.[1] He only owed his life on this occasion to a sudden illness. On his recovery Peter's fondness for his friend overcame his sense of justice. In the last year of Peter's reign fresh frauds and defalcations of Menshikov came to light, and he was obliged to appeal for protection to the empress Catherine. It was chiefly through the efforts of Menshikov and his colleague Tolstoi that, on the death of Peter, in 1725, Catherine was raised to the throne. Menshikov was committed to the Petrine system, and he recognized that, if that system were to continue, Catherine was, at that particular time, the only possible candidate. Her name was a watchword for the progressive faction. The placing of her on the throne meant a final victory over ancient prejudices, a vindication of the new ideas of progress. During her short reign (February 1725—May 1727), Menshikov was practically absolute. On the whole he ruled well, his difficult position serving as some restraint upon his natural inclinations. He contrived to prolong his power after Catherine's death by means of a forged will and a *coup d'état*. While his colleague Tolstoi would have raised Elizabeth Petrovna to the throne, Menshikov set up the youthful Peter II., son of the tsarevich Alexius, with himself as dictator during the prince's minority. He now aimed at establishing himself definitely by marrying his daughter Mary to Peter II. But the old nobility, represented by the Dolgorukis and the Golitsuins, united to overthrow him, and he was deprived of all his dignities and offices and expelled from the capital (Sept. 9, 1727). Subsequently he was deprived of his enormous wealth, and he and his whole family were banished to Berezov in Siberia, where he died on the 12th of November 1729.

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[1] See W. L. Hoffman in the *Fourteenth Report* (Washington, 1896) of the Bureau of American Ethnology and A. E. Jenks in the *Nineteenth Report* (1900).

See G. V. Esipov, *Biography of A. D. Menshikov* (Rus.) (St. Petersburg, 1875); N. I. Kostomarov, *The History of Russia in the biographies of her great Men* (Rus.), vol. ii. (St Petersburg, 1888, *&c.*); R. Nisbet Bain, *The First Romanovs* (London, 1905); ibid. *The Pupils of Peter the Great*, ch. 2–4 (Westminster, 1897). (R. N. B.)

MENSHIKOV, ALEXANDER SERGEIEVICH, PRINCE (1787–1869), great-grandson of the preceding, was born on the 11th of September 1787, and entered the Russian service as attaché to the embassy at Vienna. He accompanied the emperor Alexander throughout his campaigns against Napoleon, and retired from army service in 1823. He then devoted himself to naval matters, became an admiral in 1834, and put the Russian navy, which had fallen into decay during the reign of Alexander, on an efficient footing. At the time of the dispute as to the Holy Places he was sent on a special mission to Constantinople, and when the Crimean war broke out he was appointed commander-in-chief by land and sea. He commanded the Russian army at the Alma and in the field operations round Sevastopol. In March 1855 he was recalled, ostensibly and perhaps really, on account of failing health. He died on the 2nd of May 1869 at St Petersburg.

MENSURATION (Lat. *mensura*, a measure), the science of measurement; or, in a more limited sense, the science of numerical representation of geometrical magnitudes.

1. *Scope of the Subject.*—Even in the second sense, the term is a very wide one, since it comprises the measurement of angles (plane and solid), lengths, areas and volumes. The measurement of angles belongs to trigonometry, and it is convenient to regard the measurement of the lengths of straight lines (*i.e.* of distances between points) as belonging to geometry or trigonometry; while the measurement of curved lengths, except in certain special cases, involves the use of the integral calculus. The term "mensuration" is therefore ordinarily restricted to the measurement of areas and volumes, and of certain simple curved lengths, such as the circumference of a circle.

2. This restriction is to a certain extent arbitrary. The statement that, if the adjacent sides of a rectangle are represented numerically by 3 and 4, the diagonal is represented by 5, is as much a matter of mensuration as the statement that the area is represented by 12. The restriction is really determined by a difference in the methods of measurement. The distance between two points can, at any rate in theory, be measured directly, by successive applications of the unit of measurement. But an area or a volume cannot generally be measured by successive applications of the unit of area or volume; intermediate processes are necessary the result of which is expressed by a formula. The chief exception is in the use of liquid measure; this is of importance from the educational point of view (§ 12).

3. The measurement is *numerical*, *i.e.* it is representation in terms of a unit. The process of determining the area or volume of a given figure therefore involves two separate processes; viz. the direct measurement of certain magnitudes (usually lengths) in terms of a unit, and the application of a formula for determining the area or volume from these data. Mensuration is not concerned with the first of these two processes, which forms part of the art of measurement, but only with the second. It might, therefore, be described as that branch of mathematics which deals with formulae for calculating the numerical measurements of curved lengths, areas and volumes, in terms of numerical data which determine these measurements.

4. It is also convenient to regard as coming under mensuration the consideration of certain derived magnitudes, such as the moment of a plane figure with regard to a straight line in its plane, the calculation of which involves formulae which are closely related to formulae for determining areas and volumes.

5. On the other hand, the scope of the subject, as described in § 3, is limited by the nature of the methods employed to obtain formulae which can be applied to actual cases. Up to a certain point, formulae of practical importance can be obtained by the use of elementary arithmetical or geometrical methods. Beyond this point, analytical methods must be adopted, and the student passes to trigonometry and the infinitesimal calculus. These investigations lead, in turn, to further formulae, which, though not obtainable by elementary methods, are nevertheless simple in themselves and of practical utility. If these are included in the description "mensuration," the subject thus consists of two heterogeneous portions—elementary mensuration, comprising methods and results, and advanced mensuration, comprising certain results intended for practical application.

6. Mensuration, then, is mainly concerned with *quadrature-formulae* and *cubature-formulae*, and, to a not very clearly defined extent, with the methods of obtaining such formulae; a quadrature-formula being a formula for calculating the numerical

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[1] The Solov'evs were three brothers ostensibly employed by the Russian government to ship corn from Russia and sell it at Amsterdam. As a matter of fact they were at the head of a combination for selling Menshikov's corn in preference to the corn of the Russian government and the bulk of the proceeds went into Menshikov's pockets. From 1709 to 1711 they had exported almost as much of Menshikov's corn as of that of the government, though the export of any corn from Russia, except in account of the Treasury, was a capital offence. The affair dragged on from 1713 to 1716, when the examination of the Solov'evs' books, and the subsequent application of torture, revealed the fact that the Solov'evs had systematically robbed the Treasury of 675,000 roubles (1 rouble then = 5s.) and had accumulated a fortune of half a million. For full details see Nisbet Bain, *The first Romanovs*, pp. 327–329.

representation of an area, and a cubature-formula being a formula for calculating the numerical representation of a volume, in terms, in each case, of the numerical representations of particular data which determine the area or the volume.

7. This use of formulae for dealing with numbers, which express magnitudes in terms of units, constitutes the broad difference between mensuration and ordinary geometry, which knows nothing of units. Mensuration involves the use of geometrical theorems, but it is not concerned with problems of geometrical construction. The area of a rectangle, for instance, is found by calculation from the lengths of the sides, not by construction of a square of equal area. On the other hand, it is worth noticing that the words "quadrature" and "cubature" are originally due to geometrical rather than numerical considerations; the former implying the construction of a square whose area shall be equal to that of a given surface, and the latter the construction of a cube whose volume shall be equal to that of a given solid.

8. There are two main groups of subjects in which practical needs have tended to develop a separate science of mensuration. The first group comprises such subjects as land-surveying; here the measurements in the elementary stages take place in a plane, and the consideration of volumes necessarily constitutes a later stage; and the figures to be measured are mostly not movable, so that triangulation plays an important part. The second group comprises the mechanic arts, in which the bodies to be measured are solid bodies which can be handled; in these cases plane figures appear mainly as sections of a solid. In developing a system of mensuration-formulae the importance of this latter group of cases must not be overlooked.

A third group, of increasing importance, comprises cases in which curves or surfaces arise out of the application of graphic methods in engineering, physics and statistics. The general formulae applicable to these cases are largely approximative.

9. *Relation to other Subjects.*—As a result of the importance both of the formulae obtained by elementary methods and of those which have involved the previous use of analysis, there is a tendency to dissociate the former, like the latter, from the methods by which they have been obtained, and to regard mensuration as consisting of those mathematical formulae which are concerned with the measurement of geometrical magnitudes (including lengths), or, in a slightly wider sense, as being the art of applying these formulae to specific cases. Such a body of formulae cannot, of course, be regarded as constituting a science; it has no power of development from within, and can only grow by accretion. It may be of extreme importance for practical purposes; but its educational value, if it is studied apart from the methods by which the formulae are obtained, is slight. Vitality can only be retained by close association with more abstract branches of mathematics.

10. On the other hand, mensuration, in its practical aspect, is of importance for giving reality to the formulae themselves and to the principles on which they are based. This applies not only to the geometrical principles but also to the arithmetical principles, and it is therefore of importance, in the earlier stages, to keep geometry, mensuration and arithmetic in close association with one another; mensuration forming, in fact, the link between arithmetic and geometry.

11. It is in reference to the measurement of areas and volumes that it is of special importance to illustrate geometrical truths by means of concrete cases. That the area of a parallelogram is equal to the area of a rectangle on the same base and between the same parallels, or that the volume of a cone is one-third that of a cylinder on the same base and of the same height, may be established by a proof which is admitted to be rigorous, or be accepted in good faith without proof, and yet fail to be a matter of conviction, even though there may be a clear conception of the relative lengths of the diagonal and the side of a square or of the relative contents of two vessels of different shapes. The failure seems (§ 2) to be due to difficulty in realizing the numerical expression of an area or a solid in terms of a specified unit, while the same difficulty does not arise in the case of linear measure or liquid measure, where the number of units can be ascertained by direct counting. The difficulty is perhaps less for volumes than for areas, on account of the close relationship between solid and fluid measure.

12. The main object to be aimed at, therefore, in the study of elementary mensuration, is that the student should realize the possibility of the numerical expression of areas and volumes. The following are some important points.

(i) The double aspect of an area should be borne in mind; *i.e.* area should be treated not only as length multiplied by length, but also as volume divided by thickness. There are, indeed, certain advantages in preferring the latter to the former, and in proceeding from volumes to areas rather than from areas to volumes. While, for instance, it may be difficult to realize the equality of area of two plots of ground of different shapes, it may be easy to realize the equality of the amounts of a given material that would be required to cover them to a particular depth. This method is unconsciously adopted by the teacher who illustrates the equality of area of two geometrical figures by cutting them out of cardboard of uniform thickness and weighing them.

(ii) The very earliest stages of mensuration should be directly associated with simple arithmetical processes.

(iii) Association of solid measure with liquid measure, presenting numerical measurement in a different aspect, should be retained by testing volumes as found from linear dimensions with the volumes of the same bodies as found by the use of measures of capacity. Here, as usual, the British systems of measures produce a difficulty which would not arise under the metric system.

(iv) Solids of the same substance should be compared by measuring and also by weighing; the comparison being then extended to areas of uniform thickness (see (i) above).

(v) The idea of an *average* may be introduced at an early stage, methods of calculating an average being left to a later stage.

13. *Classification.*—The methods of mensuration fall for the most part under one or other of three main heads, viz. arithmetical mensuration, geometrical mensuration, and analytical mensuration.

14. The most elementary stage is arithmetical mensuration, which comprises the measurement of the areas of rectangles and parallelepipeds. This may be introduced very early; square tablets being used for the mensuration of areas, and cubical blocks for the mensuration of volumes. The measure of the area of a rectangle is thus presented as the product of the measures of the sides, and arithmetic and mensuration are developed concurrently. The commutative law for multiplication is directly illustrated; and subdivisions or groupings of the units lead to such formulae as $(a+\alpha)\ (b+\beta)=ab+a\beta+\alpha b+\alpha\beta$. Association with other branches of science is maintained by such methods as those mentioned in § 12.

The use of the square bricks familiarizes the scholar with the ideas of parallel lines, of equality of lengths, and of right angles. The conception of the right angle is strengthened, by contrast, by the use of bricks in the form of a rhombus.

15. The next stage is geometrical mensuration, where geometrical methods are applied to determine the areas of plane rectilinear figures and the volumes of solids with plane faces. The ordinary process involves three separate steps. The first step is the establishment of the exact equality of *congruence* of two geometrical figures. In the case of plane figures, the congruence is tested by an imaginary superposition of one figure on the other; but this may more simply be regarded as the superposition, on either figure, of the image of the other figure on a contiguous plane. In the case of solid figures a more difficult geometrical abstraction is involved. The second step is the conversion of one figure into another by a process of dissection, followed by rearrangement of parts; the figure as rearranged being one whose area or volume can be calculated by methods already established. This is the process adopted, for instance, for comparison of the area of a parallelogram with that of a rectangle on the same base and of the same height. The third step is the arithmetical calculation of the area or volume of the rearranged figure. These last two steps may introduce magnitudes which have to be subtracted, and which therefore have to be treated as negative quantities in the arithmetical calculation.

The difficulties to which reference has been made in § 11 are largely due to the abstract nature of the process involved in the second of the above steps. The difficulty should, wherever possible, be removed by making the process of dissection and rearrangement complete. This is not always done. To say, for instance, that the area of a right-angled triangle is half the area of the rectangle contained by the two sides, is not to say what the area is, but what it is the half of. The proper statement is that, if a and b are the sides, the area is equal to the area of a rectangle whose sides are a and $\frac{1}{2}b$; this being, in fact, a particular case of the proposition that the area of a trapezium is equal to the area of a rectangle whose sides are its breadth and the arithmetic mean of the lengths of the two parallel sides. This mode of statement helps to establish the idea of an average. The deduction of the formula $\frac{1}{2}ab$, where a and b are numbers, should be regarded as a later step.

Elementary trigonometrical formulae, not involving the conception of an angle as generated by rotation, belong to this stage; the additional geometrical idea involved being that of the proportionality of the sides of similar triangles.

16. The third stage is analytical mensuration, the essential feature of which is that account is taken of the manner in which a figure is generated. To prevent discontinuity of results at this stage, recapitulation from an analytical point of view is desirable. The rectangle, for instance, has so far been regarded as a plane figure bounded by one pair of parallel straight lines and another pair at right angles to them, so that the conception of "rectangularity" has had reference to boundary rather than to content; analytically, the rectangle must be regarded as the figure generated by an ordinate of constant length moving parallel to itself with one extremity on a straight line perpendicular to it. This is the simplest case of generation of a plane figure by a moving ordinate; the corresponding figure for generation by rotation of a radius vector is a circle.

To regard a figure as being generated in a particular way is essentially the same as to regard it as being made up of a number of successive elements, so that the analytical treatment involves the ideas and the methods of the infinitesimal calculus. It is not, however, necessary that the notation of the calculus should be employed throughout.

A plane figure bounded by a continuous curve, or a solid figure bounded by a continuous surface, may generally be most conveniently regarded as generated by a straight line, or a plane area, moving in a fixed direction at right angles to itself, and changing as it moves. This involves the use of Cartesian co-ordinates, and leads to important general formulae, such as Simpson's formula.

The treatment of an angle as generated by rotation, the investigation of the relations between trigonometrical ratios and circular measure, the application of interpolation to trigonometrical tables, and the general use of graphical methods to represent continuous variation, all imply an analytical onlook, and must therefore be deferred to this stage.

17. There are certain special cases where the treatment is really analytical, but where, on account of the simplicity or importance of the figures involved, the analysis does not take a prominent part.

(i) The circle, and the solid figures allied to it, are of special importance. The ordinary definition of a circle is equivalent to definition as the figure generated by the rotation of a radius of constant length in a plane, and is thus essentially analytical. The ideas of the centre and of the constancy of the radius do not, however, enter into the elementary conception of the circle as a round figure. This elementary conception is of the figure as already existing, rather than of its method of description; the test of circularity being the possibility of rotation within a surrounding figure so as to keep the two boundaries always completely in contact. In the same way, the elementary conception of the sphere involves the idea of sphericity, which would be tested in a similar way, and is in fact so tested, at an early stage by tactual perception, and at a more advanced stage by mechanical methods; the next step being the circularity of the central section, as roughly tested (where the sphere is small) by visual perception, *i.e.* in effect, by the circularity of the cross-section of a circumscribing cylinder; and the ideas of the centre and of non-central sections follow later.

It seems to follow that the consideration of the area of a circle should precede the consideration of its perimeter, and that the consideration of the volume of a sphere should precede the consideration of its surface-area. The proof that the area of a circle is proportional to the square of its diameter would therefore precede the proof that the perimeter is proportional to the diameter; the former property is the easier to grasp, since the conception of the length of a curved line as the limit of the sum of a number of straight lengths presents special difficulties. The ratio $\frac{1}{4}\pi$ would thus first appear as the ratio of the average breadth of a circle to the greatest breadth; the interpretation of π as the ratio of the circumference to the diameter being a secondary one. This order follows, in fact, the historical order of development of the subject.

(ii) Developable surfaces, such as the cylinder and the cone, form a special class, so far as the calculation of their area is concerned. The process of unrolling is analytical, but the unrolled area can be measured by methods not applicable to other surfaces.

(iii) Solids of revolution also form a special class, which can be conveniently treated by the two theorems of Pappus (§ 33).

18. The above classification relates to methods. The classification of results, *i.e.* of formulae, will depend on the purpose for which the collection of formulae is required, and may involve the grouping of results obtained by very different methods. A collection of formulae relating to the circle, for instance, would comprise not only geometrical and trigonometrical formulae, but also approximate formulae, such as Huygens's rule (§ 91), which are the result of advanced analysis.

The present article is not intended to give either a complete course of study or a complete collection of formulae, and therefore such only of the ordinary formulae are given as are required for illustrating certain general principles. For fuller discussion reference should be made to GEOMETRY and TRIGONOMETRY, as well as to the articles dealing with particular figures, such as TRIANGLE, CIRCLE, &c.

19. The most important formulae are those which correspond to the use of rectangular Cartesian co-ordinates. This implies the treatment of a plane or solid figure as being wholly comprised between two parallel lines or planes, regarded by convention as being vertical; the figure being generated by an ordinate or section moving at right angles to itself through a distance which is called the *breadth* of the figure. The length or area obtained by dividing the area or the volume of the figure by its breadth is the *mean ordinate* (mean height) or *mean section* (mean sectional area) of the figure.

Quadrature-formulae or cubature-formulae may sometimes be conveniently replaced by formulae giving the mean ordinate or mean section. In the early stages it is best to use both methods, so as to develop the idea of an average (§ 12). In the present article the formulae for area or volume will be used throughout.

20. *Approximation.*—The numerical result obtained by applying a formula to particular data will generally not be exact. There are two kinds of causes producing want of exactness.

(i) The formula itself may not be numerically exact. This may happen in either of two ways.

(*a*) The formula may involve numbers or ratios which cannot be expressed exactly in the ordinary notation. This is the case, for instance, with formulae which involve π or trigonometrical ratios. This inexactness may, however, be ignored, since the numbers or ratios in question can generally be obtained to a greater degree of accuracy than the other numbers involved in the calculation (see (ii) (*b*) below).

(*b*) The formula may only be approximative. The length of the arc of a circle, for instance, is known if the length of the chord and its distance from the middle point of the arc are known; but it may be more convenient in such a case to use a formula such as Huygens's rule than to obtain a more accurate result by means of trigonometrical tables.

(ii) The data may be such that an exact result is impossible.

(*a*) The nature of the bounding curve or surface may not be exactly known, so that certain assumptions have to be made, a formula being then used which is adapted to these assumptions. The application of Simpson's rule, for instance, to a plane figure implies certain assumptions as to the nature of the bounding curve. Such a formula is approximative, in that it is known that the result of its application will only be approximately correct; it differs from an approximative formula of the kind mentioned in (i) (*b*) above, in that it is adopted of necessity, not by choice.

(*b*) It must, however, be remembered that in all practical applications of formulae the data have first to be ascertained by direct or indirect measurement; and this measurement involves a certain margin of error.

The two sources of error mentioned under (*a*) and (*b*) above are closely related. Suppose, for instance, that we require the area of a circular grass-plot of measured diameter. As a matter of fact, no grass-plot is truly circular; and it might be found that if the breadth in various directions were measured more accurately the want of circularity would reveal itself. Thus the inaccuracy in taking the measured diameter as the datum is practically of the same order as the inaccuracy in taking the grass-plot to be circular.

(iii) In dealing with cases where actual measurements are involved, the error (i) due to inaccuracy of the formula will often be negligible in comparison with the error (ii) due to inaccuracy of the data. For this reason, formulae which will only give approximate results are usually classed together as *rules*, whether the inaccuracy lies (as in the case of Huygens's rule) in the formula itself, or (as in the case of Simpson's rule) in its application to the data.

21. It is necessary, in applying formulae to specific cases, not only, on the one hand, to remember that the measurements are only approximate, but also, on the other hand, to give to any ratio such as π a value which is at least more accurate than the measurements. Suppose, for instance, that in the example given in § 20 the diameter as measured is 15 ft. 3 in. If we take $\pi=3{\cdot}14$ and find the area to be 26288·865 sq. in. = 182 sq. ft. 80·865 sq. in., we make two separate mistakes. The main mistake is in giving the result as true to a small fraction of a square inch; but, if this degree of accuracy had been possible, it would have been wrong to give π a value which is in error by more than 1 in 2000.

Calculations involving feet and inches are sometimes performed by means of *duodecimal arithmetic; i.e.*, in effect, the tables of square measure and of cubic measure are amplified by the insertion of intermediate units. For square measure—

12 square inches = 1 superficial prime,
12 superficial primes = 1 square foot;

while for cubic measure—

12 cubic inches = 1 solid second,
12 solid seconds = 1 solid prime,
12 solid primes = 1 cubic foot.

When an area has been calculated in terms of square feet, primes and square inches, the primes and square inches have to be reduced to square inches; and similarly with the calculation of volumes. The value of π for duodecimal arithmetic is $3+1/12+8/12^2+4/12^3+8/12^4+\ldots\ldots$; so that, marking off duodecimal fractions by commas, the area in the above case is $\frac{1}{4}$ of 3, 1, 8, 4, 8×15, 3×15, 3 sq. ft. = 182, 7, 10 sq. ft. = 182 sq. ft. 94 sq. in. (or $182\frac{1}{2}$ sq. ft. approximately).

MENSURATION OF SPECIFIC FIGURES (GEOMETRICAL)

22. *Areas of Plane Rectilinear Figures.*—The following are expressions for the areas of some simple figures; the expressions in (i) and (ii) are obtained arithmetically, while those in (iii)–(v) involve dissection and rearrangement.

(i) Square: side a. Area $=a^2$.

(ii) Rectangle: sides a and b. Area $=ab$.

(iii) Right-angled triangle: sides a and b, enclosing the right angle. Area $=\frac{1}{2}ab$.

(iv) Parallelogram: two opposite sides a and a, distance between them h. Area $=ha$.

(v) Triangle: one side a, distant h from the opposite angle. Area $=\frac{1}{2}ha$.

If the data for any of these figures are other than those given above, trigonometrical ratios will usually be involved. If, for instance, the data for the triangle are sides a and b, enclosing an angle C, the area is $\frac{1}{2}ab \sin C$.

23. The figures considered in § 22 are particular cases of the *trapezium*, which is a quadrilateral with two parallel sides. If these sides are a and b, at distance h from one another, the area is $h.\frac{1}{2}(a+b)$. In the case of the triangle, for instance, b is zero, so that the area is $\frac{1}{2}ha$.

The trapezium is also sometimes called a "trapezoid," but it will be convenient to reserve this term for a different figure (§ 24).

The most important form of trapezium is that in which one of the two remaining sides of the figure is at right angles to the two parallel sides. The trapezium is then a *right trapezium*; the two parallel sides are called the *sides*, the side at right angles to them the *base*, and the fourth side the *top*.

By producing the two parallel sides of any trapezium (*e.g.* a parallelogram), and drawing a line at right angles to them, outside the figure, we see that it may be treated as the difference of two right trapezia.

It is, however, more simple to convert it into a single right trapezium. Let CABD (fig. 1) be a trapezium, the sides CA and DB being parallel. Draw any straight line at right angles to CA and DB (produced if necessary), meeting them in M and N. Along CA and DB, on the same side of MN, take MA′=CA, NB′=DB; and join A′B′. Then MA′B′N is a right trapezium, whose area is equal to that of CABD; and it is related to the latter in such a way that, if any two lines parallel to AC and BD meet AB, CD, MN, A′B′, in E, G, P, E′, and F, H, Q, F′, respectively, the area of the piece PE′F′Q of the right trapezium is equal to the area of the piece GEFH of the original trapezium. The right trapezium so constructed may be called the *equivalent right trapezium.* In the case of a parallelogram, the equivalent right trapezium is a rectangle; in the case of a triangle, it is a right-angled triangle.

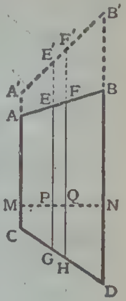

FIG. 1.

24. If we take a series of right trapezia, such that one side (§ 23) of the first is equal to one side of the second, the other side of the second is equal to one side of the third, and so on, and place them with their bases in a straight line and their equal sides adjoining each other, we get a figure such as MABCDEFS (fig. 2), which has two parallel sides MA and SF, a base MS at right angles to these, and the remainder of its boundary from A to F rectilinear, no part of the figure being outside the space between MA (produced) and SF (produced). A figure of this kind will be called a *trapezoid*.

(i) If from the other angular points B, C, D, E, perpendiculars BN, CP, DQ, ER, are drawn to the base MS (fig. 2), the area is $\text{MN}.\frac{1}{2}(\text{MA}+\text{NB})+\text{NP}.\frac{1}{2}(\text{NB}+\text{PC})+\ldots+\text{RS}.\frac{1}{2}(\text{RE}+\text{SF}) = \frac{1}{2}(\text{MN}.\ \text{MA}+\text{MP}.\ \text{NB}+\text{NQ}.\ \text{PC}+\ldots+\text{RS}.\ \text{SF})$. The lines MA, NB, PC, ... are called the *ordinates* of the points A, B, C, ... from the base MS, and the portions MN, NP, PQ, ... of the base are the *projections* of the sides AB, BC, CD, ... on the base.

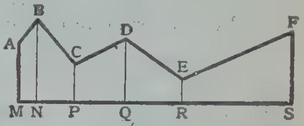

FIG. 2.

(ii) A special case is that in which A coincides with M, and F with S. The figure then stands on a base MS, the remainder of its boundary being a broken line from M to S. The formula then becomes

$$\text{area}=\tfrac{1}{2}(\text{MP}\ .\ \text{NB}+\text{NQ}\ .\ \text{PC}+\ldots+\text{QS}\ .\ \text{RE}),$$

i.e. the area is half the sum of the products obtained by multiplying each ordinate by the distance between the two adjacent ordinates. It would be possible to regard this form of the figure as the general one; the figure considered in (i) would then represent the special case in which the two end-pieces of the broken line are at right angles to the base.

(iii) Another special case is that in which the distances MN, NP, PQ, . . . RS are all equal. If this distance is h, then

$$\text{area}=h(\tfrac{1}{2}\text{MA}+\text{NB}+\text{PC}+\ldots+\tfrac{1}{2}\text{SF}).$$

25. To find the area of any rectilinear figure, various methods are available.

(i) The figure may be divided into triangles. The quadrilateral, for instance, consists of two triangles, and its area is the product of half the length of one diagonal by the sum of the perpendiculars drawn to this diagonal from the other two angular points.

For figures of more than four sides this method is not usually convenient, except for such special cases as that of a regular polygon, which can be divided into triangles by radii drawn from its centre.

(ii) Suppose that two angular points, A and E, are joined (fig. 3) so as to form a diagonal AE, and that the whole of the figure lies between lines through A and E at right angles to AE. Then the figure is (usually) the sum of two trapezoids on base AE, and its area can be calculated as in § 24. If BN, CP, DQ, ... FS, GT are the perpendiculars to AE from the angular points, the ordinates NB, PC, ... are called the *offsets* from the diagonal to the angular points.

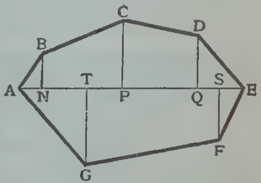

FIG. 3.

The area of the polygon in fig. 3 is given by the expression

$$\tfrac{1}{2}(\text{AP}\ .\ \text{NB}+\text{NQ}\ .\ \text{PC}+\text{PE}\ .\ \text{QD}+\text{ET}\ .\ \text{SF}+\text{SA}\ .\ \text{TG}).$$

It should be noticed (*a*) that AP, NQ, ... SA are taken in the cyclical order of the points ABC . . . GA, and (*b*) that in fig. 3, if AN and NB are regarded as positive, then SF, TG, ET and SA are negative, but the products ET . SF and SA . TG are positive. Negative products will arise if in moving from A to E along the perimeter of either side of the figure the projection of the moving point does not always move in the direction AE.

(iii) Take any straight line intersecting or not intersecting the figure, and draw perpendiculars Aa, Bb, Cc, Dd, . . . Ff, Gg to this line. Then, with proper attention to signs,

$$\text{area}=\tfrac{1}{2}(gb\ .\ a\text{A}+ac\ .\ b\text{B}+bd\ .\ c\text{C}+\ldots+fa\ .\ g\text{G}).$$

(iv) The figure may be replaced by an *equivalent trapezoid*, on the system explained in § 23. Take any base X′X, and draw lines at right angles to this base through all the angular points of the figure.

Let the lines through B, G, C, D and F (fig. 4) cut the boundary of the figure again in B′, G′, C′, D′ and F′, and meet the base X′X in K, L, M, N and P; the points A and E being at the extremities of the figure, and the lines through them meeting the base in a and e. Then, if we take ordinates Kb, Lg, Mc, Nd, Pf, equal to B′B, GG′, C′C, D′D, FF′, the figure $abgcdfe$ will be the equivalent trapezoid, and any ordinate drawn from the base to the top of this trapezoid will be equal to the portion of this ordinate (produced) which falls within the original figure.

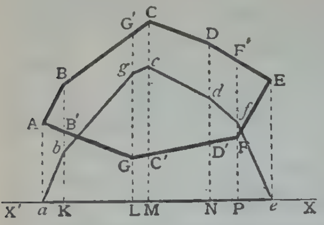

FIG. 4.

26. *Volumes of Solids with Plane Faces.*—The following are expressions for the volumes of some simple solid figures.

(i) Cube: side a. Volume $=a^3$.

(ii) Rectangular parallelepiped: sides a, b, c. Volume $=abc$.

(iii) Right prism. Volume = length of edge × area of end.

(iv) Oblique prism. Volume = height × area of end = length of edge × area of cross-section; the "height" being the perpendicular distance between the two ends.

The parallelepiped is a particular case.

(v) Pyramid with rectilinear base. Volume = height × $\frac{1}{3}$. area of base.

The tetrahedron is a particular case.

(vi) Wedge: parallel edges a, b, c; area of cross-section S. Volume $=\frac{1}{3}(a+b+c)\mathrm{S}$.

This formula holds for the general case in which the base is a trapezium; the wedge being thus formed by cutting a triangular prism by any two planes.

(vii) Frustum of pyramid with rectilinear base: height h; areas of ends (*i.e.* base and top) A and B. Volume $=h.\ \frac{1}{3}(\mathrm{A}+\sqrt{\mathrm{AB}}+\mathrm{B})$.

27. The figures considered in § 26 are particular cases of the *prismoid* (or *prismatoid*), which may be defined as a solid figure with two parallel plane rectilinear ends, each of the other (*i.e.* the lateral) faces being a triangle with an angular point in one end of the figure and its opposite side in the other. Two adjoining faces in the same plane may together make a trapezium. More briefly, the figure may be defined as a polyhedron with two parallel faces containing all the vertices.

If R and S are the ends of a prismoid, A and B their areas, h the perpendicular distance between them, and C the area of a section by a plane parallel to R and S and midway between them, the volume of the prismoid is

$$\tfrac{1}{6}h(\mathrm{A}+4\mathrm{C}+\mathrm{B}).$$

This is known as the *prismoidal formula.*

The formula is a deduction from a general formula, considered later (§ 58), and may be verified in various ways. The most instructive is to regard the prismoid as built up (by addition or subtraction) of simpler figures, which are particular cases of it.

(i) Let R and S be the vertex and the base of a pyramid. Then $\mathrm{A}=0$, $\mathrm{C}=\frac{1}{4}\mathrm{B}$, and volume $=\frac{1}{3}h\mathrm{B}=\frac{1}{6}h(\mathrm{A}+4\mathrm{C}+\mathrm{B})$. The tetrahedron is a particular case.

(ii) Let R be one edge of a wedge with parallel ends, and S the face containing the other two edges. Then $\mathrm{A}=0$, $\mathrm{C}=\frac{1}{2}\mathrm{B}$, and volume $=\frac{1}{2}h\mathrm{B}=\frac{1}{6}h(\mathrm{A}+4\mathrm{C}+\mathrm{B})$.

(iii) Let R and S be two opposite edges of a tetrahedron. Then the tetrahedron may be regarded as the difference of a wedge with parallel ends, one of the edges being R, and a pyramid whose base is a parallelogram, one side of the parallelogram being S (see fig. 9, § 58). Hence, by (i) and (ii), the formula holds for this figure.

(iv) For the prismoid in general let ABCD . . . be one end, and $abcd$ . . . the other. Take any point P in the latter, and form triangles by joining P to each of the sides AB, BC, . . . ab, bc, . . . of the ends, and also to each of the edges. Then the prismoid is divided into a pyramid with vertex P and base ABCD . . ., and a series of tetrahedra, such as PABa or PAab. By (i) and (iii), the formula holds for each of these figures; and therefore it holds for the prismoid as a whole.

Another method of verifying the formula is to take a point Q in the mid-section, and divide up the prismoid into two pyramids with vertex Q and bases ABCD . . . and $abcd$ . . . respectively, and a series of tetrahedra having Q as one vertex.

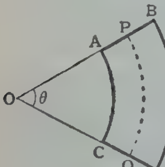

FIG. 5.

28. *The Circle and Allied Figures.*—The mensuration of the circle is founded on the property that the areas of different circles are proportional to the squares on their diameters. Denoting the constant ratio by $\frac{1}{4}\pi$, the area of a circle is πa^2, where a is the radius, and $\pi=3{\cdot}14159$ approximately. The expression $2\pi a$ for the length of the circumference can be deduced by considering the limit of the area cut off from a circle of radius a by a concentric circle of radius $a-\alpha$, when α becomes indefinitely small; this is an elementary case of differentiation.

The lengths of arcs of the same circle being proportional to the angles subtended by them at the centre, we get the idea of circular measure.

Let O be the common centre of two circles, of radii a and b, and let radii enclosing an angle θ (circular measure) cut their circumferences in A, B and C, D respectively (fig. 5). Then the area of ABDC is

$$\tfrac{1}{2}b^2\theta-\tfrac{1}{2}a^2\theta=(b-a)\cdot\tfrac{1}{2}(b+a)\theta.$$

If we bisect AB and CD in P and Q respectively, and describe the arc PQ of a circle with centre O, the length of this arc is $\frac{1}{2}(b+a)\theta$; and $b-a=\mathrm{AB}$. Hence area ABDC = AB × arc PQ. The figure ABDC is a sector of an *annulus*, which is the portion of a circle left after cutting out a concentric circle.

29. By considering the circle as the limit of a polygon, it follows that the formulae (iii) and (v) of § 26 hold for a right circular cylinder and a right circular cone; *i.e.*

volume of right circular cylinder = length × area of base;
volume of right circular cone = height × $\frac{1}{3}$ area of base.

These formulae also hold for any right cylinder and any cone.

30. The curved surfaces of the cylinder and of the cone are *developable* surfaces; *i.e.* they can be unrolled on a plane. The curved surface of any right cylinder (whether circular or not) becomes a rectangle, and therefore its area = length × perimeter of base. The curved surface of a right circular cone becomes a sector of a circle, and its area $=\frac{1}{2}\cdot$slant height × perimeter of base.

31. If a is the radius of a sphere, then

(i) volume of sphere $=\frac{4}{3}\pi a^3$;

(ii) surface of sphere $=4\pi a^2=$ curved surface of circumscribing cylinder.

The first of these is a particular case of the prismoidal formula (§ 58). To obtain (i) and (ii) together, we show that the volume of a sphere is proportional to the volume of the cube whose edge is the diameter; denoting the constant ratio by $\frac{1}{8}\lambda$, the volume of the sphere is λa^3, and thence, by taking two concentric spheres (cf. § 28), the area of the surface is $3\lambda a^2$. This surface may be split up into elements, each of which is equal to a corresponding element of the curved surface of the circumscribing cylinder, so that $3\lambda a^2=$ curved surface of cylinder $=2a.\ 2\pi a=4\pi a^2$. Hence $\lambda=\frac{4}{3}\pi$.

The total surface of the cylinder is $4\pi a^2+\pi a^2+\pi a^2=6\pi a^2$, and its volume is $2a\,.\,\pi a^2=2\pi a^3$. Hence

volume of sphere = $\frac{2}{3}$ volume of circumscribing cylinder;
surface of sphere = $\frac{2}{3}$ surface of circumscribing cylinder.

These latter formulae are due to Archimedes.

32. *Moments and Centroids.*—For every material body there is a point, fixed with regard to the body, such that the moment of the body with regard to any plane is the same as if the whole mass were collected at that point; the moment being the sum of the products of each element of mass of the body by its distance from the plane. This point is the centroid of the body.

The ideas of moment and of centroid are extended to geometrical figures, whether solid, superficial or linear. The *moment* of a figure with regard to a plane is found by dividing the figure into elements of volume, area or length, multiplying each element by its distance from the plane, and adding the products. In the case of a plane area or a plane continuous line the moment with regard to a straight line in the plane is the same as the moment with regard to a perpendicular plane through this line; *i.e.* it is the sum of the products of each element of area or length by its distance from the straight line. The *centroid* of a figure is a point fixed with regard to the figure, and such that its moment with regard to any plane (or, in the case of a plane area or line, with regard to any line in the plane) is the same as if the whole volume, area or length were concentrated at this point. The centroid is sometimes called the centre of volume, centre of area, or centre of arc. The proof of the existence of the centroid of a figure is the same as the proof of the existence of the centre of gravity of a body. (See MECHANICS.)

The moment as described above is sometimes called the *first moment.* The *second moment, third moment*, . . . of a plane or solid figure are found in the same way by multiplying each element by the square, cube, . . . of its distance from the line or plane with regard to which the moments are being taken.

If we divide the first, second, third, . . . moments by the total volume, area or length of the figure, we get the *mean distance, mean square of distance, mean cube of distance*, . . . of the figure from the line or plane. The mean distance of a plane figure from a line in its plane, or of any figure from a plane, is therefore the same as the distance of the centroid of the figure from the line or plane.

We sometimes require the moments with regard to a line or plane through the centroid. If N_0 is the area of a plane figure, and N_1, N_2, . . . are its moments with regard to a line in its plane, the moments M_1, M_2, . . . with regard to a parallel line through the centroid are given by

$$\begin{aligned}\mathrm{M}_1 &= \mathrm{N}_1 - x\mathrm{N}_0 = 0,\\ \mathrm{M}_2 &= \mathrm{N}_2 - 2x\mathrm{N}_1 + x^2\mathrm{N}_0 = \mathrm{N}_2 - x^2\mathrm{N}_0,\\ &\vdots\\ \mathrm{M}_q &= \mathrm{N}_q - qx\mathrm{N}_{q-1} + \frac{q(q-1)}{2!}x^2\mathrm{N}_{q-2}\ldots + (-)^{q-1}qx^{q-1}\mathrm{N}_1 +\\ &\qquad (-)^q x\,\mathrm{N}_0;\end{aligned}$$

where x = the distance between the two lines = N_1/N_0. These formulae also hold for converting moments of a solid figure with regard to a plane into moments with regard to a parallel plane through the centroid; x being the distance between the two planes. A line through the centroid of a plane figure (drawn in the plane of the figure) is a *central line*, and a plane through the centroid of a solid figure is a *central plane*, of the figure.

The centroid of a rectangle is its centre, *i.e.* the point of intersection of its diagonals. The first moment of a plane figure with regard to a line in its plane may be regarded as obtained by dividing the area into elementary strips by a series of parallel lines indefinitely close together, and concentrating the area of each strip at its centre. Similarly the first moment of a solid figure may be regarded as obtained by dividing the figure into elementary prisms by two sets of parallel planes, and concentrating the volume of each prism at its centre. This also holds for higher moments, provided that the edges of the elementary strips or prisms are parallel to the line or plane with regard to which the moments are taken.

33. *Solids and Surfaces of Revolution.*—The solid or surface generated by the revolution of a plane closed figure or a plane continuous line about a straight line in its plane, not intersecting it, is a *solid of revolution* or *surface of revolution*, the straight line being its axis. The revolution need not be complete, but may be through any angle.

The section of a solid of revolution by a plane at right angles to the axis is an annulus or a sector of an annulus (fig. 5), or is composed of two or more such figures. If the solid is divided into elements by a series of such planes, and if h is the distance between two consecutive planes making sections such as ABDC in fig. 5, the volume of the element between these planes, when h is very small, is approximately $h \times AB \times$ arc $PQ = h.AB.OP.\theta$. The corresponding element of the revolving figure is approximately a rectangle of area $h.AB$, and OP is the distance of the middle point of either side of the rectangle from the axis. Hence the total volume of the solid is $M.\theta$, where M is the sum of the quantities $h.AB.OP$, *i.e.* is the moment of the figure with regard to the axis. The volume is therefore equal to $S.\bar{y}.\theta$, where S is the area of the revolving figure, and $\bar{y}$ is the distance of its centroid from the axis.

Similarly a surface of revolution can be divided by planes at right angles to the axis into elements, each of which is approximately a section of the surface of a right circular cone. By unrolling each such element (§ 30) into a sector of a circular annulus, it will be found that the total area of the surface is $M'.\theta = L.\bar{z}.\theta$, where M' is the moment of the original curve with regard to the axis, L is the total length of the original curve, and $\bar{z}$ is the distance of the centroid of the curve from the axis. These two theorems may be stated as follows:—

(i) If any plane figure revolves about an external axis in its plane, the volume of the solid generated by the revolution is equal to the product of the area of the figure and the distance travelled by the centroid of the figure.

(ii) If any line in a plane revolves about an external axis in the plane, the area of the curved surface generated by the revolution is equal to the product of the length of the line and the distance travelled by the centroid of the line.

These theorems were discovered by Pappus of Alexandria (*c.* A.D. 300), and were made generally known by Guldinus (*c.* A.D. 1640). They are sometimes known as *Guldinus's Theorems*, but are more properly described as the *Theorems of Pappus*. The theorems are of use, not only for finding the volumes or areas of solids or surfaces of revolution, but also, conversely, for finding centroids or centres of gravity. They may be applied, for instance, to finding the centroid of a semicircle or of the arc of a semicircle.

34. *Segment of Parabola.*—The parabola affords a simple example of the use of infinitesimals. Let AB (fig. 6) be any arc of a parabola; and suppose we require the area of the figure bounded by this arc and the chord AB. Draw the tangents at A and B, meeting at T; draw TV parallel to the axis of the parabola, meeting the arc in C and the chord in V; and draw the tangent at C, meeting AT and BT in a and b. Then (see PARABOLA) TC = CV, AV = VB, and ab is parallel to AB, so that $aC = Cb$. Hence area of triangle ACB = twice area of triangle aTb. Repeating the process with the arcs AC and CB, and continuing the repetition indefinitely, we divide up the required area and the remainder of the triangle ATB into corresponding elements, each element of the former being double the corresponding elements of the latter. Hence the required area is double the area of the remainder of the triangle, and therefore it is two-thirds of the area of the triangle.

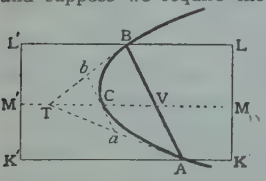

FIG. 6.

The line TCV is parallel to the axis of the parabola. If we draw a line at right angles to TCV, meeting TCV produced in M and parallels through A and B in K and L, the area of the triangle ATB is $\frac{1}{2}KL.TV = KL.CV$; and therefore the area of the figure bounded by AK, BL, KL and the arc AB, is

$$KL.\tfrac{1}{2}(AK+BL)+\tfrac{2}{3}KL\{CM-\tfrac{1}{2}(AK+BL)\}$$
$$=\tfrac{1}{6}KL(AK+4CM+BL).$$

Similarly, for a corresponding figure K'L'BA outside the parabola, the area is

$$\tfrac{1}{6}K'L'(K'A+4M'C+L'B).$$

35. *The Ellipse and the Ellipsoid.*—For elementary mensuration the ellipse is to be regarded as obtained by projection of the circle, and the ellipsoid by projection of the sphere. Hence the area of an ellipse whose axes are $2a$ and $2b$ is πab; and the volume of an ellipsoid whose axes are $2a$, $2b$ and $2c$ is $\frac{4}{3}\pi abc$. The area of a strip of an ellipse between two lines parallel to an axis, or the volume of the portion (frustum) of an ellipsoid between two planes parallel to a principal section, may be found in the same way.

36. *Examples of Applications.*—The formulae of § 24 for the area of a trapezoid are of special importance in *land-surveying*. The measurements of a polygonal field or other area are usually taken as in § 25 (ii); a diagonal AE is taken as the base-line, and for the points B, C, D, . . . there are entered the distances AN, AP, AQ, . . . along the base-line, and the lengths and directions of the offsets NB, PC, QD, . . . The area is then given by the formula of § 25 (ii).

37. The mensuration of *earthwork* involves consideration of quadrilaterals whose dimensions are given by special data, and of prismoids whose sections are such quadrilaterals. In the ordinary case three of the four lateral surfaces of the prismoid are at right angles to the two ends. In special cases two of these three lateral surfaces are equally inclined to the third.

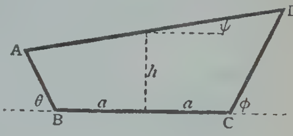

FIG. 7.

(i) In fig. 7 let base BC = $2a$, and let h be the distance, measured at right angles to BC, from the middle point of BC to AD. Also, let angle ABC = $\pi - \theta$, angle BCD = $\pi - \phi$, angle between BC and AD = ψ. Then (as the difference of two triangles)

$$\text{area ABCD} = \frac{(h \cot \psi + a)^2}{2(\cot \psi - \cot \phi)} - \frac{(h \cot \psi - a)^2}{2(\cot \psi + \cot \theta)}.$$

(ii) If $\phi = \theta$, this becomes

$$\text{area} = \frac{\tan \theta}{\tan^2 \theta - \tan^2 \psi}(h + a \tan \theta)^2 - a^2 \tan \theta.$$

(iii) If $\psi = 0$, so that AD is parallel to BC, it becomes

$$\text{area} = 2ah + \tfrac{1}{2}(\cot \theta + \cot \phi)h^2.$$

(iv) To find the volume of a prismoidal cutting with vertical ends, and with sides equally inclined to the vertical, so that $\phi = \theta$, let the values of h, ψ for the two ends be h_1, ψ_1, and h_2, ψ_2, and write

$$m_1 \equiv \frac{\cot \psi_1}{\cot \psi_1 - \cot \theta}(a + h_1 \cot \theta), \quad n_1 \equiv \frac{\cot \psi_1}{\cot \psi_1 + \cot \theta}(a + h_1 \cot \theta),$$
$$m_2 \equiv \frac{\cot \psi_2}{\cot \psi_2 - \cot \theta}(a + h_2 \cot \theta), \quad n_2 \equiv \frac{\cot \psi_2}{\cot \psi_2 + \cot \theta}(a + h_2 \cot \theta).$$

Then volume of prismoid = length $\times \frac{1}{3}\{m_1 n_1 + m_2 n_2 + \frac{1}{2}(m_1 n_2 + m_2 n_1) - 3a^2\} \tan \theta$.

MENSURATION OF GRAPHS

38. (A) *Preliminary.*—In § 23 the area of a right trapezium has been expressed in terms of the base and the two sides; and in § 34 the area of a somewhat similar figure, the top having been replaced by an arc of a parabola, has been expressed in terms of its base and of three lengths which may be regarded as the sides of two separate figures of which it is composed. We have now to consider the extension of formulae of this kind to other figures, and their application to the calculation of moments and volumes.

39. The plane figures with which we are concerned come mainly under the description of *graphs* of continuous variation. Let E and F be two magnitudes so related that whenever F has any value (within certain limits) E has a definite corresponding value. Let u and x be the numerical expressions of the magnitudes of E and F. On any line OX take a length ON equal to xG, and from N draw NP at right angles to OX and equal to uH; G and H being convenient units of length. Then we may, ignoring the units G and H, speak of ON and NP as being equal to x and u respectively. Let KA and LB be the positions of NP corresponding to the extreme values of x. Then the different positions of NP will (if x may have any value from OK to OL) trace out a figure on base KL, and extending from KA to LB; this is called the *graph* of E in respect of F. The term is also sometimes applied to the line AB along which the point P moves as N moves from K to L.

To illustrate the importance of the mensuration of graphs, suppose that we require the average value of u with regard to x. It may be shown that this is the same thing as the mean distance of elements of the graph from an axis through O at right angles to OX. Its calculation therefore involves the calculation of the area and the first moment of the graph.

40. The processes which have to be performed in the mensuration of figures of this kind are in effect processes of integration; the distinction between mensuration and integration lies in the different natures of the data. If, for instance, the graph were a trapezium, the calculation of the area would be equivalent to finding the integral, from $x=a$ to $x=b$, of an expression of the form $px+q$. This would involve p and q; but, for our purposes, the data are the sides $pa+q$ and $pb+q$ and the base $b-a$, and the expression of the integral in terms of these data would require certain eliminations. The province of mensuration is to express the final result of such an elimination in terms of the data, without the necessity of going through the intermediate processes.

41. *Trapezettes and Briquettes.*—A figure of the kind described in § 39 is called a *trapezette.* A trapezette may therefore be defined as a plane figure bounded by two straight lines, a base at right angles to them, and a top which may be of any shape but is such that every ordinate from the base cuts it in one point and one point only; or, alternatively, it may be defined as the figure generated by an ordinate which moves in a plane so that its foot is always on a straight base to which the ordinate is at right angles, the length of the ordinate varying in any manner as it moves. The distance between the two straight sides, *i.e.* between the initial and the final position of the ordinate, is the *breadth* of the trapezette. Any line drawn from the base, at right angles to it, and terminated by the top of the trapezette, is an *ordinate* of the figure. The trapezium is a particular case.

Either or both of the bounding ordinates may be zero; the top, in that case, meets the base at that extremity. Any plane figure might be converted into an equivalent trapezette by an extension of the method of § 25 (iv).

42. The corresponding solid figure, in its most general form, is such as would be constructed to represent the relation of a magnitude E to two magnitudes F and G of which it is a function; it would stand on a plane base, and be comprised within a cylindrical boundary whose cross-section might be of any shape. We are not concerned with figures of this general kind, but only with cases in which the base is a rectangle. The figure is such as would be produced by removing a piece of a rectangular prism, and is called a *briquette.* A briquette may therefore be defined as a solid figure bounded by a pair of parallel planes, another pair of parallel planes at right angles to these, a base at right angles to these four planes (and therefore rectangular), and a top which is a surface of any form, but such that every ordinate from the base cuts it in one point and one point only. It may be regarded as generated either by a trapezette moving in a direction at right angles to itself and changing its top but keeping its breadth unaltered, or by an ordinate moving so that its foot has every possible position within a rectangular base.

43. *Notation and Definitions.*—The ordinate of the trapezette will be denoted by u, and the *abscissa* of this ordinate, *i.e.* the distance of its foot from a certain fixed point or origin O on the base (or the base produced), will be denoted by x, so that u is some function of x. The sides of the trapezette are the "bounding ordinates"; their abscissae being x_0 and $x_0+\mathrm{H}$, where H is the breadth of the trapezette.

The "mid-ordinate" is the ordinate from the middle point of the base, *i.e.* the ordinate whose abscissa is $x_0+\frac{1}{2}\mathrm{H}$.

The "mean ordinate" or *average ordinate* is an ordinate of length l such that Hl is equal to the area of the trapezette. It therefore appears as a calculated length rather than as a definite line in the figure; except that, if there is only one ordinate of this length, a line drawn through its extremity is so placed that the area of the trapezette lying above it is equal to a corresponding area below it and outside the trapezette. Formulae giving the area of a trapezette should in general also be expressed so as to state the value of the mean ordinate (§§ 12 (v), 15, 19).

The "median ordinate" is the ordinate which divides the area of the trapezette into two equal portions. It arises mainly in statistics, when the ordinate of the trapezette represents the relative frequency of occurrence of the magnitude represented by the abscissa x; the magnitude of the abscissa corresponding to the median ordinate is then the "median value of x."

The "central ordinate" is the ordinate through the centroid of the trapezette (§ 32). The distance of this ordinate from the axis of u (*i.e.* from a line drawn through O parallel to the ordinates) is equal to the mean distance (§ 32) of the trapezette from this axis; moments with regard to the central ordinate are therefore sometimes described in statistics as "moments about the mean."

The data of a trapezette are usually its breadth and either the bounding ordinates or the mid-ordinates of a series of minor trapezettes or strips into which it is divided by ordinates at equal distances. If there are m of these strips, and if the breadth of each is h, so that $\mathrm{H}=mh$, it is convenient to write x in the form $x_0+\theta h$, and to denote it by x_θ, the corresponding value of u being u_θ. The data are then either the bounding ordinates $u_0, u_1, \dots u_{m-1}, u_m$ of the strips, or their mid-ordinates $u_{\frac{1}{2}}, u_{\frac{3}{2}}, \dots u_{m-\frac{1}{2}}$.

44. In the case of the briquette the position of the foot of the ordinate u is expressed by co-ordinates x, y, referred to a pair of axes parallel to a pair of sides of the base of the briquette. If the lengths of these sides are H and K, the coordinates of the angles of the base—*i.e.* the co-ordinates of the edges of the briquette—are (x_0, y_0), $(x_0+\mathrm{H}, y_0)$, $(x_0, y_0+\mathrm{K})$, and $(x_0+\mathrm{H}, y_0+\mathrm{K})$.

The briquette may usually be regarded as divided into a series of minor briquettes by two sets of parallel planes, the planes of each set being at successively equal distances. If the planes of one set divide it into m slabs of thickness h, and those of the other into n slabs of thickness k, so that $\mathrm{H}=mh$, $\mathrm{K}=nk$, then the values of x and of y for any ordinate may be denoted by $x_0+\theta h$ and $y_0+\phi k$, and the length of the ordinate by $u_{\theta,\phi}$.

The data are usually the breadths H and K and either (i) the edges of the minor briquettes, viz. $u_{0,0}, u_{0,1}, \dots u_{1,0}, u_{1,1}, \dots$ or (ii) the mid-ordinates of one set of parallel faces, viz. $u_{0,\frac{1}{2}}, u_{0,\frac{3}{2}}, \dots, u_{1,\frac{1}{2}}, \dots$ or $u_{\frac{1}{2},0}, u_{\frac{3}{2},0}, \dots u_{\frac{1}{2},1}, \dots$, or (iii) the "mid-ordinates" $u_{\frac{1}{2},\frac{1}{2}}, u_{\frac{1}{2},\frac{3}{2}}, \dots u_{\frac{3}{2},\frac{1}{2}}, \dots$ of the minor briquettes, *i.e.* the ordinates from the centres of their bases.

A plane parallel to either pair of sides of the briquette is a "principal plane." The ordinate through the centroid of the figure is the "central ordinate."

45. In some cases the data for a trapezette or a briquette are not only certain ordinates within or on the boundary of the figure, but also others forming the continuation of the series outside the figure. For a trapezette, for instance, they may be $\dots u_{-2}, u_{-1}, u_0, u_1 \dots u_m, u_{m+1}\ u_{m+2} \dots$, where u_θ denotes the same function of $x\equiv x_0+\theta h$, whether θh lies between the limits 0 and H or not. These cases are important as enabling simpler formulae, involving central differences, to be used (§ 76).

46. The area of the trapezette, measured from the lower bounding ordinate up to the ordinate corresponding to any value of x, is some function of x. In the notation of the integral calculus, this area is equal to $\int_{x_0}^{x} udx$; but the notation is inconvenient, since it implies a division into infinitesimal elements, which is not essential to the idea of an area. It is therefore better to use some independent notation, such as $\mathrm{A}_x \,.\, u$. It will be found convenient to denote $\phi(b)-\phi(a)$, where $\phi(x)$ is any function of x, by $\Big[\phi(x)\Big]_{x=a}^{x=b}$; the area of the trapezette whose bounding ordinates are u_0 and u_m may then be denoted by $\Big[\mathrm{A}_x \,.\, u\Big]_{x=x_0}^{x=x_m}$ or $\Big[\mathrm{A}_x \,.\, u\Big]_{\theta=0}^{\theta=m}$, instead of by $\int_{x_0}^{x_m} udx$.

In the same way the volume of a briquette between the planes $x=x_0$, $y=y_0$, $x=a$, $y=b$ may be denoted by

$$\Big[\Big[\mathrm{V}_{x,y} \,.\, u\Big]_{y=y_0}^{y=b}\Big]_{x=x_0}^{x=a}.$$

47. The statement that the ordinate u of a trapezette is a function of the abscissa x, or that $u=f(x)$, must be distinguished from $u=f(x)$ as the equation to the top of the trapezette.

In elementary geometry we deal with lines and curves, while in mensuration we deal with areas bounded by these lines or curves. The circle, for instance, is regarded geometrically as a line described in a particular way, while from the point of view of mensuration it is a figure of a particular shape. Similarly, analytical plane geometry deals with the curve described by a point moving in a particular way, while analytical plane mensuration deals with the figure generated by an ordinate moving so that its length varies in a particular manner depending on its position.

In the same way, in the case of a figure in three dimensions, analytical geometry is concerned with the form of the surface, while analytical mensuration is concerned with the figure as a whole.

48. *Representation of Volume by Area.*—An important plane graph is that which represents the volume of a solid figure.

Suppose that we take a pair of parallel planes, such that the solid extends from one to the other of these planes. The section by any intermediate parallel plane will be called a "cross-section." The solid may then be regarded as generated by the cross-section moving parallel to itself and changing its shape, or its position with regard to a fixed axis to which it is always perpendicular, as it moves.

If the area of the cross-section, in every position, is known in terms of its distance from one of the bounding planes, or from a fixed plane A parallel to them, the volume of the solid can be expressed in terms of the area of a trapezette. Let S be the area of the cross-section at distance x from the plane A. On a straight line OX in any plane take a point N at distance x from O, and draw an ordinate NP at right angles to OX and equal to S/l, where l is some fixed length (*e.g.* the unit of measurement). If this is done for every possible value of x, there will be a series of ordinates tracing out a trapezette with base along OX. The volume comprised between the cross-section whose area is S and a consecutive cross-section at distance θ from it is ultimately Sθ, when θ is indefinitely small; and the area between the corresponding ordinates of the trapezette is (S/l) . θ=Sθ/l. Hence the volume of each element of the solid figure is to be found by multiplying the area of the corresponding element of the trapezette by l, and therefore the total volume is l × area of trapezette.

The volume of a briquette can be found in this way if the area of the section by any principal plane can be expressed in terms of the distance of this plane from a fixed plane of the same set. The result of treating this area as if it were the ordinate of a trapezette leads to special formulae, when the data are of the kind mentioned in § 44.

49. (B) *Mensuration of Graphs of Algebraical Functions.*—The first class of cases to be considered comprises those cases in which u is an algebraical function (*i.e.* a rational integral algebraical function) of x, or of x and y, of a degree which is known.

50. The simplest case is that in which u is constant or is a linear function of x, *i.e.* is of the form $px + q$. The trapezette is then a right trapezium, and its area, if $m=l$, is $\frac{1}{2}h(u_0 + u_1)$ or $hu_{\frac{1}{2}}$.

51. The next case is that in which u is a quadratic function of x, *i.e.* is of the form $px^2 + qx + r$. The top is then a parabola whose axis is at right angles to the base; and the area can therefore (§ 34) be expressed in terms of the two bounding ordinates and the mid-ordinate. If we take these to be u_0 and u_2, and u_1, so that $m = 2$, we have

$$\text{area} = \tfrac{1}{6}\text{H}(u_0 + 4u_1 + u_2) = \tfrac{1}{3}h(u_0 + 4u_1 + u_2).$$

This is *Simpson's formula.*

If instead of u_0, u_1, and u_2, we have four ordinates u_0, u_1, u_2, and u_3, so that $m = 3$, it can be shown that

$$\text{area} = \tfrac{3}{8}h(u_0 + 3u_1 + 3u_2 + u_3).$$

This is *Simpson's second formula.* It may be deduced from the formula given above. Denoting the areas of the three strips by A, B, and C, and introducing the middle ordinate $u_{\frac{3}{2}}$, we can express A + B; B + C; A + B + C; and B in terms of u_0, u_1, u_2; u_1, u_2, u_3; u_0, $u_{\frac{3}{2}}$, u_3; and u_1, $u_{\frac{3}{2}}$, u_2 respectively. Thus we get two expressions for A + B + C, from which we can eliminate $u_{\frac{3}{2}}$.

A trapezette of this kind will be called a *parabolic* trapezette.

52. Simpson's two formulae also apply if u is of the form $px^3 + qx^2 + rx + s$. Generally, if the area of a trapezette for which u is an algebraical function of x of degree $2n$ is given correctly by an expression which is a linear function of values of u representing ordinates placed symmetrically about the mid-ordinate of the trapezette (with or without this mid-ordinate), the same expression will give the area of a trapezette for which u is an algebraical function of x of degree $2n + 1$. This will be seen by taking the mid-ordinate as the ordinate for which $x = 0$, and noticing that the odd powers of x introduce positive and negative terms which balance one another when the whole area is taken into account.

53. When u is of degree 4 or 5 in x, we require at least five ordinates. If $m = 4$, and the data are u_0, u_1, u_2, u_3, u_4, we have

$$\text{area} = \tfrac{2}{45}h(7u_0 + 32u_1 + 12u_2 + 32u_3 + 7u_4).$$

For functions of higher degrees in x the formulae become more complicated.

54. The general method of constructing formulae of this kind involves the use of the integral calculus and of the calculus of finite differences. The breadth of the trapezette being mh, it may be shown that its area is

$$mh\left\{u_{\frac{1}{2}m} + \frac{1}{24}m^2h^2u''_{\frac{1}{2}m} + \frac{1}{1920}m^4h^4u^{\text{iv}}_{\frac{1}{2}m} + \frac{1}{322560}m^6h^6u^{\text{vi}}_{\frac{1}{2}m} + \frac{1}{92897280}m^8h^8u^{\text{viii}}_{\frac{1}{2}m} + \ldots\right\},$$

where $u_{\frac{1}{2}m}$, $u''_{\frac{1}{2}m}$, $u'''_{\frac{1}{2}m}$, . . . denote the values for $x = x_{\frac{1}{2}m}$ of the successive differential coefficients of u with regard to x; the series continuing until the differential coefficients vanish. There are two classes of cases, according as m is even or odd; it will be convenient to consider them first for those cases in which the data are the bounding ordinates of the strips.

(i) If m is even, $u_{\frac{1}{2}m}$ will be one of the given ordinates, and we can express $h^2u''_{\frac{1}{2}m}$, $h^4u^{\text{iv}}_{\frac{1}{2}m}$, . . . in terms of $u_{\frac{1}{2}m}$ and its even central differences (see DIFFERENCES, CALCULUS OF). Writing $m = 2p$, and grouping the coefficients of the successive differences, we shall find

$$\text{area} = 2ph\left\{u_p + \frac{p^2}{6}\delta^2u_p + \frac{3p^4 - 5p^2}{360}\delta^4u_p + \frac{3p^6 - 21p^4 + 28p^2}{15120}\delta^6u_p + \ldots\right\}.$$

If u is of degree $2f$ or $2f + 1$ in x, we require to go up to $\delta^{2f}u_p$, so that m must be not less than $2f$. Simpson's (first) formula, for instance, holds for $f = 1$, and is obtained by taking $p = 1$ and ignoring differences after δ^2u_p.

(ii) If m is odd, the given ordinates are u_0, . . . $u_{\frac{1}{2}m-\frac{1}{2}}$, $u_{\frac{1}{2}m+\frac{1}{2}}$, . . . u_m. We then have

$$\text{area} = mh\left\{\mu u_{\frac{1}{2}m} + \frac{m^2 - 3}{24}\mu\delta^2u_{\frac{1}{2}m} + \frac{3m^4 - 50m^2 + 135}{5760}\mu\delta^4u_{\frac{1}{2}m} + \frac{3m^6 - 147m^4 + 1813m^2 - 4725}{967680}\mu\delta^6u_{\frac{1}{2}m} + \ldots\right\},$$

where $\mu u_{\frac{1}{2}m}$, $\mu\delta^2u_{\frac{1}{2}m}$, . . . denote $\frac{1}{2}(u_{\frac{1}{2}m-\frac{1}{2}} + u_{\frac{1}{2}m+\frac{1}{2}})$, $\frac{1}{2}(\delta^2u_{\frac{1}{2}m-\frac{1}{2}} + \delta^2u_{\frac{1}{2}m+\frac{1}{2}})$, . . . Simpson's second formula is obtained by taking $m = 3$ and ignoring differences after $\mu\delta^2u_{\frac{1}{2}m}$.

55. The general formulae of § 54 (p being replaced in (i) by $\frac{1}{2}m$) may in the same way be applied to obtain formulae giving the area of the trapezette in terms of the mid-ordinates of the strips, the series being taken up to $\delta^{2f}u_{\frac{1}{2}m}$ or $\mu\delta^{2f}u_{\frac{1}{2}m}$ at least, where u is of degree $2f$ or $2f + 1$ in x. Thus we find from (i) that Simpson's second formula, for the case where the top is a parabola (with axis, as before, at right angles to the base) and there are three strips of breadth h, may be replaced by

$$\text{area} = \tfrac{3}{8}h(3u_{\frac{1}{2}} + 2u_{\frac{3}{2}} + 3u_{\frac{5}{2}}).$$

This might have been deduced directly from Simpson's first formula, by a series of eliminations.

56. Hence, for the case of a parabola, we can express the area in terms of the bounding ordinates of two strips, but, if we use mid-ordinates, we require three strips; so that, in each case, three ordinates are required. The question then arises whether, by removing the limitation as to the position of the ordinates, we can reduce their number.

Suppose that in fig. 6 (§ 34) we draw ordinates QD midway between KA and MC, and RE midway between MC and LB, meeting the top in D and E (fig. 8), and join DE, meeting KA, LB, and MC in H, J, and W. Then it may be shown that DE is parallel to AB, and that the area of the figure between chord DE and arc DE is half the sum of the areas DHA and EJB. Hence the area of the right trapezium KHJL is greater than the area of the trapezette KACBL.

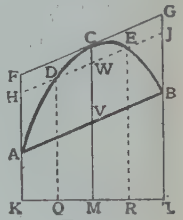

FIG. 8.

If we were to take QD and RE closer to MC, the former area would be still greater. If, on the other hand, we were to take them very close to KA and LB respectively, the area of the trapezette would be the greater. There is therefore some intermediate position such that the two areas are equal; *i.e.* such that the area of the trapezette is represented by KL . $\frac{1}{2}$(QD + RE).

To find this position, let us write QM = MR = θ . KM. Then

WC = θ^2 . VC, VW = $(1 - \theta^2)$ VC;
curved area ACB = $\frac{2}{3}$ of parallelogram AFGB = $\frac{2}{3}$KL . VC;
parallelogram AHJB = KL . VW = $(1 - \theta^2)$ KL . VC.

Hence the areas of the trapezette and of the trapezium will be equal if

$$1 - \theta^2 = \tfrac{2}{3},\ \theta = 1/\sqrt{3}.$$

This value of θ is the same for all parabolas which pass through D and E and have their axes at right angles to KL. It follows that, by taking two ordinates in a certain position with regard to the bounding ordinates, the area of any parabolic trapezette whose top passes through their extremities can be expressed in terms of these ordinates and of the breadth of the trapezette.

The same formula will also hold (§ 52) for any cubic trapezette through the points.

57. This is a particular case of a general theorem, due to Gauss, that, if u is an algebraical function of x of degree $2p$ or $2p + 1$, the area can be expressed in terms of $p + 1$ ordinates taken in suitable positions.

58. *The Prismoidal Formula.*—It follows from §§ 48 and 51 that, if V is a solid figure extending from a plane K to a parallel plane L, and if the area of every cross-section parallel to these planes is a quadratic function of the distance of the section from a fixed plane parallel to them, Simpson's formula may be applied to find the volume of the solid. If the areas of the two ends in the planes K and L are S_0 and S_2, and the area of the mid-section (*i.e.* the section by a plane parallel to these planes and midway between them) is S_1, the volume is $\frac{1}{6}\text{H}(S_0 + 4S_1 + S_2)$, where H is the total breadth.

This formula applies to such figures as the cone, the sphere, the ellipsoid and the prismoid. In the case of the sphere, for instance, whose radius is R, the area of the section at distance x from the centre is $\pi(\text{R}^2 - x^2)$, which is a quadratic function of x; the values of S_0, S_1, and S_2 are respectively 0, πR^2, and 0, and the volume is therefore $\frac{1}{6} . 2\text{R} . 4\pi\text{R}^2 = \frac{4}{3}\pi\text{R}^3$.

To show that the area of a cross-section of a prismoid is of the form $ax^2 + bx + c$, where x is the distance of the section from one end, we may proceed as in § 27. In the case of a pyramid, of height h, the area of the section by a plane parallel to the base and at distance x from the vertex is clearly x^2/h^2 × area of base. In the case of a wedge with parallel ends the ratio x^2/h^2 is replaced by x/h. For a tetrahedron, two of whose opposite edges are AB and CD, we require the area of the section by a plane parallel to AB and CD. Let the distance between the parallel planes through AB and CD be h, and let a plane at distance x from the plane through AB cut the edges AC,

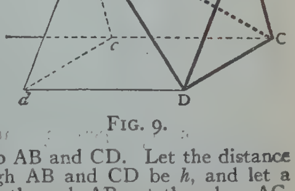

FIG. 9.

BC, BD, AD, in P, Q, R, S (fig. 9). Then the section of the pyramid by this plane is the parallelogram PQRS. By drawing Ac and Ad parallel to BC and BD, so as to meet the plane through CD in c and d, and producing QP and RS to meet Ac and Ad in q and r, we see that the area of PQRS is $(x/h-x^2/h^2)\times$ area of $c$CD$d$; this also is a quadratic function of x. The proposition can then be established for a prismoid generally by the method of § 27 (iv).

The formula is known as the *prismoidal formula*.

59. *Moments.*—Since all points on any ordinate are at an equal distance from the axis of u, it is easily shown that the first moment (with regard to this axis) of a trapezette whose ordinate is u is equal to the area of a trapezette whose ordinate is xu; and this area can be found by the methods of the preceding sections in cases where u is an algebraical function of x. The formulae can then be applied to finding the moments of certain volumes.

In the case of the parabolic trapezette, for instance, xu is of degree 3 in x, and therefore the first moment is $\frac{1}{3}h(x_0u_0+4x_1u_1+x_2u_2)$. In the case, therefore, of any solid whose cross-section at distance x from one end is a quadratic function of x, the position of the cross-section through the centroid is to be found by determining the position of the centre of gravity of particles of masses proportional to S_0, S_2, and $4S_1$, placed at the extremities and the middle of a line drawn from one end of the solid to the other. The centroid of a hemisphere of radius R, for instance, is the same as the centroid of particles of masses 0, πR^2, and $4.\frac{3}{4}\pi R^2$, placed at the extremities and the middle of its axis; *i.e.* the centroid is at distance $\frac{3}{8}$R from the plane face.

60. The method can be extended to finding the second, third, . . . moments of a trapezette with regard to the axis of u. If u is an algebraical function of x of degree not exceeding p, and if the area of a trapezette, for which the ordinate v is of degree not exceeding $p+q$, may be expressed by a formula $\lambda_0v_0+y_1v_1+\dots+\lambda_mv_m$, the qth moment of the trapezette is $\lambda_0x_0{}^qu_0+\lambda_1x_1{}^qu_1+\dots+\lambda_mx_m{}^qu_m$, and the mean value of x^q is

$$(\lambda_0x_0{}^qu_0+\lambda_1x_1{}^qu_1+\dots+\lambda_mx_m{}^qu_m)/(\lambda_0u_0+\lambda_1u_1+\dots+\lambda_mu_m).$$

The calculation of this last expression is simplified by noticing that we are only concerned with the mutual ratios of λ_0, λ_1, . . . and of u_0, u_1, . . , not with their actual values.

61. *Cubature of a Briquette.*—To extend these methods to a briquette, where the ordinate u is an algebraical function of x and y, the axes of x and of y being parallel to the sides of the base, we consider that the area of a section at distance x from the plane $x=0$ is expressed in terms of the ordinates in which it intersects the series of planes, parallel to $y=0$, through the given ordinates of the briquette (§ 44); and that the area of the section is then represented by the ordinate of a trapezette. This ordinate will be an algebraical function of x, and we can again apply a suitable formula.

Suppose, for instance, that u is of degree not exceeding 3 in x, and of degree not exceeding 3 in y, *i.e.* that it contains terms in x^3y^3, x^3y^2, x^2y^3, &c.; and suppose that the edges parallel to which x and y are measured are of lengths $2h$ and $3k$, the briquette being divided into six elements by the plane $x=x_0+h$ and the planes $y=y_0+k$, $y=y_0+2k$, and that the 12 ordinates forming the edges of these six elements are given. The areas of the sides for which $x=x_0$ and $x=x_0+2h$, and of the section by the plane $x=x_0+h$, may be found by Simpson's second formula; call these A_0 and A_2, and A_1. The area of the section by a plane at distance x from the edge $x=x_0$ is a function of x whose degree is the same as that of u. Hence Simpson's formula applies, and the volume is $\frac{1}{3}h(A_0+4A_1+A_2)$.

The process is simplified by writing down the general formula first and then substituting the values of u. The formula, in the above case, is,

$$\tfrac{1}{3}h\{\tfrac{3}{8}k(u_{0,0}+3u_{0,1}+3u_{0,2}+u_{0,3})+4\times\tfrac{3}{8}k(u_{1,0}+\dots)+\tfrac{3}{8}k(u_{2,0}+\,.\,.)\},$$

where u^θ,ϕ denotes the ordinate for which $x=x_0+\theta h$, $y=y_0+\phi k$. The result is the same as if we multiplied $\frac{3}{8}k(v_0+3v_1+3v_2+v_3)$ by $\frac{1}{3}h(u_0+4u_1+u_2)$, and then replaced u_0v_0, u_0v_1, . . . by $u_{0,0}$, $u_{0,1}$ . . . The multiplication is shown in the adjoining diagram; the factors $\frac{1}{3}$ and $\frac{3}{8}$ are kept outside, so that the sum $u_{0,0}+3u_{0,1}+\dots+4u_{1,0}+\dots$ can be calculated before it is multiplied by $\frac{1}{3}h\,.\,\frac{3}{8}k$.

$\frac{1}{3}\times\frac{3}{8}$	1	4	1
1	1	4	1
3	3	12	3
3	3	12	3
1	1	4	1

62. The above is a particular case of a general principle that the obtaining of an expression such as $\frac{1}{3}h(u_0+4u_1+u_2)$ or $\frac{3}{8}k(v_0+3v_1+3v_2+v_3)$ is an *operation* performed on u_0 or v_0, and that this operation is the sum of a number of operations such as that which obtains $\frac{1}{3}hu_0$ or $\frac{3}{8}kv_0$. The volume of the briquette for which u is a function of x and y is found by the operation of double integration, consisting of two successive operations, one being with regard to x, and the other with regard to y; and these operations may (in the cases with which we are concerned) be performed in either order. Starting from any ordinate $u_{\theta,\phi}$, the result of integrating with regard to x through a distance $2h$ is (in the example considered in § 61) the same as the result of the operation $\frac{1}{3}h(1+4E+E^2)$, where E denotes the operation of changing x into $x+h$ (see DIFFERENCES, CALCULUS OF). The integration with regard to y may similarly (in the particular example) be replaced by the operation $\frac{3}{8}k(1+3E'+3E'^2+E'^3)$, where E′ denotes the change of y into $y+k$. The result of performing both operations, in order to obtain the volume, is the result of the operation denoted by the product of these two expressions; and in this product the powers of E and of E′ may be dealt with according to algebraical laws.

The methods of §§ 59 and 60 can similarly be extended to finding the position of the central ordinate of a briquette, or the mean q^{th} distance of elements of the briquette from a principal plane.

63. (C) *Mensuration of Graphs Generally.*—We have next to consider the extension of the preceding methods to cases in which u is not necessarily an algebraical function of x or of x and y.

The general principle is that the numerical data from which a particular result is to be deduced are in general not exact, but are given only to a certain degree of accuracy. This limits the accuracy of the result; and we can therefore replace the figure by another figure which coincides with it approximately, provided that the further inaccuracy so introduced is comparable with the original inaccuracies of measurement.

The relation between the inaccuracy of the data and the additional inaccuracy due to substitution of another figure is similar to the relation between the inaccuracies in mensuration of a figure which is supposed to be of a given form (§ 20). The volume of a frustum of a cone, for instance, can be expressed in terms of certain magnitudes by a certain formula; but not only will there be some error in the measurement of these magnitudes, but there is not any material figure which is an exact cone. The formula may, however, be used if the deviation from conical form is relatively less than the errors of measurement. The conditions are thus similar to those which arise in interpolation (*q.v.*). The data are the same in both cases. In the case of a trapezette, for instance, the data are the magnitudes of certain ordinates; the problem of interpolation is to determine the values of intermediate ordinates, while that of mensuration is to determine the area of the figure of which these are the ordinates. If, as is usually the case, the ordinate throughout each strip of the trapezette can be expressed approximately as an algebraical function of the abscissa, the application of the integral calculus gives the area of the figure.

64. There are three classes of cases to be considered. In the case of mathematical functions certain conditions of continuity are satisfied, and the extent to which the value given by any particular formula differs from the true value may be estimated within certain limits; the main inaccuracy, in favourable cases, being due to the fact that the numerical data are not absolutely exact. In physical and mechanical applications, where concrete measurements are involved, there is, as pointed out in the preceding section, the additional inaccuracy due to want of exactness in the figure itself. In the case of statistical data there is the further difficulty that there is no real continuity, since we are concerned with a finite number of individuals.

The proper treatment of the deviations from mathematical accuracy, in the second and third of the above classes of cases, is a special matter. In what follows it will be assumed that the conditions of continuity (which imply the continuity not only of u but also of some of its differential coefficients) are satisfied, subject to the small errors in the values of u actually given; the limits of these errors being known.

65. It is only necessary to consider the trapezette and the briquette, since the cases which occur in practice can be reduced to one or other of these forms. In each case the data are the values of certain equidistant ordinates, as described in §§ 43–45. The terms *quadrature-formula* and *cubature-formula* are sometimes restricted to formulae for expressing the area of a trapezette, or the volume of a briquette, in terms of such data. Thus a quadrature-formula is a formula for expressing $[A_x.u]$ or $\int udx$ in terms of a series of given values of u, while a cubature-formula is a formula for expressing $[[V_{x,y}.u]]$ or $\int\int udxdy$ in terms of the values of u for certain values of x in combination with certain values of y; these values not necessarily lying within the limits of the integrations.

66. There are two principal methods. The first, which is the best known but is of limited application, consists in replacing each successive portion of the figure by another figure whose ordinate is an algebraical function of x or of x and y, and expressing the area or volume of this latter figure (exactly or approximately) in terms of the given ordinates. The second consists in taking a comparatively simple expression obtained in this way, and introducing corrections which involve the values of ordinates at or near the boundaries of the figure. The various methods will be considered first for the trapezette, the extensions to the briquette being only treated briefly.

67. *The Trapezoidal Rule.*—The simplest method is to replace the trapezette by a series of trapezia. If the data are u_0, u_1, . . . u_m, the figure formed by joining the tops of these ordinates is a trapezoid whose area is $h(\frac{1}{2}u_0+u_1+u_2+\dots+u_{m-1}+\frac{1}{2}u_m)$. This is called the *trapezoidal* or *chordal* area, and will be denoted by C_1. If the data are $u_{\frac{1}{2}}$, $u_{\frac{3}{2}}$, . . . $u_{m-\frac{1}{2}}$, we can form a series of trapezia by drawing the tangents at the extremities of these ordinates; the sum of the areas of these trapezia will be $h(u_{\frac{1}{2}}+u_{\frac{3}{2}}+\dots+u_{m-\frac{1}{2}})$. This is called the *tangential* area, and will be denoted by T_1. The

tangential area may be expressed in terms of chordal areas. If we write $C_{\frac{1}{2}}$ for the chordal area obtained by taking ordinates at intervals $\frac{1}{2}h$, then $T_1 = 2C_{\frac{1}{2}} - C_1$. If the trapezette, as seen from above, is everywhere convex or everywhere concave, the true area lies between C_1 and T_1.

68. *Other Rules for Trapezettes.*—The extension of this method consists in dividing the trapezette into minor trapezettes, each consisting of two or more strips, and replacing each of these minor trapezettes by a new figure, whose ordinate v is an algebraical function of x; this function being chosen so that the new figure shall coincide with the original figure so far as the given ordinates are concerned. This means that, if the minor trapezette consists of k strips, v will be of degree k or $k-1$ in x, according as the data are the bounding ordinates or the mid-ordinates. If A denotes the true area of the original trapezette, and B the aggregate area of the substituted figures, we have $A \bumpeq B$, where $\bumpeq$ denotes approximate equality. The value of B is found by the methods of §§ 49–55. The following are some examples.

(i) Suppose that the bounding ordinates are given, and that m is a multiple of 2. Then we can take the strips in pairs, and treat each pair as a parabolic trapezette. Applying Simpson's formula to each of these, we have

$$A \bumpeq \tfrac{1}{3}h(u_0 + 4u_1 + u_2) + \tfrac{1}{3}h(u_2 + 4u_3 + u_4) + \dots$$
$$\bumpeq \tfrac{1}{3}h(u_0 + 4u_1 + 2u_2 + 4u_3 + 2u_4 + \dots + 2u_{m-2} + 4u_{m-1} + u_m).$$

This is *Simpson's rule.*

(ii) Similarly, if m is a multiple of 3, the repeated application of Simpson's second formula gives *Simpson's second rule*

$$A \bumpeq \tfrac{3}{8}h(u_0 + 3u_1 + 3u_2 + 2u_3 + 3u_4 + \dots + 3u_{m-4} + 2u_{m-3} + 3u_{m-2} + 3u_{m-1} + u_m).$$

(iii) If mid-ordinates are given, and m is a multiple of 3, the repeated application of the formula of § 55 will give

$$A \bumpeq \tfrac{3}{8}h(3u_{\frac{1}{2}} + 2u_{\frac{3}{2}} + 3u_{\frac{5}{2}} + 3u_{\frac{7}{2}} + \dots + 2u_{m-\frac{3}{2}} + 3u_{m-\frac{1}{2}}).$$

69. The formulae become complicated when the number of strips in each of the minor trapezettes is large. The method is then modified by replacing B by an expression which gives the areas of the substituted figures approximately. This introduces a further inaccuracy; but this latter may be negligible in comparison with the main inaccuracies already involved (cf. § 20 (iii)).

Suppose, for instance, that $m=6$, and that we consider the trapezette as a whole; the data being the bounding ordinates. Since there are seven of these, v will be of degree 6 in x; and we shall have (§ 54 (i))

$$B = 6h(v_3 + \tfrac{3}{2}\delta^2 v_3 + \tfrac{11}{20}\delta^4 v_3 + \tfrac{41}{840}\delta^6 v_3) = 6h(u_3 + \tfrac{3}{2}\delta^2 u_3 + \tfrac{11}{20}\delta^4 u_3 + \tfrac{41}{840}\delta^6 u_3).$$

If we replace $\frac{41}{840}\delta^6 u_3$ in this expression by $\frac{42}{840}\delta^6 u_3$, the method of § 68 gives

$$A \bumpeq \tfrac{3}{10}h\,(u_0 + 5u_1 + u_2 + 6u_3 + u_4 + 5u_5 + u_6);$$

the expression on the right-hand side being an approximate expression for B, and differing from it only by $\frac{1}{840}H\delta^6 u_3$. This is *Weddle's rule.* If m is a multiple of 6, we can obtain an expression for A by applying the rule to each group of six strips.

70. Some of the formulae obtained by the above methods can be expressed more simply in terms of chordal or tangential areas taken in various ways. Consider, for example, Simpson's rule (§ 68 (i)). The expression for A can be written in the form

$$\tfrac{4}{3}h(\tfrac{1}{2}u_0 + u_1 + u_2 + u_3 + \dots + u_{m-2} + u_{m-1} + \tfrac{1}{2}u_m) - \tfrac{2}{3}h(\tfrac{1}{2}u_0 + u_2 + u_4 + \dots + u_{m-2} + \tfrac{1}{2}u_m).$$

Now, if p is any factor of m, there is a series of equidistant ordinates $u_0, u_p, u_{2p}, \dots u_{m-p}, u_m$; and the chordal area as determined by these ordinates is

$$ph(\tfrac{1}{2}u_0 + u_p + u_{2p} + \dots + u_{m-p} + \tfrac{1}{2}u_m),$$

which may be denoted by C_p. With this notation, the area as given by Simpson's rule may be written in the form $\frac{4}{3}C_1 - \frac{1}{3}C_2$ or $C_1 + \frac{1}{3}(C_1 - C_2)$. The following are some examples of formulae of this kind, in terms of chordal areas.

(i) m a multiple of 2 (Simpson's rule).

$$A \bumpeq \tfrac{1}{3}(4C_1 - C_2 \bumpeq C_1 + \tfrac{1}{3}(C_1 - C_2).$$

(ii) m a multiple of 3 (Simpson's second rule).

$$A \bumpeq \tfrac{1}{8}(9C_1 - C_3) \bumpeq C_1 + \tfrac{1}{8}(C_1 - C_3).$$

(iii) m a multiple of 4.

$$A \bumpeq \tfrac{1}{45}(64C_1 - 20C_2 + C_4) \bumpeq C_1 + \tfrac{4}{9}(C_1 - C_2) - \tfrac{1}{45}(C_1 - C_4).$$

(iv) m a multiple of 6 (Weddle's rule, or its repeated application).

$$A \bumpeq \tfrac{1}{10}(15C_1 - 6C_2 + C_3) \bumpeq C_1 + \tfrac{1}{2}(C_1 - C_2) - \tfrac{1}{10}(C_2 - C_3).$$

(v) m a multiple of 12.

$$A \bumpeq \tfrac{1}{35}(56C_1 - 28C_2 + 8C_3 - C_4)$$
$$\bumpeq C_1 + \tfrac{3}{5}(C_1 - C_2) - \tfrac{1}{5}(C_2 - C_3) + \tfrac{1}{35}(C_3 - C_4).$$

There are similar formulae in terms of the tangential areas T_1, T_2, T_3. Thus (iii) of § 68 may be written $A \bumpeq \frac{1}{8}(9T_1 - T_3)$.

71. The general method of constructing the formulae of § 70 for chordal areas is that, if $p, q, r, \dots$ are k of the factors (including 1) of m, we take

$$A \bumpeq PC_p + QC_q + RC_r + \dots,$$

where P, Q, R, . . . satisfy the k equations

$$\begin{aligned} P + Q + R + \dots &= 1, \\ Pp^2 + Qq^2 + Rr^2 + \dots &= 0, \\ Pp^4 + Qq^4 + Rr^4 + \dots &= 0, \\ &\vdots \\ Pp^{2k-2} + Qq^{2k-2} + Rr^{2k-2} + \dots &= 0. \end{aligned}$$

The last $k-1$ of these equations give

$$1/P : 1/Q : 1/R : \dots = p^2(p^2 - q^2)(p^2 - r^2) \dots : q^2(q^2 - p^2)(q^2 - r^2) \dots : r^2(r^2 - p^2)(r^2 - q^2) \dots : \dots$$

Combining this with the first equation, we obtain the values of P, Q, R, . . .

The same method applies for tangential areas, by taking

$$A \bumpeq PT_p + QT_q + RT_r + \dots$$

provided that $p, q, r, \dots$ are odd numbers.

72. The justification of the above methods lies in certain properties of the series of successive differences of u. The fundamental assumption is that each group of strips of the trapezette may be replaced by a figure for which differences of u, above those of a certain order, vanish (§ 54). The legitimacy of this assumption, and of the further assumption which enables the area of the new figure to be expressed by an approximate formula instead of by an exact formula, must be verified in every case by reference to the actual differences.

73. *Correction by means of Extreme Ordinates.*—The preceding methods, though apparently simple, are open to various objections in practice, such as the following: (i) The assignment of different coefficients of different ordinates, and even the selection of ordinates for the purpose of finding C_2, C_3, &c. (§ 70), is troublesome. (ii) This assignment of different coefficients means that different weights are given to different ordinates; and the relative weights may not agree with the relative accuracies of measurement. (iii) Different formulae have to be adopted for different values of m; the method is therefore unsuitable for the construction of a table giving successive values of the area up to successive ordinates. (iv) In order to find what formula may be applied, it is necessary to take the successive differences of u; and it is then just as easy, in most cases, to use a formula which directly involves these differences and therefore shows the degree of accuracy of the approximation.

The alternative method, therefore, consists in taking a simple formula, such as the trapezoidal rule, and correcting it to suit the mutual relations of the differences.

74. To illustrate the method, suppose that we use the chordal area C_1, and that the trapezette is in fact parabolic. The difference between C_1 and the true area is made up of a series of areas bounded by chords and arcs; this difference becoming less as we subdivide the figure into a greater number of strips.

The fact that C_1 does not give the true area is due to the fact that in passing from one extremity of the top of any strip to the other extremity the tangent to the trapezette changes its direction. We have therefore in the first place to see whether the difference can be expressed in terms of the directions of the tangents.

Let KABL (fig. 10) be one of the strips, of breadth h. Draw the tangents at A and B, meeting at T; and through T draw a line parallel to KA and LB, meeting the arc AB in C and the chord AB in V. Draw AD and BE perpendicular to this line, and DF and TG perpendicular to LB. Then $AD = EB = \frac{1}{2}h$, and the triangles AVD and BVE are equal.

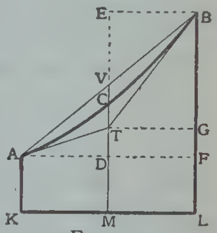

FIG. 10.

The area of the trapezette is less (in fig. 10) than the area of the trapezium KABL by two-thirds of the area of the triangle ATB (§ 34). This latter area is

$$\Delta BTE - \Delta ATD = \Delta BTG - \Delta ATD = \tfrac{1}{8}h^2 \tan GTB - \tfrac{1}{8}h^2 \tan DAT.$$

Hence, if the angle which the tangent at the extremity of the ordinate u_θ makes with the axis of x is denoted by ψ_θ, we have

$$\begin{aligned} \text{area from } u_0 \text{ to } u_1 &= \tfrac{1}{2}h(u_0 + u_1) - \tfrac{1}{12}h^2(\tan\psi_1 - \tan\psi_0), \\ \text{,, } \quad u_1 \text{ to } u_2 &= \tfrac{1}{2}h(u_1 + u_2) - \tfrac{1}{12}h^2(\tan\psi_2 - \tan\psi_1), \\ &\vdots \\ \text{,, } \quad u_{m-1} \text{ to } u_m &= \tfrac{1}{2}h(u_{m-1} + u_m) - \tfrac{1}{12}h^2(\tan\psi_m - \tan\psi_{m-1}); \end{aligned}$$

and thence, by summation,

$$A = C_1 - \tfrac{1}{12}h^2(\tan\psi_m - \tan\psi_0).$$

This, in the notation of §§ 46 and 54, may be written

$$A = C_1 + \Big[-\tfrac{1}{12}h^2 u' \Big]_{x=x_0}^{x=x_m}.$$

Since $h = H/m$, the inaccuracy in taking C_1 as the area varies as $1/m^2$.

It might be shown in the same way that

$$A = T_1 + \tfrac{1}{24}h^2(\tan\psi_m - \tan\psi_0) = T_1 + \Big[\tfrac{1}{24}h^2 u' \Big]_{x=x_0}^{x=x_m}.$$

75. The above formulae apply only to a parabolic trapezette Their generalization is given by the *Euler-Maclaurin formula*

$$A=\int_{x_0}^{x_m} u\,dx = C_1+\Big[-\tfrac{1}{12}h^2u'+\tfrac{1}{720}h^4u'''-\tfrac{1}{30240}h^6u^{\mathrm{v}}+\tfrac{1}{1209600}h^8u^{\mathrm{vii}}-\ \dots\Big]_{x=x_0}^{x=x_m};$$

and an analogous formula (which may be obtained by substituting $\frac{1}{2}h$ and $C_{\frac{1}{2}}$ for h and C_1 in the above and then expressing T_1 as $2C_{\frac{1}{2}}-C_1$)

$$A=\int_{x_0}^{x_m} u\,dx = T_1+\Big[\tfrac{1}{24}h^2u'-\tfrac{7}{5760}h^4u'''+\tfrac{31}{967680}h^6u^{\mathrm{v}}-\tfrac{127}{154828800}h^8u^{\mathrm{vii}}+\ \dots\Big]_{x=x_0}^{x=x_m}.$$

To apply these, the differential coefficients have to be expressed in terms of differences.

76 If we know not only the ordinates $u_0, u_1, \dots$ or $u_{\frac{1}{2}}, u_{\frac{3}{2}}, \dots$, but also a sufficient number of the ordinates obtained by continuing the series outside the trapezette, at both extremities, we can use central-difference formulae, which are by far the most convenient. The formulae of § 75 give

$$A=C_1+h\Big[-\tfrac{1}{12}\mu\delta u+\tfrac{11}{720}\mu\delta^3u-\tfrac{191}{60480}\mu\delta^5u+\tfrac{2497}{3628800}\mu\delta^7u-\dots\Big]_{x=x_0}^{x=x_m},$$

$$A=T_1+h\Big[\tfrac{1}{24}\delta u-\tfrac{17}{5760}\delta^3u+\tfrac{367}{967680}\delta^5u-\tfrac{27859}{464486400}\delta^7u+\ \dots\Big]_{x=x_0}^{x=x_m}.$$

77. If we do not know values of u outside the figure, we must use advancing or receding differences. The formulae usually employed are

$$A=C_1+h\Big\{\tfrac{1}{12}\Delta u_0-\tfrac{1}{24}\Delta^2u_0+\tfrac{19}{720}\Delta^3u_0-\tfrac{3}{160}\Delta^4u_0+\ \dots$$
$$+\tfrac{1}{12}\Delta' u_m-\tfrac{1}{24}\Delta'^2u_m+\tfrac{19}{720}\Delta'^3u_m-\tfrac{3}{160}\Delta'^4u_m+\ \dots\Big\},$$

$$A=T_1+h\Big\{-\tfrac{1}{24}\Delta u_{\frac{1}{2}}+\tfrac{1}{24}\Delta^2u_{\frac{1}{2}}-\tfrac{223}{5760}\Delta^3u_{\frac{1}{2}}+\tfrac{103}{2880}\Delta^4u_{\frac{1}{2}}-\ \dots$$
$$-\tfrac{1}{24}\Delta' u_{m-\frac{1}{2}}+\tfrac{1}{24}\Delta'^2u_{m-\frac{1}{2}}-\tfrac{223}{5760}\Delta'^3u_{m-\frac{1}{2}}+\tfrac{103}{2880}\Delta'^4u_{m-\frac{1}{2}}-\ \dots\Big\},$$

where Δ, Δ^2, ... have the usual meaning ($\Delta u_0=u_1-u_0$, $\Delta^2u_0=\Delta u_1-\Delta u_0$, ...), and Δ', Δ'^2, ... denote differences read backwards, so that $\Delta' u_m=u_{m-1}-u_m$, $\Delta'^2u_m=u_{m-2}-2u_{m-1}+u_m$, ... The calculation of the expressions in brackets may be simplified by taking the pairs in terms from the outside; *i.e.* by finding the successive differences of u_0+u_m, u_1+u_{m-1}, ..., or of $u_{\frac{1}{2}}+u_{m-\frac{1}{2}}$, $u_{\frac{3}{2}}+u_{m-\frac{3}{2}}$, ...

An alternative method, which is in some ways preferable, is to complete the table of differences by repeating the differences of the highest order that will be taken into account (see INTERPOLATION), and then to use central-difference formulae.

78. In order to find the corrections in respect of the terms shown in square brackets in the formulae of § 75, certain ordinates other than those used for C_1 or T_1 are sometimes found specially. *Parmentier's rule*, for instance, assumes that in addition to $u_{\frac{1}{2}}, u_{\frac{3}{2}}, \dots u_{m-\frac{1}{2}}$, we know u_0 and u_m; and $u_{\frac{1}{2}}-u_0$ and $u_m-u_{m-\frac{1}{2}}$ are taken to be equal to $\frac{1}{2}hu'_0$ and $\frac{1}{2}hu'_m$ respectively. These methods are not to be recommended except in special cases.

79. By replacing h in § 75 by $2h$, $3h$, ... and eliminating h^2u', h^4u''', ..., we obtain exact formulae corresponding to the approximate formulae of § 70. The following are the results (for the formulae involving chordal areas), given in terms of differential coefficients and of central differences. They are not so convenient as the formulae of § 76, but they serve to indicate the degree of accuracy of the approximate formulae. The expressions in square brackets are in each case to be taken as relating to the extreme values $x=x_0$ and $x=x_m$, as in §§ 75 and 76.

(i) $A=\frac{1}{3}(4C_1-C_2)+[-\frac{1}{180}h^4u'''+\frac{1}{1512}h^6u^{\mathrm{v}}-\frac{1}{14400}h^8u^{\mathrm{vii}}+\ \dots]$
$=\frac{1}{3}(4C_1-C_2)+h[-\frac{1}{180}\mu\delta^3u+\frac{31}{15120}\mu\delta^5u-\frac{557}{907200}\mu\delta^7u+\dots]$.

(ii) $A=\frac{1}{8}(9C_1-C_3)+[-\frac{1}{80}h^4u'''+\frac{1}{336}h^6u^{\mathrm{v}}-\frac{13}{19200}h^8u^{\mathrm{vii}}+\ \dots]$
$=\frac{1}{8}(9C_1-C_3)+h[-\frac{1}{80}\mu\delta^3u+\frac{41}{6720}\mu\delta^5u-\frac{967}{403200}\mu\delta^7u+\dots]$.

(iii) $A=\frac{1}{45}(64C_1-20C_2+C_4)+[-\frac{2}{945}h^6u^{\mathrm{v}}+\frac{1}{900}h^8u^{\mathrm{vii}}-\ \dots]$
$=\frac{1}{45}(64C_1-20C_2+C_4)+h[-\frac{2}{945}\mu\delta^5u+\frac{103}{56700}\mu\delta^7u-\ \dots]$.

(iv) $A=\frac{1}{10}(15C_1-6C_2+C_3)+[-\frac{1}{840}h^6u^{\mathrm{v}}+\frac{1}{2400}h^8u^{\mathrm{vii}}-\ \dots]$
$=\frac{1}{10}(15C_1-6C_2+C_3)+h[-\frac{1}{840}\mu\delta^5u+\frac{41}{50400}\mu\delta^7u-\ \dots]$.

(v) $A=\frac{1}{35}(56C_1-28C_2+8C_3-C_4)+[-\frac{1}{2100}h^8u^{\mathrm{vii}}+\ \dots]$
$=\frac{1}{35}(56C_1-28C_2+8C_3-C_4)+h[-\frac{1}{2100}\mu\delta^7u+\ \dots]$.

The general expression, if $p, q, r, \dots$ are k of the factors of m, is

$$A=PC_p+QC_q+RC_r+\dots+\Big[(-)^kb_kh^{2k}\frac{d^{2k-1}u}{dx^{2k-1}}+(-)^{k+1}b_{k+1}h^{2k+2}\frac{d^{2k+1}u}{dx^{2k+1}}+\ \dots\Big]_{x=x_0}^{x=x_m},$$

where P, Q, R, ... have the values given by the equations in § 71, and the coefficients b_k, b_{k+1}, ... are found from the corresponding coefficients in the Euler-Maclaurin formula (§ 75) by multiplying them by $Pp^{2k}+Qq^{2k}+Rr^{2k}+\dots$, $Pp^{2k+2}+Qq^{2k+2}+Rr^{2k+2}+\dots$, ...

80. *Moments of a Trapezette.*—The above methods can be applied, as in §§ 59 and 60, to finding the moments of a trapezette, when the data are a series of ordinates. To find the pth moment, when $u_0, u_1, u_2, \dots$ are given, we have only to find the area of a trapezette whose ordinates are $x_0{}^pu_0$, $x_1{}^pu_1$, $x_2{}^pu_2$, ...

81. There is, however, a certain set of cases, occurring in statistics, in which the data are not a series of ordinates, but the areas $A_{\frac{1}{2}}, A_{\frac{3}{2}}, \dots A_{m-\frac{1}{2}}$ of the strips bounded by the consecutive ordinates $u_0, u_1, \dots u_m$. The determination of the moments in these cases involves special methods, which are considered in the next two sections

82. The most simple case is that in which the trapezette tapers out in such a way that the curve forming its top has very close contact, at its extremities, with the base; in other words, the differential coefficients u', u'', u''', ... are practically negligible for $x=x_0$ and for $x=x_m$. The method adopted in these cases is to treat the areas $A_{\frac{1}{2}}, A_{\frac{3}{2}}, \dots$ as if they were ordinates placed at the points for which $x=x_{\frac{1}{2}}$, $x=x_{\frac{3}{2}}$, ..., to calculate the moments on this assumption, and then to apply certain corrections. If the first, second, ... moments, so calculated, before correction are denoted by $\rho_1, \rho_2, \dots$, we have

$$\begin{aligned}\rho_1&=x_{\frac{1}{2}}A_{\frac{1}{2}}+x_{\frac{3}{2}}A_{\frac{3}{2}}+\dots+x_{m-\frac{1}{2}}A_{m-\frac{1}{2}}\\ \rho_2&=x^2{}_{\frac{1}{2}}A_{\frac{1}{2}}+x^2{}_{\frac{3}{2}}A_{\frac{3}{2}}+\dots+x^2{}_{m-\frac{1}{2}}A_{m-\frac{1}{2}}\\ &\ \vdots\\ \rho_p&=x^p{}_{\frac{1}{2}}A_{\frac{1}{2}}+x^p{}_{\frac{3}{2}}A_{\frac{3}{2}}+\dots+x^p{}_{m-\frac{1}{2}}A_{m-\frac{1}{2}}.\end{aligned}$$

These are called the *raw moments*. Then, if the true moments are denoted by $\nu_1, \nu_2, \dots$, their values are given by

$$\begin{aligned}\nu_1&\mathrel{\underline{\Omega}}\rho_1\\ \nu_2&\mathrel{\underline{\Omega}}\rho_2-\tfrac{1}{12}h^2\rho_0\\ \nu_3&\mathrel{\underline{\Omega}}\rho_3-\tfrac{1}{4}h^2\rho_1\\ \nu_4&\mathrel{\underline{\Omega}}\rho_4-\tfrac{1}{2}h^2\rho_2+\tfrac{7}{240}h^4\rho_0\\ \nu_5&\mathrel{\underline{\Omega}}\rho_5-\tfrac{5}{6}h^2\rho_3+\tfrac{7}{48}h^4\rho_1\\ &\ \vdots\end{aligned}$$

where ρ_0 (or ν_0) is the total area $A_{\frac{1}{2}}+A_{\frac{3}{2}}+\dots+A_{m-\frac{1}{2}}$; the general expression being

$$\nu_p\mathrel{\underline{\Omega}}\rho_p-\lambda_1\frac{p!}{2!(p-2)!}h^2\rho_{p-2}+\lambda_2\frac{p!}{4!(p-4)!}h^4\rho_{p-4}-\ \dots,$$

where

$$\lambda_1=\tfrac{1}{12},\ \lambda_2=\tfrac{7}{240},\ \lambda_3=\tfrac{31}{1344},\ \lambda_4=\tfrac{127}{3840},\ \lambda_5=\tfrac{2555}{33792},\ \dots$$

The establishment of these formulae involves the use of the integral calculus.

The position of the central ordinate is given by $x=\nu_1/\rho_0$, and therefore is given approximately by $x-\rho_1/\rho_0$. To find the moments with regard to the central ordinate, we must use this approximate value, and transform by means of the formulae given in § 32. This can be done either before or after the above corrections are made. If the transformation is made first, and if the resulting raw moments with regard to the (approximate) central ordinate are $0, \pi_2, \pi_3, \dots$, the true moments $\mu_1, \mu_2, \mu_3, \dots$ with regard to the central ordinate are given by

$$\begin{aligned}\mu_1&=0\\ \mu_2&\mathrel{\underline{\Omega}}\pi_2-\tfrac{1}{12}h^2\rho_0\\ \mu_3&\mathrel{\underline{\Omega}}\pi_3\\ \mu_4&\mathrel{\underline{\Omega}}\pi_4-\tfrac{1}{2}h^2\pi_2+\tfrac{7}{240}h^4\rho_0\\ \mu_5&\mathrel{\underline{\Omega}}\pi_5-\tfrac{5}{6}h^2\pi_3\\ &\ \vdots\end{aligned}$$

83. These results may be extended to the calculation of an expression of the form $\int_{x_0}^{x_m}u\phi(x)dx$, where $\phi(x)$ is a definite function of x, and the conditions with regard to u are the same as in § 82.

(i) If $\phi(x)$ is an explicit function of x, we have

$$\int_{x_0}^{x_m}u\phi(x)dx\mathrel{\underline{\Omega}}A_{\frac{1}{2}}\psi(x_{\frac{1}{2}})+A_{\frac{3}{2}}\psi(x_{\frac{3}{2}})+\dots+A_{m-\frac{1}{2}}\psi(x_{m-\frac{1}{2}}),$$

where $\psi(x)\equiv\phi(x)-\dfrac{\lambda_1}{2!}h^2\phi''(x)+\dfrac{\lambda_2}{4!}h^4\phi^{\mathrm{iv}}(x)-\dots,$

the coefficients $\lambda_1, \lambda_2, \dots$ having the values given in § 82.

(ii) If $\phi(x)$ is not given explicitly, but is tabulated for the values .. $x_{\frac{1}{2}}, x_{\frac{3}{2}}, \dots$ of x, the formula of (i) applies, provided we take

$$\psi(x)\equiv(1-\tfrac{1}{24}\delta^2+\tfrac{3}{640}\delta^4-\tfrac{5}{7168}\delta^6+\ \dots)\phi(x).$$

The formulae can be adapted to the case in which $\phi(x)$ is tabulated for $x=x_0, x_1, \dots$

84. In cases other than those described in § 82, the pth moment with regard to the axis of u is given by

$$\nu_p=x^p{}_mA-pS_{p-1},$$

where A is the total area of the original trapezette, and S_{p-1} is the area of a trapezette whose ordinates at successive distances h, beginning and ending with the bounding ordinates, are

$0,\ x_1{}^{p-1}A_{\frac{1}{2}},\ x_2{}^{p-1}(A_{\frac{1}{2}}+A_{\frac{3}{2}}),\ \dots\ x_{m-1}^{p-1}(A_{\frac{1}{2}}+A_{\frac{3}{2}}+\dots+A_{m-\frac{3}{2}}),\ x_m^{p-1}A.$

The value of S_{p-1} has to be found by a quadrature-formula. The generalized formula is

$$\int_{x_0}^{x_m}u\phi(x)dx=A\phi(x_m)-T,$$

where T is the area of a trapezette whose ordinates at successive distances h are 0, $A_{\frac{1}{2}}\phi'(x_1)$, $(A_{\frac{1}{2}}+A_{\frac{3}{2}})\phi'(x_2)$, . . . $(A_{\frac{1}{2}}+A_{\frac{3}{2}}+\ldots+A_{m-\frac{3}{2}})\phi'(x_{m-1})$, $A\phi'(x_m)$; the accents denoting the first differential coefficient.

85. *Volume and Moments of a Briquette.*—The application of the methods of §§ 75–79 to calculation of the volume of a briquette leads to complicated formulae. If the conditions are such that the methods of § 61 cannot be used, or are undesirable as giving too much weight to particular ordinates, it is best to proceed in the manner indicated at the end of § 48; *i.e.* to find the areas of one set of parallel sections, and treat these as the ordinates of a trapezette whose area will be the volume of the briquette.

86. The formulae of § 82 can be extended to the case of a briquette whose top has close contact with the base all along its boundary; the data being the volumes of the minor briquettes formed by the planes $x=x_0$, $x=x_1$, . . . and $y=y_0$, $y=y_1$, . . . The method of constructing the formulae is explained in § 62. If we write

$$S_{p,q}\equiv\int_{x_0}^{x_m}\int_{y_0}^{y_n}x^p y^q u\,dx\,dy,$$

we first calculate the raw values $\sigma_{0,1}$, $\sigma_{1,0}$, $\sigma_{1,1}$, . . . of $S_{0,1}$, $S_{1,0}$, $S_{1,1}$, . . . on the assumption that the volume of each minor briquette is concentrated along its mid-ordinate (§ 44), and we then obtain the formulae of correction by multiplying the formulae of § 82 in pairs. Thus we find (*e.g.*)

$$
\begin{aligned}
&S_{1,1}\overset{\Omega}{=}\sigma_{1,1}\\
&S_{2,1}\overset{\Omega}{=}\sigma_{2,1}-\tfrac{1}{12}h^2\sigma_{0,1}\\
&S_{1,2}\overset{\Omega}{=}\sigma_{1,2}-\tfrac{1}{12}k^2\sigma_{1,0}\\
&S_{2,2}\overset{\Omega}{=}\sigma_{2,2}-\tfrac{1}{12}k^2\sigma_{2,0}-\tfrac{1}{12}h^2\sigma_{0,2}+\tfrac{1}{144}h^2k^2\sigma_{0,0}\\
&S_{3,1}\overset{\Omega}{=}\sigma_{3,1}-\tfrac{1}{4}h^2\sigma_{1,1}\\
&S_{3,2}\overset{\Omega}{=}\sigma_{3,2}-\tfrac{1}{4}h^2\sigma_{1,2}-\tfrac{1}{12}k^2\sigma_{3,0}+\tfrac{1}{48}h^2k^2\sigma_{1,0}
\end{aligned}
$$

where $\sigma_{0,0}$ is the total volume of the briquette.

87. If the data of the briquette are, as in § 86, the volumes of the minor briquettes, but the condition as to close contact is not satisfied, we have

$$\int_{x_0}^{x_m}\int_{y_0}^{y_n}x^p y^q u\,dx\,dy=K+L+R-x_m^p y_n^q\sigma_{0,0}$$

where $K\equiv x_m^p\times q$th moment with regard to plane $y=0$,

$L\equiv y_n^q\times p$th moment with regard to plane $x=0$,

and R is the volume of a briquette whose ordinate at (x_r, y_s) is found by multiplying by $pq\,x_r^{p-1}\,y_s^{q-1}$ the volume of that portion of the original briquette which lies between the planes $x=x_0$, $x=x_r$, $y=y_0$, $y=y_s$. The ordinates of this new briquette at the points of intersection of $x=x_0$, $x=x_1$, . . . with $y=y_0$, $y=y_1$, . . . are obtained from the data by summation and multiplication; and the ordinary methods then apply for calculation of its volume. Either or both of the expressions K and L will have to be calculated by means of the formula of § 84; if this is applied to both expressions, we have a formula which may be written in a more general form

$$
\begin{aligned}
\int_a^b\int_p^q u\phi(x,y)\,dx\,dy=&\int_a^b\int_p^q u\,dx\,dy\,.\,\phi(b,q)\\
&-\int_a^b\left\{\int_a^x\int_p^q u\,dx\,dy\right\}\frac{d\phi(x,q)}{dx}\,dx\\
&-\int_p^q\left\{\int_a^b\int_p^y u\,dx\,dy\right\}\frac{d\phi(b,y)}{dy}\,dy\\
&+\int_a^b\int_p^q\left\{\int_a^x\int_b^y u\,dx\,dy\right\}\frac{d^2\phi(x,y)}{dx\,dy}\,dx\,dy.
\end{aligned}
$$

The second and third expressions on the right-hand side represent areas of trapezettes, which can be calculated from the data; and the fourth expression represents the volume of a briquette, to be calculated in the same way as R above.

88. *Cases of Failure.*—When the sequence of differences is not such as to enable any of the foregoing methods to be applied, it is sometimes possible to amplify the data by measurement of intermediate ordinates, and then apply a suitable method to the amplified series.

There is, however, a certain class of cases in which no subdivision of intervals will produce a good result; viz. cases in which the top of the figure is, at one extremity (or one part of its boundary), at right angles to the base. The Euler-Maclaurin formula (§ 75) assumes that the bounding values of u', u''', . . . are not infinite; this condition is not satisfied in the cases here considered. It is also clearly impossible to express u as an algebraical function of x and y if some value of du/dx or du/dy is to be infinite.

No completely satisfactory methods have been devised for dealing with these cases. One method is to construct a table for interpolation of x in terms of u, and from this table to calculate values of x corresponding to values of u, proceeding by equal intervals; a quadrature-formula can then be applied. Suppose, for instance, that we require the area of the trapezette ABL in fig. 11; the curve being at right angles to the base AL at A. If QD is the bounding ordinate of one of the component strips, we can calculate the area of QDBL in the ordinary way. The data for the area ADQ are a series of values of u corresponding to equidifferent values of x; if we denote by y the distance of a point on the arc AD from QD, we can from the series of values of u construct a series of values of y corresponding to equidifferent values of u, and thus find the area of ADQ, treating QD as the base. The process, however, is troublesome.

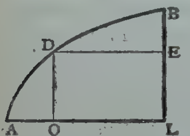

FIG. 11.

89. *Examples of Applications.*—The following are some examples of cases in which the above methods may be applied to the calculation of areas and integrals.

(i) *Construction of Mathematical Tables.*—Even where u is an explicit function of x, so that $\int^x u\,dx$ may be expressed in terms of x, it is often more convenient, for construction of a table of values of such an integral, to use finite-difference formulae. The formula of § 76 may (see DIFFERENCES, CALCULUS OF) be written

$$
\begin{aligned}
\int^x u\,dx&=h\,.\,\mu\sigma u+h\left(-\tfrac{1}{12}\,\mu\delta u+\tfrac{11}{720}\,\mu\delta^3 u-\ldots\right)\\
&=\mu\sigma\left(hu-\tfrac{1}{12}\,\delta^2 hu+\tfrac{11}{720}\delta^4 hu-\ldots\right),\\
\int^x u\,dx&=h\,.\,\sigma u+h\left(\tfrac{1}{24}\,\delta u-\tfrac{17}{5760}\delta^3 u+\ldots\right)\\
&=\sigma\left(hu+\tfrac{1}{24}\,\delta^2 hu-\tfrac{17}{5760}\delta^4 hu+\ldots\right).
\end{aligned}
$$

The second of these is usually the more convenient Thus, to construct a table of values of $\int^x u\,dx$ by intervals of h in x, we first form a table of values of hu for the intermediate values of x, from this obtain a table of values of $(1+\frac{1}{24}\delta^2-\frac{17}{5760}\delta^4+\ldots)\,hu$ for these values of x, and then construct the table of $\int^x u\,dx$ by successive additions. Attention must be given to the possible accumulation of errors due to the small errors in the values of u. Each of the above formulae involves an arbitrary constant; but this disappears when we start the additions from a known value of $\int^x u\,dx$.

The process may be repeated. Thus we have

$$
\begin{aligned}
\int^x\int^x u\,dx\,dx&=\left(\sigma+\tfrac{1}{24}\delta-\tfrac{17}{5760}\delta^3+\ldots\right)^2 h^2 u\\
&=\left(\sigma^2+\tfrac{1}{12}-\tfrac{1}{240}\delta^2+\tfrac{31}{60480}\delta^4-\tfrac{289}{3628800}\delta^6+\ldots\right)h^2 u\\
&=\sigma^2\left(h^2 u+\tfrac{1}{12}\delta^2 h^2 u-\tfrac{1}{240}\delta^4 h^2 u+\ldots\right).
\end{aligned}
$$

Here there are two arbitrary constants, which may be adjusted in various ways.

The formulae may be used for extending the accuracy of tables, in cases where, if v represents the quantity tabulated, $h\,dv/dx$ or h^2d^2v/dx^2 can be conveniently expressed in terms of v and x to a greater degree of accuracy than it could be found from the table. The process practically consists in using the table as it stands for improving the first or second differences of v and then building up the table afresh.

(ii) *Life Insurance.*—The use of quadrature-formulae is important in actuarial work, where the fundamental tables are based on experience, and the formulae applying these tables involve the use of the tabulated values and their differences.

90. The following are instances of the application of approximative formulae to the calculation of the volumes of solids.

(i) *Timber Measure.*—To find the quantity of timber in a trunk with parallel ends, the areas of a few sections must be calculated as accurately as possible, and a formula applied. As the measurements can only be rough, the trapezoidal rule is the most appropriate in ordinary cases.

(ii) *Gauging.*—To measure the volume of a cask, it may be assumed that the interior is approximately a portion of a spheroidal figure. The formula applied can then be either Simpson's rule or a rule based on Gauss's theorem for two ordinates (§ 56). In the latter case the two sections are taken at distances $\pm\frac{1}{2}H/\sqrt{3}=\pm\cdot 2887H$ from the middle section, where H is the total internal length; and their arithmetic mean is taken to be the mean section of the cask. Allowance must of course be made for the thickness of the wood.

91. Certain approximate formulae for the length of an arc of a circle are obtained by methods similar to those of §§ 71 and 79. Let a be the radius of a circle, and θ (circular measure) the unknown angle subtended by an arc. Then, if we divide θ into m equal parts, and L_1 denotes the sum of the corresponding chords, so that $L_1=2ma\sin(\theta/2m)$, the true length of the arc is $L_1+a\theta\left\{\frac{\phi^2}{3!}-\frac{\phi^4}{5!}+\ldots\right\}$, where $\phi=\theta/2m$. Similarly, if L_2 represents the sum of the chords when m (assumed even) is replaced by $\frac{1}{2}m$, we have an expression involving L_2 and 2ϕ. The method of § 71 then shows that, by taking $\frac{1}{3}(4L_1-L_2)$ as the value of the arc, we get rid of terms in ϕ^2. If we use c_1 to represent the chord of the whole arc, c_2 the chord of half the arc, and c_4 the chord of one quarter of the arc, then corresponding to (i) and (iii) of § 70 or § 79 we have $\frac{1}{3}(8c_2-c_1)$ and $\frac{1}{45}(256c_4-40c_2+c_1)$ as approximations to the length of the arc. The first of these is *Huygens's rule*.

REFERENCES.—For applications of the prismoidal formula, see Alfred Lodge, *Mensuration for Senior Students* (1895). Other works on elementary mensuration are G. T. Chivers, *Elementary Mensuration* (1904); R. W. K. Edwards, *Elementary Plane and Solid Mensuration* (1902); William H. Jackson, *Elementary Solid Geometry* (1907); P. A. Lambert, *Computation and Mensuration* (1907). A. E. Pierpoint's *Mensuration Formulae* (1902) is a handy collection. Rules for calculation of areas are also given in such works as F. Castle, *Manual of Practical Mathematics* (1903); F. C. Clarke, *Practical Mathematics* (1907); C. T. Millis, *Technical Arithmetic and Geometry*

(1903). For examples of measurement of areas by geometrical construction, see G. C. Turner, *Graphics applied to Arithmetic, Mensuration and Statics* (1907). Discussions of the approximate calculation of definite integrals will be found in works on the infinitesimal calculus; see *e.g.* E. Goursat, *A Course in Mathematical Analysis* (1905; trans. by E. R. Hedrick). For the methods involving finite differences, see references under Differences, Calculus of; and Interpolation. On calculation of moments of graphs, see W. P. Elderton, *Frequency-Curves and Correlation* (1906); as to the formulae of § 82, see also *Biometrika*, v. 450. For mechanical methods of calculating areas and moments see Calculating Machines. (W. F. Sh.)

MENTAWI, a chain of islands in the Dutch East Indies, off the west coast of Sumatra, between 1° and 3° 30′ S. There are twenty-one islands in all, of which the majority lie close to or between the four largest—Siberut, Sikaban or Sipora, North Pageh and South Pageh. The two last (also called Pagi or Poggy) are sometimes termed the Nassau Islands. The total land area is 1224 sq. m. The islands are included in the administration of Padang, Sumatra. They are apparently volcanic. Coral reefs lie off the coasts and render them difficult of access. The natives in language and customs present affinities with some Polynesians, and have been held to be a survival of the eastward immigration of people of Caucasian stock which took place before those which established the "pre-Malay" peoples (such as the Dyaks and Battas) in the Malay Archipelago. The islands produce some coco-nuts, sago, trepang and timber.

MENTEITH, or Monteith, a district of south Perthshire, Scotland, roughly comprising the territory between the Teith and the Forth. Formerly it was a stewartry and gave the title to an earldom. The title was first held by Gilchrist, a Celtic chief ennobled by Malcolm IV., and passed successively to Walter Comyn (d. 1258), to a branch of the Stewarts, and finally to the Grahams, becoming extinct in 1694. The lake of Menteith, situated $2\frac{1}{2}$ m. S. of Loch Vennachar measures $1\frac{1}{2}$ m. long by 1 m. broad, and contains three islands. On Inchmahome (Gaelic, "the Isle of Rest") are the ruins of an Augustinian priory founded in 1238 by Walter Comyn. It is Early English, with an ornate western doorway. The island was the residence of Queen Mary, when a child of five, for a few months before her departure to France in 1548. On Inch Talla stands the ruined tower of the earls of Menteith, dating from 1428. The village of Port of Monteith (pop. of parish, 1088), on the north shore of the lake, is $3\frac{1}{4}$ m. north by west of the station of the same name on the North British Railway Company's Forth & Clyde line.

MENTONE (Fr. *Menton*), a town in the department of the Alpes Maritimes in south-east France, situated on the shore of the Mediterranean, about 15 m. by rail E. of Nice. Pop. (1901), 9944. It is built in the form of an amphitheatre on a rocky promontory, which divides its semicircular bay into two portions. The main town is composed of two parts. Below, along the seashore, is the town of hotels and foreigners, while above, and inaccessible to wheeled vehicles, is that of the native Mentonese, with steep, narrow and dark streets, clinging to the mountain side around the strong castle which was once its protection against pirates. In the old town is the church of St Michel, rebuilt in great part since an earthquake in 1887, while below, in the principal street, the Corniche road, is the monument set up in 1896 to commemorate the union (in 1860) of Mentone with France. East of the main town is the suburb of Garavan, sheltered by cliffs, and filled with hotels. A mile and a half farther on is the Pont St Louis, which marks the frontier between France and Italy, while beyond it Sir Thomas Hanbury's villa at La Murtola is soon reached, with its marvellous gardens of 250 acres. West of the main town more hotels and villas are scattered along the coast towards Cap Martin. This is a pine-covered promontory which shelters the Bay of Mentone on the west, and is crowned by a great hotel, not far from which is the villa of the ex-empress Eugénie. Facing south-east, and sheltered on the north and west by mountains, the Bay of Mentone has a delicious climate and is frequented by invalids. The mean for the year is 61° F., while that for the winter is 72° in the sun, and 55° in the shade. Frost occurs on the average only once in ten years. Besides the charms of its climate Mentone offers those of an almost tropical vegetation. Lemon-trees, olive-trees and pines rise in successive stages on surrounding slopes. The district produces 40,000,000 lemons yearly, and this is its principal natural wealth. In the east bay is the harbour, constructed in 1890. It has a depth of about 26 ft., and is sheltered by a jetty about 400 yds. in length. The harbour is frequented by pleasure yachts and a few coasting vessels.

Mentone was probably the Lumone of the Itineraries, but no Roman remains exist. After having belonged to the counts of Ventimiglia and a noble Genoese family, it was purchased about the middle of the 14th century by the Grimaldis, lords of Monaco. During the First Republic and the First Empire it belonged to France, but in 1815 it reverted to the prince of Monaco, who subjected it to such exactions that in 1848 its inhabitants proclaimed the town (with Roquebrune on the west) independent, under the protection of Sardinia. In 1860 both Mentone and Roquebrune were purchased by France from the prince of Monaco, and added to the department of the Alpes Maritimes then formed out of the county of Nice, ceded the same year to France by Sardinia.

MENTOR, in Greek legend, the son of Alcimus and the faithful friend of Odysseus. During the absence of the latter, Mentor was entrusted with the care of his household and the guardianship of his son Telemachus. The word "mentor" is now used in the sense of a wise and trustworthy adviser, a meaning probably connected with the etymology of the name, from the root *mon-*, seen, in Lat. *monere*, to advise, *monitor*, adviser.

The *New English Dictionary* points out that the transferred use is due less to Homer's *Odyssey* than to Fénelon's *Télémaque*, in which Mentor is a somewhat prominent character.

MENTOR OF RHODES, brother of Memnon (*q.v.*), a Greek *condottiere* who appears first in the service of the rebellious satrap Artabazus of Phrygia in 363. When Artabazus had rebelled a second time and was in 353 forced to flee with Memnon into Macedonia, Mentor entered the service of the Egyptian king Nectanebus, and was sent by him with a body of Greek mercenaries to support the rebellious king Tennes (Tabnit) of Sidon against Artaxerxes III. But Tennes and Mentor betrayed the besieged town to the Persians (344 B.C.). Tennes was killed after his treason, but Mentor gained the favour of the king. It was due largely to him that Egypt was conquered in 343 (Diod. xvi. 45 sqq.). He now closely allied himself with the eunuch Bagoas (*q.v.*), the all-powerful vizier of Artaxerxes III. He was appointed general in Asia Minor, and with the help of Artabazus and Memnon, whose pardon and recall he obtained from the king, subdued the rebels and local dynasts. The most famous among them was Hermias of Atarneus, the protector of Aristotle, who had become master of some towns of Aeolis and Troas. By treachery he made him prisoner and occupied his towns (342 B.C.); Hermias was executed by order of the king (Diod. xvi. 52; Polyaen. vi. 48; pseudo-Arist. *Oecon.* ii. 27; Strabo xiii. 610; Didymus' commentary on Demosthenes *Phil.* 4, p. 6; cf. Diog. Laërt. vi. 9). Shortly afterwards Mentor died, and was succeeded by his brother Memnon. His son Thymondas commanded in the naval war against Alexander and at Issus (Arrian ii. 2, 1; 13, 2). (Ed. M.)

MENZEL, ADOLPH FRIEDRICH ERDMANN VON (1815–1905), German artist, was born at Breslau on the 8th of December 1815. His father was at the head of a school for girls, and intended to educate his son as a professor; but he would not thwart his taste for art. Left an orphan in 1832, Menzel had to maintain his family. In 1833 Sachse of Berlin published his first work, an album of pen-and-ink drawings reproduced on stone, to illustrate Goethe's little poem, "Künstlers Erdenwallen." He executed lithographs in the same manner to illustrate *Denkwürdigkeiten aus der brandenburgisch-preussischen Geschichte*, pp. 834–836; "The Five Senses" and "The Prayer," as well as diplomas for various corporations and societies. From 1839 to 1842 he produced 400 drawings, reviving at the same time the technique of engraving on wood, to illustrate the *Geschichte Friedrichs des Grossen* ("History of Frederick the Great") by Franz Kugler. He subsequently brought out *Friedrichs des Grossen Armee in ihrer Uniformirung* ("The Uniforms of the Army under Frederick the Great"), *Soldaten Friedrichs des Grossen* ("The Soldiers of Frederick the Great"); and finally, by order of the king Frederick William IV., he illustrated the works of Frederick the Great, *Illustrationen zu den Werken Friedrichs des Grossen* (1843–1849). By these works Menzel established his claim to be considered one of the first, if not actually the first, of the illustrators of his day in his own line. Meanwhile Menzel had set himself to study unaided the art of painting, and he soon produced a great number and variety of pictures, always showing keen observation and honest workmanship—subjects dealing with the life and achievements of Frederick the Great, and scenes of everyday life, such as "In the Tuileries," "The Ball Supper," and "At Confession." Among the most important of these works are "The Forge" (1875) and "The Market-place at Verona." Invited to paint "The Coronation of William I. at Koenigsberg," he produced an exact representation of the ceremony without regard to the traditions of official painting. Menzel died at Berlin on the 9th of February 1905. In Germany he received many honours, and was the first painter to be given the order of the Black Eagle.

MENZEL, WOLFGANG (1798–1873), German poet, critic and literary historian, was born on the 21st of June 1798, at Waldenburg in Silesia, studied at Breslau, Jena and Bonn, and after living for some time in Aarau and Heidelberg finally settled in Stuttgart, where, from 1830 to 1838, he had a seat in the Württemberg Diet. His first work, a clever and original volume of poems, entitled *Streckverse* (Heidelberg, 1823), was followed in 1824–1825 by a popular *Geschichte der Deutschen* in three volumes and in 1829 and 1830 by *Rübezahl* and *Narcissus*, the dramatized fairy-stories upon which his reputation as a poet chiefly rests. In 1851 he published the romance of *Furore*, a lively picture of the period of the Thirty Years' War; his other writings include *Geschichte Europas, 1789–1815* (2 vols. Stuttgart, 1853), and histories of the German War of 1866 and of the Franco-German War of 1870–71. From 1826 to 1848 Menzel edited a "Literaturblatt" in connexion with the *Morgenblatt*; in the latter year he transferred his allegiance from the Liberal to the Conservative party, and in 1852 his "Literaturblatt" was revived in that interest. In 1866 his political sympathies again changed, and he opposed the "particularism" of the Prussian "junkers" and the anti-unionism of south Germany. He died on the 23rd of April 1873 at Stuttgart. His library of 18,000 volumes was afterwards acquired for the university of Strassburg.

MENZELINSK, a town of eastern Russia, in the government of Ufa, 142 m. N.W. of the town of Ufa, and 10 m. from the left bank of the Kama. Pop. (1897), 7542. Its fair is one of the most important in the southern Ural region for cattle, hides, furs, grain, tea, manufactured articles, crockery, &c., which are sold to the annual value of £500,000. The town was founded in 1584.

MEPHISTOPHELES,[1] in the Faust legend, the name of the evil spirit in return for whose assistance Faust signs away his soul. The origin of the conception and name of Mephistopheles has been the subject of much learned debate. In *Dr Fausts Höllenzwang* "Mephistophiel" is one of the seven great princes of hell; "he stands under the planet Jupiter, his regent is named Zadkiel, an enthroned angel of the holy Jehovah . . .; his form is firstly that of a fiery bear, the other and fairer appearance is as of a little man with a black cape and a bald head." The origin of the idea of Mephistopheles in Faust's mind is thus clear. He was one of the evil demons of the seven planets, the *Maskim* of the ancient Akkadian religion, a conception transmitted through the Chaldeans, the Babylonians and the Jewish Kabbala to medieval and modern astrologers and magicians. This fact suggests a plausible theory of the origin of the name. In the ancient Mesopotamian religion the Intelligence of Jupiter was Marduk, "the lord of light," whose antithesis was accordingly conceived as the lord of darkness. Mephistopheles, then (or rather Mephostophiles, as the Faust-books spell the name) is "he who does not love light" (Gr. μή, φῶς, φίλης).[2]

To Faust himself, somnambulist and medium, Mephistopheles had—according to Kiesewetter—a real existence: he was "the objectivation of the transcendental subject of Faust," an experience familiar in dreams and, more especially, in the visions of mediums and clairvoyants. He was thus a "familiar spirit," akin to the "daemon" of Socrates; and if he was also half the devil of theology, half the kobold of old German myth, this was only because such "objectivations" are apt to clothe themselves in forms borrowed from the common stock of ideas current at the time when the seer lives; and Faust lived in an age obsessed with the fear of the devil, and by no means sceptical of the existence of kobolds. It is suggested, then, in the light of modern psychical research, that Mephistopheles, though (as the Faust-books record) invisible to any one else, was visible enough to Faust himself and to Wagner, the *famulus* who shared his somnambulistic experiences. He was simply Faust's "other self," appearing in various guises—as a bear, as a little bald man, as a monk, as an invisible presence ringing a bell—but always recognizable as the same "familiar."

The Mephostophiles of the Faust-books and the puppet plays passed with little or no modification into literature as the Mephistophilis of Marlowe's *Faustus*. Mephistophilis has the kobold qualities: he not only waits upon Faustus and provides him with sumptuous fare; he indulges in horse-play and is addicted to practical joking of a homely kind. He is, however, also the devil, as the age of the Reformation conceived him: a fallen angel who has not forgotten the splendour of his first estate, and who pictures to Faust the glories of heaven, in order to accentuate the horrors of the hell to which he triumphantly drags him. Goethe's Mephistopheles is altogether another conception. Some of the traditional qualities are indeed preserved: the practical joke, for instance, in the scene in Auerbach's *Keller* shows that he has not altogether shed his character as kobold; and, like the planet-spirits of the old magic he appears alternately in animal and human shape. He is also identified with the devil; thus, in accordance with old German tradition, he is dressed as a nobleman (*ein edler Junker*), all in red, with a little cape of stiff silk, a cock's feather in his hat, and a long pointed sword; at the witches' Sabbath on the Brocken he is hailed as "the knight with the horse's hoof," and Sybel in Auerbach's *Keller* is not too drunk not to notice that he limps. But his limp is the only indication that he is Lucifer fallen from heaven. He could not, like Marlowe's Mephistophilis or Milton's Satan, regretfully paint the glories of the height from which he has been hurled; for he denies the distinction between high and low, since "everything that comes into being deserves to be destroyed."[3] He is, in short, not the devil of Christian orthodoxy, a spirit conscious of the good against which he is in revolt, but akin to the Evil Principle of the older dualistic systems, with their conception of the eternal antagonism between good and evil, light and darkness, creation and destruction. (See FAUST.) (W. A. P.)

MEPPEL, a town in the province of Drente, Holland, 16½ m. by rail N. by E. of Zwolle. Pop. (1903), 10,470. It is favourably situated at the confluence of a number of canals and rivers which communicate hence with the Zuider Zee by the Meppeler Diep, and rose rapidly into prominence in the 19th century. The chief business is in butter, eggs, cattle and pigs, while bleaching, dyeing and shipbuilding are also carried on here.

MEQUINEZ (the Spanish form of the Arabic *Miknasa*), a city of Morocco, situated 1600 ft. above the sea, about 70 m. from the west coast and 36 m. W.S.W. of Fez, on the road to Rabat, in 33° 56′ N., 5° 50′ W. The town wall with its four-cornered towers is pierced by nine gates, one, the Bâb Bardain, with fine tile-work. A lower wall of wider circuit protects the luxuriant gardens in the outskirts. Mequinez at a distance appears a city of palaces, but it possesses few buildings of any note except the palace and the mosque of Mulai Ismail, which serves as the royal burying-place. The palace, founded in 1634, was described in 1821 by John Windus in his *Journey to Mequinez* (London 1825) as "about 4 m. in circumference, the whole building exceeding massy, and the walls in every part very thick; the outward one about a mile long and 25 ft. thick." The interior is composed of oblong court-yards surrounded by buildings and arcades. These buildings are more or less square with pyramidal roofs ornamented outside with green glazed tiles, and inside with richly carved and painted woodwork in Mauresque style. The walls are tiled to a height of 4 or 5 ft., and above they are finished in plaster, whitewashed or carved into filigree work. The population numbers being between thirty and forty thousand. Idrisi, writing in A.D. 1100, calls the place Takarart, and describes it as an ordinary citadel, from which the town gradually developed, taking its name from the Miknasa Berbers.

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[1] In the *Faustbuch* of 1587 it is spelt Miphostophiles; by Marlowe Mephistophilis; by Shakespeare (*Merry Wives of Windsor*, Act i.) Mephostophilus. The form Mephistopheles adopted by Goethe first appears in the version *des Christlich Meinenden*, *c.* 1712.

[2] Kiesewetter, p. 163. To Schröer this derivation seems improbable, and he appears to prefer that from Hebrew *Mephiz*, destroyer, and *tophel*, liar (*Faust*, ed. 1886, i. 25), which is certainly supported by the fact that almost all the names of devils in the magic-books of the 16th century are derived from the Hebrew.

[3] *Alles was entsteht ist werth dass es zu Grunde geht.*

MERAN, the chief town of the administrative district of the same name in the Austrian province of the Tirol, 20 m. by rail N.W. of Botzen on the Brenner line, while the Vintschgau railway connects it with Mals, 37 m. N.W. It is the chief town in the upper Adige valley, a region which bears the special name of the Vintschgau, and is on the high road either to Landeck and the Lower Engadine by the Reschen Scheideck Pass (4902 ft.), or more directly to the Lower Engadine by the Münster valley and the Ofen Pass (7071 ft.). In 1900 Meran had 9284 inhabitants (or, with the neighbouring villages of Untermais and Obermais, 13,201), mainly German-speaking and Romanist. The town is picturesquely situated, at a height of 1001 ft., at the foot of the vine-clad Küchelberg, and on the right bank of the Passer River, just above its junction with the Adige or Etsch. Meran proper consists mainly of one long narrow street, the Laubengasse, flanked by covered arcades, but the name is often used to include several adjacent villages, Untermais and Obermais being on the left bank of the Passer, while Gratsch is on its right bank and north-west of the main town. The most noteworthy buildings are the parish church (14th to 15th centuries) and the old residence (15th century) of the counts of the Tirol. Meran is best known as a much-frequented resort for consumptive patients, for whom it is well suited by reason of the purity of the air and the comparative immunity of the place from wind and rain in the winter. It is also visited in spring for the whey cure and in autumn for the grape cure.

To the north-west, on the Küchelberg, is the half-ruined castle of Tirol (2096 ft.), the original seat of the family which gave its name to the county. Meran may have been built on the site of a Roman settlement, but is first mentioned in 857. From the 12th century to about 1420 it was the capital of the ever-extending land named after it Tirol, but then had to give way to Innsbruck, while the building of the Brenner railway (1864–1867) and the rise of Botzen have decreased its commercial importance.

(W. A. B. C.)

MERBECK (or MARBECK), **JOHN** (d. *c.* 1585), English theological writer and musician, was organist of St George's, Windsor, about 1540. Four years later he was convicted of heresy and sentenced to the stake, but received a pardon owing to the intervention of Gardiner, bishop of Winchester, though Gardiner had himself censured Merbeck for compiling an English Concordance of the Bible. This work, the first of its kind in English, was published in 1550 with a dedication to Edward VI. In the same year Merbeck published his annotated *Book of Common Prayer*, intended to provide for musical uniformity in the use of the First Prayer Book of Edward VI., which was several times reprinted in the 19th century. Merbeck wrote several devotional and controversial works of a strongly Calvinistic character, and a number of his musical compositions are preserved in manuscript in the British Museum, and at Oxford and Cambridge. He died, probably while still organist at Windsor, about 1585. His son, ROGER MERBECK (1536–1605), a noted classical scholar, was appointed public orator in the university of Oxford in 1564, and in 1565 became a canon of Christ Church and was elected provost of Oriel; he left Oxford on account of an unfortunate marriage, and took to medicine as a profession, becoming the first registrar of the College of Physicians in London, and chief physician to Queen Elizabeth.

MERCADIER (d. 1200), French warrior of the 12th century, and chief of freebooters in the service of Richard I. of England. In 1183 he operated for Richard, then duke of Aquitaine, in the Limousin and the Angoumois, taking castles and laying waste the country. We know nothing of him during the ten years 1184–1194, but after Richard's return from Palestine, Mercadier accompanied him everywhere, travelling and fighting by his side. Richard eulogized Mercadier's exploits in his letters, and gave him the estates left by Adémar de Bainac, who died without heirs about 1190. During the various wars between Richard and Philip Augustus of France, Mercadier fought successively in Berry, Normandy, Flanders and Brittany. When Richard was mortally wounded at the siege of Châlus in March 1199, Mercadier avenged him by hanging the defenders of the château and flaying the crossbowman who had shot the king. Mercadier then entered the service of John, and ravaged Gascony. On Easter Monday, the 10th of April 1200, he was assassinated while on a visit to Bordeaux to pay his respects to Eleanor of Aquitaine, who was bringing from Spain Blanche of Castile. His murderer was an agent of Brandin, another freebooter in the service of John.

See Geraud, *Mercadier*, in Bibliothèque de l'École des Chartes, 1st series, t. iii., pp. 417–443.

MERCANTILE (or COMMERCIAL) **AGENCIES,** the name given in America to organizations designed to collect, record and distribute to regular clients information relative to the standing of commercial firms. In Great Britain and some European countries trade protective societies, composed of merchants and tradesmen, are formed for the promotion of trade, and members exchange information regarding the standing of business houses. These societies had their origin in the associations formed in the middle of the 19th century for the purpose of disseminating information regarding bankruptcies, assignments and bills of sale. The mercantile agency in the United States is a much more comprehensive organization. It came into existence after the financial crisis of 1837. Trade in the United States had become scattered over a wide territory. Communication was slow, and the town merchant was without adequate information as to the standing of many business men seeking credit. Undoubtedly the severity of the collapse of 1837 was due in part to the insufficiency of this information. New York merchants, who had suffered so severely, determined to organize a headquarters where reports regarding the standing of customers could be exchanged. Lewis Tappan (1788–1873), founder of the *Journal of Commerce* (1828) and a prominent anti-slavery leader, undertook the work, and established in New York, in 1841, the Mercantile Agency, the first organization of its kind. The system has been wonderfully developed and extended since.

MERCANTILE SYSTEM, the name given to the economic policy which developed in Europe at the close of the middle ages. The doctrine of the mercantile system, stated in its most extreme form, made wealth and money identical, and regarded it therefore as the great object of a community so to conduct its dealings with other nations as to attract to itself the largest possible share of the precious metals. Each country's interest was to export the utmost possible quantity of its own manufactures and to import as little as possible of those of other countries, receiving the difference of the two values in gold and silver. This difference is called the balance of trade, and the balance is favourable when more money is received than is paid. Governments might resort to all available expedients—prohibition of, or high duties on, the importation of foreign wares, bounties on the export of home manufactures, restrictions on the export of the precious metals—for the purpose of securing such a balance.

But this statement of the doctrine, though current in textbooks, does not represent correctly the views of all who belonged to the mercantile school. Many members of that school were much too clear-sighted to entertain the belief that wealth consists exclusively of gold and silver. The mercantilists may be best described, as W. G. F. Roscher remarked, not by any definite economic theorem which they held in common, but by a set of theoretic tendencies, commonly found in combination, though severely prevailing in different degrees in different minds. The underlying principles may be enumerated as follows: (1) the importance of possessing a large amount of the precious metals; (2) an exaltation (*a*) of foreign trade over domestic, and (*b*) of the industry which works up materials over that which provides them; (3) the value of a dense population as an element of national strength; and (4) the employment of state action in furthering artificially the attainment of the ends proposed.

The discoveries in the New World had led to a large development of the European currencies. The old feudal economy, founded principally on dealings in kind, had given way before the new "money economy," and the dimensions of the latter were everywhere expanding. Circulation was becoming more rapid, distant communications more frequent, city life and movable property more important. The mercantilists were impressed by the fact that money is wealth *sui generis*, that it is at all times in universal demand, and that it puts into the hands of its possessor the power of acquiring all other commodities. The period, again, was marked by the formation of great states, with powerful governments at their head. These governments required men and money for the maintenance of permanent armies, which, especially for the religious and Italian wars, were kept up on a great scale. Court expenses, too, were more lavish than ever before, and a larger number of civil officials was employed. The royal domains and dues were insufficient to meet these requirements, and taxation grew with the demands of the monarchies. Statesmen saw that for their own political ends industry must flourish. But manufactures make possible a denser population and a higher total value of exports than agriculture; they open a less limited and more promptly extensible field to enterprise. Hence they became the object of special governmental favour and patronage, whilst agriculture fell comparatively into the background. The growth of manufactures reacted on commerce, to which a new and mighty arena had been opened by the establishment of colonies. These were then viewed simply as estates to be worked for the advantage of the mother countries, and the aim of statesmen was to make the colonial trade a new source of public revenue. Each nation, as a whole, working for its own power, and the greater ones for predominance, they entered into a competitive struggle in the economic no less than in the political field, success in the former being indeed, by the rulers, regarded as instrumental to pre-eminence in the latter. A national economic interest came to exist, of which the government made itself the representative head. States became a sort of artificial hothouse for the rearing of urban industries. Production was subjected to systematic regulation, with the object of securing the goodness and cheapness of the exported articles, and so maintaining the place of the nation in foreign markets. The industrial control was exercised, in part directly by the state, but largely also through privileged corporations and trading companies. High duties on imports were resorted to, at first perhaps mainly for revenue, but afterwards in the interest of national production. Commercial treaties were a principal object of diplomacy, the end in view being to exclude the competition of other nations in foreign markets, whilst in the home market as little room as possible was given for the introduction of anything but raw materials from abroad. The colonies were prohibited from trading with other European nations than the parent country, to which they supplied either the precious metals or raw produce purchased with home manufactures.

That the efforts of governments for the furtherance of manufactures and commerce under the mercantile system were really effective towards that end is admitted by Adam Smith, and cannot reasonably be doubted, though doctrinaire free-traders have often denied it. Technical skill must have been promoted by their encouragements; whilst new forms of national production were fostered by attracting workmen from other countries, and by lightening the burden of taxation on struggling industries. Communication and transport by land and sea were more rapidly improved; and the social dignity of the industrial professions was enhanced relatively to that of the classes before exclusively dominant.

The foundation of the mercantile system was at the time when it took its rise inspired by the situation of the European nations. Such a policy had been already in some degree practised in the 14th and 15th centuries, thus preceding any formal exposition or defence of its speculative basis. At the commencement of the 16th century it began to exercise a widely extended influence. Charles V. adopted it, and his example contributed much to its predominance. Henry VIII. and Elizabeth conformed their measures to it. The leading states soon entered on a universal competition for manufacturing and commercial preponderance. Through almost the whole of the 17th century the prize, so far as commerce was concerned, remained in the possession of Holland, Italy having lost her former ascendancy by the opening of the new maritime routes, and Spain and Germany being depressed by protracted wars and internal dissensions. The admiring envy of Holland felt by English politicians and economists appears in such writers as Raleigh, Mun, Child and Temple. Cromwell, by his Navigation Act, which destroyed the carrying trade of Holland and founded the English empire of the sea, and Colbert, by his whole economic policy, domestic and international, were the chief practical representatives of the mercantile system.

See G. Schmoller, *The Mercantile System* (Eng. trans., 1896); also the articles, BALANCE OF TRADE; FREE TRADE; PROTECTION; PHYSIOCRATIC SCHOOL, &c.

MERCAPTANS (Thio-alcohols), organic chemical compounds of the type R.SH (R = an alkyl group). The name is derived from *mercurium captans*, in allusion to the fact that these compounds react readily with mercuric oxide to form crystalline mercury derivatives. The mercaptans may be prepared by the action of the alkyl halides on an alcoholic solution of potassium hydrosulphide; by the reduction of the sulpho-chlorides, *e.g.* $C_2H_5SO_2Cl$ (chlorides of sulphonic acids), by heating the salts of esters of sulphuric acid with potassium hydrosulphide, and by heating the alcohols with phosphorus pentasulphide. They are colourless liquids, which are insoluble in water and possess a characteristic offensive smell. On oxidation by nitric acid they yield sulphonic acids. They combine with aldehydes and ketones, with elimination of water and formation of mercaptals and mercaptols. (See SULPHONAL.)

Methyl mercaptan, $CH_3.SH$, is a liquid which boils at 5·8° C. (752 mm.), and forms a crystalline hydrate with water. *Ethyl mercaptan*, $C_2H_5.SH$, is a colourless liquid which boils at 36·2° C. It is used commercially in the preparation of sulphonal (*q.v.*). The mercury salt, $Hg(SC_2H_5)_2$, crystallizes from alcohol in plates. When heated with alcohol to 190° C. it decomposes into mercury and ethyldisulphide.

MERCATOR, GERARDUS [latinized form of GERHARD KREMER] (1512–1594), Flemish mathematician and geographer, was born at Rupelmonde, in Flanders, on the 5th of March 1512. Having studied at Bois-le-Duc and Louvain (where he matriculated on the 29th of August 1530, and became licentiate in October 1532), he met Gemma Frisius, a pupil of Apian of Ingolstadt, who at the request of the emperor Charles V. had settled in Louvain. From Frisius young Kremer derived much of his inclination to cartography and scientific geography. In 1534 he founded his geographical establishment at Louvain; in 1537 he published his earliest known map, now lost (*Terrae sanctae descriptio*). In 1537–1540 he executed his famous survey and map of Flanders (*Exactissima Flandriae descriptio*), of which a copy exists in the Musée Plantin, Antwerp. At the order of Charles V. Mercator made a complete set of instruments of observation for the emperor's campaigns: when these were destroyed by fire, in 1546, another set was ordered of the same maker. In 1538 appeared Mercator's map of the world in (north and south) hemispheres, which was rediscovered in 1878 in New York; this work shows Ptolemy's influence still dominant over Mercatorian cartography. In 1541 he issued the celebrated terrestrial globe, which he dedicated to Nicolas Perrenot, father of Cardinal Granvelle: this was accompanied by his *Libellus de usu globi*, which is said to have been presented to Charles V. In 1551 a celestial globe followed. Mercator early began to incline towards Protestantism; in 1533 he had retired for a time from Louvain to Antwerp, partly to avoid inquiry into his religious beliefs; in 1544 he was arrested and prosecuted for heresy, but escaped serious consequences (two of the forty-two arrested with him were burnt, one beheaded, two buried alive). He now thought seriously of emigrating; and when in 1552 Cassander, ordered by the duke of Juliers, Cleves and Berg to organize a university at Duisburg, offered Mercator the chair of cosmography the offer was accepted. The organization of the university was adjourned, and never completed in Mercator's lifetime; but he now became cosmographer to the duke and permanently settled on the German soil to which many of his ancestors and relatives had belonged. Soon after this, however, he paid a visit to Charles V. at Brussels, and presented the emperor with a *cosmos*, a celestial sphere enclosing a terrestrial, together with an explanatory *Declaratio*: this work marks an era in the observation of longitude by magnetic declination, perfected by Halley. Charles rewarded the author with the title of *imperatorii domesticus* (*Hofrath* in the epitaph at Duisburg). In 1554 Mercator published his great map of Europe in six sheets, three or four of which had already been pretty well worked out at Louvain; a copy of this was rediscovered at Breslau in 1889. Herein, though still greatly under Ptolemy's influence, Mercator begins to emancipate himself; thus Ptolemy's 62° for the length of the Mediterranean, reduced to 58° in the globe of 1541, he now cuts down to 53°. On the 28th of October 1556 he observed an eclipse at Duisburg; in 1563 he surveyed Lorraine, at the request of Duke Charles, and completed a map of the same (*Lotharingiae descriptio*); but it is uncertain if this was ever published. In 1564 he engraved William Camden's map of the British Isles; in 1568 he brought out his *Chronologia, hoc est temporum demonstratio . . . ab initio mundi usque ad annum domini 1568, ex eclipsibus et observationibus astronomicis.* In the same year was published his memorable planisphere for use in navigation, the first map on "Mercator's projection," with the parallels and meridians at right angles (*Nova et aucta orbis terrae descriptio ad usum navigantium accommodata*). Improvements were introduced in this projection by Edward Wright in 1590; the more general use of it dates from about 1630, and largely came about through Dieppese support. In 1572 Mercator issued a second edition of his map of Europe; in 1578 appeared his *Tabulae geographicae ad mentem Ptolemaei restitutae et emendatae*; and in 1585 the first part (containing Germany, France and Belgium) of the *Atlas, sive cosmographicae meditationes de fabrica mundi*, in which he planned to crown his work by uniting in one volume his various detailed maps, so as to form a general description of the globe. In 1585 he adapted his *Europe* to the *Atlas*; in 1587, with the help of his son Rumold, he added to the same a world-map (*Orbis terrarum compendiosa descriptio*), followed in 1590 by a second series of detailed maps (Italy, Slavonia, Greece and Candia). The rest of the regional and other plans in this undertaking, mostly begun by Gerard, were finished by Rumold; they include Iceland and the Polar regions, the British Isles (dedicated to Queen Elizabeth), the Scandinavian countries (dedicated to Henr. Ranzovius), Prussia and Livonia, Russia, Lithuania, Transylvania, the Crimea, Asia, Africa and America (in the last Michael Mercator, in Asia and Africa Gerard Mercator the younger, assisted). The designs are accompanied by cosmographical and other dissertations, some of the theological views in which were condemned as heretical (see the Duisburg edition of 1594, folio). In 1592 Mercator published, two years after his first apoplectic stroke, a *Harmonia evangeliorum*. He died on the 5th of December 1594, and was buried in St Saviour's church, Duisburg. Besides his famous projection, he did excellent service with Ortelius in helping to free the geography of the 16th century from the tyranny of Ptolemy; his map and instrument work is noteworthy for its delicate precision and admirable execution in detail.

See the *Vita Mercatoris* by Gualterus Ghymnius in the Latin editions of the *Atlas; Gérard Mercator, sa vie et ses œuvres*, by Dr J. van Raemdonck (St Nicolas, 1869); A. Breusing, *Gerhard Kremer* (Duisburg, 1878), and article "Mercator" in *Allgemeine deutsche Biographie*; General Wauwermans, *Histoire de l'école cartographique belge . . . au XVI.-siècle*, and article "Mercator" in *Biographie nationale* (de Belgique), vol. xiv. (Brussels, 1897). Also the lesser studies of Dr J. van Raemdonck, *Sur les exemplaires des grandes cartes de Mercator; Carte de Flandre de Mercator; Relations entre . . . Mercator et . . . Plantin . . .* (St Nicolas, 1884); *La Géographie ancienne de la Palestine: Lettre de Gérard Mercator . . . mai 22, 1567* (St N., 1884); *Les Sphères terrestre et céleste de Mercator, 1541 . . . 1551* (St N., 1885); Van Ortroy, *L'Œuvre géographique de Mercator.* (C. R. B.)

MERCENARY (Lat. *mercenarius*, from *merces*, reward, gain), one who serves or acts solely for motives of personal gain, particularly a soldier who offers himself for service in any army which may hire him. The name is sometimes used as a term of reproach by nations who raise their armies by conscription, of armies raised by voluntary enlistment whose members are paid a more or less living wage.

MERCER (through Fr. *mercier*, from popular Lat. *mercerius*, a dealer, *merx*, *merces*, merchandise), a dealer in the more costly textiles, especially in silks and velvets. The word formerly had a wider meaning. Mercery, according to W. Herbert (*History of the Twelve Great Livery Companies*, 1834), "comprehended all things sold by retail by the 'little balance' or small scales (in contradistinction to the things sold by the 'beam' or in gross), and included not only toys, together with haberdashery and various other articles connected with dress, but also spices and drugs." Many of the articles in which they dealt fell later within the sphere of other trades; thus the trade in the smaller articles of dress was taken over by the haberdashers (*q.v.*). The trade in silk seems to have been originally in the hands of the "silkmen and throwsteres." The Mercers' Company is the first in precedence of the twelve great livery companies of the city of London, and is also the wealthiest both in trust and corporate property. The first charter was obtained in 1393, but the mercers appear to have been formed into a gild much earlier. Herbert finds the mercers as patrons of a charity a few years after 1172, and one Robert Searle, who was mayor in 1214, was a "mercer." A further charter was granted in 1424, with the right to use a common seal. The history of the company is closely connected with the name of Richard Whittington (*q.v.*), and later with that of Dean Colet, who chose the company as the manager of St Paul's School. (See LIVERY COMPANIES.)

MERCERIZING, the term applied to a process, discovered in 1844 by John Mercer, a Lancashire calico printer, which consists in treating cotton (and to a limited extent other plant fibres) with strong caustic soda or certain other reagents, whereby morphological and chemical changes are brought about in the fibre. Thus, if a piece of bleached calico be immersed in caustic soda of 50° Tw. strength (sp. gr. 1·25), it rapidly changes in appearance, becoming stiff and translucent, but when taken out and well washed in running water it loses these properties and apparently reverts to its original condition. On closer examination, however, the fabric is found to have shrunk considerably both in length and breadth, so as to render the texture quite different in appearance to that of the original calico; it is also considerably stronger, and if dyed in the same bath along with some of the untreated fabric is found to have acquired a greatly increased affinity for colouring matters. This peculiar action is not restricted to caustic soda, similar effects being obtained with sulphuric acid of 105° Tw., nitric acid of 83° Tw., zinc chloride solution of 145° Tw., and other reagents. Mercer assumed that a definite compound, corresponding to the formula $C_{12}H_{20}O_{10}.Na_2O$ is formed when the cotton is steeped in caustic soda, and that this is decomposed by subsequent washing with water into a hydrated cellulose $C_{12}H_{20}O_{10}.H_2O$, which would account for the fact that in the air-dried condition mercerized cotton retains about 5% more hygroscopic moisture than ordinary cotton. This view is strengthened by the observation that when cotton is immersed in nitric acid of 83° Tw. it acquires similar properties to cotton treated with caustic soda. If, after immersion in the nitric acid, it is squeezed and then dried (without washing) in a vacuum over burnt lime, it is found to have formed a compound which corresponds approximately to the formula $C_6H_{10}O_5.HNO_3$, which is decomposed by water into free nitric acid and a hydrated cellulose.

When viewed under the microscope, mercerized cotton is seen to have undergone considerable morphological changes, inasmuch as the lumen or central cavity is much reduced in size, while the fibre has lost its characteristic band-shaped appearance and becomes rounded.

In Mercer's time the process, which he himself termed "sodaizing" or "fulling," never acquired any degree of commercial success, partly on account of the expense of the caustic soda required, but mainly on account of the great shrinkage (20 to 25%) which took place in the cloth. An important application of the process in calico printing for the production of permanent crimp or "crêpon" effects, which was originally devised by Mercer, was revived in 1890–1891 and is still largely practised by calico printers (see TEXTILE PRINTING). Another application, also dependent upon the shrinking action of caustic soda on cotton, was patented in 1884 by Depoully, and has for its object the production of crimp effects on piece-goods consisting of wool and cotton or silk and cotton. In the manufacture of such goods cotton binding threads are introduced at definite intervals in the warp or weft, or both, and the piece is passed through cold caustic soda, washed, passed through dilute sulphuric acid, and washed again till neutral. The cotton contracts under the influence of the caustic soda, while both wool and silk remain unaffected, and the desired crimped or puckered effect is thus obtained.

By far the most important application of the mercerizing process is that by which a permanent lustre is imparted to cotton goods; this was discovered in 1889 by H. A. Lowe, who took out a patent for his process in that year, this being supplemented by a further patent in 1890. Since Lowe's invention did not receive sufficient encouragement, he allowed his patents to lapse and the process thus became public property. It was not until 1895, when Messrs Thomas & Prevost repatented Lowe's invention, that actual interest was aroused in the new product and the process became a practical success. Their patent was subsequently annulled on the ground of having been anticipated.

The production of a permanent lustre on cotton by mercerizing is in principle a very simple process, and may be effected in two ways. According to the first method, the cotton is treated in a stretched condition with strong caustic soda, and is then washed, while still stretched, in water. After the washing has been continued for a short time the tension relaxes, and it is then found that the cotton has acquired a permanent lustre or gloss similar in appearance to that of a spun silk though not so pronounced. According to the second method, which constitutes but a slight modification of the first, the cotton is immersed in caustic soda of the strength required for mercerizing, and is then taken out, stretched slightly beyond its original length, and then washed until the tension slackens.

Not all classes of cotton are equally suited for being mercerized. Thus, in the case of yarns the most brilliant lustre is always obtained on twofold or multifold yarns spun from long-stapled cotton (Egyptian or Sea Island). Single yarns made from the same quality of cotton are only slightly improved in appearance by the process, and are consequently seldom mercerized; and the same applies to twofold yarns made from ordinary American cotton. In piece-goods, long-stapled cotton also gives the best results, but it is not necessary that the yarn used for weaving should be twofold. In the great majority of cases, the mercerizing of cotton, whether it be in the yarn or in the piece, is done before bleaching, but sometimes it is found preferable to mercerize after bleaching, or even after bleaching and dyeing. The strength of the caustic soda employed in practice is generally between 55° and 60° Tw. The temperature of the caustic soda has a material influence on its action on the cotton fibre, very much stronger solutions being required to produce the same effect at elevated temperatures than at the ordinary temperature, while, on the contrary, by lowering the temperature it is possible to obtain a good lustre with considerably weaker lyes.

Cotton yarn may be mercerized either in the hank or in the warp, and a great number of machines have been patented and constructed for the purpose. The simplest form of machine for hanks consists essentially of two superposed strong steel rollers, on which the hanks are placed and spread out evenly. The upper roller, the bearings of which run in a slotted groove, is then raised by mechanical means until the hanks are taut. Caustic soda of 60° Tw. is now applied, and the upper roller is caused to revolve slowly, the hanks acting as a belt and causing the lower roller to revolve simultaneously. After about three minutes the caustic soda is allowed to drain off and the hanks are washed by spurt pipes until they slacken, when they are taken off and rinsed, first in dilute sulphuric acid (to neutralize the alkali and facilitate washing), and then in water till neutral. The hanks are then bleached in the ordinary way and may be subsequently dyed, no diminution being brought about in the lustre by these operations. Cotton warps are usually mercerized on a machine similar in construction to a four box dyeing machine (see DYEING), but with the guiding rollers and their bearings of stronger construction and the squeezers at each end of the first box with a double nip (three rollers). The first box contains caustic soda, the second water, the third dilute sulphuric acid, and the fourth water.

For the continuous mercerizing of cotton in the piece much more complicated and expensive machinery is required than for yarn, since it is necessary to prevent contraction in both length and breadth. The mercerizing range in most common use for pieces is constructed on the same principle as the stentering machine used in stretching pieces after bleaching, dyeing or printing, and consists essentially of two endless chains carried at either end by sprocket wheels. The chains carry clips which run in slotted grooves in the horizontal frame of the machine, which is about 40 ft. in length. The clips close automatically and grip the cloth on either side as it is fed on to the machine from the mangle, in which it has been saturated with caustic soda. The stretching of the piece begins immediately on entering the machine, the two rows of clips being caused to diverge by setting the slotted grooves in such a manner that when the piece has travelled about one-third of the length of the machine it is stretched slightly beyond its original width. At this point the piece meets with a spray of water, which is thrown on by means of spurt pipes; and in consequence the tension slackens and the mercerizing is effected. When the piece arrives at the end of the machine the clips open automatically and release it. Thence it passes through a box containing dilute sulphuric acid, and then through a second box where washing with water is effected.

In most large works the caustic soda washings, which were formerly run to waste or were partly used up for bleaching, are evaporated down in multiple effect evaporators to 90° Tw., and the solution is used over again for mercerizing.

Cotton mercerized under tension has not as much affinity for colouring matters as cotton mercerized without tension, and although the amount of hygroscopic moisture which it retains in the air-dried condition is greater than in the case of ordinary untreated cotton, it is not so great as that held by cotton which has been mercerized without tension. By drying cotton which has been mercerized with or without tension at temperatures above 100° C. its affinity for colouring matters is materially decreased.

The cause of the lustre produced by mercerizing has been variously explained, and in some cases antagonistic views have been expressed on the subject. When viewed under the microscope by reflected light, the irregularly twisted band-shaped cotton fibre is seen to exhibit a strong lustre at those points from which the light is reflected from the surface. Cotton mercerized without tension shows a similar appearance. In the yarn or piece the lustre is not apparent, because the innumerable reflecting surfaces disperse the light in all directions. If, however, the cotton has been mercerized under tension, being plastic while still containing the caustic soda, it is stretched and is set in this condition by the washing. Thus in the finished product a large proportion of the rounded fibres are laid parallel to each other, as in the case of spun silk, and the lustre inherent to the fibre becomes visible to the naked eye.

See *The Life and Labours of John Mercer*, by E. A. Parnell (Longmans Green & Co); *Die Mercerisation der Baumwolle*, by Paul Gardner (Julius Springer, Berlin); *Mercerisation*, by the editors of *The Dyer and Calico Printer* (Heywood & Co.). (E. K.)

MERCHANT (O. Fr. *marcheant*, modern *marchand;* from Lat. *mercari*, to trade, *merx*, goods, merchandise), a trader, one who buys and sells goods for profit. The term is now usually confined to a wholesale dealer or one who trades on an extended scale with foreign countries.

MERCIA, one of the kingdoms of Anglo-Saxon England. The original kingdom seems to have lain in the upper basin of the Trent, comprising the greater part of Derbyshire and Staffordshire, the northern parts of Warwickshire and Leicestershire, and the southern part of Nottinghamshire. The name (*Merce*) seems to denote men of the March, and presumably was first applied when this district bordered upon the Welsh. In later times Mercia successively absorbed all the other territories between the Humber and the Thames except East Anglia, and some districts even beyond the Thames.

The origin of the kingdom is obscure. The royal family, according to Felix, *Life of St Guthlac* (Anglo-Saxon version), were called Iclingas. Icel, their ancestor, may have been the founder of the kingdom, but nothing is known of him. The family, however, claimed descent from the ancient kings of Angle (cf. Offa I. and Wermund). The first Mercian king of whom we have any record was Cearl, who apparently reigned about the beginning of the 7th century, and whose daughter Coenburg married Edwin, king of Deira. During Edwin's reign Mercia was subject to his supremacy, though it may have been governed throughout by princes of its own royal family. Its first prominent appearance in English history may be dated in the year 633, when the Mercian prince Penda joined the Welsh king Ceadwalla in overthrowing Edwin. According to the Saxon Chronicle, Penda began to reign in 626, and fought against the

West Saxons at Cirencester in 628. In the Mercian regnal tables, however, he is assigned a reign of only twenty-one years, which, as his death took place in 654 or 655, would give 634 as the date of his accession, presumably on the overthrow of Edwin, or perhaps on that of Ceadwalla. During the reign of Oswald Penda clearly reigned under the suzerainty of that king. In 642, however, Oswald was slain by Penda in a battle at a place called Maserfeld, which has not been identified with certainty. During the early part of Oswio's reign the Northumbrian kingdom was repeatedly invaded and ravaged by the Mercians, and on one occasion (before 651) Penda besieged and almost captured the Northumbrian royal castle at Bamborough. At the same time he extended his influence in other directions, and expelled from the throne of Wessex Coenwalh, who had divorced his sister. Indeed, at this time nearly all the English kingdoms must have acknowledged his supremacy. The kingdom of Middle Anglia, which appears to have included the counties of Northampton, Rutland, Huntingdon, and parts of Bedfordshire, Cambridgeshire, Leicestershire and Lincolnshire, was formed into a dependent principality under his son Peada. At this time also the territory corresponding to the modern counties of Cheshire, Shropshire and Herefordshire seems to have been occupied. The last of these counties is said some time later to have been under the government of another son of Penda, named Merewald. In 654 or 655 Penda again invaded Northumbria, with a huge army divided into thirty *legiones*, each under a royal prince, among whom were Æthelhere, king of East Anglia, and several Welsh kings. He was defeated and slain, however, by Oswio, at a river called the Winwaed. Mercia then came again under Northumbrian rule. Peada, the eldest son of Penda, was allowed to govern the part south of the Trent, while north Mercia was put in charge of Northumbrian officials. Penda, although he did not prohibit the preaching of Christianity, had remained a heathen to the end of his life. His death was followed by the conversion of his kingdom. Peada had embraced Christianity on his marriage with a daughter of Oswio, and under him the first Mercian bishopric was founded. Shortly afterwards Peada was murdered; but in 658 the Mercians rose under his younger brother Wulfhere and threw off the Northumbrian supremacy.

Wulfhere seems to have been a vigorous ruler, for he extended the power of Mercia as far as it had reached in the days of his father, and even farther. According to the Chronicle he invaded Wessex as far as Ashdown in Berkshire in the year 661. At the same time he conquered the Isle of Wight, which he gave to Æthelwalh, king of Sussex. Between the years 661 and 665 he was defeated by the Northumbrian king Ecgfrith and had to give up Lindsey. In 675 he again fought with the West Saxons under Aescwine, and shortly afterwards died. His brother Æthelred, who succeeded him, invaded Kent in the following year, and in 679 fought a battle on the Trent against Ecgfrith, by which he recovered Lindsey. After this, however, we hear little of Mercian interference with the other kingdoms for some time; and since it is clear that during the last 15 years of the 7th century Wessex, Essex, Sussex and Kent were frequently involved in strife, it seems likely that the Mercian king had somewhat lost hold over the south of England. In 704 Æthelred resigned the crown and became a monk, leaving his kingdom to Coenred, the son of Wulfhere. Coenred also abdicated five years later and went to Rome. Ceolred, the son of Æthelred, who succeeded, fought against the West Saxon king Ine in 715. On his death in the following year Æthelbald, a distant relative, came to the throne, and under him Mercian supremacy was fully restored over all the kingdom south of the Humber. He reigned for 41 years. After his murder in 757 the Mercian throne was held for a short time by Beornred. He was expelled the same year by Offa, who soon restored the power of Mercia, which seems to have suffered some diminution during the later years of Æthelbald. Offa's policy was apparently the extinction of the dependent kingdoms. In his reign the dynasties of Kent, Sussex and the Hwicce seem to have disappeared, or at all events to have given up the kingly title. In 787 he associated his son Ecgfrith with him in the kingdom, and after his death (796) Ecgfrith reigned alone for a few months. On the death of Ecgfrith the throne passed to Coenwulf, a descendant of Pybba, father of Penda. In 821 Coenwulf was succeeded by his brother Ceolwulf, who was deprived of the throne in 823, being succeeded by Beornwulf. In 825 Beornwulf was defeated by Ecgberht, king of Wessex, and in the same year he was overthrown and slain by the East Angles. The supremacy now passed to Wessex.

In 827 Ludeca, the successor of Beornwulf, was slain in battle with five of his earls. Wiglaf, who succeeded him, was expelled two years later by Ecgberht, but regained the throne in the following year. He died, probably in 839, and was succeeded by Berhtwulf, who reigned until 852. Under these later kings Mercia seems to have extended from the Humber to the Thames, including London, though East Anglia was independent, and that part of Essex which corresponds to the modern county of that name had been annexed to Wessex after 825. Berhtwulf was succeeded in 852 by Burgred, who married Æthelswith, daughter of Æthelwulf. His power seems to have been more or less dependent on the West Saxons. In 853, with the assistance of Æthelwulf he reduced North Wales to subjection. Again in 868 he called upon the West Saxon king Æthelred for assistance against the Danes under Loðbrok's sons, who at this time invaded Mercia after their overthrow of the Northumbrians at York. No battle took place, and the Mercians subsequently made peace with the Danes. In 872 the Danes occupied London on their return from invading Wessex, after which a truce was again made. In 873 the Danes encamped at Torksey in Lincolnshire, and although another truce ensued, they advanced in the following year to Repton, and Burgred was driven from the kingdom. He went to Rome, where he remained until his death. In 874 Ceolwulf, a king's thegn or baron, was made king by the Danes, and definitely acknowledged their overlordship. In 877, after the second invasion of Wessex, the Danes seem to have taken the eastern part of Mercia into their own hands. How long Ceolwulf reigned over the western portion is unknown. About the year 884 the most important person in English Mercia was an earl, Æthelred, who accepted the suzerainty of Alfred, and in or before the year 887 married his daughter Æthelflaed. Æthelred and Æthelflaed appear to have had practically regal power, though they did not use the royal title. In 886 London, which had been recovered by Alfred from the Danes, was restored to Æthelred. During the invasion of 893–97 English Mercia was again repeatedly ravaged by the Danes; but in the last of these years, by the united efforts of Alfred and Æthelred, they were at length expelled. With this exception, Watling Street, the Ouse and the Lea, continued to be the boundary between Mercia and the Danish kingdom of East Anglia down to the death of Æthelred, between 910 and 912. The government was then carried on by Æthelflaed, who built a number of fortresses, and in conjunction with her brother, King Edward the Elder, succeeded in expelling the Danes from Derby and Leicester by the year 917–18. After her death in the latter year her daughter Ælfwyn was soon deprived of the government by Edward, and Mercia was definitely annexed to Wessex.

From this time onwards its existence as a separate kingdom was at an end, though during the last years of Eadwig's reign the Mercians and Northumbrians set up Eadgar as king. In the last century of the Saxon period the earls of Mercia frequently occupied a semi-royal position. The most important of these were Ælfhere under Eadgar, Edward and Æthelred, Eadric Streona, under the last-mentioned king, and Leofric, under the Danish kings.

AUTHORITIES.—Bede, *Historia ecclesiastica* (ed. C. Plummer, Oxford, 1896); *Anglo-Saxon Chronicle* (ed. Earle and Plummer, Oxford, 1899); W. de G. Birch, *Cartularium saxonicum* (London, 1885–1893). (F. G. M. B.)

MERCIÉ, MARIUS JEAN ANTONIN (1845–), French sculptor and painter, was born in Toulouse on the 30th of October 1845. He entered the École des Beaux Arts, Paris, and studied under Falguière and Jouffroy, and in 1868 gained the Grand Prix de Rome. His first great popular successes were the "David" and "Gloria Victis," which was shown and received the medal of honour of the Salon. The bronze was subsequently placed in the Square Montholon. "The Genius of the Arts" (1877), a relief, is in the Tuileries, in substitution for Barye's "Napoleon III."; a similar work for the tomb of Michelet (1879) is in the cemetery of Père la Chaise; and in the same year Mercié produced the statue of Arago with accompanying reliefs, now erected at Perpignan. In 1882 he repeated his great patriotic success of 1874 with a group "Quand Même!" replicas of which have been set up at Belfort and in the garden of the Tuileries. "Le Souvenir" (1885), a marble statue for the tomb of Mme Charles Ferry, is one of his most beautiful works. "Regret," for the tomb of Cabanel, was produced in 1892, along with "William Tell," now at Lausanne. Mercié also designed the monuments to "Meissonier" (1895), erected in the Jardin de l'Infante in the Louvre, and "Faidherbe" (1896) at Lille, a statue of "Thiers" set up at St Germain-en-Laye, the monument to "Baudry" at Père-la-Chaise, and that of "Louis-Philippe and Queen Amélie" for their tomb at Dreux. His stone group of "Justice" is at the Hôtel de Ville, Paris. Numerous other statues, portrait busts, and medallions came from the sculptor's hand, which gained him a medal of honour at the Paris Exhibition of 1878 and the grand prix at that of 1889. Among the paintings exhibited by the artist are a "Venus," to which was awarded a medal in 1883, "Leda" (1884), and "Michaelangelo studying Anatomy" (1885)—his most dramatic work in this medium. Mercié was appointed professor of drawing and sculpture at the École des Beaux Arts, and was elected a member of the Académie Française in 1891, after being awarded the biennial prize of the institute of £800 in 1887.

MERCIER, HONORÉ (1840–1894), Canadian lawyer and statesman, was the son of Jean Baptiste Mercier, farmer, and of Marie Kimener, his wife. He was born in the village of St Athanase d'Iberville on the 15th of October 1840. The family came from France, and settled in the district of Montmagny, and later removed to Iberville. Mercier entered the Jesuit College of St Mary, Montreal, at the age of fourteen, and throughout his life retained a warm friendship for the society. He married, firstly in 1866 Leopoldine Boivin, and secondly in 1871 Virginie St Denis. On the completion of his course at St Mary's he studied law in the office of Laframboise and Papineau, in St Hyacinthe, and was admitted to the bar of the province in April 1865. At the age of twenty-two he became the editor of the Conservative *Courrier de St Hyacinthe*, and in this journal supported the policy of the Sicotte administration, which then represented the interests of Quebec, under the Act of Union (1840); but when Sicotte accepted a seat on the bench Mercier joined the Opposition, and contributed largely to the defeat of the Ministerial candidate. In 1864 he vigorously opposed the scheme of confederation, on the ground that it would prove fatal to the distinctive position held by the French Canadians. He resumed the editorship of the *Courrier* in 1866; but after a few months retired from journalism, and for the next five years devoted all his energy to his profession. At the commencement of the year 1871 the national party was organized in Quebec, and Mercier supported the candidates of the party on the platform. In August 1872 he was elected as a member of the House of Commons for the county of Rouville, and proved a vigorous opponent of Sir John A. Macdonald on the question of separate schools for New Brunswick. He was a candidate at the general elections in 1874, but retired on the eve of the contest in favour of another candidate of his own party. Mercier entered the arena of provincial politics in May 1879 as solicitor-general in the Joly government, representing the county of St Hyacinthe; and on the defeat of the ministry in October he passed, with his leader, into opposition. On the retirement of M. Joly from the leadership of the Liberal party in Quebec in 1883 Mercier was chosen as his successor. Towards the close of 1885 the French-Canadian mind was greatly agitated over the execution of Louis Riel, leader of the north-west rebellion, and in consequence of the attitude of Mercier on this question the Liberal minority in the Legislative Assembly, which had been reduced to fifteen, rapidly gained strength, until at the general elections held in October 1886 the province was carried in the Liberal interest. In January 1887 Mercier was sworn in as premier and attorney-general, and from this moment he exercised an extraordinary influence in the province. He succeeded in passing without opposition the Jesuit Estates Act, a measure to compensate the order for the loss of property confiscated by the Crown. This act came before the Federal House for disallowance, but was carried on division. When Mercier appealed to the electorate in 1890, his policy was endorsed, and he was able to give effect to many important measures. Early in 1891 he negotiated a loan in Europe for the province, and whilst on a visit to Rome he was created a count of the Roman Empire by Leo XIII., who three years previously had conferred upon him the rank of a commander of the order of St Gregory the Great. Of commanding presence, firm, decisive, courteous in manner, convincing in argument, and deeply attached to his native province, he had all the qualities of a popular leader. For a few years he was the idol of the people of Quebec, and French Canada loomed large in the public eye; but towards the end of 1891 serious charges were preferred against his ministry, on the ground that subsidies voted for railways had been diverted to political use, and he was dismissed by the lieutenant-governor. At the subsequent elections held in March 1892 he was returned for the county of Bonaventure, but his party was hopelessly defeated. On the formation of a new government he was brought to trial, and declared not guilty; his health, however, gave way, and he never regained his former influence.

See *Biographie, discours, conférences, &c., de l'Hon. Honoré Mercier*, by J.-O. Pelland (Montreal, 1893). (A. G. D.)

MERCIER, LOUIS SEBASTIEN (1740–1814), French dramatist and miscellaneous writer, was born in Paris on the 6th of June 1740. He began his literary career by writing heroic epistles, but early came to the conclusion that Boileau and Racine had ruined the French language, and that the true poet was he who wrote in prose. The most important of his miscellaneous works are *L' An 2440* (1770); *L'Essai sur l'art dramatique* (1773); *Néologie* (1801); *Le Tableau de Paris* (1781–1788); *Le nouveau Paris* (1799); *Histoire de France* (1802) and *Satire contre Racine et Boileau* (1808). He decried French tragedy as a caricature of antique and foreign customs in bombastic verse, and advocated the *comédie larmoyante* as understood by Diderot. To the philosophers he was entirely hostile. He denied that modern science had made any real advance; he even carried his conservatism so far as to maintain that the earth was a circular flat plain around which revolved the sun. Mercier wrote some sixty dramas, among which may be mentioned *Jean Hennuyer* (1772); *La Destruction de la ligue* (1782); *Jennéval* (1769); *Le Juge* (1774); *Natalie* (1775) and *La Brouette du vinaigrier* (1775). In politics he was a Moderate, and as a member of the Convention he voted against the death penalty for Louis XVI. During the Terror he was imprisoned, but was released after the fall of Robespierre. He died in Paris on the 25th of April 1814.

See Léon Bechard, *Sebastien Mercier, sa vie, son œuvre* (Paris, 1903); R. Doumic in the *Revue des deux mondes* (15th July 1903).

MERCK, JOHANN HEINRICH (1741–1791), German author and critic, was born at Darmstadt on the 11th of April 1741, a few days after the death of his father, a chemist. He studied law at Giessen, and in 1767 was given an appointment in the paymaster's department at Darmstadt, and a year later himself became paymaster. For a number of years he exercised considerable influence upon the literary movement in Germany; he helped to found the *Frankfurter gelehrte Anzeigen* in 1772, and was one of the chief contributors to Nicolai's *Allgemeine Bibliothek*. In 1782 he accompanied the Landgravine Karoline of Hesse-Darmstadt to St Petersburg, and on his return was a guest of the duke Charles Augustus of Weimar in the Wartburg. Unfortunate speculations brought him into pecuniary embarrassment in 1788, and although friends, notably Goethe, were ready to come to his assistance, his losses—combined with the death of five of his children—so preyed upon his mind that he committed suicide on the 27th of June 1791. Merck distinguished himself mainly as a critic; his keen perception, critical perspicacity and refined taste made him a valuable guide to the young writers of the *Sturm und Drang*. He also wrote a number of small treatises, dealing mostly with literature and art, especially painting, and a few poems, stories, narratives and the like; but they have not much intrinsic importance. Merck's letters are particularly interesting and instructive, and throw much light upon the literary conditions of his time.

Merck's *Ausgewählte Schriften zur schönen Literatur und Kunst* were published by A. Stahr in 1840, with a biography. See *Briefe an J. H. Merck von Goethe, Herder, Wieland und andern bedeutenden Zeitgenossen* (1835), *Briefe an und von J. H. Merck* (1838) and *Briefe aus dem Freundeskreise von Goethe, Herder, Höpfner und Merck* (1847), all edited by K. Wagner. Cf. G. Zimmermann, *J. H. Merck, seine Umgebung und seine Zeit* (1871).

MERCŒUR, SEIGNEURS AND DUKES OF. The estate of Mercœur in Auvergne, France, gave its name to a line of powerful lords, which became extinct in the 14th century, and passed by inheritance to the dauphins of Auvergne, counts of Clermont. In 1426 it passed to the Bourbons by the marriage of Jeanne de Clermont, dauphine of Auvergne, with Louis de Bourbon, count of Montpensier. It formed part of the confiscated estates of the Constable de Bourbon, and was given by Francis I. and Louise of Savoy to Antoine, duke of Lorraine, and his wife, Renée de Bourbon. Nicolas of Lorraine, son of Duke Antoine, was created duke of Mercœur and a peer of France in 1569. His son Philippe Emmanuel (see below) left a daughter, who married the duc de Vendôme in 1609.

MERCŒUR, PHILIPPE EMMANUEL DE LORRAINE, Duc de (1558–1602), French soldier, was born on the 9th of September 1558, and married Marie de Luxemburg, duchesse de Penthièvre. In 1582 he was made governor of Brittany by Henry III., who had married his sister. Mancœur put himself at the head of the League in Brittany, and had himself proclaimed protector of the Roman Catholic Church in the province in 1588. Invoking the hereditary rights of his wife, who was a descendant of the dukes of Brittany, he endeavoured to make himself independent in that province, and organized a government at Nantes, calling his son "prince and duke of Brittany." With the aid of the Spaniards he defeated the duc de Montpensier, whom Henry IV. had sent against him, at Craon in 1592, but the royal troops, reinforced by English contingents, soon recovered the advantage. The king marched against Mercœur in person, and received his submission at Angers on the 20th of March 1598. Mercœur subsequently went to Hungary, where he entered the service of the emperor Rudolph II., and fought against the Turks, taking Stuhlweissenburg (Székes-Fehérvár) in 1599. Mercœur died on the 19th of February 1602.

MERCURY (Mercurius), in Roman mythology, the god of merchandise (*merx*) and merchants; later identified with the Greek Hermes. His nature is more intelligible and simple than that of any other Roman deity. In the native Italian states no trade existed till the influence of the Greek colonies on the coast introduced Greek customs and terminology. It was no doubt under the rule of the Tarquins that merchants began to ply their trade. Doubtless the merchants practised their religious ceremonies from the first, but their god Mercurius was not officially recognized by the state till the year 495 B.C. Rome frequently suffered from scarcity of grain during the unsettled times that followed the expulsion of the Tarquins. Various religious innovations were made to propitiate the gods; in 496 the Greek worship of Demeter, Dionysus and Persephone was established in the city, and in 495 the Greek god Hermes was introduced into Rome under the Italian name of Mercurius (Livy ii. 21, 27), as protector of the grain trade, especially with Sicily. Preller thinks that at the same time the trade in grain was regulated by law and a regular college or gild of merchants instituted. This college was under the protection of the god; its annual festival was on the 15th (the ides) of May, on which day the temple of the god had been dedicated at the southern end of the Circus Maximus, near the Aventine; and the members were called *mercuriales* as well as *mercatores*. Mommsen, however, considers the *mercuriales* to be a purely local gild—the *pagani* of the Circus valley. The 15th of May was chosen as the feast of Mercury, obviously because Maia was the mother of Hermes, that is of Mercury; and she was worshipped along with her son by the *mercuriales* on this day. According to Preller, this religious foundation had a political object; it established on a legitimate and sure basis the trade between Rome and the Greek colonies of the coast, whereas formerly this trade had been exposed to the capricious interference of government officials. Like all borrowed religions in Rome, it must have retained the rites and the terminology of its Greek original (Festus p. 257). Mercury became the god, not only of the *mercatores* and of the grain trade, but of buying and selling in general; and it appears that, at least in the streets where shops were common, little chapels and images of the god were erected. There was a spring dedicated to Mercury between his temple and the Porta Capena; every shopman drew water from this spring on the 15th of May, and sprinkled it with a laurel twig over his head and over his goods, at the same time entreating Mercury to remove from his head and his goods the guilt of all his deceits (Ovid, *Fasti*, v. 673 seq.). The word *mercurialis* was popularly used as equivalent to "cheat."

Roman statuettes of bronze, in which Mercury is represented, like the Greek Hermes, standing holding the caduceus or staff in the one hand and a purse in the other (an element very rare in purely Hellenic representations), are exceedingly common.

MERCURY, in astronomy, the smallest major planet and the nearest to the sun; its symbol is ☿. Its proximity to the sun makes the telescopic study of its physical constitution extremely difficult. The result is that less is known on this subject than in the case of any other planet. Even the time of rotation on its axis is uncertain. J. H. Schröter inferred a period of rotation of 24 h. 5 m. 30 s., which was in seeming agreement with the observations of K. L. Harding. This period was generally accepted, though Herschel had been unable to see any changes indicating rotation. In 1882 G. Schiaparelli began a careful study of the face of the planet with a refractor of 8 in. aperture, subsequently replaced by one of 18 in. His unexpected conclusion was that the rotation of Mercury resembles that of the moon, in having its period equal to that of its orbital revolution. As the moon always presents the same face to the earth, so Mercury must, in this case, always present very nearly the same face to the sun. Schiaparelli also announced that the axis of rotation of the planet is nearly perpendicular to the plane of its orbit. The rotation being uniform, while the orbital motion, owing to the great eccentricity of the orbit, is affected by a very large inequality, it would follow that there is a libration in longitude of nearly 24° on each side of the mean position. Percival Lowell in 1897 took up the question anew by combining a long series of measured diameters of the planet with drawings of its apparent surface. The seeming constancy of the surface appearance was considered to confirm the view of Schiaparelli as to the slow rotation of the planet. But there is wide room for doubt on the question.

The period of orbital revolution of Mercury is nearly 88 days, or somewhat less than three months. Consequently, the period of synodic revolution is less than four months, during which the entire round of phases is completed. When near greatest elongation Mercury shines as a star of the first magnitude, or brighter; but in the latitudes of central and northern Europe it is so near the horizon soon after sunset as to be generally obscured by vapours or clouds.

The eccentricity of the orbit, 0·20, is far greater than that of any major planet, and nearly the average of that of the minor planets. Consequently, its distance and its greatest elongation from the sun vary widely with its position in its orbit at the time.

The mass of Mercury can be determined only from its action upon Venus; this is so small that the result is doubtful. Leverrier adopted in his tables 1: 3,000,000 as the ratio of the mass of Mercury to that of the sun. S. Newcomb, from the action upon Venus, reduced this to one-half its amount, or 1: 6,000,000.

G. W. Hill, basing his conclusions on the probable density of the planet, estimated the mass to be less than 1 : 10,000,000 The adoption of a mass even as large as that of Newcomb implies a greater density than that of the earth, but it is not possible to estimate the probability that such is the case.

The most interesting phenomenon connected with Mercury is that of its occasional transit over the disk of the sun at inferior conjunction. These occur only when the planet is near one of its nodes at the time. The earth, in its orbital revolution, passes through the line of the nodes of Mercury about the 8th of May and the 10th of November of each year. It is only near one of these times that a transit can occur. The periodic times of Mercury and the earth are such that the transits are generally repeated in a cycle of 46 years, during which 8 transits occur in May and 6 in November. The following table shows the Greenwich mean time of the middle of all the transits from 1677, the date of the first one accurately observed, until the end of the present century.

Transits of Mercury from 1677 to 2003.

			h.				h.
1677	Nov.	7	0	1845	May	8	8
1690	Nov.	9	18	1848	Nov.	9	2
1697	Nov.	2	18	1861	Nov.	11	20
1707	May	5	11	1868	Nov.	4	19
1710	Nov.	6	11	1878	May	6	7
1723	Nov.	9	5	1881	Nov.	7	3
1736	Nov.	10	22	1891	May	9	14
1740	May	2	11	1894	Nov.	10	7
1743	Nov.	4	22	1907	Nov.	14	0
1753	May	5	18	1914	Nov.	7	0
1756	Nov.	6	16	1924	May	7	14
1769	Nov.	9	10	1927	Nov.	9	18
1776	Nov.	2	10	1940	Nov.	11	11
1782	Nov.	12	3	1953	Nov.	14	5
1786	May	3	18	1957	May	5	13
1789	Nov.	5	3	1960	Nov.	7	5
1799	May	7	1	1970	May	8	20
1802	Nov.	8	21	1973	Nov.	9	23
1815	Nov.	11	15	1986	Nov.	12	16
1822	Nov.	4	14	1993	Nov.	5	16
1832	May	5	0	1999[1]	Nov.	15	9
1835	Nov.	7	8	2003	May	6	19

A perplexing problem is offered by the secular motion of the perihelion of Mercury. In 1845 Leverrier found that this motion, as derived from observation of the transits, was greater by 35″ per century than it should be from the gravitation of all the other planets. This conclusion has been fully confirmed by subsequent investigations, a recent discussion showing the excess of motion to be 43″ per century. It follows from this either that Mercury is acted upon by some unknown masses of matter, or that the intensity of gravitation does not precisely follow Newton's law. The most natural explanation was proposed by Leverrier, who attributed the excess of motion to the action of a group of intra-Mercurial planets. At first this conclusion seemed to be confirmed by the fact that occasional observations of the transit of a dark object over the sun had been observed. But no such observation was ever made by an experienced astronomer, and the frequent photographs of the sun, which have been taken at the Greenwich observatory and elsewhere since 1870, have never shown the existence of any such body. We may therefore regard it as certain that, if a group of intra-Mercurial planets exists, its members are too small to be seen when projected on the sun's disk. During the eclipses of 1900 and 1905 the astronomers of the Harvard and Lick Observatories photographed the sky in the neighbourhood of the sun so fully that the stars down to the 7th or 8th magnitude were imprinted on the plates. Careful examination failed to show the existence of any unknown body. It follows that if the group exists the members must be so small as to be entirely invisible. But in this case they must be so numerous that they should be visible as a diffused illumination on the sky after sunset. Such an illumination is shown by the zodiacal light. But such a group of bodies, if situated in the plane of the ecliptic, would produce a motion of the node of Mercury equal to that of its perihelion, while the observed motion of the node of Mercury is somewhat less than that computed from the gravitation of the known planets. The same is true of the node of Venus, which might also be affected by the same attraction. To produce the observed result, the inclination of the ring would have to be greater than that of the orbit of either Mercury or Venus. In 1895 Newcomb showed that the observed motions, both of the perihelion of Mercury and of the nodes of Mercury and Venus, could be approximately represented by the attraction of a ring of inter-mercurial bodies having a mean inclination of 9° and the mean node in 48° longitude. He also showed that if the ring was placed between the orbits of Mercury and Venus, the inclination would be 7·5° and the longitude of the node 35°. The fact that the zodiacal light appears to be near the ecliptic, and the belief that, if it were composed of a lens of discrete particles, their nodes would tend to scatter themselves equally around the invariable plane of the solar system, led him to drop these explanations as unsatisfactory, and to prefer provisionally the hypothesis that the sun's gravitation is not exactly as the inverse square. (See GRAVITATION.)

In 1896 H. H. Seeliger made a more thorough investigation than his predecessor had done of the attraction of the matter producing the zodiacal light, assuming it to be formed of a series of ellipsoids. He showed that the motions of the nodes and perihelion could be satisfactorily represented in this way. The following are the three principal elements of the hypothetical orbits as found by the two investigators:—

	Newcomb.		Seeliger.
	Intra-Mercurial Ring.	Ring between Mercury and Venus.	Zodiacal Light Matter.
Inclination	9°	7·5°	6·95°
Node	48°	35°	40·0°
Mass	—	1/37,000,000	1/2,860,000

The demonstration by E. W. Brown that the motion of the moon's perigee is exactly accordant with the Newtonian law of gravitation, seems to preclude the possibility of any deviation from that law, and renders the hypothesis of Seeliger the most probable one in the present state of knowledge. But the question is still an open one whether the zodiacal light has an inclination of the ecliptic as great as that computed by Seeliger. This is a difficult one because the action on Mercury is produced by the inner portions of the matter producing the zodiacal light. These are so near the sun that they cannot be observed, unless possibly during a total eclipse. (S. N.)

MERCURY (symbol Hg, atomic weight = 200), in chemistry, a metallic element which is easily distinguished from all others by its being liquid at even the lowest temperatures naturally occurring in moderate climates. To this exceptional property it owes the synonyms of *quicksilver* in English (with the Germans *Quecksilber* is the only recognized name) and of *hydrargyrum* (from ὕδωρ, water, and ἄργυρος, silver) in Graeco-Latin. This metal does not appear to have been known to the ancient Jews, nor is it mentioned by the earlier Greek writers. Theophrastus (about 300 B.C.) mentions it as prepared from cinnabar by treatment with copper and vinegar; Dioscorides obtained it from the same mineral with the aid of iron, employing at the same time a primitive distillation apparatus. With the alchemists it was a substance of great consequence. Its appearance commended it as a substance for investigation; many of its compounds, especially corrosive sublimate and calomel, were studied, and improved methods for extracting and purifying the metal were devised. Being ignorant of its susceptibility of freezing into a compact solid, they did not recognize it as a true metal, and yet, on the authority of Geber, they held that mercury (meaning the predominating element in this metal) enters into the composition of all metals, and is the very cause of their metallicity (see ELEMENT). When, about the beginning of the 16th century, chemistry and scientific medicine came to merge into one, this same mysterious element of "mercury" played a great part in the theories of pathology; and the metal, in the free as in certain combined states, came to be looked upon as a powerful medicinal agent.

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[1] Mercury grazes sun's limb.

Occurrence.—Mercury occurs in nature chiefly in the form of a red sulphide, HgS, called cinnabar (*q.v.*), which, as a rule, is accompanied by more or less of the reguline metal—the latter being probably derived from the former by some secondary reaction. The most important mercury mines in Europe are those of Almaden in Spain and of Idria in Illyria; and in America those of California and Texas. Deposits also occur in Russia, the Bavarian palatinate, in Hungary, Italy, Transylvania, Bohemia, Mexico, Peru and in some other countries.

Mercury occurs in formations of all ages from the Archean to the Quaternary, and it has been found in both sedimentary and eruptive rocks of the most varied character, *e.g.* conglomerates, sandstones, shales, limestones, quartzites, slates, serpentines, crystalline schists, and eruptive rocks from the most acid to the most basic. It appears that nearly all known deposits occur along lines of continental uplift, where active shearing of the formations has occurred. Large deposits are seldom found in eruptive rocks, but generally near such formations or near active or extinct hot springs. The deposits are of many types, simple fissure veins being less usual than compound, reticulated, or linked veins. Segregations and impregnations are very common. The form of the deposit seems to depend chiefly on the physical properties and structure of the enclosing rocks and the nature of the fissure systems that result from their disturbance. The principal ore is cinnabar, though metacinnabarite and native mercury are often abundant; the selenide (tiemannite), chloride, and iodide are rare. Of the associated heavy minerals, pyrite (or marcasite) is almost universal, and chalcopyrite, tetrahedrite, blende and realgar are frequent. Many deposits contain traces of gold and silver, and some deposits, as the Mercur in Utah, are more valuable for their gold than their mercury content. The usual gangue-forming minerals are quartz, dolomite, calcite, barite, fluorspar and various zeolites. Some form of bituminous matter is one of the most universal and intimate associates of cinnabar. Formerly quicksilver deposits were supposed to be formed by sublimation, but from a careful study of the California occurrences S. B. Christy was convinced as early as 1875 that this was unlikely, and that deposition from hot alkaline sulphide solutions was more probable. By treating the black mercuric sulphide with such solutions, hot and under pressure, he succeeded in producing artificial cinnabar and metacinnabarite. He also showed that the mineral water at the New Almaden mines, when charged with sulphydric acid and heated under pressure, was capable of effecting the same change, and that this method of production agreed better with all the facts than the sublimation theory. (See "Genesis of Cinnabar Deposits," *Amer. Jour. Science*, xvii. 453.) The investigations of Dr G. F. Becker on the "Quicksilver Deposits of the Pacific" (*U.S. Geol. Survey*, Mon. xiii., 1888) established the correctness of these views beyond doubt.

Production.—At one time the world's supply of mercury was almost entirely derived from the Almaden and Idrian mines; but now the greater proportion is produced in California and Texas, where cinnabar was used by the Indians as a pigment, and first turned to metallurgical purpose in 1845 by Castellero. In the United States mercury has also been found in Utah, Nevada, Oregon and Arizona. In the 16th century the Almaden and Idrian mines were practically the only producers of this metal; statistics of Almaden dating from 1564 and of Idria since 1525 are given in B. Neumann, *Die Metalle* (1904). Spain produced 1151 metric tons in 1870, and in 1889 its maximum of 1975 tons; since then it has, on the whole, been decreasing. The Austria-Hungary output steadily increased to about 550–600 tons at which it appears to remain. In 1887 Russia produced 64 tons, and has steadily improved. The United States output was over 1000 tons, in 1871, and declined to 800–900 in the period 1889–1892; it has since increased and surpassed the supply from Spain. The following table gives the production in various countries for selected years:—

	Spain.	United States.	Russia.	Austria-Hungary.	Italy.	Mexico.	Total (Metric Tons).
1901	754	1031	368	558	278	128	3120
1902	1425	1208	416	556	259	191	4056
1903	914	1288	362	567	314	188	3633
1904	1020	1192	393	581	357	190[1]	3733
1905	800	1043	318	564	370	190[1]	3285

[1] Estimated.

Mercury is transported in steel bottles closed by a screw stopper; the Almaden and Idrian bottles contain 76 ℔; and until the 1st of June 1904, the Californian bottles contained $76\frac{1}{2}$ ℔ of mercury; they now hold 75 ℔. From the smaller works the metal is sometimes sent out in sheepskin bags holding 55 ℔ of mercury.

Metallurgy.—Chemically speaking, the extraction of mercury from its ores is a simple matter. Metallic mercury is easily volatilized, and separated from the gangue, at temperatures far below redness, and cinnabar at a red heat is readily reduced to the metallic state by the action of iron or lime or atmospheric oxygen, the sulphur being eliminated, in the first case as iron sulphide, in the second as calcium sulphide and sulphate, in the third as sulphur dioxide. A close iron retort would at first suggest itself as the proper kind of apparatus for carrying out these operations, and this idea was, at one time, acted upon in a few small establishments—for instance, in that of Zweibrücken in the Palatinate, where lime was used as a decomposing agent; but the method has now been discarded. In all the large works the decomposition of the cinnabar is effected by the direct exposure of the ore to the oxidizing flame of a furnace, and the mercury vapour, which gets diffused through an immense mass of combustion gases, is recovered in more or less imperfect condensers.

With the exception of the massive deposits of Almaden in Spain and a few of those in California and Idria, cinnabar occurs in forms so disseminated as to make its mining very expensive. Rude hand-sorting of the ores is usually practised. Wet concentration has not been successful, because it necessitates ore crushing and extensive slime losses of the brittle cinnabar. As a rule low-grade ores can be roasted directly with less loss and expense. At Almaden in Spain the ores average from 5 to 7 %, but in other parts of the world much poorer ores have to be treated. In California, in spite of the high cost of labour, improved furnaces enable ores containing not more than $\frac{1}{2}$ % to be mined and roasted at a profit.

The furnaces originally used at Almaden and Idria differ only in the condensing plant. The roasting was carried out in internally fired, vertical shafts of brickwork, and, at Almaden, the vapours were led through a series of bottles named *aludels*, so arranged that the neck of one entered the sole of the next; and at Idria the vapours were led into large brickwork chambers lined with cement, and there condensed. The aludel furnace, which was designed in 1633 by Lopez Saavedra Barba in Huancavelica, Peru (where cinnabar was discovered in 1566), and introduced at Almaden in 1646 by Bustamente, by whose name it is sometimes known, has now been entirely given up. The Idrian furnace was designed in 1787 by von Leithner; it was introduced at Almaden in 1800 by Larrañaga, and used side by side with the aludel furnace. The crude mercury is purified by straining through dense linen or chamois leather bags.

The most important improvements in the metallurgy of mercury are the introduction of furnaces for treating coarse ores, and the replacement of the old discontinuous furnaces by those which work continuously. The most successful of these continuous furnaces was a modification of Count Rumford's continuous lime-kiln. This furnace was introduced at New Almaden by J. B. Randol, the author of many improvements in the metallurgy of mercury. The success of the continuous coarse-ore furnace at New Almaden led Randol to attempt the continuous treatment of fine ores also, and the Huettner and Scott continuous fine-ore furnace, which was the result of these experiments solved the problem completely. It contains several vertical shafts in which the descending ore is retarded at will by inclined shelving, which causes it to be exposed to the flames as long as may be necessary to roast it thoroughly. The time of treatment is determined by the rapidity with which the roasted ore is withdrawn at the bottom. Several similar furnaces are in use, as the Knox and Osborne, the Livermore and the Cormak-Spirek. The fumes from the roasting furnaces are received in masonry chambers, usually provided with water-cooled pipes; from these they pass through earthenware pipes, and finally through others of wood and glass. Not all the yield is in liquid mercury; much of it is entangled in masses of soot that cover the condenser walls, and this is only recovered after much labour.

The conditions for effective condensation are: (1) The furnace gases should be well oxidized, to avoid the production of an excess of soot. Gas firing would meet this requirement better than the use of wood or coal. (2) The volume of permanent gases passing through the furnace should be reduced to a minimum consistently with complete oxidation. (3) The cross-section of the condensers should be sufficient to reduce the velocity of the escaping gases, and the surface large enough for cooling and for the adhesion of condensed mercury. The latter requirement is best provided for by hanging wooden aprons in the path of the cooled gases. (4) The temperature of the escaping gases should not exceed 15° to 20° C., but cooling below this temperature would not give any adequate return for the expense. Cooling by water is quicker, but more expensive than by air. Water sprays, acting directly on the fumes, have not given good results, on account of the difficulty of recovering "floured" quicksilver from the water. (5) The use of an artificial inward draught is absolutely necessary to control the operation of the furnaces and condensers and to avoid the salivation of the workmen. (6) The condenser should be easily and quickly cleaned during the operation of the furnace. (7) Both furnaces and condensers should have inclined iron plates in their foundations to prevent the infiltration of mercury. (8) There is a great need of some substance for the construction of quicksilver condensers which shall be strong enough to be made thin, be a good conductor of heat, and resistant to abrasion and the alternate action of heat and cold. It should also resist the action of mercury and warm dilute sulphuric acid, and be not too expensive.

Quicksilver is best removed from the "soot," not by pressure, but by the opposite treatment. A machine in use for this purpose at New Almaden, devised by Colonel von Leicht, consists of an iron bowl, perforated at the bottom, in which revolves a vertical shaft carrying a propeller blade which tosses the soot (mixed with wood ashes and a little coal oil) into the air, so that the entangled mercury is free to run out through the bottom of the bowl. The residue from which no more mercury can be extracted mechanically is returned to the roasting furnace.

The losses of treatment are: (1) Furnace loss, which is easily reduced to nothing, and (2) condenser loss, which can never be zero. The latter consists of mercury lost as vapour and as mist, and its minimum amount is determined not by the richness of the ore but by the volume of escaping gases, their velocity and temperature. The percentage of loss will be higher with a poor than a rich ore. On a 3% ore the losses need not exceed 3 or 4% ore content. On a 1% ore they will run from 5 to 10%. But in poorly arranged plants under bad management they may easily be doubled or even trebled. The Huettner and Scott fine-ore furnace costs with condensers in California about $30,000, and roasts from 30 to 45 tons of ore (from 2½ in. to dust) in 24 hours at a cost of from $1 to $0·62 per ton.

Purification.—Commercial mercury, as a rule, only needs to be forced through chamois leather or allowed to run though a very fine hole to become fit for all ordinary applications; but the metal, having the power of dissolving most other metals, is very liable to get contaminated, and requires then to be purified. For this purpose many chemical methods have been proposed; the commonest consist in allowing the metal to fall in a very fine stream through a column of a mixture of nitric acid and mercurous nitrate, or of sulphuric acid, or of potassium bichromate and sulphuric acid; the metal being subsequently dried and filtered through a perforated paper filter. The only really exhaustive method is distillation in a vacuum out of a glass apparatus. Many forms of apparatus have been devised to effect this. Recent researches have shown, however, that the metal so obtained is not chemically pure, there being found in the distillate traces of other metals. Absolutely pure mercury does not at all adhere to any surface which does not consist of a metal soluble in mercury. Hence the least quantity of it, when placed on a sheet of paper, forms a neatly rounded-off globule, which retains its form on being rolled about, and, when subdivided, breaks up into a number of equally perfect globules, which tend to coalesce when sufficiently near to each other. The presence in it of the minutest trace of lead or tin causes it to "draw tails." A very impure metal may adhere even to glass, and in a glass vessel, instead of the normal convex, form an irregular flat meniscus.

Properties.—Pure mercury is a freely flowing liquid, which does not wet objects placed in it, and has a silvery white colour and perfect metallic lustre; in very thin layers it transmits a bluish-violet light. It freezes at about −39° C. (Mallet gives −38·85°; Hutchins, −39·44°) with contraction, and the formation of a white, very ductile and malleable mass, easily cut with a knife, and exhibiting crystals belonging to the cubic system. When heated the metal expands very uniformly, and vaporizes at about 360°; the volatility is generally increased by the presence of impurities; its high expansion and the wide range of temperature over which it is fluid render it especially valuable as a thermometric fluid (see THERMOMETRY). The vapour is colourless, and its density points to the conclusion that the molecules are monatomic. Its specific gravity at 0° is 13·5959, *i.e.* it is about half as heavy again as copper volume for volume, a quarter as heavy again as lead, and nearly twice as heavy as zinc; this property is turned to account in the construction of barometers and air-pumps. Its specific heat is about 0·0333 (see CALORIMETRY); its electrical conductivity is involved in the definition of the ohm (see CONDUCTION, ELECTRIC); and its thermal conductivity is about two thirds that of silver.

Pure mercury remains unchanged in dry air, oxygen, nitrous oxide, carbon dioxide, ammonia and some other gases at ordinary temperatures; hence its application for collecting and measuring gases. In damp air it slowly becomes coated with a film of mercurous oxide; and when heated for some time in air or oxygen it becomes transformed into the red mercuric oxide, which decomposes into mercury and oxygen when heated to a higher temperature; this reaction is of great historical importance, since it led to the discovery of oxygen at the hands of Priestley and Scheele. The halogen elements and sulphur combine directly with the metal. Mercury is unattacked by dilute sulphuric acid; the strong acid, however, dissolves it on heating with the formation of sulphur dioxide and mercurous or mercuric sulphate according as mercury is in excess or not. Hydrochloric acid has no action. Dilute nitric acid readily attacks it, mercurous nitrate being formed in the cold with excess of mercury, mercuric nitrate with excess of acid, or with strong acid, in the warm. The metal dissolves in solutions containing chlorine or bromine, and consequently in aqua regia.

Mercury readily dissolves many metals to form a class of compounds termed amalgams, which have considerable applications in the arts.

Compounds of Mercury.

Mercury forms two well-defined series of salts—the mercurous salts derived from the oxide Hg_2O, and the mercuric salts from the oxide HgO; the existence of these salts can hardly be inseparably connected with a variable valency, *i.e.* that mercury is monovalent in mercurous, and divalent in mercuric compounds, for according to Baker mercurous chloride or calomel (*q.v.*) has the formula Hg_2Cl_2.

Mercurous Oxide, Hg_2O, is an unstable dark-brown powder formed when caustic potash acts on calomel; it is decomposed by light or on trituration into mercury and mercuric oxide *Mercuric oxide*, HgO, occurs in two forms: it is obtained as a bright-red crystalline powder (also known as "red precipitate," or as *mercurius praecipitatus per se*) by heating the metal in air, or by calcining the nitrate, and as an orange-yellow powder by precipitating a solution of a mercuric salt with potash; the difference is probably one of subdivision. The yellow form is the most reactive and is transformed into the red when heated to 400°. If the red oxide be heated it becomes black, regaining its colour on cooling, and on further heating to 630° it decomposes into mercury and oxygen. It is slightly soluble in water, to which it imparts an alkaline reaction and strongly metallic taste. A peroxide is obtained as a brown solid from mercury and slightly acid 30% hydrogen peroxide at low temperatures.

Mercurous and mercuric chlorides, known respectively as calomel (*q.v.*) and corrosive sublimate (*q.v.*), are two of the most important salts of mercury. *Mercurous bromide*, Hg_2Br_2, is a yellowish-white powder, insoluble in water. *Mercuric bromide*, $HgBr_2$, forms white crystals, sparingly soluble in cold water, readily in hot, and prepared by the direct union of its components. *Mercurous iodide*, Hg_2I_2, is a yellowish-green powder obtained by heating its components to about 250°, or by triturating them with a little alcohol; it is also obtained by precipitating a solution of mercurous nitrate with potassium iodide. It is blackened by exposure to light. *Mercuric iodide*, HgI_2, exists in two crystalline forms. By mixing solutions of mercuric chloride and potassium iodide under a microscope, yellow rhombic plates are seen to be formed which are transformed very quickly into scarlet quadratic octahedra. On heating to about 126° the red form is transformed into the yellow modification; on cooling the reverse gradually occurs, and immediately if the yellow iodide be touched. Mercuric iodide is insoluble in water, but soluble in absolute alcohol; and also in potassium iodide solution, with the formation of K_2HgI_4, which may be obtained in lemon-yellow crystals. A strongly alkaline solution of this salt is known as Nessler's reagent, and is specially used for determining traces of ammonia (see below). Mercuric iodide dissolves in other iodide solutions to form similar compounds; these solutions are characterized by their exceptionally high specific gravity, and hence are employed in density determinations (see DENSITY). It also forms many other double salts. Oxidation with strong nitric acid gives the *iodate*, $Hg(IO_3)_2$. An iodide, Hg_2I_3, intermediate between mercurous and mercuric iodides, is obtained as a yellow insoluble powder by precipitating mercurous nitrate with a solution of iodine in potassium iodide. *Mercurous fluoride*, Hg_2F_2, and *mercuric fluoride*, HgF_2, are unstable substances obtained from the corresponding oxide and hydrofluoric acid.

Mercurous Nitrate, $Hg_2(NO_3)_2 \cdot 2H_2O$, is obtained as a white crystalline salt soluble in water by dissolving the metal in cold dilute nitric acid; if the metal be in excess a basic salt $Hg_2(NO_3)_2 \cdot 2HG_2O \cdot 3H_2O$ is obtained. Several other basic salts are known. By adding ammonia to a solution of mercurous nitrate a black precipitate of variable composition, known in pharmacy as *mercurius solubilis Hahnemanni*, is obtained.

Mercuric Nitrate.—By dissolving mercuric oxide in strong nitric acid there is obtained a thick liquid which will not crystallize, and which gives on the addition of strong nitric acid a white precipitate of $2Hg(NO_3)_2 \cdot H_2O$. Water decomposes it to give basic salts of variable composition. By dissolving the oxide in dilute nitric acid, the basic salt $Hg(NO_3)_2 \cdot HgO \cdot H_2O$, crystallizing in needles, is obtained.

Mercurous Sulphide, Hg_2S, is an unstable black powder obtained by acting with sulphuretted hydrogen, diluted with carbon dioxide, on calomel at −10°. It decomposes into mercuric sulphide and mercury at 0°. *Mercuric sulphide*, HgS, is one of the most important mercury compounds; it is the principal ore, occurring in nature as the mineral cinnabar (*q.v.*), and is extensively used as a pigment, vermilion (*q.v.*). It is obtained as a black powder by triturating mercury with sulphur, the compound thus formed being known in pharmacy as *Aethiops mineralis*, and also by precipitating a mercuric salt with sulphuretted hydrogen. It is only slightly acted upon by nitric acid; it dissolves in aqua regia; chlorine gives a yellow compound, $2HgS \cdot HgCl_2$; and it dissolves in potassium sulphide solutions to form double salts of variable composition.

Mercurous Sulphate, Hg_2SO_4, is a white, sparingly soluble, crystalline substance obtained by adding sodium sulphate to a solution of mercurous nitrate. *Mercuric sulphate*, $HgSO_4$, is a white, soluble salt obtained by dissolving mercury in hot strong sulphuric acid; on digestion with water, it decomposes into a basic salt $HgSO_4 \cdot 2HgO$ known as *turbith* or *turpeth mineral*, and into an acid salt, $HgSO_4 \cdot 2SO_3$.

Mercury Phosphide, Hg_3P_2, is obtained as brilliant red, hexagonal crystals by heating mercury with phosphorus iodide to 300° and removing the mercuric iodide simultaneously formed by means of potassium iodide solution. *Mercurous phosphate*, Hg_3PO_4, and *mercuric phosphate*, $Hg_3(PO_4)_2$, are obtained as white precipitates by adding sodium phosphate to solutions of mercurous and mercuric nitrates respectively.

Mercurammonium Compounds.—By the action of ammonia and ammonium salts mercury compounds yield a number of substances, many of which have long been used in medicine. By the action of dry ammonia on calomel mercuroso-ammonium chloride, NH_3HgCl, is obtained; aqueous ammonia on calomel gives dimercuroso-ammonium chloride, NH_2Hg_2Cl. By adding ammonia to a solution of mercuric chloride, mercurammonium chloride, known in pharmacy as "infusible white precipitate," NH_2HgCl, is obtained; "fusible white precipitate" is mercuro-diammonium chloride, $Hg(NH_3Cl)_2$, and is obtained by adding a solution of mercuric chloride to hot solutions of ammonium chloride and ammonia so long as the precipitate first formed redissolves; the substance separates out on cooling. By precipitating a strongly alkaline solution of mercuric iodide in potassium iodide (Nessler's solution) there is obtained a yellow precipitate of NH_2Hg_2OI; this reaction is the most delicate test for ammonia, a yellow coloration being given by minute traces. By passing dry ammonia over precipitated mercuric oxide at 130°, a nitride N_2Hg_3 is obtained. The oxide and ammonia solution gives the stable and basic mercurhydroxylamine, NHg_2OH. The constitution of these compounds has been especially studied by K. A. Hofmann and E. C. Marburg (*Zeit. Anorg. Chem.* 23, p. 126); these chemists formulate "infusible precipitate" as $Hg(NH_2)Cl$, "fusible precipitate" as $Hg(NH_3Cl)_2$ "Millon's base" as $(HO \cdot Hg)_2{:}NH_2OH$, thus postulating three distinct types of compounds, (1) amidochlorides; (2) amines; (3) substituted ammonium derivatives.

Analysis.—Mercury compounds, when heated in a closed tube with sodium carbonate, yield a grey to black sublimate of metallic mercury, which readily unites to form visible globules. The metal is precipitated from solutions by digestion with bright copper-foil, a coating being formed on the copper, which becomes silvery on rubbing, and disappears when the quicksilvered copper is heated in a sublimation tube.

Solutions of mercurous salts with hydrochloric acid give a white precipitate of calomel, which becomes jet-black on treatment with ammonia. Stannous chloride, in its twofold capacity as a chloride and a reducing agent, precipitates both mercurous and mercuric solutions, at first as calomel, and on addition of an excess of reagent the precipitate becomes grey through conversion into finely-divided quicksilver. Sulphuretted hydrogen, when added very gradually to an acid mercuric solution, gives at first an almost white precipitate, which, on addition of more and more reagent, assumes successively a yellow, orange and at last jet-black colour. The black precipitate is HgS, which is identified by its great heaviness, and by being insoluble in boiling nitric and in boiling hydrochloric acid. A mixture of the two (aqua regia) dissolves it as chloride.

"Mercurous" mercury is quantitatively estimated by precipitating as calomel and weighing the precipitate on a tared filter at 100°. The metal may also be estimated by distillation in a closed tube with lime, the metal being collected and weighed, or by precipitating the solution with an excess of stannous chloride. More convenient is the method of precipitating as sulphide by an excess of sulphuretted hydrogen, and weighing the precipitate on a tared filter; or by means of a Gooch crucible.

Pharmacology and Therapeutics

The use of mercury as a therapeutic agent is of comparatively recent date. To the Greeks and Romans its value was unknown, and the Arabian physicians only used it for skin affections. It was not till the middle of the 16th century that the special properties of mercury were fully appreciated, but since that time the metal has continued to hold a high though fluctuating value as a medicine. At first the metal in a finely divided state or in vapour was used; but very soon its various compounds were found to be endowed with powers even greater than those of the metal itself, and with the discovery of new compounds the number of mercurial medicines has largely increased.

The British Pharmacopeia contains some twenty-five mercurial preparations, including those of calomel (*q.v.*). Only the useful preparations will be mentioned here. Free mercury is contained in Hydrargyrum cum Creta, or "grey powder," which consists of one part of mercury to two of prepared chalk. The power of this valuable and widely used preparation varies somewhat with its age, as old specimens contain some mercuric oxide, which makes them more active. The dose is 1–5 gr., and the preparation is usually employed for children. The Pilula Hydrargyri, or "blue pill," contains one part of mercury in three, and the dose is 4–8 gr. It is usually employed for adults. There are also five preparations of free mercury for external use. Of these the most useful is the Unguentum Hydrargyri, "or blue ointment," which contains one part of mercury in two. Weaker ointments are also prepared from the red and the yellow forms of mercuric oxide. The perchloride of mercury or corrosive sublimate is therapeutically the most important salt of mercury. The dose is $\frac{1}{32}$–$\frac{1}{16}$ gr. It is incompatible with alkalies, alkaline carbonates, potassium iodide, albumen and many other substances, and should therefore be prescribed alone. It is decomposed by impure water, and distilled water is therefore used in making the Liquor Hydrargyri Perchloridi, in which form it is usually prescribed. This contains half a grain of the perchloride to the fluid ounce and its dose is 30–60 minims. The perchloride is also compounded with lime-water to form the Lotio Hydrargyri Flava, or "yellow wash," which contains two grains of the salt to the fluid ounce. Mercuric iodide is an equally potent salt and has come into wide use of late years. It has the same dose as the perchloride and is largely prescribed in the Liquor Arsenii et Hydrargyri Iodidi, or Donovan's solution, which contains 1% of arsenious iodide and 1% of mercuric iodide, the dose being 5–20 minims. An ointment widely used is prepared from the mercurammonium chloride (Unguentum Hydrargyri ammoniatum) of which it contains one part in ten. It is known as "white precipitate ointment."

In discussing the pharmacology of mercury and its compounds, it is of the first importance to observe that metallic mercury is inert as such, and that the same may practically be said of mercurous salts generally. Both mercury itself and mercurous salts tend to be converted in the body into mercuric salts, to which the action is due. When metallic mercury is triturated or exposed to air it is partly oxidized, the first stage of its transformation to an active condition being thus reached.

Metallic mercury can be absorbed by the skin, passing in minute globules through the ducts of the sweat-glands. The mercury contained in "blue ointment" is certainly thus absorbed, actually circulating in the blood in a very different form, as described below. There is no local action on the skin. The mercuric salts, and especially the chloride and iodide, are probably the most powerful of all known antiseptics. One part of the perchloride in 500,000 will prevent the growth of anthrax bacilli, and one part in 2000—the strength commonly employed in surgery—kills all known bacteria. The action is apparently specific and not due to the fact that perchloride of mercury precipitates albumen, including the albuminous bodies of bacteria, for the iodide is still more powerful as a germicide, though it does not coagulate albumen. These salts cannot be employed for sterilizing metallic instruments, which they tarnish. As these drugs are essentially poisons they must be used with the greatest care in surgical practice, and as they are particularly deleterious to the secreting structure of the kidney they must not be employed as antiseptics in diseases where renal inflammation is already present or probable. They are therefore contra-indicated for application to the throat in scarlet-fever or to the uterus in eclampsia. The stronger mercurial ointments kill cutaneous parasites and also possess some degree of antipruritic action, especially when the cause of the itching is somewhat obscure. Mercuric salts, when in strong solution, are caustic. It is important to observe that the volatility of metallic mercury and many of its compounds causes their absorption by the lungs even when no such effect is intended to follow their external application. This fact explains the occurrence of chronic mercurial poisoning in certain trades.

Single doses of mercury or its compounds have no action upon the mouth, the characteristic salivation being produced only after many doses. Their typical action on the bowel is purgative, the effect varying with the state of the mercury. So relatively inert is metallic mercury that a pound of it has been given without ill effects in cases of intestinal obstruction, which it was hoped to relieve by the mere weight of the metal. Half a grain of the perchloride, on the other hand, is a highly toxic dose. The action of mercurials on the bowel is mostly exerted on the duodenum and jejunum, though the lower part of the bowel is slightly affected. Hence a dose of mercury usually needs a saline aperient to complete its action, as in the "blue pill and black draught" of former days. Mercurials do not cause, in therapeutic doses, much increase in the intestinal secretion, the action being mainly exerted on the muscular wall of the bowel. The bile is rapidly removed from the duodenum, before any re-absorption can occur, and the bacterial action which decomposes the bile-pigment is arrested by the antiseptic power of the drug, so that the excreta are of a very dark colour. The classical experiments of William Rutherford (1839–1899), of Edinburgh, showed that calomel does not increase the amount of bile formed by the liver. Corrosive sublimate does, however, stimulate the liver to a slight degree. The value of calomel in hepatic torpor is as an excretory, not a secretory, cholagogue, the gall-bladder being stimulated to expel its stagnant contents. In large doses mercurials somewhat diminish the secretion of bile. The greater part of the mercury administered by the mouth, in whatever form, is excreted as mercuric sulphide. Prior to this decomposition the mercury exists as a complex soluble compound with sodium, chlorine and albumen. When perchloride of mercury is injected subcutaneously the sodium chloride in the blood similarly prevents the precipitation of the albuminate of mercury, and it is therefore desirable to add a little sodium chloride to the solution for injection of mercuric chloride.

Some observers assert that mercury is a haematinic, increasing, like iron, the amount of haemoglobin in the blood. Whilst this is doubtful it is certain that large doses, when continued, produce marked anaemia. The excretion of the drug is accomplished by all the secreting glands, including the breasts, if these are functioning. All the secretions of the body, except that of the peptic glands of the stomach, are stimulated, but the excretion of mercury is slow, and it is typically one of the drugs that are cumulative, like arsenic and digitalis.

Mercury is largely used in affections of the alimentary canal, and has an obscure but unquestionable value in many cases of heart-disease and arterial degeneration. But its value in syphilis (see VENEREAL DISEASES) far outweighs all its other uses.

Toxicology.—Acute poisoning by mercurials usually occurs in the case of corrosive sublimate. There is intense gastro-intestinal inflammation, with vomiting, frequent "rice-water" stools and extreme collapse. The treatment, except when the case is seen at once, is very difficult, but white-of-egg or other form of albumen is the antidote, forming an insoluble compound with the perchloride.

Chronic poisoning (hydrargyrism or mercurialism) is of great importance, since any indication of its symptoms must be closely watched for in patients who are under mercurial treatment. Usually the first symptom is slight tenderness of the teeth whilst eating, and some foetor of the breath. These symptoms become more marked and the gums become the seat of severe inflammation, being spongy, vascular and prone to bleed. The salivary glands are swollen and tender, and the saliva pours from the mouth, and may amount to pints in the course of a day. The teeth become quite loose and may fall out. The symptoms are aggravated until the tongue and mouth ulcerate, the jaw-bone necroses, haemorrhages occur in various parts of the body, and the patient dies of anaemia, septic inflammation or exhaustion. The treatment consists, besides stopping the intake of poison and relieving the symptoms, in the administration of potassium iodide in small, often repeated doses.

BIBLIOGRAPHY.—For the history of mercury see B. Neumann, *Die Metalle* (1904); A. Rossing, *Geschichte der Metalle* (1901). The general chemistry is treated in detail in O. Dammer, *Handbuch der anorganischen Chemie*, and H. Moissan, *Traité de chimie minérale.* For the metallurgy reference may be made to Carl Schnabel, *Handbook of Metallurgy*, vol. ii. (1906), translated by H. Louis.

MERCY (or MERCI), **FRANZ,** FREIHERR VON, lord of Mandre and Collenburg (d. 1645), German general in the Thirty Years' War, who came of a noble family of Lorraine, was born at Longwy between 1590 and 1598. From 1606 to 1630 he was engaged in the imperial service. By the latter year he had attained high military rank, and after distinguishing himself at the first battle of Breitenfeld (1631) he commanded a regiment of foot on the Rhine and defended Rheinfelden against the Swedes with the utmost bravery, surrendering only after enduring a five-months' siege. He now became a general officer of cavalry (*General-Feldwachtmeister*), and in 1635, 1636 and 1637 took part in further campaigns on the Rhine and Doubs. In September 1638 he was made master-general of ordnance in the army of Bavaria, then the second largest army in Germany. In the next campaign he was practically commander-in-chief of the Bavarians, and at times also of an allied army of Imperialists and Bavarians. He was now considered one of the foremost soldiers in Europe, and was made general field marshal in 1643, when he won his great victory over the French marshal Rantzau at Tuttlingen (Nov. 24–25), capturing the marshal and seven thousand men. In the following year Mercy opposed the French armies, now under the duke of Enghien (afterwards the great Condé) and the vicomte de Turenne. He fought, and in the end lost, the desperate battle of Freiburg, but revenged himself next year by inflicting upon Turenne the defeat of Mergentheim (Marienthal). Later in 1645, fighting once more against Enghien and Turenne, Mercy was killed at the battle of Nördlingen (or Allerheim) at the crisis of the engagement, which, even without Mercy's guiding hand, was almost a drawn battle. He died on the 3rd of August 1645. On the spot where he fell, Enghien erected a memorial, with the inscription *Sta viator, heroem calcas.*

His grandnephew CLAUDIUS FLORIMOND, COUNT MERCY DE VILLETS (1666–1734), Imperial field marshal, son of his brother Kaspar, who fell at Freiburg, was born in Lorraine, and entered the Austrian army as a volunteer in 1682. He won his commission at the great battle of Vienna in the following year; and during seven years of campaigning in Hungary rose to the rank of Rittmeister. A wound sustained at this time permanently injured his sight. For five years more, up to 1697, he was employed in the Italian campaigns, then he was called back to Hungary by Prince Eugène and won on the field of Zenta two grades of promotion. He displayed great daring in the first campaigns of the Spanish Succession War in Italy, twice fell into the hands of the enemy in fights at close quarters and for his conduct at the surprise of Cremona (Jan. 31, 1702) received the emperor's thanks and the proprietary colonelcy of a newly raised cuirassier regiment. With this he took part in the Rhine campaign of 1703, and the battle of Friedlingen, and his success as an intrepid leader of raids and forays became well known to friend and foe. He was on that account selected early in 1704 to harry the elector of Bavaria's dominions. He was soon afterwards promoted *General-Feldwachtmeister*, in which rank he was engaged in the battle of the Schellenberg (July 2, 1704). In the rest of the war he was often distinguished by his fiery courage. He rose to be general of cavalry in the course of these ten years. His resolute leadership was conspicuous at the battle of Peterwardein (1716) and he was soon afterwards made commander of the Banat of Temesvár. At the great battle of Belgrade (1717) he led the second line of left wing cavalry in a brilliant and decisive charge which drove the Turks to their trenches. After the peace he resumed the administration of the Banat, which after more than 150 years of Turkish rule needed a humane and capable governor. But before his work was done he was once more called away to a command in the field, this time in southern Italy, where he fought the battle of Francavilla (June 20, 1719), took Messina and besieged Palermo. For eleven years more he administered the Banat, reorganizing the country as a prosperous and civilized community. In 1734 he was made a general field marshal in the army, but on the 29th of June was killed at the battle of Parma while personally leading his troops. He left no children, and his name passed to Count Argenteau, from whom came the family of Mercy-Argenteau (see below).

MERCY (adapted from Fr. *merci*, Lat. *merces*, reward), compassion, pardon, pity or forgiveness. The Latin word was used in the early Christian ages for the reward that is given in heaven to those who have shown kindness without hope of return. The French word, except in such phrases as *Dieu merci*, *sans merci*, is principally used in the sense of "thanks," and is seen in the old English expression "gramercy," *i.e. grant merci*, great, many thanks, which Johnson took for "grant me mercy." In the medieval Church there were seven "corporal" and seven "spiritual works of mercy" (*opera misericordiae*); these were (*a*) the giving of food to the hungry and drink to the thirsty, the clothing of the naked, the visitation of the sick and of prisoners, the receiving of strangers, and the burial of the dead; (*b*) the conversion of sinners, teaching of the ignorant, giving of counsel to the doubtful, forgiveness of injuries, patience under wrong, prayer for the living and for the dead. The order of the Sisters of Mercy is a religious sisterhood of the Roman Church. It is found chiefly in England and Ireland, but there are branches in the United States of America, in South America and in Australia and New Zealand. It was founded in 1827 in Dublin by Miss Catherine McAuley (1787–1841). The object was to perform the corporal and spiritual works of mercy.

MERCY-ARGENTEAU, FLORIMOND CLAUDE, COMTE DE (1727–1794), Austrian diplomatist, son of Antoine, comte de Mercy-Argenteau, entered the diplomatic service of Austria, going to Paris in the train of Prince Kaunitz. He became

Austrian minister at Turin, at St Petersburg, and in 1766 at Paris, where his first work was to strengthen the alliance between France and Austria, which was cemented in 1770 by the marriage of the dauphin, afterwards Louis XVI., with Marie Antoinette, daughter of the empress Maria Theresa. When four years later Louis and Marie Antoinette ascended the throne, Mercy-Argenteau became one of the most powerful personages at the French court. He was in Paris during the turbulent years which heralded the Revolution, and his powerful aid was given first to Loménie de Brienne, and then to Necker. In 1792 he became governor-general of the Belgian provinces, which had just been reduced to obedience by Austria, and here his ability and experience made him a very successful ruler. Although at first in favour of moderate courses, Mercy-Argenteau supported the action of Austria in making war upon his former ally after the outbreak of the Revolution, and in July 1794 he was appointed Austrian ambassador to Great Britain, but he died a few days after his arrival in London.

See T. Juste, *Le Comte de Mercy-Argenteau* (Brussels 1863); A. von Arneth and A. Geoffroy, *Correspondances secrètes de Marie Thérèse avec le comte de Mercy* (Paris 1874); and A. von Arneth and J. Flammermont, *Correspondance secrète de Mercy avec Joseph II. et Kaunitz* (Paris 1889–1891). Mercy-Argenteau's *Correspondances secrètes de Marie Thérèse* has been condensed and translated into English by Lilian Smythe under the title of *A Guardian of Marie Antoinette* (2 vols., London 1902).

MERE. 1. (From Lat. *merus*, pure, unmixed; O. Fr. *mier*), an adjective primarily indicating something pure and unmixed; thus "mere wine" implied pure and unadulterated wine, as "mere folly" expressed folly pure and simple. Modern usage has, however, given both to the adjective "mere" and the adverb "merely" a deprecatory and disparaging idea, so that expressions like "the mere truth," a "mere statement of fact," &c., often convey the impression that they are far from being "mere" in the sense of "entire" or "absolute," but are, on the contrary, fragmentary and incomplete. The earlier idea of the word is retained in some legal phrases, especially in the phrase "mere motion," that is, of one's own initiative without help or suggestion from the outside. Another legal phrase is "mere right" (law Latin *jus merum*), *i.e.* right without possession.

2. A word which appears in various forms in several Teutonic and other languages; cf. Dutch and Ger. *Meer*. From the cognate Lat. *mare* are derived the Romanic forms, *e.g.* Fr. *mer*, Span. *mar*, &c.; the word appears also in the derivative "marsh" for "marish"; the ultimate origin has been taken to be an Indo-European root, meaning "to die," *i.e.* to lie waste; cf. Sansk. *maru*, desert), an arm of the sea or estuary; also the name given to lakes, pools and shallow stretches of water inland. In the Fen countries a mere signifies a marsh or a district nearly always under water.

3. (Derived from an O. Eng. source, *maere*, a wall or boundary; cognate with Lat. *murus*, a wall), a landmark or boundary, also an object indicating the extent of a property without actually enclosing it. A special meaning is that of a road, which forms a dividing line between two places. A "meresman" is an official appointed by parochial authorities to ascertain the exact boundaries of a parish and to report upon the condition of the roads, bridges, waterways, &c., within them. In the mining districts of Derbyshire a mere is a certain measurement of land in which lead-ore is found.

MEREDITH, GEORGE (1828–1909), British novelist and poet, was born at Portsmouth, Hampshire, on the 12th of February 1828; the parish church register records his baptism on the 9th of April. About his early life few details are recorded, but there is a good deal of quasi-autobiography, derived apparently from early associations and possibly antipathies, in some of his own novels, notably *Evan Harrington* and *Harry Richmond*, as to which the judicious may speculate. He had, as he used to boast, both Welsh (from his father) and Irish blood (from his mother) in his veins. His father, Augustus Armstrong Meredith, was a naval outfitter at Portsmouth (mentioned as such in Marryat's *Peter Simple*); and his grandfather, Melchisedek Meredith, clearly suggested the "Old Mel" of *Evan Harrington*. Melchisedek was 35 when in 1796 he was initiated as a freemason at Portsmouth; and he appears to have been known locally as "the count," because of a romantic story as to an adventure he once had at Bath; he was churchwarden in 1801 and 1804; and some of the church plate still bears his name.

Meredith's mother died when he was three years old, and he was made a ward in chancery. He was sent to school at Neuwied on the Rhine, and remained in Germany till he was sixteen. During these impressionable years he imbibed a good deal of the German spirit; and German influence, especially through the media of poetry and music, can often be traced in the cast of his thought and sentiment, as well as in some of the intricacies of his literary style. Returning to England he was at first articled to a solicitor in London, but he had little inclination for the law, and soon abandoned it for the more congenial sphere of letters, of which he had become an eager student. At the age of twenty-one he began to contribute poetry to the magazines, and he eked out a livelihood for some years by journalism, for the *Daily News* and other London papers, and for the *Ipswich Journal*, for which he wrote leaders; a certain number of his more characteristic fugitive writings are collected in the memorial edition of his works (1910). In London he became one of the leading spirits in the group of young philosophical and positivistic Radicals, among whom were John (afterwards Lord) Morley, Frederic Harrison, Cotter Morison and Admiral Maxse. But during the years when he was producing his finest novels he was practically unknown to the public. In 1849 he married Mrs Nicholls, daughter of Thomas Love Peacock, the novelist, a widow, eight years his senior, whose husband had been accidentally drowned a few months after her first marriage (1844), and who had one child, a daughter; but their married life was broken by separation; she died in 1861, and in 1864 Meredith married Miss Vulliamy, by whom he had a son and daughter. His second wife died in 1885. Up to that time there is little to record in the incidents of his life; he had not been "discovered" except by an "honourable minority" of readers and critics. It must suffice to note that during the Austro-Italian War of 1866 he acted as special correspondent for the *Morning Post*; and though he saw no actual fighting, he enjoyed, particularly at Venice, opportunities for a study of the Italian people which he turned to account in several of his novels. Towards the close of 1867, when his friend John Morley paid a visit to America, Meredith undertook in his absence the editorship of the *Fortnightly Review* for Messrs Chapman & Hall. They were not only the publishers of his books, but he acted for many years as their literary adviser, in which capacity he left a reputation for being not only eminently wise in his selection of the books to be published, but both critical and encouraging to authors of promise whose works he found himself obliged to reject. Thomas Hardy and George Gissing were among those who expressed their grateful sense of his assistance. He was indeed one of the last of the old school of "publishers' readers." In his early married life he lived near Weybridge, and later at Copsham between Esher and Leatherhead, while soon after his second marriage he settled at Flint Cottage, Mickleham, near Dorking, where he remained for the rest of his life.

Meredith's first appearance in print was in the character of a poet, and his first published poem "Chillian Wallah," may be found in *Chambers's Journal* for the 7th of July 1849. Two years later he put forth a small volume of *Poems* (1851), which was at least fortunate in eliciting the praise of two judges whose opinion was of the first importance to a beginner. Tennyson was at once struck by the individual flavour of the verse, and declared of one poem, "Love in the Valley," that he could not get the lines out of his head. Charles Kingsley's eulogy was at once more public and more particular. In *Fraser's Magazine* he subjected the volume to careful consideration, praising it for richness and quaintness of tone that reminded him of Herrick, for completeness and coherence in each separate poem, and for the animating sweetness and health of the general atmosphere. At the same time he censured the laxity of rhythm, the occasional lack of polish, and the tendency to overload the description with objective details to the confusion of the principal effect. No doubt as a result of Kingsley's introduction, two poems by Meredith appeared in *Fraser's Magazine* shortly afterwards; but with the exception of these, and a sonnet in the *Leader*, he did not publish anything for the next five years. In the meanwhile he was busy upon his first essay in prose fiction. It was early in 1856 that the *Shaving of Shagpat*, a work of singular imagination, humour and romance, made its appearance. Modelled upon the stories of the *Arabian Nights*, it catches with wonderful ardour the magical atmosphere of Orientalism, and in this genre it remains a unique triumph in modern letters. Though unappreciated by the multitude, its genius was at once recognized by such contemporaries as George Eliot and Dante Gabriel Rossetti, the latter of whom was one of Meredith's intimate friends. For his next story it occurred to Meredith to turn his familiarity with the life and legendary tradition of the Rhinelander into a sort of imitation of the grotesquerie of the German romanticists, and in 1857 he put forth *Farina, a Legend of Cologne*, which sought to transfer to English sympathies the spirit of German romance in the same way that *Shagpat* had handled Oriental fairy-lore. The result was less successful. The plot of *Farina* lacks fibre, its motive is insufficient, and the diverse elements of humour, serious narrative, and romance scarcely stand in proportion to one another. But the *Ordeal of Richard Feverel*, which followed in 1859, transferred Meredith at once to a new sphere and to the altitude of his accomplishment. With this novel Meredith deserted the realm of fancy for that of the philosophical and psychological study of human nature, and *Richard Feverel* was the first, as it is perhaps the favourite, of those wonderful studies of motive and action which placed him among the demigods of English literature. The essential theme of this fine criticism of life is the question of a boy's education. It depicts the abortive attempt of a proud and opinionated father, hide-bound by theory and precept, to bring up his son to a perfect state of manhood through a "system" which controls all his early circumstances and represses many of the natural and wholesome instincts and impulses of adolescence. The love scenes in *Richard Feverel* are gloriously natural and full of vitality, and the book throughout marked a revolution in the English treatment of manly passion. Those who have not read this novel in the original form, with the chapters which were afterwards omitted, have lost, however, the key to many passages in the story. In the following year Meredith contributed to *Once a Week*, and in 1861 published as a book the second of his novels of modern life, *Evan Harrington*, originally with the sub-title "He Would be a Gentleman"—in allusion to the hero being the son of "Old Mel," the tailor—which contains a richly humorous—in its unrevised form, splendidly farcical—plot, with some magnificent studies of character. Afterwards revised, a certain amount of the farcical element was cut out, with the result that, considered as comedy, it has weak spots; but the Countess de Saldar remains a genuine creation. A year later he produced his finest volume of poems, entitled *Modern Love, and Poems of the English Roadside, with Poems and Ballads*. An attack upon the dramatic poem which gives the volume its title appeared in the *Spectator*, and is memorable for the fact that Meredith's friend, the poet Swinburne, with one of his characteristically generous impulses, replied (*Spectator*, June 7, 1862) in a spirit of fervent eulogy. Some of the individual "sonnets" (of sixteen lines) into which *Modern Love* is divided are certainly worthy of being ranked with the most subtle and most intense poetic work of the 19th century.

Returning to fiction, Meredith next published *Emilia in England* (1864), afterwards renamed *Sandra Belloni*. His powerful story *Rhoda Fleming* (1865) followed soon afterwards. *Vittoria*, published in the *Fortnightly Review* in 1866, and in book form in 1867, is a sequel to *Emilia in England*. Four years later appeared *The Adventures of Harry Richmond* in the pages of *Cornhill* (1870–1871). Its successor was *Beauchamp's Career* (*Fortnightly Review*, 1874–1875), the novel which Meredith usually described as his own favourite. Its hero's character is supposed to have been founded upon that of Admiral Maxse. *Sandra Belloni, Rhoda Fleming, Vittoria* and *Beauchamp* are all masterpieces of his finest period, rich in incident, character and workmanship. "The House on the Beach" and "The Case of General Opie and Lady Camper" (*New Quarterly Magazine*, 1877) were slight but glittering exercises in comedy; the next important novel was *The Egoist* (1879), which shows an increase in Meredith's twistedness of literary style and is admittedly hard to read for those who merely want a "story," but which for concentrated analysis and the real drama of the human spirit is an astounding production. In an interesting series of lectures which Meredith delivered at the London Institution in 1877 his main thesis was that a man without a sense of comedy is dead to the finer issues of the spirit, and the conception of Sir Willoughby Patterne, the central figure of *The Egoist*, is an embodiment of this idea in the flesh. *The Tragic Comedians* (1880), the next of Meredith's novels, slighter in texture than his others, combines the spirits of comedy and tragedy in the story of the life of Ferdinand Lassalle, the German Socialist. The appearance of *Diana of the Crossways* (1885), a brilliant book, full of his ripest character-drawing, though here and there tormenting the casual reader by the novelist's mannerisms of expression, marks an epoch in Meredith's career, since it was the first of his stories to strike the general public. Its heroine was popularly identified with Sheridan's granddaughter, Mrs Norton, and the use made in it of the contemporary story of that lady's communication to *The Times* of the cabinet secret of Peel's conversion to Free Trade had the effect of producing explicit evidence of its inaccuracy from Lord Dufferin and others. As a matter of historical fact it was Lord Aberdeen who himself gave Delane the information, but the popular acceptance of the other version of the incident gave a factitious interest to the novel.

Meanwhile further instalments of poems—*Poems and Lyrics of the Joy of Earth* (1883)—had struck anew the full, rich note of natural realism which is Meredith's chief poetic characteristic. "The Woods of Westermain," in particular, has a sense of the mysterious communion of man with nature unapproached by any English poets save Wordsworth and Shelley. *Ballads and Poems of Tragic Life* (1887) and *A Reading of Earth* (1888) gave further evidence of the wealth of thought and vigour of expression which Meredith brought to the making of verse. To "the general," no doubt, Meredith's verse is prohibitive, or nearly so—for, after all, he has written some poems, like "Martin's Puzzle," "The Old Chartist," and "Juggling Jerry," which anybody can read with ease. But his most characteristic style in verse is so concentrated that any one accustomed to "straightforward" writing, and unwilling to read with the mind rather than with the eye, must needs, to his loss, be put off. His readers, of the verse even more than of the prose, must be prepared to meet him on a common intellectual footing. When once that is granted, however, the music and magic of such poems as "Seed-time," "Hard Weather," "The Thrush in February," "The South-Wester," "The Lark Ascending," "Love in the Valley," "Melampus," "A Faith on Trial," are very real, amid all their occasional obscurities of diction.

Meredith had now completed his sixtieth year, and with his advancing years the angles of his individuality began to grow sharper, while the difficulties of his style became accentuated. The increase in mannerism was marked in *One of Our Conquerors* (1891), otherwise a magnificent rendering of a theme full of both tragedy and comedy, and in the poem of "The Empty Purse" (1892). Neither *Lord Ormont and His Aminta* (1894) nor *The Amazing Marriage* (1895) reached the level of the earlier novels, though in the latter he seemed to catch an afterglow of genius. In 1898 appeared his *Odes in Contribution to the Song of French History*, consisting of one ode ("France, December 1870") reprinted from *Ballads and Poems* (1871), and three others previously unpublished; a fine example of his lofty thought, and magnificent—if often difficult—and individual diction. In 1901 another volume of verse, *A Reading* *of Life*, appeared. In later years too he contributed occasional poems to newspapers and reviews and similar publications, which were collected after his death (*Last Poems*, 1910). His comedy, *The Sentimentalists*, was performed on the 1st of March 1910; his early but unfinished novel, *Celt and Saxon*, was also posthumously published in that summer.

From the early 'nineties onward Meredith's fame had been firmly established. His own literary contemporaries still living could join hands with the younger generation of enthusiastic admirers in insisting on a greatness of which they themselves had been unable to persuade the public. He was chosen to succeed Tennyson as president of the Authors' Society; on his seventieth birthday (1898) he was presented with a congratulatory address by thirty of the most prominent men of letters of the day; before he died he had been included by the king in the Order of Merit; and in various other ways his position as the chief living English writer had come to be popularly recognized. The critics discussed him; and new editions of his books (both prose and verse), for which there had long been but scanty demand, were called for. One of the results was that Meredith, with very doubtful wisdom, recast some of his earlier novels; and in the sumptuous "authorized edition" of 1897 (published by the firm of Constable, of which his son, William Maxse Meredith, was a member) very large alterations are made in some of them. In fact, a reader who compares the first and last editions either of *Richard Feverel* or *Evan Harrington* will notice changes little short of revolutionary. Even in the previously current editions of 1878 onwards, published by Chapman & Hall, *Richard Feverel* had been considerably shortened as compared with the original three-volume edition; but it was now robbed again of some of its best-known passages. It is no doubt competent to an author himself to revise his earlier published work even to the extent to which Meredith in the 1897 edition revised these novels; but certainly it is not necessary to accept his judgment when this involves the excision in old age of some of the most virile passages of books that were written in the full glow and vigour of his prime. In Constable's memorial edition (1910) of his complete works the excisions were published separately, and are therefore on record for those to consult who care. But the wise will read *Richard Feverel* and *Evan Harrington* in the original versions.

Meredith's literary quality must always be considered in the light of the Celtic side of his temperament and the peculiarities of his mental equipment. His nature was intuitive rather than ratiocinative; his mental processes were abrupt and far-reaching; and the suppression of connecting associations frequently gives his language, as it gave Browning's, but even to a greater extent, the air of an impenetrably nebulous obscurity. This criticism applies mainly to his verse, but is also true of his prose in many places, though there is much exaggeration about the difficulties of his novels. When once, however, his manner has been properly understood, it is seen to be inseparable from his method of intellection, and to add to the narrative of description both vividness of delineation and intensity of realization. The essential respect in which Meredith's method of describing action and emotion in narrative differs from that of convention is that, while the ordinary method is to relate what happens from the point of view of the onlooker, Meredith frequently describes it from the point of emotion of the actor; and his influence in this direction has largely modified the art of fiction. Herein lies the secret of the peculiar brilliancy of his style, derived from his combination of the narrator with the creator, or—in its strict sense—the seer. The reader, by the transference of the interest from the audience to the stage, is transported into the very soul of the character, and made to feel as he feels and act as he acts. Moreover, Meredith's instinct for psychology is so intimate, and his sense of motive and action so true, that the interaction of character and character directly dominates the sequence of events depicted in his imaginary world, and discloses the moral idea or criticism of life, instead of the preconceived "moral" being merely illustrated by the plot. In building up the minds, actions, creeds, and tragedies or comedies of his imaginary personalities amid the selected circumstances, and inspiring them with the identical motives and educational influences of life itself, Meredith spent an elaboration and profundity of thought and an originality and vigour of analysis upon his novels which in explicitness go far beyond what had previously been attempted in fiction, and which give to his works a philosophical value of no ordinary kind. Simplicity can scarcely be expected of his language, for the interplay of ideas is in itself original and complex, and their interpretation is necessarily original and complex too. But when Meredith is at his best he is only involved with the involution of his subject; the aphorisms that decorate his style are simple when the idea they convey is simple, elaborate only in its elaboration. Pregnant, vividly graphic, capable of infinite shades and gradations, his style is a much finer and subtler instrument than at first appears, and must be judged finally by what it conveys to the mind, and not by its superficial sound upon the conventional ear. It owes something to Jean Paul Richter; something, too, to Carlyle, with whose methods of narrative and indebtedness to the apparatus of German metaphysics it has a good deal in common. To the novelist Richardson, too, a careful reader will find that Meredith, both in manner and matter (notably in *The Egoist* and in *Richard Feverel*), owes a good deal; in "Mrs Grandison" in *Richard Feverel* he even recalls "Sir Charles Grandison" by name; and nobody can doubt that Sir Willoughby Patterne, both in idea and often in expression, was modelled on Richardson's creation. Careful students of the early 19th-century English novel will find curious echoes again in Meredith of Bulwer-Lytton's (Baron Lytton's) literary manner and romantic outlook.[1] But he was, after all, an originator, and at first suffered in estimation on that score; he wrote in his own way, and what is most characteristic in Meredith remains individual. Like all the great masters, he has his own tone of voice, his own fashion of expressing an idea. Feeling, perception, reflection, judgment, have equal shares in determining his architectonic relation to a problem or a situation. He rings changes on the changing emotions of humanity, but every chime rings true. He is a literary artist. He takes great themes, not little ones; the characters in his fiction are personalities, human beings, neither "heroes" nor "sports"; and he does not descend to pander to lubricity or cater for the "reading public." His gallery of portraits of real human women, not dolls, would alone place him among the few creators in English literature.

It is beyond our scope here to enter into details concerning the philosophy which represents Meredith's "criticism of life." Broadly speaking, it is a belief in the rightness and wholesomeness of Nature, when Nature—"Sacred Reality"—is lovingly and faithfully and trustfully sought and known by the pure use of reason. Man must be "obedient to Nature, not her slave." Mystical as this philosophy occasionally becomes, it is yet an inspiring one, clean, austere and practical; and it is always dominated by the categorical imperative of self-knowledge and the striving after honesty of purpose and thought. A strong vein of political Radicalism runs through Meredith's creed. It is, however, a Radicalism allied to that of the French *philosophes*, rather than to the contemporary developments of British party politics, though in later life he gave his open support to the Liberal party. In spite of his German upbringing Meredith was always strongly French in his sympathies, and his appreciation of French character at its best and at its worst is finely shown in his Napoleon odes. In the main his politics may be summed up as a striving after liberty for reason and conscience and the constant progress of humanity—

> The cry of the conscience of life;
> *Keep the young generations in hail,*
> *And bequeath them no tumbled house.*

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[1] The fact that Bulwer-Lytton's son, the 1st Earl of Lytton, Meredith's junior by three years, took the pen-name of "Owen Meredith," led occasionally to some confusion among uninstructed contemporaries, and even the suggestion of a family connexion.

It is part of Meredith's philosophy—and this must be remembered in considering his diction—that verbal expression is *itself* a test of right thought and action. Hence is derived his passion for verbal analysis. Hence also his impulse towards and vindication of poetry—meaning still "the best words in the best order"; and hence his own dictum, otherwise perhaps hard to undiscerning minds, that Song itself is the test by which truth may be tried. The passage occurs in "The Empty Purse"—a poem which throughout is a careful though mannered exposition of Meredith's general views on life—

> Ask of thyself: This furious Yea
> Of a speech I thump to repeat,
> In the cause I would have prevail,
> For seed of a nourishing wheat,
> *Is it accepted of Song?*
> Does it sound to the mind through the ear,
> Right sober, pure sane? has it disciplined feet?
> Thou wilt find it a test severe;
> Unerring whatever the theme.
> Rings it for Reason a melody clear,
> We have bidden old Chaos retreat,
> We have called on Creation to hear;
> All forces that make us are one full stream.

Meredith is generally ranked far less high as a poet than as a novelist. But he can only be understood and appreciated properly by those who realize that not prose (in the ordinary sense) but poetry was to him the highest form of expression, and that only in it could he fully deliver his message, as a writer who aspired to contribute something more to the common stock of ideas than could be embodied dramatically in prose fiction.

On Meredith's 80th birthday in 1908, the homage of the English literary world was again paid in an address of congratulation. But his health, which for many years had been precarious, was now failing. He died at Flint Cottage, Box Hill, Surrey, on the 18th of May 1909. A strong feeling existed that he should be buried in Westminster Abbey, and a petition to that effect, which was approved by the prime minister, Mr Asquith, was signed by a large number of men of letters. But this was not to be. A memorial service was held in the abbey, but Meredith's own remains, after cremation, were interred at Dorking by the grave of his second wife. He had died only a brief span after his old friend Swinburne, his affection for whom had never suffered abatement, and it was felt that, with them, a great epoch in English literary history had closed. They were the last of the great Victorians; and in Meredith went the writer who had raised the creative art of the novel, as a vehicle of character and constructive philosophy, to its highest point—a point higher indeed than most contemporary readers were prepared for. The estimate of his genius formed by "an honourable minority," who would place him in the highest class of all, by Shakespeare, has yet to be confirmed by the wider suffrage of posterity.

A carefully compiled bibliography by John Lane was included in *George Meredith: Some Characteristics*, by R. Le Gallienne (1890). This sympathetic essay in criticism was the first substantial publication addressed to that stimulation of a wider appreciation of Meredith which was carried on by several later books, perhaps the best of which is M. Sturge Henderson's *George Meredith: Novelist Poet, Reformer* (1908); but such earlier testimonies to Meredith's importance as Justin McCarthy's, in his *History of Our Own Times*, must not be forgotten. See also J. A. Hammerton, *George Meredith in Anecdotes and Criticism* (1909). (H. Ch.)

MEREJKOVSKY (or Merezhkovskiy), **DMITRI SERGYEEVICH** (1865–), Russian novelist and critic, was born at St Petersburg in 1865. His trilogy of historical romances, collectively entitled *Christ and Antichrist*, has been translated into many European languages, notably English and French. It comprises *Smert Bogov* (Eng. trans. "The Death of the Gods," London, 1901), the central figure in which is Julian the Apostate; *Voskresenie Bogi* ("The Forerunner," London, 1902), which describes the life and times of Leonardo da Vinci; and *Antikhrist: Pëtr i Aleksyey* ("Peter and Alexis," London, 1905), which is based on the tragic story of the relations between Peter the Great and his son. The influence of Sienkiewicz can be traced in many of Merejkovsky's writings, which include critical studies of Pliny the Younger, Calderon, Montaigne, Ibsen, Tolstoy (*Tolstoy as Man and Artist*, London, 1902), and of Gorki and other Russian writers. Merejkovsky married Zinaida Nikolaevna, known in Russia for her poems, essays and short stories written under the pseudonym of Zinaida Hippius (or Gippius); her collected poems (1889–1903) were published in Moscow in 1904.

MERES, FRANCIS (1565–1647), English divine and author, was born at Kirton in the Holland division of Lincolnshire in 1565. He was educated at Pembroke College, Cambridge, where he graduated B.A. in 1587, and M.A. in 1591. Two years later he was incorporated M.A. of Oxford. His kinsman, John Meres, was high sheriff of Lincolnshire in 1596, and apparently helped him in the early part of his career. In 1602 he became rector of Wing in Rutland, where he had a school. He died on the 29th of January 1647. Meres rendered immense service to the history of Elizabethan literature by the publication of his *Palladis Tamia, Wits Treasury* (1598). It was one of a series of volumes of short pithy sayings, the first of which was *Politeuphuia: Wits Commonwealth* (1597), compiled by John Bodenham or by Nicholas Ling, the publisher. The *Palladis Tamia* contained moral and critical reflections borrowed from various sources, and embraced sections on books, on philosophy, on music and painting, and a famous "Comparative Discourse of our English poets with the Greeke, Latin, and Italian poets." This chapter enumerates the English poets from Chaucer to Meres's own day, and in each case a comparison with some classical author is instituted. The book was issued in 1634 as a school book, and has been partially reprinted in the *Ancient Critical Essays* (1811–1815) of Joseph Haslewood, Professor E. Arber's *English Garner*, and Gregory Smith's *Elizabethan Critical Essays* (1904). A sermon entitled *Gods Arithmeticke* (1597), and two translations from the Spanish of Luis de Granada entitled *Granados Devotion* and the *Sinners Guide* (1598) complete the list of his works.

MERGANSER, a word due to C. Gesner (*Hist. animalium* iii. 129) in 1555, and for long used in English as the general name for a group of fish-eating ducks possessing great diving powers, and forming the genus *Mergus* of Linnaeus, now regarded by ornithologists as a sub-family, *Merginae*, of the family *Anatidae*. The mergansers have a long, narrow bill, with a small but evident hook at the tip, and the edges of both mandibles beset by numerous horny denticulations, whence in English the name of "saw-bill" is frequently applied to them. Otherwise their structure does not much depart from the Anatine or Fuliguline type. All the species bear a more or less developed crest or tuft on the head. Three of them, *Mergus merganser* or *castor*, *M. serrator*, and *M. albellus*, are found over the northern parts of the Old World, and of these the first two also inhabit North America, which has besides a fourth species, *M. cucullatus*, said to have occasionally visited Britain. *M. merganser*, commonly known as the goosander, is the largest species, being nearly as big as the smaller geese, and the adult male in breeding-attire is a very beautiful bird, conspicuous with his dark glossy-green head, rich salmon-coloured breast, and the upper part of the body and wings black and white. This full plumage is not assumed till the second year, and in the meantime, as well as in the post-nuptial dress, the male much resembles the female, having, like her, a reddish-brown head, the upper parts grey and the lower white. In this condition the bird is often known as the "dun diver." This species breeds abundantly in many parts of Scandinavia, Russia, Siberia and North America, and occasionally in Scotland. *M. serrator*, commonly called the red-breasted merganser, is a somewhat smaller bird; and, while the fully-dressed male wants the delicate hue of the lower parts, he has a gorget of rufous mottled with black, below which is a patch of white feathers, broadly edged with black. Both these species have the bill and feet of a bright reddish-orange, while the much smaller *M. albellus*, known as the smew, has these parts of a lead colour, and the breeding plumage of the adult male is white, with quaint crescentic markings of black, and the flanks most beautifully vermiculated.

M. cucullatus, the hooded merganser of North America, is in size intermediate between *M. albellus* and *M. serrator*; the male is easily recognizable by his broad semicircular crest, bearing a fanshaped patch of white, and his elongated subscapulars of white edged with black. The conformation of the trachea in the male of *M. merganser*, *M. serrator* and *M. cucullatus* is very like that of the ducks of the genus *Clangula*, but *M. albellus* has a less exaggerated development more resembling that of the ordinary *Fuligula*.[1] From the southern hemisphere two species of *Mergus* have been described, *M. octosetaceus* or *brasilianus*, L. P. Vieillot (*N. Dict. d'Hist. naturelle*, ed. 2, vol. xiv. p. 222; *Gal. des oiseaux*, tom. ii. p. 209, pl. 283), inhabiting South America, of which but few specimens have been obtained, having some general resemblance to *M. serrator*, but much more darkly coloured, and *M. australis*, Hombron and Jacquemont (*Ann. sc. nat. zoologie*, ser. 2, vol. xvi. p. 320; *Voy. au Pol Sud; oiseaux*, pl. 31, fig. 2), known only by the unique example in the Paris Museum procured by the French Antarctic expedition in the Auckland Islands.

Often associated with the mergansers is the genus *Merganetta*, the so-called torrent-ducks of South America, of which six species have been described; but they possess spiny tails and have their wings armed with a spur. These with *Hymenolaemus Malacorhynchus*, the blue duck of New Zealand, and *Salvadorina waigiuensis* of Waigiou are placed in the sub-family *Merganettinae*. (A. N.)

MERGENTHEIM, a town of Germany, in the kingdom of Württemberg, situated in the valley of the Tauber, 7 m. S. from Lauda by rail. Pop. (1905), 4535. It contains an Evangelical and three Roman Catholic churches, a Latin and other schools, and a magnificent castle with a natural history collection and the archives of the Teutonic order. This is now used as barracks. The industries of the town include tanning, the manufacture of agricultural machinery and wine-making. Near the town is a medicinal spring called the Karlsbad.

Mergentheim (*Mariae domus*) is mentioned in chronicles as early as 1058, as the residence of the family of the counts of Hohenlohe, who early in the 13th century assigned the greater part of their estates in and around Mergentheim to the Teutonic order. It rapidly increased in fame, and became the most important of the eleven commanderies of that society. On the secularization of the Teutonic Order in Prussia in 1525, Mergentheim became the residence of the grand master, and remained so until the final dissolution of the order in 1809.

See Höring, *Das Karlsbad bei Mergentheim* (Mergentheim, 1887); and Schmitt, *Garnisongeschichte der Stadt Mergentheim* (Stuttgart, 1895).

MERGER (Fr. *merger*, to sink), in law, the sinking or "drowning" of a lesser estate in a greater, when the two come together in one and the same person without any intervening estate. In order to effect a merger the two estates must vest in the same person at the same time, must be immediately expectant one on the other, and the expectant estate must be larger than the preceding estate. The term is also used for the extinguishment of any right, contract, &c., by absorption in another, *e.g.* the acceptance of a higher security for a lower, or the embodying of a simple contract in a deed.

MERGUI, the southernmost district of Lower Burma, in the Tenasserim division, bounded on the W. by the Bay of Bengal and on the E. by Siam. Area 9789 sq. m. Two principal ranges cross the district from north to south, running almost parallel to each other for a considerable distance, with the Tenasserim river winding between them till it turns south and flows through a narrow rocky gorge in the westernmost range to the sea. The whole district, from the water's edge to the loftiest mountain on the eastern boundary, may be regarded as almost unbroken forest. The timber trees found towards the interior, and on the higher elevations, are of great size and beauty, the most valuable being teak (*Tectona grandis*), *then-gan* (*Hopea odorata*), *ka-gnyeng* (*Dipterocarpus laevis*), &c. The coast-line of the district, off which lies an archipelago of two hundred and seven islands, is much broken, and for several miles inland is very little raised above sea-level, and is drained by numerous muddy tidal creeks. Southwards of Mergui town it consists chiefly of low mangrove swamps alternating with small fertile rice plains. After passing the mangrove limits, the ground to the east gradually rises till it becomes mountainous, even to the banks of the rivers, and finally culminates in the grand natural barrier dividing Burma from Siam. The four principal rivers are the Tenasserim, Le-nya, Pakchan and Palauk, the first three being navigable for a considerable distance. Coal is found on the banks of the Tenasserim and its tributaries, but is still unworked. Gold, copper, iron and manganese are also found in various parts of the district, and there are tin mines at Maliwun, upon which European methods have been tried without much profit, owing to the cost of labour.

From the notices of early travellers it appears that Mergui, when under Siamese rule, before it passed to the Burmese, was a rich and densely peopled country. On its occupation by the British in 1824–1825 it was found to be almost depopulated —the result of border warfare and of the cruelties exercised by the Burmese conquerors. At that time the entire inhabitants numbered only 10,000. It had a population of 88,744 in 1901, showing an increase of 20% in the decade and giving a density of 9 inhabitants to the sq. m. Mergui carries on a flourishing trade with Rangoon, Bassein and the Straits Settlements. The chief exports consist of rice, rattans, torches, dried fish, areca-nuts, sesamum seeds, molasses, sea-slugs, edible birds' nests and tin. The staple imports are piece goods, tobacco, cotton, earthenware, tea and sugar. The climate is remarkably healthy, the heat due to its tropical situation being moderated by land and sea breezes. The rainfall is very heavy and usually exceeds 150 inches.

Mergui town has risen into prominence in recent years as the centre of the pearling trade in the neighbouring archipelago. The pearling grounds were practically unknown in 1890, but in the following decade they produced pearls and mother-of-peal shell of considerable value. In 1901 the population was 11,987; but the census is taken at a time when many of the fishermen and their families are away in the islands. There is a considerable coasting trade with other Burmese ports and with the Straits Settlements.

MERGUI ARCHIPELAGO, a cluster of islands in the Bay of Bengal, near the southern coast of Lower Burma. They are chiefly noted for their picturesque beauty, some of them rising to 3000 ft. They are only sparsely inhabited by the island race of Selungs.

MERIAN, MATTHEW (1593–1650), Swiss engraver, was born in Basel, on the 25th of September 1593. The family came originally from near Delémont, but in his grandfather's time settled in Basel, where in 1553 it obtained the burghership of the city. As Matthew early showed signs of artistic tastes, he was placed (1609) under the care of Dietrich Meyer, a painter and engraver of Zürich (1572–1658). He went on to Nancy in 1613, where he already displayed considerable talents as an engraver on copper. After studying in Paris, Stuttgart (1616) and the Low Countries, he came to Frankfort, where in 1618 he married the eldest daughter of J. T. de Bry, who was a publisher and bookseller as well as an engraver. Merian worked for some time with his father-in-law in Oppenheim, but then returned to Basel, whence he came back (1624) to Frankfort after Bry's death (1623), in order to take over his business;

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[1] Hybrids between, as is presumed, *M. albellus* and *Clangula glaucion*, the common golden-eye, have been described and figured (Eimbeck, *Isis*, 1831, 300, tab. iii.; Brehm, *Naturgesch. aller Vög. Deutschlands*, p. 930; Naumann, *Vög. Deutschlands*, xii. 194, frontispiece; Kjærbølling, *Jour. für Ornithologie*, 1853, Extraheft, p. 29, *Naumannia*, 1853, p. 327, *Ornithol. danica*, tab. lv., suppl. tab. 29) under the names of *Mergus anatarius*, *Clangula angustirostris*, and *Anas* (*Clangula*) *mergoides*, as though they were a distinct species; but the remarks of De Selys-Longchamps (*Bull. Ac. Sc. Bruxelles*, 1845, pt. ii. p. 354, and 1856, pt. ii. p. 21) leave little room for doubt as to their origin, which, when the cryptogamic habit and common range of their putative parents, the former unknown to the author last-named, is considered, will seem to be still more likely.

this remained in his family till 1726, when, after a great fire that destroyed most of the books in stock, it came to an end. In 1625 Merian became a burgher of Frankfort, then the great centre of the book trade in Germany, and lived there till his death on the 22nd of June 1650. Among his many works two deserve to be specially mentioned. The first is the long series of works, each entitled *Topographia*, which contained descriptions of various countries, illustrated by copper plates, largely done by Merian himself, while the accompanying text was due to Martin Zeiller (1589–1661), an Austrian by birth. The first volume was published in 1642 and described Switzerland, with the Grisons and the Valais; it contains the first known view of the glaciers of Grindelwald. "Austria" appeared in 1649, but the volume relating to Upper Saxony and Bohemia (1650) was the last issued by Merian himself. "France" appeared in 1655–1656, while in 1688 the series (extending to 30 parts, in 18 vols.) came to an end with "Italy," the volume as to Rome having appeared in 1681. The other great enterprise of Merian was the series entitled *Theatrum Europaeum*, which appeared in 21 parts between 1635 and 1738—it is a historical chronicle of events in Europe from 1617 onwards. In 1625–1630 Merian published a series of illustrations to the Bible, and in 1649 a *Dance of Death*. But he is best remembered by his views of towns, which have very considerable historical value. His best pupil, Wenceslaus Hollar (1607–1677), of Prague, settled in London (1635–1643, 1652–1677), and worthily carried on the Merian tradition. (W. A. B. C.)

See Life, by H. Eckardt (Basel, 1887).

MÉRIDA, a city of Mexico and capital of the state of Yucatan, 23 m. by rail S. of Progreso, its port on the Gulf of Mexico. Pop. (1900), 43,630, the Maya element being predominant. Mérida is the centre of an isolated railway system, connected with the ports of Progreso and Campeche, and having short lines radiating in all directions to Peto, Valladolid and Izamal. It stands on a broad, partly open plain near the northern border of the peninsula, where the thin loose soil covering a limestone foundation permits the rapid percolation and evaporation of the rainfall, and therefore supports a comparatively scanty vegetation. It is highly favourable to maguey cultivation, however, and Mérida is the centre of the henequén, or sisal fibre, industry. There is an imposing 16th-century cathedral facing upon the principal plaza, together with the government and episcopal palaces. There are also an old university, with schools of law, medicine and pharmacy, an episcopal seminary and other educational institutions. The most interesting building in the city is a Franciscan convent, dating from 1547, which covers an area of 6 acres and is surrounded by a wall 40 ft. high and 8 ft. thick. It once harboured no less than 2000 friars, but has been allowed to fall into complete decay since the expulsion of the order in 1820. The manufactures include straw hats, hammocks, cigars, soap, cotton fabrics, leather goods, artificial stone, and a peculiar distilled beverage called *estabentun*. The exports are henequén, or sisal fibre, hides, sugar, rum, chicle and indigo—all products of the vicinity. Mérida was founded in 1542 by the younger Francisco de Montejo on the site of a native city called Tihoo, or Thó, whose stone pyramids furnished building material in abundance for the invaders. It became an episcopal see in 1561.

MÉRIDA (anc. *Augusta Emerita*, capital of Lusitania), a town of western Spain, in the province of Badajoz, on the right bank of the river Guadiana, 30 m. E. of Badajoz. Pop. (1900), 11,168. Mérida is an important railway junction, for here the Madrid-Badajoz railway meets the lines from Seville, Huelva and Cáceres. No Spanish town is richer in Roman antiquities. Most of these are beyond the limits of modern Mérida, which is greatly inferior in area to the ancient city. Chief among them is the Roman bridge, constructed of granite under Trajan, or, according to some authorities, under Augustus, and restored by the Visigoths in 686 and by Philip III. in 1610. It comprised 81 arches, 17 of which were destroyed during the siege of Badajoz (1812), and measured 2575 ft. in length. There are a few remnants of Roman temples and of the colossal wall which encircled the city, besides a Roman triumphal arch, commonly called the Arco de Santiago, and a second Roman bridge, by which the road to Salamanca was carried across the small river Albarregas (*Alba Regia*). The Moorish *alcázar* or citadel was originally the chief Roman fort. From the Lago de Proserpina, or Charca de la Albuera, a large Roman reservoir, 3 m. north, water was conveyed to Mérida by an aqueduct, of which 37 enormous piers remain standing, with ten arches in three tiers built of brick and granite. The massive Roman theatre is in good preservation; there are also a few vestiges of an amphitheatre and of a circus which measured 485 yds. by 120. Other Roman remains are exhibited in the archaeological museum, and much Roman masonry is incorporated in the 16th century Mudéjar palace of the dukes of La Roca, the palace of the counts of Los Corbos, and the convent of Santa Eulalia, which is said by tradition to mark the spot where St Eulalia was martyred (*c.* 300).

Augusta Emerita was founded in 25 B.C. As the capital of Lusitania it soon became one of the most splendid cities in Iberia, and was large enough to contain a garrison of 90,000 men. Under the Visigoths it continued to prosper, and was made an archbishopric. Its fortifications included five castles and eighty-four gateways; but after a stubborn resistance it was stormed by the Moors in 713. Its Moorish governors frequently, and sometimes successfully, asserted their independence, but Mérida was never the capital of any large Moorish state. In 1129 its archbishopric was formally transferred to Santiago de Compostela, and in 1228, when Alphonso IX. of Leon expelled the Moors, Mérida was entrusted to the order of Santiago, in whose keeping it soon sank into decadence.

MERIDEN, a city of New Haven county, Connecticut, U.S.A., in the township of Meriden, S.W. of the centre of the state, about 18 m. N.N.E. of New Haven and about the same distance S.S.W. of Hartford. Pop. of the township, including the city (1900), 28,695; (1910), 32,066; of the city (1900), 24,296, of whom 7215 were foreign-born; (1910), 27,265. Meriden is served by the New York, New Haven & Hartford railway and by an inter-urban electric line. The city is bisected by Harbor Brook, a small stream, and through the S.W. part of the township flows the Quinnipiac river. A short distance N.W. of the city, in Hubbard Park, an attractive reservation of more than 900 acres, are the Hanging Hills, three elevations (West Mountain, South Mountain and Cat-Hole Mountain) in a broken range of trap ridges, which have resisted the erosion that formed the lowlands of the Connecticut valley; they rise to a height of about 700 ft. above the sea. In their vicinity, near the boundary of Berlin township, is Merimere, one of the city's four reservoirs. Meriden is the seat of the Connecticut School for Boys (Reformatory). There are also a public library (1899), a state armoury, a hospital, the Curtis Home for orphans and aged women, and a tuberculosis sanitarium supported by the city. Meriden is one of the most important manufacturing cities of Connecticut, and in 1905 produced 59·9% of the plated ware manufactured in the state, and much sterling silver. In 1905 the factory product was valued at $13,763,548, an increase of 17·1% over that of 1900. Meriden was originally a part of the township of Wallingford, but a tract in the northern part of this township was designated as Merideen by an Indian deed of 1664. It was made a separate parish under that name in 1728, but did not become a separate township until 1806. The city was chartered in 1867.

See G. W. Perkins, *Historical Sketches of Meriden* (West Meriden, 1849); C. H. S. Davis, *History of Wallingford* (Meriden, 1870), and G. M. Curtis and C. Bancroft Gillespie, *A Century of Meriden* (Meriden, 1906).

MERIDIAN, a city and the county-seat of Lauderdale county, Mississippi, U.S.A., about 90 m. E. of Jackson. Pop. (1890), 10,624; (1900), 14,050, of whom 5787 were negroes; (1910 census), 23,285. It is served by the Southern, the Alabama Great Southern, the Mobile & Ohio, and the New Orleans & North Eastern and the Alabama & Vicksburg (Queen &

Crescent Route) railways. It is the seat of the East Mississippi Insane Hospital, of the state Masonic Widows and Orphans' Home and of the Meridian Women's College (non-sectarian, opened in 1903), the Meridian Male College (opened in 1901), and, for negroes, the Lincoln School (Congregational) and Meridian Academy (Methodist Episcopal). The city is an important market for cotton grown in the surrounding country, and is the principal manufacturing city in the state. Its factory products, chiefly railway supplies and cotton products, increased in value from $1,924,465 in 1900 to $3,267,600 in 1905, or 69·8% in five years. Mineral waters (especially lithia) are bottled in and near the city. Meridian was laid out in 1854 at a proposed railway crossing, and was chartered as a city in 1860. In February 1864 General William Tecumseh Sherman, with an army of about 20,000, made an expedition from Vicksburg to Meridian, then an important railway centre and dépôt for Confederate supplies, chiefly for the purpose of making inoperative the Mobile & Ohio and the Jackson & Selma railways; on the 14th of the month his army entered Meridian, and within a week destroyed nearly everything in the city except the private houses, and tore up over 110 m. of track. In the "Meridian riot" of 1871—a prominent episode of reconstruction—when one of several negroes on trial for urging mob violence had shot the presiding judge, the whites, especially a party from Alabama interested in the trial, killed a number of negroes and burned a negro school. On the 2nd of March 1906 a cyclone caused great loss of life and property.

MERIDIAN (from the Lat. *meridianus*, pertaining to the south or mid-day), in general a direction toward the south or toward the position of the sun at mid-day. The terrestrial meridian of a place is the great circle drawn on the earth's surface from either pole through the place. As determined astronomically the celestial meridian is the great circle passing through the celestial pole and the zenith. The terrestrial meridian as practically determined is the circle on the earth's surface in which the plane of the celestial meridian cuts that surface. Owing to local deviations of the plumb-line the meridian thus determined does not strictly coincide with the terrestrial meridian as ordinarily defined, but the deviation, though perceptible in mountainous regions, is so minute that it is generally ignored.

MÉRIMÉE, PROSPER (1803–1870), French novelist, archaeologist, essayist, and in all these capacities one of the greatest masters of French style during the 19th century, was born at Paris on the 28th of September 1803. His grandfather, of Norman abstraction, had been a lawyer and steward to the maréchal de Broglie. His father, Jean François Léonor Mérimée (1757–1836), was a painter of repute. Mérimée had English blood in his veins on the mother's side, and had English proclivities in many ways. He was educated for the bar, but entered the public service instead. A young man at the time of the Romantic movement, he felt its influence strongly, though his peculiar temperament prevented him from joining any of the côteries of the period. Nothing was more prominent among the romantics than the fancy, as Mérimée himself puts it, for "local colour," the more unfamiliar the better. He exhibited this in an unusual way. In 1825 he published what purported to be the dramatic works of a Spanish lady, Clara Gazul, with a preface stating circumstantially how the supposed translator, one Joseph L'Estrange, had met the gifted poetess at Gibraltar. This was followed by a still more audacious and still more successful *supercherie.* In 1827 appeared a small book entitled *la Guzla* (the anagram of Gazul), and giving itself out as translated from the Illyrian of a certain Hyacinthe Maglanovich. This book, which has greater formal merit than *Clara Gazul*, is said to have taken in Sir John Bowring, a competent Slav scholar, the Russian poet Poushkin, and some German authorities, although not only had it no original, but, as Mérimée declares, a few words of Illyrian and a book or two of travels and topography were the author's only materials. In the next year appeared a short dramatic romance, *La Jacquerie*, in which are visible Mérimée's extraordinary faculty of local and historical colour, his command of language, his grim irony, and a certain predilection for tragic and terrible subjects, which was one of his numerous points of contact with the men of the Renaissance. This in its turn was followed by a still better piece, the *Chronique de Charles IX.* (1829), which stands towards the 16th century much as the *Jacquerie* does towards the middle ages. All these works were to a certain extent second-hand. But they exhibited all the future literary qualities of the author save the two chiefest, his wonderfully severe and almost classical style, and his equally classical solidity and statuesqueness of construction.

He had already obtained a considerable position in the civil service, and after the revolution of July he was *chef de cabinet* to two different ministers. He was then appointed to the more congenial post of inspector-general of historical monuments. Mérimée was a born archaeologist, combining linguistic faculty of a very unusual kind with accurate scholarship, with remarkable historical appreciation, and with a sincere love for the arts of design and construction, in the former of which he had some practical skill. In his official capacity he published numerous reports, some of which, with other similar pieces, have been republished in his works. He also devoted himself to history proper during the latter years of the July monarchy, and published numerous essays and works of no great length, chiefly on Spanish, Russian and ancient Roman history. He did not, however, neglect novel writing during this period, and numerous short tales, almost without exception masterpieces, appeared, chiefly in the *Revue de Paris.* The best of all, *Colomba*, a Corsican story of extraordinary power, appeared in 1840. He travelled a good deal; and in one of his journeys to Spain, about the middle of Louis Philippe's reign, he made an acquaintance destined to influence his future life not a little—that of Mme de Montijo, mother of the future empress Eugénie. Mérimée, though in manner and language the most cynical of men, was a devoted friend, and shortly before the accession of Napoleon III. he had occasion to show this. His friend, Libri Carucci dalla Sommaja, was accused of having stolen valuable manuscripts and books from French libraries, and Mérimée took his part so warmly that he was actually sentenced to and underwent fine and imprisonment. He had been elected of the Academy in 1844, and also of the Academy of Inscriptions, of which he was a prominent member. Between 1840 and 1850 he wrote more tales, the chief of which were *Arsène Guillot* and *Carmen* (1847), this last, on a Spanish subject, hardly ranking below *Colomba.*

The empire made a considerable difference in Mérimée's life. His sympathies were against democracy, and his habitual cynicism and his irreligious prejudices made legitimism distasteful to him. But the marriage of Napoleon III. with the daughter of Mme de Montijo at once enlisted what was always strongest with Mérimée—the sympathy of personal friendship—on the emperor's side. He was made a senator, but his most important rôle was that of a constant and valued private friend of both the "master and mistress of the house," as he calls the emperor and empress in his letters. He was occasionally charged with a kind of irregular diplomacy, and once, in the matter of the emperor's *Caesar*, he had to give literary assistance to Napoleon. But for the most part he was strictly the *ami de la maison.* At the Tuileries, at Compiègne, at Biarritz, he was a constant though not always a very willing guest, and his influence over the empress was very considerable and was fearlessly exerted, though he used to call himself, in imitation of Scarron, "le bouffon de sa majesté." He found, however, time for not a few more tales, of which more will be said presently, and for correspondences, which are not the least of his literary achievements, while they have an extraordinary interest of matter. One of these consists of the letters which have been published as *Lettres à une inconnue*, another of the letters addressed to Sir Anthony Panizzi, librarian of the British Museum. After various conjectures it seems that the *inconnue* just mentioned was a certain Mlle Jenny Daqin of Boulogne. The acquaintance extended over many years; it partook at one time of the character of love, at another of that of simple friendship, and Mérimée is exhibited in the letters under the most surprisingly diverse lights, most of them more or less amiable, and all interesting. The correspondence with Panizzi has somewhat less personal interest. But Mérimée often visited England, where he had many friends (among whom the late Mr Ellice of Glengarry was the chief), and certain similarities of taste drew him closer to Panizzi personally, while during part of the empire the two served as the channel for a kind of unofficial diplomacy between the emperor and certain English statesmen. These letters are full of shrewd *aperçus* on the state of Europe at different times. Both series, and others since published, abound in gossip, in amusing anecdotes, in sharp literary criticism, while both contain evidences of a cynical and Rabelaisian or Swiftian humour which was very strong in Mérimée. This characteristic is said to be so prominent in a correspondence with another friend, which now lies in the library at Avignon, that there is but little chance of its ever being printed. A fourth collection of letters, of much inferior extent and interest, has been printed by Blaze de Bury under the title of *Lettres à une autre inconnue* (1873), and others still by d'Haussonville (1888), and in the *Revue des Deux Mondes* (1896). In the latter years of his life Mérimée suffered very much from ill-health. It was necessary for him to pass all his winters at Cannes, where his constant companions were two aged English ladies, friends of his mother. The Terrible Year found him completely broken in health and anticipating the worst for France. He lived long enough to see his fears realized, and to express his grief in some last letters, and he died at Cannes on the 23rd of September 1870.

Mérimée's character was a peculiar and in some respects an unfortunate one, but by no means unintelligible. Partly by temperament, partly it is said owing to some childish experience, when he discovered that he had been duped and determined never to be so again, not least owing to the example of Henri Beyle (Stendhal), who was a friend of his family, and of whom he saw much, Mérimée appears at a comparatively early age to have imposed upon himself as a duty the maintenance of an attitude of sceptical indifference and sarcastic criticism. Although a man of singularly warm and affectionate feelings, he obtained the credit of being a cold-hearted cynic; and, though both independent and disinterested, he was abused as a hanger-on of the imperial court. Both imputations were wholly undeserved, and indeed were prompted to a great extent by political spite or by the resentment felt by his literary equals on the other side at the cool ridicule with which he met them. But he deserved in some of the bad as well as many of the good senses of the term the name of a man of the Renaissance. He had the warm partisanship and amiability towards friends and the scorpion-like sting for his foes, he had the ardent delight in learning and especially in matters of art and belles lettres, he had the scepticism, the voluptuousness, the curious delight in the contemplation of the horrible, which marked the men of letters of the humanist period. Even his literary work has this Renaissance character. It is tolerably extensive, amounting to some seventeen or eighteen volumes, but its bulk is not great for a life which was not short, and which was occupied, at least nominally, in little else. About a third of it consists of the letters already mentioned. Rather more than another third consists of the official work which has been already alluded to—reports, essays, short historical sketches, the chief of which latter is a history of Pedro the Cruel (1843), and another of the curious pretender known in Russian story as the false Demetrius (1852). Some of the literary essays, such as those on Beyle, on Turgueniev, &c., where a personal element enters, are excellent. Against others and against the larger historical sketches—admirable as they are—Taine's criticism that they want life has some force. They are, however, all marked by Mérimée's admirable style, by his sound and accurate scholarship, his strong intellectual grasp of whatever he handled, his cool unprejudiced views, his marvellous faculty of designing and proportioning the treatment of his work. In purely archaeological matters his *Description des peintures de Saint-Savin* is very noteworthy. It is, however, in the remaining third of his work, consisting entirely of tales either in narrative or in dramatic form, and especially in the former, that his full power is perceived. He translated a certain number of things (chiefly from the Russian); but his fame does not rest on these, on his already-mentioned youthful supercheries, or on his later semi-dramatic works. There remain about a score of tales, extending in point of composition over exactly forty years and in length from that of *Colomba*, the longest, which fills about one hundred and fifty pages, to that of *l'Enlèvement de la redoute* (1829), which fills just half a dozen. They are unquestionably the best things of their kind written during the century, the only *nouvelles* that can challenge comparison with them being the very best of Gautier, and one or two of Balzac. The motives are sufficiently different. In *Colomba* and *Mateo Falcone* (1829), the Corsican point of honour is drawn on; in *Carmen* (written apparently after reading Borrow's Spanish books), the gipsy character; in *la Venus d'Ille* (1837) and *Lokis* (two of the finest of all), certain grisly superstitions, in the former case that known in a milder form as the ring given to Venus, in the latter a variety of the were-wolf fancy. *Arsène Guillot* is a singular satire, full of sarcastic pathos, on popular morality and religion; *la Chambre bleue*, an 18th-century *conte*, worthy of C. P. J. Crébillon for grace and wit, and superior to him in delicacy; *The Capture of the Redoubt* just mentioned is a perfect piece of description; *l'Abbé au bain* is again satirical; *la Double méprise* (the authorship of which was objected to Mérimée when he was elected of the Academy) is an exercise in analysis strongly impregnated with the spirit of Stendhal, but better written than anything of that writer's. These stories, with his letters, assure Mérimée's place in literature at the very head of the French prose writers of the century. He had undertaken an edition of Brantôme for the Bibliothèque Elzévirienne, but it was never completed.

Mérimée's works have only been gradually published since his death. There is no uniform edition, but almost everything is obtainable in the collections of MM. Charpentier and Calmann Lévy. Most of the sets of letters above referred to from those to the first *inconnue*, where the introducer was Taine, have essay-prefaces on Mérimée. Maurice Tourneux's *Prosper Mérimée, sa bibliographie* (1876) and *Prosper Mérimée, ses portraits* (1879), are useful, while Émile Faguet and many other critics have dealt with him incidentally. But the best single book on him by far is the *Mérimée et ses amis* of Augustin Filon (1894). M. F. Chambon's *Correspondance inédite* (1897) gives little that is substantive, but supplies and corrects a good many gaps or faults in earlier editions. English translations, especially of *Colomba* and *Carmen*, are numerous. The *Chronique de Charles IX.* was translated by G. Saintsbury in 1889 with an introduction; and the same writer has also prefixed a much more elaborate essay, containing a review of Mérimée's entire work, to an American translation. (G. Sa.)

MERINO, the Spanish name for a breed of sheep, and hence applied to a woollen fabric. The Spanish word is generally taken to be an adaptation to the sheep of the name of an official (*merino*) who inspected sheep pastures. This word is from the medieval Latin *majorinus*, a steward, head official of a village, &c., from *major*, greater.

The merino is a white short-wool sheep, the male having spiral horns, the ewes being generally hornless. It is bred chiefly for its wool, because, though an excellent grazer and very adaptable, it matures slowly and its mutton is not of the best quality. The wool is close and wavy in staple, reaching 4 in. in length, and surpasses that of all other sheep in fineness; it is so abundant that little but the muzzle, which should be of an orange tint, and hoofs, are left uncovered. The best wool is produced on light sandy soils.

The merino is little known in Great Britain, the climatic moisture of which does not favour the growth of the finest wools, but it predominates in all regions where sheep are bred for their wool rather than their mutton, as in the western United States, Cape Colony, Australia, New Zealand and Argentina. In Australasia, especially in New Zealand, the merino has been crossed with Lincolns, Leicesters, Shropshires and other breeds, with the result of improving the quality of the mutton while sacrificing to some extent that of the wool.

The merino sheep appears to have originated in Africa, whence it was brought by the Moors to Spain and thence spread over Europe, especially to Austria-Hungary, Germany and France. The best-known breeds are the Rambouillet, a large merino named after the village near Paris, to which it was imported towards the end of the 18th century, and the Negretti, which stands in closer relationship to the old Spanish stock and has shorter wool but a more wrinkled fleece. Importations to America began about the beginning of the 19th century. The so-called American merino, the Delaine, the Vermont and the Rambouillet, are well-known breeds in the United States.

The term "merino" is widely employed in the textile industries with very varied meanings. Originally it was restricted to denote the wool of the merino sheep reared in Spain, but owing to the superiority of the wools grown on merino sheep and shipped from Botany Bay, the name, as applied to wool was replaced by the term "botany." In the dress-goods and knitting trades the term "merino" still implies an article made from the very best soft wool. The term "cashmere," however, is frequently confused with it, although cashmere goods should be made from true cashmere and not, as is often the case, from the finest botany wool. In the hosiery and remanufactured materials trades the term "merino" is applied to fibre-mixtures of cotton and wool in contradistinction to "all wool" goods.

MERIONETH (Welsh, *Meirionydd*), a county of North Wales, bounded N. by Carnarvon and Denbigh, E. by Denbigh and Montgomery, S.E. by Montgomery, S. by the Dovey (*Dyfi*) estuary, dividing it from Cardigan, and W. by Cardigan Bay. It is nearly triangular, its greatest length from N.E. to S.W. being about 45 m., its greatest breadth about 30 m. The relief is less bold than that of Carnarvon, but the scenery is richer and more picturesquely varied. The highest summits are the peaks of Cader Idris (*q.v.*) including Pen y gader (the head of the chair; 2927 ft.); Aran Fawddwy (2970 ft.); Arenig fawr (2600 ft.); Y Llethr (2475 ft.), and Rhobell fawr (2313 ft.). Perhaps the finest of the valleys are those of Dyfi (Dovey) Dysyni, Tal y llyn (forehead of the lake), Maw (Mawddach), and Festiniog. The Dyfrdwy (Dee) drains Bala Lake (*Llyn Tegid* or *Pimblemere*), which is fed by two brooks rising at the foot of the Berwyn Hills. The Dyfrdwy leaves the lake at the north-east corner, near Castell Goronwy (erected 1202, hardly traceable), flowing slowly to Corwen, after which it is rapid, and receives the tributaries Alwen, Ceiriog, Clywedog and Alun. The Dyfi (Dovey) rising in a small lake near Aran Fawddwy, passes Machynlleth, and expands into an estuary of Cardigan Bay. Rising north of the Aran, the Mawddach (Maw) runs south-west some 12 m., being joined by rivulets. Traeth bach is formed by the Dwyryd streamlet among others. Other streams are the Wnion, Eden, Cain (variously spelled). Besides Bala and Tal y llyn lakes, there are among the hills over fifty more, *e.g.* Llyn Mwyngil. Among the waterfalls may be mentioned Rhaiadr y glyn (cascade of the glen), near Corwen, Rhaiadr du (black), and Pistyll Cain (Cain's waterspout), some 150 ft. high.

A mountain tract of the county, 15 m. from north to south by 10 from east to west, stretching from the coast inland, is of the Cambrian age, composed of grits, quartzites and slates, and comprising the Merionethshire anticlinal. The central portion of this tract is occupied mainly by Harlech Grits and Menevian beds; it is bordered on the north, east and south by the Lingula, Tremadoc and Arenig beds, which are pierced by numerous dikes and intrusive masses, mostly greenstone. The andesitic rock of Rhobell-fawr is one of the greatest igneous masses in the whole area of the Lingula beds. The Lingula beds are quarried and mined for slate at Festiniog, and near Dolgelly gold is obtained from a quartz vein, while near Barmouth manganese has been worked. Bordering the Cambrian area are the Ordovician rocks. The Arenig beds are interstratified with and overlaid by accumulations of volcanic ashes, felspathic traps or lava-flows, which form the rugged heights of Cader Idris, the Arans, the Arenigs, Manod and Moelwyn; and these are in turn overlaid by the Llandeilo and Bala beds, the latter including the Bala limestone. Lead and copper ores have been worked near Towyn. Here and there along the eastern boundary Llandovery and Wenlock strata are included. The structure of the Silurian tract is synclinal; in the Berwyn mountains the Ordovician rocks again appear with associated andesitic and felsitic lavas and tuffs. West of Llangar, near Corwen, is a small patch of Carboniferous limestone. Glacial drift with boulder clay is a prominent feature in the valleys and on the mountain sides. A good deal of blown sand fringes the coast north and south of Harlech. At the Llyn Arenig Bach a deposit of kieselguhr has been found.

The climate varies much with the elevation, from bleak to genial, as at Aberdyfi (Aberdovey). Grain crops cover a small area only, green crops being poor, and fruits practically *nil*. While the soil is generally thin, there are fertile tracts in the valleys, and there is some reclaimed land. The small, hardy ponies (known as of Llanbedr, Conway Valley) are now almost restricted to this county and Montgomeryshire. Manufactures include woollen stockings, &c., at and near Bala, flannels at Dolgellau (Dolgelley), Towyn, and a few other places. Slate is the chief staple. The Cambrian railway skirts the coast from Portmadoc to Aberdyfi. At Barmouth junction a branch crosses to Dolgelley, where it is joined by a branch of the Great Western railway. Bala and Festiniog are also united by the Great Western, and Festiniog is further joined with Llandudno junction by the London & North Western railway, and with Portmadoc (Minffordd) by the narrow gauge railway, a light line, opened in 1865, running between Portmadoc and Duffws, rising 700 ft. in 13 m. The tourist traffic is a source of livelihood to many of the inhabitants. The coast is almost unnavigable, owing to sandbanks, and the only havens are Barmouth and Aberdyfi.

The area of the ancient county is 427,810 acres or 670 sq. m., with a population in 1891 of 49,212 and 1901 of 49,149. In the 19th century, however, the population nearly doubled. The area of the administrative county is 422,018 acres. Welsh is the tongue *par excellence* of Merionethshire. The county returns one member to parliament, and has neither parliamentary nor municipal borough. The urban districts are: Bala (pop. 1544), Barmouth (Abermaw, 2214), Dolgelley (Dolgellau, 2437), Festiniog (11,435), Mallwyd (885), Towyn (3756). The shire is in the north-west circuit, and assizes are held at Dolgellau. It is partly in the diocese of St Asaph and partly in that of Bangor, and has 37 ecclesiastical parishes and districts, with parts of four others.

History and Antiquities.—This is the only Welsh county retaining in English its primitive British name, latinized into *Mervinia*, a subdivision of *Britannia Secunda*, and in the Ordovices' territory. The poet Churchyard in 1587 described the county as remote and difficult of access in his day, and it was never made the field of battle in Saxon, Danish or Norman times, nor indeed until close on the period of Welsh loss of independence. There are not many remains, Celtic, Roman or medieval. Caer Drewyn, a British fort on the Dee, is near Corwen, where Owen Gwynnedd was posted to repel Henry II. and whither Owen Glendower retired before Henry IV. The numerous cromlechs are chiefly near the coast. The Roman *via occidentalis* ran through the county from south to north and was joined by a branch of Watling Street at Tomen y mur (perhaps *Heriri Mons*) on Sarn Helen, not far from Castell Prysor. Tomen y mur (*detritus* of the wall) and Castell Prysor have yielded Roman bricks, tiles, urns and coins. Castell y bere, an extensive ruin, and once one of Wales's largest castles, has not been inhabited since the time of Edward I. Cymmer Abbey (*Y Fanner*) near Dolgellau, a Cistercian establishment founded about 1200, and dissolved by Henry VIII., is most perfect at the east end, with lancet windows, and against the south wall there are a few Gothic pillars and arches. The architecture varies from Norman to Perpendicular. Towen y Bala, east of Bala, is supposed to be a Roman encampment. It was afterwards occupied by the Welsh, to check the English lords marchers. Moel Offrwm is near Dolgellau. Among the county families may be mentioned that of Hengwrt, since the Hengwrt Welsh MSS. are famous in north Wales and among all Celtic scholars.

MERISTEM (Gr. μεριστός, divided or divisible), a botanical term for tissue which has the power of developing new forms of tissue, such as the cambium from which new wood is developed.

MERIVALE, CHARLES (1808–1893), English historian and dean of Ely, the second son of John Herman Merivale and Louisa Heath Drury, daughter of Dr Drury, head master of Harrow, was born on the 8th of March 1808. His father (1779–1844) was an English barrister, and, from 1831, a commissioner in bankruptcy; he collaborated with Robert Bland (1779–1825) in his *Collections from the Greek Anthology*, and published some excellent translations from Italian and German. Charles Merivale was at Harrow School (1818 to 1824) under Dr Butler. His chief friends were Charles Wordsworth, afterwards bishop of St Andrews, and Richard Chenevix Trench, afterwards archbishop of Dublin. In 1824 he was offered a writership in the Indian civil service, and went for a short time to Haileybury College, where he was distinguished for proficiency in Oriental languages. But he eventually decided against an Indian career, and went up to St John's College, Cambridge, in 1826. Among other distinctions he came out as fourth classic in 1830, and in 1833 was elected fellow of St John's. He was a member of the Apostles' Club, his fellow-members including Tennyson, A. H. Hallam, Monckton Milnes, W. H. Thompson, Trench and James Spedding. He was fond of athletic exercises, had played for Harrow against Eton in 1824, and in 1829 rowed in the first inter-university boat-race, when Oxford won. Having been ordained in 1833, he undertook college and university work successfully, and in 1839 was appointed select preacher at Whitehall. In 1848 he took the college living of Lawford, near Manningtree, in Essex; he married, in 1850, Judith Mary Sophia, youngest daughter of George Frere. In 1863 he was appointed chaplain to the Speaker of the House of Commons, declined the professorship of modern history at Cambridge in 1869, but in the same year accepted from Mr Gladstone the deanery of Ely, and until his death on the 27th of December 1893 devoted himself to the best interests of the cathedral. He received many honorary academical distinctions. His principal work was *A History of the Romans under the Empire*, in seven volumes, which came out between 1850 and 1862; but he wrote several smaller historical works, and published sermons, lectures and Latin verses. Merivale as a historian cannot be compared with Gibbon for virility, but he takes an eminently common-sense and appreciative view. The chief defect of his work, inevitable at the time it was composed, is that, drawing the materials from contemporary memoirs rather than from inscriptions, he relies on literary gossip rather than on numismatics and epigraphy. The dean was an elegant scholar, and his rendering of the *Hyperion* of Keats into Latin verse (1862) has received high praise.

See *Autobiography of Dean Merivale*, with selections from his correspondence, edited by his daughter, Judith A. Merivale (1899); and *Family Memorials*, by Anna W. Merivale (1884).

MERIVALE, HERMAN (1806–1874), English civil servant and author, elder brother of the preceding, was born at Dawlish, Devonshire, on the 8th of November 1806. He was educated at Harrow School, and in 1823 entered Oriel College, Oxford. In 1825 he became a scholar of Trinity College and also won the Ireland scholarship, and three years later he was elected fellow of Balliol College. He became a member of the Inner Temple and practised on the western circuit, being made in 1841 recorder of Falmouth, Helston and Penzance. From 1837 to 1842 he was professor of political economy at Oxford. In this capacity he delivered a course of lectures on the British Colonies in which he dealt with questions of emigration, employment of labour and the allotment of public lands. The reputation he secured by these lectures had much to do with his appointment in 1847 as assistant under-secretary for the colonies, and in the next year he became permanent under-secretary. In 1859 he was transferred to the permanent under-secretaryship for India, receiving the distinction of C.B. In 1870 Merivale was made D.C.L. of Oxford. He died on the 8th of February 1874. Besides his *Lectures on Colonization and Colonies* (1841), he published *Historical Studies* (1865), and completed the *Memoirs of Sir Philip Francis* (1867); he wrote the second volume of the *Life of Sir Henry Lawrence* (1872) in continuation of Sir Herbert Edwardes's work.

A tribute to his powers as an original thinker by his chief at the Colonial Office, Sir Edward Bulwer-Lytton, is printed with a notice of his career which his brother contributed to the *Transactions* (1884) of the Devonshire Association.

MERKARA, the capital of the province of Coorg, in Southern India, situated on a plateau about 4000 ft. above the sea. Pop. (1901), 6732. It consists of two quarters: the fort, containing the public offices, the old palace, and the residence of the commissioner; and the native town of Mahadevapet. Here are the headquarters of the Coorg and Mysore Rifles, a body of volunteers chiefly composed of coffee planters.

MERLIN, ANTOINE CHRISTOPHE (1762–1833), French revolutionist, called "of Thionville" to distinguish him from his namesake of Douai (see below), was born at Thionville on the 13th of September 1762, being the son of a *procureur* in the *bailliage* of Thionville. After studying theology, he devoted himself to law, and in 1788 was an *avocat* at the parlement of Metz. In 1790 he was elected municipal officer of Thionville, and was sent by the department of Moselle to the Legislative Assembly. On the 23rd of October 1791 he moved and carried the institution of a committee of surveillance, of which he became a member. It was he who proposed the law sequestrating the property of the *émigrés*, and he took an important part in the *émeute* of the 20th of June 1792 and in the revolution of the 10th of August of the same year. He was elected deputy to the National Convention, and pressed for the execution of Louis XVI., but a mission to the army prevented his attendance at the trial. He displayed great bravery in the defence of Mainz. He took part in the reaction which followed the fall of Robespierre, sat in the Council of the Five Hundred under the Directory, and at the *coup d'état* of the 18th Fructidor (Sept. 4, 1797) demanded the deportation of certain republican members. In 1798 he ceased to be a member of the Council of Five Hundred, and was appointed director-general of posts, being sent subsequently to organize the army of Italy. He retired into private life at the proclamation of the consulate, and lived in retirement under the consulate and the empire. He died in Paris on the 14th of September 1833.

See J. Reynaud, *Vie et correspondance de Merlin de Thionville* (Paris, 1860).

MERLIN, PHILIPPE ANTOINE, COUNT (1754–1838), French politician and lawyer, known as Merlin "of Douai," was born at Arleux (Nord) on the 30th of October 1754, and was called to the Flemish bar in 1775. An indefatigable student, he collaborated in the *Répertoire de jurisprudence* published by J. N. Guyot, the later editions of which appeared under Merlin's superintendence, and also contributed to other important legal compilations. Elected to the states-general as deputy for Douai, he was one of the chief of those who applied the principles of liberty and equality embodied in the decree of the 4th of August 1789 to actual conditions. On behalf of the committee appointed to deal with feudal rights, he presented to the Convention reports on the seignorial rights which were subject to compensation, on hunting and fishing rights, forestry, and kindred subjects. He carried legislation for the abolition of primogeniture, secured equality of inheritance between relations of the same degree, and between men and women. His numerous reports to the Constituent Assembly were supplemented by popular exposition of current legislation in the *Journal de législation*. On the dissolution of the Constituent Assembly he became judge of the criminal court at Douai. He was no advocate of violent measures; but, as deputy to the Convention, he voted for the death of Louis XVI., and as a member of the council of legislation he presented to the Convention on the 17th of September 1793 the infamous law permitting the detention of *suspects*. He was closely allied with his namesake Merlin "of Thionville," and, after the counter-revolution which brought about the fall of Robespierre, he became president of the Convention and a member of the Committee of Public Safety. His efforts were primarily directed to the prevention of any recrudescence of the tyranny exercised by the Jacobin Club, the commune of Paris, and the revolutionary tribunal. He persuaded the Committee of Safety to take upon itself the closing of the Jacobin Club, on the ground that it was an administrative rather than a legislative measure. He recommended the readmission of the survivors of the Girondin party to the Convention, and drew up a law limiting the right of insurrection; he had also a considerable share in the foreign policy of the victorious republic. With Cambacérès he had been commissioned in April 1794 to report on the civil and criminal legislation of France, with the result that after eighteen months' work he produced his *Rapport et projet de code des délits et des peines* (10 Vendémiaire, an. IV.). Merlin's code abolished confiscation, branding and imprisonment for life, and was based chiefly on the penal code drawn up in September 1791. He was made minister of justice (Oct. 30, 1795) under the Directory, and showed excessive rigour against the emigrants. After the *coup d'état* of the 18th Fructidor he became (Sept. 5, 1797) one of the five directors, and was accused of the various failures of the government. He retired into private life (June 18, 1799), and had no share in the revolution of the 18th Brumaire. Under the consulate he accepted a modest place in the court of cassation, where he soon became procureur-général. Although he had no share in drawing up the Napoleonic code, he did more than any other lawyer to fix its interpretation. He became a member of the council of state, count of the empire, and grand officer of the Legion of Honour; but having resumed his functions during the Hundred Days, he was one of those banished on the second restoration. The years of his exile were devoted to his *Répertoire de jurisprudence* (5th ed., 18 vols., Paris, 1827–1828) and to his *Recueil alphabétique des questions de droit* (4th ed., 8 vols., Paris, 1827–1828). At the revolution of 1830 he was able to return to France, when he re-entered the Institute of France, of which he had been an original member, being admitted to the Académie des Sciences Morales et Politiques. He died in Paris on the 26th of December 1838.

His son, ANTOINE FRANÇOIS EUGÈNE MERLIN (1778–1854), was a well-known general in the French army, and served through most of Napoleon's campaigns.

See M. Mignet, *Portraits et notices historiques* (1852), vol. i.

MERLIN (Welsh, *Myrddhin*), the famous bard of Welsh tradition, and enchanter of Arthurian romance. His history as related in this latter may be summarized as follows. The infernal powers, aghast at the blow to their influence dealt by the Incarnation, determine to counteract it, if possible, by the birth of an Antichrist, the offspring of a woman and a devil. As in the book of Job, a special family is singled out as subjects of the diabolic experiment, their property is destroyed, one after the other perishes miserably, till one daughter, who has placed herself under the special protection of the Church, is left alone. The demon takes advantage of an unguarded moment of despair, and Merlin is engendered. Thanks, however, to the prompt action of the mother's confessor, Blayse, in at once baptizing the child of this abnormal birth, the mother truly protesting that she has had intercourse with no man, Merlin is claimed for Christianity, but remains dowered with demoniac powers of insight and prophecy. An infant in arms, he saves his mother's life and confounds her accusers by his knowledge of their family secrets. Meanwhile Vortigern, king of the Britons, is in despair at the failure of his efforts to build a tower in a certain spot; however high it may be reared in a day, it falls again during the night. He consults his diviners, who tell him that the foundations must be watered with the blood of a child who has never had a father; the king accordingly sends messengers through the land in search of such a prodigy. They come to the city where Merlin and his mother dwell at the moment when the boy is cast out from the companionship of the other lads on the ground that he has had no father. The messengers take him to the king, and on the way he astonishes them by certain prophecies which are fulfilled to their knowledge. Arrived in Vortigern's presence, he at once announces that he is aware alike of the fate destined for him and of the reason, hidden from the magicians, of the fall of the tower. It is built over a lake, and beneath the waters of the lake in a subterranean cavern lie two dragons, a white and a red; when they turn over the tower falls. The lake is drained, the correctness of the statement proved, and Merlin's position as court prophet assured. Henceforward he acts as adviser to Vortigern's successors, the princes Ambrosius and Uther (subsequently Uther-Pendragon). As a monument to the Britons fallen on Salisbury Plain he brings from Ireland, by magic means, the stones now forming Stonehenge. He aids Uther in his passion for Yguerne, wife to the duke of Cornwall, by Merlin's spells Uther assumes the form of the husband, and on the night of the duke's death Arthur is engendered. At his birth the child is committed to Merlin's care, and by him given to Antor, who brings him up as his own son. On Arthur's successful achievement of the test of the sword in the "perron," Merlin reveals the truth of his parentage and the fact that he is by hereditary right, as well as by divine selection, king of the Britons. During the earlier part of Arthur's reign Merlin acts as counsellor; then he disappears mysteriously from the scene. According to one account he is betrayed by a maiden, Nimue or Niniane (a king's daughter, or a water-fairy, both figure in different versions), of whom he is enamoured, and who having beguiled from him a knowledge of magic spells, casts him into a slumber and imprisons him living in a rocky tomb. This version, with the great cry, or *Brait*, which the magician uttered before his death, appears to have been the most popular. Another represents his prison as one of air; he is invisible to all, but can see and hear, and occasionally speak to passers by; thus he holds converse with Gawain. In the prose *Perceval* he retires voluntarily to an "Esplumeor" erected by himself, and is seen no more of man.

The curious personality of Merlin is now generally recognized as being very largely due to the prolific invention of Geoffrey of Monmouth. Nennius, upon whose *Historia* Geoffrey enlarged and "improved," gives indeed the story of Vortigern and the tower, but the boy's name is Ambrosius. Geoffrey calls him Merlin-Ambrosius, a clear proof that he was adapting Nennius' story. He represents the sage in his rôle of court diviner, his "Prophecies" being incorporated in later manuscripts of the *Historia*. Subsequently Geoffrey enlarged on the theme, composing a *Vita Merlini* in which we find the magician in the rôle of a "possessed" wood-abider, fleeing the haunts of men, and consorting with beasts. This gave rise to the idea that there had originally been two Merlins, Merlin-Ambrosius and Merlin-Sylvester, a view now discarded by the leading scholars. The *Vita* was so successful that Geoffrey obtained as reward the bishopric of St Asaph.

Welsh vernacular literature has preserved a small but interesting group of poems, strongly national and patriotic in character, which are attributed to Merlin (Myrddhin).

A few years after Geoffrey's death Merlin's adventures were amplified into a romance, the first draft of which is attributed to Robert de Borron, and which eventually took the form of a lengthy introduction to the prose *Lancelot* and cyclic redaction of the Arthurian legend.

The romantic, as distinguished from legendary or historical Merlin, exists in the following forms: (*a*) a fragmentary poem preserved in a unique manuscript of the Bibl. nat. (this gives no more than the introduction to the story); (*b*) a prose rendering of the above, of which a fair number of copies exist, generally found, as in the original poem, coupled with a version of the early history of the Grail, known as *Joseph of Arimathea*, and in two cases followed by a *Perceval* and *Mort Artus*, thus forming a small cycle; (*c*) the Ordinary or Vulgate *Merlin*, a very lengthy romance, of which numerous copies exist (see Dr Sommer's edition); (*d*) and (*e*) two continuations to the above, each represented by a single manuscript—(*d*) the "Huth" *Merlin*, which was utilized by Malory for his translation, and also formed a part of the compilation used by the Spanish and Portuguese translators, and (*e*) a very curious manuscript, 337, Bibl. nat. (fonds Français), which Paulin Paris calls the *Livre Artus*, containing much matter not found elsewhere.

M. La Villemarqué's "critical study" (*Myrdhinn, ou l'enchanteur*

Merlin, 1861) cannot be regarded as much more trustworthy than Geoffrey himself. The story of the tower, and the Boy without a Father, has been critically examined by Dr Gaster, in a paper read before the Folk-lore Society and subsequently published in *Folk-lore* (vol. xvi.). Dr Gaster cites numerous Oriental parallels to the tale, and sees in it the germ of the whole *Merlin* legend. Alfred Nutt (*Revue celtique*, vol. xxvii.) has since shown that Aengus, the magician of the Irish *Tuatha de Danaan*, was also of unknown parentage, and it seems more probable that the Boy without a Father theme was generally associated with the Celtic magicians, and is the property of no one in particular. Some years ago the late Mr Ward of the British Museum drew attention to certain passages in the life of St Kentigern, relating his dealings with a "possessed" being, a dweller in the woods, named Lailoken, and pointed out the practical identity of the adventures of that personage and those assigned by Geoffrey to Merlin in the *Vita*; the text given by Mr Ward states that some people identified Lailoken with Merlin (see *Romania*, vol. xxvii.). Ferd. Lot, in an examination of the sources of the *Vita Merlini* (*Annales de Bretagne*, vol. xv.), has pointed out the more original character of the "Lailoken" fragments, and decides that Geoffrey knew the Scottish tradition and utilized it for his *Vita*. He also comes to the conclusion that the Welsh Merlin poems, with the possible exception of the *Dialogue between Merlin and Taliessin*, are posterior to, and inspired by, Geoffrey's work. So far the researches of scholars appear to point to the result that the legend of Merlin, as we know it, is of complex growth, combined from traditions of independent and widely differing origin. Most probably there is a certain substratum of fact beneath all; there may have been, there very probably was, a bard and soothsayer of that name, and it is by no means improbable that curious stories were told of his origin. It is worth noting that Layamon, whose translation of Wace's *Brut* is of so much interest, on account of the variants he introduces into the text, gives a much more favourable form of the "Birth" story; the father is a glorious and supernatural being, who appears to the mother in her dreams. Layamon lived on the Welsh border, and the possibility of his variants being drawn from genuine British tradition is generally recognized. The poem relating a dialogue between Merlin and his brother bard, Taliessin, may also derive from genuine tradition. Further than this we can hardly venture to go; the probability is that anything more told of the character and career of Merlin rests upon the imaginative powers and faculty of combination of Geoffrey of Monmouth.

See also G. Paris and Ulrich (*Société des anciens textes français*, 1886); *Merlin*, ed. Wheatley (Early English Text Society, 1899); *Arthour and Merlin*, ed. Kölbing. (J. L. W.)

MERLON, in architecture, the solid part of an embattled parapet between the embrasures, sometimes pierced by loopholes. The word is French, adapted from Ital. *merlone*, possibly a shortened form of *mergola*, connected with Lat. *mergae*, pitchfork, or from a diminutive *moerulus*, from *murus* (*moerus*), a wall.

MERMAIDS and **MERMEN,** in the folk-lore of England and Scotland, a class of semi-human beings who have their dwelling in the sea, but are capable of living on land and of entering into social relations with men and women.[1] They are easily identified, at least in some of their most important aspects, with the Old German Meriminni or Meerfrau, the Icelandic Hafgufa, Margygr, and Marmennill (mod. Marbendill), the Danish Hafmand or Maremind, the Irish Merrow or Merruach, the Marie-Morgan of Brittany and the Morforwyn of Wales;[2] and they have various points of resemblance to the vodyany or water-sprite and the rusalka or stream-fairy of Russian mythology. The typical mermaid has the head and body of a woman, usually of exceeding loveliness, but below the waist is fashioned like a fish with scales and fins. Her hair is long and beautiful, and she is often represented, like the Russian rusalka, as combing it with one hand while in the other she holds a looking-glass. For a time at least a mermaid may become to all appearance an ordinary human being; and an Irish legend ("The Overflowing of Lough Neagh and Liban the Mermaid," in Joyce's *Old Celtic Romances*) represents the temporary transformation of a human being into a mermaid.

The mermaid legends of all countries may be grouped as follows: (*a*) *A mermaid or mermaids either voluntarily or under compulsion reveal things that are about to happen.* Thus the two mermaids (merewîp) Hadeburc and Sigelint, in the *Nibelungenlied*, disclose his future course to the hero Hagen, who, having got possession of their garments, which they had left on the shore, compels them to pay ransom in this way. According to Resenius, a mermaid appeared to a peasant of Samsöe, foretold the birth of a prince, and moralized on the evils of intemperance, &c. (*Kong Frederichs den andens Krönike*, Copenhagen, 1680, p. 302). (*b*) *A mermaid imparts supernatural powers to a human being.* Thus in the beautiful story of "The Old Man of Cury" (in Hunt's *Popular Romances of the West of England*, 1871) the old man, instead of silver and gold, obtains the power of doing good to his neighbours by breaking the spells of witchcraft, chasing away diseases, and discovering thieves. (*c*) *A mermaid has some one under her protection, and for wrong done to her ward exacts a terrible penalty.* One of the best and most detailed examples of this class is the story of the "Mermaid's Vengeance" in Hunt's book already quoted. (*d*) *A mermaid falls in love with a human being, lives with him as his lawful wife for a time, and then, some compact being unwittingly or intentionally broken by him, departs to her true home in the sea.* Here, if its mermaid form be accepted, the typical legend is undoubtedly that of *Mélusine* (*q.v.*), which, being made the subject of a romance by Jean d'Arras, became one of the most popular folk-books of Europe, appearing in Spanish, German, Dutch and Bohemian versions. (*e*) *A mermaid falls in love with a man, and entices him to go to live with her below the sea; or a merman wins the affection or captures the person of an earthborn maiden.* This form of legend is very common, and has naturally been a favourite with poets. Macphail of Colonsay successfully rejects the allurements of the mermaid of Corrievrekin, and comes back after long years of trial to the maid of Colonsay.[3] The Danish ballads are especially full of the theme; as "Agnete and the Merman," an antecedent of Matthew Arnold's "Forsaken Merman"; the "Deceitful Merman, or Marstig's Daughter"; and the finely detailed story of Rosmer Hafmand (No. 49 in Grimm).

In relation to man the mermaid is usually of evil issue if not of evil intent. She has generally to be bribed or compelled to utter her prophecy or bestow her gifts, and whether as wife or paramour she brings disaster in her train. The fish-tail, which in popular fancy forms the characteristic feature of the mermaid, is really of secondary importance; for the true Teutonic mermaid—probably a remnant of the great cult of the Vanir—had no fish-tail;[4] and this symbolic appendage occurs in the mythologies of so many countries as to afford no clue to its place of origin. The Tritons, and, in the later representations, the Sirens of classical antiquity, the Phoenician Dagon, and the Chaldaean Oannes are all well-known examples; the Ottawas and other American Indians have their man-fish and woman-fish (Jones, *Traditions of the North American Indians*, 1830); and the Chinese tell stories not unlike our own about the sea-women of their southern seas (Dennis, *Folklore of China*, 1875).

Quasi-historical instances of the appearance or capture of mermaids are common enough,[5] and serve, with the frequent use of the figure on signboards and coats of arms, to show how thoroughly the myth had taken hold of the popular imagination.[6]

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[1] The name *mermaid* is compounded of *mere*, a lake, and *mægd*, a maid; but, though *mere wif* occurs in Beowulf, *mere-maid* does not appear till the Middle English period (Chaucer, *Romaunt of the Rose*, &c.). In Cornwall the fishermen say *merry-maids* and *merry-men*. The connexion with the sea rather than with inland waters appears to be of later origin. "The Mermaid of Martin Meer" (Roby's *Traditions of Lancashire*, vol. ii.) is an example of the older force of the word; and such "meer-women" are known to the country-folk in various parts of England (*e.g.* at Newport in Shropshire, where the town is some day to be drowned by the woman's agency).

[2] See Rhys, "Welsh Fairy Tales," in *Y Cymmrodor* (1881, 1882).

[3] See Leyden's "The Mermaid," in Sir Walter Scott's *Border Minstrelsy*.

[4] Karl Blind, "New Finds in Shetlandic and Welsh Folk-Lore," in *Gentleman's Magazine* (1882).

[5] Compare the strange account of the quasi-human creatures found in the Nile given by Theophylactus, *Historiae*, viii. 16, pp. 299-302, of Bekker's edition.

[6] See the paper in *Journ. Brit. Arch. Assoc.*, xxxviii., 1882, by H. S. Cuming, who points out that mermaids or mermen occur in the arms of Earls Caledon, Howth and Sandwich, Viscounts Boyne and Hood, Lord Lyttelton and Scott of Abbotsford, as well as in those of the Ellis, Byron, Phené, Skeffington and other families. The English heralds represent the creatures with a single tail, the French and German heralds frequently with a double one.

A mermaid captured at Bangor, on the shore of Belfast Lough, in the 6th century, was not only baptized, but admitted into some of the old calendars as a saint under the name of Murgen (*Notes and Queries*, Oct. 21, 1882); and Stowe (*Annales*, under date 1187) relates how a man-fish was kept for six months and more in the castle of Orford in Suffolk. As showing how legendary material may gather round a simple fact, the oft-told story of the sea-woman of Edam is particularly interesting. The oldest authority, Joh. Gerbrandus a Leydis, a Carmelite monk (d. 1504), tells (*Annales*, &c., Frankfort, 1620) how in 1403 a wild woman came through a breach in the dike into Purmerlake, and, being found by some Edam milkmaids, was ultimately taken to Haarlem and lived there many years. Nobody could understand her, but she learned to spin, and was wont to adore the cross. Ocka Scharlensis (*Chronijk van Friesland*, Leeuw., 1597) reasons that she was not a fish because she could spin, and she was not a woman because she could live in the sea; and thus in due course she got fairly established as a genuine mermaid. Vosmaer, who has carefully investigated the matter, enumerates forty writers who have repeated the story, and shows that the older ones speak only of a woman (see "Beschr. van de zoogen. Meermin der stad Haarlem," in *Verh. van de Holl. Maatsch. van K. en Wet.*, part 23, No. 1786).

The best account of the mermaid-myth is in Baring-Gould's *Myths of the Middle Ages*. See also, besides works already mentioned, Pontoppidan, who in his logically credulous way collects much matter to prove the existence of mermaids; Maillet, *Telliamed* (Hague, 1755); Grimm, *Deutsche Mythologie*, i. 404, and *Altdän. Heldenlieder* (1811); Waldron's *Description* and Train's *Hist. and Stat. Acc. of the Isle of Man*; Folk-lore Society's *Record*, vol. ii.; Napier, *Hist. and Trad. Tales connected with the South of Scotland*; Sébillot, *Traditions de la haute Bretagne* (1882), and *Contes des marins* (1882).

MEROBAUDES, FLAVIUS (5th century A.D.), Latin rhetorician and poet, probably a native of Baetica in Spain. He was the official laureate of Valentinian III. and Aëtius. Till the beginning of the 19th century he was known only from the notice of him in the *Chronicle* (year 443) of his contemporary Idacius, where he is praised as a poet and orator, and mention is made of statues set up in his honour. In 1813 the base of a statue was discovered at Rome, with a long inscription belonging to the year 435 (*C.I.L.* vi. 1724) upon Flavius Merobaudes, celebrating his merits as warrior and poet. Ten years later, Niebuhr discovered some Latin verses on a palimpsest in the monastery of St Gall, the authorship of which was traced to Merobaudes, owing to the great similarity of the language in the prose preface to that of the inscription. Formerly the only piece known under the name of Merobaudes was a short poem (30 hexameters) *De Christo*, attributed to him by one MS., to Claudian by another; but Ebert is inclined to dispute the claim of Merobaudes to be considered either the author of the *De Christo* or a Christian.

The "Panegyric" and minor poems have been edited by B. G. Niebuhr (1824); by I. Bekker in the Bonn *Corpus scriptorum hist. Byz.* (1836); the "De Christo" in T. Birt's *Claudian* (1892), where the authorship of Merobaudes is upheld; see also A. Ebert, *Geschichte der Literatur des Mittelalters im Abendlande* (1889).

MEROE, the general name (as Island of Meroe) for the region bounded on three sides by the Nile (from Atbara to Khartum), the Atbara, and the Blue Nile; and the special name of an ancient city on the east bank of the Nile, 877 m. from Wadi Halfa by river, and 554 by the route across the desert, near the site of which is a group of villages called Bakarawiya. The site of the city is marked by over two hundred pyramids in three groups, of which many are in ruinous condition. After these ruins had been described by several travellers, among whom F. Cailliaud (*Voyage à Méroé*, Paris, 1826–1828) deserves special mention, some excavations were executed on a small scale in 1834 by G. Ferlini (*Cenno sugli scavi operati nella Nubia e catalogo degli oggetti ritrovati*, Bologna, 1837), who discovered (or professed to discover) various antiquities, chiefly in the form of jewelry, now in the museums of Berlin and Munich. The ruins were examined in 1844 by C. R. Lepsius, who brought many plans, sketches and copies, besides actual antiquities, to Berlin. Further excavations were carried on by E. W. Budge in the years 1902 and 1905, the results of which are recorded in his work, *The Egyptian Sûdân: its History and Monuments* (London, 1907). Troops were furnished by Sir Reginald Wingate, governor of the Sudan, who made paths to and between the pyramids, and sank shafts, &c. It was found that the pyramids were regularly built over sepulchral chambers, containing the remains of bodies either burned or buried without being mummified. The most interesting objects found were the reliefs on the chapel walls, already described by Lepsius, and containing the names with representations of queens and some kings, with some chapters of the *Book of the Dead*; some steles with inscriptions in the Meroitic language, and some vessels of metal and earthenware. The best of the reliefs were taken down stone by stone in 1905, and set up partly in the British Museum and partly in the museum at Khartum. In 1910, in consequence of a report by Professor Sayce, excavations were commenced in the mounds of the town and the necropolis by J. Garstang on behalf of the university of Liverpool, and the ruins of a palace and several temples were discovered, built by the Meroïte kings. (See further ETHIOPIA.)

Meroe was probably also an alternative name for the city of Napata, the ancient capital of Ethiopia, built at the foot of Jebel Barkal. The site of Napata is indicated by the villages of Sanam Abu Dom on the left bank of the Nile and Old Merawi on the right bank of the river. New Merawi, 1 m. east of Sanam Abu Dom and on the same side of the river, was founded by the Sudan government in 1905 and made the capital of the mudiria of Dongola.

(D. S. M.*)

MEROPE, the name of several figures in Greek mythology. The most important of them are the following: (1) The daughter of Cypselus, king of Arcadia, and wife of Cresphontes, ruler of Messenia. During an insurrection Cresphontes and two of his sons were murdered and the throne seized by Polyphontes, who forced Merope to marry him. A third son, Aepytus, contrived to escape, and, subsequently returning to Messenia, put Polyphontes to death and recovered his father's kingdom (Apollodorus ii. 8, 5; Pausanias iv. 3, 6). The fortunes of Merope have furnished the subject of tragedies by Euripides (*Cresphontes*, not extant), Voltaire, Maffei and Matthew Arnold. (2) The daughter of Atlas and wife of Sisyphus. She was one of the seven Pleiades, but remained invisible, hiding her light for shame at having become the wife of a mortal (Apollodorus i. 9, 3; iii. 10, 1; Ovid, *Fasti*, iv. 175).

MEROVINGIANS, the name given to the first dynasty which reigned over the kingdom of the Franks. The name is taken from Merovech, one of the first kings of the Salian Franks, who succeeded to Clodio in the middle of the 5th century, and soon became the centre of many legends. The chronicler known as Fredegarius Scholasticus relates that a queen was once sitting by the seashore, when a monster came out of the sea, and by this monster she subsequently became the mother of Merovech, but this myth is due to an attempt to explain the hero's name, which means "the sea-born." At the great battle of Mauriac (the Catalaunian fields) in which Aetius checked the invasion of the Huns (451), there were present in the Roman army a number of Frankish *foederati*, and a later document, the *Vita lupi*, states that Merovech (Merovaeus) was their leader. Merovech was the father of Childeric I. (457–481), and grandfather of Clovis (481–511), under whom the Salian Franks conquered the whole of Gaul, except the kingdom of Burgundy, Provence and Septimania. The sons of Clovis divided the dominions of their father between them, made themselves masters of Burgundy (532), and in addition received Provence from the Ostrogoths (535); Septimania was not taken from the Arabs till the time of Pippin, the founder of the Carolingian dynasty. From the death of Clovis to that of Dagobert (639), the Merovingian kings displayed considerable energy, both in their foreign wars and in the numerous wars against one another in which they found an outlet for their barbarian instincts. After 639, however, the race began to decline, one after another the kings succeeded to the throne, but none of them reached more than the age of twenty or twenty-five; this was the age of the "*rois fainéants*." Henceforth the real sovereign was the mayor of the palace. The mayors of the palace belonging to the Carolingian family were able to keep the throne vacant for long periods of time, and finally, in 751 the mayor Pippin, with the consent of the pope Zacharias, sent King Childeric III. to the monastery of St Omer, and shut up his young son Thierry in that of St Wandrille. The Merovingian race thus came to an end in the cloister.

BIBLIOGRAPHY.—See Pétigny, *Études sur l'époque mérovingienne* (Paris, 1851); G. Richter, *Annalen des fränkischen Reichs im Zeitalter der Merowinger* (Halle, 1873); F. Dahn, *Die Könige der Germanen*, vii. (Leipzig, 1894); by the same author, *Urgeschichte der germanischen und romanischen Völker*, iii. (Berlin, 1883); W. Schultze, *Deutsche Geschichte von der Urzeit bis zu den Karolingern*, ii. (Stuttgart, 1896).

Merovingian Legend.—It has long been conceded that the great French national epics of the 11th and 12th centuries must have been founded on a great fund of popular poetry, and that many of the episodes of the *chansons de geste* refer to historical events anterior to the Carolingian period. *Floovant* is obviously connected with the *Gesta Dagoberti*, and there are traces of the influence of popular songs on the Frankish heroes in Gregory of Tours and other chroniclers. See G. Kurth, *Hist. poét. des Mérovingiens* (Paris, Brussels and Leipzig, 1893); A. Darmesteter, *De Floovante vetustiore gallico poemate* (Paris, 1877); *Floovant* (Paris, 1859); ed. MM. F. Guessard and H. Michelant; P. Rajna, *Delle Origine dell' epopea francese* (Florence, 1884), with which cf. G. Paris in *Romania*, xiii. 602 seq.; F. Settegast, *Quellenstudien zur gallo-romanischen Epik* (Leipzig, 1904); C. Voretzsch, *Epische Studien* (Halle, 1900); H. Groeber, *Grundriss d. roman. Phil.* (Bd. II., abt. i. pp. 447 seq.). (C. PF.)

MERRILL, a city and the county-seat of Lincoln county, Wisconsin, U.S.A., 185 m. N.W. of Milwaukee, on both sides of the Wisconsin river. Pop. (1910 census), 8689. It is served by the Chicago, Milwaukee & St Paul railroad. The city is situated about 1270 ft. above the sea and has an invigorating climate. Brook trout and various kinds of game, including deer, abound in the vicinity. Grandfather Falls and the Delles of the Prairie river are picturesque places near the city, and furnish good water-power. The principal public building is the Lincoln county court house, and the city contains the T. B. Scott free library, a fine high-school, and the Ravn hospital, a private institution. Riverside Park is maintained by a corporation, and a park along the Prairie river is owned and maintained by the city. Merrill is an important hardwood lumber market, and its principal industry is the manufacture of lumber and lumber products. The manufacture of paper and paper pulp and of lathes is also important. In 1905 the factory products were valued at $3,260,638. There are granite quarries and brickyards in the vicinity. Merrill was settled in 1875, incorporated as a village in 1880, and chartered as a city in 1883.

MERRIMAC,[1] a river in the north-eastern part of the United States, having its sources in the White Mountains of New Hampshire, and flowing south into Massachusetts, and thence east and north-east into the Atlantic Ocean. With its largest branch it has an extreme length of about 183 m. The Merrimac proper is formed at Franklin, New Hampshire, by the junction of the Pemigewasset and Winnepesaukee rivers. The former is the larger branch and rises in the White Mountains in Grafton county; the latter is the outlet of Lake Winnepesaukee. The valley of the Merrimac was formed before the glacial period and was filled with drift as the ice retreated; subsequently the high flood plain thus formed has been trenched, terraces have been formed, and at different places, where the new channel did not conform to the pre-glacial channel, the river has come upon buried ledges, relatively much more resistant than the drift below, and waterfalls have thus resulted. The river falls 269 ft. in a distance of 110 m. from Franklin to its mouth. The greater part of the total fall is at six points, and at each of four of these is a city which owes its importance in great measure to the water-power thus provided, Lowell and Lawrence in Massachusetts, and Manchester and Concord in New Hampshire; at Lowell there is a fall of 30 ft. (Pawtucket Falls), and at Manchester there is a fall of 55 ft. (Amoskeag Falls). The region drained by the river is 4553 sq. m. in extent, and contains a number of lakes, which together with some artificial reservoirs serve as a storage system. On the navigable portion of the river, which extends 17½ m. above its mouth, are the cities of Newburyport, near its mouth, and Haverhill, at the head of navigation. In 1899–1908 the Federal government dredged a channel from Newburyport to Haverhill (14·5 m.) 7 ft. deep and 150 ft. wide at mean low water; vessels having a draft of 12·5 ft. could then pass over the outer bar of Newburyport.

MERRIMAN, HENRY SETON (d. 1903), the pen-name of Hugh Stowell Scott, English novelist. He was a member of the firm of Henry Scott & Sons, and was for some years an underwriter at Lloyd's. His literary career began in 1889 with *The Phantom Future*, and he made his first decided hit with his Russian story, *The Sowers* (1896), which was followed by many other well-constructed novels remarkable for excellence of plot and literary handling. The author was an enthusiastic traveller, many of his journeys being undertaken with his friend Stanley Weyman. He was about forty when he died at Melton, near Ipswich, on the 19th of November 1903. Among his most successful books were *Roden's Corner* (1898); *The Isle of Unrest* (1899); *In Kedar's Tents* (1897); *The Velvet Glove* (1901); *The Vultures* (1902); *Barlasch of the Guard* (1903); and *The Last Hope* (1904).

MERRITT, WESLEY (1836–), American soldier, was born in New York City on the 16th of June 1836. He graduated at West Point in 1860, and was assigned to the cavalry service. He served in Utah (1861) and in the defences of Washington (1861–62); learnt the field duties of his arm as aide (1862) to General Philip St George Cooke, who then commanded the cavalry of the Army of the Potomac; became brigadier-general, United States Volunteers, in June 1863; and in September 1863 was placed in command of a brigade of regular cavalry in the Army of the Potomac. He won great distinction in the Virginian campaigns of 1864–65 and in Sheridan's Valley campaign, being brevetted major-general of volunteers for his conduct at Winchester and Fisher's Hill, and brigadier-general of the regular army for his services at Five Forks. In the final campaign about Richmond he did such good service in command of a cavalry division that he was brevetted major-general in the regular army and was promoted major-general of volunteers. With two other Federal commissioners he arranged with the Confederate commanders for the surrender of the Army of Northern Virginia. He was mustered out of the Volunteer Service in February 1866, and in July became lieutenant-colonel of the 9th cavalry in the regular army, being promoted gradually to major-general (1895). He served in the Big Horn and Yellowstone Indian campaigns (1876) and in the expedition to relieve the command of Major Thornburgh, who was killed in 1879 by the Utes; was superintendent at West Point (1882–87); and commanded the military department of Missouri in 1887–95, and that of the Atlantic in 1897–98. He was assigned in May 1898 to the command of the United States forces that were sent to the Philippines, after Admiral Dewey's victory; stormed Manila on the 13th of August; and was military governor of the islands until the 30th of August, when he left Manila for Paris to join the peace commission. From 1899 until his retirement from active service in June 1900 he commanded the Department of the East.

MERSEBURG, a town of Germany, in the Prussian province of Saxony, on the river Saale, 10 m. by rail S. of Halle and 15 m. W. of Leipzig. Pop. (1905), 20,024. It consists of a quaint and irregularly built old town, a new quarter, and two extensive suburbs, Altenburg and Neumarkt. The cathedral, which was restored in 1884-1886, has a choir, a crypt and two towers of the 11th, a transept of the 13th and a late Gothic nave of the 16th century. Among its numerous monuments is one to Rudolph of Swabia, the rival of the emperor Henry IV. It contains a great organ dating from the 17th century. Near the cathedral is the Gothic palace, formerly the residence of the bishops of Merseburg, and now used as public offices. The town hall and the Ständehaus, where the meetings of the provincial estates were held, are also noteworthy buildings. The industries include the manufacture of machinery, paper and celluloid, and tanning and brewing.

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[1] The name is an Indian word said to mean "swift water." In popular usage the spelling "Merrimack" is used at places along the river above Haverhill.

Merseburg is one of the oldest towns in Germany. From 968 until the Reformation, it was the seat of a bishop, and in addition to being for a time the residence of the margraves of Meissen, it was a favourite residence of the German kings during the 10th, 11th and 12th centuries. Fifteen diets were held here during the middle ages, when its fairs enjoyed the importance which was afterwards transferred to those of Leipzig. The town suffered severely during the Peasants' War and also during the Thirty Years' War. From 1657 to 1738 it was the residence of the dukes of Saxe-Merseburg.

See E. Hoffmann, *Historische Nachrichten aus Alt-Merseburg* (Merseburg, 1903).

MERSEN (Meerssen), **TREATY OF,** a treaty concluded on the 8th of August 870 at Mersen, in Holland, between Charles the Bald and his half-brother, Louis the German, by which the kingdom of their nephew Lothair II. (d. 869) was divided between them. Charles received a portion of the kingdom of Lothair afterwards called Lorraine, extending from the mouths of the Rhine to Toul, together with the town of Besançon, the Lyonnais, the Viennais, the Vivarais, and the Uzège, *i.e.* the lands acquired by Lothair II. in 863 at the death of his brother Charles of Provence; while Louis had the cities of Cologne, Trier and Metz, together with Alsace, the Escuens, and the Varais, *i.e.* the greater part of the diocese of Besançon. The boundary between the two realms was marked approximately by the valleys of the Meuse and Moselle and by the Jura. Great importance has been attached to the determination of this frontier by some historians, who consider that it coincided with the dividing line between the Teutonic and Romance races and languages; but nothing is known of the bases upon which the negotiations were effected, and the situation created by this treaty came to an end in 879.

MERSENNE, MARIN (1588–1648), French philosopher and mathematician, was born of peasant parents near Oizé (Sarthe) on the 8th of September 1588, and died in Paris on the 1st of September 1648. He was educated at the Jesuit College of La Flèche, where he was a fellow-pupil and friend of Descartes. In 1611 he joined the Minim Friars, and devoted himself to philosophic teaching in various convent schools. He settled eventually in Paris in 1620 at the convent of L'Annonciade. For the next four years he devoted himself entirely to philosophic and theological writing, and published *Quaestiones celeberrimae in Genesim* (1623); *L'Impiété des déistes* (1624); *La Vérité des sciences* (1624). These works are characterized by wide scholarship and the narrowest theological orthodoxy. His greatest service to philosophy was his enthusiastic defence of Descartes, whose agent he was in Paris and whom he visited in exile in Holland. He submitted to various eminent Parisian thinkers a manuscript copy of the *Meditations*, and defended its orthodoxy against numerous clerical critics. In later life, he gave up speculative thought and turned to scientific research, especially in mathematics, physics and astronomy. Of his works in this connexion the best known is *L'Harmonie universelle* (1636), dealing with the theory of music and musical instruments.

Among his other works are: *Euclidis elementorum libri,* &c. (Paris, 1626); *Universae geometriae synopsis* (1644); *Les Méchaniques de Galilée* (Paris, 1634); *Questions inouïes ou récréations des savants* (1634); *Questions théologiques, physiques,* &c. (1634); *Nouvelles découvertes de Galilée* (1639); *Cogitata physico-mathematica* (1644).

See Baillet, *Vie de Descartes* (1691); Poté, *Éloge de Mersenne* (1816).

MERSEY, a river in the north-west of England. It is formed by the junction of the Goyt and the Etherow a short distance below Marple in Cheshire on the first-named stream. The Goyt rises in the neighbourhood of Axe Edge, south-west of Buxton, and the Etherow in the uplands between Penistone and Glossop, watering the narrow Longdendale in which are several reservoirs for the Manchester water supply. The Mersey thus drains a large part of the Peak district of Derbyshire and of the southern portion of the Pennine system. The general direction from Marple is westerly. At Stockport the river Tame joins from the north, rising in the moors to the north-east of Oldham, and the Mersey soon afterwards debouches upon the low plain to the west of Manchester, which lies on its northern tributary the Irwell. The Bollin joins from the south-east near Heatley, and the main river, passing Warrington, begins to expand into an estuary before reaching Runcorn and Widnes, which face each other across it. The estuary, widening suddenly at the junction of the Weaver from the south-east, $2\frac{1}{2}$ m. below Runcorn, is 3 m. wide off Ellesmere Port, but narrows to less than $\frac{3}{4}$ m. at Liverpool, and hardly exceeds a mile at the mouth in the Irish Sea. The fall of the Mersey is about 1600 ft. in all and about 300 from Marple; its length, including the Goyt, is 70 m. exclusive of lesser windings, and it drains an area of 1596 sq. m. The estuary is one of the most important commercial waterways in the world. (See Liverpool and Birkenhead.) The Manchester Ship Canal (*q.v.*) joins the estuary through Eastham Locks, skirts its southern shore up to Runcorn, and crosses the river several times. From the name of the river was taken the title of Lord Mersey in 1910 by Sir John Bigham (b. 1840), on his elevation to the peerage after serving as a judge of the high court from 1897 to 1909 and president of the divorce court 1909–1910.

MERSINA, a town on the south-eastern coast of Asia Minor, and capital of a sanjak in the vilayet of Adana. Pop. about 15,000 including many Christians, Armenian, Greek and European. Its existence as a port began with the silting up of the harbour of Tarsus and Pompeiopolis, east and west, in the early middle ages; but it did not rise to importance till the Egyptian occupation of Cilicia (1832). It is now the busiest port on the south coast, being the terminus of the railway from Tarsus and Adana, by which (but still more by road) the produce of the rich "Aleian" plain comes down. It is served by most of the Levantine steamship companies, and is the best point of departure for visitors desiring to see Tarsus, the Cilician remains, and the finest scenery of the East Taurus. There is, however, no enclosed harbour, but only a good jetty. The making of a breakwater has long been under consideration. The anchorage in the roadstead is good, but the bay shoals for a long way out, and is exposed to swell from south-west and south. Mersina is an American mission centre, and the seat of a British vice-consul. Like all lowland Cilicia, it has a notoriously bad summer climate, and all inhabitants, who can do so, migrate to stations on the lower slopes of Taurus.

(D. G. H.)

MERTHYR TYDFIL, or Merthyr Tydvil, a municipal, county and parliamentary borough, and market-town of Glamorganshire, south Wales, situated in a bleak and hilly region on the river Taff, on the Glamorganshire Canal, and the Brecon and Merthyr, Great Western, North Western, Taff Vale and Rhymney railways, 25 m. N.N.W. of Cardiff, 30 E.N.E. of Swansea, and 176 from London. Pop. (1901), 69,228. The town is said to have derived its name from the martyrdom of St Tydfil, daughter of Brychan, who was put to death by Saxons in the 5th century. It is for the most part irregularly built and was formerly subject to severe epidemics due to defective sanitation; but it now possesses a supply of the purest water from the lesser Taff on the southern slope of the Breconshire Beacons. The town owes its early industrial prosperity to the abundant ironstone and coal of the district, and it thus became at an early date the chief seat of the iron industry in Wales. Four great ironworks were established here between 1759 and 1782. With the earliest, that of Dowlais, the Guest family were associated, first as partners and later as sole owners from 1782 to 1901 when the works were disposed to the company of Guest, Keen and Nettlefold. In 1765, Cyfarthfa was started by Anthony Bacon, and when firmly established, sold in 1794 to Richard Crawshay by whose descendants the works were carried on till the owners formed themselves in 1890 into a limited company (Crawshay Brothers Cyfarthfa Limited), the controlling interest in which has since been acquired by the Dowlais Company. The Plymouth works, started soon after Cyfarthfa, by Wilkinson and Guest, passed later into the hands of Anthony Hill from whose descendants they were purchased in 1863. They were closed down in 1882, but the collieries belonging to them continue to be worked on a large scale, yielding over 2000 tons of coal a day. The fourth great ironworks were those of Pen-y-darran which were carried on from 1782 to 1859. It was at Dowlais (in 1856) that Bessemer steel was first rolled into rails, but the use of puddled iron was not wholly abandoned at the works till 1882. It has now eighteen blast furnaces, and extensive collieries are also worked by the company, and large branch works were opened on the sea-board at Cardiff in 1891. Cyfarthfa was converted into steel works in 1883. The iron ore used is mainly imported from Spain. Merthyr Vale is almost entirely dependent on coal-mining and has one of the largest collieries in south Wales (Nixon's Navigation). The population of this district more than quintupled between 1881 and 1901.

From 1850 the government of the town was vested in a local board of health which in 1894 became an urban district council; by charter granted on the 5th of June 1905, it was vested in a corporation consisting of a mayor, 8 aldermen and 24 councillors. It was made a county borough from the 1st of April 1908. It comprises about 17,759 acres, is divided into eight wards and besides the older town, it includes Penydarran (1 m. N.E.), Dowlais (2 m. N.E.), Plymouth (1 m. S.) and Merthyr Vale (5 m. S.). It has a separate commission of the peace, and in conjunction with Aberdare and Mountain Ash, has had a stipendiary magistrate since 1829. The parliamentary borough which was created and given one member in 1832 and a second in 1867, includes the parish of Aberdare and parts of the parishes of Llanwonno, Merthyr Tydfil and Vainor (Brecon).

There is an electric tramway (completed in 1901) from the town to Cefn and Dowlais. In 1901 about 50% of the population above three years of age spoke both Welsh and English, 7¼% spoke Welsh only, and the remainder English only. The ancient parish of Merthyr Tydfil has been divided into five ecclesiastical parishes (Merthyr, Cyfarthfa, Dowlais, Pentrebach, and Penydarran) and part of another parish (Treharris). These six parishes form the rural deanery of Merthyr in the archdeaconry and diocese of Llandaff, and in 1906 had nine churches and fifteen mission rooms. An inscribed stone (Artbeu) has been built into the east wall of the parish church; and two other inscribed stones removed from Abercar Farm in the greater Taff valley now lie in the parish churchyard. The old structure of the parish church has been entirely removed except the base of the tower. There is a Roman Catholic church in Penydarran Park and another at Dowlais. The Nonconformists, of which the chief denominations are the Baptists, Congregationalists and Methodists—Wesleyan and Calvinistic—had in 1906 82 chapels, 49 of which were used for Welsh services and 33 for English.

The public buildings include, besides the churches, a town hall and law courts (1898), drill hall (1866), library, market house, a county intermediate school, general hospital built in 1887 and enlarged in 1897, and an isolation fever hospital, a theatre (1894) and a fountain presented by Sir W. T. Lewis as a memorial to the pioneers of the town's industry. At Dowlais there are public baths (1900) and a free library which have been provided by the owners of the Dowlais Works, Oddfellows' hall (1878), and a fever hospital (1869). At Thomas Town there is a recreation ground of 16 acres, formed in 1902. In 1908 the corporation purchased Cyfarthfa Castle (formerly the residence of the Crawshay family) with a park of 62 acres including a lake of 6 acres.

The Roman road from Cardiff and Gelligaer to Brecon passed through Merthyr and the remains of a supposed fort were discovered in Penydarran park in 1902. Three miles to the north of Merthyr, on a limestone rock about 470 ft. above the lesser (eastern) Taff are the ruins of Morlais Castle, built about 1286 by Gilbert de Clare on the northern limits of his lordship of Glamorgan, its erection causing a serious feud between him and de Bohun, earl of Hereford, who claimed its site as part of the lordship of Brecknock.

(D. Ll. T.)

MERULA, GEORGIUS (the Latinized name of GIORGIO MIRLANI; *c.* 1430–1494), Italian humanist and classical scholar, was born at Alessandria in Piedmont. The greater part of his life was spent at Venice and Milan, where he held a professorship and continued to teach until his death. To Merula we are indebted for the editio princeps of Plautus (1472), of the *Scriptores rei rusticae*, Cato, Varro, Columella, Palladius (1472) and possibly of Martial (1471). He also published commentaries on portions of Cicero (especially the *De finibus*), on Ausonius, Juvenal, Curtius Rufus, and other classical authors. He wrote also *Bellum scodrense* (1474), on account of the siege of Scodra (Scutari) by the Turks, and *Antiquitates vicecomitum*, the history of the Visconti, dukes of Milan, down to the death of Matteo the Great (1322). He violently attacked Politian (Poliziano), whose *Miscellanea* (a collection of notes on classical authors) were declared by Merula to be either plagiarized from his own writings or, when original, to be entirely incorrect.

See monograph by F. Gabotto and Badini-Gonfalonieri (1894) with bibliography; for the quarrel with Politian see also C. Meiners *Lebensbeschreibungen der berühmten Männer* (1796), ii. 158.

MERV, MERU or MAUR, an oasis and town of Asia, in the Transcaspian province of Russia. The oasis is situated on the S. edge of the Kara-kum desert, in 37° 30′ N. and 62° E. It is about 230 m. N. from Herat, and 280 S.S.E. from Khiva. Its area is about 1900 sq. m. The great chain of mountains which, under the names of Paropamisus and Hindu-Kush, extends from the Caspian to the Pamirs is interrupted some 180 m. south of Merv. Through or near this gap flow northwards in parallel courses the rivers Heri-rud (Tejend) and Murghab, until they lose themselves in the desert of Kara-kum. Thus they make Merv a sort of watch tower over the entrance into Afghanistan on the north-west and at the same time create a stepping-stone or *étape* between north-east Persia and the states of Bokhara and Samarkand. The present inhabitants of the oasis are Turkomans of the Tekke tribe. In 1897 they numbered approximately 240,000. The oasis is irrigated by an elaborate system of canals cut from the Murghab. The country has at all times been renowned throughout the East for its fertility. Every kind of cereal and many fruits grow in great abundance, *e.g.* wheat, millet, barley and melons, also rice and cotton. Silkworms are bred. The Turkomans possess a famous breed of horses and keep camels, sheep, cattle, asses and mules. They are excellent workers in silver and noted as armourers, and their carpets are superior to the Persian. They also make felts and a rough cloth of sheep's wool. The heat of summer is most oppressive. The least wind raises clouds of fine dust, which fill the air, render it so opaque as to obscure the noonday sun, and make respiration difficult. In winter the climate is very fine. Snow falls rarely, and when it does, it melts at once. The annual rainfall rarely exceeds 5 in., and there is often no rain from June till October. While in summer the thermometer goes up to 97° F., in winter it descends to 19·5°. The average yearly temperature is 60°. Here is a Russian imperial domain of 436 sq. m., artificially irrigated by works completed in 1895.

History.—In Hindu (the *Puranas*), Parsi and Arab tradition, Merv is looked upon as the ancient Paradise, the cradle of the Aryan families of mankind, and so of the human race. Under the name of Mouru this place is mentioned with Bakhdi (Balkh) in the geography of the *Zend-Avesta* (*Vendidad*, ed. Spiegel, 1852–1863), which dates probably from at least 1200 B.C. Under the name of Margu it occurs in the cuneiform (Behistun) inscriptions of the Persian monarch Darius Hystaspis, where it is referred to as forming part of one of the satrapies of the ancient Persian Empire. It afterwards became a province (Margiana) of the Graeco-Syrian, Parthian and Persian kingdoms. On the Margus—the Epardus of Arrian and now the Murghab—stood the capital of the district, Antiochia Margiana, so called after Antiochus Soter, who rebuilt the city founded by Alexander the Great.

About the 5th century, during the rule of the Persian Sassanian dynasty, Merv was the seat of a Christian archbishopric of the Nestorian Church. The town was occupied (A.D. 646) by the lieutenants of the caliph Othman, and was constituted the capital of Khorasan. From this city as their base the Arabs, under Kotaiba (Qotaiba) ibn Moslim, early in the 8th century brought under subjection Balkh, Bokhara, Ferghana and Kashgaria, and penetrated into China as far as the province of Kan-suh. In the latter part of the 8th century Merv became obnoxious to Islam as the centre of heretical propaganda preached by Mokanna (*q.v.*). In 874 Arab rule in Central Asia came to an end. During their dominion Merv, like Samarkand and Bokhara, was one of the great schools of learning, and the celebrated historian Yaqut studied in its libraries. In 1040 the Seljuk Turks crossed the Oxus from the north, and having defeated Masud, sultan of Ghazni, raised Toghrul Beg, grandson of Seljuk, to the throne of Persia, founding the Seljukian dynasty, with its capital at Nishapur. A younger brother of Toghrul, Daud, took possession of Merv and Herat. Toghrul was succeeded by his nephew Alp Arslan (the Great Lion), who was buried at Merv. It was about this time that Merv reached the zenith of her glory. During the reign of Sultan Sanjar or Sinjar of the same house, in the middle of the 11th century, Merv was overrun by the Turkish tribes of the Ghuzz from beyond the Oxus. It eventually passed under the sway of the rulers of Khwarizm (Khiva).

In 1221 Merv opened its gates to Tule, son of Jenghiz Khan, chief of the Mongols, on which occasion most of the inhabitants are said to have been butchered. From this time forward the city began to decay. In the early part of the 14th century the town was made the seat of a Christian archbishopric of the Eastern Church. On the death of the grandson of Jenghiz Khan Merv was included (1380) in the possessions of Timur-i-Leng (Tamerlane), Mongol prince of Samarkand. In 1505 the city was occupied by the Uzbegs, who five years later were expelled by Ismail Khan, the founder of the Safawīd dynasty of Persia. Merv remained in the hands of Persia until 1787, when it was captured by the emir of Bokhara. Seven years later the Bokharians razed the city to the ground, broke down the dams, and converted the district into a waste. When Sir Alexander Burnes traversed the country in 1832, the Khivans were the rulers of Merv. About this time the Tekke Turkomans, then living on the Heri-rud, were forced by the Persians to migrate northward. The Khivans contested the advance of the Tekkes, but ultimately, about 1856, the latter became the sovereign power in the country, and remained so until the Russians occupied the oasis in 1883.

The ruins of Old Merv cover an area of over 15 sq. m. They consist of a square citadel (Bairam Ali Khan *kalah*), $1\frac{1}{2}$ m. in circuit, built by a son of Tamerlane and destroyed by the Bokharians, and another *kalah* or walled inclosure known as Abdullah Khan. North from these lies the old capital of the Seljuks, known as Sultan Kalah, and destroyed by the Mongols in 1219. Its most conspicuous feature is the burial mosque of Sultan Sanjar, reputedly dating from the 12th century. East of the old Seljuk capital is Giaur Kalah, the Merv of the Nestorian era and the capital of the Arab princes. North of the old Seljuk capital are the ruins of Iskender Kalah, probably to be identified with the ancient Merv of the Seleucid dynasty.

NEW MERV, the present chief town of the oasis, founded in the first quarter of the 19th century, is on the Transcaspian railway, 380 m. by rail south-west from Samarkand. It stands on both banks of the Murghab, 820 ft. above the Caspian. Pop. (1897), 8727, including Russians, Armenians, Turkomans, Persians and Jews. It has a meteorological observatory. Corn, raw cotton, hides, wool, nuts and dried fruit are exported.

See E. O'Donovan, *The Merv Oasis* (2 vols., London, 1882); C. Marvin, *Merv* (London, 1880); and H. Lansdell, *The Russians at Merv and Herat* (London, 1883). (J. T. BE.)

MERX, ADALBERT (1838–1909), German theologian and orientalist, was born at Bleicherode near Nordhausen on the 2nd of November 1838. He studied at Jena, where he became extraordinary professor in 1869. Subsequently he was ordinary professor of philosophy at Tübingen, and in 1873 professor of theology at Giessen. From 1875 till his death he was professor of theology of Heidelberg. In the course of his researches he made several journeys in the East. Among his many works are: *Grammatica syriaca* (1867–1870); *Vocabulary of the Tigrê language* (1868); *Das Gedicht vom Hiob* (1871); *Die Prophetie des Joel und ihre Ausleger* (1879); *Die Saadjanische Übersetzung der Hohenlieder ins Arabische* (1882); *Chrestomathia targumica* (1888); *Historia artis grammaticae apud Syros* (1889); *Ein samaritanisches Fragment* (1893); *Idee und Grundlinien einer allgemeiner Geschichte der Mystik* (1893). Merx devoted much of his later research to the elucidation of the Sinaitic palimpsest discovered in 1892 by Mrs Agnes Smith Lewis (see BIBLE, iv. 321, *ad fin.*), the results being embodied in *Die vier kanonischen Evangelien nach ihrem ältesten bekannten Texte* (1897–1905). His last work was an edition of the books of Moses and Joshua. He died at Heidelberg on the 6th of August 1909.

MÉRYON, CHARLES (1821–1868), French etcher, was born in Paris in 1821. His father was an English physician, his mother a French dancer. It was to his mother's care that Méryon's childhood was confided. But she died when he was still young, and Méryon entered the French navy, and in the corvette "Le Rhin" made the voyage round the world. He was already a draughtsman, for on the coast of New Zealand he made pencil drawings which he was able to employ, years afterwards, as studies for etchings of the landscape of those regions. The artistic instinct developed, and, while he was yet a lieutenant, Méryon left the navy. Finding that he was colour-blind, he determined to devote himself to etching. He entered the work room of one Bléry, from whom he learnt something of technical matters, and to whom he always remained grateful. Méryon was by this time poor. It is understood that he might have had assistance from his kindred, but he was too proud to ask it. And thus he was reduced to the need of executing for the sake of daily bread much work that was mechanical and irksome. Among learners' work, done for his own advantage, are to be counted some studies after the Dutch etchers such as Zeeman and Adrian van de Velde. Having proved himself a surprising copyist, he proceeded to labour of his own, and began that series of etchings which are the greatest embodiments of his greatest conceptions—the series called "Eaux-fortes sur Paris." These plates, executed from 1850 to 1854, are never to be met with as a set; they were never expressly published as a set. But they none the less constituted in Méryon's mind an harmonious series.

Besides the twenty-two etchings "sur Paris," characterized below, Méryon did seventy-two etchings of one sort and another —ninety-four in all being catalogued in Wedmore's *Méryon and Méryon's Paris*; but these include the works of his apprenticeship and of his decline, adroit copies in which his best success was in the sinking of his own individuality, and more or less dull portraits. Yet among the seventy-two prints outside his professed series there are at least a dozen that will aid his fame. Three or four beautiful etchings of Paris do not belong to the series at all. Two or three etchings, again, are devoted to the illustration of Bourges, a city in which the old wooden houses were as attractive to him for their own sakes as were the stone-built monuments of Paris. But generally it was when Paris engaged him that he succeeded the most. He would have done more work, however—though he could hardly have done better work—if the material difficulties of his life had not pressed upon him and shortened his days. He was a bachelor, unhappy in love, and yet, it is related, almost as constantly occupied with love as with work. The depth of his imagination and the surprising mastery which he achieved almost from the beginning in the technicalities of his craft were appreciated only by a few artists, critics and connoisseurs, and he could not sell his etchings, or could sell them only for about 10d. apiece. Disappointment told upon him, and, frugal as was his way of life, poverty must have affected him. He became subject to hallucinations. Enemies, he said, waited for him at the corners of the streets; his few friends robbed him or owed him that which they would never pay. A few years after the completion of his Paris series he was lodged in the madhouse of Charenton. Its order and care restored him for a while to health, and he came out and did a little more work, but at bottom he was exhausted. In 1867 he returned to his asylum, and died there in 1868. In the middle years of his life, just before he was placed under confinement, he was much associated with Bracquemond and with Flameng,—skilled practitioners of etching, while he was himself an undeniable genius—and the best of the portraits we have of him is that one by Bracquemond under which the sitter wrote that it represented "the sombre Méryon with the grotesque visage."

There are twenty-two pieces in the Eaux-fortes sur Paris. Some of them are insignificant. That is because ten out of the twenty-two were destined as headpiece, tailpiece, or running commentary on some more important plate. But each has its value, and certain of the smaller pieces throw great light on the aim of the entire set. Thus, one little plate—not a picture at all—is devoted to the record of verses made by Méryon, the purpose of which is to lament the life of Paris. The misery and poverty of the town Méryon had to illustrate, as well as its splendour. The art of Méryon is completely misconceived when his etchings are spoken of as views of Paris. They are often "views," but they are so just so far as is compatible with their being likewise the visions of a poet and the compositions of an artist. It was an epic of Paris that Méryon determined to make, coloured strongly by his personal sentiment, and affected here and there by the occurrences of the moment—in more than one case, for instance, he hurried with particular affection to etch his impression of some old-world building which was on the point of destruction. Nearly every etching in the series is an instance of technical skill, but even the technical skill is exercised most happily in those etchings which have the advantage of impressive subjects, and which the collector willingly cherishes for their mysterious suggestiveness or for their pure beauty. Of these, the Abside de Notre Dame is the general favourite; it is commonly held to be Méryon's masterpiece. Light and shade play wonderfully over the great fabric of the church, seen over the spaces of the river. As a draughtsman of architecture, Méryon was complete; his sympathy with its various styles was broad, and his work on its various styles unbiased and of equal perfection—a point in which it is curious to contrast him with Turner, who, in drawing Gothic, often drew it with want of appreciation. It is evident that architecture must enter largely into any representation of a city, however much such representation may be a vision, and however little a chronicle. Besides, the architectural portion even of Méryon's labour is but indirectly imaginative; to the imagination he has given freer play in his dealings with the figure, whether the people of the street or of the river or the people who, when he is most frankly or even wildly symbolical, crowd the sky. Generally speaking, his figures are, as regards draughtsmanship, "landscape-painter's figures." They are drawn more with an eye to grace than to academic correctness. But they are not "landscape-painter's figures" at all when what we are concerned with is not the method of their representation but the purpose of their introduction. They are seen then to be in exceptional accord with the sentiment of the scene. Sometimes, as in the case of La Morgue, it is they who tell the story of the picture. Sometimes, as in the case of La Rue des Mauvais Garçons—with the two passing women bent together in secret converse—they at least suggest it. And sometimes, as in L'Arche du Pont Notre Dame, it is their expressive gesture and eager action that give vitality and animation to the scene. Dealing perfectly with architecture, and perfectly, as far as concerned his peculiar purpose, with humanity in his art, Méryon was little called upon by the character of his subjects to deal with Nature. He drew trees but badly, never representing foliage happily, either in detail or in mass. But to render the characteristics of the city, it was necessary that he should know how to portray a certain kind of water—river-water, mostly sluggish—and a certain kind of sky—the grey obscured and lower sky that broods over a world of roof and chimney. This water and this sky Méryon is thoroughly master of; he notes with observant affection their changes in all lights.

Méryon's excellent draughtsmanship, and his keen appreciation of light, shade and tone, were, of course, helps to his becoming a great etcher. But a living authority, himself an eminent etcher, and admiring Méryon thoroughly, has called Méryon by preference a great original engraver—so little of Méryon's work accords with Sir Seymour Haden's view of etching. Méryon was anything but a brilliant sketcher; and, if an artist's success in etching is to be gauged chiefly by the rapidity with which he records an impression, Méryon's success was not great. There can be no doubt that his work was laborious and deliberate, instead of swift and impulsive, and that of some other virtues of the etcher—"selection" and "abstraction" as Hamerton has defined them—he shows small trace. But a genius like Méryon is a law unto himself, or rather in his practice of his art he makes the laws by which that art and he are to be judged.

It is worth while to note the extraordinary enhancement in the value of Méryon's prints. Probably of no other artist of genius, not even of Whistler, could there be cited within the same period a rise in prices of at all the same proportion. Thus the first state of the "Stryge"—that "with the verses,"—selling under the hammer in 1873 for £5, sold again under the hammer in 1905 for £100. The first state of the "Galérie de Notre Dame," selling in 1873 for £5, and at M. Wasset's sale in 1880 for £11, fetched in 1905, £52. A "Tour de l'horloge," which two or three years after it was first issued sold for half a crown, in May 1903 fetched £70. A first state (Wedmore's, not of course M. Delteil's "first state," which, like nearly all his first states, is in fact a trial proof) of the "Saint Étienne du mont," realizing about £2 at M. Burty's sale in 1876, realized £60 at a sale in May 1906. The second state of the "Morgue" (Wedmore) sold in 1905 for £65; and Wedmore's second of the "Abside," which used to sell throughout the 'seventies for £4 or £5, reached in November 1906 more than £200. At no period have even Dürers or Rembrandts risen so swiftly and steadily.

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MESA (Span. *mesa*, from Lat. *mensa*, a table), in physical geography, a high table-land capped with hard rock, being the remnant of a former plateau. This type is general where strata are horizontal. In the process of denudation the hard rock acts as a flat protective cap preserving the regions between stream valleys or other places where denudation is especially active, in the form of "table-mountains" or "fortress-hills." Many examples are found in Spain, North and South Africa, the Bad Lands and Colorado regions of North America, in Arabia, India and Australia.

MESHCHERYAKS, or MESHCHERS, a people inhabiting eastern Russia. Nestor regarded them as Finns, and even now part of the Mordvinians (of Finnish origin) call themselves Meshchers. Klaproth, on the other hand, supposed they were a mixture of Finns and Turks, and the Hungarian traveller Reguli discovered that the tatarized Meshchers of the Obi closely resembled Hungarians. They formerly occupied the basin of the Oka (where the town Meshchersk, now Meshchovsk, has maintained their name) and of the Sura, extending north-east to the Volga. After the conquest of the Kazan Empire by Russia, part of them migrated north-eastwards to the basins of the Kama and Byelaya, and thus the Meshchers divided into two branches. The western branch became russified, so that the Meshcheryaks of the governments of Penza, Saratov, Ryazan and Vladimir have adopted the customs, language and religion of the conquering race; but their ethnographical characteristics can be easily distinguished in the Russian population of the governments of Penza and Tambov. The eastern branch has taken on the customs, language and religion of Bashkirs, with whom their fusion is still more complete.

MESHED (properly *Mash-had*, "the place of martyrdom"), capital of the province of Khorasan in Persia, situated in a plain watered by the Kashaf-rud (Tortoise river), a tributary of the

Hari-rud (river from Herat, which after its junction with the Kashaf is called Tejen), 460 m. E. of Teheran (550 by road) and 200 m. N.W. of Herat, in 36° 17′ N., 59° 36′ E., at an elevation of 3800 ft. Its population is about 70,000 fixed and 10,000 floating, the latter consisting of pilgrims to the shrine of Imam Reza.[1]

The town is of irregular shape, about 6 m. in circumference and surrounded by a mud wall flanked with towers. In the south-western corner of the enclosure stands the citadel (ark), within a wall 25 ft. high and a broad dry ditch which is 40 ft. deep in parts and can be flooded from neighbouring watercourses. The city has five gates, and from one of them, called Bala Khiaban gate (upper Khiaban), the main street (Khiaban), 25 yds. broad, runs in a north-west–south-east direction, forming a fine avenue planted with plane and mulberry trees and with a stream of water running down its middle. The shrine of Imam Reza is the most venerated spot in Persia, and yearly visited by more than 100,000 pilgrims. Eastwick thus describes it (*Journal of a Diplomat's Three Years' Residence in Persia*, London, 1864):—

> "The quadrangle of the shrine seemed to be about 150 paces square. It was paved with large flagstones and in the centre was a beautiful kiosk or pavilion, covered with gold and raised over the reservoir of water for ablutions. This pavilion was built by Nadir Shah. All round the northern, western and southern sides of the quadrangle ran, at some 10 ft. from the ground, a row of alcoves, similar to that in which I was sitting, and filled with mullas in white turbans and dresses. In each of the sides was a gigantic archway, the wall being raised in a square from above the entrance. The height to the top of this square wall must have been 90 or 100 ft. The alcoves were white, seemingly of stone or plaster; but the archways were covered with blue varnish or blue tiles, with beautiful inscriptions in white and gold. Over the western archway was a white cage for the muazzin, and outside it was a gigantic minaret 120 ft. high, and as thick as the Duke of York's column in London. The beauty of this minaret cannot be exaggerated. It had an exquisitely carved capital, and above that a light pillar, seemingly 10 ft. high; and this and the shaft below the capital, or about 20 ft., were covered with gold. All this part of the mosque (shrine) was built by Shah Abbas. In the centre of the eastern side of the quadrangle two gigantic doors were thrown open to admit the people into the adytum or inner mosque (shrine) where is the marble tomb of Imam Reza, surrounded by a silver railing with knobs of gold. There was a flight of steps ascending to these doors, and beyond were two smaller doors encrusted with jewels—the rubies were particularly fine. The inner mosque would contain 3000 persons. Over it rose a dome entirely covered with gold, with two minarets at the sides, likewise gilt all over. On the right of the Imam's tomb is that of Abbas Mirza, grandfather of the reigning Shah.[2] Near him several other princes and chiefs of note are buried. Beyond the golden dome, in striking and beautiful contrast with it, was a smaller dome of bright blue. Here begins the mosque of Gauhar Shád.[3] The quadrangle is larger than that of Shah Abbas; and at the eastern side is an immense blue dome, out of which quantities of grass were growing, the place being too sacred to be disturbed. In front of the dome rose two lofty minarets covered with blue tiles. In the boulevard of the Bala Khiaban is a kitchen supported by the revenues of the shrine, where 800 persons are fed daily."

The buildings of the shrine together with a space extending to about one hundred yards beyond the gates of the shrine on each side is sanctuary (*bast*). Within it are many shops and lodgings, and criminals, even murderers, may live there in safety. The only other notable buildings in the place are some colleges (*medresseh*), the oldest being the M. Do-dar, *i.e.* "college of two doors," built in 1439 by Shah Rukh, and some fine caravanserais, two dating from 1680.

Without the pilgrims who come to visit it, Meshed would be a poor place, but lying on the eastern confines of Persia, close to Afghanistan, Russian Central Asia and Transcaspia, at the point where a number of trade routes converge, it is very important politically, and the British and Russian governments have maintained consulates-general there since 1889. Meshed had formerly a great transit trade to Central Asia, of European manufactures, mostly Manchester goods, which came by way of Trebizond, Tabriz and Teheran; and of Indian goods and produce, mostly muslins and Indian and green teas, which came by way of Bander Abbasi. With the opening of the Russian railway from the Caspian to Merv, Bokhara and Samarkand in 1886–1887, Russian manufacturers were enabled to compete in Central Asia with their western rivals, and the value of European manufactures passing Meshed in transit was much reduced. In 1894 the Russian government enforced new customs regulations, by which a heavy duty is levied on Anglo-Indian manufactures and produce, excepting pepper, ginger and drugs, imported into Russian Asia by way of Persia; and the importation of green teas is altogether prohibited except by way of Batum, Baku, Uzunada and the Transcaspian railway. Since then the transit trade has been practically nil. In 1890 General Maclean, the British consul-general, reported that there were 650 silk, 40 carpet and 320 shawl looms at work. The carpet-looms at work now number several hundreds, while looms of silk and shawl number less than half what they did in 1890.

Meshed has telegraph (since 1876) and post (since 1879) offices, and the Imperial Bank of Persia opened a branch here in 1891. The climate is temperate and healthy. The coldest month is January, with a mean temperature of about 32° F., while the hottest month is July, with a mean of 78°. The highest temperature recorded in a period of six years was 91°, the lowest 15°. The mean annual rainfall during nine years (1899–1907) was nearly 9½ in., about one-eighth of it being represented by snow. (A. H.-S.)

MESHREBIYA (drinking places), the Arabic term given to the projecting oriel windows in Cairo, enclosed with latticework, through which a good view of the street can be obtained by the occupants without being seen; the term was derived from the small semicircular bows, in which porous water-bottles are placed to cool by evaporation in the air.

MESMER, FRIEDRICH (or Franz) **ANTON** (1733–1815), Austrian doctor, from whose name the word "Mesmerism" was coined (see Hypnotism), was born at Weil, near the point at which the Rhine leaves the Lake of Constance, on the 23rd of May 1733. He studied medicine at Vienna under the eminent masters of that day, Van Swieten and De Haen, took a degree, and commenced practice. Interested in astrology, he imagined that the stars exerted an influence on beings living on the earth. He identified the supposed force first with electricity, and then with magnetism; and it was but a short step to suppose that stroking diseased bodies with magnets might effect a cure. He published his first work (*De planetarum influxu*) in 1766. Ten years later, on meeting with J. J. Gassner in Switzerland, he observed that the priest effected cures by manipulation alone. This led Mesmer to discard the magnets, and to suppose that some kind of occult force resided in himself by which he could influence others. He held that this force permeated the universe, and more especially affected the nervous systems of men. He removed to Paris in 1778, and in a short time the French capital was thrown into a state of great excitement by the marvellous effects of mesmerism. Mesmer soon made many converts; controversies arose; he excited the indignation of the medical faculty of Paris, who stigmatized him as a charlatan; still the people crowded to him. He refused an offer of 20,000 francs from the government for the disclosure of his secret, but it is asserted that he really told all he knew privately to any one for 100 louis. He received private rewards of large sums of money. His consulting apartments were dimly lighted and hung with mirrors; strains of soft music occasionally broke the profound silence; and the patients sat round a kind of vat in which various chemical ingredients were concocted. Holding each others' hands, or joined by cords, the patients sat in expectancy, and then Mesmer, clothed in the dress of a magician, glided amongst them, affecting this one by a touch, another by a look, and making "passes" with his hand towards a third. Nervous ladies became hysterical or fainted; some men became convulsed, or were seized with palpitations of the heart or other bodily disturbances. The government appointed a commission of physicians and members of the Academy of Sciences to investigate these phenomena; Franklin and Baillie were members of this commission, and drew up an elaborate report admitting many of the facts, but contesting Mesmer's theory that there was an agent called animal magnetism, and attributing the effects to physiological causes. Mesmer himself was undoubtedly a mystic; and, although the excitement of the time led him to indulge in mummery and sensational effects, he was honest in the belief that the phenomena produced were real, and called for further investigation. For a time, however, animal magnetism fell into disrepute; it became a system of downright jugglery, and Mesmer himself was denounced as a shallow empiric and impostor. He withdrew from Paris, and died at Meersburg in Switzerland on the 5th of March 1815. He left many disciples, the most distinguished of whom was the marquis de Puysegur.

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[1] Abul Hassan Ali, al Rezā, commonly known as Imam Reza, the eighth imam of the Shiites, a son of Mūsā al Kāzim, the seventh imam, was the leader from whom the party of the Alids (Shiites) had such hopes under the caliphate of Mamūn. Gold coins (dinars) of this caliph are extant on which al Reza's name appears with the title of heir-apparent. The imam died in March 819 in the village Sanabad near Tus, some miles north-west of Meshed. To the Shiites he is a martyr, being believed to have been poisoned by Mamūn.

[2] This refers to Nasr-ud-din (d. 1896), grandfather of Shah Mahommed Ali (1907).

[3] Gauhar Shád was the wife of Shah Rukh (1404–1447), and was murdered by that monarch's successor Abu Said, August 1, 1457. Her mosque was built in 1418.

MESNAGER (or Le Mesagner), **NICOLAS** (1658–1714), French diplomatist, belonged to a wealthy merchant family. He gave up a commercial career for the law, however, and became advocate before the parlement of Rouen. In 1700 he was sent as deputy of Rouen to the council of commerce which was established in Paris for the extension of French trade. Here he made his mark, and was chosen to go on three missions to Spain, between the years 1704 and 1705, to negotiate financial arrangements. In August 1711 he was sent on a secret mission to London to detach England from the alliance against France, and succeeded in securing the adoption of eight articles which formed the base of the later Treaty of Utrecht. As a reward for his skill he was made one of the three French plenipotentiaries sent to Utrecht in January 1712, and had the honour of signing the treaty the next year. As he had used much of his own large fortune to keep up his state as ambassador, he was granted a pension by the grateful king of France. His portrait by Hyacinthe Rigaud is in the gallery of Versailles.

MESNE (an Anglo-French legal form of the O. Fr. *meien*, mod. *moyen*, mean, Med. Lat. *medianus*, in the middle, cf. "mean"), middle or intermediate, an adjective used in several legal phrases. A mesne lord is one who has tenants holding under him, while himself holding of a superior lord. Mesne process was such process as intervened between the beginning and end of a suit (see Process). Mesne profits are profits derived from land whilst in wrongful possession, and may be claimed in damages for trespass either in a separate action or joined with an action for the recovery of the land. The plaintiff must prove that he has re-entered into possession, his title during the period for which he claims, the fact that the defendant has been in possession during that period, and the amount of the mesne profits. The amount recovered as mesne profits need not be limited to the rental value of the land, but may include a sum to cover such items as deterioration or reasonable costs of getting possession, &c.

MESOCEPHALIC, a term applied by anthropologists to those skulls which exhibit a cephalic index intermediate between the dolichocephalic and brachycephalic crania (see Craniometry). Taking the longer diameter of a skull, *i.e.* the one from front to back, as 100, mesocephalic skulls are those of which the transverse diameter varies between 75 to 80.

MESOMEDES of Crete, Greek lyric poet, who lived during the 2nd century A.D. He was a freedman of the emperor Hadrian, on whose favourite Antinous he is said to have written a panegyric. Two epigrams by him in the Greek anthology (*Anthol. pal.* xiv. 63, xvi. 323) and a hymn to Nemesis are extant. The hymn is of special interest as preserving the ancient musical notation written over the text. Two other hymns—to the muse Calliope and to the sun—formerly assigned to Dionysius of Alexandria, have also been attributed to him.

See J. F. Bellermann, *Die Hymnen des Dionysius und Mesomedes* (1840); C. de Jan, *Musici scriptores graeci* (1899); S. Reinach in *Revue des études grecques*, ix. (1896); Suidas, *s.v.*

MESONERO ROMANOS, RAMÓN DE (1803–1882), Spanish prose-writer, was born at Madrid on the 19th of July 1803, and at an early age became interested in the history and topography of his native city. His *Manual de Madrid* (1831) was published when literature was at a low ebb in Spain; but the author's curious researches and direct style charmed the public, and next year, in a review entitled *Cartas españolas*, under the pseudonym of "El Curioso parlante," he began a series of articles on the social life of the capital which were subsequently collected and called *Panorama matritense* (1835–1836). Mesonero Romanos was elected to the Spanish Academy in 1838 and, though he continued to write, had somewhat outlived his fame when he issued his pleasing autobiography, *Memorias de un setentón, natural y vecino de Madrid* (1880). He died at Madrid on the 30th of April 1882, shortly after the publication of his *Obras completas* (8 vols., 4to, 1881).

Name.

MESOPOTAMIA (Μεσοποταμία, sc. χώρα or Συρία, from μέσος, middle, ποταμός, river), one of the Greek renderings of the earlier Semitic names for the river-country that stretches eastward from northern maritime Syria. The earliest appearance of a Semitic name of this kind is in the last paragraph of the biography of Aḥmōse of el-Kāb, the aged officer of Tethmosis (Ṭhutmōse) I. As early therefore as the late 16th century B.C. the name Naharin (*N'h'ryn'*) was in use. That the name was connected with *nahar* (a river) was plain to some of the Egyptian scribes, who wrote the word with determinative for "water" in addition to that for "country."

The scribes show no suspicion, however, of the name's being anything but a singular.[1] Is it possible that a consciousness that the word was not a plural can have survived till the early Christian centuries, when the Targum of Onqelos (Onkelos) rendered *Naharaim* by "the river Euphrates" (Pethor of Aram *which is on the Euphrates*: Deut. xxiii. 4 [5])? The *Naharin* or *Naharen* of the Egyptian texts appears some five generations later in the Canaanitic of the Amarna letters in the form Naḥrim(a), which would seem therefore to be the pronunciation then prevalent in Phoenicia (Gebal) and Palestine (Jerusalem). About the same time Naharin (N-h-ry-n) is given as the northern boundary of Egypt's domain (year 30 of Amenhotep or Amenophis III.), over against Kush in the south (tomb of Khamhet: Breasted, *Anc. Rec.* ii. 350).

The origin of the name is suggested by the Euphrates being called "the water of Naharin,"—on the Karnak *stele* more fully "the water of the Great Bend (*pẖr wr*) of Naharin (N-h-r-n)" (Breasted, *Anc. Rec.* ii. 263), or on the Constantinople obelisk simply "the Great Bend of Naharin" (*loc. cit.* note d). The precise meaning of *pẖr wr* is not certain. When Breasted renders "Great Bend" of the Euphrates he is probably thinking of the great sweep round between Bīrejik-Zeugma and Raḳḳa-Nicephorium. W. M. Müller, on the other hand, rendering *Kreislauf*, explains it of the Euphrates water system as a whole, thought of as encompassing Naharin. The Sea of the Great Bend would seem to be the sea fed by the north-to-south waters of Naharin, just as the Mediterranean, fed by the south-to-north waters of the Nile, is called the Great Circle (*šn wr*).

For many centuries after Amenophis IV. the name cannot be found. The next occurrence is in Hebrew (Gen. xxiv. 10 = J), where the district from which a wife for Isaac is brought is called Aram-Naharaim. The diphthongal pronunciation of the termination *aim* is probably a much later development. We should probably read something like Aram-Naharīm. The meaning is: the Naharim portion of the Aramaic speaking domain.[2] Probably the author thought primarily of the district of Harrān.[3] Some generations later Aram-Naharīm is used of the district including Pĕthōr, a town on the west bank of the Euphrates[4] (Deut. xxiii.

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[1] The threefold *n* after *Nahar* in a stele of Persian or Greek times (healing of Bentresh) is probably only the determinative for "water," a fourth *n* being accidentally omitted (Breasted, *Ancient Records*, iii. § 434).

[2] Cf. Aram-Damascus, which means, the Damascus portion of the Aramaic domain; and *har-Ephraim*, which means, the Ephraim portion of the (Israelitish) highlands—EV "Mount Ephraim."

[3] Halévy's suggestion that we are to look towards the Ḥaurān, and think of the rivers of Damascus, has not met with favour.

[4] Padan-Aram (Rev. Vers. better Paddan-Aram), Gen. xxv. 20, &c., rendered by the Septuagint "Mesopotamia of Syria," is obscure. *Paddan* has been connected phonetically with *Patin*, west of the Euphrates, and explained by others as a synonym for *Harran*.

4 = D). The Syriac version of the Old Testament (2nd cent. A.D.?) uses Bêth Nahrin. This may or may not imply the belief that Nahrīn is a plural. Eventually that belief was general, as is proved by the substitution of the normal feminine plural (for the supposed masculine) in the alternative form Bēth Nahrawātha (*e.g.* Wright, *Chron. Joshua Styl.* §§ 49, 50). Bēth is probably the Syriac equivalent of the Assyrian Bīt as in Bīt-Adīni (see below, § 3 viii.), as is shown by such names as Bēth 'Arbāyē, "district of Arabians," Bēth Armāyē, "district of Aramaeans." The *Parapotamia* of Strabo xvi. 2, 11, would be a suitable Greek equivalent. Mesopotamia seems to imply the view that *bēth* is the preposition "amid," which has the same form,[1] but need not imply the meaning "between," that is, the idea that there were precisely two rivers. There is evidence of the use of this form as early as the Septuagint translation of the Pentateuch (3rd cent. B.C.). It is natural to suppose it was adopted by the Greeks who accompanied Alexander's expedition. Xenophon does not use it.

As early as the time of Ephraem (d. A.D. 373) the use of the Syriac *Gĕzīrthā*, "island," had come in, and over a century earlier Philostratus reported (*Life of Apollonius*, i. 20) that the Arabs designated Mesopotamia as an island.[2] This term in the form *al-Gazīra* became, and still is, the usual Arabic name.

The absence of any equivalent names in Babylonian or Assyrian documents is noteworthy,[3] especially as the Babylonians spoke of the "Sea-Country" (*māt Tāmtim*). The name was not distinctive enough from the point of view of Babylonia, which belonged to the same water system. Tiglath-pileser I. (Octagon Prism, 6, 40, 42 seq.) sums up the results of the military operations of his first five years as reaching from the Lower Zab Riviera to the Euphrates Riviera (*ebirtan Puratti*, well rendered "Parapotamia" by Winckler[4]) and Ḫatte-land; but this is obviously not a proper name in the same sense as Naharin.[5] That probably originated in the maritime district of Syria.

Whilst the names we have mentioned are derived from physical geography, there are related names the meaning and origin of which are not so clear. Tethmosis III. is said, in a tomb which contains a picture of "the chief of Kheta," to have "overthrown the lands of My-tn" (Breasted, *Anc. Rec.* ii. § 773), which lands are mentioned also in his hymn of victory (Breasted, *Anc. Rec.* ii. § 659). Amenophis II. receives tribute from the "chiefs of My-tn" (Breasted, *Anc. Rec.* ii. § 804). In the bilingual Hittite inscription of Tarqudimme the land is called "the land of the city of Metan," just as in the Hittite documents the Hittite country in Asia Minor is called "the land of the city of Khatti." Metan is clearly the same as Mitanni, over against Khatti, mentioned *e.g.* by Tiglath-pileser I. (vi. 63), which is the same as Mitanni, several letters from which are in the Amarna collection. Since a Mitanni princess of these letters is called in Egyptian scarabs a princess of Naharin, it is clear that Mitanni and Naharin are more or less equivalent, whilst in the Amarna letters even Tushratta, the king of Mitanni, seems to use in the same way the name Khanigalbat. A shorter form of this name is Khani, which it is difficult not to connect with Khana, the capital of which at one time was Tirqa, on the Euphrates, below the Khābūr (see § 4). The slowly accumulating data have not yet made it possible to determine precisely the probably varying relations of these various names. The great astrological work uses a term of still wider signification, Subartu, eventually Suri (written SU. EDIN; see especially Winckler's discussion in *Or. Lit.-Zeit.*, 1907). This represented one of the four quarters of the world in the early Babylonian view, the other three being Akkad (*i.e.* Babylonia) in the "north," Elam in the "south," and Amurru in the "west." It appears to have denoted the territory above Babylonia stretching from Anshan in the south-east north-westwards, across the Tigris-Euphrates district, indefinitely towards Asia Minor. At an early time it seems to have formed along with Anshan a distinct kingdom.

Extent.

Strabo (xvi. 746) makes the south limit of Mesopotamia the Median wall; Pliny (v. 24 § 21) seems to extend it to the Persian Gulf. The Latin term naturally varied in meaning with the changing extent of Roman authority. For example, under Trajan Mesopotamia reached the gulf and was bounded by Assyria and Armenia. In modern times it is often used for the whole Euphrates-Tigris country. That would provide a useful name for an important geographical unit, but is too misleading. In view of historical and geographical facts there is much to be said for applying the name Mesopotamia to the country drained by the Khābūr, the Belīkh, and the part of the Euphrates connected therewith. It would thus include the country lying between Babylonia on the south and the Armenian Taurus highlands on the north, the maritime Syrian district on the west, and Assyria proper on the east. That is practically the sense in which it is treated in this article.[6] We may begin, however, with the definition of *Jezīra* by the Arabic geographers, who take it as representing the central part of the Euphrates-Tigris system, the part, namely, lying between the alluvial plains in the south and the mountainous country in the north. Measured on the Euphrates, this would be from the place where the river, having bored its way through the rocks, issues on to the high plain a little above Samsāṭ (Samosata) only 1500 ft. above the sea, to somewhere about Hīt (Is = Id), where, probably less than 150 ft. above the sea, it begins to make its way through the alluvial deposits of the last few millenniums. In these 750 m. it has descended less than 1400 ft. Measured on the Tigris Mesopotamia would stretch from somewhere between Jezīret-ibn-'Omar and Mōṣul to somewhere below Tekrīt.

In the tract defined, physical changes unconnected with civilization have been slight as compared with those in Babylonia; the two great rivers, having cut themselves deep channels, could not shift their courses far.

Geography.

i. *Natural Divisions.*—The stretch from Samsāṭ and Jezīret-ibn-'Omar to the alluvial plain seems to divide itself naturally into three parallel belts, highland watershed district, undulating plains and steppe. (1) The Taurus foothill barrier that shuts off the east to west course of the Euphrates and Tigris culminates centrally in the rugged volcanic Ḳaraja-Dāgh (6070 ft.) which blocks the gap between the two rivers, continued eastwards by the mountainous district of Ṭūr-'Abdīn (the modern capital Midyāt is at a height of 3500 ft.) and westwards by the elevated tract that sends down southwards the promontory of J. Tektek (*c.* 1950 ft.). (2) At the line where this east to west wall ends begins the sea of undulating plains where there is enough rain for abundant wheat and barley. (3) From the alluvial flats upwards toward these undulating plains is an extensive stretch of steppe land almost destitute of rain. Not far above the transition from the barren steppe is a second mountain wall (125 m. between extremities) roughly parallel with the first, consisting of the Sinjār chain (about 3000 ft., limestone, 50 m. long, 7 m. broad), continued westwards after a marshy break by the volcanic Tell Kōkab (basalt, about 1300 ft.), and then the 'Abd al-'Azīz range (limestone), veering upwards towards its western end as if to meet the Tektek promontory from the north.

ii. *Drainage.*—The water system is thus determined. West of Tektek drains into the Belīkh, east of Tektek into the Khābūr. All this drainage, collected into two rivers, the Belīkh and the Khābūr, is towards the left bank of the Euphrates, for the Mesopotamian watershed seems to be only some 15 m. or less from the Tigris until, south of the Sinjār range, it lies farther west, and the Tharthār river is possible. The Belīkh (Balich, Bilechas, Βαλίσσος[7]), a stream some 30 ft. wide, has its main source some 50 m. north in the 'Ain Khalīl ar-Raḥmān, but receives also the waters of the united Nahr al-Ḳūt (in its upper course formerly the Daiṣān, Σκίρτος) from Edessa and Köpru Dāgh, and the Jullāb from Tektek Dāgh about as much farther north. The Khābūr (Chabur, Chabōras[8]), 80–100 ft. wide, before its last 40 m. reach in a south-west direction, has a 70 m. reach due north and south from Tell Kōkab (about 1300 ft.), near which are united the Jaghjagh (earlier, Hirmās, 20 ft. in width), which has come 50 m. from Naṣībīn in the north-east, bringing with it the waters of the many streams from the Ṭūr 'Abdīn highlands; the north 'Āwij, which at certain seasons brings much water due south from Mārdīn, and the main stream of the Khābūr, which has come 60 m. from Ras al-'Ain in the north-west, after flowing 50 m. by way of Wērānshahr from Ḳaraja Dāgh in the north. The Tharthār (Assyrian *Tartar*, in Tukulti-Ninib II.'s inscription) begins in the Sinjār range and runs southwards, to lose itself in the desert a little above the latitude of Hīt. So it was two generations before Ahab (*Annales de Tukulti Ninip*, V. Scheil, 1909). The Arabian geographers represent the Tharthār as connected at its upper end (by a canal?) with the Khābūr system.

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[1] There may be further evidence of the prevalence of the interpretation "amid" if the difficult *baināth athrawātha* of Cureton, *Anc. Syr. Doc.* p. 112, l. 21, is correctly rendered in Payne Smith, *Thesaurus Syr.* 469, "Mesopotamia," and if we may assume a reading *Nahrawātha* for *Athrawātha*.

[2] Compare the use of the adjective, Ephr. *Op. Gr.* ii. 403 (cf. *B. O.* i. 145, 168, 169), and the noun, *B. O.* ii. 108, 109.

[3] Mesopotamian personal names like *Na-ha-ra-a-u* occur (cf. Johns, *Deeds and Documents*, iii. 127); but these may be connected with a divine name Nachor.

[4] *Auszug vorderas. Gesch.* 34; on the meaning see *Alt.-orient. Forsch.* iii. 349.

[5] It seems worth considering, however, whether *ebir nari* (see Johns, *Assyr. Doomsday Book*, 69; Winckler, *Alt.-or. Forsch.* 212; Hommel, *Anc. Heb. Trad.*, index) is not *in origin* practically a *Begriff* equivalent to Naharin.

[6] In general the Tigris is considered to belong to Assyria or Babylonia, and all west of the Euphrates to Arabia or Syria.

[7] Cf. Ritter, *Erdkunde*, v. 250–253.

[8] Ibid. xi. 253–265.

iii. *Character of Surface.*[1]—(1) The tract between the Belīkh and the Euphrates is in its middle section exceedingly fertile, as is implied in the name *Anthemusia*, and according to v. Oppenheim (*Z. d. Gesellsch. f. Erdkunde*, 36, 1901, p. 80) the same is true of the southern portion also. The plain extending from Urfa to a dozen miles below Ḥarrān has a rich red-brown humus derived from the Nimrūd Dāgh east of Edessa. (2) The rolling plains north of the 'Abd al 'Azīz Sinjār mountain wall are intersected by the many streams of the Khābūr system (the Arab geographer Mustaufī speaks of 300 feeders), which under favourable political and administrative conditions would produce a marked fertility. At Naṣībīn (Nisibis) rice is cultivated with success. (3) The country south of the mountain range is steppe land, imperfectly known, and of little use except for nomadic tribes, apart from the banks of the rivers (on which see EUPHRATES, TIGRIS). It consists mainly of grey dreary flats covered with selenite; and a little below the surface, gypsum. Bitumen is found at Hīt, whence perhaps its name (Babylonian *Id* in Tukulti Ninib II.'s inscription referred to above), and near the Tigris.[2]

iv. *Climate.*[3]—Mesopotamia combines strong contrasts of climate, and is a connecting link between the mountain region of western Asia and the desert of Arabia. At Dēr ez-Zōr, for example, the heat is intense. (1) In the steppe, during the sandstorms which frequently blow from the West Arabian desert the temperature may rise to 122° F. On the other hand, in winter the warm currents coming in from the Persian Gulf being met to a large extent by northerly currents from the snow-covered tracts of Armenia, are condensed down on to the plain and discharge moisture enough to cover the gravel steppes with spring herbage. (2) In the higher plains, in mid winter, since the high temperature air from the gulf is drawn up the valleys of the Euphrates and the Tigris there may be, *e.g.* at Mōsul, a "damp mildness." In spring the grass on the rolling plains is soon parched. So when the hot sandstorms blow in the lower steppe the scorching heat is carried right up to the foot of the mountains. On the other hand, since the spurs of the Taurus bring the winter cold a long way south, and the cold increases from west to east as we leave the mild coast of the Mediterranean, far down into the Mesopotamian plain the influence of the snow-covered ridges can be felt, and in the higher parts of the plain snow and ice are not infrequent; and although there is no point of sufficient altitude to retain snow for long, the temperature may fall as low as 14° F., especially if the cold north winds are blowing.

The cycle of vegetation begins in November. The first winter rains clothe the plain with verdure, and by the beginning of the year various bulbous plants are in bloom. The full summer development is reached in June. By the end of August everything is burnt up; August and September are the low-water months in the rivers, March to May the time of flood.

v. *Flora.*[4]—(1) Botanical lists have been published by von Oppenheim (*Vom Mittelmeer zum Persischen Golf*, ii. 373–388) of a collection made in 1893 containing 43 entries for Mesopotamia, and by E. Herzfeld (*Herbaraufnahmen aus Ḳal'at-Serḳāṭ-Assur*, in *Beiheft II. zur Or. Lit.-Zeit*, 1908, pp. 29–37) of a collection made in 1903–1905 in the neighbourhood of Assur, containing 181 entries. (2) The following are among the more important products of the central zone of Mesopotamia: wheat, barley, rice (*e.g.* at Sarūj, the Khābūr), millet, sesemum (for oil, instead of olive), dura (*Holcus sorghum* and *H. bicolor*); lentils, peas, beans, vetches; cotton, hemp, safflower, tobacco; *Medicago sativa* (for horses); cucumber, melons, water-melons, figs (those of Sinjār famed for sweetness), dates (below, 'Āna and Tekrīt); a few timber trees; plane and white poplar (by streams), willow and sumach (by the Euphrates). The sides of Ḳaraja-Dāgh, J. 'Abd el-'Azīz and Sinjār are wooded, but not now the neighbourhood of Nisībis. (3) In the steppe the vegetation is that which prevails in similar soil from Central Asia to Algeria; but many of the arborescent plants that grow in the rockier and more irregular plateaux of western Asia, and especially of Persia, have been reported as missing. Endless masses of tall weeds, belonging to a few species, cover the face of the country—large *Cruciferae*, *Cynareae* and *Umbelliferae*—also large quantities of liquorice (*Glycyrrhiza glabra* and *echinata*) and *Lagonychium*, and the white ears of the *Imperata*. In autumn the withered weeds are torn up by the wind and driven immense distances.

vi. *Fauna.*[5]—The following abound: wild swine, hyaena, jackal, cheetah, fox; gazelle (in herds), antelope species (in the steppe); jerboa, mole, porcupine, and especially the common European rat (in the desert); bat, long-haired desert hare. The following are rare: wild ass; beaver, said to have been observed on the Euphrates; wolf, among others a variety of black wolf (*Canis lycaon*), said to be found in the plains; lion, said to roam as far as the Khābūr. On the Euphrates are the following: vulture, owl, raven, &c., also the falcon (*Tinnanculus alaudarius*), trained to hunt. Among game birds are: wild duck and goose, partridge, francolin, some kinds of dove, and in the steppe the buzzard. The ostrich seems almost to have disappeared. Large tortoises abound, and, in the 'Ain el-'Arūs pool, fresh-water turtles and carp. Of domestic animals in the steppe the first place belongs to the camel; next come goat and sheep (not the ordinary fat-tailed variety); the common buffalo is often kept by the Arabs and the Turkomans on the Euphrates and the Tigris; on the Euphrates is found the Indian zebu.

vii. *Towns.*[6]—The towns that have survived are on the rivers. Such are Samsāṭ (see SAMOSATA), Raḳḳa (Nicephorium) above the mouth of the Belīkh, Dēr ez-Zōr, a rising town on the right bank, where there is (since 1897) a stone bridge, 'Āna (on an island; see ANA), Hīt (*Is*, Bab. *Id*), on the Euphrates; Jezīret ibn 'Omar, Mōṣul (*q.v.*), Tekrīt, on the Tigris; Edessa (*q.v.*), Ḥarrān (*q.v.*), on confluents of the Belīkh; Vērānshehr (Tela), Rās al-'Ain (Rhesaena), Mārdīn (half-way up the mountain wall), and Naṣībīn (Assyr. Naṣibina, Nisībis), on confluents of the Khābūr; Sinjār (Singara) on the Tharthār. Villages are more numerous than has often been supposed. Von Oppenheim counted in the district west of Edessa and Ḥarrān, in a stretch of two days' march, 300 flourishing villages.

At one time, however, Mesopotamia was teeming with life. The lines of the rivers are marked at frequent intervals by the ruins of flourishing towns of Assyrian, Roman and Caliphate times. Such are Bīrejīḳ, Jerāblūs, Tell Aḥmar, Ḳāl 'at en-Najm, Bālis, Ḳarkīsiyā (Qarqisiya, Circesium), on the Euphrates; Ḳuyunjiḳ, Nimrūd on the Tigris; Khorsābād on a small tributary; 'Arbān, Tell Khalaf, on the Khābūr. The interesting oasis town el-Ḥaḍr (Hatra) is near the Tharthār. Excavation has hardly begun. The country is covered with countless mounds (*tells*), each of which marks the site of a town. The documents from the ancient Tirqa said to have been found at 'Ishāra, a few miles below Ḳarḳīsiyā, are referred to below (§ 4). At Anaz(=Dūr of Tiglathpileser IV.) was found in 1901 a slab (Pognon, *Inscript. sém. de la Syrie*, Plate xxvi. No. 59) with a bas-relief and an inscription of the governor of Dūr, Mushēzib-Shamash.[7] The *stele* referred to below (§ 7, end) as being probably[8] Nabonidus's was found in 1906 some 15–20' W. of Eski-Ḥarrān, a little nearer to it than to Ḥmeira, which is west of Eski-Ḥarrān, an hour and a half north-east of the ruins of Ḥarrān. Parts of Mesopotamia have probably always harboured wandering tribes. Exactly how far the intervening lands beyond reach of the streams have done so it is difficult to make out. Fraser (*Short Cut to India*, p. 134) insists that in the undulating plains the direct rainfall is quite sufficient for agricultural purposes.

viii. *Political Divisions.*—On the whole the natural lie of the country has been reflected in the political divisions, which have of course varied in detail. We only mention some of those most often occurring. In the pre-Persian period, besides those referred to elsewhere, we may cite Kashyari (Ṭūr 'Abdīn), Guzanu (Gozan of 2 Kings xvii. 6; in the Khābūr district), Bīt Adini (Osroene), Kummukh (north-west corner and beyond); in the Roman period, Osroene (*q.v.*), Mygdonia (in the east), and in Syriac usage Bēth 'Arbāyē (between Nisībis and Mōṣul); in the Arab period, Diarbekr (Ṭūr 'Abdīn), Diār Rebī'a (Mygdonia), Diār Muḍar (Osroene).

ix. *Roads.*[9]—The routes of communication have probably changed little in the last 5000 years. It has not yet been proved that Edessa is an ancient city (see EDESSA: § 2) but it probably was, and its neighbour Ḥarrān, the tower of which can be seen from it, bears a name which seems to indicate its position as a highway centre. (1) An obvious series of routes followed the course of the rivers: from Thapsacus (Dibse) down the Euphrates, from Jezīret ibn 'Omar down the Tigris, from Circesium up the Khābūr. The Euphrates was crossed at Bīrejiḳ (Til Barsip?), or Jerablus (Carchemish?), or Tell Aḥmar (unidentified), or Thapsacus.[10] (2) Probably the modern route from Samosata eastwards behind the Ḳaraja Dāgh to Diārbekr was also well known. The same is doubtless true of the route from Osroene by Rās al-'Ain and Naṣībīn, and that by Vērānshehr and Mārdīn to the Tigris. About other cross-roads, such as those from Ḥarrān to Tell Shaddāda on the lower Khābūr, or from 'Āna by al-Ḥaḍr to Mōṣul it is difficult to say.

History: Earliest Times.

Functionally, Mesopotamia is the domain that lies between Babylonia and the related trans-Tigris districts on the one hand, and the west Asian districts of Maritime Syria and Asia Minor on the other. Its position has given it a long, complicated and exciting history. The great rivers, in later times theoretically regarded as its boundaries, have never really been barriers (cf. *e.g.* Winckler, *Altorient. Forschungen*, iii. 348), whence the vagueness of the geographical terminology in all times. Its position, along with its character, has prevented it often or long, if ever, playing a really independent part.

Who the earliest inhabitants of Mesopotamia in approximately historical times were is not yet clear. It is possible that its connexion with the north, and Asia Minor, goes back to a very early date. It may be that some of the early north Babylonian kingdoms, such as Kish, extended control thither. The earliest Babylonian monarch of whose presence in Mesopotamia there is positive evidence is Lugalzaggisi (before 2500 B.C.), who claims, with the help of En-lil, to have led his countless host victorious to the Mediterranean. His empire, if he founded one, was before long eclipsed, however, by the rising power of the Semites. Excavation in Mesopotamia may in time cast some light on the questions whether the Semites really reached Babylonia by way of Mesopotamia,[1] when, and whom they found there, and whether they partly settled there by the way. Whether Sharru-GI, Manishtusu and Remush (often called Uru-mush) really preceded, and to some extent anticipated, "Sargon" *i.e.* Ṣhargani-sharri, as L. W. King now[2] plausibly argues, is not certain; nor whether the 32 kings who revolted and were conquered by Manishtusu, as we now learn, were by the Mediterranean, as Winckler argued, or by the Persian Gulf, as King holds. That Sargon was or became supreme in Mesopotamia cannot be doubted, since there is contemporary evidence that he conquered Amurru. The three versions of the proceedings of Sargon (Sharru-GI-NA) in Suri leave us in doubt what really happened. As he must have asserted himself in Mesopotamia *before* he advanced into the maritime district (and perhaps beyond: see SARGON), what is referred to in the Omens and the Chronicle 26,472 may be, as Winckler argued (*Or. Lit.-Zeit.* 1907, col. 296), an immigration of new elements into Suri—in that case perhaps one of the early representatives of the "Hittite" group. According to the Omens text Sargon seems to have settled colonies in Suri, and suggestions of an anticipation of the later Assyrian policy of transportation have been found by King (*op. cit.*) under the rulers of this time, and there are evidences of lively intercommunication. Mesopotamia certainly felt the Sumero-Babylonian civilization early. It was from the special type of cuneiform developed there, apparently, that the later Assyrian forms were derived (Winckler, *Altorient. Forsch.* i. 86 seq.). What the "revolt of all lands" ascribed to the later part of Sargon's reign means is not yet clear; but he or his son quickly suppressed it. Mesopotamia would naturally share in the wide trade relations of the time, probably reaching as far as Egypt. The importance of Ḥarrān was doubtless due not only to its fame as a seat of the Moon-god Sin, honoured also *west* of the Euphrates, and to its political position, but also to its trade relations. Contemporary records of sales of slaves from Amurru are known.

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[1] Ritter, *Erdkunde*, xi. 493–498.

[2] See *Geog. Journ.* lx. 528–532 (with map).

[3] Ritter, xi. 498–499.

[4] Ibid., xi. 499–502.

[5] Ibid., xi. 502–510.

[6] Ritter, *Erdkunde*, xi. 279–492.

[7] For the interpretation cf. *Or. Lit.-Zeit.* xi. 242–244.

[8] On the interpretation see P. Dhorme, *Rev. Bibl.* (Jan., 1908).

[9] Ritter, *Erdkunde*, xi. 265–278.

[10] On these and other crossing places, see Ritter, *Erdkunde*, x. 959–1004.

When the Semitic settlers of the age of Sargon, whom it is now common with some justice to call Akkadians (see SUMER), had become thoroughly merged in the population, there appeared a new immigrant element, the Amurrū, whose advance as far as Babylonia is to be traced in the troubled history of the post-Gudean period, out of the confusion of which there ultimately emerged the Khammurabi dynasty. That the Amurrū passed through Mesopotamia, and that some remained, seems most probable. Their god Dagan had a temple at Tirqa (near 'Ishāra, a little below Circesium), the capital of Khana (several kings of which we now know by name), probably taking the place of an earlier deity. At Tirqa they had month names of a peculiar type. It is not improbable that the incorporation of this Mesopotamian kingdom with Babylon was the work of Khammurabi himself.

Not quite so successful eventually was the similar enterprise farther north at Asshur [or Assur (*q.v.*)] on the east margin of Mesopotamia, although we do not know the immediate outcome of the struggle between Asshur and the first Babylonian king, Sumu-abi. Possibly the rulers of Babylon had a freer hand in a city that they apparently *raised* to a dominant position than the Semitic rulers of Asshur, who seem to have succeeded to men of the stock which we have hitherto called Mitanni, if we may judge from the names of Ushpia who, according to Shalmaneser I. and Esarhaddon, built the temple, and Kikia who, according to Ashur-rem-nisheshu, built the city wall.[3] The considerable number of such names already found in First Dynasty records seems to show that people of this race were to be found at home as far south as Babylonia. Whether they were really called Shubarū, as Ungnad suggests, we may know later.

Hittite Times.

When Khammurabi's fifth successor saw the fall of the Amorite dynasty in consequence of an inroad of "Hittites," these may have been Mesopotamian Shubarū-Mitanni; but they may, as Ungnad suggests, represent rather ancestors of the Hittites of later times. It is difficult in any case not to connect with this catastrophe the carrying away to Khani of the Marduk statue afterwards recovered by Agum, one of the earlier kings of the Kassite dynasty. Whether Hittites were still resident at Khana we do not know. The earlier Kassite kings of Babylon still maintained the Amorite claim to "the four quarters;" but it is improbable that there was much force behind the claim, although we have a document from Khana dated under Kashtiliash. It is just as uncertain how long Asshur remained under the Babylonian suzerainty of which there is evidence in the time of Khammurabi, and what the relation of Asshur to western Mesopotamia was under the early kings whose names have lately been recovered. All these matters will no doubt be cleared up when more of the many *tells* of Mesopotamia are excavated. Only two have been touched: Arbān on the Khābūr, where remains of a palace of uncertain date, among other things an XVIII. dynasty scarab, were found by Layard in 1851, and Tell Khalaf, where the confluents join, and remains of the palace of a certain Kapar, son of Hanpan, of "Hittite" affinities but uncertain date, were found by von Oppenheim in 1899. A long inscription of a certain Shamshi-Adad [Samsi-Hadad], extracts from which are quoted by Delitzsch (*Mitt. d. Deutsch Or.-Gesellschaft* No. 21 p. 50), unfortunately cannot be dated exactly, or with certainty even approximately; but if Delitzsch and Ed. Meyer are right, it belongs to a time not many generations after Agum recovered the Marduk statue. Shamshi-Adad's claims extend over the land between the Tigris and the Euphrates, and he says that he erected memorials of himself on the shore of the Great Sea.

The mystery of the Hyksos has not yet been solved; but it is not impossible that they had relations with Mesopotamia. After they had been driven out of Egypt (*q.v.*), when Aḥmōse, the officer of Tethmosis (Thutmose) I., mentions Naharin (late 16th century), he does not say anything about the inhabitants. He seems to imply, however, that there was more than one state. The first mention of Mitanni, as we saw, is under Tethmosis III., who clearly crossed the Euphrates. It is at least possible that common enmity to Mitanni led to a treaty with Assyria (under Ashur-nadin-akhe).[4] Victorious expeditions into Naharin are claimed for Amenophis II., Tethmosis IV. and Amenophis III. The Egyptian references are too contemptuous to name the rulers; but Shaushatar may have begun his reign during the lifetime of Tethmosis III., and from cuneiform sources we know the names of six other Mitanni rulers. As they all bear Aryan names, and in some of their treaties appear Aryan deities (Indra, Varuna, Mithra, &c.), it is clear that Mesopotamia had now a further new element in its population, bearing apparently the name Kharri.[5] Many of the dynasts in North Syria and Palestine in the time of Tushratta bear names of the same type. The most natural explanation is that Aryans had made their way into the highlands east of Assyria, and thence bands had penetrated into Mesopotamia, peacefully or otherwise, and then, like the Turks in the days of the Caliphate, founded dynasties. The language of the Mitanni state, however, was neither Aryan nor Semitic, and may very well be that of the mysterious "Hittite" hieroglyphic inscriptions (see HITTITES). Mitanni was one of the great powers, alongside of Egypt and Babylonia, able to send to Egypt the Ninevite 'Ishtar; and at this time as much as at any other, we must think of common political relations binding the districts east and west of the Euphrates. The king mentioned above (Shaushatar) conquered Asshur (Assur), and Assyria remained subordinate to Mitanni till near the middle of the 14th century, when, on the death of Tushratta, it overthrew Mitanni with the help of Alshe, a north Mesopotamian state, the allies dividing the territory between them. The Hittite king's interference restored the Mitannite state as a protectorate, but with a smaller territory, probably in the north-west, where it may have survived long.

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[1] On the theory that it was climatic changes in Arabia that drove the Semites to seek new homes along the route mentioned above, see L. W. King, *History of Sumer and Akkad* (1910), which appeared after this article was written.

[2] See the preceding note.

[3] Ungnad, *Beitr. z. Assyr.* VI. v. 13.

[4] See *e.g.* P. Schnabel, *Stud. z. bab.-ass. Chron.* p. 25 (1908).

[5] Winckler has identified the Kharri with *the* Aryans, to whom he assigns a *state* in Armenia (*Or. Lit.-Zeit.*, July 1910).

Assyria was now free, and Ashur-uballiț [Assur-yuballidh acc. to Sayce] knew how to make use of his opportunities, and, in the words of his great grandson, "broke up the forces of the widespread Shubari" (*AKA*, p. 7, l. 32 seq.). Knowing what we know of the colonizing power of the Assyrians, we may assume that among the "Mitanni" and other elements in the Mesopotamian population there would now be an increase of people of "Assyrian" origin. On the tangled politics of this period, especially Mesopotamia's relations with the north-west, the Boghaz-Keui documents may be expected to throw a great deal of light. We know already a little more of the chequered history of the Amorites in the Naharin district, beset by great powers on three sides. When Mitanni fell Babylon no doubt adhered to its older claims on Mesopotamia; but the Kassite kings could do little to contest the advance of Assyria, although several rectifications of the boundary between their spheres are reported.

Aramaeans.

Mitanni's fall, however, had opened the way for others also. Hence when Ashur-uballiț's grandson, Arik-den-ili (written PU.DI.ili), carried on the work of enforcing Assyria's claim to the heirship of Mitanni, he is described as conquering the warriors[1] (?) of the Akhlame and the Suti. The references to these people, who practically make their first appearance in the Amarna correspondence,[2] show that they were unsettled bands who took advantage of the loosening of authority to introduce themselves into various parts of the country, in this case Mesopotamia. Gradually settlements were made, the names of many of which are given by the various Assyrian kings who had at one time or another to assert or reassert supremacy over them—such as Chindanu, Laqe, Șuhi along the South Euphrates boundary of Mesopotamia, and various districts bearing names compounded with *Bit* = settlement (see above), such as Bit-Adini (nearly equal the later Osroene; see EDESSA), or Bit-Zamani in the north near Diārbekr. The specific name Aramaean first appears in the annals of Tiglath-pileser I., unless we identify the Arimi of Shalmaneser I. in Țūr 'Abdin with the Aramu;[3] but the name may probably with fitness be applied to a very large number of the communities mentioned from time to time. Their position in Mesopotamia must have been very like that of the Shammar at the present time (see *ad fin.*). As they gradually adopted settled life in various parts of the country the use of Aramaic spread more and more (see below, § "Persians").

Assyrian Empire.

Meanwhile Mesopotamia continued to be crossed and recrossed by the endless marches of the Assyrian kings (such as Adad-nirari, Shalmaneser I. and his son), building and rebuilding the Assyrian empire (see BABYLONIA AND ASSYRIA), and eventually pushing their conquests towards Asia Minor at the expense of the Hittite domain. If, on the fall of the Kassites, Nebuchadrezzar I. established more direct relations between Mesopotamia and Babylon, his work was presently undone by the vigorous campaigns of Tiglath-pileser I., who seems to have even won Egypt's sanction of his succession to the Hittite claims. The newly recovered (1909) tablet of Tukulti-Ninib, the grandfather of Shalmaneser II., is interesting from its account of an expedition down the course of the Tharthār to Hīț = Id (river and town now first mentioned in cuneiform sources) and up the Euphrates to the Khābūr district.

Now that Mesopotamia had passed out of the hands of Babylon, all that the later kings could do was to encourage local Mesopotamian rulers in their desire for independence (Nabu-apluiddin). These were convinced that Assyria was master, but refused their tribute when they thought they dared. To thoroughly overpower the troublesome Bit-Adini (see above, § 3, viii.), which had naturally been aided by the states west of the Euphrates, Shalmaneser II. (860–825) settled Assyrians in their midst. Ḥarrān was one of the few places that remained on his side during the great insurrection that darkened his last days. Similarly the province of Guzanu (Heb. Gozan, Γαυζανῖτις), on the Khābūr, held with the capital Asshur in the insurrection that occurred in 763 (the year of the eclipse), when evidently some one (an Adad-nirari ?) wore the crown, at least for a time. Ḥarrān was clearly closely associated with Asshur in the rights and institutions that were the subject of so much party struggle in the new Assyrian empire that began with Tiglath-pileser IV. (see BABYLONIA AND ASSYRIA). When the policy of transporting people from one part of the empire to another was developed, new elements were introduced into Mesopotamia, amongst them Israelites, of whom perhaps traces have been found in the neighbourhood of Ḥarrān at Kannu'.[4] These new elements may have been more organically attached to the Assyrian state as such than the older inhabitants, to whom the affairs of state at Nineveh would be of little interest. On the conditions at Ḥarrān some light is thrown by the census partly preserved in Ashurbanipal's library.[5] The governors of several Mesopotamian cities, such as Nașibin, Amid, took their turn as eponyms; but this would not have much significance for the people. Hence even the fall of Nineveh (607 B.C.), apart from what such cities in Mesopotamia as held by its last kings suffered through the invasion, first perhaps of Nabopolassar, who in 609 B.C. claims to be lord of Shubarū, and then of the Medes, would be a matter of comparative indifference; tribute paid to Babylon was just as hard to find as if it were going to Nineveh. Necho did not succeed, like his great XVIIIth dynasty predecessor, in crossing the Euphrates. He was defeated by Nebuchadrezzar at Carchemish (605 B.C.), and Mesopotamia was confirmed to Babylon. Its troubles began again shortly after Nebuchadrezzar's death; the Medes seized Mesopotamia and besieged Ḥarrān. Before long, however, the overthrow of Astyages by Cyrus cleared Mesopotamia, and Nabonidus (Nabu-naid) was able, drawing on the resources of the whole of Syria for the purpose, to restore the famous temple of Sin at Ḥarrān, where a few years later he erected in memory of his mother, who seems to have been a priestess there, the *stele* published in 1907 by Pognon.

Persians.

The fragmentary nature of the records does not enable us to follow the steps by which Cyrus became master of Mesopotamia, in which he probably met with little or no resistance. How much of Mesopotamia was involved in the revolt of what the Persian inscription calls Assyria (*Athur*) is not clear. Nor does it appear with certainty to which of the twenty satrapies into which, according to Herodotus, the Persian empire was divided, Mesopotamia belonged; probably it was included in *'Abar nahărā*. The fact is, we have no information from native sources.[6] The probability is that conditions remained very much what they had been; except that the policy of transportation was not continued. The satraps and other high officials would naturally be of Persian extraction; but local affairs were probably managed in the old way, and there was no important shift of population. The large Aramaic infusion had by this time been merged in the general body of the people. These settlers doubtless influenced the "Assyrian" language;[7] but gradually, especially in the west, their own language more and more prevailed. Although Aramaic inscriptions of the Assyrian period, like those of Zanjirli or that of King ZKR of Hamath, have not been found in Mesopotamia, already in the time of Shalmaneser II. mention is made of an Aramaean letter (Harper, *Ass. Bab. Letters*, No. 872, obv. l. 10), and Aramaic notes on cuneiform documents begin to appear. Weights with Aramaic inscriptions (the oldest from the reign of Shalmaneser IV., 727–22) were found at Calah. By the Achaemenian period Aramaic had become the international language, and was adopted officially.

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[1] See M. Streck, *Zeit. Assyr.*, 18, 157.

[2] On a wrongly supposed much earlier occurrence of the name Achlamu, see *Klio*, vi. 193 n. 3.

[3] So for example A. Šanda, *Die Aramäer*, 5 (1902).

[4] S. Schiffer, *Keilinschriftliche Spuren der in der zweiten Hälfte des 8. Jahrhunderts von den Assyrern nach Mesopotamien deportierten Samarier (10 Stämme)* (1907); C. H. W. Johns in *Proc. Soc. Bib. Arch.* (March, May, 1908).

[5] C. H. W. Johns, *An Assyrian Doomsday Book* (1991).

[6] For the history from the time of Herodotus onwards, see Ritter, *Erdkunde*, x. 6–284.

[7] M. Streck, *Klio*, vi. 222 seq.

How Mesopotamia was affected by the passing of Persian armies on their way to suppress revolts in Syria or Egypt, or to conquer Greece, we do not know; on the whole it probably enjoyed unwonted peace. The expedition of Cyrus the Younger, with which Xenophon has made us so familar, only skirted the left bank of the Euphrates. The route followed by Alexander, though he also crossed at Thapsacus, took him unresisted across the northern parts; but the poor people of Mesopotamia suffered from the measures taken by their satrap Mazaeus to impede Alexander's progress. In spite of this, where Cyrus failed Alexander succeeded.

Hellenism.

What would have happened had Alexander lived we can only guess. Under the Seleucids Babylon was moved across the plain to Seleucia; but before long the central authority was transferred to the other side of Mesopotamia, Antioch or elsewhere—a fateful move. It is improbable that cuneiform and the Babylonion language continued to be used in Mesopotamia during the Hellenistic period, as it did in Babylonia, where it was certainly written as late as the last century B.C.;[1] and may have been a learned language till the second Christian century.[2] Unfortunately there are no native documents from the pre-Christian Hellenistic period. That the Hellenizing process went as far as it did in Syria is unlikely; and even there Aramaic remained the language of the people, even in the towns (cf. EDESSA). Still, Greek influence was considerable. This would be mainly in the towns, the growth of which was quite a feature of the Macedonian rule in Mesopotamia (Pliny, vi. 30, § 117).[3] This is seen in the Greek names which now appear: such are Seleucia opposite Samosāta, Apamea (=Birejiḳ) opposite Zeugma, Hierapolis (=Membij), Europos, Nicatoris, Amphipolis (= Thapsacus, or near it), Nicephorium (er-Raḳḳa,) Zenodotium (stormed by Crassus), all on or by the Euphrates; Edessa (*q.v.*) on the upper waters of the Belīkh, Ichnae (perhaps Khnēs, above the junction of the Qaramuch with the Belīkh). These are all in the Osroene district; but Naṣībīn became an Antioch, and as its district was known as Mygdonia (from Macedon) there were doubtless many other Greek settlements. To a less extent the same influences would be at work in towns called even by Western writers by their real names, such as Batnae, Carrhae (Charran), Rhesaena.

Mesopotamia naturally had its share of suffering in the struggles that disturbed the time, when Eumenes or Seleucus traversed it or wintered there. It was invaded and temporarily annexed in 245 by Ptolemy III. Euergetes in his rapid expedition to beyond the Tigris. When Molon revolted on the accession of the youthful Antiochus III. (224 B.C.) he entered Mesopotamia from the south. Antiochus skirted the northern highlands by way of Naṣībīn. How far the natives of Mesopotamia shared the desire of the Greek settlers (Joseph. *Antiq.* xiii. 5, 11, § 184–186) to help Demetrius II. Nicator in checking the aggressions of the rising power of Parthia under Mithradates I. we do not know. It was in Mesopotamia that a large part of the army of Antiochus VII. Sidetes was destroyed in 130 B.C., and the Syrian kings did not again seriously attempt to assert their rule beyond the Euphrates. When Phraates II. turned the Scythians against himself, however, even Mesopotamia suffered from the plunderers (*Joh. Antioch*, in Müller iv. 561). The immigration of Arabs must have been going on for long. About this time they even founded a dynasty in Aramaean Osroene (see EDESSA).

Parthian Period.

Under Mithradates II. Mesopotamia was a definite part of the Parthian empire, of which the Euphrates became the western boundary; but in 92 B.C. on that river his ambassador met Sulla, though the long duel did not begin immediately.

It was perhaps a Parthian governor of Mesopotamia that was called in to help Strato of Beroea against Demetrius III.; but before long Mesopotamia (especially the district of Niṣībis) was attached to the growing dominions of Armenia under its ambitious king Tigranes, perhaps with the consent of Sinatruces (Sanatruces). The lost territory, however, was recovered by Phraates III., and Mesopotamia was guaranteed to Parthia by the treaties of Lucullus and Pompey (66 B.C.). It was traversed, however, several times by Roman troops crossing from Armenia to Syria, and Parthia's declaration of war against Armenia involved it with Rome. Gabinius crossed the Euphrates (54); but the command was assumed by Crassus, who, though he seized Ichnae, &c., and Raqqa (Raḳḳa), fell near Carrhae (53), and the Parthian dominion was confirmed. The tragedy of the Ides of March saved Mesopatamia and the East from a great campaign by Julius Caesar, and it was at the hands of Ventidius Bassus, and *west* of the Euphrates, at Gindarus (north east of Antioch), that the Parthians received the check that put an end to any real rivalry with Rome. Mesopotamia narrowly escaped being the scene of the struggle when Antonius in 36 finally decided to make his disastrous attempt against Phraates IV. by way of Armenia. In A.D. 36, Tiridates found support in his attempt to secure the throne of Artabanus III. in Mesopatamia, and it was there that he saw his army melt away. The affairs of Armenia continued to be the source of friction between Parthia and Rome, and Niṣībis changed hands several times. The expedition against Rome of Vologaeses I. (*q.v.*) of A.D. 62 reached no further westwards than Niṣībis, and in 66 a peaceable arrangement was come to. Of the half-century that preceded Trajan's great oriental undertaking not much is known. When in 115 Trajan entered Mesopotamia from the north no serious resistance was offered, and it became a province as far as Singara. The woods at Niṣībis, the headquarters, provided material for the boats with which in 116 he crossed the Tigris. Hatra, an interesting fortress which seems to have been Aramaean, fell, and the army advanced to Hīt, where it found the fleet that was subsequently transferred to the Tigris. For the revolt that occurred while Trajan was on the Persian Gulf, in which the Jews had an important hand, Niṣībis and Edessa suffered capture and destruction. Hatra successfully withstood siege, however, and Hadrian abandoned Mesopotamia, setting the boundary at the Euphrates. Again for half a century there is not much to relate. Then, when Vologaeses, yielding to his growing discontent, took advantage of the death of Antoninus to invade Armenia the Romans were victorious (164), and after the storming of places such as Nicephorium, Edessa, Niṣībis, western Mesopotamia was once more Roman as far as the Khābūr, Carrhae becoming a free city and Osroene a dependency.

By this time Christianity had secured a foothold, perhaps first among the Jews (see EDESSA), and we enter upon the earliest period from which documents in the Edessan dialect of Aramaic, known as Syriac, have been preserved. Unfortunately they contain practically nothing that is not of Christian origin.[4] On the death of Aurelius Hatra aided Niger against Septimius Severus in 194; Osroene rose against Rome, and Niṣībis was besieged and other Roman places taken; but Septimius Severus appeared in person (195), and from Niṣībis as headquarters subdued the whole country, of which he made Niṣībis metropolis, raising it to the rank of a colony, the Sinjār district, where Arabs from Yemen had settled, being incorporated. On his retiring everything was undone, only Niṣībis holding out; but on his reappearance in 198 the Parthians withdrew. Again the Euphrates bore a Roman fleet. Hatra, however, was besieged twice in vain. Peace then prevailed till Carcalla's unprovoked attack on Parthia in 216, after he had reduced Osroene to a province. On his assassination near Carrhae (217), Macrinus was defeated at Niṣībis and had to purchase peace, though he retained Roman Mesopotamia, reinstating the princely house in Osroene.

The power of Ardashir, the Sassanian, however, was already rising, and the Parthian Artabanus died in battle in 224 (or 227); and Ardashir proposed to prove himself the successor of the Achaemenidae. Hatra resisted the first Persian attack as it

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[1] Probably the latest cuneiform document of certain date is a contract of 68 B.C. (cf. *Klio*, vi. 223 n. 3).

[2] See G. J. F. Gutbrod, *Zeitsch. f. Assyr.* vi. 26–33; cf. M. Streck, *Klio*, vi. 223 n. l.

[3] See E. R. Bevan, *House of Seleucus*, i. 219–222, and references given there.

[4] The earliest inscription in Syriac yet known dates from A.D. 77, and was found at Serrīn (opposite Ḳal'at en-Najm) by von Oppenheim.

Sassanian Period.

had resisted Rome; but Mesopotamia was overrun, Niṣībis and Carrhae being taken (233). It was immediately, indeed, recovered by Alexander Severus, and retained, whatever was the precise success of the war; but Niṣībis and Carrhae were retaken by the Persians in the reign of Maximin. Under Gordian III. in 242 Mesopotamia was entered by a great Roman army which recovered Carrhae and Niṣībis, and defeated the Persians at Rhesaena; but when Gordian, after a difficult march down the Khābūr, was murdered at Zaitha below Circesium, Philip the Arabian (244) made the best terms he could with Shapur I. Whatever they were, the Roman garrisons seem not to have been really withdrawn. A rest for Mesopotamia seems to have followed; but in 258 Shapur, tempted by the troubles in the Roman empire, overran the country taking Niṣībis and Carrhae, and investing Edessa, and when Valerian invaded Mesopotamia he was eventually made prisoner, by Edessa (260). After Shapur's cruel victories in Syria, however, he was defeated by Odaenathus, who relieved Edessa, and Mesopotamia became for ten years practically part of an Arabian Empire (see Palmyra), as it was to be four centuries later. In consequence of the revolt of Zenobia Mesopotamia was lost to Rome, and the Euphrates became the frontier. Aurelian overthrew the Palmyran rule; but he was assassinated before he could carry out his intended expedition against Persia, Probus was assassinated before he was able to do anything (or much), and although Carus easily overran Mesopotamia, which became Roman again, and even took Ctesiphon, the Romans retreated on his death (283–4). The next incident is the defeat of Galerius, between Carrhae and Callinicus, where he had entered Mesopotamia (about 296), in the war provoked by Narses in consequence of his relations with Armenia. When it was retrieved by a signal victory, Diocletian advanced to Niṣībis and thence dictated terms of peace by which Mesopotamia to the Tigris was definitely ceded to Rome (298).

One result of the connexion with Rome was, naturally, that Mesopotamia came within the range of the Decian, and later the Diocletian persecutions (see Edessa: § Sassanian Period). At the Nicene Council there were bishops from Niṣībis (Jacob), Rhesaena, Macedonopolis (on the Euphrates, west of Edessa), and Persia (Harnack, *Mission and Expansion of Christianity*, ii. 146; see generally 142–152).

After a forty years' peace the struggle was resumed by Shapur II. Niṣībis thrice endured unsuccessful siege (338, 346, 350), although meanwhile Constantine had suffered defeat at Singara (348). Then Mesopotamia enjoyed two short rests (separated by a sharp struggle) while the rivals were engaged elsewhere, when in 363 Julian (*q.v.*) made his disastrous attempt, and Jovian bought peace at the price, among other things, of Singara and Niṣībis—*i.e.* practically all eastern Mesopotamia.

The surrender of Niṣībis, which had been in the possession of Rome for so many generations, caused consternation among the Christians, and Ephraem (*q.v.*) moved to Edessa, where his "school of the Persians" soon became famous (see Edessa). In the war of 421, in which the north-east of Mesopotamia was chiefly concerned, the Romans failed to take Niṣībis, and it became a natural rallying point for the Nestorians after the decision of Ephesus (431). Matters were still more complicated when the Western Christians of Edessa found themselves unable to accept the ruling of Chalcedon against Monophysitism in 451 (see Monophysites), and there came to be three parties: Nestorians (*q.v.*), Jacobites (see Jacobite Church) and Melchites (*q.v.*).

In the beginning of the 6th century there was another severe struggle in Mesopotamia, which found an anonymous Syriac historian (see Edessa), and in infringement of agreement the Romans strongly fortified Dārā against Niṣībis. The Persian invasion of Syria under Kavadh I. (*q.v.*) was driven back by Belisarius; but the latter was defeated in his pursuit at Raḳḳa (531). The peace begun by Chosroes I. (532) was not long kept, and Roman Mesopotamia, except the pagan Ḥarrān, suffered severely (540), Edessa undergoing a trying siege (544). The fifty years' peace also (562) was short lived; the Romans again failed in an attempt to recover Niṣībis (573), whilst Chosroes' siege of Dārā was successful. Mesopotamia naturally suffered during the time of confusion that preceded and followed the accession of Chosroes II., and the Romans recovered their old frontier (591).

With the accession of Phocas (602) began the great war which shook the two kingdoms. The loss of Edessa, where Narses revolted, was temporary; but the Roman fortress of Dārā fell after nine months' siege (*c.* 605); Ḥarrān, Rās al-'Ain and Edessa followed in 607, many of the Christian inhabitants being transported to the Far East, and Chosroes carried the victorious arms of Persia far into the Roman Empire. Finally Heraclius turned the tide, and Kavadh II. restored the conquests of his predecessor. The Syrian Christians, however, found that they had only exchanged the domination of a Zoroastrian monarch for an unsympathetic ecclesiastical despotism. In the confusion that followed, when men of letters had to live and work in exile, Niṣībis set up for a time (631–632) a grandson of Chosroes II. Finally all agreed on Yazdegerd III.; but, while Chosroes II. and Heraclius had been at death grips with each other a great invasion had been preparing in Arabia.

The Caliphate.

The Arab tribes in Mesopotamia were Christian, and Heraclius at Edessa hoped for their support; but Ḳarḳīsiyā and Hīt succumbed (636), and then Tekrīt; and Heraclius retired to Samosāta. When in 638 he made another attempt, it is said at the entreaty of the Mesopotamian Christians, Arab forces appeared before Raḳḳa, Edessa, Naṣībīn and other places, and all Mesopotamia was soon in the hands of the Arabs. Henceforth it looked to Damascus and to Kūfa and Baṣra, instead of to Constantinople or Ctesiphon. The new régime brought welcome relief to the Christian part of the population, for the Arabs took no note of their orthodoxies or heterodoxies. (Moawiya is said to have rebuilt the dome of the great church at Edessa after an earthquake in 678.) Fortunately for Mesopotamia the seats of the factions which immediately broke the peace of Islam were elsewhere; but it could not escape the fate of its geographical position.

The men of Raḳḳa were compelled to help 'Ali, after his march across Mesopotamia from near Mōṣul, in getting a bridge made at Raḳḳa to convey his men to Ṣiffīn. Not long afterwards there was a new excitement in Moawiya's incursion across to the Tigris. The discontent under Yazīd III. was keen in Mesopotamia, where Merwān in fact got a footing, and when the troubles increased after he became caliph he abandoned Damascus in favour of his seat at Ḥarrān. His son was besieged by Daḥḥāk and his Khārijites and Ṣaffarids in Naṣībīn; but a fierce battle at Mārdīn ended in Merwān's favour (745). The cruelties that accompanied the overthrow of the Omayyad dynasty excited a revolt, which spread to Mesopotamia, and Ḥarrān had to undergo a siege by one of Merwān's generals. It was next besieged by al-Manṣūr's brother; but the battle between the brothers was fought at Naṣībīn. It was decisive, but there were further risings, involving Mesopotamia.[1]

An inevitable effect of the reign of Islām had been that the kindred language of the Arabs gradually killed the vernacular Syriac of Mesopotamia (see Edessa) as the alien Greek and Persian had shown no tendency to do, and the classical period (4th to 8th centuries) of the only Mesopotamian literature we know, such as it is, useful but uninviting, came to an end (see Syriac Literature). This naturally encouraged grammatical study. Among the Aramaic-speaking people the revolution which displaced the Arabian court of Damascus in favour of a cosmopolitan world centred at the Babylonian seat of the civilizations dealt with in the preceding paragraphs naturally gave an impulse to the wider scholarship. Translations were made from Greek, as, *e.g.* by Thābit b. Qurra of Ḥarrān (d. 901), and from Pahlavi.

Manṣūr built a castle at Rāfiqa opposite Raḳḳa to control the country round, and his son Hārūn al-Rashīd actually resided during most of his reign, not at Bagdād but at Raḳḳa, where two generations later al-Battāni of Ḥarrān was making the astronomical observations on which his tables were based (see Albategnius) Abu Qurra, bishop of Ḥarrān, and acquaintance of the caliph Ma'mūn, who was one of the earlier Aramaean Christians to use Arabic, has been thought to have contributed to the influences that developed the Mu'tazilite (Motazilite) sect. Naṣībīn was the scene of another revolt (793) under a Khārijite leader. Hārun's son Motaṣim displeased the people by creating a bodyguard of Turks, and therefore transferred his seat to Sāmarrā. This put the caliphs fatally at the mercy of their guards.

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[1] For this and following section see further Caliphate and Persia: *History*.

Decline of Caliphate.

Mesopotamia fell partly under the power of Aḥmad ibn Ṭūlūn of Egypt and his son; but before the end of the 9th century the Ḥamdānids, descendants of the Arab tribe of Tāghlib, were in possession of Mārdīn, and in 919 one of them was governor of Diār Rabi'a. Later the brothers Nāṣir ad-Daula and Ṣaif ad-Daula ruled over Mesopotamia and North Syria respectively. Meanhwile the caliph Mottaqi appeared as a fugitive at Mōṣul, Naṣībīn, Raḳḳa (944). The Ḥamdānids were followed by the 'Oqaylids, who had their seats at various places, such as Mōṣul, Naṣībīn, Raḳḳa, Ḥarrān, between 996 and 1096. By 1055 the Seljūḳs had taken the caliph under their charge. They arrived at Jerusalem in 1076, the first crusaders reached Asia in 1097, and Bīt Adini became the countship of Edessa (*q.v.*). The power of the Seljūḳs quickly disintegrated. The son of a slave of the third Seljūḳ sultan, Zangi, governor of 'Irāḳ, made himself gradually (Mōṣul, Sinjār, Jezīra, Ḥarrān) master of Mesopotamia (1128), capturing Edessa in 1144. Mesopotamia fell to one of his sons, Saif ad-Dīn, and branches sprang up at Sinjār and Jezīra. To the same period belong other Atābeg dynasties; Begtigīnids at Ḥarrān, Tekrīt, &c.; Ortoḳids at Edessa, 'Āna, &c., with Mārdīn as their headquarters. By 1185–1186 Saladin had made Egypt supreme over all these principalities, thus achieving what the XVIIIth and XIXth Egyptian dynasties had attempted in vain. Mesopotamia remained in the hands of the Ayyūbite family till the appearance of the Mongols. The petty principalities were unable to unite to resist the terrible attack, and Jezīra, Edessa, Naṣībīn, Māridīn, &c., fell in 1259–60. The leading men of Ḥarrān emigrated into Syria, the rest were carried into slavery, and the ancient town was laid in ruins. It was the Mamlūk rulers of Egypt that checked the death-bringing flood. Near Bīra was the scene of one of their victories (in 1273), and their authority extended to Karḳīsiyā. The Ortoḳid dynasty survived the Mongol inundation, and it was in the 14th century that its laureate Ṣafiy ad-Dīn al-Ḥillī flourished. From the Mongol invasions of the 13th century western Asia has never recovered. Then, before the next century was out, came the invasion of Timur (1393–94). The Ortoḳids were followed by the Ḳaraḳuyunli. In 1502 Mesopotamia passed for a time into the hands of the Ṣafawid shah, Ishmael; but in 1516 it came under the Osmanli Turks, to whom it has belonged ever since. The inroad of the Persians in the 17th century was confined to the south.

Nomad Arabs.

Since Mesopotamia finally came into the power of the Ottoman sultans considerable changes in the population have occurred. About that time parts of a confederation of tribes which had taken the name of Shammar from a mountain in their neighbourhood, moved northwards from Central Arabia in search of better pasture, &c. Successfully displacing their forerunners, they made themselves at home in the Syrian steppe—until their possession was in turn disputed by a later emigrant from Arabia, for whom they finally made room by moving on into Mesopotamia, over which they spread, driving before them their predecessors the Ṭai (whose name the Mesopotamian Aramaeans had adopted as a designation for Arab in general), partly north of the Sinjār, partly over the Tigris. Others they forced to abandon the nomadic life, and settle by the Khābūr (*e.g.* the Jebur) or the Euphrates. These adjustments, it is supposed, had been effected by 1700.

In 1831 'Ali, a newly appointed Turkish governor of Bagdād, induced Ṣufūg the chief of the Jerbā, the more important division of the Shammar, to help him to dislodge his predecessor, Dāūd, who would not vacate his position, but then refused them the promised payment. To defend himself from the enraged Shammar 'Ali summoned the 'Anaza from across the Euphrates. Having also succeeded in detaching part of the Shammar under Shlōsh, he told the 'Anaza he no longer needed their help. In the futile attempt of the three parties to dislodge the 'Anaza Shlōsh lost his life; but with the help of the Zubeid the other two succeeded, and Ṣufūg was now supreme, "King of the Steppe," levying blackmail as he pleased. Other methods of disposing of him having failed, the Porte made his nephew a rival *sheikh*; but he basely assassinated him. Ṣufūg then suffered the same fate himself at the hands of the pasha, but has since become a hero. Two of his sons became involved in a quarrel with the government, in consequence of which for years all Mesopotamia was in danger, till the second was put to death in 1868, and Ferḥān, the eldest son, a peaceable man who had been made pasha, became supreme. One of Ṣufūg's widows had fled to her Ṭai kindred in Central Arabia with her youngest son Fāris; but when he grew up she brought him back in the seventies, and he immediately attracted a great following. He kept to the far north of Mesopotamia to avoid his brother Ferḥān; but finally half-sedentary tribes on the Khābūr and the Belīkh became tributary to him, and a more or less active warfare sprang up between the brothers, which ended in a partition of Mesopotamia.

Ferḥān and the South Shammar claimed the steppe south-east of a line from Mōṣul to Mayādin (just below Ḳarḳīsiyā), and Fāris and the North Shammar the north-west. Since Ferḥān's death the Porte has favoured one after another of his many sons, hoping to keep the South Shammar disunited, especially as they are more than the others. The Shammar have been in undisputed mastery from Urfa to the neighbourhood of Bagdād, practically all tribes paying *khuwwa* to them, and even the towns, till the government garrisoned them. Some 60 of these more or less nomadic communities, of one or two thousand tents (or houses) each, representing a population of several hundred thousands are described by Oppenheim. Each has its recognized camping ground, usually one for summer and another for winter. Most of them are Arab and Mahommedan. Some are Christian and some are not Arab: viz. Kurds, Turkomans or Circassians. For some years the Porte has been applying steady pressure on the nomads to induce them to settle, by increasing the number of military posts, by introducing Circassian colonies, as at Ras al-'Ain, sometimes by forcible settlement. More land is thus being brought under cultivation, the disturbing elements are being slowly brought under control, and life and property are becoming more secure.

Present Time.

Security is what the country chiefly needs. Hence its primary interest in the railway scheme, with a view to agricultural development and perhaps the growth of cotton; Sir W. Willcocks' irrigation schemes had not up to 1910 affected "Mesopotamia" directly. Apparently the real problem is one of population adequate to effect the improvements demanded. The new régime introduced in 1908 seems to justify a hopeful attitude. Apart from the disturbing effects of recent events in Persia, an exposition of present conditions would show progress. Exact statistics are not available because the vilayet of Mōṣul (35,130 sq. m., 351,200 pop.) takes in on the east territory with which we are not concerned, and omits the Osroene district, which goes with Aleppo. Urfa is a town of 55,000; Mōṣul, 61,000, Bagdād, 145,000. The exports of Mōṣul for 1908 were (in thousands of pounds sterling): United Kingdom 195, India 42, other countries 52, parts of Turkey 218; the imports: United Kingdom 56, India 16, other countries 35, parts of Turkey 24. The language is in most parts Arabic; but Turkish is spoken in Bīrejiḳ and Urfa, Kurdish and Armenian south of Diarbekr, and some Syriac in Ṭūr 'Abdīn. There are Christian missionary institutions of European origin in various places, such as Urfa, Mārdīn, Mōṣul. An interesting survival of early faiths is to be found in the Yezīdīs of the Sinjār district.

AUTHORITIES—*Land and People*: full references to Greek, Latin, Arabic and other writers are given in Ritter, *Erdkunde* x. 6–284, 921–1149; xi. 247–510, 660–762; for the conditions since the Arab conquest, Guy le Strange, *Lands of the Eastern Caliphate* (1905), chiefly pp. 86–114, is especially useful. Of recent works the following are valuable: E. Sachau, *Reise in Syrien u. Mesopotamien* (1883); M. v. Oppenheim, *Vom Mittelmeer zum Persischen Golf*, vol. ii (1889). We may mention further D. G. Hogarth, *The Nearer East* (1902), *passim*; K. Regling, "Zur historischen Geographie des mesopotamischen Parallelograms" (Sarug district), in *Klio*, I. 443–476; M. Sykes, "Journeys in North Mesopotamia" in *Geog. Journal*, xxx. 237–254, 384–395; "The Western Bend of the Euphrates," *op. cit.* xxxiv. 61–65 (plans of two castles); D. Fraser, *Short Cut to India* (1909); W. Kurz, "Beurteilung der Aussichten auf eine Wiederbelebung der Kultur der Euphrat- und Tigrisniederung," in *Deutsche geographische Blätter*, xxxi. 147–179 (1908); E. Pears, "The Bagdad Railway," in *Contemp. Rev., 1908*, 570–591; K. Baedeker, *Palestine and Syria* (1906), pp. 389–412. The annual Consular Reports most nearly bearing on Mesopotamia are those for Aleppo, Mōṣul, Bagdād and Basra.

Maps.—The following deserve special mention: v. Oppenheim, *op. cit.*, a most valuable large scale folding map in pockets of volumes; Sachau. *op. cit.*; M. Sykes, *Geog. Journ.* xxx. opp. p. 356, and xxxiv. opp. p. 120; Hogarth, *op. cit.*, orographic, &c.

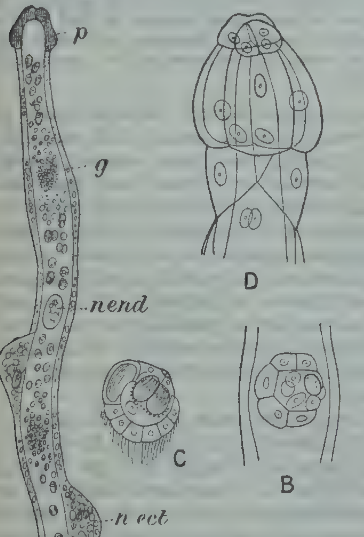
Excavations at 'Arbān: A. H. Layard, *Nineveh and Babylon* (1849–1851), pp. 230–242; at Tell Khalaf: M. v. Oppenheim, *Der Tell Halaf* (1908), in the *Der alte Orient* series (see an account by J. L. Myres in *Annals of Archaeology and Anthropology*, ii. 139–144; at Asshur: *Sendschriften der deutsch. or. Gesellsch.*, and W. Andrae,

Der Anu Adad Tempel (1909). See also D. G. Hogarth, "Carchemesh and its Neighbourhood" (*Annals*, &c. ii. 165–184), and W. Andrae's *Die Ruinen von Hatra* (1908).

History.—Early period: besides the histories of Babylonia and Assyria see Winckler, various essays in his *Altor. Forschungen*, "Vorläufige Nachrichten über die Ausgrabungen in Boghaz-köi im Sommer, 1907," in *Mitteilungen der Deutsch. Orient. Gesellschaft*, No. 35, and "Suri" in *Oriental. Lit.-Zeit*, x. 281–299, 345–357, 401–412, 643; O. Weber, the notes to Knudtzon's *Die El-Amarna Tafeln*; A. Ungnad, *Untersuchungen zu den* [illegible] *Urkunden aus Dilbat* (1909), pp. 8–21; P. Schnabel, *Studien zur bab.-assyrischen Chronologie* (1908); A. Šanda, *Die Aramäer* (1902) in the *Der Alte Orient* series; M. Streck, "Über die älteste Geschichte der Aramäer" in *Klio*, vi. 185–225. For the later periods see PERSIA: *History*; HELLENISM; ROME: *History*; PARTHIA; SYRIAC LITERATURE; CALIPHATE and authorities there given. (H. W. H.)

MESOXALIC ACID (dioxymalonic acid), $(HO_2C)_2C(OH)_2$ or $C_3H_4O_6$, is obtained by hydrolysis of alloxan with baryta water (J. v. Liebig, *Ann.*, 1838, 26, p. 298), by warming caffuric acid with lead acetate solution (E. Fischer, *Ann.*, 1882, 215, p. 283), or from glycerin diacetate and concentrated nitric acid in the cold (E. Seelig, *Ber.*, 1891, 24, p. 3471). It crystallizes in deliquescent prisms and melts with partial decomposition at 119-120° C. It behaves as a ketonic acid, being reduced in aqueous solution by sodium amalgam to tartronic acid, and also combining with phenylhydrazine and hydroxylamine. It reduces ammoniacal silver solutions. When heated with urea to 100° C. it forms allantoin. By continued boiling of its aqueous solution it is decomposed into carbon dioxide and glyoxylic acid, $C_2H_4O_4$.

MESOZOA. Van Beneden[1] gave this name to a small group of minute and parasitic animals which he regarded as intermediate between the Protozoa and the Metazoa. The Mesozoa comprise two classes: (1) the *Rhombozoa*, which are found only in the kidneys of Cephalopods, and (2) the *Orthonectida*, which infest specimens of Ophiurids, Polychaets, Nemertines, Turbellaria and possibly other groups.



(From *Cambridge Natural History*, vol. ii. "Worms, &c.," by permission of Macmillan & Co. Ltd. After Gamble.)

FIG. 1.—*Dicyemennea eledones* Wag. from the kidney of *Eledone moschata*.

A. Full-grown Rhombogen with infusoriform embryos (*emb*).

g. Part of endoderm cell where formation of the embryos is actively proceeding.

n. ect. Nucleus of ectoderm cell.

n. end. Nucleus of endoderm cell.

p. "Calotte."

B. Developing infusoriform embryo.

C. One fully developed.

D. "Calotte" of nine cells.

Class I. RHOMBOZOA (E. van Beneden).—These animals consist of a central cell from which certain reproductive cells arise, enclosed in a single layer of flattened and for the most part ciliated cells; some of them are modified at the anterior end and form the polar cap. The Rhombozoa comprises two orders: (*a*) *Dicyemida*, ciliated vermiform creatures whose polar cap has 8 or 9 cells arranged in two rows (*Dicyema*, Koll., *Dicyemennea*, Whitm.); (*b*) *Heterocyemida*, non-ciliated animals with no polar cap, but whose anterior ectodermal cells contain refringent bodies and may be produced into wart-like processes (*Conocyema*, v. Ben. in *Octopus vulgaris*; *Microcyema* in *Sepia officinalis*). Unlike the Dicyemida, which are fixed in the renal cells of their host by their polar cap, the Heterocyemida are free. The number of ectoderm cells apart from the polar cap is few, some fourteen to twenty-two.

The central cell is formed by the layer of the first two blastomeres, and remains quiescent until surrounded by the micromeres or products of division of the smaller blastomere. It then divides unequally, and of the two cells thus formed the larger repeats the process. Each of the two small cells are now called "primary germ cells," and they enter into and lie inside the large central cell. The primary germ cells divide until there are eight of them all lying within the axial cell. At this stage the future of the parasite may take one of two directions. Following one path, the animal (now called a "Nematogen") gives rise by the segmentation of its primary germ cells to vermiform larvae which, though smaller, are but replicas of the parent form. Following the other path, the animal (now termed a "Rhombogen") gives origin to a number of "infusoriform larvae," several of these arising from each primary germ-cell. The vermiform larvae leave their Nematogen parent and swimming through the renal fluid attach themselves to the renal cells. They never leave their host, and die in sea-water. The infusoriform larvae have a very complicated structure; they escape from the Rhombogen, and, unlike the vermiform larvae they can live in sea-water. They possibly serve to infect new hosts. Some authorities look upon these infusoriform larvae as males, and consider that they fertilize some of the Nematogens, which then give rise to males again, whereas the females which produce the vermiform embryos arise from unfertilized vermiform larvae. After the infusoriform larvae have left the parent's body, the Rhombogen takes to producing vermiform offspring, and thus becomes a secondary Nematogen. Thus, if the above views be correct, a Rhombogen is a protandrous hermaphrodite.

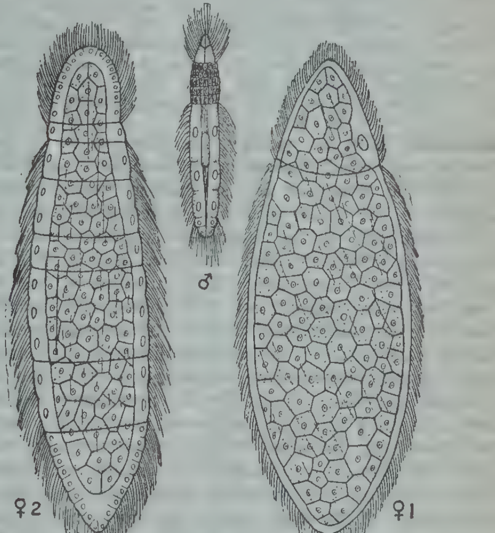


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FIG. 2.—*Rhopalura giardii* Metschn. from *Amphiura squamata*.

♂. Full grown male.
♀1. Flattened form of female.
♀2. Cylindrical female.

E. Nerescheimer has recently described under the name of *Lohmanella catenata* an organism parasitic in *Fritillaria* which shows marked affinities with the Rhombozoa. The genus *Haplozoon* of which two species have been found in the worms *Travisia* and *Clymene* by Dogiel is classed as a new group of Mesozoa.

Class II. ORTHONECTIDA (A. Giard).—The Orthonectida contain animals with a central mass of eggs destined to form male and female reproductive cells surrounded by a single layer of ciliated ectoderm cells arranged in regular rings which contain varying numbers of rows of cells. Muscular fibrils occur between the outer and inner cells. The sexes are separate and unlike, and there are two kinds of females, cylindrical and flat. There are but two genera, *Rhopalura* and *Staecharthrum*, the latter found in a Polychaet. The male *R. giardii* lives in the body-cavity of *Amphiura squamata*, has six rings of ectodermal cells all ciliated except the second, whose cells contain refringent granules. The ectoderm encloses the testis, a mass of cells which have arisen from a single axial cell in the embryo. The female differs from the male in appearance, and in size it is larger. It occurs in two forms: (1) The cylindrical with 8 (or 9) rows of ectoderm cells; here as in the male the second ring is devoid of cilia. (2) The flat females are broader, uniformly ciliated, and have not rings of ectoderm cells. The central mass of cells forms ova which are free in the cylindrical forms; they leave the mother through the dehiscing of the cells of the non-ciliated ring, are fertilized and develop parthenogenetically into females both flat and cylindrical.

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[1] *Bull. Ac. Belgique* (1876), p. 35.

R. pelseneeri and *S. giardi* are said to be hermaphrodite. The parasites first make their appearance in a host in the form of a plasmodium comparable with the sporocyst of a Trematode. By the segregation of nuclei and some of the surrounding protoplasm, germ cells arise which develop into ciliated larvae and ultimately into males and females which only discharge their spermatozoa and ova when they reach sea-water. The product of the consequent fertilization is unknown; presumably it infects new hosts, entering them in the form of a nucleated plasmodium.

The original idea that in the Rhombozoa and Orthonectida we had animals intermediate between the Protozoa and Metazoa is no longer widely held. The modern view is that the simplicity of their structure is secondary and not primary, and is correllated with their parasitic habit of life. They are probably derived from some Platyhelminthine ancestor and perhaps come nearer to the Trematoda than to any other group.

Literature.—E. van Beneden, *Bull. Ac. Belgique* (2), (1876) xli. 85, 116; (1876), xlii. 35; also *Arch. Biol.* (1882), iii. 197; C. O. Whitman, *Mt. Stat. Neapel.* (1883), iv. 1; W. M. Wheeler, *Zool. Anz.*, (1899), xxii. 169; A. Giard, *Jour. anat. physiol.* (1879), xv. 449; *Quart. Jour. Micr. Sci.* (1880), xx. 225; St Joseph, *Bull. Soc. Zool. France* (1896), xxi. 58; Caullery and Mesnil, *C. R. ac. sci.* (1899), cxxviii. 457 and 516; C. Julin, *Arch. Biol.* (1882), iii. 1; E. Nerescheimer, *Zeitschr. wiss. Zool.* (1904), lxxvi. 137; V. A. Dogiel, *Trav. soc. imp. natur. St Pètersbourg* (1907), xxxviii. 28, and *Zool. Anz.* (1906), xxx. 895. (A. E. S.)

MESOZOIC ERA, in geology, the name given to the period of time between the Palaeozoic and Cainozoic eras; it is synonymous with the older and less satisfactory term "Secondary" as applied to the major divisions of geological time and with the "Flözgebirge" of the Wernerian school. This era is subdivided into a lower, Triassic, a middle, Jurassic, and an upper, Cretaceous period or epoch. The duration of the Mesozoic era was not more than one fourth of that of the Palaeozoic era, measured by the thickness of strata formed during these periods. It was an era marked by peaceful conditions in the earth's crust and by a general freedom from volcanic activity. The sediments as a whole are characterized by the prevalence of limestones as compared with those of the preceding era; they are seldom much altered or disturbed except in the younger mountain regions. Mammals, represented by small marsupials, and primitive forms of birds and bony fishes make their first appearance in rocks of Mesozoic age. Saurian reptiles played an extremely prominent part; ammonites and belemnites lived in extraordinary variety in the seas along with the echinoids and pelecypods, which had to a great extent supplanted the crinoids and brachiopods of the preceding periods. The first clear indications of monocotyledonous and dicotyledonous angiosperms made their appearance, while Cycads and Conifers constituted the bulk of the land flora.

MESQUITE, or Honey Locust, in botany, a tree, native of the southern United States and extending southwards through Mexico and the Andean region to Chile and the Argentine Republic. It is known botanically as *Prosopis juliflora*, and belongs to the natural order Leguminosae (suborder Mimoseae). It reaches 40 or 50 ft. in height with a trunk usually not more than 6 to 12 in. in diameter, and divided a short distance above the ground into numerous irregular crooked branches forming a loose straggling head. The remarkable development of its main root in relation to water-supply renders it most valuable as a dry-country plant; the root descends to a great depth in search of water, and does not branch or decrease much in diameter till this is reached. It can thus flourish where no other woody plant can exist, and its presence and condition afford almost certain indications of the depth of the water-level. When the plant attains the size of a tree, water will be found within 40 or 50 ft. of the surface; when it grows as a bush, between 50 or 60 ft.; while, when the roots have to descend below 60 ft., the stems are only 2 or 3 ft. high. These woody roots supply valuable fuel in regions where no wood of fuel value is produced above ground. The leaves are compound, the main axis bearing two or sometimes four secondary axes on which are borne a number of pairs of narrow bluntish leaflets. The minute greenish-white fragrant flowers are densely crowded on slender cylindrical spikes from $1\frac{1}{2}$ to 4 in. long; the long narrow pods are constricted between the seeds, of which they contain from ten to thirty surrounded by a thick spongy layer of sweet pulp. The wood is heavy, hard and close-grained, but not very strong; it is almost indestructible in contact with soil, and is largely used for fence-posts and railway ties. The ripe pods supply the Mexicans and Indians with a nutritious food; and a gum resembling gum arabic exudes from the stem.

An allied species *Prosopis pubescens*, a small tree or tall shrub, native of the arid regions of the south-western United States, is known as the screw-bean or screw-pod mesquite from the fact that the pods are twisted into a dense screw-like spiral; they are used for fodder and are sweet and nutritious, but smaller and less valuable than those of the mesquite.

For a fuller account of these trees see Charles Sprague Sargent, *Silva of North America*, iii. p. 99 (1892).

MESS (an adaptation of O. Fr. *mes*, mod. *mets*; Ital. *messo*; derived from the Late Lat. *missum*, past participle of *mittere* "to send or place in position"), a service of meat, a dish sent to table. The term is also used of the persons who are in the habit of eating their meals together, and thus particularly of the parties into which a ship's company or a regiment is divided, either according to their rank, or for convenience in catering. Originally, a mess in this sense was a group of four persons sitting at one table and helped from the same dishes. In the Inns of Court, London, the original number is preserved, four benchers or four students dining together.

In early times the word mess was applied to food of a more or less liquid character, as soup, porridge, broth, &c. It is probably in allusion to the sloppy nature of semi-liquid messes of food that a mess has come also to mean a state of disorder, confusion and discomfort. Skeat takes the word in this sense to be a variant of "mash," originally to mix up.

MESSAGE (a word occurring in slightly different forms in several languages, *e.g.* Fr. *message*, Span. *mensaje*, Ital. *messagio*; adapted from the Low Lat. *missaticum*, from *mittere*), a communication either verbal, written or printed, sent from one person to another. Message is the term generally applied to the official communications addressed by the heads of states to their legislatures at the opening of the session or at other times. These also, though written, are borne and delivered by special messengers and have the force of a face to face speech. The sessional and other messages to Congress of the president of the United States of America are printed state documents. Washington and John Adams delivered them in person but the practice was discontinued by Jefferson.

"Messenger" is of the same derivation; the earlier form of the word was *messager* (cf. passe*n*ger, scave*n*ger). In ordinary language the word means one who is charged with the delivery of a message. In Scottish law a messenger-at-arms is an official appointed by Lyon-King-at-Arms to execute summonses and letters of diligence connected with the Court of Sessions and Court of Justiciary (see Writ: § *Scotland*). Technically the term "messenger" is given to an endless rope or chain, passing from the capstan to the cable so that the latter may be hauled in when the messenger is wound round the capstan; also to a similar contrivance for hauling in a dredge.

MESSAGER, ANDRE CHARLES PROSPER (1853–), French musician, was born at Montluçon on the 30th of December 1853; he studied at Paris, and in 1874 became organist at St Sulpice. He was for some time a pupil of Saint-Saëns. In 1876 he won the gold medal of the Société des Compositeurs with a symphony. In 1880 he was appointed music director at Ste Marie-des-Batignolles. In 1883 he completed Firmin Bernicat's comic opera *François des bas bleus*; and in 1885 produced his own operettas, *La Fauvette du temple* and *La Béarnaise*, the latter being performed in London in 1886. His ballet *Les Deux pigeons* was produced at the Paris Opéra in 1886. But it was the production of his comic opera *La Basoche* in 1890 at the Opéra Comique (English version in London the following year) that established his reputation; and subsequently this was increased by such tuneful and tasteful light operas as *Madame Chrysanthème* (1893), *Mirette* (1894), *Les Petites Michus* (1897), and *Véronique* (1898), the latter of which had a great success in London. Besides conducting for some years at the Opéra Comique in Paris, Messager's services were also secured in London in 1901 and later years as one of the directors of the Covent Garden opera.

MESSALLA CORVINUS, MARCUS VALERIUS (64 B.C.–A.D. 8), Roman general, author and patron of literature and art. He was educated partly at Athens, together with Horace and the younger Cicero. In early life he became attached to republican principles, which he never abandoned, although he avoided offending Augustus by too open an expression of them. He moved that the title of *pater patriae* should be bestowed upon Augustus, and yet resigned the appointment of praefect of the city after six days' tenure of office, because it was opposed to his ideas of constitutionalism. In 43 B.C. he was proscribed, but managed to escape to the camp of Brutus and Cassius. After the battle of Philippi (42) he went over to Antony, but subsequently transferred his support to Octavian. In 31 Messalla was appointed consul in place of Antony, and took part in the battle of Actium. He subsequently held commands in the East, and suppressed the revolted Aquitanians; for this latter feat he celebrated a triumph in 27.

Messalla restored the road between Tusculum and Alba, and many handsome buildings were due to his initiative. His influence on literature, which he encouraged after the manner of Maecenas, was considerable, and the group of literary persons whom he gathered round him—including Tibullus, Lygdamus and the poet Sulpicia—has been called "the Messalla circle." With Horace and Tibullus he was on intimate terms, and Ovid expresses his gratitude to him as the first to notice and encourage his work. The two panegyrics by unknown authors (one printed among the poems of Tibullus as iv. 1, the other included in the *Catalepton*, the collection of small poems attributed to Virgil) indicate the esteem in which he was held. Messalla was himself the author of various works, all of which are lost. They included *Memoirs* of the civil wars after the death of Caesar, used by Suetonius and Plutarch; bucolic poems in Greek; translations of Greek speeches; occasional satirical and erotic verses; essays on the minutiae of grammar. As an orator, he followed Cicero instead of the Atticizing school, but his style was affected and artificial. Later critics considered him superior to Cicero, and Tiberius adopted him as a model. Late in life he wrote a work on the great Roman families, wrongly identified with an extant poem *De progenie Augusti Caesaris* bearing the name of Messalla, but really a 15th-century production.

Monographs by L. Wiese (Berlin, 1829), J. M. Valeton (Gröningen, 1874), L. Fontaine (Versailles, 1878); H. Schulz, *De M. V. aetate* (1886); "Messalla in Aquitania" by J. P. Postgate in *Classical Review*, March 1903; W. Y. Sellar, *Roman Poets of the Augustan Age. Horace and the Elegiac Poets* (Oxford, 1892), pp. 213 and 221 to 258; the spurious poem ed. by R. Mecenate (1820).

Two other members of this distinguished family of the Valerian gens may be mentioned:—

1. MARCUS VALERIUS MESSALLA, father of the preceding, consul in 53 B.C. He was twice accused of illegal practices in connexion with the elections; on the first occasion he was acquitted, in spite of his obvious guilt, through the eloquence of his uncle Quintus Hortensius; on the second he was condemned. He took the side of Caesar in the civil war. Nothing appears to be known of his later history. He was augur for fifty-five years and wrote a work on the science of divination.

Cicero, *Ad Fam.* vi. 18, viii. 4, *ad Atticum*, iv. 16; Dio Cassius xl. 17, 45; *Bellum africanum*, 28; Macrobius, *Saturnalia*, i. 9, 14; Aulus Gellius xiii. 14, 3.

2. MANIUS VALERIUS MAXIMUS CORVINUS MESSALLA, consul 263 B.C. In this year, with his colleague Manius Otacilius (or Octacilius) Crassus, he gained a brilliant victory over the Carthaginians and Syracusans; the honour of a triumph was decreed to him alone. His relief of Messana obtained him the cognomen Messalla, which remained in the family for nearly 800 years. To commemorate his Sicilian victory, he caused it to be pictorially represented on the wall of the Curia Hostilia, the first example of an historical fresco at Rome. He is said also to have brought the first sun-dial from Catana to Rome, where it was set up on a column in the forum.

Polybius i. 16; Diod. Sic. xxiii. 4; Zonaras viii. 9; Pliny, *Nat. Hist.*, vii. 60, xxxv. 4 (7).

MESSALLINA, VALERIA, the third wife of the Roman emperor Claudius (*q.v.*). She was notorious for her profligacy, avarice and ambition, and exercised a complete ascendancy over her weak-minded husband, with the help of his all-powerful freedmen. During the absence of Claudius from the city, Messallina forced a handsome youth named Gaius Silius to divorce his wife and go through a regular form of marriage with her. The freedman Narcissus, warned by the fate of another freedman Polybius, who had been put to death by Messallina, informed Claudius of what had taken place, and persuaded him to consent to the removal of his wife. She was executed in the gardens of Lucullus, which she had obtained on the death of Valerius Asiaticus, who through her machinations had been condemned on a charge of treason. She was only twenty-six years of age. By Claudius she was the mother of the unfortunate Britannicus, and of Octavia, wife of Nero.

See Tacitus, *Annals*, xi. 1–38; Dio. Cassius lx. 14–31; Juvenal vi. 115–135, x. 333, xiv. 331; Suetonius, *Claudius*; Merivale, *Hist. of the Romans under the Empire* ch. 50; A. Stahr, "Agrippina" in *Bilder aus dem Alterthume*, iv. (1865).

MESSAPII, an ancient tribe which inhabited, in historical times, the south-eastern peninsula or "heel" of Italy, known variously in ancient times as Calabria, Messapia and Iapygia. Their chief towns were Uzentum, Rudiae, Brundisium and Uria. They are mentioned (Herod. vii. 170) as having inflicted a serious defeat on the Greeks of Tarentum in 473 B.C. Herodotus adds a tradition which links them to the Cretan subjects of "King Minos." Their language is preserved for us in a scanty group of perhaps fifty inscriptions of which only a few contain more than proper names, and in a few glosses in ancient writers collected by Mommsen (*Unteritalische Dialekte*, p. 70). Unluckily very few originals of the inscriptions are now in existence, though some few remain in the museum at Taranto. The only satisfactory transcripts are those given by (1) Mommsen (*loc. cit.*) and by (2) I. P. Droop in the *Annual of the British School at Athens* (1905–1906), xii. 137, who includes, for purposes of comparison, as the reader should be warned, some specimens of the unfortunately numerous class of forged inscriptions. A large number of the inscriptions collected by Gamurrini in the appendices to Fabretti's *Corpus inscriptionum italicarum* are forgeries, and the text of the rest is negligently reported. It is therefore safest to rely on the texts collected by Mommsen, cumbered though they are by the various readings given to him by various authorities. In spite, however, of these difficulties some facts of considerable importance have been established.

The inscriptions, so far as it is safe to judge from the copies of the older finds and from Droop's facsimiles of the newer, are all in the Tarentine-Ionic alphabet (with [for *v* and ⊦ for *h*). For limits of date 400–150 B.C. may be regarded as approximately probable; the two most important inscriptions—those of Bindisi and Vaste—may perhaps be assigned provisionally to the 3rd century B.C.

Mommsen's first attempt at dealing with the inscriptions and the language attained solid, if not very numerous, results, chief of which were the genitival character of the endings—*aihi* and *ihi*; and the conjunctional value of *inθi* (*loc. cit.* 79–84 sqq.). Since that time (1850) very little progress has been made. There is, in fact, only one attempt known to the present writer to which the student can be referred as proceeding upon thoroughly scientific lines, that of Professor Alf Torp in *Indogermanische Forschungen* (1895), v., 195, which deals fully with the two inscriptions just mentioned, and practically sums up all that is either certain or probable in the conjectures of his predecessors. Hardly more than a few words can be said to have been separated and translated with certainty—*kalatoras* (masc. gen. sing.) "of a herald" (written upon a herald's staff which was once in the Naples Museum); *aran* (acc. sing. fem.) "arable land"; *mazzes*, "greater" (neut. acc. sing.), the first two syllables of the Latin *maiestas*; while *tepise* (3rd sing. aorist indic.) "placed" or "offered"; and forms corresponding to the article (*ta-* = Greek τὸ) seem also reasonably probable.

Some phonetic characteristics of the dialect may be regarded as quite certain; (1) the change of the original short *ŏ* to *ă* (as in the last syllable of the genitive *kalatoras*); (2) of final *-m* to *-n* (as in *aran*); (3) of *-ni̯- -ti̯- -si̯-* respectively to *-nn- -tθ-* and *-ss-* as in *dazohonnes* "Dasōnius," *dazohonniki* "Dasōnii"; *dazetθes*, gen. *dazetθiki* "Dazetius, Dazetii," from the shorter stem *dazet-*; *Vallasso* for *Vallasio* (a derivative from the shorter name *Valla*); (4) the loss of final *d* (as in *tepise*), and probably of final *t* (as in *-des*, perhaps meaning "set," from the root of Gr. τίθημι); (5) the change of original *dh* to *d* (*anda* = Gr. ἔνθα and *bh* to *b* (*beran* = Lat. *ferant*); (6) *-au-* before (at least some) consonants becomes *-ā-* (*Bāsta*, earlier βαῦστα). (7) Very great interest attaches to the form *penkaheh*—which Torp very probably identifies with the Oscan stem *pompaio*—which is a derivative of the Indo-European numeral **penque* "5."

If this last identification be correct it would show that in Messapian (just as in Venetic and Ligurian) the original velars were retained as gutturals and not converted into labials. The change of *o* to *a* is exceedingly interesting as being a phenomenon associated with the northern branches of Indo-European such as Gothic, Albanian and Lithuanian, and not appearing in any other southern dialect hitherto known. The Greek Ἀφροδίτα appears in the form *Aprodita* (dat. sing., fem.). The use of double consonants which has been already pointed out in the Messapian inscriptions has been very acutely connected by Deecke with the tradition that the same practice was introduced at Rome by the poet Ennius who came from the Messapian town Rudiae (Festus, p. 293 M).

It should be added that the proper names in the inscriptions show the regular Italic system of gentile nomen preceded by a personal praenomen; and that some inscriptions show the interesting feature which appears in the Tables of Heraclea of a crest or coat of arms, such as a triangle or an anchor, peculiar to particular families. The same reappears in the Iovilae (*q.v.*) of Capua and Cumae.

For further information the student must be referred to the sources already mentioned and further to W. Deecke in a series of articles in the *Rheinisches Museum*, xxxvi. 576 sqq.; xxxvii. 373 sqq.; xl. 131 sqq.; xlii. 226 sqq.; S. Bugge, *Bezzenbergers Beiträge*, vol. 18. A newly discovered inscription has been published by L. Ceci *Notizie degli Scavi* (1908), p. 86; and one or two others are recorded by Professor Viola, ibid. 1884, p. 128 sqq. and in *Giornale degli Scavi di Pompei*, vol. 4 (1878), pp. 70 sqq. The place-names of the district are collected by R. S. Conway, *The Italic Dialects*, p. 31; for the Tarentine-Ionic alphabet see ibid. ii., 461.

For a discussion of the important ethnological question of the origin of the Messapians see W. Helbig, *Hermes*, xi., 257; P. Kretschmer, *Einleitung in die Geschichte der griechischen Sprache*, pp. 262 sqq., 272 sqq.; H. Hirt, *Die sprachliche Stellung der Illyrischen* (*Festschrift für H. Kiepert*, pp. 179–188). Reference should also be made to the discussion of their relation to the Veneti by C. Pauli in *Die Veneter*, p. 413 sqq., especially p. 437; and also to R. S. Conway, *Italic Dialects*, i. 15. (R. S. C.)

MESSENE, an ancient Greek city, the capital of Messenia, founded by Epaminondas in 369 B.C., after the battle of Leuctra and the first Theban invasion of the Peloponnese. The town was built by the combined Theban and Argive armies and the exiled Messenians who had been invited to return and found a state which should be independent of Spartan rule. The site was chosen by Epaminondas and lay on the western slope of the mountain which dominates the Messenian plain and culminates in the two peaks of Ithome and Eua. The former of these (2630 ft.) served as the acropolis, and was included within the same system of fortifications as the lower city. Messene remained a place of some importance under the Romans, but we hear nothing of it in medieval times and now the hamlet of Mavromati occupies a small part of the site.

Pausanias has left us a description of the city (iv. 31–33), its chief temples and statues, its springs, its market-place and gymnasium, its place of sacrifice (ἱεροθύσιον), the tomb of the hero Aristomenes (*q.v.*) and the temple of Zeus Ithomatas on the summit of the acropolis with a statue by the famous Argive sculptor Ageladas, originally made for the Messenian helots who had settled at Naupactus at the close of the third Messenian War. But what chiefly excited his wonder was the strength of its fortifications, which excelled all those of the Greek world. Of the wall, some 5½ m. in extent, considerable portions yet remain, especially on the north and north-west, and almost the entire circuit can still be traced, affording the finest extant example of Greek fortification. The wall is flanked by towers about 31 ft. high set at irregular intervals: these have two storeys with loopholes in the lower and windows in the upper, and are entered by doors on a level with the top of the wall which is reached by flights of steps. Of the gates only two can be located, the eastern or Laconian, situated on the eastern side of the saddle uniting Ithome and Eua, and the northern or Arcadian gate. Of the former but little remains: the latter, however, is excellently preserved and consists of a circular court about 20 yds. in diameter with inner and outer gates, the latter flanked by square towers some 11 yds. apart. The lintel of the inner gate was formed by a single stone 18 ft. 8 in. in length, and the masonry of the circular court is of astonishing beauty and accuracy. The other buildings which can be identified are the theatre, the stadium, the council chamber or Bouleuterion, and the propylaeum of the market, while on the shoulder of the mountain are the foundations of a small temple, probably that of Artemis Laphria.

See E. Curtius, *Peloponnesos*, ii. 138 sqq.; W. M. Leake, *Travels in the Morea*, i. 366 sqq.; J. G. Frazer, *Pausanias's Description of Greece*, iii. 429 sqq.; W. G. Clark, *Peloponnese*, 232 sqq.; A. Blouet, *Expéd. scient. de Morée: Architecture*, i. 37–42, Plates 38–47; E. P. Boblaye, *Recherches géogr. sur les ruines de la Morée*, 107 sqq.; C. Bursian, *Geographie von Griechenland*, ii. 165 sqq. (M. N. T.)

MESSENIA (Gr. Μεσσήνη or Μεσσηνία), the S.W. district of the Peloponnese, bounded on the E. by Mt Taÿgetus, on the N. by the river Neda and the Arcadian Mountains, on the S. and W. by the sea. Its area is some 825,000 acres, considerably less than that of Shropshire or Wiltshire. Historically and economically its most important part is the great plain, consisting of two distinct portions, watered by the river Pamisus (mod. Pirnatza) and its affluents. This is the most fertile tract in Greece, and at the present day produces oranges, citrons, almonds, figs, grapes and olives in great abundance and of excellent quality. The plain is bounded on the north by the Nomian Mountains (mod. Tetrási, 5210 ft.) and their westerly extension, on the west by the mountains of Cyparissia (4000 ft.), a southern continuation of which forms the south-west peninsula of the Morea, attaining its greatest height in Mt Mathia (mod. Lykódimo 3160 ft.). Off the south coast of this peninsula lie the three Oenussae islands and the islet of Theganussa (Venetikó). In spite of its long coast-line, Messenia has no good harbours except the Bay of Pylos (Navarino), and has never played an important part in Greek naval history.

The earliest inhabitants of Messenia are said to have been Pelasgians and Leleges (*qq.v.*), of whom the latter had their capital at Andania. Then came an Aeolo-Minyan immigration, which apparently extended to Messenia, though the Pylos of Nestor almost certainly lay in Triphylia, and not at the site which in historic times bore that name. In the Homeric poems eastern Messenia is represented as under the rule of Menelaus of Sparta, while the western coast is under the Neleids of Pylos, but after Menelaus's death the Messenian frontier was pushed eastwards as far as Taÿgetus. A body of Dorians under Cresphontes invaded the country from Arcadia, and, taking as their capital Stenyclarus in the northern plain, extended first their suzerainty and then their rule over the whole district. The task apparently proved an easy one, and the Dorians blending with the previous inhabitants produced a single Messenian race with a strong national feeling. But the fertility of the soil, the warm and genial climate, the mingling of races and the absence of opposition, combined to render the Messenians no match for their hardy and warlike neighbours of Sparta. War broke out—in consequence, it was said, of the murder of the Spartan king Teleclus by the Messenians—which, in spite of the heroism of King Euphaes and his successor Aristodemus (*q.v.*) ended in the subjection of Messenia to Sparta (*c.* 720 B.C.). Two generations later the Messenians revolted and under the leadership of Aristomenes (*q.v.*) kept the Spartans at bay for some seventeen years (648–631 B.C., according to Grote): but the stronghold of Ira (Eira) fell after a siege of eleven years, and those Messenians who did not leave the country were reduced to the condition of helots. The next revolt broke out in 464, when a severe earthquake destroyed Sparta and caused great loss of life; the insurgents defended themselves for some years on the rock-citadel of Ithome, as they had done in the first war; but eventually they had to leave the Peloponnese and were settled by the Athenians at Naupactus in the territory of the Locri Ozolae. After the battle of Leuctra (371 B.C.) Epaminondas invited the exiled Messenians scattered in Italy, Sicily, Africa and elsewhere to return to their country: the city of Messene (*q.v.*) was founded in 369 to be the capital of the country and, like Megalopolis in Arcadia, a powerful check on Sparta. Other towns too were founded or rebuilt at this time, though a great part of the land still remained very sparsely peopled. But though independent Messenia never became really powerful or able to stand without external support. After the fall of the Theban power, to which it had owed its foundation, it became an ally of Philip II. of Macedon and took no part in the battle of Chaeroneia (338 B.C.). Subsequently it joined the Achaean League, and we find Messenian troops fighting along with the Achaeans and Antigonus Doson at Sellasia in 222 B.C. Philip V. sent Demetrius of Pharos to seize Messene, but the attempt failed and cost the life of Demetrius: soon afterwards the Spartan tyrant Nabis succeeded in taking the city, but was forced to retire by the timely arrival of the Philopoemen and the Megalopolitans. A war afterwards broke out with the Achaean League, during which Philopoemen was captured and put to death by the Messenians (183 B.C.), but Lycortas took the city in the following year, and it again joined the Achaean League, though much weakened by the loss of Abia, Thuria and Pherae, which broke loose from it and entered the League as independent members (see ACHAEAN LEAGUE). In 146 B.C. the Messenians, together with the other states of Greece, were brought directly under Roman sway by L. Mummius. For centuries there had been a dispute between Messenia and Sparta about the possession of the *Ager Dentheliates* on the western slope of Taÿgetus: after various decisions by Philip of Macedon, Antigonus, Mummius, Caesar, Antony, Augustus and others, the question was settled in A.D. 25 by Tiberius and the Senate in favour of the Messenians (Tac. *Ann.* iv. 43).

In the middle ages Messenia shared the fortunes of the rest of the Peloponnese. It was overrun by Slavic hordes, who have left their traces in many village names, and was one of the chief battlefields of the various powers—Byzantines, Franks, Venetians and Turks—who struggled for the possession of the Morea. Striking reminders of these conflicts are afforded by the extant ruins of the medieval strongholds of Kalamata, Coron (anc. *Asine*, mod. Korone), Modon (*Methone*) and Pylos. At the present day Messenia forms a department with its capital at Kalamata, and a population numbering (according to the census of 1907), 127,991.

See W. M. Leake, *Travels in the Morea* (London, 1830), i. 324 sqq.; E. Curtius, *Peloponnesos* (Gotha, 1852), ii. 121 sqq.; C. Bursian, *Geographie von Griechenland* (Leipzig, 1868), ii. 155 sqq.; E. P. Boblaye, *Recherches géographiques sur les ruines de la Morée* (Paris, 1835), 103 sqq.; Strabo viii. 358 sqq.; Pausanias iv., and the commentary in J. G. Frazer, *Pausanias's Description of Greece*, vol. iii.; and articles by W. Kolbe, *Athenische Mitteilungen* (1904), 364 sqq., and M. N. Tod, *Journal of Hellenic Studies*, xxv. 32 sqq. Physical features: A. Philippson, *Der Peloponnes* (Berlin, 1892), 340–381. Inscriptions: *Inscriptiones graecae*, v.; Le Bas-Foucart, *Voyage archéologique: Inscriptions*, Nos. 291–326 A; Collitz-Bechtel, *Sammlung der griech. Dialektinschriften*, iii. 2, Nos. 4637–4692. (M. N. T.)

MESSIAH (Dan. x. 25, 26), and MESSIAS (John i. 41; iv. 25), transcriptions (the first form modified by reference to the etymology) of the Greek Μεσσίας, (Μεσίας, Μεσσείας), which in turn represents the Aramaic מְשִׁיחָא (*mĕshīḥā*), answering to the Hebrew הַמָּשִׁיחַ, "the anointed."[1] There can be no doubt that a magical power was ascribed to the anointing oil (cf. Frazer, *Golden Bough*, 2nd ed., ii. 364 sqq.). The king was thereby rendered sacrosanct (1 Sam. xxiv. 6 sqq.; 2 Sam. i. 14 sqq.; iv. 9 sqq.), and he was considered to be endowed with a special virtue. Thus whosoever curses the king is stoned as though God Himself had been cursed (2 Sam. xix. 22). In ancient Egyptian cultus the priest, after he has solemnly saluted the gods, begins the daily toilet of the god, which consists in sprinkling his image, clothing it with coloured cloths, and anointing it with oil (Erman, *Die aegyptische Religion*, p. 49). In the magical texts of Babylonia a similar virtue was attached to oil: "bright oil, pure oil, resplendent oil that bestows magnificence on the Gods . . . the oil for the conjuration (*šiptu*) of Marduk" (Tallquist, *Maklû* series, tablet vii. col. 1, 31 sqq.; cf. Gressmann, *Der Ursprung der israelitisch-jüdischen Eschatologie*, p. 258, sqq.). We have, in Schrader's *K.I.B.* v. letter 37 (p. 98), evidence from the Tell el-Amarna tablets that the anointing of kings was practised in Egypt or Syria in 1450 B.C. (*c.*) in a letter addressed to the Egyptian king by Ramman-nirari of Nuḥašši. On the intimate relation which in primitive times subsisted between the sorcerer and the king see the citation from Frazer's *Early History of Kingship*, p. 127, in the article PRIEST, and cf. p. 29: "Classical evidence points to the conclusion that in prehistoric ages . . . the various tribes or cities were ruled by kings who discharged priestly duties" (p. 31). Thus the early kings of Assyria were priests of Assur (Ašur), the tutelary deity of Assyria. Tiglath-Pileser I. (*c.* 1100 B.C.) calls his predecessors, Šamši-Ramman and Išmi-Dagan, *iššakku* (*pa-te-si*) of the God Assur (Prism-insc. col. vii. 62, 63). Later kings, *e.g.* Shalmaneser II. (Nimrud-obelisk, line 15, monolith, line 11) and Assur-bani-pal (Rassam cyl. col. vii. 94) call themselves by the more definite title of *šangu* of Assur. The Hebrew word with the article prefixed occurs in the Old Testament only in the phrase "the anointed priest" (Lev. iv. 3, 5, 16; vi. 22 [15]), but "Yahweh's anointed" is a common title of the king of Israel, applied in the historical books to Saul and David, in Lam. iv. 20 to Zedekiah, and in Isa. xlv. 1 extended to Cyrus. In the Psalms corresponding phrases (My, Thy, His anointed)[2] occur nine times, to which may be added the lyrical passages 1 Sam. ii. 10, Hab. iii. 13.

In the present attitude of literary criticism it would be most difficult to assert, as Robertson Smith did in the 9th edition of this work, that "in the intention of the writers it [*i.e.* the term messiah or "anointed"] refers to the king then on the throne." Nor would most recent critics agree with Professor Driver (*L.O.T.*, 8th ed. p. 385) in considering Pss. ii. and lxxii. as "presumably pre-exilic." G. Buchanan Gray (*J.Q.R.*, July 1895, p. 658 sqq.) draws a parallel between the "king" in the Psalms and the "servant" in Deutero-Isaiah or Yahweh's "Son" (in Hos. xi. 1, &c.) which is applied to Israel either actual or idealized. It would be possible so to interpret "king" or "anointed" in some Psalms, *e.g.* lxi., lxiii. and lxxxiv., but hardly in Pss. ii., lxxii. and lxxxix., where the Messianic reference is strongly personal.[3] In the Psalms the ideal aspect of the kingship, its religious importance as the expression and organ of Yahweh's sovereignty, is prominent. When the Psalter became a liturgical book the historical kingship had gone by, and the idea alone remained, no longer as the interpretation of a present political fact but as part of Israel's religious inheritance. It was impossible, however, to think that a true idea had become obsolete merely because it found no expression on earth for the time being; Israel looked again for an anointed king to whom the words of the sacred hymns should apply with a force never realized in the imperfect kingship of the past. Thus the Psalms were necessarily viewed as prophetic; and meantime, in accordance with the common Hebrew representation of ideal things as existing in heaven, the true king remains hidden with God. The steps by which this result was reached must, however, be considered in detail.

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[1] The transcription is as in Γεσσουρ Γεσουρ for גְּשׁוּר, *Onomastica*, ed. Lag., pp. 247, 281, Βασ. β ii. 3. For the termination -ας for אָ, see Lagarde, *Psalt. Memph.*, p. vii.

[2] The plural is found in Ps. cv. 15, of the patriarchs as consecrated persons.

[3] In Ps. lxxxiv. 9 [10] it is disputed whether the anointed one is the king, the priest, or the nation as a whole. The second view is perhaps the best.

The hope of the advent of an ideal king was only one feature of that larger hope of the salvation of Israel from all evils, which was constantly held forth by all the prophets, from the time when the seers of the 8th century B.C. proclaimed that the true conception of Yahweh's relation to His people could become a practical reality only through a great deliverance following a sifting judgment of the most terrible kind. The idea of a judgment so severe as to render possible an entire breach with the guilty past is common to all the prophets, but is expressed in a great variety of forms and images. As a rule the prophets directly connect the final restoration with the removal of the sins of their own age; to Isaiah the last troubles are those of Assyrian invasion, to Jeremiah the restoration follows on the exile to Babylon, to Daniel on the overthrow of the Greek monarchy. But all agree in giving the central place to the realization of a real effective kingship of Yahweh; in fact the conception of the religious subject as the nation of Israel, with a national organization under Yahweh as king, is common to the whole Old Testament, and connects prophecy proper with the so-called Messianic psalms and similar passages which speak of the religious relations of the Hebrew commonwealth, the religious meaning of national institutions, and so necessarily contain ideal elements reaching beyond the empirical present. All such passages are frequently called Messianic; but the term is more properly reserved as the specific designation of one particular branch of the Hebrew hope of salvation, which, becoming prominent in post-canonical Judaism, used the name of the Messiah as a technical term (which it never is in the Old Testament), and exercised a great influence on New Testament thought—the term "the Christ" (ὁ χριστός) being itself nothing more than the translation of "the Messiah."

In the period of the Hebrew monarchy the thought that Yahweh is the divine king of Israel was associated with the conception that the human king reigns by right only if he reigns by commission or "unction" from Him. Such was the theory of the kingship in Ephraim as well as in Judah (Deut. xxxiii.; 2 Kings ix. 6), till in the decadence of the northern state Amos (ix. 11) foretold[1] the redintegration of the Davidic kingdom, and Hosea (iii. 5; viii. 4) expressly associated a similar prediction with the condemnation of the kingship of Ephraim as illegitimate. So the great Judaean prophets of the 8th century connect the salvation of Israel with the rise of a Davidic king, full of Yahweh's Spirit, in whom all the energies of Yahweh's transcendental kingship are as it were incarnate (Isa. ix. 6 seq.; xi. 1 seq.; Micah v.). This conception, however, is not one of the constant elements of prophecy; other prophecies of Isaiah look for the decisive interposition of Yahweh in the crisis of history without a kingly deliverer. Jeremiah again speaks of the future David or righteous sprout of David's stem (xxiii. 5 seq.; xxx. 9) and Ezekiel uses similar language (xxxiv., xxxvii.); but that such passages do not necessarily mean more than that the Davidic dynasty shall be continued in the time of restoration under worthy princes seems clear from the way in which Ezekiel speaks of the prince in chs. xlv., xlvi. As yet we have no fixed doctrine of a personal Messiah, but only material from which such a doctrine might be drawn. The religious view of the kingship is still essentially the same as in 2 Sam. vii., where the endless duration of the Davidic dynasty is set forth as part of Yahweh's plan.

There are other parts of the Old Testament—notably 1 Sam. viii., xii. (belonging to the later *stratum*)—in which the very existence of a human kingship is represented as a departure from the theocratic ideal, and after the exile, when the monarchy had come to an end, we find pictures of the latter days in which its restoration has no place. Such is the great prophecy of Isa. xl.–xlviii., in which Cyrus is the anointed of Yahweh. So too there is no allusion to a human kingship in Joel or in Malachi; the old forms of the Hebrew state were broken, and religious hopes expressed themselves in other shapes.[2] In the book of Daniel it is collective Israel that, under the symbol of a "son of man," receives the kingdom (vii. 13, 18, 22, 27).

Meantime, however, the decay and ultimate silence of the living prophetic word concurred with prolonged political servitude to produce an important change in Hebrew religion. To the prophets the kingship of Yahweh was not a mere ideal, but an actual reality. Its full manifestation indeed, to the eye of sense and to the unbelieving world, lay in the future; but true faith found a present stay in the sovereignty of Yahweh, daily exhibited in providence and interpreted to each generation by the voice of the prophets. And, while Yahweh's kingship was a living and present fact, it refused to be formulated in fixed invariable shape.

But when the prophets were succeeded by the scribes, the interpreters of the written word, and the yoke of foreign oppressors rested on the land, Yahweh's kingship, which presupposed a living nation, found not even the most inadequate expression in daily political life. Yahweh was still the lawgiver of Israel, but His law was written in a book, and He was not present to administer it. He was still the hope of Israel, but the hope too was only to be read in books, and these were interpreted of a future which was no longer the ideal development of forces already at work, but wholly new and supernatural. The present was a blank, in which religious duty was summed up in patient obedience to the law and penitent submission to the Divine chastisements. The scribes were mainly busied with the law; but no religion can subsist on mere law; and the systematization of the prophetic hopes, and of those more ideal parts of the other sacred literature which, because ideal and dissevered from the present, were now set on one line with the prophecies, went on side by side with the systematization of the law, by means of a harmonistic exegesis, which sought to gather up every prophetic image in one grand panorama of the issue of Israel's and the world's history. The beginnings of this process can probably be traced within the canon itself, in the book of Joel and the last chapters of Zechariah;[3] and, if this be so, we see from Zech. ix. that the picture of the ideal king claimed a place in such constructions. The full development of the method belongs, however, to the post-canonical literature, and was naturally much less regular and rapid than the growth of the legal traditions of the scribes. It was in crises of national anguish that men turned most eagerly to the prophecies, and sought to construe their teachings as a promise of speedy deliverance (see APOCALYPTIC LITERATURE). But these books, however influential, had no public authority, and when the yoke of oppression was lightened but a little their enthusiasm lost much of its contagious power. It is not therefore safe to measure the general growth of eschatological doctrine by the apocalyptic books, of which Daniel alone attained a canonical position. In the Apocrypha eschatology has a relatively small place; but there is enough to show that the hope of Israel was never forgotten, and that the imagery of the prophets was accepted with a literalness not contemplated by the prophets themselves.

It was, however, only very gradually that the figure and name of the Messiah acquired the prominence which they have in later Jewish doctrine of the last things and in the official exegesis of the Targums. In the very developed eschatology of Daniel they are, as we have seen, altogether wanting, and in the Apocrypha, both before and after the Maccabean revival, the everlasting throne of David's house is a mere historical reminiscence (Ecclus. xlvii. 11; 1 Macc. ii. 57). So long as the wars of independence occupied the Palestinian Jews, and the Hasmonaean sovereignty promised a measure of independence and felicity under the law, the hope that connected itself with the House of David was not likely to rise to fresh life, especially as a considerable proportion of the not very numerous passages of Scripture which speak of the ideal king might with a little straining be applied to the rising star of the new dynasty (cf. 1 Macc. xiv. 4–15). It is only in Alexandria, where the Jews were still subject to the yoke of the Gentile, that at this time (*c.* 140 B.C.) we find the oldest Sibylline verses (iii. 652 seq.) proclaiming the approach of the righteous king whom God shall raise up from the East (Isa. xli. 2.) The name Messiah is still lacking, and the central point of the prophecy is not the reign of the deliverer but the subjection of all nations to the law and the temple.[1]

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[1] Most recent critics regard Amos ix. 9–15 as a later addition, and the same view is held by Nowack, Harper and others respecting Hos. iii. 5, though on grounds which seem questionable. Isa. ix. 1–7, xi. 1 sqq. are held by Hackmann, Cheyne, Marti, and other critics to be post-exilian. Duhm and others hold that they are genuine. It may be admitted that Isa. xi. 1 seq. might be held to be contemporary with Isa. lv. 3, 4, and to refer to Zerubbabel. Cf. Haggai ii. 21–23, composed seventeen years afterwards. Mic. v. 1–8 can with difficulty be regarded as genuine.

[2] The hopes which Haggai and Zechariah connect with the name of Zerubbabel, a descendant of David, hardly form an exception to this statement. There may even be a reference to him in Isa. lv. 3, 4.

[3] See Stade's articles "Deuterozacharja," *Z. f. A.-T.-liche Wiss.*, 1881–1882. Cf. Dan. ix. 2 for the use of the older prophecies in the solution of new problems of faith.

With the growing weakness and corruption of the Hasmonaean princes, and the alienation of a large part of the nation from their cause, the hope of a better kingship begins to appear in Judaea also; at first darkly shadowed forth in the *Book of Enoch* (chap. xc.), where the white steer, the future leader of God's herd after the deliverance from the heathen, stands in a certain contrast to the actual dynasty (the horned lambs); and then much more clearly, and for the first time with use of the name Messiah, in the *Psalter of Solomon*, the chief document of the protest of Pharisaism against its enemies the later Hasmonaeans. The struggle between the Pharisees and Sadducees, between the party of the scribes and the aristocracy, was a struggle for mastery between a secularized hierarchy whose whole interests were those of their own selfish politics, and a party to which God and the exact fulfilment of the law according to the scribes were all in all. This doctrine had grown up under Persian and Grecian rule, and no government that possessed or aimed at political independence could possibly show constant deference to the punctilios of the schoolmen. The Pharisees themselves could not but see that their principles were politically impotent; the most scrupulous observance of the Sabbath, for example—and this was the culminating point of legality—could not thrust back the heathen. Thus the party of the scribes, when they came into conflict with an active political power, which at the same time claimed to represent the theocratic interests of Israel, were compelled to lay fresh stress on the doctrine that the true deliverance of Israel must come from God.

But now the Jews were a nation once more, and national ideas came to the front. In the Hasmonaean sovereignty these ideas took a political form, and the result was the secularization of the kingdom of God for the sake of a harsh and rapacious aristocracy. The nation threw itself on the side of the Pharisees; not in the spirit of punctilious legalism, but with the ardour of a national enthusiasm deceived in its dearest hopes, and turning for help from the delusive kingship of the Hasmonaeans to the true kingship of Yahweh, and to His vicegerent the king of David's house. It is in this connexion that the doctrine and name of the Messiah appear in the *Psalter of Solomon*. The eternal kingship of the House of David, so long forgotten, is seized on as the proof that the Hasmonaeans have no divine right.

> "Thou, Lord, art our king for ever and ever. . . . Thou didst choose David as king over Israel, and swarest unto him concerning his seed for ever that his kingship should never fail before Thee. And for our sins sinners (the Hasmonaeans) have risen up over us, taking with force the kingdom which Thou didst not promise to them, profaning the throne of David in their pride. But Thou, O Lord, will cast them down and root out their seed from the land, when a man not of our race (Pompey) rises up against them. . . . Behold, O Lord, and raise up their king the Son of David at the time that Thou hast appointed, to reign over Israel Thy servant; and gird him with strength to crush unjust rulers; to cleanse Jerusalem from the heathen that tread it under foot, to cast out sinners from Thy inheritance; to break the pride of sinners and all their strength as potter's vessels with a rod of iron (Ps. ii. 9); to destroy the lawless nations with the word of his mouth (Isa. xi. 4); to gather a holy nation and lead them in righteousness. . . . He shall divide them by tribes in the land, and no stranger and foreigner shall dwell with them; he shall judge the nations in wisdom and righteousness. The heathen nations shall serve under his yoke; he shall glorify the Lord before all the earth, and cleanse Jerusalem in holiness, as in the beginning. From the ends of the earth all nations shall come to see his glory and bring the weary sons of Zion as gifts (Isa. lx. 3 seq.); to see the glory of the Lord with which God hath crowned him, for he is over them a righteous king taught of God. In his days there shall be no unrighteousness in their midst; for they are all holy and their king the anointed of the Lord (*χριστὸς κύριος*, mistranslation of משיח יהוה).—*Psalt. Sol.* xvii.

This conception is traced in lines too firm to be those of a first essay; it had doubtless grown up as an integral part of the religious protest against the Hasmonaeans. And while the polemical motive is obvious, and the argument from prophecy against the legitimacy of a non-Davidic dynasty is quite in the manner of the scribes, the spirit of theocratic fervour which inspires the picture of the Messiah is broader and deeper than their narrow legalism. In a word, the Jewish doctrine of the Messiah marks the fusion of Pharisaism with the national religious feeling of the Maccabean revival. This national feeling, claiming a leader against the Romans as well as deliverance from the Sadducee aristocracy, again sets the idea of the kingship rather than that of resurrection and individual retribution in the central place. Henceforward the doctrine of the Messiah is the centre of popular hope and the object of theological culture. The New Testament is the best evidence of its influence on the masses (see especially Matt. xxi. 9); and the exegesis of the Targums, which in its beginnings doubtless reaches back before the time of Christ, shows how it was fostered by the Rabbins and preached in the synagogues.[2] Its diffusion far beyond Palestine, and in circles least accessible to such ideas, is proved by the fact that Philo himself (*De praem. et poen.* § 16) gives a Messianic interpretation of Num. xxiv. 27 (LXX). It must not indeed be supposed that the doctrine was as yet the undisputed part of Hebrew faith which it became when the fall of the state and the antithesis to Christianity threw all Jewish thought into the lines of the Pharisees. It has, for example, no place in the *Assumption of Moses* or the *Book of Jubilees*. But, as the fatal struggle with Rome became more and more imminent, the eschatological hopes which increasingly absorbed the Hebrew mind all group themselves round the person of the Messiah. In the later parts of the *Book of Enoch* (the "symbols" of chap. xlv. seq.) the judgment day of the Messiah (identified with Daniel's "Son of Man") stands in the forefront of the eschatological picture. Josephus (*B. J.* vi. 5, § 4) testifies that the belief in the immediate appearance of the Messianic king gave the chief impulse to the war that ended in the destruction of the Jewish state; after the fall of the temple the last apocalypses (*Baruch*, 4 *Ezra*) still loudly proclaim the near victory of the God-sent king; and Bar Cochebas, the leader of the revolt against Hadrian, was actually greeted as the Messiah by Rabbi Aqiba (cf. Luke xxi. 8). These hopes were again quenched in blood; the political idea of the Messiah, the restorer of the Jewish state, still finds utterance in the daily prayer of every Jew (the *Shemōnē Esrē*), and is enshrined in the system of Rabbinical theology; but its historical significance was buried in the ruins of Jerusalem.[3]

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[1] In *Sibyll.* iii. 775, *νηόν* must undoubtedly be read for *υἱόν*.

[2] The Targumic passages that speak of the Messiah are registered by Buxtorf, *Lex. Chald.*, *s.v.*

[3] False Messiahs have continued from time to time to appear among the Jews. Such was Serenus of Syria (*c.* 720 A.D.). Soon after, Messianic hopes were active at the time of the fall of the Omayyads, and led to a serious rising under Abu 'Isa of Ispahan, who called himself forerunner of the Messiah. The false Messiah David Alrui (Alroy) appeared among the warlike Jews in Azerbijan in the middle of the 12th century. The Messianic claims of Abraham Abulafia of Saragossa (born 1240) had a cabalistic basis, and the same studies encouraged the wildest hopes at a later time. Thus Abarbanel calculated the coming of the Messiah for 1503 A.D.; the year 1500 was in many places observed as a preparatory season of penance; and throughout the 16th century the Jews were much stirred and more than one false Messiah appeared. See also SABBATAI, SEBI.

But this proof that the true kingdom of God could not be realized in an earthly state, under the limitations of national particularism, was not the final refutation of the Old Testament hope. Amidst the last convulsions of political Judaism a new spiritual conception of the kingdom of God, of salvation, and of the Saviour of God's anointing, had shaped itself through the preaching, the death, and the resurrection of Jesus of Nazareth. As applied to Jesus the name of Messiah lost all its political and national significance. Between the Messiah of the Jews and the Son of Man who came to give His life a ransom for many there was on the surface little resemblance; and from their standpoint the Pharisees reasoned that the marks of the Messiah were conspicuously absent from this Christ. But when we look at the deeper side of the Messianic conception in the *Psalter of Solomon*, at the heartfelt longing for a leader in the way of righteousness and acceptance with God which underlies the aspirations after political deliverance, we see that it was in no mere spirit of accommodation to prevailing language that Jesus did not disdain the name in which all the hopes of the Old Testament were gathered up.

Messianic Parallels.—Within the limits of this article it is impossible to attempt any extended survey of parallels to Hebrew Messianic conceptions drawn from other religions. One interesting analogy communicated by Professor Rapson, may, however, be cited from the *Bhagavad-gītā*, iv. 5–8, in which Krishna says:—

5 "Many are the births that have passed of me and of thee
Arjuna.
All these I know: thou knowest them not, O conqueror of
thy foes.
6 Unborn, of imperishable soul, the Lord of all creatures,
Taking upon me mine own nature, I arise by my own power.
7 For whensoever, O son of Bharata, there is decay of righteousness
And a rising up of unrighteousness, then I create myself,
8 For the protecting of the good and for the destroying of
evil-doers,
And for the establishing of righteousness I arise from age
to age."

"Somewhat similar are the avatars of Vishnu, who becomes incarnate in a portion of his essence on ten occasions to deliver mankind from certain great dangers. Krishna himself is usually regarded as one of these avatars." This we may consider as one of the striking parallels which meet us in other religions to that "hope of the advent of an ideal king which was one of the features of that larger hope of the salvation of Israel from all evils, the realization of perfect reconciliation with Jehovah and the felicity of the righteous in Him," to which reference was made in an early portion of this article and which constitutes the essential meaning of Messiahship. The form in which the Indian conception presents itself in the above quoted lines is more closely analogous amid many differences to the later and apocalyptic type of the Messianic idea as it appears in Judaism.

The interesting parallels between the Babylonian Marduk (Merodach) god of light and Christ as a world saviour are ingeniously set forth by Zimmern in *K.A.T.*, 3rd ed., pp. 376–391, but the total impression which they leave is vague.

It would carry us too far to consider in this place the details of the Jewish conception of the Messiah and the Messianic times as they appear in the later apocalypses or in Talmudic theology. See for the former the excellent summary of Schürer, *Geschichte des jüdischen Volkes im Zeitalter Jesu Christi*, 3rd ed., vol. ii. pp. 497–556. See also Weber, *Jüdische Theologie*, ch. xxiii. For the whole subject see also Drummond, *The Jewish Messiah*, and Kuenen, *Religion of Israel*, ch. xii. For the Messianic hopes of the Pharisees and the *Psalter of Solomon* see especially Wellhausen, *Pharisäer und Sadducäer* (Greifswald, 1874). In its ultimate form the Messianic hope of the Jews is the centre of the whole eschatology, embracing the doctrine of the last troubles of Israel (called by the Rabbins the "birth pangs of the Messiah"), the appearing of the anointed king, the annihilation of the hostile enemy, the return of the dispersed of Israel, the glory and world-sovereignty of the elect, the new world, the resurrection of the dead and the last judgment. But even the final form of Jewish theology shows much vacillation as to these details, especially as regards their sequence and mutual relation, thus betraying the inadequacy of the harmonistic method by which they were derived from the Old Testament and the stormy excitement in which the Messianic idea was developed. It is, for example, an open question among the Rabbins whether the days of the Messiah belong to the old or to the new world (הָעוֹלָם הַזֶּה or הָעוֹלָם הַבָּא), whether the resurrection embraces all men or only the righteous, whether it precedes or follows the Messianic age. Compare MILLENNIUM.

We must also pass over the very important questions that arise as to the gradual extrication of the New Testament idea of the Christ from the elements of Jewish political doctrine which had so strong a hold of many of the first disciples—the relation, for example, of the New Testament Apocalypse to contemporary Jewish thought. A word, however, is necessary as to the Rabbinical doctrine of the Messiah who suffers and dies for Israel, the Messiah son of Joseph or son of Ephraim, who in Jewish theology is distinguished from and subordinate to the victorious son of David. The developed form of this idea is almost certainly a product of the polemic with Christianity, in which the Rabbins were hard pressed by arguments from passages (especially Isa. liii.) which their own exegesis admitted to be Messianic, though it did not accept the Christian inferences as to the atoning death of the Messianic king. That the Jews in the time of Christ believed in a suffering and atoning Messiah is, to say the least, unproved and highly improbable. See, besides the books above cited, De Wette, *Opuscula*; Wünsche, *Die Leiden des Messias* (1870).

See the articles on "Messiah" in Hastings's *D. B.* (together with Fairweather's art., "Development of Doctrine," in extra vol., pp. 295–302) in *Ency. Bibl.* Also *P.R.E.* 3rd ed., as well as Hastings's *Dict. of Christ and the Gospels*, should be consulted. Comp. Edersheim, *Life and Times of Jesus the Messiah*, 2nd ed., i. 160–179, ii. 434 sqq., 710–741; Stanton, *The Jewish and the Christian Messiah* (1886); Wendt, *Teaching of Jesus*, i. 60–84, 176–181, ii. 122–139; Holtzmann, *N. T. Theologie* (1897), pp. 81–85, 234–304; Baldensperger, *Das Selbstbewusstsein Jesu*; Wellhausen, *Israel. u. jüd. Geschichte* (1895), pp. 198–204; Charles's *Book of Enoch* and *Apocalypse of Baruch* (especially the introductions); Bousset, *Religion des Judentums*, 2nd ed., pp. 245–277; Volz, *Jüdische Eschatologie von Daniel bis Akiba*, pp. 55–68, 213–237; Dalman, *Der leidende u. sterbende Messias*; Gressmann, *Ursprung der israelitisch-jüdischen Eschatologie*, pp. 250–345. A fuller survey of literature will be found in Schürer, *op. cit.*, p. 496 sqq. (W. R. S.; O. C. W.)

MESSINA, a city of Sicily, 7 m. S.S.W. of the promontory of Faro (anc. *Promontorium Pelorum*), which forms the north-eastern angle of the island, the capital of the province of Messina and the seat of an archbishop. Pop. (1850), 97,074; (1881), 126,497; (1901), 149,778; (1905), 158,812. The site of the town curves round the harbour, between it and the strongly fortified hills of Antennamare, the highest point of which is 3707 ft. The straits, which take their name from the town, are here about $3\frac{1}{2}$ m. wide, and only a little over 2 m. at the promontory of Faro. The numerous earthquakes from which the city had suffered, notably that in 1783, had left it few remains of antiquity. But it was a flourishing and beautiful city when in 1908 one of the most disastrous earthquakes ever recorded destroyed it totally. The earthquake occurred early in the morning of December 28, and so far as Messina was concerned the damage was done chiefly by the shock and by the fires which broke out afterwards; the seismic wave which followed was comparatively innocuous. But it did vast damage elsewhere along the strait, notably at Reggio, Calabria, which was also totally destroyed. Many other smaller towns suffered both in Sicily and in Calabria; the loss of life was appalling and the distress widespread, in spite of the prompt assistance rendered by Italian naval and military forces and by the crews of British, Russian and German warships and other vessels, and the contribution of funds for relief works from every part of the world. The immediate seismic focus appeared to be in the straits, but Dr E. Suess pointed out that it was surrounded by a curved line of earth-fracture, following an arc drawn from a centre in the Lipari Islands, from Catanzaro to Etna, and so westward; within this arc he held that the crust of the earth is gradually sinking, and is in an unstable condition. According to an official estimate the earthquake caused the loss of 77,283 lives.[1] (See also EARTHQUAKE.)

The façades of buildings at Messina in great part withstood the earthquake, but even when they did so the remainder of the buildings was destroyed. The cathedral, which was completely wrecked, was begun in 1098 and finished by Roger II. It had a fine Gothic façade: the interior had mosaics in the apses dating from 1330, and the nave contained 26 granite columns, said to have been brought from a temple of Poseidon near Faro, and had a fine wooden roof of 1260. The rest of the edifice was in the baroque style; the high altar (containing the supposed letter of the Virgin Mary to the people of Messina), richly decorated with marbles, lapis lazuli, &c., was begun in 1628 and completed in 1726. The importance of Messina was almost entirely due to its harbour, a circular basin open on the north only, formed by a strip of land curving round like a sickle, from which it took its original name, Zancle (*ζάγκλον*, or rather *δάγκλον*, the Sicilian equivalent of the Greek *δρέπανον*,[1] according to Thucydides, vi. 4).

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[1] See S. Franchi, "Il Terremoto . . . a Messina . . . ," in *Boll. R. Comit. geologico d'Ital.*, 4th series, vol. x. (1909).

Zancle was first founded, no doubt on the site of an earlier settlement, by pirates from Cumae, and again more regularly settled, after an unknown interval, by settlers from Cumae under Perieres, and from Chalcis under Crataemenes, in the first quarter of the 8th century B.C. Mylae must have been occupied as an outpost very soon afterwards, but the first regular colony of Zancle was Himera, founded in 648 B.C. After the capture of Miletus by the Persians in 494 B.C. Skythes, king of Zancle, invited the Ionians to come and settle at Καλὴ Ἀκτή, then in the occupation of the Sicels (the modern Marina di Caronia, 25 m. east of Cefalu); but at the invitation of Anaxilas of Regium the Samians proceeded instead to the latter place. About 488 B.C. Anaxilas and the Samians occupied Zancle in the absence of Skythes, and it was then that the name was changed to Messene, as the existence of coins of the Samian type, bearing the new name, proves. About 480, however, Anaxilas thoroughly established his authority at Messene, and the types of coinage introduced by him persevere down to about 396 B.C.,[2] when Anaxilas himself zealously supported his son-in-law Terillus in inviting the Carthaginians' invasion of 480 B.C. In 426 the Athenians gained the alliance of Zancle, but soon lost it again, and failed to obtain it in 415.

Messina fell into the hands of the Carthaginians during their wars with Dionysius the elder of Syracuse (397 B.C.). The Carthaginians destroyed the city, but Dionysius recaptured and rebuilt it. During the next fifty years Messina changed masters several times, till Timoleon finally expelled the Carthaginians in 343 B.C. In the wars between Agathocles of Syracuse and Carthage, Messina took the side of the Carthaginians. After Agathocles' death, his mercenaries, the Mamertines, treacherously seized the town about 282 B.C. and held it. They came to war with Hiero II. of Syracuse and appealed for help to Rome, which was granted, and this led to a collision between Rome and Carthage, which ended in the First Punic War. Messina was almost at once taken by Rome. At the close of the war, in 241 B.C., Messina became a free and allied city (*civitas foederata*), and obtained Roman citizenship before the rest of Sicily, probably from Caesar himself. During the civil wars which followed the death of Caesar, Messina held with Sextus Pompeius; and in 35 B.C. it was sacked by Octavian's troops. After Octavian's proclamation as emperor he founded a colony here; and Messina continued to flourish as a trading port. In the division of the Roman empire it belonged to the emperors of the East; and in A.D. 547 Belisarius collected his fleet here before crossing into Calabria. The Saracens took the city in A.D. 831; and in 1061 it was the first permanent conquest made in Sicily by the Normans. In 1190 Richard I. of England, with his crusaders, passed six months in Messina. He quarrelled with Tancred, the last of the Hauteville dynasty, and sacked the town. In 1194 the city, with the rest of Sicily, passed to the house of Hohenstaufen under the emperor Henry VI., who died there in 1197; and after the fall of the Hohenstaufen was contended for by Peter I., king of Aragon, and Charles I., count of Anjou. At the time of the Sicilian Vespers (1282), which drove the French out of Sicily, Messina bravely defended itself against Charles of Anjou, and repulsed his attack. Peter I., through his commander Ruggiero di Loria, defeated the French off the Faro; and from 1282 to 1713 Messina remained a possession of the Spanish royal house. In 1571 the fleet fitted out by the Holy League against the Turk assembled at Messina, and in the same year its commander, Don John of Austria, celebrated a triumph in the city for his victory at Lepanto. Don John's statue stands in the Piazza dell' Annuziata. For one hundred years, thanks to the favours and the concessions of Charles V., Messina enjoyed great prosperity. But the internal quarrels between the Merli, or aristocratic faction, and the Malvezzi, or democratic faction, fomented as they were by the Spaniards, helped to ruin the city (1671–1678). The Messinians suspected the Spanish court of a desire to destroy the ancient senatorial constitution of the city, and sent to France to ask the aid of Louis XIV. in their resistance. Louis despatched a fleet into Sicilian waters, and the French occupied the city. The Spaniards replied by appealing to Holland, who sent a fleet under Ruyter into the Mediterranean. In 1676 the French admiral, Abraham Duquesne, defeated the combined fleet of Spain and Holland; but, notwithstanding this victory, the French suddenly abandoned Messina in 1678, and the Spanish occupied the town once more. The senate was suppressed, and Messina lost its privileges. This was fatal to the importance of the city. In 1743 the plague carried off 40,000 inhabitants. The city was partially destroyed by earthquake in 1783. During the revolution of 1848 against the Bourbons of Naples, Messina was bombarded for three consecutive days. In 1854 the deaths from cholera numbered about 15,000. Garibaldi landed in Sicily in 1860, and Messina was the last city in the island taken from the Bourbons and made a part of united Italy under Victor Emmanuel.

Messina was the birthplace of Dicaearchus, the historian (*c.* 322 B.C.); Aristocles, the Peripatetic; Euhemerus, the rationalist (*c.* 316 B.C.); Stefano Protonotario, Mazzeo di Ricco and Tommaso di Sasso, poets of the court of Frederick II. (A.D. 1250); and Antonello da Messina, the painter (1447–1499), of whose works one is preserved in the museum. During the 15th century the grammarian, Constantine Lascaris, taught in Messina; and Bessarion was for a time archimandrite there. (T. As.)

MESSUAGE (from Anglo-French *mesuage*, probably a corruption of *mésuage*, *ménage*, popular Lat. *mansionaticum*, from *mansio*, whence mod. Fr. *maison*, from *manere*, to dwell), in law, a term equivalent to a dwelling-house, and including outbuildings, orchard, curtilage or court-yard and garden. At one time "messuage" is supposed to have had a more extensive meaning than that comprised in the word "house," but such distinction, if it ever existed, no longer survives.

MESTIZO (adopted from the Spanish, the Portuguese form being *mestiço*, from Lat. *miscere*, to mix), a term originally meaning a half-breed, one of whose parents was Spanish, and now used occasionally of any half-breed, but especially to denote persons of mixed Spanish (or Portuguese) and American Indian blood. The offspring of such half-breeds are also called mestizoes. The feminine form is mestiza.

MESUREUR, GUSTAVE EMIL EUGÈNE (1847–), French politician, was born at Marcq-en-Baroeul (Nord) on the 2nd of April 1847. He worked as a designer in Paris, and became prominent as a member of the municipal council of Paris, rousing much angry discussion by a proposal to rename the Parisian streets which bore saints' names. In 1887 he became president of the council. The same year he entered the Chamber of Deputies, taking his place with the extreme left. He joined the L. Bourgeois ministry of 1895–1896 as minister of commerce, industry, post and telegraphs, was vice-president of the Chamber from 1898 to 1902, and presided over the Budget Commission of 1899, 1901 and 1902. He was defeated at the polls in 1902, but became director of the Assistance Publique. His wife, Amélie de Wailly (b. 1853), is well known as a writer of light verse and of some charming children's books.

META, the Latin word for the goal which formed the turning-point for the chariot races in the Roman circus. The metae consisted of three conical pillars resting on a single podium. None have been preserved, but they are shown on coins, gems and terra-cotta bas-reliefs.

METABOLIC DISEASES. All disease is primarily due to alterations (Gr. *μεταβολή*, change), quantitative or qualitative, in the chemical changes in the protoplasm of some or all of the tissues of the body. But while in some pathological states these modifications lead to structural changes, in others they do not produce gross lesions, and these latter conditions are commonly classified as Functional Diseases. When such functional disturbances affect the general nutrition of the body they have been termed Metabolic Diseases (*Stoffwechselkrankheiten*). It is impossible to draw a hard and fast line between functional and organic disease, since the one passes gradually into the other, as is well seen in gout. Nor is it always easy to decide how far the conditions are due merely to quantitative alterations in the metabolism and how far to actual qualitative changes, for it is highly probable that many of the apparently qualitative alterations are really quantitative disturbances in one part of the protoplasmic mechanism, leading to an apparent qualitative change in the total result of the activity.

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[1] From this word Trapani derives its name.

[2] This account is at variance with the literary evidence and rests on that of the coins, as set forth by J. H. Dodd in *Journal of Hellenic Studies*, xxviii. (1908) 56 sqq.

Obesity.—It is as fat that the surplus food absorbed is stored in the body; but the power of storing fat varies enormously in different individuals, and in some it may be considered pathological. The reasons of this are very imperfectly understood. One undoubted cause of obesity is taking a supply of food in excess of the energy requirements of the individual. The amount of food may be *absolutely* large, or large *relatively* to the muscular energy evolved in mechanical work or in heat-production; but in either case, when fat begins to be deposited, the muscular activity of the body tends to diminish and the loss of heat from the surface is reduced; and thus the energy requirements become less, and a smaller diet is sufficient to yield the surplus for further storage of fat. Fat is formed from carbohydrates, and possibly indirectly from proteids (see NUTRITION). Individuals probably vary in their mode of dealing with these substances, some having the tendency to convert them to fat, some to burn them off at once. Carl von Noorden, however, who has studied the metabolism in cases of obesity, finds no marked departure from the normal. It may be that in some persons there is a very perfect absorption of food, but so far no scientific evidence for this view is forthcoming. In all cases the fat stored is available as a source of energy, and this circumstance is taken advantage of in the various fat "cures," which consist in giving a diet containing enough proteids to cover the requirements of the body, with a supply of fats and carbohydrates insufficient to meet the energy requirements of the individual. This is illustrated by the dietaries of some of the best known of these "cures":—

	In Grms. per Diem.			
	Proteid.	Fat.	Carbohydrates.	Calories.
Banting's cure	172	8	81	1112
Oertel's ,,	156–170	25–45	75–120	1180–1608
Ebstein's ,,	102	85	47	1401

In a normal individual in moderate muscular activity about 3000 Calories per diem are required (see DIETETICS), and therefore under the diets of these "cures," especially when accompanied by a proper amount of muscular exercise, the fats stored in the body are rapidly used up.

Diabetes, as distinguished from transitory glycosuria, is produced by a diminution in the power of the tissues to use sugar, which thus accumulates in the blood and escapes in the urine. One great source of energy being unavailable, the tissues have to use more fats and more proteids to procure the necessary energy, and hence, unless these are supplied in very large quantities, there is a tendency to emaciation.

The power of storing and using sugar in the tissues is strictly limited, and varies considerably in healthy individuals. Normally, when about 200 grms. of glucose are taken at one time, some of it appears in the urine within one hour. In some individuals the taking of even 100 grms. leads to a transient glycosuria, while others can take 250 grms. or more and use it all. But even in the same healthy individual the power of using sugar varies at different times and in different conditions, muscular exercise markedly increasing the combustion. Again, some sugars are more readily used than others, and therefore have a less tendency to appear in the urine when taken in the food. Milk-sugar and laevulose appear in the urine more readily than glucose. This power of using sugar possessed by an individual may depend to a small extent on the capacity of the liver to store as glycogen any excess of carbohydrates absorbed from the food, and some slight cases of transient glycosuria may be accounted for by a diminution of this capacity. But the typical form of diabetes cannot be thus explained. It has been maintained that increased production of sugar is a cause of some cases of the disease, and this view has been supported by Claude Bernard's classical experiment of producing glycosuria by puncturing the floor of the fourth ventricle in the brain of the rabbit. But after such puncture the glycosuria occurs only when glycogen is present in the liver. It is transient and has nothing to do with true diabetes. The fact that various toxic substances, *e.g.* carbon monoxide, produce glycosuria has been used as an argument in support of this view, but they too seem to act by causing a conversion of glycogen to glucose, and are effective only when the liver is charged with the former substance. At one time it was thought that the occurrence of glycosuria under the administration of phloridzin proved that diabetes is due to a poison. But the fact that, while sugar appears abundantly in the urine under phloridzin, it is not increased in the blood, shows that the drug acts not by diminishing the power of the tissues to use sugar, but by increasing the excretion of sugar through the kidneys and thus causing its *loss* to the body. Hence the tissues have to fall back upon the proteids, and an increased excretion of nitrogen is produced. This, however, is a totally different condition from diabetes.

Anything which produces a marked diminution in the normally limited power of the tissues to use sugar will cause the disease in a lighter or graver form. As age advances the activity of the various metabolic processes may diminish irregularly in certain individuals, and it is possible that the loss of the power of using sugar may be sooner impaired in some than in others, and thus diabetes be produced. But Minkowski and von Mering have demonstrated, by experiments upon animals, that pathological changes in the pancreas have probably a causal relationship with the disease. They found that excision of that organ in dogs, &c., produced all the symptoms of diabetes—the appearances of sugar in the urine, its increased amount in the blood, the rapid breaking-down of proteids, and the resulting emaciation and azoturia. At the same time the absorption from the intestine of proteids, fats and carbohydrates was diminished. How this pancreatic diabetes is produced has not been explained. It has been suggested that the pancreas forms an internal secretion which stimulates the utilization of sugar in the tissues. Though in a certain number of cases of diabetes disease of the pancreas has been found, other cases are recorded where grave disease of that organ has not produced this condition. But the apparent extent of a lesion is often no measure of the depth to which the functions of the structure in which it is situated are altered, and it is very possible that the functions of the pancreas may in many cases be profoundly modified without our methods of research being able to detect the change. The pancreas consists of two parts, the secreting structure and the epithelial islets, and one or other of these may be more specially involved, and thus alteration in digestion and absorption on the one hand, and changes in the utilization of carbohydrates on the other, may be separately produced. The subcutaneous injection of large doses of extracts of the supra-renal bodies causes glycosuria and an increase of sugar in the blood, but the relationship of this condition to diabetes has not yet been investigated.

The disease may be divided into two forms:—

1. *Slight Cases.*—The individual can use small quantities of sugar, but the taking of larger amounts causes glycosuria. Supposing that the energy requirements of an individual are met by a diet of—

Proteid	100 grms.	410 Calories.
Fat	100 ,,	930 ,,
Carbohydrate	400 ,,	1640 ,,
		2980 ,,

then if only 100 grms. of glucose can be used, the energy value of 300 grms., *i.e.* 1230 Calories, must be supplied from proteids and fats. To yield this, 300 grms. of proteids or 132 grms. of fats would be required. If these are not forthcoming in the diet, they must be supplied from the tissues, and the individual will become emaciated; hence a diabetic on an ordinary diet is badly nourished, and hence the huge appetite characteristic of the disease.

2. *Grave Cases.*—From the products of the splitting of proteids sugar can be formed, probably in the liver, and in the more serious form of the disease, even when carbohydrates are excluded from the food, a greater or lesser quantity of the sugar thus formed escapes consumption and may be excreted. Theoretically, 100 grms. of proteid can yield 113·6 grms. of glucose, *i.e.* 1 grm. of nitrogen will be set free for each 7·5 grms. of glucose formed. In the urine of grave cases of diabetes on a proteid diet, the proportion of nitrogen to sugar is about 1 to 2. This may mean that the theoretically possible amount of sugar is not yielded, or that some of the sugar formed is used in the economy. Both hypotheses may be correct, but the latter is supported by the fact that even in grave cases the decomposition of proteid may be diminished by giving sugar, and that in muscular exercise the proportion of sugar may fall.

In the course of the disease the amount of sugar which the tissues can use varies from day to day. It is in the utilization of glucose—the normal sugar of the body—that the tissues chiefly fail. Many diabetics are able to use laevulose, or the inulin from which it is derived, and lactose (milk-sugar) to a certain extent. It has, however, been observed that under the administration of these sugars the excretion of glucose may be increased, the tissues, apparently by using the foreign sugar, allowing part of the glucose which they would have consumed to escape.

The increased decomposition of proteid, rendered necessary to supply the energy not forthcoming in the sugar, leads to the appearance of a large quantity of nitrogen in the urine—*azoturia*—and it also leads to the formation of various acids. Sulphuric acid and phosphoric acid are formed by oxidation of the sulphur and phosphorus in the proteid molecule. Organic acids of the lower fatty acid series β oxybutyric and aceto-acetic acid with their derivative acetone also appear in the course of diabetes. They are in part formed from the disintegration of proteids and in part from fats, as the result of a modified metabolism induced by the withdrawal of carbohydrates. To neutralize them ammonia is developed and hence the proportion of ammonia in the urine is increased. By the development of these various acids the alkalinity of the blood is diminished. The development of these acids in large quantities is associated with extensive decomposition of proteid, and is sometimes indicative of the onset of a comatose condition, which seems to be due rather to an acid intoxication than to the special toxic action of any particular acid.

Myxoedema.—The thyroid gland forms a material which has the power of increasing the metabolism of proteids and of fats; and when the thyroid is removed, a condition of sluggish metabolism, with low temperature and a return of the connective tissues to an embryonic condition, supervenes, accompanied by the appearance of depression of the mental functions and by other nervous symptoms. The disease myxoedema, which was first described by Sir William Gull in 1873, was shown by Ord in 1878 to be due to degenerative changes in the thyroid gland. It affects both sexes, but chiefly females, and is characterized by a peculiar puffy appearance of the face and hands, shedding of the hair, a low temperature, and mental hebetude. The symptoms are similar to those produced by removal of the thyroid, and are indicative of a condition of diminished activity of metabolism. The nervous symptoms may be in part due to some alteration in the metabolism, leading to the formation of toxic substances. The administration of thyroid gland extract causes all the symptoms to disappear.

Cretinism may now be defined as myxoedema in the infant, and it has been definitely proved to be associated with non-development or degeneration of the thyroid gland. The characters of the disease are all due to diminished metabolism, leading to retarded development, and the treatment which has proved of service, at least in some sporadic cases, is the administration of various thyroid preparations.

Exophthalmic Goître—Graves's Disease or Basedow's Disease.—This disease chiefly affects young women, and is characterized by three main symptoms: increased rate and force of the heart's action, protrusion of the eyeballs, and enlargement of the thyroid gland. The patient is nervous, often sleepless, and generally becomes emaciated and suffers from slight febrile attacks. The increased action of the heart is the most constant symptom, and the enlargement of the thyroid gland may not be manifest. Various theories as to the pathology of the condition have been advanced, but in the light of our knowledge of the physiology of the thyroid the most probable explanation is an increased functional activity of that gland or of changes in the parthyroids.

Gout has often been divided into the typical and atypical forms. The first is undoubtedly a clinical and pathological entity, but the second, though containing cases of less severe forms of true gout, is largely constituted of imperfectly diagnosed morbid conditions. The accumulation of urate of soda in the tissues in gout formerly led physicians to believe in a causal relationship between an increased formation of that substance and the onset of the disease. Sir A. Garrod's investigations, however, seemed to indicate that diminished excretion rather than increased production is the cause of the condition. He found an accumulation of uric acid in the blood and a diminution in its amount in the urine during the attack. That uric acid is increased in the blood is undoubted, but the changes described by Garrod in the urine, and considered by him as indicative of diminished excretion and retention, are rendered of less value by the imperfections of the analytic method employed. More recent work with better methods has thrown still further doubt upon the existence of such a relationship, and points rather to the accumulation of uric acid being, like the other symptoms of the condition, a result of some unknown modification in the metabolism, and a purely secondary phenomenon. The important fact that in leucaemia (von Jaksch), in lead-poisoning (Garrod), and in other pathological conditions, uric acid may be increased in the blood and in the urine without any gouty symptoms supervening, is one of the strongest arguments against the older views. That the gouty inflammation is not caused by the deposit of urate of soda, seems to be indicated by the occurrence of cases in which there is no such deposition. The source of the uric acid which is so widely deposited in the gouty is largely the phosphorus containing nucleins of the food and tissues. These in their decomposition yield a series of di-ureides, the purin bodies, of which uric acid is one. Their excretion is increased when substances rich in nuclein, *e.g.* sweetbreads, &c., are administered. While uric acid itself has not been demonstrated to have any injurious action, the closely allied adenin has been found to produce toxic symptoms. After the discovery of this source of uric acid, physiologists for a time inclined to regard it as the only mode of production. But it must be remembered that in birds uric acid is formed from the ammonia compounds coming from the intestine and muscles, just as urea is formed from the same substance in mammals. Uric acid is a di-ureide—a body composed of two urea molecules linked by acrylic acid—an unsaturated propionic acid. It is therefore highly probable that in many conditions the conversion of ammonia compounds to urea is not complete, and that a certain amount of uric acid is formed apart from the decomposition of nucleins.

Sir William Roberts has adduced evidence to show that uric acid circulates in the blood in a freely soluble combination or quadurate—that is, a compound in which one molecule of an acid salt $BH\bar{U}$ is linked to a molecule of the acid $BH\bar{U}. H_2U$. These compounds are said to be readily decomposed and the bi-urates formed, which are at first gelatinous but become crystalline. The deposition of urate of soda in joints, &c., has been ascribed to this change. Francis Tunnicliffe, however, has published the results of certain investigations which throw doubt upon this explanation. The most recent investigations on the metabolism of the gouty have shown that there is undoubtedly a slowing in the rate of elimination of uric acid and also of the total nitrogen of the urine with occasional sudden increases sometimes connected with a gouty paroxysm, sometimes independent of it. Whether this is due to the action of some toxin developed in the body or is caused by a constitutional renal inadequacy is difficult to decide. Certain it is these renal diseases often develop in the course of gout.

Rheumatism.—Rheumatic fever was formerly regarded as due to some disturbance in the metabolism, but it is now known to be a specific micro-organismal disease. The whole clinical picture is that of an infective fever, and it is closely related to gonorrhoeal rheumatism and to certain types of pyaemia. A number of independent observers have succeeded in isolating from cases of rheumatic fever a diplococcus which produces similar symptoms in the rabbit to those which characterize the disease in man.

Excluding the peculiar changes in the joints which occur in *rheumatoid arthritis* and in *Charcot's disease*, and which are almost certainly primary affections of the nervous system, it is found that a large number of individuals suffer from pain in the joints, in the muscles, and in the fibrous tissues, chiefly on exposure to cold and damp or after indiscretions of diet. This so-called *chronic rheumatism* appears to be a totally distinct condition from rheumatic fever; and although its pathology is not determined, it looks as if it were due either to a diminished elimination or an increased production of some toxic substance or substances, but so far we have no evidence as to their nature.

Rickets is undoubtedly a manifestation of a profound alteration of the metabolism in childhood, but how far it is an idiopathic condition and how far a result of the action of toxins introduced from without is not yet definitely known. Kassowitz long ago showed that the bone changes are similar to those which can be produced in animals by chronic phosphorus poisoning, and that they are really irritative in nature. Spillmann, in his work *Le Rachitisme*, discusses the evidence as regards the action of various conditions, and comes to the conclusion that there is no evidence that it is due to a mere primary disturbance of the metabolism, or to excessive production of lactic acid, or to any specific micro-organismal poisoning. But he adduces evidence, perhaps not very convincing, that in the disease there is a specific intoxication derived from the alimentary canal and provoking inflammatory lesions in the bones.

See generally Carl von Noorden, *Metabolism and Practical Medicine* (1907). (D. N. P.)

METABOLISM (from Gr. μεταβολή, change), the biological term for the process of chemical change in a living cell (see PHYSIOLOGY).

METAL (through Fr. from Lat. *metallum*, mine, quarry, adapted from Gr. μέταλλον, in the same sense, probably connected with μεταλλᾶν, to search after, explore, μετά, after, ἄλλος, other). Originally applied to gold, silver, copper, iron, tin, lead and bronze, *i.e.* substances having high specific gravity, malleability, opacity, and especially a peculiar lustre, the term "metal" became generic for all substances with these properties. In modern chemistry, however, the metals are a division of the elements, the members of which may or may not possess all these characters. The progress of science has, in fact, been accompanied by the discovery of some 70 elements, which may be arranged in order of their "metallic" properties as above indicated, and it is found that while the end members of the scale are most distinctly metallic (or non-metallic), certain central members, *e.g.* arsenic, may be placed in either division, their properties approximating to both metallic and non-metallic. One chemical differentia utilizes the fact that metals always form at least one basic oxide which yields salts with acids, while non-metals usually form acidic oxides, *i.e.* oxides which yield acids with water. This definition, however, is highly artificial and objectionable on principle, because when we speak of metals we think, not of their chemical relations, but of a certain sum of mechanical and physical properties which unites them all into one natural family.

All metals, when exposed in an inert atmosphere to a sufficient temperature, assume the form of liquids, which all present the following characteristic properties. They are (at least practically) non-transparent; they reflect light in a peculiar manner, producing what is called "metallic lustre." When kept in non-metallic vessels they take the shape of a convex meniscus. These liquids, when exposed to higher temperatures, some sooner than others, pass into vapours. What these vapours are like is not known in many cases, since, as a rule, they can be produced only at very high temperatures, precluding the use of transparent vessels. Silver vapour is blue, potassium vapour is green, many others (mercury vapour, for instance) are colourless. The liquid metals, when cooled down sufficiently, some at lower, others at higher, temperatures freeze into compact solids, endowed with the (relative) non-transparency and the lustre of their liquids. These frozen metals in general form compact masses consisting of aggregates of crystals belonging to the regular or rhombic or (more rarely) the quadratic system. Compared with non-metallic solids, they in general are good conductors of heat and of electricity. But their most characteristic, though not perhaps their most general, property is that they combine in themselves the apparently incompatible properties of elasticity and rigidity on the one hand and plasticity on the other. To this remarkable combination of properties more than to anything else the ordinary metals owe their wide application in the mechanical arts. In former times a high specific gravity used to be quoted as one of the characters of the genus; but this no longer holds, since we now know a series of metals lighter than water.

Non-Transparency.—This, in the case of even the solid metals, is perhaps only a very low degree of transparency. In regard to gold this has been proved to be so; gold leaf, or thin films of gold produced chemically on glass plates, transmit light with a green colour. On the other hand, infinitely thin films of silver which can be produced chemically on glass surfaces are absolutely opaque. Very thin films of liquid mercury, according to Melsens, transmit light with a violet-blue colour; also thin films of copper are said to be translucent.

Colour.—Gold is yellow; copper is red; silver, tin, and some others are pure white; the majority are greyish.

Reflection of Light.—Polished metallic surfaces, like those of other solids, divide any incident ray into two parts, of which one is refracted while the other is reflected—with this difference, however, that the former is completely absorbed, and that the latter, in regard to polarization, is quite differently affected. The following values are due to Rubens and Hagen (*Ann. der Phys.*, 1900, p. 352); they express the percentage of incident light reflected. The superiority of silver is obvious.

Name of Metal.	Violet.	Yellow.	Red.
	λ=450	λ=550	λ=650
Silver	90·6	92·5	93·6
Platinum	55·8	61·1	66·3
Nickel	58·5	62·6	65·9
Steel	58·6	59·4	60·1
Gold	36·8	74·7	88·2
Copper	48·8	59·5	89
Glass backed with silver	79·3–85·7	82–88	83–89
Glass backed with mercury	72·8	71·2	71·5

Crystalline Form and Structure.—Most (perhaps all) metals are capable of crystallization. The crystals belong to the following systems: *regular system*—silver, gold, palladium, mercury, copper, iron, lead; *quadratic system*—tin, potassium; *rhombic system*—antimony, bismuth, tellurium, zinc, magnesium. Perhaps all metals are crystalline, only the degree of visibility of the crystalline arrangement is very different in different metals, and even in the same metal varies according to the slowness of solidification and other circumstances.

Antimony, bismuth and zinc exhibit a very distinct crystalline structure: a bar-shaped ingot readily breaks, and the crystal faces are distinctly visible on the fracture. Tin also is crystalline: a thin bar, when bent, "creaks" audibly from the sliding of the crystal faces over one another; but the bar is not easily broken, and exhibits an apparently non-crystalline fracture.—Class I.

Gold, silver, copper, lead, aluminium, cadmium, iron (pure), nickel and cobalt are practically amorphous, the crystals (where they exist) being so closely packed as to produce a virtually homogeneous mass.—Class II.

The great contrast in apparent structure between cooled ingots of Class I. and of Class II. appears to be owing chiefly to the fact that, while the latter crystallize in the regular system, metals of Class I. form rhombic or quadratic crystals. Regular crystals expand equally in all directions; rhombic and quadratic expand differently in different directions. Hence, supposing the crystals immediately after their formation to be in absolute contact with one another all round, then, in the case of Class II., such contact will be maintained on cooling, while in the case of Class I. the contraction along a given straight line will in general have different values in any two neighbouring crystals, and the crystals consequently become slightly detached from one another. The crystalline structure which exists on both sides becomes visible only in the metals of the first class, and only there manifests itself as brittleness.

Closely related to the structure of metals is their degree of "plasticity" (susceptibility of being constrained into new forms without breach of continuity). This term of course includes as special cases the qualities of "malleability" (capability of being flattened out under the hammer) and "ductility" (capability of being drawn into wire); but these two special qualities do not always go parallel to each other, for this reason amongst others—that ductility in a higher degree than malleability is determined by the tenacity of a metal. Hence tin and lead, though very malleable, are little ductile. The quality of plasticity is developed to very different degrees in different metals, and even in the same species it depends on temperature, and may be modified by mechanical or physical operations.

A bar of zinc, for instance, as obtained by casting, is very brittle; but when heated to 100° or 150° C. it becomes sufficiently plastic to be rolled into the thinnest sheet or to be drawn into wire. Such sheet or wire then remains flexible after cooling, the originally only loosely cohering crystals having got intertwisted and forced into absolute contact with one another—an explanation supported by the fact that rolled zinc has a somewhat higher specific gravity (7·2) than the original ingot (6·9). The same metal, when heated to 205° C., becomes so brittle that it can be powdered in a mortar. Pure iron, copper, silver and other metals are easily drawn into wire, or rolled into sheet, or flattened under the hammer. But all these operations render the metals harder, and detract from their plasticity. Their original softness can be restored to them by "annealing," *i.e.* by heating them to redness and then quenching them in cold water. In the case of iron, however, this applies only if the metal is perfectly pure. If it contains a few parts of carbon per thousand, the annealing process, instead of softening the metal, gives it a "temper," meaning a higher degree of hardness and elasticity (see below).

What we have called plasticity must not be confused with the notion of "softness," which means the degree of facility with which the plasticity of a metal can be discounted. Thus lead is far softer than silver, and yet the latter is by far the more plastic of the two. The famous experiments of H. E. Tresca show that the plasticity of certain metals at least goes considerably farther than had before been supposed.

He operated with lead, copper, silver, iron and some other metals. Round disks made of these substances were placed in a closely fitting cylindrical cavity drilled in a block of steel, the cavity having a circular aperture of two or four centimetres below. By an hydraulic press a pressure of 100,000 kilos was made to act upon the disks, when the metal was seen to "flow" out of the hole like a viscid liquid. In spite of the immense rearrangement of parts there was no breach of continuity. What came out below was a compact cylinder with a rounded bottom, consisting of so many layers superimposed upon one another. Parallel experiments with layers of dough or sand plus some connecting material proved that the particles in all cases moved along the same tracks as would be followed by a flowing cylinder of liquid. Of the better known metals potassium and sodium are the softest; they can be kneaded between the fingers like wax. After these follow first thallium and then lead, the latter being the softest of the metals used in the arts. Among these the softness decreases in about the following order: lead, pure silver, pure gold, tin, copper, aluminium, platinum, pure iron. As liquidity might be looked upon as the *ne plus ultra* of softness, this is the right place for stating that, while most metals, when heated up to their melting points, pass pretty abruptly from the solid to the liquid state, platinum and iron first assume, and throughout a long range of temperatures retain, a condition of viscous semi-solidity which enables two pieces of them to be "welded" together by pressure into one continuous mass.

According to Prechtl, the ordinary metals, in regard to the degree of facility or perfection with which they can be hammered flat on the anvil, rolled out into sheet, or drawn into wire, form the following descending series:—

Hammering.	*Rolling into Sheet.*	*Drawing into Wire.*
Lead.	Gold.	Platinum.
Tin.	Silver.	Silver.
Gold.	Copper.	Iron.
Zinc.	Tin.	Copper.
Silver.	Lead.	Gold.
Copper.	Zinc.	Zinc.
Platinum.	Platinum.	Tin.
Iron.	Iron.	Lead.

To give an idea of what can be done in this way, it may be stated that gold can be beaten out to leaf of the thickness of $\frac{1}{3800}$ mm.; and that platinum, by judicious work, can be drawn into wire $\frac{1}{20000}$ mm. thick.

By the "hardness" of a metal we mean the resistance which it offers to the file or engraver's tool. Taking it in this sense, it does not necessarily measure, *e.g.* the resistance of a metal to abrasion by friction. Thus, for instance, 10% aluminium bronze is scratched by an ordinary steel knife-blade, yet the sets of needles used for perforating postage stamps last longer if made of aluminium bronze than if made of steel.

Elasticity.—All metals are elastic to this extent that a change of form, brought about by stresses not exceeding certain limit values, will disappear on the stress being removed. Strains exceeding the "limit of elasticity" result in permanent deformation or (if sufficiently great) in rupture. Referring the reader to the article ELASTICITY for the theoretical and to the STRENGTH OF MATERIALS for the practical aspects of this subject, we give here a table of the "modulus of elasticity," E (column 2), for millimetre and kilogramme. Hence 1000/E is the elongation in millimetres per metre length per kilo. Column 3 shows the charge causing a permanent elongation of 0·05 mm. per metre, which, for practical purposes, Wertheim takes as giving the limit of elasticity; column 4 gives the breaking strain. These values may vary within certain limits for different specimens.

Name of Metal.	E.	For Wire of 1 sq. mm. Section, Weight (in Kilos) causing	
		Permanent Elongation of $\frac{1}{20000}$.	Breakage.
Lead, drawn	1,803	0·25	2·1
,, annealed	1,727	0·20	1·8
Tin, drawn	4,148	0·45	2·45
,, annealed	1,700	0·20	
Cadmium	7,070		2·24
Gold, drawn	8,131	13·5	27
,, annealed	5,585	3·0	10
Silver, drawn	7,357	11·3	29
,, annealed	7,140	2·6	16
Zinc, pure, cast in mould.	9,021		
,, ordinary, drawn .	8,735	0·75	13
Palladium, drawn . . .	11,759	18	
,, annealed . .	9,709	under 5	27
Copper, drawn	12,449	12	40
,, annealed . . .	10,519	under 3	30
Platinum wire, medium thickness, drawn . .	17,004	26	34
Platinum, annealed . .	15,518	14	23
Iron, drawn	20,869	32	61
,, annealed	20,794	under 5	47
Nickel, drawn	23,950		$\frac{3}{2}\times 61$
Aluminium . . .	7,200		
,, bronze . . .	10,700		
Brass ($ZnCu_2$) . . .	8,543		
German silver ($Zn_4Cu_{13}Ni_5$)	10,788		

Specific Gravity.—This varies in metals from ·594 (lithium) to 22·48 (osmium), and in one and the same species is a function of temperature and of previous physical and mechanical treatment. It has in general one value for the powdery metal as obtained by reduction of the oxide in hydrogen below the melting point of the metal, another for the metal in the state which it assumes spontaneously on freezing, and this latter value, in general, is modified by hammering, rolling, drawing, &c. These mechanical operations do not necessarily add to the density; stamping, it is true, does so necessarily, but rolling or drawing occasionally causes a diminution of the density. Thus, for instance, chemically pure iron in the ingot has the specific gravity 7·844; when it is rolled out into thin sheet, the value falls to 7·6; when drawn into thin wire, to 7·75. The following table gives the specific gravities of many metals. Where special statements are not made, the numbers hold for the ordinary temperature (15° to 17° or 20° C.), referred to water of the same temperature as a standard, and to hold for the natural frozen metal.

Name of Metal.	Specific Gravity.
Lithium	·594
Potassium	·875
Sodium	·978
Rubidium	1·52
Calcium	1·578
Magnesium	1·743
Caesium	1·88
Beryllium	2·1
Strontium	2·5
Aluminium, pure, ingot	2·583 at 4°
,, ordinary, hammered	2·67

Name of Metal.	Specific Gravity.
Barium	3·75
Zirconium	4·15
Vanadium, powder	5·5
Gallium	5·95
Lanthanum	6·163
Cerium	6·68
Antimony	6·62
Chromium	6·50
Zinc, ingot	6·915
,, rolled out	7·2
Manganese	7·39
Tin, cast	7·29 to 7·299
,, crystallized by electrolysis from solutions	7·178
Indium	7·42
Iron, chemically pure, ingot	7·844
,, thin sheet	7·6
,, wrought, high quality	7·8 to 7·9
Nickel, ingot	8·279
,, forged	8·666
Cadmium, ingot	8·546
,, hammered	8·667
Cobalt	8·6
Molybdenum, containing 4 to 5 % of carbon	8·6
Copper, native	8·94
,, cast	8·92
,, wire or thin sheet	8·94 to 8·95
,, electrotype, pure	8·945
Bismuth	9·823 at 12°
Silver, cast	10·4 to 10·5
,, stamped	10·57
Lead, very slowly frozen	11·254
,, quickly frozen in cold water	11·363
Palladium	11·4 at 22·5°
Thallium	11·86
Rhodium	12·1
Ruthenium	12·26 at 0°
Mercury, liquid	13·595 at 0°
,, solid	14·39 below −40°
Tungsten, compact, by H_2 from chloride vapour	16·54
,, as reduced by hydrogen, powder	19·13
Uranium	18·7
Gold, ingot	19·265 at 13°
,, stamped	19·31 to 19·34
,, powder, precipitated by ferrous sulphate	19·55 to 19·72
Platinum, pure	21·50
Iridium	22·2
Osmium	22·477

Thermal Properties.—The specific heats of most metals have been determined. The general result is that, conformably with Dulong and Petit's law, the "atomic heats" all come to very nearly the same value (of about 6·4); *i.e.* atomic weight by specific heat =6·4. Thus we have for silver by theory 6·4/108=·0593, and by experiment ·0570 for 10° to 100° C.

The expansion by heat varies greatly. The following table gives the linear expansions from 0° to 100° C. according to Fizeau (*Comptes rendus*, lxviii. 1125), the length at 0° being taken as unity.

Name of Metal.	Expansion 0° to 100°.
Platinum, cast	·000 907
Gold, cast	·001 451
Silver, cast	·001 936
Copper, native, from Lake Superior	·001 708
,, artificial	·001 869
Iron, soft, as used for electromagnets	·001 228
,, reduced by hydrogen and compressed	·001 208
Cast steel, English annealed	·001 110
Bismuth, in the direction of the axis	·001 642
,, at right angles to axis	·001 239
,, mean expansion, calculated	·001 374
Tin, of Malacca, compressed powder	·002 269
Lead, cast	·002 948
Zinc, distilled, compressed powder	·002 905
Cadmium, distilled, compressed powder	·003 102
Aluminium, cast	·002 336
Brass (71·5 % copper, 28·5 % zinc)	·001 879
Bronze (86·3 % copper, 9·7 % tin, 4·0 % zinc)	·001 802

The coefficient of expansion is constant for such metals only as crystallize in the regular system; the others expand differently in the directions of the different axes. To eliminate this source of uncertainty these metals were employed as compressed powders. The cubical expansion of mercury from 0° to 100° C. is ·018153 $=\frac{1}{55\cdot087}$ (Regnault). (See THERMOMETRY.)

Fusibility and Volatility.—The fusibility in different metals is very different, as shown by the following table, which, besides including all the fusing points (in degrees C.) of metals which have been determined numerically, indicates those of a selection of other metals by the positions assigned to them in the table.

Name of Metal.	Melting Point.	Boiling Point.
Mercury	−38·8	357·3
Caesium	26–27	
Gallium	30·1	
Rubidium	38·5	
Potassium	62·5	719–731
Sodium	95·6	861–954
Indium	155	
Lithium	180·0	
Tin	231·9	1450–1600
Bismuth	269·2	1090–1450
Thallium	290	
Cadmium	320·7	780
Lead	327·7	1450–1600
Zinc	419	929–954
Incipient red heat	525	
Antimony	629·5	
Magnesium	632·6	about 1100
Aluminium	655	
Cherry red heat	700	
Calcium	780	
Lanthanum	810	
Barium	850	
Silver	962	
Gold	1064	
Copper	1082	2100
Yellow heat	1100	
Iron	1300–1400	
Nickel	1427	
Cobalt	1800 (?)	
Dazzling white heat	1500–1600	
Palladium	1500	
Platinum	1760	
Rhodium	above Pt.	
Iridium	,, 2200	
Ruthenium	,, Ir.	
Tantalum Osmium	In electric furnace	

For practical purposes the volatility of metals may be stated as follows:—

1. Distillable below redness: mercury.
2. Distillable at red heats: cadmium, alkali metals, zinc, magnesium.
3. Volatilized more or less readily when heated beyond their fusing points in open crucibles: antimony (very readily), lead, bismuth, tin, silver.
4. Barely so: gold, (copper).
5. Practically non-volatile: (copper), iron, nickel, cobalt, aluminium; also lithium, barium, strontium and calcium.

In the oxyhydrogen flame silver boils, forming a blue vapour, while platinum volatilizes slowly, and osmium, though infusible, very readily.

Latent Heats of Liquefaction.—Of these we know little. The following numbers are due to Person—ice, it may be stated, being 80.

Name of Metal.	Latent Heat.	Name of Metal.	Latent Heat.
Mercury	2·82	Cadmium	13·6
Lead	5·37	Silver	21·1
Bismuth	12·4	Zinc	28·1

The latent heat of vaporization of mercury was found by Marignac to be 103 to 106.

Conductivity.—Conductivity, whether thermic or electric, is very differently developed in different metals; and, as an exact knowledge of these conductivities is of great importance, much attention has been given to their numerical determination (see CONDUCTION, ELECTRIC; and CONDUCTION OF HEAT).

The following table gives the electric conductivities of a number of metals as determined by Matthiesen, and the relative internal thermal conductivities of (nominally) the same metals as determined by Wiedemann and Franz, with rods about 5 mm. thick, of which one end was kept at 100° C., the rest of the rod in a "vacuum" (of 5 mm. tension) at 12° C. Matthiesen's results, except in the two cases noted, are from his memoir in *Pogg. Ann.*, 1858, ciii. 428

Name of Metal.	Relative Conductivities.	
	Electric.	Thermic.
Copper, commercial, No. 3	·774 at 18·8°	
,, ,, No. 2	·721 ,, 22·6	
,, chemically pure, hard drawn	·93[1]	
Copper		·748
Gold, pure	·552 ,, 21·8	·548
,, absolutely pure	·73[1] ,, 19·0	
Brass		·25
Tin, pure	·115 ,, 21·0	·154
Pianoforte wire	·144 ,, 20·4	
Iron rod		·101
Steel		·103
Lead, pure	·0777 ,, 17·3	·079
Platinum	·105 ,, 20·7	·094
German silver	·0767 ,, 18·7	·073
Bismuth	·0119 ,, 13·8	
Aluminium	·196 ,, 19·6	
Mercury	·0163 ,, 22·8	
Silver, pure	1·000 ,, 0	1·000

Magnetic Properties.—Iron, nickel and cobalt are the only metals which are attracted by the magnet and can become magnets themselves. But in regard to their power of retaining their magnetism none of them comes at all up to the compound metal steel. See MAGNETISM.

Chemical Changes.—Metals may unite chemically both with metals and with non-metals. The compounds formed in the first case, which may be either definite chemical compounds or solid solutions, are discussed under ALLOYS; in this place only combinations with non-metals are discussed, it being premised that the free metal takes part in the reaction.

Metallic Substances Produced by the Union of Metals with Small Proportions of Non-Metallic Elements.

Hydrogen, as was shown by Graham, is capable of uniting with or being occluded by certain metals, notably with palladium (*q.v.*), into metal-like compounds.

Oxygen.—Mercury and copper and some other metals are capable of dissolving their own oxides. Mercury, by doing so, becomes viscid and unfit for its ordinary applications. Copper, when pure to start with, suffers considerable deterioration in plasticity. But the presence of moderate proportions of cuprous oxide has been found to correct the evil influence of small contaminations by arsenic, antimony, lead and other foreign metals. Commercial coppers sometimes owe their good qualities to this compensating influence.

Arsenic combines readily with all metals into true arsenides, which latter, in general, are soluble in the metal itself. The presence in a metal of even small proportions of arsenide generally leads to considerable deterioration in mechanical qualities.

Phosphorus.—The remark just made might be said to hold for phosphorus were it not for the existence of what is called "phosphorus-bronze," an alloy of copper with phosphorus (*i.e.* its own phosphide), which possesses valuable properties. According to Abel, the most favourable effect is produced by from 1 to 1½% of phosphorus. Such an alloy can be cast like ordinary bronze, but excels the latter in hardness, elasticity, toughness and tensile strength.

Carbon.—Most metals when molten are capable of dissolving at least small proportions of carbon, which, in general, leads to a deterioration in metallicity, except in the case of iron, which by the addition of small percentages of carbon gains in elasticity and tensile strength with little loss of plasticity (see IRON).

Silicon, so far as we know, behaves to metals pretty much like carbon, but our knowledge of facts is limited. What is known as cast iron is essentially an alloy of iron proper with 2 to 6% of carbon and more or less of silicon (see IRON). Alloys of copper and silicon were prepared by Deville in 1863. The alloy with 12% of silicon is white, hard and brittle. When diluted down to 4·8%, it assumes the colour and fusibility of bronze, but, unlike it, is tenacious and ductile like iron.

Action of the More Ordinary Chemical Agents on Simple Metals.

The metals to be referred to are always understood to be given in the compact (frozen) condition, and that, wherever metals are enumerated as being similarly attacked, the degree of readiness in the action is indicated by the order in which the several members are named—the more readily changed metal always standing first.

Water, at ordinary or slightly elevated temperatures, is decomposed more or less readily, with evolution of hydrogen gas and formation of a basic hydrate, by (1) potassium (formation of KHO), sodium (NaHO), lithium (LiOH), barium, strontium, calcium (BaH_2O_2, &c.); (2) magnesium, zinc, manganese (MgO_2H_2, &c.). In the case of group 1 the action is more or less violent, and the hydroxides formed are soluble in water and very strongly basic; metals of group 2 are only slowly attacked, with formation of relatively feebly basic and less soluble hydroxides. Disregarding the rarer elements, the metals not named so far may be said to be proof against the action of pure water in the absence of free oxygen (air).

By the joint action of water and air, thallium, lead, bismuth are oxidized, with formation of more or less sparingly soluble hydroxides (ThHO, PbH_2O_2, BiH_3O_3), which, in the presence of carbonic acid, pass into still less soluble basic carbonates. Iron, when exposed to moisture and air, "rusts"; but this process never takes place in the absence of air, and it is questionable whether it ever sets in in the absence of carbonic acid (see RUST).

Copper, in the present connexion, is intermediate between iron and the following group of metals.

Mercury, if pure, and all the "noble" metals (silver, gold, platinum and platinum-metals), are absolutely proof against water even in the presence of oxygen and carbonic acid.

The metals grouped together above, under 1 and 2, act on steam pretty much as they do on liquid water. Of the rest, the following are readily oxidized by steam at a red heat, with formation of hydrogen gas—zinc, iron, cadmium, cobalt, nickel, tin. Bismuth is similarly attacked, but slowly, at a white heat. Aluminium is barely affected even at a white heat, if it is pure; the ordinary impure metal is liable to be very readily oxidized.

Aqueous Sulphuric or Hydrochloric Acid readily dissolves groups 1 and 2, with evolution of hydrogen and formation of chlorides or sulphates. The same holds for the following group (A): [manganese, zinc, magnesium] iron, aluminium, cobalt, nickel, cadmium. Tin dissolves readily in strong hot hydrochloric acid as $SnCl_2$; aqueous sulphuric acid does not act on it appreciably in the cold; at 150° it attacks it more or less quickly, according to the strength of the acid, with evolution of sulphuretted hydrogen or, when the acid is stronger, of sulphurous acid gas and deposition of sulphur (Calvert and Johnson). A group (B), comprising copper, is, substantially, attacked only in the presence of oxygen or air. Lead, in sufficiently dilute acid, or in stronger acid if not too hot, remains unchanged. A group (C) may be formed of mercury, silver, gold and platinum, which are not touched by either aqueous acid in any circumstances.

Hot (concentrated) sulphuric acid does not attack gold, platinum and platinum-metals generally; all other metals (including silver) are converted into sulphates, with evolution of sulphur dioxide. In the case of iron, ferric sulphate, $Fe_2(SO_4)_3$, is produced; tin yields a somewhat indefinite sulphate of its oxide SnO_2.

Nitric Acid (*Aqueous*)—Gold, platinum, iridium and rhodium only are proof against the action of this powerful oxidizer. Tin and antimony (also arsenic) are converted by it (ultimately) into hydrates of their highest oxides SnO_2, Sb_2O_5 (As_2O_5)—the oxides of tin and antimony being insoluble in water and in the acid itself. All other metals, including palladium, are dissolved as nitrates, the oxidizing part of the reagent being generally reduced to oxides of nitrogen. Iron, zinc, cadmium, also tin under certain conditions, reduce the dilute acid, partially at least, to nitrous oxide, N_2O, or ammonium nitrate, NH_4NO_3.

Aqua Regia, a mixture of nitric and hydrochloric acids, converts all metals (even gold, the "king of metals," whence the name) into chlorides, except only rhodium, iridium and ruthenium, which, when pure, are not attacked.

Caustic Alkalis.—Of metals not decomposing liquid pure water, only a few dissolve in aqueous caustic potash or soda, with evolution of hydrogen. The most important of these are aluminium and zinc, which are converted into aluminate, $Al(OK,Na)_3$, and zincate, $Zn(OK,Na)_2$, respectively. But of the rest the majority, when treated with boiling sufficiently strong alkali, are attacked at least superficially; of ordinary metals only gold, platinum, and silver are perfectly proof against the reagents under consideration, and these accordingly are used preferably for the construction of vessels intended for analytical operations involving the use of aqueous caustic alkalis. For commercial purposes iron is universally employed and works well; but it is not available analytically, because a superficial oxidation of the empty part of the vessel (by the water and air) cannot be prevented. Basins made of pure malleable nickel are free from this drawback; they work as well as platinum, and rather better than silver ones do. There is hardly a single metal which holds out against the alkalis themselves when in the state of fiery fusion; even platinum is most violently attacked. In chemical laboratories fusions with caustic alkalis are always effected in vessels made of gold or silver, these metals holding out fairly well even in the presence of air. Gold is the better of the two. Iron, which stands so well against aqueous alkalis, is most violently attacked by the fused reagents. Yet tons of caustic soda are fused daily in chemical works in iron pots without thereby suffering contamination, which seems to show that (clean) iron, like gold and silver, is attacked only by the joint action of fused alkali and air, the influence of the latter being of course minimized in large-scale operations.

Oxygen or Air.—The noble metals (from silver upwards) do not combine directly with oxygen given as oxygen gas (O_2), although, like silver, they may absorb this gas largely when in the fused condition, and may not be proof against ozone, O_3. Mercury, within a certain range of temperatures situated close to its boiling point, combines slowly with oxygen into the red oxide, which, however, breaks up again at higher temperatures. All other metals, when heated in oxygen or air, are converted, more or less readily, into stable oxides. Potassium, for example, yields peroxide, K_2O_2 or K_2O_4; sodium gives Na_2O_2; the barium-group metals, as well as magnesium, cadmium, zinc, lead, copper, are converted into their monoxides MeO. Bismuth and antimony give (the latter very readily) sesquioxide (Bi_2O_3 and Sb_2O_3, the latter being capable of passing into Sb_2O_4). Aluminium, when pure and kept out of contact with siliceous matter, is only oxidized at a white heat, and then very slowly, into alumina, Al_2O_3. Tin, at high temperatures, passes slowly into oxide, SnO_2.

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[1] Published in 1860, and declared by Matthiesen to be more exact than the old numbers.

Sulphur.—Amongst the better known metals, gold and aluminium are the only ones which, when heated with sulphur or in sulphur vapour remain unchanged. All the rest, under these circumstances, are converted into sulphides. The metals of the alkalis and alkaline earths, also magnesium, burn in sulphur vapour as they do in oxygen. Of the heavy metals, copper is the one which exhibits by far the greatest avidity for sulphur, its subsulphide Cu_2S being the stablest of all heavy metallic sulphides in opposition to dry reactions.

Chlorine.—All metals, when treated with chlorine gas at the proper temperatures, pass into chlorides. In some cases the chlorine is taken up in two instalments, a lower chloride being produced first, to pass ultimately into a higher chloride. Iron, for instance, is converted first into $FeCl_2$, ultimately into $FeCl_3$, which practically means a mixture of the two chlorides, or pure $FeCl_3$ as a final product. Of the several products, the chlorides of gold and platinum ($AuCl_3$ and $PtCl_4$) are the only ones which when heated beyond their temperature of formation dissociate into metal and chlorine. The ultimate chlorination product of copper, $CuCl_2$, when heated to redness, decomposes into the lower chloride, CuCl, and chlorine. All the rest, when heated by themselves, volatilize, some at lower, others at higher temperatures.

Of the several individual chlorides, the following are liquids or solids, volatile enough to be distilled from glass vessels: $AsCl_3$, $SbCl_3$, $SnCl_4$, $BiCl_3$, $HgCl_2$, the chlorides of arsenic, antimony, tin, bismuth, mercury respectively. The following are readily volatilized in a current of chlorine, at a red heat: $AlCl_3$, $CrCl_3$, $FeCl_3$, the chlorides of aluminium, chromium, iron. The following, though volatile at higher temperatures, are not volatilized at dull redness: KCl, NaCl, LiCl, $NiCl_2$, $CoCl_2$, $MnCl_2$, $ZnCl_2$, $MgCl_2$, $PbCl_2$, AgCl, the chlorides of potassium, sodium, lithium, nickel, cobalt, manganese, zinc, magnesium, lead, silver. Somewhat less volatile than the last-named group are the chlorides (MCl_2) of barium, strontium and calcium.

Metallic chlorides, as a class, are readily soluble in water. The following are the most important exceptions: silver chloride, AgCl, and mercurous chloride, HgCl, are absolutely insoluble; lead chloride, $PbCl_2$, and cuprous chloride, CuCl, are very sparingly soluble in water. The chlorides $AsCl_3$, $SbCl_3$, $BiCl_3$, are at once decomposed by (liquid) water, with formation of oxide (As_2O_3) or oxychlorides (SbOCl, BiOCl) and hydrochloric acid. The chlorides $MgCl_2$, $AlCl_3$, $CrCl_3$, $FeCl_3$, suffer a similar decomposition when evaporated with water in the heat. The same holds in a limited sense for $ZnCl_2$, $CoCl_2$, $NiCl_2$, and even $CaCl_2$. All chlorides, except those of silver and mercury (and, of course, those of gold and platinum), are oxidized by steam at high temperatures, with elimination of hydrochloric acid.

For the characters of metals as chemical elements see the special articles on the different metals.

See generally A. Rossing *Geschichte der Metalle* (1901); B. Neumann, *Die Metalle* (1904); also treatises on chemistry.

METALLOGRAPHY.—The examination of metals and alloys by the aid of the microscope has assumed much importance in comparatively recent years, and it might at first be considered to be a natural development of the use of the microscope in determining the constitution of rocks, a study to which the name petrography has been given. It would appear, however, that it is an extension of the study of the structure of meteoric irons. There can be no question that in the main it was originated by Dr H. C. Sorby, who in 1864 gave the British Association an account of his work. Following the work of Sorby came that of Professor A. Martens of Charlottenburg, presenting many features of originality. F. Osmond has obtained results in connexion with iron and steel which are of the highest interest. A list of the more important papers by these and other workers will be found in the appended bibliography.

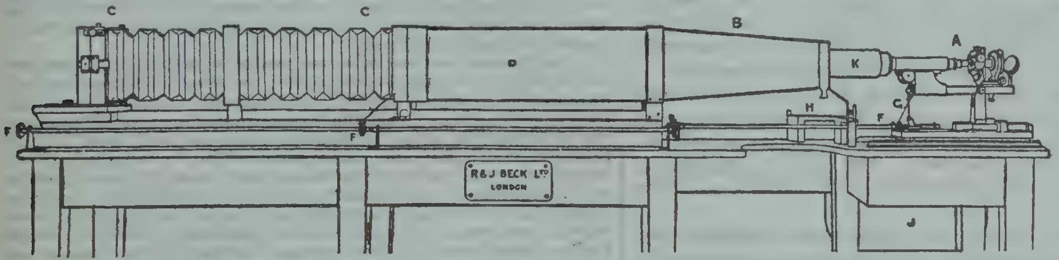
Preparation of the Specimen.—Experience alone can enable the operator to determine what portion of a mass of metal or alloy will afford a trustworthy sample of the whole. In studying a series of binary alloys it has been found advantageous in certain cases to obtain one section which will show in a general way the variation in structure from one end of the series to the other. This has been effected by pouring the lighter constituent carefully on the surface of the heavier constituent, and allowing solidification to take place. A section through the culot so obtained will show a gradation in structure from pure metal on one side to pure metal on the other. A thin slice of metal is usually cut by means of a hack-saw driven by mechanism. The thickness of the piece should not be less than ¼ in. and in order that it may be firmly held between the fingers it should not be less than 1 in. square. The preliminary stages of polishing are effected by emery paper placed preferably on wooden disks capable of being revolved at a high rate of speed. The finest grade of emery paper that can be obtained is used towards the end of the operation. Before use the finer papers should be rubbed with a hard steel surface to remove any coarse particles. The completion of the operation of polishing is generally effected on wet cloth or parchment covered with a small amount of carefully washed jeweller's rouge. Various mechanical appliances are employed to minimize the labour and time required for the polishing. These usually consist of a series of interchangeable revolving disks, each of which is covered with emery paper, cloth or parchment, according to the particular stage of polishing for which it is required. In the case of brittle alloys and of alloys having a very soft constituent, which during polishing tends to spread over and obliterate the harder constituents, polishing is in many cases altogether avoided by casting the alloy on the surface of glass or mica. In this way, with a little care, a perfect surface is obtained, and it is only necessary to develop the structure by suitable etching. In adopting this method, however, instances have occurred in which the removal of the cast surface has shown a structure differing considerably from the original.

Polishing in Bas-Relief.—If the polishing be completed with fine rouge on a sheet of wet parchment, placed upon a comparatively soft base such as a piece of deal, certain soft constituents of an alloy may often be eroded in such a manner as to leave the hardest portions in relief. For the later stages of polishing H. L. Le Chatelier recommends the use of alumina obtained by the calcination of ammonium alum; and for the final polish of soft metals, chromium oxide.

Although in some cases a pattern becomes visible after polishing, yet more frequently a mirror-like surface is produced in which no pattern can be detected, or if there is a pattern it is blurred, as if seen through a veil or mist. This is due to a thin layer of metal which has been dragged, or smeared, uniformly over the whole surface by the friction of the polishing process. Such a surface layer is formed in all cases of polishing, and the peculiar lustre of burnished silver or steel is probably due to this layer. But to the metallographist it is an inconvenience, as it conceals scratches left by imperfect polishing, and also hides the pattern. It is therefore desirable to conduct the polishing so as to make this layer as thin as possible; it is claimed for alumina that it can be so used as to produce a much thinner surface layer than that due to the employment of rouge. The surface layer is very readily removed by appropriate liquid reagents, and, the true surface of the metal having been laid bare, the etching reagent acts differently on the individual substances in the alloy and the pattern can thus be emphasized to any required extent. Osmond divides etching reagents into three classes—acids, halogens and salts. As regards acids, water containing from 2 to 10% of hydrochromic acid is useful. It is made by mixing 10 grams of potassium bichromate with 10 grams of sulphuric acid in 100 grams of water. The use of nitric acid requires much experience. It is frequently employed in the examination of steels, Sir W. C. Roberts-Austen preferred a 1% solution in alcohol, but many workers use concentrated acid, and effect the etching by allowing a stream of water to dilute the film of acid left on the surface of the specimen after dipping it. Of the halogens, iodine is the most useful. A solution in alcohol is applied, so that a single drop covers half a square inch of surface. The specimen is then washed with alcohol, and dried with a piece of fine linen or chamois leather. Tincture of iodine also affords a means of identifying lead in certain alloys by the formation of a yellow iodide of lead, while the vapour of iodine has in certain cases been used to tint the constituents. Thin coloured films may often be produced by the oxidation of the specimen when heated in air. This, as a means of developing the structure, in the case of the copper alloys is specially useful. Tinted crystals may thus be distinguished from the investing layer caused by the presence of a minute quantity of another constituent. The temper colours produced by heating iron or steel in air are well known. Carbide of iron is less oxidizable than the iron with which it is intimately associated, and it assumes a brown tint, while the iron has reached the blue stage. These coloured films may be fixed by covering with thin films of gelatine.

In some cases the alloy may be attacked electrolytically by exposing it for a few minutes to a weak electric current in a bath of very dilute sulphuric acid. Certain organic bodies give very satisfactory results. The Japanese, for instance, produce most remarkable effects by simple reagents of which an infusion of certain forms of grass is a not unimportant constituent. In the case of iron and steel a freshly prepared infusion of liquorice root has been found to be most useful for colouring certain constituents of steel. Osmond, who was the first to use this reagent, insisted that it should be freshly prepared and always used under identical conditions as regards age and concentration. His method of applying it was to rub the specimen on parchment moistened with it, but he has subsequently modified this "polish attack" by substituting a 2% solution of ammonium nitrate for the liquorice infusion. In each case a small quantity of freshly precipitated calcium sulphate is used on the parchment to assist the polishing.

Appliances used in Micrography.—The method of using the microscope in connexion with a camera for photographic purposes will now be considered. Every micrographer has his own views as to the form of an installation to be adopted, and it will therefore be well to give an illustration of a definite apparatus which has been found to give satisfactory results. It consists of a microscope A with a firm base placed in a horizontal position. The microscope can be connected by a tube, B with the expanded camera CC, at the end of which is the usual frame to receive the photographic plate. A practised observer can focus on a plate of clear glass by the aid of a subsidiary low-power microscope lens. If a semi-transparent plate is employed it should be as fine as possible. The surface of the table is cut in such a way near H that the observer who is seated may conveniently examine the object on the stage of the microscope, the portion B turning aside for this purpose. The subsequent focusing is effected by a rod, FFF, and gearing attached to the fine adjustment of the microscope, GA; flap J when raised forms the support of the lamp used for illumination. As an illuminant an arc light has many advantages, as the exposure of the plate used will seldom exceed 10 seconds. The filament of a Nernst lamp can be used as the source of light; though not so brilliant as the arc it possesses the great advantage of perfect immobility. For the best results, especially with high powers, the source of light must be small, so that its image can be focussed on to the surface of the object; this advantage is possessed by both of these illuminants. Next in value comes the acetylene flame, and an incandescent lamp or a gas lamp with a mantle will give good results, but with much longer exposure. Actual illumination is best effected by a Beck vertical illuminator or a Zeiss prism. It is necessary that the lens used for concentrating the light on the illuminator should be an achromatic one, as colour effects cause trouble in photographing the objects. For lower powers the Lieberkuhn parabolic illuminator is useful. Certain groups of alloys show better under oblique illumination, which may be effected by the aid of a good condensing lens, the angle of incidence being limited by the distance of the object from the objective in the case of high magnification. As regards objectives, the most useful are the Zeiss 2 mm., 4 mm. and 24 mm.; two other useful objectives for low powers being 35 mm. and 70 mm., both of which are projecting objectives. A projecting eye-piece, preferably of low power, should be employed with all but the two latter objectives. The immersion lens, the Zeiss 2 mm., is used with specially thickened cedar oil, and if the distance from the objective to the plate is 7 feet, magnifications of over 2000 diameters can easily be obtained. As regards sensitized plates, excellent results have been obtained with Lumière plates sensitive to yellow and green. The various brands of "process" plates are very serviceable where the contrasts on the specimen are not great. Some reproductions of photo-micrographs of metals and alloys will be found in the plate accompanying the article ALLOYS.



Micrographic Apparatus.

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METALLURGY, the art of extracting metals from their ores; the term being customarily restricted to commercial as opposed to laboratory methods. It is convenient to treat electrical processes of extraction as forming the subjects of Electrochemistry and Electrometallurgy (*qq.v.*). The following table enumerates in the order of their importance the metals which our subject at present is understood to include; the second column gives the chemical characters of the ores utilized, italics indicating those of subordinate importance. The term "oxide" includes carbonate, hydrate, and, when marked with*, silicate.

Metal.	Character of Ores.
Iron	Oxides, *sulphide.*
Copper	Complex sulphides, also oxides, *metal.*
Silver	Sulphide and reguline metal, *chloride.*
Gold	Reguline metal.
Lead	Sulphide and basic carbonate, *sulphate,* &c.
Zinc	Sulphide, oxide.*
Tin	Oxide.

Metal.	Character of Ores.
Mercury	Sulphide, reguline metal.
Antimony	Sulphide.
Bismuth	Reguline metal.
Nickel and cobalt	Arsenides.
Platinum, iridium, &c.	Reguline.

General Sequence of Operations.—Occasionally, but rarely, metallic ores occur as practically pure compact masses, from which the accompanying matrix or "gangue" can be detached by hand and hammer. In most cases the "ore" (see MINERAL DEPOSITS; VEINS), as it comes out of the mine or quarry, is simply a mixture of ore proper and gangue, in which the latter not unfrequently predominates. Hence it is generally necessary to purify the ore before the liberation of the metal is attempted. Most metallic ores are specifically heavier than the accompanying impurities and their purification is generally effected by reducing the crude ore to a fine enough powder to detach the metallic from the earthy part, and then washing away the latter by a current of water, as far as possible (see ORE-DRESSING).

The majority of ores being chemical compounds, the extraction of their metals demands chemical treatment. The chemical operations involved may be classified as follows:—

1. *Fiery Operations.*—The ore, generally with some "flux," is exposed to the action of fire. The fire in most cases has a chemical, in addition to its physical, function. Moreover the furnace (*q.v.*) is designed so as to facilitate the action of the heat and furnace gases in the desired direction. It is intended either to burn away certain components of the ore—in which case it must be so regulated as to contain a sufficient excess of unburned oxygen; or it is meant to deoxidize ("reduce") the ore, when the draught must be restricted so as to keep the ore constantly wrapped up in combustible flame gases (carbon monoxide, hydrogen, marsh-gas, &c.). The majority of the chemical operations of metallurgy fall into this category, and in these processes other metal-reducing agents than those naturally contained in the fire (or blast) are only exceptionally employed.

2. *Amalgamation.*—The ore by itself (if it is a reguline one), or with certain reagents (if it is not), is worked up with mercury so that the metal is obtained as an amalgam, which can be separated mechanically from the dross. The purified amalgam is distilled, when the mercury is recovered as a distillate while the metal remains.

3. *Wet Processes.*—Strictly speaking, certain amalgamation methods fall under this head; but, in its ordinary acceptance, the term refers to processes in which the metal is extracted either from the natural ore, or from the ore after roasting or other preliminary treatment, by an acid or salt solution, and from this solution precipitated—generally in the reguline form—by some suitable reagent.

Few methods of metal extraction at once yield a pure product. What as a rule is obtained is a more or less impure metal, which requires to be "refined" to become fit for the market.

Chemical Operations.—Amalgamation and wet-way processes have limited applications, being practically confined to copper, gold and silver. We therefore here confine ourselves, in the main, to pyro-chemical operations.

The method to be adopted for the extraction of a metal from its ore is determined chiefly, though not entirely, by the nature of the non-metallic component with which the metal is combined. The simplest case is that of the reguline ores where there is no non-metallic element. The important case is that of gold.

Oxides, Hydrates, Carbonates and Silicates.—All iron and tin ores proper fall under this heading, which, besides, comprises certain ores of copper, of lead and of zinc. The first step consists in subjecting the crude ore to a roasting or calcining process, the object of which is to remove the water and carbon dioxide, and burn away, to some extent at least, the sulphur, arsenic or organic matter. The residue consists of an impure oxide of the respective metal, which in all cases is reduced by treatment with fuel at a high temperature. Should the metal be present as a silicate, lime must be added in the smelting to remove the silica and liberate the oxide.

The temperature required for the reduction of zinc lies above the boiling point of the metal; hence the mixture of ore and reducing agent (charcoal is generally used) must be heated in a retort combined with condensing apparatus. In all the other cases the reduction is effected in the fire itself, a tower-shaped blast furnace being preferably used. The furnace is charged with alternate layers of fuel and ore (or rather ore and flux, see below), and the whole kindled from below. The metallic oxide, partly by the direct action of the carbon with which it is in contact, but principally by that of the carbon monoxide produced in the lower strata from the oxygen of the blast and the hot carbon there, is reduced to the metallic state; the metal fuses and runs down, with the slag, to the bottom of the furnace, whence both are withdrawn by opening plug-holes.

Sulphides.—Iron, copper, lead, zinc, mercury, silver and antimony very frequently present themselves in this state of combination, as components of a family of ores which may be divided into two sections: (1) such as substantially consist of simple sulphides, as iron pyrites (FeS_2), galena (PbS), zinc blende (ZnS), cinnabar (HgS); and (2) complex sulphides, such as the various kinds of sulphureous copper ores (all substantially compounds or mixtures of sulphides of copper and iron); bournonite, a complex sulphide of lead, antimony and copper; rothgiltigerz, sulphide of silver, antimony and arsenic; fahlerz, sulphides of arsenic and antimony, combined with sulphides of copper, silver, iron, zinc, mercury, silver; and mixtures of these and other sulphides with one another.

In treating a sulphureous ore, the first step as a rule is to subject it to oxidation by roasting it in a reverberatory or other furnace, which leads to the burning away of at least part of the arsenic and part of the sulphur. The effect on the several individual metallic sulphides (supposing only one of these to be present) is as follows:—

1. Those of silver (Ag_2S) and mercury (HgS) yield sulphur dioxide gas and metal; in the case of silver, sulphate is formed at low temperatures. Metallic mercury, in the circumstances, goes off as a vapour, which is collected and condensed; silver remains as a regulus, but pure sulphide of silver is hardly ever worked.

2. Sulphides of iron and zinc yield the oxides Fe_2O_3 and ZnO as final products, some basic sulphate being formed at the earlier stages, especially in the case of zinc. The oxides can be reduced by carbon.

3. The sulphides of lead and copper yield, the former a mixture of oxide and normal sulphate, the latter one of oxide and basic sulphate. Sulphate of lead is stable at a red heat; sulphate of copper breaks up into oxide, sulphur dioxide and oxygen. In practice, neither oxidation process is ever pushed to the end; it is stopped as soon as the mixture of roasting-product and unchanged sulphide contains oxygen and sulphur in the ratio of $O_2 : S$. The access of air is then stopped and the whole heated to a higher temperature, when the whole of the sulphur and oxygen is eliminated. This method is largely utilized in the smelting of lead from galena and of copper from copper pyrites.

4. Sulphide of antimony, when roasted in air, is converted into a kind of alloy of sulphide and oxide; the same holds for iron, only its oxysulphide is quite readily converted into the pure oxide Fe_2O_3 by further roasting. Oxysulphide of antimony, by suitable processes can be reduced to metal, but these processes are rarely used, because the same end is far more easily obtained by "precipitation," *i.e.* withdrawing the sulphur by fusion with metallic iron, forming metallic antimony and sulphide of iron. Both products fuse, but readily part, because fused antimony is far heavier than fused sulphide of iron. A precisely similar method is used occasionally for the reduction of lead from galena. Sulphide of lead, when fused together with metallic iron in the proportion of $2Fe : 1PbS$ yields a regulus ($=1Pb$) and a "mat" Fe_2S, which, however, on cooling, decomposes into the ordinary sulphide FeS, and finely divided iron. What we have been explaining are special cases of a more general metallurgic proposition: Any one of the metals, copper, iron, tin, zinc, lead, silver, antimony, arsenic, in general, is capable of desulphurizing (at least partially) any of the others that follows it in the series just given, and it does so the more readily and completely the greater the number of intervening terms. Hence, supposing a complete mixture of these metals to be melted down under circumstances admitting of only a partial sulphuration of the whole, the copper has the best chance of passing into the "mat," while the arsenic is the first to be eliminated as such, or, in the presence of oxidants, as oxide.

Arsenides.—Although arsenides are amongst the commonest impurities of ores generally, ores consisting essentially of arsenides are comparatively rare. The most important are certain double arsenides of cobalt and nickel, which in practice are always contaminated with the arsenides or other compounds of foreign metals, such as iron, manganese, &c. The general mode of working these ores is as follows. The ore is first roasted by itself, when a part of the arsenic goes off as such and as oxide, while a complex of lower arsenides remains. This residue is now subjected to careful oxidizing fusion in the presence of some solvent for metallic bases. The effect is that the several metals are oxidized away and pass into the slag (as silicates) in the following order—manganese, iron, cobalt, nickel; and at any stage the as yet unoxidized residue of arsenide assumes the form of a fused regulus, which sinks down through the slag as a "speis." (This term has the same meaning in reference to arsenides as "mat" has in regard to sulphides.) By stopping the process at the right moment, we can produce a speis which contains only cobalt and nickel, and if at this stage also the flux is renewed we can further produce a speis which contains only nickel and a slag which substantially is one of cobalt only. The composition of the speises generally varies from $AsMe_{3/2}$ to $AsMe_2$, where "Me" means one atomic weight of metal *in toto*, so that in general $1Me = xFe + yCo + zNi$, where $x + y + z = 1$. The siliceous cobalt is utilized as a blue pigment called "smalt"; the nickel-speis is worked up for metal.

Minor Reagents.—Besides the oxidizing and reducing agents present in the fire, and the "fluxes" added for the production of slags, various minor reagents may be noticed. Metallic iron as a desulphurizer has already been referred to.

Oxide of lead, PbO (litharge), is largely used as an oxidizing agent. At a red heat, when it melts, it readily attacks all metals, except silver and gold, the general result being the formation of a mixed oxide and of a mixed regulus, a distribution, in other words, of both the lead and the metal acted on between slag and regulus. More important is its action on metallic sulphides, which, in general, results in the formation of three things besides sulphur dioxide, viz. a mixed oxide slag including the excess of litharge, a regulus of lead (which may include bismuth and other more readily reducible metals), and, if the litharge is not sufficient for a complete oxidation, a "mat" comprising the more readily sulphurizable metals. Oxide of lead, being a most powerful solvent for metallic oxides generally, is also largely used for the separation of silver or gold from base metallic oxides.

Metallic lead is to metals generally what oxide of lead is to metallic oxides. It accordingly is available as a solvent for taking up small particles of metal diffused throughout a mass of slag, and uniting them into one regulus. This leads us to the process of "cupellation," which serves for the extraction of gold (*q.v.*; see also ASSAYING) and silver from their alloys with base metals.

Fluxes.—All ores are contaminated with more or less gangue, which in general consists of infusible matter, and if left unheeded in the reduction of the metallic part of the ore would retain more or less of the metal disseminated through it, or at best foul the furnace. To avoid this, the ore as it goes into the furnace is mixed with "fluxes" so selected as to convert the gangue into a fusible "slag," which readily runs down through the fuel with the regulus and separates from the latter. The quality and proportion of flux should, if possible, be so chosen that the formation of the slag sets in only after the metal has been reduced and molten; or else part of the basic oxide of the metal to be extracted may be dissolved by the slag and its reduction thus be prevented or retarded. Slags are not a necessary evil; if an ore were free from gangue we should add gangue and flux from without to produce a slag, because one of its functions is to form a layer on the regulus which protects it against the further action of the blast or furnace gases. Fluxes may be arranged under the three heads of (1) fluor-spar, (2) basic fluxes and (3) acid fluxes.

Fluor-spar fuses up at a red heat with silica, sulphates of calcium and barium, and a few other infusible substances into homogeneous masses. It shows little tendency to dissolve basic oxides, such as lime, &c. One part of fluor-spar liquefies about half a part of silica, four parts of calcium sulphate and one and a half parts of barium sulphate. Upon these facts its extremely wide application in metallurgy is founded. Carbonate of soda (or potash) is the most powerful basic flux. It dissolves silica and all silicates into fusible glasses. On the other hand, borax may be taken as a type for the acid fluxes. At a red heat, when it forms a viscid fluid, it readily dissolves all basic oxides into fusible complex borates. Now the gangue of an ore in general consists either of some basic material such as carbonate of lime (or magnesia), ferric oxide, alumina, &c., or of silica (quartz) or some more or less acid silicate, or else of a mixture of the two classes of bodies. So any kind of gangue might be liquefied by means of borax or by means of alkaline carbonate; but neither of the two is used otherwise than for assaying; what the metal-smelter does is to add to a basic gangue the proportion of silica, and to an acid ore the proportion of lime, or, indirectly, of ferrous or perhaps manganous oxide, which it may need for the formation of a slag of the proper qualities. The slag must possess the proper degree of saturation. In other words, taking $SiO_2 + nMeO$ (where MeO means an equivalent of base) as a formula for the potential slag, n must have the proper value. If n is too small, *i.e.* if the slag is too acid, it may dissolve part of the metal to be recovered; if n is too great, *i.e.* the slag too basic, it may refuse to dissolve, for instance, the ferrous oxide which is meant to go into it, and this oxide will then be reduced, and its metal (iron in our example) contaminate the regulus. In reference to the problem under discussion, it is worth noting that oxides of lead and copper are more readily reduced to metals than oxide of iron Fe_2O_3 is to FeO, the latter more readily to FeO than FeO itself to metal, and FeO more readily to metal than manganous oxide is. Oxide of calcium (lime) is not reducible at all. The order of basicity in the oxides (their readiness to go into the slag) is precisely the reverse.

Most slags being, as we have seen, complex silicates, it is a most important problem of scientific metallurgy to determine the relations in this class of bodies between chemical composition on the one hand and fusibility and solvent power for certain oxides (CaO, FeO, Fe_2O_3, Al_2O_3, SiO_2, &c.) on the other. Their general composition may be expressed as $n(MO+xSiO_2)+m[(fe \text{ or } al)O + xSiO_2]$ ($M=Ca$, Mg, Fe, K_2, &c.; $fe=\frac{2}{3}Fe$, $al=\frac{2}{3}Al$.) The following mode of classifying and naming composition in silicates is metallurgical; scientific chemists designate Class I. as orthosilicates, Class II. as metasilicates, Class III. as sesquisilicates. In the formulae M stands for K_2, Ca, Fe, &c., or for $al=\frac{2}{3}Al$, $fe=\frac{2}{3}Fe$, &c.

Name.	Formula.	Oxygen Ratio.			x
		Base.		Acid.	
I. Singulo-silicates .	$\frac{1}{2}SiO_2+1MO$	1	:	1	$\frac{1}{2}$
II. Bi-silicates . .	$1SiO_2+1MO$	1	:	2	1
III. Tri-silicates . .	$\frac{3}{2}SiO_2+1MO$	1	:	3	$\frac{3}{2}$

It should be possible to represent each quality of a silicate as a function of x, n/m, and of the nature of the individual bases that make up the MO and (fe or al) O respectively. Our actual knowledge falls far short of this possibility. The problem, in fact, is very difficult, the more so as it is complicated by the existence of aluminates, compounds such as $Al_2O_3 . 3CaO$, in which the alumina plays the part of acid, and the occasional existence of compounds of fluorides and silicates in certain slags. The formation of slags, or, what comes to the same thing, of metallic silicates, was especially studied by Percy, Smith, Bischof, Plattner and others, and in more recent times by Vogt, Doelter, and at the Geophysical laboratory of the Carnegie Institution, Washington.

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METAL-WORK. Among the many stages in the development of primeval man, none can have been of greater moment in his struggle for existence than the discovery of the metals, and the means of working them. The names generally given to the three prehistoric periods of man's life on the earth—the Stone, the Bronze and the Iron age—imply the vast importance of the progressive steps from the flint knife to the bronze celt, and lastly to the keen-edged elastic iron weapon or tool.

The metals chiefly used in the arts have been gold, silver, copper and tin (the last two generally mixed, forming an alloy called bronze), iron and lead (see the separate articles on these metals). Their peculiarities have naturally marked out each of them for special uses and methods of treatment. The durability and the extraordinary ductility and pliancy of gold, its power of being subdivided, drawn out or flattened into wire or leaf of almost infinite fineness, have led to its being used for works where great minuteness and delicacy of execution were required; while its beauty and rarity have, for the most part, limited its use to objects of adornment and luxury, as distinct from those of utility. In a lesser degree most of the qualities of gold are shared by silver, and consequently the treatment of these two metals has always been very similar, though the greater abundance of the latter metal has allowed it to be used on a larger scale and for a greater variety of purposes. The great fluidity of bronze when melted, the slightness of its contraction on solidifying, together with its density and hardness, make it especially suitable for casting, and allow of its taking the impress of the mould with extreme sharpness and delicacy. In the form of plate it can be tempered and annealed till its elasticity and toughness are much increased, and it can then be formed into almost any shape under the hammer and punch. By other methods of treatment, known to the ancient Egyptians, Greeks and others, but now forgotten, it could be hardened and formed into knife and razor edges of the utmost keenness. In many specimens of ancient bronze, small quantities of silver, lead and zinc have been found, but their presence is probably accidental. In modern times brass has been much used, chiefly for the sake of its cheapness as compared with bronze. In beauty, durability and delicacy of surface it is very inferior to bronze, and, though of some commercial importance, has been of but little use in the production of works of art. To some extent copper was used in an almost pure state during medieval times, especially from the 12th to the 15th century, mainly for objects of ecclesiastical use, such as pyxes, monstrances, reliquaries and croziers, partly on account of its softness under the tool, and also because it was slightly easier to apply enamel and gilding to pure copper than to bronze (see fig. 1). In the medieval period it was used to some extent in the shape of thin sheeting for roofs, as at St Mark's, Venice; while during the 16th and 17th centuries it was largely employed for ornamental domestic vessels of various sorts.

Iron.[1]—The abundance in which iron is found in so many places, its great strength, its remarkable ductility and malleability in a red-hot state, and the ease with which two heated surfaces of iron can be welded together under the hammer combine to make it specially suitable for works on a large scale where strength with lightness are required—things such as screens, window-grills, ornamental hinges and the like. In its hot plastic state iron can be formed and modelled under the hammer to almost any degree of refinement, while its great strength allows it to be beaten out into leaves and ornaments of almost paper-like thinness and delicacy. With repeated hammering, drawing out and annealing, it gains much in strength and toughness, and the addition of a very minute quantity of carbon converts it into steel, less tough, but of the keenest hardness. The large employment of cast iron is comparatively modern, in England at least only dating from the 16th century; it is not, however, incapable of artistic treatment if due regard be paid to the necessities of casting, and if no attempt is made to imitate the fine-drawn lightness to which wrought iron so readily lends itself. At the best, however, it is not generally suited for the finest work, as the great contraction of iron in passing from the fluid to the solid state renders the cast somewhat blunt and spiritless.

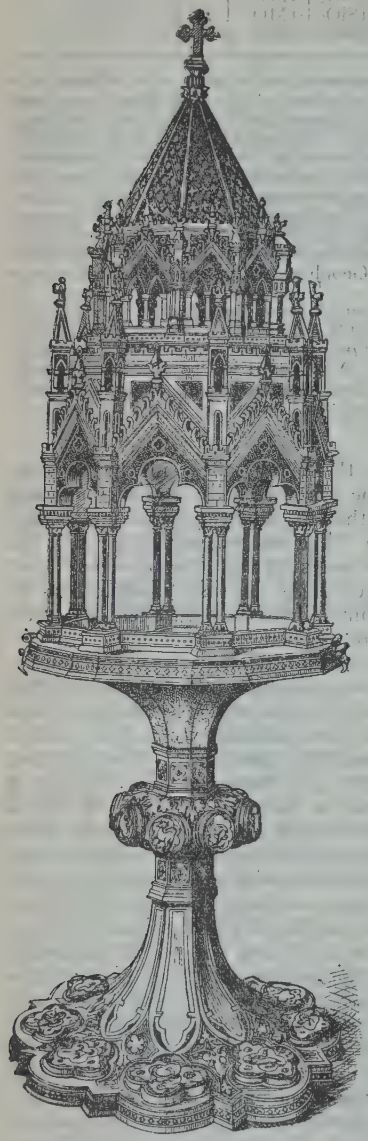

FIG. 1.—Monstrance of Copper Gilt; Italian work of the 15th century.

Among the Assyrians, Egyptians and Greeks the use of iron, either cast or wrought, was very limited, bronze being the favourite metal almost for all purposes. The difficulty of smelting the ore was probably one reason for this, as well as the now forgotten skill which enabled bronze to be tempered to a steel-like edge. It had, however, its value, of which a proof occurs in Homer (*Il.* xxiii.), where a mass of iron is mentioned as being one of the prizes at the funeral games of Patroclus.

Methods of Manipulation in Metal-Work.—Gold, silver and bronze may be treated in various ways, the chief of which are (1) casting in a mould, and (2) treatment by hammering and punching (Fr. *repoussé*).

The first of these, casting is chiefly adapted for bronze, or in the case of the more precious metals only if they are used on a very small scale. The reason of this is that a repoussé relief is of much thinner substance than if the same design were cast, even by the most skilful metal-worker, and so a large surface may be produced with a very small expenditure of valuable metal. Casting is probably the most primitive method of metal-work. This has passed through three stages, the first being represented by solid castings, such as are most celts and other implements of the prehistoric time; the mould was formed of clay, sand or stone, and the fluid metal was poured in till the hollow was full. The next stage was, in the case of bronze, to introduce an iron core, probably to save needless expenditure of the more valuable metal. The British Museum possesses an interesting Etruscan or Archaic Italian example of this primitive device. It is a bronze statuette from Sessa on the Volturno, about 2 ft. high, of a female standing, robed in a close-fitting chiton. The presence of the iron core has been made visible by the splitting of the figure, owing to the unequal contraction of the two metals. The forearms, which are extended, have been cast separately and soldered or brazed on to the elbows. The third and last stage in the progress of the art of casting was the employment of a core, generally of clay, round which the metal was cast in a mere skin, only thick enough for strength, without waste of metal. The Greeks and Romans attained to the greatest possible skill in this process. Their exact method is not certainly known, but it appears probable that they were acquainted with the process now called *à cire perdue*—the same as that employed by the great Italian artists in bronze. Cellini, the great Florentine artist of the 16th century, has described it fully in his *Trattato della Scultura*. If a statue was to be cast, the figure was first roughly modelled in clay—only rather smaller in all its dimensions than the future bronze; all over this a skin of wax was laid, and worked by the sculptor with modelling tools to the required form and finish. A mixture of pounded brick, clay and ashes was then ground finely in water to the consistence of cream, and successive coats of this mixture were then applied with a brush, till a second skin was formed all over the wax, fitting closely into every line and depression of the modelling. Soft clay was then carefully laid on to strengthen the mould, in considerable thickness, till the whole statue appeared like a shapeless mass of clay, round which iron hoops were bound to hold it all together. The whole was then thoroughly dried, and placed in a hot oven, which baked the clay, both of the core and the outside mould, and melted the wax, which was allowed to run out from small holes made for the purpose. Thus a hollow was left, corresponding to the skin of wax between the core and the mould, the relative positions of which were preserved by various small rods of bronze, which had previously been driven through from the outer mould to the rough core. The mould was now ready, and melted bronze was poured in till the whole space between the core and the outer mould was full. After slowly cooling, the outer mould was broken away from outside the statue and the inner core as much as possible broken up and raked out through a hole in the foot or some other part of the statue. The projecting rods of bronze were then cut away, and the whole finished by rubbing down and polishing over any roughness or defective places. The most skilful sculptors, however, had but little of this after-touching to do, the final modelling and even polish which they had put upon the wax being faithfully reproduced in the bronze casting. The further enrichment of the object by enamels and inlay of other metals was practised at a very early period by Assyrian, Egyptian and Greek metal-workers, as well as by the artists of Persia and medieval Europe.

The second chief process, that of hammered work (Gr. σφυρήλατος; Fr. *repoussé*), was probably adopted for bronze-work on a large scale before the art of forming large castings was discovered. In the most primitive method thin plates of bronze were hammered over a wooden core, rudely cut into the required shape, the core serving the double purpose of giving shape to and strengthening the thin metal. A further development in the art of hammered work consisted in laying the metal plate on a soft and elastic bed of cement made of pitch and pounded brick. The design was then beaten into relief from the back with hammers and punches, the pitch bed yielding to the protuberances which were thus formed, and serving to prevent the punch from breaking the metal into holes. The pitch was then melted away from the front of the embossed relief, and applied in a similar way to the back, so that the modelling could be completed on the face of the relief, the final touches being given by the graver. This process was chiefly applied by medieval artists to the precious metals, but by the Assyrians, Greeks and other early nations it was largely used for bronze. The great gates of Shalmaneser II., 858–823 B.C., from Balawat, now in the British Museum, are a remarkable example of this sort of work on a large scale, though the treatment of the reliefs is minute and delicate. The "Siris bronzes," in the same museum, are a most astonishing example of the skill attained by Greek artists in this repoussé work (see Brönsted's *Bronzes of Siris*, 1836). They are a pair of shoulder-pieces from a suit of bronze armour, and each has in very high relief a combat between a Greek warrior and an Amazon. No work of art in metal has probably ever surpassed these little figures for beauty, vigour and expression, while the skill with which the artist has beaten these high reliefs out of a flat plate of metal appears almost miraculous. The heads of the figures are nearly detached from the ground, their substance is little thicker than paper, and yet in no place has the metal been broken through by the punch. They are probably of the school of Praxiteles, and date from the 4th century B.C. (see fig. 2).

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[1] Analyses of the iron of prehistoric weapons have brought to light the interesting fact that many of these earliest specimens of iron manufacture contain a considerable percentage of nickel. This special alloy does not occur in any known iron ores, but is invariably found in meteoric iron. It thus appears that iron was manufactured from meteorolites which had fallen to the earth in an almost pure metallic state, possibly long before prehistoric man had learnt how to dig for and smelt iron in any of the forms of ore which are found on this planet.

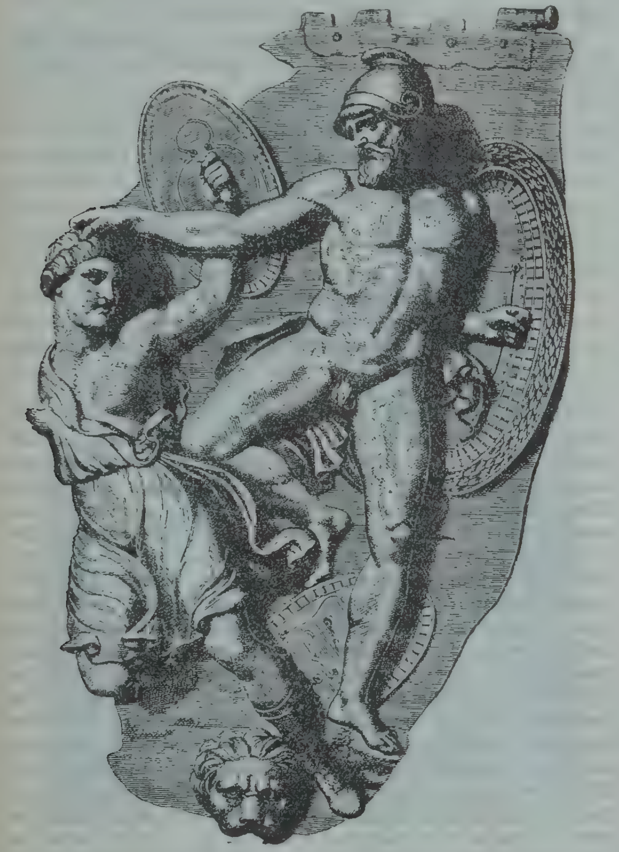


FIG. 2.—One of the Siris Bronzes.

Copper and tin have been but little used separately. Copper in its pure state may be worked by the same methods as bronze, but it is inferior to it in hardness, strength and beauty of surface. Tin is too weak and brittle a metal to be employed alone for any but small objects. Some considerable number of tin drinking-cups and bowls of the Celtic period have been found in Cornwall in the neighbourhood of the celebrated tin and copper mines, which have been worked from a very early period. The use of lead has been more extended. In sheets it forms the best of all coverings for roofs and even spires. In the Roman and medieval periods it was largely used for coffins, which were often richly ornamented with cast work in relief. Though fusible at a very low temperature, and very soft, it has great power of resisting decay from damp or exposure. Its most important use in an artistic form has been in the shape of baptismal fonts, chiefly between the 11th and the 14th centuries. The superior beauty of colour and durability of old specimens of lead is owing to the natural presence of a small proportion of silver. Modern smelters carefully extract this silver from the lead ore, thereby greatly impairing the durability and beauty of the metal.

As in almost all the arts, the ancient Egyptians excelled in their metal-work, especially in the use of bronze and the precious metals. These were worked by casting and hammering, and ornamented by inlay, gilding and enamels with the greatest possible skill. From Egypt perhaps was derived the early skill of the Hebrews. Further instruction in the art of metal-working came probably to the Jews from the neighbouring country of Tyre. The description of the great gold lions of Solomon's throne, and the laver of cast bronze supported on figures of oxen, shows that the artificers of that time had overcome the difficulties of metal-working and founding on a large scale. The Assyrians were perhaps the most remarkable of all ancient nations for the colossal size and splendour of their works in metal; whole circuit walls of great cities, such as Ecbatana, are said to have been covered with metal plates, gilt or silvered. Herodotus, Athenaeus and other Greek and Roman writers have recorded the enormous number of colossal statues and other works of art for which Babylon and Nineveh were so famed. The numerous objects of bronze and other metals brought to light by the excavations in the Tigris and Euphrates valleys, though mostly on a small scale, bear witness to the great skill and artistic power of the people who produced them; while the discovery of some bronze statuettes, shown by inscriptions on them to be not later than 2200 B.C., proves how early was the development of this branch of art among the people of Assyria.

The Metal-Work of Greece.—The early history of metal-working in Greece is extremely obscure, and archaeologists are divided in opinion even on so important a question as the relative use of bronze and iron in the Homeric age. The evidence of Mycenaean remains, as compared with the literary evidence of Homer, is both inadequate and inconclusive (see AEGEAN CIVILIZATION; GREEK ART; ARMS AND ARMOUR, *Ancient*; PLATE; &c.). The poems of Homer are full of descriptions of elaborate works in bronze, gold and silver, which, even when full allowance is made for poetic fancy, show clearly enough very advanced skill in the working and ornamenting of these metals. Homer's description of the shield of Achilles, made of bronze, enriched with bands of figure reliefs in gold, silver and tin, could hardly have been written by a man who had not some personal acquaintance with works in metal of a very elaborate kind. Again, the accuracy of his descriptions of brazen houses—such as that of Alcinous, *Od.* vii. 81—is borne witness to by Pausanias's mention of the bronze temple of Athena Χαλκίοικος in Sparta, and the bronze chamber dedicated to Myron in 648 B.C., as well as by the discovery of the stains and bronze nails, which show that the whole interior of the so-called treasury of Atreus at Mycenae was once covered with a lining of bronze plates. Of the two chief methods of working bronze, gold and silver, it is probable that the hammer process was first practised, at least for statues, among the Greeks, who themselves attributed the invention of the art of hollow casting to Theodorus and Rhoecus, both Samian sculptors, about the middle of the 6th century B.C. Pausanias specially mentions that one of the oldest statues he had ever seen was a large figure of Zeus in Sparta, made of hammered bronze plates riveted together. With increased skill in large castings, and the discovery of the use of cores, by which the fluid bronze was poured into a mere skin-like cavity, hammered or repoussé work was only used in the case of small objects in which lightness was desirable, or for the precious metals in order to avoid large expenditure of metal. The colossal statues of ivory and gold by Pheidias were the most notable examples of this use of gold, especially his statue of Athena in the Parthenon, and the one of Zeus at Olympia. The nude parts, such as face and hands, were of ivory, while the armour and drapery were of beaten gold. The comparatively small weight of gold used by Pheidias is very remarkable when the great size of the statues is considered.

A graphic representation of the workshop of a Greek sculptor in bronze is given on a fictile vase in the Berlin Museum (see Gerhard's *Trinkschalen*, plates xii., xiii.). One man is raking out the fire in a high furnace, while another behind is blowing the bellows. Two others are smoothing the surface of a statue with scraping tools, formed like a strigil. A fourth is beating the arm of an unfinished figure, the head of which lies at the workman's feet. Perhaps the most important of early Greek works in cast bronze, both from its size and great historical interest, is the bronze pillar (now in the Hippodrome at Constantinople) which was erected to commemorate the victory of the allied Greek states over the Persians at Plataea in 479 B.C. (see Newton's *Travels in the Levant*). It is in the form of three serpents twisted together, and before the heads were broken off was at least 20 ft. high. It is cast hollow, all in one piece, and has the names of the allied states engraved on the lower part of the coils. Its size and the beauty of its surface show great technical skill in the founder's art. On it once stood the gold tripod dedicated to Apollo as a tenth of the spoils. It is described by both Herodotus and Pausanias.

Marble was comparatively but little used by the earlier Greek sculptors, and even Myron, a rather older man than Pheidias, seems to have executed nearly all his most important statues in metal. Additional richness was given to Greek bronze-work by gold or silver inlay on lips, eyes and borders of the dress; one remarkable statuette in the British Museum has eyes inlaid with diamonds and fret-work inlay in silver on the border of the chiton. The mirrors of the Greeks are among the most important specimens of their artistic metal-work. These are bronze disks, one side polished to serve as a reflector, and the back ornamented with engraved outline drawings, often of great beauty (see Gerhard, *Etruskische Spiegel*, 1843–1867). In metal-work, as in other arts, the Romans were pupils and imitators of the Greeks. Owing to the growth of the spirit of luxury, a considerable demand arose for magnificent articles of gold and silver plate. The finest specimens of these that still exist are the very beautiful set of silver plate found buried near Hildesheim in 1869, now in the Berlin Museum. They consist of drinking vessels, bowls, vases, ladles and other objects of silver, parcel-gilt, and exquisitely decorated with figures in relief, both cast and repoussé. There are electrotypes of these in the Victoria and Albert Museum. When the seat of the empire was changed, Byzantium became the chief centre for the production of artistic metal-work. From Byzantium the special skill in this art was transmitted in the 9th and 10th centuries to the Rhenish provinces of Germany and to Italy, and thence to the whole of western Europe; in this way the 18th century smith who wrought the Hampton Court iron gates was the heir to the mechanical skill of the ancient metal-workers of Phoenicia and Greece. In that period of extreme degradation into which all the higher arts fell after the destruction of the Roman Empire, though true feeling for beauty and knowledge of the subtleties of the human form remained for centuries almost dormant, yet at Byzantium at least there still survived great technical skill and power in the production of all sorts of metal-work. In the age of Justinian (first half of the 6th century) the great church of St Sophia at Constantinople was adorned with an almost incredible amount of wealth and splendour in the form of screens, altars, candlesticks and other ecclesiastical furniture made of massive gold and silver.

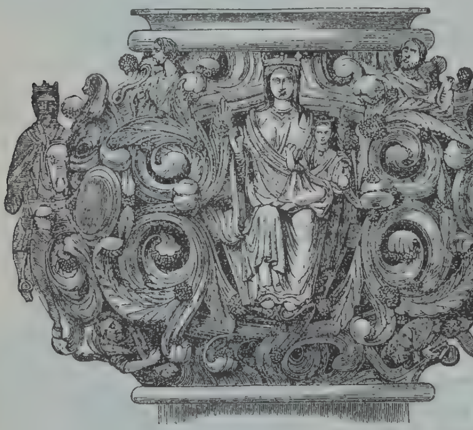


FIG. 3.—Boss from the Milanese Candelabrum.

Metal-Work in Italy.—It was therefore to Byzantium that Italy turned for metal-workers, and especially for goldsmiths, when, in the 6th to the 8th centuries, the basilica of St Peter's in Rome was enriched with masses of gold and silver for decorations and fittings, the gifts of many donors from Belisarius to Leo III., the mere catalogue of which reads like a tale from the *Arabian Nights*. The gorgeous Pala d'oro, still in St Mark's at Venice, a gold retable covered with delicate reliefs and enriched with enamels and jewels, was the work of Byzantine artists during the 11th century. This work was in progress for more than a hundred years, and was set in its place in 1106 A.D., though still unfinished (see Bellomo, *Pala d'oro di St Marco*, 1847). It was, however, especially for the production of bronze doors for churches, ornamented with panels of cast work in high relief, that Italy obtained the services of Byzantine workmen (see Garrucci, *Arte cristiana*, 1872–1882). One artist, named Staurachios, produced many works of this class, some of which still exist, such as the bronze doors of the cathedral at Amalfi, dated 1066 A.D. Probably by the same artist, though his name was spelled differently, were the bronze doors of San Paolo fuori le Mura, Rome, careful drawings of which exist, though the originals were destroyed in the fire of 1824. Other important examples exist at Ravello (1197), Salerno (1099), Amalfi (1062), Atrani (1087); and doors at Monreale in Sicily and at Trani, signed by an artist named Barisanos (end of the 12th century); the reliefs on these last are remarkable for expression and dignity, in spite of their early rudeness of modelling and ignorance of the human figure. Most of these works in bronze were enriched with fine lines inlaid in silver, and in some cases with a kind of niello or enamel. The technical skill of these Byzantine metal-workers was soon acquired by native Italian artists, who produced many important works in bronze similar in style and execution to those of the Byzantine Greeks. Such, for example, are the bronze doors of San Zenone at Verona (unlike the others, of repoussé not cast work); those of the Duomo of Pisa, cast in 1180 by Bonannus, and of the Duomo of Troia, the last made in the beginning of the 12th century by Oderisius of Benevento. Another artist, named Roger of Amalfi, worked in the same way; and in the year 1219 the brothers Hubertus and Petrus of Piacenza cast the bronze door for one of the side chapels in San Giovanni in Laterano. One of the most important early specimens of metal-work is the gold and silver altar of Sant' Ambrogio in Milan. In character of work and design it resembles the Venice Pala d'Oro, but is still earlier in date, being a gift to the church from Archbishop Angilbert II. in 835 A.D. (see Du Sommerard, and D'Agincourt, *Moyen Âge*). It is signed WOLVINIVS MAGISTER PHABER; nothing is known of the artist, but he probably belonged to the semi-Byzantine school of the Rhine provinces; according to Dr Rock he was an Anglo-Saxon goldsmith. It is a very sumptuous work, the front of the altar being entirely of gold, with repoussé reliefs and cloisonné enamels; the back and ends are of silver, with gold ornaments. On the front are figures of Christ and the twelve apostles; the ends and back have reliefs illustrating the life of St Ambrose.

The most important existing work of art in metal of the 13th century is the great candelabrum now in Milan Cathedral. It is of gilt bronze, more than 14 ft. high; it has seven branches for candles, and its upright stem is supported on four winged dragons. For delicate and spirited execution, together with refined gracefulness of design, it is unsurpassed by any similar work of art. Every one of the numerous little figures with which it is adorned is worthy of study for the beauty and expression of the face, and the dignified arrangement of the drapery (see fig. 3). The semi-conventional open scroll-work of branches and fruit which wind around and frame each figure or group is devised with the most perfect taste and richness of fancy, while each minute part of this great piece of metal-work is finished with all the care that could have been bestowed on the smallest article of gold jewellery. Though something in the grotesque dragons of the base recalls the Byzantine school, yet the beauty of the figures and the keen feeling for graceful curves and folds in the drapery point to a native Italian as being the artist who produced this wonderful work of art. There is a cast in the Victoria and Albert Museum.

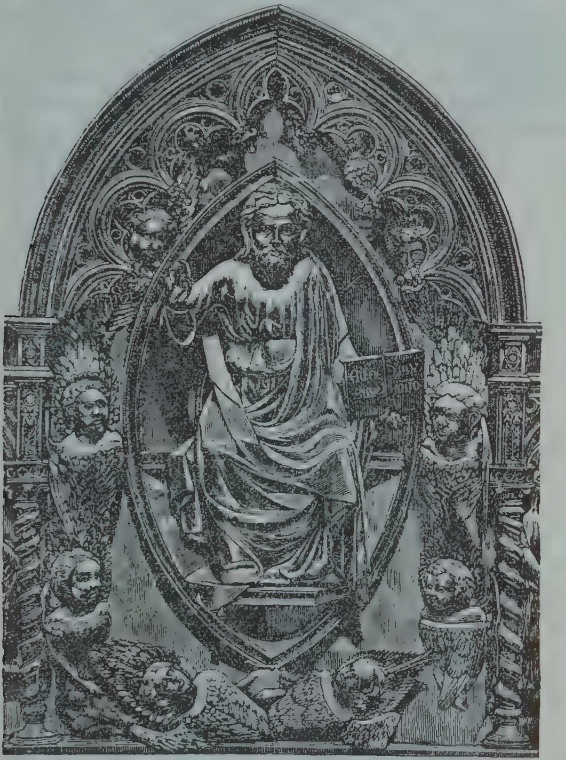


Fig. 4.—Silver Repoussé Reliefs from the Pistoia Retable.

During the 13th and 14th centuries in Italy the widespread influence of Niccola Pisano and his school encouraged the sculptor to use marble rather than bronze for his work. At this period wrought iron came into general use in the form of screens for chapels and tombs, and grills for windows. These are mostly of great beauty, and show remarkable skill in the use of the hammer, as well as power in adapting the design to the requirements of the material. Among the finest examples of this sort of work are the screens round the tombs of the Scala family at Verona, 1350–1375,—a sort of network of light cusped quatrefoils, each filled up with a small ladder (scala) in allusion to the name of the family. The most elaborate specimen of this wrought work is the screen to the Rinuccini chapel in Santa Croce, Florence, of 1371, in which moulded pillars and window-like tracery have been wrought and modelled by the hammer with extraordinary skill (see Wyatt, *Metal-Work of Middle Ages*). Of about the same date are the almost equally magnificent screens in Sta Trinita, Florence, and at Siena across the chapel in the Palazzo Pubblico. The main part of most of these screens is filled in with quatrefoils, and at the top is an open frieze formed of plate iron pierced, repoussé, and enriched with engraving. In the 14th century great quantities of objects for ecclesiastical use were produced in Italy. The silver altar of the Florence baptistery was begun in the first half of the 14th century, and not completed till after 1477 (see *Gaz. des beaux-arts*, Jan. 1883). The greatest artists in metal laboured on it in succession, among them Orcagna, Ghiberti, Verrocchio, Ant. Pollaiuolo and many others. It has elaborate reliefs in repoussé work, cast canopies and minute statuettes, with the further enrichment of translucent coloured enamels. The silver altar and retable of Pistoia Cathedral (see fig. 4), and the great shrine at Orvieto, are works of the same class, and of equal importance.

Whole volumes might be devoted to the magnificent works in bronze produced by the Florentine artists of this century, works such as the baptistery gates by Ghiberti, the statues of Verrocchio, Donatello and many others, the bronze screen in Prato cathedral by Simone, brother of Donatello, in 1444–1461, and the screen and bronze ornaments of the tomb of Piero and Giovanni dei Medici in San Lorenzo, Florence, by Verrocchio, in 1472. At the latter part of the 15th century and the beginning of the 16th the Pollaiuoli, Ricci and other artists devoted much labour and artistic skill to the production of candlesticks and smaller objects of bronze, such as door-knockers, many of which are works of the greatest beauty. The candlesticks in the Certosa near Pavia, and in the cathedrals of Venice and Padua, are the finest examples of these. Niccolò Grossi, who worked in wrought iron under the patronage of Lorenzo dei Medici, produced some wonderful specimens of metal-work, such as the candlesticks, lanterns, and rings fixed at intervals round the outside of the great palaces (see fig. 5). The Strozzi palace in Florence and the Palazzo del Magnifico at Siena have fine specimens of these — the former of wrought iron, the latter in cast bronze. At Venice fine work in metal, such as salvers and vases, was being produced, of almost Oriental design, and in some cases the work of resident Arab artificers. In the 16th century Benvenuto Cellini was supreme for skill in the production of enamelled jewellery, plate and even larger works of sculpture (see Plon's *Ben. Cellini*, 1882), and Giovanni de Bologna in the latter part of the same century inherited to some extent the skill and artistic power of the great 15th-century artists.

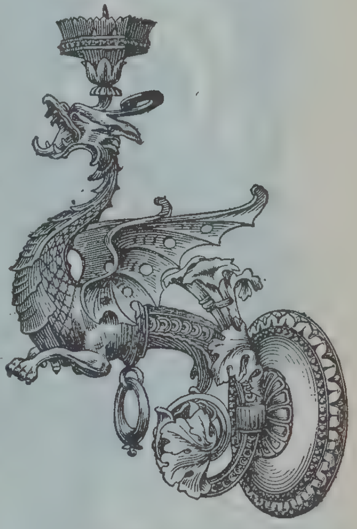


Fig. 5.—Wrought-iron Candle Pricket; late 15th-century. Florentine work.

Spain.—From a very early period the metal-workers of Spain have been distinguished for their skill, especially in the use of the precious metals. A very remarkable set of specimens of goldsmith's work of the 7th century are the eleven votive crowns, two crosses and other objects found in 1858 at Guarrazar, and now preserved at Madrid and in Paris in the Cluny Museum (see Du Sommerard, *Musée de Cluny*, 1852). Magnificent works in silver, such as shrines, altar crosses and church vessels of all kinds, were produced in Spain from the 14th to the 16th century—especially a number of sumptuous tabernacles (*custodia*) for the host, magnificent examples of which still exist in the cathedrals of Toledo and Seville. The bronze and wrought-iron screens—*rejas*, mostly of the 15th and 16th centuries—to be found in almost every important church in Spain are very fine examples of metal-work. They generally have moulded rails or balusters, and rich friezes of pierced and repoussé work, the whole being often thickly plated with silver. The common use of metal for pulpits is a peculiarity of Spain; they are sometimes of bronze, as the pairs in Burgos and Toledo cathedrals, or in wrought iron, like those at Zamora and in the church of San Gil, Burgos. The great candelabrum or *tenebrarium* in Seville Cathedral is the finest specimen of 16th-century metal-work in Spain; it was mainly the work of Bart. Morel in 1562. It is of cast bronze enriched with delicate scroll-work foliage, and with numbers of well-modelled statuettes. Especially in the art of metal-work Spain was much influenced in the 15th and 16th centuries by both Italy and Germany, so that numberless Spanish objects produced at that time owe little or nothing to native designers. At an earlier period Arab and Moorish influence is no less apparent.

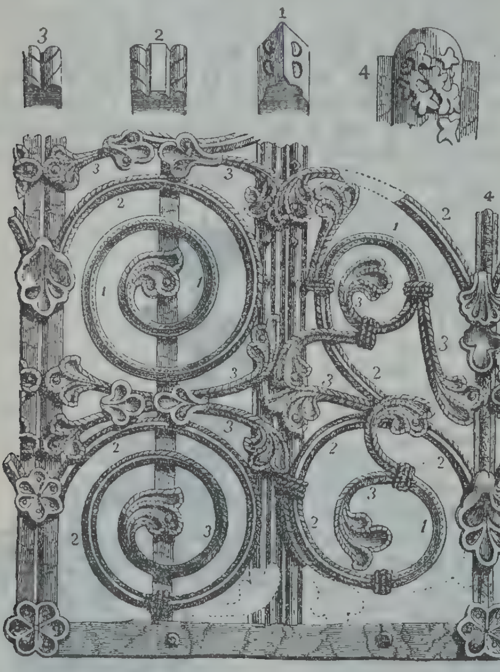


FIG. 6.—Part of the "Eleanor Grill."

England.—In Saxon times the English metal-workers, especially of the precious metals, possessed great skill, and appear to have produced shrines, altar-frontals, retables and other ecclesiastical furniture of considerable size and magnificence. Dunstan, archbishop of Canterbury (925–988), like Bernward, bishop of Hildesheim a few years later, and St Eloi of France three centuries earlier, was himself a skilful worker in all kinds of metal. The description of the gold and silver retable given to the high altar of Ely by Abbot Theodwin in the 11th century, shows it to have been a large and elaborate piece of work decorated with many reliefs and figures in the round. In 1241 Henry III. gave the order for the great gold shrine to contain the bones of Edward the Confessor. It was the work of members of the Otho family, among whom the goldsmith's and coiner's crafts appear to have been long hereditary. Countless other imporant works in the precious metals adorned every abbey and cathedral church in the kingdom. In the 13th century the English workers in wrought iron were especially skilful. The grill over the tomb of Queen Eleanor at Westminster, by Thomas de Leghton, made about 1294, is a remarkable example of skill in welding and modelling with the hammer (see fig. 6). The rich and graceful iron hinges, made often for small and out-of-the-way country churches, are a large and important class in the list of English wrought-iron work. Those on the refectory door of Merton College, Oxford, are a beautiful and well-preserved example dating from the 14th century. More mechanical in execution, though still very rich in effect, is that sort of iron tracery work produced by cutting out patterns in plate, and superimposing one plate over the other, so as to give richness of effect by the shadows produced by these varying planes. The screen by Henry V.'s tomb at Westminster is a good early specimen of this kind of work. The screen to Bishop West's chapel at Ely, and that round Edward VI.'s tomb at Windsor, both made towards the end of the 15th century, are the most magnificent English examples of wrought iron; and much wrought-iron work of great beauty was produced at the beginning of the 18th century, especially under the superintendence of Sir Christopher Wren (see Ebbetts, *Iron Work of 17th and 18th Centuries*, 1880). Large flowing leaves of acanthus and other plants were beaten out with wonderful spirit and beauty of curve. The gates from Hampton Court are the finest examples of this class of work (see fig. 7).

From an early period bronze and latten (a variety of brass) were much used in England for the smaller objects both of ecclesiastical and domestic use, but except for tombs and lecterns were but little used on a large scale till the 16th century. The full-length recumbent effigies of Henry III. and Queen Eleanor at Westminster, cast in bronze by the "cire perdue" process, and thickly gilt, are equal, if not superior, in artistic beauty to any sculptor's work of the same period (end of the 13th century) that was produced in Italy or elsewhere. These effigies are the work of an Englishman named William Torel. The gates to Henry VII.'s chapel, and the screen round his tomb at Westminster (see fig. 8), are very elaborate and beautiful examples of "latten" work, showing the greatest technical skill in the founder's art. In latten also were produced the numerous monumental brasses of which a large number still exist in England (see BRASSES, MONUMENTAL).

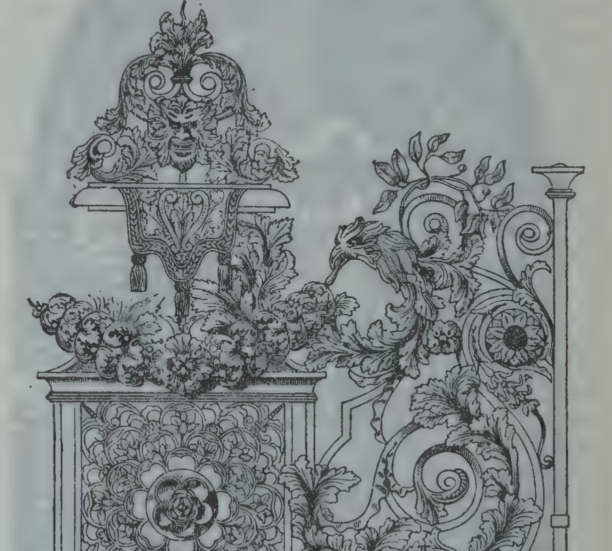


FIG. 7.—Part of one of the Hampton Court Gates.

In addition to its chief use as a roof covering, lead was sometimes used in England for making fonts, generally tub-shaped, with figures cast in relief. Many examples exist: *e.g.* at Tidenham, Gloucestershire; Warborough and Dorchester Oxon; Chirton, Wilts; and other places.

Germany.—Unlike England, Germany in the 10th and 11th centuries produced large and elaborate works in cast bronze, especially doors for churches, much resembling the contemporary doors made in Italy under Byzantine influence. Bernward, bishop of Hildesheim, 992–1022, was especially skilled in this work, and was much influenced in design by a visit to Rome in the suite of Otho III. The bronze column with winding reliefs now at Hildesheim was the result of his study of Trajan's column, and the bronze door which he made for his own cathedral shows classical influence, especially in the composition of the drapery of the figures in the panels. The bronze doors of Augsburg (1047–1072) are similar in style. The bronze tomb of Rudolph of Swabia in Merseburg Cathedral (1080) is another fine work of the same school. The production of works in gold and silver was also carried on vigorously in Germany. The shrine of the three kings at Cologne is the finest surviving example. At a later time Augsburg and Nuremberg were the chief centres for the production of artistic works in the various metals. Hermann Vischer, in the 15th century, and his son and grandsons were very remarkable as bronze founders. The font at Wittenberg, decorated with reliefs of the apostles, was the work of the elder Vischer, while Peter and his son produced, among other important works, the shrine of St Sebald at Nuremberg, a work of great finish and of astonishing richness of fancy in its design. The tomb of Maximilian I., and the statues round it, at Innsbruck, begun in 1521, are perhaps the most meritorious German work of this class in the 16th century, and show considerable Italian influence. In wrought iron the German smiths, especially during the 15th century, greatly excelled. Almost peculiar to Germany is the use of wrought iron for grave-crosses and sepulchral monuments, of which the Nuremberg and other cemeteries contain fine examples. Many elaborate well-canopies were made in wrought iron, and gave full play to the fancy and invention of the smith. The celebrated 15th-century example over the well at Antwerp, attributed to Quintin Matsys, is the finest of these.

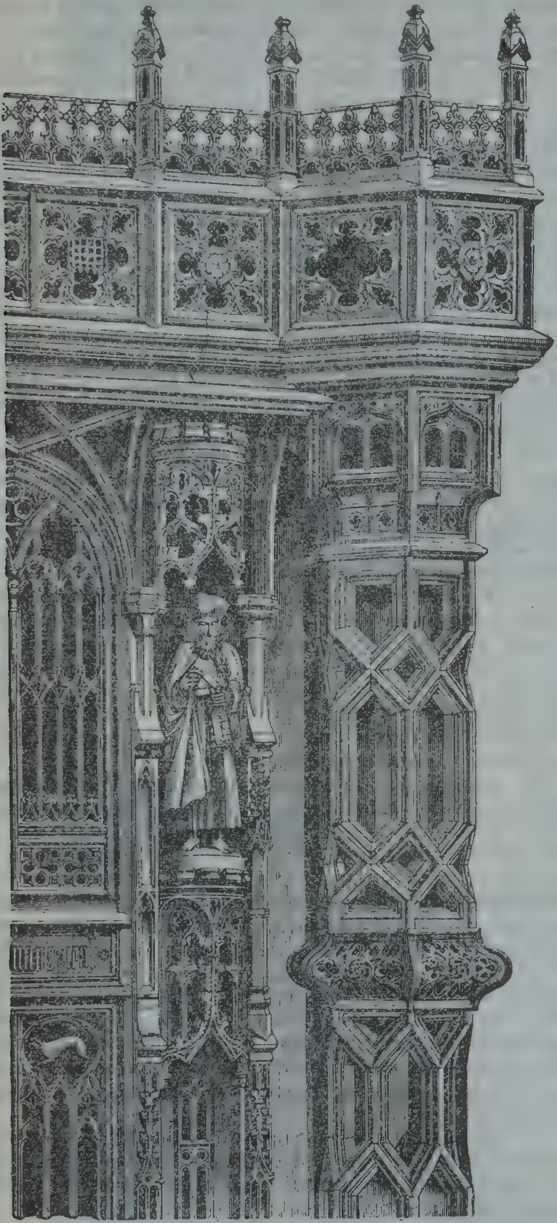


FIG. 8.—Part of Henry VII.'s Bronze Screen.

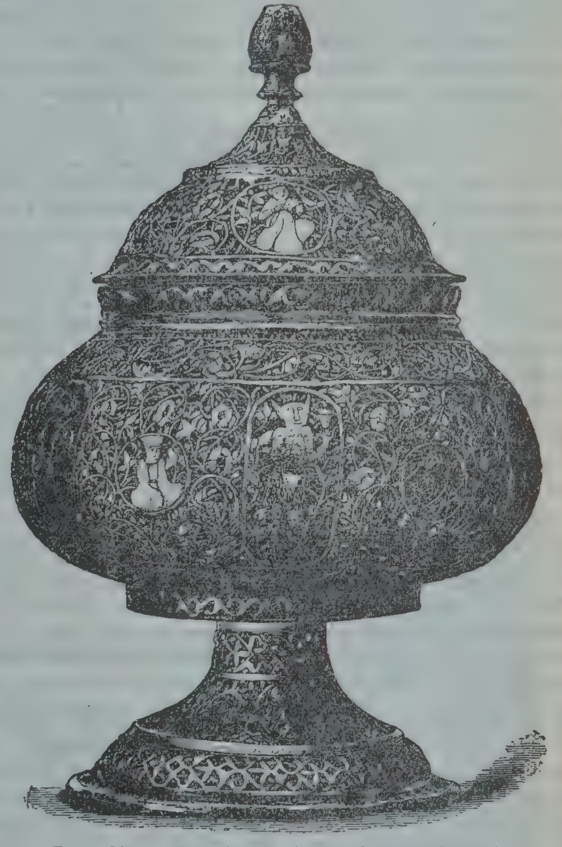


FIG. 9.—Brass Vase, pierced and gilt; 17th century Persian work.

France.—From the time of the Romans the city of Limoges has been celebrated for all sorts of metal-work, and especially for brass enriched with enamel. In the 13th and 14th centuries many life-size sepulchral effigies were made of beaten copper or bronze, and ornamented by various-coloured "champlevé" enamels. The beauty of these effigies led to their being imported into England; most are now destroyed; but a fine specimen still exists at Westminster on the tomb of William de Valence (1296). In the ornamental iron-work for doors the French smiths were pre-eminent for the richness of design and skilful treatment of their metal. Probably no examples surpass those on the west doors of Notre Dame in Paris—unhappily much falsified by restoration. The crockets and finials on the flèches of Amiens and Rheims are beautiful specimens of a highly ornamental treatment of cast lead, for which France was especially celebrated. In most respects, however, the development of the various kinds of metal-working went through much the same stages as in England.

Persia and Damascus.—The metal-workers of the East, especially in brass and steel, were renowned for their skill even in the time of Theophilus, the monkish writer on the subject in the 13th century. But it was during the reign of Shah Abbas I. (d. 1628) that the greatest amount of skill both in design and execution was reached by the Persian workmen. Delicate pierced vessels of gilt brass, enriched by tooling and inlay of gold and silver, were among the chief specialties of the Persians (see fig. 9). A process called by Europeans "damascening" (from Damascus, the chief seat of the export) was used to produce very delicate and rich surface ornament. A pattern was incised with a graver in iron or steel, and then gold wire was beaten into the sunk lines, the whole surface being then smoothed and polished. In the time of Cellini this process was copied in Italy, and largely used, especially for the decoration of weapons and armour. The repoussé process both for brass and silver was much used by Oriental workers, and even now fine works of this class are produced in the East, old designs still being adhered to. (J. H. M.)

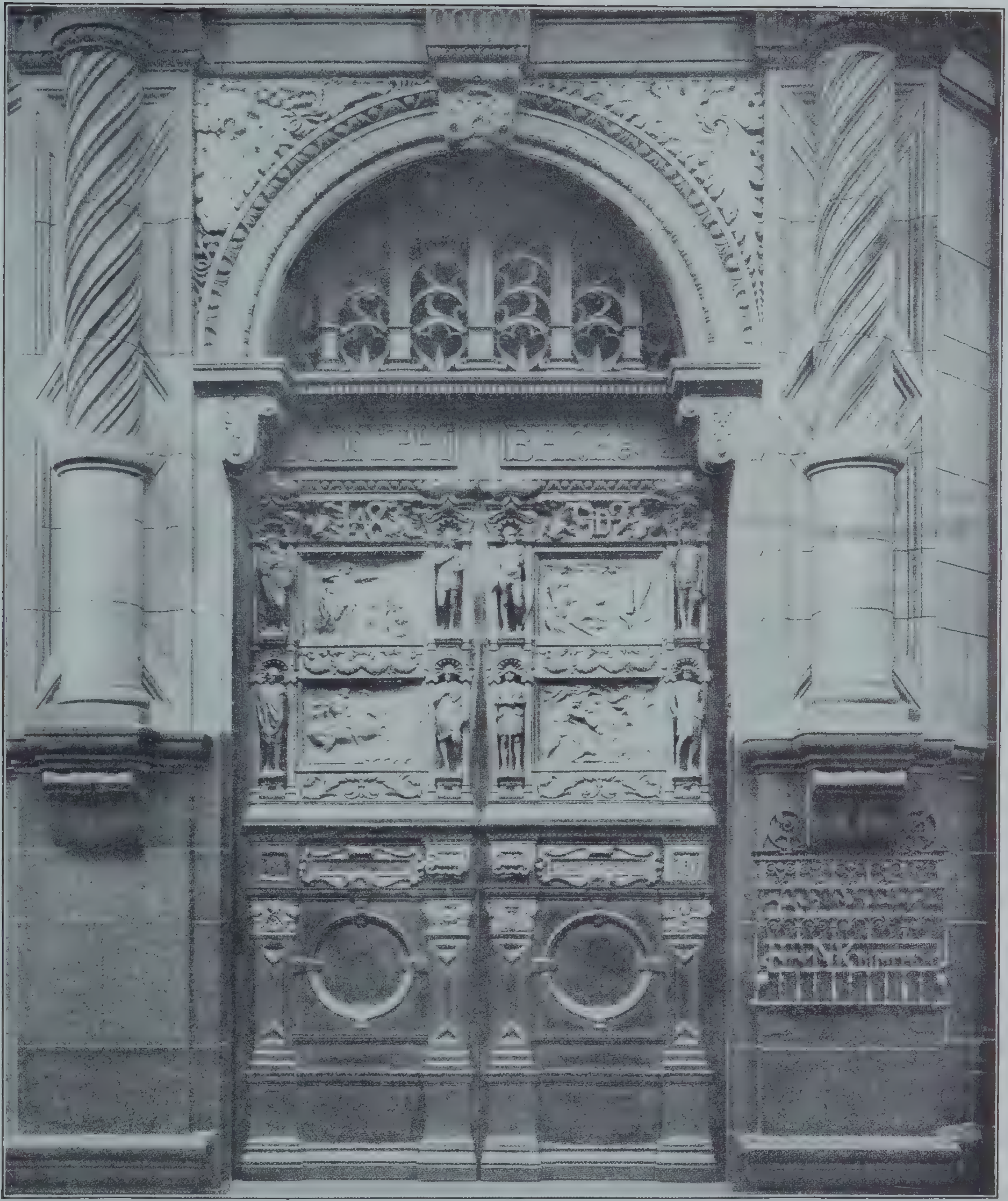
Modern Art Metal-Work.—The term "art metal-work" is applied to those works in metal in which beauty of form or decorative effect is the first consideration, irrespective of whether the object is intended for use or is merely ornamental; and it embraces any article from a Birmingham brass bedstead to works of the highest artistic merit. The term, as definitely distinguishing one branch of metal-working from another, is objected to by many on the ground that no such prefix was required in the best periods of art, and that allied crafts continue to do without it to the present day. Indeed, as long as metal-working remained a handicraft—in other words, until the introduction of steam machinery—every article, however humble its purpose, seems to have been endowed with some traditional beauty of form. The robust, florid and distinctly Roman rendering of the classic, which followed the refined and attenuated treatment associated with the architecture of the brothers Adam, who died in 1792 and 1794, is the last development in England which can be regarded as a national style. The massively moulded ormolu stair balustrade of Northumberland House, now at 49 Prince's Gate; the candelabra at Windsor and Buckingham Palace, produced in Birmingham by the firm of Messenger; the cast-iron railings with javelin heads and lictors' fasces, the tripods, Corinthian column standard lamps and candelabra, boat-shaped oil lamps and tent-shaped lustres with classic mountings, are examples of the metal-work of a style which, outside the eccentric Brighton Pavilion and excursions into Gothic and Elizabethan, was universally accepted in the United Kingdom from the days of the Regency until after the accession of Victoria. Except perhaps the silversmiths, no one was conscious of being engaged in "art metal-working," yet the average is neither vulgar nor in bad taste, and the larger works are both dignified and suited to their architectural surroundings.

The introduction of gas as an illuminant, about 1816, at once induced a large demand and a novel description of metal fitting; and the craft fell under the control of a new commercial class, intent on breaking with past traditions, and utilizing steam power, electro-deposition, and every mechanical and scientific invention tending to economize metal or labour. But when all artistic perception in Great Britain appeared lost in admiration of the triumphs of machinery and the expansion of trade, a new influence in art matters, that of the prince consort, began to make itself felt. The Great Exhibition, state-aided schools of design, the South Kensington Museum, and the establishment of a Science and Art Department under Government, were among the results of the important art revival which he inaugurated. He is credited with having himself designed candelabra and other objects in metal, and he directly encouraged the production of the sumptuous treatise on metal-work by Digby Wyatt, which laid the foundations of the revival. To this work, and that of Owen Jones, can be traced the origin of the eclecticism which has laid all past styles of art under contribution. The Gothic revival also helped the recognition of art, without very directly affecting the movement. It was valuable in teaching how to work within definite limitations, but without slavish copying; it also emancipated a considerable body of craftsmen from the tyranny of manufacturers whose sole idea was that machine-work should supersede handicraft. Its greatest efforts were the metal chancel-screens designed by Sir G. G. Scott, that for Hereford Cathedral having been exhibited in 1862. It does not appear that the influence either of Owen Jones or Digby Wyatt on metal-working extended beyond bringing the variety and beauty of past styles to the direct notice of designers. Neither can the London silversmiths, though they employed the best talent available, particularly in the decade following the Great Exhibition of 1851, be credited with much influencing the art metal revival. They were rivalled by Elkington of Birmingham, who secured the permanent assistance of at least one fine artist, Morel Ladeuil, the producer of the Elcho Challenge Shield. Perhaps the first actual designer to make a lasting impression on the crafts was Thomas Jeckyll, some of whose work, including gates for Sandringham, was exhibited in 1862. Infinitely greater as a designer was Alfred Stevens, whose influence on English craftsmen might be regarded as almost comparable to that of Michelangelo on that of his Italian contemporaries. Stevens's designs certainly directly raised the standard of production in several metal-working firms by whom he was employed; whilst in the Wellington Memorial in St Paul's Cathedral, and in Dorchester House, his work is seen unfettered by commercial considerations. Omitting many whose occasional designs have had little influence on the development of the metal crafts, we come to Alfred Gilbert, whose influence for a time was scarcely less than that of Stevens himself. Monumental works, such as his statue of Queen Victoria at Winchester and his work at Windsor, may be handed down as his greatest achievements, but judged as art metal-work, his smaller productions, such as the centrepiece presented by the army and navy to Queen Victoria on her Jubilee, have been more important.

The charming bronze statuettes of Onslow Ford, the most representative of which are in the Tate Gallery; the work of George Frampton, as seen in the Mitchell Memorial; and the beautiful bas-reliefs of W. Stirling Lee, examples of which are the bronze gates of the Adelphi Bank at Liverpool, have all contributed, especially when applied to architectural decoration, to a high standard of excellence. Painters also have frequently designed and modelled for metal-work, for example, Lord Leighton, who produced bronze statuettes of most refined character; and Sir L. Alma-Tadema, who designed the grilles for his studio and entrance hall; but none so conspicuously as Professor H. von Herkomer, who, whether working in gold and enamel, iron, or his favourite alloy, pewter, infuses a freshness into his designs and methods which displays an unusual mastery over materials.

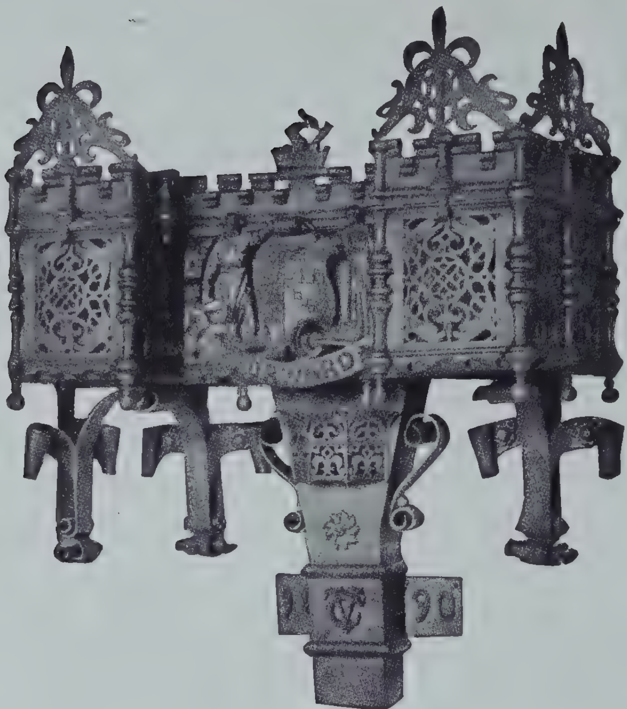
The gift of reproducing effects of nature or art by brush or chisel is not necessarily accompanied by power to design; but a noteworthy exponent of the dual faculty is G. C. Haité, whose designs are widely applied.

It is chiefly to architecture that metal-work owes its permanent artistic improvement. In England buildings of Norman Shaw and Ernest George demanded quiet and harmonious metal-work; and the custom of these architects of superintending and designing every detail, even for interiors, created the supply. The work of every worthy architect raises the standard of the crafts; but beyond others Messrs Ashbee, Lethaby and Wilson have taken an active personal interest in schools of metal-work. The technical schools have also been of immense service in creating a class of self-respecting craftsmen, whose wages enable them to regard their work as worthy occupation abounding in interest. Home industries such as the metal-working round Keswick (founded in 1884 by Canon and Mrs Rawnsley), executed during hours of idleness by field labourers and railway porters, educate the passer-by as well as the worker.

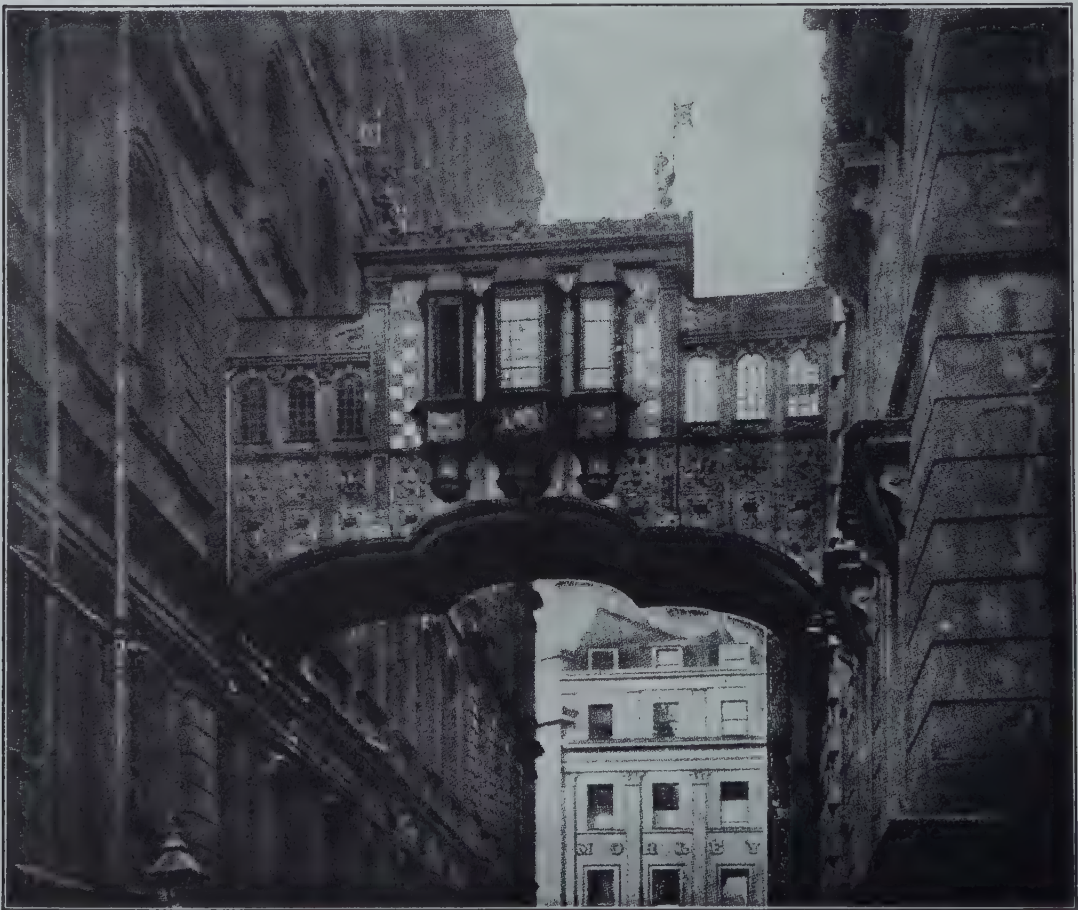


CAST BRONZE GATES, ADELPHI BANK, LIVERPOOL.
Designed by W. D. Caröe, the figures by Stirling Lee, executed by Starkie Gardner and Co.

METAL-WORK



RAIN-WATER HEAD, IN LEAD, FOR THE VICTORIA LAW COURTS, BIRMINGHAM.
Designed by ASTON WEBB and INGRES BELL, and executed by DENT AND HELLIER.



COVERED BRIDGE OF IRON, SHEATHED IN CAST LEAD, GRAND HOTEL, LONDON.
Designed by WILLIAM WOODWARD, and executed by STARKIE GARDNER AND Co.

British architects and artists who design for the principal decorating firms are to-day as conversant with the Renaissance and succeeding styles of France and Italy as medieval revivalists were familiar with the Gothic styles with which they made us so well acquainted. Metal-work more or less based upon every kind of past style is produced in vast quantities, and in some cases so skilful are the workers that modern forgeries and reproductions are almost beyond the power of experts to detect. This large class of designers and craftsmen, to whom a thorough knowledge of the history of design is a necessity, follows and develops traditional lines. The new art school, on the contrary, breaks wholly with tradition, unless unconsciously influenced by the Japanese, and awards the highest place to originality in design. It is not to be expected that an art-revival following on, and in possession of, all the results of a period of unprecedented activity in scientific research should proceed with the same restraint as heretofore; but the unfettered activity, and the general encouragement to abandon the traditions of art, have no exact parallel in the past, and may yet prove a danger. It is perhaps the very rapidity of the movement that is likely to retard its progress, and to fail to carry with it the wealthy clients and the decorators they employ, or perhaps even to increase the disposition to cling to the reproductions of the styles of the 17th and 18th centuries. The multiplication of art periodicals, lectures, books, photographs, meetings of societies and gilds, museums, schools of arts and crafts, polytechnics, scholarships, facilities for travel, exhibitions, even those of the Royal Academy, to which objects of applied art are now admitted, not only encourages many persons to become workers and designers in the applied arts, but exposes everything to the plagiarist, who travesties the freshest idea before it has well left the hands of its originator. Thus the inspirations of genius, appropriated by those who imperfectly appreciate their subtle beauty and quality, become hackneyed and lose their charm and interest. The keen desire to be unconventional in applied art has spread from Great Britain and the United States to Germany, Austria and other countries, but without well-defined first principles, or limitations. It seems agreed in a general way that the completed work in metal is to be wholly the conception and, as far as possible, the actual handiwork of the designer: casting by the *cire-perdue* process, left practically untouched from the mould, and embossing, being the two most favoured processes. The female figure is largely made use of, and rich and harmonious colours are sought, the glitter of metal being invariably subdued by deadening its lustre, or by patinas and oxides. Gilding, stains and lacquers, electro-plating, chasing, "matting," frosting, burnishing, mechanically produced mouldings and enrichments, and the other processes esteemed in the 19th century, are disused and avoided. New contrasts are formed by the juxtaposition of differently toned metals; or these with an inlay of haliotis shell, introduced by Alfred Gilbert; or of coloured wax, favoured by Onslow Ford; or enamelling, perfected by Professor von Herkomer; or stained ivory, pearls, or semi-precious stones. The quality of the surface left by the skilled artist or artisan is more regarded than symmetry of design, or even than correct modelling. Frequently only the important parts in a design are carefully finished and the rest merely sketched: the mode of working, whether by modelling-tools or hammer, being always left apparent.

The newer kinds of art metal-work have, until recently, reached the purchaser direct from the producer's workshop; but they may now also be seen in the shops of silversmiths, jewellers, and general dealers, who are thus helping to transfer production from large commercial manufactories to smaller ateliers under artistic control. The production of the larger household accessories, such as bedsteads, fenders, gas and electric fittings, clocks, &c., has hardly as yet come under the influence of the art movement. The services rendered by Mr W. A. S. Benson of Chiswick, who commenced about 1886 to revolutionize the production of sheet-brass and copper utensils, cannot be passed over. The average ecclesiastical metal-work has rather receded than progressed in merit, except when designed by architects and executed under their supervision. Though the demand for good domestic wrought-iron work has enormously increased, adaptations from the beautiful work of the 17th and 18th centuries have been found so suited to their architectural surroundings, that new departures have been relatively uncommon. Of such the gates for Sandringham, by Jeckyll; for Crewe Hall, by Charles Barry; and for the Victoria and Albert Museum, by Gamble, are the earliest and best known. Of the vast number designed upon traditional lines may be cited those for Lambton Castle, Welbeck, Eaton Hall, Twickenham, Clieveden, and the Astor Estate Office on the Victoria Embankment. Cast iron, brought to perfection by the Coalbrookdale Company about 1860, but now little esteemed, owing to the poverty of design which so often counterfeits smiths' work, presents great opportunities to founders possessing taste or willing to submit to artistic control. A very large field is also opening for cast-lead work, whether associated with architecture, as in the leaden covered-way over Northumberland Street, in London (see Plate), and the fine rain-water heads of the Birmingham Law Courts (see Plate), or with the revival of the use of metal statuary and vases in gardens. The subdued colour and soft contours of pewter render it once more a favoured material, peculiarly adapted to the methods of the art revival, and perhaps destined to supersede electro-plate for household purposes. In silver-work the proportion of new art designs exhibited by dealers and others is still relatively small; but jewellers, except when setting pure brilliants and pearls, are becoming more inclined to make their jewels of finely modelled gold and enamel enriched with precious and semi-precious stones, than of gems merely held together by wholly subordinate settings.

On the continent of Europe, France was the first to recognize the merits of its bygone designers and craftsmen, and even antecedent to the Exhibition of 1851, when art in Great Britain was dormant, it was possible to obtain in Paris faithful reproductions of the finest ormolu work of the 18th century. At the same time a most active production of modern designs was proceeding, stimulated by rewards, with the result that the supply of clocks, lamps, candelabra, statuettes, and other ornaments in bronze and zinc to the rest of Europe became a monopoly of Paris for nearly half a century. In all connected with their own homes the French adhere to their traditions far more than other nations, and the attempt at originality in the introduction of metal-work into the scheme of decoration of a room is almost unknown. In the domain of bronze and imitation bronze statuary the originality of the French is absolutely unrivalled. And not only in bronze, but in Paris jewellery, enamels, silver, pewter and iron work a cultured refinement is apparent, beside which other productions, even the most finished, appear crude. The French artist attains his ideal, and it is difficult to imagine, from his standpoint, that the metal-work of the present can be surpassed. The best English metal-worker, on the contrary, is probably not often quite satisfied with the results he attains, perhaps because in Great Britain the pursuit of art has for centuries been fitful and individual, while in France art traditions are hereditary. The metal-work of Belgium is based at present entirely on that of France, without attaining the same standard, unless designed for ecclesiastical uses. In Holland these crafts have not progressed. Italian metal-workers are mainly employed in reproduction; but traditions linger in some remote parts, while the sporadic appearance of craftsmen of a high order is evidence that the ancient artistic spirit is not wholly extinct. Similarly, the surprising damascening by Messrs Zuluaga of Madrid in the monument to General Prim, and that of Alvarez of Toledo, give hope that the Spanish craftsman only needs to be properly directed. German and Austrian workers had for years shown more energy than originality, but they have recently embraced the newest English developments and carried them to extremes of exaggeration. For really fresh and progressive indigenous art we may perhaps have, in the near future, to turn to America and to Russia, where, having little artistic past to refer to, designers and craftsmen display unequalled individuality and force. It is from the Far East, however, that the most serious rivalry may be anticipated. The metal-work of China and Japan, so pleasantly naïve and inexpensive, though becoming undesirably modified as to design through contact with European buyers, is losing none of its matchless technique, which indeed in Japan is still being developed. In any history of the art revival the influence of such firms as Barbedienne and Christofle in Paris and Tiffany in New York cannot be ignored.

(J. S. G.)

Industrial Metal-Work.

The malleability and ductility of metals lie at the basis of the work of the gold- and silver-smiths at one extreme, and of the boiler-maker at the other. Sheet metals can be made to assume almost any shape under the hammer, or by pressure, provided they are subjected to annealing to restore the property of malleability. The most awkward shapes, involving excessive extensions of metal, are produced by drawing processes between dies of iron and steel in power presses. All the common domestic utensils in tinned and enamelled ware, and all the ordinary patterns of the silversmiths, are similarly done. Frequent annealings are necessary to prevent fracture of the metal; but with these and the observance of certain other precautions of a practical character the degree of extension possible is enormous. Another illustration of the malleability of metal is afforded by metal spinning. A sheet of metal set revolving at a high speed in a lathe is bent over into cup-shaped forms with numerous mouldings, by a blunt hardened tool. A great deal of work is done in this way, though this sphere has also been invaded by the draw presses, whose output would seem incredible to those not familiar with the work. Objects that do not require annealing are produced by dozens per minute, and all the movements of feeding and stamping and removal are often automatic. The ductility of metals and alloys is utilized in wire and tube-drawing through dies on long benches. This work also requires frequent annealing, for otherwise the wires or tubes would rupture. Even hard steel is treated in this way to form tubes for the highest hydraulic and steam pressures.

Platers' Work (see BOILER) is distinguished from work in sheet metals by the fact that plates have considerable thickness, which sheets have not. Plates range in thickness from ¼ in. to 2 in., but for most purposes they do not go beyond ¾ in. or 1 in. Over these thicknesses they are used chiefly for the largest marine boilers. Armour plates which are several inches in thickness do not come in this group, being a special article of manufacture. Sheets are of thicknesses of less than ¼ in. This distinction of thickness is of importance in its bearing on workshop practice. A thin sheet requires a very different kind of treatment from a thick plate. Not only is more powerful machinery required for the latter, but in bending it allowance has to be made for the difference in radius of outer and inner layers, which increases with increase of thickness. Short, sharp bends which are readily made in thin sheets cannot be done in thick plates, as the metal would be stressed too much in the outer layers. The methods of union also differ, riveting being adopted for thick plates, and soldering or brazing generally for thin.

Coppersmiths' Work is an important section of sheet-metal working. It is divided into two great departments: the domestic utensil side, on which the brazier's craft is exercised; and the engineering side, which is concerned in some engine-work, locomotive and marine, and in the manufacture of brewers' utensils. The methods of the first are allied to those of the tinman, those of the second to the methods of the plater. Tinsmiths' work resembles the lighter part of the work of the coppersmith. There is no essential difference in dealing with tin (*i.e.* sheets of iron or steel coated with tin) and copper of the same thickness. Hence the craft of tinmen and braziers is carried on by the same individuals. There are, however, differences of treatment in detail, because copper is more malleable and softer than tin plate. The geometry of sheet-metal work and of platers' and boiler-makers' work is identical up to a certain stage. The divergence appears when plates are substituted for sheets. A thin sheet has for all practical purposes no thickness—that is, the geometrical pattern marked on it will develop the object required after it is bent. Nearly all patterns are the developments of the envelopes of geometrical solids of regular or irregular outlines, few of plane faces; when they are made up of combinations of plane faces, or of faces curved in one plane only, there is no difference in dealing with thin sheets or thick plates. But when curving occurs in different planes at right or other angles (hollowing), the metal has to be drawn or extended on the outside, and important differences arise. A typical form is the hemisphere, from which many modified forms are derived. The production of this is always a tedious task. It involves details of "wrinkling" and "razing," if done by hand-work in copper. In thick plates it is not attempted by hand, but pressing is done between dies, or segments of the sphere are prepared separately and riveted together. In tin it is effected by stamping. In all work done in thick plates the dimensions marked out must have reference to the final shape of the article. Generally the dimensions are taken as in the middle of the plate, but they may be on the inside or outside according to circumstances. But in any case the thickness must enter into the calculations, whereas in thin sheets no account is taken of thickness.

Raised Work.—All the works in sheet metal that are bent in one plane only are easily made. The shapes of all polygonal and all cylindrical and conical forms are obtained by simple development—that is, the envelopments of these bodies are marked out on a flat plane, and when cut, are bent or folded to give the required envelopes. Only common geometrical problems are involved in the case of sheets of sensible thickness, and allowances are made for thickness. But in those forms where curving must take place in different directions the layers or fibres of metal are made to glide over one another, extension taking place in some layers but not in others, and this goes on without producing much reduction in the thickness. This is only possible with malleable and ductile metals and alloys. As a general rule it is restricted to metals which are not cast, for, with some slight exceptions, it is impossible to produce relative movements of the layers in cast iron, steel or cast brass. But most rolled metals and alloys can be so treated, copper being the best for the purpose. The methods employed are "raising" by the hammer, and pressing in dies. But the severity of the treatment would tear the material asunder if rearrangement of the particles were not obtained by frequent annealing (*q.v.*).

If an object has to be beaten into concave form from a flat thin sheet, the outer portions must be hammered until they occupy smaller dimensions than on the flat sheet. If a circular disk is wrought into a hemisphere and the attempt is made to hammer the edges round, crumpling must occur. This in fact is the first operation, termed wrinkling, the edge showing a series of flutes. These flutes have to be obliterated by another series of hammerings termed razing. The result is that the object assumes a smooth concave and convex shape, without the thickness of the metal becoming reduced.

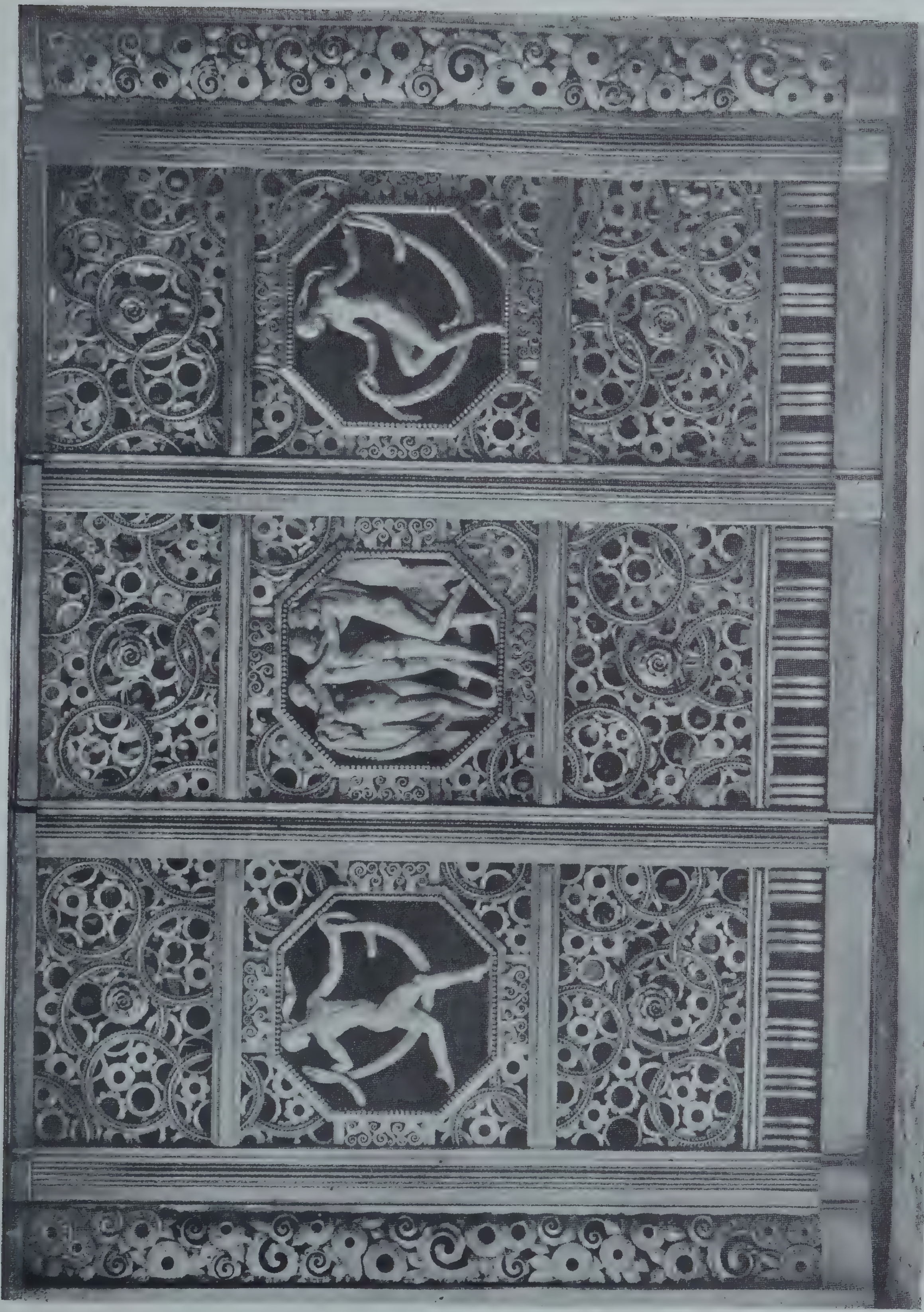
Cast Work.—The metals and alloys which are neither malleable nor ductile can only be worked into required shapes by melting and casting in moulds. Abundance of remains which date from the Neolithic period testify to the high antiquity of this class of work, and also to the great skill which the ancient founders had acquired. Statue-founding is a highly specialized department of metal-work, in which the artists of the middle ages excelled. Two methods have been employed, the *cire-perdue*, or wax process (see above), and the present, or all sand method. In the latter the artist provides a model in plaster from which the founder takes a mould within an encircling box. This mould must obviously be made in scores of little separate sections (false cores or drawbacks) to permit of their removal from the model without causing fracture of the sand. These are subsequently replaced piece by piece in the encircling frame, and a core made within it, leaving a space of ¼ in. or thereabouts into which the metal is poured. The advantage of this process is that the artist's model is not destroyed as in the *cire-perdue*, and if a "waster" results, a second mould can be taken. A large statue occupies from one to three months in the moulding.

The extreme tenuity of objects which are hammered, drawn or rolled cannot for obvious reasons be attained by casting. Casting also is complicated by the shrinkage which occurs in cooling down from the molten state, and in some alloys by the formation of eutectics, and the liquation of some constituents. The temperature of pouring is now known to be of more importance than was formerly suspected. The after-treatment of castings by annealing exercises great influence on results in malleable cast iron and steel.

There are many metals and alloys which are malleable and ductile, and also readily fused and cast. This is the case with gold, silver, copper, tin, lead and others, and especially with low carbon steel, which is first cast as an ingot, then annealed and rolled into plates as well as the thinnest sheets. The ancient wootz, and the products of the native furnaces of Africa are first cast, then hammered out thin. Many of the patent bronzes are by slight variations in the proportions of the constituents made suitable for casting, for forging, and for rolling into sheets. But in all the great modern manufacturing processes it is true that metals and alloys, though of the same name, have a different composition according as they are intended for casting on the one hand, or for forging, rolling and drawing on the other. Wrought or malleable iron has less of carbon and other elements in its composition than has cast iron. Steel intended for castings has slightly more carbon and other elements than the cast-steel ingot intended for rolling into plates. So also with the numerous bronzes, the phosphor, the delta, the aluminium and other alloys of copper; each is made in several grades to render it suitable for different kinds of treatment.

There are no materials used in manufacture of which the craftsman is able to vary the composition and physical qualities so extensively as the metals and their alloys. Much light has been thrown on facts which have long been known in a practical way, by the labours of the Alloys Research Committee of the Institution of Mechanical Engineers (England). These, together with independent researches into the heat treatment of steel and iron, have opened up many unsolved problems fraught with deepest interest and importance.

One of the most difficult problems with which the metal-worker



(*Edgar Brandt.*)
"The Golden Age," triple doors of wrought iron and bronze, by Edgar Brandt, Paris. These doors have both sides alike and are 8 ft. 10 in. high and 13 ft. 2 in. wide over all. Other examples of this artist's work are: The iron doors of the Verdun monument; the receptacle for the Eternal Flame at the Tomb of the Unknown Soldier, Paris; the balustrade for the great stairway at the Louvre; grilles for Cheney Brothers, New York, and grilles exhibited at the Metropolitan Museum of Art. See also the article DECORATIVE ART in Vol. 29.

who handles constructional forms has to deal is the maintenance of a due relation between absolute strength and a useful degree of elasticity. Only after many failures has the fact been grasped that a very high degree of strength is inconsistent with a trustworthy degree of elasticity. The reasons were not understood until the researches of Wöhler demonstrated the difference between the effects of merely dead loads and of live loads, and between repetitions of stress of one kind only, and the vastly more destructive effects of both kinds alternating.

The texture of metals and alloys is related to the character of the operations which can be done upon them. Broadly the malleable and ductile metals and alloys show a fibrous character when ruptured, the fusible ones a crystalline fracture. The difference is seen both in the workshop and in the specimens ruptured in testing-machines. A piece of wrought iron, or mild steel or copper, if torn asunder shows long lustrous fibres, resembling a bundle of threads in appearance. A piece of cast iron, or steel or bronze, shows on rupture a granular, crystalline surface destitute of any fibre. The ductile metals and alloys also extend from 10 to 30% with reduction of area before they fracture, the crystalline ones snap shortly without warning. In some instances, however, the method of application of stress exercises an influence. Wrought iron and mild steel may be made to show a short and crystalline fracture by a sudden application of stress, while if drawn asunder slowly they develop the silky, fibrous appearance. The men who design and work in metals have to take account of these vital differences and characteristics, and must be careful not to apply treatment suitable to one kind to another of a dissimilar character. Tools, appliances and methods have little in common. Between the work of the smith, the sheet-metal worker and the founder, there is a great gulf. An artistic taste will recognize the essential differences, and not endeavour, apart from questions of strength, to graft a design suitable for one on another. It is bad taste to imitate the tracery of the ductile wrought iron in cast designs, the foliations of ancient wrought-iron grilles and screens in heavy cast iron. Severe simplicity is also most in harmony with constructional designs in plated work, where stresses occur in straight lines. From this point of view the lattice-girder bridge is an ideal design in steel.

One of the most valuable characteristics of the iron alloys is their capacity for hardening, which they owe in the main to the presence of certain small percentages of carbon relatively to minute quantities of other elements: as manganese, tungsten, nickel and others of less importance. The capacity for hardening is an invaluable property not only in regard to cutting-tools, but also in prolonging the life of parts subjected to severe friction. Great advances have been made in the utilization of this property as a result of the growth of the precision grinding-machines, which are able to correct the inaccuracies of hardened work as effectually as those of soft materials. It is utilized in the spindles of machine-tools, in the balls and rollers for high-speed bearings, slides, pivots and such like.

Methods of Union.—The methods of union of works in metal are extremely varied. An advantage in casting is that the most complicated shapes are made in one piece. But all other complicated forms have to be united by other means—as welding, soldering, riveting or bolting. The two first-named are trustworthy, but are evidently unsuitable for the greater portion of engineers' work, for which riveting and bolting are the methods adopted. Even the simple elements of rivets and bolts have produced immense developments since the days when bolts were made by hand, holes cored or hand-drilled, and rivets formed and closed by hand labour. Nut- and bolt-making machinery, both for forging and screw cutting, operates automatically, and drilling machinery is highly specialized. Hand-riveting on large contracts has been wholly displaced by power-riveting machines. The methods of union adopted are not allowed to impair the strength of structures, which is calculated on the weakest sections through the rivet or bolt holes. Hence much ingenuity is exercised in order to obtain the strongest joint which is consistent with security of union. This is the explanation of all the varied forms of riveted joints, which to casual observers often appear to be of a fanciful character.

Protection of Surfaces.—The protection and coloration of metals and alloys includes a large number of industries. The engineer uses paints for his iron and steel. A small amount of work is treated by the Bower-Barff and allied processes, by which a coating of magnetic oxide is left on the metal. Hot tar—Angus Smith's process—is used for water-pipes. Boiled linseed-oil is employed as a non-corrosive coating preceding the application of the lead and iron oxide paints. In steam boilers artificial galvanic couples are often set up by the suspension of zinc plates in the boiler, so that the corrosion of the zinc may preserve the steel boiler plates from waste. Various artificial protective coatings are applied to the plates of steel ships. Bright surfaces are protected with oil or with lacquer. The ornamental bronzes and brasses are generally lacquered, though in engineers' machinery they are as a rule not protected with any coating. For ornamental work lacquering divides favour with colouring—sometimes done with coloured lacquers, but often with chemical colourings, of which the copper and iron salts are the chief basis. (J. G. H.)

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METAMERISM (Gr. *μετά*, after, *μέρος*, a part), a technical term used in natural science. In chemistry it denotes the existence of different substances containing the same elements in the same proportions and having the same molecular weight; it is a form of isomerism.

In zoology, metamerism is the repetition of parts in an organized body, a phenomenon which is, as E. Haeckel, W. Bateson and others have recognized, only a special case of a tendency to repetition of structural units or parts which finds one expression in bilateral symmetry. It occurs in almost every group of the animal kingdom, but is most conspicuous in segmented worms, arthropods and vertebrates. In certain worms (the Cestoidea and some Planarians) metameric segmentation is accompanied by the separation of the completed metameres one by one from the older (anterior) extremity of the chain (strobilation), but it by no means follows that metameric segmentation has a necessary origin in such completion and separation of the "meres." On the contrary, metamerism seems to arise from a property of organisms which is sometimes more (eumerogenesis) and sometimes less (dysmerogenesis) fully exhibited, and in some groups not exhibited at all. The most complete and, at the same time, simplest instances of metameric segmentation are to be seen in the larger Chaetopods, where some hundreds of segments succeed one another—each practically indistinguishable in structure from the segment in front or from that behind; muscles, right and left appendage or parapodium, colour-pattern of the skin, gut, blood-vessels, coelom, nephridia, nerve-ganglion and nerves are precisely alike in neighbouring segments. The segment which is least like the others is the first, for that carries the mouth and a lobe projecting beyond it—the prostomium. If (as sometimes happens) any of the hinder segments completes itself by developing a prostomium, the chain breaks at that point and the segment which has developed a prostomium becomes the first or head-bearing segment of a new individual. Compare such an instance of metameric segmentation with that presented by one of the higher Arthropods—*e.g.* the crayfish. Here the somites are not so clearly marked in the tegumentary structures; nevertheless, by examining the indications given by the paired parapodia, we find that there are twenty-one somites present—a limited definite number which is also the precise number found in all the higher Crustacea.

We can state as a FIRST LAW[1] of metamerism or somite formation that it is either indefinite in regard to number of metameres or somites produced, or is definite. Animals in the first case we call anomomeristic; those in the second case, nomomeristic. The nomomeristic condition is a higher development, a specialization, of the anomomeristic condition.

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[1] The word "LAW" is used in this summary merely as a convenient heading for the statement of a more or less general proposition.

The SECOND LAW, or generalization, as to metamerism which must be noted is that the meres or somites (excepting the first with its prostomium) may be all practically alike or may differ from one another greatly by modification of the various constituent parts of the mere or somite. Metamerized animals are either homoeomeric or heteromeric. The reference of the variation in the form of the essential parts contained in a "metamere" or "somite" introduces us to the necessity of a general term for these constituent or subordinate parts; they may be called "meromes" (μέρος). The meromes present in a metamere or somite differ in different annulate or segmented animals according to the general organization of the group to which the animal belongs. As a matter of convenience we distinguish in the Arthropod as meromes, first, the tegumentary chitinized plates called terga, placed on the dorsal aspect of the somites; second, the similar sternal plates. In Chaetopods we should take next to these the masses of circular and logitudinal muscular fibres of the body-wall and the dorso-ventral muscles. The latter form the third sort of merome present in the Arthropods. The fourth kind of merome is constituted by the parapodia or appendages; the fifth by the coelomic pouches and their ducts and external apertures (coelomo-ducts), whether renal or genital. The sixth by the blood-vessels of the somite; the seventh by the bit of alimentary tract which traverses it; and the eighth by the neuromere (nerve ganglion pair, commissures, connectives and nerve branches).

The THIRD LAW of metamerism is that heteromerism may operate in such a way as to produce definite regions of like modification of the somites and their appendages, differing in their modification from that observed in regions before and behind them. It is convenient to have a special word for such regions of like meres, and we call each a tagma (ταγμα, a regiment). The word "tagmosis" is applicable to the formation of such regions. In the Chaetopods tagmosis always occurs to a small extent so as to form the head. In some Chaetopods, such as *Chaetopterus* and the sedentary forms, there is marked tagmosis, giving rise to three or even more tagmata. In Arthropods, besides the head, we find very frequently other tagmata developed. But it is to be noted that in the higher members of each great class or line of descent, the tagmosis becomes definite and characteristic just as do the total number of meres or somites, whilst in the lower grades of each great class we find what may be regarded as varying examples of tentative tagmosis. The terms nomotagmic and anomotagmic are applicable with the same kind of implication as the terms nomomeristic and anomomeristic.

The FOURTH LAW of metamerism (auto-heterosis of the meromes) is that the meromes of a somite or series of somites may be separately and dissimilarly affected by heteromerism. It is common enough for small changes only to occur in the inner visceral meromes whilst the appendages and terga or sterna are largely changed in form, But of equal importance is the independent "heterosis" of these visceral meromes without any corresponding heterosis of the body wall. As instances, we may cite the gizzards of various earthworms and the special localization of renal, genital and gastric meromes, with obliteration elsewhere, in a few somites in Arthropoda.

The FIFTH LAW, relating also to the independence of the meromes as compared with the whole somite, is the law of autorhythmus of the meromes. Metamerism does not always manifest itself in the formation of complete new segments; but one merome may be repeated so as to suggest several metameres, whilst the remaining meromes are, so to speak, out of harmony with it and exhibit no repetition. Thus in the hinder somites of the body of *Apus* the Crustacean we find a series of segments corresponding apparently each to a complete single somite; but when the appendages are examined we find that they have multiplied without relation to the other meromes of a somite: we find that the somites carry from two to seven pairs of appendages, increasing in number as we pass backwards from the genital segment. The appendages are autorhythmic meromes in this case. They take on a quasi-independent metamerism and are produced in numbers which have no relation to the numbers of the body-rings, muscles and neuromeres. This possibility of the *independent* metameric multiplication of a single merome must have great importance in the case of dislocated meromes, and no doubt has application to some of the metameric phenomena of Vertebrates.

The SIXTH LAW is the law of dislocation of meromes. This is a very important and striking phenomenon. A merome, such as a pair of appendages (Araneae) or a neuromere or a muscular mass (frequent), may (by either a gradual or sudden process, we cannot always say which) quit the metamere to which it belongs, and in which it originated, and pass by actual physical transference to another metamere. Frequently this new position is at a distance of several metameres from that to which the wandering merome belongs in origin. The movement is more usual from behind forwards than in the reverse direction; but this, probably, has no profound significance and depends simply on the fact that, as a rule, the head must be the chief region of development on account of its containing the sense organs and the mouth.

In the Vertebrata the independence of the meromes is more fully developed than in other metamerized animals. Not only do we get auto-heterosis of the meromes on a most extensive scale, but the dislocation of single meromes and of whole series (tagmata) of meromes is a common phenomenon. Thus, in fishes the pelvic fins may travel forwards to a thoracic and even jugal position in front of the pectoral fins; the branchiomeromes lose all relation to the position of the meromes of muscular, skeletal, coelomic and nervous nature, and the heart and its vessels may move backwards from their original metameres in higher Vertebrates carrying nerve-loops with them.

The SEVENTH LAW of metamerism is one which has been pointed out to the writer by E. S. Goodrich. It may be called the law of "translation of heterosis." Whilst actual physical transference of the substance of meromes undeniably takes place in such a case as the passage of the pelvic fins of some fishes to the front of the pectorals, and in the case of the backward movement of the opisthosomatic appendages of spiders, yet the more frequent mode in which an alteration in the position of a specialized organ in the series or scale of metameres takes place is *not* by migration of the actual material organ from somite to somite, but by translation of the *quality* or morphogenetic peculiarity from somite to somite accompanied by correlative change in all the somites of the series. The phenomenon may be compared to the transposition of a piece of music to a higher or lower key. It is thus that the lateral fins of fishes move up and down the scale of vertebral somites; and thus that whole regions (tagmata), such as those indicated by the names cervical, thoracic, lumbar and sacral, are translated (accompanied by terminal increase or decrease in the total number of somites) so as to occupy differing numerical positions in closely allied forms (cf. the varying number of cervical somites in allied Reptiles and Birds).

What, in this rapid enumeration, we will venture to call the EIGHTH LAW of metamerism is the law of homoeosis, as it is termed by W. Bateson. Homoeosis is the making of a merome into the likeness of one belonging to another metamere, and is the opposite of the process of "heterosis"—already mentioned. We cite this law here because the result of its operation is to *simulate* the occurrence of dislocation of meromes and has to be carefully distinguished from that process. A merome can, and does in individual cases of abnormality, assume the form and character of the corresponding merome of a distant somite. Thus the antenna of an insect has been found to be replaced by a perfectly well-formed walking leg. After destruction of the eye-stalk of a shrimp a new growth appears, having the form of an antenna. Other cases are frequent in Crustacea, as individual abnormalities. They prove the existence in the mechanism of metamerized animals, of structural conditions which are capable of giving these results. What those structural conditions are is a matter for separate inquiry, which we cannot even touch here.

We now come to the questions of the production of *new* somites or the addition of new somites to the series, and the converse problem of the suppression of somites, whole or partial. We state as the NINTH LAW of metamerism "that new somites or metameres are added to a chain consisting of two or more somites by growth and gradual elaboration— what is called 'budding'—of the anterior border of the hindermost somite. This hindermost somite is therefore different from all the other somites and is called the 'telson.' However long or short or heteromerized the chain may be, new metameres or somites are only produced at the anterior border of the telson, except in the Vertebrata." That is the general law. But amongst some groups of metamerized animals partial exceptions to it occur. It is probably absolutely true for the Arthropoda from lowest to highest. It is not so certain that it is true for the Chaetopoda, and would need modification in statement to meet the cases of fissiparous multiplication occurring among Syllids and Naidids. In the Vertebrata, where tagmosis and heterosis of meromes and dislocation of merones and tagmata are, so to speak, rampant, new formation of metameres (at any rate as represented by important meromes) takes place at more than one point in the chain. Such points are found where two highly diverse "tagmata" abut on one another. It is possible, though the evidence at present is entirely against the supposition, that at such points in Arthropoda new somites may be formed. Such new somites are said to be "intercalated." The question of the intercalation of vertebrae in the Vertebrata has received some attention. It must be remembered that a vertebra even taken with its muscular, vascular and neural accessories is only a partial metamere—a merome—and that, so far as *complete* metameres are concerned, the Vertebrata do conform to the same law as the Arthropods. Intercalation of meromes, branchial, vertebral and dermal (fin-supports) seems to have taken place in Vertebrata in the fishes, while in higher groups intercalation of vertebrae in large series has been accepted as the only possible explanation of the structural facts established by the comparison of allied groups. The elucidation of this matter forms a very important part of the work lying to the hand of the investigator of vertebrate anatomy, and it is possible that the application of Goodrich's law (the seventh of our list) may throw new light on the matter.

In regard to the diminution in the number of somites in the course of the historical development of those various groups of metamerized animals, which have undoubtedly sprung from ancestors with more numerous somites than they themselves possess, it appears that we may formulate the following laws as the tenth, eleventh, twelfth and thirteenth laws of metamerism.

The TENTH LAW is that individual somites tend to atrophy and finally disappear as distinct structures, most readily at the anterior and the posterior ends of the series constituting an animal body. This is very generally exhibited in the head of Arthropoda, where, however, the operation of the law is largely modified by fusion (see below). With regard to the posterior end of the body, the atrophy of segments does not, as a rule, affect the telson itself so much as the somites in front of it and its power of producing new somites. Sometimes, however, the telson is very minute and nonchitinized (Hexapoda).

The ELEVENTH LAW may be stated thus: any somite in the series which is the anterior or posterior somite of a tagma may become atrophied, reduced in size or partially aborted by the suppression of some of its meromes; and finally, such a somite may disappear and leave no obvious trace in the adult structure of its presence in ancestral forms. This is called the excalation of a somite. Frequently, however, such "excalated" somites are obvious in the embryo or leave some merome (*e.g.* neuromere, muscle or chitin-plate) which can be detected by minute observation (microscopic) as evidence of their former existence. The somite of the maxillipede (third post-oral appendage) of *Apus cancriformis* is a good example of a somite on its way to excalation. The third prae-oral and the praemaxillary somites of Hexapod insects are instances where the only traces of the vanished somite are furnished by the microscopic study of early embryos. The praegenital somite of the Arachnida is an example of a somite which is preserved in some members of the group and partially or entirely excalated in other cases, sometimes with fusion of its remnants to neighbouring somites.

The TWELFTH LAW of metamerism might very well be placed in logical order as the first. It is the law of *lipomerism*, and asserts that just as the metameric condition is produced by a change in the bodies of the descendants of unisegmental ancestors, so highly metamerized forms—*i.e.* strongly segmented forms with specialized regions of differentiated metameres—may gradually lose their metamerized structure and become apparently and practically unisegmental animals. The change here contemplated is not the atrophy of terminal segments one by one so as to *reduce* the size of the animal and leave it finally as a single somite. On the contrary, no loss of size or of high organization is necessary. But one by one, and gradually, the metameric grouping of the bodily structures disappears. The cuticle ceases to be thickened in rings—the muscles of the body-wall overrun their somite boundaries. Internal septa disappear. The nerve-ganglia concentrate or else become diffused equally along the cords; one pair of renal coelomoducts and one pair of genital coelomoducts grow to large size and remain—the rest disappear. The appendages atrophy or become limited to one or two pairs which are widely dislocated from their ancestral position. The animal ceases to present any indication of metameric repetition of parts in its entire structure. Degrees in this process are frequently to be recognized. We certainly can observe such a change in the posterior region of some Arthropods, such as the hermit-crabs and the spiders. Admitting that the Echiurids are descended from Chaetopoda, such a change has taken place in them, amounting to little short of complete lipomerism, though not absolutely complete.

Recent suggestions as to the origin of the Mollusca involve the supposition that such an effacement of once well-marked metamerism has occurred in them, leaving its traces only in a few structures such as the multiple gill-plumes and shell-shields of the Chitons and the duplicated renal sacs of *Nautilus*.

A further matter of importance in this connexion is that when the old metameres have been effaced a new secondary segmentation may arise, as in the jointed worm-like body of the degenerate Acarid, *Demodex folliculorum*.

Such secondary annulation of the soft body calls to mind the secondary annulation of the metameres of leeches and some earthworms. Space does not permit of more than an allusion to this subject; but it is worth while noting that the secondary annuli marking the somites of leeches and *Lumbricidae* in definite number and character are perhaps comparable to the redundant pairs of appendages on the hinder somites of *Apus*, and are in both cases examples of independent repetition of tegumentary meromes—a sort of ineffectual attempt to subdivide the somite which only prevails on the more-readily susceptible meromes of the integument.

The last law of metamerism which we shall attempt to formulate here, as the THIRTEENTH, relates to the fusion or blending of neighbouring somites. Fusion of adjacent somites has often been erroneously interpreted in the study of Arthropoda. There are, in fact, very varying degrees of fusion which need to be carefully distinguished. The following generalization may be formulated. "The homologous meromes of two or more adjacent somites tend to fuse with one another by a blending of their substance. Very generally, but not invariably, the fused meromes are found as distinct separated structures in the embryo of the animal, in which they unite at a later stage of growth." The fusion of neighbouring meromes is often preceded by more or less extensive atrophy of the somites concerned, and by arrest of development in the individual ontogeny. Thus, a case of fusion of partially atrophied somites may simulate the appearance of incipient merogenesis or formation of new somites, and, vice versa, incipient merogenesis may be misinterpreted as a case of fusion of once separate and fully-formed somites.

A very complete fusion of somites is that seen on the head of Arthropoda. The head or prosoma of Arthropoda is a tagma consisting of one, two, or three prosthomeres or somites in front of the mouth and of one, two, three, up to five or six opisthomeres. The cephalic tagma or prosoma may thus be more or less sharply divided into two subtagmata, the prae-oral and the post-oral.

(E. R. L.)

METAMORPHISM (Gr. μετά, change of, and μορφή, shape), in petrology, the alteration of rocks in their structural or mineral characters by which they are transformed into new types. In the history of rock masses changes of many kinds are inevitable. Loose sands, clays and heaps of shells are gradually converted into sandstones, shales and limestones by the action of percolating water and the pressure of over-lying accumulations. All rocks exposed at the earth's surface or traversed by waters circulating through the earth's crust, undergo changes in their component minerals due to weathering and the chemical action of the atmosphere and of rain. These processes of cementation and decomposition, though not unlike those of metamorphism, are not regarded as essentially the same. They are considered, so to speak, normal episodes in the history of rocks to which all are subject. When rocks, however, are exposed to the heat of intrusive masses (granite, &c.) or have been compressed, folded, crushed, and more or less completely recrystallized, they assume new characters so different from their original ones that they are ascribed to a quite distinct class, namely, the *metamorphic rocks.*

The transformation is always gradual, so that in suitable districts every stage can be followed from an unaltered or nearly unaltered sedimentary or igneous rock to a perfectly metamorphic one. The transition may be slow or rapid, and the abundance of intermediate forms renders it impossible to lay down any hard and fast lines of distinction. A black shale with fossils may in two or three feet pass into a splintery hornfels; a sandstone or grit becomes a sheared grit, a granulitic gneiss, and a completely recrystallized gneiss sometimes within a few hundred yards; in a thoroughly metamorphic hornblende-schist or chlorite-schist small kernels sometimes occur which can easily be recognized as little modified dolerites or diabases. Still, the metamorphic rocks as a class have many well-defined characteristics, and in perfectly typical development cover enormous areas of the earth's surface and must be, in the aggregate, of vast thickness. A great number of them are recognizably of igneous origin; others are equally certainly sedimentary. Hence some writers have suggested that they are not entitled to rank as a separate class, but only as states or conditions of other rocks. It is generally agreed, however, that when the primitive structures and the original minerals of sedimentary or igneous rocks are so transformed as to be no longer easily recognizable the rock should be included in the metamorphic class.

Only rarely, however, does metamorphism produce much difference in the chemical composition of the rocks affected. Sandstones become quartzites and quartz schists, limestones are converted into marbles, granite passes into gneiss, and so on, without their bulk composition being greatly modified. From all that we know it seems established that however great the heat and pressure to which metamorphic rocks have been exposed they have very rarely been melted or reduced to the liquid state. Hence there has been no opportunity for intermixture by solution or diffusion; the changes, including the growth of crystals of new-formed minerals, have gone on in the solid rocks. The chemical molecules already present have aggregated into new combinations and have built up new minerals without travelling for more than infinitesimal distances from the places they occupied in the original rock. Exceptions to this occur, but they are so few that they do not invalidate the general rule. Thin bands of limestone, for example, may be followed for miles in belts of mica-schist or gneiss, never losing their identity by blending with the rocks on either side of them. By tracing out zones such as these it is often possible to unravel the highly complicated stratigraphy of metamorphic regions where the rocks have been greatly folded and displaced. Another important consequence of the persistence of the chemical individuality of metamorphosed rocks is that very often an analysis indicates in the clearest possible fashion what was the original nature of the rock mass. Sandstones, limestones, ironstones, shales, granites, dolerites and serpentines may be totally changed in structure and very completely also in mineral composition, but their chemical characters are practically indelible. Confusion arises sometimes from the fact that two rocks of different origin may have much the same composition, *e.g.* a felspathic sandstone may closely approach a granite, or an impure dolomite may simulate a basic igneous rock. Individual specimens, consequently, cannot always be relegated with perfect certainty to sediments or igneous rocks; but in dealing with a complex containing a variety of types the geologist is rarely long in doubt as to their original nature.

Two distinct kinds of metamorphism are recognized, namely contact or thermal metamorphism, and folding or regional metamorphism. The former is associated with intrusive masses of molten igneous rock which were injected at a very high temperature and produced extensive changes in the surrounding rocks. The second occurs in districts where earth folding and the movements attendant on the formation of mountain ranges have flexured and crushed the strata, probably at the same time considerably raising their temperature. Although these processes are very different in their origin, and in the great majority of cases produce quite different effects on the rocks they involve, there are instances in which the results are closely comparable. A sandstone may be converted into quartzite and a limestone into marble by either kind of metamorphism. It is best, however, to describe them as phenomena essentially different from one another.

Contact Metamorphism (*thermo-metamorphism*).—Any kind of rock—igneous or sedimentary—which has come in contact with an igneous molten magma is likely to show alteration of this type. The extent and intensity of the changes depend principally on two factors: (1) the nature of the rock concerned, and (2) the magnitude of the igneous mass. It is to be expected that a great intrusion of granite will produce more extensive effects of this kind than a narrow dike a few inches or a few feet broad. At the edges of such dikes only a slight induration may be noticeable in the country rock, or there may be recrystallization with formation of new minerals for a few inches. Rarely does the alteration extend beyond this. Shales are baked and hardened, sandstones are rendered more compact or occasionally are partly fused, limestones may be converted into marble containing garnet, wollastonite, augite or other calc-silicates. A great granite boss, which may be ten or twenty miles broad, is often surrounded by a wide aureole of contact alteration. This may be a few hundred yards broad or a couple of miles; in rare cases the breadth of the aureole is only a few yards. These variations may have structural causes; thus when the aureole is narrow the junction of granite with country rock may be vertical; when the aureole is broad the granite may be a flat-topped mass which dips at low angles outwards on each side. When a broad aureole accompanies a vertical junction we may suppose that molten rock has flowed upwards along this boundary line for a prolonged period, and has gradually raised the rocks to a very high temperature, even at some distance away from the contact. Where the alteration is slight and local there is usually something in the composition of the rocks or in their crystalline state to account for this.

No less important is the nature of the rocks involved. Where a granite intrudes into a succession of various types of sedimentary and igneous rocks the differences in their behaviour are often very marked. Sandstones alter less readily than shales or slates, and limestones, especially if they be marly or argillaceous, are often full of new minerals, when purer shales on each side of them are not visibly affected. Schists and gneisses, being already highly crystalline, are very resistant to thermal alteration, and may show it only for a few inches where they are in actual contact with the granite, or in minute fragments which have been broken off and surrounded by the invading magma. Igneous rocks, since they consist of minerals which have formed at very high temperatures, may show no change whatever. If they are decomposed, however, their secondary products, including those which fill veins and amygdaloidal cavities, are often entirely recrystallized in new combinations. Instances of this will be given later.

The intensity of the alteration depends very greatly on the proximity to the intrusive rock. A typical aureole surrounding a granite boss, for example, consists of rocks in all stages of alteration, the most affected being nearest the granite, while as we travel outwards we pass over zones of successively diminishing metamorphism. Around the granites of Cornwall, the Lake District and Ireland there are tracts of altered slate which show these stages very well. The first sign of metamorphism is a slight increase in hardness and glossiness, making the slate a little brighter and more brittle. This is due to the formation of mica in small crystalline plates mostly parallel to the cleavage of the rock. Nearer the granite a faint spotting is visible on broken surfaces of the slates, and this becomes more pronounced as we enter the middle part of the aureole. These spotted slates, in Cornwall for instance, often occupy a zone a mile in breadth. They are less fissile than the unaltered slates and have rounded or elliptical spots about a quarter of an inch across. The spots are usually darker than the body of the slate, though sometimes paler. Angular, branched, lenticular and rhomboidal spots sometimes occur. Under the microscope these rocks consist mainly of brown mica, quartz and organic matters, iron oxides, &c.; the spots may be due to aggregation of biotite or of quartz, but often differ little in composition from the surrounding rock. Their dark colour is due to abundance of iron oxides or graphite, with chlorite and biotite. Still closer to the granite a development of crystals takes place in the slates; the commonest are andalusite, chiastolite (with cross-shaped dark enclosures), cordierite, staurolite and garnet. At the same time the minerals formerly enumerated crystallize in larger individuals (biotite, quartz, iron oxides, &c.), so that the rock becomes rather more coarse-grained. At this stage the fissility and cleavage structures of the slate tend to be obliterated, and the rocks are dark, lustrous (from the abundance of mica), hard and splintery. To this type the name *hornfels* is given. The innermost zones of the aureole consist mainly of hornfelses, and where there are slate fragments enclosed in the granite they usually show these characters in their most pronounced form.

The nature of the new minerals produced depends principally, of course, on the chemical composition of the rocks affected. In pure sandstones only quartz is formed, and pure limestones merely recrystallize as marbles. Argillaceous rocks are characterized by abundance of alumina; hence, when thermally altered, they may contain corundum, or silicates of alumina such as sillimanite, kyanite, andalusite and chiastolite. Most rock masses, however, are far from pure and hence the variety of minerals which may arise in them from contact alteration is very great. Argillaceous limestones, for example, very frequently contain garnet, vesuvianite, wollastonite, diopside, tremolite, sphene, epidote and feldspar; that is to say, minerals in which lime is present along with silica, alumina, magnesia and other substances. Calcareous sandstones yield augite, garnet, sphene, epidote; argillaceous sandstones are characterized rather by biotite, sillimanite and spinel.

In each case the materials already present in the rock have united to form new mineral combinations. Crystallization has been stimulated by the rise of temperature, aided, no doubt, by moisture. Water vapour, even at comparatively low temperatures when the pressure is considerable, is a powerful mineralizing agent and greatly facilitates crystallization. Often the rocks acquire ultimately a pseudoporphyritic or porphyro-blastic structure, as they contain large or conspicuous crystals scattered through a finer grained ground-mass; not only these porphyritic ingredients but the body of the rock shows increased crystallization, for contact alteration as a rule makes rocks more coarse-grained than before.

In rare instances fusion may take place, but this must be exceptional, as the finest original structures are often very perfectly preserved by rocks which have been in great measure recrystallized. Finely laminated argillaceous sandstones, for example, may pass into cordierite—or andalusite—hornfelses showing a mineral banding which corresponds exactly with the original lamination. For this reason the newly developed minerals are not frequently of good crystalline form. When weathered out of the rock they have mostly rough, imperfect faces, but exceptions to this occur in garnet, staurolite, tourmaline and a few others which often produce good crystals even in these adverse circumstances.

It is only true in a general way that the rocks which are thermally altered experience no change in their chemical composition. The new minerals which are substituted for the original ones are such as are stable at high temperatures. Many of the silicates which form a large part of sedimentary rocks contain combined water; examples are chlorite, kaolin and clay. The water, or part of it, is expelled, forming silicates with little or no water, *e.g.* biotite, felspar, andalusite. Carbonic acid may be retained or driven out; in a siliceous limestone the silica tends to combine with the lime producing calc-silicates by replacing the carbonic acid. In a pure limestone the carbonate merely recrystallizes as marble. This loss of volatile ingredients must occasion a diminution in the bulk of the sedimentary mass involved; in cooling there will be contraction, and fissures are produced which may be filled with igneous dikes or with veins deposited by ascending hot waters. Hence contact aureoles are common sites for mineral deposits of economic value.

In some aureoles the sediments or schists have their bedding and foliation planes wedged apart by the intrusive force of the granite, and are permeated by igneous material invading them along these fissures. In this way a *mélange* is produced of sedimentary rock with threads and veinlets of igneous nature, and to some extent a blending of the two rocks takes place, though usually each preserves its identity however intimately mixed. In microscopic sections veins of granite not more than a tenth of an inch in width may be traced, sharply distinct from the slate or schist they penetrate. Cases, however, are described in which the rocks of the aureole have been felspathized or filled with new felspar derived from the granite; this, however, is not common. Shales are often converted, when in contact with diabase, into pale-coloured, flinty-looking rocks known as adinoles. These are exceptionally rich in albite and contain as much as 10 % of soda, an amount which is not met with in unaltered shales. It seems probable that alkalis have been transferred from the igneous rock to the sedimentary, perhaps through the medium of the vapours exhaled. The breadth of the adinole belt is as a rule only a few inches or a foot or two.

The vapours given off by intrusive igneous masses may contain substances which combine with the ingredients of the surrounding rocks and thus modify their composition. Boron, fluorine and phosphorus are the principal elements which are transferred in this way, and minerals such as tourmaline, topaz and mica are the characteristic products in quartzose or argillaceous rocks; while apatite, fluorspar, axinite, datolite and chondrodite are commonest in limestones. This is a form of pneumatolytic action (see PNEUMATOLYSIS).

Extreme cases of the mutual interaction of the intrusive rock with the masses invaded by it are provided by the fragments enclosed in the molten magma (known as *xenoliths*). These are often rounded and eroded, as if softened or partly fused and dissolved. Similar changes are found in the rocks of the aureole for a few feet or yards where in actual contact with the granite. This belt of indurated hornfelses often weathers much more slowly than the igneous rock, and stands out as a prominent, sharp-edged ridge running round the granite margin.

Where sediments are dissolved in igneous rock we may expect to find modifications in the chemical composition and in the minerals produced on crystallization of the magma. Some granites, for example, which contain many rounded, partly dissolved enclosures of slate are themselves full of corundum, andalusite, cordierite and other minerals, which appear to indicate the effect of absorbed slate material. Much discussion has taken place as to the importance of such processes in modifying the facies presented by igneous rocks. Granites are alleged to have absorbed impure limestones and thus to be changed to diorites (Pyrénées). At the contact of the two rocks a narrow zone of diorite intervenes between the granite and the limestone. In this case an acid rock has become basic (or intermediate) in character; similarly, basic rocks—such as gabbro—are said to become granitic where they have melted down large quantities of felspathic quartzite. On the other side it is argued that as precisely the same modifications of the igneous rocks are known to occur where these explanations cannot possibly hold good—*e.g.* zones of diorite at the contact of granite with quartzite or mica-schist—they are really due to chemical segregation or differentiation in the magma and not to any admixture with foreign material.

Such modifications in the igneous rock at its contacts are often said to be endomorphic, while those which take place in the aureole or country rocks are exomorphic. The endomorphic changes are not always strictly of the nature of contact alteration. The commonest are the presence of a fine-grained, sometimes glassy, chilled edge due to rapid solidification from sudden cooling of the magma. The fine-grained marginal facies is often porphyritic, while the interior of the mass is granular or eugranitic. There is often a tendency to the development of special minerals in the edge of intrusive masses. Some of these arise probably from absorption of country rock, *e.g.* cordierite, andalusite, iron oxides (in granite). At the same time there may be a great abundance of angular or rounded enclosures, so that the marginal rock is brecciform. Where granite penetrates gabbro the fragments of the latter are sometimes melted down and digested in the granite till only the crystals of their augite or diallage are left (Skye). Granite margins are not always more basic than the average of the mass; they may be exceedingly rich in quartz and at the same time very coarse-grained or pegmatitic. This seems to arise from the production of fissures at the contact after the granite has to a large extent solidified. In these fissures the pegmatites are laid down by escaping vapours. Metasomatic changes are especially common also in this situation, and have often formed very valuable mineral deposits along igneous contacts. There also pneumatolytic processes often concentrate their attack; schorl-rock, greisen, topaz-rock and china-stone (or kaolinized granite) are characteristic products, and the active vapours often transform the sediments around, forming schorl-schist, calc-silicate rocks and sericite-schists.

Regional Metamorphism.—The second kind of metamorphism is known as "regional" because it is not confined to narrow areas like contact metamorphism, but affects wide tracts of country. Metamorphic rocks of this kind often cover a large part of a continent (*e.g.* the centre of Africa or Scandinavia and Finland). Whatever the causes be which produced it, they must have been of widespread operation and connected either with great geophysical processes or with definite stages of the earth's development. Where such rocks occur there is generally much evidence of earth movement accompanied by crushing and folding. They are very characteristic of the central axes of great mountain chains, especially when these have been denuded and their deeper cores exposed. Most geologists believe that this connexion is causal, holding that the contraction of the outer layers of the earth's crust, due to shrinkage of a nearly rigid shell upon a cooling and contracting interior, has bent and folded the rocks, and at the same time has crushed and largely recrystallized them. According to this view regional metamorphism is the result of pressure and folding; hence the name *dynamo-metamorphism* is frequently applied to it.

A great number of observations collected in all regions of the globe may be adduced in support of this hypothesis, forming a mass of evidence so strong as to be almost overwhelming. The structural features which prove that there has been great folding in these rocks are accompanied by microscopic and lithological characters which demonstrate that extensive crushing has taken place. Through progressive stages a slate with fossils may be traced into a phyllite, which becomes a mica-schist, or, in places, a micaceous gneiss. At first the fossils are distorted or torn apart, but they disappear as crystallization advances. Limestones under great pressure flow almost like plastic masses, losing their fossils and becoming crystalline. Grits, quartzites and granites show the effects of crushing in the pulverization of their minerals and the breaking down of their original clastic or igneous textures, fine slabby mylonites (*q.v.*) and granulites being produced. Moreover, the degree of metamorphism in the rock can often be shown to correspond closely to the extent to which it has been folded and crushed.

Another argument in favour of dynamo-metamorphism, which has been urged with much insistence by the extreme supporters of these theories, is the retention of original chemical characters in the metamorphic rocks. Some of them bear unmistakably the stamp of sedimentary origin, *e.g.* the limestones and marbles, quartzites, graphite-schists and aluminous mica-schists. Others have the normal composition of granites, diorites, gabbros and other types of plutonic igneous rocks. This leads to the inference that these were originally normal sediments and intrusives or lavas, and that their present crystalline state and foliated structure are the result of agencies which operated on them subsequently to their formation. Where the degree of metamorphism is not too high, and the folding and dislocation not too complex, the sandstones, shales and limestones may be mapped out, and igneous bosses, dikes and sills, with their contact aureoles, veins, pegmatites and segregations, convincingly delineated on the maps. This shows that a whole complex or terrane, consisting of diverse petrological types of normal sediments and igneous rocks, may be converted by metamorphism into a great series of gneisses and schists. Although recrystallization has been complete, the original rock masses still retain their identity in their new state.

The metamorphism in a rock series may be of nearly uniform intensity over a large area; the sediments, for example, may have all their clastic and organic structures effaced, and in the igneous rocks the porphyritic, ophitic, graphic and other textures may have completely disappeared. This, however, is not always the case, especially when the metamorphism is not of very intense degree. Parts of the rock may retain original structures, while others are typical crystalline schists and gneisses. Kernels, lumps or phacoids of massive rock are often found embedded in schists, and it is clear upon inspection that the phacoids represent the original state of the rock, while the schist is the effect of metamorphism. At other times a rock mass, such as an intrusive sill, is schistose at its edges and surrounded by schistose sediments, while near its centre it is almost entirely massive. The hard igneous rock has proved more rigid than the soft and plastic sediments; in folding, the latter have yielded to the stresses, and internal movement has produced foliation. The crystalline rock of the intrusive sheet has been strong enough to withstand the pressures and has folded like a rigid mass. At the junctions the effect of differential movement is shown by the presence of a belt of rock which often has a most pronounced schistosity. Some intrusive dikes show foliation especially marked along their edges; or they may be traversed by planes of movement, running obliquely or directly across them, and characterized by the development of very marked schistosity. Exceedingly sudden transitions between normal igneous rocks and schists or gneisses have been described in sheared dikes. A normal dolerite, with ophitic structure and abundant augite, has been shown to pass in a few feet or inches into an epidiorite, where hornblende has replaced the primary augite, and lastly into a perfectly typical hornblende-schist, completely recrystallized with development of epidote, green hornblende, sphene and other minerals of metamorphic facies from the original constituents of the dolerite. These phenomena are regarded as establishing that the rock had consolidated as a normal dolerite before the processes which caused the metamorphism began to act; that these processes resulted in internal movement in the rock mass along certain narrow belts; and that recrystallization was set up along with the development of schistose structure. The operating cause cannot have been anything but pressure, especially as the foliated rocks occur not infrequently in lines of dislocation and shear; in other cases the foliated types are at the margins of the dike, and the transition from massive igneous rock to metamorphic schist may take place within the space of one inch. The best examples of phenomena of this order are those described by J. J. H. Teall from Scourie in the north-west of Scotland.

Where rocks of any kind are traversed by powerful dislocations or thrusts they often present a schistose facies in the immediate vicinity of the planes of movement. In the Highlands of Scotland great thrusts occur, along which the rocks are displaced for distances which may be as much as ten miles; and immediately adjoining these thrust-planes very perfect foliation is induced in all kinds of rocks, sedimentary, igneous or metamorphic, which have been involved in the movements. The minute structure of these rocks is generally of the mylonitic, granulitic or finely crushed type. In the same way the serpentine of the Lizard in Cornwall passes into fine talcose and tremolitic schists along narrow zones of displacement. Many other examples of this might be cited from regions where folding and crushing have taken place on a large scale. As a rule, almost without exception, the foliation thus produced is parallel to the direction of movement in the rock masses.

In the mineral transformations which accompany metamorphism the operation of pressure is no less clearly indicated. There are, for example, three minerals which consist of silicate of alumina, viz. andalusite, sillimanite and kyanite. The last of these has the highest specific gravity. In andalusite-bearing rocks which have been sheared, with production of foliation, we sometimes find pseudomorphs of kyanite after andalusite, retaining the characteristic form of the original mineral. Compression, it seems reasonable to suppose, would produce that one of the three crystalline silicates of alumina which has its molecules most closely packed, and consequently the highest specific gravity. This explains the conversion of andalusite into kyanite. The principle that substances tend to assume that mineral form which has the least molecular volume is of wide application among metamorphic rocks. It has been calculated, for example, that when olivine and anorthite felspar are replaced by garnet (a change which takes place not infrequently when basic igneous rocks are metamorphosed) the molecular volume of the mineral aggregate diminishes from 145 to 121 or about 17%. On the other hand, when garnet is fused it recrystallizes as a mixture of olivine and anorthite. This has led to the generalization that all minerals formed by the crystallization of a fused magma at high temperatures have a large molecular volume, while those which are produced in rocks at temperatures below their fusion points and under great pressures have smaller molecular volumes. Loewinson Lessing pointed out that some minerals have a greater molecular volume than the oxides which enter into their composition; in other minerals the reverse holds good. The former group are, on the whole, characteristic of igneous rocks and products of contact alteration, both of which classes have been formed at high temperatures (*e.g.* wollastonite, spinel, nepheline, leucite and andalusite). The minerals of the second group are often of common occurrence in metamorphic schists and gneisses (*e.g.* staurolite, kyanite, hornblende, talc, epidote and garnet). Although there are exceptions to this rule, there can be no doubt that it expresses a generalization which is of great value in the study of mineral paragenesis.

The mineral changes are usually not of so simple a kind as those above enumerated. Mutual interaction takes place between adjacent components of the rocks. Titaniferous iron oxides, for example, obtain silica and lime from such minerals as augite or lime felspar and sphene results. Felspar often breaks up into epidote, quartz and albite; the epidote obtains its iron from adjacent crystals of augite or hornblende. Equations can be written to show the transformation of one rock to another; thus, diabase (labradorite, augite, ilmenite) may be converted into amphibolite (acid plagioclase, hornblende, garnet, sphene and quartz). In this case, the molecular volumes are for diabase 671 and for amphibolite 635·6, indicating a diminution on metamorphism. Many striking illustrations of this principle have been adduced. Caution, however, is required in applying it to concrete cases; if it was always strictly correct the metamorphic rocks should have higher specific gravities than their representatives among sediments and igneous rocks. Very frequently this is not the case, and there must be some counteracting process at work. We find this antagonistic principle in the tendency for the minerals of metamorphic rocks to contain water of combination, *e.g.* epidote, muscovite, chlorite, hornblende, talc. This indicates that they were formed at comparatively low temperatures.

We arrive then by many independent lines of reasoning (stratigraphical, microscopical, chemical and mineralogical evidence being abundantly available) at the conclusion that pressure acting on sedimentary and igneous rocks at temperatures below their fusion points has been able to change them into metamorphic rocks. This is the theory of dynamo-metamorphism, which has won acceptance from the majority of geologists who have made the petrology of metamorphic rocks their special study. It has still, however, many incisive critics, and in recent years dissent has on the whole gained strength.

One of the principal objections is that by these processes it is possible to destroy original structures and to break down the minerals of which a rock consists, but not to induce crystallization and build up rock structures of a new type. It is pointed out that in many regions the rocks though intensely folded are not highly metamorphic; in other places immense dislocations can be proved to exist, yet the rocks are only slightly altered or are converted into fine-grained mylonites and not into typical schists and gneisses. Conversely, it is argued, there are many districts where metamorphism is very intense, yet evidence of folding and pressure is only slight. It seems clear that another factor must be taken into account, and in all probability that factor is the action of water in rocks at a comparatively high temperature. All rock masses contain interstitial water, and many also consist of minerals in some of which water exists in combination. Hence all metamorphism must be regarded as taking place in presence of water. It is almost equally certain that metamorphism must be accompanied by a rise of temperature in nearly every case—in fact it is difficult to imagine such a process going on without considerable heat. Now heated water (or water vapour) is a most potent mineralizer. Crystals of quartz, for example, have been produced in glass tubes containing a little water, heated in a furnace to a temperature of about 300° C.

The heat required for the more intense stages of metamorphism may be derived from more than one source. Most regions of gneiss and schists contain igneous rocks in the form of great intrusive masses. These rocks themselves are frequently gneissose, and the possibility must not be overlooked that they were injected into the older rocks at a time when folding was going on. The metamorphism would then be partly of the contact type and partly the effect of pressure and movement, "pressure-contact-metamorphism." The vapours already present would be augmented by those given out from the igneous rock, and intensely crystalline, foliated masses, often containing minerals found in contact zones (andalusite, cordierite, sillimanite, staurolite, &c.), would be produced. Cases are now known where it is in every way probable that the metamorphism is the result of a combination of causes of this order. Some of the Alpine schists which surround the central granite gneisses have been referred to this group.

Heat must also have been produced by the crushing of the rock components. In many metamorphic rocks we find hard minerals possessing little cleavage (such as quartz) reduced to an exceedingly fine state of division, and it is clear that the stresses which have acted on regions of metamorphic rocks are often so powerful that all the minerals may have been completely shattered. The interstitial movement of the particles must also have generated heat. There are no experimental data to enable us to say what rise of temperature may have been produced in this way, but we cannot doubt that it was considerable. If the crushing was slow the heat generated may have been conducted away to the surface almost as fast as it was produced. If the belt of crushing was narrow, heat would rapidly pass away into the colder rocks beyond. This may explain why in some rocks there has been much grinding down but little crystallization. The heat also may be absorbed in promoting chemical combinations of the endothermal type, but it is not likely that much was used up in this way. With rising temperature the rocks would become more plastic and fold more readily. Then if the crushing and folding ceased, a long period would follow in which the temperature gradually fell. The minerals would crystallize in larger grains after the well-known law that the larger particles tend to grow at the expense of the smaller ones, and finely granulitic aggregates would be replaced by mosaics of coarser structure. If there has been a considerable rise of temperature we might expect analogies in structure and constitution between the folded rocks and those which come from a contact aureole; this has in fact been noted by many geologists.

Another factor which must have been of importance is the depth below the surface at which the rocks lay at the time when they were folded. In the deeper zones the pressures must have been greater, and the escape of the heat generated must have been less rapid. The uppermost members of a complex which was undergoing folding are under the lowest pressures, are at the lowest temperatures and probably also contain most moisture. Hence minerals such as epidote, chlorite, albite, sericite and carbonates, which are often produced by weathering alone, might be expected to prevail. In the deepest zones the temperature and pressure are high from the first and are increased by folding; such minerals as biotite, augite, garnet, felspar, sillimanite, kyanite and staurolite might be produced under these conditions. The earth's crust might in this way be divided into bathymetric zones, each of which was characterized by distinctive types of mineral paragenesis. Some geologists ascribe the greatest importance to this conception; they establish two or three types of metamorphism, each of which belongs, in their opinion, to a definite horizon. This is to some extent a resuscitation of the old idea, now discarded, that the Archean rocks are sediments of a peculiar kind formed only in the heated waters of the primal globe; the first deposits were laid down under great heat and pressure and are typical gneisses which may resemble igneous rocks; the schists of later origin exhibit a progressive transition to normal sediments. Without admitting that it is possible to classify metamorphic rocks according to the depth at which they were situated when metamorphosed, we may admit that there is much reason to believe that the more intense stages of alteration characterize as a rule the rock masses which were oldest or most deeply situated during the epoch of folding.

While rocks near the surface which are under comparatively slight pressures yield to stress by fracturing, it is conceivable that at greater depths the minerals would become plastic and suffer deformation without rupture. For this zone of "flowage," as he terms it, van Hise estimates a depth of not more than 12 kilometres, depending on many factors such as the strength of the rocks and nature of the minerals concerned, the temperature, amount of moisture and rapidity of the deformation. Between it and the zone of fracture, which lies above, a gradual transition must take place. Doelter, on the other hand, believes that the depth at which plastic flow begins must be at least 35 kilometres; it is difficult to imagine that rocks which have been so profoundly buried can now be exposed at any part of the earth's surface.

In the attempt to explain the existence of large masses of metamorphic rocks which are perfectly foliated, but at the same time coarsely crystalline, and show no grinding down of their components, as might be expected on the hypothesis of pure dynamo-metamorphism, F. Becke brought into prominence another principle which may prove to be widely applicable. Although known as Riecke's law, it was advanced many years ago by Sorby. It enunciates that when minerals are subjected to unilateral pressure (acting in a definite direction and not like hydrostatic pressure, equally in all directions) they tend to be dissolved on those sides which face the pressure, while the sides which are not compressed tend to grow by additional deposit. Minerals having platy or rod-like forms will thus be produced, all having a parallel orientation, and the rock will be schistose, with foliation corresponding in direction to the extension of the mineral plates, and perpendicular to the stresses which were in action. The solvents which dissolve the mineral on one side and deposit it on the other side are the interstitial moisture and vapours present in the rock. By this means schists and gneisses will be produced, which are perfectly foliated yet have their minerals homogeneous and uncrushed. Experimental data are at present wanting to show how far this principle is operative and what are its limits, but as a supplementary contribution to the theory of dynamometamorphism it may prove to be of great importance. This has been described as the development of "schistosity by crystallization."

More interesting still are E. Weinschenk's theories of pressure-crystallization and piezo-crystallization (pressure-contact action). He adduces evidence to show that many gneisses are igneous rocks which were foliated from the first, and a large body of observations in many European countries confirms his statement. In his opinion plutonic rocks crystallizing under certain conditions of pressure necessarily assume a banded structure, and contain minerals which are not identical with those of igneous rocks but with the components of schists and gneisses. In the surrounding rocks there is contact alteration but not of the ordinary type as the recrystallized products also have a banding or foliation owing to the pressure acting on them during metamorphism. Bonney urged the hypothesis that many gneisses are merely plutonic igneous rocks which exhibit a flow banding and an imperfect idiomorphism of their minerals owing to their having been injected in a half-solid state; the component crystals by mutual attrition assume rounded or lenticular forms. Undoubtedly there is much truth in these hypotheses, yet in both cases they seem to necessitate the presence of extraordinary earth-pressures such as accompany mountain building. We know that heat greatly increases the plasticity of rocks. Assuming that intrusions take place during an epoch of earth movement, we may be certain that as solidification goes on the pressures will force the rock forward, and the structures will be very different from those assumed by a rock which has crystallized in a condition of rest.

Lastly, there are many geologists who hold that certain kinds of gneiss are due to the injection of plutonic igneous rocks as masses of all sizes into sedimentary schists forming a *mélange*. The igneous rock veins the sediment in every direction; the veins are often exceedingly thin and nearly parallel or branch again and again. In this way a banding or foliation is set up, and the mixed rock has the appearance of a gneiss. In the sediment, intensely heated, new minerals are set up. The igneous rock digests or absorbs the materials which it penetrates; and it is often impossible to say what is igneous and what is sedimentary. Acid intrusions may in this way break up and partly assimilate older basic rocks. Very good examples of this process are known, and they may be much more common than is at present suspected. Conditions which favour assimilation at great depths are the enormous pressures and the high temperature of the earth's crust; the igneous rocks may also be much above their consolidation points. It is quite reasonable to believe that at deep levels absorption of sediments by igneous masses goes on extensively, while in higher zones there is little or none of this action. (J. S. F.)

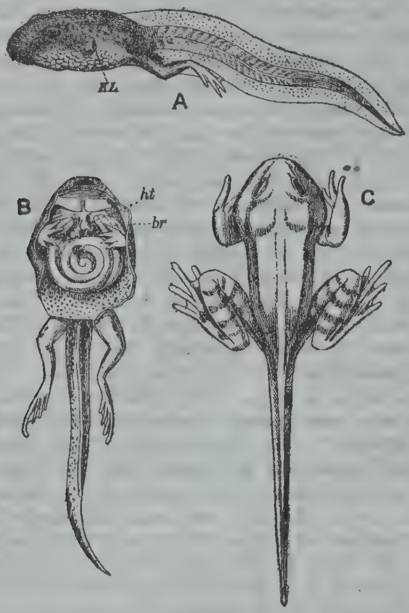
METAMORPHOSIS, a term used in zoology in different senses by different authors, and sometimes in different senses by the same author. E. Korschelt and K. Heider, in their work on the development of the Invertebrata, usually apply it to the whole of the larval development. For instance, in their account of the Bryozoa, they say (p. 18, part 2, of the English translation): "The metamorphosis of a Bryozoan larva comprises a more or less protracted free-swimming stage during which no perceptible advance is made in the development of the larva, and the subsequent somewhat complicated changes which bring about its transformation into the first primary zooid of the young Bryozoan colony." Throughout their account of the Crustacea they use the word in the same sense, *i.e.* as applied to the whole of the changes which the larva undergoes in passing into the adult. On the other hand, in their account of Mollusca they seem to restrict the term to the final change by which the larva passes into the adult form (*op. cit.*, part 4, p. 14). F. Balfour in his great work on Comparative Embryology seems to limit the word to a sudden change in the larval history. For instance, he says: "The chief point of interest in the above development is the fact of the primitive nauplius form becoming gradually converted without any special metamorphosis into the adult condition" (*Comparative Embryology*, 1885, i. 463). "By the free Cypris stage into which the larva next passes a very complete metamorphosis has been effected" (*op. cit.* i. 490). "The change undergone by the Tadpole in its passage into the Frog is so considerable as to deserve the name of a metamorphosis" (*op. cit.* ii. 137). Finally and most decisively he says in his general account of larvae: "In the larval type [of development] they are born at an earlier stage of development, in a condition differing to a greater or less extent from the adult, and reach the adult state either by a series of small steps or by a more or less considerable metamorphosis" (*op. cit.* ii. 360). Here the term will be used in the sense of the last quotations from Balfour and will be regarded as applicable only to those cases of sudden and marked change which frequently occur at the end of the larval period and sometimes at more or less frequent intervals during its course (Crustacea).

Some authors (see H. G. Bronn, *Thierreich*, "Myriapoda," Bd. 5, Abth. 2, p. 113) have applied the term "metamorphosis" only to those cases of larval development in which the young leaves the egg with provisional organs which are lost in the later development. Such authors apply the term "anamorphosis" to cases in which the just-hatched young is without provisional organs but differs from the adult in size, and in the number of segments and joints, &c. Such writers apply the term "epimorphosis" when there is merely an acquisition of sexual maturity and increase in size after birth or hatching.

The essential feature of metamorphosis is the sudden bursting into function of new organs, whether these organs suddenly arise or have been gradually formed, without becoming functional in preceding larval stages. Another feature of it is the disappearance of organs which have been of use to the larva but which are not required at all or are not required in the same form in the new environment. The term is only used in connexion with larval development and is not applied to the sudden changes, due to a change of environment (*e.g.* the passage of the mammalian embryo from the oviduct into the uterus), which sometimes occur in embryos. Neither is it used in connexion with the sudden changes of conditions which occur at the birth or hatching of an embryo, although, especially in the case of birth, this event is frequently accompanied by profound morphological alteration.

The most familiar examples of metamorphosis are the abrupt changes which occur at the end of the larval history of the frog and of many insects. In both these cases there is a sudden and great change of environment; there is a sudden demand for new organs which would have been quite useless in the old environment, and organs which were of use in the old environment and are of no use in the new have to be eliminated. The two examples we have chosen have the advantage of showing us the two methods by which the crisis in the life-history is met.

In the frog (fig. 1) the structural changes which obtain full fruition at the metamorphosis take place gradually during the previous tadpole life. They relate mainly to the alterations of the respiratory organs and vascular system which are required for the purely terrestrial life of the frog, and to the appearance of the paired limbs. The changes in the respiratory and vascular organs are led up to in the tadpole, which during the greater part of its aquatic life is a truly amphibious animal, breathing by lungs as well as by gills; but a sudden change occurs in these organs at the metamorphosis. The limbs which were slowly formed during tadpole life—the posterior pair visibly, the anterior under cover of the operculum (fig. 1, B)—are of no use to the tadpole and must constitute a pure burden to it. The principal events of the metamorphosis are the sudden appearance of the anterior limbs, and the complete closure of the gill aperture (fig. 1, C). The appearance of the anterior limbs and the acquisition of functional importance by both pairs enable the frog to leave the water and pass on to the land to lead its terrestrial life. The other larval organs, such as the gills and the tail, gradually shrink in size and ultimately vanish. In the case of the gills this shrinkage had begun before the metamorphosis, but the tail shows no sign of diminution until the frog is ready to pass on to the land.



After Leuckart and Nitsche's *Wandtafeln*, by permission of T G. Fisher & Co.

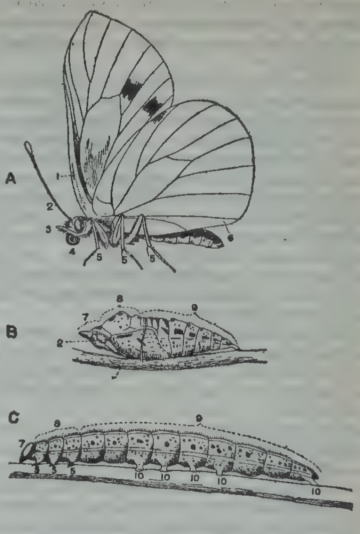
FIG. 1.—Drawings illustrating the metamorphosis of the frog (*Rana temporaria*).

A, Side view of an advanced tadpole with well-developed posterior limbs; the anterior limbs are present but hidden beneath the operculum.

B, Ventral view of the same with operculum removed showing the anterior limbs *in situ*; the ventral body wall has also been removed and the heart (*ht*) and intestine exposed. (*br*) Gills; (*KL*) spiracle.

C, A frog after the metamorphosis but before the absorption of the tail.

The distinguishing feature of this type of metamorphosis is that the animal is burdened for a certain period, both before and after, with organs which are useless to it. In the next type, which is exemplified by the metabolous Insecta, this occurs to a much smaller extent, although the changes of habitat and the corresponding changes of structure are more remarkable. In insecta the change is usually from a terrestrial or aquatic habitat to an aerial one. The larva of a butterfly is a worm-like organism which creeps on and voraciously devours the foliage of certain plants (fig. 2, C). During its life it undergoes much growth, but no important change in structure. When it leaves the egg it is adapted to live and feed on a particular species of plant, on or near which the eggs are deposited by the parent butterfly. It has powerful biting jaws by which it procures its vegetable food. The adult, on the other hand, is a winged creature which also lives on plants but in quite a different way to the larva (fig. 2, A). It flies from plant to plant and obtains its food by sucking the juices of flowers and other parts. The powerful mandibles of the larva have disappeared and in their place we find a suctorial proboscis formed by the first maxillae [fig. 2, A (4)].



After Leuckart and Nitsche's *Wandtafeln*, by permission of T. G. Fisher & Co.

FIG. 2.—Three stages in the life-history of the cabbage butterfly, *Pieris brassicae*, L.

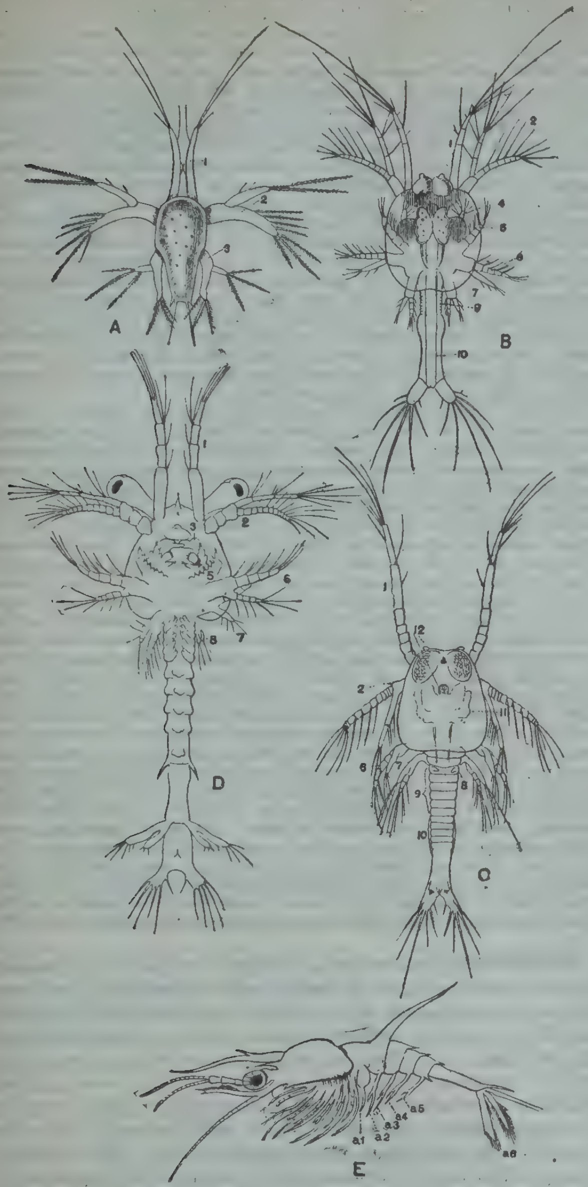
A, Imago (female), side view.

B, Pupa fixed by a cord across the middle of the body and by the tail.

C, Caterpillar.

(1) Forewing;
(2) antenna;
(3) labial palp;
(4) first maxilla;
(5) thoracic legs;
(6) hind wing;
(7) the head;
(8) the thorax;
(9) the abdomen, some of the segments of which in the caterpillar carry a pair of prolegs (10).

Between the larva and the adult insect there is interposed a resting stage, the so-called pupa (fig. 2, B), during which no food is taken, but very important changes of structure occur. These changes consist of two processes: (1) histolysis, by which most of the larval organs are destroyed by the action of phagocytes; and (2) histogenesis, by which the corresponding organs of the imago are developed from the imaginal disks. The imaginal disks appear to arise in the embryo in which they develop, some of them from the epiblast and some from the hypoblast. They persist practically unchanged through larval life and become active as centres of growth in the pupa. The pupal stage in such a metamorphosis may be compared to a second embryonic stage in which the organs of the adult assume their final shape. In this kind of metamorphosis the larval organs are entirely got rid of in the pupal stage, during which the insect is as a rule incapable of locomotion and takes no food; and the new formation of organs—especially those of locomotion and alimentation—which is necessitated by the totally different habits of the larva and mature insect, is also accomplished at the same period, largely, no doubt, at the expense of the material afforded by the disrupted larval organs. The larva itself does not form any of these organs and carry them about during its active life, though it does possess the very minute centres of growth known as the imaginal disks which burst into activity after the larval life is over. It must not be supposed that in all insects in which the sexual animal has a different habitat from the young form, there is a metamorphosis of the kind just described. In the may-flies and dragon-flies, in which the larva is aquatic, the change is prepared for some time before the actual metamorphosis, the organs which are necessary for the aerial existence being gradually acquired during larval life. In such cases, the metamorphosis belongs to our first type and consists of the act by which the organs previously and gradually acquired suddenly become functional. We have now considered in detail two typical cases of metamorphosis. In the first the change is gradually led up to and the larva is burdened, in its later stages at least, with organs which are of no use to it and only become functional at the metamorphosis. In the other, the change is not led up to. It is sudden, and a kind of second embryonic period is established to enable the important and far-reaching transformation to be accomplished. It is clear that the two kinds of metamorphosis only differ in degree and that no line can be drawn between them.



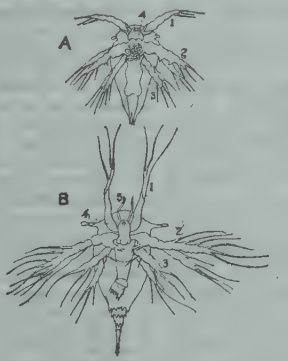
A and B after Fritz Müller in *Archiv. für Naturgeschichte*, vol. xxix., 1863; C, D, and E after C. Claus, *Untersuch. zur Erforschung Crustaceen-Systems.*

FIG. 3.—Drawings showing various stages in the larval history of *Penaeus.*

A, Nauplius larva, dorsal view, showing the three pairs of appendages and the simple median eye.
B, Protozoaea larva, dorsal view, the rudiments of the paired eyes are visible through the cuticle, by which the rudiments of the maxillae are still covered.
C, Older Protozoaea, dorsal view; the six posterior thoracic segments are distinct, but the five abdominal segments are still hidden beneath the skin.
D, Zoaea larva, ventral view, with the rudiments of the thoracic limbs and the appendages of the sixth abdominal segment.
E, Mysis stage, side view; the thoracic and abdominal appendages have been developed.

(1) first antenna;
(2) second ,,
(3) mandible;
(4) first maxilla;
(5) second ,,
(6) first maxilliped;
(7) second ,,
(8) third ,,
(9) thorax;
(10) abdomen;
(11) liver;
(12) frontal sense organ, just behind which are the compound eyes;
(a1) to (a6) the six abdominal appendages.

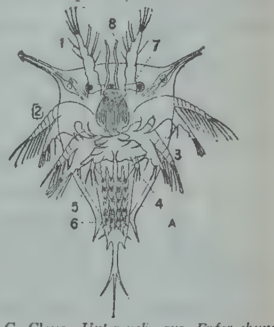
In the Crustacea, as has already been pointed out, many authors apply the term metamorphosis to the whole larval development, which consists of a series of changes leading to the adult form. But this is in our opinion an incorrect use of the word. The typical larval development of a Crustacean consists of a series of small metamorphoses. At each moult new organs which have been developed since the preceding moult become manifest and some of them functional. For instance, the prawn *Penaeus* leaves the egg as a nauplius larva (fig. 3, A). It issues from the first moult as a metanauplius which has a forked tail, a beginning of the cephalo-thoracic shield, and a large helmet-shaped upper lip. It also possesses stump-like rudiments of the maxillae and two anterior pairs of maxillipeds. After the next moult it is known as a protozoaea (fig. 3, B), in which a cephalo-thoracic shield is well developed, the posterior part of the body is prolonged into a tail, in the anterior part of which the thoracic segments are obscurely indicated, and the four pairs of stump-like rudiments have become functional appendages [fig. 3, B (4), (5), (6), (7)]. This passes into a later protozoaea stage (C) in which the rudiments of the compound eyes and of the abdominal segments are visible beneath the cuticle and in which certain functional changes (jointing, &c.) have appeared in the limbs. This is succeeded by the zoaea stage (fig. 3, D), characterized by the stalked and functional condition of the eyes, the increased size of the abdominal segments, and the appearance of appendages on the sixth of them, the increase of size in the third pair of maxillipeds (8) which had appeared as small rudiments in the preceding stage, and the appearance of the five pairs of posterior thoracic limbs as small biramous appendages. The zoaea stage is followed by the mysis stage (fig. 3, E) in which the thoracic feet are biramous, as in *Mysis.* From this the adult form proceeds. The transformation is more gradual than would be gathered from this short description, because moults occur during the later stages from each of which the larva comes with some slight transformation.



After Spence Bate in *Annals and Magazine of Nat. History*, vol. 8, 2nd series, 1851.

FIG. 4.—Nauplius of *Balanus balanoides.*

A, As just hatched;
B, After the first moult.
(1) first pair of nauplius appendages;
(2) second ,, ,,
(3) third ,, ,,
(4) upper lip;
(5) frontal sense organ.

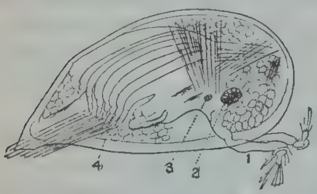


After C. Claus, *Untersuch. zur Erforschung Crustaceen-Systems.*

FIG. 5.—Metanauplius larva of *Balanus* (Naples), immediately preceding the Cypris larva; ventral view. The six pairs of biramous appendages of the Cypris stage are visible beneath the cuticle. The median simple eye and the compound eye are both visible.

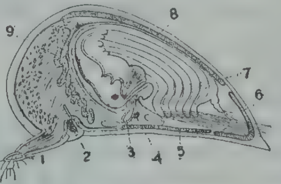
(1) first antenna;
(2) second ,,
(3) mandibles;
(4) rudiment of the maxilla;
(5) first pair of biramous limbs;
(6) sixth ,, ,,
(7) upper lip;
(8) frontal sense organs.

In the life-history of a typical Cirripede there may be said to be two distinct metamorphoses, with gradual developmental stages taking place between them. The animal is hatched as a nauplius. This undergoes a series of moults during which increase in size and slight changes in form occur (fig. 4, A, B). At the last of them several organs characteristic of the second or *Cypris* stage are discernible [fig. 5 (5), (6)] beneath the cuticle. When this is moulted the free-swimming cypris larva is liberated with its six pairs of biramous thoracic legs, its bivalve shell, and its paired compound eyes (fig. 6). This is the first metamorphosis. After a certain period of free life the Cypris larva attaches itself by its anterior antennae to some foreign object and enters upon the pupal stage (fig. 7). During this the larva takes no food and ceases to move, and undergoes important changes of structure and form beneath the larval cuticle, which invests it like a pupal case. These changes lead to the attainment of the adult form and structure. When they are completed the cuticle, including the shell-valves, is cast off and the young cirriped emerges. This is the second and final metamorphosis, which resembles in its main features the metamorphosis of the metabolous Insecta.



After C. Claus, *Schriften der Gesellsch. zur Beförd. der gesammten Naturwissen. zu Marburg.*

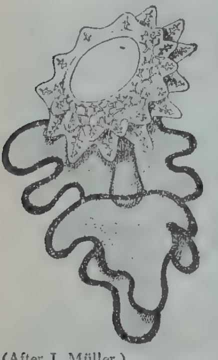
FIG. 6.—Cypris larva of *Lepas fascicularis.*
(1) first antenna;
(2) compound eye;
(3) simple eye;
(4) biramous appendages.



After C. Claus, *Untersuch. zur Erforschung Crustaceen-Systems.*

FIG. 7.—Pupa of *Lepas pectinata* in optical section.
(1) first antenna; (6) tergum;
(2) compound eye; (7) biramous feet;
(3) liver; (8) carina;
(4) simple eye; (9) cement gland.
(5) scutum;

Metamorphosis occurs in most groups of the animal kingdom. It is generally found in attached organisms, for these nearly always have free-swimming larvae and the metamorphosis occurs when the change of habit is effected. For the details of the process the reader is referred to systematic works on zoology. Here only the most striking instances of it can be mentioned. It occurs in a remarkable form in some sponges, in which at the metamorphosis the larval epidermis, which acts as a locomotive organ, is said to become transformed into the collared flagellated cells of the canal system, the adult epidermis being a new formation. It occurs in the Polyzoa, and is, in some of these, characterized by an almost complete disruption of the larval organs and a subsequent new formation of the organs of the adult. The metamorphosis in such cases belongs to our second type, the new organs being new formations at the metamorphosis and not developed from rudiments which make their appearance in the earlier larval history. In *Phoronis* the metamorphosis of the larva (Actinotrocha), which occurs on fixation, is gradually led up to, but the mode of destruction of some of the larval organs is peculiar; the brain and sense organs of the larva pass into the stomach and are digested. In the Tunicata, in which fixation of the free larva is effected by the head, as in Cirripedia and some, if not all, Polyzoa, the metamorphosis occurs entirely after fixation as a rapid series of developmental changes which occur *ad hoc* and are not prepared for by preceding changes. In Amphioxus there is no metamorphosis though the larval changes are most remarkable and extensive, but the larval life is a long one and the development very gradual, the new organs coming into function as soon as they are formed.



(After J. Müller.)

FIG. 8.—A ventral view of a bipinnaria carrying the body of the young star-fish.

In most Mollusca there is also a prolonged and important larval life, marked by very interesting stages of structure (trochosphere, veliger, &c.), but it is not usual to speak of a metamorphosis for the changes are gradual, each organ developing with great rapidity and coming into function at once. In certain forms, however, a metamorphosis occurs, *e.g.* in the glochidium larva of *Anodonta*, which embeds itself in the skin of a fish and there metamorphoses into the adult.

In the Echinodermata there is a particular stage in the larval history, when the ciliary locomotive apparatus breaks up and is absorbed and the animal takes to its creeping adult life. This metamorphosis is gradually prepared for in the precedent larval development by changes which ultimately lead to the complete establishment of the adult radial symmetry. The metamorphosis belongs therefore to our first type, but it is remarkable for the heavy burden of adult structures which the larva, in its later stages at least, carries about (fig. 8). The adult body is, in the main, fashioned out of the larval body, and it takes over most of the organs of the latter; but as a rule the adult mouth, oesophagus and anus are new formations, and the central nervous system of the larva when present shares the fate of the larval locomotory apparatus. In Asteroids and Crinoids the metamorphosis is accompanied by fixation to foreign objects, the fixation being effected as in Cirripedes by the preoral lobe.

In the Vertebrata a metamorphosis occurs in the lamprey and the Amphibia. The metamorphosis of the lamprey is peculiar. It lives for three or four years as a sexless larva, known as the ammocoete. It then quite rapidly (in three or four days) undergoes a series of changes and becomes converted into the adult. The metamorphosis affects the alimentary canal, the eyes, the respiratory apparatus and other organs, and especially the reproductive organs, which become mature. The adult lives for a few months only, spawning soon after the metamorphosis. This metamorphosis belongs to our second type, but there does not appear to be any resting stage during the few days in which it is effected. In the Amphibia the metamorphosis is fairly exemplified by that of the frog. In many fishes there is a considerable larval development, but this is perfectly gradual and there does not appear to be anything of the nature of a metamorphosis.

In most cases of metamorphosis those organs of the larva, which are found also in the adult, persist through the transformation, undergoing merely the ordinary modifications of development. But it sometimes happens that such organs are completely destroyed and rebuilt during the metamorphosis. This is conspicuously the case in the metabolous Insecta, in some of which all the internal organs undergo disruption and are reformed. It happens also in those nemertine worms which develop by a larva; in these the larval epidermis is cast off, a new one having been formed. It is possible that the same phenomenon occurs in sponges. In most Echinoderms a similar phenomenon is observed with regard to the oesophagus and the mouth and anus. The probable explanation of this remarkable phenomenon would appear to be that in certain cases the larval organs become so highly specialized in connexion with the larval life that they are unable to undergo further change; new formation is therefore necessary. The phenomenon is one of considerable interest, for it is found in the case of the blastopore, in cases in which there is no metamorphosis, sometimes even in embryonic development. There can be little doubt that the mouth and anus are both genetically connected with the earlier blastopore and that the blastopore is homologous in most animals; and yet how seldom does the blastopore become transformed into the adult openings and how various is its fate. The hypothesis suggested above applies completely to this behaviour of the blastopore; that is to say, it is suggested that the primitive mouth or blastopore becomes, or has become in some vanished larval history, so highly specialized in connexion with larval needs that it is unable to give rise to both mouth and anus, and in some cases to either. (A. Se.*)

METAPHOR (Gr. μεταφορά, transfer of sense, from μεταφέρειν, to carry over), a figure of speech, which consists in the transference to one object of an attribute or name which strictly and literally is not applicable to it, but only figuratively and by analogy. It is thus in essence an emphatic comparison, which if expressed formally is a "simile" (Lat. *similis*, like); thus it is a metaphorical expression to speak of a ship ploughing her way through the waves, but a simile when it takes the form of "the ship, like a plough, moves," &c. The "simple" metaphor, such as the instance given, becomes the "continued" metaphor when the analogy or similitude is worked out in a series of phrases and expressions based on the primary metaphor; it is in such "continued metaphors" that the solecism of "mixed" metaphors is likely to occur.

METAPHYSICS, or METAPHYSIC (from Gr. μετά, after, φυσικά, things of nature, φύσις, *i.e.* the natural universe), the accepted name of one of the four great departments of philosophy (*q.v.*). The term was first applied to one of the treatises of Aristotle on the basis of the arrangement of the Aristotelian canon made by Andronicus of Rhodes, in which it was placed "after the physical treatises" with the description τὰ μετὰ τὰ φυσικά. The term was used not in the modern sense of above or transcending nature (a sense which μετά cannot bear), but simply to convey the idea that the treatise so-called comes "after" the physical treatises.[1] It is therefore nothing more than a literary accident that the term has been applied to that department or discipline of philosophy which deals with first principles. Aristotle himself described the subject matter of the treatise as "First

[1] On the true order of the Aristotelian treatises see ARISTOTLE.

Philosophy" or "Theology," which deals with being as being (*Metaph.* Γ. i., ἐστὶν ἐπιστήμη τις ἣ θεωρεῖ τὸ ὂν ᾗ ὂν καὶ τὰ τούτῳ ὑπάρχοντα καθ' αὑτό). From this phrase is derived the later term "Ontology" (*q.v.*). The misapprehension of the significance of μετά led to various mistaken uses of the term "metaphysics," *e.g.* for that which is concerned with the supernatural, not only by the schoolmen but even as late as 17th-century English writers, and within narrower limits the term has been dangerously ambiguous even in the hands of modern philosophers (see below). In the widest sense it may include both the "first philosophy" of Aristotle, and the theory of knowledge (in what sense can there be true knowledge?), *i.e.* both ontology and epistemology (*q.v.*), and this is perhaps the most convenient use of the term; Kant, on the other hand, would represent metaphysics as being "nothing more than the inventory of all that is given us by pure reason, systematically arranged" (*i.e.* epistemology). The earliest "metaphysicians" concerned themselves with the nature of being (ontology), seeking for the unity which they postulated behind the multiplicity of phenomena (see IONIAN SCHOOL OF PHILOSOPHY and articles on the separate thinkers); later thinkers tended to inquire rather into the nature of knowledge as the necessary pre-requisite of ontological investigation. The extent to which these two attitudes have been combined or separated is discussed in the ensuing article which deals with the various schools of modern metaphysics in relation to the principles of the Aristotelian "first philosophy."[1] (X)

1.—The Science of Being

Side by side with psychology, the science of mind, and with logic, the science of reasoning, metaphysics is tending gradually to reassert its ancient Aristotelian position as the science of being in general. Not long ago, in England at all events, metaphysics was merged in psychology. But with the decline of dogmatic belief and the spread of religious doubt—as the special sciences also grow more general, and the natural sciences become more speculative about matter and force, evolution and teleology—men begin to wonder again about the nature and origin of things, just as it was the decay of polytheism in Greek religion and his own discoveries in natural science which impelled Aristotle to metaphysical questions. There is, however, a certain difference in the way of approaching things. Aristotle emphasized being as being, without always sufficiently asking whether the things whose existence he asserted are really knowable. We, on the contrary, mainly through the influence of Descartes, rather ask what are the things we know, and therefore, some more and some less, come to connect ontology with epistemology, and in consequence come to treat metaphysics in relation to psychology and logic, from which epistemology is an offshoot.

To this pressing question then—What is the world as we know it?—three kinds of definite answers are returned: those of materialism, idealism and realism, according to the emphasis laid by metaphysicians on body, on mind, or on both. *Metaphysical materialism* is the view that everything known is body or matter; but while according to ancient materialists soul is only another body, according to modern materialists mind without soul is only an attribute or function of body. *Metaphysical idealism* is the view that everything known is mind, or some mental state or other, which some idealists suppose to require a substantial soul, others not; while all agree that body has no different being apart from mind. *Metaphysical realism* is the intermediate view that everything known is either body or soul, neither of which alone exhausts the universe of being. Aristotle, the founder of metaphysics as a distinct science, was also the founder of metaphysical realism, and still remains its main authority. His view was that all things are substances, in the sense of distinct individuals, each of which has a being of its own different from any other, whereas an attribute has only the being of its substance (*Met.* Z 1–3; *Post. An.* i. 4); that bodies in nature are obviously natural substances, and as obviously not the only kind of substance; and that there is supernatural substance, *e.g.* God, who is an eternal, perfect, living being, thinking, but without matter, and therefore not a body.

At the present day realism is despised on the ground that its differentiation of body and soul, natural and supernatural, ignores the unity of being. Indeed, in order to oppose this unity of being to the realistic duality, both materialists and idealists describe themselves as monists, and call realists dualists by way of disparagement. But we cannot classify metaphysics by the antithesis of monism and dualism without making confusion worse confounded. Not to mention that it has led to another variety, calling itself pluralism, it confuses materialism and idealism. Extremes meet; and those who believe only in body and those who believe only in mind, have an equal right to the equivocal term "monist." Moreover, there is no real opposition between monism and dualism, for there can very well be one kind of being, without being all body or all soul; and as a matter of fact, Aristotelian realism is both a monism of substance and a dualism of body and soul.

It is in any case unfair to decide questions by disparaging terms, and to argue as if the whole choice were between materialistic or idealistic monism, leaving realism out of court. In this case it would also hide the truth of things, which requires two different kinds of substance, body and soul. The strength of materialism consists in recognizing nature without explaining it away, its weakness in its utter inability to explain consciousness either in its nature or in its origin. On the other hand, it is the virtue of idealism to emphasize the fact of consciousness, but its vice to exaggerate it, with the consequence of resorting to every kind of paradox to deny the obvious and get rid of bodies. There are in reality two species of substances, or entirely distinct things, those which are impenetrably resisting, and those which are conscious substances; and it is impossible to reduce bodies and souls to one another, because resistance is incompatible with the attributes of spirit, and consciousness inexplicable by the attributes of body. So far true metaphysics is a dualism of body and soul. But this very dualism is also monism: both bodies and souls are substances, as Aristotle said; and we can go farther than Aristotle. Men are apt to dwell too much on the co-existence and too little on the inclusiveness of substances. The fact is that many substances are often in one; *e.g.* many bodies in the one body, and both body and soul in the one substance, of man. So far true metaphysics is a monism of substance, in the sense that all things are substances and that all substances, however different, are members of one substance, the whole universe of body and spirit. In this case metaphysics generally will have to recognize three monisms, a materialistic monism of body, an idealistic monism of soul, and a realistic monism of substance, which is also a dualism of substances. But a term so equivocal, leading to an antithesis so misleading as that between monism and dualism, can never represent the real difference between metaphysical schools. We shall return, then, to the clearer and more authoritative division, and proceed to discuss materialism, idealism and realism in their order.

2.—Materialism

1. *Materialism Proper.*—Materialism in its modern sense is the view that all we know is body, of which mind is an attribute or function. Several causes, beginning towards the end of the 18th century, gradually led up to the materialism of Moleschott, Vogt and Büchner, which flourished in the middle of the 19th century. The first cause was the rapid progress of natural science, *e.g.* the chemistry of Lavoisier, the zoology of Lamarck, the astronomy of Laplace and the geology of Lyell. These advances in natural science, which pointed to a unity and gradual evolution in nature, were accompanied by a growth in commerce, manufactures and industrialism; the same kind of spirit showed itself in the revolutionary upheaval of 1848, and in the materialistic publications which immediately followed, while these

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[1] The article is supplemented by *e.g.* IDEALISM; PRAGMATISM; RELATIVITY OF KNOWLEDGE, while separate discussions of ancient and medieval philosophers will be found in biographical articles and articles on the chief philosophical schools, *e.g.* SCHOLASTICISM; NEOPLATONISM.

publications have reacted on the industrial socialism of our own time. Meanwhile, philosophic forces to counteract materialism were weak. Realism was at a low ebb. Idealism was receding for the moment. Hegelianism had made itself unpopular, and its confusion of God, nature and man had led to differences within the school itself (see HEGEL).

These causes, scientific, industrial and philosophical, led to the domination of materialism in the middle of the 19th century in Germany, or rather to its revival; for in its main position, that matter and motion are everything and eternal, it was a repetition of the materialism of the 18th century in France. Thus Karl Christoph Vogt (*q.v.*) repeated the saying of the French physician Cabanis, "The brain is determined to thought as the stomach is to digestion, or the liver to the secretion of bile," in the form, "Thought stands in the same relation to the brain as the bile to the liver or the urine to the kidneys." But the new materialism was not mere repetition. J. Moleschott (1822–1893) made a diligent use of the science of his day in his *Kreislauf des Lebens* (1852). Starting from Lavoisier's discoveries, he held that life is metabolism, a perpetual circulation of matter from the inorganic to the organic world, and back again, and he urged this metabolism against the hypothesis of vital force. Aristotle had imputed to all living beings a soul, though to plants only in the sense of a vegetative, not a sensitive, activity, and in Moleschott's time many scientific men still accepted some sort of vital principle, not exactly soul, yet over and above bodily forces in organisms. Moleschott, like Lotze, not only resisted the whole hypothesis of a vital principle, but also, on the basis of Lavoisier's discovery that respiration is combustion, argued that the heat so produced is the only force developed in the organism, and that matter therefore rules man. He put the whole materialistic view of the world into the following form: Without matter no force, without force no matter. L. Büchner (*q.v.*) himself said that he owed to Moleschott the first impulse to composing his important work *Kraft und Stoff* (1855), which became a kind of textbook of materialism. Passing from Moleschott to Lyell's view of the evolution of the earth's crust and later to Darwin's theory of natural selection and environment, he reached the general inference that, not God but evolution of matter, is the cause of the order of the world; that life is a combination of matter which in favourable circumstances is spontaneously generated; that there is no vital principle, because all forces, non-vital and vital, are movements; that movement and evolution proceed from life to consciousness; that it is foolish for man to believe that the earth was made for him, in the face of the difficulties he encounters in inhabiting it; that there is no God, no final cause, no immortality, no freedom, no substance of the soul; and that mind, like light or heat, electricity or magnetism, or any other physical fact, is a movement of matter. Sometimes he spoke of mind as an effect of matter; but, though his expressions may be careless, nothing is to be made of the difference, for he called it movement and effect indifferently in the same context. His definitely expressed view was that psychical activity is "nothing but a radiation through the cells of the grey substance of the brain of a motion set up by external stimuli."

Moleschott.

Büchner.

E. Haeckel belongs to a slightly later time than the materialists hitherto mentioned. His book *Die Welträthsel* (Eng. trans. J. M'Cabe, *The Riddle of the Universe*) identifies substance with body. Starting like his predecessors with the indestructibility of matter, Haeckel makes more than they do of the conservation of energy, and merges the persistence of matter and energy in one universal law of substance, which, on the ground that body is subject to eternal transformation, is also the universal law of evolution. His strong point consists in inferring the fact of evolution of some sort from the consideration of the evidence of comparative anatomy, palaeontology and embryology. On the strength of the consilience of arguments for evolution in the organic world, he carries back the process in the whole world, until he comes to a cosmology which recalls the rash hypotheses of the Presocratics.

Haeckel.

He supposes that all organisms have developed from the simple cell, and that this has its origin by spontaneous generation, to explain which he propounds the "carbon-theory," that protoplasm comes from inorganic carbonates. He not only agrees with Laplace and Lyell about the evolution of the solar system, but also supposes that the affinities, pointed out by Lothar Meyer and Mendeleeff, between groups of chemical elements prove an evolution of these elements from a primitive matter (*prothyl*) consisting of homogeneous atoms. These, however, are not ultimate enough for him; he thinks that everything, ponderable and imponderable or ether, is evolved from a primitive substance, which condenses first into centres of condensation (*pyknatoms*), and then into masses, which when they exceed the mean consistency become ponderables, and when they fall below it become imponderables. Here he stops; according to him substance is eternal and eternally subject to the law of substance; and God is the eternal force or energy of substance. What, then, is the origin of mind or soul? Haeckel answers that it has no origin, because sensation is an inherent property of all substance. He supposes that *aesthesis* and *tropesis*, as rudimentary sensation and will, are the very causes of condensation; that they belong to *pyknatoms*, to ponderables and imponderables, to chemical atoms and molecules. Hence, when he returns to organisms, it does not surprise us that he assigns to ova and spermatozoa cell-souls, to the impregnated ovum germ-soul, to plants tissue-souls, to animals nerve-souls; or that he regards man's body and soul as born together in the impregnated ovum, and gradually evolved from the bodies and souls of lower animals. It appears to his imagination that the affinity of two atoms of hydrogen to one of oxygen, the attraction of the spermatozoon to the ovum, and the elective affinity of a pair of lovers are all alike due to sensation and will.

But has Haeckel solved the problems of mind? When he applies sensation and will to nature, and through plants to the lowest animals, he considers their sensation and will to be rudimentary and unconscious. Consciousness, according to his own admission, is not found even in all animals, although it is present not only in the highest vertebrates—men, mammals, birds—but also in ants, spiders, the higher crabs and molluscs. He holds indeed that, in accordance with the law of substance, consciousness must be evolved from unconsciousness with the development of sense organs and a central nervous organ. At the same time he admits, firstly, that to mark the barrier between unconscious and conscious is difficult; secondly, that it is impossible to trace the first beginning of consciousness in the lower animals; and, thirdly, that "however certain we are of the fact of this natural evolution of consciousness, we are, unfortunately, not yet in a position to enter more deeply into the question" (*Riddle of the Universe*, 191). Thus in presence of the problem which is the crux of materialism, the origin of consciousness, he first propounds a gratuitous hypothesis that everything has mind, and then gives up the origin of conscious mind after all. He is certain, however, that the law of substance somehow proves that conscious soul is a mere function of brain, that soul is a function of all substances, and that God is the force or energy, or soul or spirit, of nature. He, in fact, returns to ancient hylozoism (*q.v.*), which has tended to revive from time to time in the history of thought. He believes that mind and soul are inherent attributes of all bodies. Curiously enough, he supposes that by making mind a universal attribute of matter he has made his philosophy not materialism, but monism. It is really both: monistic, because it reduces substance to one kind; materialistic, because it identifies that one kind of substance with body or matter, and reduces mind to an attribute of matter. It makes no difference to attribute mind to all matter, so long as it is attributed as an attribute. It is at least as materialistic to say that unconscious mind is an attribute of nature as to say that conscious mind is an attribute of brain; and this is the position of Haeckel. Materialists seem to dread the word "materialism." Büchner also entreats us "to abandon the word 'materialism,' to which (it is not clear why) a certain scientific odium attaches, and substitute 'monism' for it" (*Last Words on Materialism*, 273). His reason, however, is different: it is that a philosophy, not of matter as such, but of the unity of force and matter, is not materialism. But if a philosophy makes force an attribute of matter only, as his does, it will recognize nothing but matter possessing force, and will therefore be materialism as well as monism, and in short materialistic monism. The point is that neither Büchner nor Haeckel could on their assumptions recognize any force but force of body, or any mind but mind of body, or any distinct thing or substance except body. This is materialism.

2. *Materialistic Tendencies.*—Besides these direct instances of materialism, there are philosophers to whom the scientific tendencies of the age have given a materialistic tendency. In Germany, for example, Eugen Dühring (*q.v.*) was a realist, whose intention is to prove against Kant a knowledge of the thing in itself by attributing time, space and categories generally to the real world. But, under the influence of Trendelenburg's attempt to reconcile thought and being by assigning motion to both, his *Wirklichkeitsphilosophie*, in a similar effort after a unity of being, lands him in the contention that matter is absolute being, the support of all reality underlying all bodily and mental states. So Avenarius (*q.v.*) was no materialist, but only an empiricist anxious to reclaim man's natural view of the world from philosophic incrustations; yet when his *Empiriokriticismus* ends in nothing but environment, nervous system, and statements dependent on them, without soul, though within experience, he comes near to materialism, as Wundt has remarked. In France, again, positivism is not materialism, but rather the refusal to frame a metaphysical theory. Comte tells us that man first gets over theology, then over metaphysics, and finally rests in positivism. Yet in getting over theology he ceases to believe in God, and in getting over metaphysics he ceases to believe in soul. As Paul Janet truly remarked, positivism contains an unconscious metaphysics in rejecting final causes and an immaterial soul. Now, when in surrendering theology and metaphysics we have also to surrender God and the soul, we are not free from materialism. Positivism, however, shelters itself behind the vague word "phenomena." Lastly, in England we have not only an influence of positivism, but also, what is more important, the synthetic philosophy of Herbert Spencer. The point of this philosophy is not materialism, but realism. The author himself says that it is transfigured realism—which is realism in asserting objective existence as separate from subjective existence, but anti-realism in denying that objective existence is to be known. In his *Principles of Psychology* he twice quotes his point that "what we are conscious of as properties of matter, even down to its weight and resistance, are but subjective affections produced by objective agencies which are unknown and unknowable." This then is his transfigured realism, which, as far as what is known goes, is idealism, but as far as what exists goes, realism—of a sort. His *First Principles*, his book on metaphysics, is founded on this same point, that what we know is phenomena produced by an unknown noumenal power. He himself identifies phenomenon, appearance, effect or impression produced on consciousness through any of the senses. He divides phenomena into impressions and ideas, vivid and faint, object and subject, non-ego and ego, outer and inner, physical and psychical, matter and spirit; all of which are expressions of the same antithesis among phenomena. He holds that all the time, space, motion, matter known to us are phenomena; and that force, the ultimate of ultimates, is, as known to us, a phenomenon, "an affection of consciousness." If so, then all we know is these phenomena, affections of consciousness, subjective affections, but produced by an unknown power. So far as this main point of transfigured realism is steadily maintained, it is a compound of idealism and realism, but not materialism. But it is not maintained, on the side either of phenomena or of noumena; and hence its tendency to materialism.

Spencer.

In the first place, the term "phenomenon" is ambiguous, sometimes meaning a conscious affection and sometimes any fact whatever. Spencer sets himself to find the laws of all phenomena. He finds that throughout the universe there is an unceasing redistribution of matter and motion, and that this redistribution constitutes evolution when there is a predominant integration of matter and dissipation of motion, and constitutes dissolution where there is a predominant absorption of motion and disintegration of matter. He supposes that evolution is primarily *integration*, from the incoherent to the coherent, exemplified in the solar nebula evolving into the solar system; secondly *differentiation*, from the more homogeneous to the more heterogeneous, exemplified by the solar system evolving into different bodies; thirdly *determination*, from the indefinite to the definite, exemplified by the solar system with different bodies evolving into an order. He supposes that this evolution does not remain cosmic, but becomes organic. In accordance with Lamarck's hypothesis, he supposes an evolution of organisms by hereditary adaptation to the environment (which he considers necessary to natural selection), and even the possibility of an evolution of life, which, according to him, is the continuous adjustment of internal to external relations. Next, he supposes that mind obeys the same law of evolution, and exemplifies integration by generalization, differentiation by the development of the five senses, and determination by the development of the order of consciousness. He holds that we pass without break from the phenomena of bodily life to the phenomena of mental life, that consciousness arises in the course of the living being's adaptation to its environment, and that there is a continuous evolution from reflex action through instinct and memory up to reason. He throws out the brilliant suggestion that the experience of the race is in a sense inherited by the individual; which is true in the sense that animal organisms become hereditarily better adapted to perform mental operations, though no proof that any elements of knowledge become a priori.

Now, Spencer has clearly, though unconsciously, changed the meaning of the term "phenomenon" from subjective affection of consciousness to any fact of nature, in regarding all this evolution, cosmic, organic, mental, social and ethical, as an evolution of phenomena. The greater part of the process is a change in the facts of nature before consciousness; and in all that part, at all events, the phenomena evolved must mean physical facts which are not conscious affections, but, as they develop, are causes which gradually produce life and consciousness. Moreover, evolution is defined universally as an "integration of matter and dissipation of motion," and yet mental, social and moral developments are also called evolution, so that, in accordance with the definition, they are also integrations of matter and dissipations of motion. It is true that the author did not see that he was passing from transfigured realism into materialism. He thinks that he is always speaking of phenomena in the sense of subjective affections; and in spite of his definition, he half unconsciously changes the meaning of evolution from a change in matter and motion, first into a change in states of consciousness, then to a change in social institutions, and finally into a change in moral motives. He also admits himself that mental evolution exemplifies integration of matter and dissipation of motion only indirectly. But here he becomes hopelessly inconsistent, because he had already said, in defining it, that "evolution is an integration of matter and concomitant dissipation of motion" (*First Principles*, § 145). However, with all the author's disclaimers, the general effect left on the reader's mind is that throughout the universe there is an unceasing change of matter and motion, that evolution is always such a change, that it begins with phenomena in the sense of physical facts, gradually issues in life and consciousness, and ends with phenomena in the sense of subjective affections of consciousness.

In the second place, having declared the noumenal power, which causes phenomena, or conscious affections, to be unknowable, and having left anybody who pleased to make it a god and an object of religion, he proceeds to describe it as if it were known force, and known in two respects as persistent and as resistant force. He supposes that the law of evolution is deducible from the law of persistent force, and includes in force what is now called energy. Then having discussed force as something thoroughly material, and laying special emphasis on resistance, he tells us that "the force of which we assert persistence is that Absolute Force of which we are indefinitely conscious as the necessary correlate of the force we know" (*First Principles*, § 62). Similarly, both in *First Principles* and in the *Principles of Psychology*, he assigns to us, in addition to our definite consciousness of our subjective affections, an indefinite consciousness of something out of consciousness, of something which resists, of objective existence. Thus it turns out that the objective agency, the noumenal power, the absolute force, declared unknown and unknowable, is known after all to exist, persist, resist and cause our subjective affections or phenomena, yet not to think or to will. Such a noumenon looks very like body or matter. Lastly, when a theory of the world supposes a noumenal power, a resistent and persistent force, which results in an evolution, defined as an integration of matter and a dissipation of motion, which having resulted in inorganic nature and organic nature, further results without break in consciousness, reason, society and morals, then such a theory will be construed as materialistically as that of Haeckel by the reader, whatever the intention of the author.

It may be urged in reply that the synthetic philosophy could be made consistent by transferring the knowable resistance and persistence of the unknowable noumenon to knowable phenomena on the one hand, and on the other hand by maintaining that all phenomena from the original nebula to the rise of consciousness are only "impressions produced on consciousness through any of the senses," after all. But in that case what will become of Spencer's theory of evolution? It will have asserted the evolution of man and his consciousness out of the phenomena of his consciousness. The truth is that his theory of evolution can be carried through the whole process without a break, only by giving the synthetic philosophy a materialistic interpretation, and by adhering consistently to

Spencer's own materialistic definition of evolution; otherwise there will be a break at least between life and mind. If everything knowable is an example of evolution, and evolution is by definition a transformation of matter and motion, then everything knowable is an example of a transformation of matter and motion. As an exponent of universal evolution Haeckel is more consistent than Spencer.

Huxley. **Tyndall.**

Huxley (1825–1895) developed views very like those of Spencer, and similarly materialistic without being materialism, because inconsistent. He regarded everything known as evolved from matter, and reduced consciousness to a mere collateral product ("epiphenomenon") of cerebral operations without any power of influencing them. Matter, according to him, impresses the afferent nervous system, this the brain, this the efferent nervous system, while consciousness remains a mere spectator. "In man, as in brutes," said he, "there is no proof that any state of consciousness is the cause of change in the nature of the matter of the organism"; so that "we are conscious automata." But, in spite of these materialistic tendencies, he followed Hume in reducing matter and everything knowable to phenomena of consciousness; and, supposing that nothing is knowable beyond phenomena, concluded that we can neither affirm nor deny that anything exists beyond, but ought to take up an attitude which the ancient sceptics called Aphasia, but he dubbed by the new name of Agnosticism. Thus Huxley first reduced consciousness to a product of matter, and then matter to a phenomenon of consciousness. By combining materialism with idealism he made consciousness a product of itself. Tyndall (1820–1893), again, came still nearer to materialism, and yet avoided it. In his Belfast address (1874), while admitting that matter as understood by Democritus is insufficient, because atoms without sensation cannot be imagined to produce sensation, he contended, nevertheless, that matter properly understood is "the promise and potency of all terrestrial life." In thus endowing all matter with sensation like Haeckel he was not avoiding materialism. But in the very same address, as well as on other occasions, he did not identify mind with matter, but regarded them as concomitant.

All these materialistic tendencies seem to have one explanation. They emanate from scientific writers who rightly try to rise from science to metaphysics, but, as Bacon says, build a universal philosophy on a few experiments. The study of evolution, without considering how many conditions are required for "the integration of matter and the dissipation of motion" to begin, and the undoubted discoveries which have resulted from the study of inorganic and organic evolution, have led men to expect too much from this one law of Nature. This tendency especially prevails in biology, which is so far off the general principles of natural philosophy that its votaries are often ignorant of the real nature of body as matter and force. The close dependency of all mental operations on brain also tempts them to the conclusion that brain is not only an organ, but the whole organ of conscious mind.[1] It appears also that Darwin, having extended his theory of evolution as far as the rational and moral nature of man, in the *Descent of Man*, ended in his *Autobiography* by declaring his attitude to first and final causes to be that of an agnostic. Not that he was a materialist, and shortly before his death, in a conversation with Büchner, he maintained his agnosticism against his opponent's atheism. Still, his agnosticism meant that, though he did not assert that there is no God, he did assert that we cannot know whether there is or is not. To the evolutionary biologist brain is apt to appear to be the crowning object of knowledge. On the other hand, scientific men, such as Herschel, Maxwell and Stokes, who approach nature from mathematics and mechanics, and therefore from the universal laws of motion, have the opposite tendency, because they perceive that nature is not its own explanation. In order to exert force, or at all events that force of reciprocal pressure which we best understand, and on which, in impact, the third law of motion was founded, there are always at least two bodies, enduring, triply extended, mobile, each inert, mutually impenetrable or resistent, different yet similar; and in order to have produced any effect but equilibrium, some bodies must at some time have differed either in mass or in velocity, otherwise forces would only have neutralized one another. Why do bodies exist, with all these conditions, so similar yet different—that is, in so harmonious an order? Natural science has no answer: natural theology has an answer. This essence of bodies, this resemblance in difference, this prevailing order of Nature, is the deepest proof of God; and it cannot be the result of evolution, because it is the condition of natural force, and therefore of natural evolution. A second argument for God is the prevailing goodness or adaptation of Nature to the ends of conscious beings, which might conceivably be explained by Lamarckian evolution, but has not yet been so explained, and if it were, would not be inconsistent with a divine design in evolution. Further, the very existence of conscious beings is the best proof of the distinct or substantial being of the soul, existing in man with body, in God as pure spirit. It seems hopeless to expect that natural science, even with the aid of evolution, can explain by mere body the origin and nature of this fact of consciousness. If so, materialism is not the whole truth of metaphysics.

3.—The Rise of Metaphysical Idealism

Descartes. **Spinoza.** **Leibnitz.**

1. *Descartes to Leibnitz.*—Metaphysical arises from psychological idealism, and always retains more or less of an epistemological character. Psychological idealism assumes without proof that we perceive nothing but mental objects, and metaphysical idealism draws the logical but hypothetical conclusion that all we can know from these mental objects of sense is mental objects of knowledge. But at first this logical conclusion was not drawn. Descartes, the founder of psychological idealism, having proceeded from the conscious fact, *cogito ergo sum*, to the *non sequitur* that I am a soul, and all a soul can perceive is its ideas, nevertheless went on to the further illogical conclusion that from these mental ideas I can (by the grace of God) infer things which are extended substances or bodies, as well as thinking substances or souls. He was a psychological idealist and a metaphysical realist. This illogicality could not last. Even the Cartesian school, as it came more and more to feel the difficulty of explaining the interaction of body and mind, and, indeed, any efficient causation whatever, gradually tended to the hypothesis that the real cause is God, who, on the occasion of changes in body, causes corresponding changes in mind, and vice versa. This occasionalism is not idealism, but its emphasis on the will of God gave it an idealistic tendency. Thereupon Spinoza advanced a pantheism which supposed that bodies and souls are not, as Descartes thought, different substances, but merely attributes—the one the extension and the other the thought of one substance, Nature or God. Taking the Aristotelian theory that a substance is a thing in itself, not in Aristotle's sense of any individual existing differently from anything else, but in the novel meaning of something existing alone, he concluded, logically enough from this mere misunderstanding, that there can be only one substance, and that, as no finite body or soul can exist alone, everything finite is merely a mode of one of the attributes of the one infinite substance which alone can exist by itself. Spinozism, however, though it tramples down the barrier between body and soul, is not yet metaphysical idealism, because it does not reduce extension to thought, but only says that the same substance is at once extended and thinking—a position more akin to materialism. At the same time Spinoza maintained a parallelism between extension and thinking so close as to say that the order of ideas is the same as the order of things, so that any mode of extension and the idea of it are the same thing expressed in two ways, under the attribute of extension and under the attribute of thought (see H. H. Joachim's *Study of the Ethics of Spinoza*, 1901, p. 72). It remained, however, for Schelling to convert this parallelism into identity by identifying motion with the intelligence of God, and so to transform the pantheism of Spinoza into pantheistic idealism. Leibnitz, again, having become equally dissatisfied with Cartesianism, Spinozism and the Epicurean realism of Gassendi, in the latter part of his life came still nearer than Spinoza to metaphysical idealism in his monadology, or half-Pythagorean, half-Brunistic analysis of bodies into monads, or units, or simple substances, indivisible and unextended, but endowed with perception and appetite.

He gradually fell under the dominion of two false assumptions. On the one hand, essentially a mathematician, he supposed that unity is indivisibility, whereas everything known to be one is merely undivided or individual, and that there must be simple because there are compound substances, although composition only requires simpler or relatively simple elements. On the other hand, under the influence of the mechanics of his day, which had hardly distinguished between inertia, or the inability of a body to change itself, and resistance or the ability of bodies to oppose one another, he concluded that, as inertia is passive, so is resistance, and refused to recognize that in collision the mutual resistance of moving bodies is a force, or active power, of changing their movements in opposite directions. From these two arbitrary hypotheses about corporeal motion, that it requires indivisibly simple elements, and that it offers only passive resistance, he concluded that behind bodies there must be units, or monads, which would be at once substantial, simple, indivisible and active. He further supposed that the monads are "incorporeal automata," not interacting like bodies, but each perceiving what was passing in the other, and acting in consequence by appetite, or self-acting. Such mentally endowed substances might be called souls; but, as he distinguished between perception and apperception or consciousness, and considered that perceptions are often unconscious, he preferred to divide monads into unconscious entelechies of inorganic bodies, sentient souls of animals, and rational souls, or spirits, of men; while he further concluded that all these are derivative monads created by God, the monad of monads. All derivative monads, he allowed, are accompanied by bodies, which, however, are composed of other monads dominated by a central monad. Further, he explained the old Cartesian difficulty of the relation of body and mind by transforming the Spinozistic parallelism of extension and thought into a parallelism between the motions of bodies and the perceptions of their monads; motions always proceeding from motions, and perceptions from perceptions; bodies acting according to efficient causes, and souls according to final causes by appetition, and as if one influenced the other without actually doing so. Finally, he explained the concomitance of these two series, as well as that between the perceptions of different monads, by supposing a pre-established harmony ordained by the primitive monad, God.

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[1] Cf. H. Maudesley, *Lessons of Materialism* (1879).

Up to this point, then, Leibnitz opened one of the chief avenues to metaphysical idealism, the resolution of the material into the immaterial, the analysis of bodies into mental elements. His theory of bodies involved an idealistic analysis neither into bodily atoms nor into mathematical units, but into mentally endowed simple substances. There remained, however, his theory of the nature of bodies; and here he hesitated between two alternatives. According to one alternative, which consistently flowed from the psychological idealism of Descartes, as well as from his own monadism, he suggested that bodies are real phenomena; phenomena, because they are aggregates of monads, which derive their unity only from appearing together to our perceptions; real phenomena well founded, because they result from real monads. In support of this view, he said that bodies are not substances, though *substantiata*; that their apparent motion and resistance are results of the passions of their monads; that their primary matter is nothing but passive power of their monads; that the series of efficient causes between them is merely phenomenal. According to this alternative, then, there is nothing but mental monads and mental phenomena; and Leibnitz is a metaphysical idealist. According to the other alternative, however, he suggested that at least organic bodies are compound or corporeal substances, which are not phenomena; but something realizing or rather substantializing phenomena, and not mere aggregates of monads, but something substantial beyond their monads, because an organic body, though composed of monads, has a real unity (*unio realis*). From this point of view he believed that the real unity of a body is a *vinculum substantiale*, which gives it its real continuity and is the principle of its actions; that its primary matter is its own principle of resistance; and that it has not only this passive, but also an active, power of its own. He suggested that this theory of the substantial unity of a body might explain transubstantiation, by supposing that, while the monads and phenomena of bread remain, the *vinculum substantiale* of the body of Christ is substituted. He feared also whether we can explain the mystery of the Incarnation, and other things, unless real bonds or unions are added to monads and phenomena. According to this alternative, these organic bodies are compound or corporeal substances, between monads and phenomena; and Leibnitz is a metaphysical realist. He was held to this belief in the substantiality of bodies by his Christianity, by the influence of Aristotle, of scholasticism and of Cartesianism, as well as by his own mechanics. But the strange thing is that at the very end of his life and at the very same time, in 1714–1716, he was writing the idealistic alternative to Remond de Montmort and Dangicourt, and the realistic alternative to Father des Bosses. He must have died in doubt. We cannot, therefore, agree with many recent idealists who regard Leibnitz as one of themselves, though it is true that, when stripped of its realism, his metaphysics easily passed into the metaphysical idealisms of Lotze and of Fechner. It is true, also, that on its idealistic side the philosophy of Leibnitz is the source of many current views of panpsychism, of psychophysical parallelism as well as of the phenomenalism of bodies, and of the analysis of bodies into mental elements.

2. *Locke to Hume.*—Meanwhile in England, Locke, though differing from Descartes about the origin of ideas, followed him in the illogical combination of psychological idealism with metaphysical realism. He thought that we perceive nothing but ideas both of primary and of secondary qualities, and yet that somehow we are able to infer that, while our ideas of secondary qualities are not, those of primary qualities are, like the real qualities of external things. Berkeley saw the inconsistency of this position, and, in asserting that all we perceive and all we know is nothing but ideas in "mind, spirit, soul, or myself," has the merit of having made, as Paulsen remarks, "epistemological idealism the basis of metaphysical idealism." According to him, a body such as the sun is my idea, your idea, ideas of other minds, and always an idea of God's mind; and when we have sensible ideas of the sun, what causes them to arise in our different minds is no single physical substance, the sun, but the will of God's spirit. Hume saw that in making all the objects of perception ideas Berkeley had given as little reason for inferring substantial souls as substantial bodies. He therefore concluded that all we know from the data of psychological idealism is impressions or sensations, ideas, and associations of ideas, making us believe without proof in substances and causes, together with "a certain unknown, inexplicable *something* as the cause of our preceptions." We have here, in this sceptical idealism, the source of the characteristically English form of idealism still to be read in the writings of Mill and Spencer, and still the starting-point of more recent works, such as Pearson's *Grammar of Science* and James's *Principles of Psychology.*

3. *Kant and Fichte.*—Lastly, in Germany, partly influenced by Leibnitz and partly roused by Hume, Kant elaborated his transcendental or critical idealism, which if not, as he thought, the prolegomena to all future metaphysics, is still the starting-point of most metaphysical idealists. Kantism consists of four main positions, which it will be well to lay out, as follows:—

Kant.

a. As to the origin of knowledge, Kant's position is that sense, outer and inner, affected by things in themselves, receives mere sensations or sensible ideas (*Vorstellungen*) as the matter which sense itself places in the a priori forms of space and time; that thereupon understanding, by means of the synthetic unity of apperception, "I think"—an act of spontaneity beyond sense, in all consciousness one and the same, and combining all my ideas as mine in one universal consciousness—and under a priori categories, or fundamental notions, such as substance and attribute, cause and effect, &c., unites groups of sensations or sensible ideas into objects and events, *e.g.* a house, one ball moving another; and that, accordingly, perception and experience, requiring both sense and understanding, are partly a posteriori and partly a priori, and constitute a knowledge of objects which, being sensations combined by synthetic unity under a priori forms, are more than mere sensations, but less than things in themselves. This first position is psychological idealism in a new form and supported by new reasons; for, if experience derives its matter from mental sensations and its form from mental synthesis of sensations, it can apprehend nothing but mental objects of sense, which, according to Kant, are sensible ideas having no existence outside our thought, not things in themselves; or *phenomena*, not *noumena.*

b. As to the known world, Kant's position was the logical deduction that from such phenomena of experience all we can know by logical reason is similar phenomena of actual or possible experience; and therefore that the known world, whether bodily or mental, is not a Cartesian world of bodies and souls, nor a Spinozistic world of one substance, nor a Leibnitzian world of monadic substances created by God, but a world of sensations, such as Hume supposed, only combined, not by association, but by synthetic understanding into phenomenal objects of experience, which are phenomenal substances and causes—a world of phenomena not noumena. This second position is a new form of metaphysical idealism, containing the supposition, which lies at the foundation of later German philosophy, that since understanding shapes the objects out of sensations, and since nature, as we know it, consists of such objects, "understanding, though it does not make, shapes nature," as well as our knowledge. Known nature is a mental construction in part, according to Kant.

c. As to existence, Kant's position is the wholly illogical one that, though all known things are phenomena, there are things in themselves, or noumena; things which are said to cause sensations of outer sense and to receive sensations of inner sense, though they are beyond the category of causality which is defined as one of the notions uniting phenomena; and things which are assumed to exist and have these causal attributes, though declared unknowable by any logical use of reason, because logical reason is limited by the mental matter and form of experience to phenomena; and all this according to Kant himself. This third position is a relic of ancient metaphysical realism; although it must be remembered that Kant does not go to the length of Descartes and Locke, who supposed that from mere ideas we could know bodies and souls, but suggests that beneath the phenomena of outer and inner sense the thing in itself may not be heterogeneous (*ungleichartig*). In this form we shall find the thing in itself revived by A, Riehl.

d. As to the use of reason beyond knowledge, Kant's position is that, in spite of its logical inability to transcend phenomena, reason in its pure, or a priori use, contains necessary a priori "ideals" (*Ideen*), and practical reason, in order to account for moral responsibility, frames postulates of the existence of things in themselves, or noumena, corresponding to these "ideals"; postulates of a real free-will to practise morality, of a real immortality of soul to perfect it, and of a real God to crown it with happiness.

The fourth position is the coping-stone of Kant's metaphysics. It is quite inconsistent with its foundation and structure. Kant first deduced that from the experience of mental phenomena all logical use of reason is limited to mental phenomena, and then maintained that to explain moral responsibility practical reason postulates the existence of real noumena. But what is a postulate of practical reason to explain moral responsibility except a logical use of reason? Nevertheless, in his own mind Kant's whole speculative and practical philosophy was meant to form one system. In the preface to the second edition of the *Kritik* he says that it was necessary to limit speculative reason to a knowledge of phenomena, in order to allow practical reason to proceed from morality to the assumption of God, freedom, and immortality, existing beyond phenomena: "Ich musste also das *Wissen* aufheben, um zum *Glauben* Platz zu machen." He forgot that he had also limited all logical use of reason, and therefore of practical reason, to phenomena, and thereby undermined the rationality not only of knowledge, but also of faith.

Fichte.

Fichte now set himself in the *Wissenschaftslehre* (1794) to make transcendental idealism into a system of metaphysical idealism without Kant's inconsistencies and relics of realism. His point was that there are no things in themselves different from minds or acting on them; that man is no product of things; nor does his thinking arise from passive sensations caused by things; nor is the end of his existence attainable in a world of things; but that he is the absolute free activity constructing his own world, which is only his own determination, his self-imposed limit, and means to his duty which allies him with God. In order to prove this novel conclusion he started afresh from the Cartesian "I think" in the Kantian form of the synthetic unity of apperception acting by a priori categories; but instead of allowing, with all previous metaphysicians, that the Ego passively receives sensations from something different, and not contenting himself with Kant's view that the Ego, by synthetically combining the matter of sensations with a priori forms, partially constructs objects, and therefore Nature as we know it, he boldly asserted that the Ego, in its synthetic unity, entirely constructs things; that its act of spontaneity is not mere synthesis of passive sensations, but construction of sensations into an object within itself; and that therefore understanding makes as well as shapes Nature.

This construction, or self-determination, is what Fichte called positing (*setzen*). According to him, the Ego posits first itself (thesis); secondly, the non-Ego, the other, opposite to itself (antithesis); and, thirdly, this non-Ego within itself (synthesis), so that all reality is in consciousness. But, he added, as the Ego is not conscious of this self-determining activity, but forgets itself, the non-Ego seems to be something independent, a foreign limit, a thing in itself, or *per se*. Hence it is the office of the theory of knowledge to show that the Ego posits the thing *per se* as only existing for itself, a *noumenon* in the sense of a product of its own thinking. Further, according to Fichte, on the one hand the Ego posits itself as determined through the non-Ego—no object, no subject; this is the principal fact about theoretical reason; on the other hand, the Ego posits itself as determining the non-Ego—no subject, no object; this is the principal fact about practical reason. Hence he united theoretical and practical reason, which Kant had separated, and both with will, which Kant had distinguished; for he held that the Ego, in positing the non-Ego, posits both its own limit and its own means to the end, duty, by its activity of thinking which requires will. The conclusion of his epistemology is that we start with ourselves positing subjective sensations—*e.g.* sweet, red—and refer them as accidents to matter in space, which, though mental, is objective, because its production is grounded on a law of all reason. The metaphysics resulting from this epistemology is that the so-called thing in itself is not a cause of our sensations, but a product of one's own thinking, a determination of the Ego, a thing known to the Ego which constructs it. Fichte thus transformed the transcendental idealism of Kant by identifying the thing with the object, and by interpreting noumenon, not in Kant's sense of something which speculative reason conceives and practical reason postulates to exist in accordance with the idea, but in the new meaning of a thought, a product of reason. This change led to another. Kant had said that the synthetic unity "I think" is in all consciousness one and the same, meaning that I am always present to all my ideas. Fichte transformed this unity of the conscious self into a unity of all conscious selves, or a common consciousness; and this change enabled him to explain the unity of anything produced by the Ego by contending that it is not the different objects of different thinkers, but the one object of a pure Ego or consciousness common to them all. According to Kant, the objective is valid for all consciousnesses; according to Fichte it is valid for one consciousness. Here he was for the first time grappling with a fundamental difficulty in metaphysical idealism which is absent from realism, namely, the difficulty of explaining the identity of a thing, *e.g.* the sun. As long as even the meagre realism of the Kantian thing in itself is maintained, the account of there being one sun is simply that one thing causes different phenomena in different minds. But as soon as the thing in itself is converted into something mental, metaphysical idealists must either say that there are as many suns as minds, or that there is one mind and therefore one sun. The former was the alternative of Berkeley, the latter of Fichte.

Thus the complete metaphysical idealism of Fichte's *Wissenschaftslehre* formed out of the incomplete metaphysical idealism of Kant's *Kritik*, is the theory on its epistemological side that the Ego posits the non-Ego as a thing in itself, and yet as only a thing existing for it as its own noumenon, and on its metaphysical side that in consequence all reality is the Ego and its own determinations, which are objective, or valid for all, as determinations, not of you or of me, but of the consciousness common to all of us, the pure or absolute Ego. Lastly, Fichte called this system realism, in so far as it posits the thing in itself as another thing; idealism, in so far as it posits it as a noumenon which is a product of its own thinking; and on the whole real idealism or ideal realism.

God does not seem to find much place in the *Wissenschaftslehre*, where mankind is the absolute and nature mankind's product, and where God neither could be an absolute Ego which posits objects in the non-Ego to infinity without ever completing the process, nor could be even known to exist apart from the moral order which is man's destination. Hence in his *Philosophical Journal* in 1798 Fichte prefaced a sceptical essay of Forberg by an essay of his own, in which he used the famous words, "The living moral order is God; we need no other God, and can comprehend no other." Having, however, in consequence, lost his professorship at Jena, he gradually altered his views, until at length he decided that God is not mere moral order, but also reason and will, yet without consciousness and personality; that not mankind but God is the absolute; that we are only its direct manifestations, free but finite spirits destined by God to posit in ourselves Nature as the material of duty, but blessed when we relapse into the absolute; that Nature, therefore, is the direct manifestation of man, and only the indirect manifestation of God; and, finally, that being is the divine idea or life, which is the reality behind appearances. In this extension of metaphysical idealism he was influenced by his disciple, Schelling. Nevertheless, he refused to go as far as Schelling, and could not bring himself to identify either man or nature with Absolute God. He wanted to believe in the absolute without sacrificing personality and freedom. God determines man, and man determines Nature: this is the final outcome of Fichte's pure idealism.

Fichte completed the process from psychological and epistemological to metaphysical idealism, which it has been necessary to recall from its beginnings in France, England and Germany, in order to understand modern idealism. The assertion of absolute substance by Spinoza incited Schelling and Hegel. The analysis of bodies into immaterial elements by Leibnitz incited Lotze. The Spinozistic parallelism of extension and thought, and the Leibnitzian parallelism of bodily motion and mental action, incited Schelling and Fechner. Berkeley and Hume produced the English idealism of Mill and Spencer, with their successors, and occasioned the German idealism of Kant. Kant's a priori synthesis of sensations into experience lies at the root of all German idealism. But Fichte was the most fertile of all. He carried metaphysical idealism to its height, by not only resolving the bodily into the mental, but also elevating the action of mind into absolute mental construction; not inferring things in themselves beyond, but originating things from within, mind itself. By changing the meaning of "noumenon" from the thing apprehended (νοούμενον) to the thought (νόημα), and in the hypothesis of a common consciousness, he started the view that a thing is not yours or my thought, but a common thought of all mankind, and led to the wider view of Schelling and Hegel that the world is an absolute thought of infinite mind. In making the essence of mind activity and construction, in destroying the separation of theoretical and practical reason, in asserting that mind thinks things as means to ends of the will, he prepared the way for Schopenhauer and other voluntarists. In making the essence of the Absolute not mere reason, but will, action and life, he anticipated Lotze. In reducing the thing in itself to a thought he projected the neo-Kantism of Lange and Cohen. In the doctrine—no object, no subject—no subject, no object—that is, in the utter identification of things with objects of subjects, he anticipated not only Schelling and Hegel, but also Schuppe and Wundt with their congeners. In expanding Kant's act of synthesis till it absorbed the inner sense and the innermost soul, he started the modern paradox that soul is not substance, but subject or activity, a paradox which has been gradually handed down from Schelling and Hegel to Fechner, and from Fechner to Paulsen and Wundt. Meanwhile, through holding with Kant that man is not God, but a free spirit, whose destiny it is to use his intelligence as a means to his duty, he is still the resort of many who vindicate man's independence, freedom, conscience, and power of using nature for his moral purposes, *e.g.* of Eucken and Münsterberg (*qq.v.*). Kant and Fichte together became the most potent philosophic influences on European thought in the 19th century, because their emphasis was on man. They made man believe in himself and his mission. They fostered liberty and reform, and even radicalism. They almost avenged man on the astronomers, who had shown that the world is not made for earth, and therefore not for man. Kant half asserted, and Fichte wholly, that Nature is man's own construction. The *Kritik* and the *Wissenschaftslehre* belonged to the revolutionary epoch of the "Rights of Man," and produced as great a revolution in thought as the French Revolution did in fact. Instead of the old belief that God made the world for man, philosophers began to fall into the pleasing dream, I am everything, and everything is I—and even I am God.

4.—Noumenal Idealism in Germany

Noumenal idealism is the metaphysics of those who suppose that all known things are indeed mental, but not all are phenomenal in the Kantian sense, because a noumenon is knowable so long as by a noumenon we mean some mental being or other which we somehow can discover beyond phenomena. The noumenal idealists of Germany assumed, like all psychological idealists, the unproved hypothesis that there is no sense of body, but there is a sense of sensations; and they usually accepted Kant's point, that to get from such sensations to knowledge there is a synthesis contributing mental elements beyond the mental data of sense. They saw also the logic of Kant's deduction, that all we can know from such mental data and mental categories must also be mental. This was the starting-point of their metaphysical idealism. But they disagreed with Kant, and agreed with Fichte about things in themselves or noumena, and contended that the mental things we know are not mere phenomena of sense, but noumena, precisely because noumena are as mental as phenomena, and therefore can be known from similar data: this was the central point of their noumenal idealism. They rightly revolted against the inconsistencies of Kant's third and fourth positions about the existence of unknown but postulated things in themselves, hidden from theoretical, but revealed to practical, reason. In a way they returned to the wider opinions of Aristotle, which had come down to Descartes and Locke, that reason in going beyond sense knows more things than phenomena; yet they would not hear of external bodies, or of bodies at all. No realists, they came nearer to Spinozistic pantheism and to Leibnitzian monadism, but only on their idealistic side; for they would not allow that extension and body are different from thinking and mind. Their real founder was Fichte, on account of his definite reduction of the noumenal to a mental world. This was indeed the very point—the knowability of a noumenal mental world. At the same time it soon appeared that they could not agree among themselves when they came to ask what it is, but in attempting to define it seem to have gone through the whole gamut of mind. Schelling and Hegel thought it was infinite reason; Schopenhauer, unconscious will; Hartmann, unconscious intelligence and will; Lotze, the activity or life of the divine spirit; Fechner, followed by Paulsen, a world of spiritual actualities comprised in the one spiritual actuality, God, in whom we live and move and have our being.

Schelling.

1. Of these noumenal idealisms the earliest in time and the nearest to Fichte's philosophy was the panlogism, begun by Schelling (1775–1854), completed by his disciple Hegel (1770–1831), and then modified by the master himself. Starting from Fichte's "Wissenschaftslehre," Schelling accepted the whole process of mental construction, and the deduction that noumena are knowable products of universal reason, the Absolute Ego. But from the first he was bolder than Fichte, and had no doubt that the Absolute is God. God, as he thought, is universal reason, and Nature a product of universal reason, a direct manifestation, not of man, but of God. How is this Absolute known? According to Schelling it is known by intellectual intuition. Kant had attributed to God, in distinction from man's understanding, an intellectual intuition of things. Fichte had attributed to man an intellectual intuition of himself as the Absolute Ego. Schelling attributes to man an intellectual intuition of the Absolute God; and as there is, according to him, but one universal reason, the common intelligence of God and man, this intellectual intuition at once gives man an immediate knowledge of God, and identifies man with God himself.

Hegel.

On Schelling's idealistic pantheism, or the hypothesis that there is nothing but one absolute reason identifying the opposites of subjectivity and objectivity, Hegel based his panlogism. But, while he fully recognized his indebtedness to his master, he differed from him profoundly in one fundamental respect. He rightly objected that the system was wanting in logical proof. He rightly, therefore, rejected the supposed intellectual intuition of the Absolute. He rightly contended that, if we are to know anything beyond sense, we must know it by a process of logical reason. But, unfortunately, he did not mean the logical inferences described in the *Organon* and the *Novum organum*. He meant a new "speculative" method, dialectic, founded on an assumption which he had already learnt from Schelling, namely, that things which are different but similar can have the same attribute, and therefore be also the same. With this powerful instrument of dialectic in hand, he attempted to show how absolute reason differentiates itself into subjective and objective, ideal and real, and yet is the identity of both—an identity of opposites, as Schelling had said. By the same dialectic Hegel was able to justify the gradual transformation of transcendental into noumenal idealism by Fichte and Schelling. If things different but similar have the same attributes, and are thereby the same, then in the first place the Kantian categories, though thoughts of mental origin and therefore confined to mind, are nevertheless applicable to things, because things, though different from, are the same as, thoughts, and have the categories of thoughts; in the second place, the Fichtian Ego of mankind is not the Absolute Reason of God, and yet is the same Absolute Reason; in the third place, the Schellingian Nature is the "other" of Spirit, and yet, being a mere reflex of the Idea of Nature, is identical with Spirit; and as this Spirit is everywhere the same in God and men, Nature is also identical with our Spirit, or rather with the Infinite Spirit, or Absolute Reason, which alone exists. The crux of all metaphysical idealism is the difficulty of reconciling the unity of the object with the plurality of subjects. Hegel's assumption of identity in difference at once enabled him to deal with the whole difficulty by holding that different subjects are yet one subject, and any one object, *e.g.* the sun, is at once different from, and identical with, the one subject which is also many. By the rough magic of this modern Prospero the universe of being is not, and yet is, thought, idea, spirit, reason, God. So elastic a solution established a dominant Hegelian school, which is now practically extinct, in Germany, and from Germany spread Hegelianism to France, England, America, and, in fact, diffused it over the civilized world to such an extent that it is still a widespread fashion outside Germany to believe that the world of being is a world of thought.

Criticism of Panlogism.

The plain answer is to contest the whole assumption. Different things, however similar, have only similar attributes, and therefore are never the same. God created man in His own image, and the world in the image of the Divine Idea; but I am not God, and the transitory sun is not the same as God's eternal idea of it. The creatures, however like, are not the same as the Creator and His thoughts. Each is a distinct thing, as Aristotle said. Reality is not Reason. It is strange that the underlying assumption of panlogism was not at once contested in this plain way. Nevertheless, objection was soon taken to the unsatisfactoriness of the system reared upon it. Schelling himself, as soon as he saw his own formulae exposed in the logic or rather dialectic of his disciple, began to reconsider his philosophy of identity, and brought some powerful objections against both the conclusions and the method of Hegel. Schelling perceived that Hegel, in reducing everything to infinite mind, absorbed man's free but finite personality in God, and, in declaring that everything real is rational, failed to explain evil and sin: indeed, the English reader of T. H. Green's *Prolegomena to Ethics* can see how awkward is the Hegelian transition from "one spiritual principle" to different men's individual freedom of choice between good and evil. Again, Schelling urged that besides the rational element there must be something else; that there is in nature, as *natura naturans*, a blind impulse, a will without intelligence, which belongs to the existent; and that even God Himself as the Absolute cannot be pure thought, because in order to think He must have an existence which cannot be merely His thought of it, and therefore pure being is the prior condition of thought and spirit. Hence Schelling objected to the Hegelian dialectic on the ground that, although reason by itself can apprehend notions or essences, and even that of God, it cannot deduce a priori the existence either of God or of Nature, for the apprehension of which experience is required. He now distinguished two philosophies: negative philosophy starting from notions, and positive philosophy starting from being; the former a philosophy of conditions, the latter of causes, *i.e.* of existence. Hegel, he said, had only supplied the logic of negative philosophy; and it must be confessed that the most which could be extracted from the Hegelian dialectic would be some connexion of thoughts without proving any existence of corresponding things. Schelling was right; but he had too much affinity with Hegelian assumptions, *e.g.* the panlogistic confusion of the essences of things with the notions of reason, to construct a positive philosophy without falling into fresh mysticism, which failed to exorcise the effect of his earlier philosophy of identity in the growing materialism of the age.

Schopenhauer.

2. Meanwhile, by the side of panlogism arose the panthelism of Schopenhauer (1788–1860). This new noumenal idealism began, like the preceding, by combining psychological idealism with the transcendentalism of Kant and Fichte. In *Die Welt als Wille und Vorstellung* Schopenhauer accepted Kant's position that the world as phenomenal is idea (*Vorstellung*); but he added that the world as noumenal is will (*Wille*). He got the hint of a noumenal will from Kant; but in regarding the noumenal as knowable, because mental, as well as in the emphasis he laid on the activity of will, he resembled Fichte. His theory of the nature of will was his own, and arrived at from a voluntaristic psychology leading to a voluntaristic metaphysics of his own. His psychological starting-point was the unproved assumption that the only force of which we are immediately aware is will; his metaphysical goal was the consistent conclusion that in that case the only force we can know, as the noumenal essence of which all else is phenomenal appearance, is will. But by this noumenal will he did not mean a divine will similar to our rational desire, a will in which an inference and desire of a desirable end and means produces our rational action. He meant an unintelligent, unconscious, restless, endless will. In considering the force of instinct in animals he was obliged to divest will of reason. When he found himself confronted with the blind forces of Nature he was obliged to divest irrational will of feeling. As he resolved one force after another into lower and lower grades of will he was obliged to divest will of all consciousness. In short, his metaphysics was founded on a misnomer, and simply consisted in calling unconscious force by the name of unconscious will (*Unbewusster Wille*). This abuse of language brought him back to Leibnitz. But, whereas Leibnitz imputed unconscious perception as well as unconscious appetition to monads, Schopenhauer supposed unconscious will to arise without perception, without feeling, without ideas, and to be the cause of ideas only in us. Hence he rejected the infinite intelligence supposed by Fichte, Schelling and Hegel against whom he urged that blind will produces intelligence, and only becomes conscious in us by using intelligence as a means to ends. He also rejected the optimism of Leibnitz and Hegel, and placed the most irrational of wills at the base of the worst possible of worlds (see further SCHOPENHAUER). This pessimistic panthelism gradually won its way, and procured exponents such as J. Frauenstädt, J. Bahnsen, and, more recently, P. Deussen. The accident of its pessimism attracted F. W. Nietzsche, who afterwards, passing from the philosophy of will to the theory of evolution, ended by imagining that the struggle of the will to live produces the survival of the fittest, that is, the right of the strongest and the will to exercise power, which by means of selection may hereafter issue in a new species of superior man—the *Uebermensch*. Finally, Schopenhauer's voluntarism has had a profound effect on psychology inside and outside Germany, and to a less degree produced attempts to deduce from voluntaristic psychology new systems of voluntaristic metaphysics, such as those of Paulsen and Wundt.

Hartmann.

3. The first to modify the pure voluntarism of Schopenhauer was E. von Hartmann, who (*Die Philosophie des Unbewussten*, 1869, 1st ed.), advanced the view that the world as noumenal is both unconscious intelligence and unconscious will, thus founding a panpneumatism which forms a sort of reconciliation of the panlogism of Hegel and the panthelism of Schopenhauer. In his tract entitled *Schelling's positive Philosophie als Einheit von Hegel und Schopenhauer* (1869) he further showed that, in his later philosophy, Schelling had already combined reason and will in the Absolute. Indeed, Fichte had previously characterized the life of the Absolute by reason and will without consciousness; and, before Fichte, Leibnitz had asserted that the elements of Nature are monads with unconscious perception and appetition. Hartmann has an affinity with all these predecessors, and with Spinoza, with whom he agrees that there is but one substance unaltered by the plurality of individuals which are only its modifications. Following, however, in the footsteps of Schelling, he idealizes the one extended and thinking substance into one mental being; but he thinks that its essence consists in unconscious intelligence and will, of which all individual intelligent wills are only activities. The merit of this fresh noumenal idealism consists in its correction of the one-sidedness of Schopenhauer: intelligence is necessary to will. But Hartmann's criticism does not go far enough. He ends by outdoing the paradox of Schopenhauer, concluding that Nature in itself is intelligent will, but unconscious, a sort of immanent unconscious God.

As with his master, his reasons for this view are derived, not from a direct proof that unconscious Nature has the mental attributes supposed, but from human psychology and epistemology. Like Leibnitz, he proceeds from the fact that our perceptions are sometimes conscious, sometimes unconscious, to the inconsequent conclusion, that there are beings with nothing but unconscious perceptions; and by a similar *non sequitur*, because there is the idea of an end in will, he argues that there must be an unconscious idea of an end in instinctive, in reflex, in all action. Again, in his *Grundproblem der Erkenntnisstheorie* (1889) he uses without proof the hypothesis of psychological idealism, that we perceive psychical effects, to infer with merely hypothetical consistency the conclusion of noumenal metaphysical idealism that all we can thereby know is psychical causes, or something transcendent, beyond phenomena indeed, yet not beyond mind. But, according to him, this transcendent is the unconscious (*Kraftvolles unbewusst ideales Geschehen*). He calls this epistemology "transcendent realism"; it is really "transcendent idealism." On these foundations he builds the details of his idealistic metaphysics. (*a*) He identifies matter with mind by identifying atomic force with the striving of unconscious will after objects conceived by unconscious intelligence, and by defining causality as logical necessity receiving actuality through will. (*b*) He contends that, when matter ascends to the evolution of organic life, the unconscious has a power, over and above its atomic volitions, of introducing a new element, and that in consequence the facts of variation, selection and inheritance, pointed out by Darwin, are merely means which the unconscious uses for its own ends in morphological development. (*c*) He explains the rise of consciousness by supposing that, while it requires brain as a condition, it consists in the emancipation of intelligence from will at the moment when in sensation the individual mind finds itself with an idea without will. Here follows his pessimism, like to, but differing from, that of his master. In his view consciousness begins with want, and pain preponderates over pleasure in every individual life, with no hope for the future, while the final end is not consciousness, but the painlessness of the unconscious (see PESSIMISM). But why exaggerate? The truth of Nature is force; the truth of will is rational desire; the truth of life is neither the optimism of Leibnitz and Hegel, nor the pessimism of Schopenhauer and Hartmann, but the moderatism of Aristotle. Life is sweet, and most men have more pleasures than pains in their lives.

Lotze.

4. Lotze (1817–1881) elaborated a very different noumenal idealism, which perhaps we may express by the name "Panteleologism," to express its conclusion that the known world beyond phenomena is neither absolute thought nor unconscious will, nor the unconscious at all, but the activity of God; causing in us the system of phenomenal appearances, which we call Nature, or bodies moving in time and space; but being in itself the system of the universal reciprocal actions of God's infinite spirit, animated by the design of the supreme good. The *Metaphysik* of Lotze in its latest form (1879) begins with a great truth: metaphysics must be the foundation of psychology. He saw that the theories of the origin of knowledge in idealistic epistemology are unsound. Like Aristotle, then, he proposed anew the question, What is being? Nevertheless he was too much a child of his age to keep things known steadily before him; having asked the metaphysical question he proceeded to find a psychological answer in a theory of sensation, which asserted the mere hypothesis that the being which we ascribe to things on the evidence of sensation consists in their being felt. He really accepted, like Kant, the hypothesis of a sense of sensations which led to the Kantian conclusion that the Nature we know in time and space is mere sensible appearances in us. Further, from an early period in his *Medicinische Psychologie* (1852) he reinforced the transcendental idealism of Kant by a general hypothesis of "local signs," containing the subordinate hypotheses, that we cannot directly perceive extension either within ourselves or without; that spatial bodies outside could not cause in us spatial images either in sight or in touch; but that besides the obvious data of sense, *e.g.* pressure, heat and colour, there must be other qualitative different excitations of different nerve-fibres, by means of which, as non-local signs of localities, the soul constructs in itself an image of extended space containing different places. This hypothesis of an acquired perception of a space mentally constructed by "local signs" supplied Lotze and many succeeding idealists, including Wundt, with a new argument for metaphysical idealism. Lotze concluded that we have no more reason for supposing an external space like space constructed out of our perceptions, than we have for supposing an external colour like perceived colour. Agreeing, then, with Kant that primary qualities are as mental as secondary, he agreed also with Kant that all the Nature we know as a system of bodies moving in time and space is sensible phenomena. But while he was in fundamental agreement with the first two positions of Kant, he differed from the third; he did not believe that the causes of sensible phenomena can be unknown things in themselves. What then are they? In answering this question Lotze regarded Leibnitz as his guide. He accepted the Leibnitzian fallacy that unity is indivisibility, which led to the Leibnitzian analysis of material bodies into immaterial monads, indivisible and therefore unextended, and to the theory of monadic souls and entelechies. Indeed, from the time of Leibnitz such attempts either to analyse or to construct matter had become a fashion. Lotze agreed with Leibnitz that the things which cause phenomena are immaterial elements, but added that they are not simple substances, self-acting, as Leibnitz thought, or preserving themselves against disturbance, as Herbart thought, but are interacting modifications of the one substance of God.

In the first place, he resolved the doubt of Leibnitz about bodies by deciding entirely against his realistic alternative that an organic body is a *substantia realizans phaenomena*, and for his idealistic alternative that every body is a phenomenon and not a substance at all. Secondly, he accepted the Leibnitzian hypothesis of immaterial elements without accepting their self-action. He believed in reciprocal action; and the very essence of his metaphysics consists in sublimating the interaction of bodies into the interaction of immaterial elements, which produce effects on one another and on the soul as one of them. According to the mechanics of Newton, when two bodies collide each body makes the other move equally and oppositely; but it has become a convenient habit to express this concrete fact in abstract language by calling it the conservation of momentum, by talking of one body communicating its motion to the other; as if bodies exchanged motion as men do money. Now Lotze took this abstract language literally, and had no difficulty in showing that, as an attribute is not separated from its substance, this supposed communication of motion does not really take place: nothing passes. But instead of returning to the concrete fact of the equivalence of momentum, by which each body moving makes the other move oppositely, he denied that bodies do reciprocally act on one another, and even that bodies as mutually resisting substances press one another apart in collision. Having thus rejected all bodily mechanism, he had to suppose that reciprocal action somehow takes place between immaterial elements. This brought him to another difference from Leibnitz as well as from Newton. According to Leibnitz, while each immaterial element is a monadic substance and self-acting secondary cause, God is the primary cause of all. According to Lotze, the connexion required by reciprocity requires also that the whole of every reciprocal action should take place within one substance; the immaterial elements act on one another merely as the modifications of that substance interacting within itself; and that one substance is God, who thus becomes not merely the primary but the sole cause, in scholastic language a *causa immanens*, or agent of acts remaining within the agent's being. At this point, having rejected both the Newtonian mechanism of bodily substances and the Leibnitzian automatism of monadic substances, he flew to the Spinozistic unity of substance; except that, according to him, the one substance, God, is not extended at all, and is not merely thinking, but is a thinking, willing and acting spirit.

Lotze's metaphysics is thus distinguished from the theism of Newton and Leibnitz by its pantheism, and from the pantheism of Spinoza by its idealism. It is an idealistic pantheism, which is a denial of all bodily mechanism, a reduction of everything bodily to phenomena, and an assertion that all real action is the activity of God. At the same time it is a curious attempt to restore mechanism and reconcile it with teleology by using the word "mechanism" in a new meaning, according to which God performs His own reciprocal actions within Himself by uniform laws, which are also means to divine ends. It is also an attempt to reconcile this divine mechanism with freedom. In his *Metaphysik* (1879), as in his earlier *Mikrokosmus* (1856–1864), Lotze vindicated the contingency of freedom by assigning to God a miraculous power of unconditional commencement, whereby not only at the very beginning but in the course of nature there may be new beginnings, which are not effects of previous causes, though once started they produce effects according to law. Thus his pantheistic is also a teleological idealism, which in its emphasis on free activity and moral order recalls Leibnitz and Fichte, but in its emphasis on the infinity of God has more affinity to Spinoza, Schelling and Hegel. Hence his philosophy, like the Hegelian, continually torments one with the difficulty that its sacrifice of the distinct being of all individual substances to the universality of God entails the sacrifice of the individual personality of men. Our bodies were reduced by Lotze to the general ruck of phenomenal appearances. Our souls he tried his best to endow with a quasi-existence, arguing that the unity of consciousness requires an indivisible subject, which is distinct from the plurality of the body but interacting with it, is in a way a centre of independent activities, and is so far a substance, or rather able to produce the appearance of a substance. But at the end of his *Metaphysik*, from the conclusion that everything beyond phenomena is divine interaction, he drew the consistent corollary that individual souls are simply actions of the one genuine being. His final view was that certain actions of the divine substance are during consciousness gifted with knowledge of themselves as active centres, but during unconsciousness are non-existent. If so, we are not persons with a permanent being of our own distinct from that of God. But in a philosophy which reduces everything to phenomenal appearance except the self-interacting substance of God, there is no room for either the bodies or the souls of finite substances or human persons.

Fechner.

5. Fechner (1801–1887) affords a conspicuous instance of the idealistic tendency to mysterize nature in his Panpsychism, or that form of noumenal idealism which holds that the universe is a vast communion of spirits, souls of men, of animals, of plants, of earth and other planets, of the sun, all embraced as different members in the soul of the world, the highest spirit—God, in whom we live and move and have our being; that the bodily and the spiritual, or the physical and the psychical, are everywhere parallel processes which never meet to interact; but that the difference between them is only a difference between the outer and inner aspects of one identical psychophysical process; and yet that both sides are not equally real, because while psychical and physical are identical, the psychical is what a thing really is as seen from within, the physical is what it appears to be to a spectator outside; or spirit is the self-appearance of matter, matter the appearance of one spirit to another. Fechner's panpsychism has a certain affinity both to Stahl's animism and to the hylozoism of materialists such as Haeckel. But, while it differs from both in denying the reality of body, it differs from the former in extending conscious soul not only to plants, as Stahl did, but to all Nature; and it differs from the latter in the different consequences drawn by materialism and idealism from this universal animism. According to Haeckel, matter is the universal substance, spirit its universal attribute. According to Fechner, spirit is the universal reality, matter the universal appearance of spirit to spirit; and they are identical because spirit is the reality which appears. Hence Fechner describes himself as a twig fallen from Schelling's stem. Schelling's adherent Oken by his *Lehrbuch der Naturphilosophie* conveyed to his mind the life-long impression that God is the universe and Nature God's appearance. At the same time, while accepting the Schellingian parallelistic identity of all things in God, Fechner was restrained by his accurate knowledge of physics from the extravagant construction of Nature, which had failed in the hands of Schelling and Hegel. Besides, he was deeply impressed by the fact of man's personality and by the problem of his personal immortality, which brought him back through Schelling to Leibnitz, whose *Monadologie* throughout maintains the plurality of monadic souls and the omnipresence of perception, sketches in a few sections (§§ 23, 78–81) a panpsychic parallelism, though without identity, between bodily motions and psychic perceptions, and, what is most remarkable, already uses the conservation of energy to argue that physical energy pursues its course in bodies without interacting with souls, and that motions produce motions, perceptions produce perceptions. Leibnitz thus influenced Fechner, as in other ways he influenced Lotze. Both, however, used this influence freely; and, whereas Lotze used the Leibnitzian argument from indivisibility to deduce indivisible elements and souls, Fechner used the Leibnitzian hypotheses of universal perception and parallelism of motions and perceptions, in the light of the Schellingian identification of physical and psychical, to evolve a world-view (*Weltansicht*) containing something which was neither Leibnitz nor Schelling.

Pan-psychism.

Fechner's first point was his panpsychism. Emphasizing the many real analogies between physical and mental agency, but underrating the much stronger evidences that all the mental operations of men and animals require a nervous system, he flew to the paradox that soul is not limited to men and animals, but extends to plants, to the earth and other planets, to the sun, to the world itself, of which, according to him, God is the world-soul. In this doctrine of universal animation he was like Leibnitz, yet very different. Whereas Leibnitz confined a large area of the world to wholly unconscious perceptions, and therefore preferred to call the souls of inorganic beings "Entelechies," Fechner extended consciousness to the whole world; and accordingly, whereas Leibnitz believed in a supramundane Creator, "au dessus du Monde" and "dans le Monde," Fechner, in the spirit of Schelling, identified God with the soul of the world. Fechner's second point was that, throughout the animated universe, physical processes accompany psychical processes without interaction. In this panpsychistic parallelism he was again like Leibnitz, and he developed his predecessor's view, that the conservation of energy prevents interaction, into the supposition that alongside the physical there is a parallel psychical conservation of energy. Here, again, he went much further than Leibnitz, but along with Schelling, in identifying the physical and the psychical as outer and inner sides of the same process, in which the inner is the real and the outer the apparent. Fechner's third point carried him beyond all his predecessors, containing as it does the true originality of his "world-view." He advanced the ingenious suggestion that, as body is in body and all ultimately in the world-body, so soul is in soul and all ultimately in the world-soul. By this means he explained immortality and vindicated personality. His fourth point was connected with this inclusion of personal spirits in higher spirits and in the highest. It is his so-called "synechological view" of the soul. Herbart and Lotze, both deeply affected by the Leibnitzian hypothesis of indivisible monads, supposed that man's soul is seated at a central point in the brain; and Lotze supposed that this supposition is necessary to explain the unity of consciousness. Fechner's supposition was that the unity of consciousness belongs to the unity of the whole body; that the seat of the soul is the living body; that the soul changes its place as in different parts a process rises above the "threshold of consciousness"; and that soul is not substance but the single psychical life which has its physical manifestation in the single bodily life. Applying this "synechological view" to the supposed inclusion of soul in soul, he deduced the conclusion that, as here the nature of one's soul is to unite one's little body, so hereafter its essence will be to unite a greater body, while God's spirit unites the whole world by His omnipresence; and he pertinently asked, in opposition to the "punctual" view, whether God's soul is centred in a point. Lastly, the whole of this "world-view" was developed by Fechner in early life, under the influence of his religious training, and out of a pious desire to understand those main truths of Christianity which teach us that we are children of God, that this natural body will become a spiritual body, and that, though we are different individual members, we live and move and are in God: "in Deo vivimus, movemus, et sumus." It is important to notice that Fechner maintained this "world-view" in a little book, *Das Büchlein vom Leben nach dem Tode*, which he originally published in 1836 under the pseudonym of Dr Mises, but which he afterwards republished in his own name in 1866, and again in 1887, as a sketch of his *Weltansicht*. Afterwards in *Nanna* (1848) he discussed the supposed souls of plants, and in *Zendavesta* (1851) the supposed souls of the earth and the rest of the world. Then in 1855 he published his *Atomenlehre*, partly founded on his physics, but mainly on his metaphysics. Under the influence of Leibnitz, Boscovich, Kant and Herbart, he supposed that bodies are divisible into punctual atoms, which are not bodies, but centres of forces of attraction and repulsion; that impenetrability is a result of repulsive force; and that force itself is only law—taking as an instance that Newtonian force of attraction whose process we do not understand, and neglecting that Newtonian force of pressure and impact whose process we do understand from the collision of bodies already extended and resisting. But, in thus adapting to his own purposes the Leibnitzian analysis of material into immaterial, he drew his own conclusions according to his own metaphysics, which required that the supposed centres of force are not Leibnitzian "monads," nor Herbartian "reals," nor divine modifications such as Lotze afterwards supposed, but are elements of a system which in outer aspect is bodily and in inner aspect is spiritual, and obeying laws of spirit. At the same time his synechological view prevented him from saying that every atom has a soul, because according to him a soul always corresponds to a unity of a physical manifold. Thus his metaphysics is Leibnitzian, like that of Lotze, and yet is opposed to the most characteristic feature of monadology—the percipient indivisible monad.

In 1860 appeared Fechner's *Elemente der Psychophysik*, a work which deeply affected subsequent psychology, and almost revolutionized metaphysics of body and soul, and of physical and psychical relations generally. It becomes necessary, therefore, to determine how far Fechner derived his psychophysics from experience, how far from fallacies of inference, from his romantic imagination and from his theosophic metaphysics, which indeed coloured his whole book on psychophysics. At the very outset he started with his previous metaphysical hypothesis of parallelistic identity without interaction. He now compared the spiritual and bodily sides of a man to the concave and convex sides of a circle, as inner and outer sides of the same process, which is psychical as viewed from within and physical as viewed from without. He also maintained throughout the book that physical and psychical energy do not interfere, but that the psychical is, like a mathematical quantity, a function of the physical, depending upon it, and vice versa, only in the sense that a constant relation according to law exists, such that we may conclude from one to the other, but without one ever being cause of the other. By his psychophysics he meant the exact doctrine of the relations of dependency between physical and psychical. The name was new, but not the doctrine. From antiquity men had applied themselves to determine the relations between the physical stimuli and the so-called "quality" of sensations. But what was new was the application of this doctrine to the relations between the stimuli and the so-called "intensity" of sensations. He generalized Weber's law (*q.v.*) in the form that sensation generally increases in intensity as the stimulus increases by a constant function of the previous stimulus; or increases in an arithmetical progression as the stimulus increases in a geometrical ratio; or increases by addition of the same amount as the stimulus increases by the same multiple; or increases as the logarithm of the stimulus. There are then, at least within the limits of moderate sensations, concomitant variations between stimuli and sensations, not only in "quality," as in the intervals of sounds, which were understood long ago, but also in "intensity"; and the discovery of the latter is the importance of Weber's and Fechner's law. By the rules of induction from concomitant variations, we are logically bound to infer the realistic conclusion that outer physical stimuli cause inner sensations of sensible effects. But, unfortunately for Fechner, the very opposite conclusion followed from the presuppositions of his parallelistic metaphysics, and from the Leibnitzian view of the conservation of energy, which he was the first in our time to use in order to argue that a physical cause cannot produce a psychical effect, on the ground that physical energy must be exactly replaced by physical energy.

Having satisfied himself in what he called "outer psychophysics," that the stimulus causes only the nervous process and not sensation, he passed to what he called "inner psychophysics," or the theory of the relation between nervous and psychical processes. He rightly argued against the old theory that the continuity of nervous processes in the brain is interrupted by mental processes of thought and will: there is a nervous process for every mental process. But two questions then arose. What is the relation between nervous process and sensation? What causes sensation? The first question he answered from his imagination by supposing that, while the external world is stimulus of the nervous process, the nervous process is the immediate stimulus of the sensation, and that the sensation increases by a constant fraction of the previous stimulus *in the nervous system*, when Weber's law proves only that it increases by a constant fraction of the previous stimulus *in the external world*. The second question he answered from his parallelistic metaphysics by deducing that even within the organism there is only a constant dependency of sensation on nervous process without causation, because the nervous process is physical but the sensation psychical. This answer supposed that the whole physical process from the action of the external stimulus on the nervous system to the reaction of the organism on the external world is one series, while the conscious process beginning with sensation is only parallel and as it were left high and dry. What then is the cause of the sensation? Huxley, it will be remembered, in similar circumstances, answered this question by degrading consciousness to an epiphenomenon, or bye-product of the physical process. Fechner was saved from this absurdity, but only to fall into the greater absurdity of his own panpsychism. Having long assumed that the whole world is animated throughout, and that there are always two parallel series, physical and psychical, he concluded that, while a physical stimulus is causing a physical nervous process, a psychical accompaniment of the stimulus is causing the sensation, which, according to him, is the psychical accompaniment of the nervous process; and that, as the whole physical and the whole psychical series are the same, differing only as outer and inner, this identity holds both of stimulus and its psychical accompaniment and of nervous process and its accompanying sensation. Accordingly, he calls these and all other processes "psychophysical"; and as he recognized two parallel energies, physical and psychical, differing only as outer and inner aspects of the same energy, he called this "psychophysical energy." In such a philosophy all reality is "psychophysical." At the same time Fechner would not have us suppose that the two sides are equal; according to him, the psychical, being the psychophysical as viewed from within, is real, the physical, being the psychophysical viewed from without, is apparent; so in oneself, though nervous process and psychical process are the same, it is the psychical which is the reality of which the nervous is mere appearance; and so everywhere, spirit is the reality, body the appearance of spirit to spirit. Finally, he supposed that one spirit is in another, and all in the highest spirit, God. By this means also he explained unconsciousness. In point of fact, many stimuli are beneath the "threshold" of a man's consciousness. Leibnitz, in the *Nouveaux Essais*, ii. 11, had also said that we have many "petites perceptions," of which we are unconscious, and had further suggested that a perception of which we are, is composed of a quantity of "petites perceptions" of which we are not, conscious. Proceeding on this suggestion, and misled by the mathematical expression which he had given to Weber's law, Fechner held that a conscious sensation, like its stimulus, consists of units, or elements, by summation and increments of which conscious sensations and their differences are produced; so that consciousness, according to this unnecessary assumption, emerges from an integration of unconscious shocks or tremors. But by the hypothesis of the inclusion of spirit in spirit, he was further able to hold that what is unconscious in one spirit is conscious in a higher spirit, while everything whatever is in the consciousness of the highest spirit of God, who is the whole of reality of which the spirits are parts, while the so-called physical world is merely outer appearance of one spirit to another.

Fechner first confused physics and metaphysics in psychophysics, and next proceeded to confuse them again in his work on evolution (*Einige Ideen zur Schöpfungs und Entwicklungs-geschichte der Organismen*, 1873). He perceived that Darwinism attributed too much to accident, and was also powerless to explain the origin of life and of consciousness. But his substitute was his own hypothesis of panpsychism, from which he deduced a "cosmorganic" evolution from a "cosmorganic" or original condition of the world as a living organism into the inorganic, by the principle of tendency to stability. The world, as he thought, on its physical side, always was a living body; and on its psychical side God always was its conscious spirit; and, so far from life arising from the lifeless, and consciousness from unconsciousness, the life and consciousness of the whole world are the origin of the lifeless and the unconscious in parts of it, by a kind of secondary automatism, while we ourselves are developed from our own mother-earth by differentiation. By thus supposing a psychical basis to evolution, Fechner, anticipating Wundt, substituted a psychical development of organs for Darwinian accidental variation. The difficulty of such speculations is to prove that things apparently dead and mindless are living souls. Their interest to the metaphysician is their opposition to physics on the one hand and to theism on the other. Shall we resign our traditional belief that the greater part of the world is mere body, but that its general adaptability to conscious organisms proves its creation and government by God, and take to the new hypothesis, which, by a transfer of design from God to Nature, supposes that everything physical is alive, and conducts its life by psychical impulses of its own? Fechner himself went even further, and together with design transferred God Himself to Nature. This is the subject of his last metaphysical work, *Die Tagesansicht gegenüber der Nachtansicht* (1879). The "day-view" (Fechner's) is the view that God is the psychophysical all-embracing being, the law and consciousness of the world. It resembles the views of Hegel and Lotze in its pantheistic tendency. But it does not, like theirs, sacrifice our personality; because, according to Fechner, the one divine consciousness includes us as a larger circle includes smaller circles. By this ingenious suggestion of the membership of one spirit in another, Fechner's "day-view" also puts Nature in a different position; neither with Hegel sublimating it to the thought of God's mind, nor with Lotze degrading it to the phenomena of our human minds, but identifying it with the outer appearance of one spirit to another spirit in the highest of spirits.

We have dwelt on this curious metaphysics of Fechner because it contains the master-key to the philosophy of the present moment. When the later reaction to Kant arose against both Hegelianism and materialism, the nearly contemporary appearance of Fechner's *Psychophysics* began to attract experimental psychologists by its real as well as its apparent exactness, and both psychologists and metaphysicians by its novel way of putting the relations between the physical and the psychical in man and in the world. Fechner saw psychology deriving advantage from the methods, as well as the results, of his experiments, and in 1879 the first psychological laboratory was erected by Wundt at Leipzig. But he had also to endure countless objections to his mathematical statement of Weber's law, to his unnecessary assumption of units of sensation, and to his unjustifiable transfer of the law from physical to physiological stimuli of sensations, involving in his opinion his parallelistic view of body and mind. Among psychologists Helmholtz, Mach, Brentano, Hering, Delboeuf, were all more or less against him. Sigwart in his *Logic* has also opposed the parallelistic view itself; and James has criticized it from the point of view that the soul selects out of the possibilities of the brain means to its own ends. Nevertheless, largely under the influence of the exaggeration of the conservation of energy, many psychologists—Wundt, Paulsen, Riehl, Jodl, Ebbinghaus, Münsterberg, and in England Lewes, Clifford, Romanes, Stout—have accepted Fechner's psychophysical parallelism, as far at least as men and animals are concerned. Most stop here, but some go with Fechner to the full length of his metaphysical parallelism of the physical and psychical, as psychophysical, throughout the whole world. This influence extended from Germany to Denmark, where it was embraced by Höffding, and to England, where it was accepted by Romanes, and in a more qualified manner as "a working hypothesis" by Stout. But the most thorough and most eloquent of Fechner's metaphysical disciples was F. Paulsen (*q.v.*), who spread panpsychism far and wide in his *Einleitung in die Philosophie.*

Paulsen.

Here reappear all the characteristic points of Fechner's "world-view"—the panpsychism, the universal parallelism with the identification of physical and psychical, the inclusion of spirit in spirit, the synechological view of spirit, and the final "day-view" that all reality is spirit, and body the appearance of spirit to spirit. But Paulsen tries to supply something wanting in Fechner. The originality of Paulsen consists in trying to supply an epistemological explanation of the metaphysics of Fechner, by reconciling him with Kant and Schopenhauer. He borrows from Kant's "rationalism" the hypothesis of a spontaneous activity of the subject with the deduction that knowledge begins from sense, but arises from understanding; and he accepts from Kant's metaphysical idealism the consequence that everything we perceive, experience and know about physical nature, and the bodies of which it consists, is phenomena, and not bodily things in themselves. But he has a different theory of human nature and soul, and so does not accept the Kantian conclusion that things in themselves, in the sense of things beyond phenomena, are all unknowable. On the contrary, his contention is that of Fechner—that all knowable things are inner psychical realities beneath outer physical appearances—the invisible symbolized by the visible. Kant, however, had no epistemology for such a contention, because according to him both outer and inner senses give mere appearance, from which we could not know either body in itself, or soul in itself. Parting, then, from Kant, Paulsen resorts to a paradox which he shares with Fechner and Wundt. He admits, indeed, Kant's hypothesis that by inner sense we are conscious only of mental states, but he contends that this very consciousness is a knowledge of a thing in itself. He agrees with Fechner and Wundt that there is no substantial soul, and that soul is nothing but the mental states, or rather their unity—thus identifying it with Kant's synthetic unity. On this assumption he deduces that in being conscious of our mental states we are conscious of soul not merely as it appears, but as it is in itself, and therefore can infer similar souls, other psychical unities, which are also things in themselves.

But what is the essence of this psychical reality which we thus immediately and mediately know? Here he appeals to Schopenhauer's doctrine that will of some sort is the fundamental fact of mental life. Taking, then, will to be the essential thing in itself of which we are conscious, he deduces that we can infer that the psychical things in themselves beyond ourselves are also essentially "wills." Combining with this the central dogma of Fechner that spirit extends throughout the world of bodily appearance, he concludes that the realities of the world are "wills," that bodies are mere appearances of "wills," and that there is one universal and all-embracing spirit which is "will." His ultimate metaphysics, then, is this: Everything is spirit, and spirit is "will." Lastly, by "will" he does not mean "rational desire," which is its proper meaning, but inapplicable to Nature; nor unconscious irrational will, which is Schopenhauer's forced meaning; nor unconscious intelligent will, which is Hartmann's more correct meaning, though inapplicable to Nature. His "will" is instinct, impulsive feeling, a "will to live," not indeed unconscious, but often subconscious, without idea, without reasoning about ends and means, yet pursuing ends—in short, what he calls, after K. E. von Baer, *Zielstrebigkeit.* How persistent is ancient animism! Empedocles, Plato and Aristotle; Telesio, Bruno and Campanella; Leibnitz; the idealists, Schopenhauer and Hartmann, Fechner and Paulsen; and the materialist, Haeckel—all have agreed in according some sort of appetition to Nature. So prone are men to exaggerate adaptation into aim! So prone are they to transfer to Nature the part played by the providence of God! (see Bacon, *De augmentis*, iii. 4, *sub fin.*).

Noumenal idealism is not dead in Germany. It died down for a time in the decline of Hegelianism and the rise of materialism. It has since revived. The pure idealism of Fichte is at the bottom of it all. The panlogism of Schelling and Hegel survives in its influence. So still more does the pantheism of Schopenhauer. The three most vital idealisms of this kind at the moment are the panpneumatism of Hartmann, combining Hegel with Schopenhauer; the panteleologism of Lotze, reviving Leibnitz; and the panpsychism of Paulsen, continuing Fechner, but with the addition of an epistemology combining Kant with Schopenhauer. All these systems of metaphysics, differ as they may, agree that things are known to exist beyond sensible phenomena, but yet are mental realities of some kind. Meanwhile, the natural substances of Aristotelian realism are regarded with common aversion.

5.—PHENOMENAL IDEALISM IN GERMANY

Phenomenal idealism is the metaphysics which deduces that, as we begin by perceiving nothing but mental phenomena of sense, so all we know at last from these data is also phenomena of sense, actual or possible. So far it is in general agreement not only with Hume, but also with Kant in his first two positions. But it follows Fichte in his revolt against the unknown thing in itself. On the other hand, as the speculative systems of noumenal idealism, starting from Fichte, succeeded one another, like ghosts who "come like shadows, so depart," without producing conviction, and often in flagrant opposition to the truths of natural science, and when, in consequence, a wave of materialism threatened to submerge mind altogether by reducing it to a function of matter, many philosophers began to despair of the ambitious attempts which had been made to prove that there is a whole world of mind beyond phenomena, as the noumenalists had supposed. Thus they were thrown back on the limits of human knowledge prescribed by Kant, but purged of the unknown thing in itself by Fichte. Phenomenal idealism is the Kantian contention that Nature, as known to science, is phenomena of experience. Unfortunately, the word "phenomenon" is equivocal (see *Mind*, xiv. 309). Sometimes it is used for any positive fact, as distinguished from its cause. But sometimes also it means what appears, or can appear, to the senses, as distinguished from what does not appear, but can be inferred to exist. Now, Kant and his followers start from this second and narrower meaning, and usually narrow it still more by assuming that what appears to the senses is as mental as the sensation, being undistinguishable from it or from the idea of it, and that an appearance is a mental idea (*Vorstellung*) of sense; and then they conclude that we can know by inference nothing but such mental appearances, actual and possible, and therefore nothing beyond sensory experience. When, on the other hand, the objects of science are properly described as phenomena, what is meant is not this pittance of sensible appearances, but positive facts of all kinds, whether perceptible or imperceptible, whether capable of being experienced or of being inferred from, but beyond, experience, *e.g.* the farther side of the moon, which is known to exist only by inference. Hence the doctrine of Kant, that Nature as known to science is phenomena, means one thing in Kantism and another thing in science. In the former it means that Nature is mental phenomena, actual and possible, of sensory experience; in the latter it means that Nature is positive facts, either experienced or inferred. It is most important also to notice that Kantism denies, but science asserts, the logical power of reason to infer actual things beyond experience. But the phenomenal idealists have not, any more than Kant, noticed the ambiguity of the term "phenomenon"; they fancy that, in saying that all we know is phenomena in the Kantian sense of mental appearances, they are describing all the positive facts that science knows; and they follow Kant in supposing that there is no logical inference of actual things beyond experience.

1. *The Reaction to Kant.*—The reaction to Kant ("Zurück zu Kant!") was begun by O. Liebmann in *Kant und die Epigonen* (1865). Immediately afterwards, in 1866, appeared Lange's *Geschichte des Materialismus.* In 1870 J. B. Meyer published his *Kants Psychologie*, and in 1871 H. Cohen his more important *Kants Theorie der Erfahrung*, which led Lange to modify his interpretation of Kant in the second edition of his own book. Lange (*q.v.*) by his *History of Materialism* has exercised a profound influence, which is due partly to its apparent success in answering materialism by Kantian arguments, and partly to

Lange.

its ingenious attempt to give to Kantism itself a consistency, which, however, has only succeeded in producing a new philosophy of Neo-Kantism, differing from Kantism in modifying the a priori and rejecting the thing in itself. Lange to some extent modified the transcendentalism of Kant's theory of the origin of knowledge. A priori forms, according to Kant, are contributions of the mental powers of sense, understanding, and reason; but, according to Lange, they are rooted in "the physico-psychical organization." This modification was the beginning of a gradual lessening of the antithesis of a priori to a posteriori, until at last the a priori forms of Kant have been transmuted into "auxiliary conceptions," or "postulates of experience." But this modification made no difference to the Kantian and Neo-Kantian deduction from the epistemological to the metaphysical. Lange entirely agreed with Kant that a priori forms can have no validity beyond experience when he says: "Kant is at any rate so far justified as the principle of intuition in space and time a priori is in us, and it was a service to all time that he should in this first great example, show that what we possess a priori, just because it arises out of the disposition of our mind, beyond our experience has no longer any claim to validity" (*Hist. of Materialism*, trans. E. C. Thomas, ii. 203). Hence he deduced that whatever we know from sensations arranged in such a priori forms are objects of our own experience and mental phenomena. Hence also his answer to materialism. Science, says the materialist, proves that all known things are material phenomena. Yes, rejoins Lange, but Kant has proved that material are merely mental phenomena; so that the more the materialist proves his case the more surely he is playing into the hands of the idealist—an answer which would be complete if it did not turn on the equivocation of the word "phenomenon," which in science means any positive fact, and not a mere appearance, much less a mental appearance, to sense and sensory experience. Having, however, made a deduction, which is at all events consistent, that on Kantian assumptions all we know is mental phenomena, Lange proceeded to reduce the rest of Kantism to consistency. But his ardent love of consistency led him far away from Kant in the end; for he proceeded consistently from the assumption, that whatever we think beyond mental phenomena is ideal, to the logical conclusion that in practical matters our moral responsibility cannot prove the reality of a noumenal freedom, because, as on Kant's assumption we know ourselves from inner sense only as phenomena, we can prove only our phenomenal freedom. Lange thus transmuted inconsistent Kantism into a consistent Neo-Kantism, consisting of these reformed positions: (1) we start with sensations in a priori forms; (2) all things known from these data are mental phenomena of experience; (3) everything beyond is idea, without any corresponding reality being knowable. "The intelligible world," he concluded, "is a world of poetry." Our reflection is that there is a great difference between the essence and the consistency of Kant's philosophy. Its essence, as stated by Kant, was to reduce the logical use of reason to mental phenomena of experience in speculation, in order to extend the practical use of reason to the real noumena, or things in themselves, required for morality. Its consistency, as deduced by Lange, was to reduce all use of reason, speculative and practical, to its logical use of proceeding from the assumed mental data of outer and inner sense, arranged a priori, to mental phenomena of experience, beyond which we can conceive ideas but postulate nothing. As H. Vaihinger, himself a profound Kantian of the new school, says: "Critical scepticism is the proper result of the Kantian theory of knowledge."

Riehl.

There is only one Neo-Kantian way out of this dilemma, but it is to alter the original assumptions of Kant's psychological idealism. This is the alternative of A. Riehl, who in *Der philosophische Kriticismus* (1876, &c.) proposes the non-Kantian hypothesis that, though things in themselves are unknowable through reason alone, they are knowable by empirical intuition; and therefore also by empirical thought starting from intuition. Like all true followers of Kant, Riehl prefers epistemology to metaphysics; yet in reality he founds a metaphysics on epistemology, which he calls "critical realism," so far as it asserts a knowledge of things beyond phenomena, and "critical monism," so far as it holds that these things are unlike both physical and psychical phenomena, but are nevertheless the common basis of both. He accepts the Kantian positions that unity of consciousness combines sensations by a priori synthesis, and that therefore all that natural science knows about matter moving in space is merely phenomena of outer sense; and he agrees with Kant that from these data we could not infer things in themselves by reason. But his point is that the very sensation of phenomena or appearances implies the things which appear. "Sensory knowledge," he says, "is the knowledge of the relations of things through the relations of the sensations of things." Further, holding that, "like every other perception, the perception of a human body immediately involves the existence of that body," and, like Fichte, believing in a "common consciousness," he concludes that the evidence of sense is verified by "common consciousness" of the external world as objective in the Kantian sense of universally valid. He interprets the external world to be the common basis of physical and psychical phenomena. He rightly relies on the numerous passages, neglected by Lange, in which Kant regards things in themselves as neither phenomena nor ideas, but things existing beyond both. But his main reliance is on the passage in the *Kritik*, where Kant, speaking of the Cartesian difficulty of communication between body and soul, suggests that, however body and soul appear to be different in the phenomena of outer and inner sense, what lies as thing in itself at the basis of the phenomena of both may perhaps be not so heterogeneous (*ungleichartig*) after all. Riehl elaborates this bare suggestion into the metaphysical theory that the single basis of physical and psychical phenomena is neither bodily nor mental, nor yet space and motion. In order to establish this paradox of "critical monism," he accepts to a certain extent the psychophysical philosophy of Fechner. He agrees with Fechner that physical process of nerve and psychical process of mind are really the same psychophysical process as appearing on the one hand to an observer and on the other hand to one's own consciousness; and that physical phenomena only produce physical phenomena, so that those materialists and realists are wrong who say that physical stimuli produce sensations. But whereas Fechner and Paulsen hold that all physical processes are universally accompanied by psychical processes which are the real causes of psychical sensations, Riehl rejects this paradox of universal parallelism in order to fall into the equally paradoxical hypothesis that something or other, which is neither physical not psychical, causes both the physical phenomena of matter moving in space and the psychical phenomena of mind to arise in us as its common effects. In supposing a direct perception of such a nondescript thing, he shows to what straits idealists are driven in the endeavour to supplement Kant's limitation of knowledge to phenomena by some sort of knowledge of things.

2. *The Reaction to Hume.*—When the Neo-Kantians, led by Lange, had modified Kant's hypothesis of a priori forms, and retracted Kant's admission and postulation of things in themselves beyond phenomena and ideas, and that too without proceeding further in the direction of Fichte and the noumenal idealists, there was not enough left of Kant to distinguish him essentially from Hume. For what does it matter to metaphysics whether by association sensations suggest ideas, and so give rise to ideas of substance and causation a posteriori, or synthetic unity of consciousness combines sensations by a priori notions of substance and causation into objects which are merely mental phenomena of experience, when it is at once allowed by the followers of Hume and Kant alike that reason in any logical use has no power of inferring things beyond the experience of the reasoner? In either case, the effective power of inference, which makes us rational beings, is gone. Naturally then the reaction to Kant was followed by a second reaction to Hume, partly under the name of "Positivism," which has attracted a number of adherents, such as C. Göring (1841–1879), author of an incomplete *System der Kritischen Philosophie* (1874–1875) and E. Laas (*q.v.*), and partly under the name of the "physical phenomenology" of E. Mach.

Mach.

Ernst Mach (*q.v.*) is a conspicuous instance of a confusion of physics and psychology ending in a scepticism like that of Hume. He tells us how from his youth he pursued physical and psychological studies, how at the age of fifteen he read Kant's *Prolegomena*, and later rejected the thing in itself, and came to the conclusion that the world with his ego is one mass of sensations. For a time, under the influence of Fechner's *Psychophysics*, he thought that Nature has two sides, a physical and a psychological, and added that all atoms have feeling. But in the progress of his physical work, which taught him, as he thought, to distinguish between what we see and what we mentally supply, he soon passed from this noumenalism to a "universal physical phenomenology." It retains some relics of Fechner's influence; first, the theory of identity, according to which the difference between the physical and psychical is not a dualism, but everything is at once both; and secondly, the substitution of mathematical dependence for physical causality, except that, whereas Fechner only denied causality between physical and psychical, Mach rejects the entire distinction between causality and dependence, on the ground that "the law of causality simply asserts that the phenomena of Nature are dependent on one another." He comes near to Hume's substitution of succession of phenomena for real causality. He holds, like Hume, that nothing is real except our sensations and complexes of sensory elements; that the ego is not a definite, unalterable, sharply bounded unity, but its continuity alone is important; and that we know no real causes at all, much less real causes of our sensations; or, as he expresses it, bodies do not produce sensations, but complexes of sensations form bodies. If he has any originality, it consists in substituting for the association of ideas the "economy of thinking," by which he means that all theoretical conceptions of physics, such as atoms, molecules, energy, &c., are mere helps to facilitate our consideration of things. But he limits this power of mind beyond sensations to mere ideas, and like Hume, and also like Lange, holds at last that, though we may form ideas beyond sensations or phenomena, we cannot know things. If we ask how Mach arrived at this scepticism, which is contained in his well-known scientific work *Die Mechanik in ihrer Entwickelung* (1883; ed. 1908) as well as in his psychological work on the Analysis of Sensations (*Beiträge zur Analyse der Empfindungen*, 1886), we find two main causes, both psychological and epistemological; namely, his views on sense and on inference. In the first place, he displays in its most naked form the common but unproved idealistic paradox of a sense of sensations, according to which touch apprehends not pressure but a sensation of pressure, sight apprehends not colour but a sensation of colour, and there is no difference between the sensory operation and the sensible object apprehended by any sense, even within the sentient organism. Hence, according to him, sensations are not apprehensions of sensible objects (*e.g.* pressures felt) from which we infer similar objects beyond sense (*e.g.* similar pressures of outside things), but are the actual elements out of which everything known is made; as if sensations were like chemical elements. Within the limits of these supposed sensory elements he accords more than many psychologists do to sense; because, following the nativists, Johannes Müller and Hering, he includes sensations of time and space, which, however, are not to be regarded as "pure intuitions" in the style of Kant. But here again he identifies time and space with the sensations of them (*Zeitempfindungen* and *Raumempfindungen*). On the assumption, then, that time and space are not objects, but systems, of sensations, he concludes that a body in time and space is "a relatively constant sum of touch-and-light-sensations, joined to the same time-and-space-sensations," that each man's own body is included in his sensations, and that to explain sensations by motions would only be to explain one set of sensations from another. In short, sensations are elements and bodies complexes of these elements. Secondly, his theory of inference contains the admission that we infer beyond sensations: he remarks that the space of the geometer is beyond space-sensations, and the time of the physicist does not coincide with time-sensations, because it uses measurements such as the rotation of the earth and the vibrations of the pendulum. But by inference beyond sense he does not mean a process of concluding from sensible things to similar things, *e.g.* from tangible pressures to other similar pressures in the external world. Inference, according to him, is merely mental completion of sensations; and this mental completion has two characteristics: it only forms ideas, and it proceeds by an "economy of thought." In the course of his learned studies on the history of mechanics he became deeply impressed with Galileo's appeals to simplicity as a test of truth, and converted what is at best only one characteristic of thinking into its essence. According to him, whatever inferences we make, certain or uncertain, are mere economies of thought, adapting ideas to sensations, and filling out the gaps of experience by ideas; whatever we infer, whether bodies, or molecules, or atoms, or space of more than three dimensions, are all without distinction equally provisional conceptions, things of thought; and "bodies or things are compendious mental symbols for groups of sensations—symbols which do not exist outside thought." Moreover, he applies the same scepticism to cause and effect. "In Nature," says he, "there is no cause and no effect." He thinks that repetitions of similar conjunctions occur in Nature, the connexion of cause and effect only in abstraction. He refers to Hume as recognizing no causality but only a customary and habitual succession, but adds that Kant rightly recognizes that mere observation cannot teach the necessity of the conjunction. But in reality his theory is neither Hume's theory of association nor Kant's of an a priori notion of understanding under which a given case is subsumed. He thinks that there is a notion of understanding (*Verstandesbegriff*), under which every new experience is subsumed, but that it has been developed by former experience, instinctively, and by the development of the race, as part of the economy of thinking. "Cause and effect are therefore," he concludes, "thought-things of economical function (*Gedankendinge von ökonomischer Function*)." His philosophy, therefore, is that all known things are sensations and complexes of sensory elements, supplemented by an economy of thinking which cannot carry us beyond ideas to real things, or beyond relations of dependency to real causes.

Kirchhoff.

It is important to understand that Mach had developed this economical view of thought in 1872, more than ten years before the appearance of his work on the history of mechanics as he tells us in the preface, where he adds that at a later date similar views were expressed by Kirchhoff in his *Vorlesungen über mathematische Physik* (1874). Kirchhoff asserted that the whole object of mechanics is "to describe the motions occurring in Nature completely in the simplest manner." This view involves the denial of force as a cause, and the assertion that all we know about force is that the acceleration of one mass depends on that of another, as in mathematics a function depends on a variable; and that even Newton's third law of motion is merely a description of the fact that two material points determine in one another, without reciprocally causing, opposite accelerations. It is evident that Kirchhoff's descriptive is the same as Mach's economical view. "When I say," says Mach, "that a body A exerts a force on a body B, I mean that B, on coming into contraposition with A, is immediately affected by a certain acceleration with respect to A." In a word, Mach and Kirchhoff agree that force is not a cause, convert Newtonian reciprocal action into mere interdependency, and, in old terminology, reduce mechanics from a natural philosophy of causes to a natural history of mere facts. Now, Mach applies these preconceived opinions to "mechanics in its development," with the result that, though he shows much skill in mathematical mechanics, he misrepresents its development precisely at the critical point of the discovery of Newton's third law of motion.

The true order of discovery, however, was as follows:—

(*a*) Sir Christopher Wren made many experiments before the Royal Society, which were afterwards repeated in a corrected form by Sir Isaac Newton in the *Principia*, experimentally proving that bodies of ascertained comparative weights, when suspended and impelled against one another, forced one another back by impressing on one another opposite changes of velocity inversely as their weights and therefore masses; that is, by impressing on one another equal and opposite changes of momentum.

(*b*) Wallis showed that such bodies reduce one another to a joint mass with a common velocity equal to their joint momentum divided by their joint weights or masses. This result is easily deducible also from Wren's discovery. If m and m' are the masses, v and v' their initial velocities, and V the common velocity, then $m(v - \mathrm{V}) = m'(\mathrm{V} - v')$, therefore $mv + m'v' = (m + m')\mathrm{V}$, and hence $(mv + m'v')/(m + m') = \mathrm{V}$.

(*c*) Wren and Huygens further proved that the law of equal action and reaction, already experimentally established by the former, is deducible from the conservation of the velocity of the common centre of gravity, which is the same as the common velocity of the bodies, that is, deducible from the fact that their common centre of gravity does not change its state of motion or rest by the actions of the bodies between themselves; and they further extended the law to bodies, *qua* elastic.

(*d*) Hence, first inductively and then deductively, the third law was originally discovered only as a law of collision or impact between bodies of ascertained weights and therefore masses, impressing on one another equal and opposite changes of momentum, and always reducing one another to a joint mass with a common velocity to begin with, apart from the subsequent effects of elasticity.

(*e*) Newton in the *Principia*, repeating and correcting Wren's experiments on collision, and adding further instances from attractive forces of magnetism and gravity, induced the third law of motion as a general law of all forces.

This order of discovery shows that the third law was generalized from the experiments of Wren on bodies of ascertained comparative weights or masses, which are not material points or mass-points. It shows that the bodies impress on one another opposite changes of velocity inversely as their weights or masses; and that in doing so they always begin by reducing one another to a joint mass with a common velocity, whatever they may do afterwards in consequence of their elasticities. The two bodies therefore do not penetrate one another, but begin by acting on one another with a force precisely sufficient, instead of penetrating one another, to cause them to form a joint mass with a common velocity. Bodies then are triply extended substances, each occupying enough space to prevent mutual penetration, and by this force of mutual impenetrability or inter-resistance cause one another to form a joint mass with a common velocity whenever they collide. Withdraw this foundation of bodies as inter-resisting forces causing one another in collision to form a joint mass with a common velocity but without penetration, and the evidence of the third law disappears; for in the case of attractive forces we know nothing of their *modus operandi* except by the analogy of the collision of inter-resisting bodies, which makes us believe that something similar, we know not what, takes place in gravity, magnetism, electricity, &c. Now, Mach, though he occasionally drops hints that the discovery of the law of collision comes first, yet never explains the process of development from it to the third law of motion. On the contrary, he treats the law of collision with other laws as an application of the third law of motion, because it is now unfortunately so taught in books of mechanics. He has therefore lost sight of the truths that bodies are triply extended, mutually impenetrable substances, and by this force causes which reduce one another to a joint mass with a common velocity on collision, as for instance in the ballistic pendulum; that these forces are the ones we best understand; and that they are reciprocal causes of the common velocity of their joint mass, whatever happens afterwards. In the case of this one force we know far more than the interdependence supposed by Mach and Kirchhoff; we know bodies with impenetrable force causing one another to keep apart. It might have been expected that scepticism on this subject would not have had much effect. But the idealists are only too glad to get any excuse for denying bodily substances and causes; and, while Leibnitz supplied them with the fancied analysis of material into immaterial elements, and Hume with the reduction of bodies to assemblages of sensations, Mach adds the additional argument that bodily forces are not causes at all. In Great Britain Mach's scepticism was welcomed by Karl Pearson to support an idealistic phenomenalism derived from Hume, and by Ward to support a noumenal idealism derived from Lotze. No real advance in metaphysics can take place, and natural science itself is in some danger, until the true history of the evidences of the laws of mechanical force is restored; and then it will soon appear that in the force of collision what we know is not material points determining one another's opposite accelerations, but bodies by force of impenetrable pressure causing one another to keep apart. Mechanics is a natural philosophy of causes.

3. *Dualism within Experience.*—Besides those philosophies which are reactions to Kant or to Hume, there are a number of other modern systems which start with the common hypothesis that knowledge is experience. The consequence is that whatever is true of experience they transfer to all knowledge. One of the characteristics of actual experience is that its object is, or has been, present to an experiencing subject; and of possible experience that it can be present. As a matter of fact, this characteristic differentiates experience from inference. By inference we know that things, such as the farther side of the moon, which neither are, nor have been, nor can be, present to an experiencing subject on the earth, nevertheless exist. But, on the hypothesis that knowledge contains no inferences beyond experience, it follows that all the objects of knowledge, being objects of experience, are, or have been, or can be, present to an experiencing subject. Hence it is common nowadays to hold that there is indeed a difference between knower and known, ego and non-ego, subject and object, but that they are inseparable; or that all known things are objects and subjects inseparably connected in experience. This view, however, is held in different forms; and two opposite forms have arisen in Germany, "immanent philosophy" and "empirio-criticism," the former nearer to Kant, the latter to Hume.

Immanent Philosophy.

Immanent Philosophy is the hypothesis that the world is not transcendent, but immanent in consciousness. Among the upholders of this view are Anton von Leclair, who expresses it in the formula—"Denken eines Seins = gedachtes Sein," and R. von Schubert-Soldern, who says that every fragment of the pretended transcendent world belongs to the immanent. But the best known representative of Immanent Philosophy is W. Schuppe, who, in his *Erkenntnistheoretische Logik* (1878), and in his shorter *Grundriss der Erkenntnistheorie und Logik* (1894), gives the view a wider scope by the contention that the real world is the common content or object of common consciousness, which, according to him, as according to Fichte, is one and the same in all individual men. Different individual consciousnesses plainly differ in having each its own content, in which Schuppe includes each individual's body as well as the rest of the things which come within the consciousness of each; but they also as plainly agree, *e.g.* in all admitting one sun. Now, the point of Schuppe is that, so far as they agree, individual consciousnesses are not merely similar, but the same in essence; and this supposed one and the same essence of consciousness in different individuals is what he calls consciousness in general (*Bewusstsein überhaupt*). While in this identification he follows Fichte, in other respects he is more like Kant. He supposes that the conscious content is partly a posteriori, or consisting of given data of sense, and partly a priori, or consisting of categories of understanding, which, being valid for all objects, are contributed by the common consciousness. He differs, however, from Kant, not only because he will not allow that the given data are received from things in themselves, but also because, like Mach, he agrees with the nativists that the data already contain a spatial determinacy and a temporal determinacy, which he regards as a posteriori elements of the given, not like Kant, as a priori forms of sense. He allows, in fact, no a priori forms except categories of the understanding, and these he reduces, considering that the most important are identity with difference and causality, which in his view are necessary to the judgments that the various data which make up a total impression (*Gesammteindruck, Totaleindruck*) are each different from the others, together identical with the total impression, and causally connected in relations of necessary sequence and coexistence. At the same time, true to the hypothesis of "immanence," he rigidly confines these categories to the given data, and altogether avoids the inconsistent tendency of Kant to transfer causality from a necessary relation between phenomena to a necessary relation between phenomena and things in themselves as their causes. Hence he strictly confines true judgment and knowledge to the consciousness of the identity or difference, and the causal relations of the given content of the common consciousness. From this epistemology he derives the metaphysical conclusion that the things we know are indeed independent of my consciousness and of yours, taken individually, or, to use a new phrase, are "trans-subjective"; but, so far from being independent of the common consciousness, one and the same in all of us, they are simply its contents in the inseparable relation of subject and object. To the objection that there are objects, *e.g.* atoms, which are never given to any consciousness, he returns the familiar Kantian answer that, though unperceived, they are perceptible. The whole known world, then according to him, is the perceived and the perceptible content of common consciousness.

Empirio-Criticism.

The "empirio-criticism" of R. Avenarius (*q.v.*) is the hypothesis of the inseparability of subject and object, or, to use his own phraseology, of ego and environment, in purely empirical, or a posteriori form. It is like "immanent philosophy," in opposing experience to the transcendent; but it also opposes experience to the transcendental, or a priori. It opposes "pure experience" to "pure reason," while it agrees with Kant's limitation of knowledge to experience. Avenarius held a view of knowledge very like that of Mach's view of the economy of thinking. In his first philosophical treatise, *Philosophie als Denken der Welt gemäss dem Princip des kleinsten Kraftmaasses, Prolegomena zu einer Kritik der reinen Erfahrung* (1876), he based his views on the principle of least action, contending that, as in Nature the force which produces a change is the least that can be, so in mind belief tends in the easiest direction. In illustration of this tendency, he pointed out that mind tends to assimilate a new impression to a previous content, and by generalization to bring as many impressions under as few general conceptions as possible, and succeeds so far as it generalizes from pure experience of the given. Nor is there any objection to this economical view of thought, as long as we remember what Avenarius and Mach forget, that the essence of thought is the least action neither more nor less than necessary to the point, which is the reality of things. Afterwards, in his *Kritik der reinen Erfahrung* (1888–1890), Avenarius aimed at giving a description of pure experience which he identified with the natural view of the world held by all unprejudiced persons. What, then, is this pure experience? "Every human individual," says he, "originally accepts over against him an environment with manifold parts, other individuals making manifold statements, and what is stated in some way dependent upon the environment." Statements dependent upon the environment are what he means by pure experience. At first this starting-point looks like dualistic realism, but in reality the author only meant dualism within experience. By the environment he meant not a thing existing in itself, but only a counterpart (*Gegenglied*) of ourselves as central part (*Centralglied*). "We cannot," he adds, "think ourselves as central part away." He went so far as to assert that, where one assumes that at some time there was no living being in the world, all one means is that there was besides oneself no other central part to whom one's counterparts might also be counterparts. The consequence is that all the world admitted into his philosophy is what he called the "empirio-critical essential co-ordination" (*empirio-kritische Prinzipialkoordination*), an inseparable correlation of central part and counterpart, of ego and environment. Within this essential co-ordination he distinguished three values: *R-values* of the environment as stimulus; *C-values* of the central nervous system; and *E-values* of human statements—the latter being characterized by that which at the time of its existence for the individual admits of being named, and including what we call sensations, &c., which depend indirectly on the environment and directly on the central nervous system, but are not, as the materialist supposes, in any way reducible to possessions of the brain or any other part of that system. This division of values brings us to the second point in his philosophy, his theory of what he called "vital series," by which he assayed to explain all life, action and thought. A vital series he supposed to be always a reaction of C against disturbance by R, consisting in first a vital difference, or diminution by R of the maintenance-value of C, and then the recovery by C of its maintenance-value, in accordance with the principle of least action. He further supposed that, while this independent vital series of C is sometimes of this simple kind, at other times it is complicated by the addition of a dependent vital series in E, by which, in his fondness for too general and far-fetched explanations, he endeavoured to explain conscious action and thought. (Thus, if a pain is an E-value directly dependent on a disturbance in C, and a pleasure another E-value directly dependent on a recovery of C, it will follow that a transition from pain to pleasure will be a vital series in E directly dependent on an independent vital series in C, recovering from a vital difference to its maintenance-maximum.) Lastly, supposing that all human processes can in this way be reduced to vital series in an essential co-ordination of oneself and environment, Avenarius held that this empirio-critical supposition, which according to him is also the natural view of pure experiences, contains no opposition of physical and psychical, of an outer physical and an inner psychical world—an opposition which seemed to him to be a division of the inseparable. He considered that the whole hypothesis that an outer physical thing causes a change in one's central nervous system, which again causes another change in one's inner psychical system or soul, is a departure from the natural view of the universe, and is due to what he called "introjection," or the hypothesis which encloses soul and its faculties in the body, and then, having created a false antithesis between outer and inner, gets into the difficulty of explaining how an outer physical stimulus can impart something into an inner psychical soul. He concluded therefore that, having disposed of this fallacy of introjection, we ought to return to the view of reality as an essential co-ordination of ego and environment, of central part and counterpart, with R-values, C-values and E-values.

It is curious that Avenarius should have brought forward this artificial hypothesis as the natural view of the world, without reflecting that on the one hand the majority of mankind believes that the environment (R) exists, has existed, and will exist, without being a counterpart of any living being as central part (C); and that on the other hand it is so far from being natural to man to believe that sensation and thought (E) are different from, and merely dependent on, his body (C), that throughout the Homeric poems, though soul is required for other purposes, all thinking as well as sensation is regarded as a purely bodily operation. It is indeed difficult to assign any rational place to the empirio-criticism of Avenarius. It is materialistic without being materialism; it is realistic without being realism. Its rejection of the whole relation of physical and psychical makes it almost too indefinite to classify among philosophical systems. But its main point is the essential co-ordination of ego and environment, as central part and counterpart, in experience. It is therefore nearly connected with "immanent philosophy." Schuppe, indeed, wrote an article in the *Vierteljahrsschrift* of Avenarius to prove their essential agreement. At the same time Schuppe's hypothesis of one common consciousness uniting the given by a priori categories could hardly be accepted by Avenarius as pure experience, or as a natural view of the world. His "empiriocriticism" is idealistic dualism within experience in an a posteriori form, but with a tendency towards materialism.

4. *Voluntaristic Phenomenalism of Wundt.*—Wundt's metaphysics will form an appropriate conclusion of this sketch of German idealism, because his patient industry and eclectic spirit have fitted him to assimilate many of the views of his predecessors. Wundt proves that all idealisms are in a way one. He starts as a phenomenalist from the hypothesis, which we have just described, that knowledge is experience containing subject and object in inseparable connexion, and has something in common with the premature attempt of Avenarius to develop the hypothesis of dualism in experience into a scientific philosophy comprehending the universe in the simplest possible manner. Again he agrees with the reaction both to Hume and to Kant in limiting knowledge to mental phenomena, and has affinities with Mach as well as with Lange. His main sympathies are with the Neo-Kantians, and especially with Lange in modifying the a priori, and in extending the power of reason beyond phenomena to an ideal world; and yet the cry of his phenomenalism is not "back to Kant," but "beyond Kant." Though no noumenalist, in many details he is with noumenalists; with Fechner in psychophysics, in psychophysical parallelism, in the independence of the physical and the psychical chains of causality, in reducing physical and psychical to a difference of aspects, in substituting impulse for accident in organic evolution, and in wishing to recognize a gradation of individual spiritual beings; with Schopenhauer and Hartmann in voluntarism; and even with Schelling and Hegel in their endeavour, albeit on an artificial method, to bring experience under notions, and to unite subject and object in one concrete reality. He has a special relation to Fichte in developing the Kantian activity of consciousness into will and substituting activity for substantiality as the essence of soul, as well as in breaking down the antithesis between phenomena and things in themselves. At the same time, in spite of his sympathy with the whole development of idealism since Kant, which leads him to reject the thing in itself, to modify a priorism, and to stop at transcendent "ideals," without postulates of practical reason, he nevertheless has so much sympathy with Kant's *Kritik* as on its theories of sense and understanding to build up a system of phenomenalism, according to which knowledge begins and ends with ideas, and finally on its theory of pure reason to accord to reason a power of logically forming an "ideal" of God as ground of the moral "ideal" of humanity—though without any power of logically inferring any corresponding reality. He constructs his system on the Kantian order—sense, understanding, reason—and exhibits most clearly the necessary consequence from psychological to metaphysical idealism. His philosophy is the best exposition of the method and argument of modern idealism—that we perceive the mental and, therefore, all we know and conceive is the mental.

Wundt.

Wundt founds his whole philosophy on four psychological positions: his phenomenalistic theory of unitary experience, his voluntarism, his actualistic theory of soul, and his psychological theory of parallelism. They are positions also which deeply affect, not only the psychological, but also the metaphysical idealisms of our time, in Germany, and in the whole civilized world.

i. His first position is his phenomenalistic theory of unitary experience. According to him, we begin with an experience of ideas, in which object and idea are originally identical (*Vorstellungsobject*); we divide this unitary experience into its subjective and objective factors; and especially in natural science we so far abstract the objects as to believe them at last to be independent things; but it is the office of psychology to warn us against this popular dualism, and to teach us that there is only a duality of psychical and physical, which are divisible, not separable, factors of one and the same content of our immediate experience; and experience is our whole knowledge. His metaphysical deduction from this psychological view is that all we know is mental phenomena, "the whole outer world exists for us only in our ideas," and all that our reason can logically do beyond these phenomena is to frame transcendent "ideals."

ii. His second position is his voluntarism. He agrees with Schopenhauer that will is the fundamental form of the spiritual. He does not mean that will is the only mental operation; for he recognizes idea derived from sensation, and feeling, as well as will. Moreover, he contends that we can neither have idea without feeling and will, nor will without idea and feeling; that idea alone wants activity, and will alone wants content; that will is ideating and activity (*vorstellende Thätigkeit*), which always includes motives and ends and consequently ideas. He is therefore a follower of Schopenhauer as corrected by Hartmann. Like these predecessors, and like his younger contemporary Paulsen, in calling will fundamental he includes impulse (*Trieb*). Accordingly he divides will into two species: on the one hand, simple volition, or impulse, which in his view requires as motive a feeling directed to an end, and therefore an idea, *e.g.* the impulse of a beast arising from hunger and sight of prey; on the other hand, complex volition issuing in a voluntary act requiring decision (*Entscheidung*) or conscious adoption of a motive, with or without choice. Like other German voluntarists, he imputes "impulsive will" to the whole organic world. He follows Fechner closely in his answer to Darwin. If he is to be believed, at the bottom of all organic evolution organic impulses becoming habits produce structural changes, which are transmitted by heredity; and as an impulse thus gradually becomes secondarily automatic, the will passes to higher activities, which in their turn become secondarily automatic, and so on. As now he supposes feeling even in "impulsive will" to be directed to an end, he deduces the conclusion that in organic evolution the pursuit of final causes precedes and is the origin of mechanism. But at what a cost! He has endowed all the plants in the world with motives, feelings directed to an end, and ideas, all of which, according to him, are required for impulse! He apparently forgets that mere feelings often produce actions, as when one writhes with pain. But even so, have plants even those lowest impulses from feelings of pain or pleasure? Wundt, however, having gone so far, there stops. It is not necessary for him to follow Schopenhauer, Hartmann and Fechner in endowing the material universe with will or any other mental operation, because his phenomenalism already reduces inorganic nature to mere objects of experiencing subjects. Wundt's voluntarism takes a new departure, in which, however, he was anticipated by the paradox of Descartes: that will is required to give assent to anything perceived (*Principia philosophiae*, i. 34). Wundt supposes not only that all organisms have outer will, the will to act, but also that all thinking is inner will—the will to think. Now there is a will to think, and Aristotle pointed out that thinking is in our power whenever one pleases, whereas sense depends on an external stimulus (*De anima*, ii. 5). There is also an impulse to think, *e.g.* from toothache. But it does not follow that thought is will, or even that there is no thinking without either impulse or will proper. The real source of thinking is evidence. Wundt, however, having supposed that all thinking consists of ideas, next supposes that all thinking is willing. What is the source of this paradox? It is a confusion of impulse with will, and activity with both. He supposes that all agency, and therefore the agency of thinking, is will. In detail, to express this supposed inner will of thinking, he borrows from Leibnitz and Kant the term "apperception," but in a sense of his own. Leibnitz, by way of distinction from unconscious perception, gave the name "apperception" to consciousness. Kant further insisted that this apperception, "I think," is an act of spontaneity, distinct from sense, necessary to regarding all my ideas as mine, and to combining them in a synthetic unity of apperception; which act Fichte afterwards developed into an active construction of all knowledge, requiring will directed to the end of duty. Wundt, in consequence, thinking with Kant that apperception is a spontaneous activity, and with Fichte that this activity requires will, and indeed that all activity is will, infers that apperception is inner will. Further, on his own account, he identifies apperception with the process of attention, and regards it as an act necessary to the general formation of compound ideas, to all association of ideas, to all imagination and understanding. According to him, then, attention, even involuntary attention, requires inner will; and all the functions imputed by Hume to association, as well as those imputed to understanding by Kant, require apperception, and therefore inner will. At the same time he does not suppose that they all require the same kind of will. In accordance with his previous division of outer will into impulsive and decisive, he divides the inner will of apperception into passive apperception and active apperception. Apperception in general thus becomes activity of inner will, constituting the process of attention, passive in the form of impulsive will required for association, and active in the form of decisive will required for understanding and judgment. Now, beneath these confusing phrases the point to be regarded is that, in Wundt's opinion, though we can receive sensations, we cannot think at all beyond sense, without some will. This exaggeration of the real fact of the will to think ignores throughout the position of little man in the great world and at the mercy of things which drive him perforce to sense and from sense to thought. It is a substitution of will for evidence as ground of assent, and a neglect of our consciousness that we often believe against our will (*e.g.* that we must die), often without even an impulse to believe, often without taking any interest, or when taking interest in something else of no importance. "The Dean is dead (Pray, what is trumps?)." Yet many psychologists accept the universality of this will to believe, and among them James, who says that "it is far too little recognized how entirely the intellect is built up of practical interests." We should rather say "far too much." Wundt, however, goes still farther. According to him, that which acts in all organisms, that which acts in all thinking, that which divides unitary experience into subject and object, the source of self-consciousness, the unity of our mental life, "the most proper being of the individual subject is will." In short, his whole voluntarism means that, while the inorganic world is mere object, all organization is congealed will, and all thinking is apperceptive will. But it must be remembered that these conclusions are arrived at by confusing action, reaction, life, excitability, impulse, and rational desire, all under the one word "will," as well as by omitting the involuntary action of intelligence under the pressure of evidence. It may well be that impulsive feeling is the beginning of mind; but then the order of mind is feeling, sense, inference, will, which instead of first is last, and implies the others. To proceed, however, with voluntarism, Wundt, as we have seen, makes personality turn on will. He does not accept the universal voluntarism of Schopenhauer and Hartmann, but believes in individual wills, and a gradation of wills, in the organic world. Similarly, he supposes our personal individual will is a collective will containing simpler will-unities, and he thinks that this conclusion is proved by the continuance of actions in animals after parts of the brain have been removed. In a similar way he supposes our wills are included in the collective will of society. He does not, however, think with Schuppe that there is one common consciousness, but only that there is a collective consciousness and a collective will; not perceiving that then the sun—in his view a mere object in the experience of every member of the collection—would be only a collective sun. Lastly, he believes that reason forms the "ideal" of God as world-will, though without proof of existence. On the whole, his voluntarism, though like that of Schopenhauer and Hartmann, is not the same; not Schopenhauer's, because the ideating will of Wundt's philosophy is not a universal irrational will; and not Hartmann's, because, although ideating will, according to Wundt's phenomenalism, is supposed to extend through the world of organisms, the whole inorganic world remains a mere object of unitary experience.

iii. His third position is his actualistic theory of soul, which he shares with Fichte, Hegel, Fechner and Paulsen. When Fichte had rejected the Kantian soul in itself and developed the Kantian activity of apperception, he considered that soul consists in constructive activity. Fechner added that the soul is the whole unitary spiritual process manifested in the whole unitary bodily process without being a substance. Wundt accepts Fichte's theory of the actuality, and Fechner's synechological view, of the soul. Taking substance entirely in the sense of substrate, he argues that there is no evidence of a substantial substrate beneath mental operations; that there is nothing except unitary experience consisting of ideas, feelings, volitions, and their unity of will; and that soul in short is not *substantia*, but *actus*. He does not see that this unity is only apparent, for men think not always, and will not always. Nor does he see that a man is conscious not of idea, feeling, will, experience, but of something conceiving, feeling, willing and experiencing, which he gradually learns to call himself, and that he is never conscious of doing all this "minding" without his body. If, then, these mental operations were merely actuality, they would be actuality of a man's bodily substance. In truth there is no sound answer to Materialism, except that, besides bodily substance, psychical substance is also necessary to explain how man performs mental actualities consciously (see case *Physical Realism*, ch. v.). Wundt, however, has satisfied himself, like Fechner, that there is no real opposition of body and soul, and concludes, in accordance with his own phenomenalism, that his body is only an object abstracted from his unitary experience, which is all that really is of him.

iv. Hence his fourth point is his psychological theory of parallelism of physical and psychical reduced to identity in unitary experience. Here his philosophy is Fechnerism phenomenalized. He accepts Fechner's extension of Weber's law of the external stimuli of sense, while judiciously remarking that "the physiological interpretation is entirely hypothetical." He accepts psychophysical parallelism in the sense that every psychical process has a physical accompaniment, every physiological function has a psychical meaning, but neither external stimulus nor physiological stimulus is cause of a psychical process, nor vice versa. Precisely like Fechner, he holds that there is a physical causality and energy and there is a psychical causality and energy, parallels which never meet. He uses this psychical causality to carry out his voluntarism into detail, regarding it as an agency of will directed to ends, causing association and understanding, and further acting on a principle which he calls the heterogony of ends; remarking very truly that each particular will is directed to particular ends, but that beyond these ends effects follow as unexpected consequences, and that this heterogony produces social effects which we call custom. But while thus sharply distinguishing the physical and the psychical in appearance, he follows Fechner in identifying them in reality; except that Fechner's identification is noumenal, Wundt's phenomenal. Wundt does not allow that we know beyond experience any souls of earth, or any other inorganic being. He does not, therefore, allow that there is a universal series of physical and psychical parallels. According to his phenomenalism, the external stimulus and the physiological stimulus are both parallels of the same psychical process; the external body, as well as my body, is merely an object abstracted from an idea of my experience; and what is really known in every case is a unitary experience; divisible, but not separable, into body and soul, physical and psychical factors of one and the same unitary experience. Wundt is confined by his starting-point to his deduction that what we know is mental phenomena, ideas regarded as objects and subjects of experience.

With these four positions in hand, Wundt's philosophy consecutively follows, beginning with his psychology. He begins with psychical elements, sensations and feelings, but he asserts that these always exist in a psychical compound, from which they can be discovered only by analysis and abstraction; and his paradox that *a pure sensation is an abstraction* is repeated by W. James. Further, Wundt declares that the psychical compound of sensations, with which, according to him, we actually start, is not a complex sensation, but a compound idea; so that I am expected to believe that, when I hear the chord of D, I am not conscious of single sensations of D, F, A, and have only a compound idea of the chord—as if the hearing of music were merely a series of ideas! Wundt, however, has a reason for substituting compound idea for sensation: he accepts Lotze's hypothesis of local signs, and adds a hypothesis of temporal signs. He supposes that we have no sensations of space and time, as the nativists suppose, but that, while local signs give us spatial ideas, feelings of expectation are temporal signs giving us temporal ideas, and that these ideas enter into the psychical compound, which is our actual starting-point. It follows that every psychical compound into which temporal and spatial ideas enter must itself be an idea; and, as time at any rate accompanies all our sensations, it follows that every psychical compound of sensations, containing as it does, always temporal, if not also spatial, ideas, must be a compound idea, and not, as nativists suppose, Schuppe for instance, a compound sensation. The next question is, how compounded? Wundt's answer is that inner impulsive will, in the form of passive apperception, forms compound ideas by association; so that all these operations are necessary to the starting-point. He prefixes to the ordinary associations, which descend from Hume, an association which he calls fusion (*Verschmelzung*), and supposes that it is a fundamental process of fusing sensations with spatial and temporal ideas into a compound idea. But he also recognizes association by similarity, or assimilation, or "apperception" in Herbart's more confined sense of the word, and association by contiguity, or complication. Recognizing, then, three kinds of association in all, he supposes that they are the first processes, by which inner will, in the form of passive apperception, generates ideas from sense. So far his psychology is a further development of Hume's. But he does not agree with Hume that mind is nothing but sensations, ideas, and associations, but with Kant, that there are higher combinations. According to him, inner decisive will, rising to active apperception, proceeds to what he calls "apperceptive combinations" (*Apperceptionverbindungen*); first to simple combinations of relating and comparing, and then to complex combinations of synthesis and analysis in imagination and understanding; in consequence of which synthesis issues in an aggregate idea (*Gesammtvorstellung*), and then at last analysis, by dividing an aggregate idea into subject and predicate, forms a judgment (see further LOGIC). The main point of this theory is that, if it were true, we should be for ever confined to a jumble of ideas. Wundt, indeed, is aware of the consequences. If judgment is an analysis of an aggregate idea into subject and predicate, it follows, as he says, that "as judgment is an *immediate*, so is inference a *mediate*, reference of the members of any aggregate of ideas to one another" (*System der Philosophie*, 66, first ed.). He cannot allow any inference of things beyond ideas. His psychology poisons his logic.

In his logic, and especially in his epistemology, Wundt appears as a mediator between Hume and Kant, but with more leaning to the latter. While he regards association as lying at the basis of all knowledge, he does not think it sufficient, and objects to Hume that he does not account for necessity, nor for substance and causation as known in the sciences. He accepts on the whole the system of synthetic understanding which Kant superimposed on mere association. Yet he will not proceed to the length of Kant's transcendentalism. Between Hume's a posteriori and Kant's a priori hypothesis he proposes a *logical* theory of the origin of notions beyond experience. He explains that the arrangement of facts requires "general supplementary notions (*Hülfsbegriffe*), which are not contained in experience itself, but are gained by a process of logical treatment of this experience." Of these supplementary notions he holds that the most general is that of causality, coming from the necessity of thought that all our experiences shall be arranged according to ground and consequent. That sense only gives to experience coexistences and sequences of appearances, as Hume said and Kant allowed, is also Wundt's starting-point. How then do we arrive at causality? Not, says Wundt, by association, as Hume said, but by thinking; not, however, by a priori thinking, as Kant said, but by logical thinking, by applying the logical principle of ground and consequent (which Leibnitz had called the principle of sufficient reason) as a causal law to empirical appearances. Now, Wundt is aware that this is not always possible, for he holds that the logical principle of ground belongs generally to the connexion of thoughts, the causal law to the combination of empirical appearances. Nevertheless he believes that, when we can apply measures to the combination of empirical appearances, then we can apply the logical principle as causal law to this combination, and say that one appearance is the cause of another, thus adding a notion of causality not contained in the actual observations, but specializing the general notion of causality. He quotes as an instance that Newton in this way added to the planetary appearances contained in Kepler's laws the gravitation of the planets to the sun, as a notion of causality not contained in the appearances, and thus discovered that gravitation is the cause of the appearances. But Newton had already discovered beforehand in the mechanics of terrestrial bodies that gravitation constantly causes similar facts on the earth, and did not derive that cause from any logical ground beyond experience, any more than he did the third law of motion. Wundt does not realize that, though we can often use a cause or real ground (*principium essendi*) as a logical ground (*principium cognoscendi*) for deducing effects, we can do so only when we have previously inferred from experience that that kind of cause does produce that kind of effect (see LOGIC). Otherwise, logical ground remains logical ground, as in any non-causal syllogism, such as the familiar one from "All men are mortal," which causes me to know that I shall die, without telling me the cause of death. Wundt, however, having satisfied himself of the power of mere logical thought beyond experience, goes on to further apply his hypothesis, and supposes that, in dealing with the physical world, logical thinking having added to experience the "supplementary notion" of causality as the connexion of appearances which vary together, adds also the "supplementary notion" of substance as substratum of the connected appearances. But, using substance as he does always in the Kantian sense of permanent substratum beneath changing phenomena, and never in the Aristotelian sense of any distinct thing, he proceeds to make distinctions between the applications of causality and of substance. Even in the physical, he confines substance to matter, or what Aristotle would call material causes, thus makes its power to be merely passive, and limits substantial causality to potential energy, while he supposes that actual causality is a relation not of substances but of events. On this false abstraction Sigwart has made an excellent criticism in an appendix at the end of his *Logic*, where he remarks that we cannot isolate events from the substances of which they are attributes. Motions do not cause motions; one body moving causes another body to move: what we know is causal substances. Secondly, when Wundt comes to the psychical, he naturally infers from his narrow Kantian definition of substance that there is no proof of a substrate over and above all mental operations, and falsely thinks that he has proved that there is no substance mentally operating in the Aristotelian sense. Thirdly, on the grounds that logical thinking adds the notion of substance, as substrate, to experience of the physical, but not of the psychical, and that the most proper being of mind is will, he concludes that wills are not active substances, but substance-generating activities ("nicht thätige Substanzen sondern substanzerzeugende Thätigkeiten," *System*, 429).

What kind of metaphysics, then, follows from this compound of psychology and epistemology? As with Kant against Hume, so with Wundt against Mach and Avenarius, the world we know will contain something more than mere complexes of sensations, more than pure experience: with Wundt it will be a world of real causes and some substances, constituted partly by experience and partly by logical thinking, or active inner will. But as with Kant, so with Wundt, this world will be only the richer, not the wider, for these notions of understanding; because they are only contributed to the original experience, and, being mentally contributed, only the more surely confine knowledge to experience of mental phenomena. Hence, according to Wundt, the world we know is still unitary experience, distinguished, not separated, into subject and object, aggregates of ideas analysed by judgment and combined by inference, an object of idea elaborated into causes and substances by logical thinking, at most a world of our ideas composed out of our sensations, and arranged under our categories of our understanding by our inner wills, or a world of our ideating wills; but nothing else. It is Wundt's own statement of his solution of the epistemological problem "that on the one hand the whole outer world exists for us only in our ideas, and that on the other hand a consciousness without objects of idea is an empty abstraction which possesses no actuality" (*System*, 212–213). There remains his theory of reason. His pupil, Oswald Külpe (1862–), who bases his *Grundriss der Psychologie* on the hypothesis of unitary experience, says in his *Einleitung in die Philosophie* (1895; 4th ed. 1907) that Wundt in his *System* derives the right of metaphysics to transcend experience from similar procedure within the limits of the special sciences. This is Wundt's view, but only in the sense that reason passes from ideas to "ideals," whether in the special sciences or in metaphysics. Reason, as in most modern psychologies and idealisms, is introduced by Wundt, after all sorts of operations, too late; and, when at length introduced, it is described as going beyond ideas and notions to "ideals" (*Ideen*), as an ideal continuation of series of thoughts beyond given experience—nothing more. Reason, according to Wundt, is like pure reason according to Kant; except that Wundt, receiving Kantism through Neo-Kantism, thinks that reason arrives at "ideals" not a priori, but by the logical process of ground and consequent, and, having abolished the thing in itself, will not follow Kant in his inconsequent passage from pure to practical reason in order to postulate a reality corresponding to "ideals" beyond experience. Wundt, in fact, agrees with Lange: that reason transcends experience of phenomena only to conceive "ideals." This being so, he finds in mathematics two kinds of transcendence—real, where the transcendent, though not actual in experience, can become partly so, *e.g.* the divisibility of magnitudes; imaginary, where it cannot, *e.g.* *n*-dimensions. He supposes in metaphysics the same transcendence in forming cosmological, psychological, and ontological "ideals." He supposes real as well as imaginary transcendence in cosmological "ideals"; the former as to the forms of space and time, the latter as to content, *e.g.* atoms. But he limits psychological and ontological "ideals" entirely to imaginary transcendence. The result is that he confines metaphysical transcendence to "a process into the imaginary" as regards the substantial and causal content of cosmological "ideals," and altogether as regards psychological and ontological "ideals." Thus, according to him, in the first place reason forms a cosmological "ideal" of a multitude of simple units related; secondly, it forms a psychological "ideal" of a multitude of wills, or substance-generating activities, which communicate with one another by ideas so that will causes ideas in will, while together they constitute a collective will, and it goes on to form the moral ideal of humanity (*das sittliche Menschheitsideal*); and, thirdly, it forms an ontological "ideal" of God as ground of this moral "ideal," and therewith of all being as means to this end, and an "ideal" of God as world-will, of which the world is development, and in which individual wills participate each in its sphere. "Herein," says Wundt, "consists the imperishable truth of the Kantian proposition that the moral order of the world is the single real proof of the existence of God" (*System*, 405; cf. 439). "Only," he adds, "the expression *proof* is here not admissible. Rational 'ideals' are in general not provable." As the same limit is applied by him to all transcendent rational "ideals," and especially to those which refer to the content of the notion of the world, and, like all psychological and ontological "ideals," belong to the imaginary transcendent, his conclusion is that reason, in transcending experience, logically conceives "ideals," but never logically infers corresponding realities.

The conclusion that reason in transcending experience can show no more than the necessity of "ideals" is the only conclusion which could follow from Wundt's phenomenalism in psychology, logic, and epistemology. If knowledge is experience of ideas distinguished by inner will of apperception into subject and object in inseparable connexion, if the starting-point is ideas, if judgment is analysis of an aggregate idea, if inference is a mediate reference of the members of an aggregate of ideas to one another, then, as Wundt says, all we can know, and all reason can logically infer from such data, is in our ideas, and consciousness without an object of idea is an abstraction; so that reason, in transcending experience, can show the necessity of ideas and "ideals," but infer no corresponding reality beyond, whether in nature, or in Man, or in God. Wundt, starting from a psychology of unitary experience, deduces a consistent metaphysics of no inference of things transcending experience throughout—or rather until he came to the very last sentence of his *System der Philosophie* (1889), where he suddenly passes from a necessity of "ideals" (*Ideen*), to a necessity of "faith" (*Glauben*), without "knowledge" (*Wissen*). He forgets apparently that faith is a belief in things beyond ideas and ideals, which is impossible in his psychology of judgment and logic of inference. The fact is that his *System* may easily seem to prove more than it does. He describes it as idealism in the form of ideal realism, because it recognizes an ideating will requiring substance as substratum or matter for outer relations of phenomena. But when we look for the evidence of any such will beyond ourselves and our experience, we find Wundt offering nothing but an ontological "ideal" of reason, and a moral "ideal" requiring a religious "ideal," but without any power of inferring a corresponding reality. The *System* then ends with the necessity of an "ideal" of God as world-will, but provides no ground for the necessity of any belief whatever in the being of God, or indeed in any being at all beyond our own unitary experience.

Wundt, however, afterwards wrote an *Einleitung in die Philosophie* (1901; 4th ed., 1906), in which he speaks of realism in the form of ideal realism as the philosophy of the future. It is not to be idealism which resolves everything into spirit, but realism which gives the spiritual and the material each its own place in harmony with scientific consciousness. It is not to be dualistic but monistic realism, because matter is not separate from spirit. It is not to be materialistic but ideal realism, because the physical and the psychical are inseparable parallels inexplicable by one another. It is to be monistic ideal realism, like that of Fichte and Hegel; not, however, like theirs idealistic in method, a *Phantastisches Begriffsgebäude*, but realistic in method, a *Wissenschaftliche Philosophie*. It is to be ideal realism, as in the *System*. It is not to be a species of idealism, as in the *System*—but of realism. How are we to understand this change of front? We can only explain it by supposing that Wundt wishes to believe that, beyond the "ideal," there really is *proof* of a transcendent, ideating, substance-generating will of God; and that he is approaching the noumenal voluntarism of his younger contemporary Paulsen. But to make such a conversion from phenomenalism plausible, it is necessary to be silent about his whole psychology, logic, and epistemology, and the consequent limitation of knowledge to experience, and of reason to ideas and "ideals," without any power of inferring corresponding things.

What a pity it is that Wundt had committed himself by his psychology to phenomenalism, to unitary experience, and to the limitation of judgment and reason to ideas and ideals! For his phenomenalism prevents him from consistently saying the truth inferred by reason—that there is a world beyond experience, a world of Nature, and a will of God, real as well as ideal. To understand Wundt is to discover what a mess modern psychology has made to metaphysics. To understand phenomenal idealism in Germany is to discover what a narrow world is to be known from the transcendental idealism of Kant shorn of Kant's inconsistencies. To understand noumenal idealism in Germany and the rise of metaphysical idealism in modern times is to discover that psychological is the origin of all metaphysical idealism. If we perceive only what is mental, all that we know is only mental. But who has proved that psychological starting-point? Who has proved that, when I scent an odour in my nostrils, I apprehend not odour but a sensation of odour; and so for the other senses? Sensation, as Aristotle said, is not of itself: it is the apprehension of a sensible object in the organism. I perceive pressure, heat, colour, sound, flavour, odour, in my five senses. Having felt reciprocal pressures in touch, I infer similar pressures between myself and the external world.

6.—English Idealism

1. *The Followers of Hume's Phenomenalism.*—Compared with the great systems of the Germans, English idealism in the 19th century shows but little originality. It has been largely borrowed either from previous English or from later German idealism, and what originality it has possessed has been mainly shown in that spirit of eclectic compromise which is so dear to the English mind. The predominant influence, on the whole,

has been the phenomenalism of Hume, with its slender store of sensations, ideas and associations, and its conclusion that all we know is sensations without any known thinkers or any other known things. This phenomenalism was developed by James Mill (1773–1836) and J. S. Mill (1806–1873), and has since been continued by A. Bain. It also became the basis of the philosophies of Huxley and of Spencer on their phenomenalistic side. It is true that Spencer's "transfigured realism" contains much that was not dreamt of by Hume. Spencer widens the empirical theory of the origin of knowledge by his brilliant hypothesis of inherited organized tendencies, which has influenced all later psychology and epistemology, and tends to a kind of compromise between Hume and Kant. He describes his belief in an unknowable absolute as "carrying a step farther the doctrine put into shape by Hamilton and Mansel." He develops this belief in an absolute in connexion with his own theory of evolution into something different both from the idealism of Hume and the realism of Hamilton, and rather falling under the head of materialism. Nevertheless, as he believes all the time that everything knowable throughout the whole world of evolution is phenomena in the sense of subjective affections of consciousness, and as he applies Hume's distinction of impressions and ideas as a distinction of vivid and faint states of consciousness to the distinction of ego and non-ego, spirit and matter, inner and outer phenomena, his philosophy of the world as knowable remains within the limits of phenomenalism. Nothing could be more like Hume than his final statement that what we are conscious of is subjective affections produced by objective agencies unknown and unknowable. The "anti-realism," which takes the lion's share in "transfigured realism," is simply a development of the phenomenalism of Hume. Hume was also at the bottom of the philosophies of G. H. Lewes, who held that there is nothing but feelings, and of W. K. Clifford. Nor is Hume yet dethroned, as we see from the works of Karl Pearson and of William James, who, though an American, has exercised a considerable influence on English thought. The most flourishing time of phenomenalism, however, was during the lifetime of J. S. Mill. It was counteracted to some extent by the study at the universities of the deductive logic of Aristotle and the inductive logic of Bacon, by parts of Mill's own logic, and by the natural realism of Reid, Stewart, and Hamilton, which met Hume's scepticism by asserting a direct perception of the external world. But natural realism, as finally interpreted by Hamilton, was too dogmatic, too unsystematic, and too confused with elements derived from Kantian idealism to withstand the brilliant criticism of Mill's *Examination of Sir William Hamilton's Philosophy* (1865), a work which for a time almost persuaded us that Nature as we know it from sensations is nothing but permanent possibilities of sensation, and oneself only a series of states of consciousness.

2. *The Influence of Kant and Hegel.*—Nevertheless, there have never been wanting more soaring spirits who, shocked at the narrowness of the popular phenomenalism of Hume, have tried to find a wider idealism. They have, as a rule, sought it in Germany. Before the beginning of the 19th century, Kant had made his way to England in a translation of some of his works, and in an account of the *Elements of the Critical Philosophy* by A. F. M. Willich, both published in 1798. After a period of struggle, the influence of Kant gradually extended, and, as we see in the writings of Coleridge and Carlyle, of Hamilton and Mansel, of Green and Caird, of Laurie, Martineau and others, has secured an authority over English thought almost equal to that of Hume (see IDEALISM). Both philosophers appeal to the English love of experience, and Kant had these advantages over Hume: that within the narrow circle of sensible phenomena his theory of understanding gave to experience a fuller content, and that beyond phenomena, however inconsistently, his theory of reason postulated the reality of God, freedom and immortality. Other and wider German philosophies gradually followed that of Kant to England. Coleridge (1772–1834) not only called attention to Kant's distinction between understanding and reason, but also introduced his countrymen to the noumenal idealism of Schelling. In the *Biographia Literaria* (1817) he says that in Schelling's *Naturphilosophie* and *System des transcendentalen Idealismus* he first found a general coincidence with much that he had toiled out for himself, and he repeated some of the main tenets of Schelling. Carlyle (1795–1881) laid more emphasis on Fichte. At the height of his career, when between 1840 and 1850 many of Fichte's works were being translated in the Catholic Series, he called attention to Fichte's later view that all earthly things are but as a vesture or appearance under which the Divine idea of the world is the reality. Extravagant as this noumenalism is, it was a healthy antidote to the phenomenalism of the day. Among other followers of German idealism were J. F. Ferrier (*q.v.*), who adopted the hypothesis of Schelling and Hegel that there is one absolute intelligence (see his *Lectures and Philosophical Remains*, 1866, i. 1–33; ii. 545–568), and J. Hutchison Stirling (*q.v.*). About the same time Benjamin Jowett (*q.v.*) had been studying the philosophy of Hegel; but, being a man endowed with much love of truth but with little belief in first principles, he was too wise to take for a principle Hegel's assumption that different things are the same. He had, however, sown seeds in the minds of two distinguished pupils, T. H. Green and E. Caird (*q.v.*). Both proceeded to take Hegelianism seriously, and between them spread a kind of Hegelian orthodoxy in metaphysics and in theology throughout Great Britain. Green (*Prolegomena to Ethics*, 1883) tried to effect a harmony of Kant and Hegel by proceeding from the epistemology of the former to the metaphysics of the latter. Taken for granted the Kantian hypothesis of a sense of sensations requiring synthesis by understanding, and the Kantian conclusion that Nature as known consists of phenomena united by categories as objects of experience, Green argued, in accordance with Kant's first position, that knowledge, in order to unite the manifold of sensations by relations into related phenomena, requires unifying intelligence, or what Kant called synthetic unity of apperception, which cannot itself be sensation, because it arranges sensations; and he argued, in accordance with Kant's second position, that therefore Nature itself as known requires unifying intelligence to constitute the relations of its phenomena, and to make it a connected world of experience. When Green said that "Nature is the system of related appearances, and related appearances are impossible apart from the action of an intelligence," he was speaking as a pure Kantian, who could be answered only by the Aristotelian position that Nature consists of related bodies beyond appearances, and by the realistic supposition that there is a tactical sense of related bodies, of the inter-resisting members of the organism, from which reason infers similar related bodies beyond sense. But now, whatever opinion we may have about Nature, at all events, as Green saw, it does not come into existence in the process by which this person or that begins to think. Nature is not my nature, nor your nature, but one. From this fact of unity of Nature and of everything in Nature, combined with the two previous positions accepted, not from Nature, but from Kant, Green proceeded to argue, altogether beyond Kant, that Nature, being one, and also requiring unifying intelligence, requires one intelligence, an eternal intelligence, a single spiritual principle, prior to, and the condition of, our individual knowledge. According to him, therefore, Nature is one system of phenomena united by relations as objects of experience, one system of related appearances, one system of one eternal intelligence which reproduces itself in us. The "true account" of the world in his own words is "that the concrete whole, which may be described indifferently as an eternal intelligence realized in the related facts of the world, or as a system of related facts rendered possible by such an intelligence, partially and gradually reproduces itself in us, communicating piecemeal, but in inseparable correlation, understanding and the facts understood, experience and the experienced world." Nobody can mistake the Schellingian and Hegelian nature of this conclusion. It is the Hegelian view that the world is a system of absolute reason. But it is

T. H. Green.

E. Caird.

not a Kantian view; and it is necessary to correct two confusions of Kant and Hegel, which have been imported with Hegelianism by Green and Caird. Ferrier was aware that in Kant's system "there is no common nature in all intelligence" (*Lectures*, ii. 568). Green, on the other hand, in deducing his own conclusion that the world is, or is a system of, one eternal intelligence, incautiously put it forward as "what may be called broadly the Kantian view" (*Prolegomena*, § 36), and added that he follows Kant "in maintaining that a single active conscious principle, by whatever name it be called, is necessary to constitute such a world, as the condition under which alone phenomena, *i.e.* appearances to consciousness, can be related to each other in a single universe" (§ 38). He admitted, however, that Kant also asserted, beyond this single universe of a single principle, a world of unknowable things in themselves, which is a Kantian not a Hegelian world. But Caird endeavoured to break down even this second barrier between Kant and Hegel. According to Caird, Kant "reduces the inaccessible thing in itself (which he at first speaks of as affecting our sensibility) to a noumenon which is projected by reason itself" (*Essays*, ii. 405); and in the Transcendental Dialectic, which forms the last part of Kant's *Kritik*, the noumenon becomes the object of an intuitive understanding "whose thought," says Caird, "is one with the existence of the objects it knows" (ibid. 412, 413). Kant, then, as interpreted by English Hegelians, already believed, before Hegel, that there is one intelligence common to all individuals, and that a noumenon is a thought of this common intelligence, "an ideal of reason"; so that Kant was trying to be a Hegelian, holding that the world has no being beyond the thoughts of one intelligence. But history repeats itself; and these same two interpretations of Kant had already been made in the lifetime of Kant by Fichte, in the two Introductions to the "Wissenschaftslehre," which he published in his *Philosophical Journal* in 1797. Now, the curious fact is, that Kant himself wrote a most indignant letter, dated 7th August 1799 (*Kant's Werke*, ed. Hartenstein, viii. 600–601), on purpose to repudiate all connexion with Fichte. Fichte's "Wissenschaftslehre," he said, is a completely untenable system, and a metaphysics of fruitless *apices*, in which he disclaimed any participation; his own *Kritik* he refused to regard as a propaedeutic to be construed by the Fichtian or any other standpoint, declaring that it is to be understood according to the letter; and he went so far as to assert that his own critical philosophy is so satisfactory to the reason, theoretical and practical, as to be incapable of improvement, and for all future ages indispensable for the highest ends of humanity. After this letter it cannot be doubted that Kant not only differed wholly from Fichte, both about the synthetic unity of apperception and about the thing in itself, but also is to be construed literally throughout. When he said that the act of consciousness "I think," is *in allem Bewusstsein ein und dasselbe*, he meant, as the whole context shows, not that it is one in all thinkers, but only that it accompanies all my other ideas and is one and the same in all my consciousness, while it is different in different thinkers. Though again in the Transcendental Dialect he spoke of pure reason conceiving "ideals" of noumena, he did not mean that a noumenon is nothing but a thought arising only through thinking, or projected by reason, but meant that pure reason can only conceive the "ideal" while, over and above the "ideal" of pure reason, a noumenon is a real thing, a thing in itself, which is not indeed known, but whose existence is postulated by practical reason in the three instances of God, freedom, and immortality. Consequently, Kant's explanation of the unity of a thing is that there is always one thing in itself causing in us many phenomena, which as understood by us are objectively valid for all our consciousnesses. What Kant never said and what his whole philosophy prevented his saying, was that a single thing is a single thought of a single consciousness; either of men, as in Fichte's philosophy, or of God and man, as in Hegel's. The passage from Kant to Hegel attempted by Green, and the harmony of Kant and Hegel attempted by Green and Caird, are unhistorical, and have caused much confusion of thought. The success, therefore, of the works of Green and Caird must stand or fall by their Hegelianism, which has indeed secured many adherents, partly metaphysical and partly theological. Among the former we may mention W. Wallace, the translator of most of Hegel's *Encyklopädie*, who had previously learnt Hegelianism from Ferrier; W. H. Fairbrother, who has written a faithful account of *The Philosophy of Thomas Hill Green* (1896); R. L. Nettleship, D. G. Ritchie, J. H. Muirhead, J. S. Mackenzie, and J. M. E. M'Taggart, who closes his acute *Studies in Hegelian Cosmology* (1901) with "the possibility of finding, above all knowledge and volition, one all-embracing unity, which is only not true, only not good, because all truth and all goodness are but distorted shadows of its absolute perfection—'das Unbegreifliche, weil es der Begriff selbst ist.'"

There are still to be mentioned two English Hegelians, who have not confused Kant and Hegel as Green did: namely, Simon Somerville Laurie (1829–1909) and F. H. Bradley (b. 1846), fellow of Merton College, Oxford.

Laurie.

Laurie wrote *Metaphysica, nova et vetusta, a Return to Dualism*, by Scotus Novanticus (1884; 2nd ed., enlarged, 1889). His attitude to Green is expressed towards the end of his book, where he says: "The more recent argument for God which resolves itself into the necessity of a self-distinguishing one basis to which nature as a mere system of relations must be referred, is simply the old argument of the necessity for a First Cause dressed up in new clothes. Not by any means an argument to be despised, but stopping short of the truth through an inadequate analytic of knowledge." His aim is to remedy this defect by psychology, under the conviction that a true metaphysics is at bottom psychology, and a true psychology fundamentally metaphysics. His psychology is founded on a proposed distinction between "attuition" and reason. His theory of "attuition," by which he supposes that we become conscious of objects outside ourselves, is his "return to dualism," and is indeed so like natural realism as to suggest that, like Ferrier, he starts from Hamilton to end in Hegel. As, however, he does not suppose that we have a direct perception of something resisting the organism, such as Hamilton maintained, it becomes necessary to state exactly what he means by "attuition." It is, according to him, something more than sensation, but less than perception; it is common to us with lower animals such as dogs; its operation consists in co-ordinating sensations into an aggregate which the subject throws back into space, and thereby has a consciousness of a total object outside itself, *e.g.* a stone or a stick, a man or a moon. He carries its operation before reason still farther, supposing that "attuition" makes particular inferences about outside objects, and that a man, or a dog, through association "attuites" sequence and invariableness of succession, and, in fact, gets as far in the direction of causation as Hume thought it possible to go at all. Laurie's view is that a dog who has no higher faculty than "attuition," can go no farther; but that a man goes farther by reason. He thinks that "attuition" gives us consciousness of an object, but without knowledge, and that knowledge begins with reason. His theory of reason brings him into contact with the German idealists: he accepts from Kant the hypothesis of synthesis and a priori categories, from Fichte the hypothesis that will is necessary to reason, from Schelling and Hegel the hypothesis of universal reason, and of an identity between the cosmic reason and the reason of man, in which he agrees also with Green and Caird. But he has a peculiar view of the powers of reason; that (1) under the law of excluded middle it states alternatives, A or B or C or D; (2) under the law of contradiction it negates B, C, D; (3) under the law of sufficient reason it says "therefore"; and (4) under the law of identity it concludes, A is A. In working out this process he supposes that reason throws into consciousness a priori categories, synthetic predicates a priori, or, as he also calls them, "dialectic percepts." Of these the most important is cause, of which his theory, in short, is that by this a priori category and the process of reason we go on from sequence to consequence; first stating that an effect may be caused by several alternatives, then negating all but one, next concluding that this one as sufficient reason is cause, and finally attaining the necessity of the causal nexus by converting causality into identity, *e.g.* instead of "Fire burns wood," putting "Fire is comburent, wood is combustible." Lastly, while he agrees with Kant about a priori categories, he differs about the knowledge to be got out of them. Kant, applying them only to sensations, concluded that we can know nothing beyond by their means. But Laurie, applying them to "attuitions" of objects outside, considers that, though they are "reason-born," yet they make us know the objects outside to which they are applied. This is the farthest point of his dualism, which suggests a realistic theory of knowledge, different in process from Hamilton's, but with the same result. Not so: Laurie is a Hegelian, using Kant's categories, as Hegel did, to argue that they are true not only of thoughts but of things; and for the same reason, that things and thoughts are the same. At first in his psychology he speaks of the "attuition" and the rational perception of an outside object. But in his metaphysics founded thereon he interprets the outside object to mean an object outside you and me, but not self-subsistent; not outside universal reason, but only "*Beënt* reason." He quotes with approval Schelling's phrase, "Nature is visible Intelligence and Intelligence visible Nature." He agrees with Hegel that there are two fundamental identities, the identity of all reason, and the identity of all reason and all being. Hence he explains, what is a duality for us is only a "quasi-duality" from a universal standpoint. In fact, his dualism is not realism, but merely the distinction of subject and object within idealism. Laurie's metaphysics is an attempt to supply a psychological propaedeutic to Hegelian metaphysics.

Bradley.

Bradley's *Appearance and Reality* (1893) is a more original performance. It proceeds on the opposite method of making metaphysics independent of psychology. "Metaphysics," says he, "has no direct interest in the origin of ideas" (254), and "we have nothing to do here with the psychological origin of the perception" (35). This metaphysical method, which we have already seen attempted by Lotze, is the true method, for we know more about things than about the beginnings of our knowledge. Bradley is right to go straight to reality, and right also to inquire for the absolute, in order to take care that his metaphysical view is comprehensive enough to be true of the world as a whole. He is unconsciously returning to the metaphysics of Aristotle in spirit; yet he differs from it *toto coelo* in the letter. His starting-point is the view that things as ordinarily understood, and (we may add) as Aristotle understood them (though with important qualifications) are self-contradictory, and are therefore not reality but appearances. If they were really contradictory they would be non-existent. However, he illustrates their supposed contradictoriness by examples, such as one substance with many attributes, and motion from place to place in one time. But he fails to show that a substance is one and many in the same respect, and that motion requires a body to be in two places at the same moment of one time. There is no contradiction (as Aristotle said) between a man being determined by many attributes, as rational, six-foot-high, white, and a father, and yet being one whole substance distinct from any other, including his own son; nor is there any contradiction between his body being in bed at 8.15 and at breakfast at 8.45 within the same hour. Bradley's supposed contradictions are really mere differences. So far he reminds one of Herbart, who founded his "realistic" metaphysics on similar misunderstandings; except that, while Herbart concluded that the world consists of a number of simple "reals," each with a simple quality but unknown, Bradley concludes that reality is one absolute experience which harmonizes the supposed contradictions in an unknown manner. If his starting-point recalls Herbart his method of arriving at the absolute recalls Spinoza. In his Table of Contents, ch. xiii., on the General Nature of Reality, he says, in true Spinozistic vein, "The Real is one substantially. Plurality of Reals is not possible." In the text he explains that, if there were a plurality of reals, they would have to be beings independent of each other, and yet, as a plurality related to each other—and this again seems to him to be a contradiction. Throughout the rest of the work he often repeats that a thing which is related cannot be an independent thing. Now, if "independent" means "existing alone" and unrelated the same thing could not be at once related and independent; and, taking substance as independent in that sense, Spinoza concluded that there could only be one substance. But this is not the sense in which a plurality of things would have to be independent in order to exist, or to be substances in the Aristotelian sense. "Independent" (χωριστόν), or "self-subsistent" (καθ' αὑτό) means "existing apart," *i.e.* existing differently: it does not mean "existing alone," solitary, unrelated. This existing apart is the only sense in which a plurality of things need be independent in order to be real, or in order to be substances; and it is a sense in which they can all be related to each other, as I am not you, but I am addressing you. There is no contradiction, then, though Bradley supposes one, between a thing being an individual, independent, self-subsistent substance, existing apart as a distinct thing, and being also related to other things. Accordingly, the many things of this world are not self-discrepant, as Bradley says, but are distinct and relative substances, as Aristotle said. The argument, therefore, for one substance in Spinoza's *Ethics*, and for one absolute, the Real, which is one substantially, in Bradley's *Appearance and Reality*, breaks down, so far as it is designed to prove that there is only one substance, or only one Real. Bradley, however, having satisfied himself, like Spinoza, by an abuse of the word "independent," that "the finite is self-discrepant," goes on to ask what the one Real, the absolute, is; and, as he passed from Herbart to Spinoza, so now he passes from Spinoza to Kant. Spinoza answered realistically that the one substance is both extended and thinking. Bradley answers idealistically that the one Real is one absolute experience, because all we know is experience. "This absolute," says he, "is experience, because that is really what we mean when we predicate or speak of anything." But in order to identify the absolute with experience he is obliged, as he before abused the words "contradictory" and "independent," so now to abuse the word "experience." "Experience," says he, "may mean experience only direct, or indirect also. Direct experience I understand to be confined to the given simply, to the merely felt or presented. But indirect experience includes all fact that is constructed from the basis of the 'this' and the 'mine.' It is all that is taken to exist beyond the bare moment" (248). This is to substitute "indirect experience" for all inference, and to maintain that when, starting from any "direct experience," I infer the back of the moon, which is always turned away from me, I nevertheless have experience of it; nay, that it is experience. Having thus confused contradiction and difference, independence and solitariness, experience and inference, Bradley is able to deduce finally that reality is not different substances, experienced and inferred, as Aristotle thought it, but is one absolute super-personal experience, to which the so-called plurality of things, including all bodies, all souls, and even a personal God, is appearance—an appearance, as ordinarily understood, self-contradictory, but, as appearing to one spiritual reality, somehow reconciled. But how?

G.H.Lewes.

3. *Other German Influences.*—Brief reference only can be made to four other English idealists who have quarried in the rich mines of German idealism: G. H. Lewes, W. K. Clifford, G. J. Romanes and Karl Pearson. Lewes (*q.v.*), starting from the phenomenalism of Hume, fell under the spell of Kant and his successors, and produced a compromise between Hume and Kant which recalls some of the later German phenomenalisms which have been described (see his *Problems of Life and Mind*). Rejecting everything in the *Kritik* which savoured of the "metempirical," he yet sympathized so far with Hegel's noumenalism as to accept the identification of cause and effect, though he interpreted the hypothesis phenomenalistically by saying that cause and effect are two aspects of the same phenomenon. But his main sympathy was with Fechner, the gist of whose "inner psychophysics" he adopted, without, however, the hypothesis that what is conscious in us is conscious in the all-embracing spirit of God. His phenomenalism also compelled him to give a more modified adhesion to Fechner's "outer psychophysics." It will be remembered that Fechner regarded every composite body as the appearance of a spirit; so that when, for example, molecular motion of air is said to cause a sensation of sound in me, it is really a spirit appearing as air which causes the sensation in my spirit. This noumenalism would not do for Lewes, who says that air is a group of qualities, and qualities are feelings, and motion is a mode of feeling. What, then, could he make of the external stimulus? He was obliged by his phenomenalism to say that it is only one feeling causing another in me. He ingeniously suggested that the external agent is one feeling regarded objectively, and the internal effect another feeling regarded subjectively; "and therefore," to quote his own words, "to say that it is a molecular movement which produces a sensation of sound, is equivalent to saying that a sensation of sight produces a sensation of hearing." Accordingly,

his final conclusion is that "existence—the absolute—is known to us in feeling," and "the external changes are symbolized as motion, because that is the mode of feeling into which all others are translated when objectively considered: objective consideration being the attitude of *looking at* the phenomena, whereas subjective consideration is the attitude of any other sensible response." He does not say what happens when we use vision alone and still infer that an external stimulus causes the internal sensation. But his metaphysics is an interesting example of a phenomenalist, sympathizing with noumenalists so different as Hegel and Fechner, and yet maintaining his phenomenalism. In this feature the phenomenalism of Lewes is the English parallel to the German phenomenalism of Wundt. At the same time, and under the derivative influence of Wundt, rather than the more original inspiration of Fechner, W. K. Clifford (*q.v.*) was working out the hypothesis of psychophysical parallelism to a conclusion different from that of Lewes, and more allied to that of Leibnitz, the prime originator of all these hypotheses. Clifford advanced the hypothesis that the supposed unconscious units of feeling, or psychical atoms, are the "mind-stuff" out of which everything physical and psychical is composed, and are also things in themselves, such as Kant supposed when he threw out the hint that after all "the *Ding-an-sich* might be of the nature of mind" (see *Mind*, 1878, p. 67). As a matter of fact, this "mind-stuff" of Clifford is far more like the "petites perceptions" of Leibnitz, from which it is indirectly derived. This hypothesis Clifford connected with the hypothesis of psychophysical parallelism. He maintained that the physical and the psychical are two orders which are parallel without interference; that the physical or objective order is merely phenomena, or groups of feelings, or "objects," while the psychical or subjective order is both a stream of feelings of which we are conscious in ourselves, and similar streams which we infer beyond ourselves, or, as he came to call them, "ejects"; that, if we accept the doctrine of evolution at all, we must carry these ejective streams of feelings through the whole organic world and beyond it to the inorganic world, as a "quasimental fact"; that at bottom both orders, the physical phenomena and the psychical streams, are reducible to feelings; and that therefore there is no reason against supposing that they are made out of the same "mind-stuff," which is the thing-in-itself. The resemblance of this noumenal idealism to that of Fechner is unmistakable. The difference is that Clifford considers "mind-stuff" to be unconscious, and denies that there is any evidence of consciousness apart from a nervous system. He agrees with du Bois-Reymond in refusing to regard the universe as a vast brain animated by conscious mind. He disagrees with Fechner's hypothesis of a world-soul, the highest spirit, God, who embraces all psychophysical processes. Curiously enough, his follower G. J. Romanes (*q.v.*) took the one step needed to bring Cliffordism completely back to Fechnerism. In his Rede Lecture on *Mind and Motion* (1885), he said that Clifford's deduction, that the universe, although entirely composed of "mind-stuff," is itself mindless, did not follow from his premisses. Afterwards, when the lecture was published in *Mind and Motion and Monism* (1895), this work also contained a chapter on "The World as an Eject," in which Romanes again contended against Clifford that the world does admit of being regarded as an eject, that is, as a mind beyond one's own. At the same time, he refused to regard this "world-eject" as personal, because personality implies limitation. He concludes that the integrating principle of the whole—the Spirit, as it were, of the Universe—must be something akin to, but immeasurably superior to, the "psychism" of man. Nothing can be more curious than the way in which a school of English philosophers, which originally started from Hume, the most sceptical of phenomenalists, thus gradually passed over to Leibnitz and Fechner, the originators of panpsychistic noumenalism. The Spirit of the Universe contemplated by Romanes is identical with the World-soul contemplated by Fechner.

W. K. Clifford.

G. J. Romanes.

Karl Pearson (*The Grammar of Science*, 1892, 2nd enlarged ed., 1900), starting from Hume's phenomenal idealism, has developed views closely allied to Mach's universal physical phenomenology. What Hume called repeated sequence Pearson calls "routine" of perceptions, and, like his master, holds that cause is an antecedent stage in a routine of perceptions; while he also acknowledges that his account of matter leads him very near to John Stuart Mill's definition of matter as "a permanent possibility of sensations." His views, in his chapter on the Laws of Motion, that the physicist forms a conceptional model of the universe by aid of corpuscles, that these corpuscles are only symbols for the component parts of perceptual bodies, and that force is a measure of motion, and not its cause, are the views of Mach. At the end of this chapter he says that the only published work from the perusal of which he received any help in working out his views in 1882 and 1884, was Mach's *Die Mechanik in ihrer Entwicklung* (1883). Mach had begun to put them forward in 1872, and Kirchhoff in 1874. But they may very well have been developed independently in Germany and in England from their common source in Hume. Their point is to stretch Hume's phenomenalism so as to embrace all science, by contending that mechanism is not at the bottom of phenomena, but is only the conceptual shorthand by aid of which men of science can briefly describe phenomena, and that all science is description and not explanation. These are the views of Mach and of Pearson, as we read them in the latter's Preface. Nor can we find any difference, except the minute shade that Pearson takes up a position of agnosticism between Clifford's assertion of "mind-stuff" and Mach's denial of things in themselves.

James Ward.

James Ward (*q.v.*), in *Naturalism and Agnosticism* (1899), starts from the same phenomenalistic views of Mach and Kirchhoff about mechanics; he proceeds to the hypothesis of duality within experience, which we have traced in the phenomenalisms of Schuppe, Avenarius and Wundt, and to the hypothesis of one consciousness, which appears variously in the German idealisms, not of Kant, as Ward thinks, but of Fichte, Hegel and Schuppe; and somehow he manages to end with the noumenalistic conclusion that Nature is God's Spirit. Though this work evinces a thoroughly English love of compromise, yet it is not merely eclectic, but is animated throughout by the inspiration of his "old teacher, Lotze." Lotze, as we saw, rejected bodily mechanism, reduced known bodies to phenomena, and concluded that reality is the life of God. Ward on the whole follows this triple scheme, but modifies it by new arguments founded on later German phenomenalism.

Under the first head he attacks mechanics precisely as Mach had done (see above); if this attack had been consistently carried out it would have carried him no further than Mach. Under the second head, according to Ward, as according to Wundt, knowledge is experience; we must start with the duality of subject and object, or perpetual reality, phenomenon, in the unity of experience, and not believe, as realists do, that either subject or object is distinct from this unity; moreover, experience requires "conation," because it is to interesting objects that the subject attends; conation is required for all synthesis, associative and intellective; thinking is doing; presentation, feeling, conation are one inseparable whole; and the unity of the subject is due to activity and not to a substratum. But, in opposition to Wundt and in common with Schuppe, he believes that experience is (1) experience of the individual, and (2) experience of the race, which is but an extension of individual experience, and is variously called, in the course of the discussion, universal, collective, conceptual, rational experience, consciousness in general, absolute consciousness, intelligence, and even, after Caird, "a perfect intelligence." He regards this universal experience as the result entirely of intersubjective intercourse, and concludes that its subject is not numerically distinct from the subject of individual experience, but is one and continuous with it, and that its conceptions depend on the perceptions of individual experience. He infers the corollary that universal experience contains the same duality of subjective and objective factors without dualism. He thinks that it is the origin of the categories of causality, which he refers to "conation," and substance, which he attributes to the interaction of active subjects with their environment and to their intercourse with each other. He applies universal experience, as Schuppe does, to explain the unity of the object, and its independence of individual but not of universal experience, holding that the one sun, and the whole world of intersubjective intercourse, or the "trans-subjective" world, though "independent of the individual percipient as such," is "not independent of the universal experience, but the object of that experience" (ii. 196–197). He applies universal experience to explain how we come, falsely in his opinion, to believe that the object of experience is an independent thing; and he uses three arguments, which are respectively those of Schuppe, Avenarius and Wundt. He supposes first, that we falsely conclude from the sun being independent of each to being independent of all; secondly, that by "introjection" we falsely conclude that another's experience is in him and therefore one's own in oneself, while the sun remains outside; and thirdly, that by "reification" of abstractions, natural science having abstracted the object and psychology the subject, each falsely believes that its own abstract, the sun or the subject, is an independent thing. What, then, could we know from this "duality in experience"? He hardly has a formal theory of inference, but implies throughout that it only transcends perceptions, and perceptual realities or phenomena, in order to conclude with ideas, not facts. When we combine his view of Nature under the first head that whatever is inferred in the natural sciences is ideas, with his view of knowledge under the second head that knowledge is experience, and experience, individual or universal, is of duality of subject and object in the unity of experience, it follows that all we could know from the data would be one experience of the race, one subject consisting of individual subjects, and in Nature single objects in the unity of this universal experience; and beyond we should be able to form conceptions dependent on the perceptions of individual experience in the unity of universal experience: that is all. There can be no doubt that Mach, Schuppe and Wundt drew the right phenomenalistic conclusions from such phenomenalistic data. Not so Ward, who proceeds to a Natural Theology, on the ground that "from a world of spirits to a Supreme Spirit is a possible step." He had definitely confined universal experience to the one experience of the race. But perhaps Caird's phrase "a perfect intelligence" has beguiled him into thinking that the one subject of universal experience is not mere mankind, but God Himself. Under the third head, however, his guide is Lotze. The argument may be shortly put as follows: As the Nature which is the object of mechanics and all natural sciences is not natural substances, but phenomena and ideas; as mass is not substance, and force is not cause; as activity is not in the physical but in the psychical world; as the laws of Nature are not facts but teleological conceptions, and Nature is teleological, as well as not mechanical but kinematical; as the category of causality is to be referred to "conation"; as, in short, "mind is active and matter inert," what then? One subject of universal experience, one with the subjects of individual experience, you would suppose, and that Nature as a whole is its one object. Not so, according to Ward; but "God as the living unity of all," and "no longer things, but the connecting conserving acts of the one Supreme." What, then, is the relation of God to the one universal experience, the experience of the race, which was under the second head the unity in duality of all knowledge? He does not say. But instead of any longer identifying the experience of the race and universal experience, he concludes his book by saying "our reason is confronted and determined by universal reason." This is his way of destroying Naturalism and Agnosticism.

4. *Personal Idealism.*—The various forms of idealism which have been described naturally led in England, even among idealists themselves, to a reaction against all systems which involve the denial of personality. English moral philosophy cannot long tolerate a metaphysics which by merging all minds in one would destroy personality, personal causation and moral responsibility, as James Martineau well said. A new school, therefore, arose of which the protagonist was Andrew Seth Pringle-Pattison (b. 1856; professor of logic and metaphysics at Edinburgh University from 1880) in his *Scottish Philosophy* (1885), and *Hegelianism and Personality* (1887).

"Each of us is a self," he says, and in another passage, "The real self is one and indivisible, and is unique in each individual. This is the unequivocal testimony of consciousness." What makes his vindication of conscious personality all the more interesting is that he has so much in common with the Hegelians; agreeing as he does with Hegel that self-consciousness is the highest fact, the ultimate category of thought through which alone the universe is intelligible, and an adequate account of the great fact of existence. He agrees also that there is no object without subject. It is difficult to see exactly where he begins to differ from Hegel; but at any rate he believes in different self-conscious persons; he does not accept the dialectical method, but believes in beginning from the personal experience of one's own self-consciousness; and, though he is not very clear on the subject, he would have to admit that a thing, such as the sun, is a different object in each person's consciousness. He is not a systematic thinker, but is too much affected by the eclectic notion of reconciling all philosophies. F. C. S. Schiller (b. 1864, fellow of Corpus Christi College, Oxford), in *Riddles of the Sphinx* (1891), is a more systematic thinker. He rejects the difference between matter and spirit. He agrees with Leibnitz in the analysis of the material into the immaterial, but with Lotze in holding that the many immaterial elements coexist and interact. At the same time he differs from Lotze's conclusion that their union requires one absolute substance. Again, he thinks that substance is activity; differing from both Leibnitz and Lotze herein, and still more in not allowing the existence of the many beyond experience. Hence his personal or pluralistic idealism is the view that the world is a plurality of many coexisting and interacting centres of experience, while will is the most fundamental form of experience.[1] In connexion with these views reference should be made to a work entitled *Personal Idealism, Philosophical Essays by Eight Members of the University of Oxford* (1902), edited by H. Sturt, and numbering Schiller, as well as G. F. Stout, H. Rashdall and others among its contributors (cf. also H. Sturt, *Idola theatri*, 1908). They do not all agree with one another, or perhaps even with the title. Nevertheless, there is a common tendency in them, and in the university of Oxford, towards the belief that, to use the words of the editor, "We are free moral agents in a sense which cannot apply to what is merely natural." There is indeed much more activity of thought at Oxford than the world suspects. Mansel and Jowett, Green and Caird, Bradley and Bosanquet arose in quick succession, the predecessors of a generation which aims at a new metaphysics. The same sort of antithesis between the one and the many has appeared in the United States. Josiah Royce (b. 1855, professor of philosophy, Harvard) believes in the absolute like Green and Bradley, in "the unity of a single self-consciousness, which includes both our own and all finite conscious meanings in one final eternally present insight," as he says in *The World and the Individual* (1900; see also later works). G. T. Ladd (*q.v.*) also believes in "a larger all-inclusive self," and goes so far as the paradox that perfect personality is only reconcilable with one infinite being. While Royce is Hegelian, Ladd prefers Lotze, but both believe in one mind. William James (*q.v.*), on the other hand, in his psychological works shows that the tendency of recent psychology is to personality, interpreted idealistically; though without a very clear appreciation of what a person is, and personality means. By a curious coincidence, almost at the time of the appearance of the *Essays on Personal Idealism*, an American writer, G. H. Howison, published *The Limits of Evolution, and other Essays illustrating the Metaphysical Theory of Personal Idealism* (1901). In fact there has been an increase of philosophical intercourse between English and American universities, which is a hopeful sign of progress.

The advent of personal idealism is a welcome protest against the confusion of God and man in one mind, and against the confusion of one man's mind with another's. The school undoubtedly tends towards realism. I am conscious only of myself as a person, and of my bodily signs. I know the existence of other human persons and minds only through their giving similar bodily signs. If the personal idealist consistently denies other bodies, then the bodily signs become, according to him, only part of his experience, which can prove only the existence of himself. To infer another mind he must infer another body, and the bodily environment including his and other bodies. Again, in being conscious of myself, I am not conscious of my mind in the abstract without my body. I cannot separate touching from my tactile organs, seeing from my eyes, or hearing from my ears. I cannot think my body away. Moreover, I am not conscious of my whole personal life at all. How do I know that I was born, though I cannot remember it, and that I shall die, though I am not now conscious of death? How do I know that I am the same person from birth to death? Not by my consciousness, but by knowing the bodies of others—of babies on the one hand, and of old men on the other hand. It is usual to say that the body has not enough unity to be part of the person: the objection is much more true of conscious mind. The truth is that not the unity of consciousness but the fact of its existence is the important point. The existence of my consciousness is my evidence for my soul. But it does not prove that I am nothing but soul. As a human person, I am body and soul; and the idealistic identification of the Ego with soul or mind, involving the corollary that my body belongs to the non-Ego and is no part of myself, is the *reductio ad absurdum* of idealism. Lastly, though the personal idealists are right in rejecting the hypothesis of one mind, they are too hasty in supposing that the hypothesis is useless for idealistic purposes. No idealism can explain how we all know one sun, except by supposing that we all have one mind. The difficulty of personal idealism, on the other hand, is to reconcile the unity of the thing with the plurality of thinkers. The unity of the sun can only be explained either idealistically by supposing it to be one object of one mind, or realistically by supposing it to be one thing distinct from the many minds which think about it. The former alternative is false, the latter true. Personal idealism, therefore, must end in personal realism.

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[1] For Dr Schiller's views, see further PRAGMATISM.

7.—Realism

1. *Metaphysical and Psychological Realism.*—Realism is the view that some known things are bodily, and some are mental. At its best, it is the Aristotelian view that both are substances. The modern misunderstanding of "substance" has been a main cause of the confusion of modern thought. Aristotle meant by it any distinct thing; *e.g.* I, you, an animal, a plant, the earth, the moon, the sun, God. He calls each of these, as existing apart, a thing *per se* (καθ' αὑτό). It is true that, having divided a natural substance into form and matter, he called each element "substance." But these are not primary meanings; and matter, or supposed substratum, in particular, he says, is not actually substance (*Met.* Z 3) or is only potentially substance (*Met.* H 1–2). In modern times, Spinoza, by a mere mistake, changed the meaning of "substance" from "existing apart" to "existing alone," and consistently concluded that there is only one. Locke mistook it to mean "substratum," or support of qualities, and naturally concluded that it is unknown. Kant, taking it in the mistaken meaning of Locke, converted it into the a priori category of the permanent substrate beneath the changes of phenomena, and even went so far as to separate it from the thing in itself, as *substantia phenomenon* from *noumenon.* When it had thus lost every vestige of its true meaning, Kant's successors naturally began to speak of things as being distinct without being substances. Fichte began this by saying that ego is activity, and being is life. Hegel said that spirit is not substance but subject, which to Aristotle would have meant that it is not a distinct thing, yet is a distinct thing. Fechner, Wundt and Paulsen have fixed the conclusion in psychology that soul is not substance but unity of mental life; and Wundt concludes from the modern history of the term that substance or "substrate" is only a secondary conception to that of causality, and that, while there is a physical causality distinct from that of substance, psychical causality requires no substance at all.

The result of this confusion is that the moderns have no name at all for a distinct thing, and, being mere slaves of abstract terms, constantly speak of mere attributes, such as activity, life, will, actuality, unity of mental operations, as if they were distinct things. But an attribute, though real, is not a distinct reality, but only a determinant of a substance, and has no being of its own apart from the substance so determined; whereas a substance, determined by all its attributes, is different from everything else in the world. Though, for simplicity and universality of thought, even in science, we must use the abstraction of attributes, and, by the necessity and weakness of language, must signify what are not substances by nouns substantive, we must guard against the over-abstraction of believing that a thing exists as we abstract it. The point of true realism is Aristotle's point that the world consists of such distinct, though related, things, and therefore of substances, natural and supernatural. Again, the method of true realism is that of Aristotle, and consists in recognizing the independence of metaphysics. The contrary method is psychological metaphysics, which makes metaphysics dependent on psychology, on the ground that the origin of knowledge determines its limits. This is the method which, as we have seen, has led from psychological to metaphysical idealism, by the argument that what we begin by perceiving is mental, and, therefore, what we end by knowing is mental. Now, there is no principle of method superior to that of Aristotle—we must begin with what is known to us. The things best known to man are the things which he now knows as a man. About these known things there is some agreement: about the beginnings of knowledge there is nothing but controversy. We do not know enough about the origin of knowledge to determine its limits. Hence, to proceed from psychology to metaphysics is to proceed from the less to the more known; and the paradoxes of psychological have caused those of metaphysical idealism.

The realist, then, ought to begin with metaphysics without psychological prejudices. He must ask what are known things, and especially what has been discovered in the sciences; in mechanics, in order to find the essence of bodies which is neglected by idealism; in mental science, in order to understand consciousness which is neglected by materialism. With the conviction that the only fair way of describing metaphysics has been to avoid putting forward one system, and even to pay most attention to the dominant idealism, we have nevertheless been driven occasionally to test opinions by this independent metaphysical method. The chief results we have found against idealism are that bodies have not been successfully analysed except into bodies, as real matter; and that bodies are known to exert reciprocal pressure in reducing one another to a joint mass with a common velocity by being mutually impenetrable, as real forces. The chief results we have found against materialism are that bodies evolving account neither for the origin of themselves, their nature, and their fundamental order of resemblance and difference, nor for the nature and origin of consciousness, nor even as yet for their becoming good for conscious beings. Hence we come to the realistic conclusions that among known substances some are bodies, others are souls; that man is body and soul; and that God is a pure soul or spirit. At the same time, while the independence of metaphysics leads us to metaphysical realism, this is not to deny the value of psychology, still less of logic. Besides the duty of determining what we know, there is the duty of determining how we know it. But in order to discharge it, a reform of psychology as well as of metaphysics is required. Two psychological errors, among many others, constantly meet us in the history of idealism—the arbitrary hypothesis of a sense of sensations, or of ideas, and the intolerable neglect of logical inference. Logical inference from sense is a process from sensible to insensible existence. The former error needs something deeper than a Kantian critique of reason, or an Avenarian criticism of experience; it needs a criticism of the senses. We want an answer to this question—What must we know by the senses in order to enable us to know what we infer by reason in the sciences? Without here aiming at exhaustiveness, we may bring forward against the dominant idealism a psychological theory of sense and reason. By touch I perceive one bodily member reciprocally pressing another in myself, *e.g.* lip pressing lip; by touch again I perceive one bodily member similarly pressing but not another member in myself, *e.g.* only one lip pressing; by inference from touch I infer that it is reciprocally pressing another body similar to my other bodily member, *i.e.* another body similar to my other lip. On this theory, then, founded on the conscious facts of double and single pressure in touch, and on the logic of inference, we have at once a reason for our knowledge of external bodies, and an explanation of the early appearance of that knowledge. The child has only to have its mother's nipple in its mouth in order to infer something very like the mutually pressing parts of its own mouth. Having thus begun by touch and tactile inference, we confirm and extend our inferences of bodies in Nature by using the rest of the senses. This is not to forget that the five senses are not our whole stock or to confine inference to body. We have also the inner sense of consciousness which is inexplicable by body alone. By combining, moreover, our knowledge of Nature with our consciousness of our own works, we can infer that Nature is a work of God. Next, finding that He gives signs of bodily works, but no signs of bodily organs, we can infer that God is a Spirit. Finally, returning to ourselves, we can conclude that, while the conscious in God is Spirit without Body, in us it is spirit with body. This final distinction between bodily and spiritual substances we owe to Descartes.

2. *The Undercurrent of Modern Realism.*—Coming after the long domination of Aristotelian realism, Descartes and Locke, though psychological idealists, were metaphysical realists. Their position was so illogical that it was easily turned into metaphysical idealism. But their psychological method and

idealism produced another mistake—the tendency to a modicum of realism, as much as seemed to this or that author to follow from psychological idealism. In Germany, since the victory of Kant over Wolff, realism has always been in difficulties, which we can appreciate when we reflect that the Germans by preference apply the term "realism" to the paradoxes of Herbart (1776–1841), who, in order to avoid supposed contradictions, supposed that bodies are not substances, but show (*Schein*), while "reals" are simple substances, each with a simple quality, and all preserving themselves against disturbance by one another, whether physically or psychologically, but not known to be either material or spiritual because we do not know the simple quality in which the nature of the real consists. There have indeed been other realisms in Germany. Trendelenburg (1802–1872), a formidable opponent of Hegel, tried to surmount Kant's transcendental idealism by supposing that motion, and therefore time, space and the categories, though a priori, are common to thought and being. Dühring, with a similar object, makes matter a common basis. While these realisms come dangerously near to materialism, that of the Roman Catholic A. Günther (1783–1863), "Cartesius correctus," erected too mystical an edifice on the psychological basis of Descartes to sustain a satisfactory realism. Yet Güntherism has produced a school, of which the most distinguished representative is the Old Catholic bishop in Bonn, Th. Weber, whose *Metaphysik*, completed in 1891, starting from the ego and the analysis of consciousness, aims at arriving at the distinction between spirit and nature, and at rising to the spirit of God the Creator. Other realistic systems are those of J. H. von Kirchmann (1802–1884), author, among other works, of *Die Philosophie des Wissens* (1864) and *Ueber die Principien des Realismus* (1875); Goswin Uphues (b. 1841; professor of philosophy at Halle), directed against the scepticism of Shute's *Discourse on Truth*; and Hermann Schwarz (born 1864), who completes the psychological view of Uphues that we can know objects as they are, by the metaphysical view that they can be as we know them. But German realism lacks critical power, and is little better than a weed overshadowed by the luxuriant forest of German idealism.

French Realism.

In France, the home of Cartesian realism, after the vicissitudes of sensationalism and materialism, which became connected in the French mind with the Revolution, the spirit of Descartes revived in the 19th century in the spiritualistic realism of Victor Cousin. But Cousin's psychological method of proceeding from consciousness outwards, and the emphasis laid by him on spirit in comparison with body, prevented a real revival of realism. He essayed to answer Locke by Kant, and Kant by Reid, Maine de Biran and Schelling. From Reid he adopted the belief in an external world beyond sensation, from Biran the explanation of personality by will, from Schelling the identification of all reason in what he called "impersonal reason," which he supposed to be identical in God and man, to be subjective and objective, psychological and ontological. We start, according to him, from a psychological triplicity in consciousness, consisting of sensation, personal will and impersonal reason, which by a priori laws of causality and substance carries us to the ontological triplicity of oneself as ego willing, the non-ego as cause of sensation, and God as the absolute cause beneath these relative causes. So far this ontological triplicity is realism. But when we examine his theory of the non-ego, and find that it resolves matter into active force and this into animated activity, identifies law with reason, and calls God absolute substance, we see at once that this spiritual realism is not very far from idealism. About 1840, owing largely to the teaching of E. Saisset in the spiritualistic school, the influence of Descartes began to give way to that of Leibnitz. Leibnitz has been used both realistically and idealistically in France. He was taken literally by spiritual realists, *e.g.* by Paul Janet (*q.v.*). Janet accepted the traditional ontological triplicity—God, souls and bodies—and, in answer to Ravaisson, who called this realism "demi-spiritualisme," rejoined that he was content to accept the title. At the same time, like Cousin, his works show a tendency to underrate body, tending as they do to the Leibnitzian analysis of the material into the immaterial, and to the supposition that the unity of the body is only given by the soul. His emphasis is on spirit, and he goes so far as to admit that "no spiritualist is engaged to defend the existence of matter." The strength of Janet's position is his perception that the argument from final causes is in favour of an omnipresent rational will making matter a means to ends, and not in favour of an immanent mind of Nature working out her own ends.

The psychological metaphysics of Cousin and of Janet was, however, too flimsy a realism to withstand its passage into this very idealism of matter which has become the dominant French metaphysics. Étienne Vacherot (*q.v.*) deserted Descartes for Hegel. He accepted from Hegel "the real is rational" without the Hegelian method, for which he substituted conscious experience as a revelation of the divine. Matter he held to be mind at the minimum of its action, and evolution the "expansion de l'activité incessante de la cause finale." God, according to his latest view, is the absolute being as first cause and final end. "Let us leave," says he in deference to Janet, "the category of the ideal, which applies to nothing real or living." But the most noticeable passage in *Le Nouveau spiritualisme* (1884) is its contrast between the old and the new; where he says that the old spiritualism opposed spirit to matter, God to Nature, the new spiritualism places matter in spirit, Nature in God (p. 377). F. Ravaisson (see RAVAISSON-MOLLIEN), by his *Rapport* (prepared for the Exhibition of 1867) on philosophy in France, gave a fresh impulse to the transition from spiritual realism to idealism, by developing the Aristotelian ἔφεσις of matter and the Leibnitzian appetition of monads into "l'amour" as the very being of things. Jules Lachelier (born 1832) agreed with Ravaisson that beauty is the last word of things, but, under the influence of Kant and his successors, put his idealism rather in the form that all is thought. A. Fouillée (*q.v.*) rightly objects that we must not thus impute thought and intention to Nature, and yet does not scruple to impute to it life, sensation and want. Starting from consciousness, he argues that all known things are phenomena of consciousness. Then, agreeing with evolutionism, that things are necessarily determined by forces, but with Leibnitz that body is merely passive, he infers that force, being active, is psychical—a force, which he describes as "idée-force," and as "vouloir-vivre." In connexion with the "idées directrices et organisatrices," supposed by the French physiologist Claude Bernard, and the universal will supposed by German voluntarists, Fouillée concludes that the world is a society of wills. Meanwhile, more under the influence of Kant, C. B. Renouvier (*q.v.*) has worked out an idealism which he calls "Néo-criticisme," rejecting the thing-in-itself, while limiting knowledge to phenomena constituted by a priori categories. Phenomena he identifies with "représentations représentatives et représentées." But he takes the usual advantage of this most ambiguous of terms when he extends it to embrace God, freedom, and immortality required by the moral law. In his later work, *La Nouvelle monadologie* (1899), he maintains that each monad is a simple substance, endowed with representation, which is consciousness in form, phenomenon in matter as represented. In order to explain free will, he supposes, contrarily to Fouillée, that the laws of phenomena are indeterminate, contingent and liable to exceptions. Here we trace the influence of Leibnitz and Lotze, which is still more marked in *La Contingence des lois de la nature* (1874), by E. Boutroux. Fouillée meets the mechanics of evolution by the argument that will to live determines its necessary laws, Boutroux by denying the necessity. His point is, that the world only appears to be phenomena governed by necessary laws, and is really a spontaneity which makes new beginnings, such as life and consciousness, tending to good. These examples are enough to show that the psychological metaphysics of spiritual realism has not been able to withstand the rise and progress of spiritual idealism in France.

English Realism.

In England, the land of Bacon and Locke, the realistic tendency has been more active, and is exhibited in Bacon's *Novum organum* and *De Augmentis scientiarum*, as well as to a less degree in the Fourth Book of Locke's *Essay*. After the metaphysical idealism, begun by Berkeley, had eventuated in Hume's reduction of the objects of knowledge to sensations, ideas and associations, the Scottish school, applying the Baconian method to the study of mind, began to inquire once more for the evidences of our knowledge, and produced the natural or intuitive realism of T. Reid, Dugald Stewart and Sir William Hamilton, who, having been followed by H. L. Mansel, as well as by J. Veitch, H. Calderwood and J. M'Cosh, prolonged the existence of the school, in which we may venture to place L. T. Hobhouse and F. W. Bain, author of *The Realization of the Possible* (1899), down to our own time.

Its main tenet, that we have an immediate perception of the external world, is roughly expressed in the following words of Reid: "I do perceive matter objectively—that is, something

Reid.

Hamilton.

Calderwood.

M'Cosh.

which is extended and solid, which may be measured and weighed, is the immediate object of my touch and sight. And this object I take to be matter, and not an idea. And, though I have been taught by philosophers that what I immediately touch is an idea, and not matter, yet I have never been able to discover this by the most accurate attention to my own perceptions." No opposition to idealism could be more distinct. Reid, however, did not always express himself so distinctly. Moreover, he and his successors mixed up so many accidents with the essence of their realism that the whole system broke down under its own weight. Their psychology contained valuable points. It also contained much that was doubtful, and much that was ill-adapted to the metaphysics of realism. Yet they thought it the only avenue to metaphysics. It is full of appeals to common sense, and of principles of common sense, which Reid also called intuitive first principles, and self-evident truths. It is spoilt by Locke's hypothesis that we do not perceive things but qualities implying things. While it asserted a realism of individuals, it admitted a conceptualism of universals. Stewart also said that our knowledge of matter and mind is merely relative. Hamilton went still further; he tried to combine the oil of Reid with the water of Kant; and converting the intuitive into the a priori, he found a further reason for the relativity of knowledge. "Our knowledge is relative," said he, "first, because existence is not cognizable absolutely and in itself, but only in special modes; second, because these modes thus relative to our faculties are presented to and known by the mind, only under modification, determined by these faculties themselves." Not only so, but in his review of Cousin ("Philosophy of the Unconditioned," in *Discussions*, pp. 12–15), he made conception the test of knowledge, argued that "the mind can conceive, and consequently can know, only the limited, and the conditionally limited," that "to think is to condition," that all we know either of mind or matter is "the phenomenal," that "we can never in our highest generalizations rise above the finite," and concluded that we cannot conceive or know the unconditioned, yet must believe in its existence. Nevertheless, in spite of all this Kantism, he adhered to his natural realism. He vacillated a great deal about our mode of perceiving the external world; but his final view (edition of Reid's works, note D*) consisted in supposing that (1) sensation is an apprehension of secondary qualities purely as affections of the organism viewed as ego; (2) perception in general is an apprehension of primary qualities as relations of sensations in the organism viewed as non-ego; while (3) a special perception of a so-called "secundo-primary" quality consists in "the consciousness of a resisting something external to our organism." Hamilton's views both on the absolute and on perception affected Mansel and Spencer. They were not, however, received without question even by his followers. H. Calderwood, in his *Philosophy of the Infinite* (1854), made the pertinent objection that, though thought, conception and knowledge are finite, the object of thought may be infinite. Hamilton, in fact, made the double mistake of limiting knowledge to what we can conceive, and confusing the determinate with the finite or limited. We never know anything except as determined by its attributes; but that would not prevent us from inferring something determined as unconditioned, whether infinite or absolute. J. M'Cosh again, in *The Prevailing Types of Philosophy: Can they logically reach reality?* (1891), rightly protests against Hamilton's combination of Scottish and German schools which will not coalesce, and exhorts the former "to throw away its crutches of impressions, instincts, suggestions, and common sense, and give the mind a power of seeing things directly." He has the merit of presenting natural or intuitive realism in its purity.

The common tenet of the whole school is that without inference we immediately perceive the external world, at all events as a resisting something external to our organism. But is it true? There are three reasons against it, and for the view that we perceive a sensible object within, and infer an external object without, the organism. In the first place, there are great differences between the sensible and the external object; they differ in secondary qualities in the case of all the senses; and even in the case of touch, heat felt within is different from the vibrating heat outside. Secondly, there are so-called "subjective sensations," without any external object as stimulus, most commonly in vision, but also in touch, which is liable to formication, or the feeling of creeping in the skin, and to horripilation, or the feeling of bristling in the hair; yet, even in "subjective sensations," we perceive something sensible, which, however, must be within, and not outside, the organism. Thirdly, the external world and the senses always act on one another by cause and effect and by pressure, although we only feel pressure by touch. Now, when the thing with which touch is in a state of reciprocal pressure is external, *e.g.* a table, we feel our organism pressed and pressing; we do not feel the table pressing and pressed, but infer it. The Scottish School never realized that every sensation of the five senses is a perception of a sensible object in the bodily organism; and that touch is a perception, not only of single sensible pressure, but also of double sensible pressure, a perception of our bodily members sensibly pressing and pressed by one another, from which, on the recurrence of a single sensible pressure, we infer the pressure of an external thing for the first time. Intuitive Realism is to be replaced by Physical Realism.

3. *Reaction to Hypothetical Realism.*—The three evidences, which are fatal to intuitive realism, do not prove hypothetical realism, or the hypothesis that we perceive something mental, but infer something bodily. This illogical hypothesis, which consists of incautiously passing from the truth that the sensible object perceived is not external but within the organism to the *non-sequitur* that therefore it is within the mind, derived what little plausibility it ever possessed from three prejudices: the first, the scholastic dogma that the sensible object is a *species sensibilis*, or immaterial sensible form received from the external thing; the second, the Cartesian a priori argument that the soul as thinking thing can perceive nothing but its own ideas; the third, the common assumption of a sense of sensations. But notwithstanding its illogicality, its tendency to underrate Nature as inferred from such idealistic premises, and its certain transition into a consistent idealism, hypothetical realism has, with little excuse, revived among us in the writings of Shadworth Hodgson, James Martineau and A. J. Balfour. The cause of this anachronism has been the failure of intuitive realism and the domination of idealism, which makes short-sighted men suppose that at all events they must begin with the psychology and the psychological idealism of the day, in the false hope that on the sands of psychological idealism they may build a house of metaphysical realism.

Hodgson.

Shadworth Holloway Hodgson (born 1832; hon. fellow of Corpus Christi College, Oxford), whose chief work is *The Metaphysic of Experience* (4 vols., 1898), believing that philosophy is an analysis of the contents of consciousness, or experience, and that this is metaphysics, begins, like Kant, with an analysis of experience. Like Kant, he supposes that experience is concerned with sensations, distinguishes matter and form in sense, identifies time and space, eternal time and infinite space, with the formal element, and substitutes synthesis of sensations of touch and sight for association and inference, as the origin of our knowing such a solid material object as a bell. Although he does not agree with Kant that either the formal element in sense or the synthesis of sensations is a priori, yet in very Kantian fashion, through not distinguishing between operation and object, he holds that, in synthetically combining sensations of touch and sight, we not only have a complex perception of a solid body, but also know this "object thought of" as itself the complex of these sensations objectified. Hence he concludes that "*matter* is the name for the sensation-elements derived from both senses, abstracting in thought, so far as possible, from the extension-elements of both" (i. 296).

Here you would expect him to stop, as the German Neo-Kantism of Lange stops, with the consistent conclusion that all we know of Nature from such data is these complexes of sensation-elements, or phenomena in the Kantian meaning. Not so; like Kant himself, Hodgson supposes something beyond; not, however, an unknown thing in itself causing sensations, but a condition, or *sine qua non*, of their existence, without being a cause of their nature. In order to make this leap he supposes that we have beyond perceptions a conception of condition. His account of the origin of this conception is puzzling. (i. 380). Whatever its origin may be, it could not, any more than a Kantian category of cause, justify us in concluding anything more than a relation of perceptions as conditions of one another, seeing that they were supposed to be the whole data, and matter itself to be "sensation-elements." But what he proceeds to suppose is that, having the conception, and finding that the complex of perceptions needs accounting for, we infer a real condition, *e.g.* the solid interior of a bell. What we know, however, of this condition, according to him, has two limits: on the one hand, it is the condition only of the existence of our perceptions; on the other hand, all we know of its nature is our perceptions. Matter thus, which had at first been defined as a complex of perceptions objectified, now turns out to be a condition without which perceptions would not exist, but whose nature is known only as a complex of perceptions. Finally, according to him, having inferred matter as the condition of our perceptions, we are entitled to infer that the condition of the existence of matter is God, whose nature, however, can be inferred only by practical reason from conscience. He avers that this "metaphysic of experience" is not idealism, or the tenet that consciousness is the only reality. It is realism—but inconsequent and inadequate realism, something like that of Spencer; according, indeed, more knowledge of the distinction between Nature as condition of sensations and God as condition of Nature; but very like in holding that all we know of natural forces is our perceptions. We know more, however, about a body, such as a bell, than either Spencer or Hodgson allows. We know, from the concomitant variations between its vibrations and our perceptions, that its vibrations are not mere conditions but real causes of our perceptions; and that those vibrations are not our perceptions, because we cannot perceive them, but are real attributes of the bell. It will be objected that they are merely possible perceptions. But as they really produce our real perceptions, they are themselves not merely possible, but real or actual. A possible cause could not actually produce an actual effect.

Martineau.

James Martineau (*q.v.*) in *A Study of Religion* (1888), like Shadworth Hodgson, started from Kant, and tried to found on transcendental idealism "a return to dualism." If there is one thing certain in the Kantian philosophy, it is its author's perception that what is contributed by mind must not be extended to things beyond mind. Hegel only extended a priori forms to things by resolving things into thoughts. Mill also protested "against adducing, as evidence of the truth of a fact in external nature, the disposition, however strong or however general, of the human mind to believe it." Yet Martineau adopted, as his view of the limits of human intelligence, that Kant was right in making space and time a priori forms of sense, but wrong in limiting them to sensations. But in order to make space a form of external things, Martineau had to take the external in space, by which Kant meant one sensation out of another, in the very different meaning of the self here and the not-self there. He facilitated this awkward transition by adding to Kant's a priori forms of space and time an "a priori form of alternative causality," or, as he also called it, "an intuition of causality involved in the elementary exercise of perception," which is the key to his whole philosophy. He supposed that this intuition of causality arises when will is resisted, and, further supposing that causality requires decision between alternatives, concluded that the intuition of will resisted is an intuition of will against will, mine against other (i. 65). To pass over its confusion of a priori and intuitive, there are two fatal objections to this view. In the first place, the intuition of causality does not require will at all, because we often perceive one bodily member pressing another involuntarily; a man suffering from lockjaw neither wills nor can avoid feeling the pressure of his upper and lower jaws against one another. Secondly, though causality requires alternatives in the material cause, *e.g.* wax may or may not be melted, the determination between them is not always a decision of will, but in physical causation depends on the efficient cause, *e.g.* the fire: as Aristotle says, when the active and passive powers approach, the one must act and the other suffer, and it is only in rational powers that will decides (*Met.* Θ 5).

A. J. Balfour.

A. J. Balfour, in *The Foundations of Belief, being Notes Introductory to the Study of Theology* (1895), begins by maintaining that the evidence of the senses is not a foundation of belief, and then expects us to believe in Nature and in God. He revives the "Acatalepsia" of the New Academy. In Part II., ch i., he makes three assumptions about the senses, and, without stopping to prove them, or even to make them consistent, deduces from them his thesis that the evidence of the senses is not a foundation of belief in Nature. He first assumes an immediate experience of a body, *e.g.* a green tree; and then deduces that the evidence of the senses proves now and then to be fallacious, because we may have an experience indistinguishable from that of a tree but incorrect; and further, that our perceptions are habitually mendacious, because all visual experiences are erroneous, as colour is a sensation while the thing consists of uncoloured particles. This argument from a pure assumption is a confusion of sense and inference. In no case is the evidence of the senses fallacious or mendacious; the fallacy is in the inference.

He next assumes that we have no immediate experience of independent things—that sense perceives sensations, feelings, or ideas; while all else, *e.g.* a tree, is a matter of inference. On this quite new assumption of a sense of sensations he deduces that, from a perception of these mental facts, we could not infer material facts, *e.g.* a tree; so that again the evidence of the senses does not afford trustworthy knowledge of the material universe. His deduction is logical; but he has forgotten to prove the assumption, and now confuses sensory operation with sensible object. Vision does not perceive a sensation of colour; it perceives a visible picture, *e.g.* green, which is in the organism, but has never been proved to be a mental fact, or not to be a material fact. So touch perceives not a sensation of pressure, but a pressure which is a material fact in the organism. From a material pressure within we logically infer a material pressure outside. He thirdly assumes an appendix to the second assumption: he assumes that sense perceives mental sensations with succession but without causality, because no kind of cause is open to observation. On this assumption of a sense of sensations, but not of causality, he deduces that we could not from such data infer any particular kind of cause, or a bodily cause, *e.g.* a tree, or indeed any cause at all, or any event beyond perception, without assuming the principle of causation that Nature is uniform in cause and effect over great intervals of time and space. Nevertheless he gives absolutely no proof of the assumption that there is no sense of causality. There is none in the subsidiary senses, because none of them perceives the pressures exerted on them. But the primary sense of touch perceives one bodily member causing pressure on another, reciprocally, within the organism, from which we infer similar particular pressures caused between the organism and the external world; but without needing the supposed stupendous belief and assumption of the uniformity of Nature, which is altogether ignored in the inferences of the ordinary man. Finally, as touch perceives reciprocal pressure within, and tactile inference infers it without, touch is the primary evidence of the senses which is the foundation and logical ground of our belief in Nature as a system of pressing bodies. Balfour, however, having from unproved assumptions denied the evidence of the senses, and the rational power of using them to infer things beyond oneself, has to look out for other, and non-rational, foundations of belief. He finds them in the needs of man. According to him, we believe in Nature because it satisfies our material needs, and in God because he satisfies our spiritual needs. But bare need, *e.g.* a pang of hunger, is no cause of belief beyond itself; and desire, or need of something prospective, *e.g.* a desire of food, is effect, not cause, of a previous belief that there is such a thing, and of a present inference that it may again be realized. Moreover, when the belief or inference is uncertain, need even in the shape of desire is not in itself a foundation of belief in the thing desired: to need a dinner is not to believe in getting it; and, as Aristotle said, "there is a wish for impossibilities." It is fair, however, to add that Balfour has a further foundation for the belief in Nature, the survival of the fittest, by which those only would survive who possessed and could transmit the belief. But here he fails exactly as Darwin himself failed. Darwin said, given that organisms are fit, they will tend to survive; but he failed to show how they become fit. Balfour says, given that men believe in Nature, they will survive; but he fails to show how they come to believe in it. Inference from sense is the one condition of all belief in anything beyond oneself, whether it be Nature, or Authority, or God; and it is the one condition of all needs, which are not mere feelings, but desires of things. The result of undermining this sure foundation emerges in Balfour's attitude to the beliefs themselves. He holds that space, time, matter, motion, force, are all full of the insoluble contradictions supposed by Spencer; and that all our beliefs, in Nature and in God, stand on the same footing of approximations. Hence his really valuable arguments from Nature to God sink to the problematic form—there may be Nature; if so, there is God.

Such is the modern "Acatalepsia," which arises from denying the evidence of the senses, and from citing the transfigured realism of Spencer instead of the original realism of Aristotle, about whom Balfour speaks as follows: "It would be difficult, perhaps impossible, to sum up our debts to Aristotle. But assuredly they do not include a tenable theory of the universe."

4. *The Past and Future of Metaphysics.*—Aristotelian realism is the strong point of Roman Catholic philosophy. As interpreted by Thomas Aquinas, it is now in danger of becoming a dogma. In 1879 Pope Leo XIII. addressed to the bishops the *Encyclica aeterni patris*, which contained the words, "Sancti Thomae sapientiam restituatis et quam latissime propagetis." From the Roman Catholic point of view this reaction to "Thomism" was a timely protest against modern metaphysics. It was founded upon a feeling of uneasiness at a growing tendency among Roman Catholic writers not only to treat theology freely, but to corrupt it by paradoxes. One cannot but feel regret at seeing the Reformed Churches blown about by every wind of doctrine, and catching at straws now from Kant, now from Hegel, and now from Lotze, or at home from Green, Caird, Martineau, Balfour and Ward in succession, without ever having considered the basis of their faith; while the Roman Catholics are making every effort to ground a Universal Church on a sane system of metaphysics. However this may be, the power of the movement is visible enough from the spread of Thomism over the civilized world, and in England from the difference between the freer treatment of metaphysics by some Roman Catholic writers and that which has arisen under the immediate influence of Thomism. J. H. Newman (1801–1890), maintaining the authority of conscience and the probabilism of the understanding, concluded to the necessity of a higher authority in the primitive church. W. G. Ward was a philosophical critic of Mill. St George Mivart, in *The Ground-work of Science* (1898), maintained the reality of an active causative power underlying Nature, and the dignity of human reason, from an independent point of view. On the other hand, more under the influence of the Thomist reaction, Thomas Harper published *The Metaphysics of the School* (1879, &c.), describing scholasticism, as it appears in the works of Aquinas; and *The Manuals of Catholic Philosophy*, edited by R. F. Clarke, include *General Metaphysics* (1890), by John Rickaby, who effectively criticizes Hegel by precise distinctions, which, though scholastic, did not deserve to be forgotten.

The Thomist reaction has had a good effect in the way of encouraging the study of Aristotelian philosophy in itself, and as modified by Aquinas. Nevertheless, the world cannot afford to surrender itself to Aristotle, or to Aquinas. Aristotle could not know enough, physically, about Nature to understand its matter, or its motions, or its forces; and consequently he fell into the error of supposing a primary matter with four contrary primary qualities, hot and cold, dry and moist, forming by their combinations four simple bodies, earth, water, air and fire, with natural rectilineal motions to or from the centre of the earth; to which he added a quintessence of ether composing the stars, with a natural circular motion round the earth. Metaphysically, he did not, indeed, as is often supposed, think the nature of substance to be matter and form, because in his view God is a substance, yet with no matter; but he did think that every natural substance or body is a concrete whole, composed of matter and form different from matter. He thought that besides proximate matter, or one body as matter of another, there is a primary formless matter beneath all bodies, capable of becoming all in turn, but itself potentially, not actually, substance. He thought not only that a form, or essence, is something different from, and at most conjoined with, matter in a concrete body, but also that in all the bodies of one kind, *e.g.* in all men, there is one undivided form or essence, *e.g.* rational animal, communicated from one member to another member of the kind, *e.g.* from father to son, by what we still call, though without any meaning, the propagation of the species. He thought, in consequence, that the *principium individuationis*, which differentiates two members of the kind, *e.g.* Socrates and Callias, is their one form or essence only as conjoined with different matters, *e.g.* different bones and flesh. He thought, moreover, that the one form of a kind is an original essence (τὸ τί ἦν εἶναι), which is uncreate; and, in order to avoid the "separate forms" supposed by Plato, he concluded that the world of Nature must be eternal, in order that each original essence may from eternity always be in some individual or another of its kind. On this assumption of the eternity of the world, God could not be a Creator. Aristotle thought that God is only prime mover, and that too only as the good for the sake of which Nature moves; so that God moves as motive. Psychologically, Aristotle applied his dualism of matter and form to explain the antithesis of body and soul, so that the soul is the form, or entelechy, of an organic body, and he applied the same dualism to explain sensation, which he supposed to be reception of the sensible form or essence, without the matter, of a body, *e.g.* of the form of white, without the matter, of a white stone. He thought that in the soul there is a productive intellect and a passive intellect, and that, when we rise from sense by induction, the productive causes the passive intellect to receive the universal form or essence, *e.g.* of all white things; and he thought that this productive intellect is our immortal faculty. Lastly, he thought that, while other operations have, intellect (νοῦς) has not, a bodily organ; and hence he became responsible for the fancy that there is a break in bodily continuity between sense and will, while intellect is working out a purely immaterial operation of soul, resulting from the former and tending to the latter. It is evident that a philosophy containing so many questionable opinions is not fit to be made into an authoritative orthodoxy in metaphysics.

Now these, on the whole, are the very opinions of Aquinas, except so far as they were clearly inconsistent with the Christian faith. Aquinas thought, as an article of faith, that the world began, and that God is its Creator. This involved a change of detail in the theory of essences and of universals generally. Aquinas thought that before the creation the one eternal essence of any kind was an abstract form, an idea in the intellect of God, like the form of a house in the mind of a builder, *ante rem*; that after the creation of any kind it is *in re*, as Aristotle supposed; and that, as we men think of it, it is *post rem*, as Aristotle also supposed. Of this view the part which was not Aristotle's, the state of "universalia ante rem," was due to the Neoplatonists, who interpreted the "separate forms" of Plato to be ideas in intellect, and handed down their interpretation through St Augustine to the medieval Realists like Aquinas, who thus combined Neoplatonism with Aristotelianism. Hence too Aquinas opposed essence to existence much more than Aristotle did. Lastly, as a Christian, he supposed the whole soul to be immortal, and to form for itself a new body after death. But, with these modifications he accepted the general physics of Aristotle, the metaphysical dualism of matter and form, and the psychology founded upon it. The Thomism, therefore, of our day is wrong, from a metaphysical point of view, so far as it elevates Aristotelianism, as seriously modified but not fundamentally corrected by Aquinas, into an authoritative orthodoxy in metaphysics.

Centuries elapsed after Aquinas before Galileo and his successors reformed natural science, and before Bacon destroyed the metaphysical dualism of matter and form by showing that a form in Nature is only a law of the action of matter, and that, as the action of a body is as individual as the body, the form is eternal only in thought (*ratione*). The psychology of Aristotle and Aquinas thus became impossible; for, if the form of a body is only a mode of matter, to call one's soul the form of one's body is to reduce it to only a mode of matter, and fall into materialism. Hence Descartes began the reform of psychology not only by the appeal to consciousness, "I think," but also by opposing body and soul, no longer as matter and form, but as different substances. These great improvements, due to the genius of Galileo, of Bacon, of Descartes, are the fresh beginnings of modern thought, from which we dare not turn back without falling into obscurantism. What, then, is the future of metaphysics? We must return not to the authority but to the study of Aristotle. The independence of metaphysics as the science of being, the principles of contradiction and excluded middle with their qualifications, the distinction without separation between substance and attributes, the definition of substance as a distinct individual thing, the discovery that the world consists of substances existing apart but related to one another, the distinction between material and efficient causes or matter and force, the recognition both of the natural and of the supernatural—all these and many other half-forgotten truths are the reasons why we must always begin with the study of Aristotle's *Metaphysics*. But their incompleteness shows that we must go forward from Aristotle to Bacon and modern science, and even pass through the anarchy of modern metaphysics, in the hope that in the future we may discover as complete an answer as possible to these two questions:—

1. What is the world of things we know?
2. How do we know it?

For authorities see the works quoted above, and the references in the articles on philosophers and philosophical subjects. (T. Ca.)

METAPONTUM (Gr. *Μεταπόντιον*, mod. Metaponto), an ancient city of Magna Graecia situated on the Gulf of Tarentum, near the mouth of the river Bradanus, and distant about 24 m. from Tarentum and 14 m. from Heraclea. It was founded by an Achaean colony from Sybaris and Crotona about 700 B.C. Metapontum was one of the cities that played a conspicuous part in the troubles arising from the introduction of the Pythagorism into Magna Graecia, and it was there that Pythagoras died in 497 B.C. His tomb was still shown in the time of Cicero.

At the time of the Athenian expedition to Sicily (415 B.C.) Metapontum appears to have been an opulent and powerful city, whose alliance was courted by the Athenians; but it contented itself with a very trifling support. In 332 B.C., at the time of the expedition of Alexander, king of Epirus, into Italy, it was one of the first cities to enter into an alliance with him. The Second Punic War gave a fatal blow to its prosperity. After the battle of Cannae in 216 B.C. it was among the first cities in the south of Italy to declare in favour of Hannibal, and became for some years the headquarters of Hannibal. Hence, when the defeat of Hasdrubal at the Metaurus (207 B.C.) compelled him to abandon this part of Italy, the inhabitants of Metapontum abandoned their city, and followed him in his retreat.

From this time Metapontum sank; though it was still existing in the days of Cicero, Pausanias tells us that in his time nothing remained of it but a theatre and the circuit of the walls.

Metapontum has the remains of two temples, both of which seem to belong to the period 510–480 B.C. (Koldewey and Puchstein, *Die griechischen Tempel in Unteritalien und Sicilien*, Berlin, 1899, pp. 35–41). The so-called Chiesa di Sansone, which lay within the ancient town, and was probably dedicated to Apollo Lycius, was a peripteros measuring 186 by 91¾ ft., of which only the foundations are left. The capitals were 3⅓ ft. in diameter. The temple was decorated with finely painted terra-cottas. Of the other temple, the so-called Tavole Paladine, which lay outside the area of the ancient city, and was a peripteros with 6 columns, 3⅓ ft. in diameter, in front and 12 ft. at the sides, 15 columns are standing, with the lower portion of the epistyle. It measured 105 ft. by 49 ft. without the steps. There are also traces of the town walls, which have served for the construction of farmhouses, of tombs, and of a harbour by the shore. Pliny speaks of a temple of Juno at Metapontum supported by columns of vinewood (*Hist. nat.* xiv. 9). An archaic treasure-house dedicated at Olympia by the people of Metapontum has been discovered there. The railway station is the junction of the line from Battipaglia (and Naples) with that from Taranto to Reggio. (T. As.)

See M. Lacava, *Topografia e storia di Metaponto* (Naples, 1891).

METASOMATISM (Gr. *μετά*, change, *σῶμα*, body), in petrology, a process of alteration of rocks by which their chemical composition is modified, new substances being introduced while those originally present are partly or wholly removed in solution. For example a limestone may be converted into a siliceous chert, a dolomite, an ironstone, or a mass of metalliferous ores by metasomatic alteration. The process is usually incomplete, greater or smaller portions of the original rock remaining. The agencies of metasomatism are in nearly all cases aqueous solutions; probably they were often at a high temperature, as metasomatic changes are especially liable to occur in the vicinity of igneous intrusions (laccolites, dikes and necks) where large quantities of water were given off by the volcanic magma at a time when it had solidified but was not yet cold. Metasomatism also usually goes on at some depth, so that we may readily believe that it is favoured by increase of pressure. On the other hand, there are many instances in which these processes cannot be shown to have taken place at temperatures or pressures above those which normally exist in the upper part of the earth's crust (*e.g.* dolomitization and silicification of many limestones). There are also cases of metasomatism in which steam and other vapours are supposed to have been operative; the temperatures were probably above the critical temperature of water. Changes of this sort are described as pneumatolytic, being induced by gases (see Pneumatolysis).

By metasomatism new minerals replace the primitive ones; at the same time the original rock-structures may be completely obliterated. An igneous rock for example may be entirely replaced by crystalline massive quartz, a fossiliferous limestone by granular crystalline dolomite. It is equally common, however, to find that the structure of the original rock is preserved though its substance has been entirely altered. An oolitic limestone may become an oolitic ironstone or chert (see Petrology, Pl. IV. fig. 5.) and casts of the fossils which the limestone contained may be formed of siderite or of chalcedony. In this case the rock resembles a pseudomorph, which is the term applied to a mineral which has been entirely replaced by another mineral without losing its original crystalline form. As a result of metasomatism rocks usually become more crystalline, especially those which have been in large part built up of fossil organic remains; this is a consequence of the new substances having been deposited by purely inorganic processes from solution in water.

The chemical change is often complete, as when a limestone is replaced by chert or otherwise silicified, but it is probably more usually incomplete, part of the substance of the original rock having been retained though possibly in new mineral combinations. When a limestone is replaced by ironstone (*e.g.* carbonate of iron or siderite) part at least of the carbonic acid may be that of the limestone. A dolomite, formed from a limestone, contains more than one-half of its weight of carbonate of lime presumably derived from the limestone itself; yet in this case the mineral transformation may be perfect, as the dolomite retains none of the calcite of which the limestone was formed; it is all present as the double carbonate of lime and magnesia (or dolomite). When a granite is converted by emanations containing fluorine and boron into a quartz-tourmaline rock (schorl rock, *q.v.*) or a quartz mica rock (greisen, *q.v.*) it can be proved by analysis that there has been very little modification of the chemical composition of the original mass. This resembles paramorphism in minerals, in which one mineral is substituted for another having the same chemical composition (*e.g.* kyanite for andalusite).

The relations between metamorphism and metasomatism are very close; in fact some authors regard metasomatism as a variety of metamorphism. It is generally true, however, that in metamorphic changes there is little chemical alteration; sandstones pass into quartzites, clays into mica-schists and gneisses, limestones into marbles without any essential modification in chemical composition, for the original minerals new ones being substituted and new structures being produced at the same time. In metasomatism, on the other hand, chemical alteration is supposed by most geologists to be an essential feature; new minerals appear, but the original structures are sometimes retained.

The facility with which a rock undergoes metasomatism depends partly on its nature, and partly on the circumstances in which it is placed. Limestones, being readily soluble under natural conditions, are especially liable. The Cleveland iron ores of Yorkshire are limestones replaced by siderite and limonite; the Whitehaven iron ores are metasomatic replacements of limestone by haematite. The former are of Mesozoic, the latter of Palaeozoic age, but both have been changed in very much the same way by percolating solutions containing salts of iron. In some cases limonite and magnetite are the principal ores. Often the changes have taken place very irregularly, along bedding planes, faults and fractures. An ironstone may in many places be traced laterally into a limestone, the amount of iron in the rock gradually diminishing. Some ironstones (Carboniferous, Jurassic, &c.) retain the oolitic structures of the original limestone; others show corals, shells and other calcareous fossils replaced by iron ores. When beds of shale or sandstone are intercalated among the limestones they usually show little change, a fact which indicates that the ready solubility of the calcareous rocks was a dominating factor in determining the metasomatic deposits. It is believed that the Whitehaven iron ores may be derived from the ironstones of the Coal-Measures which once covered the limestone districts.

Dolomitization of limestones is even more common than replacement by iron ores. That it is going on at the present day is evident from the fact that cores obtained by boring in recent coral reefs have shown that these may be extensively dolomitized in their deeper parts, and the older limestones such as the Triassic of the Alps, the Carboniferous Limestone of England and the Cambrian

Limestone of Scotland are sometimes converted into dolomite over wide areas. There has been an introduction of magnesia, with sometimes a little silica and iron; the rock recrystallizes owing to the formation of small rhombohedra of dolomite; it frequently becomes porous and full of drusy cavities, owing to the contraction in volume which takes place, and the fossils and other organic structures of the original rock disappear. The change proceeds outwards from fissures and bedding planes and spreads gradually through the mass of the limestone; often the transformation is complete and no unaltered rock remains. Silicification or the replacement of limestone by chalcedony, chert or quartz, is often exhibited on a large scale. The formation of flint nodules and chert bands is of this nature; the silica is not really an introduction from without, but is merely the material of the fine siliceous skeletons of sponges, radiolaria and other organisms, which at first were widely scattered through the limestone and at a later time were dissolved by percolating waters, percolated through the rock and were deposited in certain situations as bands, nodules and tabular masses of cryptocrystalline silica. In limestones extensive deposits of zinc ore may occur, usually calamine. These are important sources of the metal and there is little room for doubt that they have formed by a process of metasomatic replacement, *e.g.* Carthagena, Raibl (in Carinthia) and Belgium. In many parts of western North America (Nevada, Arizona, &c.) great deposits of copper, lead and silver ores are worked in crystalline limestones. They are often highly silicified, and associated with them are intrusive igneous rocks such as granite, dacite, porphyry and diabase. The ores occur not only in veins and shoots, but also in great masses replacing the limestone, and the geologists who have examined these mining districts are nearly unanimous as to the metasomatic nature of a large part of these deposits. Other rocks such as tuff, volcanic breccia, shale, porphyry and granite may also be impregnated with metalliferous ores, but the largest ore bodies are found in the limestones. Secondary enrichment has often taken place on a considerable scale. The constant presence of igneous rocks indicates that they are connected with the introduction of the metals, and the deposits are often of such a kind as to show that post-volcanic discharges of magmatic gases and water have been the actual mineralizing agents. Bisbee, Clifton and the Globe district in Arizona, Flagstaff in Utah, and the Eureka district in Nevada are good examples of the deposits in question.

As indicated above, shales, sandstones and igneous rocks may be silicified and mineralized under suitable conditions. Rhyolites and rhyolitic tuffs are often impregnated with silica to such an extent that they become almost massive quartz, and the fluidal, porphyritic, spheroidal and other igneous structures of the original rock may be retained in the siliceous pseudomorph. There are many examples of this in North Wales and the Pentland Hills. In andesites, serpentines and trachytes silicification is frequently found in circumstances indicating that the changes are not due to weathering but are the effect of post-volcanic emanations of heated waters. Silicified shales may accompany mineral deposits, *e.g.* in the Cornish tin mines the killas or grey slate may be converted into quartz and brown tourmaline and contains small quantities of tin stone. In the copper mines of Parys Mountain, Anglesey, formerly of great importance as producers of this metal, there are large areas of silicified slate and silicified porphyry. White mica, kaolin, gilbertite, chlorite and epidote are frequently present in silicified igneous rocks. As a further instance of mineral deposition in metasomatized igneous rocks we may quote the Cripple Creek goldfield in Colorado, where syenites, latites, phonolites, breccias, &c., have been filled with pyrite, dolomite, fluorite, calaverite and other new minerals together with quartz.

Another type of metasomatic alteration is phosphatization. This is most common in limestones, and many of the most important bedded phosphate deposits are of this origin. Trachytes and other igneous rocks are occasionally phosphatized. The source of the phosphate is for the most part the skeletons of animals, vertebrate bones and teeth, shells of certain brachiopods, trilobites and other organisms. Guano, the excreta of birds, is rich in phosphates and these are washed downwards by rain producing metasomatic changes in the underlying rocks. Phosphatized limestones are obtained in great quantities in Christmas Island, Sombrero, Curaçoa and other uninhabited limestone islands. (J. S. F.)

METASTASIO (1698–1782). Pietro Trapassi, the Italian poet who is better known by his assumed name of Metastasio, was born in Rome on the 13th of January 1698. His father, Felice Trapassi, a native of Assisi, came to Rome and took service in the Corsican regiment of the papal forces. He subsequently married a Bolognese woman, called Francesca Galasti, and established himself in business as a grocer in the Via dei Cappellari. Two sons and two daughters were the fruit of this marriage. The eldest son, Leopoldo, must be mentioned, since he played a part of some importance in the poet's life. Pietro, while quite a child, often held a crowd attentive in the streets while he recited impromptu verses on a given subject. It so happened that, while he was thus engaged one evening in the year 1709, two men of distinction in Roman society stopped to listen to his declamation. These were Gian Vincenzo Gravina, famous for legal and literary erudition, famous no less for his dictatorship of the Arcadian Academy, and Lorenzini, a critic of some note. Gravina was at once attracted by the boy's poetical talent and charm of person, interested himself in the genius he had accidentally discovered, made Pietro his protégé, and in the course of a few weeks adopted him. Felice Trapassi was glad enough to give his son the chance of a good education and introduction into the world under auspices so favourable. Gravina hellenized the boy's name Trapassi into Metastasio; and intended his adopted son to be a jurist like himself. He therefore made the boy learn Latin and begin the study of law. At the same time he cultivated his literary gifts, and displayed the youthful prodigy both at his own house and in the Roman coteries. Metastasio soon found himself competing with the most celebrated improvisatori of his time in Italy. Days spent in severe studies, evenings devoted to the task of improvising eighty stanzas at a single session, were fast ruining Pietro's health and overstraining his poetic faculty. At this juncture Gravina had to journey into Calabria on business. He took Metastasio with him, exhibited him in the literary circles of Naples, and then placed him under the care of his kinsman Gregorio Caroprese at a little place called Scaléa. In country air and the quiet of the southern seashore Metastasio's health revived. It was decreed by Gravina that he should never improvise again, but should be reserved for nobler efforts, when, having completed his education, he might enter into competition with the greatest poets.

Metastasio responded to his patron's wishes. At the age of twelve he translated the *Iliad* into octave stanzas; and two years later he composed a tragedy in the manner of Seneca upon a subject chosen from Trissino's *Italia liberata*—Gravina's favourite epic. It was called *Giustino*. Gravina had it printed in 1713; but the play is lifeless; and forty-two years afterwards we find Metastasio writing to his publisher, Calsabigi, that he would willingly suppress it. Caroprese died in 1714, leaving Gravina his heir; and in 1718 Gravina also died. Metastasio inherited house, plate, furniture and money, which amounted to 15,000 scudi, or about £4000. At a meeting of the Arcadian Academy, he recited an elegy on his patron, and then settled down, not it seems without real sorrow for his loss, to enjoy what was no inconsiderable fortune at that period. Metastasio was now twenty. During the last four years he had worn the costume of abbé, having taken the minor orders without which it was then useless to expect advancement in Rome. His romantic history, personal beauty, charming manners and distinguished talents made him fashionable. That before two years were out he had spent his money and increased his reputation for wit will surprise no one. He now very sensibly determined to quit a mode of life for which he was not born, and to apply himself seriously to the work of his profession. Accordingly he went to Naples, and entered the office of an eminent lawyer named Castagnola. It would appear that he articled himself as clerk, for Castagnola exercised severe control over his time and energies. While slaving at the law, Metastasio in 1721 composed an epithalamium, and probably also his first musical serenade, *Endimione*, on the occasion of the marriage of his patroness the Princess Pinelli di Sangro to the Marchese Belmonte Pignatelli. But the event which fixed his destiny was the following. In 1722 the birthday of the empress had to be celebrated with more than ordinary honours, and the viceroy applied to Metastasio to compose a serenata for the occasion. He accepted this invitation, but it was arranged that his authorship should be kept secret. Under these conditions Metastasio produced *Gli orti esperidi*. Set to music by Porpora, it won the most extraordinary applause. The great Roman prima donna, Marianna Bulgarelli, called La Romanina from her birthplace, who had played the part of Venus in this drama, spared no pains until she had discovered its author. La Romanina forthwith took possession of him, induced him to quit his lawyer's office, and promised to secure for him fame and independence, if he would devote his talents to the musical drama. In La Romanina's house Metastasio became acquainted with the greatest composers of the day—with Porpora, from whom he took lessons in music; with Hasse, Pergolese, Scarlatti, Vinci, Leo, Durante, Marcello, all of whom were destined in the future to set his plays to melody. Here too he studied the art of singing, and learned to appreciate the style of such men as Farinelli. Gifted himself with extraordinary facility in composition, and with a true poetic feeling, he found no difficulty in producing plays which, while beautiful in themselves, judged merely as works of literary art, became masterpieces as soon as their words were set to music, and rendered by the singers of the greatest school of vocal art the world has ever seen. Reading Metastasio in the study, it is impossible to do him justice. But the conventionality of all his plots, the absurdities of many of his situations, the violence he does to history in the persons of some leading characters, his "damnable iteration" of the theme of love in all its phases, are explained and justified by music.

Metastasio resided with La Romanina and her husband in Rome. The generous woman, moved by an affection half maternal half romantic, and by a true artist's admiration for so rare a talent, adopted him more passionately even than Gravina had done. She took the whole Trapassi family—father, mother, brother, sisters—into her own house. She fostered the poet's genius and pampered his caprices. Under her influence he wrote in rapid succession the *Didone abbandonata*, *Catone in Utica*, *Ezio*, *Alessandro nell' Indie*, *Semiramide riconosciuta*, *Siroe* and *Artaserse*. These dramas were set to music by the chief composers of the day, and performed in the chief towns of Italy. But meanwhile La Romanina was growing older; she had ceased to sing in public; and the poet felt himself more and more dependent in an irksome sense upon her kindness. He gained 300 scudi (about £60) for each opera; this pay, though good, was precarious, and he longed for some fixed engagement. In September 1729 he received the offer of the post of court poet to the theatre at Vienna, with a stipend of 3000 florins. This he at once accepted. La Romanina unselfishly sped him on his way to glory. She took the charge of his family in Rome, and he set off for Austria.

In the early summer of 1730 Metastasio settled at Vienna in the house of a Spanish Neapolitan, Niccolò Martinez, where he resided until his death. This date marks a new period in his artistic activity. Between the years 1730 and 1740 his finest dramas, *Adriano*, *Demetrio*, *Issipile*, *Demofoonte*, *Olimpiade*, *Clemenza di Tito*, *Achille in Sciro*, *Temistocle* and *Attilio Regolo*, were produced for the imperial theatre. Some of them had to be composed for special occasions, with almost incredible rapidity—the *Achille* in eighteen days, the *Ipermnestra* in nine. Poet, composer, musical copyist and singer did their work together in frantic haste. Metastasio understood the technique of his peculiar art in its minutest details. The experience gained at Naples and Rome, quickened by the excitement of his new career at Vienna, enabled him almost instinctively, and as it were by inspiration, to hit the exact mark aimed at in the opera.

At Vienna Metastasio met with no marked social success. His plebeian birth excluded him from aristocratic circles. But, to make up in some measure for this comparative failure, he enjoyed the intimacy of a great lady, the Countess Althann, sister-in-law of his old patroness the Princess Belmonte Pignatelli.. She had lost her husband, and had some while occupied the post of chief favourite to the emperor. Metastasio's liaison with her became so close that it was even believed they had been privately married. The even tenor of his existence was broken in the year 1734 by the one dark and tragic incident of his biography. It appears that La Romanina had at last got tired of his absence. Could not Metastasio get her an engagement at the court theatre? The poet at this juncture revealed his own essential feebleness of character. To La Romanina he owed almost everything as a man and as an artist. But he was ashamed of her and tired of her. He vowed she should not come to Vienna, and wrote dissuading her from the projected visit. The tone of his letters alarmed and irritated her. It is probable that she set out from Rome, but died suddenly upon the road. All we know is that she left him her fortune after her husband's life interest in it had expired, and that Metastasio, overwhelmed with grief and remorse, immediately renounced the legacy. This disinterested act plunged the Bulgarelli-Metastasio household at Rome into confusion. La Romanina's widower married again. Leopoldo Trapassi, and his father and sister, were thrown upon their own resources.

As time advanced the life which Metastasio led at Vienna, together with the climate, told upon his health and spirits. From about the year 1745 onward he wrote but little, though the cantatas which belong to this period, and the canzonet *Ecco quel fiero istante*, which he sent to his friend Farinelli, rank among the most popular of his productions. It was clear, as Vernon Lee has phrased it, that "what ailed him was mental and moral ennui." In 1755 the Countess Althann died, and Metastasio was more than ever reduced to the society which gathered round him in the bourgeois house of the Martinez. He sank rapidly into the habits of old age; and, though his life was prolonged till the year 1782, very little can be said about it. On the 12th of April he died, bequeathing his whole fortune of some 130,000 florins to the five children of his friend Martinez. He had survived all his Italian relatives.

During the long period of forty years in which Metastasio overlived his originality and creative powers his fame went on increasing. In his library he counted as many as forty editions of his own works. They had been translated into French, English, German, Spanish, even into modern Greek. They had been set to music over and over again by every composer of distinction, each opera receiving this honour in turn from several of the most illustrious men of Europe. They had been sung by the best virtuosi in every capital, and there was not a literary academy of note which had not conferred on him the honour of membership. Strangers of distinction passing through Vienna made a point of paying their respects to the old poet at his lodgings in the Kohlmarkt Gasse. But his poetry was intended for a certain style of music—for the music of omnipotent vocalists, of thaumaturgical soprani. With the changes effected in the musical drama by Gluck and Mozart, with the development of orchestration and the rapid growth of the German manner, a new type of libretto came into request. Metastasio's plays fell into undeserved neglect, together with the music to which he had linked them. Farinelli, whom he styled "twin-brother," was the true exponent of his poetry; and, with the abolition of the class of singers to which Farinelli belonged, Metastasio's music suffered eclipse. It was indeed a just symbolic instinct which made the poet dub this unique soprano his twin-brother.

The musical drama for which Metastasio composed, and in working for which his genius found its proper sphere, has so wholly passed away that it is now difficult to assign his true place to the poet in Italian literary history. His inspiration was essentially emotional and lyrical. The chief dramatic situations are expressed by lyrics for two or three voices, embodying the several contending passions of the agents brought into conflict by the circumstances of the plot. The total result is not pure literature, but literature supremely fit for musical effect. Language in Metastasio's hands is exquisitely pure and limpid. Of the Italian poets, he professed a special admiration for Tasso and for Marini. But he avoided the conceits of the latter, and was no master over the refined richness of the former's diction. His own style reveals the improvisatore's facility. Of the Latin poets he studied Ovid with the greatest pleasure, and from this predilection some of his own literary qualities may be derived. For sweetness of versification, for limpidity of diction, for delicacy of sentiment, for romantic situations exquisitely rendered in the simplest style, and for a certain delicate beauty of imagery sometimes soaring to ideal sublimity, he deserves to be appreciated so long as the Italian language lasts.

There are numerous editions of Metastasio's works. That by Calsabigi (Paris, 1755, 9 vols. 8vo) published under his own superintendence, was the poet's favourite. Another of Turin (1757) and a third of Paris (1780) deserve mention. The posthumous works were printed at Vienna, 1795. The collected editions of Genoa (1802) and Padua (1811) will probably be found most useful by the general student. An edition of the letters, by Cardacci, was published at Bologne in 1883. Metastasio's life was written by Aluigi (Assisi, 1783); by Charles Burney (London, 1796); and by others; but by far the most vivid sketch of his biography will be found in Vernon Lee's *Studies of the 18th Century in Italy* (London, 1880) a work which throws a flood of light upon the development of Italian dramatic music, and upon the place occupied by Metastasio in the artistic movement of the last century. (J. A. S.)

METAURUS (mod. *Metauro*; the form Mataurus is later, and is more frequent in inscriptions of the imperial period), a river of Italy, which flows into the sea a little south-east of Fanum Fortunae (mod. *Fano*). On its banks Hasdrubal, while marching to the aid of Hannibal in 207 B.C., was defeated and slain by the Roman army, this being the decisive battle of the Second Punic War. The exact site of the battle is uncertain; tradition places it between Fossombrone and the Furlo Pass, but it is probable that it occurred nearer the sea-coast.

METAXAS, ANDREAS (1786–1860), Greek politician, was born in the island of Cephalonia. During the latter part of the War of Independence (1824–1827) he accompanied Capo d'Istria to Greece, and was appointed by him minister of war. When Capo d'Istria was murdered in 1831 Metaxas became a member of the provisional government which held office till the accession of King Otho in 1833. During the minority of Otho he was named privy councillor and minister at Madrid and Lisbon. In 1840 he was recalled and appointed minister of war. In 1843–1844 he was president of the council of ministers, and he subsequently held the post of ambassador at Constantinople from 1850 to 1854. He died at Athens on the 19th of September 1860.

MÉTAYAGE SYSTEM, the cultivation of land for a proprietor by one who receives a proportion of the produce. The system has never existed in England and has no English name, but in certain provinces of Italy and France it was once almost universal, and is still very common. It is also not unusual in Portugal, in Greece, and in the countries bordering on the Danube. In Italy and France, respectively, it is called *mezzeria* and *métayage*, or halving—the halving, that is, of the produce of the soil between landowner and landholder. These expressions are not, however, to be understood in a more precise sense than that in which we sometimes talk of a larger and a smaller half. They merely signify that the produce is divisible in certain definite proportions, which must obviously vary with the varying fertility of the soil and other circumstances, and which do in practice vary so much that the landlord's share is sometimes as much as two-thirds, sometimes as little as one-third. Sometimes the landlord supplies all the stock, sometimes only part—the cattle and seed perhaps, while the farmer provides the implements; or perhaps only half the seed and half the cattle, the farmer finding the other halves—taxes too being paid wholly by one or the other, or jointly by both.

English writers were unanimous, until J. S. Mill adopted a different tone, in condemning the métayer system. They judged it by its appearance in France, where it has never worn a very attractive aspect. Under the *ancien régime* not only were all direct taxes paid by the métayer, the noble landowner being exempt, but these taxes, being assessed according to the visible produce of the soil, operated as penalties upon all endeavours to augment its productiveness. No wonder, then, if the métayer fancied that his interest lay less in exerting himself to augment the total to be divided between himself and his landlord, than in studying how to defraud the latter part of his rightful share; nor if he has not yet got rid of habits so acquired, especially when it is considered that he still is destitute of the fixity of tenure without which métayage cannot prosper. French métayers, in Arthur Young's time, were "removable at pleasure, and obliged to conform in all things to the will of their landlords," and so in general they are still. Yet even in France, although métayage and extreme rural poverty usually coincide, there are provinces where the contrary is the fact, as it is also in Italy. Indeed, to every tourist who has passed through the plains of Lombardy with his eyes open, the knowledge that métayage has for ages been there the prevailing form of tenure ought to suffice for the triumphant vindication of métayage in the abstract. An explanation of the contrasts presented by métayage in different regions is not far to seek. Métayage, in order to be in any measure worthy of commendation, must be a genuine partnership, one in which there is no sleeping partner, but in the affairs of which the landlord, as well as the tenant, takes an active part. Wherever this applies, the results of métayage appear to be as eminently satisfactory, as they are decidedly the reverse wherever the landlord holds himself aloof.

In France there is also a system termed *métayage par groupes*, which consists in letting a considerable farm, not to one métayer, but to an association of several, who work together for the general good, under the supervision either of the landlord himself, or of his bailiff. This arrangement gets over the difficulty of finding tenants possessed of capital enough for any but very small farms.

See further the section *Agriculture* in the articles FRANCE, GREECE, ITALY, &c.; and consult J. Cruveilhier, *Étude sur le métayage* (Paris, 1894).

METCALF, WILLARD LEROY (1858–), American artist, was born at Lowell, Massachusetts, on the 1st of July 1858. He was a pupil of the Boston Normal Art School, of the Boston Art Museum School, and of the Académie Julien, Paris. After early figure-painting and illustration, he became prominent as a landscape painter. He was one of the "Ten American Painters" who in 1897 seceded from the Society of American Artists. For some years he was an instructor in the Woman's Art School, Cooper Union, New York, and in the Art Students' League, New York. In 1893 he became a member of the American Water Colour Society, New York.

METCALFE, CHARLES THEOPHILUS METCALFE, BARON (1785–1846), Indian and colonial administrator, was born at Calcutta on the 30th of January 1785; he was the second son of Thomas Theophilus Metcalfe, then a major in the Bengal army, who afterwards became a director of the East India Company, and was created a baronet in 1802. Having been educated at Eton, he in 1800 sailed for India as a writer in the service of the Company. After studying Oriental languages as the first student at Lord Wellesley's College of Fort William, he, at the age of nineteen, was appointed political assistant to General Lake, who was then conducting the final campaign of the Mahratta war against Holkar. In 1808 he was selected by Lord Minto for the responsible post of envoy to the court of Ranjit Singh at Lahore; here, on the 25th of April 1809, he concluded the important treaty securing the independence of the Sikh states between the Sutlej and the Jumna. Four years afterwards he was made resident at Delhi, and in 1819 he received from Lord Hastings the appointment of secretary in the secret and political department. From 1820 to 1825 Sir Charles (who succeeded his brother in the baronetcy in 1822) was resident at the court of the nizam, and afterwards was summoned in an emergency to his former post at Delhi. In 1827 he obtained a seat in the supreme council, and in March 1835, after he had acted as the first governor of the proposed new presidency of Agra, he provisionally succeeded Lord William Bentinck in the governor-generalship. During his brief tenure of office (it lasted only for one year) he carried out several important measures, including that for the liberation of the press, which, while almost universally popular, complicated his relations with the directors at home to such an extent that he resigned the service of the Company in 1838. In the following year he was appointed by the Melbourne administration to the governorship of Jamaica, where the difficulties created by the recent passing of the Negro Emancipation Act had called for a high degree of tact and ability. Sir Charles Metcalfe's success in this delicate position was very marked, but unfortunately his health compelled his resignation and return to England in 1842. Six months afterwards he was appointed by the Peel ministry to the governor-generalship of Canada, and his success in carrying out the policy of the home government was rewarded with a peerage shortly after his return in 1845. He died at Malshanger, near Basingstoke, on the 5th of September 1846.

See J. W. Kaye's *Life and Correspondence of Charles Lord Metcalfe* (London, 1854).

METELLUS, the name of a distinguished family of the Caecilian (plebeian) gens in ancient Rome. The following are the most important:—

1. Lucius Caecilius Metellus, general during the first Punic War. Consul in 251 B.C., he was sent to Sicily, and gained a decisive victory over Hasdrubal, who, trusting to his numerically superior forces and the alarm inspired by his elephants, ventured to attack him. Metellus's victory was in great measure due to a panic caused amongst the elephants by his clever manœuvring. A number of these animals were sent in specially constructed rafts to adorn his triumph, and from this time the elephant frequently occurs as a device on the coins of the Metelli. In 241, when the temple of Vesta was destroyed by fire, Metellus succeeded in bringing out the Palladium uninjured, but lost his eyesight. As a reward, he was granted permission to ride to the senate-house in a carriage, a privilege hitherto unheard of. But the story of his blindness is doubtful, since it is hardly consistent with his appointment as dictator in 224 "for the purpose of holding the comitia," nor is any mention made of it in the extract [Pliny, *Nat. Hist.* vii. 43 (45)] from the funeral oration pronounced over him by his son.

2. Quintus Caecilius Metellus, son of (1), became consul in 206 as a reward for his services at the Metaurus. In 205 he was dictator for holding the comitia; in 201 one of the commissioners for dividing the public land in Samnium and Apulia amongst the Roman veterans; in 186 he conducted an embassy to Macedonia, afterwards proceeding to Peloponnesus to investigate the quarrel between Sparta and the Achaeans. He is the Metellus who caused the poet Naevius (*q.v.*) to be imprisoned and exiled for having attacked him on the stage.

3. Lucius Caecilius Metellus, possibly son of (1), when the disastrous news of the battle of Cannae (216) reached Rome, proposed to a number of young nobles that they should leave Italy and offer their services to some foreign ruler, but they were prevented by the threats of the younger Scipio from carrying out their purpose. For this offence, when quaestor two years later, he was degraded by the censors from his tribe to the class of *aerarii*. Nevertheless, he was elected one of the tribunes for the following year, but his attempt to call the censors to account for their action proved unsuccessful in the face of the opposition of his colleague.

4. Quintus Caecilius Metellus Macedonicus (d. 115 B.C.), praetor 148 B.C., defeated the usurper Andriscus (*q.v.*) in Macedonia and forced him to surrender. Under his superintendence the country was made a Roman province. In 146, he attacked the Achaeans to avenge an insult offered to a Roman embassy at Corinth. He gained decided successes over them at Scarpheia and Chaeroneia, but was superseded by L. Mummius. On his return to Italy he received the honour of a triumph and the title of *Macedonicus*. Consul in 143, he reduced the Celtiberians in northern Spain to obedience. In 131, when censor with Q. Pompeius (they were the first two plebeian censors), he proposed that all citizens should be compelled to marry. He expelled a number of senators, one of whom, the tribune C. Atinius Labeo, proposed that he should be hurled from the Tarpeian rock; his life was only saved through the intervention of another tribune. He was an opponent of the Gracchi, although not averse from moderate reform. He was a strict disciplinarian, a good general, and a type of the ancient Roman both in public and private life. He erected a splendid colonnade in the Campus Martius, and two temples dedicated to Jupiter Stator and Juno.

5. Quintus Caecilius Metellus Numidicus, consul 109, and commander in the Jugurthine War. He defeated Jugurtha (*q.v.*) by the river Muthul, and after a difficult march through the desert took his stronghold, Thala. Marius, however, who had been intriguing for the command, accused Metellus of protracting the war, and received the consulship for 107 with the province of Numidia. Metellus received a splendid triumph and the title of *Numidicus*. Saturninus, whom as a censor he tried to remove from the senate, passed in 100 an agrarian law, inserting a provision that all senators should swear to it within five days. All complied but Metellus, who retired to Asia. After Saturninus was killed he returned, and died (probably in 91). He was a man of the highest integrity, a strict and efficient general, and one of the chief leaders of the aristocratic party. He was a man of education and learning, and Cicero speaks highly of him as an orator.

6. Quintus Caecilius Metellus Pius, so called from his efforts to bring about the recall of his father Numidicus from exile. He was one of the commanders in the Social War, and defeated Q. Pompaedius Silo, the Marsian leader (88). Sulla, on his departure for Asia, gave him proconsular command over south Italy. When Marius returned to Italy and joined Cinna, the soldiers, who had no confidence in the consul Gnaeus Octavius, wished Metellus to take command, but he refused. The soldiers deserted in large numbers, and considering it impossible to defend Rome, Metellus retired to Africa and afterwards to Liguria, resuming his former proconsular command on Sulla's return. In the war against Marius he gained several important successes, and after his victory over C. Norbanus at Faventia (82) he subdued the whole of upper Italy. Consul in 80 with Sulla, he went to Spain next year against Sertorius, who pressed him hard till the arrival of Pompey in 76. Next year Metellus defeated Sertorius's lieutenant Hirtuleius at Italica and Segovia, and joining Pompey rescued him from the consequences of a check at Sucro. From this time Sertorius grew weaker till his murder in 72. In 71 Metellus returned to Rome and triumphed. He became pontifex maximus, and died probably at the end of 64. He was an upright man, of moderate ability.

7. Quintus Caecilius Metellus Celer, legate of Pompey in Asia 65 B.C., praetor 63. He was despatched to cut off the retreat of Catiline to the north by blocking the passes, and in 62 went into the province of Cisalpine Gaul with the title of proconsul, although he did not become consul till 60. A strong supporter of the optimates and an enemy of Pompey, he strenuously opposed the agrarian law brought forward by the tribune Lucius Flavius, to provide for Pompey's veterans, and stood firm even though imprisoned; the law had to be given up. He also tried, though fruitlessly, to obstruct Caesar's agrarian law in 59. He died suddenly in the same year—it was usually supposed from poison administered by his wife Clodia.

8. Quintus Caecilius Metellus Nepos, son of a Metellus of the same name, so called because he was the grandson of (4). He was legate to Pompey in the war against the Mediterranean pirates (67), and took part in the Syrian campaign. In 63 he returned to Rome, to assist Pompey in carrying out his plans. He violently attacked Cicero, and refused to allow him to deliver the customary speech on laying down office as consul; he even threatened to impeach him for having executed Roman citizens (referring to the Catilinarian conspirators) without a trial. In 62 his proposal that Pompey should be summoned to Italy to restore order was bitterly opposed by Cato, and on the day set down for the bill a fight took place in the forum. Metellus fled to Pompey, but soon returned with him to Rome. In 60, when praetor, he proposed a law for the abolition of the *vectigalia* in Italy. In 57 he was consul, but offered no opposition to the return of Cicero from exile. In 56 he was governor of Hither Spain, where he was engaged in hostilities against the Vaccaei with indifferent success. He appears to have died in Rome in the following year. He was a mere creature of Pompey.

9. Quintus Caecilius Metellus Pius Scipio, son of P. Scipio Nasica, was adopted by (6). He was accused of bribery in 60 B.C., and defended by Cicero, to whom he had rendered valuable assistance during the Catilinarian conspiracy. In August 52, he became consul through the influence of Pompey, who had married his daughter Cornelia. In 49 he proposed that Caesar should disband his army within a definite time, under pain of being declared an enemy of the state. After the outbreak of the civil war, the province of Syria was assigned to

him, and he was about to plunder the temple of Artemis at Ephesus when he was recalled by Pompey. He commanded the centre at Pharsalus, and afterwards went to Africa, where by Cato's influence he received the command. In 46 he was defeated at Thapsus; while endeavouring to escape to Spain he fell into the hands of P. Sittius, and put himself to death. His connexion with two great families gave him importance, but he was selfish and licentious, wanting in personal courage, and his violence drove many from his party.

10. Quintus Caecilius Metellus, surnamed *Creticus*, Roman general. Consul in 69 B.C., he was appointed to the command of the war against Crete, the headquarters of the pirates of the Mediterranean. Its subjugation proceeded slowly but surely until 67, when Pompey claimed the control of affairs in virtue of the powers conferred upon him by the Gabinian law. Thereupon the Cretans, who had been treated with great harshness by Metellus, offered to surrender to Pompey, who enjoyed a reputation for leniency towards the conquered. Pompey accepted the offer and sent instructions to Metellus to suspend operations. Metellus refused and completed the conquest of the island, which was annexed to Cyrene and became a Roman province. On Metellus's return to Rome the partisans of Pompey succeeded in keeping him out of a triumph until after the Catilinarian conspiracy, when he made his entry into the city and received the name *Creticus* in honour of his achievements. Metellus naturally joined the senatorial party in their opposition to Pompey, and had the satisfaction of preventing the ratification of what he had done in Asia. He was one of a commission of three sent (60) to investigate the state of affairs in Gaul, where disturbances were apprehended. He appears to have been alive in 54, but nothing further is known of him.

On the family of the Metelli generally, see M. Wende, *De Caeciliis Metellis*, i. (Bonn, 1875), for its history up to the time of the Gracchi the new edition by P. Gröbe of Drumann's *Geschichte Roms*, ii.; and the article *s.v.* "Caecilius" by F. Münzer in Pauly-Wissowa's *Realencyclopädie der classischen Altertumswissenschaft*, iii. pt. 1 (1897).

METEMPSYCHOSIS (Gr. μετεμψύχωσις), or Transmigration of the Soul, the doctrine that at death the soul passes into another living creature, man, animal, or even plant. This doctrine, famous in antiquity and still held as a religious tenet by certain sects of the civilized world, has its roots far back in primitive culture. It is developed out of three universal savage beliefs: (1) that man has a soul, connected in some vague way with the breath, which can be separated from his material body, temporarily in sleep, permanently at death; (2) that animals and even plants have souls, and are possessed to a large extent of human powers and passions; (3) that souls can be transferred from one organism to another. Innumerable examples might be mentioned of the notion that a new-born child is the reincarnation of someone departed, as in Tibet the soul of the Dalai-Lama is supposed to pass into an infant born nine months after his decease. Transmigration of human souls into non-human bodies is implied in totemism (*q.v.*), for, as Professor Frazer says, "it is an article of faith that as the clan sprang from the totem, so each clansman at death reassumes the totem form." All these savage notions are to be regarded as presuppositions of metempsychosis, rather than identified with that doctrine itself as a reasoned theory.

Till full investigation of Egyptian records put us in possession of the facts, it was supposed that the Egyptians believed in metempsychosis, and Herodotus (ii. 123) explicitly credits them with it. We now know that he was wrong. All that they believed was that certain privileged souls might in the other world be able to assume certain forms at pleasure, those of a sparrow-hawk, lily, &c. Herodotus misunderstood the Egyptians to hold beliefs identical with those which were current in his day in Greece. In India, on the contrary, the doctrine was thoroughly established from ancient times; not from the most ancient, as it is not in the Vedas; but onwards from the Upanishads. In them it is used for moral retribution: he who kills a Brahman is, after a long progress through dreadful hells, to be reborn as a dog, pig, ass, camel, &c. This we always find in metempsychosis as a reasoned theory. It is formed by combination of two sets of ideas which belong to different planes of culture: the ideas of judgment and punishment after death elaborated in a relatively cultured society by a priestly class are combined with ideas, like that of totem-transmigration, proper to a savage society. In India we may explain the whole phenomenon as an infusion of the lower beliefs of the non-Aryan conquered races into the higher religious system of their Aryan conquerors. In later Hinduism metempsychosis reached a monstrous development; according to Monier-Williams it was believed that there were 8,400,000 forms of existence through which all souls were liable to pass before returning to their source in the Deity. Buddhism appeared as a reaction against all this, and sought by a subtle modification to harmonize the theory with its own pessimistic view of the world. According to Buddhism there is no soul, and consequently no metempsychosis in the strict sense. Something, however, is transmitted, *i.e. Karma* (character), which passes from individual to individual, till in the perfectly righteous man the will to live is extinguished and that particular chain of lives is brought to an end.

We do not know exactly how the doctrine of metempsychosis arose in Greece; it cannot, as was once supposed, have been borrowed from Egypt and is not likely to have come from India. It is easiest to assume that savage ideas which had never been extinguished were utilized for religious and philosophic purposes. The Orphic religion, which held it, first appeared in Thrace upon the semi-barbarous north-eastern frontier. Orpheus, its legendary founder, is said to have taught that "soul and body are united by a compact unequally binding on either; the soul is divine, immortal and aspires to freedom, while the body holds it in fetters as a prisoner. Death dissolves this compact, but only to re-imprison the liberated soul after a short time: for the wheel of birth revolves inexorably. Thus the soul continues its journey, alternating between a separate unrestrained existence and fresh reincarnation, round the wide circle of necessity, as the companion of many bodies of men and animals. To these unfortunate prisoners Orpheus proclaims the message of liberation, that they stand in need of the grace of redeeming gods and of Dionysus in particular, and calls them to turn to God by ascetic piety of life and self-purification: the purer their lives the higher will be their next reincarnation, until the soul has completed the spiral ascent of destiny to live for ever as God from whom it comes." Such was the teaching of Orphism which appeared in Greece about the 6th century B.C., organized itself into private and public mysteries at Eleusis and elsewhere, and produced a copious literature.

The earliest Greek thinker with whom metempsychosis is connected is Pherecydes; but Pythagoras, who is said to have been his pupil, is its first famous philosophic exponent. Pythagoras probably neither invented the doctrine nor imported it from Egypt, but made his reputation by bringing Orphic doctrine from North-Eastern Hellas to Magna Graecia and by instituting societies for its diffusion.

The real weight and importance of metempsychosis is due to its adoption by Plato. Had he not embodied it in some of his greatest works it would be merely a matter of curious investigation for the anthropologist and student of folk-lore. In the eschatological myth which closes the *Republic* he tells the story how Er, the son of Armenius, miraculously returned to life on the twelfth day after death and recounted the secrets of the other world. After death, he said, he went with others to the place of Judgment and saw the souls returning from heaven and from purgatory, and proceeded with them to a place where they chose new lives, human and animal. "He saw the soul of Orpheus changing into a swan, Thamyras becoming a nightingale, musical birds choosing to be men, the soul of Atalanta choosing the honours of an athlete. Men were seen passing into animals and wild and tame animals changing into each other." After their choice the souls drank of Lethe and then shot away like stars to their birth. There are myths and theories to the same effect in other dialogues, the *Phaedrus*, *Meno*, *Phaedo*, *Timaeus* and *Laws*. In Plato's view the number of souls was fixed;

birth therefore is never the creation of a soul, but only a transmigration from one body to another. Plato's acceptance of the doctrine is characteristic of his sympathy with popular beliefs and desire to incorporate them in a purified form into his system. Aristotle, a far less emotional and sympathetic mind, has a doctrine of immortality totally inconsistent with it. In later Greek literature the doctrine appears from time to time; it is mentioned in a fragment of Menander (the *Inspired Woman*) and satirized by Lucian (Gallus § 18 seq.). In Roman literature it is found as early as Ennius, who in his Calabrian home must have been familiar with the Greek teachings which had descended to his times from the cities of Magna Graecia. In a lost passage of his *Annals*, a Roman history in verse, Ennius told how he had seen Homer in a dream, who had assured him that the same soul which had animated both the poets had once belonged to a peacock. Persius in one of his satires (vi. 9) laughs at Ennius for this: it is referred to also by Lucretius (i. 124) and by Horace (*Epist. II*. i. 52). Virgil works the idea into his account of the Underworld in the sixth book of the *Aeneid* (vv. 724 sqq.). It persists in antiquity down to the latest classic thinkers, Plotinus and the other Neoplatonists.

Attempts have been made with little success to find metempsychosis in early Jewish literature. But there are traces of it in Philo, and it is definitely adopted in the Kabbala. Within the Christian Church it was held during the first centuries by isolated Gnostic sects, and by the Manichaeans in the 4th and 5th centuries, but was invariably repudiated by orthodox theologians. In the middle ages these traditions were continued by the numerous sects known collectively as Cathari. At the Renaissance we find the doctrine in Giordano Bruno, and in the 17th century in the theosophist van Helmont. A modified form of it was adopted by Swedenborg. During the classical period of German literature metempsychosis attracted much attention: Goethe played with the idea, and it was taken up more seriously by Lessing, who borrowed it from Charles Bonnet, and by Herder. It has been mentioned with respect by Hume and by Schopenhauer. Modern theosophy, which draws its inspiration from India, has taken metempsychosis as a cardinal tenet; it is, says a recent theosophical writer, "the master-key to modern problems," and among them to the problem of heredity.

Outside the somewhat narrow circle of theosophists there is little disposition to accept the doctrine: but it may be worth while to point out that there are two fatal objections to it. The first is that personal identity depends on memory, and we do not remember our previous incarnations. The second is that the soul, whatever it may be, is influenced throughout all its qualities by the qualities of the body: modern psychology discredits the idea that the soul is a metaphysical essence which can pass indifferently from one body to another. If (to suppose the impossible) the soul of a dog were to pass into a man's body it would be so changed as to be no longer the same soul; and so, in a less degree, of change from one human body to another.

See A. Bertholet, *The Transmigration of Souls* (trans. from the German by H. J. Chaytor); E. Rohde, *Psyche*. (H. St.)

METEOR (Gr. μετέωρα, literally "things in the air," from μετά, beyond, and ἀείρειν, to lift up), a term originally applied by the ancient Greeks to many atmospheric phenomena—rainbows, halos, shooting stars, &c.—but now specially restricted to those luminous bodies known as shooting stars, falling stars, fireballs and bolides. Though these objects only become visible in the atmosphere they are extra-terrestrial planetary bodies, and properly belong to the domain of astronomy. The extra-terrestrial bodies which happen to find a resting-place on the earth are studied under the name of *meteorites* (*q.v.*).

In ancient times meteors were supposed to be generated in the air by inflammable gases. Isolated fireballs and star showers had been occasionally observed, but instead of being attentively watched they had been neglected, for their apparitions had filled mankind with dread, and superstition attributed to them certain malevolent influences. It was the brilliant exhibition in November 1833 that, in modern times particularly, attracted earnest students to investigate the subject of meteors generally, and to make systematic observations of their apparitions on ordinary nights of the year. Historical records were searched for references to past meteoric displays, and these were tabulated and compared. The attention devoted to the matter soon elucidated the phenomena of meteors, and proved them to be small planetary bodies, practically infinite in numbers and illimitable in the extent and variety of their orbits.

The various kinds of meteors are probably but different manifestations of similar objects. Perhaps the most important meteors are those which, after their bright careers and loud detonations, descend upon the earth's surface and can be submitted to close inspection and analysis (see METEORITES). The fireball or *bolide* (Gr. βολίς, a missile) comes next in order from its size and conspicuous effects. It may either be interspersed with many smaller meteors in a shower or may be isolated. The latter usually move more slowly and approach rather near to the earth. The ordinary shooting stars vary from the brilliancy of a first- to a sixth-magnitude star. They exhibit a great dissimilarity in paths, motions and colours. The smallest and most numerous class are the telescopic meteors invisible to the naked eye. They range from the 7th magnitude to the smallest object perceptible in large telescopes.

The altitudes at which these bodies are visibly presented to us differ in individual cases. More than a thousand observations in duplicate have been made of the paths of identical meteors seen from two stations many miles apart. These pairs of observations have shown a parallax from which the elevation of the objects above the earth, the lengths and directions of their courses, &c. could be computed. The average heights are from 80 to 40 m. A few, however, first appear when higher than 80 m. and some, usually slow-moving meteors, descend below 40 m. But altitudes beyond 100 and within 20 m. are rare:—

	Average Heights.		Length of Path.	Velocity per sec.
	Beginning.	Ending.		
Swift fireballs .	85 m.	50 m.	55 m.	38 m.
Slow fireballs . .	66 ,,	25 ,,	116 ,,	15 ,,
Slow fireballs (radiants near horizon) . . .	59 ,,	48 ,,	121 ,,	13 ,,
Swift shooting stars	81 ,,	56 ,,	42 ,,	41 ,,
Slow shooting stars	63 ,,	49 ,,	36 ,,	17 ,,

30 of the November Leonids give a mean height of 84½ to 57½ m.
40 of the August Perseids ,, ,, ,, 80 to 54 m.

When the length of a meteor's course is known and the duration of its flight has been correctly estimated it is easy to compute the velocity in miles. The visible life of an ordinary shooting star is, however, comprised within one second, and it is only rarely that such short time intervals can be accurately taken. The real velocities derived from good observations are rarely, if ever, under 7 or 8 m. per second, or over 60 or 70 m. per second. In a few exceptional cases abnormal speed has been indicated on good evidence. The slower class of meteors overtaking the earth (like the Andromedids of November) have a velocity of about 8 or 10 m. per second, while the swifter class (meeting the earth like the Leonids of November) have a velocity of about 44 m. per second.

When the members of a shower are observed with special regard to their directions it is seen that they diverge from a common focus. The apparent scattering or diversity of the flights is merely an effect of perspective upon objects really traversing parallel lines. The centre upon which the observed paths converge is called the *radiant point* or, shortly, the *radiant*. On every night of the year there are a great number of these radiants in action, but the large majority represent very attenuated showers. In 1876 the number of radiants known was 850, but about 5000 have been determined up to the present time. These are not all the centres of separate systems, however: many of the positions being multiple observations of the same showers. Thus the August Perseids, the returns of which have been witnessed more frequently than those of any other meteoric stream have had their radiant point fixed on more than 250 occasions.

There appear to be moving and stationary radiants, contracted and diffused radiants, and long-enduring and brief radiants. The Perseids are visible from about the 11th of July to the 20th of August, the radiant having a daily motion of about 1° R.A. to E.N.E. The Lyrids also vary in the position of their radiant, but the Orionids form a stationary position from about the 9th to the 24th of October. A large proportion of the ordinary feeble showers also appear to be stationary.

Solid bodies (chiefly stone or stone and iron) enter the atmosphere from without at all conceivable angles and at a velocity of about 26 m. per second, while the earth's orbital velocity is about $18\frac{1}{4}$ m. per second. In thus rapidly penetrating the air heat is generated, the meteor becomes incandescent, and the phenomena of the streak or train is produced. Before the object can pierce the dense lower strata of air its material is usually exhausted, but on rare occasions it withstands the fiery ordeal, and fragments of the original mass fall upon the earth.

Multitudes of meteors infest space. On a clear moonless night one person may count eight or ten shooting stars in an hour. But there are more than twice as many visible in the early morning hours as in the evenings, and during the last half of the year there are also more than twice as many visible as during the first half. It is computed that twenty millions of meteors enter the atmosphere every day and would be visible to unassisted vision in the absence of sunlight, moonlight and clouds, while if telescopic meteors are included the number will be increased twentyfold. Ordinary meteors, in the region of the earth's orbit, appear to be separated by intervals of about 250 m. In special showers, however, they are much closer. In the rich display of the 12th of November 1833, the average distance of the particles was computed as about 15 m., in that of the 27th of November 1885 as about 20 m., and in that of the 27th of November 1872 as about 35 m.

The meteors, whatever their dimensions, must have motions around the sun in obedience to the law of gravitation in the same manner as planets and comets—that is, in conic sections of which the sun is always at one focus. The great variety in the apparent motions of meteors proves that they are not directed from the plane of the ecliptic; hence their orbits are not like the orbits of planets and short-period comets, which are little inclined, but like the orbits of parabolic comets, which often have great inclinations.

Historical records supply the following dates of abundant meteoric displays:—

902, Oct. 13.	1101, Oct. 17.	1602, Oct. 28.	1833, Nov. 13.
931, Oct. 14.	1202, Oct. 19.	1698, Nov. 9.	1866, Nov. 14.
934, Oct. 14.	1366, Oct. 23.	1799, Nov. 12.	1867, Nov. 14.
1002, Oct. 15.	1533, Oct. 25.	1832, Nov. 13.	1868, Nov. 14.

These showers occurred at intervals of about one-third of a century, while the day moved along the calendar at the rate of one month in a thousand years. The change of style is, however, responsible for a part of the alteration in date. The explanation of these recurring phenomena is that a great cloud or distended stream of meteors revolves around the sun in a period of $33\frac{1}{3}$ years, and that one portion of the elliptical orbit intersects that of the earth. As the meteors have been numerously visible in five or six successive years it follows they must be pretty densely distributed along a considerable arc of their orbit. It also follows that, as some of the meteors are seen annually, they must be scattered around the whole orbit. Travelling at the rate of 26 m. per second, they encounter the earth moving $18\frac{1}{4}$ m. per second in an opposite direction, so that the apparent velocity of the meteors is about 44 m. per second. They radiate from a point within the Sickle of Leo and are termed Leonids. In 1867 the remarkable discovery was made that Tempel's comet (1866 : I.) revolved in an orbit identical with that of the Leonids. That the comet and meteors have a close physical association seems certain. The disintegrated and widely dispersed material of the comet forms the meteors which embellish our skies on mid-November nights.

Fine meteoric showers occurred in 1798 (Dec. 7), 1838 (Dec. 7), 1872 (Nov. 27), 1885 (Nov. 27), 1892 (Nov. 23) and 1899 (Nov. 23 and 24), and the dates indicate an average period of 6·7 years for fifteen returns. The meteors move very slowly, as they have to overtake the earth, and their apparent velocity is only about 9 m. per second. They are directed from a point in the sky near the star γ Andromedae. Biela's comet of 1826, which had a period of 6·7 years, presented a significant resemblance of orbit with that of the meteors, but the comet has not been seen since 1852 and has probably been resolved into the meteoric stream of Andromedids.

Rich annual displays of meteors have often been remarked on about the 10th of August, directed from Perseus, but they do not appear to have exhibited periodical maxima of great strength. They are probably dispersed pretty evenly along a very extended ellipse agreeing closely in its elements with comet 1862 : III. But the times of revolution are doubtful; the probable period of the comet is 121 years and that of the meteors $105\frac{1}{2}$ years. This shower of Perseids is notable for its long duration in the months of July and August and for its moving radiant.

There was a brilliant exhibition of meteors on the 20th of April 1803, and in other years meteors have been very abundant on about the 19th to the 21st of April, shooting from a radiant a few degrees south-west of α Lyrae. The display is apparently an annual one, though with considerable differences in intensity, and the cycle of its more abundant returns has not yet been determined. A comet which appeared in 1861 had a very suggestive agreement of orbit when compared with that of the meteors, and the period computed for it was 415 years.

Apart from the instances alluded to there seem few coincidences between the orbital elements of comets and meteors. Halley's comet conforms very well, however, with a meteoric shower directed from Aquarius early in May. But there are really few comets which pass sufficiently near the earth to give rise to a meteoric shower. Of 80 comets seen during the 20 years ending 1893, Professor Herschel found that only two, viz. Denning's comet of 1881 and Finlay's of 1886, approached comparatively near to the earth's path, the former within 3,000,000 m. and the latter within 4,600,000 m.

Radiants of Principal Showers.—The following is a list of the chief radiant points visible during the year:—

Date.	Radiant R.A. Dec.	Date.	Radiant R.A. Dec.
Jan. 2–3 .	230°+53°	July–Sept. .	47°+43°
Feb. 10–15 .	75°+41°	Sept. 5–15 .	62°+37°
March 1–4 .	166°+ 4°	Sept. 3–22 .	74°+41°
March 24 .	161°+58°	Oct. 2 . .	230°+52°
April 19–22 .	271°+33°	Oct. 4 . .	310°+79°
April–May .	193°+58°	Oct. 15–24 .	92°+15°
May 1–6 .	338°− 2°	Oct. 20–25 .	100°+13°
May 11–18 .	231°+27°	Oct. 30–Nov. 1	43°+22°
May–July .	252°−21°	Nov. 2 . .	58°+ 9°
June 13 . .	310°+61°	Nov. 14–16 .	151°+22°
July 15–19 .	314°+48°	Nov. 16–28 .	154°+40°
July 28–30 .	339°−11°	Nov. 20–23 .	63°+22°
Aug. 9–13 .	45°+57°	Nov. 17–23 .	25°+43°
Aug. 10–15 .	290°+53°	Dec. 4 . .	162°+58°
Aug. 21–25 .	291°+60°	Dec. 9–12 .	108°+33°

Many meteors exhibit the green line of magnesium as a principal constituent. Professor N. von Konkoly remarked in the fireball of 1873 (July 26) the lines of magnesium and sodium. Other lines in the red and green have been detected and found by comparison with the lines of marsh gas. Bright meteors often emit the bluish-white light suggestive of burning magnesium. In addition to magnesium and sodium the lines of potassium, lithium and also the carbon flutings exhibited in cometary spectra, have been seen.

Meteoric observation has depended upon rough and hurried eye estimates in past years, but the importance of attaining greater accuracy by means of photography has been recognized. At several American observatories, and at Vienna, fairly successful attempts were made in November 1898 to photograph a sufficient number of meteor-trails to derive the Leonid radiant, and the mean position was at R.A. 151° 33′ Dec. + 22° 12′. But the materials obtained were few, the shower having proved inconspicuous. The photographic method appears to have practically failed during recent years, since there has been no brilliant display upon which to test its capacity. Really large meteors can be satisfactorily photographed, but small ones leave no impression on the plates.

Meteors look larger than they are, from the glare and flaming effect due to their momentary combustion. The finer meteors on entering the air only weigh a few hundred or, at most, a few thousand pounds, while the smallest shooting stars visible to the eye may probably be equal in size to coarse grains of sand, and still be large enough to evolve all the light presented by them. (W. F. D.)

METEORA, a group of monasteries in Thessaly, in the northern side of the Peneius valley, not quite 20 m. N.E. of Trikkala, and near the village of Kalabaka (the ancient Aeginium, medieval Stagus or Stagoi). From the Cambunian chain two masses of rock are thrust southward into the plain, surmounted by isolated columns from 85 to 300 ft. high, "some like gigantic tusks, some like sugar-loaves, and some like vast stalagmites," but all consisting of iron-grey or reddish-brown conglomerate of gneiss, mica-slate, syenite and greenstone. The monasteries stand on the summit of these pinnacles; they are accessible only by aid of rope and net worked by a windlass from the top, or by a series of almost perpendicular ladders climbing the cliff. In the case of St Stephen's, the peak on which it is built does nor rise higher than the ground behind, from which it is separated by a deep, narrow chasm, spanned by a drawbridge. Owing to the confined area, the buildings are closely packed together; but each monastery contains beside the monks' cells and water-cisterns, at least one church and a refectory, and some also a library. At one time they were fourteen in number, but now not more than four (the Great Monastery, Holy Trinity, St Barlaam's and St Stephen's) are inhabited by more than two or three monks. The present church of the Great Monastery was erected, according to Leake's reading of the local inscription, in 1388 (Björnståhl, the Swedish traveller, had given 1371), and it is one of the largest and handsomest in Greece. A number of the manuscripts from these monasteries have now been brought to the National Library at Athens. Aeginium is described by Livy as a strong place, and is frequently mentioned during the Roman wars; and Stagus appears from time to time in Byzantine writers.

See W. M. Leake, *Northern Greece* (4 vols., London, 1835); Professor Kriegk in *Zeitschr. f. allg. Erdk.* (Berlin, 1858); H. F. Tozer, *Researches in the Highlands of Turkey* (1869); L. Heuzey and H. Daumet, *Mission archéologique de Macédoine* (Paris, 1876), where there is a map of the monasteries and their surroundings; *Guide-Joanne*; *Grèce*, vol. ii. (Paris, 1891).

METEORITE, a mass of mineral matter which has reached the earth's surface from outer space. Observation teaches that the fall of a meteorite is often preceded by the flight of a fireball (see METEOR) through the sky, and by one or more loud detonations. It was inferred by Chladni (1794) that the fireball and the detonations result from the quick passage of the meteorite through the earth's atmosphere.

The fall of stones from the sky, though not credited by scientific men till the end of the 18th century, had been again and again placed on record. One of the most famous of meteorites fell in Phrygia and was worshipped there for many generations under the name of Cybele, the mother of the gods. After an oracle had declared that possession of the stone would secure to the Romans a continual increase of prosperity, it was demanded by them from King Attalus about the year 204 B.C., and taken with great ceremony to Rome. It is described by the historian as "a black stone, in the figure of a cone, circular below and ending in an apex above." Plutarch relates the fall of a stone in Thrace about 470 B.C., during the time of Pindar, and according to Pliny the stone was still preserved in his day, 500 years afterwards. Both Diana of the Ephesians "which fell down from Jupiter," and the image of Venus at Cyprus, appear to have been conical or pyramidal stones. One of the holiest relics of the Moslems is preserved at Mecca, built into a corner of the Kaaba; its history goes back far beyond the 7th century; the description of it given to Dr Partsch suggests that the stone had fallen from the sky. The oldest existing meteorite of which the fall is known to have been observed is that which fell at Ensisheim in Elsass on the 10th of November 1492. It was seen to strike the ground and was immediately dug out; it had penetrated to a depth of 5 ft. and was found to weigh 260 lb. It was long suspended by a chain from the roof of the parish church, and is now kept in the Rathhaus of the town.

It was not till scientific men gave credence to the reports of the fall of heavy bodies from the sky that steps were taken for the formation of meteorite collections. The British Museum (Natural History) at South Kensington now contains specimens belonging to 566 distinct falls; of these falls 325 have been actually observed; the remaining specimens are inferred to have come from outer space, because their characters are similar to those of the masses which have been seen to fall. Of these meteorites the following twelve have fallen within the British Isles:—

	Place.	Date.
In England.	Wold Cottage, Thwing, Yorkshire	Dec. 13, 1795.
	Launton, Oxfordshire	Feb. 15, 1830.
	Aldsworth, Gloucestershire	Aug. 4, 1835.
	Rowton, Shropshire	April 20, 1876.
	Middlesbrough, Yorkshire	March 4, 1881.
In Scotland.	High Possil, Glasgow	April 5, 1804.
	Perth	May 17, 1830.
In Ireland.	Mooresfort, Tipperary	Aug. 1810.
	Adare, Limerick	Sept. 10, 1813.
	Killeter, Tyrone	April 29, 1844.
	Dundrum, Tipperary	Aug. 12, 1865.
	Crumlin, Antrim	Sept. 13, 1902.

Meteoritic falls are independent of thunderstorms and all other terrestrial circumstances; they occur at all hours of the day and night, and at all seasons of the year; they favour no particular latitudes. The number of stones which reach the ground from one fireball is very variable. In each of the two Yorkshire falls only one stone was found; the Guernsey County meteor yielded 30; at Toulouse, as many as 350 are estimated to have fallen; at Hessle, over 500; at Knyahinya, more than 1000; at L'Aigle, from 1000 to 2000; at both Pultusk and Mocs no fewer than 100,000 are estimated to have reached the earth's surface. The largest single mass seen to fall is one of those which came down at Knyahinya, Hungary, in 1866, and weighed 547 lb; but far larger masses, inferred from their characters to be meteorites, have been met with. The larger of the Cranbourne masses, now in the British Museum (Natural History), before rusting weighed 3½ tons; the largest of the masses brought by Lieut. Peary from western Greenland weighs 36½ tons. A mass found at Bacubirito in Mexico is 13 ft. long, 6 ft. wide and 5 ft. thick, and is estimated to weigh 50 tons.

From observations of the path and time of flight of the luminous meteor it is calculated that meteorites enter the earth's atmosphere with absolute velocities ranging from 10 to 45 m. a second; but the speed of a meteorite after the whole of the resisting atmosphere has been traversed is extremely small and comparable with that of an ordinary falling body. According to Professor A. S. Herschel's experiments, the meteorite which fell at Middlesbrough must have struck the ground with a velocity of only 412 ft. a second. In the case of the Hessle fall, several stones fell on the ice, which was only a few inches thick, and rebounded without breaking the ice or being broken themselves. The depth to which a meteorite penetrates depends on the speed, form, weight and density of the meteorite and on the nature of the ground. At Stannern a meteoric stone weighing 2 lb entered to a depth of only 4 in.; the large Knyahinya stone already mentioned made a hole 11 ft. deep.

The area of the earth's surface occupied by towns and villages being comparatively small, the probability of a shower of stones falling within a town is extremely minute; the likelihood of a living creature being struck is still more remote. The first Yorkshire stone, that of Wold Cottage, struck the ground only 10 yds. from a labourer; the second, that of Middlesbrough, fell on the railroad only 40 yds. away from some platelayers at work; a stone completely buried itself in the highway at Kaba; one fell between two carters on the road at Charsonville, throwing the ground up to a height of 6 ft.; the Tourinnes-la-Grosse meteorite broke the pavement and was broken itself; the Krähenberg stone fell within a few paces of a little girl; the Angers stone fell close to a lady standing in her garden; the Braunau mass went through the roof of a cottage; at Macao, in Brazil, where there was a shower of stones, some oxen are said to have been killed; at Nedagolla, in India, a man was so near that he was stunned by the shock; while at Mhow, also in India, a man was killed in 1827 by a stone which is a true meteorite, and is represented by fragments in museum collections.

Though the surface of a meteoric stone becomes very hot during the early part of the flight through the air, it is cooled again during the later and slower part of the flight. Meteorites are generally found to be warm to the touch if immediately dug out; at the moment of their impact they are not hot enough to char woody fibre on which they chance to fall, nor is the surface then soft, for terrestrial matter with which the surface comes into contact makes no impression upon the meteorite. Where many stones fall at the same time they are generally distributed over a large area elongated in the direction of the flight of the luminous meteor, and the largest stones generally travel farthest. At Hessle, for instance, the stones were distributed over an area of 10 m. long and 3 m. broad.

Meteorites are almost invariably found to be completely covered with a thin crust such as would be caused by intense heating of the material for a short time; its thinness shows the slight depth to which the heat has had time to penetrate. They are presumably cold and invisible when they enter the earth's atmosphere, and become heated and visible during their passage through the air; doubtless the greater part of the superficial material flicks off as the result of the sudden heating and is left behind floating in the air as the trail of the meteor. The crust varies in aspect with the mineral composition of the meteorite; it is generally black; it is in most cases dull but is sometimes lustrous; more rarely it is dark-grey in colour. Each stone of a shower is in general completely covered with crust; but occasionally, as in the case of the Butsura fall, stones found some miles apart fit each other closely and the fitting surfaces are uncrusted, showing that a meteorite may break up during a late and cool stage of the flight through the atmosphere. A meteorite is generally covered with pittings which have been compared in size and form to thumbmarks; the pittings are probably caused by the unequal conductivity, fusibility and frangibility of the superficial material. As picked up, complete and covered with crust, meteorites are always irregularly-shaped fragments, such as would be obtained on breaking up a rock presenting no regularity of structure.

About one-third, and those the most common, of the chemical elements at present recognized as constituents of the earth's crust have been met with in meteorites; no new chemical element has been discovered. The most frequent or plentiful in their occurrence are: aluminium, calcium, carbon, iron, magnesium, nickel, oxygen, phosphorus, silicon and sulphur; while less frequently or in smaller quantities are found antimony, arsenic, chlorine, chromium, cobalt, copper, hydrogen, lithium, manganese, nitrogen, potassium, sodium, strontium, tin, titanium, vanadium. The existence of minute traces of several other elements has been announced; of these special mention may be made of gallium, gold, iridium, lead, platinum and silver. Iron occurs chiefly in combination with nickel, and phosphorus almost always in combination with both nickel and iron (schreibersite); carbon occurs both as indistinctly crystallized diamond and as graphitic carbon, the latter generally being amorphous, but occasionally having the forms of cubic crystals (cliftonite); free phosphorus has been found in one meteorite; free sulphur has also been observed, but may have resulted from the decomposition of a sulphide since the fall of the stone.

Of the mineral constituents of meteorites, the following are by many mineralogists regarded as still unrepresented among native terrestrial products: *cliftonite*, a cubic form of graphitic carbon; *phosphorus*; various alloys of nickel and iron; *moissanite*, silicide of carbon; *cohenite*, carbide of iron and nickel (corresponding to cementite, carbide of iron, found in artificial iron); *schreibersite* phosphide of iron and nickel; *troilite*, protosulphide of iron; *oldhamite*, sulphide of calcium: *osbornite*, oxysulphide of calcium and titanium or zirconium; *daubréelite*, sulphide of iron and chromium; *lawrencite*, protochloride of iron; *asmanite*, a species of silica; *maskelynite*, a singly refractive mineral with the chemical composition of labradorite; *weinbergerite*, a silicate intermediate in chemical composition to pyroxene and nepheline.

Of these troilite is perhaps identical with some varieties of terrestrial pyrrhotite; asmanite has characters which approach very closely to those of terrestrial tridymite; maskelynite, according to one view, is the result of fusion of labradorite, according to another view, is an independent species chemically related to leucite. Other compounds are present corresponding to the following terrestrial minerals: olivine and forsterite; enstatite and bronzite; diopside and augite; anorthite, labradorite and oligoclase; magnetite and chromite; pyrites; pyrrhotite; breunnerite. Quartz (silica), the most common of terrestrial minerals, is absent from the stony meteorites; but from the Toluca meteoric iron microscopic crystals have been obtained of which some have certain resemblances to quartz, and others to zircon. Free silica is present in the Breitenbach meteorite but as asmanite. In addition to the above there are several compounds or mixtures of which the nature has not yet been satisfactorily ascertained.

Meteorites are conveniently distributed into three classes, which pass more or less gradually into each other: the first (siderites or meteoric irons) includes all those which consist mainly of metallic iron alloyed with nickel; only nine of them have been actually seen to fall; the second (siderolites) includes those in which metallic iron (alloyed with nickel) and stony matter are present in large proportion; few of them have been seen to fall; those of the third class (aerolites or meteoric stones) consist almost entirely of stony matter; nearly all have been seen to fall.

In the meteoric irons the iron generally varies from 80 to 95% and the nickel from 6 to 10%; the latter is generally alloyed with the iron, and several alloys or mixtures have been distinguished by special names (kamacite, taenite, plessite). Troilite is frequently present as plates, veins or large nodules, sometimes surrounded by graphite; schreibersite is almost always present, and occasionally also daubréelite. The compositeness and the structure of meteoric iron are well shown by the figures generally called into existence when a polished surface is etched by means of acids or bromine-water; they are due to the inequality of the etching action on thick and thin plates of various constituents, the plates being composed chiefly of two nickel-iron materials (kamacite and taenite). A third nickel-iron material (plessite) fills up the spaces formed by the intersection of the joint plates of kamacite and taenite; it is probably not an independent substance but an intimate intergrowth of kamacite and taenite. The figures were first observed in 1808 and are generally termed "Widmanstätten figures" in honour of their discoverer; the plates which give rise to them are parallel to the faces of the regular octahedron, and such masses have therefore an octahedral structure. A small number of the remaining masses have cubic cleavage; instead of Widmanstätten figures they yield fine linear furrows when etched; the furrows were found by Neumann in 1848 to have directions such as would result from twinning of the cube about an octahedral face; they are known as "Neumann lines." For meteoric irons of cubic structure the percentage of nickel is lower than 6 or 7; for those of octahedral structure it is higher than 6 or 7; the plates of kamacite are thinner, and the structure therefore finer the higher the percentage of that metal. A considerable number of meteoric irons, however, show no crystalline structure at all, and have percentages of nickel both below and above 7; it has been suggested that each of these masses may once have had crystalline structure and that it has disappeared as a result of prolonged heating throughout the mass while the meteorite has been passing near a star.

An investigation of the changes of the magnetic permeability of the Sacramento meteoric iron with changing temperature led Dr S. W. J. Smith to infer that the magnetic behaviour can only be explained by imagining the meteorite to consist largely of plates of nickel-iron containing about 7% of nickel (kamacite), separated from each other by thin plates of a nickel-iron constituent (taenite), containing about 27% of nickel and having different thermomagnetic characters from those of kamacite; he suggests, however, that taenite is not a definite chemical compound but a eutectic mixture of kamacite and a nickel-iron compound containing not less than 37% of nickel.

About eleven out of every twelve of the known meteoric stones belong to a division to which Rose gave the name "chondritic" (*χόνδρος*, a grain); they present a very fine-grained but crystalline matrix or paste, consisting of olivine and enstatite or bronzite, with more or less nickel-iron, troilite, chromite, augite and triclinic feldspar; through this paste are disseminated round chondrules of various sizes and generally with the same mineral composition as the matrix; in some cases the chondrules consist wholly or in great part of glass. Some meteorites consist almost solely of chondrules; others contain only few; in some cases the chondrules are easily separable from the surrounding material. In mineral composition chondritic meteorites approximate more or less to terrestrial lherzolites.

A few meteorites belonging to the chondritic division are remarkable as containing carbon in combination with hydrogen and oxygen; those of Alais and Cold Bokkeveld are good examples.

The remaining meteoric stones are without chondrules and contain little or no nickel-iron; of these the following may be mentioned as illustrative of the varieties of mineral composition: *Juvinas*, consisting essentially of anorthite and augite; *Petersburg*, of anorthite, augite and olivine, with a little chromite and nickel-iron (both Juvinas and Petersburg may be compared to terrestrial basalt); *Shergholty*, chiefly of augite and maskelynite; *Angra dos Reis*, almost wholly of augite, but olivine is present in small proportion; *Bustee*, of diopside, enstatite and a little triclinic feldspar, with some nickel-iron, oldhamite and osbornite; *Bishopville*, of enstatite and triclinic feldspar, with occasional augite, nickel-iron, troilite and chromite; *Roda*, of olivine and bronzite; and *Chassigny*, consisting of olivine with enclosed chromite, and thus mineralogically identical with terrestrial dunite.

Almost all meteoric stones appear to be made up of irregular angular fragments, and some of them bear a close resemblance to volcanic tuffs. In the large group of chondritic stones, chondrules or spherules, some of which can only be seen under the microscope while others reach the size of a walnut, are embedded in a matrix apparently made up of minute splinters such as might result from the fracture of the chondrules themselves. In fact, until recently it was thought by some mineralogists that the chondrules owe their form, not to crystallization, but to friction, and that the matrix was actually produced by the wearing down of the chondrules through frequent collision with each other as oscillating components of a comet or during repeated ejection from a volcanic vent of some small celestial body. Chondrules have been observed, however, presenting forms and crystalline surfaces incompatible with such a mode of formation, and others have been described which exhibit features resulting from mutual interference during their growth. The chondritic structure is different from anything which has yet been observed in terrestrial rocks, and the chondrules are distinct in character from those observed in perlite and obsidian. It is now generally believed that the structural features of meteoric stones are the result of hurried crystallization.

No organized matter has been found in meteorites and they have brought us, therefore, no evidence of the existence of living beings outside our own world.

AUTHORITIES.—The literature consists chiefly of memoirs dispersed through the journals of scientific societies. The following separate works may be consulted: A. Brezina, *Die Meteoriten-Sammlung d. k-k. min. Hofkabinetes in Wien* (Vienna, 1896); A. Brezina u. E. Cohen, *Die Structur und die Zusammensetzung der Meteoriten* (Stuttgart, 1886–1887); P. S. Bigot de Morogues, *Mémoire historique et physique sur les chutes des pierres* (Orléans, 1812); Chladni, *Ueber den Ursprung der von Pallas gefundenen und anderer ihr ähnlicher Eisenmassen* (Riga, 1794), and *Ueber Feuer-Meteore, und über die mit denselben herabgefallenen Massen* (Vienna, 1819); E. Cohen, *Meteoritenkunde* (Stuttgart, 1894–1905); L. Fletcher, *An Introduction to the Study of Meteorites*, 10th ed. (London, 1908); E. King, *Remarks concerning Stones said to have fallen from the Clouds both in these Days and in Ancient Times* (London, 1796); S. Meunier, *Météorites* (Paris, 1884); C. Rammelsberg, *Die chemische Natur der Meteoriten* (Berlin, 1870–1879); G. Rose, *Beschreibung und Eintheilung der Meteoriten* (Berlin, 1864); G. Tschermak, *Die mikroskopische Beschaffenheit der Meteoriten* (Stuttgart, 1883–1885); E. A. Wülfing, *Die Meteoriten in Sammlungen und ihre Literatur* (Tübingen, 1897). (L. F.)

METEOROLOGY (Gr. *μετέωρα*, and *λόγος*, *i.e.* the science of things in the air), the modern study of all the phenomena of the atmosphere of gases, vapours and dust that surrounds the earth and extends to that unknown outer surface which marks the beginning of the so-called interstellar space. These phenomena may be studied either individually or collectively. The collective study has to do with statistics and general average conditions, sometimes called normal values, and is generally known as *Climatology* (see CLIMATE, where the whole subject of regional climatology is dealt with). The study of the individual items may be either descriptive, explanatory, physical or theoretical. Physical meteorology is again subdivided according as we consider either the changes that depend upon the motions of masses of air or those that depend upon the motions of the gaseous molecules; the former belong to hydrodynamics, and the latter are mostly comprised under thermodynamics, optics and electricity.

History.—The historical development of meteorology from the most ancient times is well presented by the quotations from classic authors compiled by Julius Ludwig Ideler (*Meteorologia veterum graecorum et romanorum*, Berlin, 1832). We owe to the Arabian philosophers some slight advance on the knowledge of the Greeks and Romans; especially as to the optical phenomena of the atmosphere. The *Meteorologia* of Aristotle (see Zeller, *Phil. der Griechen*) accords entirely with the *Philosophica* of Thomas Aquinas, the poetic songs of the troubadours, and the writings of Dante (see Kuhn's *Treatment of Nature in Dante's Divina Commedia*; London, 1897). Dante's work completed the passage from the ancient mythological treatment of nature to the more rational recognition of one creator and lawgiver that pervades modern science. The progress of meteorology has been coincident with the progress of physics and chemistry in general, as is shown by considering the works of Alhazen (1050) on twilight, Vitellio (1250) on the rainbow, Galileo (1607) on the thermometer and on the laws of inertia, on attractions and on the weight of the air, Toricelli (1642) on the barometer, Boyle (1659) on the elastic pressure of the air in all directions, Newton (1673) on optics; Cavendish (1760), elastic pressure of aqueous vapour; Black (1752), separation of carbonic acid gas from ordinary air; Rutherford (1772), separation of nitrogen; Priestley and Scheele (1775) and Cavendish (1777), separation of oxygen; Lavoisier (1783), general establishment of the character of the atmosphere as a simple mixture of gases and vapour; De Saussure's measurement of relative humidity by the accurate hair hygrometer (1780), Dalton's measurement of vapour tension at various temperatures (1800), Regnault's and Magnus's revision of Dalton's tension of water vapour (1840), Marvin's and Juhlins's measurements of tension of ice vapour (1891), and the isolation of argon by Rayleigh and Ramsay (1894).

Theoretical meteorology has been, and always must be, wholly dependent on our knowledge of thermodynamics and on mathematical methods of dealing with the forces that produce the motions within the atmosphere. Progress has been due to the most eminent mathematicians at the following approximate dates: Sir Isaac Newton (1670), Leonhard Euler (1736), Pierre Simon Laplace (1780), Jean Baptiste Joseph Fourier (1785), Simon Denis Poisson (1815), Sir George Gabriel Stokes (1851), Hermann von Helmholtz (1857), Lord Kelvin (1860), C. A. Bjerknes (1868), V. Bjerknes (1906), and to their many distinguished followers.

The earliest systematic daily record of local weather phenomena that has survived is that kept by William Merle, rector of Driby, during seven years 1331–1338: the manuscript is preserved in the Digby MS., Merton College, Oxford, and was published in facsimile by George G. Symons in 1891. Doubtless many similar monastic diaries have been lost to us. In 1653 Ferdinand II. of Tuscany organized a local system of stations and daily records which extended over and beyond northern Italy. This was the first fairly complete meteorological system in Europe. The records kept during the years 1655–1670 at the Cloister Angelus near Florence were reduced by Libri, professor of mathematics at Pisa, and published in 1830.

The history of meteorology is marked by the production of comprehensive treatises embodying the current state of our knowledge. Such were Louis Cotte's *Traité de météorologie* (Paris, 1774) and his *Mémoires sur la météorologie, supplément au traité* (1788); Ludwig Kämtz's *Lehrbuch der Meteorologie* (Halle, 1831–1836) and his *Vorlesungen* (1840; French 1842, English 1845); Sir John Herschel's *Meteorology* (London, 1840); the splendid series of memoirs by H. W. Brandes in Gehler's *Physikalisches Wörterbuch* (Leipzig, 1820–1840); E. E. F. W. Schmid's *Grundriss der Meteorologie* (Leipzig, 1862); Ferrel's *Recent Advances in Meteorology* (Washington, 1885); the great works of Julius Hann, as summarized in his *Handbuch der Klimatologie* (1883; 2nd ed., Stuttgart, 1897; vol. i. English 1903) and his *Lehrbuch der Meteorologie* (Leipzig, 1901, 2nd ed. 1906); the extensive studies of J. E. Woeikoff (Voeikof), as presented in his *Klima der Erde* (Russian 1883, German 1885) and his *Meteorologie* (Russian 1904).

The development of this science has been greatly stimulated by the regular publication of special periodicals such as the *Zeitschrift* of the Austrian Meteorological Society, 1866–1885, vol. 21 appearing with vol. 3 of the *Meteorologische Zeitschrift* of the German Meteorological Society in 1886, and since that date this journal has been jointly maintained by the two societies. The analogous journals of the Royal Meteorological Society, London, 1850 to date, the Scottish Meteorological Society, 1860 to date, the Meteorological Society of France, 1838 to date, the Italian Meteorological Society, and the American Meteorological Journal, 1885–1895, have all played important parts in the history of meteorology. On the other hand, the *Annals* of the Central Meteorological Office at Paris, the *Archiv* of the Deutsche Seewarte at Hamburg, the *Annals* and the *Repertorium* of the Central Physical Observatory at St Petersburg, the *Annales* of the Central Meteorological Office at Rome, *Bulletin of International Simultaneous Met. Obs.* and the *Monthly Weather Review* of the Weather Bureau at Washington, the *Abhandlungen* of the Royal Prussian Meteorological Institute at Berlin, the *Meteorological Papers* of the Meteorological Office, London, and the transactions of numerous scientific societies, have represented the important official contributions of the respective national governments to technical meteorology.

The recent international union for aerial exploration by kites and balloons has given rise to two important publications, *i.e.* the *Veröffentlichungen* of the International Commission for Scientific Aerostatics (Strassburg, 1905, et seq.), devoted to records of observations, and the *Beiträge zur Physik der freien Atmosphäre* (Strassburg, 1904, et seq.), devoted to research.

The necessity of studying the atmosphere as a unit and of securing uniform accuracy in the observations has led to the formation of a permanent International Meteorological Committee (of which in 1909 the secretary was Professor Dr G. Hellmann of Berlin, and the president Dr W. N. Shaw of London). Under its directions conferences and general congresses have been held, beginning with that of 1872 at Leipzig. Its *International Tables, Atlas of Clouds, Codex of Instructions*, and *Forms for Climatological Publications* illustrate the activity and usefulness of this committee.

Modern meteorology has been developed along two lines of study, based respectively on maps of monthly and annual averages and on daily weather maps. The latter study seems to have been begun by H. W. Brandes in Leipzig, who first, about 1820, compiled maps for 1783 from the data collected in the *Ephemerides mannheimensis*, and subsequently published maps of the European storms of 1820 and 1821. Simultaneously with Brandes we find William C. Redfield in New York compiling a chart of the hurricane of 1821, which was published in 1831, and was the first of many memoirs by him on hurricanes that completely established their rotary and progressive motion. Soon after this Piddington and Sir William Reid began their great works on the storms of the Orient. About 1825 James Pollard Espy, in Philadelphia, began the publication of his views as to the motive power of thunderstorms and tornadoes, and in 1842 was appointed "meteorologist to the U.S. government" and assigned to work in the office of the surgeon-general of the army, where he prepared daily weather maps that were published in his four successive "Reports." In 1848 the three American leaders united in letters to Professor Joseph Henry, secretary of the Smithsonian Institution, urging that the telegraph be used for collecting data for daily maps and weather predictions. Favourable action was taken in 1849, the Smithsonian maps began to be compiled about 1851 and were displayed in public from 1853 onwards. Meanwhile in England James Glaisher, with the help of the daily press, carried out similar work, publishing his first map in 1851 as soon as daily weather maps of sufficient extent could be promptly prepared by the help of the telegraph. The destructive storm of the 14th of November 1854, in the Crimea gave U. J. J. Le Verrier, at Paris, an opportunity to propose the proper action, and his proposals were immediately adopted by the secretary of war, Marshal Vaillant. On the 17th of February 1855 the emperor ordered the director-general of government telegraph lines to co-operate completely with Le Verrier in the organization of a bureau of telegraphic meteorology. The international daily bulletin of the Paris Observatory began to be printed in regular form on the 1st of January 1858, and the daily map of isobars was added to the text in the autumn of 1863. The further development of this bulletin, the inclusion of British and ocean reports in 1861, the addition of special storm warnings in 1863, the publication of the *Atlas des mouvements généraux* covering the Atlantic in 1865, the study of local thunderstorms by Hippolyte Marié-Davy, Sonrel, Fron, Peslin, in France, and the work of Fitzroy, Buys-Ballot, Buchan, Glaisher and Thomson in Great Britain, parallel the analogous works of the American students of meteorology and form the beginnings of our modern dynamic meteorology.

The details of the historical development of this subject are well given by Hugo Hildebrand-Hildebrandsson and Léon Teisserenc de Bort in their joint work, *Les Bases de la météorologie dynamique* (Paris, 1898–1907). The technical material has been collected by Hann in his *Lehrbuch.* Many of the original memoirs have been reproduced by Brillouin in his *Mémoires originaux* (Paris, 1900), and in Cleveland Abbe's *Mechanics of the Earth's Atmosphere* (vol. i., 1891; vol. ii., 1909).

The publication of daily weather charts and forecasts is now carried on by all civilized nations. The list of government bureaux and their publications is given in Bartholomew's *Atlas* (vol. iii., London, 1899). Special establishments for the exploration of the upper atmospheric conditions are maintained at Paris, Berlin, Copenhagen, St Petersburg, Washington and Strassburg.

The general problems of *climatology* (1900) are best presented in the *Handbook* of Dr Julius Hann (2nd ed., Stuttgart, 1897). The general distribution of temperature, winds and pressure over the whole globe was first given by Buchan in charts published by the Royal Society of Edinburgh in 1868, and again greatly revised and improved in the volume of the *Challenger* reports devoted to meteorology. The most complete atlas of meteorology is Buchan and Herbertson's vol. iii. of Bartholomew's *Atlas* (London, 1899). Extensive works of a more special character have been published by the London Meteorological Office, and the Deutsche Seewarte for the Atlantic, Pacific and Indian Oceans. Daily charts of atmospheric conditions of the whole northern hemisphere were published by the U.S. Weather Bureau from 1875 to 1883 inclusive, with monthly charts; the latter were continued through 1889. The physical problems of meteorology were discussed in Ferrel's *Recent Advances in Meteorology* (Washington, 1885). Mathematical papers on this subject will be found in the author's collection known as *The Mechanics of the Earth's Atmosphere*; the memoirs by Helmholtz and Von Bezold contained in this collection have been made the basis of a most important work by Brillouin (Paris, 1898), entitled *Vents contigus et nuages.* A general summary of our knowledge of the mechanics and physics of the atmosphere is contained in the *Report on the International Cloud Work*, by F. H. Bigelow (Washington, 1900). The extensive *Lehrbuch* (Leipzig, 1901; 2nd ed., 1906) by Dr Julius Hann is an authoritative work. The optical phenomena of the atmosphere are well treated by E. Mascart in his *Traité d'optique* (Paris, 1891–1898), and by J. M. Penter, *Meteorologische Optik* (1904–1907). Of minor treatises especially adapted to collegiate courses of study we may mention those by Sprung (Berlin, 1885); W. Ferrel (New York, 1890); Angot (Paris, 1898); W. M. Davis, (Boston, 1893); Waldo (New York, 1898); Van Bebber (Stuttgart, 1890); Moore (London, 1893); T. Russell (New York), 1895. The brilliant volume by Svante Arrhenius, *Kosmische Physik* (Leipzig, 1900) contains a section by Sändstrom on meteorology, in which the new hydrodynamic methods of Bjerknes are developed.

I.—Fundamental Physical Data

There can be no proper study of meteorology without a consideration of the various physical properties of the atmospheric gases and vapours, each of which plays an independent part, and yet also reacts upon its neighbours.

Atmospheric air is a mixture of nitrogen, oxygen, aqueous vapour, carbonic acid gas (carbon dioxide), ammonia, argon, neon, helium, with slight traces of free hydrogen and hydro-carbons. The proportions in which these gases are present are quite constant, except that the percentage of aqueous vapour is subject to large variations. In an atmosphere that is saturated at the temperature of 90° F., as may occur in such a climate as that of Calcutta, the water may be $2\frac{1}{2}$% of the whole weight of any given volume of air. When this aqueous vapour is entirely abstracted, the remaining dry gas is found to have a very uniform constitution in all regions and at all altitudes where examination has been carried out. In this so-called dry atmosphere the relative weights are about as follows: Oxygen, 23·16; nitrogen and argon, 76·77; carbonic acid, 0·04; ammonia and all other gases, less than 0·01 in the lower half of the atmosphere but probably in larger percentages at great altitudes. Of still greater rarity are the highly volatile gases, argon (*q.v.*), neon, krypton and helium (*q.v.*).

Outer Limit.—These exceedingly volatile components of the atmosphere cannot apparently be held down to the earth by the attraction of gravitation, but are continually diffusing through the atmosphere outwards into interstellar space, and possibly also from that region back into the atmosphere. There are doubtless other volatile gases filling interstellar space and occasionally entering into the atmosphere of the various planets as well as of the sun itself; possibly the hydrogen and hydro-carbons that escape from the earth into the lower atmosphere ascend to regions inaccessible to man and slowly diffuse into the outer space. The laws of diffusion show that for each gas there is an altitude at which as many molecules diffuse inwards as outwards in a unit of time. This condition defines the outer limit of each particular gaseous atmosphere, so that we must not imagine the atmosphere of the earth to have any general boundary. The only intimation we have as to the presence of gases far above the surface of the globe come from the phenomena of the Aurora, the refraction of light, the morning and evening twilight, and especially from the shooting stars which suddenly become luminous when they pass into what we call our atmosphere. (See C. C. Trowbridge, "On Luminous Meteor Trains" and "On Movements of the Atmosphere at Very Great Heights," *Monthly Weather Review*, Sept. 1907.)

Such observations are supposed to show that there is an appreciable quantity of gas at the height of 100 m., where it may have a density of a millionth part of that which prevails at the earth's surface. Such matter is not a gas in the ordinary use of that term, but is a collection of particles moving independently of each other under those influences that emanate from sun and earth, which we call radiant energy. According to Störmer this radiant energy is that of electrons from the sun, and their movements in the magnetic field surrounding the earth give rise to our auroral phenomena.

According to Professor E. W. Morley, of Cleveland, Ohio, the relative proportions of oxygen and nitrogen vary slightly at the surface of the earth according as the areas of high pressure and low pressure alternately pass over the point of observation; his remarkably exact work seems to show a possible variation of a small fraction of 1%, and he suggests that the air descending within the areas of high pressure is probably slightly poorer in oxygen. The proportion of carbonic acid gas varies appreciably with the exposure of the region to the wind, increasing in proportion to the amount of the shelter; it is greater over the land than over the sea, and it also slightly increases by night-time as compared with day, and in the summer and winter as compared with the spring and autumn months. During the year 1896 Professor S. Arrhenius in the *Phil. Mag.*, and in 1899 Professor T. C. Chamberlin in the *Amer. Geol. Jour.*, published memoirs in which they argued that a variation of several per cent. in the proportion of carbonic acid gas is quite consistent with the existence of animal and vegetable life and may explain the variations of climate during geological periods. But the specific absorption of this gas for solar radiations is too small (C. G. Abbot, 1903) to support this argument. The question whether free ozone exists in the atmosphere is still debated, but there seems to be no satisfactory evidence of its presence, except possibly for a few minutes in the neighbourhood of, and immediately after, a discharge of lightning. The general proportions of the principal gases up to considerable altitudes can be calculated with close approximation by assuming a quiescent atmosphere and the ordinary laws of diffusion and elastic pressure; on the other hand, actual observations show that the rapid convection going on in the atmosphere changes these proportions and brings about a fairly uniform percentage of oxygen, nitrogen and carbonic acid gas up to a height of 10 m.

Aqueous Vapours.—The distribution of aqueous vapour is controlled by temperature quite as much as by convection and has very little to do with diffusion; the law of its distribution in altitude has been well expressed by Hann by the simple formula: $\log e = \log e_0 - h/6517$ where h is the height expressed in metres and e and e_0 are the vapour pressures at the upper station and sea-level respectively. Hann's formula applies especially to observations made on mountains, but R. J. Süring, *Wissenschaftliche Luftfahrten*, III. (Berlin, 1900) has deduced from balloon observations the following formula for the free air over Europe—

$$\log e = \log e_0 - h(1 + h/20000)/6000.$$

He has also computed the specific moisture of the atmosphere or the mixing ratio, or the number of grams of moisture mixed with 1 kilogram of dry air for which he finds the formula

$$\log m = \log m_0 - h(1 + 3h/40)/9000.$$

The relative humidity varies with altitude so irregularly that it cannot be expressed by any simple formula. The computed values of e and m are as given in the following table:—

Altitude Metres. h.	Relative Vapour Pressure. e/e_0.	Relative Specific Moisture. m/m_0.
0	1000	1000
1000	665	759
2000	431	555
3000	266	391
4000	158	264
5000	91	172
6000	50	108
7000	27	65
8000	14	38

In addition to the gases and vapours in the atmosphere, the motes of dust and the aqueous particles that constitute cloud, fog and haze are also important. As all these float in the air, slowly descending, but resisted by the viscosity of the atmosphere, their whole weight is added to the atmosphere and becomes a part of the barometric record. When the air is cooled to the dew-point and condensation of the vapour begins, it takes place first upon the atoms of dust as nuclei; consequently, air that is free from dust is scarcely to be found except within a mass of cloud or fog.

Mass.—According to a calculation published in the *U.S. Monthly Weather Review* for February 1899, the total mass of the atmosphere is 1/1,125,000 of the mass of the earth itself but, according to Professor R. S. Woodward (see *Science* for Jan. 1900), celestial dynamics shows that there may possibly be a gaseous envelope whose weight is not felt at the earth's surface, since it is held in dynamic equilibrium above the atmosphere; the mass of this outer atmosphere cannot exceed $\frac{1}{1200}$th of the mass of the earth, and is probably far less, if indeed it be at all appreciable.

Conductivity.—Dry air is a poor conductor of heat, its coefficient of conduction being expressed by the formula: 0·000 0568 (1 + 0·00190 t) where the temperature (t) is expressed in centigrade degrees. This formula states the fact that a plate of air 1 centimetre thick can conduct through its substance for every square centimetre of its area, in one second of time, when the difference of temperature between two faces of the plate is 1° C., enough heat to warm 1 gram of water 0·000 0568° C., or 1 gram of air 0·000 239° C., or a cubic centimetre of air 0·1850° C., if that air is at the standard density for 760 millimetres of pressure and 0° C. The figure 0·1850° C. is the thermometric coefficient as distinguished from the first or calorimetric coefficient (0·000 0568° C.), and shows what great effect on the air itself its poor conductivity may have.

Diathermancy.—Dry air is extremely diathermanous or transparent to the transmission of radiant heat. For the whole moist atmosphere the general coefficient of transmission increases as the waves become longer: and for a zenithal sun it is about 0·4 at the violet end of the spectrum and about 0·8 at the red. By specific absorption many specific wave-lengths are entirely cut off by the vapours and gases, so that in general the atmosphere may appear to be more transparent to the short wave-lengths or violet end of the spectrum, but this is not really so. When the zenithal sun's rays fall upon a station whose barometric pressure is 760 mm., then only from 50 to 80% of the total heat reaches the earth's surface, and thus the general coefficient of transmission for the thickness of one atmosphere is usually estimated at about 60%. Of course when the rays are more oblique, or when haze, dust or cloud interfere, the transmission is still further diminished. In general one half of the heat received from the sun by the illuminated terrestrial hemisphere is absorbed by the clearest atmosphere, leaving the other half to reach the surface of the ground, provided there be no intercepting clouds. The thermal conditions actually observed at the immediate surface of the globe during hazy and cloudy weather are therefore of minor importance in the mechanism of the whole atmosphere, as compared with the influence of the heat retained within its mass.

The transmission of solar radiation through the earth's atmosphere is the fundamental problem of meteorology, and has been the subject of many studies, beginning with J. H. Lambert and P. Bouguer. The pyrheliometer of C. S. M. Pouillet gave us our first idea of the thermal equivalent of solar radiation outside of our atmosphere or the so-called "solar constant," the value of which has been variously placed at from 2 to 4 calories per sq. cm. per minute. At present the weight of the argument is in favour of 2·1, with a fair presumption that both the intensity and the quality of the solar radiation as it strikes the upper layers of our atmosphere are slightly variable. It is also likely that this "constant" does not represent the sun proper, but the remaining energy after the sunbeam has sifted through masses of matter between the sun and our upper atmosphere, so that it may thus come to have appreciable variations.

The coefficients of absorption for specific wave-lengths were first determined by L. E. Jewell, of Johns Hopkins University, for numerous vapour lines in 1892 (see *W. B. Bulletin*, No. 16). In 1904 C. G. Abbot published a table based on bolograph work at Washington showing the coefficient of atmospheric transmission for solar rays passing through a unit mass of air—namely, from the zenith to the ground. He showed that this coefficient increased with the wave-length; hence any change in the quality of the solar radiation will affect the general coefficient of transmission. The following table gives his averages for the respective wave-lengths, as deduced from ten clear days in 1901–1902 and nine clear days in 1903:—

Wave Length.	Coefficient of Atmospheric Transmission (Abbot).		
	1901–1902.	1903.	Mean by Weights.
microns.			
0·40 violet	—	0·484	—
0·45	—	0·557	—
0·50	0·765	0·627	0·700
0·60	0·769	0·692	0·730
0·70	0·857	0·753	0·808
0·80 red	0·897	0·797	0·847
0·90	0·910	0·825	0·856
1·00	0·921	0·847	0·884
1·20	0·933	0·874	0·903
1·60	0·930	0·909	0·920
2·00	0·950	0·912	0·919

Any variation in the energy that the atmosphere receives from the sun will have a corresponding influence on meteorological phenomena. Such variations were simultaneously announced in 1903 by Charles Dufour in Switzerland and H. H. Kimball in Washington (*Monthly Weather Review*, May 1903); the latter was then conducting a series of observations with Angström's electric compensation pyrheliometer, and his conclusions have been confirmed by the work of L. Gorczynski at Prague (1901–1906) and C. G. Abbot at Washington. Kimball's pyrheliometric work on this problem is still being continued; but meanwhile Abbot and Fowle from their bolometric observations at the Smithsonian Astrophysical Observatory have deduced preliminary values of the observed total energy, or the solar constant, for numerous dates when the sky was very clear, as follows (see *Smithsonian Mis. Coll.*, xlv. 78 and xlvii. 403, 1905):—

Date.	Abbot. Calories.	Fowle. Calories.
1902 Oct. 9	2·19	2·19
,, ,, 15	2·19	—
,, ,, 22	2·16	—
1903 Feb. 19	2·28	2·27
,, ,, 19	2·25	—
,, March 3	2·26	—
,, ,, 25	2·27	2·23
,, ,, 26	2·10	-
,, ,, 26	2·07	2·09
,, April 17	1·99	2·18
,, ,, 28	2·27	—
,, ,, 29	1·97	1·96
,, July 7	—	2·14
,, Oct. 14	—	1·96
,, Dec. 7	—	1·94
,, ,, 23	—	1·99
1904 Jan. 27	—	2·02
,, Feb. 11	—	2·26
,, May 28	—	2·09
,, Oct. 5	—	2·32
,, Nov. 16	—	1·98

If the relative accuracy of these figures is 1 %, as estimated by Abbot, then they demonstrate irregular fluctations of 5 %. But different observers and localities vary so much that Abbot estimates the reliability of the mean value, 2·12, to be about 10 %. The causes of this variation apparently lie above our lower atmosphere and move slowly eastward from day to day, and as the variability is comparable with that of other atmospheric data, therefore conservative meteorologists at present confine their attention to the explanation of terrestrial phenomena under the assumption of a constant solar radiation. The large local changes of weather and climate are not due to changes in the sun, but to the mechanical and thermodynamic interactions of earth and ocean and atmosphere. Excellent illustrations of this principle are found in the studies of Blanford, Eliot and Walker on the monsoons of India, of Sieger (1892) on the contrasts of temperature between Europe and North America, of Hann (1904) on the anomalies of weather in Iceland, of Meinardus (1906) on periodical variations of the icedrift near Iceland.

The absorption of solar radiation by the atmosphere is apparently explained by the laws of diffuse reflection, selective diffusion and fluorescence in accordance with which each atom and molecule and particle becomes a new centre for the diffusion in all directions of the energy represented by some specific wave-length. The specific influences of carbon dioxide and water vapour are less than those of the liquid particles (and of cloud and rains) and of the great mass of oxygen and nitrogen that make up the atmosphere.

Specific Heat.—The capacity of dry air for heat varies according as the heat increases the volume of the air expanding under constant pressure, or the pressure of the air confined in constant volume. The specific heat under constant pressure is about 1·4025 times the specific heat under constant volume. The numerical value of the specific heat under constant pressure is about 0·2375—that is to say, that number of gram-calories, or units of heat, is required to change the temperature of 1 gram of air by 1° C. This coefficient holds good, strictly speaking, between the temperatures $-30°$ and $+10°$ C., and there is a very slight diminution for higher temperatures up to 200°. The specific heat of moist air is larger than that of dry air, and is given by the expression $C_p'' = (0{\cdot}2375 + 0{\cdot}4805\ x)$ where x is the number of kilograms of vapour associated with 1 kilogram of dry air. As x does not exceed 0·030 (or 30 grams) the value of C_p'' may increase up to 0·2519. The latent heat evolved in the condensation of this moisture is a matter of great importance in the formation of cloud and rain.

Radiating Power.—The radiating power of clean dry air is so small that it cannot be measured quantitatively, but the spectroscope and bolometer demonstrate its existence. The coefficient of radiation of the moisture diffused in the atmosphere is combined with that of the particles of dust and cloud, and is nearly equal to that of an equal surface of lamp-black. From the normal diurnal change in temperature at high and low stations, it should be possible to determine the general coefficient of atmospheric radiation for the average condition of the air in so far as this is not obscured by the influence of the winds. This was first done by J. Maurer in 1885, who obtained a result in calories that may be expressed as follows: the total radiation in twenty-four hours of a unit mass of average dusty and moist air towards an enclosure whose temperature is 1° lower is sufficient to lower the temperature of the radiating air by 3·31° C. in twenty-four hours. This very small quantity was confirmed by the studies of Trabert, published in 1892, who found that 1 gram of air at 278° absolute temperature radiates 0·1655 calories per minute toward a black surface at the absolute zero. The direct observations of C. C. Hutchins on dry dusty air, as published in 1890, gave a much larger value—evidently too large. Slight changes in water, vapour and carbon dioxide affect the radiation greatly. The investigation of this subject prosecuted by Professor F. W. Very at the Allegheny Observatory, and published as "Bulletin G" of the U.S. Weather Bureau, shows the character and amount of the radiation of several gases, and especially the details of the process going on under normal conditions in the atmosphere.

Density.—The absolute density or mass of a cubic centimetre of dry air at the standard pressure, 760 millimetres, and temperature 0° C., is 0·001 29305 grams; that of a cubic metre is 1·29305 kilograms; that of a cubic foot is 0·08071 ℔ avoirdupois. The variations of this density with pressure, temperature, moisture and gravity are given in the Smithsonian meteorological tables, and give rise to all the movements of the atmosphere; they are, therefore, of fundamental importance to dynamic meteorology.

Expansion.—The air expands with heat, and the expansion of aqueous vapour is so nearly the same as that of dry air that the same coefficient may be used for the complex atmosphere itself. The change of volume may be expressed in centigrade degrees by the formula $V = V_0\ (1 + 0{\cdot}000\ 3665t)$, or in Fahrenheit degrees $V = V_0\ (1 + 0{\cdot}000\ 237t)$.

Elasticity.—The air is compressed nearly in proportion to the pressure that confines it. The pressure, temperature and volume of the ideal gas are connected by the equation $pv = RT$, where T is the absolute temperature or 273° plus the centigrade temperature p is the barometric pressure in millimetres and v the volume of a unit mass of gas, or the reciprocal of the density of the gas. The constant R is 29·272 for dry atmospheric air when the centimetre, the gram, the second and the centigrade degrees are adopted as units of measure, and differs for each gas. For aqueous vapour in a gaseous state and not near the point of condensation R has the value 47·061. For ordinary air in which x is the mass of the aqueous vapour that is mixed with the unit mass of dry air, the above equation becomes $pv = (29{\cdot}272 + 47{\cdot}061x)\,T$. This equation is sometimes known as the equation of condition peculiar to the gaseous state. It may also be properly called the equation of elasticity or the elastic equation for gases, as expressing the fact that the elastic pressure p depends upon the temperature and the volume. The mose exact equations given by Van der Waals, Clausius, Thiesen, are not needed by us for the pressures that occur in meteorology.

Diffusion.—In comparison with the convective actions of the winds, it may be said that it is difficult for aqueous vapour to diffuse in the air. In fact, the distribution of moisture is carried on principally by the horizontal convection due to the wind and the vertical convection due to ascending and descending currents. Diffusion proper, however, comes into play in the first moments of the process of evaporation. The coefficient of diffusion for aqueous vapour from a pure water surface into the atmosphere is 0·18 according to Stefan, or 0·1980 according to Winkelmann; that is to say, for a unit surface of 1 sq. centimetre, and a unit gradient of vapour pressure of one atmosphere per centimetre, as we proceed from the water surface into the still dry air, at the standard pressure and temperature, and quantity of moisture diffused is 0·1980 grams per second. This coefficient increases with the temperature, and is 0·2827 at 49·5° C. But the gradient of vapour pressure, and therefore rate of diffusion, diminishes very rapidly at a small distance from the free surface of the water, so that the most important condition facilitating evaporation is the action of the wind.

Viscosity.—When the atmosphere is in motion each layer is a drag upon the adjacent one that moves a little faster than it does. This drag is the so-called molecular or internal friction or viscosity. The coefficient of viscosity in gases increases with the absolute temperature, and its value is given by an equation like the following; $0{\cdot}000\,248\,(1+0{\cdot}003\,665t)^{\frac{2}{3}}$, which is the formula given by Carl Barus (*Ann. Phys.*, 1889, xxxvi.). This expression implies that for air whose temperature is the absolute zero there is no viscosity, but that at a temperature (t) of 0° C., or 273° on the absolute scale, a force of 0·000 248 grams is required in order to push or pull a layer of air 1 centimetre square past another layer distant from it by 1 centimetre at a uniform rate of 1 centimetre per second.

Friction.—The general motions of the atmosphere are opposed by the viscosity of the air as a resisting force, but this is an exceedingly feeble resistance as compared with the obstacles encountered on the earth's surface and the inertia of the rising and falling masses of warm and cold air. The coefficient of friction used in meteorology is deduced from the observations of the winds and results essentially not from viscosity, but from the resistances of all kinds to which the motion of the atmosphere is subjected. The greater part of these resistances consists essentially in a dissipation of the energy of the moving masses by their division into smaller masses which penetrate the quiet air in all directions. The loss of energy due to this process and the conversion of kinetic into potential energy or pressure, if it must be called friction, should perhaps be called convective friction, or, more properly, convective-resistance.

The coefficient of resistance for the free air was determined by Mohn and Ferrel by the following considerations. When the winds, temperatures and barometric pressures are steady for a considerable time, as in the trade winds, monsoons and stationary cyclones, it is the barometric gradient that overcomes the resistances, while the resulting wind is deflected to the right (in the northern hemisphere) by the influence of the centrifugal force of the diurnal rotation (ω) of the earth. The wind, therefore, makes a constant angle (α) with the direction of the gradient (G). There is also a slight centrifugal force to be considered if the winds are circulating with velocity v and radius (r) about a storm centre, but neglecting this we have approximately for the latitude

$$G \sin \alpha = 2\omega v \sin \phi,\ G \cos \alpha = \kappa v,$$

where (κ) is the coefficient connecting the wind-velocity (v) with the component of the gradient pressure in the direction of the wind. These relations give $\kappa = 2\omega \sin \phi / \tan \alpha$. The values of α and v as read off from the map of winds and isotherms at sea level give us the data for computing the coefficients for oceanic and continental surfaces respectively, expressed in the same units as those used for G and v. The extreme values of this coefficient of friction were found by Guldberg and Mohn to be 0·00002 for the free ocean and 0·00012 for the irregular surface of the land. For Norwegian land stations Mohn found $\phi = 61°$ $\alpha = 56{\cdot}5°$ $\kappa = 0{\cdot}0000845$. For the interior of North America Elias Loomis found $\phi = 37{\cdot}5°$ $\alpha = 42{\cdot}2°$ $\kappa = 0{\cdot}0000803$.

Gravity.—The weight of the atmosphere depends primarily upon the action of gravity, which gives a downward pressure to every particle. Owing to the elastic compressibility of the air, this downward pressure is converted at once into an elastic pressure in all directions. The force of gravity varies with the latitude and the altitude, and in any exact work its variations must be taken into account. Its value is well represented by the formula due to Helmert, $g = 980{\cdot}6\ (1 - 0{\cdot}0026 \cos 2\phi) \times (1 - fh)$, where ϕ represents the latitude of the station and h the altitude. The coefficient f is small and has a different value according as the station is raised above the earth's surface by a continent, as, for instance, on a mountain top, or by the ocean, as on a ship sailing over the sea, or in the free air, as in a balloon. Its different values are sufficiently well known for meteorological needs, and are utilized most discreetly in the elaborate discussion of the hypsometric formula published by Angot in 1899 in the memoirs of the Central Meteorological Bureau of France.

Temperature at Sea-Level.—The temperature of the air at the surfaces of the earth and ocean and throughout the atmosphere is the fundamental element of dynamic meteorology. It is best exhibited by means of isotherms or lines of equal temperature drawn on charts of the globe for a series of level surfaces at or above sea-level. It can also be expressed analytically by spherical harmonic functions, as was first done by Schoch. The normal distribution of atmospheric temperature for each month of the year over the whole globe was first given by Buchan in his charts of 1868 and of 1888 (see also the U.S. Weather Bureau "Bulletin A," of 1893, and Buchan's edition of Bartholomew's *Physical Atlas*, London, 1899). The temperatures, as thus charted, have been corrected so as to represent a uniform special set of years and the conditions at sea-level, in order to constitute a homogeneous system. The actual temperature near the ground at any altitude on a continent or island may be obtained from these charts by subtracting 0·5°C. for each 100 metres of elevation of the ground above sea-level, or 1° F. for 350 ft. This reduction, however, applies specifically to temperatures observed near the surface of the ground, and cannot be used with any confidence to determine the temperature of points in the free air at any distance above the land or ocean. On all such charts the reader will notice the high temperatures near the ground in the interior of each of the continents in the summer season and the low temperatures in the winter season. In February the average temperatures in the northern hemisphere are not lowest near the North Pole, but in the interiors of Siberia and North America; in the southern hemisphere they are at the same time highest in Australia, and Africa and South America. In August the average temperatures are unexpectedly high in the interior of Asia and North America, but low in Australia and Africa.

Temperature at Upper Levels.—The vertical distribution of temperature and moisture in the free air must be studied in detail in order to understand both the general and the special systems of circulation that characterize the earth's atmosphere. Many observations on mountains and in balloons were made during the 19th century in order to ascertain the facts with regard to the decrease of temperature as we ascend in the atmosphere; but it is now recognized that these observations were largely affected by local influences due to the insufficient ventilation of the thermometers and the nearness of the ground and the balloon. Strenuous efforts are being directed to the elimination of these disturbing elements, and to the continuous recording of the temperature of the free air by means of delicate thermographs carried up to great heights by small free "sounding balloons," and to lesser heights by means of kites. Many international balloon ascents have been made since 1890, and a large amount of information has been secured.

The development of kite-work in the United States began in October 1893, at the World's Columbian Congress at Chicago, when Professor M. W. Harrington ordered Professor C. F. Marvin of the Weather Bureau to take up the development of the Hargrave or box kite for meteorological work. At that time W. A. Eddy of Bayonne, New Jersey, was applying his "Mălay" kite to raising and displaying heavy objects, and in August 1894 (at the suggestion of Professor Cleveland Abbe) he visited the private observatory of A. L. Rotch at Blue Hill and demonstrated the value of his Malay kite for aerial research. The first work done at this observatory with crude apparatus was rapidly improved upon, while at the same time Professor Marvin at Washington was developing the Hargrave kite and auxiliary apparatus, which he brought up to the point of maximum efficiency and trustworthiness. When he reported his apparatus as ready to be used by the Weather Bureau on a large scale, Professor Willis L. Moore, as the successor of Professor Harrington, ordered its actual use at seventeen kite stations in July 1898. This was the first attempt to prepare isotherms for a special hour over a large area at some high level, such as 1 m., in the free air. Daily meteorological charts were prepared for the region covered by these observations; but it became necessary to discontinue them, and nothing more was done by the Weather Bureau in this line of work until the inauguration of kite work at Mount Weather in 1906. Meanwhile a special method for the reduction and study of such observations was devised by Bjerknes and Sandstrom, and was published in the *Trans. American Philosophical Society* (Philadelphia, 1906). The general average results as to temperature gradients were compiled by Dr H. C. Frankenfield and published in the United States Weather Bureau "Bulletin F." from these were deduced the following tables, published in the *Monthly Weather Review:*—

Mean Temperature Gradients in degrees Fahrenheit per 1000 ft. from the ground up to the respective altitudes.

Stations.	1000 ft.	1500 ft.	2000 ft.	3000 ft.	4000 ft.	5000 ft.	6000 ft.
	°	°	°	°	°	°	°
Washington, D.C.	5·6	4·4	4·0	3·5	3·2	3·0	3·1
Cairo, Ill.	9·7	6·6	6·0	4·9	4·7	4·3	—
Cincinnati, O.	13·0	6·3	6·9	5·8	5·6	4·7	4·2
Fort Smith, Ark.	7·2	7·0	6·7	5·8	3·8	—	—
Knoxville, Tenn.	8·4	6·2	6·6	5·4	5·0	—	—
Memphis, Tenn.	7·8	6·8	5·0	3·8	3·7	3·5	—
Springfield, Ill.	7·6	5·7	5·1	4·4	4·0	3·7	3·6
Cleveland, O.	5·7	4·1	3·6	3·5	4·1	4·1	4·3
Duluth, Minn.	5·2	4·8	4·6	4·6	4·3	3·8	4·6
Lansing, Mich.	7·5	6·0	4·7	4·1	3·9	3·8	—
Sault Ste Marie, Mich.	6·6	6·2	5·2	4·5	3·9	3·0	—
Dodge, Kans.	6·3	5·2	4·8	3·7	3·1	3·2	3·2
Dubuque, Iowa	6·9	5·9	4·6	3·5	3·2	3·3	—
North Platte, Neb.	6·8	6·5	5·9	5·2	4·4	4·7	5·4
Omaha, Neb.	—	5·4	4·9	3·6	3·2	3·5	3·8
Pierre, S. Dak.	5·9	5·1	4·8	4·3	3·7	4·4	4·0
Topeka, Kans.	7·4	6·2	4·9	4·0	3·8	3·9	4·5
Average	7·4	5·8	5·2	4·4	4·0	3·8	4·1

Stations	Altitude.	Temperature.	
	Feet.	Gradient.	Reduction.
		° F.	° F.
Washington	210	—3·00	—15·2
Cairo	315	—4·30	—25·6
Cincinnati	940	—5·15	—27·5
Fort Smith	527	?	?
Knoxville	990	—5·00	—21·5
Memphis	319	—3·50	—17·3
Springfield	684	—3·85	—17·7
Cleveland	705	—4·10	—18·8
Duluth	1197	—4·30	—17·6
Lansing	869	—3·85	—17·0
Sault Ste Marie	722	—3·45	—15·7
Dodge	2473	—4·10	—11·6
Dubuque	894	—3·30	—14·5
North Platte	2811	—5·40	—13·3
Omaha	1241	—3·20	—12·9
Pierre	1595	—3·90	—14·4
Topeka	972	—3·83	—16·5

In this table the second column gives the altitude of the ground at the reel on which the kite wire was wound. The third column shows the average gradient in degrees Fahrenheit per 1000 ft. between the reel at the respective stations, and a uniform altitude 5280 ft. above sea-level. The fourth column shows the total reduction to be applied to the temperature at the reel in order to obtain the temperature at the 1 m. level above sea. These gradients and reductions are based upon observations made only during the six warm months from May to October 1898.

The kite-work at the Blue Hill Observatory has been published in full in the successive Annals of the Harvard College Observatory, beginning with 1897, vol. xlii. It has been discussed especially by H. H. Clayton with reference to special meteorological phenomena, such as areas of high and low pressure, fair and cloudy weather, the winds and their velocities at different elevations, insolation, radiation, &c., and has served as a stimulus and model for European meteorologists. Kite-work has also been successfully prosecuted at Trappes, Hamburg, Berlin, St Petersburg, and many other European stations. The highest flights that have been attained have been about 8000 metres.

The great work of L. Teisserenc de Bort began with 1897, when he founded his private observatory at Trappes near Paris devoted to the problems of dynamic meteorology. His results are published in full in the Memoirs of the Central Meteorological Bureau of France for 1897 and subsequent years. Beginning with the sounding balloons devised by Hermite, he subsequently added kite work as supplementary to these. In the *Comptes rendus* (1904), he gives the mean temperatures as they result from five years of work, 1899–1903, at Trappes. Out of 581 ascensions of sounding balloons there were 141 that attained 14 km. or more, and the following table gives the average temperatures recorded in these ascensions. It will be seen that there is a slow decrease in temperate up to 2 km.; a rapid decrease thence up to 10 km., and a slow decrease, almost a stationary temperature, between 11 and 14 km.; this is the "thermal zone" as discovered and so called by him.

Altitude.	Winter. Dec., Jan., Feb.	Spring. Mar., Apl., May.	Summer. June, July, Aug.	Autumn. Sept., Oct., Nov.
Km.	° C.	° C.	° C.	° C.
Ground	+ 1·9	+ 5·1	+13·0	+ 7·5
0·5	+ 1·4	+ 4·7	+13·6	+ 7·7
1·0	− 0·2	+ 2·4	+11·8	+ 6·1
1·5	− 0·2	+ 0·1	9·7	+ 4·0
2·0	− 1·4	− 2·1	7·3	+ 2·2
2·5	− 3·7	− 4·3	5·0	+ 0·4
3·0	− 6·0	− 6·4	2·1	− 1·7
3·5	− 8·7	− 9·3	+ 0·2	− 4·2
4·0	−10·9	−12·2	− 2·7	− 6·5
4·5	−14·2	−15·2	− 5·3	− 9·3
5·0	−17·0	−18·5	− 8·3	−12·4
6·0	−23·7	−25·2	−14·8	−18·7
7·0	−31·5	−32·0	−21·7	−25·8
8·0	−39·0	−39·0	−29·3	−33·5
9·0	−46·9	−46·7	−38·0	−41·4
10·0	−54·6	−52·7	45·3	−48·3
11·0	−57·9	−53·6	50·3	−54·4
12·0	−57·9	−53·1	52·7	−57·1
13·0	−56·9	−52·2	51·5	−57·1
14·0	−55·5	−52·5	−51·3	−57·1

It is evident that the annual average vertical gradient of temperature over Paris is between 4° and 6° C. per 1000 metres of ascent in the free air, agreeing closely with the value 5° per 1000 metres, which has come into extensive use since the year 1890, on the recommendation and authority of Hann, for the reduction of land observations to sea-level. The winter gradients are less than those for summer, possibly owing to the influence of the condensation into cloud and rain during the winter season in France; the same value may not result from observations in the United States, where the clouds and precipitation of winter do not so greatly exceed those of summer. The work at Trappes is therefore not necessarily representative of the general average of the northern hemisphere, but belongs to a coastal region in which during the summer time, at great heights, the air is cooler than in the winter time, since during the latter season there is an extensive flow of warm south winds from the ocean over the cold east winds from the land. Sounding balloons have also been used elsewhere with great success. The greatest heights attained by them have been 25,989 metres at Uccle, Belgium, on the 5th of September 1907, and 25,800 metres at Strassburg, August 1905.

The most extensive meteorological explorations of the free atmosphere have been those accomplished in Germany by Richard Assmann and Arthur Berson, beginning (1887) in co-operation with the German Verein for the Promotion of Aeronautics and the Aeronautic Section of the German Army, afterwards under the auspices of the Prussian Meteorological Office, but later as a wholly independent institution at Lindenberg. All the details of the work during 1887–1889 and the scientific results of seventy balloon voyages were published in three large volumes, *Wissenschaftliche Luftschiffahrten* (Berlin, 1900). The work done at Tegel at the Aeronautical Observatory of the Berlin Meteorological Office, the 1st of October 1899 to April 1905, was published in three volumes of *Ergebnisse*. But the location at Tegel had to be given up and a new independent establishment, the "Royal Prussian Aeronautic Observatory," was founded at Lindenberg, under the direction of Dr Assmann, who has published the results of his work in annual volumes of the *Ergebnisse* of that institution, considering it as a continuation of the work done at Berlin and Tegel. In addition to these elaborate official publications various summaries have been published, the most instructive of which is the chart embodying daily observations with corresponding isotherms at all attainable altitudes, published monthly since January 1903 in *Das Wetter*. The growth of this aerial work and the reliability of the results may be inferred from a statement of the number of ascensions made each year: 1899, 6; 1900, 39; 1901, 169; 1902, 261; 1903, 481; 1905, 513. This large number, combined with 581 voyages of Teisserenc de Bort at Trappes and many others made in England,

	Annual Temperatures and Wind.							
	Tegel, 1903.		Tegel, 1904.		Lindenberg, 1905.		Lindenberg, 1905.	
Altitude.	Days.	°C.	Days.	°C.	Days.	°C.	Days.	Metres per sec.
Ground	365	9·2	366	9·1	365	8·5	365	4·65
500 m.	363	6·7	364	6·5	365	6·2	362	8·65
1,000 ,,	344	4·3	361	4·2	352	4·0	356	8·85
1,500 ,,	252	2·0	279	2·2	294	2·6	306	8·55
2,000 ,,	170	0·0	186	−0·2	242	0·5	257	9·5
2,500 ,,	98	−1·8	132	−1·7	179	−1·1	195	10·0
3,000 ,,	55	−3·9	79	−3·6	119	−2·8	127	10·7

Holland and Russia, amounting in all to over 2000, enabled Assmann to compute the monthly and annual means of temperature and wind velocity for each altitude; the German results are given in table at foot of page 269.

The results of these numerous ascents, during these six years, have also been grouped into monthly means that have a reliability proportionate to the number of days on which observations were obtained at a given level, and we are now able to speak of the annual and even of the diurnal periodicity of temperature at different altitudes in the free air with considerable confidence.

Some of the most important conclusions to be drawn from the best recent work were published by Hann either in special memoirs or in his *Lehrbuch*, from which we take the following table. The actual temperatures given in this table have only local importance, but the differences or the vertical gradients doubtless hold good over a large portion of Europe if not of the world.

Temperature in Free Air over Europe 1899–1904.

Altitude.	Annual Averages.				International.		All countries combined.
	Berlin. 15 Ascents.	International. 130 Ascents.	Manned balloons. 36 Ascents.	Trappes. 581 Ascents.	Feb.	Aug.	
Km.	°C.	°C.	°C.	°C.	°C.	°C.	°C.
0	—	8·3	—	—	+ 0·3	+18·2	—
1	+ 5·4	6·0	+ 5·5	+ 5·3	− 1·4	+15·1	5·0
2	+ 0·5	1·7	+ 0·3	+ 0·7	− 3·6	+10·2	0·5
3	− 5·0	− 3·3	− 4·4	− 4·0	− 8·7	+ 4·8	− 4·0
4	−10·3	− 9·0	−10·3	− 9·4	−14·7	− 1·0	− 9·2
5	−16·6	−15·3	−16·5	−15·4	−21·9	− 7·1	−15·4
6	−24·2	−22·1	−23·0	−21·9	−28·9	−13·3	−22·0
7	−30·2	−29·1	−30·2	−29·0	−36·1	−19·5	−29·0
8	−37·4	−36·2	−37·0	−36·2	−43·7	−27·1	−36·2
9	−46·4	−43·2	—	−43·5	−50·1	−33·8	−43·2
10	—	−49·0	—	−49·3	−55·4	−39·5	−49·2

The differences of temperature between any layer and those above it and below it, or the vertical gradients at each level go through annual periodical changes quite analogous to those derived from mountain observations; the most rapid falls of temperature, or the largest vertical gradients in the free air occur on the following dates over Europe:—

Altitude.	Over Germany.	Over Trappes.
1, 2, 3 km.	May, June	May 15
3, 4, 5	March	Feb. 15
5, 6, 7	April	Jan. 27
7, 8, 9	July	July 28
9, 10, 11	—	Sept. 14

The values above given as deduced from 141 high ascensions at Trappes show that between 11 and 14 km. there was no appreciable diminution of temperature, in other words, the air is warmer than could be expected and therefore has a higher potential temperature. This fact was first confirmed by the Berlin ascensions, and is now recognized as wellnigh universal. The altitude of the base of this warm stratum is about 12 km. in areas of high pressure and 10 km. in areas of low pressure. It is higher as we approach the tropics and above ordinary balloon work near the equator if indeed it exists there. At first this unexpected warmth was considered as possibly a matter of error in the meteorographs, but this idea is now abandoned. Assmann suggested that the altitude is that of the highest cirrus, from which Cleveland Abbe inferred that it had something to do with the absorption of the solar and terrestrial heat by dissolving cirri. But the most plausible explanation is that published simultaneously in September 1908 by W. J. Humphreys of Washington, and Ernest Gold of London.

The daily diagrams in *Das Wetter* show that both the irregular and the periodic and the geographic variations of temperature in the upper strata are unexpectedly large, almost as large as at the earth's surface, so that the uniform temperature of space that was formerly supposed to prevail in the upper air must be looked for, if at all, far above the level to which sounding balloons have as yet attained. It is evident that both horizontal and vertical convection currents of great importance really occur at these great altitudes. These upper currents cannot be due to any very local influence at the earth's surface, but only to the interchange of the air over the oceans and continents or between the polar and equatorial regions. They constitute the important feature of the so-called general circulation of the atmosphere, which we have hitherto mistakenly thought of as confined to lower levels; their general direction is from west to east over all parts of the globe as far as yet known, showing that they are controlled by the rotation of the earth. It is likely that masses of air having special temperature conditions or clouds of vapour dust such as came from Krakatoa, may be carried in these high currents around the globe perhaps several times before being dissipated.

The average eastward movement or the west wind at 3 km. above Germany is 10·7 m. per sec. or 1° of longitude (at 45° latitude) in 42·4 minutes, or such as to describe the whole circumference of this small circle in 10·5 days. At the equator above the calm belt the velocity westward or the east wind as given by Krakatoa volcanic-dust phenomena was 34·5 m per sec., on 30° of a great circle daily, or around the equator in 12·5 days, while its poleward movement was only 1° per day or 1·3 metre per second. The average motion of the storm centres moving westward in northern tropical and equatorial regions but eastward in the north temperate zone is at the rate of one circumference or a small circle at latitude 45° in 19 days. Observations of the cloud movements gave Professor Bigelow the following results for the United States:—

Altitude.	Moving eastward.	Moving westward.
10·0 km.	36 m. p.s.	2·0 m. p.s.
7·5	35	2·0
5·0	26	1·5
3·0	20	1·0
1·0	8	0·5
0	4	

Evidently, therefore, the great west wind (that James H. Coffin deduced from his work on the winds of the northern hemisphere and that William Ferrel deduced from his theoretical studies) represents with its gentle movement poleward a factor of fundamental importance. We must consider all our meteorological phenomena except at the equator as existing beneath and controlled, if not

Month.	Average temperature gradient per 100 metres.		Altitude (metres).	Total Fall of Temperature from Ground upward.			
	Altitudes.			October to March.		April to September.	
	From 0 to 1000 metres.	From 1000 to 2000 metres.		Cloudiness 0–7.	Cloudiness 8–10.	Cloudiness 0–7.	Cloudiness 8–10.
	°C.	°C.		°C.	°C.	°C.	°C.
January	0·11	0·58	2000	8·24	7·63	15·33	14·18
February	0·39	0·30	1800	7·22	6·60	14·20	12·97
March	0·33	0·40	1600	6·28	6·04	13·01	11·75
April	0·73	0·48	1400	5·35	5·15	11·66	10·59
May	0·90	0·66	1200	4·48	4·35	10·32	9·32
June	0·99	0·72	1000	3·62	3·52	9·13	7·96
July	0·96	0·67	800	2·20	2·82	7·55	6·65
August	0·86	0·62	600	1·54	2·33	5·77	5·23
September	0·77	0·58	400	0·65	1·85	3·88	3·63
October	0·57	0·43	200	0·35	1·05	1·88	1·76
November	0·36	0·53	0	0·00	0·00	0·00	0·00
December	0·30	0·53	—	—	—	—	—
Year	0·61	0·53					

caused, by this general deep swift upper current of air that began as an ascending east wind above the calm equatorial air but speedily overflowed as west wind settling down to the sea-level in the temperate and polar regions as great areas of high pressure and dry clear cool weather containing air on its return passage to the equator. The upper air is thrown easily into great billows, and wherever it rises the warm equatorial wind flows in beneath it, but when it descends we have blizzards and dry clear weather. It is a covering for the lower strata of air, it flows over them in standing waves and sometimes mixes with them at the surface of contact. It receives daily accessions from below and gives out corresponding accessions to the lower strata, by a process of overturning such as has been studied theoretically by Margules and Bigelow.

At the fifth conference of the International Committee on Scientific Aeronautics (Milan, October 1906) Rykatchef presented the results of kite-work during 1904 and 1905 at Pavlosk, near St Petersburg, from which we select the results for these two years given in table at foot of page 270.

Many inversions occur during January below 1000 metres. The decrease is more rapid in summer than in winter and in clear weather than in cloudy, but of course these observations did not extend above the upper level of the cumulus cloud layer. A general survey of the existing state of knowledge of the upper atmosphere is given in the *Report* of the British Association for 1910.

Distribution of Aqueous Vapour.—The distribution of aqueous vapour is best shown by lines of equal dew-point or vapour tension, though for some purposes lines of equal relative humidity are convenient. The dew-point lines are not usually shown on charts, partly because the lines of vapour pressure are approximately parallel to the lines of mean temperature of the air, and partly because the observations are of very unequal accuracy in different portions of the globe. In general we may consider any isotherm as agreeing with the dew-point line for dew-points a few degrees lower than the temperature of the air. The distribution of moisture is quite irregular both in a horizontal and in a vertical direction. On charts of the world we may draw lines based on actual observations to represent equal degrees of relative humidity, or equal dew-points and vapour pressures; but as regards the distribution of moisture in a vertical direction we are, in the absence of specific observations, generally forced to assume that the vapour pressure at any altitude h follows the average law first deduced from a limited number of observations by Hann, and expressed by the logarithmic equation, $\log e = \log e_0 - h/6517$, which is quite analogous to the elementary hypsometric formula, $\log p = \log p_0 - h/18400$. Therefore, in general, the ratio between the pressure of the vapour and the pressure of the atmosphere at any altitude is represented by the approximate formula, $\log e/p = \log e_0/p_0 - h/10091$. Of course these relations can only represent average or normal conditions, which may be departed from very widely at any moment; they have, however, been found to agree remarkably with all observations which have as yet been published. The average results are given in the following table, which is abbreviated from one published by Hann, but with the addition of the work done by the U.S. Weather Bureau, as reduced by Dr Frankenfield in 1899. The vapour constituent of the atmosphere is not distributed according to the law of gaseous diffusion, but, like temperature and the ratio between oxygen and nitrogen, is controlled by other laws prescribed by the winds and currents, namely—convection.

Diminution of the Relative Vapour Pressure with Altitude.

Authority.	1500 ft.	2000 ft.	3000 ft.	4000 ft.	5000 ft.	6000 ft.	7000 ft.	8000 ft.	No. Obs.
Kites. (U.S.W.B.)	0·82	0·78	0·70	0·61	0·52	0·49	0·39	0·44	1123
Balloons. (Hammon.)	0·97	0·96	0·87	0·68	0·44	0·59	—	—	4
Balloons. (Hazen.)	0·89	0·83	0·80	0·78	0·67	0·46	0·44	—	2
Balloons. (Hann.)	0·84	0·80	0·66	0·61	0·50	0·54	0·41	0·37	15
Mountains (Hann.)	0·83	0·81	0·80	0·66	0·61	0·58	0·55	0·47	6
Computed by Hann.	0·85	0·81	0·72	0·65	0·58	0·52	0·47	0·42	—

Note.—The vapour pressure at any altitude is supposed to be expressed as a fraction of that observed at the ground. When the altitudes are given in ft. Hann's formula becomes $\log e/e_0 = h/29539$.

From 78 high balloon voyages in Germany, 1887–1899, Süring deduced the average vapour pressure in millimetres as found in the first line of the table at foot of this page (see *Wissenschaftliche Luftfahrten*, Bd. III., and Hann, *Lehrbuch*, 1906, p. 169). The observations on mountains gave Hann the pressures in the second line. Süring's figures result from the use of Assmann's ventilated psychrometer and are therefore very reliable.

Diminution of Pressure of Aqueous Vapour in the Free Air.

Alt.	km. 0·5	km. 1·0	km. 1·5	km. 2·0	km. 2·5	km. 3·0	km. 3·5	km. 4·0	km. 4·5	km. 5·0	km. 6·0	km. 7·0	km. 8·0
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Süring	0·83	0·68	0·51	0·41	0·34	0·26	0·20	0·17	0·14	0·11	0·054	0·028	0·013
Hann	0·83	0·70	0·58	0·48	0·40	0·34	0·28	0·23	0·19	0·16	—	—	—

The vapour pressure in mm. in free air over Europe is best given by Süring's formula

$$\log e_h = \log e_0 - \frac{h}{6}\left(1 + \frac{h}{20}\right)$$

where the altitude is to be expressed in kilometres. From this formula we derive the "specific moisture" or the mass of vapour contained in a kilogram of moist air as given in the following table whose numbers do not appreciably differ from "the mixing ratio" or quantity of moisture associated with a kilogram of dry air. The relative humidities vary irregularly depending on convection currents, but in clear weather when descending currents prevail they have been observed in America and over Berlin as shown in the third and fourth columns of the following table:—

Observed Specific Moisture and Relative Humidity.

Alt.	Specific moisture.	Relative Humidity.	
		U.S.A.	Berlin.
Km.		%	%
0·0	1·00	—	77
0·5	—	65	71
1·0	0·76	65	71
1·5	0·65	59	62
2·0	0·55	59	57
2·5	0·47	45	58
3·0	0·39	—	55
3·5	—	—	49
4·0	0·26	—	53
4·5	—	—	54
5·0	0·17	—	—
5·6	0·11	—	—
5·7	0·07	—	—
5·8	0·04	—	—

The total amount of vapour in the atmosphere, according to Hann's formula, is between one-fourth and one-fifth of the amount required by Dalton's hypothesis, as is illustrated by the following table taken from an article by Cleveland Abbe in the Smithsonian Report for 1888, p. 410:—

Total Vapour in a Vertical Column that is saturated at its base.

Altitude. Feet.	Relative Tension $=e/e_0$.	Actual Weight Gr. per Cubic Foot.				Total Vapour in the Columns expressed as Inches of Rain.			
		80° F.	70° F.	60° F.	50° F.	80° F.	70° F.	60° F.	50° F.
0	1·000	10·95	7·99	5·76	4·09	0·0	0·0	0·0	0·0
6000	0·524	5·75	4·19	3·02	2·14	1·3	1·0	0·7	0·5
12,000	0·275	3·01	2·20	1·58	1·12	2·1	1·5	1·1	0·8
18,000	0·144	1·58	1·15	0·83	0·59	2·5	1·8	1·3	0·9
24,000	0·075	0·82	0·62	0·43	0·31	2·7	2·0	1·4	1·0
30,000	0·040	0·43	0·32	0·23	0·16	2·8	2·1	1·5	1·1

A heavy rainfall results from the precipitation of only a small percentage of the water contained in the fresh supplies of air brought by the wind; if all moisture were abstracted from the atmosphere it could only affect the barometer throughout the equatorial regions by 2·8/13·6 inches, or about two-tenths of an inch, while at the polar regions the diminution would be much less than one-tenth. Evidently, therefore, it is idle to argue that the fall of pressure in an extensive storm is to be considered as the simple result of the condensation of the vapour into rain.

Barometric Pressure.—The horizontal distribution of barometric pressure over the earth's surface is shown by the *isobars, or lines* of equal pressure at sea-level; it can also be expressed by a system of complex spherical harmonics. As the indications of the mercurial barometer must vary with the variation of apparent gravity, whereas those of the aneroid barometer do not, it has been agreed by the International Meteorological Conventions that for scientific purposes all atmospheric pressures, when expressed as barometric readings, must be reduced to one standard value of gravity, namely, its value at sea-level and at 45° of latitude. In this locality its value is such as to give in one second an acceleration of 980·8 centimetres, or 32·2 English ft. per second. The effect of the variation of apparent gravity with latitude is therefore to make the mercurial barometer read too high, between 45° and the equator, and too low, between 45° and the pole. The gravity-correction to be applied to any mercurial barometric-reading at or near sea-level, in order to get the atmospheric pressure in standard units, should be given on the edge of a meteorological chart, unless the isobars shown thereon already contain this correction. On such charts it will be perceived that the barometric pressure at sea-level is by no means uniform over the earth's surface, and daily weather charts show very great fluctuations in this respect, the lowest pressures being storm centres and the highest pressures areas of clear cool dry weather. But even the normal average charts show high pressures over the continents in the winter and low pressures over the oceans, these conditions being reversed in the summer time; moreover, Schouff (*Pogg. Ann.*, 1832) first demonstrated that the average pressure in the neighbourhood of the equator is slightly less than under either tropic, and that there is a still more remarkable diminution of pressure from either tropic towards its pole. The exact statement of these variations of pressure with latitude was subsequently worked out very precisely by Ferrel, and forms the basis of his explanation of the general circulation of the earth's atmosphere and its influence on the barometer. The series of monthly charts for the whole globe, compiled by Buchan and published by the Royal Society of Edinburgh in 1868, as well as Buchan's later and more perfect charts in the meteorology of the "Challenger" Expedition, Edinburgh, 1889, and in Bartholomew's *Atlas*, first revealed clearly the fact that the distinct areas of high and low pressure which are located over the continents and the oceans vary during the year in a fairly regular manner, so that the pressure is higher over the continents in the winter season and lower in the summer season, the amount of the change depending principally upon the size of the continent. A part of this annual variation in pressure is undoubtedly introduced by the methods of reduction to sea-level; indeed, if the data of the lower stations are reduced up to the level of 10,000 or 15,000 ft., we sometimes find the barometric conditions quite reversed. These annual changes are intimately connected as cause and effect with the annual changes of temperature, moisture and wind; it is quite erroneous to say that the observed charted pressures control the winds; there is a reaction going on between the wind and the barometric gradient, the resistance and rotation of the earth's surface, such that the true relation between these factors is a complex but fundamental problem in the mechanics of the atmosphere.

The vertical distribution of pressure as deduced from observation shows a rate of diminution with increasing altitude very closely but not entirely accordant with the laws of static equilibrium, as first elaborated by Laplace in his hypsometric formula. The departures from this law of static equilibrium are sufficient to show that, if our atmosphere is really in a state of equilibrium, it must be a matter of dynamics and not of statics. The general average relation of the density of the air to the altitude and temperature, and the total pressure of the superincumbent atmosphere, are shown in the accompanying diagram (fig. 1), which is taken from a memoir on the equations of motion by Joseph Cottier, published in the *U.S. Monthly Weather Review* for July 1897. The diminution of pressure with altitude, as shown in this diagram for average conditions, but not for the temporary conditions that continually occur, follows a logarithmic law, and can undoubtedly be extended upwards for the normal atmosphere only to a height of 20 or 30 m., owing to our uncertainty as to the actual conditions in the upper portions of the atmosphere. This diagram is based upon the assumption that the atmosphere is in a state of convective equilibrium such that the ascending and descending masses expand and cool as they ascend, or contract and warm up as they descend, nearly but not quite in accordance with the adiabatic law of the change of temperature in pure gases.

The departure of atmospheric temperatures from the strictly adiabatic law, as shown by Cottier, is undoubtedly due largely to the heat absorbed by and radiated from moist or hazy or dusty air. In 1890, Abbe showed that a very moderate rate of radiation from the atmosphere suffices to explain the coolness of slowly descending air. The absorption by the atmosphere of radiations from the earth and sun, or the balance between warming by absorption and cooling by radiation, is the basis of the arguments of W. J. Humphreys (*Astrophysics*, Jan. 1909), and E. Gold (*Proc. Roy. Soc.*, 1908, lxxxii., 45 A.), explaining the existence of the "thermal layer."

The direct evaluation of this radiation and absorption has been attempted by many. The genuine law $\alpha(q-p)$ is adopted by Gold as closely representing nature, whence it follows that (1) the adiabatic rate of cooling in convection currents must cease at a height corresponding to one-half of the barometric pressure at sea-level; (2) an isothermal layer must exist at the level where the absorption of solar radiation equals that of the terrestrial and atmospheric radiation; (3) within this thermal layer convection is difficult or impossible; (4) above this region the vertical temperature gradient must depend essentially on radiation and is less than that needed for convective equilibrium; (5) below this level the atmospheric radiation exceeds the atmospheric absorption and vertical currents can only be kept up by the convection of heat or aqueous vapour from the earth's surface to the adjacent layer of air.

Limit of the Atmosphere.—The limiting height of the atmosphere must be at some unknown elevation above 20 m. where the temperature falls to absolute zero. But the uncertainty of the various hypotheses as to the physical properties of the upper atmosphere forbids us to entertain any positive ideas on this subject at the present time. If we define the outer limit of the atmosphere as that point at which the diffusion of gases inwards just balances the diffusion outwards, then this limit must be determined not by the hypsometric formula, but by the properties of gases at low temperatures and pressures under conditions as yet uninvestigated by physicists.

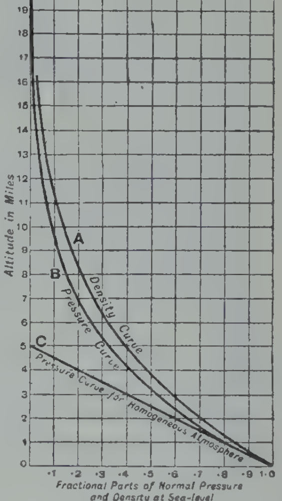

FIG. 1.

Cloudiness.—It is evident that the clouds (*q.v.*) are formed from clear transparent air by the condensation of the invisible moisture therein into numerous minute particles of water, ice or snow. Notwithstanding their transparency, these individual globules and crystals, when collected in large masses, disperse the solar rays by reflection to such an extent that direct light from the sun is unable to penetrate fog or cloud, and partial darkness results. In a general survey of the atmosphere the geographical distribution of the amount of cloudy sky is important. When the solar heat falls upon the surface of the cloud it is so absorbed and reflected that, on the one hand, scarcely any penetrates to the ground beneath, while on the other hand the upper surface of the cloud becomes unduly heated. Even if this upper surface is completely evaporated, it may continually be renewed from below, and, moreover, the evaporated moisture mixing with the air renders it very much lighter specifically than it would otherwise be. Hence the upper surface of the cloud replaces the surface of the ground and of the ocean; the air in contact with it acquires a higher temperature and greater buoyancy, while the ground and air beneath it remain colder than they would be in sunshine. The average cloudiness over the globe is therefore intimately related to the density and circulation of the atmosphere; it was first charted in general terms by L. Teisserenc de Bort of Paris, about 1886. The manifold modifications of the clouds impress one with the conviction that, when properly understood and interpreted, they will reveal to us the most important features of the processes going on in the atmosphere. If the farmer and sailor can correctly judge of the weather several hours in advance by a casual glance at the clouds, what may not the professional meteorologist hope to do by a more careful study? Acting on this idea, in 1868 Abbe asked from all of his correspondent observers full details as to the quantity, kind and direction of motion of each layer of clouds; these were telegraphed daily for publication in the Weather Bulletin of the Cincinnati Observatory, and for use in the weather predictions made at that time. Since January 1872 similar data have been regularly telegraphed for the use of the U.S. Weather Bureau in preparing forecasts, although the special cloud maps that were compiled thrice daily have not been published, owing to the expense. These data were also published in full in the *Bulletin of the International Simultaneous Meteorological Observations* for the whole northern hemisphere during the years 1875–1884. Abbe's work on the U.S. Eclipse Expedition to the West Coast of Africa in 1889–1890 was wholly devoted to the determination of the height and motions of the clouds by the use of his special form of the marine nephoscope. The use of such a nephoscope is to be strongly recommended, as it gives the navigator a means of determining the bearing of a storm centre at sea by studying the lower clouds, better than he can possibly do by the observation of the winds alone. The importance of cloud study has been especially emphasized by the International Meteorological Committee, which arranged for a complete year of systematic cloud-work by national weather bureaus and individual observatories throughout the world from May 1896 to June 1897. In this connexion H. H. Clayton of Blue Hill Observatory published a very comprehensive report on cloud forms in 1906. The complete report by Professor F. H. Bigelow on the work done by the U.S. Weather Bureau forms a part of the annual report for 1899, and constitutes a remarkable addition to our knowledge of the subject. Some preliminary account of this work was published in the *American Journal of Science* for December 1899.

Although all the international cloud-work of 1896–1897 has now been published in full by the individual institutions, as in the case of the International Polar Research Work of 1883, yet a comprehensive study of the results still remains to be made. Some of these have, however, been brought together in Mohn's discussion of the observations by Nansen during the voyage of the "Fram" and also in Hann's *Lehrbuch* and in Bigelow's *Report on Cloud-work*. The mean altitudes of cirrus and strato-cumulus clouds resulted as follows.

Place.	Latitude.	Cirrus.	St. cu.	Highest Cirrus.	Lowest Cirrus.
	°	kil.	kil.	kil.	kil.
Cape Thordsen	78·5	7·3	2·5	—	—
Bossekop, 1838–1842	70	8·3	1·3	11·8	5·5
Storlien	63·5	8·3	1·8	—	—
Upsala, 1884–1885	60	8·9	2·3	13·4	3·6
,, 1896–1897	60	8·2	1·8		
Pavlosk	60	8·8	1·9	11·7	4·7
Dantzig	54·5	10·0	2·2	—	—
Irkutsk	52·3	10·9	2·3	—	
Blue Hill, 1890–1891	42·5	9·0	3·2	—	—
Potsdam, summer	52	9·1	2·2	—	—
,, winter	52	8·1	1·4	—	—
Blue Hill, summer	42·5	9·5	1·2	15·0	5·4
,, ,, winter	42·5	8·6	1·6		
Toronto, summer	43·6	10·9	2·0	—	—
,, winter		10·0	1·5		
Washington, summer	39	10·4	2·9	16·5	5·0
,, winter		9·5	2·4		
Allahabad	25·5	12·4	3·5	—	—
Manila	15	10·9	2·0	18·0	4·0

The annual average velocity of hourly movement in metres per second without regard to direction may be summarized as follows:—

	500–2000.	2–4000.	4–6000.	6–8000.	8–10,000.	10–12,000	12–14,000.
	m.	m.	m.	m.	m.	m.	
Bossekop	6·5	7·3	12·5	15·4	19·0	24·4	—
Upsala	9·1	8·7	16·0	20·4	26·6	—	—
Potsdam	9·3	10·3	16·9	20·8	25·4	—	—
Blue Hill	9·8	14·2	17·1	34·3	34·2	(33)	—
Toronto	9·4	17·1	18·4	32·0	30·8	28·8	—
Washington[1]	(8·6)	14·6	17·3	20·3	25·8	(28·9)	26·8
Allahabad	3·4	6·4	13·0	17·6	22·3	20·7	34·0
Manila	5·5	7·1	6·5	8·0	13·6	13·0	13·4

The movements of the upper clouds are more rapid in winter than in summer at these northern stations, but among the median and lower clouds a retardation takes place apparently due to the ascending currents that form rain and snow. Above 8000 metres at Upsala the average velocity in winter exceeds 30 metres per second, whereas in summer it is 20; at Toronto and Blue Hill the absolute velocities are larger but in the same ratio. In the United States the maximum velocities from the west attain 100 metres per second and over 80 or 70 metres per second are not rare, but in Europe the corresponding figures are 70, 60, 50. (See also CLOUD.)

II.—METEOROLOGICAL APPARATUS AND METHODS

The observational basis of meteorology is the frequent and, if possible, continuous record of the temperature, moisture and barometric pressure at different altitudes in the free atmosphere, the direction and velocity of the wind, the rain and snow-fall, and the kind, amount and motion of the clouds. For Europe these data have been furnished with more or less accuracy and continuity by thousands of observers ever since 1653, when Ferdinand II., grand duke of Tuscany, organized a system of daily observations in Italy under the general supervision of Luigi Antinori. During the 19th century great efforts were made to obtain equally full records from all parts of the land and ocean, and thousands of navigators were added to the great corps of observers. Other matters have also been investigated, the most important being the intensity of radiation from the earth at night-time and from the sun by day-time, the optical phenomena of the sky, the amount of dust in the air, the electrical condition and the chemical constitution of the atmosphere. Although all the instruments used belong to the category of physical apparatus, yet certain points must be considered as peculiar to their use in connexion with meteorology.

Thermometer.—In using the thermometer to determine the temperature of the free air it is necessary to consider not merely its intrinsic accuracy as compared with the standard gas thermometer of the International Bureau of Weights and Measures at Paris, but especially its sluggishness, the influence of noxious radiations, the gradual change of its zero point with time, and the influence of atmospheric pressure.

Sensitiveness.—The thermometer indicates the temperature of the outside surface of its own bulb only when the whole mass of the instrument has a uniform temperature. Assuming that by appropriate convection we can keep the surface of the thermometer at the temperature of the air, we have still to remember that ordinarily this itself is perpetually changing both in rapid oscillations of several degrees and in diurnal periods of many degrees, while the thermometer, on account of its own mass or thermal inertia, always lags behind the changes in the temperature of its own surface. On the other hand, radiant heat passes easily through the air, strikes the thermometer, and raises its temperature quite independently of the influence of the air whose temperature we wish to measure. The internal sluggishness or the sensitiveness of the thermometer is usually different for rising and for falling temperatures, and is measured by a coefficient which must be determined experimentally for each instrument by observing the rate at which its indications change when it is plunged into a well-stirred bath of water whose temperature is either higher or lower than its own. This coefficient indicates the rate per minute at which the readings change when the temperature of the surface of the bulb is one degree warmer or colder than the temperature of the bath. Such coefficients usually vary between $\frac{1}{20}$th of a degree centigrade for sluggish thermometers, and one or two degrees for very sensitive thermometers. Suppose, for instance, that the coefficient is one-half degree, then when the rate of change in the temperature of the air is one degree per minute this is exactly the same as the rate of change which the thermometer itself undergoes when its own temperature is two degrees different from that of the air; consequently, the thermometer will lag behind the air temperature to that extent and by the corresponding amount of time, assuming that the air itself flows fast enough to keep the surface of the bulb at the air temperature. When the air temperature ceases to rise or fall, and begins to change at the same rate in the opposite direction, the thermometer will fail to record the true maximum or minimum temperature by an appreciable error depending upon the rapidity of the change, and will follow the new temperature changes with the same lag. For example, in the case just quoted, if a rising temperature suddenly changes to a falling temperature, the error of the thermometer at the maximum temperature will be two degrees, and yet the thermometer may be absolutely correct as compared with the standard when it is allowed five or ten minutes' time to overcome the sluggishness. It is very difficult to obtain the temperature of the free air at any moment within $\frac{1}{10}$th of a degree Centigrade, owing to the sluggishness of all ordinary thermometers and the perpetual variations in the temperatures of the atmospheric currents.

Radiation.—When a thermometer bulb is immersed in a bath of liquid all radiant heat is cut off, but when hung in the open air it is subject to a perpetual interchange of radiations between itself and all its surroundings; consequently its own temperature has only an indirect connexion with that of the air adjacent to it. One of the most difficult problems of meteorology is so to expose a thermometer as to cut off noxious radiations and get the true temperature of the atmosphere at a specific place and time. The following are a few of the many methods that have been adopted to secure this end: Melloni put the naked glass bulbs within open sheltering caps of perforated silver paper. Flaugergues used a protection consisting of a simple vertical cylinder of two sheets of silver paper enclosing a thin layer of non-conducting substance, like cotton or wool. The influence of radiation upon a thermometer depends upon the radiating and absorbing powers of its own surface; a roughened surface of lamp-black radiates and absorbs perfectly; one of chalk powder does nearly as well; glass much more imperfectly; while a polished silver surface reflects with ease, but radiates and absorbs with the greatest difficulty. Fourier proposed to use two thermometers side by side, one of plain glass and the other of blackened glass; the difference of these would indicate the effect of radiation at any moment; but instead of plain glass he should have used polished silver. His method was quite independently devised and used by Abbe in 1865 and 1866 at Poulkova, where the thermometers were placed within a very light shelter of oiled paper. In order to use this method successfully, both the black and the silvered thermometers should be whirled side by side inside the thermometer shelters (see *Bulletin of the Philosophical Society of Washington* for 1883). Various forms of open lattice-work and louvre screens have been devised and used by Glaisher, Kupffer, Stevenson, Stowe, Dove, Renou, Joseph Henry and others, in all of which the wind is supposed to blow freely through the screens, while the latter cut off the greater part of the direct sunshine and other obnoxious radiations by day, and also prevent obnoxious radiation from the thermometer to the sky by night. The Italian physicist Belli first proposed a special artificial ventilation drawing the fresh air from the outside and making it flow rapidly over the thermometer. Even before his day de Saussure, Espy, Arago and Bravais whirled the thermometer rapidly either by a small whirling machine, or by attaching it to a string and swivel and whirling it like a sling. When this whirling is done in a shady place excellent results are obtained. Renou and Craig placed the thermometer in a thin metallic enclosure or shelter, and whirled the latter. Wild established the thermometer in a fixed louvre shelter, but by means of a ventilating apparatus drew currents of fresh air from below into the shelter, where they circulated rapidly and passed out. In Germany, since 1885, Dr Assmann has developed the apparatus known as the ventilated psychrometer, in which the dry-bulb thermometer is placed within a double shelter of thin metallic tubing, and the air is drawn in rapidly by means of a small ventilating fan. In the observations made by Abbe on the cruise of the "Pensacola" to the West Coast of Africa, the dry- and wet-bulb thermometers were enclosed within bamboo tubes and rapidly whirled. The inside of the wet-bulb tube was kept wet, so that its surface, being cooled by evaporation, could not radiate injuriously to the thermometer. In the system of exposure adopted by the U.S. Weather Bureau the dry and wet bulbs are whirled by a special apparatus fixed within the louvred shelter, which is about 3½ ft. cube, and is placed far enough above the ground or building to ensure free exposure to the wind. In using the whirling and ventilating methods it is customary to take a reading after whirling one minute, and a second reading at the end of the second minute, and so on until no appreciable changes are shown in the thermometer. Of course in perfectly calm weather these methods can only give the temperature of the air for the exact locality of the thermometer. On the other hand, when a strong wind is blowing the indicated temperature is an average that represents the long narrow stream of air that has blown past the thermometer during the few minutes that are necessary in order that its bulb may obtain approximately the temperature of the air.

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[1] We have here inserted the Washington data as interpolated from the figures given by Hann, *Lehrbuch*, 1906, p. 282.]

Change of Zero.—All thermometers having glass bulbs, especially those of cylindrical shape, are sensitive to changes of atmospheric pressure. The freezing-point, determined under a barometric pressure of 30 in., or at sea-level, stands higher on the glass tube than if it had been determined under a lower pressure on a mountain top. Therefore delicate thermometers, when transported to great heights, or even during the very low pressure of a storm centre, read too low and need a correction for pressure. The zero-point also changes with time and with the method of treatment that the bulb has received as to temperature. Owing to the slow adjustment of the molecules of the glass bulb to the state of stable equilibrium, their relations among themselves are disturbed whenever the bulb is freshly heated. At this time the freezing-point is temporarily depressed to an amount nearly proportional to the heating. The normal method of treatment consists in first determining the boiling-point of the thermometer, and, after a few minutes, the freezing-point. If this method is uniformly followed the two fiducial points will stay in permanent relation to each other. A thermometer that has been used for many years by a faithful meteorological observer has almost inevitably been going through a steady series of changes; in the course of ten years its freezing-point may have risen by 2° or 3° F., and, moreover, it changes by fully a tenth of a degree between summer and winter. The only way completely to eliminate this source of error from meteorological work is to discard the mercurial thermometer altogether; but instead of adopting that course, the use is generally recommended of thermometers whose bulbs are made of a special glass, upon which heating and cooling have comparatively very little influence. Any argument as to secular changes in the temperature of the atmosphere is likely to be greatly weakened by the unknown influence of this source of error, as well as by changes in the methods of exposure and in the hours of observation.

Barometer.—The barometer (*q.v.*) indicates the elastic pressure prevailing in gas or liquid at the surface of the mercury in the open tube or cistern, provided that the fluid at that point is in a state of quiet relative to the mercury.

Any motion of the air will have an influence upon the reading quite independently of the prevailing elastic pressure. The pressure within a mass of gas at any point is the summation of the effects due to the motions of the myriad molecules of the gas at that point; it is the kinetic energy of the molecules striking against each other and the sides of the enclosure, which in this case is the surface of the mercury in the cistern of the instrument. If the barometer moves with respect to the general mass of the gas there is a change in the pressure on the mercurial surface, although there may be none in the general mass of the free gas, and a barometer giving correctly the pressure of the air at rest within a room will give a different indication if the instrument or the air is set in rapid motion so that the air strikes violently against it. If the barometer moves with the air it will indicate the elastic pressure within the air. When the wind blows against an obstacle the air pressure is increased slightly on the windward side and diminished on the leeward side. It is thus obvious that in determining the pressure within the free atmosphere the exposure of the barometer must be carefully considered. The influence of a gale of wind is to raise the elastic pressure within a room whose window faces to the windward, but to lower the pressure if the window faces to the leeward. The influence of the draught up chimney, produced by the wind blowing over its summit, is to lower the pressure within the room. The maximum effect of the wind in raising the pressure is given by the formula. $P-P_0 = 0{\cdot}000\ 038\ 3 \times V^2$, where the pressure is given in inches and the velocity in miles per hour. This amounts to about one-tenth of an inch in a 50-m. wind, and to nearly four-tenths in a 100-m. wind. The diminution by a leeward window or a draught up chimney is usually less than this amount. This alteration in pressure, due to the local effect of wind, does not belong to the free atmosphere but to the method of exposure of the barometer, and can be eliminated only by methods first described by Abbe in 1882: it is a very different matter from the general diminution of pressure in the atmosphere produced by the movement of the wind over a rotating earth and by the centrifugal force within a vortex. The latter is an atmospheric phenomenon, independent of instruments and locality, which in hurricanes and tornadoes may amount to several inches of the mercurial column. It is, however, quite common to find in the continuous records of pressure during a hurricane evidence of the fact that the low pressure due to the hurricane and the special diminution due to the exposure of the barometer are combined together, so that when the calm centre of a hurricane passes over a station the pressure temporarily rises by the amount due to the sudden stoppage of the wind and the local exposure effect.

The other sources of error that give rise to discrepancies in meteorological work relate to the temperature of the instrument, the sluggishness of the movement of the mercury, and the inevitable large secular changes in the correction for capillarity, due principally to the changes in the condition of the surfaces of the glass and the mercury, especially those that are exposed to the open air. The international comparisons of barometers show that discrepancies exist between the best normals or standards, and that ordinary barometers must always be compared with such standards at the temperatures and pressures for which they are to be used.

Anemometer.—The wind is measured either by means of its pressure against any obstacle or by revolving apparatus that gives some idea of the velocity of its movement. The pressure is supposed to interest the engineer and navigator, but the velocity is the fundamental meteorological datum; in fact, the pressure of the wind varies with the nature of the obstacle, the method of exposure, the density of the air, and even the mass of rain carried along with it.

Pressure anemometers date from the pendulous tablet devised by Sir Christopher Wren about 1667, and such pressure plates continue to be used in an improved form by Russian observers. Normal pressure plates are used at a few English and Continental stations. The windmill anemometers devised by Schober and Woltmann were modified by Combes and Casella so as to make an exceedingly delicate instrument for laboratory use; another modification by Richard is extensively used by French observers. In the early part of the 19th century Edgeworth devised and Robinson perfected a windmill system in which hemispherical cups revolved around a vertical axis, and these have come into general use in both Europe and America. Many studies have been made of the exact ratio between the velocity of the wind and the rotations of the Robinson anemometer. The factor 3 is usually adopted and incorporated into the mechanism of the apparatus, but in ordinary circumstances this factor is entirely too large, and the recorded velocities are therefore too large. The whirling cups do not revolve with any simple relation to the velocity of the wind, even when this is perfectly steady. The relation varies with the dimensions of the cups and arms and the speed of the wind, but especially with the steadiness or gustiness of the wind. The exact ratio must always be determined experimentally for each specific type of instrument; in most instruments in actual use the factor for steady wind varies between 2·4 and 2·6. When the wind is gusty the moment of inertia of the moving parts of the instrument necessitates an appreciable correction; thus, when the gust is at its height the revolving parts receive an impetus that lasts after the gust has gone down, so that the actual velocity of the cups is too high. For this reason, also, comparisons and studies of anemometers made in the irregular natural winds of a free air are unsatisfactory. For the average natural and gusty winds at Washington, D.C., and on Mount Washington, N.H., and the small type of Robinson's anemometer used in the U.S. Weather Bureau Service, Professor C. F. Marvin deduced the table (see p. 275) for reduction from recorded to true velocity. This table involves the moment of inertia of the revolving parts of the instrument and the gustiness of the winds at Washington, and will therefore, of course, not apply strictly to other types of instruments or winds, for which special studies must be made.

About 1842 a committee of the American Academy of Arts and Sciences experimentally determined, for a large variety of chimney caps, or cowls, or hoods, the amount of suction that produces the draught up a chimney, and shortly afterwards a similar committee made a similar investigation at Philadelphia (see *Proc. Amer. Acad.* i. 307, and *Journal of Franklin Institute*, iv. 101). These investigations showed that the open end of the chimney, acting as an obstacle in the wind, is covered by a layer of air moving more rapidly than the free air at a little distance, and that therefore between this layer and the aperture of the chimney there is a space within which barometric pressure is less than in the neighbouring free air. The draught up the chimney is due to the pressure of the air at the lower end or fireplace pushing up the flue into this region of low pressure, quite as much as it is due to the buoyancy of the heated air within the flue. From such experiments as these there has been developed the vertical suction-tube anemometer, as devised by Fletcher in 1867, re-invented by Hagemann in 1876, and introduced into England by Dines. In his *Meteorological Apparatus and Methods* (Washington, 1887) Abbe gives the theory of this class of anemometers and develops the following additional forms: Two vertical tubes, whose apertures are respectively directed to the windward and the leeward, and within which are two independent barometers, give the means of determining the barometric pressure plus the wind pressure and minus the wind pressure respectively, so that both the velocity of the wind and the true barometric pressure can be determined. If instead of a simple opening at the top of the tube we place there horizontally the contracted Venturi's tube, we obtain a maximum wind effect, which gives an accurate measure of the wind velocity, and is the form recommended by Bourdon as an improvement on that of Arson. In all anemometers of this class the inertia of the moving parts is reduced to a minimum, and the measurement of rapid changes in velocity and of the maximum intensity of gusts becomes feasible. On the other hand, these researches have shown how to expose a barometer so that it shall be free from the dynamic or wind effect even in a gale. It has only to be placed within a room or box that is connected with the free air by a tube that ends in a pair of parallel plane plates. When the wind blows past the end of this tube it flows between these plates in steady linear motion, and can produce no disturbance of pressure at the mouth of the tube if the plates are at a suitable distance apart. This condition of stable flow, as contrasted with permanent flow, was first defined by Sir William Thomson (Lord Kelvin) (see *Phil. Mag.*, Sept. 1887). Such a pair of small circular plates can easily be applied to a tube screwed into the air-hole at the back of any aneroid barometer, and thus render it independent of the influence of the wind.

Marvin's Table for the Reduction of Velocities, given by the small-sized Robinson's Anemometer in gusty winds.

Indicated Velocity.	True Velocity.									
Miles.	0	1	2	3	4	5	6	7	8	9
0	—	—	—	—	—	5·1	6·0	6·9	7·8	8·7
10	9·6	10·4	11·3	12·1	12·9	13·8	14·6	15·4	16·2	17·0
20	17·8	18·6	19·4	20·22	21·0	21·8	22·6	23·4	24·2	24·9
30	25·7	20·5	27·5	28·0	28·8	29·6	30·3	31·1	31·8	32·6
40	33·3	34·1	34·8	35·6	36·3	37·1	37·8	38·5	39·3	40·0
50	40·8	41·5	42·2	43·0	43·7	44·4	45·1	45·9	46·6	47·3
60	48·0	48·7	49·4	50·2	50·9	51·6	52·3	53·0	53·8	54·5
70	55·2	55·9	56·6	57·3	58·0	58·7	59·4	60·1	60·8	61·5
80	62·2	62·9	63·6	64·3	65·0	65·8	66·4	67·1	67·8	68·5
90	69·2	—	—	—	—	—	—	—	—	—

As to the exposure of the anemometer, no uniform rules have as yet been adopted. Since the wind is subject to exceedingly great disturbances by the obstacles near the ground, an observer who estimates the force of the wind by noticing all that goes on over a large region about him has some advantage over an instrument that can only record the wind prevailing at one spot. The practice of the U.S. Weather Bureau has been to insist upon the perfectly free exposure of all anemometers as high as can possibly be attained above buildings, trees and hills; but, of course, in such cases they give records for an elevated point and not for the ground. These are therefore not precisely appropriate for use in local climatological studies, but are those needed for general dynamic meteorology, and proper for comparison with the isobars and the movements of the clouds shown on the daily weather map.

Hygrometer.—Moisture floats in the atmosphere either as invisible vapour or as visible haze, mist and cloud. The presence of the latter generally assures us that the air is fully saturated. The total amount of both visible and invisible vapour contained in a unit volume of cloud or mist is directly determined by the Schwackhofer or Svenson hygrometer, or it may be ascertained by warming a definite portion of the air and fog and measuring the tension of the vapour by Edelmann's apparatus. Both these methods, however, are in practice open to many sources of error. If only invisible aqueous vapour is present we may determine its amount by several methods: (*a*) the chemical method, by absorbing and weighing it; (*b*) the dew-point method, by cooling the air down to the temperature where condensation begins; (*c*) Edelmann's method, by absorbing the moisture chemically and measuring the change in vapour tension; (*d*) by adding vapour until the air is saturated, and measuring either the increased tension or the quantity of evaporation; (*e*) the psychrometric method, by determining the temperature of evaporation.

The wet-bulb thermometer, which is the essential feature of the last method, was used by Baumé in 1758 and de Saussure in 1787, but merely as giving an index of the dryness of the air. The correct theory of its action was elaborated by many early investigators: Ivory, 1822; August, 1825; Apjohn, 1834; Belli, 1838; Regnault, 1845. From the last date until recent years no important progress was made in our knowledge of the subject, and it was supposed that the psychrometer was necessarily crude and unsatisfactory; but in its modern form it has become an instrument of much greater precision, probably quite as trustworthy as the dew-point apparatus or other method of determining atmospheric moisture. In order to secure this accuracy the two bulbs must be of the same size, style and sensitiveness; the wet bulb must be covered with thin muslin saturated with pure water; both thermometers must be whirled or ventilated rapidly, but at the definite prearranged rate for which the tables of reduction have been computed; and, finally, both thermometers must be carefully sheltered against obnoxious radiations. In order to attain these conditions European observers tend to adopt Assmann's ventilated psychrometer, but American observers adopt Arago's whirled psychrometer, set up within an ordinary thermometer shelter. By either method the dew-point should be determined with an accuracy of one-tenth degree C. or two-tenths F. As a crude approximation, we may assume that the temperature of the dew-point is below the temperature of the wet bulb as far as that is below the dry bulb. A greater accuracy can be attained by the use of Ferrel's or Marvin's psychrometric tables or Grossman's formula. But the vapour tension over ice and over water as measured by Marvin and by Juhlin must be carefully distinguished and allowed for. The Smithsonian Meteorological Tables (ed. of 1908) and the new psychrometer tables by Bjerkeland for temperatures below freezing (Christiania, 1907) represent the present condition of our knowledge of this subject. Glaisher deduced empirically from a large mass of observations certain factors for computing the dew-point, but these do not represent the accuracy that can be attained with the whirled psychrometer, nor are they thoroughly satisfactory when used with Regnault's tables and the stationary psychrometer. Especially should their use be discarded when the wet bulb is greatly depressed below the dry bulb and the atmosphere correspondingly dry. For occasional use at stations, and especially for daily use by travellers and explorers, nothing can exceed the convenience and accuracy of the sling psychrometer, especially if the bulbs are protected from radiation by a slight covering of non-conducting material, or even metal, as was done by Craig in 1866–1869 for the stations of the U.S. Army Surgeon-General. The hair hygrometer gives directly the relative humidity or the ratio between the moisture in the air and that which it would contain if saturated. The very best forms perform very well for a time, and are strongly recommended by Pernter, and must be used in self-recording apparatus for balloons and kites; they are standardized by comparison with the ventilated psychrometer, which itself must be dependent on the standard dew-point apparatus.

Rain and Snow Gauge.—The simple instrument for catching and measuring the quantity of rain, snow or hail that falls upon a definite horizontal area consists essentially of a vertical cylinder and the measuring apparatus. The receiving mouth of the cylinder is usually terminated by a cone or funnel, so that the water running down through the funnel and stored in the cylinder is protected from evaporation or other loss. The cylinder is firmly attached to the ground or building, so that the mouth is held permanently at a definite altitude.

The sources of error in its use are the spattering into it from the ground or neighbouring objects, and the loss due to the fact that when the wind blows against the side of the cylinder it produces eddies and currents that carry away drops that would otherwise fall into the mouth, and even carries out of the cylinder drops that have fallen into it. As a consequence all the ordinary rain-gauges catch and measure too little rainfall. The deficit increases with the strength of the wind and the smallness or lightness of the raindrops and snowflakes. If we assume that the correct rainfall is given by a gauge whose mouth is flush with the level of the ground and is surrounded by a trench wide enough to prevent any spatter, then, on the average of many years and numerous observations with ordinary rain-gauges in western Europe, and for the average character of the rain in that region and the average strength of the attending winds, the deficit of rain caught by a rain-gauge whose mouth is 1 metre above the ground is 6% of the proper amount; if its elevation is 1 ft. above ground, the deficit will be 3½%. This deficit increases as the gauges are higher above the ground in proportion approximately to the square root of the altitude, provided that they are fully exposed to the increase of wind that prevails at those altitudes. It is evident that even for altitudes of 5 or 10 ft. the records become appreciably discrepant from those obtained at the surface of the ground. The following table shows in the last column the observed ratio between the catches of gauges at various altitudes and those of the respective standards at the level of the ground. Unfortunately, there are no records of the force of the wind to go with these measurements; but we know that in general, and on the average of many years, corresponding with those here tabulated, the velocity of the wind increases very nearly as the square root of the altitude. Although this deficit with increasing altitude has been fully recognized for a century, yet no effort has been made until recent years to make a proper correction or to eliminate this influence of the wind at the mouth of the gauge. Professor Joseph Henry, about 1850, recommended to the observers of the Smithsonian Institution the use of the "pit-gauge." About 1858 he recommended a so-called shielded gauge, namely—a simple cylindrical gauge 2 in. in diameter, having a wide horizontal sheet of metal like the rim of an inverted hat soldered to it. This would undoubtedly diminish the obnoxious currents of air around the mouth of the gauge, but the suggestion seems to have been overlooked by meteorologists. In 1878 Prof. F. E. Nipher of St Louis, Missouri, constructed a much more efficient shield, consisting of an umbelliform screen of wire-cloth having about sixty-four meshes to the square inch. This shield seems to have completely annulled the splashing, and to have broken up the eddies and currents of wind. With Nipher's shielded gauges at different altitudes, or in different situations at the same altitude, the rain catch becomes very nearly uniform; but the shield is not especially good for snow, which piles up on the wire screen. Since 1885 numerous comparative observations have been made in Europe with the Nipher gauge, and with the "protected gauge" devised by Boernstein, who sought to prevent injurious eddies about the mouth of the gauge by erecting around it at a distance of 2 or 3 ft. an open board fence with its top a little higher than the mouth of the gauge. The boards or slats are not close together, but apparently afford as good a protection as the shield of Professor Nipher, and give good results with both snow and rain.

Altitude and Relative Catch of Rain.

Situation and Size of Gauge.	Years of Record.	Altitude.	Relative Catch.
		Metres.	%
		0	100
Calne, 5-in. and 8-in.	4	1	90
Castleton, 5-in. and 8-in.	3	2	88
Rotherham, 5-in.	8	3	86
St Petersburg: Central Physical		4	85
Observatory, 10-in.	10	5	85
		6	84
London: Westminster Abbey	1	9·1	77
Emden	2	11	72
St Petersburg: Central Physical Observatory	1	13	68
York: Museum	3	13	80
Calcutta: Alipore Observatory	7	15	87
Woodside: Walton-on-Thames	1	15	73
Philadelphia: Frankford Arsenal	3	16	95
Sheerness: Waterworks	3	21	52
Whitehaven: St James's Church	10	24	66
St Petersburg: Central Physical Observatory	10	25	59
Paris: Astronomical Observatory	40	27	81
Dublin: Monkstown	6	27	64
Oxford: Radcliffe Observatory	8	34	59
Copenhagen: Observatory	4	36	67
London: Westminster Abbey	1	46	52
Chester: Leadworks	2	49	61
Wolverhampton: Waterworks	3	55	69
York Minster	3	65	60
Boston: St Botolph's Church	2	79	47

In general it is now conceded by several high authorities that the measured rainfall must be corrected for the influence of the wind at the gauge, if the latter is not annulled by Nipher's or Boernstein's methods. A practicable method of measuring and allowing for the influence of the wind, without introducing any very hazardous hypothesis, was explained by Abbe in 1888 (see *Symons's Meteorological Magazine* for 1889, or the *U.S. Monthly Weather Review* for 1899). This method consists simply in establishing near each other several similar gauges at different heights above the ground, but in otherwise similar circumstances. On the assumption that for small elevations the diminution of the wind, like that of the rainfall, is very nearly in proportion to the square root of the altitude, the difference between the records for two different altitudes may be made the basis of a calculation which gives the correction to be applied to the record of the lower gauge, in order to obtain the rainfall that would have been caught if there were no wind. It is only when the catch of the gauge has been properly corrected for the effect of the wind on the gauge that we obtain numbers that are proper to serve for the purpose of determining the variation of the rainfall with altitude and locality, the influence of forests and the periodical changes of climate. Methods of measuring dew, frost, hail, sleet, *glatteis* and other forms of precipitation still remain to be devised; each of these has its thermodynamic importance and must eventually enter into our calculations.

It has been common to consider that the rain-gauge cannot be properly used on ships at sea, owing to the rolling and pitching of the vessel and the interference of masts and rigging; but if gauges are mounted on gimbals, so as to be as steady as the ordinary mariner's compass, their records will be of great importance. Experimental work of this sort was done by Mohn, and afterwards in 1882 by Professor Frank Waldo; but the most extensive inquiry has been that of Mr W. G. Black (see *Journal Manchester Geographical Society*, 1898, vol. xiv.), which satisfactorily demonstrates the practicability and importance of the marine rain-gauge.

Evaporometer.—The moisture in the atmosphere comes from the surface of the earth or ocean by evaporation, a process which goes on continually, replacing the moisture that is precipitated as rain, hail, snow and dew, and maintaining the total quantity of the moisture in the atmosphere at a very uniform figure. The rate of evaporation depends on the temperature, the dryness, and the velocity of the wind. It is not so important to meteorologists to know where the moisture comes from as to know its amount in the atmosphere, and in fact no method has yet been devised for determining how much moisture is given up by any specific portion of the earth, or ocean, or forest. Our evaporometers measure the quantity of moisture given off by a specific surface of water, but it is so difficult to maintain this water under conditions the same as obtain in nature that no conclusions can be safely deduced as to the actual evaporation from natural surfaces. The proper meteorological use of these evaporometers is, as integrating hygrometers, to give the average humidity of the air, the psychrometer giving the conditions prevailing at any moment.

Among the many forms of evaporometer the most convenient is that devised by Piche, which may be so constructed as to be exceedingly accurate. The Piche evaporometer consists essentially of a glass tube, whose upper end is closed hermetically, whereas the lower end is covered by a horizontal disk of bibulous paper, which is kept wet by absorption from the water in the tube. As the water evaporates its descent in the tube is observed, whence the volume evaporated in a unit of time becomes known. So long as the paper remains clean, and the water is pure, the records of the instrument depend entirely upon the evaporating surface, the dryness of the air, and the velocity of the wind. Careful comparisons between the Piche and the various forms of absolute evaporometers were made by Professor Thomas Russell, and the results were published in the *U.S. Monthly Weather Review* for September 1888, pp. 235–239. By placing the Piche apparatus upon a large whirling machine he was able to show the effect of the wind upon the amount of evaporation. This important datum enabled him to explain the great differences recorded by the apparatus established at eighteen Weather Bureau stations; based upon these results, he prepared a table of relative evaporation within thermometer shelters at all stations. The actual evaporations from ground and water in the sunshine may run parallel to these, but cannot be accurately computed. It is probable that Professor Russell's computations are smaller than the evaporations from shallow bodies of water in the sunshine, but larger than for deep bodies, like the great lakes, and for running rivers. Recent elaborate studies of evaporation have been undertaken in Egypt and in South Africa—but perhaps the most interesting case occurs in southern California. Here the Colorado river, having broken through its bounds, emptied itself into a great natural depression and formed the so-called "Salton Sea," about 80 m. long, 20 wide and 100 ft. deep, before it could be brought under control. This sea is now isolated, and will, it is hoped, dry up in eight or ten years. Meanwhile the U.S. Weather Bureau has established a large number of evaporation stations in and around it, and has begun the study not only of the relation between evaporation, wind and temperature, but of the eventual disposition of this evaporation throughout the atmosphere in the neighbourhood of the sea (see the Reports of Professor F. H. Bigelow in *U.S. Monthly Weather Review*, 1907–1909, as also the elaborate bibliography of evaporation in the same volumes). Although the influence of the evaporation on local climate is scarcely appreciable to our hygrometric apparatus, yet it is said to be so in the development and ripening and drying of the dates raised on the U. S. government experimental "date farm" a few miles north-east of the Salton Sea.

Nephoscope.—The direction and apparent velocity of the motion of a cloud are best observed by means of the nephoscope, which has now become a necessary item in the outfit of any first-class meteorological station. Among the various forms of this instrument are the nephodoscope of Fornioni, the marine nephoscope of Fineman, the simple mirror with attachments used by Clayton, the cloud camera of Vettin, and the alt-azimuths of Mohn and Lettry. The most perfect form for use on land is that devised by Professor Marvin in 1896 for the U.S. Weather Bureau stations (see fig. 2); while the most convenient for use at sea is that devised and used in 1889 by Professor Abbe on the cruise of the U.S. ship "Pensacola" to the west coast of Africa, but first described in the report of the International Meteorological Congress held at Chicago in August 1893.

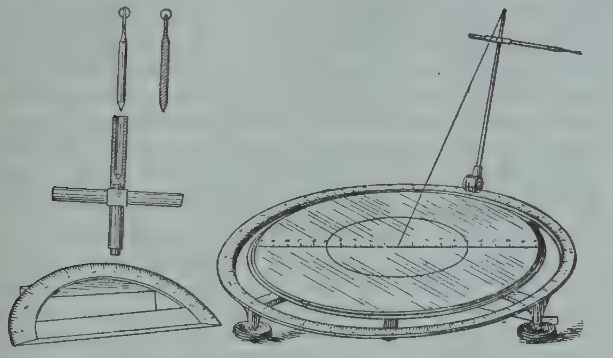

FIG. 2.—Marvin's Nephoscope.

The construction of this instrument is shown in figs. 3, 4, 5. In using it the observer looks down upon a horizontal mirror and observes the reflection of the cloud. By moving his eye he brings any cloudy point into coincidence with the reflection of a small fixed spherical knob K above the mirror, and keeps the images of the knob and the cloud coincident as they pass from the centre of the mirror to its edge. This line of motion shows the azimuth of the horizontal component of the cloud's motion. The course of the vessel is shown by the compass card and lubber line AF seen below the mirror. The apparent angular velocity of the cloud, as it would be if the cloud started from the zenith, is obtained by counting the seconds that elapse between its passage from the centre to the edge, or to a small circle inscribed within the edge. With Marvin's nephoscope two observers a short distance apart may easily determine the apparent altitude, and azimuth, and motion of any cloud, whence its true altitude and velocity may be computed. But when the observer uses Abbe's marine nephoscope on a vessel which is itself in motion he observes the resultant of his own motion and that of the cloud. If his vessel is under his control, so that he may change its velocity or direction at will, he easily determines this resultant for two different courses, and obtains data by which he is enabled to calculate the real altitude and velocity of the cloud in terms of his own velocity. As the marine nephoscope can be used on a wagon moving rapidly over a smooth road, or in a small boat on a smooth pond, almost as well as on a larger sea-going vessel, it becomes an instrument of universal application for cloud study. It is also equally convenient for observing the positions of auroras, halos, meteors, and other special phenomena. For the international work undertaken during the year 1898 the photographic camera established upon an alt-azimuth mounting, or the so-called photogram-meter, was especially developed. In this apparatus photographs of the clouds are taken simultaneously at two or more stations, and in each case the centre of the photographic plate has its altitude and azimuth determined. From this centre one can measure on the plate the additional angles required in order to fix the altitude and azimuth of any point that is photographed, and thus the dimensions of the whole visible cloud and its internal or differential motions can be determined, as well as its general motion. During the years 1896–1898 about twenty stations were occupied throughout the world for the purpose of determining accurately the altitudes and motions of every layer of cloud.

Sunshine Recorder.—The ordinary meteorological record specifies the proportion of sky that appears to be covered with cloud, or the so-called cloudiness, usually expressed in tenths. The observer generally confines his attention to that portion of the sky within sixty degrees of the zenith, and ignores the lower zone, since the clouds that are found therein are often at so great a distance from him that their record is not supposed to belong to his locality. As the cloudiness—or its reciprocal, the sunshine—is supposed to be the most important item in agricultural climatology, and is certainly very important for dynamic meteorology, it is usually considered desirable to obtain more complete records than are given by only one or two specified hours of observation. To this end apparatus for recording sunshine, or, rather, the effect of cloudiness, is widely adopted. At least three forms are worth describing as being extensively used.

The *Jordan photographic sunshine recorder* consists of a cylinder enclosing a sheet of sensitive paper; the sun's rays penetrate through a small aperture, and describe a path from sunrise to sunset, which appears on this sheet after it has been properly washed with the fixing solution. Any interruption in this path, due to cloudiness or haze, is of course clearly shown, and gives at once the means of estimating what percentage of the day was clear and what cloudy. The modified form of the instrument devised by Professor Marvin has been used for many years at about forty Weather Bureau stations, but the original construction is still employed by other observers throughout the world. The *Stokes-Campbell recorder* consists of a globe of glass acting as a burning-glass. A sheet of pasteboard or a block of wood at the rear receives the record, and the extent of the charring gives a crude measure of the percentage of full or strong sunshine. Many of these instruments are used at stations in Great Britain and the British colonies. The *Marvin thermometric sunshine recorder* consists of a thermometer tube, having a black bulb at the lower end and a bright bulb at the other. The excess of temperature in the black bulb causes a thread of mercury to move upwards, and for a certain standard difference of temperature of about 5° F., such as would be produced by the sun shining through a very thin cloud or haze, a record is made by an electric current on a revolving drum, and simply shows when during the day sunshine of a certain intensity prevailed, or was prevented by cloudiness. D. T. Maring, in the *U.S. Monthly Weather Review* for 1897, described an ingenious combination of the thermometer and the photographic register of cloudiness which is worthy of further development. It gives both the quantity of cloudiness and intensity of the sunshine on some arbitrary relative scale.

The intensity of the sunshine, as sometimes employed in general agricultural studies, is crudely shown by Violle's conjugate bulbs, which are thin copper balls about 3 in. in diameter, one of them being blackened on the outside and the other gilded. When exposed to the sunshine the difference in temperature of the two bulbs increases with the intensity of the sunshine, but as the difference is dependent to a considerable extent on the wind, the Violle bulbs have not found wide application. The Arago-Davy actinometer, or bright and black bulbs *in vacuo*, constitutes a decided improvement upon the Violle bulbs, in that the vacuous space surrounding the thermometers diminishes the effect of the wind. The physical theory involved in the use of the Arago-Davy actinometer was fully developed by Ferrel, and he was able to determine the coefficient of absorption of the earth's atmosphere and other data, thereby showing that this apparatus has considerable pretensions to accuracy. In using it as contemplated by Arago and Davy and by Professor Ferrel, we read simply the stationary temperature attained by the bright and black thermometers at any moment, whereas the best method in actinometry consists in alternately shading and exposing any appropriate apparatus so as to determine the total effect of the solar radiation in one minute, or some shorter unit of time; this method of using the Arago-Davy actinometer was earnestly recommended by Abbe in 1883, and in fact tried at that time; but the apparatus and records were unfortunately burned up. This so-called dynamic, as distinguished from the static, method was first applied by Pouillet in 1838 in using his pyrheliometer, which was the first apparatus and method that gave approximate measures of the radiant heat received from the sun. In order to improve upon Pouillet's work more delicate apparatus has been constructed, but the fundamental methods remain the same. Thus Ångström has applied both Langley's bolometer and his own still more sensitive thermoelectric couple and balance method; Violle uses his absolute actinometer, consisting of a most delicate thermometer within a polished metal sphere, whose temperature is kept uniform by the flow of water; while Crova, with a thermometer within an enclosure of uniform temperature, claims to have attained an accuracy of one part in a thousand. Chwolson has reviewed the whole subject of actinometry, and has shown the greater delicacy of his own apparatus, consisting of two thin plates alternately exposed to and shielded from sunshine, whose differences of temperature are measured by electric methods.

As none of the absolute methods for determining the solar radiation in units of heat lend themselves to continuous registration, it is important to call attention to the possibility of accomplishing this by chemical methods. The best of these appears to be that devised by Marchand, by the use of a device which he calls the Phot-antitupimeter. In this the action of the sunlight upon a solution of ferric-oxalate and chloride of iron liberates carbonic acid gas, the amount of which can be measured either continuously or every hour; but in its present form the apparatus is affected by several serious sources of error.

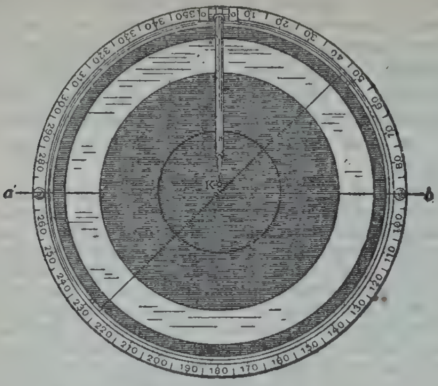

FIG. 3.—Abbe's Marine Nephoscope. Horizontal Projection of Mirror.

The electric compensation pyrheliometer, as invented by Knut Angström (*Ann. Phys.*, 1899), offers a simple method of determining accurately the quantity of radiant energy. He employs two blackened platinum surfaces, one of which receives the radiations to be measured, while the other is heated by an electric current. The difference of temperature between the two disks is determined by a thermocouple, and they are supposed to receive and lose the same amount of energy when their temperatures are the same. A Hefner lamp is used as an intermediate standard source of radiation, and alternate observations on any other source of radiant heat give the means of determining their relation to each other. By means of two such instruments Angström secured simultaneous observations on the intensity of the solar radiation at two points, respectively, 360 and 3352 metres above sea-level, and determined the amount of heat absorbed by the intermediate atmosphere. An accuracy of 1–1000 appears to be attainable, and this apparatus is now being widely used. The records of 1901–1905 have already given rise to the belief that there is a variation in our insolation that may eventually be traced back to the sun's atmosphere.

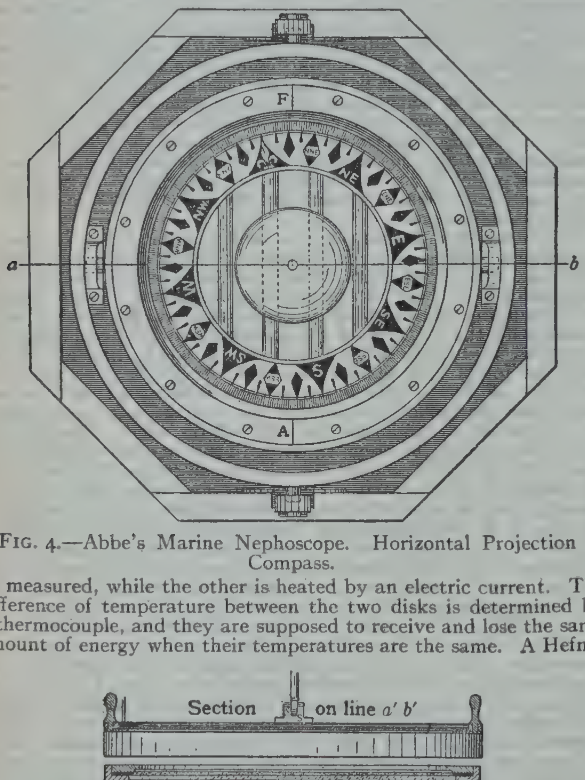

FIG. 4.—Abbe's Marine Nephoscope. Horizontal Projection of Compass.

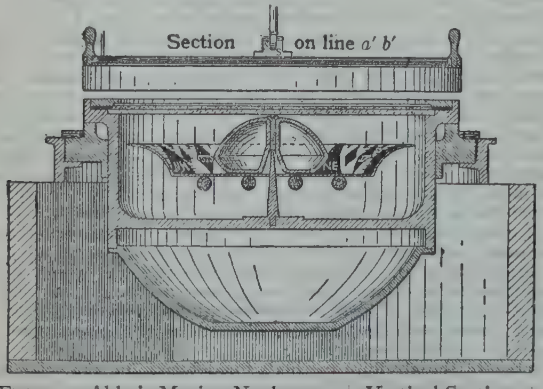

FIG. 5.—Abbe's Marine Nephoscope. Vertical Section.

Meteorograph.—The numerous forms of apparatus designed to keep frequent or continuous register of the prevailing pressure, temperature, moisture, wind, rainfall, sunshine, evaporation, and other phenomena are instruments that belong peculiarly to meteorology as distinguished from laboratory physics. Such apparatus may be broadly divided into several classes according as the records are obtained by the help of photography, or electricity, or by direct mechanical action. The prevailing tendency at present is in favour of apparatus in which the work of the recording pen is done by a falling weight, whose action is timed and limited by the making and breaking of electric currents by the meteorological apparatus proper. The most serious defect in such instruments, even when kept in good working order, is a want of sensitiveness commensurate with the desired openness of scale. It is very important that a fraction of a minute of time should be as recognizable as one-tenth of a degree of temperature; one thousandth of an inch of barometric pressure, and velocities of one hundred miles per hour, as well as rapid changes in all these elements, must be measurable. But instruments whose scales are large enough to record all these quantities are usually so sluggish as regards time that the comparison of the records is very unsatisfactory. In order to study the relationships between temporary and fleeting phenomena, it is necessary that all instruments should record upon the same sheet of paper, so that the same time-scale will answer for all.

The instruments that respond most nearly to the general needs of meteorology are the various forms of meteorographs devised by Wild for use at St Petersburg, by Sprung and Fuess for use at Hamburg and Berlin, and by Marvin for Washington. The photographic systems for pressure and temperature introduced many years ago at stations in Great Britain and the British colonies are not quite adequate to present needs. The portable apparatus manufactured by Richard Frères at Paris is in use at a very large number of land stations and on the ocean, and by giving special care to regular control-observations of time, pressure and temperature, important results may be obtained; but in general the time-scales are too small, and the unknown sources of error too uncertain, to warrant implicit reliance upon the records.

Polarimeter.—The brightness and blueness of the sky light, and especially its polarization, have been observed with increasing interest, as it seems possible from these elements to ascertain something with regard to the condition and amount of the moisture of the air. With a simple Nicol's prism held in the hand and turned slowly about the axis of vision one can quickly recognize the fact that the sky light is polarized, and that the polarization is largely due to the air or dust lying between us and the clouds in the distant horizon. Arago, with a more delicate form of polariscope, determined the existence of a so-called neutral region near the sun. Babinet located a neutral point or zone about as far from the anti-sun as was Arago's from the sun itself. Brewster discovered a neutral point near the sun and horizon, disappearing when the sun is more than 15° above the horizon. Finally, Brewster explored the sky sufficiently to draw lines of equal polarization, which he published in Johnston's *Physical Atlas*, and which were confirmed by Zantedeschi in 1849. Since those days far more delicate work has been done—first by Bosanquet of Oxford, afterwards by Prof. E. C. Pickering of Harvard University and Prof. A. W. Wright of Yale University. A later contribution to the subject is by Jensen (see *Met. Zeit.* for Oct.–Dec. 1899), who has observed the brightness as well as the polarization, and thus completed the data necessary for testing the various physical theories that have been proposed for the explanation of this phenomenon. We owe to Tyndall the discovery that when a beam of white light penetrates a mass of fine aqueous mist the latter sends off at right angles a delicate blue light, which is almost wholly polarized in a plane at right angles to the plane of reflection. As the particles of mist grow larger, the blue light becomes whiter and the polarization disappears. The original vapour particles are undoubtedly so small as to be comparable in size with a fraction of the wave-length of ordinary light, and Rayleigh was able to show that molecular as well as minute particles must have a power of selection, and that the diffused sky light comes to us by selective reflection. On this basis we should expect that in the driest air at great heights, where the temperature is low and condensation has but just begun, and the dust particles are rare, there would occur the smallest aqueous particles reflecting light of the feeblest intensity but the largest percentage of polarization. Rayleigh has shown that it is quite possible that the molecules of oxygen and nitrogen constituting the atmosphere may also exercise a diffuse selective reflection, and contribute to the brightness and polarization that are mainly due to aqueous vapours. (See SKY.)

We thus see the theoretical importance of adding photometry and polarimetry to the work of a meteorological observatory. The apparatus to be used in this connexion will vary somewhat with the exact character of the observations to be made. The most extensive researches that have yet been carried out in this line with a meteorological application in view are those of Jensen, Crova, Cornu, Pickering, Kimball, Nichols, and especially Rubenson, who in fact recommended that polarimetry and photometry should go hand in hand. In order to measure the position of the plane of polarization the Arago polariscope may be used, but, in order to measure the percentage of polarized light, Mascart's modification of the Savart is better. In order to measure the general brightness of a spot in the sky, Jensen has used a slight modification of the Weber photometer, and in fact Weber himself has applied the same method to the measurement of the daylight. The complete work of Jensen was published in the *Schriften* of the Scientific Association of Schleswig-Holstein in 1899, and, like the memoir published by Rubenson in 1863, it gives the meteorological conditions in full as a basis for the investigation of the connexion between sky light and the moisture in the atmosphere. In his work during 1906–1909 with Ångström's pyrheliometer Mr A. H. Kimball of Washington has advantageously used the Pickering polarimeter, and has shown that the transparency of the air and the polarization of light go hand in hand.

Cyanometer.—The cyanometer devised by Arago to measure the blueness of the sky consisted of an arbitrary scale of blues on a strip of porcelain, with which one could compare the blue of the sky. This comparison, however, is open to many subjective errors. A more satisfactory apparatus is Zollner's photometer, or some equivalent, in which a patch of white surface is illuminated by any particular tint or combination that may be desired. In fact, Maxwell's colour-box admits of ready application to the analysis of sky light, and reveals at once the proportions of red, yellow, and blue that may be contained therein.

Dust-counter.—The importance of observing the dustiness of the atmosphere has been especially realized since the invention and use of various forms of apparatus for counting the number of particles of dust in a small volume of air. These inventions are due to Mr John Aitken, of Edinburgh.

The latest form of his apparatus is the very convenient "pocket dust-counter." In this the air contained in a small receiver is rendered dustless by repeated expansions; the cooling due to expansion forces the vapour to condense upon the dust, which, becoming heavy, falls to the bottom, so that in a short time all is removed. A small stop-cock is now turned, so as to allow a definite small quantity of air to enter and mix with the dustless air in the receiver. The dusty and the dustless airs are now thoroughly mixed, and again the whole quantity within the receiver is expanded, and the dust nuclei fall down by the condensation of vapour upon them. Assuming that every particle of dust is represented by a minute droplet of water, we have but to count the latter; this is easily done by causing all the drops to fall upon a polished plate of black glass, which is divided into small squares by fine lines ruled with a diamond point. Usually each of these squares represents a small fraction of a cubic centimetre of air; thus in one case the number of fog particles averaged 2·6 per square millimetre of the glass plate, and, as the multiplying factor was 100, this corresponded to 260 particles of dust in a cubic centimetre of air. The cleanest air has been found in the West Highlands of Scotland, where 16 particles per cubic centimetre was once recorded as the minimum, while 7600 was the maximum. On the Rigi Kulm, in Switzerland, the cleanest air gave 210, and the dustiest 16,500. On comparing the records of the dust-counter with the record of the apparent state of the air, Mr Aitken found that 500 particles per cubic centimetre corresponded to clear air, and 1900 to a thick haze in which distant mountain tops were hidden. In the cities the particles of soot and effluvia of all kinds act as dust, and both in London and Paris the numbers ran as high as 80, 116, 150 and 210 thousand per cubic centimetre.

Electrical Apparatus.—The electrical phenomena of the atmosphere undoubtedly belong to meteorology, and yet the methods of observation have been so unsatisfactory and the difficulty of interpreting the results has been so baffling that regular observations in electricity are only carried out at a very few meteorological institutions. A general summary of our knowledge of the subject was prepared by J. Elster and H. Geitel for the International Congress held at Chicago in 1893, but since that date the methods and apparatus of observation have received important modifications.

In general the water-dropping collector of Lord Kelvin, arranged for continuous record by Mascart, continues to be the best apparatus for continuous observation at any locality, and a portable form of this same apparatus is used by explorers and in special series of local observations. In order to explore the upper air the kite continues to be used, as was done by A. J. McAdie for the Weather Bureau in 1885 and by Weber at Kiel in 1889. The difference of potential between the upper and lower end of a long vertical wire hanging from a balloon has been measured up to considerable altitudes by Elster and Tuma. In general it is known that negative electricity must be present in the upper strata just as it is in the earth, while the intervening layer of air is positively electrified. The explanation of the origin of this condition of affairs is given in the recent researches of Sir J. J. Thomson (*Phil. Mag.*, Dec. 1899), and his interpretation is almost identical with that now recognized by Elster (see *Terrestrial Magnetism*, Jan. 1900, iv. 213). According to these results, if positive and negative ions exist in the upper strata and are carried up with the ascending masses of moist air, then the condensation of the moisture must begin first on the negative ions, which are brought down eventually to the earth's surface; thus the earth receives its negative charge from the atmosphere, leaving a positive charge or an excess of positive ions in the middle air. (See G. C. Simpson, "Atmospheric Electricity," *Monthly Weather Review*, Jan. 1906, p. 16.)

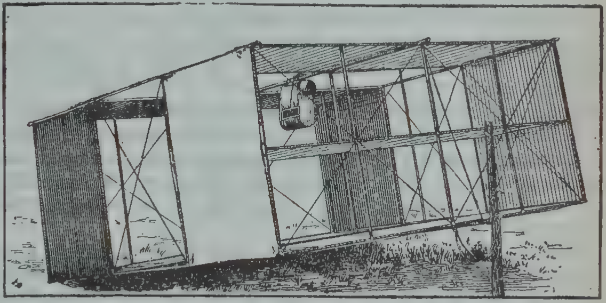

FIG. 6.—Marvin-Hargrave Kite, with Meteorograph in position.

The observations of atmospheric electricity consist essentially in determining the amount and character of the difference of potential between two points not very far distant from each other, as, for instance, the end of the pipe from which the water-drops are discharged, and the nearest point of the earth or buildings resting on the earth. The record may have only an extremely local value, thus the investigations of Professor John Trowbridge of Harvard University, made in conjunction with the U.S. Weather Bureau in 1882–1885, show that the differences vary so much with the winds, the time of day, and the situation of the water-dropper that the mere comparison of records gives no correct idea of the general electrical relationships. It has been suggested that possibly daily telegrams of electric conditions and daily maps of equipotential curves over the North American continent would be of help in the forecasting of storms, but it is shown to be useless to attempt any such system until some uniform normal exposure can be devised. Indeed it has not yet been shown that atmospheric electricity is of importance in dynamic meteorology. (See ATMOSPHERIC ELECTRICITY.)

Kites.

Aerial Research.—The exploration of the upper atmosphere is to be regarded as the most important field of research at the present time; the kite and the balloon enable observers and apparatus to be carried to considerable heights, though by no means so far as is desirable. The kite was first used in meteorological work by Alexander Wilson at or near Glasgow in 1749, and has since then been frequently used by English observers. It was used in 1867 by Abbe in studying the winds under a thundercloud, and in 1877 in

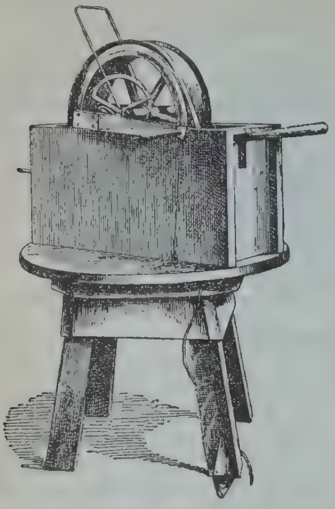

FIG. 7.—Marvin Kite Reel for hand power.

studying the depth of the ocean breeze on the coast of New Jersey, but the later revival of interest in the subject dates from the work done in England in 1882 by E. D. Archibald, who used the kite to carry up anemometers to very considerable heights, and thereby determined the relative movement of the air in the free atmosphere. In 1883 Alexander McAdie used the kite in his studies of atmospheric electricity, Professor Cleveland Abbe proposed to use it for a complete exploration as to temperature, moisture and wind, but W. A. Eddy of New York first forced its varied capabilities upon public attention, and accepted the suggestion of Professor Cleveland Abbe to employ it for meteorological work. Having flown his kites at the Blue Hill Observatory, and having carried up with them the self-registering apparatus devised by Mr Ferguson, Eddy left the further prosecution of this work to Mr Rotch, who has made this a prominent feature of the work at his observatory, having carried up meteorographs to the height of 15,000 feet by means of a series of kites flying in tandem. The officials of the U.S. Weather Bureau have developed the admirable cellular kite, invented by Hargrave of Australia, and Professor Marvin's works on the theory and construction of this form are well known.

The general appearance of the Marvin or Weather Bureau kite, his reel and other apparatus that go with it, and his meteorograph, are shown in Figs. 6, 7, 8. The size ordinarily used carries about 68 sq. ft. of supporting surface of muslin tightly stretched on a light wooden frame. The line, made of the best steel piano-wire, is wound and unwound from a reel which keeps an automatic record of the intensity and direction of the pull. The reeling in and out may be done by hand, but ordinarily demands a small gas-engine. The observer at the reel makes frequent records of the temperature, pressure and wind, the apparent angular elevation of the kite, and the length of wire that is played out. At the kite itself the Marvin meteorograph keeps a continuous record of the pressure, temperature, humidity and velocity of the wind. The meteorograph, with its aluminium case, weighs about two pounds, and is so securely lashed behind the front cell of the kite that no accident has ever happened to one, although the kites sometimes break loose and settle to the ground in a broken country many miles away from the reel. On four occasions the line has been completely destroyed by slight discharges of lightning; but in no case has the kite, the observer, or the reel been injured thereby. Of course, such lightning is preceded by numerous rapidly increasing sparks of electricity from the lower end of the wire, which warn the observer of danger. During the six months from May to October 1898, seventeen kite stations were maintained by the U.S. Weather Bureau in the region of the lakes, the Upper Mississippi and the Lower Missouri valleys, in order to obtain data for the more thorough study of atmospheric conditions over this particular part of the country. During these months 1217 ascents were made, and as no great height was attempted they were mostly under 7000 or 8000 feet. There was thus obtained a large amount of information relating to the air within a mile of the earth's surface. The general gradients of temperature, which were promptly deduced and published by H. C. Frankenfield in 1899 in a bulletin of the Weather Bureau, gave for the first time in the history of meteorology trustworthy observations of air temperatures in the free atmosphere in numbers sufficient to indicate the normal condition of the air.

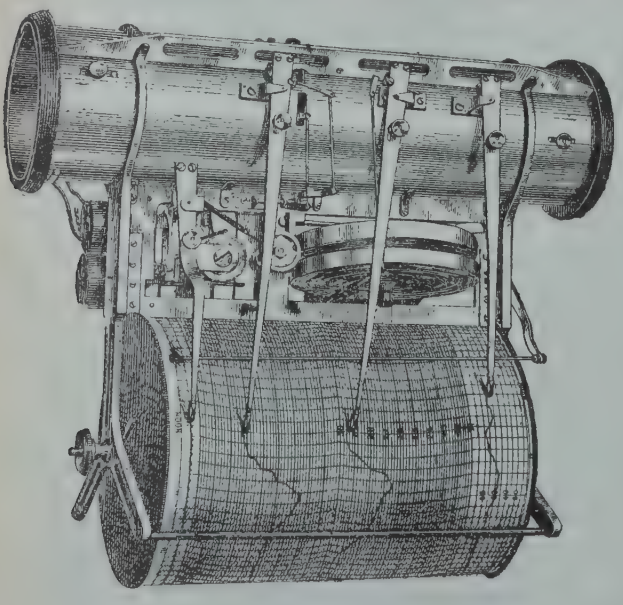

FIG. 8.—Marvin Kite Meteorograph.

The kite and meteorograph have now been adopted for use by all meteorologists. The highest flight seems to be that of the 3rd of October 1907, at Mt Weather in Virginia, when 23,110 ft. above sea-level or 21,385 ft. above the reel was attained by the use of 37,300 ft. of wire and 8 kites tandem.

Balloon.

The balloon was used for the scientific exploration of the atmosphere quite freely during the 19th century. The first important voyages were those of Gay-Lussac and Biot at Paris in August and September of 1804. The next important ascent was that of Bixio and Barral in 1850 at Paris. The most remarkable high ascents have been those of James Glaisher, 2nd of September 1862, and Berson at Berlin in 1889; on both of these occasions the aeronauts attained altitudes of from 30,000 to 35,000 feet. Systematic ascents at many points in Europe simultaneously on pre-arranged dates were made during the years 1895–1899, and led to the development of a general international system of ascension on pre-arranged days of the year that is now a very important feature in the study of the atmosphere.

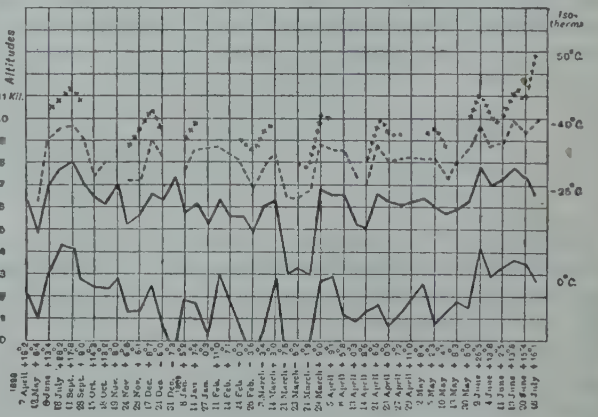

FIG. 9.—Chart of Isotherms in Free Air above Trappes.

This diagram shows the height at which the isotherms of 0°, −25°, −40°, −50° C. were encountered on the respective dates. Below the ground-line are given both the dates and the temperatures of the air observed at the ground when the balloon started on each ascent. The isotherms of −40° and −50° are not given for certain ascents, because in these the balloon did not rise high enough to encounter those temperatures.

Owing to the great risk of human life in these high ascents and especially to the fact that we desire records from still greater heights, efforts have been made to devise self-recording apparatus that may be sent up alone to the greatest heights attainable by free hydrogen balloons carrying the least possible amount of ballast. The pioneer in this new field of work was Léon Teisserenc de Bort of Paris. As these ascensions are made with great velocity, and therefore as nearly vertical as possible, he called them "soundings," because of their analogy to the mariner's usage at sea, and his balloon is called a "sounding balloon." The balloons of silk collapse, those of india-rubber explode, and descend about as rapidly as they ascended, Such balloon soundings have been made not only individually, but, by pre-arranged system, simultaneously in combination with the ascent of free-manned balloons above referred to; and at some places kites have been simultaneously used in order to obtain records for the lower atmosphere. The first experiments in simultaneous work were made in 1896 and 1897, when ascents were made at eight or more points in France, Germany and Russia. These experiments and the discussions to which they gave rise have emphasized the importance of increasing the sensitiveness of the self-recording apparatus, and as far as practicable the rapidity of the ventilation of the thermometers, and of providing more perfect protection against radiation from the sun or to the sky. It is believed that accurate records may be attained up to at least 30,000 metres, but as yet only 26,000 has been attained, and the records brought back are still under considerable criticism on account of instrumental defects. In general the wind that supports a kite also furnishes sufficient ventilation for the thermometer; but in the case of the sounding balloon, which as soon as its rapid rate of ascent diminishes floats along horizontally in the full sunshine, a strong artificial ventilation must be provided. Moreover, the sluggishness of the best thermometers is such that during the rapid rise the records of temperature that are being made at any moment really belong to some altitude considerably below the balloon, and a most critical interpretation of the records is required. Notwithstanding all criticisms, however, the balloon work in all localities agrees in showing the existence of a region above the 10,000-metre level, where temperatures cease to diminish rapidly, and may even become stationary.

III.—PHYSICAL AND THEORETICAL METEOROLOGY

The ultimate aim of those who are devoted to any branch of science is to penetrate beyond the phenomena observed on the surface to their ultimate causes, and to reduce the whole complex of observations and empirical rules based upon limited experiences to a simple deductive system of mechanics in which the phenomena observed shall be shown to flow naturally from the few simple laws that underlie the structure of the universe. A correct "theoria" or physical and logical argumentation deducing from primary laws all the phenomena constitutes the noblest achievement of man in science. It is by such works that Newton and Laplace distinguished themselves in astronomy. The development of the true physical and mechanical theories of atmospheric phenomena has made great progress, but is still inferior in completeness to astronomical work, owing to the great complexity of the meteorological problems. The optical and the thermal phenomena have been very satisfactorily elucidated, the electrical phenomena promise to become clear, but the phenomena of motion or aerodynamics have only been elucidated to a limited extent. We must, however, introduce the reader to some of the works that have been published on the subject, in the hope that thereby he will himself be persuaded to further study and stimulated to contribute to our knowledge.

Between the years 1853 and 1861 Professor William Ferrel published in *Gould's Astronomical Journal*, *Runkle's Mathematical Monthly*, and the *American Journal of Science* several treatises on the motions of solids and fluids relative to the earth's surface. His work resulted in the elucidation of the problems of the atmosphere, and in ingenious ways, applicable approximately to such complex cases, and analytically equivalent to the arithmetical method of quadratures or the graphic methods of geometry, he deduced important relations between the density of the air, the barometric pressure, and the attending winds. His essays seemed to show that it might be possible to treat the complex problems of meteorology logically and deductively by analytical, numerical and graphic processes, and his memoirs were the first in which observed average meteorological conditions were properly co-ordinated with the fundamental formulae of mechanics. A beautiful memoir on the steady motions of the atmosphere was published in 1868 in the *Astronomische Nachrichten* by Professor Adolph Erman, and is now reprinted in vol. ii. of Abbe's *Mechanics of the Earth's Atmosphere.* Espy's, Coffin's, Henry's and Ferrel's ideas were made the basis of the system of daily weather predictions published by the present writer in 1869 in the *Daily Weather Bulletin* of the Cincinnati Observatory. Subsequently this work was taken up by the government, and greatly enlarged during 1871–1891 by the chief signal officers of the army, and after 1891 by the chiefs of the U.S. Weather Bureau. Ferrel's writings first attracted the attention of European meteorologists in consequence of reviews published by Hann in the *Zeitschrift* of the Austrian Meteorological Society in January 1875, but especially after they had been reprinted in a convenient form by the U.S. Signal Office as "Bulletin No. VIII." In 1881 Ferrel, after finishing his works on the tides for the U.S. Coast and Geodetic Survey, began a new and extensive series of meteorological contributions, three of which were published by the U.S. Coast Survey and the rest by the Signal Office. Stimulated by the urgent needs of the modern weather bureaus throughout the world, and by the beauty of the mathematical problems presented, numerous mathematicians have lately taken up the study of the earth's atmosphere, so that the literature of the subject is now far more extensive than is generally supposed, including memoirs by Helmholtz, Kelvin, Bjerknes and other famous men.

In addition to the purely mechanical problems, the numerous physical problems have also been carefully treated, both experimentally and mathematically. The problems of radiation have been elucidated by Langley, Hutchins, Angström, Paschen, Violle, Maurer, Crova, Chwolson, Very, Homin, Tamura, Trabort and Coblendz. The thermodynamic problems have been especially developed by Kelvin, Hertz, von Bezold, Ferrel, Brillouin, Neuhoff, Bigelow and Margules. The physical problems involved in the formation of rain-drops have been studied by an optical method by Carl Barus, and with brilliant success, from an electrical point of view, by C. T. R. Wilson and Sir J. J. Thomson at the Cavendish Laboratory, Cambridge, England.

In a complete study of the mechanics of the earth's atmosphere we naturally begin by expressing in simple analytic formulae all the various conditions and laws according to which every particle of the air must move. Some of these conditions are local, depending upon the resistances at various points of the earth's surface; others are of the nature of discontinuous functions, as, for instance, when the ascent of moist air above a certain level suddenly gives rise to condensation and clouds, to the evolution of latent heat, to the precipitation of rain, to the shading of the air and the ground below the clouds, and to the sudden interception of all the solar heat at the upper surface of the cloud. It seems, therefore, incredible that the problems of the atmosphere can ever be resolved by purely analytical methods; there must be devised combinations of numerical and graphical, and possibly even mechanical methods to reproduce the conditions and give us special solutions adapted to particular cases. But even these special methods can only be perfected in proportion as we attain approximate solutions of the simpler problems, and it is in this preliminary work that a good beginning has already been made.

The present state of theoretical physical and mechanical meteorology cannot be fully presented in non-technical English text. It is necessary to employ algebraic formulae, or numerical tables, or graphic diagrams, the former being certainly the least cumbersome and the most generally available. The uniform system of notation devised by Professor F. H. Bigelow, and a very complete summary of the formulae of physical meteorology expressing the results of many recent students will be found in chapters x. and xi. of his Report on the International Cloud Observations, published as vol. ii. of the annual report of the chief of the U.S. Weather Bureau for 1898–1899.

The fundamental laws to which the atmosphere is subject are as follows:—

A. The Equation of Elastic Pressure.—The pressure shown and measured by the barometer is an elastic pressure acting in all directions equally at the point where it is measured. By virtue of this elastic pressure a unit volume of air will expand in all directions if not rigidly enclosed, but will cool in so doing. On the other hand, if forcibly compressed within smaller dimensions, it will become warmer. For a given temperature and pressure a unit volume of air of a prescribed chemical constitution will have a prescribed definite weight. The general relations between absolute temperature, pressure and volume are expressed by the formula

$$pv = \mathrm{RT} \qquad (1)$$

where T expresses the absolute temperature, p the elastic pressure, v the volume, and R is a constant which differs for each gas, being 29·2713 for ordinary pure dry air and 47·060 for pure aqueous vapour, if we use as fundamental units the kilogram, metre and centigrade degree. This equation is sometimes called the law of Boyle and Charles, or of Gay-Lussac and Marriotte, and it is also known as the equation of condition for true gases, meaning thereby that it expresses the fact that the ideal gas would change its volume directly in proportion to its absolute temperature and inversely in proportion to its elastic pressure. All gases depart from this law in proportion as they approach the vaporous condition on the one hand, which is brought about by great pressure and low temperature, or the ultra-gaseous condition on the other hand, which obtains under high temperatures and low pressures. The more accurate law of Van der Waals would complicate our problems too much. In place of the absolute temperature T we may substitute the expression 273° C. $\times (1 + \alpha t)$, where α is the coefficient of volumetric expansion of the gas for a unit degree of temperature $= 0{\cdot}00367$ and t is the temperature expressed on the centigrade scale.

B. Hypsometric Conditions.—The pressure of the atmosphere at any place depends primarily on the weight of the superincumbent mass of air, and therefore diminishes as we ascend to greater heights. If the air is in motion, that and other considerations come in to affect the pressure; but if the air is quiet relative to the earth's surface, then the pressure at any altitude is expressed by the so-called barometric or hypsometric formula

$$p = \int_{h_o}^{h} -\sigma g dh \qquad (2)$$

where σ is the density and g the apparent gravity for each layer of air whose vertical thickness is dh. The integral of this formula depends upon the vertical distribution of temperature, and moisture, and gravity; but under the simplest possible assumptions as to these vertical gradients, the following formula was deduced by Laplace and is generally known as his hypsometric formula:—

$$h - h_o = 18400(1 + 0{\cdot}00367t)\left(1 + 0{\cdot}378\,\frac{e}{p}\right)(1 + 0{\cdot}0026\cos 2\phi)$$
$$\left(1 + \frac{h + h_o}{6370191}\right)(1 + 0{\cdot}00157)\log\frac{p_o}{p}. \qquad (2a)$$

In this formula t is the average temperature, e the average vapour tension of the layer of air, p the barometric pressure at the top of the layer, p_o the pressure at the bottom, ϕ the latitude of the station, h the elevation above sea-level of the lower limit of the stratum, and h_o that of the upper limit. The modifications which this formula needs in order to adapt it to other hypotheses representing more nearly the actual distribution of temperature, moisture and gravity, have been elaborately investigated by Angot in a memoir published in 1899 in Part I. of the Memoirs of the Central Meteorological Bureau of France for the year 1896. Angot, Hergesell and Rykatcheff have also shown that for hypsometric work of any pretensions to accuracy it is simplest and best to use Laplace's formula for successive thin strata of air, and add together the individual results, rather than attempt a more complex single formula for the whole stratum; yet the latter seems to be essential for work in aërodynamics.

C. Thermodynamic Relations.—The temperature of the air is due to the quantity of molecular energy that is present in the form of heat, but usually there is also present a quantity of molecular energy that is spoken of as latent heat. This latent heat is said to do internal work, such as melting ice or boiling water, while the sensible heat does external work, such as expanding and pushing in all directions. These molecular energies can be transformed into each other over and over again without appreciable loss, and this power of transformation is expressed by the various equations of thermodynamics, of which the fundamental one for our purpose is

$$dQ = C_v dt + Apdv = C_v dt + ART\,dv/v. \qquad (3)$$

This equation expresses the fact that when a quantity of heat measured in calories, dQ, is added to or taken from a mass of dry air, there may result both a change of temperature, dt, corresponding to one portion of the heat, $C_v dt$, and a quantity of external work corresponding to the remaining portion of the heat ($Apdv$). It usually happens that the quantity of heat in a given mass of air does not remain the same for any length of time; it is diminished by radiation or is increased by absorption, and a certain quantity is lost when rain, snow or hail drops down from the air, while a quantity is added to the atmosphere when moisture evaporates and mixes with the dry air as invisible vapour, even the passage of rain-drops down through a lower layer alters the thermal conditions appreciably. The changes due to increase and diminution of moisture are usually small as compared with the great gain due to absorption and convection of solar heat or with the loss by radiation. If these losses and gains are to be taken account of, then the quantity dQ in the above equation is finite and important. On the other hand, in some cases atmospheric processes go on so rapidly or under such peculiar circumstances —for instance, in the interior of a cloud—that the change in the quantity of heat may be considered as temporarily negligible. In these cases dQ is zero; the changes in temperature balance the changes in external work, and the thermal process is said to be adiabatic.

D. The Condition of Continuity.—When a mass of liquid or gas goes through several motions and changes without being disrupted or otherwise broken into smaller portions, and without the formation of either local condensations into solid or liquid masses or of bubbles and vacuous spaces in its interior, and when all the changes that go on proceed by gradual continuous processes as to time, then the mass of the fluid is subject to the law of continuity as to mass, and the motion of the fluid is continuous as to velocity. These conditions are assumed in elementary hydrodynamics, and are implied in the process of integration, and in the equation of continuity

$$\frac{\partial\rho}{\partial t} + \frac{\partial(\rho u)}{\partial x} + \frac{\partial(\rho v)}{\partial y} + \frac{\partial(\rho w)}{\partial z} = o \qquad (4)$$

where ρ is the density, t is the time and ∂ the ordinary symbol for partial differentiation. But the fact is that meteorologists have to deal entirely with discontinuous external forces such as insolation ceasing at sunset and renewed daily; radiations of heat changing abruptly with land and ocean and cloudiness and snow covering; discontinuous boundary conditions and resistances at the earth's surface altering at every change from mountains to plains; discontinuous masses changing with additions and abstractions of moisture, rain and snow—all which lead to discontinuous vortex motions and overturnings and rearrangements of the atmospheric strata. The only factors that are continuous for any length of time or extent of area are the rotation of the earth and the attraction of gravitation. In the presence of such difficulties as these we must at present confine ourselves to the solution of very special local definite problems or to the general statistical problems of our atmosphere.

E. Conditions as to Energy and Motion.—When the total quantity of heat, both latent and sensible, remains constant or changes in a continuous manner, and when the motions are continuous, the mechanical and thermal processes are expressible by ordinary differentials and integrals. Motions of fluids involve both energy and inertia, and are subject to conditions expressed by the following equations of hydrodynamics:—

a. Equations of energy. Let the kinetic energy be T, the potential energy V, the intrinsic energy W: l, m, n, be cosines of the angle between the pressure p, and S the inwardly directed normal to the boundary surface. Then will

$$\frac{\partial(T + V + W)}{\partial t} = \int\int p(lu + mv + nv)dS. \qquad (5)$$

b. Equations of acceleration and inertia. Let P be the potential of the external forces acting on a unit mass of the atmosphere; μ, be the coefficient of viscosity or internal friction. Then will

$$\left.\begin{aligned}
-\frac{\partial P}{\partial x} - \frac{1}{\rho}\frac{\partial p}{\partial x} &= \frac{\partial u}{\partial t} + u.\frac{\partial u}{\partial x} + v.\frac{\partial u}{\partial y} + w.\frac{\partial u}{\partial z} \\
&\qquad - \mu\left[\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2}\right] \\
-\frac{\partial P}{\partial y} - \frac{1}{\rho}\frac{\partial p}{\partial y} &= \frac{\partial v}{\partial t} + u.\frac{\partial v}{\partial x} + v.\frac{\partial v}{\partial y} + w.\frac{\partial w}{\partial z} \\
&\qquad - \mu\left[\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} + \frac{\partial^2 v}{\partial z^2}\right] \\
-\frac{\partial P}{\partial z} - \frac{1}{\rho}\frac{\partial p}{\partial z} &= \frac{\partial w}{\partial t} + u.\frac{\partial w}{\partial x} + v.\frac{\partial w}{\partial y} + w.\frac{\partial w}{\partial z} \\
&\qquad - \mu\left[\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2} + \frac{\partial^2 w}{\partial z^2}\right]
\end{aligned}\right\} \qquad (6)$$

Approximate Assumptions and Solutions.—After introducing into the preceding system of fundamental equations (1–6) the actual conditions as accurately as they are known relative to gravity, solar radiation, the rotation of the earth, the viscosity of the air, its mass or inertia, its absorption and radiation of heat, its variable content of moisture, the precipitation of rain and cloud, the mutual interconversions of latent and sensible heat, a special difficulty occurs when we attempt to integrate these equations, because we have still to express analytically the initial conditions of the atmosphere as to pressure and temperature, and its boundary conditions as between the rough earth surface on its lower side and the unknown outward surface on its upper side. As the true earth's surface cannot be represented by any simple algebraic formula, it is customary to assume that it is a uniform sphere, neglecting at least partially, if not wholly, the spheroidal shape. We may first assume that there is no friction between the earth and the air, but must afterwards make allowance for its influence. Thirdly, we assume that the action of the earth's surface to heat the air and to throw moisture by evaporation into the atmosphere is perfectly uniform. Finally, in many cases we go so far as to assume that the atmosphere is an incompressible rare liquid having a uniform density and a uniform depth of about 8000 metres, corresponding to the average standard density of dry air under a pressure of 760 millimetres and a temperature of 0° C. Even under these simplifications the analytic difficulties have been too great to admit of rigorous solutions, except in a few of the simplest cases.

The treatment of atmospheric problems by Ferrel was followed by an equally ingenious mathematical treatment by Professors Guldberg and Mohn, of Christiania, in two papers published by them in 1876 and 1880 respectively. These authors, like Ferrel, treat isolated portions of the atmosphere and obtain special solutions, which, however, have not the generality that must eventually be demanded in a rigorous and general discussion of the atmosphere movements. Elegant mathematical solutions of our problems were first given in 1882 by Oberbeck, of the university of Halle, in the *Ann. Phys.* xvii. 128. But even Oberbeck's solutions are obtained under various simplifying assumptions that restrict their satisfactory application to the daily weather conditions. Oberbeck's first memoir treats of the mechanics of stationary cyclonic movements. Assuming that the isobars are concentric circles, and that in the outer portion of a cyclone the air has only horizontal movements, while in the inner portion it has only vertical movements, he solves his system of equations for the inner and outer regions of the cyclone separately. He shows that in general the pressure increases on all sides outwards from the centre; the gradient also increases from the centre outwards to the limit of the inner region, whence it diminishes in the outer region and at a great distance becomes inappreciable. In both regions the paths of the wind are curved lines, logarithmic spirals, which cut the isobars or the radial gradient everywhere at the same angle; therefore the movement of the air can be considered as a spiral inflow from all sides towards the centre. But the angle between the wind and the gradient follows different laws in the outer and inner regions, depending in the former on the rotation of the earth and the friction, but in the latter also on the intensity of the ascending current of air. In passing from the outer to the inner surface the wind experiences a sudden change of angle, so that the directions of the winds are not continuous, although the movement and the barometric pressures are assumed to be continuous. This latter peculiarity does not occur in nature, and is undoubtedly an analytical result peculiar to Oberbeck's method of treating the fundamental equations.

An improvement in the mathematical analysis was introduced by Dr F. Pockels of Göttingen in a memoir published in the *Met. Zeit.*, 1893, pp. 9–19. He deduces equations showing the continuous changes of temperature, pressure, gradient, wind direction, and velocity from the centre of the cyclone to the outer edge of the anti-cyclone, or, more properly, the peri-cyclone; these, therefore, may reasonably be supposed to have their counterparts in nature. Such mathematical solutions, however, are based upon the assumption that we are dealing with a comparatively small portion of the earth's surface, which may be considered as a plane having a uniform diurnal rotation and a uniform coefficient of friction. Moreover, the movements in the cyclones and anti-cyclones are assumed to be steady and permanent by reason of the perfect balance of all the forces involved therein. Of course these conditions are not exactly fulfilled, but in general Pockels shows that his theoretical results agree fairly well with the observed conditions as to wind and pressure. He computes the actual distribution of these elements under the assumption that the centre of the anti-cyclone is at latitude 55·5, and that the coefficient of friction is 0·00008, whereas viscosity proper would require only 0·0002. An elegant mathematical presentation of these studies in cyclonic motion is given by W. Wien, *Lehrbuch der Hydrodynamik* (Leipzig, 1900).

Notwithstanding the fact that these difficult mathematical investigations still lead us to unsatisfactory results, they are yet eminently instructive as showing the methods of interaction of the various forces involved in the motions of the atmosphere. We must therefore mention the interesting attack made by Oberbeck upon the problem of the general circulation of the atmosphere. His memoir on this subject was published in the *Sitzungsberichte* of the Academy of Sciences at Berlin in 1888. The fundamental assumption in this memoir implies that there is a general and simple system of circulation between the equatorial and the polar regions, but the eventual solution of the problem leads Oberbeck to two independent systems of winds, an upper and a lower, without any well-defined connexion at the polar and equatorial ends of these two currents, so that after all they are not rigorously re-entrant. Among the hypotheses introduced in the course of his mathematical work, the most important, and perhaps the one most open to objection, is that the distribution of temperature throughout the atmosphere in both the upper and lower strata can be represented by the equation $T = A + B\,(1 - 3\cos^2\theta)$. Undoubtedly this equation represents observations in the lower strata near the surface of the earth, but the constants that enter into it, if not the form itself, must be changed for the upper strata. The solution arrived at by Oberbeck gives the following equations representing the components of the movement of the atmosphere toward the zenith V, toward the north N, and toward the east O:—

$$V = C\,(1 - 3\cos^2\theta)\,f\sigma$$
$$N = -6\,C\cos\theta\sin\theta\,\phi\,\sigma$$
$$O = D\,[\sin\theta\,(1 - 3\cos^2\theta)\,g\sigma + 6\cos^2\theta\gamma\sigma].$$

In accordance with these equations he deduces the general circulation of the atmosphere as follows: In the lower current the air flows from the polar regions eastward until it reaches the parallel of 30° or 40°; it then turns directly towards the equator, and eventually westward, until at the equator it becomes a strong east wind (or a so-called west current). In the upper layer the movement begins as an east wind, turns rapidly to the north at latitude 20° or 30°, and then becomes a south-west wind (or north-eastern current) in the northern hemisphere, but a north-west wind (and south-eastern current) in the southern hemisphere. Of course in the higher strata of air the currents must diminish in strength. In a second paper in the same year, 1888, Oberbeck determines the distribution of pressure over the earth's surface as far as it is consistent with his system of temperatures and winds. His general equation shows that as we depart from the equator the pressure must depend upon the square and the fourth power of the cosine of the polar distance or the sine of the latitude, and in this respect harmonizes with Ferrel's work of 1859, although more general in its bearings. By comparing his formulae with the observed mean pressure in different latitudes, Oberbeck obtains the general angular velocity of the air relative to the earth, *i.e.* $0{\cdot}0292\,(\sin^2\phi - 0{\cdot}0836)$, which is quite small and is a maximum (4·6 metres per second) at latitude S. 56°27′. H. Hildebrandsson (1906) showed that observations do reveal an east wind prevailing above the equatorial belt of calms.

Contemporary with Oberbeck's admirable memoirs are those by Professor Diro Kitao, of the university of Tōkyō, who, as a student of mathematics in Germany, had become an expert in the modern treatment of hydrodynamic problems. In three memoirs published by the Agricultural College of the university of Tōkyō in the German language in the years 1887, 1889 and 1895, he develops with great patience many of the minutiae of the movement of the earth's atmosphere and cyclonic storms. The assumptions under which he conducts his investigations do not depart from nature quite so far as those adopted by other mathematicians. Like Ferrel, he adheres as closely as possible to the results of physical and meteorological observations; and although, like all pure mathematicians, he considers Ferrel as having departed too far from rigorous mathematical methods, yet he also unites with them in acknowledging that the results attained by Ferrel harmonize with the meteorology of the earth.

The fact is that the solution of the hydrodynamic equations is not single, but multiplex. Every system of initial and boundary conditions must give a solution appropriate and peculiar to itself. The actual atmosphere presents us with the solution or solutions peculiar to the conditions that prevail on the earth. Entirely different conditions prevail on Jupiter and Saturn, Venus and Mars, and even on the earth in January and July, and therefore a wholly new series of solutions belongs to each case and to each planet of the solar system. It matters not whether we attempt to resolve our equations by introducing terrestrial conditions expressed by means of analytical algebraic formulae, and integrate the equations that result, or whether we adopt a graphic process for the representation of observed atmospheric conditions and integrate by arithmetical, geometrical or mechanical processes. In all cases we must come to the same result, namely, our resulting expressions for the distribution of pressure and wind will agree with observations just as closely as our original equations represented the actual temperatures, resistances and other attending conditions.

In the last portion of Kitao's third memoir he gives some attention to the interaction of two cyclonic systems upon each other when they are not too far apart in the atmosphere, and shows how the influence of one system can be expressed by the addition of a certain linear function to the equations representing the motions of the other. He even gives the basis for the further study of the extension of cyclonic storms into higher latitudes where conditions are so different from those within the tropics. Finally, he suggests in general terms how the resistances of the earth's surface, in connexion with the internal friction or viscosity of the air, are to be taken into consideration, and shows under what conditions the assumptions that underlie his own solutions may, and in fact must, very closely represent the actual atmosphere.

The General Circulation of the Atmosphere.—If the meteorologist had a sufficient number of observations of the motions of the air to represent both the upper and lower currents, he would long since have been able to present a satisfactory scheme showing the average movement of the atmosphere at every point of its course, and the paths of the particles of air as they flow from the poles to the equator and return, but hitherto we have been somewhat misled by being forced to rely mainly on the observed movements of clouds. This motion has been called the general circulation of the atmosphere; it would be a complex matter even if the surface of the earth were homogeneous and without special elevations, but the actual problem is far different. Something like this general circulation is ordinarily said to be shown by the monthly and annual charts of pressure, winds and temperature, such as were first prepared and published by Buchan in 1868, and afterwards in Bartholomew's *Physical Atlas* of 1899. We must not, however, imagine that such charts of averages can possibly give us the true path of any small unit mass of air. The real path is a complex curve, not re-entrant, never described twice over, and would not be so even if we had an ideal atmosphere and globe. It is a compound of vertical and undulatory movements in three dimensions of space, variable as to time, which cannot properly be combined into one average.

The average temperatures, winds and pressures presented on these charts suggest hypothetical problems to the student's mind quite different from the real problems in the mechanics of the atmosphere —problems that may, in fact, be impossible of solution, whereas those of the actual atmosphere are certainly solvable. The momentary condition presented on any chart of simultaneous observations constitutes the real, natural and important problems of meteorology. The efforts of mathematicians and physicists have been devoted to the ideal conditions because of their apparent simplicity, whereas the practical problems offered by the daily weather chart are now so easily accessible that attention must be turned towards them. The most extensive system of homogeneous observations appropriate to the study of the dynamics of the atmosphere is that shown in the *Daily Bulletin of International Simultaneous Observations*, published by the U.S. Signal Service in the years 1875–1884, with monthly and annual summaries, and a general summary in "Bulletin A," published by the U.S. Weather Bureau in 1893. The study of these daily charts for ten years shows how the general circulation of the atmosphere differs from the simple problems presented in the idealized solutions based on monthly and annual averages. The presence of a great and a small continent, and a great and small ocean, and especially of the moisture, with its consequent cloud and rain, must enter into the study of the problem of the general circulation. The most prominent features of the general circulation of the atmosphere are the system of trade winds, north-easterly in the northern tropics and south-easterly in the southern tropics, the system of westerly winds beyond the trade-wind region, namely, north-westerly in the north temperate and south-westerly in the south temperate zone, and again the system of upper winds shown by the higher clouds, namely, south-westerly in the northern hemisphere and north-westerly in the southern.

Halley in 1680, and Hadley in 1735, gave erroneous or imperfect explanations of the mechanical principles that bring about these winds. As some errors in regard to this subject are still current, it is necessary to say that it is erroneous to teach that atmospheric air weighs less on being heated, or by reason of the infusion of more moisture, and that therefore the barometer falls. The addition of more moisture must increase its weight as a whole; heat, being imponderable, cannot directly affect its weight either way. We are liable to disseminate error by the careless use of the world "lighter," since it means both a diminution in absolute weight and a diminution in relative weight or specific gravity. Heat and moisture may diminish the specific gravity of a given mass of air by increasing its volume, or of a given volume by diminishing its mass, but neither of them can of themselves affect the pressure shown by the barometer so far as that is due to the weight of the atmosphere. It is not proper to say that by warming the air, thereby diminishing its specific gravity and causing it to rise, so that colder air flows in to take its place, we thereby diminish the barometric pressure. It is easily seen that in the expression $p = RT/v$, which, as we have before said, is the law of elasticity, T and v may so vary as to counterbalance each other, and allow the pressure p to remain the same. Within any given room or other enclosure hot air may rise on one side, flow over to the opposite, cool and return, and the circulation be kept up indefinitely without any necessary change in pressure. The problem of the relation between wind and pressure in the free atmosphere is more complex than this, and involves the consideration of the inertia of the masses of air that are in motion with the earth around its axis. The air is so extremely mobile that it moves quickly in response to slight differences in pressure that cannot be detected by ordinary barometric measurement. The gradients or differences of pressure that are shown on meteorological charts are not directly, but only very indirectly, due to buoyancy, as caused by heat and moisture. The pressure gradients, so-called, are not merely the prime causes of the winds, but are equally and essentially the results of the winds. They are primarily due to the fact that the atmosphere is rapidly revolving with the surface of the earth around the earth's axis, while at the same time it may be circulating about a storm centre. Inappreciable differences of pressure start the winds in motion, and the air moves towards the region of low pressure, just as in the pneumatic despatch tubes the flow of air towards the low pressure carries the packages along. But in the free air, where there are less important resistances to be overcome, the freedom of motion is greater than in these pneumatic tubes. No sooner is the atmosphere thus set in motion by pressure from all sides towards the central low pressure than it rapidly acquires a spiral circulation, and thereby there is superimposed (in the northern hemisphere) a decided diminution of pressure on the left hand side of the wind, and an equally rapid increase on the right hand side. The gradient of pressure in the direction of the wind overcomes resistances, but the gradient of pressure, perpendicular to the direction of the wind, is far greater than that in the direction of the wind, and is that which produces the areas of decided low pressures that appear as storm centres on the daily weather map. Therefore, in general, the wind cuts across the charted isobars in oblique directions and at angles which are nearly 90° for the feeble winds far removed from the centres, but which are almost zero for the most violent winds near the low centre. The winds acquire this spiral circulation for two reasons—(*a*) all straight line, gusts or jets in fluids, subject to any form of resistance, necessarily break up into rotating spirals whenever the velocity exceeds a certain limit, because the resistances deprive some particles of the fluid of a little more of their original velocity and energy than the other particles near by them, and thus the whole series is drawn away from linear into curvilinear paths; (*b*) in addition to their rectilinear motions the particles of air have a rapid circular motion in common with the whole atmosphere diurnally around the earth's axis. Therefore every particle of moving air comes under the influence of a set of forces depending on its own rate of motion relative to the earth's surface and its position relative thereto. If the particles are moving eastward, viz. in the same direction as the earth's diurnal rotation, then the result is as though the atmosphere were rotating more rapidly than does the earth at present; consequently the particles of wind push toward the equator as though the atmosphere were trying to adopt a more flattened spheroidal figure corresponding to its greater velocity of rotation. If the particles are moving westward, on the other hand, it is as though the atmosphere were revolving less rapidly than the earth, and as though the flattened spheroid of revolution due to the present rate of rotation were more decidedly flattened than need be; consequently the particles of air push towards the poles. If the winds blow toward either pole, then their initial moment of inertia about the earth's axis, due to the initial radius and the eastward movement of the air, must be retained; consequently, as the air advances into higher latitudes and to smaller circles of diurnal rotation its velocity must increase, and must carry the particles to the east of their initial meridians. If the wind blow towards the equator its initial moment of inertia must be applied to a larger radius, and its velocity correspondingly diminished, so that it is left behind or falls away somewhat to the west. "The reasoning of those who in attempting to explain the trade winds assume that the atmosphere in moving toward or from the equator has a tendency to retain the same original linear velocity is erroneous "(Ferrel's *Movements of Fluids*, 1859). In general the winds tend to retain their moments of inertia, and in the northern hemisphere must necessarily always be deflected continuously toward the right hand. The exact amount of this deflection was first distinctly stated by Poisson,[1] as applied to the movements of projectiles; it was also announced by Tracy of New Haven in 1843, but was first applied to the atmosphere by Ferrel, who deduced its meteorological consequences. This law is not to be confounded with that of Buys Ballot, who in 1861 deduced from his observations in Holland the rule that the gradient of pressure between two stations for any day would be followed in twenty-four hours by a wind perpendicular to that gradient, and having the lower pressure on the left hand. Buys Ballot's law was in the nature of a rule for prediction, and was modified by Buchan 1868, who enunciated the following: "The wind blows towards the regions of low pressure, but is inclined to the gradient at an angle which is less than 90°." In this form Buchan's law was an improvement upon the laws current among cyclonologists, who had assumed that, in a rough way, the wind blew in circles around the low centre, and was therefore sensibly at right angles to the gradient. It ought, however, to be said that Redfield throughout the whole course of his studies, from 1831 to 1857, never gave adherence to this view, and in fact for the severer portions of hurricanes determined the average inclination of the movements of the lower clouds at New York City to be about 7° inwards as compared with the truly circular theory. Now Ferrel's law explains mechanically the reason why the winds do not blow either radially or circularly, and gives the means for determining their inclination to the isobars in all portions of the cyclone and for various degrees of resistance by the earth's surface. The general proposition that the barometric gradients on the weather map are not those that cause the wind, but are, properly speaking, the result of the combined action of the wind, the rotation of the earth, and the resistances at the earth's surface, as first explained by Ferrel, seems to have been neglected by meteorologists until brought to their attention repeatedly by Professor Abbe between 1869 and 1875, and especially by Professor Hann in a review of Ferrel's work (see *Met. Zeit.* 1874). The independent investigations of Sprung, Koeppen, Finger, and especially Guldberg and Mohn, confirm in general the correctness of Ferrel's law.

It is quite erroneous to imagine that the low pressures in storm areas and in the polar regions, and especially the belt of low pressure at the equator are due simply to the diminution of the density and weight of the air by the action of its warmth or its moisture, or to the abundant rainfall as relieving the atmosphere of the weight of water. It has been clearly shown that none of these operations can directly affect the barometric pressure to any appreciable extent, but that high and low pressure areas, as we see them on the weather map, owe their existence entirely to the mechanical interaction of the diurnal rotation of the earth and the motions of the atmosphere. The demonstration of this point by Ferrel in 1857 is considered to have opened the way for modern progress in theoretical meteorology.

Both Espy and Hann have abundantly shown that the formation and downfall of rain do not produce any low barometric pressure unless they produce a whirling action of the wind—that, in fact, the latent heat evolved by the condensation of vapour into rain may so warm up the cloud as to produce a temporary rise in pressure even at the surface of the ground, due to the outward push produced by the sudden expansion of the cloud. [The details of the thermodynamics of this operation have been elucidated by Wm. von Bezold.] The force with which the wind presses to the right or tends to be deflected in that direction is $2nv \sin \phi$, while the curvature of the path of the wind is measured by its radius of curvature, which is $v/2n \sin \phi$, where v is the velocity of the wind, n is the equatorial velocity of the earth's rotation, and ϕ is the latitude. It will be seen from this that there is no deflection at the equator; therefore, as Ferrel stated, there is no tendency to the formation of great whirlwinds at the equator, hence hurricanes and typhoons are rarely found within 10° of the equator.

Ferrel frequently speaks of an anti-cyclone, whereby he means the area of high pressure just outside of a strong cyclonic whirl; the expression peri-cyclone would have been more appropriate and is sometimes substituted. The term *anti-cyclone*, as first introduced by Galton in 1863, is applied to a system of winds blowing out from a central area of high pressure, and this is the common usage of the term in modern meteorology. The term cyclone among meteorologists and throughout English literature, except only a few cases in the United States, is equivalent to the older usage of whirlwind, and it is unfortunate that misunderstandings often arise because local usages in America apply the word cyclone to what has for centuries been called a tornado. The mechanical principles discussed by Ferrel led him to an algebraic relation between the barometric gradient G, the wind velocity v, the radius of curvature of the isobar r, and the inclination i between the wind and the isobar, which is expressed by the following formula for the pressures that prevail at sea-level:—

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[1] *Recherche sur le mouvement des projectiles dans l'air en ayant égard à l'influence du mouvement diurne de la terre*; dated 1837, printed Paris, 1839.

$$G=[(2n \sin\phi+\cos i v/r)v \sec i]/[83,000,000].$$

A popular exposition of this and other results of Ferrel's work is given by Archibald in *Nature* (May 4, 1882), and still better in Ferrel's *Treatise on the Winds* (New York, 1889, and later editions).

The charts of mean annual pressure, temperature and wind above referred to show certain broad features that embrace the whole system of atmospheric circulation, viz. the low pressures at the equator and the poles, the high pressures under the tropics, the trade winds below and the anti-trades above, with comparative calms under the belts of equatorial low pressure and tropical high pressure. The first effort of the mathematician was to explain how these mean average conditions depend upon each other, and to devise a system of general circulation of the wind consistent with the pressures, resistances and densities. But, as we have already said, such a system may be very far from that presented by the real atmosphere, and little by little we are being led to a different view of the question of the general circulation. The earlier students of storms generally accepted one of two views as to the cause of whirlwinds. They were either (1) formed mechanically between two principal currents of air flowing past each other, the so-called polar and equatorial currents; or (2) they were due to the ascent of buoyant air while the heavier air flowed in beneath, the whirling motion being communicated by the influence of the rotation of the earth, or by the greater resistances on one side than on the other. In order to explain why hurricanes and typhoons exist continuously for many days, or even weeks, it is necessary that there should be a source of energy to maintain a continued buoyancy and rising current at the centre, and this was supposed to be fully provided for by Espy's proof of the liberation of latent heat consequent on the formation of cloud and rain. To this latter consideration Abbe in 1871 added the important influence of the sun's heat intercepted at the upper surface of the cloud. At this stage of the investigation the whirlwind is but an incident in the general circulation of the atmosphere, but further consideration shows that it ought rather to be regarded as an essential portion of that circulation, and that when temperature gradients and density gradients exceed a certain limit the formation of great whirlwinds is inevitable. Therefore an atmosphere containing several whirlwinds is just as truly a system of general circulation in the one case as an atmosphere without a whirlwind is in the other. The formation of rain, the evolution of latent heat, and even the absorption of heat at the upper surface of the cloud really constitute a normal general circulation in this special case. We may therefore consider a system of vortices, which is a system of discontinuous motions, as the most natural solution of the equations of motion—but the mathematical treatment of this form of motion has not yet been sufficiently well developed, for the discontinuity relates not only to the motion but to the thermal conditions and the interchange of vapour and water.

In 1890 Professor Hann published a careful analysis of the actual temperature conditions prevailing over an extensive area of high pressure in Europe, and showed that the temperatures of the upper strata in both high and low areas, namely, in anti-cyclones and cyclones are often directly contrary to those supposed to prevail by Espy and Ferrel. This study necessitated a more careful examination into the radiation of heat from the dust and moisture of the atmosphere, and Professor Abbe seems to have shown that in areas of high pressure and clear weather a very slow descending movement throughout each horizontal layer gives time for a radiation of heat that explains the anomalies of temperature, but the dynamic phenomena still remained unexplained. On the other hand, von Helmholtz in several memoirs of 1888–1891 showed that waves or billows may be formed in the atmosphere of great extent at the dividing surface between upper and lower strata moving in different directions and with different velocities. Under specific conditions these billows may become like the breakers and caps of waves of the ocean when driven by the wind. The hypothesis that these aerial breakers correspond to our troughs of low pressure and the storms experienced in the lower atmosphere seemed very plausible. As these billows are formed between upper and lower air currents of great extent, which themselves represent a large portion of the horizontal circulation between the poles and the equator, it results that if von Helmholtz's suggestion and Hann's hypothesis are correct then all general storms must be considered as essentially a part of the general circulation rather than as caused by the vertical circulation over any locality. It must occur to everyone to adopt the intermediate view that, on the one hand, the local vertical circulation, with its clouds, rain, hail and snow, and evolution of latent heat, and, on the other hand the waves and whirls in the general circulation, mutually contribute toward our storms and fair weather. It only remains to allot to each its proper importance in any special case.

Undoubtedly aerial billows, and the clouds that must frequently accompany them, exist everywhere in the earth's atmosphere. Perhaps their extent and importance are not properly appreciated. A voyage around the Atlantic Ocean in 1889–1890, made by Professor Abbe, specifically to study cloud phenomena, revealed many remarkable cases, such as the cumulus rolls that extend in a remarkably symmetrical series from the island of Ascension westwards for 100 m. in the south-easterly trades, or the delicate fields of cirro-cumuli that extend from the islands of Santa Lucia and Barbados for 200 m. eastwards under favourable conditions. The mixtures and vorticose motions going on within aerial billows to form these clouds have been interpreted by Brillouin. In the further elucidation of the mechanism of storms Hann showed that every study of observational material confirms the conclusion that the descent of denser cool dry air is as important as the ascent of warm moist air, and that although the evolution of latent heat *within the clouds* of a storm may explain the local cloud phenomena, yet it will not explain the storm as a whole. The first "norther or blizzard" that was charted at Washington in November 1871 was at once seen to be a case of the underflow of a thin layer of cold dry air descending from high altitudes above Canada on the eastern slope of the Rocky Mountains, but driven southward by an excess of centrifugal energy added to a moderate barometric gradient. It was seen that in such grand overturnings the descent of masses implies energy communicated by the action of gravity, but the whole mechanics of this process was not clear until the publication by Margules of his memoir *Über die Energie der Stürme* (Vienna, 1905), which will be referred to hereafter.

Mathematics have, almost without exception, assumed a so-called steady condition in the motion of the atmosphere in order to achieve a successful integration of the general equations of motion. The restrictions within which Helmholtz and others have worked, and the limits within which their results are to be accepted, have been analysed by Dr E. Herrmann in a memoir of which a translation is published in the bulletin of the American Mathematical Society for June 1896. Of course Herrmann's own investigation is also based upon certain simplifying hypotheses, such as the absence of outside disturbing forces and of viscosity and friction, a homogeneous ellipsoidal surface, and a uniform initial temperature and rate of revolution corresponding to an initial state of equilibrium. If now the initial static equilibrium be disturbed by introducing a different distribution of temperature, viz. one that varies with altitude and latitude, but is uniform in longitude along any circle of latitude, then the first question is whether the atmosphere can settle down to a new state of static equilibrium. Herrmann shows that in general it cannot do so, but that the new state and the future states can only be those of motion and dynamic equilibrium. If, however, there be no external forces acting on the atmosphere, then in one case static equilibrium relative to the earth can occur, namely, when the new temperatures are so distributed in the atmosphere as to satisfy the equation

$$\int \rho r^2 w \, dV = M,$$

in addition to the ordinary equations of elasticity, inertia and continuity previously given, and to those representing the boundary conditions, M being the total amount of inertia of the atmosphere relative to the axis of rotation. In general, the movements in the atmosphere must consist not only of an interchange between the poles and the equator, but also of east and west motions, and there must therefore be a different rate of diurnal rotation for each stratum. The second step in this inquiry is, Can these movements become perfectly steady with this unvarying or steady distribution of temperature? In other words, Can the temperature and the movements be so adjusted to each other that each shall remain invariable within any given zone of latitude? The reply to this is, that if they are to become thus adjusted they must satisfy a certain differential equation, which itself shows that steady motions and stationary temperatures cannot exist if there be any north or south component. Apart from the fact that Herrmann assumes no friction, it would seem that he has proved that steady motions and stationary pressures cannot exist in the atmosphere over a homogeneous spherical surface, and presumably the same result would follow of a rotating globe for the irregular surface of the actual globe. The motions of the real atmosphere must therefore consist of irregular and periodic oscillations and discontinuous whirls and rolls superimposed upon more uniform, regular progressions, but never repeating themselves. Consequently, the conclusions deduced by those who have assumed that steady conditions are possible must depart more or less from meteorological observations. There is a general impression that the belt of low pressure at the equator and the low areas at the poles and the high pressures under the tropics are pseudo-stationary, and really represent what would be steady conditions if we had an ideal smooth globe; but Herrmann's researches show that the unsteadiness observed to attach to these areas under existing conditions would also attach to them under ideal conditions. They really have and must have irregular motions, and we, by taking annual averages, obtain an ideal annual distribution of pressure, temperature and wind that does not represent any specific dynamic problem. The averages represent what is considered proper in climatology, but are quite improper and misleading from a dynamic point of view, and have no logical mechanical connexion with each other.

Closely connected with this study of steady motions under a constant supply and steady distribution of solar heat comes the further question as to what regular variations in atmospheric pressure and wind can be produced by regular seasonal variations in the heat received from the sun; for instance, what variation in the earth's atmosphere corresponds to the periodic variations of the solar spots. The general current of Helmholtz's investigations shows that no periodic change in the earth's atmosphere can be maintained for any length of time by a given periodic influence outside of the atmosphere. On the other hand, it is barely possible that wave and vortex phenomena on the sun's surface may have the same periodicities as regular phenomena in the earth's atmosphere, so that there may be a parallelism without any direct connexion between the two.

An important paper on the application of hydrodynamics to the atmosphere is that by Professor V. Bjerknes, of Stockholm, Sweden, which was read in September 1899 at Munich, and is now published in an English translation in the *U.S. Monthly Weather Review*, Oct. 1900 ("On the Dynamic Principle of Circulatory Movements in the Atmosphere"). In this memoir Bjerknes applies certain fundamental theorems in fluid motion by Helmholtz, Kelvin and Silberstein, and others of his own discovery to the atmospheric circulation. He simplifies the hydrodynamic conceptions by dealing with density directly instead of temperature and pressure, and uses charts of "isosteres," or lines of equal density, very much as was proposed by Abbe in 1889 in his *Preparatory Studies*, where he utilized lines of equal buoyancy or "isostaths," and such as Elkholm published in 1891 as "*isodenses*" and which were called "*isopyks*" by Müller-Hauenfels. Bjerknes has thus made it practicable to apply hydrodynamic principles in a simple manner without the necessity of analytically integrating the equations, at least for many ordinary cases. He also gives an important criterion by which we may judge in any given case between the physical theory, according to which cyclones are perpetually renewed, and the mechanical theory, according to which they are simply carried along in the general atmospheric current. Bjerknes's paper is illustrated by another one due to Mr Sandström, of Stockholm, who has applied these methods to a storm of September 1898 in the United States.[1] The further development of Bjerknes's methods promises a decided advance in theoretical and practical meteorology. His profound lectures at Columbia University in New York and in Washington in December 1905 aroused such an interest that the Carnegie Institution at once assigned the funds needed to enable him to complete and publish the applications to meteorology of the methods of analysis given in detail in Bjerknes's *Vorlesungen* (Leipzig, i. 1900, ii. 1902), and in his *Recherche sur les champs de force hydrodynamiques* (Stockholm), *Acta Matematica* (Oct. 1905). In his lectures of 1905 at Columbia University Bjerknes treated the atmosphere as a continuous hydrodynamic field of aerial solenoids and forces acting on them, to which vector analysis can be applied, as was done by Heaviside for electric and magnetic problems. Every material point is a small spherical mass of air free to extend or contract with pressure, temperature or moisture; free to rotate about each of three movable axes passing through its centre and to move along and revolve about three fixed axes through the centre of the earth. These numerous degrees of freedom are easily expressed in Bjerknes's notation and by his typical equations of motion. The density at any point is recognized as the fundamental "dimension" controlling inertia and movement. The observed atmospheric condition at any moment is shown by a series of *isodense* surfaces intersecting potential surfaces of equal gravity and thus forming a continuous mass of unit solenoids. This field becomes either an electric, magnetic or hydrodynamic field according to the interpretation assigned to the notations—in either case the analytical processes are identical. The analogies or homologies of these three sets of phenomena are complete throughout, and those of one field elucidate or illustrate those of the two other fields. This is the outcome of the study of such analogies begun by Euler, Helmholtz, Hoppe, and extensively furthered by Maxwell and Kelvin, but especially by C. A. Bjerknes. The homologies or analogies by V. Bjerknes are given at p. 122 of his *Recherche* (1905), and include the following six triads:—

I.	Hydrodynamics	velocity of unit mass
	Magnetics	magnetic induction
	Electrics	electric induction
II.	Hydrodynamics	intensity of the field
	Magnetics	,, ,, ,,
	Electrics	,, ,, ,,
III.	Hydrodynamics	velocity of energy
	Magnetics	intrinsic magnetic polarization
	Electrics	,, electric ,,
IV.	Hydrodynamics	velocity of expansion per unit volume
	Magnetics	density of the true magnetic mass
	Electrics	,, ,, electric ,,
V.	Hydrodynamics	density of the dynamic vortex
	Magnetics	,, ,, steady magnetic current
	Electrics	,, ,, ,, magnetic ,,
VI.	Hydrodynamics	specific volume
	Magnetics	magnetic permeability
	Electrics	dielectric constant

which have been slightly rectified by Dr G. H. Ling, *Am. Jour. Math.* (1908). In the application of Bjerknes's methods of study to the daily weather map Sandström draws special maps to represent the solenoids and the forces. Barometric pressures are reduced from the observing stations not only down to sea-level but up to other level surfaces of gravity. The differences between these level surfaces represent the work done in raising a unit mass from one level to the next (see Bjerknes and Sandström, *A Treatise on Dynamic Meteorology and Hydrography*, Washington, 1908).

The Diurnal and Semi-diurnal Periodicities in Barometic Pressure.—For a long time attempts were made to explain the periodic variations of the barometer by a consideration of static conditions, but it is now evident that this problem, like that of the circulation of the atmosphere, is a question of aerodynamics. A most extensive series of researches into the character of the phenomena from an observational point of view has been made by Hann, who gave a summary of our knowledge of the subject in the *Met. Zeit.* for 1898, translated by R. H. Scott in the *Quart. Jour. Roy. Met. Soc.* (Jan. 1899) (see also an important addition by Hann and Trabert in the *Met. Zeit.*, Nov. 1899, and the summary of his results as given in his *Lehrbuch*, 1906). Hann has shown that at the earth's surface three regular periodic variations are established by observation, viz. the diurnal, semi-diurnal and ter-diurnal. On the higher mountains these variations change their character with altitude. (1) At the equator the diurnal variation is represented by the formula $0{\cdot}30$ mm. $\sin(5^\circ+x)$, where x is the local hour angle of the sun. In higher latitudes either north or south the coefficient $A_1=0{\cdot}30$ mm. diminishes, but the phase angle, 5°, varies greatly, generally growing larger. It is therefore evident that this diurnal oscillation depends directly on the hour angle of the sun, and probably, therefore, principally on the amount of heat and vapour received by the atmosphere from the ocean and the ground at any locality and season of the year. It is apparently but little affected by the wind, but somewhat by altitude above sea; the amplitude diminishes to zero at a certain elevation, and then reappears and increases with the opposite sign; the phase angle does not change. (2) Superimposed upon this diurnal oscillation is a larger semi-diurnal one, which goes through its maximum and minimum phases twice in the course of a civil day. The amplitude of this variation is largest in equatorial regions, and is expressed by the formula $A_2=(0{\cdot}988\text{ mm.}-0{\cdot}573\text{ mm.}\sin{}^2\phi)\cos{}^2\phi$ as given by Hann, or $A_2=(0{\cdot}92\text{ mm.}-0{\cdot}495\sin{}^2\phi)\cos{}^2\phi$ as revised by Trabert. This amplitude also may be considered as variable along each zone of latitude having a maximum value on certain central local meridians. The times at which the semi-diurnal phases of maximum and minimum occur are subject to laws different from those for the diurnal period. Within the tropics the phase angle is 160° and at 50° N. it is 147°, and between these limits it seems to be the same over the whole globe, so that the phase does not depend clearly upon the hour angle of the sun or on the local time. The amplitudes appear to depend on the excess of land in the northern hemisphere as compared with the water and cloud of the southern hemisphere. The amplitude also varies during the year, being greatest at perihelion and least at aphelion. Hann suggests that this is an indirect effect of the sun's heat on the earth, as the northern hemisphere is hotter when the earth is in aphelion than is the southern hemisphere when the earth is in perihelion, owing to the preponderance of land in the north and water in the south. (3) The ter-diurnal oscillation has the approximate value shown by the formula $0{\cdot}04$ mm. $\sin(355^\circ+3x)$. The phase angle is sensibly the same everywhere, and the amplitude varies slightly with the latitude. Both phase and amplitude have a pronounced annual period which is as remarkable as that of the semi-diurnal oscillation; the maximum amplitude occurs in January in the northern hemisphere, and in July in the southern.

The physics of the atmosphere has not yet been explored so exhaustively as to explain fully these three systematic barometric variations, but neither have we as yet any necessity for appealing to some unknown cosmic action as a possible cause of their existence. The action of the solar heat upon the illuminated hemisphere, and the many consequences that result therefrom, may be expected to explain the barometric periods. The variations of sunshine and cloud must inevitably produce periodic variations of temperature, moisture, pressure and motion, whose exact laws we have not as yet fathomed. Among the many methods of action that have been studied or suggested in connexion with the barometric variations the most important of all is the so-called tidal wave of pressure due to temperature. Laplace applied his investigations on the tides to the gravitational tide of the ocean, and when he passed to the corresponding solar and lunar gravitational tides of the atmosphere he was able to show that they must be inappreciable, unless, indeed, certain remarkable relations existed between the circumference of the earth and the depth of the atmosphere. As these relations do not exist, it is generally conceded as certain that the gravitational tides, both diurnal and semi-diurnal, cannot exceed a few thousandths of an inch of barometric pressure. On the other hand, the same process of mathematical reasoning enables us to investigate the action of the sun's heat in producing a wave of pressure that has been called a pressural tide, due to the expansion of the lower layer of air on the illuminated half of the globe. The laws that must govern these pressural tides have been investigated by Kelvin, Rayleigh (*Phil.*

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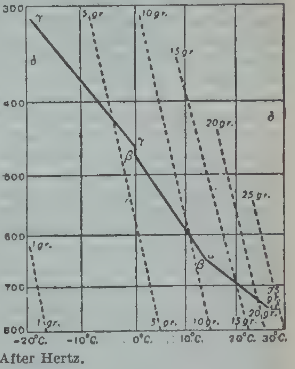
[1] "On the Construction of Isobaric Charts for High Levels in the Earth's Atmosphere and their Dynamic Significance," *Trans. Am. Phil. Soc.* (1906).

Mag., Feb. 1890), and especially by Margules (*Vienna Sitz. Ber.* 1890–1893). The two latter have shown the truth of a proposition enunciated by Kelvin in 1882, without demonstration, to the effect that the free oscillation produced by a relatively small amount of tide-producing force will have an amplitude that is larger for the half-day term than for the whole-day term. They therefore explain the diurnal and semi-diurnal variations of the barometric pressure as simple pressural tides or waves of expansion, originally produced by solar heat, but magnified by the resonance between forced and free waves in an atmosphere and on a globe having the specific dimensions of our own. The analytical processes by which Laplace and Kelvin arrived at this special solution of the tidal equation were objected to by Airy and Ferrel, but the matter has been, as we think, most fully cleared up by Dr G. H. Ling, in a memoir published in the *Annals of Mathematics* in 1896. He seems to have shown that, although a literally correct result was attained by Laplace in his first investigation, yet his methods as presented in the *Mécanique céleste* were at fault from a rigorous analytical point of view. The process by which a diurnal temperature wave produces a semi-diurnal pressure oscillation, as explained by Rayleigh and Margules, may be stated as follows: The diurnal temperature wave having a twenty-four hours period is the generating force of a diurnal pressure tide, which is essentially a forced and small oscillation. The natural period of the free waves in the atmosphere agrees much more nearly with twelve than with twenty-four hours. In so far as the forced and the free waves reinforce each other, the semi-diurnal waves are reinforced far more than the other, so that a very small semi-diurnal term in the temperature oscillations will produce a pressure oscillation two or three times as large as the same term would in the diurnal period. These reinforcements, however, depend upon the elastic pressure within the atmosphere, just as does the velocity of sound. If the prevailing barometric pressures were slightly increased, the adjustment of the twelve-hours free wave of pressure to the forced wave of temperature could be so perfect that the barometric wave would increase to an indefinite extent. For the actual temperatures the periodicity of the free wave is about thirteen hours, or somewhat longer than the forced wave of temperature, so that the barometric oscillation does not become excessive. It would seem that we have here a suggestion to the effect that if in past geological ages the average temperature at any time has been about 268° C. on the absolute scale, then the pressure waves could have been so large as to produce remarkable and perhaps disastrous consequences, involving the loss of a portion of the atmosphere. A modification of this idea of resonance has been developed by Dr Jaerisch, of Hamburg (*Met. Zeit.*, 1907), but the general truth of the Kelvin-Margules-Rayleigh theorem still abides.

The Thermodynamics of a Moist Atmosphere.—The preceding section deals with an incompressible gas, and therefore with simple, pure hydrodynamics. If now we introduce the conception of an atmosphere of compressible gas, whose density increases with altitude, so that rising and falling currents change their temperatures by reason of the expansion and compression of the masses of air, we take the first step in the combination of thermodynamic and hydrodynamic conditions. If we next introduce moisture, and take precipitation into consideration, we pass to the difficult problems of cloud and rain that correspond more nearly to those which actually occur in meteorology. This combination has been elucidated by the works of Espy and Ferrel in America, Kelvin in England, Hann and Margules in Austria, but especially by Hertz, Helmholtz, and von Bezold in Germany, and by Brillouin in France. A general review of the subject will be found in Professor Bigelow's report on the cloud work of the U.S. Weather Bureau and his subsequent memoirs "On the Thermodynamics of the Atmosphere" (*Monthly Weather Review*, 1906–1909).

The proper treatment of this subject began with the memoir of Kelvin on convective equilibrium (see *Trans. Manchester Phil. Soc.*, 1861). The most convenient method of dealing approximately with the problems is graphic and numerical rather than analytical, and in this field the pioneer work was done by Hertz, who published his diagram for adiabatic changes in the atmosphere in the *Met. Zeit.* in 1884. He considers the adiabatic changes of a kilogram of mixed air and aqueous vapour, the proportional weights of each being λ and μ respectively. In a subsequent elaborate treatment of the same subject by von Bezold in four memoirs published during 1889 and 1899, the formulae and methods are arranged so as to deal easily with the ordinary cases of nature which are not adiabatic; he therefore prepares diagrams and tables to illustrate the changes going on in a unit mass of dry air to which has been added a small quantity of aqueous vapour, which, of course, may vary to any extent. Both Hertz and von Bezold consider separately four stages or conditions of atmosphere: (A) The dry stage, where aqueous vapour to a limited extent only is mixed with the dry air. (B) The rain stage, where both saturated vapour and liquid particles are simultaneously present. (C) The hail stage, where saturated aqueous vapour, and water, and ice are all three present. (D) The snow stage, where ice vapour and snow itself, or crystals of ice, are present. The expressions aqueous vapour and ice vapour do not occur in Hertz's article, but are now necessary, since Marvin, Fischer and Juhlin have been able to show that vapour from water and vapour from ice exert different elastic pressures, and must therefore represent different modifications of liquid water. According to Hertz, we may easily follow this mass of moist air as it rises in the atmosphere, if by expansion it cools adiabatically so as to go successively through the four preceding stages. For a few thousand feet it remains dry air. It then becomes cloudy and enters the second stage. Next it rises higher until the cloudy particles begin to freeze into snow, sleet or hail, which characterizes the third stage. When the water has frozen and the cloud has ascended higher, it contains only ice particles and the vapour of ice, a condition which characterizes the fourth or snow stage. If in this condition we give it plenty of time the precipitated ice or snow may settle down, and the cloudy air, becoming clear, return to the first stage; but the ordinary process in nature is a circulation by which both the cloud and the air descend together slowly, warming up as they descend, so that eventually the mixture returns to the first stage at some level lower than the clouds, though higher than the starting-point.



After Hertz.

FIG. 10.—Diagram for Graphic Method of following Adiabatic Changes.

The exact study of the ordinary non-adiabatic process can be carried out by the help of Professor Bigelow's tables, and especially by the very ingenious tables published by Neuhoff (Berlin, 1900), but the approximate adiabatic study is so helpful that in fig. 10 we have traced a few lines from Hertz's diagram sufficient to illustrate its use and convenience. The reader will perceive a horizontal line at the base representing sea-level; near the middle of this line is zero centigrade; as we ascend above this base into the upper regions of the air we come under lower pressures, which are shown by the figures on the left-hand side. The scale of pressures is logarithmic, so that the corresponding altitudes would be a scale of equal parts. The temperature and pressure at any height in the atmosphere are shown by this diagram. If the air be saturated at a given temperature, then the unit volume can contain only a definite number of grams of water, and this condition is represented by a set of moisture lines, indicated by short dashes, showing the temperature and pressure under which 5, 10 or 20 grams of water may be contained in the saturated air. Let us now suppose that we are following the behaviour of a kilogram mass of air rising from near sea-level, where it has a pressure of 750 millimetres, a temperature of 27° C., and a relative humidity of 50%. A pointer pressing down upon the diagram at 750 millimetres and 27° C. will represent this initial condition. A line drawn through that point parallel to the moisture lines will show that if this air were saturated it would contain about 22 grams of water; but inasmuch as the relative humidity is only 50%, therefore it actually contains only 11 grams of water, and an auxiliary moisture line may be drawn for this amount. If now the mass rises and cools by expansion, the relation between pressure and temperature will be shown by the line α α. When this line intersects the inclined moisture line for 11 grams of water we know that the rising mass has cooled to saturation, and this occurs when the pressure is about 640 millimetres and the temperature 13·2° C. By further rise and expansion a steady condensation continues, but by reason of the latent heat evolved the rate of cooling is diminished and follows the line β β. The condensed vapour or cloud particles are here supposed to be carried up with the cooling air, but the temperature of freezing or zero degrees centigrade is soon attained—as the diagram shows—when the pressure is about 472 millimetres. At this point the special evolution of latent heat of freezing comes into play; and although the air rises higher and more moisture is condensed, the temperature does not fall because the water already converted into vapour and now becoming ice is giving out latent heat sufficient to counteract the cooling due to expansion. This illustration from Hertz's diagram therefore shows that the curve for cooling temperature coincides with the vertical line for freezing, and is represented on the diagram by the short piece β γ. By this expansion due to ascent the volume is increased while the temperature is not changed; therefore, the quantity of aqueous vapour has increased. When the ascending mass has reached the level where the pressure is 463 millimetres it has also reached the moisture line that represents this increase in aqueous vapour. As this shows that the aqueous particles have now all been frozen, and as the air is now continuously rising, while its temperature is always below freezing-point, therefore at levels above this point the vapour that condenses from the air is supposed to pass directly over into the condition of solid ice. Therefore from this point onwards the falling temperatures follow along the line γ γ, and continue along it indefinitely. From these considerations it follows that the clouds above the altitude of freezing temperatures are essentially snow crystals, and if the air rises slowly there may be time for the water and ice to settle down towards the ground; in this case the quantity of snow left within the clouds must be very small, and the cloud has the delicate appearance peculiar to cirrus. Hertz's original diagram is quite covered by these systems of α, β, γ and δ lines, and the moisture lines. The lines show the density of the moist air at any stage of the process. The improved diagram by Neuhoff, published in 1900, is reprinted in the second volume of Abbe's *Mechanics of the Earth's Atmosphere*, and its arrangements help to solve many problems suggested by the recent progress of aerial research.

In von Bezold's treatment of this subject only illustrative diagrams are published, because the accurate figures, drawn to scale, are necessarily too large and detailed. He presents graphically the exact explanation of the cooling by expansion, the loss of both mass and heat by the rainfall and snowfall, and the warmth of the remaining air when it descends as foehn winds in Switzerland and chinook winds in Montana. Even in the neighbourhood of a storm over low lands and the ocean, the warm moist air in front, after being carried up to the rain or snow stage, flows away on the upper west wind until a corresponding portion of the latter descends drier and warmer on the opposite side of the central low pressure. In order to have a convenient term expressive of the fact that two masses of air in different portions of the atmosphere having different pressures, temperatures and moistures, would, if brought to the same pressure, also necessarily attain the same temperature, von Bezold introduced the expression "potential temperature," and devised a simple diagram by which the potential temperature may be determined for any mass of air whose present temperature, pressure and moisture are known. In an ascending mass of air, from the beginning of the condensation onwards, the potential temperature steadily increases by reason of the loss of moisture, but in a descending mass of air it remains constant at the maximum value attained by it at the highest point of its previous path. In general the potential temperatures of the upper strata of the atmosphere are higher than those of the lower. In general the so-called vertical temperature gradient is smaller than would correspond to the adiabatic rate for the dry stage. This latter gradient is 0·993° C. per hundred metres for the dry stage, but the actual atmospheric observations give about 0·6°. Apparently this difference represents primarily the latent heat evolved by the condensation of vapour as it is carried into the upper layers, but it also denotes in part the effect of the radiant heat directly retained in the atmosphere by the action of the dust and the surfaces of the clouds. Passing from simple changes due to ascent and descent, von Bezold next investigated the results of the mixture of different masses of air, having different temperatures and humidities, or different potential temperatures. The importance of such mixtures was exaggerated by Hutton, while that of thermodynamic processes was maintained by Espy, but the relative significance of the two was first clearly shown by Hann as far as it relates to the formation of rain, and further details have been considered by von Bezold. The practical tables contained in Professor Bigelow's report on clouds, and those of Neuhoff as arranged for the use of those who follow up von Bezold's train of thought, complete our methods of studying this subject.

A most important application of the views of von Bezold, Hertz and Helmholtz was published by Brillouin in his memoir of 1898. Just as we have learned that the motions of the atmosphere are not due either to the general distribution of heat or to local influences exclusively, but in part to each, and just as we have learned that the temperature of the air is not due either to radiation and absorption or to dynamic processes exclusively, but to both combined, so in the phenomena of rain and cloud the precipitation is not always due to the cooling by mixture, or to the cooling by expansion, or to radiation, but is in general a complex result of all. The effect of the evaporation of cloudy particles in the production of descending cold currents has always been understood in a general way, but was first brought to prominence by Espy in 1838, and perhaps equally forcibly by Faye in 1875. Helmholtz, in his memoirs on billows in the atmosphere, showed how contiguous currents may interact on each other and mix together at their boundary surface; but Brillouin explains how these mixtures produce cloud and rain—not heavy rains, of course, but light showers, and spits of snow and possibly hail. He says: "When the layers of clear or cloudy air are contiguous, but moving with very different velocities, their motion, relative to the earth because of the rotation of our globe, assumes a much more complicated character than that which obtains when the air has no horizontal but only a vertical motion. We know in a general manner what apparent auxiliary forces must be introduced in order to take into account this rotation, and numerous meteorologists have published important works on the subject since the first memoirs by Ferrel. But their points of view have been very different from mine. The subjects that I desire to study are the surfaces of discontinuity as to velocity, temperature and cloudiness in one special case only. Analytical methods permit us to resolve complex questions only for limited areas in longitude and for contiguous zones within which the movements are steady, but not necessarily uniform nor parallel. But it is evident that one can learn much as to the condition of permanence or destruction of annular zones having uniform and parallel movements. Thus simplified, the questions can be treated by elementary geometric methods, by means of which we at once rediscover and complete the results given by Helmholtz for zones of clear air and discover a whole series of new results for zones of cloudy air." Among Brillouin's results are the following theorems:—

A. If the atmosphere be divided into narrow zonal rings, each extending completely around the globe, thus covering a narrow zone of latitude, and if each is within itself in convective equilibrium so that the surfaces of equal pressure shall be surfaces of revolution around the axis of rotation, then within any such complete ring in convective equilibrium the angular velocity of any particle of the air will vary in inverse ratio of the square of its distance from the axis of rotation, or αr^2 is constant; that is to say, the air will not move like a rotating solid, but will have a variable angular velocity, smaller far from the axis and greater near to it.

B. The surfaces of equal pressure are more concave towards the centre than is the surface of the globe itself, and they are tangent to the latter only along the parallel where calms prevail.

C. A heavy gaseous atmosphere resting upon a rotating frictionless globe divides itself into concentric rings whose angular movements increase as we pass from the polar region towards the equatorial ring; the central globe rotates more rapidly than the equatorial atmospheric ring.

D. The surface of separation between two contiguous concentric rings must be such that the atmospheric pressure shall have the same value as one approaches this surface from either direction, and the surface of separation is stable if the differences of pressure in different parts of this surface are directed towards the surface of equilibrium. As the distribution of pressure along a line parallel to the axis of rotation is independent of the velocity of rotation, the ordinary condition of stability, viz. that the gas of which the lower ring is composed shall be denser than that above, will hold good for this line. In general, any inclination of the surface of separation to the horizon amounting to 10° must be associated with very small differences of density and large differences of velocity; in practice the inclinations are far less than 10°.

E. If the surfaces of equal pressure or isobars are nearly horizontal, as in ordinary cases, the calculations are comparatively easy to make. Let the inclination of the isobaric surface ascending towards the pole be ϕ; let h_1 be a distance counted along the axis of the earth, and H_1 the distance measured in the direction of the attraction of gravity; then the angle of inclination of the isobaric surface is given by the equation

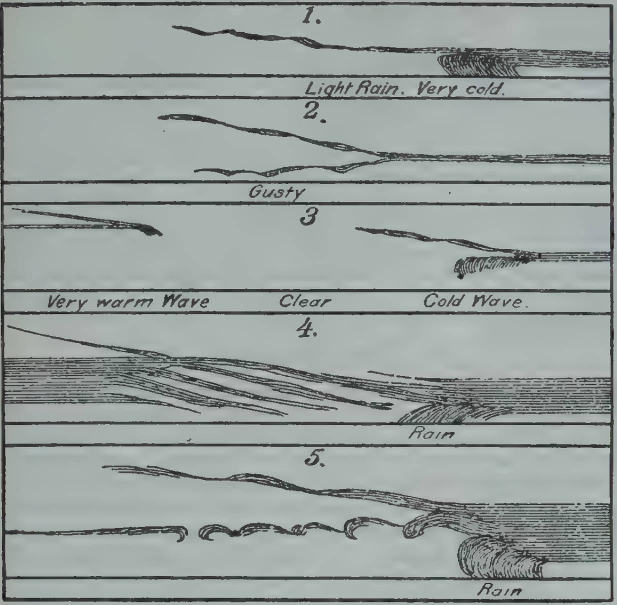
$$\tan\phi = -\frac{H_1 - h_1 \sin\lambda}{h_1 \cos\lambda}$$

where λ is the complement of the angle between the direction of gravity and the line drawn to the poles, or the axis of rotation of the earth. The surface of separation is that over which the pressure is the same in two contiguous masses or zones, and is identical with a vertical plane only when the densities and velocities in the two layers have certain specific relations to each other. It can never lie between the isobaric surfaces that Brillouin designates as 1 and 2. In order that the equilibrium may be stable, it is necessary that when ascending in the atmosphere along a line parallel to the polar axis one should traverse layers of diminishing density. In the midst of any zone there cannot exist another zone of limited altitude; it must extend upwards indefinitely. Whenever there is any zone of limited altitude it must necessarily have, near its highest or lowest point, an edge by which it is attached to the surface of separation of two other neighbouring zones. In other words, the surfaces of separation of the three zones, of which one is limited and the other two are indefinite, must all run together at a common point or edge, very much as in the problem of the equilibrium of thin films.

F. When the contiguous zones are cloudless the mixtures take place under the following conditions: Starting from the stable conditions, the cloudless mixture ascends on the polar side when the west wind which prevails on the equatorial side of the surface of separation is warmer, but descends between the pole and the equatorial side of the horizon when the west wind which prevails on the equatorial side of the surface of separation is colder. The mixtures of cloudless air rapidly occupy the whole height of the two layers that are mixing. When they form along a surface that becomes unstable the whirlwind that is thus engendered is sensibly cylindrical at first, but finally becomes extremely conical. This whirlwind may be limited as to height when the two contiguous masses that are mixing are surmounted by a third clear or cloudy layer which intersects the other two and whose lower surface is stable. (Brillouin suggests that possibly this corresponds to the formation of water-spouts and tornadoes.)

G. When the contiguous zones are cloudy and the mixtures produce decided condensations, and sometimes even precipitation, the study of these must follow closely in the train of thought followed out by von Bezold. When the contiguous winds are feeble, but the temperatures are very different and the zones are near the equator, then the position of the mixture can be inverted by condensation, since the influence of difference of pressure becomes predominant. At the equator, whatever may be the difference of temperature, a mixture that is accompanied by condensation always rises if the surface of separation is stable. The condensation increases by the expansion, each zone of mixture being an outburst of ascending cumuli. At the equator, whatever may be the difference of temperature, a mixture accompanied by condensation always descends when the surface of separation is unstable; moreover, the adiabatic compression rapidly evaporates the mixture.

In the last three chapters of his memoir, Brillouin applies these principles and other details to almost every observed variety of mixtures due to the pressure of one current of air against another. Fig. 11, prepared for the *U.S. Monthly Weather Review* (Oct. 1897), gives five of the cases elucidated by Brillouin. In each of these the left-hand side of the diagram is the polar side, the air being cold above and the wind from the east, while the right-hand side is the equatorial side, the air being warm above and the wind from the west. The reader will see that in each case, depending on the relative temperatures and winds, layers of cloud are formed of marked individuality. As none of these clouds appear in the *International Cloud Atlas* or the various systems of notation for clouds, one is all the more impressed with the importance of their study and the success with which Brillouin has opened up the way for future investigators. "We have no longer to do with personal and local experience, but with an analytical description of a small number of characteristics easy to comprehend and applicable at every locality throughout the globe."



After Brillouin.

FIG. 11.—Diagram illustrating Clouds due to Mixture.

From a thermodynamic point of view the most important study is that published by Margules, *Ueber die Energie der Stürme* (Vienna, 1905). This work considers only the total energy and its adiabatic transformations within a mass of air constituting a closed system. Truly adiabatic changes in closed systems do not occur within any special portion of the earth's atmosphere, neither can our entire atmosphere be considered as one such system—but Margules' results are approximately applicable to many observed cases and complete the demonstration of the general truth that we must not confine our studies to the simpler cases treated by Espy, Reye, Sohncke, Peslin, Ferrel, Mohn. All imaginable combinations of conditions exist in our atmosphere, and a method must be found to treat the whole subject comprehensively and rigorously.

The three equations of energy on which Margules bases his work are:—

$$\mathrm{R}+\delta(\mathrm{K}+\mathrm{P})+\delta\mathrm{A}=0$$
$$\delta\mathrm{I}-\delta\mathrm{A}=\mathrm{Q}$$
$$\mathrm{R}+\delta(\mathrm{K}+\mathrm{P})+\delta\mathrm{I}=\mathrm{Q}$$

where R = energy lost by friction or converted into heat; K = kinetic energy due to velocity of moving masses; P = potential energy due to location and gravity and pressure heat; A = work done by internal forces when air is expanding or contracting; I = internal energy due to the existing pressure and temperature; Q = quantity of heat or thermal energy added or lost during any operation and which is zero during adiabatic processes only.

These equations are applied to cases in which masses of air of different temperatures and moistures are superposed and then left free to assume stable equilibrium. It results in every case that there is no free energy developed. Any condensation of moisture by expansion is counterbalanced by redistribution of potential energy and by the work done in the interchange of locations. The idea that barometric pressure gradients make the storm-winds is seen to be erroneous and the primary importance of gravity gradients is brought to light. "The source of a storm is to be sought only in the potential energy of position and in the velocity of ascent and descent, although these are generally lost sight of owing to the great horizontal and small vertical dimensions of the storm areas. The horizontal distribution of pressure seems to be a forced transformation within the storm areas at the boundary surface of the earth, by reason of which a small part of the mass of air acquires a greater velocity than it could by ascending in the coldest or sinking in the warmest part of the storm areas. But here we come to problems that cannot be solved by considering the energy only."

This latter quotation emphasizes the necessity of returning to the equations of motion. The thermodynamics and hydrodynamics of the atmosphere must be studied in intimate connexion—they can no longer be studied separately. Apparently we may expect this next step to be taken in the above-mentioned work promised by V. Bjerknes, but meanwhile Professor F. H. Bigelow has successfully attacked some features of the problem in his "Studies on the Thermodynamics of the Atmosphere" (*Monthly Weather Review*, Jan.–Dec. 1906). In ch. iii. of his studies (*Monthly Weather Review*, March 1906) Bigelow establishes a thermodynamic formula applicable to non-adiabatic processes by introducing a factor n so that the pressure (P) and absolute temperature (T) are connected by the formula

$$\frac{\mathrm{P}_0}{\mathrm{P}}=\left(\frac{\mathrm{T}}{\mathrm{T}_0}\right)^{n\kappa(c\kappa-1)}$$

In our fig. 1 above given, Cottier has assumed $n=1{\cdot}2$, but as the values have now been computed for all altitudes from the observations given by balloons and kites, and have a very general importance and interest, we copy them from Bigelow's Table 16 as below:—

The existence of such large values of n shows the great extent to which non-adiabatic processes enter into atmospheric physics. Heat is being radiated, absorbed, transferred and transformed on all occasions and at all altitudes. Knowing thus the thermodynamic structure of areas of high and low pressure we find the modifications needed in the energy formula for non-adiabatic processes—and Bigelow applies the resulting formula most satisfactorily to a famous waterspout of the 19th of August 1896 over Nantucket Sound, for which many photographs and measurements are available. The thermodynamic study of this waterspout being thus accomplished, it was followed by a combined thermohydrodynamic study of all storms (*Monthly Weather Review*, November 1907–March 1909) with considerable success.

Altitudes.	Values of *n* between successive levels.						All.
	America.		Europe.		Both A. and E.		
	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.	
kil.							
16–14	3·04	2·82	3·04	3·59	3·04	3·20	3·12
14–12	4·39	2·82	4·39	3·04	4·39	2·93	3·66
12–10	2·08	1·72	2·08	1·64	2·08	1·68	1·88
10– 9	1·52	1·47	1·52	1·41	1·52	1·44	1·48
9– 8	1·39	1·41	1·41	1·32	1·40	1·36	1·38
8– 7	1·41	1·52	1·41	1·41	1·41	1·46	1·44
7– 6	1·45	1·67	1·41	1·52	1·43	1·60	1·52
6– 5	1·52	1·52	1·41	1·62	1·46	1·57	1·52
5– 4	1·79	1·41	1·67	1·70	1·73	1·56	1·64
4– 3	1·97	1·32	1·79	1·94	1·88	1·63	1·76
3– 2	2·10	1·65	2·01	2·30	2·06	1·98	2·02
2– 1	3·52	1·83	2·24	1·67	2·88	1·75	2·32
1– 0	2·30	1·83	2·47	1·64	2·38	1·74	2·06

We have thus passed in review the steady progress of mathematical physicists in their efforts to unravel the complex dynamics of our atmosphere. The profound importance of this subject to governmental weather bureaus, and through them to the whole civilized world, stimulates diligent effort to overcome the inherent difficulties of the problems. An elaborate system of study and laboratory experimentation leading up to research in meteorology has been devised by Cleveland Abbe, culminating in experiments on models of the atmosphere as a whole by which to elucidate both the local and the general circulations on globes whose orography and distribution of land and water is as irregular as that of the earth.

The Formation of Rain.—Not only has dynamic meteorology made the progress delineated in the previous sections, but one of the most important questions in molecular physics is in process of being cleared up. The study of atmospheric nuclei and condensation and the formation of clouds in their relation to daily meteorological work began with the appointment of Dr Carl Barus in 1891 as physicist to the U.S. Weather Bureau, and his work has been laboriously continued and extended in his laboratory at Providence, Rhode Island. The formation of rain, from a physical point of view, is the ultimate step in the formation of cloud. The cloud consists, like fog, of extremely small particles. so light that they float indefinitely in the air; rain and snow represent those particles that have grown to be too large and heavy to be any longer sustained by the air—that is to say, their rate of fall through the air is greater than the ascending component of the air in which they float. The process by which larger drops are formed out of the lighter particles that constitute a cloud has not yet been satisfactorily explained. It is probable that either one of several processes contributes to bring about this result, and that in some cases all of these conspire together. The following paragraphs represent the hypotheses that have marked the gradual progress of our knowledge:—

A. Cloud particles may be driven together by the motions imparted to them by the wind, and may thus mechanically unite into larger ones, which, as they descend more rapidly, overtake the smaller ones and grow into rain-drops.

B. The particles on the upper boundary of a cloud may at night-time, or in the shade, cool more decidedly than their neighbours below them, either by radiation or by mixture; then the air in their immediate vicinity becomes correspondingly cold, the particles and their envelopes of cold air sink more rapidly, overtaking, and therefore uniting, with other particles until the large rain-drops are formed.

C. Some cloud particles may be supposed to be electrified positively and others negatively, causing them to attract each other and run together into larger ones, or, again, some may be neutral and others charged, which may also bring about attraction and union.

D. When any violent agitation of the air, such as the sound waves due to thunder, or cannonading, or other explosions, sets the particles in motion, they may be driven together until brought into contact, and united into larger drops.

E. The air—or, properly speaking, the vapour—between cloudy particles—that is to say, within fog or cloud, is generally in a state of supersaturation; but if it is steadily rising to higher altitudes, thereby expanding and cooling, the supersaturation must increase steadily until it reaches a degree at which the molecular strain gives way, and a sudden violent condensation takes place, in which process both the vapour and the cloud particles within a comparatively large sphere are instantaneously gathered into a large drop. The electricity that may be developed in this process may give rise to the lightning flash, instead of the reverse process described in the preceding paragraphs (C and D).

F. However plausible the preceding five hypotheses have seemed to be, it must be confessed that no one has ever yet observed precipitation actually formed by these processes. The laborious observations of C. T. R. Wilson of Cambridge, England, probably give us our first correct idea as to the molecular processes involved in the formation of rain. After having followed up the methods inaugurated by Aitken showing that the particles of dust floating in the air, no matter of what they may be composed, become by preference the nuclei upon which the moisture begins to condense when air is cooled by expansion, Wilson then showed that in absolutely dustless air, having therefore no nuclei to facilitate condensation, the latter could only occur when the air is cooled to a much greater extent than in the case of the presence of dust; in fact, dustless air requires to be expanded more than dusty air in the ratio of 4 to 3, or $1\frac{1}{3}$ times more. The amount of this larger expansion may vary somewhat with the temperature, the moisture and the gases. More remarkable still, he showed that dustless air, having no visible or probable nuclei, acquired such nuclei when a beam of ultra-violet light, or of the röntgen rays, or the uranium radiation, or of ordinary sunlight (which possibly contains all of these radiations), was allowed to pass through the moist air in his experimental tube. In other words, these rays produce a change in the mixed gas and vapour similar to the formation of nuclei, and condensation of aqueous vapour takes place upon these invisible nuclei as readily as upon the visible dust nuclei. Further, the presence of certain metals within the experimental tube also produces nuclei; but the amount of expansion, and therefore of cooling, required to produce condensation upon these metallic nuclei is rather larger than in the case of dust nuclei. The nuclei thrown into the experimental tube by the discharge of electricity from a pointed metal wire produced very dense fogs by means of expansions slightly exceeding those required for ordinary dust. Finally, Wilson has been able to show that when dust particles are electrified negatively their tendency to condense vapour upon themselves as nuclei is much greater than when they are electrified positively, and he suggests that the descent of the rain-drops to the ground, carrying negative electricity from the atmosphere to the earth, may perhaps explain the negative charge of the earth and the positive electricity of the atmosphere.

At this point we come into contact with the views developed by J. J. Thomson as to the nature of electricity and the presence of negative and positive nuclei in the atmosphere. According to him, "The molecules made up of what chemists call atoms must be still further subdivided, and the atoms must be conceived as made up of corpuscles; the mass of a corpuscle is the same as the mass of the negative ion in a gas at low pressure. In the normal atom this assemblage of corpuscles forms a system which is electrical and neutral. Though the individual corpuscles behave like negative ions, yet when they are assembled in a neutral atom the negative effect is balanced by something which causes the space through which the corpuscles are spread to act as if it had a charge of positive electricity equal in amount to the sum of the negative charges on the corpuscles. I regard electrification of a gas as due to the splitting up of some of the atoms of the gas, resulting in the detachment of a corpuscle from such atoms. The detached corpuscles behave like negative ions, each carrying a constant negative charge which we shall call the unit charge, while the part of the atom left behind behaves like a positive ion with the units positively charged but with a mass that is large compared with that of the negative ion. In a case of the ionization of the gas by röntgen or uranium rays, the evidence seems to be in favour of the view that not more than one corpuscle can be detached from any one atom. Now the ions by virtue of their negative charges act as nuclei around which drops of water condense when moist dust-free gas is suddenly expanded. . . . C. T. R. Wilson has shown that it requires a considerably greater expansion to produce a cloud in dust-free air on positive ions than on negative ones, when the ions are produced by röntgen rays." It would therefore appear that the moist atmosphere above us may, through the action of sunlight or the lightning flash as well as by other means, become ionized. The negative ions attract moisture to themselves more readily than the positive; they grow to be larger drops, and descending to the earth with their negative charges give it negative electricity, while the atmosphere is left essentially either positive or neutral. (See also ATMOSPHERIC ELECTRICITY.)

IV.—COSMICAL METEOROLOGY

Under this title have been included all possible, plausible or imaginary relations between the earth's atmosphere and interplanetary space or the heavenly bodies. The diffusion to and fro at the outer limit of the atmosphere, the bombardment by ions from the sun, the explanation of auroral lights and of magnetic storms, the influence of shooting stars and comet tails, the relation of the zodiacal light and the Gegenschein to the atmosphere, the parallelisms between terrestrial phenomena and the variations of the solar spots and protuberances, the origin of long or short climatic periods, the cause of special widespread cold days, the existence of lunar or solar gravitation tides analogous to oceanic tides, the influence of slow changes in the earth's orbit or the earth's axis of rotation —all are grouped under cosmical meteorology.

But, in the writer's judgment these matters, while curious and interesting, have no appreciable bearing on the current important questions of atmospheric mechanics. There seem to be many widespread delusions and mistakes in regard to these problems, analogous to the popular errors in regard to astrology, and it is hardly necessary to do more than allude to them here. The leading meteorologists have relegated such questions to the care of theoretical astronomers and physicists until our knowledge is more firmly established. Undoubtedly the earth does come under other influences than that of the radiation from the sun; but in the present stage of dynamic meteorology we consider only this latter, and, assuming it to be constant as regards quantity and quality, we find the variable selective absorptions and reflections within our own atmosphere, and its complex internal mechanism afford us a bewildering maze of problems such that so long as these are unsolved it would be folly to spend time on those.

V.—METEOROLOGICAL ORGANIZATIONS

During the latter half of the 19th century the prosecution of work in meteorology gradually passed out of the hands of individuals into the control of large national organizations. This was the natural result of the discovery that, by the spread of the electric telegraph and ocean cables, it had become possible to compile daily weather-maps for large portions of the globe and make predictions of the weather and the storms for a day or two in advance, of sufficient accuracy to be of the greatest importance to the material interests of civilized nations. The development of wireless telegraphy since 1900 has even made it possible for isolated ships at sea to exchange weather telegrams, compile daily maps and study surrounding storms. One by one every civilized nation has established either a weather bureau or a meteorological office, or a bureau of hydrography and marine meteorology, or an elaborate establishment for aerial explorations according as its special interests demanded. These governmental bureaus usually pursue both climatology and theoretical meteorology in addition to their daily practical work of telegraphy, forecasting, and publication of charts. Although, of course, in most cases, the so-called practical work absorbs the greater part of the labour and the funds, yet everywhere it is recognized that research and the development of a correct theory of the motions of the atmosphere are essential to any important progress in the art of forecasting. Among other important general works in which the official weather bureaus have united, we may enumerate the International Meteorological Congresses, of which the first was held in 1853 at Brussels, the second in 1873 at Vienna, and others more frequently since that date; the establishment of an International Committee, to which questions of general interest are referred; the organization of a systematic exploration of the polar regions in the years 1882 and 1883; the general extension of the meteorological services to include terrestrial magnetism as an essential part of the physics of the globe; the systematic exploration of the upper atmosphere by means of kites and balloons; and the universal co-operation with the U.S. Weather Bureau in the contribution of simultaneous data for its international bulletin and its daily map of the whole northern hemisphere. The hydrographic offices and marine bureaus of the principal commercial nations have united so far as practicable in the daily charting of the weather, but have especially developed the study of the climatology of the ocean, not only along the lines laid down by Maury and the Brussels Conference of 1853, but also with particular reference to the tracks of storm centres and the laws of storms on the ocean. The condition of these governmental organizations was discussed in the annual address of the Hon. F. Campbell Bayard, delivered before the Royal Meteorological Society of London in January 1899, and in the text accompanying Bartholomew's *Physical Atlas*, vol. iii.

The development of meteorology, in both its scientific and its practical aspects, is intimately dependent upon the progress of our knowledge of physics, and its study offers innumerable problems that can be solved only by proper combinations of mathematical theory and laboratory experimentation. The professors in colleges and universities who have hitherto lectured on this subject have not failed to develop some features of dynamic meteorology, although most of their attention has been given to climatology. In fact, many of them have been engrossed in the study of general problems in molecular physics, and could give meteorology only a small part of their attention. The early textbooks on meteorology were frequently mere chapters or sections of general treatises on physics or chemistry. The few prominent early cases of university professorships devoted to meteorology are those of the eminent Professor Heinrich Wilhelm Dove at Berlin, Professor Adolphe Quetelet at Brussels and Professor Ludwig Friedrich Kaemtz at Halle and Dorpat. In modern times we may point to Professor Wilhelm von Bezold and George Hellmann at Berlin, Professor Julius Hann at Vienna and Gratz, Professor Josef Maria Pernter at Linz and Vienna, Professor Alexander Woeikof at St Petersburg, Professors Hugo Hildebrand-Hildebrandsson at Upsala, Henrik Mohn at Christiania, Elias Loomis at New Haven, Connecticut, W. M. Davis and R. de C. Ward at Cambridge, Massachusetts, Alfred Angot and Marcel Brillouin at Paris, Hugo Hergesell at Strassburg, Arthur Schuster at Manchester, Peter Polis at Bonn, and Richard Börnstein at the School of Agriculture in Berlin. With these exceptions the great universities of the world have as yet given but little special encouragement to meteorology; it has even been stated that there is no great demand for higher education on the subject. On the other hand, the existence of thousands of voluntary observers, the profound interest in the weather actually taken by every individual, and the numerous schemes for utilizing our very limited knowledge of the subject through the activities of the large weather bureaus of the world demonstrate that there is a demand for knowledge perhaps even higher than the universities can offer. It would be very creditable to a nation or to a wealthy patron of science if there should be established meteorological laboratories in connexion with important universities, at which not only instruction but especially investigation might be pursued, as is done at the magnificent astronomical observatories that are so numerous throughout the world. Every atmospheric phenomenon can be materially elucidated by exact laboratory experiments and measurements, theory can be confronted with facts; and the student can become an original investigator in meteorology.

The great difficulties inherent to meteorology should stimulate the devotion of the highest talent to the progress of this branch of science. The practical value of weather predictions justifies the expenditure of money and labour in order to improve them in every detail.

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METER, ELECTRIC. In the public supply of electric energy for lighting and power it is necessary to provide for the measurement of the electric energy or quantity by devices which are called electric meters. Those in use may be classified in several ways: (i) according to the kind of electric supply they are fitted to measure, *e.g.* whether continuous current or alternating current, and if the latter, whether monophase or polyphase; (ii) according to whether they record intermittently or continuously; (iii) according to the principle of their action whether mechanical or electrolytic; (iv) according to the nature of the measurement, whether quantity or energy meters. The last subdivision is fundamental. Meters intended to measure electric energy (which is really the subject of the sale and purchase) are called *joule meters*, or generally *watt-hour meters*. Meters intended to measure electric quantity are called *coulomb meters* and also *ampere-hour meters*; they are employed for the measurement of public electric supply on the assumption that the electromotive force or pressure is constant. Most of the practical meters in use at the present time may be classified under the following five heads: electrolytic meters, motor meters, clock meters, intermittent registering meters and induction meters.

Electrolytic Meters are exclusively ampere-hour meters, measuring electric quantity directly and electric energy only indirectly, on the assumption that the pressure of the supply is constant. The first electrolytic house meter in connexion with public electric supply was described by St. George Lane-Fox. He was followed by F. J. Sprague and T. A. Edison, the last-named inventor elaborating a type of meter which he employed in connexion with his system of electric lighting in its early days. The Edison electric meter, like those of Sprague and Lane-Fox, was based upon the principle that when an electric current flows through an electrolyte, such as sulphate of copper or sulphate of zinc, the electrodes being plates of copper or zinc, metal is dissolved off one plate (the anode) and deposited on the other plate (the cathode). It consisted of a glass vessel, containing a solution of sulphate of zinc, in which were placed two plates of pure amalgamated zinc. These plates were connected by means of a german-silver shunt, their size and the distance between them being so adjusted that about $\frac{1}{1000}$ part of the current passing through the meter travelled through the electrolytic cell and $\frac{999}{1000}$ of the current passed through the shunt. Before being placed in the cells the zinc plates were weighed. The shunted voltameter was then inserted in series with the electric supply mains leading to the house or building taking electric energy, and the current which passed dissolved the zinc from one plate and deposited it upon the other, so that after a certain interval of time had elapsed the altered weight of the plates enabled the quantity of electricity to be determined from the known fact that an electric current of one ampere, flowing for one hour, removes 1·2133 grammes of zinc from a solution of sulphate of zinc. Hence the quantity in ampere-hours passing through the electrolytic cell being known and the fraction of the whole quantity taken by the cell being known, the quantity supplied to the house was determined. To prevent temperature from affecting the shunt ratio, Edison joined in series with the electrolytic cell a copper coil the resistance of which increased with a rise of temperature by the same amount that the electrolyte decreased. Owing to the cost and trouble of weighing a large number of zinc plates, this type of meter fell into disuse.

A more modern type of electrolytic meter is that due to C. O. Bastian.[1] The whole current supplied to the house flows through an electrolytic cell consisting of a glass tube containing two platinum electrodes; the electrolyte is dilute sulphuric acid covered with a thin layer of oil to prevent evaporation. As the current flows it decomposes the liquid and liberates oxygen and hydrogen gases, which escape. The quantity of electricity which is passed is estimated by the diminution in the volume of the liquid. A third electrolytic meter of the shunted voltameter type is that of A. Wright. In this meter the electrolyte is a solution of mercurous nitrate which is completely enclosed in a glass tube of a particular form, having a mercury anode and a platinum or carbon cathode. The current is determined by measuring the volume of the mercury delivered at the cathode. In the Long-Schattner electrolytic meter a solution of sulphate of copper is electrolyzed.

Motor Meters.—Amongst motor meters one well-known type belonging to the ampere-hour species is that of S. Z. Ferranti, who introduced it in 1883. It consists of an electromagnet within the iron core of which is a flat disk-like cavity containing mercury, the sides of the cavity being stamped with grooves. The thin disk of mercury is therefore traversed perpendicularly by lines of magnetic force when the magnet is excited. The current to be measured is passed through the coils of the electromagnet, then enters the mercury disk at the centre, flows through it radially in all directions, and emerges at the periphery. The mass of mercury is thus set in motion owing to the tendency of a conductor conveying an electric current to move transversely across lines of magnetic force; it becomes in fact the armature of a simple form of dynamo, and rotates with a speed which increases with the strength of the current. The roughness of the surface of the cavity serves to retard it. The rotation of the mercury is detected and measured by means of a small vane of platinum wire immersed in it, the shaft of this vane being connected by an endless screw with a counting mechanism. The core of the electromagnet is worked at a point far below magnetic saturation (see MAGNETISM); hence the field is nearly proportional to the square of the current, and the resistance offered to the rotating mercury by the friction against the sides of the cavity is nearly proportional to the square of the speed. It follows that the number of the revolutions the mercury makes in a given time is proportional to the quantity of electricity which is passed through the meter. In order to overcome the friction of the counting train, Ferranti ingeniously gave to the core of the electromagnet a certain amount of permanent magnetism. Another well-known motor meter, working on a somewhat similar principle, is that of Chamberlain and Hookham. In its improved form this meter consists of a single horseshoe permanent magnet formed of tungsten-steel having a strong and constant field. Two air-gaps are made in this field parallel to each other. In one of these a copper disk, called the brake disk, revolves, and in the other a copper armature disk. The latter is slit radially, and the magnetic field is so arranged that it perforates each half of the disk in opposite directions. The armature is immersed in a shallow vessel filled with mercury, which is insulated from the vessel and the armature, except at the ends of the copper strips. The current to be measured passes transversely across the disk and causes it to revolve in the magnetic field; at the same time the copper brake, geared on the same shaft, revolves in the field and has local or eddy currents produced in it which retard its action. The principle of the meter is to make the breaking and driving action so strong that the friction of the train becomes immaterial in comparison. This meter is an ampere-hour meter and applicable only to continuous current circuits. Another form of motor meter which is much used is that of Elihu Thomson. It takes the form of a small dynamo having an armature and field magnets without any iron core. The armature carries on its shaft a commutator made of silver slips, and the current is fed into the armature by means of brushes of silver wire. The current to be measured passes through the fixed field-coils, whilst through the armature passes a shunt current obtained by connecting the brushes across the supply mains through a constant resistance. The driving force is balanced against a retarding force produced by the rotation of a copper disk fixed on the armature shaft, which rotates between the poles of a permanent magnet. Induced or eddy currents are thus created in the copper disk, and the reaction of these against the magnetic field offers a resistance to the rotation of the disk. Hence when a current is passed through the meter, the armature rotates and increases its speed until the driving force is balanced against the retarding force due to the eddy currents in the copper brake disk. In these circumstances the number of rotations made by the armature in a given time is proportional to the product of the strength of the current flowing through the armature and that flowing through the field-coils, the former being the current to be measured. Hence the meter is a watt-hour meter and measures electric energy. In order to overcome the friction of the train the field-coils are wound with an auxiliary shunt coil which supplies a driving force sufficient to overcome the friction of the counting train. This last is geared to the shaft of the armature by an endless screw, and the number of revolutions of the armature is reckoned by the counting-dials, which are so arranged as to indicate the consumption in Board-of-Trade units (1 Board-of-Trade unit = 1000 watt-hours). A modification of the above meter with some mechanical improvements has been devised by S. Evershed.[2]

Clock Meters.—Among clock meters the best known is that of H. Aron, which is based upon a principle described by W. E. Ayrton and J. Perry in 1882. It can be constructed to be either an ampere-hour meter or a watt-hour meter, but is usually the latter. Its principle is as follows: Suppose there are two pendulum clocks, one having an ordinary pendulum and the other having a pendulum consisting of a fine coil of wire through which a current is passed proportional to the potential difference of the supply mains—in other words, a shunt current. Below this pendulum let there be placed another coil through which passes the current to be measured; then when currents pass through these coils the pendulum of the second clock will be either accelerated or retarded relatively to the other clock, since the action of gravity is supplemented by that of an electric attraction or repulsion between the coils. Hence the second clock will gain or lose on the other. The two clock motions may be geared to a single counting mechanism which records the difference in the rates of going of the two clocks. If the difference of the number of oscillations made by the two pendulums in a given time is small compared to the number made by either of them separately, then it is easy to show that the power given to the circuit is measured by the gain or loss of one clock over the other in a given time, and can therefore be indicated on a counting mechanism or registering dials. By the use of a permanent magnet instead of a shunt coil as the bob of one pendulum, the meter can be made up as an ampere-hour meter. In this form it has the advantage that it can be used for either continuous or alternating currents.

In *Intermittent Registering Meters* some form of ampere-meter or watt-meter registers the current or power passing into the house; and a clock motion electrically driven is made to take readings of the ampere-meter or watt-meter at definite intervals—say, every five minutes—and to add up these readings upon a set of registered dials. The arrangement therefore integrates the ampere-hours or watt-hours. These meters, of which one well-known form is that of Johnson and Phillips, have the disadvantage of being unsuited for the measurement of electric supply in those cases in which it is irregular or intermittent—as in a theatre or hotel.

Induction Meters are applicable only in the case of alternating current supply. One of the most widely used forms is the Westinghouse-Shallenberger. It consists of a disk of aluminium, the axis of which is geared to a counting mechanism and which runs between the poles of permanent magnets that create eddy currents in it and therefore exert a retarding force. In proximity to the upper side of the disk is placed a coil of wire having an iron core, which is a shunt coil, the ends of the coil being connected to the terminals of the supply mains. Under the disk are two other coils which are placed in series with the supply. When these last coils are traversed by an alternating current they induce local or eddy currents in the disk. The current in the shunt coil lags 90 degrees behind the impressed electromotive force of the circuit to be measured; hence if the main current is in step with the potential difference of the terminals of the supply mains, which is the case when the supply is given wholly to electric lamps, then the field due to the main coil differs from that due to the shunt coil by 90 degrees. Since the eddy currents induced in the disk are 90 degrees in phase behind the inducing field, the eddy currents produced by the main coil are in step with the magnetic field due to the shunt coil, and hence the disk is driven round by the revolution due to the action of the shunt coil upon the induced currents in the disk. Hence the disk will be accelerated until the driving force is balanced by the retarding force due to the induced currents created in the disk by the permanent magnets. When this is the case, the number of revolutions of the meter in a given time is a measure of the watt-hours or energy which is passed through the meter. The counting mechanism and dials may be so arranged as to indicate this energy directly in watt-hours. The meter is made up also in a form suitable for use with two or three fixed electric currents. (See ELECTROKINETICS.)

Requirements of a good House Meter.—A gas meter which has an error of more than 2% in favour of the seller or 3% in favour of the customer is not passed for use. An electricity meter should therefore have approximately the same accuracy. As a matter of fact, it is difficult to rely upon most electric meters to register correctly to less than 4% even between quarter-load and full load. Out of nearly 700 current motor meters of various makes tested at Munich in 1902, only 319 had an error of less than 4%, whilst 259 had errors varying from 4½ to 10%. If possible, however, the departures from absolute accuracy should not be more than 2% at quarter-load, nor more than 3% at a full load. The accuracy of a meter is tested by drawing calibration curves showing the percentage departure from absolute accuracy in its reading for various decimal fractions of full load. Such a test is made by determining with an accurate ammeter or watt-meter the current or power supplied to a circuit for a period measured by a good clock and comparing with this the actual reading of the meter during the same time. A common source of trouble is the short circuiting of the shunt coils owing to the shellaced cotton covering of the wire becoming moist.

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[1] See *Electrician*, 41, 112, and *Journ. Inst. Elec. Eng.* (London, 1898), 27, 547.

[2] See *Journ. Inst. Elec. Eng. Lond.* (1899), 29, 743.

A good meter should start with a current which is not more than 2% of its full load current. With a supply pressure of 200 volts a 5 c.p. carbon filament lamp takes only 0·1 ampere; hence unless a meter will begin to register with $\frac{1}{10}$ ampere it will fail to record the current consumed by a single small incandescent lamp. In a large supply system such failure would mean a serious loss of revenue. The resistance of the meter coils causes a fall in voltage down the series coil which reduces the supply pressure to the consumer. On the other hand the resistance of the shunt coil absorbs energy which generally varies from 1 to 3 watts and is a loss either to the consumer or to the supply company, according to the manner in which the shunt coil is connected. In those meters which are compounded—that is, have a shunt coil wound on the field magnets to compensate for the friction of the train—it is important to notice whether the meter will operate or continue operating when there is no current in the series coil, since a meter which "runs on the shunt" runs up a debt against the consumer for which it gives no corresponding advantage.

Generally speaking, the price of the meter is a subordinate consideration. Since the revenue-earning power of a supply station depends entirely upon its meters, inaccuracy in meter record is a serious matter. The cost of measuring current by the aid of a meter is made up of three parts: (1) the prime cost of the meter, which varies from £2 to £6 for an ordinary 25-light house electric meter; (2) the capital value of the energy absorbed in it, which if the cost of the energy is taken at 2d. per Board-of-Trade unit, with interest and depreciation at 6%, may amount to £10 per customer; and (3) the annual working costs for repairs and also the wages of the staff of meter men, who take the required monthly or quarterly readings. In the case of small and irregular consumers, such as the inhabitants of model dwellings and flats inhabited chiefly by working-class tenants, coin-in-the-slot meters are much employed. The customer cannot obtain current for electric lighting until he has placed in a slit a certain coin—say, a shilling—entitling him to a certain number of Board-of-Trade units—say, to 2 or 4, as the case may be. In the Long-Schattner electrolytic meter, the insertion of the coin depresses a copper plate or plates into an electrolytic cell containing a solution of sulphate of copper; the passage of the current dissolves the copper off one of the plates, the loss in weight being determined by the quantity of the electricity passed. As soon as the plate has lost a certain amount of weight corresponding to the value of the electric energy represented by the coin, the plate rises out of the liquid and cuts off the current.

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(J. A. F.)

METHODISM, a term[1] denoting the religious organizations which trace their origin to the evangelistic teaching of John Wesley. The name "Methodist" was given in derision to those Oxford students who in company with the Wesleys used to meet together for spiritual fellowship; and later on when John Wesley had organized his followers into "societies" the name was applied to them in the same spirit. It was however accepted by him, and in official documents he usually styles them "the people called Methodists." The fact that standards of Methodist doctrine are laid down as consisting of "Mr Wesley's Notes on the New Testament and the 1st Series of his Sermons" (fifty-three in number), might seem to indicate a departure from existing systems, but it was not so. He fully accepted the recognized teaching of the Church of England, and publicly appealed to the Prayer Book and the Thirty-nine Articles in justification of the doctrines he preached. Methodism began in a revival of personal religion, and it professed to have but one aim, viz. "to spread Scriptural holiness over the land." Its doctrines were in no sense new. It was the zeal with which they were taught, the clear distinction which they drew between the profession of godliness and the enjoyment of its power—added to the emphasis they laid upon the immediate influence of the Holy Spirit on the consciousness of the Christian—which attracted attention, gave them distinction, and even aroused ridicule and opposition. Wesley and his helpers, finding the Anglican churches closed against them, took to preaching in the open air; and this method is still followed, more or less, in the aggressive evangelistic work of all the Methodist Churches. As followers rapidly increased they were compelled to hold their own Sunday services, and this naturally led them to appoint as preachers godly laymen possessing the gift of exhortation. These followed their ordinary avocations on week-days, but on Sundays preached to congregations in their own immediate neighbourhood, and hence were called *local preachers* as distinguished from *travelling preachers*. The extent to which the employment of the local preacher is characteristic of Methodism may be seen from the fact that in the United Kingdom while there are only about 5000 Methodist ministers, there are more than 18,000 congregations; some 13,000 congregations, chiefly in the villages, are dependent on local preachers.

In the organization adopted to foster spiritual life the very characteristic "Class-meetings for Christian fellowship" take a prominent place. Membership in the church depends solely upon being enrolled as a member of one of these meetings for Christian fellowship, and thus placing oneself under pastoral oversight.

The *Wesleyan Methodists* now represent the original body as founded by John Wesley in Great Britain and Ireland; but in America those who looked upon him as their founder adopted the episcopal mode of Church government after the War of Independence, and have since that time been known as *Episcopal Methodists* (see below). It should be noted that the *Welsh Calvinistic Methodists* are only slightly connected with the original body. They were indirectly the outcome of the evangelistic efforts of Howell Harris and Rowlands. Their work received the sympathy of Wesley and liberal financial help from the Countess of Huntingdon (see CALVINISTIC METHODISTS). For a time Whitefield was leader, and we find a reference to the "Whitefieldian and Wesleyan Methodists" in the Supplement to the *Gentleman's Magazine* for 1747, p. 619. The theological views of these teachers proved quite incompatible with the Arminianism of Wesley, and a definite breach between them and him took place in 1770. The *Welsh Calvinistic Methodists* are now a branch of the Presbyterian Church. Other divisions have been formed at various times by secessions from the Wesleyan Methodists (see separate articles). They are: Methodist New Connexion (founded 1797–1798); Bible Christians (1815); United Methodist Free Churches[2] (about 1836); Primitive Methodists (founded 1807–1810); Independent Methodist Churches (about 1806); Wesleyan Reform Union (1850, reorganized 1859). These bodies have separated solely on matters of Church government and not on points of doctrine. The *Primitive Methodists in Ireland* were a small body who in 1817 seceded because they wished to maintain that close connexion with the Church of England which existed at the time of Wesley's death, but in 1878 they rejoined the parent body. Methodism has always been aggressive, and her children on emigrating have taken with them their evangelistic methods. (For the American branches see below.)

The statistics given in the following table (not including Junior Society Classes) are from the Minutes of the Conference of the Wesleyan Methodist Church for 1909. At the death of Wesley the figures were: 313 preachers, 119 circuits and mission stations, and 76,968 members. In the United States: 97 circuits, 198 preachers and 43,265 members.

In 1837 the membership in Great Britain and Ireland was 318,716; in foreign mission stations, 66,007; in Upper Canada, 14,000; while the American Conferences had charge of 650,678 members. Total for the world: 1,049,401, with 4478 ministers.

Three Oecumenical Conferences have been held—two at City Road, London, in 1881 and 1901, and one at Washington in 1891. The statistics presented at the last showed that the Church during the preceding decade had gained about a million members and three million adherents. At the same time there has been a steadily growing feeling in favour of union. Canada and Australasia led the way, for in these countries the Methodist Church was undivided, and the sentiment was greatly strengthened by the formation in the United Kingdom of the United Methodist Church in 1907.

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[1] "Methodism" is derived from "method" (Gr. μέθοδος), a rule. A "methodist" is one who follows a "method," the term being applied not only to the Wesleyan body, but earlier to the Amyraldists, and in the 17th century to certain Roman Catholic apologists.

[2] These first three were joined in 1907 under the name of the United Methodist Church.

See *A New History of Methodism*, ed. W. J. Townsend, H. B. Workman, George Eayrs (2 vols., London, 1909). (J. A. V.)

Denomination.	Ministers.	Lay Preachers.	Church Members and Probationers.	Sunday Schools.	Officers and Teachers.	Sunday Scholars.	Churches, &c.
Wesleyan Methodists:—							
Great Britain	2,454	19,826	520,868	7,589	132,186	987,953	8,606[1]
Ireland	246	621	29,531	353	2,557	25,969	414[2]
Foreign Missions	617	4,965	143,467	1,754	7,651	91,113	3,502
French Conference	35	89	1,675	70[3]	142	1,996	127
South African Conference	253	5,797	117,146	788	2,893	39,329	3,930
Primitive Methodists	1,178	16,158	212,168	4,155	59,557	465,531	5,148
United Methodist Church	891	6,183	186,905	2,404	43,169	323,675	3,188
Wesleyan Reform Union	21	527	8,489	181	2,762	22,312	196
Independent Methodist Churches	424	—	9,442	153	3,041	27,219	156
Australasian Methodist Church	975	4,576	150,751	3,973	24,322	231,553	6,418
United States:—							
Methodist Episcopal[4]	19,421	14,743	3,376,888	34,619	361,667	3,068,248	29,765
Union American Methodist Episcopal	138	—	18,500	—	—	—	255
African Methodist Episcopal	6,070	15,885	850,000	—	—	—	6,815
African Union Methodist Protestant	200	750	4,000	350	900	2,770	125
African Methodist Episcopal Zion	3,912	1,520	578,310	2,034	14,404	122,467	3,241
Methodist Protestant	1,551	1,135	183,894	2,034	16,680	126,031	2,242
Wesleyan Methodist	524	—	19,064	465	—	18,344	598
Methodist Episcopal (South)	6,978	4,800	1,673,892	14,892	111,137	1,084,238	15,496
Congregational Methodist	415	—	24,000	—	—	—	425
Congregational Methodist (coloured)	5	—	319	—	—	—	5
New Congregational Methodist	238	—	4,022	—	—	—	417
Zion Union Apostolic	30	—	2,346	—	—	—	32
Coloured Methodist Episcopal	2,673	2,786	219,739	4,007	7,098	79,876	2,619
Primitive Methodist	72	138	7,013	108	—	11,754	104
Free Methodist	1,126	1,299	31,435	1,175	7,376	40,660	1,117
Independent Methodist	8	—	2,569	—	—	—	15
Evangelistic Missionary	92	27	5,014	—	—	1,200	47
Canadian Methodist Church	2,384	3,809	329,904	3,556	35,323	305,649	3,789
Japan Methodist Church[5]	47	35	4,083	121	544	11,136	28
Totals	52,978	105,669	8,715,434	84,781	833,409	7,089,023	98.820

METHODISM IN THE UNITED STATES

There are in the United States sixteen distinct Methodist denominations, all agreeing essentially in doctrine. John Wesley had been conducting his United Societies for more than twenty years before the movement took root in North America.

A.—*Episcopal Methodist Churches.*

Philip Embury (1729–1775), a Wesleyan local preacher, emigrated in 1760 from Limerick to New York. Robert Strawbridge (?–1781), a local preacher and native of Ireland, settled in Maryland. In 1766 Embury was stimulated by his relative, Mrs Barbara Heck, to begin Methodist preaching, and a society was soon formed, which grew rapidly. Embury was reinforced by the arrival of Thomas Webb (1724–1796), an English local preacher and a captain in the British army. Webb and Thomas Taylor, a layman of superior ability, appealed to Wesley to send over missionaries, and the 26th annual British Conference, held in 1768, sent to the society in New York £50 and furnished passage money for two missionaries, Richard Boardman and Joseph Pilmoor (1739–1825). Three years later Francis Asbury was sent over, and was made assistant superintendent. Meanwhile Strawbridge had been preaching with success in Maryland and in Virginia.

These "advance agents" of this spiritual propaganda brought with them Wesley's Arminian Theology. They brought also "the means of grace" on which Wesley placed the greatest stress; such as personal testimony in private and public, class and prayer meetings, watch-nights, love-feasts, the direct and fervent preaching of the Gospel and the singing of Wesleyan hymns, carried on by means of circuits and stations, exhorters, local and travelling preachers, and the organization of local societies with class leaders, stewards and trustees. The intention was to make American Methodism a facsimile of that in England, subject to Wesley and the British Conference—a society and not a Church. Pilmoor and others objected to Asbury's strict discipline, and Wesley, hearing of the disagreement, in 1773 appointed Thomas Rankin (*c.* 1738–1810) superintendent of the entire work of Methodism in America.

The First American Conference.—The first American Conference was held in 1773, and consisted of ten preachers, all of whom were born in England or Ireland. Asbury came to America to remain permanently; but Rankin, unable to identify himself with its people, to take the test oaths required in the Revolution, or to sympathize with the colonies, returned to England, as did all the English preachers except Asbury. By May 1776 there were 24 preachers and 4921 members; but in the first year of the Revolution there was a loss of 7 preachers and nearly 1000 members. The next year saw extensive revivals, in sections removed from the seat of war, which added more than 2600 to the number of members.

The preachers in the South determined upon administration of the sacraments, and a committee was chosen whose members ordained themselves and others. The Northern preachers opposed this step and for several years the Connexion was on the verge of disruption. An agreement was finally made to suspend the administration until Wesley's desires and judgment could be ascertained. He perceived that the society would disintegrate unless effective measures were speedily taken, and, aided by two presbyters of the Church of England, early in 1784 he ordained Thomas Coke (1747–1814), already a presbyter of that Church, as superintendent. He likewise ordained two of his lay preachers as deacons and elders, to accompany Coke, whom Wesley sent to America as his commissioner to establish, for the Methodist Society, a system of Church government, which should include the administration of Baptism and of the Lord's Supper. Coke was furnished by Wesley with a document setting forth the grounds on which he had taken this step. Wesley also appointed Thomas Coke and Francis Asbury "to be joint superintendents over our brethren in North America." Soon after Coke and his companions arrived they met Asbury and fifteen preachers, and a special conference was called, which opened on the 24th of December 1784, in the suburbs of Baltimore, Maryland. This convention organized itself into a Methodist Episcopal Church, in which the liturgy sent by Wesley should be read, and the sacraments should be administered by superintendents, elders and deacons, these elders and deacons to be ordained by a presbytery using the episcopal form. Coke and Asbury were unanimously elected superintendents, Coke, aided by his clerical companions from England, ordaining Asbury as deacon and elder and formally consecrating him a general superintendent. Several elders were ordained. This convention adopted the first Discipline of the Methodist Episcopal Church. It adopted the existing doctrinal standards, consisting chiefly of Wesley's Sermons and his Notes on the New Testament; also twenty-five of the Articles of Religion of the Church of England, modified so as to eradicate all trace of High Church ritualism, Anglican or Roman, and the distinctive doctrines of Calvinism.

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[1] Seating accommodation, 2,374,425.

[2] Other preaching-places, 1561.

[3] Sunday and Thursday Schools.

[4] Methodism is also represented in several European countries by Conferences and Missions affiliated to the Methodist Episcopal Church of America, and their membership is included in the figures given above. The 1908 returns are: Bulgaria, 546 members; Denmark, 3771; Finland and St Petersburg, 1367; France, 221; Italy, 3669; North Germany, 12,886; Norway, 6054; South Germany, 11,808; Sweden, 15,430; Switzerland, 9419.

[5] Western Conference only.

The Church thus established began its ecclesiastical career with 18,000 members, 104 travelling preachers, about the same number of local preachers, and more than 200 licensed exhorters. There were 60 chapels and 800 regular preaching places.

The energy of Asbury, and the position of Coke in the Church of England, his wealth, culture, and preaching power, greatly reinforced the efforts of the preachers. The administration of the sacraments brought peace; and many who would not unite with the "Society" asked admission to the Church. Within five years the number of preachers swelled to 227, and the members to 45,949 (white) and 11,682 (coloured).

To bind the whole body the existing method required the concurrence of each Annual Conference with every proposition. This was inconvenient and occasioned much loss of time; therefore a General Conference was established to meet once in four years. The first was held in 1792, and therein arose a sharp conflict. James O'Kelly (1735–1826), a Presiding Elder in control of a large district, proposed that, when the list of appointments was read in the Conference, if any preacher was not pleased with his assignment he might appeal to the Conference. The motion being lost, O'Kelly and several other preachers seceded. The Conference in 1804 limited the power of the Bishops by forbidding them to appoint any pastor for more than two consecutive years in charge of the same church. As all "travelling preachers" were eligible, without election, to seats in General Conferences, widespread dissatisfaction prevailed among the distant Conferences. The era of the steamboat and the railway not having arrived, it was possible for two Annual Conferences, adjacent to the seat of the General Conference, to out-vote all others combined. This led to a demand for the substitution of a delegated General Conference, which was conceded by the Conference of 1808 to take effect four years later. The office then known as the Presiding Eldership had become powerful: Bishops appointed the pastors to churches, Presiding Elders to districts; but it was the purpose of the majority to transfer to the Annual Conferences the power of appointing Presiding Elders. The change, though discussed for many years, has not been accomplished.

Several issues had been settled; but one, that of slavery, had to be faced. The storm burst on the Conference of 1844. Bishop James Osgood Andrew (1794–1871), a native of the South, had, by inheritance and marriage, become a slaveholder. After debates of many days, he was requested "to desist from the exercise of the office of Bishop while this impediment remained." The Southern members declared that the infliction of such a stigma upon Bishop Andrew would make it impossible for them to maintain the influence of Methodism in the South, and a tentative plan of separation was adopted by the Conference by an almost unanimous vote. The result was that the Methodist Episcopal Church was bisected, and when the General Conference of 1848 convened it represented 780 travelling preachers and 532,290 members fewer than it had numbered four years before.

After the Civil War the increase in membership was noteworthy. The quadrennial Conference of 1868 represented 222,687 members more than its predecessor; of this gain 117,326 were in the Southern States. In 1872 lay representatives were admitted, the Constitution having been amended so as to make it legal. It was not, however, an equal representation, for though ministerial Conferences were represented according to their number, in no circumstances could there be more than two lay representatives from one Annual Conference. Not till 1900 were lay and clerical representation equalized. In 1864 the time limit of pastorates was lengthened to three years, and in 1888 to five years. This limit was taken off in 1900, and pastors can be reappointed at the will of the Bishop.

Five women presented credentials as lay delegates in 1888. Their eligibility was questioned; and they were denied admission. For the next four General Conferences the struggle for the admission of women recurred. In 1900–1904 a general revision of the Constitution took place, and the words "lay members" were substituted for "laymen" in that part of the Constitution which deals with the eligibility of delegates to the General Conference.

The General Conference has power to make rules and regulations for the Church, subject only to restrictions which protect the Standards of Doctrine, the General Rules, the disposition of the property of the Book Concern and its income, the income of the Chartered Fund, and the right of ministers to trial before a jury of their peers, an appeal, and similar rights of the laity. By a two-thirds vote of a General Conference, and two-thirds votes of the members of the Annual Conference, and of the members of the Lay Electoral Conferences, present and voting, what is said in these "Restrictive Rules" can be altered or repealed, except that which deals with the Articles of Religion and "the present existing and established Standards of Doctrine." In the Annual Conferences the Bishop is the sole interpreter of law, subject to appeal to the General Conference. When presiding in the General Conference, a Bishop has no authority to decide questions of law, but may decide questions of order subject to an appeal to the body. The district superintendent visits each charge several times annually, presiding in the Quarterly Conference, the highest local authority in the Church, and he is expected to conserve the unity of the denomination and a regard for laws enacted by the supreme body. In the absence of a Bishop the district superintendent represents him, and may transfer any ministers within the bounds of his district.

Connexional Institutions.—The Book Concern, established in 1789, publishes the necessary devotional books of the Church, such as hymnal, discipline, theological works, religious experience, and numerous magazines and papers.

The Board of Foreign Missions carries on extensive operations in China, Japan, Korea, India and Malaysia, Italy, South America and Mexico. It assists the Methodist Churches organized in Norway, Sweden, Denmark, Finland, Germany and Switzerland, and has recently established missions in Russia and France.

The Board of Home Missions and Church Extension supplies the foreign peoples domiciled in the United States with ministers of their own tongue. It assists all English-speaking churches in need of help, and secures, by gifts and time loans, the erection of churches wherever needed. Invaluable coadjutors of these Boards are the Women's Foreign Missionary and the Women's Home Missionary societies.

The Board of Education, with the aid of a University Senate, assists young people to obtain education, and raises the standard of seminaries, colleges and universities. The Church, in the United States, supports 54 colleges and universities and 10 theological seminaries. The Freedmen's Aid Society is devoted to the educational needs of the negro race in the United States, in which work it has been very successful.

The Sunday School Union, Epworth League, Methodist Brotherhood, hospitals, homes for the aged, deaconess homes and children's institutions are maintained by an increasing army of workers.

The whole number of ministers (exclusive of foreign missions) in 1907, was 17,694; churches, 27,691; communicants, 2,984,261.

The Methodist Episcopal Church South.—After the adjournment of the General Conference of 1844, the representatives of thirteen Conferences covering the states holding slaves appealed to their constituents to determine what should be done to prevent Methodism in the South from being deprived of its influence over the whites and of the privilege, till then fully accorded, of preaching the Gospel and teaching its precepts to slaves. In 1845 a representative Convention was called; this body, with the approval and participation of Bishop Andrew, organized the Methodist Episcopal Church South. At its first General Conference, in 1846, the senior Bishop of the Methodist Episcopal Church, Joshua Soule (1781–1867), offered himself to the Church, which accepted him in his episcopal capacity. William Capers (1790–1855) and Robert Paine (1799–1882) were elected to the Episcopacy. The Church thus founded began with 460,000 members, of which 2972 were Indians, 124,961 coloured, and 1519 travelling ministers.

A difficulty arose on the division of the property of the Book Concerns, which the Methodist Episcopal Church maintained involved a change in the Constitution. A vote to authorize the division failed, and the Methodist Episcopal Church South, hopeless of relief, brought two suits, one against the Book Concern in New York, and the other against the Book Concern in Cincinnati. The former was decided in favour of the Methodist Episcopal Church South, and the latter in favour of the Methodist Episcopal Church. In the latter case an appeal was taken by the Methodist Episcopal Church South to the Supreme Court of the United States, which body unanimously decided that the Methodist Episcopal Church South was an integral part of the Methodist Episcopal Church which owned the Book Concerns, and ordered that the Southern Church should receive a proportionate part of the property of both Book Concerns. The amount ordered by the Court was in due time received.

The membership of the Church in 1860 was more than three-quarters of a million; but the Church was doomed to feel the force of the destructive elements of the Civil War. In April 1862 New Orleans was in possession of the Federal Government, rendering it impossible to hold the General Conference due at that time and place.

At the close of the war the Missionary Society of the Church was $60,000 in debt, the Publishing House practically in ruins, and of the more than 200,000 coloured members in 1860 there remained fewer than 50,000. The Conference of 1866 convened in New Orleans. Radical changes in polity were effected. Attendance upon class meetings, which, from the origin of the Church had been obligatory, was made voluntary, and the rule was repealed which required a probation of six months before admission into full membership. The time limit on the continuation of pastorates was extended from two to four years. The most radical change was the introduction into the General Conference of a number of lay representatives equal to the number of clerical, and the admission into each Annual Conference of four lay delegates for each Presiding Elder's district.

The coloured people, with the consent of the Church, withdrew in 1870, and formed a new Church called the Coloured Methodist Episcopal Church.

The most striking denominational effort in its history was the maintenance of the solvency of the Publishing House, which was seized by the Federal Troops, and used as a United States printing office; with the damage done, and debts incurred in rebuilding, after a fire, interest, &c., the liabilities were $35,000, with debts $125,000 in excess of assets. The concern was declared insolvent; but the necessary funds were forthcoming, and the honour of the Church was maintained.

Education has received unceasing attention. The titles to 175 institutions are held by the Church, and the list of colleges and their character is a credit to the denomination. The most important is Vanderbilt University, at Nashville, Tennessee, founded in 1872, and largely endowed by members of the family whose name it bears. The chief foreign missions are in China, Mexico, Brazil, Japan, Korea and Cuba. Its mission in Japan and the mission of the Methodist Episcopal Church and the Methodist Church of Canada were united in 1907 in a new organization entitled the Methodist Church of Japan. A distinguishing feature of this church is a practical veto power possessed by the bishops, to be exercised when the conference adopts any measure which in their opinion is unconstitutional. They have the right to present written objections and should the General Conference, by two-thirds vote adhere to its action, the proposal is sent down to the Annual Conference for ratification; otherwise it is void. Fraternal relations between the two great Episcopal Methodist Churches were fully established in 1876, and have broadened in spirit and scope from that time.

The Methodist Episcopal Church South in 1907 had 6774 ministers, 16,156 churches and 1,631,379 communicants.

The African Methodist Episcopal Church.—This body originated in strained relations between the white and coloured Methodists of Philadelphia, Pennsylvania, the result of which was, that the coloured people organized themselves, in 1816, into an independent body. They adopted as their standards the doctrines of the Methodist Episcopal Church, and, with a few modifications, its form of government. The Church steadily prospered, but for several years not proportionately in the department of education. Daniel Alexander Payne (1811–1893), who had studied in the Gettysburg Theological Seminary, led a reform, which involved a marked elevation of the qualifications for ministers, and from that time the body has constantly risen in public estimation. One of its peculiarities is that the bishops are members of the General Conference. It sustains Wilberforce University (at Wilberforce, Ohio) and other educational institutions, and has missions in Africa, South America, the West Indies and Hawaii. Notable orators have risen up among its members, who have added greatly to the respect felt for their race and Church. The African Methodist Episcopal Church, the largest Christian denomination consisting wholly of the Negro race, in 1907 comprised 6190 ministers, 5321 churches, and 842,023 communicants.

The African Methodist Episcopal Zion Church.—Some of the coloured people in the city of New York, "feeling themselves oppressed by caste prejudice, and suffering the deprivation of Church privileges permitted to others," organized among themselves, in 1796, and in the year 1800 built a church and named it Zion. For twenty years the Methodist Episcopal Church supplied this church with pastors. Then the members induced three white ministers to ordain as elders three of their brethren, already deacons. Since they had Methodist precedents for such ordination, these proceeded to ordain others, and established churches in Philadelphia and New Hampshire. The elders ordained one of their number a bishop. As late as 1863 the Church had only 92 ministers and 5000 members, but in twelve years it doubled its membership more than five times. In this Church the sexes are equally eligible to all positions. Its educational operations at first were failures, but gradually became successful. Its foreign missions were made a separate department in 1884. This Church had, in 1907, 3871 ministers, 3206 churches and 573,107 communicants.

The Coloured Methodist Episcopal Church.—In 1866 the General Conference of the Methodist Episcopal Church South authorized the bishops to organize its coloured members into an independent ecclesiastical body, if it should appear that they desired it. The bishops formed a number of Annual Conferences, consisting wholly of coloured preachers, and in 1870 these Conferences requested the appointment of five commissioners of the Caucasian part of the Church to meet five of their own number to create an independent Church. Two Bishops of the Methodist Episcopal Church South presided, and ordained to the Episcopacy two coloured elders, selected by the eight coloured conferences. The coloured people by vote named the organization the Coloured Methodist Episcopal Church.

The Union American Methodist Episcopal Church agrees in doctrines and usages with other Methodist bodies. It is divided into Conferences and elects its Bishops for life. It had in 1907, 18,500 members, 138 ministers and 255 churches.

B.—*Non-Episcopal Methodist Churches.*

The Methodist Protestant Church.—In 1821 ministers and laymen of the Methodist Episcopal Church began to criticize its polity, and when their utterances became aggressive the adherents to the regular order replied with equal vigour. During the General Conference of 1824, held in Baltimore, a Convention of "Reformers" met, and established a periodical entitled *The Mutual Rights of the Ministers and Members of the Methodist Episcopal Church*, and made arrangements to organize Union Societies. Travelling and local ministers and laymen were expelled for schism and spreading incendiary publications. Prior to the Conference those expelled, and their sympathizers, formed themselves into a society named "Associate Methodist Reformers." These sent memorials to the General Conference of 1828, and issued addresses to the public. After a powerful and painful discussion, the appeals of the expelled members of

Conferences were rejected. The controversy centred upon lay representation, the episcopacy and the presiding eldership.

A General Convention was held on the 2nd of November 1830, a Constitution was adopted, and a new organization was established, styled the Methodist Protestant Church. Within eight years it had accumulated 50,000 members, the majority of whom were in the South and bordering states. The Methodist Protestant Church has a presbyterial form of government, the powers being in the Conference. There is no episcopal office or General Superintendent; each Annual Conference elects its own chairman. Its General Conference meets once in four years. Ministers and laymen equal in number are elected by the Annual Conferences, in a ratio of one delegate for 1000 members. The General Conference of the Methodist Episcopal Church of 1908 sent delegates to the Conference of the Methodist Protestant Church, making overtures toward an organic union, but formal negotiations have not been instituted. This Church had, in 1907, 1551 ministers, 2242 churches and 183,894 communicants.

The Wesleyan Methodist Connection or Church of America.—In the Methodist Episcopal Church slavery was always a cause of contention. In 1842 certain Methodist abolitionists conferred as to the wisdom of seceding. Among the leaders were Orange Scott (1800–1847), Jotham Horton and Le Roy Sunderland (1802–1885) and in a paper, which they had established, known as *The True Wesleyan*, they announced their withdrawal from the Church, and issued a call for a convention of all like-minded, which met on the 31st of May 1843, at Utica, New York, and founded the Wesleyan Methodist Connection or Church of America. The enterprise started with 6000 laymen and 22 travelling ministers of the Methodist Episcopal Church, and nearly as many more from the Methodist Protestant Church and other small bodies of Methodist antecedents. Its General Conference has an equal number of ministers and laymen. In less than eighteen months this body had gained in members 250%; but as the Methodist Episcopal Church had purged itself from slavery in 1844, and slavery itself was abolished in 1862, a large number of ministers and thousands of communicants, connected with this body, returned to the Methodist Episcopal Church. It had in 1907 539 ministers, 609 churches and 18,587 communicants.

The Congregational Methodists originated in Georgia in 1852; but in polity they are not strictly Congregational. Appeals from the decision of the Lower Church may be taken to a District Conference, thence to the State Conference, and ultimately to the General Conference. This Church had, in 1907, chiefly in Southern states, 24,000 members, 415 ministers and 425 churches.

The Free Methodist Church.—This body was organized in August 1860, and was the result of ten years of agitation. A number of ministers and members within the bounds of the Genesee Conference, in Western New York, in 1850, began to deplore and denounce the decline of spirituality in the Methodist Episcopal Church. The Rev. B. T. Roberts, the ablest among them, was reprimanded by the Bishop presiding in the Annual Conference, and next year he was expelled. Similar proceedings were taken against others, who appealed to the General Conference of 1860, but their expulsion was confirmed. It was the purpose of the founders to conserve the usage and the spirit of primitive Methodism. The government of the Church is simple, in all but the Episcopacy and its adjuncts resembling that of the Church whence it sprang. The Free Methodist Church had, in 1907, 1032 ministers, 1106 churches, and 31,376 communicants.

Minor Methodist Churches.—The Primitive Methodist Church, as it exists in the United States, came from England. In 1907 it reported 7013 communicants. *The Independent Methodists* are composed of congregations in Maryland, Tennessee and the District of Columbia. They had fewer than 3000 members in 1907. *The Evangelist Missionary Church* comprises ministers and members in Ohio, who in 1886 withdrew from the African Methodist Episcopal Zion Church. They had in 1907 about 5000 members. *The New Congregational Methodists* in 1881 withdrew from the Methodist Episcopal Church South, in Georgia. They had 4022 members in 1907. *The African Union Methodist Protestant Church* dates from 1816, and differed from the African Methodist Episcopal Church in opposing itinerancy, "paid ministers," and episcopacy. In 1907 it had 3867 members in eight states. *The Zion Union Apostolic Church* was organized in 1869, in Virginia. It was reported in 1890 to have 2346 communicants, and shows no gain at the present time.

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(J. M. Bu.)

METHODIST NEW CONNEXION, a Protestant Nonconformist Church, formed in 1797 by secession from the Wesleyan Methodists, and merged in 1907 into the United Methodist Church (*q.v.*). The secession was led by Alexander Kilham (*q.v.*), and resulted from a dispute regarding the position and rights of the laity, Kilham and his party desiring more power for the members of the Church and less for the ministers. In its conferences ministers and laymen were of equal number, the laymen being chosen by the circuits and in some cases by "guardian representatives" elected for life by conference. Otherwise the doctrines and order of the Connexion were the same as those of the Wesleyans. At the time of the union with the Bible Christians and the United Methodist Free Church in 1907 the Methodist New Connexion had some 250 ministers and 45,000 members.

METHODIUS (*c.* 825–885), the apostle of the Slavs, was a native of Thessalonica, probably by nationality a Graecized Slav. His father's name was Leo, and his family was socially distinguished; Methodius himself had already attained high official rank in the government of Macedonia before he determined to become a monk. His younger brother Constantine (better known as Cyril, the name he adopted at Rome shortly before his death) was a friend of Photius, and had earned the surname "the Philosopher" in Constantinople before he withdrew to monastic life. Constantine about 860 had been sent by the emperor Michael III. to the Khazars, a Tatar people living north-east of the Black Sea, in response to their request for a Christian teacher, but had not remained long among them; after his return to within the limits of the empire, his brother and he worked among the Bulgarians of Thrace and Moesia, baptizing their king Bogoris in 861. About 863, at the invitation of Rastislav, king of "Great Moravia," who desired the Christianization of his subjects, but at the same time that they should be independent of the Germans, the two brothers went to his capital (its site is unknown), and, besides establishing a seminary for the education of priests, successfully occupied themselves in preaching in the vernacular and in diffusing their translations of Scripture lessons and liturgical offices. Some conflict with the German priests, who used the Latin liturgy, led to their visiting Pope Nicholas I., who had just been engaged in his still extant correspondence with the newly converted Bulgarian king; his death (in 867) occurred before their arrival, but they were kindly received by his successor Hadrian II. Constantine died in Rome (in 869), but Methodius, after satisfying the pope of his orthodoxy and obedience, went back to his labours in "Moravia" as archbishop of Syrmia (Sirmium) in Pannonia. His province appears to have been, roughly speaking, co-extensive with the basins of the Raab, Drave and Save, and thus to have included parts of what had previously belonged to the provinces of Salzburg and Passau. In 871 complaints on this account were made at Rome, nominally on behalf of the archbishop of Salzburg, but really in the interests of the German king and his Germanizing ally Swatopluk, Rastislav's successor; they were not, however, immediately successful. In 879, however, Methodius was again summoned to Rome by Pope John VIII., after having declined to give up the practice of celebrating mass in the Slavonic tongue; but, owing to the peculiar delicacy of the relations of Rome with Constantinople, and with the young church of Bulgaria, the pope, contrary to all expectation, ultimately decided in favour of a Slavonic liturgy, and sent Methodius (880) back to his diocese with a suffragan bishop of Neitra, and with a letter of recommendation to Swatopluk. This suffragan, a German named Wiching, unfortunately proved the reverse of helpful to his metropolitan, and through his agency, especially after the death of John VIII. in 882, the closing years of the life of Methodius were embittered by continual ecclesiastical disputes, in the course of which he is said to have laid Swatopluk and his supporters under the ban, and the realm under interdict. The most trustworthy tradition says that Methodius died at Hardisch on the March, on the 6th of April 885. He was buried at Welehrad (probably Stuhlweissenburg).

The Greek Church commemorates St Cyril on February 14 and St Methodius on May 11; in the Roman Church both are commemorated on March 9. Their canonization (by Leo XIII. in 1881) is noteworthy, in view of the fact that Gregory VII. and several other popes condemned them as Arians. After the death of Methodius much of his work was undone; his successor Gosrad, a Slav, was expelled, with all the Slav priests, and the Latin language and liturgy supplanted the vernacular. On the 5th of July 1863 a millennial celebration of the two brother apostles was held by the people of Bohemia and Moravia.

See Schafarik's *Slawische Alterthümer*; L. K. Götz, *Geschichte der Slavenapostel Konstantinus und Methodius* (Gotha, 1897); N. Bonwetsch, *Cyrill und Methodius, die Lehrer der Slaven* (Erlangen, 1885), and art. in Hauck-Herzog's *Realencyk. für prot. Theol.* iv. 384, where the literature is cited; G. F. Maclear, *Conversion of the Slavs* (London, 1879).

METHUEN, BARONY OF. The English title of Baron Methuen of Corsham (Wilts) was created in 1838 for Paul Methuen (1779–1849), who had been a Tory member of parliament for Wilts from 1812 to 1819, and then sat as a Whig for North Wilts from 1833 to 1838. His father, Paul Methuen, was the cousin and heir of the wealthy Sir Paul Methuen (1672–1757), a well-known politician, courtier, diplomatist and patron of art and literature, who was the son of John Methuen (*c.* 1650–1706), Lord Chancellor of Ireland (1697–1703) and ambassador to Portugal. It was the last-named who in 1703 negotiated the famous "Methuen Treaty," which, in return for the admission of English woollens into Portugal, granted differential duties favouring the importation of Portuguese wines into England to the disadvantage of French, and thus displaced the drinking of Burgundy by that of port. He and his son were both buried in Westminster Abbey. The 1st baron was succeeded in the title by his son Frederick Henry Paul Methuen (1818–1891), and the latter by his son Paul, 3rd baron (b. 1845), a distinguished soldier, who became a major-general in 1890, and general officer commanding-in-chief in South Africa in 1907. The 3rd baron joined the Scots Guards in 1864, served in the Ashanti War of 1874 and the Egyptian War of 1882, and commanded Methuen's Horse in Bechuanaland in 1884–85, and the first division of the 1st Army Corps in the South African War of 1899–1902. (See TRANSVAAL.)

METHUSELAH, in the Old Testament, the seventh in descent from Adam, and father of Lamech. According to Genesis v. 21 he lived 969 years (see BIBLE: *Old Testament*, § 5, "Chronology"). The name itself has been much discussed. Holzinger interprets it as "man of the javelin": Hommel prefers "man of Selah," Selah being the Hebraized form of the Babylonian Sarrahu (*i.e.* the god Sin), and identifies it with the Ἀμέμψινος of Berossus. The form Methushael, used by the author of Gen. iv. 18 and by some commentators preferred for Gen. v. 21, is variously explained as meaning "man of El" (Ball), or as a transcription (Sayce) of the Babylonian Mutu-ṣa-ili (possibly, "man of the goddess").

METHVEN, a village and parish of Perthshire, Scotland, 7¾ m. W. by N. of Perth by the Caledonian Railway. Pop. of parish (1901), 1699. Only an aisle remains of the collegiate church founded in 1433 by Walter Stewart, earl of Atholl (d. 1437). One mile east of the village, Methven Castle, dating partly from 1680, occupies a fine situation in a park in which stands the Pepperwell oak, 18 ft. in circumference. At Dronach Haugh near the banks of the Almond, which bounds the parish on the N., the earl of Pembroke defeated Robert Bruce in 1306. At Lynedoch, his estate on the Almond, Thomas Graham (1748–1843), the Peninsular general, afterwards Lord Lynedoch, carried on many experiments in farming and stock-breeding. He formerly owned Balgowan House, about 3 m. south-west of Methven, where many years after his death the proprietor discovered, during certain alterations, the portrait of Lord Lynedoch's wife, the Hon. Mrs Graham (a daughter of the 9th Lord Cathcart), one of Gainsborough's masterpieces, now in the National Gallery in Edinburgh; 4½ m. north-west of Methven, occupying a beautiful position in Glenalmond, is Trinity College, a public school on the English model, the first of its kind in Scotland, founded in 1841 through the efforts of W. E. Gladstone, J. R. Hope-Scott, Dean Ramsay and others, and opened in 1847. In 1851 Charles Wordsworth, the first warden, afterwards bishop of St Andrews, added the chapel. At Tibbermore, or Tippermuir, about 3 m. south-east of Methven, Montrose won the first of a series of battles over the Covenanters on the 1st of September 1644.

METHYL ALCOHOL (CH_3OH), the simplest aliphatic alcohol; an impure form is known in commerce as wood-spirit, being produced in the destructive distillation of wood. The name methyl, from Gr. μέθυ, wine, ὕλη, wood, explains its origin. Discovered by Boyle in 1661, it was first carefully studied by Dumas and Péligot in 1831; its synthesis from its elements (through methane and methyl chloride) was effected by Berthelot in 1858. It is manufactured by distilling wood in iron retorts at about 500° C., when an aqueous distillate, containing methyl alcohol, acetone, acetic acid and methyl acetic ester, is obtained. This is neutralized with lime and redistilled in order to remove the acetic acid. The distillate is treated with anhydrous calcium chloride, the crystalline compound formed with the alcohol being separated and decomposed by redistilling with water. The aqueous product is then dehydrated with potash or lime. To obtain it perfectly pure the crude alcohol is combined with oxalic, benzoic or acetic acid, and the resulting ester separated, purified, and finally decomposed with potash. Methyl alcohol is also obtained in the dry distillation of molasses. The amount of methyl alcohol present in wood spirit is determined by converting it into methyl iodide by acting with phosphorus iodide; and the acetone by converting it into iodoform by boiling with an alkaline solution of iodine in potassium iodide; ethyl alcohol is detected by giving acetylene on heating with concentrated sulphuric acid, methyl alcohol, under the same circumstances, giving methyl ether.

Pure methyl alcohol is a colourless mobile liquid, boiling at

66°–67°, and having a specific gravity of 0·8142 at 0° C. It has a burning taste, and generally a spirituous odour, but when absolutely pure it is said to be odourless. It mixes in all proportions with water, alcohol and ether. Its compound with calcium chloride has the formula $CaCl_2 \cdot 4CH_3 \cdot OH$, and with barium oxide $BaO \cdot 2CH_3OH$. Oxidation gives formaldehyde, formic acid and carbonic acid; chlorine and bromine react, but less readily than with ethyl alcohol. The chief industrial applications are for making denatured alcohol (*q.v.*), and as a solvent, *e.g.* in varnish manufacture; it is also used for a fuel; a purer product is extensively used in the colour and fine chemical industries.

Methyl chloride CH_3Cl, is a gas, boiling at –23°, obtained by chlorinating methane, or better, from methyl alcohol; wood spirit is treated with salt and sulphuric acid, or hydrochloric acid gas conducted into the boiling spirit in the presence of zinc chloride, the evolved gas being washed with potash and dried by sulphuric acid. It is also prepared by heating trimethylamine hydrochloride. Alcohol dissolves 35 volumes and water 4. *Methyl bromide* is a liquid, specific gravity 1·73, boiling point 13°; *methyl iodide* has a specific gravity of 2·19, and boils at 43°.

METICULOUS (through Fr. *méticuleux*, from Lat. *meticulosus*, timid, cautious; *metus*, fear), a term meaning pedantically or excessively careful of details, over-scrupulous, laying too much stress on *minutiae*.

METOCHITA, THEODORE [THEODOROS METOCHITES], a Byzantine author, man of learning and statesman, who flourished during the reign of Andronicus II. Palaeologus (1282–1328). After the deposition of his patron by Andronicus III., Metochita was deprived of his office of great logothete (chancellor) and sent into exile. He was soon recalled, but retired from political life to a convent, where he died in 1332. He was a man of very great learning, only surpassed by Photius and Michael Psellus. His pupil Nicephorus Gregoras, who delivered his funeral oration, calls him a "living library."

Only a few of his numerous works have been preserved. The best known is Ὑπομνηματισμοὶ καὶ σημειώσεις γνωμικαί, *Miscellanea philosophica et historica* (ed. C. G. Müller and T. Kiessling, 1821), containing some 120 essays; for a list of them see Fabricius, *Bibliotheca graeca* (ed. Harles), x. 417; in these he chiefly made use of Synesius. Of his rhetorical pieces two have been published by C. N. Sathas in Μεσαιωνικὴ βιβλιοθήκη (1872), and two poems on religious subjects by M. Treu (1895). The poems, dealing mainly with contemporary and personal matters, are written in hexameter, not in the usual "political" verse. Metochita was also the author of works on philosophical and astronomical subjects.

METONIC CYCLE, in chronology, a period of 19 years during which there are 235 lunations, so called because discovered by Meton. Computation from modern data shows that 235 lunations are 6939 days, 16·5 hours; and 19 solar years, 6939 days, 14·5 hours. The relation between integral numbers of months and years expressed by Meton's rule therefore deviates only two hours from the truth. Since 19 Julian years make 6939 days, 18 hours, the relation errs by only 1·5 hour when the Julian year is taken. Meton was an Athenian astronomer (fl. 432 B.C.).

METONYMY (Gr. *μετωνυμία*, change of name, from *μετά* denoting change, and *ὄνομα*, name), a figure of speech, in which the name of one thing is changed for that of another, to which it is related by association of ideas, as having close relationship to one another. Thus "sceptre," "throne," "crown," are used for royal power or authority, "hearth and home" is used for "country," &c.

"Synecdoche" (Gr. *συνεκδοχή*, from *συνεκδέχεσθαι*, to join in receiving) is a rhetorical figure similar to metonymy, in which the part is used for the whole or vice versa, thus "hands" is used for the members of the crew of a vessel; a regiment of infantry is said to number so many "bayonets," &c.

METOPE (Gr. *μετόπη*, a middle space), a term in architecture for the square recess between the triglyphs in a Doric frieze, which is sometimes filled with sculpture.

METRE (*μετρική*, sc. *τέχνη*, from Gr. *μέτρον*, measure), in prosody, the harmonious and regulated disposition of syllables into verse. Metrical form is distinguished from prose by the uniformity of corresponding lines in relation to the number of syllables and the similarity of final sound (rhyme or assonance), by the repetition of certain letters at regular intervals (in alliterative measure), or merely by the regular succession of ups and downs of intonation. In ancient classic poetry the measure which creates the metrical form consists only of this last quantitative element, which is rhythm.

For the rules and divisions of the various metrical systems, see VERSE. For the restricted use of "metre" as a unit of measurement, see METRIC SYSTEM below.

METRIC SYSTEM (adapted from Gr. *μέτρον*, measure), that system of weights and measures of which the metre is the fundamental unit. The theory of the system is that the metre is a $\frac{1}{10000000}$ part of a quandrant of the earth through Paris; the litre or unit of volume is a cube of $\frac{1}{10}$ metre side; the gramme or unit of weight is (nominally) $\frac{1}{1000}$ of the weight of a litre of water at 4° C. The idea of adopting scientific measurements had been suggested as early as the 17th century, particularly by the astronomer Jean Picard (1620–1682), who proposed to take as a unit the length of a pendulum beating one second at sea-level, at a latitude of 45°. These suggestions took practical shape by a decree of the National Assembly in 1790 appointing a committee to consider the suitability of adopting either the length of the seconds pendulum, a fraction of the length of the equator or a fraction of the quadrant of the terrestrial meridian. The committee decided in favour of the latter and a commission was appointed to measure the arc of the meridian between Dunkirk and Mont Jany, near Barcelona. Another commission was also appointed to draw up a system of weights and measures based on the length of the metre and to fix the nomenclature, which on the report of the commission was established in 1795. It was not until 1799 that the report on the length of the metre was made. This was followed by the law of the 10th of December 1799 fixing definitely the value of the metre and of the kilogramme, or weight of a litre of water, and the new system became compulsory in 1801. It was found necessary however to pass an act in 1837, forbidding as and from the 1st of January 1840, under severe penalties, the use of any other weights and measures than those established by the laws of 1795 and 1799. The metric system is now obligatory in Argentina, Austria-Hungary, Belgium, Brazil, Chile, France, Germany, Greece, Italy, Mexico, Netherlands, Norway, Peru, Portugal, Rumania, Servia, Spain, Sweden, Switzerland. Its use is legalized in Egypt, Great Britain, Japan, Russia, Turkey and the United States. In 1875 there was constituted at Paris the International Bureau of Weights and Measures, which is managed by an international committee. The object of the Bureau is to make and provide prototypes of the metre and kilogramme, for the various subscribing countries.

In England action has frequently been taken both by individuals and by associations of commercial men for the purpose of endeavouring to make the metric system compulsory. A Decimal Association was formed in 1854, but did not make very much headway. A bill was introduced into parliament in 1864 to make the metric system compulsory for certain purposes, but owing to government objections a permissive bill was substituted and subsequently became law as the Metric Act 1864. It was, however, repealed by the Weights and Measures Act 1878. In 1871 another bill for compulsory adoption was rejected by the House of Commons on the second reading by a majority of five. In 1893 a representative delegation of business men pressed its adoption on the chancellor of the exchequer (Sir W. V. Harcourt), but he declined. But in 1897 a statute was passed, the Weights and Measures (Metric System) Act, which legalized the use in trade of the metric system, and abolished the penalty for using or having in one's possession a weight or measure of that system.

See also DECIMAL COINAGE and WEIGHTS AND MEASURES.

METROCLES, a Greek philosoper of the Cynic school, was a contemporary of Crates, under whose persuasion he deserted the views of Theophrastus. It was his sister, Hipparchia, whose romantic attachment to Crates is a fascinating sidelight on the almost truculent asceticism of the Cynics. He was a man of peculiar strength of character, and esteemed the joys of life so low that he was deterred from an early suicide only by the influence of Crates. His philosophical views, which were identical with those of Crates (*q.v.*), he expounded by precept and example with great success, and had among his pupils

Menippus of Sinope. Having weighed the probable pains and pleasures of approaching old age, he decided that life had nothing left for which he greatly cared, and drowned himself. He is said to have written several works, which he afterwards burnt. Of one, entitled Χρεῖαι, Diogenes preserves a single line (vi. 6).

METRODORUS, the name of five philosophers.

1. Metrodorus of Athens was a philosopher and painter who flourished in the 2nd century B.C. It chanced that Paullus Aemilius, visiting Athens on his return from his victory over Perseus in 168 B.C., asked for a tutor for his children and a painter to glorify his triumph. The inhabitants suggested Metrodorus as capable of discharging both duties, and it is recorded that Aemilius was entirely satisfied (see Pliny, *Nat. Hist.* xxv. 135).

2. Metrodorus of Chios was an important member of the Atomistic school. A pupil of Nessus, or, as some accounts prefer, of Democritus himself, he was a complete sceptic. He accepted the Democritean theory of atoms and void and the plurality of worlds, but held a theory of his own that the stars are formed from day to day by the moisture in the air under the heat of the sun. His radical scepticism is seen in the first sentence of his Περὶ φύσεως, quoted by Cicero in the *Academics* ii. 23 § 73. He says, "We know nothing, no, not even whether we know or not!" and maintains that everything is to each person only what it appears to him to be. Metrodorus is especially interesting as the teacher of Anaxarchus, the friend of Pyrrho, and, therefore, as the connecting link between atomism proper and the later scepticism. It cannot be decided whether a work entitled the Τρωϊκά quoted by Athenaeus (iv. 184 a) is by this, or another, Metrodorus. The same difficulty is found in the case of the Περὶ ἱστορίας referred to by the scholiast on Apollonius.

3. Metrodorus of Lampsacus was the disciple and intimate friend of Epicurus, and is described by Cicero (*de Fin.* ii. 28. 92) as "almost a second Epicurus." He died in 277 B.C. at the age of fifty-three, seven years before his master, who adopted his children and in his will commended them to the care of his pupils. The wife of Metrodorus was Leontion, herself, like many other women of the time, a member of the Epicurean society. Athenaeus (vii. 279 F.) quotes from the words of Metrodorus showing that he was in entire agreement with Epicurus, and was, if possible, even more dogmatic in his doctrine of pleasure. He censures his brother, Timocrates, who, though professedly Epicurean, maintained the existence of pleasures other than those of the body.

4. Another Metrodorus of Lampsacus was a pupil of Anaxagoras, and one of the earliest to attempt to interpret Homer allegorically. He explained not only the gods but also the heroes Agamemnon, Achilles, Hector, as representing primary elements and natural phenomena.

5. Metrodorus of Stratonice was a pupil, first of Apollodorus, and later of Carneades. He flourished about 110 B.C., and is reputed to have been an orator of great power. His defection from the Epicurean school is almost unique. It is explained by Cicero as being due to his theory that the scepticism of Carneades was merely a means of attacking the Stoics on their own ground. Metrodorus held that Carneades was in reality a loyal follower of Plato.

METRONOME (Gr. μέτρον, measure, and νόμος, law), an instrument for denoting the speed at which a musical composition is to be performed. Its invention is generally, but falsely, ascribed to Johann Nepomuk Maelzel, a native of Ratisbon (1772–1838). It consists of a pendulum swung on a pivot; below the pivot is a fixed weight, and above it is a sliding weight that regulates the velocity of the oscillations by the greater or less distance from the pivot to which it is adjusted. The silent metronome is impelled by the touch, and ceases to beat when this impulse dies; it has a scale of numbers marked on the pendulum, and the upper part of the sliding weight is placed under that number which is to indicate the quickness of a stated note, as M.M. (Maelzel's Metronome) 𝅗𝅥=60, or ♩=72, or ♪=108, or the like. The number 60 implies a second of time for each single oscillation of the pendulum—numbers lower than this denoting slower, and higher numbers quicker beats. The scale at first extended from 50 to 160, but now ranges from 40 to 208. A more complicated metronome is impelled by clock-work, makes a ticking sound at each beat, and continues its action till the works run down; a still more intricate machine has also a bell which is struck at the first of any number of beats willed by the person who regulates it, and so signifies the accent as well as the time.

The earliest instrument of the kind, a weighted pendulum of variable length, is described in a paper by Étienne Loulié (Paris, 1696; Amsterdam, 1698). Attempts were also made by Enbrayg (1732) and Gabory (1771). Harrison, who gained the prize awarded by the English government for his chronometer, published a description of an instrument for the purpose in 1775. Davaux (1784), Pelletier, Abel Burja (1790) and Weiske (also 1790) described their various experiments for measuring musical time. In 1813 Gottfried Weber, the composer, theorist and essayist, proposed a weighted ribbon graduated by inches or smaller divisions, which might be held or otherwise fixed at any desired length, and would infallibly oscillate at the same speed so long as the impulse lasted. Stöckel and Zmeskall produced each an instrument; and Maelzel made some slight modification of that by the former, about the end of 1812, which he announced as a new invention of his own, and exhibited from city to city on the Continent. It was, as nearly as can be ascertained, in 1812 that Winkel, a mechanician of Amsterdam, devised a plan for reducing the inconvenient length of all existing instruments, on the principle of the double pendulum, rocking on both sides of a centre and balanced by a fixed and a variable weight. He spent three years in completing it, and it is described and commended in the *Report of the Netherlands Academy of Sciences* (Aug. 14, 1815). Maelzel thereupon went to Amsterdam, saw Winkel and inspected his invention, and, recognizing its great superiority to what he called his own, offered to buy all right and title to it. Winkel refused, and so Maelzel constructed a copy of the instrument, to which he added nothing but the scale of numbers, took this copy to Paris, obtained a patent for it, and in 1816 established there, in his own name, a manufactory for metronomes. When the impostor revisited Amsterdam, the inventor instituted proceedings against him for his piracy, and the Academy of Sciences decided in Winkel's favour, declaring that the graduated scale was the only point in which the instrument of Maelzel differed from his. Maelzel's scale was needlessly and arbitrarily complicated, proceeding by twos from 40 to 60, by threes from 60 to 72, by fours from 72 to 120, by sixes from 120 to 144 and by eights from 144 to 208. Dr Crotch constructed a time measurer, and Henry Smart (the violinist, father of the composer of the same name) made another in 1821, both before that received as Maelzel's was known in England. In 1882 James Mitchell, a Scotsman, made an ingenious amplification of the Maelzel clock-work, reducing to mechanical demonstration what formerly rested wholly on the feeling of the performer.

Although "Maelzel's metronome" has universal acceptance, the silent metronome and still more Weber's graduated ribbon are greatly to be preferred, for the clock-work of the other is liable to be out of order, and needs a nicety of regulation which is almost impossible; for instance, when Sir George Smart had to mark the traditional times of the several pieces in the Dettingen Te Deum, he tested them by twelve metronomes, no two of which beat together. The value of the machine is exaggerated, for no living performer could execute a piece in unvaried time throughout, and no student could practise under the tyranny of its beat; and conductors of music, nay, composers themselves, will conduct the same piece slightly slower or quicker on different occasions, according to the circumstances of performance.

METROPOLIS (Gr. μήτηρ, mother, πόλις, city), properly a mother-city, and so the name of the parent state from which colonies were founded in ancient Greece (see Greece, sect. *History, Ancient*). The word was used in post-classical Latin for the chief city of a province, the seat of the government, and in particular ecclesiastically for the seat or see of a metropolitan bishop (see Metropolitan). It is thus used now for the capital of a country, which contains the various official buildings of the administrative departments, the Houses of Parliament, &c. In the case of London, the term "metropolitan" is sometimes applied to the whole area including the "City of London," *e.g.* "Metropolitan Asylums Board"; and sometimes, as in "Metropolitan Police," excludes the City, which has its own police force (see London).

METROPOLITAN (Lat. *metropolitanus*, Gr. μητροπολίτης), in the Christian church, the title of a bishop who has the oversight over bishops of subordinate sees. In the Western church the metropolitan is practically the same as the archbishop (*q.v.*); in the Eastern church he ranks above the archbishop, but below the patriarch (*q.v.*). Metropolitans first appear in the East in the 4th century as presiding over a province (*provincia* or *ἐπαρχία*), and their see is fixed in the principal town (*μητρόπολις*) of the province, which remains the normal custom both in East and West. In Africa, however, the metropolitan jurisdiction was exercised by the senior bishop (*primas*, *primae sedis episcopus*, *senex*) for the time being, a custom which prevailed for a time also in Spain. Thus, too, in the Scottish Episcopal Church and the Protestant Episcopal Church of America there are no metropolitans, the *primas* being the senior bishop.

METSU, GABRIEL (1630–1667), Dutch painter, was the son of Jacob Metsu, who lived most of his days at Leiden, where he was three times married. The last of these marriages was celebrated in 1625, and Jacomma Garnijers, herself the widow of a painter, gave birth to Gabriel in 1630. According to Houbraken Metsu was taught by Gerard Dow, though his early works do not lend colour to this assertion. It is certain, however, that he was influenced in turn by Jan Steen, Rembrandt, and Hals. Metsu was registered among the first members of the painters' corporation at Leiden; and the books of the gild also tell us that he remained a member in 1649. In 1650 he ceased to subscribe, and works bearing his name and the date of 1653 give countenance to the belief that he had then settled at Amsterdam, where he probably continued his studies under Rembrandt. One of his earliest pictures is the "Lazarus" at the Strassburg Museum, painted under the influence of Jan Steen. Under the influence of Rembrandt he produced the "Woman taken in Adultery," a large picture with the date of 1653 in the Louvre. To the same period belong the "Departure of Hagar," formerly in the Thoré collection, and the "Widow's Mite" at the Schwerin Gallery. But he probably observed that sacred art was ill suited to his temper, or he found the field too strongly occupied, and turned to other subjects for which he was better fitted. That at one time he was deeply impressed by the vivacity and bold technique of Frans Hals can be gathered from Lord Lonsdale's picture of "Women at a Fishmonger's Shop." What Metsu undertook and carried out from the first with surprising success was the low life of the market and tavern, contrasted, with wonderful versatility, by incidents of high life and the drawing-room. In no single instance do the artistic lessons of Rembrandt appear to have been lost upon him. The same principles of light and shade which had marked his schoolwork in the "Woman taken in Adultery" were applied to subjects of quite a different kind. A group in a drawing-room, a series of groups in the market-place, or a single figure in the gloom of a tavern or parlour, was treated with the utmost felicity by fit concentration and gradation of light, a warm flush of tone pervading every part, and, with that, the study of texture in stuffs was carried as far as it had been by Ter Borch or Dow, if not with the finish or the *brio* of De Hooch.

Metsu went to Amsterdam before 1655, married in 1658, and became a citizen of that city in 1659. One of the best pictures of Metsu's manhood is the "Market-place of Amsterdam," at the Louvre, respecting which it is difficult to distribute praise in fair proportions, so excellent are the various parts, the characteristic movement and action of the dramatis personae, the selection of faces, the expression and the gesture, and the texture of the things depicted. Equally fine, though earlier, are the "Sportsman" (dated 1661) and the "Tavern" (also 1661) at the Hague and Dresden Museums, and the "Game-Dealer's Shop," also at Dresden, with the painter's signature and 1662. Among the five examples of the painter at the Wallace Collection, including "The Tabby Cat," "The Sleeping Sportsman," which cost Lord Hertford £3000, is an admirable example technically considered. Among his finest representations of home life are the "Repast" at the Hermitage in St Petersburg; the "Mother nursing her Sick Child" of the Steengracht Gallery at the Hague; the "Amateur Musicians" at the Hague Gallery; the "Duet" and the "Music Lesson" at the National Gallery, and many more examples at nearly all the leading European galleries.

METTERNICH-WINNEBURG, CLEMENS WENZEL LOTHAR, PRINCE (1773–1859), Austrian statesman and diplomatist, was born at Coblenz on the 15th of May 1773. His father, Count Franz Georg Karl von Metternich-Winneburg zu Beilstein[1] (d. 1818), was a diplomatist who had passed from the service of the archbishop-elector of Trier to that of the court of Vienna; his mother was Countess Maria Beatrix Aloisia von Kagenegg. At the time of Clemens Metternich's birth, and for some time subsequently, his father was Austrian ambassador to the courts of the three Rhenish electors, and the boy was thus from the first brought up under the influence of the tone and ideas which flourished in the small German courts that lay within the sphere of influence of the France of the *ancien régime*.. In 1788 he went to the university of Strassburg, where he studied German constitutional law; but the outbreak of the French Revolution caused him to leave after two years. Metternich was a witness of the excesses of the mob in Strassburg, and he ascribed his life-long hatred of political innovation to these early experiences of the victory of liberal ideas. In 1790, by way of striking contrast, he was deputed by the Catholic bench of the Westphalian college of counts to act as their master of the ceremonies at the coronation of the Emperor Leopold II. at Frankfort, a function which he again performed at the coronation of Francis II. in 1792. The intervening time he spent at Mainz, attending the university and frequenting the court of the archbishop-elector, where his impressions of the Revolution were strengthened by his intercourse with the French *émigrés* who had made it their centre. The outbreak of the revolutionary war drove him from Mainz, and he went to Brussels, where he found employment in the chancery of his father, at that time Austrian minister to the government of the Netherlands. Here, in August 1794, he issued his first publication, a pamphlet in which he denounced the "shallow pates" of the old diplomacy and argued that the only way to combat the French revolutionary armies was by a *levée en masse* of the populations on the frontier of France—singular views for the statesman who was destined to be the last great representative of the old diplomacy and the greater part of whose life was to be spent in combating the national enthusiasms by which the revolutionary power of France was ultimately overthrown.

After a long stay in England, where he made the acquaintance of the prince of Wales (afterwards George IV.), Metternich went to Vienna; and on the 27th of September 1795 he married at Austerlitz the Countess Eleonore von Kaunitz, a grand-daughter of that Austrian chancellor who in many respects was his prototype. This alliance not only brought him great estates in Austria, but introduced him into the most exalted circles of Viennese society. Here he was well qualified to hold his own by reason of his handsome presence, the exquisite courtesy of his address and a certain reputation for gallantry. He was far, however, from being a mere carpet diplomatist. His interests were many and varied, and he found time for the serious study of natural science and medicine. In December 1797 he was chosen by the Westphalian counts as their representative at the congress of Rastadt, where he remained till 1799. This was his first experience of the great world of practical politics and especially of those rough diplomatists of the Revolution of whom in his letters he has left so vivid a description. In January 1801 he was appointed Austrian envoy to the elector of Saxony. His two years' stay at the court of Dresden was mainly useful to him by bringing him into touch with the many Russian and Polish families of importance; his serious diplomatic career did not begin till his appointment, in November 1803, as ambassador at Berlin. His instructions at the outset were to prevent Prussia from joining the alliance of Russia and Great Britain against the French Republic and to make himself agreeable to the representative of France; but shortly afterwards his part was exactly reversed, owing to the shifting of political forces which led to the war of the third coalition, and he laboured to secure the adhesion of Prussia to the alliance of Austria, Russia and Great Britain against Napoleon. His diplomacy was not successful; for though Prussia ultimately signed the treaty of the 5th of November 1805 with Austria and Russia, the influence of the emperor Alexander and the wound given to her pride by Napoleon's contemptuous violation of her territory had more to do with Prussia's decision than Metternich's veiled threats. His reward was the grand cross of the order of St Stephen and the appointment of ambassador at St Petersburg; but his commission to make himself agreeable to the French ambassador at Berlin was carried out to such excellent effect that, as a result of M. Laforest's reports, Napoleon requested that he might be appointed to represent Austria at the Tuileries, and in August 1806 Metternich took up his residence as ambassador in Paris.

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[1] The family of Metternich, originally established in the county of Jülich, can trace its descent to the middle of the 14th century. In 1637 they received from the archbishop of Trier the countships of Winneburg and Beilstein. These were confiscated in 1803, and the lands of the suppressed abbey of Ochsenhausen, with the title of prince of the Empire, were granted by the edict as compensation. The new principality was "mediatized" in 1806 in favour of Württemberg; but in virtue of their short tenure of it the descendants of Prince Metternich enjoy the privileges of mediatized princes.

This was the beginning of his ever growing influence in European affairs. Established in the diplomatic character of an "honourable spy" in the very centre of Napoleon's power, he used his exceptional gifts of fascination not only to become a *persona grata* at the Tuileries, but to establish relations with those elements in the society of the empire which were already intriguing against Napoleon's power. His intimacy with Talleyrand and with Caroline Murat, Napoleon's sister, was destined to produce notable results later. Though on the look-out, however, for any chance of weakening the French emperor's power, Metternich was not at first sanguine of success, for he believed Napoleon to be invincible. For Austria the best policy seemed to him to be to temporize; he was willing, therefore, to co-operate with France in the agreement made between Napoleon and Alexander I. of Russia at Tilsit for the partition of the Ottoman Empire; failing the success of the efforts of Austrian diplomacy to break the Franco-Russian alliance, this would at least secure for the Habsburg monarchy a share of the spoils. With the postponement of Napoleon's Oriental schemes, however, the situation was once more changed. During the summer of 1808 Metternich had reason to suspect fresh designs of the French emperor against Austria, and his suspicions appeared to be confirmed when, during an interview on the 15th of August, Napoleon indulged in one of his violent tirades, denouncing Count Stadion's action in strengthening the Austrian armaments. In November Metternich was at Vienna, urging the Austrian government to an early declaration of war—for which the moment seemed to him opportune owing to the French losses in Spain, of which he had received exaggerated reports. On the 1st of January 1809 he was back in Paris, but no longer as a *persona grata*. At the outbreak of the war he was placed under arrest, in retaliation for the action of the Austrian government in interning two members of the French embassy in Hungary; and in June, on Napoleon's capture of Vienna, he was conducted there under military guard. In July he was exchanged at Komárom for the French diplomatists, and he was present with the emperor Francis at the battle of Wagram. At a council held on the 7th of July it was decided, on Metternich's initiative, to open negotiations for peace; next day Stadion tendered his resignation, which was provisionally accepted. Stadion was sent as diplomatic adviser to the headquarters of the archduke Charles, while Metternich took his place at the emperor's side. On the 4th of August Metternich was named minister of state, and soon afterwards was sent with Count Nugent to the peace conference at Altenburg, where Champagny attended as Napoleon's representative. The conference, however, dragged on without result, and the emperor Francis decided to open negotiations with Napoleon direct. Count Bubna was accordingly sent to Schönbrunn; the result was the French ultimatum which issued in the treaty of Schönbrunn (Vienna), signed by Prince Liechtenstein on behalf of the emperor Francis on the 14th of October 1809. With the negotiation and signature of this humiliating instrument Metternich therefore had nothing to do, though on the 8th of October he had been definitely appointed minister for foreign affairs, an office he was destined to hold for nearly forty years.

The position of the new minister was no easy one. By the treaty of Schönbrunn Austria was reduced to the position of a second-rate power, and by secret articles undertook during the continuance of the maritime war to limit her force of all arms to 150,000 men, and to dismiss from her service all officers or civil officers born in the territories of ancient France, Piedmont or the former Venetian republic. Weak as she had become, the menace of the future seemed even more disquieting. To the south she was divided from the French dominions by the Save; to the west and north the vassal states of France, traditionally her enemies, lay along the frontier; to the east was Russia, which as the reward for her alliance with Napoleon had received a portion of East Galicia as her share of the spoils, and to all appearance was firmly established in the Danubian principalities. Austria seemed hopelessly cut off by Napoleon from any chance of re-asserting her traditional preponderance in Germany, by Russia from any prospect of obtaining compensation at the expense of the Ottoman Empire. One false move on the part of those who guided its destinies, and the Habsburg monarchy might easily have ceased to exist altogether.

The saving factor in the situation was the improbability of the alliance between Napoleon and Alexander continuing, and the immediate task of Metternich was to hasten its dissolution, while securing Austria's safety in the East by bringing about the end of the Russo-Turkish War. It was a task of extreme delicacy; for any revelation of its true tendency might have thrown the emperor Alexander into the arms of France and plunged Austria into an unequal struggle for life and death with Russia on the banks of the Danube. Metternich was helped by the rapid development of the causes of disagreement between the French and Russian emperors. Early in 1810 Europe was full of contradictory rumours of war between France and Russia, of a marriage of Napoleon with a Russian grand duchess. Then suddenly came Napoleon's formal request for the hand of the Austrian archduchess Marie Louise. A proposal so nicely calculated to forward Metternich's plans was suspected of being due to his inspiration; certainly it was his influence that decided the emperor Francis to agree to an alliance which could not but be distasteful to him and was resented as a crowning humiliation by the proud aristocrats of Vienna.

On the 13th of March 1810 Metternich left Vienna for Paris in company with the archduchess. His object was to use so favourable an occasion for obtaining the abrogation of some of the more onerous articles of the treaty of Schönbrunn, and for coming to some arrangement whereby the serious inconvenience caused in Austria by Napoleon's coercion of the pope might be obviated. His diplomacy, however, met with but slight success. His efforts to persuade Pius VII. to purchase a measure of liberty of action by concessions to Napoleon broke down on the gentle old man's refusal to traffic with his principles. From Napoleon he extracted a lame apology for the execution of Andreas Hofer, the reversal of a few sequestrations and, as a crowning grace, the abrogation of the article of the Schönbrunn treaty limiting Austrian armaments. In the matter of restoring the access of Austria to the Adriatic, Napoleon would make no concession; his answer to Metternich's representations was only a commercial treaty which failed to obtain ratification at Vienna. Anything further, *e.g.* an exchange of the Illyrian provinces for Galicia, must depend on the attitude of Austria in the forthcoming Russian war which, in an interview of the 20th of September, Napoleon declared to be now inevitable.

On the 10th of October Metternich was back in Vienna, where his presence was urgently needed. The policy of a Franco-Austrian *entente* was popular with the public and the army, resentful of the treacherous attitude of Russia in the late war, but in the powerful circles of the court it had scarce an adherent. Prince Metternich himself, who had acted as foreign secretary during his son's absence, favoured an understanding with Russia, and was even believed to be intriguing to retain the portfolio of foreign affairs, which would have meant the victory of the Russian party. On the other hand, the French party were clamouring for the speedy conclusion of a definite alliance with Napoleon. By an admirably clear *exposé* of the situation Metternich won over the emperor Francis to that middle course, the policy of armed abstention, which was to be the basic principle of his diplomatic action during the crisis of the coming years. An alliance with Russia, he argued, would be worse than useless; Austria would at any time obtain better terms from the tsar's growing needs. An alliance with France would be one with "a power whose exclusive object is the destruction of the old order of things, which has hitherto found its defence in Austria." Alone of European Powers Austria still had the possibility of choice; let her work for the preservation of peace and at the same time remain free, should war break out, to make her own terms. It would little serve Austria's interests to become the ally of Russia, merely to serve as a barrier behind which the emperor Alexander could carry out his designs on Turkey in safety. In an interview with Count Shuvalov, the Russian agent, Metternich roundly declared that the maintenance of the integrity of Turkey was for Austria the question of supreme interest.

With the approach of the Russo-French War the situation became increasingly difficult. The partisans of a Russian alliance remained powerful and clamorous; but Metternich did not share the doubts as to the outcome of Napoleon's invasion of Russia, which he believed would leave Austria, if she remained neutral, isolated amid a huge European confederation. To him the only safe course seemed to be to offer the French emperor substantial assistance, stipulating for some *quid pro quo* in the settlement to follow the war. The emperor Francis shared this view; and on the 14th of March a treaty of alliance was signed by which Austria agreed to support the French army with an army corps of 30,000 men operating from Galicia. This treaty was ratified at Vienna on the 25th of March, the day of Napoleon's passage of the Niemen. It was characteristic of Metternich's diplomacy that the Austrian generals in Galicia were ordered to act only on the defensive, and that the court of St Petersburg was informed that Austria would only take part in the war as a principal should Russia force her to do so.

This cautious attitude was soon justified by the astounding developments of the Moscow campaign. When the full extent of the catastrophe that had overwhelmed Napoleon's army became known, Metternich realized the advantageous position in which Austria lay for exploiting the changed situation. His first idea was that France should commission Austria to mediate a peace in Russia and in England (Despatch of Otto, November 10); but, as affairs developed, this was replaced by the policy of temporizing until Austria should be in a position to intervene with decisive effect. Napoleon's demand that Austria should raise her contingent from 30,000 to 100,000 men was, indeed, from Metternich's point of view doubly opportune: for it enabled him quietly to assume that the treaty of the 14th of March, which stipulated only for an "alliance limitée," had been abrogated by Napoleon's own act; that Austria had reverted to a position of neutrality; and that, should she take part in the war, it would no longer be in a subordinate character but as a principal. "Le passage de la neutralité à la guerre," said Metternich to the emperor Francis, "ne sera possible que par la médiation armée"; which meant in effect that Austria required time to complete her armaments. To gain this time was, during the weeks that followed, the object of his diplomacy. For this purpose he encouraged Napoleon to believe that Austria was prepared for a settlement on terms very favourable to the French emperor; with the result that Napoleon, though he would not hear of a "mediation," not only consented to, but pressed for, Austrian "intervention" (*entremise*). But Metternich had made up his mind that the only chance of an effective restoration of the Habsburg influence in Europe lay in using this opportunity for destroying or limiting Napoleon's power, and he had already opened negotiations with the allied courts, with a view to enforcing a common agreement as to a basis of peace, when the indecisive battle of Lützen (May 2) gave him the opportunity of making his policy of mediation effective. Count Stadion was now sent to the emperor Alexander to lay before him the terms on which Austria was prepared to mediate; he was also to "agree to the bases of an active military co-operation on our part, in the event of the non-success of our efforts on behalf of peace." On the 20th of March Napoleon gained another indecisive victory at Bautzen, which still further strengthened Metternich's position; for Napoleon allowed himself to be persuaded into signing the ill-omened armistice of Pleiswitz (Poischwitz), on the 4th of June, and to become entangled in the insincere negotiations of the congress of Prague. Austria thus had time to complete her armaments. Meanwhile, on the 14th and 15th of June, were signed at Reichenbach the treaties of alliance between Great Britain, Russia and Prussia, by which the signatory Powers agreed neither to negotiate nor to conclude treaty or truce with Napoleon except by common consent. In an interview with the emperor Alexander, Metternich now presented the terms which he proposed to offer to Napoleon, and on this basis a treaty between Austria, Russia and Prussia was agreed to, Austria contracting to put 150,000 men into the field, should Napoleon reject the ultimatum, and not to make peace without the consent of Russia and Prussia—which in effect involved that of Great Britain also.

Before this second treaty of Reichenbach was signed (June 27), Metternich went on Maret's invitation to Dresden, where on the 26th he had the famous interview with Napoleon. The whole scene was on his part a masterpiece of Machiavellian diplomacy. The terms he offered to the emperor were so favourable that he has been denounced by every Prussian historian since as the enemy of Germany; while French historians have enlarged on Napoleon's infatuation in rejecting them. In spite of the fact that the draft of the treaty of Reichenbach was in his pocket, he posed as the impartial "mediator," with a leaning in favour of Napoleon, assuring the emperor "on his honour as a German count" that Austria was still "free from all engagements," which was true only in so far as the treaty was not signed till the next day. Metternich's object was, in fact, only to gain an extension of the armistice till the 10th of August, on which date Schwarzenberg had declared that he would be ready to take the offensive. As for the terms offered to Napoleon his acceptance of them need not hamper the plans of the Allies; for the consent of Great Britain would have to be obtained, and, moreover, Napoleon was sure before long to provide an excuse for a fresh breach; his rejection of them, on the other hand, would be a blow to his waning popularity in France. The interview was long and stormy; Napoleon struggled vainly in the toils; in his excitement he dropped his hat, which the imperturbable Metternich did not condescend to pick up; "Napoleon," he records in his *Memoirs*, "seemed to me small." Metternich, however, gained his immediate point; the armistice was extended to the 10th of August. At midnight on that date, Napoleon not having come to terms, Metternich gave orders for the lighting of the beacons that signalled to the Austrian army in Silesia the outbreak of the war.

Napoleon's victory at Dresden (Aug. 26 and 27) for the moment brought discord into the counsels of the Allies and threatened the ruin of Metternich and his plans; but the successive defeats of Vandamme at Kulm (Aug. 28), of Macdonald at Katzbach (Aug. 29) and Oudinot at Grossbeeren (Aug. 30) completely altered the aspect of affairs; and on the 9th of September Metternich signed at Töplitz a treaty with Russia which committed Austria yet more closely to the policy of the Allies. Then followed the battle of Leipzig (Oct. 16–18) and the advance of the Allies into France. The diplomatic situation throughout the campaign was, from the Austrian point of view, one of extreme delicacy. The necessity of curbing the power of Napoleon and rendering him for ever incapable of again oversetting the balance of Europe was practically the only object Austria had in common with her allies. She did not share the implacable resentment with which Great Britain pursued Napoleon; she watched with alarm the development of the ambitions of Alexander I., which threatened to substitute a Russian for a French supremacy in Europe; she was far from sympathizing with the noisy enthusiasm of the patriots of the War of Liberation for a united Germany, in which the traditional influence of the Habsburgs would be balanced or overshadowed by that of Prussia. Metternich had no wish to see the husband of Marie Louise ousted in favour of the Bourbons, who had little reason to be grateful to Austria; still less did he desire to see on the throne of France Alexander's protégé Bernadotte, whose name was being whispered in the Paris salons as the destined saviour of his native country. But if Napoleon was to remain sovereign of France, it must be not by his own force, but by grace of his father-in-law, and hedged round with limitations which would have made him little more than the lieutenant of the Habsburg monarchy. This was the secret of the moderate terms of accommodation ostentatiously offered by Metternich to Napoleon at various stages of the campaign. From Frankfort he sent, through General de Saint-Aignan, a diplomatist on whose indiscretion he could rely, an informal offer of peace on the basis of France's "natural frontier," the Rhine, the Alps and the Pyrenees. The famous manifesto of Frankfort, issued on behalf of the Allies (Dec. 4, 1813), contained no such offer of acceptable terms; but Metternich's object was attained; for Napoleon refused to be drawn into the trap, and the French people cursed the emperor's infatuation in refusing a settlement which, from what had leaked out of Saint-Aignan's mission, they believed would have satisfied the legitimate ambitions of France. On the other hand, Metternich did his best to oppose a too rapid advance of the allied forces on Paris, which would have played into the hands of Russia and Prussia; and it was to his initiative that the conferences of Châtillon were due. Only when the breakdown of the negotiations made it clear that Napoleon had seen through his plans, and preferred the chances of war to the certainty of ruin or of surviving only as the puppet of Austria, did Metternich join with Castlereagh in pressing upon the tsar the necessity for restoring the Bourbons. On the 1st of March 1814, he set his hand to the treaty of Chaumont, of which the immediate object was the restoration and preservation of the old dynasty in a France reduced to her "legitimate frontier." In other respects, however, the treaty was a triumph for Metternich; for it laid down that at the final settlement Germany was to be reconstituted as a confederation of sovereign states, and it also did much to temper the fear of a Russian dictatorship by consecrating the principle of that concerted action of the Great Powers, in affairs of international interest, which after Napoleon's fall was to govern the European system. On the 10th of April Metternich arrived at Paris, ten days after its occupation by the Allies. He was now at the height of his reputation; on the 20th of October 1813, two days after Leipzig, he had been created an hereditary prince of the Austrian Empire; he now received from the emperor Francis a unique honour: the right to quarter the arms of the house of Austria-Lorraine with those of Metternich. At the same time (April 21) the countship of Daruvar was bestowed upon him. On the 30th of May Metternich set his signature to the treaty of Paris, and immediately afterwards accompanied the emperor Alexander and King Frederick William on a visit to England. On the 18th of July he was back in Vienna, where the great congress was to meet in the autumn. The dignity of a Hungarian magnate was bestowed upon him before it assembled.

At the congress Metternich's charm of manner and great social gifts gave him much personal influence; the ease and versatility with which he handled intricate diplomatic questions, too, excited admiration; at the same time he was blamed for his leaning to intrigue and *finesse* and for a certain calculated disingenuousness which led to an open breach with the emperor Alexander, who roundly called him a liar. In the difficult questions of Poland and Saxony the honest and conciliatory attitude of Castlereagh was of more avail in reaching an acceptable settlement than all Metternich's cleverness. If in the Italian and German questions, however, Austria's views triumphed, this was due to the foresight displayed in Metternich's diplomacy during the campaigns and to the address with which he handled the questions at issue at the congress. The complacency of Hardenberg had allowed Austria alone to negotiate with the states of the Confederation of the Rhine with a view to detaching them from Napoleon; and he had used this opportunity to render impossible the idea of a united Germany. On the 8th of October 1813 he had signed with Bavaria the treaty of Ried, which in the event of the liberation of Germany guaranteed to Bavaria a sovereign and independent status. This instrument, which was reinforced by a secret treaty signed at Paris on the 3rd of June 1814, served as a model for similar agreements with other courts; and the principle involved was, as mentioned above, included in the treaty of Chaumont. Thus all the unionist ideals, represented at the congress by Stein, were sterilized from the outset; and the Act of Confederation embodied in the Final Act of Vienna gave to Germany exactly the form desired by Metternich as best calculated to perpetuate Austrian preponderance (see GERMANY: *History*). The same was true of the settlement of Italy. The question here was complicated by the treaty of alliance signed by Metternich with Murat as the price of his treason to Napoleon. But Metternich from the first had known that the treaty was but a temporary expedient; that Great Britain would never recognize "the person at the head of the government of Naples"; and that sooner or later Murat himself would afford excuse enough for tearing the treaty up. Not Murat's dream of an Italy united under his own rule, but the traditional Austrian policy of possession in the north and preponderance throughout the Peninsula was Metternich's goal, and this he secured at the congress. Murat, in view of Austria's engagements, was suffered to survive for the time being; he himself shattered the alliance during the Hundred Days; and the Bourbons returned to Naples, pledged by a secret agreement to attune their policy to that of Vienna (see NAPLES: *History*).

Metternich, then, emerged from the congress of Vienna confirmed in the confidence of his sovereign, and therefore supreme in Germany and in Italy. To him had been due the marvellous recovery of the Habsburg monarchy; in spite of Gentz's lament that in the latter stages of the campaign of 1814 "Europe" had been substituted for "Austria" in his diplomacy, Metternich had acted throughout first and foremost in the interests of Austria, as he was bound to do. This, too, gives the key to his policy after 1815, the policy of using the European concert, established by the treaty of Chaumont and the Paris treaty of the 20th of November 1815, as an instrument for ensuring the "stability" of Europe by suppressing any "revolutionary" manifestations by which the settlement made at Vienna might be endangered.

After the campaign of Waterloo and Napoleon's second downfall Metternich was again in Paris, where he co-operated with the emperor Alexander and Castlereagh in securing tolerable terms of peace for France. A few days after the signing of the two treaties of the 20th of November 1815, he left Paris for Milan, where he met the crown prince Louis of Bavaria and Baron von Rechberg, with whom he came to terms on certain outstanding questions between Austria and Bavaria, terms embodied in the treaty of Munich of the 14th of April 1816. During his visit to Italy, which he repeated in 1816 and 1817, Metternich could not but be impressed with the general signs of discontent with Austrian rule. Neither was he blind to the true causes of this discontent: the atrophy of the administration owing to its rigid centralization at Vienna, and the policy of enforcing Germanism on the Italians by a ruthless police system. He made half-hearted proposals for removing something of both these grievances; but his terror of revolution from below made him fearful of reforms from above. While therefore in Prussia king and ministers were labouring hard to remodel and consolidate the monarchy, Metternich did next to nothing to reform the most obvious abuses of the Austrian Empire. Yet the fault was not wholly, or mainly, his. Sir Robert Gordon,[1] in a letter to Castlereagh (dated Florence, July 11, 1819), gives the true reason for this attitude: "How much is it to be desired that the superior talents of Prince Metternich were more occupied with the revision and improvement of the administration of affairs in his own country. He is too enlightened not to perceive its most palpable defect . . . He might have courage to sacrifice himself for the institution of effective remedies, but he fears that the confiding benignity of his Sovereign might afterwards be dissuaded from the just and vigorous application of them." (F.O. *Austria. Gordon.* Jan.–Dec., 1819.) Metternich's power, after all, was limited by the goodwill of his master, the emperor Francis, and Francis trusted him precisely because he seemed to share his own fanatical hatred of all change. It is this fact that seems to explain Metternich's feverish anxiety to justify his obscurantist attitude to himself and to the world. It suited him to ascribe the general discontent, of which the causes were not obscure, to the wanton agitation of the "sects," and his agents all over Europe earned their pay by supplying him with plentiful proof of the correctness of his contention. The result was well summed up in another letter of Gordon to Castlereagh (ibid. No. 26, Florence, July 12, 1819). "Nothing," he writes, "can surpass Prince Metternich's activity in collecting facts and information upon the inward feelings of the people; with a habit of making these researches he has acquired a taste for them. . . . The secrecy with which this task is indulged leads him to attach too great importance to his discoveries. Phantoms are conjured up and magnified in the dark, which probably if exposed to light would sink into insignificance; and his informers naturally exaggerate their reports, aware that their profit is to be commensurate with the display of their phantasmagoria." The judgment is instructive, coming as it does from a diplomatist in intimate touch with Metternich and in general sympathy with his views.

There was, none the less, method in this madness. Behind the agitations of the "sects" loomed the figures of the emperor Alexander and of his confidant Capo d'Istria, "the Coryphaeus of Liberalism," whose agents, official or unoffical, were intriguing in every country in Europe, and not least in Italy. The factor, then, that determined Metternich's attitude was not so much a dread of revolutions in themselves as of revolutions exploited by the "Jacobin" tsar to establish his own preponderance in Europe. Metternich's object, then, in respect of the revolutionary agitations, was twofold: he wished to impress Alexander with the peril of this imperial coquetting with democratic forces; he wished to convince the "sects" that they could not rely on the tsar's support. He succeeded in both these objects during the period from the congress of Aix-la-Chapelle in 1818 to that of Verona in 1822. (See ALEXANDER I. OF RUSSIA; EUROPE: *History*.)

On his way to the congress of Aix, Metternich spent a few days at Frankfort, where his presence was sufficient to settle the difficult question of the constitution of the federal forces. It was a signal triumph. "You can have no idea of the effect produced by my appearance at the diet," he wrote exultingly to his wife, "I have become a species of moral power in Germany and, perhaps, even in Europe" (*Mem.* iv. 64). This self-complacency was characteristic of the man; but, if we accept his view of "morality," the boast scarce seems exaggerated. In the main questions debated at Aix, indeed, it was Castlereagh's influence rather than that of Metternich which prevailed; the abolition of the supervision of French affairs by the committee of ambassadors was, for instance, carried against his opinion. But it was at Aix that Metternich was not only reconciled with Alexander, but laid the foundations of that personal influence over the tsar that was to bear notable fruit later; from Aix, too, where he arrived at a complete understanding with King Frederick William III. and the Prussian ministers, dates his preponderant influence in German affairs.

The outlook in Europe at the beginning of 1819 seemed to Metternich particularly gloomy. In France the ministry of Decazes was, in his opinion, under the inspiration of the Russian ambassador Pozzo di Borgo, heading straight for a new revolution; in Italy Russian agents were openly carrying on a Liberal propaganda; Germany, and notably the Prussian bureaucracy, was honeycombed with revolutionary ideas. Then came the news of the murder of Kotzebue (March 23). Metternich was in Italy at the time; but he determined at once to take advantage of this senseless crime to carry his views in the matter of muzzling the Liberal agitation in Germany. In the summer he met King Frederick William and Prince Hardenberg at Töplitz; a conference that resulted in the indefinite postponement of the Prussian constitution and in a secret agreement (Aug. 1) on the proposals to be laid before a conference of German ministers to be held at Carlsbad in the same month. The result of this were the famous Carlsbad Decrees (*q.v.*), by which liberty of speech and of the press was abolished throughout Germany. The Vienna conferences that followed in November and issued in the Final Act of the 15th of May 1820, was not so complete a triumph for Metternich; but his diplomacy, none the less, had succeeded in riveting on Germany the yoke of the Austrian system, which it was to bear with but partial and temporary relaxations for nearly thirty years (see GERMANY: *History*).

The year 1820 was marked by critical events which drew Metternich's attention once more from the affairs of Germany to those of Europe at large. The revolution in Spain, with which Austria had no immediate concern, interested him little; but his attitude towards it is characteristic and illuminating. The emperor Alexander for whom the idea of the confederation of Europe was an article of faith, proposed a European intervention and offered to march a Russian army through northern Italy into Spain. Metternich, to whom the remedy seemed far worse than the disease, covered his dissent from this proposal with a great display of principle. The ills of Spain were "material," those of Europe at large "moral"; and the European Alliance was there to deal with moral, not material, troubles. The revolution that followed in Naples, however, necessitated a different attitude. Strictly speaking, it concerned Austria alone; but Metternich was anxious to range Alexander openly against Italian Liberalism, and he therefore consented to the question being laid before a congress to be assembled at Troppau. The congresses of Troppau (1820) and Laibach (1821) are dealt with elsewhere (see EUROPE: *History*; ITALY: *History*, and the articles *s. v.*). For Metternich they represented a signal triumph. Not only did he complete his ascendancy over the emperor Alexander; but he openly committed all the Powers to an approval of the Austrian system in Italy, a success that outweighed his failure to win over Great Britain to the general principle of intervention enunciated in the Troppau Protocol. His attempt, however, to crown his system in Italy by setting up a central committee on the model of the Mainz commission was defeated at the congress of Verona (1822) by the opposition of the Italian princes headed by the pope and the grand duke of Tuscany.

The sort of moral dictatorship which Metternich had acquired on the continent was shattered by the developments of the Eastern Question. At first, indeed, the peril of a Russian attack on Turkey had drawn Austria and Great Britain closer together, and in a meeting at Hanover in October 1821 Metternich and Castlereagh had come to an understanding as to using the Holy Alliance to prevent Alexander from acting independently of the concert. But Metternich's hope that the Greek revolt would burn itself out "beyond the pale of civilization" was belied by events; and even before Castlereagh's death it was clear that Great Britain would have sooner or later to adopt a policy of intervention opposed to all Metternich's ideas. The breach was hastened by the accession to office of George Canning, who hated Metternich and all his ways. At Verona in 1822 the withdrawal of Great Britain from the system of the continental Allies was proclaimed to all the world; in March 1823 Canning recognized the Greek flag. This opened up the whole Eastern Question in the precise form that Metternich had sought to avoid; for the action of Great Britain involved a move on the part of Russia, jealous of her prestige in the Levant, and thus led ultimately to a rearrangement of the relations of the Powers which, so far as the affairs of the Ottoman empire were concerned, left Austria isolated. It is impossible here even to outline Metternich's diplomacy during the eleven years between the outbreak of the Greek revolt and the signature of the treaty of London (1832) by which the kingdom of Greece was established. The principles that guided it are, however, sufficiently simple. In common with Great Britain he desired to maintain the integrity of the Ottoman Empire as a barrier against Russian domination in the Balkan peninsula; he wished also to avert a Russo-Turkish war, not only for the above reason, but also because this would involve the breakdown of the system by which he hoped to curb the revolutionary forces in the West. He therefore attempted, and for a while successfully, to persuade the tsar that the Greeks were only "ordinary rebels against legitimate authority." But, when this expedient failed, he was the first to suggest the complete independence of Greece, which seemed to him less dangerous to Austrian interests than a tributary principality on the model of Moldavia and Wallachia. In the end his attitude was one of abstention and protest, since he rightly considered that the action of the Powers which culminated in the treaty of London was fatal to the doctrine of legitimacy, on which his system was based.

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[1] Sir Robert Gordon (1791–1847), brother of the 4th earl of Aberdeen, was between 1815 and 1821 associated with Wellington as minister plenipotentiary at Vienna.

The Greek question was not finally settled when the outbreak of the revolutions of 1830 threatened the overthrow of the whole structure of 1815 in the West. Events which seemed to involve the complete ruin of Metternich's system gave it in effect, however, a new lease of life. Austria, isolated by the events in the East, was once more brought into touch with Russia by a crisis that concerned both Powers equally. On the receipt of the news of the July revolution in Paris Metternich hastened to meet Count Nesselrode at Carlsbad; and, though the Russian statesman refused to commit himself to the idea of an immediate reconstitution of a league of the three autocratic Powers, a common basis of action was agreed upon, and the foundations were laid for that cordial understanding that ripened in the meeting of Münchengrätz three years later. Meanwhile, though his language was still "European," Metternich's attitude towards the revolutions was wholly Austrian. He preached the sacred duty of intervention, but he refused to intervene, save where the interests of the Habsburg monarchy were directly concerned. He was even the first to recognize the revolutionary government of Louis Philippe (Sept. 8); he answered the appeal of the king of Holland for help with an ironical reference to the geographical situation of Austria; he did not even interfere with the revolutions in Germany and Poland. But when in Italy revolts broke out that threatened the Austrian hegemony, he acted with promptitude and decision, in spite of the threatening attitude of France; in the spring of 1831 Austrian bayonets restored order in Parma, Modena and the Papal States. Yet even here Metternich showed an unwonted moderation: not only did he soon withdraw the Austrian troops from Ancona, but he took the initiative in impressing on the papal government the urgent necessity for drastic reform. This attitude was, indeed, mainly determined by the uncertainty as to the relations of the three autocratic courts on whose co-operation the effectiveness of a policy of repression ultimately depended; and Metternich's next work was to attempt to re-cement the broken alliance. With Prussia he had little difficulty; the timidity of King Frederick William III. had increased with years and the events of 1830, and the Prussian and Austrian governments came to complete understanding on a common policy in Germany. Its first fruits were the additional articles appended by the Federal Diet (June 28, 1832) to the Vienna Final Act, by which the control of the diet over the state legislatures was increased. As for Russia, Count Nesselrode at first maintained the reticent attitude he had adopted at Carlsbad; but finally, in 1833, Metternich met the emperor Nicholas I. himself at Münchengrätz and by adroit flattery won him over to his views. The Berlin convention of the 15th of October 1833, which reaffirmed the divine right of intervention, was a fresh triumph for Metternich's diplomacy. This had been rendered possible by the change in Russia's attitude towards the Turkish question after 1829, which made a co-operation of Austria and Russia possible in the East (see MEHEMET ALI); and in its turn it made possible the maintenance for a while longer of the Austrian system in Germany.

The convention of Berlin marked the last conspicuous intervention of Metternich in the general affairs of Europe. "The Holy Alliance of the East," as Palmerston called it, served the immediate purpose of securing "stability" in the countries immediately subject to the Powers composing it; it made no attempt at more than "moral" intervention in questions, *e.g.* that of Spain, that lay beyond its own sphere of influence; and the development of the Eastern Question, leading to the rapprochement between Russia and Great Britain, though Austria joined the Quadruple Alliance of 1840, tended to loosen the cordial ties between the courts of Vienna and St Petersburg. The Straits Convention of 1841, by which France was formally readmitted to the concert, was due largely to Metternich's initiative; so, too, was the ill-judged effort of the continental Powers in 1847 to interfere in favour of the *Sonderbund* in Switzerland. But, on the whole, the growing crisis within the Habsburg monarchy itself was sufficient to deter Metternich from foreign adventures. So long as the emperor Francis lived all question of reform was impossible, and when he died, in 1835, the rusty machinery of the Austrian administration was too completely out of gear to be set right by anything short of a complete reconstruction, to which Metternich was too old to set his hand, even had he had the inclination to do so. He was too experienced not to realize the sickness of the state, but he was content to veil it from himself and to attempt to veil it from others. The world was not deceived; but it was not until the Vienna mob, in 1848, was thundering at the door of his cabinet that Metternich himself realized the truth to which he had tried to blind himself. With his fall his system also fell; and his flight from Vienna was the signal for the revolutions by which in 1848 all the countries under Habsburg influence were convulsed.

The resignation of Prince Metternich, handed in on the 13th of March 1848, was accepted by the emperor on the 18th, and the prince and his family at once left for England. Here he lived in great retirement, at Brighton and London, until October 1849, when he went to Brussels. In May 1851 he went to his estate of Johannesberg, where he was visited by King Frederick William IV. and Bismarck; in September he returned to Vienna. The events of 1848 had not shaken his self-complacency; they seemed to him rather to confirm the soundness of his own political principles, which would have scotched the evil betimes had not the weakness of others allowed the forces of disorder to gather strength. But though, in his own opinion, triumphantly vindicated, he did not again take office; he maintained, none the less, as a critic and adviser no mean influence on the counsels of the Austrian court, though it was contrary to his advice that Austria signed the treaty of the 2nd of December 1854 with France and Great Britain. He lived to see the beginning of the struggle of France and Italy against Austria, dying on the 11th of June 1859.

Probably no statesman of all time has, in his own day, been more beslavered with praise and bespattered with abuse than Metternich. By one side he was reverenced as the infallible oracle of diplomatic inspiration, by the other he was loathed and despised as the very incarnation of the spirit of obscurantism and oppression. The victories of democracy brought the latter view into fashion, and to the Liberal historians of the latter part of the 19th century the name of Metternich was synonymous with that of a system in which they could recognize nothing but a senseless opposition to the forces of enlightenment. A juster estimate of the man and his work has, however, become possible as the age has moved farther away from the smoke of controversy. On the whole, history has tended to endorse the sane judgment on Metternich pronounced by Castlereagh when he was first brought into diplomatic contact with him. Writing from Chaumont to Lord Liverpool, on the 26th of February 1814, he said: "Austria both in army and government is a timid Power. Her minister is constitutionally temporizing—he is charged with more faults than belong to him, but he has his full share, mixed up, however, with considerable means for carrying forward the machine, more than any other person I have met with at Head Quarters" (F. O. 2 France, *From Lord Castlereagh*). This gives the key to Metternich's character and policy: Austria was a timid Power, and Metternich was an Austrian minister. His policy of "stability," so necessary for the Habsburg monarchy, at least secured a long period of peace for Europe at large. Europe, her strength renewed, passed a severe judgment on the statesman who acted on the assumption that what the generality of people wanted was peace, not liberty; and justly, in so far as his pessimism led him to convert what might have been legitimate as a temporary counsel of expediency into an immutable principle. But, as Demelitsch points out, it will be time for *Austrians* to condemn him when Austria shall have survived half a century of constitutional experiment under the dual monarchy.

Of the *technique* of diplomacy Metternich was a master. His despatches are models of diplomatic style. If they have any fault, it is that they are often over-elaborate, the work of a man who evidently loves diplomacy for its own sake and glories in the fine turn of a phrase. In this respect they are comparable to those of Canning, who modelled himself upon Chateaubriand; they are in vivid contrast to the crabbed businesslike letters of Castlereagh. Metternich almost invariably begins his despatches and his reports with a broad discussion of the principles involved in the case in point, and argues from these down to the facts. In this again he is in sharp contrast with Castlereagh, who, with characteristic British practical sense, politely sweeps the principles aside and prefers to argue upward from the facts. Yet Metternich's phrase-making was often the result of astute calculation. His diplomatic genius was never so well displayed as in disguising perilous issues in phrases that soothed even when they did not convince; and, like Gladstone after him, when the occasion demanded it, he was master of the art of appearing to say much when in fact he said nothing. When he wished to make his meaning plain, no one could do so more clearly; when he wished to be reticent, no reticence could have been more pleasingly eloquent.

In private life Metternich was a kind, if not always faithful, husband and a good father, devoted to his children, of whom he had the misfortune to lose several before his death. He was three times married. His second wife, Baroness Antonie von Leykam, Countess von Beilstein, died in 1829; his third wife, Melanie, Countess Zichy-Ferraris, died on the 3rd of March 1854. Of his sons three survived him: Richard Clemens Lothar (1829–1895), his son by his second marriage, who was Austrian ambassador in Paris from 1859 to 1871; Prince Paul (1834–1906), and Prince Lothar (1837–1904), his sons by his third marriage. His grandson Prince Clemens (b. 1869), son of Prince Paul, married in 1905 Isabella de Silva Carvajal, daughter of the marquis de Santa Cruz.

BIBLIOGRAPHY.—A vast mass of unpublished material for the life of Prince Metternich exists in public and private archives; to some of those in the F.O. Records references are given in the bibliography to chap. I. of vol. x. of the *Cambridge Mod. Hist.* Of published documents the most important are in the collection *Aus Metternichs nachgelassenen Papieren* (8 vols., 1880–1884), edited by his son, Prince Richard Metternich. There is a complete French translation issued contemporaneously, and an English version, of which only five volumes (down to 1835) have been published, under the title *Memoirs, &c.* (London, 1880–1882). These *Memoirs*, especially the autobiographical parts, must be read with considerable reserve; even the official letters and documents, which are their most valuable contents, have been to a certain extent "edited." See also Count Anton Prokesch-Osten (the younger) *Aus dem Nachlass von Prokesch-Osten* (2 vols., Vienna, 1881); the writings and correspondence of Friedrich von Gentz (*q.v.*), especially as collected under the title *Oesterreichs Theilnahme an den Befreiungskriegen*; Wilhelm Oncken, *Österreich und Preussen im Befreiungskriege* (1876–1879); A. Beer, *Zehn Jahre österreichischer Politik, 1801–1810* (1877); *Die Finanzen Österreichs* (1883); *Die orientalische Politik Österreichs seit 1774* (1883); T. T. de Martens, *Recueil des traités, &c.*, vols. iii. and iv.; Thiers, *Hist. du consulat et de l'empire*, which was frequently commended by Metternich himself as giving an accurate account of his policy, a statement, however, controverted by Albert Sorel, whose *l'Europe et la révolution française*, gives a detailed and masterly account of Metternich's share in the overthrow of Napoleon. Fedor von Demelitsch's *Fürst Metternich und seine auswärtige Politik*, vol. i., to 1812 (Munich, 1898), is an elaborate and useful analysis of Metternich's foreign policy, based on a large mass of unpublished archives. The best short biography of Metternich is that by A. Beer in *Der neue Plutarch* (1877), vol. v.; but both this and Colonel G. B. Malleson's *Life of Metternich* (London, 1888) were written before the publication of the important works of Demelitsch and Sorel. (W. A. P.)

METZ, a town, first-class fortress and episcopal see of Germany, in the imperial province of Alsace-Lorraine, capital of (German) Lorraine, on the Moselle, 99 m. N.W. of Strassburg by rail, and at the radiation of lines to Luxemburg, Coblenz and Novéant, on the French frontier (10½ m. W.). Pop. (1905), 60,396. The general appearance of the town is quaint and irregular, but there are several handsome modern streets. The Moselle, which is here joined by the Seille, flows through it in several arms, and is crossed by fourteen bridges. In the south-west corner of the town is the esplanade, with an equestrian statue of the emperor William I., and monuments to Prince Frederick Charles and Marshal Ney, commanding a fine view of the "pays messin," a fertile plain lying to the south. Of the ten city gates the most interesting are the Porte d'Allemagne, or Deutsche Tor, on the east, a castellated structure erected in 1445 and still bearing traces of the siege by Charles V.; the Porte Serpenoise, or Römer Tor, on the south, and the Porte Française, or Französische Tor, on the west. Among its ecclesiastical edifices (nine Roman Catholic and four Protestant churches) the most noteworthy is the Roman Catholic cathedral, with huge pointed windows, slender columns and numerous flying buttresses, which, begun in the 13th century and consecrated in 1546, belongs to the period of the decadence of the Gothic style. The Gothic churches of St Vincent and St Eucharius, and the handsome Protestant garrison church, completed in 1881, also deserve mention. Among secular buildings the most important are the town-hall, the palace of justice, the theatre, the governor's house, and the various buildings for military purposes. The public library contains 40,000 volumes, including an extensive collection of works relating to the history of Lorraine. In the same building is the museum, which contains a picture gallery, a numismatic cabinet, and a collection of specimens of natural history. Metz also possesses several learned societies, charitable institutions and schools, and a military academy. The cemetery of Chambière contains the graves of 7200 French soldiers who died here in 1870. The chief industries are tanning and the manufacture of weapons, shoes, cloth, hats and artificial flowers. There is a trade in wine, beer, wood and minerals.

As a fortress, Metz has always been of the highest importance, and throughout history down to 1870 it had never succumbed to an enemy, thus earning for itself the name of *La pucelle*. It now ranks with Strassburg as one of the two great bulwarks of the west frontier of Germany. The original town walls were replaced by ramparts in 1550, and the citadel was built a few years later. By 1674 the works had been reconstructed by Vauban. Under Napoleon III. the fortress was strengthened by a circle of detached forts, which, after 1870, were modified and completed by the Germans, who treated the fortress as the principal pivot of offensive operations against France. The plans in FORTIFICATION AND SIEGECRAFT (fig. 43) show Metz as it was about 1900; in the years following a new outer chain of defences was constructed, which extends as far as Thionville on the north side and has its centre in front of Metz on the Gravelotte battleground. The old enceinte (which includes Cormontaingne's forts—Moselle and Bellevroix) is doomed to demolition, and has in part been already removed. The garrison, chiefly composed of the XVI. Army Corps, numbers about 25,000. (See GERMANY: *Army*.)

History.—Metz, the Roman Divodurum, was the chief town of the Mediomatrici, and was also called by the Romans

Mediomatrica, a name from which the present form has been derived by contraction. Caesar describes it as one of the oldest and most important towns in Gaul. The Romans, recognizing its strategical importance, fortified it, and supplied it with water by an imposing aqueduct, the remains of which still exist. Under the Roman emperors Metz was connected by military roads with Toul, Langres, Lyons, Strassburg, Verdun, Reims and Trier. Christianity was introduced in the 3rd century of our era. In the middle of the 5th century the town was plundered by the Huns under Attila; subsequently it came into possession of the Franks, and was made the capital of Austrasia. On the partition of the Carolingian realms in 843 Metz fell to the share of the emperor Lothair I. as the capital of Lorraine. Its bishops, whose creation reaches back to the 4th century, now began to be very powerful. Metz acquired the privileges of a free imperial town in the 13th century, and soon attained great commercial prosperity. Having adopted the reformed doctrines in 1552 and 1553, it fell into the hands of the French through treachery, and was heroically and successfully defended against Charles V. by Francis duke of Guise. It now sank to the level of a French provincial town, and its population dwindled from 60,000 to about 22,000. At the peace of Westphalia in 1648 Metz, with Toul and Verdun, was formally ceded to France, in whose possession it remained for upwards of two centuries. The battles of August 1870, and the investment and capture of the army of Metz which followed, are described below. By the peace of Frankfort on the 10th of May 1871 Metz was again united to the German Empire.

See Westphal, *Geschichte der Stadt Metz* (1875–1877); Georg Lang, *Metz und seine Umgebungen* (1883), the *Statistisch-topographisches Handbuch für Lothringen*; Albers, *Geschichte der Stadt Metz* (Metz, 1902); G. A. Prost, *Études sur l'histoire de Metz* (1897); and Tauber, *Die Schlachtfelder von Metz* (Berlin, 1902). (See also FRANCO-GERMAN WAR: *Bibliography.*)

BATTLES AROUND METZ, IN THE FRANCO-GERMAN WAR, 1870

1. *Colombey-Borny* (*August 14*).—The French army under Marshal Bazaine was in and about Metz. The German I. and II. armies, on the march from the Saar, were heading for the Moselle between Metz and Pont-à-Mousson, and on the morning of the 14th of August the German I. Army (I., VII. and VIII. Corps, under General v. Steinmetz) lay on and east of the French, with outposts well to the front, watching the French camps east of Metz, which were little more than 1 m. to the front. Steinmetz had received from headquarters overnight instructions that on the 14th of August the I. Army would maintain the positions occupied during the 13th, and merely passed on these orders to his corps commanders. In Metz, meanwhile, Bazaine had decided to retreat, and during the morning orders to that effect reached his corps commanders, who commenced preparations for their execution. The 2nd Corps (Frossard) and 6th (Canrobert) began to retire about midday, the 3rd (Lebœuf), 4th (Ladmirault) and Imperial Guard (Bourbaki) were to follow. These preparations being observed, the German outposts got under arms. General von der Goltz, in command of the VII. Corps (7 battalions, 4 squadrons, 2 batteries) hearing from a passing officer that the I. Corps on his right was preparing to attack, and noting personally signs of retreat in the enemy's lines, determined at 3 p.m. to advance his whole command to the ridge between Colombey and Borny (which was still occupied by French outposts), in order to clear up the situation. The ridge was captured with little resistance, but the sound of the firing at once set all the neighbouring troops in motion, and fortunately so, for the French had immediately retaliated on von der Goltz's audacious attack. Between 4 and 6 p.m. there was continuous heavy fighting on the front from Borny to Méy, as both sides brought fresh troops into the field. The convex slopes falling from the Prussian position towards Metz gave plenty of cover to the French, and the setting sun shone full in the faces of the Prussian artillerymen. Thus the Prussian infantry encountered unusually obstinate resistance and the troops engaged rapidly slipped from all superior control. The above front was held by the French 3rd Corps. Shortly before 6.30 the 4th Corps (Ladmirault) suddenly began to deploy on the high ground to the north-west beyond Méy, thus threatening the right flank of the Prussian I. Corps (General v. Manteuffel). To meet this danger Manteuffel was compelled to direct his corps artillery and reserves, which were now rapidly coming up, away from the hard-pressed centre towards the oncoming infantry masses of Ladmirault. These, with the sun now almost at their backs, were shooting better than usual, and Manteuffel was compelled to call on the VIII. Corps for assistance, which its commander, under positive orders from Steinmetz, refused to give. Meanwhile Steinmetz had been sending peremptory orders to the battlefield to stop the battle, but neither of the corps commanders was able to enforce them. Fortunately for the Prussians, Bazaine had issued similar orders to his subordinates, who, having their men better in hand, were able to obey; and as night began to close in the French broke off the action and retired under the guns of the Metz forts, convinced that at last they had "broken the spell" of German success.

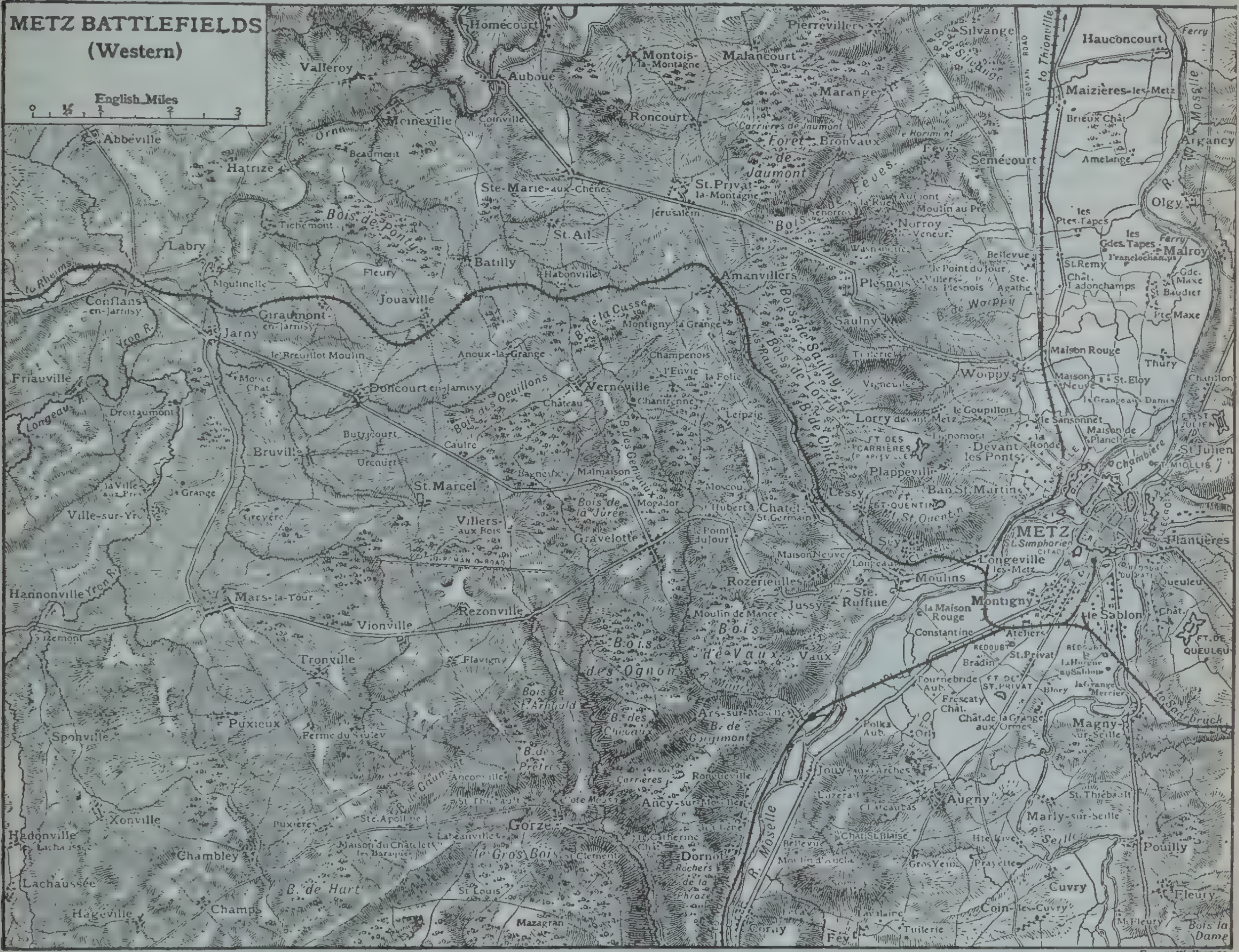
Finding that, in spite of his orders, the firing at the front continued increasing in intensity, Steinmetz at length rode to the front himself. Meeting Manteuffel near the Brasserie of Noisseville, he overwhelmed him with reproaches, and at the crisis of this scene the bands struck up "*Heil dir im Siegeskranz*"! In this action the Germans brought 30,500 rifles and 150 guns on to the battlefield only out of more than 100,000 with 300 guns which could have been engaged before darkness. Bazaine actually deployed 50,700 rifles and 206 guns to oppose them. He might, however, had he been so minded, have struck with his whole army—nearly three times this force, and, judging from the course events actually took, we can have little doubt as to the result of such a blow. The losses on either side were in killed and wounded—French about 3600, Germans about 4800.

The chain of causation in this action is particularly worthy of attention: A young reserve officer, seeing some troops of the I. Corps standing to arms, reported to von der Goltz that the corps was standing to arms and about to attack. Von der Goltz thereupon decided to go forward and discover what was actually going on, and this action unchained the whole battle power of all the troops within call. When, on the following morning, Steinmetz reported von der Goltz and the commander of the I. Corps for disobedience, the king thanked Manteuffel warmly for the part he had played, and then turned to the young brigadier who had disobeyed orders and congratulated him on having twice distinguished himself in the first fortnight of the war.

2. *The Battle of Vionville—Mars-la-Tour* (*August 16*).—On the following day (15th) the II. German Army approached the Moselle above and below Pont-à-Mousson, with a view to overtaking and heading off Bazaine in his presumed retreat to the Meuse (see FRANCO-GERMAN WAR). So far, however, from being ahead of the Germans on the road to Verdun, the French were actually, late in the afternoon of the 15th of August, bivouacked on the plateau of Rezonville, and there their outposts were placed, not where they could see the surrounding country, but at the regulation distances of 600 to 1000 paces from the bivouacs. Friendly inhabitants kept Bazaine well informed as to the magnitude of the danger threatening him from the south, and a special telegram from Paris, the true origin of which has never been traced, led him to believe that the I. German Army was crossing the Moselle near Thionville and about to descend on him from the north. This telegram might have exercised the most prejudicial influence on the course of the battle had not Ladmirault (4th Corps), nearer to the seat of the imaginary danger, taken upon himself to disregard the warning transmitted to him by headquarters. At daybreak on the 16th, no Prussians being reported in sight by the outposts, the troops began nonchalantly to prepare for the resumption of the march.

On the Prussian side, von Alvensleben's Corps (III.) shortly after daybreak was moving north-westward from the Moselle in two columns, on the right the 5th division, via Gorze and Flavigny on Vionville, on the left the 6th division with corps artillery by Arnaville on Mars-la-Tour, von Alvensleben himself riding a little in advance between the two. The 6th cavalry division was ordered to precede the right column and scout towards Rezonville. No one was aware of the dangerous proximity of the French army.

About 9 a.m. the 5th cavalry division, reinforced by two horse artillery batteries (flank guard of the X. Corps from Thiancourt), and accompanied by von Caprivi (chief of staff, X. Corps, and afterwards chancellor of the German Empire), were trotting up the western slopes of the ridge which runs between Tronville and Vionville. Reaching its summit they suddenly found themselves in face of at least 40,000 French troops, which were not under arms, but busied with miscellaneous camp duties. The temptation proved too great for the artillery, who promptly fired into the midst of the cavalry camp (Forton's division) which lay nearest to them. The momentary result was a wild panic, especially among the horses; but this panic gave the alarm to the infantry all along the road, and these (Frossard's 2nd Corps) at once stood to arms and moved forward, deployed for attack—one division to the west, another division, from Rezonville, to the south. The latter almost at once encountered the heads of the 6th cavalry division, at that moment just clearing the defile leading up to the Rezonville plateau from Gorze. The Prussian cavalry promptly bore away to cover to the westward, and reported what they had seen to superior authority, but not to the advanced guard of the 5th infantry division, which, emerging in its turn from the defile, ran right against the deployed French infantry moving to meet them. So sudden was the collision that the Prussian advanced guard battery had to fire case to clear its own front.


METZ BATTLEFIELDS
(Western)
English Miles
0 ½ 1 2 3
Homécourt
Valleroy
Auboué
Montois-la-Montagne
Malancourt
Pierrevillers
Silvange
Hauconcourt
Ferry
Maizières-les-Metz
Moselle
Meineville
Coinville
Roncourt
Marange
Abbéville
R. Orne
Beaumont
Carrières de Jaumont
Forêt de Jaumont
Bronvaux
Fèves
Semécourt
Brieux Chât.
Argancy
Amelange
Hatrize
Ste-Marie-aux-Chênes
St. Privat la-Montagne
Jérusalem
Auboué
Moulin au Pré
Norroy
Olgy
Bois de Pont
Tichémont
Labry
St. Ail
Bois de Fèves
Les Ptes Tapes
Les Gdes Tapes
Malroy
Ferry
Francloshamps
to Rheims
Moulinelle
Batilly
Fleury
Habonville
Amanvillers
Plesnois
Bellevue
le Point du Jour
Villers-les Plesnois
Ste. Agathe
St. Remy
Chât. Ladonchamps
Gde. Maxe
St Baudier
Conflans-en-Jarnisy
Giraumont
Jarny
Jouaville
B. de la Cusse
Montigny la Grange
B. de Woippy
Saulny
Pte Maxe
Yron R.
le Breuilot Moulin
Anoux-la-Grange
Champenois
l'Envie
la Folie
Bois de Saulny
Bois de Lorry
Maison Rouge
Thury
Friauville
Doncourt en Jarnisy
Bois des Oeuillons
Verneville
Chantrenne
Château
Vigneulles
Woippy
Maison Neuve
St. Eloy
Chatillon
Longeau R.
Droitaumont
Moulin Chât.
Leipzig
B. de Chatel
Lorry devant Metz
le Coupillon
la Grange aux Dames
le Sansonnet
Maison de Planche
Ft. St. Julien
St. Julien
Bruville
Butricourt
Caulre
Urcourt
Bois Genivaux
Ft. des Carrières
Tignomont
Devant les Ponts
Ronde
Chambière
Ft. Miollis
la Ville aux Prés
la Grange
Malmaison
Baroneux
Plappeville
St. Marcel
Moscou
Lessy
Ban St. Martin
Ville-sur-Yron
Greyère
Villers-aux Bois
Bois de la Jurée
Mogador
Hubert
Chatel St. Germain
Ft. St. Quentin
St. Quentin
Gravelotte
Point du Jour
Maison Neuve
Scy
METZ
St. Symphorien
Citadel
Plantières
Longeville-les-Metz
Rozerieulles
Longeau
Moulins
Hannonville
Yron R.
Mars-la-Tour
Ste. Ruffine
Jussy
Montigny
Queuleu
Vionville
Rezonville
Moulin de Mance
Bois de Vaux
Vaux
la Maison Rouge
le Sablon
Chât.
Ft. de Queuleu
Sizemont
Bois des Ognons
Constantine
Ateliers
Redoubt
Tronville
Flavigny
Bradin
St. Privat
la Horgne au Sablon
Fournebride Aub.
Ft. de St. Privat
Blory
Jafrange Mercier
Bois de St. Arnould
Ars-sur-Moselle
Frescaty Chât.
Chât. de la Grange aux Ormes
Puxieux
Ferme du Sauley
B. des Chevaux
B. de Gaumont
Polka Aub.
Orly
Magny-sur-Seille
to Saarbrück
Sponville
B. de Prêtre
Ancorville
Carrières
Rongueville
Jouy-aux-Arches
Augny
Lazerat
Châteaubas
St. Thiébault
Marly-sur-Seille
Gaumont
St. Thiébault
Ancy-sur-Moselle
Xonville
Puxières
Ste. Apolline
Gorze
R. Moselle
Hadonville
Lachaussée
Maison du Chatelet
les Baraques
Lagrange
le Gros Bois
Clémerie
Ste. Catherine Chap.
Dornot
Rochers de la Pierre
Bellevue
Moulin d'Ancla
Chât. St. Blaise
Gros Yeux
Praytelle
Heu Rive
Seille
Pouilly
Chambley
B. de Hart
St. Louis
Cuvry
Fleury
Hageville
Champs
Mazagran
Corny
Fey
Tuilerie
Coin-les-Cuvry
Mt. Fleury
Bois la Dame
to Thionville

Emery Walker sc.

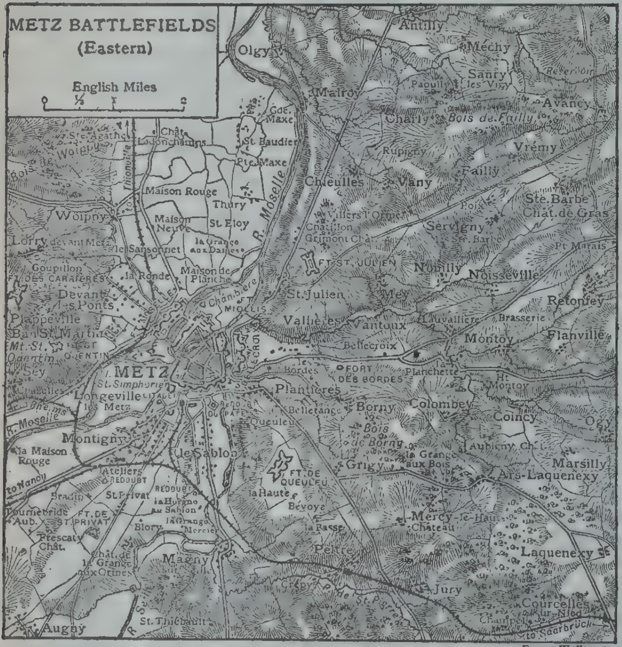
Meanwhile von Alvensleben himself, riding on the field track from Gorze towards Vionville, whence he could overlook the whole country to the north and west, had met von Rheinbaben (commanding the 5th cavalry division) and had seen the surprise of the French camps. The sound of the heavy firing coming from the eastward convinced him of what had been gradually dawning on him—that with barely 30,000 men he was in the presence of the whole French army, whose attitude at this moment sufficiently indicated their determination to fight.

In a few moments his decision was taken. Calling on the X. Corps, away to the south-westward, for support, he determined to screen his own weakness by a vigorous attack. By universal consent this is approved as the boldest resolution arrived at by an independent commander throughout the war. Orders were forthwith despatched to the 6th infantry division, at that moment between Puxieux and Tronville, to wheel in to their right and attack, and, their movement being still hidden from the enemy, these troops were formally drawn up for action and sent forward as a whole. The French meanwhile had occupied Vionville and Flavigny, and other troops were moving down the slopes from Rezonville to their support, but the united onset of this whole German division overbore all resistance, and the French began to retire eastward, suffering terribly from the shell fire of the Prussian batteries.

Marshal Bazaine had meanwhile arrived on the scene, and ordering forward fresh troops to relieve (not to reinforce) those already engaged, he rode forward with a horse artillery battery to watch the operations. The retreating French troops belonged to Frossard's command, and as they were in considerable confusion Frossard called on du Preuil's brigade of the imperial guard cavalry to charge. He gave no objective, and when the brigadier pointed out that the enemy was still beyond the striking radius of his horses, Frossard reiterated the order, which was obeyed to the letter.

The result was disastrous. The Prussians, having seen the cavalry whilst yet at a distance, ceased firing, formed their skirmishers into groups, and the closed supports standing in deployed lines, two deep, shattered the cavalry with volleys and file-firing, as with blown and exhausted horses they endeavoured to close with their adversaries. When in addition two hussar regiments struck them in flank they were driven back in wild disorder upon Rezonville. In the dust and confusion of the charge a group of the hussars approached Bazaine and his horse artillery battery, and almost carried off the marshal.

Alvensleben, mistaking the withdrawal of the French for the beginning of a retreat, had meanwhile sent orders to the 6th cavalry division to charge in pursuit towards Rezonville; but before it could reach the field the French relieving troops had forced their way through the stragglers and showed such a bold front to the Prussian horsemen that an attack held no promise of success, more especially since they had lost their intervals in their advance and had no room for a proper deployment. To steady the young soldiers, the cavalry commander (Carl von Schmidt) halted his men, made them correct their intervals and dressing as in peace, though under a heavy fire from the French infantry, and then withdrew them behind the cover of the nearest hill at a walk.


METZ BATTLEFIELDS
(Eastern)
English Miles
0
½
1
2
Olgy
Antilly
Méchy
Sanry les Vigy
Paouilly
Reservoir
Malroy
Avancy
Charly
Bois de Failly
Gde. Maxe
Ste. Agathe
Châtᵘ Ladonchamps
St Baudier
Woippy
Bois de Woippy
Rupigny
Vrémy
Pte. Maxe
Failly
Thionville
Chieulles
Vany
Maison Rouge
Thury
R. Moselle
Poix
Ste. Barbe
Chât. de Gras
Woippy
Maison Neuve
St. Eloy
Villers l'Orme
Chatillon
Grimont Châ
Servigny
Ste. Barbe
Lorry devant Metz
le Sansonnet
la Grange aux Dames
Pt Marais
Goupillon
FT. DES CARRIÈRES
la Ronde
Maison de Planche
FT. ST. JULIEN
Nouilly
Noisseville
Devant les Ponts
Chambière
FT. MIOLLIS
St. Julien
Mey
Retonfey
Plappeville
Ban St. Martin
Vallières
Vantoux
Lauvallière
Brasserie
Mt. St. Quentin
FT. QUENTIN
Bellecroix
Montoy
Flanville
Sey
METZ
les Bordes
FORT DES BORDES
la Planchette
Ht Montoy
Chazelles
St. Symphorien
Longeville les Metz
Plantières
Belletange
Borny
Colombey
Rhe. ms
R. Moselle
Queuleu
Coincy
Ogy
Montigny
Bois de Borny
Aubigny Châ
la Maison Rouge
le Sablon
la Grange aux Bois
Grigy
Marsilly
Ateliers
REDOUBT
FT. DE QUEULEU
Ars-Laquenexy
to Nancy
Bradin
St. Privat
REDOUBT
la Horgne au Sablon
la Haute
Bévoye
Tournebride Aub.
FT. DE ST. PRIVAT
la Grange Mercier
la Basse
Mercy-le-Haut
Château
Blory
Frescaty Chât.
Peltre
Laquenexy
Chât. de la Grange aux Ormes
Magny
Crépy
R. de St. Pierre
Jury
Courcelles sur Nied
Augny
St. Thiébault
R. Seille
Chaumpel
to Saarbrück
Emery Walker sc.

The threat of the charge had, however, induced caution on the French side, and for about two hours there was a lull in the fighting, which the Prussians utilized on their right in bringing up reinforcements through the Bois des Ognons. On their left, however, no fresh troops were as yet available, and on being informed, about 2·30 p.m., that French cavalry seemed to be about to charge the exhausted 6th division, Alvensleben ordered Bredow's cavalry brigade to charge, and if necessary to sacrifice itself, to save the infantry. Bredow's command (six squadrons of the 16th Ulans and 7th Cuirassiers) was at that moment drawn up under cover about half a mile west of Vionville, and from its position could see nothing of the events in progress on the battlefield. Nettled by the form in which the order was conveyed to him, Bredow drew his sword and ordered his trumpeter to sound the "trot," the brigade moving off in line of squadron columns at close interval in the direction in which they happened at the moment to be facing. Near Vionville they took ground to their left, opening to full intervals as they did so, and then ascended the gentle incline which still hid them from their enemy.

Arrived at the summit, Bredow sounded "line to the front," but at that moment a storm of French bullets swept down on them, and the men, no longer to be restrained, dashed forward, before the line could be completed, almost due east against long lines of infantry and artillery which they now saw for the first time about 1200 yards in front of them.

This distance was covered at the fullest extended speed of the horses, and reaching the infantry they swept over them "like hounds over a fence"—in the words of an eyewitness. So sudden had been their onset that very few were hit until the infantry had been passed; then the latter, recovering from the shock, turned and fired into the cavalry from behind, whilst a whole fresh division of French horsemen charged them in flank. After a desperate mêlée of some minutes, the rally was sounded, and the survivors of the charge, breaking their way a second time through the French infantry, eventually reached the shelter of their own lines, having lost rather more than half their numbers, but having saved the situation momentarily for their own army. Again there was a lull in the operations.

Meanwhile, unknown to Alvensleben, a fresh storm was brewing on his left rear.

Ladmirault, commanding the French 4th Corps had seen, during the afternoon of the 15th, the terrible crowd and confusion prevailing in the defiles leading to Gravelotte, and resolved to disobey his orders and to move direct from his bivouacs by the road from Woippy to St Privat, disregarding altogether the alleged danger from the Prussians supposed to be advancing from Thionville. Thus, about noon on the 16th he reached the high ground between St Privat and Amanvillers, and still without instructions he determined to direct his corps on Bruville and Doncourt, whence he could judge from the drift of the smoke-clouds whether he could fall on the Prussian left.

Much time was lost owing to the heat of the day and the fatigue of the troops, but shortly after 3 p.m. he reached a position north of the Tronville copses whence his guns could fire into the left rear of the long line of Prussian guns (6th division and corps artillery) on the heights above Vionville and Flavigny. Their fire threw the latter into serious confusion and he had already decided to attack with his nearest division (de Cissey) in the direction of the steeple of Vionville, when his attention was caught by the outbreak of heavy firing in the copses below him, and the entry of fresh Prussian guns into action.

This diversion was brought about by the arrival of the corps artillery of the X. Corps and of the 40th brigade, which latter had been at once ordered into the Tronville copses to check portions of Tixier's division of the French 3rd Corps, which under cover of these copses had gradually worked round the Prussian flank. Seeing then that the troops before him could hold their own, Ladmirault continued his preparations for his counterstroke, and Cissey's division had begun to move into its prescribed alignment, facing towards Vionville, when the sudden apparition of a closed mass of Prussian troops detaching itself from the low dust-cloud of a slow-moving infantry column, and forming to the south of Mars-la-Tour, again arrested his attention. Unanimously he and his staff agreed that this fresh enemy could only be the advanced guard of a large Prussian force, possibly, it was suggested, of the crown prince's army, from Alsace and Nancy, and a fresh delay arose while the situation was investigated. Actually this body consisted only of the 38th brigade (von Wedell), forming part of the X. Corps. It had no knowledge of the state of affairs on the battlefield, or in the direction of Bruville, though Prussian cavalry had been observing the approach of Ladmirault's corps for some hours. It was now ordered to deploy and to co-operate with the 40th brigade in an attack on the Tronville copses. This meanwhile had been delivered, and had more or less failed.

The deployment completed, about 4 p.m. the 38th brigade began its advance on the north-west corner of the Tronville copses, this direction taking them diagonally across the front of Cissey's division, still out of their sight but moving due south. Hardly had they stepped off when Cissey's first line, catching sight of them, opened a devastating fire upon their left flank, and to meet this fresh danger the Prussians endeavoured to change front half-left whilst still on the move. Without pausing to fire, the men raced onward, but the French striking their outer wing rolled up the whole line in succession, the actual collision occurring in and near the Bruville ravine, a deep-cut natural trench which, starting from the Tronville copses, here intersects the plateau from west to east. Against the weight of French numbers, nearly three to one, the Prussians were unable to stand, and presently they broke and drifted backwards, completely routed. Then the 1st Guard Dragoons (since known as Queen Victoria's regiment), after a brilliant manœuvre under heavy fire, to get into the best position for delivering a charge, rode down the whole French line of pursuers from left to right, and by their heroic self-sacrifice relieved the remnants of the infantry from further pursuit.

This was the scene which for the moment held the attention of Prince Frederick Charles when at length he reached the battlefield from Pont-à-Mousson. All along the rest of the line the Prussians were still holding their own, and on the extreme right fresh troops from the IX. Corps were streaming up through the woods against the French left wing. But on the left there was every sign of incipient disaster, and to avert this only the cavalry were at hand. Sending, therefore, hasty orders to the 5th and 6th cavalry divisions to concentrate to the west of Mars-la-Tour, the prince ordered them from there to sweep round on the right rear of the French army. The same idea had, however, occurred to Ladmirault, and he had called on the two nearest French cavalry divisions to put it into execution, and as the Prussians began to reach the plateau west of Mars-la-Tour and the Yron brook from the south, the French were deploying across it some two thousand yards to the north.

Then followed a duel—the one great cavalry duel of the war—between upwards of two thousand horsemen a side. But it was delivered by both sides in a series of regimental charges, and in result was singularly indecisive. For about half an hour great crowds of riders, hidden by dense clouds of dust, drifted aimlessly about the plain, till at length the charge of a single squadron of the Oldenburg Dragoons (who had joined in on their own initiative) delivered on the outer French flank, brought the whole mass into motion north-eastward, and, both sides sounding the rally, the engagement gradually ceased.

It was now about 7 p.m. and night was coming on. Seeing the dust-clouds drifting away northward, and noting the lethargy which seemed to have settled over the whole French line, Prince Frederick Charles decided to assert his own independent will to conquer by a final assault along his whole front. Guns, cavalry, infantry, everything that could still stand were to take part in it. Weary as they all were, his indomitable will put fresh life into the whole army. With drums beating and colours flying, every unit within call went forward for the final effort. It was almost dark when the Prussians approached the French position between Rezonville and the woods to the northward, and the troops soon lost direction in the smoke and became involved in the direst confusion; the firing again blazed out for a few moments, only to die away as utter exhaustion at length put an end to the Prussian advance. Then the wearied troops, for the most part, lay down and slept in the positions they had reached.

Thus closed the hardest fought battle of the Franco-German War. From 9 a.m. to 3 p.m. only 23,700 rifles, 8100 sabres and 126 guns had been brought into action by the Germans against 59,100 rifles, 6700 sabres, and 300 guns on the French side, and even at the close of the day the former had only deployed 47,100 rifles, 8300 sabres and 222 guns against 83,000 rifles, 8000 sabres and 432 guns including 24 mitrailleuses. The chief characteristic of the day's fighting was the terrible effectiveness of the Prussian artillery, which was handled in masses and not, as on the French side, by batteries. The manœuvring power of the latter attracted the admiration of the Germans, but arriving singly on the field they were generally reduced to silence in a few minutes. Deprived of their support, not all the gallantry of the French infantry could avail anything. Again and again, particularly on their left wing, they chased the German infantry before them, but the moment the retreat of the latter downhill uncovered the pursuing French to the Prussian guns, a tornado of shells shattered their order and compelled them to retreat. Though the cavalry were freely engaged, the training of both was so far beneath the standard of the present day that the most that can be credited to them in respect of results is that they from time to time averted imminent disaster, but failed altogether to achieve such a decision as was well within their potential capacities.

3. *Gravelotte—St Privat* (*August 18*).—The position on to which the French army fell back from the field of Vionville is formed by a ridge some six miles long running from Rozerieulles almost due north to Roncourt, a little village overhanging the steep and wooded banks of the Orne, and connected with the general plateau between the Meuse and Moselle by a gentle saddle running from about Amanvillers nearly due west through the Bois de la Cusse towards Doncourt. North of this saddle the slopes show a slight concavity, but are passable by troops of all arms in close order. To the south the rivulet of the Mance soon forms a formidable obstacle as its bed cuts its way through the sandstone. Scrub and woods with dense undergrowth line both its banks, and, except by the great chaussée from Metz to Verdun, access to the French side becomes impossible to troops in ordered bodies.

It does not appear that the position had been systematically examined, or apportioned to the several corps in accordance with any predetermined plan. The army merely swung backwards, pivoting on its left wing, the corps preserving their relative order as it had been on the 16th, with the exception that the Imperial Guard was withdrawn to the spur on which Fort Plappeville stands, and the 6th Corps (Marshal Canrobert) crossed the line of march of the 3rd and 4th Corps in order to gain St Privat la Montagne. No lines of march were assigned to the several units, consequently the confusion became so great that though the distance to be traversed in no case exceeded six miles, only the right wing and centre reached their destinations as night was falling. Many of them had so little idea of the general situation that they actually placed outposts to the north and east, whilst the whole of the enemy's army lay to the south and west. No attempt was made to entrench the position systematically, but on the left the 2nd and 3rd Corps made some disconnected shelter trenches and gun-pits, while the 4th Corps in the centre began to improve available cover about an hour before the battle began, and the 6th corps on the right, not yet having received any entrenching tools, could do no more than improvise a few loopholes in the walls of the villages of St Privat and Roncourt with such tools as the sappers could obtain from the inhabitants.

Fortunately for the French the Germans were too exhausted by the battle of the 16th to attempt to interfere with these movements. At daybreak on the morning of the 18th the royal headquarters (which now for the first time arrived at the front) still had no certain knowledge as to whether the French main army was in retreat—covered by the force which they could see on the high ground north of the Metz road—or whether they had taken up a position in order to fight.

Hence the orders issued overnight on the presumption that the main force of the French was retreating to the north and west were allowed to stand, and the whole II. Army (Prince Frederick Charles) moved off in échelon from left to right, the I. army under Steinmetz, consisting for the day of the I., II. and VII. Corps, being left in observation of the troops visible on their front and of the garrison of Metz itself. The I. Corps was kept back beyond the Moselle on the east side of Metz, the II. was not due to arrive at Rezonville before 4 p.m., hence the VII. only was immediately available if the enemy counter-attacked. But Steinmetz had not ordered, nor had von Zastrow, the corps commander, undertaken, any preparations to meet an emergency. About 10 a.m. the corps had reached the following positions:

VIII. Corps, Rezonville; XI. near St Marcel; Guard approaching Donçourt; XII. towards Jarny; the III. and X., which had been so heavily engaged on the 16th, still in their bivouacs preparing to move. The cavalry of the Saxons had established the fact that the French had not retreated northward, but though scouts from the Guard had already seen the enemy on the heights of St Privat, this information had not yet reached headquarters, nor had it been transmitted to the IX. Corps, which it most closely concerned.

Shortly after 10 a.m. Moltke, still under the impression that the French right extended no farther than La Folie (2 m. north of the Metz road), determined to attack with the IX. and VIII. Corps whilst the Guard executed a turning movement via Habonville against the French right. The IX. Corps was to engage, but not to push its attack home until the Guard could co-operate. The XII. Corps was left to its own devices, but fortunately the crown prince of Saxony, who commanded it, had ridden forward and, seeing the French in force towards Roncourt, had issued orders which in the event proved decisive.

In pursuance of his instructions von Manstein, commanding the IX. Corps, set his two divisions in motion towards La Folie and the Bois de la Cusse, and advanced to reconnoitre the French position. From the eastern edge of the above-named copses he suddenly descried the camp of a whole French Corps (the 4th), evidently ignorant of their danger, on the slopes trending westward from Amanvillers. Unmindful of the experience of the 16th, he decided to execute an artillery surprise on a grand scale, and sent orders to his corps artillery to come into action on the long spur overlooking the French camps from the westward. At noon, just as the French infantry were falling in for midday roll-call, sufficient guns were in position, and suddenly opened fire. But the effect was disappointing. The French infantry ran to their arms, piled along the front of their positions, and moved forward to attack, covering their advance by a hail of bullets. Simultaneously the French artillery also took up the challenge, and from the heights near St Privat the 6th Corps, whose presence had been unsuspected by the Prussians, joined in the fight.

In a few minutes the batteries on the extreme Prussian left were completely overwhelmed, and suddenly dense lines of French skirmishers emerged from a fold in the ground upon their flank and front, and the gunners were compelled to resort to case-shot, so imminent was their danger. But at this critical moment the leading companies of the Hessian infantry arrived, re-established the equilibrium (though not before four Prussian batteries had been temporarily overrun by the enemy), and a most obstinate fight ensued.

Prince Frederick Charles now rode forward to a point north-east of Vernéville, whence the southern boundary of St Privat could be seen. But the northern side of the village and the country towards Roncourt was hidden from his view by the high poplars bordering the Metz-Briey road. Seeing the Hessians hard pressed, he now brought forward the 2nd division of the Guard to their assistance, sending in the 3rd brigade immediately, and holding the 4th brigade in reserve. The 1st division, warned by their own scouts that French troops were in Ste Marie, deployed to attack this village, and were assisted in their endeavour by a brigade of Saxons detached by the crown prince of Saxony, who from his position could see behind the poplar screen that limited the view of the commander-in-chief. Hence he was already aware that the French position extended to Roncourt at least, and had despatched a whole division down the valley of the Orne to outflank them. No news of this movement, however, appears to have reached Prince Frederick Charles.

The French troops in Ste Marie were only an outpost of the 6th corps, and seeing themselves outnumbered, they withdrew about 2.30, the Prussians rushing the village immediately afterwards. Considerable confusion arose from the convergence of these three brigades upon one village, and more than an hour passed before the troops could be disentangled and massed for further operations. The leaders of the two Guard brigades, still ignorant of the extent of the French position, rallied their men on the main bodies of their commands (which had not been engaged) and then lay down facing exactly as they had done when brought forward to the attack. Thus the 1st brigade lay, facing about east-south-east, south of the chaussée and some five hundred yards west of the village. The 2nd brigade lay south-west of the village about three hundred yards away from it and facing nearly north-east.

The Saxons were on the left rear of the 1st brigade, but took longer to recover themselves than the Guards. With the Hessians and the IX. Corps the action still dragged; the 3rd brigade of the Guards had become involved in the fight, and notwithstanding the arrival of the corps artillery of the III. Corps in the centre the situation was still critical. From the south also came the thunder of guns and no encouraging news from that quarter had as yet reached the prince's headquarters.

About 4.30 p.m. the prince therefore had to consider how long it would take to obtain a decision. To postpone it till the morrow seemed undesirable: to achieve it before nightfall was only possible at the cost of immediate effort.

He therefore decided to assault St Privat with all the Guards available, and called up the III., X. and Saxons to assist them.

The 4th brigade of the Guards now received their orders to attack Jérusalem (a hamlet a little south of St Privat), and the 1st division was ordered to assault St Privat itself.

Von Pape, commanding the latter division, pointed out that no artillery force adequate to prepare the way for him was as yet on the ground, and that the Saxons were still a long way to the rear. But his orders were imperative, and the 4th brigade was already moving off and had to be supported at any cost. Actually all available batteries had already been sent for and were trotting forward from every quarter towards the objective. He accordingly transmitted his orders, and the 2nd brigade was the first to attempt their execution. It had to wheel half-right in mass to bring it in the required direction, and then to advance till its rear was clear of the obstruction formed by the gardens of St Marie. By the time (5.30) it had sufficiently cleared this village it became apparent that the 4th brigade in its extension for attack would overlap the front assigned to the 2nd, hence a further (half-left) wheel, still in mass, had to be undertaken before room for deployment could be obtained. Almost as the commands were given, the French suddenly opened an overwhelming long-range fire and their bullets swept like hail through the crowded mass of the German troops. Nevertheless the wheel was effected, the fresh direction taken, the troops extended for attack, and then the whole brigade dashed towards the houses assigned them as their objective. Meanwhile the 1st brigade had moved round the north of the village and carried out its extension without serious hindrance. But emerging from the hollow running north from St Marie, they came under a heavy fire not only from St Privat but also from Roncourt, which latter village they now saw for the first time. Instinctively a portion of their line worked to the left to face this new menace, and the front thus became dangerously extended. They were, however, now abreast of the 2nd brigade, and the whole line raced forward to reach the effective range of their very inferior weapons, which were about equal at 200 yds. to the French rifle at 600. But the losses of the 2nd brigade, particularly in officers, had been too heavy, and the rush died out whilst still 500 yds. from the two villages.

It was now about 6 p.m. and a long pause ensued, while the 220 guns, which by degrees had unlimbered behind them, brought St Privat and Roncourt under fire. About 7 p.m. the Saxon turning-movement took effect; their infantry from the Orne valley attacked Roncourt from the north, and about 7.15 the village was carried.

Neither Prince Frederick Charles nor the troops in the fighting-line could see what had taken place; but the former seeing other Saxons moving towards Montois and the masses of the III. and X. Corps approaching, whilst the rain of shells into St Privat exceeded anything hitherto seen on any battlefield, decided to call on the whole of his force to attack. He was in the act of issuing his orders when a psychological wave swept through the fighting-line, and the men rose and rushed the village at the point of the bayonet. It was now about eight o'clock, and the light was rapidly failing.

The French artillery had already evaded the coming blow, and had changed position, "right back," to cover the flank of the rest of the army, and the Prussian and Saxon artillery trotting forward conformed to this new front, their shells sweeping the ground for 2000 yds. to the south of Amanvillers. The confusion in and around St Privat, where troops from four several corps were all intermingled, became so extreme that no further infantry-advance could be attempted; so under cover of the fierce artillery duel the remnants of the unfortunate 6th corps drifted away towards Metz down the many ravines leading into the river valley. The "annihilation" of the Guard at St Privat has become historic. Yet, heavy as were the losses of the 1st Guard division they were not excessive compared to those previously endured. In round numbers one-third of their effectives had fallen—most of them in the first great rush forward at 5.30 p.m.; but actually they had been more or less under fire since about 2 p.m., and many were hit by French shells plunging into the turmoil about St Privat from 8 to 10 p.m. But the legend cannot be justified when the facts are compared with the slaughter of the Seven Years' War, of Napoleon's battles, the Crimea, and the American Civil War, or with the horrible punishment of von Wedell's brigade (38th) only two days before.

It is now time to return to the southern theatre of the battlefield, where an entirely independent engagement had been raging all the afternoon. Von Goeben with the VIII. Corps was standing massed about Rezonville when von Manstein's guns opposite Amanvillers suddenly made themselves heard. Wheeling his corps to face the French to the eastward he immediately sent forward his artillery and prepared to support his comrade. Von Zastrow with the VII. Corps followed his example. Both corps took as their primary objective the farms of St Hubert and Point du Jour, standing just above the defile made by the Verdun-Metz road where it climbs out of the Mance ravine towards the French position. About 3·30 p.m. St Hubert was carried by a confused mass of some 49 companies, and von Steinmetz, believing the main French position to have been pierced, ordered the 4th cavalry division to cross the ravine by the chaussée and pursue. Simultaneously von Zastrow, under the same impression, had ordered his corps artillery to advance by the same road, and von Goeben, thinking his troops in front required support, had sent forward an infantry brigade by the same line of road.

Presently all these columns converged upon the defile and a hopeless entanglement ensued. Three batteries succeeded in struggling through the mass, and, in coming into action, their left resting on St Hubert. But the remainder of the troops had to be withdrawn, and confusion breaking out in their rear, exposed to all the random bullets and shells of the French, a panic ensued, thousands of men breaking away and flying in wildest confusion through Gravelotte towards the west. Hardly had they melted away when the French made a most brilliant counter-attack from their main position between the farms of Leipzig and Moscow. This was stopped almost entirely by the Prussian artillery fire; but the news of its coming spread through the stragglers in the ravine south of the great road, and a wave of panic again swept through the mass, many thousands bolting right upon the front of their own batteries, thus masking their fire at the most critical moment, and something like a crisis in the battle arose. Fortunately the II. Corps was now rapidly approaching (about 6 p.m.), and the king, against Moltke's advice, now ordered von Steinmetz (to whom the II. Corps had been allotted for the day) to attack again with all his forces. Meanwhile a third panic broke out which delayed the preliminary movements and it was now growing dark in the ravine. At length the II. Corps, together with all of the VII. that could be collected, moved down into the valley. Just as the leading German troops were approaching St Hubert the French again began to fire, their bullets plunging down among the fresh arrivals, who knowing nothing of what had taken place about St Hubert (where the remnant of their own infantry were still offering a desperate resistance) opened fire into the backs of their own men, and a fourth panic began which soon spread to the stragglers crowding the Mance ravine. Fortunately, by the superb gallantry of some of the company officers and men, the new arrivals were induced to recognize their mistake, and by degrees about 10 p.m. the whole of the II. Corps succeeded in reaching the plateau between St Hubert and Point du Jour, where the débris of the VII. and VIII. Corps had gathered. But in the darkness and confusion no forward movement against the French (only 400 yds. to their front) could be initiated, therefore the whole mass passed the night where they stood until daylight disclosed that the French had retreated.

Meanwhile the king, Moltke, and Bismarck, had ridden back behind Gravelotte where they passed two hours of intense anxiety. From the flash of the rifles, it was clear that the French main position was still intact, and as every body of troops within thirty-six hours' call had been engaged there seemed little prospect of renewing the struggle next morning. No news too had come in from Prince Frederick Charles. Ultimately about midnight the welcome tidings of the capture of St Privat arrived, and all anxiety was at an end.

4. *The Investment of Metz* (*Aug. 19–Oct. 14*).—During the night following the battle of Gravelotte the French army withdrew within the line of the forts round Metz. The 6th Corps only was severely shaken, the 4th (the best in the whole army), though it had fought hard twice within forty-eight hours, losing nearly 30% of its strength, was still well in hand, and the 3rd, 2nd and Imperial Guards were almost intact. A fresh issue of ammunition and food was all the men needed to make them a thoroughly efficient fighting force comprising some 100,000 troops capable, with a resolute leader and an efficient staff, of crossing over to the right bank of the Moselle, overrunning the I. German Corps, the only one in their direct path, and then fighting their way across the communications of the II. and III. German Armies until they regained touch with the French railways to the south-west about Troyes.

The mere fact of the effort being made would have given the battle of Gravelotte the moral effect of a victory, and the reaction in the German ranks from the feeling of over-confidence, which had mastered them after the early successes of Spicheren and Woerth, must have had most far-reaching consequences.

Bazaine, however, withdrew entirely under cover of the forts, and set about the reorganization of his troops in the most leisurely manner. The Metz forts, though neither sufficiently armed nor even completely finished in some cases, were nevertheless, with their deep ditches and self-protecting bastion trace, far too formidable for any field army to attempt without the aid of a siege train of some 200 guns, which for the moment were not available. Of this fact the Germans were well aware, and hence they decided from the first to reduce the place by hunger, calculating that with the extra 150,000 men thrown back upon the fortress, its food supplies could not last very long. On the morning of the 19th the German army was far too exhausted for further efforts. Except the I. Corps, which had been summoned overnight from its position about Courcelles towards the battlefield of Gravelotte and had almost reached the Moselle before this move could be counterordered, the remainder kept their places of the previous night, only following the French retreat with a screen of outposts. They were sufficiently occupied in collecting the wounded and clearing up the confusion resulting from an accumulation of trains and transport in the defiles of Gorze and about Novéaut. No eastward movement could have taken place that day. In the course of the afternoon of the 19th the royal headquarters, creating a new army under the crown prince of Saxony (Guard, IV. and XII. (Saxons) Corps) for field operations towards the Meuse, assigned the remainder of the II. Army, and the whole of the I., to Prince Frederick Charles as commander-in-chief of the army of investment.[1] This brought the strength of his command up to eight corps, numbering some 220,000 men; an enormous mass to feed in a district swept bare of supplies by the operations of the preceding week, and with only one railway line, terminating at Courcelles, to depend upon.

For the moment the chief care of the Prince was to guard against an attempt of the French army to break out to the westward. The I. Army Corps with Kummer's Landwehr division (which arrived during the night of the 19th–20th of August) were to occupy a position to cover the rail head at Courcelles–Rémilly, and the remainder were disposed in the following order: The X. Corps was on the north, with a bridge head at Hauconcourt-sur-Moselle, the II., VIII. and VII. along the eastern slopes overlooking the Moselle valley, the latter having also a fortified bridge head at Ars-sur-Moselle. The III. and IX. were cantoned almost on the battlefield of the 18th, between Caulre Farm and Roncourt, ready to move off to the left and support the X. Corps in the event of an attempt on the part of the French to break out towards Thionville.

The positions were fortified with a light outpost line, behind which was drawn a main position on which every art of the engineer was expended. Ample arrangements were made for obtaining and circulating intelligence, and all lateral communications were improved and supplemented to the utmost. A light field-railway from Rémilly to Pont à Mousson (14 m.) was also put in hand, but progress on this was very slow. The water-supply of the town was promptly interrupted, but the river water was quite drinkable.

Meanwhile, the French in Metz had been diligently at work. There was no real deficiency of ammunition and stores in the fortress, and provisions for forty days were reported in hand. Bazaine was still in communication with the outside world, though return messages came in sparingly. On the afternoon of the 25th he decided to break out to the northward by the right bank of the river, and orders to this effect were duly issued. Many delays arose in their execution, and it was not till 2 p.m. on the 26th that the troops were formed up ready for action. But at the last moment the marshal wavered. Calling a council of war on the heights of Fort St Julien, he asked the opinion of his subordinates, who were unanimously against the proposed sortie, principally because the artillery "had only ammunition enough for a *single* battle!" Besides, the Germans had long since become aware of the movement in progress, and all chance of surprise was past. It was also raining very heavily. Accordingly the scheme was abandoned.

On the 29th of August Bazaine received a despatch, dated the 27th, from MacMahon, according to which his army should have been at Stenay on the Meuse and farther to the south by the 30th. The marshal accordingly determined to renew the attempt of the 26th, and orders—almost a repetition of those of the previous occasion—were issued.

At this moment (Aug. 31) the positions of von Manteuffel's command (I. Corps and 3rd Landwehr division) were most dangerously extended, and a surprise at daybreak might have had far-reaching results. But the habit of excessive bugling and band-playing betrayed the French design even before daybreak. Not until 1.30 p.m. was the concentration completed, and Bazaine again assembled his commanding officers to give them their final instructions. This time he adhered to his decision, and about 4 p.m. the attack opened (battle of Servigny or Noisseville); but his opportunity had been allowed to slip, and though his first onset overwhelmed the German outposts, their main line held good, and masses of guns unlimbering over a front of some 4 m. rendered all further attempts to break the German cordon abortive. Firing only ceased as darkness fell, and next morning the fighting was again renewed. But the whole French army was disheartened. It was obvious that what they had failed to do by surprise was hopeless now that twenty-four hours had been given in which the Germans could make counter-preparations. Therefore about noon a general retirement under the guns of the forts took place, and the last serious hope of the French army had vanished. Some 120,000 men with 528 guns had been engaged against 60,000 Germans with 222 guns, and had been beaten off with a loss of 3500 men. The Germans had lost about 3000.

The investment now resumed its regular course. The Germans, secure in the strength of their position on the left bank of the Moselle, drew more troops over to the right, and added to their defences and communications. The idea was even mooted of damming up the river near Hauconcourt, and thus flooding out the whole of the civil population of Metz; but expert civil engineers, who were sent for from Germany, reported against the proposal.

As time wore on the conditions in Metz and the surrounding camps became deplorable. The hospitals and private houses had been crowded with wounded from the first, and now, owing to the persistent wet weather, smallpox and dysentery became epidemic. Towards the close of September rations had to be reduced, and the troops began slaughtering the cavalry horses for food. Probably to cheer the men by a semblance of activity, Marshal Bazaine attempted a sortie on a large scale on the 1st of October in the direction of Ladorchamps, and fighting continued into the 2nd, but without prospect of success, and the profound depression following on defeat sent up the sick list rapidly. One other sortie towards Noisseville followed on the 7th, the alleged reason for which was the hope of obtaining provisions in the neighbouring villages. But it was beaten off with the utmost ease by the investing troops, who were well fed and cared for; and as by this time even the gun-teams had followed the cavalry horses to the slaughter-house, the French army as an army—*i.e.* a combination of the three arms—had ceased to exist. On the recognition of this fact negotiations for the capitulation of Metz were begun on the 13th of October, and on the 14th the Army of the Rhine surrendered. Had it held out even forty-eight hours longer events before Paris and Orleans might have taken a different turn.

The investment of Metz had lasted 54 days, and the death-roll of the civil population had risen to 3587 against 1200 in the corresponding period of a normal year. The army itself had only lost from sickness 2600 men, or barely 2% of its full effective. (F. N. M.)

MEUDON, a town of northern France, in the department of Seine-et-Oise, 6 m. E. of Versailles by rail and about 2½ m. S.W. of Paris. Pop. (1906), 9597. The remains of a castle (17th century) burned during the siege of Paris in 1871 have since been adapted as an observatory. Its terrace commands a fine view of Paris. The handsome Galliera Institutions, on the hill of Fleury, were founded by the duchess of Galliera for the reception of aged persons and orphans. The buildings were completed in 1885, at a cost of £560,000. The town has a monument of Rabelais, who was curé there in 1553, and manufactures munitions of war for the artillery, and in the neighbouring park of Chalais is the Government military ballooning establishment. In the 16th century the cardinal, Charles of Lorraine, built at Meudon a magnificent château, which was destroyed in 1803. The present remains belong to a building erected by the dauphin, son of Louis XIV. The wood of Meudon lies for the most part to the west of the town.

MEULEN, ANTONY FRANCIS VAN DER (1634–1690), Flemish painter, born in Brussels, was called to Paris about 1666 by Colbert, at the instance of Le Brun, to fill the post of battle painter to Louis XIV. His paintings during the campaigns of Flanders (1667) so delighted Louis that from that date Van der Meulen was ordered to accompany him in all his expeditions. In 1673 he was received into the French Academy, attained the grade of councillor in 1681, and died full of honours in Paris in 1690. He is best represented by the series of twenty-three paintings, mostly executed for Louis XIV., now in the Louvre. The show that he always retained his Flemish predilections in point of colour, although his style was modified by that of the French school.

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[1] Steinmetz was shortly afterwards relieved of his command and returned to Germany.

MEUNIER, CONSTANTIN (1831–1905), Belgian painter and sculptor, was born at Etterbeek, Brussels. His first exhibit was a plaster sketch, "The Garland," at the Brussels Salon in 1851. Soon afterwards, on the advice of the painter Charles de Groux, he abandoned the chisel for the brush. His first important painting, "The Salle St Roch" (1857), was followed by a series of paintings including "A Trappist Funeral" (1860), "Trappists Ploughing" (1863), in collaboration with Alfred Verwée, "Divine Service at the Monastery of La Trappe" (1871) and episodes of the Peasants' War (1878). About 1880 he was commissioned to illustrate those parts of Camille Lemonnier's description of Belgium in *Le Tour du monde* which referred to miners and factory-workers, and produced "In the Factory," "Smithery at Cockerill's," "Melting Steel at the Factory at Seraing" (1882), "Returning from the Pit," and "The Broken Crucible" (1884). In 1882 he was employed by the government to copy Pedro Campana's "Descent from the Cross" at Seville, and in Spain he painted such characteristic pictures as "The Café Concert," "Procession on Good Friday," and "The Tobacco Factory at Seville" (Brussels Gallery). On his return to Belgium he was appointed professor at the Louvain Academy of Fine Arts. In 1885 he returned to statuary and produced "The Puddler," "The Hammerer" (1886), "Firedamp" (1889, Brussels Gallery), "Ecce Homo" (1891), "The Old Mine-Horse" (1891), "The Mower" (1892), "The Glebe" (1892), the monument to Father Damien at Louvain (1893), "Puddler at the Furnace" (1893), the scheme of decoration for the Botanic Garden at Brussels in collaboration with the sculptor Charles van der Stappen (1893), "The Horse at the Pond," in the square in the north-east quarter of Brussels, and two unfinished works, the "Monument to Labour" and the Zola monument, in collaboration with the French sculptor Charpentier. The "Monument to Labour," which was acquired by the State for the Brussels Gallery, comprises four stone bas-reliefs, "Industry," "The Mine," "Harvest," and the "Harbour"; four bronze statues, "The Sower," "The Smith," "The Miner," and the "Ancestor"; and a bronze group, "Maternity," Meunier died at Brussels on the 4th of April 1905.

MEURICE, FRANÇOIS PAUL (1818–1905), French dramatist, was born in Paris on the 7th of February 1818. In 1848 he became the editor of the *Événement*, founded by Victor Hugo, and in 1869 he was one of the promoters of the *Rappel*, a journal on similar lines. He was the literary executor of Victor Hugo, and edited his works (1880–1885). In collaboration with Auguste Vacquerie and Théophile Gautier, he produced *Falstaff* (1842), a play in imitation of Shakespeare, and in 1843 an imitation of the *Antigone*; and with Alexandre Dumas a *Hamlet* (1847). He also wrote *Benvenuto Cellini* (1852), *Schamyl* (1854), *Struensée* (1893), and dramatic versions of *Les Misérables* (1878), *Notre Dame de Paris* (1876), *Quatre-vingt-treize* (1881). He died on the 12th of December 1905.

MEURSIUS [JOHANNES VAN MEURS] (1579–1639), Dutch classical scholar and antiquary, was born at Loosduinen, near the Hague. He was extremely precocious, and at the age of sixteen produced a commentary on the *Cassandra* of Lycophron. In 1610 he was appointed professor of Greek and history at Leiden, and in the following year historiographer to the states-general. In consequence of the disturbed state of his country he welcomed the offer (1625) of Christian IV. of Denmark to become professor of history and politics at Sorö, in Zealand, combined with the office of historiographer royal. He died at Sorö on the 20th of September 1639. Meursius was the author of classical editions and treatises, many of which are printed in J. F. Gronovius's *Thesaurus antiquitatum graecarum.* Their lack of arrangement detracts from their value, but they are a storehouse of information, and Meursius does not deserve the epithets of "pedant" and "ignoramus" which Scaliger applied to him. Meursius also wrote on the troubles in the Netherlands and the history of Denmark.

Complete edition of his works by J. Lami (1741–1763). See Van der Aa's *Biographisch Woordenboek der Nederlanden* (1869), and J. E. Sandys, *Hist. of Class. Scholarship* (1908), ii. 311.

MEURTHE-ET-MOSELLE, a department of north-eastern France, formed in 1871 out of those parts of the old departments of Meurthe and Moselle which continued French. Before 1790 it belonged to Lorraine, or to one or other of the bishoprics of Toul, Metz and Verdun. Pop. (1906), 517,508. Area 2038 sq. m. It is bounded E. by Lorraine, N. by Belgium and the grand-duchy of Luxemburg, W. by the department of Meuse, and S. by that of Vosges. Meurthe-et-Moselle is of a hilly character, the highest elevation, the Grand Rougimont (2041 ft.), being in the Vosges. The valley of the Moselle runs through it from south to north. Extensive forests, the chief of which is the Forest of Haye, are found in the south-western region. Only a small part of the drainage of Meurthe-et-Moselle flows into the Meuse, by far the greater part reaching the Rhine by way of the Moselle. The principal affluents of the Moselle are the Madon and the Orne on the left, and on the right, besides the Meurthe, the Seille, which in one part of its course forms the boundary of Alsace-Lorraine. The principal tributary of the Meuse within the department is the Chiers. Climatologically Meurthe-et-Moselle belongs to the Vosgian region, and has hot summers and severe winters. Its mean annual temperature is between 48° and 49° F., being 2° lower than that of Paris (which has the same latitude). The annual rainfall averages between 28 and 32 in. The department possesses much fertile land, the chief crops being cereals and potatoes, together with clover, mangel-wurzels, tobacco, hops and beetroot. The vine is also cultivated, its best products being those of the Toul district. The most common fruit trees are the pear, the apple, the walnut, the cherry and the plum. Of forest trees the oak and the wych-elm are most frequent in the west of the department, the beech and the fir in the Vosges. The French school of forestry has its seat at Nancy. The salt-workings (the chief of which lie between Nancy and St Nicolas,) and the iron-mines (round Nancy and Longwy) of Meurthe-et-Moselle are the most productive in France. Other important industries are the manufacture of boots and shoes, straw and felt hats, pottery, and tanning and brewing (at Tantonville). Cotton and wool spinning, and the manufacture of cotton goods, hosiery, embroidery, chemicals (at Dombasle, close to Nancy), soap, tobacco, matches, crystal (at Baccarat, which has a population of 5617), mirrors (Cirey), glass, army clothing and paper may also be mentioned. The department is served by the Eastern railway, the chief line being that from Paris to Strassburg through Nancy. The main waterway is formed by the canal between the Marne and the Rhine. This canal communicates with the Moselle, which is navigable from Frouard downwards, and with the Eastern canal, which unites the Meuse and the Moselle with the Saône and the Rhone. The department constitutes the diocese of Nancy, has its court of appeal at Nancy, and forms a part of the district of the VI. army corps (Châlons-sur-Marne), and of the académie (educational division) of Nancy. There are 4 arrondissements (Nancy, Briey, Lunéville and Toul), 29 cantons and 598 communes. The principal towns of the department are Nancy, the capital, Lunéville, Toul, Longwy, Pont-à-Mousson and St Nicolas. Other places of interest are Prény, with ruins of an important stronghold (12th and 13th centuries) of the dukes of Lorraine; and Vaudémont, seat of a famous countship, with ruins of a stronghold of the 12th and 14th centuries.

MEUSE (Flem. *Maes*, Du. *Maas*), a river rising at Pouilly, in the department of Haute Marne, France. After passing through a great part of Belgium and Holland it flows into the Waal channel of the Rhine at Fort Loevenstein. A few miles below Gorinchem the Meuse, or Waal as it is then called, divides into two branches. The northern flows almost due west, and joins the Lek (Rhine) above Rotterdam, and enters the North Sea at the Hook of Holland. Ocean-going steamers for Rotterdam use, however, the New Waterway (*Nieuwe Waterweg*), a little north of the Meuse. The southern branch turns south, crosses the marsh of Biesbosch by the canalized channel of New Merwede, enters the Hollandsch Diep, and reaches the sea by the arms called Haringvliet and Krammer.

The length of the Meuse is nearly 560 m., of which 360 are navigable, and probably its traffic is only exceeded by that of the Rhine. Near Bazeilles it disappears under ground for a distance of over 3 m. The Chiers, the Semois, the Lesse, the Sambre, the Ourthe and the Roer are its most important tributaries. In Belgium it is canalized between Liége and Vise, and the Dutch are engaged on the same operation below Maestricht. The principal towns on the Meuse are: in France, Verdun, Sêdan, Mézières and Givet; in Belgium, Dinant, Namur, Huy, Liége and Maeseyck; in Holland, Maestricht, Roermond, Venlo, Dordrecht and Rotterdam.

MEUSE, a department of north-eastern France, formed out of a part of Lorraine (portions of the Three Bishoprics, and the Barrois and Clermontais) and Champagne. Pop. (1906), 280,220. Area, 2409 sq. m. It is bounded N. by Belgium and the department of Ardennes, E. by that of Meurthe-et-Moselle, S. by those of Vosges and Haute-Marne, and W. by those of Marne and Ardennes. About one-half belongs to the basin of the river Meuse, which is enclosed on the west by the wooded region of Argonne, on the east by the hills known as the Côtes de Meuse. On the north-east it is watered by the Orne, a tributary of the Moselle, and the Chiers, which runs by Montmédy to join the Meuse. The other half sends its waters to the Seine by the Aire, a tributary of the Aisne, both of which take their rise here, and by the Ornain, an affluent of the Saulx, the two last being tributary to the Marne. The highest elevation (1388 ft.) occurs to the south-west, on the line of the ridge which separates the basin of the Meuse from that of the Seine. The heights gradually sink from south to north, but seldom fall below 1000 ft. The hills of the Argonne similarly sink rapidly down to the valley of the Saulx, where the lowest level of the department (377 ft.) is reached. Its winters are less severe than those of the Vosges, but it is not so temperate as the Seine region. The average annual rainfall is about 30 in. The chief crops of the department are wheat, oats, rye, barley, clover, potatoes and mangel-wurzels. The vine is cultivated to some extent, the best growths being those of Bar. The forests, occupying more than a quarter of the area, are principally of oak, and are rich in game, as are the rivers in fish. Basket-making is prosecuted in the Argonne. The mineral wealth of the department includes good freestone (Euville, Lérouville). It has iron and steel works, wire-works, and manufactories of files, hardware and edge tools. Ligny-en-Barrois (pop. 4879) manufactures scientific instruments. There are cotton-spinning, wool-weaving, and hemp, flax and jute factories, saw-mills, carriage works, leather manufactures, glassworks, paper-mills, distilleries and flour-mills. The department is served by the Eastern railway, the principal lines being that from Paris to Strassburg through Bar-le-Duc and Commercy, that from Paris to Metz through Verdun, and the branch line of the Meuse valley. The chief waterways are the canal connecting the Marne with the Rhine and the Eastern canal along the Meuse valley; the two together have a length of 145 miles. Ecclesiastically the department forms the diocese of Verdun; it has its court of appeal at Nancy, and constitutes part of the district of the army corps of Châlons-sur-Marne, and of the educational division of Nancy. There are 4 arrondissements—Bar-le-Duc, Commercy, Montmédy and Verdun—28 cantons and 586 communes. The principal places in the department are Bar-le-Duc, the capital, Commercy, Verdun and St Mihiel, which receive separate treatment. Other places of interest are Avioth, which has a church of the 14th and 15th centuries with a beautiful chapel of the 15th century adjoining it, and Rembercourt-aux-Pots with a fine church of the 15th century.

MEUSE-LINE, the chain of French forts closing the passages of the Meuse between Verdun and Toul. The total length of the line is 31 m., and the *forts d'arrêt* are disposed along the right bank. The forts are: between Verdun and St Mihiel, Génicourt and Troyon; near St Mihiel, Les Paroches (left bank) and Camp des Romains; and near Commercy—Liouville St Agnant, Gironville and Jouy-sous-les-Côtes. Above the circle of the Toul defences there are barrier forts on the Upper Meuse at Pagny (la-Blanche-Côte) and near Neufchâteau; but these last are practically in second line, and between Toul and Épinal the frontier districts are designedly left open. At Épinal the "Moselle-Line" begins. These lines form part of the defensive scheme adopted by France in 1873–1875. Their general design is that of the French fort illustrated in FORTIFICATION AND SIEGECRAFT, fig. 43, though they are varied in accordance with the site.

MEVANIA (mod. *Bevagna*), an ancient town of Umbria, on the river Clitumnus and on the Via Flaminia, 8 m. W.S.W. of Forum Flaminii, and 5 m. W. of Fulginium (Foligno), 738 ft. above sea-level. There are remains of a temple near the north gate, and of an amphitheatre built into the modern houses. The walls, which have disappeared, were, according to Pliny (*Hist. Nat.* xxxv. 173), built of unbaked bricks. In 310 B.C. the consul Fabius broke the Umbrian forces here; but otherwise it is not mentioned until the 1st century A.D. In 69 the army of Vitellius awaited here the advance of Vespasian. Its pastures near the river and its white oxen are mentioned by Propertius, whose family belonged to Asisium (mod. Assisi) and after him by Silius Italicus, Lucan and Statius. The town was a *municipium*. The churches of S. Michele Arcangelo and S. Nicolo are Romanesque buildings of the 12th century.

MEW. (1) An imitative word, also spelled *miaou*, representing the cry of a cat or of sea-birds. The name mew, usually sea-mew, as applied to the *Larus canus*, or common sea-gull, is, according to Skeat, also imitative. As the name of the sea-bird it appears in Du. *meeuw*, Ger. *Möwe*, and other languages. (2) (Through Fr. *muer*, from Lat. *mutare*, to change), a term originally applied in French to the moulting of a hawk or falcon, and then to the caging of the bird during that period; thus "to mew up" has come to mean to confine. The English word chiefly survives in the plural form mews, applied to a stable-yard, coach-houses, stalls for horses, and living accommodation, found in narrow streets in large towns. This use was due to the Royal Mews at Charing Cross, where the royal hawks were kept from 1377 to 1537, when the building became the royal stables.

MEWS, PETER (1619–1706), English royalist and divine, was born at Caundle Purse in Dorset on the 25th of March 1619, and was educated at the Merchant Taylors' school, and at St John's College, Oxford, of which he was scholar and fellow. When the Civil War broke out in 1642 he joined the Royalist army, and, having been made a captain, was taken prisoner at Naseby; but he was soon released and in 1648 sought refuge in Holland. He became friendly with Charles I.'s secretary, Sir Edward Nicholas, and being skilful at disguising himself was very useful to the Royalists during the rule of Oliver Cromwell, undertaking two journeys to Scotland in 1653. Before this Mews had been ordained. Taking the degree of D.C.L. and regaining his fellowship at Oxford after the Restoration, he became archdeacon of Huntingdon, vicar of St Mary's, Reading, and chaplain to the king; then, having obtained two other livings, he was made canon of Windsor, canon of St David's, and archdeacon of Berkshire. In 1667, when at Breda arranging peace between England and Holland, he was chosen president of St John's College, Oxford, in succession to his father-in-law, Dr Richard Baylie, afterwards becoming vice-chancellor of the university and dean of Rochester. Appointed bishop of Bath and Wells in 1672, Mews resigned his presidency in 1673, and in 1684 he was elected bishop of Winchester, a position which this "old, honest cavalier," as Thomas Hearne calls him, filled until his death on the 9th of November 1706. The bishop is buried in Winchester cathedral. Mews lent his carriage horses to pull the cannon at a critical moment during the battle of Sedgemoor, where he was wounded whilst accompanying the royal army. He was, however, in sympathy with the seven bishops, and was only prevented by illness from attending their meeting; and as visitor of Magdalen College, Oxford, he supported the fellows in their resistance to James II., admitted their nominee, John Hough, to the presidency, and restored the ejected fellows in October 1688.

He took the oaths to William and Mary in 1689. In the absence of Compton, bishop of London, Mews took the chief part at the consecration of Tillotson as archbishop of Canterbury in 1691.

See S. H. Cassan, *Lives of the Bishops of Winchester* (1827); and the *Nicholas Papers*, edited by G. F. Warner (1886–1897).

MEXBOROUGH, an urban district in the West Riding of Yorkshire, England, on the Don, 11 m. N.E. of Sheffield on the Great Central and Midland railways. Pop. (1891), 7734; (1901), 10,430. The Don affords water communication with the Humber. The church of St John the Baptist has Early English portions. The large industrial population is mainly employed in glass, pottery and iron works, and in the neighbouring stone-quarries. The Castle Hill is crowned with some fine earthworks of uncertain date.

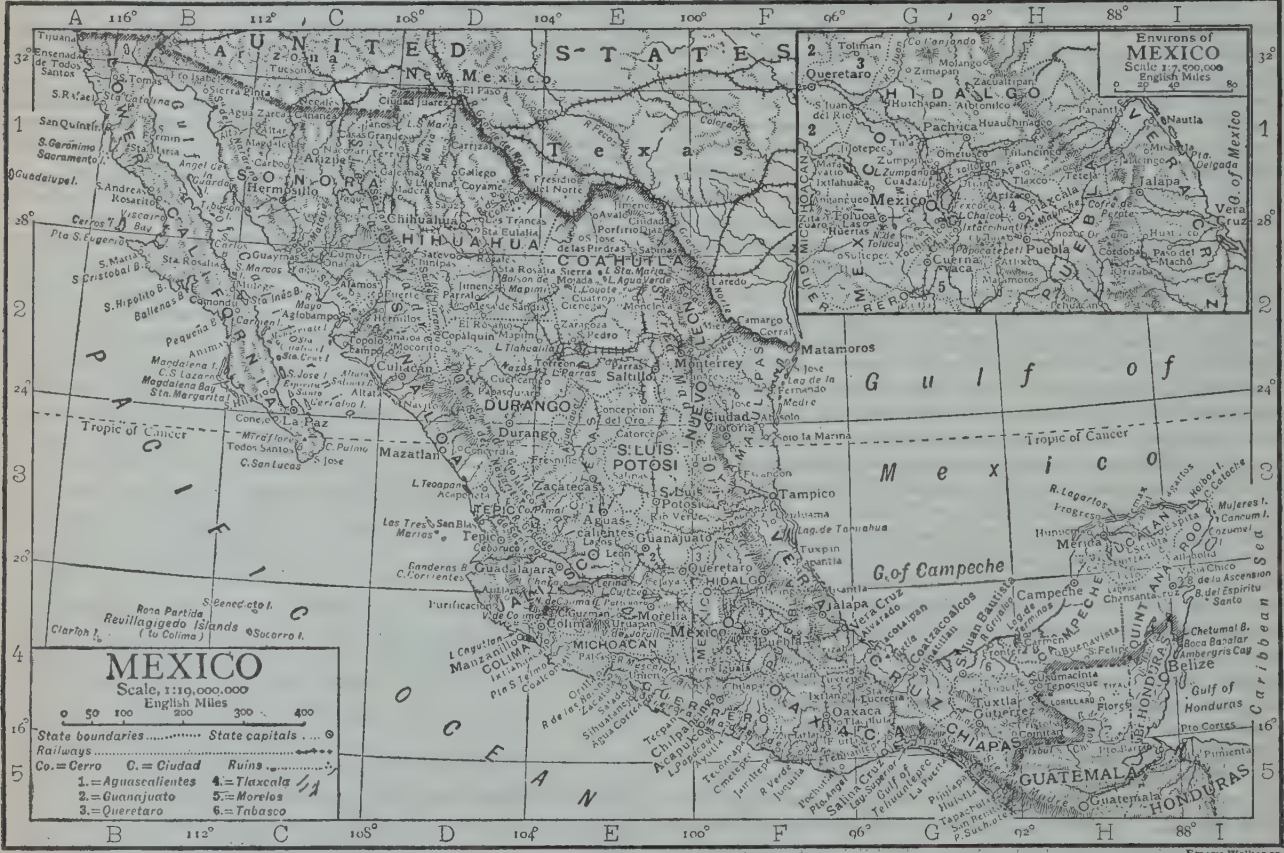
MEXICO (Span. *Méjico*, or *Mexico*,) officially styled *Estados Unidos Mexicanos* and *República Mexicana*, a federal republic of North America extending from the United States of America southward to Guatemala and British Honduras, and lying between the Pacific Ocean on the west and the Gulf of Mexico and Caribbean Sea on the east. Its northern boundary line was fixed by the Guadalupe-Hidalgo treaty of 1848 and the Gadsden treaty of 1853; it follows the Rio Grande del Norte from its mouth north-westward to lat. 31° 47′ N., thence on that parallel W. 100 m., thence S. to lat. 31° 20′ N., thence due W. to the 111th meridian, thence in a straight line (nearly W.N.W.) to a point on the Colorado river 20 m. below the mouth of the Gila river, thence northward to the mouth of the Gila, and thence, nearly due W., along the old line between Upper and Lower California to a point on the Pacific coast one marine league S. of the southernmost point of San Diego Bay; this line has a total length of 1810 m., of which the Rio Grande comprises 1136 and the land route 674 m. The boundary line with Guatemala, for a long time in dispute, was fixed by the treaties of 1882 and 1895. It is an arbitrary line and follows only two natural lines of demarcation—the Suchiate river from the Pacific coast to its source, and the Chixoy and Usumacinta rivers from near the 16th parallel N.W. to a point on the latter 25 kilometres, S. of Tenosique (Tabasco). Between these rivers the boundary line is determined by the peaks of Tacaná, Buenavista and Ixbul, and from the Usumacinta eastward it follows two parallels of latitude, one on the point of departure from that river, and the other, the longer, on that of 17° 49′ to the British Honduras frontier. The boundary with British Honduras was determined by a treaty of 1893 and is formed in great part by the Hondo river down to the head of Chetumal Bay, and thence through that bay to the Boca Bacalar Chica—the channel separating Yucatán from Ambergris Cay. Geographically, Mexico extends from 14° 30′ 42″ (the mouth of the Suchiate) to 32° 42′ N. lat., and from 86° 46′ 08″ to 117° 07′ 31″ W. long. Approximately its greatest length from N.W. to S.E. is 1900 m., its greatest width 750 m., and its least width a little short of 140 m. In outline it is sometimes compared to a huge cornucopia with its small end curving S.E. and N. The interior curve formed by the Gulf of Mexico is comparatively regular and has a coast-line of about 1400 m. The Caribbean coast-line is about 327 m. long, exclusive of indentations. The outer curve facing the Pacific is less regular, is deeply broken by the Gulf of California, and has a coast-line of 4574 m., including that of the Gulf. The peninsula of Lower California (*q.v.*) lies parallel with the mainland coast and extends southward to about 22° 52′N. lat., a distance of nearly 760 m. The area of Mexico is commonly given by English authorities as 767,005 sq. m., by German statisticians as 1,987,201 sq. kiloms. (767,290 sq. m.), and by H. H. Bancroft, who quotes official figures, as 1,962,899 sq. kiloms. (757,907 sq. m.).

Physiography.—The surface features consist of an immense elevated plateau with a chain of mountains on its eastern and western margins, which extends from the United States frontier southward to the Isthmus of Tehuantepec; a fringe of lowlands (*tierras calientes*) between the plateau and coast on either side; a detached, roughly mountainous section in the south-east, which belongs to the Central American Plateau, and a low sandy plain covering the greater part of the Isthmus of Yucatán. The peninsula of Lower California is traversed from north to south by a chain of barren mountains which covers the greater part of its surface. The slopes are precipitous on the east coast, but on the west they break down in hills and terraces to the Pacific. This range may be considered a southward continuation of the Californian Sierra Nevada. The great plateau of Mexico is very largely of volcanic origin. Its superstructure consists of igneous rocks of all descriptions with which the original valleys between its marginal ranges have been filled by volcanic action. The remains of transverse and other ranges are to be seen in the isolated ridges and peaks which rise above the level of the table-land, in some cases forming well-defined basins; otherwise the surface is singularly uniform in character and level. The two noteworthy depressions in its surface, the Valley of Mexico and Bolsón de Mapimí, once contained large bodies of water, of which only small lakes and marshy lagoons now remain. The highest part of this great plateau is to be found in the states of Mexico and Puebla, where the general elevation is about 8000 ft. Southward the slope is broken into small basins and terraces by transverse ranges, and is comparatively abrupt. Northward the slope is gentle, and is broken by several transverse ridges. At Ciudad Juarez (adjoining El Paso, Texas), on the northern frontier, the elevation is 3600 ft., which shows a slope of only 4½ ft. to the mile. Less is definitely known of the elevated regions of Chiapas, on the border of Guatemala, which are separated from the great Mexican Plateau by the low Isthmus of Tehuantepec (718 ft. at the highest point of the transisthmian railway), but their general elevation is much lower, and they are broken by wooded sierras and eroded by water-courses.

The mountain ranges which form part of the great Mexican Plateau consist of two marginal chains known as the Sierra Madre Occidental, on the west, the Sierra Madre Oriental, on the east, and a broken, weakly-defined chain of transverse ranges and ridges between the 18th and 20th parallels known as the Cordillera de Anáhuac. All these chains are known locally under diverse names. The Sierra Madre Occidental consists of several parallel ranges in the north, where a broad belt of country is covered with a labyrinth of ridges and valleys. The most eastern of these are known as the Sierra Tarahumare and Sierra del Durango, and the most western as the Sierra del Nazareno, Sierra Yaqui and Sierra Fuerte. These converge in southern Sinaloa and Durango to form the Sierra de Nayarit. Near the 20th parallel the great chain again divides, the eastern part crossing the southern end of the plateau, and the western, or Sierra Madre del Sur, following the shore line closely to Tehuantepec. The Sierra Madre Occidental has but few noteworthy elevations, its culminating points being the Nevado de Colima (14,363 ft.) and Volcán de Colima (12,750 ft.) in the state of Jalisco. In the Sierra de Nayarit the Cerro Pimal rises to an elevation of 11,319 ft., and in the extreme south the Cerro del Leone to 10,302 ft. These sierras lying near the coast have an imposing appearance from the lowlands, but when seen from the plateau their general elevation is so dwarfed as to render them comparatively inconspicuous. The Sierra Madre Oriental consists of a broken chain of ranges extending along the eastern margin of the plateau from the great bend in the Rio Grande south-eastward to about the 19th parallel. In the north these ranges are low and offer no great impediment to railroad building. South of Tampico, however, they are concentrated in a single lofty range. This range extends south-eastward along the western frontier of Vera Cruz (state) and includes the snow-capped cone of Orizaba or Citlaltepetl (18,209 ft.), and the Cofre de Perote, or Nanchampapetl (13,419 ft.). The eastern slopes are abrupt and difficult, and are a serious impediment to communication with the coast. Rising from the open plateau half way between this range and the city of Mexico is the isolated cone of Malinche, or Malintzin (14,636 ft.). Crossing the highest part of the Mexican Plateau is a broken series of ranges, which form the water-parting between its northern and southern slopes. To a part of these ranges has been given the name of Cordillera de Anáhuac, but there is no true cordillera across this part of Mexico. In a general sense these ranges may be considered part of the eastern branch of the Sierra Madre Occidental, which turns eastward on the 20th parallel and crosses the plateau in a south by east direction. Southward the plateau is traversed by many low ranges and breaks down in terraces, forming one of the most fertile and attractive parts of the republic. Close to the capital are the Sierra de Ajusco, whose highest point is 13,078 ft. above sea-level, the Nevado de Toluca (15,168 ft.), in a range which separates the valleys of Mexico and Toluca, the Montes de las Cruces, and that volcanic, spur-like range, running northward at right angles to the axis of the other ranges, whose culminating points, some 20 m. south-east of the city, are the gigantic, snow-clad volcanoes of Popocatepetl (Smoking Mountain) and Ixtaccihuatl (White Woman). Both of them are extinct and Popocatepetl no longer smokes. Their elevations, according to the Comisión Geográfica Exploradora, are 17,888 and 17,343 ft. respectively, that of Ixtaccihuatl being the highest of its three crests. This part of Mexico is highly volcanic in character, the transverse ridge just described having a large number of extinct volcanoes and at least three (Colima, Jorullo and Ceboruco) that are either active or semi-active. Colima was in a state of eruption as late as 1909, Jorullo (4262 ft.) is said to date from 1759, when its cone was formed, and Ceboruco (7100 ft.) in the territory of Tepic, shows occasional signs of activity. Near the coast in the state of Vera Cruz is San Martin, or Tuxtla (9708 ft.), which has been quiescent since its violent eruption of the 2nd of March 1793. Orizaba is sometimes included among the semi-active volcanoes, but this is a mistake. It has been quiescent since 1566, and is now completely extinct. Earthquakes are common throughout the greater part of the republic, especially on the western coast. They are most violent from San Blas southward to the Guatemala frontier, and some of the Spanish towns on or near this coast have suffered severely. Chilpancingo, in Guerrero, was badly shattered in 1902, and in 1907, and in 1909 was reduced to a mass of ruins. The earthquake shocks of the 30th and 31st of July 1909 were unusually severe throughout southern Mexico, reducing Acapulco and Chilpancingo to ruins and shaking the city of Mexico severely. In Acapulco a tidal wave followed the shock. Slight shocks, or *temblores*, are of almost daily occurrence. According to Humboldt's theory there is a deep rent in the earth's crust about the 19th parallel through which at different periods the underground fires have broken at various points between the Gulf of Mexico and the Revillagigedo Islands. "Only on the supposition that these volcanoes, which are on the surface connected by a skeleton of volcanic rocks, are also united under the surface by a chain of volcanic elements in continual activity, may we account for the earthquakes which in the direction mentioned cause the American continent, from the Gulf of Mexico to the Pacific Ocean, to oscillate at the same time" (*Egloffstein*, p. 37).

The lowland or *tierra caliente* region, which lies between the sierras and coast on both sides of Mexico, consists of a sandy zone of varying width along the shore-line, which is practically a tidewater plain broken by inland channels and lagoons, and a higher belt of land rising to an elevation of about 3000 ft. and formed in great part by the débris of the neighbouring mountain slopes. On the Pacific side there are places where the mountain spurs extend down to the coast, but in general this lowland region ranges from 30 to 40 m. in width, except in southern Vera Cruz, Tabasco, Campeche and Yucatán, where it extends farther into the interior. The talus zone of this region, especially at elevations of 1000 to 3000 ft., is noted for its great fertility and the luxuriance of its vegetation.

There are no large islands on the coast of Mexico, and most of the smaller ones are unimportant. Many of those that fringe the Gulf coast are sand-keys, or parts of a new coast formation. They are commonly barren and uninhabitable. The Isla del Cármen, which partly shuts in the Laguna de Términos (Campeche), is one of the largest of this class, and has the town and port of Cármen at its western extremity. On the northern coast of Yucatán is the small, inhabited island of Holbox or Holboy, and on the eastern coast the islands of Mujeres, Cancum and Cozumel, of which the first and last have a considerable population and good ports. On the Pacific coast there are a number of islands off the rocky shores of Lower California and in the Gulf of California—most of them barren and uninhabitable like the adjacent coast. The largest of these, some of them inhabited, are: Guadalupe—about 75 m. west of the coast on the 29th parallel, which is fertile and stocked with cattle; Cerros, off Viscaino Bay, and Santa Margarita, which partly shelters Magdalena Bay, on the Pacific side; and Angel de la Guarda, Tiburon, San Marcos, Cármen, Monserrate, Santa Catalina, Santa Cruz, San José, Espiritu Santo and Cerralvo in the Gulf. Lying off San Blas in the broad entrance to the Gulf are the Tres Marias, and directly west of Colima, to which it belongs, is the scattered volcanic group of Revillagigedo.



Emery Walker sc.

The peculiar surface formation of Mexico—a high plateau shut in by mountain barriers, and a narrow lowland region between it and the coast—does not permit the development of large river basins. Add to this the light rainfall on the plateau and a lack of forests, and we have conditions which make large rivers impossible. The hydrography of Mexico, therefore, is of the simplest description—a number of small streams flowing from the plateau or mountain slopes eastward to the Gulf of Mexico and westward to the Pacific. Most of these are little more than mountain torrents, but one has a course exceeding 500 m., and few have navigable channels. The principal watershed is formed by the sierras of the state of Mexico, from which streams flow north-east to the Gulf of Mexico, north-west to the Pacific and south-west to the same coast below its great eastward curve. The Rio Grande del Norte, or Rio Bravo, on the northern frontier, is practically an American river, as it rises in American territory and receives very little water from the Mexican side. Its larger Mexican tributaries are the Rio de los Conchos, Salado and Pesqueria. Of the Suchiate and Hondo, which form part of Mexico's southern boundary, the first is a short, impetuous mountain torrent flowing into the Pacific, and the other a sluggish lowland stream rising in north-eastern Guatemala and flowing north-east through a heavily forested region to Chetumal Bay. The peninsula of Yucatán has no rivers, and that of Lower California only a few insignificant streams in the north. This is due to the porosity of the soil in the former, and the very limited rainfall in the latter. The largest rivers of Mexico are: the Rio Grande de Santiago, called the Lerma above Lake Chapala, rising in the state of Mexico and flowing westward across Guanajuato, Jalisco and

Tepic to the Pacific coast, with a total length of 540 m., celebrated for its deep canyons and waterfalls; the Rio de las Balsas, or Mescala, which rises in Tlaxcala and flows south and west to the Pacific with a course of 426 m.; the Yaqui, which rises in western Chihuahua and, after breaking through the northern ranges of the Sierra Madre Occidental, flows south-westerly across Sonora to the Gulf of California, with a length of 390 m.; the Grijalva, also called the Chiapas on its upper course, which has its sources in the state of Chiapas and flows north-west and north across Tabasco to the Gulf of Mexico, with a total length of 350 m.; the Fuerte, which rises in southern Chihuahua and, after breaking through the sierras, flows south-west across Sinaloa to the Gulf of California, with a course of 340 m.; the Usumacinta, which is formed by the confluence of the Chixoy and Pasión on the east frontier of Chiapas, and flows north-west across Tabasco to the Grijalva, with a course of 330 m.; and the Pánuco, which has its source in the north-west of the state of Mexico and flows north-eastward to the Gulf of Mexico. The rivers of the Pacific coast have no navigable channels worth mentioning, but many on the Gulf coast are navigable for considerable distances. The more important of these are in Tabasco—the Grijalva, navigable for about 93 m., and the Usumacinta, for about 270 m. The country about the Laguna de Términos is low and flat, and is traversed in all directions by deep, sluggish streams. Many of the rivers crossing the lowlands bordering the Gulf have short navigable channels, the most important of which is the Pánuco and its tributaries. The Rio Grande is navigable for small vessels up to Matamoros (31 m.), and for smaller craft 65 m. farther. Nearly all the Gulf coast rivers, however, are obstructed by bars owing to the quantity of silt brought down from the sierras and the prevailing winds and currents on the coast.

The lakes of Mexico are small and few in number. They may be divided into two classes; those of the plateau region which occupy lacustrine depressions and receive the drainage of the surrounding country; and the tide-water lagoons of the coast formed by the building up of new sand beaches across the indentations in the coast-line. Of the former, the best known are the lakes of the Valley of Mexico—Texcoco, Chalco, Xochimilco, Zumpango, Xaltocán and San Cristobal—which are probably the remains of a lake once occupying the whole valley. They receive considerable surface drainage, but are slowly diminishing in area. Some of them, like Xochimilco, will eventually disappear. The largest, Texcoco, has an area of about 11½ sq. m. (30 sq. kiloms.), but it covered a much larger area at the time of the Spanish conquest. Its surroundings are bleak and sterile and its waters brackish and polluted with the drainage of the neighbouring city for nearly four centuries. The other lakes are wholly different in character and surroundings, especially Chalco and Xochimilco. Texcoco is now connected with the new drainage works of the capital and is no longer a menace to its population through inundations and pestilential fevers. Another group of lakes is to be found in the Laguna district of south-western Coahuila, where the Tlahualila, Mairan, Parras and others occupy a large lacustrine depression and receive the waters of the Nazas and Aguanaval rivers from the south-west (Durango). The size of this isolated drainage basin is very large, the Nazas River alone having a length of about 370 m. The great Mapimí desert of western Coahuila is another lacustrine depression, but only marshy lagoons remain. In eastern Coahuila, near Monclova, are the Agua Verde and Santa Maria lakes, and in eastern Chihuahua there is a similar group. The largest and most attractive of the plateau lakes is Chapala, in the state of Jalisco, about 80 m. long by 10–35 m. wide, which receives the waters of the Lerma and discharges into the Pacific through the Santiago. On the lower terraces of Michoacán are Patzcuaro and Cuitzéo lakes, and elsewhere among the sierras are numerous other small bodies of water. Among the tide-water lagoons, of which there are many along the Gulf coast, the best known are the Laguna de Términos in Campeche, Tamiahua in Vera Cruz, Madre (130 m. long), Pesquerias (21 m. long) and Chairel (near Tampico) in Tamaulipas. All these lagoons are navigable, and those of northern Vera Cruz and Tamaulipas, when connected and improved, will afford a safe inland route for some hundreds of miles along the coast. The north coast of Yucatán is remarkable for the extensive banks built up by the Gulf current from 5 to 7 m. from the shore-line. Inside the present sandy coast is a peculiar tide-water channel called the Rio Lagartos, which follows almost the whole northern shore, with occasional openings or *bocas*, connecting with the open sea. It is apparently of the same character as the lagoons of Tamaulipas. There are a number of these lagoons on the Pacific coast—such as Superior and Inferior near Salina Cruz, Papacayo, near Acapulco, Cayutlan, near Manzanillo, and Tecapan in Tepic—but they are usually shallow, sometimes swampy, and have no value for commerce.

There is a marked difference between the Gulf and Pacific coast-lines of Mexico in regard to their minor indentations and harbours. The south-west part of the Gulf of Mexico is called the Gulf of Campeche (Campeachy), but no distinction is necessary. This coast has no bays of importance, its rivers are obstructed by sand-bars, and it has only one natural harbour—that of Cármen and the Laguna de Términos, which has sufficient depth for the larger classes of vessels and is sheltered by the islands of Cármen and Puerto Real. Of the principal ports on this coast, Matamoros, Tampico, Tuxpan, Coatzacoalcos and Frontera are on rivers, which are obstructed by bars. Tampico and Coatzacoalcos, however, have been improved by breakwaters or jetties, and the deepening of the Channels across the bars, into safe and commodious harbours. Vera Cruz is an open anchorage inside a series of reefs which afford no protection to vessels from the "northers." A breakwater has remedied this defect and Vera Cruz is no longer considered a dangerous port. Campeche has a small artificial harbour, which is so silted up that vessels drawing 9 ft. must anchor 1 m. outside and larger vessels still farther away. Progreso, Yucatán, has only an open roadstead, and large vessels cannot approach its landing-place nearer than 6 m. On the east coast of Yucatán there are two deep, well-sheltered bays, Ascensión and Espiritu Santo, which afford good anchorages, and at the north end of the island of Cozumel the bay of Santa Maria offers an excellent harbour. The Pacific coast has several deep and well-sheltered bays; but they are separated from the interior by the rough and difficult ranges of the Sierra Madre Occidental. There are two large indentations of the coast—the Gulfs of Tehuantepec and California. The former is opposite the Gulf of Campeche, and possesses no distinguishing characteristic. The Gulf of California, on the other hand, penetrates the continent for a distance of 739 m., from south-east to north-west, with a maximum breadth of 190 m. Its area is usually restricted to the waters north of the latitude of Cape San Lucas, but it should be extended to the outer waters enclosed by a line from Cape San Lucas to Cape Corrientes. Its upper waters are not much navigated because of the aridity of its coasts, but there are two or three important ports towards the south. The Gulf has a considerable number of islands, most of them near the peninsular coast, and several deep, well-protected bays—those of La Paz and Santa Inés in Lower California, Guaymas in Sonora, Agiobampo, Topolobampo and Altata Salinas in Sinaloa. On the Pacific coast of Lower California are the Ensenada de Todos Santos and the bays of San Quentin, Viscaino and Magdalena. The principal bays on the mainland coast are Olas Atlas, which is the harbour of Mazatlán, San Blas, Banderas, Manzanillo, Acapulco, Salina Cruz and Tonalá. Several of these are being improved.

[*Geology*.—By far the greater part of Mexico is covered by deposits of Cretaceous and later date, the pre-Cretaceous rocks occurring only in comparatively small and isolated patches. At the southern extremity of the great table-land, however, in the state of Puebla, there is a considerable mass of crystalline rocks which is believed to be of Archaean age. Similar rocks occur also in Chiapas, Oaxaca, Guerrero and elsewhere; but owing to the absence of any early fossiliferous deposits, the age of these rocks is very uncertain. Silurian and Devonian fossils have been reported at one or two localities, but for the present the observations are open to doubt. The earliest fossiliferous beds which have been proved to exist in Mexico belong to the Carboniferous system. They are found on the borders of Guatemala and consist of limestones and dolomites with Productus.

The Mesozoic beds are of greater importance. The Triassic and Jurassic systems are met with only in scattered patches. The former consists of sandstones and clays, and the fossils found in them are chiefly plants, including *Gangamopteris* and *Macrotaeniopteris*, two characteristic genera of the Indian Gondwana system. The Jurassic beds are marls, sandstones and limestones, which contain marine fossils. The Cretaceous rocks take a far larger share in the formation of the country. They form the greater part of the Sierra Madre Oriental and also cover most of the central plateau. They contain many fossils, including Hippurites and Ammonites. The sedimentary deposits of the Tertiary era do not occupy a very wide area. They occur, however, along the coasts, where they are marine, and also on the central plateau, where they are of lacustrine origin. But by far the most important of the Tertiary rocks are the volcanic lavas, agglomerates and ashes, which cover so much of the country. It is in the western half of Mexico that they are most fully developed, but towards the southern extremity of the plateau they spread nearly to the eastern coast. The eruptions are said to have begun with the ejection of syenites, diorites and diabases, which probably took place at the close of the Cretaceous or the beginning of the Eocene period. In the Miocene period andesites of various kinds were erupted, while at the close of the Pliocene began the great eruptions of basalt which reached their maximum in Quaternary times and continue to the present day.[1] (P. La.)]

Climate.—Mexico stretches across 17 parallels of latitude, with the Tropic of Cancer crossing her territory about midway. This implies tropical and sub-tropical conditions. The relief of the land and varying degrees of rainfall and vegetation, however, serve to modify these conditions in many important particulars. The elevation and extent of the great central plateau, which penetrates deeply into the tropical half of the country, carry with them temperate and sub-tropical conditions over much the greater part of the republic. Above the plateau rise the marginal sierras, while a few isolated peaks in the region of perpetual snow give to Mexico a considerable area of cold temperate and a trace of arctic conditions. Descending to the lowlands on either side of the plateau, the temperature rises steadily until the upper limit of the tropical region, called *tierras calientes*, is reached, where the climate is hot, humid and unhealthy, as elsewhere in the forested coastal plains of tropical America.

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[1] See J. G. Aguilera, *Sinopsis de geologia mexicana*; "Bosquejo geológico de México," segunda parte, Bol. inst. geol., Mexico, Nos. 4–6 (1897), pp. 189–270, with map—a summary of this paper will be found in *Science Progress*, new series (1897), vol. i. pp. 609–615. See also the *Livret-guide* of the Tenth Cong. Géol. Internat. (1906).

The *tierras calientes* (hot lands) of Mexico include the two coastal zones, the Isthmus of Tehuantepec, the states of Tabasco, Campeche, and part of Chiapas, the peninsula of Yucatán and a part of eastern Oaxaca. The mean temperature ranges from 77° to 82° F., seldom falling below 60°, but often rising to 105°, and in the sultry districts of Vera Cruz, Guaymas and Acapulco to and even above 110°. The rainfall is heavy in the south, except Yucatán, but diminishes gradually toward the north, until on the Pacific and Gulf of California coasts it almost disappears. These lowland districts are densely forested in the south, except Yucatán, and large areas are covered with streams, swamps and lagoons, the abode of noxious insects, pestilential fevers and dysentery. On both coasts yellow fever epidemics appear at frequent intervals. The great fertility of these regions and the marvellous wealth of their forests are irresistible attractions to industrial and commercial enterprise, but their unhealthiness restricts development and is a bar to any satisfactory increase in population. The heavy rainfall on the Gulf coast, however, which reaches a maximum of 90 to 100 in. in the Huatusco district of Vera Cruz, causes the flooding of large areas of lowlands, and will make improvement very difficult. The peninsula of Yucatán, whose general level does not rise above 130 to 200 ft. above the sea, consists almost wholly of an open, dry, calcareous plain. The temperature ranges from 66° to 89°, but the heat is tempered by the cool sea-breezes which sweep unobstructed across its plains. The rainfall is abundant in the rainy season, but in the long dry season it is extremely rare. In the wet season the rain is quickly absorbed by the dry, porous soil; consequently there are no rivers and no lakes except near the forested region of the south-east. These exceptional conditions give to Yucatán a moderately hot, dry, and comparatively healthful climate. Another hot, dry climate is that of the *tierras calientes* of Sonora. The coast is low and extremely arid, and would be uninhabitable were it not for the proximity of the Sierra Madre, where a light rainfall is experienced, and for the numerous rivers that cross the arid belt between the mountains and the sea. The maximum temperatures in this region are 98° at Hermosillo and 119° at Guaymas.

To a large extent the climate of Mexico is determined by vertical zones. According to H. H. Bancroft (*Resources of Mexico*, pp. 3–4), the *tierras calientes*, which include a coastal zone 30 to 40 m. wide and the low-lying states already mentioned, rise from sea-level to an elevation of 3280 ft. The *tierra templada*, or sub-tropical zone, rises to an elevation of 5577 ft., and comprises "the greater portions of Coahuila, Nuevo León, San Luis Potosí, nearly half of Tamaulipas, a small part of Vera Cruz, nearly the whole of Chiapas, nearly all of Oaxaca, a large portion of Guerrero, Jalisco, Sinaloa and Sonora," together with small parts of the inland states of Puebla, Mexico, Morelos and Michoacán. The mean annual temperature is about 75°. Above this is the *tierra fria*, which ranges from 5577 to 8200 ft., and includes all the higher portions of the Mexican plateau, and which corresponds to the temperate regions of Central United States where frosts are very rarely experienced. Even here the high sun temperatures give a sub-tropical character to the country. In the sierras, above the *tierras frias*, which are not "cold lands" at all, are the colder climates of the temperate zone, suitable for cereals, grazing and forest industries, and, farther up, the isolated peaks which rise into the regions of snow and ice.

Speaking generally, the four seasons are clearly marked north of lat. 28° N. only. South of that parallel they merge in the *estación de las aguas*, or rainy season, from May to October, and the *estación seca*, or dry season, which prevails for the rest of the year. The rains generally begin on the east coast and gradually move northwards. The windward slopes of the Sierra Madre Oriental receive the greater part of the rainfall, and the winds, deprived of their moisture, pass over the northern plateau without further precipitation. On the Pacific coast the belt of calms, known as the northern horse latitudes, crosses the northern parts of Lower California and Sonora, which accounts for their extreme aridity. The southern terraces of the plateau have no high mountain barriers between them and the moist winds of the Caribbean, and they too receive an abundant rainfall in the wet season, especially during the prevalence of heavy "northers" on the Gulf coast. The precipitation varies widely, that of the western side of the northern plateau (Chihuahua and Durango) being about 39 in., that of the Valley of Mexico about 25 in., and that of the whole republic 59 in. Long droughts are common in many parts of the country, and on the barren surfaces of the plateau the rains drain away rapidly, leaving but slight beneficial results.

Flora and Fauna.—The types of animal and vegetable life found in Mexico belong, in a general sense, to those of the northern temperate region, and those of the tropical regions of Central and South America. The great central plateau and its bordering lowlands form an intermediate territory in which these dissimilar types are found side by side, the tropical species extending northward along the coast to the United States, while the northern species have found their way to the southern limits of the plateau. The jaguar and puma have found their way into the United States, while the wolf, coyote, bear and beaver have gone far southward on the plateau, and the buffalo was once found in large numbers on its more favoured northern plains. This intermingling of types does not apply to south-eastern Mexico, where animal life is represented by many of the genera and species found in the forested lowlands of the great Amazon basin.

Aside from its origin, the fauna of Mexico includes at least five species of monkey, the jaguar, puma, ocelot (*Felis pardalis*), wolf, coyote, lynx, badger, otter (*Lutra felina*), beaver, muskrat, bear, raccoon (*Procyon*), coati (*Nasua*), tapir, two species of peccary (*Dicotyles torquatus* and *D. labiatus*), skunk (*Mephitis*, *Spilogale* and *Conepatus*), marten, several species of opossum (including a pigmy species of the Tres Marias islands), sloth, two species of ant-bear (*Myrmecophaga tetradactylus* and *Cyclothurus didactylus*), armadillo (*Dasypus novemcinctus*), a small arboreal porcupine (*Synetheres mexicanus*), the kinkajou (*Cercoleptes caudivolvulus*), three species of deer—the white-tailed *Cariacus toltecus*, the little black-faced brocket, *Coassus rufinus*, which is also found in Brazil, and the Sonora deer (*Odocoileus couesi*)—the Mexican bighorn (*Ovis mexicanus*) of Chihuahua, at least two species of hare (*Lepus calotis* and *L. palustris*), rabbits, black, gray, red and ground squirrels, gophers, and many small rodents. Alligators and crocodiles are numerous in the lagoons and rivers of the coast and the iguana is to be found everywhere throughout the tropical lowlands, the large black *Ctenosura acanthinurus* being partly arboreal in habit when full grown. Mexico is a paradise of lizards, which are noted for their diversity in form as well as for their remarkable colouration. Frogs and toads are represented by scores of species, some of which, *e.g.* the tree-frogs (*Hylidae*), are extremely interesting. The ophidians are also very numerous, ranging from the comparatively harmless boa-constrictor to the deadly "palanca" or "fer de lance" (*Lachesis lanceolatus*) and rattlesnake (*Crotalus*), of which there are several species. In southern Mexico in 1902 and 1904 Hans Gadow collected specimens of 44 different kinds of snakes, which he estimated to be only about 45% of the species in the states visited. The arboreal life of the tropical forests has developed the tree-climbing habit among snakes as well as among frogs and toads, and also the habit of mimicry, their colour being in harmony with the foliage or bark of the trees which form their "hunting-grounds." Bats are numerous, both in species and individuals. The sanguinary vampire (*Desmodus rufus*) has an extensive range through the *tierras calientes* and *tierras templadas* of the southern states. The coasts of Mexico, together with their accessible lagoons and rivers, afford innumerable breeding-places for turtles, which include the large green and tortoise-shell species. In some places the capture of the latter is the source of a considerable export trade in tortoise-shell. The coast of Lower California is a favourite resort for the fur-bearing seal, and pearl oysters find a congenial habitat in the south waters of the Gulf. There are some good fishing-grounds on the coasts, but fishing as an organized industry does not exist. The inland waters, with the exception of Lake Chapala, have comparatively few species, but the government has introduced carp, brook-trout and salmon-trout.

The avifauna of Mexico includes most of the species of the tropical and temperate regions of America—such as parrots (chiefly the yellow-headed *Chrysotis*), parakeets (*Conurus canicula*), macaws (*Ara macao* and *A. militaris*), toucans, trogons, herons, egrets, ibis, spoonbills, boat-bills (*Cancroma*), ducks, pelicans, cormorants, bitterns, stilts, sandpipers, curlews, grackles, kingfishers, motmots, "Chachalacas" (*Ortalida poliocephala*), woodpeckers, jays, cuckoos, "garrapateros" (*Crotophaga sulcirostris*), the ingenious weaver-bird (*Icterus*), and another species (*Cassicus*), whose curiously woven, sack-like nests are suspended from the slender limbs of trees, and sometimes even from telegraph-wires, scarlet-crested fly-catchers (*Muscivora mexicana*), tanagers, mocking-birds (called "zenzontl"), turkeys, partridge, quail (*Colinus*, *Lophortyx*, *Callipepla* and *Cyrtonyx*), doves, pigeons, eagles, caracara hawks (*Polyborus*), fish-hawks, falcons, crows, and turkey-buzzards (both the red-faced "aura" of North America and the black-faced "zopilote" of the tropics), which are the scavengers of the country. The most numerous, perhaps, are the humming-birds, of which there are many genera and species, each one distinct in form and colour. They are called "huitzilin" (spikelet) by the Aztecs, and "colibrí," "chupaflor" and "chupa-miel" (flower- or honey-sucker), and "pájaro-mosca" (fly-bird) by the Spanish-speaking Mexicans. These descriptive names are highly poetic, as also that of the Portuguese, "beija-flor" (flower-kisser); but the humming-bird is insectivorous, and thrusts his long bill into flowers in search of insects instead of honey. Mexico is credited with a great variety of song-birds, but these are to be found chiefly in the partly-forested country of the *tierras templadas* and *tierras frias*. Her chief distinction, however, is in birds of varied and gorgeous feathering. The wonderful plumage of the "quetzal" (*Trogon resplendens*) was, it is said, reserved by the Aztec rulers for their own exclusive use. Of the indigenous birds, the turkey has been fully domesticated, and the musk-duck and "chachalaca" are easily reared. Sea-fowl are most numerous on the coasts of Lower California, where certain islands in the arid belt are frequented at night by countless numbers of them. It should be added that many of the migrating birds of North America pass the winter in Mexico.

The insect fauna of Mexico covers a very wide range of genera and species which, like the other forms of animal life, is largely made up of migratory types. No complete study has ever been made of this fauna, but much has been, and is being done by the U.S. Biological Survey and Plant Industry Bureau. To the traveller, the most conspicuous among the Mexican insects, perhaps, are the butterflies, beetles, ants and the myriads of mosquitoes, midges, fleas and chinches. Among the mosquitoes, which are extraordinarily numerous in some of the hot lowland districts, are the species credited with the spread of malarial and yellow fevers. The midges are even more numerous than the mosquitoes. In pleasing contrast to such pests are the butterflies of all sizes and colours, beetles of an inconceivable variety of size, shape and colouration, and ants of widely dissimilar appearance and habits. An interesting species of the last is the leaf-cutting ant (*Eciton*) which lives in large underground colonies and feeds upon a fungus produced by leaf-cuttings stored in subterranean passages to promote fermentation. These ants will strip a tree in a few hours and are very destructive to fruit plantations. Some of the native trees have developed ingenious methods of defence, one of which is that of attracting small colonies of another species to drive away the marauders. Most destructive, also, are the termites or white ants, whose ravages are to be seen in the crumbling woodwork and furniture of all habitations in the hot zones. Some species build their nests in trees—great globular masses sometimes three feet in diameter, supported on the larger branches, and connected with the ground by covered passages on the outside of the tree. These insects are blind and avoid the light. Bees find a highly congenial habitat in Mexico, and some honey is exported. Spiders are also represented by a large number of genera and species, the most dreaded being the venomous "tarantula" and the savage "mygale."

Few countries, if any, can present so great a diversity in plant life as Mexico. This is due not only to its geographical position and its vertical climatic zones, which give it a range from tropical to arctic types, but also to its peculiar combination of humid and arid conditions in which we find an extensive barren table-land interposed between two tropical forested coastal zones. These widely divergent conditions give to Mexico a flora that includes the genera and species characteristic of nearly all the zones of plant life on the western continents—the tropical jungle of the humid coastal plains with its rare cabinet-woods, dye-woods, lianas and palms; the semi-tropical and temperate mountain slopes where oak forests are to be found and wheat supplants cotton and sugar-cane; and above these the region of pine forests and pasture lands. Then, there are the mangrove-fringed coasts and the dripping wooded slopes where rare orchids thrive, and above these, on the inland side of the sierra, a treeless, sun-scorched table-land where only the cactus, yucca, and other coarse vegetation of the desert can thrive without irrigation.

For convenience of description, the flora of Mexico may be divided into four great divisions: that of the comparatively barren plateau and the arid coast regions, the humid *tierras calientes*, the intermediate *tierras templadas* and *tierras frias*, and the higher regions of the sierras. The line of demarcation cannot be very sharply drawn, as the zones everywhere overlap each other and local climatic conditions greatly modify plant types. In general, the aspect of the great central plateau north of the Anáhuac sierras is that of a dusty, treeless plain. There is but little natural vegetation to be seen—ragged yucca trees, many species of agave and cactus, scrubby mesquite bushes, sage bushes and occasional clumps of coarse grasses. The rainy season completely changes the appearance of these plains, new grass appears, and wheat and Indian corn are cultivated. The rains do not last long, however, and sometimes fail altogether. The most common plants of the Mexican plateau are the agaves, yuccas and cacti, each of which is represented by a number of species. The first is chiefly known in the south by the "magueys," from which the national drinks "pulque" and "mescal" are extracted. There is some confusion in the specific names of these agaves; the "pulque"-producing plant is usually described as the *Agave americana*, though *A. atrovirens* and several others are also credited with the product. The mescal-producing magueys have a thinner leaf and are not cultivated, with the exception of the species producing the "tequila" mescal. The chief value of the agaves, however, is in their fibres, of which a great variety is produced. The principal plateau agaves producing fibre are the *A. lechuguilla* and *A. lophantha* and *A. univittata* of the Jaumave Valley, Tamaulipas, which furnish what may be termed the genuine ixtle fibre. The "tapemete" fibre of western Mexico is credited by Mr E. W. Nelson to the *A. vivipara*, which is found chiefly in the warmer and lower elevations of the Pacific slope. There are many other fibre-producing agaves, including some of those from which pulque is derived. The cactus is unquestionably the characteristic plant of Mexico. About one thousand species have been described, a very large percentage of which are to be found on the Mexican plateau.

Explorations by botanists of the United States Department of Agriculture have been made in many localities, in Jalisco, Zacatecas, Michoacán and Tamaulipas, but many years must elapse before the whole ground can be covered. In central and southern Mexico the mountain slopes are forested up to 12,500 to 13,500 ft., juniper bushes continuing up to 14,000 ft. The forests consist of several species of evergreen and deciduous oaks, "oyamel" (*Abies religiosa*), the arbutus or strawberry tree, the long-leaved *Pinus liophylla* and the short-leaved "ocote" or *Pinus montezumae* and the alder, with an undergrowth of elder (*Sambucus mexicana*), broom and shrubby heath. In the Southern Sierra Madre, the "oyamel" and "ocote" pine are the giants of the forest, sometimes rising to a height of 100 ft. Oaks are to be found over a wide area and at lower elevations of the sub-tropical zone as well. They are represented by a number of species, and are called "roble" and "encina" by the natives.

In the intermediate zones between the higher sierras and the *tierras calientes* the flora is very largely composed of species characteristic of the bordering hot and cold regions. Oaks are everywhere common and the "ocote" pine on the Gulf coast is found as far down as 6300 ft. In southern Mexico the pine is found at even lower elevations where the tropical growth has been destroyed by cultivation and fire. The lower slopes of the sierras, especially those of southern Mexico, are well forested and include an immense number of species. The most common families on the eastern slopes, where the precipitation is heavy, are the magnolias, crotons, mimosas, acacias, myrtles, oaks, plane-trees and bamboos. Palms are common, the chestnut abounds in many places, the cacti are almost as numerous as on the open plateau. On the southern slopes of the Ajusco and other sierras considerable forests of the "ahuehuete" or cypress (*Taxodium distichum*) are to be found. The "higuerilla" or castor-oil plant (*Ricinus communis*) is widely distributed throughout the plateau and the open plains of the lower zones. In some localities the characteristic types of the two climatic extremes, the palm and the pine, are to be found growing side by side.

No brief description can adequately portray the marvellous variety and magnificence of the flora of the *tierras calientes*. Its forests are not composed of one or a few dominating species, as in the cold temperate zone, but of countless genera and species closely interwoven together—a confused mass of giant trees, lianas and epiphytes struggling to reach the sunlight. This struggle for existence has completely changed the habits of some plants, turning the palm and the cactus into climbers, and even some normal species into epiphytes. Among the more important and conspicuous trees of these tropical forests are mahogany, rosewood, Spanish cedar (*Cedrela*), cassias, ceibas (*Bombax*), rubber (*Castilloa*), palms of many species including the oil-producing *Attalea* of Manzanillo and *Acrocomia* of Acapulco, guayacan (*Guaiacum*), logwood (*Haematoxylon campechianum*), brazilwood (*H. boreale*) which should not be confounded with the Brazilian *Caesalpinia*, palo blanco (*Lysiloma candida*), the cascalote and divi-divi trees (*Caesalpinia Cacalaco* and *C. coriaria*), the "zapote chico" (*Achras sapota*) from which chicle is extracted, "zapote prieto" (*Diospyros ebenaster*), wild fig, myrtles, bamboos and many of the types already mentioned in connexion with the sub-tropical zone. Of the 114 species of trees and cabinet-woods, 17 of oil-bearing plants, and over 60 of medicinal plants and dyewoods indigenous to Mexico, by far the larger part are represented in the *tierras calientes*. Among the well-known forest products of this zone are arnotto, jalap, ipecacuanha, sarsaparilla, rubber, orchids and a great variety of gums.

Of the economic plants and products of Mexico, the list is surprisingly long and interesting. The cereals, fruits and vegetables of Europe have been introduced and some of them have done well. Wheat is widely cultivated and a considerable part of the population depend upon it for their bread. Indian corn, which is believed to have had its origin in Mexico, also provides food for a large part of the population. "Tunas" or cactus fruit, red peppers, "zapotes" (the fruit of various trees), "arrayan" (*Myrtus arayan*), "ciruelas" or Mexican plums (*Spondias*), guavas, "huamuchil" (*Pithecolobium dulce*), tamarinds, aguacates (*Persea gratissima*), bananas, plantains, pineapples, grapes, oranges, lemons, limes, granadillas, chirimoyas, mammees (*Mammea americana*), coco-nuts, cacao, mangoes, olives, gourds and melons, are among the fruits of the country, and rice, wheat, Indian corn, beans, yams, sweet potatoes, onions and "tomatoes" (*Physalis*) are among its better-known food products. The food of the common people is chiefly made up of Indian corn, beans, red peppers and "tomatoes." There are about 50 known species of beans (*Phaseolus*) in Mexico and Central America, and probably a dozen species of red peppers (*Capsicum*) which are used both in seasoning and in making chili sauce. The "tomato" or "tomatillo" mentioned, is the fruit of the *Physalis ixocarpa*, sometimes called the "strawberry tomato" and the "Mexican ground-cherry," which is used with red peppers to make chili sauce. The common potato (*Solanum tuberosum*), of which wild varieties are found, is not commonly used as a vegetable, but as a flavouring for soups and other dishes. Among other economic plants are the fibre-producing agaves, the best known of which is the *A. rigida* var. *elongata* which produces the "henequen" fibre, or sisal hemp, of Yucatán, silk or tree-cotton (*Ceiba casearia*), sugar-cane, cotton (*Gossypium*), indigo and "canaigre" (*Rumex hymenosepalus*) whose root contains a large percentage of tannin.

Mexico has suffered much from the reckless destruction of her forests, not only for industrial purposes but through the careless burning of grassy areas. The denuded mountain slopes and plateaus of southern Mexico are due to the prehistoric inhabitants who cleared away the tropical forest for their Indian corn fields, and then left them to the erosive action of the tropical rains and subsequent occupation by coarse grasses. Fire was generally used in clearing these lands, with the result that their arboreal vegetation was ultimately killed and their fertility destroyed. In the valleys of some of these denuded slopes oak and pine are succeeding the tropical species where fires have given them a chance to get a good foothold.

Population.—According to the census of 1900 the population of Mexico numbered 13,607,259, of which less than one-fifth (19%) were classed as whites, 38% as Indians, and 43% as mixed bloods. There were 57,507 foreign residents, including a few Chinese and Filipinos. Since then the Japanese have acquired an industrial footing in Mexico. Under the constitution of 1824 all race distinctions are abolished, and these diverse ethnic elements are nominally free and equal. For many years, however, the Indians remained in subjection and took no part in the political activities of their native country. Since about 1866, spurred on by the consciousness that one of their own race, Benito Juárez, had risen to the highest positions in the gift of the country, they have taken greater interest in public affairs and are already making their influence felt. In southern Mexico the Zapotecas furnish schoolmasters for the village schools. Peonage, however, is still prevalent on many of the larger estates, and serious cruelties are sometimes reported. The government itself must be held partly responsible, as for the transportation of the mountain-bred Yaquis to the low, tropical plains of Yucatán (see Herman Whitaker's *The Planter*, 1909), but the influence of three and a half centuries of slavery and peonage cannot be shaken off in a generation.

According to Humboldt, the census of 1810 gave a total population of 6,122,354, of which the whites had 18%, the mestizos 22% and the Indians 60%. The census of 1895 increased the whites to 22%, which was apparently an error, the mixed bloods to 47%, and reduced the Indians to 31%. It is probable that the returns have never been accurate in regard to the mixed bloods and Indians, but it is the general conclusion that the Indians have been decreasing in number, while the mixed bloods have been increasing. Neglect of their children, unsanitary habits and surroundings, tribal intermarriage and peonage are the principal causes of the decreasing Indian population. Recent observers, however, deny the assertion that the Indians are now decreasing in number except where local conditions are exceptionally unfavourable. The death rate among their children is estimated at an average of not less than 50%, which in families of five and six children, on an average, permits only a very small natural increase. The larger part of the population is to be found in the southern half of the republic, owing to the arid conditions prevailing in the north. The unhealthfulness of the coastal plains prevents their being thickly populated, although Vera Cruz and some other states return a large population. The most favourable regions are those of the *tierras templadas*, especially on the southern slopes of the great central plateau which were thickly populated in prehistoric times.

The dissimilar races that compose the population of Mexico have not been sufficiently fused to give a representative type, which, it may be assumed, will ultimately be that of the *mestizos*. Mexico was conquered by a small body of Spanish adventurers, whose success in despoiling the natives attracted thither a large number of their own people. The discovery of rich deposits of gold and silver, together with the coveted commercial products of the country, created an urgent demand for labourers and led to the enslavement of the natives. To protect these adventurers and to secure for itself the largest possible share in these new sources of wealth, the Spanish crown forbade the admission of foreigners into these colonies, and then harassed them with commercial and industrial restrictions, burdened them with taxes, strangled them with monopolies and even refused to permit the free emigration thither of Spaniards. Out of such adverse conditions has developed the present population of Mexico. It was not till after the middle of the 19th century that a long and desperate resistance to foreign intervention under the leadership of Benito Juárez infused new life into the masses and initiated the creation of a new nationality. Then came the long, firm rule of Porfirio Diaz, who first broke up the organizations of bandits that infested the country, and then sought to raise Mexico from the state of discredit and disorganization into which it had fallen. Suspicion and jealousy of the foreigner is disappearing, and habits of industry are displacing the indolence and lawlessness that were once universally prevalent.

The white race is of Spanish descent and has the characteristics common to other Spanish-American creoles. Their political record previous to the presidency of Porfirio Diaz was one of incessant revolutionary strife, in which the idle, unsettled half-breeds took no unwilling part. The Indian element in the population is made up of several distinct races—the Aztec or Mexican, Misteca-Zapoteca, Maya or Yucateco, Otomi or Othomi, and in smaller number the Totonac, Tarasco, Apache, Matlanzingo, Chontal, Mixe, Zoque, Guaicuro, Opata-Pima, Tapijulapa, Seri and Huavi. As the tendency among separated tribes of the same race is to develop dialects and as habitat and customs tend still further to differentiate them, it may be that some of these smaller families are branches of the others. In 1864 Don Manuel Orozco y Berra found no fewer than 51 distinct languages and 69 dialects among the Indian inhabitants of Mexico, to which he added 62 extinct idioms—making a total of 182 idioms, each representing a distinct tribe. Thirty-five of these languages, with 69 dialects, he succeeded in classifying under 11 linguistic families. A later investigator, Don Francisco Belmar (*Lenguas indigenas de Mexico*, Mexico, 1905), has been able to reduce these numerous idioms to a very few groups. None of them were written except through the use of ideographs, in the making of which the Aztecs used colours with much skill, while the Mayas used an abbreviated form, or symbols.

The Aztecs, who called themselves Mejica or Mexicans after they had established themselves on the high table-land of Mexico, belong to a very large family or group of tribes speaking a common idiom called Nahua or Nahóa. These Nahua-speaking tribes were called the Nahuatlaca, and compose a little more than one-fourth of the present Indian population. They inhabit the western Sierra Madre region from Sinaloa southward to Chiapas, the higher plateau states, which region was the centre of their empire when Cortés conquered them, and parts of Vera Cruz, Tabasco, Oaxaca, Morelos, Aguascalientes and San Luis Potosí. They were energetic and warlike and evidently had not reached the zenith of their power when Cortés came. They had been preceded on the same plateau by the Chichimecs, possibly of the same race, who were conquered by the Aztecs sometime in the 15th century after a supposed occupation of the territory about 400 years. The characteristic civilization of prehistoric Mexico, however, antedates both of these periods.

An Aboriginal race called the Toltecs is said to have occupied Vera Cruz and Tabasco and to have extended its empire westward on the plateau to and perhaps beyond the present capital. They were the builders of the pyramids of Cholula and Teotihuacan, near the city of Mexico, and of Papantla, Huatusco and Tuzapan, in Vera Cruz. One of their towns was Tollan (now Tula) 50 m. north of the national capital, and it is not improbable that the people of Cholula, Texcoco and Tlaxcala at the time of the Spanish invasion were occupying the sites of older Toltec towns. There has been much discussion in regard to the origin of the Toltecs, some assuming that they were a distinct race, and others that they belonged to the Nahuatlaca. Another and perhaps a better supposition is that they belonged to the Maya group, and represented a much earlier civilization than that of the builders of Palenque, Quirigua and Copan. Confirmatory evidence of this is to be found, not only in the character of their constructions, but in the circumstance that a tribe closely akin to the Mayas (the Huastecos) still occupies a retired mountain valley of Vera Cruz, entirely separated from their kinsmen of the south, and that a dialect of the Maya language is still spoken in northern Vera Cruz. There is evidence to show that the Aztecs adopted the civilization of the Toltecs, including their religion (Quetzalcoatl being a god of the Toltecs and Mayas), calendar and architecture. Perhaps the most remarkable of the Mexican races are the Mayas, or Maya-Quiché group, which inhabit the Yucatán peninsula, Campeche and parts of Tabasco, Chiapas, and the neighbouring states of Central America (*q.v.*). The remarkable ruins of Palenque, Uxmal, Chichenitza, Lorillard, Ixinché, Tikal, Copan and Quirigua, with their carved stonework and astonishing architectural conceptions, show that they had attained a high degree of civilization. They were agriculturists, lived in large, well-built towns, cultivated the mountain sides by means of terraces, and had developed what must have been an efficient form of government.

The Mistecas, or Mixtecas, and Zapotecas, who occupy the southern slopes of the central plateau, especially Puebla, Morelos, Oaxaca and Guerrero, form another distinct race, whose traditional history goes back to the period when the structures now known as Mitla, Monte Alban, Xochicalco and Zaachila were built. Their prehistoric civilization appears to have been not inferior to that of the Mayas. They were an energetic people, were never subdued by the Aztecs, and are now recovering from their long subjection to Spanish enslavement more rapidly than any other indigenous race. The Otomis comprise a large number of tribes occupying the plateau north of the Anáhuac sierras. They are a hardy people, and are the least civilized of the four principal native races.

The Totonacs inhabit northern Vera Cruz and speak a language related to that of the Mayas; the Tarascos form a small group living in Michoacán; the Matlanzingos, or Matlaltzincas, live near the Tarascos, the savage Apaches, a nomadic group of tribes ranging from Durango northward into the United States; the Opata-Pima group, inhabiting the western plateau region from Sonora and Chihuahua south to Guadalajara, is sometimes classed as a branch of the Nahuatlaca; the Seris, a very small family of savages, occupy Tiburon Island and the adjacent mainland of Sonora; and the Guaicuros, or Yumas, are to be found in the northern part of the peninsula of Lower California. In southern Mexico, the Chontales, Tapijulapas, Mixes and Zoques inhabit small districts among and near the Zapotecas, the first being considered by Belmar a branch of that family. The Huavis inhabit four small villages among the lagoons on the southern shore of Tehuantepec and have been classed by Belmar as belonging to the Maya stock. The census of 1895 gave these Indian races an aggregate population of nearly 4,000,000, of which nearly 3,450,000 belonged to the first four groups. Three of these four had made important progress toward civilization. Some of the others had likewise made notable progress, among which were the Tarascos, Totonacs and Zoques.

The builders of Casas Grandes (*q.v.*), in Chihuahua, evidently belonged to the Pueblo tribes of Arizona and New Mexico. As for the builders of Quemada, in Zacatecas, nothing positive is known. The ruins apparently are of an earlier period than those of Mitla and Xochicalco, and have no inscriptions and architectural decorations, but the use of dressed stone in the walls, rather than adobe, warrants the conclusion that they belonged to the civilization of southern Mexico.

From the records made at the time of the Spanish conquest, and from the antiquities found in the abandoned cities of prehistoric Mexico, it is certain that the Indians lived in substantial houses, sometimes using dressed stone, inscriptions and ornamental carvings on the more pretentious edifices; they cultivated the soil, rudely perhaps, and produced enough to make it possible to live in large towns; they made woven fabrics for dress and hangings, using colours in their manufacture; they were skilful in making and ornamenting pottery, in making gold and silver ornaments, and in featherwork; they used the fibres that Nature lavishly provided in weaving baskets, hangings, mats, screens and various household utensils. Copper was known to them, and it is possible that they knew how to make cutting instruments from it, but they generally used stone axes, hammers and picks, and their most dangerous weapon was a war-club into which chips of volcanic glass were set. Many of these primitive arts are still to be found in the more secluded districts, and perhaps the best work in pottery moulding in Mexico to-day is that of uneducated Indian artists.

Of the half-breed element which has become so important a part of the Mexican population, no safe estimate can be made. Education, industrial occupation, commercial training and political responsibility are apparently working a transformation in a class that was once known chiefly for indolence and criminal instincts, and many of the leaders of modern Mexico have sprung from this race. Settled government, settled habits, remunerative employment and opportunities for the improvement of their condition are developing in them the virtues of the two parent races. Brigandage was formerly so common that travel without an armed escort was extremely dangerous; under President Diaz, however, not only has such lawlessness been repressed but the brigands themselves have been given regular employment as rural guards under the government. This class is also furnishing the small traders of the towns, overseers on the plantations and public works, petty officials, and to some extent the teachers and professional men of the provincial towns.

Political Divisions.—The republic of Mexico is politically divided into 27 states, one federal district, and three territories. The states are generally subdivided into *distritos* (districts) or *partidos,* and these into *municipios* (municipalities) which correspond to the townships of the American system. The state of Nuevo Léon, however, is divided into *municipios* only, while some other states use entirely different titles for the divisions, the larger being described as *departamentos, cantons* and *municipios*, and the smaller as *partidos, directorias* and *vecindarios rurales.* The Federal District consists of thirteen municipalities. The territory of Lower California is divided into two large districts, northern and southern, and the latter into partidos and municipios—the larger divisions practically forming two distinct territories.

The states and territories, with their areas, capitals and populations, are as follows:—

Name.	Area, sq. m.	Pop. 1900.	Capital.	Pop. 1900.
Aguascalientes	2,950	102,416	Aguascalientes	35,052
Campeche	18,087	86,542	Campeche	17,109
Chiapas	27,222	360,799	Tuxtla Gutierrez	9,395
Chihuahua	87,802	327,784	Chihuahua	30,405
Coahuila	63,569	296,938	Saltillo	23,996
Colima	2,272	65,115	Colima	20,698
Durango	38,009	370,294	Durango	31,092
Guanajuato	11,370	1,061,724	Guanajuato	41,486
Guerrero	24,996	479,205	Chilpancingo	7,497
Hidalgo	8,917	605,051	Pachuca	37,487
Jalisco	31,846	1,153,891	Guadalajara	101,208
Mexico	9,247	934,463	Toluca	25,940
Michoacán	22,874	935,808	Morelia	37,278
Morelos	2,773	160,115	Cuernavaca	9,584
Nuevo León	23,592	327,937	Monterrey	62,266
Oaxaca	35,382	948,633	Oaxaca	35,049
Puebla	12,204	1,021,133	Puebla	93,152
Querétaro	3,556	232,389	Querétaro	33,152
San Luis Potosí	25,316	575,432	San Luis Potosí	61,019
Sinaloa	33,671	296,701	Culiacán	10,380
Sonora	76,900	221,682	Hermosillo	10,613
Tabasco	10,072	159,834	San Juan Bautista	10,543
Tamaulipas	32,128	218,948	Ciudad Victoria	10,086
Tlaxcala	1,595	172,315	Tlaxcala	2,715
Vera Cruz	29,201	981,030	Jalapa	20,388
Yucatán	35,203	309,652	Mérida	43,630
Zacatecas	24,757	462,190	Zacatecas	32,866
Distrito Federal	463	541,516	Mexico	344,721
Territories:—				
Baja California	58,328	47,624	La Paz	5,046
Tepic	11,275	150,098	Tepic	15,488
Quintana Roo	—	—	Santa Cruz de Bravo	276
Islands	1,420	—		

The area and population of Yucatán include those of the territory of Quintana Roo, which formed part of that state at the time of the census.

Baja, or Lower California, is divided into two districts for administrative convenience. The Distrito del Norte is credited with a population of 7583 and has its capital at Ensenada (pop. 1026); the Distrito del Sur has a population of 40,041 and has its capital at La Paz.

Tepic was detached from the north-west part of Jalisco and organized as a territory in 1889.

Quintana Roo was detached from the state of Yucatán in 1902 and received a territorial government.

The principal cities of Mexico, other than the capitals above mentioned, are as follows, the populations being those of 1900 except when otherwise stated: Acapulco (pop. 4932), a famous port on the Pacific coast in Guerrero, which was wrecked by the earthquake of 1909; Carmen, or Laguna de Términos (about 6000), a thriving commercial town and port on the Gulf coast in Campeche; Celaya (25,565), a railway centre and manufacturing town of Guanajuato; Ciudad Guzman, or Zapotlán (about 17,500), an interesting old town of Jalisco; Cholula (about 9000), an ancient native town of Puebla, widely known for its great pyramid; Comitán (9316), the commercial centre of Chiapas; Cordoba (7974 in 1895), a picturesque Spanish town in the sierras of Vera Cruz; Cuautla (6269), the centre of a rich sugar-producing district of Morelos; Guaymas (8648), a flourishing port of Sonora on the Gulf of California; León (62,623), the largest city in Guanajuato and distinguished for its commercial activity, manufactures and wealth; Linares (20,690), the second city of Nuevo León in size and importance; Matamoros (8347), a prominent commercial centre and river port of Tamaulipas; Mazatlán (17,852), the foremost Mexican port on the Pacific coast; Orizaba (32,894), a city of Vera Cruz famous for its delightful climate and picturesque surroundings; Parral (14,748), a well-known mining centre of southern Chihuahua; San Cristobal (about 16,000), once capital of Chiapas and rich in historical associations; Tampico (16,313), a Gulf port and railway terminus of Tamaulipas; Tehuantepec (10,386), the largest town on the Tehuantepec railway in Oaxaca; Vera Cruz (29,164), the oldest and best known Gulf port of Mexico.

Communications.—Railways began in Mexico with a line of four kilometres between the capital and Guadalupe, which was finished in 1854 and afterwards became a part of the Ferrocarril Mexicano. The latter dates from 1857, when a concession was granted for the construction of a railway from the city of Mexico to Vera Cruz. The French invasion of 1862 found only 10 m. in operation outside of Vera Cruz and military needs led to its immediate extension to Paso del Macho, at the foot of the sierras, about 35 m. At the same time the English company holding the concession extended the Guadalupe line to Puebla. Nothing more was accomplished until after the downfall of Maximilian, and with a liberal subsidy from the Mexican government the Ferrocarril Mexicano was pushed to its completion in 1873. It is celebrated because of the difficulties overcome on the precipitous eastern slopes of the Sierra Madre, the beauties of the mountain scenery through which it passes, and the rapid transition from the hot, humid coastal plain to the cool, arid plateau, 7924 ft. above the sea at Boca del Monte. The railway extends 263 m. between Vera Cruz and Mexico City, to which 58 m. were added in branches from Apizaco to Puebla, and from Ometusco to Pachuca. The line was capitalized at $46,000,000 and has paid a good profit on the investment. The period of active railway construction, however, did not begin until 1878, during the first term of President Porfirio Diaz. In 1874 a concession was granted for a line from the port of Progreso to Mérida (22½ m.), and in 1878 four concessions were added under which 806 m. were constructed. The principal of these four concessions was the Ferrocarril Interoceánico running from Vera Cruz to Mexico City and across the republic toward Acapulco. In 1880 concessions were granted to the F.C. Occidental, F.C. Central Mexicano, F.C. Nacional Mexicano and three others of less importance, aggregating nearly 3500 m. The first three of these have become important factors in the development of Mexico. The first runs southward from the capital to Oaxaca through the rich sub-tropical states of Puebla and Oaxaca, and the other two run northward from the same point to the American frontier. These two lines, popularly called the Mexican Central and Mexican National, have their northern termini at Ciudad Juárez and Laredo on the Rio Grande and connect with American trunk lines at El Paso and Laredo. These two great lines were merged in 1908, with an aggregate capital of $460,000,000 Mexican money, of which the Mexican government holds $230,004,580, or a controlling interest. Important branches of these lines extend to Tampico on the Gulf coast, to Manzanillo on the Pacific coast, and westward and southward into Michoacán and Guerrero, with a coast terminus at or near Acapulco. The next important line is the F.C. Internacional Mexicano, running from Ciudad Porfirio Diaz, on the Rio Grande, south-westward across the plateau to Durango, and is to be extended to Mazatlán, on the Pacific coast. This line was built with American capital and without a subsidy. Another line built with American capital and in connexion with American railway interests extends southward from Nogales, on the northern frontier, to Hermosillo, Guaymas and Mazatlán; it is to be extended to Guadalajara and possibly to other points in southern Mexico. Monterrey is connected with Tampico by a Belgian line known as the F.C. de Monterrey al Golfo Mexicano, and the capital is to have direct connexion with the Pacific, other than the F.C. Interoceánico, by a line through Cuernavaca and Iguala to the coast. Indirectly the capital has a Pacific coast connexion by way of Cordoba and the F.C. Vera Cruz al Pacifico to a junction with the Tehuantepec line. One of the most important railways in Mexico is the F.C. Nacional Interoceánico de Tehuantepec, also called the Tehuantepec National, and the Mexican Isthmus railway, which is 192 m. long and was formally opened in 1907. This line crosses the Isthmus of Tehuantepec from Coatzacoalcos (officially Puerto Mexico) on the Gulf coast to Salina Cruz on the Pacific coast, and has been under construction many years. The railway was first completed in 1894, but light and defective construction, together with lack of shipping facilities at its terminal points, rendered it useless. To correct these defects the line was completely rebuilt and terminal ports constructed. In 1909 the ports were ready to receive large ocean steamships, and regular traffic was begun, including cargoes of Hawaiian sugar for New York. The highest point on the line (Chivela Pass) is 735 ft. above sea-level. The railway has been built by the Mexican government as a transcontinental route for international commerce. Its final construction together with that of its two ports were executed by S. Pearson & Sons, Ltd., of London, who also undertook the working of the line when open. It was estimated in 1907 that the total cost of the railway and ports when completed would be about £13,000,000. The line is connected at the station of Santa Lucrecia (109 m. from Salina Cruz) with the Vera Cruz and Pacific railway which gives an all-rail connexion with Vera Cruz and Mexico City, the distance between the latter and Salina Cruz being 520 m. According to the President's Message of April 1909, there were 14,857 m. of railway in operation, of which 11,851 m. belonged to or were controlled by the government. It is the evident policy of the Mexican government to prevent the absorption of its railways by private monopolies, and this is effected by state ownership of a controlling share in most of the trunk lines.

Mexico is well provided with tramway lines in its larger cities. A British consular report for 1904 stated that Mexico City and Torreon only were using electric traction, but that Guadalajara, Monterrey, Aguascalientes, Lagos, Colima, Vera Cruz and San Luis Potosí would soon be using it. No official reports are available. The telegraph lines had an aggregate length of 35,980 m. at the end of 1907, of which 33,000 m. belonged to the national government. The President reports an addition of 1626 m. in 1908. Wireless telegraphy was represented in 1908 by a connexion between Mazatlán and Lower California, which was in successful operation. Telephone lines were in use in all the large cities and in connexion with the large industrial enterprises and estates, beside which the government had 500 m. of its own in 1908.

Commerce.—In 1905 the mercantile marine of Mexico comprised only 32 steamers, of 13,199 tons, and 29 sailing vessels, of 8451 tons. The ocean-carrying trade was almost wholly in the hands of foreigners, the government wisely refraining from an attempt to develop an occupation for which its citizens had no natural aptitude. The coastwise trade is principally under the Mexican flag, but the steamers are owned abroad. An official publication entitled "Mexico: Yesterday and To-day, 1876–1904," states that while the number of steamers engaged in the foreign trade increased from 841 to 969 in the 17 years from 1886 to 1903, the number of Mexican steamers decreased from 55 to 4. For the year 1906–1907 the entries of vessels from foreign ports numbered 1697, of 3,282,125 tons, and the clearances were 1669, of 3,257,932 tons. Subventions are paid for regular steamship service at the principal ports, the total expenditure in 1907–1908 being £42,876. These ports are well served by a large number of foreign steamship companies, which give direct communication with the principal ports of the United States, Europe, and the west coast of South America, and the initiation of a Japanese line in 1908 also brings Mexico into direct communication with the far East. The larger ports for foreign trade are Vera Cruz, Tampico, Progreso, Carmen and Coatzacoalcos on the Gulf coast, and Guaymas, La Paz, Mazatlán, Manzanillo, San Blas, Acapulco and Salina Cruz on the Pacific coast. Some of these—Vera Cruz, Tampico, Coatzacoalcos, Salina Cruz, Manzanillo and Mazatlán—have been greatly improved with costly port works. Among the smaller ports, some of which are open to foreign trade, are Matamoros, Tuxpan, Alvarado, Tlacotálpan, Frontera, Campeche and the island of Mujeres (coast of Yucatán) on the Gulf side, and Ensenada, Altata, Santa Rosalia and Soconusco on the Pacific.

The foreign trade has shown a steady increase during the period of industrial development, to which better means of transport have been an invaluable aid. In 1906–1907 the imports were valued at $111,234,968 U.S. gold, and the exports at $123,512,969, of which very nearly one half consisted of precious metals. According to an official report issued early in 1909 there had been a heavy decrease in both imports and exports, the former being returned at $36,195,469 and the latter at $54,300,896 for the six months ending the 31st of December 1908. Too rapid development and overtrading were given as reasons for this decline. Import and export duties are levied, the former in many cases for the protection of national industries. The imports largely consist of railway material, industrial machinery, cotton, woollen and linen textiles and yarns for national factories, hardware, furniture, building material, mining supplies, drugs and chemicals, wines and spirits, wheat, Indian corn, paper and military supplies and equipment. The exports include gold, silver, copper, coffee, henequén or sisal, ixtle and other fibres, cabinet woods, chicle, rubber and other forest products, hides and skins, chickpeas, tobacco and sugar.

Agriculture.—The agricultural resources of Mexico are large and unusually varied, as they comprise some of the cereals and other food products of the temperate zone, and most of the leading products of the tropics. Agriculture, however, received slight attention, owing to the early development of the mining industries. An indirect result of the industrial development of Mexico, which began during the last quarter of the 19th century, has been an increased interest in agriculture, and especially in undertakings requiring large investments of capital, such as coffee, sugar and rubber plantations. A large part of the country is too arid for agriculture, and even with irrigation the water supply is sufficient for only a small part of the dry area. This region has, for the most part, a temperate climate, and produces wheat, barley, Indian corn and forage crops. Long droughts often destroy the wheat and Indian corn and compel their importation in large quantities to supply the people with food. This uncertainty in the wheat crop extends to the southern limits of the higher plateau, and is a serious obstacle to the increased production of this cereal. Indian corn, also, is a comparatively uncertain product on the plateau, and for the same reason. As it is a staple food with the poorer classes, the deficiency is made up through importation. These drawbacks tend to restrict agriculture on the plateau to comparatively limited areas, and the country people are, in general, extremely poor and badly nourished. A comparatively new product in this region is that of canaigre, which is grown for the tannin found in its root. It is a native of the arid regions and is now cultivated with success. The district about Parras, in southern Coahuila, produces grapes, which are principally used in the manufacture of wine and brandy. An important product of the plateau and of the open districts of the *tierras calientes*, growing in the most arid places, is the " nopal " or prickly pear cactus (*Opuntia ficus indica*). Its fruit, called " tuna " by the natives, is refreshing and wholesome and is a staple food in spite of its spiny covering. In the *tierras calientes* of Mexico, however, better conditions prevail. A fertile soil, abundant rainfall and high temperatures have covered these mountain slopes and lowland plains with a wealth of vegetation. The problem for the agriculturist here is not irrigation, but drainage and keeping down spontaneous growths. In these regions, sugar, tobacco, indigo, cacao, rice, sweet potatoes, alfalfa, beans and cassava are produced, and Indian corn yields two and three crops a year. Fruits also are plentiful, both wild and cultivated. Among them are the banana, plantain, tuna, chili pepper, olive, coco-nut, orange, lemon, lime, mango, pomegranate, " piña " or pineapple (wild and cultivated), fig, ahuacatl (*Persea gratissima*), chirimoya (*Anona chirimolia*), papaya, gourd, melon, guava, ciruela (plum), and the several " zapote " fruits, including " chico zapote " from the *Achras sapota*, which produces the " chicla " or chicle-gum of commerce, " zapote blanco " from the *Casimiroa edulis*, " zapote-barracho " (or " amarillo ") from the *Lucuma salicifolia*, " zapote-prieto " (or " negro ") from the *Diospyros obtusifolia*, and " zapote-mamey." The production of rubber is becoming an important industry, large plantations having been set with both *Hevea* and *Castilloa* rubber trees. Lying between these two regions is the subtropical belt where coffee of an excellent quality is produced, and where cotton is cultivated. Coffee has become an important article of export, but cotton does not yield enough for the domestic factories. Better cultivation would probably increase the output and make it an article of export. A peculiar and highly profitable branch of Mexican agriculture is the cultivation of the *Agave* for two widely different purposes—one for its fibre, which is exported, and the other for its sap, which is manufactured into intoxicating liquors called " pulque " and " mescal." In Yucatán immense plantations of the *Agave rigida* var. *elongata* are cultivated, from which large quantities of " henequén " or " sisal," as the fibre is called, are exported. It is produced on light shallow soils overlying calcareous rock. It is also cultivated in Campeche and Chiapas. The pulque industry is located on the plateau surrounding the city of Mexico, the most productive district being the high, sandy, arid plain of Apam, in the state of Hidalgo, where the " maguey " (*Agave americana*) finds favourable conditions for its growth—a dry calcareous surface with moisture sufficiently near to be reached by its roots. Its cultivation is the chief industry of the states of Mexico, Hidalgo, Puebla and Tlaxcala. Of the 208 plantations in the state of Hidalgo in 1897, 129 were devoted to maguey. The plant is propagated from suckers and requires very little attention after transplanting to the field where it is to remain, but it takes six to eight years to mature and then yields an average of ten gallons of sap during a period of four or five months, after which it dies. " Pulque " is the fermented drink made from this sap: " mescal " is the distilled spirit made from the leaves and roots of the plant. There are other agaves used both in the production of drinks and fibres, but they are not cultivated. The " ixtle " fibres shipped from Tampico and Chiapas are all obtained from the agaves and yuccas found growing wild.

The natural and forest products of Mexico include the agave and yucca (ixtle) fibres already mentioned; the " ceibón " fibre derived from the silk-cotton tree (*Bombax pentandria*); rubber and vanilla in addition to the cultivated products; palm oil; castor beans; ginger; chicle, the gum extracted from the " chico-zapote " tree (*Achras sapota*); logwood and other dye-woods; mahogany, rosewood, ebony, cedar and other valuable woods; " cascalote " or divi-divi; jalap root (*Ipomaea*); sarsaparilla (*Smilax*); nuts and fruits.

Stock-raising dates from the earliest Spanish settlements in Mexico and received no slight encouragement from the mother country. For this reason much importance has always been attached to the industry, and stock-raising of some sort is to be found in every state of the republic, though not always to a great extent. The Spaniards found no indigenous domestic animals in the country, and introduced their own horses, cattle, sheep and swine. From these are descended the herds and flocks of to-day, with no admixture of new blood until toward the end of the 19th century. The horses and cattle are of a degenerate type, small, ungainly and inured to neglect and hard usage. The horse is chiefly used for saddle purposes and is not reared in large numbers. The mule is more generally used in every part of the country, being hardier, more intelligent and better adapted for service as a draft and pack animal. The transport of merchandise and produce was wholly by means of pack animals before the advent of railways, and is still the common means of transport away from the railway lines. For this purpose the sure-footed mule is invaluable. In some districts, however, oxen and ox-carts are employed, especially in the southern states, and always in the open, level country. The varying climatic conditions of Mexico have produced breeds of cattle that have not only departed from the original Spanish type, but likewise present strikingly different characteristics among themselves. Those of the northern plateau are small, hardy and long-lived, being bred on extensive ranges in a cooler atmosphere, and accustomed to long journeys in search of water and pasture. In the south they are larger and better nourished, owing to the permanent character of the pasturage, but are less vigorous because of the heat and insect plagues. In Yucatán the open plains, rich pasture, and comparative freedom from moist heat, insects and vampire bats, have been particularly favourable to cattle-raising, and the animals are generally rated among the best in Mexico. Notwithstanding the frequency of long, destructive droughts, cattle-raising is a preferred industry among the landowners of the northern states, and especially near the American frontier. Almost total losses are frequently experienced, but the profits of a favourable year are so great that losses seldom deter ranchers from trying again. In the sierra regions of western Chihuahua and Durango, Nuevo León, Coahuila, Aguascalientes, San Luis Potosí, and the plateau states farther south, the rainfall is more abundant and the conditions more favourable. The largest herds are to be found in Chihuahua and Durango. Above 5000 ft. the wild pasturage is short, tender and reproduces itself annually. It is exceptionally nutritious, but it disappears altogether in the dry season because of its short roots. The lowland pasture, from 2000 to 5000 ft., is composed of more vigorous grasses, with an undergrowth of an exceptionally succulent character. The stock-raiser on the border pastures his herds on the uplands during the rainy season, and on the lower pastures during the remainder of the year. Next in importance is the breeding of sheep, which is largely confined to the cooler sierra districts. They are commonly of the Spanish merino breed, and suffer in many localities on account of insufficient pasturage. Some attention is given to the breeding of goats because of the local demand for their skins, but the industry is apparently stationary. The raising of swine, however, is increasing. In the last decade of the 19th century the capital invested in these live-stock industries was estimated (by Bancroft) to exceed $700,000,000, but an official return of the 30th of June 1902 gave an aggregate valuation of only $120,523,158 (Mexican), or about £12,052,316. According to this report, which is not strictly trustworthy, there were in the republic 5,142,457 cattle, 859,217 horses, 334,435 mules, 287,991 asses, 3,424,430 sheep, 4,206,011 goats and 616,139 swine. Two years later home consumption returns noted the slaughter of 958,058 cattle (129,938 in the Federal District), 561,982 sheep, 992,263 goats and 887,130 hogs—the last item being larger than the census return of 1902. The greater part is consumed in the country, but there is a considerable export of cattle to the United States, Cuba and Central America, and of hides and skins to the United States and Europe. A few mules are sent to Central America, but the home demand usually exceeds the supply.

Other Industries.—There are no fisheries of importance except the pearl fisheries on the eastern coast of Lower California, and the tortoise fisheries on the coasts of Campeche, Yucatán, and some of the states facing the Pacific. The pearl fisheries have been worked since the arrival of the Spaniards, and were once very productive notwithstanding the primitive methods employed. Since the closing years of the last century pearl fishing in the Gulf of California has been carried on with modern appliances and better results by an English company under a concession from the government. Mother-of-pearl or abalone and other shells are also found, and, with sponges, are exported. Fishing for the tortoiseshell turtle gives employment to a large number of natives in the season, and considerable quantities of the shell are exported. Other industries of a desultory character include the collection of archil, or Spanish moss, on the western side of the Californian peninsula, hunting herons for their plumes and alligators for their skins, honey extraction (commonly wild honey), and the gathering of cochineal and ni-in insects. The cochineal insect was once an important commercial product, but the industry has fallen into decay. The "ni-in" (also known as "axe") is a small scale insect belonging to the genus *Coccus*, found in Yucatán, Oaxaca, Vera Cruz, Michoacán and other southern states, where it inhabits the spondia trees and produces a greasy substance called "ni-inea," which is much used by the natives as a varnish, especially for domestic utensils, as it resists fire as well as water.

Mining.—The best-known and most productive of the industries of Mexico is that of mining. It was the chief object of Spanish exploration, and the principal occupation of European residents and capital during three centuries of Spanish rule. Agricultural and pastoral industries gradually gained footholds here and there, and in time became important, but mining continued far in advance until near the end of the 19th century. Mines of some description are to be found in 26 of the 31 states and territories, and of these the great majority yield silver. According to the official records, there were registered in September 1906, 23,191 mining properties, of which very nearly five-sixths were described as producing silver, either by itself or in combination with other metals. The properties were classed as 1572 gold, 5461 silver, 970 copper, 383 iron, 151 mercury, 94 lead, 86 sulphur, 52 antimony, 49 zinc, 40 tin, 21 opals, 9 manganese, 6 "sal gema," 5 tourmalines, 1 bismuth and 1 turquoise—the remainder being various combinations of these minerals. The absence of coal from this list is due to the circumstance that coal mines were at that time considered as private property and were not registered under the general mining laws. A comparison with 1888–1889, when 8970 properties were registered, will show how rapidly the mining industries have been developed during that period. Besides the above, the mineral resources of Mexico include coal, petroleum, asphalt, platinum, graphite, soda and marble. In 1906 the productive mines numbered 1786, of which 491 were in Sonora, 282 in Chihuahua, 211 in Durango, 113 in Oaxaca and 105 in Nuevo León. Gold is found in Chihuahua, Durango, Guanajuato, Guerrero, Jalisco, Mexico, Morelos, Oaxaca, Puebla, Sinaloa, Sonora, Vera Cruz, Zacatecas, and to a limited extent in other states; silver in every state and territory except Campeche, Chiapas, Tabasco, Tlaxcala and the Yucatán peninsula; copper in Lower California, Guanajuato, Guerrero, Jalisco, Michoacán, Sonora, Tamaulipas and some other states; mercury chiefly in Guanajuato, Guerrero, San Luis Potosí, Vera Cruz and Zacatecas; tin in Guanajuato; coal, petroleum and asphalt in 20 states, but chiefly in Coahuila, Hidalgo, Michoacán, Oaxaca, Puebla, Sonora, Tabasco, Tamaulipas and Vera Cruz; iron in Durango, Hidalgo, Oaxaca and other states; and lead in Hidalgo, Querétaro and in many of the silver-producing districts. The most celebrated iron deposit is that of the Cerro del Mercado, in the outskirts of the city of Durango—a mountain 640 ft. in height, 1100 in breadth, and 4800 in length, reputed to be almost a solid mass of iron. Large masses of the metal are also said to exist in the sierras of Lower California. The principal coalfields that have been developed are in the vicinity of Sabinas, Coahuila. They have been opened up by American capitalists and the coal is used on the railways passing through that region. Mexican coal is of a low grade—similar to that found in Texas, but as an official geological report of 1908 estimates the supply in sight at 300,000,000 tons its industrial value to the country cannot be considered inferior to that of the precious metals. The same is true of the petroleum deposits in Tamaulipas, near Tampico, and in southern Vera Cruz. An investigation by the U.S. Geological Survey in 1909 finds that the crude Mexican oils are of low grade, but that while not equal to those found in the upper Mississippi basin for refining purposes, they furnish an excellent fuel for railway engines and other industrial purposes. Many of the Mexican railways are using these fuel oils, which are superseding imported coal. In 1909 a well was opened in the southern oilfields whose yield was equal to the best American product.

Manufactures.—Although Mexico is usually described as a non-manufacturing country, its industrial development under President Porfirio Diaz will warrant some modification of this characterization. Manufacturing for international trade has not been and may never be reached, but the industry certainly has reached the stage of meeting a great part of the home demand for manufactured goods, where the raw material can be produced in the country. There were of course some crude industries in existence before the arrival of the Spaniards, such as weaving and dyeing of fabrics made from various fibres, and making earthenware utensils, images, &c. The Spaniards introduced their own industries, including sugar-making, weaving, tanning, and leather- and metal-working, some of which still exist. The early methods of making cane sugar, clarified with clay and dried in conical moulds, are to be found all over Mexico, and the annual output of this brown or muscovado sugar (called "panela" by the natives) is still very large. The sugar crop of 1907-1908 was reported as 123,285 metric tons, in addition to which the molasses output was estimated at 70,947·5 metric tons, and "panela" at 50,000 tons. Other estimates make the "panela" output much larger, the product being largely consumed in the rural districts and never appearing in the larger markets. The estimated number of sugar mills in 1904 was about 2000, of which only about 300 were important for size and equipment. Merino sheep were introduced in 1541 and woollen manufactures date from that time. Large factories are now to be found in all parts of Mexico, and good and serviceable grades of broadcloths, cassimeres, blankets and other fabrics are turned out. There is also a considerable quantity of carpeting, underwear and hosiery manufactured. An important branch of this industry is the manufacture of "zarapes" (called "ponchos" in other parts of Spanish America)—a blanket slit in the centre for the head to pass through, and worn in place of a coat by men of the lower classes. The most important textile industry is cotton manufacture, which has become a highly successful feature in the industrial life of the republic. There were 146 factories in 1905, of which 19 were idle, and these were distributed over a very large part of the country. About one-half the raw cotton consumed was produced in Mexico, and the balance imported in fibre or as yarn. The industry is protected by a high tariff, as is also the production of raw cotton, and further encouragement is offered through a remission of internal revenue taxes where Mexican fabrics are exported for foreign consumption. The cotton factories of 1905 were equipped with 22,021 looms having 678,058 spindles, and with 38 stamping machines, employed 30,162 operatives, and turned out 13,731,638 pieces of cloth. Statistical returns, however, are somewhat incomplete and conflicting, and cannot be used with confidence. Coarse fabrics chiefly are manufactured, but the product also comprises percales, fine calicoes, ginghams, shirtings, towelings, sheetings and other kinds of goods. Considerable attention is given to the manufacture of "rebozos," the long shawls worn by women. Another very important manufacturing industry is that of tobacco, the consumption of its various products being large among all classes of the population. There were 467 tobacco factories reported in 1905 to be engaged in the manufacture of cigars, cheroots, cigarettes, snuff and cut tobaccos for the pipe. The number of factories reported for 1899 was 743, but as the consumption of leaf tobacco increased from 5,546,677 to 8,587,356 kilogrammes, it may be assumed that the decrease in factories is due to the absorption or disappearance of the small shops using old-fashioned methods. Other important manufactories are flour mills, of which there were over 500 in 1904; iron and steel works, of which there are 7 large establishments, including the immense plant at Monterey; 90 smelters for the reduction of precious metals; tanneries, potteries, and factories for the manufacture of hats, paper, linen, hammocks, harness and saddles, matches, explosives, aerated waters, soap, furniture, chocolate and sweetmeats. There are also a large number of distilleries, breweries, and establishments for the manufacture of "pulque," "mescal," and imitation or counterfeited liquors. In addition to these are the many small domestic industries, such as the making of straw hats, mats, baskets, pottery, ropes and rough textiles. The policy of the Mexican government is to encourage national manufactures, and protective duties are levied for that purpose. Other favours include exemption from taxation and exemption from import duties on machinery and raw materials. These inducements have attracted large sums of foreign capital and have brought into the country large numbers of skilled operatives, especially in the cotton, iron and steel, and smelting industries.

Constitution.—Under the Constitution of the 5th of February 1857, subsequently modified in many important particulars, the government of Mexico is described as a federation of free and sovereign states invested with representative and democratic institutions. Practically it is a Federal Republic with centralized executive powers. Its political divisions consist of 27 states (originally 19) having independent local governments, 3 territories and 1 federal district in which the national capital stands. The central government consists of three co-ordinate branches—executive, legislative and judicial—each nominally independent of the other. The executive branch consists of a president and vice-president, assisted by a cabinet of 8 secretaries of state: (1) foreign affairs; (2) interior; (3) justice; (4) public instruction and fine arts; (5) fomento, colonization and industry; (6) communications and public works; (7) finance and public credit; (8) war and marine. The president and vice-president are elected indirectly through an electoral college chosen by popular vote, and serve for a period of six years (the term was four years previous to 1904), the vice-president succeeding to the office in case of the death or permanent disability of the president. The office of vice-president was created on the 6th of May, 1904, and that official serves as president of the senate. A constitutional amendment of 1890 permits the re-election of the president without limit, the original clause prohibiting such a re-election. A candidate for the presidency must be a native-born Mexican citizen in the full exercise of his political rights, 35 years of age, not an ecclesiastic, and a resident of the republic at the time of the election. Although the authority of the president is carefully defined and limited by the Constitution, the exercise of dictatorial powers has been so common that the executive may be considered practically supreme and irresponsible. Previous to the presidency of General Porfirio Diaz in 1877 political disorders and changes in government were frequent.

The legislative branch of government consists of a Congress of two chambers—a senate and a chamber of deputies. Two ordinary congressional sessions are held each year—April 1 to May 31 and September 16 to December 15—and a permanent committee of 29 members (14 senators and 15 deputies) sits during recess, with the power to confirm executive appointments, to give assent to a mobilization of the national guard, to convene extra legislative sessions, to administer oaths, and to report at the next session on matters requiring congressional action. The senate is composed of 56 members—or two from each state and from the federal district—who are elected by popular vote for a term of four years, one-half the number retiring every two years. A senator must be not under 30 years of age, a Mexican citizen in the full enjoyment of his rights, a resident of the state he represents, and not an ecclesiastic. The chamber of deputies is composed of popular representatives, in the proportion of one deputy for each 40,000 inhabitants or fraction over 20,000, who are elected for a term of two years. A deputy must be not less than 25 years of age, other qualifications being the same as those for a senator. The salary for either senator or deputy is $3000 and that of the president $50,000. Federal officials and ecclesiastics are ineligible for election to either chamber.

Mexican citizenship includes all persons born of Mexican parents, all naturalized aliens, and all foreigners owning real estate in the republic or having children by Mexican mothers unless formal declaration is made of an intention to retain the citizenship of another country. In some cases exemptions are granted from specified taxes and military duties, otherwise naturalized citizens are treated the same as native-born. Aliens are granted the civil rights enjoyed by Mexicans, but the government reserves the right to expel those guilty of pernicious conduct. Suffrage is extended to all Mexican citizens who possess honest means of livelihood, the age limit being 18 for the married and 21 for the unmarried.

The judicial branch of the government consists of a supreme court of justice, three circuit courts, and 32 district courts. The supreme court is composed of 11 "ministros" or justices, four alternates, a "fiscal" or public prosecutor and the attorney-general—all elected by popular vote for a term of six years. It has jurisdiction in cases arising from the enforcement of the federal laws, except cases involving private interests, in admiralty cases, in cases where the republic is a party, in those between two or more states, or between a state and the citizens of another state, in those originating in treaties with foreign states, and in those affecting diplomatic and consular officials. There are likewise supreme and inferior courts in most of the states, governed by the civil and criminal codes in force in the federal district. The territories are governed by federal laws. The department of justice has oversight in matters relating to the enforcement of the federal laws and the administration of justice through minor courts. The police service is both municipal and federal in character. In some states a local police service is maintained, but in most states the federal government maintains a very efficient force of mounted "*rurales.*"

The states are organized very much like the federal government, each with its own governor, legislature, laws and judiciary. Elections are generally indirect, like those for the national executive, and official terms correspond closely to those of similar offices in the national organization. The state is nominally sovereign within its own boundaries, and the authority of its officers and courts in local questions is supreme except in cases where federal intervention or supervision is provided for by the federal constitution. The larger political divisions of the state (*partidos, distritos*, &c.) are governed by a *jefe politico*, or prefect, and the smaller by a municipal council called an *ayuntamiento*.

Defence.—The Mexican army consisted in 1908 of 2474 officers and 24,132 men, organized on modern lines, and commanded by a general staff at the capital. There were 30 battalions of infantry and 4 battalions cadres with an effective strength of 730 officers and 14,898 men; 14 regiments of cavalry and 4 regimental cadres with 493 officers and 6058 men; 2 regiments and 3 cadres of field artillery; one regiment and one cadre each of horse and mountain artillery, 4 sections of garrison artillery, and one mitrailleuse company, in all 147 officers and 1647 men; and the remainder divided among other services. Administration and headquarters staffs comprised 885 officers and 531 men. This force represented the peace footing of the army, which is recruited in part by voluntary enlistments and in part by a form of conscription that might be called impressment. Mauser rifles (1901 model) and carbines are used by the infantry and cavalry, and Schneider Canet quick-firing guns by the field and horse artillery. The nominal war strength of the army is rated at 2510 officers and 81,984 men. Factories for arms and ammunition have been established with modern machinery, and uniforms and other equipment are made in the country. The military school in the capital occupies a part of the historic castle of Chapultepec and has been thoroughly reorganized on modern lines. There is also an artillery school at Vera Cruz and subordinate schools in other parts of the republic. The national guard, to which reference is sometimes made, has no effective organization.

Mexico may be said to have no navy, the ten small vessels in commission in 1908 hardly meriting such a designation. There were 2 old despatch boats and 2 old unarmoured gunboats, a steel training cruiser, the "Zaragoza," and 5 small modern gunboats. The personnel consisted of 198 officers and 965 men. Six new cruisers were projected, but the republic has no pressing need of a navy. Small naval schools are maintained at Campeche and Mazatlán.

Education.—Education in Mexico may be said to have entered upon a progressive phase. The institutions founded by the Spaniards were wholly under ecclesiastical control. The first college in Mexico was founded during the administration of Viceroy Mendoza (1535–1550), but it taught very little beyond Latin, rhetoric, grammar and theology. The university of Mexico, planned by Mendoza and founded on the 21st of September 1551, was formally opened on the 25th of January 1553, with faculties of law, philosophy and theology. Practically nothing was done for the natives beyond oral instruction in the catechism. The university of Mexico received much support from both church and state, but it never gained a position comparable to the universities of South America—Cordoba, Lima (San Marcos) and Bogotá. The overthrow of Spanish rule in Mexico was the beginning of a new period, and efforts were made to introduce educational reforms, but the colonists and ecclesiastics were still governed by their fears and prejudices, and little was accomplished. In 1833 the university of Mexico suspended work, and in 1865 passed out of existence altogether. In 1857 the adoption of a more liberal and democratic constitution paved the way for a new period in the educational history of the country. Its realization was delayed by the wars that devastated the country down to the overthrow of Maximilian, but the leaven was at work, and with the return of peace a marked increase in the number of primary and secondary schools was noted. Colleges of law, medicine and engineering were created in Mexico City in 1865 in place of the old university and were successful from the beginning. Professional schools were also established in several of the more important provincial capitals, and everywhere increasing interest in educational matters was apparent. The best proof of this was to be found in the development of the primary schools, of which there were 8226 in 1874, with an attendance of 360,000 pupils. Of these, 603 were supported by the national government, 5240 by municipalities, 2260 by private enterprise, 117 by the Catholic church, and the remainder by Protestant denominations. Handsome schools were built in the cities and larger towns, and schools were opened in all the villages and hamlets. In some parts the natives made most creditable progress in all branches of learning. This was especially true of the Mixtecos and Zapotecas of Oaxaca, from whom have come some of the leading men of the republic. The national school laws now in force had their origin in the recommendations made by a national congress of public education convened on the 1st of December 1889, and again on the 1st of December 1890. The first result was a law regulating free and compulsory education in the federal district and national territories, which came into effect on the 17th of January 1892. From 1822 to this time the government primary schools had been under the supervision of the Compañia Lancasteriana, but they were now placed under charge of the Department of Public Education. On the 19th of May 1896 a general public education law was promulgated, which provided further regulations for the public schools, and outlined a comprehensive system. Compulsory attendance had been adopted in 1888, but did not come into effect until after the enactment of the law of 1896. It provides for uniform, free and non-sectarian primary instruction, and compulsory attendance for children of 6 to 12 years of age. Preparatory courses for professional training in the government schools were also made free and secular. As the states have control of the schools within their own boundaries there was at first a great lack of uniformity, but the national system is being generally adopted. In the official report for 1904 the number of public schools, exclusive of infant schools, was returned at 9194 (against 5843 in 1874), with an enrolment of 620,476. Of these 6488 were supported by the national and state governments and 2706 by the municipalities. The private, religious and association schools numbered 2281, with 135,838 pupils. For secondary instruction the national and state schools numbered 36 with 4642 pupils, and for professional instruction 65 with 9018 students, of whom 3790 were women. Normal schools for the training of teachers are also maintained at public expense and are giving good results. Besides these, the government maintains schools of law, medicine, agriculture and veterinary practice, engineering, mining, commerce and administration, music and fine arts. There is also a mechanics' training school (*artes y oficios*) for men and a similar school for women, schools for the blind and for deaf-mutes, reform schools, and garrison schools for soldiers. Early estimates were that 90% of the population were illiterate. In 1895 this percentage was reduced to about 84%, and the work of the schools is slowly cutting it down. Mention must be made of the National Library in Mexico City with about 225,000 volumes, and 138 public libraries (in 1904) in other parts of the republic, 34 museums for scientific, educational and art purposes, and 11 meteorological observatories. Newspapers and periodicals, whose educational value varies widely, numbered 459 in 1904, of which 439 were in Spanish and 12 in English.

Religion.—The people of Mexico are almost wholly of the Roman Catholic faith, the census of 1900 returning 13,533,013 communicants of that church, 51,795 Protestants (in great part foreigners), 3811 of other faiths, and 18,640 of no faith. The constitution of 1857 grants toleration to all religions, and since 1868 several Protestant denominations have established missions in the towns, but their numbers are still comparatively small. The Roman Catholic religion was enforced at the time of the conquest, but a large percentage of the natives may still be considered semi-pagan, the gods of their ancestors being worshipped in secret, and the forms and tenets of the dominant faith, which they but faintly comprehend, being largely adulterated with superstitions and practices of pagan origin. The church hierarchy consists of 3 archbishops and 23 suffragan bishops. It dates from the creation of the bishopric of Mexico in 1530, with Fray Juan de Zumárraga as bishop, although two previous creations had been proclaimed at Rome, that of Yucatán in 1518 and Puebla in 1525. In 1545 the bishopric of Mexico was elevated to an archbishopric, which in 1863 was divided into three archdioceses—Mexico, Michoacán and Guadalajara. An Inquisition tribunal was established in the capital in 1571, and in 1574 its first *auto-da-fé* was celebrated with the burning of "twenty-one pestilent Lutherans." The Inquisition was active in Mexico during two and a half centuries, and was finally suppressed on the 31st of May 1820. The great power exercised by the Roman Catholic church during the colonial period enabled it not only to mould the spiritual belief of the whole people, but also to control their education, tax their industries, and shape the political policies governing their daily life. In this way it acquired great wealth, becoming the owner of extensive estates in every part of the country and of highly productive properties in the towns. It was said in 1859 that the church owned one-third of the real and personal property of the republic. The reform laws of that year nationalized its property, abolished its numerous orders and institutions and deprived it of state support and of all participation in political affairs. Subsequent legislation removed clerical influence from public instruction, made marriage a civil ceremony and closed all conventual establishments. The church still exercises a boundless influence over the Mexican lower classes, and is still the most influential organization in the republic.

Finance.—The national revenues are derived from import and export duties, port dues and other taxes levied on foreign commerce; from excise and stamp taxes and other charges upon internal business transactions; from direct taxes levied in the federal district and national territories, covering a land tax in rural districts, a house tax in the city, commercial and professional licences, water rates, and sundry taxes on bread, pulque, vehicles, saloons, theatres, &c.; from probate dues and registry fees; from a surcharge on all taxes levied by the states, called the "federal contribution," which is paid in federal revenue stamps; from post and telegraph receipts; and from some minor sources of income. The most fruitful revenue is the duty on imports, which is sometimes used for the protection of national industries, and which yields from 40 to 45% of the total receipts. The excise taxes in 1905 were levied on tobacco, alcohol and alcoholic beverages, and on cotton goods. Mining taxes, which are subject to periodic changes, consist of an initial or registry tax on the claim (*pertenencia*), an annual or rental tax on each claim, and a tax of 3½% (1905) on the export of unrefined gold and silver, 2½% on partially refined ores, and 1½% on pure silver. The expenditures are chiefly for the services of the public debt, military expenses, public works and internal affairs (Department of the Interior). The public debt service alone required $26,201,873 (£2,620,187) in 1908.

For the fiscal year 1906–1907 the revenue produced a total of 114,286,122 *pesos* (dollars), or, approximately, £11,428,612, and the expenditure was 85,076,641 *pesos*, or £8,507,664. The estimates for 1908–1909 show a marked decline owing to the commercial depression, the revenue being computed at 103,385,000 *pesos*, and the expenditure at 103,203,830 *pesos*. Of the former 46,500,000 *pesos* are credited to import duties, 31,930,000 *pesos* to stamps, excise taxes, &c., 10,930,000 *pesos* to direct taxes, and the balance to various sources. Owing to the circumstance that the great majority of the Mexican people own no property, carry on no industry, and are not even to be considered regular productive labourers, the revenues are small in relation to the population and are comparatively inelastic.

The revenues and expenditures of the states and municipalities in 1904, the latest date available, aggregated as follows:—

	Revenue.	Expenditure.
States	24,519,926 pesos	23,557,968 pesos
Municipalities . . .	14,605,022 ,,	14,160,132 ,,

The taxes cover a great variety of occupations and property, often to a minute and vexatious degree, and the expenditure includes the expenses of local administration, schools, police, streets and other objects of purely local interest.

The public indebtedness of Mexico includes a foreign debt payable in gold, an internal debt payable in silver, and a floating debt covering unpaid balances on appropriations, unpaid interest, and other credits and obligations. The paper money issues are by banks and not by the government, and the national treasury keeps no cash in its vaults and has no sinking funds to offset this indebtedness. The foreign debt dates from 1825, when £10,000,000 were borrowed in London through two loans. Interest defaults led to a conversion of the debt in 1851, the interest rate being reduced from 5% to 3%. Further defaults followed and in 1888 another adjustment was made by the issue of 6% gold-bearing bonds. From this time the Mexican government has met its obligations promptly, in consequence of which its credit is rated high and its bonds have even been quoted at a premium. In 1899 the government placed a loan of £22,700,000 in Europe at 5% for the conversion of its 6% bonds, securing it by the hypothecation of 62% of its import and export duties. Further loans have considerably increased the debt since then, but it is still within the normal resources of the country. According to Matias Romero (*Mexico and the United States*, 1898), a new type of indebtedness was inaugurated in 1850 in the shape of an internal debt payable in silver. Other loans and obligations contracted during periods of disorder were afterwards consolidated under this type, and later on unpaid railway subsidies were also included. The rate of interest is from 3% to 5%, and both principal and interest are payable in silver. The rapid development of railway construction has largely increased this part of the public debt, the revenues of the country being insufficient to meet the subsidy obligations, but as the railways are built for the development of valuable resources and the opening of needed trade communications, the increase has occasioned no loss of credit. At the end of 1908 the total public indebtedness of the republic was:—

Foreign, or gold debt, including City of Mexico loan . . .		£30,927,348
Internal, or silver debt . . .	$130,892,100	
Floating debt	860,495	
	$131,752,595 or	£13,175,259
Total		£44,102,607

The fiscal or tax valuation of property throughout the republic in 1904 was computed to be—the fiscal value being two-thirds of the real value:—

Urban	$312,950,983
Rural	488,182,009
Federal District	252,716,454
Total	$1,053,849,446

Previous to 1905 all monetary transactions in Mexico were based in practice on a fluctuating silver standard and free coinage. By a law of the 9th of December 1904, promulgated by an executive decree of the 25th of March 1905, the gold standard was adopted, and the silver *peso*, ·9027 fine and containing 24·438 grammes of pure silver, was made the monetary unit with a valuation of ·75 grammes of gold. At the same time the free coinage of silver was suspended, the government reserving to itself the sole privilege of coining money. The coinage of Mexico, now concentrated at the mint in the capital (all others having been closed) is based (since November 28, 1867) on the decimal system—the *peso* being divided into 100 *centavos*—and consists of gold, silver, nickel and bronze coins, whose weight and fineness are determined by the monetary law of 1904. The coins minted under this law are:—

GOLD: 10 *pesos*, ·900 fine, weighing 8·333⅓ grammes.
5 *pesos*, ,, ,, ,, 4·116⅔ ,,
(the first called a "hidalgo" and the second a "medio hidalgo").

SILVER: 1 *peso*, ·9027 fine, containing 24·438 grammes of pure silver,
50 *centavos*, ·800 fine,
20 " " "
10 " " "
NICKEL: 5 "
BRONZE: 1 and 2 *centavos*, 95 parts copper , 4 tin, 1 zinc.

Provisions are also made for continuing the coinage of "trade dollars" for export, which have a wide circulation in the Orient but are not current at home. Fractional silver coin is not legal tender above 20 *pesos*, and bronze and nickel coins not above 1 *peso*, but the government maintains conversion offices where such coins can be converted into silver *pesos* without loss. The amount of gold in circulation is small, the bank notes convertible into gold taking its place. Foreign coins are permitted to circulate in the republic.

There were 34 chartered banks in Mexico in 1908, of which 29 enjoyed the privilege of issuing bank notes; the total note circulation on the 31st of December 1906 was 97,787,878 *pesos*. These note issues are everywhere current at full nominal value, being secured under the provisions of the national banking law of 1896 by metallic reserves. The notes are not legal tender, and it is forbidden to count them as "cash on hand" in bank returns, but ample safeguards both as to issue and redemption inspire full confidence in their employment as a substitute for gold. Restrictions on speculative operations in real estate and on the use of hypothecated and discounted paper as security for other transactions, together with the publication of detailed monthly balance sheets, have kept these banks free from unsound methods, and their record thus far (1909) has been conspicuously good. Mortgage and loan banks have also been established in accordance with the law of 1896, and are subject to official supervision. Private banks are numerous, but foreign banks are not encouraged to open agencies. The use of cheques is very limited because of the stamp tax.

Weights and Measures.—Mexico adopted the metric system in 1862, and it is used in all official transactions, land measurements, railway calculations and public school work. The old Spanish weights and measures, modified in many particulars, continued in private use, however, and in 1895 it became necessary to declare the metric system the only legal system and to make its use compulsory after the 16th of September 1896.

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(A. J. L.)

HISTORY

I.—Ancient Mexico.

The name Mexico is connected with the name of the group of American tribes calling themselves *Mexica* (sing. *Mexicatl*) or *Azteca*. The word is related to or derived from the name of the Mexican national war-god, Mexitl, better known as Huitzilopochtli. The Aztecs from the 12th century appear to have migrated from place to place over the mountain-walled plateau of *Anahuac*, the country "by the water," so called from its salt lagoons, which is now known as the Valley of Mexico. About 1325 they founded on the lake of Tezcuco the permanent settlement of Mexico Tenochtitlan, which is still represented by the capital city, Mexico. The name Mexico[1] was given by the Spanish conquerors to the group of countries over which the Aztec power more or less prevailed at the time of the European invasion. Clavigero (*Storia antica del Messico*, vol. i.) gives a map of the so-called "Mexican empire," which may be roughly described as reaching from the present Zacatecas to beyond Guatemala; it is noticeable that both these names are of Mexican origin, derived respectively from words for "straw" and "wood." Eventually Mexico and New Mexico came to designate the still vaster region of Spanish North America, which (till cut down by changes which have limited the modern republic of Mexico) reached as far as the Isthmus of Panama on the south and took in California and Texas on the north. Mexico in this wide sense is of high interest to the anthropologist from the several native American civilizations which appear within its limits, and which conveniently if loosely group themselves round two centres, the Mexican proper and the Central American.

When early in the 16th century the Spaniards found their way from the West India Islands to this part of the mainland of America, they discovered not rude and simple tribes like the islanders of the Antilles, but nations with armies, official administrators, courts of justice, high agriculture and mechanical arts, and, what struck the white men especially, stone buildings whose architecture and sculpture were often of dimensions and elaborateness to astonish the builders and sculptors of Europe. Here was a problem which excited the liveliest curiosity and gave rise to a whole literature. Hernandez and Acosta shared the opinion of their time that the great fossil bones found in Mexico were remains of giants, and that, as before the deluge there were giants on the earth, therefore Mexico was peopled from the Old World in antediluvian times. On the other hand the multitude of native American languages suggested that the migration to America took place after the building of the tower of Babel, and Siguenza arrived at the curiously definite result that the Mexicans were descended from Naphtuhim, son of Mizraim and grandson of Noah, who left Egypt for Mexico shortly after the confusion of tongues. Although such speculations have fallen out of date, they induced the collection of native traditions and invaluable records of races, languages and customs, which otherwise would have been lost for ever. Even in the 19th century Lord Kingsborough spent a fortune in printing a magnificent compilation of Mexican picture-writings and documents in his *Antiquities of Mexico* to prove the theory advocated by Garcia a century earlier, that the Mexicans were the lost tribes of Israel. Modern archaeologists approach the question from a different standpoint, but the origin of the American aborigines and of Mexican civilization remains extremely obscure (see AMERICA, where the primitive Mexican cultures are fully illustrated, and CENTRAL AMERICA).

Real information as to the nations of Mexico before Spanish times is very imperfect, but not altogether wanting. The accurate and experienced Alexander von Humboldt considered the native Americans of both continents to be substantially similar in race-characters. Such a generalization will become sounder, if, as is now generally done by anthropologists, the Eskimo with their pyramidal skulls, dull complexion and flat noses are removed into a division by themselves. Apart from these polar nomads, the American indigenes group roughly into a single division of mankind, of course with local variations. If our attention is turned to the natives of Mexico especially, the unity of type will be found particularly close. The native population of the plateau of Mexico, mainly Aztecs, may still be seen by thousands without any trace of mixture of European blood. Their stature is estimated to be about 5 ft. 3 in., but they are of muscular and sturdy build. Measurements of their skulls show them mesocephalic (index about 78), or intermediate between the dolichocephalic and brachycephalic types of mankind. The face is oval, with low forehead, high cheek-bones, long eyes sloping outward towards the temples, fleshy lips, nose wide and in some cases flattish but in others aquiline, coarsely moulded features, with a stolid and gloomy expression. Thickness of skin, masking the muscles, has been thought the cause of a peculiar heaviness in the outlines of body and face; the complexion varies from yellow-brown to chocolate (about 40 to 43 in the anthropological scale); eyes black; straight coarse glossy black hair; beard and moustache scanty. Among variations from this type may be mentioned higher stature in some districts, and lighter complexion in Tehuantepec and elsewhere. If now the native Americans be compared with the races of the regions across the oceans to their east and west, it will be seen that their unlikeness is extreme to the races eastward of them, whether white Europeans or black Africans. On the other hand they are considerably like the Mongoloid peoples of north and east Asia (less so to the Polynesians); so that the general tendency among anthropologists has been to admit a common origin, however remote, between the tribes of Tartary and of America. This original connexion, if it may be accepted, would seem to belong to a long-past period, to judge from the failure of all attempts to discover an affinity between the languages of America and Asia. At whatever date the Americans began to people America, they must have had time to import or develop the numerous families of languages actually found there, in none of which has community of origin been satisfactorily proved with any other language-group at home or abroad. In Mexico itself the languages of the Nahua nations, of which the Aztec is the best-known dialect, show no connexion of origin with the language of the Otomi tribes, nor either of these with the languages of the regions of the ruined cities of Central America, the Quiché of Guatemala and the Maya of Yucatan. The remarkable phenomenon of nations so similar in bodily make but so distinct in language can hardly be met except by supposing a long period to have elapsed since the country was first inhabited by the ancestors of peoples whose language has since passed into so different forms. The original peopling of America might then well date from the time when there was continuous land between it and Asia.

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[1] In this, as in all other Aztec names, the *x* (or *j*) represents the English sound *sh*; hence *Mexitli* and *Mexico* should be properly pronounced *Meshitli*, *Meshico*. But they do not appear to have ever been so pronounced by the Spaniards, who naturally gave to the *x* its ordinary Spanish sound of the German *ch*.

It would not follow, however, that between these remote ages and the time of Columbus no fresh immigrants can have reached America. We may put out of the question the Scandinavian sea-rovers who sailed to Greenland about the 10th century. But at all times communication has been open from east Asia, and even the South Sea Islands, to the west coast of America. The importance of this is evident when we consider that late in the 19th century Japanese junks still drifted over by the ocean current to California at the rate of about one a year, often with some of the crew still alive. Further north, the Aleutian islands offer a line of easy sea passage, while in north-east Asia, near Bering's Strait, live Chukchi tribes who carry on intercourse with the American side. Moreover there are details of Mexican civilization which are most easily accounted for on the supposition that they were borrowed from Asia. They do not seem ancient enough to have to do with a remote Asiatic origin of the nations of America, but rather to be results of comparatively modern intercourse between Asia and America. Humboldt (*Vues des Cordillères*, Pl. xxiii.) compared the Mexican calendar with that in use in eastern Asia. The Mongols, Tibetans, Chinese and other neighbouring nations have a cycle or series of twelve animals, viz. rat, bull, tiger, hare, dragon, serpent, horse, goat, ape, cock, dog, pig, which may possibly be an imitation of the ordinary Babylonian-Greek zodiac familiar to ourselves. The Mongolian peoples not only count their lunar months by these signs, but they reckon the successive days by them, rat-day, bull-day, tiger-day, &c., and also, by combining the twelve signs in rotation with the elements, they obtain a means of marking each year in the sixty-year cycle, as the wood-rat year, the fire-tiger year, &c. This method is highly artificial, and the reappearance of its principle in the Mexican and Central American calendar is suggestive of importation from Asia. Humboldt also discussed the Mexican doctrine of four ages of the world belonging to water, earth, air and fire, and ending respectively by deluge, earthquake, tempest and conflagration. The resemblance of this to some versions of the Hindu doctrine of the four ages or yuga is hardly to be accounted for except on the hypothesis that the Mexican theology contains ideas learnt from Asiatics. Among Asiatic points of resemblance to which attention has since been called is the Mexican belief in the nine stages of heaven and hell, an idea which nothing in nature would suggest directly to a barbaric people, but which corresponds to the idea of successive heavens and hells among Brahmans and Buddhists, who apparently learnt it (in common with our own ancestors) from the Babylonian-Greek astronomical theory of successive stages or concentric planetary spheres belonging to the planets, &c. The Spanish chronicles also give accounts of a Mexican game called *patolli*, played at the time of the conquest with coloured stones moved on the squares of a cross-shaped figure, according to the throws of beans marked on one side; the descriptions of this rather complicated game correspond closely with the Hindu backgammon called *pachisi* (see Tylor in *Jour. Anthrop. Inst.*, viii. 116).

The native history of Mexico and Central America is entitled to more respect than the mere recollections of savage tribes. The Mexican pictures so far approached writing proper as to set down legibly the names of persons and places and the dates of events, and at least helped the professional historians to remember the traditions repeated orally from generation to generation. Thus actual documents of native Aztec history, or copies of them, are still open to the study of scholars, while after the conquest interpretations of these were drawn up in writing by Spanish-educated Mexicans, and histories founded on them with the aid of traditional memory were written by Ixtilxochitl and Tezozomoc. In Central America the rows of complex hieroglyphs to be seen sculptured on the ruined temples probably served a similar purpose. The documents written by natives in later times thus more or less represent real records of the past, but the task of separating myth from history is of the utmost difficulty. Among the most curious documents of early America is the *Popol-Vuh* or national book of the Quiché kingdom of Guatemala, a compilation of traditions written down by native scribes, found and translated by Father Ximenez about 1700, and published by Scherzer (Vienna, 1857) and Brasseur de Bourbourg (Paris, 1861). This book begins with the time when there was only the heaven with its boundaries towards the four winds, but as yet there was no body, nothing that clung to anything else, nothing that balanced itself or rubbed together or made a sound; there was nought below but the calm sea alone in the silent darkness. Alone were the Creator, the Former, the Ruler, the Feathered Serpent, they who give being and whose name is Gucumatz. Then follows the creation, when the creators said "Earth," and the earth was formed like a cloud or a fog, and the mountains appeared like lobsters from the water, cypress and pine covered the hills and valleys, and their forests were peopled with beasts and birds, but these could not speak the name of their creators, but could only chatter and croak. So man was made first of clay, but he was strengthless and senseless and melted in the water; then they made a race of wooden mannikins, but these were useless creatures without heart or mind, and they were destroyed by a great flood and pitch poured down on them from heaven, those who were left of them being turned into the apes still to be seen in the woods. After this comes the creation of the four men and their wives who are the ancestors of the Quichés, and the tradition records the migrations of the nation to Tulan, otherwise called the Seven Caves, and thence across the sea, whose waters were divided for their passage. It is worth while to mention these few early incidents of the national legend of Guatemala, because their Biblical incidents show how native tradition incorporated matter learnt from the white men. Moreover, this Central American document, mythical as it is, has an historical importance from its bringing in names belonging also to the traditions of Mexico proper. Thus Gucumatz, "Feathered Serpent" corresponds in name to the Mexican deity Quetzalcoatl; Tulan and the Seven Caves are familiar words in the Aztec migration traditions, and there is even mention of a chief of Toltecat, a name plainly referring to the famed Toltecs. Thus the legends of the *Popol-Vuh* confirm what is learnt from comparing the culture of Central America and Mexico proper, that, though these districts were not connected by language, the intercourse between them had been sufficient to justify the anthropologist in including both districts in one region. Historical value of the ordinary kind may be found in the latter part of the *Popol-Vuh*, which gives names of chiefs down to the time when they began to bear Spanish names and the great city of Quiché became the deserted ruin of Santa Cruz. The Maya district of Yucatan has also some vestiges of native traditions in the manuscript translated by D. Pio Perez (in Stephens, *Incidents of Travel in Yucatan*) and in the remarkable 16th century *Relacion de las cosas de Yucatan* by Diego de Landa, published by Brasseur de Bourbourg (Paris, 1864). As in the Guatemala traditions, we hear of ancient migration from the Mexican legendary region of Tula; and here the leaders are four famous chiefs or ancestors who bear the Aztec name of the Tutul-Xiu, which means "Bird-Tree." Unfortunately for the historical standing of these four ancestors, there are in the Aztec picture-writings representations of four trees, each with a bird perched on it, and placed facing the four quarters, which make it probable that the four Tutul-Xiu of tradition may be only mythic personifications of the four cardinal points (see Schultz-Sellack in *Zeitschr. f. Ethn.*, 1879, p. 209). Nevertheless, part of the later Maya records may be genuine—for instance, when they relate the war about three centuries before the Spanish conquest, when the king of Chichen-Itza destroyed the great city of Mayapan. Though the Central American native kings have too little interest for traditions of them to be dwelt on here, they bring into view one important historical point—that the ruined cities of this region are not monuments of a forgotten past, but that at least some of them belong to history, having been inhabited up to the conquest, apparently by the very nations who built them.

Turning now to the native chronicles of the Mexican nations, these are records going back to the 12th or 13th century, with some vague but not worthless recollections of national events from times some centuries earlier. These traditions, in some measure borne out by linguistic evidence of names, point to the immigration of detachments of a widespread race speaking a common language, which is represented by the Aztec, still a spoken language in Mexico. This language was called *nahuatl*, and one who spoke it as his native tongue was called *nahuatlacatl*, so that modern anthropologists are following native precedent when they use the term *Nahua* for the whole series of peoples now under consideration. Earliest of the Nahua nations, the Toltecs are traditionally related to have left their northern home of Huehuetlapallan in the 6th century; and there is other evidence of the real existence of the nation. Their name *Toltecatl* signifies an inhabitant of *Tollan* (land of reeds), a place which has a definite geographical site in the present Tulan or Tula, north of the valley of Anahuac, where a Toltec kingdom seems to have had its centre. To this nation was due the introduction of maize and cotton into Mexico, the skilful workmanship in gold and silver, the art of building on a scale of vastness still witnessed to by the mound of Cholula, said to be Toltec work, and the Mexican hieroglyphic writing and calendar. With the Toltecs is associated the tradition of Quetzalcoatl, a name which presents itself in Mexican religion as that of a great deity, god of the air, and in legend as that of a saintly ruler and civilizer. His brown and beardless worshippers describe him as of another race, a white man with noble features, long black hair and full beard, dressed in flowing robes. He came from Tulan or from Yucatan (for the stories differ widely), and dwelt twenty years among them, teaching men to follow his austere and virtuous life, to hate all violence and war, to sacrifice no men or beasts on the altars, but to give mild offerings of bread and flowers and perfumes, and to do penance by the votaries drawing blood with thorns from their own bodies. Legend tells stories of his teaching men picture-writing and the calendar, and also the artistic work of the silversmith, for which Cholula was long famed; but at last he departed, some say towards the unknown land of Tlapallan, but others to Coatzacoalcos on the Atlantic coast on the confines of Central America, where native tradition still keeps up the divine names of Gucumatz among the Quichés and Cukulcan among the Mayas, these names have the same meaning as Quetzalcoatl in Aztec, viz. "Feathered Serpent." Native tradition held that when Quetzalcoatl reached the Atlantic he sent back his companions to tell the Cholulans that in a future age his brethren, white men and bearded like himself, should land there from the sea where the sun rises and come to rule the country. That there is a basis of reality in the Toltec traditions is shown by the word *toltecatl* having become among the later Aztecs a substantive signifying an artist or skilled craftsman. It is further related by the Mexican historians that the Toltec nation all but perished in the 11th century by years of drought, famine and pestilence, a few only of the survivors remaining in the land, while the rest migrated into Yucatan and Guatemala. After the Toltecs came the Chichimecs, whose name, derived from *chici*, dog, is applied to many rude tribes; they are said to have come from Amaquemecan under a king named Xolotl, names which being Aztec imply that the nation was Nahua; at any rate they appear afterwards as fusing with more cultured Nahua nations in the neighbourhood of Tezcuco. Lastly is recorded the Mexican immigration of the seven nations, Xochimilca, Chalca, Tepaneca, Acolhua, Tlahuica, Tlascalteca, Azteca. This classification of the Nahuatlac tribes has a meaning and value. It is true that Aztlan, the land whence the Aztecs traced their name and source, cannot be identified, but the later stages of the long Aztec migration seem historical, and the map of Mexico still shows the names of several settlements recorded in the curious migration map, published by Gemelli Careri (*Giro del mondo*, Venice, 1728) and commented on by Humboldt; among these local names are Tzompanco, "place of skulls," now Zumpango in the north of the Mexican valley, and Chapultepec, "grasshopper hill," now a suburb of the city of Mexico itself, where the Aztecs are recorded to have celebrated in 1195 the festival of tying up the "bundle of years" and beginning a new cycle.

The Aztecs moving from place to place in Anahuac found little welcome from the Nahua peoples already settled there. One of the first clear events of the Aztec arrival is their being made tributary by the Tepanecs, in whose service they showed their warlike prowess in the fight near Tepeyacac, where now stands the famous shrine of Our Lady of Guadalupe. Thus they overcame the Acolhuas, who had made Tezcuco a centre of prosperity. By the 13th century the Aztecs by their ferocity had banded their neighbours together against them; some were driven to take refuge on the reedy lake shore at Acoculco, while others were taken as captives into Culhuacan. The king of this district was Coxcoxtli, whose name has gained an undeserved reputation even in Europe as "Coxcox, the Mexican Noah," from a scene in the native picture-writing where his name appears together with the figure of a man floating in a dug-out tree, which has been mistaken even by Humboldt for a representation of the

Mexican deluge-myth. Coxcoxtli used the help of the Aztecs against the Xochimilco people; but his own nation, horrified at their bloodthirsty sacrifice of prisoners, drove them out to the islands and swamps of the great salt lagoon, where they are said to have taken to making their *chinampas* or floating gardens of mud heaped on rafts of reeds and brush, which in later times were so remarkable a feature of Mexico. As one of the Aztec chiefs at the time of the founding of their city was called Tenoch, it is likely that from him was derived the name Tenochtitlan or "Stone-cactus place." Written as this name is in pictures or rebus, it probably suggested the invention of the well-known legend of a prophecy that the war-god's temple should be built where a prickly pear was found growing on a rock, and perched on it an eagle holding a serpent; this legend is still commemorated on the coins of Mexico. Mexico-Tenochtitlan, founded about 1325, for many years afterwards probably remained a cluster of huts, and the higher civilization of the country was still to be found, especially among the Acolhuas in Tezcuco. The wars of this nation with the Tepanecs, which went on into the 15th century, were merely destructive, but larger effects arose from the expeditions under the Culhua king Acamapichtli, where the Aztec warriors were prominent, and which extended far outside the valley of Anahuac. Especially a foray southward to Quauhnahuac, now Cuernavaca, on the watershed between the Atlantic and Pacific, brought goldsmiths and other craftsmen to Tenochtitlan, which now began to rise in arts, the Aztecs laying aside their rude garments of aloe-fibre for more costly clothing, and going out as traders for foreign merchandise. In the 14th century the last great national struggle took place. The Acolhuas had at first the advantage, but Ixtlilxochitl did not follow up the beaten Aztecs but allowed them to make peace, whereupon, under professions of submission, they fell upon and sacked the city of Tezcuco. The next king of Tezcuco, Nezahualcoyotl, turned the course of war, when Azcapuzalco, the Tepanec stronghold, was taken and the inhabitants sold as slaves by the conquering Acolhuas and Aztecs; the place thus degraded became afterwards the great slave-market of Mexico. In this war we first meet with the Aztec name Moteuczoma, afterwards so famous in its Spanish form Montezuma. About 1430 took place the triple alliance of the Acolhua, Aztec and Tepanec kings, whose capitals were Tezcuco, Mexico and Tlacopan, the latter standing much below the other two. In fact the rest of native history may be fairly called the Aztec period, notwithstanding the magnificence and culture which make Tezcuco celebrated under Nezahualcoyotl and his son Nezahualpilli. When the first Moteuczoma was crowned king of the Aztecs, the Mexican sway extended far beyond the valley plateau of its origin, and the gods of conquered nations around had their shrines set up in Tenochtitlan in manifest inferiority to the temple of Huitzilopochtli, the war-god of the Aztec conquerors. The rich region of Quauhnahuac became tributary; the Miztec country was invaded southward to the Pacific, and the Xicalanca region to what is now Vera Cruz. It was not merely for conquest and tribute that the fierce Mexicans ravaged the neighbour-lands, but they had a stronger motive than either in the desire to obtain multitudes of prisoners whose hearts were to be torn out by the sacrificing priests to propitiate a pantheon of gods who well personified their bloodthirsty worshippers. (E. B. T.)

Ancient Civilization.

Government.

While the prairie tribes of America lived under the loose sway of chiefs and councils of old men, the settled nations of Mexico had attained to a highly organized government. This may be seen by the elaborate balance of power maintained in the federation of Mexico, Tezcuco and Tlacopan, where each king was absolute in his own country, but in war or other public interests they acted jointly, with powers in something like the proportion in which they divided conquered lands and spoil, which was two-fifths each to Mexico and Tezcuco and one-fifth to Tlacopan. The successor of the Aztec king was customarily a chosen brother or nephew, the eldest having the first claim unless set aside as incompetent; this mode of succession, which has been looked on as an elaborate device for securing practical advantages, seems rather to have arisen out of the law of choice among the descendants of the female line, found in American tribes of much lower culture. Something like this appears in the succession of kings of Tezcuco and Tlacopan, which went to sons by the principal wife, who was usually of the Aztec royal family. The Mexican chronicles, however, show instances of the king's son succeeding or of powerful chiefs being elected to the kingship. The term republic is sometimes used to describe the little state of Tlascala, but this was in fact a federation of four chiefs, with an assembly of nobles. In the Zapotec district the Wiyatao or high-priest of Zopaa was a divine ruler before whom all prostrated themselves with faces to the ground; he was even too sacred to allow his foot to touch the earth, and was only seen carried in a litter.

Palaces, &c.

The accounts of the palaces of the native kings must be taken with some reserve, from the tendency to use descriptive terms not actually untrue, but which convey erroneous ideas taken from European architecture; thus what are called columns of porphyry and jasper supporting marble balconies might perhaps be better described as piers carrying slabs, while the apartments and terraces must have been more remarkable for number and extent than architectural grandeur, being but low one-storied buildings. The principal palace of Mexico consisted of hundreds of rooms ranged round three open squares, of such extent that one of the companions of Cortes records having four times wandered about till he was tired, without seeing the whole. Not less remarkable was the palace of Tezcuco, surrounded with its groves and pleasure-gardens; and, though now hardly anything remains of the buildings above ground, the neighbouring hill of Tezcotzinco still has its stone steps and terraces; and the immense embankment carrying the aqueduct-channel of hewn stone which supplied water to basins cut in the solid rock still remains to prove that the chroniclers' descriptions, if highly coloured, were at any rate genuine. Till the 18th century the gigantic figures of Axayacatl and his son Montezuma were to be seen carved in the porphyry hill of Chapultepec, but these as well as the hanging gardens have been destroyed, and only the groves of *ahuehuete* (cypress) remain of the ancient beauties of the place. That in the palace gardens flowers from the *tierra caliente* were transplanted, and water-fowl bred near fresh and salt pools fit for each kind, that all kinds of birds and beasts were kept in well-appointed zoological gardens, where there were homes even for alligators and snakes—all this testifies to a cultivation of natural history which was really beyond the European level of the time. From the palaces and retinues of thousands of servants attached to the royal service may be inferred at once the despotic power of the Mexican rulers and the heavy taxation of the people; in fact some of the most remarkable of the picture-writings are tribute-rolls enumerating by hundreds and thousands the mantles, ocelot-skins, bags of gold-dust, bronze hatchets, loads of chocolate, &c., furnished periodically by the towns. Below the king was a numerous and powerful class of nobles, the highest of whom (*tlatoani*) were great vassals owing little more than homage and tribute to their feudal lord, while the natural result of the unruliness of the noble class was that the king to keep them in check increased their numbers, brought them to the capital as councillors, and balanced their influence by military and household officers, and by a rich and powerful merchant class. The nobles not only had privileges of rank and dignity, but substantial power over the plebeian or peasant class (*macehualli*). The greatest estates belonged to the king, or had been granted to military chiefs whose sons succeeded them, or were the endowments of temples, but the *calpulli* or village community still survived, and each freeman of the tribe held and tilled his portion of the common lands. Below the freemen were the slaves, who were war-captives, persons enslaved for punishment, or children sold by their parents. Prisoners of war were mostly doomed to sacrifice, but other classes of slaves were mildly treated, retaining civil rights, and their children were born free.

Justice.

The superior courts of law formed part of the palace, and there were tribunals in the principal cities, over each of which presided a supreme judge or *cihuacoatl*, who was irremovable, and whose criminal decisions not even the king might reverse; he appointed the lower judges and heard appeals from them; it is doubtful whether he judged in civil cases, but both kinds of suits were heard in the court below, by the *tlacatecatl* and his two associates, below whom were the ward-magistrates. Lands were set apart for the maintenance of the judges, and indeed nothing gives a higher idea of the elaborate civilization of Mexico than this judicial system, which culminated in a general court and council of state presided over by the king. The laws and records of suits were set down in picture-writings, of which some are still to be seen; sentence of death was recorded by drawing a line with an arrow across the portrait of the condemned, and the chronicles describe the barbaric solemnity with which the king passed sentence sitting on a golden and jewelled throne in the divine tribunal, with one hand on an ornamented skull and the golden arrow in the other. Among the resemblances to old-world law was the use of a judicial oath, the witness touching the ground with his finger and putting it to his lips, thus swearing by Mother Earth. The criminal laws were of extreme severity, even petty theft being punished by the thief being enslaved to the person he had robbed, while to steal a tobacco pouch or twenty ears of corn was death; he who pilfered in the market was then and there beaten to death, and he who insulted Xipe, the god of the gold- and silversmiths, by stealing his precious metal, was skinned alive and sacrificed to the offended deity. Though aloe-beer or "pulque" was allowed for feasts and to invalids in moderation, and old people over seventy seem to be represented in one of the picture-writings as having liberty of drunkenness, young men found drunk were clubbed to death and young women stoned. For such offences as witchcraft, fraud, removing landmarks, and adultery the criminal had his heart cut out on the altar, or his head crushed between two stones, while even lesser punishments were harsh, such as that of slanderers, whose hair was singed with a pine-torch to the scalp.

War. Based on conquest as the Aztec kingdom was, and with the most bloodthirsty religion the world ever saw, the nation was, above all, a fighting community. To be a tried soldier was the road to honour and office, and the king could not be enthroned till he had with his own hand taken captives to be butchered on the war-god's altar at his coronation. The common soldiers were promoted for acts of daring, and the children of chiefs were regularly trained to war, and initiated by being sent into battle with veterans, with whose aid the youth took his first prisoner, but his future rise depended on how many captives he took unaided in fight with warlike enemies; by such feats he gained the dignity of wearing coloured blankets, tassels and lip-jewels, and reached such military titles as that of "guiding eagle." The Mexican military costumes are to be seen in the picture-writings, where the military orders of princes, eagles and tigers are known by their braided hair, eagles' beaks and spotted armour. The common soldiers went into battle brilliant in savage war-paint, but those of higher rank had helmets like birds and beasts of prey, armour of gold and silver, wooden greaves, and especially the *ichcapilli*, the quilted cotton tunic two fingers thick, so serviceable as a protection from arrows that the Spanish invaders were glad to adopt it. The archers shot well and with strong bows, though their arrows were generally tipped only with stone or bone; their shields or targets, mostly round, were of ordinary barbaric forms; the spears or javelins had heads of obsidian or bronze, and were sometimes hurled with a spear-thrower or *atlatl*, of which pictures and specimens still exist, showing it to be similar in principle to those used by the Australians and Eskimo. The most characteristic weapon of the Mexicans was the *maquahuitl* or "hand-wood," a club set with two rows of large sharp obsidian flakes, a well-directed blow with which would cut down man or horse. These two last-mentioned weapons have the look of highly developed savage forms, while on the other hand the military organization was in some respects equal to that of an Asiatic nation, with its regular companies commanded each by its captain and provided with its standard. The armies were very large, an expedition often consisting of several divisions, each numbering eight thousand men; but the tactics of the commanders were quite rudimentary, consisting merely of attack by arrows and javelins at a distance, gradually closing into a hand-to-hand fight with clubs and spears, with an occasional feigned retreat to draw the enemy into an ambuscade. Fortification was well understood, as may still be seen in the remains of walled and escarped strongholds on hills and in steep ravines, while lagoon-cities like Mexico had the water approaches defended by fleets of boats and the causeways protected by towers and ditches; even after the town was entered, the pyramid-temples with their surrounding walls were forts capable of stubborn resistance. It was held unrighteous to invade another nation without a solemn embassy to warn their chiefs of the miseries to which they exposed themselves by refusing the submission demanded, and this again was followed by a declaration of war, but in Mexico this degenerated into a ceremonial farce, where tribute was claimed or an Aztec god was offered to be worshipped in order to pick a quarrel as a pretext for an invasion already planned to satisfy the soldiers with lands and plunder, and to meet the priests' incessant demands for more human sacrifices.

Religion. Among the accounts of the Mexican religion are some passages referring to the belief in a supreme deity. The word *teotl*, god, has been thought in some cases to bear this signification, but its meaning is that of deity in general, and it is applied not only to the sun-god but to very inferior gods. It is related that Nezahualcoyotl, the poet-king of Tezcuco, built a nine-storied temple with a starry roof above, in honour of the invisible deity called Tloquenahuaque, "he who is all in himself," or Ipalnemoani, "he by whom we live," who had no image, and was propitiated, not by bloody sacrifices, but by incense and flowers. These divinities, however, seem to have had little or no place in the popular faith, which was occupied by polytheistic gods of the ordinary barbaric type. Tezcatlipoca was held to be the highest of these, and at the festival of all the gods his footsteps were expected to appear in the flour strewn to receive this sign of their coming. He was plainly an ancient deity of the race, for attributes of many kinds are crowded together in him. Between him and Quetzalcoatl, the ancient deity of Cholula, there had been old rivalry. As is *related in the legends, Quetzalcoatl* came into the land to teach men to till the soil, to work metals and to rule a well-ordered state; the two gods played their famous match at the ball-game, and Tezcatlipoca persuaded the weary Quetzalcoatl to drink the magic pulque that sent him roaming to the distant ocean, where he embarked in his boat and disappeared from among men.[1] These deities are not easily analysed, but on the other hand Tonatiuh and Metztli, the sun and moon, stand out distinctly as nature gods, and the traveller still sees in the huge adobe pyramids of Teotihuacan, with their sides oriented to the four quarters, an evidence of the importance of their worship. The war-god Huitzilopochtli was the real head of the Aztec pantheon; his idol remains in Mexico, a huge block of basalt on which is sculptured on the one side his hideous personage, adorned with the humming-bird feathers on the left hand which signify his name, while the not less frightful war-goddess Teoyaomiqui, or "divine war-death," occupies the other side. Centeotl, the goddess of the all-nourishing maize, was patroness of the earth and mother of the gods, while Mictlanteuctli, lord of dead-land, ruled over the departed in the dim under-world. There were numbers of lesser deities, such as Tlazolteotl, goddess of pleasure, worshipped by courtesans, Tezcatzoncatl, god of strong drink, whose garment in grim irony clothed the drunkard's corpse, and Xipe, patron of the goldsmiths. Below these were the nature-spirits of hills and groves, whose shrines were built by the roadside. The temples were called *teocalli* or "god's house," and rivalled in size as they resembled in form the temples of ancient Babylon. They were pyramids on a square or oblong base, rising in successive terraces to a small summit-platform. The great teocalli of Huitzilopochtli in the city of Mexico stood in an immense square, whence radiated the four principal thoroughfares, its courtyard being enclosed by a square, of which the stone wall, called the *coatepantli* or serpent-wall from its sculptured serpents, measured nearly a quarter of a mile on each side. In the centre, the oblong pyramid of rubble cased with hewn stone and cemented 375 × 300 ft. at the base, and rising steeply in five terraces to the height of 86 ft., showed conspicuously to the city the long processions of priests and victims winding along the terraces and up to corner flights of steps. On the paved platform were three-storey tower temples in whose ground-floor stood the stone images and altars, and before that of the war-god the green stone of sacrifice, humped so as to bend upward the body of the victim that the priest might more easily slash open the breast with his obsidian knife, tear out the heart and hold it up before the god, while the captor and his friends were waiting below for the carcase to be tumbled down the steps for them to carry home to be cooked for the feast of victory. Before the shrines reeking with the stench of slaughter the eternal fires were kept burning, and on the platform stood the huge drum, covered with snakes' skin, whose fearful sound was heard for miles. From the terrace could be seen seventy or more other temples within the enclosure, with their images and blazing fires, and the *tzompantli* or "skull-place," where the skulls of victims by tens of thousands were skewered on cross-sticks or built into towers. There also might be seen the flat circular *temalacatl* or "spindle-stone," where captives armed with wooden weapons were allowed the mockery of a gladiatorial fight against well-armed champions. The great pyramid of Cholula with its hemispherical temple of Quetzalcoatl at the top, now an almost shapeless hill surmounted by a church, was about thrice as long and twice as high as the teocalli of Mexico. A large fraction of the Mexican population were set apart as priests or attendants to the services of the gods. The rites performed were such as are found elsewhere—prayer, sacrifice, processions, dances, chants, fasting and other austerities, but there are some peculiarities of detail. Prayers and other formulas have been copied down by Sahagun and other chroniclers, of endless prolixity, but not without occasional touches of pathos. These prayers seem essentially genuine; indeed there was no European model from which they could have been imitated; but at the same time it must be remembered that they come down in Spanish writing, and not untouched by Spanish influence, as in one passage where there is a mention of sheep, an animal unknown to the Mexicans. As to sacrifice, maize and other vegetables were offered, and occasionally rabbits, quails, &c., but, in the absence of cattle, human sacrifice was the chief rite, and cannibalism prevailed at the feasts. Incense was constantly used, especially the *copalli* (copal) well known to us for varnish; little terra-cotta censers are among the commonest of Mexican antiquities. Long and severe religious fasts were customary at special seasons, and drawing blood from the arms, legs and body, by thrusting in aloe-thorns, and passing sharp sticks through the tongue, was an habitual act of devotion recalling the similar practices of devotees in India. The calendar of religious festivals for the Mexican year has been preserved. Each 20-day period had one or more such celebrations. In the month of the "diminishing of waters" the rain gods or Tlalocs were propitiated by a procession of priests with music of flutes and trumpets carrying on plumed litters infants with painted faces, in gay clothing with coloured paper wings, to be sacrificed on the mountains or in a whirlpool in the lake. It is said that the people wept as they passed by; but if so this may have been a customary formality, for the religion of these nations must have quenched all human sympathy. In the next month the god Xipe-totec, already mentioned, had his festival called the "flaying of men" from the human victims being flayed, after their hearts were torn out, for young men to dress in their skins and perform dances and sham fights. The succeeding festival of Camaxtli was marked by a severe fast of the priests, after which stone knives were prepared with which a hole was cut through the tongue of each, and numbers of sticks passed through. For the great festival of Tezcatlipoca, the handsomest and noblest of the captives of the year had been chosen as the incarnate representative of the god, and paraded the streets for public adoration dressed in an embroidered mantle with feathers and garlands on his head and a retinue like a king; for the last month they married him to four girls representing four goddesses; on the last day wives and pages escorted him to the little temple of Tlacochcalco, where he mounted the stairs, breaking an earthenware flute against each step; this was a symbolic farewell to the joys of the world, for as he reached the top he was seized by the priests, his heart torn out and held up to the sun, his head spitted on the tzompantli, and his body eaten as sacred food, the people drawing from his fate the moral lesson that riches and pleasure may turn into poverty and sorrow. The manner of the victim's death in these festivals afforded scope for variety; they dressed them and made them dance in character, threw them into the fire for the fire-god, or crushed them between two balanced stones at the harvest-festival. The ordinary pleasures of festivals were mingled with all this, such as dances in beast-masks, sham fights and children's games, but the type of a religious function was a sickening butchery followed by a cannibal feast.

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[1] One of the most important sources for the ancient Mexican traditions and myths is the so-called "Codex Chimalpopoca," a manuscript in the Mexican language discovered by the Abbé Brasseur de Bourbourg. It is the interpretation of different mythological and historical Mexican picture-writings, composed by an anonymous author some time after the conquest and copied by Fernando de Alva (Ixtlilxochitl, 1568–1648). It belonged to the priceless collection of Mexican documents brought together in the 18th century by Lorenzo Boturini (see his "Catálogo del Museo historico indiano," appendix of his *Idea de una nueva historia general de la America septentrional*, Madrid, 1746, § viii., No. 13). It is named there *Historia de los reynos de Colhuacan y de Mexico*. Other copies of the same manuscript, made by Leon y Gama, José Pichardo, Aubin and Brasseur, exist in the Paris National Library in the Aubin-Goupil collection. Brasseur died before he could realize his plan to publish the whole MS. in Nahuatl with a translation. Some extracts are to be found in his *Histoire des nations civilisées du Mexique*, and in Leon y Gama, *Dos Piedras* . . . , ed. Bustamente (Mexico, 1832). Larger fragments of the Ixtlilxochitl copy were published in the *Anales del museo nacional de Mexico*, tom. iii., appx. pp. 7–70; but in this edition the Mexican text is very corrupt, and the two Spanish translations are by no means exact. The Paris MSS. and the Ixtlilxochitl copy were carefully collated by Dr Walter Lehmann (see *Zeitschrift für Ethnologie*, 1906, pp. 752–760; *Journal de la Société des Américanistes de Paris, nouv. sér.* vol. iii. No. 2; Dr E. Seler, *Verhandlungen des XVI. Internationalen Amerikanisten-Kongresses*, Vienna, 1909, II., pp. 129–150). The precious Ixtlilxochitl copy was found by Lehmann in the library of the National Museum of México, and arrangements were made for the publication of the whole MS. by him in conjunction with Professor E. Seler. Another very important MS. was discovered by Dr Lehmann, in Guatemala. It is the MS. of Father Francisco Ximenez, *Historia de la Provincia de San Vicente de Chiapa y de Guatemala*, in three big volumes in folio, which contain the famous Spanish translation of the Quiché myths or the "Popol-Vuh." The MS. was bought at the expense of the duke of Loubat, who decided to present it, after the death of Dr Lehmann, to the Royal Library at Berlin.

Picture-writing.

The Mexican priesthood were much concerned with the art of picture-writing, which they used systematically as a means of recording religious festivals and legends, as well as keeping calendars of years and recording the historical events which occurred in them. Facsimiles of several of these interesting documents, with their translations, may be seen in Kingsborough; splendid reproductions of the beautiful Mexican and Mixteco-Zapotecan codices have also been published at the expense of the duke of Loubat and by the "Junta Colombina" (Mexico, 1892). Gods are represented with their appropriate attributes—the fire-god hurling his spear, the moon-goddess with a shell, &c.; the scenes of human life are pictures of warriors fighting with club and spear, men paddling in canoes, women spinning and weaving, &c. An important step towards phonetic writing appears in the picture-names of places and persons. The simplest forms of these depict the objects signified by the name, as where *Chapultepec* or "grasshopper-hill" is represented by a grasshopper on a hill, or a stone with a cactus on it stands for *Tenoch* or "stone-cactus," the founder of *Tenochtitlan*. The system had, however, risen a stage beyond this when objects were drawn to represent, not themselves, but the syllables forming their names, as where a trap, an eagle, a pricker, and a hand are put together not to represent these objects, but in order that the syllables of their names *mo-quauh-zo-ma* should spell the word Moquauhzoma (see Aubin's introduction to Brasseur, *Hist. du Mexique*, i. 68.). The analogy of this to the manner in which the Egyptian hieroglyphs passed into phonetic signs is remarkable, and writing might have been invented anew in Mexico had it not been for the Spanish conquest. The Aztec numerals, which were vigesimal or reckoned by scores, were depicted by dots or circles up to 20, which was represented by a flag, 400 (a score of scores) by a feather, and 8000 (a score of scores of scores) by a purse; but for convenience these symbols might be halved and quartered, so that 534 might be shown by one feather, one quarter of a feather, one flag, one-half of a flag, and four dots. The Mexican calendar depended on the combination of numbers with picture-signs, of which the four principal were the rabbit, reed, flint, house—*tochtli*, *acatl*, *tecpatl*, *calli*. The cycle of 52 years was reckoned by combining these signs in rotation with numbers up to 13, thus: 1 rabbit, 2 reed, 3 flint, 4 house, 5 rabbit, 6 reed, &c. By accident this calendar may be exactly illustrated with a modern pack of cards laid out in rotation of the four suits, as, ace of hearts, 2 of spades, 3 of diamonds, 4 of clubs, 5 of hearts, 6 of spades, &c. In the Mexican ritual calendar of the days of the year, the same method is carried further, the series of twenty day-signs being combined in rotation with numbers up to 13; as this cycle of days only reaches 260, a series of nine other signs are affixed in addition, to make up the 365-day year. It is plain that this rotation of signs served no useful purpose whatever, being less convenient than ordinary counting such as the Mexicans employed in their other calendar already mentioned, where the 20-day periods had each a name like our months, and their days had signs in regular order. Its historical interest depends on its resemblance to the calendar-system of central and eastern Asia, where among Mongols, Tibetans, Chinese, &c., series of signs are thus combined to reckon years, months and days; for instance, the Mongol cycle of 60 years is recorded by the zodiac or series of 12 signs—mouse, bull, tiger, &c., combined in rotation with the five male and female elements—fire, earth, iron, water, wood; as "male-fire-bull" year, &c. This comparison is worked out in Humboldt's *Vues des Cordillères*, as evidence of Mexican civilization being borrowed from Asia. Naturally the Mexican calendar-system lent itself to magic in the same way as the similar zodiac-signs of the Old World, each person's fate being affected by the qualities of the signs he was born under, and the astrologer-priests being called in to advise on every event of life. Of all Mexican festivals the most solemn was that of the *xiuhmolpilli*, or "year-binding," when the 52-year cycle or bundle of years came to an end. It was believed that the destruction of the world, which after the Hindu manner the Mexicans held to have already taken place three or four times, would happen again at the end of a cycle. As the time drew near, the anxious population cleansed their houses and put out all fire, and on the last day after sunset the priests, dressed in the garb of gods, set out in procession for the hill of Huixachtla, there to watch for the approach of the Pleiades to the zenith, which gave the auspicious signal for the lighting of the new fire. The finest of the captives was thrown down and fire kindled on his breast by the wooden drill of the priest; then the victim's heart was torn out, and his body flung on the pile kindled with the new flame. The people watching from their flat housetops all the country round saw with joy the flame on the sacred hill, and hailed it with a thank-offering of drops of blood drawn from their ears with sharp stone-flakes. Swift runners carried burning brands to re-kindle the fires of the land, the sacred fire on the teocalli of the war-god blazed up again, and the people began with feasting and rejoicing the new cycle.

Education.

Mexican education, at any rate that of the upper class, was a systematic discipline much under the control of religion, which here presents itself under a more favourable light. After the birth of a child, the *tonalpouhqui* or "sun-calculator" drew its horoscope from the signs it was born under, and fixed the time for its solemn lustration or baptism, performed by the nurse with appropriate prayers to the gods, when a toy shield and bow were provided if it was a boy, or a toy spindle and distaff if it was a girl, and the child received its name. An interesting picture-writing, to be seen in Kingsborough, shows the details of the boy's and girl's education, from the early time when three small circles over the child show it to be three years old, and a drawing of half a tortilla or corn-cake shows its allowance for each meal; as they grow older the lads are seen beginning to carry burdens, paddle the canoe and fish, while the girls learn to spin and weave, grind maize, and cook—good conduct being enforced by punishments of increasing severity, up to pricking their bodies with aloe-thorns and holding their faces over burning chillies. The schools were extensive buildings attached to the temples, where from an early age boys and girls were taught by the priests to sweep the sanctuaries and keep up the sacred fires, to fast at proper seasons and draw blood for penance, and where they received moral teaching in long and verbose formulas. Those fit for a soldier's life were trained to the use of weapons and sent early to learn the hardships of war; children of craftsmen were usually taught by their fathers to follow their trade; and for the children of nobles there was elaborate instruction in history, picture-writing, astrology, religious doctrines and laws. Marriages depended much, as they do still in the East, on comparison of the horoscopes of the pair to ascertain if their birth-signs were compatible. Old women were employed as go-betweens, and the marriage ceremony was conducted by a priest who after moral exhortations united the young couple by tying their garments together in a knot, after which they walked seven times round the fire, casting incense into it; after the performance of the marriage ceremony, the pair entered together on a four days' fast and penance before the marriage was completed.

Marriages.

Funerals.

The funeral rites of the Mexicans are best seen in the ceremonies at the death of a king. The corpse laid out in state was provided by the priest with a jug of water for his journey, and with bunches of cut papers to pass him safely through each danger of the road—the place where the two mountains strike together, the road guarded by the great snake and the great alligator, the eight deserts and the eight hills; they gave him garments to protect him from the cutting wind, and buried a little dog by his side to carry him across the nine waters. Then the royal body was invested in the mantles of his patron-gods, especially that of the war-god, for Mexican kings were warriors; on his face was placed a mask of turquoise mosaic, and a green chalchihuite-stone as a heart between his lips. In older times the dead king was buried on a throne with his property and dead attendants round him. But after cremation came in a mourning procession of servants and chiefs carrying the body to the funeral pyre to be burnt by the demon-dressed priests, after which the crowd of wives and slaves were exhorted to serve their lord faithfully in the next world, were sacrificed and their bodies burnt. Common people would not thus be provided with a ghostly retinue, but their simpler funeral ceremonies were as far as they went similar to those of their monarch.

The staple food of the Mexicans before the conquest has continued with comparatively little change among the native race, and has even been adopted by those of European blood. **Agriculture and food.** Maize or Indian corn was cultivated on patches of ground where, as in the Hindu *jūm*, the trees and bushes were burnt and the seed planted in the soil manured by the ashes. A sharp-pointed planting stick, a wooden shovel, and a bronze-bladed hoe called a *coatl* were the simple implements. The Mexicans understood digging channels for irrigation, especially for the cultivation of the *cacahuatl*, from which they taught the Europeans to prepare the beverage *chocollatl*; these native names passed into English as the words cacao, or coco and chocolate. Other vegetables adopted from Mexico are the tomato (*tomatl*) and the *chilli*, used as flavouring to native dishes. The maize was ground with a stone roller on the grinding stone or *metlatl*, still known over Spanish America as the *metate*, and the meal baked into thin oval cakes called by Aztecs *tlaxcalli*, and by Spaniards *tortilla*, which resemble the *chapati* of India and the oatcake of Scotland. The Mexicans were also skilful makers of earthen pots, in which were cooked the native beans called by the Spanish *frijoles*, and the various savoury stews still in vogue. The juice extracted by tapping the great aloe before flowering was fermented into an intoxicating drink about the strength of beer, *octli*, by the Spaniards called *pulque*. Tobacco, smoked in leaves or cane-pipes or taken as snuff, was in use, especially at feasts. **Clothing and Ornaments.** In old times Mexican clothing was of skins of woven aloe and palm fibre, but at the time of the conquest cotton was largely cultivated in the hot lands, spun with a spindle, and woven in a rudimentary loom without a shuttle into the mantles and breech-cloths of the men and the chemises and skirts of the women, garments often of fine texture and embroidered in colours. Ornaments of gold and silver, and jewels of polished quartz and green chalchihuite were worn—not only the ears and nose but the lips being pierced for ornaments. **Metal-work.** The artificers in gold and silver melted the metals by means of a reed-blowpipe and cast them solid or hollow, and were also skilled in hammered work and chasing, as some fine specimens remain to show, though the famous animals modelled with gold and silver, fur, feathers and scales have disappeared. Iron was not known, but copper and tin ores were mined, and the metals combined into bronze of much the same alloy as in the Old World, of which hatchet blades and other instruments were made, though their use had not superseded that of obsidian and other sharp stone flakes for cutting, shaving, &c. Metals had passed into a currency for trading purposes, especially quills of gold-dust and T-shaped pieces of copper, while coco-beans furnished small change. The vast size of the market-squares with their surrounding porticos, and the importance of the caravans of merchants who traded with other nations, show that mercantile had risen into some proportion to military interests. Nor was the wealth and luxury of Mexico and surrounding regions without a corresponding development of art. **Art and Pastime.** The stone sculptures such as that remaining of Xochicalco, which is figured by Humboldt, as well as the ornamented woodwork, feather-mats, and vases, are not without artistic merit. The often-cited poems attributed to Nezahualcoyotl may not be quite genuine, but at any rate poetry had risen above the barbaric level, while the mention of ballads among the people, court odes, and the chants of temple choirs would indicate a vocal cultivation above that of the instrumental music of drums and horns, pipes and whistles, the latter often of pottery. Solemn and gay dances were frequent, and a sport called the bird-dance excited the admiration of foreigners for the skill and daring with which groups of performers dressed as birds let themselves down by ropes wound round the top of a high mast, so as to fly whirled in circles far above the ground. The ball-game of the Mexicans, called *tlachtli*, was, like tennis, the pastime of princes and nobles; special courts were built for it, and the ball of india-rubber (perhaps the first object in which Europeans became acquainted with this valuable material) might not be touched by the hands, but was driven against the walls by blows of the knee or elbow, shoulder or buttock. The favourite game of *patolli* has been already mentioned for its similarity to the *pachisi* of modern India.

The accounts given by Spanish writers of the Central Americans in their state after the Spanish conquest are very scanty in comparison with the voluminous descriptions of Aztec life. They bring out perfectly, however, the fact of close connexion between the two civilizations. **Central-American Culture.** Some Central-American peoples were actually Mexican in their language and culture, especially the Pipils and a large part of the population of Nicaragua. The investigations made by Dr Walter Lehmann in Central America (1907–1909), prove that these Mexican elements were extended through Guatemala, Salvador, a small part of Nicaragua (the territory of the Nicaraos) and on several places in the peninsula of Nicoya (Costa Rica) amongst the autochthonous Chorotega or Mangue. It is an error of the Spanish authorities to pretend that the Pipil civilization in Guatemala and Salvador is not older than the time of King Ahuitzotl (*c.* 1482–1486). The language spoken by the Pipils of Salvador (Balsam Coast) is a very old dialect of the Mexican language of the highland of Mexico. It has preserved in the conjugation and in the formation of the plural older forms than the classical Nahuatl itself. The separation of the Pipils from the chief tribes of the Nahuatl branch happened centuries before the conquest, and they developed a singular and characteristic civilization, which can be seen in the wonderful stone-reliefs and sculptures of Sta Lucia de Cozumalhuapa on the Pacific coast of Guatemala.

Dr Lehmann's archaeological and linguistic researches, especially in Salvador and Nicaragua, also enabled him to prove another very important fact, viz. that these Pipils, who may be descendants from the peoples of the Mexican Plateau, migrated into territories previously occupied by an older race of Mayan origin. The archaeological and linguistic evidence proves also that a great part of Salvador and Honduras was once occupied by peoples of the Maya race—Pokomam, Chorti and perhaps other unknown tribes. They left typical Mayan ruins in Honduras (Tenampua) and in Salvador (Opico near Tehuacan, Quelepa near San Miguel), which seem, however, to be destitute of Mayan hieroglyphic inscriptions. The easternmost limit of prehistoric Mayan civilization, on the Pacific coast of Central America, is Fonseca Bay, with the island of Zacate Grande.

It is noteworthy that archaeological objects of the type characteristic of northern Honduras (Ulloa Valley) have been found on the Pacific coast of Salvador. A strange stone sculpture of the so-called Chac-Mol type, known before only from the country of the Tarascs, from Tlaxcala and Chichen Itza, was discovered in Salvador (Ahuachapan).

In the nearly unexplored central part of Nicaragua Dr Lehmann found fragments of painted polychrome clay pottery similar to objects known from the Ulloa Valley (Honduras) amongst other ceramic pieces which seem to have been left by the ancestors of the Sumo Indians, now extinct in that territory. It is possible that these remains of Mayan pottery came into central Nicaragua as articles of commerce.

It is significant that Mayan civilization cannot be traced in any other part of Nicaragua or Costa Rica.

The above-mentioned prehistoric Mayan peoples lived in contact with "barbarous" nations and with another little-known civilized race. The barbarians belonged to the great family of the Sumo-Misquito Indians, the civilized race was that of the Chorotega or Mangue (Dirian, Orotiñan, &c.). The Sumo-Misquito Indians occupied the Atlantic coast and the interior of Nicaragua and Honduras, where they still live in small tribes; a dialect of the hitherto unknown Sumo languages is the Matagalpan, now extinct in Nicaragua, and nearly identical with the Matagalpan is the language spoken by the Indians of Cacaopera in Salvador (Ultra-Lempa territory). There is no doubt that, at the time of the Pipil invasion, tribes of the Sumo-Misquito family were the immediate neighbours of the Pipils towards the east and north. This fact is proved by the names of some places in Salvador, *e.g.* Santiago Nonohualco, San Juan Nonohualco and San Pedro Nonohualco. The word *Nonohualco* signifies in the Mexican language a place where a language changes, where another idiom begins. To the east of the three places whose names are compounded with "Nonohualco," must have dwelt, in the time of the Pipil Indians, the Nonoualca, called also by Mexican tribes Chontales or Popoloca. The western neighbours of the Sumo Indians were and are (though few still survive) the Lenca Indians, who formerly occupied large parts of Honduras. A linguistic relationship can be established between all the Indian languages spoken on the Atlantic coast and in the interior of Nicaragua and Honduras. Several tribes, such as the Paya (or Poya) and the Jicaques, form together with the Lenca, Sumo (Matagalpa, Tauakhca and Ulua) and Misquito one great family.

The position of the isolated Xinca (or Sinca) Indians, regarded from this point of view, becomes very interesting. There are scientific reasons to believe that the Xinca also belong to the same great family as the Lenca, Jicaques, Paya, Misquito-Sumo. It may be possible either that these tribes are the autochthonous inhabitants who dwelt in Guatemala, Salvador, Honduras and Nicaragua before the immigration of the prehistoric Maya peoples; or else that they invaded this region after it had been deserted by a prehistoric oriental branch of the Maya family.

The Chorotega race had its centre in Nicaragua (Pacific coast) and at one time extended thence as far as Guanacaste (Costa Rica); at another time it extended as far as Honduras (actual department of Choluteca) and into eastern Salvador as far as the state of Chiapas in Mexico, where the Chorotega penetrated amongst the Mixe. The Chorotega or Mangue language, so closely affiliated to the Chiapanec, is now extinct, but its former extension is to be recognized by many Indian local names. It seems that there was formerly a mutual interpenetration between Lenca, Sumo and Chorotega tribes. The territories of all these tribes can be, more or less exactly, calculated by the existence of Indian local names. The Misquito country is characterized by names terminating in *laya*, water, or *auala*, river; the Sumo and Ulua country by names in *uas*, water; the Matagalpan by names in *li*, water; the Lenca by names in *tique*, *lique*, *isque and* (*ai*) *quin*. Such Lenca names occur on the north-eastern boundary of the Ultra-Lempa country of Salvador. It is strange that there is not a single place-name in Salvador either of Mayan origin, or, as it seems, of Chorotegan origin. Probably the Mexican elements superseded the Maya so completely that there remained no trace of the Maya except archaeological objects; it is to be supposed that the Lenca and Sumo tribes superseded the Chorotega in Salvador. If we can be sure—and the linguistic evidence admits of no doubt—that the Chorotega had their centre in Nicaragua and thence extended north-westwards, it may be hoped that Chorotegan remains will be found in the vast territory occupied for many centuries by the Maya peoples in the Pacific part of Guatemala. These remains would, of course, be archaeological or place-names.

How closely related some of the Central-American nations were in institutions to the Mexicans appears, not only in their using the same peculiar weapons, but in the similarity of their religious rites; the connexion is evident in such points as the ceremony of marriage by tying together the garments of the couple, or in holding an offender's face over burning chillies as a punishment; the native legends of Central America make mention of the royal bali-play, which was the same as the Mexican game of tlachtli already mentioned. At the same time many of the Central-American customs differed from the Mexican; thus in Yucatán we find the custom of the youths sleeping in a great bachelor's house, an arrangement common in various parts of the world, but not in Mexico; the same remark applies to the Maya exogamous law of a man not taking a wife of his own family name (see Diego de Landa, *Relacion de Yucatan*, ed. Brasseur de Bourbourg, p. 140), which does not correspond with Mexican custom. We have the means of comparing the personal appearance of the Mexicans and Central Americans by their portraits on early sculptures, vases, &c.; and, though there does not appear any clear distinction of race-type, the extraordinary back-sloping foreheads of such figures as those of the bas-reliefs of Palenque prove that the custom of flattening the skull in infancy prevailed in Central America to an extent quite beyond any such habit in Mexico. The notion that the ruined cities now buried in the Central-American forests were of great antiquity and the work of extinct nations has no solid evidence; some of them may have been already abandoned before the conquest, but others were inhabited by the ancestors of the Indians who now build their mean huts and till their patches of maize round the relics of the grander life of their ancestors. In comparing these ruins in Yucatán, Chiapas, Guatemala and Honduras, it is evident that, though they are the work of two or more nations highly distinct in language, yet these nations had a common system of pictorial or written characters. One specimen of a Central-American inscription may give a general idea of them all, whether it be from the sculptured façade of a temple sketched by Catherwood, or from the painted deerskin called the Dresden Codex (reproduced in Kingsborough), or from the chapter of Diego de Landa where he professes to explain and translate the characters themselves. These consist of combinations of faces, circles, lines, &c., arranged in compartments in so complex a manner that hardly two are found alike. How they conveyed their meaning, how far they pictorially represented ideas or spelt words in the different languages of the country, is a question not yet answered in a complete way; Landa's description (p. 320) gives a table of a number of their elements as phonetically representing letters or syllables, but, though there may be a partial truth in his rules, they are insufficient or too erroneous to serve for any general decipherment. One point as to the Central-American characters is clear, that part of them are calendar-signs recording dates. From the accounts given by Landa and other writers it is plain that the Central-American calendar, reckoning the year in twenty-eight periods of thirteen days, was the same in its principle of combining signs as that of Mexico. The four leading Maya signs called *kan*, *muluc*, *ix*, *cauac* corresponded in their position to the four Aztec signs rabbit, reed, flint, house, but the meanings of the Maya signs are, unlike the Aztec, very obscure. A remarkable feature of the Central-American ruins is the frequency of truncated pyramids built of hewn stone, with flights of steps up to the temple built on the platform at top. The resemblance of these structures to the old descriptions and pictures of the Mexican teocallis is so striking that this name is habitually given to them. The teocallis built by the Nahua or Mexican nations have been mostly destroyed, but two remain at Huatusco and Tusapan (figured in Bancroft, iv. 443, 456), which bear a strong resemblance to those of Palenque. On the whole it is not too much to say that, in spite of differences in style, the best means of judging what the temples and palaces of Mexico were like is to be gained from the actual ruins in Central America. On the other hand, there are features in Central-American architecture which scarcely appear in Mexican. Thus at Uxmal there stands on a terraced mound the long narrow building known as the governor's house (Casa del Gobernador), 322 ft. long, 39 ft. wide, 26 ft. high, built of rubble stone and mortar faced with square blocks of stone, the interior of the chambers rising into a sloping roof formed by courses of stonework gradually overlapping in a "false arch." The same construction is seen in the buildings forming the sides of a quadrangle and bearing the equally imaginary name of the nunnery (Casa de Monjas); the resemblance of the interior of one of its apartments to an Etruscan tomb has often been noticed (see Fergusson, *History of Architecture*, vol. i; Viollet-le-Duc, in Charnay).

The explorations made by Dr Lehmann in 1909 in the famous ruins of Teotihuacan, near Mexico city throw new light upon certain chronological problems. Like the excavations made by Dr Max Uhle in Peru, they tend to determine the relative antiquity of the different periods of the ancient civilization. They also show that these various culture-periods followed one another among the Mexicans in much the same sequence as among the Peruvians. At a considerable depth below the foundations of a temple-palace at Teotihuacan, Dr Lehmann discovered certain ceramic fragments of a type quite different from any hitherto classed as Mexican. These are painted on a fine stucco in beautiful colours (notably a kind of turquoise-green) and represent archaic forms of flowers and butterflies. The relation between the wall paintings of Teotihuacan and ornaments at Chichen Itza, as also the existence of sculptured stone yokes in Teotihuacan, in the country of the Totonacs, in Guatemala and in Salvador, furnish important material for the investigation of the obscure problems of the Toltecs and Olmecs, and of the extension of Maya peoples on the Atlantic coast of the Mexican Gulf from Campeche as far as Tabasco and Vera Cruz.

Attempts to trace the architecture of Central America directly from Old-World types have not been successful, while on the other hand its decoration shows proof of original invention, especially in the imitations of woodwork which passed into sculptured ornament when the material became stone instead of wood. Thus the architectural remains, though they fail to solve the problem of the culture of the nations round the Gulf of Mexico, throw much light on it when their evidence is added to that of religion and customs. At any rate two things seem probable—first, that the civilizations of Mexico and Central America were pervaded by a common influence in religion, art, and custom; second, that this common element shows traces of the importation of Asiatic ideas into America.

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(E. B. T.; W. L.*)

II.—Colonial Period. 1520–1821.

The conquest of Mexico by the Spanish forces under Hernando Cortes (*q.v.*) in 1520, and the death of the last Aztec emperor, Guatemozin, introduced what is known as the colonial period of Mexican history, which lasted down to the enforced resignation of the last viceroy, O'Donoju, in 1821. During these three centuries, after a brief but most unsatisfactory experience of government by audiencias (1521–1535), sixty-four viceroys ruled over New Spain. Of these a few were ecclesiastics: two had two terms of office; only two or three were of native birth, and their previous official life had always been passed in other parts of the Spanish dominions.

New Spain: Extent.

New Spain was one of four great viceroyalties, the other three being New Granada, Buenos Aires and Peru. Its viceroy ruled over districts differing in status and with overlapping and conflicting authorities, some of these being appointed directly by the king of Spain, and responsible to him. New Spain in its widest meaning includes the audiencias or judicial districts of Manila, San Domingo and Guatemala, and the viceroy had some sort of authority over them: but in its narrower meaning it comprised the audiencia district of Mexico and the subordinate audiencia district of Guadalajara, which together extended from Chiapas and Guatemala to beyond the eastern boundary of the modern state of Texas and northwards, eventually, to Vancouver's Island. In the course of the 18th century this came to consist of the following divisions: (1) the kingdom of Mexico, which included the peninsula of Yucatán but not the present state of Chiapas or a part of Tabasco, these belonging to Guatemala. Approximately its south border ran from a point slightly east of Tehuantepec to the bay of Honduras, and its north limit was that of the modern states of Michoacan and Guanajuato, then cutting across San Luis Potosí to a point just above Tampico. (2) The kingdom of New Galicia, including the present states of Zacatecas, Jalisco and part of San Luis Potosí. (3) The Nuevo Regno de Leon (the present state of that name). (4) The Provincias Internas, *i.e.* "interior" regarded from the capital, viz. Nuevo Santander (Tamaulipas, and Texas to the bay of Corpus Christi, founded 1749), the several provinces of Nuevo Biscaya or Chihuahua, Durango, Sonora with Sinaloa, Coahuila, Texas (from Corpus Christi Bay to the mouth of the Mermenton in the present state of Louisiana), and the two Californias.

Government and Organization.

The audiencia councils also advised the viceroy in matters of administration; and, as with other officials, his career was subject at its close to a formal examination by a commission—a process known as "taking his residencia." Local government till 1786 was largely in the hands of *alcaldes majores* and *corregidores*, the latter established in 1531 to look after the Indians, and both appointed by purchase. Towns, which were to some extent founded after the conquest as centres of civilization for the Indians, were governed by civic officials appointed in the first instance by the governor of the province, but subsequently as a rule purchasing their posts.

The Church and the People.

The church rapidly supplemented the work of the conquerors. The first Franciscan mission arrived in 1524; other orders followed. The announcement of the apparition of the Virgin to an Indian near Mexico City provided a place of pilgrimage and a patroness in Our Lady of Guadalupe; and the friars ingeniously used the hieroglyphic writing for instruction in Christian doctrine, and taught the natives trades, for which they showed much aptitude. The university of Mexico was founded in 1553. The Jesuits established themselves in 1572, devoting themselves actively to the education both of whites and of natives, and were a powerful factor in the exploring and civilizing of the northern districts. The Inquisition was introduced in 1571. With the natives south of the latitude of Tampico there was little trouble after the Mixton War (in Guadalajara) in 1540–1562, save for occasional risings in Yucatán, Tehuantepec, and in 1711 in the Nayarit mountain region west of Zacatecas, and Tamaulipas was conquered in 1748; but the wild Indians of Sonora and New Mexico gave constant trouble to the missions and outlying settlers. There were occasionally riots due to scarcity of corn (notably in Mexico itself in 1692). As in other Spanish possessions, Indian labour was replaced or supplemented by that of negro slaves, but these were almost wholly confined to the coast regions of Vera Cruz and Acapulco, and early in the 19th century there were only some 10,000 in all.

Races and Castes.

As the Spanish conquerors brought few women, there was much mixture of races. Among the pure whites—who were practically all of Spanish extraction—there were two well-defined classes, the Gachupines or chapetones, Spaniards born in Europe, said to be so named in allusion to their spurs, from Aztec words meaning "prickers with the foot," and the native-born or creoles: the former, though a small minority, had almost all the higher positions both in the public services and in commerce. Besides these there were five well-defined *castas*: mestizoes (Indian and white); mulattoes (negro and white); Zambos (negro and Indian), who were regarded as specially vicious and dangerous; native Indians and negroes. But there were about a dozen intermediate "named varieties," of which the *salto-atras* (tending away from white) and *tente en l'aire* (tending towards white) may be mentioned; and many of the last named eventually passed into the Creole class, sometimes by the decree of a court. The fact that the trade route to Manila passed through Vera Cruz, Mexico City and Acapulco entailed the settlement also of a few Chinese and Malays, chiefly on the Pacific coast.

Position of the Natives.

The natives were subject to tribute and kept in perpetual tutelage: divided at the conquest, with the land, as serfs of the conquerors, in *repartimientos* or *encomiendas*, they were gradually freed at an early date from their serfage, and allowed to sell their labour as they pleased; they were, however, to a great extent kept in villages or settlements, compelled to cultivate land which they held for their life only, and strictly controlled by the friars or the priests. Their numbers were several times seriously reduced by the *matlazhuatl*, apparently analogous to yellow fever, but not attacking the whites, and unknown before the conquest. The negroes were allowed to buy their freedom gradually at rates fixed by the judicial authorities, and slavery seems never to have taken much hold except in the coast region.

Leading Events: 1535-1822.

Of the events of this period only a bare outline can here be given. The term of office of the first viceroy, Antonio de Mendoza, was marked by the Mixton War, by an attempt to suppress the encomienda system, and by a violent epidemic among the natives. Under his successor, Velasco, the measures taken for the relief of the natives provoked the landowners to a conspiracy (repressed with great severity) to set up Cortes' son as king of New Spain. In 1568 the island of Sacrificios, near Vera Cruz, was seized by John Hawkins (*q.v.*), who was surprised by the Spanish fleet accompanying the new viceroy, de Almansa, and escaped with Sir Francis Drake (*q.v.*), but without the remaining ships of his squadron. In 1572 and 1578, however, Drake took abundant vengeance, and in 1587 Cavendish captured the Manila galleon—a success repeated in the next century.

The Drainage of the Capital.

For the next sixty years an urgent question was the prevention of floods in the capital. Situated on the lowest of four lakes, whose waters had only one small outlet from the valley, it was only 4 ft. above the level of the lowest, and was flooded on an average once in every twenty-five years. It had been protected under the native kings by a system of dikes, which were added to under the earlier viceroys, but serious inundations in 1553 and 1580 flooded the city, and the latter suggested the relief of the highest lake, that of Zumpango, by a tunnel carrying its chief affluent into a tributary of the Panuco, and so to the Atlantic. This, however, was not then undertaken, and when mooted again in 1603 was opposed as certain to involve a heavy sacrifice of Indian life. Another inundation, in 1604, suggested the transfer of the city to Tacubaya, but the landowners opposing and the city being again inundated in 1607, the Nochistongo tunnel was begun under the auspices of a Jesuit, Enrico Martinez, and roughly completed in eleven months. It passed under a depression in the mountains of the extreme north of the valley. Humboldt states that it was 6600 metres long, 3½ wide and 4 high. But it did nothing for the southern lakes, so that a further system of dikes was recommended in preference, in 1614, by the Dutch engineer Adrian Boot; it was inadequate for its work and, not being lined with masonry, it was liable to be choked by falls. Repairs were suspended in 1623, and a further inundation, with great losses of life, occurred from 1629 to 1634. The removal of the city was again mooted and, though sanctioned by the king of Spain, successfully opposed by the landowners. Another flood occurred in 1645. After a disastrous attempt to enlarge the tunnel in 1675, it was eventually converted into an open cutting, but the work was not finished till 1789, and the bottom was then 29 ft. 6 in. above the level of the lowest lake. The drainage was only satisfactorily accomplished at the end of the 19th century (see below).

Church and State.

A negro revolt in the Vera Cruz region (1609) and an Indian rebellion in Sinaloa and Durango may be mentioned among the events of the earlier part of the 17th century. The regular and secular clergy had early come into conflict, particularly over the tithe and the control of the Indians; and in 1621, the marquis de Gelves, an energetic reformer, who as viceroy favoured the appointment of the regulars to deal with the natives, came into conflict with Archbishop Serna of Mexico, who placed the city under interdict, excommunicated the viceroy and constrained him to hide from the mob. Some years later the bishop of Puebla, Juan de Palafox y Mendoza, transferred many native congregations from the friars to secular priests, and subsequently, in 1647, came into conflict with the Jesuits, whom he excommunicated, but who eventually triumphed with the aid of the Dominicans and the archbishop. The power of the church may be judged from the petition of the Ayuntamiento of Mexico to Philip IV. (1644) to stop the foundation of religious houses, which held half the property in the country, to suspend ordinations because there were 6000 unemployed priests, and to suppress feast days because there were at least two per week.

Buccaneer Raids.

To check the Dutch and British corsairs the Barlovento ("windward") squadron had been set up in 1635; but the British capture of Jamaica (1655) aggravated the danger to the Spanish convoys. During the rest of the century the ports of Yucatán and Central America were frequently raided, and in 1682 Tampico suffered a like disaster; in May 1683 Vera Cruz itself was captured through stratagem by two buccaneers, Van Horn and Laurent, who plundered the town for ten days, committed shocking outrages, and escaped as the Spanish fleet arrived. In 1685–86 the Pacific coast was ravaged by Dampier and Swan, and in 1709 Woodes Rogers, with Dampier as pilot, captured the Manila treasure galleon, a feat repeated by Anson in 1743. But the European wars of the 18th century had little effect on Mexico, save that the privileges of trade given to Great Britain by the treaty of Utrecht facilitated smuggling. In the first half of the 18th century we may note the appearance, intermittently at first, of the first Mexican periodical—the *Gaceta de Mexico*—in 1722, a severe epidemic of yellow fever in 1736, and the establishment about 1750 of a standing army with a nucleus of Walloons and Swiss, negroes and Indians being excluded and the half-breeds admitted under restrictions. But the great event of the 18th century was the expulsion of the Jesuits from Mexico, as from the other Spanish dominions, in 1767, under orders from Charles III. They were arrested *en masse* on the night of the 26th of June; their goods were sequestrated, and they themselves deported to Havana, then to Cadiz, Genoa, and eventually Corsica. They had done much to civilize the natives and to educate the whites, and their expulsion, which was greatly resented by the Creoles, probably tended to increase the popular discontent and prepare for the overthrow of Spanish rule.

Centralized Government.

In 1769 Don José de Galvez was sent out as special commissioner to devise reforms, with powers independent of the then viceroy, but without much immediate result. It was, however, a consequence of his work that in 1786 the provinces and kingdoms were replaced by twelve intendencias (Guadalajara, Zacatecas, Durango, Sonora, Puebla, Vera Cruz, Merida, Oaxaca, Valladolid, Guanajato, San Luis Potosí, Mexico), whose governors and minor officials were directly dependent on the viceroy, the former alcaldes, mayores and corregidores, who were very corrupt, being abolished. Possibly it is from this reform that we may date the antithesis of Federals and Centralists, which is so conspicuous in the history of republican Mexico. Among the later viceroys the Conde de Revillagigedo (1789–1794) deserves mention as a progressive ruler who developed commerce and improved administration, and took the first, but very imperfect, census, on which Humboldt based his estimate of the population in 1803 at 5,840,000.

Beginnings of Severance.

The European wars of the French revolutionary period interfered with the traffic with Spain, and so relaxed the bonds of a commercial system which hampered the manufactures of Mexico and drained away its wealth. Already in 1783 the Conde de Aranda had suggested to the Spanish king the scheme of setting up three Spanish-American kingdoms bound to Spain by perpetual treaties of alliance and reciprocity and by frequent royal intermarriages, and with the king of Spain as overlord. The plan was devised as a means of rivalling Anglo-Saxon supremacy, but was rejected through fear of the mixed races predominating over the whites. A similar fear helped to keep down the tendencies inspired by French revolutionary literature, though plots occurred against the viceroy Branciforte in 1798 and 1799. But the real causes of the revolution were local. The chief was the Creole jealousy of the Spanish immigrants. There was oppressive taxation, restriction on commerce and manufacture in the interest of Spain, even vineyards having been prohibited; and the courts were very corrupt. But to these grievances was added in 1804 the sequestration, to provide for Spain's needs, of the benevolent funds (*obras pias*) in Mexico, amounting to about $45,000,000, and nearly all invested on mortgage. The mortgages were called in: forced sales were necessary, the mortgagers were frequently ruined, and less than a fourth of the total was realized. Other confiscations and exactions followed; and when the rule of Fernando VII. was succeeded by that of Joseph Bonaparte, the municipality of Mexico invited Iturrigaray, the viceroy, to declare the country independent. He proposed the convocation of a national congress, but was overthrown by a conspiracy of Spaniards under one Yermo, who feared that they would lose their privileged position through severance from Spain. The two next viceroys were incompetent; further demands from the Spanish authorities in revolt against Joseph Bonaparte increased the disaffection, which was not allayed by the grant of representation in the Spanish Cortes to the colonies; and, on the demands being repeated by a third viceroy, Venegas, Creole conspiracies arose in Querétaro and Guanajato. Their discovery in 1810 was followed by the outbreak of the revolution. Hidalgo, a parish priest, and Allende, a captain of cavalry, with forces consisting largely of Indians, captured a stronghold at Guanajato and even threatened the capital; but the revolutionists were defeated in 1811 at Calderon, and the leaders executed. Another priest, however, named Morelos, continued the movement, and, despite defeat in the terrible siege of Cuatla (now Morelos) on the 2nd of May 1812, raised the south, so that in the next year his forces overran most of the kingdom of Mexico and held its southern parts, and he was able to convoke a congress and issue a constitution. But he also was captured, and executed at Mexico City in 1815. Though revolutionary movements still continued, by 1817 only one leader, Vincente Guerrero, was left in the field. But in March 1820 the Spanish constitution, repudiated by King Fernando VII. soon after his restoration, was restored after a military rising in Spain. It was promulgated in Mexico, and the ecclesiastics and Spaniards, fearing that a Liberal Spanish government would force on them disendowment, toleration and other changes, induced Augustin de Iturbide, who had already been conspicuous in suppressing the risings, to take the field in order to effect what may be called a reactionary revolution.

III.—Independent Mexico.

General Characteristics.

Thenceforward, till the second election of Porfirio Diaz to the presidency in 1884, the history of Mexico is one of almost continuous warfare, in which Maximilian's empire is a mere episode. The conflicts, which may at first sight seem to be merely between rival generals, are seen upon closer examination to be mainly (1) between the privileged classes, *i.e.* the church and (at times) the army, and the mass of the other civilized population; (2) between Centralists and Federalists, the former being identical with the army, the church and the supporters of despotism, while the latter represent the desire for republicanism and local self-government. Similar conflicts are exhibited, though less continuously, by most of the other Spanish-American states. On both sides in Mexico there was an element consisting of honest doctrinaires; but rival military leaders exploited the struggles in their own interest, sometimes taking each side successively; and the instability was intensified by the extreme poverty of the peasantry, which made the soldiery reluctant to return to civil life, by the absence of a regular middle class, and by the concentration of wealth in a few hands, so that a revolutionary chief was generally sure both of money and of men. But after 1884 under the rule of Diaz, the Federal system continued in name, but it concealed in fact, with great benefit to the nation, a highly centralized administration, very intelligent, and on the whole both popular and successful—a modern form of rational despotism.

General Iturbide becomes Emperor, 1822-1823.

Iturbide eventually combined with Guerrero, and proclaimed the "Plan of Iguala," which laid down, as the bases of the new state, the maintenance of the Roman Catholic religion and the privileges of the clergy, the establishment of a limited monarchy, and equality of rights for Spaniards and native-born Mexicans. Iturbide sought the co-operation of the viceroy Apodaca, who, however, refused; but he was presently superseded by General O'Donojú, who, being unable to get beyond Vera Cruz, recognized the independence of Mexico. O'Donojú shortly afterwards died; the Spanish government repudiated his act; and Spanish troops held the fortress of San Juan de Ulúa, off Vera Cruz, till 1827. A provisional Junta, nominated by Iturbide, issued a declaration of independence (Oct. 1821), and nominated a regency of five, with Iturbide as its president. The first Mexican Congress met on the 24th of February 1822. A section of it favoured a republic; another, monarchy under Iturbide; another, which was broken up by the refusal of Spain (continued until 1836) to recognize Mexican independence, monarchy under a Bourbon prince. A conflict now arose between the republican majority and Iturbide, which was settled by a military pronunciamiento in his favour, and the Congress elected him emperor. He was crowned on the 21st of July 1822. Fresh conflicts broke out between him and the Congress, and Antonio Lopez de Santa Anna, captain-general of Vera Cruz, proclaimed a republic, promising to support the Plan of Iguala. He was defeated at Jalapa and driven to Vera Cruz; but the army deserted Iturbide, who was compelled to abdicate (April 19, 1823). The Congress deported him to Italy, and granted him a pension. He returned, almost immediately, on the pretext that Spain was intriguing against Mexican independence, and on landing (having been previously outlawed) was arrested and executed (July 1, 1824).

President Guerrero, 1825-1831.

Santa Anna, Dictator, 1834.

Bustamante, President, 1837.

The Congress had meanwhile undone much of his work, and had divided into Federalists and Centralists, the latter largely Monarchists and Freemasons. The Federalists were strong enough to secure the adoption of a constitution (Oct. 4, 1824) modelled on that of the United States, with additional clauses, notably one declaring the Roman Catholic religion to be alone recognized. A source of abundant discord was opened by the provision that each state should contribute its quota to the Federal revenues. No proper statistical basis for estimating the quotas existed, and the device gave each state a plausible reason for attempting secession on occasion. Moreover, the capital and some territory round it was made into a "Federal district"—another grievance intensifying the antagonism of the state to the central power. The Freemasons had been largely instrumental in overthrowing Iturbide; they now divided into the Escoceses (lodges of the Scottish ritual), who were Monarchist and Centralist, and the Yorkinos, who took their ritual from New York, and their cue, it was alleged, from the American minister, Joel Poinsett. An attempt at revolt, headed by Nicolas Bravo, vice-president, the Grand Master of the Escoceses, was suppressed, but dissensions ensued in the Yorkino party between the followers of President Guerrero (a man largely of native blood, and the last of the revolutionary leaders) and of Gomez Pedraza, the war minister. A conflict broke out, the Guerrerists were victorious, and the pillage of foreign shops in Mexico City (1828), among them that of a French baker, gave a basis for the foreign claims which, ten years later, caused the "Pastry War" with France. Meanwhile, attacks on Spanish ships off Cuba by a Mexican squadron, commanded by an American, David Porter, had induced Spain to send an expedition to reconquer Mexico (1829) which was checked at Tampico by Santa Anna. During the invasion Vice-President Antonio Bustamante declared against President Guerrero; the bulk of the army supported him. Guerrero was deposed, and his partisans in the south were defeated at Chilpancingo (Jan. 2, 1831); and Guerrero, retiring to Acapulco, was enticed on board an Italian merchant-ship, and treacherously seized, tried and executed (Jan.–Feb. 1831). Next year, however, a revolt broke out against Bustamante, which was joined by Santa Anna, and eventually resulted in a pronunciamiento in favour of Gomez Pedraza. He, and his successor, Vice-President Gomez Farias (1833), assailed the exemption of the clergy and of military officers from the jurisdiction of the civil courts, and the latter attempted to laicize higher education and to relax monastic bonds. Santa Anna took advantage of the situation to assume the presidency. He eventually became dictator, dissolved Congress (May 31, 1834) and the state legislatures, and substituted creatures of his own for the governors of the states and mayors of towns, then retiring into private life. A new Congress, having resolved itself into a constituent assembly, followed up this Centralist policy (Dec. 30, 1836) by framing a new constitution, the Siete Leyes or Seven Laws, which converted the states into departments, ruled by governors appointed by the central authority, and considerably reduced popular representation. Antonio Bustamante became the first president under it. The French claims set up by the pillage of foreign shops in Mexico had, however, remained unsatisfied, and in 1838 a French fleet blockaded the coast, bombarded the fortress of San Juan de Ulúa, off Vera Cruz, and occupied the town. The Mexican government gave way, threatened by Federalist risings and secessions of states, which culminated in 1841. Santa Anna appeared, nominally as a

Santa Anna Restored, 1841.

mediator, and put forward the bases of Tacubaya (Sept. 28, 1841), abolishing all the Siete Leyes except the part relating to the judicial system, arranging for a new constituent assembly, and reserving for the president (himself) full power of re-organizing the administration. The Centralist government, after a vain attempt to defeat him by professing a more thorough Federalism, gave way to force, and Bustamante was allowed to leave the country. But the new Congress was too Federalist for Santa Anna, and he retired, leaving the reins to Nicolas Bravo, under whom a new Centralist constitution was established (1843). This expressly retained the privileges of the clergy and army, and was in some respects more anti-Liberal than that of 1836.

The Texas Question.

But new complications were now introduced by the question of Texas. Though a state of the Mexican Union, it had been settled from the United States in consequence of a land grant given by the Spanish viceroy to Stephen Austin in 1820, and had been estranged from Mexico partly by the abolition of slavery under a decree of President Guerrero, and partly by the prospect of the Centralist constitution of 1836. It then seceded. Santa Anna attempted to reduce it, showing great severity, but was eventually defeated and captured by Houston at the battle of San Jacinto, and compelled to sign a treaty recognizing Texan independence, which was disavowed on his return to Mexico. A state of war thus continued nominally between Mexico and its seceded member, whose independence was recognized by England, France and the United States. The slaveholders in the United States favoured annexation of Texas, and pressed the claims due from Mexico to American citizens, partly perhaps with the aim of forcing war. Most of these claims were settled by a mixed commission, with the king of Prussia as umpire, in 1840–1841, and a forced loan was raised to pay them in 1843, which stimulated the revolt of Paredes against Santa Anna, who had returned to power in 1844. It resulted in Santa Anna's downfall, imprisonment at Perote and eventual exile (Dec. 1844 to Jan. 1845), and the election of General José Joaquin Herrera as president. But Herrera was displaced in the last days of 1845 by a pronunciamiento in favour of Paredes, who undertook to uphold the national rights against the United States, and who was elected president on the 3rd of January 1846. Texas had meanwhile applied for admission into the American Union. The annexation, rejected in 1844 by the United States Senate, was sanctioned on the 1st of March 1845, and carried out on the 22nd of December 1845. The Mexican minister withdrew from Washington, and both sides made active preparations for war.

War with United States, 1846-48.

The United States forces were ordered by President Polk to advance to the Rio Grande in January 1846. They established a depot at Point Ysabel (behind the opening of Brazos Santiago), and erected a fort in Texan territory, commanding Matamoros, on the Mexican side of the Rio Grande. This provoked the Mexican forces into a defensive invasion of Texas, to cut the American communications with Point Ysabel. They were, however, defeated at Palo Alto (May 8) and Resaca de la Palma (May 9). There was an outburst of warlike feeling in the United States (with a counter-movement in the North), and an invasion of Mexico was planned by three routes—from Matamoros towards Monterey in New Leon, from San Antonio de Bexar to Chihuahua, and from Fort Leavenworth to New Mexico. Importance attaches chiefly to the movements of the first force under General Zachary Taylor. During the war preparations President Paredes, suspected of intriguing to overthrow the Republic and set up a Spanish prince, had to give place to his vice-president Bravo, who in his turn gave way before Santa Anna, who was hastily recalled from his exile at Havana to assume the presidency and the conduct of the war (Aug. 1846). He was allowed by the American squadron blockading Vera Cruz to pass in without hindrance. Probably it was thought his presence would divide the Mexicans.

Treaty of Peace.

The preparations of the United States took some months. It was not till the 5th of September 1846 that General Zachary Taylor could leave his depôt at Camargo on the Rio Grande, and march on Monterey. It was taken by assault on the 23rd of September; Santa Anna was defeated at Buena Vista (near Saltillo) on the 23rd of February 1847, and forced back on San Luis Potosí. New Mexico was occupied without opposition; Chihuahua was occupied, but not held, owing to the difficulties in maintaining communications; and Upper California was seized in the autumn of 1846 by John C. Fremont, who had been exploring a route across the continent, and by the United States Pacific squadron, and made secure by the aid of the New Mexico expedition. But as Mexico still continued to fight, it was determined to reach the capital via Vera Cruz. That city was taken by General Scott after a siege and bombardment (March 7 to 29, 1847); and after winning the battle of Cerrogordo (April 18), and a long delay at Puebla, Scott marched on Mexico City, stormed its defences against greatly superior forces, and effected an entrance after severe fighting on the 13th of September 1847. This virtually ended the war; Santa Anna was deprived of his command, and the treaty of Guadalupe Hidalgo, concluded on the 2nd of February 1848, ceded to the United States Texas, New Mexico and Upper California, in return for a payment of $15,000,000 by the United States to Mexico, and the assumption of liability by it for the claims of its subjects which it had hitherto been pressing against Mexico. This payment was doubtless intended to strengthen the United States' title to the conquered territory. It is generally admitted that Mexico was provoked into aggression in order that additional territory might be available for the extension of slavery.

Herrera, President, 1848-1851.

The American forces were withdrawn in May and June 1848 after the ratification of the treaty by Mexico. Under the presidency of Herrera (1848–1851) attempts were made to restore order and the public credit. An arrangement was effected with English holders of Mexican stock; an attempt was made to carry out a consolidation of the internal debt, which failed; the army was reduced and reorganized, and the northern frontier was defended by military colonies, formed partly of civilized Seminole Indians from the United States. But the financial situation was desperate; the federal revenue, mostly from customs—which were evaded by extensive smuggling—was not half the expenditure; and Indian revolts in Yucatan (1847–1850) and in the Sierra Gorda had added to the strain. Arista succeeded Herrera as president (Jan. 1851), but resigned (Jan. 1853).

Santa Anna in Power, 1853-1854.

After a sort of interregnum (Jan.–March 1853) Santa Anna was recalled (by a vote of the majority of the states under the Plan of Arroyozarco, on the 4th of February 1853, the result of a pronunciamiento), and made dictator in the interests of federation. His measures, partly inspired by an able Conservative leader, Lucas Alaman, proved strongly Centralist: one is especially noteworthy, the establishment of the ministry of "fomento," or encouragement to public works, education, and intellectual and economic development, which is a conspicuous aid to Mexican welfare to-day. He also negotiated (at the end of 1853) the sale of the Mesilla valley (now Arizona) to the United States, but the purchase money was soon dissipated. On the 16th of December 1853 Santa Anna issued a decree making himself dictator, with the title of serene highness. On the 1st of March 1854, at Ayutla in Guerrero, a section of the army under Colonel Villareal proclaimed the Plan of Ayutla, demanding Santa Anna's deposition and the establishment of a provisional government to secure a new constitution. Among the leaders in the movement were Generals Alvarez and Comonfort, and it is said that Porfirio Diaz, subsequently president, then a young soldier, made his way to Benito Juarez, then in prison, and arranged with him the preliminaries of the revolt. It spread, and Santa Anna left the country (Aug. 1854).[1]

Two filibustering expeditions at this time—one by William Walker, afterwards notorious in Nicaragua, in Lower California

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[1] Santa Anna tried to get back to politics in Mexico after Maximilian's fall, without success. He was amnestied with other exiles in 1874, and died in obscurity in 1876.

(Dec. 1853), the other by Count Raousset de Boulbon in Sonora (July 1854)—added to the general disorder.

Benito Juarez.

The provisional president, General Carrera, proving too Centralist, was replaced by Alvarez (Sept. 24, 1855), two of whose ministers are conspicuous in later history—Ignacio Comonfort, minister of war, and Benito Juarez, minister of finance. Juarez (b. 1806) was of unmixed Indian blood. The son of a Zapotec peasant in a mountain village of Oaxaca, he was employed as a lad by a bookbinder in Oaxaca city, and aided by him to study for the priesthood. He soon turned to the law, though for a time he was teacher of physics in a small local college; eventually went into politics, and did excellent work in 1847 as governor of his native state. Juarez almost immediately secured the enactment of a law (Ley Juarez, Nov. 23, 1855) subjecting the clergy and the army to the jurisdiction of the ordinary courts. "Benefit of clergy" was the curse of Mexico. Officers and soldiers could be tried only by courts-martial, the clergy (including numbers of persons in minor orders, who were practically laymen) only by ecclesiastical courts. The proposed reform roused the Clericals to resistance. Alvarez gave place (Dec. 8, 1855) to his war minister Comonfort, who represented the less anti-Clerical Liberals. He appointed a commission to consider the question of draining the valley of Mexico, which adopted the plan ultimately carried out in 1890–1900; suppressed a Clerical rising in Puebla (March 1856), which was punished by a considerable confiscation of church property; sanctioned a law releasing church land from mortmain, by providing for its sale, for the benefit, however, of the ecclesiastical owners (called after its author Miguel Lerdo de Tejada, brother of the subsequent president), and a new draft constitution, largely modelled on that of the United States (Feb. 5, 1857). The clergy protested violently, and the Plan of Tacubaya (Dec. 17, 1857), which made Comonfort dictator, provided for the construction of a new constitution under his auspices. He was presently displaced by a thorough reactionary, General Zuloaga, and expelled from Mexico early in 1858; and for three years Mexico was a prey to civil war between two rival governments —the Republicans at Vera Cruz under Juarez, who, as Chief Justice of the Supreme Court, succeeded Comonfort; and the reactionaries at the capital. The latter were at first presided over by Zuloaga, who, proving incompetent, was replaced at the end of 1858 by Pezuela, who early in 1859 gave place to Miguel Miramon, a young, able and unscrupulous soldier who was shortly afterwards accepted as "constitutional" president by his party. The Juarists were defeated outside the city of Mexico twice, in October 1858 and on the 11th of April 1859.

Miramon.

On the second occasion the whole body of officers, who had surrendered, were shot with Miramon's authority, if not by his express orders, together with several surgeons (including one Englishman, Dr Duval) (the fifty-three "martyrs of Tacubaya"). This atrocity caused great indignation in Mexico and abroad: the reactionists were divided; their financial straits were extreme, as the Juarists held all the chief ports. Juarez was recognized by the United States, and allowed to draw supplies of arms and volunteers thence; and in July 1859 he published laws suppressing the religious orders, nationalizing ecclesiastical property (of the estimated value of $45,000,000), establishing civil marriage and registration, transferring the cemeteries to civil control, and, in short, disestablishing the church. But the apparent hopelessness of any ending to the conflict, together with the frequent outrages of both parties on foreigners, afforded strong reasons for foreign intervention. Early in 1859 President Buchanan had recommended the step to Congress, which did not respond. On the 12th of December 1859 the M'Lean-Juarez treaty was concluded, which gave the United States a sort of disguised protectorate over Mexico, with certain rights of way for railroads over the Isthmus of Tehuantepec and between the Rio Grande and Pacific. The American Senate, however, did not ratify the treaty, and a motion for its reconsideration late in 1860 came to nothing, owing to the approach of the War of Secession.

When Napoleon III. was in captivity at Ham he dreamed of a Central America civilized and opened up to modern enterprise by a transoceanic canal: and the clerical refugees in Paris, among them Labastida, archbishop of Mexico, easily influenced the Empress Eugénie, herself a Spaniard, to interest her husband in the cause of centralized monarchy and the church: it is said that even in 1859 they had thoughts of setting up the Archduke Maximilian as ruler of Mexico.

Overthrow of Miramon, 1860.

The question of a joint intervention of Great Britain, France, Spain and Prussia was mooted between those powers in 1860. Early in 1859 the outrages on British subjects had caused the British minister to break off diplomatic relations. Forced contributions had been levied by both sides on goods or bullion, being European property, the reactionaries being the worst offenders; and there were numerous cases of murder and robbery of Europeans. At last, on the 17th of November 1860, Miramon, under the plea of necessity, seized $630,000 in specie which had been left under seal at the British Legation and was intended for the bondholders. On the 22nd of December 1860 his forces were routed by the Juarist general Ortega at Arroyozarco, and his government was overthrown.

European Intervention, 1861.

Juarez entered Mexico City on the 11th of January 1861. He soon found that his government was held responsible to Europe for the excesses of its rival as well as its own. Miramon's government had violated the British Legation; the Spanish minister, the papal legate and the representatives of Guatemala and Ecuador were expelled from the country for undue interference on behalf of the reactionaries; the payments of the British loan were suspended by Juarez's Congress in July 1861; and various outrages had been committed on the persons and property of Europeans for which no redress could be obtained. The French *chargé d'affaires*, Dubois de Saligny, who had been sent out in November 1860, urged French intervention, and took up the Jecker claims. Jecker, a Swiss banker settled in Mexico, had lent Miramon's government in 1859 $750,000 (subject, however, to various deductions): in return, Miramon gave him 6% bonds of the nominal value of $15,000,000 which were ingeniously disguised as a conversion scheme. Jecker had failed early in 1860, Miramon was overthrown a few months later. Jecker's creditors were mostly French, but he still held most of the bonds, and there is reason to believe that he won over Dubois de Saligny by corrupt means to support his claims. Intercepted correspondence (since confirmed from the archives of the Tuileries) showed that the Duc de Morny promised Jecker his patronage in return for 30% of the profits (De la Gorce, *Hist. du Second Empire*, IV. c. 1). An imperial decree naturalized Jecker in France, and Napoleon III. took up his claim. A convention between Great Britain, France and Spain for joint interference in Mexico was signed in London on the 31st of October 1861. A separate arrangement of the British claims was negotiated by Juarez, but rejected by the Mexican Congress, November 1861; and the assistance of the United States with a small loan was declined, Mexican territory being demanded as security. On the 14th of December Vera Cruz was occupied by Spanish troops under General Prim; the French fleet and troops arrived soon after, with instructions to seize and hold the Gulf ports and collect the customs for the three Powers till a settlement was effected; Great Britain sent ships, and landed only 700 marines. In view of the unhealthiness of Vera Cruz, the convention of Soledad was concluded with the Mexican government, permitting the foreign troops to advance to Orizaba and incidentally recognizing Mexican independence. But as the French harboured leaders of the Mexican reactionaries, pressed the Jecker claims and showed a disposition to interfere in Mexican domestic politics, which lay beyond the terms of the joint convention, Great Britain and Spain withdrew their forces in March 1862.

More troops were sent from France. Their advance was checked by Zaragoza and Porfirio Diaz in the battle of Cinco de Mayo, on the 5th of May 1862; and in September of that year 30,000 more French troops arrived under General Forey. Wintering at Orizaba, they recommenced their advance

(Feb. 17, 1863), besieged and reduced Puebla, and entered Mexico City on the 7th of June. A provisional government of Mexicans, nominated directly or indirectly by Dubois de Saligny, adopted monarchy, offered the crown to Maximilian of Austria, brother of the Emperor Francis Joseph, and should he refuse, left its disposal to Napoleon III.

French Expedition, 1862-63.

Maximilian Emperor, 1864.

Maximilian, after some difficulty as to renouncing his right of succession to the throne of Austria, accepted the crown subject to the approval of the Mexican people, and reached Mexico city on the 12th of June 1864. Juarez meanwhile had set up his capital, first in San Luis Potosí, then in Chihuahua. The new empire was unstable from the first. Before Maximilian arrived the provisional government had refused to cancel the sales of confiscated Church lands, as the clericals demanded. When he came, a host of new difficulties arose. A new loan, nominally of about eight millions sterling, but yielding little more than four, owing to discount and commission, was raised in Europe, but no funds were really available for its service. Maximilian carried the elaborate etiquette of the court of Vienna to Mexico, but favouring toleration of Protestantism, and the supremacy of the Crown over the Church, he was too liberal for the clericals who had set him up. As a foreigner he was unpopular, and the regiments of Austrians and Belgians which were to serve as the nucleus of his own army were more so. His reforms, excellent on paper, could not be carried out, for the trained bureaucracy necessary did not exist. For a time he nominally held sway over about two-thirds of the country—roughly, from lat. 18° to 23°, thus excluding the extreme north and south. Oaxaca city, under Porfirio Diaz,[1] capitulated to Bazaine—who had superseded the too pro-clerical Forey in October 1864—in February 1865, and by the autumn of that year the condition of the Juarists in the north seemed desperate. But the towns asked for permanent French garrisons, which were refused, as weakening their own power of self-defense. Instead, the country was traversed by flying columns, and the guerillas dealt with by a French service of "contre-guerilla," who fought with much the same savagery as their foes. Directly the French troops had passed, Republican bands sprang up, and the non-combatant Mexicans, to save themselves, could only profess neutrality. Yet on the 3rd of October 1865, Maximilian, misled by a false report that Juarez had left the country, issued a decree declaring the Juarists guerillas, who, whenever captured, were to be tried by court-martial and shot. Mexican generals on both sides had done as much. But Maximilian's decree prepared his own fate.

Maximilian deserted by France.

The American Civil War ended in the spring of 1865, and a strong popular feeling was at once manifested in favour of asserting the Monroe doctrine against Maximilian's government. In the summer there were threatening movements of United States troops towards the Rio Grande; early in 1866 Napoleon III. announced his intention of withdrawing his forces; in response to a note of Seward, the United States secretary of state, of the 12th of February 1866, he was induced to promise their return by three instalments—in November 1866, March and November 1867. Maximilian now turned for support to the Mexican clericals; meditated abdication, but was dissuaded by his wife Charlotte, the daughter of Leopold I. of Belgium (and "the better man of the two," as he had once jestingly said), who went to intercede for him with the emperor of the French. Finding him obdurate, she went on to appeal to the pope; while at Rome she went mad (end of September 1866).

Execution of Maximilian, 1867.

Maximilian had meanwhile drawn nearer to the clericals and farther from the French, and, to protect French interests, Napoleon III. had decided to send out General Castelnau to supersede Bazaine, arrange for the withdrawal of the French forces in one body, and restore the Republic under Ortega, who had quarrelled with Juarez, and was therefore, of all republicans, least unacceptable to the clericals. But fearing the prospect, they induced Maximilian, who had retired to Orizaba for his health, to remain. He yielded on condition that a congress of all parties should be summoned to decide the fate of the empire. Hereupon he returned to the capital; the Juarist dominion extended rapidly; the French troops left (in one body) on the 5th of February 1867, and shortly after Maximilian took command of the army at Querétaro. Here, with Miramon, he was besieged by the Juarists under Escobedo, and the garrison, when about to make a last attempt to break out, was betrayed[2] by Colonel Lopez to the besiegers (May 15, 1867). Maximilian, with the Mexican generals Miramon and Mejia, was tried by court-martial, and, refusing (or neglecting) to avail himself of various opportunities of escape, was convicted on charges which may be summarized as rebellion, murder and brigandage, on the 14th of June, and shot, with Miramon and Mejia, on the 19th of June 1867, despite many protests from European governments and prominent individuals, including Garibaldi and Victor Hugo. (An effort to save him made by the U.S. Government was frustrated by the dilatoriness of the U.S. Minister accredited to Juarez's Government.) After considerable difficulty with the Republican Government, his body was brought to Europe.

Juarez President.

Death of Juarez, 1872.

Administration of Lerdo de Tejada.

Porfirio Diaz President, 1877.

Meanwhile Porfirio Diaz had captured Puebla (April 2) and besieged Mexico City, which fell on the 21st of June. The last anti-Juarist stronghold (Inayarit) submitted on the 20th of July 1867. A good deal of discontent existed among the republican rank and file, and Juarez's election in October to the presidency was opposed by Diaz's friends, but without success. But so soon as Juarez was elected, insurrections broke out, and brigandage prevailed throughout the following year. There were unsuccessful insurrections also in 1869 (clerical) and 1870 (republican), but an amnesty, passed on the 13th of October 1870, helped to restore peace; trouble again arose, however, at the 1871 election, at which the candidates were Juarez, Sebastian Lerdo de Tejada and Diaz. Juarez's continued re-election was regarded as unconstitutional, and no party obtaining a clear majority, the matter was thrown into Congress, which elected him. Diaz's supporters refused to recognize him, and a revolution broke out, which went on sporadically till Juarez's death on the 18th of July 1872. Sebastian Lerdo de Tejada, as president of the Supreme Court, succeeded him, and amnestied the rebels, but made no further concessions. In the next year, however, laws were passed repeating in a stronger form the attacks of 1857 on the supremacy of the Church, and prohibiting monastic life. The first day of 1873 was marked by the opening of the Vera Cruz & Mexico railway. Protestant missions established themselves (with some opposition) in the country, and diplomatic relations were renewed with France and Spain (1874). But towards the close of Lerdo de Tejada's term he was suspected of aiming at a dictatorship, and Diaz, whom he had proscribed, made preparations for a rising, then retiring to Texas. At the beginning of 1876 the revolution broke out in Oaxaca with the plan of Tuxtepec, which was adopted by Diaz, and proclaimed as the plan of Palo Blanco (March 21). Diaz's attempt to raise the north, however, failed, and, trying to reach Vera Cruz by sea, he was recognized on the steamer, and recaptured while attempting a four-mile swim ashore. The purser, however, made it appear that he had again jumped overboard, concealed him for some days—generally inside one of the saloon sofas—and helped him to get ashore in disguise at Vera Cruz. He then escaped to Oaxaca and raised a force. Lerdo was declared re-elected, but was overthrown by Diaz after the battle of Tecoac (Nov. 16, 1876) and forced into exile (Jan. 1877), and Diaz was declared president on the 2nd of May 1877. A law forbidding the re-election of a president till four years had elapsed from his retirement from office was passed in the autumn of that year.

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[1] Diaz refused parole, and was confined at Puebla for some months, but made his escape, and was soon in the field again.

[2] Lopez said he acted as Maximilian's agent, but his story rested on an alleged letter from Maximilian which was discredited as a forgery. The evidence of his treason was published in *El Nacional* of Mexico, Sept. 11, 1887.

Diaz's first presidency (1870–1880) was marked by some unsuccessful attempts at revolution notably by Escobedo from Texas in 1878, and by a more serious conspiracy in 1879. Diplomatic relations were resumed with Spain, Germany, Italy and some South American states (1877), and France (1880). There were some frontier difficulties with the United States, and with Guatemala, which revived a claim dropped since 1858 to a portion of the state of Chiapas; and there was considerable internal progress, aided by a too liberal policy of subsidies to railways and even to lines of steamships. The boundary questions were settled under President Gonzalez (1880–1884); relations with Great Britain were renewed in 1884. The claims of the railways, however, necessitated retrenchment on official salaries, and the president's plan for conversion of the debt roused unexpected and successful opposition in an ordinarily subservient Congress. At the end of 1884 Porfirio Diaz was again elected president, and was continually re-elected, the constitution being modified expressly to allow him to continue in office.

Mexico under Diaz.

Financial reorganization.

The history of Mexico from 1884 to 1910 was almost void of political strife. President Diaz's policy was to keep down disorder with a strong hand; to enforce the law; to foster railway development and economic progress; to develop native manufactures by protective tariffs; to introduce new industries, *e.g.* the production of silk and wine, of coca and quinine; to promote forestry; to improve elementary and higher education—for all which purposes the Ministerio del Fomento is a potent engine; to encourage colonization; and, above all, to place the national credit on a sound basis. The first step in this process was a settlement of the British debt by direct arrangement with the bondholders. In 1890 the Spanish bondholders' claims were satisfactorily arranged also. In 1891 the tariff was made more protectionist. In 1893 the depreciation of silver necessitated stringent retrenchment; but the budget balanced for the first time during many years, the floating debt was converted, and a loan raised for the completion of the Tehuantepec Railway. After 1896 substantial annual surpluses were spent in reducing taxation and in the extinction of debt. In 1895 the 6% external debt was converted into a 5% debt, the bonds of which remained at a premium for 1902; in 1896 the alcabalas or interstate customs and municipal *octrois* were abolished, and replaced in part by direct taxation and increased stamp duties.

Pacification of the Country.

The institution by Diaz of the *guardias rurales*, a mounted gendarmerie composed of the class who in former days drifted into revolution and brigandage, was a potent means of maintaining order, and the extension of railways and telegraphs enabled the government to cope at once with any disturbance. The old local revolutions practically disappeared. In 1886–1887 there were some disturbances in Coahuila, New Leon, Sinaloa and Tamaulipas; subsequently hardly anything was heard of such disorders except on the Texan frontier, where in 1890 Francisco Ruiz Sandoval and in 1891 Catarino Garza made incursions into Mexico. Occasionally the Church gave trouble—the presence of foreign priests was complained of; attempts to evade the law prohibiting conventual life were detected and foiled (1891, 1894); and there were Indian risings, repressed sometimes with great severity, among the Mayas of Yucatán, whose last stronghold was taken in 1891, and the Yaquis of Sonora (1899–1900). Under federal and democratic forms, Diaz exercised a strictly centralized and personal rule. He was invited to approve the candidates proposed for state governorships; in all law cases affecting the Government or political matters the judges asked his opinion; he drafted bills, and discussed their text with individual members and committees of congress. Similarly, the state legislatures, as well as the judges and municipal officers, were actually or virtually selected by the state governors, who were practically agents of the president. Now and then the old passions broke out: in September 1898 an absurd attempt to assassinate President Diaz was made by a countryman named Arroyo, but discontent with Diaz's rule was apparently confined to a small minority.[1] In 1909 indeed there were some disquieting symptoms. Owing to Diaz's age the vice-presidency had been revived in 1904, and Don Ramon Corral elected to it; but at the elections of 1909 a movement arose in favour of replacing him by General Bernardo Reyes, Governor of Nuevo Leon, but he was disposed of by an official commission to study the military systems of Europe. It was, therefore, regarded as certain that, should President Diaz die in office, Señor Corral would succeed him without serious difficulty.

Foreign Affairs.

In foreign affairs the rule of Diaz was uneventful. There were transient disputes with the United States (1886, 1888). In 1888–1890 and 1894–1895 a boundary dispute with Guatemala became serious. But Guatemala gave way at the threat of war (Jan. 1895) and a new treaty was made (April 1, 1895). Again in 1907 there was some friction owing to the murder of a Guatemalan ex-president by a compatriot in Mexico: later in the year, however, the Mexican government was active in stopping a war between its Central American neighbours. In the difficulty between England and the United States over the Venezuelan boundary (Dec. 1895) Mexico expressed strong adherence to the Monroe doctrine in the abstract, and suggested that its maintenance should not be left wholly to the United States, but should be undertaken by all American Powers. The first Pan-American congress met in Mexico City in 1901, and the country was represented at the second, held in Rio Janeiro in 1906. Mexico also took part in establishing the permanent Central American Court of Arbitration, inaugurated on the 25th of May 1908 at Cartago, Costa Rica, under the Washington treaties of December 1907, and showed readiness to associate herself with the Government of her great northern neighbour in preserving peace among the Central American States. On the 17th of October 1909 President Taft and President Diaz exchanged visits at the frontier at El Paso, Texas.

Economic Progress.

In brief, under President Diaz's rule the history of Mexico is mainly economic. In the six financial years 1893–1894 to 1899–1900 inclusive the yield of the import duties increased by upwards of 80%; the revenue from stamps over 60%, though the duties were reduced; the postal revenue from 1895–1896 to 1899–1900 rose 60%; the telegraph revenue over 75%. Again, in 1898–1899 the total ordinary revenue of the state was £6,013,921; in 1906–1907 it had increased to £11,428,612, or by more than 90%, and though 1907–1908 was a year of depression its total revenue (£11,177,186) exceeded that of any year save its immediate predecessor. The great drainage scheme which completed the works of the 17th century by taking out the surplus waters of the southern lakes of the valley of Mexico was devised in 1856, begun under Maximilian, proceeded with intermittently till 1885, then taken up with improved plans, practically completed by 1896, and inaugurated in 1900;[2] the harbour of Vera Cruz was finished in 1902; the Tehuantepec railway, likely to prove a formidable rival to any interoceanic canal, was opened on the 24th of January 1906. All three were the work of an English firm of contractors, the head of which was Sir Weetman Pearson. American, and later Canadian, capital and enterprise have also been very largely concerned in the development of the country; and its progress was not permanently interfered with by the great earthquakes of April 1907 and July 1909 at Acapulco, and the floods in August 1909 at Monterey. In 1891 elementary education was reorganized, and made compulsory, secular and gratuitous. Great attention has been paid to higher education, and—at least in the hospitals—to modern sanitation and hygiene.

AUTHORITIES.—For English readers the standard work is H. H. Bancroft, *Collected Works* (Histories of the Pacific States, Central America, &c., vols. x.–xiv. (Mexico, 1521–1887) with vols. xv., xvi.

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[1] Don Augustin Iturbide, grandson of the emperor, godson and (perhaps) at one time the destined heir of Maximilian, was turned out of the army and imprisoned in 1890 for abusing President Diaz.

[2] For a full account of the works see J. B. Body in *Proceedings of the Institution of Civil Engineers*, cxliii. 286, sqq.

(Texas), and vol. xvii. (New Mexico, &c.). Mention may also be made of Gaston Routier's *Histoire de Mexique* (1895). Standard Mexican authorities are: C. M. de Bustamante, *Quadro historico de la revolucion mexicana*, 6 vols. (Mexico, 1832–1846); Lucas Alaman, *Historia de Mexico* (Mexico, 1849–1852); N. de Zamacois, *Historia de Mexico desde sus tiempos mas remotos hasta nostras dias*, 19 vols. (Barcelona, 1876–1882); J. E. Hernández y Davalos, *Coleccion de documentos para la historia de la Independencia* (Mexico, 6 vols). A huge and informative illustrated work, edited by Justo Sierra (3 vols. large 4to), sumptuously produced and badly translated, is *Mexico, its Social Evolution* (Barcelona, 1900–1904); a useful and handy chronicle is Nicolas Leon's *Compendio de la historia general de Mexico hasta el año de 1900* (Mexico and Madrid, 1902). For the colonial period, Alexander v. Humboldt, *Essai politique sur la royaume de la Nouvelle Espagne* (Paris, 1811, 2 vols., and atlas; also an English translation). For the war with the United States see R. S. Ripley, *The War with Mexico* (New York, 1849); E. D. Mansfield, *The Mexican War* (New York, 1849); and Winfield Scott's *Memoirs*. For Maximilian, the Blue-books on Mexican affairs contained in *Accounts and Papers* (presented to parliament), vol. lxv. 1862, and vol. lxiv. 1863, are valuable; E. de Kératry, *La Créance Jecker; l'empereur Maximilien, son élévation et sa chute* (translated into English by Venables); *La Contre-guerilla française au Mexique*, are specially noteworthy; Prince Felix Salm-Salm's *Diary* gives valuable information as to Maximilian's decline and fall. Also Dela Gorce, *Histoire du second empire*, vols. iv. v.; J. F. Domenech, *L'Empire mexicain* (Mexico, 1866), and *Le Mexique tel qu'il est* (Paris, 1867); Daran, *El General Miguel Miramon* (in French) (Rome, 1886); Schmidt von Tavera, *Gesch. d. Regierung d. Kaisers Maximilian I.* (Vienna, 1903). Ulick Ralph Burke's *Life of Benito Juarez* (London, 1894) is of considerable value and interest. For the period since 1887 information in English must be sought chiefly in magazine articles: Matias Romero, "The Garza Raid and its Lessons," *North American Review* (Sept. 1892); Don Agustin Iturbide, "Mexico under Diaz," ibid. (June 1894); Romero, "The Philosophy of Mexican Revolutions," ibid. (Jan. 1896); and C. F. Lummis, "The Awakening of a Nation" (New York, 1898, previously in *Harper's Magazine*), are valuable as giving information (especially the last named) and points of view. Van Dyke, "Politics in Mexico," *Harper's Magazine* (1885), vol. lxxi., gives particulars of the opposition to Gonzalez's debt conversion scheme of 1884. President Diaz's message of November 1896, giving an account of his stewardship from 1884 to that year, has been translated into French (*Rapport du Général Porfirio Diaz . . . à ses compatriotes sur les actes de son administration, &c.*), edited by Auguste Génin (Paris, 1897). The early constitutions of the Republic have been published (in Spanish) in three volumes; a study of that of 1857 by B. Moses (of the University of California) is in the *Annals of the American Academy of Political Science*, II. i. 1891. Various books, chiefly American, have been written on Mexico of late years from a tourist's standpoint. Mrs Alec Tweedie's *Mexico as I saw it* (London, 1901) and *Life of Porfirio Diaz* (1906) contain valuable information personally obtained from good authorities in Mexico. See also Percy F. Martin, *Mexico of the Twentieth Century*, 2 vols. (London, 1907); and C. R. Enock, *Mexico* (1909). (J. S. Ma.)

MEXICO, a state of the republic of Mexico, bounded N. by Hidalgo, E. by Tlaxcala and Puebla, S. by Morelos and Guerrero, and W. by Michoacán. Pop. (1900), 934,468, largely Indian. Area, 9247 sq. m., a large part of which lies within that great depression of the Mexican plateau known as the Valley of Mexico. Enclosed within its boundaries, except on the south, is the Federal District and capital city of Mexico with an area of 463 sq. m., which is not included in that of the state. The state is divided into two unequal parts by the Sierra de Ajusco and Montes de las Cruces, which form a wooded ridge across it from east to west, with a general elevation of about 10,000 ft. above sea-level, or about 2500 above the plateau level. These ranges are part of a broken irregular chain which sometimes bears the name of Anahuac. A considerable part of the northern plateau consists of a broad plain, once the bed of a great lake but now covered with swamps, sodden meadows and lakes. The surrounding country drains into this depression, but an artificial outlet has been created by the opening of the Tequixquiac tunnel. Beyond its margin the plateau drains westward to the Pacific through the Lerma, and north-east to the Gulf through the San Juan and Pánuco. South of the Sierra de Ajusco the country is roughly mountainous and drains to the Pacific through tributaries of the Balsas. Within the lacustrine depression of the north are the lakes of Zumpango, San Cristobal, Xaltocán, Chalco, Xochimilco, and Texcoco, the latter three lying partly or wholly in the Federal District. Texcoco has the lowest level and its water is brackish and undrinkable, though that of the streams flowing into it and of the other lakes is sweet. Lake Xochimilco is celebrated for its "floating gardens" or *chinampas* (see Mexico, Federal District of). The principal industries of the state are agricultural, and the principal products are cereals, sugar, maguey (from which "pulque" is made), coffee, and fruit. Stock-raising has also had a profitable development, owing to the proximity of the national capital. The manufacturing industries are important; among the manufactures are cotton and woollen fabrics, flour, dairy products, glass-ware, pottery, bricks, wines and spirits. The making of "pulque" from the sap of the maguey plant (*Agave americana*) is the chief industry of the state, and the product is exported in large quantities to the national capital. The state is traversed by the Central, National, Mexican International and Interoceanic railways, and by short lines from the national capital to neighbouring towns. The capital is Toluca, and other important towns are Zumpango (pop. 5942 in 1900), 30 m. N. of the national capital, Tenango del Valle (5881 in 1900), 15 m. S.E. of Toluca, and Lerma (estimated, 7200), near the western frontier of the state.

MEXICO, a city and the county-seat of Audrain county, Missouri, U.S.A., N.E. of the centre of the state, and about 110 m. N.W. of St Louis. Pop. (1890), 4789; (1900), 5099, including 948 negroes and 111 foreign-born; (1910), 5939. It is served by the Chicago & Alton, the Chicago, Burlington & Quincy, and the Wabash railway systems. Mexico is the seat of Hardin College and Conservatory of Music (Baptist, 1873), for young women, an institution founded and endowed by Charles H. Hardin (1820–1892), governor of the state in 1872–1874, and of the Missouri Military Academy (1889). The city is situated in the blue grass region of Missouri, and is a shipping-point for horses and mules. Among the manufactures are flour, shoes and fire-clay products. Mexico was laid out as "New Mexico" in 1836, and became the county-seat under its present name in 1837. It was incorporated as a town in 1855, was entered by the Wabash road in 1858 and by the Alton in 1872, and was first chartered as a city in 1874.

MEXICO CITY, capital of the Republic of Mexico and chief town of the Federal District, near the southern margin of the great central plateau of Mexico, in lat. 19° 25′ 45″ N., long. 99° 7′ W. It is about 200 m. in a direct line W. by N. of Vera Cruz, its nearest port on the Gulf of Mexico, with which it is connected by two railway lines, one of which is 264 m. long; and about 181 m. in a direct line N.N.E. of Acapulco, its nearest port on the Pacific, with which it is connected partly by rail and partly by a rough mountain trail (the *camino real*) to the coast. Pop. (1900), 344,721.

The city stands on a small plain occupying the south-western part of a large lacustrine depression known as the Valley of Mexico (*El Valle de Mêxico*), about 3 m. from the western shore of Lake Texcoco, whose waters once covered a considerable part of the ground now occupied by the city. The Valley, including the drainage basin of Lake Zumpango, has an area of 2219 sq. m. (1627 sq. m. without that basin). The elevation of the city above sea-level is 7415 ft., only a few feet above the level of Lake Texcoco. The general elevation of the Valley is about 7500 ft., that of Lake Zumpango being 7493 ft., and of Lake Chalco 7480 ft. The rim of the Valley is formed by spurs of the transverse cordillera on the north and south sides—the Sierra de Guadalupe (650 to 750 ft. above the city) on the north, and the Sierra Nevada with its snow-clad peaks of Popocatapetl and Ixtaccihuatl farther away to the south-east—and by a part of the Sierra de Ajusco, known as the Montes de las Cruces, from which the greater part of the city's water supply is derived. Lake Texcoco (*Tezcoco* or *Tezcuco*) is a comparatively shallow body of brackish water, with an area of about 11½ sq. m., and is fed by a number of small streams from the neighbouring mountains, and by the overflow of the other lakes. Its shores are swampy and desolate and show considerable belts of saline incrustations with the fall in its level. The Aztecs settled there because of the security afforded by its islands and shallow waters—their city, Tenochtitlán, being so completely surrounded by water that a handful of warriors could easily defend its approaches against a greatly superior force. The Chalco and Xochimilco lakes, 8 or 9 m. to the southward, which are separated by a narrow ridge of land, are connected with the lower part of the city by an artificial canal, called "La Viga," 16 m. long and 30 ft. wide, which serves as an outlet for the overflow of those lakes and as a waterway for the natives who bring in flowers and vegetables for sale. Lake Xochimilco, celebrated for its *chinampas*, or "floating gardens" (see MEXICO, FEDERAL DISTRICT OF), is supplied very largely by fresh-water springs opening within the lake itself, which the city has partially diverted for its own water supply. Lake Chalco is also greatly reduced in size by railway fillings and irrigation works, to the great distress of the natives who have gained their living by fishing in its waters since long before the Spanish conquest.

The climate of the city is temperate, dry and healthful. The temperature ranges from a minimum of 35° F. in winter to a maximum of 79° in summer. The winter range is 35° to 68°, and the summer 50° to 79°. The nights are always cool. The year is divided into a wet and dry season, the former from April to September, the latter from October to March. The rainfall, however, is light, about 20 to 25 in., but, with the assistance of irrigation, it serves to sustain a considerable degree of cultivation in the neighbourhood of the city. The health of the city, unfortunately, does not correspond with its favourable climatic conditions. With a wet, undrained subsoil and a large population of Indians and half-breeds living in crowded quarters, the death-rate has been notoriously high, though the completion of the Valley drainage works in 1900, supplemented by underground sewers in the better parts of the city, and by better sanitation, have recently improved matters. The annual death-rate per 1000 was 54 per 1000 for the Federal District in 1901, 50 in 1902, 48 in 1903, 46 in 1904, and 56 in 1905; the increase for the last-mentioned year being due to an epidemic of typhus fever.

The city is laid out with almost unbroken regularity and is compactly built—the streets running nearly with the cardinal points of the compass. The new and better residence sections are on the western side; the poorer districts are on the eastern side nearer the swampy shores of Lake Texcoco. As the name of a street changes with almost every block, according to the old Spanish custom, a list of street names is sometimes mistakenly accepted as the number of continuous thoroughfares in the city, so that it has been said that Mexico has 600 to 900 streets and alleys. An attempt was made in 1889 to rename the streets—all running east and west to be called *avenidas*, all running north and south *calles*, and all continuous thoroughfares to have but one name—but the people clung so tenaciously to the old names that the government was compelled to restore them in 1907. Outside the Indian districts of the eastern and southern outskirts, the streets are paved with asphalt and stone, lighted with electricity and gas, and served with an efficient street railway service. The political and commercial centre of the city is the Plaza Mayor, or Plaza de la Constitución, on which face the cathedral, national palace, and municipal palace. Grouped about the Plaza de Santo Domingo are the old convent and church of Santo Domingo, the court of the Inquisition now occupied by the School of Medicine, the offices of the Department of Communicaciones, and the old custom-house (*aduana*). Close by are the old church of the Jesuits and the mechanics' school (*artes y oficios*) with its large and well-equipped shops. Among other well-known *plazas* are: Loreto, on which faces the great enclosed market of the city; Guardiola, in the midst of handsome private residences; San Fernando, with its statue of Vicente Guerrero; and Morelos, with its marble statue of the national hero of that name. The Paseo de la Reforma, the finest avenue of the city, is a broad boulevard extending from the Avenida Juárez south-west to Chapultepec, a distance of nearly three miles. At intervals are circular spaces, called "glorietas," with statues (the famous bronze equestrian statue of Charles IV., and monuments to Columbus, Cuauhtemoc the last of the Aztec emperors, and Juárez). Other notable avenues are Bucareli and Juárez, and the Avenida de la Viga, which skirts the canal of that name. The principal business streets runs westward from the Plaza Mayor toward the Alameda, and is known as the Calle de los Plateros (Silversmiths' Street) for two squares, Calle de San Francisco for three squares, and Avenida Juárez along the south side of the Alameda to its junction with the Paseo. The Alameda, or public garden, ½ m. west of the Plaza Mayor, covers an area of 40 acres, and occupies the site of the old Indian market and place of execution, where occurred the first auto-da-fé in Mexico in 1574.

The great cathedral stands on or near the site of the Aztec temple (*teocalli*) destroyed by Cortés in 1521. The foundations were laid in 1573, the walls were completed in 1615, the roof was finished in 1623, its consecration took place in 1645 and its dedication in 1667, the towers were completed in 1791, and the great church was finished about 1811. It is 426 ft. in length by 197 ft. in width, and its towers rise to a height of 204 ft. Its general plan is that of a Greek cross, with two great naves and three aisles, twenty side-chapels and a magnificent high altar supported by marble columns and surrounded by a tumbago balustrade with sixty-two tumbago statues carrying elaborate candelabra made from a rich alloy of gold, silver and copper. The elaborately carved choir is also enclosed by tumbago railings made in Macao, weighing 26 tons. The vaulted roof is supported by twenty Doric columns, 180 ft. in height, and the whole interior is richly carved and gilded. The walls are covered with rare paintings. Standing close beside the cathedral is the highly ornamented façade of a smaller church called El Sagrario Metropolitano. The city has about sixty church edifices, including La Profesa, Loreto, Santa Teresa, Santo Domingo and San Hipólito. At the time of the secularization of Church properties there were about 120 religious edifices in the city—churches, convents, monasteries, &c.—many of which were turned over to secular uses.

The national palace, also on the Plaza Mayor, has a frontage of 675 ft. on the east of the Plaza, and covers a square of 47, 840 sq. yds., or nearly 10 acres. It contains the executive offices of the government and those of five cabinet ministers (interior, foreign affairs, treasury, war and justice), the senate chamber, the general archives, national museum, observatory and meteorological bureau. The palace occupies the site of the residence of Moctezuma, which was destroyed by the Spaniards, and that of Hernando Cortés, which was also destroyed in 1692. It has three entrances on the Plaza, and over its main gateway hangs the "liberty bell" of Mexico, first rung by the humble parish priest Hidalgo, on the night of the 16th of September 1810, to call the people of Dolores to arms, and now rung at midnight on each recurring anniversary by the president himself. The national museum, which occupies the east side of the national palace, is rich in Mexican antiquities, among which are the famous "calendar stone,"[1] supposed to be of Toltec origin, and the "sacrificial stone" found in the ruins of the great *teocalli* destroyed by Cortés. Near the cathedral is the *monte de piedad*, or government pawnshop, endowed in 1775 by Pedro Romero de Terreros (conde de Regla) with £75,000, and at one time carrying on a regular banking business including the issue of bank-notes. Its business is now limited to the issue of small loans on personal property—the aggregate sometimes reaching nearly £50,000 a month. The national library, which has upwards of 225,000 volumes, occupies the old St Augustine Church, dedicated in 1692 and devoted to its present use by Juárez in 1867. It contains an interesting collection of the busts of Mexican celebrities. The academy of San Carlos and school of fine arts (founded in 1778) likewise contains good collections of paintings and statuary.

Among other institutions are the new post office, begun in 1902 and finished in 1907; the Minería, occupied by the schools of mining and engineering; the military school, occupying a part of the castle of Chapultepec; the Iturbide palace, now occupied as a hotel; the Iturbide theatre, occupied by the chamber of deputies, for which a new legislative palace to cost 2,500,000 pesos was under construction in 1909; the new palace of justice; the old mint, dating from 1537; the new penitentiary, completed in 1900; the Pantéon, with its monuments to the most celebrated Mexicans; the new general hospital; the jockey club on Plaza Guardiola, a new university (1910) and new school edifices of modern design. The city is likewise generously provided with hospitals and asylums.

The old Spanish edifices were very solidly constructed of stone, and private residences were provided with iron gates and window guards strong enough to withstand an ordinary assault. Private houses were also provided with flat roofs (*azoteas*) and battlements, which gave them great defensive strength, as well as a cool, secluded retreat for their inmates in the evening. The old Moorish style of building about an open court, or *patio*, prevails, and the living-rooms of the family are on the second floor. The better residences of the old style were commonly of two storeys—the ground-floor being occupied by shops, offices, stables and servants' quarters. The more modern constructions of the Colonia Juárez and other new residence districts are more attractive and pretentious in appearance, but are less solidly built.

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[1] Bandelier thinks it should be called the "Stone of the Sun."

Mexico was formerly one of the worst drained large cities of the New World, its subsoil being permanently saturated and its artificial drainage being through open ditches into the San Lazaro Canal which nominally discharged into Lake Texcoco. The difference in level between the city and the lake being less than six feet and the lake having no natural outlet, typhus fever became a common epidemic in its lower and poorer sections. The earliest effort to correct this evil was by the Dutch engineer Maartens (Span., Martinez), who planned a deep cutting through Nochistongo Hill, north of the city, to carry away the overflow of Lake Zumpango (7493 ft. elevation) to the river Tula, a tributary of the Panuco. The cutting was 13 m. long and is known as the Tajo de Nochistongo. It was begun in 1607—a year when the city was completely flooded—but was not completed until 1789, and then it was found that the city was still subject to partial inundations, although an enormous sum of money and 70,000 lives of Indian labourers had been expended upon it. The worst inundation in the history of the city occurred in 1629, when its streets were covered to a depth of 3 ft. and remained flooded until 1634. In 1856 President Ignacio Comonfort invited tenders for drainage works conditional on the use of waste waters for irrigation purposes, and the plan executed consists of a canal and tunnel 43 m. long, starting from the east side and 4¼ ft. below the mean level of the city and running north to Zumpango and thence eastward into a tunnel over 6 m. long, which discharges into a small tributary of the Panuco river near the village of Tequixquiac. The greatest depth of the tunnel is 308 ft. below the surface. The works were inaugurated in 1900.

For the water supply the Aztecs used the main causeway through their city as a dam to separate the fresh water from the hills from the brackish water of Texcoco, and obtained drinking water from a spring at the base of the hill of Chapultepec. The Spaniards added three other springs to the supply and constructed two long aqueducts to bring it into the city. Three other sources were added during the 19th century, and in 1899–1900 steps were taken to secure a further supply from the Rio Hondo. Besides these there are 11 public and 1375 private artesian wells in the city. All these sources are estimated to yield about 220 to 230 litres per head.

Considerable attention has always been given to education in Mexico, but in colonial times it was limited in scope, and to the dominant classes. The old university of Mexico, with its faculties of theology, law and medicine (founded 1551 and inaugurated 1553), ceased to exist in 1865 and was succeeded by schools of engineering, law and medicine, which have been signally successful. The government also maintains schools of agriculture, commerce, fine arts, music, pharmacy, technology, and an admirable preparatory or high school, besides a large number of primary and secondary schools for which modern school buildings have been erected. Normal and industrial schools for both sexes are maintained, the latter (*artes y oficios*) performing a very important service for the poorer classes. In 1908 there were 353 government schools in the city, including 13 professional and technical schools, and nearly 200 private schools. There are also several scientific organizations and societies. The Mexican Geographical Society (*Sociedad mexicana de geografía y estadística*), founded in 1833, has rendered invaluable services in the work of exploration and publication; there are also the Geological Society, the Association of Engineers and Architects, and the Society of Natural History.

Through lack of water-power and cheap fuel Mexico has never been rated as a manufacturing city. However, the development of electric power, and the possibility of transmitting it for long distances, have worked a noteworthy change in this respect, and a large number of industries have been added in recent years. The largest of these electric-power plants is on the Necaxa and Tenango rivers, in the state of Puebla, 92 m. from the city, which is designed to furnish 40,000 horse-power for industrial and lighting purposes, and a duplicate plant was decided upon in 1904. Another plant is in the suburb of San Lazaro, the current being distributed by over 100 m. of underground mains in the city and many miles of overhead wires in its outskirts and suburbs. Other plants are at San Ildefonso, 12 m. distant, and on the Churubusco river, 16 m. south. According to a British consular report for 1904 there were 153 manufacturing establishments in the city producing cotton, linen and silk textiles, leather, boots and shoes, alcohol and alcoholic beverages, beer, flour, conserves and candied fruits, cigars and cigarettes, Italian pastes, chocolate, starch, hats, oils, ice, furniture, pianos and other musical instruments, matches, beds, candles, chemicals, iron and steel, printing-type, paint and varnish, glass, looking-glass, cement and artificial stone, earthenware, bricks and tiles, soap, cardboard, papier mâché, cartridges and explosives, white lead, perfumery, carriages and wagons, and corks. To these should be added the foundries and iron-working shops which add so much to the prosperity of modern Mexico. Perhaps the most important of these manufactories are the cotton mills, of which there are 13, and the cigar and cigarette factories, of which there are 10. In the suburbs, oils, chemicals, cigarettes and bricks are made at Tacuba; cotton textiles at Contreras, San Angel and Tlalpam; paper and boots at Tacubaya, and bricks at Mixcoac and Coyoacan. A little farther away are the woollen mills of San Ildefonso, the paper-mills of San Rafael, and important works for the manufacture of railway rolling stock.

The railway connexions include direct communication with one port on the Gulf coast and with two on the Pacific—lines were under construction in 1909 to two other Pacific ports—and indirect communication with two on the Gulf. The Mexican and Interoceanic lines connect with Vera Cruz, the Mexican Central with Manzanillo, via Guadalajara and Colima, and the Vera Cruz & Pacific (from Cordoba) with the Tehuantepec line and the port of Salina Cruz. The last-mentioned line also gives indirect connexion with the port of Coatzacoalcos, and the Mexican Central, via San Luis Potosí, with Tampico. A southern extension of the Mexican Central, via Cuernavaca, has reached the Balsas river and will be extended to Acapulco, once the chief Pacific port of Mexico and the dépôt for the rich Philippine trade. A Mexican extension of the (American) Southern Pacific which has been completed from Nogales to Mazatlán is to be extended to Guadalajara, which will give the national capital direct communication with the thriving ports of Mazatlán and Guaymas. In addition to these, the Mexican Central and Mexican National, now consolidated, give communicaton with the northern capitals and the United States, and the Mexican Southern runs southward, via Puebla, to the city of Oaxaca. These railways, with the shorter lines radiating from the city, connect it with nearly all the state capitals and principal ports.

The population by the census of 1900 was 344,721—an increase of 14,947 over the returns of 1895. The great majority of the inhabitants is composed of Indians and half-breeds, from whom come the factory workers, labourers, servants, porters and other menial wage-earners. In former times Mexico was overrun with mendicants (*pordioseros*), vagrants and criminals (*rateros*), and the "Portales de las Flores" on the east of the Plaza Mayor was a favourite "hunting-ground" for them because of its proximity to the cathedral; but modern conditions have largely reduced this evil. The foreign population includes many capitalists and industrial managers who are doing much to develop the country, the American colony being concentrated in a fine modern residential district on the south-western side of the city.

History.—The City of Mexico dates, traditionally, from the year 1325 or 1327, when the Aztecs settled on an island in Lake Texcoco. The Aztec name of the city was Tenochtitlán, derived either from Tenoch, one of their priests and leaders, or from *tenuch*, the Indian name for the "nopal," which is associated with its foundation. The modern name is derived from Mexitli, one of the names of the Aztec god of war Huitzilopochtli, which name was later on applied also to the Aztecs themselves. The island settlement, which was practically a lake-village built on islets—some of them undoubtedly artificial, and perched on stakes—grew rapidly with the increasing power and civilization of its inhabitants, who had the remains of an earlier civilization (Tula, Teotihuacán, Cholula, and other older towns) to assist in their development. About the middle of the 15th century their mud-and-rush dwellings were partly replaced by stone structures, grouped around the central enclosure of the great *teocalli*, and bordering the causeways leading to the mainland. The town had reached its highest development when the Spaniards appeared in 1519, when it is said to have had, including suburban towns, a total of 60,000 dwellings, representing about 300,000 inhabitants. It was at that time about 12 m. in circumference, everywhere intersected by canals, and connected with the mainland by six long and solidly constructed causeways, as shown in the plan given in the edition of Cortés's letters published at Nuremberg in 1524 (reproduced in vol. i. of H. H. Bancroft's *History of Mexico*, San Francisco, 1883, p. 280). Allowance should be made for the habit of exaggeration among the Spanish adventurers of that time, and also for the diplomacy of Cortés in magnifying his exploits to win the favour of his king. The truth is, without doubt, that the dwellings of the lower classes were still built of reeds and mud, and covered the greater part of the city's area, otherwise it is impossible to understand how a mere handful of Spanish soldiers, without tools and explosives, could so easily have levelled it to the ground. After its almost total destruction in November 1521, Cortés employed some 400,000 natives in rebuilding the city on its former site. Since then the lake has decreased greatly in extent, its area being reduced to 11½ sq. m. and its shore-line being more than 3 m. distant from the city it once surrounded. During Spanish rule the only break in the ordinary course of events was the revolt of 1692, which resulted in the destruction of the municipal buildings. The city was not much disturbed by the struggle for independence, but it was afterwards the scene of many a revolution until the dictatorial authority of Porfirio Diaz put an end to petty pronunciamentos and partisan intrigues.

In the war between Mexico and the United States the most decisive campaign was that of General Winfield Scott directed against the Mexican capital. With the advanced guard of an army of about 10,000 men he arrived on the 10th of August 1847 at Ayolta, on the national road 16 m. south-east of the city; but as the approaches from this direction were very strongly fortified he cut a new road southward along the eastern shore of Lake Chalco and westward along the southern shore of lakes Chalco and Xochimilco to San Augustin, where his army arrived on the 17th and 18th of August. The city was now 10 m. distant by a direct road to the northward, but as the village of San Antonio, only 3 m. ahead, was strongly fortified, another short detour was made to the westward by cutting a road through a field of broken lava. This movement brought the Americans to the hill of Contreras, which was held by General Valencia with a force of some 7000 and 22 pieces of artillery, while President Santa Anna was in the neighbourhood with reinforcements numbering 12,000 or more. The Mexicans were routed on the morning of the 20th of August after suffering heavy losses. San Antonio was easily taken about noon of the same day, and in the afternoon the main division of the Mexican army was driven from the stone church and intrenchments at Churubusco. Three days later General Scott agreed to an armistice, but Mexico rejected the terms of peace, and hostilities were resumed on the 7th of September. During the armistice the American troops were quartered in and about the village of Tacubaya, about 2½ m. west by south of the city. Near Tacubaya, on the north by west, were some massive stone buildings known as El Molino del Rey, or the King's Mill. When attacked by the Americans under the immediate command of General W. J. Worth in the early morning of the 8th of September these buildings were defended by more than 10,000 Mexicans under Generals Leon, Alvarez and Perez, and they were captured only after a most desperate fight, which cost the Americans 787 killed and wounded and the Mexicans at least 2000 killed, wounded, and prisoners. To enter the city by way of the Tacubaya causeway it was still necessary for the Americans to capture Chapultepec. This hill, defended by about 4000 Mexicans under General Nicolas Bravo, was bombarded on the 12th of September, and was carried by assault on the 13th. On the following day the City of Mexico surrendered. It was then occupied by the American army under General Winfield Scott, and held by them until the signing of the treaty of Guadalupe-Hidalgo (May 1848).

The French intervention of 1861 led to a second occupation by a foreign power—a French military force under General Forey taking possession in June 1863. Maximilian, archduke of Austria, was crowned emperor of Mexico in the cathedral in June 1864, and held possession of the capital until the 21st of June 1867, when it was captured by General Porfirio Diaz. Earthquake shocks are of frequent occurrence, but the city rarely suffers any material damage. The great earthquake shocks of the 30th and 31st of July 1909, however, caused considerable damage in the city, and a few lives were lost.

For further description see H. H. Bancroft, *History of Mexico* (6 vols., San Francisco, 1883); Robert S. Barrett, *Standard Guide to the City of Mexico and Vicinity* (Mexico, 1900); Thomas A. Janvier, *The Mexican Guide* (5th ed., New York, 1890); D. Charnay, *Ancient Cities of the New World* (Eng. ver., New York, 1887); and the *Plano de la ciudad de México*, in the *Diccionario enciclopédico hispano-americano* (Barcelona, 1893), xii. 740.

MEXICO, FEDERAL DISTRICT OF, a territory set apart for the independent and exclusive use of the Mexican Federal Government, occupying the south-eastern part of the Valley of Mexico, and taken from and lying within the State of Mexico, which forms its boundaries on all sides except the south where it touches the state of Morelos. Pop. (1900), 540,478, largely Indian and half-breeds; area, 463 sq. m., or accordingly to later computation 1498¾ sq. kilom. (578⅝ sq. m.). The district is very irregular in outline, its greatest length (N.W. to S.E.) being 30 m., and its greatest breadth 25 m. It was formerly divided into one urban municipality and four rural prefectures, but under the law of the 26th of March 1903 it is divided into 13 municipalities, Mexico, Guadalupe-Hidalgo, Atzcapotzalco, Tacuba, Tacubaya, Mixcoac, Cuajimalpa, San Angel, Coyoacan, Tlalpám, Xochimilco, Milpa Alta and Ixtapalapa; the first of these comprises the national capital and its immediate suburbs, and the other 12 the unequal divisions of the district with a considerable number of towns and villages. Indians and half-breeds form more than one-half of the rural population engaged in agriculture and gardening, beside which there is a large percentage employed in manufacturing industries. The government of the district is exercised by the national executive in accordance with the organic law of 1903, though some measure of popular government is vested in municipal councils (*ayuntamientos*) elected by popular vote for terms of four years. These councils have lost much of their original legislative character, but they must be consulted in matters of local importance, such as water supply, sanitary works, and the exploitation or sale of municipal property, and in regard to all contracts affecting the municipality. They can veto by a two-thirds vote the execution of any contract or administrative project, which then, at the end of four months, if again vetoed must be taken before the President of the Republic for adjudication. The administrative officers, who are appointed by the national executive, consist of a governor of the federal district, the director-general of public works, and the president of the superior board of health. The three form a superior council of district government which exercises a supervisory and advisory power, "revising, confirming, reforming or revoking the acts of each one of the members of the council, whenever these acts are called in question." The council also exercises a general supervision of the making of contracts. The governor represents the national government, and has special charge of the fire and police departments, prisons, imposition of penalties for violation of ordinances, public diversions and festivities, civil registry, street traffic, inspection of weights and measures, and the sale of intoxicating liquors. The director-general of public works has special charge of the water supply, streets and roads, parks, monuments, public lighting, drainage, street cleaning, public buildings not under federal control, cemeteries, slaughter-houses and markets, building operations, and all municipal or communal property. The president of the superior board of health has charge of all sanitary works, general sanitary inspection, the sanitary administration of markets, slaughter-houses and cemeteries, and the introduction of meats from other localities. The government of the district is copied, in part, from that of the District of Columbia in the United States, but its citizens are not disfranchised. They elect the *ayuntamientos*, which exercise no slight influence in local affairs, and, like any state, elect senators and deputies to the National Congress.

The principal towns of the district, some of which are merely suburbs of the capital, are Guadalupe, Tacubaya, Tlalpám and Xochimilco. Within the municipal limits of Mexico City are Chapultepec, Santa Anita and the hot springs of El Peñón, which are popular suburban resorts easily reached by the ordinary urban tramway service. Chapultepec (Grasshopper Hill) is an isolated rock nearly 200 ft. high surrounded by a beautiful park and surmounted by a fortified structure called the "Castle," containing the summer residence of the president and the national military school. A finely graded road leads to the summit. The park contains a grove of old cypress trees (*Taxodium distichum*, called "ahuehuetes" by the natives), one of which is 45 ft. in circumference and nearly 200 ft. high. The hill is nearly 3 m. south-west of the city and once commanded one of its principal causeway approaches. It was assaulted and captured by the American forces under General Winfield Scott on the 13th of September 1847, after a stubborn resistance. A monument to the cadets of the military school who died in this battle stands in the park. The castle, which was built by the viceroys, was greatly embellished by the emperor Maximilian, who planned for it the drive known as the Paseo de la Reforma. Of the neighbouring towns Guadalupe or Guadalupe-Hidalgo (pop. 5834 in 1900), 2½ m. north by east from Mexico City, near the shore of Lake Texcoco, is chiefly known for its shrine to Our Lady of Guadalupe, who is said to have appeared there to the Indian Juan Diego in 1531. The shrine stands on the principal plaza and is visited by many thousands of pilgrims during the year, whose pious contributions have so enriched the church that its sacred vessels, altar-rails, candelabra and other accessories are estimated to contain fifty tons of silver. The treaty of peace between Mexico and the United States was signed here on the 2nd of February 1848. Tacubaya (pop. 18,342 in 1900), on the lower slopes of the Montes de las Cruces, about 5 m. west-south-west of the city, with which it is connected by rail, is noted for its fine old residences and beautiful gardens. The National Astronomical Observatory occupies a fine modern edifice. At Popotla is an aged tree under which, according to tradition, Cortés sat and wept after his terrible retreat from the Aztec capital on the *noche triste*. Farther south on the lowest slopes of the mountain range are San Angel and Tlalpam, the latter (pop. 4732 in 1900) standing partly on the plain 12 m. south by west of the capital. In both much attention is given to floriculture, and both are favourite country residences of the richer citizens. Xochimilco (field of flowers), (pop. 10,712 in 1900) on the west shore of the lake of that name and 10 m. south by east of the city, is an Indian town dating long before the discovery of America. It lies in the midst of a fertile plain devoted to the production of fruit, vegetables and flowers for the city markets. Its gardens are carried out on the shallow lake by floating masses of water-plants covered with soil and secured by poplar stakes, which, taking root, soon surround them with living boundaries. These remarkable and productive gardens, called *chinampas*, have so increased in number and extent that the lake is practically covered by them, with the exception of the waterways, which are kept open by scooping up mud from the bottom. From the lake a broad canal runs northward to the eastern suburbs of the city. It is known as the Viga, and is believed to have been opened by the Aztecs for the transportation of garden produce to their island capital.

MEXICO, GULF OF, a mediterranean gulf almost surrounded by the coasts of the United States and Mexico, and forming the northern division of the extension westward of the west Atlantic trench (see ATLANTIC OCEAN). Its southern boundary is defined by the partly submerged ridge which extends eastwards from the peninsula of Yucatán, and on which the island of Cuba is situated: to the east it communicates directly with the Atlantic by the Strait of Florida. On the western side of Yucatán a southerly embayment is formed by the Gulf of Campeachy. The United States coast closely follows the parallel of 30° N., while the parallel of 20° N. cuts across the Gulf of Campeachy: the greatest length—Vera Cruz to Florida—is 1120 m., and greatest width—Galveston to Campeachy—680 m. The total area is approximately 716,000 sq. m.

The deepest part of the Gulf of Mexico, the so-called "Sigsbee" deep, lies below the line of 2000 fathoms, between 23° and $25\frac{1}{2}$° N., and $84\frac{1}{2}$° to 95° W. It is widest to the west, where the breadth is about 120 m., and narrows to 25 m. at its greatest depth (2119 fathoms) between 86° and 88° W., widening again to some 80 m. farther eastward. The continental shelf is for the most part narrow: its breadth is 6 m. at Cape Florida, 120 m. along the west coast of Florida, 10 m. at the south pass of the Mississippi, 130 m. near the boundary of Texas and Louisiana, and 15 m. off Vera Cruz. The shores are low, sandy and marshy, the coast-line being frequently doubled by lagoons. There are no islands except the "Keys" of Florida and Yucatán, and Cuba. The tides in the Gulf of Mexico are of comparatively small range (springs rarely exceed 4 ft. and neaps $2\frac{1}{2}$ ft.), but a remarkable feature is the exaggeration of the diurnal inequality to such an extent as almost to extinguish the semi-diurnal tide in the inner parts of the gulf, giving high and low water only once daily. The mean level of the water in the Gulf of Mexico was formerly given as about 40 in. above that of mean sea-level at New York, but later reports on precise levellings from New York to Biloxi through St Louis describe it vaguely as "somewhat higher." The current movement in the Gulf of Mexico consists of a rotational movement in the direction of the hands of a watch, the branch of the equatorial current which enters the Caribbean Sea passing into the Gulf by the Strait of Yucatán and issuing from it by the Strait of Florida as the Gulf Stream, which unites with the remainder of the northward moving water, forming the Antilles current.

From March to September the prevailing winds are the north-east trades; these undergo considerable modification on account of the configuration of the surrounding land, and the rains which accompany them are interrupted by spells of calm thick weather, and rarely by northerly winds known as *Nortes del hueso colorado* and *Chocolateros*. In the colder dry season, from October to April, the climatic situation is dominated by the relatively high temperature of the surface of the gulf, causing a cyclonic inflow of air which is associated with the strong northerly winds or "northers" prevailing on the western side, more particularly along the Mexican coast. The northers sometimes blow with terrific force and are at times accompanied by rain. The form and position of the Gulf of Mexico exercise a profound influence on the climate of the whole of the southern and south-eastern states of the Union, and indeed of the greater part of North America. (H. N. D.)

MEYER, CHRISTIAN ERICH HERMANN VON (1801–1869), German palaeontologist, was born at Frankfort-on-the-Main, on the 3rd of September 1801. In 1832 he issued a work entitled *Palaeologica*, and in course of time he published a series of memoirs on various fossil organic remains: mollusca, crustacea, fishes and higher vertebrata. His more elaborate researches were those on the Carboniferous amphibia, the Permian reptiles, the Triassic amphibia and reptiles, and the reptiles of the Lithographic slates; and the results were embodied in his great work *Zur Fauna der Vorwelt* (1845–1860), profusely illustrated with plates drawn on stone by the author. He was associated with W. Dunker and K. A. Zittel in the publication of the *Palaeontographica*, which began in 1851. He was awarded the Wollaston medal by the Geological Society of London in 1858. He died on the 2nd of April 1869.

MEYER, HEINRICH AUGUST WILHELM (1800–1873), German Protestant divine, was born at Gotha on the 10th of January 1800. He studied theology at Jena, and eventually became (1841) pastor, member of the consistory, and superintendent at Hanover. He died on the 21st of June 1873. He is chiefly noted for his valuable *Kritischexegetischer Kommentar zum Neuen Testament* (16 vols.), which began to appear in 1832, was completed in 1859 with the assistance of J. E. Huther, Friedrich Düsterdieck and G. K. G. Lünemann, and has been translated into English. New editions have been undertaken by such scholars as A. B. Ritschl, B. Weiss, H. Wendt, K. F. G. Heinrici, W. Beyschlag and F. A. E. Sieffert.

Meyer also published an edition of the New Testament, with a translation (1829) and a Latin version of the symbolical books of the Lutheran Church (1830).

He is not to be confounded with JOHANN FRIEDRICH VON MEYER (1772–1849), the senator of Frankfort, who published a translation of the Bible in 1819 (*Die heilige Schrift in berichtigter Übersetzung mit kurzen Anmerkungen*; 2nd ed., 1823; 3rd ed., 1855).

MEYER, JULIUS LOTHAR (1830–1895), German chemist, was born on the 19th of August 1830, at Varel in Oldenburg. He was the son of a physician, and went to study medicine first at Zürich University in 1851, and then, two years later, at Würzburg, where he had R. Virchow as his teacher in pathology. The influence of C. F. W. Ludwig, under whom he studied at Zürich, decided him to devote his attention to physiological chemistry, and therefore he went, after his graduation (1854), to Heidelberg, where R. Bunsen held the chair of chemistry. There he was so influenced by G. R. Kirchhoff's mathematical teaching that he took up the study of mathematical physics at Königsberg under F. E. Neumann. In 1859 he became privat-docent in physics and chemistry at Breslau, where in the preceding year he had graduated as Ph. D. with a thesis on the action of carbon monoxide on the blood. In 1866 he accepted a post in the School of Forestry at Neustadt-Eberswalde, but soon moved to Carlsruhe Polytechnic. During the Franco-German campaign the Polytechnic was used as a hospital, and he took an active part in the care of the wounded. Finally, in 1876, he became professor of chemistry at Tübingen, where he died on the 11th of April 1895. His name is best known for the share he had in the periodic classification of the elements. He noted, as did J. A. R. Newlands in England, that if they are arranged in the order of their atomic weights they fall into groups in which similar chemical and physical properties are repeated at periodic intervals; and in particular he showed that if the atomic weights are plotted as ordinates and the atomic volumes as abscissae, the curve obtained presents a series of maxima and minima, the most electro-positive elements appearing at the peaks of the curve in the order of their atomic weights. His book on *Die modernen Theorien der Chemie*, which was first published in Breslau in 1864, contains a discussion of relations between the atomic weights and the properties of the elements. In 1882 he received from the Royal Society, at the same time as D. J. Mendeléeff, the Davy medal in recognition of his work on the Periodic Law. A younger brother, O. E. Meyer, became professor of physics at Breslau in 1864.

MEYER, KONRAD FERDINAND (1825–1898), Swiss poet and novelist, was born at Zürich on the 11th of October 1825. After studying law at the university, he went for considerable periods to Lausanne, Geneva and Paris, and in Italy interested himself in historical research. In 1875 he settled at Kilchberg near Zürich, was created in 1880 a doctor philosophiae *honoris causa* by that university, and died at Kilchberg on the 28th of November 1898. After Gottfried Keller, Konrad Meyer is the most important Swiss poet of modern times, though as a novelist he was perhaps more successful. His poetical works include *Balladen* (1867); *Romanzen und Bilder* (1870); the epic poem, *Huttens letzte Tage* (1871); and *Gedichte* (1882; 20th ed., 1901). Among his novels must be specially mentioned *Jürg Jenatsch* (1876; 20th ed., 1894); *Der Schuss von der Kanzel* (1878); *Der Heilige* (1880; 12th ed., 1894; English by M. von Wendheim, *Thomas à Becket, the Saint*, 1885); *Die Richterin* (1885); *Die Versuchung des Pescara* (1887); *Angela Borgia* (1891). His shorter stories were collected in two volumes in 1885 (5th ed., 1892).

See A. Reitler, *Konrad Ferdinand Meyer* (1885); Lina Frey, *K. F. Meyer's Gedichte und Novellen* (1892); K. E. Kranzos, *K. F. Meyer* (1899); A. Frey, *K. F. Meyer* (1900); H. Kraeger, *K. F. Meyer: Quellen und Wandlungen seiner Gedichte* (1901); B. Meyer, *K. F. Meyer in der Erinnerung seiner Schwester* (1904); *Briefwechsel zwischen Luise von François und K. F. Meyer*, herausg. von A. Bettelheim (1905); A. Langmesser, *K. F. Meyer* (1905).

MEYER, [MARIE] PAUL HYACINTHE (1840–   ), French philologist, was born in Paris on the 17th of January 1840. He was educated at the École des Chartes, and in 1863 was attached to the manuscript department of the Bibliothèque Nationale. In 1876 he became professor of the languages and literatures of southern Europe at the Collège de France. In 1882 he was made director of the École des Chartes, and a year later was nominated a member of the Academy of Inscriptions. He was one of the founders of the *Revue critique*, and a founder and the chief contributor to *Romania* (1872). Paul Meyer began with the study of old Provençal literature, but subsequently did valuable work in many different departments of romance literature, and ranks as the chief modern authority on the French language. He is the author of *Rapports sur les documents manuscrits de l'ancienne littérature de la France conservés dans les bibliothèques de la Grande Bretagne* (1871); *Recueil d'anciens textes bas-latins, provençaux et français* (2 parts, 1874–1876); *Alexandre le Grand dans la littérature française du moyen âge* (2 vols., 1886). He edited a great number of old French texts for the *Société des anciens textes français*, the *Société de l'histoire de France* and independently. Among these may be mentioned *Aye d'Avignon* (1861), with Guessard; *Flamença* (1865); the *Histoire* of Guillaume le Maréchal (3 vols., 1892–1902); *Raoul de Cambrai* (1882), with A. Longnon; *Fragments d'une vie da Saint Thomas de Cantorbéry* (1885); *Guillaume de la Barre* (1894).

MEYER, VICTOR (1848–1897), German chemist, was born at Berlin on the 8th of September 1848, and studied at Heidelberg University under R. W. Bunsen, H. F. M. Kopp, G. R. Kirchhoff and H. L. F. Helmholtz. At the age of twenty he entered J. F. W. A. Baeyer's laboratory at Berlin, attacking among other problems that of the composition of camphor. In 1871, on Baeyer's recommendation, he was engaged by H. von Fehling as his assistant at Stuttgart Polytechnic, but within a year he left to succeed J. Wislicenus at Zürich. There he remained for thirteen years, and it was during this period that he devised his well-known method for determining vapour densities, and carried out his experiments on the dissociation of the halogens. In 1882, on the death of W. Weith (1844–1881), professor of chemistry at Zürich University, he undertook to continue the lectures on benzene derivatives, and this led him to the discovery of thiophen. In 1885 he was chosen to succeed Hans Hübner (1837–1884) in the professorship of chemistry at Göttingen, where stereochemical questions especially engaged his attention; and in 1889, on the resignation of his old master, Bunsen, he was appointed to the chair of chemistry in Heidelberg. He died on the 8th of August 1897. In recognition of his brilliant experimental powers, and his numerous contributions to chemical science, he was awarded the Davy medal by the Royal Society in 1891.

MEYERBEER, GIACOMO (1791–1863), German composer, first known as Jakob Meyer Beer, was born at Berlin on the 5th of September 1791,[1] of a wealthy and talented Jewish family. His father, Herz Beer, was a banker; his mother, Amalie (*née* Wulf), was a woman of high intellectual culture; and two of his brothers distinguished themselves in astronomy and literature. He studied the pianoforte, first under Lauska, and afterwards under Lauska's master, Clementi. When seven years old he played Mozart's Concerto in D Minor in public, and at nine he was pronounced the best pianist in Berlin. For composition he was placed under Zelter, and then under Bernard Weber, director of the Berlin opera, by whom he was introduced to the Abbé Vogler. Vogler invited him to Darmstadt, and in 1810 received him into his house, where he formed an intimate friendship with Karl Maria von Weber, who also took daily lessons in counterpoint, fugue and extempore organ-playing. At the end of two years the grand duke appointed Meyerbeer composer to the court. His first opera, *Jephtha's Gelübde*, failed lamentably at Darmstadt in 1811, and his second, *Wirth und Gast* (*Alimelek*), at Vienna in 1814. These checks discouraged him so cruelly that he feared he had mistaken his vocation. Nevertheless, by advice of Salieri he determined to study vocalization in Italy, and then to form a new style. But at Venice he was so captivated by Rossini that, renouncing all thought of originality, he produced a succession of seven Italian operas—*Romilda e Costanza*, *Semiramide riconosciuta*, *Eduardo e Cristina*, *Emma di Resburgo*, *Margherita d'Anjou*, *L'Esule di Granata* and *Il Crociato in Egitto*—which all achieved a success as brilliant as it was unexpected. Against this act of treason to German art Weber protested most earnestly; and before long Meyerbeer himself grew tired of his defection. An invitation to Paris in 1826 led him to review his position dispassionately, and he came to the conclusion that he was wasting his powers. For several years he produced nothing in public; but, in concert with Scribe, he planned his first French opera, *Robert le Diable*. This gorgeous spectacle was produced at the Grand Opéra in 1831. It was the first of its race, a grand romantic opera, with situations more theatrically effective than any that had been attempted either by Cherubini or Rossini, and with ballet music such as had never yet been heard, even in Paris. Its popularity exceeded all expectations; yet for five years Meyerbeer appeared before the public no more.

His next opera, *Les Huguenots*, was first performed in 1836. In gorgeous colouring, rhetorical force, consistency of dramatic treatment, and careful accentuation of individual types, it is at least the equal of *Robert le Diable*. In two points only did its interest fall short of that inspired by the earlier work. Meyerbeer had shown himself so eminently successful in his treatment of the supernatural that one regretted the omission of that element; and, more important still, the fifth act proved to be an anti-climax. The true interest of the drama culminates at the close of the fourth act, when Raoul, leaping from the window to his death, leaves Valentine fainting upon the ground. The opera now usually ends at the fourth act.

After the production of *Les Huguenots* Meyerbeer spent many years in the preparation of his next greatest works—*L'Africaine* and *Le Prophète*. The libretti of both these operas were furnished by Scribe; and both were subjected to countless changes; in fact, the story of *L'Africaine* was more than once entirely rewritten.

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[1] Or, according to some accounts, 1794.

Meanwhile Meyerbeer accepted the appointment of kapellmeister to the king of Prussia, and spent some years at Berlin, where he produced *Ein Feldlager in Schlesien*, a German opera, in which Jenny Lind made her first appearance in Prussia. Here also he composed, in 1846, the overture to his brother Michael's drama, *Struensee*. But his chief care at this period was bestowed upon the worthy presentation of the works of others. He began by producing his dead friend Weber's *Euryanthe*, with scrupulous attention to the composer's original idea. With equal unselfishness he procured the acceptance of *Rienzi* and *Der fliegende Holländer*, the first two operas of Richard Wagner, who, then languishing in poverty and exile, would, but for him, have found it impossible to obtain a hearing in Berlin. With Jenny Lind as prima donna and Meyerbeer as conductor, the opera flourished brilliantly in the Prussian capital; but the anxieties materially shortened the composer's life.

Meyerbeer produced *Le Prophète* at Paris in 1849. In 1854 he brought out *L'Étoile du nord* at the Opéra Comique, and in 1859 *Le Pardon de Ploërmel* (*Dinorah*). His last great work, *L'Africaine*, was in active preparation at the Académie when, on the 23rd of April 1863, he was seized with a sudden illness, and died on the 2nd of May. *L'Africaine* was produced with pious attention to the composer's minutest wishes, on the 28th of April 1865.

Meyerbeer's genius was criticized by contemporaries with widely different results. Mendelssohn thought his style exaggerated; Fétis thought him one of the most original geniuses of the age; Wagner ungratefully calls him "a miserable music-maker," and "a Jewish banker to whom it occurred to compose operas." The reality of his talent has been recognized throughout all Europe; and his name will live so long as intensity of passion and power of dramatic treatment are regarded as indispensable characteristics of dramatic music. But his work shows that these qualities, with the aid of an experienced stage-writer, may be entirely independent of genuine musical insight.

MEYNELL, ALICE CHRISTIANA (1850–), English poet and essayist, was the daughter of T. J. Thompson. Her early life was spent chiefly in Italy, and she was educated by her father. Her first volume of verse, *Preludes* (1875), illustrated by her sister Elizabeth, afterwards Lady Butler, attracted little public notice, but the delicacy and beauty of the poems and especially of the sonnet "Renunciation," were warmly praised by Ruskin. She married in 1877 the well-known Roman Catholic journalist and author Wilfrid Meynell, who became proprietor and editor of the *Weekly Register*. Under W. E. Henley's editorship she wrote regularly in prose for the *National Observer*, and also later for the *Pall Mall Gazette*, the *Saturday Review*, &c. Her *Poems* (1893), including much of the earlier volume of *Preludes*, brought her at last more definitely before the public; and this was followed in 1901 by another slender book of delicate verse, *Later Poems*. Mrs Meynell also showed herself a fine critic of poetry by her admirable selection, *The Flower of the Mind* (1897), an anthology of English verse. She edited the *Selected Poems* (1894) of T. G. Hake, the *Poetry of Pathos and Delight* (1896) of her intimate friend Coventry Patmore, and the selections from Patmore in the "Muses' Library." Her prose essays, remarkable for fineness of culture and peculiar restraint of style, appeared in successive volumes as *The Rhythm of Life* (1893), *The Colour of Life and other Essays* (1896), *The Children* (1897), and *The Spirit of Place* (1898). Later books are *London Impressions* (1898) and *The Work of John S. Sargent* (1903).

See W. Archer, *Poets of the Younger Generation* (1902).

MEYR, MELCHOIR (1810–1871), German poet, novelist and philosopher, was born at Ehringen on the 28th of June 1810, and died at Munich on the 22nd of April 1871. He read law and philosophy at Heidelberg and Munich. His greatest success was the *Erzählungen aus dem Ries* (4th ed. Leipzig, 1892), remarkable as an accurate and sympathetic picture of rural life and character. He wrote also tragedies (*Herzog Albrecht*, 1851; *Karl der Kühne*, 1862), novels (*Vier Deutsche*, 1861; *Ewige Liebe*, 1864), and, in later life, philosophical works with a strong religious tendency. Among these were *Emilie* (philosophical dialogues, 1863), *Die Religion des Geistes* (1871), *Die Fortdauer nach dem Tode* (1869), *Die Religion und ihre jetzt gebotene Fortbildung* (1871), and *Gedanken über Kunst, Religion und Philosophie* (1874). In these works he attempted to develop a Deistic system of philosophy. He was the author of an anonymous work entitled *Gespräche mit einem Grobian* (1866).

See *Melchior Meyr. Biographisches, Briefe und Gedichte*, edited by Graf Bothmer and M. Carrière (Leipzig, 1874).

MEYRIFAB, a small semi-nomad tribe of Africans of Semitic stock, settled on the east bank of the Nile near Berber. Contrary to Arab custom, it is said they never marry slaves.

MÉZERAY, FRANÇOIS EUDES DE (1610–1683), French historian, was born at Rye near Argentan, where his father was a surgeon. He had two brothers, one of whom, Jean Eudes, was the founder of the order of the Eudists. François studied at the university of Caen, and completed his education at the college of Ste Barbe at Paris. His *Histoire de France depuis Faramond jusqu' à Louis le Juste* (3 vols., 1643–1651), is a fairly accurate summary of French and Latin chronicles. Mézeray was appointed historiographer of France, and in 1649, on the death of Vincent Voiture, was admitted to the Académie Française. His *Abrégé chronologique* (3 vols., 1667–1668) went through fifteen editions between 1668 and 1717; but he did not hesitate in this work to attack the financiers, with the result that his salary as historiographer was diminished by Colbert. Mézeray succeeded Conrart as permanent secretary to the Académie Française (1675), and died at Paris on the 10th of July 1683. He translated Grotius's *Traité de la religion chrétienne* (1640), and a *Histoire des Turcs depuis 1612 jusqu'en 1649* (1650), which is an addition to a continuation of Chalcondyles.

See Daniel de Larroque, *Vie de François Eudes de Mézeray* (1720); vol. xiii. of *Causeries du lundi* by Sainte-Beuve, and Levavasseur's *Notice sur les trois frères: Jean Eudes, François Eudes, et Charles Eudes* (1855).

MÉZIÈRES, PHILIPPE DE (*c.* 1327–1405), French soldier and author, was born at the château of Mézières in Picardy. He belonged to the poorer nobility, and first served under Lucchino Visconti in Lombardy, but within a year he entered the service of Andrew, king of Naples, who was assassinated in September 1345. In the autumn of that year he set out for the East in the French army. After the battle of Smyrna in 1346 he was made a knight, and when the French army was disbanded he made his way to Jerusalem. He realized the advantage which the discipline of the Saracens gave them over the disorderly armies of the West, and conceived the idea of a new order of knighthood, but his efforts proved fruitless. The first sketch of the order was drawn up by him in his *Nova religio passionis* (1367–1368; revised and enlarged in 1386 and 1396). From Jerusalem he found his way in 1347 to Cyprus to the court of Hugo IV., where he found a kindred enthusiast in the king's son, Peter of Lusignan, then count of Tripoli; but he soon left Cyprus, and had resumed his career as a soldier of fortune when the accession of Peter to the throne of Cyprus (Nov. 1358) and his recognition as king of Jerusalem induced Mézières to return to the island, probably in 1360, when he became chancellor. He came under the influence of the pious legate Peter Thomas (d. 1366), whose friend and biographer he was to be, and Thomas, who became patriarch of Constantinople in 1364, was one of the chief promoters of the crusade of 1365. In 1362 Peter of Cyprus, with the legate and Mézières, visited the princes of western Europe in quest of support for a new crusade, and when the king returned to the east he left Mézières and Thomas to represent his case at Avignon and in the cities of northern Italy. They preached the crusade throughout Germany, and later Mézières accompanied Peter to Alexandria. After the capture of this city he received the government of a third part of it and a promise for the creation of his order, but the Crusaders, satisfied by the immense booty, refused to continue the campaign. In June 1366 Mézières was sent to Venice, to Avignon and to the princes of western Europe, to obtain help against the Saracens, who now threatened the kingdom of Cyprus. His efforts were in vain; even Pope Urban V. advised peace with the sultan. Mézières remained for some time at Avignon, seeking recruits for his order, and writing his *Vita S. Petri Thomasii* (Antwerp, 1659), which is invaluable for the history of the Alexandrian expedition. The *Prefacio* and *Epistola*, which form the first draft of his work on the projected order of the Passion, were written at this time.

Mézières returned to Cyprus in 1368, but was still at Venice when Peter was assassinated at Nicosia at the beginning of 1369, and he remained there until 1372, when he went to the court of the new pope Gregory XI. at Avignon. He occupied himself with trying to establish in the west of Europe the feast of the Presentation of the Virgin, the office of which he translated from Greek into Latin. In 1373 he was in Paris, and he was thenceforward one of the trusted counsellors of Charles V., although this king had refused to be dragged into a crusade. He was tutor to his son, the future Charles VI., but after the death of Charles V. he was compelled, with the other counsellors of the late king, to go into retirement. He lived thenceforward in the convent of the Celestines in Paris, but nevertheless continued to exert an influence on public affairs, and to his close alliance with Louis of Orleans may be put down the calumnies with which the Burgundian historians covered his name. When Charles VI. freed himself from the domination of his uncles the power of Mézières increased. To this period of his life belong most of his writings. Two devotional treatises, the *Contemplatio horae mortis* and the *Soliloquium peccatoris*, belong to 1386–1387. In 1389 he wrote his *Songe du vieil pêlerin*, an elaborate allegorical voyage in which he described the customs of Europe and the near East, and advocated peace with England and the pursuit of the Crusade. His *Oratio tragedica*, largely autobiographical, was written with similar aims. In 1395 he addressed to Richard II. of England an *Épistre* pressing his marriage with Isabella of France. The Crusade of 1396 inspired Mézières with no enthusiasm. The disaster of Nicopolis on the 28th of September 1396 justified his fears and was the occasion of his last work, the *Épistre lamentable et consolatoire*, in which he put forward once more the principles of his order as a remedy against future disasters. Mézières died in Paris on the 29th of May 1405.

Some of his letters were printed in the *Revue historique* (vol. xlix.); the two *épistres* just mentioned in Kervyn de Lettenhove's edition of Froissart's *Chroniques* (vols. xv. and xvi.). The *Songe du vergier* or *Somnium viridarii*, written about 1376, is sometimes attributed to him, but without definite proofs.

See Antoine Becquet, *Gallicae coelestinorum congregationis monasteria, fundationes* . . . . . (1719); the Abbé Jean Lebeuf's *Mémoires* in the *Mémoires* of the Academy of Inscriptions, vols. xvi. and xvii. (1752 and 1753); J. Delaville le Roulx, *La France en Orient au xiv. siècle* (1886–1890); A. Molinier, *Manuel de bibliographie historique* vol. iv. (1904); and especially the researches of N. Jorga, published in the *Bibliothèque de l'école des hautes études* vol. 110 (Paris 1896); and the same writer's *Philippe de Mézières, et la croisade au xiv. siècle* (1896). Jorga gives a list of his works and of the MSS. in which they are preserved, and analyses many of them. On the *Songe du vergier*, see P. Paris, in *Mémoires* vol. xv. (1843) of the Academy of Inscriptions.

MÉZIÈRES, a town of northern France, capital of the department of Ardennes, 55 m. N.E. of Reims by the Eastern railway. Pop. (1906), town, 7007; commune, 9393. The town itself, the streets of which are narrow and irregular, is situated on the neck of a peninsula formed by a loop of the Meuse. The river separates it from its suburb of Arches and the town of Charleville on the north and from the suburb of Pierre on the south. Adjoining Pierre is Mohon (pop. 5874), with metallurgical works. The fortifications of Mézières, as well as the citadel still dominating the town on the east, were built under Vauban's direction, but were dismantled in 1885 and 1886. Immediately to the east of the citadel runs a canal, which provides river-traffic with a short cut across the isthmus. The parish church (16th cent.) contains inscriptions commemorating the raising of the siege of Mézières in 1521 and the marriage of Charles IX. with the daughter of the emperor Maximilian II. (1570). The north and south portals, the Renaissance tower at the west end, and the lofty vaultings, are worthy of remark. The church, which suffered severely in 1870–71, has since been restored. The prefecture and the hôtel de ville, which contains several interesting pictures relating to the history of the town, belong to the 18th century. Mézières is the seat of a prefect and of a court of assizes, and there are manufactures of bicycles, and iron and steel castings for motors, railway-carriages, &c.

Founded in the 9th century, Mézières was at first only a stronghold belonging to the bishops of Reims, which afterwards became the property of the counts of Rethel. The town was increased by successive immigrations of the people of Liége, flying first from the emperor Otto, and afterwards from Charles the Bold; and also by concessions from the counts of Rethel. Walls were built in the 13th century, and in 1521 it was defended against the Imperialists by the Chevalier Bayard, to whom a statue was erected in 1893. The anniversary of the deliverance is still observed yearly on the 27th of September. In 1815 the Germans were kept at bay for six weeks, and in 1871 the town only capitulated after a bombardment during which the greater part of it was destroyed.

MEZÖTÚR, a town of Hungary, in the county of Jász-Nagykun-Szolnok, 88 m. S.E. of Budapest by rail. Pop. (1900), 25,367. It possesses important potteries. Large herds of cattle are reared on the communal lands, which are productive also of wheat, rapeseed and maize. Several well-attended fairs are held here annually.

MEZZANINE (It. *mezzano*; Fr. *entresol*; Ger. *Zwischengeschoss*), in architecture, a storey of small height introduced between two lofty storeys, or sometimes employed to allow of the introduction of two storeys equal together in height to lofty rooms on the same floor.

MEZZOFANTI, GIUSEPPE CASPAR (1774–1849), Italian cardinal and linguist, was born on the 17th of September 1774, at Bologna, and educated there. He was ordained priest in 1797, and in the same year became professor of Arabic in the university, but shortly afterwards was deprived for refusing to take the oath of allegiance to the Cisalpine Republic. In 1803 he was appointed assistant librarian of the institute of Bologna, and soon afterwards was reinstated as professor of oriental languages and of Greek. The chair was suppressed by the viceroy in 1808, but again rehabilitated on the restoration of Pius VII. in 1814, and continued to be held by Mezzofanti until his removal from Bologna to Rome in 1831, as a member of the congregation *de propaganda fide*. In 1833 he succeeded Angelo Mai as chief keeper of the Vatican library, and in 1838 was made cardinal and director of studies in the Congregation. He died at Rome on the 15th of March 1849. His peculiar talent, comparable in many respects to that of the so-called "calculating boys," was not combined with any exceptional measure of intellectual power, and produced nothing of permanent value. It seems certain, however, that he spoke with considerable fluency, and in some cases even with attention to dialectic peculiarities, some fifty or sixty languages of the most widely separated families, besides having a less perfect acquaintance with many others.

See Russell, *Life of the Cardinal Mezzofanti* (London, 1857); A. Bellesheim, *Giuseppe Cardinal Mezzofanti* (Würzburg, 1880).

MEZZOTINT. During the 19th century two revolutions occurred in the British art of mezzotinto engraving—"la manière anglaise." The original defect of the method was the incapacity of the mezzotint "burr" on copper to yield as many fine impressions as other forms of engraving. To this defect was attributable the introduction, in 1823, of steel instead of the soft copper previously used—a change which, with the endeavour to avoid technical difficulties, led to the "mixed style," or combination of mezzotint with etching, and a general departure from the traditional form of the art, "pure mezzotint" on copper. The affinity of the method to painting in black and white which differentiates it from other kinds of engraving, and was the distinguishing charm of the mezzotints of the 17th and 18th centuries, was for a time lost, but a revival of pure mezzotint on copper, beginning in 1880—a return, in fact, to the mode in which the classics of the art were engraved in the time of Sir Joshua Reynolds—was made possible by the invention of steel-facing. By this process engraved copper plates are electroplated with a film of steel, renewable when worn in course of printing; and a mezzotint on copper, so protected, yields more fine impressions than if it had been engraved on steel, whilst the painter-like quality remains unimpaired.

In "pure mezzotint" the design is evolved from dark to light entirely by scraping away more or less of the previously laid "ground," the original "burr" of which is left untouched in the extreme darks, and no acid, etching or line-work is used in it at all. The usual short descriptions of the method are misleading, because they fail to explain that it is the "ground," and not the "burr" of it only, which is scraped away in greater or smaller degree to produce the varying tones of the design. The necessity of realizing that there are two constituents of the "ground," the "burr" and the indentations out of which the "burr" is raised, will be appreciated later. The "rocking-tool," with which the "ground" is laid, somewhat resembles a carpenter's chisel, but the blade is 3 in. wide and only about 2¾ in. long, whilst the cutting edge, instead of being straight, is curved in the segment of a circle. One side of the blade is deeply engraved with lines from edge to handle, and the ridges which remain between these lines form teeth at the cutting edge when the unengraved side of the tool is bevelled as an ordinary chisel is sharpened.

The tools contain from 35 to 120 teeth to each inch of their width, those with the most teeth producing grounds of the finest texture. The operator rocks the curved edge of the tool from side to side on the bare copper plate, causing the tool to travel forward, whilst each tooth makes an indentation in the copper and throws up a corresponding particle of metal, which is called the "burr." When the whole plate has been so rocked across in 45 to 60 different directions, so that no visible speck of the original bright copper surface remains unfretted by the teeth of the "rocking-tool," the "ground" is termed "full," and is ready for scraping the design. The innumerable particles of copper forming the raised "burr" give to a "full ground" much the appearance of copper-coloured plush, and a print from it, taken before any scraping has been done on it, looks not unlike a piece of black velvet. The lights and semi-tones of the design are produced by subsequent scraping and burnishing.

Assuming that a mezzotint is to be scraped from a lady's portrait by Sir Joshua Reynolds in which a piece of black drapery crosses a white dress—the engraver begins to work on a previously laid "ground" which would print uniformly black before scraping commences. In the extreme darks of the black drapery the raised "burr" is left untouched by the "scraper"—a two-edged steel instrument resembling an ancient Roman sword-blade in miniature, but having a longer point. Working from dark to light, the engraver produces the varying tones of the folds of the black drapery by scraping the raised "burr" down more or less, lowering it in fact so that it will not hold so much ink as where it is left untouched in the extreme darks. In the highest lights of the black drapery all the raised "burr" will have been removed and the original surface of the plate reached, but as yet the engraver has not produced any tone lighter than middle tint (although he has completely modelled up the black drapery), because the indentations out of which the "burr" was raised still remain in the plate and hold ink in printing. In order to produce the infinite gradation of delicate tones in the white dress, or in a sky, the scraping is continued, the indentations being thus made shallower in the passages scraped, and therefore less capable of holding ink, whilst they are obliterated almost entirely in the highest lights. When the mezzotint is finished the black drapery will stand higher than the surface of the plate modelled in a relief composed of the raised "burr," whilst all the tones of the white dress, from middle tint to pure white, will be so many actual depressions in the plate, the highest lights being the deepest. The speck of light in the eye, for instance, is a pit in the plate, surrounded by a tract of more or less raised "burr," which provides the intense black of the pupil and the half-tints of the iris. The difference of surface levels is very appreciable where high-lights impinge on strong darks, but it exists in varying degree all over the plate, and the greatest technical difficulty in pure mezzotint is to obtain adequate "edge" and definition, because the tendency is to remove too much "ground" from the edges of adjacent darks in the course of the constant scrapings necessary to smooth and polish the depressed lights.

In printing a mezzotint a non-fluid ink is thoroughly worked into every part of the plate, and the superfluities wiped off again, leaving as much ink as possible in the darks, the raised "burr." If the bottom of the small lights is not quite smooth, the ink sticks in the roughness and they print dark instead of light, or the printer has to wipe so hard to get the ink out of the depressed lights that he removes too much from the raised darks. In either case loss of definition and contrast of effect results. This inherent difficulty of scraping to a sharp edge caused the use of the "mixed" methods, in which the details were sharpened by outlining them with stipple or line etching.

Mezzotint is the best form of engraving for completeness of representation, but etching is better adapted for sketching from nature or for the expression of any fleeting idea. The two arts have distinct uses and limitations. The art function of true etching as practised by Rembrandt lies in economy of expressive line to suggest the artist's meaning, and that of mezzotint in completion of tonality to explain it. Artistic suggestion, which is not inherent in the solid tones of mezzotint, has to be imparted to the work entirely by the free play of the "scraper" on the "ground," much as the painter attains it on canvas with the brush.

History.

The first reputed mezzotint was produced at Amsterdam in 1643 by Ludwig von Siegen, an officer in the service of the Landgrave of Hesse, and an amateur artist; but the work was a direct drawing on copper with an instrument of comparative precision resembling the roulette rather than a mezzotint, ground laid with the rocking-tool and scraped from dark to light in the present manner of the art. Siegen's innovation was led up to by the previous stipple work of Giulio Campagnola and Janus Lutma; the roulette appears to have been used before his time; and though he shared in the evolution of the rocking-tool, he was not the sole inventor of it. The earliest works referable to the method at the print room of the British Museum afford evidence, though inconclusive, that Prince Rupert, to whom Siegen showed his mode of work in 1654, and possibly also their common friend, Th. Caspar von Fürstenberger, and Rupert's assistant, Vallerant Vaillant, were more or less concerned in the gradual development of mezzotint engraving. The rocking-tool was apparently improved by Abraham Blooteling, a Dutch painter and engraver of fine portrait mezzotints, who worked in Holland and in England about the year 1680.

Rupert brought the new art over to England at the Restoration, and the portrait of Charles II., dated 1669, by William Sherwin, the first English mezzotinter, bears the engraver's acknowledgment of his indebtedness to Rupert for the secrets of the method. Mezzotint continued to be practised for a while on the Continent, but the successors of Sherwin in England so excelled in it that it early acquired abroad the title of "la manière Anglaise," and has since become an exclusively British art. Though used for transcribing the subject-pictures of the great Italian masters, and of Rembrandt, Vandyck and Rubens, almost every kind of subject being later engraved in it, the staple production in mezzotint has always been the portrait. Until the middle of the 18th century the tools continued somewhat archaic, causing in the prints an appearance of warp and woof, like that of ill-woven material, which detracted from reality of representation. The coarseness and unequal depth of the "grounds" offered so much resistance to freedom of execution with the "scraper" that, though the early engravers were quite as good artists as their successors, painter-like touch was not conspicuous in the work until M'Ardell and the interpreters of Sir Joshua Reynolds had improved the tools and technique.

Except for the collector, therefore, the chief attraction in the prints of F. Place and Luttrell, Beckett and Williams, and later those of John Simon, John Smith and John Faber, jun., who were the principal exponents of mezzotint in the last years of the seventeenth and first half of the eighteenth centuries, lies in their long series of portraits after Vandyck, Lely, Kneller and the Dutch painters then practising in England, representing such interesting personages as Charles II. and Nell Gwynn, Addison and Pope, Congreve and Wycherley, Locke and the great duke of Marlborough.

The classics of mezzotint engraving are to be found amongst the best plates after Sir Joshua Reynolds by James M'Ardell, J. R. Smith and Valentine Green, the Watsons, Dickinson, Fisher, Dixon and some others, who worked during the last half of the 18th century. The brushwork of Reynolds was more in harmony with the mezzotint method than the slighter painting technique of Gainsborough and Romney, who were much less frequently engraved, perhaps because it is the highest technical difficulty in mezzotint to render the sharp edges of a sketch. For this reason a typical Gainsborough was never successfully engraved in the method. Though professional publishers and printers existed at this time and earlier, the word "excudit" on an old print, implying "published," not "engraved," the authors of the "Sir Joshua" mezzotints in most cases printed, published and sold their own works, and pure mezzotint, unmixed with etching, was almost exclusively the method they employed. Mezzotints were occasionally printed in colours, notably those engraved later after George Morland, the primary object being to conceal the worn-out condition of the plates.

The departure from pure mezzotint and temporary decay of the art began when, towards the end of the 18th century, Richard Earlom, otherwise a fine artist in the traditional method, notably in translations of Vandyck and Wright of Derby, began to outline the details of his plates with stipple etching in order to avoid the labour and difficulty of scraping them to a sharp edge, using the "ground" alone. Earlom, however, did not destroy the mystery of the rich velvety darks by etching into them. A demand then arose for larger editions than the soft copper plates would yield, and the engravers attempted to meet it by combining mezzotint with positive line-etching throughout the work, thus shortening the labour of scraping the details, and fortifying the darks with lines sunk below the surface of the plate. The harmony of line and tone in some of the prints in this style by S. W. Reynolds and Charles Turner, after Sir Joshua, Hoppner and their contemporaries, was more convincing than the later "mixed style" of Samuel Cousins, because there was a certain artistic significance in the etched line itself apart from the mezzotint tone, but every touch of line in a mezzotint does something to destroy the painter-like quality, and a decadence was in progress.

The same mixed method on copper was used by J. W. M. Turner in his *Liber Studiorum* series of landscape plates, his object being to rival the pen-and-wash drawings of Claude's *Liber Veritatis*. Turner, however, was not so practised in etching or mezzotint as the engravers before mentioned, and the etched foundation of the *Liber* plates was too strong for the mezzotint tone, destroying the breadth of the light, the richness of the darks, and the artistic "keeping" of the whole effect. It is the grand design of Turner reflected in the plates, rather than any quality of mezzotint or etching in them, which appeals to the artist and the connoisseur. Perhaps the greatest success in harmonizing line and tone in one plate was achieved by David Lucas in his "English Landscape" series of mezzotint after John Constable, in which he sharpened his details with the roulette, or with a slight line put in with the point of the scraper as scraping proceeded, retaining the pure "burr" in his darks. Lucas, like Samuel Cousins and his contemporaries, was handicapped by being compelled to work on the steel plates introduced in 1823, and this was the cause of the chief defect of his plates, the excessive opposition of black and white. The warm general tone which assisted the picturesqueness of the 18th century mezzotints was lost by the use of steel, because the ink did not cling to it as it does to the more porous copper. Steel being harder than copper, the rocking-tool penetrated less deeply, raising less "burr," and the consequent loss of force in the darks necessitated the scraping up of the lights to a higher key to force contrast of effect, which was also enhanced by the use of very white paper and a coarse black ink. It was soon found that the unfortified "burr," even on steel, would not yield the constantly increasing numbers of impressions demanded. The labour of scraping sharp lights was greatly enhanced, and though some pure mezzotints were engraved on steel, painter-like touch was practically unattainable on it, and the general effect was cold and uninteresting.

The early work of Samuel Cousins after Lawrence in the comparatively pure method, and the final development of the "mixed style" on steel in his later plates after Reynolds, Millais and Landseer, are referred to in the article on Samuel Cousins.

For nearly forty years pure mezzotint ceased to be practised altogether, and the revival of it, which began in 1880, was led up to by the invention of steel-facing. The competition of photogravure, which steel-facing made a commercial possibility, for a time checked the new movement, but a photogravure, despite a mere surface resemblance to a mezzotint, is a photograph manipulated to imitate an engraving, entirely devoid of artistic individuality. In 1898 for the first time a Society of Mezzotint Engravers was formed to foster the art.

Authorities.—*British Mezzotinto Portraits*, by John Challoner Smith (London, 1878), a standard book of reference, contains a long list of others at p. xiv., pt. i. See also *Lectures on Etching and Mezzotint*, by Hubert von Herkomer, R.A. (London, 1890), the most useful work on the technique. *Etching, Engraving and other Methods of Printing Pictures*, by H. W. Singer and William Strang (London, 1897); *On the Making of Etchings*, by Frank Short (London, 1898), containing a slight reference to mezzotint technique; *Art of Engraving*, by T. H. Fielding (London, 1854); Alfred Whitman, *Masters of Mezzotint* (London, 1898), *Valentine Green* (1902), *Samuel William Reynolds* (1903), *Samuel Cousins* (1904), *Charles Turner* (1907); Gordon Gordain, *James McArdell* (1903), *Thomas Watson, James Watson, Elizabeth Judkins* (1904); W. G. Rawlinson, *Turner's Liber Studiorum, a Description and a Catalogue* (2nd ed., 1906); F. Wedmore's catalogue of the David Lucas mezzotints. A little anonymous book, *A History of the Art of Engraving in Mezzotinto, from Its Origin to the Present Times* [by Dr James Chelsum] (Winchester, 1786), is of considerable interest. Works on the technique are somewhat elementary, and no complete history of the art exists. (G. P. R.)

MFUMBIRO, or Kirunga, general names for a chain of volcanic mountains extending across the Central African, or Albertine, rift-valley immediately north of Lake Kivu. The range, the result probably of recent geological changes, completely blocks the valley at this point, forming a divide between the rivers flowing north to the Nile and the waters of Lake Kivu, connected through Tanganyika with the Congo system. The chain consists of two groups of mountains, surrounded by a vast lava field. The western group lies directly north of Lake Kivu, and contains two active volcanoes, Kirunga-cha-gongo, the nearest to the lake (11,194 ft. high), and Kirunga-namlagira (9711 ft.), some 10 m. further north. The eastern group contains several higher peaks—some rising to needle-like points, others being truncated cones. The most lofty, Karissimbi (14,683 ft.), lies in 29° 27′ 20″ E., 1° 30′ 20″ S. Mikeno, a few miles north and west of Karissimbi, is 14,385 ft. high. The most easterly of the peaks, Muhavuru (13,562 ft.), in 29° 40′ 30″ E., 1° 23′ S., is an isolated sugarloaf-shaped mass with a crater filled with water on its summit. This is the mountain to which the names Mfumbiro and Kirunga were originally applied. Some 6 m. west and a little north of Muhavuru is Sabyino (Sabinjo), 11,881 ft. high. The eastern peaks are snowclad for a part of the year. North of these high mountains is a district, extending towards Albert Edward Nyanza, containing hundreds of low peaks and extinct volcanoes. It is to this region that the name Umfumbira or Mfumbiro is said properly to belong.

Mfumbiro, *i.e.* Muhavuru, was first seen by a white man in 1861, J. H. Speke, in his journey to discover the source of the Nile, obtaining a distant view of the cone, which was also seen by H. M. Stanley in 1876. By its Baganda name of Mfumbiro (cook-house mountains) it figured on the maps somewhat east of its true position, first ascertained by Franz Stuhlmann in 1891. In 1894 Count von Götzen travelled through the volcanic region, and the range was subsequently explored by E. S. Grogan, Major St Hill Gibbons, Captain Herrmann, Dr R. Kandt and others, the principal heights being determined in 1903. In 1907–1908 the range was geologically and topographically examined by the duke of Mecklenberg's expedition. By the Anglo-German agreement of the 1st of July 1890 "Mount Mfumbiro" was included in the British sphere in East Africa.

See Captain Herrmann, "Vulkangebiet des zentralafrikanischen Grabens," in *Mitteil. v. Forsch. u. Gelehrten a. d. deutschen Schutzgebieten*, vol. xvii. (Berlin, 1904), and Adolf Friedrich, duke of Mecklenburg, *Ins Innerste Afrika* (Leipzig, 1909); both give maps.

MHOW, a town of Central India, with British military cantonment, within the native state of Indore, on the Malwa branch of the Rajputana railway, 13 m. S. of Indore. Pop. (1901), 36,039. It is the headquarters of the 5th division of the southern army, and one of the chief military stations of India. There are two high schools, a Zoroastrian and a Canadian mission, the Dorabji Pestonji dispensary, and a gaol.

MIAGAO, a town on the southern coast of the province of Iloilo, island of Panay, Philippine Islands, about 25 m. W.S.W. of the town of Iloilo, the capital. Pop. (1903), 20,656; in the same year the neighbouring town of San Joaquin (pop. 1903, 14,333) was incorporated with Miagao. It has a cool and healthful climate. The neighbouring country is hilly and sterile, but produces sibucao in considerable quantities. The weaving of fabrics of abacá (*Musa textilis*), or Manila hemp, and pineapple fibre is the most important local industry. The language is Panay-Visayan.

MIALL, EDWARD (1809–1881), English Nonconformist divine and journalist, was born at Portsmouth on the 8th of May 1809. He was Congregational minister at Ware (1831) and Leicester (1834), and in 1841 founded the *Nonconformist*, a weekly newspaper in which he advocated the cause of disestablishment. Miall saw that if the programme of Nonconformity was to be carried through it must have more effective representation in Parliament. One of the firstfruits of his work was the entrance of John Bright into parliamentary life; and by 1852 forty Dissenters were members of the House of Commons. This was due largely to the efforts of the Anti-State Church Association, afterwards known as the Liberation Society, which Miall had founded in 1844. The long fight for the abolition of compulsory church-rates was finally successful in 1868, and then in 1870 Miall was prominent in the discussions aroused by the Education Bill. He was at this time M.P. for Bradford (1869–1874), having previously (1852–1867) sat for Rochdale. In 1874 he retired from public life, and received from his admirers a present of ten thousand guineas. He died at Sevenoaks on the 29th of April 1881.

See the *Life*, by A. Miall (1884).

MIAMI, a city and the county-seat of Dade county, Florida, U.S.A., in the S.E. part of the state, on the N. bank of the Miami river and on Biscayne Bay. Pop. (1900), 1681; (1905), 4733; (1910), 5471. It is served by the Florida East Coast railway and by lines of coastwise steamships, and is the point of departure of the P. & O. steamships for Nassau and Havana. Miami is the centre of a farming country in which citrus fruits, especially grape-fruit, pineapples and winter vegetables are raised for northern markets. There is excellent rod-fishing; Spanish and king mackerel and blue-fish are shipped from Miami in large quantities; and in Biscayne Bay there are important sponge fisheries. An alligator "farm" and the Subtropical Laboratory of the U.S. government are points of interest. In the city is Fort Dallas (now abandoned), where American troops were quartered during the Seminole War; and Miami is still the trading point of the Seminole Indians, being immediately south of the Everglades, their home. In 1909 a project was on foot to cut a channel from Miami to Lake Okechobee and from the other side of that lake west to the Gulf at Fort Myers, thus providing an inland waterway and draining much swampy but fertile land. In 1896 there were only two dwellings and one storehouse within the present corporate limits, but in that year the place was chosen as the southern terminal of the Florida East Coast railway, which was afterwards extended towards Key West. Soon afterwards Henry M. Flagler (b. 1830), the owner of the railway, began the construction of the magnificent Royal Palm hotel, and Miami became a popular winter resort. Then came the development of commerce by the improvement of the harbour, by donations from Mr Flagler and grants by the United States government.

MIAMI, a tribe of North American Indians of Algonquian stock. The English called them *Twightwees*, a corruption of the native name, which meant the cry of the crane. They were first found in south-eastern Wisconsin, and in 1764 numbered about 1750. Their civilization was advanced and they lived in stockaded towns. They took part in Pontiac's conspiracy in 1764 and in the American War of Independence and American War of 1812 they fought on the English side. At the close of this war they were greatly reduced in numbers. A few Miami still live on a reservation in Oklahoma and in Wabash county, Indiana.

MIANTONOMO (? –1643), chief of the Narraganset tribe of North American Indians, nephew of their grand sachem, Canonicus (d. 1647). He seems to have been friendly to the English colonists of Massachusetts and Connecticut, though he was accused of being treacherous. In 1636, when under suspicion, he went to Boston to prove his loyalty to the colonists. In the following year he permitted John Mason to lead his Connecticut expedition against the Pequot Indians through the Narraganset country, and in 1638 he signed for the Narraganset the tripartite treaty between that tribe, the Connecticut colonists and the Mohegan Indians, which provided for a perpetual peace between the parties, and he agreed to take under his jurisdiction eighty of the two hundred troublesome Pequot. In 1643 a quarrel broke out between the Mohegan and the Narraganset, and Miantonomo led his warriors against those of Uncas, the Mohegan sachem. He was defeated and captured at what is now Norwich, Conn., was turned over to the Connecticut authorities, and was later tried at Boston by the commissioners of the United Colonies of New England. A committee of five clergymen, to whom his case was referred, recommended that he be executed, and the commissioners accordingly sentenced him to death and chose Uncas as his executioner. Miantonomo, who was kept in ignorance of this sentence, was taken to the scene of his defeat and was there tomahawked in cold blood by Wawequa, the brother of Uncas. There is a monument to Miantonomo in Sachem's Park, Norwich, Conn.

MIANWALI, a town and district of India in the Multan division of the Punjab. The town is situated on the left bank of the Indus, 655 ft. above sea-level. Pop. (1901), 3591. The district was formed in 1901, after the creation of the North-West Frontier Province, out of the Cis-Indus portions of Bannu and Dera Ismail Khan districts. Area 7816 sq. m. Pop. (1901), 424,588, showing an increase of 6·1% in the decade. About three-quarters of the district lies to the east of the Indus. Along the river is a low fertile tract, liable to floods. The remaining upland, known as the Thal, is barren and sandy, cultivable only where irrigation is possible. In the north-east the district includes the western flank of the Salt Range. The part of the district west of the Indus is a level and fairly fertile plain, enclosed by the Chichali and Maidani hills. The chief agricultural products are wheat and other grains and oil-seeds. Hides and wool are also exported, together with small quantities of alum (abundant in the Salt Range), salt (from the Salt and Maidani ranges), and coal of poor quality, which is found at several points. Petroleum has been discovered. The district is served by the Multan-Rawalpindi line of the North-Western railway.

MIAOTSZE, or MIAUTSE, one of the aboriginal tribes of southern China. At one time they occupied a considerable portion of the fertile lands which now form the central province of the empire, but as the Chinese advanced southwards they were driven into the mountain districts of the provinces of Yunnan, Kwei-chow, Kwang-si and Kwang-tung, where they are found at the present day. As early as the reign of King Suan (about 800 B.C.) we read of an expedition having been sent to drive them out of Hu-nan. The last important campaign against them was undertaken by the emperor K'ien-lung, who, having completely subjugated the Eleuths, attacked the Miaotsze, who suffered a crushing defeat, and were compelled to purchase peace by swearing allegiance to their conquerors. They still maintain a semi-independence in their mountain-homes, but are a decaying race, gradually giving way before the Chinese. They are allowed to govern themselves on their own patriarchal system. The Miaotsze of both sexes are shorter and darker-complexioned than the Chinese, their faces are rounder and their features sharper.

See *Sketches of the Miau-tsze*, trans. by E. C. Bridgman; J. Edkins, *The Miautsi Tribes, their History*; and "Quaint Customs in Kwei-chow," *Cornhill Magazine* (Jan. 1872); Playfair, *The Maotzu of Kwei-chow and Yunnan* (London, 1877); A. R. Colquhoun, *Across Chrysé* (1883).

MIAOULIS, ANDREAS VOKOS or BOKOS (1768–1835), Greek admiral and politician, was born in Negropont. The surname Miaoulis, which was added to his family name of Vokos, or Bokos, is said to be derived from the Turkish word *miaoul*, a felucca. He settled in the island of Hydra on the east of the Morea, and when the Greek War of Independence began was known among his fellow townsmen as a trader in corn who had gained wealth, and who made a popular use of his money. He had been a merchant captain, and was chosen to lead the naval forces of the islands when they rose against the government of the Sultan. The islanders had enjoyed some measure of exemption from the worst excesses of the Turkish officials, but suffered severely from the conscription raised to man the Turkish ships; and though they seemed to be peculiarly open to attack by the Sultan's forces from the sea, they took an early and active part in the rising. As early as 1822 Miaoulis was appointed navarch, or admiral, of the swarm of small vessels which formed the insurgent fleet. He commanded the expedition sent to take revenge for the massacre of Chio (see KANARIS) in the same year. He continued to be the naval chief of the Greeks till Lord Dundonald entered their service in 1827, when he retired in order to leave the English officer free to act as commander. In the interval he had had the general direction of the naval side of the Greek struggle for freedom. He had a share in the successful relief of the first siege of Missolonghi in December 1822 and January 1823. In 1824, after the conquest of Psara by the Turks, he commanded the Greek forces which prevented the further progress of the Sultan's fleet, though at the cost of the loss of many fire ships and men to themselves. But in the same year he was unable to prevent the Egyptian forces from occupying Navarino, though he harassed them with some success. During 1825 he succeeded in carrying stores and reinforcements into Missolonghi, when it was besieged for the second time, though he could not avert its fall. His efforts to interrupt the sea communications of the Egyptian forces failed, owing to the enormous disproportion of the two squadrons in the siege and strength of the ships. As the war went on the naval power of the Greeks diminished, partly owing to the penury of their treasury, and partly to the growth of piracy in the general anarchy of the Eastern Mediterranean. When Miaoulis retired to make room for Dundonald the conduct of the struggle had really passed into the hands of the powers. When independence had been obtained, Miaoulis in his old age was entangled in the civil conflicts of his country, as an opponent of Capodistrias and the Russian party. He had to employ his skill in the employment of fireships against them at Poros in 1831. He was one of the deputation sent to invite King Otho to accept the crown of Greece, and was made rear-admiral and then vice-admiral by him. He died on the 24th of June 1835 at Athens.

MICA, a group of widely distributed rock-forming minerals, some of which have important commercial applications. The principal members of the group are muscovite, biotite, phlogopite and lepidolite (*q.v.*). The name mica is probably derived from the Latin *micare*, to shine, to glitter; the German word *glimmer* has the same meaning. The mineral was probably included with selenite under Pliny's term *lapis specularis*.

Mineralogical Characters.—The micas are characterized by a very easy cleavage in a single direction and by the high degree of flexibility, elasticity and toughness of the extremely thin cleavage flakes. They all crystallize in the monoclinic system, often, however, in forms closely resembling those of the rhombohedral or orthorhombic systems. Crystals have usually the form of hexagonal or rhomb-shaped scales, plates or prisms, with plane angles of 60° and 120°, and, with the exception of the basal planes, are only rarely bounded by smooth and well-defined faces. The crystal represented in fig. 1 is bounded by the basal pinacoid *c* (001) parallel to which is the perfect cleavage, the clinopinacoid *b* (010) parallel to the plane of symmetry, and the pyramids *m* (221) and *o* (112). The angles between these pyramids and the basal plane are 85½° and 73° respectively. The prism (110) at 90° from the basal plane is not developed as a crystal face, but is a plane of twinning, the two individuals of the twin being united parallel to the basal plane (fig. 2). The different species of mica have very nearly the same forms and interfacial angles, and they not infrequently occur intergrown together in parallel position. The best developed crystals are those of Vesuvian biotite.

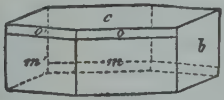

FIG. 1.

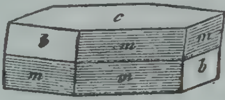

FIG. 2.

When a cleavage flake of mica is struck a sharp blow with a blunt needle-point a six-rayed star of cracks or "percussion figure" is developed: the rays intersect at angles of approximately 60°, and the pair most prominently developed are parallel to the plane of symmetry of the crystal. A similar six-rayed system of cracks, bisecting the angles between the rays of the previous set, is produced when a blunt punch is gradually pressed against a sheet of mica; this is known as the "pressure figure." These cracks coincide with planes of easy separation or of gliding in the crystal; they are especially useful in helping to determine the crystallographic orientation of a cleavage flake of mica when crystal faces are absent. Sheets of mica which have been subjected to earth-movements are frequently cracked and ridged parallel to these directions, and are then valueless for economic purposes.

In their optical characters the micas exhibit considerable variations. The indices of refraction are not high, the mean index being about 1·58–1·60, but the double refraction is very strong (0·04–0·05) and is negative in sign. The angle between the optic axes varies from 70°–50° in muscovite and lepidolite to 10–0° in biotite and phlogopite; the latter are thus frequently practically uniaxial. The acute bisectrix of the optic axes never deviates from the normal to the basal plane by more than a degree or two, hence a cleavage flake of mica will always show an optic figure in convergent light when placed on the stage of a polarizing microscope. The plane of the optic axes may be either perpendicular or parallel to the plane of symmetry of the crystal, and according to its position two classes of mica are distinguished. To the first class, with the optic axial plane perpendicular to the plane of symmetry, belong muscovite, lepidolite, paragonite, and a rare variety of biotite called anomite; the second class includes zinnwaldite, phlogopite, lepidomelane and most biotites. Dark coloured micas are strongly pleochroic. Accurate determinations of the optical orientation, as well as the symmetry of the etching figures on the cleavage planes, seem to suggest that the micas, except muscovite, may be anorthic rather than monoclinic in crystallization.

The different kinds of mica vary from perfectly colourless and transparent—as in muscovite—through shades of yellow, green, red and brown to black and opaque—as in lepidomelane; the former have a pearly lustre and the latter a submetallic lustre on the cleavage surfaces. Sheets of mica very often show coloured rings and bands (Newton's rings), due to the interference of light at the surfaces of internal cleavage cracks. The spec. grav. varies between 2·7 and 3·1 in the different species. The hardness is 2–3; smooth cleavage surfaces can be just scratched with the finger-nail. The micas are bad conductors of heat and electricity, and it is on these properties that many of their technical applications depend.

Inclusions of other minerals are frequently to be observed in mica. Flattened crystals of garnet, films of quartz, and needles of tourmaline are not uncommon. Cleavage sheets are frequently disfigured and rendered of little value by brown, red or black spots and stains, often with a dendritic arrangement of iron oxides. Minute acicular inclusions, probably of rutile, arranged parallel to the rays of the percussion figure, give rise to the phenomenon of "asterism" in some micas, particularly phlogopite: a candle-flame or spot of light viewed through a cleavage sheet of such mica appears as a six-rayed star.

Chemical Composition.—The micas are extremely complex and variable in composition. They are silicates, usually orthosilicates, of aluminium together with alkalis (potassium, sodium, lithium, rarely rubidium and caesium), basic hydrogen, and, in some species magnesium, ferrous and ferric iron, rarely chromium, manganese and barium. Fluorine is also often an essential constituent, and titanium is sometimes present.

The composition of the several species of mica is given by the following formulae, some of which are only approximate. It will be seen that they may be divided into two groups—alkali-micas (potash-mica, &c.) and ferromagnesian micas—which correspond roughly with the division into light and dark micas.

Muscovite	$H_2K\ Al_3(SiO_4)_3$
Paragonite	$H_2Na\ Al_3(SiO_4)_3$
Lepidolite.	$KLi[Al(OH,F)_2]Al(SiO_3)_3$
Zinnwaldite	$(K,Li)_3[Al(OH,F)_2]FeAl_2Si_5O_{16}$
Biotite	$(H,K)_2(Mg,Fe)_2(Al,Fe)_2(SiO_4)_3$
Phlogopite	$[H,K,(MgF)]_3Mg_3Al(SiO_4)_3$

The water which is present in muscovite to the extent of 4 to 6%, and rather less in the other species, is expelled only at a high temperature; it is therefore water of constitution, existing as basic hydrogen or as hydroxyl replacing fluorine.

Roscoelite is a mica in which the aluminium is largely replaced by vanadium (V_2O_3, 30%); it occurs as brownish-green scaly aggregates, intimately associated with gold in California, Colorado and Western Australia.

Various attempts have been made to explain the variations in composition of the micas. G. Tschermak, in 1878, regarded them as isomorphous mixtures of the following fundamental molecules: $H_2KAl_3(SiO_4)_3$, corresponding with muscovite; $Mg_6Si_3O_{12}$, a hypothetical polymer of olivine; and $H_4Si_5O_{12}$, a hypothetical silicic acid. F. W. Clarke (1889–1893) supposes them to be substitution derivatives of normal aluminium orthosilicate $Al_4(SiO_4)_3$, in which part of the aluminium is replaced by alkalis, magnesium, iron and the univalent groups (MgF), (AlF_2),(AlO), (MgOH); an excess of silica is explained by the isomorphous replacement of H_4SiO_4 by the acid $H_4Si_3O_8$.

Artificially formed crystals of the various species of mica have been observed in furnace-slags and in silicate fusions.

Occurrence.—Mica occurs as a primary and essential constituent of igneous rocks of almost all kinds; it is also a common product of alteration of many mineral silicates, both by weathering and by contact- and dynamo-metamorphic processes. In sedimentary rocks it occurs as detrital material.

Muscovite and biotite are commonly found in siliceous rocks, whilst phlogopite is characteristic of calcareous rocks. The best crystallized specimens of any mica are afforded by the small brilliant crystals of biotite, which encrust cavities in the limestone blocks ejected from Monte Somma, Vesuvius. Large sheets of muscovite, such as are of commercial value, are found only in the very coarsely crystallized pegmatite veins traversing granite, gneiss or mica-schist. These veins consist of felspar, quartz and mica, often with smaller amounts of other crystallized minerals, such as tourmaline, beryl and garnet; they are worked for mica in India, the United

States (South Dakota, Colorado and Alabama), and Brazil (Goyaz, Bahia and Minas Geraes). The commercially valuable micas of Canada and Ceylon are mainly phlogopite (*q.v.*), which has a rather different mode of occurrence. The mica mined in India is practically all muscovite. The principal mining districts are those of Hazāribāgh in Bengal and Nellore in Madras; in the former district the mica has usually a ruby tint, whilst in the latter it is more often greenish. In the Inikūrti mine, Nellore, "books" of mica measuring 10 ft. across, and up to 15 ft. across the folia have been found, and rectangular sheets measuring 30 by 24 in. and free from cracks and flaws have frequently been obtained.

Uses.—On account of its transparency and its resistance to fire and sudden changes of temperature, mica has been much used for the windows of stoves and lanterns, for the peep-holes of furnaces, and the chimneys of lamps and gas-burners. At one time it was used for window panes of houses and the port-holes of Russian men-of-war, being commonly known as "Muscovy glass." Spangles of mica are much used for decorative purposes of various kinds, and the mineral was formerly known as *glacies Mariae* (Ger., *Frauenglas*) because of its use for decorating statues of the Virgin. The *lapis specularis* of Pliny, scattered over the Circus Maximus to produce a shining whiteness, was probably mica. Large quantities of ground mica are used in the manufacture of wall-paper, and to produce a frosted effect on toys, stage scenery, &c. Powdered mica is also used in the manufacture of paints and paper, as a lubricant, and as an absorbent of nitro-glycerine and disinfectants. Sheets of mica are used as a surface for painting, especially in India; for lantern slides; for carrying photographic films; as a protective covering for pictures and historical documents; for mounting soft and collapsible natural history specimens preserved in spirit; for the vanes of anemometers; mirrors of delicate physical instruments; for various optical and many other purposes. Being a bad conductor of heat it is used for the packing and jackets of boilers and steam-pipes. Other applications depend on the strength of its resistance to acids.

The most extensive application of mica at the present day is for electrical purposes. Being a bad conductor of electricity it is of value as an insulator, and the smooth flexible sheets are much used in the construction of armatures of dynamos and in other electrical machinery. For various purposes a manufactured material known as "micanite" or "micanite cloth" is much used; this consists of small sheets of mica cemented with shellac or other insulating cement on cloth or paper.

Muscovite and phlogopite are practically the only species used commercially, the former being the more common. Phlogopite is rarely found as colourless transparent sheets and is therefore almost exclusively used for electrical purposes. Many other uses of mica might be mentioned. The potassium it contains renders it of value as a manure. The species lepidolite is largely used for the manufacture of lithium and rubidium salts.

Mining, Preparation and Value.—Mica mining is an industry of considerable importance, especially in India; but here the methods of mining are very primitive and wasteful. In working downwards in open quarries and in tortuous shafts and passages much of the mica is damaged, and a large amount of labour is expended in hauling waste material to the surface. Since the mineral occurs in definite veins, a more satisfactory and economical method of working would be that adopted in metalliferous mines, with a vertical shaft, cross-cuts, and levels running along the strike of the vein: the mica could then be extracted by overhead stopping, and the waste material used for filling up the worked-out excavations.

In dressing mica the "books" are split along the cleavage into sheets of the required thickness, and the sheets trimmed into rectangles with a sharp knife, shears or guillotine, stained and damaged portions being rejected. The dressed sheets are sorted according to size, transparency, colour and freedom from spots or stains. Scrap mica is ground to powder or used in the manufacture of micanite.

The price of mica varies very considerably according to the size, transparency and quality of the sheets. An average price for cut sheets of all sizes is about 4s. per lb, but for large sheets it may be as high as 54s. per lb.

REFERENCES.—For the mineralogical characters see the text-books of J. D. Dana and C. Hintze; for economic questions, the following: T. H. Holland, "The Mica Deposits of India," *Memoirs of the Geological Survey of India* (1902), xxxiv. 11-121; G. P. Merrill, *The Non-Metallic Minerals* (New York, 1904), pp. 163-180; "The Mining and Preparation of Mica for Commercial Purposes," *Bulletin of the Imperial Institute* (London, 1904), ii. 278-291; F. Cirkel, "Mica: its Occurrence, Exploitation and Uses" (Canadian Dept. of the Interior, Mines Branch, Ottawa 1905, 148 pp.). (L. J. S.)

MICAH (מִיכָה), in the Bible, the name prefixed to the sixth in order of the books of the minor prophets.[1] He was a contemporary and fellow-worker of Isaiah. The name in various modifications—*Mīcāiāhū*, *Mīcāiĕhū*, *Mīcāiāh*—is common in the Old Testament, expressing as it does a fundamental point of Hebrew faith: Who is like Yahweh?[2] It was also borne among others by the Danite whose history is given in Judges xvii. seq. (see separate article), by the prophet who opposed Ahab's expedition to Ramoth-Gilead (1 Kings xxii.),[3] and by the son of Jonathan (see SAUL).

The editorial title of the book of Micah declares that Micah prophesied "in the days of Jotham (739–734), Ahaz (733–721) and Hezekiah (720–693), kings of Judah." Nothing in the book itself can claim to belong to the reign of Jotham, but the prophecy against Samaria (i. 5–8) may have been uttered originally before the fall of Samaria in 722, *i.e.* in the reign of Ahaz. In its present form, however, it has been incorporated in a prophecy against Judah, belonging, most probably, to the years 705–701, when a new Palestinian rising provoked Sennacherib's campaign of 701 (Nowack; cf. Marti). This prophetic activity of Micah under Hezekiah is confirmed by the direct statement of Jer. xxvi. 17 seq., where Mic. iii. 12 is quoted ("Zion shall be plowed as a field," &c.). The verse quoted forms the climax of Mic. i.–iii., from which chapters only any certain conclusions as to the prophetic message of the historic Micah can be drawn; the remaining sections of the present book (iv.–v., vi.–vii.) consist, in whole or in greater part, of writings belonging to a later period.

Chs. i.–iii. (with the exception of two verses, ii. 12, 13)[4] are a prediction of judgment on the sins of Judah and Ephraim. In a majestic exordium Yahweh Himself is represented as coming forth in the thunderstorm (cf. Amos i. 2) from His heavenly palace, and descending on the mountains of Palestine, at once as witness against His people, and the executer of judgment on their sins. Samaria is sentenced to destruction for idolatry; and the blow extends to Judah also, which participates in the same guilt (ch. i.). But, while Samaria is summarily dismissed, the sin of Judah is analysed at length in chs. ii. and iii., in which the prophet no longer deals with idolatry, but with the corruption of society, and particularly of its leaders—the grasping aristocracy whose whole energies are concentrated on devouring the poor and depriving them of their little holdings, the unjust judges and priests who for gain wrest the law in favour of the rich, the hireling and gluttonous prophets who make war against every one "that putteth not into their mouth," but are ever ready with assurances of Yahweh's favour to their patrons, the wealthy and noble sinners that fatten on the flesh of the poor. The internal disorders of the realm depicted by Micah are also prominent in Isaiah's prophecies; they were closely connected, not only with the foreign complications due to the approach of the Assyrians, but with the break-up of the old agrarian system within Israel, and with the rapid and uncompensated aggrandisement of the nobles during those prosperous years when the conquest of Edom by Amaziah and the occupation of the port of Elath by his son (2 Kings xiv. 7, 22) placed the lucrative trade between the Mediterranean and the Red Sea in the hands of the rulers of Judah. On the other hand the democratic tone which distinguishes Micah from Isaiah, and his announcement of the impending fall of the capital (the deliverance of which from the Assyrian appears to Isaiah as the necessary condition for the preservation of the seed of a new and better kingdom), are explained by the fact that, while Isaiah lived in the centre of affairs, Micah, a provincial prophet, sees the capital and the aristocracy entirely from the side of a man of the oppressed people, and foretells the utter ruin of both. But this ruin does not present itself to him as involving the captivity or ruin of the nation as a whole; the congregation of Yahweh remains in Judaea when the oppressors are cast out (ii. 5); Yahweh's words are still good to them that walk uprightly; the glory of Israel is driven to take refuge in Adullam,[1] as in the days when David's band of broken men was the true hope of the nation, but there is no hint that it is banished from the land.

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[1] A confusion between the two prophets of the name has led to the insertion in the Massoretic text of 1 Kings xxii. 28 of a citation from Micah i. 2, rightly absent from the LXX.

[2] See, however, Gray, *Hebrew Proper Names*, p. 157: "In later times they were perhaps virtually synonymous; but this is not to be assumed for early times. The shorter forms may well have had a purely secular reference, signifying 'who is like this child'?"

[3] He is called "the Morashtite" (Mic. i. 1; Jer. xxvi. 18) from his birthplace, Moresheth-Gath. That Micah lived in the Shephelah or Judaean lowland near the Philistine country is clear from the local colouring of i. 10 seq., where a number of places in this quarter are mentioned together (in connexion with the war in Philistia), and their names played upon in a way that could hardly have suggested itself to any but a man of the district. The paronomasia makes the verses difficult, and in i. 14 none of the ancient versions recognizes Moresheth-Gath as a proper name. The word Morashtite (*Mōrashti*) was therefore obscure to them; but this only gives greater weight to the traditional pronunciation with *ô* in the first syllable, which is as old as the LXX., and goes against the view, taken by the Targum both on Micah and on Jeremiah, and followed by some moderns (including Cheyne, E.B., 3198), that Micah came from Mareshah. When Eusebius placed Μωρασθεί near Eleutheropolis it is not likely that he is thinking of Mareshah (Maresa), for he speaks of the former as a village and of the latter as a ruin 2 m. from Eleutheropolis. Jerome too in the *Epit. Paulae* (*Ep.* cviii.), speaking as an eye-witness, distinguishes Morashtim, with the church of Micah's sepulchre, from Maresa. This indeed was after the pretended miraculous discovery of the relics of Micah in A.D. 385; but the name of the village which then existed (*Praef. in Mich.*) can hardly have been part of a pious fraud.

[4] These two verses are a prophecy of restoration; they are admittedly an interruption in their present context (so, *e.g.*, Driver, G. A. Smith); they belong in substance to the second section of the book (iv. v.).

Our only evidence as to the reception of Micah's message by his contemporaries is that afforded by Jer. xxvi. 17 seq., both directly, in the recorded effect on Hezekiah and the people; and indirectly, in the fact that the impression created was remembered a century afterwards. Micah resembles Amos, both in his country origin, and in his general character, which expresses itself in strong emphasis on the ethical side of religion. As the last of the four great prophets of the 8th century he undoubtedly contributed to that religious and ethical reformation whose literary monument is the Book of Deuteronomy.[2]

The remainder of the book bearing the name of Micah falls into two main divisions, viz. iv., v. and vi., vii. Each differs from the first division (i.–iii.) in a marked degree. The second consists mainly of prophecies of restoration including eschatological (iv. 1 seq.)[3] and Messianic (v. 2 seq.) hopes. The third is formed of three or four apparently unrelated passages, on the spirituality of true worship (vi. 1–8), social immorality and its doom (vi. 9–16; vii. 1–6), and Israel's future recovery from present adversity through Divine grace (vii. 7–20). It is improbable that much, if any, of these chapters can be ascribed to Micah himself,[4] not only because their contents are so different from his undoubted work (i.–iii.), for which he was subsequently remembered (Jer. xxvi. 18), but because they presuppose the historic outlook of the Exile, or a later age (*e.g.* iv. 6 seq.; vii. 7 seq.). It is neither psychologically nor historically impossible for a prophet of judgment to be also a prophet of comfort; but the internal evidence of composite and (in whole or part) later authorship must outweigh the traditional attachment of these passages to a MS. containing the work of Micah.

The sequence of thought in chs. iv. v. is really difficult, and has given rise to much complicated discussion. Thus iv. 11–13 stands in direct contradiction to iv. 9, 10, and indeed to iii. 12. The last two passages agree in speaking of the capture of Jerusalem, the first declares Zion inviolable, and its capture an impossible profanation. Such a thought can hardly be Micah's, even if we resort to the violent harmonistic process of imagining that two quite distinct sieges, separated by a renewal of the theocracy, are spoken of in consecutive verses. Another difficulty lies in the words "and thou shalt come even to Babylon" in iv. 10. Micah unquestionably looked for the destruction of Jerusalem as well as of Samaria in the near future and by the Assyrians (i. 9), and this was the judgment which Hezekiah's repentance averted. If these words, therefore, belong to the original context, they mark it as not from Micah's hand; though they might be a later gloss. The prophetic thought is that the daughter (population) of Zion shall not be saved by her present rulers or defensive strength; she must come down from her bulwarks and dwell in the open field; there, and not within her proud ramparts, Yahweh will grant deliverance from her enemies. Opposition to present tyranny expresses itself in recurrence to the old popular ideal of the first simple Davidic kingdom (iv. 8). These old days shall return once more. A new David, like him whose exploits in the district of Micah's home were still in the mouths of the common people (? i. 15), goes forth from Bethlehem to feed the flock in the strength of Yahweh. The kindred Hebrew nations are once more united to their brethren of Israel (cf. Amos ix. 12, Isa. xvi. 1 seq.). The remnant of Jacob springs up in fresh vigour, inspiring terror among the surrounding peoples, and there is no lack of chosen captains to lead them to victory against the Assyrian foe. In the rejuvenescence of the nation the old stays of that oppressive kingship which began with Solomon, the strongholds, the fortified cities, the chariots and horses so foreign to the life of ancient Israel, are no more known; they disappear together with the divinations, the soothsayers, the idols, the *mazzebah* and *asherah* of the high places. Yahweh is king on Mount Zion, and no inventions of man come between Him and His people.

The sixth chapter of Micah presents a very different situation from that of chs. i.–iii. or iv., v. Yahweh appears to plead with His people for their sins, but the sinners are no longer a careless and oppressive aristocracy buoyed up by deceptive assurances of Yahweh's help, by prophecies of wine and strong drink; they are bowed down by a religion of terror, wearied with attempts to propitiate an angry God by countless offerings, and even by the sacrifice of the first-born. Meantime the substance of true religion—justice, charity and a humble walk with God—is forgotten, fraud and deceit reign in all classes, the works of the house of Ahab are observed (worship of foreign gods). Yahweh's judgments are multiplied against the land, and the issue can be nothing else than its total desolation. All these marks may be held to fit exactly the evil times of Manasseh as described in 2 Kings xxi. Cp. vii. 1–6, in which the public and private corruption of a hopeless age is bitterly bewailed, possibly belongs to the same context.

Micah may very well have lived into Manasseh's reign, but the title in i. 1 does not cover a prophecy which certainly falls after Hezekiah's death, and the style has nothing in common with the earlier part of the book. It is therefore prudent to regard the prophecy, with Ewald, as anonymous. Ewald ascribed the whole of chs. vi., vii. to one author. Wellhausen, however, remarks with justice that the thread is abruptly broken at vii. 6, and that verses 7–20[1] represent Zion as already fallen before the heathen and her inhabitants as pining in the darkness of captivity. The hope of Zion is in future restoration after she has patiently borne the chastisement of her sins. Then Yahweh shall arise mindful of His oath to the fathers, Israel shall be forgiven and restored, and the heathen humbled. The faith and hope which breathe in this passage have the closest affinities with the book of Lamentations and Isa. xl.–lxvi. Indeed, as Marti points out (p. 259) the triple division of the book of Micah (i.–iii.; iv., v.; vi., vii.) corresponds with that of the book of Isaiah (i.–xxxix.; xl.–lv.; lvi.–lxvi.) in the character of the three divisions (judgment; coming restoration; prayer for help in adversity) respectively, and in the fact that the first alone gives us pre-exilic writing in the actual words of the prophet to whom the whole book is ascribed. In both cases, it need hardly be said, the great literary and spiritual value of the later passages ought in no way

[1] i. 15; the reference is, however, obscure and uncertain.

[2] See the Introduction to the *Century Bible*, "Deuteronomy and Joshua," by H. Wheeler Robinson.

[3] Mic. iv. 1–3 and Isa. ii. 2–4 are but slightly modified recensions of the same text, and as Isa. ii. is older than the prophecy of Micah, while on the other hand Mic. iv. 4 seems the natural completion of the passage, it is common to suppose that both copy an older prophet. But the words have little connexion with the context in Isaiah, and may be the quotation of a copyist suggested by ver. 5. On the other hand it has been urged that the passage belongs to a later stage of prophetic thought than the 8th century B.C. Reasons making this view the more probable one are given by Wellhausen (p. 142) and Marti (p. 281).

[4] Nowack thinks that iv. 9, 10^a, 14 and v. 10–14 may possibly belong to Micah; Wellhausen recognizes the same possibility, which he extends, however, to vi. 1–8. Marti, who (like Cheyne in *Ency. Bib.*) finds nothing by Micah in iv.–vii., thinks these chapters have crystallized round two central passages, viz. iv. 1–4, and vi. 6–8, whose addition to the first three chapters formed the second stage in the growth of the present book. More conservative views as to authorship are taken by Driver and G. A. Smith, the former suggesting, however, that "the existing Book of Micah consists only of a collection of *excerpts*, in some cases fragmentary excerpts, from the entire series of the prophet's discourses" (*L. O. T.*, ch. vi. § 6).

[1] Regarded by Stade (*Z. A. T. W.*, 1903, p. 164 seq.) as an independent psalm.

to suffer prejudice from critical conditions as to their date and authorship.

LITERATURE.—The chief modern commentaries are those of Nowack (*Die Kleinen Propheten*, 1897; 2nd ed., 1904) and Marti (*Dodekapropheton*, 1904), where detailed references to the older literature may be found; cf. Wellhausen, *Die Kleinen Propheten* (3rd ed., 1898). In English, reference may be made to Cheyne ("Micah," in the *Cambridge Bible*, 1882; 2nd ed., 1895), and to G. A. Smith ("The Book of the Twelve," vol. i., in The *Expositor's Bible*, 1896); also to the articles on "Micah" by Nowack in Hastings's *Dict. of the Bible* (1900), iii. 359, 360, and by Cheyne in the *Ency. Bibl.* (1902), iii. c. 3068–3074, the latter incorporating most of the original article (*Ency. Brit.* 9th ed.) by W. Robertson Smith, which has been revised above. For a review of recent criticism see Cheyne, introduction to W. R. Smith's *The Prophets of Israel*, 2nd ed., pp. xxiii.–xxvii.; also *Ency. Bib. loc. cit.* J. M. P. Smith discusses "The Strophic Structure of the Book of Micah" in a volume of *Old Test. and Semitic Studies: in memory of W. R. Harper* (Chicago, 1908). (W. R. S.; H. W. R.*)

MICAH, in the Bible, a man of the hill-country of Ephraim whose history enters into that of the foundation of the Israelite sanctuary at Dan (Judges xvii. seq.). He had stolen from his mother eleven hundred pieces of silver (for the number cf. Judges xvi. 5), and when she uttered a curse upon the unknown thief he restored the money and she consecrated it to Yahweh. A carved image was made and set up in his private temple together with an ephod-idol and teraphim (objects used in divination, cf. Gen. xxxi. 19, 30; Hos. iii. 4). He employed one of his sons to serve as priest, but when a Levite from Bethlehem in Judah came along he gladly installed him as "father and priest." When the tribe of Dan subsequently sought new territory and sent men to search for a suitable district they passed by Micah's house, recognized the Levite and requested an oracle from him. When, later, they migrated, they despoiled the sacred place and carried off the gods and priest to their newly won home at Laish.

MICA-SCHIST, in petrology, a rock composed essentially of mica and quartz, and having a thin parallel-banded or foliated structure, with lamellae rich in mica alternating with others which are principally quartz. They split readily along the micaceous films, and have smooth or slightly uneven surfaces covered with lustrous plates of muscovite or biotite; the quartzose lamellae are often visible only when the specimens are looked at edgewise. Mica-schists are very common in regions of Archean rocks accompanying gneisses, crystalline limestones and other schists. Some have a flat banding yielding smooth slabs; others are crumpled or contorted with undulating foliation. Occasionally the quartz forms elliptical lenticles or "eyes." In some cases mica composes nearly the whole of the rock, in others quartz preponderates so that they approach quartz-schists and quartzites.

The mica may be muscovite or biotite; both are often present, while paragonite and green fuchsite or chrome-mica are not so common. In addition to quartz there may be a small amount of feldspar, usually albite. A great number of accessory minerals are known in mica-schists, and when these are conspicuous or important they may be regarded as constituting special varieties receiving distinctive names. Garnet, in rounded red crystals, not uncommonly idiomorphic, is the most frequent. Brown staurolite, pinkish andalusite, and grey or blue kyanite occur in some kinds of mica-schist, separately or together. The white mica-schist of the St Gothard contains kyanite and staurolite. Graphite (or graphitoid) is also a very frequent ingredient of these rocks, giving them a leaden grey colour and causing them to soil the fingers when handled. In some mica-schists there is much calcite (calc-mica-schists); and hornblende, scapolite and augite are often seen in rocks of this sort. Tourmaline occurs, sometimes in large black prisms but more commonly in minute crystals visible only in microscopic sections. Rutile in tiny prisms, ilmenite and hematite in black or brown scales, zircon, apatite, granules of epidote or zoisite chlorite, chloritoid and pyrites occur with more or less frequency in the rocks of this group.

Mica-schists are in nearly all cases sedimentary rocks which have been recrystallized and have obtained a schistose structure during the process. This can be proved by their chemical composition, which is very much the same as that of clays, shales and slates. In some districts it is possible to trace every gradation from a slate (*q.v.*) to a mica-schist, the intermediate stages being represented by phyllites (*q.v.*) which consist of quartz, muscovite and chlorite, and are neither so crystalline nor so well foliated as the schists. In a few places, *e.g.* Bergen in Norway, fossils have been found in mica-schists. The association of quartzites and quartz-schists, graphite-schists and crystalline limestones with mica-schists in the field is explained by the fact that all these rocks are altered sediments, viz. sandstones, carbonaceous shales and limestones.

Under the microscope the appearance presented by mica-schists differs according to whether the rock is cut parallel to or across the planes of foliation. In the latter case thin alternating bands composed of black or brown mica, and of quartz, cross the field of view (see PETROLOGY, Plate 4, fig. 8). The mica scales have their cleavages and their flat sides parallel; the quartz occurs in rounded, elliptical or irregular grains, with usually a small admixture of feldspar (albite, oligoclase, orthoclase); apatite and iron oxides are rarely absent from these rocks. If garnet is present it may form large well-shaped crystals containing innumerable enclosures of quartz, biotite and iron ores; in some cases the garnets are cracked as if they had been broken by the pressures to which the rock had been subjected. Often the garnets are surrounded by small "eyes" of quartz, and they may be embedded in green chlorite, which is probably a secondary or decomposition product. Some mica-schists are rich in iron oxides and pass into haematite-schists (itabirites). When graphite occurs in mica-schists its crystals are small flat plates perfectly opaque even in the thinnest sections.

Like all metamorphic rocks, mica-schists are principally found in Archean areas; the great majority of them are of pre-Cambrian age. There are, however, in the Alps, Himalayas, &c., many rocks of this sort which are believed to be secondary or even tertiary; the evidence for this is not in all cases satisfactory, as of course the fossils, which if preserved would be sufficient to prove it, are nearly always destroyed by the metamorphism. Mica-schists are rarely of economic value, being too fissile for building-stones and too brittle for roofing-slates. They are of wide-spread distribution in the Scottish Highlands, Norway and Sweden, Bohemia, Saxony, Brittany, the Alps, many parts of North America, &c. (J. S. F.)

MICCA, PIETRO, Piedmontese soldier (d. 1706), was born at Andorno, and achieved fame by his death in the defence of Turin. During the siege of that city by the French in 1706 a party of the besiegers had succeeded in penetrating by surprise into the moat of the fortress on the night of August 29–30, and would undoubtedly have captured it had not Micca, a soldier in the engineers, fired a mine, with the result that they were blown into the air and the rest of the force driven back with heavy losses. Micca's heroism has been the subject of poems, plays and romances. But, according to Count Giuseppe Solaro della Margherita, the commander of the Turin garrison at the time, it was through a miscalculation of the pace of the fuse. and not by deliberate intent, that he sacrificed his life.

See A. Manno *Pietro Micca ed il generale conte Solaro della Margherita* (Turin, 1883).

MICHAEL (Hebrew מִיכָאֵל, "Who is like God?"), an Old Testament name, synonymous with Micaiah or Micah (Num. xiii. 13; 1 Chron. v. 13 *et passim*). In the book of Daniel the name is given to one of the chief "princes" of the heavenly host, the guardian angel or "prince" of Israel (Dan. x. 13, 21; xii. 1; cf. Enoch xx. 5 and possibly Mal. iii. 1), and as such he naturally appears in Jewish theosophy as the greatest of all angels, the first of the four (or seven) who surround the throne of God, and the antagonist of Sammael, the enemy of God. He holds the secret of the mighty "word" by which God created heaven and earth (Enoch lxix. 14), and was "the angel who spoke to Moses in the Mount" (Acts vii. 38). It was through Babylonian and Persian influence that names were given to the angels, and according to Kohut (*Jüd. Angel.* p. 24) Michael is parallel to Vohumano, "Ahura's first masterpiece," one of the Zoroastrian Amesha-spentas or archangels. It is as guardian angel of Israel, or of the Church, the true Israel, that Michael appears in Jude 9 and Rev. xii. 7. This latter passage is of distinctly pre-Christian origin; it is not the Child that overthrows Satan, the figure of the Messiah is ousted by that of Michael. There is also here a relic of the primeval Babylonian myth of the struggle between the light god Marduk and the forces of chaotic darkness. In the Western Church the festival of St Michael and All Angels (Michaelmas) is celebrated on the 29th of September; it appears to have grown out of a local celebration of the dedication of a church of St Michael either at Mount Garganus in Apulia or at Rome, and was a great day by the beginning of the 9th century. The Greek Church dedicates the 8th of November to St Michael, St Gabriel and All Angels.

MICHAEL (1596–1645), tsar of Russia, was the first tsar of the house of Romanov, being the son of Theodore Nekitich Romanov, afterwards the Patriarch Philaret (*q.v.*), and Xenia Chestovaya, afterwards the nun Martha. He was elected unanimously tsar of Russia by a national assembly on the 21st of February 1613, but not till the 24th of March did the delegates of the council discover the young tsar and his mother at the Ipatievsky monastery near Kostroma. At first Martha protested that her son was too young and tender for so difficult an office in such troublesome times. At the last moment, however, Michael consented to accept the throne, but not till the weeping boyars had solemnly declared that if he persisted in his refusal they would hold him responsible to God for the utter destruction of Muscovy. In so dilapidated a condition was the capital at this time that Michael had to wait for several weeks at the Troitsa monastery, 75 m. off, before decent accommodation could be provided for him at Moscow. He was crowned on the 22nd of July. The first care of the new tsar was to clear the land of the robbers that infested it. Sweden and Poland were then got rid of respectively by the peace of Stolbova (March 10, 1617) and the truce of Deulina (Feb. 13, 1619). The most important result of the truce of Deulina was the return from exile of the tsar's father, who henceforth took over the government till his death in October 1633, Michael occupying quite a subordinate position. He was a gentle and pious prince who gave little trouble to any one and effaced himself behind his counsellors. Fortunately for him they were relatively honest and capable men. Michael's failure to wed his daughter Irene with Prince Waldemar of Denmark, in consequence of the refusal of the latter to accept orthodoxy, so deeply afflicted him as to contribute to bring about his death on the 12th of July 1645.

See R. Nisbet Bain, *The First Romanovs* (Lond., 1905). (R. N. B.)

MICHAEL, the name of nine East-Roman emperors.

Michael I. Rhangabes (d. 845), an obscure nobleman who had married Procopia, the daughter of Nicephorus I., and been made master of the palace. He was made emperor in a revolution against his brother-in-law, Stauracius (811).

Elected as the tool of the bigoted orthodox party in the Church, Michael diligently persecuted the iconoclasts on the northern and eastern frontiers of the empire, but meanwhile allowed the Bulgarians to ravage a great part of Macedonia and Thrace; having at last taken the field in the spring of 813, he was defeated near Bersinikia, and Leo the Armenian was saluted emperor in his stead in the following summer. Michael was relegated as a monk to the island of Prote, where he lived unmolested till his death in 845.

Michael II., called Psellus, "the stammerer," emperor 820–829, was a native of Amorium in Phrygia, who began life as a private soldier, but rose by his talents to the rank of general. He had favoured the enthronement of his old companion in arms Leo the Armenian (813), but, detected in a conspiracy against that emperor, had been sentenced to death in December 820; his partisans, however, succeeded in assassinating Leo and called Michael from the prison to the throne. The principal features of his reign were a struggle against his brother general, Thomas, who aimed at the throne (822–824); the conquest of Crete by the Saracens in 823; and the beginning of their attacks upon Sicily (827). In spite of his iconoclastic sympathies, he endeavoured to conciliate the image-worshippers, but incurred the wrath of the monks by entering into a second marriage with Euphrosyne, daughter of Constantine VI., who had previously taken the veil.

Michael III. (839–867), "the drunkard," was grandson of Michael II., and succeeded his father Theophilus when three years old (842). During his minority the empire was governed by his mother Theodora, who in spite of several defeats inflicted upon her generals maintained the frontiers against the Saracens of Bagdad and Crete. The regent displayed her religious zeal by restoring image-worship (842) and persecuting the Paulician heretics, but she entirely neglected the education of her son. As a result Michael grew up a debauchee, and fell under the sway of his uncle Bardas, who induced him to banish Theodora to a convent and practically assumed the chief control (857). Bardas justified this usurpation by introducing various internal reforms; in the wars of the period Michael himself took a more active part. During a conflict with the Saracens of the Euphrates (856–63), the emperor sustained a personal defeat (860), which was retrieved by a great victory on the part of his uncle Petronas in Asia Minor. In 861 Michael and Bardas invaded Bulgaria and secured the conversion of the king to Christianity. On sea the empire suffered under the ravages of the Cretan corsairs; and in 865 the first pillaging expedition of the Russians endangered the Bosporus. In 867 Michael was assassinated by Basil the Macedonian, a former groom, who had overthrown the influence of Bardas and in 866 been associated in the Empire.

Michael IV. (d. 1041), "the Paphlagonian," owed his elevation to Zoe, daughter of Constantine VIII., who was the wife of Romanus III., but becoming enamoured of Michael, her chamberlain, poisoned her husband and married her attendant (1034). Michael, however, being of a weak character and subject to epileptic fits, left the government in the hands of his brother, John the Eunuch, who had been first minister of Constantine and Romanus. John's reforms of the army and financial system revived for a while the strength of the Empire, which held its own successfully against its foreign enemies. On the eastern frontier the important post of Edessa was relieved after a prolonged siege. The western Saracens were almost driven out of Sicily by George Maniakes (1038–40); but an expedition against the Italian Normans suffered several defeats, and after the recall of Maniakes most of the Sicilian conquests were lost (1041). In the north the Serbs achieved a successful revolt (1040), but a dangerous rising by the Bulgarians and Slavs which threatened the cities of Thrace and Macedonia was repressed by a triumphant campaign which the decrepit emperor undertook in person shortly before his death (1041).

Michael V. Calaphates, or "the caulker," nephew and successor of the preceding, surnamed after the early occupation of his father. He owed his elevation (Dec. 1041) to his uncle John, whom along with Zoe he almost immediately banished; this led to a popular tumult in consequence of which he was dethroned after a brief reign of four months, and relegated to a monastery. His unpopularity seems largely due to his attempts at administrative reform, which were strongly resented by the dominant classes.

Michael VI., "the warlike," was already an old man when chosen by the empress Theodora as her successor shortly before her death in 1056. He was unable to check the disaffection of the feudal aristocracy, who combined with an officer named Isaac Comnenus to depose him. After a successful battle in Phrygia, the rebels had no difficulty in dethroning Michael (1057), who spent the rest of his life in a monastery.

Michael VII. Ducas, or Parapinaces, was the eldest son of Constantine X. Ducas. After a joint reign with his brothers, Andronicus I. and Constantine XI. (1067–1071), he was made sole emperor through his uncle John Ducas. The feebleness of Michael, whose chief interest lay in trifling academic pursuits, and the avarice of his ministers, was disastrous to the empire. As the result of anarchy in the army, the Byzantines lost their last possessions in Italy (1071), and were forced to cede a large strip of Asia Minor which they were unable to defend against the Seljuk Turks (1074). These misfortunes, which were but partially retrieved by the suppression of a Bulgarian revolt (1073), caused widespread dissatisfaction. In 1078 two generals, Nicephorus Bryennius and Nicephorus Botaniates, simultaneously revolted. Michael resigned the throne with hardly a struggle and retired into a monastery. His nickname *Parapinaces* ("starver") was due to his causing the price of wheat to rise.

Michael VIII. Palaeologus (1234–1282) was the son of Andronicus Palaeologus Comnenus and Irene Angela, the granddaughter of Alexius Angelus, emperor of Constantinople. At an early age he rose to distinction, and ultimately became commander of the French mercenaries in the employment of the emperors of Nicaea. A few days after the death of Theodore Lascaris II. in 1259, Michael, by the assassination of Muzalon (which he is believed but not proved to have encouraged) became joint guardian with the patriarch Arsenius of the young emperor, John Lascaris, then a lad of eight years. Afterwards invested with the title of "despot," he was finally proclaimed joint-emperor and crowned alone at Nicaea on the 1st of January 1260. In July 1261 Michael, who had attacked Constantinople with the help of the Genoese, conquered the town through his general Strategopoulos. He thereupon had John Lascaris blinded and banished. For this last act he was excommunicated by Arsenius, and the ban was not removed until six years afterwards (1268) on the accession of a new patriarch. In 1263 and 1264 respectively, Michael, with the help of Urban IV., concluded peace with Villehardouin, prince of Achaia, and Michael, despot of Epirus, who had previously been incited by the pope to attack him, but had been decisively beaten at Pelagonia in Thessaly (1259); Villehardouin was obliged to cede Mistra, Monemvasia and Maina in the Morea. Subsequently Michael was involved in wars with the Genoese and Venetians, whose influence in Constantinople he sought to diminish by maintaining the balance of strength between them. In 1269 Charles of Sicily, aided by John of Thessaly, made war with the alleged purpose of restoring Baldwin to the throne of Constantinople, and pressed Michael so hard that he consented to send deputies to the council of Lyons (1274) and there accept the papal supremacy. The union thus brought about between the two Churches was, however, extremely distasteful to the Greeks, and the persecution of his "schismatic" subjects to which the emperor was compelled to resort weakened his power so much that Martin IV. was tempted to enter into alliance with Charles of Anjou and the Venetians for the purpose of reconquering Constantinople. The invasion, however, failed, and Michael so far had his revenge in the "Sicilian Vespers," which he helped to bring about. He died in Thrace in December 1282. In reconstituting the Byzantine Empire Michael restored the old administration without endeavouring to correct its abuses. By debasing the coinage he hastened the decay of Byzantine commerce.

MICHAEL IX. PALAEOLOGUS, was the son of Andronicus II. and was associated with him on the throne from 1295, but predeceased him (1320). He took the field against the Turks (1301, 1310) and against the Grand Catalan Company (1305), but was repeatedly defeated.

See Gibbon's *Decline and Fall* (ed. Bury, 1896); G. Finlay, *Hist. of Greece* (ed. 1877); G. Schlumberger, *l'Epopée byzantine* (1896); J. Bury, in *Eng. Hist. Rev.* (1889); Meliarakes, *'Ιστορία τοῦ βασιλείου τῆς Νικαίας καὶ τοῦ δεσποτάτου τῆς 'Ηπείρου*, pp. 539–627 (Athens, 1898).

MICHAEL OBRENOVICH III. (1823–1868), Prince of Servia, was the youngest son of Prince Milosh, the founder of the Obrenovich dynasty. After the abdication of his father (1839) and the death of his elder brother Milan Obrenovich II. (1840) he ascended the throne of Servia. He wished to continue the work of his father, in liberating all the Servian people, and if possible all other Balkan Christians, from direct Turkish rule. But while this programme made the Sultan hostile, it also failed to win the support of Austria, which did not wish the Eastern Question to be opened by the ambitious Servian. The support which his aspirations found in Russia increased Turkey's and Austria's suspicions of the prince's activity. At the same time the political situation at home was not favourable to his anti-Turkish policy. The power was in the hands of men who had forced Obrenovich I. to abdicate, and feared that Obrenovich III. might avenge his father. They thought it safer for them to replace him on the throne by a man who was not an Obrenovich, and who would be personally obliged to them for his elevation. These motives were at the bottom of the revolt, started and led by Vuchich in August 1842, the outcome of which was that Prince Michael left the country and that his equerry, Alexander Karageorgevich, was elected Prince of Servia. As an exile Prince Michael lived principally in Vienna, improving his education by studies and travels, and frequently visiting England. He constantly refused to agree to suggestions for his restoration by forcible means. His device was *Tempus et meum jus*, "Time and my right." He supported Servian authors and artists, and wrote himself a book in defence of his father Milosh against the attacks of Cyprian Robert. He wrote poetry too, and some of his songs, set to beautiful music, were very popular amongst the Servians. He married in 1856 the beautiful Julia, Countess Hunyadi.

In 1858 the Servians, having dethroned Prince Karageorgevich, recalled Michael's father Milosh Obrenovich I. Michael returned to Servia, and on his father's death (1860) ascended the Servian throne for the second time. His proclamation "that henceforth the law is the highest will in Servia," opened a new era of strict legality and at the same time of entire emancipation from foreign influences, and more especially from Turkey's interference with the internal affairs of Servia. The old constitution, granted to Servia by the sultan as the suzerain and the tsar as the protector of Servia as far back as 1839, was discarded and replaced by one which limited the power of the oligarchic senate and gave a certain share in legislation to the "Narodna Skupshtina" (the National Assembly). He established the Servian national army and increased the regular army. Reforms in all branches of public administration were introduced, and Servia, until then a half-oriental and half-patriarchal state, was resolutely led to become a civilized country in a European sense. When in 1862 the Turkish garrison bombarded the town of Belgrade from its citadel, Prince Michael, supported by the European diplomacy, succeeded in obtaining evacuation of some of the smaller forts in Servia, but the strong fortress of Belgrade still remained garrisoned by the Turkish troops. Prince Michael now made vigorous political and military preparations for war against Turkey. He made secret arrangements with the Bulgarian, Bosnian and Albanian leaders, an alliance with Montenegro and an understanding with Greece, with the object that they all should rise if Servia declared war on Turkey. He even succeeded in obtaining Austria's promise, that it would observe an attitude of friendly neutrality and would have nothing against an eventual annexation of the largest part of Bosnia to Servia, and he secured to himself the sympathies of Napoleon III. and his government. In the beginning of 1867 he formally asked the Porte to withdraw the Turkish garrisons from the fortress of Belgrade, as well as from other two fortresses of minor importance (Shabats and Smederevo (Semendria)). For some time the chances were that a war would take place that spring (1867) between Servia and Turkey, but peace was kept by the action of Great Britain, who advised the sultan to withdraw the Turkish garrisons from the Servian fortresses; and this advice, backed by Russia, France and Austria, prevailed at last with the sultan. On the 26th of April 1867 the fortresses were delivered over to Prince Michael, who shortly afterwards went to Constantinople to thank the sultan personally.

Prince Michael's policy had triumphed. But his success was short-lived. A group of young men, mostly educated in France and Germany, now started a liberal movement under the leadership of Yovan Ristich (or Ristitch). They wanted a more liberal constitution than that which Prince Michael had given; and this movement tended to qualify his popularity. Meanwhile the prince contemplated divorce from his wife Princess Julia, by whom he had no children, and marriage with the daughter of his cousin Madame Anka Constanitinovich; and the adherents of the exiled Karageorgevich dynasty were alarmed at the prospect of his eventually having legal heirs to the throne. A former private secretary to Prince Alexander Karageorgevich, and two of the same prince's brothers-in-law, formed a conspiracy, which resulted in the brutal assassination of Prince Michael on the 29th of May (June 10 (O.S.), 1868), whilst he was walking in the park of Koshutnyak, a few miles distant from Belgrade. (C. Mi.)

MICHAELIS, JOHANN DAVID (1717–1791), German biblical scholar and teacher, a member of a family which had the chief part in maintaining that solid discipline in Hebrew and the cognate languages which distinguished the university of Halle in the period of Pietism. Johann Heinrich Michaelis (1668–1738) was the chief director of A. H. Francke's *Collegium orientale theologicum*, a practical school of biblical and oriental philology then quite unique, and the author of an annotated Hebrew Bible and various exegetical works of reputation, especially the *Adnotationes uberiores in hagiographos* (1720). In his chief publications J. H. Michaelis had as fellow-worker his sister's son Christian Benedikt Michaelis (1680–1764), the father of Johann David, who was likewise influential as professor at Halle, and a sound scholar, especially in Syriac. J. D. Michaelis was trained for academical life under his father's eye. At Halle he was influenced, especially in philosophy, by Sigmund J. Baumgarten (1706–1757), the link between the old Pietism and J. S. Semler, while he cultivated his strong taste for history under Chancellor Ludwig. In 1739–1740 he qualified as university lecturer. One of his dissertations was a defence of the antiquity and divine authority of the vowel-points in Hebrew. His scholarship still moved in the old traditional lines, and he was also much exercised by religious scruples, the conflict of an independent mind with that submission to authority at the expense of reason encouraged by the Lutheranism in which he had been trained. A visit to England in 1741–1742 lifted him out of the narrow groove of his earlier education. In passing through Holland he made the acquaintance of Albert Schultens (1686–1750), whose influence on his philological views became all-powerful a few years later. At Halle Michaelis felt himself out of place, and in 1745 he gladly accepted an invitation to Göttingen as *privatdozent*. In 1746 he became professor extraordinarius, in 1750 ordinarius, and in Göttingen he remained till his death in 1791.

His intellect was active in many directions; universal learning indeed was perhaps one of his foibles. Literature—modern as well as ancient—occupied his attention; one of his works was a translation of four parts of *Clarissa*; and translations of some of the then current English paraphrases on biblical books manifested his sympathy with a school which, if not very learned, attracted him by its freer air. His oriental studies were reshaped by diligent perusal of the works of Schultens; for the Halle school, with all its learning, had no conception of the principles on which a fruitful connexion between Biblical and Oriental learning could be established. His linguistic work indeed was always hampered by the lack of manuscript material, which is felt in his philological writings, *e.g.* in his valuable *Supplementa* to the Hebrew lexicons (1784–1792).[1] He could not become such an Arabist as J. J. Reiske (1716–1774); and, though for many years the most famous teacher of Semitic languages in Europe, he had little of the higher philological faculty, and neither his grammatical nor his critical work has left a permanent mark, with the exception perhaps of his text-critical studies on the Peshitta.[2] His tastes were all for such studies as history, antiquities, and especially geography and natural science. He had in fact started his university course as a *medicinae cultor*, and in his autobiography he half regrets that he did not choose the medical profession. In geography he found a field hardly touched since Samuel Bochart, in whose footsteps he followed in the *Spicilegium geographiae hebraeorum exterae post Bochartum* (1769–1780); and to his impulse we owe the famous Eastern expedition conducted by Carsten Niebuhr. In spite of his doctrinal writings—which at the time made no little noise, so that his *Compendium of Dogmatic* (1760) was confiscated in Sweden, and the knighthood of the North Star was afterwards given him in reparation—it was the natural side of the Bible that really attracted him, and no man did more to introduce the modern method of studying Hebrew antiquity as an integral part of ancient Eastern life.

The personal character of Michaelis can be read between the lines of his autobiography with the aid of the other materials collected by J. M. Hassencamp (1743–1797) the editor (*J. D. Michaelis Lebensbeschreibung*, &c., 1793). The same volume contains a full list of his works. Besides those already mentioned it is sufficient to refer to his New Testament *Introduction* (the first edition, 1750, preceded the full development of his powers, and is a very different book from the later editions), his reprint of Robert Lowth's *Praelectiones* with important additions (1758–1762), his German translation of the Bible with notes (1773–1792), his *Orientalische und exegetische Bibliothek* (1775–1785) and *Neue O. and E. Bib.* (1786–1791), his *Mosaisches Recht* (1770–1771) and his edition of E. Castle's *Lexicon syriacum* (1787–1788). His *Litterarischer Briefwechsel* (1794–1796) contains much that is interesting for the history of learning in his time.

MICHAUD, JOSEPH FRANÇOIS (1767–1839), French historian and publicist, was born of an old family on the 19th of June 1767, at Albens, Savoy, was educated at Bourg-en-Bresse, and afterwards engaged in literary work at Lyons, where the events of 1789 first called out the strong dislike to revolutionary principles which manifested itself throughout the rest of his life. In 1791 he went to Paris, where, not without danger, he took part in editing several royalist journals. In 1796 he became editor of *La Quotidienne*, for his connexion with which he was arrested after the 13th of Vendémiaire; he succeeded in escaping his captors, but was sentenced to death *par contumace* by the military council. Having resumed the editorship of his newspaper on the establishment of the Directory, he was again proscribed on the 18th of Fructidor, but at the close of two years returned to Paris when the consulate had superseded the Directory. His Bourbon sympathies led to a brief imprisonment in 1800, and on his release he for the time abandoned journalism, and began to write or edit books. Along with his brother and two colleagues he published in 1806 a *Biographie moderne, ou dictionnaire des hommes qui se sont fait un nom en Europe depuis 1789*, the earliest work of its kind; and in 1811 appeared the first volume of his *Histoire des croisades* and also the first volume of his *Biographie universelle*. In 1814 he resumed the editorship of *La Quotidienne*, and in the same year was elected Academician. In 1815 his brochure entitled *Histoire des quinze semaines ou le dernier règne de Bonaparte* met with extraordinary success, passing through twenty-seven editions within a very short time. His political services were now rewarded with the cross of an officer in the Legion of Honour and the modest post of king's reader, of which last he was deprived in 1827 for having opposed Peyronnet's "Loi d'Amour" against the freedom of the Press. In 1830–1831 he travelled in Syria and Egypt for the purpose of collecting additional materials for the *Histoire des croisades*; his correspondence with a fellow explorer, J. J. F. Poujoulat, consisting practically of discussions and elucidations of various points in that work, was afterwards published (*Correspondance d'orient*, 7 vols., 1833–1835). Like the *Histoire*, it is more interesting than exact. The *Bibliothèque des croisades*, in four volumes more, contained the "Pièces justificatives" of the *Histoire*. Michaud died on the 30th of September 1839, at Passy, where his home had been since 1832.

His *Histoire des croisades* was published in its final form in six volumes in 1840 under the editorship of his friend Poujoulat (9th ed., with appendix, by Huillard-Bréholles, 1856). Michaud, along with Poujoulat, also edited *Nouvelle collection des mémoires pour servir à l'histoire de France* (32 vols., 1836–1844). See Sainte-Beuve, *Causeries du lundi*, vol. vii.

MICHAUX, ANDRÉ (1746–1802), French botanist and traveller, was born at Versailles on the 7th of March 1746. In 1779 he spent some time botanizing in England, and in 1780 he explored Auvergne, the Pyrénées and the north of Spain. In 1782 he was sent by the French government on a botanical mission to Persia. His journey began unfavourably, as he was robbed by Arabs of all his equipment except his books; but he gained influential support in Persia, having cured the shah of a dangerous illness. After two years he returned to France with a fine herbarium, and also introduced numerous Eastern plants into the botanic gardens of France. In 1785 he was sent by the French government to North America, and travelled with his son François André (1770–1855) through Canada,

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[1] By a strange fortune of war it was the occupation of Göttingen by the French in the Seven Years' War, and the friendly relations he formed with the officers, that procured him the Paris MS. from which he edited Abulfeda's description of Egypt.

[2] *Curae in actus apostolorum syriacos* (1755).

Nova Scotia and the United States. On his return to France in 1797 he was shipwrecked and lost most of his collections. In 1800 he went to Madagascar to investigate the flora of that island, and died there on the 16th of November 1802. His work as a botanist was chiefly done in the field, and he added largely to what was previously known of the botany of the East and of America.

He wrote two valuable works on North American plants—the *Histoire des chênes de l'Amérique septentrionale* (1801), with 36 plates, and the *Flora Boreali-Americana* (2 vols., 1803), with 51 plates. His son François published a *Histoire des arbres forestiers de l'Amérique septentrionale* (3 vols., 1810–1813), with 156 plates, of which an English translation appeared in 1817–1819 as *The North American Sylva*.

MICHEL, CLAUDE, known as CLODION (1738–1814), French sculptor, was born on the 20th of December 1738 in Nancy. Here and probably in Lille he spent the earlier years of his life. In 1755 he came to Paris and entered the workshop of Lambert Sigisbert Adam, his maternal uncle, a clever sculptor. He remained four years in this workshop, and on the death of his uncle became a pupil of J. B. Pigalle. In 1759 he obtained the grand prize for sculpture at the Académie Royale; in 1761 he obtained the first silver medal for studies from models; and in 1762 he went to Rome. Here his activity was considerable between 1767 and 1771. Catherine II. was eager to secure his presence in St Petersburg, but he returned to Paris. Among his patrons, which were very numerous, were the chapter of Rouen, the states of Languedoc, and the *Direction générale.* His works were frequently exhibited at the Salon. In 1782 he married Catherine Flore, a daughter of the sculptor Augustin Pajou, who subsequently obtained a divorce from him. The agitation caused by the Revolution drove Clodion in 1792 to Nancy, where he remained until 1798, his energies being spent in the decoration of houses. Among Clodion's works are a statue of Montesquieu, a "Dying Cleopatra," and a chimney-piece at present in the South Kensington Museum. One of his last groups represented Homer as a beggar being driven away by fishermen (1810). On the 29th of March 1814 Clodion died in Paris, on the eve of the invasion of Paris by the allies.

Thirion's *Les Adam et Clodion* (Paris, 1885) contains a list of the sculptor's works sold between 1767 and 1884. See also A. Jacquot, *Les Adam et les Michel et Clodion* (Paris, 1898).

MICHEL, CLÉMENCE LOUISE (1830–1905), French anarchist, called *la Vierge rouge de Montmartre*, was born at the château of Vroncourt (Haute-Marne) on the 29th of May 1830, the daughter of a serving-maid, Marianne Michel, and the son of the house, Étienne Charles Demahis. She was brought up by her father's parents, and received a liberal education. After her grandfather's death in 1850 she was trained to teach, but her refusal to acknowledge Napoleon III. prevented her from serving in a state school. She found her way in 1866 to a school in the Montmartre quarter of Paris, where she threw herself ardently into works of charity and revolutionary politics. She became violently anti-Bonapartist, and is said to have meditated the assassination of Napoleon. During the siege of Paris she joined the ambulance service, and untiringly preached resistance to the Prussians. On the establishment of the Commune she joined the National Guard. She offered to shoot Thiers, and suggested the destruction of Paris by way of vengeance for its surrender. She was with the Communards who made their last stand in the cemetery of Montmartre, and was closely allied with Théodore Ferré, who was executed in November 1871. This ardent attachment was perhaps one of the sources of the exaltation which marked her career, and gave many handles to her enemies. When she was brought before the 6th council of war in December 1871 she defied her judges and defended the Commune. She was sent as a convict to New Caledonia, among her companions being Henri Rochefort, who remained her friend till the day of her death. The amnesty of 1880 found her revolutionary ardour unchanged. She travelled throughout France, preaching revolution, and in 1883 she led a Paris mob which pillaged a baker's shop. For this she was condemned to six years' imprisonment, but was released in 1886, at the same time as Prince Kropotkin and other prominent anarchists. After a short period of freedom she was again arrested for making inflammatory speeches. She was soon liberated, but, hearing that her enemies hoped to intern her in a lunatic asylum, she fled to England. She returned to France in 1895, and in 1902 was back in London. She was touring France and lecturing on behalf of anarchist propaganda when she died at Marseilles on the 10th of January 1905.

Her *Mémoires* (Paris, 1886) contain accounts of her trials. See also *La Bonne Louise* (Paris, 1906), by E. Girault.

MICHEL, FRANCISQUE XAVIER (1809–1887), French antiquary, was born at Lyons on the 18th of January 1809. He became known for his editions of French works of the middle ages, and the French Government, recognizing their value, sent him to England (1833) and Scotland (1837) to continue his researches there. In 1839 he was appointed professor of foreign literature in the *Faculté des lettres* at Bordeaux. Between 1834 and 1842 he published editions of a large number of works written between the eleventh and fourteenth centuries in French, English and Saxon, including the *Roman de la rose* and the *Chanson de Roland*. Subsequently he published French translations of Goldsmith, Sterne, Shakespeare and Tennyson. He died in Paris on the 18th of May 1887.

His original works include *Histoire des races maudites de la France et de l'Espagne* (1847); *Recherches sur le commerce pendant le moyen âge* (1852–1854); *Les Écossais en France et les français en Écosse* (1862); *Études de philologie comparée sur l'argot* (1856); *Le Pays basque* (1857); *Histoire du commerce et de la navigation à Bordeaux* (1867–1871); and, in conjunction with Edouard Fournier, *Histoire des hôtelleries, cabarets, hôtels garnis* (1851–1854).

MICHELANGELO (MICHELAGNIOLO BUONARROTI) (1475–1564), the most famous of the great Florentine artists of the Renaissance, was the son of Ludovico Buonarroti, a poor gentleman of that city, and of his wife Francesca dei Neri. The Buonarroti Simoni were an old and pure Florentine stock of the Guelf faction: in the days of Michelangelo's fame a connexion of the family with the counts of Canossa was imagined and admitted on both sides, but has no foundation in fact. Ludovico was barely able to live on the income of his estate, but made it his boast that he had never stooped to add to it by mercantile or mechanical pursuits. The favour of the Medici procured him temporary employment in minor offices of state, among them that of podestà or resident magistrate for six months, from the autumn of 1474, at Castello di Chiusi and Caprese in the Casentino. At Caprese, on the 6th of March 1475, his second son Michelagniolo or Michelangelo was born. Immediately afterwards the family returned to Florence, and the child was put to nurse with a marble-worker's wife of Settignano. His mother's health had already, it would seem, begun to fail; at all events in a few years from this time, after she had borne her husband three more sons, she died. While still a young boy Michelangelo determined, in spite of his father's opposition, to be an artist. He had sucked in the passion, as he himself used to say, with his foster-mother's milk. After a sharp struggle his stubborn will overcome his father's pride of gentility, and at thirteen he got himself articled as a paid assistant in the workshop of the brothers Ghirlandaio Domenico Ghirlandaio, bred a jeweller, had become by this time the foremost painter of Florence. In his service the young Michelangelo laid the foundations of that skill in fresco with which twenty years afterwards he confounded his detractors at Rome. He studied also, like all the Florentine artists of that age, in the Brancacci chapel, where the frescoes of Masaccio, painted some sixty years before, still victoriously held their own; and here, in reply, to a taunt he had flung at a fellow-student, Torrigiano, he received the blow on the nose which disfigured him to his dying day.

Though Michelangelo's earliest studies were directed towards painting, he was by nature and predilection much more inclined to sculpture. In that art he presently received encouragement and training under the eye of an illustrious patron, Lorenzo dei Medici. On the recommendation, it is said, of Ghirlandaio, he was transferred, before the term of his apprenticeship as a painter had expired, to the school of sculpture established by Lorenzo in the Medici gardens. Here he could learn to match himself against his great predecessor, Donatello, one of whose pupils and assistants, the aged Bertoldo, was director of the school, and to compare the works of that master and his Tuscan contemporaries with the antiques collected for the instruction of the scholars. Here, too, he could listen to discourses on Platonism, and steep himself in the doctrines of an enthusiastic philosophy which sought to reconcile with Christian faith the lore and the doctrines of the Academy. Michelangelo remained a Christian Platonist to the end of his days; he was also from his youth up a devoted student of Dante. His powers of mind and hand soon attracted attention, and secured him the regard and favour of his patrons in spite of his rugged exterior and scornful unsociable temper.

Michelangelo had been attached to the school and household of the Medici for barely three years when, in 1492, his great patron Lorenzo died. Lorenzo's son Piero dei Medici inherited the position but not the qualities of his father; Florence soon chafed under his authority; and towards the autumn of 1494 it became apparent that disaster was impending over him and his adherents. Michelangelo was constitutionally subject to dark and sudden presentiments: one such seized him now, and without awaiting the popular outbreak, which soon followed, he took horse with two companions and fled to Bologna. There, being now in his twentieth year, he was received with kindness by a member of the Aldovrandi family, on whose commission he executed two figures of saints and one of an angel for the shrine of St Dominic in the church of St Petronius. After about a year, work at Bologna failing, and his name having been included in his absence on the list of artists appointed to provide a new hall of assembly for the great council of Florence, Michelangelo returned home. The strange theocracy established by Savonarola was now in force, and the whole character of civic life at Florence was for the time being changed. The influence of the fervent Dominican upon the mind and character of the young Michelangelo became as profound as that of the Platonists and of Dante. He was not left without employment. He found a friend in another Lorenzo, the son of Pierfrancesco dei Medici, for whom he at this time executed a statue of the boy St John. Having also carved a recumbent Cupid in imitation of the antique, it was suggested to him by the same patron that it should be so tinted and treated as to look like a real antique, and sold accordingly. Without increasing the price he put upon the work, Michelangelo for amusement lent himself to the counterfeit, and the piece was then actually sold for a large sum, as a genuine work of antiquity, to a Roman collector, Raffaelle Riario, cardinal di San Giorgio; the dealer appropriating the profits. When the cardinal discovered the fraud he caused the dealer to refund; but as to Michelangelo himself, it was represented to the young sculptor that if he went to Rome the amateur who had just involuntarily paid so high a tribute to his skill would certainly befriend him. He set forth accordingly, and arrived at Rome for the first time at the end of June 1496. Such hopes as he may have entertained of countenance from the cardinal di San Giorgio were quickly dispelled. Neither did the banished Piero dei Medici, who also was now living at Rome, do anything to help him. On the other hand Michelangelo won the favour of a Roman nobleman, Jacopo Galli, and through him of the French cardinal Jean de Villiers de la Grolaie, abbot of St Denis. From the former he received a commission for a "Cupid" and a "Bacchus," from the latter for a "Pietà" or "Mary lamenting over the body of Christ"—works of which the two last named only are preserved. Equal originality of conception and magnificence of technical execution mark the two contrasted subjects—one as noble and the other as nearly ignoble as anything Michelangelo ever did—of the mother with the dead son on her lap, indicating with a contained but eloquent gesture of her left hand a tragedy too great for outcries, and the titubant sensual young wine-god (a condition in which ancient art would never have exhibited the god himself, but only his satellites).

Michelangelo's stay in Rome at this time lasted five years—from the summer of 1496 till that of 1501. The interval had been one of extreme political distraction at Florence. The excitement of the French invasion, the mystic and ascetic regimen of Savonarola, the reaction which led to his overthrow, and finally the external wars and internal dissidences which preceded a new settlement, had all created an atmosphere most unfavourable to art. Nevertheless Ludovico Buonarroti, who in the troubles of 1494 had lost a small permanent appointment he held in the customs, and had come to regard his son Michelangelo as the mainstay of his house, had been repeatedly urging him to come home. A spirit of family duty and family pride was the ruling principle in all Michelangelo's conduct. During the best years of his life he submitted himself sternly and without a murmur to pinching hardship and almost superhuman labour for the sake of his father and brothers, who were ever selfishly ready to be fed and helped by him. Having now, after an illness, come home in 1501, Michelangelo was requested by the cardinal Francesco Piccolomini to adorn with a number of sculptured figures a shrine already begun in the cathedral of Siena in honour of the most distinguished member of his house, Pope Pius II. Four only of these figures were ever executed, and those not apparently, or only in small part, by the master's hand. A work of greater interest in Florence itself had diverted him from his engagement to his Sienese patrons. This was the execution of the famous colossal statue of David, popularly known as "the Giant." It was carved out of a huge block of marble on which another sculptor, Agostino d'Antonio, had begun unsuccessfully to work forty years before, and which had been lying idle ever since. Michelangelo had here a difficult problem before him. Without much regard to the traditional treatment of the subject or the historical character of his hero, he carved out of the vast but cramped mass of material an adolescent, frowning colossus, tensely watchful and self-balanced in preparation for his great action. The result amazed every beholder by its freedom and science of execution and its victorious energy of expression. All the best artists of Florence were called in council to determine on what site it should be set up, and after much debate the terrace of the palace of the Signory was chosen, in preference to the neighbouring Loggia dei Lanzi. Here accordingly the colossal "David" of Michelangelo took, in the month of May 1504, the place which it continued to hold until in 1882 it was removed for the sake of protection to a hall in the Academy of Fine Arts, where it inevitably looks crushed and cabined. Other works of sculpture belong to the same period: among them a second "David," in bronze and on a smaller scale, commissioned by the maréchal Pierre Rohan and left by the young master to be finished by Benedetto da Rovezzano, who despatched it to France in 1508; a great rough-hewn "St Matthew" begun but never completed for the cathedral of Florence; a "Madonna and Child" executed on the commission of a merchant of Bruges; and two unfinished bas-reliefs of the same subject.

Neither was Michelangelo idle at the same time as a painter. Leaving disputed works for the moment out of sight, he in these days at any rate painted for his and Raphael's common patron, Angelo Doni, the "Holy Family" now in the Uffizi at Florence. In the autumn of 1504, the year of the completion of the "David," he received from the Florentine state a commission for a work of monumental painting on a heroic scale. Leonardo da Vinci had been for some months engaged on his great cartoon of the "Battle of Anghiari," to be painted on the wall of the great hall of the municipal council. The gonfaloniere Piero Soderini now procured for Michelangelo the commission to design a companion work. Michelangelo chose an incident at the battle of Cascina during the Pisan war of 1364, when the Florentine soldiery had been surprised by the enemy in the act of bathing. He dashed at the task with his accustomed fiery energy, and had carried a great part of the cartoon to completion when, in the early spring of 1505, he broke off the work in order to obey a call to Rome which reached him from Pope Julius II. His unfinished cartoon, in its power over the varieties and contrasts of energetic and vitally significant action, showed how greatly Michelangelo had profited by the example of his elder rival, Leonardo, little as, personally, he yielded to Leonardo's charm or could bring himself to respond to his courtesy. The work of Michelangelo's youth is for the most part comparatively tranquil in character. His early sculpture, showing a degree of science and perfection unequalled since the antique, has also something of the antique serenity. It bears strongly the stamp of intellectual research, but not by any means that of storm or strain. In the cartoon of the "Bathers" the qualities afterwards proverbially associated with Michelangelo—his *furia*, his *terribilità*, the tempest and hurricane of the spirit which accompanied his unequalled technical mastery and knowledge—first found expression.

With Michelangelo's departure to Rome early in 1505 the first part of his artistic career may be said to end. It will be convenient here to recapitulate its principal results in sculpture and painting, both those preserved and those recorded but lost.

Sculpture.—*Florence, 1489–1494.*—"Head of a Faun," marble; lost. Condivi describes Michelangelo's first essay in sculpture as a head of an aged faun with a front tooth knocked out, this latter point having been an afterthought suggested by Lorenzo dei Medici. The head is sometimes identified with one in the National Museum at Florence, which however bears no marks of Michelangelo's early style and is in all probability spurious.—"Madonna seated on a Step," bronze; Casa Buonarroti, Florence. This bas-relief, executed in imitation of the technical style of Donatello, is a genuine example of Michelangelo's early work in the Medicean school under Bertoldo.—"Centauromachia," marble; Casa Buonarroti. A fine and genuine work in full relief, of probably somewhat later date than the last-mentioned. The subject occurs often in ancient sarcophagus reliefs: Michelangelo has followed the antique in his conception and treatment of the nude, but the arrangement of the subject is his own.

Bologna, 1494–1495.—Statuettes of "St Petronius," "St Proculus," and a "Kneeling Angel," marble; part of the decorations of the shrine of St Dominic in the church of that saint at Bologna: the style of all three much influenced by the work of Jacopo della Quercia in the same church; the attitude of the kneeling angel with the candelabrum imitated from an ancient bas-relief.

Florence, 1495–1496.—"St John in the Wilderness," executed for Lorenzo di Pierfrancesco dei Medici, marble; probably lost. Declared in 1874 to have been found again in the possession of Count Gualandi-Rossalmini at Pisa. Vehement and prolonged discussion arose as to the authenticity of this newly-found S. Giovannino, and at last it was bought for the Berlin Museum, where its genuineness is still stoutly maintained. But the finicking and affected elegance of the conception denote a different temperament from Michelangelo's and probably a later date. With this figure must be given up also the restoration of an antique group of "Bacchus and Ampelus" at the Uffizi, which is clearly by the same hand and is claimed also as an early work of Michelangelo.—"Recumbent Cupid," bought by the cardinal San Giorgio as an antique, marble; lost. The attempts to recognize it in certain extant copies or servile imitations of the antique, especially one now at Turin, must be held mistaken.

Rome, 1495–1501.—"Virgin lamenting the dead Christ," commissioned by the abbot de la Grolaie; marble, St Peter's, Rome.—"Bacchus and young Faun," commissioned by Jacopo Galli; marble, National Museum, Florence. (Of these two masterpieces of Michelangelo's youth enough has been said above).—"Cupid," commissioned by the abbot de la Grolaie; marble; lost; has been commonly identified as the "Kneeling Cupid" of the Victoria and Albert Museum, but this, if by Michelangelo at all, which is not quite certain, must in all likelihood belong to a later time.

Florence, 1501–1506.—"Five Saints, in niches decorating the shrine of Pius II.," commissioned by the Piccolomini family; marble; cathedral of Siena. The contract for the sculptured decoration of this shrine was one of those which the pressure of other work prevented the artist from ever taking seriously in hand. Of the five saints in niches, traditionally reputed to be his work, the St Peter alone shows any clear marks of his style; the other four were probably designed, and certainly carried out, by weaker hands.—"David" (the "Gigante"), commissioned for the city of Florence by Piero Soderini; marble; Florence Academy. Besides what has been said above, it has only to be added that a wax model in the Casa Buonarroti, showing nearly the same design with a different movement of the legs, is probably Michelangelo's original sketch for the subject. "David," commissioned by Pierre Rohan; bronze, lost; a clay model in the National Museum, Florence, may probably be a sketch for it; more than one bronze has been brought forward with claims to be the original, but none has stood the test of criticism. "Virgin and Child," commissioned for Taddeo Taddei; circular relief, unfinished, marble; London, Royal Academy. The motive of the Christ-child frightened by the flutterings of the bird held out by St John is the most playful in all Michelangelo's work; the whole design shows the influence of Leonardo in his gentler, as much as the cartoon of the "Bathers" shows it in his more violent, moods. "Virgin and Child with St John," commissioned by Bartolommeo Pitti; nearly circular relief, unfinished, marble; Florence, National Museum: a more tranquil and very charming presentment. "Madonna and Child," sold to the Mouscron family of Bruges (known in Italy as Moscheroni), and by them presented to the church of Notre Dame in that city; group in the round, marble; church of Notre Dame, Bruges. A meditative seated Virgin with upright head, the naked child seated between her knees, his smoothly rounded form in strong contrast with her complicated draperies. "St Matthew": one of a set of twelve statues of Apostles commissioned by the consuls of the Arte della Lana for the cathedral at Florence; marble; National Museum, Florence. Unfinished (only roughly blocked out), the other figures of the set never having been so much as begun; the contract was signed in 1503 and cancelled in 1505. There is an early drawing by Raphael from this statue.

Painting.—"Holy Family," painted for Angelo Doni; tempera, circular: Florence, Uffizi. The only perfectly well-attested panel painting of Michelangelo which exists. His love of restless and somewhat strained actions is illustrated by the gesture of the Madonna, who kneels on the ground holding up the child on her right shoulder; his love of the nude by the introduction (wherein he follows Luca Signorelli) of some otherwise purposeless undraped figures in the background. "Virgin and Child with Four Angels"; tempera; National Gallery, London. This unfinished painting, strongly marked by the influence of Michelangelo in his work at this period, has been confidently claimed for him, but lacks his strength and mastery, and is far more probably the work of his imitator and intimate associate, Francesco Granacci. "Cartoon of the Bathers"; lost and utterly perished. The only authentic records of it are contained in a few early engravings by Marcantonio and Agostino Veneziano and a certain number of sketches and studies by the master himself, chiefly at the Albertina, Vienna, the British Museum and the University Galleries, Oxford. An elaborate drawing of many figures at Holkham Hall, well known and often engraved, seems to be a later *cento* destitute of real authority.

Michelangelo had not been long in Rome before Pope Julius devised fit employment for him. That capacious and headstrong spirit, on fire with great enterprises, had conceived the idea of a sepulchral monument to commemorate his glory when he should be dead, and to be executed according to his own plans while he was still living. He entrusted this congenial task to Michelangelo. The design being approved, the artist spent the winter of 1505–1506 at the quarries of Carrara, superintending the excavation and shipment of the necessary marbles. In the spring he returned to Rome, and when the marbles arrived fell to with all his energy at the preparations for the work. For a while the pope followed their progress eagerly, and was all kindness to the young sculptor. But presently his disposition changed. In Michelangelo's absence an artist who was no friend of his, Bramante of Urbino, had been selected by Julius to carry out a new architectural scheme, commensurate with the usual vastness of his conceptions, viz. the rebuilding of St Peter's church. To the influence and the malice of Bramante Michelangelo attributed the unwelcome invitation he now received to interrupt the great work of sculpture which he had just begun in order to decorate the Sixtine chapel with frescoes. Soon, however, schemes of war and conquest interposed to divert the thoughts of Julius, not from the progress of his own monument merely, but from artistic enterprises altogether. One day Michelangelo heard him say at table to his jeweller that he meant to spend no more money on pebbles, either small or great. To add to the artist's discomfiture, when he went to apply in person for payments due, he was first put off from day to day, and at last actually with scant courtesy dismissed. At this his dark mood got the mastery of him. Convinced that not his employment only but his life was threatened, he suddenly took horse and left Rome, and before the messengers of the pope could overtake him was safe on Florentine territory. Michelangelo's flight took place in April 1506. Once among his own people, he turned a deaf ear to all overtures made from Rome for his return, and stayed throughout the summer at Florence, how occupied we are not distinctly informed, but apparently, among other things, on the continuation of his great battle cartoon.

During the same summer Julius planned and executed the victorious military campaign which ended with his unopposed entry at the head of his army into Bologna. Thither, under strict safe-conduct and promises of renewed favour, Michelangelo was at last persuaded to betake himself. Julius received the truant artist kindly, as indeed between these two volcanic natures there existed a natural affinity, and ordered of him his own colossal likeness in bronze, to be set up, as a symbol of his conquering authority, over the principal entrance of the church of St Petronius. For the next fifteen months Michelangelo devoted his whole strength to this new task. The price at which he undertook it left him, as it turned out, hardly any margin to subsist on. Moreover in the technical art of metal casting he was inexperienced, and an assistant whom he had summoned from Florence proved insubordinate and had to be dismissed. Nevertheless his genius prevailed over every hardship and difficulty, and on the 21st of February 1508 the majestic bronze colossus of the seated pope, robed and mitred, with one hand grasping the keys and the other extended in a gesture of benediction and command, was duly raised to its station over the church porch. Three years later it was destroyed in a revolution. The people of Bologna rose against the authority of Julius; his delegates and partisans were cast out, and his effigy hurled from its place. The work of Michelangelo, after being trailed in derision through the streets, was broken up and its fragments cast into the furnace.

Meanwhile the artist himself, as soon as his work was done, had followed his reconciled master back to Rome. The task that here awaited him, however, was after all not the resumption of the papal monument, but the execution of the series of paintings in the Sixtine chapel which had been mooted before his departure. Painting, he always averred, was not his business; he was aware of his enemy's hopes that a great enterprise in fresco-painting would prove beyond his powers; and he entered with misgiving and reluctance upon his new undertaking. Destiny, however, so ruled that the work thus thrust upon him remains his chief title to glory. His history is one of indomitable will and almost superhuman energy, yet of will that hardly ever had its way, and of energy continually at war with circumstance. The only work which in all his life he was able to complete as he had conceived it was this of the decoration of the Sixtine ceiling. The pope had at first desired a scheme including figures of the twelve apostles only. Michelangelo began accordingly, but could rest content with nought so meagre, and soon proposed instead a design of many hundred figures embodying the story of Genesis from the Creation to the Flood, with accessory personages of prophets and sibyls dreaming on the new dispensation to come, and, in addition, those of the forefathers of Christ. The whole was to be enclosed and divided by an elaborate framework of painted architecture, with a multitude of nameless human shapes supporting its several members or reposing among them—shapes mediating, as it were, between the features of the inanimate framework and those of the great dramatic and prophetic scenes themselves. The pope bade the artist do as he pleased. By May 1508 the preparations in the chapel had been completed and the work begun. Later in the same year Michelangelo summoned a number of assistant painters from Florence. Trained in the traditions of the earlier Florentine school, they were unable, it seems, to interpret Michelangelo's designs in fresco either with sufficient freedom or sufficient uniformity of style to satisfy him. At any rate he soon dismissed them, and carried out the remainder of his colossal task alone, except for the necessary amount of purely mechanical and subordinate help. The physical conditions of prolonged work, face upwards, upon this vast expanse of ceiling were adverse and trying in the extreme. After four and a half years of toil the task was accomplished. Michelangelo had during its progress been harassed alike by delays of payment and by hostile intrigue, his ill-wishers casting doubts on his capacity, and vaunting the superior powers of Raphael. That gentle spirit would by nature have been no man's enemy, but unluckily Michelangelo's moody, self-concentrated temper prevented the two artists being on terms of amity such as might have stopped the mouths of mischief-makers. Absolute need of funds for the furtherance of the undertaking constrained him at one moment to break off work and pursue his inconsiderate patron as far as Bologna. This was between September 1510, by which time the whole of the great series of subjects along the centre of the vault were completed, and January 1511, when the master set to work again and began filling the complicated lateral spaces of his decorative scheme.

The main field of the Sixtine ceiling—in form a depressed barrel vault—is divided in Michelangelo's scheme into four larger, alternating with five smaller fields. The following is the order of the subjects depicted in them: (1) the dividing of the light from the darkness; (2) the creation of sun, moon and stars; (3) the creation of the waters; (4) the creation of man; (5) the creation of woman; (6) the temptation and expulsion; (7) the sacrifice of Noah; (8) the deluge; (9) the drunkenness of Noah. The figures in the last three of these scenes are on a smaller scale than those in the first six. In numbers 1, 3, 5, 7 and 9 the field of the picture is reduced by the encroachments of the architectural framework with its seated pairs of supporters, commonly known as "Slaves" or "Atlases." Flanking these smaller compositions, along the lateral spaces between the crown of the vault and the walls on either side, are seated figures of prophets and sibyls alternately; two other prophets are introduced at each extremity of the series—making seven prophets and five sibyls in all. In the triangles to right and left of the prophets at the two extremities are the death of Goliath, the death of Holofernes, the brazen serpent and the punishment of Haman. In the twelve lunettes above the windows are groups of the ancestors of Christ, their names designated by inscriptions, and in the twelve triangles above them (between the prophets and sibyls) other kindred groups crouched or sitting. These last are all shown in relatively simple human actions and household relations, heightened but not falsified by the artist's genius, and rising into majestic significance from roots deep in daily human nature. The work represents all the powers of Michelangelo at their best. Disdaining all the accessory allurements of the painter's art, he has concentrated himself upon the exclusive delineation of the human form and face at their highest power. His imagination has conceived, and his knowledge and certainty of hand have enabled him to realize, attitudes and combinations of unmatched variety and grandeur, and countenances of unmatched expressiveness and power. But he has not trusted, as he came later to trust, to science and acquired knowledge merely; neither do his personages, so far as they did afterwards, transcend human possibility or leave the facts of actual life behind them. The profoundest knowledge and the most searching realism serve to embody all this inspiration and sustain all this sublimity; the sublimity, moreover is combined with the noblest elements of grace and even of tenderness. As for the intellectual meanings of his vast design, over and above those which reveal themselves at a first glance or by a bare description, they are from the nature of the case inexhaustible, and can never be perfectly defined. Whatever the soul of this great Florentine, the spiritual heir of Dante, with the Christianity of the middle ages not shaken in his mind, but expanded and transcendentalized, by the knowledge and love of Plato;—whatever the soul of such a man, full of suppressed tenderness and righteous indignation, and of anxious questionings of coming fate could conceive—that Michelangelo has expressed or shadowed forth in this great and significant scheme of paintings. The powers of the artist seem to have expanded with the progress of his work. He seems to have begun (as the spectator entering the chapel has to begin) with what is chronologically the last subject of the series, the drunkenness of Noah, and to have worked backwards, increasing the scale of his figures for their better effect from the fourth subject (the Temptation and Expulsion), and rising in ascending scale of majesty through the successive acts of creation from the last to the first.

The Sixtine chapel was no sooner completed than Michelangelo resumed work upon the marbles for the monument of Julius. But four months only had passed when Julius died. His heirs immediately entered (in the summer of 1513) into a new contract with Michelangelo for the execution of the monument on a reduced scale. What the precise nature and extent of the original design had been we do not know, only that the monument was to be detached from the wall, and to stand four-square and free—a thing hitherto unknown in Renaissance sepulchral architecture—in one of the chapels of St Peter's. But the new design was extensive and magnificent enough. It was to consist of a great three-sided structure, two courses high, projecting from the church wall, and decorated on its three unattached sides with statues. On the upper course was to be placed the colossal recumbent figures of the pope, with a vision of the Virgin and Child above him, angels mourning at the sides, and prophetic and allegoric personages at the angles—sixteen figures in all. The lower course was to be enriched with twenty-four figures in niches and on projecting pedestals: in the niches, Victories; in front of terminal pilasters between them, slaves or captives denoting, it would seem, either conquered provinces or arts and sciences in bondage after their patron's death. A much injured and not indisputable sketch by the master at Berlin, with a copy of the same by Sacchetti, are supposed to show the design at this stage of its reduction. The entire work was to be completed in nine years' time. During the next three years, it would seem, Michelangelo brought to completion three at least of the promised figures, for which the blocks had reached Rome from Carrara as early as July 1508; and they are among the most famous of all existing works of the sculptor's art—namely, the "Moses," now in the church of S. Pietro in Vincoli at Rome and the two "Slaves" at the Louvre.

The "Moses," originally intended for one of the angles of the upper course, is now placed at the level of the eye, in the centre of the principal face of the monument as it was at last finished, on a deplorably reduced and altered scale, by Michelangelo and his assistants in his old age. The prophet, supposed to have just come down from Mount Sinai and found the Israelites worshipping the golden calf, sits, heavily bearded and draped, with only his right arm bare, his left foot drawn back, his head raised and turned to the left, his left hand laid on his lap and his right grasping the tables of the law—an incarnation of majestic indignation and menace. The work, except in one or two places, is of the utmost finish, and the statue looks like one of the prophets of the Sixtine ceiling done in marble. The "Slaves" at the Louvre are youthful male figures of equally perfect execution, nude but for the band which passes over the breast of one and the right leg of the other. One, with his left hand raised to his head and his right pressed to his bosom, his eyes almost closed, seems succumbing to the agonies of death; the other, with his arms bound behind his back, looks upward still hopelessly struggling. All three of these figures were finished between 1513 and 1516.

By 1516 Michelangelo's evil star was again in the ascendant. Julius II. had been succeeded on the papal throne by Cardinal Giovanni de' Medici under the title of Leo X. The Medici, too, had about the same time by force and fraud re-established their sway in Florence, overthrowing the free institutions that had prevailed there since the days of Savonarola. Now, on the one hand, this family were the hereditary friends and patrons of Michelangelo; on the other hand he was a patriotic son of republican Florence; so that henceforward his personal allegiance and his political sympathies were in conflict. Over much of his art, as has been thought, the pain and perplexity of this conflict have cast their shadow. For the present the consequence to him of the rise to power of the Medici was a fresh interruption of his cherished work on the tomb of Julius. Leo X. and his kinsmen were full of a vast new scheme for the enrichment and adornment of the façade of their own family church of San Lorenzo in Florence. Michelangelo, carried away by the idea and forgetful of his other still great and onerous task, offered his services for the new façade. They were eagerly accepted, although for a moment the idea had been entertained of entrusting the work to Leonardo da Vinci. The heirs of Julius on their part showed an accommodating temper, and at the request of Leo allowed their three-years'-old contract to be cancelled in favour of another, whereby the scale and sculptured decorations of the Julian monument were again to be reduced by nearly a half. Michelangelo soon produced for the San Lorenzo façade a design of combined sculpture and architecture as splendid and ambitious in its way as had been that for the original monument of Julius. The contract was signed in January 1518, and the artist went to Carrara to superintend the excavation of the marbles.

Michelangelo was now in his forty-fourth year. Though half his life was yet to come, yet its best days had, as it proved, been spent. All the hindrances which he had encountered hitherto were as nothing to those which began to beset him now. For the supply of materials for the façade of San Lorenzo he had set a firm of masons to work, and had himself, it seems, entered into a kind of partnership with them, at Carrara, where he knew the quarries well, and where the industry was hereditary and well understood. When all was well in progress there under his own eye, reasons of state induced the Medici and the Florentine magistracy to bid him resort instead to certain new quarries at Pietrasanta, near Serravalle in the territory of Florence. Hither, to the disgust of his old clients at Carrara and to his own, Michelangelo accordingly had to transfer the scene of his labours. Presently he found himself so impeded and enraged by the mechanical difficulties of raising and transporting the marbles, and by the disloyalty and incompetence of those with whom he had to deal, that he was fain to throw up the commission altogether. The contracts for the façade of San Lorenzo were rescinded in March 1518, and the whole magnificent scheme came to nothing. Michelangelo then returned to Florence, where proposals of work poured in on him from many quarters. The king of France desired something from his hand to place beside the two pictures he possessed by Raphael. The authorities of Bologna wanted him to design a façade for their church of St Petronius; those of Genoa to cast a statue in bronze of their great commander, Andrea Doria. Cardinal Grimani begged hard for any picture or statue he might have to spare; other amateurs importuned him for so much as a pencil drawing or sketch. Lastly his friend and partisan Sebastian del Piombo at Rome, ever eager to keep up the feud between the followers of Michelangelo and those of Raphael, besought him on Raphael's death to return at once to Rome, and take out of the hands of the dead master's pupils the work of painting still remaining to be done in the Vatican chambers. Michelangelo complied with none of these requests. All that we certainly know of his doing between 1518 and 1522 is the blocking out in the rough of four more of the "Slaves" for the tomb of Julius, and carrying out a commission, which he had received from three citizens of Rome as early as 1514, for a statue of the risen Christ. The roughed-out "Slaves" now stand immured in a grotto in the Boboli Gardens, Florence; the Christ, practically finished by the master but with the last touches added by pupils, stands in the church, for which it was destined, of Sta Maria sopra Minerva at Rome; there is little in it either of devotional spirit or imaginative power, although, in those parts which Michelangelo himself finished, there is extreme accomplishment of design and workmanship.

The next twelve years of Michelangelo's life (1522–1534) were spent at Florence, and again employed principally in the service of his capricious and uncongenial patrons—the Medici. The plan of a great group of monuments to deceased members of this family, to be set up in a new sacristy or mortuary chapel in San Lorenzo, was first broached to Michelangelo in 1520 by Cardinal Giulio de' Medici. No practical impulse, however was given to the work until Giulio, after the death of Leo X and the brief pontificate of the puritanical and iconoclastic Adrian VI., had in his turn become pope in 1523 under the title of Clement VII. Even then the impulse was a wavering one. First Clement proposed to associate another artist Sansovino, with Michelangelo in his task. This proposal being on Michelangelo's peremptory demand abandoned, Clement next distracted the artist with an order for a new architectural design—that, namely, for the proposed Medicean or "Laurentian" library. When at last after many changes of scope and scheme the plans for the sepulchral chapel or "Sagrestìa nuova" took shape, they did not include, as had been at first intended memorials to the founders of the house's greatness, Cosimo (*pater patriae*) and Lorenzo the Magnificent, or even to Pope Leo X. himself, but only to two younger members of the house lately deceased, Giuliano, duke of Nemours, and Lorenzo duke of Urbino. Michelangelo brooded long over various designs for this work, and was still engaged on its execution—his time being partly also taken up by the building-plans for the Medicean library—when political revolutions interposed to divert his industry. In 1527 came to pass the sack of Rome by the Austrians, and the apparently irretrievable ruin of Pope Clement. The Florentines seized the occasion to expel the Medici from their city, and set up a free republican government once more. Naturally no more funds for the works in San Lorenzo were forthcoming, and Michelangelo, on the invitation of the new signory, occupied himself for a while with design for a group of Hercules and Cacus, and another of Samson and the Philistines—the latter to be wrought out of a block of marble which had been rough-hewn already for another purpose by Baccio Bandinelli. Soon, however, he was called to help in defending the city itself from danger. Clement and his enemy Charles V. having become reconciled, both alike were now bent on bringing Florence again under the rule of the Medici. In view of the approaching siege, Michelangelo was appointed engineer-in-chief of the fortifications. He spent the early summer of 1529 in strengthening the defences of San Miniato; from July to September he was absent on a diplomatic mission to Ferrara and Venice. Returning in the middle of the latter month, he found the cause of Florence hopeless from internal treachery and from the overwhelming strength of her enemies. One of his dark seizures overcame him, and he departed again suddenly for Venice. There for a while he remained, negotiating for a future residence in France. Then, while the siege was still in progress, he returned once more to Florence; but in the final death-struggle of her liberties he bore no part. When in 1530 the city submitted to her conquerors, no mercy was shown to most of those who had taken part in her defence. Michelangelo believed himself in danger with the rest, but on the intervention of Baccio Valori he was presently taken back into favour and employment by Pope Clement. For four years more he continued to work at intervals on the completion of the Medici monuments, with the help from 1532 of Giovanni Montorsoli and other pupils, and on the building of the Laurentian library. In 1531 he suffered a severe illness; in 1532 he made a long stay at Rome, and entered upon yet another contract for the completion of the Julian monument, to be reduced now to a still more shrunken scale and to be placed not in St Peter's but in the church of San Pietro in Vincoli. In the autumn of 1534 he left Florence for good. What remained to be done in the Medici chapel was done by pupils, and the chapel was not finally opened to view until 1545.

The statues of the Medici monument take rank beside the "Moses" and the "Slaves" as the finest work of Michelangelo's central time in sculpture. They consist of a Madonna and Child and of the two famous monumental groups, each composed of an armed and seated portrait-statue in a niche, with two emblematic figures reclining on each side of a sarcophagus below. The "Madonna and Child" (left unfinished because the marble was short in bulk) combines astonishingly the divers qualities of realistic motive and natural animation with learned complexity of design and imposing majesty of effect. It was set up finally—not at all in accordance with the artist's first intention—against a blank wall of the chapel, and flanked at wide intervals by statues of Sts Cosmo and Damian, the work of pupils. The portraits are treated not realistically but typically. In that of Lorenzo seems to be typified the mood of crafty brooding and concentrated inward thought; in that of Giuliano, the type of alert and confident practical survey immediately preceding action. To this contrast of the meditative and active characters corresponds a contrast in the emblematic groups accompanying the portraits. At the feet of the duke Giuliano recline the shapes of "Night" and "Day"—the former a female, the latter a male, personification; the former sunk in an attitude of deep but uneasy slumber, the latter (whose head and face are merely blocked out of the marble) lifting himself in one of wrathful and disturbed awakening. But for Michelangelo's unfailing grandeur of style, and for the sense which his works convey of a compulsive heat and tempest of thought and feeling in the spirit that thus conceived them, both these attitudes might be charged with extravagance. As grand, but far less violent, are those of the two companion figures that recline between sleep and waking on the sarcophagus of the pensive Lorenzo. Of these, the male figure is known as "Evening," the female as "Morning" (*Crepusculo* and *Aurora*). In Michelangelo's original idea, partly founded on antique precedent in pedimental and sarcophagus groups, figures of "Earth" and "Heaven" were to be associated with those of "Night" and "Day" on the monument of Giuliano, and others—no doubt of a corresponding nature, with those of the Morning and Evening Twilight on that of Lorenzo. These figures afterwards fell out of the scheme and the recesses designed for them remain empty. Michelangelo's obvious and fundamental idea was, as some words of his own record, to exhibit the elements and the powers of earth and heaven lamenting the death of the princes. River-gods were to recline on the broad bases at the foot of the monuments. These too are lacking. They were never finished, but a bronze cast from a small model of one of them, and the torso of a large model, have lately been identified, the former in the National Museum and the latter in the Academy at Florence.

Other works of 1522–1534.—"Victory" marble (National Museum, Florence). A youthful conqueror standing over a bearded enemy, whose shoulders he crushes down with his left knee. Fine and finished work: whether intended for one of the emblematic Victories of the Julian monument, or having some connexion with the "Hercules and Cacus" and "Samson and the Philistine," subjects undertaken for the Signory in 1528, must remain uncertain. For the former of these two subjects a wax model at the Victoria and Albert Museum, for the latter a plaster model at the Casa Buonarroti, are claimed, perhaps rightly, as original. "David" (formerly called "Apollo"), marble, unfinished (National Museum, Florence). Both the authenticity and the approximate date of this fine work are beyond doubt: of its origin and destination we are uninformed. "Crouching boy," marble, unfinished (the Hermitage, Petersburg). Another masterly sketch in marble; the seated lad stoops forward between his parted knees, having both hands occupied with his left foot; the figure blocked out of the marble, with the least possible sacrifice of the material; the subject and motive enigmatical. "Cupid," kneeling, apparently in the act of shooting downward with a bow, marble (Victoria and Albert Museum). Probably, but not quite certainly, authentic; if so, then of 1530 or thereabouts; its identification with the early Cupid done for Jacopo Galli at Rome in 1496 is untenable. "Leda," painting, done for the duke of Ferrara, but withheld because of the misconduct of his messenger, and given by the master to his pupil Antonio Mini in 1531; lost. A fine injured tempera painting of the subject in the store-rooms of the National Gallery in London may presumably be an early copy.

Michelangelo had fully purposed, as soon as he could get free of his task on the Medici tombs, to devote all his powers to the completion of the Julian monument in accordance with the new contract of 1532. But his intention was again frustrated. Pope Clement insisted that he must complete his decorations of the Sixtine Chapel by painting anew the great end wall above the altar, adorned until then by frescoes of Perugino. The subject chosen was the Last Judgment; and Michelangelo began to prepare sketches. In the autumn of 1534, in his sixtieth year, he settled finally, and for the remainder of his life, at Rome. Immediately afterwards Clement died, and was succeeded by a Farnese under the title of Paul III. Even more than his predecessor, Paul insisted on claiming the main services of Michelangelo for himself, and forced him to let all other engagements drift. For the first seven years after the artist's return to Rome, his time was principally taken up with the painting of the colossal and multitudinous "Last Judgment." This being completed in 1541, he was next compelled to undertake two more great frescoes—one of the Conversion of Paul and another of the Martyrdom of Peter—in a new chapel which the pope had caused to be built in the Vatican, and named after himself—Capella Paolina.

The fresco of the "Last Judgment" in the Sixtine Chapel is probably the most famous single picture in the world. In it Michelangelo shows more than ever the omnipotence of his artistic science, and the fiery daring of his conceptions. But the work, so far as its deplorably deteriorated condition admits comparison, is hardly comparable in the qualities of colour and decorative effect to the earlier and far more nobly inspired frescoes of the ceiling. It is to these and not to the "Last Judgment" that the student must turn if he would realize what is best and greatest in the art of Michelangelo.

The frescoes of the Pauline Chapel are on their part so injured as to be hardly susceptible of useful study or criticism. In their ruined state they bear evidence of the same tendencies that made the art of Michelangelo in its latest phase so dangerous an example to weaker men—the tendency, that is, to seek for unqualified energy and violence of action, both in place and out, for "terribleness" *quand même,* and to design actions not by help of direct study from nature, but by scientific deduction from the abstract laws of structure and movement. At best these frescoes can never have been happy examples of Michelangelo's art.

Other Work of the years 1534–1549. SCULPTURE.—During the fifteen years when Michelangelo was mainly engaged on these paintings, he had also at last been enabled to acquit himself, although in a manner that can have been satisfactory to none concerned, of his engagements to the heirs of Julius. Once more the influence of the pope had prevailed on them to accept a compromise altogether to their disadvantage. By a final contrast dated 1542, it was agreed that the "Moses" executed thirty years before, seated on a low plinth in a central recess, should be the chief figure of the new scheme; in niches at either side of him were to be standing figures of "Leah" and "Rachel." These Michelangelo himself executed hastily with the help of assistants. To pupils entirely was left the carrying out of the upper cornice, with the recumbent effigy of the pope occupying the centre of a weak and incongruous architectural scheme, a Madonna and Child in a niche above, and a prophet and a sibyl in recesses at either side. Meantime all idea of incorporating any of the "Slaves" in the new design had been abandoned. The master gave the two that had been finished in 1513–1516 to Robert Strozzi, who gave them to Francis I.; while the four that had been roughed out between 1518 and 1522 remained at Florence. "Brutus," marble (National Museum, Florence). Probably executed soon after 1539, in memory of the tyrannicide Lorenzino de' Medici. To the end of this period or to a year or two later belongs the infinitely pathetic unfinished sketch in marble of a life-size "*Pietà*" (Palazzo Rondini, Rome)—the mourning mother, standing on an elevation behind her son, holds his body upright in front of her by the shoulders. Still later, after 1550, is the more complicated and more finished group of the "*Pietà*," with the corpse of Christ collapsing in utter relaxation through the arms of those who try to uphold it: this Michelangelo destined for his own sepulchre; it stands now in the cathedral at Florence.

PAINTING.—"The Entombment of Christ" (National Gallery, London). This unfinished painting bears all the marks of Michelangelo's design, and must have been begun from a cartoon by him, probably of about 1535–1540. The touch of his own hand seems evident in some parts, particularly the body of Christ; other parts, in various degrees of incompletion, are apparently the work of various pupils or imitators.

For nearly all his great life-works mentioned above, preparatory sketches and studies by the master's hand exist. These, with a large number of other drawings, finished and unfinished, done for their own sakes and not for any ulterior use, are of infinite value and interest to the student. Michelangelo was the most learned and scientific as well as the most inspired and daring of draughtsmen, and from boyhood to extreme old age never ceased to practise with pen, chalk or pencil. He is said to have burned vast numbers of his drawings with his own hand and caused others to be burned by friends and pupils to whom he had given them; so that what we possess must be less than a tithe of what he executed. But there are some 250 genuine sheets—enough to let us follow and understand his modes of conceiving, preparing and maturing his designs at all periods of his life. They are scattered amongst various collections, chiefly public; those in England (at the British Museum, the University Galleries, Oxford, and the Royal Library, Windsor), are quite half the whole number; other important examples remain still at what was for centuries the home of his heirs, the Casa Buonarroti at Florence; others at the Uffizi, Florence; the Venice Academy; the Albertina, Vienna; the Louvre; the Condé Museum at Chantilly; the Berlin Museum; and, not least, the Teyler Museum at Haarlem. By means of these drawings and the many published facsimiles we are best able to trace the progress of the master's genius and its secrets. We see him diligently copying in youth from the frescoes of Giotto, Masaccio, and his own master Ghirlandaio. At this date his instrument was the pen only, used in a manner of hatching: sometimes extremely careful and close, at others fiercely bold and free, and in either case all his own. Sketches and studies thus drawn with the pen exist for the "David," the "Bathers Surprised," the accessory figures for the tomb of Julius as first conceived, and the great series of the Sixtine Chapel decorations. By, or even before, the date of the Sixtine Chapel, chalk, red or black, comes into use along with the pen, and many of the finest studies for the "Slaves" or "Atlases" and other decorative figures of the ceiling are in the latter material (many more studies are preserved for these subordinate figures than for the main compositions). After the Sixtine Chapel period the pen gives way to red or black chalk almost entirely. Sketches are rare for the great abortive scheme of the Julius monument; almost non-existent for the equally abortive San Lorenzo façade; fairly abundant for the various stages of the Medici monument scheme in its architectural parts, but not for the great figures. About the time of Michelangelo's final change of domicile from Florence to Rome (1532–1535) he began the practice of making highly finished and fully shaded drawings of classic or symbolic subjects in red or black chalk for presentation to his friends, especially to young Tommaso Cavalieri, the object of his passionate Platonic affection, from about 1532. The "Fall of Phaeton," the "Tityos," the "Ganymede," the "Men shooting at a Mark," are well-known examples; in this class of work the Windsor collection is far the richest. At the same time or soon afterwards, were produced drawings little less powerful and finished of Christian subjects, especially the "Crucifixion," "Entombment" and "Resurrection." Then comes the great fresco of the "Last Judgment," for which there exist both general sketches and particular studies. In the few extant drawings for the Cappella Paolina a faltering both of the imagination and of the hand become discernible. To the same or to still later years belong many beautiful but somewhat tentative drawings done either directly for, or nearly in the spirit of, the famous "Crucifixion" which he is recorded to have painted with so much devotion for Vittoria Colonna. About many of these, for all their intensity of feeling, there is a wavering touch betraying the approach of infirmity; so there is about many of the architectural studies done for the buildings of which he had charge in his last years at Rome; but signs of the old impressive power and penetration are not wanting in some even of the latest drawings that have come down to us.

During his later years the long-pent human elements of fervour and tenderness in Michelangelo's nature had found vent and utterance such as they had never found before. He had occasionally practised poetry in youth, and there are signs of some transient love-passages during his life at Bologna. But it was not until towards his sixtieth year that the springs of feeling were fairly opened in the heart of this solitary, this masterful and stern, life-wearied and labour-hardened man. About 1533–1534 we find him beginning to address impassioned sonnets—of which the sentiment is curiously comparable to that expressed in some of Shakespeare's—to a beautiful and gifted youth, the young Roman noble Tommaso Cavalieri. Soon afterwards he made the acquaintance of the pious, accomplished, and high-souled lady, Vittoria Colonna, widow of the Marquess Pescara. For ten years until her death, which happened in 1547, her friendship was the great solace of Michelangelo's life. On her, in all loyalty and reverence, he poured out all the treasures of his mind and all his imprisoned powers of tenderness and devotion. She was the chief inspirer of his poetry—of which, along with her praises, the main themes are the Christian religion, the joys of Platonic love, and the power and mysteries of art. Michelangelo's poetical style is strenuous and concentrated like the man. He wrote with labour and much self-correction; we seem to feel him flinging himself on the material of language with the same overwhelming energy and vehemence with which contemporaries describe him as flinging himself on the material of marble—the same impetuosity of temperament combined with the same fierce desire of perfection, but with far less either of innate instinct for the material or of trained mastery over its difficulties.

And so the mighty sculptor, painter, and poet reached old age. An infirmity which settled on him in 1544, and the death of Vittoria Colonna in 1547, left him broken in health and heart. But his strength held on for many a year longer yet. His father and brothers were dead, and his family sentiment concentrated itself on a nephew, Leonardo, to whom he showed unremitting practical kindness, coupled with his usual suspiciousness and fitfulness of temper. In almost all his relations the old man continued to the end to manifest the same loyal and righteous heart, accompanied by the same masterful, moody, and estranging temper, as in youth. Among the artists of the younger generation he held a position of absolute ascendancy and authority; nor was his example, as we have said, by any means altogether salutary for them. To artists, and to a certain number of chosen friends, belonging chiefly to the lettered, diplomatic, and secretarial classes, he was more accessible and affable than he had been to any one in earlier days, though still formidable in moods of scorn and scoffing. His great age and fame made him the most honoured citizen of Rome, to whom the highest, both of his fellow countrymen and foreigners, were eager to do homage. During the last years of his life he made but few more essays in sculpture, and those not successful, but was much employed in the fourth art in which he excelled—that of architecture. A succession of popes demanded his services for the embellishment of Rome. Between 1536 and 1546 he was engaged on plans for the rearrangement and reconstruction of the great group of buildings on the Capitol—plans which were only partially and imperfectly carried out during his lifetime and after his death. For Paul III. he finished the palace called after the name of the pope's family the Farnese. On the death of Antonio da San Gallo he succeeded to the onerous and coveted office of chief architect of St Peter's church, for which he remodelled all the designs, living to see some of the main features, including the supports and lower portion of the great central dome, carried out in spite of all obstacles, according to his plans. The dome as it stands is his most conspicuous and one of his noblest monuments: the body of the church was completed in a manner quite different from his devising. Other great architectural tasks on which he was engaged were the reconstruction of the Porta Pia, and the conversion of a portion of the baths of Diocletian into the church of Sta Maria degli Angeli; the great cloister with its hundred columns, now used as the Museo delle Terme, is the only part of this reconstruction which remains as he designed it. At length, in the midst of these vast schemes and responsibilities, the heroic old man's last remains of strength gave way. He died on the threshold of his ninetieth year, on the 18th of February 1564.

Authorities.—For the earlier bibliography of Michelangelo, which is extensive, see the useful though very imperfect compilation of Passerini, *Bibliografia di Michelangelo Buonarroti*, &c. (Florence, 1875). The most important works, taken in chronological order, are the following: P. Giovio, supplement to the fragmentary *Dialogus de viris litteris illustribus*, written soon after 1527, first published by Tiraboschi, *Storia della letteratura italiana* (Modena, 1871); G. Vasari, in *Vite degli più eccellenti architettori, pittori, e scultori*, &c. (Florence, 1550); A. Condivi, *Vita di Michelangelo Buonarroti* (1553); this account, for which the author, a pupil and friend of the master's, had long been collecting materials, was much fuller than that of Vasari, who made use of it in rewriting his own life of Michelangelo for his second edition, which appeared after the master's death (1568). The best edition of Vasari is that by Milanesi (Florence 1878–1883); of Condivi, that by Gori and Mariette (Pisa, 1746); for English readers there is a useful translation with notes, by Sir Charles Holroyd. The first additions of importance were published by Bottari, *Raccolta di lettere sulla pittura*, &c. (Rome, 1754; 2nd ed. by Ticozzi, Milan, 1822); the next by Gaye, *Carteggio inedito* (1840). Portions of the correspondence preserved in the Buonarroti archives were published by Guasti in his notes to the *Rime di Michelangelo Buonarroti* (1863), and by Daelli in *Carte Michelangelsche inedite* (Milan, 1865). Complete biographies of Michelangelo had been meanwhile attempted by J. Harford (London, 1857), and with more power by Hermann Grimm, *Leben Michelangelos* (Hanover, 5th ed., 1879). A great increment of biographical material was at length obtained by the publication, in the four-hundredth year after Michelangelo's birth, of the whole body of his letters preserved in the Buonarroti archives, *Lettere di Michelangelo Buonarroti*, ed. G. Milanesi (Florence, 1875). This material was first employed in a connected but too trivial narrative by A. Gotti, *Vita di Michelangelo* (Florence, 1875). Next followed C. Heath Wilson, *Life and Works of Michelangelo Buonarroti* (Florence, 1876), the technical remarks in which, especially as concerns the fresco paintings, are still valuable. Other lives of Michelangelo are by Anton Springer, in his *Michelangelo u. Raphael* (Leipzig, 1883); J. A. Symonds, *The Life of Michelangelo* (London, 1893), full of valuable matter on the history and spirit of Michelangelo's times, but not trustworthy in the criticism of his works; H. Mackowksy, *Michelagniolo* (Berlin, 1908), excellent in all respects, and in moderate compass; Emile Gebhardt, *Michel-Ange, sculpteur et peintre* (1808) is a handsome volume of reproductions with text. *Michelangelo*, by Fritz Knapp, in the *Klassiker der Kunst* series (Stuttgart, 1906) is a very useful compendium. For the early works of Michelangelo the standard authority is H. Wölfflin, *Die Jugendwerke Michelangelos* (Munich, 1891, and later editions), a masterly work, though at variance with Berlin official opinion. The most elaborate study of the Sixtine frescoes, magnificently illustrated, is by E. Steinmann, *Die Sixtinische Kapelle*, vol. ii. (Munich, 1905). Consult also C. Justi, *Michelangelo* (Leipzig, 1903), and with caution H. Thode, *Michelangelo u. das Ende der Renaissance* (Berlin, 1902–1903). Of the poems of Michelangelo the first sound edition is that already referred to, G. Guasti, *Rime di Michelangelo Buonarroti* (1863); in earlier editions the text had been recklessly tampered with, and the rugged individuality of the master's style smoothed down. An edition with German translations was published by Hasenclever (Leipzig, 1875); and a thorough critical edition by Karl Frey (Berlin, 1897); for the English student the translations by J. A. Symonds, in *Sonnets of Michelangelo and Campanella* (London, 1878) are invaluable. On the drawings of Michelangelo see especially B. Berenson, *The Drawings of Florentine Painters* (London, 1903). A comprehensive work on the same subject, in which the most important examples are reproduced and discussed, unfortunately not arranged chronologically, is Karl Frey, *Die Zeichnungen Michelangelos* (Berlin, 1908 seq.), still in progress. An elaborate life by the same author (Karl Frey, *Michelagniolo Buonarroti, sein Leben und seine Werke*) is also in progress, but is more to be prized for documentary fullness and accuracy than for critical insight.

(S. C.)

MICHELET, JULES (1798–1874), French historian, was born at Paris on the 21st of August 1798, of a family which had Huguenot traditions. His father was a master printer, not very prosperous, and the son at an early age assisted him in the actual work of the press. A place was offered him in the imperial printing office, but his father was able to send him to the famous Collège or Lycée Charlemagne, where he distinguished himself. He passed the university examination in 1821, and was shortly after appointed to a professorship of history in the Collège Rollin. Soon after this, in 1824, he married. The period of the restoration and the July monarchy was one of the most favourable to rising men of letters of a somewhat scholastic cast that has ever been known in France, and Michelet had powerful patrons in Villemain, Victor Cousin and others. But, though he was an ardent politician (having from his childhood embraced republicanism and a peculiar variety of romantic free-thought), he was first of all a man of letters and an inquirer into the history of the past.

His earliest works were school-books, and they were not written at a very early age. Between 1825 and 1827 he produced divers sketches, chronological tables, &c., of modern history. His *Précis* of the subject, published in the last-mentioned year, is a sound and careful book, far better than anything that had appeared before it, and written in a sober yet interesting style. In the same year he was appointed maître de conférences at the École normale. Four years later, in 1831, the *Introduction à l'histoire universelle* showed a very different style, exhibiting no doubt the idiosyncrasy and literary power of the writer to greater advantage, but also displaying the peculiar visionary qualities which made Michelet the most stimulating, but the most untrustworthy (not in facts, which he never consciously falsifies, but in suggestion) of all historians. The events of 1830 had unmuzzled him, and had put him in a better position for study by obtaining for him a place in the Record Office, and a deputy-professorship under Guizot in the literary faculty of the university. Very soon afterwards he began his chief and monumental work, the *Histoire de France*. But he accompanied this with numerous other books, chiefly of erudition, such as the *Œuvres choisies de Vico*, the *Mémoires de Luther écrits par lui-même*, the *Origines du droit français*, and somewhat later the *Procès des templiers*. 1838 was a year of great importance in Michelet's life. He was in the fullness of his powers, his studies had fed his natural aversion to the principles of authority and ecclesiasticism, and at a moment when the revived activity of the Jesuits caused some real and more pretended alarm he was appointed to the chair of history at the Collège de France. Assisted by his friend Edgar Quinet, he began a violent polemic against the unpopular order and the principles which it represented, a polemic which made their lectures, and especially Michelet's, one of the most popular resorts of the day. He published, in 1839, his *Histoire romaine*, but this was in his graver and earlier manner. The results of his lectures appeared in the volumes *Le Prêtre, la femme, et la famille* and *le peuple*. These books do not display the apocalyptic style which, partly borrowed from Lamennais, characterizes Michelet's later works, but they contain in miniature almost the whole of his curious ethico-politico-theological creed—a mixture of sentimentalism, communism, and anti-sacerdotalism, supported by the most eccentric arguments, but urged with a great deal of eloquence. The principles of the outbreak of 1848 were in the air, and Michelet was not the least important of those who condensed and propagated them: indeed his original lectures were of so incendiary a kind that the course had to be interdicted. But when the actual revolution broke out Michelet, unlike many other men of letters, did not attempt to enter on active political life, and merely devoted himself more strenuously to his literary work. Besides continuing the great history, he undertook and carried out, during the years between the downfall of Louis Philippe and the final establishment of Napoleon III., an enthusiastic *Histoire de la révolution française*. Despite or because of its enthusiasm, this was by no means Michelet's best book. The events were too near and too well known, and hardly admitted the picturesque sallies into the blue distance which make the charm and the danger of his larger work. In actual picturesqueness as well as in general veracity of picture, the book cannot approach Carlyle's; while as a mere chronicle of the events it is inferior to half a dozen prosaic histories older and younger than itself.

The *coup d'état* lost Michelet his place in the Record Office, as, though not in any way identified with the republic administratively, he refused to take the oaths to the empire. But the new régime only kindled afresh his republican zeal, and his second marriage (with Mlle Adèle Malairet, a lady of some literary capacity, and of republican belongings) seems to have further stimulated his powers. While the history steadily held its way, a crowd of extraordinary little books accompanied and diversified it. Sometimes they were expanded versions of its episodes, sometimes what may be called commentaries or companion volumes. In some of the best of them natural science, a new subject with Michelet, to which his wife is believed to have introduced him, supplies the text. The first of these (by no means the best) was *Les Femmes de la révolution* (1854), in which Michelet's natural and inimitable faculty of dithyrambic too often gives way to tedious and not very conclusive argument and preaching. In the next, *L'Oiseau* (1856), a new and most successful vein was struck. The subject of natural history was treated, not from the point of view of mere science, nor from that of sentiment, nor of anecdote nor of gossip, but from that of the author's fervent democratic pantheism, and the result, though, as was to be expected, unequal, was often excellent. *L'Insecte*, in the same key, but duller, followed. It was succeeded by *L'Amour* (1859), one of the author's most popular books, and not unworthy of its popularity, but perhaps hardly his best. These remarkable works, half pamphlets half moral treatises, succeeded each other as a rule at the twelve months' interval, and the succession was almost unbroken for five or six years. *L'Amour* was followed by *La Femme* (1860), a book on which a whole critique of French literature and French character might be founded. Then came *La Mer* (1861), a return to the natural history class, which, considering the powers of the writer and the attraction of the subject, is perhaps a little disappointing. The next year (1862) the most striking of all Michelet's minor works, *La Sorcière*, made its appearance. Developed out of an episode of the history, it has all its author's peculiarities in the strongest degree. It is a nightmare and nothing more, but a nightmare of the most extraordinary verisimilitude and poetical power.

This remarkable series, every volume of which was a work at once of imagination and of research, was not even yet finished, but the later volumes exhibit a certain falling off. The ambitious *Bible de l'humanité* (1864), an historical sketch of religions, has but little merit. In *La Montagne* (1868), the last of the natural history series, the tricks of staccato style are pushed even farther than by Victor Hugo in his less inspired moments, though—as is inevitable, in the hands of such a master of language as Michelet—the effect is frequently grandiose if not grand. *Nos fils* (1869), the last of the string of smaller books published during the author's life, is a tractate on education, written with ample knowledge of the facts and with all Michelet's usual sweep and range of view, if with visibly declining powers of expression. But in a book published posthumously, *Le Banquet*, these powers reappear at their fullest. The picture of the industrious and famishing populations of the Riviera is (whether true to fact or not) one of the best things that Michelet has done. To complete the list of his miscellaneous works, two collections of pieces, written and partly published at different times, may be mentioned. These are *Les Soldats de la révolution* and *Légendes démocratiques du nord.*

The publication of this series of books, and the completion of his history, occupied Michelet during both decades of the empire. He lived partly in France, partly in Italy, and was accustomed to spend the winter on the Riviera, chiefly at Hyères. At last, in 1867, the great work of his life was finished. In the usual edition it fills nineteen volumes. The first of these deals with the early history up to the death of Charlemagne, the second with the flourishing time of feudal France, the third with the 13th century, the fourth, fifth, and sixth with the Hundred Years' War, the seventh and eighth with the establishment of the rural power under Charles VII. and Louis XI. The 16th and 17th centuries have four volumes apiece, much of which is very distantly connected with French history proper, especially in the two volumes entitled *Renaissance* and *Réforme.* The last three volumes carry on the history of the 18th century to the outbreak of the Revolution. Michelet was perhaps the first historian to devote himself to anything like a picturesque history of the middle ages, and his account is still the most vivid that exists. His inquiry into manuscript and printed authorities was most laborious, but his lively imagination, and his strong religious and political prejudices, made him regard all things from a singularly personal point of view. Circumstances which strike his fancy, or furnish convenient texts for his polemic, are handled at inordinate length, while others are rapidly dismissed or passed over altogether.

Uncompromisingly hostile as Michelet was to the empire, its downfall and the accompanying disasters of the country once more stimulated him to activity. Not only did he write letters and pamphlets during the struggle, but when it was over he set himself to complete the vast task which his two great histories had almost covered by a *Histoire du XIXe siècle.* He did not, however, live to carry it farther than Waterloo, and the best criticism of it is perhaps contained in the opening words of the introduction to the last volume—"l'âge me presse." The new republic was not altogether a restoration for Michelet, and his professorship at the Collège de France, of which he contended that he had never been properly deprived, was not given back to him. He died at Hyères on the 9th of February 1874.

Almost all Michelet's works, the exceptions being his translations, compilations, &c., are published in uniform size and in about fifty volumes, partly by Marpon and Flammarion, partly by Calmann Lévy. He has not received much recent attention from critics and monographers, but his *Origines du droit français, cherchées dans les symboles et formules du droit universel* was edited by Émile Faguet in 1890 and went into a second edition in 1900. See G. Monod, *Jules Michelet; Études sur la vie et ses œuvres* (Paris, 1905).

(G. Sa.)

MICHELET, KARL LUDWIG (1801–1893), German philosopher, was born on the 4th of December 1801, at Berlin, where he died on the 16th of December 1893. He studied at the gymnasium and at the university of his native town, took his degree as doctor of philosophy in 1824, and became professor in 1829, a post which he retained till his death. Educated in the doctrine of Hegel, he remained faithful to his early teaching and spent his life in defending and continuing the Hegelian tradition. His first notable work was the *System der philosophischen Moral* (Berlin, 1828), an examination of the ethical theory of responsibility. In 1836 he published, in Paris, a treatise on the *Metaphysics* of Aristotle, written in French and crowned by the Académie des Sciences Morales et Politiques. He wrote also two other treatises on Aristotle. *Nikomachische Ethik* (2nd ed., 1848) and *Die Ethik des Aristoteles in ihrem Verhältniss zum System der Moral* (1827). His own views are best expressed in his *Vorlesungen über die Persönlichkeit Gottes* (1841) and *Die Epiphanie der ewigen Persönlichkeit des Gottes.* The philosophical theology developed in these works has been described as a "Neo-Christian Spiritualism."

Among his other publications may be mentioned *Geschichte der letzten Systeme der Philos. in Deutschland von Kant bis Hegel* (1837–1838); *Anthropologie und Psychologie* (1840); *Esquisse de logique* (Paris, 1856); *Naturrecht oder Rechtsphilosophie* (1866); *Hegel der unwiderlegte Weltphilosoph* (1870), *Wahrheit aus meinem Leben* (1886). From 1832 to 1842, Michelet was engaged in publishing the complete works of Hegel, and in 1845 he founded the Berlin Philosophical Society, which has continuously represented the Hegelianism of Germany. He was the first editor of *Der Gedanke* (1860), the official organ of the society.

MICHELL, JOHN (1724–1793), English natural philosopher and geologist, was born in 1724, and educated at Queens' College, Cambridge. His name appears fourth in the Tripos list for 1748–1749; and in 1755 he was moderator in that examination. He became M.A. in 1752, and B.D. in 1761. He was a fellow of his college, and was appointed Woodwardian professor of geology in 1762, and in 1767 rector of Thornhill in Yorkshire, where he died on the 29th of April 1793. He was elected a fellow of the Royal Society in the same year as Henry Cavendish (1760). In 1750 he published at Cambridge a work of some eighty pages entitled *A Treatise of Artificial Magnets, in which is shown an easy and expeditious method of making them superior to the best natural ones.* Besides the description of the method of magnetization which still bears his name, this work contains a variety of accurate magnetic observations, and is distinguished by a lucid exposition of the nature of magnetic induction. He was the original inventor of the torsion balance, which afterwards became so famous in the hands of its second inventor Coulomb. Michell described it in his proposal of a method for obtaining the mean density of the earth. He did not live to put his method into practice; but this was done by Henry Cavendish, who made, by means of Michell's apparatus, the celebrated determination that now goes by the name of Cavendish's experiment (*Phil. Trans.*, 1708). His most important geological essay was that entitled *Conjectures concerning the Cause and Observations upon the Phaenomena of Earthquakes* (*Phil. Trans.*, li. 1760), which showed a remarkable knowledge of the strata in various parts of England and abroad.

Michell's other contributions to science are: "Observations on the Comet of January 1760 at Cambridge, *Phil. Trans.* (1760); "A Recommendation of Hadley's Quadrant for Surveying," ibid. (1765); "Proposal of a Method for measuring Degrees of Longitude upon Parallels of the Equator," ibid. (1766); "An Inquiry into the Probable Parallax and Magnitude of the Fixed Stars," ibid. (1767); "On the Twinkling of the Fixed Stars," ibid. (1767); "On the Means of Discovering the Distance, Magnitude, &c., of the Fixed Stars," ibid. (1784).

MICHEL OF NORTHGATE, DAN (*fl.* 1340), English writer, the author of the *Ayenbite of Inwyt.* Nothing is known of him except what can be gathered from his work. It is a literal translation in the Kentish dialect of a French treatise entitled *Le Somme des vices et des vertues* (also known as *Le Miroir du monde* or *Le Livre des commandemens*, &c.), which was written in 1279 by Laurentius Gallus, a Dominican monk and confessor to Philip III. of France. This work was translated into Flemish, Catalonian, Spanish and Italian, and appears in no less than six English translations. Dan Michel's autograph MS. is preserved in Arundel MS. 57, which states that the work was completed in the year 1340 on the eve of the apostles Simon and Jude by Dan Michel of Northgate, a brother of the cloister of St Austin of Canterbury. The value of the book is chiefly philological as an authenticated and dated example of the southern dialect.

The *Ayenbite of Inwyt* was edited for the Roxburghe Club by the Rev Joseph Stevenson in 1855, and for the Early English Text Soc. by Richard Morris in 1876.

MICHELOZZO DI BARTOLOMMEO (1391–1472?), Italian sculptor, was a Florentine by birth, the son of a tailor, and in early life a pupil of Donatello. He worked in marble, bronze and silver. The statue of the young St John over the door of the Duomo at Florence, opposite the Baptistery, is by him; and he also made the beautiful silver statuette of the Baptist on the altar-frontal of San Giovanni. Michelozzo's great friend and patron was Cosimo dei Medici, whom he accompanied to Venice in 1433 during his short exile. While at Venice, Michelozzo built the library of San Giorgio Maggiore, and designed other buildings there. In 1428, together with Donatello, he erected an open-air pulpit at an angle of the cathedral of St Stephen at Prato. The magnificent Palazzo dei Medici at Florence built by Cosimo, was designed by him; it is one of the noblest specimens of Italian 15th-century architecture, in which the great taste and skill of the architect has combined the delicate lightness of the earlier Italian Gothic with the massive stateliness of the classical style. With great engineering skill Michelozzo shored up, and partly rebuilt, the Palazzo Vecchio, then in a ruinous condition, and added to it many important rooms and staircases. When, in 1437, through Cosimo's liberality, the monastery of San Marco at Florence was handed over to the Dominicans of Fiesole, Michelozzo was employed to rebuild the domestic part and remodel the church. For Cosimo I. he designed numerous other buildings, mostly of great beauty and importance. Among these were a guest-house at Jerusalem for the use of Florentine pilgrims, Cosimo's summer villa at Careggi, and the strongly fortified palace of Cafagiuolo in Mugello. For Giovanni dei Medici, Cosimo's son, he built a very large and magnificent palace at Fiesole. In spite of Vasari's statement that he died at the age of sixty-eight, he appears to have lived till 1472. He is buried in the monastery of San Marco, Florence. Though skilled both as a sculptor and engineer, his fame chiefly rests on his architectural works, which claim for him a position of very high honour even among the greatest names of the great 15th-century Florentines.

See Hans Stegmann, *Michelozzo di Bartolommeo, eine kunstgeschichtliche Studie* (1888); Fritz Wolff, *Michelozzo di Bartolommeo* (1900); cf. also Hans Semper, *Donatello* (1887).

MICHIGAN, a north central state of the United States, situated between latitudes 41° 44′ and 47° 30′ N.[1] and longitudes 82° 25′ and 90° 31′ W., and consisting of two peninsulas—the upper or northern and the lower or southern—separated by a strait. The upper or northern peninsula is bounded N. by Lake Superior; E. by lakes Superior, George, Huron, and Michigan, and by St Mary's River, which separates it from the Province of Ontario, Canada; S. by lakes Huron and Michigan and the Straits of Mackinac, which separate it from the lower peninsula; and S. and W. by Wisconsin, and the Menominee, Montreal and Brulê Rivers, which separate it in part from Wisconsin. The lower or southern peninsula is bounded N. by lakes Michigan and Huron and the Straits of Mackinac, E. by lakes Huron, St Clair and Erie, and the St Clair and Detroit Rivers, which separate it from Ontario; S. by Ohio and Indiana, and W. by Lake Michigan. In size Michigan ranks eighteenth among the states of the Union, its total area being 57,980 sq. m., of which 500 sq. m. are water surface.[2]

Physical Features.—Physiographically the history of the state is similar to that of Minnesota. The northern part is rugged mountainous "old land," not completely worn down by erosion; and the southern part is a portion of the old coastal plain, whose layers contain salt, gypsum and some inferior coal. Lake Huron on the east and Lake Michigan on the west of the lower peninsula are each 581⅓ ft. above sea-level, and Lake Superior on the north of the upper peninsula is 602 ft. above sea-level. For the most part the surface of the state is gently undulating and at a slight elevation above the lakes, but low marsh lands are common to many sections; the north part of the lower peninsula is occupied by a plateau of considerable dimensions, and the north-west part of the upper peninsula is rugged with hills and mountains. Crossing the lower peninsula from Saginaw Bay west by south through the valleys of the Saginaw, Maple and Grand rivers, is a depression—the former channel of an old glacial river—in which elevations for a considerable area are less than 100 ft. above the lakes. To the south-east of this depression a water-parting with summits varying from about 400 to 600 ft. above the lakes extends from a point between Saginaw Bay and Lake Huron south by west to the south border of the state and beyond. The east slope descends quite rapidly to a low flat belt from 5 to 40 m. wide along the east border of the state south from Lake Huron. From Lake Huron to the south-east shore of Saginaw Bay a wide sandy beach is followed northward by precipitous shores abounding in rocks and bluffs. West of the divide and south of the depression, south-west Michigan is occupied by the valleys of the St Joseph, Kalamazoo and Grand rivers, by the gently rolling uplands that form the parting divides between them, and by sand dunes, which here and there rise to a height of from 100 to 200 ft. or more along the shore of Lake Michigan, and are formed on this side (but not on the Wisconsin side) of the lake by the prevailing west winds. The north and north-west portions of the lower peninsula—including the counties of Roscommon and Missaukee, parts of Wexford and Ogemaw, and those to the north and north-west of these—are occupied by a rolling plateau which attains an elevation at its highest point, north of its centre, of upwards of 1100 ft. above Lake Michigan; to the south of this plateau the land slopes gently down to the depression and to the low shores of Lake Michigan and Saginaw Bay. The surface of the upper peninsula is more irregular than that of the lower peninsula. A portion extending through the middle from east to west and south, from west of the centre to Green Bay, is either flat and even swampy or only gently undulating. Eastward from Green Bay are two ranges of hills: the one lining the south shore and ranging from 100 to 300 ft. in height, the other close to or touching the north shore and reaching in places an elevation of 600 ft. above Lake Superior. The famous Pictured Rocks in Alger county on the lake shore, east of Munising, form the west portion of this north range; they are of sandstone formation, extend for several miles along the coast, rise almost perpendicularly from the water's edge, and display an interesting diversity of shapes as well as a great variety of tints and hues, especially of gray, blue, green and yellow. The most rugged portion of the state is farther west. South and south-east of Keweenaw Bay, in the Marquette iron district, is an irregular area of mountains, hills, swamps and lakes, some of the mountain peaks of the Huron Mountains (in Marquette county) rising to an elevation of 1400 ft. or more above the lake. These and a peak in the Porcupine Mountains (2023 ft. above the sea) in the north-west part of Ontonagon county are the highest in the state. To the south of this is the Menominee iron district, marked somewhat regularly by east and west ridges. Extending in a general north-east and south-west direction through Keweenaw peninsula to the Wisconsin border and beyond is the middle of three approximately parallel ranges, separated from each other by flat lands, with here and there an isolated peak (in the Porcupine Mountains) having an elevation of from 900 to 1400 ft. above the lake. The north portion of these ranges, together with Isle Royale some distance farther north, which is itself traversed by several less elevated parallel ridges, contains the Michigan copper-bearing rocks; while to the south, along the Wisconsin border, is another iron district, the Gogebic. The rivers of the entire state consist of numerous small streams of clear water. In the interior of the upper peninsula, along the east border of the lower peninsula south from Lake Huron, and in Saginaw valley, they are rather sluggish; but many of the larger streams of the lower peninsula have sufficient fall to furnish a large amount of water-power, while the small streams that flow into Lake Superior from the central portion of the upper peninsula as well as some of the larger ones farther west, have several falls and rapids; in places also they are lined with steep, high banks. Most of the larger rivers of the state—the Muskegon, Grand, St Joseph, Manistee and Kalamazoo—are in the west portion of the lower peninsula. Several thousand lakes of clear water, formed by glacial action, dot the surface of the state, and many of them are lined with picturesque woodland shores. Islands in lakes Superior, Michigan and Huron are scarcely less numerous.

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[1] This is the northernmost point of the mainland; the most northerly of the islands north-east of Isle Royal and belonging to Michigan is more than 40′ further north.

[2] In addition, within the boundaries of Michigan, are approximately 16,653 sq. m. of Lake Superior, 12,992 sq. m. of Lake Michigan, 9925 sq. m. of Lake Huron and 460 sq. m. of lakes St Clair and Erie.

Fauna and Flora.—Michigan, especially the north portion, still abounds in game. The mammals include black bear, deer, lynx, porcupine, fox, squirrels, hares, rabbits, musk rats, minks, weasels, skunks and woodchucks. Among the game birds are quails ("Bob White"), "partridges" (ruffed grouse), ducks, geese, woodcocks, snipes and plovers. Of song birds the favourites are the robin, thrushes, bobolink, oriole, chickadee, meadow-lark, cat-bird, bluebird, wrens and warblers. Among fishes, white fish, lake trout, perch, herring, sun-fish, bass, sturgeon, pickerel, suckers, German carp and fresh-water drum abound in the lakes. The speckled trout thrives in many of the streams.

Before it was settled by the whites the area now included in Michigan was a forest, except in the south-west, where there were a few small prairies, possibly cleared by the Indians. The remainder of the south part of this area for about 60 m. along the southern boundary was a part of the great hardwood forest of the Ohio Basin with woods varying with soil and drainage: on the drier gravel lands were oak forests consisting of red, black and white oak, hickory, ash, cherry, basswood and walnut; in depressions there were maple, elm, ash, beech, sycamore, poplar and willow; and in the south-east there were a few chestnuts and tulip trees. North of this southern hardwood forest there were pine forests on the sandier land, mixed hardwoods and conifers on the loam and clay, and tamaracks and cedar in the swamps. The sandy lands were in part burnt over by Indians, and there was a growth of scrub oak, aspens and huckleberry bushes. The tamarack and cedar swamps now have a growth, especially on their edges, of spruce, balsam, white pine, soft maple, ash and aspens. In 1909 about 25 % of the area was "cut over" or "burned over" lands, mostly the old pine woods, the region of the old hardwood forest was almost entirely farmland, and about 40 % of the state was still in woods. Red oak, birch, elm, ash, white cedar, hemlock, basswood, spruce, poplar, balsam, fir and several other kinds of trees are found in many sections; but a large portion of the merchantable timber, especially in the lower peninsula, has been cut.[1] Among forest shrubs are the willow, hazel, alder, shrub maple, birch, hawthorn, dogwood, elderberry, viburnum and snowberry. Yews are common in the north, and dwarf juniper in the south. In 1900 the woodland area, including stump lands, was estimated at 38,000 sq. m., or nearly two-thirds of the entire state. Huckleberry, blackberry and raspberry bushes are common in the north sections. Smilax, clematis, honeysuckle and woodbine are the commoner forest vines.

Soil.—The soil of south-west and south-east Michigan is for the most part a dark clay loam or muck; in the north central part of the lower peninsula it is a light sandy loam, along the Huron shore it is heavy with blue clay, in the mining districts of the north-west the rocks are usually either barren or very thinly covered; and elsewhere in the state the soil is generally rich in a variety of mineral elements, and varies chiefly in the proportions of vegetable loam, sand or gravel, and clay.

Climate.—Although the temperature of the entire lower peninsula is considerably influenced by the lakes, yet, the prevailing winds being westerly, it is in the west portion of that peninsula that the moderation is greatest, both the summer and winter isotherms being there deflected more than half the length of the peninsula. On the other hand, the prevailing winds of the upper peninsula being north-westerly, the lakes have little effect on the temperature there; and so, while in the south-west the extremes are not great, in the rest of the state they have ranged within two years from 104° F. at points in the south-east to 49° F. in the north-west. Throughout the state July is invariably the warmest month, February the coldest, the mean annual temperature is about 45° F. The mean annual precipitation is not far from 31 in., a little more than one-half of which falls during the five growing months from May to October; the rain is evenly distributed over all parts of the state, but the snow is exceptionally heavy along the north shore of the upper peninsula.

Productions.—Of the total land surface of the state in 1900 48·08 % (in 1904, 47·1 %) was included in farms and 67·2 % (in 1904, 66·9 %) of the farm land was improved; the total number of farms was 203,261 (in 1904, 189,167), of which 143,688 contained less than 100 acres, 54,556 others contained less than 260 acres, and 136 contained 1000 acres or more, the average size being 86·4 acres (in 1904, 91·5 acres). Of the total number of farms 168,814 were operated by the owners (in 1904, 161,037 by owners and 914 by managers), 22,482 (in 1904, 19,525) by share tenants, 9731 (in 1904, 7685) by cash tenants; and 312,462 of the inhabitants of the state, or 34·5 % of all who were engaged in gainful occupations, were farmers. Of the total acreage in 1900 of all crops 58·3 % was in cereals and 28·8 % in hay and forage; of the acreage of cereals 40·8 % was in wheat, 31·8 % in Indian corn, 21·6 % in oats and 3·7 % in rye. In 1907 the buckwheat crop was 852,000 bushels; rye, 5,452,000 bushels; the hay crop, 3,246,000 tons; oats, 30,534,000 bushels; barley, 1,496,000 bushels; wheat 12,731,000 bushels; and Indian corn 57,190,000 bushels. Of livestock, sheep are the most numerous (2,130,000 in 1907), and Michigan's wool clip in 1907 was 14,080,500 lb. The number of neat cattle in 1907 was 1,852,000 (849,000 dairy cows). The number of hogs was 1,388,000; and of horses 704,000.

Michigan produces the bulk of the peppermint crop of the United States, and it is in the front rank as a fruit-producing state.

Barley and buckwheat are grown chiefly in the east part of the lower peninsula south of Saginaw Bay. Potatoes are grown in considerable quantities in the north-west part of the lower peninsula in the vicinity of Grand Traverse Bay as well as throughout the southern portion of the state; the largest crops of beans are grown in the south central part of the lower peninsula, and of peas in the counties bordering on Lake Huron. Kalamazoo, Jackson, Washtenaw, Lenawee, Ingham, Bay and Muskegon are the leading celery-producing counties; the peppermint district is in the south-west corner of the state; and market gardening is an important industry both in the south-west and in the south-east counties. All the principal fruits are grown in largest quantities in what is commonly known as the fruit belt in the south-west, particularly in Berrien, the corner county.

The fresh-water fish caught in the Great Lakes by residents in Michigan exceed in value those caught by residents of other states, and in 1907 the catch was valued at $1,806,767. Nearly one-half both in quantity and value are taken from Lake Michigan, and, although as many as twenty kinds are caught in considerable quantities, more than 90 % of the value of the catch consists of trout, herring, white fish and perch. Both the state government and the national government have established hatcheries within the state, and state laws protect the industry by regulating the size of mesh in the nets used, prescribing the size of fish that may be taken and kept, establishing close seasons for several kinds of fish, and by other limitations.

Minerals.—Of the mineral products (for which the state is noted) iron is the most valuable. This mineral was discovered in the Marquette district along the shore of Lake Superior early in the 18th century, but active operations for mining it did not begin until 1845; in 1877 mining of the same mineral began farther south in the Menominee district, and seven years later farther west along the Wisconsin border in Gogebic county. The annual product steadily increased from 3000 long tons in 1854 to 11,830,342 in 1907; from 1890 to 1901 Michigan ranked first in the union as an iron-producing state, but after 1901 its product was exceeded by that of Minnesota. Up to 1909 it was estimated that 380,417,085 tons of ore were shipped from the Lake Superior region. Next in value among the mineral products is copper; there are about twenty copper mines in Keweenaw peninsula and its vicinity. The Calumet and Hecla mine, in the central part of that peninsula, is probably the most profitable copper mine in the world; up to 1909 it had paid

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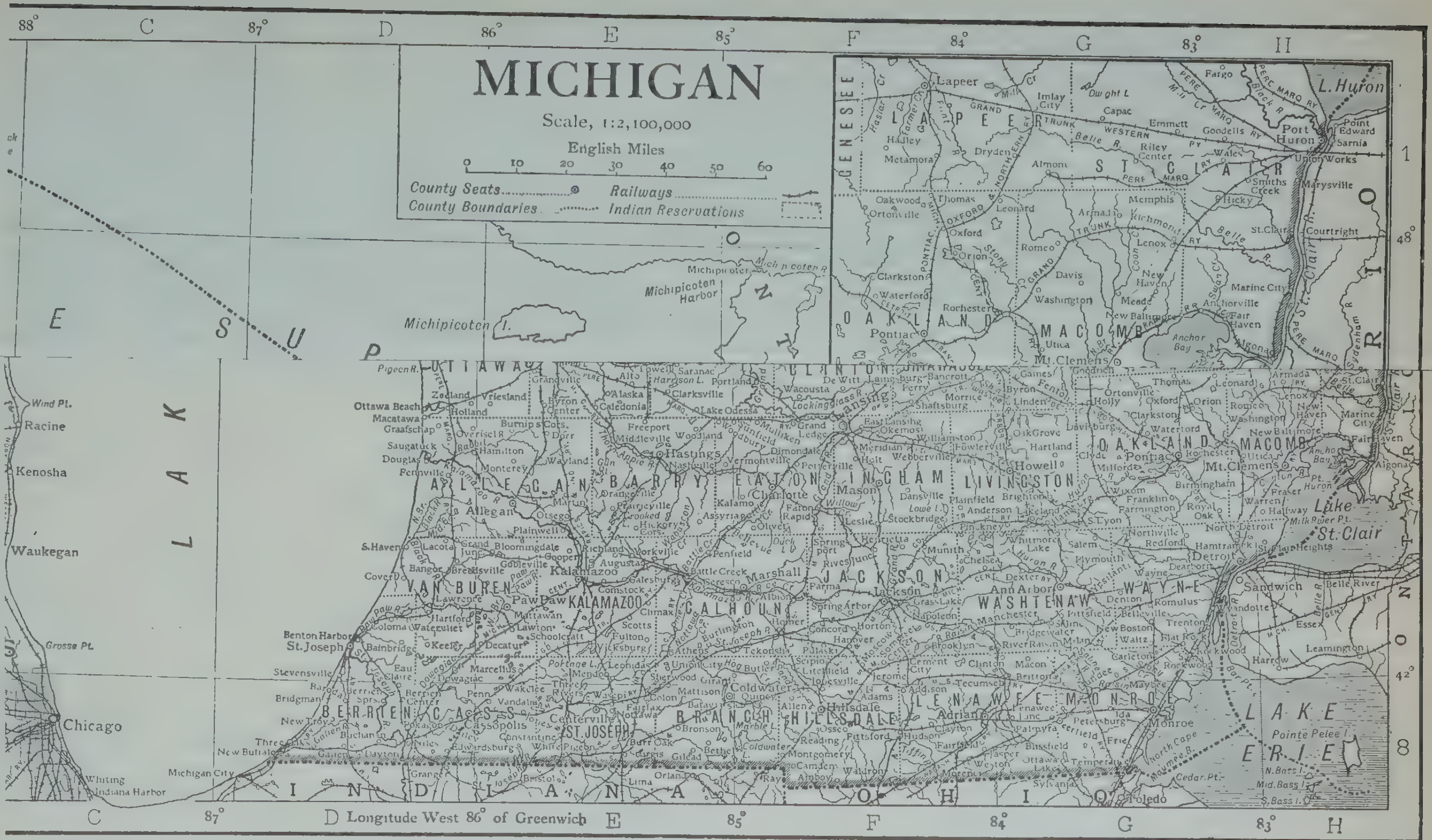
[1] Under the revised constitution of 1908 the legislature is authorized to provide for the reforestation of state lands.


MICHIGAN
Scale, 1:2,100,000
English Miles
0 10 20 30 40 50 60
County Seats
Railways
County Boundaries
Indian Reservations
88° C 87° D 86° E 85° F 84° G 83° H
1
48°
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8
Longitude West 86° of Greenwich
LAKE SUPERIOR
ONTARIO
INDIANA
OHIO
LAKE ERIE
L. Huron
Lake St. Clair
Michipicoten I.
Michipicoten Harbor
Chicago
Racine
Kenosha
Waukegan
Michigan City
Benton Harbor
St. Joseph
Kalamazoo
Lansing
Jackson
Ann Arbor
Detroit
Pontiac
Port Huron
Toledo
Monroe
Adrian
Lapeer
OTTAWA
ALLEGAN
BARRY
EATON
INGHAM
LIVINGSTON
OAKLAND
MACOMB
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
BERRIEN
CASS
ST. JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
LAPEER
ST. CLAIR
GENESEE
CLINTON
SHIAWASSEE

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about $107,850,000 in dividends. Copper mining in the state began about the same time as iron mining, and the quantity mined increased from 12 long tons in 1845 to 102,543 in 1906 (in 1907, 97,175 long tons). From 1847 to 1887 the product of Michigan exceeded that of any other state; from 1847 to 1883 its copper product was more than one-half that of all the states, but after 1887 (except in 1891) more of that mineral was mined in Montana than in Michigan, and in 1906 and in 1907 the yield in both Arizona and Montana was greater than in Michigan. Fields of bituminous coal extend over an area of over 10,000 sq. m. in the central portion of the lower peninsula; but its quality is inferior. The mining of coal began in Jackson county in 1835 and there was a slow increase in the output until 1882 (135,339 short tons); then there was a tendency to decrease until 1897, from which time the product increased from 223,592 short tons to 2,035,858 short tons in 1907. The principal mines are in Saginaw, Bay, Eaton, Jackson, Huron and Shiawassee counties. Salt wells are numerous in the middle and south-east sections of the lower peninsula; the first successful one was drilled in Saginaw county in 1859 and 1860. For a number of years prior to 1893 Michigan was the leading salt-producing state, and, though her output was subsequently (except in 1901) exceeded by that of New York, it continued to increase up to 1905, when it was 9,492,173 barrels; in 1907, the product was 10,786,630 barrels. Gypsum is obtained from deposits along the banks of the Grand river in Kent county and in the vicinity of Alabaster along the shore of Lake Huron in Iosco county. Operations on the deposit near Grand Rapids were begun in 1841, and although that near Alabaster was opened in 1862, it was not until 1902 that it became of much importance; in that year the output of the state was 208,563 short tons; in 1907 317,261 short tons were mined. Marl is found in the south part of the state; limestone most largely in the north part of the lower peninsula, and the east part of the upper peninsula; and the production of Portland cement increased rapidly from 77,000 barrels in 1898 to 3,572,668 in 1907. Besides limestones and dolomites, the only building stone of much commercial importance is the Potsdam sandstone, extensive beds of which lie in the north part of the upper peninsula. Grindstones are produced in considerable quantity in Huron county. A small quantity of petroleum is obtained from thirteen wells in St Clair county in the east part of the lower peninsula; and the mineral waters at Mount Clemens, Benton Harbor and Alma are of considerable commercial value for medicinal purposes.

Manufactures.—In 1900 the value of the manufactured products of Michigan amounted to $356,944,082, which was an increase of 28·4% over that of 1890, and by 1904 there was a further increase of 20·19%.[1] During the same period, however, the value of the products of the lumber and timber industry, which in 1870, 1880 and 1890 was greater than that of any other state, and in 1900 was still more than twice as great as that of the products of any other manufacturing industry in the state and was exceeded only by that of the product of Wisconsin, decreased from $83,121,969 in 1890 to $53,915,647 (35·1%) in 1900, and to $40,569,335 in 1904, this decrease being due to the fact that the large quantities of raw material (both hard wood and pine) formerly found in the forests of Michigan had become so far exhausted that much of it had to be brought in from other states and from Canada. The value of the products of the furniture factories and of the planing mills, nevertheless, has steadily increased; that of the furniture factories (of which Grand Rapids is the leading centre not only in Michigan but in the United States) rising from $10,767,038 in 1890 to $14,614,506 in 1900 and $18,421,735 in 1904, and that of the planing mills from $10,007,603 in 1890 to $12,469,532 in 1900 and $14,375,467 in 1904. The total value of the lumber and timber products, the furniture products, and the planing-mill products amounted in 1900 to $80,999,685; the value of those manufactures based upon minerals mined or quarried amounted in the same year to $83,730,930.

Another important class of manufactures is that based on agriculture: the value of flour and grist mill products amounted to $21,643,547 in 1900, and $26,512,027 in 1904; that of food preparations, for which Battle Creek is noted, to $1,891,516 in 1900 and $6,753,699 in 1904; that of agricultural implements to $6,339,508 in 1900 and $8,719,719 in 1904; and of malt liquors to $5,296,825 in 1900 and $6,999,251 in 1904.

Among other manufactures in which the state ranks high and in which there was a large increase in value during the same period are: leather, carriages and waggons, chemicals, paper and wood pulp and beet sugar. In 1904 Michigan manufactured automobiles valued at $6,876,708.

The ten leading manufacturing centres are, in the order of the value of their products in 1904: Detroit, Grand Rapids, Kalamazoo, Battle Creek, Saginaw, Jackson, Lansing, Muskegon, Bay City and Port Huron, all in the south half of the lower peninsula.

Communications.—The building of railways in Michigan began in 1830, but little progress had been made in 1837 when the state began the construction of three railways and two canals across the south half of the lower peninsula. The Michigan Central was completed from Detroit to Ypsilanti in January 1838, a portion of the Michigan Southern was in operation in November 1840, and considerable work was done on the proposed Michigan Northern and the two canals. By 1846, however, the state had proved itself incompetent to carry on the work and sold its interests to private companies. In 1850 there were 342 m. completed, and from then until 1880 the mileage increased to 3938; but the great period of railway building in Michigan was in the decade from 1880 to 1890, when the mileage was increased to 7108·48. By the close of 1908 it had further increased to 8629·35. The principal lines are the Michigan Central, the Père Marquette, the Lake Shore & Michigan Southern, the Grand Rapids & Indiana, the Ann Arbor, the Grand Trunk, the Chicago & North-Western, the Duluth South Shore & Atlantic, the Minneapolis, St Paul & Sault Ste. Marie, and the Chicago, Milwaukee & St Paul. A board of railway commissioners, which in 1907 succeeded a commissioner (whose office was created in 1873) hears complaints, has power to issue various orders and permits of minor importance to railway companies, and reports annually to the governor.[2] The legislature is empowered to appoint a commission to fix transportation rates for railways and express companies. Besides railway communication Michigan has a coast line of about 1600 m., along which vessels of 2000 tons can sail and find several good harbours, the water communication having been extended and improved by several canals, among which are the Sault Ste. Marie, which passes the rapids of St Mary's River; the St Clair Flats, at the north end of Lake St Clair, by which a deeper channel is made through shallow water; and the Portage Lake, in the copper district, which connects that lake with Lake Superior. The state undertook to construct that at Sault Ste. Marie in 1837 but little had been accomplished in 1852 when the national government granted 750,000 acres of land to the state in aid of the enterprise, and three years after that the canal was completed. Since its completion, the national government has enlarged its locks so as to make it navigable for vessels drawing 21 ft. of water. The national government constructed the canal at the St Clair Flats in 1871 and contributed land for aid in the construction of that connecting lakes Portage and Superior, which was completed in 1873 and passed under national control in 1891.

Population.—The population of Michigan in 1880 was 1,636,937; in 1890 it was 2,093,889, an increase of 27·9% within the decade; in 1900 it was 2,420,982, a further increase of 15·6% and in 1910, according to the preliminary returns of the U.S. census, it was 2,810,173. Of the total population in 1900, 2,398,563 or 99·07% were whites, 15,861 were negroes, 6354 were Indians, 240 were Chinese, and 9 were Japanese. 1,879,329 or 77·6% were native born and 541,653 were foreign-born, 184,398 of the foreign-born being natives of Canada (151,915 English; 32,483 French), 125,074 of Germany, 43,839 of England, and 30,406 of Holland. In 1906 982,479 communicants of different denominations were reported: of these 492,135 were Roman Catholics, 128,675 Methodists, 105,803 Lutherans, 50,136 Baptists, 37,900 Presbyterians, 28,345 members of Reformed bodies, and 26,349 members of the Protestant Episcopal Church. In 1900 39·3% of the total population lived in places having at least 2500 inhabitants.

Administration.—The constitution under which Michigan is now governed was first adopted in 1850, when it was felt that the powers which the first one, that of 1835, conferred upon the executive and the legislature were too unrestricted. In 1908 it was revised, and many changes were made.

The constitution admits of amendment by an affirmative vote of two-thirds of the members of each house of the legislature, followed at the next succeeding spring or autumn election by an affirmative vote of a majority of the electors voting upon the question; or an amendment may be proposed by an initiative petition signed by more than 20% of the total number of electors who voted for secretary of state at the preceding election, and such an amendment (unless disapproved by a majority vote in a joint meeting of the two houses of the legislature) is submitted to popular vote at the next election and comes into effect only if it receives a favourable majority of the popular vote. Amendments suggested by the legislature have been frequently adopted, and one, adopted in 1862, provided that the question of a general revision of the constitution shall be submitted to a popular vote once every sixteen years and at such other times as may be provided by law. When this question was so submitted for the first time, in 1866, the vote was to revise; but the revision prepared by a convention called for the purpose was rejected at the polls. The revision by the Constitutional Convention of 1907-1908 was adopted by popular vote in 1908.

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[1] The 1904 census, taken by the Federal Bureau of the Census in co-operation with the secretary of state of Michigan, covered the year ending on the 30th of June 1904, and is thus not strictly comparable with the "1905" census of manufactures for other states, which were for the year ending on the 31st of December 1904. But like the special census of manufactures in other states, it is confined to establishments under the factory system, and hence its figures are considerably less than they would have been had it been taken on the same basis as that of the 1900 census, which included hand trades and other custom work; for example, on the basis of the 1904 census the value of the manufactured products in 1900 was only $319,691,856, and as that of 1904 was $429,120,060, the real increase was 34·2% instead of 20·19%. In the above text from this point the statistics given for 1900 are for factory products only.

[2] In 1909 telegraph and telephone companies were put under the supervision of the same board.

In its present form the constitution confers suffrage upon every male citizen of the United States who is twenty-one years of age or over and has resided in the state six months and in his township or ward twenty days immediately preceding an election; and any woman may vote in an election involving the direct expenditure of public money or the issue of bonds if she have the qualifications of male electors and if she have property assessed for taxes in any part of the district or territory affected by the election in question. At the head of the executive department is the governor, who is elected for two years, and who at the time of his election must be at least thirty years of age and must have been for five years a citizen of the United States, and for the two years immediately preceding a resident of the state. A lieutenant-governor, for whom the same qualifications are prescribed, is elected at the same time for the same term. Under the first constitution the secretary of state, treasurer, auditor-general, attorney-general, commissioner of the land office, superintendent of public instruction and the judges were all appointed by the governor, but under the present one they are elected and only minor officers are appointed. In 1893 the legislature created a board of four members to be appointed by the governor, one of whom must be a physician, another an attorney, and made it its duty to investigate the case of every convict for whom a petition for pardon is received and then report and recommend to the governor what it deem expedient. The governor's salary is fixed by the revised constitution of 1908 at $5000 a year. The lieutenant-governor succeeds the governor in case of vacancy, and next in order of succession comes the secretary of state.

The legislature, consisting of a Senate of 32 members, and a House of Representatives of 100 members (according to the constitution not less than 64 and not more than 100), meets biennially, in odd-numbered years, at Lansing. Both senators and representatives are elected for a term of two years by single districts, except that a township or city which is entitled by its population to more than one representative elects its representatives on a general ticket. Beginning in 1913 and at each subsequent tenth year, the legislature, under the revised constitution of 1908, rearranges the senatorial districts and reapportions the representatives among the counties and districts, using as a basis the returns of the next preceding decennial census; the taking of a state census between the decennial periods is discontinued.

No bill can pass either house except by an affirmative vote of a majority of the members elected to that house, and on its third reading the ayes and noes must be taken and recorded; for appropriation bills a two-thirds majority of all members elected to each house is required. All legislation must be by bill, legislation by joint and concurrent resolutions thus being prevented. No bill may be passed at a regular session until it has been printed and in possession of each house for five days; no bill may be passed at a special session on any subject not expressly stated in the governor's proclamation or submitted by special message. The governor has ten days (Sundays not being counted) in which to exercise his veto power (which may be applied to any item or items of any bill making appropriations of money and embracing distinct items), and an affirmative vote in each house of two-thirds of the members elected is required to pass a bill over his veto. Under the revised constitution of 1908 any bill passed by the legislature and approved by the governor, except appropriation bills, may be referred by the legislature to the qualified electors; and no bill so referred shall become law unless approved by a majority of the electors voting thereon; no local or special act, passed by the legislature, takes effect until it is approved by a majority vote of the electors in the affected district.

The administration of justice is entrusted to a supreme court, a continually increasing number of circuit courts (thirty-eight in 1909), one probate court in each county, and not exceeding four justices of the peace in each township. The supreme court is composed of one chief justice and seven associate justices, all elected for a term of ten years, not more than two retiring every two years; it holds four sessions annually, exercises a general control over the inferior courts, may issue, hear and determine any of the more important writs, and has appellate jurisdiction only in all other important cases. There is only one circuit court judge for a circuit, unless the legislature provides for the election of more; the term of office is six years. Circuit court judges have original jurisdiction in most matters civil and criminal, hear appeals from the lower courts, and must hold at least four sessions annually in each county of the circuit. Each county elects a judge of probate for a term of four years; he has original concurrent jurisdiction with the circuit court in matters of probate, and has original jurisdiction in all cases of juvenile delinquents and dependents. The legislature may provide for the election of more than one judge of probate in a county with more than 100,000 inhabitants. Justices of the peace are elected by the townships for a term of four years—there are not more than four in each township; in civil matters they have exclusive jurisdiction of cases in which the demand does not exceed $100 and concurrent jurisdiction with the circuit courts in contract cases in which the demand does not exceed $300.

For purposes of local government the state is divided into eighty-three counties, each of which is in turn divided regularly by N. and S. and E. and W. lines into several townships. In the more sparsely inhabited counties of the upper peninsula and in the N.E. section of the lower peninsula the townships are much larger than in other parts of the state. The officers of the township are a supervisor, clerk, treasurer, highway-commissioner, one overseer of highways for each highway district, a justice of the peace, and not more than four constables, all of whom are elected at the annual township meeting in April. The supervisor, two of the justices of the peace and the clerk constitute the township board, whose duty it is to settle claims against the township, audit accounts, and publish annually an itemized statement of receipts and disbursements. The supervisor is also the township assessor, and the several township supervisors constitute the county board of supervisors who equalize property valuations as between townships, authorize townships to borrow money with which to build or repair bridges, are entrusted with the care and management of the property and business of the county, and may borrow or raise by tax what is necessary to meet the more common expenses of the county. Other county officers are a treasurer, clerk, sheriff, register of deeds, attorney, surveyor and two coroners, each elected for a term of two years, a school commissioner elected for a term of four years, and one or more notaries public appointed by the governor.

Under the revised constitution of 1908 the former classification of cities into four classes and the practice of granting special charters were abolished, and the legislature is required to provide by general laws for the incorporation of cities and villages; "such general laws shall limit their rate of taxation for municipal purposes and restrict their powers of borrowing money and contracting debts." Cities and villages are permitted —upon authorization by the affirmative vote of three-fifths of the electors voting on the question—to own and operate, even outside their corporate limits, public utilities for supplying water, light, heat, power and transportation, and may sell and deliver, outside their corporate limits, water, heat, power and light to an amount not more than one-fourth that furnished by them in each case within their corporate limits; but no city or village of less than 25,000 inhabitants may own or operate transportation facilities. Under the revision of 1908 corporate franchises cannot be granted for a longer term than thirty years.

Law.—A wife in Michigan has the same right to her property acquired either before or after marriage as she would have if single, except that she cannot under ordinary circumstances give, grant or sell it to another without her husband's consent. Grounds for a divorce are adultery, physical incapacity at the time of marriage, sentence to imprisonment for three years or more, desertion for two years, habitual drunkenness, extreme cruelty, or, in case of the wife, refusal of the husband to provide for her maintenance when sufficiently able to do so; but in case the parties were married outside of Michigan the party seeking the divorce must reside within the state at least one year before petitioning for the same. An insolvent debtor's homestead—consisting of not more than 40 acres of land with a house thereon, or a house and lot in a city or village not exceeding $1500 in value, together with not less than $500 of his personal property—is exempt from execution. For several years previous to 1876 a clause of the constitution prohibited the sale of intoxicating liquors within the state. Since then the whole liquor business has been subjected to a heavy tax, and since 1887 the prohibition of it has been left to the option of each of the several counties. A state court of mediation and arbitration, consisting of three members appointed by the governor with the consent of the senate, was created in 1889 to inquire into the cause of grievances threatening or resulting in any strike or lock-out and to endeavour to effect a settlement.

Charitable and Penal Institutions.—The state supports the Michigan Asylum for the Insane (opened 1859), at Kalamazoo; the Eastern Michigan Asylum for the Insane (opened 1878), at Pontiac; the Northern Michigan Asylum for the Insane (opened 1885), at Traverse City; the Michigan Asylum for the Dangerous and Criminal Insane (established 1885), at Ionia; the Upper Peninsula Hospital for the Insane, at Newberry; a Psychopathic Hospital (established 1907), at Ann Arbor; a State Sanatorium (established 1905), at Howell; the Michigan State Prison (established 1839), at Jackson; the Michigan Reformatory (established 1887), at Ionia; the State House of Correction and Branch Prison (established 1885), at Marquette; the Industrial School for Boys, at Lansing; the Industrial Home for Girls (established 1879), near Adrian; the State Public School (opened 1874), at Coldwater, a temporary home for dependent children until homes in families can be found for them; the School for the Deaf (established 1854), at Flint; the School for the Blind, at Lansing; an Employment Institution for the Blind (established 1903), at Saginaw; the Home for the Feeble Minded and Epileptic (established 1893), at Lapeer; and the Michigan Soldiers' Home (established 1885), at Grand Rapids. Each of these institutions is under the control of a board of three or more members appointed by the governor with the approval of the Senate, and at the head of the department is the State Board of Corrections and Charities, consisting of the governor and four other members appointed by him, with the approval of the Senate, for a term of eight years, one retiring every two years. This board is required to visit each of the institutions at least once a year to ascertain its condition and needs, and all proposed appropriations for their support, plans of buildings, proposed systems of sewerage, ventilation and heating must be submitted to it.

Education.—Michigan was a pioneer state in creating the American educational system; she began the organization of it at the time of her admission into the Union in 1837, and has since been noted for the high standard of her schools. Each township operating under the District Act has two school inspectors—one being elected at each town meeting for a term of two years—who with the township clerk constitute the township board of school inspectors, and to this board is given authority to divide the township into school districts and to exercise a general supervision over the several schools within their jurisdiction; a township may be organized as a single district, called a "township unit district." The qualified electors of each district having an ungraded school elect a moderator, a director and a treasurer—one at each annual school meeting —for a term of three years, who constitute the district school board, and this board is entrusted with ample power for directing the affairs of the school. In a district having more than 100 children of school age a graded school under the control of five trustees is formed whenever two-thirds of the electors vote for it at a town meeting, and the trustees of a graded school may establish a high school whenever a majority of the electors authorize them to do so. A high school may also be established in any township in which there is no incorporated village or city if when the question is submitted to the electors of that township a majority of the votes cast are in the affirmative. Each county has a county school commissioner, elected for a term of four years, who exercises a general supervision over the schools within his jurisdiction, and a board of examiners, consisting of three members (including the commissioner) and appointed by the several boards of county supervisors, from whom teachers receive certificates. Finally, at the head of all the public elementary and secondary schools of the state is the state superintendent of public instruction, elected for a term of two years; he is *ex officio* a member and secretary of the state board of education, and a member, with the right to speak but not to vote, of all other boards having control of public instruction in any state institution. In every district having as many as 800 children between the ages of five and twenty the state requires that the school be taught not less than nine months a year; and a compulsory education law requires the attendance of all children between the ages of eight and fifteen for four months each year, in cities all between the same ages for the full school year, and between the ages of seven and sixteen if found frequenting public places without lawful occupation.

The higher state institutions of learning consist of a university, to which graduates of high schools on an accredited list are admitted without examination, four normal schools, an agricultural college, and a school of mines. The university (at Ann Arbor) was established in 1837, and is under the control of a board of regents elected by the people for a term of eight years, two every two years; the president of the institution and the superintendent of public instruction are members of the board but without the right to vote. The state normal schools are: the Michigan State Normal College at Ypsilanti (organized in 1849); the Central Michigan Normal School at Mount Pleasant (established in 1895); the Northern State Normal School at Marquette (established in 1899); and the Western State Normal School at Kalamazoo (established in 1904). All of them are under the state board of education, which consists of the state superintendent of public instruction and three other members elected, one every two years, for a term of six years. The agricultural college, at East Lansing, 3 m. east of Lansing, is the oldest in the United States; it was provided for by the state constitution of 1850, organized in 1855 and opened in 1857, and is under the control of the state board of agriculture, consisting of the president of the college and six other members elected by popular vote for a term of six years, two every two years. The college of mines, at Houghton, was established in 1885 and is under the control of a board of six members appointed by the governor with the approval of the Senate, two every two years. In 1908 it had 35 instructors, 253 students, and a library of 22,000 volumes. Other important institutions of learning within the state but not maintained by it are: Albion College (Methodist Episcopal; opened in 1843), at Albion; Hillsdale College (Free Baptist, 1855), at Hillsdale; Kalamazoo College (Baptist, 1855), at Kalamazoo; Adrian College (controlled by the Methodist Protestant Church since 1867), at Adrian; Olivet College (Congregational, 1859), at Olivet; Hope College (Reformed, 1866), at Holland; Detroit College (Roman Catholic, 1877), at Detroit; Alma College (Presbyterian; incorporated 1886), at Alma; and some professional schools at Detroit (*q.v.*).

Finance.—The revenue of the state is derived almost wholly from taxes, about 87% from a direct or general property tax and the rest from various specific or indirect taxes, such as the liquor tax and the inheritance tax. The direct tax, other than that on the property of corporations, is assessed by the township supervisors, or, in cities and incorporated villages by the officer named in the charter for that service, on what is supposed to be the full cash value of the property. The assessment roll thus prepared is reviewed by a local board of review; an equalization between the assessing districts in a county is made annually by the county board of supervisors, and between the counties in the state every five years (and at such other times as the legislature may direct) by the state board of equalization, which is composed of the lieutenant-governor, auditor-general, secretary of state, treasurer, and commissioner of the land office. But at the head of the whole taxing system is the board of state tax commissioners and *ex officio* state board of assessors, consisting of three members appointed by the governor with the approval of the senate for a term of six years. It exercises a general supervision over all other taxing officers and is itself the assessor of the property of railroads, express companies and certain car companies. Mainly through the efficiency of this board the assessed value of the taxable property of the state was increased from $968,189,087 in 1899 to $1,418,251,858 in 1902, or 46·4%, and the taxes levied on railways, which had hitherto been assessed on their gross earnings, were increased from $1,483,907 in 1901 to $3,288,162 in 1902, or 121·6%. In entering upon the work of public improvements in 1837 the state borrowed $5,200,000, and the greater portion of the bonds were sold to the Morris Canal and Banking Company and to the Pennsylvania United States Bank, both of which failed when they had only in part paid for the bonds. About this time it was seen that the cost of the improvements undertaken would be much greater than the original estimate and that several of them were impracticable. The difficulty of meeting the interest as it became due soon threatened to be insurmountable, but the state finally sold the improvements made and came out of the experience with good credit although with a large debt—about two and a half millions of dollars. This was further increased during the Civil War, but after the close of that war it was rapidly diminished and finally was extinguished in the last decade of the century. The present constitution (as revised in 1908) forbids the contraction of a state debt exceeding $250,000 except for repelling an invasion or suppressing an insurrection, and the borrowing power of the minor civil divisions is restricted by a general law.

The early experience of the state with banks was scarcely less serious than that with public improvements. Although there were already fifteen banks in the state in 1837 yet the cry against monopoly was loud, and so in that year a general banking law was passed whereby any ten or more freeholders might establish a bank with a capital of not less than fifty thousand nor more than three hundred thousand dollars and begin business as soon as 30% of the capital was paid in in specie. Only a few provisions were made, and those ineffectual, for the protection of the public: later in the same year the legislature passed an act for the suspension of specie payments until the 6th of May 1838, and the consequence was that the state was flooded with irredeemable paper currency. But most of the "wild cat" banks had passed out of existence by 1839, and in 1844 the bank act of 1837 was declared unconstitutional. Profiting by this experience, the framers of the constitution of 1850 inserted a provision in that document whereby no general banking law can have effect until it has been submitted to the people and has been approved by a majority of the votes cast on the question. This provision is included in the revised constitution adopted in 1908, with an additional provision that no amendment shall be made to any banking law unless it shall receive an affirmative two-thirds vote of both branches of the legislature. The present banking law provides that the capital stock of a state bank shall be not less than $20,000 in a city of not more than 1500 inhabitants, not less than $25,000 in a city of not more than 5000, not less than $50,000 in a city of between 5000 and 20,000, not less than $100,000 in a city of between 20,000 and 110,000, and not less than $250,000 in all larger cities. Commercial banks and savings banks are required to keep on hand at least 15% of their total deposits. Every stockholder in a bank is made individually liable to the amount of his stock at its par value in addition to the said stock. And all banks are subject to the inspection and supervision of the commissioner of the state banking department, who is appointed by the governor with the approval of the Senate for a term of four years.

History.—From 1613 until 1760 the territory now within the borders of Michigan formed a part of New France, and the first Europeans to found missions and settlements within those borders were Frenchmen. Two Jesuits, Raymbault and Jogues, visited the site of Sault Sainte Marie as early as 1641 for the conversion of the Chippewas; in 1668 Marquette founded there the first permanent settlement within the state; three years later he had founded a mission among the Hurons at Michilimackinac; La Salle built a fort at the mouth of the Saint Joseph in 1679; and in 1701 Cadillac founded Detroit as an important point for the French control of the fur trade. But the missionaries were not interested in the settlement of the country by Europeans, the fur traders were generally opposed to it, there was bitter strife between the missionaries and Cadillac, and the French system of absolutism in government and monopoly in trade were further obstacles to progress. Even Detroit was so expensive to the government of the mother country that there was occasional talk of abandoning it; and so during the last fifty-nine years that Michigan was a part of new France there were no new settlements, and little if any growth in those already established. During the last war between the English and the French in America the Michigan settlements passed into the possession of the English, Detroit in 1760 and the others in 1761, but the time had not yet come for much improvement. The white inhabitants, still mostly French, were subjected to an English rule that until the Quebec Act of 1774 was chiefly military, and as a consequence many of the more thrifty sought homes elsewhere, and the Indians, most of whom had been allies of the French, were so ill-treated, both by the officers and traders, that under Pontiac, chief of the Ottawas, a simultaneous attack on the English posts was planned. Detroit was besieged for five months and both Michilimackinac and Saint Joseph were taken. Moreover, the English policy, which first of all was concerned with the profits of trade and manufacture, gave little more encouragement to the settlement of this section of the country than did the French. By the Treaty of Paris, in 1783, which concluded the American War of Independence, the title to what is now Michigan passed to the United States, and in 1787 this region became a part of the North-West Territory; but it was not until 1796 that Detroit and Mackinac (Michilimackinac), in accordance with Jay's Treaty of 1794, were surrendered by Great Britain. In 1800, on the division of the North-West Territory, the west portion of Michigan became a part of the newly-established Indiana Territory, into which the entire area of the present state was embodied in 1802, when Ohio was admitted to the Union; and finally, in 1805, Michigan Territory was organized, its south boundary being then described as a line drawn east from the south extremity of Lake Michigan until it intersected Lake Erie, and its west boundary a line drawn from the same starting point through the middle of Lake Michigan to its north extremity and then due north to the north boundary of the United States. In 1812, during the second war between Great Britain and the United States, General William Hull, first governor of the Territory, although not greatly outnumbered, surrendered Detroit to the British without a struggle; in the same year also Mackinac was taken and Michigan again passed under British rule. This rule was of short duration, however, for soon after Commodore Oliver H. Perry's victory on Lake Erie, in September of the next year, Detroit and the rest of Michigan except Mackinac, which was not recaptured until July 1815, were again taken into the possession of the United States. Up to this time the Territory had still remained for the most part a wilderness in which the fur trade reaped the largest profits, its few small settlements being confined to the borders; and the inaccurate reports of the surveyors sent out by the national government described the interior as a vast swamp with only here and there a little land fit for cultivation. The large number of hostile Indians was also a factor in making the Territory unattractive. But during the efficient administration of Lewis Cass, governor of the Territory from 1813 to 1831, the interference of the British was checked and many of the Indians were removed to the west of the Mississippi; printing presses, established during the same period at Detroit, Ann Arbor, Monroe and Pontiac, became largely instrumental in making the country better known; the first steamboat, the "Walk-in-the-Water," appeared at Detroit in 1818; the Erie canal was opened in 1825; by 1830 a daily boat line was running between Detroit and Buffalo, and the population of Michigan, which was only 4762 in 1810 and 8896 in 1820, increased to 31,639 in 1830 and 212,267 in 1840. In 1819 the Territory had been empowered to send a delegate to Congress. By 1832 the question of admission into the Union had arisen, and in 1835 a convention was called in Detroit, a constitution was framed in May, that constitution was adopted by popular vote in October, state officers were elected, and application for admission was made; but a dispute with Ohio over the boundary between the two caused a delay in the admission by Congress until early in the year 1837. Although the ordinance creating the North-West Territory fixed the boundary line as claimed by Michigan, yet that line was found to be farther south than was at the time expected and when the constitution of Ohio was adopted it was accompanied with a proviso designed to secure to that state a north boundary that was north of the mouth of the Maumee River. The territory between the two proposed lines was unquestionably of greater economic importance to Ohio than to Michigan, and, besides, at this particular time there were forcible political reasons for not offending the older state. The consequence was that after the bloodless "war" between the two states for the possession of Toledo, Congress settled the dispute in Ohio's favour and gave to Michigan the territory since known as the upper peninsula. The boundaries as fixed by Congress were rejected by a convention which met on the 4th of September at Ann Arbor, but they were accepted by the convention of the Jackson party, which met, also at Ann Arbor, on the 6th of December; the action of this latter convention was considered authoritative by Congress, which admitted Michigan into the Union as a state on the 26th of January 1837. Since admission into the Union the more interesting experiences of the state have been with internal improvements and with banking, which together resulted in serious financial distress; in the utilization of its natural resources, which have been a vast source of wealth; and in the development of its educational system, in which the state has exerted a large influence throughout the Union. From the beginning of its government under its first state constitution in 1835 until 1855 Michigan had a Democratic administration with the exception of the years 1840–1842, when opposition to the financial measures of the Democrats placed the Whigs in power. But it was in Michigan that the Republican party received its first official recognition, at a state convention held at Jackson on the 6th of July 1857, and from the beginning of the following year the administration has been Republican with the exception of two terms from 1883 to 1885, and from 1891 to 1893, when it was again Democratic.

GOVERNORS OF MICHIGAN

	Territorial.	
William Hull		1805–1813
Lewis Cass		1813–1831
Stevens Thompson Mason (acting)		1831
George Bryan Porter		1831–1834
Stevens Thompson Mason (acting)		1834–1835
John Scott Horner (acting)		1835
	State.	
Stevens Thompson Mason	Democrat	1835–1840
William Woodbridge	Whig	1840–1841
James Wright Gordon (acting)	„	1841–1842
John Steward Barry	Democrat	1842–1846
Alpheus Felch	„	1846–1847
William L. Greenly (acting)	„	1847–1848
Epaphroditus Ransom	„	1848–1850
John Steward Barry	„	1850–1851
Robert McClelland	„	1851–1853
Andrew Parsons (acting)	„	1853–1855
Kinsley S. Bingham	Republican	1855–1859
Moses Wisner	„	1859–1861
Austin Blair	„	1861–1865
Henry Howland Crapo	„	1865–1869
Henry Porter Baldwin	„	1869–1873
John Judson Bagley	„	1873–1877
Charles Miller Croswell	„	1877–1881
David Howell Jerome	„	1881–1883
Josiah W. Begole	Democrat and Greenback	1883–1885
Russell Alexander Alger	Republican	1885–1887
Cyrus Gray Luce	„	1887–1891
Edwin Baruch Winans	Democrat	1891–1893
John T. Rich	Republican	1893–1897
Hazen Smith Pingree	„	1897–1901
Aaron Thomas Bliss	„	1901–1905
Fred M. Warner	„	1905–1911
Chase S. Osborn	„	1911

AUTHORITIES.—*The Publications of the Michigan Geological Survey* (Detroit, Lansing and New York, 1838 seq.) deal largely with the mining districts of the upper peninsula. Alexander Winchell, *Michigan: Being Condensed Popular Sketches of the Topography, Climate and Geology of the State* (1873), is in large measure restricted to the south half of the state. W. J. Beal and C. F. Wheeler, *Michigan Flora* (Lansing, 1892), contains the results of an extensive study of the subject. See also the *Twelfth Census of the United States* (Washington, 1901–1902); Silas Farmer, *Michigan Book: a State Cyclopaedia with Sectional County Maps* (Detroit, 1901); Bela Hubbard, *Memorials of a Half-Century* (New York, 1887), a well written account of observations, chiefly upon scenery, fauna, flora and climate; Webster Cook, *Michigan: its History and Government* (New York, 1905), written primarily for use in schools and containing a reference bibliography; A. C. McLaughlin, *History of Higher Education in Michigan*, in Circulars of Information of the United States Bureau of Education (Washington, 1891), being an account of the origin of the public school system and an individual account of each higher institution of learning; T. M. Cooley, *Michigan: a History of Government* (Boston, 1885), a critical but popular narrative by an eminent jurist; J. V. Campbell, *Outlines of the Political History of Michigan* (Detroit, 1876), also by a jurist of the state; Henry M. Utley and Byron M. Cutcheon, *Michigan as a Province, Territory and State* (4 vols., New York, 1906); Michigan Pioneer and Historical Society, *Historical Collections: Collections and Researches* (Lansing, 1877 seq.); and *Publications of the Michigan Political Science Association* (Ann Arbor, 1893).

MICHIGAN, LAKE, the only one of the great lakes of North America wholly within the boundaries of the United States, and the second largest body of fresh water in the world. It lies S. of Lake Superior and W. of Lake Huron, between 41° 37′ and 46° 05′ N. and 84° 45′ and 88° W.; is bounded on the N. and E. by the state of Michigan, on the W. by Wisconsin, while Illinois and Indiana touch its S. end. It is 320 m. long, and has an average width of 65 m. The maximum depth recorded by the United States Lake Survey is 870 ft.; the mean level of the surface is $581\frac{1}{3}$ ft. above mean sea-level, being the same as that of Lake Huron and 21 ft. below that of Lake Superior. Its area is 22,400 sq. m., and it has a basin 68,100 sq. m. in area.

The shores of Lake Michigan are generally low and sandy, and the land slopes gradually to the water. The northern shore of the lake is irregular and more rugged and picturesque than the other shores, the summit of the highest peak being about 1400 ft. above the sea. On the eastern side are numerous sand hills, formed by the wind into innumerable fantastic shapes, sometimes covered with stunted trees and scanty vegetation, but usually bare and rising to heights of from 150 to 250 ft. The south-western shore is generally low, with sand hills covered with shrivelled pines and bur oaks. Along the western shore woods and prairies alternate, interspersed with a few high peaks. The cliffs on the east shore of Green Bay form a bold escarpment, and from this ridge the land slopes gradually to the lake. With the exception of Green and Traverse bays, Lake Michigan has few indentations of the coast line, and except at the north end it is free from islands. The waters near shore are shoal, and as there are few harbours of refuge of easy access navigation is dangerous in heavy storms. Around the lake the climate is equable, for, though the winter is cold and the summer hot, the waters of the lake modify the extremes, the mean temperature varying from 40° to 54° F. The average annual rainfall is 33 in. The finest agricultural land in the United States is near the lake, and there is an immense trade in all grains, fruits, livestock and lumber, and in products such as flour, pork, hides, leather goods, furniture, &c. Rich lead and copper mines abound, as also salt, iron and coal. Abundant water power promotes manufactures of all kinds. Beer and distilled liquors are largely manufactured, and fine building stone is obtained from numerous quarries.

The lake is practically tideless, though true tidal pulsations amounting to 3 in. in height are stated to have been observed in Chicago. In the water of the lake there is a general set of current towards the outlet at the strait of Mackinac, following the east shore, with slight circular currents in the main portion of the lake and at the northern end around Beaver island. These currents vary in speed from 4 to 10 m. per day. Surface currents are set up by prevailing winds, which also seriously affect water levels, lowering the water at Chicago and raising it at the strait, or the reverse, so as greatly to inconvenience navigation. The level of the lake is subject to seasonal fluctuations, reaching a maximum in midsummer and a minimum in February, as well as to alternating cycles of years of high and low water. Standard high-water of 1838 was 3·36 ft. above mean level and standard low-water of 1895, 2·82 ft. below that datum, giving an extreme recorded range slightly over 6 ft.

The northern portion of the lake only is covered with ice in winter, and ice never reaches as far south as Milwaukee. Milwaukee River remains closed on an average for one hundred days—from the beginning of December to the middle of March. The average date of the opening and closing of navigation at the strait of Mackinac, where the ice remains longest, is the 17th of April and the 9th of January respectively.[1] Regular lines of steamers specially equipped to meet winter conditions, most of them being car ferries, cross the lake and the strait of Mackinac all winter between the various ports.

No notable rivers flow into Lake Michigan, the largest being the Big Manistee and Muskegon on the east shore, and on the west shore the Menominee and the Fox, both of which empty into Green Bay, the most important arm of the lake. The numerous harbours are chiefly artificial, usually located at the mouths of streams, the improvements consisting of two parallel piers extending into the lake and protecting a dredged channel. Sand bars keep filling up the mouths of these channels, necessitating frequent dredging and extension of the breakwaters, work undertaken by the Federal government, which also maintains a most comprehensive and complete system of aids to navigation, including lighthouses and lightships, fog alarms, gas and other buoys, life-saving, storm signal and weather report stations.

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[1] *Report of Deep Waterways Commission* (1896).

Chicago, the principal port on the lake, is at its south-west extremity, and is remarkable for the volume of its trade, the number of vessels arriving and departing exceeding that of any port in the United States, though the tonnage is less than that of New York. It is a large railway centre, and the number and size of the grain elevators are noticeable. The port is protected by breakwaters enclosing a portion of the lake front. The level of the city above the lake being only 14 ft., much difficulty arose in draining it. A sanitary and ship canal 34 m. long was therefore completed in 1900 to divert the Chicago river, a small stream that flows into the lake, into the head waters of the Des Plaines river and thence through the river Joliet into the Mississippi at St Louis. The discharge of water is by law so regulated that the maximum flow shall not exceed 250,000 cub. ft. per minute. The effect upon the permanent level of the lakes of the withdrawal of water through this artificial outlet is receiving much attention. Milwaukee, situated on the shore of Milwaukee Bay, on the western side of the lake, is, next to Chicago, the largest city on the lake, and has a large commerce and a harbour of refuge. Escanaba, on Little Bay de Noc (Noquette), in the northern part of the lake, is a natural harbour and a large iron shipping port. Green Bay and Lake Michigan are connected by a canal extending from the lake to the head of Sturgeon Bay. Lake Michigan is connected at its north-east extremity with lake Huron by the strait of Mackinac, 48 m. long, with a minimum width of 6 m.; the water is generally deep and the shoals lying near the usually travelled routes are well marked.

BIBLIOGRAPHY.—*Sailing directions for Lake Michigan, Green Bay, and the Strait of Mackinac*, U.S. Navy Hydrographic office publication No. 108 B (Washington, 1906); *Bulletin No. 17: Survey of Northern and North-western Lakes*, U.S. Lake Survey Office (Detroit, Michigan, 1907); *St Lawrence Pilot*, 7th ed., Hydrographic Office Admiralty (London, 1906); *Effect of Withdrawal of Water from Lake Michigan by the Sanitary District of Chicago*, U.S. House of Representatives' Document No. 6, 59th Congress, 1st session (Washington, 1906). (W. P. A.)

MICHIGAN, UNIVERSITY OF, one of the principal educational institutions of the United States, situated at Ann Arbor, Michigan. It embraces a department of literature, science and the arts (including industry and commerce), opened in 1841, and including a graduate school, organized in 1892; a department of medicine and surgery, opened in 1850; a department of law, opened in 1859; a school of pharmacy, opened as a separate department in 1876; a homoeopathic medical college, opened in 1875; a college of dental surgery, opened in 1875; and a department of engineering, separately organized in 1895, which includes courses in marine engineering, architecture, and architectural engineering. The university was one of the first to admit women, having opened its doors to them in 1870 as a natural consequence of its receiving aid from the state (since 1867), and since 1900 they have constituted nearly one-half of the student body in the department of literature, science and the arts. In 1907–1908 there were in all departments 350 instructors and 5013 students (1796 in the department of literature, science and the arts; 1354 in the department of engineering; 391 in the department of medicine and surgery; 791 in the department of law; 101 in the school of pharmacy; 82 in the homoeopathic medical college; 168 in the college of dental surgery; and 1070 in the summer sessions). Besides the several main department buildings there is a library building, a museum building, several laboratories, a gymnasium for men, and a gymnasium for women. The general library in 1908 contained 172,940 volumes, 3800 pamphlets, and 3370 maps, and the several department libraries brought the total up to 222,600 volumes and 5000 pamphlets. The general museum contains large zoological collections, geological and anthropological collections, including the exhibit of the Chinese government at the New Orleans Exposition, which was given by the government to the university in 1885; there are besides several special collections in some of the laboratories. The astronomical observatory is surmounted by a movable dome in which is mounted a refracting telescope having a thirteen-inch object glass. The several laboratories are equipped for use in instruction in physics, chemistry, mineralogy, geology, zoology, psychology, botany, forestry, actuarial work, engineering, histology, physiology, hygiene, electrotherapeutics, pathology, anatomy and dentistry.

The university is governed from without by a board of eight regents elected by popular suffrage, two biennially, at the same time as the election of judges of the supreme court; from within the government is to a large extent in the hands of a university senate, in which the faculty of each department is represented. The university is maintained by a permanent annuity of $30,000, derived from the land set apart for it by the Ordinance of 1787, by the proceeds of a three-eighths mill tax, and by small fees paid by the students. Its organic relation to the other public schools of the state was well established in 1870, when it was provided that graduates from such high schools as had been examined and approved by a committee of the university should be admitted without examination; one of the most important functions of the university is to prepare students for teaching in the high schools.

The first charter for a university within what is now the state was granted by the governor and judges of the Territory of Michigan in 1817, for a "Catholepistemiad," or University of Michigania, with a remarkable "Greek" system of nomenclature for its courses and faculties; this institution did practically no teaching. A second charter was granted in 1821, for a University of Michigan in Detroit; but little was accomplished until the admission of Michigan into the Union as a state in 1837, when by the third charter the aim was to model the institution after the German university minus the theological department, and the university was entrusted to a board of regents and a chancellor appointed by the governor. Branches to correspond to the German gymnasia were established in the principal towns before any money was spent on the University proper, but the question of the constitutionality of their establishment and maintenance arose, and they were soon discontinued. Plans for building at Ann Arbor were begun in 1838. The first class graduated in 1845. The department of literature, science and the arts was at first much like a New England college. For some time the prospects did not seem promising; but in 1851 a new state constitution provided that the regents should be elected, and directed them to choose a president; and it was under the administration (1852–1863) of the first incumbent of that office, Henry Philip Tappan (1805–1881), that the present broad and liberal basis was established. Although he was a Presbyterian clergyman, he endeavoured at the outset to substitute the tests of scholarship for those of religion; at the same time a scientific course was introduced, courses in pedagogy followed, and in 1878 the elective system, which has since rapidly expanded, was established. President Tappan was succeeded in 1863 by Erastus Otis Haven (1820–1881), who resigned in 1869, and was succeeded temporarily (1869–1871) by Professor Henry S. Frieze (1817–1889), and in 1871 by James Burrill Angell (b. 1829),[1] who resigned in 1909. In 1871–1872 the German seminar method was introduced in graduate work in history, by Prof. Charles Kendall Adams (1835–1902), afterwards president of Cornell University (1885–1892) and of the University of Wisconsin (1892–1902).

See B. A. Hinsdale and I. N. Demmon, *History of the University of Michigan* (Ann Arbor, 1906); Elizabeth M. Farrand, *History of the University of Michigan* (Ann Arbor, 1885); and *The Quarter Centennial of the Presidency of James Burrill Angell* (Ann Arbor, 1896).

MICHIGAN CITY, a city of Laporte county, Indiana, U.S.A., on the S.E. shore of lake Michigan, about 40 m. E. by S. of Chicago. Pop. (1890) 10,776; (1900), 14,850, of whom 3662 were foreign-born; (1910 census) 19,027. Michigan City is served by the Chicago, Indianapolis & Louisville, the Lake Erie & Western, the Michigan Central and the Père Marquette railways, by interurban electric lines, and by several lines of lake steamships. The city contains a United States Life Saving Station and the Indiana State Prison, and is the seat of a Protestant Episcopal bishop. Its transportation advantages make it one of the principal commercial cities in the state. Its shipments of lumber are of special importance, and it has also a large transshipment trade in salt and iron ore. The total factory product in 1905 was valued at $6,314,226. The municipality owns and operates its water-works system. Michigan City was first settled about 1830, was incorporated as a village in 1837, and was first chartered as a city in 1867.

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[1] President Angell graduated in 1849 at Brown University, where he was assistant librarian in 1849–1850 and was professor of modern languages in 1853–1860; was editor of the Providence *Journal* in 1860–1866; was president of the University of Vermont in 1866–1871, was United States minister to China in 1880–1881, was a member of the joint commission of 1887–1888 to settle fishery disputes between the United States and Great Britain, was chairman of the international deep waterways commission in 1896, and in 1897–1898 was United States minister to Turkey.

MICHMASH, a place in Benjamin, about 9 Roman miles north of Jerusalem (*Onom*, ed. Lag., p. 280), the scene of one of the most striking episodes in Old Testament history (1 Sam. xiv.). Though it did not rank as a city (not being mentioned in Joshua xviii. 21 seq.), Michmash was recolonized after the exile (Neh. xi. 31), and, favoured by the possession of excellent wheat-land (*Mishna*, Men. viii. 1), was still a very large village (Μαχμάς) in the time of Eusebius. The modern Mukhmas is quite a small place.

The historical interest of Michmash is connected with the strategical importance of the position, commanding the north side of the Pass of Michmash, which made it the headquarters of the Philistines and the centre of their forays in their attempt to quell the first rising under Saul, as it was also at a later date the headquarters of Jonathan the Hasmonaean (1 Macc. ix. 73). From Jerusalem to Mount Ephraim there are two main routes. The present caravan road keeps the high ground to the west near the watershed, and avoids the Pass of Michmash altogether. But another route, the importance of which in antiquity may be judged of from Isa. x. 28 sqq., led southwards from Ai over an undulating plateau to Michmash. Thus far the road is easy, but at Michmash it descends into a very steep and rough valley, which has to be crossed before reascending to Geba.[1] At the bottom of the valley is the Pass of Michmash, a noble gorge with precipitous craggy sides. On the north the crag is crowned by a sort of plateau sloping backwards into a round-topped hill. This little plateau, about a mile east of the present village of Mukhmas, seems to have been the post of the Philistines, lying close to the centre of the insurrection, yet possessing unusually good communication with their establishments on Mount Ephraim by way of Ai and Bethel, and at the same time commanding the routes leading down to the Jordan from Ai and from Michmash itself.

See further C. R. Conder, *Tentwork* ii. 112 seq.; and T. K. Cheyne in *Encyc. Bib.*, *s.v.* (R. A. S. M.)

MICHOACÁN, or MICHOACÁN DE OCAMPO, a state of Mexico touching on the Pacific, bounded N. by Jalisco and Guanajuato, E. by Mexico and Guerrero, S. by Guerrero and the Pacific, and W. by the Pacific, Colima, and Jalisco. Pop. (1900), 935,808, chiefly Indians and mestizos. Area, 22,874 sq. m. Its territory is divided into two nearly equal parts by the eastern branch of the Sierra Madre Occidental, the northern part belonging to the great central plateau region, and the southern to an extremely broken region formed by the diverging branches of the Sierra Madre, with their wooded terraces and slopes and highly fertile valleys. The general slope of the southern part is southward to the river Balsas, or Mescala, which forms its boundary-line with Guerrero. The narrow coastal zone on the Pacific is only 101 m. long and has no ports or towns of importance, the slopes of the Sierra Madre del Pacifico being precipitous and heavily wooded and the coast-belt sandy, hot and malarial. The Lerma, on the northern frontier, and the Balsas on the southern, are the only rivers of importance of the state, their tributaries within its boundaries being small and swift-flowing. There are several large and beautiful lakes in the state, the best known of which are Patzcuaro and Cuitzéo. Lake Chapala lies on the northern boundary. Michoacán lies within the most active volcanic region of Mexico: Jorullo (4262 ft.) is near its southern line, and Colima (12,750 ft.) is northwest of it in the state of Jalisco. Earthquake shocks are numerous, and Colima was in violent eruption in 1908–1909. The highest summit in the state is Tancitaro (12,660 ft.). The climate is for the most part temperate and healthy, but it is hot and unhealthy on the coast. Michoacán is essentially a mining region, producing gold, silver, lead and cinnabar, and having rich deposits of copper, coal, petroleum and sulphur. The natural products include fine cabinet and construction woods, rubber, fruit, palm oil and fibres. The soil of the valleys is highly fertile, and produces cereals in the higher regions, and sugar-cane, tobacco, coffee and tropical fruits in the lower. Though the plateau region was settled soon after the arrival of the Spaniards in Mexico, there are large districts on the southern and Pacific slopes that still belong almost exclusively to the Indians. Besides Morelia, the capital and largest city, the principal towns of the state are: La Piedad (pop. 15,123), an important commercial town on the Lerma river and on the Mexican Central railway, 112 m. N.N.W. of Morelia; Zamora (10,373), 75 m. W.N.W. of Morelia; Uruapan (9808), on the Mexican National, 55 m. S.W. of Morelia in a mountainous district celebrated for the fine quality of its coffee; Puruandiro (7782), a commercial and manufacturing town 40 m. N.W. of Morelia; Patzcuaro (7621), on Patzcuaro lake, with a station on the Mexican National, 7550 ft. above sea level; Sahuayo (7408), 103 m. W. by N. of Morelia near Lake Chapala; Zitacuaro (6052), 60 m. S.E. of Morelia on a branch of the Mexican National, which also passes through the mining town of Angangueo (9115) in the same district; and Tacambaro (5070), 46 m. S.S.W. of Morelia in a fertile valley of the Rio de las Balsas basin.

MICKIEWICZ, ADAM (1798–1855), Polish poet, was born in 1798, near Nowogrodek, in the present Russian government of Minsk, where his father, who belonged to the schlachta or lesser nobility, had a small property. The poet was educated at the university of Vilna; but, becoming involved in some political troubles there, he was forced to terminate his studies abruptly, and was ordered to live for a time in Russia. He had already published two small volumes of miscellaneous poetry at Vilna, which had been favourably received by the Slavonic public, and on his arrival at St Petersburg he found himself admitted to the leading literary circles, where he was a great favourite both from his agreeable manners and his extraordinary talent of improvisation. In 1825 he visited the Crimea, which inspired a collection of sonnets in which we may admire both the elegance of the rhythm and the rich Oriental colouring. The most beautiful are *The Storm*, *Bakchiserai*, and *Grave of the Countess Potocka*.

In 1828 appeared his *Konrad Wallenrod*, a narrative poem describing the battles of knights of the Teutonic order with the heathen Lithuanians. Here, under a thin veil, Mickiewicz represented the sanguinary passages of arms and burning hatred which had characterized the long feuds of the Russians and Poles. The objects of the poem, although evident to many, escaped the Russian censors, and it was suffered to appear, although the very motto, taken from Machiavelli, was significant: "Dovete adunque sapere come sono duo generazioni da combattere . . . bisogna essere volpe e leone." This is a striking poem and contains two beautiful lyrics. After a five years' exile in Russia the poet obtained leave to travel; he had secretly made up his mind never to return to that country or Poland so long as it remained under the government of the Muscovites. Wending his way to Weimar, he there made the acquaintance of Goethe, who received him cordially, and, pursuing his journey through Germany, he entered Italy by the Splügen, visited Milan, Venice, and Florence, and finally took up his abode at Rome. There he wrote the third part of his poem *Dziady*, the subject of which is the religious commemoration of their ancestors practised among Slavonic nations, and *Pan Tadeusz*, his longest poem, by many considered his masterpiece. A graphic picture is drawn of Lithuania on the eve of Napoleon's expedition to Russia in 1812. In this village idyll, as Brückner calls it, Mickiewicz gives us a picture of the homes of the Polish magnates, with their somewhat boisterous but very genuine hospitality. We see them before us, just as the knell of their nationalism, as Brückner says, seemed to be sounding, and therefore there is something melancholy and dirge-like in the poem in spite of the pretty love story which forms the main incident. Mickiewicz turned to Lithuania with the loving eyes of an exile, and gives us some of the most delightful descriptions of Lithuanian skies and Lithuanian forests. He describes the weird sounds to be heard in the primeval woods in a country where the trees were sacred. The cloud-pictures are equally striking. There is nothing finer in Shelley or Wordsworth.

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[1] So Isa. x. 28 describes the invader as leaving his heavy baggage at Michmash before pushing on through the pass.

In 1832 Mickiewicz left Rome for Paris, where his life was for some time spent in poverty and unhappiness. He had married a Polish lady, Selina Szymanowska, who became insane. In 1840 he was appointed to the newly founded chair of Slavonic languages and literature in the Collège de France, a post which he was especially qualified to fill, as he was now the chief representative of Slavonic literature, Pushkin having died in 1837. He was, however, only destined to hold it for a little more than three years, his last lecture having been given on the 28th of May 1844. His mind had become more and more disordered under the influence of religious mysticism. He had fallen under the influence of a strange fanatic named Towianski. His lectures became a medley of religion and politics, and thus brought him under the censure of the Government. A selection of them has been published in four volumes. They contain some good sound criticism, but the philological part is very defective, for Mickiewicz was no scholar, and he is obviously only well acquainted with two of the literatures, viz. Polish and Russian, the latter only till the year 1830. A very sad picture of his declining days is given in the memoirs of Herzen. At a comparatively early period the unfortunate poet exhibited all the signs of premature old age; poverty, despair and domestic affliction had wrought their work upon him. In 1849 he founded a French newspaper, *La Tribune des peuples*, but it only existed a year. The restoration of the French Empire seemed to kindle his hopes afresh; his last composition is said to have been a Latin ode in honour of Napoleon III. On the outbreak of the Crimean War he was sent to Constantinople to assist in raising a regiment of Poles to take service against the Russians. He died suddenly there in 1855, and his body was removed to France and buried at Montmorency. In 1900 his remains were disinterred and buried in the cathedral of Cracow, the Santa Croce of Poland, where rest, besides many of the kings, the greatest of her worthies.

Mickiewicz is held to have been the greatest Slavonic poet, with the exception of Pushkin. Unfortunately in other parts of Europe he is but little known; he writes in a very difficult language, and one which it is not the fashion to learn. There were both pathos and irony in the expression used by a Polish lady to a foreigner, "Nous avons notre Mickiewicz à nous." He is one of the best products of the so-called romantic school. The Poles had long groaned under the yoke of the classicists, and the country was full of legends and picturesque stories which only awaited the coming poet to put them into shape. Hence the great popularity among his countrymen of his ballads, each of them being connected with some national tradition. Besides *Konrad Wallenrod* and *Pan Tadeusz*, attention may be called to the poem *Grazyna*, which describes the adventures of a Lithuanian chieftainess against the Teutonic knights. It is said by Ostrowski to have inspired the brave Emilia Plater, who was the heroine of the rebellion of 1830, and after having fought in the ranks of the insurgents, found a grave in the forests of Lithuania. A fine vigorous Oriental piece is *Farys*. Very good too are the odes to Youth and to the historian Lelewel; the former did much to stimulate the efforts of the Poles to shake off their Russian conquerors. It is enough to say of Mickiewicz that he has obtained the proud position of the representative poet of his country; her customs, her superstitions, her history, her struggles are reflected in his works. It is the great voice of Poland appealing to the nations in her agony.

His son, Ladislas Mickiewicz, wrote *Vie d'Adam Mickiewicz* (Posen, 1890–1895, 4 vols.), also *Adam Mickiewicz, sa vie et son œuvre* (Paris, 1888). Translations into English (1881–1885) of *Konrad Wallenrod* and *Pan Tadeusz* were made by Miss Biggs. See also *Œuvres poétiques de Mickiewicz*, trans. by Christien Ostrowski (Paris, 1845). (W. R. M.)

MICKLE, WILLIAM JULIUS (1735–1788), Scottish poet, son of the minister of Langholm, Dumfries-shire, was born on the 28th of September 1735. He was educated at the Edinburgh high school, and in his fifteenth year entered business as a brewer. His father purchased the business, and on his death William Mickle became the owner; but he neglected his affairs, devoting his time to literature, and before long became bankrupt. In 1763 he went to London, where in 1765 he published "a poem in the manner of Spenser" called the *Concubine* (afterwards *Syr Martyn*); was appointed corrector to the Clarendon Press, and translated the *Lusiad* of Camoens into heroic couplets (specimen published 1771, whole work, 1775). So great was the repute of this translation that when Mickle—appointed secretary to Commodore Johnstone—visited Lisbon in 1779, the king of Portugal gave him a public reception. On his return to London he was appointed one of the agents responsible for the distribution of prize-money, and this employment, in addition to the sums brought him by his translation of the Lusiad, placed him in comfortable circumstances.

It has been suggested that the Scottish poem "There's nae luck aboot the hoose" was Mickle's. It is more likely, however, that Jean Adams was the author. Scott read and admired Mickle's poems in his youth, and founded *Kenilworth* on his ballad of *Cumnor Hall*, which appeared in Thomas Evans's *Old Ballads . . . with some of Modern Date* (1784).

MICMAC, a tribe of North American Indians of Algonquian stock. They formerly occupied all Nova Scotia, Cape Breton and Prince Edward Islands, and portions of New Brunswick, Quebec and Newfoundland. They fought on the French side in the colonial wars. They are now civilized and almost all profess Catholicism. They number some 4000 in settled communities throughout their former territory.

There is an excellent account of the Micmac Indians in J. G. Millais's *Newfoundland and its Untrodden Ways* (1908).

MICON, a Greek painter of the middle of the fifth century B.C. He was closely associated with Polygnotus of Thasos, in conjunction with whom he adorned the Painted Stoa, at Athens, with paintings of the battle of Marathon and other battles. He also painted in the Anaceum at Athens.

MICROCLINE, a rock-forming mineral belonging to the feldspar group (see FELSPAR). Like orthoclase it is a potash-feldspar with the formula $KAlSi_3O_8$, but differs from this in crystallizing in the anorthic system. The name (from Greek *μικρός*, small, and *κλίνειν*, to incline) was given by A. Breithaupt in 1830, and has reference to the fact that the angle (89° 30′) between the two perfect cleavages differs but little from a right angle: the species was, however, first definitely established by A. Des Cloizeaux in 1876. The crystals and cleavage masses are very like orthoclase in appearance, and the hardness (6) and specific gravity (2·56) are the same for the two minerals; there are, however, important differences in the twinning and in the optical characters. In addition to being twinned according to the same laws as orthoclase, microcline is repeatedly twinned according to the albite-law and the pericline-law, producing a very characteristic grating or cross-hatched structure which is especially prominent when thin sections of the mineral are examined in polarized light. This lamellar structure is often on a very minute scale, sometimes so minute as to be almost indistinguishable: it has therefore been suggested that orthoclase is really a microcline in which the twin-lamellae are ultra-microscopic. In a section parallel to the basal plane *c* (001) of a microcline crystal the lamellae do not extinguish optically parallel to the edge *bc* as in orthoclase, but at an angle of 15° 30′; further, the obtuse bisectrix of the optic axes in microcline is inclined to the normal of the plane *b* (010) at an angle of 15° 26′. Green microcline is distinctly pleochroic.

Microcline occurs, usually with orthoclase, as a constituent of pegmatites, granites and gneisses; it is rare in porphyries and is not known in volcanic rocks. A beautiful crystallized variety of a bright verdigris-green colour is known as amazon-stone (*q.v.*). Chesterlite is a variety occurring as crystals on dolomite in Chester county, Pennsylvania.

Closely allied to microcline is the anorthic soda-potash-feldspar known as anorthoclase or natron-microcline. Here sodium predominates over potassium and a little calcium is also often present, the formula being $(Na, K)\,AlSi_3O_8$. It resembles microcline in having a cleavage angle of very nearly 90° and in the cross-hatched structure, the latter being usually very minute and giving rise to a mottled extinction. It is the characteristic feldspar of volcanic rocks which are rich in soda, and is typically developed in the lavas of the island of Pantelleria near Sicily and those of Kilimanjaro and Mount Kenya in East Africa: the rhomb-shaped porphyritic feldspars of the "rhomb-porphyry" of southern Norway also belong here.

(L. J. S.)

MICROCOSM, a term often applied in philosophical and in general literature to man regarded as a "little world" (Gr. *μικρός κόσμος*) in opposition to the "macrocosm," great world, in which he lives. From the dawn of speculative thought in Greece the analogy between man and the world has been a common-place, and may be traced from Heraclitus and Empedocles, through Plato, Aristotle, the Stoics, the Schoolmen and the thinkers of the Renaissance down to the present day. Thus Lotze's comprehensive survey of mental and moral science is termed *Microcosmus* The most systematic expression of the tendency indicated by the term is the monadology of Leibnitz, in which the monad is regarded as containing within its own closed sphere an expression of the universe, the typical created monad being the human soul.

MICROCOSMIC SALT, or ammonium sodium hydrogen orthophosphate, $NH_4NaHPO_4 \cdot 4H_2O$, so named by the alchemists because it is contained in the decomposing urine of man (the "microcosm"). It is interesting historically as being the raw material from which Brand prepared phosphorus, whence it is also called "salt of phosphorus." It may be obtained in large transparent crystals from a mixture of solutions of salammoniac and disodium phosphate, or by saturating a solution of monosodium phosphate with ammonia. When heated to redness, it leaves a transparent glass of sodium metaphosphate, $NaPO_3$, which like borax dissolves most metallic oxides, with formation of glasses that often exhibit characteristic colours, and which may be used in the qualitative analysis of substances. (See CHEMISTRY, § *Analytical.*)

MICROMETER (from Gr. *μικρός*, small, *μέτρον*, a measure), an instrument generally applied to telescopes and microscopes for measuring small angular distances with the former or the dimensions of small objects with the latter.

Before the invention of the telescope the accuracy of astronomical observations was necessarily limited by the angle that could be distinguished by the naked eye. The angle between two objects, such as stars or the opposite limbs of the sun, was measured by directing an arm furnished with fine "sights" (in the sense of the "sights" of a rifle) first upon one of the objects and then upon the other (*q.v.*), or by employing an instrument having two arms, each furnished with a pair of sights, and directing one pair of sights upon one object and the second pair upon the other. The angle through which the arm was moved, or, in the latter case, the angle between the two arms, was read off upon a finely graduated arc. With such means no very high accuracy was possible. Archimedes concluded from his measurements that the sun's diameter was greater than 27′ and less than 32′; and even Tycho Brahe was so misled by his measures of the apparent diameters of the sun and moon as to conclude that a total eclipse of the sun was impossible.[1] Michael Maestlin in 1579 determined the relative positions of eleven stars in the Pleiades (*Historia coelestis Lucii Baretti*, Augsburg, 1666), and A. Winnecke has shown (*Monthly Notices R.A.S.*, xxxix. 146) that the probable error of these measures amounted to about ± 2′.[2]

The invention of the telescope at once extended the possibilities of accuracy in astronomical measurements. The planets were shown to have visible disks, and to be attended by satellites whose distance and position angle relative to the planet it was desirable to measure. It became, in fact, essential to invent a "micrometer" for measuring the small angles which were thus for the first time rendered sensible. There is now no doubt that William Gascoigne, a young gentleman of Yorkshire, was the first inventor of the micrometer. William Crabtree, a friend of his, taking a journey to Yorkshire in 1639 to see Gascoigne, writes thus to his friend Jeremiah Horrocks. "The first thing Mr Gascoigne showed me was a large telescope amplified and adorned with inventions of his own, whereby he can take the diameters of the sun and moon, or any small angle in the heavens or upon the earth, most exactly through the glass, to a second." The micrometer so mentioned fell into the possession of Richard Townley of Lancashire, who exhibited it at the meeting of the Royal Society held on the 25th of July 1667.

The principle of Gascoigne's micrometer is that two pointers having parallel edges at right angles to the measuring screw, are moved in opposite directions symmetrically with and at right angles to the axis of the telescope. The micrometer is at zero when the two edges are brought exactly together. The edges are then separated till they are tangent to the opposite limbs of the disk of the planet to be measured, or till they respectively bisect two stars, the angle between which is to be determined. The symmetrical separation of the edges is produced and measured by a single screw; the fractions of a revolution of the screw are obtained by an index attached to one end of the screw, reading on a dial divided into 100 equal parts. The whole arrangement is elegant and ingenious. A steel cylinder (about the thickness of a goose-quill), which forms the micrometer screw, has two threads cut upon it, one-half being cut with a thread double the pitch of the other. This screw is mounted on an oblong box which carries one of the measuring edges; the other edge is moved by the coarser part of the screw relatively to the edge attached to the box, whilst the box itself is moved relatively to the axis of the telescope by the finer screw. This produces an opening and closing of the edges symmetrically with respect to the telescope axis. Flamsteed, in the first volume of the *Historia coelestis*, has inserted a series of measurements made by Gascoigne extending from 1638 to 1643. These include the mutual distances of some of the stars in the Pleiades, a few observations of the apparent diameter of the sun, others of the distance of the moon from neighbouring stars, and a great number of measurements of the diameter of the moon. Dr John Bevis (*Phil. Trans.* (1773), p. 190) also gives results of measurements by Gascoigne of the diameters of the moon, Jupiter, Mars and Venus with his micrometer.

Delambre gives[3] the following comparison between the results of Gascoigne's measurements of the sun's semi-diameter and the computed results from modern determinations:—

			Gascoigne.	*Conn. d. temps.*
October	25	(o.s.)	16′ 11″ or 10″	16′ 10″·0
,,	31	,, ...	16′ 11″	16′ 11″·4
December	2	,, ...	16′ 24″	16′ 16″·8

Gascoigne, from his observations, deduces the greatest variation of the apparent diameter of the sun to be 35″; according to the *Connaissance des temps* it amounts to 32″·3.[3] These results prove the enormous advance attained in accuracy by Gascoigne, and his indisputable title to the credit of inventing the micrometer.

Huygens, in his *Systema saturnium* (1659), describes a micrometer with which he determined the apparent diameters of the principal planets. He inserted a slip of metal, of variable breadth, at the focus of the telescope, and observed at what part it exactly covered the object under examination; knowing the focal length of the telescope and the width of the slip at the point observed, he thence deduced the apparent angular breadth of the object. The Marquis Malvasia in his *Ephemerides* (Bologna, 1662) describes a micrometer of his own invention. At the focus of his telescope he placed fine silver wires at right angles to each other, which, by their intersection, formed a network of small squares. The mutual distances of the intersecting wires he determined by counting, with the aid of a pendulum clock, the number of seconds required by an equatorial star to pass from web to web, while the telescope was adjusted so that the star ran parallel to the wires at right angles to those under investigation.[4] In the *Phil. Trans.* (1667), No. 21, p. 373, Adrien Auzout gives the results of some measures of the diameter of the sun and moon made by himself, and this communication led to the letters of Townley and Bevis above referred to. The micrometer of Auzout and Picard was provided with silk fibres or silver wires instead of the edges of Gascoigne, but one of the silk fibres remained fixed while the other was moved by a screw. It is beyond doubt that Huygens independently discovered that an object placed in the common focus of the two lenses of a Kepler telescope appears as distinct and well-defined as the image of a distant body; and the micrometers of Malvasia, Auzout and Picard are the natural developments of this discovery. Gascoigne was killed at the battle of Marston Moor on the 2nd of July 1644, in the twenty-fourth year of his age, and his untimely death was doubtless the cause that delayed the publication of a discovery which anticipated, by twenty years, the combined work of Huygens, Malvaison, Auzout and Picard in the same direction.

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[1] Grant, *History of Physical Astronomy*, p. 449.

[2] This is an astonishing accuracy when the difficulty of the objects is considered. Few persons can see with the naked eye—much less measure—more than six stars of the Pleiades, although all the stars measured by Maestlin have been seen with the naked eye by a few individuals of exceptional powers of eyesight.

[3] Delambre, *Hist. ast. moderne*, ii. 590.

[4] *Mém. acad. des sciences* (1717), pp. 78 seq.

Spider Web.

As the powers of the telescope were gradually developed, it was found that the finest hairs or filaments of silk, or the thinnest silver wires that could be drawn, were much too thick for the refined purposes of the astronomer, as they entirely obliterated the image of a star in the more powerful telescopes. To obviate this difficulty Felice Fontana of Florence (*Saggio del real gabinetto di fisica e di storia naturale*, 1755) first proposed the use of spider webs in micrometers,[1] but it was not till the attention of Troughton had been directed to the subject by Rittenhouse that the idea was carried into practice.[2] In 1813 Wollaston proposed fine platinum wires, prepared by surrounding a platinum wire with a cylinder of silver, and drawing out the cylinder with its platinum axis into a fine wire.[3] The surrounding silver was then dissolved by nitric acid, and a platinum wire of extreme fineness remained. But experience soon proved the superiority of the spider web; its perfection of shape, its lightness and elasticity, have led to its universal adoption.

Beyond the introduction of the spider line it is unnecessary to mention the various steps by which the Gascoigne micrometer assumed the modern forms now in use, or to describe in detail the suggestions of Hooke,[4] Wren, Smeaton, Cassini, Bradley, Maskelyne, Herschel, Arago, Pearson, Bessel, Struve, Dawes, &c., or the successive productions of the great artists Ramsden, Troughton, Fraunhofer, Ertel, Simms, Cooke, Grubb, Clarke and Repsold. It will be sufficient to describe those forms with which the most important work has been done, or which have survived the tests of time and experience.

Before astronomical telescopes were mounted parallactically, the measurement of position angles was seldom attempted. Indeed, in those days, the difficulties attached to such measures, and to the measurement of distances with the filar micrometer, were exceedingly great, and must have taxed to the utmost the skill and patience of the observer. For, on account of the diurnal motion, the direction of the axis of the telescope when pointed to a star is always changing, so that, to follow a star with an altazimuth mounting, the observer requires to move continuously the two handles which give slow motion in altitude and azimuth.

Sir William Herschel was the first astronomer who measured position angles; the instrument he employed is described in *Phil. Trans.* (1781), lxxi, 500. It was used by him in his earliest observations of double stars (1779–1783); but, even in his hands, the measurements were comparatively crude, because of the difficulties he had to encounter from the want of a parallactic mounting. In the case of close double stars he estimated the distance in terms of the disk of the components. For the measurement of wider stars he invented his lamp-micrometer, in which the components of a double star observed with the right eye were made to coincide with two lucid points placed 10 ft. from the left eye. The distance of the lucid points was the tangent of the magnified angles subtended by the stars to a radius of 10 ft. This angle, therefore, divided by the magnifying power of the telescope gives the real angular distance of the centres of a double star. With a power of 460 the scale was a quarter of an inch for every second.

The Modern Filar Micrometer.

When equatorial mountings for telescopes became more general, no filar micrometer was considered complete which was not fitted with a position circle.[5] The use of the spider line or filar micrometer became universal; the methods of illumination were improved; and micrometers with screws of previously unheard of fineness and accuracy were produced. These facilities, coupled with the wide and fascinating field of research opened up by Sir William Herschel's discovery of the binary character of double stars, gave an impulse to micrometric research which has continued unabated to the present time. A still further facility was given to the use of the filar micrometer by the introduction of clockwork, which caused the telescope automatically to follow the diurnal motion of a star, and left the observer's hands entirely at liberty.[6]

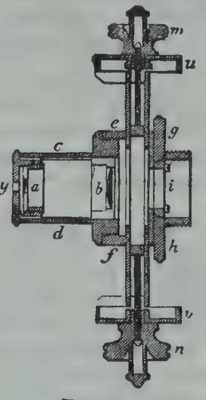

FIG. 1.

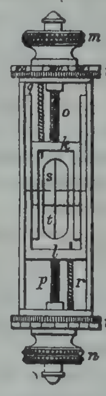

FIG. 2.

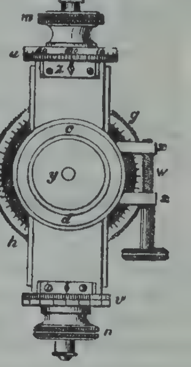

FIG. 3.

The micrometer represented in figs. 1, 2, 3 is due to Troughton. Fig. 1 is a horizontal section in the direction of the axis of the telescope. The eyepiece *ab* consists of two plano-convex lenses *a*, *b*, of nearly the same focal length, and with the two convex sides facing each other. They are placed at a distance apart less than the focal length of *a*, so that the wires of the micrometer, which must be distinctly seen, are beyond *b*. This is known as Ramsden's eyepiece, having been made originally by him. The eyepiece slides into the tube *cd*, which screws into the brass ring *ef*, through two openings in which the oblong frame, containing the micrometer slides, passes. These slides are shown in fig. 2, and consist of brass forks *k* and *l*, into which the ends of the screws *o* and *p* are rigidly fitted. The slides are accurately fitted so as to have no sensible lateral shake, but yet so as to move easily in the direction of the greatest length of the micrometer box. Motion is communicated to the forks by female screws tapped in the heads *m* and *n* acting on the screws *o* and *p* respectively. Two pins *q*, *r*, with spiral springs coiled round them, pass loosely through holes in the forks *k*, *l*, and keep the bearings of the heads *m* and *n* firmly pressed against the ends of the micrometer box. Thus the smallest rotation of either head communicates to the corresponding slide motion, which, if the screws are accurate, is proportional to the amount through which the head is turned. Each head is graduated into 100 equal parts on the drums *u* and *v*, so that, by estimation, the reading can easily be carried to $\frac{1}{1000}$th of a revolution. The total number of revolutions is read off by a scale attached to the side of the box, but not seen in the figure.

Two spider webs are stretched across the forks, one (*t*) being cemented in a fine groove cut in the inner fork *k*, the other (*s*) in a similar groove cut in the outer fork *l*. These grooves are simultaneously cut *in situ* by the maker, with the aid of an engine capable of ruling fine straight lines, so that the webs when accurately laid in the grooves are perfectly parallel. A wire *st* is stretched across the centre of the field, perpendicular to the parallel wires. Each movable web must pass the other without coming in contact with it or the fixed wire, and without rubbing on any part of the brass-work. Should either fault occur (technically called "fiddling") it is fatal to accurate measurement. One of the most essential points in a good micrometer is that all the webs shall be so nearly in the same plane as to be well in focus together under the highest powers used, and at the same time absolutely free from "fiddling." For measuring position angles a brass circle *gh* (fig. 3), fixed to the telescope by the screw *i*, has rack teeth on its circumference that receive the teeth of an endless screw *w*, which, being fixed by the arms *xx* to the oblong box *mn*, gives the latter a motion of rotation round the axis of the telescope; an index upon this box points out on the graduated circle *gh* the angular rotation of the instrument.

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[1] In 1782 (*Phil. Trans.* lxxii. 163) Sir W. Herschel writes:—"I have in vain attempted to find lines sufficiently thin to extend them across the centres of the stars, so that their thickness might be neglected." It is a matter of regret that Fontana's suggestion was unknown to him.

[2] J. T. Quekett in his *Treatise on the Microscope* ascribes to Ramsden the practical introduction of the spider web in micrometers. The evidence appears to be in favour of Troughton.

[3] *Phil. Trans.* (1813), pp. 114–118.

[4] Dr Hooke made the important improvement on Gascoigne's micrometer of substituting parallel *hairs* for the parallel edges of its original construction (Hooke's *Posthumous Works*, p. 497).

[5] Herschel and South (*Phil. Trans.*, 1824, part iii. p. 10) claim that the micrometer by Troughton, fitted to their 5 ft. equatorial telescope, is the first position micrometer constructed capable of measuring position angles to 1′ of arc.

[6] So far as we can ascertain, the first telescope of large size driven by clockwork was the 9-in. equatorial made for Struve at Dorpat by Fraunhofer; it was completed in 1825. The original idea appears to be due to Claude Simeon Passemant (*Mem. Acad.*, Paris, 1746). In 1757 he presented a telescope to the king, so accurately driven by clockwork that it would follow a star all night long.

The English micrometer still retains the essential features of Troughton's original construction above described. The later English artists have somewhat changed the mode of communicating motion to the slides, by attaching the screws permanently to the micrometer head and tapping each micrometer screw into its slide. Instead of making the shoulder of the screw a flat bearing surface, they have given the screw a spherical bearing resting in a hollow cone (fig. 4) attached to the end of the box. The French artists still retain Troughton's form.

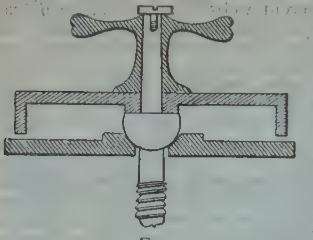

FIG. 4.

Fraunhofer's Filar Micrometer.—The micrometer represented in fig. 5 [1] is the original Merz micrometer of the Cape Observatory, made on Fraunhofer's model. S is the head of the micrometer screw proper, *s* that of the screw moving the slide to which the so-called "fixed web" is attached, *s'* that of a screw which moves the eyepiece E. C is the clamp and M the slow motion in position angle. L, L are tubes attached to a larger tube N; the latter fits loosely on a strong hollow cylinder which terminates in the screw V. By this screw the whole apparatus is attached to the telescope. The nozzles of small lamps are inserted in the tubes L, L, for illuminating the webs in a dark field; the light from these lamps is admitted through apertures in the strong hollow cylinder above mentioned (for illumination, see p. 385). In this micrometer the three slides moved by *S*, *s*, and *s'* are simple dovetails. The lowest of these slides reposes upon a foundation-plate *pp*, into one end of which the screw *s* is tapped. In the middle of this slide a stiffly fitting brass disk is inserted, to which a small turn-table motion may be communicated by an attached arm, acted on by two fine opposing screws accessible to the astronomer; and by their means the "fixed web" may be rendered strictly parallel with the movable one. Another web is fixed parallel to the axis of the screw, as nearly as possible in the same plane with it and passing through the axis of rotation of the micrometer. For the internal structural details of the micrometer the reader is referred to the article "Micrometer" in the 9th edition of the *Encyclopaedia Britannica.*

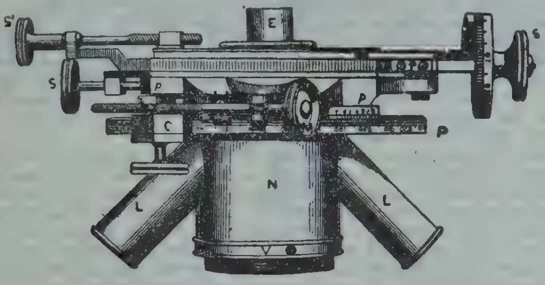

FIG. 5.

To use the instrument, it is well first to adjust the web moved by the screw S, so that its point of intersection with the web (commonly called the "position-web"), which is parallel to the axis of the screw, shall be nearly coincident with the axis of rotation of the micrometer box. For this purpose it is only necessary to direct the telescope to some distant object, bisect that object with the movable wire, and read the number of revolutions and parts of a revolution of the screw; now reverse the micrometer box 180° and repeat the observation; the mean of the two readings will be the point required. Now direct the telescope to a star near the equator and so that the star's image in its diurnal motion shall pass across the intersection of the two webs which mark the axis of rotation of the micrometer box. Then, as the diurnal motion causes the star-image to travel away from the axis of rotation, the micrometer box is rotated till the image of the star when at a considerable distance from the axis is bisected by the position-web. The micrometer is now clamped in position-angle by the clamp C, the star again brought back to the axis, and delicate adjustment given in position-angle by the slow-motion screw M, till the star-image remains bisected whilst it traverses the whole length of the position-web by the diurnal motion only. This determines the reading of the position-circle corresponding to position-angle 90° or 270°.[2]

The position-angles of double stars are reckoned from north through east, the brighter star being taken as origin. To observe the position-angle of a double star it is only necessary to turn the position-web so that it shall be parallel to the line joining the centres of the components of the double star. To test this parallelism the single web must be made to bisect the images of both components simultaneously, as in fig. 6, because it is evident that if the two components of the double star are not exactly equal in magnitude, there will be great tendency to systematic error if the web is placed on one side or other of the stars.

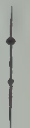

FIG. 6.

To avoid such error Dawes used double *wires*, not spider webs, placing the image of the star symmetrically between these wires, as in fig. 7, and believed that by the use of wires, much thicker than spider webs, the eye could estimate more accurately the symmetry of the star-images with respect to the wires. Other astronomers use the two distance-measuring webs, placed at a convenient distance apart, for position wires. This plan has the advantage of permitting easy adjustment of the webs to such a distance apart as may be found most suitable for the particular observation, but has the disadvantage that it does not permit the zero of the position-circle to be determined with the same accuracy; because, whilst by means of the screw *s'* (fig. 5) the eyepiece can be made to follow the star for a considerable distance along a position-web parallel to the screw, the bisection of the web by a star moving by the diurnal motion at right angles to the micrometer screw can only be followed for a limited distance, viz. the field of the eyepiece. But, as the angle between the position-web and the distance-webs is a constant, the remedy is to determine that angle (always very nearly a right angle) by any independent method and employ the distance-webs as position-webs in the way described, using the position-web only to determine the instantaneous index error of the position-circle.

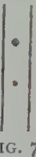

FIG. 7.

To measure distances with the Fraunhofer micrometer, the position-circle is clamped at the true position-angle of the star, and the telescope is moved by its slow motions so that the component A of the star is bisected by the fixed wire; the other component B is then bisected by the web, which is moved by the graduated head S. Next the star B is bisected by the fixed web and A by the movable one. The difference between the two readings of S is then twice the distance between A and B.

The great improvement now introduced into all the best micrometers is to provide a screw *s*, which, not as in the Fraunhofer micrometer, moves only one of the wires, but which moves the whole micrometer box, *i.e.* moves both webs together with respect to the star's image in the direction of the axis of the screw. Thus the fixed wire can be set exactly on star A by the screw *s*, while star B is simultaneously bisected by the movable wire, or vice versa, without disturbing the reading for coincidence of the wires. No one, unless he has previously worked without such an arrangement, can fully appreciate the advantage of bringing up a star to bisection by moving a micrometer with a delicate screw-motion, instead of having to change the direction of the axis of a huge telescope for the same purpose. When it is further remembered that the earlier telescopes were not provided with the modern slow motions in right ascension and that the Struves, in their extensive labours among the double stars, used to complete their bisections of the fixed wire by a pressure of the finger on the side of the tube, one is puzzled whether more to wonder at such poor adaptation of means to ends or the patience and skill which, with such means, led to such results.[3] Dawes, who employed a micrometer of the English type (figs. 1, 2 and 3), used to bolt the head of one of the screws, and the instrument was provided with a slipping piece, giving motion to the micrometer by screws acting on two slides, one in right ascension, the other in declination, so that "either of the webs can be placed upon either component of a double star with ease and certainty" (*Mem. R.A.S.* xxxv. 19).

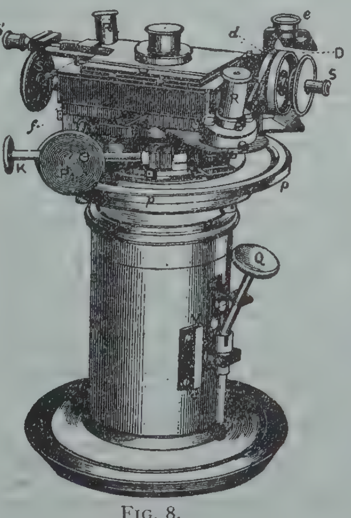

FIG. 8.

The micrometer shown in fig. 8 was made by Repsolds for the Cape Observatory. Fig. 9 represents the same micrometer with the upper side of the box removed. The letters in the description refer to both figures.

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[1] When it is remembered that the measurements of the Struves, Dembowski, Secchi, the Bonds, Maclear and of most modern European astronomers have been made with Fraunhofer or Merz micrometers it is not too much to say that fig. 5 represents the instrument with which a half of the astronomical measurements of the 19th century were made.

[2] For the corrections applicable to measures of position-angle in different hour angles, on account of errors of the equatorial instrument and of refraction, see Chauvenet's *Practical and Spherical Astronomy*, ii. 392 and 450.

[3] Professor Watson used to say, "After all the most important part of a telescope is the man at the small end."

S is the head of the micrometer screw, s that of the screw by which the micrometer box is moved relative to the plate f (fig. 8), s' that of the screw which moves the eyepiece slide. K is the clamp in position angle, P the slow motion screw in position-angle; pp is the position circle, R, R its two readers. The latter are in fact little microscopes carrying a vernier etched on glass, in lieu of a filar micrometer. These verniers can be read to $1'$, and estimated to $0'\cdot 2$. D is the drum-head which gives the fraction of a revolution, d that which gives the whole number of revolutions, I is the index or pointer at which both drums are read. This index is shown in fig. 9, but only its mode of attachment (X, fig. 9) in fig. 8. The teeth of the pinion z, fig. 9, are cut on the axis of the micrometer screw. The drum d and its attached tooth wheel are ground to turn smoothly on the axis of the screw. The pinion z and the toothed wheel d are connected by an intermediate wheel and pinion Y; the numbers of teeth in the wheels and pinions are so proportioned that twenty-four revolutions of the micrometer screw produce one revolution of the drum and wheel d. The divisions of both drums are conveniently read, simultaneously, by the lens e; at night the lamp which illuminates the webs and the position-circle also illuminates the drum-heads (see on illumination p. 385). $aaaa$ is the web-frame (fig. 9), $\beta\gamma$ is a single rod consisting of two cylinders accurately fitting in the ends of the micrometer box, the larger cylinder being at β. There is a hole in the web-frame which smoothly fits the larger cylinder at β', and another which similarly fits the smaller cylinder at γ'. A spiral spring, coiled round the cylinder γ, resting one end on the shoulder formed by the difference of the diameters of the cylinders β and γ and the other on the inside of the web-frame, presses the latter continuously towards γ. Contact of the web-frame of the micrometer with the side of the box at γ would therefore take place, were it not for the micrometer screw. This screw fits neatly in the end of the box at ϵ, passes loosely through the web-frame at ϵ', is tapped into the frame at ζ', and its end rests on a flat hardened surface at ζ. Rotation of the web-frame about $\beta\gamma$ is prevented by the heads of the screws at m; the head of the screw on the lower side of the frame reposes on the plane $\nu\nu$, that on the upper side (fig. 9) touches lightly on the inner surface of the lid of the box. Such rotation can obviously be controlled within limits that need not be further considered. But freedom of rotation in the plane of the paper (fig. 9) is only prevented by good fitting of the holes β' γ'; and, since the weight of the slide is on one side of the screw, misfit here will have the effect of changing the reading for coincidence of the movable with the fixed web in reverse positions of the micrometer. With the Cape micrometer a systematic difference has been found in the coincidence point for head above and head below amounting to $0''\cdot 14$. This corresponds, in the Cape instrument, with an excess of the diameters of the holes over those of the cylinders of about $\frac{1}{15000}$th of an inch—a quantity so small as to imply good workmanship, though it involves a systematic error which is very much larger than the probable error of a single determination of the coincidence point. The obvious remedy is to make all measures on opposite sides of the fixed web before reversing in position-angle—a precaution, however, which no careful observer would neglect. In measuring differences of declination, where the stars are brought up by the diurnal motion, this precaution cannot be adopted, because it is necessary always to bisect the preceding star with the fixed web. But in $\Delta\delta$ measures index error can be eliminated by bisecting both stars with the same web (or different webs of known interval fixed on the same frame), and not employing the fixed web at all. The discordance in zero, when known to exist, is really of no consequence, because the observations can be so arranged as to eliminate it.

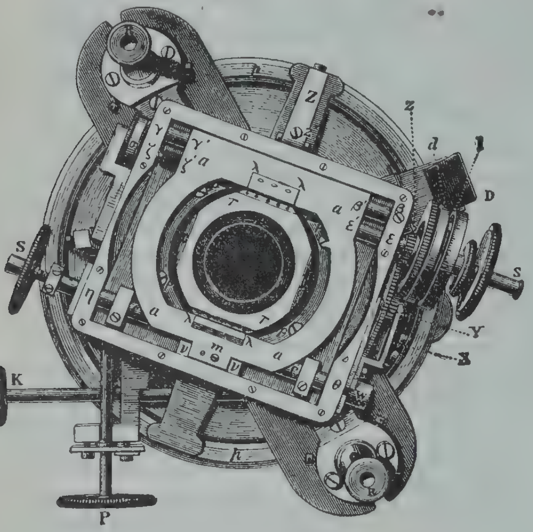

FIG. 9.

The box is mounted on a strong hollow steel cylinder CC (fig. 9) by holes η, θ in the ends of the box, which fit the cylinder closely and smoothly. The cylinder is rigidly fixed in the studs C, C, and these are attached to the foundation plate f. The cylinder contains towards η a sliding rod, and towards θ a compressed spiral spring. There is thus a thrust outwards of the spring upon the hollow cap W (attached outside the box), and a thrust of the rod upon the end of the screw s. The position of the box relative to the plate f, in the direction of measurement, depends therefore on the distance between the end of the screw s and the fixed stud C. A screwing in of s thus causes the box to move to the left, and vice versa. Rotation of the box round CC is prevented by downward pressure of the spring Z on a projection attached to the side of the box. The amount of this pressure is regulated by the screw z'.

The short screw whose divided milled head is σ shifts the zero of the micrometer by pushing, without turning, the short sliding rod whose flat end forms the *point d'appui* of the micrometer screw at ζ. The pitch of the screw σ is the same as that of the measuring screw (50 threads to the inch), and its motion can be limited by a stop to half a revolution.

The five fixed webs are attached to the table $\tau\tau$, which is secured to the bottom of the box by the screws ρ. The three movable webs are attached to the projections $\lambda\lambda$ on the frame aa. The plane surfaces $\tau\tau$ and $\lambda\lambda$ are composed of a bronze of very close texture, which appears capable of receiving a finish having almost the truth and polish of an optical surface. It seems also to take a very clean V cut, as the webs can be laid in their furrows with an astonishing ease and precision. These furrows have apparently been cut *in situ* with a very accurate engine; for not the slightest departure from parallelism can be detected in any of the movable webs relative to the fixed webs. Extraordinary care has evidently been bestowed in adjusting the parallelism and distance of the planes τ and λ, so that the movable wires shall almost, but not quite, touch the surface τ. The varnish to fix the webs is applied, not on the surface τ as is usual, but on a bevel for the purpose,[1] the position of the webs depending on their tension to keep them in their furrows. The result is that no trace of "fiddling" exists, and the movable and fixed webs come sharply together in focus with the highest powers. Under such powers the webs can be brought into apparent contact with such precision and delicacy that the uncertainty of measurement seems to lie as much in the estimation of the fraction of the division of the head as in the accuracy of the contact. It is a convenient feature in Repsolds' micrometer that the webs are very near the inner surface of the top of the box, so that the eye is not brought inconveniently close to the plate when high powers are used.

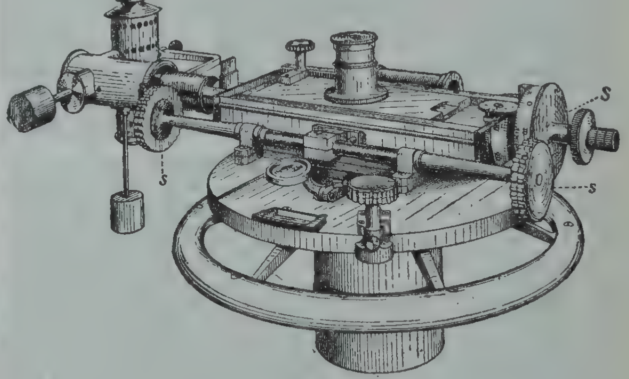

FIG. 10.

Another excellent micrometer, originally based on a model by Clark of Cambridge, Massachusetts, has been largely used by Burnham and others in America. The form, as constructed by Warner and Swasey for the 40-in. Yerkes telescope, is shown in figs. 10 and 11. The micrometer box, and of course with it the whole system of spider webs, is moved by the screw s, whilst the measuring web is independently moved by the screw S. The other parts of the instrument will be readily understood from the figure without further explanation. The method of counting the total number of revolutions gives more friction and is less convenient than Repsolds', and no provision seems to be made for illuminating the micrometer head in the practical and convenient plan adopted by Repsolds.

Repsolds' more recent form of the spider-line micrometer (since

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[1] The marks of varnish so applied will be seen in fig. 9.

1893) for large telescopes is shown in fig. 12. Quick motion in position-angle for rough setting or for the measurement of close double stars is given by the large ring R. The micrometer is clamped in position-angle by the screw K and slow motion in position-angle is given by the screw *p*. The small drum-head T opposite the micrometer head S turns a screw which acts upon a short cylinder that cannot turn but can move only in the direction of the axis of the micrometer screw. The end-plane of this cylinder receives the pressure of the micrometer screw, so that by turning the small drum-head the coincidence-reading of the movable web with the fixed web can be changed, and thus any given angle can be measured with different parts of the micrometer screw in order to eliminate the effects of periodic error of the screw. The electric lamp *a* gives illumination of the webs in a dark field, nearly in the manner described for the Cape transit circle micrometer; the intensity of illumination is regulated by a carbon-resistance controlled by the screw *b*. The lamp *c* illuminates the drum-head and also, by reflection, the portions of the position-circle which come under the microscopes *d* and *e*. The head *f* is a switch which enables the observer to illuminate lamp *a* or *c* at pleasure. These lamps, although shown in the figure, are in reality covered so as not to shine upon the observer's eye. The illumination of the field is given by a lamp near the object glass, controlled by a switch near the micrometer.

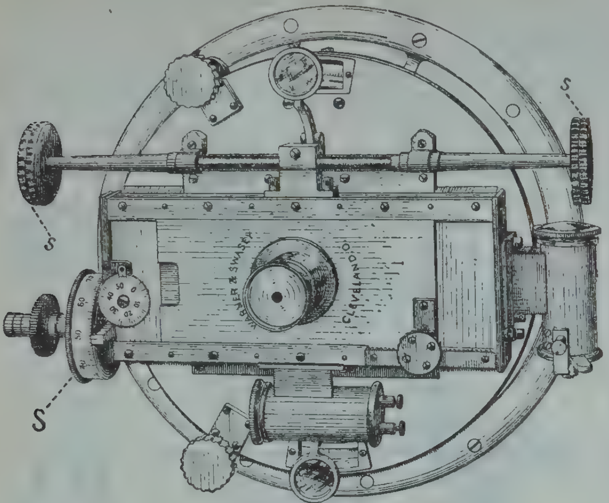


FIG. 11.

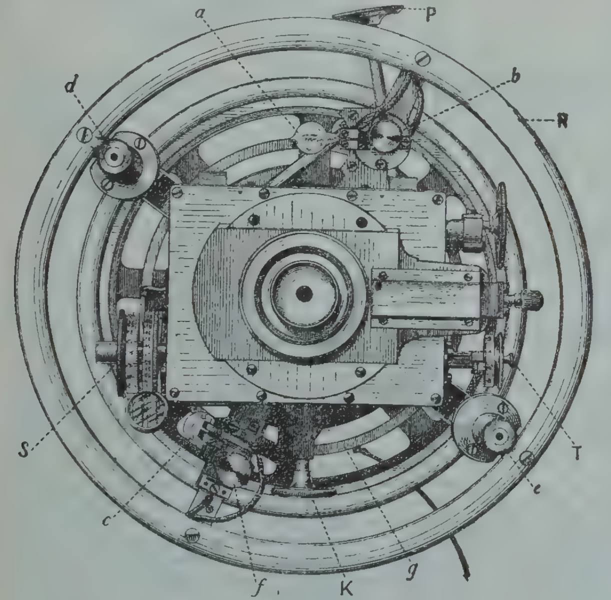


FIG. 12.

Repsolds in more recent micrometers under construction give a second motion to the eyepiece at right angles to the axis of the micrometer screw; this enables the observer to determine the zero of position-angle for his movable webs with the same accuracy as he formerly could only do for the so-called position-angle webs. Repsolds also provide two insulated sliding contact rings instead of the single ring *g*, so that the electric current for illuminating the lamps does not pass through the instrument itself but may come to the micrometer from the storage battery through two insulated leads. The same firm is also constructing a micrometer in which the readings of the head are printed on a band of paper instead of being read off at the time of observation.

Instruments have been invented by Alvan Clark and Sir Howard Grubb for measuring with the spider-line micrometer angles which are larger than the field of view of the eyepiece. In both cases two eyepieces are employed, one to view each separate web. One drawback to this form of instrument is that the two webs cannot be viewed simultaneously, and therefore the observer must rely on the steadiness of rate of the clockwork and uniformity in the conditions of refraction whilst the eye is moved from one eyepiece to the other.

Clark's micrometer was exhibited at the June meeting of the Royal Astronomical Society in 1859 (*Monthly Notices, R.A.S.*, vol. xix.). Grubb's duplex micrometer is described in the 9th edition of the *Encyclopaedia Britannica*. Some examples of use of the latter are given by Professor Pritchard (*Mem. R.A.S.* xlvii. 4–12), who estimates the accuracy attainable with the duplex micrometer as equal to that of the heliometer; but as few measures of permanent value have been made with the instrument, and those made exhibit an accuracy far inferior to that of the heliometer, it is unnecessary to describe the instrument here in greater detail.

The Reading Micrometer-Microscope.—Micrometers used for subdividing the spaces on graduated circles and scales have, in general, only a single pair of cross-webs or parallel webs moved by a single screw. The normal form of the apparatus is shown in figs. 13 and 14. C is the objective, D the micrometer box, E the graduated head of the screw, G the milled head by which the screw *cc* is turned, A an eyepiece sliding in a tube B, *aa* (fig. 14) the slide, and *b*, *b* the spiral springs. The focal length of the objective and the distance between the optical centre of the lens and the webs are so arranged that images of the divisions are formed in the plane of the webs, and the pitch of the screw is such that one division of the scale corresponds with some whole number of revolutions of the screw.

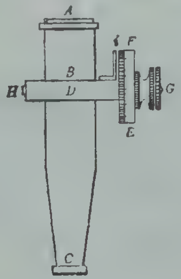


FIG. 13.

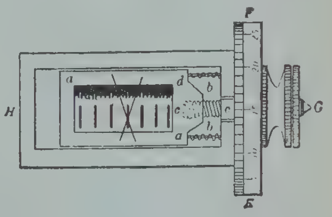


FIG. 14.

There is what is technically called a "comb" inserted in the micrometer box at *d* (fig. 14)—its upper surface being nearly in the plane of the wires. This comb does not move with reference to the box, and serves to indicate the whole revolution of which a fraction is read on the head. In fig. 14 a division is represented bisected by cross webs, and five revolutions of the screw correspond with one division of the scale. In all modern reading micrometers the cross webs of fig. 14 are replaced by parallel webs embracing the division (fig. 15). The means for changing the length of the tube and the distance of C from the scale are omitted in the figure. These appliances are required if the "run" has to be accurately adjusted. By "run" is meant the difference between the intended whole number of screw-revolutions and the actual measures of the space between two adjacent divisions of the scale in turns of the screw divided by the number of intended revolutions. In delicate researches two divisions of the scale should always be read, not merely for increased accuracy but to obtain the corrections for "run" from the observations themselves.

FIG. 15.

Repsolds employ for the micrometers of their reading microscopes the form of construction shown in fig. 9, omitting, of course, the motion of the whole micrometer box given by the screw *s* for those cases in which the axis of the micrometer is supposed to remain constant in position, as, for example, in the case of the reading microscopes of transit circles (see TRANSIT CIRCLE).

But when the relative positions of two adjacent objects or scale-divisions have to be determined (as, for example, in the case of heliometer scales), much time is saved by retaining the motion of the micrometer box. One double web, fixed in the box, is pointed symmetrically, as in fig. 15, on one of the scales, by moving the whole micrometer box by means of the screw *s*; the pair of webs, moved by the screw S, is then pointed upon an adjacent division on the other scale. If the reading for coincidence of the movable with the fixed webs is known, we then obtain from the single reading of S the difference from coincidence of the divisions of the two scales.

It is generally possible so to arrange the method of observation as to eliminate the effect of an error in "the reading for coincidence of the webs" from the results. This excellent time-saving contrivance has also been used in Gill's apparatus for measuring astrographic plates (see below).

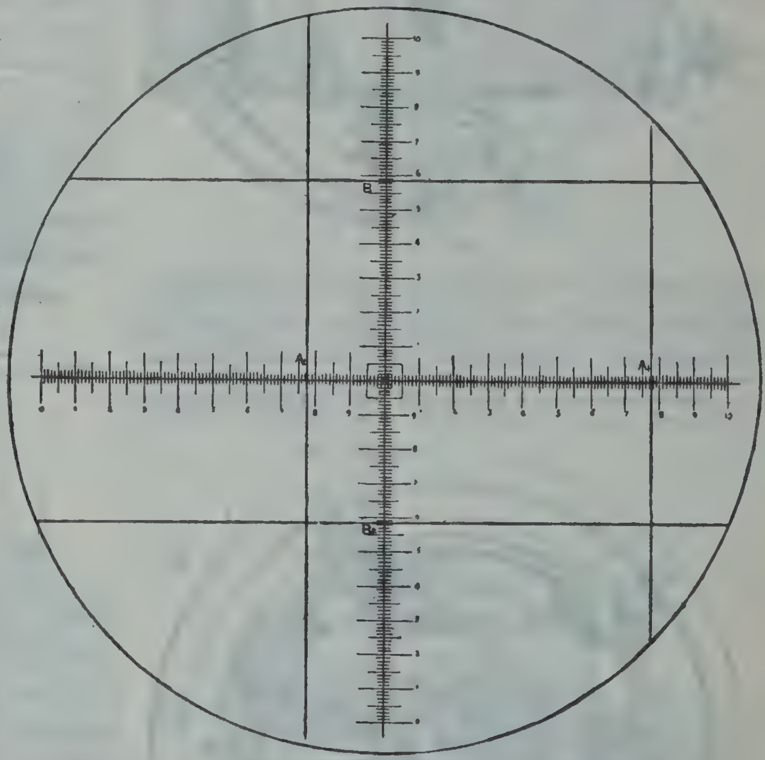
Ghost Micrometer.—C. E. Burton and Sir Howard Grubb (*Monthly Notices*, xli. 59), after calling attention to J. von Lamont's paper (*Jahrbuch der K. S. b. München*, p. 187) and K. L. von Littrow's paper (*Proc. of Vienna Acad. of Sciences*, xx. 253) on a like subject, proceed to describe a most ingenious form of "Ghost Micrometer," in which the *image* of a fine line or lines ruled in (or rather cut through) a silver film deposited on glass is formed at the common focus of an object-glass and eyepiece of a telescope. A faint light being thrown on the outside of the silvered plate, there appear bright lines in the field of view. We have not had an opportunity of testing this, nor Grubb's more recent models; but, should it be found possible to produce such images satisfactorily, without distortion and with an apparatus convenient and rigid in form, such micrometers may possibly supersede the filar micrometer. Their absolute freedom from diffraction, the perfect control of the illumination and thickness of the lines, and the accuracy with which it will be possible to construct scales for zone observations will be important features of the new method.

The Astrographic Micrometer or Measuring Machine.—The application of photography to exact astronomy has created the necessity for new forms of apparatus to measure the relative positions of stellar and planetary images on photographic plates, and the relative positions of lines in photographic spectra.

Especially important has been the problem of measuring the "catalogue plates" of the international *Carte du ciel*—a work that implies the determination of the positions of some millions of stars—that is to say, of all stars to the 11th or 12th magnitude. The problem has been how to accomplish this work with the minimum of labour consistent with the desired accuracy. The adoption of a réseau photographed upon the plate has greatly facilitated the procedure. A plate of parallel-surfaced glass has a film of silver deposited upon it. On this film is ruled a system of lines 5 mm. apart, and another similar system of lines at right angles to the first, thus dividing the silvered surface of the plate into squares 5 mm. on the side. The cutter employed to rule these lines removes the silver in fine lines from the surface of the glass. Thus, if a photographic plate, before it is exposed in the telescope, is placed with its sensitive surface nearly in contact with the silvered surface of this réseau, and if parallel light, normal to the surface of the plate, is allowed to fall on the silvered film through the glass on which the film has been deposited, that light will pass through the fine lines in the silver film where the silver has been removed by the cutter, but will otherwise be intercepted by the silver film. Thus a latent image of the "réseau-lines" will be formed on the sensitive plate, and, when the latter has been exposed to the sky in the telescope, we obtain, on development, a negative of the images both of the stars and of the réseau-lines. If the errors of the rectangular co-ordinates of these lines are known, the problem of determining the co-ordinates of any star-image on the plate becomes reduced to the comparatively simple one of interpolating the co-ordinates of the star relative to the sides of the 5 mm. square within which that image is included. This interpolation can, of course, be accomplished with the aid of a micrometer-microscope whose optical axis is normal to the plate, provided that the plate is mounted on slides which enable the observer to bring the réseau-squares successively under the microscope.

This system has an additional advantage beyond its convenience, viz. that if any distortion of the film takes place during development the same distortion will be communicated both to the star-images and to the réseau-lines, and consequently its effect will be eliminated from the resulting star co-ordinates, except in so far as the distortion within the 5 mm. square is of an irregular character; this exception is hardly worth consideration. An originally unanticipated difficulty has arisen from the fact that the réseau-lines have not been ruled on plates of optical glass with optical surfaces, and that, in consequence of irregular refraction in the glass plate, the rays do not always pass through the silver film-lines in a direction strictly normal to the silvered surface; therefore, if the sensitive surface of the photographic plate is not in contact with the silver film of the réseau, the undeveloped photographic copy of the réseau may in such a case not be an exact reproduction of the silvered réseau. It is practically impossible to work with the sensitive film in contact with the réseau-film, not only because dust particles and contact would injure the silver film, but also because the plate-glass used for the photographic plates is seldom a perfect plane. The discrepancies produced in this way are, however, very small, if care is taken to minimize the distance between the silver film and the photographic plate and to select a reasonably good piece of glass for the réseau. For very refined work, however, the irregularities in the reproduction of the réseau may be studied by comparing the measures of the original réseau with the mean of corresponding measures of a number of photographed copies of it.

At Greenwich, Oxford and several other observatories, instead of measuring the distances of the star's image from the opposite sides of the 5 mm. réseau-square by means of a spider-line micrometer, a glass scale, on the plan shown in fig. 16, is employed in the common focus of the objective and the eyepiece. The image of the star is set upon the intersections of the lines of the central cross, and the positions of the réseau-lines are read off by estimation to $\frac{1}{10}$ of a division on the glass scale. As each division corresponds to 3 sec. of arc, the nearest estimate corresponds with a nominal accuracy of ± 0·3″. This involves a loss of accuracy because, with a spider-line micrometer, the accidental error of pointing is of the order of ± 0·1″ of arc.



Greenwich Astrographic Catalogue, vol. i., by permission of the Controller of H.M. Stationery office.

Fig. 16.—Diagram of the diaphragm in eyepieces of the micrometer used for measuring the plates of the Astrographic Catalogue.

In the measuring machines in general use the field of view, as in the case of the glass-scale micrometer, is sufficiently large to include the image of the 5 mm. square. The microscope or viewing telescope is fitted with a spider-line micrometer having two screws at right angles to each other, by means of which readings can be made first on one réseau-line, then on the star, and finally on the opposite réseau-line in both co-ordinates. This form of micrometer is of course capable of giving results of high precision, but the drawback is that the process involves a minimum of six pointings and the entering of six screw-head readings in order to measure the two co-ordinates of the star.

Gill's Measuring Machine.—Sir David Gill (*Monthly Notices, R.A.S.* lix. 61) devised a measuring machine which combines the rapidity of the glass-scale micrometer with the accuracy of the spider-line micrometer and simplifies the reductions of the observations at the same time. The essential conditions of the instrument are:—

1. The object glass of the micrometer-microscope is placed midway between the plane of the photographic plate and the plane of the micrometer webs.

2. The micrometer is provided with a "fixed square" 5 mm. × 5 mm., the sides of this square being parallel spider webs 4″ of arc apart; the size of the square is reckoned from centre to centre of these double webs.

3. The two micrometer screws (X and Y, fig. 17), which actuate the movable slides, have heads divided into 100 parts, one revolution =0·5 mm.; so that ten revolutions are ≑ 5 mm., or = the interval between two adjacent réseau-lines, or = the interval between the sides of the "fixed square."

4. Two other screws, *o*, *p*, the heads of which are not graduated, give motions to the whole micrometer box through ≑ 1 mm. in directions parallel to the axes of the two micrometer screws.

5. Each of the two micrometer screws X and Y moves a system of six parallel webs, placed 4″ of arc apart from each other. These webs serve not only for pointing on stars to determine their co-ordinates (in manner afterwards described), but also for estimating the diameters of the star-images in terms of these 4″ intervals.

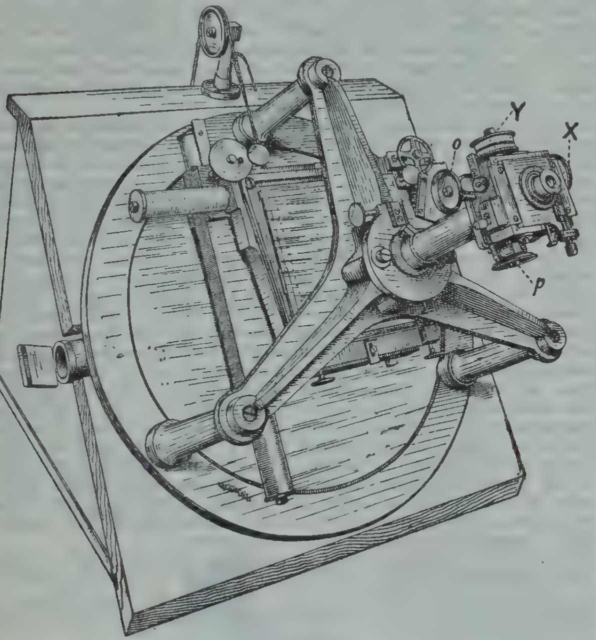


FIG. 17.

6. All the essential parts of the micrometer, including the slides, micrometer box, tube, &c., are of steel or cast-iron, so that changes of temperature do not affect the adjustments.

The necessary adjustments are the following:—

1. The webs of each set of movable webs shall, *inter se*, be strictly parallel, and the two sets shall be strictly at right angles to each other.

2. The double webs composing the sides of the fixed square shall be strictly parallel, and shall form a true square of exactly ten revolutions of the screw on the side.

3. The two micrometer screws shall be without sensible periodic or other error, and exactly alike in pitch.

4. The micrometer readings for coincidence of the movable webs with the webs of the fixed square shall be exactly $0{\cdot}000^{\mathrm{R}}$ and $10{\cdot}000^{\mathrm{R}}$.

5. The image of a normal réseau-square, as viewed in the microscope, shall exactly coincide with the square formed by the fixed webs—that is to say, the image of the sides of a normal réseau-square shall measure exactly 10 screw-revolutions.

Assuming that these conditions can be rigidly realized, we have the following very simple *modus operandi*:—

1. By means of the quick rack motions A and B move the plate so as to bring the réseau-square into the centre of the field of the micrometer; then, by means of the screw heads *o*, *p*, perfect the coincidence of the "fixed square" of webs, with the image of the réseau-square.

2. By means of one of the micrometer screws X place the star's image in the middle of the six parallel webs which are moved by X.

3. Similarly, place the star's image in the middle of the webs moved by Y.

4. Estimate the diameter of the star's image in terms of the 4″ intervals of the movable webs.

By employing both hands, operation (1) can be made as quickly as a single pointing with the ordinary spider-line micrometer, and operations (2) and (3) can be similarly performed in the time required for a single pointing. The reading (2) is then the required co-ordinate in x and that of (3) is the required co-ordinate in y; or, if the plate is reversed, 180°, these readings have to be subtracted from $10{\cdot}000^{\mathrm{R}}$.

A general idea of the construction of the machine can be gathered from fig. 17 above, but the reader will find a detailed account of it, and of the manner in which the requisite adjustments are made, in the paper already quoted.

The apparatus has been used with complete success at the Royal Observatory, Cape of Good Hope, and at Melbourne, Sydney and Córdoba.

Effects of Wear on the Micrometer Screws.—The accuracy of this apparatus has been frequently criticized on the ground that errors are produced in the screws by the effect of wear. One reply to this is that it is not difficult to determine from time to time the errors of the screws and to apply the necessary corrections to the observations. But a little consideration will show that when the plate is reversed 180° the effects of errors of the screws produced by wear are practically eliminated.

In discussing the effect of wear upon a screw, it will be convenient to imagine the thread unrolled and forming a wedge, of which we can represent the unworn bearing-side by a straight line AB (fig. 18), on which rubs the block CD, which represents the female screw or bush, and moves between the points E and F, sometimes towards E, sometimes towards F, but having as often to measure short distances as long distances from the middle point of this range, and these as often towards E as towards F. Now, if CD is pressed by its weight or by a spring on the surface AB, the effect of wear will be to produce a symmetrical grinding away of both surfaces, which may be represented thus, fig. 19. That is to say, the screw-errors will be identical for revolution n and for $10-n$, and thus will disappear in their effect in the mean of observations made in reversed positions of the plate. At the Cape of Good Hope, after more than 200,000 pointings had been made, the screw-errors were redetermined; the results proved the truth of the above conclusions, viz. the absolute freedom of the derived co-ordinates from the effects of wear of the screws in the mean of measures made in reversed positions of the plate.

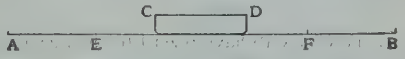


FIG. 18.

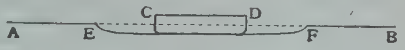


FIG. 19.

Hinks's Measuring Machine.—A very refined modification of the Cape machine is described by A. Hinks (*Monthly Notices, R.A.S.*, vol. 61, p. 444), and the instrument contains many elegant mechanical and optical details due to Horace Darwin and Messrs Zeiss respectively.

Its fundamental principle is that, by a combination of glass scales with a micrometer screw, "the chief part of the distance to be measured is read off on the scale; the fractional part of the scale-space is not estimated but measured by the screw." Hinks claims that thus never more than one- or two-tenths of a revolution of the screw need be used in making the measure, and little time is lost in running the screw backwards and forwards. All this is true, but three readings instead of one for each pointing, much more figure-work in computation (especially if corrections have to be applied to the scale readings to reduce them to exact normal screw readings), are factors which involve a far greater expenditure of time than making a few additional turns of a screw in the process of measurement. Hinks's further claim that, in consequence of the small motion of the screw, less error is produced in the screw by wear is not true; for, although large movements of the screw produce a large amount of wear, that wear is spread over longer parts of the screw but remains the same for any particular part of the screw; the resulting errors are exaggerated towards the extremity of the range of screw employed (see *Monthly Notices, R.A.S.*, vol. 45, p. 83), and are therefore more likely to produce errors which are not eliminated on reversal of the plate in cases where the screw range is not strictly limited, and the wear therefore not strictly symmetrical.

The excellent manner in which the scales and micrometers are mounted, the employment of a compound microscope for viewing the scales, with its ingeniously arranged and admirably efficient reversing prism, and the perfection of its slow motions for focusing and reading, combine to render this a most accurate and convenient instrument for very refined measures, although too slow for work in which the measures must depend on single pointings in each of two reversed positions of the plate, and where speed of working is essential.

Apparatus for Measuring Star-Spectra, &c.—These machines may be divided into three classes, viz. A, in which the motion of the slide which carries the photographic plate is measured entirely by a screw; B, in which that motion is measured by combination of a scale and screw; and C, in which the photographic plate is fixed and the measuring microscope is moved.

The chief drawback to type A is that the errors of the screw are liable to change by wear, otherwise the apparatus, as made and used at Potsdam, is, on the whole, a convenient and accurate one. In determining the errors of the screw of the Potsdam form of machine it is necessary to have regard to the fact that the screw is placed at one side of the slide, as in fig. 20.

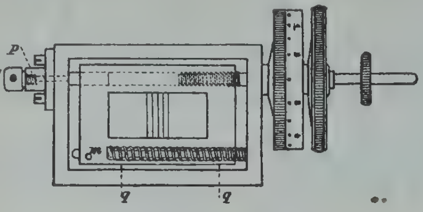


FIG. 20.

The result is that, if the screw is bent—if, for example, the end of the frame next the screw-head is raised and that next the end *p* is lowered in the diagram—a twist will be given to the web-frame, and the centre of the web will be moved nearer to the micrometer-drum than it should be, whilst the reverse effect will follow when the head has been turned 180°. This would, of course, create a periodic error, which would be determinable for the motion of any particular point (say the middle) of the web, but which would be smaller for a point near the axis of the screw and greater for a point farther from that axis. In the Potsdam form of this apparatus the micrometer is, for convenience, provided with a motion at right angles to the axis of the screw, and it has been found at the Cape Observatory that the periodic errors in this apparatus do vary very sensibly according as the microscope is directed to a point more or less distant from the measuring screw. Since the discovery of this fact all measurements have been made in that fixed position of the microscope with respect to the axis of the screw for which the errors of the screw have been determined.

In the apparatus of type B as made by Zeiss there are two microscopes attached to a base-plate, one of which views the spectrum-plate (or other object) to be measured, while the other views a scale that moves with the slide on which the spectrum-plate is mounted. In this way the scale can be viewed by a microscope of much higher magnifying power than can be employed for the photographed spectrum. Indeed, if the scale were subdivided to $\frac{1}{10}$ mm. the power employed might only be limited by the sharpness of the division-lines. But for refined work this would imply the investigation of too many divisions of the scale; it is therefore more usual to divide the scale into single millimetres or half-millimetres and to provide a micrometer which subdivides the millimetre into 1000 or, by estimation, into 10,000 parts. For very accurate work it is desirable that the base-plate, the slide and the scale should be of nickel steel, having the same thermal coefficient of expansion as glass.

The forms of measuring machines of type C, often seen in physical laboratories, should be at once rejected for refined measurements, because it is impossible to construct slides of such perfection that the axis of the microscope will remain absolutely normal to the surface of the plate (assumed to be a plane) throughout the range of measurement. Even if the slide itself is mechanically perfect, the irregularity in the thickness of the lubricating oil between the bearing surfaces of the slide is apt to produce a variable error.

Bakhuyzen (*Bulletin de Com. perm. congres. astrog*, i. 164) described a measuring-machine by Repsolds, in which the micrometer-microscope tilts in the bearings of the chariot on which it moves, so that it can view either a graduated scale or the photographic plate. We have, in fact, in this instrument a combination of types B and C. Even in this apparatus if the slide on which the chariot moves is not perfect (and no slide is perfect), the azimuth of the axis of the microscope is liable to change in the course of movement of the slide, and thus equal spaces on the scale will not be represented by equal spaces on the plate under measurement. The remedy proposed by Repsold for this proved fault is to cause the whole slide to tilt instead of the microscope only; this should prove a complete remedy.

The Travelling Wire Micrometer.—An important modern application of the micrometer, which is not dealt with in the article TRANSIT CIRCLE, is that which is now called "the travelling wire micrometer."

In the *Astronomische Nachrichten*, No. 2940, Dr Repsold proposed a method of meridian observing which consists in causing a web to follow the image of a star in transit by motions communicated by the observer's hands alone, whilst electrical contacts on the drum of the micrometer screw register on the chronograph the instants corresponding to known intervals from the line of collimation. The purpose of his paper was to show that if the axis, by which the observer imparts motion to the slide on which the travelling web is mounted, is provided with two disks at its extremities, so that the observer can use the thumb and finger of *both* hands in rotating it, there is no difficulty, after a little practice, in keeping the web constantly bisecting the star in transit, and that with a little practice the mean of the absolute errors in following the star becomes nearly zero.

In the *Astron. Nach.*, No. 3377, Repsold gives a detailed description of two forms of eye-ends of transit circles, fitted with means of observing in this manner, to which he gives the name of "the impersonal micrometer." This method of observation was very successfully employed, under Seeliger at Munich, in an extensive series of meridian observations, and, under the auspices of the Geodetic Institute at Potsdam, in telegraphic longitude operations. Still more recently the method has been largely employed at the Cape of Good Hope and elsewhere.

Under the date March 1901 Dr H. Struve published an account of the application of clockwork as an aid in Repsold's method; and, later, Dr Cohn published a more elaborate paper on the same subject in the *Astron. Nach.*, 3767. The method consisted in having motion transmitted to the micrometer screw from an axis on which is mounted a disk that presses with friction-contact upon a cone that revolves uniformly by clockwork. The velocity of rotation of the micrometer-screw could therefore be varied for stars of different declination by varying the distance from the apex at which the revolving disk presses upon the revolving cone. In the Königsberg transit instrument used by Struve and Cohn, the clockwork was attached to the eye-end of the instrument—a condition which is obviously undesirable both from the necessarily unsymmetrical position of the clockwork with respect to the optical axis, and from the impossibility of securing the uniform going of the clock in different positions of the instrument. In more recent instruments at the observatories of the Cape of Good Hope and Paris the motion is transmitted from a separately mounted cone and clock by a light rod passing through a perforation in the pivot of the transit instrument and thence through bevel-wheels in the cube of the axis to a second rod leading to the eyepiece. This rod turns a worm-screw which acts on a worm-wheel fitted "spring tight" upon the axis of the micrometer-screw.

It should be mentioned that an essential feature of the travelling wire micrometer is that the eyepiece as well as the wire shall be moved by the micrometer-screw. Thus, if the star's image is kept in bisection by the wire, both star and wire will appear at rest in the field of view.

The distinction between the old and new method of observation may thus, in one sense, be described as the difference between shooting at a moving object and in shooting at one at rest. In the case of the original Repsold plan without clockwork the description is not quite exact, because both the process of following the object and correcting the aim are simultaneously performed; whilst, if the clockwork runs uniformly and the friction-disk is set to the proper distance from the apex of the cone, the star will appear almost perfectly at rest, and the observer has only to apply delicate corrections by differential gear—a condition which is exactly analogous to that of training a modern gun-sight upon a fixed object. It is impossible in this article to give a detailed description of the apparatus, but the reader is referred to *Astron. Nach.*, 3377, for an illustrated account of the original Repsolds instrument and to the *History and Description of the Cape Observatory* for a complete description of the most modern form of its application to the Cape transit circle, with and without clockwork.

The Hartmann Spectrocomparator.—For accurate measurement of the displacements of lines of stellar spectra which are produced by the relative motion of star and observer in the line of sight, a very beautiful instrument has been devised by Dr J. Hartmann of Potsdam, and is described by him in the *Publicationen des astrophysikalischen Observatoriums zu Potsdam*, Bd. 18, Stück 53 (1906). An English translation of this paper is given in the *Astrophysical Journal*, xxiv. 285–302. The method originally used by Huggins, who first conceived and proved the possibility of measuring stellar velocities in the line of sight, was to measure with a filar micrometer the displacement of some well-known line in a stellar spectrum relative to the corresponding line of a terrestrial spectrum. Vogel of Potsdam introduced the method of photographing stellar and terrestrial spectra on the same plate, and in this way obtained an immense advance in the ease and precision of observation. Vogel and his successors employed one or other form of measuring machine, provided with a microscope having single or close parallel webs which could be successively pointed on the photographed lines of the star spectrum and the lines of the terrestrial spectrum. To derive the stellar velocity in the line of sight relative to the observer it was then necessary to assume that the normal wave-lengths of the stellar and terrestrial spectra are accurately known. But in the complex spectra of stars of the solar type this is by no means the case; for, as Dr Hartmann remarks, "in the first place the lines in these spectra are so numerous that their complete measurement and reduction would require many days, and in the second place a rigorous reduction of such material has hitherto not been at all possible because the wave-lengths of the lines are not known with sufficient accuracy. On this account, observers have until now limited themselves to a partial treatment of such spectra, measuring only a small number of lines, whereby the major part of the rich material present in the plate remains unutilized." But the spectroscopes that can be employed for stellar spectrographs are not sufficiently powerful to separate fully lines which are very closely adjacent, and therefore a line, assumed to be of a known wave-length, may be *apparently* displaced by the near neighbourhood of an unknown line. Hartmann overcame these and many other difficulties by directly superposing the image of the spectrogram of a star, having iron comparison lines, upon the image of a spectrogram of the sun taken also with iron comparison lines.

The apparatus for this purpose is shown in fig. 21, its principle of construction is shown in figs. 22 and 23. The solar spectrograph is attached by clamps to the plate A_1, the stellar spectrograph to the plate A_2. The plate A_1 is mounted on the dove-tailed slide B_1, upon the metallic stage T, and can be moved to right or left relative to T by the micrometer-screw S; whilst the plate A_2 is mounted on the dove-tailed slide B_2 and can be moved at right angles to its greatest length by the screw G. The micrometer-screw S has a pitch of 0·5 mm., its head is divided into 100 parts. Two spiral springs underneath press the plate B_1 with its agate end-bearing against the rounded end of the screw S. The whole number of revolutions of the screw is read by the scale X (fig. 23). The whole stage T, carrying both spectrograms, can be moved from right to left on the steel cylinder Z, by turning the head K, on the axis of which is a pinion that gears into a toothed rack attached to the lower side of the cylinder Z. A scale N on the cylinder Z serves for setting the slide to any required position. The preliminary conditions of measurement are:—

1. The centre of both spectrographs shall be parallel to the axis of the cylinder Z.

2. The distance between the centres of the two spectrographs shall be equal to the distance between the optical axes of the two viewing microscopes.

3. The scales of the images formed in the focus of the eyepiece common to both microscopes shall be identical.

To fulfil condition (1) the plates A_1 and A_2 are mounted in circular slides, whose centres are E_1 and E_2 respectively, so that by means of the screws D_1, D_2, with their corresponding opposing springs F_1 and F_2, the operation can be very easily accomplished. To fulfil condition (2) the two microscopes whose object glasses are O_1 and O_2 (fig. 22) are attached to the plate L, their optical axes being normal to the stage T. The screw Q serves to adjust the axis of O_1 to coincidence with the centre of the lines of the solar spectrograph, and the screw G then serves to move the slide B_2 till the optical axis of O_2 is coincident with the centre of the lines of the stellar spectrograph. Suppose now the solar spectrogram to be viewed in the focus of O_1, and the converging rays to be reflected by the prisms P_1 and P_3, till an image is formed in the focus of the eyepiece at the point where the axis of the eyepiece intersects

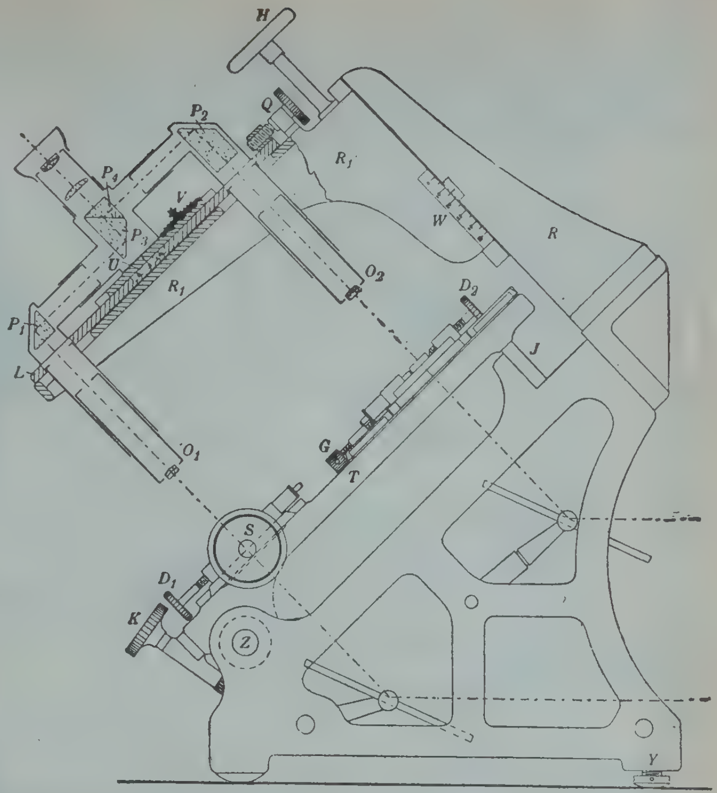


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FIG. 22.

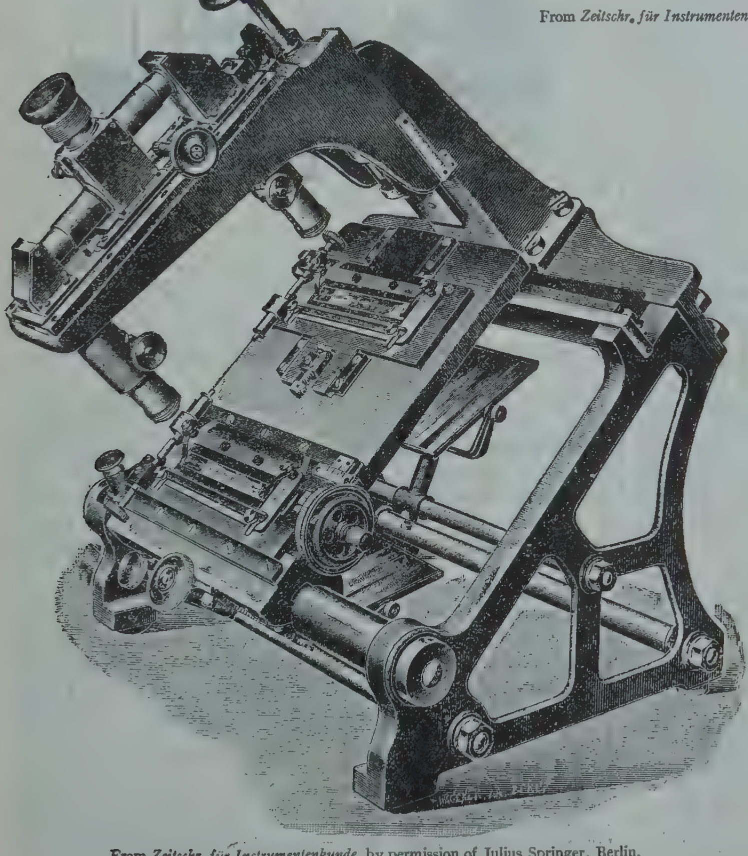

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FIG. 21.

the upper face of the prism P_3. Then if the prism P_4 is cemented to P_3, a sharp image of such lines of the solar spectrograph as are visible in the field of view will be seen in the eyepiece. If the stellar spectrograph is viewed in the focus of O_2 and the converging rays are reflected by the prism P_2 to P_4, no image would be seen in the eyepiece, for the rays would pass out directly through the parallel glass plate which is formed by the cementing together of the prisms P_3 and P_4. But if the cemented face of P_4 is silvered, then the lines of the stellar spectrogram would be seen in focus of the eyepiece and the image of the solar spectrograph would be obliterated. Therefore, if one-half of the cemented face of P_4 is silvered, it becomes possible to view, side by side, one-half of the image of the solar spectrograph formed by O_1 and one-half of the image of the stellar spectrograph formed by O_2. A prism half silvered in this way is provided, which enables the observer to compare the equality of scale of both photographs. If, for example, it is found that the image of the solar spectrograph is the larger of the two it becomes necessary to adjust the object glass O_1 farther from the stellar spectrograph. This has the effect of forming the image of the latter farther from the observer's eye, and so it becomes necessary to turn the handle of the rack-pinion V in such a way as to move the prisms P_3 and P_4 nearer to P_2 till the lines of the stellar spectrograph are again sharply in focus. The effect of turning the pinion V is, of course, to displace the focus both of the solar and stellar spectrographs in the field of the eyepiece, but this displacement is easily restored by the focussing screws O_1 and O_2. By successive adjustments of this kind condition (3) can be accurately realized.

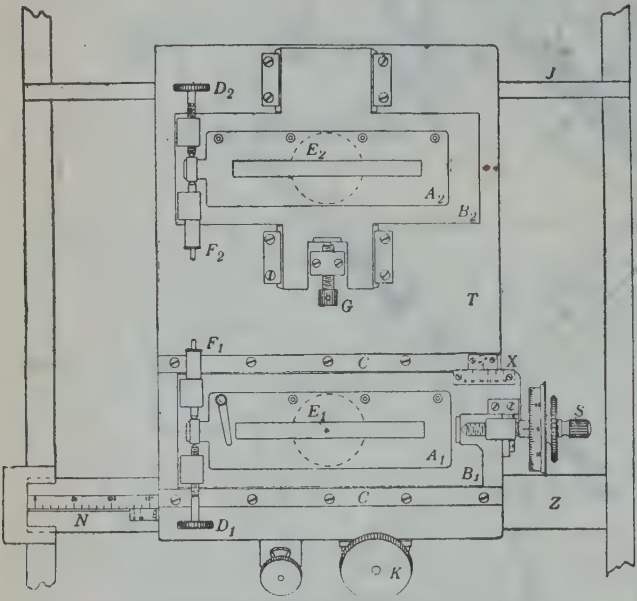

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FIG. 23.

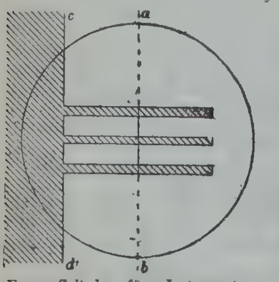

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FIG. 24.

These three adjustments having been made, the prisms P_3 and P_4 are removed and replaced by another prism in which the silvering is arranged as in fig. 24, where the hatched lines denote the silvered surfaces. The narrow tongues of the silvered surface will now reflect corresponding parts of the star-spectrograph, and will obliterate corresponding parts of the solar spectrograph—as shown in figs. 25 and 26. Fig. 25 shows the stellar and solar lines of the two spectrographs in coincidence, whilst the metallic lines of comparison are non-coincident. Fig. 26 shows the metallic lines of comparison in coincidence whilst the solar and stellar lines are non-coincident. It is obvious that these two conditions can be produced at the will of the observer by simply turning the screw S, and that the difference of the readings of the screw-head, which are required to reproduce the two conditions in question, gives a measure of the displacement of the stellar lines relative to the solar lines. If then the screw-value in kilometres per second is known for the neighbourhood of each of the comparison lines employed, the radial velocity of the star can be independently derived directly from coincidences made in above manner in the neighbourhood of each comparison line. For the special purpose of determining the solar parallax this instrument has been used in a most refined and perfect manner by Dr Halm at the Cape of Good Hope (*Annals of the Cape Observatory*, vol. x. part 3).

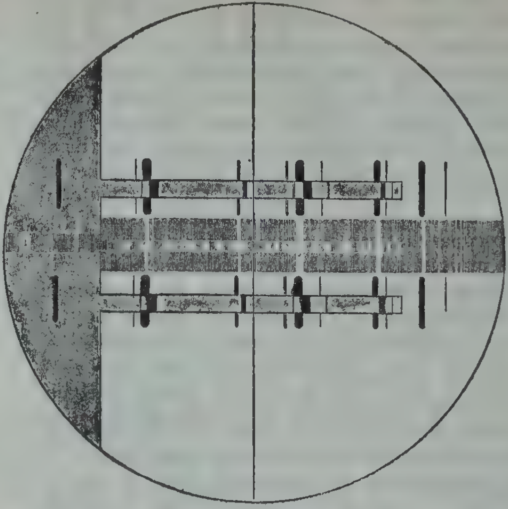

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FIG. 25.

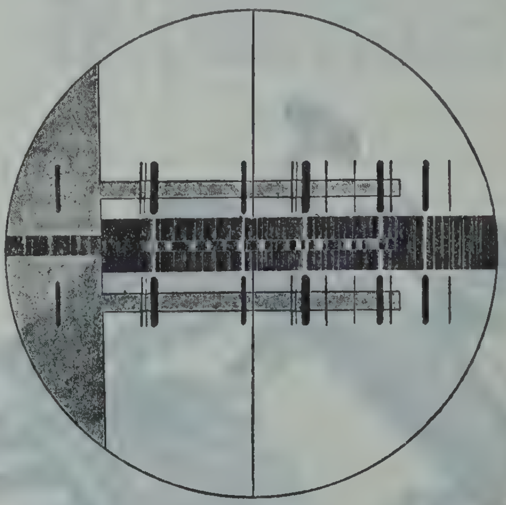

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FIG. 26.

Double Image Micrometers are described in the article HELIOMETER (*q.v.*). (D. GL.)

MICRONESIA (from Gr. μικρός, small, and νῆσος, island), one of the three great divisions of the oceanic islands in the central and western Pacific. Lying to the north of Melanesia, it embraces the following groups: Mariana, Pelew, Caroline, Marshall and Gilbert. See articles under these headings, and PACIFIC OCEAN (section on *Islands*).

The Micronesian islanders form in the main a branch of the Polynesian race, but distinguished from it by well-marked differences in appearance, language and institutions. Many of the islanders, however, show signs of hybridism. The proximity of Japan and the Philippines[1] on the west, and of the Papuan

The traditions of the Gilbert Islanders tell us that their islands and South Polynesian islands on the south and south-east, suggests, what in fact is found, a combination of races. In some places the oblique Mongolian eye is noticed, and (together with certain Indo-Chinese customs) there is often a scantiness of beard and general "Malay" look, which increases westwards, and seems to imply relations with the archipelago subsequent to the departure thence of the pure Polynesians. In the Gilberts the traces of Polynesian (Samoan) influences are evident, and are confirmed by tradition. Among the Carolines and the Marshalls darker and more savage communities are found, suggesting a Melanesian element, which is further traceable in the Ebon (Marshall) and other languages.

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[1] There are authenticated instances of Japanese junks, with living people in them, having been found in various parts of the North Pacific. In 1814 the British brig "Forester" met with one off the coast of California (about 30° N. lat.), with three living men and fourteen dead bodies on board. In December 1832 a Japanese junk arrived at the Hawaiian Islands with four of the crew living. If these junks could cross the Pacific in the latitude of Hawaii it is not at all unlikely that others running in a south-easterly direction would reach some of the many atolls which stretch over about 35° of longitude, forming the Caroline and Marshall archipelagoes.

Each of the four main groups, viz. the Caroline, Marshall, Gilbert and Ladrone (Mariana), from long isolation, has developed ethnological peculiarities of its own. The most advanced folk were the "Chamorros" of the Ladrones, owing to the greater natural resources of the islands, and perhaps more frequent contact with influences from the west; but as a separate people they no longer exist, having been nearly exterminated by the Spaniards in the 17th century. Next in advancement come the Caroline islanders. The general Micronesian type is a well-proportioned rather slightly built figure, with small and regular features; head high and well proportioned, but forehead rather retreating and narrow at the temples; cheek bones and chin slightly prominent; straight black hair, lanker than that of the Polynesians, colour somewhat darker than the Polynesians, the Marshalls being darker and more vigorous than the Carolines, while the Gilbert type, though smaller than the latter, is still darker and coarser. The upper class greatly surpasses the common people in physique and intelligence.

There is a division of society into septs or clans, the membership of which constitutes the closest tie. Persons of the same sept must not intermarry, and when two islands or communities meet in war the members of one sept, however widely separated by distance of space or time, will not injure or fight with each other. Each community is usually composed (but there are local differences) of—(1) an upper class of chiefs, from among whom the head (*tamol* or *iros*) is chosen; (2) a lower but still noble class; and (3) common people, mostly without rights of property. These last are only allowed one wife. Here and there are traces, as in Tonga, of a spiritual sovereign, the descendants probably of a conquered dynasty. Succession is through the female side, which assures to women a certain position, and leads besides to some curious results (see paper by J. S. Kubary in *Das Ausland*, 1880, No. 27). The upper class are the keepers of traditions, boat-builders, leaders of expeditions; tattooing is generally done by them, the amount increasing with a man's rank; the custom here still has definite religious associations. Both sexes are tattooed.

The Marshall Islanders are the boldest and most skilful navigators in the Pacific. Their voyages of many months' duration, in great canoes sailing with outrigger to windward, well-provisioned, and depending on the skies for fresh water, help to show how the Pacific was colonized. They have a sort of chart, *medo*, of small sticks tied together, representing the positions of islands and the directions of the winds and currents. A two-edged weapon, of which the blade is of sharks' teeth, and a defensive armour of braided sennit, are also peculiar to the islands; a large adze, made of the shell of the *Tridacna gigas* (the largest bivalve known), was formerly used in the Carolines, probably by the old builder race.

The dialects of Micronesia, though grammatically alike, differ widely in their vocabularies. They have the chief characteristics of the Polynesian, with Malay affinities, and peculiarities such as the use of suffixes and inseparable pronouns and, as in Tagal, of the infix to denote changes in the verb; in the west groups there is a tendency to closed syllables and double consonants, and a use of the palatals *ch*, *j*, *sh*, the dental *th*, and *s* (the last perhaps only in foreign words), which is alien to the Polynesian. These letters are wanting in the Gilbert language, which differs considerably from all the others, and has much greater affinities with the Polynesian. Most words take the accent on the penult. In some of the dialects there appears to be no true article, but in the Gilbert Islands the Polynesian *te* is used for both definite and indefinite article. Gender is sexual only. Number in the noun is either gathered from the requirement of the sense or is marked by pronominal words or numerals. Case is known by the position of the noun in the sentence or by prepositions. In the language of Ebon, one of the islands in the Marshall archipelago, nouns have the peculiarity which is characteristic of the Papuan languages: those which indicate close relationship—as of a son to a father, or of the members of a person's body—take a pronominal suffix which gives them the appearance of inflexions. Many words are used indiscriminately as nouns, adjectives or verbs, without any change of form. In some languages the personal pronouns are singular, dual and plural. In others there are no special dual forms, but the numeral for two is used to indicate the dual. In the Ebon language there are inclusive and exclusive forms of the personal pronouns which, so far as has been ascertained, do not occur in any of the other languages. The verbs usually have no inflexions to express relations of voice, mood, tense, number of person—such distinctions being indicated by particles. In the Ebon language, however, the tenses are sometimes marked; but in that the simple form of the verb is frequently given. All have verbal directive particles. In Ponape, one of the Caroline Islands, many words of ceremony are used in addressing chiefs, as they are used in Samoa. The custom of tabooing words is also found there as it is in the Polynesian languages.

The religious myths are generally identifiable with the Polynesian, but a belief in the gods proper is overshadowed by a general deification of ancestors, who are supposed from time to time to occupy certain blocks of stone, set up near the family dwelling, and surrounded by circles of smaller ones. These stones are anointed with oil, and worshipped with prayer and offerings, and are also used for purposes of divination, in which, and in various omens, there is a general belief. In the Marshalls, in place of these stones, certain palm trees are similarly enclosed. The spirits also sometimes inhabit certain birds or fishes, which are then taboo, as food, to the family; but they will help to catch them for others. Temples are very rare, though these blocks of coral are sometimes surrounded by a roofless enclosure opening to the west. The bodies of the dead, and sometimes even of the sick, are despatched to sea westwards, with certain rites; those of the chiefs, however, are buried, for the order has something essentially divine about it; their bodies therefore are sacred, and their spirits naturally assume the position above described. Such a belief greatly strengthened the king's authority, for the spirits of his ancestors were necessarily more powerful than any other spirits. Thus too it comes that the chiefs, and all belonging to them, are taboo as regards the common people. There are various other subjects and occasions of taboo, but the institution has not the oppressive and all-pervading character which it has in Polynesia. Its action is often economical or charitable, *e.g.* the ripening coco-nuts are taboo as long as the bread-fruit lasts, thus securing the former for future use; or it is put on after a death, and the nuts thus saved are given to the family—a kindness to them, and a mark of respect for the dead.

The houses in the Gilberts and Marshalls (much less elaborate than in the Carolines) consist merely of a thatched roof resting on posts or on blocks of coral about 3 ft. high, with a floor at that level, which is reached from an opening in the centre. On this the principal people sleep, and it serves as a storehouse inaccessible to rats, which infest all the islands.

MICRONUCLEUS, the smaller nucleus in Infusoria (*q.v.*). In fission it divides by mitosis, and in conjugation furnishes the pairing or gametonuclei, by whose reciprocal fusion a zygote-nucleus is formed, which gives rise to the meganuclei and micronuclei of the individuals of the next cycle of fission.

MICROPEGMATITE, in petrology, a very fine intergrowth of quartz and alkali felspar, occurring as the last product of consolidation in many igneous rocks which contain high or moderately high percentages of silica. It shows the same structure on a minute scale as certain pegmatites (*q.v.*) or coarse granitic veins do on a large scale (see Petrology, Pl. 2, figs. 6 and 8); the quartz forms angular patches scattered through a matrix of felspar. In polarized light the separate areas of each mineral extinguish at the same time, and this proves that even though apparently discontinuous they have the same crystalline orientation. The felspar may be considered an irregular crystal of spongy structure, the interstices being filled up by another spongy crystal of quartz. This kind of mineral intergrowth is said to be "graphic," because the coarsely graphic veins have triangular quartz areas dotted over a felspathic background resembling certain primitive inscriptions. Micropegmatite differs from "graphic granite" only in being so much finer grained that its nature can only be detected with the microscope. The felspar of micropegmatite is usually orthoclase, but sometimes albite, oligoclase or microcline. Occasionally it has crystalline form, and then it has been proved that the quartz

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were peopled from the west and also from the east. Those who came from the east are expressly said to be from Samoa. Those from the west were more numerous than those from the east. There are also traditions of the arrival of other strangers at some of these islands. On the island of Peru, in the Gilbert group, in 1869 there was still the remnants of a large proah which, from the description given, appears to have been like those used in the Indian Archipelago.

may be so disposed that the two minerals have a definite relation between their crystallographic axes (parallel growth). The quartz typically occurs as angular patches; at other times it forms club-shaped, curved or vermiform threads (vermicular micropegmatite, myrmekite), and then some authors consider that the felspar has been corroded and the quartz fills up the spaces thus produced (*quartz de corrosion* of French petrographers). Micropegmatite is often so fine grained that even in the thinnest sections and with high powers it cannot be resolved into its components. This fine micropegmatite resembles threads, having a divergent arrangement. In some rocks the whole ground mass consists of such spherulitic growths of fibrous micropegmatite (see QUARTZ—PORPHYRY); in their centres there is often a quartz or felspar crystal; the outer boundaries of the spherulites are not usually circular but irregular owing to the interlocking of adjacent spherulites at their margins ("granophyric structure"). Micrographic structures may occur in other minerals, *e.g.* quartz and garnet, cordierite, epidote or hornblende, augite and felspar, but are less common, and the name micropegmatite is usually reserved for aggregates of quartz and felspar.

In rocks where micropegmatite frequently occurs (*e.g.* granite, porphyry and granophyre, quartz-diorite) it is usually the last product of consolidation, and represents the mother liquor left over after the other minerals had separated out in more or less perfect crystals. Hence it has no definite form of its own, but fills up the irregular interspaces between the earlier crystallizations. For that reason it has been compared to a eutectic, and supposed to be the mixture of quartz and felspar which has the lowest fusion point. Eutectics are common in alloys and often have a very perfect micrographic structure. The eutectic mixture of quartz and orthoclase has been estimated to contain 70–75% of the latter. This theory, however, is not without its difficulties; analyses of micropegmatite prove that its composition is by no means constant (this may perhaps be due to small admixtures of soda and lime felspars); and experimental researches on the fusion points of mixtures of quartz and felspar have not yet shown that there is a definite mixture which melts at a lower temperature than any other. Furthermore micropegmatite is not always the last consolidation product, as a eutectic should be, but may occur as well-shaped phenocysts lying in a felsitic or glassy matrix which solidified at a still later time. Micrographic structures in the minerals of igneous rocks prove only that these minerals crystallized simultaneously. (J. S. F.)

MICROSCOPE (Gr. μικρός, small, σκοπεῖν, to view), an optical instrument for examining small objects or details of such objects; it acts by making the angles of vision under which the images appear greater than when the objects themselves are viewed by the naked eye.

Microscopes are distinguished as *simple* and *compound*. A simple microscope consists of a single positive lens, or of a lens combination acting as a single lens, placed between the eye and the object so that it presents a virtual and enlarged image. The compound microscope generally consists of two positive lens systems, so arranged that the system nearer the object (termed the *objective*) projects a real enlarged image, which occupies the same place relatively to the second system (the *eyepiece* or *ocular*) as does the real object in the simple microscope. An image is therefore projected by the ocular from the real magnified image produced by the objective with increased magnification.

History of the Simple Microscope.—Any solid or liquid transparent medium of lenticular form, having either one convex and one flat surface or two convex surfaces whose axes are coincident, may serve as a "magnifier," the essential condition being that it shall refract the rays which pass through it so as to cause widely diverging rays to become either parallel or but slightly divergent. Thus if a minute object be placed on a slip of glass, and a single drop of water be placed upon it, the drop will act as a magnifier in virtue of the convexity of its upper surface; so that when the eye is brought sufficiently near it (the glass being held horizontally) the object will be seen magnified. Again if a small hole be made in a thin plate of metal, and a minute drop of water be inserted in it, this drop, having two convex surfaces, will serve as a still more powerful magnifier. There is reason to believe that the magnifying power of transparent media with convex surfaces was very early known. A convex lens of rock-crystal was found by Layard among the ruins of the palace of Nimrud; Seneca describes hollow spheres of glass filled with water as being commonly used as magnifiers.

The perfect gem-cutting of the ancients could not have been attained without the use of magnifiers; and doubtless the artificers who executed these wonderful works also made them. Convex glass lenses were first generally used to assist ordinary vision as "spectacles"; and not only were spectacle-makers the first to produce glass magnifiers (or simple microscopes), but by them also the telescope and the compound microscope were first invented. During the Thirty Years' War the simple microscope was widely known. Descartes (*Dioptrique*, 1637) describes microscopes wherein a concave mirror, with its concavity towards the object, is used, in conjunction with a lens, for illuminating the object, which is mounted on a point fixing it at the focus of the mirror. Antony van Leeuwenhoek appears to be the first to succeed in grinding and polishing lenses of such short focus and perfect figure as to render the simple microscope a better instrument for most purposes than any compound microscope then constructed. At that time the "compass" microscope was in use. One leg of a compass carried the object, and the other the lens, the distance between the two being regulated by a screw. Stands were also in use, permitting the manipulation of the object by hand. Robert Hooke shaped the minutest of the lenses with which he made many of the discoveries recorded in his *Micrographia* from small glass globules made by fusing the ends of threads of spun glass; and the same method was employed by the Italian Father Di Torre. Early opticians and microscopists gave their chief attention to the improvement of the simple microscope, the principle of which we now explain.

SIMPLE MICROSCOPE

Position and Size of the Image.—A person with normal vision can see objects distinctly at a distance varying from ten inches to a very great distance. Objects at different distances, however, are not seen distinctly simultaneously, but in succession. This is effected by the power of accommodation of the eye, which can so alter the focal length of its crystalline lens that images of objects at different distances can be produced rapidly and distinctly one after another upon the retina.

The angle under which the object appears depends upon the distance and size of the object, or, in other words, the size of the image on the retina is determined by the distance and the dimensions of the object. The ratio between the real size of the object y (fig. 1) and the distance l, which is equal to the tangent of the visual angle w, is termed the "apparent size" of the object. From the figure, which represents vision with a motionless eye, it is seen that the apparent size increases as the object under observation is approached. The greater the visual angle, the more distinctly are the details of the object perceived. On the other hand, as the observer recedes from the object, the apparent size, and also the image on the retina diminishes; details become more and more confused, and gradually, after a while, disappear altogether, and ultimately the external configuration of the object as a whole is no longer recognizable. This case arises when the visual angle, under which the object appears, is approximately a minute of arc; it is due to the physiological construction of the retina, for the ends of nerve fibres, which receive the impression of light, have themselves a definite size. The lower limit of the resolving power of the eye is reached when the distance is approximately 3438 times the size of the object. If the object be represented by two separate points, these points would appear distinct to the normal eye only so long as the distance between them is at the most only 3438 times smaller than their distance from the eye. When the latter distance is increased still further, the two appear as one. Therefore when it is desired to distinctly recognize exceedingly small objects or details of such, they are brought as near as possible to the eye. The eye is strained in bringing its focal length to the smallest possible amount, and when this strain is long continued it may cause pain. When the shortest distance obtained by the highest strain of accommodation is insufficient to recognize small objects, distinct vision is possible at even a shorter distance by placing a very small diaphragm

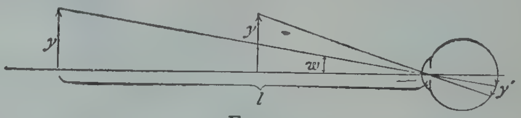

FIG. 1.

between the eye and the object, the pencils of rays proceeding from the object-points, which otherwise are limited by the pupils of the eye, being thus restricted by the diaphragm. The object is then projected with such acute pencils on the plane focused for, in this case on the plane on which the eye can just accommodate itself, that the circle of confusion arising there is still so small that it is below the limit of angular visual distinctness and on that account appears as a sharp point. However, the loss of light in this procedure is extraordinarily large, so that only most intensely illuminated objects can be investigated.

A naked short-sighted eye, which would be corrected for distant objects by a spectacle glass of −10 diopters, may approach the object up to about 4 in. and have a sharp image upon the retina without any strain whatever. For the observation of small objects, a myopic eye is consequently superior to a normal eye; and the normal eye in its turn is superior to the hypermetropic one. When the details are no longer recognizable by the unaided eye, the magnifying glass or the simple microscope is necessary. As a rule large magnification is not demanded from the former, but a larger field of view, whilst the simple microscope should ensure powerful magnification even when the field is small. The simple microscope enlarges the angle of vision, and does not tire the eye when it is arranged so that the image lies in the farthest limit of distinct vision (the *punctum remotum*). A normal eye will therefore see an image formed by the magnifying glass most conveniently when it is produced at a great distance, *i.e.* when the object is in its front focal plane. If y (fig. 2) be the object the image appears to a normal eye situated behind the system L with passive accommodation at a very great distance under the angle w'. Since $H'P = FO, = y$, from the focal length of the simple microscope, the visual angle w' is given by

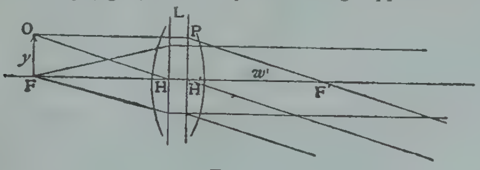

FIG. 2.

$$\tan w'/y = 1/f' = \mathrm{V}, \qquad (1)$$

in which $f', = H'F'$, is the image-side focal length (see LENS). Since the lens is bounded by air, the image- and object-side focal lengths f' and f are equal. The value $1/f'$ or V in (1), is termed the *power* of the lens. In most cases the number of "diameters" of the simple microscope is required; *i.e.* the ratio between the apparent sizes of the object when observed through the microscope and when viewed by the naked eye. When a person of normal vision views a small object, he brings it to the distance of distinct vision, which would average about 10 in. The apparent size is then (fig. 1) $\tan w = y/l$, where $l = 10$ in., whilst the apparent size of the object viewed through the magnifying glass would result from the formula (1) $\tan w' = y/f$. Consequently the number of diameters will be

$$\mathrm{N} = \tan w'/\tan w = y/f \,.\, l/y = l/f = \mathrm{V}.l; \qquad (2)$$

it is thus equal to the magnifying power multiplied by the distance of distinct vision, or the number of times that the focal length is contained in 10 in.

Since this value for the distance of distinct vision is only conventional, it is understood that the capacity of the simple microscope given in (2) holds good only for eyes accustomed to examine small objects 10 in. away; and observation through the magnifying glass must be undertaken by the normal eye with passive accommodation. A lens of 1 in. focal length must be spoken of, according to this notation, as a × 10 lens, and a lens of $\frac{1}{10}$ in. focal length as a × 100 lens. Obviously the position of a normal eye free from accommodation is immaterial for determining the magnification. A × 10 magnification is, however, by no means guaranteed to a myopic eye of −10 D by a lens of 1 in. focus. Since this short-sighted observer can view the object with the naked eye with no inconvenience to himself at 4 in. distance, it follows (to him) the apparent size is $\tan w = y/4$; and to secure convenient vision through the lens the short-sighted person would bring the object to such a distance that a virtual, magnified image would be projected in his *punctum remotum*. In addition it will be supposed that the centre of the pupil of the observer coincides with the back focal point of the system. The apparent size of the object seen through the lens is then $\tan w' = y/f$. The magnification, resulting from the simple microscope of 1 in. focus, is here $\mathrm{N} = \tan w'/\tan w = y/f \,.\, 4/y = 4/f = 4$. Thus, while a lens of 1 in. focal length assures to the normal-sighted person a × 10 magnification, it affords to the short-sighted individual only × 4. On the other hand, it is even of greater use to the hypermetropic than to the observer of normal sight. From this it appears that each observer obtains specific advantages from one and the same simple microscope, and also the individual observer can obtain different magnifications by either using different accommodations, or by viewing in passive accommodation.

Regulation of the Rays.[1]—In using optical instruments the eye in general is moved just as in free vision; that is to say, the attention is fixed upon the individual parts of the image one after another, the eye being turned in its cavity. In this case the eye is always directed so that the part of the image which is wished to be viewed exactly falls upon the most sensitive portion of the retina, viz. the *macula lutea* (yellow spot). Corresponding to the size of the yellow spot only a small fraction of the image appears particularly distinctly. The other portions which are reproduced on the retina on the regions surrounding the yellow spot will also be perceived, but with reduced definition. These external and less sensitive parts of the retina, therefore, merely give information as to the general arrangement of the objects and to a certain extent act as guide-post in order to show quickly and conveniently, although not distinctly, the places in the image which should claim special attention. Vision with a motionless eye, or "indirect vision," gives a general view over the whole object with particular definition of a small central portion. Vision with a movable eye, or "direct vision," gives exact information as to the parts of the object one after another.

The simple microscope permits such vision. If the instrument has a sensible lens diameter, and is arranged so that the centre of rotation of the eye can coincide with the intersection of the principal rays, the lens can then form with the eye a centred system. Such lenses are termed "lenses for direct vision." By moving the eye about its centre of rotation M the whole field can be examined. The margin of the mount of the lens serves as the diaphragm of the field of view. The selection of the rays emerging from the lens and actually employed in forming the image is undertaken by the pupil of the eye which, in this case, is consequently the exit pupil of the instrument. In fig. 3 $P'P'_1$ designates the exit pupil of the lens, and the image of $P'P'_1$, *i.e.* PP_1, which is formed by the lens, limits the aperture of the pencils of rays on the object-side; consequently it is the entrance pupil of the instrument. Since the exit pupil moves in observing the whole field, the entrance pupil also moves. The principal rays, which on the object-side connect the object-points with the centre of the entrance pupil, intersect the axis on the image-side at the centre of rotation M of the eye. M is therefore the intersection of the principal rays.

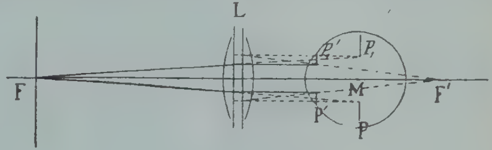

FIG. 3.

So long as the exit pupil is completely filled the brightness of the image will be approximately equal to that of free vision. If, however, we fix the points lying towards the margin of the field of view, the diaphragm gradually cuts off more and more of the rays which were necessary to fill the pupil, and in consequence the brightness gradually falls off to zero. This vignetting can be observed in all lenses.

In most cases, and also in corrected systems, the intersection of the principal rays is no longer available for the centre of rotation of the eye, and this kind of observation is impossible.

In some instruments observation of the whole available field is only possible when the head and eye are moved at the same time, the lens retaining its position. Dr M. von Rohr terms this kind of vision "peep-hole observation." It has mainly to be considered in connexion with powerful magnifying glasses. In most cases a diaphragm regulates the rays. Fig. 4 shows the position of the diaphragms to be considered in this kind of observation. PP_1 is the entrance pupil, $P'P_1'$ the exit pupil, and GG the diaphragm. The intersection of the principal rays in this case lies in the middle of the entrance pupil or of the exit pupil. By head and eye motion the various parts of the whole field can be viewed one after another. The distance of the eye from the lens is here immaterial. In this case also the illumination must fall to zero by the vignetting of the pencils coming from objects at the margin of the field of view. C and D are the outermost rays which can pass through the instrument.

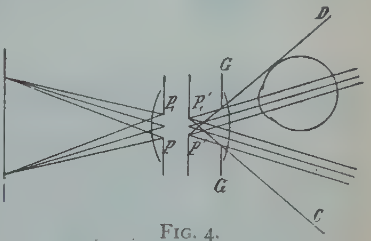

FIG. 4.

Magnifying glasses are often used for viewing three-dimensional objects. Only points lying on the plane focused for can be sharply reproduced in the retina, which acts as object-plane to the retina.

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[1] See also LENS.

All points lying out of this plane are reproduced as circles of confusion. The central projection, of which the centre is the middle point of the entrance pupil on the plane focused for, will show in weaker systems, or those very much stopped down, a certain finite depth of definition; that is to say, the totality of points, which lie out of the plane focused for, and which are projected with circles of confusion so small that they appear to the eye as sharp points, will include the sharp object relief, and determine the depth of definition of the lens. With increasing magnification the depth of definition diminishes, because the circles of confusion are greater in consequence of the shorter focal length. Very powerful simple microscopes have hardly any depth of definition so that in fact only points lying in one plane can be seen sharply with one focusing.

Illumination.—So long as the pupil of the observer alone undertakes the regulation of the rays there is no perceptible diminution of illumination in comparison with the naked eye vision. The losses of light which occur in this case are due to reflection, which takes place in the passage of the light through the glass surfaces. In a lens with two bounding surfaces in air there is a loss of about 9%; and in a lens system consisting of two separated lenses, *i.e.* with four surfaces in air, about 17%. Losses due to absorption are almost zero when the lenses are very thin, as with lenses of small diameter. A very marked diminution in illumination occurs, however, when the exit pupil of the instrument is smaller than the pupil of the eye. In such instruments an arrangement is often required to intensely illuminate the object.

Forms of the Simple Microscope.—If the ordinary convex lens be employed as magnifying glass, great aberrations occur even in medium magnifications. These are: (1) chromatic aberration, (2) spherical aberration and (3) astigmatism (see ABERRATION).

When the pupil regulates the aperture of the rays producing the image the aberrations of the ordinary lenses increase considerably with the magnification, or, what amounts to the same thing, with the increase in the curvature of the surfaces. For lenses of short focus the diameter of the pupil is too large, and diaphragms must be employed which strongly diminish the aperture of the pencils, and so reduce the errors, but with a falling off of illumination. To reduce the aberrations Sir David Brewster proposed to employ in the place of glass transparent minerals of high refractive index and low dispersion. In this manner lenses of short focus can be produced having lower curvatures than glass lenses necessitate. The diamond has the requisite optical properties, its index of refraction being about 1·6 times as large as that of ordinary glass. The spherical aberration of a diamond lens can be brought down to one-ninth of a glass lens of equal focus. Apart, however, from the cost of the mineral and its very difficult working, a source of error lies in its want of homogeneity, which often causes a double or even a triple image. Similar attempts made by Pritchard with sapphires were more successful. With this mineral also spherical and chromatic aberration are a fraction of that of a glass lens, but double refraction, which involves a doubling of the image, is fatal to its use. Improvements in glass lenses, however, have rendered further experiments with precious stones unnecessary. The simplest was a sphere of glass, the equator of which (*i.e.* the mount) formed the diaphragm. Wollaston altered this by taking two plano-convex lenses, placing the plane surfaces towards each other and employing a diaphragm between the two parts (fig 5).

Wollaston. Brewster. Brewster (Stanhope).

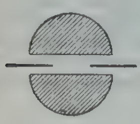


FIG. 5.

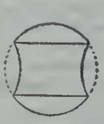


FIG. 6.

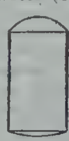


FIG. 7.

Sir David Brewster found that Wollaston's form worked best when the two lenses were hemispheres and the central space was filled up with a transparent cement having the same refractive index as the glass; he therefore used a sphere and provided it with a groove at the equator (see fig. 6). Coddington employed the same construction, and for this reason this device is frequently called the Coddington lens; although he brought the Wollaston-Brewster lens into general notice, he was neither the inventor nor claimed to be. This lens reproduced all points of a concentric spherical surface simultaneously sharp. A construction also employing one piece of glass forms the so-called Stanhope lens (fig. 7), which was really due to Brewster. This is a glass cylinder, the two ends of which are spherical surfaces. The more strongly curved surface is placed next the eye, the other serves at the same time as specimen carrier. This lens is employed in articles found in tourist resorts as a magnifying glass for miniature photographs of the locality.

Doublets, &c.—To remove the errors which the above lenses showed, particularly when very short focal lengths were in question, lens combinations were adopted. The individual components required weaker curvatures and permitted of being more correctly manufactured, and, more particularly, the advantage of reduced aberrations was the predominant factor.

Wollaston's doublet (fig. 8) is a combination of two plano-convex lenses, the focal lengths of which are in the ratio of 3 : 1; the plane sides are turned towards the object, and the smaller of the two lenses is nearer the object. This construction was further improved (1) by introducing a diaphragm between the two lenses; (2) by altering the distance between the two lenses; and (3) by splitting the lower lens into two lenses. Triplets are employed when the focal length of the simple microscope was less than $\frac{1}{10}$ in. When well made such constructions are almost free from spherical aberration, and the chromatic errors are very small. Similar doublets composed of two plano-convex lenses are the Fraunhofer (fig. 9) and the Wilson (fig. 10). Axial aberration is reduced by distributing the refraction between two lenses; and by placing the two lenses farther apart the errors of the pencils of rays proceeding from points lying outside the axis are reduced. The Wilson has a greater distance between the lenses, and also a reduction of the chromatic difference of magnification, but compared with the Fraunhofer it is at a disadvantage with regard to the size of the free working distance, *i.e.* the distance of the object from the lens surface nearer it.

Wollaston.

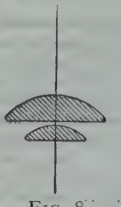


FIG. 8.

Fraunhofer.

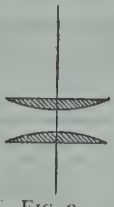


FIG. 9.

Wilson.

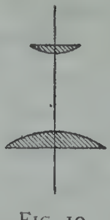


FIG. 10.

Steinheil.

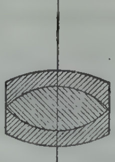


FIG. 11.

Chevalier (Brücke).

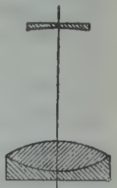


FIG. 12.

By introducing a dispersive lens of flint the magnifying glass could be corrected for both chromatic and spherical aberrations. Browning's "platyscopic" lens and the Steinheil "aplanatic" lens (fig. 11) are of this type. Both yield a field of good definition free from colour.

The manner in which the eye uses such a lens was first effectively taken into account by M. von Rohr. These anastigmatic lenses, which are manufactured up to × 40, are chromatically and spherically corrected, and for a middle diaphragm the errors of lateral pencils, distortion, astigmatism and coma are eliminated. "Peephole" observation is employed, observation being made by moving the head and eye while the lens is held steady. Even in powerful magnifications a good image exists in all parts of a relatively large field, and the free working distance is fairly large.

For especially large free working distances the corrections proposed by Chevalier and carried out by E. Brücke must be noticed (fig. 12). To an achromatic collective lens, which is turned towards the object, a dispersive lens is combined (this type to a certain extent belongs to the compound microscope). By altering the distance of the collective and dispersive members the magnification can be widely varied. Through the large free working distance, which for certain work offers great advantages, the size of the field of view is diminished.

In magnifying glasses for direct vision the eye must always be considered. The lens is brought as close as possible to the eye so as to view as large a field as possible. The watchmaker's glass is one of the earliest forms of this kind. Gullstrand showed how to correct these lenses for direct vision, *i.e.* to eliminate distortion and astigmatism when the centre of rotation of the eye coincided with the point where the principal rays crossed the axis. Von Rohr fulfilled this condition by constructing the Verant lens, which are low power systems intended for viewing a large flat field.

Stands.—For dissecting or examining objects it is an advantage to have both hands free. Where very short focus simple microscopes are employed, using high magnifications, it is imperative to employ a stand which permits exact focusing and the use of a special illuminating apparatus. Since, however, only relatively low powers are now employed, the ordinary rack and pinion movement for focusing suffices, and for illuminating the object only a mirror below the stage is required when the object is transparent, and a condensing lens above the stage when opaque.

Dissecting stands vary as to portability, the size of the stand, and the manner in which the arm-rests are arranged. A stand is shown in fig. 57 (Plate). On the heavy horseshoe foot is a column carrying the stage. In the column is the guide for the rack-and-pinion movement. Lenses of various magnifications can be adapted to the carrier and moved about over the stage. The rests can be attached to the stage, and when done with folded together. Illumination of transparent objects is effected by the universal-jointed mirror. By turning the knob A, placed at the front corner of the stage, a black or white plate, forming a dark or light background, can be swung underneath the specimen.

When the recognition of the arrangement in space of small objects is desired a stereoscopic lens can be used. In most cases refracting and reflecting systems are arranged so that the natural inter-pupillary distance is reduced. Stereoscopic lenses can never be powerful systems, for the main idea is the recognition of the depth of objects, so that only systems having a sufficient depth of definition can be utilized. Very often such stereoscopic lenses, owing to faulty construction, give a false idea of space, ignoring the errors which are due to the alteration of the inter-pupillary distance and the visual angles belonging to the principal rays at the object-side (see BINOCULAR INSTRUMENTS).

COMPOUND MICROSCOPE

The view held by early opticians, that a compound microscope could never produce such good images as an instrument of the simple type, has proved erroneous; and the principal attention of modern opticians has been directed to the compound instrument. Although we now know how the errors of lenses may be corrected, and how the simple microscope may be improved, this instrument remains with relatively feeble magnification, and to obtain stronger magnifications the compound form is necessary.

By compounding two lenses or lens systems separated by a definite interval, a system is obtained having a focal length considerably less than the focal lengths of the separate systems. If f and f' be the focal lengths of the combination, f_1, f_1' and f_2, f_2' the focal lengths of the two components, and Δ the distance between the inner foci of the components, then $f = -f_1 f_2/\Delta$, $f' = f_1' f_2'/\Delta$ (see LENS). Δ is also equal to the distance $F_1'F_2$. The accented f's are always on the image side, whilst the unaccented are on the object side. From this formula it follows, for example, that one obtains a system of $\frac{1}{8}$ in. focal length by compounding two positive systems of 1 in. each, whose focal planes, turned towards one another, are separated by 8 in.

A microscope objective being made in essentially the same way as a simple microscope, and the front focus of the compound system being situated before the front focus of the objective, the magnification due to the simple system makes the free object distance greater than that obtained with a simple microscope of equal magnification. Moreover, this distance between the object and eye is substantially increased in the compound microscope by the stand; the inconveniences, and in certain circumstances also the dangers, to the eye which may arise, for example by warming the object, are also avoided. The convenient and rapid change in the magnification obtained by changing the eyepiece or the objective is also a special advantage of the compound form.

In the commonest compound microscopes, which consist of two positive systems a real magnified image is produced by the objective. This permits researches which are impossible with the simple microscope. For example, the real image may be recorded on a photographic plate; it may be measured; it can be physically altered by polarization, by spectrum analysis of the light employed by absorbing layers, &c. The greatest advantage of the compound microscope is that it represents a larger area, and this much more completely than is possible in the simple form. According to the laws of optics it is only possible either to portray a small object near one of the foci of the system with wide pencils, or to produce an image from a relatively large object by correspondingly narrow pencils. The simple microscope is subject to either limitation. As we shall see later, one of the principal functions of the microscope objective is the representation with wide pencils. In that case, however, in the compound microscope a small object may always be represented by means of wider pencils, one of the foci of the objective (not of the collective system) being near it. For the eyepiece the other rule holds; the object is represented by narrow pencils, and it is hence possible to subject the relatively great object, viz. the magnified real image, to a further representation.

History of the Compound Microscope.—The arrangement of two lenses so that small objects can be seen magnified followed soon after the discovery of the telescope. The first compound miscroscope (discovered probably by the Middelburg lens-grinders, Johann and Zacharias Janssen about 1590) was a combination of a strong biconvex with a still stronger biconcave lens; it had thus, as well as the first telescope, a negative eyepiece. In 1646 Fontana described a microscope which had a positive eyepiece. The development of the compound microscope essentially depends on the improvement of the objective; but no distinct improvement was made in its construction in the two centuries following the discovery. In 1668 the Italian Divini employed several doublets, *i.e.* pairs of plano-convex lenses, and his example was followed by Griendl von Ach. But even with such moderate magnification as these instruments permitted many faults were apparent. A microscope, using concave mirrors, was proposed in 1672 by Sir Isaac Newton; and he was succeeded by Barker, R. Smith, B. Martin, D. Brewster, and, above all, Amici. More recently these catadioptric microscopes were disregarded because they yielded unfavourable results. From 1830 onwards many improvements were made in the miscroscope objective; these may be best followed from a discussion of the faults of the image.

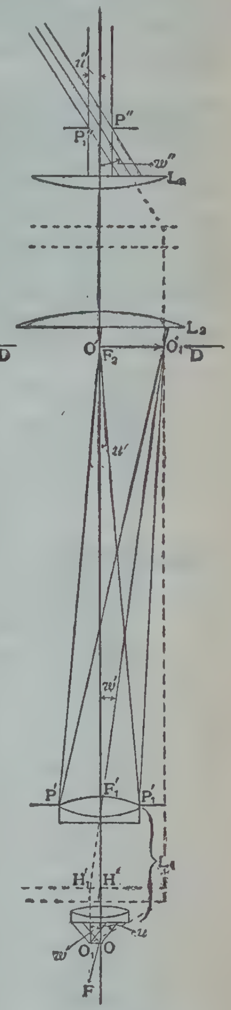


FIG. 13.—Ray transmission in compound microscope with a positive ocular.

L_1 = objective, L_2 L_3 = eyepiece of the Ramsden type.
F_1, F_1' = object- and image-side foci of objective.
F_2 = front focus of eyepiece.
$P'P_1'$ = exit pupil of objective.
$P''P_1''$ = exit pupil of complete microscope.
D D = diaphragm of field of view.

Position and Size of Image.—In most microscopic observations the object is mounted on a plane glass plate or slide about 0·06 in. thick, embedded in a liquid such as water, glycerine or Canada balsam, and covered with a plane glass plate of about 0·008 to 0·006 in. thick, called the cover-slip. If we consider the production of the image of an object of this kind by the two positive systems of a compound microscope shown in fig. 13, the objective L_1 forms a real magnified image $O'O_1'$; the object OO_1 must therefore lie somewhat in front of the front focus F_1 of the objective. Let $OO_1 = y$, $O'O_1' = y'$, the focal distance of the image $F_1'O' = \Delta$, and the image-side focal length f_1', then the magnification

$$M = y'/y = \Delta/f_1'. \qquad (3)$$

The distance Δ is called the "optical tube length."

Weak and strong microscope objectives act differently. Weak systems act like photographic objectives. In this case the optical tube length may be altered within fixed limits without spoiling the image; at the same time the objective magnification M is also altered. This change is usually effected by mounting the objective and eyepiece on two telescoping tubes, so that by drawing apart or pushing in the tube length is increased or diminished at will. For strong objectives there is, however, only one optical tube length in which it is possible to obtain a good image by means of wide pencils, any alteration of the tube length involving a considerable spoiling of the image. This limitation is examined below.

When forming an image by a microscope objective it often happens that the transparent media bounding the system have different optical properties. A series of objectives with short focal lengths are available, which permit the placing of a liquid between the cover-slip and the front lens of the objective; such lenses are known as "immersion systems"; objectives bounded on both sides by air are called "dry systems." The immersion liquids in common use are water, glycerine, cedar-wood oil, monobromnaphthalene, &c. Immersion systems in which the embedding liquid, cover-slip, immersion-liquid and front lens have equal refractive indices are called "homogeneous immersion systems." In immersion systems the object-side focal length is greater than the image-side focal length. Nothing is altered as to objective magnification, however, as the first surface is plane, and the employment of the immersion means that the value of f_1' is unaltered.

If we assume that a normal eye observes the image through the eyepiece, the eyepiece must project a distant image from the real image produced by the objective. This is the case if the image $O'O_1'$ lies in the front focal plane of the eyepiece. In this case the optical tube length equals the distance of the adjacent focal planes of the two systems, which equals the distance of the image-side focus of the objective F_1' from the object-side focus of the eyepiece F_2. The image viewed through the eyepiece appears then to the observer under the angle w'', and as with the single microscope

$$\tan w''/y' = 1/f_2' \qquad (4)$$

where f'_2 is the image-side focal length of the eyepiece.

To obtain the magnification of the complete microscope we must combine the objective magnification M with the action of the eyepiece. If we replace y' in equation (4) by the value given by (3), we obtain

$$\tan w''/y = \Delta/f_1' . 1/f_2'' = V, \qquad (5)$$

the magnification of the complete microscope. The magnification therefore equals the power of the joint system.

The magnification is also expressed as the ratio of the apparent size of the object observed through the microscope to the apparent size of the object seen with the naked eye. As the conventional distance for clear vision with naked eye is 10 in., it results from fig. 1 that the apparent size is $\tan w = y/l$. If this value of y be inserted in equation (5), we obtain the magnification number of the compound microscope:—

$$N = \tan w''/\tan w = \Delta l/f_1'f_2' = Vl. \qquad (6)$$

The magnification number increases then with the optical tube-length and with the diminution of the focal lengths of objective and eyepiece. As with the simple microscope, different observers see differently in the same compound microscope; and hence the magnification varies with the power of accommodation.

The image produced by a microscope formed of two positive systems (fig. 13) is inverted, the objective L_1 tracing from the object OO_1 a real inverted image $O'O'_1$, and the eyepiece L_2L_3 maintaining this arrangement. For many purposes it is immaterial whether the image is inverted or upright; but in some cases an upright image lightens the work, or may be indispensable.

The simplest microscope which produces an upright image has a negative lens as eyepiece. As shown in fig. 14, the real image formed by the objective must fall on the object-side focal plane of the eyepiece F_2, where a normal eye without accommodation can observe it. But as the object-side focus F_2 lies behind the eyepiece, the real image is not produced, but the converging pencils from the objective are changed by the eyepiece into parallels; and the point O_1 in the top of the object y appears at the top to the eye, *i.e.* the image is upright.

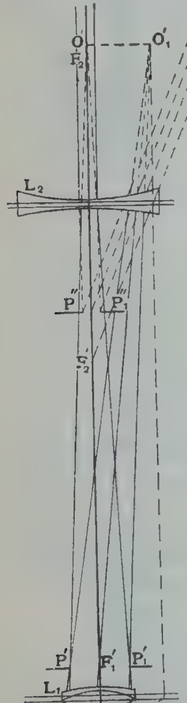


FIG. 14.—Ray transmission in compound microscope with a negative eyepiece.

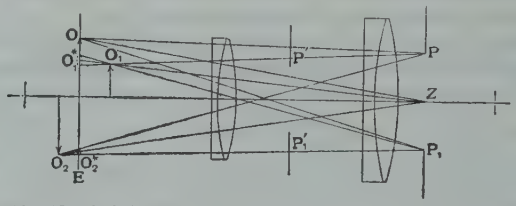
L_1 = weak achromatic objective.
L_2 = negative eyepiece.
F_1, F_1' = object- and image-side foci of objective.
F_2, F_2' = object- and image-side foci of eyepiece.
$P'P_1'$ = exit pupil of objective.
$P''P_1'$ = virtual image of P_1P_1' = exit pupil of complete microscope.

The erection of inverted images by prisms, which was applied to the simple telescope by Porro, and to the binocular (*q.v.*) by A. A. Boulanger was employed by K. Bratuscheck in the Greenough double microscope; these inverting prisms permit a convenient adaptation of the instrument to the interpupillary distance of the observer. Double microscopes, which produce a correct impression of the solidity of the object, must project upright images. The terrestrial eyepiece (see TELESCOPE), which likewise ensures an upright image, but which involves an inconvenient lengthening, has also been employed in the binocular microscope.

Regulation of the Rays.—Weak and medium microscope objectives work like photographic objectives in episcopic or diascopic projection; in the microscope, however, the projected image is not intercepted on a screen, but a real image in air is formed. This must lie in the front focal plane of the eyepiece if we retain the supposition that it is to be viewed by a normal eye with passive accommodation. The plane in the object conjugate to the focal plane of the eye-piece is the plane focused for; and all points in it are sharply portrayed (a perfect objective being assumed). Object points lying out of the focal plane, on the other hand, are projected as circles of confusion on the plane focused for, the centre of the entrance pupil being the centre of projection and the circles of confusion constituting, with the points of the focal plane, the object-side *imago*. As the pencils used in the representations are of wide aperture on the object-side, only such points as are proportionately very near the focal plane can produce such small dispersion circles on the plane focused for, that they, so far as the objective- and eyepiece-magnification permit, appear as points to the eye. It follows that the depth of definition of the microscope is in general very trifling. As it is entirely a function of the aperture and the magnification, it can be increased by diminishing the entrance pupil, the magnification remaining unchanged. A diminution of the aperture, however, would injure a very much more important property, viz. the resolving power (see below). With powerful systems, object-points lying quite near the plane focused for would be represented by such large dispersion circles that practically only the points lying in one plane appear simultaneously sharp; and it is only by varying the focus that the object-points lying in other planes can be observed.

The position of the diaphragm limiting the pencils proceeding from the object-points is not constant in the compound microscope. In all microscopes the rays are limited, not in the eyepiece, but in the objective, or before the objective when using a condenser. If the pencils are limited in the objective, the restriction of the pencil proceeding from the object-point is effected by either the front lens itself, by the boundary of a lens lying behind, by a real diaphragm placed between or behind the objective, or by a diaphragm-image.

The centre of the entrance pupil is the point of intersection of the principal rays; and it is therefore determinative for the perspective representation on the plane focused for. In fig. 15 the centre of the entrance pupil lies behind the focal plane, and consequently nearer objects appear larger, and farther objects smaller ("entocentric transmission," see below). If a diaphragm lying in the back focal plane of the objective forms the exit pupil for the objective, as in figs. 13 and 14, so that its image, the entrance pupil, lies at infinity, all the principal rays in the object-space are parallel to the axis, and we have on the object-side "telecentric" transmission. The size of the *imago* on the focal plane is always equal to its actual size, and is independent of the distance of the object from the plane focused for. This representation acquires a special importance if the object be micrometrically measured, for an inaccuracy in focusing does not involve an alteration of the size of the image. To ensure the telecentric transmission, the diaphragm in the back focus of the objective may be replaced by a diaphragm in the front focal plane of the condenser, supposing that uniformly illuminated objects are being dealt with; for in this case all the principal rays in the object-space are transmitted parallel to the axis.

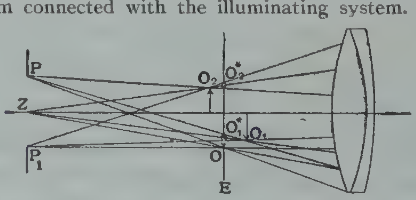


(After M. v. Rohr.)

FIG. 15.—Entocentric transmission through a microscope objective.

E = plane focused for; O_1^*, O_2^* = projections of O_1O_2 on E; Z = centre of projection; P P_1 = a virtual image of real diaphragm $P'P_1'$ with regard to the preceding part of the objective is the entrance pupil.

With uniformly illuminated objects it may happen that the pencil in the object-space may be limited before passing the object, either through the size of the source of light employed or through a diaphragm connected with the illuminating system. In fig. 16 the intersection of the principal rays lies in front of the object, and consequently objects in front of the plane focused for will be projected on E magnified and the objects lying behind it diminished ("hypercentric" transmission). It produces a perspective representation entirely opposed to ordinary vision. As objects lying near us appear smaller in the case of hypercentric transmission than those lying farther from us, we receive a false impression of the spatial arrangement of the object.



(After M. v. Rohr.)

FIG. 16.—Hypercentric transmission in a microscope objective.

E, O_1^*, O^* and Z as in fig. 15. PP_1 is the entrance pupil.

Whether the entrance pupil be before or behind the object, in general its position is such that it lies not too near the object, so that the principal rays will have in the object space only trifling inclinations towards one another or are strictly parallel. This is specially important, for otherwise pencils from points placed somewhat laterally to the axis arrive with diminished aperture at the image.

We see from fig. 13 that the objective's exit pupil $P'P_1'$ is portrayed by the positive eyepiece, the image $P''P_1''$ limits the pencils proceeding from the eyepiece. This image $P''P_1''$ is then the exit pupil of the combined system, and consequently the image of the entrance pupil of the combined system. As the exit pupil $P'P_1'$ for the objective lies before the front focus of the eyepiece, generally at some distance and near the objective, the eyepiece projects a real image from it behind its image-side focus, so that if this point is accessible it is the exit pupil $P''P_1''$. If, *e.g.* in the object-space the objective has telecentric transmission, the exit pupil must coincide with the back focal plane of the combined system, and it always lies behind the image-side focus of the eyepiece. The exit pupil, often called Ramsden's circle, is thus accessible to the observer, who by head- and eye-movements may survey the whole field.

We can now understand the ray transmission in the compound microscope, shown in fig. 13. Points of a small object (compared with the focus of the objective) send to the objective wide pencils. The diaphragm limiting them, *i.e.* the entrance pupil, is placed so that the principal rays are either parallel or slightly inclined. The pencils producing the real image are very much more acute, and their inclination is the smaller the stronger the magnification. The eyepiece, which by means of narrow pencils represents the relatively large real image at infinity, transmits from all points of this real image parallel pencils, whereby the inclination of the principal rays becomes further increased. The point of intersection, *i.e.* the centre of the exit pupil, is accessible to the eye of the observer. In the case of the negative eyepiece, on the other hand, the divergence of the principal rays through the eyepiece is also further augmented, but their point of intersection is not accessible to the eye. This property shows the superiority of the collective eyepiece over the dispersive.

The increase of the inclination of the principal rays, which arises with the microscope, influences the perception of the relief of the object. In entocentric transmission this phenomenon appears in general as in the case of the contemplation of perspective representations at a too short distance, the objects appearing flattened. Although in the case of the spatial comprehension of a perspective representation experience plays a large part, in observing through a microscope it does not count, or only a little, for the object is presumably quite unknown. In telecentric and hypercentric transmission we obtain a false conception of the spatial arrangement of the objects or their details; in these cases one focusses by turns on the different details, and so obtains an approximate idea of their spatial arrangement.

While the limiting of the pencil is almost always effected by the objective, the limiting of the field of view is effected by the eyepiece, and indeed it is carried out by a real diaphragm DD arranged in the plane of the real image $O'O_1'$ (fig. 13) projected from the objective. The entrance window is then the real image of this diaphragm projected by the objective in the surface conjugate to the plane focused for, and the exit window is the image projected by the eyepiece; this happens with the image of the object lying at infinity. The result must be that the field of view exhibits a sharp border. In the case of the dispersive eyepiece, on the contrary, no sharply limited field can arise, but vignetting must occur.

Illumination.—The dependence of the clearness of the image on the aperture of the system, *i.e.* on the angular aperture of the image-producing pencil, holds for all instruments.

The brightnesses of image points in a median section of the pencil are proportional to the aperture of the lens, supposing that the rays are completely reunited. This is valid so long as the pencil is in air; but if, on the other hand, the pencil passes from air through a plane surface into an optically denser medium, *e.g.* water or glass, the pencil becomes more acute and the aperture smaller. But since no rays are lost in this transmission (apart from the slight loss due to reflection) the brightness of the image point in the water is as large as that in air, although the apertures have become less. Fig. 17 shows a pencil in air, A, dispersing in water, W, from the semi-aperture u_1, or a pencil in water dispersing in air from the semi-aperture u_2. If the value of the clearness in air be taken as $\sin u_1$, then by the law of refraction $N = \sin u_1 / \sin u_2$, the value for the clearness in water is $N \sin u_2$. This rule is general. The value of the clearness of an image-point in a median section is the sine of the semi-aperture of the pencil multiplied with the refractive index of the medium.

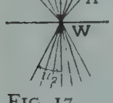


FIG. 17.

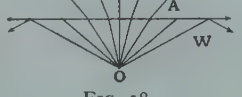


FIG. 18.

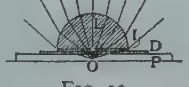


FIG. 19.

An illustration of this principle is the immersion experiment. A view taken under water from the point O (fig. 18) sees not only the whole horizon, but also a part of the bed of the sea. The whole field of view in air of 180° is compressed to one of 97·5° in water. The rays from O which have a greater inclination to the vertical than 48·75° cannot come out into the air, but are totally reflected. If pencils proceed from media of high optical density to media of low density, and have a semi-aperture greater than the critical angle, total reflection occurs; in such cases no plane surface can be employed, hence front lenses have small radii of curvature in order to permit the wide pencils to reach the air (see fig. 19, in which P is the preparation, O the object-point in it, D the cover slip, I the immersing fluid, and L the front lens).

The function $n \sin u = A$, for the microscope, has been called by Abbe the *numerical aperture*. In dry-systems only the sine of the semi-aperture is concerned; in immersion-systems it is the product of the refractive index of the immersion-liquid and the sine of the object-side semi-aperture. In the case of the brightness of large objects obviously the whole pencil is involved, and hence the clearness is the squares of these values, *i.e.* $\sin^2 u$ or $n^2 \sin^2 u$. As the semi-aperture of a pencil proceeding from an object point cannot exceed 90°, the numerical aperture of a dry-system cannot be greater than 1. On the other hand, in immersion-systems the numerical aperture can almost amount to the refractive index, for $A = n \sin u < n$. Dry systems of 0·98 numerical aperture, water immersion ($n = 1{\cdot}33$) from $A = 1{\cdot}25$, oil immersion ($n = 1{\cdot}51$) from $A = 1{\cdot}40$, and even α-bromnaphthalene immersions ($n = 1{\cdot}65$) from $A = 1{\cdot}60$, are available. In immersion-systems of such considerable aperture no medium of smaller refractive index than the immersion liquid may be placed between the surface of the front lens and the object, as otherwise total reflection would occur. This is especially inconvenient in the case of the α-bromnaphthalene immersion. As the embedding and immersing liquids must have equal refractive indexes, one must use α-bromnaphthalene for embedding; but this substance destroys organic preparations, so that one can employ this immersion-system only for examining inorganic materials, *e.g.* fine diatoms.

In immersion-systems a very much greater aggregate of rays is used in the representation than is possible in dry-systems. In addition to a considerable increase in brightness the losses due to reflection are avoided; losses which arise in passing to the back surface of the cover-slip and to the front surface of the front lens.

THE PHYSICAL THEORY

In order to fully understand the representation in the microscope, the process must be investigated according to the wave-theory, especially in considering the representation of objects or object details having nearly the size of a wave-length. The rectilinear rays, which we have considered above, but which have no real existence, are nothing but the *paths* in which the light waves are transmitted. According to Huygens's principle (see DIFFRACTION) each aether particle, set vibrating by an incident wave, can itself act as a new centre of excitement, emitting a spherical wave; and similarly each particle on this wave itself produces wave systems. All systems which are emitted from a single source can by a suitable optical device be directed that they simultaneously influence one and the same aether particle. According to the phase of the vibrations at this common point, the waves mutually strengthen or weaken their action, and there arises greater clearness or obscurity. This phenomenon is called interference (*q.v.*). E. Abbe applied the Fraunhofer diffraction phenomena to the explanation of the representation in the microscope of uniformly illuminated objects.

If a grating is placed as object before the microscope objective, Abbe showed that in the image there is intermittent clear and dark banding only, if at least two consecutive diffraction spectra enter into the objective and contribute towards the image. If the illuminating pencil is parallel to the axis of the microscope objective, the illumination is said to be direct. If in this case the aperture of the objective be so small, or the diffraction spectra lie so far from each other, that only the pencil parallel to the axis, *i.e.* the spectrum of zero order, can be admitted, no trace is generally found of the image of the grating. If, in addition to the principal maximum, the maximum of 1st order is admitted, the banding is distinctly seen, although the image does not yet accurately resemble the object. The resemblance is greater the more diffraction spectra enter the objective. From the Fraunhofer formula $\delta = \lambda / n \sin u$ one can immediately deduce the limit to the diffraction constant δ, so that the banding by an objective of fixed numerical aperture can be perceived. The value $n \sin u$ equals the numerical aperture A, where n is the refractive index of the immersion-liquid, and u is the semi-aperture on the object-side. For microscopy the Fraunhofer formula is best written $\delta = \lambda / A$. This expresses δ as the resolving power in the case of direct lighting. All details of the object so resolved are perceived, if two diffraction maxima can be passed through the objective, so that the character of the object is seen in the image, even if an exact resemblance has not yet been attained.

The Fraunhofer diffraction phenomena, which take place in the back focal plane of the objective, can be conveniently seen with the naked eye by removing the eyepiece and looking into the tube, or better by focusing a weak auxiliary microscope on the back focal plane of the objective. If one has, *e.g.* in the case of a grating, telecentric transmission on the object-side, and in the front focal plane of the illuminating system a small circular aperture is arranged, then by the help of the auxiliary microscope one sees in the middle of the back focal plane the round white image O (fig. 20) and to the right and left the diffraction spectra, the images of different colours partially overlapping. If a resolvable grating is considered, the diffraction phenomenon has the appearance shown in fig. 21.

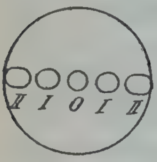


FIG. 20.

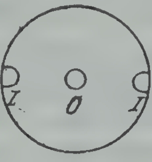


FIG. 21.

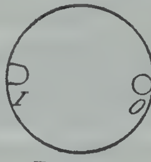


FIG. 22.

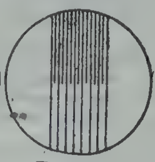


FIG. 23.

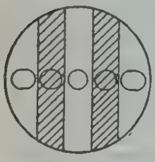


FIG. 24.

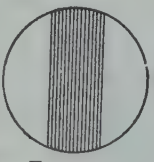


FIG. 25.

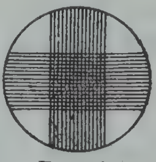


FIG. 26.

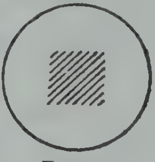


FIG. 27.

(From Abbe, *Theorie der Bilderzeugung im Mikroskop.*)

It is possible to almost double the resolving power, as in the case of direct lighting, so that a banding of double the fineness can be perceived, by inclining the illuminating pencil to the axis; this is controlled by moving the diaphragm laterally. If the obliquity of illumination be so great that the principal maximum passes through the outermost edge of the objective, while a spectrum of 1st order passes the opposite edge, so that in the back focal plane the diffraction phenomenon shown in fig. 22 arises, banding is still to be seen. The resolution in the case of oblique illumination is given by the formula $\delta=\lambda/2A$.

Reverting to fig. 13, we suppose that a diffracting particle of such fineness is placed at O that the diffracted pencils of the 1st order make an angle *w* with the axis; the principal maximum of the Fraunhofer diffraction phenomena lies in F'_1; and the two diffraction maxima of the 1st order in P′ and P'_1. The waves proceeding from this point are united in the point O′. Suppose that a well corrected objective is employed. The image O′ of the point O is then the interference effect of all waves proceeding from the exit pupil of the objective P_1P_1'.

Abbe showed that for the production of an image the diffraction maxima must lie within the exit pupil of the objective. In the silvering of a glass plate lines are ruled as shown in fig. 23, one set traversing the field while the intermediate set extends only half-way across. If this object be viewed by the objective, so that at least the diffraction spectra of 1st order pass the finer divisions, then the corresponding diffraction phenomenon in the back focal plane of the objective has the appearance shown in fig. 21, while the diffraction figure corresponding to the coarser ruling appears as given in fig. 20. If one cuts out by a diaphragm in the back focal plane of the objective all diffraction spectra except the principal maximum, one sees in the image a field divided into two halves, which show with different clearness, but no banding. By choosing a somewhat broader diaphragm, so that the spectra of 1st order can pass the larger division, there arises in the one half of the field of view the image of the larger division, the other half being clear without any such structure. By using a yet wider diaphragm which admits the spectra of 2nd order of the larger division and also the spectra of 1st order of the fine division, an image is obtained which is similar to the object, *i.e.* it shows bands one half a division double as fine as on the other. If now the spectrum of 1st order of the larger division be cut out from the diffraction figure, as is shown in fig. 24, an image is obtained which over the whole field shows a similar division (fig. 25), although in the one half of the object the represented banding does not occur. Still more strikingly is this phenomenon shown by Abbe's diffraction plate (fig. 26). This is a so-called cross grating formed by two perpendicular gratings. Through a suitable diaphragm in the back focal plane, banding can easily be produced in the image, which contains neither the vertical nor the horizontal lines of the two gratings, but there exist streaks, whose direction halves the angle under which the two gratings intersect (fig. 27). There can thus be shown structures which are not present in the object. Colonel Dr Woodward of the United States army showed that interference effects appear to produce details in the image which do not exist in the object. For example, two to five rows of globules were produced, and photographed, between the bristles of mosquito wings by using oblique illumination. In observing with strong systems it is therefore necessary cautiously to distinguish between spectral and real marks. To determine the utility of an objective for resolving fine details, one experiments with definite objects, which are usually employed simultaneously for examining its other properties. Most important are the fine structures of diatoms such as *Surirella gemma* and *Amphipleura pellucida* or artificial fine divisions as in a Nobert's grating. The examination of the objectives can only be attempted when the different faults of the objective are known.

If microscopic preparations are observed by diffused daylight or by the more or less white light of the usual artificial sources, then an objective of fixed numerical aperture will only represent details of a definite fineness. All smaller details are not portrayed. The Fraunhofer formula permits the determination of the most useful magnification of such an objective in order to utilize its full resolving power.

As we saw above, the apparent size of a detail of an object must be greater than the angular range of vision, *i.e.* 1′. Therefore we can assume that a detail which appears under an angle of 2′ can be surely perceived. Supposing, however, there is oblique illumination, then formula (5) can always be applied to determine the magnifying power attainable with at least one objective. By substituting *y*, the size of the object, for *d*, the smallest value which a single object can have in order to be analysed, and the angle *w*′ by 2′, we obtain the magnifying power and the magnification number:

$$V_2=\tan w'/d=2A\tan 2'/\lambda;\ N_2=2Al\tan 2'/\lambda;$$

where *l* equals the sight range of 10 in.

Even if the details can be recognized with an apparent magnification of 2′, the observation may still be inconvenient. This may be improved when the magnification is so increased that the angle under which the object, when still just recognizable, is raised to 4′. The magnification and magnifying number which are most necessary for a microscope with an objective of a given aperture can then be calculated from the formulae:

$$V_4=2A\tan 4'/\lambda;\ N_4=2Al\tan 4'/\lambda.$$

If 0·55 μ is assumed for daylight observation, then according to Abbe (*Journ. Roy. Soc.*, 1882, p. 463) we have the following table for the limits of the magnification numbers, for various microscope objectives, μ=0·001 mm.

$A=n\sin u$.	*d* in μ.	N_2.	N_4.
0·10	2·75	53	106
0·30	0·92	159	317
0·60	0·46	317	635
0·90	0·31	476	952
1·20	0·23	635	1270
1·40	0·19	741	1481
1·60	0·17	847	1693

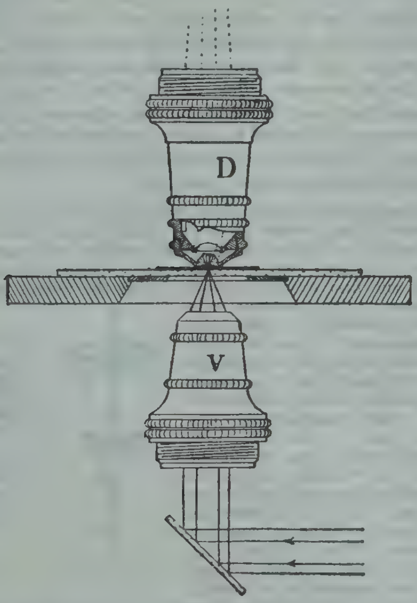
From this it can be seen that, as a rule, quite slight magnifications suffice to bring all representable details into observation. If the magnification is below the given numbers, the details can either not be seen at all, or only very indistinctly; if, on the contrary, the given magnification is increased, there will still be no more details visible. The table shows at the same time the great superiority of the immersion-system over the dry-system with reference to the resolving power. With the best immersion-system, having a numerical aperture of 1·6, details of the size 0·17 μ can be resolved, while the theoretical maximum of the resolving power is 0·167 μ, so that the theoretical maximum has almost been reached in practice. Still smaller particles cannot be portrayed by using ordinary daylight.

In order to increase the resolving power, A. Köhler (*Zeit. f. Mikros.*, 1904, 21, pp. 129, 273) suggested employing ultra-violet light, of a wave-length 275 μμ; he thus increased the resolving power to about double that which is reached with day-light, of which the mean wave-length is 550 μμ. Light of such short wave-length is, however, not visible, and therefore a photographic plate must be employed. Since glass does not transmit the ultra-violet light, quartz is used, but such lenses can only be spherically corrected and not chromatically. For this reason the objectives have been called monochromats, as they have only been corrected for light of one wave-length. Further, the different transparencies of the cells for the ultra-violet rays render it unnecessary to dye the preparations. Glycerin is chiefly used as immersion fluid. M. v. Rohr's monochromats are constructed with apertures up to 1·25. The smallest resolving detail with oblique lighting is $\delta=\lambda/2A$, where $\lambda=275$ μμ. As the microscopist usually estimates the resolving power according to the aperture with ordinary day-light, Köhler introduced the "relative resolving power" for ultra-violet light. The power of the microscope is thus represented by presupposing day-light with a wave-length of 550 μμ. Then the denominator of the fraction, the numerical aperture, must be correspondingly increased, in order to ascertain the real resolving power. In this way a monochromat for glycerin of a numerical aperture 1·25 gives a relative numerical aperture of 2·50.

If the magnification be greater than the resolving power demands, the observation is not only needlessly made more difficult, but the entrance pupil is diminished, and with it a very considerable decrease of clearness, for with an objective of a certain aperture the size of the exit pupil depends upon the magnification. The diameter of the exit pupil of the microscope is about 0·04 in. with the magnification N_3, and about 0·02 in. with the magnification N_4. Moreover, with such exceptionally narrow pencils shadows are formed on the retina of the observer's eye, from the irregularities in the eye itself. These disturbances are called "entoptical phenomena." From the section *Regulation of the Rays* (above) it is seen that the resolving power is opposed to the depth of definition, which is measured by the reciprocal of the numerical aperture, 1/A.

Dark-field Illumination.—It is sometimes desirable to make minutest objects in a preparation specially visible. This can be done by cutting off the chief maximum and using only the diffracted spectra for producing the image.

At least two successive diffraction maxima must be admitted through the objective for there to be any image of the objects. With this device these particles appear bright against a dark background, and can be easily seen. The cutting off of the chief maximum can be effected by a suitable diaphragm in the back focal plane of the objective. But, owing to the various partial reflections which the illuminating cone of rays undergoes when traversing the surfaces of the lenses, a portion of the light comes again into the preparation, and into the eye of the observer, thus veiling the image. This defect can be avoided (after Abbe) if a small central portion of the back surface of the front lens be ground away and blackened; this portion should exactly catch the direct cone of rays, whilst the edges of the lens let the deflected cone of rays pass through (fig. 28).



(By permission of C. Zeiss.)

FIG. 28.

The large loss of light, which is caused in dark-field illumination by the cutting off of the direct cone of rays, must be compensated by employing exceptionally strong sources. By dark-field illumination it is even possible to make such small details of objects perceptible as are below the limits of the resolving power. It is a similar phenomenon to that which arises when a ray of sunlight falls into a darkened room. The extremely small particles of dust (motes in a sunbeam) in the rays are made perceptible by the diffracted light, whilst by ordinary illumination they are invisible. The same observation can be made with the cone of rays of a reflector, and in the same way the fine rain-drops upon a dark background and the fixed stars in the sky become visible. It is not possible to recognize the exact form of the minute objects because their apparent size is much too small; only their presence is observable. In addition, the particles can only be recognized as separate objects if their apparent distance from one another is greater than the angular definition of sight.

Ultramicroscopy.—This method of illumination has been used by H. Siedentopf in his ultramicroscope. The image consists of a diffraction disk from whose form and size certain conclusions may be drawn as to the size and form of the object. It is impossible to get a representation as from an object. Very finely divided sub-microscopic particles in liquids or in transparent solids can be examined; and the method has proved exceptionally valuable in the investigation of colloidal solutions.

Siedentopf employed two illuminating arrangements. With the orthogonal arrangement for illuminating and observing the beam of light traverses an extremely fine slit through a well-corrected system, whose optic axis is perpendicular to the axis of the microscope; the system reduces the dimensions of the beam to about 2 to 4 μ in the focal plane of the objective. For the microscopic observation it is the same as if a thin section of a thickness of 2 to 4 μ had been shown. In this optical way it is possible to show thin sections even in liquid preparations. The inconvenience of orthogonal illumination, which certainly gives better results, is avoided in the coaxial apparatus. Care must here be taken, by using suitable dark-field screens, that no direct rays enter the observing system. The only sources of light are sunlight or the electric arc. The limit at which sub-microscopic particles are made visible is dependent upon the specific intensity of the source of light. With sunlight particles can be made visible to a size of about 0·004 μ.

Production of the Image.—As shown in LENS and ABERRATION, for reproduction through a single lens with spherical surfaces, a combination of the rays is only possible for an extremely small angular aperture. The aberrations, both spherical and chromatic, increase very rapidly with the aperture. If it were not possible to recombine in one image-point the rays leaving the objective and derived from one object-point, *i.e.* to eliminate the spherical and chromatic aberrations, the large angular aperture of the objective, which is necessary for its resolving power, would be valueless. Owing to these aberrations, the fine structure, which in consequence of the large aperture could be resolved, could not be perceived. In other words, a sufficiently good and distinct image as the resolving power permits cannot be arrived at, until the elimination, or a sufficient diminution, of the spherical and chromatic aberrations has been brought about.

The objective and eyepiece have such different functions that as a rule it is not possible to correct the aberrations of one system by those of the other. Such a compensation is only possible for one single defect, as we shall see later. The demands made upon the eyepiece, which has to represent a relatively large field by narrow cones of rays, are not very considerable. It is therefore not very difficult to produce a usable eyepiece. On the other hand, the correction of the objective presents many difficulties.

We will now examine the conditions which must be fulfilled by an objective, and then how far these conditions have been realized.

Consider the aberrations which may arise from the representation by a system of wide aperture with monochromatic light, *i.e.* the spherical aberrations. The rays emitted from an axial object-point are not combined into one image-point by an ordinary biconvex lens of fixed aperture, but the central rays come to a more distant focus than the outer rays. The so-called "caustic" occupies a definite position in the image-space. The spherical aberrations, however, can be overcome, or at least so diminished that they are quite harmless, by forming appropriate combinations of lenses.

The aberration of rays in which the outer rays intersect the axis at a shorter distance than the central rays is known as "under-correction." The reverse is known as "over-correction." By selecting the radii of the surfaces and the kind of glass the under- or over-correction can be regulated. Thus it is possible to correct a system by combining a convex and a concave lens, if both have aberrations of the same amount but of opposite signs. In this case the power of the crown lens must preponderate so that the resulting lens is of the same sign, but of a little less power. Correction of the spherical aberration in strong systems with very large aperture can not be brought about by means of a single combination of two lenses, but several partial systems are necessary. Further, under-corrected systems must be combined with over-corrected ones. Another way of correcting this system is to alter the distances. If, by these methods, a point in the optic axis has been freed from aberration, it does not follow that a point situated only a very small distance from the optic axis can also be represented without spherical aberration. The representation, free from aberration, of a small surface-element, is only possible, as Abbe has shown, if the objective simultaneously fulfils the "sine-condition," *i.e.* if the ratio of the sine of the aperture u on the object-side to the sine of the corresponding aperture u' on the image-side is constant; *i.e.* if $n \sin u/\sin u' = C$, in which C is a constant. The sine-condition is in contrast to the tangent-condition, which must be regarded as the point-by-point representation of the whole object-space in the image-space (see LENS), and according therefore the equation $n \tan u/\tan u' = C$ must exist. These two conditions are only compatible when the representation is made with quite narrow pencils, and where the apertures are so small that the sines and tangents are of about the same value.

Very large apertures occur in strong microscope objectives, and hence the two conditions are not compatible. The sine-condition is, however, the most important as far as the microscopic representation is concerned, because it must be possible to represent a surface-element through the objective by wide cones of rays. The removal of the spherical aberration and the sine-condition can be accomplished only for two conjugate points. A well-corrected microscope objective with a wide aperture therefore can only represent, free from aberrations, one object-element situated on a definite spot on the axis. As soon as the object is moved a short distance away from this spot the representation is quite useless. Hence the importance of observing the length of the tube in strong systems. If the sine-condition is not fulfilled but the spherical aberrations in the axis have been removed, then the image shown in fig. 19 results. The cones of rays issuing from a point situated only a little to the side, which traverse different zones of the objective, have a different magnification. The sine-condition can therefore also be understood as follows: that all objective zones must have the same magnification for the plane-element.

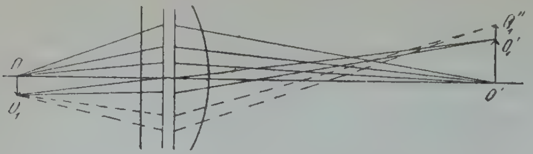


FIG. 29.—The lens is spherically corrected for OO′, but the sine-condition is not fulfilled. Hence the different magnifications of a point O₁ beyond the axis.

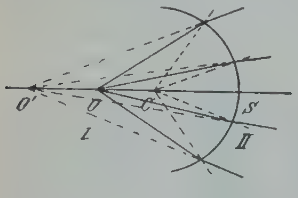


FIG. 30.—O′ is the virtual image of O formed at a spherical surface of centre C and radius CS.

According to Abbe, a system can only be regarded as aplanatic if it is spherically corrected for not only one axial point, but when it also fulfils the sine-condition and thus magnifies equally in all zones a surface-element situated vertically on the axis at this point.

A second method of correcting the spherical aberration depends on the notion of aplanatic points. If there are two transparent substances separated from one another by a spherical surface, then there are two points on the axis where they can be reproduced free from error by monochromatic light, and these are called "aplanatic points." The first is the centre of the sphere. All rays issuing from this point pass unrefracted through the dividing surface; its image-point coincides with it. Besides this there is a second point on the axis, from which all issuing rays are so refracted at the surface of the sphere that, after the refraction, they appear to originate from one point—the image-point (see fig. 30). With this, the object-point O, and consequently the image-point O′ also, will be at a quite definite distance from the centre. If however the object-point does not lie in the medium with the index n, but before it, and the medium is, for example, like a front lens, still limited by a plane surface, just in front of which is the object-point, then in traversing the plane surface spherical aberrations of the under-corrected type again arise, and must be removed. By homogeneous immersion the object-point can readily be reduced to an aplanatic point. By experiment Abbe proved that old, good microscope objectives, which by mere testing had become so corrected that they produced usable images, were not only free from spherical aberrations, but also fulfilled the sine-condition, and were therefore really aplanatic systems.

The second aberration which must be removed from microscope objectives are the chromatic. To diminish these a collective lens of crown-glass is combined with a dispersing lens of flint; in such a system the red and the blue rays intersect at a point (see ABERRATION). In systems employed for visual observation (to which class the microscope belongs) the red and blue rays, which include the physiologically most active part of the spectrum, are combined; but rays other than the two selected are not united in one point. The transverse sections of these cones of rays diverge more or less from the transverse section of the chosen blue and red cones, and produce a secondary spectrum in the image, and the images still appear to have a slightly coloured edge, mostly greenish-yellow or purple; in other words, a chromatic difference of the spherical aberrations arises (see fig. 31). This refers to systems with small apertures, but still more so to systems with large ones; chromatic aberrations are exceptionally increased by large apertures.

The new glasses produced at Schott's glass works, Jena, possessed in part optical qualities which differed considerably from those of the older kinds of glass. In the old crown and flint glass a high refractive index was always connected with a strong dispersion and the reverse. Schott succeeded, however, in producing glasses which with a comparatively low refraction have a high dispersion, and with a high refraction a low dispersion. By using these glasses and employing minerals with special optical properties, it is possible to correct objectives so that three colours can be combined, leaving only a quite slight tertiary spectrum, and removing the spherical aberration for two colours. Abbe called such systems "apochromats." Good apochromats often have as many as twelve lenses, whilst systems of simpler construction are only achromatic, and are therefore called "achromats."

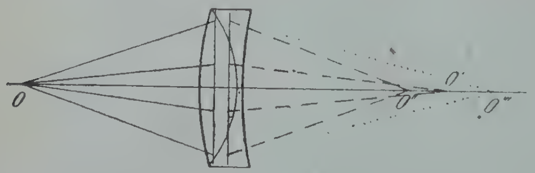


FIG. 31.—Showing a system with chromatic difference of spherical aberration. O″=image of O for red light; O‴ for blue. The system is under-corrected for red, and over-corrected for blue rays.

Even in apochromats it is not possible to entirely remove the chromatic difference of magnification, *i.e.* the images produced by the red rays are somewhat smaller than the images produced by the blue. A white object is represented with blue streaks and a black one with red streaks. This aberration can, however, be successfully controlled by a suitable eyepiece (see below).

A further aberration which can only be overcome with difficulty, and even then only partially, is the "curvature of the field," *i.e.* the points situated in the middle and at the edge of the plane object can not be seen clearly at the same focusing.

Historical Development.—The first real improvement in the microscope objective dates from 1830 when V. and C. Chevalier, at first after the designs of Selligue, produced objectives, consisting of several achromatic systems arranged one above the other. The systems could be used separately or in any combination. A second method for diminishing the spherical aberration was to alter the distances of the single systems, a method still used. Selligue had no particular comprehension of the problem, for his achromatic single systems were simply telescope objectives corrected for an infinitely distant point, and were placed so that the same surface was turned towards the object in the microscope objective as in the telescope objective; although contrary to the telescope, the distance of the object in the microscope objective is small in proportion to the distance of the image. It would have been more correct to have employed these objectives in a reverse position.

These circumstances were considered by Chevalier and Lister. Lister showed that a combination of lenses can be achromatic for only two points on the axis, and therefore that the single systems must be so arranged that the aplanatic (virtual) image-point O′ (fig. 32) of the first system coincides with the object-point of the next system. This system will always be aplanatic. These objectives permitted a much larger aperture than a simple achromatic system. Although such systems have been made recently for special purposes, this construction was abandoned, and a more complex one adopted, which also made the production of better objectives possible; this is the principle of the compensation of the aberrations produced in the different parts of the objective. Even Lister, who proceeded on quite different lines, hinted at the possibility of such a compensation. This method makes it specially possible to overcome the chromatic and spherical aberrations of higher orders and to fulfil the sine-condition, and the chief merit of this improvement belongs to Amici. He had recognized that the good operation of a microscope objective depended essentially upon the size of the aperture, and he therefore endeavoured to produce systems with wide aperture and good correction. He used chiefly a highly curved plano-convex front lens, which has since always been employed in strong systems. Even if the object-point on the axis cannot be reproduced quite free from aberration through such a lens, because aberrations of the type of an under-correction have been produced by the first plane outer limiting surface, yet the defects with the strong refraction are relatively small and can be well compensated by other systems. Amici chiefly employed cemented pairs of lenses consisting of a plano-convex flint lens and a biconvex crown lens (fig. 33), and constructed objectives with an aperture of 135°. He also showed the influence of the cover-slip on pencils of such wide aperture. The lower surface of the slip causes under-correction on being traversed by the pencil, with over-correction when it leaves it; and since the aberration of the surface lying farthest from the object, *i.e.* those caused by the upper surface preponderate, an over-corrected cone of rays enters the objective. The over-correction increases when the glass is thickened. In order to counteract this aberration the whole objective must be correspondingly under-corrected. Objectives with definite under-correction can however only produce really good images with glass covers of a specified thickness. With apertures of 0·90–0·95 differences of even 0·004–0·008 in. in the glass covers can be noticed by the deterioration of the image. In systems with smaller apertures variations of the thickness of the glass cover are not so

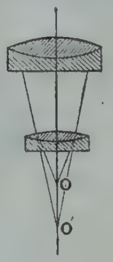


FIG. 32.

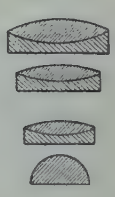


FIG. 33.

noticeable. For this reason Amici constructed objectives of a similar aperture and focus for different thicknesses of glass covers.

This expensive method was simplified in 1837 by Andrew Ross by making the upper and lower portion of the objective variable by means of a so-called correction-collar, and so giving the objective a corresponding under-correction according to the thickness of the glass cover. The alteration of the focus and the aperture are little influenced. The correction-collar was improved by Wenham and Zeiss, by working the upper system upon the lower, and not the reverse; for in this way the preparation remains almost exactly focused during the operation (see fig. 34).

The injurious influence of the glass cover is substantially lessened if no air is admitted to the space between the glass cover and the front lens (as in the dry-system) but if the intervening space is filled with an immersion-liquid. Amici was likewise the first to produce practical and good immersion-systems. The slight difference of the refractive indexes of the glass cover and the immersion-liquid involves a diminution of the aberrations, by which the objective will become less sensitive to the differences in thickness of the glass covers and admits of a more perfect adjustment. Water-immersion was introduced by Amici in 1840, and was improved by E. Hartnack in 1855.

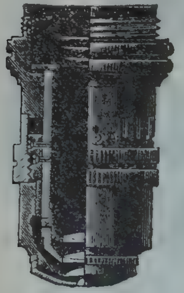


FIG. 34.—Objective fitted with correction collar (Zeiss).

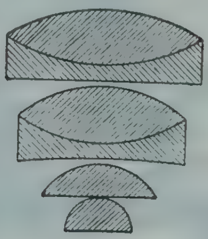


FIG. 35.—Achromatic objective for homogeneous immersion.

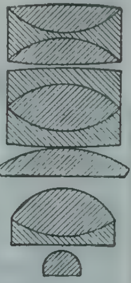


FIG. 36.—Apochromatic system.

The advantages of the immersion over the dry-systems are greatest when the embedding-liquid, the glass cover, the immersion-liquid and the front lens have the same refractive index. Such systems with a so-called homogeneous immersion were first constructed after the plan of E. Abbe in 1878 in the Zeiss workshops at the instigation of J. W. Stephenson. Cedarwood oil (Canada balsam), which has a refractive index of 1·515, is the immersion-liquid. The structure of a modern system of this type, with a numerical aperture of 1·30, is shown in fig. 35.

The most perfect microscope objective was invented by E. Abbe in 1886 in the so-called apochromatic objective. In this, the secondary spectrum is so much lessened that for all practical purposes it is unnoticeable. In the apochromats the chromatic difference of the spherical aberrations is eliminated, for the spherical aberration is completely avoided for three colours. Since in these systems the sine-condition can be fulfilled for several colours, the quality of the images of points beyond the axis is better. There still remains a slight chromatic difference in magnification, for although the magnification consequent upon the fulfilment of the sine-condition is the same for all zones for *one* colour, it is impossible to avoid a change of the magnification with the colour. Abbe overcame this defect by using the so-called compensation ocular, made with Jena glasses. Fig. 36 shows an apochromat of a numerical aperture of 1·40.

THE EYEPIECE OR OCULAR

The eyepiece is considerably simpler in its construction than the objective.

Its purpose in a microscope is by means of narrow cones of rays to represent at infinity the real magnified image which the objective produces. As, however, the object represents a real image, the problem is to project a transparent diapositive. It is therefore impossible to observe this image through an ordinary lens. Since many of the rays coming from the exit-pupil of the objective would not reach the eye of the observer at all, it is necessary, in order to make use of all of them, to direct the diverging rays forming the real image so that the whole of the light enters the eye of the observer. This is effected by a collective lens; it may be compared with the second part of the condenser system of a projecting lantern.

The two most customary eyepieces consist in two simple planoconvex lenses, whose distance one from the other is equal to half the sum of the two focal lengths. One of these is the Ramsden eyepiece (fig. 37). If the real image produced by the objective coincides with the collective lens, only the inclination of the principal rays is altered, the form of the cone being affected only to a very small extent. The lens nearer the eye, which has about the same focal length as the collective lens, is distant from it by about its focal length. The eye-lens converts diverging pencils into parallels. Both lenses together form the exit-pupil of the objective behind the eye-lens, so that this image, the exit-pupil of the total system or the Ramsden circle, is accessible to the eye of the observer. It is possible to see the whole field through this pupil by slightly moving the head and eye. In practice the real image is formed not directly on the collective lens but a little in front of it, because otherwise all the particles of dust on the collective would also be seen magnified.

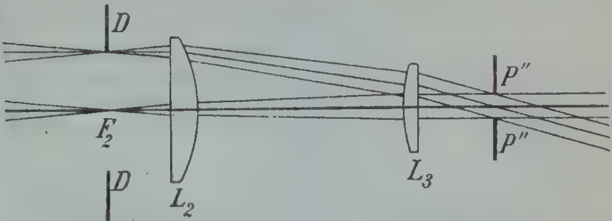


FIG. 37.—Ramsden Eyepiece.
L_2 = collective-, L_3 = eye-lens.
DD = diaphragm of the field of view.
$P''P''$ = Ramsden's circle, or exit-pupil of whole microscope.

In the other type, the Huygenian eyepiece (fig. 38), which is much more widely used, the collective lens is in front of the real image; it alters the direction of the principal rays and somewhat diminishes the real image. In this type the eye-lens is about twice as powerful as the collective lens, and makes the rays parallel. Here also the exit-pupil is accessible to the eye and through it the whole field can be seen by moving the head and eye. In both eyepieces micrometers or cross-wires are used for measuring in the plane of the real image. The Ramsden eyepiece is the most convenient for this because this plane lies in front of the collective lens, and the objective image has not yet been influenced by the eyepiece. As both eyepieces are used with very small apertures (about f: 20) no attempt has been made to overcome the spherical aberrations, which are usually very slight; neither, as a rule, are the eyepieces chromatically corrected, care has only to be taken by a suitable choice of the distance of one lens from the other, that the coloured images derived from a colourless object should have the same apparent size. Since, however, the difference of chromatic magnification cannot be overcome in powerful objectives, this error is still further increased by the eyepiece. The difference of chromatic magnification cannot even be overcome in apochromats, and to cancel this aberration Abbe devised the compensating ocular (fig. 39).

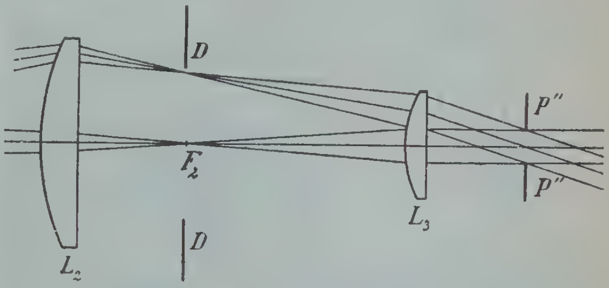


FIG. 38.—Huygenian Eyepiece.
L_2 = collective-, L_3 = eye-lens.
DD = diaphragm of the field of view.
$P''P''$ = Ramsden's circle, or exit-pupil of whole microscope.

The weak compensation oculars resemble a Huygenian eyepiece with achromatic eye-lens, whilst the more powerful ones are of a different construction. These eyepieces are intentionally provided with a different chromatic magnification, which however is in opposition to that originating in the objective. They have also a shorter focus for red, and a longer one for blue, and thus magnify the red image more than the blue; and as the objective gives a large blue and a small red image, the two cancel one another and a colourless image is produced.

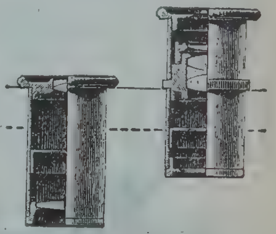


FIG. 39.—Compensating Eyepieces (Zeiss).

These eyepieces are very convenient in use, for when they are changed the lower focus always falls in about the same plane. In German and French microscopes the optical length of the tube, when apochromats and compensation-eyepieces are used, is 180 mm. By multiplying the magnification of the objective by the number on the eyepiece the total magnification of the microscope is obtained. By the magnification of the objective is meant the ratio of the distance of distinct vision to the focal length of the objective. As powerful achromatic objectives show differences of chromatic magnification in the same way as apochromats, compensation eyepieces can be used in combination with these objectives.

Illuminating Systems

Most microscopic observations are made with transmitted light; an illuminating arrangement is therefore necessary, and as the plane of the object is nearly always horizontal or only slightly inclined, the illuminating rays must be directed along the optical axis of the microscope.

To fully utilize the aperture of the system all dispersing rays in the object-space of the objective must be retained in the image-space of the illuminating system. When this occurs the greatest brightness will be obtained if the corresponding diaphragms of the two systems coincide; *i.e.* the field-diaphragm on the image-side of the observing system with object-side of the illuminating system, and the exit pupil of the illuminating system with the entrance pupil of the objective.

For slight magnifications a revolving plane mirror fixed below the object for altering the direction of the rays suffices. For this mirror to illuminate all the points of the objective so that the rays fill up the objective, it must not be too small, and should be as near as possible to the stage plate, and the source of light must be considerably extended (fig. 40). Diffused daylight is very suitable. If the aperture of the objective is increased, the diameter of the illuminating surface must also be increased so that the system is quite filled up, from which it follows that this method of illuminating soon fails. The possibilities of illuminating with a concave mirror seem a little more favourable. As a rule a concave mirror of similar aperture is fitted on the other side of the plane mirror. With the concave mirror an image of the source of light can be thrown upon the object. The distance of the concave mirror from the stage plate is about equal to its focal length. This is also the most suitable distance when diffused daylight is used, but it is too short with artificial light; the distance between the stage plate and the mirror should then be increased, so that an image of the source of light can be thrown upon the object. It is simpler to place an illuminating lens in front of the source of light so that the source falls approximately at the front focus of this lens and consequently is represented at infinity through the illuminating lens. By a correct choice of the focal length of the illuminating lens in relation to the focal length of the mirror, it is possible to choose the size of the image of the source of light so that the whole object-field is uniformly lighted.

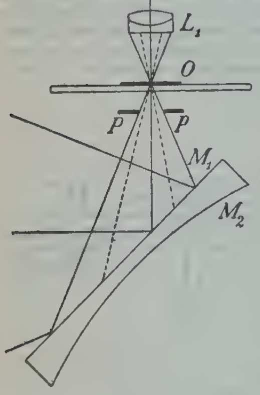


Fig. 40.—Mirror Illumination.
M_1 = plane-, M_2 = curved-mirror.
O = object; L_1 = front lens of microscope;
PP = diaphragm.

Too much light is useless for observing delicately coloured or colourless preparations, whose parts only become visible as a result of slight differences of diffraction. Then it is necessary to use powerfully concentrated cones of light. The apparatus must be such that the apertures of the illuminating rays can easily be altered, *e.g.* by inserting diaphragms in the course of the rays of the illuminating cone below the stage plate (fig. 40, *PP*). This concentration is most easily produced by sliding or revolving diaphragms. A series of holes of different sizes perforate a revolving disk below the stage plate at an equal radial distance from the axis of the disk, so that the holes can be brought under the preparation in turn, the centre of the diaphragms always being a continuation of the optical axis of the microscope.

The so-called cylinder diaphragms (fig. 41) are used especially in German microscopes. A changeable diaphragm is placed at the upper end of a short tube which can be moved in a case below the stage in the direction of the optical axis. By bringing the diaphragm nearer the object the aperture of the rays is increased; if the diaphragm is removed farther from the object the cone of rays is diminished (cf. fig. 40). These diaphragms are sometimes fitted in a slide, so that it is possible to move the diaphragm sideways and give oblique illumination (see below).

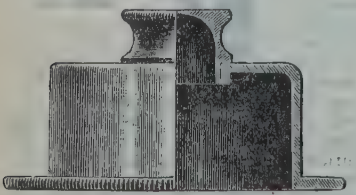


Fig. 41.—Cylinder Diaphragm (Zeiss).

With very powerful objectives these methods are insufficient; and a condenser is fitted below the stage plate. As a rule an iris diaphragm, which can be moved sideways, is now fitted below this condenser; below is the mirror which can be moved in all directions. The Abbe apparatus consists of a condenser, movable iris diaphragm, and mirror (fig. 42). The whole apparatus can be focused by a rack and the button *s*. The iris diaphragm can be regulated by the lever *p*; it can also be turned to one side round the pivot *z*, so that the condenser *k* can be removed or changed. The correct direction can be given to the illuminating cone by the mirror *m*. It is often desirable to pass from direct to oblique lighting. The Abbe apparatus makes this easy. The iris diaphragm *i* is pushed to the side by the rack and pinion *t n*. The chief cone of rays then enters obliquely into the objective, the angle between the direct cone of rays and the diffraction spectrum of the first order can then become as large again as with direct lighting, and still be taken up in the objective. Oblique lighting, however, can only be in an azimuth, so that the object must be turned in order that the details may be observed. Hence a condenser, for lighting with very oblique cones, must have about the same aperture as the objective, and therefore be of very wide aperture; they therefore closely resemble microscope objectives in construction. Especially powerful achromatic condensers are really only magnified microscope objectives, with the difference that they are not corrected for the thickness of the cover slip, but for the thickness of the glass on which the object is placed. For exceptionally accurate work microscope objectives are sometimes used as condenser systems. When using immersion objectives, an immersion condenser must also be used if rays of extreme obliquity are wanted, for, in consequence of the total reflections, rays can only come from the upper plane surface of the condenser, which have not a larger inclination to the axis than about 41°, varying according to the refractive index of the glass. In order to let highly inclined rays pass out from the condenser, some immersion liquid must be placed between the upper surface of the condenser and the object slide. Condensers are for this reason also constructed with apertures up to 1·40.

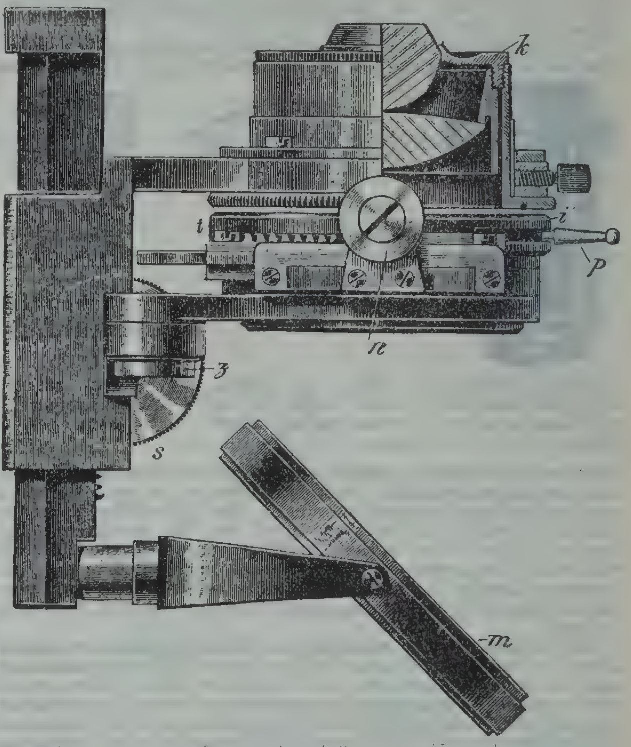


Fig. 42.—Abbe Illuminating Apparatus with Ordinary Condenser (Zeiss).

Vertical Illuminators.—Opaque objects can only be seen by reflected light. With low magnifying systems and a large free object distance, ordinary good daylight is sufficient. If the objects have a low reflecting power, or if a slightly higher magnification is needed, the lighting can be improved by optical system.

To examine small opaque objects with a high magnification the Lieberkühn mirror, so named after its inventor, was formerly much used. This was a concave mirror, pierced in the middle, fixed to the objective, and directed towards the object and with such a focal length that rays parallel to the axis falling upon it were united exactly upon the object. In this case the object lay upon a stage plate, whose centre had so far been made opaque, so that the rays coming from the illuminating plane mirror could not reach the objective direct, but only the rays passing the stage plate to the side of this blackened portion reached the Lieberkühn mirror, and were used in lighting. The disadvantage of this method was that only *small* opaque objects could be examined. Much more easily manipulated is the parabolic side-illuminator invented by R. Beck, which can be conveniently fitted in and used for objectives with different focal lengths. It consists in half of a short focused parabolic mirror, which concentrates all the light coming from the one side on to the object. To examine objects with objectives of high power and low free object distance, the apparatus for side-illumination is not sufficient, and a so-called vertical illuminator is used. In Zeiss's form (fig. 43) a small prism *p*, which also revolves upon a horizontal axis, is placed as near as possible to the back lens of the objective. The edge which is the separating line of the horizontal and hypothenuse surfaces of the prism, lies approximately over the middle of the system, so that the rays entering through the opening in the side after having been reflected by the hypothenuse surface are concentrated through one half of the objective on to the object. When observing only the other half of the objective is used. The sources of light used should be arranged so that the objective throws an image of the light-source upon the object. It is best if the image of the light is not larger than the object examined, and to effect this, an illuminating lens with an iris diaphragm is often placed between the source of light and the illuminator. By suitable adjustment and by changing the iris diaphragm the size of the illuminating field can be controlled. The objects observed with the vertical illuminator must not have a glass cover if the dry system is employed, because the upper surface of the glass cover would send so much light back into the objective by reflection, that the image would be indistinct. It is, on the contrary, possible to examine covered objects with the vertical illuminator, if the immersion system be employed. Owing to the slight difference of illumination between the immersion liquid and the cover, the portion of light reflected on the cover is not noticeable.

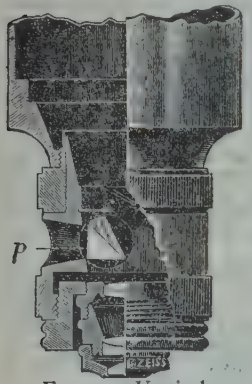


FIG. 43.—Vertical Illuminator (Zeiss).

Dark Field Illumination.—As was seen when discussing the physical theory, the minute details of the object cause diffractions, and can only be examined if the objective can take up at least two consecutive diffraction spectra. These diffracting details become especially distinct if the direct lighting cone of rays, the spectrum of zero order or the chief maximum, is not allowed to enter the objective and instead only two or more diffraction maxima are taken up; the details then appear bright on a dark background. In dark field illumination care has to be taken that no direct rays reach the objective, and hence a good dark field illumination can be produced if the condenser system has a larger aperture than the objective. If an Abbe lighting apparatus is used a dark field diaphragm (fig. 44) can be placed in the iris diaphragm case. The central diaphragm disk keeps away all the light which would otherwise fall directly into the objective, and the open zones send so many oblique rays through the object that they cannot all be taken up by the objective. Exactly the same effect is reached when, as is shown in Fig. 45, a more powerful system D is used for a condenser, which has a blackened section on the back of the front lens of such a size that no light can enter the objective A. In this way it is only possible for diffracted rays to enter the objective.

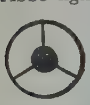


FIG. 44.

Apparatus for a good dark field illumination has received much attention, because in this way ultra-microscopical particles can be made visible. This depends on the good combination of the entering cones of rays, which should be as oblique as possible; this is most easily done by mirror condensers. A number of early inventions have been revived for this purpose.

Wenham's paraboloid illuminator (fig. 46) is made entirely of glass, and is in the form of a paraboloid, having on the top a spherical hole, of such a curvature that all entering rays, *r r′ r″*, parallel to the axis, after their reflection on the surface of the paraboloid, traverse the spherical surface perpendicularly and unite in F, the centre of the sphere. A diaphragm *s* is placed in the middle of the spherical surface, and this keeps back the central rays. This diaphragm is sometimes fixed to a handle piercing the condenser, and which can be moved up and down, so that the aperture of the oblique entering cones of rays can be altered. Another form of the paraboloid condenser, also due to Wenham, has a plane surface on the upper side. Some immersion fluid must then be placed between the stage plate and the condenser in order to allow all the rays to pass out; otherwise only those rays would be able to pass out which are close to the axis of the condenser in the inside of the condenser, and are smaller than the limiting angle of the total reflection.

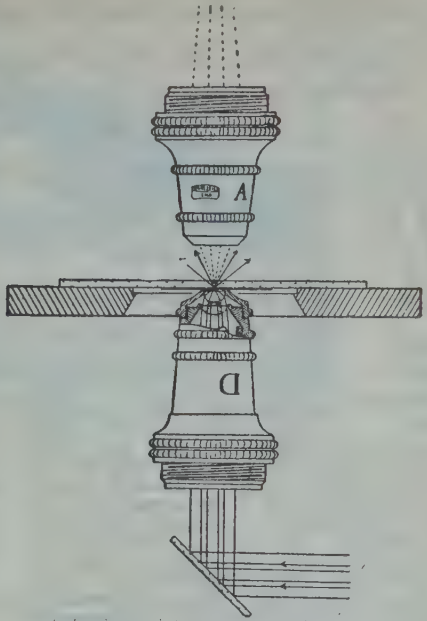


FIG. 45.—Path of Rays for dark-ground illumination with fixed diaphragm in the objective.

(Objective D can also be used as a condenser (Zeiss).)

Th. Ross's "spot lens," invented in 1855, and J. W. Stephenson's catoptric illuminator (1879), may also be mentioned. A recent condenser of very high illuminating power is due to H. Siedentopf (fig. 47). It is a double mirror system, whose reflecting surfaces are a sphere *a* and a cardioid *b*. The combination of rays is also sufficient in practice if the cardioid surface is replaced by a spherical one.

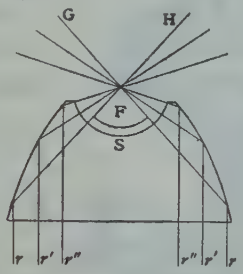


FIG. 46.—Wenham's Paraboloid Condenser.

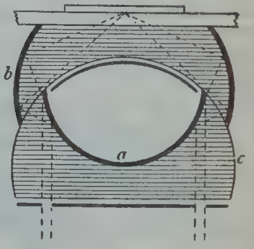


FIG. 47.—Siedentopf's Cardioid Condenser.

A supplementary spherical surface *c* is necessary for the completion of the condenser.

BINOCULAR INSTRUMENTS

The stereoscopic microscope is the most suitable for finding out the space taken up by the separate parts of a preparation. (See also BINOCULAR INSTRUMENTS and STEREOSCOPY.) The observer has a stereoscopic impression of an object, when different perspective representations are presented to both eyes, which, through the action of the central nerve system, resolve into one impression.

One way of receiving a stereoscopic impression through a microscope is by fixing an apparatus as directly as possible above the last lens of the microscopic objective, which divides the rays passing out and directs half into each eyepiece. The half cones of rays have now semicircular sections, the diaphragms having the same form. The cones must be so directed through the divided system that the two exit pupils correspond to the interpupillary distance of the observer. The distance of the centres of the semicircular entrance pupils and their distance from the object regulates the difference of the two perspective representations, which are presented one to the right eye and one to the left. If the perspective centres lie too near one another in the object-space, as may happen with slightly opened and weak systems, the difference of the perspective is then too slight to make any real stereoscopic impression. On the other hand, a very much exaggerated stereoscopic effect can be derived from short focused systems of wide aperture. On account of the slight depth definition, short focused systems of wide aperture are not at all specially suitable for stereoscopic observation, because the possibility of observing objects taking up a good deal of space is too limited when such systems are used.

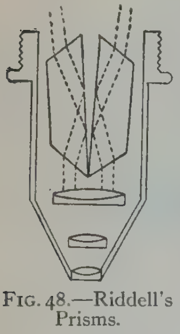


FIG. 48.—Riddell's Prisms.

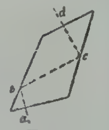


FIG. 49. Wenham's Prism.

Professor J. L. Riddell (*Quart. Journ. Micros*, 1853, p. 236; 1854, pp. 18–24) published an arrangement of prisms, which, however, imparted a pseudomorphous impression if image-forming oculars were not used, and in 1854 a second system (fig. 48), essentially a Wheatstone pseudoscope, added just above the objective. This gave an orthoscopic image even in ordinary eyepieces. By adopting right-angled reflection-prisms above the eyepiece he completely erected the image. Stephenson's stereoscopic microscope (fig. 58, Plate) resembles this apparatus in all essentials. A construction of prisms by Nachet is now almost forgotten, while on the contrary an extremely simple dividing prism published by Wenham (*Lond. Micros. Soc.*, 1861, i. 109) has been exceptionally well attested in practice. It is more easily used than any other apparatus (see BINOCULAR INSTRUMENTS, fig. 8). A reflection-prism (fig. 49) in a setting is placed above the last surface of the objective and divides the exit rays. The group of rays coming from the left half of the objective can continue its way without hindrance to the right eye. The group of rays coming from the right half of the objective is reflected twice in the prism and directed to the left eye. The tube containing the left eyepiece is a little inclined towards the right tube, which is perpendicular. It can be adapted to the interpupillary distance by changing the tube slide. If it is desired to use the instrument as a monocular, the setting with the prism at the lower end of the tube is taken away.

A second manner of making stereoscopic observations employs stereoscopic eyepieces. The first of such eyepieces was proposed by R. B. Tolles.[1] He realized that the division of the cones of rays by prisms could only be satisfactorily performed if the prism was placed in the position of the exit pupil of the objective or in the position of the real image of this exit pupil. He employed a Nachet combination of prisms and placed the dividing prism at the spot where a special reversing system formed a real image of the exit pupil of the objective. A second stereoscopic eyepiece was devised by A. Prazmowski who substituted a Wenham diffracting division prism at the position of the real image of the exit pupil of the objective formed by a reversing system. The newest form of a stereoscopic microscope resembles the oldest in so far as two completely separate microscopes are used. In the oldest microscope by Cherubin d'Orleans the observer receives a pseudoscopic impression in consequence of the reversed image. This defect has been avoided in the instruments constructed in the Zeiss factory (fig. 59, Plate) at the instigation of the American zoologist H. S. Greenough. The system of Porro prisms employed affords a convenient method of adapting the ends of the eyepieces to the interpupillary distance. The two tubes are inclined to one another at an angle of about 14°. The microscope is only intended for slight magnifications. The possibility already suggested of using both eyes for observing without having a stereoscopic impression, is often regarded as a great advantage. Binocular microscopes have therefore been constructed on this plan. Such a combination of prisms was used by Wenham, who placed it directly behind the last objective lens. As a rule this arrangement of prisms can be exchanged for the Wenham stereoscopic reflection-prisms.

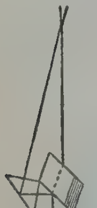


FIG. 50. Powell's Prisms.

A second kind of dividing prism which directs the entire course of rays to both eyes, and thus produces identical images, was used by Powell and Lealand (fig. 50). Every ray is divided into a reflected and a refracted portion on the front side of a parallel plate. Whilst the refracted portion after leaving the plate continues its way in the same direction, displaced a little to one side, the reflected portion is directed into the side tube by a reflection-prism. With these microscopes, which are not stereoscopic, objectives of any power can be used. The surfaces of the dividing prisms must be very exact, so that no deterioration of the image may arise from them. A microscope for two eyes can also be obtained by employing the Abbe stereoscopic eyepiece.

By the supplementary use of one of Wenham's prisms every ray is analysed into a more powerful refracted and a weaker reflected one. The same image can be presented to each eye by using this eyepiece also. No stereoscopic impression is then felt. It is brought about by placing special semicircular diaphragms in the plane of the exit pupil of the microscope. By turning the diaphragms 180° round the optical axis, the orthoscopic impression can be changed into the pseudoscopic. The mechanical arrangement of the eyepiece is such that the distance of the two exit pupils can be adjusted to the interpupillary distance.

MECHANICAL ARRANGEMENTS

Although the optical system is the first consideration in a microscope, the system is valueless if the fittings do not allow its correct use. The optical system must be kept at a certain distance and well centred, and a correct position for the object in relation to the system must be assured.

In fig. 60, Plate, the microscope is seen to consist of the heavy metal foot A, which rests on the table at three points. The whole microscope is fitted to this foot. The object can be held firmly on the stage plate B by cramps C. On the lower side of the stage plate are the condenser and the diaphragms, and the illuminating mirror J is held by a rod D fixed to the stage plate. Likewise on the stage plate is the support for the tube E. The rough adjustment of the microscope can be made by a rack and pinion F; and the fine adjustment by the screw G. The tube containing the eyepiece and the objective is double. The inner tube H is movable, making a change in the length of the tube possible. As a rule this inner tube has a mark which allows the length of the tube to be set.

It is most important the stand should be free of vibration. A fine adjustment is also necessary, in order to perform conveniently and with certainty the slight motion of the microscope in relation to the object. In cheap stands the rough adjustment was worked by moving the inner tube by hand, but the more convenient rack and pinion is now used almost exclusively.

For slight magnifications rough adjustment is sufficient, but with objectives of a focus below $\frac{1}{4}$ in., a fine adjustment is wanted. Very different constructions are in use. Almost all are such that the whole microscope tube is raised or sunk by the mechanism of the fine adjustment, and not only the objective. The most used is the micrometer screw adjustment (fig. 51). The tube carrier B fits closely on to a column A which is fixed firmly to the stage plate. The end of the column C is traversed by the micrometer screw D which is set in action by the knob E. The column A contains a powerful spiral spring, which exercises a strong pressure on the plate F fixed to the carrier B. By screwing in the micrometer, the spring is compressed and the tube lowered. By the contrary movement the spring pressure raises the tube as far as is allowed by the screw. The strong pressure of the spring practically excludes motion, which with fine adjustments is very important. Another very good adjustment is that of Messrs Swift & Son, shown in fig. 52. The long lever D is pressed to one side by the screw F, and is thus turned round the pin E. On the tube very near to the pin E is a cylinder C, which by the action of the screw F is very slightly raised or lowered. A double lever is used in a fine adjustment by Messrs Watson & Sons (fig. 53). According to whether the screw A or B is used, the adjustment is fine or coarse. In other fine adjustments by means of springs and balance wheels either a micrometer screw is moved (Zeiss), or a curved disk fixed to the balance wheel is turned (Leitz), or an oblique disk arranged more or less in a circle and attached to the balance wheel is revolved (Reichert). These modern adjustments are made so exact that motions can be easily measured

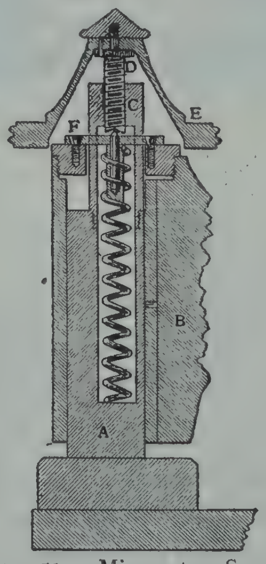


FIG. 51.—Micrometer Screw Adjustment of Leitz.

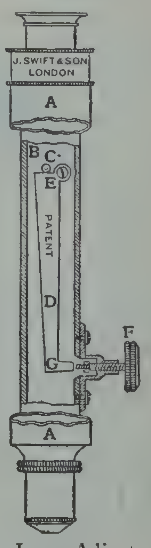


FIG. 52.—Lever Adjustment o J. Swift & Son.

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[1] R. B. Tolles, *Sill. Journ.* (1865), xxxix. 212; *Journ. Roy. Micr. Soc.* (1890), pt. i. p. 383.

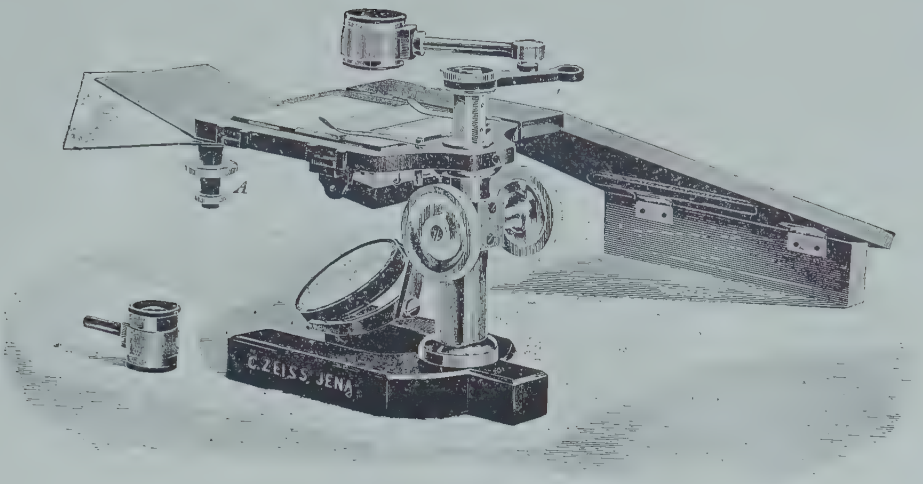
A
C. ZEISS. JENA

FIG. 57.—LARGE DISSECTING STAND (ZEISS).

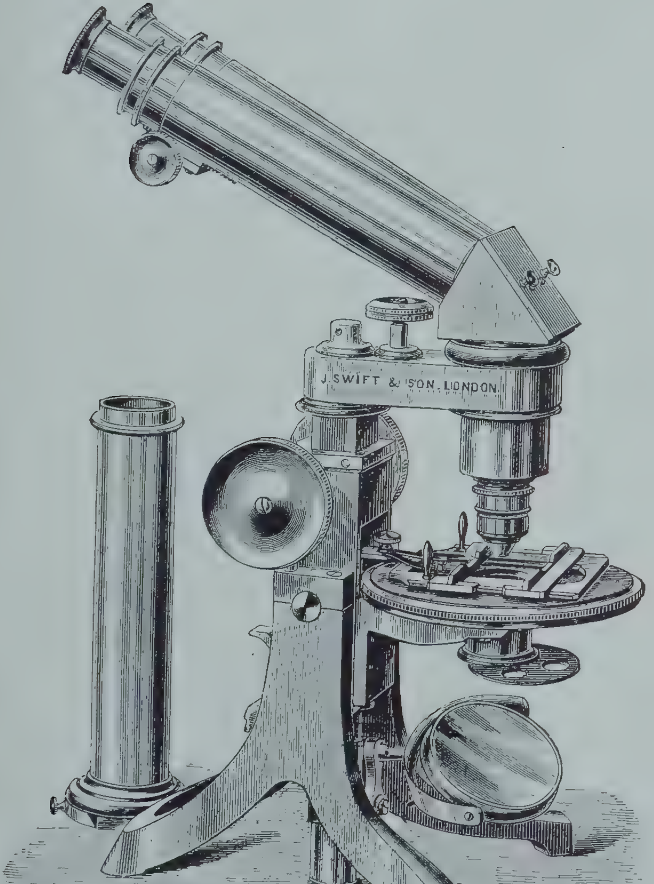
J. SWIFT & SON. LONDON.
HEADINGTON

FIG. 58.—STEPHENSON'S BINOCULAR MICROSCOPE (SWIFT).

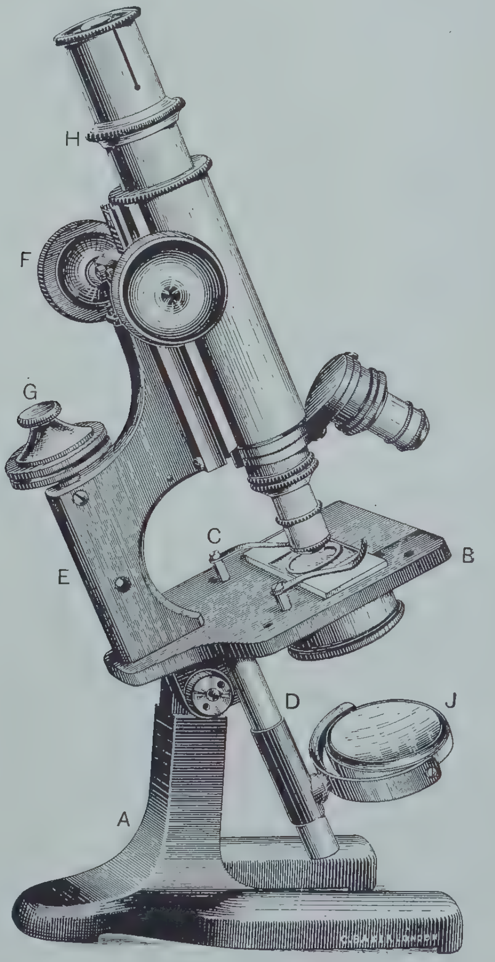
H
F
G
C
E
B
D
J
A
C. BAKER. LONDON

FIG. 60.—THE DEMONSTRATION MICROSCOPE (BAKER).

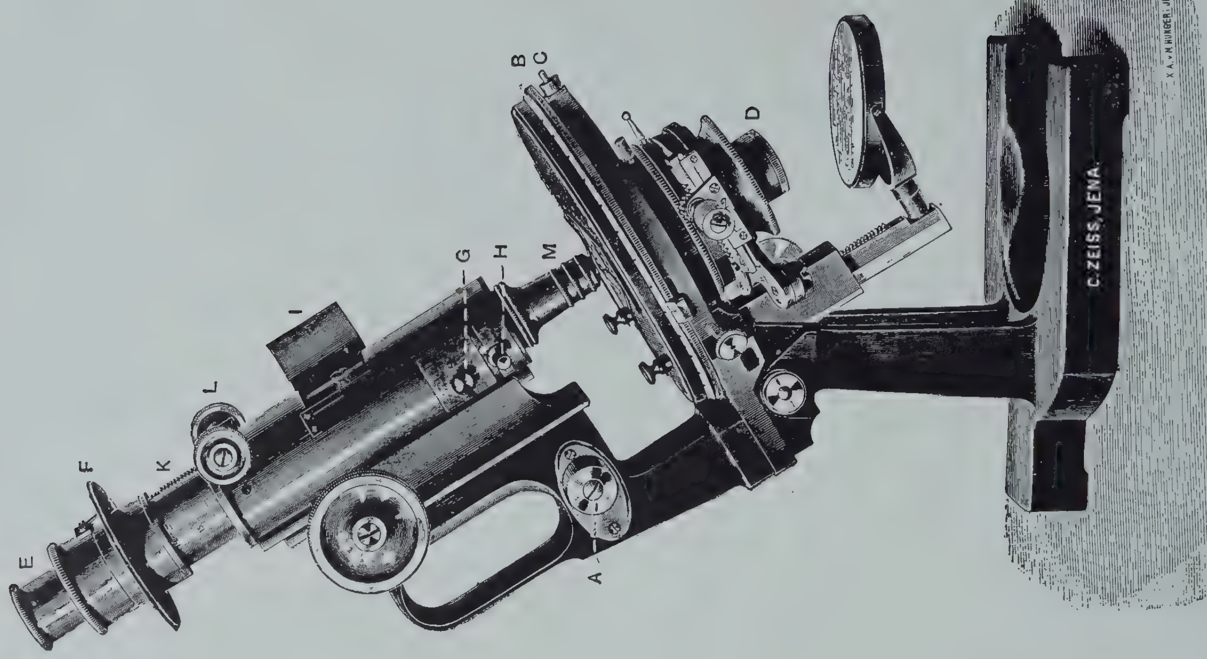
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FIG. 61.—PETROGRAPHICAL MICROSCOPE (ZEISS).

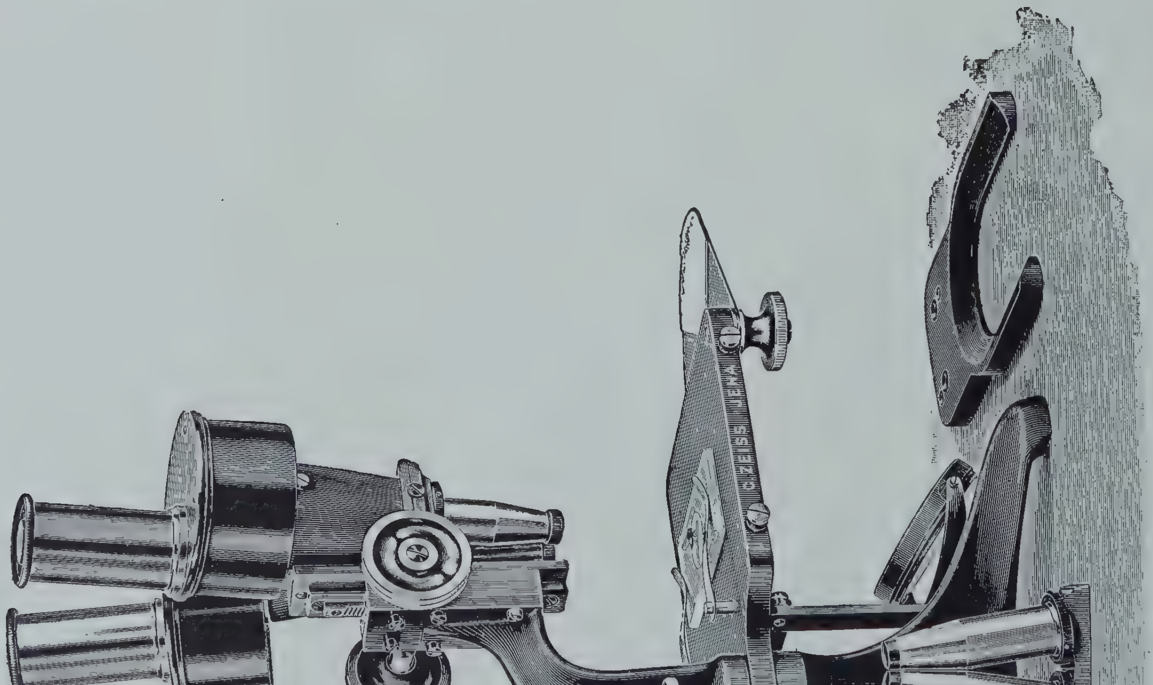

C. ZEISS JENA

FIG. 59.—GREENOUGH'S BINOCULAR MICROSCOPE (ZEISS).

up to 0·002 mm. An essential in all rough and fine adjustments is that the motion must always be parallel to the optical axis of the microscope, so that the same point in the object remains in the centre of the field.

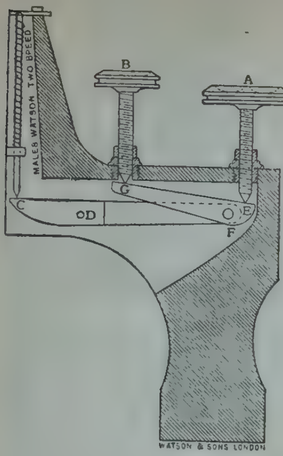


Fig. 53.—Double Lever Adjustment of Watson & Sons.

Another condition which must be fulfilled by a good stand is the power of inclination. It is only rarely necessary to arrange the preparation really horizontal; and for easy observation, especially when it will take a long time, it is of great assistance if the microscope can be inclined, so that the observations can be made in a natural position. The apparatus for inclining the microscope is chiefly such, that the microscope can be placed in all positions between the vertical and the horizontal. The horizontal position is sometimes necessary if photographs are to be taken by the microscope.

Many devices are available for changing the objective. It is essential that the objective is always brought before the lower end of the tube in such a way that the optic axis of the objective coincides with the optic axis of the rest of the system. The fittings of the objective and the changer are so arranged that little or no fine adjustment is necessary after the change. The most widely used is the revolving changer (fig. 60, Plate). The revolver may hold two, three or four objectives. In the sliding changer the objective is, dovetailed to a slide, the correct position being secured by clamps.

Fully equipped microscopes have apparatus for moving and turning the object. In simple microscopes the stage plate lies on the stand held by two springs, and must be moved by the hand (fig. 60, Plate). For elaborate work a so-called cross-table is indispensable. By means of screws the stage plate is movable in two directions at right angles to one another, in the plane of the stand. In many cases the stand is also movable round the optic axis.

The microscope stands described above can be used for the greater number of the naturalist's experiments. For very special objects the stand must be expressly made; thus stands with tube carriers very much projecting are made for examining sections of the brain. The petrographical microscope is shown in fig. 61, Plate.

In order to determine the refractive index when the thickness of the crystal is known, or the thickness of the crystal when the index is known, a fine adjustment A makes it possible to measure exactly the changes in the length of the microscope. Further, a revolving stage plate provided with a graduation B is used to determine the angle in crystals. To obviate mistakes the optical axis of the microscope must coincide with the revolving axis of the plate, and the revolving plate has a central position C to keep this condition fulfilled. In many stands the objective can be centred instead of the plate. For measuring this angle, an eyepiece with cross-threads is used. In the lower focal plane of the eyepiece, at the spot where the real image which the objective forms of the object arises, a glass plate is introduced on which are two fine cross lines or even two very thin threads. The eye-lens can be adjusted for the thread-plate, so that different observers can see the cross clearly. The cross is always adjusted first. When observing with such an eyepiece, care must be taken that the real image of the object lies in the plane of the cross-threads, *i.e.* that there is no parallax. The adjustment is easily controlled. If the eye is moved to and fro over the eyepiece and the image makes apparently similar movements in relation to the cross threads, then the image does not yet lie in the plane of the threads.

To measure the angle, the images of the crystal edges are covered in turn by one of the threads by turning the table, and the angle of rotation is read from the scale. A cross-table is very convenient for this calculation, for with the aid of the two movable slides situated in the plane of the plate and at right angles to one another, the point where the two crystal edges intersect can be quickly and correctly brought into the revolving axis of the plate. This measurement can also be made with a goniometer eyepiece, in which a row of parallel double-marks are used instead of the cross threads. The fitting of the eyepiece at the upper end of the tube is provided with a graduated circle. The eyepiece proper with the parallel strokes can be revolved, and the rotation be read from the graduated circle. In carrying out this calculation the marks of the thread-plate have only to be placed exactly parallel to the crystal edge.

For examining preparations in polarized light a polarizer D is introduced in the illuminating apparatus below the diaphragm and an analyser E above the eyepiece. The analyser can be rotated, the angle being read by a divided circle F. Very often the analyser is placed in the tube, a little above the objective: it is then generally in a case G, which can be put into the tube. The placing of the analyser near the objective has the advantage that the field of view is not restricted, as is the case if the analyser is used above the eyepiece. Nicols's, Glan-Thomson prisms or similar polarization apparatus are used as polarizers and analysers. Below the analyser G a plate H of selenite or mica may be put in the course of the rays. This small plate can also be laid above the polarizer in the illuminating apparatus or in the eyepiece.

To examine crystals, especially in converging light, a condenser, movable in the optic axis, is needed above the polarizer. The image produced by the microscope objective M in its back focus plane is then observed through a supplementary microscope. The objective of this supplementary microscope, the Bertrand lens, can be applied through a window I at the lower end of the inner tube K. By using a rack and pinion movement L the supplementary microscope can be adjusted for the images. There is nearly always an arrangement to observe the preparation first in convergent light and then in parallel polarized light. This change can often be brought about by taking away or adding parts of the condenser.

Micrometry

It is often required in microscopical work to determine the size of objects or parts of objects.

There are three essential ways of performing this. The first method uses the objective screw micrometer. The object is placed on a slide in the plane of the stage plate and able to be very finely moved by the micrometer screw, which has as fine a worm as possible. A divided cylinder is fixed to the turning knob, which thus makes it possible to measure fractions of the revolution. The revolutions of the cylinder are registered by a calculator. The use of an eyepiece with a cross thread is essential to this measurement. After the microscope has been so adjusted that the image of the object to be measured falls exactly in the plane of the cross threads, the object is moved by the micrometer until one edge of the object is exactly covered by a thread. The micrometer is now read. Then the object is moved by the micrometer till the image of the other edge is covered by the thread in the eyepiece, and the micrometer is again read. The difference between the two positions gives the size of the object. The objective screw micrometer is, however, not sufficiently delicate, and is only used when comparatively large objects are to be measured, and especially for objects whose edges do not appear at the same time in the field of view.

The second and most widely used method employs a micrometer eyepiece. In this case not the object itself but a real image which has already been magnified by the objective is measured, and obviously much more accurate results are possible. The most accurate calculations are obtained by using the screw micrometer ocular (fig. 54). Directly below the collective lens of a Ramsden eyepiece a slide *b* can be moved by a micrometer screw *a*; the slide carries a little glass plate *c* provided with a graduation. With the help of this scale the total revolutions of the screw can be read; fractions of the revolution can be read from the divided cylinder *d*. The scale is generally divided into hundredths of millimetres or thousandths of inches. A fixed mark which serves as an index is placed on the lower side of the collective lens and is seen clearly at the same time as the graduation of the movable slide. The micrometer stands at zero if the zero mark of the cylinder coincides with the index and the fixed mark is at a known division. The calculation is most convenient if the micrometer is left in the position of zero and the object is moved till one of its edges corresponds to the zero mark of the eyepiece scale. If the micrometer is then moved till another graduation corresponds to the other edge of the image the size of the image can be read off. As this method measures

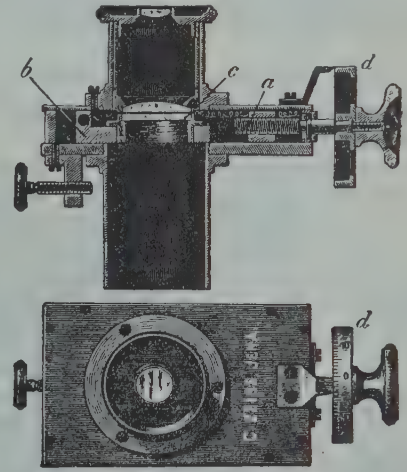


Fig. 54.—Screw Micrometer Ocular. Sectional elevation and plan (Zeiss).

the image correctly to a few thousandths of millimetres, the object itself is measured accurately to some hundred-thousandths of millimetres, if it has been magnified a hundred times by the objective. To keep up this degree of exactitude the magnification of the objective must be carefully ascertained, *e.g.* by using an objective micrometer. A fine scale with known intervals is put on the stage plate, and by determining the distance between the graduations of the objective micrometer formed through the same objective, by means of the screw micrometer ocular, the magnification of the objective is determined. As the errors in the graduation of the objective micrometer are also magnified, very exact scales are necessary. When determining the magnification the microscope must be used under exactly the same conditions: neither the length of the tube nor the focal length of the objective may be altered.

A fixed eyepiece micrometer is simpler and more popular. This consists of a scale on a little glass plate, which, instead of a cross wire, is placed in the eyepiece. The adjustment must be such that the image produced by the objective falls exactly in the plane of the scale. The size of the image is determined by calculating the entire interval taken up by it. By using an objective micrometer in place of the object, the magnification of the objective can be ascertained and from this the actual size of the object. As fractions of intervals can only be estimated in this method, a measurement with such an eyepiece scale can of course not be as exact as with a screw micrometer ocular. However, such a determination of size is often quite accurate enough.

A third method employs a drawing prism. The object and the drawing plane are seen at the same time and the outlines can be readily drawn. If, as before, an objective micrometer is placed below the microscope in the place of the object, and the size of a special micrometer-interval is drawn on the same board, then the actual size of the object can be ascertained. Instead of first drawing the object and the objective micrometer, they can of course be projected at the same moment on a scale on the drawing board.

The errors attending the determination of the size of a microscopic object depend chiefly on the accuracy of the objective micrometer; any errors in the micrometer being magnified by the objective. These may be diminished by using different parts of the objective micrometer for the correction of the eyepiece scale, and the calculation of the size is based on the found mean value. A second error can arise through the inaccuracy of the eyepiece micrometer, and also in the case of a screw micrometer through periodic faults of the screw, and through dead motion. The eyepiece micrometer allows its errors to be diminished, if one measures at different points and then fixes a mean value. The dead motion of a micrometer screw is best avoided by working the screw always from one and the same side. The thickness of the cross wire may also occasion a fault. For this reason there is sometimes employed two very narrow threads lying beside one another, and which limit the image as nearly as possible.

The Testing of the Microscope

The excellence of a microscope objective depends on its definition and its resolving power.

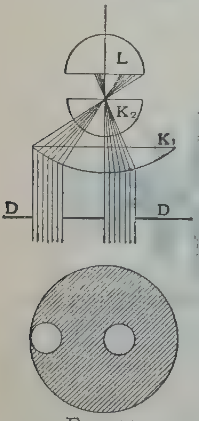


Fig. 55.
DD = diaphragm.
K_1K_2 = condenser.
L = front lens of the objective.
The lower figure shows the plan of the transmission.

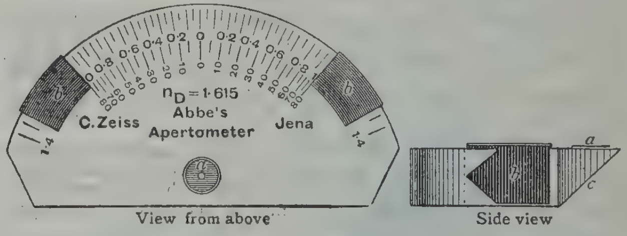
The definition is better according as the chromatic and spherical aberrations are removed; there always remains in even the best constructions some slight aberration. In consequence of these residual aberrations, every object-point is not reproduced in an ideal image-point, but as a small circle of aberration. These circles will be objectionable when the smallest details are examined. The size of these circles depends, in the case of equal tube lengths, only on the type of the objective, and not on the focal length, exact execution being assumed. Object details will only be well seen if the aberration circles are small in comparison. The size of these details in the image depends only on the magnification of the objective, $M = \Delta/f_1'$, and can by appropriate choice of the focal length of the objective be brought to the right value. In the case of a suitable ocular magnification, the details will be well seen, while the aberration circles remain invisible. It is therefore possible to judge the excellence of the focusing of objectives on the strength of the ocular-magnification, or the over-magnification, which they permit.

E. Abbe, through the so-called delicate ray transmission, suggested a way by which the quality of the images of objectives can be observed. The ray transmission, shown in fig. 55, is obtained by means of a stop of the form shown in the lower figure and placed under the condenser in the plane of the iris diaphragm. The entrance pupil is in this way reduced on two small separate fields, which nevertheless contain rays of all zones. It is necessary that the outside edge of the diaphragm coincides with the edge of the entrance pupil. This can be attained by drawing the iris diaphragm so far as to form the entrance pupil. The double diaphragm is then in such a position that the edge of the outer diaphragm coincides with the edge of the iris diaphragm.

The object employed must have distinct boundaries. Abbe's test plate consists of an object carrier on which six cover glasses of exactly determined thickness (between 0·09 mm. and 0·24 mm.) are cemented. The cover glasses are silvered on their under surfaces, and in the silvering fine lines are drawn; these lines form the test object. This plate admits at the same time of a correct determination of the thickness of the cover glass, for which the best correction exists. So long as the object is not sharply focused two separate dispersion figures will be seen. The defects of the objective are revealed, *e.g.* two adjacent sharp images are formed, which become indistinct if they coincide, or one pencil produces a distinct, the other an indistinct image, or that the images are surrounded with coloured rings. Owing to the curvature of the image, all parts of the object are not seen distinctly at one and the same time.

The resolving power of an objective depends on its numerical aperture. The numerical aperture can be determined in two ways. A diaphragm with a very narrow hole is placed on the stage, and the microscope sharply focused on the edges of the hole. The illuminating mirror is turned aside and a graduated scale is laid on the foot of the microscope. Strong systems produce in the proximity of their back focal plane an image of the scale, which can be inspected with a weak auxiliary microscope, and the length of the visible part of the graduation determined. The ratio of half the length of the visible piece of the scale to its distance from the edge of the diaphragm on the stage gives the tangent of half the angular aperture. The sine of this angle is the numerical aperture for dry lenses. With weak systems no auxiliary microscope is necessary, the eyepiece being removed and the scale viewed directly in the tube.

E. Abbe constructed a simple instrument for the determination of the aperture, termed the apertometer (fig. 56). A semi-circular glass plate bears two scales, over which two black thin metal plates bent back at right angles may be moved. A little hole in the silvered plate *a* marks the centre of this circle. Through this hole the points of the metal plates *b* can be observed by total reflection on the surface *c*. The apertometer is laid on the stage, so that the hole lies in the axis of the microscope, and the hole is sharply focused. The eyepiece being removed the image of the metal plates *b* produced by the objective is seen. In order to ensure for the eye a central position, there is fixed on the upper end of the tube in place of the eyepiece a disk of pasteboard or metal with an axial hole. The metal plates *b* are then moved till the points just cut off the edge of the field to be surveyed. The angular or numerical aperture can then be read off. With strong systems the vanishing of the points is observed with an auxiliary microscope, formed by means of the inner tube. In immersion systems the immersion liquid is placed between the front lens and apertometer.



View from above
Side view

Fig. 56.—Abbe's Apertometer (Zeiss).

If the numerical aperture be known the resolving power is easily found. The resolving power can also be determined by using different fine test objects. Norbert's test plates, which bear graduated groups of extremely fine and narrow divisions are very useful, while the tests of *Amphipleura pellucida* and *Surirella gemma* are often employed.

The magnification of a microscope is determined from the focal lengths of the two optical systems and the optical tube length, for $N = 250\ \Delta/f_1'f_2$. To determine the optical tube length Δ, it is necessary to know the position of the focal planes of the objective and of the ocular. If one focuses an auxiliary microscope, carried in the inner tube, on the image situated in the back focal plane of the objective of a distant object, and then on the dust particles lying on a slide pressed against the end of the outer tube, the displacement of the auxiliary microscope gives the distance of the back focal plane of the objective from the end of the outer tube. To determine the position of the anterior focal plane of the eyepiece, the eyepiece is placed on the stage with the eye-lens downwards. An auxiliary microscope is now focused first on the image of a distant object and then on the plane of the edge of the setting. This plane can be marked by a small piece of paper. This gives the distance of the anterior focal plane of the eyepiece from the bottom edge of the setting of the eyepiece and consequently also of the edge of the eyepiece carried by the upper end of the tube. These measurements determine the optical tube length Δ.

There are many methods for determining the focal length of the objective. The objective to be examined is placed on the stage, and in the manner just shown, the distance of the focal plane from the edge of the fittings or to the surface plane of the front lens is determined. Any plane object a few yards distant can be used. If the object can be seen by using the mirror, the plane mirror must be used; then the actual size of the object and of the image produced by the objective is measured (of the image by a micrometer ocular). The distance of the object from the nearer focus of the objective is next determined. This distance is composed of the distance of the object from the centre of the plane mirror, and of the distance of the focus of the objective on the stage plate from the centre of the plane mirror. Let the size of the object be y, the size of the image y' the distance of the object from the focus x, then $y/y'=x/f_1$ from which f_1 can be calculated (see LENS). The same method can be used to determine the focal length of the eyepiece. These are the dimensions necessary for determining the magnification of the microscope, viz. the optical length of the tube Δ, the focal lengths of the objective f_1'; and of the eyepiece f_2.

The focal length of an objective can be more simply determined by placing an objective micrometer on the stage and reproducing on a screen some yards away by the objective which is to be examined. If the size of the image of a known interval of the objective micrometer is determined by an ordinary scale, and the distance of the image from the focal plane of the objective belonging to it is measured, then the focal length can be calculated from the ratio $y/y'=f_1'/x_1'$, in which y is the size of the object, y' that of the image, and x_1' the distance of the image from the focal plane belonging to it.

Besides this indirect method of determining the magnification there is also a direct one, in which it is not necessary to first measure f_1, f_2 or Δ. If a drawing prism is used above the eyepiece, and an objective micrometer is inserted, then if a scale is laid on the drawing board which is 25 cm. distant from the exit pupil, one or more intervals of the objective micrometer can be seen projected on the scale lying on the board. The comparison of the two scales gives directly the magnification. The course of the light within the drawing prism must be taken into account when determining the distance of the scale from the exit pupil. Although this method does not give very accurate results, it is more convenient and simple than the indirect method.

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MICROTOMY (Gr. τόμη; τέμνειν, to cut), the term applied to the preparation of minute sections of organic tissue for the microscope. In 1875 the methods were yet in their infancy; their development has enabled observers to achieve the most exact study of minute anatomy, in the case of small objects, which without these methods could only be investigated by the unsatisfactory process of focusing with the microscope through the solid object.

It is not necessary here to detail at length the *wet method* of preparing sections. Briefly, the tissue is soaked in a solution of gum, or of gum and syrup, and after being frozen by ether spray, or by a mixture of ice and salt, is cut into sections either by the Rutherford, Cathcart or some similar section-cutter, or by apparatus which can be fitted to the more modern types of microtome referred to below. This method, which is to-day used mainly by pathologists, has two main disadvantages: the prolonged action of watery fluids on the tissues, and the impossibility of getting ribbons, each section having to be picked up separately.

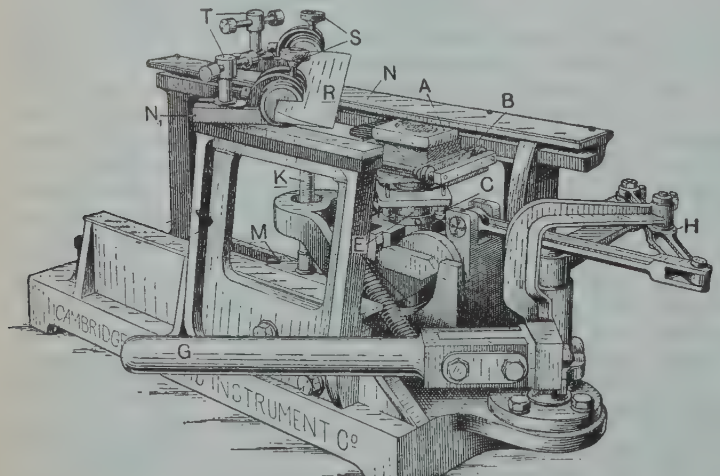
The general processes of the *dry method* employed in zoological and botanical microtomy are, up to a certain point, practically identified with those used for the preservation of animals and their tissues for other branches of microscopic work. In the first place the tissues must be *killed*; in the second, they must be *fixed*, *i.e.* the protoplasm must be set or coagulated as far as possible in the condition in which it appears in life; and in the third, they must be *hardened*, *i.e.* in most cases dehydrated. Killing may be effected by asphyxiation or narcotization (nicotine, cocaine, chloral hydrate, &c.) in special cases, but is generally achieved by fixing reagents, of which corrosive sublimate and other chlorides, picric, acetic, osmic and chromic acids, alone or in combination, chromates and strong alcohol are the most usual. These serve to a great extent also as hardening agents, but alcohol, used after them, completes this process effectively, and when not too strong (70%) is the best storage fluid. The second set of processes relates to the *staining*, without which transparent sections are almost invisible. The stains are divisible into *general* stains, which dye the tissue practically uniformly and indifferently; and *selective* stains, which have affinity for special tissues or cell elements. Of the latter group some fasten on nuclei, others only on the chromatin of the nuclei; some on connective tissues, others on muscle fibres and so on. It is probable that the action of all these selective stains is produced by definite chemical combination with compounds originally present in, generated in, or introduced into the tissue selected. The most generally useful stains for ordinary work belong either to the *cochineal* series (borax-carmine, carmalum, &c.), or to the *logwood* series (haematoxylin, haemalum, iron haematoxylin, &c.); in both of these great improvements have been introduced of late years by Dr Paul Mayer. The activity of these stains apparently depends upon the presence of alumina or of some similar base. For more special researches, such as cytology, neuropathology, neurohistology, and so forth, greater dependence is placed on the *coal-tar* colours, the name of which is legion. Some of these, such as safranine or gentian violet, are regressive stains; that is to say, the tissues are overstained uniformly, and the superfluous colouring matter washed out either by alcohol or by weak hydrochloric acid from the unselected parts. Others, such as methyl green, are progressive—that is, the colour is brought up to the pitch required and the reaction promptly stopped. The coal-tar stains can be used singly, or in combinations of two or three. Some of the best, unfortunately, are not permanent. A third group of stains is furnished by such reagents as silver nitrate, gold chloride, and the like (impregnation stains), which can be made not only to stain, but also to deposit a fine metallic precipitate on certain structures. In the case of small and delicate objects, the staining is done in the mass before any further preparation for sections, but with larger animals, or large pieces of resistant tissue, the stain is applied to the sections only. The processes so far mentioned are applicable to many branches of microscopic work.

When preparing tissues for sections the first step is complete dehydration, generally effected by bringing the object into absolute alcohol. It is then transferred to one of a group of reagents, which are miscible with absolute alcohol, but would form an emulsion with water, and are solvents of the embedding medium. The embedding mass in most general use is paraffin wax, melting at a temperature of 54° to 60° C., according to the character of the object and the thickness of section required. The object is transferred from absolute alcohol to benzol, chloroform, cedar oil, or similar fluid to the melted paraffin; the fluid diffuses and evaporates, leaving the tissues to be completely permeated by the paraffin. This process can be greatly hastened by the use of a partial vacuum. When impregnation is complete the paraffin is cooled rapidly, so as to assume a homogeneous non-crystalline condition, and the tissue thus comes to form part of a block of soft but tenacious material, which protects it from damage by air or damp, and can be readily cut by a razor. The block is then trimmed to the form of a triangle or rectangle, and fixed by a clamp or by local melting in the holder of the microtome.

The first automatic microtome suitable for cutting a block of tissue into a continuous series of sections was made in 1883 in the university workshops of Cambridge, from a design by W. H. Caldwell and R. Threlfall. Only a single machine was made, but in 1884 twelve machines were made by the Cambridge Scientific Instrument Company from a design by Caldwell. Since then numerous excellent and simpler forms of microtome have been evolved. Some of these have distinct advantages over others, but with microtomes as with other tools—the success of the results depends very largely on the manipulator, for every one works best with his accustomed instrument. In one type of microtome the razor is attached at one end only to a heavy block, sliding backwards and forwards in a horizontal V-groove; the paraffin block is fed to this either up a vertical guide (Schanze, Reichert, &c.) or up an inclined plane (Thoma-Jung). In another type the razor is firmly clamped at both ends, to diminish vibration, and the paraffin block advances to it at the end of a long lever on trunnion bearings (Cambridge rocker) or up a vertical guide (Minot types).

In the selection of a microtome, apart from its steadiness, rigidity, accuracy of workmanship, and so forth, it must be borne in mind that, in general, simplicity of working parts means longer life, and that an elaborate "automatic" mechanism, by which a single movement is translated into several in different directions, not only complicates the machine, but robs the operator of those alterations of pace, rigidity, pressure, &c., which are often necessitated by the varying texture in different parts of the object cut. For general use by less skilful students in a laboratory, price, simplicity and rapidity of work recommend the rocking microtome of the Cambridge Scientific Instrument Company, but it tends to fail at large or hard objects. For the all-round work of an investigator, its simplicity and finish have made Jung's sliding microtome with the Naples improvements deservedly popular for many years; it can be fitted with special apparatus for cutting celloidin and frozen objects, and it can be relied upon to cut any tissue, however difficult; but it cannot be worked as rapidly as some others, nor produce long ribbons of large objects. For this latter purpose the Minot-Becker, Minot-Zimmermann and Reinhold-Gilltay have been strongly recommended; these, however, are all of more complicated construction, with corresponding liability to uneven wear and damage; they are highly "automatic," leaving nothing but pace under control of the operator, and they are (particularly the last) expensive.

[In 1910 the Cambridge Scientific Instrument Company issued a new microtome designed primarily for cutting larger sections than was possible in their earlier forms, which respectively dealt with sections 12×20 mm. and 30 mm. in diameter; the new instrument cuts sections measuring 150×120 mm. (6×4⅜ in.) embedded in paraffin or celloidin and of a thickness varying from 0·002 to 0·06 mm., each division of the scale being equal to 0·002 mm. and the total distance of automatic feed being 21 mm. The construction and action of the instrument can be understood by referring to the figure; a detailed description is given, since the same principles are utilized to a greater or less extent in all sliding microtomes.



Large Sliding Microtome.

The object to be cut, having been embedded in a suitable preparation A, is fixed to a wooden block which is attached by clamps to the object-holder B. The object-holder is provided with mechanism by means of which the height of the block is determined; this is effected by mounting the holder in a cup-shaped socket at the extremity of a brass pillar E, which can be raised or lowered and fixed in any position by a clamp. In addition, the direction in which a section is cut can be varied by adjusting the four screws, one of which is shown at C, which orientate the block. The object-holder and feeding mechanism are carried on a sliding carriage which rests at three points on two guides in the frame N, N_1 of the instrument; and in order to secure easy running the necessary lubrication of the bearing surfaces is provided for by a groove in which oil is placed. The motion of the carriage in either direction is effected by the handle G, connected to a system of levers H, which, being constructed on geometrical principles, prevent any side-play and ensure a uniform motion. The arrangement for determining the thickness of the section cut consists of a stop-pin, which, operating through the ratchet M, causes a toothed wheel to revolve, which in turn raises the pillar K; the amount of the motion can be read off by an index. On the return stroke of the sliding carriage the stop-pin is again actuated in such a manner that just before the knife R reaches the object-holder the mechanism depresses this part of the instrument so that the knife is not fouled; and after its passage the object-holder is raised to the position appropriate for taking the next section. The knife R is rigidly set in two heavy brass clamps adjustable by the screws S, and these clamps are attached to the frame of the instrument by the screws T. The angle which the cutting edge makes with the frame is also adjustable, and by means of a small angular scale engraved on the knife-holders any setting can be easily determined or repeated. The knife is flat on one side and hollow-ground on the other. In using the microtome it is essential that the cutting edge of the knife points towards the end of the instrument where the handle is placed; the hollow-ground face should be uppermost, and the flat surface should not be exactly horizontal but slightly inclined so that the lower facet of the cutting edge is parallel to the frame. As to the relation of the position of the knife to the direction of motion, it is the usual practice, when paraffin sections are to be taken, to have the cutting edge at right angles to the motion; when, on the other hand, celloidin preparations are being cut, the knife must be set obliquely across the frame, an angle of 30° being convenient. This oblique setting is also recommended for paraffin sections. In addition it must be remembered that celloidin preparations always require lubricating when being cut, and it is also necessary to keep both the knife and the preparation constantly moistened with either 80% alcohol or with cedar-wood oil.]

The sections, when cut by the microtome with the knife straight and the two sides of the rectangular paraffin block parallel to it, in most cases can be got off in a continuous ribbon, each sticking to its predecessor. This very desirable result generally can be insured by a coating of softer paraffin; but if the object be large, or brittle, or of varying texture, it is safer to cut the sections singly from a triangular block with an oblique knife. The sections or ribbon are often not quite flat, but rolled, creased or compressed; they must be flattened before being attached to the slide. It is possible to carry out these two processes simultaneously by covering the carefully cleaned slide with plenty of a very dilute solution of Mayer's glycerine and albumen, and laying the sections on the fluid and the slide on a hot-plate; as the water becomes warm the sections flatten out, and as it evaporates they settle down on the slide, and are held there by the albumen (many other methods are in use). The slide is then warmed to melt the paraffin, and plunged into benzol, or some similar fluid, which removes the paraffin; thence into absolute alcohol, which dehydrates and coagulates the albumen. If the tissue has not been stained *en bloc* the sections can now be stained on the slide. After staining they are fully dehydrated, rendered transparent by oil of cloves, and mounted in xylol-dammar or Canada balsam. W. Giesbrecht was the first to fix sections on the slide, using a solution of shellac in creasote in 1881; and also in the same year and in the laboratory of the Naples aquarium, W. H. Caldwell first cut and fixed ribbons of sections.

For ordinary work the paraffin method excels all others for rapidity, certainty and cleanliness; but for large and hard objects, or crumbling tissues (such as ova with a large quantity of yolk), some manipulators prefer to embed in celloidin. By this method, after dehydration, the tissue is soaked in a mixture of absolute alcohol and ether; thence transferred either to increasingly strong solutions of celloidin in the same mixture or to a thin solution which is then boiled down till strong. The celloidin mass is then hardened: at first, if necessary, by drying; afterwards by a bath of chloroform or its vapour. It can then be cut in the microtome, either wet, or (if previously cleaned with cedar oil) dry like a paraffin block. The method is more tedious and more messy than the paraffin process; but amongst its advantages must be reckoned that little or no heat is required, and that the embedding mass is transparent, though it does not allow of such thin sections as paraffin.

The above accounts present an outline of the complex processes employed to-day, by which, on the one hand, sections 30 μ in thickness may be made through the entire human brain; and, on the other, organisms invisible to the naked eye may be cut into a long ribbon of consecutive sections 1 μ (one-thousandth of a millimetre) thick, every minutest fragment being retained in its proper place.

The standard book on the subject is Bolles Lee's *Microtomist's vade-mecum*. Other works are G. Mann, *Methods and Theory of Physiological Histology* (Oxford, 1902), and A. Flatters, *Methods in Microscopical Research* (London, 1905). (G. H. Fo.)

MIDAS, the name of several Phrygian kings. The first of these was said to have been the son of Gordius and Cybele, whose first priest he was, and in whose honour he founded a temple at Pessinus. Having taken the drunken Silenus back to his youthful charge Dionysus, he was rewarded by the god with the power of transforming everything he touched into gold. Finding himself in danger of starvation, even his food and drink being changed by his touch, Midas entreated Dionysus to take back the gift. By the command of the god he bathed in the river Pactolus, which henceforth became auriferous (Ovid, *Metam.* xi. 85–145; Hyginus, *Fab.* 191). Another story connects him with the musical contest between Apollo and Marsyas (or Pan). Having decided against the god, his ears were changed into those of an ass. He concealed them under a Phrygian cap; but the secret was discovered by his barber, who, being unable to keep it, dug a hole in the ground and whispered into it "Midas has the ears of an ass." He then filled up the hole, thinking his secret safe; but the reeds which grew up over the spot proclaimed it to all the world. Midas with the ass's ears was a frequent subject of the Attic satyr-drama. There is no doubt that Midas was the name of one or more real persons around whom religious legends have grown up. The name "Midas the king" occurs on a very ancient tomb in the valley of the Sangarius, the legendary seat of the Phrygian kingdom. The Phrygian monarchy was destroyed by the Cimmerians about 670 B.C., and the name Midas became in Greek tradition the representative of this ancient dynasty.

On the connexion between Midas and the Attic story see J. G. Frazer, *The Golden Bough*, ii. 134.

MIDDELBURG, the ancient capital of the province of Zeeland, Holland, in the middle of the island of Walcheren, 4 m. by rail N. by E. of Flushing, with which it is also connected by steam tramway and by ship canal (1873), which continues to Veere on the N.E. coast, with a branch eastward to Arnemuiden. Pop. (1903), 19,002. Middelburg contains many splendid old houses, which recall the prosperity which distinguished it until the end of the 18th century. The beautiful town-hall, built by Anton Keldermans about 1512, with a square tower 180 ft. high, and a façade adorned with statues of the counts and countesses of Zeeland and Holland, contains the valuable city archives and antiquarian and historical collections. The old abbey of St Nicholas, founded in 1150, and now occupied by the provincial council, has some fine old tapestry of the end of the 16th century. The building was added to in the 14th and 15th centuries, and partly rebuilt after a fire in 1492. It was the scene in 1505 of a meeting of the knights of the Golden Fleece, and was frequently the residence of royal visitors, including Maximilian, Philip the Fair and Charles V. The abbot of Middelburg formerly possessed a vote of his own in the Provincial States. What was formerly the nave of the abbey church is now the New Church, and the ancient choir constitutes the Choir Church. These churches are interesting for the monuments of William II., count of Holland, king of the Romans (d. 1256), the 16th century scholar Hadrian Junius, and Jan Pieterszoon; and the tombs of Jan and Cornelius Evertsen, who fell in the naval war against England in 1666. The high tower (280 ft.), known as *de lange Jan*, standing apart from the church contains a good chime of bells. The corn exchange, the hof St Joris and the hof St Sebastian (formerly buildings belonging to the gilds of archers, and now places of amusement) also deserve mention. The museum of antiquities belonging to the Zeeland Society of Arts and Sciences (founded at Flushing in 1769, and transferred to Middelburg in 1801) contains a complete collection of the fauna and flora of the province, many maps, plans and drawings relating to Zeeland, the first telescope made by Hans Lippershey and Zacharias Jansen in Middelburg in 1608, and some provincial Roman antiquities.

The extensive trade which Middelburg formerly carried on with the East and West Indies and with England and Flanders, was ruined by the war with England and the French occupation. But the construction of the railway in 1872, followed by the opening of the ship canal and the large dock (1876), as well as the establishment, by the aid of the chamber of commerce, of certain manufacturing industries (iron, machinery, furniture, oil and cigars), lifted it out of its isolation.

MIDDELBURG, a town of the Transvaal, 98 m. E. by rail of Pretoria, and 251 m. W. of Lourenço Marques. Pop. (1904), 5085—of whom 2343 were whites. It is prettily situated on the high veld, 5090 ft. above the sea, on one of the head streams of the Olifants River. Middelburg is the chief town of an administrative division of the same name, and is a trading centre for a large district. It is also the centre of one of the richest coalfields in South Africa. From some of the adjacent collieries excellent steam coal is obtained. Copper and cobalt are found in the neighbourhood.

Middelburg was chosen in 1901 as the place of conference for peace negotiations between the British and the Boers. After the occupation of Pretoria in June 1900 by Lord Roberts the Boer forces had been reduced to guerilla warfare, and Lord Kitchener, learning that the Transvaal commandants were despondent, invited General Botha to enter into negotiations, on the basis of the recognition of British sovereignty. The conference between Lord Kitchener and General Botha was opened on the 28th of February and the negotiations, which ended in failure, were protracted until the 16th of March (see TRANSVAAL: *History*, § *The War of 1899–1902*).

Middelburg is also the name of a town in the Cape Province, South Africa, 250 m. N. by W. of Port Elizabeth. Pop. (1904), 6137.

MIDDLE AGES, THE. This name is commonly given to that period of European history which lies between what are known as ancient and modern times, and which has generally been considered as extending from about the middle of the 5th to about the middle of the 15th centuries. The two dates adopted in old textbooks were 476 and 1453, from the setting aside of the last emperor in the West until the fall of Constantinople. In reality it is impossible to assign any exact dates for the opening and close of such a period. The trend of recent historical research leads one even to doubt the validity of the very conception of any definite medieval period. The evolution of modern European society has been continuous. Progress has not been uniform. There was much retrogression with the intrusion of new barbarian races; but from their absorption by the 10th century until the 20th there is not a century in which some notable gain was not made towards the attainments of modern civilization. The correct perspective places between the summits of modern and ancient times, not a long level stretch of a thousand years, with mankind stationary, spell-bound under the authority of the Church, absorbed in war or monastic dreams, but a downward and then a long upward slope, on both of which the forces which make for civilization may be seen at work.

It is clear that a survey of the history of these so-called middle ages—long use makes the term inevitable—must include not only the political phase, but also economics, religion, law, science, literature, &c., since all are involved in the concept. A hurried outline of each of these vital branches of our civilization will at once reveal the falseness of the usual periodizing. It is only after having traced these one by one that we can properly review the process as a whole.

In political history, the epochal fact which marks the close of ancient times is the decline of the Roman Empire. This was a process extending over three or four centuries, in which no one date lends itself to the historian. The deposition of Romulus Augustulus, the last Roman emperor in the West, in 476, was certainly not one of those events upon which the history of the Western world depends. Outwardly it did not mark the end of the Empire, but the restoration of imperial unity. The throne in Italy had been vacant before, and the restoration of unity was realized in fact under Justinian. There is no reason why the date 476 should stand out in European history more strongly than half a dozen other such dates. Yet we may say that the 5th century did witness the actual dismemberment of the Roman Empire. The new nations in Spain, Gaul, parts of Italy and Britain were forming the rude beginnings of what were to become national states in the centuries following. Western Europe was taken out of the imperial mould and broken up. This is a revolution of sufficient magnitude to be regarded as politically the opening of a new era. It had been long preparing in the economic and administrative decline of the Empire, and in the steady influx of Germanic peoples into Roman territory for over two centuries; but the power of the old civilization to absorb the new races was exhausted by the 5th century, and the political history of Europe was turned into a different path. That path, however, was not destined to end blindly in a "middle age." The line of political development marked out in the 5th century—that of the national state—still continues. The revolution in which Alaric, Theodoric and Clovis figured did not set the problem for the middle ages only, as is frequently stated; its full meaning did not appear until the Peninsular War, the Prussia of Stein and Scharnhorst, and even Solferino and Sedan. Thus the 5th century politically introduces not so much the history of the middle ages as that of modern Europe.

The immediate introduction, however, was a long one—so long and so distinct from the later development as to constitute in itself a distinct phase. For five or six centuries—from the 5th until about the 11th—comparatively little permanent progress was made. The Germanic tribes were still adjusting themselves and slowly learning to combine their primitive institutions with the remains of those of Rome; the premature union under Charlemagne gave way before new invasions, and anarchy became crystallized in feudalism. It was not until the 12th and 13th centuries that modern national states really took shape: England with its trial by jury, circuit courts, Magna Charta and parliament; France under the strong hand of the Capetians. A political middle age certainly lay between Theodosius and William the Conqueror, or at least between Justinian and Henry II. It is difficult to grasp its vastness. Few students of history realize that the period from the Saxon to the Norman Conquest of England would take us as far back as from George V. to Edward I.; or that from Theodosius to Philip Augustus there is an interval equal to that between the accession of Hugh Capet and the French Revolution.

This, however, is not the period most frequently termed the middle ages in political histories. It does not include those two institutions which more than any others stand in popular imagination as genuinely medieval—the papal monarchy and the Holy Roman Empire. The papacy received its full monarchial structure under Hildebrand (Gregory VII.) in the middle of the 11th century; its political decline set in suddenly after the pontificate of Boniface VIII. at the opening of the 14th. The great age of the Empire began slightly earlier, and continued until the fall of the Hohenstaufen in the middle of the 13th century. One cannot now deny the term middle ages to the period of these two institutions. It has been consecrated to this use too long. Yet when we include under a common name two eras so distinct as this and that preceding, our term becomes so vague as to be almost valueless. Moreover, it is doubtful if this second period is really as "medieval" as it has seemed. Papal monarchy and Holy Roman Empire were not the only political phenomena of their age, and it is possible that their vast pretensions have somewhat blinded historians as to their real importance. While they were struggling to enforce their claims to universal sovereignty, the royal power, less extravagant but more real, was welding together the feudal states of France and moulding the England of to-day. Compared with this obscure process—this spread of the king's peace along the highways and through the distant forest lands of the 12th and 13th centuries—papal interdicts and jubilees, however impressive their spectacle, are but fleeting shows. The chivalry of Germany pouring through Alpine passes for an Italian campaign, or a coronation, left little trace in history except the lesson of their futility. There is much in the imperial and papal histories that is merely spectacular and romantic; much that appeals to the imagination and lends itself to myth; and since the sources are abundant—the papal archives inexhaustible and the German chronicles easily accessible—an undue emphasis has been placed upon them. It is at least evident that the political middle ages were already disintegrating during the period of papal monarchy and Holy Roman Empire.

In economic history there is a more definite line traceable. The one great economic change brought about by the decline of the Roman Empire was the lessening of urban life throughout the greater part of Europe, the closing up of avenues of communication and the predominance of isolated agricultural communities. This phase began to give way in the 11th century to a commercial and industrial renaissance, which received a great impetus from the crusading movements—themselves largely economic—and by the 14th century had made the Netherlands the factory of Europe, the Rhine a vast artery of trade, and north Italy a hive of busy cities. The discovery of America and the expansion of commerce merely readjusted conditions already highly developed. The period of isolated economy which we may term medieval lasted only from about the 5th to the 12th centuries. As for manufactures, the antique methods survived until the 18th and 19th centuries.

In religious history—to be distinguished from that of the political organization referred to above as the papal monarchy—the official recognition of the Christian Church by Galerius in 311 serves as a convenient starting-point for what we know as universal Christendom, though the slow disappearance of paganism, as distinct from Christianity, stretches over at least a century more. The Reformation of the 16th century has long been regarded as the close of the period. The real close, however, is the present day—as the result of the rationalism and science of the 18th and 19th centuries. The heroes of the Reformation, judged by modern standards, were reactionaries. Unconsciously and to its own ultimate damage the Reformation forged the weapons of progress; but it was itself in no sense, except the institutional and political, the end of that religious history inaugurated before the Council of Nicaea. The real change in attitude which marks the dawn of a new era came in the generation of Voltaire. And "medievalism" is only now on the defence against "modernism," both Catholic and Protestant.

In legal history there was a distinct medieval period, when Germanic customs superseded Roman law, that most splendid of Rome's legacies. But the renaissance of law began relatively early; by the 12th century it had created a university, by the 13th it was helping to organize national states and laying the basis for that order which the economic renaissance was already demanding.

In science there was no great product in antiquity to be lost. Compared with art or law, literature or philosophy, ancient science (in our sense) was almost insignificant. The promise in Aristotle of such production remained unfulfilled. The 17th century is not so much a renaissance here as a mere beginning. No one can deny the general unscientific, uncritical nature of "medieval" thought. A single Roger Bacon does not relieve his age of the charge. But the middle age in science must include much of antiquity, including Pliny.

Philosophy was the one subject which had, clearly and definitely, a medieval period. Scholasticism, which absorbed the attention of most thinkers from about the 11th to about the

15th centuries, is so easily marked off and played so considerable a rôle in the academic history of that time, that historians often refer to it as the only intellectual interest of "medieval" men. Then, selecting some of the later and less virile scholastics as victims, they ask how men could be seriously interested in their trivialities. But these men were not all busy over the problem of how many angels could stand on a needle-point; nor were they all dominated by the religious spirit of faith or intellectual cowardice. They were searching for truth with scientific eagerness. Their very failure made possible the modern era. It is perhaps unnecessary to point out how small a proportion of the "intellectuals" were scholastics even in the 13th century.

In the realm of art the "middle ages" had already set in before Constantine robbed the arch of Titus to decorate his own, and before those museums of antiquity, the temples, were plundered by Christian mobs. The victory of Christianity—iconoclastic in its primitive spirit—was but a single chapter in the story of decline. The process was completed by the misery of the decaying empire, and by the Germanic invasions. The barbarians, however, destroyed less than has been commonly supposed. Destruction was more the product of necessity than of wantonness. Thus public monuments became fortresses, and antique sculpture was built into city walls. Such art as continued was almost wholly religious; for in the wilderness of the times the churches formed oases of comparative prosperity and peace, and, even in the darkest times, wherever such oases existed there the seeds of art took root. The Church architecture of the "middle ages," then developed naturally and without a break, through the Byzantine and Romanesque styles, out of the secular and religious architecture of Greece and Rome. And, with the return of comparatively settled and prosperous conditions, not only architecture but the other arts also blossomed under the influence of what was later stigmatized as the "Gothic" spirit into new and original forms. Down to the Reformation the churches continued to be, as the temples of the ancient world had been, the main centres of the arts; yet the arts were not confined to them, but flourished wherever, as in castles or walled cities, the conditions essential to their development existed. With the revival of civilized conditions in secular life, secular ideals in art also revived; the ecclesiastical traditions in painting and sculpture, which always tend to become stereotyped, began in the West to be encroached upon long before the period of the "Renaissance." The 12th and 13th centuries, which witnessed the great struggle between the secular and spiritual powers in the state, witnessed also the rise of a literature inspired by the lay spirit, and of an art which was already escaping from the thraldom of the stereotyped ecclesiastical forms. Gothic sculpture was not incidentally decorative, it was an essential element in the harmony of the architectural design. The elongated kings that guard the door of Chartres Cathedral, or the portals with the Last Judgment, are a necessary element in the façade. Thus fettered, even the realism of the Gothic sculptors failed, except in rare instances, of its full expression. The plastic arts were left for Italy, where antique models were at hand, and the glory of its achievement in the 15th and 16th centuries was so great as to obscure in men's eyes what had been done before.

But this Italian renaissance was not the only one. It was but one of many; and it was concerned with the two subjects which perhaps least deeply influence the lives of the mass of men—literary humanism and art. It is obviously absurd, in the face of the foregoing facts, to regard it as the end of a middle age in anything but in its own field.

When one studies the history of Europe subject by subject, as indicated above, and not merely in a monastic chronicle of things in general, chosen according to the author's point of view, one sees the old-time framework passing away. The traditional idea of a barren middle age and a single glorious renaissance proves false. An organic study of the past reveals a more rational picture of the process which produced the Europe of to-day. Cataclysm and special creation here as elsewhere give way to evolution. The new synthesis reveals a universal decline from the 5th to the 10th centuries, while the Germanic races were learning the rudiments of culture, a decline that was deepened by each succeeding wave of migration, each tribal war of Franks or Saxons, and reached its climax in the disorders of the 9th and 10th centuries when the half-formed civilization of Christendom was forced to face the migration of the Northmen by sea, the raids of the Saracen upon the south and the onslaught of Hungarians and Slavs upon the east. That was the dark age. It left Europe bristling with feudal castles, and already alert for the march of progress. At once the march begins. Henry the Fowler beats back the Slavs and places the outposts of Christendom along the Elbe and the Oder. Otto I., his son, drives the Magyars from southern Germany and establishes the East Mark (Austria) to guard the upper Danube. The restoration of the Empire in 962 marks the first milestone on the pathway of recovery. Already scholarship had found a home in monasteries planted in the heart of the German forests. The succeeding century brought the Empire to the acme of its power, until Henry III. in the Synod of Sutri, sat in judgment on the impotent and demoralized papacy. Meanwhile France had been learning something even in its feudal anarchy. The monks of Cluny were at work. The Capetians had begun. The great monastery of Bec was drawing the sons of northern sea-robbers to the service of that greatest civilizing force, the Church. The progress made through even this darkest age may be measured by the difference between the army of Rollo and that which William the Conqueror gathered for the invasion of England.

There is a legend, current among historians from the days of Robertson and Hallam, that as the year 1000 approached mankind prepared for the Last Judgment; that the earth "clothed itself with the white mantle of churches," and like a penitent watched in terror and in prayer for the fatal dawn. Contemporary sources fail to bear out this beautiful conception. Apart from the fact that reckoning from the birth of Christ was by no means universal, and consequently the mass of men were ignorant that there was such a thing as the year 1000, one wonders how that most enduring type of architecture, the Romanesque, reached its maturity among men who thought that the earth itself was so soon to "shrivel like a parched scroll." Recent scholarship has absolutely disproved this legend, founded on a few trite phrases in monastic chronicles, and still to be heard in similar contexts. The year 1000 marks no epoch in medieval history.

The latter half of the 11th century witnessed the most remarkable political creation in Europe since the days of Caesar, the papal monarchy of Hildebrand. The great scholastic controversies had already begun in the schools of France; the revival of Roman law had called forth the university of Bologna, and the canonists had begun the codification of the law of the Church. The way was already cleared for the busy 12th century—the age of Louis VI. and Henry II., of Glanvill and Suger, of Abelard and Maimonides, of Frederick Barbarossa and Alexander III., of the emancipation of French communes and cities and the independence of those of Lombardy, of the growth of gilds and the extension of commerce, of trouvère and troubadour and the beginnings of vernacular literature, of the creation of Gothic art, of trial by jury and the supremacy of royal justice. Such are but a fraction of its achievements. The 12th century stands beside the 18th as one of the greatest creative centuries in human history. The 13th like the 19th applied these creations in the transformation of society. The century of Dante was also that of the first English parliament; its vast economic expansion enabled the national state to triumph in both England and France, and furnished the grounds for the overthrow of Boniface VIII. Into the complex history of this momentous age it is impossible to go in any detail. Sufficient to say that in the opening quarter of the 14th century England and France at least stood on the brink of "modern times." Then these two nations entered upon that long tragedy of the Hundred Years' War, a calamity absolutely immeasurable to both. But during its massacres, jacqueries, plagues and famines, the cities of Italy, growing rich with trade and manufactures, were in their turn the centres of progress, this time in a new direction, toward the recovery of the antique past and the development of art.

This is the so-called Renaissance (*q.v.*). The humanists which it produced, interested only in its splendid revelations, forgot or ignored the achievements of the period which intervened between Cicero and Petrarch. Then by the genius of their work they fastened their mistaken perspective upon historians and the cultured world at large. They struck upon the unfortunate and opprobrious term "middle ages" for that which stood between them and their classic ideals. The term was first used in this sense by Flavio Biondo, whose "decades" was an attempt to block out the annals of history from 410 to 1410. His treatment fell in admirably with the ideas of his age and of that following. To Protestants the age of the papal monarchy was like the reign of Anti-Christ. Then, after the indifference of humanists and Protestant polemic, came the disgust of men of science at the scholastic philosophy—an attitude best exhibited in Bacon's *Advancement of Learning*. The 18th century was thus trebly barred from a knowledge of genuine medieval history. Romanticism, that reaction in which Sir Walter Scott, the Schlegels and Victor Hugo so largely figured, was as far from understanding what it admired as classicism had been from what it hated. Its extravagant praise of all that savoured of the middle ages was still blind to their real progress and work. They were, for it, the ages of romance and chivalry. The view of the romanticists was as one-sided as any that had gone before. It is only with the introduction of a wider outlook in the scientific study of history that it has been possible to straighten the perspective and modify the traditional scheme.

In the purely intellectual sphere it is certainly true that the recovery of the antique world was of great importance; that it made possible genuine criticism by presenting new points of contrast and opening up fields that led away from theological quibbles. But it did not mean the "double discovery of the outer and inner world." Mankind did not, as Burckhardt and J. A. Symonds lead one to imagine, suddenly throw off a cowl that has blinded the eyes for a thousand years to the beauty of the world around, and awaken all at once to the mere joy of living. If any one was ever awake to the joys of living it was the minnesinger, troubadour or goliard, and the world had to wait until Rousseau and Burns before its external beauty was discovered, or at least deeply appreciated, by any but a few Dutch artists. Even Goethe crossed the Alps with his carriage shutters closed. Mont Blanc is not mentioned by travellers until after the middle of the 18th century. The discovery of the outer world is a recent thing in art as well as in science. As for the claim that the "Renaissance" delivered men from that blind reliance upon authority which was typical of "medieval" thought, that is a fallacy cherished by those who themselves rely upon the authority of historians, blind to the most ordinary processes of thought. In this regard, indeed, in spite of the advance of scientific method and the wealth of material upon which to base criticism, we are still for the most part in the middle ages. The respect for anything in books, the dogma of journalistic inerrancy which still numbers its devotees by millions, the common acceptance of even scientific conceptions upon the dicta of a small group of investigators, these are but a few of the signs of the persistence of what is surely not a medieval but a universal trait. The so-called Renaissance did much; but it did not do the things attributed to it by those who see the "middle ages" through humanist glasses.

Upon the whole, therefore, it would seem that not only was there no one middle age common to all branches of human evolution, except the period more definitely marked as the dark age, but that those characteristics which are generally regarded as "medieval" were by no means limited to a single epoch of European history. In short, the dark age was a reality; but the traditional "middle ages" are a myth. (J. T. S.*)

MIDDLEBORO, a township of Plymouth county, Massachusetts, U.S.A., in the S.E. part of the state, bounded on the N.W. by the Taunton river. Pop. (1890), 6065; (1900), 6885—of whom 920 were foreign-born; (1910 census) 8214. Area, about 70 sq. m. The principal village also is named Middleboro; it is 35 m. S. of Boston, is served by the New York, New Haven & Hartford railroad and by electric lines connecting with Taunton, Boston, New Bedford and Cape Cod, and has a town-house, a soldiers' monument, and a public library housed in a building erected from a fund (part of which is used as a permanent endowment) bequeathed by Thomas Sprout Peirce (1823–1901), a merchant of the township, who, in addition, bequeathed about $500,000 as a special trust-fund for the use and benefit of the town of Middleboro; the income has been spent largely in the construction of macadam roads, the erection of an almshouse and the installation of special courses in the high school. The village, a place of considerable natural beauty, is a summer resort, and has various manufactures. Other villages in the township are North, East and South Middleboro, and Rock. The township had important herring fisheries in early times and manufactured straw hats (from 1828) and ladies' dress goods. Middleboro was settled about 1662 under the Indian name Nemasket; became a part of the township of Plymouth in 1663; and in 1669 was incorporated as a separate township, taking its name probably from Middlesbrough, North Riding, York.

See Thomas Weston, *History of the Town of Middleboro, Massachusetts* (Boston, 1906).

MIDDLEBURY, a village and the county-seat of Addison county, Vermont, U.S.A., in Middlebury township, on Otter Creek, about 31 m. N.N.W. of Rutland. Pop. of the village (1890), 1762; (1900), 1897 (221 foreign-born); (1910), 1866; of the township, (1900), 3045; (1910), 2848. Middlebury is served by the Rutland railroad. It is picturesquely situated near the Green Mountain range, and is the seat of Middlebury College (chartered, 1800; co-educational since 1883), which offers a classical course and a Latin-scientific course, and had in 1907–1908 12 instructors and 203 students (84 of whom were women), and a library of 35,000 volumes. The Sheldon art museum and a public library are among the public institutions of the village, and the principal buildings include the court-house and the opera-house. The principal industrial establishments are marble quarries, "Italian" marble works, iron foundries, lime-kilns, flour-mills, and door, sash and lumber mills. About 1 m. north of the village, in the township of Weybridge, there is a large United States government breeding station for Morgan horses; and merino sheep are raised in the vicinity.

The township of Middlebury was incorporated in 1761, and the first settlement on the site of the present village was made in 1773. At the outbreak of the War of Independence the settlement was deserted, and all except two or three of the houses were destroyed by British troops; but the settlers returned soon after the close of the war, and the township was formally organized and sent a member to the state assembly in 1788. Middlebury was incorporated as a borough in 1813, and as a village in 1832.

MIDDLESBROUGH, a municipal, county and parliamentary borough and seaport in the North Riding of Yorkshire, England, 238½ m. N. by W. from London, on the North Eastern railway. Pop. (1891), 75,532; (1901), 91,302. It lies on the south bank of the Tees, 5 m. from its mouth in the North Sea, and is the centre of one of the most important iron-working districts in the world. It is wholly of modern growth, having been incorporated in 1853. Its chief buildings are a fine town-hall with lofty clock-tower and spire (1889), containing the municipal offices, free library, &c.; the exchange, county court, Dorman memorial museum and Roman Catholic cathedral. Besides iron and steel works, the first of which was that of Messrs Bolckow, Vaughan & Co., there are rolling-mills, tube works, wire-mills, engineering works, oil works, chemical works, salt works and a considerable shipbuilding industry. The district abounds in blast furnaces. The docks are accessible to large vessels, the entrance having a depth of 32 ft. Extensive dredging operations are carried on in the river. The accommodation for shipping includes two graving docks, two patent slips, &c. The entrance to the river is protected by two breakwaters named respectively the North Gare and South Gare. The furnaces within the port produce some

2,500,000 tons of pig iron annually. Middlesbrough is the seat of a Roman Catholic bishop. The parliamentary borough falling within the Cleveland division of the county, returns one member. The county borough was created in 1888. The town is governed by a mayor, ten aldermen and thirty councillors. Area, 2823 acres.

The earlier history of the place is meagre. Where Middlesbrough now stands there were at one time a small chapel and priory founded by Robert de Brus of Skelton Castle. These were dedicated to St Hilda, and with some lands were given by de Brus to the abbey of St Hilda at Whitby in 1130. The priory fell into ruins at the time of the Reformation, and no trace now remains beyond some stones built into the wall of a brewery. The Oak Chair in the town-hall also is made from a fragment. In 1801 there were upon the site of Middlesbrough only four farmhouses. In 1829 a company styling itself the Middlesbrough Owners bought 500 acres of land, and began building in the town. In 1830 the Stockton & Darlington railway was extended to Middlesbrough; four years later the town was lighted with gas; and after six years more a public market was established. The census of 1831 showed the population to be 154; that of 1841 showed 5709. In 1842 the opening of the docks gave additional importance to the town. From the year 1851, when John Vaughan discovered the presence of ironstone in the Eston hills, the town advanced rapidly.

MIDDLESEX, LIONEL CRANFIELD, 1ST EARL OF (1575–1645), was a successful London merchant, who was introduced to King James I. by Henry Howard, earl of Northampton, and entered the royal service in 1605. In 1613 he was knighted and was appointed surveyor-general of customs; in 1616 he became one of the masters of requests, and in 1619 master of the court of wards and liveries and chief commissioner of the navy. He was returned to parliament as member for Hythe in 1614 and for Arundel in 1621. Cranfield, who was also master of the wardrobe, was responsible for many economies in the public service, and his business acumen was very useful to the king. He took part in the attack on Bacon in 1621, and although, contrary to general expectation, he did not succeed Bacon as lord chancellor, he was created Baron Cranfield in July of this year. In 1621 also he became lord high treasurer, and in September 1622 was created earl of Middlesex, losing his positions and influence shortly afterwards because he opposed the projected war with Spain, and had incurred the hostility of Prince Charles and George Villiers, duke of Buckingham. Impeached by the House of Commons for corruption, he was found guilty by the House of Lords in May 1624 and was sentenced to lose all his offices, to pay a heavy fine and to be imprisoned during the king's pleasure. However, he was released from prison in a few days, was pardoned in the following year, and was restored to his seat in the House of Lords in 1640. The earl's second wife was Anne Brett (d. 1670), a cousin of Buckingham's mother, whom he married somewhat reluctantly in 1621 in order to ensure Buckingham's support. Middlesex died on the 6th of August 1645, leaving with other issue a son James (1621–1651), 2nd earl of Middlesex, who was a partisan of the parliamentary party during the Civil War. James was succeeded by his brother, Lionel, and when this earl died in October 1674 his titles became extinct. The first earl's daughter Frances married Richard Sackville, 5th earl of Dorset, and their son Charles was created earl of Middlesex in 1675. Two years later he became earl of Dorset, and the title of earl of Middlesex was borne by the earls and dukes of Dorset until 1843.

MIDDLESEX, a south-eastern county of England, bounded N. by Hertfordshire, E. by Essex, S.E. by the county of London, S. by Surrey, and W. by Buckinghamshire. The area is 283·3 sq. m., and, excepting Rutland, the county is the smallest in England. The area outside the county of London, or extra-metropolitan area, with which this article is mainly concerned, is 233·8 sq. m. It lies entirely in the basin of the river Thames, which forms its southern boundary. On the east it is separated from Essex by the Lea, the largest northern tributary of the Thames. The other rivers, in order westward, are the Brent, the Crane or Yedding Brook, and the Colne. The waters of several streams are collected in the artificial Brent reservoir near Hendon, from which the Brent flows with a circuitous course to the Thames at Brentford. The Crane, rising in the high ground near Harrow-on-the-Hill, joins the Thames at Isleworth; and the Colne, which rises on the elevated plain between Hatfield and St Albans (Hertfordshire), traverses a flat valley on the western boundary of the county, where it divides into several channels, and joins the main river at Staines. The highest ground, exceeding 400 ft. at several points, and reaching 503 ft. above Stanmore, is found along the northern boundary, in a line from Stanmore through Elstree, Chipping Barnet and Potter's Bar. Two well-marked lines of heights, detached from the main line, project southward, the eastern from Whetstone through Finchley and Highgate to Hampstead, where, within the county of London, a height of 443 ft. is found on Hampstead Heath; the western being the isolated elevation on which stands Harrow-on-the-Hill. The hills skirting the Lea valley, in the neighbourhood of Enfield, are abrupt, though of no great elevation. Elsewhere the country is very slightly undulating or quite flat, as along the banks of the Thames and Lea. The Thames, however, beautifies its immediate neighbourhood, and rich sylvan scenery is not wanting in the higher districts. The greater part of the county was formerly densely forested and sparsely populated, and the name of Enfield Chase, a royal preserve in the north-east, still recalls this condition. In modern times the visible influence of London has spread over practically the entire county. Villages have grown into populous suburbs; large institutions, for which sites adjacent to rather than within the metropolis have been found preferable, are numerous, and the development of suburban railway communications has brought fresh ground within reach of builders.

Geology.—The county lies entirely within the structural basin of the Thames, and, as in the neighbouring counties, the general slope of the ground and dip of the strata is towards the south-east. South of an irregular line passing from Uxbridge, north of Hayes, by Hanwell and Ealing to Hyde Park and east of a similar line from the upper side of the Park to Tottenham and on from that point to Enfield, the only visible deposits are the gravels, loams, brick-earths and sands laid down in former times by the Thames, with contributions by the Lea and the Colne. These alluvial deposits rise gradually northward from the Thames and westward from the Lea, in a series of gentle terraces. The earliest portions of London were built upon these terraces, because while they were dry at the surface, water could be obtained by sinking shallow wells. The alluvium has yielded many flint implements and the bones of the mammoth, bear and rhinoceros, great elk and other extinct forms. The loams are dug for bricks and the gravel for ballast, &c., about West Drayton, Southall, Enfield and Tottenham.

The London clay, a marine deposit, is bluish where it has not been turned brown by exposure to the weather. It underlies all the river deposits and rises to the surface north and east of the alluvial boundary indicated above. It gives rise to the undulating grassy country round Harrow, Chipping Barnet and Elstree. Below the London clay are the more sandy Reading beds, they may be seen at Harefield and at South Mimms; inliers occur at Pinner and Ruislip. Chalk is only visible on the side of the Colne valley at Harefield, where it is quarried, and at South Mimms. Formerly, the sandy and pebbly Bagshot beds covered all the London clay area, but now only isolated patches remain, such as those on the top of Harrow, Hampstead and Highgate hills. Long after the Bagshot beds were laid down the country was covered by a variety of glacial deposits; such are the pebble gravels of Stanmore Heath and the district north of Barnet, the clay and sand of Finchley, Muswell Hill and Southgate, the chalky boulder clay to be seen at Finchley, Southgate and Potter's Bar. Several deep borings in the London basin prove the existence, beneath the chalk, of beds which do not crop out in Middlesex. The most interesting is that at Meux's Brewery, Tottenham Court Road (about 1146 ft.), which passes through the following formations: gravel and clay, 21 ft.; London clay, 64 ft.; Reading beds, 51 ft.; Thanet sand, 21 ft.; chalk, 655 ft.; upper greensand, 28 ft.; gault, 160 ft.; lower greensand, 64 ft.; Devonian rocks, 80 ft.[1]

Industries, &c.—The climate of some of the high-lying districts is particularly healthy. Little more than one-half the total area of the county is under cultivation; and the grain crops, greatly decreasing, are insignificant. The soil in the north and north-west is heavy, poor clay; but the rich alluvial soil of the Thames Valley is specially suitable for market gardens. On the outskirts of London much land now built over was formerly devoted to market gardening. The number of livestock decreases; in fact, agriculture as a whole has slowly to give place to extension of building. Industries are extensive and varied. The county is naturally, in view of the proximity of London, closely intersected with railways, the following companies, from east to west and south, affording communications: Great Eastern, Great Northern, Midland, London & North-Western, Metropolitan, Great Central, Metropolitan District, Great Western, London & South-Western. Moreover, in some parts the tramway system has been extended over a wide area from London; thus Uxbridge, in the extreme west of the county, is so served. The principal canals are the Grand Junction, running west from Brentford to the Colne Valley, and thence northward; with a branch (the Paddington Canal) connecting it with the Regent's Canal in London; and, in the east, the Lea navigation.

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[1] See "Geology of Part of the London Basin," *Mem. Geol. Survey*, 2 vols.; "Soils and Subsoils," ditto; *Proceedings of the Geologists' Association.* A large model of the geology of London is exhibited in the Museum of Practical Geology, Jermyn Street, London.

Population and Administration.—The area of the ancient county is 181,320 acres, with a population in 1871 of 2,539,765; in 1891 of 3,251,671; and in 1901 of 3,585,323. At the time of the Domesday Survey the population of Middlesex, exclusive of London, was 2302. The extra-metropolitan area is 149,668 acres, with a population in 1901 of 798,738. The part of the ancient county transferred to the county of London under the Local Government Act 1888 was 31,484 acres in extent, and 771 acres were then transferred to Hertfordshire; while under the London Government Act 1899 the southern part of Hornsey was transferred to London. The area of the administrative county is 148,700 acres. The county contains six hundreds. The municipal boroughs are Ealing (pop. 33,031), Hornsey (72,056). The urban districts are Acton (37,744), Brentford (15,171), Chiswick (29,809), Edmonton (46,899), Enfield (42,738), Feltham (5280), Finchley (22,126), Friern Barnet (11,566), Greenford (819), Hampton (6813), Hampton Wick (2606), Hanwell (10,438), Harrow-on-the-Hill (10,220), Hayes (3000), Hendon (22,450), Heston and Isleworth (30,863), Kingsbury (757), Ruislip-Northwood (3850), Southall Norwood (13,200), Southgate (14,993), Staines (6688), Sunbury-on-Thames (4544), Teddington (14,037), Tottenham (102,541), Twickenham (20,991), Uxbridge (8585), Wealdstone (5901), Wembley (4519), Willesden (114,811), Wood Green (34,233). The county is in the jurisdiction of the central criminal court, and the whole extra-metropolitan county is within the metropolitan police district, the name of "Greater London" covering it. There are one court of quarter sessions and eight petty sessional divisions. The number of civil parishes is 60. Middlesex (extra-metropolitan) is wholly in the diocese of London, excepting a small portion in that of Oxford, and includes 153 ecclesiastical parishes or districts, wholly or in part. The extra-metropolitan parliamentary divisions, each returning one member, are Enfield, Tottenham, Hornsey, Harrow, Uxbridge, Brentford and Ealing.

History.—The district which is now Middlesex was colonized in the 6th century by an offshoot of the East Saxon tribe, and derived its name from its position between the kingdoms of the East and West Saxons. In a charter dated 704 Middlesex is mentioned by name as a dependency of Essex, but soon after it acknowledged the supremacy of Mercia, and from 748 onwards the Mercian council was held at London, and from 780 onwards at Brentford. In the 9th century Middlesex formed part of the Danelagh, and in 993 Anlaf the Dane came with 93 ships to Staines. The only reference to Middlesex in the Saxon Chronicle occurs in 1011, when it was again overrun by the Danes. The Conqueror's march upon London was preceded by a general devastation of the surrounding country, the effects of which are illustrated in the Domesday Survey by the diminution in land values. At this time the district north of London formed the vast forest of Middlesex, the greater part of which was disafforested in the reign of Henry III. Enfield had woodlands for 2000 pigs; Ruislip for 1500 pigs; and Kingsbury, Hillingdon and Hendon for 1000 pigs each. Vineyards are mentioned at Holborn, Colham, Kempton and Kensington; fishponds at Harmondsworth and Harefield produced each 1000 eels.

As a shire Middlesex probably originated about the time of the frith of 886, when it is described as the land dependent upon London, and in 912 is referred to as "London and the land which owed obedience thereto." During the Saxon period the extensive manors held by the church of Canterbury, the bishop of London and his canons of St Paul's, and the abbey of Westminster were held as independent franchises, the courts for St Paul's being held at Stepney and Fulham, for Westminster at Westminster and Staines, and for Canterbury at Harrow. By charter of Henry I. (confirmed by Stephen and Henry II.) the citizens of London held Middlesex at farm for £300, with power to elect a sheriff from among their number, and by charter from John the shrievalty of both London and Middlesex was granted to the mayor and citizens in fee. By charter of 1242 the common pleas for the county of Middlesex were ordered to be held at the stone cross in the Strand. Under a charter of 1447 the lord mayor was authorized to nominate one of the city aldermen as justice of the peace for Middlesex. The six modern hundreds of Edmonton, Elthorne, Gore, Isleworth, Ossulston, and Spelthorne have been scarcely changed since the Domesday Survey, except that Isleworth was then Honeslaw (Hounslow), while in the 12th century hidage a hundred of "Mimes" is mentioned, corresponding with the Domesday hundred of Edmonton. Middlesex has always been included in the diocese of London. The archdeaconry of Middlesex, which includes part of Essex, is mentioned in 1151, but the Middlesex portion was not subdivided into rural deaneries until 1857, when the deaneries of Fulham, Ealing, Uxbridge, Staines, Hampton, Enfield, Harrow and St Pancras were created. The deaneries of Chelsea, Hammersmith, Hampstead, Hornsey, Kensington, Paddington, St Marylebone, Westminster and Willesden were created later, but Staines was abolished.

In 1215 Middlesex was ravaged by William, earl of Salisbury, and Falkes de Breauté, and in the same year at Runnimede near Staines John was forced to issue the Magna Carta. In the Civil War of the 17th century Middlesex supported the Parliamentary cause, joining in 1642 with Hertfordshire and Essex in a petition that the votes of the bishops and popish lords might be disallowed in the House of Lords, and that the forts and castles of the kingdom might be placed in such hands as the Parliament could confide in. Sir Denzil Hollis was defeated by the Royalists at Brentford in 1642, and in 1645 a fruitless treaty between Charles I. and the Parliament was concluded at Uxbridge. Brentford had famous election contests in 1768 and 1769.

The woollen and leather industries flourished in Middlesex in Norman times. London was the great place of slaughter, and hides were tanned at Enfield. Bricks were also manufactured from early times, and Heston was noted for its wheat. Paper was extensively manufactured in the 17th century, and much distress was caused in 1636 by a decree prohibiting the purchase of old rags for the Middlesex paper-mills for fear of the plague. In 1640 the manufacturers of mohair yarn in Middlesex appealed against a bill prohibiting the wearing of material made of the said yarn during the winter season. In 1655 a certificate of a hundred master tanners and other traders of Middlesex approved an invention for converting raw hides into leather by means of new liquor, with or without oak-bark.

Middlesex returned two members to parliament in 1295. (For the representation of London, see London.)

See John Norden, *Speculum Britanniae: the firste parte, an historicall and chorographicall description of Middlesex* (London, 1593; reprinted 1637 and 1723); Daniel Lysons, *The Environs of London* (1792–1796); *Victoria County History, Middlesex.*

MIDDLETON, EARLS OF. John Middleton, 1st Earl of Middleton (*c.* 1619–1674), belonged to a Kincardineshire family which had held lands at Middleton since the 12th century. In early life he served as a soldier in France; later he fought against Charles I. both in England and in Scotland, being especially prominent at the battle of Philiphaugh and in other operations against the great Montrose. He held a high command in the Scottish army which marched to rescue the king in 1648, and he was taken prisoner after the battle of Preston. He joined Charles II. when that monarch reached Scotland in 1650, but he was soon at variance with the party which at that time was dominant in church and state and was only restored to favour after doing a public penance at Dundee. He was a captive for the second time after the battle of Worcester, where he commanded the Royalist cavalry, but he escaped from the Tower of London to Paris. In 1653 Middleton was chosen by Charles II. to head the projected rising in Scotland. He reached that country in February 1654, but the insurrection was a complete failure. Its leader, who cannot be held responsible for this result, remained in Scotland until 1655, when he rejoined Charles II., who made him an earl in 1656. He returned to England with the king in 1660 and was appointed commander-in-chief of the troops in Scotland and lord high commissioner to the Scottish parliament, which he opened in January 1661. He was an ardent advocate of the restoration of episcopacy, this being one reason which led to serious dissensions between the earl of Lauderdale and himself, and in 1663 he was deprived of his offices. He was afterwards (1667) governor of Tangier, where he died in June 1674.

His eldest son CHARLES, 2ND EARL OF MIDDLETON (c. 1640–1719), held several offices under Charles II. and James II., being envoy extraordinary at Vienna and afterwards joint secretary for Scotland. In 1684 he became an English secretary of state, and with Richard Graham, Viscount Preston, he had the difficult task of managing the House of Commons for James II. He was loyal to James after the king fled to France, although he remained in England, where, as the leader of the moderate Jacobites, he sought to bring about a restoration by peaceful means. In 1693 the earl joined the exiled king at St Germains, where he became his secretary of state; afterwards he held the same office at the court of James Edward, the old pretender, in Flanders and in Lorraine. He was partly responsible for the unsuccessful expedition of the Jacobites to Scotland in 1707, and he resigned his office as secretary in 1713. Middleton, who had been created earl of Monmouth by the pretender, died in 1719. His titles had been declared forfeited in 1695, but they were claimed by his son John, who died unmarried about 1746. The earl was a Protestant, although a lukewarm one, until 1701, when he yielded to the dying wish of James II. and joined the Roman Catholic Church.

One of Middleton's kinsmen was SIR CHARLES MIDDLETON, Bart. (1726–1813). Having served in the navy Middleton was comptroller of the navy from 1778 to 1790, "standing out through that period of inept administration as the pillar of the service." In April 1805, at a most critical time, he was, although eighty years of age, appointed first lord of the admiralty by Pitt and was created Lord Barham. It has been usual to regard Barham as a cipher at the admiralty board, but more recent research, especially an examination of the *Barham Papers*, has proved this to be the reverse of the truth. He enjoyed the absolute confidence of Pitt, and it was his experience, industry and energy which made possible the great campaign which ended at Trafalgar. He resigned office in January 1806 and died on the 17th of January 1813. His barony passed through his daughter Diana (1762–1823) to the Noels, earls of Gainsborough, by whom it is still held. The *Barham Papers* are being edited by Sir J. K. Laughton (vol. i. 1907; vol. ii. 1910). See also J. S. Corbett, *The Campaign of Trafalgar* (1910).

See A. C. Biscoe, *The Earls of Middleton* (1876).

MIDDLETON, ARTHUR (1742–1787), American politician and signer of the Declaration of Independence, was born at Middleton Place on the Ashley river, South Carolina, on the 26th of June 1742. His family was one of the most prominent in the colony. The grandfather, Arthur Middleton (1681–1737), was president of the Council in 1721–1730 and as such was acting governor in 1725–1730, and the father, Henry Middleton (1717–1784), was speaker of the Assembly in 1745–1747 and again in 1754–1755, a delegate to the Continental Congress in 1774–1776, and its president from October 1774 to May 1775, a member of the South Carolina Committee of Safety, and in 1775 president of the South Carolina Provincial Congress. Like most wealthy South Carolinians of the 18th century, Arthur Middleton was educated in England—at Hackney, at Westminster School, and at St John's College, Cambridge. He then returned to South Carolina, but soon afterwards went back to England to live, and travelled on the Continent. In 1773 he again returned to South Carolina, and in the controversies between the colonists and the home government became a leader of the Whigs. He was a member of the provincial Council of Safety in 1775–1776, and a delegate to the Continental Congress in 1776–1777. In 1778 he was elected governor of South Carolina, but owing to his dissatisfaction with the new state constitution he declined to serve. He was captured by the British at Charleston in May 1780, was exchanged in July 1781, was again a delegate to Congress in 1781–1783, and later served in the state legislature. He died on the 1st of January 1787 at Middleton Place, near Charleston.

His eldest son, HENRY MIDDLETON (1770–1846), was an orator of ability, was governor of South Carolina in 1810–1812, a representative in Congress in 1815–1819, and the United States minister to Russia from 1820 to 1830, negotiating in 1824 a convention "relative to navigation, fishing and trading in the Pacific Ocean, and to establishments on the North-West Coast." This was the first treaty between the United States and Russia.

MIDDLETON, CONYERS (1683–1750), English divine, was born at Richmond in Yorkshire on the 27th of December 1683. He graduated at Cambridge, took orders, and in 1706 obtained a fellowship, which he soon resigned upon contracting an advantageous marriage. In 1717 a dispute with Richard Bentley, who made an extortionate demand on the occasion of Middleton's being created D.D., involved him in an acrimonious controversy. He wrote several trenchant pamphlets, among them the "Remarks" and "Further Remarks" on Bentley's *Proposals for a New Edition of the Greek Testament*, an endeavour to visit his grievances upon the text of the New Testament. In 1723 he was involved in a lawsuit by personalities against Bentley, which had found their way into his otherwise judicious tract on library administration, written on the occasion of his appointment as university librarian. In 1726 he offended the medical profession by a dissertation contending that the healing art among the ancients was only exercised by slaves or freedmen. Between the dates of these publications he visited Italy, and made those observations on the pagan origin of church ceremonies and beliefs which he subsequently embodied in his *Letter from Rome* (1729). This cogent tract probably contributed to prepare the storm which broke out against him on his next publication (1731). In his remonstrance with Daniel Waterland on occasion of the latter's reply to Matthew Tindal's *Christianity as Old as the Creation*, Middleton takes a line which in his day could hardly fail to expose him to the reproach of infidelity. He gives up the literal truth of the primeval Mosaic narratives; and, in professing to indicate a short and easy method of confuting Tindal, lays principal stress on the indispensableness of Christianity as a mainstay of social order. This was to resign nearly everything that divines of the Waterland stamp thought worth defending. Middleton was warmly assailed from many quarters, and retreated with some difficulty under cover of a sheaf of apologetic pamphlets and a more regular attendance at church. His next important publication was a *Life of Cicero* (1741), largely told in that statesman's own words. Though Middleton's reputation was much enhanced by this piece of work, there is no doubt that he drew largely from the scarce book of William Bellenden, *De tribus luminibus Romanorum*. The work was undertaken at the instance of Lord Hervey, in correspondence with whom also originated his disquisition on *The Roman Senate*, published in 1747. The same year and the following produced the most important of all his writings, the *Introductory Discourse* and the *Free Inquiry* "concerning the miraculous powers which are supposed to have subsisted in the church from the earliest ages." In combating this belief Middleton indirectly established two propositions of capital importance. He showed that ecclesiastical miracles must be accepted or rejected in the mass; and he distinguished between the authority due to the early fathers' testimony to the beliefs and practices of their times, and their very slender credibility as witnesses to matters of fact. Some individual grudge seems to have prompted him to expose, in 1750, Bishop Sherlock's eccentric notions of antediluvian prophecy, which had been published 25 years before. On the 28th of July 1750 he died at Hildersham, near Cambridge.

Middleton's most ambitious work is obsolete from no fault of his, but his controversial writings retain a permanent place in the history of opinion. In his more restricted sphere he may not inappropriately be compared with Lessing. Like Lessing's, the character of his intellect was captious and iconoclastic, but redeemed from mere negation by a passion for abstract truth, too apt to slumber until called into activity by some merely personal stimulus. His diction is generally masculine and harmonious. Pope thought him and Nathaniel Hooke the younger the only prose writers of the day who deserved to be cited as authorities on the language. Samuel Parr, while exposing his plagiarisms, heaps encomiums on his style. But his best qualities, his impatience of superstition and disdain of mere external authority, are rather moral than literary.

The best general view of his intellectual character and influence is to be found in Sir Leslie Stephen's *English Thought in the Eighteenth Century*, ch. vi. A handsome edition of his works, containing several posthumous tracts, but not including the *Life of Cicero*, appeared in 4 vols. in 1752 and in 5 vols. in 1755.

MIDDLETON, THOMAS (*c.* 1570–1627), English dramatist, son of William Middleton, was born about 1570, probably in London. There is no proof that he studied at either university, but he may be safely identified with one of the Thomas Middletons entered at Gray's Inn in 1593 and 1596 respectively. He began to write for the stage with *The Old Law*, in the original draft of which, if it dates from 1599 as is generally supposed, he was certainly not associated with William Rowley and Philip Massinger, although their names appear on the title-page of 1656. By 1602 he had become one of Philip Henslowe's established playwrights. The pages of Henslowe's *Diary* contain notes of plays in which he had a hand, and in the year 1607–1608 he produced no less than six comedies of London life, which he knew as accurately as Dekker and was content to paint in more realistic colours. In 1613 he devised the pageant for the installation of the Lord Mayor, Sir Thomas Middleton, and in the same year wrote an entertainment for the opening of the New River in honour of another Middleton. From these facts it may be reasonably inferred that he had influential connexions. He was frequently employed to celebrate civic occasions, and in 1620 he was made city chronologer, performing the duties of his position with exactness till his death.

The most notable event in his career was the production at the Globe theatre in 1624 of a political play, *A Game at Chess*, satirizing the policy of the court, which had just received a rebuff in the matter of the Spanish marriage, the English and Spanish personages concerned being disguised as the White Knight, the Black King, and so forth. The play was stopped, in consequence of remonstrances from the Spanish ambassador, but not until after nine days' performances, and the dramatist and the actors were summoned to answer for it. It is doubtful whether Middleton was actually imprisoned, and in any case the king's anger was soon satisfied and the matter allowed to drop, on the plea that the piece had been seen and passed by the master of the revels, Sir Henry Herbert. Middleton died at his house at Newington Butts, and was buried on the 4th of July 1627.

He worked with various authors, but his happiest collaboration was with William Rowley, this literary partnership being so close that F. G. Fleay (*Biog. Chron. of the Drama*) treats the dramatists together. The plays in which the two collaborated are *A Fair Quarrel* (printed 1617), *The World Lost at Tennis* (1620), an ingenious masque, *The Changeling* (acted 1624, printed 1653), and *The Spanish Gipsie* (acted 1623, printed 1653). The main interest of the *Fair Quarrel* centres in the mental conflict of Captain Ager, the problem being whether he should fight in defence of his mother's honour when he no longer believes his quarrel to be just. The underplot, dealing with Jane, her concealed marriage, and the physician, which is generally assigned to Rowley, was suggested by a story in Giraldi Cinthio's *Hecatommithi*. *The Changeling* is the most powerful of all the plays with which Middleton's name is connected. The plot is drawn from the tale of Alsemero and Beatrice-Joanna in Reynolds's *Triumphs of God's Reveng against Murther* (bk. i., hist. iv.), but the story, black as it is, receives additional horror in Middleton's hands. The famous scene in the third act between Beatrice and De Flores, who has murdered Piracquo at her instigation, is admirably described by Swinburne:

> "That note of incredulous amazement that the man whom she has just instigated to the commission of murder 'can be so wicked' as to have served her end for any end of his own beyond the pay of a professional assassin, is a touch worthy of the greatest dramatist that ever lived. . . . That she, the first criminal, should be honestly shocked as well as physically horrified by revelation of the real motive which impelled her accomplice into crime, gives a lurid streak of tragic humour to the lifelike interest of the scene; as the pure infusion of spontaneous poetry throughout redeems the whole work from the charge of vulgar subservience to a vulgar taste for the presentation or the contemplation of criminal horror."

Leigh Hunt thought that the character of De Flores, for effect at once tragical, probable and poetical, "surpassed anything with which he was acquainted in the drama of domestic life." The underplot of the piece, though it is based on the humours of a madhouse, has genuine comic flashes. *The Spanish Gipsie* has a double plot based on the *Fuerza de la sangre* and the *Gitanilla* of Cervantes Much has been said on the collaboration of Middleton with Rowley, who was much in demand with fellow-dramatists, especially for his experience in low comedy. These plays, even in scenes where the evidence in favour of one or other of the collaborators is clear, rise to excellence which neither dramatist was able to achieve alone. It was clearly no mechanical partnership the limits of which can be said to be definitely assigned when the actual text has been parcelled out between the collaborators.

With Thomas Dekker he wrote *The Roaring Girle, or Moll Cut-Purse* (1611). The frontispiece represents Moll herself in man's attire, indulging in a pipe of tobacco. She was drawn or idealized from life, her real name being Mary Frith (1584–1659?), who was made to do penance at St Paul's Cross in 1612. "Worse things, I must confess," says Middleton in his preface, "the world has taxed her for than has been written of her; but 'tis the excellency of a writer to leave things better than he finds 'em." In the play she is the champion of her sex, and is equally ready with her sword and her wits. Middleton is also credited with a share in Thomas Dekker's *Honest Whore* (pt. i., 1604). *The Witch*, first printed in 1778 from a unique MS., now in the Bodleian, has aroused much controversy as to whether Shakespeare borrowed from Middleton or vice versa. The dates of both plays being uncertain, there are few definite data. The distinction between the two conceptions has been finely drawn by Charles Lamb, and the question of borrowing is best solved by supposing that what is common to the incantations of both plays was a matter of common property. *The Mayor of Quinborough* was published with Middleton's name on the title-page in 1661. Simon, the comic mayor, is not a very prominent character in the plot, which deals with Vortiger, Hengist, Horsus and Roxena among other characters. One of its editors, Mr Havelock Ellis, thinks the proofs of its authenticity as Middleton's work very slender. It is generally supposed to have been a very early work subjected to generous revision.

The plays of Middleton still to be mentioned may be divided into romantic and realistic comedies of London Life. Dekker had as wide a knowledge of city manners, but he was more sympathetic in treatment, readier to idealize his subject. *Two New Playes. Viz.: More Dissemblers besides Women. Women beware Women*, of which the former was licensed before 1622, appeared in 1657. The plot of *Women beware Women* is a double intrigue from a contemporary novel, *Hyppolito and Isabella*, and the genuine history of Bianca Capello and Francesco de Medici. This play, which ends with a massacre appalling even in Elizabethan drama, may be taken as giving the measure—no mean one—of Middleton's unaided power in tragedy.

The remaining plays of Middleton are: *Blurt, Master-Constable. Or the Spaniards Night-walke* (1602); *Michaelmas Terme* (1607), described by A. C. Swinburne as an excellent Hogarthian comedy; *The Phoenix* (1607), a version of the Haroun-al-Raschid trick; *The Famelie of Love* (1608); *A Trick to catch the Old-one* (anonymously printed, 1608); *Your Five Gallants* (licensed 1608); *A Mad World, my Masters* (1608); *A Chast Mayde in Cheapside* (printed 1630), notable for the picture of Tim, the Cambridge student, on his return home; *Anything for a Quiet Life* (*c.* 1617, printed 1662); *No Wit, No Help like a Woman's* (*c.* 1613, printed 1657); *The Widdow* (printed 1652), on the title-page of which appear also the names of Ben Jonson and John Fletcher, though their collaboration may be doubted. Eleven of his masques are extant. A tedious poem, *The Wisdom of Solomon paraphrased, by Thomas Middleton*, was printed in 1597, and *Microcynicon, Six Snarling Satires by T. M. Gent*, in 1599. Two prose pamphlets, dealing with London life, *Father Hubbard's Tale* and *The Black Book*, appeared in 1604 under his initials. His non-dramatic work, however, even if genuine, has little value.

AUTHORITIES.—His works were edited by Alexander Dyce (5 vols.) in 1840, with a valuable introduction quoting many documents, and by A. H. Bullen (8 vols.) in 1885. *The Best Plays of Thomas Middleton* were edited for the Mermaid series (1887) by Havelock Ellis with an introduction by A. C. Swinburne. See also Miss P. G. Wiggin's *Inquiry into the Authorship of the Middleton-Rowley Plays* (Boston, 1897), and the notice on Middleton in Professor A. W. Ward's *Hist. of Eng. Dram. Lit.* (ed. 1899; ii., 493–540), which contains a full account of Middleton's *Game at Chesse.* A careful examination of the parallelisms between the plays of Shakespeare and Middleton is made by D. Hugo Jung in "Das Verhältnis Thomas Middleton's zu Shakspere" (*Münchener Beiträge zur roman. u. engl. Phil.* vol. xxix., 1904).

MIDDLETON, a market town and municipal borough in the Middleton parliamentary division of Lancashire, England, on the Irk, near the Rochdale Canal, and on the Lancashire & Yorkshire railway, 6 m. N.N.E. from Manchester. Pop. (1901), 25,178. The church of St Leonards is of mixed architecture, with a low square tower. The oldest portion of the building (the tower arch) dates from the 12th century, but the main portion from 1412, and the south aisle from 1524. Two chapels in it contain memorials of, and are named after, two ancient Lancashire families, the Asshetons and the Hopwoods. The Queen Elizabeth grammar-school, a building in the Tudor style, was founded in 1572 by Nowell, dean of St Paul's, London. There are a handsome town-hall and municipal technical schools. An extensive system of tramways and electric light railways connects the town with its suburbs and adjacent industrial centres. The prosperity of the town dates from the introduction of manufactures at the close of the 18th century. The staple trade is the spinning and weaving of cotton, and the other industries include silk weaving, calico-printing, bleaching, dyeing, iron-founding and the manufacture of soap and chemicals. There are collieries in the neighbourhood. The town was incorporated in 1886, and the corporation consists of a mayor, 6 aldermen and 18 councillors. Area, 4775 acres.

MIDDLETOWN, a city and the county-seat of Middlesex county, Connecticut, U.S.A., in the township of Middletown, in the south central part of the state, on the west bank of the Connecticut river, about 30 m. from its mouth, and about 15 m. south of Hartford. Pop. (1890), 9013; (1900), 9589, of whom 2316 were foreign-born; (1910 census) 11,851. Within a radius of 2 m. from the city hall there was found in 1910 most of the township's population of 20,749. The city is served by two branches of the New York, New Haven & Hartford railroad, by a line of coast steamers, and by electric lines connecting with neighbouring cities and villages. The city is connected by a long highway bridge with the village of Portland in the township of Portland (pop. in 1910, 3425; area 26 sq. m.), which is known for its brown-stone quarries. Four miles south of Middletown is Chestnut Mountain (or Bull Hill), which commands a fine view; and about 3 m. east are the "Narrows" of the Connecticut river, where the water flows between high hills. Middletown has a number of handsome residences. In High Street stand the buildings of Wesleyan university (Methodist Episcopal), founded in 1831 by the Rev. Wilbur Fisk, who became the first president and the Rev. Laban Clark (1778–1868), who became the first president of the board of trustees. Women were first admitted in 1872, but coeducation was later discontinued, and the last freshman class of women students under the old system entered in 1909. The university offers classical and scientific courses, and in 1908–1909 had 36 instructors, 322 students (30 being women), and a library of 79,000 volumes. In 1875–1877 the work of the first agricultural experiment station in the United States was carried on here under state supervision in Wesleyan University, with Professor Wilbur Olin Atwater (1844–1907) as director; it was then removed to New Haven. Middletown is also the seat of the Berkeley divinity school (Protestant Episcopal), founded in 1849 as the theological department of Trinity College, Hartford, rechartered and removed to Middletown in 1854, and having in 1907 a faculty of 8, and 16 students; and the city has a free public library (1874) with 17,700 vols. in 1907. South-east of the city is the Connecticut hospital for the insane, and south-west of the city, the Connecticut industrial school for girls (reformatory). The total value of the factory products in 1905 was $5,604,676, an increase of 35 % over that for 1900. The municipality owns and operates the waterworks.

Middletown occupies the site of an Indian village, Mattabesec or Mattabesett (from *Massa-sepues-et,* "at a great rivulet or brook"), the principal village of the Mattabesec Indians, an Algonquian tribe which included the Wongunk, Pyquaug and Montowese Indians and seems to have had jurisdiction over the whole of south-western Connecticut. The township of Middletown was settled by whites in 1650, and until 1653, when the present name was adopted, was known by the Indian name, Mattabesett. It was incorporated in 1651; and the city was chartered in 1784. Shipbuilding and commerce became the principal sources of wealth. In the middle of the nineteenth century Middletown was one of the leading cities of Connecticut, and as late as 1886 it was a port of entry; but the development of rival ports, especially New Haven, Hartford and Bridgeport, into railway centres, retarded the growth of manufacturing, and commerce declined after the Civil War.

MIDDLETOWN, a city of Orange county, New York, U.S.A., on the Wallkill river, 67 m. N.N.W. of New York City. Pop. (1890) 11,977; (1900) 14,522, including 1700 foreign-born and 480 negroes; (1905, state census) 14,516; (1910) 15,313. It is served by the Erie, the New York, Susquehanna & Western, and the New York, Ontario & Western railways, and is connected by an electric line with Goshen (pop. in 1910, 3081), the county-seat. It is situated in an attractive dairy and agricultural country; and in the city and vicinity there are many summer residences. Here are the state homoeopathic hospital for the insane, a state armoury, Thrall hospital, and Thrall library. Middletown is primarily a manufacturing city, and has the car shops of the New York, Ontario & Western railway. The value of its factory products increased from $2,154,742 in 1900 to $3,356,330 in 1905, or 55·8 %. The municipality owns and operates its waterworks. Middletown was settled about 1706 and owed its early commercial importance to its being a "half-way house" (whence its name) for travellers on the Minisink Road to western New York, and it was for a time a terminus of the Erie railroad. It was incorporated as a village in 1848, and first chartered as a city in 1888.

MIDDLETOWN, a city of Butler county, Ohio, U.S.A., on the Miami river, 34 m. N. of Cincinnati. Pop. (1890), 7681; (1900), 9215, of whom 769 were foreign-born and 314 were negroes; (1910) 13,152. It is served by the Cleveland, Cincinnati, Chicago & St Louis, the Cincinnati, Hamilton & Dayton, the Cincinnati Northern (New York Central system), and a branch of the Cincinnati, Lebanon & Northern (Pennsylvania system) railways. It is the trade centre of a rich and beautiful agricultural region in which tobacco, wheat and Indian corn are the principal crops. The river furnishes considerable water-power and the total factory product in 1905 was valued at $8,357,993, an increase of 47·2 % over that in 1900. The waterworks are owned and operated by the municipality. Middletown was laid out in 1802 and was named from its location between Cincinnati and Dayton; it was incorporated in 1833.

MIDDLETOWN, a borough of Dauphin county, Pennsylvania, U.S.A., on the east bank of the Susquehanna river, 9 m. below Harrisburg. Pop. (1890), 5080; (1900), 5608 (340 foreign-born and 289 negroes); (1910), 5374. It is served by the Pennsylvania and the Philadelphia & Reading railways, and by an electric line to Harrisburg. The borough has a considerable trade with the surrounding agricultural country, and owing to the proximity of the Yorkhaven power-plant (across the river) and the excellent railway service, is a manufacturing centre. The municipality owns its electric lighting plant. Middletown was founded in 1755 by Friends (from Philadelphia and other places in Pennsylvania) and Scotch-Irish, and was so named because of its position midway between Lancaster and Carlisle. It was first incorporated as a borough in 1828.

MIDDLEWICH, an urban district in the Northwich parliamentary division of Cheshire, England, 166 m. N.W. of London, on the London & North Western railway. Pop. (1901), 4669. It lies in open country near the river Dane, having water communications by the Trent and Mersey canal, and a branch giving access to the Shropshire Union canal. The church of St Michael and All Angels is of various periods and contains numerous monuments. In the streets not a few old buildings remain, making for picturesqueness, and a number of the fine timbered houses in which Cheshire abounds are seen in the immediate neighbourhood. Middlewich shares in the salt industry common to several towns, such as Northwich and Winsford, in this part of the county; there are also chemical works and a manufacture of condensed milk.

MIDHAT PASHA (1822–1884), Turkish statesman, the son of a civil judge, was born at Constantinople in 1822. His father, a declared partisan of reform, trained him for an administrative career, and at the age of twenty-two he was attached as secretary to Faïk Effendi, whom he accompanied in Syria for three years. On his return to Constantinople Midhat was appointed chief director of confidential reports, and after a new financial mission in Syria was made second secretary of the grand council. His enemies, however, succeeded in ousting him from this post, and caused him to be entrusted with the apparently impossible task of settling the revolt and brigandage rampant in Rumelia. His measures were drastic and their success was startling and the government made him an official of the first rank and restored him to his place in the grand council. In similar vigorous fashion he restored order in Bulgaria in 1857. In 1860 he was made vizier and pasha, and entrusted with the government of Nisch, where his reforms were so beneficial that the sultan charged him, in conjunction with Fuad Pasha and Ali Pasha, to prepare the scheme for adapting them to the empire which was afterwards known as the law of the vilayets. After further administrative work in his province, he was ordered to organize the council of state in 1866, and was then made governor of Bagdad, where his success was as decisive as at Nisch, but attended with much greater difficulties. In 1871 the anti-reform influence of the grand vizier, Mahmoud Nedim, seemed to Midhat a danger to the country, and in a personal interview he boldly stated his views to the sultan, who was so struck with their force and entire disinterestedness that he appointed Midhat grand vizier in place of Mahmoud. Too independent, however, for the court, Midhat remained in power only three months, and after a short governorship of Salonica he lived apart from affairs at Constantinople until 1875.

From this time forward, however, Midhat Pasha's career resolved itself into a series of strange and almost romantic adventures. While sympathizing with the ideas and aims of the "Young Turkey" party, he was anxious to restrain its impatience, but the sultan's obduracy led to a coalition between the grand vizier, the war minister and Midhat Pasha, which deposed him in May 1876, and he was murdered in the following month. His nephew Murad V. was in turn deposed in the following August and replaced by his brother, Abdul Hamid II. Midhat Pasha now became grand vizier, reforms were freely promised, and the Ottoman parliament was inaugurated with a great flourish. In the following February, however, Midhat was dismissed and banished for supposed complicity in the murder of Abdul Aziz. He then visited various European capitals, and remained for some time in London, where he carefully studied the procedure in the House of Commons. Again recalled in 1878, he was appointed governor of Syria, and in August exchanged offices with the governor of Smyrna. But in the following May the sultan again ordered him to be arrested, and although he effected his escape and appealed to the powers, he shortly afterwards saw fit to surrender, claiming a fair hearing. The trial accordingly took place in June, when Midhat and the others were sentenced to death. It was, however, generally regarded as a mockery, and on the intercession of the British government the sentence was commuted to banishment. The remaining three years of his life were consequently spent in exile at Taif in Arabia, where he died, probably by violence, on the 8th of May 1884. To great ability, wide sympathies, and undoubted patriotism he added absolute honesty, that rare quality in a vizier, for he left office as poor as when he entered it. (G. F. B.)

MIDHURST, a market town in the north-western parliamentary division of Sussex, England, 12 m. N. by E. of Chichester by the London, Brighton & South Coast railway; served also by the London & South Western railway. Pop. (1901), 1674. It is pleasantly situated on slightly rising ground near the river Rother. The church of St Mary Magdalen and St Denis is a large Perpendicular building. The town retains several picturesque old houses, and in the vicinity, by the river, are the ruins of the 16th century mansion of Cowdray, burnt down in 1793. A grammar-school was founded at Midhurst in 1672 and attained some eminence. After being closed for many years it was re-opened in 1880. In 1906 a magnificent sanatorium for consumptives was opened about 4 m. from Midhurst; it bears the name of King Edward VII., who laid its foundation stone and opened it.

The name of Midhurst (Middeherst, Mudhurst) first occurs in the reign of Henry I. when Savaric Fitz-Cana held it of the honour of Arundel, then presumably in the king's hands. The charter of Henry I., although no longer extant, is quoted in later confirmation charters of Richard I., Henry III., Edward III. and Richard II. Franco de Bohun inherited Midhurst from his uncle Savaric Fitz-Savaric, and the De Bohuns held the lordship until 1499 when Sir David Owen obtained it through his marriage with the daughter of the last male heir. He sold it to Sir William Fitz-William, from whom it passed to Sir Anthony Browne and descended to the viscounts Montague. Midhurst is definitely called a borough in the reign of Edward I., but the borough-court and market were probably in existence much earlier. It was governed by a bailiff, elected annually, until the office lapsed, probably early in the 19th century. In an act of 1883 it is mentioned as one of the towns which had long ceased to be municipal. No charter of incorporation is known. Midhurst returned two members to parliament from 1300–1301 till 1832, and from that date one member until 1885 when it was disfranchised. In the reign of Henry VI. a market was held by the burgesses every Thursday, and a fair on Whit-Tuesday, by grant from Sir John Bohun. In 1888 the fair-days were the 6th of April, the 9th of May and the 29th of October. The market-day was Thursday. Pleasure-fairs are still held on the 6th of April and the 29th of October, but there is no market.

MIDIAN (properly Madyān, so Sept.), in the Bible, one of the peoples of North Arabia whom the Hebrews recognized as distant kinsmen, representing them as sons of Abraham's wife Ketūrah ("incense"). Thus the sons of Ketūrah are the "incense-men," not indeed inhabitants of the far south incense-land, but presumably the tribes whose caravans brought the incense to Palestine and the Mediterranean ports. So the Midianites appear in connexion with the gold and incense trade from Yemen (Isa. lx. 6), and with the trade between Egypt and Syria (Gen. xxxvii. 28, 36). They appear also as warriors invading Canaan from the eastern desert, and ravaging the land as similar tribes have done in all ages when Palestine lacked a strong government (see Gideon). Again, they are described as peaceful shepherds, and the pastures of the Midianites, or of the branch of Midian to which Moses's father-in-law (Jethro or Reuel, or Hobab) belonged, lay near Mount Horeb (Exod. iii. 1). The Kenites who had friendly relations with Israel, and are represented in Judg. i. 16, iv. 11, as the kin of Moses's father-in-law, appear to have been but one fraction of Midian which took a separate course from their early relations to Israel.[1] Balaam, according to one version of the story, was a Midianite (Num. xxii. seq.) and his association with Moab has been connected with the statement in Gen. xxxvi. 35, that the Edomite king Hadad defeated Midian in the land of Moab; (see Balaam, Edom).

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[1] The admixture of Midianite elements in Judah and the other border tribes of Israel is confirmed by a comparison of the names of the Midianite clans in Gen. xxv. 4 with the Hebrew genealogies (1 Chron. ii. 46, Ephah; iv. 17, Epher; Gen. xlvi. 9, Hanoch). Epher is also associated with 'Ofr near Ḥanākiya (Hanoch), three days north from Medina, also with Apparu a Bedouin locality mentioned by Assur-bani-pal. Ephah is probably the Ḥayapa transported by Sargon to Beth-Omri (Samaria).

A place Midian is mentioned in 1 Kings xi. 18, apparently between Edom and Paran, and in later times the name lingered in the district east of the Gulf of ʽAkaba, where Eusebius knows a city Madiam in the country of the Saracens and Ptolemy (vi. 7) places Modiana. Still later Madyan was a station on the pilgrim route from Egypt to Mecca, the second beyond Aila (Elath). Here in the middle ages was shown the well from which Moses watered the flocks of Shoʽaib (Jethro), and the place is still known as "the caves of Shoʽaib." It has considerable ruins, which have been described by Sir R. Burton (*Land of Midian*, 1879).

This district which has on its east Taimā, a centre of civilization in the 5th century B.C., and on its south-east El-ʽOlā whose existence as a seat of culture is possibly even older, is identified by some scholars with the Muṣrān of the Minaean (south Arabian) inscriptions, on which see SABAEANS, YEMEN. That this part of north-west Arabia had frequent intercourse with Palestine appears certain from its commercial relations with Gaza; and the association of the Midianite Jethro with early Hebrew legislation, as also the possibility that Mizraim ("Egypt") in the Old Testament should be taken in some cases to refer to this district, have an important bearing upon several Old Testament questions. See MIZRAIM.

MIDLETON, WILLIAM ST JOHN FREMANTLE BRODRICK, 9TH VISCOUNT (1856–   ), English politician, was the son of the 8th viscount (1830–1907). He came of a Surrey family who in the 17th century, in the persons of Sir St John Brodrick and Sir Thomas Brodrick, obtained grants of land in the south of Ireland. Sir St John Brodrick settled at Midleton, between Cork and Youghal in 1641; and his son Alan Brodrick (1660–1728), speaker of the Irish House of Commons and lord chancellor of Ireland, was created Baron Brodrick in 1715 and Viscount Midleton in 1717 in the Irish peerage. In 1796 the title of Baron Brodrick in the peerage of the United Kingdom was created. The English family seat at Peper Harow, near Godalming, Surrey, was designed by Sir William Chambers. The 8th viscount was a Conservative in politics, who for a few years had a seat in the House of Commons, and who was responsible in the House of Lords for carrying the Infants Protection Act. His brother, the Hon. G. C. Brodrick, was for many years warden of Merton College, Oxford. As Mr St John Brodrick, the 9th viscount had a distinguished career in the House of Commons. After being at Eton and Balliol, Oxford, and serving as president of the Oxford Union, he entered parliament as conservative member for one of the Surrey divisions in 1880. From 1886 to 1892 he was financial secretary to the war office; under secretary for war, 1895–1898; under secretary for foreign affairs, 1898–1900; secretary of state for war, 1900–1903; and secretary of state for India, 1903–1905. He lost his seat for the Guildford division of Surrey at the general election of January 1906. In March 1907 he was made an alderman of the London County Council. He married, first in 1880, Lady Hilda (d. 1901), daughter of the 9th earl of Wemyss, by whom he had a family; and secondly in 1903, Madeleine Stanley, daughter of Lady St Helier by her first husband.

MIDLETON, or MIDDLETON, a market town of Co. Cork, Ireland, on the river Owenacurra, 13 m. E. of Cork by the Youghal branch of the Great Southern & Western railway. Pop. (1901), 3361. The river here enters a branch of Cork harbour. The surrounding hilly country is pleasant and fertile, and furnishes the town with a good agricultural trade. There are also whisky-distilleries. Ballinacurra, 1½ m. south on the estuary, serves as a small port. The grammar school was founded in 1696, and here among its students were John Philpot Curran and Isaac Butt. Midleton is governed by an urban district council.

MIDNAPORE, a town and district of British India, in the Burdwan division of Bengal. The town is 68 m. W. of Calcutta; it has a station on the Bengal Nagpur railway. Pop. (1901), 33,140. It is an important centre of trade, being the terminus of a navigable canal to Calcutta, and also the junction for the Sini branch of the Bengal-Nagpur railway. There are manufactures of brass and copper wire. It has an American mission, a municipal college, and a public library founded in 1852.

The DISTRICT OF MIDNAPORE has an area of 5186 sq. m. The general appearance is that of a large open plain, of which the greater part is under cultivation. In the northern portion the soil is poor, and there is little wood. The country along the western boundary, known as the Jungle Mahals, is undulating and picturesque; it is almost uninhabited. The eastern and south-eastern portions are swampy and richly cultivated. The chief rivers of the district are the Hugli and its three tributaries, the Rupnarayan, the Haldi and the Rasulpur. The Midnapore high-level canal used also for irrigation runs almost due east and west from the town of Midnapore to Ulubaria on the Hugli 16 m. below Calcutta, and affords a continuous navigable channel 53 m. in length. There is also a tidal canal for navigation, 26 m. in length, extending from the Rupnarayan river. The district is traversed as well by the Bengal-Nagpur railway towards Orissa, with a branch to Chota Nagpur. The jungles in the west of the district yield lac, tussur, silk, wax, resin, fire-wood, charcoal, &c., and give shelter to large and small game. The principal exports are rice, silk and sugar; and the chief imports consist of cotton cloth and twist. Salt, indigo, silk, mats and brass and copper utensils are manufactured. Both silk and indigo are decaying industries. The population in 1901 was 2,789,114, showing an increase of 6% in the decade.

The early history of Midnapore centres round the ancient town of Tamluk, which in the beginning of the 5th century was an important Buddhist settlement and maritime harbour. The first connexion of the English with the district dates from 1760, when Mir Kasim ceded to the East India Company Midnapore, Chittagong, and Burdwan (then estimated to furnish one-third of the entire revenue of Bengal) as the price of his elevation to the throne of Bengal on the deposition of Mir Jafar.

MIDRASH, a very common term in Jewish writings for "exposition" and a certain class of expository literature. The word also occurs twice in the Old Testament (2 Chron. xiii. 22, xxiv. 27; R.V. rather poorly "commentary").

1. *Introduction.*—The term (Heb. *midrāsh* from *dārash* "to search out, enquire") denotes some explanation or exposition, which, in contrast to the more literal exegesis (technically called *pĕshat* "simple"), endeavours to reach the spirit lying below the text. It may be defined as a didactic or homiletic development of some thought or theme, characterized by a more subjective, imaginative and ampliative treatment. Jewish Midrash falls broadly into two classes: *Halaka* (*q.v.*) or *Hălākā* (walking, way, conduct) and *Haggādah* (narrative [with a purpose], homily; Aramaic equivalent *Aggādah*; the incorrect form *Agadah* rests upon a mistaken etymology). The former dealt with legal and ritual matters; it flourished in the schools and developed into the most subtle casuistry. The latter covered all non-halakic exposition and was essentially popular. It embraced historical and other traditions; stories, legends, parables and allegories; beliefs, customs and all that may be called folk-lore. It fed itself, not upon the laws, but upon the narrative, the prophetical and the poetical writings of the Old Testament, and it had a more spiritual and ethical tone than the Halaka. In both classes, accepted tradition (written or oral) was reinterpreted in order to justify or to deduce new teaching (in its widest sense), to connect the present with a hallowed past, and to be a guide for the future; and the prevalence of this process, the innumerable different examples of its working, and the particular application of the term Midrash to an important section of Rabbinical literature complicates both the study of the subject and any attempt to treat it concisely.[1] Apart from the popular paraphrastic translations of the Old Testament (see TARGUM), the great mass of orthodox Rabbinical literature consists of (1) the independent Midrāshīm, and (2) the Mishna which, with its supplement the Gĕmārā, constitutes the Talmud. Both contain Halaka and Haggada, although the Mishna itself is essentially Halaka, and the Midrashim are more especially Haggadic; and consequently further information bearing upon Midrash must be sought in the art. TALMUD. These two articles

[1] For a careful study of the meaning of the term, see W. Bacher, *Jew. Quart. Rev.* IV. 406–429.

handle one of the most famous bodies of ancient literature, which, in its turn, has given rise to innumerable Jewish and non-Jewish works, and has many points of value and interest which cannot be adequately discussed here. It must suffice, therefore, to deal rather broadly with the subject, and to refer for fuller details to the special encyclopaedias, viz.: Hamburger's *Real-Encyc. für Bibel und Talmud*, and the very elaborate articles in the *Jewish Encyclopedia*.

2. *Narrative Midrash.*—Of the three different kinds of historical writing—the genetic or scientific, the purely narrative and the pragmatic—it is the last which has prevailed among religious historians. It is extremely difficult to avoid the subjective element in dealing with matters of fact, and the religious treatment of history is influenced, however unconsciously, by the mental environment of the writers. In giving greater prominence to events of religious importance and to their bearing upon the spiritual needs of contemporaries they view and interpret the past in a particular light, and will see in the past those growths which only in their own time have become mature. A latent significance is found, a particular connexion is traced, and a continuity is established, the true nature of which must be tested by critical students. Now, it is subjective history which we find in the earliest references to Midrash. The Midrash of the prophet Iddo (2 Chron. xiii. 22) like the Visions and the Histories of Iddo and Shemaiah (ix. 29, xii. 15) which are quoted for the lives of Solomon, Abijah and Jeroboam, are evidently quite distinct from the sources cited in the parallel portions of the earlier compilation, and the entire spirit of the narratives is different. Similarly, there is a conspicuous difference of treatment of the life of Joash in 2 Kings xi. seq., compared with 2 Chron. xxiii. seq., which refers to some Midrash of the Book of the Kings (xxiv. 27). Although it is uncertain whether this comprehensive Midrash also included the "books of the Kings" (xvi. 11, xxvii. 7, &c.), and the Midrash of Iddo and other related works, it is clear that the Book of Chronicles (*q.v.*) marks a very noteworthy advance upon the records in the (canonical) Book of Kings (*q.v.*). It is now recognized that the compiler of the former has used many novel narratives of a particular edifying and didactic stamp, and scholars are practically unanimous that these are subsequent to the age of the Israelite monarchy and present a picture of historical and religious conditions which (to judge from *earlier* sources) is untrustworthy. At the same time various details (as comparison with the Book of Kings shows) are relatively old and, on a priori grounds, it is extremely unlikely that the unhistorical elements are necessarily due to deliberate imagination or perversion rather than to the development of earlier traditions. The religious significance of the past is dominant, and the past is idealized from a later standpoint; and whether the narratives in Chronicles are expressly styled Midrash or not, they are the fruit of an age which sought to inculcate explicitly those lessons which, it conceived, were implied in the events of the past. The value of the book lay not in history for its own sake, but in its direct application to present needs. But the tendency to reshape history for the edification of later generations was no novelty when Chronicles was first compiled (about 4th cent. B.C.), Pragmatic historiography is exemplified in the earliest continuous sources (viz. of the "Deuteronomic" writers, *i.e.* allied to Deut., especially the secondary portions); and there are many relatively early narratives in which the details have been modified, and the heroes of the past are the mouthpiece for the thought of a later writer or of his age. Numerous instructive examples of the active tendency to develop tradition may be observed in the relationship between Genesis and the "Book of Jubilees," or in the embellishments of Old Testament history in the *Antiquities* of Josephus, or in the widening gaps in the diverse traditions of the famous figures of the Old Testament (Adam, Noah, Enoch, Abraham, Moses, Isaiah, Ezra, &c.), as they appear in non-canonical writings. In such cases as these one can readily perceive the different forms which the same material elements have assumed, and one may distinguish the unreliable accretions which are clearly later and secondary. Accordingly, when there are narratives which cannot be tested in this manner, should they show all the internal marks of didactic expansion and date from an age much later than the times with which they deal, their immediate value will not necessarily lie in the details which appear to be of historical interest, but in their contribution to later forms of tradition and phases of thought. So far then, Midrash tends to include moralizing history, whether we call it narrative or romance, attached to names and events, and it is obviously exemplified whenever there are unmistakable signs of untrustworthy amplification and of some explicit religious or ethical aim colouring the narrative. This, however, is only one of the aspects which have to be taken into consideration when one advances to the Rabbinical Midrash.

For Old Testament "Midrash" see further K. Budde, *Zeitschr. f. alt-test. Wissenschaft*, xii. 37, seq., and commentaries on Chronicles (*q.v.*). The elaborate study by the Jewish scholar Zunz (*Die gottesdienstlichen Vorträge*, ch. viii.) is also valuable for bridging the gulf between the canonical and the non-canonical traditions and for its just attitude to the criticism of historical traditions. The rigid line between fact or fiction in religious literature, which readers often wish to draw, cannot be consistently justified, and in studying old Oriental religious narratives it is necessary to realize that the teaching was regarded as more essential than the method of presenting it. "Midrash" which may be quite useless for historical investigation may be appreciated for the light it throws upon forms of thought. Historical criticism does not touch the reality of the ideas, and since they may be as worthy of study as the apparent facts they clothe, they thus indirectly contribute to the history of their period. In any case, while the true historical kernel of the Midrashic narrative (*e.g.* dealing with Adam, Moses or Isaiah) will always be a matter of dispute, the teaching to which it is applied stands on an independent footing as also does the application of that teaching to other ages.

3. *Continuity of Literature and Material.*—Amid obscure vicissitudes in the 7th to 5th centuries, B.C., the Canonical books of the Old Testament gradually began to assume their present shape (see PALESTINE: *History*). The internal peculiarities show that the compilations are the much edited remains of a larger body of literature, and it may reasonably be supposed that the older sources did not at once perish. There is literary critical evidence for late insertions by exilic or later compilers;[1] the compiler of Chronicles apparently refers to accessible works; and there is a close material relationship between the Old Testament and later literature. All this suggests that Old Hebrew writings, apart from those preserved in the Canon, persisted to a relatively late period. No a priori distinction can be made and no precise chronological line can be drawn between the books of the Canon (Canticles, Ecclesiastes, Esther, Ezekiel and Proverbs had been at one time or another subjects of debate among the Rabbis) and the Apocrypha (Ecclesiasticus, Judith, Maccabees and Tobit, were "allowed"); and the intimate relation between them appears in the character of the "Wisdom Literature" (*e.g.* Proverbs, and the Wisdom of Solomon), in the treatment of the stories of Esther and Daniel (the history of Susanna), and also in the twofold recensions Ezra and 1 Esdras. Historical or narrative Midrash is exemplified in the "canonical" books Daniel, Esther, Jonah and Ruth, and in the "apocryphal" stories of Daniel (viz. Susanna, where the point lies in the name Daniel "God is judge"), Esther, Judith, Tobit (and the Ahiqar cycle of stories), the story of Zerubbabel (1 Esd. iii. seq., the sequel of which belongs to the canonical Ezra), and the martyrdom of Eleazer (2 Macc. vi. seq., compare 4 Macc.). This is not the place to notice the course of Jewish literary activity in Palestine or Alexandria, whether along the more rigid lines of Pharisaic legalism (the development of the canonical "priestly" law), or the popular and less scholastic phases, which recall the earlier apocalyptical tendencies of the Old Testament and were cultivated alike by early Jewish and Christian writers. But after the fall of Jerusalem, partly through the need for systematizing the traditional post-biblical law, and partly through disputes with the Christians, orthodox Rabbinism received the stamp which has since characterized it. The traditional or oral law was codified in the Mishna (see TALMUD, § 1 seq.), the Canon was

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[1] *E.g.* Judg. i. (see G. F. Moore, *Ency. Bib.* "Historical Lit.," col. 2085, middle), 2 Sam. ix.-xx., &c.

fixed, and the fluctuations in the MSS. of the Old Testament (which, like the numerous variations in the Septuagint, complicated exact exegesis) gave way to what was virtually a single text. Moreover, the important body of apocalyptical and pseudepigraphical literature, with all its links between Christianity and Judaism, fell into disfavour on both sides. This literature is especially valuable because it illustrates contemporary Halaka and Haggada, and it illuminates the circle of thought with which Jesus and his followers were familiar; it thus fills the gap between the Old Testament and the authoritative Rabbinical Midrashim which, though often in a form several centuries later, not rarely preserve older material.[1]

A few miscellaneous examples of related Midrashic details may be cited:—

i. The book of Jubilees (a haggadic and halakic Midrash on Genesis, about 2nd century B.C.), contains the story of the war between Amorite Kings and Jacob (ch. xxxiv.). This is known to the probably contemporary Testament of Judah and to much later Midrashim (*Mid. Wayyisā'ū*, *Yalqūt Shimeonī*, also the apocryphal "book of Jashar"), and is evidently connected with the cryptic allusion to the capture of Shechem in Gen. xlviii. 22 (R.V. marg.). Unless we suppose that the latter was suddenly expanded into the stories which thenceforth persisted, it may be inferred that an old extra-canonical tradition (for which a case can be made) continued to survive the compilation of Genesis (*q.v.*) and ultimately assumed the various exaggerated forms now extant. Naturally the probability of such a tradition—the merest hint of which happens to be preserved in Gen. *loc. cit.*—does not prejudice the problem of its origin or accuracy; in Jub. the story is useless for Jacob's history, and is probably influenced by a recollection of more recent events in the Maccabaean age.

ii. A curious account of war between Egypt and Canaan after Joseph's death recurs in *Jub.* xli., *Test. of Simeon*, viii., and *Benjamin* vii., and is connected with details (burial of Jacob's sons at Hebron) recorded by Josephus (*Ant.* ii. 8). Josephus in turn has another story wherein Moses leads the Egyptians against Ethiopia (*Ant.* ii. 10, for parallels see Moore, *Ency. Bib.* col. 2089 seq.), and this is found in the late chronicles of Jerahmeel and the Book of Jashar (cf. also *Mid. Dibrē ha-yāmīm shel-Mōsheh*; see *Jew. Ency.* viii. 573 seq.). The former may be linked with Gen. l. 9 (where the concourse of chariots and horsemen would invite speculation), and the latter with the Cushite wife of Moses; but although one may grant that the canonical sources do not by any means preserve all the older current traditions, the contents of the latter cannot be recovered from the later persisting Midrashim.[2]

iii. The allusion in Jude *v.* 9 to the contention of the archangel Michael for the body of Moses belongs to a group of traditions which have been collected by R. H. Charles (*Assumption of Moses*, pp. 105 seq.), and it appears that the incident was familiar to Clement of Alexandria, Origen and other early writers. Moreover, Jude *v.* 16 agrees very closely with the Latin version of the Testament of Moses, which has other parallels in Matt. xxiv. 29; Acts vii. 36, 38 seq. (ibid. pp. lxii. seq.). Here may be added Jannes and Jambres, who withstood Moses (2 Tim. iii. 8); these or related names were known to the elder Pliny (xxx. i. 11), Apuleius (first half of 2nd century), Origen (who refers to a book of Jannes and Mambres), and various earlier and later Jewish sources; see I. Abrahams, *Ency. Bib.* col. 2327 seq.; H. St J. Thackeray, *Relation of St Paul to contemporary Jewish thought* (London, 1900), pp. 215 sqq.

iv. Jewish traditions of Abraham in Ur of the Chaldees recur in the Targums, Midrashic works, and earlier in the book of Jubilees (ch. xii., ed. Charles, p. 91; cf. also Judith v. 6 seq.). The legends of his escape from a fiery furnace may have a philological basis (*ūr* interpreted as "fire"), but the allusion to the redemption of Abraham in Isa. xxix 22 seems to indicate that older tradition was fuller than the present records in Genesis, and supplies another example of the link connecting the Old Testament with Rabbinical thought.

v. Not to multiply examples further, it may suffice to refer to (*a*) the apparent belief that the serpent tempted Eve to unchastity (2 Cor. xi. 2 seq., see Thackeray pp. 50 seq.); (*b*) the descent of the angels upon earth (Gen. vi. 1 seq.; Jude 6, 14 seq., see Charles, *Jub.* p. 33 seq., Clermont-Ganneau, *Quart. Statements of the Pal. Explor. Fund*, 1903, pp. 233 seq. and the Midr. *Abkir.* see *Jew, Ency.* viii. 572); (*c*) the relationship between the Midrashic developments of the story of Esther in Josephus, the Greek and Old Latin Versions, the Targums and later Jewish sources (see L. B. Paton, Comm. on *Esther*, pp. 20, 100 and *passim*); and finally (*d*) the numerous minor miscellaneous parallels noticed in recent annotated editions of the pseudepigraphical literature (especially those of R. H. Charles). (See further Talmud, § 5.)

4. *Midrashic Exposition.*—The Talmud poetically describes Midrash as a hammer which wakes to shining light the sparks which slumber in the rock; and the simile is a happy one when one considers the exegetical implements, the workmen and their workmanship. For the expository or interpretative Midrash was bound up with rules and methods which often appear crude and arbitrary, they are nevertheless those of the age and they helped to build up lasting monuments.[3] It was believed that the Written Word had an infinite fulness; according to the *Midr. Bemidbar Rabbah* every word of the Law had seventy different aspects, and Philo of Alexandria held that there are no superfluous words in Scripture. Consequently an exaggerated emphasis is often laid upon single words; as, for example, in the school of Rabbi 'Aqība, where even individual letters were forced to reveal their meaning. Thus, since the Hebrew *eth*, which marks the accusative, is also the preposition "with," Deut. x. 20 ("thou shalt fear [*eth*-] Yahweh thy God") was interpreted to include the veneration of the doctors of the law *along with* Yahweh.[4] Many examples of literal interpretation can of course be found, but arbitrary cases of the kind just noticed are due either to an obviously far-fetched interpretation or to the endeavour to find some authoritative support for teaching which it was desired to inculcate. Thus faulty proof rather than faulty inference is illustrated when the word "in-number" (Ex. xii. 4) was used to confirm the Halaka that the man who killed the Passover Lamb must know how many people were about to share it (*Jew. Ency.* viii. 570). Often the biblical text cannot be said to supply more than a hint or a suggestion, and the particular application in Halaka or Haggada must be taken on its merits, and the teaching does not necessarily fall because the exegesis is illegitimate. To take another specimen: the *Mekilta* on Ex. xx. 25 infers from the unusual form of the word "it," that the prohibition of iron applies only to *it, i.e.* the altar, and not to stones used in building the temple. This Halaka is followed by a haggadic explanation of the prohibition: "iron abridges life while the altar prolongs it; iron causes destruction and misery, while the altar produces reconciliation between God and man; and therefore the use of iron cannot be allowed in making the altar."[5] Such were the sparks that could be hammered out of the rock, and it is instructive to observe similar exegetical methods in the New Testament. Emphasis upon a single word is illustrated by Gal. iii. 16, where the argument rests upon the word "seed" (and not the plural "seeds") in the proof-text, and the same word in Rabbinical writings is used to support other arguments.[6] By identical kinds of exegesis Lev. xix. 14 (not to put a stumbling block before the blind) is the ground for cautioning a father against striking an adult child, and Deut. xxv. 4 (the law of the muzzled ox) is used to show that God's labourer is worthy of his hire.[7] Again, since through Eve sin entered into the world, woman must be subordinate to man (1 Tim. ii. 11–14), or, she who has thus extinguished "the light of the world" should atone by lighting the festal candles on the sabbath (Talm. *Shabb.* 5*b*). By the allegorical method Isa. lxi. is interpreted as applying to Jesus (Luke iv. 16–22), and frequently passages which originally had another application have a Messianic reference in

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[1] On the history of his intermediate stage see E. Schürer, *Hist. of Jew. People* (Edinburgh, 1886), Germ. *Gesch. Jüd. Volkes*; M. Friedländer, *Relig. Bewegungen innerhalb des Judentums im Zeitalter Jesu* (Berlin, 1905); W. Fairweather, *Background of the Gospels* (Edinburgh 1908). See also Apocalyptic Lit. and Apocryphal Lit.

[2] Note also the allusion to the wisdom of Moses in Acts vii. 22, upon which contemporary writings are pretty well informed.

[3] For the Rabbinical "rules" and examples of their working see F. Weber, *Jüd. Theologie* (Leipzig, 1897), pp. 109–125; C. A. Briggs *Study of Holy Scripture* (Edinburgh, 1899), ch. xviii.; *Jew. Ency.* xii. 30–33; S. Schechter, *Hastings's Dict. Bible*, v. 59, 63; and H. L. Strack, *Einleitung in den Talmud* (Leipzig, 1908), pp. 119–131.

[4] So Aquila, the disciple of 'Aqība, translates the accusative particle by σὺν; see W. R. Smith, *Old Test. in the Jew. Church*, p. 63.

[5] Oesterley and Box, *Religion and Worship of the Synagogue* (London, 1907), p. 80; pp. 44–97 deal with Midrashic and other Jewish literature.

[6] Mish. *Sanhed.* iv. 5, see A. Geiger, *Zeit. f. morgenländ. Gesellschaft*, 1858, pp. 307 sqq., S. R. Driver, *Expositor*, ix. (1889), p. 18 seq.

[7] The Talmud *Mō'ed Qaṭan*, 7*a*, and New Testament (1 Cor. ix. 9, 1 Tim. v. 18) respectively.

Christian and Rabbinical teaching. Similarly the application of Hos. ii. 23, not to the scattered tribes of Israel, but to the Gentiles, is common to the Mishna and to Romans ix. 25 seq. (Sanday and Headlam, *Comment. ad loc.*) The Apostle Paul, once a disciple of the famous Rabbi Gamaliel, uses in 1 Cor. x. 4 ("the spiritual rock that followed them") a familiar Jewish Haggada which, however, he reinterprets, even as, when he identifies the "rock" with Christ, he diverges from the Alexandrian Philo who had identified it with Wisdom or the Word of God. Moreover, not only are passages thus taken out of their context, but they are combined, especially when they contain the same words or phrases, or appear to have the same or similar thoughts or aims. The Talmud, with a reference to Prov. xxxi. 14 ("she bringeth her food from afar"), says "the words of the Torah are poor (or deficient) in one place but rich in another." Hence in the *Mid. Siphrē* on Numbers xv. 39, "ye shall not seek after . . . your own eyes" is explained to refer to adultery, after the words of Samson "she is pleasing in my eyes" (Judg. xiv. 3); and on Deut. vi. 5 it charges man to love the Lord "with all thy soul . . . even if he should take away thy soul," the teaching being based upon Ps. xliv. 22.[1] Similarly, in the New Testament, after the same method, Mal. iii. 1 and Is. xl. 3 (linked by the phrase "to prepare the way") are combined in Mark i. 2 seq.; Abraham's faith (Gen. xv. 6) and temptation (xxii. 1) are associated in James ii. 21-23, as also in contemporary Jewish thought; and by other combined quotations Paul enunciates the universality of sin (Rom. iii. 10 sqq.) and the doctrine that Christians are God's temple (2 Cor. vi. 16 sqq). Proceeding upon such lines as these, the Jews wove together their Midrashic homilies or sermons where, though we may find much that seems commonplace, there are illuminating parables and proverbs, metaphors and similes, the whole affording admirable examples of the contemporary thought and culture, both of the writers and—what is often overlooked—the level of their hearers or readers. Like many less ancient discourses, the Midrashim are apt to suffer when read in cold print, and they are sometimes judged from a standpoint which would be prejudicial to the Old Testament itself. But they are to be judged as *Oriental* literature and if they contain jarring extravagances and puerilities, one may recall that even in modern Palestine it was found that the natives understood *Robinson Crusoe* as a religious book more readily than the *Pilgrim's Progress* (J. Robertson, *Early Rel. of Israel*, 1892, p. 66). In making allowance for the defects (without which they would probably not have appealed to the age) it must be remembered that some of the Rabbis themselves recognized that the Midrashic Haggada was not always estimable.

An interesting example of combined quotation is illustrated in Matt. xii. 4-8, where the teaching of Jesus on the law of the Sabbath rests upon 1 Sam. xxi. 1-6, Num. xxviii. 9 seq. and Hos. vi. 6. Apropos of this law the Rabbinical arguments are worth noticing. Apparently the severe rules laid down in Jubilees l. 8-12 (see R. H. Charles, *ad loc.*) were exceptional. It was allowed that the Sabbath need not be too rigorously kept, and this was justified by Exod. xxxi. 13, where the singular use of the restrictive particle *ak* (EV "verily") supported the teaching that other Sabbaths need not be observed. Also, from the words "holy unto you" (*v.* 14) it was taught that "the Sabbath is given to you to desecrate in case of need, but thou art not given to the Sabbath." Hence the Sabbath might be broken when life was in danger. Moreover, it was argued that a battle need not be stopped from religious considerations, *e.g.* the Sabbath. This was justified by Deut. xx. 20 "until it fall" (Talm. *Shabb.* 19*a*). Also, the Passover Lamb could be sacrificed on the Sabbath, and justification for this was found in Num. ix. 2 "in its season" (*Pesah.* 66*a*). See further on this subject, and on the evasions of the Sabbath law, S. Shechter, *Studies in Judaism*, pp. 297 sqq.; ibid. in C. G. Montefiore, *Hibbert Lectures* (for 1892), Appendix; ibid. *Hastings' Dict. Bib.* v. 63, and also S. R. Driver, *Hastings' Dict.* iv. 320 seq. With the above interpretations, cf. A. H. McNeile on Matt. xii. 5, John vii. 23: "the à priori element in them perhaps suggests that [these verses] were due to later reflexion on the part of Christians who had realized the inadequacy of the law" (Swete's *Camb. Bibl. Essays*, 1909, p. 226). For other examples illustrating Rabbinical methods of exegesis in the New Testament, see McNeile, pp. 221, sqq. ("Our Lord's use of the Old Testament"); Briggs, *op. cit.* pp. 436, sqq., and Thackeray, *op. cit.* (ch. vii. "use of the Old Testament," ch. viii. "St Paul the Haggadist"). The latter observes (p. 203): "the arguments by which Paul tried to convince his opponents of the true meaning of the Old Testament as pointing forward to Christ, are those which they would themselves have employed for another purpose; and to some extent we need not doubt that they were selected for that very reason. They were the arguments which were best calculated to appeal to them." Quite in accordance with Rabbinical custom is the system of question and answer (Rom. x. 5, seq., 16 seq.), and the argument in the sequence: statement, objection and reply, appears already in the book of Malachi (*q.v.*).

5. *The Jewish Midrashim.*—The earlier stages in the growth of the extant Rabbinical Midrashim cannot be traced with any certainty. Although there are several allusions to early written works, other references manifest an objection to the writing down of Haggada and Halaka. Perhaps it was felt that to preserve uniformity of teaching in the schools it was undesirable to popularize the extant collections, or perhaps the references must be reconsidered in the light of those significant changes after the fall of Jerusalem which have been mentioned above (§ 3).[2] However this may be, the independent Hălākōth (where the oral decisions are interpreted or discussed on the basis of the Old Testament) were gradually collected and arranged according to their subject in the Mishnah and Tōsephtā (TALMUD, § 1), while in the halakic Midrashim (where the decisions are given in connection with the biblical passage from which they were derived) they follow the sequence of the text of the Old Testament. The Haggada was likewise collected according to the textual sequence of the Old Testament. But the sermons or discourses of the *homiletic* Midrashim are classified according to the reading of the Pentateuch in the Synagogue, either the three year cycle, or else according to the sections of the Pentateuch and Prophetical books assigned to special and ordinary Sabbaths and festival days. Hence the latter are sometimes styled Pesiqta ("section"). The homiletic Midrashim are characterized by (*a*) a proem, an introduction based upon some biblical text (not from the lesson itself), which led up to (*b*) the exposition of the lesson, the first verse of which is more fully discussed than the rest. They conclude (*c*) with Messianic or consolatory passages on the future glory of Israel. A feature of some Midrashim (*e.g.* nos. 4, 5*d*, *e*, and 7 below) is the halakic exordium which precedes the proems.[3]

Among the more important Midrashim are: i.—*Mĕkilta* (Aram. "measure," *i.e.* "rule") best known as the name of a now imperfect halakic Midrash on Exod. xii.–xxiii. 19 (also xxxi. 12-17 and xxxv. 1-3). It represents the school of R. (Rabbi) Ishmael, is a useful source for old Haggadah (especially on the narrative portions of Exodus), and is interesting for its variant readings of the Canonical Massoretic text.[4] Edited by Blasius Ugolinus, *Thes. Antiq. Sacr.* xiv. (Venice, 1744, with a poor Latin translation), more recently by J. H. Weiss (Vienna, 1865) and M. Friedmann (ibid. 1870), Germ. trans. by J. Winter and A. Wünsche Leipzig, 1909). See further J. Z. Lauterbach, *Jew. Ency.* viii. 444 seq.

ii. *Siphrā* (Aram. "the book") or *Tōrath Kōhănīm* ("the law of the priests"), a commentary on Leviticus, mainly halakic, the text being a source for various maxims. (On Lev. xix. 17 seq., neighbourly love and abstinence from vengeance constitute, according to R. Aqiba, the great principle of the Torah.) It is useful for the interpretation of the Mishnah treatises *Qŏdāshīm* and *Ṭĕhārōth*. Latin trans. in Ugolinus, vol. xiv.; recent editions by I. H. Weiss (Vienna, 1862), and with the commentary of Shimshon (Samson) of Siens (Warsaw, 1866); see *Jew. Ency.* xi. 330 sqq.

iii. *Siphrē* (Aram. "the books"), an old composite collection of Halaka on Numbers, after R. Ishmael's school; and on Deut. after that of R. Aqiqa, although the haggadic portions belong to the former. Latin in Ugol. xv.; recent edition, with good introduction by Friedmann (Vienna, 1864); see *Jew. Ency.* xi. 332 seq.

The above works, although of 5th century or later date in their present form, contain much older material, which was perhaps first redacted in the earlier part of the 2nd century, A.D. They are of

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[1] Cited by S. Schechter, *Hastings, Dict. Bible*, v. 64.

[2] See, on this point, *Jew. Ency.* viii. 549 seq., 552, 576; Schechter, *op. cit.* p. 62; Strack, *op. cit.* pp. 10 sqq.

[3] See more fully *Jew. Ency.* viii. 553. Cf. for the structure, the hopeful concluding notes in the prophecies (*e.g.* Amos) and the discourse after the reading of the lesson from the prophets in Luke iv. 17 sqq., Acts xiii. 15 sqq.

[4] See I. Abrahams in Swete's *Cambridge Bibl. Essays* (1909), pp. 174 seq.

Palestinian origin, although the main redaction was made in Babylonia.[1]

iv. *Tanḥūmā*, one of the oldest on the lessons of the Pentateuch, with many proems ascribed to R. Tanḥūmā ben ("son of") Abbā, one of the most famous haggadists of Palestine (4th century), who systematized and fixed the haggadic literature. This collection of 158–161 homilies is also known as *T. Yelammedēnū*, from the opening words, *Yel. Rabbēnū*, "our Rabbi teaches us"; on the critical questions connected with the titles and the present redaction (probably 5th century), see *Jew. Ency.* viii. 560 seq., xii. 44 sqq. Recent edition by Buber (Wilna, 1885).

v. *Midrash Rabbah* (or *Rabboth*), a large collection of very diverse origin and date, probably not completed before the 13th century. It covers the Pentateuch (1st ed., Constantinople, 1512) and the "Five Rolls" (Pesaro, 1519; the whole printed first at Venice, 1545); Germ. trans. by A. Wünsche, *Bibliotheca rabbinica* (Leipzig, 1880–1885). The several portions are named after the ordinary Jewish titles of the Old Testament books with the addition of *Rabbah* "great." These are (*a*) *Bĕrēshith* ("in the beginning," Gen. i. 1) *Rabbah*, on Genesis, the oldest and most valuable of haggadic Midrashim. Traditionally ascribed to R. Hōshaiah (3rd. century), but in the main a redaction of 6th century. Ed. J. Theodor; see *Jew. Ency.* iii. 62 seq.; viii. 557 seq. (*b*) *Shēmōth* ("names" Exod. i. 1) *R.*, a composite and incomplete work of 11th and 12th century date, but valuable nevertheless for its Tanḥūmā homilies. Exod. i.–xi. is a commentary on the text in continuation of (*a*).[2] See *Jew. Ency.* viii. 562 (*c.*) *Wayyiqrā* ("and he called") *R.*, on Leviticus, perhaps 7th century, based upon sources in 2 and 5*a* above. It is characterized by its numerous proverbs (*e.g.* on xix. 6: "do not care for the good pup of a bad dog, much less for the bad pup of a bad dog"). See *Jew. Ency.* viii. 560, xii. 478 seq. (*d*) *Bemidbar* ("in the desert of . . . ") *R.*, 33 homilies on Numbers, mainly derived from 4 above (though in an earlier text), with a later haggadic exposition, perhaps of 12th century, on Num. i.–vii. See *Jew. Ency.* ii. 669 sqq., viii. 562. (*e*) *Dĕbārīm* ("words") *R.*, independent homilies on Deuteronomy, of about A.D. 900, but with a good collection of Tanḥūmās and excerpts from the old sources. See *Jew. Ency.* iv. 487 seq. (*f*) *Shir* ("song") *R.*, or (after the opening words) *Aggadath Ḥazith*, a late compilation of haggadah on Canticles, illustrating the allegorical interpretation of the book in reference to the relation between God and Israel (so already in the exegesis of R. Aqiba, cf. also 2 Esd. v. 24, 26, vii. 26). For this and other Mid. on this popular book, see *Jew. Ency.* viii. 564 seq., xi. 291 seq. (*g*) *Mid. Ruth* or *Ruth Rabbah*, a compilation including an exposition of 1 Chron. iv. 21–23, xi. 13–15 and interesting Messianic references. For this and similar Mid. on Ruth, see *Jew. Ency.* viii. 565, x. 577 seq. (*h*) *Ékāh* ("how") *Rabbathi*, a compilation of about the 7th century on Lamentations, from sources cited also in the Palestinian Talmud. Thirty-six proems precede the commentary. See *Jew. Ency.* v. 85 seq. (*i*) *Mid. Koheleth* or *Koh. Rabbah*, on Ecclesiastes; see *Jew. Ency.* vii. 529 sqq.; viii. 565. (*j*) *Mid. Megillath Esther*, dating, to judge from its indebtedness to Josippon (the pseudo-Josephus), after 10th century. On this and other similar works dealing with this ever-popular book, see *Jew. Ency.* v. 241, viii. 566, and Paton's Comment. on Esther, p. 104.

vi. *Pesiqtā* ("section") or *P. de-Rab Kāhana*, contains 33 or 34 homilies (on the principal festivals), the first of which opens with a sentence of R. Abba bar Kahana, who was confused with a predecessor, Rab Kahana. Although it goes back to early Haggada it has received later additions (as is shown by the technique of the proems). Edited by S. Buber (Lyck, 1868), Germ. trans. by A. Wünsche (Leipzig, 1885); see *Jew. Ency.* viii. 559 seq. Not to be confused with this is:—

vii. *Pesiqtā Rabbāthi.*—A very similar but larger collection of 51 homilies, of which 28 have a halakic exordium prefixed to the Tanḥūmā–proems, perhaps of 9th century. Edited by M. Friedmann (Vienna, 1880). Quite another and later work is the *Pēs. Zūtarta* or *Leqaḥ Tōb* of Tobiah b. Eliezer of Mainz (trans. Ugolinus, vol. xv. seq.; ed. Buber, 1880); see *Jew. Ency.* viii. 561 sqq.

viii. In addition to the more prominent Midrashim mentioned above there are numerous self-contained works of greater or less interest. Some are connected with Old Testament books; *e.g. Aggadath Bereshith*, 83 homilies on Genesis, each in three parts connected with a section from the lectionary of the Pentateuch, and one from the Prophets, and a Psalm (ed. Buber, Cracow, 1903; see *Jew. Ency.* viii. 563); the *Mid. Tehillīm* on the Psalms (Germ. trans. A. Wünsche, Trier, 1892–1893), &c. Others are historical, *e.g. Pirqe* or *Baraitha de-Rabbi Eliezer*, a fanciful narrative of events selected from the Pentateuch, &c.; the eschatology is interesting. Though associated by name with a well-known 1st century Rabbi, it is hardly earlier than the 8th (Latin trans. by Vorstius, Leiden, 1644; see *Jew. Ency.* viii. 567). Further, the *Megillath Ta'anith* ("roll of fasts"), an old source with a collection of miscellaneous legends, &c.; *Megillath Antiokhos*, on the martyrdom under Hadrian; *Seder 'Olām Rabbah*, on biblical history from Adam to the rebellion of Bar Kōkba (Barcocheba); the "Book of Jashar"; the Chronicle of Jeraḥmeel," &c. Liturgical Midrash is illustrated by the *Haggada shel Pesaḥ*, part of the ritual recited at the domestic service of the first two Passover evenings. In *Mid. Ta'ame Ḥăsērōth we-Yĕthērōth*, Hebrew words written "defectively" or "fully," and other Massoretic details, are haggadically treated. Finally Kabbalah (*q.v.*) is exemplified in *Ōthiyyōth de R. Aqība* on the alphabet, and *M. Tadshe* (or *Baraitha de-R. Phineḥas b. Yā'īr*), on groups of numbers, &c.; of some interest for its relation to the book of Jubilees.

ix. Of collections of Midrash the chief are (*a*) the *Yalqūṭ Shimeoni*, which arranges the material according to the text of the Old Testament (extending over the whole of it), preserves much from sources that have since disappeared, and is valuable for the criticism of the text of the Midrashim (recent ed. Wilna, 1898) translation of the Yalqut on Zechariah by E. G. King (Cambridge, 1882; see further *Jew. Ency.* xii. 585 seq.). (*b*) *Yal. ha-Makiri*, perhaps later, covers only certain books, is useful for older sources and their criticism; portions have been edited by Spira (1894, on Isaiah); Buber (1899, on Psalms); Grünhut (1902, on Proverbs). (*c*) *Midrash ha-Gādōl* ("the great"), an extensive thesaurus, but later (quoting from Ibn Ezra, Maimonides, &c.); the arrangement is not so careful as in (*a*) and (*b*). See further *Jew. Ency.* viii. 568 seq.

Of modern collections special mention must be made of A. Jellinek's *Bet ha-Midrasch* (Leipzig, 1853) and A. Wünsche's valuable translations; to those already mentioned must be added his *Aus Israels Lehrhallen* (excerpts of a more miscellaneous character (Leipzig, 1907 sqq.).

Besides dictionary articles on this subject (S. Schiller-Szinessy, *Ency. Brit.*, 9th ed.; H. L. Strack, *Real-Ency. f. Protest. Theol. u. Kirche*; and especially J. Theodor and others in the *Jew. Ency*), see D. Hoffmann, *Zur Einleitung in die halachischen Midraschim* (Berlin, 1888), and the great work by Zunz, *Die gottesdienstlichen Vorträge der Juden*, 2nd ed. by N. Brüll (Frankfort on Main, 1892). These, as also the citations in the course of this article, give fuller information. (See further TALMUD.) (S. A. C.)

MIDSHIPMAN, the title in the British and American navies of the "young gentlemen" who are serving in order to qualify themselves to hold a commission as lieutenant. The English midshipman was originally a petty officer, one of the crew under the immediate orders of the boatswain. After the restoration of King Charles II., in 1660, the king and his brother, James Duke of York, lord high admiral, decided to train officers for the sea service. They therefore decided to send a volunteer to each ship of a squadron in commission, with a "letter of service," which instructed the admirals and captains that the bearer was to be shown "such kindness as you shall judge fit for a gentleman, both in accommodating him in your ship and in furthering his improvement." He was to receive the pay of a midshipman, and one midshipman less was to be borne in the ship. Until 1729 the young gentlemen who entered the British navy were known as "king's letter boys." In that year the system was altered. A school, known as the naval academy, was founded at Portsmouth in which forty lads were to be trained for the sea service. In 1773 the school, having proved unsatisfactory, was reorganized and the number of boys to be trained there increased from forty to seventy. In 1806 it was again reorganized, under the name of the naval college, and was finally suppressed in 1837, when the practice of training the boys under instructors in the ships was introduced. A special school was re-established in 1857, and was finally placed in the "Britannia." In the meantime the number of midshipmen had increased far beyond one for a ship. A line-of-battle ship in the 18th century carried as many as twenty-four, and the title had come to be confined entirely to those who were being trained as officers. The immense majority of officers of the British navy never passed through the academy or the college. They entered the ships directly as "captains' servants" or "volunteers," and were rated midshipman, if there was a vacancy, at the age of fifteen. As they were expected to learn navigation, they were instructed by the master, and at the age of seventeen were supposed to be qualified to be masters' mates. To-day the midshipman is the officer of the British and American navies who has passed through the preliminary schools and has been appointed to a ship. The French equivalent is *aspirant*, and other European navies use that name, or *cadet*.

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[1] They contain (as I. Abrahams has pointed out to the present writer) a good deal of haggada, but far more halakic material than those which follow. The latter (nos. 4 sqq.) also contain halaka, but the chief contents are haggadic and homiletical.

[2] I. Abrahams points out to the writer that the rest is more summary. This difference is accounted for by the fact that Exod. xii. onwards and the rest of the Pentateuch have independent Midrashim: the Law proper was held by the Rabbis to begin at Exod. xii.

MIDSOMER NORTON, an urban district in the northern parliamentary division of Somersetshire, England, 12½ m. S.S.W. of Bath, on the Somerset & Dorset and the Great Western railways. Pop. (1901), 5809. The town is pleasantly situated in a hilly district, between two branches of the small river Somer. The church of St John the Baptist, principally Perpendicular, has in its tower three bells presented by Charles II. Both this town and the adjacent urban district of Radstock (pop. 3355) have a considerable trade in coal, which is mined in the vicinity. The coalfield extends northwestward towards Bristol, and is of great importance to the manufactures of that city.

MIDWIFE (Mid. Eng. *midwif*, *mydwyf* or *medewife*, from preposition *mid*, with, and *wife*, *i.e.* woman, in the sense of one who is *with* the mother, or from adjective *mid*, one who is the means of delivering the mother, a woman who assists other women in childbirth). As a class, midwives were recognized in Egypt in the time of the Jewish captivity. It was the universal practice in Europe until the middle of the 16th century, as it is to-day in the East, that women should be attended in confinement only by those of their own sex. From that period more attention was given to the practice of midwifery by the medical profession (see Obstetrics), while in continental Europe, towards the close of the 17th century, special schools were instituted for the proper training of midwives. But it was not until well on in the 19th century that any supervision or regulation was imposed on those who acted as midwives. Now in practically every European country midwives are under strict state control, they are required to undergo a course of thorough training, and their practice is carefully regulated by legislation.

In France midwives (*sages femmes*) are divided into a first and a second class. Those qualifying for both classes go through a two years' course of training and must qualify both in the theory and practice of midwifery, as well as in anatomy, physiology and pathology. A midwife of the first class has a superior status and can practise in any part of France, while those of the second class are restricted in their practice to the department for which the certificate was issued. Their qualifications allow them also to vaccinate and to prescribe certain antiseptic preparations. They are not allowed to use instruments and must call in a medical man in difficult cases. All cases must be reported to a central officer. In Spain midwives are allowed to practise on the result of an examination after studies covering at least four half-years. The diploma is issued by the director-general of public instruction. In Germany midwives are appointed, recognized and authorized by the state. They can conduct confinements independently and without the aid of a medical man. They must be provided with a certificate from the police authorities, and must reside in special districts assigned to them by the authorities. In Austria midwives before they are allowed to practise must pass a strict examination, after having followed a six months' course at one of the state schools of midwifery. They are subject to elaborate "instructions for midwives" issued from time to time by the ministry of the interior. In Italy a midwife must pass an examination and obtain a diploma from a recognized authority; but in order to obviate the difficulty which the poorer classes in the smaller communes would find in obtaining properly-authorized midwives, a certificate of permission to practise may be given to a certain number who have practised without the sanction of the law satisfactorily during a term of five years. These certificates are distributed by the prefect. In Russia matters pertaining to the appointment, transfer, dismissal and pay of midwives are under the charge of the medical department of the ministry of the interior. In each town of a province or region there is stationed one senior midwife and a number of junior midwives in proportion to the number of districts in the province. The examination of midwives and the issue of certificates of competency is carried out by the Medico-Chirurgical Academy and certain of the universities. A duly-licensed midwife, on presentation of her licence, is at once excluded from the tax-paying class to which she may have belonged. The general code of Russian laws lays down extensive rules for the carrying out of the duties of midwives. In Norway all midwives are licensed after examination and are under the control and inspection of the board of health. Provision is made for infirm and aged midwives. They are usually paid by the parish, but also receive fees according to the means of the person attended. In Sweden a certificate of competency and of having passed an examination does not give a midwife a right to practise until a note has been made on the certificate that the oath of office has been duly taken. All midwives are under the control of the board of health. When a midwife takes up her residence in a parish, or moves from one place to another, she must announce the fact within a month to the nearest appointed doctor and exhibit her certificate. In towns a midwife must put up a notice board outside her residence; she must not absent herself from home without leaving word as to where she may be found and at what hour she will probably return. In the country a midwife may be paid out of the poor rate. In Denmark, also, midwives are recognized by the state, and the practise of midwifery is almost entirely in the hands of women. In Holland a certain number of candidates are given free training by the state in return for their practising midwifery in scattered country districts at a fixed salary. Many of the states of the United States have also passed laws for the registration of midwives.

In England alone there was no regulation of any kind so late as 1902. Any person, however ignorant and untrained, could describe herself as a midwife and practise for gain. Several societies made continuous efforts towards the close of the 19th century to obtain legislation. A select committee on midwives' registration reported in 1892 that the evidence they had taken showed that there was at the time "serious and unnecessary loss of life and health and permanent injury to both mother and child in the treatment of childbirth, and that some legislative provision for improvement and regulation was desirable." A similar committee reported to the same effect in 1893. Eventually a bill was drafted with the object of securing the examination and registration of midwives, but, although introduced several times into the House of Commons, it was not successful until 1902. The Midwives Act 1902 forbids any woman after the 1st of April 1905 to call herself "midwife" without a certificate, or to act as a midwife for gain without a certificate after the 1st of April 1910. Existing midwives (those who held certificates in midwifery from certain recognized institutions, or produced satisfactory evidence at the passing of the act that they had been for at least one year in bona fide practice as midwives, and bore good characters) were allowed to claim certificates within two years from the 1st of April 1903. The act created a central midwives' board, whose duties are, *inter alia*, to regulate the issue of certificates and the conditions of admission to the roll of midwives; to regulate the course of training and conduct of examinations; to regulate, supervise and restrict within due limits the practice of midwives; to publish annually a roll of duly certified midwives; to remove from the roll the name of any midwife who disobeys the rules and regulations laid down from time to time; to issue and cancel certificates, &c. There is an appeal to the High Court of Justice against removal of a name, but the appeal must be made within three months. Local authorities are required to exercise supervision over the midwives within their area; they must investigate charges of malpractice, negligence or misconduct; exercise the power of suspension and report convictions. They must supply the central board with the names and addresses of those practising within their area, and notify any death. The local authority must appoint a committee to carry out its powers or duties under the act, and may, if it think fit, delegate its powers to a lesser local authority, such as a district council. The act provides for penalties for obtaining a certificate by false representation or for wilful falsification of the roll. The act does not apply to Ireland or Scotland. (T. A. I.)

MIERES, a town of northern Spain, in the province of Oviedo, 12 m. by rail S.E. of Oviedo, on the river Caudal, a tributary of the Nalon. Pop. (1900), 18,083. Mieres is the chief town of a mountainous, fertile and well-wooded region in which coal, iron, and copper are extensively mined and sulphur and cinnabar are obtained in smaller quantities. The town contains large iron foundries and chemical works, and has an active trade in fruit, cider, timber and live stock.

MIEREVELT (Miereveld, or Mireveldt), **MICHIEL JANSZ VAN** (1567–1641), Dutch painter, was born at Delft, the son of a goldsmith, who apprenticed him to the copperplate engraver J. Wierix. He subsequently became a pupil of Willem Willemz and Augusteyn of Delft, until Anthonie van Montfoort (Blocklandt), who had seen and admired two of Mierevelt's early engravings, "Christ and the Samaritan" and "Judith and Holofernes," invited him to enter his school at Utrecht. Devoting himself first to still life, he eventually took up portraiture, in which he achieved such success that the many commissions entrusted to him necessitated the employment of numerous assistants, by whom hundreds of portraits were turned out in factory fashion. The works that can with certainty be ascribed to his own brush are remarkable for their sincerity, severe drawing and harmonious colour, but comparatively few of the two thousand or more portraits that bear his name are wholly his own handiwork. He settled down in his native town, but went frequently to The Hague, where he entered the gild of St Luke in 1625. So great was his reputation that he was patronized by royalty in many countries and acquired great wealth. The king of Sweden and the count palatine of Neuburg presented him with golden chains, Archduke Albrecht gave him a pension, and Charles I. vainly endeavoured to induce him to visit the English court. Though Mierevelt is chiefly known as a portrait painter, he also executed some mythological pieces of minor importance. Many of his portraits have been reproduced in line by the leading Dutch engravers of his time. He died at Delft on the 27th of June 1641.

The Ryks Museum in Amsterdam has the richest collection of Mierevelt's works, chief of them being the portraits of William, Philip William, Maurice, and Frederick Henry of Orange, and of the count palatine Frederick V. At The Hague Museum are the portraits of four princes of the house of Orange, of Frederick V., king of Bohemia, and of Louise de Coligny as a widow. Other portraits by him are at nearly all the leading continental galleries, notably at Brunswick (3), Gotha (2), Schwerin (3), Munich (2), Paris (Louvre, 3), Dresden (4), Berlin (2), and Darmstadt (3). The town hall of Delft also has numerous examples of his work.

Many of his pupils and assistants rose to fame. The most gifted of them were Paulus Moreelse and Jan van Ravesteyn. His sons Pieter (1596–1623) and Jan (d. 1633), and his son-in-law Willem Jacobz Delff, probably painted many of the pictures which go under his name. His portrait was painted by Van Dyck and engraved by Delff.

MIERIS, the name of a family of artists who practised painting at Leiden for three generations in the 17th and 18th centuries.

1. Frans van Mieris, the elder (? 1635–1681), son of Jan van Mieris, a goldsmith and diamond setter, was born, according to Houbraken, at Leiden on the 16th of April 1635, and died there on the 12th of March 1681. His father wished to train him to his own business, but Frans preferred drawing to chasing, and took service with Abraham Torenvliet, a glazier who kept a school of design. In his father's shop he became familiar with the ways and dress of people of distinction. His eye was fascinated in turn by the sheen of jewelry and stained glass; and, though he soon gave up the teaching of Torenvliet for that of Gerard Douw and Abraham van den Tempel, he acquired a manner which had more of the finish of the exquisites of the Dutch school than of the breadth of the disciples of Rembrandt. It should be borne in mind that he seldom chose panels of which the size exceeded 12 to 15 in., and whenever his name is attached to a picture above that size we may surely assign it to his son Willem or to some other imitator. Unlike Gerard Douw when he first left Rembrandt, or Jan Steen when he started on an independent career, Mieris never ventured to design figures as large as life. Characteristic of his art in its minute proportions is a shiny brightness and metallic polish. The subjects which he treated best are those in which he illustrated the habits or actions of the wealthier classes; but he sometimes succeeded in homely incidents and in portrait, and not unfrequently he ventured on allegory. He repeatedly painted the satin skirt which Ter Borch brought into fashion, and he often rivalled Ter Borch in the faithful rendering of rich and highly-coloured woven tissues. But he remained below Ter Borch and Metsu, because he had not their delicate perception of harmony or their charming mellowness of touch and tint, and he fell behind Gerard Douw, because he was hard and had not his feeling for effect by concentrated light and shade. In the form of his composition, which sometimes represents the framework of a window enlivened with greenery, and adorned with bas-reliefs within which figures are seen to the waist, his model is certainly Gerard Douw.

It is a question whether Houbraken has truly recorded this master's birthday. One of his best-known pieces, a party of ladies and gentlemen at an oyster luncheon, in the Hermitage at St Petersburg, bears the date of 1650. Celebrated alike for composition and finish, it would prove that Mieris had reached his prime at the age of fifteen. Another beautiful example, the "Doctor Feeling a Lady's Pulse" in the gallery of Vienna, is dated 1656; and Waagen, in one of his critical essays, justly observes that it is a remarkable production for a youth of twenty-one. In 1657 Mieris was married at Leiden in the presence of Jan Potheuck, a painter, and this is the earliest written record of his existence on which we can implicitly rely. Of the numerous panels by Mieris, twenty-nine at least are dated—the latest being an allegory, long in the Ruhl collection at Cologne, illustrating what he considered the kindred vices of drinking, smoking and dicing, in the year 1680.

Mieris had numerous and distinguished patrons. He received valuable commissions from Archduke Leopold, the elector-palatine, and Cosimo III., grand-duke of Tuscany. His practice was large and lucrative, but never engendered in him either carelessness or neglect. If there be a difference between the painter's earlier and later work, it is that the former was clearer and more delicate in flesh, whilst the latter was often darker and more livid in the shadows. When he died his clients naturally went over to his son Willem, who in turn bequeathed his painting-room to his son Frans. But neither Willem nor Frans the younger equalled Frans the elder.

2. Willem van Mieris (1662–1747), son of Frans. His works are extremely numerous, being partly imitations of the paternal subjects, or mythological episodes, which Frans habitually avoided. In no case did he come near the excellence of his sire.

3. Frans van Mieris, the younger (1689–1763), also lived on the traditions of his grandfather's studio.

The pictures of all the generations of the Mieris family were successfully imitated by A. D. Snaphaan, who lived at Leipzig and was patronized by the court of Anhalt-Dessau. To those who would study his deceptive form of art a visit to the collection of Wörlitz near Dessau may afford instruction.

MIFFLIN, THOMAS (1744–1800), American soldier and politician, was born in Philadelphia, Pennsylvania, on the 10th of January 1744, of Quaker parentage. He graduated at the college of Philadelphia (now the university of Pennsylvania) in 1760. As a member of the Pennsylvania house of representatives in 1772–1775, he was an ardent Whig, and in 1774 was a member of the first Continental Congress. After the outbreak of the War of Independence he devoted himself chiefly to the enlisting and drilling of troops, and was chosen major of a regiment. In June 1775 he entered the continental service as Washington's first aide-de-camp, and in August was chosen quartermaster-general. He became a brigadier-general in May 1776 and a major-general in February 1777. On the 5th of June 1776 he was succeeded as quartermaster-general by Stephen Moylan. Moylan, however, proved incompetent, and Mifflin resumed the office on the 1st of October. In the autumn of 1777 Mifflin was a leader in the obscure movement known as the Conway Cabal, the object of which was to replace Washington by General Horatio Gates. On the ground of ill health Mifflin tendered his resignation on the 8th of October, and on the 7th of November Congress accepted his resignation as quartermaster-general, but continued him in rank as major-general without pay. On the same day he was appointed a member of the new board of war, and on the following day was asked to continue as quartermaster-general until his successor should be appointed. On the 21st of November he urged before the old board of war and ordnance that Gates should be made president of the new board of war "from a conviction that his military skill would suggest reformations in the different departments of the army essential to good discipline, order and economy, and that his character and popularity in the army would facilitate the execution of such reformations when adopted by Congress." The attacks on Washington failed, and in March 1778 Mifflin was finally superseded as quartermaster-general by General Nathanael Greene. In October of the same year he was removed from the board of war. The sufferings of the troops at Valley Forge having been charged to his mismanagement as quartermaster-general, Congress, in June 1778, ordered an investigation; but before this inquiry had proceeded far, Congress granted him $1,000,000 to settle all claims against the office during his administration. In February 1779 he resigned his commission as major-general. During the war his eloquence was repeatedly of assistance to Congress in recruiting soldiers. He was a delegate in Congress in 1782–1784, and from November 1783 to November 1784 was president, in which office he received Washington's resignation of the command of the army and made a congratulatory address. In 1785–1788 he was speaker of the Pennsylvania general assembly (then consisting of only one house); he was a member of the Federal Constitutional Convention of 1787, and president of the state supreme executive council (or chief executive officer of the state) in 1788–1790. He was president of the Pennsylvania Constitutional Convention of 1789–1790; was the first governor of the state, from 1790 to 1799, after the adoption of the new state constitution; and during the Whisky Insurrection assumed personal command of the Pennsylvania militia. Towards the close of his last term as governor he was elected a member of the state assembly, but died during the first session, at Lancaster, on the 20th of January 1800.

See William Rawle, "Sketch of the Life of Thomas Mifflin," in *Memoirs of the Historical Society of Pennsylvania* (vol. 2, part 2, Philadelphia, 1830); and J. H. Merrill, *Memoranda relating to the Mifflin Family* (Philadelphia, 1890).

MIGNARD, PIERRE (1610–1695), called—to distinguish him from his brother Nicholas—Le Romain, French painter, was born at Troyes in 1610, and came of a family of artists. In 1630 he left the studio of Simon Vouet for Italy, where he spent twenty-two years, and made a reputation which brought him a summons to Paris. Successful with his portrait of the king, and in favour with the court, Mignard pitted himself against Le Brun, declined to enter the Academy of which he was the head, and made himself the centre of opposition to its authority. The history of this struggle is most important, because it was identical, as long as it lasted, with that between the old gilds of France and the new body which Colbert, for political reasons, was determined to support. Shut out, in spite of the deserved success of his decorations of the cupola of Val de Grace (1664), from any great share in those public works the control of which was the attribute of the new Academy, Mignard was chiefly active in portraiture. Turenne, Molière, Bossuet, Maintenon (Louvre), La Vallière, Sévigné, Montespan, Descartes (Castle Howard), all the beauties and celebrities of his day, sat to him. His readiness and skill, his happy instinct for grace of arrangement, atoned for want of originality and real power. With the death of Le Brun (1690) the situation changed; Mignard deserted his allies, and succeeded to all the posts held by his opponent. These late honours he did not long enjoy; in 1695 he died whilst about to commence work on the cupola of the Invalides. His best compositions have been engraved by Audran, Edelinck, Masson, Poilly and others.

MIGNE, JACQUES PAUL (1800–1875), French priest and publisher, was born at St Flour, Cantal, on the 25th of October 1800. He studied theology at Orleans, was ordained priest in 1824 and placed in charge of the parish of Puiseaux, in the diocese of Orleans. In 1833 he went to Paris, and started *L'Univers religieux*, which afterwards became Louis Veuillot's ultramontane organ. On severing his connexion with the paper three years later, he opened at Petit Montrouge, near Paris, the great publishing house which brought out in rapid succession numerous religious works at popular prices. The best known of these are: *Scripturae sacrae cursus completus*, and *Theologiae cursus* (each in 28 vols., 1840–1845); *Collection des auteurs sacrés* (100 vols., 1846–1848); *Encyclopédie théologique* (171 vols., 1844–1866); *Patrologiae cursus completus*, Latin series in 221 vols. (1844–1855; 2nd edition, 1878 seq.); Greek series, first published in Latin (85 vols., 1856–1861); with Greek text and Latin translation (165 vols., 1857–1866). Unfortunately these editions, brought out in great haste and often edited by superficial scholars, do not come up to the requirements of modern criticism. By far the most noteworthy is the Patrology, which was superintended by the learned Benedictine J. B. Pitra. Its vast scope leaves it still unique and valuable, where other editions of special works do not exist. The indices in 3 vols. are arranged so that one may easily find any reference in the patristic writings. In February 1868 a great fire destroyed the whole of Migne's printing premises, but he established a new house in Paris, which was purchased in 1876 by the publishers Garnier Frères, who still own all the works brought out by Migne. He died in Paris on the 25th of October 1875.

For a more complete account of Migne's life, see the article in the *Catholic Encyclopedia* (New York, 1906 seq.).

MIGNET, FRANÇOIS AUGUSTE ALEXIS (1796–1884), French historian, was born at Aix in Provence on the 8th of May 1796, and died at Paris on the 24th of March 1884. His father, a Vendean by birth, was an ordinary locksmith, who enthusiastically accepted the principles of the French Revolution and roused in his son the same love for liberal ideas. François had brilliant successes when studying at Avignon in the *lycée* where he was afterwards professor (1815); he returned to Aix to study law, and in 1818 was called to the bar, where his eloquence would have ensured his success had he not preferred the career of an historian. His abilities were shown in an *Éloge de Charles VII.*, which was crowned by the Académie de Nîmes in 1820, and a memoir on *Les Institutions de Saint Louis*, which in 1821 was crowned by the Académie des Inscriptions et Belles Lettres. He then went to Paris, where he was soon joined by his friend and compatriot, Adolphe Thiers, the future president of the French republic. He was introduced by J. A. Manuel, formerly a member of the Convention, to the Liberal paper, *Courrier français*, where he became a member of the staff which carried on a fierce pen-and-ink warfare against the Restoration. He acquired his knowledge of the men and intrigues of the Napoleonic epoch from Talleyrand. He wrote a *Histoire de la révolution française* (1824) in support of the Liberal cause. It was an enlarged sketch, prepared in four months, in which more stress was laid on fundamental theories than on the facts, which are more rigidly linked together than their historical sequence warrants. In 1830 he founded the *National* with Thiers and Armand Carrel, and signed the journalists' protest against the *Ordonnances de juillet*, but he refused to accept his share of the spoil after his party had won. He was satisfied with the modest position of director of the archives at the Foreign Office, where he stayed till the revolution of 1848, when he was dismissed, and retired permanently into private life. He had been elected a member of the Académie des Sciences Morales et Politiques, re-established in 1832, and in 1837 was made the permanent secretary; he was also elected a member of the Académie Française in 1836, and sought no further honours. He was well known in fashionable circles, where his witty conversation and his pleasant manners made him a favourite. The greater part of his time was, however, given to study and to his academic duties. Eulogies on his deceased fellow-members, the Academy reports on its work and on the prizes awarded by it, which it was part of Mignet's duty as secretary to draw up, were literary fragments thoroughly appreciated by connoisseurs. They were collected in Mignet's *Notices et portraits*. He worked slowly when in his study, and willingly lingered over research. With the exception of his description of the French Revolution, which was chiefly a political manifesto, all his early works refer to the middle ages—*De La féodalité, des institutions de Saint Louis et de l'influence de la législation de ce prince* (1822); *La Germanie au viii*^{e} *et au ix*^{e} *siècle, sa conversion au christianisme, et son introduction dans la société civilisée de l'Europe occidentale* (1834); *Essai sur la formation territoriale et politique de la France depuis la fin du xi*^{e} *siècle jusqu'à la fin du xv*^{e} (1836); all of these are rough sketches showing only the outlines of the subject. His most noted works are devoted to modern history. For a long time he had been taken up with a history of the Reformation, but only one part of it, dealing with the Reformation at Geneva, has been published. His *Histoire de Marie Stuart* (2 vols., 1851) is well worth reading; the author made liberal use of some important unpublished documents, taken for the greater part from the archives of Simancas. He devoted some volumes to a history of Spain, which had a well-deserved success—*Charles Quint, son abdication, son séjour, et sa mort au monastère de Yuste* (1845); *Antonio Perez et Philippe II.* (1845); and *Histoire de la rivalité de François I. et de Charles Quint* (1875). At the same time he had been commissioned to publish the diplomatic acts relating to the War of the Spanish Succession for the *Collection des documents inédits*; only four volumes of these *Négociations* were published (1835–1842), and they do not go further than the peace of Nijmwegen; but the introduction is celebrated, and Mignet reprinted it in his *Mélanges historiques.*

See the eulogy of Mignet by Victor Duruy, delivered on entering the Académie Française on the 18th of June 1885, and the notice by Jules Simon, read before the Académie des Sciences Morales et Politiques on the 7th of November 1885.

MIGNON, ABRAHAM (1640–1697), Dutch painter, was born at Frankfort. His father, a merchant, placed him under the still-life painter Jacob Merrel, by whom he was taken to Holland about 1660. He then worked under de Heem at Utrecht, where in 1675 he married the daughter of the painter Cornelis Willaerts. Sibylle Merian (1647–1717), daughter of the engraver Matthew Merian, became his pupil and achieved distinction as a flower painter. He died at Wetzlar. Mignon devoted himself almost exclusively to flowers, fruit, birds and other "still life," though at times he also attempted portraiture. His flower pieces are marked by careful finish and delicate handling. His favourite scheme was to introduce red or white roses in the centre of the canvas and to set the whole group of flowers against a dark background. Nowhere can his work be seen to better advantage than at the Dresden Gallery, which contains fifteen of his paintings, twelve of which are signed. Six of his pictures are at the Louvre, four at the Hermitage, and other examples are to be found at the museums of Amsterdam, The Hague, Rotterdam, Brussels, Munich, Karlsruhe, Brunswick, Cassel, Schwerin, Copenhagen and Turin.

MIGNONETTE, or MIGNONNETTE (*i.e.* "little darling"), the name given to a popular garden flower, the *Reseda odorata* of botanists, a "fragrant weed," as Cowper calls it, highly esteemed for its delicate but delicious perfume. The mignonette is generally regarded as being of annual duration, and is a plant of diffuse decumbent twiggy habit, scarcely reaching a foot in height, clothed with bluntish lanceolate entire or three-lobed leaves, and bearing longish spikes—technically racemes—of rather insignificant flowers at the ends of the numerous branches and branchlets. The plant thus naturally assumes the form of a low dense mass of soft green foliage studded over freely with the racemes of flowers, the latter unobtrusive and likely to be overlooked until their diffused fragrance compels attention. It is probably a native of North Africa and was sent to England from Paris in 1742; and ten years later it appears to have been sent from Leiden to Philip Miller at Chelsea. Though originally a slender and rather straggling plant, there are now some improved garden varieties in which the growth is more compact and vigorous, and the inflorescence bolder, though the odour is perhaps less penetrating. The small six-petalled flowers are somewhat curious in structure: the two upper petals are larger, concave, and furnished at the back with a tuft of club-shaped filaments, which gives them the appearance of being deeply incised, while the two lowest petals are much smaller and undivided; the most conspicuous part consists of the anthers, which are numerous and of a brownish red, giving the tone of colour to the inflorescence. In the varieties named Golden Queen and Golden Machet the anthers have a decided tint of orange-yellow, which imparts a brighter golden hue to the plants when in blossom. A handsome proliferous or double-flowered variety has also been obtained, which is a very useful decorative plant, though only to be propagated by cuttings; the double white flowers grow in large massive panicles (proliferous racemes), and are equally fragrant with those of the ordinary forms.

What is called tree mignonette in gardens is due to the skill of the cultivator. Though practically a British annual, as already noted, since it flowers abundantly the first season, and is utterly destroyed by the autumnal frosts, and though recorded as being annual in its native habitat by Desfontaines in the *Flora Atlantica*, the mignonette, like many other plants treated in England as annuals, will continue to grow on if kept in a suitable temperature. Moreover, the life of certain plants of this semi-annual character may be prolonged into a second season if their flowering and seeding are persistently prevented. In applying these facts to the production of tree mignonette, the gardener grows on the young plants under glass, and prevents their flowering by nipping off the blooming tips of the shoots, so that they continue their vegetative growth into the second season. The young plants are at first supported in an erect position, the laterals being removed so as to secure clean upright stems, and then at the height of one or two feet or more, as may be desired, a head of branches is encouraged to develop itself. In this way very large plants can be produced.

For ordinary purposes, however, other plans are adopted. In the open borders of the flower garden mignonette is usually sown in spring, and in great part takes care of itself; but being a favourite either for window or balcony culture, and on account of its fragrance a welcome inmate of town conservatories, it is also very extensively grown as a pot plant, and for market purposes with this object it is sown in pots in the autumn, and thinned out to give the plants requisite space, since it does not transplant well, and it is thereafter specially grown in pits protected from frosts, and marketed when just arriving at the blooming stage. In this way hundreds of thousands of pots of blooming mignonette are raised and disposed of year by year.

In classifying the odours given off by plants Rimmel ranks the mignonette in the class of which he makes the violet the type; and Fée adopts the same view, referring it to his class of "iosmoids" along with the violet and wallflower.

The genus *Reseda* contains about fifty species, natives of Europe and West Asia. *R. luteola*, commonly called dyer's-weed and weld, yields a valuable yellow dye. *R. alba* is a fine biennial about 2 ft. high, with erect spikes of whitish flowers.

MIGNONS, LES. In a general sense the French word *mignon* means "favourite," but the people of Paris used it in a special sense to designate the favourites of Henry III. of France, frivolous and fashionable young men, to whom public malignity attributed dissolute morals. According to the contemporary chronicler Pierre de l'Estoile, they made themselves "exceedingly odious, as much by their foolish and haughty demeanour, as by their effeminate and immodest dress, but above all by the immense gifts the king made to them." The Guises appear to have stirred up the ill will of the Parisians against them. From 1576 the *mignons* were attacked by popular opinion, and historians accredited without proof the scandalous stories of the time. The best known of the *mignons* were the dukes of Joyeuse and of Épernon.

MIGNOT, CLAUDINE FRANÇOISE [commonly called MARIE] (*c.* 1617–1711), French adventuress, was born near Grenoble, at Meylan. At the age of sixteen she attracted the notice of the secretary of Pierre des Portes d'Amblérieux, treasurer of the province of Dauphiny, and Amblérieux promised to promote their marriage. He married the girl himself, however, and left her his fortune. His will was disputed by his family, and Claudine went to Paris in 1653 to secure its fulfilment. She sought the protection of François de l'Hôpital, marshal of France, then a man of seventy-five. He married her within a week of their first meeting, and after seven years of marriage died leaving her part of his estate. By a third and morganatic marriage in 1672 with John Casimir, ex-king of Poland, a few weeks before his death, she received a third fortune. Immediately on her marriage with Amblérieux she had begun to educate herself, and her wealth and talents assured her a welcome in Paris. She retired in her old age to a Carmelite convent in the city, where she died on the 30th of November 1711.

Her history, very much modified, was the subject of a play by Bayard and Paul Duport, *Marie Mignot* (1829).

MIGRATION. Under this title will be considered movements of men with intention of changing their residence or domicile. Such migration (Lat. *migrare*) may be either external—that is, from one country to another, including emigration from mother country to colony; or it may be internal—that is, within the limits of a single country. Under external migration are comprised *emigration* and *immigration*, denoting simply direction from and to. The emigrants are at the same time the immigrants; that is, the material of the movement is the same, but the effect upon the country giving up and the country receiving the migrant requires separate treatment. Hence it is proper to separate emigration from immigration. Temporary migration, or travel for purposes of business, enterprise or pleasure, will be considered only incidentally, and because in some cases it is difficult to distinguish between such movements and permanent migration.

Migration in general may be described as a natural function of social development. It has taken place at all times and in the greatest variety of circumstances. It has been tribal, national, class and individual. Its causes have been political, economic, religious, or mere love of adventure. Its causes and results are fundamental for the study of ethnology (formation and mixture of races), of political and social history (formation of states and survival of institutions), and of political economy (mobility of labour and utilization of productive forces). Under the form of conquest it makes the grand epochs in history (*e.g.* the fall of the Roman Empire); under the form of colonization it has transformed the world (*e.g.* the settlement of America); under free initiative it is the most powerful factor in social adjustment (*e.g.* the growth of urban population). It must suffice here to indicate the character of the principal movements in the past, and then describe certain aspects of modern migration. The early movements may be grouped as follows: (*a*) Prehistoric migrations. Among savage and nomadic nations the whole tribe often moves into new territory, either occupying it for the first time or exterminating or driving out the indigenous inhabitants. We have only vague knowledge of these early movements, laboriously gleaned from archaeology, anthropology and philology. The cause has been commonly said to be the pressure of population on the food-supply. A more probable explanation is the love of booty and the desire of the stronger to take possession of the lands of the weaker. (*b*) Greek and Roman colonization. Both of these ancient civilizations extended their influence through migration of individual families and the planting of colonies. The motive seems to have been primarily commercial—that is, the love of gain. It may have been partly a sort of "swarming" process, caused by pressure of population at home. In some cases it had a political motive, as the planting of military colonies or providing new homes for the proletariat. The consequences were of course momentous. (*c*) The German Conquest. Beginning about the 5th century, the Roman empire was overthrown by German tribes from the north of the river Danube and east of the river Rhine. This *Völkerwanderung*, as it is called by German historians, again transformed the face of Europe, resulting in the establishment of independent kingdoms and a great mixture of races and institutions. It was coincident with the building-out of the feudal system. The conquered in many cases could be left as serfs and tillers of the soil, while the conquerors seized the higher positions of administration and power. (*d*) The later middle ages saw many minor migratory movements, such as those accompanying the crusades, the pushing of German colonization among the Slavs, and the introduction of Flemish weavers into England. The religious reformation caused a considerable amount of expatriation, culminating in the expulsion of the Huguenots from France. (*e*) The period of discovery and colonization opened up a new era for migration. The first expeditions were for adventure and booty, especially the discovery of gold and silver. Then came the establishment of commercial posts or factories for the purposes of trade. Finally came colonization proper—that is, the settlement of new countries by Europeans intending to remain there permanently, but still retaining their connexion with the mother country. This meant the opening up of the world to commerce and the extension of European civilization to vast areas formerly peopled by savages or half-civilized peoples. It meant a great outlet for the spirit of enterprise and adventure, relief from over-population, an enormous increase in wealth and power, and a struggle for supremacy among the nations of Europe. Colonization and colonial policy excited immense attention in Europe; and this extended into the 19th century (*e.g.* E. G. Wakefield's plans for colonization, and the various colonization societies of modern times). The colonial policy proper was broken down by the revolt of the North American colonies from Great Britain, and later of Mexico and Central and South America from Spain. (*f*) The movement of population, however, has continued under the form of emigration. This movement is characterized firstly by its magnitude; secondly, by the fact that the emigrant changes his political allegiance, for by far the greater part of modern emigration is to independent countries, and even where it is to colonies the colonies are largely self-governing and self-regarding; and thirdly, it is a movement of individuals seeking their own good, without state direction or aid. This is 20th-century emigration, differing from all preceding forms and having an importance of its own.

Statistics of Emigration.—The direction of the modern movement is from Europe to America, Australia and South Africa, as shown in the following table:—

Emigration from Certain States of Europe, 1890–1905.[1]

Year.	Italy.	France.	Belgium.	Holland.	Spain.[2]	Portugal.	Austria-Hungary.	Switzer-land.	Germany.
1890	115,595	20,560	2976	3526	37,025	28,945	74,002	6693	97,103
1891	189,746	6,217	3456	4075	37,721	33,234	81,407	6521	120,089
1892	116,642	5,528	5174	6290	30,190	20,772	74,947	6689	116,339
1893	142,269	5,586	3881	4820	38,707	30,093	65,554	5229	87,677
1894	114,566	No information available	1267	1146	34,102	26,656	25,536	2863	40,964
1895	187,908		1318	1314	36,220	44,420	63,552	3107	37,498
1896	197,554		1429	1387	45,317	27,625	66,547	2441	32,152
1897	174,545		760	792	39,366	21,369	35,634	1778	23,249
1898	139,188		928	851	38,546	23,280	53,947	1694	20,966
1899	145,440		600	1347	47,058	17,539	99,299	1701	22,114
1900	171,735		876	1899	55,452	20,794	117,372	2650	20,921
1901	288,947		1019	1874	48,892	20,439	136,557	2968	20,874
1902	295,443		1695	2301	44,401	23,880	185,449	3617	30,915
1903	292,033		2101	2963	—	21,291	222,218	4669	35,453
1904	267,249		2269	2440	—	27,925	144,038	3727	27,265
1905	479,349		2540	2297	—	—	—	3780	27,403

Year.	Sweden.	Norway.	Russia.[3]	Denmark.	Great Britain and Ireland.			
					England and Wales.	Scotland.	Ireland.	Total United Kingdom.
1890	30,128	10,991	85,548	10,298	139,979	20,653	57,484	218,116
1891	38,318	13,341	109,415	10,382	137,881	22,190	58,446	218,507
1892	41,275	17,049	74,681	10,442	133,815	23,325	52,902	210,042
1893	37,504	18,778	40,545	9,150	134,045	22,637	52,132	208,814
1894	9,678	5,642	17,792	4,105	99,590	14,432	42,008	156,030
1805	15,104	6,207	36,725	3,607	112,538	18,294	54,349	185,181
1896	12,919	6,679	32,127	2,876	102,837	16,866	42,222	161,925
1897	8,926	4,669	18,107	2,260	94,658	16,124	35,678	146,460
1898	7,321	4,859	27,853	2,340	90,679	15,570	34,395	140,644
1899	12,028	6,699	63,101	2,799	87,400	16,072	42,890	146,362
1900	16,434	10,931	92,833	3,570	102,448	20,472	45,905	168,825
1901	20,464	12,745	87,431	4,657	111,585	20,920	39,210	171,715
1902	33,477	20,343	110,453	6,823	137,121	26,285	42,256	205,662
1903	35,975	26,784	140,211	8,214	177,581	36,801	45,568	259,950
1904	—	22,264	—	9,034	175,733	37,445	58,257	271,435
1905	—	21,059	—	8,051	170,408	41,510	50,159	262,077

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[1] The figures relate only to the emigrants of each nationality emigrating from their own country to countries outside of Europe.

[2] Exclusive of emigrants to Spanish colonies.

[3] Russian emigrants from German ports.

Since 1820 over twenty million persons have emigrated from Europe to countries beyond the sea. The greater part of this emigration has been to the United States of North America. The history of emigration is well shown in the following table of emigration from Great Britain and Ireland. Down to 1853 the figures include all emigrants from British ports; after 1853 emigrants of British and Irish origin only.

Emigration from Great Britain and Ireland, 1815–1905.

	To British North America.	To United States.	To Australia.	To other Places.	Total.
All Emigrants.					
1815–1820 (5 years) .	70,438	50,359	—	2,731	123,528
1821–1830 (10 „) .	139,269	99,801	9,036	1,805	249,911
1831–1840 (10 „) .	322,485	308,247	67,882	4,536	703,150
1841–1850 (10 „) .	429,044	1,094,556	127,124	34,168	1,684,892
1851–1852 (2 „) .	75,478	511,618	109,413	8,221	704,730
1815–1852 (37 years) .	1,036,714	2,064,581	313,455	51,461	3,466,211
Emigrants of British and Irish Origin.					
1853–1860 (8 years) .	123,408	805,596	365,307	18,372	1,312,683
1861–1870 (10 „) .	130,310	1,132,626	267,358	41,535	1,571,829
1871–1880 (10 „) .	177,976	1,087,372	303,367	110,204	1,678,919
1881–1890 (10 „) .	301,922	1,713,953	372,744	169,916[1]	2,558,535
1891–1900 (10 „) .	176,336	1,090,685	119,018	258,942[2]	1,644,981
1901–1905 (5 „) .	181,504	290,679	27,120	85,607[3]	584,910
1853–1905 (53 years) .	1,091,456	6,120,911	1,454,914	684,576	9,351,857

The general direction of emigration from Europe is shown in the following table:—

Emigration from various Countries of Europe.

Country.	*Country of Destination.*							
	United States.	British North America.	Brazil.	Argentine.	Australasia.	Africa.	All other.	Total.
Great Britain and Ireland, 1905	122,370	82,437	—	—	15,139	26,307	15,824	262,077
Norway, 1905	19,638	1,386	—	—	4	25	6	21,059
Sweden, 1903	35,439	329	—	—	51	118	38	35,975
Germany, 1905	26,005	243	333	674	84	57	7	27,403
Denmark, 1905	7,158	453	—	—	55	19	366	8,051
Holland, 1905	2,282		—	—	—	15	—	2,297
Belgium, 1905	2,162	—	—	—	2	101	275	2,540
France, 1905			No information available.					
Portugal, 1904	4,351		21,449	—	—	1,954	—	27,925
Spain, 1902	Cannot be given.		1,120	8,767	—	20,460	—	44,401
Italy, 1905	316,797	5,930	30,079	88,840	765	13,072	3,866	479,349
Switzerland, 1905	4,349	—	53	471	—	—	—	5,049
Austria-Hungary, 1905 . . .	284,967	10,399	—	5,346	—	—	—	—

Statistics of Immigration.—The statistics of the United States are the most important and the most complete. The statistics since 1820 are shown in the following table:—

Immigration into the United States, 1820–1905.

Decade ending 30th June.	Aggregate Arrivals.	Annual Average.
1830	143,439	14,343
1840	599,125	59,912
1850	1,713,251	171,325
1860	2,598,214	259,821
1870	2,314,824	231,482
1880	2,812,191	281,219
1890	5,246,613	524,661
1900	3,844,422	384,442
1901–1905 . . .	3,833,076	766,615
Total . . .	23,116,501	

Prior to 1820 there was no official record of immigration, but it is estimated that the total number of immigrants from the close of the Revolutionary War was 250,000. During the decade from 1820 to 1830 the movement was very moderate. From 1830 to 1840 it steadily increased, but never reached 100,000 per annum. In 1846 came the Irish potato famine, and an enormous emigration began, followed by a very large German emigration from similar causes. The Civil War of the United States interrupted the movement, but it was speedily resumed on an enlarged scale owing especially to the improved means of ocean transportation. It culminated in the decade 1880–1890, and declined after the commercial crisis of 1893. Later there was another increase.

The relative movement of nationalities is best presented by the statistics of the United States. The nationality (country of origin of immigrants coming to the United States, 1871–1895) is shown in the following table:—

Nationality of Immigration to the United States.

	25 Years 1871–1895.	Per cent. of Total Immigration
Anglo-Saxons, Celts, and Welshmen—		
England and Wales . . .	1,334,817	12·9
Scotland	286,807	2·8
Total	1,621,624	15·7
Irish—Ireland	1,334,635	12·9
Teutons—		
Austria	374,872	3·6
Germany	2,607,562	25·3
Netherlands	96,035	0·9
Total	3,078,469	29·8
Latins—		
Belgium	42,447	0·4
France	148,683	1·4
Italy	655,104	6·3
Spain	14,292	0·2
Portugal	17,108	0·2
Total	877,634	8·5
Scandinavians—		
Denmark	159,759	1·5
Norway	331,258	3·2
Sweden	660,193	6·4
Total	1,151,210	11·1
Czechs, Magyars, Slavs—		
Bohemia	77,247	0·7
Hungary	256,347	2·5
Poland	141,908	1·4
Rumania	10,377	0·1
Russia	500,797	4·8
Total	986,676	9·5
Swiss—Switzerland	135,736	1·3
Greeks—Greece	7,325	0·1
Turks—Turkey	3,411	
Europe, not specified . . .	294	
Total Europe	9,197,014	88·9
North America	776,071	7·5
All other countries . . .	366,454	3·6
Grand Total	10,339,539	100·0

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[1] Of these, 77,409 went to the Cape of Good Hope and Natal.
[2] Of these, 152,797 went to the Cape of Good Hope and Natal.
[3] Of these, 69,052 went to the Cape of Good Hope and Natal.

A very important transformation has taken place in the proportionate number coming from different countries during the last half of the 19th century. At first the Irish and Germans were most prominent. Of later years, the Italians, Czechs, Hungarians and Russians were, as will be seen from the following table, numerously represented.

Nationality of Immigrants to the United States, 1901–1905.

	Number.	%
Austria-Hungary	944,239	25·0
Belgium	16,884	0·44
Bulgaria, Servia and Montenegro	6,637	0·17
Denmark	33,968	0·9
France	31,419	0·8
Germany	176,995	4·6
Greece	49,962	1·3
Holland	18,501	0·48
Italy	959,768	25·0
Norway	103,065	2·7
Portugal	30,532	0·8
Rumania	35,185	0·4
Russia	658,735	17·0
Spain	10,243	0·27
Sweden	154,607	4·0
Switzerland	17,820	0·46
Turkey	10,909	0·3
United Kingdom—		
England	155,343	4·0
Ireland	184,096	4·8
Scotland	38,842	1·0
Wales	6,972	0·18
All other European countries	216	0·006
Total	3,645,018	95

The following table shows the relative number of different nationalities represented in the immigration to the United States:—

Country.	1861–70.	1871–80.	1881–90.	1891–1900.
	%	%	%	%
Great Britain	24·5	16·4	12·5	7·5
Ireland	18·8	15·5	12·5	10·0
Germany	34·0	25·5	27·7	14·0
Austria-Hungary	0·3	2·6	6·7	16·0
Norway and Sweden	4·7	7·5	10·8	8·6
Russia and Poland	0·2	1·9	5·1	14·0
Italy	0·5	2·0	5·9	18·0

Sex and Age.—Of all the immigrants (1871–1895), 61·25 % were males and 38·75 % were females.

This percentage remains fairly constant, but the proportion differs somewhat among different nationalities. The following table shows the proportions for 1905:—

	Males.	Females.
Austria-Hungary	207,034	77,933
France	5,574	3,889
Germany	21,586	15,357
Holland	3,082	1,758
Italy	216,268	51,273
Russia	111,795	66,065
Sweden and Norway	29,907	18,105
United Kingdom—		
England	29,993	18,160
Ireland	18,754	18,890
Scotland	9,264	5,022

The immigrants were in the most vigorous period of life, few children and few old people, as shown in the following table:—

Ages of Immigrants to the United States, 1881–1890.

Country of Origin.	Under 15.		From 15 to 40.		Over 40 years.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Germany	386,934	26·6	904,002	62·2	162,034	11·2
Ireland	92,308	14·1	515,089	78·6	48,085	7·3
England	151,315	23·5	420,303	65·2	73,062	11·3
Sweden and Norway	104,254	18·3	414,609	73·0	49,499	8·7
Italy	47,603	15·3	212,475	69·2	47,771	15·5
Russia (including Poland)	65,427	24·7	174,754	65·9	24,907	9·4
Austria	50,027	22·1	149,909	66·3	26,109	11·6
Scotland	36,192	24·2	97,819	65·2	15,858	10·6
Hungary	18,785	14·7	95,635	74·9	13,261	10·4

Occupation.—The immigrants are for the most part unskilled labourers. The statistics for the United States show the following figures for the years 1881–1890:—

Occupation of Immigrants to the United States.

	Males.	Females.	Total.
Professional	25,257	1,749	27,006
Skilled	514,552	25,859	540,411
Miscellaneous	1,833,325	245,810	2,079,135
Not stated	73,327	42,830	116,157
Without occupation	759,450	1,724,454	2,483,904
Total	3,205,911	2,040,702	5,246,613

Those "without occupation" are mostly women and children. The "miscellaneous" are day labourers. It is probable that about 20 % of the adult males are "skilled."

Immigration to Other Countries.—In no other country is immigration conducted on so important a scale as in the United States. The statistics are very imperfect. The main figures have already been given in the table of emigration. Australia has an annual immigration of about 250,000, mostly of British origin. This is offset by a very heavy emigration, which sometimes exceeds the immigration in certain of the states. The immigration to Canada for the year 1905 was put down as 146,266, but a portion of this consisted of immigrants passing through to the United States. Brazil has had a large immigration (in 1895 equal to 169,524, but in 1904 only 12,447). The Argentine is credited with an immigration in 1905 of 177,117, and Uruguay with an immigration in 1903 of 6247. In all the South American immigration the countries principally represented are those of southern Europe, especially Italy. The majority of the immigrants are adult males and farm labourers.

Balance of Emigration and Immigration.—Even in the case of emigration from Europe to countries beyond the seas there is some return movement. Emigrants who have been successful in business return in order to end their days in the old country. Those who have not succeeded return in order to be cared for by friends and relatives, or simply from home-sickness. Thus, for Great Britain and Ireland, while the emigration of persons of British and Irish origin was, in 1905, 262,077, the immigration of persons of the same category was 122,712, leaving a net emigration of only 139,365. In the United States' statistics we cannot distinguish in the outgoing passenger movement emigrants from other persons. But if for a period of years we take the total inward passenger movement and subtract from it the total outward passenger movement, we ought to have the net immigration. By this method we arrive at the conclusion that while the gross immigration during the five years 1901–1905 was 3,833,076, the net immigration was only 1,779,976, showing an outward movement of 273,134, or about 7·12 % of the total number of immigrants.

Temporary Emigration.—In many European countries there is not only emigration beyond seas, but a very considerable movement to neighbouring countries in search of work, and generally with the intention of returning. Thus in Italy, the "permanent" emigration (*i.e.* to countries beyond seas) numbered, in 1905, 447,083; the "temporary" emigration to European or Mediterranean countries amounted to 279,248. This temporary emigration is strongest in the spring, and consists principally of adult males (agriculturists, farm and day labourers, bricklayers and masons) in search of work. It resembles somewhat the movement of Irish labourers into Great Britain at harvest time. It is notorious that the Italians who emigrate to the United States largely return.

Effects of Emigration.—There are two views with regard to emigration: one unfavourable, viz., that it is a drain on population, reducing its economic strength and disturbing social and political relations; the second looking upon it as a relief from over-population and a congested labour market. As a matter of fact, emigration has not succeeded in diminishing the population of Europe, which, on the contrary, doubled during the 19th century. The one great exception is Ireland, where population declined from 8,175,124 in 1841 to 4,458,745 in 1901. From 1851 to 1901 the total emigration from Ireland was 3,881,246 or 72·5 % of the average population. Emigration, by carrying off the young men and women, also reduced the Irish marriage and birth-rates, which were almost the lowest in Europe. But hitherto the countries of strongest emigration (England, Germany, &c.) have shown practically undiminished birth and marriage-rates and a steady growth in population.

The intensity of emigration is measured not by the absolute number of emigrants, but by the number of emigrants to the total population. Its effect is shown by comparing the number of emigrants with the excess of births over deaths per 1000 of the population. This is shown in the following table (1905):—

	Excess of births over deaths per 1000 Inhabitants.	Emigrants per 1000 Inhabitants.
Great Britain and Ireland	11·4	6·06
England and Wales	12·0	4·96
Scotland	12·2	8·45
Ireland	6·3	11·42
Germany	13·2	·45
Switzerland	9·5	1·45
Sweden (1903)	10·6	6·89
Norway	12·6	9·11
Denmark	13·5	3·12
Italy	10·6	14·33
Austria-Hungary	12·2	6·29

It will be observed that, with the exception of Ireland and Italy, wherever there is a heavy emigration there is usually a considerable excess of births over deaths, *i.e.* natural increase more than makes up for the loss by emigration. Even taking Great Britain and Ireland together, the loss by emigration per annum has not been very large, as is shown by the following table:—

Annual Emigration per 1000 of the Average Population of Great Britain and Ireland.

1853–1855	8·4	1881–1890	7·1
1856–1860	4·3	1891–1895	5·1
1861–1870	5·2	1896–1900	3·7
1871–1880	5·1	1901–1905	5·5

Even in particular districts where emigration is heavy the loss is made up by births. For instance, in 1891 the emigration from the provinces of West Prussia and Posen was extraordinarily heavy—10·9 and 10·4 per mille respectively—but the excess of births over deaths was 19·6 per mille. Emigration may give temporary relief to congested districts, but it is not in itself a remedy for so-called over-population.

It is difficult to analyse closely the economic effect of emigration, because so much depends upon the character of the emigrants and the condition of the labour market. The following considerations have been urged at different times: Although emigration does not diminish population, yet, as the emigrants are in the most productive period of life (15 to 45), the country of emigration loses adults and replaces them with children. It thereby loses the cost of rearing that number of people to adult age, and is left with a disproportionate number of children and old people. The age distribution of the population of Ireland lends some support to this view. In the same vein it is urged that voluntary emigration takes away the cream of the working-classes. It is the man of energy, of some means, of ambition, who takes the chances of success in the new country, leaving the poor, the indolent, the weak and crippled at home. It is maintained that such emigration institutes a process of selection which is unfavourable to the home country.

On the other side, it is said that the men who are doing well at home are the ones least likely to emigrate, because they have least to gain. Modern means of transportation have made the voyage so cheap that almost any one is able to go. It is therefore the restless, the unsuccessful, or at least those not fitted for the strenuous competition of the older countries, who are tempted to go. Emigration affords a natural outlet for the superfluous labour force of a country. The supply of labour is somewhat reduced, but wages are kept up for those who remain. Those who go find means of bettering their own condition beyond the seas, where they become producers of food and raw material for the home country, and at the same time customers for her manufactured products. Emigration is therefore an economic gain, both directly and indirectly. It is evident from these arguments that no general answer can be given to the question. In some cases it may be an evil; in most, when conducted under normal conditions, it would seem to offer little danger.

The same remark would hold true in regard to the social and political effects of emigration. In some cases, by taking away the strong, self-reliant and energetic, it may result in the deterioration of the home population. In other cases it allows restless spirits who have failed at home to try again elsewhere. Often in cases of political revolution the members of the defeated party have sought refuge elsewhere, as after the revolutionary movements of 1848. In case of conquest the conquered nationality takes to emigration on an extensive scale, as after the absorption of Alsace-Lorraine by Germany in 1871. The movement may be aided either by the state or by private associations. Of such character have been the *state-aided* emigration from Ireland, and the *assisted* emigration of paupers, criminals and other persons in the effort to relieve a congested population, or simply from the desire to get rid of undesirable members of the community. Such efforts fail if the new countries are unwilling to admit these persons. Finally, we have the expulsion of the Jews from Russia as an example of the effort of a community to get rid of an element which has made itself obnoxious to the local sentiment.

Effects of Immigration.—The effects of emigration are negative in character; those of immigration are positive. (*a*) On population: immigration, of course, is a direct addition to the population of new countries, and greatly accelerates the growth by natural increase, especially as the immigrants are in the most productive ages of manhood and womanhood. In the United States, for instance, out of a population of 76,303,387 (in 1900), there were 26,147,407 persons who were either foreign-born or who had one or both parents foreign-born. This does not mean that the population would have been twenty-six millions less if it had not been for immigration; for the rate of natural increase among the native-born might have maintained itself. Nevertheless, immigration has probably stimulated the growth of population. (*b*) Economic effects: The economic gain of immigration to new countries is evident. It adds directly to their available labour force, that is, to the number of adults engaged in the work of producing wealth.

According to the United States census of 1900, out of 29,073,233 (1900) persons engaged in gainful occupations, 5,851,399 or 20·1%, were of foreign birth. If we add to these the native whites of foreign parentage (5,300,924) we have 11,152,323 persons of foreign extraction or 39·4% of the total labour force. The foreign whites alone constituted 10·4% of the total number of persons engaged in agricultural pursuits; 11·4% of those in professional services; 25·7% in domestic and personal services; 19·2% in trade and transportation; and 30·6% of those engaged in manufacturing and mechanical industries. In addition to these, the native whites of foreign parentage constituted, in agriculture, &c., 10·6%; in professional service, 20·6%; in domestic and personal service, 16·4%; in trade and transportation, 25·7% in manufacturing and mechanical, 25·4% of all those engaged in those occupations. The labour force of the United States is thus made up very largely of immigrants and the children of immigrants.

Attempts have sometimes been made to put a money value on the economic gain by immigration. The amount of money brought by the immigrants is not large, and is probably more than offset by the money sent back by immigrants for the support of families and friends at home or to aid them in following. The valuable element is the able-bodied immigrant himself as a factor of production. It is said, for instance, that an adult slave used to be valued at from $800 to $1000, so that every adult immigrant may be looked upon as worth that sum to the country. Or, it has been said that an adult immigrant represents what it would cost to bring up a child from infancy to the age, say, of 15. This has been estimated by Ernst Engel as amounting to $550 for a German child. The most scientific procedure, however, is to calculate the probable earnings of the immigrant during the rest of his lifetime, and deduct therefrom his expenses of living. The remainder represents his net earnings which he will contribute to the well-being of the new country. W. Farr reckoned this to be, in the case of unskilled English emigrants, about £175. Multiplying the total number of adult immigrants by any one of these figures, we get the annual value of immigration. Such attempts to put a precise money value on immigration are futile. They neglect the question of quality and of opportunity. The immigrant is worth what it has cost to bring him up only if he is able-bodied, honest and willing to work. If he is diseased, crippled, dishonest or indolent, he may be a direct loss to the community instead of a gain. So, too, the immigrant is worth his future net earnings to the community only if there is a demand for his labour.

Social and Political Effects of Immigration.—The influx of millions of persons of different nationality, often of a foreign language and generally of the lower classes, would seem to be a danger to the homogeneity of a community. The United States, for instance, has felt some inconvenience from the constant addition of foreigners to its electorate and its population. The foreign-born are more numerously represented among the criminal, defective and dependent classes than their numerical strength would justify. They also tend to segregate more or less, especially in large cities. Nevertheless, the process of assimilation goes on with great rapidity. Intermarriage with the native-born occurs to a considerable extent. The influence of the physical environment leads to the adoption of the same mode of life. The most powerful influences, however, seem to be social. These are common school education and the adoption of one language (English); participation in political life, which is granted to all adult males after five years' residence; and the general influence of social standards embodied in laws, institutions and customs already established. Doubtless immigration in the last fifty years of the 19th century had a modifying effect on American life; but on the whole the power of a modern civilized community working through individual freedom to assimilate elements not differing from it too radically has been displayed to a remarkable degree.

Restriction of Immigration.—New countries have sought to escape certain evils of indiscriminate immigration. These evils were as follows: (*a*) The immigration of criminals, paupers, persons diseased in mind or body, and persons unable to support themselves. By the Acts of 1882 and 1893 such persons were refused admission to the United States, and, when rejected, the steamship companies that brought them were compelled to take them back. The number debarred from 1896 to 1905 is shown in the following table:—

Causes.	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905
Insane	10	6	12	19	32	16	27	23	33	92
Paupers	2010	1277	2261	2599	2974	2798	3944	5812	4798	7898
Diseased	2	1	258	348	393	309	709	1773	1560	2198
Assisted	—	3	79	82	2	50	—	9	38	19
Convicts	—	1	2	8	4	7	9	51	35	39
Prostitutes	—	—	—	—	7	3	3	13	9	24
Contract Labourers	776	328	417	741	833	327	275	1086	1501	1164
All other	1	1	1	1	1	6	7	2	20	445
Total debarred	2799	1617	3030	3798	4246	3516	4974	8769	7994	11,879

No law of international comity is violated by the refusal to receive these unfortunates. They should be taken care of at home. The English legislature in 1905 passed an act to prevent the landing of undesirable aliens, and the number refused admission in 1906 was 493. (*b*) Immigration sometimes increases the competition in the labour market, and thus lowers wages. One case is particularly aggravating, viz. when employers import foreign labourers in order to take the place of their men who are on strike. In 1885 the United States passed what is called the Contract Labor Law, forbidding the landing of any person who is under contract to perform labour in the United States. It is very difficult to discover such cases, but the number rejected is fairly large (see table above). (*c*) The immigration of men of alien race who refuse to assimilate with the natives is said sometimes to be a danger to the country. This at least is the excuse for the entire exclusion of Chinese labourers from the United States since 1882 (provisions made more severe in 1888 and 1892) (see also the article COOLIE).

Internal Migration.—In modern times there is constant movement of population within national lines, from section to section, and especially from rural districts to the cities. No record is kept of this, and we can trace it only through the census statistics of birthplace. In the United States, for instance, it was shown in 1890 that more than 21·5 per cent. of the native-born inhabitants were living in a state other than that in which they were born. Still further, it appears that about one-half of the native-born inhabitants had moved out of the county in which they were born. In 1890 there were 1,233,629 natives of the state of New York living in other states. The movement is principally westwards in direction and along parallels of latitude. For instance, New York has made large contributions to the population of Ohio, Michigan, Illinois, Wisconsin, Iowa and so on. Virginia has contributed largely to the population of West Virginia, Kentucky, Ohio, Indiana, Illinois and Missouri. In Europe there is a similar movement; but it is difficult to make comparisons, because of the differences in the administrative areas. In England in 1891, 71·6% of the population were residing in their native county; in Prussia, 69·7% in the *kreis*; in France, 81·7% in the department; in Austria, 80·2% in the *bezirk*; in Switzerland, 82·1% in the canton where they were born (Weber, *Growth of Cities*, p. 249). The most important phase of internal migration is the movement from the rural districts to the cities. The statistical results are shown in the following table extracted from the admirable work of Weber, just quoted:—

Percentage of Population living in Towns of 10,000 and over at Three Periods.

	About 1800 or 1801.	About 1850 or 1851.	About 1890 or 1891.
England and Wales	21·3	39·5	61·7
Scotland	17·0	32·2	50·0
Australia (7 colonies)	—	—	41·4
Belgium	13·5	20·8	34·8
Netherlands	29·5	29·0	31·3
Prussia (1816)	7·3	10·6	30·0
United States	3·8	12·0	27·6
France	9·5	14·4	25·9
Denmark	10·9	9·6	23·6
Italy	—	—	20·6
Ireland	7·8	10·1	18·0
Norway	3·3	5·3	16·7
Switzerland (1822)	4·3	7·3	16·5
Austria	4·4	5·8	15·8
Hungary	5·4	9·1	16·1
Sweden	3·9	4·7	13·7
Portugal	12·7	2·9	12·7
Russia	3·7	5·3	9·3

Everywhere the city population is increasing faster than the rural. In the United States the rate of increase per decade was as follows:—

Year.	United States.	In Towns of 8000 and over.	Rural Districts.
	%	%	%
1790–1800	35·1	60	34
1800–1810	36·4	69	35
1810–1820	33·0	33	33
1820–1830	33·6	82	31
1830–1840	32·7	68	30
1840–1850	35·9	99	30
1850–1860	35·6	75	30
1860–1870	22·6	59	15
1870–1880	30·1	40	27
1880–1890	24·9	61	15
1890–1900	20·8	37	14

In England and Wales the rural population increased in the aggregate during the first half of the 19th century, but at a gradually diminishing rate; in the second half of the century the population declined with varying regularity, until the decennium 1891–1900, when there was an increase. But notwithstanding this aggregate increase there are many rural districts which still show a steadily declining population. The urban population is increasing, as shown in the following table:—

Decennial Rate of Increase or Decrease.

Year.	Urban.	Rural.
	%	%
1851–1861	+21·9	+1·88
1861–1871	+28·1	−5·86
1871–1881	+25·6	−3·84
1881–1891	+18·5	−2·76
1891–1900	+15·22	+2·94

Somewhat the same phenomenon is seen in France. According to the census of 1891 not less than 55 out of the 87 departments had decreased in population; and out of the 32 that had increased, 7 showed a decrease in their rural parts when the large towns were deducted. In Germany the towns of 10,000 and over show a much more rapid increase than the rural districts; and the same fact is generally true of the other countries of Europe. This more rapid increase of population in cities is due only in part to migration from the country. Until the 19th century deaths generally exceeded births in cities, so that if it had not been for constant immigration the cities would not only not have grown, but would have decreased in population. Cities grow more rapidly now than formerly, because the excess of deaths over births has been turned into an excess of births over deaths. Thereby the cities are becoming less dependent upon immigration for increase of population than formerly, but the migration still goes on. The causes of migration from country to city are mainly economic. In early stages of culture men are scattered over the country, or at most gathered together in hamlets and villages. Each of these is self-sufficing, having its own artisans and handicraftsmen, and producing what it needs. With the beginning of exchange commercial centres spring up, situated on navigable streams and especially at points where land and water journeys are broken. With the growth of manufactures, industrial centres spring up where the division of labour can be fully provided for. In modern times two factors have accelerated this process, viz.: (1) the building of railways, which have developed commerce to a very great degree and favoured the large towns at the expense of the small; and (2) the invention of machinery, which has greatly increased the possibility of division of labour and manufactures on a large scale. The old handicraftsman has been superseded by machine labour and the village artisan by the factory hand. At the same time improvements in agriculture and the opening up of new countries have enabled the modern community to gain its food and raw material with a less expenditure of labour force, and the surplus agricultural population has gone to the city. The attractive influences upon individuals have been higher wages, greater scope for the ambitious, and the social advantages of city life.

The general laws of internal migration may be summarized (according to Ravenstein) as follows:—

1. The great body of migrants proceed only a short distance.

2. The process of absorption goes on as follows: The inhabitants of the country immediately surrounding a town of rapid growth flock into it; the gaps thus left in the rural population are filled up by migrants from more remote districts, until the attractive force of one of the rapidly-growing cities makes its influence felt, step by step, to the most remote corner of the land. Migrants enumerated in a certain centre of absorption will consequently grow less with the distance, proportionately to the native population which furnishes them.

3. The process of dispersion is the inverse of that of absorption, and exhibits similar features.

4. Each main current of migration produces a compensating countercurrent.

5. Migrants proceeding long distances generally go by preference to one of the great cities of commerce or industry.

6. The natives of towns are less migratory than those of the rural parts of the country.

7. Females are more migratory than males.

AUTHORITIES.—The statistics of migration are to be found in the official returns of different countries, especially the statistical tables relating to emigration and immigration published by the British Board of Trade, and the Reports (annual) of the Commissioner-General of Immigration of the United States. For general discussion see Philippovich, *Auswanderung und Auswanderungspolitik* (Leipzig, 1892). An exhaustive bibliography will be found in an article by same author, "Auswanderung," in *Handwörterbuch der Staatswissenschaften*; R. Mayo-Smith, *Emigration and Immigration*, with bibliography (New York, 1890). For internal migration see A. F. Weber, *Growth of Cities* (New York, 1899). See also Ravenstein, "The Laws of Migration," in *Journal of Royal Statistical Society* (1885 and 1889). Professor Flinders Petrie, in his Huxley Lecture for 1906 on *Migrations* (reprinted by the Anthropological Institute), deals with the mutations and movements of races from an anthropological standpoint with profound knowledge and originality.

(R. M.-S.; T. A. I.)

MIGRATION, in Zoology. In zoology considerable importance attaches to the problems of migration, by which is meant the wandering of living creatures into another, usually distant, locality in order to breed there; this implies a return, and the double phenomenon is annual. All other changes of the abode are either sporadic, epidemic, or fluctuating within lesser limits. Further, migration should not be confounded with "spreading," which proceeds steadily, and in epicycles, with a totally different result. It need not be emphasized that hard and fast lines between these phenomena do not exist; they are often a question of degree. For instance, when the common toad, which is a strictly terrestrial creature, wanders every spring to a frequently distant pool in order to spawn there, this is a true migration. The same applies, strictly speaking, to those insects which hibernate in the ground, at the root of the tree on which they feed and breed. The grey plover breeds in the arctic circle and winters in equatorial countries. To complicate matters further, it is not necessary that the migration be undertaken periodically, more than once, by the same individual. For instance, the common eel ascends the rivers as an elver in its youth; years after it returns to the sea, there to breed and to die, whilst other fishes come and go, year after year. Further, some of the larger birds, for instance swans and cranes, are still immature in their second year, and yet they migrate like their older relations. It seems permissible to use this fact as an indication that the breeding as such is not the prime reason of their wanderings. The fundamental impelling agent must have been the want of food, and what we usually understand by migration cannot suddenly have sprung into existence to its full extent, but is more likely the cumulative effect of the doings of countless generations. The faculty of shifting the abode was of course always there, the necessity of moving further on was also present, and those which went in the wrong direction came to grief, while the others flourished and returned with their progeny. They did not at first cover enormous distances, but just enough to find unoccupied ground. The annual repetiton became an established habit, at last an ineradicable instinct. There can be but little doubt that the prime impulse was want of food. The new growing grass on the prairie or on the veldt attracts every year those creatures which live upon pasture. The inter-tropical belt of the world is so crowded with creatures that there is the keenest competition, whilst in the temperate and cold regions is a long winter quiescence unfit for the support of many creatures, whereas in the summer these same regions are covered with new vegetation, with its concomitant abundance of insects and other invertebrates. The tables are decked again, and these opportunities are not wasted.

The process of migration, in its most striking cases, is now very complicated. Many a bird goes actually to the arctic regions for the shortest of summers, but spends most of the year within the tropics. On the other hand there are many species which do not go so far north, but stop to breed in the intermediate regions. We must not take the extremes when trying to unravel the development of the problem. The periodical migrations of mammals, with their more limited extent and greater leisure, are less perplexing.

It has been argued with some show of reason that the real home of a bird is that country in which it was born, in other words where the species breeds, but this is not in every case a valid conclusion. It applies to most creatures, but it can well bear exceptions if we leave sentiment aside. When it comes to a question of domicile, the ten weeks' sojourn of the swift, *Cypselus*, in England are more than weighted down by the nine months or more which these birds spend in southern countries, although we do not know whether they are resident there or roam about. The breeding time is the busiest period of a bird's life; then the numbers of each species are suddenly multiplied, and so is the stress of providing food, and the particular food which is best for the young may not be available in every country. The idea that the arctic circle is the original home of the numerous kinds of birds which breed in it, whence they are now periodically driven away by stress, has been coupled with the glacial epoch, that supposed solution of so many difficulties. We have only to assume that the old, permanent home of these migrants was in the arctic region, that the progressing glaciation drove them away, of course towards the equator, and that, when times improved again, the birds returned to their old home. This sounds very plausible, but it involves huge assumptions. The birds, not the individuals, but the species, are supposed to have inherited such a loving reminiscence of their old home, that after thousands of years—with most of the small birds meaning as many generations—they returned at the first opportunity. It implies that their long continued sojourn in foreign lands, where—under this assumption—thousands of generations must have been bred and have spent all their lives, was not sufficient to naturalize them, so to speak, in other words to supplant the instinctive love of the primary ancient home. That the last glacial epoch has driven the limit of many kinds of animals and plants farther south is as certain as that many have recovered the lost ground after the reversion of the glaciation, but it must have been a very slow and steady process of spreading. It may, and probably does, account for the present annual visitations of arctic lands, as a phenomenon which has been evolved *de novo*, which would have come to pass even if no birds had existed in pre-glacial times.

How do birds manage to find their way, thousands and thousands of miles across land and water? This question has been extolled as a mystery of mysteries. It has been stated that the old birds show the way to the young, a speculation which does not apply to those many cases in which old and young notoriously travel at different times. It has been assumed that they travel by sight, taking advantage of certain landmarks; another untenable idea, since—experience having to be excluded in a flock of birds which made the journey for the first time—it implies that the young must have inherited the reminiscence of those landmarks! Others have likened the bird to a kind of compass, because in eastern Siberia E. von Middendorff found some migration routes to coincide with the direction of the magnetic pole. The whole question reduces itself to a sense of direction, a faculty which is possessed by nearly all animals; in some it is present to an astonishing extent; but the manifestations of this sense vary only in degree. The cat which escapes out of the bag finds its way back, directly or after many adventures. The bee, after having loaded itself with pollen, returns by the proverbial line to the hive which may be a mile away, but, move the small entrance hole in the meantime an inch to the right or left, and the bee will knock its head against the hive and blunder about; move the hive a few yards and bee after bee returning will be puzzled to find its hive again. They, maybe with the help of landmarks, have accustomed themselves to steer a course. Such instances need not be multiplied. The principle is the same whether the journey be one of a few yards or of many miles. Given the sense of direction, it is no more difficult to steer a course due north than it is to lay one south-east by east, provided always the impetus to be on the move. There is no mystery, except that we, the most intellectual of mankind, should so well nigh have lost this sense, and even this fact is simply an instance of the loss of a faculty through long-continued disuse.

Birds.—(The following account is to a great extent based upon A. Newton's article "Birds" in *Ency. Brit.*, 9th ed.)

In almost all countries there are some species which arrive in spring, remain to breed, and depart in autumn; others which arrive in autumn, stop for the winter and depart in spring; and others again—and these are strictly the "birds of passage"—which show themselves but twice a year, passing through the country without staying long in it, and their transient visits take place about spring and autumn. These three apparently different categories of migrants are all acted upon by the same impulse in spite of the at first sight dissimilar nature of their movements. The species which resort to Britain and to other temperate countries in winter are simply those which have their breeding quarters much nearer the poles, and in returning to them on the approach of spring are but doing exactly as do those species which, having their winter abode nearer the equator, come to us with the spring.

The birds-of-passage proper, like our winter visitants, have their breeding quarters nearer the pole, but like our summer visitants, they seek their winter abode nearer the equator, and thus perform a somewhat larger migration. As H. Seebohm puts it (*Geograph. Distrib. of the family Charadriidae*, London):—

"They all represent birds which breed in the north and winter in the south. Every migratory bird wintering in England goes north to breed, and every migratory bird breeding in England goes south to winter. It is a rule without exception in the northern hemisphere that each bird breeds in the extreme north point of its migrations. To make the rule apply to the southern hemisphere as well it must be modified as follows: each bird breeds in the coldest climate which it visits on its migrations. . . . It is a remarkable fact that whilst there are many birds breeding in the northern hemisphere and wintering in the southern, it is not known that any land-bird breeds in the southern and habitually winters in the northern! This is probably owing to the difference in the distribution of the land, there being no antarctic breeding grounds. . . . Birds breeding in the tropics are always resident, except when they breed on mountains, where the climate causes them to descend into the valleys for the winter."

In many countries we find that while there are some species, such as in England the swallow or the fieldfare, of which every individual disappears at one period of the year or another, there are other species, such as the pied-wagtail or the woodcock, of which only the majority of individuals vanish—a few being always present—and these species form the so-called "partial migrants." In England the song-thrushes receive in the autumn a considerable accession in numbers from the birds which arrive from the north, though the migration is by no means so well marked as it is on the continent, where the arrival of the strangers sets all the fowlers at work. In most localities in Britain the newcomers depart after a short sojourn, and are accompanied by so many of the home-bred birds that in some parts of the island it may be safely declared that not a single song-thrush can be found from the end of November to the end of January, while in others examples can always be seen. Much the same may be said of the redbreast. Undeniably resident as a species, attentive scrutiny will reveal the fact that its numbers are subject to very considerable variation, according to the season of the year. At no time do our redbreasts collect in bands, but towards the end of summer they may be seen in the south of England successively passing onward, the travellers being mostly—if not wholly—young birds of the year; and so the great majority disappear, departing it may be safely presumed for more southern countries, since a few weeks later the markets of most towns, first in France and then in Italy, are well supplied with this species. But the migratory influence affects, though in a less degree, many if not most of the redbreasts that remain with us. Every bird of the northern hemisphere is to a greater or less degree migratory in some part or other of its range.

Want of food, and perhaps of the special, proper kind during the breeding season, seems to be the most obvious cause of migration, and none can wonder that those animals which possess the power of removing themselves from a place of scarcity should avail themselves of it, while it is unquestionable that birds possess this faculty in the greatest degree. Even among those species which we commonly speak of as sedentary it is only the adults which maintain their ground throughout the year. It has long been known that birds-of-prey customarily drive away their offspring from their own haunts so soon as the young are able to shift for themselves. The reason generally, and no doubt truly, given for this behaviour, which at first sight appears so unnatural, is the impossibility of both parents and progeny getting a livelihood in the same vicinity. The practice, however, is not limited to the birds-of-prey alone, but is much more universal. We find it to obtain with the redbreast, and if we watch our feathered neighbours closely we shall perceive that most of them indulge in it. The period of expulsion, it is true, is in some birds deferred from the end of summer or the autumn, in which it is usually performed, until the following spring, when indeed from the maturity of the young it must be regarded as much in the light of a voluntary secession on their part as in that of an act of parental compulsion, but the effect is ultimately the same.

The mode in which the want of sustenance produces migration may best be illustrated by confining ourselves to the unquestionably migrant birds of our own northern hemisphere. As food grows scarce towards the end of summer in the most northern limits of the range of a species, the individuals affected thereby seek it elsewhere. Thus doing, they press upon the haunt of other individuals: these in like manner upon that of yet others, and so on, until the movement which began in the far north is communicated to the individuals occupying the extreme southern range of the species at that season; though, but for such an intrusion, these last might be content to stay some time longer in the enjoyment of their existing quarters.

This seems satisfactorily to explain the southward movement of all migrating birds in the northern hemisphere; but when we consider the return movement which takes place some six months later, doubt may be entertained whether scarcity of food can be assigned as its sole or sufficient cause, and perhaps it would be safest not to come to any decision on this point. On one side it may be urged that the more equatorial regions which in winter are crowded with emigrants from the north, though well fitted for the resort of so great a population at that season are deficient in certain necessaries for the nursery. Nor does it seem too violent an assumption to suppose that even if such necessaries are not absolutely wanting, yet that the regions in question would not supply sufficient food for both parents and offspring—the latter being at the lowest computation twice as numerous as the former—unless the numbers of both were diminished by the casualties of travel.[1] But on the other hand we must remember what has above been advanced in regard to the pertinacity with which birds return to their accustomed breeding-places, and the force of this passionate fondness for the old home cannot but be taken into account, even if we do not allow that in it lies the whole stimulus to undertake the perilous voyage.

A. R. Wallace in some remarks on the subject (*Nature*, x. 459) ingeniously suggests the manner in which the habit of migration has come to be adopted[2]:—

"It appears to me probable that here, as in so many other cases, 'survival of the fittest' will be found to have had a powerful influence. Let us suppose that in any species of migratory bird, breeding can as a rule be only safely accomplished in a given area; and further, that during a great part of the rest of the year sufficient food cannot be obtained in that area. It will follow that those birds which do not leave the breeding area at the proper season will suffer, and ultimately become extinct; which will also be the fate of those which do not leave the feeding area at the proper time. Now, if we suppose that the two areas were (for some remote ancestor of the existing species) coincident, but by geological and climatic changes gradually diverged from each other, we can easily understand how the habit of incipient and partial migration at the proper seasons would at last become hereditary, and so fixed as to be what we term an instinct. It will probably be found that every gradation still exists in various parts of the world, from a complete coincidence to a complete separation of the breeding and the subsistence areas; and when the natural history of a sufficient number of species is thoroughly worked out we may find every link between species which never leave a restricted area in which they breed and live the whole year round, to those other cases in which the two areas are absolutely separated."

A few more particulars respecting migration are all that can here be given, and it is doubtful whether much can be built upon them. It has been ascertained by repeated observation that in the spring-movement of most species of the northern hemisphere the cock-birds are always in the van of the advancing army, and that they appear some days, or perhaps weeks, before the hens. It is not difficult to imagine that, in the course of a journey prolonged throughout some 50° or 60° of latitude, the stronger individuals should outstrip the weaker by a very perceptible distance, and it can hardly be doubted that in most species the males are stronger, as they are bigger than the females. Some observers assert that the same thing takes place in the return journey in autumn—Seebohm, for instance, says that, from Europe, first go the young, then the males, having finished their moult of autumn, and lastly the females—but on this point others are not so sure, which is not surprising when we consider that the majority of observations have been made towards what is the northern limit of the range of the *Passeres*, to which the remark is especially applicable—in the British islands, France, North Germany and the Russian empire—for it is plain that at the beginning of the journey any inequality in the speed of travelling will not have become so very manifest. There is also another matter to be noticed. It has been suspected that where there is any difference in the size of birds of the same species, particularly in the dimensions of their wings, the individuals that perform the most extensive journeys would be naturally those with the longest and broadest *remiges*, and in support of this view it certainly appears that in some of the smaller migrants—such as the wheatear (*Saxicola oenanthe*) and willow-wren (*Phylloscopus trochilus*)—the examples which reach the extreme north of Europe and there pass the summer possess greater mechanical powers of flight than those of the same species which stop short on the shores of the Mediterranean. It may perhaps be also inferred, though precise evidence is wanting, that these same individuals push further to the southward in winter than do those which are less favoured in this respect. It is pretty nearly certain that such is the case with some species, and it may well be so with individuals. H. B. Tristram has remarked (*Ibis*, 1865, p. 77) that, in many genera of birds, "those species which have the most extended northerly have also the most extended southerly range; and that those which resort to the highest latitudes for nidification also pass further than others to the southward in winter," fortifying his opinion by examples adduced from the genera *Turdus*, *Fringilla*, *Cypselus* and *Turtur*.

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[1] If the relative proportion of land to water in the southern hemisphere were at all such as it is in the northern, we should no doubt find the birds of southern continents beginning to press upon the tropical and equatorial regions of the globe at the season when they were thronged with the emigrants from the north, and in such a case it would be only reasonable that the latter should be acted upon by the force of the former, according to the explanation given of the southward movement of northern migrants. But, though we know almost nothing of the migration of birds of the other hemisphere, yet, when we regard the comparative deficiency of land in southern latitudes all round the world, it is obvious that the feathered population of such as nowadays exists can exert but little influence, and its effects may be practically disregarded.

[2] In principle F. W. Hutton had already foreshadowed the same theory (*Trans. New Zeal. Inst.*, 1872, p. 235).

For many years past a large number of persons in different countries have occupied and amused themselves by carefully registering the dates on which various migratory birds first make their appearance, and there is now an abundance of records so compiled. Still it does not seem that they have been able to determine what connexion, if any, exists between the arrival of birds and the weather; in most cases no corresponding observations have been made about the weather in the places whence the travellers are supposed to have come. As a rule it would seem as though birds were not dependent on the weather to any great degree. Occasionally the return of the swallow or the nightingale may be somewhat delayed, but most sea-fowls may be trusted, it is said, as the almanac itself. Foul weather or fair, heat or cold, the puffins (*Fratercula arctica*) repair to some of their stations punctually on a given day as if their movements were regulated by clockwork. Whether they have come from far or from near we know not, but other birds certainly come from a great distance, and yet make their appearance with scarcely less exactness. Nor is the regularity with which certain species disappear much inferior; every observer knows how abundant the swift (*Cypselus apus*) is up to the time of its leaving its summer-home—in most parts of England, the first days of August—and how rarely it is seen after that time is past.

It must be allowed, however, that, with few exceptions, the mass of statistics above spoken of has never been worked up and digested so as to allow proper inferences to be made from it, and therefore it would be premature to say that little would come of it, but the result of those exceptions is not very encouraging. E. von Middendorff carefully collated the records of the arrival of migratory birds throughout the Russian Empire, but the insight into the question afforded by his published labours is not very great. His chief object has been to trace what he has termed the *isepipteses* (ἴσος = *aequalis*, ἐπίπτησις = *advolatus*) or the lines of simultaneous arrival, and in the case of seven species these are laid down on the maps which accompany his treatise. The lines are found by taking the average date of arrival of each species at each place in the Russian dominions where observations have been regularly made, and connecting those places where the dates are the same for each species by lines on the map. The curves thus drawn indicate the inequality of progress made by the species in different longitudes, and assuming that the advance is directly across the isepiptesial lines, or rather the belts defined by each pair of them, the whole course of the migration is thus most accurately made known. In the case of his seven sample species the maps show their progressive advance at intervals of a few days, and the issue of the whole investigation, according to him, proves that in the middle of Siberia the general direction of the usual migrants is almost due north, in the east of Siberia from south-east to north-west, and in European Russia from south-west to north-east. Thus nearly all the migrants of the Russian empire tend to converge upon the most northern part of the continent, the Taimyr peninsula, but it is almost needless to say that few of them reach anything like so far, since the country in those high latitudes is utterly unfit to support the majority. With the exception of some details this treatise fails to show more. The routes followed by migratory birds have been the subject of a very exhaustive memoir by J. A. Palmén, but it would be beyond our limits to do more than mention his results concisely. He enters very fully into this part of the inquiry and lays down with much apparent probability the chief roads taken by the most migratory birds of the palaearctic region in their return autumnal journey, further asserting that in the spaces between these lines of flight such birds do not usually occur. Broadly speaking, the birds of Europe, Russia and Western Siberia go for the winter to Africa, those of middle Siberia to Mongolia, and those of Siberia east of the Lena go towards Japan.

But lay down the paths of migratory birds, observe their comings and goings, or strive to account for the impulse which urges them forward as we will, there still remains for consideration the most marvellous thing of all—how do the birds find their way so unerringly from such immense distances? This seems to be by far the most inexplicable part of the matter. Year after year the migratory wagtail will build her nest in the accustomed spot, and year after year the migratory cuckoo will deposit her eggs in that nest, and yet in each interval of time the former may have passed some months on the shores of the Mediterranean, and the latter, absent for a still longer period, may have wandered into the heart of Africa. That particular form of bluethroat which yearly repairs to breed upon the mosses of the subalpine and northern parts of Scandinavia (*Cyanecula suecica*) is hardly ever seen in Europe south of the Baltic. Throughout Germany it may be said to be quite unknown, being replaced by a conspicuously different form (*C. leucocyana*), and as it is a bird in which the collectors of that country, a numerous and well-instructed body, have long taken great interest, we are in a position to declare that it is not known to stop in its transit from its winter haunts, which we know to be Egypt and the valley of the Upper Nile, to its breeding-quarters. Other instances, though none so crucial as this, could be cited from among European birds were there room here for them. In New Zealand there are two cuckoos which are annual visitors: one, a species of *Chrysococcyx*, is supposed to come from Australia, the other, *Eudynamis taitensis* is widely spread throughout Polynesia, yet both these birds yearly make two voyages over the enormous waste of waters that surrounds the country to which they resort to breed. But space would utterly fail us were we to attempt to recount all the examples of these wonderful flights. Yet it seems impossible that the sense of sight should be the faculty whereby they are so guided to their destination, any more than in the case of those which travel in the dark. J. A. Palmén asserted (*op. cit.* p. 195) that migrants are led by the older and stronger individuals among them, and, observing that most of those which stray from their right course are yearlings that have never before taken the journey, he ascribed the due performance of the flight to "experience." There are many birds which cannot be said to migrate in company. While swallows, to take a sufficiently evident example, conspicuously congregate in vast flocks and so leave our shores in large companies, the majority of our summer-visitors slip away almost unobserved, each apparently without concert with others. Experience here can only signify the result of knowledge acquired on former occasions and obtained by sight. Now it was stated by C. J. Temminck (*Manuel d'ornithologie*, III. Introd., 1820) many years ago, and so far as would appear the statement has not been invalidated, that among migrants the young and the old always journey apart and most generally by different routes. The former can have no "experience," and yet the greater number of them safely arrive at the haven where they would be. The sense of sight, essential to a knowledge of landmarks, is utterly insufficient to account for the success that attends birds which travel by night, or in a single flight span oceans or continents. Yet without it the idea of "experience" cannot be substantiated. We may admit that inherited but unconscious experience, which is really all that can be meant by instinct, is a factor in the whole matter—certainly, as Wallace seems to have proved, in originating the migratory impulse, but yet every aspect of the question is fraught with difficulty.

Less than nothing is known about the speed at which birds fly during their long stretches of migration. Gaetke, in his otherwise very interesting book, has startled ornithologists by various statements, but his calculations were based upon such crude observations that the results are ridiculous. For instance, he proved to his satisfaction that the grey or hooded crow, *Corvus cornix*, which notoriously is not a fast bird, flies from Heligoland to the coast of Lincolnshire in England at the rate of one hundred and twenty miles an hour. To the little bluethroat he assigned a velocity of two hundred and forty miles an hour, a statement as silly as that made by some fanciful observer in Portugal who convinced himself that "Turtle-doves leaving Kent or Surrey at dawn might easily be the very birds that a few hours later were skimming over the Portuguese pine forests on their way to Central Africa." Fifty miles an hour would be a high average speed for most migratory birds, and there are no reliable data to tell how long such birds can continue their flight without interruption. All we seem to know is that not a few kinds manage, in various parts of the world, to cross enormous distances without the chance of a break. It was Gaetke's notion that migration was for the most part carried on at such a height in the air as to be beyond our ken, and that what comes to our perception consists chiefly of the abortive or unsuccessful attempts, when birds are checked in their course, and being unable to proceed present themselves to our sight and hearing. Now for obvious reasons birds could not well fly at very great heights in very thin air, as experiments with pigeons released from balloons have shown, and the condor soaring far above the tops of the Andes is a myth. The few trustworthy instances in which birds have been observed through a telescope passing across the face of the moon have naturally yielded but vague calculations as to distance and height. W. E. D. Scott (*Bull. Nuttall Orn. Club*, vi. 97–100), computed heights varying from 1 to 2 m. F. M. Chapman's observations (*Auk*, 1888, pp. 37–39) resulted in a height of from 1500 to 15,000 ft.; average, say, 1 m. If the sky is clouded and the birds fly above the clouds the migration proceeds beyond our ken, and if for some reason or other they are below the clouds the phenomenon becomes to us very noticeable. It is well known "that on clear and bright nights birds are rarely heard passing overhead, while on nights that are overcast, misty and dark, especially if slight rain be falling, flocks may often be heard almost continuously." It is in such weather, continues Newton, that birds while migrating are most vociferous, doubtless with the result that thereby the company of fellow-travellers is kept together.

There yet remain a few words to be said on what may be termed Exceptional Migration, that is when from some cause or other the ordinary practice is broken through. The erratic movements of the various species of crossbill (*Loxia*) and some allied forms afford perhaps the best-known examples. In England no one can say in what part of the country or at what season of the year he may not fall in with a company of the common crossbill (*L. curvirostra*), and the like may be said of many other lands. The food of these birds consists mainly of the seeds of conifers, and as its supply in any one locality is intermittent or precarious, we may not unreasonably guess that they shift from place to place in its quest, and may thus find an easy way of accounting for their uncertain appearance. The great band of nutcrackers (*Nucifraga caryocatactes*) which in the autumn of 1844 pervaded western and central Europe (*Bull. Acad. Bruxelles*, xi. 298), may also have been actuated by the same motive, but we can hardly explain the roaming of all other birds so plausibly. The inroads of the waxwing (*Ampelis garrulus*) have been the subject of interest for more than 300 years, and by persons prone to superstitious auguries were regarded as the forerunners of dire calamity. Sometimes years have passed without the bird being seen in central, western or southern Europe, and then perhaps for two or three seasons in succession vast flocks have suddenly appeared. Later observation has shown that this species is as inconstant in the choice of its summer as of its winter-quarters. One of the most extraordinary events known to ornithologists is the irruption into Europe in 1863 of Pallas's sand-grouse (*Syrrhaptes paradoxus*). Of this bird, hitherto known only as an inhabitant of the Tatar steppes, a single specimen was obtained at Sarepta on the Volga in the winter of 1848. In May 1859 a pair is said to have been killed in the government of Vilna, on the western borders of the Russian empire, and a few weeks later five examples were procured, and a few others seen, in western Europe—one in Jutland, one in Holland, two in England and one in Wales. In 1860 another was obtained at Sarepta; but in May and June 1863 a horde computed to consist of at least 700 individuals overran Europe—reaching Sweden, Norway, the Faeroes and Ireland in the northwest, and in the south extending to Sicily and almost to the frontiers of Spain. On the sandhills of Jutland and Holland some of these birds bred, but they were all killed off. A much greater visitation took place in 1888, which met with the same fate. The number of birds was quite incalculable, the wave extending from Norway to southern Spain.

In comparison with the periodic annual migrations of so very many birds, those of other creatures are scarce and insignificant, excepting fishes.

Mammals.—Few trustworthy observations have been recorded. The most regular and least limited migrations seem to be those of the eared seals. The walrus also goes each year to the north in the summer, further south in the winter. *Delphinapterus leucas*, one of the Cetacea, ascends the Amoor regularly on the breaking of the ice, a distance of 400 m. up the stream, Some bats are supposed to migrate. The American bison used to roam north and south, according to the season, in search of pasture; and similar periodic wanderings have often been recorded of various kinds of game on the South African veldt. They are all obviously a mere matter of commissariat and have little to do with the breeding, except in the case of seals.

In one way the lemming's "migrations" are instructive. They are quite sporadic. When, owing to combination of some favourable circumstances they suddenly increase, enormous numbers forsake the highlands for the lowlands of Norway; not in a methodical way, but quite lawlessly; that means to say they radiate from their centres of dispersal. At any given spot, however, they seem to keep to the same direction, and no obstacles seem to divert their course. Those which arrive at the much indented coast are known even to rush into the sea, where of course they get drowned. There is no sense in this. The overcrowded condition of their home impels them to leave, and this impulse continues blindly. They do not attempt to settle anywhere between their home and the sea. A year or two after the irruption not a lemming is there to be found, and where during their stampede they come across suitable districts, they find these already occupied by resident lemmings.

Such and similar irruptions have no doubt taken place often during the world's history; and yet such sporadic stampedes into a foreign country hardly ever lead to its regular settlement, especially when such a country possesses already a kindred fauna of its own.

Fishes.—Many fishes make periodic migrations for breeding purposes, which by their numbers and the distances travelled much resemble those of birds, but very little is known about these fishes. Take the incredible masses of herrings and their kindred; the collecting of the cod and its allies on their breeding-ground. According to D. S. Jordan (*A Guide to the Study of Fishes*, New York, 1905) some kinds are known mainly in the waters they make their breeding-homes, as in Cuba, southern California, Hawaii or Japan, the individuals being scattered at other times through the wide seas. The tunny, which has a world-wide distribution, arrives off the south coast of Portugal in the month of May; enormous numbers pass through the Straits of Gibraltar and support great fishing industries in the Mediterranean. In the month of August they return to the ocean (*A pesca do Atum no Algarve em 1898*, por D. Carlos de Braganza, Lisboa, 1899; with many maps).

Many fresh-water fishes, as trout and suckers (quoting Jordan) forsake the large streams in the spring, ascending the small brooks where their young can be reared in greater safety. Still others, known as *anadromous* fishes, feed and mature in the sea, but ascend the rivers as the impulse of reproduction grows strong. Among such fishes are the salmon, shad, alewife, sturgeon and striped bass in American waters; *Clupea alosa*, the Allis shad, and *C. finta*, the Twait shad, *Alepocephalus rostratus*, the "*maifisch*" of the Rhine, in Europe. "The most remarkable case of the anadromous instinct is found in the king-salmon or quinnat (*Onchorhynchus tschawytscha*), of the Pacific coast. This great fish spawns in November, at the age of four years and an average weight of twenty-two pounds. In the Columbia river it begins running with the spring freshets in March and April. It spends the whole summer, without feeding, in the ascent of the river. By autumn the individuals have reached the mountain streams of Idaho, greatly changed in appearance, discoloured, worn and distorted. On reaching the spawning-beds, which may be 1000 m. from the sea in the Columbia, over 2000 m. in the Yukon, the female deposits her eggs in the gravel of some shallow brook. The male covers them and scrapes the gravel over them. Then both male and female drift, tail foremost, helplessly down the stream; none, so far as certainly is known, ever survive the reproduction act. The same habits are found in the five other species of salmon in the Pacific. The salmon of the Atlantic has a similar habit, but the distance travelled is everywhere much less, and most of the hook-jawed males drop down to the sea and recover, to repeat the act of reproduction."

Few fishes are *katadromous*, i.e. their usual habitat is in rivers and lakes, but they descend into the sea for breeding purposes. The common eel is the classical example.

Insects.—D. Sharp makes the following remarks (*Cambridge Nat. Hist.* vi.): "Odonata are among the few kinds of insects that are known to form swarms and migrate. Swarms of this kind have been frequently observed in Europe and in North America; they usually consist of a species of the genus *Libellula*, but species of various other genera also swarm, and sometimes a swarm may consist of more than one species.

"Locust swarms do not visit the districts that are subject to their invasions every year, but as a rule only after intervals of a considerable number of years. . . . The irregularity seems to depend upon three facts, viz. that the increase of locusts is kept in check by parasitic insects; that the eggs may remain more than one year in the ground and yet hatch out when a favourable season occurs, and that the migratory instinct is only effective when great numbers of superfluous individuals are produced. . . . It is well established that locusts of the migratory species exist in countries without giving rise to swarms or causing any serious injuries. . . . When migration of locusts does occur it is attended by remarkable manifestations of instinct. Although several generations may elapse without a migration, it is believed that the locusts when they migrate do so in the direction taken by predecessors. They are said to take trial flights to ascertain the direction of a favourable wind, and that they alight and wait for a change. The most obscure point is their disappearance from a spot they have invaded. A swarm will alight on a locality, deposit there a number of eggs, and then move on. But after a lapse of a season or two there will be few or none of the species present in the spot invaded. In other cases they again migrate after growth to the land of their ancestors. It has been ascertained by the United States Entomological Commission that such return swarms do occur."

See J. A. Palmén, *Om Foglarnes flyttningsvägar* (Helsingfors, 1874). The same in German: *Über die Zugstrassen der Vögel* (Leipzig, 1896). In this and the work of von Middendorff, already cited, reference is made to almost every important publication on the subject of migration, which renders a notice of its very extensive literature needless here, and a pretty full bibliographical list is given in Giebel's *Thesaurus ornithologiae* (i. 146–155). Yet mention may be made of Schlegel's *Over het trekken der Vogels* (Harlem, 1828); Hodgson's "On the Migration of the *Natatores* and *Grallatores* as observed at Kathmandu" in *Asiatic Researches* (xviii. 122–128), and Marcel de Serres's *Des Causes des migrations des animaux et particulièrement des oiseaux et des poissons* (Harlem, 1842). This last, though one of the largest publications on the subject, is one of the least satisfactory. S. F. Baird's excellent treatise "On the Distribution and Migrations of North American Birds," *Am. Journ. Sc. and Arts* (2nd ser. 1866), pp. 78–90, 187–192, 337–347; reprinted *Ibis* 1867, pp. 257–293. N. A. Severzoff, "Études sur le passage des oiseaux dans l'Asie centrale," *Bull. Soc. Nat.* (Moscow, 1880), pp. 234–287; Menzbier, "Die Zugstrassen der Vögel im europäischen Russland," *op. cit.* (1886), pp. 291–369; Palmén, *Referat über den Stand der Kenntniss des Vogelzuges*, Intern. Ornith. Congr., Budapest, 1891; W. W. Cooke and C. H. Merriam, *Report on Bird Migration in the Mississippi Valley*, U.S. Dep. Agric.-Economic Ornithol., publ. 2 (Washington, 1888); Gaetke, *Die Vogelwarte Helgoland* (Braunschweig, 1891). In English: *Heligoland as an Ornithological Observatory* (Edinburgh, 1895); A. Newton, article "Migration," *Dict. Birds* (1893). (H. F. G.)

MIGUEL, MARIA EVARIST (1802–1866), usually known as Dom Miguel, whose name is chiefly associated with his pretensions to the throne of Portugal, was the third son of King John VI. of Portugal, and of Carlota Joaquina, one of the Spanish Bourbons; he was born at Lisbon on the 26th of October 1802. In 1807 he accompanied his parents in their flight to Brazil, where he grew up an uneducated and fanatical debauchee; in 1821, on his return to Europe, it is said that he had not yet learned to read. In 1822 his father swore fidelity to the new Portuguese constitution which had been proclaimed in his absence; and this led Carlota Joaquina, who was an absolutist of the extremest Bourbon type, and hated her husband, to seek his dethronement in favour of Miguel her favourite son. The insurrections which ensued (see Portugal) resulted in her imprisonment and the exile of Miguel (1824), who spent a short time in Paris and afterwards lived in Vienna, where he came under the teaching of Metternich. On the sudden death of John VI. in May 1826, Pedro of Brazil, his eldest son, renounced the crown in favour of his daughter Maria da Gloria, on the understanding that she should become the wife of Miguel. The last named accordingly swore allegiance to Pedro, to Maria, and to the constitution which Pedro had introduced, and on this footing was appointed regent in July 1827. He arrived in Lisbon in February 1828, and, regardless of his promises, dissolved the new Cortes in March; having called together the old Cortes, with the support of the reactionary party of which his mother was the ruling spirit, he got himself proclaimed sole legitimate king of Portugal in July. His private life was characterized by the wildest excesses, and he used his power to oppose all forms of liberalism.

The public opinion of Europe became more and more actively hostile to his reign, and after the occupation of Oporto by Dom Pedro in 1832, the destruction of Miguel's fleet by Captain (afterwards Sir Charles) Napier off Cape St Vincent in 1833, and the victory of Saldanha at Santarem in 1834, Queen Christina of Spain recognized the legitimate sovereignty of Maria, and in this was followed by France and England. Dom Miguel capitulated at Evora on the 29th of May 1834, renouncing all pretensions to the Portuguese throne. He lived for some time at Rome, where he enjoyed papal recognition, but afterwards retired to Bronnbach, in Baden, where he died on the 14th of November 1866.

MIHRAB, a term in Mahommedan architecture given to the niche which in a mosque indicates the direction of Mecca, towards which the Moslems turn when praying.

MIKADO (Japanese for "exalted gate"), the poetical title associated by foreign countries with the sovereign of Japan; the Japanese title, corresponding to "emperor," is *tenno*, the term *kotei* being used of his function in relation to external affairs. By the constitution of 1889, the emperor of Japan transferred a large part of his former powers as absolute monarch to the representatives of the people, but as head of the empire he appoints the ministers, declares war, makes peace and concludes treaties, acting generally as a constitutional sovereign but with all the personal authority attaching to his august position. The history of the mikados goes back to very early times; but from 1600 to 1868 the real power was in the hands of the shoguns, who nevertheless were in ceremonial theory always successively invested with their authority by the mikado. The revolution of 1867 restored the real power into the mikado's hands. (See Japan: *History*; and Mutsu-Hito.)

MIKIRS, a hill tribe of India, occupying two or three detached tracts in Nowgong and Sibsagar districts of Eastern Bengal and Assam, known as the Mikir hills. In 1901 their total number was returned as 87,056. Mikir is the name given to them by the Assamese; they call themselves Arleeng, which means "man" in general. They have long settled down to agriculture, and are distinguished from the tribes around them by the absence of savagery. Their language, which has been studied by missionaries, seems to connect them with the Kuki-Chin stock on the Burmese frontier.

See Sir C. Lyall, *The Mikirs* (1908).

MIKLOSICH, FRANZ VON (1813–1891), Austrian philologist, was born at Luttenberg, Styria, on the 29th of November 1813. He graduated at the university at Gratz as a doctor of philosophy, and was for a time professor of philosophy there. In 1838 he went to Vienna, where he took the degree of doctor of law. He devoted himself, however, to the study of Slavonic languages, abandoned the law, and obtained a post in the imperial library, where he remained from 1844 to 1862. In the former year he published a noteworthy review of Bopp's *Comparative Grammar*, and this began a long series of works of immense erudition which completely revolutionized the study of Slavonic languages. In 1849 Miklosich was appointed to the newly created chair of Slavonic philology at the university of Vienna, and he occupied it until 1886. He became a member of the Academy of Vienna, which appointed him secretary of its historical and philosophical section, a member of the council of public instruction and of the upper house, and correspondent of the French Academy of Inscription. His numerous writings deal not only with the Slav languages, but with Rumanian, Albanian, Greek, and the language of the gypsies. Miklosich died on the 7th of March 1891.

MILAN (Ital. *Milano*, Ger. *Mailand*, anc. *Mediolanum*, *q.v.*), a city of Lombardy, Italy, capital of the province of Milan, 93 m. by rail E.N.E. of Turin. Pop. (1881), 321,839; (1906), 560,613. It is the seat of an archbishop, the headquarters of the II. army corps, the chief financial centre of Italy and the wealthiest manufacturing and commercial town in the country. It stands on the little river Olona, near the middle of the Lombard plain, 400 ft. above sea-level.

The plain around Milan is extremely fertile, owing at once to the richness of the alluvial soil deposited by the Po, Ticino, Olona and Adda, and to the excellent system of irrigation. Seen from the top of the cathedral, the plain presents the appearance of a vast garden divided into square plots by rows of mulberry or poplar trees. To the east this plain stretches in an unbroken level, as far as the eye can follow it, towards Venice and the Adriatic; on the southern side the line of the Apennines from Bologna to Genoa closes the view; to the west rise the Maritime, Cottian and Graian Alps, with Monte Viso as their central point; while northward are the Pennine, Helvetic and Rhaetian Alps, of which Monte Rosa, the Saasgrat and Monte Leone are the most conspicuous features. In the plain itself lie many small villages; and here and there a larger town like Monza or Saronno, or a great building like the Certosa of Pavia, makes a white point upon the greenery. The climate is changeable and trying; in summer it is intensely hot, in winter very cold. Snow is often seen, and the thermometer is frequently below freezing-point.

In shape Milan is a fairly regular polygon, and its focus is the splendid Piazza del Duomo, from which a number of broad modern streets radiate in all directions. These streets are connected by an inner circle of boulevards, constructed just outside the canal, which marks the site of the town moat. The arches of Porta Nuova are almost the last trace of the inner circuit, constructed after the destruction of the city by Frederick Barbarossa, to which also belonged the Porta dei Fabbri, demolished in 1900. Curious reliefs from the Porta Romana are to be seen in the museum. Within this circle the majority of the streets are narrow and crooked, while those between it and the bastions, though broader on the whole, have but little regularity. An outer circle of boulevards, planted with trees and commanding the view of the suburbs, lies just beyond the present walls of the city, erected by the Spaniards in the 16th century; the entire length of these boulevards is traversed by an electric tramway 7 m. long.

Occupying one end of the Piazza del Duomo is the famous cathedral. It is built of brick cased in marble from the quarries which Gian Galeazzo Visconti gave in perpetuity to the cathedral chapter. It was begun in 1386. The name of the original architect is unknown, but it is certain that many German master-masons were called to Milan to assist the Italian builders. It was then the largest church in existence, and now, after St Peter's at Rome and the cathedral of Seville, the Duomo of Milan is the largest church in Europe; it covers an area of 14,000 sq. yds. and can hold 40,000 people. The interior is 486 ft. long, 189 ft. wide; the nave is 157 ft. high, and the distance from the pavement to the top of the tower is 356 ft. The style is Gothic, very elaborately decorated, but it shows many peculiarities, for the work was continued through several centuries and after many designs by many masters, notably by Amadeo, who carried out the octagonal cupola (the pinnacle of which dates from 1774), and by Tibaldi, who laid down the pavement and designed a baroque façade. This last feature was begun after Tibaldi's design in 1615, but was not finished till 1805, when Napoleon caused the work to be resumed. With its Renaissance windows and portals this façade, though good in itself, was utterly out of keeping with the general style of the church, and in 1900 the removal of the inharmonious features was begun, to be replaced in a style strictly in accordance with the Gothic style of the rest of the building from the designs of Giuseppe Brentano. In shape the church is cruciform, with double aisles to the nave and aisles to the transepts. The roof is supported by fifty-two pillars with canopied niches for statues instead of capitals; the great windows of the choir, reputed to be the largest in the world, are filled with stained glass of 1844. To the right of the entrance is the tomb of Archbishop Heribert, the champion of Milanese liberty, while beside him rests Archbishop Otto Visconti, the founder of that family as a reigning house. The large bronze candelabrum in the left transept is said to be 13th century work. In a crypt under the choir lies the body of the cardinal saint Carlo Borromeo, who consecrated the cathedral in 1577. It is contained in a rock-crystal shrine, encased in silver, and is vested in full pontifical robes blazing with jewels. The roof of the cathedral is built of blocks of marble, and the various levels are reached by staircases carried up the buttresses; it is ornamented with a profusion of turrets, pinnacles and statues, of which last there are said to be no fewer than 4440, of very various styles and periods. In front of the cathedral rises a colossal bronze equestrian statue of Victor Emmanuel II.

There are two noteworthy palaces in the Piazza del Duomo. The first is the Palazzo Reale dating from 1772, but occupying the site of the earliest mansion of the Viscontis and the Sforza; its great hall is a handsome chamber with a gallery supported by caryatides. Built into the palace is the ancient church of San Gottardo, a Romanesque building which was built by Azzone Visconti in 1328–1339, and was the scene of the murder of Giovanni Maria Visconti in 1412. Its campanile is a beautiful example of early Lombard terra-cotta work. The second palace is that of the archbishops, the fine façade of which is the work of Fabio Magnone. It has an older north colonnade, by some attributed to Bramante, but, like many other buildings, without sufficient evidence, and a fine court with double colonnades by Tibaldi, to whom the back façade is due. The Palazzo della Ragione, erected in the Piazza dei Mercanti, just west of the Piazza del Duomo, the central point of the medieval city, in 1223–1238 by the podestà, Oldrado da Tresseno, whose equestrian portrait in high relief adorns it, still exists in fine preservation. It is a brick edifice with a portico on the ground floor and a large hall on the upper. Close by to the south is the beautiful Loggia degli Osii, erected in 1316, with two loggie or open porticos, one above the other, in black and white marble.

Among the most interesting buildings in Milan is the ancient church of S. Ambrogio. Here St Ambrose baptized St Augustine; here he closed the doors against the emperor Theodosius after his cruel massacre at Thessalonica; here the Lombard kings and the early German emperors caused themselves to be crowned with the iron crown of Lombardy, and the pillar at which they took their coronation oaths is preserved under the lime-trees in the piazza. The church was built by St Ambrose early in the 4th-century (on the site of a temple of Bacchus it is said), but as it stands it is a Romanesque basilica of the 12th century, recently well restored (like many other churches in Milan), with a brick exterior, like so many churches of Milan and Lombardy, curious galleries over the façade, and perhaps the most perfectly preserved atrium in existence. The wooden door belongs to the original 4th century church; it has carvings with scenes from the life of David. In a great silver reliquary (modern) in the crypt lie the bones of St Ambrose, above which rises the high altar, which retains its original decorations, the only intact example of its period (835). These consist of reliefs in gold and silver enriched with enamel and gems, and are the work of one Vuolfvinus, a German. The baldacchino, with sculptures of the 12th or early 13th century, is borne by four ancient columns of porphyry, with 9th-century capitals. In the tribune are fine mosaics of the 9th century, which, Burckhardt remarks, completely break with Byzantine tradition. In the side chapel of S. Satiro are even earlier mosaics (5th century); there are also fine frescoes by Borgognone and Bernardino Lanini. The lofty brick campanile (789–824) is among the earliest in Italy, and is decorated with coloured majolica disks. The court of the neighbouring canonica is by Bramante, and so also may be the design of the cloisters of the monastery of S. Ambrogio, now the military hospital. S. Lorenzo, in the south portion of the town, dates from before A.D. 538, thus being practically contemporary with S. Vitale at Ravenna (though Burckhardt considers it to belong to about A.D. 300, and to be a part of the thermae or palace of Maximian), but was burnt down and restored in 1071 (in the restoration Corinthian capitals were used as bases). Thirty-three years later part of it collapsed, and a second fire followed in 1124. It was restored, but collapsed again in 1573, and a great part of it had to be reconstructed, including the dome (1574–1591). (The chapel of S. Aquilino, possibly a part of the original structure, contains mosaics of the 5th or 6th century.) In plan the church is an octagon, supported at the corners by four square towers in brickwork, which belong to the original structure. The interior with its two orders is a very fine one, and its influence on Renaissance architects has been very considerable. S. Eustorgio, one of the largest Gothic churches in Milan, with some Romanesque survivals, dates, as it stands, with its campanile, from the end of the 13th century, and has a modern façade in the old style. It has some interesting medieval works of sculpture, and a fine chapel (Cappella Portinari), with a good dome and a beautiful frieze of angels, built by Michelozzo in 1462–1468, and containing the splendid sculptured tomb (a marble sarcophagus with reliefs, supported by statues) of Peter Martyr (*q.v.*), the masterpiece of Giovanni di Balduccio of Pisa (1339); the walls of the chapel are decorated with important frescoes by Vincenzo Foppa of Brescia. S. Simpliciano, too, though originally Romanesque, is now in the main Gothic, and has been much altered.

S. Vincenzo in Prato (833), now restored to its basilican form, with nave and two aisles divided by columns and three apses, and with small, flat arcading on the exterior, which is in brickwork; S. Satiro, founded in 879; S. Babila, also restored to its original form, &c., are interesting for their Romanesque architecture. The small domed structure on the left of S. Satiro is earlier than the church, while the campanile is part of the original structure, though preceded in date by that of S. Ambrogio, which is one of the earliest genuine campanili in Italy (789–824). The reconstruction of the church of S. Satiro was Bramante's earliest work in Milan (after 1476). The choir is painted in perspective (there was no room to build one), the earliest example of this device, which was so frequently used in baroque architecture. The octagonal sacristy (before 1488), with niches below and a gallery above, with stucco decorations by Bramante himself (the frieze with putti and medallions is ascribed to Caradosso), is a masterly work, and one of his best. The Cistercian abbey-church of Chiaravalle, 5½ m. south of Milan, is a fine brick building in the plan of a Latin cross, with nave and two aisles with round pillars, with a lofty domed tower, in the so-called Romanesque Transition style, having comparatively slender round pillars and cross vaulting, while the exterior is still quite Romanesque. It was founded in 1135 by St Bernard and consecrated in 1221. It is interesting as the model for the plan of many other churches in Lombardy, *e.g.* S. Maria del Carmine and

S. Francesco in Pavia. S. Marco, modernized inside, still retains a beautiful façade of 1254 and a tower—in brick as elsewhere—and contains another tomb by Balduccio. S. Maria Incoronata is unique as a double Gothic church, in the horizontal sense (1451–1487).

Of the secular buildings of the beginning of the 15th century, the most notable is the Palazzo Borromeo, which still preserves its Gothic courtyard. It has a good collection of Lombard pictures. At no great distance from S. Ambrogio, in the Corso Magenta, is the church of Santa Maria delle Grazie, built by the Dominicans about 1460, to which the Gothic façade and nave belong. The choir, crossing, and beautiful sixteen-sided dome, with the elegant external decorations in terra-cotta and marble, are by Bramante (*c.* 1492). Adjoining the church is the convent, long used as barracks. Leading from the fine cloisters, also the work of Bramante, is the former refectory, on the walls of which Leonardo da Vinci painted his celebrated "Last Supper," a work which is unfortunately in a bad state of preservation.

Farther along the Corso, but nearer the Piazza del Duomo, is San Maurizio, the interior of which is covered by exceedingly effective frescoes by Luini and his contemporaries. The interior was erected by Giovanni Dolcebuono, a pupil of Bramante, to whom is also due S. Maria presso S. Celso (the interior and the baroque façade are by Alessi). Thence the Via Bollo leads to the Piazza della Rosa, in which is situated the renowned Biblioteca Ambrosiana, erected in 1603–1609 by Fabio Manzone, to whom the Palazzo del Senato is also due, rich in MSS. In the same building there is also a picture gallery, in which is Raphael's cartoon for his fresco the "School of Athens" in the Vatican. Situated just within the Naviglio, the canal encircling the inner town (adjacent to San Nazaro, which contains Bernardino Lanini's [*fl.* 1546] masterpiece, the "Martyrdom of St Catherine"), is the Ospedale Maggiore. This institution, which can accommodate 2400 patients, was founded in the reign of Francesco Sforza. The principal court (there are nine in all) is surrounded by fine arcades of the 17th century by Ricchini. The entire edifice is covered externally with terra-cotta, and its façade, designed by the Florentine Antonio Averulino (Filarete) and begun in 1457, is superior to any other of the kind in Milan.

The city is rich in works of art, for Milan, with the introduction of the early Renaissance style by Filarete and Michelozzo after 1450, became the home of a Lombard school of sculpture, among the chief masters of which may be mentioned Giovanni Antonio Amadeo, or Omodeo,[1] of Pavia (1447–1522), Cristoforo Solari, and, the last of them, Agostino Busti, known as Bambaia (*c.* 1480–1548), whose work may be seen in the cathedrals of Como and Milan and in the Certosa di Pavia. Subsequently, towards the close of the 15th century, the refined court of Lodovico Sforza attracted such celebrated men as Bramante, the architect, Gauffino Franchino, the founder of one of the earliest musical academies, and Leonardo da Vinci, from whose school came Luini, Boltraffio, Gaudenzio Ferrari, Marco d'Oggiono, &c. Later, Pellegrino Tibaldi and Galeazzo Alessi of Genoa (the former a man of very wide activity) were the chief architects, and Leone Leoni of Arezzo the chief sculptor. In still more recent times Beccaria (1738–1794) as a jurist, Monti (1754–1828) as a poet and Manzoni (1785–1873) as a novelist, have won for the Milanese a high reputation.

The picture gallery of the Brera, one of the finest in Italy, occupies an imposing palace with a good courtyard by Ricchini. It was built as a Jesuit college in 1651, but since 1776 has been the seat of the Accademia di Belle Arti, and contains besides the picture gallery a library of some 300,000 volumes, a collection of coins numbering about 60,000, and an excellent observatory founded in 1766. The Brera Gallery, the nucleus of which was formed in 1806, possesses Raphael's famous "Sposalizio," and many pictures and frescoes by Luini, Guadenzio Ferrari and Bramantino; the collection of the works of Carlo Crivelli (*fl.* 1480) affords an instructive survey of his work, which connects the Paduan school with the Venetian, here particularly well represented by works of Paolo Veronese, Paris Bordone, Gentile Bellini, Cima da Conegliano, Bonifazio, Moroni and Carpaccio. Additions are continually made to it.

The Castel Sforzesco, or Castle of Milan, stands in the Parco Nuovo; it was built in 1450 by Francesco Sforza on the site of one erected by Galeazzo II. Visconti (1355–1378) and demolished in 1447 by the populace after the death of Filippo Maria Visconti. After suffering many vicissitudes and being partially destroyed more than once, it was restored—including especially the splendid entrance tower by Antonio Averulino (Filarete, 1451–1453), destroyed by a powder explosion in 1521—in the 15th-century style in 1893 sqq., and it is now a most imposing pile. Some of the fine windows with their terra-cotta decorations are preserved. The archaeological museum is housed here on the ground floor; besides Roman and pre-Roman objects it contains fragments of the 9th century basilica of Santa Maria in Aurona, one of the first examples of vaulted Lombard architecture; the bas-reliefs of the ancient Porta Romana of Milan, representing the return of the Milanese in 1171 after the defeat of Barbarossa; the remains of the church of Santa Maria in Brera, the work of Balduccio da Pisa; the grandiose sepulchral monument of Bernabò Visconti formerly in the church of San Giovanni in Conca; the tomb of Regina della Scala, the wife of Bernabò; the funeral monument of the Rusca family; the great portal of the palace of Pigello Portinari, seat of the Banco Mediceo at Milan, a work of Michelozzo; a series of Renaissance sculptures, including works by Amadeo Mantegazza, Agostino Busti (surnamed Bambaia), including fragments of the tomb of Gaston de Foix. Several of the rooms occupied by the archaeological museum bear traces of the decorations executed under Galeazzo Maria and Lodovico il Moro, and one of them has a splendid ceiling with trees in full foliage, painted so as to cover the whole vaulting, ascribed to Leonardo da Vinci. In the upper rooms is placed a large collection of Milanese and central Italian ceramics, stuffs, furniture, bronzes, ivories, enamels, glass and historical relics; together with a picture gallery containing works by Vincenzo Foppa, Gianpietrino, Boltraffio, Crivelli, Pordenone, Morone, Cariani, Correggio, Antonello da Messina, Tiepolo, Guardi, Potter, Van Dyck and Ribeira.

The finest of the modern thoroughfares of Milan is the Via Dante, constructed in 1888; it runs from the Piazza de' Mercanti to the spacious Foro Bonaparte, and thence to the Parco Nuovo, the great public garden in which stands the Castello Sforzesco. This park was once a national drilling ground, which was taken over by the municipality with a view to erecting upon it a new residential quarter, rendered necessary by the phenomenal growth of the city during the last twenty-five years of the 19th century. This design was happily abandoned, and around the Parco Nuovo has grown up a new quarter of wide streets, spacious gardens and private villas.

To the north of the castle is the Arena, a kind of circus erected by Napoleon in 1805; while facing the castle on the opposite side of the park is the Arco della Pace, begun by Napoleon in 1806 from the designs of Cagnola to mark the beginning of the Simplon Road, but finished by the Austrians in 1833. Leading east-north-east from the Piazza del Duomo, the centre of Milanese traffic, especially of electric trams, is the Corso Vittorio Emanuele. Connecting the piazza with the neighbouring Piazza della Scala is the famous Galleria Vittorio Emanuele, a great arcade in the form of a Latin cross, with an octagon in the centre, crowned at the height of 160 ft. with a glass cupola; it is roofed with glass throughout, and is 320 yds. long, 16 yds. wide and 94 ft. high. It has splendid façades at each end, and was constructed in 1865–1867 at the cost of £320,000; it is the finest of its kind in Europe.

In the Via Morone near the Piazza della Scala is a collection of art treasures bequeathed to the town in 1879 by a Milanese patrician, the Cavaliere Poldi-Pezzoli. It comprises valuable pictures, textile fabrics, arms, armour and a number of antiquities, and is exhibited in the house once occupied by the founder. In the middle of the neighbouring Piazza della Scala stands Magni's monument of Leonardo da Vinci (1872). Opposite is the celebrated Teatro della Scala, built in 1778 on the site of a church founded by Beatrice della Scala, wife of Bernabò Visconti. After the San Carlo at Naples it is the largest theatre in Europe, and can seat 3600 spectators. Looking on to the piazza is the fine Palazzo Marino, the seat of the municipality since 1861; it was built by Galeazzo Alessi in 1558, to whom the side façade and the court are due, but was not completed until 1890, when the main façade was erected by Luca Beltrami. S. Fedele by Tibaldi (1569) is close by. Milan has a royal scientific and literary academy with a faculty of philosophy, a royal technical institute, a school of veterinary science, a royal school of agriculture, a polytechnic with the Bocconi commercial school (founded 1898) and numerous other learned and educational institutions. Milan has long been famous as one of the great musical centres of Europe, and numerous students resort here for their musical education. There are many philanthropic institutions, the most interesting of which is the Albergo Popolare, an establishment conducted on lines similar to the houses established in England by Lord Rowton in 1894. Sport and athletics are provided by a number of clubs, notably the Touring Club Italiano, founded in 1894.

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[1] See F. Malaguzzi Valeri, *G. A. Amadeo, scultore e architetto* (Bergamo, 1905).

The modern industrial development of Milan, with its suburbs and neighbouring towns, such as Monza, Gallarate, Saronno, Busto Arsizio and Legnano, has been noteworthy. Machine-making on a large scale is carried on by firms widely celebrated for the construction of locomotives, railway trucks and carriages, steam-boilers and motors, turbines, pumps, metal bridges and roofs. Minor industries are represented by workshops for the production of surgical, musical and geodetic instruments; of telephone and telegraph accessories; dynamos, sewing-machines, bicycles and automobiles. There is also a large carriage industry. In textile industries silk holds the first place. The amount of silk handled and woven in Milan is greater than that dealt with at Lyons. Spinning and twisting are as highly developed as the weaving industry. Milan is also the centre of the Italian cotton industry. Cotton-weaving, dyeing and printing are extensively carried on. Linen, flax, jute and wool are also spun and woven. The Milanese manufactures of articles in caoutchouc and of electric cables have acquired a world-wide reputation. In typography Milan is renowned principally for its musical editions and for its heliotype and zincotype establishments. There is, besides, a huge production of posters for advertisement. The manufacture of furniture of all kinds is still extensively carried on, Milan being the chief Lombard market and centre of exportation. The towns of Cantu, Meda, Lissone and Carugo supply Milanese firms with most of their merchandise, the furniture being made by the workmen at their own homes with materials supplied by the Milanese buyers, who also advance the capital necessary for working expenses. Theatrical costumes and appliances are also made in Milan, which is an important theatrical centre. House industry is still widely diffused in Milan itself, especially as regards working in gold, silver, vulcanite, bronze and leather. The motive power for much of the house industry is supplied by electricity. The electricity is partly furnished by hydraulic works at Paderno, 24 m. from Milan; the horse-power is continually being increased owing to new needs. Gas is also much used. Milan is also a centre of the export trade in cheese; chocolate, biscuits, &c., are also manufactured.

The municipal schools of Milan are as well organized as any in Italy, and the exhibit in connexion with them at the great international exhibition of 1906 was of interest. There were, in 1907, 76 buildings for schools and 47,968 pupils, while in the evening and holiday classes there were 10,724 older pupils; 2,109,920 free rations and 215,135 paid rations were distributed to 16,526 pupils, and douches were supplied. Pizzoli's Tavolo Psicoscopico for examining the mental qualities of the pupils is of interest. The international exhibition of 1906 held in Milan was of considerable importance, all the leading states of the world taking part in it. The retrospective exhibition of means of transport was interesting in view of the recent opening of the Simplon tunnel, the occasion of the exhibition. Among the most noteworthy exhibits were those of machinery, of automobiles and bicycles, of agriculture, of transports by sea, of modern art and architecture, of Italian home industries, of the city of Milan; besides which, all the countries exhibiting had their own separate pavilions.

Until 1898 the octroi circle did not extend beyond the walls; but in that year it was found necessary, owing to the growth of the city and of municipal expenditure, to include the external quarters or Corpi Santi (a name also applied to the extramural portions of Cremona and Pavia), with their large industrial population. Since that time municipal finance has been in a prosperous condition.

The water supply, from wells some 150 ft. deep in the sub-soil, is fairly good; one of the towers of the Castello Sforzesco is used as a distributing centre, while the sewerage system consists of 48 m. of sewers on the single channel principle, with collectors discharging into the Vettabia, a tributary of the Lambro.

In 1860 a large cemetery, the Cimitero Monumentale, was opened, but found to be insufficient, it is reserved for important monuments, that of Musocco, 3 m. from the city, being used for general purposes.

History—(For earlier history see MEDIOLANUM).—After the establishment of the Lombard capital at Pavia in 569 Milan remained the centre of Italian opposition to the foreign conquest. The Lombards were Arians, and the archbishops of Milan from the days of Ambrose had been always orthodox. Though the struggle was unequal, their attitude of resolute opposition to the Lombards gained for them great weight among the people, who felt that their archbishop was a power around whom they might gather for the defence of their liberty and religion. All the innate hatred of the foreigner went to strengthen the hands of the archbishops, who slowly acquired, in addition to their spiritual authority, powers military, executive and judicial. These powers they came to administer through their delegates, called viscounts. When the Lombard kingdom fell before the Franks under Charlemagne in 774, the archbishops of Milan were still further strengthened by the close alliance between Charles and the Church, which gave a sort of confirmation to their temporal authority, and also by Charles's policy of breaking up the great Lombard fiefs and dukedoms, for which he substituted the smaller counties. Under the confused government of Charles's immediate successors the archbishop was the only real power in Milan. But there were two classes of difficulties in the situation, ecclesiastical and political; and their presence had a marked effect on the development of the people and the growth of the commune, which was the next stage in the history of Milan. On the one hand the archbishop was obliged to contend against the heretics or against fanatical reformers who found a following among the people; and on the other, since the archbishop was the real power in the city, the emperor, the nobles and the people each desired that he should be of their party; and to whichever party he did belong he was certain to find himself violently opposed by the other two. From these causes it sometimes happened that there were two archbishops, and therefore no central control, or no archbishop at all, or else an archbishop in exile. The chief result of these difficulties was that a spirit of independence and a capacity of judging and acting for themselves was developed in the people of Milan. The terror of the Hunnish invasion, in 899, further assisted the people in their progress towards freedom, for it compelled them to take arms and to fortify their city, rendering Milan more than ever independent of the feudal lords who lived in their castles in the country. The tyranny of these nobles drove the peasantry and smaller vassals to seek the protection for life and property, the equality of taxation and of justice, which could be found only inside the walled city and under the rule of the archbishop. Thus Milan grew populous, and learned to govern itself. Its inhabitants became for the first time Milanese, attached to the standard of St Ambrose—no longer subjects of a foreign conqueror, but a distinct people, with a municipal life and prospects of their own. For the further growth of the commune, the action of the great archbishop, Heribert (1018–1045), the establishment of the carroccio, the development of Milanese supremacy in Lombardy, the destruction of Lodi, Como, Pavia and other neighbouring cities, the exhibition of free spirit and power in the Lombard league, and the battle of Legnano, see the articles ITALY and LOMBARDS. In 1157 an almost circular moat, still preserved in the inner canal or Naviglio, was constructed round the town; but in 1162 Frederick Barbarossa took and almost entirely destroyed the city, only a few churches surviving. The city with its walls was, however, rebuilt five years later by the allied cities of Bergamo, Brescia, Mantua and Verona.

After the battle of Legnano, in 1174, although the Lombard cities failed to reap the fruit of their united action, and fell to mutual jealousy once more, Milan internally began to grow in material prosperity. After the peace of Constance (1183) the city walls were extended; the arts flourished, each in its own quarter, under a syndic who watched the interests of the trade. The manufacture of armour was the most important industry. During the struggles with Barbarossa, when freedom seemed on the point of being destroyed, many Milanese vowed themselves, their goods and their families to the Virgin should their city come safely out of her troubles. Hence arose the powerful fraternity of the "Umiliati," who established their headquarters at the Brera, and began to develop the wool trade, and subsequently gave the first impetus to the production of silk. From this period also date the irrigation works which render the Lombard plain a fertile garden. The government of the city consisted of (*a*) a parlamento or consiglio grande, including all who possessed bread and wine of their own—a council soon found to be unmanageable owing to its size, and reduced first to 2000, then to 1500 and finally to 800 members; (*b*) a credenza or committee of 12 members, elected in the grand council, for the despatch of urgent or secret business, (*c*) the consuls, the executive, elected for one year, and compelled to report to the great council at the term of their office.

The bitter and well-balanced rivalry between the nobles and the people, and the endless danger to which it exposed the city owing to the fact that the nobles were always ready to claim the protection of their feudal chief, the emperor, brought to the front two noble families as protagonists of the contending factions—the Torriani of Valsassina, and the Visconti, who derived their name from the office of delegates which they had held under the archbishops. After the battle of Cortenova, in 1237, where Frederick II. defeated the Guelph army of the Milanese and captured their carroccio, Pagano della Torre rallied and saved the remnants of the Milanese. This act recommended him to popular favour, and he was called to the government of the city—but only for the distinct purpose of establishing the "catasta," a property tax which should fall with equal incidence on every citizen. This was a democratic measure which marked the party to which the Torriani belonged and rendered them hateful to the nobility. Pagano died in 1241. His nephew Martino followed as podestà in 1256, and in 1259 as signore of Milan—the first time such a title was heard in Italy. The nobles, who had gathered round the Visconti, and who threatened to bring Ezzelino da Romano, the Ghibelline tyrant of Padua, into the city, were defeated by Martino, and 900 of their number were captured. Martino was followed by two other Torriani, Filippo his brother (1263–1265) and Napoleone his cousin (1265–1277), as lords of Milan. Napoleone obtained the title of imperial vicar from Rudolph of Hapsburg. But the nobles under the Visconti had been steadily gathering strength, and Napoleone was defeated at Desio in 1277. He ended his life in a wooden cage at Castel Baradello above Como.

Otto Visconti, archbishop of Milan (1262), the victor of Desio, became lord of Milan, and founded the house of Visconti, who ruled the city—except from 1302 to 1310—till 1447, giving twelve lords to Milan. Otho (1277–1295), Matteo (1310–1322), Galeazzo (1322–1328), Azzo (1328–1339), Lucchino (1339–1349) and Giovanni (1349–1354) followed in succession. Giovanni left the lordship to three nephews—Matteo, Galeazzo and Bernabò. Matteo was killed (1355) by his brothers, who divided the Milanese, Bernabò reigning in Milan (1354–1385) and Galeazzo in Pavia (1354–1378). Galeazzo left a son, Gian Galeazzo, who became sole lord of Milan by seizing and imprisoning his uncle Bernabò. It was under him that the cathedral of Milan and the Certosa di Pavia were begun. He was the first duke of Milan, having obtained that title from the emperor Wenceslaus. His sons Giovanni Maria, who reigned at Milan (1402–1412), and Filippo Maria, who reigned at Pavia (1402–1447), succeeded him. In 1412, on his brother's death, Filippo united the whole duchy under his sole rule, and attempted to carry out his father's policy of aggrandizement, but without success.

Filippo was the last male of the Visconti house. At his death a republic was proclaimed, which lasted only three years. In 1450 the general Francesco Sforza, who had married Filippo's only child Bianca Visconti, became duke of Milan by right of conquest if by any right. Under this duke the castello was rebuilt and the canal of the Martesana, which connects Milan with the Adda, and the Great Hospital were carried out. Francesco was followed by five of the Sforza family. His son Galeazzo Maria (1466–1476) left a son, Gian Galeazzo, a minor, whose guardian and uncle Lodovico (il Moro) usurped the duchy (1479–1500). Lodovico was captured in 1500 by Louis XII. of France, and Milan remained for twelve years under the French crown. In the partial settlement which followed the battle of Ravenna, Massimiliano Sforza, a protégé of the emperor, was restored to the throne of Milan, and held it by the help of the Swiss till 1515, when Francis I. of France reconquered the Milanese by the battle of Marignano, and Massimiliano resigned the sovereignty for a revenue from France. This arrangement did not continue. Charles V. succeeded the emperor Maximilian, and at once disputed the possession of the Milanese with Francis. In 1522 the imperialists entered Milan and proclaimed Francesco Sforza (son of Lodovico). Francesco died in 1535, and with him ended the house of Sforza. From this date till the War of the Spanish Succession (1714) Milan was a dependency of the Spanish crown. At the close of that war it was handed over to Austria; and under Austria it remained till the Napoleonic campaign of 1796. For the results of that campaign, and for the history of Italian progress towards independence, in which Milan played a prominent part by opening the revolution of 1848, with the insurrection of the Cinque Giornate (March 17–22), by which the Austrians were driven out; the reader is referred to the article ITALY. The Lombard campaign of 1859, with the battles of Solferino and Magenta, finally made Milan a part of the kingdom of Italy.

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MILANESI, GAETANO (1813–1895), Italian scholar and writer on the history of art, was born at Siena, where he studied law, and in 1838 he obtained an appointment in the public library. In 1856 he was elected member of the Accademia della Crusca, in which capacity he took part in the compilation of its famous but still unfinished dictionary, and two years later was appointed assistant keeper of the Tuscan archives, in Florence; then he took charge of the famous Medici archives, whence he collected a vast body of material on the history of Italian art, not all of which is yet published. In 1889 he became director of the archives, but retired in 1892, and died three years later. His most important publication is his edition of Vasari's works in nine volumes, with copious and valuable notes (Florence, 1878–1885). Of his other writings the following may be mentioned: *Il diario inedito di Alessandro Sozzini* (in the *Archivio storico Italiano*, 1842); *Documenti per la storia dell' arte senese*, 3 vols. (Siena, 1854–1856) and *Discorsi sulla storia civile ed artistica di Siena* (Siena, 1862). He also edited a number of Italian classics.

See E. Ridolfi's article in the *Nuova antologia* (May 15, 1895); and A. Virgili's article in the *Atti della regia Accademia della Crusca* (Florence, 1895).

MILAN OBRENOVICH IV. (1854–1901), king of Servia, was born on the 22nd of August 1854, at Jassy. He was the grand-nephew of the famous Milosh, whose brother Jefrem (d. 1856) had a son, Milosh (1829–1861), who married Maria Katardži, a Moldavian. Milan was their son. While still very young, he lost both his parents, and was adopted by his cousin, Michael Obrenovich, who returned to Servia on the expulsion of the Karageorgeviches in 1858 and became ruling prince on the death of his father, Milosh, in 1860. During the reign of Michael young Milan was educated in Paris, at the Lycée Louis-le-Grand, where he displayed considerable precocity, but he was only fourteen years of age when in 1868 his cousin was assassinated and he succeeded to the throne under a regency. In 1872 he was declared of age, and taking the reins of government into his own hands, soon manifested great intellectual power, coupled with a passionate headstrong character. Eugene Schuyler, who saw him about this time, found him "a very remarkable young man . . . singularly intelligent and well-informed." By a careful balancing of the Austrian and Russian parties in Servia, with a judicious leaning towards the former, Prince Milan was enabled in 1878, at the end of the Turkish War, to induce the Porte to acknowledge his independence, and was proclaimed king in 1882. (The history of his reign is told in detail under SERVIA.) Acting under Austrian influence, King Milan devoted all his energies to the improvement of means of communication and the development of natural resources, but the cost, which was unduly increased by reckless extravagance, led to proportionately heavy taxation. This, coupled with increased military service, rendered King Milan and the Austrian party most unpopular; and his political troubles were further increased by the defeat of the Servians in the war against Bulgaria, 1885–86. In 1885 (Sept.) the union of Rumelia and Bulgaria caused widespread agitation in Servia, and Milan precipitately declared war upon his kinsman Prince Alexander on the 15th of November. After a short but decisive campaign, the Servians were utterly routed at the battles of Slivinska and Pirot, and Milan's throne was only saved by the direct intervention of Austria. Domestic difficulties now arose which rapidly assumed a political significance. In October 1875 King Milan had married Natalie, the sixteen-years-old daughter of Peter Ivanovich Ketchko, a Moldavian Boyar, who was a colonel in the Russian army, and whose wife, Pulcheria, was by birth Princess Sturdza. A son, Alexander, was born in 1876, but the king and queen showed signs of friction. Milan was anything but a faithful husband. Queen Natalie was greatly influenced by Russian sympathies; and the couple, ill-assorted both personally and politically, separated in 1886, when the queen withdrew from the kingdom, taking with her the young prince, Alexander, afterwards king, then ten years of age. While she was residing at Wiesbaden in 1888, King Milan succeeded in recovering the crown prince, whom he undertook to educate; and in reply to the queen's remonstrances, he exerted considerable pressure upon the metropolitan, and procured a divorce, which was afterwards annulled as illegal. King Milan now seemed master of the situation, and on the 3rd of January 1889 promulgated a new constitution much more liberal than the existing one of 1869. Two months later (March 6) he suddenly abdicated in favour of his son, a step for which no satisfactory reason was assigned, and settled as a private individual in Paris. In February 1891 a Radical ministry was formed, Queen Natalie and the ex-metropolitan Michael returned to Belgrade, and Austrian influence began to give way to Russian. Fear of a revolution and of King Milan's return led to a compromise, by which in May 1891 the queen was expelled, and Milan was allowed a million francs from the civil list, on condition of not returning to Servia during his son's minority. Milan in March 1892 renounced all his rights, and even his Servian nationality. The situation altered, however, after the young King Alexander in April 1893 had effected his *coup d'état* and taken the reins of government into his hands. Servian politics began to grow more complicated, and Russian intrigue was rife. In January 1894 Milan suddenly appeared at Belgrade, and his son gladly availed himself of his experience and advice. On the 29th of April a royal decree reinstated Milan and Natalie, who in the meantime had become ostensibly reconciled, in their position as members of the royal family. On the 21st of May the constitution of 1869 was restored, and Milan continued to exercise considerable influence over his son. The queen, who had been residing chiefly at Biarritz, returned to Belgrade in May 1895, after four years' absence, and was greeted by the populace with great enthusiasm. In 1897 Milan was appointed commander-in-chief of the Servian army. In this capacity he did some of the best work of his life, and his success in improving the Servian military system was very marked. His relations with the young king also remained good, and for a time it seemed as though all Russian intrigues were being checked. The good relations between father and son were interrupted, however, by the latter's marriage in July 1900. Milan violently opposed the match, and resigned his post as commander-in-chief; and the young king banished him from Servia and threw himself into the arms of Russia. Milan retired to Vienna, and there he died unexpectedly on the 11th of February 1901. Milan was an able, though headstrong man, but he lived a scandalously irregular life, and was devoid of moral principle. In considering his relations with his young son, it must be remembered that in the dynastic and political condition of Servia natural feeling was inevitably subordinated in Milan to other considerations. (H. Ch.)

MILÁ Y FONTANALS, MANUEL (1818–1884), Spanish scholar, born at Villafranca del Panadés, near Barcelona, on the 4th of May 1818, was educated first at Barcelona, and afterwards at the university of Cervera. In 1845 he became professor of literature at the university of Barcelona, and held this post till his death at Villafranca del Panadés on the 16th of July 1884. The type of the scholarly recluse, Milá y Fontanals was almost unknown outside the walls of the university till 1859, when he was appointed president of the *juegos florales* at Barcelona. On the publication of his treatise, *De Los trovadores en España* (1866), his merits became more generally recognized, and his monograph, *De La poesía heróico-popular castellana* (1873) revealed him to foreign scholars as a master of scientific method.

MILAZZO, a seaport on the north coast of Sicily, in the province of Messina, 22 m. W. of Messina by rail. Pop. (1901), 16,422. It is mainly built on the low isthmus of a peninsula, which stretches some 3 m. farther north and forms a good harbour: but the old town, which contains a castle, mainly the work of Charles V., lies on a hill above. Milazzo is the ancient *Mylae*, an outpost of Zancle, occupied before 648 B.C., perhaps as early as 716 B.C. (E. A. Freeman, *History of Sicily*, I., pp. 395, 587). It was taken by the Athenians in 426 B.C. The people of Rhegium planted here the exiles from Naxos and Catana in 395 B.C. as a counterpoise to Dionysius' foundation of Tyndaris; but Dionysius soon took it. In the bay Duilius won the first Roman naval victory over the Carthaginians (260 B.C.).

MILDENHALL, a market town in the Stowmarket parliamentary division of Suffolk, England, 76½ m. N.N.E. from London by a branch of the Great Eastern railway from Cambridge. Pop. (1901), 3567. It lies on the edge of Mildenhall Fen, the great Fen district stretching northward and westward from here. The church of St Andrew has an Early English chancel with fine east window and chancel arch. The remainder is principally Perpendicular with a magnificent carved oak roof, ornate north porch and lofty tower with fan tracery within. There is a wooden market cross of the 15th century; the manor house is a picturesque gabled building of the 17th century, and there is a modern public hall. Flour milling is an industry. The discovery of Roman remains indicates a small settlement.

MILDEW (O. Eng. *meledēaw* or *mildeaw*, explained as "mealdew," cf. Ger. *Mehlthau*, with more probability, as "honeydew," Goth. *melith*, honey, cf. Lat. *mel*, Gr. μέλι), a popular name given to various minute fungi from their appearance, and from the sudden, dew-like manner of their occurrence. Like many other popular names of plants, it is used to denote different species which possess very small botanical affinity. The term is applied, not only to species belonging to various systematic groups, but also to such as follow different modes of life. The corn-mildew, the hop-mildew and the vine-mildew are, for example, parasitic upon living plants, and the mildews of damp linen and of paper are saprophytes (Gr. σαπρός, rotten), that is, they subsist on matter which is already dead. As regards mildews in general, the conditions of life and growth are mainly suitable nutrition and dampness accompanied by a high temperature. The life history of the same species of mildew frequently covers two or more generations, and these are often passed on hosts of different kinds. In some cases again the same generation confines its attack to the same kind of host, while in others the same generation grows on various hosts (see FUNGI; HOP; and WHEAT).

MILES, NELSON APPLETON (1839–), American soldier, was born in Westminster, Massachusetts, on the 8th of August 1839. He was engaged in mercantile pursuits in Boston when the Civil War began, and he entered the army in September 1861 as a lieutenant in the 22nd Massachusetts volunteer infantry. He served with distinction in the Peninsular campaign, and at Antietam, Fredericksburg and Chancellorsville, where he received a wound which incapacitated him up to the opening of Grant's Virginia campaign of 1864. He had been commissioned in September 1862 colonel of the 61st New York volunteers, commanded a brigade at the Wilderness and Spottsylvania, and in May 1864 was rewarded for his gallant leadership by the grade of brigadier-general of volunteers. He fought in the Cold Harbor and Petersburg operations in 1864–65, was brevetted major-general of volunteers for his conduct at Reams Station, and at the close of the war was in temporary command of an army corps. In July 1866 he was made colonel of a regular infantry regiment, and in 1867 he was brevetted brigadier-general in the regular army for his services at Chancellorsville and major-general for his services at Spottsylvania. He was promoted to be brigadier-general U.S.A. (Dec. 1880), and to be major-general (April 1890), and in 1895 succeeded General John McA. Schofield as commanding general of the United States army. He was conspicuously successful (1869–1886) in dealing with Indian outbreaks, fighting the Cheyenne, Kiowa and Comanche on Llano Estacado (1875) and the Sioux in Montana (1876), capturing the Nez Percés under Chief Joseph (1877), and defeating the Chiricahua Apaches under Geronimo (1886), and he commanded the United States troops sent to Chicago during the railway riots in 1894. He was in nominal direction of military operations during the war with Spain in 1898, though his personal share of the operations was confined to directing the almost unopposed Porto Rico expedition. He was raised to the rank of lieutenant-general in June 1900, and retired from active service in August 1903. In 1905–1906 he was adjutant-general and chief-of-staff under Governor William L. Douglas in Massachusetts. He wrote *Personal Recollections* (1896), *Military Europe* (1898) and *Observations Abroad* (1899).

MILETUS (mod. *Palatia*), an ancient city of Asia Minor, on the southern shore of the Latmic Gulf near the mouth of the Maeander. Before the Ionic migration it was inhabited by Carians (*Iliad* ii. 876; Herod. i. 146), and pottery, found by Th. Wiegand on the spot proves that the site was inhabited, and had relations with the Aegean world, in the latest Minoan age. The Greek settlers from Pylos under Neleus are said to have massacred all the men in the old city, and built for themselves a new one on the coast. Miletus occupied a very favourable situation at the mouth of the rich valley of the Maeander, and was the natural outlet for the trade of southern Phrygia (Hipponax, *Fr.* 45). It had four harbours, one of considerable size, and its power extended inland for some distance up the valley of the Maeander, and along the coast to the south, where it founded the city of Iasus. Its enterprise extended to Egypt, where it had much to do with the settlement of Naucratis (*q.v.*). Very little "Naucratiti" pottery, however, was found on the site by Wiegand, and only in the Athena temple. The Black Sea trade, however, was the greatest source of wealth to the Ionian cities. Miletus, like the rest, turned its attention chiefly to the north, and succeeded in almost monopolizing the traffic. Along the Hellespont, the Propontis and the Black Sea coasts it founded more than sixty cities—among them Abydus, Cyzicus, Sinope, Dioscurias, Panticapaeum and Olbia. All these cities were founded before the middle of the 7th century; and before 500 B.C. Miletus was decidedly the greatest Greek city. During the time when the enterprise of the seafaring population raised Miletus to such power and wealth nothing is known of its internal history, though the analogy of all Greek cities, and some casual statements in later writers, suggest that the usual struggles took place between oligarchy and democracy, and that tyrants sometimes raised themselves to supreme power. Miletus was equally distinguished at this early time as a seat of literature. The Ionian epic and lyric poetry indeed had its home farther north; philosophy and history were more akin to the practical race of Miletus, and Thales, Anaximander, Anaximenes and Hecataeus all belonged to this city. The poet Timotheus and the famous Aspasia were also natives. The three Ionian cities of Caria—Miletus, Myus and Priene—spoke a peculiar dialect of Ionic.

The Mermnad kings of Lydia found in Miletus their strongest adversary. War was carried on for many years, till Alyattes III. concluded a peace with Thrasybulus, tyrant of Miletus; the Milesians afterwards seem to have acknowledged peaceably the rule of Croesus. On the Persian conquest Miletus passed under a new master; it headed the Ionian revolt of 500 B.C., and was taken by storm after the battle of Lade (see Ionia). Darius massacred most of the inhabitants, transported the rest to Ampe at the mouth of the Tigris, and gave up the city to the Carians. This disaster was long remembered in Greece and made the theme of a tragedy by Phrynichus. Henceforth the history of Miletus has no special interest. It revived indeed when the Persians were expelled from the coast in 479 B.C., became a member of the Delian League (*q.v.*), revolted to Sparta in 412, passed into Carian hands, and opposed Alexander on his southward march, succumbing only to a siege in form (334 B.C.). It was a town of commercial importance throughout the Graeco-Roman period, and received special attention from Trajan. Its harbours, once protected by Lade and the other Tragasaean islands, were gradually silted up by the Maeander, and Lade is now a hill some miles from the coast. Ephesus took its place as the great Ionian harbour in Hellenistic and Roman times. Miletus became the seat of a Christian bishopric and was strengthened by a Byzantine castle (*κάστρον τῶν Παλατίων*) built above the theatre; but its decay was inevitable, and its site is now a marsh.

Since 1899 Miletus has been the scene of extensive excavations directed by Dr Th. Wiegand for the Berlin Academy. The ruins lie about the base of a hillock projecting north-east into a bend of the Maeander. On the north is a well-preserved theatre of Roman times on the site of an older Greek building. When complete it had 54 rows of seats. It was as large as any theatre in Asia Minor, and is still imposing, the auditorium, though deprived of its upper ranks and colonnade, rising nearly 100 ft. Cyriac of Ancona described the building as practically complete in his day (1446). The front is over 150 yds. long. East of this was the ancient north harbour, now silted up, and on the hillside above it stood a large heroön of Hellenistic time remarkable for being, like the tomb of Brasidas at Amphipolis, within the walls. South of the harbour head lies the Hellenistic agora with ruins of large magazines of Doric style. South of these again lie a nymphaeum of the age of Titus, and a senate-house of theatral form. On the east opens a great hall surrounded by porticoes and enclosing a high altar of Artemis, once richly adorned with reliefs. The Roman agora lies beyond this again. A straight street leads south-west from the north harbour to the Didyma Gate in the wall, which runs across the neck of the peninsula and was rebuilt by Trajan, when he undertook to raise the level of the outer quarters of the city; and streets cross this at right angles in the geometric Hellenistic manner. A Sacred Way lined with tombs, led to Didymi. Two temples have been discovered by Dr Wiegand, one, on the south-east, being a large sanctuary of Apollo Delphinius with triple colonnade enclosing a court with central tripod. This seems to have been the chief temple of the city and the place where public records, treaties, &c., were engraved. The other temple, an archaic sanctuary of Athena, lies west of the stadium.

See O. Rayet and A. Thomas, *Milet et le golfe Latmique* (1877); Th. Wiegand, "Vorläufige Berichte über die Ausgrabungen in Milet," in *Sitzungsberichte* of the Berlin Academy (1900, foll.); A. von Salis, "Die Ausgrabungen in Milet und Didyma" in *Neue Jahrb. f. d. k. Alt.*, xxv. 2, 1910. (D. G. H.)

MILFORD, a township of New Haven county, Connecticut, U.S.A., on Long Island Sound, separated from the township of Stratford on the W. by the Housatonic river, and about 10 m. S.W. of New Haven. Pop. (1890), 3811; (1900), 3783, including 541 foreign-born and 173 negroes; (1910), 4366. Area, about 16 sq. m. Milford is served by the New York, New Haven & Hartford railroad, and by an electric line connecting with Bridgeport and New Haven. Within its borders are various popular beaches, including Woodmont (incorporated as a borough in 1903), Pond Point, Bay View, Fort Trumbull Beach (where a fortification, named Fort Trumbull, was erected in 1776), Myrtle Beach, Meadow's End, Walnut Beach and Milford Point. The township is traversed by the Wepowaug river, which here empties into the Sound. Milford is a typical old New England town, and many of the permanent inhabitants are descendants from the first settlers. The burying-ground includes the tomb of Robert Treat (1622–1710), commander of the Connecticut troops in King Philip's War, leader of the company that founded Newark, New Jersey, governor of Connecticut (from 1683 to 1698) at the time its charter was demanded by Governor Andros in 1686–1687, and deputy-governor in 1676–1683 and 1698–1708; and also that of Jonathan Law (1674–1751), governor of Connecticut from 1742 to 1751. Spanning the Wepowaug river near a gorge and not far from its mouth is a granite bridge and tower, built, as a memorial to the first settlers, in 1889, in connexion with the celebration of the 250th anniversary of the founding of the town. Milford has a beautiful green of about four acres, containing a soldiers' monument. It has also the Taylor Library (founded in 1894), and along the Sound are many summer residences. Named after Milford, England, it was founded in 1639 by Rev. Peter Prudden and his followers from New Haven and Wethersfield. The land was purchased from the Indians for 6 coats, 10 blankets, 1 kettle, 12 hatchets, 12 hoes, 24 knives and 12 small mirrors. A "church-state" was immediately organized after the model of that of New Haven, but two or three years later the town bestowed suffrage on six of its inhabitants who were not church members. These citizens were an obstacle to the town's admission to the New Haven Jurisdiction, which was formed in 1643, but in the following year a compromise was effected and Milford was admitted on condition that, in the future, suffrage should be granted only to church members and that none of the objectionable six should be elected to any office of the Jurisdiction. In 1664 Milford, with the other members of the Jurisdiction, was absorbed by Connecticut; this caused considerable dissatisfaction and some of the inhabitants under the lead of Robert Treat removed to New Jersey and assisted in the founding of Newark. The regicides Whalley and Goffe were concealed in Milford from 1661 to 1664.

See M. Louise Greene, "Early Milford," in the *Connecticut Magazine*, vol. v. (Hartford, 1899).

MILFORD, a township of Worcester county, Massachusetts, U.S.A., about 16 m. S.E. of Worcester. Pop. (1890), 8780; (1900) 11,376, of whom 3342 were foreign-born; (1910 census) 13,055. Within its area of about 15 sq. m. are a large rural population and the village of Milford, on the Charles river, about 33 m. S.W. of Boston, served by the Boston & Albany, the New York, New Haven & Hartford and the Grafton & Upton railways (the last named having its passenger department operated by electricity and its freight by steam, and connecting Milford with North Grafton), and by inter-urban electric lines. The village has a memorial hall, housing the public library, and in the township there is an excellent hospital, the gift of Eben. S. Draper. The village is a shipping point for an agricultural and manufacturing district. In 1905 the value of the township's factory products was $3,390,504 (32·8% more than in 1900). The most important manufactures are boots and shoes; the industry was established in 1795, and for many years the special product was brogans for Southern negroes. In 1908 there were 12 large granite quarries in the township (north and north-east of the village). Milford granite is the typical stone of an area reaching into Rhode Island south of the southern boundary of Providence county; it is a biotite granite of post-Cambrian age, is generally pinkish-gray in colour (owing to the large proportion of feldspar among its constituents), and is widely used for building purposes. The township was the east precinct of Mendon until 1780, when it was incorporated; in 1835 parts of Holliston and Hopkinton were annexed; in 1886 a part was separated as Hopedale.

See Adin Ballou, *History of Milford* (Boston, 1882); and T. Nelson Dale, *The Chief Commercial Granites of Massachusetts, New Hampshire and Rhode Island* (Washington, 1908), Bulletin 354 of the U.S. Geological Survey.

MILFORD HAVEN, a market town, seaport, urban district and contributory parliamentary borough of Pembrokeshire, Wales, situated on the north shore of the celebrated harbour of the same name. Pop. (1901), 5102, including the adjacent village of Hakin. Milford Haven is the terminus of a branch-line of the South Wales section of the Great Western railway. The town possesses a pier and important dock accommodation, including a graving-dock 600 ft. long, and is the centre of a valuable and increasing fishing industry. The promenade of Hamilton Terrace commands a fine view of the broad expanse of the Haven with its various towns and forts.

The present town of Milford Haven, originally a hamlet in the parish of Steynton, is of modern growth, and was first called into existence by the exertions of the Hon. R. F. Greville, nephew of Sir William Hamilton, who in 1790 laid out a town on this spot, the advantages of which as a convenient port for the Irish traffic he clearly recognized. In the opening years of the 19th century a royal dockyard was established here, but in 1814 dockyard and arsenal were removed to Paterchurch near Pembroke. The growth of the town was further checked twenty years later by the development of Neyland, or New Milford, further east on the Haven, whither the Irish packet service was transferred; but towards the close of the 19th century the town recovered much of its former prosperity. The importance of the place is wholly due to its excellent situation on the splendid land-locked harbour, which is here 2 m. broad.

Milford Haven itself, designated by the Welsh Aberdaugleddau, as the estuary of the united East and West Cleddy rivers, has played an important part on several occasions in the course of history. Throughout Plantagenet times it formed the chief point of embarcation for Ireland. It was from Milford Haven that Henry II. set sail for the conquest of Ireland in 1172, and to this harbour he made his return journey. In 1399 Richard II. landed at Milford Haven from Ireland, shortly before his surrender to Henry of Lancaster, afterwards Henry IV., in whose reign a French fleet with 12,000 men on board sailed to the Haven and disembarked with the object of assisting the rebellion of Owen Glendower. In 1485 Henry, earl of Richmond, disembarked here on his return from France, and was welcomed on landing by Sir Rhys ap Thomas and much of the chivalry of Wales. In 1588 the leading persons of Pembrokeshire, with Bishop Anthony Rudd of St David's at their head, petitioned Queen Elizabeth to fortify the Haven against the projected Spanish invasion, upon which the block-houses of Dale and Nangle at either side of the mouth of the harbour were accordingly erected. During the 19th century numerous forts have been constructed for the protection of the Haven and of the royal dockyard at Pembroke Dock.

MILICZ, or MILITSCH (d. 1374), Bohemian divine, was the most influential among those preachers and writers in Moravia and Bohemia who, during the 14th century, in a certain sense paved the way for the reforming activity of Huss. The date of his birth is not known, but he was in holy orders in 1350, in 1360 was attached to the court of the emperor Charles IV., whom he accompanied into Germany in that year, and about the same time also held a canonry in the cathedral of Prague along with the dignity of archdeacon. About 1363 he resigned all his appointments that he might become a preacher pure and simple; he addressed scholars in Latin, and (an innovation) the laity in their native Czech, or in German, which he learnt for the purpose. He was conspicuous for his apostolic poverty and soon roused the enmity of the mendicant friars. The success of his labours made itself apparent in the way in which he transformed the notorious "Benatki" street of Prague into a benevolent institution, "Jerusalem." As he viewed the evils inside and outside the church in the light of Scripture, the conviction grew in his mind that the "abomination of desolation" was now seen in the temple of God, and that antichrist had come, and in 1367 he went to Rome (where Urban V. was expected from Avignon) to expound these views. He affixed to the gate of St Peter's a placard announcing his sermon, but before he could deliver it was thrown into prison by the Inquisition. Urban, however, on his arrival, ordered his release, whereupon he returned to Prague, and from 1369 to 1372 preached daily in the Teyn Church there. In the latter year the clergy of the diocese complained of him in twelve articles to the papal court at Avignon, whither he was summoned in Lent 1374, and where he died in the same year, not long after being declared innocent and authorized to preach before the assembly of cardinals. He was the author of a *Libellus de Antichristo*, written in prison at Rome, a series of *Postillae* and *Lectiones quadragesimales* in Latin, and a similar series of *Postils* (devotional tracts) in Czech.

See Count Lützow, *Life and Times of Master John Hus* (1909), pp. 27-38.

MILITARY FRONTIER (Ger. *Militärgrenze*, Slav. *Granitza*), a narrow strip of Austrian-Hungarian territory stretching along the borders of Turkey, which had for centuries a peculiar military organization, and from 1849 to 1873 constituted a crown-land. As a separate division of the monarchy it owed its existence to the necessity of maintaining during the 16th and 17th centuries a strong line of defence against the invasions of the Turks, and may be said to have had its origin with the establishment of the captaincy of Zengg (a coast town about 35 m. south-east of Fiume) by Matthias Corvinus and the introduction of Uskoks (*q.v.*) into Croatia. By the close of the 17th century there were three frontier "generalates"—Carlstadt, Warasdin and Petrinia or Petrinja (the last also called the Banal). After the defeat of the Turkish power by Prince Eugene it was proposed to abolish the military constitution of the frontier, but the change was successfully resisted by the inhabitants of the district; in fact a new Slavonian frontier district was established in 1702, and Maria Theresa extended the organization to the march-lands of Transylvania (the Szekler frontier in 1764, the Wallachian in 1766).[1]

As a reward for the service it rendered the government in the suppression of the Hungarian insurrection in 1848, the Military Frontier was erected in 1849 into a crown-land, with a total area of 15,182 sq. m. and a population of 1,220,503. In 1851 the Transylvanian portion (1177 sq. m.) was incorporated with the rest of Transylvania; and in 1871 effect was given to the imperial decree of 1869 by which the districts of the Warasdin regiments (St George and the Cross) and the towns of Zengg, Belovar, Ivanič, &c., were "provincialized" or incorporated with the Croatian-Slavonian crown-land. In 1872 the Banat regiments followed suit; and in 1873 the old military organization was abolished in the rest of the frontier. Not till 1881, however, were the Croatian-Slavonian march-lands completely merged in the kingdoms to which they naturally belonged.

The social aspect of the military frontier régime is interesting. The *zadruga* system of land tenure was artificially kept in existence (see SERVIA). Watch-towers with wooden clappers and the beacons which flashed the alarm along the whole frontier in a few hours are still features in the landscape.

MILITARY LAW, "the law which governs the soldier in peace and in war, at home and abroad. At all times and in all places the conduct of officers and soldiers as such is regulated by military law." The above is the definition as given in the opening chapter of the *Manual of Military Law*, which is issued under the authority of the English War Office, and which is the text-book used by all English courts martial. The definition is, however, somewhat too wide, as the British system does not exclude in time of peace the action of the civil courts. In time of peace all persons who belong to the military class in most European continental countries are judged by military law and by military courts. There is also in most continental countries an intermediate stage between war and peace, known as in *état de siège*, which may be declared for a fixed period for a district, or even a city, by reason of domestic insurrection or the presence of an enemy. It requires legislative enactment. Thirdly comes a state of war, when the military authorities are supreme; and whilst they can call upon the civil power to act in concert with them, the military authority is final. This is a brief summary of the system of military law that prevails in most countries of the continent. The cardinal point of difference between the British and the continental systems lies in the fact that in the United Kingdom the soldier is not only a soldier, but a citizen also; and although he may be tried for civil offences by a military tribunal, the power is not exercised in all cases. Thus treason, treason-felony, murder, manslaughter, rape, are brought before a civil court in times of peace, if the offence is committed in the United Kingdom, or if it is committed anywhere else in the king's dominions, except Gibraltar, within a hundred miles from a place where the offender can be tried by a civil court. Minor civil offences, when not committed within military lines, or when the person affected by the offence is a civilian, or when it is a case for a jury, or where intricate questions of law may arise, may also be brought before a civil tribunal. But an offence, of whatever nature, committed on active service would be brought before a military tribunal.

English Law.

The military law of England in early times existed, like the forces to which it applied, in a period of war only. Troops were raised for a particular service, and were disbanded upon the cessation of hostilities. The crown, of its mere prerogative, made laws known as Articles of War, for the government and discipline of the troops while thus embodied and serving. Except for the punishment of desertion, which offence was made a felony by statute in the reign of Henry VI., these ordinances or Articles of War remained almost the sole authority for the enforcement of discipline until 1689, when the first Mutiny Act was passed and the military forces of the crown were brought under the direct control of parliament. Even the Parliamentary forces in the time of Charles I. and Cromwell were governed, not by an act of the legislature, but by articles of war similar to those issued by the king and authorized by an ordinance of the Lords and Commons, exercising in that respect the sovereign prerogative. This power of law-making by prerogative was, however, held to be applicable during a state of actual war only, and attempts to exercise it in time of peace were ineffectual. Subject to this limitation it existed for considerably more than a century after the passing of the first Mutiny Act. From 1689 to 1803, although in peace time the Mutiny Act was occasionally suffered to expire, a statutory power was given to the crown to make Articles of War to operate in the colonies and elsewhere beyond the seas in the same manner as those made by prerogative operated in time of war. In 1715, in consequence of the rebellion, this power was created in respect of the forces in the kingdom. But these enactments were apart from and in no respect affected the principle acknowledged all this time—that the crown of its mere prerogative could make laws for the government of the army in foreign countries in time of war. The Mutiny Act of 1803 effected a great constitutional change in this respect: the power of the crown to make any Articles of War became altogether statutory, and the prerogative merged in the act of parliament. So matters remained till the year 1879, when the last Mutiny Act was passed and the last Articles of War were promulgated. The Mutiny Act legislated for offences in respect of which death or penal servitude could be awarded, and the Articles of War, while repeating those provisions of the act, constituted the direct authority for dealing with offences for which imprisonment was the maximum punishment as well as with many matters relating to trial and procedure. The act and the articles were found not to harmonize in all respects. Their general arrangement was faulty, and their language sometimes obscure. In 1869 a royal commission recommended that both should be recast in a simple and intelligible shape. In 1878 a committee of the House of Commons endorsed this view and made certain recommendations as to the way in which the task should be performed. In 1879 the government submitted to parliament and passed into law a measure consolidating in one act both the Mutiny Act and the Articles of War, and amending their provisions in certain important respects. This measure was called the "Army Discipline and Regulation Act 1879." After one or two years' experience of its working it also was found capable of improvement, and was in its turn superseded by the Army Act 1881, which now forms the foundation and the main portion of the military law of England. It contains a proviso saving the right of the crown to make Articles of War, but in such a manner as to render the power in effect a nullity; for it enacts that no crime made punishable by the act shall be otherwise punishable by such articles. As the punishment of every conceivable offence is provided for by the act, any articles made thereunder can be no more than an empty formality having no practical effect. Thus the history of English military law up to 1879 may be divided into three periods, each having a distinct constitutional aspect: (1) that prior to 1689, when the army, being regarded as so many personal retainers of the sovereign rather than servants of the state, was mainly governed by the will of the sovereign; (2) that between 1689 and 1803, when the army, being recognized as a permanent force, was governed within the realm by statute and without it by the prerogative of the crown; and (3) that from 1803 to 1879, when it was governed either directly by statute or by the sovereign under an authority derived from and defined and limited by statute. Although in 1879 the power of making Articles of War became in effect altogether inoperative, the sovereign was empowered to make rules of procedure, having the force of law, which regulate the administration of the act in many matters formerly dealt with by the Articles of War. These rules, however, must not be inconsistent with the provisions of the Army Act itself, and must be laid before parliament immediately after they are made. Thus in 1879 the government and discipline of the army became for the first time completely subject either to the direct action or the close supervision of parliament.

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[1] By 1848 the following had come to be the division of the Military Frontier: (1) *The Carlstadt* (*Carlowatz*), *Warasdin and Banal Generalate*; corresponding to the original three generalates. (2) *The Slavonian Generalate*; (district of Mitrovica). (3) *The Banat Generalate*; south and east of Temesvar, and (4) *The Transylvanian Generalate.* Twelve towns, known as "military communities," had communal constitutions not unlike those of the free towns of Hungary-Carlopago, Zengg, Petrinia, Kostajnica, Belovar, Ivanič, Brod, Peterwardein, Carlowitz, Semlin, Pancsova and Weisskirchen.

A further notable change took place at the same time. The Mutiny Act had been brought into force on each occasion for one year only, in compliance with the constitutional theory that the maintenance of a standing army in time of peace, unless with the consent of parliament, is against law. Each session therefore the text of the act had to be passed through both Houses clause by clause and line by line. The Army Act, on the other hand, is a fixed permanent code. But constitutional traditions are fully respected by the insertion in it of a section providing that it shall come into force only by virtue of an annual act of parliament. This annual act recites the illegality of a standing army in time of peace unless with the consent of parliament, and the necessity nevertheless of maintaining a certain number of land forces (exclusive of those serving in India) and a body of royal marine forces on shore, and of keeping them in exact discipline, and it brings into force the Army Act for one year.

Military law is thus chiefly to be found in the Army Act and the rules of procedure made thereunder, the Militia Acts, the Reserve Forces Acts and the Volunteer Acts, together with certain acts relating to the yeomanry, the Territorial and Reserve Forces Act 1907, and various royal warrants and regulations. In the Army (Annual) Act 1906 important amendments were made to the Army Act for the purpose of preventing soldiers convicted of offences against discipline under the act, and not discharged with ignominy, being subjected to the stigma attaching to imprisonment. This was effected by creating a new punishment, termed detention, the places in which soldiers undergo detention being termed detention barracks. The change, while principally one of nomenclature, removed an undoubted grievance. The Army Act itself is, however, the chief authority. Although the complaint has been sometimes made, and not without a certain amount of reason, that it does not accomplish much that it might in point of brevity, simplicity and clearness of expression, it is a very comprehensive piece of legislation, and shows some distinct improvements upon the old Mutiny Acts and Articles of War.

When a person subject to military law commits an offence he is taken into military custody, which means either arrest in his own quarters or confinement. He must without unnecessary delay be brought before his commanding officer, who upon investigating the case may dismiss the charge, if in his discretion he thinks it ought not to be proceeded with, or may take steps to bring the offender before a court martial. Where the offender is not an officer he may dispose of the case summarily, the limit of his power in this respect being seven days' imprisonment with hard labour, a fine not exceeding 10s. for drunkenness, certain deductions from pay, confinement to barracks for twenty-eight days, this involving severe extra drills, deprivations and other minor punishments. Where the offence is absence without leave for a period exceeding seven days, the commanding officer may award a day's imprisonment in respect of each day of such absence up to twenty-one. It is only in the case of the imprisonment exceeding seven days that the evidence before the commanding officer is taken on oath, and then only in the event of the accused so desiring it. The commanding officer is enjoined by regulation not to punish summarily the more serious kind of offences, but his legal jurisdiction in this respect is without limit as regards any soldier brought before him, and when he has dealt summarily with a case the accused is free from any other liability in respect of the offence thus disposed of. In any instance where the commanding officer has summarily awarded imprisonment, fine or deduction from pay, the accused may claim a district court martial instead of submitting to the award.

Ordinary courts martial are of three kinds, viz. (1) a regimental court martial, usually convened and confirmed by the commanding officer of the regiment or detachment, presided over by an officer not under the rank of captain, composed of at least three officers of the regiment or detachment with not less than one year's service, and having a maximum power of punishment of forty-two days' detention; (2) a district court martial, usually convened by a general officer having authority to do so, consisting of not less than three officers, each with not less than two years' service, and having a maximum power of punishment of two years' imprisonment; (3) a general court martial, the only tribunal having authority to try a commissioned officer, and with a power of punishment extending to death or penal servitude, for offences for which these penalties are authorized by statute; it consists of not less than nine officers in the United Kingdom, India, Malta and Gibraltar and of five elsewhere, each of whom must have had over three years' service, five being not under the rank of captain. There is another kind of tribunal, viz. a field general court martial. It is convened (1) by any officer in command of a detachment or portion of troops beyond the seas when not on active service, or by any officer in immediate command of a body of forces on active service where it appears to him on complaint or otherwise that a person subject to military law has committed an offence. The officer must be satisfied that it is not practicable, with due regard to the public service, to try the person by an ordinary court martial. The quorum of the court is three, if consistent with military exigencies, and each member must have held a commission for not less than a year. The quorum may be reduced when the public service requires it. The procedure of ordinary courts martial is observed as far as possible, and the proceedings always should be in writing when possible. But in the circumstances in which these courts are assembled, it is not always possible to adhere to the technical rules which obtain in the ordinary tribunals, although the broad principles are not violated. The evidence on a field general court martial is taken on oath. The prisoner may cross-examine the witnesses for the prosecution, and may call any available witnesses for his defence. The prisoner is allowed to address the court in his own defence.

The Army Act prescribes the maximum punishment which may be inflicted in respect of each offence. That of death is incurred by various acts of treachery or cowardice before the enemy, or by, when on active service, interfering with or impeding authority, leaving without orders a guard or post, or when sentry sleeping or being drunk on a post, plundering or committing an offence against the person or property of an inhabitant, intentionally causing false alarms, or deserting. Whether upon active service or not, a soldier also becomes liable to the punishment of death who mutinies or incites to or joins in or connives at a mutiny, who uses or offers violence to or defiantly disobeys the lawful command of his superior officer when in the execution of his office. Penal servitude is the maximum punishment for various acts and irregularities upon active service not distinctly of a treacherous or wilfully injurious character, for using or offering violence or insubordinate language to a superior, or disobeying a lawful command when upon active service. The same punishment is applicable when not upon active service to a second offence of desertion or fraudulent enlistment (*i.e.* enlistment by one who already belongs to the service), certain embezzlements of public property, wilfully releasing without authority a prisoner or wilfully permitting a prisoner to escape, enlisting when previously discharged from the service with disgrace without disclosing the circumstances of such discharge, or any other offence which by the ordinary criminal law of England is punishable with penal servitude. Imprisonment for two years is the maximum punishment for minor forms and degrees of those offences which if committed upon active service would involve death or penal servitude, such as using or offering violence or insubordinate language to a superior or disobeying a lawful command, and for the following offences: resisting an escort, breaking out of barracks, neglect of orders, a first offence of desertion or attempted desertion or aiding or conniving at desertion, or of fraudulent enlistment, absence without leave, failure to appear at parade, going beyond prescribed bounds, absence from school, malingering or producing disease or infirmity, maiming with intent to render a soldier unfit for service, an act of a fraudulent nature, disgraceful conduct of a cruel, indecent or unnatural kind, drunkenness, releasing a prisoner without proper authority or allowing him to escape, being concerned in the unreasonable detention of a person awaiting trial, escaping or attempting to escape from lawful custody, conniving at exorbitant exactions, making away with, losing by neglect, or wilfully injuring military clothing or equipments, ill-treating a horse used in the service, making false or fraudulent representations in public documents, making a wilfully false accusation against an officer or soldier, making a false confession of desertion or fraudulent enlistment, or a false statement in respect of the prolongation of furlough, misconduct as a witness before a court martial or contempt of such court, giving false evidence on oath, any offence specified in relation to billeting or the impressment of carriages, making a false answer to a question put upon attestation, being concerned in unlawful enlistment, using traitorous or disloyal words regarding the sovereign, disclosing any circumstance relating to the numbers, position, movements or other circumstances of any part of His Majesty's forces so as to produce effects injurious to His Majesty's service, fighting or being concerned in or conniving at a duel, attempting suicide, obstructing the civil authorities in the apprehension of any officer or soldier accused of an offence, any conduct, disorder or neglect to the prejudice of good order and military discipline, any offence which if committed in England would be punishable by the law of England. There is another offence which can be committed by officers only, namely "scandalous conduct unbecoming the character of an officer and a gentleman." It necessitates cashiering, a punishment which in the case of an officer may be awarded as an alternative to imprisonment in several other instances. There is also an offence peculiar to officers and non-commissioned officers, that of striking or ill-treating a soldier or unlawfully detaining his pay. A sentence of cashiering as distinguished from that of dismissal in the case of an officer involves an incapacity to serve the crown again. An officer may be also sentenced to forfeiture of seniority of rank and to reprimand or severe reprimand. A non-commissioned officer may be sentenced to be reduced to a lower grade or to the ranks, and where sentenced to penal servitude or imprisonment the tribunal also has power to deprive him of his seniority. The Army Council in England, or the commander-in-chief in India or in either of the presidencies, may also cause a non-commissioned officer to be reduced to a lower grade or to the ranks. An acting non-commissioned officer may be ordered by his commanding officer for an offence or for inefficiency or otherwise to revert to his permanent grade—in other words, to forfeit his acting rank.

It will have been observed that persons subject to military law are liable to be tried by court martial for offences which if committed in England would be punishable by the ordinary law, and to suffer either the punishment prescribed by the ordinary criminal law or that authorized for soldiers who commit offences to the prejudice of good order and military discipline. The effect of the latter alternative is that for many minor offences for which a civilian is liable to a short term of imprisonment, or perhaps only to a fine, a soldier may be awarded two years' imprisonment or detention. A court martial, however, cannot take cognizance of the crimes of treason, murder, manslaughter, treason-felony or rape if committed in the United Kingdom. If one of these offences be committed in any place within His Majesty's dominions other than the United Kingdom or Gibraltar, a court martial can deal with it only if it be committed on active service or in a place more than 100 miles from a civil court having jurisdiction to try the offence. With regard to all civil offences the military law, it is to be understood, is subordinate to the ordinary law, and a civilian aggrieved by a soldier in respect of a criminal offence against his property or person does not forfeit his right to prosecute the soldier as if he were a civilian.

The crimes for which soldiers are most usually tried are desertion, absence without leave, loss of necessaries, violence or insubordination to superiors, drunkenness, and various forms of conduct to the prejudice of discipline. The punishments are, generally speaking, gauged as much with regard to the character and antecedents of the prisoner as to the particular offence. For a first offence of an ordinary kind a district court martial would give as a rule fifty-six days' imprisonment with hard labour, for a second or graver crime eighty-four days. There are not many instances in which the period of imprisonment exceeds six months. Corporal punishment, which had been practically limited to offences committed upon active service, and in 1879 to crimes punishable with death, was finally abolished in 1881, and a summary punishment substituted. The practice of marking a soldier with the letters "D" (deserter) or "BC" (bad character), in order to prevent his re-enlistment, was abolished in 1879 in deference to public opinion, which erroneously adopted the idea that the "marking" was effected by red-hot irons or in some other manner involving torture. Many military men regretted its abolition, and maintained that if the practice were still in force the army would not be tainted by the presence of many bad characters who find means of eluding the vigilance of the authorities and enlisting after previous discharge.

The course of procedure in military trials is as follows. When a soldier is remanded by his commanding officer for trial by a district or general court martial, a copy of the charge, together with the statements of the witnesses for the prosecution (called the summary of evidence), is furnished to him, and he is given proper opportunity of preparing his defence, of communicating with his witnesses or legal adviser, and of procuring the attendance of his witnesses. Further, if he desires it, a list of the officers appointed to form the court shall be given him. Any officer is disqualified to sit as a member who has convened the court, who is the prosecutor or a witness for the prosecution, who has made the preliminary inquiry into the facts, who is the prisoner's commanding officer, or who has a personal interest in the case. The prisoner may also object to any officer on the ground of bias or prejudice, similarly as a civilian might challenge a juror. Except as regards the delay caused by the writing out of the evidence, the procedure at a court martial is very much the same as that at an ordinary criminal trial—the examination and cross-examination of the witnesses, addresses of the prosecutor and prisoner, and the rules governing the admission or rejection of evidence being nearly identical. At a general court martial, and sometimes at a district court, a judge advocate representing the judge advocate general officiates, his functions being very much those of a legal assessor to the court. He advises upon all points of law, and sums up the evidence just as a judge charges a jury. When the prisoner pleads guilty the court finds a verdict accordingly, reads the summary of evidence, hears any statement in mitigation of punishment, and takes evidence as to character before proceeding to pass sentence. The sentence is that of the majority of the court, except where death is awarded, when two-thirds of the members in the case of a general court martial and the whole in that of a field general court martial must concur. When an acquittal upon all the charges takes place the verdict is announced in open court, and the prisoner is released without any further proceeding. When the finding is "guilty," evidence as to character is taken, and the court deliberates in private upon the sentence, but the result is not made known until the proceedings are confirmed and promulgated. No conviction or sentence has any effect until it is thus confirmed by the proper authority. The confirming authority in the case of a regimental court is the commanding officer, in that of a district court martial an officer authorized to convene general courts martial or some officers deriving authority to confirm the findings and sentences of district courts martial, and in that of a general court, if held in the United Kingdom, His Majesty, and if abroad in most cases the general officer commanding. The confirming authority may order the reassembling of the court in order that any question or irregularity may be revised and corrected, but not for the purpose of increasing a sentence. He may, however, of his own discretion and without further reference to the court, refuse confirmation to the whole or any portion of the finding or sentence, and he may mitigate, commute or entirely remit the punishment. In the case of a general court martial the proceedings are sent to the judge advocate general, who submits to the sovereign his opinion as to the legality of the trial and sentence. If they are legal in all respects he sends the proceedings to the Army Council, upon whom rests the duty of advising the sovereign regarding the exercise of clemency. In addition to confirmation, however, every general or district court martial held out of India has another ordeal to go through. It is reviewed and examined in the office of the judge advocate general, and any illegality that may be disclosed is corrected and the prisoner is relieved of the consequences. To a certain extent a protection against illegality also exists in the case of regimental courts martial. A monthly return of those held in each regiment is laid before the general commanding, by whom any question that might appear to him doubtful would be referred to the adjutant general or the judge advocate general for decision. It is to be noted, however, that the judge advocate general, although fulfilling duties which are in their nature judicial, is only an adviser. He is not actually a judge in an executive sense, and has no authority directly to interfere with or correct an illegal conviction. In many cases the law thus provides no remedy for an officer or soldier who may have been wronged by the finding or sentence of a court martial—for instance, through a verdict not justified by the evidence or through a non-observance of the rules and practice prescribed for these tribunals. A person who has suffered injustice may appeal to the king's bench division of the high court of justice. But, speaking generally, that tribunal would not interfere with a court martial exercising its jurisdiction within the law as regards the prisoner, the crime and the sentence. In most cases, therefore, the virtual protector of an accused person against illegality is the judge advocate general, who personally advises the sovereign and the military authorities that the law shall be complied with (see JUDGE ADVOCATE GENERAL).

The Army Act applies to European officers and soldiers serving in India in the same manner as to the rest of the army, but natives of India are governed by their own Articles of War, and in the case of civil offences they are dealt with according to the provisions of the Indian penal code. There are judge advocates general for each of the presidencies, and a deputy judge advocate at each of the more important military centres.

Important changes were made in the system of courts of inquiry by an Army Order of the 10th of February 1902. A court of inquiry is and has been an assembly of officers directed by a commanding officer to collect evidence and report with respect to a transaction into which he cannot conveniently

Courts of Inquiry.

himself make inquiry. But now, whenever any inquiry affects the character or military reputation of an officer or soldier, full opportunity must be given him of being present at the inquiry and of giving any evidence or making any statement, or cross-examining adverse witnesses, or producing witnesses, on his own behalf. Evidence may now be ordered to be taken on oath if the assembling officer thinks the case requires it. No proceedings of a court of inquiry, no confession, statement or answer, is admissible in a court martial. But an officer or soldier tried by court martial in respect of matter which has been the subject of a court of inquiry is entitled to a copy of the proceedings on payment of the cost of the copy. The finding and sentence are only valid after confirmation by the proper military authority. A sentence of death or penal servitude can only be confirmed by the general or field officer in command of the forces with which the prisoner is present. The rule which allows the prisoner and his wife to tender their evidence on oath under the Criminal Evidence Act 1898 as regards evidence is applicable to field general courts martial. It is useful to note that the Army Act, sec. 70, enables His Majesty to make new provisions under the hand of a secretary of state for, amongst other things, the assembly and the procedure of courts of inquiry. The power to make changes by Army Order or rule is only limited by the principle that the rules must not be contrary to or inconsistent with the act.

Continental Military Law.

In an authoritative report published by the Norwegian government, and compiled by a trained Norwegian lawyer who visited the various countries, the systems of twenty-two states are reviewed. The earliest military law still in force is found in Norway and Denmark, and dates from 1683, while England and Sweden date from 1881. Sweden has a military penal code, and England is ruled by the Army Act. There are two kinds of military courts of first instance: (1) those belonging to separate military bodies, such as divisions, brigades, regiments; (2) those having jurisdiction in a certain territory, and their seat determined. In times of war the courts must follow the military bodies. In Bavaria and Switzerland a military jury is attached to a court martial. In several states "auditors," *i.e.* judicial guides, are attached to courts martial. In some a military jurisconsult (lawyer) is attached as judge, always a fixed post. This obtains in Sweden, Finland, Austria-Hungary, Switzerland and Portugal. In Norway, Denmark, Sweden, Finland, Belgium, Great Britain, Germany, Austria, United States, Spain, Württemberg and Switzerland the presiding officer is chosen for the single trial. In other states the military judges are appointed for a certain term, usually six months. The quorum of judges required on military courts on the continent differs. Seven judges sit in Belgium, Holland, France, Spain, Portugal, Greece, Turkey and Württemberg; three only, in cases of ordinary offences committed by non-commissioned officers and soldiers in Switzerland, Russia, the United Kingdom, United States and Bavaria. In grave cases in the United Kingdom five to nine sit, nine in Russia, five to thirteen in the United States. In Norway and Denmark the court is of thirteen up to twenty-five, unless replaced by a commission and a military lawyer.

Summary Courts Martial.

In Norway, Denmark, Sweden, Finland, and Bavaria and other places in Germany, special summary courts martial are held when necessary. Certain forms and legal guarantees are then dispensed with. Such are held in Belgium and Holland "in a town or place in state of siege." *La Prévôté* is a special court of a judge assisted by a registrar, for vagabonds, servants, sutlers, and with a very limited competence over soldiers who have committed a petty offence, held in time of war in France, Rumania and Greece.

The United Kingdom has a summary court martial when the regular court martial cannot be held without injuring the military service. In the United States there are the "field officers' court martial" and "military commission," consisting of three officers. The second is for judging spies and some other matters that escape the jurisdiction of the regular courts martial. A special military tribunal in Germany judges the officials attached to the army. *Courts of honour* exist in Russia, Germany, Bavaria, Württemberg, Austria-Hungary and Spain. Great Britain and the United States have the system of a "court of inquiry." This was only a commission of inquiry, but it is now public, the accused is present, and the witnesses are sworn.

Competence of Military Courts.

Soldiers not on active service, says the Swedish report, should be answerable for infractions of common law under the jurisdiction of the civil courts. All infractions of military order or discipline committed by soldiers, whether on active service or no, should be judged by military courts. In time of war, it is equally admitted, military courts must judge all offences, even offences at common law, committed by soldiers forming part of an army on campaign. The difference lies in regard to offences committed in time of peace. Sweden, Great Britain, France, Italy and the United States, as a general rule, place offences against the common law (*infractions de droit commun*) *in time of peace* under the jurisdiction of the civil courts. In the United States offences against good order, in Great Britain personal offences (such as drunkenness), are judged by courts martial. In most other states the general rule is that soldiers, even in time of peace, if on actual service are judged by courts martial. In the case of complicity between a soldier and a civilian, sometimes one is judged by a military and the other by a civil court (in Germany, Switzerland and Spain), sometimes both by a military court (Belgium, Italy, Servia, Rumania and Greece); sometimes it depends on the nature of the crime—in the United Kingdom, United States, Sweden, Finland, Holland and Portugal. In Norway a mixed tribunal judges them.

Procedure.

The procedure in military courts differs according to the countries. In some systems (*a*) the examination and preparation of evidence are confided to a *juge d'instruction*; (*b*) in other systems they are confided to a special commission of inquiry; (*c*) again, in other places they are left to the court martial itself that will judge the case. The United Kingdom and the United States follow the last plan. There is no preparatory examination in these two countries. A commission of inquiry for the preparation of evidence is held in Norway, Denmark, Germany, Württemberg, Austria-Hungary, Servia, Belgium and Holland. An auditor directs these courts of inquiry. In Russia an officer acts as *juge d'instruction*; in grave cases he must be a military jurisconsult. In Italy, Spain, Rumania, Greece and Turkey an officer acts as *juge d'instruction.*

Publicity.

The proceedings before a court martial are usually public, except in the case of matters that offend morality, compromise public order, or where publicity is considered injurious to the interests of the service (cases of discipline, disclosing plans, &c.). This does not apply (except in Great Britain and the United States) to the proceedings before the courts charged with preliminary investigation. In several states, *i.e.* Norway, Denmark, Holland, Austria, Servia, Germany and Württemberg, the public prosecutor is also the counsel of the accused. The auditor who directs the court of inquiry fills these offices (except in cases of small importance in Germany and Württemberg). In other states there is a special office of public prosecutor. In Spain, Portugal, Rumania, Greece and Turkey he is an officer. In Russia, Belgium, Bavaria, Switzerland and Italy he is a military lawyer. In these countries the accused has the right to choose a counsel, or one is assigned him. In the United Kingdom and the United States, when the matter is grave, the direction of the case is put in the hands of a judge advocate. In the United States the judge advocate is the public prosecutor.

Appeal, when allowed and to whom.

There is no superior tribunal to which to appeal in Denmark, Great Britain and the United States. In Denmark the cases are sent to the auditor-general, who can annul if there is error in form, and send back the case to be tried anew. In Great Britain and the United States judgment in ordinary cases must be confirmed by the commanding officer by whose order the court was called. He can lighten the sentence. In certain cases of great gravity it must go to the head of the state, after passing the revision of the judge advocate general, who in Great Britain is the constitutional adviser of the crown as regards courts martial from the view of legality. There is also in these two countries a special revision of judgments in the judge advocate general's office. This revisional power is the safeguard of military justice, as all decisions are reviewed, and if any illegality is pointed out the proceedings are consequently quashed. The effect of this disapproval is not merely to annul the proceedings, but it also prevents the accruing of any disability or forfeiture. The British judge advocate's office has been much strengthened. It now consists of: (1) The judge advocate general (one of H.M. judges); (2) a deputy judge advocate general, who is a trained lawyer; (3) a deputy judge advocate, also a trained lawyer; (4) a military officer of the rank of colonel who has been called to the bar; (5) in South Africa (since 1899, and on a five-years' appointment from 1902) a colonel who has been called to the bar.

In Germany there is no appeal, except for officials attached to the army. In Austria-Hungary the sentence can be lightened by the commanding officer. It can also be returned for trial by a superior court if it appears to him too light. In Spain all judgments have to be confirmed, and if confirmation is refused, it is carried before the supreme court of the navy and army. The condemned has no power of appeal himself, but all cases of death or life sentences go before the supreme court of the navy and army. Russia only requires the confirmation of the commanding officer. In Rumania and Greece all condemned prisoners in time of peace can demand a court of revision, composed of a general and four superior officers. In time of war the court may be composed of three.

Disciplinary Punishments.

Certain forms of punishment, in all countries but the United States, can be given by the superior officer, without judicial intervention, for small purely military offences, where a summary procedure is required. The offender, if he prefers, may be carried before court-martial. The punishment is immediately carried into force, but the person punished can complain to higher military authority. In that case, if the complaint is not admitted, the punishment is enhanced. The commonest of these disciplinary punishments are deprivation of liberty, confined to barracks, arrests and prison. Certain special punishments obtain in certain countries—for instance, imprisonment in Turkey may be accompanied by a bread-and-water diet; and officers in Finland and Russia may be deprived of advancement.

In 1908 France took steps to abolish courts-martial in time of peace, all common law offences to be judged by the ordinary courts, and breaches of military discipline such as rebellion, insubordination, desertion and the like by mixed courts composed of civil and military magistrates.

See Clode, *Military Forces of the Crown*; T. Gram, *Fonctionnement de la justice militaire dans les différents États de l'Europe.* (JNO. S.)

MILITIA (Fr. *milice*, Ger. *Miliz*, from Lat. *miles*, soldier, *militia*, military service), a term used generally for organized military forces which are not professional in character and not permanently embodied. All ancient armies, with the exception of the personal guards of their leaders, were militias or national levies, remaining under arms for the war or the campaign and returning to their ordinary occupations at the close of each military episode. Militias such as those of the Greek city-states and that of Rome were of course highly trained to the use of arms; so were the barbarian "nations in arms"; which overcame the professionalized Roman armies of the Empire; and although in the Eastern Empire these new fighting elements were absorbed into a fully organized regular arm, in the West the tribal militia system gradually developed into feudalism. The noble and the knight indeed spent the greater part of their lives in the field and devoted themselves from their youth to the cult of arms, but the feudal tenantry, who were bound to give forty days' war service and no more, and the burghers who, somewhat later in the history of civilization, formed the efficient garrisons of the walled towns were true militias. The English Yeomanry indeed almost ruled the battlefield.

In the 15th century the introduction of firearms began to weigh down the balance in favour of the professional soldier. Artillery was always the arm of the specialist. The development of infantry, "fire-power," with the early arquebus and musket, called for the highest skill and steadiness in the individual soldier, and cavalry too adopted the new weapon in the form of long and expensive wheel-lock pistols. In the new military organization there was no place for the unprofessional soldier. The rôle of the unprofessional combatant, generally speaking, was that of an insurgent—harassing small detachments of the enemy, cutting off stragglers, and plundering convoys. Towards the end of the first civil war in England (1645) the country-folk banded themselves together to impose a peace on the two warring armies, but their menace was without effect, and they were easily disarmed by Fairfax and Cromwell, who did not even trouble to hold them as prisoners. The calling out of the *arrière ban* of Franche-Comté in 1675 displayed its ludicrous inefficiency, and thereafter in France, which set the fashion to Europe in all military matters, the "provincial militia," which Louvois and Barbezieux raised in place of the discredited *arrière ban*, was employed partly to find drafts for and partly to augment the regular army.

When a first line army was large enough to absorb the fighting strength of the country there was neither room nor need for a true militia force. This was the case with France under Napoleon's régime, but things were different elsewhere. In Great Britain the county militia (whose special history is briefly sketched below) was permanently embodied during the greater part of the Napoleonic Wars. Destitute as it was of technical and administrative services, of higher staffs and organization, and even of cavalry, this militia was a regular army in all but name. Combining continuous service with territorial recruiting as it did, it consisted of men of a better stamp than the casually recruited regular forces. In those days, the militia was a county force commanded by the lords-lieutenant and officered by men of influence; it was not administered by the War Office.

In other countries, Napoleon's invading armies had only to deal with regular or professional troops. Once these were crushed, nothing remained for the beaten side but to make peace with the conqueror on such terms as could be obtained. Militias existed in name as organizations, for the production of more or less unwilling drafts for the line, but the fundamental militia obligation of defending the *fatherland* as distinct from defending the *state*, produced only local and occasional outbursts of guerrilla warfare. In the Crimean War, the 1859 war in Italy, the 1866 war in Germany, and other wars (the Hungarian War of 1848–49 excepted) the forces, other than the regular troops, engaged in first line were guerrilleros, insurgents, Garibaldians, &c., and behind the forces in first line there were draft-supplying agencies, but no true militia. Only the British militia and the Prussian landwehr represented the self-contained army of second line, and of these the former was never put to the test, while the latter, responding feebly to a political call to arms in 1850, was in consequence so entirely reorganized that it formed a mere rear rank to the line troops. This latter system, consecrated by the German successes of 1870, became the universal model for the continent of Europe, and organized and self-contained militias to-day are only to be found in states maintaining first line armies of "general service" professionals, or in states which maintain no first line troops whatever. In the first class are the auxiliary forces of the British Empire and the United States, in the second the Swiss, Norwegian, Dutch and Swedish forces.

MILITIA OF THE UNITED KINGDOM

The title of "militia" disappeared from the list of the British forces in 1908, on the conversion of the existing self-contained militia into an army "special reserve" which is restricted to the rôle of providing drafts for the first line.[1] The "self-contained" second line army of the present day is the Territorial Force (see UNITED KINGDOM: *Army*).

The county organization of England, with which throughout the militia was closely associated, began with the advent of the Saxons. The prototype of the militia was the Fyrd. In this force as reorganized by Alfred liability of service was general on the part of every able-bodied male between the ages of 16 and 60. Although the title of "The Fyrd" survived until long after the Norman Conquest, the force established by King Alfred was known as the general levy, which was bound to appear armed when ordered to aid in suppressing domestic riots as well as in defending the realm against invasion by foreign foes. Service was restricted to the counties, except in case of invasion, when it was extended to the whole kingdom. For centuries these remained with little alteration as the principles governing the national forces of the kingdom, and form in effect with certain developments the basis of the modern militia system. The Norman Conquest was immediately followed by the introduction of the feudal levy in addition to the general levy, the distinction between these forces being that while obligation to serve in the latter rested upon every male within certain limits of age, service in the feudal levy depended upon tenure of land under the king as feudal lord. The general levy was not in any case liable for service overseas, but the king for a long time employed his feudal tenants in continental wars until they too, successfully resisted the demand. Personal service formed the basis of both levies, but service by deputy, or payment in lieu of personal service, and the calling out of a quota only, were allowed from very early times. The feudal levy was discontinued during the Commonwealth and abolished at the Restoration; but liability to serve in the general levy has never been extinguished, but remains in the statutory and practical form of liability to serve both in the general and local militia. Even at the abolition of these forces the statutory liability to service in them was not done away with. Inspections of arms and the assembly and training of the men raised under this national system were secured from time to time by means of "assizes of arms," "views of armour," "commissions of array," and "commissions of musters," dating from early in the 12th century down to the 16th century. The machinery employed to carry out the law formed the basis of the existing procedure for the enforcement of the ballot for the militia, which thus bears a strong resemblance to the means adopted from ancient times. These constitutional powers were frequently abused by "electing" or impressing men to serve out of the kingdom, but this was checked in the year 1327 by an Act of Parliament, which strictly regulated the scope and limits of military service within the kingdom at the charge of the parishes or counties, but provided for service abroad at the charge of the Crown. "Commissions of musters" were a development of preceding measures for raising men and material for military service, under which the commissioners registered and mustered persons liable to serve, sorted them into bands and trained and exercised them at the charge of the county. These bands became known as *train* or *trained bands*, and were mustered annually. With them were associated lieutenants of counties, first appointed in 1549 by Edward VI., subsequently in Queen Mary's reign called lords lieutenant, and after the Restoration appointed as statutory officers for the militia, their commissions at the present day being issued under the Militia Act. There does not appear to have been any clearly defined regimental organization in existence until these bands or companies were called into active service, but the Acts of the Commonwealth supplied this defect, and initiated a permanent regimental system. One of the earliest attempts to reform the force since the time of King Alfred was made by Charles I. in 1629, when Orders in Council were issued instructing lords lieutenant to put the militia on a better footing and to fill up vacancies among the officers. Cromwell subsequently issued similar orders couched in strong terms, though under the Commonwealth the duties of lords lieutenant were not recognized, the militia being raised by commissioners. The great services rendered by the militia in the "crowning mercy" of Worcester are a historic exception to the general decadence of second line troops in the 17th and 18th centuries (see GREAT REBELLION). At the Restoration an act was passed declaring that the control of the militia was the prerogative of the king. By the same statute the militia of each county was placed under the lieutenant, who was vested with the appointment of officers, but with a reservation to the Crown in the way of commissioning and dismissal. The cost of the annual training—for fourteen days—fell upon the local authority. Offences against discipline were dealt with by the civil magistrates, but with a power to the officers of fining and of imprisoning in default. Upon this footing the militia of England remained for nearly a century with the general approval of the community. It was recognized as an instrument for defence and for the preservation of internal order, while it was especially popular from the circumstance that from its constitution and organization the Crown could not use it as a means of violating the constitution or abridging the liberty of the subject. It was controlled and regulated in the county; it was officered by the landowners and their relatives, its ranks were filled by men not depending for their subsistence or advancement upon the favour of the Crown; its numbers and maintenance were beyond the royal control; its government was by statute. While the supreme command was distinctly vested in the Crown, every practical security was thus taken against its use by the Crown for any object not constitutional or legitimate. It was regarded as, and was, in fact, the army of the state as distinguished from the standing army, which was very much the army of the king personally. The latter consisted of hired soldiers, and was more than once recruited by a conscription, confined, however, to persons of the vagrant class not having a lawful employment, while the former was mainly composed of those having a fixed abode and status. The militia thus enjoyed for many years as compared with the regular forces a social as well as a constitutional superiority. To this, however, along with the general breakdown of militia systems under the new "professional" conditions of warfare, explained above, and perhaps the practice of trying military offences by civil courts, may be attributed the disrepute into which the militia fell and the inefficiency it displayed, with the exception of the trained bands of London, until it was reorganized in 1757. Under the act of 1662 all train bands were discontinued in the counties, but those of London, with their auxiliaries, remained until 1794, when they were reorganized as the City of London Militia. In 1688 an act was passed raising the militia for one year, and for some time it was an annually sanctioned force as the regular army is to-day. In 1690, on the occasion of the threatened French invasion, the militia was embodied; and again in 1715 and 1745 during the troubles caused by the Old and Young Pretenders. In a pamphlet of 1712 the English militia was estimated at 7450 horse and 84,391 foot soldiers. From 1715 until 1734, and again from that year until 1757, with the exception of 1745, no votes were taken in parliament for the militia.

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[1] Various dominions and colonies of the British Empire have militias, for which see UNITED KINGDOM: *Army*. For the Swiss Militia System, which is in many respects the archetype of modern militias, see SWITZERLAND; and for the organized militia of the United States see UNITED STATES.

The foregoing remarks apply only to the English militia and its predecessors. Ireland and Scotland did not furnish any regular militia until 1715 and 1797 respectively, although in Scotland militia existed long before 1797, *e.g.* in Perthshire in 1684; and in addition corps of fencibles were raised and embodied. The Irish militia when first raised in 1715 was restricted to Protestants between the ages of 16 and 60, who were bound to appear or provide substitutes. The force was not made subject to military law, but various military offences were punishable by fine or imprisonment. Several amendments and other acts followed until 1793, when a new act was passed providing for raising a force of militia by ballot among men between the ages of 18 and 45, to serve for four years. Each county was liable to a fine of £5 for each man deficient, and enlistment in the army was prohibited. Other amendments followed from time to time, and notably one in 1797 abolishing religious restrictions for the supplementary militia, and another in 1802 removing the same restrictions in the case of the general militia. Finally, all the acts were consolidated in 1809 by an act which fixed establishments, provided for raising the men by ballot, but gave power to the lord-lieutenant to authorize voluntary enlistment by means of bounties, and also to suspend the raising of any regiment. The Scottish militia was at first raised by ballot among men between the ages of 19 and 30. In 1802 former acts were replaced by an Act providing for the organization of the militia on a basis similar to that on which the militia of England was organized by the Consolidation Act passed in that year.

To return to England, the immediate cause of the organic reform carried out in 1757 was the disclosure of the inefficiency of the militia during the Rebellion of 1745. The act of 1662 followed the old law by requiring owners of property to furnish men, horses and arms in proportion to the value of their property, and the liability of persons of small property was to be discharged out of a rate levied in the parish. This was entirely altered in 1757, a liability on the part of the county or parish being substituted for a liability on the part of individuals. Each county was required to furnish a quota apportioned among the various parishes; men were to be chosen by lot to serve for three years (this being the first provision of a fixed term of service) or to provide, or pay £10 for the provision of, a substitute, and vacancies were to be filled from time to time by a like process of ballot. The ages of liability were from 18 to 45. The system thus legalized is practically the existing though suspended ballot system. The force was to be annually trained and exercised for a limited period, and in case of invasion or danger thereof, or in case of rebellion, the Crown could order it or any portion of it to be embodied; but only on condition of informing parliament (which was if not sitting to be summoned for the purpose). During the embodiment or annual training it was subject to the Mutiny Act, except that no punishment during training was to extend to "life or limb"; to prevent an unconstitutional use of the militia by the Crown, the estimate for its training was framed each year, not by an executive minister of the sovereign, but by the House of Commons itself. Upon the initiative of a committee of the house, an act was passed providing for the pay and clothing of the militia for the year. The king directly appointed the permanent staff and was given a veto on the appointment and promotion of the officers, who were to have a property qualification.

Under this act 30,000 militiamen were raised by ballot and embodied from 1759 to 1763. This force was exclusively "Protestant," and remained so until 1802. The service of the militia as thus arranged remained nearly in the same state until 1870. Pitt's reform, however, was followed by numerous amendments, new enactments, and other changes, of which the following is a summary in chronological order:—

1758. Men volunteering to serve recognized as counting towards the quota.

1761. Raising of quota made compulsory on counties under penalty of fines.

Mutiny Act applied to militia when out for training as well as when embodied.

1775. (American War.) Act passed empowering embodiment of militia in case of colonial as well as domestic rebellion.

1786. Charge on parishes for storage of arms, &c., transferred to counties.

1795. Enlistment into regulars encouraged.

1796. Supplementary militia formed, consisting of 63,878 men.

1798. (Irish Rebellion.) English militia volunteered for service in Ireland.

1799. Irish militia volunteered to serve in Great Britain.

15,000 militiamen volunteered to regular army.

1803. 45,492 men raised for militia by ballot, but of these 40,998 were substitutes.

1805. Militia affiliated to line for purposes of recruiting for regulars.

1806. Training Act to raise by ballot 200,000 men to be trained for one whole year, and then to discharge them from training for two years.

1808. Difficulties having arisen under above Act, local militia (which is in effect the old general levy) established in addition to general militia then embodied.

27,000 militiamen volunteered to regular army during preceding twelve months.

1811. English militia, hitherto not liable to serve out of the kingdom, now made liable to serve in any part of the United Kingdom under certain restrictions, which were subsequently (in 1859) removed.

Method of obtaining men from militia for regulars further systematized.

1812. In this year there were 250 regiments of local militia, with an establishment of 240,388 men and 214,418 actually enrolled.

1813. During ten years, from 1803 to 1813, nearly 100,000 militiamen joined the regular army.

Act passed to enable militia to serve abroad as militia with their own officers. Three strong battalions joined the British army in France.

1815. Militiamen recruited in great numbers the army which fought at Waterloo.

Local militia ceased to be raised.

1816. Local militia and Ballot Act suspended.

General militia disembodied.

1820–21–25. Militia called out for training.

1829. Act passed suspending ballot for the general militia.

1831. Militiamen raised by ballot in accordance with Order in Council, 27th of December 1830. This was the last occasion on which the ballot was put in force.

In the latter stages of the great French war the tendency of the government was to use the general militia rather as a reservoir producing drafts (in the end whole units) for service abroad, and the local militia as the real defensive force. During the height of the war (in 1812) the relative position of the various branches of the army was as follows: First line, the standing army; second line, the general or regular militia, which as the war went on were more and more used abroad; third line, the local militia, with the survivors of the volunteers, who at that time numbered about 68,000 men. After the peace of 1815 the militia was allowed practically to fall into abeyance, and although the permanent staff was maintained, it had no duties to perform. In 1848 the Prime Minister intimated in parliament his intention to re-establish the militia, but it was not until 1852, after an unsuccessful attempt to resuscitate the local militia, that the general militia of England was reorganized under a system of voluntary enlistment with the ballot in reserve, Scotland and Ireland being included in 1854. The property qualification of officers which had hitherto existed (with exception in favour of ex-officers of the army and navy) was reduced, and after a further reduction in 1854, abolished in 1869. Larger powers respecting the militia were conferred upon the Crown, and during the Crimean War the queen was authorized to embody the militia whenever a state of war existed with any foreign power. In that war the militia was embodied and did garrison duty not only in the United Kingdom but in the Mediterranean garrisons, thus enabling the authorities to send most of the available regular troops to the scene of hostilities. It further contributed many officers and some 30,000 men to the line. During the Indian Mutiny it filled scarcely less useful functions when again called out. The acceptance of voluntary offers of service in the Channel Islands and Isle of Man was definitely authorized in 1859, and extended to service in Malta and Gibraltar in 1875.

In 1871 an important constitutional change was made. It was part of the new army system inaugurated in that year that the control of the militia should be removed from the lord-lieutenant of the county and vested wholly in the Crown. It now virtually ceased to exist as a distinct body, and in 1881 it became a part of the regular forces with a limitation as to the time and area and other conditions of service. Militia battalions were united with the line battalions to form territorial regiments, the artillery and engineers being also closely associated with the regular services. Various amendments and new enactments followed, all in the direction of increasing the usefulness of the militia, rendering it more efficient and readier for service, though at the same time making it more and more a means for supplying recruits, both officers and men, to the regular army. The officers, who were commissioned by the Crown, were in 1877 made subject at all times to military law. Non-commissioned officers and men were only so subject when embodied or out for training, with extension in the case of men convicted of offences committed during training until the expiration of the punishment.[1] Enlistment was voluntary, compulsory service by ballot remained legal, but suspended. The period of engagement was for six years, re-engagements for periods of four years up to the age of 45 being permitted. Bounties were paid to militiamen at various rates upon enlistment, conclusion of training, re-engagement, enlistment into reserve or special service section, and other special circumstances. Recruit training, maximum six months, as a rule did not exceed three months. Recruits were either drilled immediately upon enlistment at any time of the year, which is now the most usual system, or else at preliminary drills (first instituted in 1860), immediately preceding the annual training of the corps. The annual training varied with the different branches of the service. The usual term for infantry was 27 days, but when on manœuvres this was generally extended to 34 days, 56 days being the legal maximum. Artillery and fortress engineers trained for 41 days and submarine mining engineers for 55 days. Trainings took place for the most part in camp or barracks, and large numbers of militia battalions were latterly called on to take part in field manœuvres. The militia dépôts occupied as a rule the same barracks, and officers and men wore (with slight distinctions) the same uniform as the regulars. The militia occupied an important position in the mobilization scheme for national defence. The permanent staff (adjutant, quartermaster, and an establishment of non-commissioned officers and buglers or drummers, all regulars) was engaged during the non-training period of the year in recruiting, care of arms, clothing &c., and in drilling recruits. The general lines of the system, as regards training are still followed with the Special Reserve, though the constitution of the new force is very different.

The militia ordinarily was liable only for service in the United Kingdom, but by legislation in 1899 may voluntarily serve in any part of the world, including India. During 1899–1900, 22,000 militiamen were thus accepted for service abroad, the bulk of them proceeding to the seat of war in South Africa.

The militia reserve consisted of men selected from the ranks of the militia for special enlistment for service in the regular army when called upon in emergencies, in the following proportions to the establishments of the various corps: Artillery, one-third; engineers and infantry, one-fourth; medical staff corps, one-half. The militia reserve was first formed in 1867, and in 1900 numbered 30,000 men. During an emergency in 1878, 20,000 militia reservists joined the regular army. The term "militia" reserve was therefore a complete misnomer, and the force so called was purely an army reserve. The special service section of the militia was formed by royal warrant in 1898, and consisted of (1) militia units and (2) individual militiamen. A militia unit was considered as available for special service if not less than 75 % of the officers and men present at training made a voluntary offer to engage for special service in any part of the world, and if in the infantry at least 500 and in the artillery at least 250 men were accepted as qualified. Individual militiamen engage to serve either with their militia unit if it were registered for service, or else for special service with the regular forces. Liability for service was limited to twelve months. Men of the special service section could also belong to the militia reserve, and receive a bounty in addition to that given for the reserve. The result of this special section was not up to 1900 satisfactory. Very few units could qualify for registration, and the response of individual men was comparatively insignificant.

During and after the South African War, while militia recruiting for the regulars showed a constant increase compared with preceding years, the strength of the militia itself decreased year after year. Its militia character had been diminishing ever since the creation of the "militia reserve" and the close affiliation of the force to the regular army. For good or evil, then, it had become in the first place a draft-producing agency, and on the reorganization of the forces of the Crown into two lines by Mr Haldane the old "constitutional force" was frankly reorganized as a reserve for the line, enlistment and training conditions remaining somewhat similar to those in vogue in the militia, but the liability for service abroad becoming the first and most important condition in the "special reservist's" enlistment.

MILK (O. Eng. *meoluc*; from a common Indo-European root, cf. Lat. *mulgere*, Gr. ἀμέλγειν), the fluid secreted by the mammary glands of the division of vertebrate animals called *Mammalia* (see MAMMARY GLAND), and primarily devised for the nourishment of their own young.

The milk of various domesticated animals is more or less used by man for food. The milk of the cow, which may be taken as typical of all others, and is indeed by far the most important and valuable of all (see DAIRY AND DAIRY FARMING), is, when newly drawn, an opaque white fluid, with a yellowish tinge, soft, bland and sweetish to the taste, and possessed of a faintly animal odour. This odour, according to Schreiner, is due to the presence of sulphuretted hydrogen, and disappears after a short exposure. The specific gravity of milk ordinarily ranges from 1·029 to 1·033, very seldom reaching 1·035 or falling so low as 1·027. In chemical constitution it consists of an emulsion of fatty globules (cream) in a watery alkaline solution of casein, and a variety of sugar, peculiar to milk, called lactose. The fat (which when separated we know as butter) and the lactose constitute the carbonaceous portion of the milk regarded as food. The casein, which forms the principal constituent of cheese, and a certain proportion of albumen which is present, form the nitrogenous, while the complex saline substances and water are the mineral constituents. These various substances are present in the proportions which render milk a perfect and typical food suitable to the wants of the young of the various animals for whom it is provided by nature. The milk of animals, so far as is known, contains them, although they are present in somewhat different proportions. It is probable that the milk of ruminants possesses certain physical and physiological distinctions from that of non-ruminant animals, which will account for the virtues attributed to the milk of the ass and mare. The following table exhibits the chemical constitution of the kinds of milk most frequently used by man:—

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[1] This, though here mentioned as part of a process of "regularizing" the militia, was in fact a reform that was advisable under any conditions. The new Territorial Force when created out of the Volunteer Force (which had no such liabilities except when training or serving with regulars) was made subject to military law, officers at all times, men whenever under instruction.

	Cow.		Goat.	Ewe.[1]	Mare.	Ass.	Human.
	Winter Blyth.	Cameron.	Voelcker.	Voelcker.	Cameron.	Chevallier and Henry.	Gerber.
Water . .	86·87	87·00	84·48	83·70	90·310	91·65	88·02
Fat . . .	3·50	4·00	6·11	4·45	1·055	0·11	2·90
Casein and albumin .	4·75	4·10	3·94	5·16	1·953	1·82	1·60
Sugar . . .	4·00	4·28	4·68	5·73	6·285	6·08	7·03
Ash . . .	0·70	0·62	0·79	0·96	0·369	0·34	0·31

In addition to these constituents milk contains small proportions of the gases carbonic acid, sulphuretted hydrogen, nitrogen and oxygen, and minute quantities of other principles, the constant presence and essential conditions of which have not been determined. These consist of galactin and lactochrome, substances peculiar to milk, discovered by Winter Blyth, with certain animal principles such as leucin, pepton, kreatin, tyrosin, &c. The salts in milk consist, according to the average of numerous analyses by Fleischmann, of the following constituents:—

Phosphoric acid . .	28·31	Potash	17·34
Chlorine	16·34	Magnesia	4·07
Lime	27·00	Ferric oxide . . .	0·62
Soda	10·00		

Milk thus is not to be regarded as a definite chemical compound nor even as a mixture of bodies in fixed and invariable proportions. Not only does the milk of different races and breeds of cows vary within comparatively wide limits; the milk of the same animal is subject to extensive fluctuation. The principal causes of variation in the individual are age, period of lactation, nature and amount of food, state of health, and treatment, such as frequency of milking, &c. The following table indicates the range of normal variations:—

Water	90·00 to 83·65
Fat	2·80 ,, 4·50
Casein and albumin	3·30 ,, 5·55
Sugar	3·00 ,, 5·50
Ash	0·70 ,, 0·80

The average quantity of milk yielded by cows is also highly variable, both in individuals and breeds.

Milk and Disease.—Although the milk of a perfectly healthy cow may be absolutely sterile, it is difficult to obtain it in that condition. In the report of the joint committee appointed for the purpose by the county boroughs of Bradford, Hull, Leeds, Rotherham and Sheffield in 1908, the following conclusions were drawn: (1) Cows' milk freshly drawn from the udder by ordinary methods contains bacteria. They are more numerous in the first flow of the milk. (2) There is a great increase in contamination in the milk at each stage before it reaches the customer. This is due to (*a*) the dirty condition of the cows' udders, (*b*) the imperfect cleansing of the cans and of the hands of the milkers. The committee recommend: "(1) The washing of the udder and flanks with soap and water, and similar attention to the hands of the milker. (2) Efficient sterilization of all vessels by steam if possible, or by abundance of boiling water. (3) Rejection of the first draw of the milk from each teat. (4) Avoidance of any work raising dust immediately before or during milking. (5) Removal of the milk of each cow immediately from the shed. (6) Ventilation and cleanliness of the cowsheds." This provides for the reduction as far as possible of contamination during the milking process itself. As any bacteria present in the milk tend to multiply rapidly on the way to the consumer, it is mainly a question of the time which elapses before consumption. It is, therefore, further recommended (*a*) that the milk be rapidly cooled or chilled, as the lower the temperature the less do the bacteria multiply, (*b*) that contamination during railway transit be avoided by dust-proof locked milk cans.

By treating milk at a temperature of 60° C. for one hour, 70° C. for ten minutes, and 95° C. for one minute, tubercle bacilli, if present, will certainly be killed. Cholera and typhoid organisms are less resistant, and are killed more quickly than tubercle bacilli at the above temperatures. Only a single pathogenic species can withstand the short boiling to which milk is ordinarily treated in domestic management, and this is the anthrax bacillus containing spores. The danger from this source is remote, as the microbe does not form spores within the animal body. Even in the worst cases, therefore, only vegetable forms, easily destroyed by boiling, can find their way into the milk from the body of the cow.

The lactic acid bacillus, always present in unboiled milk (to which the souring of milk is due), is easily destroyed by heat; but the *bacillus mesentericus*, often found in it, forms spores, which are not destroyed by ordinary boiling, and germinate when the milk is kept at a moderately warm temperature, producing a brisk fermentation whereby a large volume of gas is liberated. The fundamental idea of Soxhlet's method for sterilizing milk is to boil it for forty minutes in small bottles holding just enough for one meal, and closing the same with an impervious stopper, which is only removed just before use. Milk so treated will keep at the ordinary room temperature, as the spores of the *B. mesentericus* do not develop below 15° C.; but if it be introduced into the alimentary canal of a child the spores will rapidly multiply, and in such cases large quantities of gas, giving rise to flatulency, will be formed, and possibly also poisonous decomposition products of albuminoid matter. To render milk sterile in the strict sense of the word it is necessary to raise it to a temperature of about 120° C. for twenty minutes. Under these conditions the lactose decomposes into dark-brown fission products, the fat loses its emulsified condition and separates out as cream which cannot be made to diffuse again even by shaking, and the albuminoids are converted into a form very difficult of digestion.

In short, there is the greatest difficulty in freeing milk on a large scale from germs without at the same time seriously prejudicing its flavour and nutritive value. Since, then, the destruction of the hardy germs is so difficult, the greater care should be taken, by washing the udder, hands and milk vessels, to secure extreme cleanliness in the preparation of milk intended for infant consumption. Sterilization then becomes an easier task, the milk drawn under these conditions being very poor in spore-forming bacteria. It is imperative that cream destined for butter-making should be free from pathogenic organisms. The organisms of cholera, typhoid fever and tuberculosis present in butter retain their vitality for a long time. As butter is consumed in the raw state, a trustworthy preliminary treatment of the cream is in the highest degree desirable. Schuppan has shown that it is possible to produce good butter from Pasteurized or even sterilized cream, and Weigmann introduced the plan of artificially souring cream by means of pure cultures of *B. acidi lactici*.

Since Metchnikoff's introduction (see LONGEVITY) of the use of soured milk for dietetic purposes—the lactic acid bacillus destroying pathogenic bacteria in the intestine—a great impetus has been given to the multiplication of laboratory preparations containing cultures of the bacillus; and in recent years much benefit to health has, in certain cases, been derived from the discovery.

See also the articles ADULTERATION; DAIRY AND DAIRY FARMING; INFANCY; DIETETICS; FOOD and FOOD PRESERVATION; in the last of which the preparation of condensed milk is described.

MILKWORT, in botany, the common name for plants of the genus *Polygala* (natural order Polygalaceae), a large genus widely dispersed in temperate and tropical regions and represented by a few species in Britain. The common species, *P. vulgaris*, is a small wiry perennial found on heaths and in meadows throughout the British Isles. The stems are 2 to 10 in. long and bear narrow rather tough leaves and small, ⅙ to ⅓ in. long, white, pink, blue, lilac or purple flowers. The flowers (see fig.) are peculiar in form and arrangement of parts; they have five free sepals the two inner of which (*b*) are large petaloid and winglike, forming the most conspicuous part of the flower; the petals are united below with the sheath of the eight stamens forming a tube split at the base behind; their form recalls that of the pea family. The name *Polygala* is from the Greek πολὺς, much, and γάλα, milk, the plant being supposed to increase the yield of milk in cows. Some species with showy flowers are known in cultivation as greenhouse, or hardy annual or perennial, herbs or shrubs. The root of *P. Senega*, snake-root, a North American species is officinal. Sea milkwort is the common name for *Glaux maritima*, a small succulent herb found on seashores and in estuaries in the British Isles; it belongs to the primrose order (Primulaceae).

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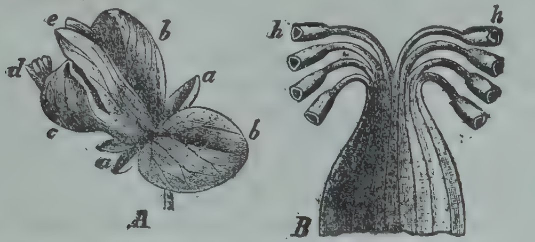
[1] Ewe's milk is exceedingly variable, especially in its percentage of fat. The above analysis is one of nine by Dr Arthur Voelcker, in which the fat was found to range from about 2 to 12¾%.



After Berg & Schmidt, from Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.

Polygala Senega.

A, Flower; *a*, small sepals; *b*, large sepals; *c*, keel, representing the anterior petal; *d*, its fimbriated edge; *e*, lateral petals.

B, The 8 stamens united into a sheath below; *h*, anthers (magnified).

MILL, JAMES (1773–1836), historian and philosopher, was born on the 6th of April 1773, at Northwater Bridge, in the parish of Logie-Pert, Forfarshire, the son of James Mill, a shoemaker. His mother, Isabel Fenton, of a good family which had suffered from connexion with the Stuart rising of 1745, resolved that he should receive a first-rate education, and sent him first to the parish school and then to the Montrose Academy, where he remained till the unusual age of seventeen and a half. He then entered the university of Edinburgh, where he distinguished himself as a Greek scholar. In October 1798 he was licensed as a preacher, but met with little success. From 1790 to 1802, in addition to holding various tutorships, he occupied himself with historical and philosophical studies. Finding little prospect of a career in Scotland, in 1802 he went to London in company with Sir John Stuart, then member of parliament for Kincardineshire, and devoted himself to literary work. From 1803 to 1806 he was editor of an ambitious periodical called the *Literary Journal*, which professed to give a summary view of all the leading departments of human knowledge. During this time he also edited the *St James's Chronicle*, belonging to the same proprietor. In 1804 he wrote a pamphlet on the corn trade, arguing against a bounty on the exportation of grain. In 1805 he published a translation (with notes and quotations) of C. F. Villers's work on the Reformation, an unsparing exposure of the alleged vices of the papal system. In 1805 he married Harriet Burrow, whose mother, a widow, kept an establishment for lunatics in Hoxton. He then took a house in Pentonville, where his eldest son, John Stuart Mill (*q.v.*), was born in 1806. About the end of this year he began his *History of India*, which he took twelve years to complete, instead of three or four, as he had expected.

In 1808 he became acquainted with Jeremy Bentham, and was for many years his chief companion and ally. He adopted Bentham's principles in their entirety, and determined to devote all his energies to bringing them before the world. Between 1806 and 1818 he wrote for the *Anti-Jacobin Review*, the *British Review* and the *Electric Review*; but there is no means of tracing his contributions. In 1808 he began to write for the *Edinburgh Review*, to which he contributed steadily till 1813, his first known article being "Money and Exchange." He also wrote on Spanish America, China, General Miranda, the East India Company, and the Liberty of the Press. In the *Annual Review* for 1808 two articles of his are traced—a "Review of Fox's History," and an article on "Bentham's Law Reforms," probably his first published notice of Bentham. In 1811 he co-operated with William Allen (1770–1843), quaker and chemist, in a periodical called the *Philanthropist*. He contributed largely to every number—his principal topics being Education, Freedom of the Press, and Prison Discipline (under which he expounded Bentham's "Panopticon"). He made powerful onslaughts on the Church in connexion with the Bell and Lancaster controversy, and took a prominent part in the discussions which led to the foundation of London University in 1825. In 1814 he wrote a number of articles, containing an exposition of utilitarianism, for the supplement to the fifth edition of the *Encyclopaedia Britannica*, the most important being those on "Jurisprudence," "Prisons" and "Government."

In 1818 the *History of India* was published, and obtained a great and immediate success. It brought about a change in the author's position. The year following he was appointed an official in the India House, in the important department of the examiner of Indian correspondence. He gradually rose in rank till he was appointed, in 1830, head of the office, with a salary of £1900, raised in 1836 to £2000. His great work, the *Elements of Political Economy*, appeared in 1821 (3rd and revised ed. 1826).

From 1824 to 1826 Mill contributed to the *Westminster Review*, started as the organ of his party, a number of articles in which he attacked the *Edinburgh* and *Quarterly Reviews* and ecclesiastical establishments. In 1829 appeared the *Analysis of the Human Mind*. From 1831 to 1833 Mill was largely occupied in the defence of the East India Company, during the controversy attending the renewal of its charter, he being in virtue of his office the spokesman of the court of directors. For the *London Review*, founded by Sir William Molesworth in 1834, he wrote a notable article entitled "The Church and its Reform," which was much too sceptical for the time, and injured the *Review*. His last published book was the *Fragment on Mackintosh* (1835). He died on the 23rd of June 1836.

Mill had a thorough acquaintance with Greek and Latin literature, general history, political, mental and moral philosophy. His intellect was logical in the highest degree; he was clear and precise, an enemy of loose reasoning, and quick to refute prevailing fallacies. All his work is marked by original constructive thought, except in a few subjects, in which he confessedly expounded Bentham's views. At a time when social subjects were as a rule treated empirically, he brought first principles to bear at every point. His greatest literary monument is the *History of India*. The materials for narrating the acquisition by England of its Indian Empire were put into shape for the first time; a vast body of political theory was brought to bear on the delineation of the Hindu civilization; and the conduct of the actors in the successive stages of the conquest and administration of India was subjected to a severe criticism. The work itself, and the author's official connexion with India for the last seventeen years of his life, effected a complete change in the whole system of governing that country.

Mill played a great part also in English politics, and was, more than any other man, the founder of what was called "philosophic radicalism." His writings on government and his personal influence among the Liberal politicians of his time determined the change of view from the French Revolution theories of the rights of man and the absolute equality of men to the claiming of securities for good government through a wide extension of the franchise. Under this banner it was that the Reform Bill was fought and won. His *Elements of Political Economy*, which was intended only as a textbook of the subject, shows all the author's precision and lucidity. As Dr J. K. Ingram said, it has the "character of a work of art." It followed up the views of Ricardo, with whom Mill was always on terms of intimacy. Its interest is mainly historical, as an accurate summary of views which are now largely discarded. Among the more important of its theses are: (1) that the chief problem of practical reformers is to limit the increase of population, on the assumption that capital does not naturally increase at the same rate as population (ii. § 2, art. 3); (2) that the value of a thing depends entirely on the quantity of labour put into it; and (3) that what is now known as the "unearned increment" of land is a proper object for taxation. The work as a whole is a striking example of the weakness of treating economic problems from a purely a priori standpoint by the deductive method.

By his *Analysis of the Mind* and his *Fragment on Mackintosh* Mill acquired a position in the history of psychology and ethics. He took up the problems of mind very much after the fashion of the Scottish school, as then represented by Reid, Stewart and Brown, but made a new start, due in part to Hartley, and still more to his own independent thinking. He carried out the principle of association into the analysis of the complex emotional states, as the affections, the aesthetic emotions and the moral sentiment, all which he endeavoured to resolve into pleasurable and painful sensations. But the salient merit of the *Analysis* is the constant endeavour after precise definition of terms and clear statement of doctrines. The *Fragment on Mackintosh* is a severe exposure of the flimsiness and misrepresentations of Sir James Mackintosh's famous *Dissertation on the Progress of Ethical Philosophy* (1830), and discusses the foundations of ethics from the author's utilitarian point of view.

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MILL, JOHN (*c.* 1645–1707), English theologian, was born about 1645 at Shap in Westmorland, entered Queen's College, Oxford, as a servitor in 1661, and took his master's degree in 1669 in which year he spoke the "Oratio Panegyrica" at the opening of the Sheldonian Theatre. Soon afterwards he was chosen fellow and tutor of his college; in 1676 he became chaplain to the bishop of Oxford, and in 1681 he obtained the rectory of Bletchington, Oxfordshire, and was made chaplain to Charles II. From 1685 till his death he was principal of St Edmund's Hall; and in 1704 he was nominated by Queen Anne to a prebendal stall in Canterbury. He died on the 23rd of June 1707, just a fortnight after the publication of his Greek Testament.

Mill's *Novum testamentum græcum, cum lectionibus variantibus MSS. exemplarium, versionum, editionum SS. patrum et scriptorum ecclesiasticorum, et in easdem notis* (Oxford, fol. 1707), was undertaken by the advice and encouragement of John Fell (*q.v.*), his predecessor in the field of New Testament criticism; it represents the labour of thirty years, and is admitted to mark a great advance on all that had previously been achieved. The text indeed is that of R. Stephanus (1550), but the notes, besides embodying all previously existing collections of various readings, add a vast number derived from his own examination of many new MSS, and Oriental versions (the latter unfortunately he used only in the Latin translations). Though the amount of information given by Mill is small compared with that in modern editions, it is probable that no one person, except perhaps Tischendorf, has added so much material for the work of textual criticism. He was the first to notice, though only incidentally, the value of the concurrence of the Latin evidence with the Codex Alexandrinus, the only representative of an ancient non-Western Greek text then sufficiently known; this hint was not lost on Bentley (see Westcott and Hort, *Introduction to New Testament*). Mill's various readings, numbering about thirty thousand, were attacked by Daniel Whitby (1638–1726) in his *Examen* as destroying the validity of the text; Antony Collins also argued in the same sense though with a different object. The latter called forth a reply from Bentley (*Phileleutherus lipsiensis*). In 1710 Kuster reprinted Mill's Testament at Amsterdam with the readings of twelve additional MSS.

MILL, JOHN STUART (1806–1873), English philosopher and economist, son of James Mill, was born on the 20th of May 1806 in his father's house in Pentonville, London. He was educated exclusively by his father, who was a strict disciplinarian, and at the age of three was taught the Greek alphabet and long lists of Greek words with their English equivalents. By his eighth year he had read Aesop's *Fables*, Xenophon's *Anabasis*, and the whole of Herodotus, and was acquainted with Lucian, Diogenes Laërtius, Isocrates and six dialogues of Plato (see his *Autobiography*). He had also read a great deal of history in English—Robertson's histories, Hume, Gibbon, Robert Watson's *Philip II.* and *Philip III.*, Hooke's *Roman History*, part of a translation of Rollin's *Ancient History*, Langhorne's *Plutarch*, Burnet's *History of My Own Times*, thirty volumes of the *Annual Register*, Millar's *Historical View of the English Government*, Mosheim's *Ecclesiastical History*, M'Crie's *Knox*, and two histories of the Quakers. A contemporary record of Mill's studies from eight to thirteen is published in Bain's sketch of his life. It shows that the *Autobiography* rather understates the amount of work done. At the age of eight he began Latin, Euclid, and algebra, and was appointed schoolmaster to the younger children of the family. His main reading was still history, but he went through all the Latin and Greek authors commonly read in the schools and universities, besides several that are not commonly read by undergraduates. He was not taught to compose either in Latin or in Greek, and he was never an exact scholar; it was for the subject matter that he was required to read, and by the age of ten he could read Plato and Demosthenes with ease. His father's *History of India* was published in 1818; immediately thereafter, about the age of twelve, John began a thorough study of the scholastic logic, at the same time reading Aristotle's logical treatises in the original. In the following year he was introduced to political economy and studied Adam Smith and Ricardo with his father.

Not unnaturally the training which the younger Mill received has aroused amazement and criticism; and it is reasonable to doubt whether the material knowledge which he retained in the result was as valuable to him as his father imagined. It is important, however, to note that the really important part of the training was the close association which it involved with the strenuous character and vigorous intellect of his father. From his earliest days he spent much time in his father's study and habitually accompanied him on his walks in North London. Much therefore of what he acquired was assimilated without difficulty, and the accuracy of his impressions was tested by his subsequently drafting a *résumé* of their conversations. He thus learned early to grapple with difficulties and to accustom himself to the necessity of precision in argument and expression. It was an inevitable result of such an education that Mill acquired many of his father's speculative opinions, and his father's way of defending them. But he did not receive the impress passively and mechanically. "One of the grand objects of education," according to the elder Mill, "should be to generate a constant and anxious concern about evidence." The duty of collecting and weighing evidence for himself was at every turn impressed upon the boy; he was taught to accept no opinion on authority. He was deliberately educated as an apostle, but it was as an apostle of reasoned truth in human affairs, not as an apostle of any system of dogmatic tenets. It was to prevent any falling off from this high moral standard till it should become part of his being that his father kept the boy so closely with himself. Mill expressly says that his childhood was not unhappy. It seems unhappy only when we compare it with the normal life of a boy and decline to imagine its peculiar enjoyments and aspirations. Mill complains that his father often required more than could be expected of him, but his tasks were not so severe as to prevent him from growing up a healthy and high-spirited boy, though he was not constitutionally robust, and his pursuits were so different from those of other boys of the same age.

From May 1820 till July 1821 Mill was in France in the family of Sir Samuel Bentham, brother of Jeremy Bentham. Away from his father he maintained his laborious habits. Copious extracts from a diary kept by him at this time are given by Bain; they show how methodically he read and wrote, studied chemistry and botany, tackled advanced mathematical problems, made notes on the scenery and the people and customs of the country. He also gained a thorough acquaintance with the French language. On his return in 1821 he added to his work the study of psychology, and that of Roman law, which he read with John Austin, his father having half decided on the bar as the best profession open to him. In 1822, however, when he had just completed his seventeenth year, this intention was abandoned, and he entered as a clerk in the examiner's office of the India House, "with the understanding that he should be employed from the beginning in preparing drafts of despatches, and be thus trained up as a successor to those who then filled the highest departments of the office."

Mill's work at the India House, which was henceforth his livelihood, did not come before the public; hence some have scouted his political writings as the work of an abstract philosopher, entirely unacquainted with affairs. From the first he was more than a clerk, and after a short apprenticeship he was promoted, in 1828, to the responsible position of assistant-examiner with a salary of £600 a year. The duty of the so-called examiners was to examine the letters of the agents of the Company in India, and to draft instructions in reply. The character of the Company's government was almost entirely dependent upon their abilities as statesmen. For twenty years, from 1836 (when his father died) to 1856, Mill had charge of the Company's relations with the native states, and in 1856 he became chief of the office with a salary of £2000. In the hundreds of despatches that he wrote in this capacity, much, no doubt, was done in accordance with established routine, but few statesmen of his generation had a wider experience of the responsible application of the principles of government. About this work he said little in the *Autobiography*, probably because his main concern there was to expound the influences that effected his moral and mental development.

About the time of his entering the India House Mill read Dumont's exposition of Bentham's doctrines in the *Traité de Législation*, which made a lasting impression upon him. When he laid down the last volume, he says, he had become a different being. It gave unity to the detached and fragmentary parts of his knowledge and beliefs. The impression was confirmed by the study of the English psychologists, as well as Condillac and Helvetius, and in 1822–1823 he established among a few friends the "Utilitarian" Society, taking the word, as he tells us, from Galt's *Annals of the Parish*. Two newspapers were open to him—the *Traveller*, edited by a friend of Bentham's, and the *Morning Chronicle*, edited by his father's friend Black. One of his first efforts was a solid argument for freedom of discussion, in a series of letters to the *Chronicle* apropos of the prosecution of Richard Carlile. But he watched all public incidents with a vigilant eye, and seized every passing opportunity of exposing departures from sound principle in parliament and courts of justice. Another outlet was opened up for him (April 1824) by the starting of the *Westminster Review*, and still another in the following year in the *Parliamentary History and Review*. This year also he found a congenial occupation in editing Bentham's *Rationale of Judicial Evidence*. All the time, his mind full of public questions, he discussed eagerly with the many men of distinction who came to his father's house. He engaged in set discussions at a reading society formed at Grote's house in 1825, and in set debates at a Speculative Society formed in the same year.

From the *Autobiography* we learn that in 1826 Mill's enthusiasm was checked by a misgiving as to the value of the ends which he had set before him. This expression was the result, no doubt, of his strenuous training and the comparative lack of congenial friendships. His father was reserved, undemonstrative even to the pitch of chilling sternness, and among young Mill's comrades contempt of feeling was almost a watchword. Himself absorbed in abstract questions and projects of general philanthropy, he had been careless of personal attachment. On the other hand without experience he could not have been prepared for the actual slowness of the reformer's work. In 1826 he looked back to four years of eager toil. What were the results? He had become convinced that his comrades in the Utilitarian Society, never more than ten, had not the stuff in them for a world-shaking propaganda; the society itself was dissolved; the *Parliamentary Review* was a failure; the *Westminster* did not pay its expenses; Bentham's *Judicial Evidence* produced little effect on the reviewers. His own reception at the Speculative Debating Society, where he first measured his strength in public conflict, was calculated to produce self-distrust. He found himself looked upon with curiosity as a precocious phenomenon, a "made man," an intellectual machine set to grind certain tunes. The outcome of this period of depression was a broadening of his outlook on the problems which he had set himself to solve. He now saw that regard for the public good was too vague an object for the satisfaction of a man's affections. It is a proof of the dominating force of his father's character that it cost the younger Mill such an effort to shake off his stern creed about poetry and personal emotion. Like Plato, the elder Mill would have put poets under ban as enemies of truth, and he subordinated private to public affections. Landor's maxims of "few acquaintances, fewer friends, no familiarities" had his cordial approval. These doctrines the younger Mill now felt himself forced in reason to abandon. Too much in awe of his father to make him a confidant, he wrestled in the gloomy solitude of his own mind. He gained from the struggle a more catholic view of human happiness, at delight in the poetry of nature and the affections as well as the poetry of heroic unselfishness, a disposition to study more sympathetically the point of view of opponents, a more courteous style of polemic, a hatred of sectarianism, an ambition, no less noble and disinterested, but moderated to practical possibilities.

In the course of the next few years he wrote comparatively little, but he continued his reading, and also derived much benefit from discussions held twice a week at Grote's house in Threadneedle Street. Gradually also he had the satisfaction of seeing the debates in the Speculative Society becoming famous enough to attract men with whom it was profitable for him to interchange opinions, among others Mauriçe and John Sterling. He ceased to attend the society in 1829, but he carried away from it the strengthening memory of failure overcome by persevering effort, and the important doctrinal conviction that a true system of political philosophy was "something much more complex and many-sided than he had previously had any idea of, and that its office was to supply, not a set of model institutions but principles from which the institutions suitable to any given circumstances might be deduced."

The first sketch of Mill's political philosophy appeared in a series of contributions to the *Examiner* in the autumn of 1830 entitled "Prospects in France." He was in Paris soon after the July Revolution, and made the acquaintance of the leading spirits among the younger men; in his discussion of their proposals we find the germs of many thoughts afterwards more fully developed in his *Representative Government*. It is from this time that Mill's letters supply a connected account of his life (see Hugh Elliott, *Letters of John Stuart Mill*, 1910).

The letters in the *Examiner* may be taken as marking the close of his period of meditative search, and his return to hopeful aspiring activity. It was characteristic of his nature that he should be stirred to such delight by the Revolution in France, and should labour so earnestly to make his countrymen understand with what gravity and sobriety it had been effected. Their own Reform Bill came soon after and it is again characteristic of Mill—at once of his enthusiasm and of his steady determination to do work that nobody else seemed able or willing to do—that we find him in the heat of the struggle in 1831 writing to the *Examiner* a series of letters on "The Spirit of the Age" which drew from Carlyle the singular exclamation "Here is a new mystic!" How little this criticism was justified may be seen from the fact that Mill's inductive logic was the direct result of his aspirations after political stability as determined by the dominion of the wisest (*Examiner* letters). "Why is it," he asked, "that the multitude accept implicitly the decisions of the wisest, of the specially skilled, in physical science?" Because in physical science there is all but complete agreement in opinion. "And why this agreement?" Because all accept the same methods of investigation, the same tests of truth. Is it possible then to obtain unanimity as to the methods of arriving at conclusions in social and political matters, so as to secure similar agreement of opinion among the specially skilled, and similar general respect for their authority? The same thought appears in a review of Herschel's *Natural Philosophy*, written about the same time. Mill remarks that the uncertainty hanging over the very elements of moral and social philosophy proves that the means of arriving at the truth in those sciences are not yet properly understood. "And whither," he adds, "can mankind so advantageously turn, in order to learn the proper means, and to form their minds to the proper habits, as to that branch of knowledge in which by universal acknowledgment the greatest number of truths have been ascertained, and the greatest possible degree of certainty arrived at?"

By 1831 the period of depression had passed; Mill's enthusiasm for humanity had been thoroughly reawakened, and had taken the definite shape of an aspiration to supply an unimpeachable method of search for conclusions in moral and social science. No mystic ever worked with warmer zeal than Mill. But his zeal encountered a check which baffled him for several years, and which left its mark in various inconsistencies and incoherences in his completed system. He had been bred by his father in a great veneration for the syllogistic logic as an antidote against confused thinking. He attributed to his early discipline in this logic an impatience of vague language which in all likelihood was really fostered in him by his study of the Platonic dialogues and of Bentham, for he always had in himself more of Plato's fertile ingenuity in canvassing the meaning of vague terms than the schoolman's rigid consistency in the use of them. Be this as it may, enthusiastic as he was for a new logic that might give certainty to moral and social conclusions, Mill was no less resolute that the new logic should stand in no antagonism to the old. In his *Westminster* review of Whately's *Logic* in 1828 (invaluable to all students of the genesis of Mill's logic) he appears, curiously enough, as an ardent and brilliant champion of the syllogistic logic against highfliers such as the Scottish philosophers who talk of "superseding" it by "a supposed system of inductive logic." His inductive logic must "supplement and not supersede." But for several years he searched in vain for the means of concatenation.

Meantime, while recurring again and again, as was his custom, to this cardinal difficulty, Mill worked indefatigably in other directions where he saw his way clear. The working of the new order in France, and the personalities of the leading men, had a profound interest for him; he wrote on the subject in the *Examiner*. He had ceased to write for the *Westminster* in 1828; but during the years 1832 and 1833 he contributed many essays to *Tait's Magazine*, the *Jurist*, and the *Monthly Repository*. In 1835 Sir William Molesworth founded the *London Review* with Mill as editor; it was amalgamated with the *Wesminster* (as the *London and Westminster Review*) in 1836, and Mill continued editor (latterly proprietor also) till 1840. Much of what he wrote then was subsequently incorporated in his systematic works: some of his essays were reprinted in his first two volumes of *Dissertations and Discussions* (1859). The essays on Bentham and Coleridge constituted the first manifesto of the new spirit which Mill sought to breathe into English Radicalism. But the reprinted papers give no just idea of the immense range of Mill's energy at this time. His position in the India Office, where alone he did work enough for most men, cut him off from entering parliament; but he laboured hard though ineffectually to influence the legislature from without by combating the disposition to rest and be thankful. In his *Autobiography* he admits that the attempt to form a Radical party in parliament at that time was chimerical.

It was in 1837, on reading Whewell's *Inductive Sciences* and re-reading Herschel, that Mill at last saw his way clear both to formulating the methods of scientific investigation and joining on the new logic as a supplement to the old. The *Logic* was published in 1843. In 1844 appeared his *Essays on Some Unsettled Questions in Political Economy*. These essays were worked out and written many years before, and show Mill in his first stage as a political economist. Four out of the five essays are elaborate and powerful solutions of perplexing technical problems—the distribution of the gains of international commerce, the influence of consumption on production, the definition of productive and unproductive labour, the precise relations between profits and wages. Though Mill appears here purely as the disciple of Ricardo, striving after more precise statement, and reaching forward to further consequences, we can well understand in reading these essays how about the time when he first sketched them he began to be conscious of power as an original and independent thinker.

That originality and independence became more conspicuous when he reached his second stage as a political economist, struggling forward towards the standpoint from which his systematic work was written. It would seem that in his fits of despondency one of the thoughts that marred his dreams of human improvement was the apparently inexorable character of economic laws, condemning thousands of labourers to a cramped and miserable existence, and thousands more to semi-starvation. From this oppressive feeling he found relief in the thought set forth in the opening of the second book of his *Political Economy*—that, while the conditions of production have the necessity of physical laws, the distribution of what is produced among the various classes of producers is a matter of human arrangement, dependent upon alterable customs and institutions. There can be little doubt that this thought, whether or not in the clear shape that it afterwards assumed, was the germ of all that is most distinctive in his system of political economy. This system, which for many years subsequently was regarded as authoritative, has been subjected to vigorous criticism by later economists, and it is perhaps not too much to say that it now possesses mainly an historical interest. Its chief importance is perhaps the stress which it laid on the vital connexion which must subsist between true economic theory and the wider facts of social and national development.

While his great systematic works were in progress, Mill wrote very little on events or books of the day. He turned aside for a few months from his *Political Economy* during the winter of the Irish famine (1846–1847) to advocate the creation of peasant-proprietorships as a remedy for distress and disorder in Ireland. He found time also to write elaborate articles on French history and Greek history in the *Edinburgh Review* apropos of Michelet, Guizot and Grote, besides some less elaborate essays.

The *Political Economy* was published in 1848. Mill could now feel that his main work was accomplished; he remained, however, on the alert for opportunities of useful influence, and pressed on with hardly diminished enthusiasm in his search for useful truth. Among other things, he made a more thorough study of socialist writers, with the result that, though he was not converted to any of their schemes as being immediately practicable, he began to look upon some more equal distribution of the produce of labour as a practicability of the remote future, and to dwell upon the prospect of such changes in human character as might render a stable society possible without the institution of private property. This he has called his third stage as a political economist, and he says that he was helped towards it by the lady, Mrs Taylor,[1] who became his wife in 1851. It is generally supposed that he writes with a lover's extravagance about this lady's powers when he compares her with Shelley and Carlyle. But a little reflection will show that he wrote with his usual accuracy and sobriety when he described her influence on him. He expressly says that he owed none of his technical doctrine to her, that she influenced only his ideals of life for the individual and for society; the only work perhaps which was directly inspired by her is the essay on the enfranchisement of women (*Dissertations*, vol. ii.). It is obvious from what he says that his inner life became very different after he threw off his father's authority. This new inner life was strengthened and enlarged by Mrs Taylor.

During the seven years of his married life Mill published less than in any other period of his career, but four of his most closely reasoned and characteristic works, the *Liberty*, the *Utilitarianism*, the *Thoughts on Parliamentary Reform*, and the *Subjection of Women*, besides his posthumously published essays on *Nature* and on the *Utility of Religion*, were thought out and partly written in collaboration with his wife. In 1856 he became head of the examiner's office in the India House, and for two years, till the dissolution of the Company in 1858, his official work, never a light task, kept him fully occupied. It fell to him as head of the office to write the defence of the Company's government of India when the transfer of its powers was proposed. Mill was earnestly opposed to the transfer, and the documents in which he substantiated the proud boast for the Company that "few governments, even under far more favourable circumstances, have attempted so much for the good of their subjects or carried so many of their attempts to a beneficial issue," and exposed the defects of the proposed new government, are models of trenchant and dignified pleading.

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[1] Mrs Taylor (Harriet Hardy) was the wife of John Taylor, a wholesale druggist in the city of London. She was a confirmed invalid, and lived in the country, where Mill visited her regularly for twenty years, with the full consent of her husband, a man of limited mental powers, but of high character and unselfishness. Mill's friendship with Mrs Taylor and their marriage in 1851 involved a break with his family (apparently due to his resentment at a fancied slight, not to any bitterness on their part), and his practical disappearance from society. (On these points see Mary Taylor, Mrs Mill's grand-daughter, in Elliott's edition of the *Letters*.)

On the dissolution of the Company Mill was offered a seat in the new council, but declined, and retired with a pension of £1500. His retirement from official work was followed almost immediately by his wife's death at Avignon, whither they had come in the course of a tour. So great was the shock that for the rest of his life he spent most of his time at a villa at St Véran, near Avignon, returning to his Blackheath residence only for a short period in each year. He sought relief in active literary occupation, in politics, sociology and psychology. He published, with a touching dedication to his wife, the treatise on *Liberty*, which they had wrought out together. He then turned to politics, and published, in view of the impending Reform Bill, a pamphlet on parliamentary reform. The chief feature in this was an idea concerning which he and Mrs Mill often deliberated —the necessity of providing checks against uneducated democracy. His suggestion of a plurality of votes, proportioned to the elector's degree of education, was avowedly put forward only as an ideal; he admitted that no authentic test of education could for the present be found. An anonymous Conservative caught at the scheme in another pamphlet, proposing income as a test. Soon after Mill supported in *Fraser's*, still with the same object, Hare's scheme for the representation of minorities. In the autumn of the same year he turned to psychology, reviewing Bain's works in the *Edinburgh Review*. In his *Representative Government* (1860) he systematized opinions already put forward in many casual articles and essays. His *Utilitarianism* (published in *Fraser's* in 1861) was a closely-reasoned systematic attempt to answer objections to his ethical theory and remove misconceptions of it. He was especially anxious to make it clear that he included in "utility" the pleasures of the imagination and the gratification of the higher emotions, and to show how powerfully the good of mankind as a motive appealed to the imagination. His next treatise, *The Subjection of Women*, was not published till 1869.[1] His *Examination of Hamilton's Philosophy*, published in 1865, had engaged a large share of his time for three years before.

While mainly occupied in those years with philosophical studies, Mill did not remit his interest in current politics. He supported the North in the American crisis of 1862, using all his strength to explain what has since been universally recognized as the issue really at stake in the struggle, the abolition of slavery. It was characteristic of the closeness with which he watched current events, and of his zeal in the cause of "lucidity," that when the *Reader*, an organ of science and unpartisan opinion, fell into difficulties in 1865 Mill joined with some distinguished men of science and letters in an effort to keep it afloat. He supplied part of the money for carrying it on, contributed several articles, and assisted the editor, Fraser Rae, with his advice. The effort was vain, though such men as Herbert Spencer, Huxley, Tyndall, Cairnes, Mark Pattison, F. Harrison, Sir Frederick Pollock and Lockyer were among the contributors.

In 1865 he agreed to stand as parliamentary candidate for Westminster, on conditions strictly in accordance with his principles. He would not canvass, nor pay agents to canvass for him, nor would he engage to attend to the local business of the constituency. He was with difficulty persuaded even to address a meeting of the electors. The story of this remarkable election has been told by James Beal, one of the most active supporters of Mill's candidature. In parliament he adhered to his life-long principle of doing only work that needed to be done, and that nobody else seemed equally able or willing to do. It may have been a consciousness of this fact which prompted a remark, made by the Speaker, that Mill's presence in parliament elevated the tone of debate. The impression made by him in parliament is in some danger of being forgotten, because he was not instrumental in carrying any great measure that might serve as an abiding memorial. But, although his first speech on the bill for the prevention of cattle diseases excited the opposition of country members, and a subsequent speech against the suspension of the Habeas Corpus Act in Ireland was very unfavourably received, Mill thoroughly succeeded in gaining the ear of the House. The only speech made by him during his three years in parliament that was listened to with impatience was, curiously enough, his speech in favour of counteracting democracy by providing for the representation of minorities. His attack on the conduct of Governor Eyre in Jamaica (*q.v.*) was listened to, but with repugnance by the majority, although his action in this matter in and out of parliament was far from being ineffectual. He took an active part in the debates on Disraeli's Reform Bill (moving an amendment to omit the word "man" and insert "person"), and helped to extort from the government several useful modifications of the Bill for the Prevention of Corrupt Practices. The reform of land tenure in Ireland, the representation of women, the reduction of the national debt, the reform of London government, the abrogation of the Declaration of Paris, were among the topics on which he spoke with marked effect. He took occasion more than once to enforce what he had often advocated in writing, England's duty to intervene in foreign politics in support of the cause of freedom. As a speaker Mill was somewhat hesitating, pausing occasionally as if to recover the thread of his argument, but he showed great readiness in extemporaneous debate. Viewed as a candidate for ministerial office, he might be regarded as a failure in parliament, but there can be no doubt that his career there greatly extended his influence.

Mill's subscription to the election expenses of Bradlaugh, and his attitude towards Governor Eyre, are generally regarded as the main causes of his defeat in the general election of 1868. But, as he suggests himself, his studied advocacy of unfamiliar projects of reform had made him unpopular with "moderate Liberals." He retired with a sense of relief to his cottage and his literary life at Avignon. His parliamentary duties and the quantity of correspondence brought upon him by increased publicity had absorbed nearly the whole of his time. The scanty leisure of his first recess had been devoted to writing his St Andrews rectorial address on higher education and to answering attacks on his criticism of Hamilton; of the second, to annotating in conjunction with Bain and Findlater, his father's *Analysis of the Mind*. Now he looked forward to a literary life, and his letters show how much he enjoyed the change. His little cottage was filled with books and newspapers; the beautiful country round it furnished him with a variety of walks; he read, wrote, discussed, walked, botanized. He was extremely fond of music, and was himself a fair pianist. His step-daughter, Miss Taylor (d. January 1907), was his constant companion after his wife's death. "Helen," he wrote to W. T. Thornton, an old colleague in the India House, "has carried out her long-cherished scheme (about which she tells me she consulted you) of a 'vibratory' for me, and has made a pleasant covered walk, some 30 ft. long, where I can vibrate in cold or rainy weather. The terrace, you must know, as it goes round two sides of the house, has got itself dubbed the 'semi-circumgyratory.' In addition to this, Helen has built me a herbarium, a little room fitted up with closets for my plants, shelves for my botanical books, and a great table whereon to manipulate them all. Thus, you see, with my herbarium, my vibratory, and my semi-circumgyratory, I am in clover; and you may imagine with what scorn I think of the House of Commons, which, comfortable club as it is said to be, could offer me none of these comforts, or, more perfectly speaking, these necessaries of life." Mill was an enthusiastic botanist all his life long, and a frequent contributor of notes and short papers to the *Phytologist*. One of the things that he looked forward to during his last journey to Avignon was seeing the spring flowers and completing a flora of the locality. His delight in scenery frequently appears in letters written to his friends during his summer and autumn tours.

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[1] He was one of the founders, with Mrs P. A. Taylor, Miss Emily Davies and others, of the first women's suffrage society, which developed into the National Union of Women's Suffrage Societies, and his writings are still the most important theoretical statement of the case for women's suffrage. He presented to Parliament the first petition on the subject (see further Blackburn, *Women's Suffrage Record*).

Yet he did not relax his laborious habits nor his ardent outlook on human affairs. The essays in the fourth volume of his *Dissertations*—on endowments, on land, on labour, on metaphysical and psychological questions—were written for the *Fortnightly Review* at intervals after his short parliamentary career. One of his first tasks was to send his treatise on the *Subjection of Women* (written 1861, published 1869, many editions) through the press. The essay on *Theism* was written soon after. The last public work in which he engaged was the starting of the Land Tenure Reform Association. The interception by the state of the unearned increment, and the promotion of co-operative agriculture, were the most striking features in his programme. He wrote in the *Examiner* and made a public speech in favour of the association a few months before his death. The secret of the ardour with which he took up this question probably was his conviction that a great struggle was impending in Europe between labour and capital. He regarded his project as a timely compromise.

Mill died at Avignon on the 8th of May 1873. He was a man of extreme simplicity in his method of life. Though occasionally irritable in speech, in his written polemics he was remarkable for courtesy to opponents and a capacity to understand their point of view. His references to his friends were always generous, and he was always ready to assist those whose work needed help. For example, he desired to guarantee the cost of the first books of Bain and Herbert Spencer. A statue in bronze was placed on the Thames Embankment, and there is a good portrait by Watts (a copy of which, by Watts himself, was hung in the National Gallery).

The influence which Mill's works exercised upon contemporary English thought can scarcely be overestimated. His own writings and those of his successors (*e.g.* J. E. Cairnes and Alexander Bain) practically held the field during the third quarter of the 19th century and even later. In philosophy his chief work was to systematize and expound the utilitarianism of his father and Bentham (see Utilitarianism). He may, in fact, be regarded as the final exponent of that empirical school of philosophy which owed its impulse to John Locke, and is generally spoken of as being typically English. Its fundamental characteristic is the emphasis laid upon human reason, *i.e.* upon the duty incumbent upon all thinkers to investigate for themselves rather than to accept the authority of others. Knowledge must be based upon experience. In reasserting and amplifying the empirical conclusions of his predecessors, especially in the sphere of ethics, Mill's chief function was the introduction of the humanist element. This was due, no doubt, to his revulsion from the sternness of his upbringing and the period of stress through which he passed in early manhood, but also to the sympathetic and emotional qualities which manifested themselves in his early manhood. We have seen, for example, that he was led to investigate the subject of logic because he found in attempting to advance his humanitarian schemes in politics an absence of that fundamental agreement which he recognized as the basis of scientific advance. Both his logical and his metaphysical studies were thus undertaken as the pre-requisites of a practical theory of human development. Though he believed that the lower classes were not yet ripe for socialism, with the principles of which he (unlike James Mill and Bentham) was in general agreement, his whole life was devoted to the amelioration of the conditions of the working classes. This fact, no doubt, should be taken into account in any detailed criticism of the philosophic work; it was taken up not as an end but as ancillary to a social and ethical system. Reference to the articles on Logic, Metaphysics, &c., will show that subsequent criticism, however much it has owed by way of stimulus to Mill's strenuous rationalism, has been able to point to much that is inconsistent, inadequate and even superficial in his writings. Two main intellectual movements from widely different standpoints have combined to diminish his influence. On the one hand there has arisen a school of thinkers of the type of Thomas Hill Green, who have brought to bear on his metaphysical views the idealism of modern German thinkers. On the other hand are the evolutionists, who have substituted for the utilitarian ideal of the "greatest happiness" those of "race-preservation" and the "survival of the fittest" (see Ethics, *ad. fin.*; Spencer). In the sphere of psychology, likewise—*e.g.* in connexion with Mill's doctrine of Association of Ideas (*q.v.*) and the phrase "Mental Chemistry," by which he sought to meet the problems which Associationism left unsolved—modern criticism and the experimental methods of the psycho-physiological school have set up wholly new criteria, with a new terminology and different fields of investigation (see Psychology).

A similar fate has befallen Mill's economic theories. The title of his work, *Principles of Political Economy, with some of their Applications to Social Philosophy*, though open to criticism, indicated a less narrow and formal conception of the field of the science than had been common amongst his predecessors. He aimed in fact at producing a work which might replace in ordinary use the *Wealth of Nations*, which in his opinion was "in many parts obsolete and in all imperfect." Adam Smith had invariably associated the general principles of the subject with their applications, and in treating those applications had perpetually appealed to other and often far larger considerations than pure political economy affords. And in the same spirit Mill desired, whilst incorporating all the results arrived at in the special science by Smith's successors, to exhibit purely economic phenomena in relation to the most advanced conceptions of his own time in the general philosophy of society, as Smith had done in reference to the philosophy of his century. This design he certainly failed to realize. His book is very far indeed from being a "modern Adam Smith." It is an admirably lucid, and even elegant, exposition of the Ricardian economics, the Malthusian theory being of course incorporated with these; but, notwithstanding the introduction of many minor novelties, it is in its scientific substance little or nothing more.

With respect to economic method he shifted his position, yet to the end occupied uncertain ground. In the fifth of his early essays he asserted that the method a priori is the only mode of investigation in the social sciences, and that the method a posteriori "is altogether inefficacious in those sciences as a means of arriving at any considerable body of valuable truth." When he wrote his *Logic* he had learned from Comte that the a posteriori method—in the form which he chose to call "inverse deduction"—was the only mode of arriving at truth in general sociology; and his admission of this at once renders the essay obsolete. But, unwilling to relinquish the a priori method of his youth, he tries to establish a distinction of two sorts of economic inquiry, one of which, though not the other, can be handled by that method. Sometimes he speaks of political economy as a department "carved out of the general body of the science of society;" whilst on the other hand the title of his systematic work implies a doubt whether political economy is a part of "social philosophy" at all, and not rather a study preparatory and auxiliary to it. Thus, on the logical as well as the dogmatic side, he halts between two opinions. Notwithstanding his misgivings and even disclaimers, he yet remained as to method a member of the old school, and never passed into the new "historical" school.

Bibliography.—*Works: System of Logic* (2 vols., 1843; 9th ed., 1875; "People's" ed., 1884); *Essays on some Unsettled Questions of Political Economy* (1844, ed. 1874); *Principles of Political Economy* (2 vols., 1848; many ed., especially ed. by W. J. Ashley, 1909); *On Liberty* (1859; ed. Courtney, 1892; W. B. Columbine, 1903; with introd. Pringle-Pattison, 1910); *Thoughts on Parliamentary Reform* (1859); *Dissertations and Discussions* (i., ii., 1859; iii., 1867; iv., 1876); *Considerations on Representative Government* (1861; 3rd ed. 1865); *Utilitarianism* (1863); *Examination of Sir W. Hamilton's Philosophy* (1865); *Aug. Comte and Positivism* (1865, ed. 1908); *Inaugural Address at the University of St Andrews* (1867); *England and Ireland* (1868); *Subjection of Women* (1869; ed. with introd. by Stanton Coit, 1906); *Chapters and Speeches on the Irish Land Question* (1870). The *Autobiography* appeared in 1873 (ed. 1908), and *Three Essays on Religion* (1874). Many of these have been translated into German, and there is a German edition by Th. Gomperz (12 vols., 1873–1880). A convenient edition in the New Universal Library appeared between 1905 and 1910.

Biographical and Critical.—Many of Mill's letters are published in Mrs Grote's life of her husband, in Duncan's *Life of Herbert Spencer*, in the *Memories* of Caroline Fox, and in Kingsley's letters. There are also editions of the correspondence with Gustave d'Eichtal and Comte (specially that of Lévy-Bruhl, 1899). By far the most illuminating collection is that of Hugh Elliott, *Letters of John Stuart Mill* (2 vols., 1910), which contains letters to John Sterling, Carlyle, E. Lytton Bulwer (Lord Lytton), John Austin, Alex. Bain, and many leading French and German writers and politicians. These letters are essential to an understanding of Mill's life and thought. Besides the *Autobiography* and many references in the writings of Mill's friends (*e.g.* Alex. Bain's *Autobiography*, 1904), see further

A. Bain, *John Stuart Mill, a Personal Criticism* (1882); Fox Bourne, *Life of J. S. Mill* (1873); John (Viscount) Morley, *Miscellanies* (1877), ii. 239–327; J. E. Cairnes, *J. S. Mill* (1873), on economic theories; W. L. Courtney, *Mataphysics of J. S. Mill* (1879) and *Life* (1889); Douglas, *John Stuart Mill, a Study of his Philosophy* (1895), and *Ethics of J. S. Mill* (1897); Albee, *Hist. of Eng. Utilitarianism* (1902); Sir Leslie Stephen, *The English Utilitarians* (1900); J. MacCunn, *Six Radical Thinkers* (1907); Fred. Harrison, *Tennyson, Ruskin, Mill* (1899); John Watson, *Comte, Mill and Spencer* (1895); T. Whittaker, *Comte and Mill* (1905); Charles Douglas, *J. S. Mill, a Study of his Philosophy* (1895); J. Rickaby, *Free Will and Four English Philosophers* (1906); J. M. Robertson, *Modern Humanists* (1891); D. G. Ritchie, *Principles of State Interference* (1891); W. Graham, *English Political Philosophy from Hobbes to Maine* (1899). There are also a number of valuable French and German criticisms, *e.g.* Taine, *Positivisme anglais, étude sur Stuart Mill* (Paris, 1864); F. A. Lange, *Mills Ansichten über die soziale Frage* (Duisburg, 1866); Littré, *A. Çomte et Stuart Mill* (3rd ed., Paris, 1877); Cauret, *Philosophie de Stuart Mill* (Paris, 1885); Gomperz, *John S. Mill, ein Nachruf* (Vienna, 1889); S. Sanger, *J. S. Mill, sein Leben und Lebenswerk* (Stuttgart, 1901); S. Becher, *Erkenntnistheoretische Untersuchungen zu Stuart Mills Theorie der Kausalität* (1906); E. M. Kantzer, *La Religion de J. S. Mill* (1906). See also histories of modern philosophy.

See further LOGIC (Historical Sketch); PSYCHOLOGY; ASSOCIATION OF IDEAS. (W. M.; J. M. M.)

MILL (O. Eng. *mylen*, later *myln*, or *miln*, adapted from the late Lat. *molina*, cf. Fr. *moulin*, from Lat. *mola*, a mill, *molere*, to grind; from the same root, *mol*, is derived " meal;" the word appears in other Teutonic languages, cf. Du. *molen*, Ger. *mühle*), the term given to the apparatus or machinery used in the grinding of corn into flour, and hence applied to similar mechanical devices for grinding, crushing to powder, or pulping other substances, *e.g.* coffee-mill, powder-mill. " Mill " was first used of the building containing the apparatus, frequently with a word attached descriptive of the motive power, *e.g.* wind-mill, water-mill, &c. It was not the early word used of the actual grinding mechanism. The old hand-mill was known as a " quern," a word which appears in this sense in many Indo-European languages; the ultimate root is *gar-*, to grind. " Quern " (see FLOUR) is only remotely connected with " churn " (*q.v.*). The word is also applied to many mechanical devices by which raw material is transformed into a condition ready for use or into a stage preparatory to other processes, *e.g.* saw-mill, rolling-mill, &c., or still more widely to buildings containing machinery used in manufactures, *e.g.* cotton-mill. In mining it is applied to various machines used in breaking and crushing the ore (see ORE-DRESSING).

In the engineering industries milling machines constitute a very important class of machine tools, the characteristic of which is that rotary cutters are employed for shaping the metal (see TOOLS). In coins the " milling is the serrated edge, called " crenneling " by John Evelyn (*Discourse on Medals*, 1697, p. 225), which is formed on them to prevent clipping and filing. Coins made by the old process of hammering were apt to have irregular edges which invited mutilation; but the introduction of the screw press, which came to be known as a mill (cf. W. Lowndes, *Amendm. Silver Coinage*, 1695, p. 93), permitted the production of a regular edge with serrations, which in consequence were termed milling. This machine also enabled legends to be impressed round the edges of coins, such as the *Decus et tutamen* suggested by Evelyn (see W. J. Hocking, *Catalogue of the Coins, &c., in the Museum of the Royal Mint*, 1906). It was invented about the middle of the 16th century, and has generally been attributed to Guyot Brucher (d. 1556), who was succeeded at the Paris mint by his brother Antoine. Introduced into England by one Eloye Mestrel in 1561, it was used for twelve years, and was then abandoned owing to the opposition of the mint officials to Mestrel, who was executed for counterfeiting and striking money outside the precincts of the Tower of London; but it was again introduced by one Peter Blondeau in 1662, when it permanently superseded hammering. In the United States of America the term " milling " or " milled " is applied to the raised edge on the face of the coin; this is known in the British mint as " marking " (see MINT).

MILLAIS, SIR JOHN EVERETT (1829–1896), English painter, was born at Southampton on the 8th of June 1829, the son of John William Millais, who belonged to an old Norman family settled in Jersey for many generations, and Emily Mary, *née* Evamy, the widow of a Mr Hodgkinson. After his birth the family returned to Jersey, where the boy soon began to sketch. At the age of eight he drew his maternal grandfather. He went to school for a short time, but showed no inclination for study, and was afterwards educated entirely by his mother. In 1835 the family removed to Dinan in Brittany, where he sketched the French officers, to their great amusement, and in 1837, on the family's return to Jersey, he was taught drawing by a Mr Bissel. In 1838 he came to London, and on the strong recommendation of Sir Martin Archer Shee, P.R.A., his future was decided. He was sent at once to Sass's school, and entered the Academy schools in 1840. He won a silver medal from the Society of Arts in 1839, and carried off all the prizes at the Royal Academy. He was popular amongst the students, and was called " the child," because he wore his boyish costume till long after the usual age. In 1840 and the immediately succeeding years he made the acquaintance of Wordsworth and other interesting and useful people. He was at this time painting small pictures, &c., for a dealer named Thomas, and defraying a great part of the household expenses in Gower Street, where his family lived. In 1846 he exhibited " Pizarro seizing the Inca of Peru " at the Royal Academy, and in 1847 " Elgiva seized by the Soldiers of Odo." In the latter year he competed unsuccessfully at the exhibition of designs for the decoration of the Houses of Parliament, sending a very large picture of " The Widow's Mite," which was afterwards cut up. In the beginning of 1848 he and W. Holman Hunt, dissatisfied with the theory and practice of British art, which had sunk to its lowest and most conventional level, initiated what is known as the Pre-Raphaelite movement, and were joined by Dante Gabriel Rossetti, and afterwards by five others, altogether forming the Pre-Raphaelite Brotherhood. Rossetti was then engaged, under the technical guidance of Hunt, upon his picture of " The Girlhood of Mary Virgin," which, with Hunt's " Light of the World " and Millais's " Christ in the House of His Parents," forms what has been called the trilogy of Pre-Raphaelite art. According to Millais, the Pre-Raphaelites had but one idea—" to present on canvas what they saw in Nature." Millais's first picture on his new principles was a banquet scene from Keats's " Isabella " (1849), and contains all the characteristics of Pre-Raphaelite work, including minute imitation of nature down to the smallest detail, and the study of all persons and objects directly from the originals. The tale was told with dramatic force, and the expression of the heads was excellent. His next important picture, " Christ in the House of His Parents," or " The Carpenter's Shop " (1850), represented a supposed incident in the childhood of our Lord treated in a simply realistic manner, and drew down upon him a storm of abuse from nearly all quarters, religious and artistic. The rest of his more strictly Pre-Raphaelite pictures—" The Return of the Dove to the Ark," " The Woodman's Daughter " and the " Mariana " of 1851, " The Huguenot " and " Ophelia " of 1852, " The Proscribed Royalist " and " The Order of Release " of 1853—met with less opposition, and established his reputation with the public. Indeed, this may be said to have been accomplished by the " Huguenot " and " Ophelia," the refined sentiment and exquisite execution of which appealed to nearly all who were unprejudiced. The public were also greatly influenced by the splendid championship of Ruskin, who, in letters to *The Times*, and in a pamphlet called " Pre-Raphaelitism," enthusiastically espoused the cause of the Brotherhood. In 1851 Millais, who had refused to read *Modern Painters*, where the supposed principles of the Brotherhood were first recommended, became acquainted with Ruskin, and in 1853 went to Scotland with him and Mrs Ruskin, the latter of whom sat for the woman in " The Order of Release." He made several designs for Ruskin, and painted his portrait. In 1855 Millais exhibited " The Rescue," a scene from a fire, which drew great attention, from the frantic expression of the mother and the brilliant painting of the glare. In the Paris Exhibition of this year he was represented by " The Order of Release," " Ophelia " and " The Return of the Dove." This was also the year of his marriage with Mrs Ruskin (Euphemia Chalmers, daughter of Mr George Gray of Bowerswell, Perth), who had obtained a decree of the nullity of her previous marriage. The newly-wedded couple went to live at Annat Lodge, near Bowerswell, where "Autumn Leaves," described by Ruskin as "the first instance of a perfect twilight," was painted. This and "Peace Concluded" were singled out for special praise by Ruskin in his notes on the Academy Exhibition of 1856, which contained, with other works by Millais, the picture of "A Blind Girl," with a beautiful background of Icklesham and its common. The principal pictures of 1857 were "Sir Isumbras at the Ford," and "The Escape of a Heretic," both of which were violently attacked by Ruskin, who was kinder to the "Apple-blossoms" and "Vale of Rest" of 1859, extolling the power of their painting, but still insisting on the degeneracy of the artist. The "Black Brunswicker" of 1860 was in motive very like the "Huguenot," but it was less refined in expression, and a great deal broader in execution, and may be said to mark the end of the period of transition from his minute Pre-Raphaelite manner to the masterly freedom of his mature style. From 1860 to 1869 the invention of Millais was much employed in illustration, especially of Trollope's novels, beginning with *Framley Parsonage* in the *Cornhill Magazine*. He made altogether eighty-seven drawings for Trollope, and was the cleverest and one of the most prolific of the book illustrators of the 'sixties. He contributed to Moxon's illustrated edition of *Tennyson's Poems*, and made occasional drawings for *Once a Week*, the *Illustrated London News*, *Good Words*, and other periodicals and books. In 1863 he was elected a Royal Academician. The most important pictures of this and the next few years were "The Eve of St Agnes," remarkable for the painting of moonlight, "Romans leaving Britain" (1865), "Jephthah" (1867), "Rosalind and Celia" (1868), "A Flood," and "The Boyhood of Raleigh" (1870). All these were executed in a very broad and masterly manner. In many of his pictures of this period, such as "The Boyhood of Raleigh," his children were his models, and formed the subject of many more, like "My First Sermon," "My Second Sermon," "Sleeping," "Awake," "Sisters," "The First Minuet," and "The Wolf's Den." He now painted many single figures with more or less sentiment, like "Stella," "Vanessa," and "The Gambler's Wife," with occasionally a more important composition, like "Pilgrims to St Paul's," and "Victory, O Lord" (exhibited 1871), representing Aaron and Hur holding up Moses' hands (Exod. xvii. 12). With it was exhibited the first and most popular of his pure landscapes, called "Chill October," which was followed at intervals by several others remarkable for literal truth to nature and fine execution. They were all from Perthshire, where he generally spent the autumn, and included "Scotch Firs" and "Winter Fuel" (painted in 1874), "Over the Hills and Far away," and "The Fringe of the Moor" (1875) and "The Sound of Many Waters" (1876). A later series was painted in the neighbourhood of Murthly, a village in the parish of Little Dunkeld, Perthshire, where he rented a house and shooting from 1881 to 1891. It was to painting nature and the world around him that he principally devoted himself for the last twenty-five years of his life, abandoning imaginative or didactic themes. To this period belong a number of pictures of children, with fancy titles, like "Cherry Ripe," "Little Miss Muffet," "Bubbles," and others well known by reproductions in black and white and in colour for the illustrated papers; and also some charming studies of girlhood, like "Sweetest eyes were ever seen," and "Cinderella." Amongst his more serious pictures were "The Princes in the Tower" (1878), "The Princess Elizabeth" (1879), two pictures from Scott—"Effie Deans" and "The Master of Ravenswood"—painted for Messrs Agnew in 1877 and 1878, and "The North-West Passage," sometimes regarded as his masterpiece, representing an old mariner (painted from Edward John Trelawney, the friend of Byron) listening to some tale of Arctic exploration in a room overlooking the sea and strewn with charts. "A Yeoman of the Guard" (1877) was perhaps his most splendid piece of colour, and was greatly admired at the Paris Exhibition of 1878, where it was sent with "Chill October" and three others of his pictures. But perhaps the works of his later years by which he will be most remembered are his portraits—especially his three portraits of Gladstone (1879, 1885 and 1890), and those of John Bright, of Lord Tennyson, and of Lord Beaconsfield, which was left unfinished at his death. He also painted the marquess of Salisbury, Lord Rosebery, the dukes of Devonshire and Argyll, Cardinal Newman, Thomas Carlyle, Sir James Paget, Sir Henry Irving, George Grote, Lord Chief Justice Russell, J. C. Hook, R.A., and himself (Uffizi Gallery, Florence). He drew Charles Dickens after his death. Amongst his finer portraits of women were those of Mrs Bischoffsheim, the duchess of Westminster, Lady Campbell and Mrs Jopling.

No very serious interruption of his usual life as a prosperous English gentleman occurred in these years, except the death of his second son, George, in 1878. In 1875 he went to Holland, one of his few visits to the Continent. In 1879 he left Cromwell Place for a house at Palace Gate, Kensington, which he built, and where he died. In 1885 he was created a baronet, on the suggestion of Mr Gladstone. In 1892 his health began to break down. After a bad attack of influenza he was troubled with a swelling in his throat, which proved to be due to cancer. He suffered much from depression, but worked when he could, and derived much pleasure in painting several pictures, including "St Stephen," "A Disciple," "Speak! Speak!" (which was bought out of the Chantrey Bequest), and "The Forerunner"—his last exhibited subject-picture. His finely-characterized portraits of Mr John Hare, the actor, and Sir Richard Quain belong also to his last years. In 1895, in consequence of the illness of Lord (then Sir Frederick) Leighton, he was called upon to preside at the annual banquet of the Royal Academy, and on the death of Lord Leighton he was elected to the presidential chair. He died on the 13th of August 1896, and was buried in St Paul's Cathedral. The Winter Exhibition of the Royal Academy in 1898 was devoted to his works. The list of his honours at home and abroad is a long one. Millais was one of the greatest painters of his time, and did more than any other to infuse a new and healthy life into British art. He had not the imagination of an idealist, but he could paint what he saw with a force which has seldom been excelled. As a man he was manly, frank and genial, devoted to his art and his family, and very fond of sport, especially hunting, fishing and shooting. He was greatly loved by a very large circle of friends. He was singularly handsome, and had a fine presence. The National Gallery of British Art possesses many of his finest works. He is also represented in the National Gallery, in the National Portrait Gallery, the Victoria and Albert Museum, and in the public galleries at Manchester, Liverpool and Birmingham.

AUTHORITIES.—J. G. Millais, *Life and Letters, &c.*; Ruskin's *Modern Painters*, *Notes on Royal Academy Exhibitions*, *Pre-Raphaelitism, &c.*; *Catalogues* of Grosvenor Gallery (summer of 1886); and of Royal Academy (winter of 1898); M. H. Spielmann, *Millais and his Works* (London, 1896); A. L. Baldry, *Sir J. E. Millais, his Art and Influence* (London, 1899). (C. Mo.)

MILLAR, ANDREW (1707–1768), British publisher, was born in 1707. About 1729 he started business as a bookseller and publisher in the Strand, London. His own judgment in literary matters was small, but he collected an excellent staff of literary advisers, and did not hesitate to pay what at the time were considered large prices for good material. "I respect Millar, sir," said Dr Johnson in 1755, "he has raised the price of literature." He paid Thomson £105 for *The Seasons*, and Fielding a total sum of £700 for *Tom Jones* and £1000 for *Amelia*. He was one of the syndicate of booksellers who financed Johnson's *Dictionary*, and on him the work of seeing that book through the press mainly fell. He also published the histories of Robertson and Hume. He died at his villa at Kew Green, near London, on the 8th of June 1768.

MILLAU, a town of southern France, capital of an arrondissement in the department of Aveyron, on the right bank of the Tarn at its confluence with the Dourbie, 74 m. N. of Béziers on the Southern railway. Pop. (1906), 16,853. Millau lies in a rich valley 1200 ft. above the sea surrounded by the spurs of the Levezou, Causse Noir and Larzac ranges. The streets are narrow and some of the houses of great antiquity, but the town is surrounded by spacious boulevards. One of its squares is bordered on two sides by wooden galleries supported on stone columns. The only buildings of special interest are the Romanesque church of Notre Dame, restored in the 16th century, and the fine Gothic belfry of the old hôtel de ville. Millau is seat of a sub-prefect, and possesses tribunals of first instance and of commerce, a board of trade-arbitrators, a chamber of commerce and a communal college. The principal industry is the manufacture of gloves, and various branches of the leather industry are carried on. The chief articles of trade are skins, wool, wine and Roquefort cheese.

In the middle ages Millau was the seat of a viscounty held by the counts of Barcelona and afterwards by the counts of Armagnac. In the 16th century it became one of the leading strongholds of Calvinism in southern France. In 1620 it revolted against Louis XIII., and after its submission Richelieu caused its fortifications to be dismantled. The edict of Nantes hastened the decline of the town, which did not recover its prosperity till after the Revolution.

MILLBURY, a township of Worcester county, Massachusetts, on the Blackstone river, 5 m. S.S.E. of Worcester. Pop. (1890), 4428; (1900) 4460 (1176 foreign-born); (1905, state census) 4631; (1910) 4740. Area, 15·79 sq. m. Millbury is served by the New York, New Haven & Hartford, and the Boston & Albany railways, and by electric interurban railways. It lies for the most part in the valley of the Blackstone river, from which water-power is derived for its mills; among its manufactures are cotton, linen, felt and woollen goods, hemp thread, and foundry and machine-shop products. The municipality owns and operates the waterworks and electric-lighting plant. Millbury was formed in 1813 from the North Parish of Sutton; in 1851 a part of Auburn was annexed to the township.

MILLEDGEVILLE, a city and the county-seat of Baldwin county, in the central part of Georgia, U.S.A., on the Oconee river, at the head of navigation, 32 m. E.N.E. of Macon. Pop. (1890), 3322; (1900), 4219 (2663 negroes); (1910), 4385. It is served by the Georgia and the Central of Georgia railways. Milledgeville is situated in the Cotton Belt, and its principal industry is the preparation of cotton for the markets. The importance of the place, however, is mainly educational and historical. It is the seat of the Middle Georgia Military and Agricultural College, which occupies the old capitol building, and of the Georgia Normal and Industrial College for girls (1889; enrolment 1908–1909, 653), which is a part of the University of Georgia, and occupies the site of the old state penitentiary. About 2 m. north-west of Milledgeville is the state juvenile reformatory; 2 m. south of the city are the state asylums for white and negro insane; and 3 m. north-west is the state prison farm. Milledgeville was founded in 1803, and was named in honour of John Milledge (1757–1818), a representative in Congress in 1792–1793 and 1795–1802, governor of Georgia in 1802–1806, a United States senator in 1806–1809, and a benefactor of the state university. In 1804 it was made the seat of the state government in place of Louisville (capital in 1795–1804; pop. in 1900, 1009), a dignity it held until 1868. The city was first chartered in 1836. Although admirably situated for trade and manufacturing, Milledgeville was surpassed in both by Macon, which became the commercial emporium of middle Georgia; but it was a favourite place of residence for the wealthy and cultivated class of Georgians before the Civil War. It was seized by General William T. Sherman on the 23rd of November 1864. In order to remove the state documents beyond reach of the enemy, Governor Joseph E. Brown called upon the convicts in the penitentiary for aid, granting them pardons in return for their services.

MILLENNIUM (a pseudo-Latin word formed on the analogy of *biennium*, *triennium*, from Lat. *mille*, a thousand, and *annus*, year), literally a period of a thousand years. The term is specially used of the period of 1000 years during which Christ, as has been believed, would return to govern the earth in person. Hence it is used to describe a vague time in the future when all flaws in human existence will have vanished, and perfect goodness and happiness will prevail. The attribution of a mystic significance to the millennium-period, though perhaps not prominent in that theory of Christian eschatology to which the names Millenarianism and Chiliasm (from Gr. χιλιάς, a thousand) are given, is quite common in non-Christian religions and cosmological systems.

Faith in the nearness of Christ's second advent and the establishing of his reign of glory on the earth was undoubtedly a strong point in the primitive Christian Church. In the anticipations of the future prevalent amongst the early Christians (*c.* 50–150) it is necessary to distinguish a fixed and a fluctuating element. The former includes (1) the notion that a last terrible battle with the enemies of God was impending; (2) the faith in the speedy return of Christ; (3) the conviction that Christ will judge all men, and (4) will set up a kingdom of glory on earth. To the latter belong views of the Antichrist, of the heathen world-power, of the place, extent, and duration of the earthly kingdom of Christ, &c. These remained in a state of solution; they were modified from day to day, partly because of the changing circumstances of the present by which forecasts of the future were regulated, partly because the indications—real or supposed—of the ancient prophets always admitted of new combinations and constructions. But even here certain positions were agreed on in large sections of Christendom. Amongst these was the expectation that the future kingdom of Christ on earth should have a fixed duration—according to the most prevalent opinion, a duration of one thousand years. From this fact the whole ancient Christian eschatology was known in later times as "chiliasm"—a name which is not strictly accurate, since the doctrine of the millennium was only one feature in its scheme of the future.

1. This idea that the Messianic kingdom of the future on earth should have a definite duration has—like the whole eschatology of the primitive Church—its roots in the Jewish apocalyptic literature, where it appears at a comparatively late period. At first it was assumed that the Messianic kingdom in Palestine would last for ever (so the prophets; cf. Jer. xxiv. 6; Ezek. xxxvii. 25; Joel iv. 20; Dan. vi. 27; Sibyll. iii. 49 seq., 766; Psalt. Salom. xvii. 4; Enoch lxii. 14), and this seems always to have been the most widely accepted view (John xii. 34). But from a comparison of prophetic passages of the Old Testament learned apocalyptic writers came to the conclusion that a distinction must be drawn between the earthly appearance of the Messiah and the appearance of God Himself amongst His people and in the Gentile world for the final judgment. As a necessary consequence, a limited period had to be assigned to the Messianic kingdom. According to the Apocalypse of Baruch (xl. 3) this kingdom will last "donec finiatur mundus corruptionis." In the Book of Enoch (xci. 12) "a week" is specified, in the Apocalypse of Ezra (vii. 28 seq.) four hundred years. This figure, corresponding to the four hundred years of Egyptian bondage, occurs also in the Talmud (Sanhedrin 99*a*). But this is the only passage; the Talmud has no fixed doctrine on the point. The view most frequently expressed there (see Von Otto in *Hilgenfeld's Zeitschrift*, 1877, p. 527 seq.) is that the Messianic kingdom will last for one thousand (some said two thousand) years. "In six days God created the world, on the seventh He rested. But a day of God is equal to a thousand years (Ps. xc. 4). Hence the world will last for six thousand years of toil and labour; then will come one thousand years of Sabbath rest for the people of God in the kingdom of the Messiah." This idea must have already been very common in the first century before Christ. The combination of Gen. i., Dan. ix. and Ps. xc. 4 was peculiarly fascinating.

Nowhere in the discourses of Jesus is there a hint of a limited duration of the Messianic kingdom. The apostolic epistles are equally free from any trace of chiliasm (neither 1 Cor. xv. 23 seq. nor 1 Thess. iv. 16 seq. points in this direction). In Revelation however, it occurs in the following shape (ch. xx.). After

Christ has appeared from heaven in the guise of a warrior, and vanquished the antichristian world-power, the wisdom of the world and the devil, those who have remained steadfast in the time of the last catastrophe, and have given up their lives for their faith, shall be raised up, and shall reign with Christ on this earth as a royal priesthood for one thousand years. At the end of this time Satan is to be let loose again for a short season; he will prepare a new onslaught, but God will miraculously destroy him and his hosts. Then will follow the general resurrection of the dead, the last judgment, and the creation of new heavens and a new earth. That *all* believers will have a share in the first resurrection and in the Messianic kingdom is an idea of which the author of Revelation knows nothing. The earthly kingdom of Christ is reserved for those who have endured the most terrible tribulation, who have withstood the supreme effort of the world-power—that is, for those who are actually members of the church of the last days. The Jewish expectation is thus considerably curtailed, as it is also shorn of its sensual attractions. "Blessed and holy is he that hath part in the first resurrection; on such the second death hath no power; but they shall be priests of God and of Christ, and shall reign with Him a thousand years." Other ancient Christian authors were not so cautious. Accepting the Jewish apocalypses as sacred books of venerable antiquity, they read them eagerly, and transferred their contents bodily to Christianity. Nay more, the Gentile Christians took possession of them, and just in proportion as they were neglected by the Jews—who, after the war of Bar-Cochba, became indifferent to the Messianic hope and hardened themselves once more in devotion to the law—they were naturalized in the Christian communities. The result was that these books became "Christian" documents; it is entirely to Christian, not to Jewish, tradition that we owe their preservation. The Jewish expectations are adopted for example, by Papias, by the writer of the epistle of Barnabas, and by Justin. Papias actually confounds expressions of Jesus with verses from the Apocalypse of Baruch, referring to the amazing fertility of the days of the Messianic kingdom (Papias in Iren. v. 33). Barnabas (*Ep.* 15) gives us the Jewish theory (from Gen. i. and Ps. xc. 4) that the present condition of the world is to last six thousand years from the creation, that at the beginning of the Sabbath (the seventh millennium) the Son of God appears, to put an end to the time of "the unjust one," to judge the ungodly and renew the earth. But he does not indulge, like Papias, in sensuous descriptions of this seventh millennium; to Barnabas it is a time of rest, of sinlessness, and of a holy peace. It is not the end, however; it is followed by an eighth day of eternal duration—"the beginning of another world." So that in the view of Barnabas the Messianic reign still belongs to *οὗτος ὁ αἰών*. Justin (*Dial.* 80) speaks of chiliasm as a necessary part of complete orthodoxy, although he knows Christians who do not accept it. He believes, with the Jews, in a restoration and extension of the city of Jerusalem; he assumes that this city will be the seat of the Messianic kingdom, and he takes it as a matter of course that there all believers (here he is at one with Barnabas) along with patriarchs and prophets will enjoy perfect felicity for one thousand years. That a philosopher like Justin, with a bias towards an Hellenic construction of the Christian religion, should nevertheless have accepted its chiliastic elements is the strongest proof that these enthusiastic expectations were inseparably bound up with the Christian faith down to the middle of the 2nd century. And another proof is found in the fact that even a speculative Jewish Christian like Cerinthus not only did not renounce the chiliastic hope, but pictured the future kingdom of Christ as a kingdom of sensual pleasures, of eating and drinking and marriage festivities (Euseb. *H. E.* iii. 28, vii. 25).

After the middle of the 2nd century these expectations were gradually thrust into the background. They would never have died out, however, had not circumstances altered, and a new mental attitude been taken up. The spirit of philosophical and theological speculation and of ethical reflection, which began to spread through the churches, did not know what to make of the old hopes of the future. To a new generation they seemed paltry, earthly and fantastic, and far-seeing men had good reason to regard them as a source of political danger. But more than this, these wild dreams about the glorious kingdom of Christ began to disturb the organization which the churches had seen fit to introduce. In the interests of self-preservation against the world, the state and the heretics, the Christian communities had formed themselves into compact societies with a definite creed and constitution, and they felt that their existence was threatened by the white heat of religious subjectivity. So early as the year 170, a church party in Asia Minor—the so-called Alogi—rejected the whole body of apocalyptic writings and denounced the book of Revelation as a book of fables. All the more powerful was the reaction. In the so-called Montanistic controversy (*c.* 160–220) one of the principal issues involved was the continuance of the chiliastic expectations in the churches. The Montanists of Asia Minor defended them in their integrity, with one slight modification: they announced that Pepuza, the city of Montanus, would be the site of the New Jerusalem and the millennial kingdom. After the Montanistic controversy chiliastic views were more and more discredited in the Greek Church; they were, in fact, stigmatized as "Jewish" and consequently "heretical." It was the Alexandrian theology that superseded them; that is to say, Neo-Platonic mysticism triumphed over the early Christian hope of the future, first among the "cultured," and then, when the theology of the "cultured" had taken the faith of the "uncultured" under its protection, amongst the latter also. About the year 260 an Egyptian bishop, Nepos, in a treatise called *ἔλεγχος ἀλληγοριστῶν*, endeavoured to overthrow the Origenistic theology and vindicate chiliasm by exegetical methods. Several congregations took his part; but ultimately Dionysius, bishop of Alexandria, succeeded in healing the schism and asserting the allegorical interpretation of the prophets as the only legitimate exegesis. During this controversy Dionysius became convinced that the victory of mystical theology over "Jewish" chiliasm would never be secure so long as the book of Revelation passed for an apostolic writing and kept its place among the homologoumena of the canon. He accordingly raised the question of its apostolic origin; and by reviving old difficulties, with ingenious arguments of his own, he carried his point. At the time of Eusebius the Greek Church was saturated with prejudice against the book and with doubts as to its canonicity. In the course of the 4th century it was removed from the Greek canon, and thus the troublesome foundation on which chiliasm might have continued to build was got rid of. The attempts of Methodius of Tyre at the beginning of the 4th century and Apollinarius of Laodicea about 360 to defend chiliasm and assail the theology of Origen had no result. For many centuries the Greek Church kept Revelation out of its canon, and consequently chiliasm remained in its grave. It was considered a sufficient safeguard against the spiritualizing eschatology of Origen and his school to have rescued the main doctrines of the creed and the *regula fidei* (the visible advent of Christ; eternal misery and hell-fire for the wicked). Anything beyond this was held to be Jewish. It was only the chronologists and historians of the church who, following Julius Africanus, made use of apocalyptic numbers in their calculations, while court theologians like Eusebius entertained the imperial table with discussions as to whether the dining-hall of the emperor—the second David and Solomon, the beloved of God—might not be the New Jerusalem of John's Apocalypse. Eusebius was not the first who dabbled in such speculations. Dionysius of Alexandria had already referred a Messianic prediction of the Old Testament to the emperor Gallienus. But mysticism and political servility between them gave the death-blow to chiliasm in the Greek Church. It never again obtained a footing there; for, although, late in the middle ages, the book of Revelation—by what means we cannot tell—did recover its authority, the Church was by that time so hopelessly trammelled by a magical cultus as to be incapable of fresh developments. In the Semitic churches of the East (the Syrian, Arabian and Ethiopian), and in that of Armenia, the apocalyptic literature was preserved much longer than in the Greek Church. They were very conservative of ancient traditions in general, and hence chiliasm survived amongst them to a later date than in Alexandria or Constantinople.

But the Western Church was also more conservative than the Greek. Her theologians had, to begin with, little turn for mystical speculation; their tendency was rather to reduce the gospel to a system of morals. Now for the moralists chiliasm had a special significance as the one distinguishing feature of the gospel, and the only thing that gave a specifically Christian character to their system. This, however, holds good of the Western theologians only after the middle of the 3rd century. The earlier fathers, Irenaeus, Hippolytus, Tertullian, believed in chiliasm simply because it was a part of the tradition of the church and because Marcion and the Gnostics would have nothing to do with it. Irenaeus (v. 28, 29) has the same conception of the millennial kingdom as Barnabas and Papias, and appeals in support of it to the testimony of disciples of the apostles. Hippolytus, although an opponent of Montanism, was nevertheless a thorough-going millennarian (see his book *De Antichristo*). Tertullian (cf. especially *Adv. Marcion.*, 3) aimed at a more spiritual conception of the millennial blessings than Papias had, but he still adhered, especially in his Montanistic period, to all the ancient anticipations. It is the same all through the 3rd and 4th centuries with those Latin theologians who escaped the influence of Greek speculation. Commodian, Victorinus Pettavensis, Lactantius and Sulpicius Severus were all pronounced millennarians, holding by the very details of the primitive Christian expectations. They still believe, as John did, in the return of Nero as the Antichrist; they still expect that after the first resurrection Christ will reign with his saints "in the flesh" for a thousand years. Once, but only once (in the Gospel of Nicodemus), the time is reduced to five hundred years. Victorinus wrote a commentary on the Apocalypse of John; and all these theologians, especially Lactantius, were diligent students of the ancient Sibylline oracles of Jewish and Christian origin, and treated them as divine revelations. As to the canonicity and apostolic authorship of the Johannine Apocalypse no doubts were ever entertained in the West; indeed an Apocalypse of Peter was still retained in the canon in the 3rd century. That of Ezra, in its Latin translation, must have been all but a canonical book—the numbers of extant manuscripts of the so-called 4 Ezra being incredibly great, while several of them are found in copies of the Latin Bible at the beginning of the 16th century. The Apocalypse of Hermas was much read till far through the middle ages, and has also kept its place in some Bibles. The apocalyptic "Testamenta duodecim patriarcharum" was a favourite reading-book; and Latin versions of ancient apocalypses are being continually brought to light from Western libraries (*e.g.* the *Assumptio Mosis*, the *Ascensio Jesajae*, &c.). All these facts show how vigorously the early hopes of the future maintained themselves in the West. In the hands of moralistic theologians, like Lactantius, they certainly assume a somewhat grotesque form, but the fact that these men clung to them is the clearest evidence that in the West millennarianism was still a point of "orthodoxy" in the 4th century.

This state of matters, however, gradually disappeared after the end of the 4th century. The change was brought about by two causes—first, Greek theology, which reached the West chiefly through Jerome Rufinus and Ambrose, and, second, the new idea of the church wrought out by Augustine on the basis of the altered political situation of the church. Augustine was the first who ventured to teach that the catholic church, in its empirical form, was the kingdom of Christ, that the millennial kingdom had commenced with the appearing of Christ, and was therefore an accomplished fact. By this doctrine of Augustine's, the old millennarianism, though not completely extirpated, was at least banished from the official theology. It still lived on, however, in the lower strata of Christian society; and in certain undercurrents of tradition it was transmitted from century to century. At various periods in the history of the middle ages we encounter sudden outbreaks of millennarianism, sometimes as the tenet of a small sect, sometimes as a far-reaching movement. And, since it had been suppressed, not, as in the East, by mystical speculation, its mightiest antagonist, but by the political church of the hierarchy, we find that wherever chiliasm appears in the middle ages it makes common cause with all enemies of the secularized church. It strengthened the hands of church democracy; it formed an alliance with the pure souls who held up to the church the ideal of apostolic poverty; it united itself for a time even with mysticism in a common opposition to the supremacy of the church; nay, it lent the strength of its convictions to the support of states and princes in their efforts to break the political power of the church. It is sufficient to recall the well-known names of Joachim of Floris, of all the numerous Franciscan spiritualists, of the leading sectaries from the 13th to the 15th century who assailed the papacy and the secularism of the church—above all, the name of Occam. In these men the millennarianism of the ancient church came to life again; and in the revolutionary movements of the 15th and 16th centuries—especially in the Anabaptist movements—it appears with all its old uncompromising energy. If the church, and not the state, was regarded as Babylon, and the pope declared to be the Antichrist, these were legitimate inferences from the ancient traditions and the actual position of the church. But, of course, the new chiliasm was not in every respect identical with the old. It could not hold its ground without admitting certain innovations. The "everlasting gospel" of Joachim of Floris was a different thing from the announcement of Christ's glorious return in the clouds of heaven; the "age of the spirit" which mystics and spiritualists expected contained traits which must be characterized as "modern"; and the "kingdom" of the Anabaptists in Münster was a Satanic caricature of that kingdom in which the Christians of the 2nd century looked for a peaceful Sabbath rest. Only we must not form our ideas of the great apocalyptic and chiliastic movement of the first decades of the 16th century from the rabble in Münster. There were pure evangelical forces at work in it; and many Anabaptists need not shun comparison with the Christians of the apostolic and post-apostolic ages.

The German and Swiss Reformers also believed that the end of the world was near, but they had different aims in view from those of the Anabaptists. It was not from poverty and apocalypticism that they hoped for a reformation of the Church. In contrast to the fanatics, after a brief hesitation they threw millennarianism overboard, and along with it all other "opiniones Judaicae." They took up the same ground in this respect which the Roman Catholic Church had occupied since the time of Augustine. How millennarianism nevertheless found its way, with the help of apocalyptic mysticism and Anabaptist influences into the churches of the Reformation, chiefly among the Reformed sects, but afterwards also in the Lutheran Church, how it became incorporated with Pietism, how in more recent times an exceedingly mild type of "academic" chiliasm has been developed from a belief in the verbal inspiration of the Bible, how finally new sects are still springing up here and there with apocalyptic and chiliastic expectations—these are matters which cannot be fully entered upon here.

See Schürer, *Lehrbuch der neutestamentlichen Zeitgeschichte* (1874), §§ 28, 29; Corrodi, *Kritische Geschichte des Chiliasmus* (1781); R. H. Charles, *The Doctrine of a Future Life* (1899); *Book of the Secrets of Enoch* (1896), pp. xxvii–xxx, ch. xxxii. 2–xxxiii. 2; *Apocalypse of Baruch* (1896), xxix. 3–8 (notes); *Book of Enoch* (index, *s.v.* "Messianic Kingdom"); Bousset, *Religion des Judenthums* (1903), 273–276; C. A. Briggs, *The Messiah of the Apostles*, p. 284 seq.; Sabatier, *Les Origines littéraires et la composition de l'Apocalypse de St Jean* (1887); Spitta, *Die Offenbarung des Johannes untersucht* (1889). See also ESCHATOLOGY and works there quoted. (A. HA.)

MILLER, HUGH (1802–1856), Scottish geologist and man of letters, was born in humble circumstances at Cromarty, on the 10th of October 1802; his father, Hugh Miller, a seaman, was drowned when he was but five years old. His primary education was acquired at a dame's school and afterwards at the parish school, and at the age of six he had learned that "the art of reading is the art of finding stories in books." At the age of twelve he began to write verses. Two of his mother's brothers, James and "Sandy" Wright, hard-working men at Cromarty, offered to assist him to enter the ministry, but he felt no call to the sacred office, and from 1820 to 1822 he was apprenticed to a stone-mason. During the next few years he obtained employment as a journeyman mason in Edinburgh, Inverness and various other parts of Scotland. The writing of verses occupied his leisure hours, and in 1826 he sent to the *Scotsman* an "Ode on Greece" which was refused. It was not until 1829 that he met with his first success in the publication of *Poems written in the Leisure Hours of a Journeyman Mason.* These were printed and issued from the office of the *Inverness Courier*. Miller now turned his attention to prose and contributed many essays to the *Inverness Courier*. As remarked by Sir A. Geikie, "These made so favourable an impression that they were soon afterwards reprinted separately. They marked the advent of a writer gifted with no ordinary powers of narration and with the command of a pure, nervous and masculine style."

At the age of thirty-two he was still a stone-mason, but in the latter part of 1834 he was offered a post as accountant in the Commercial Bank of Scotland, and was almost immediately transferred to the Cromarty branch. His prose writings had now attracted much notice, and he next issued in 1835 *Scenes and Legends of the North of Scotland, or the traditional history of Cromarty*, in which he introduced some memoranda on the geology. This work met with a cordial reception. Miller, while still a stone-mason, had observed the abundant fossils in the Jurassic shales on the shores of Ethie, but it was not until 1830 that he first obtained remains of fossil fishes in the Old Red Sandstone. These for many years he collected and studied as far as he could, and in 1837 some of his specimens were brought to the notice of R. I. Murchison and Professor Agassiz. In the following year he was in communication with Murchison and his career as a geologist was definitely opened.

In 1837 Miller married Lydia Falconer Frazer (1811?–1876), a lady of good position and great natural ability, whom he had met six years previously. He set up his household in Cromarty, on a salary of sixty pounds a year, aided by the small sums he then earned by literary work; and his wife took a few pupils. Mrs Miller eventually became well known under the pseudonym of Mrs Harriet Myrtle as author of the *Ocean Child* (1857) and other story-books for children.

Soon after his marriage, Miller became greatly stirred by the internal dissensions in the Church of Scotland, of which he was a staunch member, and he published two pamphlets which brought him to the notice of some of the prominent members of the liberal church party. In 1839 he went by invitation to Edinburgh to edit a new Whig newspaper, the *Witness*, which was intended to support the views of those who after the disruption in 1843 formed the Free Church. The paper rapidly attained a large circulation; and this was no doubt largely due to his own literary and scientific essays. In 1840 he contributed a series of articles on *The Old Red Sandstone*, and these were reprinted in book form in the following year. The charm of this work was widely appreciated, as was also the natural sagacity shown in the descriptions and restorations of some of the fossil fishes. His *Footprints of the Creator* was published in 1849, and *My Schools and Schoolmasters* in 1854. He was engaged on the final proofs of his *Testimony of the Rocks* on the day of his death. During the last year of his life he suffered from inflammation of the lungs; and the strain of ill-health proving too severe, he died by his own hand in Edinburgh on the 23rd of December 1856. By request of his wife, *The Cruise of the Betsey, with Rambles of a Geologist* (1858) previously printed only in the *Witness* newspaper was published under the editorship of the Rev. W. S. Symonds.

In memory of Hugh Miller a monument was erected by public subscription in 1860 at Cromarty; and the cottage in which he was born was acquired at a later period by his son Hugh. In it have been placed part of his library, a set of the *Witness* newspaper, some letters addressed to him, and a number of geological specimens, including many referred to in his *Old Red Sandstone.* On the 22nd of August 1902 the centenary of his birth was celebrated at Cromarty, and was attended by scientific representatives from all parts of the world.

His elder son, Hugh Miller (1850–1896), passed through the Royal School of Mines and joined the Geological Survey in England in 1873; afterwards he was transferred to Scotland and surveyed the country around Cromarty and other parts of Ross-shire and Sutherlandshire. He was author of *Landscape Geology*, 1891.

See *The Life and Letters of Hugh Miller*, by Peter Bayne (2 vols., 1871); *Hugh Miller; his work and influence*, address by Sir A. Geikie, at the centenary celebration. (H. B. Wo.)

MILLER, JOAQUIN (CINCINNATUS HEINE) (1841–), American poet, was born in Indiana, on the 10th of November 1841, and was educated for the law. After some experiences of mining and journalism in Idaho and Oregon, he settled down in 1866 as judge in Grant county, Oregon, and during his four years' tenure of this post he began to write verse. In 1870 he travelled in Europe, and in 1871 he published his first volume of poetry, full of tropical passion, *Songs of the Sierras*, on which his reputation mainly rests. His *Songs of the Sunlands* (1873) followed in the same vein, and after other volumes had appeared, his *Collected Poems* were published in 1882. He also wrote plays, *The Danites in the Sierras* having some success as a sensational melodrama. On his return from Europe he became a journalist in Washington, but in 1887 returned to California. His pen-name, "Joaquin Miller," by which he is known, was assumed by him when he published his first book, in consequence of his having written an article in defence of Joaquin Murietta, the Mexican brigand.

Revised editions of his *Complete Poetical Works* appeared at San Francisco in 1902.

MILLER, JOE (JOSEPH or JOSIAS((1684–1738), English actor, first appears in the cast of Sir Robert Howard's *Committee* at Drury Lane in 1709 as Teague. Trinculo in *The Tempest*, the First Grave-digger in *Hamlet* and Marplot in *The Busybody*, were among his many favourite parts. He is said to have been a friend of Hogarth. He died on the 16th of August 1738. After his death, John Mottley (1692–1750) brought out a book called *Joe Miller's Jests, or Wit's Vade Mecum* (1739), a collection of contemporary and ancient coarse witticisms, only three of which are told of Miller. Owing to the quality of the jokes in Mottley's book, their number increasing with each of the many subsequent editions, any time-worn jest has, somewhat unjustly, come to be called "a Joe Miller."

MILLER, SAMUEL FREEMAN (1816–1890), American jurist, was born in Richmond, Kentucky, on the 5th of April 1816, of Pennsylvania-German stock. He was brought up on a farm, was a clerk in a drug-store, graduated from the medical department of Transylvania University in 1838, and practised medicine in Barboursville, Kentucky, until 1847. In that year he was admitted to the bar, and entered politics as a Whig. His anti-slavery sympathies induced him to settle in Iowa, where in 1850 he freed his slaves and began to practise law in Keokuk, and he soon became a leader of the Republican party in the state. In 1862 he succeeded Justice Peter V. Daniel (1784–1860), as a justice of the U.S. Supreme Court, and served until his death in Washington, D.C., on the 13th of October 1890, when he was senior justice. Miller was a man of great mental force and individuality, and his judgments carried great weight. In 1877 he was a member of the electoral commission, which adopted his motion that Congress could not "go behind the returns" as properly accredited by state officials. He was a prominent member of the Unitarian Church and for three years was president of its national conference. He published a volume of *Lectures on the Constitution of the United States* (New York, 1891).

See Wm. A. Maury, in *The Juridical Review of Edinburgh* (for January 1891), and Chas. M. Gregory, in *Yale Law Journal* (for April 1908).

MILLER, WILLIAM (1782–1849), leader of the Second Adventists in America, was born on the 5th of February 1782 at Pittsfield, Massachusetts. He was a recruiting officer at the beginning of the War of 1812, and after Plattsburg he was promoted captain, retiring from the army in 1815. About 1816 he settled in Low Hampton, Washington county, New York.

He now joined the Baptist Church at Low Hampton, and, after two years of minute study of the Bible, about 1818 became a Second Adventist. In 1831 he began to lecture, arguing that the "two thousand three hundred days" of Daniel viii. 14 meant 2300 years, and that these years began with Ezra's going up to Jerusalem in 457 B.C., and therefore came to an end in 1843, and urging his hearers to make ready for the final coming of Christ in that year. To his many followers, after the year 1843 had passed, he proclaimed that 1844 was the year, that his error was due to following Hebrew instead of Roman chronology, and that the 22nd of October was to be the day. There was renewed excitement among Miller's followers; many of them left their business, and in white muslin robes, on house tops and hills, awaited the epiphany. In spite of disappointment, many still believed with him that the time was near. He returned to Low Hampton and died there on the 20th of December 1849. The Adventists or Millerites, who were formed into a single body in a convention called by him in April 1845, have since separated into several sects: the Evangelical Adventists (1147 in the United States in 1908), who believe in everlasting punishment; the Seventh Day Adventists (64,332), who observe the seventh day, and practise the sacrament of foot-washing; the Advent Christians (26,500), the Churches of God in Jesus Christ (2872), and the Life and Advent Union (3800). Their total number in the United States in 1908 was about 99,300. Miller published in 1833 a pamphlet which was the basis of his lectures; these were published in 1842 as *Evidence from Scripture and History of the Second Coming of Christ about the Year 1843.*

See Sylvester Bliss, *Memoirs of William Miller* (Boston, 1853); James White, *Sketches of the Christian Life and Public Labors of William Miller* (Battle Creek, 1875); and Edward Eggleston's novel, *End of the World* (1872).

MILLER, WILLIAM (1795–1861), British soldier, who took a prominent part in the South American Wars of Liberation, entered the British artillery service in 1811, and till 1814 he was continuously on active service with Wellington's army in the Peninsula. In the latter year he accompanied the ill-fated New Orleans expedition. After the general peace he travelled for two years about Europe, and then went to South America. The war which culminated in the expulsion of the Spaniards was just breaking out, and he took command in the Chilean artillery, with which he served during the Chilean part of the war. As a major he commanded the marines on Cochrane's vessel, the "O'Higgins." In 1821 he landed in Peru, to assist General San Martin against the Spanish General Canterac. He was made general of brigade, and became very intimate with Simon Bolivar. He rendered the most conspicuous services at Junin (Aug. 6, 1824), and his regiment, the "Hussars of Junin," covered itself with glory in the decisive victory of Ayacucho (Dec. 9, 1824). From 1830 to 1839 he filled various high military and political offices in Peru. In the latter year he was involved in the fall of Santa Cruz, and went into exile. For some years he filled the post of British Consul-General of the Pacific Coast. He died on board H.M.S. "Naiad" at Callao, on the 31st of October 1861.

See the *Memoirs* published by his brother John Miller (London, 1827).

MILLER, WILLIAM (1796–1882), Scottish line-engraver, was born in Edinburgh on the 28th of May 1796. After studying in London under George Cook, a pupil of Basire's, he returned to Edinburgh. He executed plates after Thomson of Duddingston, Macculloch, D. O. Hill, Sir George Harvey, and other Scottish landscapists, but his chief works were his transcripts from Turner. The first of these was the Clovelly (1824), of *The Southern Coast*, a publication undertaken by George Cook and his brother William B. Cook, to which Miller also contributed the Combe Martin and the Portsmouth. He was engaged on the illustrations of *England and Wales*, 1827–1838; of *The Rivers of France*, 1833–1835; of Roger's *Poems*, 1834; and very largely on those of *The Prose and Poetical Works of Sir Walter Scott*, 1834. In *The Provincial Antiquities and Picturesque Scenery of Scotland*, 1826, he executed a few excellent plates after Thomson and Turner. Among his larger engravings of Turner's works may be mentioned "The Grand Canal, Venice"; "The Rhine. Osterprey and Feltzen"; "The Bell Rock"; "The Tower of London"; and "The Shepherd." The art of William Miller was warmly appreciated by Turner himself, and Ruskin pronounced him to be on the whole the most successful translator into line of the paintings of the greatest English landscapist. His renderings of complex Turnerian sky-effects are especially delicate and masterly. Towards the end of his life Miller abandoned engraving and occupied his leisure in the production of water-colours, many of which were exhibited in the Royal Scottish Academy, of which he was an honorary member. He resumed his burin, however, to produce two final series of vignettes from drawings by Birket Foster illustrative of Hood's *Poems*, published by Moxon in 1871. Miller, who was a Quaker, died on the 20th of January 1882.

MILLER, WILLIAM HALLOWES (1801–1880), British mineralogist and crystallographer, was born at Velindre near Llandovery, Carmarthenshire, on the 6th of April 1801. He was educated at St John's College, Cambridge, where he graduated in 1826 as fifth wrangler, and became a fellow in 1829. For a few years he was occupied as a college tutor and during this time he published treatises on hydrostatics and hydrodynamics. He also gave special attention to crystallography, and on the resignation of W. Whewell he succeeded in 1832 to the professorship of mineralogy, a post which he occupied until 1870. His chief work, on *Crystallography*, was published in 1838. He was elected F.R.S. in 1838. In 1852 he edited a new edition of H. J. Brooke's *Elementary Introduction to Mineralogy*. He assisted in 1843 the committee appointed to superintend the construction of the new Parliamentary standards of length and weight (see *Phil. Trans.*, 1856). He died in Cambridge on the 20th of May 1880.

MILLERAND, ALEXANDRE (1859–), French socialist and politician, was born in Paris on the 10th of February 1859. He was educated for the bar, and made his reputation by his defence, in company with Georges Laguerre, of Ernest Roche and Duc-Quercy, the instigators of the strike at Decazeville in 1883; he then took Laguerre's place on M. Clemenceau's paper, *La Justice*. He was elected to the Chamber of Deputies for the department of the Seine in 1885 as a radical socialist. He was associated with MM. Clemenceau and Camille Pelletan as an arbitrator in the Carmaux strike (1892). He had long had the ear of the Chamber in matters of social legislation, and after the Panama scandals had discredited so many politicians his influence grew. He was chief of the Socialist left, which then mustered sixty members, and edited until 1896 their organ in the press, *La Petite République*. His programme included the collective ownership of the means of production and the international association of labour, but when in June 1899 he entered Waldeck-Rousseau's cabinet of "republican defence" as minister of commerce he limited himself to practical reforms, devoting his attention to the improvement of the mercantile marine, to the development of trade, of technical education, of the postal system, and to the amelioration of the conditions of labour. Labour questions were entrusted to a separate department, the Direction du Travail, and the pension and insurance office was also raised to the status of a "direction." The introduction of trades-union representatives on the Supreme Labour Council, the organization of local labour councils, and the instructions to factory inspectors to put themselves in communication with the councils of the trades-unions, were valuable concessions to labour, and he further secured the rigorous application of earlier laws devised for the protection of the working-classes. His name was especially associated with a project for the establishment of old age pensions, which became law in 1905. He became in 1898 editor of *La Lanterne*. His influence with the extreme Socialists had already declined, for it was said that his departure from the true Marxist tradition had disintegrated the party.

For his administration in the Waldeck-Rousseau cabinet see A. Lavy, *L'Œuvre de Millerand* (1902); his speeches between 1899 and 1907 were published in 1907 as *Travail et travailleurs*.

MILLERITE, a mineral consisting of nickel sulphide, NiS. Crystals belong to the rhombohedral system and have the form of slender needles arranged in divergent groups or of delicate fibres loosely matted together. The colour is brass-yellow and the lustre metallic. Before the chemical composition of the mineral had been determined it had been known as "capillary pyrites" or "hair pyrites" (Ger., *Haarkies*), and was not distinguished from the capillary forms of pyrites and marcasite: the name millerite was given by W. Haidinger in 1845, in honour of W. H. Miller. The hardness is 3–3½ and the specific gravity 5·65. There are perfect cleavages parallel to the faces of the rhombohedron (100); and gliding planes parallel to the faces of the rhombohedron (110), on which secondary twinning may be readily produced artificially by pressure.

Typical specimens of millerite are found in the coal measures in the neighbourhood of Merthyr Tydvil in South Wales, where the delicate needles and fibres occur with crystals of quartz and pearl-spar in the fissures of septarian nodules of clay-ironstone. Radiating groups of needles are found with ankerite in cavities in haematite in the Sterling mine at Antwerp in Jefferson county, New York. At the Gap mine in Lancaster county, Pennsylvania, the mineral occurs as fibrous encrusting masses with a velvety lustre. The most perfect crystals are those formerly found with calcite, diopside and a bright green chrome-garnet in a nickel mine at Orford in Sherbrooke county, Quebec. (L. J. S.)

MILLER'S THUMB (*Cottus gobio*), a small fish, abundant in all rivers and lakes of northern and central Europe with clear water and gravelly bottom. The genus *Cottus*, to which the miller's thumb belongs, is easily recognized by its broad, flat head, rounded and scaleless body, large pectoral and narrow ventral fins, with two dorsal fins, the anterior shorter than the posterior; the praeoperculum is armed with a simple or branched spine. The species of the genus *Cottus* are rather numerous, and are confined to the north temperate zone of the globe, the majority being marine, and known by the name of "bullheads." The miller's thumb is confined to fresh water; and only one other freshwater species is found in Europe, *C. poecilopus*, from rivers of Hungary, Galicia, and the Pyrenees; some others occur in the fresh waters of northern Asia and North America. The miller's thumb is common in all suitable localities in Great Britain, but is extremely rare in Ireland; in the Alps it reaches to an altitude exceeding 7000 ft. Its usual length is from 3 to 5 in. Generally hidden under a stone or in a hollow of the bank, it watches for its prey, which consists of small aquatic animals, and darts when disturbed with extraordinary rapidity to some other place of refuge. The female deposits her ova in a cavity under a stone, whilst the male watches and defends them until the young are hatched and able to shift for themselves.

MILLET, FRANCIS DAVIS (1846–), American artist, was born at Mattapoisett, Massachusetts, on the 3rd of November 1846. He was a drummer boy with the Union forces in the Civil War; graduated from Harvard College in 1869; and in 1871 entered the Royal Academy of Fine Arts, Antwerp, where he studied under Van Lerius and De Keyser. In 1873 he was made secretary of the Massachusetts commission to the Vienna Exposition. During the Russo-Turkish War of 1877–78 he was correspondent of the London *Daily News* and *Graphic*, and of the *New York Herald*. On his return he was made a member from the United States of the International Art Jury at the Paris Exposition of 1878. He was director of decorations at the Columbian Exposition, Chicago, 1893, and in 1898 he went to Manila as war correspondent for *The Times* and for *Harper's Weekly*. In 1880 he became a member of the Society of American Artists, and in 1885 was elected to full membership in the National Academy of Design, New York, and was for one term its vice-president; he became a member also of the American Water Color Society and of the Institute of Painters in Oil Colours, London. As a decorative artist his work may be seen at Trinity Church, Boston; the Bank of Pittsburg; and the Capitol at St Paul, Minnesota. His pictures are in many public collections: among them are "A Cosy Corner," in the Metropolitan Museum of Art, New York; "At the Inn," in the Union League Club, New York; and "Between two Fires," in the Tate Gallery, London. He also wrote essays and short stories, and an English version of Tolstoi's *Sebastopol* (1887); and among his publications are *The Danube* (1891), *Capillary Crime and other Stories* (1892), and *Expedition to the Philippines* (1899).

MILLET (or **MILÉ**), **JEAN FRANÇOIS** (*c.* 1642–1679), commonly called FRANCISQUE, was born at Antwerp about 1642, and is generally classed amongst the painters of Flanders on account of the accident of his birth. But his father was a Frenchman, a turner in ivory of Dijon, who took service with the prince of Condé and probably returned after a time to his native country. He remained long enough in Antwerp to apprentice his son to an obscure member of a painter family called Laurent, pupil of Gabriel Franck. With Laurent, Francisque left Antwerp for Paris, and there settled in 1660 after marrying his master's daughter. He was received a member of the Academy of Painting at Paris in 1673, and after gaining consideration as an imitator of the Poussins he died in 1679, bequeathing his art and some of his talents to one of his sons. Francisque probably knew, as well as imitated, Nicolas Poussin, Gaspar Dughet and Sebastian Bourdon; and it is doubtless because of his acquaintance with these travelled artists that, being himself without familiarity with the classic lands of Italy and Greece, he was able to imagine and reproduce Italian and Arcadian scenery with considerable grace and effectiveness. It is indeed surprising to observe, even at this day how skilfully he executed these imaginary subjects, enlivened them with appropriate figures, and shed over them the glow of a warm yet fresh and sparkling tone. Twelve of his most important landscapes, which remained in the palace of the Tuileries, were destroyed by fire; and though many of his pieces may still be found catalogued in Continental and English collections, others in great number remain unknown and unacknowledged.

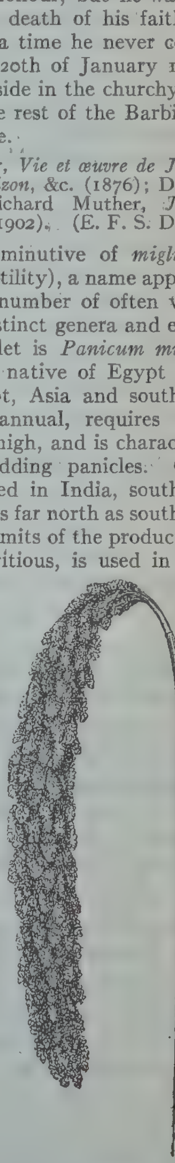
His son JEAN FRANÇOIS MILLET, the younger (1666–1723), also called Francisque, was born in Paris, and was made a member of the Academy of Painting in 1709. He is not quite so independent in his art as his father; but he had clever friends, and when he wanted figures to his landscapes, he consulted Watteau, and other followers of the "court shepherdess" school. In the museum of Grenoble is a "Paysage" by him which is prettily adorned with Watteau's figures.

MILLET, JEAN FRANÇOIS (1814–1875), French painter, who came of a peasant family, was born on the 4th of October 1814 in the hamlet of Gruchy, near Gréville (La Manche), in the wild and picturesque district called La Hague. His boyhood was passed working in his father's fields, but the sight of the engravings in an old illustrated Bible set him drawing, and thenceforth, whilst the others slept, the daily hour of rest was spent by Millet in trying to render the familiar scenes around him. From the village priest the lad learnt to read the Bible and Virgil in Latin, and acquired an interest in one or two other works of a high class which accompanied him through life; he did not, however, attract attention so much by his acquirements as by the stamp of his mind. The whole family seems, indeed, to have worn a character of austerity and dignity, and when Millet's father finally decided to test the vocation of his son as an artist, it was with a gravity and authority which recalls the patriarchal households of Calvinist France. Two drawings were prepared and placed before a painter at Cherbourg named Mouchel, who at once recognized the boy's gifts, and accepted him as a pupil; but shortly after (1835) Millet's father died, and the eldest son, with heroic devotion, took his place at home, nor did he return to his work until the pressing calls from without were solemnly enforced by the wishes of his own family. He accordingly went back to Cherbourg, but after a short time spent there with another master (Langlois) started with many misgivings for Paris. The council-general of the department had granted him a sum of 600 francs, and the town council promised an annual pension of 400, but in spite of friendly help and introductions Millet went through great difficulties. The system of the École des Beaux Arts was hateful to him, and it was not until after much hesitation that he decided to enter an official studio—that of Delaroche. The master was certainly puzzled by his pupil; he saw his ability, and, when Millet in his poverty could not longer pay the monthly fees, arranged for his free admission to the studio, but he tried in vain to make him take the approved direction, and lessons ended with "Eh, bien, allez à votre guise, vous êtes si nouveau pour moi que je ne veux rien vous dire." At last, when the competition for the Grand Prix came on, Delaroche gave Millet to understand that he intended to secure the nomination of another, and thereupon Millet withdrew himself, and with his friend Marolle started in a little studio in the Rue de l'Est. He had renounced the beaten track, but he continued to study hard whilst he sought to procure bread by painting portraits at 10 or 15 francs apiece and producing small "pastiches" of Watteau and Boucher. In 1840 Millet went back to Gréville, where he painted "Sailors Mending a Sail" and a few other pictures—reminiscences of Cherbourg life.

His first success was obtained in 1844, when his "Milkwoman" and "Lesson in Riding" (pastel) attracted notice at the Salon, and friendly artists presented themselves at his lodgings only to learn that his wife had just died, and that he himself had disappeared. Millet was at Cherbourg; there he remarried, but having amassed a few hundred francs he went back to Paris and presented his "St Jerome" at the Salon of 1845. This picture was rejected and exists no longer, for Millet, short of canvas, painted over it "Oedipus Unbound," a work which during the following year was the object of violent criticism. He was, however, no longer alone; Diaz, Eugène Tourneux, Rousseau, and other men of note supported him by their confidence and friendship, and he had by his side the brave Catherine Lemaire, his second wife, a woman who bore poverty with dignity and gave courage to her husband through the cruel trials in which he penetrated by a terrible personal experience the bitter secrets of the very poor. To this date belong Millet's "Golden Age," "Bird Nesters," "Young Girl and Lamb," and "Bathers"; but to the "Bathers" (Louvre) succeeded "The Mother Asking Alms," "The Workman's Monday," and "The Winnower." This last work, exhibited in 1848, obtained conspicuous success, but did not sell till Ledru Rollin, informed of the painter's dire distress, gave him 500 francs for it, and accompanied the purchase with a commission, the money for which enabled Millet to leave Paris for Barbizon, a village on the skirts of the forest of Fontainebleau. There he settled in a three-roomed cottage for the rest of his life—twenty-seven years, in which he wrought out the perfect story of that peasant life of which he alone has given a "complete impression." Jules Breton has coloured the days of toil with sentiment; others, like Courbet, whose eccentric "Funeral at Ornans" attracted more notice at the Salon of 1850 than Millet's "Sowers and Binders," have treated similar subjects as a vehicle for protest against social misery; Millet alone, a peasant and a miserable one himself, saw true, neither softening nor exaggerating what he saw. In a curious letter written to M. Sensier at this date (1850) Millet expressed his resolve to break once and for all with mythological and undraped subjects, and the names of the principal works painted subsequently will show how steadfastly this resolution was kept. In 1852 he produced "Girls Sewing," "Man Spreading Manure"; 1853, "The Reapers"; 1854, "Church at Gréville"; 1855—the year of the International Exhibition, at which he received a medal of second class—"Peasant Grafting a Tree"; 1857, "The Gleaners"; 1859, "The Angelus," "The Woodcutter and Death"; 1860, "Sheep Shearing"; 1861, "Woman Shearing Sheep," "Woman Feeding Child"; 1862, "Potato Planters," "Winter and the Crows"; 1863, "Man with Hoe," "Woman Carding"; 1864, "Shepherds and Flock, Peasants Bringing Home a Calf Born in the Fields"; 1869, "Knitting Lesson"; 1870, "Buttermaking; 1871, "November—recollection of Gruchy." Any one of these works will show how great an influence Millet's previous practice in the nude had upon his style. The dresses worn by his figures are not clothes, but drapery through which the forms and movements of the body are strongly felt, and their contour shows a grand breadth of line which strikes the eye at once. Something of the imposing unity of his work was also, no doubt, due to an extraordinary power of memory, which enabled Millet to paint (like Horace Vernet) without a model; he could recall with precision the smallest details of attitudes or gestures which he proposed to represent. Thus he could count on presenting free from afterthoughts the vivid impressions which he had first received, and Millet's nature was such that the impressions which he received were always of a serious and often of a noble order, to which the character of his execution responded so perfectly that even a "Washerwoman at her Tub" will show the grand action of a Medea. The drawing of this subject is reproduced in *Souvenirs de Barbizon*, a pamphlet in which M. Piédagnel has recorded a visit paid to Millet in 1864. His circumstances were then less evil, after struggles as severe as those endured in Paris. A contract by which he bound himself in 1860 to give up all his work for three years had placed him in possession of 1000 francs a month. His fame extended, and at the exhibition of 1867 he received a medal of the first class, and the ribbon of the Legion of Honour, but he was at the same moment deeply shaken by the death of his faithful friend Rousseau. Though he rallied for a time he never completely recovered his health, and on the 20th of January 1875 he died. He was buried by his friend's side in the churchyard of Chailly. His pictures, like those of the rest of the Barbizon school, have since greatly increased in value.

See the article BARBIZON; also A. Sensier, *Vie et œuvre de J. F. Millet* (1874); Piédagnel, *Souvenirs de Barbizon*, &c. (1876); D. C. Thomson, *The Barbizon School* (1891); Richard Muther, *J. F. Millet* (1905); Gensel, *Millet und Rousseau* (1902). (E. F. S. D.)

MILLET (Fr. *millet*; Ital. *miglietto*, diminutive of *miglio* = Lat. mille, a thousand, in allusion to its fertility), a name applied with little definiteness to a considerable number of often very variable species of cereals, belonging to distinct genera and even subfamilies of Gramineae. Common millet is *Panicum miliaceum* (German *Hirse*). It is probably a native of Egypt and Arabia but has been cultivated in Egypt, Asia and southern Europe from prehistoric times. It is annual, requires rich but friable soil, grows to about 3 or 4 ft. high, and is characterized by its bristly, much branched nodding panicles. One variety has black grains. It is cultivated in India, southern Europe, and northern Africa, and ripens as far north as southern Germany, in fact, wherever the climate admits of the production of wine. The grain, which is very nutritious, is used in the form of groats, and makes excellent bread when mixed with wheaten flour. It is also largely used for feeding poultry, for which purpose mainly it is imported. Hungarian grass, *Setaria italica* (also called *Panicum italicum*), a native of eastern Asia is one of the most wholesome and palatable Indian cereals. It is annual, grows 4 to 5 ft. high, and requires dry light soil. German Millet (Ger. *Kolbenhirse*, *Mohar*) is probably merely a less valuable and dwarf variety of *S. italica*, having an erect, compact, and shorter spike. The grains of both are very small, only one half as long as those of common millet, but are exceedingly prolific. Many stalks arise from a single root, and a single spike often yields 2 oz. of grain, the total yield being five times that of wheat. They are imported for poultry feeding like the former species and for cage-birds, but are extensively used in soups, &c., on the Continent. Numerous other species belonging to the vast genus *Panicum*—the largest among grasses, of which the following are among the most important—are also cultivated in tropical or subtropical countries for their grain or as fodder



Setaria italica.

grasses, or both, each variety of soil, from swamp to desert, having its characteristic forms.

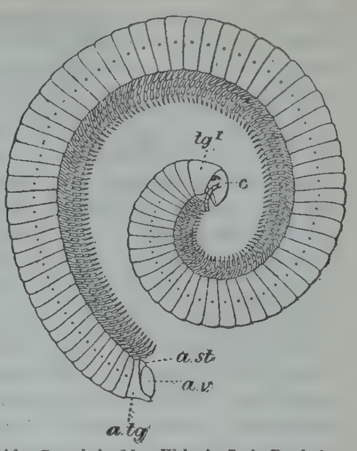
Polish millet is *P. sanguinale*; *P. frumentaceum*, shamalo, a Deccan grass, is probably a native of tropical Africa; *P. decompositum* is the Australian millet, its grains being made into cakes by the aborigines. *P. maximum* is the Guinea grass, native of tropical Africa; it is perennial, grows 8 ft. high, and yields abundance of highly nutritious grain. *P. spectabile* is the coapim of Angola, but has been acclimatized in Brazil and other tropical countries. Other gigantic species 6 or 7 ft. high form the field-crops on the banks of the Amazon. Of species belonging to allied genera, *Pennisetum typhoideum*, bajree, sometimes also called Egyptian millet or pearl millet, is largely cultivated in tropical Asia, Nubia and Egypt. Species of *Paspalum*, *Eleusine* and *Milium*, are also cultivated as millets. For Indian millet, see DURRA.

MILLIGAN, WILLIAM (1821–1892), Scottish theologian, was born on the 15th of March 1821, the eldest son of the Rev. George Milligan and his wife Janet Fraser. He was educated at the High School, Edinburgh, and, from the age of fourteen, at the university of St Andrews, where he graduated in 1839. In 1843 at the disruption he took the side of those who remained in the Establishment, and in 1844 became minister of Cameron in Fifeshire. In 1845, his health having given way, he went to Germany, and studied at the university of Halle. After his return to Scotland and his resumption of his clerical duties he began to write articles on Biblical and critical subjects for various reviews. This led to his appointment in 1860 to the professorship of Biblical criticism in the university of Aberdeen. In 1870 he was appointed one of the committee for the revision of the translation of the New Testament. His fervent piety, and his wide interest in educational and social questions, extended his influence far beyond the circle of theologians. His contributions to periodical literature for many years were numerous and valuable; but his reputation chiefly rests on his works on the *Resurrection* (1890) and *Ascension of our Lord* (1892), his Baird lectures (1886) on the *Revelation of St John*, and his *Discussions* (1893) on that book. All these volumes are distinguished by great learning and acuteness, as well as by breadth and originality of view. He died on the 11th of December 1892.

MILLINER, originally a dealer in goods from the city of Milan in Italy, whence the name. Such goods were chiefly steel work, including cutlery, needles, also arms and armour and textile fabrics, ribbons, gloves and "Milan bonnets." The "milliners" of London, though never formed into a Livery Company seem to have been associated with the "Cappers and Hurers," which later were amalgamated with the "Haberdashers" (*q.v.*). Minsheu's derivation of the word from *mille*, thousand ("as having a thousand small wares to sell"), though a typical instance of guessing etymologies, shows the miscellaneous character of their trade in the 16th and 17th centuries. The modern use of the word is confined chiefly to one who makes and sells bonnets and hats for women; but articles of "millinery" include ribbons, laces, &c., usually retailed by haberdashers.

MILLIPEDE, the popular name of the best known members of a group of the Arthropoda, scientifically known as Diplopoda, and formerly united with the Chilopoda (see CENTIPEDE), the Pauropoda and the Symphyla as an order of the class Myriapoda. This classification, however, has of late years been abandoned on account of the recognition of closer affinity between the Chilopoda (centipedes) and the Hexapoda (insects) than between the Chilopoda and Diplopoda. By modern writers the above-mentioned groups of "tracheate" Arthropoda are either regarded as independent classes of this phylum Arthropoda, or associated in two superclasses, the Opisthogonea or Opisthogoneata for the Chilopoda and Hexapoda; and the Prosogonea or Prosogoneata for the Diplopoda, Pauropoda and Symphyla. The structural character upon which these superclasses are based is the position of the generative apertures which open anteriorly in the Prosogonea and posteriorly in the Opisthogonea. Although the Pauropoda and Symphyla are not, strictly speaking, Diplopoda, these three groups of prosogoneate arthropods are here for convenience considered together.

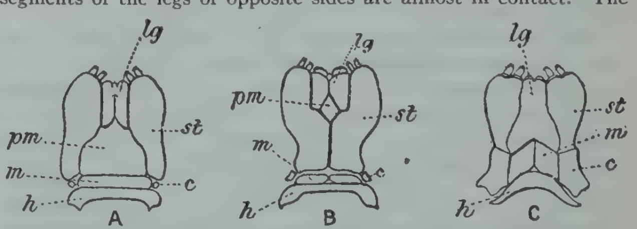
CLASS DIPLOPODA.



After Pocock in Max Weber's *Zool. Ergebnisse*, &c., IV., Pl. XXI., fig. 8, 1894.

FIG. 1.—*Spirostreptus vittatus*, an Oriental species of the Spirostreptoidea, lateral view, showing the repugnatorial pores on the sides of the segments.

c, head with eyes and antennae.
tg^1, tergal plate of first segment.
a.tg, tergal plate of last or anal segment.
a.st, sternal plate of ditto.
a.v, anal valve.

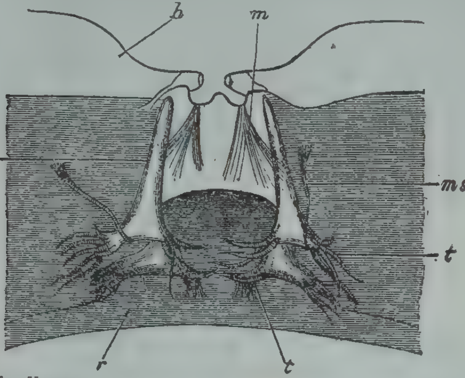


After Silvestri, *Ann. Mus. Genova*, (2), xvi, figs. 17, 19, 25.

FIG. 2.—The Gnathochilarium or jaws of second pair of various Chilongatha.

A, of *Spirostreptus*. B, of *Julus*. C, of *Glomeris*.
c, cardo.
st, stipes.
lg, linguae.
m, mentum.
pm, promentum.
h, hypostoma.

Structure.—The anterior extremity is provided with a distinct head which by its general form and the nature of its appendages is as sharply marked off from the body as is the case in the Hexapoda. It always bears at least three pairs of appendages, the eyes when present and, in the Oniscomorpha a peculiar sense organ. The inferior edge of the head plate overhangs the mouth and is termed the labrum. The exoskeleton of a typical somite consists of the following elements: a dorsal plate, a ventral plate, and a pleural plate on each side. To the external margin of the ventral plate or sternum is articulated a pair of legs and between the leg and the pleural plate is situated the spiracle of the tracheal system. But the segmentation of the Diplopoda presents two marked peculiarities. The first is the fact that, with the exception of a few of the anterior leg-bearing segments and perhaps one or two of those at the posterior end of the body, a single dorsal plate or tergum with its pleural plates overlies two sternal plates, two pairs of legs and two pairs of spiracles. Hence the segments appear to be double and to be furnished with twice as many legs as is normal in the Arthropoda—a peculiarity which has suggested the term "Diplopod" or "double-footed," for this group. It is generally believed that each tergal plate results from the coalescence of the terga of two originally distinct adjoining segments; but the same effect would be produced by the enlargement of one of a pair of terga and the complete excalation of the other. It is in favour of the latter view that there is only a single pair, and not two pairs, of stink-glands on each so-called double tergal plate. Unfortunately the history of the development of the segments does not clear up the difficulty since the terga of the double segments are single from the first, and no evidence either of fusion or excalation is supplied. The second of the two peculiarities above-mentioned is the great development of the tergal sclerite as compared with the sternal. Only very rarely (*i.e.* in *Platydesmus*) is there a broad sternal area. In the majority of cases the lateral edges of the tergum are bent downwards and inwards towards the mid ventral line; the sternum at the same time is so much reduced that the basal segments of the legs of opposite sides are almost in contact. The pleural plate on each side usually disappears either by suppression or by fusion with the tergum. The sterna with their attached legs often remain free. But quite commonly the coalescence of the skeletal elements is carried to such an extreme that each segment is a solid ring with two pairs of movable appendages. The last segment is differently constructed from the others. It is always limbless, and usually consists of a complete tergal ring, a single sternal plate, and a pair of movable anal valves which are normally closed, but are capable of being opened for the passage of faeces. These anal valves are possibly the homologues of the plural scutes of a normal segment. The appendages are modified as a single pair of antennae, two or three pairs of jaws and a variable number of walking-legs, of which one or more pairs may be transformed into gonopods. The antennae are short and very similar to the legs. They are preoral in position, and usually consist of seven segments, the seventh or distal segment being small, as a rule, and furnished with a sense organ which is probably olfactory or tactile in function. The mandibles or jaws of the first pair are the most anterior of the postoral appendages. They are large, powerful, and usually consist of three or two segments, a basal or cardo, which is sometimes absent, a second or stipes, and a third or mala, the latter being supplied with a strong tooth and pectinate lamellae. In all Diplopods, with the exception of the Pselaphognatha, there are only two pairs of jaws, those of the second pair forming a large plate, the gnathochilarium, which acts as a lower lip. It consists of several distinct sclerites, two external on each side, the proximal known as the cardo, the distal as the stipes, the latter being tipped with one or two lobes (malae) and far exceeding the cardo in size. Between the external plates there is a median proximal plate (mentum) generally of large size and often itself subdivided, and a pair of distal plates (linguae). Behind the base of the gnathochilarium there is a single large transverse plate, the hypostoma. In the Pselaphognatha, the jaws representing the gnathochilarium are differently constructed and an additional pair, the maxillulae, has been recently detected between the gnathochilarium and the mandibles. Behind the gnathochilarium, which from embryological data appears to result from the modification of a single pair of appendages, a legless somite has been detected in some embryos. Possibly the plate referred to above as the hypostoma is its sternal element.



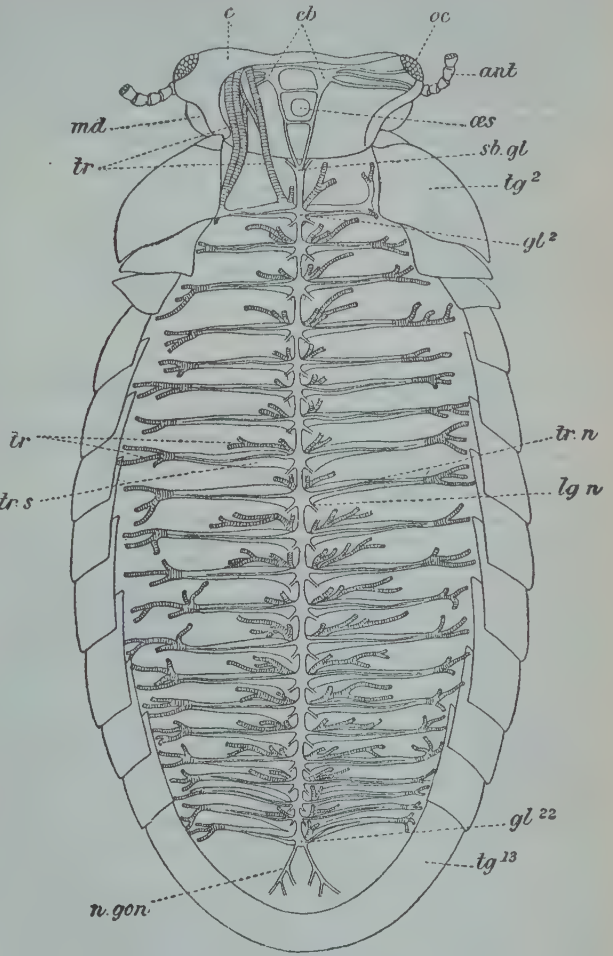
After Voges.

FIG. 3.—Inner view of ventral area of a single segment of *Julus*, much enlarged to show the structure and arrangement of the tracheal organs. The two pairs of tracheae are seen *in situ*, the posterior pair overlapping the anterior.

h, Posterior margin of the body-ring (tergum).
r, Anterior border.
st, Tubular chamber of tracheae.
t, Fine tracheae given off from it.
ms, Respiratory muscle attached to tracheal sac.
m, Ventral body muscle.

The heart is a median dorsal vessel composed of a series of chambers each giving off a pair of arteries and furnished with a pair of orifices or ostia. According to Newport, the anterior chamber lying in the second segment is prolonged into an aortic trunk from which arise three pairs of lateral arteries dipping down on each side of the alimentary canal and uniting beneath it in a common ventral vessel. The heart is enveloped in a delicate pericardial membrane and is supported by lateral alary muscles. The alimentary canal is a simple tube extending usually straight through the body from mouth to anus. Only in the Oniscomorpha is it looped, thus suggesting the origin of this short-bodied group of millipedes from longer, more vermiform ancestors. A pair of so-called salivary glands opens into the fore-gut near its anterior extremity and one or two pairs of malpighian tubes communicate with the hind-gut at its junction with the broad mesenteric portion of the canal. Respiration is effected by means of tracheal tubes which communicate with the exterior by means of spiracles situated just above the bases of the walking limbs. Each spiracle leads into a longer or a shorter pouch whence the tracheae, which are of two kinds, arise. In the majority of the orders the tracheae are tufted, that is to say, they form two bundles of short simple tubules springing from the innermost corners of each pouch. In the Oniscomorpha, however, each pouch gives rise to a number of long tubes which extend through the body and somewhat resemble those of the Chilopoda except that they neither branch nor are extensive. As in the Chilopoda and Hexapoda the tracheae are strengthened and kept expanded by a slender spiral filament.

The ventral nerve cord consists of two strands so closely approximated as to be practically fused, with a small ganglionic enlargement for each pair of legs. Hence in the double segments there are two such ganglia, which in addition to the crural nerve give off on each side a large branching nerve to other organs in the segment. In the Opisthospermophora (*Julus*, *Spirostreptus*) and the Oniscomorpha (*Glomeris*, *Sphaerotherium*) the ganglia are spaced at equal distances on the cord, but in the Merochaeta (*Polydesmus*) they are grouped in pairs to correspond to the spacing of the legs. The apodous penultimate and anal segments are innervated from the last ganglion of the cord, as are also the gonopods of the males of the Oniscomorpha. The first (suboesophageal) ganglion of the cord supplies the mandibles and gnathochilarium and is connected by the oesophageal commissures with the bilobed cerebral nerve whence arises the nerves for the eyes, when present, and the antennae.

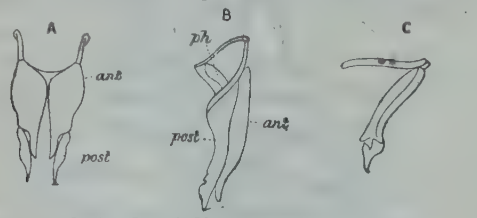


After G. C. Bourne, *J. Linn. Soc.* xix., Pl. 29, 1886.

FIG. 4.—Diagram of the nervous and circulatory system of *Sphaerotherium obtusum*, a South African species of Oniscomorpha.

c, Head.
oc, Eye-cluster.
ant, Antenna.
md, Basal segment of mandible.
tg^2 and *tg*^{13}, Part of the terga of the second and thirteenth segments.
cb, Cerebral ganglia supplying the eyes and antennae.
oes, Oesophagus, cut through.
sb.gl, Suboesophageal or first ganglion of ventral chain.
gl^2 and *gl*^{22}, Second and twenty-second ganglia of chain, the posterior nerve of each ganglion, *lg.n*, supplies the leg, the anterior, *tr.n*, the tracheal sac and other organs.
n.gon, Nerve to gonopods.
tr, Tracheal tubes with spiral filament.
tr.s, Tracheal sac.

Eyes are sometimes absent, as in all the genera of Merochaeta and in many genera of other groups, as in *Siphonophora*, one of the Colobognatha, and several of the Juloidea (*Typhloblaniulus*). In other cases they are represented by one or two ocelli on each side (Stemmiuloidea); or by a vertical series of ocelli as in the Glomeroidea and *Polyzonium* amongst the Colobognatha. But in the majority of the orders they are represented by triangular or subspherical aggregations of ocelli recalling in a certain degree those of the Lithobiomorpha amongst the Chilopoda. They are simple in structure and consist externally of a cuticular corneal thickening or lens and internally of a retinular layer of enlarged epidermic cells, the internal or proximal ends of which are continuous with the fibres of the optic nerve. The ovary is unpaired and extends almost the entire length of the body beneath the alimentary canal. The oviducts are sometimes separate tubes (*Lysiopetalum*), sometimes confluent and divided just before terminating in the two orifices behind the base of the legs of the second pair (*Julus*). The testes and seminal ducts occupy the same position and extent as the ovary and oviducts. The ducts are sometimes coiled, sometimes divided, sometimes united. The two testes are sometimes united by transverse branches across the middle line, and are sometimes branched posteriorly They bear short caecal diverticula in which the semen is developed. There are no accessory glands associated with the generative organs; but in some forms, *e.g. Polyxenus*, there is a pair of receptacula seminis extending backwards alongside the ovary and opening into the oviduct.



After Pocock, *J. Linn. Soc.* xxi., Pl. 25.

FIG. 5.—Gonopods of *Trigoniulus andersoni*, one of the Opisthospermophora (Spiroboloidea).

A, Anterior view, and B, lateral views of the apparatus. *ant*, anterior, and *post*, posterior portions of the coleopod ensheathing the phallopod, of which the proximal portion, *ph*, is shown.
C, Phallopod removed from the coleopod.

The secondary sexual characters of the males are of great taxonomic importance. The seminal ducts, like the oviducts, open behind the legs of the second pair. Associated with them in the Limacomorpha (*Glomeridesmus*), there is a pair of very long retractile penes. In the Spirostreptoidea and Juloidea the penes are much shorter and have coalesced. Sometimes they are undeveloped (Spiroboloidea). In other cases, the Merochaeta, Oniscomorpha, &c., the ducts traverse the coxae of the legs of the second pair. But in all these groups, with the exception of the Oniscomorpha, semen is transferred from the genital orifices, with or without the aid of the penes, either into the first or second pairs of appendages of the seventh segment which are modified in various ways, and are termed phallopods. When the posterior legs are so modified the anterior are as a rule even more profoundly altered to form a protective sheath, or coleopod, for the phallopod; and as a further precaution the entire apparatus is usually withdrawn within the seventh segment. In the Oniscomorpha the semen is transferred into a pair of receptacles developed upon the coxae of the legs of the last pair, which are chelate. The male appendages that are modified in the above described ways are comprehensively spoken of as gonopods. Other secondary sexual characters, like the stridulating organs of the males of some Oniscomorpha, the suctorial pads on the legs of Spirostreptoidea, the development of angular processes upon the mandible or first tergal plate, or of fine ridges in the gnathochilarium—all of which are concerned in enabling the male to maintain a secure hold upon the female—are of great taxonomic use in distinguishing the genera and species.

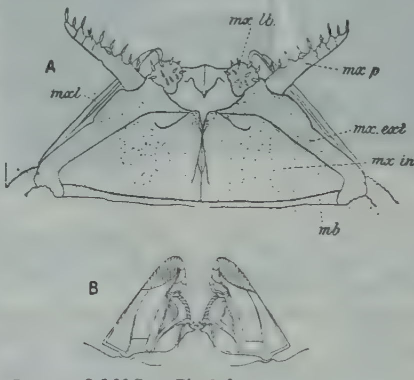
The most important glands in the Diplopoda are the repugnatorial or stink-glands, which, except in the Oniscomorpha, Limacomorpha and Ascospermophora, open by pores upon the sides of more or fewer of the segments. They secrete a fluid with an unpleasant odour, breaking up in one case into cyanide of potassium, and are practically the only means of protection, apart from the hard exoskeleton, which Diplopods possess. In some millipedes silk glands also exist and open upon papillae upon the posterior border of the last tergal plate. They are found in the Ascospermophora, Stemmiuloidea and Proterospermophora, and are used for spinning nests for the eggs and protective cases for the young during exuviation.

Classification.—The existing members of the class Diplopoda may be classified as follows:—

Subclass 1. PSELAPHOGNATHA.
  Order: *Penicillata* (*Polyxenus*).
" 2. CHILOGNATHA.
  Order: *Oniscomorpha* (*Glomeris, Zephronia*).
  " *Limacomorpha* (*Glomeridesmus*).
  " *Colobognatha* (*Polyzonium, Siphonophora*).
  " *Ascospermophora* (*Chordeuma*).
  " *Proterospermophora* (*Lysiopetalum*).
  " *Merochaeta* (*Polydesmus*).
  " *Opisthospermophora*.
    Suborder: Stemmiuloidea (*Stemmiulus*).
    " Spiroboloidea (*Spirobolus*).
    " Spirostreptoidea (*Spirostreptus*).
    " Juloidea (*Julus, Nemasoma*).

Subclass PSELAPHOGNATHA.

Diplopods with the soft integument strengthened by weakly chitinized sclerites and furnished above and on the head with transverse rows of short, stout, somewhat squamiform bristles; laterally, on each side of the principal segments, with a thick tuft of long bristles and with a large, silky, white tuft projecting backwards from the posterior extremity. Mandibles one-jointed. Behind them a pair of small, one-jointed maxillulae, attached to a median membranous "lingua." Behind the "lingua" and maxillulae, a large, double, transverse plate with a long, external sclerite bearing distally in *Polyxenus* an inner short-lobate process and an outer long spiny palpiform branch. The latter, however, is absent in *Lophoproctus*. These sclerites probably represent the gnathochilarium of the Chilognatha, but the homology between the skeletal elements of the jaws in question is not clearly understood. It has been suggested that they represent two pairs of jaws, but embryological proof of this does not exist.



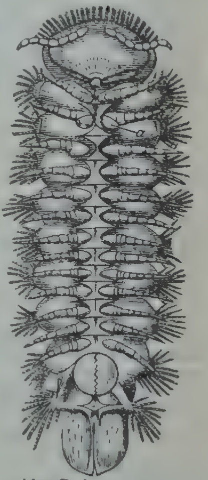
A, after Carpenter, *Q.J.M.S.* 49, Pl. 28, fig. 1.
B, after Latzel, *Die Myr. Ost. Ung. Mon.* II., Pl. ii., 1884.

FIG. 6.—Jaws of *Polyxenus lagurus*.

A, Jaws of second and third pairs. *mxl*, maxillula; *mx.p*, palpiform branch of maxilla; *mx.lb*, lobate process of maxilla; *mx.ext*, external plate of maxilla perhaps corresponding to the stipes of the gnathochilarium of the Chilognatha; *mx.int*, internal plate of maxilla, perhaps corresponding to the mentum and promentum of the gnathochilarium (by Carpenter *mx.int* is regarded as an appendage posterior to the maxilla); *mb*, membrane.
B, Mandibles of *Polyxenus lagurus*.

Order *Penicillata* (= *Ancyrotricha*).

Head large, usually with lateral eyes. Antennae eight-jointed, attached near the middle of the front of the head. On the dorsal side of the body there are eleven segments, simple and compound. The first four of these bear one pair of legs each, the succeeding four two pairs of legs, the ninth segment one pair, making a total of thirteen pairs of legs. The tenth and eleventh or anal segment are legless. There is a narrow sternal area separating the bases of the legs of the two sides. There are no repugnatorial glands. In the male none of the legs are modified as gonopods, but the coxa of each of the legs of the second pair is furnished with a conical penis, which during copulation, it may be supposed, is inserted into the genital orifice of the female, which occupies a corresponding position in that sex. The young when first hatched has only three pairs of legs and five segments. The millipedes of this order are all of small size, measuring at most only a few millimetres in length. The best-known genera are *Polyxenus* and *Lophoproctus*, both of which occur in Europe. Other forms have been discovered in the West Indies, North and South America, and Ceylon; and it is probable that the group has an almost cosmopolitan range. They live under stones or the loosened bark of trees. The carboniferous fossil, *Palaeocampa*, is usually referred to this subclass.



After Bode.

FIG. 7. — Ventral view of *Polyxenus lagurus* much enlarged, actual length a little over $\frac{1}{13}$th of an inch.

a, Position of generative openings.

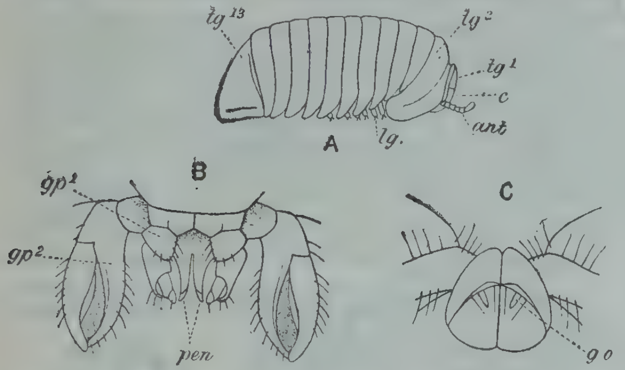
Subclass CHILOGNATHA.

Diplopods with firmly chitinized exoskeleton, sometimes thickly, sometimes sparsely covered with short, simple hairs, but never decorated with tufts or rows of peculiarly modified bristles.

Mandibles, two- or three-jointed; maxillulae absent, the jaws of the second pair being represented by the gnathochilarium described above.

Order *Oniscomorpha.*

Body short and broad, hemispherical in transverse section; convex above, flat below, and capable of being spherically coiled. The exoskeleton of a typical compound segment consists of a vaulted tergum, a pair of free pleural sclerites, two pairs of small tracheal sclerites and two pairs of legs, the latter attached to the ventral membrane, which has no sternal plates. The tergal plates are twelve or thirteen in number, whereof the first is very small, the second enormously expanded laterally, and the last, also enlarged and probably representing at least three segments, extends laterally and posteriorly like a hood over the posterior end of the body without forming a chitinous ring round the anal valves and sternum. In the male the legs of the penultimate pair are sometimes modified as claspers; those of the last pair are always enlarged and prehensile, and bear on their coalesced basal segments a pair of sperm-carrying processes analogous to the phallopods of other groups. Apart from these organs the male has no penis, the seminal ducts perforating the coxae of the legs of the second pair. This order contains two well-marked suborders, the Glomeroidea and the Zephronioidea. The Glomeroidea, comprising the families *Glomeridae, Gervaisiidae, Onomeridae*, have the antennae approximated on the head, the eyes uniserial and twelve (rarely eleven) tergal plates. To this group belong the common pill-millipedes of Europe and North Africa. In North America the *Onomeridae* alone are found. The Zephronioidea, with the single family *Zephroniidae*, have the antennae at the sides of the head, the eyes composed of a spherical cluster of ocelli, and always thirteen tergal plates. This group is common in the tropical and southern continents of the Old World, having representative genera in South Africa, Madagascar, India, Malaysia, Australia and New Zealand. They are much larger forms than the Glomeroidea, large specimens reaching two or three inches in length. In addition to the characters mentioned above the Oniscomorpha differ from all other Diplopods in having long tubular tracheae and the alimentary canal bent upon itself.



After Pocock, in Max Weber's *Zool. Ergebnisse*, &c., IV., Pl. xx.

FIG. 8.—*Sphaeropoeus hercules*, a Sumatran species of the Oniscomorpha.

A, Lateral view of the entire animal. *c*, head; *ant*, antenna; tg^1, tg^2 and tg^{13}, tergal plates of first, second and thirteenth segments; *lg*, extremities of some of the anterior legs.

B, Gonopods of the male. gp^1 and gp^2, anterior and posterior pairs of gonopods, both being chelate claspers; *pen*, processes arising from the basal segments of the gonopods of the second pair, which act as penes.

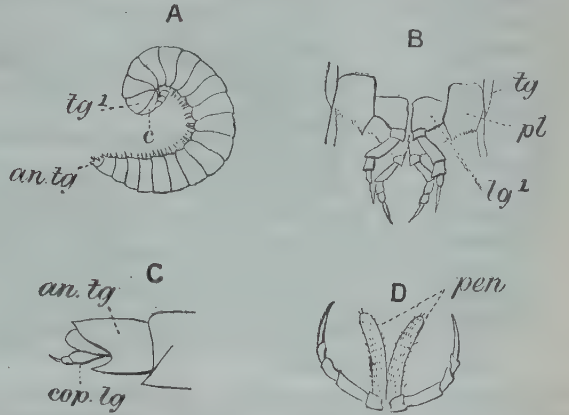
C, Vulvae or genital plates attached to the basal segments of the legs of the second pair in the female. *g.o*, genital orifice.

Order *Limacomorpha.*

Resembling the Oniscomorpha in the shape and structure of a typical segment, except that the tracheal plates are unrepresented; in the facts that the last tergal plate does not form a complete ring round the anal area, and that the last pair of legs in the male are modified; but differing from them in that the body consists of nineteen or twenty segments, is elongate, and tapers anteriorly and posteriorly, the second and last tergal plates being small; in the presence in the male of a pair of long hairy protrusible penes between the legs of the second and third pairs, and in the structure of the gonopods, which, instead of being chelate, terminate in a slender, tapering tarsal segment. This order contains two families: *Zephroniodesmidae* (*Zephroniodesmus*) and *Glomeridesmidae* (*Glomerisdesmus*), the former from tropical Asia, the latter from tropical America. The largest of these millipedes reach a length of only about 7 mm. Nothing special is known of their habits.

Order *Colobognatha.*

Body elongate, capable of being spirally coiled, consisting of a large and indefinite number of segments, each being furnished with a distinct often large sternal area, and with the pleural sclerite or membrane distinct from the tergum. The last tergal plate forms a complete ring round the anal valves. Legs with coxal pouches; those of the seventh segment transformed into gonopods of a very simple type in the male, which is also furnished with a double penis completely or partially confluent with the coxae of the legs of the second pair. Head always small, frequently triangular or piriform, in the latter case the gnathites reduced in size and complexity. Repugnatorial pores present and lateral. The genera of this order are divisible into three families: the *Platydesmidae* (*Platydesmus, Pseudodesmus*), *Polyzonidae* (*Polyzonium, Siphonotus*), *Siphonophoridae* (*Siphonophora*). Of these the *Platydesmidae* have departed least and the *Siphonophoridae* most from the typical Diplopod in the structure of the mouth parts. The group is for the most part tropical, one genus only, *Polyzonium*, extending as far north as Central Europe.



After Pocock, *J. Linn. Soc.* xxiv., Pl. 37.

FIG. 9.—*Glomeridesmus marmoreus*, one of the Limacomorpha.

A, Lateral view. *c*, head with antennae; tg^1, tergal plate of first segment; *an.tg*, tergal plate of last or anal segment.

B, Lower view of one of the segments. *tg*, inferior edge of the tergal plate; *pl*, pleural sclerite; lg^1, basal segment of leg.

C, Posterior extremity of body. *an.tg*, tergal plate of anal segment; *cop.lg*. gonopod or copulatory leg.

D, Legs of the third pair with extruded penes, *pen*, in front of them.

Order *Ascospermophora.*

Body elongate, consisting of from twenty-six to thirty-two segments, but not varying within specific limits; the pleurae coalesced with the terga, the sterna free. More or fewer of the anterior ten pairs of legs may be modified in the males, but no true phallopods are differentiated, the function of seminal receptacles being performed (according to C. Verhoeff) by the exsertile coxal pouches of the two pairs of legs of the eighth segment. The seminal ducts in the male perforate the coxae of the legs of the second pair. There are no repugnatorial pores, and the terga are furnished with three pairs of symmetrically placed hairs or bristles. On the posterior border of the last tergal plate there is a pair of spinning papillae. The millipedes of this order, also called Coelochoeta, are referable to several families: *Chordeumidae* (*Chordeuma*), *Craspedosomidae* (*Craspedosoma*), *Heterochordeumidae* (*Heterochordeuma*), &c. The *Heterochordeumidae* belong to the Oriental region, extending from India to New Zealand. The others are particularly abundant in genera and species in North and Central America and Europe; but are unknown in Africa, south of the Sahara.

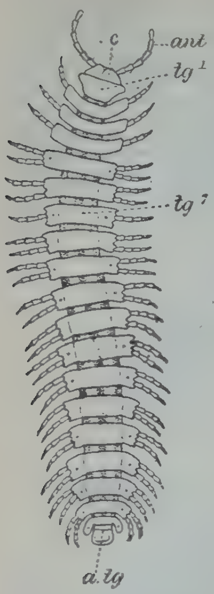
Order *Proterospermophora.*

Differing from the Ascospermophora in that the number of segments is large and variable; they are furnished with repugnatorial pores, and not with the three pairs of setae. In the males the anterior appendages of the seventh segment are modified as phallopods, and the seminal ducts perforate the coxae of the legs of the second pair.

This order, containing the family *Lysiopetalidae* (*Lysiopetalum*), is widely distributed in Europe and North America. Large examples of some of the species, *e.g. L. xanthinum*, reach a length of 4 or 5 ins.

Order *Merochaeta.*

Resembling the Proterospermophora in having only the anterior appendages of the seventh segment converted into phallopods and the seminal ducts perforating the coxae of the second legs in the males; but differing essentially in that the sterna are solidly welded to the rest of the exoskeleton of the segments, which are either nineteen or twenty in number, in the absence of eyes and of spinning papillae, and in having six-jointed legs. This order is cosmopolitan in distribution and consists of a very large number of genera which by some authors are referred to the single family *Polydesmidae*; by others to numerous families. Many species are brightly coloured, and some individuals of the Oriental genus *Platyrhachus* may reach a length of 5 ins. The segments are usually provided with lateral laminate or tubercular expansions bearing the repugnatorial pores, which are only very rarely absent.



After Pocock, in Max Weber's *Zool. Ergebnisse*, &c., IV., Pl. xx.

FIG. 10.

Platyrhachus mirandus, a Sumatran species of *Polydesmidae*, to show the form characteristic of the order Merochaeta.

c,	Head.
ant,	Antenna.
tg^1,	Tergal plate of first body segment.
tg^7,	Ditto of seventh.
a.tg,	Tergal plate of anal segment.

The figure also shows the repugnatorial pores which are present upon the majority of the segments, the laterally expanded tergal plates, and the presence of two pairs of legs for each of the segments except the two last, the four first and the seventh; the latter, since the figured specimen was a male, has the anterior leg converted into a phallopod which is concealed beneath the body.

Order *Opisthospermophora*.

Resembling the Proterospermophora in possessing a large and variable number of segments, each of which, with the exception of the last and the anterior four or five, is furnished with a pair of repugnatorial pores, but differing essentially from them in that the posterior pair of appendages of the seventh segment are converted into phallopods, and the anterior into protective coleopods in the male, and that the seminal ducts in this sex do not perforate the coxae of the legs of the second pair but are usually associated with a distinct penis situated immediately behind them. The genera of this order present greater diversity of structure than is found in the other orders and are referred to four suborders, which by some zoologists are erected to ordinal rank, namely, the Stemmiuloidea (Monochaeta); the Spiroboloidea (Anochaeta); the Spirostreptoidea (Diplochaeta); and the Juloidea (Zygochaeta).

In the Stemmiuloidea the sterna are free and the pleurae partially so; the terminal segment of the legs is bisegmented; there are two pairs of spinning papillae on the last tergite; the penis is a single long tube, and the eyes are represented by one or two large lenses on each side of the head. The genus *Stemmiulus*, constituting the *Stemmiulidae*, is represented by a few species recorded from the Oriental, Ethiopian and Neotropical regions. In the possession of silk-glands this suborder resembles the Ascospermophora and Proterospermophora, and should perhaps rank as an order apart from the Opisthospermophora.

The Spiroboloidea, containing one family, the *Spirobolidae* (*Spirobolus*, *Rhinocricus*, &c.), have the sterna and pleurae coalesced, the tarsi undivided; no spinning papillae, no penis, the eyes represented by an aggregation of ocelli; and the first five segments each with a single pair of legs, the sixth carrying two pairs. This group attains its maximum of development in the tropics, where species and genera are numerous and specimens of large size, *i.e.* 6 ins. or over, are met with.

The Spirostreptoidea resemble the Spiroboloidea in many particulars, but the fourth segment is footless, and the fifth has two pairs of limbs; the male has a distinct and double penis, and in both sexes the stipites of the gnathochilarium extend to the proximal end of the mentum, which is relatively small. The distribution of this order, which contains several families: *Spirostreptidae* (*Spirostreptus*, *Rhynchoproctus*), *Cambalidae* (*Cambala*, *Julomorpha*), &c., is practically the same as that of the Spiroboloidea. Specimens over 6 ins. in length are met with in the tropics of Africa and Asia.

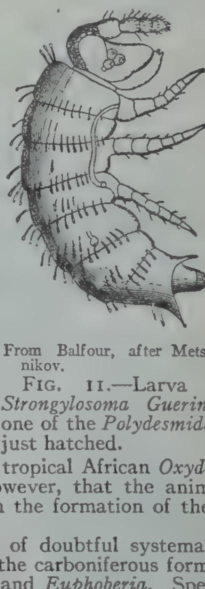
The Juloidea differ from the Spirostreptoidea in having the third segment limbless, the first, second and fourth with a single pair of appendages, and the stipites of the gnathochilarium much expanded and meeting for a considerable distance in the middle line behind the very small promentum.

The best marked family of this group is the *Julidae*, which is widely distributed in the northern hemisphere. Its species and genera (*Julus*, *Pachyiulus*) are abundant in Europe. Another European family, the *Nemasomidae*, is founded for the genus *Nemasoma*, which is remarkable for having the sterna free.

Habits, &c.—Millipedes are principally cryptozoic, living under stones or logs of wood in damp, secluded localities. They feed almost wholly upon decaying vegetable matter, and drink a considerable quantity of water. Some of the tropical species emerge in numbers from their hiding-places after heavy rains, and crawl over the ground and bushes in search of moisture in broad daylight. Their method of progression over level ground is quite peculiar. The body is held in a straight line and is propelled by a succession of wave-like movements of the legs, which are moved in groups, the groups on the right and left side exactly corresponding. Some forms, *e.g. Stemmiulus*, have been described as attempting to evade capture by a hopping action caused by vigorous jerking and wriggling of the body. Many of the species are very conspicuously coloured and the association of brilliant colouring with the existence of the nauseous secretion of the repugnatorial glands suggests that the coloration is aposematic or of warning significance.

Copulation between the sexes takes place before oviposition. In the Opisthospermophora the males and females coil together with the ventral surface of the anterior ends of their bodies opposed, the male holding the female securely by the head while the extended phallopods carrying the semen are brought into contact with her genital orifice. In the *Polydesmidae* pairing is effected in the same way except that the male and female instead of intercoiling remain extended, the male clasping the female with his legs. In the Oniscomorpha the sexes also pair front to front, not head to head, however, but head to tail, so that the gonopods in the anal segment of the male can be applied to the second pair of postoral appendages in the female. Some males of this group, *e.g. Sphaerotherium*, have a stridulating organ on their posterior gonopods and stridulate when finding the females.

The method of disposing of the young, which usually have only three pairs of legs at hatching, differs in various groups. In *Julus* and *Polydesmus* the female burrows below the surface and makes a subspherical nest of small blocks of earth which are moistened with the salivary secretion and moulded to the proper shape between her jaws and anterior legs. When the receptacle is nearly finished she deposits her eggs in it, and, closing the aperture, leaves the whole to its fate. On the other hand, a female specimen of the South African species, *Archispirostreptus erythrocephalus*, that lived in the London Zoological Gardens, buried herself, coiled round the eggs, and remained with her young for some time after they were hatched. Again, millipedes, like the Stemmiuloidea and Ascospermophora, which possess silk-glands, spin silken cases for the protection of their eggs. Immature specimens of these groups spin similar silken cases at the time of exuviation; and cases, resembling the nests, are likewise made for purposes of moulting by immature forms of some exotic species of *Polydesmidae*, *e.g.* by the tropical African *Oxydesmus*. There is good reason to think, however, that the animal makes use of its own voided excrement in the formation of these receptacles.



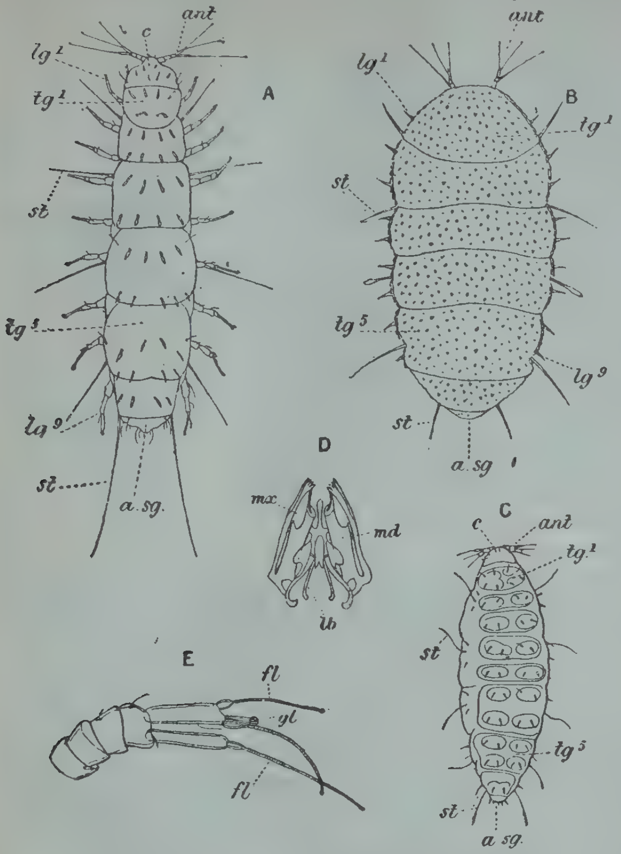
From Balfour, after Metschnikov.

FIG. 11.—Larva of *Strongylosoma Guerinii*, one of the *Polydesmidae*, just hatched.

A considerable number of Chilognatha of doubtful systematic position have been recorded from beds of the carboniferous formation. The best known are *Acantherpestes* and *Euphoberia*. Specimens referred to existing genera have been discovered in amber beds of Oligocene age.

CLASS PAUROPODA.

As in the Diplopoda there is a distinct head bearing a pair of antennae and two pairs of jaws. On each side of the head there is an eye-like spot which may conceivably represent a degenerate eye, although the external cuticle shows no corneal thickening nor the epidermis retinular specialization, and optic nerves are absent from the brain. The antennae are structurally unique in the Arthropoda. There are four short basal segments from the distal of which arise two one-jointed branches, an external thinner and an internal thicker. The external or postaxial branch is tipped with a single long annulate flagelliform bristle with a rounded apical knob; and the internal or preaxial branch with two similar but shorter bristles and a globular, usually pedunculated, sense organ between them. The mandibles or jaws of the first pair are large and one-jointed. Those of the second pair are very short, piriform, and attached to the ventral side of the head by a long, rod-like sclerite. Between these two pairs of jaws there is a horny framework forming a kind of lower lip to the mouth. The correspondence between these mouth parts and those of the Diplopoda is not understood. No doubt the mandibles are homologous in the two groups; but whether the jaws of the second pair in the Pauropoda correspond to the maxillulae of the Pselaphognatha, or to part of the gnathochilarium in the Chilognatha, or whether the chitinous framework alone or in conjunction with the pair of jaws answers to the gnathochilarium are questions to which no answer can as yet be given. Judging from the segmentation and the appendages the body is composed of twelve somites, including the last or anal, which, like the penultimate somite, is limbless. Each somite in front of the penultimate bears a single pair of legs, nine pairs of which are fully developed ambulatory limbs, while those of the first segment are reduced to a pair of bud-like processes. The first and last pairs of ambulatory limbs consist of five segments; in the remaining pairs the terminal segment may be subdivided into two, so that there may be six segments in all. The ambulatory limbs are usually terminated by three claws, a principal and two subsidiary, each claw being accompanied by a membranous pad. Between these limbs, which are relatively longer and stronger than in the Diplopoda and evenly spaced on each side of the body, extends a soft-skinned sternal area. The distensible pleural region of the body is also membranous, but the dorsal area is covered by chitinous plates or terga, usually six in number, excluding that of the anal segment; each of the anterior five of these overlies two limb-bearing somites, the first covering the somite of the rudimentary limbs and of the first pair of locomotor legs, the second those of the second and third pairs of locomotor legs, and so on. This condition is an adumbration of the far completer fusion of somites seen in the Diplopoda. The sixth tergal plate belongs to the limbless penultimate somite. The duplex character of the first five terga is suggested in *Pauropus* by the presence of two rows of sensory bristles; there being only one such row upon the sixth tergum. In the aberrant genus *Brachypauropus* the evidence is practically completed by the correspondence in number between the terga and pairs of legs, there being a divisional line between the two rows of setae. On each side of the body there are five long pubescent tactile setae situated on the second to the sixth terga in *Pauropus*, and on the pleural area corresponding to these terga in *Brachypauropus*.



A and B, after Kenyon, *Tufts Coll. Studies*, iv., 1895; C, after Hansen, *Vid. Meddel.*, 1901, Pl. VI., fig. 3*a*; D. and E, after Kenyon.

FIG. 12.—PAUROPUS.

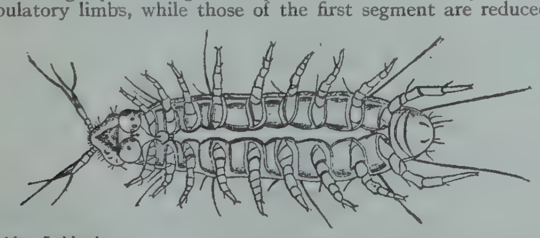
A. *Pauropus huxleyi* (?): *c*, head; *ant.* antenna; tg^1 and tg^5, first and fifth double tergal plates; lg^1, first walking-leg (=2nd post-cephalic appendage); lg^9, ninth walking-leg; *a.sg*, anal segment; *st*, setae.

B. *Eurypauropus spinosus.* Lettering as in A.

C. *Brachypauropus superbus.* Lettering as in A and B; (tg^1) = first and second terga; tg^5, = ninth and tenth terga.

D. Jaws of *Pauropus huxleyi*; *md*, mandible; *mx*, maxilla; *lb*, labial framework.

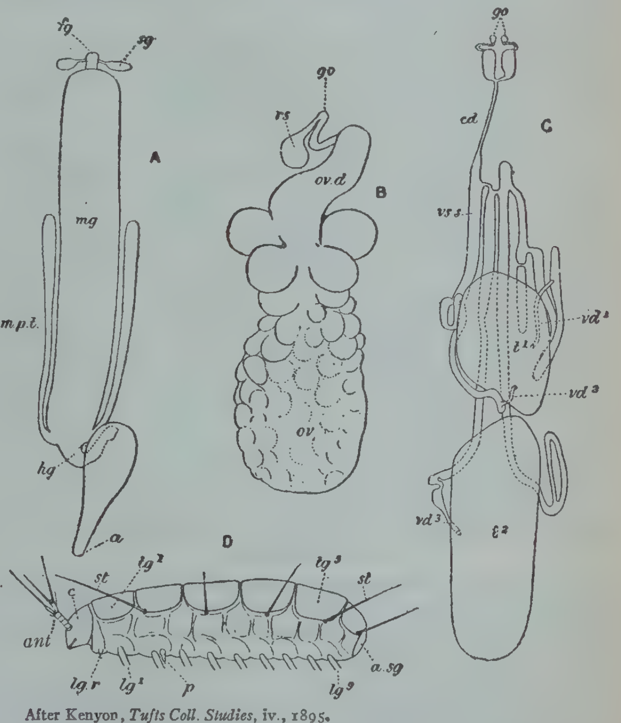
E. Antenna of *Eurypauropus spinosus*; *fl*, flagella; *gl*, sensory organ.



After Lubbock.

FIG. 13.—Enlarged view of *Pauropus huxleyi*, from ventral side.

The cerebral mass of the nervous system is large and when viewed from above is seen to consist of two lobes defined by a median groove. In the absence of eyes no optic nerves are given off. Beneath these are two antennal lobes whence arise, close together, the antennal nerves. Two short commissural cords connect the cerebral mass with the suboesophageal ganglion, a composite mass formed of the nervous centres which supply the two pairs of jaws and the rudimentary legs of the first pair. Behind this large ganglion the cord, which shows superficially no trace of its double origin, presents a ganglionic swelling for each pair of legs. No circulatory or respiratory organs have been detected.



After Kenyon, *Tufts Coll. Studies*, iv., 1895.

FIG. 14.—PAUROPODA.

A. Alimentary canal of *Pauropus*; *fg*, fore-gut; *sg*, salivary gland; *mg*, mid-gut; *hg*, anterior portion of hind-gut; *a*, anus; *m.p.t.*, malpighian tubule.

B. Female genital organs of *Eurypauropus*; *ov*, ovary; *ovid*, oviduct; *rs*, receptaculum seminis; *go*, genital orifice.

C. Male genital organs of *Pauropus*; t^1 and t^2, anterior and posterior portions of testes; vd^1, vd^2, vd^3, vasa deferentia; *vs.s*, vesicula seminalis; *cd*, common duct; *go*, genital orifices.

D. Lateral view of *Pauropus*; *c*, head; *ant.* antenna; tg^1,tg^5, first and fifth tergal plates; *a.sg*, anal segment; *st*, lateral bristles; *lg.r*, rudimentary leg; lg^1 and $lg,^9$ first and ninth fully formed walking legs; *p*, penis.

The alimentary canal consists of a short, narrow fore-gut, a large, straight mid-gut, and a moderately long hind-gut which is itself composed of two parts, an anterior narrow tube which opens into a dilated, piriform, posterior portion, narrowing gradually to terminate in the anus. Opening into the anterior extremity of the fore-gut there is a pair of "salivary" glands. Malpighian tubes have been found in some forms, *i.e.* females of *Eurypauropus spinosus*, but not in any examples, male or female, of *Pauropus huxleyi.* Where present they open at the point of union of the mid-

and hind-guts. The generative organs in the female are very simple, and much like those of the Diplopoda. In the male they are highly complex, and unlike those of any known Arthropod in certain particulars. The wide, unpaired ovary extends nearly to the posterior end of the body. Anteriorly it passes into an oviduct which is unpaired throughout its length. The posterior portion of the duct is wide. The anterior, an abruptly narrowed tube, curves round the nerve-cord and opens by a single sub-median orifice in the third segment. Just within the orifice there opens into the oviduct the short duct of a spherical receptaculum seminis. In the male the testis is never paired. Sometimes it is single, sometimes divided into an anterior and a posterior mass, and sometimes merely constricted. It lies above the intestine in the posterior half of the body in the adult, but at least in the young in some cases, where as many as four divisions have been detected, its position is more lateral. Leading from the sperm masses there may be as many as three slender short ducts which soon expand into wider tubes. These tubes, regarded as seminal vesicles, after forming a complex of loops, coils and caecal prolongations, ultimately unite beneath the intestine in a single tube which passing forwards divides on each side of the alimentary canal to terminate in the two penes situated just behind the bases of the second pair of complete legs, that is to say, the legs of the third segment. Just at the root of the penis there is an accessory gland on the duct, and a little farther back a much larger glandular swelling.

The Pauropoda are divided into three rather sharply defined groups or families which may be briefly characterized as follows:—

Pauropodidae.—Head not covered by the first tergal plate. Anal segment not covered by the sixth tergal plate. Terga of the first ten body segments fused in couples. Tactile setae situated on the lateral portions of the terga which are neither sculptured nor spinous. (*Pauropus, Stylopauropus.*)

Brachypauropodidae.—Head and anal segment free and the terga smooth as in the last; but each of the double terga of the *Pauropodidae* divided into an anterior and posterior plate by a transverse band of membrane and each of these into a pair of plates by a longitudinal integumental strip. The tactile setae arising from the pleural area of the segments. (*Brachypauropus.*)

Eurypauropodidae.—Body wide and onisciform, the head and the anal segment concealed dorsally by the first and penultimate terga respectively. Terga fused as in the *Pauropodidae*, but thickly spinous or sculptured. The tactile setae situated beyond the edge of the terga, as in the *Brachypauropodidae.* (*Eurypauropus.*)

The genus *Pauropus* is probably world-wide in distribution, since it has been discovered in Europe, North and South America, and in Siam. The two known species of *Brachypauropus* were found respectively in Italy and Austria. *Eurypauropus* has representatives in North America and Europe. Examples of *Pauropus* are extremely agile, recalling the centipede *Lithobius* in their movements; those of *Eurypauropus*, on the contrary, are extremely slow and quite comparable in lack of agility to the common pill-millipede. They are usually found in woods, under stones, fallen branches, dead leaves or other damp situations. They are believed to be vegetable feeders and are oviparous. The young upon hatching has four segments and three pairs of legs representing the first three pairs of ambulatory legs of the adult. The two last segments are apodous, the first bears the first pair of legs, and the second the second and third pairs. The young passes through four successive moults, and gradually acquires its full complement of segments and limbs.

CLASS SYMPHYLA.

Prosogoneate Arthropods, differing in many important particulars from the Diplopoda and Pauropoda. The axis of the head lies in the same straight line as that of the body, as in the Chilopoda, and not at right angles to it as in the Diplopoda and Pauropoda. There are no eyes. The antennae are very long and many-jointed. Four pairs of gnathites attached to the under-side of the head have been detected. The first pair (mandibles) are two-jointed, as in many Diplopods. The second pair (maxillulae) are minute, one jointed and articulated to a median lobe or hypopharynx which is supported by two chitinous skeletal rods. The third pair (maxillae) consist of a long, basal segment terminating distally in two lobes; near the distal end of the basal segments there is externally a minute one- or two-jointed process, regarded as a palpus. Between the maxillae lies a large, double plate (labium or maxillae of second pair) which is attached proximally to two rod-like basal segments and terminates distally in two pairs of short lobes. The body is long and narrow and bears on its dorsal side fifteen tergal plates. The first of these, immediately succeeding the head, is very short; the remainder are large and sub-equal in size. The adult animal is furnished with twelve pairs of walking legs, which, with the exception of the first pair, are alike in size and segmentation. Each consists of five segments, the distal of which is long and terminates with two powerful claws. The proximal segment bears internally a slender, cylindrical process which may be termed the parapod. It has been asserted that the segment bearing this parapod is in reality the second and that the true basal segment or coxa is embedded in the ventral integument. The legs of the first and second pairs never have the parapod, but they are invariably present in the remaining ten pairs. The legs of the first pair are never more than four-jointed; they are always smaller than the others, and are sometimes reduced to mere bud-like processes. They belong to the first segment behind the head. The segment represented by the last tergal plate has no ambulatory limbs; but articulated to its posterior border is a pair of large, backwardly directed sclerites, which are perforated by the ducts of two spinning glands. These segments are regarded by some authors as the appendages of the last segment, and have been compared to the cercopods of insects. Attached also to the sides of the last segment in front of the spinning mamilla there is a sub-conical papilla bearing an apical seta arising from a cuplike depression. It has been suggested that these papillae also represent a pair of appendages. In that case the last segment must be double and bear two pairs of appendages. Thus there may be as many as fourteen pairs of trunk appendages. There are, however, only twelve pairs known to exist with certainty. These are represented by as many segments on the ventral side; but are numerically less by two than the terga. It is not known whether this very unusual phenomenon is to be accounted for by the addition of two supernumerary terga or by the excalation of two pairs of appendages. The legs of the first pair are basally in contact; the rest are separated by a triangular sternal area. At the base of the legs, with the exception of those of the first and last pair, there is a slit-like orifice recalling the coxal sacs of certain Diplopoda (*e.g. Lysiopetalum, Platydesmus*). In internal anatomy the Symphyla closely resemble the Diplopoda. The alimentary canal is straight and simple, with a pair of "salivary" glands opening into the fore-gut, and a pair of malpighian tubes joining the hind-gut close to its communication with the mid-gut. There is a dorsal heart with segmental ostia and valves, and also a supraneural vessel. The silk glands, which occur in both sexes, are situated as in *Lysiopetalum.* The generative glands and ducts, which are paired, lie between the alimentary canal above and the normally constructed nerve-cord below, and are accompanied in the male by a pair of seminal vesicles; and the orifice lies ventrally in the third segment behind the head. A peculiarity in which the Symphyla differ from all "tracheate" arthropoda is the presence of a single pair of tracheal tubes opening by a pair of spiracles on the lower surface of the head behind the antennae.

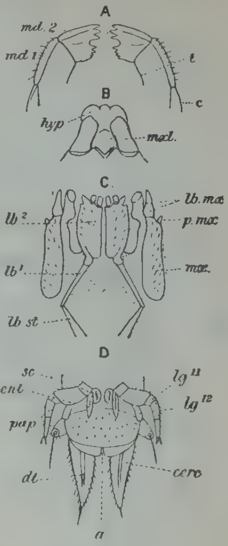


FIG. 15.

After Latzel, *Die Myr. Ost. Ung. Mon.* II. Pl. L. 1884.

A. Mandibles or jaws of first pair of *Scolopendrella*; md^1, md^2, first and second segments; *t*, tendon; *c*, part of ventral skeleton of head.

B. Jaws of second pair; *mxl*, maxillula; *hyp*, hypopharynx.

C. Jaws of third and fourth pairs; *mx*, maxilla; *p.mx*, maxillary palp; *lb.mx*, maxillary lobes; *lb.st*, sternal plate of jaw of fourth pair or labium; lb^1, lb^2, first and second segments of labium. (Figs. A, B, C modified from Hansen, *Q.J.M.S.*, 47, pl. I.)

D. Posterior end of body from below; lg^{11}, leg of 11th pair: lg^{12}, rudimentary leg of 12th pair of immature specimen; *sc*, exsertile sac; *ent.*, parapod; *pap*, sensory papilla; *cerc*, cercus or spinning sclerite: *dl*, duct of silkgland; *a*, anus.

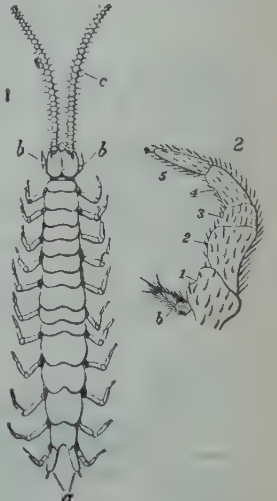


FIG. 16.—1, *Scutigerella sp?* highly magnified (slightly modified from Packard); *a*, spinning sclerites; *b*, *b*, legs of first pair; *c*, antennae.

2, One of the functional legs further enlarged (from Wood Mason), showing the five joints and terminal pair of claws; *b*, parapod.

The newly hatched young has a smaller number of appendages than the adult, the full complement of legs being reached only after successive moults.

The known species of Symphyla are referred to two genera, *Scolopendrella* and *Scutigerella*, which together constitute the family *Scolopendrellidae.* The chief difference between the two lies in the form of the tergal plates, which in *Scolopendrella* have the posterior angles produced and angular, whereas in *Scutigerella* they are rounded. Both genera are widely distributed and are represented, in Europe, South America, Siam, &c. Large specimens reach a limit of between six and seven millimetres. They live in earth, beneath stones, dead leaves or fallen branches, and resemble diminutive centipedes (*Scolopendra* or *Lithobius*) both in appearance and movements. The Symphyla have frequently been compared with the Thysanurous Hexapods, the parapods with their adjacent exsertile vesicles in *Scolopendrella* being very similar to the abdominal appendages and vesicles of such an insect as *Machilis*; while the posterior spinning sclerites or cerci of the former bear much resemblance to the cercopods of *Japyx*. It must be remembered, however, that the spinning glands of certain Diplopods occupy the same position as those of the Symphyla and open upon papilliform processes of the last tergal plate, which are certainly not appendages. Hence, if the papillae are the homologues of the cerci in *Scolopendrella*, these cerci cannot be morphologically comparable to the cercopods of *Japyx* or other insects. But even if the full force of the arguments in favour of relationship between the Symphyla and the Hexapoda be admitted, the Symphyla, nevertheless, differ essentially from the Hexapoda in the anterior position of the generative orifice, and in the presence of twelve pairs of similar ambulatory limbs. (R. I. P.)

MILLOM, a market town in the Egremont parliamentary division of Cumberland, England, in the extreme south-west of the county, on the Furness railway. Pop. of urban district (1901), 10,426. The church of Holy Trinity, Early Norman and Decorated in date, is chiefly of interest for its curious pillars, alternately round and octagonal, and for a window in the north aisle, which has five lights, and is known, on account of its unique shape, as the "fish-window." A massive roodstone stands in the churchyard. Millom Castle, dating from shortly after the Conquest, was fortified in the 14th century by Sir John Huddlestone, whose descendants held it until 1774. For centuries, they exercised the power of life and death; a stone stands where the gallows were formerly erected, and indicates that here they exercised *jura regalia*. Though strongly built, the castle was never of great size, and it has been largely dismantled. A fine carved staircase, however, still exists in the main chapel. In 1648 the Parliamentary forces besieged Millom Castle, and early in the 19th century its park was converted into farmland. In the neighbourhood of Millom there are blast furnaces and highly productive mines of red haematite ore. The deposit lies partly under the foreshore of the river Duddon, and a company has expended upwards of £120,000 upon a sea-wall and embankment to protect the mine from the sea.

MILLS, JOHN (d. 1736), English actor, was a member of the company at Drury Lane from 1695 almost uninterruptedly to the time of his death, playing and creating hundreds of parts. He was at his best in tragedy. His wife was an actress, and their son William—"the younger Mills"—was also an actor of some merit.

MILLS, ROGER QUARLES (1832–), American legislator, was born in Todd county, Kentucky, on the 30th of March 1832. He went to Texas in 1839, studied law, and was admitted to the bar by a special act of the legislature before he was twenty-one. He entered the Confederate army in 1861, took part as a private in the battle of Wilson's Creek, and as colonel commanded the Tenth Texas Infantry at Arkansas Post, Chickamauga (where he commanded a brigade during part of the battle), Missionary Ridge and Atlanta. He served in the national House of Representatives as a Democrat from 1873 to 1892 and in the Senate from 1892 to 1899. He made the tariff his special study, and was long recognized as the leading authority in Congress. As chairman of the Ways and Means Committee of the House of Representatives in 1887–1889 during President Cleveland's first administration, he led the fight for reform. From his committee he reported in April 1888 the "Mills Bill," which provided for a reduction of the duties on sugar, earthenware, glassware, plate glass, woollen goods and other articles, the substitution of *ad valorem* for specific duties in many cases, and the placing of lumber (of certain kinds), hemp, wool, flax, borax, tin plates, salt and other articles on the free list. This bill was passed by the Democratic House on the 21st of July, and was then so amended by a Republican Senate as to be unacceptable to the house. The tariff thus became the chief issue in the presidential campaign of 1888. In 1891 Mills was a candidate in the Democratic caucus for Speaker of the house, but was defeated by Charles F. Crisp (1845–1896) of Georgia. During the free silver controversy he adhered to the Cleveland section of the Democratic party, and failed to be re-elected when his term in the Senate expired in 1899. He then retired to Corsicana, Texas, where he engaged in business and the practice of law.

MILLSTONE GRIT, in geology, a series of massive sandstones, grits and conglomerates with alternate shales, the whole resting directly upon the Carboniferous Limestone or upon intervening shales (Yoredale, Limestone Shales), usually in stratigraphical continuity. Its occasional coal-seams show that conditions of coal-formation had already begun. In Great Britain its outcrop extends from the Bristol Coalfield through South and North Wales to its fullest development in the north-midland counties, Lancashire and Yorkshire, and thence to Scotland, where the Roslin Sandstone of the Lothians and the Moor Rock of Lanark and Stirling are considered its equivalents. Characterized by grits and sandstones of the same general type, though individually variable, as sandbanks formed on the shoaling of the Carboniferous sea, yet often persistent over wide areas, the formation, estimated as 5000 ft. thick in Lancashire, contains typically the following grits in descending order: First, or Rough Rock; second, or Haslingden Flags (Lancashire); third, or Chatsworth Grit (the last two being the Middle Grits of Yorkshire); fourth and fifth, or Kinderscout Grits and the Shale Grits. The first and third, the most persistent, are often coarse and pebbly, like the Kinderscout Grits. In the north of England these grits lose their identity. In South Wales the Millstone Grit, immediately succeeding the Carboniferous Limestone, consists of 450 ft. of grit and shale, its upper member being the massive pebbly Farewell Rock. It extends into the Bristol Coalfield, though not recognized in the Devonshire Culm. In Ireland certain grey grits and flags are assigned to it.

In northern France and Belgium it loses its individuality and is merged in the Coal-measures. It reappears east of the Rhine, but is unrecognizable in the somewhat different Carboniferous succession of eastern Europe. In America the Pottsville Conglomerate, 1500 ft. thick in the south Appalachians, with workable coals, and widely unconformable upon the Mississippian, introduces the Pennsylvanian (Upper Carboniferous) system, and approximately represents the Millstone Grit of western Europe, as does the red conglomerate of Nova Scotia.

The shales of the Millstone Grit include thin beds of marine goniatites (*Glyphioceras bilingue*, *Gastrioceras carbonarium*), *Pterinopecten papyraceus*, and *Lingula mytiloides*, while the grits contain *Lepidodendron*, *Stigmaria* and calamites. In Scotland plants and estuarine fishes differ markedly above and below the Roslin Sandstone.

The English Millstone Grit produces a characteristic scenery of wild moorland plateaux, or alternations of shale-valleys and rugged grit-ridges. The grits furnish valuable building-stones and grindstones. They also afford an excellent water supply. (C. B. W.*)

MILLVILLE, a city of Cumberland county, New Jersey, U.S.A., on the Maurice river, 40 m. S. by E. of Philadelphia. Pop. (1890) 10,002; (1900) 10,583 (598 foreign-born); (1905, state census) 11,884; (1910) 12,451. It is served by the West Jersey & Seashore railway, by electric lines to Philadelphia, Bridgeton, Vineland and Fairton, and by schooners and small freight boats. Peaches and small fruit are cultivated extensively in the surrounding country. In the north part of the city is a large public park, in which a beautiful lake 3 m. long and about 1 m. wide has been formed by damming the river. Glass and moulding sand is found in the vicinity, and the city is engaged principally in the manufacture of glass (especially druggists' ware). The value of the city's factory products increased from $2,513,433 in 1900 to $3,719,417 in 1905, or 48%; and of the total value in 1905, $2,332,614, or 62·7%, was the value of the glass products. Millville was incorporated as a town in 1801, was chartered as a city in 1866, and its charter was revised in 1877.

MILMAN, HENRY HART (1791–1868), English historian and ecclesiastic, third son of Sir Francis Milman, Bart., physician to George III., was born in London on the 10th of November 1791. Educated at Eton and at Brasenose College, Oxford, his university career was brilliant. He gained the Newdigate prize with a poem on the *Apollo Belvidere* in 1812, was elected a fellow of Brasenose in 1814, and in 1816 won the English essay prize with his *Comparative Estimate of Sculpture and Painting*. In 1816 he was ordained, and two years later was presented to the living of St Mary's, Reading. Milman had already made his appearance as a dramatic writer with his tragedy *Fazio* (produced on the stage under the title of *The Italian Wife*). He also wrote *Samor, the Lord of The Bright City*, the subject of which was taken from British legend, the "bright city" being Gloucester; but he failed to invest it with serious interest. In subsequent poetical works he was more successful, notably the *Fall of Jerusalem* (1820) and the *Martyr of Antioch* (1822). The influence of Byron is seen in his *Belshazzar* (1822). A tragedy, *Anne Boleyn*, followed in 1826; and Milman also wrote "When our heads are bowed with woe," and other hymns; an admirable version of the Sanskrit episode of Nala and Damayanti; and translations of the *Agamemnon* of Aeschylus and the *Bacchae* of Euripides. In 1821 he was elected professor of poetry at Oxford, and in 1827 he delivered the Bampton lectures on the character and conduct of the apostles as an evidence of Christianity. His poetical works were published in three volumes in 1839.

Turning to another field, Milman published in 1829 his *History of the Jews*, which is memorable as the first by an English clergyman which treated the Jews as an Oriental tribe, recognized sheikhs and amirs in the Old Testament, sifted and classified documentary evidence, and evaded or minimized the miraculous. In consequence, the author was violently attacked and his inevitable preferment was delayed. In 1835, however, Sir Robert Peel made him rector of St Margaret's, Westminster, and canon of Westminster, and in 1849 he became dean of St Paul's. By this time his unpopularity had nearly died away, and generally revered and beloved, he occupied a dignified and enviable position, which he constantly employed for the promotion of culture and in particular for the relaxation of subscription to ecclesiastical formularies. His *History of Christianity to the Abolition of Paganism in the Roman Empire* (1840) had been completely ignored; but widely different was the reception accorded to the continuation of his work, his great *History of Latin Christianity* (1855), which has passed through many editions. In 1838 he had edited Gibbon's *Decline and Fall of the Roman Empire*, and in the following year published his *Life of Gibbon*. Milman was also responsible for an edition of Horace, and when he died he had almost finished a history of St Paul's Cathedral, which was completed and published by his son, A. Milman (London, 1868), who also collected and published in 1879 a volume of his essays and articles. Milman died on the 24th of September 1868, and was buried in St Paul's Cathedral. By his wife, Mary Ann, a daughter of Lieut.-General William Cockell, he had four sons and two daughters. His nephew, Robert Milman (1816–1876), was bishop of Calcutta from 1867 until his death, and was the author of a *Life of Torquato Tasso* (1850).

See A. C. Tait, *Sermon in Memory of H. H. Milman* (London, 1868), and Arthur Milman, *H. H. Milman* (London, 1900). See also the *Memoirs of R. Milman, bishop of Calcutta*, by his sister, Frances Maria Milman (1879).

MILNE-EDWARDS, HENRY (1800–1885), French zoologist, the son of an Englishman, was born in Bruges on the 23rd of October 1800, but spent most of his life in France. At first he turned his attention to medicine, in which he graduated at Paris in 1823; but his passion for natural history soon prevailed, and he gave himself up to the study of the lower forms of animal life. One of his earliest papers (*Recherches anatomiques sur les crustacés*), which was presented to the Academy of Sciences in 1829, formed the theme of an elaborate and eulogistic report by G. Cuvier in the following year. It embodied the results of two dredging expeditions undertaken by him and his friend J. V. Audouin during 1826 and 1828 in the neighbourhood of Granville, and was remarkable for clearly distinguishing the marine fauna of that portion of the French coast into four zones. Much of his original work was published in the *Annales des sciences naturelles*, with the editorship of which he was associated from 1834. Of his books may be mentioned the *Histoire naturelle de crustacés* (3 vols., 1837–1841), which long remained a standard work; *Histoire naturelle des coralliaires*, published in 1858–1860, but begun many years before; *Leçons sur la physiologie et l'anatomie comparée de l'homme et des animaux* (1857–1881), in 14 volumes; and a little work on the elements of zoology, originally published in 1834, but subsequently remodelled, which enjoyed an enormous circulation. He was appointed in 1841 professor of entomology at the muséum d'histoire naturelle, where twenty-one years later he succeeded Geoffroy Saint-Hilaire in the chair of zoology. The Royal Society in 1856 awarded him the Copley medal in recognition of his zoological investigations. He died in Paris on the 29th of July 1885. His son, Alphonse Milne-Edwards (1835–1900), who became professor of ornithology at the muséum in 1876, devoted himself especially to fossil birds and deep-sea exploration.

MILNER, ALFRED MILNER, Viscount (1854–), British statesman and colonial administrator, was born at Bonn on the 23rd of March 1854, the only son of Charles Milner, M.D., whose wife was a daughter of Major-General Ready, sometime governor of the Isle of Man. His paternal grandfather, an Englishman, settled in Germany and married a German lady; and their son, Charles Milner, practised as a physician in London and became later Reader in English at Tübingen University. Alfred Milner was educated first at Tübingen, then at King's College, London, and under Jowett as a scholar of Balliol College, Oxford, from 1872 to 1876. He graduated in 1877, with a first class in classics, having won the Hertford, Craven, Eldon and Derby scholarships, and was elected to a fellowship of New College. At Oxford he formed a close friendship with Arnold Toynbee, and was associated with his schemes of social work; and subsequently he wrote a tribute to his friend, *Arnold Toynbee: a Reminiscence* (1895). In 1881 he was called to the bar at the Inner Temple and joined the staff of the *Pall Mall Gazette* under John Morley, becoming assistant editor under W. T. Stead. In 1885 he abandoned journalism, and became Liberal candidate for the Harrow division of Middlesex at the general election, but was defeated. He acted as private secretary to Mr (afterwards Lord) Goschen, and in 1887, when Goschen became chancellor of the exchequer, was appointed his principal private secretary. It was by Goschen's influence that in 1889 he was made under-secretary of finance in Egypt. He remained in Egypt four years, his period of office coinciding with the first great reforms, after the danger of bankruptcy had been avoided. Milner returned to England in 1892, and was appointed chairman of the Board of Inland Revenue, being made C.B. in 1894 and K.C.B. in 1895. Shortly after his return to England he published his *England in Egypt*, which at once became the authoritative account of the work done since the British occupation.

Sir Alfred Milner remained at the Board of Inland Revenue until 1897. He was regarded as one of the clearest-headed and most judicious officials in the British service, and his position as a man of moderate Liberal views, who had been so closely associated with Goschen at the Treasury, Cromer in Egypt and Hicks-Beach (Lord St Aldwyn) and Sir W. Harcourt while at the Inland Revenue, marked him out as one in whom all parties might have confidence. The moment for testing his capacity in the highest degree had now come. In April Lord Rosmead resigned his posts of high commissioner for South Africa and governor of Cape Colony. The situation resulting from the Jameson raid (see Transvaal and South Africa) was one of the greatest delicacy and difficulty, and Mr Chamberlain, now colonial secretary, selected Milner as Lord Rosmead's successor. The choice was cordially approved by the leaders of the Liberal party, and warmly recognized at a farewell dinner presided over by Mr Asquith (March 28th, 1897). The appointment was avowedly made in order that an acceptable British statesman, in whom public confidence was reposed, might go to South Africa to consider all the circumstances, and to formulate a policy which should combine the upholding of British interests with the attempt to deal justly with the Transvaal and Orange Free State governments.

Sir Alfred Milner reached the Cape in May 1897, and after the difficulties with President Kruger over the Aliens' Law had been patched up he was free by August to make himself personally acquainted with the country and peoples before deciding on the lines of policy to be adopted. Between August 1897 and May 1898 he travelled through Cape Colony, the Bechuanaland Protectorate, Rhodesia and Basutoland. The better to understand the point of view of the Cape Dutch and the burghers of the Transvaal and Orange Free State, Milner also during this period learned both Dutch and the South African "Taal." He came to the conclusion that there could be no hope of peace and progress in South Africa while there remained the "permanent subjection of British to Dutch in one of the Republics." He also realized—as was shown by the triumphant re-election of Mr Kruger to the presidency of the Transvaal in February 1898—that the Pretoria government would never on its own initiative redress the grievances of the "Uitlanders." In a speech delivered at Graaf Reinet, a Bond stronghold, on the 3rd of March 1898, he made it clear that he was determined to secure freedom and equality for the British subjects in the Transvaal, and he urged the Dutch colonists to induce the Pretoria government to assimilate its institutions, and the temper and spirit of its administration, to those of the free communities of South Africa. The effect of this pronouncement was great, and it alarmed the Afrikanders, who at this time viewed with apprehension the virtual resumption by Cecil Rhodes of his leadership of the Progressive (British) party at the Cape. That Milner had good grounds for his view of the situation is shown in a letter written (March 11) by Mr J. X. Merriman to President Steyn of the Free State: "The greatest danger (wrote Mr Merriman) lies in the attitude of President Kruger and his vain hope of building up a State on a foundation of a narrow unenlightened minority, and his obstinate rejection of all prospect of using the materials which lie ready to his hand to establish a true republic on a broad liberal basis. Such a state of affairs cannot last. It must break down from inherent rottenness." Though this was recognized by the more far-seeing of the Bond leaders, they were ready to support Kruger, whether or not he granted reforms, and they sought to make Milner's position impossible. His difficulties were increased when at the general election in Cape Colony the Bond obtained a majority. Acting strictly in a constitutional manner, Milner thereupon (Oct. 1898) called upon Mr W. P. Schreiner to form a ministry, though aware that such a ministry would be opposed to any direct intervention of Great Britain in the Transvaal. Convinced that the existing state of affairs, if continued, would end in the loss of South Africa by Britain, Milner came to England in November 1898. He returned to the Cape in February 1899 fully assured of the support of Mr Chamberlain, though the government still clung to the hope that the moderate section of the Cape and Free State Dutch would induce Kruger to deal justly with the Uitlanders. He found the situation more critical than when he had left, ten weeks previously. Johannesburg was in a ferment, while General Sir William Butler, who acted as high commissioner in Milner's absence, had allowed it to be seen that he did not take a favourable view of the Uitlander grievances. On the 4th of May Milner penned a memorable despatch to the Colonial Office, in which he insisted that the remedy for the unrest in the Transvaal was to strike at the root of the evil—the political impotence of the injured. "It may seem a paradox," he wrote, "but it is true that the only way for protecting our subjects is to help them to cease to be our subjects." The policy of leaving things alone only led from bad to worse, and "the case for intervention is overwhelming." Milner felt that only the enfranchisement of the Uitlanders in the Transvaal would give stability to the South African situation. He had not based his case against the Transvaal on the letter of the Conventions, and regarded the employment of the word "suzerainty" merely as an "etymological question," but he realized keenly that the spectacle of thousands of British subjects in the Transvaal in the condition of "helots" (as he expressed it) was undermining the prestige of Great Britain throughout South Africa, and he called for "some striking proof" of the intention of the British government not to be ousted from its predominant position. This despatch was telegraphed to London, and was intended for immediate publication; but it was kept private for a time by the home government. Its tenor was known, however, to the leading politicians at the Cape, and at the instance of J. H. Hofmeyr a conference was held (May 31–June 5) at Bloemfontein between the high commissioner and the president of the Transvaal. Milner then made the enactment by the Transvaal of a franchise law which would at once give the Johannesburgers a share in the government of the country his main, and practically his only, demand. The conference ended without any agreement being reached, and the diplomatic discussion which followed (see TRANSVAAL) gradually became more and more contentious. When war broke out, October 1899, Milner rendered the military authorities "unfailing support and wise counsels," being, in Lord Roberts's phrase "one whose courage never faltered."

In February 1901 he was called upon to undertake the administration of the two Boer states, both now annexed to the British Empire, though the war was still in progress. He thereupon resigned the governorship of Cape Colony, while retaining the post of high commissioner. The work of reconstructing the civil administration in the Transvaal and Orange River Colony could only be carried on to a limited extent while operations continued in the field. Milner therefore returned to England to spend a "hard-begged holiday," which was, however, mainly occupied in work at the Colonial Office. He reached London on the 24th of May 1901, had an audience with the king on the same day, was made a G.C.B. and privy councillor, and was raised to the peerage with the title of Baron Milner of St James's and Cape Town. Speaking next day at a luncheon given in his honour, answering critics who alleged that with more time and patience on the part of Great Britain war might have been avoided, he asserted that what they were asked to "conciliate" was "panoplied hatred, insensate ambition, invincible ignorance." Meanwhile the diplomacy of 1899 and the conduct of the war had caused a great change in the attitude of the Liberal party in England towards Lord Milner, whom Mr Leonard Courtney even characterized as "a lost mind." A violent agitation for his recall, in which Sir Henry Campbell-Bannerman joined, was organized, but without success, and in August he returned to South Africa, where he plunged into the herculean task of remodelling the administration. In the negotiations for peace he was associated with Lord Kitchener, and the terms of surrender, signed at Pretoria on the 31st of May 1902, were drafted by him. In recognition of his services he was, on the 15th of July, made a viscount.

Immediately following the conclusion of peace Milner published (June 21) the Letters Patent establishing the system of crown colony government in the Transvaal and Orange River colonies, and exchanging his title of administrator to that of governor. The reconstructive work necessary after the ravages of the war was enormous. He provided a steady revenue by the levying of a tax of 10% on the annual net produce of the gold mines, and devoted special attention to the repatriation of the Boers, land settlement by British colonists, education, justice, the constabulary, and the development of railways. While this work of reconstruction was in progress domestic politics in England were convulsed by the tariff reform movement and Mr Chamberlain's resignation. Milner, who was then spending a brief holiday in Europe, was urged by Mr Balfour to take the vacant post of secretary of state for the colonies. This offer he declined (Oct. 1, 1903), considering it more important to complete his work in South Africa, where economic depression was becoming pronounced. He was back in Johannesburg in December 1903, and had to consider the crisis in the gold-mining industry caused by the shortage of native labour. Reluctantly he agreed, with the assent of the home government, to the proposal of the mineowners to import Chinese coolies on a three years' contract, the first batch of Chinese reaching the Rand in June 1904.

In the latter part of 1904 and the early months of 1905 Lord Milner was engaged on the elaboration of a scheme to provide the Transvaal with a system of "representative" government, a half-way house between crown colony administration and that of self-government. Letters patent providing for representative government were issued on the 31st of March 1905.[1] For some time he had suffered in health from the incessant strain of work, and he determined to retire. He left Pretoria on the 2nd of April and sailed for Europe on the following day. Speaking at Johannesburg on the eve of his departure, he recommended to all concerned the promotion of the material prosperity of the country and the treatment of Dutch and British on an absolute equality. Having referred to his share in the war, he added: "What I should prefer to be remembered by is a tremendous effort subsequent to the war not only to repair the ravages of that calamity but to re-start the colonies on a higher plane of civilization than they have ever previously attained." He left South Africa while the economic crisis was still acute and at a time when the voice of the critic was audible everywhere; but, in the words of the colonial secretary (Mr Alfred Lyttelton) he had in the eight eventful years of his administration "laid deep and strong the foundation upon which a united South Africa would arise to become one of the great states of the empire." On his return home his university honoured him with the honorary degree of D.C.L.

Experience in South Africa had shown him that underlying the difficulties of the situation there was the wider problem of imperial unity. In his farewell speech at Johannesburg he concluded with a reference to the subject. "When we who call ourselves Imperialists talk of the British Empire we think of a group of states bound, not in an alliance—for alliances can be made and unmade—but in a permanent organic union. Of such a union the dominions of the sovereign as they exist to-day are only the raw material." This thesis he further developed in a magazine article written in view of the colonial conference held in London in 1907. He advocated the creation of a permanent deliberative imperial council, and favoured preferential trade relations between the United Kingdom and the other members of the empire; and in later years he took an active part in advocating the cause of tariff reform and colonial preference.

In March 1906 a motion censuring Lord Milner for an infraction of the Chinese labour ordinance, in not forbidding light corporal punishment of coolies for minor offences in lieu of imprisonment, was moved by a Radical member of the House of Commons. On behalf of the Liberal government an amendment was moved, stating that "This House, while recording its condemnation of the flogging of Chinese coolies in breach of the law, desires, in the interests of peace and conciliation in South Africa, to refrain from passing censure upon individuals." The amendment was carried by 355 votes to 135. As a result of this left-handed censure, a counter-demonstration was organized, led by Sir Bartle Frere, and a public address, signed by over 370,000 persons, was presented to Lord Milner expressing high appreciation of the services rendered by him in Africa to the crown and empire.

See also E. B. Iwan-Müller, *Lord Milner and South Africa* (London, 1902); W. B. Worsfold, *Lord Milner's Work in South Africa* (London, 1906); W. T. Stead, "Sir Alfred Milner," in *The Review of Reviews*, vol. xx. (1899); and the bibliography to SOUTH AFRICA.

MILNER, JOSEPH (1744–1797), English evangelical divine, was born at Leeds and educated at Leeds grammar-school and Cambridge. After taking his degree he went to Thorparch, Yorkshire, as curate and assistant schoolmaster. Subsequently he became head master of Hull grammar-school, and in 1768 he was chosen afternoon lecturer at Holy Trinity church, Hull. He became a strong supporter of the evangelical movement of the period, and greatly contributed to its success in Hull. In addition to his work as head master, he took charge of North Ferriby parish, about 9 m. from Hull. His published works include essays and numerous sermons, but his best known work is the *History of the Church of Christ* (London, 1794–1809). He lived to complete the first three volumes, and two more were added by his brother, Isaac Milner (1750–1820), dean of Carlisle, who re-edited the whole work in 1810.

MILNGAVIE (locally pronounced Millguy), a police burgh of Dumbartonshire, Scotland. Pop. (1901), 3481. It lies 6 m. N.N.W. of Glasgow by the North British railway. The chief industries include bleach-fields, dye-works, a distillery and a paper mill; but the town is largely a residential quarter for Glasgow business men. Close to the town are two reservoirs, Mugdock (62 acres) and Craigmaddie (88 acres), in which is stored the water from Loch Katrine. Mugdock Castle, 1¾ m. N. of Milngavie, is an old stronghold of the Grahams; in Baldernock parish, about 2 m. E., stands a cromlech, called "the Auld Wives' Lift" (400 ft. high), commanding a fine view of the lands between the Forth and Clyde. Dougalston Loch, ¾ m. S.E., contains several rare aquatic plants.

MILO, or MILON, of Crotona, Greek athlete, lived about the end of the 6th century B.C. He was six times crowned at the Olympic games and six times at the Pythian for wrestling, and was famous throughout the civilized world for his feats of strength—such as carrying an ox on his shoulders through the stadium at Olympia. In his native city he was much honoured, and he commanded the army which defeated the people of Sybaris in 511. The traditional account of his death is often used to point a moral: he found a tree which some woodcutters had partially split with a wedge, and attempted to rend it asunder; but the wedge fell out, and the tree closed on his hand, imprisoning him till wolves came and devoured him. His name became proverbial for personal strength (Diod. Sic. xii. 9; Pausanias vi. 14; Strabo vi. 263; Herodotus iii. 137).

MILO, TITUS ANNIUS, Roman political agitator, was the son of C. Papius Celsus, but was adopted by his mother's father, T. Annius Luscus. He joined the Pompeian party, and organized bands of mercenaries and gladiators to support the cause by public violence in opposition to P. Clodius, who gave similar support to the democratic cause. Milo was tribune of the plebs in 57 B.C. He took a prominent part in bringing about the recall of Cicero from exile, in spite of the opposition of Clodius. In 53, when Milo was candidate for the consulship and Clodius for the praetorship, the two leaders met by accident on the Appian Way at Bovillae and Clodius was murdered (January 52). Milo was impeached; his guilt was clear, and his enemies took every means of intimidating his supporters and his judges. Cicero was afraid to speak, and the extant *Pro Milone* is an expanded form of the unspoken defence. Milo went into exile at Massilia, and his property was sold by auction. He joined M. Caelius Rufus in 48 in his rising against Caesar, but was slain near Thurii in Lucania. His wife was Fausta, daughter of the dictator Sulla.

MILO OF GLOUCESTER, lord of Brecknock and earl of Hereford (d. 1143), was the son of Walter of Gloucester, who appears as sheriff of that county between 1104 and 1121. Milo succeeded his father about the latter year. He was high in the service of Henry I. between 1130 and 1135, and combined the office of sheriff with that of local justiciar for Gloucestershire. After the death of Henry I. he declared for Stephen, at whose court he appears as constable in 1136. But in 1139, when the empress Matilda appeared in England, he declared for her, and placed the city of Gloucester at her disposal; he was further distinguished by sacking the royalist city of Worcester and reducing the county of Hereford. In 1141, at Matilda's coronation, he was rewarded with the earldom of

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[1] Owing to the advent of a Liberal ministry in England, December 1905, this scheme remained inoperative (see TRANSVAAL: *History*).

Hereford. He remained loyal to the empress after her defeat at Winchester. John of Salisbury classes him with Geoffrey de Mandeville and others who were *non tam comites regni quam hostes publici.* The charge is justified by his public policy; but the materials for appraising his personal character do not exist.

See the *Continuation of Florence of Worcester* (ed. B. Thorpe, 1848–1849); the Cartulary of Gloucester Abbey (Rolls series); and J. H. Round's *Geoffrey de Mandeville* (1892).

MILORADOVICH, MICHAEL ANDRIJEVICH, Count (1770–1825), Russian general, saw service under Suvarov in the wars against Turkey and Poland, and in the campaign of Italy and Switzerland (1799) earned much distinction as a commander of advanced troops. In 1805, having attained the rank of lieutenant-general, he served under Kutusov in the campaign of Austerlitz, taking part in the actions of Enns and Krems and in the decisive battle of the 2nd of December, in which his column held the Pratzen heights. In the Turkish War he distinguished himself at Giurgevo (1807). Promoted general of infantry in 1810, he commanded a corps at Borodino, and subsequently inflicted the defeat of Tarutino (or Winkovo) on Murat, king of Naples (October 18, 1812). His corps was one of those most active in the pursuit of Napoleon's *Grande Armée*, and in 1813 he led the rear-guard of the Allies after their earlier defeats. At the victory of Kulm he was present in command of a Russian-Prussian corps, which he led at Leipzig and in the campaign of 1814. From 1818 to the time of his death he was military governor of St Petersburg. He perished in the popular outbreak in the capital, on the 26th (14th o.s.) of December 1825.

MILOSH OBRENOVICH I. (1780–1860), prince of Servia, founder of the Obrenovich dynasty, was born in 1780 of poor Servian peasants. When he later became prince of Servia he used to tell how for a penny a day he drove cattle from Servia to Dalmatia. His half-brother, Milan Obrenovich, who had developed into a successful exporter of cattle and pigs into Austria, associated him in his own export trade and otherwise supported him. Partly from gratitude and partly because the family name of his half-brother was already honourably known in the country, Milosh adopted that name as his own, and called himself Obrenovich, instead of Theodorovich. Karageorge, the leader of the first Servian revolution against the Turks, appointed Milosh Obrenovich in 1807 a voyvode, *i.e.* district commander of the national army and civil administrator. As such he distinguished himself in many battles, and was reputed a wise and energetic administrator and a just judge. When in 1813 the Turks under the Grand Vizier Khurshid occupied Servia, and Karageorge and almost all his voyvodes left the country for Austria, Milosh, although strongly advised to follow their example, refused to do so. He remained in the country, surrendered to the Turks, and was recognized by them as the voyvode of Rudnik (Central Servia). As he was then practically the only chief of the nation, the Turks called him to Belgrade, where he was kept through the year 1814 as a hostage. But he found means to prepare a new rising of the Servians against the Turks, and on Palm Sunday 1815 he appeared with his voyvode's standard before the people round the small church of Takovo, and started the second and successful insurrection. Not so much by his victories on the battlefields as by his clever exploitation of the international difficulties of Turkey, and of the known weakness of the Turkish pashas for "baksheesh"—no doubt also by his statesmanlike moderation—he succeeded in less than two years in obtaining from the Porte the practical recognition of the Servian people's right to self-government. The National Assembly in 1817 elected him prince of Servia.

From that year began the organization of Servia by the Servians as an autonomous province of the Ottoman Empire. But its existence as such rested on no safe and legal basis, except on the readiness of the Servians to defend it with all their might and on the goodwill of the sultan and his "Sublime Porte." Milosh therefore worked hard to obtain some sort of international recognition of the semi-independent status of Servia. Russia came to his assistance, and by the Treaty of Adrianople of 1829 the Porte engaged formally to grant Servia full autonomy. This engagement was somewhat developed in the Hatti-sherif of 1830, which added to Servia three districts (Krushevats, Alexinats, Zaechar), acknowledged her full autonomy, recognized Milosh as hereditary prince of Servia, and declared that the Turks in Servia could have properties and live only in fortified places where there were Turkish garrisons, and not in other towns and villages. Milosh won for his family the hereditary right to the throne of Servia without the co-operation of Russia. The creation of a hereditary dynasty in Servia was outside the Russian Balkan policy of that time, and this great and independent success of Milosh was the first cause of Russia's dissatisfaction with him. The second cause was that, yielding to the pressure exercised on him by his own people, he gave the country a constitution without asking "the protector of Servia," the tsar, for his approval of the step. The third cause was that Milosh consistently resented the interference of Russia in the internal affairs of the principality. The climax of his misdeeds, from the Russian point of view, was that on the occasion of his visit to the Sultan Mahmud II. in 1836 he persuaded the British ambassador, Lord Ponsonby, that it would be useful to establish a British consulate in Belgrade. The first British consul in Servia, Colonel Hodges, became speedily an intimate friend of Prince Milosh, who—probably under his new friend's influence—began to agitate to replace the exclusive protectorate of Russia by the joint protectorate of all the great Powers of Europe. The cabinet of St Petersburg now decided to remove Milosh from the throne of Servia, and, supported by the Russian consul-general, the leaders of the Servian opposition, who posed as champions of a constitutional system, succeeded in forcing him to abdicate in 1839. After his abdication Milosh lived mostly on his estates in Rumania, or in Vienna. In December 1858 the National Assembly of Servia, having dethroned Prince Alexander Karageorgevich, recalled Milosh to the throne of Servia. Milosh came, accompanied by his son Michael, and began to reign in his own old fashion; but death closed his activity on the 14th (27th n.s.) of September 1860. He was buried in the cathedral of Belgrade. (C. Mi.)

MILTIADES, the name of two Athenian statesmen and generals of a family (the Philaidae) of Aeginetan origin, which claimed descent from Aeacus.

1. Miltiades (6th century B.C.), the son of Cypselus, a prominent opponent of Peisistratus. According to Herodotus (vi. 36, 37) he led a colony to the Thracian Chersonese at the request of the Doloncians, who, hard pressed by the Absinthians (or Apsinthians), were advised by the Delphian oracle to invite to their country the man who should first show them hospitality after leaving the temple. Since, however, the Athenians had from *c.* 600–590 B.C. held Sigeum in the Troad, whence they had fought against Mitylene, it is probable that the Doloncians appealed for help to Athens, and that Peisistratus took the opportunity of getting rid of one of his chief opponents by sending Miltiades. He became "tyrant" of the Chersonesus, which he fortified by a wall across the isthmus from Cardia to Pactya. He was captured by the people of Lampsacus, but released on the intercession of Croesus of Lydia. He was succeeded by Stesagoras, son of his half-brother, Cimon.

2. Miltiades (died *c.* 488 B.C.), the victor of Marathon, was another son of Cimon. On the death of Stesagoras, he was sent to the Chersonese (? about 518–516) by Hippias—no doubt to support Hegesistratus at Sigeum (see Peisistratus). He entrapped and imprisoned the chief men of Chersonesus, which was then in a turbulent condition, and strengthened himself by an alliance with Hegesipyle, daughter of the Thracian prince Olorus (Herod. vi. 39). He led a contingent in the Scythian expedition of Darius Hystaspis and, according to Herodotus, advised the leaders who were left at the Danube bridge to destroy it and leave Darius to his fate. This story is improbable, as Darius left Miltiades in possession of the Chersonese for some

twenty years longer, though Persian forces were frequently in the neighbourhood. Miltiades was, according to Herodotus, expelled by Scythian invaders, but was brought back by the Doloncians, and subsequently captured Lemnos and Imbros for Athens from the so-called Pelasgian inhabitants, who were Persian dependents. Having thus (probably) incurred the enmity of Darius, Miltiades fled to Athens on the approach of the Persians under Datis and Artaphernes, leaving his son Metiochus a prisoner in Persian hands, and was at once impeached unsuccessfully on the charge of tyranny in the Chersonese.[1] Possibly the story of his having tried to destroy the Danube bridge was invented or exaggerated at this time as an argument in his favour (see Grote, *History of Greece*, 1 vol., ed. 1907, p. 119 note). Since, however, Herodotus almost certainly relied on Alcmaeonid tradition, which was hostile to Miltiades, the whole story is uncertain; the statement that he fled before a Scythian invasion is especially improbable. If Miltiades really recommended the destruction of the bridge, we may infer that the Herodotean story of his flight before the Scythians is a misunderstanding of the fact that his residence in Chersonese after the Scythian invasion was insecure and not continuous.

On the approach of the Persians Miltiades was made one of the ten Athenian generals, and it was on his advice that the polemarch Callimachus decided to give battle at Marathon (*q.v.*). Subsequently he used his influence with the Athenians to induce them to give him a fleet of seventy ships without any indication of his object (Herod. vi. 132–136). Cornelius Nepos (*Miltiades*, c. vii.), probably on good authority (? Ephorus), states that he had a commission to regain control over the Aegean. No doubt his object was to establish an outer line of defence against future Persian aggression. Herodotus says that, having besieged Paros vainly for nearly a month, he made a secret visit to Timo, a priestess of Demeter in Paros, with a view to the betrayal of the island, and being compelled to flee wounded himself severely in attempting to leap a fence (but see Ephorus in *Fragm. hist. gr.* 107).

On his return to Athens he was impeached by Xanthippus, who was allied by marriage to the Alcmaeonids, on the ground that he had "deceived the people," and only escaped on the strength of his past services with a fine of 50 talents. The facts of the trial and the charge are difficult to recover, nor do we know why the siege was raised. Some authorities hold that he was bribed to this course, and hence that the charge was one of treason; others suggest that he retired in the belief that a Persian fleet was approaching. All that is known is that he died of his wound (489–488), without paying the fine, which was paid subsequently by his son Cimon (*q.v.*). He appears to have been a man of strong determination and great personal courage, of a type characteristic of the pre-Cleisthenic constitution. His absence in the Chersonese during the first years of the new democracy (508–493?) and his patrician lineage account naturally for the difference which existed between him and the popular leaders—Themistocles and Aristides.

See the passages of Herodotus and Cornelius Nepos, quoted above, and histories of Greece. On the Parian expedition and the trial, R. W. Macan, *Herodotus iv.–vi.*, vol. 2, appendix xi.; on the foreign policy of Miltiades see THEMISTOCLES. (J. M. M.)

MILTON, JOHN (1608–1674), English poet, was born in Bread Street, Cheapside, London, on the 9th of December 1608. His father, known as Mr John Milton of Bread Street, scrivener, was himself an interesting man. He was a native of Oxfordshire, the son of a Richard Milton, yeoman of Stanton-St-John's, one of the sturdiest adherents to the old Roman Catholic religion in his district, and was educated at Christ Church, Oxford, where he turned Protestant. According to the poet's earliest biographer, John Milton senior was disinherited in the beginning of Queen Elizabeth's reign for reading the Bible. With a good education and good abilities, especially in music, he may have lived for some time in London by musical teaching and practice. Not till 1595, at all events, when he must have been long past the usual age of apprenticeship, do we hear of his preparation for the profession of a scrivener; and not till February 1599–1600, when he was about thirty-seven years of age, did he become a qualified member of the Scriveners' Company. It was then that he set up his "house and shop" at the sign of the Spread Eagle in Bread Street, and began his business of drawing up wills, marriage-settlements, and the like, with such related business as that of receiving money from clients for investment and lending it out to the best advantage. It was at the same time that he married, not, as stated by Aubrey, a lady named Bradshaw, but Sarah Jeffrey, one of the two orphan daughters of a Paul Jeffrey, of St Swithin's, London, "citizen and merchant-taylor," originally from Essex, who had died before 1583. At the date of her marriage she was about twenty-eight years of age. Six children were born to the scrivener and his wife, of whom three survived infancy—Anne, who married Edward Phillips; John, the poet; and Christopher (1615–1693), who was knighted and made a judge under James II.

Life and Works.

The first sixteen years of Milton's life, coinciding exactly with the last sixteen of the reign of James I., associate themselves with the house in Bread Street. His father, while prospering in business, continued to be known as a man of "ingeniose" tastes, and acquired distinction in the London musical world of that time. He contributed a madrigal to Thomas Morley's *Triumph of Oriana* (1601), four motets to Sir William Leighton's *Tears and Lamentations of a Sorrowful Soul* (1614), and some hymn tunes—one of which, "Yor," is still in common use—in Thomas Ravenscroft's *Whole Book of Psalms* (1621). Music was thus a part of the poet's domestic education from his infancy. Again and again Milton speaks with gratitude and affection of the ungrudging pains bestowed by his father on his early education. "Both at the grammar school and also under other masters at home," is the statement in one passage, "he caused me to be instructed daily." When Milton was ten years of age his tutor was Thomas Young (1587–1655), a Scottish divine, who afterwards became master of Jesus College, Cambridge. Young's tutorship lasted till 1622, when he accepted the pastorship of the congregation of English merchants in Hamburg. Already, however, for a year or two his teaching had been only supplementary to the education which the boy was receiving by daily attendance at St Paul's public school, close to Bread Street. The headmaster of the school was Alexander Gill, an elderly Oxford divine, of high reputation for scholarship and teaching ability. Under him, as usher or second master, was his son, Alexander Gill the younger, also an Oxford graduate of scholarly reputation, but of blustering character. Milton's acquaintanceship with this younger Gill, begun at St Paul's school, led to subsequent friendship and correspondence. Far more affectionate and intimate was the friendship formed by Milton at St Paul's with his schoolfellow Charles Diodati, the son of an Italian physician, Dr Theodore Diodati, a naturalized Englishman settled in London, and much respected, both on his own account and as being the brother of the famous Protestant divine, Jean Diodati of Geneva. Young Diodati, who was destined for his father's profession, left the school for Trinity College, Oxford, early in 1623; but Milton remained till the end of 1624. In that year his elder sister, Anne, married Edward Phillips, a clerk in the Government office called the Crown Office in Chancery.

Milton had then all but completed his sixteenth year, and was as scholarly, as accomplished and as handsome a youth as St Paul's school had sent forth. We learn from himself that his exercises "in English or other tongue, prosing or versing, but chiefly this latter," had begun to attract attention even in his boyhood. Of these poems the only specimens that now remain are two copies of Latin verses, preserved in a commonplace book of his (printed by the Camden Society in 1877), and his "Paraphrase on Psalm CXIV" and his "Paraphrase on Psalm CXXXVI." At the age of sixteen years and two months, Milton was entered as a student of Christ's College, Cambridge, in the grade of a "Lesser Pensioner," and he matriculated two months later, on the 9th of April 1625. The master of Christ's was Dr Thomas Bainbrigge; and among the thirteen fellows were Joseph Meade, still remembered as a commentator on the Apocalypse, and William Chappell, afterwards an Irish bishop. It was under Chappell's tutorship that Milton was placed when he first entered the college. At least three students who entered Christ's after Milton, but during his residence, deserve mention. One was Edward King, a youth of Irish birth and high Irish connexions, who entered in 1626, at the age of fourteen, another was John Cleveland, afterwards known as royalist and satirist, who entered in 1627; and the third was Henry More, subsequently famous as the Cambridge Platonist, who entered in 1631, just before Milton left. Milton's own brother, Christopher, joined him in the college in February 1630–1631, at the age of fifteen.

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[1] So Herodotus; but the story is difficult to believe in view of the fact that the family of Miltiades was distinctively *μισοτύραννος*. Possibly the trial is merely a hostile version of the ordinary test of a man's qualification for office (*δοκιμασία*).

Milton's academic course lasted seven years and five months, bringing him from his seventeenth year to his twenty-fourth. The first four years were his time of undergraduateship. It was in the second of these—the year 1626—that there occurred the quarrel between him and his tutor, Chappell, which Dr Johnson, making the most of a lax tradition from Aubrey, magnified into the supposition that Milton may have been one of the last students in either of the English universities that suffered the indignity of corporal punishment. The legend deserves no credit; but it is certain that Milton, on account of some disagreement with Chappell, left college for a time, though he did not lose his term; and that when he did return, he was transferred from the tutorship of Chappell to that of Nathaniel Tovey. From the first of the Latin elegies one infers that the cause of the quarrel was some outbreak of self-assertion on Milton's part. We learn indeed, from words of his own elsewhere, that it was not only Chappell and Bainbrigge that he had offended by his independent demeanour, but that, for the first two or three years of his undergraduateship, he was generally unpopular, for the same reason, among the younger men of his college. They had nicknamed him "the Lady"—a nickname which the students of the other colleges took up, converting it into "the Lady of Christ's"; and, though the allusion was chiefly to the peculiar grace of his personal appearance, it conveyed also a sneer at what the rougher men thought his unusual prudishness, the haughty fastidiousness of his tastes and morals. A change in this state of things had certainly occurred before January 1628–1629, when, at the age of twenty, he took his B.A. degree. By that time his intellectual preeminence had come to be acknowledged. His reputation for scholarship and literary genius, extraordinary even then, was more than confirmed during the remaining three years and a half of his residence in Cambridge. A fellowship in Christ's which fell vacant in 1630 would undoubtedly have been his had the election to such posts depended then absolutely on merit. As it was, the fellowship was conferred, by royal favour on Edward King, his junior in college standing by sixteen months. In July 1632 Milton completed his career at the university by taking his M.A. degree. Tradition still points out Milton's rooms at Christ's College. They are on the first floor on the first stair on the north side of the great court.

Of Milton's skill at Cambridge, in what Wood calls "the collegiate and academical exercises," specimens remain in his *Prolusiones quaedam oratoriae.* They consist of seven rhetorical Latin essays, generally in a whimsical vein, delivered by him, either in the hall of Christ's College or in the public university schools. To Milton's Cambridge period belong four of his Latin "Familiar Epistles," and the greater number of his preserved Latin poems, including: (1) the seven pieces, written in 1626, which compose his *Elegiarum liber*, two of the most interesting of them addressed to his friend, Charles Diodati, and one to his former tutor, Young, in his exile at Hamburg; (2) the five short Gunpowder Plot epigrams, now appended to the *Elegies*; and (3) the first five pieces of the *Sylvarum liber*, the most important of which are the hexameter poem "In quintum novembris" (1626), and the piece entitled *Naturam non pati senium* (1628). Of the English poems of the Cambridge period the following is a dated list: "On the Death of a fair Infant" (1625–1626), the subject being the death of the first-born child of his sister Anne Phillips; "At a Vacation Exercise in the College" (1628), the magnificent Christmas ode; "On the Morning of Christ's Nativity" (1629); the fragment called "The Passion" and the "Song on May Morning," both probably belonging to 1630; the sonnet "On Shakespeare," certainly belonging to that year, printed in the Shakespeare folio of 1632; the two facetious pieces "On the University Carrier" (1630–1631); the "Epitaph on the Marchioness of Winchester" (1631); the sonnet "To the Nightingale," probably of the same year; the sonnet "On arriving at the Age of twenty-three," dating itself certainly in December 1631.

Just before Milton quitted Cambridge, his father, then verging on his seventieth year, had practically retired from his Bread Street business, leaving the active management of it to a partner, named Thomas Bower, a former apprentice of his, and had gone to spend his declining years at Horton in Buckinghamshire, a small village near Colnbrook, and not far from Windsor. Here, in a house close to Horton church, Milton mainly resided for the next six years—from July 1632 to April 1638.

Although, when he had gone to Cambridge, it had been with the intention of becoming a clergyman, that intention had been abandoned. His reasons were that "tyranny had invaded the church," and that, finding he could not honestly subscribe the oaths and obligations required he "thought it better to preserve a blameless silence before the sacred office of speaking, begun with servitude and forswearing."[1] In other words, he was disgusted with the system which Laud was establishing and maintaining in the Church of England. "Church-outed by the prelates," as he emphatically expresses it, he seems to have thought for a time of the law, but he decided that the only life possible for himself was one dedicated wholly to scholarship and literature. His compunctions on this subject, expressed already in his sonnet on arriving at his twenty-third year, are expressed more at length in an English letter of which two drafts are preserved in Trinity College, Cambridge, sent by him, shortly after the date of that sonnet, and with a copy of the sonnet included, to some friend who had been remonstrating with him on his "belatedness" and his persistence in a life of mere dream and study. There were gentle remonstrances also from his excellent father. Between such a father and such a son, however, the conclusion was easy. What it was may be learnt from Milton's fine Latin poem *Ad patrem.* There, in the midst of an enthusiastic recitation of all that his father had done for him hitherto, it is intimated that the agreement between them on their one little matter of difference was already complete, and that, as the son was bent on a private life of literature and poetry, it had been decided that he should have his own way, and should in fact, so long as he chose, be the master of his father's means and the chief person in the Horton household. For the six years from 1632 this, accordingly, was Milton's position. In perfect leisure, and in a pleasant rural retirement, with Windsor at the distance of an easy walk, and London only about 17 m. off, he went through, he tells us, a systematic course of reading in the Greek and Latin classics, varied by mathematics, music, and the kind of physical science we should now call cosmography.

It is an interesting fact that Milton's very first public appearance in the world of English authorship was in so honourable a place as the second folio edition of *Shakespeare* in 1632. His enthusiastic eulogy on Shakespeare, written in 1630, was one of three anonymous pieces prefixed to that second folio. Among the poems actually written by Milton at Horton the first, in all probability, after the Latin hexameters *Ad patrem*, were the exquisite companion pieces *L'Allegro* and *Il Penseroso.* There followed, in or about 1633, the fragment called *Arcades.* It was part of a pastoral masque performed by the young people of the noble family of Egerton before the countess-dowager of Derby, at her mansion of Harefield, about 10 m. from Horton. That Milton contributed the words for the entertainment was, almost certainly, owing to his friendship with Henry Lawes, who supplied the music. Next in order among the compositions at Horton may be mentioned the three short pieces, "At a Solemn Music," "On Time," and "Upon the Circumcision"; after which comes *Comus*, the largest and most important of all Milton's minor poems. The name by which that beautiful drama is now universally known was not given to it by Milton himself. He entitled it, more simply and vaguely, "A Masque presented at Ludlow Castle, 1634, on Michaelmas night, before John Earl of Bridgewater, Lord President of Wales" (1637). The earl of Bridgewater, the head of the Egerton family, had been appointed president of the council of Wales; among the festivities on his assumption of the office, a great masque was arranged in the hall of Ludlow Castle, his official residence. Lawes supplied the music and was stage manager; he applied to Milton for the poetry; and on Michaelmas night, the 29th of September 1634, the drama furnished by Milton was performed in Ludlow Castle before a great assemblage of the nobility and gentry of the Welsh principality, Lawes taking the part of "the attendant spirit," while the parts of "first brother," "second brother" and "the lady," were taken by the earl's three youngest children, Viscount Brackley, Mr Thomas Egerton and Lady Alice Egerton.

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[1] See the preface to Book II. of his *Reason of Church Government* (1641–1642), which is of great biographical interest.

From September 1634 to the beginning of 1637 is a comparative blank in our records. Straggling incidents in this blank are a Latin letter of date December 4, 1634, to Alexander Gill the younger, a Greek translation of "Psalm CXIV.," a visit to Oxford in 1635 for the purpose of incorporation in the degree of M.A. in that university, and the beginning in May 1636 of a troublesome lawsuit against his now aged and infirm father. The lawsuit, which was instituted by a certain Sir Thomas Cotton, bart., nephew and executor of a deceased John Cotton, Esq., accused the elder Milton and his partner Bower, or both, of having, in their capacity as scriveners, misappropriated divers large sums of money that had been entrusted to them by the deceased Cotton to be let out at interest.

The lawsuit was still in progress when, on the 3rd of April 1637, Milton's mother died, at the age of about sixty-five. A flat blue stone, with a brief inscription, visible on the chancel-pavement of Horton church, still marks the place of her burial. Milton's testimony to her character is that she was "a most excellent mother and particularly known for her charities through the neighbourhood." The year 1637 was otherwise eventful. It was in that year that his *Comus*, after lying in manuscript for more than two years, was published by itself, in the form of a small quarto of thirty-five pages. The author's name was withheld, and the entire responsibility of the publication was assumed by Henry Lawes. Milton seems to have been in London when the little volume appeared. He was a good deal in London, at all events, during the summer and autumn months immediately following his mother's death. The plague, which had been on one of its periodical visits of ravage through England since early in the preceding year, was then especially severe in the Horton neighbourhood, while London was comparatively free. It was probably in London that Milton heard of the death of Edward King, who had sailed from Chester for a vacation visit to his relatives in Ireland, when, on the 10th of August, the ship in perfectly calm water struck on a rock and went down, he and nearly all the other passengers going down with her. There is no mention of this event in Milton's two Latin "Familiar Epistles" of September 1637, addressed to his friend Charles Diodati, and dated from London; but in November 1637, and probably at Horton, he wrote his matchless pastoral monody of *Lycidas*. It was his contribution to a collection of obituary verses, Greek, Latin and English, inscribed to the memory of Edward King by his numerous friends, at Cambridge and elsewhere. The collection appeared early in 1638. The second part contained thirteen English poems, the last of which was Milton's monody, signed only with his initials "J. M."

Milton was then on the wing for a foreign tour. He had long set his heart on a visit to Italy, and circumstances now favoured his wish. The vexatious Cotton lawsuit, after hanging on for nearly two years, was at an end, as far as the elder Milton was concerned, with the most absolute and honourable vindication of his character for probity, though with some continuation of the case against his partner, Bower. Moreover, Milton's younger brother Christopher, though but twenty-two years of age, and just about to be called to the bar of the Inner Temple, had married; and the young couple had gone to reside at Horton to keep the old man company.

Before the end of April 1638 Milton was on his way across the channel, taking one English man-servant with him. At the time of his departure the last great news in England was that of the National Scottish Covenant. To Charles the news of this "damnable Covenant," as he called it, was enraging beyond measure; but to the mass of the English Puritans it was far from unwelcome, promising, as it seemed to do, for England herself, the subversion at last of that system of "Thorough," or despotic government by the king and his ministers without parliaments, under which the country had been groaning since the contemptuous dissolution of Charles's third parliament ten years before. Through Paris, where Milton received polite attention from the English ambassador, Lord Scudamore, and had the honour of an introduction to the famous Hugo Grotius, then ambassador for Sweden at the French court, he moved on rapidly to Italy, by way of Nice. After visiting Genoa, Leghorn and Pisa, he arrived at Florence, in August 1638. Enchanted by the city and its society, he remained there two months, frequenting the chief academies or literary clubs, and even taking part in their proceedings. Among the Florentines with whom he became intimate were Jacopo Gaddi, founder of an academy called the Svogliati, young Carlo Dati, author of *Vite de' pittori antichi*, Pietro Frescobaldi, Agostino Coltellini, the founder of the Academy of the Apatisti, the grammarian Benedetto Buommattei, Valerio Chimentelli, afterwards professor of Greek at Pisa, Antonio Francini and Antonio Malatesti. It was in the neighbourhood of Florence also that he "found and visited" the great Galileo, then old and blind, and still nominally a prisoner to the Inquisition for his astronomical heresy.[1]

By way of Florence and Siena, he reached Rome some time in October, and spent about another two months there, not only going about among the ruins and antiquities and visiting the galleries, but mixing also, as he had done in Florence, with the learned society of the academies. Among those with whom he formed acquaintance in Rome were the German scholar, Lucas Holstenius, librarian of the Vatican, and three native Italian scholars, named Alessandro Cherubini, Giovanni Salzilli and a certain Selvaggi. There is record of his having dined once, in company with several other Englishmen, at the hospitable table of the English Jesuit College. The most picturesque incident, however, of his stay in Rome was his presence at a great musical entertainment in the palace of Cardinal Francesco Barberini. Here he had not only the honour of a specially kind reception by the cardinal himself, but also, it would appear, the supreme pleasure of listening to the marvellous Leonora Baroni, the most renowned singer of her age.

Late in November he left Rome for Naples. Here he met the aged Giovanni Battista Manso, marquis of Villa (1560–1645), the friend and biographer of Tasso, and subsequently the friend and patron of Marini. He had hardly been in Naples a month, however, when there came news from England which not only stopped an intention he had formed of extending his tour to Sicily and thence into Greece, but urged his immediate return home. "The sad news of civil war in England," he says, "called me back; for I considered it base that, while my fellow-countrymen were fighting at home for liberty, I should be travelling at my ease for intellectual culture" (*Defensio secunda*). In December 1638, therefore, he set his face northwards again. His return journey, however, probably because he learnt that the news he had first received was exaggerated or premature, was broken into stages. He spent a second January and February (1638–1639) in Rome, in some danger, he says, from the papal police, because the English Jesuits in Rome had taken offence at his habit of free speech, wherever he went, on the subject of religion. From Rome he went to Florence, his second visit to the city, including an excursion to Lucca, extending over two months; and not till April 1639 did he take his leave, and proceed, by Bologna and Ferrara, to Venice. About a month was given to Venice; and thence, having shipped for England the books he had collected in Italy, he went on, by Verona and Milan, over the Alps, to Geneva. In this Protestant city he spent a week or two in June, forming interesting acquaintanceships there too, and having daily conversations with the great Protestant theologian Dr Jean Diodati, the uncle of his friend Charles Diodati. From Geneva he returned to Paris, and so to England. He was home again in August 1639, having been absent in all fifteen or sixteen months.

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[1] This interview forms the subject of one of W. S. Landor's *Imaginary Conversations*.

Milton's Continental tour, and especially the Italian portion of it, which he describes at some length in his *Defensio secunda*, remained one of the chief pleasures of his memory through all his subsequent life. Nor was it without fruits of a literary kind. Besides two of his Latin *Epistolae familiares*, one to the Florentine grammarian Buommattei, and the other to Lucas Holstenius, there have to be assigned to Milton's sixteen months on the Continent his three Latin epigrams *Ad Leonoram Romae canentem*, his Latin scazons *Ad Salsillum poetam romanum aegrotantem*, his fine Latin hexameters entitled *Mansus*, addressed to Giovanni Battista Manso, and his five Italian sonnets, with a canzone, in praise of a Bolognese lady.

His bosom friend and companion from boyhood, Charles Diodati, died in Blackfriars, London, in August 1638, not four months after Milton had gone away on his tour. The intelligence did not reach Milton till some months afterwards, probably not till his second stay in Florence; and, though he must have learnt some of the particulars from his friend's uncle in Geneva, he did not know them fully till his return to England. How profoundly they affected him appears from his *Epitaphium Damonis*, then written in memory of his dead friend. The importance of this poem in Milton's biography cannot be overrated. It is perhaps the noblest of all his Latin poems; and, though written in the artificial manner of a pastoral, it is unmistakably an outburst of the most passionate personal grief. In this respect *Lycidas*, artistically perfect though that poem is, cannot be compared with it; and it is only the fact that *Lycidas* is in English, while the *Epitaphium Damonis* is in Latin, that has led to the notion that Edward King of Christ's College was peculiarly and pre-eminently the friend of Milton in his youth and early manhood.

We should not have known, but for an incidental passage in the *Epitaphium Damonis*, that, at the time of his return from Italy, he had chosen a subject for a great poem from the Arthurian legend. The passage (lines 160–178) is one in which, after referring to the hopes of Diodati's medical career so suddenly cut short by his death, Milton speaks of himself and of his own projects in *his* profession of literature. Milton wrote that he was meditating an epic of which King Arthur was to be the central figure, but which should include somehow the whole cycle of British and Arthurian legend. This epic was to be in English, and he had resolved that all his poetry for the future should be in the same tongue.

Not long after Milton's return the house at Horton ceased to be the family home. Christopher Milton and his wife went to reside at Reading, taking the old gentleman with them, while Milton himself preferred London. He had first taken lodgings in St Bride's Churchyard, at the foot of Fleet Street; but, after a while, probably early in 1640, he removed to a " pretty garden house " of his own, at the end of an entry, in the part of Aldersgate Street which lies immediately on the city side of what is now Maidenhead Court. His sister, whose first husband had died in 1631, had married a Mr. Thomas Agar, his successor in the Crown Office; and it was arranged that her two sons by her first husband should be educated by their uncle. John Phillips, the younger of them, only nine years old, had boarded with him in the St Bride's Churchyard lodgings; and, after the removal to Aldersgate Street, the other brother, Edward Phillips, only a year older, became his boarder also. Gradually a few other boys, the sons of well-to-do personal friends, joined the two Phillipses, whether as boarders or for daily lessons, so that the house in Aldersgate Street became a small private school.

The Arthurian epic had been given up, and his mind was roving among many other subjects, and balancing their capabilities. How he wavered between Biblical subjects and heroic subjects from British history, and how many of each kind suggested themselves to him, one learns from a list in his own handwriting among the Milton MSS. at Cambridge. It contains jottings of no fewer than fifty-three subjects from the Old Testament, eight from the Gospels, thirty-three from British and English history before the Conquest, and five from Scottish history. It is curious that all or most of them are headed or described as subjects for " tragedies," as if the epic form had now been abandoned for the dramatic. There are four separate drafts of a possible tragedy on the Greek model under the title of *Paradise Lost*, two of them merely enumerating the dramatis personae, but the last two indicating the plot and the division into acts. In 1641 he wrote in the *Reason of Church Government* that he was meditating a poem on high moral or religious subjects. But the fulfilment of these plans was indefinitely postponed. Milton became absorbed in the ecclesiastical controversies following on the king's attempt to force the episcopal system on the Scots.

Of the first proceedings of the Long Parliament, including the trial and execution of Strafford, the impeachment and imprisonment of Laud and others, and the breakdown of the system of Thorough by miscellaneous reforms and by guarantees for parliamentary liberty, Milton was only a spectator. It was when the church question emerged distinctly as the question paramount, and there had arisen divisions on that question among those who had been practically unanimous in matters of civil reform, that he plunged in as an active adviser. There were three parties on the church question. There was a high-church party, contending for episcopacy by divine right, and for the maintenance of English episcopacy very much as it was; there was a middle party, defending episcopacy on grounds of usage and expediency, but desiring to see the powers of bishops greatly curtailed, and a limited episcopacy, with councils of presbyters round each bishop, substituted for the existing high episcopacy; and there was the root-and-branch party, as it called itself, desiring the entire abolition of episcopacy and the reconstruction of the English Church on something like the Scottish Presbyterian model. Since the opening of the parliament there had been a storm of pamphlets from these three parties. The manifesto of the high-church party was a pamphlet by Joseph Hall, bishop of Exeter, entitled " Humble Remonstrance to the High Court of Parliament." In answer to Hall, and in representation of the views of the root-and-branch party, there had stepped forth, in March 1640–1641, five leading Puritan parish ministers, the initials of whose names, clubbed together on the title-page of their joint production, made the uncouth word " Smectymnuus." These were Stephen Marshall, Edmund Calamy, Thomas Young, Matthew Newcomen and William Spurstow. Thomas Young was the Scottish divine who had been Milton's tutor in Bread Street; he had returned from Hamburg in 1628, and had been appointed to the vicarage of Stowmarket in Suffolk. The famous Smectymnuan pamphlet in reply to Hall was mainly Young's. What is more interesting is that his old pupil Milton was secretly in partnership with him and his brother-Smectymnuans. Milton's hand is discernible in a portion of the original Smectymnuan pamphlet; and he continued to aid the Smectymnuans in their subsequent rejoinders to Hall's defences of himself. In May 1641 he put forth a defence of the Smectymnuan side in *Of Reformation touching Church Discipline in England and the Causes that hitherto have hindered it.* He reviewed English ecclesiastical history, with an appeal to his countrymen to resume that course of reformation which he considered to have been prematurely stopped in the preceding century, and to sweep away the last relics of papacy and prelacy. Among all the root-and-branch pamphlets of the time it stood out, and stands out still, as the most thorough-going and tremendous. It was followed by four others in rapid succession, —*Of Prelatical Episcopacy and whether it may be deduced from the Apostolical Times* (June 1641), *Animadversions upon the Remonstrant's Defence against Smectymnuus* (July 1641), *The Reason of Church Government urged against Prelaty* (Feb. 1641–1642), *Apology against a Pamphlet called a Modest Confutation of the Animadversions*, &c. (March and April 1641–1642). The first of these was directed chiefly against that middle party which advocated a limited episcopacy, with especial reply to the arguments of Archbishop Ussher, as the chief exponent of the views of that party. Two of the others, as the titles imply, belong to the Smectymnuan series, and were castigations of Bishop Hall. The greatest of the four, and the most important of all Milton's anti-episcopal pamphlets after the first, is that entitled *The Reason of Church Government.* It is there that Milton takes his readers into his confidence, speaking at length of himself and his motives in becoming a controversialist. Poetry, he declares, was his real vocation; it was with reluctance that he had resolved to "leave a calm and pleasing solitariness, fed with cheerful and confident thoughts, to embark in a troubled sea of noises and hoarse disputes"; but duty had left him no option. The great poem or poems he had been meditating could wait; and meanwhile, though in prose-polemics he had the use only of his "left hand," that hand should be used with all its might in the cause of his country and of liberty. The *Apology* was in answer to a *Modest Confutation of a Slanderous and Scurrilous Libel*, the joint work of Hall and his son, attacking Milton's personal character.

The parliament had advanced in the root-and-branch direction so far as to have passed a bill for the exclusion of bishops from the House of Lords, and compelled the king's assent to that bill, when, in August 1642, the further struggle between Charles and his subjects took the form of civil war. The Long Parliament moved on more and more rapidly in the root-and-branch direction, till, by midsummer 1643, the abolition of episcopacy had been decreed, and the question of the future non-prelatic constitution of the Church of England referred to a synod of divines, to meet at Westminster under parliamentary authority. Of Milton's life through those first months of the Civil War little is known. He remained in his house in Aldersgate Street, teaching his nephews and other pupils; and the only scrap that came from his pen was the semi-jocose sonnet bearing the title "When the Assault was intended to the City." In the summer of 1643, however, there was a great change in the Aldersgate Street household. About the end of May, as his nephew Edward Phillips remembered, Milton went away on a country journey, without saying whither or for what purpose; and, when he returned, about a month afterwards, it was with a young wife, and with some of her sisters and other relatives in her company. He had, in fact, been in the very headquarters of the king and the Royalist army in and round Oxford; and the bride he brought back with him was a Mary Powell, the eldest daughter of Richard Powell, of Forest Hill, near Oxford. She was the third of a family of eleven sons and daughters, of good standing, but in rather embarrassed circumstances, and was seventeen years and four months old, while Milton was in his thirty-fifth year. However the marriage came about, it was a most unfortunate event. The Powell family were strongly Royalist, and the girl herself seems to have been frivolous, and entirely unsuited for the studious life in Aldersgate Street. Hardly were the honeymoon festivities over, when, her sisters and other relatives having returned to Forest Hill and left her alone with her husband, she pined for home again and begged to be allowed to go back on a visit. Milton consented, on the understanding that the visit was to be a brief one. This seems to have been in July 1643. Soon, however, the intimation from Forest Hill was that he need not look ever to have his wife in his house again. The resolution seems to have been mainly the girl's own; but, as the king's cause was then prospering in the field, Edward Phillips was probably right in his conjecture that the whole of the Powell family had repented of their sudden connexion with so prominent a Parliamentarian and assailant of the Church of England as Milton. While his wife was away, his old father, who had been residing for three years with his younger and lawyer son at Reading, came to take up his quarters in Aldersgate Street.

Milton's conduct under the insult of his wife's desertion was most characteristic. Always fearless and speculative, he converted his own case into a public protest against the existing law and theory of marriage. *The Doctrine and Discipline of Divorce, Restored to the good of both Sexes from the Bondage of Canon Law and other Mistakes* was the title of a pamphlet put forth by him in August 1643, without his name, but with no effort at concealment, declaring the notion of a sacramental sanctity in the marriage relation to be a clerically invented superstition, and arguing that inherent incompatibility of character, or contrariety of mind, between two married persons is a perfectly just reason for divorce. If the date, the 1st of August, is correct, the pamphlet must have been written almost immediately on his wife's departure and before her definite refusal to return. There was no reference to his own case, except by implication; but the boldness of the speculation roused attention and sent a shock through London. It was a time when the authors of heresies of this sort, or of any sort, ran considerable risks. The famous Westminster Assembly of Divines, called by the Long Parliament, met on the 1st of July 1643. Whether Milton's divorce tract was formally discussed in the Assembly during the first months of its sitting is unknown; but it is certain that the London clergy, including not a few members of the Assembly, were then angrily discussing it in private. That there might be no obstacle to a more public prosecution, Milton put his name to a second and much enlarged edition of the tract, in February 1644, dedicated openly to the parliament and the assembly. Then, for a month or two, during which the gossip about him and his monstrous doctrine was spreading more and more, he turned his attention to other subjects.

Among the questions in agitation in the general ferment of opinion brought about by the Civil War was that of a reform of the national system of education and especially of the universities. To this question Milton made a contribution in June 1644, in a small treatise, *Of Education*, in the form of a letter to Samuel Hartlib, a German then resident in London and interesting himself busily in all philanthropic projects and schemes of social reform. In the very next month, however, July 1644, he returned to the divorce subject in a pamphlet addressed specially to the clergy and entitled *The Judgment of Martin Bucer concerning Divorce.* The outcry against him then reached its height. He was attacked in pamphlets; he was denounced in pulpits all through London, and especially by Herbert Palmer in a sermon preached on the 13th of August, before the two Houses of Parliament; strenuous efforts were made to bring him within definite parliamentary censure. In the cabal formed against him for this purpose a leading part was played, at the instigation of the clergy, by the Stationers' Company of London, which had a plea of its own against him on the ground that his doctrine was not only immoral, but had been put forth in an illegal manner. His first divorce treatise, though published immediately after the "Printing Ordinance" of the parliament of the 14th of June 1643, requiring all publications to be licensed for press by one of the official censors, and to be registered in the books of the Stationers' Company, had been issued without license and without registration. Complaint to this effect was made against Milton, with some others liable to the same charge of contempt of the printing ordinance, in a petition of the Stationers of the House of Commons in August 1644; and the matter came before committee both in that House and in the Lords.

It is to this circumstance that the world owes the most popular and eloquent, if not the greatest, of all Milton's prose writings, his famous *Areopagitica, a Speech of Mr John Milton for the Liberty of Unlicensed Printing, to the Parliament of England.* It appeared on the 25th of November 1644, deliberately unlicensed and unregistered, and was a remonstrance addressed to the parliament, as if in an oration to them face to face, against their ordinance of June 1643 and the whole system of licensing and censorship of the press. Nobly eulogistic of the parliament in other respects, it denounced their printing ordinance as utterly unworthy of them, and of the new era of English liberties which they were initiating, and called for its repeal. Though that effect did not follow, the pamphlet virtually accomplished its purpose. The licensing system had received its death-blow; and, though the Stationers returned to the charge in another complaint to the House of Lords, Milton's offence against the press ordinance was condoned. He was still assailed in pamphlets, and found himself "in a world of disesteem"; but he lived on through the winter of 1644/5 undisturbed in his house in Aldersgate Street. To this period there belong, in the shape of verse, only his sonnets ix. and x., the first to some anonymous lady, and the second "to the Lady Margaret Ley," with perhaps the Greek lines entitled *Philosophus ad regem quendam.* His divorce speculation, however, still occupied him; and in March 1644/5 he published simultaneously his *Tetrachordon: Expositions upon the four chief places of Scripture which treat of Marriage*, and his *Colasterion, a Reply to a nameless Answer against the Doctrine and Discipline of Divorce.* In these he replied to his chief recent assailants, lay and clerical, with merciless severity.

Through the latter part of 1644, Milton had been saved from the penalties which his Presbyterian opponents would have inflicted on him by the general championship of liberty of opinion by Cromwell and the army Independents. Before the middle of 1645 he, with others who were on the black books of the Presbyterians as heretics, was safer still. Milton's position after the battle of Naseby may be easily understood. Though his first tendency on the Church question had been to some form of a Presbyterian constitution for the Church, he had parted utterly now from the Scots and Presbyterians, and become a partisan of Independency, having no dread of "sects and schisms," but regarding them rather as healthy signs in the English body-politic. He was, indeed, himself one of the most noted sectaries of the time, for in the lists of sects drawn out by contemporary Presbyterian writers special mention is made of one small sect who were known as *Miltonists* or *Divorcers.*

So far as Milton was concerned personally, his interest in the divorce speculation came to an end in July or August 1645, when, by friendly interference, a reconciliation was effected between him and his wife. The ruin of the king's cause at Naseby had suggested to the Powells that it might be as well for their daughter to go back to her husband after their two years of separation. It was not, however, in the house in Aldersgate Street that she rejoined him, but in a larger house, which he had taken in the adjacent street called Barbican, for the accommodation of an increasing number of pupils.

The house in Barbican was tenanted by Milton from about August 1645 to September or October 1647. Among his first occupations there must have been the revision of the proof sheets of the first edition of his collected poems. It appeared as a tiny volume, copies of which are now very rare, with the title, *Poems of Mr John Milton, both English and Latin, compos'd at several times. Printed by his true Copies. The songs were set in Musick by Mr Henry Lawes. . . .* The title-page gives the date 1645, but the 2nd of January 1645/6 seems to have been the exact day of its publication. Whether because his pedagogic duties now engrossed him or for other reasons, very few new pieces were added in the Barbican to those that the little volume had thus made public. In English, there were only the four sonnets now numbered xi.–xiv., the first two entitled "On the Detraction which followed upon my writing certain Treatises," the third "To Mr Henry Lawes on his Airs," and the fourth "To the Religious Memory of Mrs Catherine Thomson," together with the powerful anti-Presbyterian invective or "tailed sonnet" entitled "On the New Forcers of Conscience under the Long Parliament"; and in Latin there were only the ode *Ad Joannem Rousium*, the *Apologus de Rustico et Hero*, and one interesting "Familiar Epistle" (April 1647) addressed to his Florentine friend Carlo Dati.

Some family incidents of importance belong to this time of residence in Barbican. The fall of Oxford in 1646 compelled the whole of the Powell family to seek refuge in London, and most of them found shelter in Milton's house. His first child, a daughter named Anne, was born there on the 29th of July that year; on the 1st of January 1646/7 his father-in-law Richard Powell died there, leaving his affairs in confusion; and in the following March his own father died there, at the age of eighty-four, and was buried in the adjacent church of St Giles, Cripplegate.

From Barbican Milton removed, in September or October 1647, to a smaller house in that part of High Holborn which adjoins Lincoln's Inn Fields. His Powell relatives had now left him, and he had reduced the number of his pupils, or perhaps kept only his two nephews. But, though thus more at leisure, he did not yet resume his projected poem, but occupied himself rather with three works of scholarly labour which he had already for some time had on hand. One was the compilation in English of a complete history of England, or rather of Great Britain, from the earliest times; another was the preparation in Latin of a complete system of divinity, drawn directly from the Bible; and the third was the collection of materials for a new Latin dictionary. Milton had always a fondness for such labours of scholarship and compilation. Of a poetical kind there is nothing to record, during his residence in High Holborn, but an experiment in psalm-translation, in the shape of Ps. lxxx.–lxxxviii. done into service-metre in April 1648, and the sonnet to Fairfax, written in September of the same year.

The crushing defeat of the Scottish army by Cromwell in the three days' battle of Preston (1648) and the simultaneous suppression of the English Royalist insurrection in the south-east counties by Fairfax's siege and capture of Colchester, left King Charles at the mercy of the victors. Milton's sonnet "On the Lord General Fairfax, at the siege of Colchester," attested the exultation of the writer at the triumph of the parliamentary cause. His exultation continued through what followed. When the king was beheaded (1649) the first Englishman of mark out of parliament to attach himself openly to the new republic was John Milton. This he did by the publication of his pamphlet entitled "Tenure of Kings and Magistrates, proving that it is lawful, and hath been held so in all ages, for any who have the power, to call to account a Tyrant or wicked King, and, after due conviction, to depose and put him to death, if the ordinary Magistrate have neglected or denied to do it." It was out within a fortnight after the king's death, and was Milton's last performance in the house in High Holborn. The chiefs of the new republic could not but perceive the importance of securing the services of a distinguished man who had so opportunely and so powerfully spoken out in favour of their tremendous act. In March 1649, accordingly, Milton was offered, and accepted, the secretaryship for foreign tongues to the council of state of the new Commonwealth. The salary was to be £288 a year (worth about £1000 a year now). To be near his new duties in attendance on the council, which held its daily sittings for the first few weeks in Derby House, close to Whitehall, but afterwards regularly in Whitehall itself, he removed at once to temporary lodgings at Charing Cross. In the very first meetings of council which Milton attended he must have made personal acquaintance with President Bradshaw, Fairfax, Cromwell himself, Sir Henry Vane, Whitelocke, Henry Marten, Haselrig, Sir Gilbert Pickering and the other chiefs of the council and the Commonwealth, if indeed he had not known some of them before. After a little while, for his greater convenience, official apartments were assigned him in Whitehall itself.

At the date of Milton's appointment to the secretaryship he was forty years of age. His special duty was the drafting in Latin of letters sent by the council of state, or sometimes by the Rump Parliament, to foreign states and princes, with the examination and translation of letters in reply, and with personal conferences, when necessary, with the agents of foreign powers in London, and with envoys and ambassadors. As Latin was the language employed in the written diplomatic documents, his post came to be known indifferently as the secretaryship for foreign tongues or the Latin secretaryship. In that post, however, his duties, more particularly at first, were very light in comparison with those of his official colleague, Walter Frost, the general secretary. Foreign powers held aloof from the English republic as much as they could; and, while Frost had to be present in every meeting of the council, keeping the minutes, and conducting all the general correspondence, Milton's presence was required only when some piece of foreign business turned up. Hence, from the first, his employment in very miscellaneous work. Especially, the council looked to him for everything in the nature of literary vigilance and literary help in the interests of the struggling Commonwealth. He was employed in the examination of suspected papers, and in interviews with their authors and printers; and he executed several great literary commissions expressly entrusted to him by the council. The first of these was his pamphlet entitled *Observations on the Articles of Peace* (between Ormonde and the Irish). It was published in May 1649, and was in defence of the republic against a complication of Royalist intrigues and dangers in Ireland. A passage of remarkable interest in it is one of eloquent eulogy on Cromwell. More important still was the *Eikonoklastes* (which may be translated "Image-Smasher"), published by Milton in October 1649, by way of counterblast to the famous *Eikon Basilike* ("Royal Image"), which had been in circulation in thousands of copies since the king's death, and had become a kind of Bible in all Royalist households, on the supposition that it had been written by the royal martyr himself (see GAUDEN, JOHN). In the end of 1649 there appeared abroad, under the title of *Defensio regia pro Carolo I.*, a Latin vindication of the memory of Charles, with an attack on the English Commonwealth. As it had been written, at the instance of the exiled royal family, by Salmasius, or Claude de Saumaise, of Leiden, then of enormous celebrity over Europe as the greatest scholar of his age, it was regarded as a serious blow to the infant Commonwealth. Milton threw his whole strength into a reply through the year 1650, interrupting himself only by a new and enlarged edition of his *Eikonoklastes.* His Latin *Pro populo anglicano defensio* (1651), ran at once over the British Islands and the Continent, and was received by scholars as an annihilation of Salmasius. Through the rest of 1651 the observation was that the two agencies which had co-operated most visibly in raising the reputation of the Commonwealth abroad were Milton's books and Cromwell's battles.

Through the eventful year 1651, in addition to the other duties of his secretaryship, Milton acted as licenser and superintending editor of the *Mercurius politicus*, a newspaper issued twice a week, of which Marchamont Nedham was the working editor and proprietor. Milton's hand is discernable in some of the leading articles.

About the end of 1651 Milton left his official rooms in Whitehall for a "garden house" he had taken on the edge of St James's Park in what was then called Petty France, Westminster, but is now York Street. The house, afterwards 19 York Street, was occupied by James Mill and William Hazlitt in succession, and was not pulled down till 1877. Milton had now more to do in the special work of his office, in consequence of the increase of correspondence with foreign powers. But he had for some time been in ailing health; and a dimness of eyesight which had been growing upon him gradually for ten years had been settling rapidly, since his labour over the answer to Salmasius, into total blindness. Before or about May 1652, when he was but in his forty-fourth year, his blindness became total, and he could go about only with some one to lead him. Hence a rearrangement of his secretarial duties. Such of these duties as he could perform at home, or by occasional visits to the Council Office near, he continued to perform; but much of the routine work was done for him by an assistant, a well-known German, George Rudolph Weckherlin, succeeded later by Philip Meadows and, eventually, by Andrew Marvell. Precisely to this time of a lull in Milton's secretaryship on account of his ill-health and blindness we have to refer his two great companion sonnets "To the Lord General Cromwell" and "To Sir Henry Vane the Younger."

In 1652 died his only son, who had been born at Whitehall in the March of the preceding year. His wife died in 1653/4, just after she had given birth to his third daughter, Deborah. With the three children thus left him—Anne, but six years old, Mary, not four, and the infant Deborah—the blind widower lived on in his house in Petty France in such desolation as can be imagined. He had recovered sufficiently to resume his secretarial duties; and the total number of his dictated state letters for the single year 1652 is equal to that of all the state letters of his preceding term of secretaryship put together. To the same year there belong also three of his Latin "Familiar Epistles." In December 1652 there was published *Joannis Philippi Angli responsio ad apologiam anonymi cujusdam tenebrionis*, being a reply by Milton's younger nephew, John Phillips, but touched up by Milton himself, to one of several pamphlets that had appeared against Milton for his slaughter of Salmasius.

In December 1653 Cromwell's formal sovereignty began under the name of the Protectorate, passing gradually into more than kingship. This change from Government by the Rump and its council to government by a single military lord protector and his council was regarded by many as treason to the republican cause, and divided those who had hitherto been the united Commonwealth's men into the "Pure Republicans," represented by such men as Bradshaw and Vane, and the "Oliverians," adhering to the Protector. Milton, whose boundless admiration of Cromwell had shown itself already in his Irish tract of 1649 and in his recent sonnet, was recognized as one of the Oliverians. He remained in Oliver's service and was his Latin secretary through the whole of the Protectorate. For a while, indeed, his Latin letters to foreign states in Cromwell's name were but few—Thurloe, as general secretary, officiating as Oliver's right-hand man in everything, with a Philip Meadows under him, at a salary of £200 a year, as deputy for the blind Milton in foreign correspondence and translations. The reason for this temporary exemption of Milton from routine duty may have been that he was then engaged on an answer to the pamphlet from the Hague entitled *Regii sanguinis clamor ad coelum adversus parricidas anglicanos* (March 1652). Salmasius was now dead, and the Commonwealth was too stable to suffer from such attacks; but no Royalist pamphlet had appeared so able or so venomous as this in continuation of the Salmasian controversy. All the rather because it was in the main a libel on Milton himself did a reply from his pen seem necessary. It came out in May 1654, with the title *Joannis Miltoni Angli pro populo anglicano defensio secunda* (Second Defence of John Milton, Englishman, for the People of England). The author of *Regii sanguinis clamor* was Dr Peter du Moulin the younger, a naturalized French Presbyterian minister, then moving about in English society, close to Milton; but, as that was a profound secret, and the work was universally attributed on the Continent to an Alexander More or Morus, a French minister of Scottish descent then a professor at Middelburg, who had certainly managed the printing in consultation with the now deceased Salmasius, and had contributed some portion of the matter—Milton made More the responsible person and the one object of his invective. The savage attack on More's personal character, however, is but part of the *Defensio secunda.* It contains passages of singular autobiographical and historical value, and includes laudatory sketches of such eminent

Commonwealth's men as Bradshaw, Fairfax, Fleetwood, Lambert and Overton, together with a long panegyric on Cromwell himself and his career, which remains to this day unapproached for elaboration and grandeur by any estimate of Cromwell from any later pen.

From about the date of the publication of the *Defensio secunda* to the beginning of 1655 the only specially literary relics of Milton's life are his translations of Ps. i.–viii. in different metres, done in August 1654, his translation of Horace's *Ode*, i. 5, done probably about the same time, and two of his Latin "Familiar Epistles." The most active time of his secretaryship for Oliver was from April 1655 onwards. In that month, in the course of a general revision of official salaries under the Protectorate, Milton's salary of £288 a year hitherto was reduced to £200 a year, with a kind of redefinition of his office, recognizing it, we may say, as a Latin secretaryship extraordinary. Philip Meadows was to continue to do all the ordinary Foreign Office work, under Thurloe's inspection; but Milton was to be called in on special occasions. Hardly was the arrangement made when a signal occasion did occur. In May 1655 all England was horrified by the news of the massacre of the Vaudois Protestants (Waldenses) by the troops of Emanuele II., duke of Savoy and prince of Piedmont, in consequence of their disobedience to an edict requiring them either to leave their native valleys or to conform to the Catholic religion. Cromwell and his council took the matter up with all their energy; and the burst of indignant letters on the subject despatched in that month and the next to the duke of Savoy himself, Louis XIV. of France, Cardinal Mazarin, the Swiss cantons, the states-general of the United Provinces, and the kings of Sweden and Denmark, were all by Milton. His famous sonnet "On the Late Massacre in Piedmont" was his more private expression of feeling on the same occasion. This sonnet was in circulation, and the case of the Vaudois Protestants was still occupying Cromwell, when, in August 1655, there appeared the last of Milton's Latin pamphlets. It was his *Pro se defensio* . . . in answer to an elaborate self-defence which More had put forth on the Continent since Milton's attack on his character. In that year also appeared Milton's *Scriptum domini protectoris . . . contra hispanos.*

Through the rest of Cromwell's Protectorate, Milton's life was of comparatively calm tenor. He was in much better health than usual, bearing his blindness with courage and cheerfulness; he was steadily busy with important despatches to foreign powers on behalf of the Protector, then in the height of his great foreign policy; and his house in Petty France seems to have been, more than at any previous time since the beginning of his blindness, a meeting-place for friends and visitors, and a scene of pleasant hospitalities. The four sonnets now numbered xix.–xxii., one of them to young Lawrence, the son of the president of Cromwell's council, and two of the others to Cyriack Skinner, once his pupil, belong to this time of domestic quiet, as do also no fewer than ten of his Latin "Familiar Epistles." His marriage with Katherine Woodcock on the 12th of November 1656 brought him a brief period of domestic happiness; but, after only fifteen months, he was again a widower, by her death in childbirth in February 1657/8. The child dying with her, only the three daughters by the first marriage remained. The touching sonnet which closes the series of Milton's *Sonnets* is his sacred tribute to the memory of his second marriage and to the virtues of the wife he had so soon lost. Even after that loss we find him still busy for Cromwell. Andrew Marvell, in September 1657 succeeded Meadows, much to Milton's satisfaction, as his assistant secretary; but this had by no means relieved him from duty. Some of his greatest despatches for Cromwell, including letters, of the highest importance, to Louis XIV., Mazarin and Charles Gustavus of Sweden, belong to the year 1658.

There is, unfortunately, no direct record to show what Cromwell thought of Milton; but there is ample record of what Milton thought of Cromwell. "Our chief of men," he had called Cromwell in his sonnet of May 1652; and the opinion remained unchanged. He thought Cromwell the greatest and best man of his generation, or of many generations; and he regarded Cromwell's assumption of the supreme power, and his retention of that power with a sovereign title, as no real suppression of the republic, but as absolutely necessary for the preservation of the republic, and for the safeguard of the British Islands against a return of the Stuarts. Nevertheless, under this prodigious admiration of Cromwell, there were political doubts and reserves. Milton was so much of a modern radical of the extreme school in his own political views and sympathies that he cannot but have been vexed by the growing conservatism of Cromwell's policy through his Protectorate. To his grand panegyric on Oliver in the *Defensio secunda* of 1654 he had ventured to append cautions against self-will, over-legislation and over-policing; and he cannot have thought that Oliver had been immaculate in these respects through the four subsequent years. The attempt to revive an aristocracy and a House of Lords, on which Cromwell was latterly bent, cannot have been to Milton's taste. Above all, Milton dissented *in toto* from Cromwell's church policy. It was Milton's fixed idea, almost his deepest idea, that there should be no such thing as an Established Church, or state-paid clergy, of any sort or denomination or mixture of denominations, in any nation, and that, as it had been the connexion between church and state, begun by Constantine, that had vitiated Christianity in the world, and kept it vitiated, so Christianity would never flourish as it ought till there had been universal disestablishment and disendowment of the clergy, and the propagation of the gospel were left to the zeal of voluntary pastors, self-supported, or supported modestly by their flocks. He had at one time looked to Cromwell as the likeliest man to carry this great revolution in England. But Cromwell, after much meditation on the subject in 1652 and 1653, had come to the opposite conclusion. The conservation of the Established Church of England, in the form of a broad union of all evangelical denominations of Christians, whether Presbyterians, or Independents, or Baptists, or moderate Old Anglicans, that would accept state-pay with state-control, had been the fundamental notion of his Protectorate, persevered in to the end. This must have been Milton's deepest disappointment with Cromwell's rule.

Cromwell's death on the 3rd of September 1658 left the Protectorship to his son Richard. Milton and Marvell continued in their posts, and a number of the Foreign Office letters of the new Protectorate were of Milton's composition. In October 1658 appeared a new edition of his *Defensio prima*, and, early in 1659, a new English pamphlet, entitled *Treatise of Civil Power in Ecclesiastical Causes showing that it is not lawful to compel in Matters of Religion*, in which he advocated the separation of Church and State. To Richard's Protectorate also belongs one of Milton's Latin "Familiar Epistles."

The last of his known official performances in his Latin secretaryship are two letters in the name of William Lenthall, as the speaker of the restored Rump, one to the king of Sweden and one to the king of Denmark, both dated the 15th of May 1659. Under the restored Rump, if ever, he seemed to have a chance for his notion of church-disestablishment; and accordingly, in August 1659, he put forth, with a prefatory address to that body, a pamphlet entitled *Considerations touching the likeliest means to remove Hirelings out of the Church.* The restored Rump had no time to attend to such matters. They were in struggle for their own existence with the army chiefs; and to prevent the restoration of the monarchy, to argue against it and fight against it to the last, was the work to which Milton set himself; the preservation of the republic in any form, and by any compromise of differences within itself, had become his one thought, and the study of practical means to this end his most anxious occupation. In a *Letter to a Friend concerning the Ruptures of the Commonwealth,* written in October 1659, he had propounded a scheme of a kind of dual government for reconciling the army chiefs with the Rump; through the following winter, marked only by two of his Latin "Familiar Epistles," his anxiety over the signs of the growing enthusiasm throughout the country for the recall of Charles II. had risen to a passionate vehemence which found vent in a pamphlet entitled *The Ready and Easy Way to Establish* *a Free Commonwealth, and the Excellence thereof compared with the Inconveniences and Dangers of readmitting Kingship to this Nation.* An abridgment of this pamphlet was addressed by him to General Monk in a letter entitled "The Present Means and Brief Delineation of a Free Commonwealth" (March 1660). Milton's proposal was that the central governing apparatus of the British Islands for the future should consist of one indissoluble grand council or parliament, which should include all the political chiefs, while there should be a large number of provincial councils or assemblies sitting in the great towns for the management of local and county affairs.

Not even when the king's cause was practically assured would Milton be silent. In *Brief Notes upon a late Sermon*, published in April 1660, in reply to a Royalist discourse by a Dr Matthew Griffith, he made another protest against the recall of the Stuarts, even hinting that it would be better that Monk should become king himself; and in the same month he sent forth a second edition of his *Ready and Easy Way*, more frantically earnest than even the first, and containing additional passages of the most violent denunciation of the royal family, and of prophecy of the degradation and disaster they would bring back with them. This was the dying effort. On the 25th of April the Convention Parliament met; on the 1st of May they resolved unanimously that the government by King, Lords and Commons should be restored; and on the 29th of May, Charles II. made his triumphal entry into London. The chief republicans had by that time scattered themselves, and Milton was hiding in an obscure part of the city.

How Milton escaped the scaffold at the Restoration is a mystery now, and was a mystery at the time. The Commons voted that he should be taken into custody by the serjeant-at-arms, for prosecution by the attorney-general on account of his *Eikonoklastes* and *Defensio prima*, and that all copies of those books should be called in and burnt by the hangman. There was a story that Milton had once protected Davenant and now owed his immunity to him; but it is more likely that he was protected by the influence of Marvell, by Arthur Annesley, afterwards earl of Anglesey, and by other friends who had influence at court. At all events, on the 29th of August 1660, when the Indemnity Bill did come out complete, with the king's assent, Milton did not appear as one of the exceptions on any ground or in any of the grades. From that moment, therefore, he could emerge from his hiding, and go about as a free man. Not that he was yet absolutely safe. There were several public burnings by the hangman at the same time of Milton's condemned pamphlets; and the appearance of the blind man himself in the streets, though he was legally free, would have caused him to be mobbed and assaulted. Though the special prosecution ordered against him by the Commons had been quashed by the subsequent Indemnity Bill, the serjeant-at-arms had taken him into custody. Entries in the Commons journals of the 17th and 19th of December show that Milton complained of the exorbitant fees charged by the serjeant-at-arms for his release, and that the matter was referred to a committee at the instance of Andrew Marvell.

Milton did not return to Petty France. For the first months after he was free he lived as closely as possible in a house near what is now Red Lion Square, Holborn. Thence he removed, apparently early in 1661, to a house in Jewin Street, in his old Aldersgate Street and Barbican neighbourhood. In Jewin Street Milton remained for two or three years, or from 1661 to 1664. This is the time of which he says:—

> " . . . though fallen on evil days,
> On evil days though fallen, and evil tongues,
> In darkness, and with dangers compassed round,
> And solitude."

The "evil days" were those of the Restoration in its first or Clarendonian stage, with its revenges and reactions, its return to high Episcopacy and suppression of every form of dissent and sectarianism, its new and shameless royal court, its open proclamation and practice of anti-Puritanism in morals and in literature no less than in politics. For the main part of this world of the Restoration Milton was now nothing more than an infamous outcast, the detestable blind republican and regicide who had, by too great clemency, been left unhanged. The friends that adhered to him still, and came to see him in Jewin Street, were few in number, and chiefly from the ranks of those nonconforming denominations, Independents, Baptists or Quakers, who were themselves under similar obloquy. Besides his two nephews, the faithful Andrew Marvell, Cyriack Skinner and some others of his former admirers, English or foreign, we hear chiefly of a Dr Nathan Paget, who was a physician in the Jewin Street neighbourhood, and of several young men who would drop in upon him by turns, partly to act as his amanuenses, and partly for the benefit of lessons from him— one of them a Quaker youth, named Thomas Ellwood. With all this genuine attachment to him of a select few, Milton could truly enough describe his condition after the Restoration as one of "solitude." Nor was this the worst. His three daughters, on whom he ought now to have been able principally to depend, were his most serious domestic trouble. The poor motherless girls, the eldest in her seventeenth year in 1662, the second in her fifteenth and the youngest in her eleventh, had grown up, in their father's blindness and too great self-absorption, ill-looked-after and but poorly educated; and the result now appeared. They "made nothing of neglecting him"; they rebelled against the drudgery of reading to him or otherwise attending on him; they "did combine together and counsel his maid-servant to cheat him in her marketings"; they actually "had made away some of his books, and would have sold the rest."

It was to remedy this state of things that Milton consented to a third marriage. The wife found for him was Elizabeth Minshull, of a good Cheshire family, and a relative of Dr Paget. They were married on the 24th of February 1662/3, the wife being then only in her twenty-fifth year, while Milton was in his fifty-fifth. She proved an excellent wife; and the Jewin Street household, though the daughters remained in it, must have been under better management from the time of her entry into it. Meanwhile, he had found some solace in renewed industry of various kinds among his books and tasks of scholarship, and more particularly he had been building up his *Paradise Lost.* He had begun the poem in earnest, we are told, in 1658 at his house in Petty France, not in the dramatic form contemplated eighteen years before, but deliberately in the epic form. He had made but little way when there came the interruption of the anarchy preceding the Restoration and of the Restoration itself; but the work had been resumed in Jewin Street and prosecuted there steadily, by dictations of twenty or thirty lines at a time to whatever friendly or hired amanuensis chanced to be at hand. Considerable progress had been made in this way before his third marriage; and after that the work proceeded apace, his nephew, Edward Phillips, who was then out in the world on his own account, looking in when he could to revise the growing manuscript.

It was not in the house in Jewin Street, however, that *Paradise Lost* was finished. Not very long after the third marriage, probably in 1664, he removed to another house, with a garden, in "Artillery Walk, leading to Bunhill Fields." Here *Paradise Lost* was certainly finished before July 1665—Aubrey says in 1663—for when Milton and his family, to avoid the Great Plague of London, went into temporary country-quarters in a cottage in Chalfont St Giles, Buckinghamshire,[1] the finished manuscript was taken with him, in probably more than one copy. This we learn from Thomas Ellwood, who had taken the cottage for him, and was allowed to take a copy of the manuscript way with him for perusal, during Milton's stay at Chalfont (*Life of Thomas Ellwood*, 1714). The delay in the publication of the poem may be explained partly by the fact that the official licenser hesitated before granting the necessary imprimatur to a book by a man of such notorious republican antecedents, and partly by the paralysis of all business in London by the Great Fire of September 1666. It was not till the 27th of April 1667 that Milton concluded an agreement, still preserved in the British

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[1] Milton's cottage here is still standing, and is open to visitors.

Museum, with Samuel Simmons, printer, of Aldersgate Street, London, to dispose of the copyright for £5 down, the promise of another £5 after the sale of the first edition of 1300 copies, and the further promise of two additional sums of £5 each after the sale of two more editions of the same size respectively. It was as if an author now were to part with all his rights in a volume for £17, 10s. down, and a contingency of £52, 10s. more in three equal instalments. The poem was duly entered by Simmons as ready for publication in the Stationers' Registers on the 20th of the following August; and shortly after that date it was out in London as a neatly printed small quarto, with the title *Paradise Lost: A Poem written in Ten Books: By John Milton.* The reception accorded to *Paradise Lost* has been quoted as an example of the neglect of a great work, but the sale of an edition of 1300 copies in eighteen months proves that the poem found a wide circle of readers. "This man cuts us all out, and the ancients too" is the saying attributed to Dryden on the occasion; and it is the more remarkable because the one objection to the poem which at first, we are told, "stumbled many" must have "stumbled" Dryden most of all. Except in the drama, rhyme was then thought essential in anything professing to be a poem; blank verse was hardly regarded as verse at all; Dryden especially had been and was the champion of rhyme, contending for it even in the drama. That, notwithstanding this obvious blow struck by the poet at Dryden's pet literary theory, he should have welcomed the poem so enthusiastically and proclaimed its merits so emphatically, says much at once for his critical perception and for the generosity of his temper. According to Aubrey, Dryden requested Milton's leave to turn the poem into a rhymed drama, and was told he might "tag his verses if he pleased." The result is seen in Dryden's opera, *The State of Innocence and the Fall of Man* (1675). One consequence of Milton's renewed celebrity was that visitors of all ranks again sought him out for the honour of his society and conversation. His obscure house in Artillery Walk, Bunhill, we are told, became an attraction now, "much more than he did desire," for the learned notabilities of his time.

Accounts have come down to us of Milton's personal appearance and habits in his later life. They describe him as to be seen every other day led about in the streets in the vicinity of his Bunhill residence, a slender figure, of middle stature or a little less, generally dressed in a grey cloak or overcoat, and wearing sometimes a small silver-hilted sword, evidently in feeble health, but still looking younger than he was, with his lightish hair, and his fair, rather than aged or pale, complexion. He would sit in his garden at the door of his house, in warm weather, in the same kind of grey overcoat, "and so, as well as in his room, received the visits of people of distinguished parts, as well as quality." Within doors he was usually dressed in neat black. He was a very early riser, and very regular in the distribution of his day, spending the first part, to his midday dinner, always in his own room, amid his books, with an amanuensis to read for him and write to his dictation. Music was always a chief part of his afternoon and evening relaxation, whether when he was by himself or when friends were with him. His manner with friends and visitors was extremely courteous and affable, with just a shade of stateliness. In free conversation, either at the midday dinner, when a friend or two happened, by rare accident, to be present, or more habitually in the evening and at the light supper which concluded it, he was the life and soul of the company, from his "flow of subject" and his "unaffected cheerfulness and civility," though with a marked tendency to the satirical and sarcastic in his criticisms of men and things. This tendency to the sarcastic was connected by some of those who observed it with a peculiarity of his voice or pronunciation. "He pronounced the letter *r* very hard," Aubrey tells us, adding Dryden's note on the subject: "*litera canina*, the dog-letter, a certain sign of a satirical wit." He was extremely temperate in the use of wine or any strong liquors, at meals and at all other times; and when supper was over, about nine o'clock, "he smoked his pipe and drank a glass of water, and went to bed." He suffered much from gout, the effects of which had become apparent in a stiffening of his hands and finger-joints, and the recurring attacks of which in its acute form were very painful. His favourite poets among the Greeks were Homer and the Tragedians, especially Euripides; among the Latins, Virgil and Ovid; among the English, Spenser and Shakespeare. Among his English contemporaries, he thought most highly of Cowley. He had ceased to attend any church, belonged to no religious communion, and had no religious observances in his family. His reasons for this were a matter for curious surmise among his friends, because of the profoundly religious character of his own mind; but he does not seem ever to have furnished the explanation. The matter became of less interest perhaps after 1669, when his three daughters ceased to reside with him, having been sent out "to learn some curious and ingenious sorts of manufacture that are proper for women to learn, particularly embroideries in gold or silver." After that the household in Bunhill consisted only of Milton, his wife, a single maid-servant, and the "man" or amanuensis who came in for the day.

The remaining years of Milton's life, extending through that part of the reign of Charles II. which figures in English history under the name of the "Cabal Administration," were by no means unproductive. In 1669 he published, under the title of *Accedence commenced Grammar*, a small English compendium of Latin grammar that had been lying among his papers. In 1670 there appeared, with a prefixed portrait of him by Faithorne, done from the life, his *History of Britain . . . to the Norman Conquest*, being all that he had been able to accomplish of his intended complete history of England; and in the same year a Latin digest of Ramist logic, entitled *Artis logicae plenior institutio*, of no great value, and doubtless from an old manuscript of his earlier days. In 1671 there followed his *Paradise Regained* and *Samson Agonistes*, bound together in one small volume, and giving ample proof that his poetic genius had not exhausted itself in the preceding great epic. In 1673, at a moment when the growing political discontent with the government of Charles II. and the conduct of his court had burst forth in the special form of a "No-Popery" agitation and outcry, Milton ventured on the dangerous experiment of one more political pamphlet, in which, under the title "Of True Religion, Heresy, Schism, Toleration, and what best means may be used against the growth of Popery," he put forth, with a view to popular acceptance, as mild a version as possible of his former principles on the topics discussed. In the same year appeared the second edition of his *Poems . . . both English and Latin*, which included, with the exception of the Sonnets to Cromwell, Fairfax, Vane and the second address to Cyriack Skinner, all the minor poems.

Thus we reach the year 1674, the last of Milton's life. One incident of that year was the publication of the second edition of *Paradise Lost*, with the poem rearranged as now—into twelve books, instead of the original ten. Another was the publication of a small volume[1] containing his Latin *Epistolae familiares*, together with the *Prolusiones oratoriae* of his student-days at Cambridge—these last thrown in as a substitute for his Latin state-letters in his secretaryship for the Commonwealth and the Protectorate, the printing of which was stopped by order from the Foreign Office. A third publication of the same year, and probably the very last thing dictated by Milton, was a translation of a Latin document from Poland, relating to the recent election of the heroic John Sobieski to the throne of that kingdom, with the title *A Declaration or Letters Patents of the Election of this present King of Poland, John the Third.* It seems to have been out in London in August or September 1674. On Sunday the 8th of the following November Milton died, in his house in Bunhill, of "gout struck in," at the age of sixty-five years and eleven months. He was buried, the next Thursday, in the church of St Giles, Cripplegate, beside his father; a considerable concourse attending the funeral.

Family.

Before the Restoration, Milton—what with his inheritance from his father, what with the official income of his Latin secretaryship—must have been a man of very good means indeed. Since then, however, various heavy losses, and the cessation of all official income, had greatly reduced his estate, so that he left but £900 (worth about or over £2700 now) besides furniture and household goods. By a word-of-mouth will, made in presence of his brother Christopher, he had bequeathed the whole to his widow, on the ground that he had done enough already for his "undutiful" daughters, and that there remained for them his interest in their mother's marriage portion of £1000, which had never been paid, but which their relatives, the Powells of Forest Hill, were legally bound for, and were now in circumstances to make good. The daughters, with the Powells probably abetting them, went to law with the widow to upset the will; and the decision of the court was that they should receive £100 each. With the £600 thus left, the widow, after some further stay in London, retired to Nantwich in her native Cheshire. There, respected as a pious member of a local Baptist congregation, she lived till 1727, having survived her husband fifty-three years. By that time all the three daughters were also dead. The eldest, Ann Milton, who was somewhat deformed, had died not long after her father, having married "a master-builder," but left no issue; the second, Mary Milton, had died, unmarried, before 1694; and only the third, Deborah, survived as long as her step-mother. Having gone to Ireland, as companion to a lady, shortly before her father's death, she had married an Abraham Clarke, a silk-weaver in Dublin, with whom she returned to London about 1684, when they settled in the silk-weaving business in Spitalfields, rather sinking than rising in the world, though latterly some public attention was paid to Deborah, by Addison and others, on her father's account. One of her sons, Caleb Clarke, had gone out to Madras in 1703, and had died there as "parish-clerk of Fort George" in 1719, leaving children, of whom there are some faint traces to as late as 1727, the year of Deborah's death. Except for the possibility of further and untraced descent from this Indian grandson of Milton, the direct descent from him came to an end in his granddaughter, Elizabeth Clarke, another of Deborah's children. Having married a Thomas Foster, a Spitalfields weaver, but afterwards set up a small chandler's shop, first in Holloway and then in Shoreditch, she died at Islington in 1754, not long after she and her husband had received the proceeds of a performance of *Comus* got up by Dr Johnson for her benefit. All her children had predeceased her, leaving no issue. Milton's brother Christopher, who had always been on the opposite side in politics, rose to the questionable honour of a judgeship and knighthood in the latter part of the reign of James II. He had then become a Roman Catholic—which religion he professed till his death in retirement at Ipswich in 1692. Descendants from him are traceable a good way into the 18th century. Milton's two nephews and pupils, Edward and John Phillips, both of them known as busy and clever hack-authors before their uncle's death, continued the career of hack-authorship, most industriously and variously, though not very prosperously, through the rest of their lives: Edward in a more reputable manner than John, and with more of enduring allegiance to the memory of his uncle. Edward died about 1695; John was alive till 1706. Their half-sister, Ann Agar, the only daughter of Milton's sister by her second husband, had married, in 1673, a David Moore, of Sayes House, Chertsey; and the most flourishing of all the lines of descent from the poet's father was in this Agar-Moore branch of the Miltons.

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[1] *Joannis Miltonii Angli epistolarum familiarum liber unus; quibus accesserunt ejusdem (jam olim in collegio adolescentis) prolusiones quaedam oratoriae* (1674; translation by J. Hall, 1829).

Posthumous Publications.

Of masses of manuscript that had been left by Milton, some portions saw the light posthumously. Prevented, in the last year of his life from publishing his Latin *State Letters* in the same volume with his Latin *Familiar Episiles*, he had committed the charge of the *State Letters*, prepared for the press, together with the completed manuscript of his Latin *Treatise of Christian Doctrines*, to a young Cambridge scholar, Daniel Skinner, who had been among the last of his amanuenses, and had, in fact, been employed by him especially in copying out and arranging those two important MSS. Negotiations were on foot, after Milton's death, between this Daniel Skinner and the Amsterdam printer, Daniel Elzevir, for the publication of both MSS., when the English government interfered, and the MSS. were sent back by Elzevir, and thrown aside, as dangerous rubbish, in a cupboard in the State Paper Office. Meanwhile, in 1676, a London bookseller, named Pitt, who had somehow got into his possession a less perfect, but still tolerably complete, copy of the *State Letters*, had brought out a surreptitious edition of them, under the title *Literae pseudo-senatus anglicani, Cromwellii . . . nomine et jussu conscriptae a Joanne Miltono*. No other posthumous publications of Milton's appeared till 1681, when another bookseller put forth a slight tract entitled *Mr John Milton's Character of the Long Parliament and Assembly of Divines*, in 1641, consisting of a page or two, of rather dubious authenticity, said to have been withheld from his *History of Britain* in the edition of 1670. In 1682 appeared *A Brief History of Moscovia, and of other less-known Countries lying Eastward of Russia as far as Cathay* . . . undoubtedly Milton's, and a specimen of those prose compilations with which he sometimes occupied his leisure. Of the fate of his collections for a new Latin *Dictionary*, which had swelled to three folio volumes of MS., all that is known is that, after having been used by Edward Phillips for his *Enchiridion* and *Speculum*, they came into the hands of a committee of Cambridge scholars, and were used for that Latin dictionary of 1693, called *The Cambridge Dictionary*, on which Ainsworth's *Dictionary* was based. In 1698 there was published in three folio volumes, under the editorship of John Toland, the first collective edition of Milton's prose works, professing to have been printed at Amsterdam, though really printed in London. A very interesting folio volume, published in 1743 by "John Nickolls, junior," under the title of *Original Letters and Papers of State addressed to Oliver Cromwell*, consists of a number of intimate Cromwellian documents that had somehow come into Milton's possession immediately after Cromwell's death, and were left by him confidentially to the Quaker Ellwood. Finally, a chance search in the London State Paper Office in 1823 having discovered the long-lost parcel containing the MSS. of Milton's Latin *State Letters* and his Latin *Treatise of Christian Doctrine*, as these had been sent back from Amsterdam a hundred and fifty years before, the *Treatise on Christian Doctrine* was, by the command of George IV., edited and published in 1825 by the Rev. C. R. Sumner, keeper of the Royal Library, and afterwards bishop of Winchester, under the title of *Joannis Miltoni Angli de doctrina christiana libri duo posthumi*. An English translation, by the editor, was published in the same year. Those state papers of Milton which had not been already printed were edited by W. D. Hamilton for the Camden Society, in 1859.

Milton's literary life divides into three almost mechanically distinct periods: (1) the time of his youth and minor poems, (2) his middle twenty years of prose polemics, and (3) the time of his later Muse and greater poems.

Characteristics.

Had Milton died in 1640, when he was in his thirty-second year, and had his literary remains been then collected, he would have been remembered as one of the best Latinists of his generation and one of the most exquisite of minor English poets. In the latter character, more particularly, he would have taken his place as one of that interesting group or series of English poets, coming in the next forty years after Spenser, who, because they all acknowledged a filial relationship to Spenser, may be called collectively the Spenserians. In this group or series, counting in it such other true poets of the reigns of James I. and Charles I. as Phineas and Giles Fletcher, William Browne and Drummond of Hawthornden, Milton would have been entitled, by the small collection of pieces he had left, and which would have included his *Ode on the Nativity*, his *L'Allegro* and *Il Penseroso*, his *Comus* and his *Lycidas*, to recognition as indubitably the very highest and finest. There was in him that peculiar Spenserian something which might be regarded as the poetic faculty in its essence, with a closeness and perfection of verbal finish not to be found in the other Spenserians, or even in the master himself. Few as the pieces were, and owning discipleship to Spenser as the author did, he was a Spenserian with a difference belonging to his own constitution—which prophesied, and indeed already exhibited, the passage of English poetry out of the Spenserian into a kind that might be called the Miltonic. This Miltonic something, distinguishing the new poet from other Spenserians, was more than mere perfection of literary finish. It consisted in an avowed consciousness already of the *os magna soniturum*, "the mouth formed for great utterances," that consciousness resting on a peculiar substratum of personal character that had occasioned a new theory of literature. "He who would not be frustrate of his hope to write well hereafter on laudable things ought himself to be a true poem" was Milton's own memorable expression afterwards of the principle that had taken possession of him from his earliest days; and this principle of moral manliness as the true foundation of high literary effort, of the inextricable identity of all literary productions in kind, and their coequality in worth, with the personality in which they have their origin, might have been detected, in more or less definite shape, in all or most of the minor poems. It is a specific form of that general Platonic doctrine of the invincibility of virtue which runs through his *Comus*.

That a youth and early manhood of such poetical promise should have been succeeded by twenty years of all but incessant prose polemics has been a matter of regret with many. But this is to ignore his political and social side. If Burke, whose whole public career consisted in a succession of speeches and pamphlets, is looked back upon as one of the greatest men of his century on their account, why should there be regret over the fact that Milton, after having been the author of *Comus* and *Lycidas*, became for a time the prose orator of *his* earlier and more tumultuous generation? Milton was not only the greatest pamphleteer of his generation—head and shoulders above the rest—but there is no life of that time, not even Cromwell's, in which the history of the great Revolution in its successive phases, so far as the deep underlying ideas and speculations were concerned, may be more intimately and instructively studied than in Milton's. Then, on merely literary grounds, what an interest in those prose remains! Not only of his *Areopagitica*, admired now so unreservedly because its main doctrine has become axiomatic, but of most of his other pamphlets, even those the doctrine of which is least popular, it may be said confidently that they answer to his own definition of "a good book," by containing somehow "the precious life-blood of a master-spirit." From the entire series there might be a collection of specimens, unequalled anywhere else, of the capabilities of that older, grander and more elaborate English prose of which the Elizabethans and their immediate successors were not ashamed. Nor will readers of Milton's pamphlets continue to accept the hackneyed observation that his genius was destitute of humour. Though his prevailing mood was the severely earnest, there are pages in his prose writings, both English and Latin, of the most laughable irony, reaching sometimes to outrageous farce, and some of them as worthy of the name of humour as anything in Swift. Here, however, we touch on what is the worst feature in some of the prose pamphlets—their measureless ferocity, their boundless licence in personal scurrility.

While it is wrong to regard Milton's middle twenty years of prose polemics as a degradation of his genius, and while the fairer contention might be that the youthful poet of *Comus* and *Lycidas* actually promoted himself, and became a more powerful agency in the world and a more interesting object in it for ever, by consenting to lay aside his "singing robes" and spend a portion of his life in great prose oratory, who does not exult in the fact that such a life was rounded off so miraculously at the close by a final stage of compulsory calm, when the "singing robes" could be resumed, and *Paradise Lost*, *Paradise Regained* and *Samson Agonistes* could issue in succession from the blind man's chamber? Of these three poems, and what they reveal of Milton, no need here to speak at length. *Paradise Lost* is one of the few monumental works of the world, with nothing in modern epic literature comparable to it except the great poem of Dante. This is best perceived by those who penetrate beneath the beauties of the merely terrestrial portion of the story, and who recognize the coherence and the splendour of that vast symbolic phantasmagory by which, through the wars in heaven and the subsequent revenge of the expelled archangel, it paints forth the connexion of the whole visible universe of human cognisance and history with the grander, pre-existing and still environing world of the eternal and inconceivable. To this great epic *Paradise Regained* is a sequel, and it ought to be read as such. The legend that Milton preferred the shorter epic to the larger is quite incorrect. All that is authentic on the subject is the statement by Edward Phillips that, when it was reported to his uncle that the shorter epic was "generally censured to be much inferior to the other," he "could not hear with patience any such thing." The best critical judgment now confirms Milton's own, and pronounces *Paradise Regained* to be not only, within the possibilities of its briefer theme, a worthy sequel to *Paradise Lost*, but also one of the most artistically perfect poems in any language. Finally, the poem in which Milton bade farewell to the Muse, and in which he reverted to the dramatic form, proves that to the very end his right hand had lost none of its power or cunning. *Samson Agonistes* is the most powerful drama in the English language after the severe Greek model, and it has the additional interest of being so contrived that, without any deviation from the strictly objective incidents of the Biblical story which it enshrines, it is yet the poet's own epitaph and his condensed autobiography.

Much light is thrown upon Milton's mind in his later life, and even upon the poems of that period, by his posthumous Latin *Treatise of Christian Doctrine*. It differs from all his other prose writings of any importance in being cool, abstract and didactic. Professing to be a system of divinity derived directly from the Bible, it is really an exposition of Milton's metaphysics and of his reasoned opinions on all questions of philosophy, ethics and politics. The general effect is to show that, though he is rightly regarded as the very genius of English Puritanism, its representative poet and idealist, yet he was not a Puritan of what may be called the first wave, or that wave of Calvinistic orthodoxy which broke in upon the absolutism of Charles and Laud, and set the English Revolution agoing. He belonged distinctly to that larger and more persistent wave of Puritanism which, passing on through Independency, and an endless variety of sects, many of them rationalistic and freethinking in the extreme, developed into what has ever since been known as English Liberalism. The treatise makes clear that, while Milton was a most fervid theist and a genuine Christian, believing in the Bible, and valuing the Bible over all the other books in the world, he was at the same time one of the most intrepid of English thinkers and theologians. (D. MA.; X.)

Portraits.

Considerable interest attaches among collectors to the variety of prints representing portraits of Milton. So far as the original contemporary portraits are concerned, which have inspired the large number of engravings, the following may be mentioned: (1) The existing Janssen painting, 1618 ("*aetatis suae* 10"), which belonged to Mrs Milton. (2) An unknown painting of 1623 (? 1620), from which was taken an engraving in the *Gentleman's Magazine* for September 1787 ("*aet. suae* 12"). (3) The "Onslow" painting of Milton when a Cambridge scholar (lost), which belonged to Mrs Milton and in 1794 was in Lord Onslow's possession; a copy by Van der Gucht was made for Lord Harcourt and is still at Nuneham. (4) William Marshal's engraved frontispiece to Moseley's edition of the poems (1645). (5) William Faithorne's engraving of Milton from life, at the age of sixty-two, in Milton's *History of Britain* (1670). (6) Faithorne's original drawing for the above, belonging in 1909 to Sir R. H. Hobart. (7) The Bayfordbury (or Tonson) drawing (probably by Faithorne, or (?) by White or Richardson) at Bayfordbury Park near Hertford. (8) A drawing by George Vertue in Dr Williamson's collection. (9) A clay bust (? by Pierce or Simon) at Christ's College. (10) A miniature by Cooper (1653), which is, however, considered by Dr G. C. Williamson not to be of Milton at all. (11) A painting by Pieter Van der Plas (d. 1704) in the National Portrait Gallery. (12) An oil painting at Christ's College. (13) The "Woodcock" miniature of Milton when about forty-eight. In Poets' Corner, Westminster Abbey, a bust by Rysbrack was put up in 1737. A monument in St Giles, Cripplegate, by John Bacon, R.A., was erected by Samuel Whitbread in 1793; and a modern statue by Horace Montford also stands there. A memorial window in St Margaret's, Westminster, with an inscription by J. G. Whittier, was presented by G. W. Childs, of Philadelphia.

BIBLIOGRAPHY.—MSS. of the poems of Milton's earlier period in his own handwriting are preserved in the library of Trinity College, Cambridge. These are not enumerated among the gifts made by Sir Henry Newton Puckering in 1691, but presumably belonged to him, and came to the library at his death in 1700, as they were found by Charles Mason, a fellow of the college, among papers and books which had been his. They were bound in a folio volume by the care of Thomas Clarke, afterwards Master of the Rolls, in 1736. Besides the poems, with many interlineations and corrections, the MS. contains suggestions, and in some cases fully developed plans, for works generally dramatic in form. This manuscript volume, invaluable as an index to Milton's methods of work, was reproduced in facsimile (Cambridge, 1899) by W. Aldis Wright.

The first complete edition of *The Poetical Works of Mr John Milton* . . . was printed by Jacob Tonson in 1695. In 1732 Richard Bentley put forward a curious edition of *Paradise Lost* in which long passages were rejected and placed in the margin on the ground that they were interpolations made possible by Milton's blindness. The Latin and Italian poems, with a translation by William Cowper, were printed by W. Hayley in 1808. The most important of the numerous later editions of Milton's poetical works are by H. J. Todd (6 vols., 1801); J. Mitford ("Aldine edition," 3 vols., 1832); T. Keightley (2 vols., 1859), whose notes are most original and interesting; D. Masson ("Library" or "Cambridge" edition, 3 vols., 1874; of which a new edition appeared in 1890, with memoir, introduction, notes and an essay on Milton's English and versification); John Bradshaw (new "Aldine edition," 2 vols., 1892); also a careful reprint retaining the peculiarities of the earlier printed copies, by H. C. Beeching ("Oxford edition," 1904); and another, with variant readings, by W. Aldis Wright (Cambridge University Press, 1903). The prose works were first partially collected in 1697. They were edited by J. Toland (3 vols., 1698), by C. Symmons (7 vols., 1806), by Pickering (8 vols., 1851) with the poetical works, and by J. A. St John for Bohn's "Libraries" (5 vols., 1848–1853). There are numerous annotated editions of separate works.

The earliest life of Milton is contained in Wood MS. D. 4 in the Bodleian Library, Oxford, and was printed in the *Eng. Hist. Review* for January 1902, also by E. S. Parsons in *Colorado College Studies*, No. X (1903). The author, who sympathized with the poet's political views, is unknown, but the name of Milton's friend, Dr Nathan Paget, is suggested. His account formed the basis of the life given by Anthony à Wood in *Fasti oxonienses* (1691). Wood was also indebted to John Aubrey, whose *Brief Lives* were not printed until later. The life by his nephew Edward Phillips was prefixed to the *Letters of State* printed in 1694, and reprinted by William Godwin in his *Lives of E. and J. Phillips* (1815). Samuel Johnson's famous *Life of Milton* (1779), which contains some valuable criticism, is written from a somewhat unfriendly standpoint. The records of Milton's official life, available in the State Papers, were first made use of by H. J. Todd in a third edition (1829) of his *Milton*. All the available information was gathered in Professor Masson's *Life of John Milton; narrated in Connexion with the Political, Ecclesiastical and Literary History of his Time* (6 vols., 1859–1880, with index, 1894; new ed. of vol. i., 1881) which contains ample reference to original authorities. Shorter works are *Milton und seine Zeit* (2 pts., 1877, 1879), by Alfred Stern; *Milton* (1879), by Mark Pattison in the "English Men of Letters" series, and *Life of John Milton* (1890) by Dr Richard Garnett in the "Great Writers" series, with a bibliography by J. P. Anderson.

The sources of *Paradise Lost* have given rise to much discussion. It has been supposed to owe something to *Adamo*, a comedy by Giovanni Battista Andreini (1578–1652), to the *Paraphrase* associated with the name of Caedmon which was printed at Amsterdam in 1655 by Francis Junius, and to the *Lucifer* and other plays of Joost van den Vondel. Parallelisms between Vondel and Milton were pointed out by Mr Edmund Gosse in *Literatures of Northern Europe* (1879), and the comparison was carried further in Mr G. Edmundson's *Milton and Vondel; A Curiosity of Literature* (1885), a book which aroused much discussion. A valuable contribution to Miltonic criticism was made in 1893 by Mr Robert Bridges in an essay on *Milton's Prosody*. This was reprinted in 1901, with some additional matter and an essay on "Classical Metres in English Verse" by W. J. Stone. Amongst other critical essays should be mentioned essays by Macaulay (*Edinburgh Review*, 1825); Walter Bagehot (*Literary Studies*, vol. i., 1879); S. T. Coleridge (*Seven Lectures on Shakespeare and Milton* 1856); Edward Dowden (*Transcripts and Studies*, 1888); Edmond Scherer (*Études sur la littérature contemporaine*, vol. vi., 1882); Augustine Birrell (*Obiter dicta*, second series 1887); Walter Raleigh (*Milton*, 1900); E. Allodoli, *Giovanni Milton e l'Italia* (Prato, 1907).

Concordances of Milton's *Poetical Works* were compiled by G. L. Prendergast (Madras, 1856–1857); by C. J. Cleveland (1867), based on a verbal index used in an American edition 1853, of the *Poetical Works*; by John Bradshaw (1894), by L. E. Lockwood, *Lexicon to the English Poetical Works of John Milton* (New York, 1907).

The tercentenary of Milton's birth was celebrated in 1908 in Cambridge, London and elsewhere. An exhibition of the portraits of Milton, authentic and supposed, with a great collection of valuable editions of the poet's works, was held in June and July at Christ's College, Cambridge. The catalogue of this exhibition, drawn up by Dr G. C. Williamson, forms a valuable bibliography and iconography of the poet. A collection of Milton autographs, early editions and portraits was also held in December at the British Museum, and the anniversary itself was celebrated by a special meeting of the British Academy, at which papers by Professors W. J. Courthope, Edward Dowden and others were read. There was a religious service at St Mary-le-Bow, Cheapside, and a banquet at the Mansion House.

MILTON, a township of N.E. Norfolk county, Massachusetts, U.S.A., about 7 m. S. of Boston, the Neponset river forming a large part of its N. and N.W. boundary. Pop. (1890), 4278; (1900), 6578 (1840 being foreign-born); (1905, state census), 7054; (1910) 7924. It is served by the New York, New Haven & Hartford railway, and is primarily a residential suburb of Boston, with which it is connected by electric lines. The township covers an area of about 13 sq. m., and includes the villages of Milton, East Milton and Mattapan. The country is rolling and hilly, the Blue Hills (with the exception of a part included in Braintree in 1712 and now in Quincy) lying in Milton. On Great Blue Hill, the highest (635 ft. above tide-level), great fires were kindled at the news of the repeal of the Stamp Act, of the adoption of the Declaration of Independence, and of the surrenders of Burgoyne and Cornwallis; beacon fires were burned during the American War of Independence; an "observatory" for tourists was built at an early date; and in 1885 the Blue Hill Observatory for meteorological investigation was established by Abbott Lawrence Rotch (b. 1861), who made important investigations concerning clouds, and attracted attention by his use of kites for obtaining meteorological data. Milton Academy (a non-sectarian school) was founded in 1798, opened in 1805, and suspended in 1867; a new academy was opened in 1885. There is a public library, which was opened in 1871, and in 1909 had more than 20,000 volumes. Cunningham Park is under the control of the trustees of a fund left for the benefit of the township, and contains a gymnasium, skating-pond, tennis courts, &c., open to townspeople only. Hutchinson Field, another public park, is a part of the estate of the last royal governor, Thomas Hutchinson; Governor Jonathan Belcher also lived in Milton for a time. There are two granite quarries in the township immediately north-west of the Blue Hills; the granite is of the "dark Quincy" variety—dark bluish grey in colour—and is used chiefly for monuments. Milton, originally a part of Dorchester, was first settled in 1640, and was called Uncataquissett. The township was separated from Dorchester and incorporated in 1662. It owes its name either to its early paper and grist mills (Milton being abbreviated from Milltown) or to Milton Abbey, Dorset, whence members of the Tucker family came, it is supposed, to Milton about 1662. In 1712 the Blue Hill lands were divided between Milton and Braintree, and in 1868 part of Milton was included in the new township of Hyde Park. In Milton, on the 9th of September 1774, at the house of Daniel Vose, a meeting, adjourned from Dedham, passed the bold "Suffolk Resolves" (Milton then being included in Suffolk county), which declared that a sovereign who breaks his compact with his subjects forfeits their allegiance, that parliament's repressive measures were unconstitutional, that tax-collectors should not pay over money to the royal treasury, that the towns should choose militia officers from the patriot party, that they would obey the Continental Congress and that they favoured a Provincial Congress, and that they would seize crown officers as hostages for any political prisoners arrested by the governor; and recommended that all persons in the colony should abstain from lawlessness.

See A. K. Teele, *History of Milton, Mass., 1640 to 1887* (Milton, 1887).

MILTON, a borough of Northumberland county, Pennsylvania, U.S.A., on the Susquehanna river at the mouth of Limestone Run, about 66 m. N. of Harrisburg. Pop. (1890), 5317; (1900), 6175 (166 foreign-born); (1910), 7460. It is served by the Pennsylvania, and the Philadelphia & Reading railways, and is connected with Lewisburg and Watsontown by an electric line. Milton has an attractive public park, is in an agricultural region, and has various manufactures. It was founded in 1792, and incorporated as a borough in 1817. In 1880 it was in great part destroyed by fire.

MILWAUKEE, a city and the county-seat of Milwaukee county, Wisconsin, U.S.A., the largest city of the state, at the mouth of the Milwaukee river on the W. shore of Lake Michigan, about 85 m. N. of Chicago. Pop. (1900), 285,315; (1910), 373,857. The Milwaukee river entering the city from the north is joined about ½ m. from its mouth by the Menominee flowing from the west and a short distance from the lake by the Kinnikinnic flowing from the south. These rivers are navigable for lake traffic into the heart of the city. Milwaukee Bay, into which their combined waters empty, is an inlet of Lake Michigan, about 6 m. across. By the construction of extensive piers and breakwaters a fine harbour of refuge has been created; and its inner harbour is deep enough for the largest lake-steamers.

From the shore of the lake the land rises, rather abruptly in most places, to a height of from 75 to 100 ft. From a broad plateau overlooking the lake the land slopes gradually westward to the river, again rising on the north, west and south to a height of 125 ft. or more. The rivers separate the city into three distinctly marked divisions of varying character known as the east, west and south sides. The manufactories are largely on the "flats" along the rivers and on the south side. The extensive use as building material of cream-coloured brick made in the vicinity gives the city its nickname, "the Cream City."

The city has many beautiful parks and squares, the most picturesque of which is Juneau Park, along the lake bluff. It contains statues of Leif Ericsson and Solomon Juneau. Other parks are Lake Park, also on the lake shore, at North Point, where stands the waterworks pumping station with its tall tower; Riverside and Kilbourn Parks, east and west respectively of the upper Milwaukee river, in the northern part of the city, Washington Park on the west side, containing a menagerie and a herd of deer; Sherman Park on the west side, and Kosciusko, Humboldt and Mitchell Parks on the south side. McKinley Park on the lake shore south of the city, and Whitefish Bay 6 m. north of the city, are popular bathing resorts. In addition to the statues in Juneau Park there is a statue of Kosciusko in the park of that name; one of Washington and a soldiers' monument on Grand Avenue; a statue of Henry Bergh in front of the city hall; one of Robert Burns in the First Ward Park, and, in Washington Park, a replica of Ernst Rietschel's Schiller-Goethe monument in Jena, given to the city in 1908 by the Germans of Milwaukee. Of the several cemeteries, that of Forest Home, south-west of the city, is the largest and most beautiful. The city is well sewered, and has an excellent water-supply system owned by the municipality and representing an investment of more than $5,000,000. The water is obtained from Lake Michigan through an intake far out in the lake. Through a tunnel ½ m. long, constructed in 1888, water is pumped by means of one of the largest single pumps in the world from the lake into the upper Milwaukee river, which is thus completely flushed by fresh water every twenty-four hours.

Milwaukee is one of the most healthful of the larger cities of the United States. Its average annual death-rate for 1900–1904 was 13·6. The proximity of Lake Michigan cools the atmosphere in summer and tempers the cold in winter. As a result, the extremes of heat and cold are not as great as those in most inland cities. The mean monthly temperatures vary between 20° in January and 70° in July, with extremes of 100° and −25°. The mean annual precipitation is 31·4 in.

Suburbs.—Milwaukee proper occupies 22½ sq. m., a small area as compared with other cities near it in population—Detroit (36 sq. m.) and Washington, D.C. (69¼ sq. m.). As a result, the population has overflowed into several populous suburbs industrially a part of a "greater" Milwaukee. Of these by far the most important are the township of Wauwatosa (pop., 1905, 11,132; 1910, 11,536), and the city of the same name, separated from the township in 1897 and having in 1910 a population of 3346; the city and township are on the Menominee river, immediately adjoining the city on the west. The first settlement was made here in 1835. Wauwatosa has important manufactures, including machinery. brick, lime, beer, chemicals and wooden-ware, and extensive market gardens and nurseries and valuable stone quarries. It has a Carnegie library, and is the seat of an Evangelical Lutheran theological seminary (1865), of Lutheran homes for the aged and orphan, of the Milwaukee county hospital for the insane, of the Milwaukee sanatorium for nervous diseases, and of the north-western branch of the national soldiers' home, which has grounds covering 385 acres and with main building and barracks affording quarters for over 2000 disabled veterans, and has a hospital, a theatre, and a library of 15,000 volumes. Within the limits of Wauwatosa also are the State Fair grounds. Other suburbs are West Allis pop., 1905, 2306; U. S. census 1910, 6645), an incorporated rapidly growing manufacturing city on the west; Cudahy (pop., 1910, 3691), a manufacturing village south of Milwaukee, largely devoted to meat packing; South Milwaukee (pop. 1910, 6092), an incorporated city with several large manufactories, and North Milwaukee (pop., 1910, 1860), a village immediately adjoining the city on the north.

Public Buildings, Institutions, &c.—The principal public building in the city is the Federal building (1895–1898), the post office, customhouse and local headquarters for the United States courts. The public library and museum, on the north side of Grand Avenue, in addition to an excellent collection of natural history, palaeontology, &c., contained in 1909 a library of about 190,000 volumes. The city hall on the east side is surmounted by a tall clock-tower containing one of the largest bells in the world. The Layton Art Gallery contains one of the best collections of paintings west of the Alleghanies. The chamber of commerce, and the Pabst, Mitchell, North-Western Life Insurance, Germania Sentinel and Wells buildings, are among the principal business structures. In Milwaukee are St John's Roman Catholic Cathedral and All Saints Protestant Episcopal Cathedral—the city is the see of a Roman Catholic archbishopric (established in 1892) and of a Protestant Episcopal bishopric. Among other church structures are Plymouth Congregational, Westminster Presbyterian, Church of Gesu (Roman Catholic) and Trinity Lutheran. The hotels include the Pfister on the east side and the Plankinton, the Republican and the Schlitz on the west side. Among the theatres are the Davidson, Majestic, Schubert, Bijou, Alhambra and the Pabst German. During the summer there are open-air theatres in several private parks or "gardens." The social clubs include the Milwaukee, Deutscher-Concordia, University and Marquette clubs. The predominance of Germanic influence in the city is evidenced by at least 75 musical clubs and numerous *Turnverein* societies. There are 12 hospitals (3 of them city institutions), 6 orphan asylums, 4 homes for the aged, a foundlings' home and a state industrial school for girls.

The educational institutions are numerous. Marquette University was established in 1906 by a union of Marquette College (1881), a Roman Catholic school of high rank, and existing schools of medicine, pharmacy, dentistry and law; in 1908 it added a department of engineering, and in that year it had 81 instructors and 630 students. Milwaukee-Downer College (for girls), in the north-east part of the city was established in 1895 by a consolidation of Milwaukee College for girls, and Downer College, formerly at Fox Lake. Other institutions are Concordia College (1881, Lutheran), a state normal school (1880), the Wisconsin College of physicians and surgeons (1893), the national German-American teachers' seminary (normal), Milwaukee academy (1864), Milwaukee University school, Milwaukee school of engineering (1904), Milwaukee Turnverein school of physical culture, one of the largest schools of the sort in the United States, St John's Catholic institute, Our Lady of Mercy academy (Roman Catholic), Wisconsin academy of music, the Wisconsin school of art (art students' league), a Catholic normal school, St Rose's manual training school, the industrial chemical institute (the only technical school for brewers in the United States) and several business and commercial schools. At St Francis, adjoining the city on the south, is the seminary of St Francis of Sales (Roman Catholic), and St Joseph's institute for deaf mutes (Roman Catholic). The Milwaukee public school system comprises four high schools, a high school of trades, and in addition to the ordinary grades, a kindergarten department and day schools for the blind and deaf.

Transportation.—Milwaukee is favourably situated commercially, with excellent facilities for shipping both by lake and rail afforded by four trunk lines and a dozen lines of lake steamboats. It is served by the Chicago & North-Western, the Chicago, Milwaukee & St Paul, the Minneapolis, St Paul & Sault Ste Marie, the Grand Trunk, and the Père Marquette railways. The last-named connects with the main line at Ludington, Michigan, by means of a railway ferry across Lake Michigan; the Grand Trunk has a railway ferry from Milwaukee to Grand Haven. The city's extensive street railway system connects with interurban electric lines leading to Waukesha, Oconomowoc and Watertown on the west, Sheboygan and Fond du Lac on the north, and Chicago and intermediate points along the lake shore on the south.

Trade and Commerce.—Commercially Milwaukee is one of the most important of the inland cities of the United States, although its trade it largely domestic. It is a distributing point for a considerable part of Wisconsin, and several states farther west, its wholesale business aggregating about $350,000,000 annually. The country produce sold in Milwaukee averages about $75,000,000 a year in value. The chief commodities of trade are coal, grain, lumber, flour and various products of the city's own manufactories. Milwaukee is an important grain shipping port—in 1908 it shipped 28,618,519 bushels of grain and 3,752,033 barrels of flour, and its 25 elevators have a capacity of over 12,500,000 bushels. It is one of the largest distributing centres in the country for coal, which is received by lake, and stored in enormous coal docks for transshipment by rail throughout the west and north-west. The city is a port of entry, and in 1908 its imports were valued at $3,080,437, and its exports at only $75,525.

Manufactures.—In 1905 the total value of Milwaukee's factory products was $138,881,545, 25·3% more than in 1900. In the manufacture of malt liquors and malt Milwaukee stands first among the cities of the United States and of the world. The total value of these products for 1905 was $29,909,248, of which $22,134,580 was the value of malt liquors and $3,774,668 was the value of malt. In 1905 Milwaukee manufactured 77·1% of the malt liquors manufactured in the state and 7·4% of the entire product of the United States. Other products exceeding $1,000,000 in value were: leather ($14,074,397), Milwaukee being second in the manufacture of leather among the cities of the United States: foundry and machine shop products ($10,232,723); iron and steel ($7,010,793); flour and grist-mill products ($6,320,428); slaughtering and meat-packing products ($5,958,515); men's clothing ($4,759,548); boots and shoes ($2,929,405); electrical machinery, apparatus and supplies ($2,257,229); chewing and smoking tobacco ($1,966,930) and cigars and cigarettes ($1,540,019); furniture ($1,767,290); trunks and valises ($1,623,310); hosiery and knit goods ($1,535,176); confectionery ($1,379,668); stoves and furnaces ($1,288,931); leather gloves and mittens ($1,207,633); structural iron work ($1,037,217); wooden packing boxes ($1,024,750); and paints ($1,015,774). Among Milwaukee's largest industrial establishments are: the Pabst and the Schlitz breweries, on the west side of the city, the machine shops (35 acres) of the Allis-Chalmers Company at West Allis, employing about 5000 men and making engines of all kinds; and the plant of the Illinois Steel Company, at Bay View on the south side, which covers 154 acres. The flour mills of Milwaukee have a capacity of about 12,000 barrels a day. Two of the city's tanneries are among the largest in America. In the Menominee river valley the peculiar cream-coloured Milwaukee bricks are made. North of the city on the Milwaukee river are extensive cement works.

Newspapers.—The first newspaper in Milwaukee, the *Advertiser*, began publication in 1836. The first German newspaper was established in 1844. In 1909 there were eleven daily newspapers, as follows: *Evening Wisconsin* (1847; Republican), *Free Press* (1901; Independent Republican), *Journal* (1882; Independent Democrat), *News* (1886; Independent), and *Sentinel* (1837; Republican), the oldest paper in continuous publication, *Daily Commercial Letter* (Commercial), *Reporter* (legal and commercial), *Dziennik Milwaucki* (Polish), *Kuryer Polski* (1888; Republican; Polish), *Germania Abendpost* (1872; Independent; German); and *Der Herold* (1854; Independent; German). Of more than a hundred other publications thirty-two, 10 monthly or quarterly and 22 weekly, were published in German. There are 5 Polish weekly publications, 3 Bohemian, 1 Italian and one periodical for the blind.

Population.—The population of Milwaukee in 1840 was only 1712. During the following decade there was a steady flow of immigrants from the eastern states and from Europe, with the result that in 1850, two years after the admission of Wisconsin to the Union, the population was 20,061. The population at the succeeding decennial censuses was as follows: (1860), 45,246; (1870), 71,440; (1880), 115,587; (1890), 204,468; (1900), 285,315. In 1905, according to the state census, the population was 312,948. The fact that out of a population of 285,315 in 1900, 88,991 were foreign-born, and 235,889 were of foreign parentage, that 53,854 were born in Germany, that 124,211 had both parents born in Germany, and that 26,834 additional had one or the other parent born in Germany, stamps the character of Milwaukee's population. The negro population in 1900 was only 862. The proportion of illiterates is small. Of the male population, aged 10 years or more, only 3206 (2968 foreign-born whites; 194 native-born whites) were illiterate in 1900.

Government.—Milwaukee is governed under a city charter of 1874, providing the form of city government most common in America, a mayor (elected biennially) and a single board of aldermen. There are the usual administrative boards whose members are appointed by the mayor, some of them with the approval of the board of aldermen, though the board of school directors is elected by direct popular vote. Two boards of civil service commissioners, one for fire and police departments and one for all other departments, have supervision over the city's civil service.

The assessed valuation of taxable property, in the city, in August 1906 was $201,585,127, of which $157,611,560 represented realty and $43,973,567 personality. The valuation is about 60 % of the actual value. The tax rate for all purposes in that year was $2·26 per $100. According to a special report of the census the cost of the city government of Milwaukee in 1906 was smaller per capita than that of any other city in the country with a population of over 300,000. At the close of the year 1906 the total debt was $8,835,049, and the funded debt was $8,106,500.

History.—The first Europeans known to have visited the site of Milwaukee were Father Jacques Marquette, the Jesuit missionary, and his companion, Louis Joliet, who on their return in the autumn of 1673 to the mission of St Francis Xavier at De Pere from their trip down the Mississippi, skirted the west shore of Lake Michigan in their canoes from Chicago northward. Milwaukee Bay is distinctly marked in the map attributed to Marquette, the original of which is now in the Jesuit College at Montreal, Canada; it was discovered in a convent in Montreal by Felix Martin (1804–1886), of the Society of Jesus, and was copied by Parkman. In 1679 La Salle and his party probably stopped here on their way south, and in the Jesuit *Relations* of that year the name Milwaukee first appears, as "Millioke." This, and the various other spellings of the name, attempted to reproduce the Indian name of the village here, which Kelton thinks was pronounced Minewagi and meant "there is a good point" or "there is a point where huckleberries grow," in allusion to the fertile soil. Doubtless the *coureurs du bois* who at this time began to frequent the Wisconsin forests, touched at the bay many times within the succeeding years as the place was known to be a favourite rendezvous of the Fox (or Outagamie) Indians. In 1699–1700 Father St Cosme, a Recollet friar, was here, finding bands of Mascoutens, Fox, Winnebago and Potawatomi. He called the river "Melwarik," "Melwarck" and "Meliwarik."

For more than half a century no definite reference to the place can be found. In 1760 its advantageous situation attracted the adventurous trader, Alexander Henry, the first Englishman known to have visited the spot. Three years later (1763) there was a French fur-trading post here, but it is uncertain just when it was established or how long it was maintained. In 1795 Jacques Vieau, a Frenchman in the employ of the North-Western Fur Company, established a permanent post here, which seems to have continued, under his direction, with practically no interruption until 1820, when it was superseded by that of Astor's American Fur Company. Vieau built a dwelling and a warehouse and conducted extensive trading operations. In 1818 there joined the settlement a young Frenchman named Laurent Solomon Juneau (1793–1856), who married one of Vieau's daughters and eventually bought out his business. Juneau and several others who arrived at about the same time built homes on the east side of the river near the foot of the present Wisconsin Street. Vieau's house and store was at this time on the south side. Milwaukee was on the direct route of travel between Fort Dearborn (Chicago) and the flourishing settlement at Green Bay, and at once after the treaties between the United States and the Menominee in 1831 and 1833 for the extinguishing of the Indian titles, settlers began to come to the neighbourhood. A map of 1830 shows a small settlement on "Milwalky Bay"; and the treaty of the 8th of February 1831 speaks of the "Milwauky or Manawauky River." Morgan L. Martin (1805–1887) of Green Bay, a lawyer and judge, and a delegate to Congress in 1845–1847 from Wisconsin territory, explored the harbour facilities in 1833 and made a map of the place which he called "Milwaukie." He entered into an agreement later in the same year with Juneau and Michael Dousman for its development. A saw-mill was built in 1834, and settlers began to arrive. The east side was platted in the summer of 1835, and very soon afterward the plat of a settlement on the west side was also recorded, Byron Kilbourn being the chief projector and proprietor of the latter. The rival settlements, officially known as Milwaukee East Side and Milwaukee West Side, bore the popular designations of "Juneautown" and "Kilbourntown." A third settlement, begun on the south side by George H. Walker and known as "Walker's Point," was subsequently platted independently. The rivalry between the east and west side towns was intense, the plats were so surveyed that the streets did not meet at the river, and there were bitter quarrels over the building of bridges. Milwaukee county was set off from Brown county in 1834, and in 1836 the establishment of townships was authorized. Under this act the east and west sides were independently incorporated in February 1837. A realization that the continuation of independent and rival corporations retarded growth eventually led to a compromise by which the two were united as two wards of the same village in 1839, the autonomy of each being still recognized by an odd arrangement whereby each maintained practically independent management of its finances and affairs. Walker's Point, the south side, was annexed as a third ward in 1845, and in 1846 the three wards were incorporated as the city of Milwaukee, of which Solomon Juneau was elected first mayor. The influence of this early rivalry may be seen in several provisions of the existing city charter.

About 1840 a strong tide of immigration from Germany set in, continuing steadily for a half-century. It was greatly accelerated by the German revolutionary movements of the late 'forties, which added to the city's population a considerable element of educated Germans of the upper class. From this time the Teutonic character of the population was marked. The first newspaper, the *Advertiser*, began publication in 1836; the first bank was established in 1837. In 1839 George Smith and Alexander Mitchell established the Fire and Marine Insurance Company Bank. As "Mitchell's Bank" this institution was known for forty years as one of the strongest banking houses west of the Alleghanies, its notes passing at par during panics in which even the government issues were depreciated. Through it the Chicago Milwaukee & St Paul and other western railways were financed. Beer was first brewed in Milwaukee in 1840. Milwaukee was connected with Chicago by telegraph in 1849, and by railway in 1856. Previous to this, however, in 1851, the first train ran over the Chicago Milwaukee & St Paul railway to Waukesha, and in 1857 through trains were run over the same road to the Mississippi at Prairie du Chien.

See J. S. Buck, *Pioneer History of Milwaukee* (4 vols., Milwaukee, 1876–1886); A. C. Wheeler, *Chronicles of Milwaukee* (Milwaukee, 1861); E. S. Mack, "The Founding of Milwaukee" in *Proceedings of the State Historical Society for 1906* (Madison, 1907); and L. M. Larson, *Administrative History of Milwaukee* (Madison, Wisconsin, 1908).

MIMETITE, a mineral consisting of lead chloro-arsenate, $(PbCl)Pb_4(AsO_4)_3$, crystallizing in the hexagonal system and closely resembling pyromorphite (*q.v.*) in appearance and general characters. The arsenic is usually partly replaced by equivalent amounts of phosphorus, and there may thus be a gradual passage from mimetite to pyromorphite. The two species can, as a rule, only be distinguished by chemical analysis, and because of their close resemblance the less frequently occurring chloro-arsenate was named mimetite or mimetesite, from Gr. μιμητής, imitator. Crystals of pyromorphite though usually optically uniaxial are sometimes biaxial, but in mimetite this anomalous character is almost always present; a cross-section of a hexagonal prism of mimetite shows a division into six optically biaxial sectors or a complex lamellated structure. In colour mimetite is usually yellow or brown, rarely white or colourless; the lustre is resinous to adamantine. The hardness is $3\frac{1}{2}$, and the specific gravity 7·0–7·25. Like pyromorphite, mimetite is found in the upper parts of veins of lead ore, where it has been formed by the oxidation of galena and mispickel. When found in large amount it is of importance as an ore of lead. The best crystallized specimens are those from Johanngeorgenstadt in Saxony and Wheal Unity in Cornwall. It was formerly found in considerable amount at Dry Gill in Cumberland, as six-sided barrel-shaped crystals of a brownish-red or orange-yellow colour and containing a considerable proportion of phosphoric acid; this variety has been called campylite, from Gr. καμπύλος, curved, on account of the remarkable curvature of the faces of the crystals. (L. J. S.)

MIMICRY, in zoology, the deceptive and advantageous resemblance presented by defenceless and edible species of animals to other species of animals living in the same locality, which are harmful or distasteful and are consequently avoided by all or by a majority of the enemies of the class to which the mimetic and usually the mimicked species belong. Mimicry is a special form of protective resemblance, differing from ordinary protective resemblance as exemplified by the similarity of the resting goat-sucker to a piece of bark or of leaf- and stick-insects to the objects after which they are named, in that the imitated object belongs to the animal kingdom and not to the vegetable kingdom or to inorganic nature. Although, like protective resemblance, quite independent of affinity between the organisms concerned in the likeness, mimicry occurs most commonly between animals structurally similar, and therefore related, to one another, the relationship may be close or remote. For instance, the commonest and best-known cases are found in insects where both mimic and model may belong to the same genus, sub-family, family or order, or to different orders. More rarely it occurs between members of distinct classes of the same sub-kingdom, *i.e.* between spiders and ants or spiders and beetles; yet even in this case both mimic and model have in common certain fundamental structural points to which the finishing touches completing the mimetic likeness are superadded. Still more rarely mimicry exists between totally unrelated species like caterpillars and snakes or spiders and snails. But in no case does it appear that the modifications in shape and colour, which contribute to bring about a mimetic resemblance, are greater and more elaborate than those which result in the simpler examples of ordinary protective resemblance.

The principle of protective resemblance, for which the term mimicry, as above defined, was originally employed, was first explained by H. W. Bates. Subsequently the meaning of the word was extended by F. Müller to include cases of mutual resemblance between two or more noxious species inhabiting the same area. Hence the resemblances belonging to the first category are commonly termed "Batesian mimicry," and those belonging to the second category "Müllerian mimicry," or more properly "Müllerian resemblance." The difference between the two phenomena is essential and evident; but without experimental information as to palatability it is impossible to know with certainty to which of the two a particular case of mimicry is to be assigned. Over and over again extended knowledge on this point and inferences drawn from other facts have shown the certainty or probability of examples of mimicry being in reality "Müllerian," which were previously accepted without question as "Batesian." A simple illustration will serve to explain these two aspects of mimicry and to show the advantage in the struggle for existence that mimicry confers upon the species concerned.

There is a common English Syrphid fly (*Eristalis tenax*) known as the drone-fly from its resemblance to a large hive or honey bee. Honey bees are protected from a large number of insect enemies because they sting and are distasteful. Insect-eating birds soon learn to associate distastefulness with the size, form and colour of the bees, and consequently leave them alone after one or more trials. But flies of the drone-fly kind cannot sting, and, so far as is known, are perfectly innocuous and edible. The advantage to the fly of its deceptive resemblance to the bee is theoretically perfectly evident and practically can be demonstrated by experiment. It is in the first place a matter of common knowledge that human beings who have been taught to avoid handling bees invariably fear to touch drone-flies, unless specially trained to distinguish the one from the others. Moreover, Professor Lloyd Morgan found that young birds that had tasted and rejected workers of the hive bee as unpalatable subsequently refused to taste not only drones, which have no sting, but also drone-flies. So far as our information at present extends the resemblance between these two insects is a simple case of mimicry in the Batesian sense of the word. That is to say, an edible species is protected by resembling one that is inedible. But if it be discovered, as is possible, that the drone-fly is also inedible, the mimicry must be ascribed to the Müllerian category, and the reason for it becomes less evident. In what way, it may be asked, are two or more distasteful species of insects, occurring in the same locality, benefited by resembling each other? The ingenious explanation suggested by Fritz Müller for similar cases met with in butterflies is probably the true answer. This explanation depends upon what is now an experimentally demonstrated fact that insectivorous birds, and probably other animals, have no instinctive knowledge of what insects are edible and what inedible. This knowledge is acquired by experience; and since it is not, at all events as a rule, taught by the first taste to any individual bird, it is reasonable to infer that a considerable amount of injury, sufficient to disable if not to kill, is annually inflicted upon insects belonging to species protected by distastefulness or kindred qualities. Now insects that possess noxious attributes, and the same is true of other animals, usually have a conspicuous warning coloration which appeals to the eyes of enemies and helps them to remember more easily the cause of an unpleasant experience, helps in fact to establish a psychical association between a particular style of coloration and a nasty taste or a painful wound. This being so, it is evident that if all the distasteful species in a given area are differently coloured, some individuals of all the species will be annually sacrificed to the experimental tasting of inexperienced foes before the numerous lessons have been learnt. But if all the species in question resemble each other the resemblance will be mutually beneficial to them because the association between the two attributes they have in common, namely distastefulness and a particular scheme of colour, will be rapidly established. One lesson only, instead of many, has to be learnt; and once learnt at the expense of a few individuals of one or two species it will thereafter be applied indiscriminately to all. This type of mimicry has been well defined by Professor E. B. Poulton as the unification of warning colours.

Since belief in the adequacy of the two theories, above outlined, to account for the facts they profess to explain, depends ultimately upon the testimony that can be brought forward of the usefulness of warning characters, of the deception of mimicry and of the capacity for learning by experience possessed by enemies, it is necessary to give some of the evidence that has been accumulated on these points. (1) In South America there are butterflies formerly grouped as Heliconidae which are conspicuously coloured, slow of flight and abundant in individuals so as to be susceptible of easy capture. They possess scent glands. By observation and experiment it was discovered independently by Messrs Bates, Wallace and Bell that they are not attacked by birds nor by many other enemies that prey upon unprotected Lepidoptera. (2) As the result of a series of trials made in Calcutta F. Finn came to the conclusion that young birds have no instinctive knowledge of the unpalatability of distasteful insects, but that experimental tasting soon teaches them to recognize and avoid species they have previously rejected with dislike, and that having once learnt the lesson they long remember it. (3) That birds may also be deceived by insects that mimic those they have found to be uneatable has been shown by the above-quoted experiment with the drone-fly and the honey-bees made by Professor Lloyd Morgan. He also found that chickens that had been given meal moistened with quinine and placed upon glass slips banded black and yellow, afterwards refused to touch meal moistened with water and spread upon the same slips, although they had previously eaten it with readiness off plain coloured slips. With two exceptions, these chickens that had learnt to associate black and yellow banding with a bitter taste also refused to touch the caterpillar of the cinnabar moth (*Euchelia jacobaeae*), which is banded with these colours. Moreover, young birds that had been taught by experience that these caterpillars are uneatable also left wasps untouched. (4) Guy Marshall once offered to a baboon a distasteful butterfly (*Acraea anemosa*), holding the insect in such a way as to display its bright red and black markings to the monkey. It was taken but rejected after being tasted. A specimen of another butterfly (*Precis sesamus*) which mimics the *Acraea* was then offered in the same manner. The baboon took it, held it in her hands for a few moments, and then let it escape uninjured without trying to taste it. But when another butterfly of the same species, but with the wings cut off, was offered to her she promptly ate it without showing any sign of dislike. The results of this experiment with the baboon and of those with the birds are precisely what would be expected if the theory of mimicry is true. Experiments to test distastefulness have also been made with various kinds of insectivorous Arthropoda, like spiders and mantises. These experiments have shown that Arthropods also have their likes and dislikes in the matter of insect-food and frequently refuse to eat insects which are warningly coloured and are distasteful to vertebrated enemies. They appear, however, to have no appreciation of mimetic and warning colours, and have therefore not influenced in any way the evolution of mimetic resemblances dependent upon hues and patterns. Nevertheless, as explained below, it seems to be highly probable that ant-imitating insects and spiders, when the resemblance is dependent to a greater extent upon size, shape and movement than upon tint, have acquired their mimetic likeness especially to protect them from the attacks of such insect-enemies as predaceous wasps of the family Pompilidae, flies of the family Asilidae, and from so-called parasitic hymenoptera of the family Ichneumonidae, as well as from other insect-eating Arthropods.

The term mimicry has also been applied to resemblances of a different kind from the two enumerated above—resemblances, that is to say, by which predaceous species are supposed to be enabled to approach or mix without detection with animals they prey upon or victimize in other ways. To this end the resemblance may be actually to the species victimized or preyed upon or else to a species which the species preyed upon does not fear. This phenomenon is termed " aggressive mimicry " as opposed to the Batesian and Müllerian phenomena, which are termed " protective mimicry." A few possible cases of aggressive mimicry are enumerated in the following summary of some of the recorded cases of mimicry in different classes of the animal kingdom; but the phenomenon is of comparatively rare occurrence, and the supposed instances may be susceptible of other interpretations, excluding them altogether from mimicry, or bringing them under the Batesian or Müllerian interpretation of the phenomenon.

Among mammalia there are no certain cases of mimicry known. It has been claimed that the resemblance between some of the Oriental tree-shrews of the genus *Tupaia* and squirrels comes under the category of aggressive mimicry, the tupaias being enabled by their likeness to approach and pounce upon small birds or other animals which, mistaking them for the vegetable-feeding squirrels, make no effort to get out of the way. But this hypothesis cannot be accepted as furnishing a satisfactory explanation of the likeness. For in the first place there seems to be no good reason for thinking that the Tupaias feed to any considerable extent upon prey of that kind, and in the second place the resemblance is due to characters which may be merely adaptations to a similar mode of life. A long and bushy tail, for instance, is a useful balancer and is a not uncommon feature in mammals which lead an active arboreal life. Similarly the dull coloration of the two sets of animals is very possibly procryptic and serves to hide both shrews and squirrels from enemies. Hence there seem to be good reasons for regarding the likeness in question as due to similarity in habitat and not as mimetic.

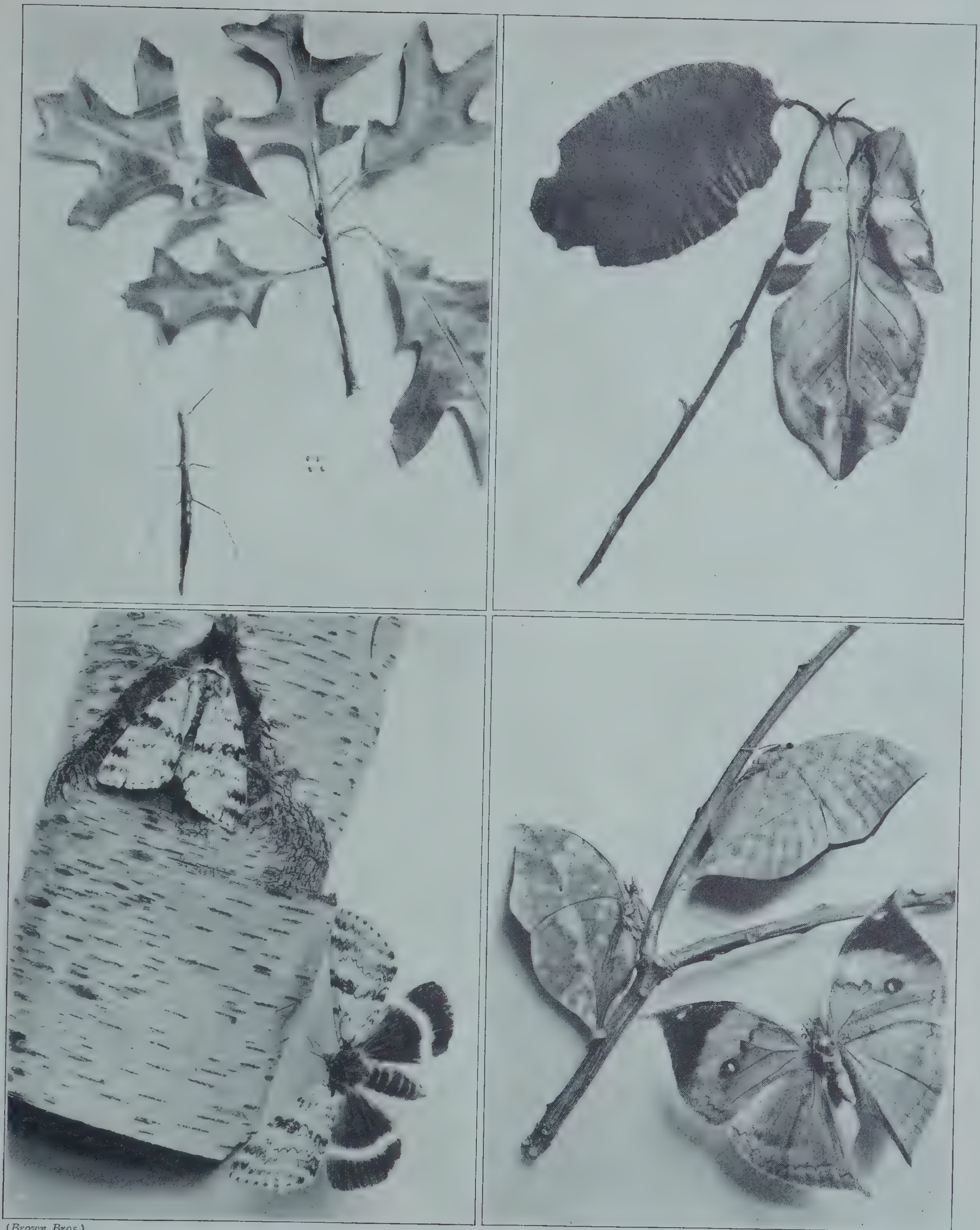
In East and South Africa there is a genus of Mustelidae known as *Ictonyx* (*Zorilla*) which possesses a foetid odour and is warningly coloured with black and white bands after the manner of skunks. There also occurs in South Africa another member of this family (*Poecilogale albinucha*), which is very similarly coloured. It is possible that this resemblance is mimetic in the Batesian sense of the word, and that the *Poecilogale*, if inoffensive, profits by its likeness to the highly offensive and warningly coloured *Ictonyx*. But, on the other hand, *Poecilogale* may itself be a protected form since subcaudal stink-glands are commonly found in species of the weasel tribe. If this be the case the two species probably furnish an instance of true Müllerian mimicry. In South America there is considerable superficial resemblance between the little bush dog (*Speothos venaticus*) of Guiana and Brazil and the large weasel-like animal of the same countries—the tayra (*Galera barbara*). The tayra is, when adult, black beneath and on the legs, and not uncommonly has a considerable quantity of greyish hair on the head. In these particulars, as well as in size and shortness of leg, the dog resembles the weasel; and since there are good reasons for believing that the latter is protected alike by ferocity and stink-glands, it is quite possible that the dog, of unusual coloration and form for the Canidae, is protected from the attacks of pumas, jaguars and ocelots by his likeness to the tayra.

A few cases of mimicry have been recorded in birds. The common cuckoo and some other species inhabiting Africa and Asia closely resemble sparrow-hawks. Some cuckoos are singular for their habit of using the nests of smaller birds to lay their eggs in, so that the young may be reared by foster-parents; and it has been suggested that the object of the likeness exhibited to the hawk is to enable the cock cuckoo either to frighten the small birds away from their nests or to lure them in pursuit of him, while the hen bird quietly and without molestation disposes of her egg. The fact that both sexes of the cuckoo resemble the hawk does not necessarily prove this suggested explanation to be false; but if it be true that the smaller passerine birds are duped by the similarity to the bird of prey, it may be that the cuckoos themselves escape molestation from larger hawks on account of their resemblance to the sparrow-hawk. Another species of this group, the black cuckoo of India, apparently mimics the black drongo-shrike (*Dicrurus ater*), the resemblance between the two species being very close. The drongo is a fierce and powerful bird which will not tolerate a strange bird of the size of a cuckoo near its nest, yet on account of its resemblance to the drongo, the hen cuckoo is enabled, it has been claimed, to lay her egg in the nest of the drongo, which mistakes the cuckoo for one of its own kind. In this case also both sexes of the cuckoo mimic the drongo, whereas according to the theory it would be necessary for the hen bird alone to do so. This suggests that the resemblance to the pugnacious drongo may be beneficial in protecting the defenceless cuckoo from enemies.

Some observations, however, of Guy Marshall on the inedibility of certain birds suggest that the resemblance between cuckoos and hawks on the one hand and cuckoos and drongos on the other may be susceptible of another explanation in full agreement with the theory of mimicry as propounded by Bates. He found that a South African drongo (*Dicrurus* (*Buchanga*) *assimilis*) was rejected after one or two attempts to eat it by a hungry mongoose (*Herpestes galera*) which had been starved for purposes of the experiment. The drongo is blue and black and is, he believes, warningly coloured. The same mongoose also refused to eat a kestrel (*Cerchneis rupicoloides*) and a hobby (*Falco subbuteo*), although it devoured certain

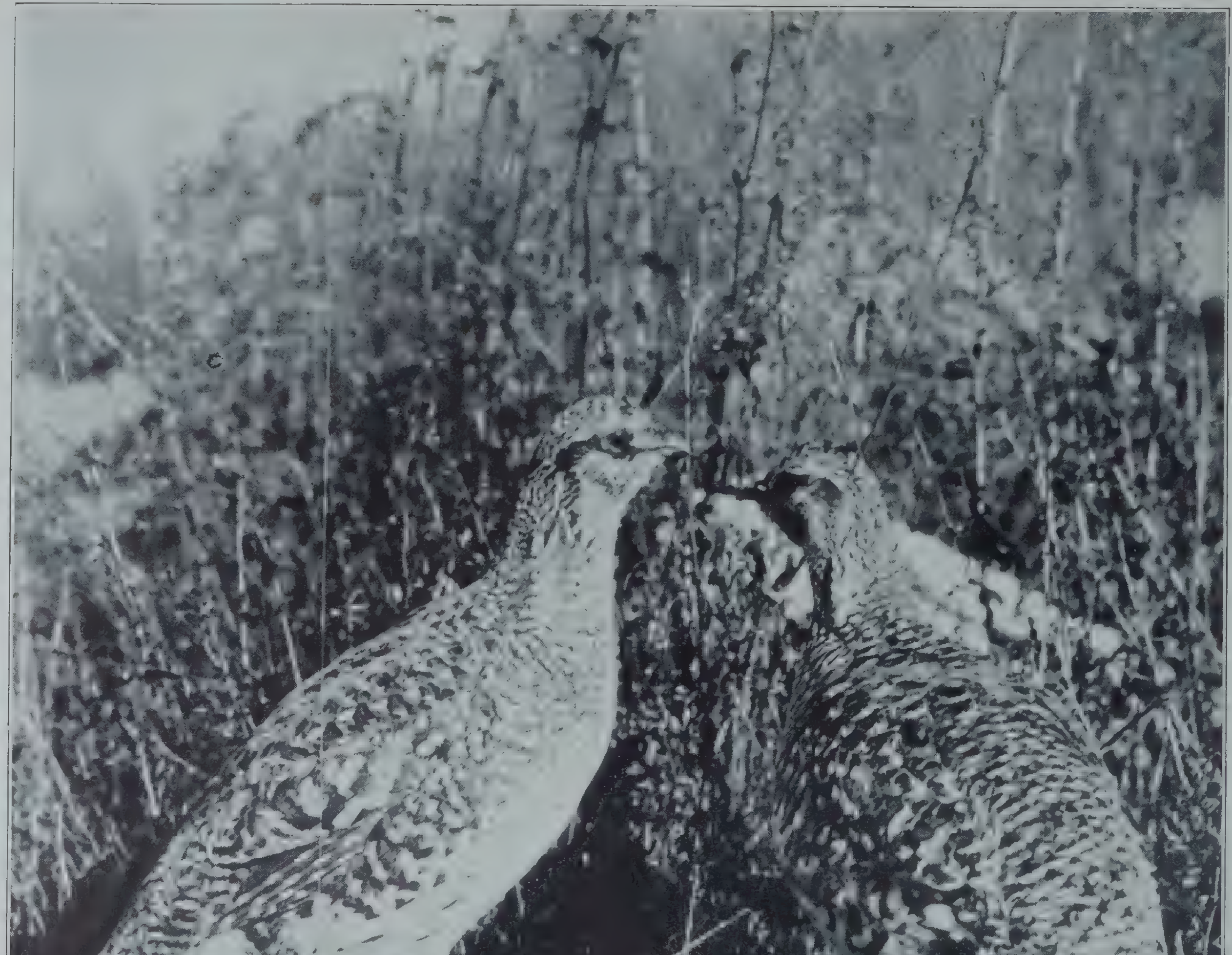
MIMICRY

PLATE I.



(Brown Bros.)

FIG. 1. The "Walking Stick" or "stick-bug" clinging to an oak twig is hard to detect. Another specimen is shown separately for comparison. FIG. 2. The "Walking Leaf" found in India is an extreme example of protective mimicry. FIG. 3. Moth resting on trunk of birch tree. A flying moth at the side. FIG. 4. Two butterflies resting on twigs, simulating leaves; with third butterfly in flight, for comparison. See COLOURS OF ANIMALS, Vol. 29.



(*Ewing Galloway.*)

Prairie Chicken, Canada, showing how the colouring simulates the broken lights and shadows of the underbrush and grass. A further discussion of this interesting subject will be found in the article COLOURS OF ANIMALS, Vol. 29. Its extension to the field of modern warfare is dealt with in the article CAMOUFLAGE in the same volume.

other birds that were given to it. It is clearly possible, therefore, that cuckoos which mimic drongos and hawks may be protected from those enemies which find these birds distasteful.

One of the most perfect cases of mimicry in birds is presented by a Madagascar thrush or babbler (*Tylas eduardi*), which resembles feather for feather a shrike (*Xenopirostris polleni*), from the same island. The *Tylas* has departed from the normal coloration of its group to take on that of the shrike, a comparatively powerful and pugnacious bird. Analogous cases are supplied by the mimicry that exists between some of the orioles (*Mimeta*) and the friar-birds (*Philemon* or *Tropidorhynchus*) of the Austro-Malayan Islands. The friar-birds are noisy and pugnacious species of the group of honey-eaters, and mob hawks and other birds of prey, which leave them unmolested. The general style of coloration of orioles is gaudy yellow and black, rendering them invisible in sunlit foliage, and quite different from the more sombre hues of the friar-birds; but in the islands of Bourou, Timor and Ceram the orioles have not only assumed the tints of friar-birds in general, but in each of the islands named a species of oriole has acquired the little peculiarities in colour of plumage possessed by the friar-bird of the same locality. There seem to be no reasons for doubting that these are cases of genuine protective mimicry.

Apparently the only instances of mimicry known amongst reptiles occur amongst snakes; and in all the cases quoted by Wallace harmless snakes mimic venomous species. In tropical America the genus *Elaps*, which is both poisonous and warningly coloured, is a model for several innocuous snakes. In Guatemala *Elaps fulvus* is mimicked by *Pliocerus equalis*; in Mexico *Elaps corallinus* by *Homalocranium semicinctum*, and in Brazil, *Elaps lemniscatus* by *Oxyrhopus trigeminus*. In South Africa the harmless egg-eating snake (*Dasypeltis scaber*) is very like the Cape adder (*Bitis atropos*); and in Ceylon the harmless Colubrine *Lycodon aulicus* is alleged to mimic *Bungarus ceylonicus*, an ally of the deadly krait of India. Considering, however, the numbers of venomous and innocuous snakes that occur in most tropical countries, it might be supposed that mimicry in this order of reptiles would be of commoner occurrence than appears to be the case. It must be remembered, however, that apart from size and colour all snakes resemble each other in a general way in their form and actions. They present a strong family likeness which is not found in any other terrestrial vertebrated animals with exception of some lizards and possibly Caecilians amongst the Amphibia. So close indeed is the similarity that many monkeys, apes and human beings have an apparently instinctive fear of all snakes and do not discriminate between poisonous and non-poisonous forms. Hence it may be that innocuous snakes are in many instances sufficiently protected by their likeness in shape to poisonous species that close and exact resemblance in colour to particular species is superfluous.

As a possible instance of mimicry in fishes, A. T. Masterman recalls the fact that two species of weever (*Trachinus draco* and *T. vipera*), have the same habitat in British waters as certain species of soles (*e.g. Solea vulgaris*). The weevers are poisonous and the venom is concentrated principally in the six spines of the first dorsal fin. These spines are sharp and connected by a black membrane which projects, when the fish is disturbed, as a danger singal, it is believed, above the surface of the sand in which the fishes lie hid awaiting prey. For protective purposes soles, which are edible, also lie buried in or on the sand which they match in colour, with the exception of the right or upper pectoral fin which has a large black patch. When disturbed the soles raise this black fin and, as a rule, hold it rigid so that it becomes a very conspicuous object. If the view that the sole is protected by the blackness of the pectoral fin resembling the blackness of the dorsal fin of the weever, be correct, these fishes furnish an instance of Batesian mimicry. Furthermore, there is a common littoral fish in the Mediterranean (*Uranoscopus scaber*), belonging to the same family as *Trachinus*, exhibiting the same habits and living on the same ground, which also has a jet black erectile dorsal fin, and is believed to be poisonous. It is probable that the resemblance between *Uranoscopus* and *Trachinus* with respect to the colour of the dorsal fin is mutually beneficial to the two fishes. If so, the likeness must be regarded as an instance of Müllerian mimicry.

It is amongst Arthropods, however—and especially amongst insects—that mimicry, both Batesian and Müllerian, occurs in greatest profusion and perfection.

In insects of the order Orthoptera, departure from the normal in form and colour, carrying with it similarity to other living things, usually takes the line of protective resemblance to parts of plants. This is well exemplified by the leaf-insects (*Phyllium*) and stick-insects (*Bactra*), where the likeness to the models after which they are named is procryptic; and also by various species of tropical Mantidae which resemble flowers for the purpose of alluring insects within striking distance and perhaps also for concealing their identity from enemies. Some cases of genuine mimicry, however, are known in the order. Perhaps the best is that of the Sudanese Locustid (*Myrmecophana fallax*), which is strikingly ant-like. The head is large, the neck slender, the antennae short, and the legs longish, and the appearance of the long stalk-like waist of the ant is produced by a patch of whitish hair on each side of the forepart of the abdomen which has the effect of cutting away the parts of the segments so covered, leaving a narrow dark-coloured median area to represent the waist. This at least is the method of disguise suggested by examination of the dried insect; but representatives of the same or an allied species found in Mashonaland were observed in the living state to be green with the antlike parts represented in black pigment. These parts were quite conspicuous against the green of the plants frequented by the insects, wherever the green portions were rendered invisible by the same background. Ant-mimicry has also been recorded in the case of the larva of one of the Indian species of Mantidae. Again, several species of this order have become profoundly modified in form in imitation of inedible beetles. In the Philippines, a cricket (*Scepastus pachyrhynchoides*), has taken on the shape and coloration of a species of *Apocyrtus*, a hard and inedible weevil (*Curculionidae*); and *Phoraspis*, a kind of grasshopper similarly resembles ladybirds (*Coccinellidae*). A species of beetle (*Caria dilatata*) of this family in Borneo is mimicked by a species of a genus allied to *Gammarotettix* not only in shape and coloration but also in the habit of remaining still when disturbed. In the same island a species of *Gryllacris* mimics *Pheropsophus aquatus*, a "Bombardier" beetle which ejects a puff of volatile formic acid when attacked; and *Condylodera tricondyloides* mimics different species of tiger-beetles (*Cicindelidae*) at different stages of its growth. Finally the larva of one of the Bornean Mantidae, which is a floral simulator in its pupal and adult stages, closely resembles in its black and red coloration the larva of the stinking and warningly coloured bug *Eulyes amoena*.

Comparatively few cases of mimicry in the Neuroptera have been observed. There are records, however, of species of *Mantispa* mimicking the wasp *Polistes* in North America and Borneo and *Belonogaster* in South Africa; and other species of the genus imitate parasitic hymenoptera of the genera *Bracon* and *Mesostenus*.

Coleoptera (beetles) supply instances of mimicry of ants, wasps and Ichneumonids, and some defenceless forms of this order mimic others that are protected. A good illustration of wasp-mimicry is furnished by a large heteromerous beetle (*Coloborhombus fasciatipennis*) from Borneo which is remarkably like a large wasp (*Mygnimia aviculus*) from the same island. The front wings of the wasp have a conspicuous white patch near the tip and a patch similar in size and colour is present on the wings of the beetle, which, unlike the majority of beetles, habitually keeps its wings extended, and since the elytra are exceptionally short the wings are not covered by them when folded. The resemblance also extends to the general form of the body and to the length and thickness of the wings and antennae. The elytra are equally reduced, and apparently for the same purpose, in an Australian Longicorn beetle (*Esthesis ferrugineus*), which, like so many wasp-like Hymenoptera, has the body banded red and black. This beetle probably mimics the Australian hornet (*Abispa australis*). In the European Longicorn (*Clytus arietis*), on the other hand, the elytra are of normal length and are banded with yellow stripes. The beetle, moreover, is of slender build and all its actions are suggestively wasp-like. This may, however, be an instance of Müllerian rather than of Batesian mimicry, the beetle being itself inedible; for Shelford has stated his conviction that the Bornean representatives of the sub-family (Clytinae), to which *Clytus arietis* belongs, are all highly distasteful and are warningly coloured, as are members of this sub-family from other parts of the world.

In the Philippine Islands several species of Longicorns of the genus *Doliops* mimic hard inedible weevils (*Curculionidae*) of the genus *Pachyrhynchus*. The antennae of these weevils are short and end in a knob; those of the Longicorns are very much larger, but the weevil-like look is produced by the presence of a knob-like swelling upon the third joint, the terminal portion of the antenna being so extremely fine as to be almost invisible. Similar modification of the antennae in the Longicorn *Estigmenida variabilis* brings about the resemblance between this beetle and a beetle, *Estigmena chinensis*, one of the Phytophaga of the family Hispidae. Numerous instances of mimicry in this order of insects have recently been recorded from Borneo by R. W. C. Shelford, a large number of them being in all probability Müllerian.

Instances of ant-mimicry, unique in the method employed to bring about the resemblance, are supplied by some insects of the Homopterous group of the Rhynchota, belonging to the family Membracidae. In one of these (*Heteronotus trinodosus*), the dorsal area of the forepart of the thorax is developed into a plate which projects backwards over the body of the insect, which retains its normal form, and conceals all but the head, wings and legs. This shield if shaped in such a manner as to resemble closely the body of an ant, the median portion of the shield being deeply constricted in imitation of the waist and the terminal portion sub-globular like the abdomen of the ant. This insect comes from Central America. Still more curious is the mimicry of another of these insects from Venezuela which is found in company with a leaf-cutting ant (*Oecodoma cephalotes*) of that country. When pursuing their operations of leaf-storage, these ants present the appearance of a crawling crowd of leaf-particles, fragments of leaves being carried by the insects in such a way as to conceal to a great extent the insect underneath, of which little more than the dark coloured legs project beyond the burden. The immature form of the above-mentioned species of Membracidae mimics both ant and leaf-particle. The legs and lower part of the body are dark coloured, but the dorsal surface of the thorax and abdomen is coloured green and is raised so as to form a crest with jagged edges exactly reproducing the irregular margin of a fragment of leaf cut out by the mandibles of the ant. In Borneo the Homopteron *Issus bruchoides* mimics a species of Curculionid beetle of the genus *Alcides*.

In the Hemipterous group of the Rhynchota ant-mimicry is illustrated by the larva of a British species of Reduviidae (*Nabis lativentris*) in which the forepart of the abdomen is furnished on each side with a patch of white hairs leaving a central narrow dark portion in imitation of the waist of the ant; and also by an East African species (*Myrmoplasta mira*) which in its general form exhibits a close resemblance to an ant (*Polyrrhacis gagates*) which occurs in the same neighbourhood. Another instance in this group is supplied by a Bornean species of Reduviidae which mimics a species of the genus *Bracon*, one of the parasitic Hymenoptera.

Typical dipterous insects (flies) closely resemble in general form aculeate Hymenoptera belonging to the families of bees and wasps. The changes in colour and structure required to complete the resemblance to particular species are comparatively slight and much less complicated than those needed to produce a likeness to other protected insects. Hence we find that the majority of flies that mimic insects of other orders have bees or wasps for their models. Many of the Syrphidae are banded black and yellow and present a general resemblance to wasps, especially when they alight, the resemblance being enhanced by a twitching action of the abdomen imitating the similar action so familiar in species of stinging hymenoptera. These flies are characterized by a peculiar method of flight. They commonly hang poised in the air, then dart with lightning swiftness to another spot and poise themselves again. This habit, the origin of the name "hover-flies," is probably connected with their mimetic coloration. If they flew like ordinary flies their resemblance to Hymenoptera would be obscured by the rapidity of their flight and they might be caught on the wing by insectivorous birds or other insects; but when poised they display their coloration. When the latter is lost during flight, the rapidity of their movement defies pursuit. The particular likeness to a honey-bee presented by one member of this family, the drone-fly (*Eristalis tenax*), has been already referred to. But the likeness probably goes deeper than superficial resemblance that appeals to the eye; for spiders which distinguish flies from bees by touch and not by sight, treat drone-flies after touching them, not in the fearless way they evince towards bluebottles (*Calliphora*), but in the cautious manner they display towards bees and wasps, warily refraining from coming to close quarters until their prey is securely enswathed in silk. This forcibly suggests that the drone-fly mimics a honey-bee not only in appearance but also in the feel of its hairs or the nature of its buzz. Other flies of the genus *Volucella*, larger and heavier in build than *Eristalis*, resemble humble-bees in colour and form, and it was formerly supposed that the purpose of this similarity was to enable the flies to enter with impunity the nests of the humble-bees and to lay their eggs amongst those of the latter insects. But it has been ascertained that the species of *Volucella* which behave in this manner also visit for a like purpose the nests of wasps, which they do not resemble. Hence it is probable that this case of mimicry is purely of a protective and not of an aggressive nature and serves to save the flies from destruction by insectivorous enemies. The same explanation no doubt applies to the mimicry, both in Borneo and South Africa, of hairy bees of the family Xylocopidae by Asilid flies of the genus *Hyperechia*, and also to other cases of mimicry of Hymenoptera as well as of inedible beetles of the family Lycidae by Diptera. Numerous other cases of mimicry between Diptera and Hymenoptera might be cited.

The Lepidoptera furnish more instances of mimicry, both Batesian and Müllerian, than any other order of insects. In the majority of cases both model and mimic belong alike to the Lepidoptera, and it is often uncertain whether both are inedible (Müllerian mimicry) or whether inedibility is the attribute only of the model (Batesian mimicry). A large number of cases that were formerly regarded as belonging to the latter category are now suspected of belonging rather to the former. Sometimes Lepidoptera mimic protected members of other orders of insects—such as Coleoptera, Hymenoptera and Hemiptera; but perhaps the most singular illustrations of the phenomenon known in the order are exemplified by the larvae of the hawk-moth *Chaerocampa*, which imitate the heads of snakes. Professor Poulton long ago suggested, and supported the suggestion by experimental evidence on a lizard, that the larvae of two British species, *C. elpenor* and *C. porcellus*, are protected by the resemblance to the heads of snakes presented by the anterior extremities of their bodies which are ornamented with large eye-like spots. When the larvae are disturbed the similarity is produced with startling suddenness by the telescopic contraction of the anterior segments in such a manner as to suggest a triangular, pointed head with two large dorsal eyes. Subsequent observers (A. Weismann, Lady Verney) have shown by experimenting upon birds that this suggestion is correct; and Guy Marshall found that baboons which are afraid of snakes are also afraid of the snake-like larva of the South African *Chaerocampa osiris*. Finally Shelford states that the anterior end of a Bornean species (*C. myodon*) offers a striking and detailed resemblance to the head of a snake (*Dendrophis picta*).

Instances of ant-mimicry in this order are sometimes confined to the larval stage. The early larval stage of the "Lobster Moth" (*Stauropus fagi*), for example, presents a general resemblance, due to a combination of shape, colour, attitude and movements, to black ants, the swollen head and the caudal disk with its two tentacles representing respectively the abdomen and antenna-bearing head of the model. A parallel case of mimicry exists at Singapore between the larva of a Noctuid moth and the common red tree-ant (*Oecophylla smaragdina*). In this case also the posterior end of the larva represents the anterior end of the ant. Another instance of mimicry affecting the larval form is supplied by the moth *Endromis versicolor*, the caterpillars of which resemble the inedible larvae of saw-flies. The resemblance that certain moths—*e.g. Trochilium apiforme*, *crabroniforme*—present to bees and wasps is effected in the main by the loss of the scales from the wings, leaving these organs transparent. It is important to note that the scales are present when the moths first emerge from the pupa-case, but are loosely attached and fall off with the first flight.

Of the multitudes of cases of mimicry between different species of Lepidoptera, a few only can be selected for description. These cases, however, have a peculiar interest and importance for they have been studied in fuller detail than any others and the discovery of a particular instance in South America first suggested to Bates the theoretical explanation of this bionomical phenomenon. On the Amazons and in other parts of South America there are butterflies of the group Ithomiinae which are distasteful and have all the characters of specially protected species, being conspicuously coloured, slow of flight, careless of exposure and abundant in individuals. The wings are transparent and are black-bordered and black-barred, the anterior wing having two black bars and the posterior one. This type of colouring is also found in genera of quite distinct sub-families of butterflies, namely in Danainae and Pierinae, as well as in some diurnal moths, all of which occur in the same district as the Ithomiinae. The following species may be cited as instances of this type of pattern: *Methona confusa*, *Thyridia psidii*, *Eutresis imitatrix* and *Dirgenna dero* (Ithomiinae); *Itura ilione* and *I. phenarete* (Danainae); *Dismorphia orise* (Pierinae); *Anthomyza buckleyi* (moth of the family Pericopidae) and *Castnia linus* (moth of the family Castniidae). So alike in form, colour and mode of flight are those Lepidoptera that when on the wing it is almost or quite impossible to distinguish one from the other, and the resemblance between members belonging to different sub-families cannot be assigned to affinity. Microscopical examination of the wings, moreover, has shown that the transparency of the wings, common to all, has been acquired by a different modification of the scales in each of the genera exhibiting the Ithomiine type of coloration. That the Danaine and Ithomiine species are distasteful is known. *Itura*, for example, belonging to the former, has protrusible scent-emitting processes at the end of the abdomen; and *Thyridia* has scent-producing tufts of hair on the edge of the posterior-wing. Bates offered no satisfactory explanation of the resemblance between these two genera and others of the same protected sub-families; but he did not hesitate to ascribe the resemblance to them presented by the Pierine, *Dismorphia* (*Leptalis*) *orise*, to mimicry, believing *Dismorphia* to be unprotected and noting that it departed widely in the matter of coloration from typical members of the sub-family to which it belongs. Although mimicry in the Lepidoptera has been carried to a greater extreme in South America than in any other country of the world, remarkable instances of it have taken place in the Ethiopian and Oriental regions. A classical and highly complex case first investigated and explained by R. Trimen is that of *Papilio dardanus* which is widely distributed in Africa and is represented by several sub-species or geographical races. The most primitive of these is *antinorii* from Abyssinia, which is non-mimetic and has the two sexes nearly alike. The males of the other sub-species are much like the males of *antinorii*; but the females are widely different and mimic various species of inedible butterflies belonging to the protected groups of the Danainae and Acraeinae. One of these sub-species, *merope*, which ranges from the west coast to Victoria Nyanza, is polymorphic and occurs under three forms, namely (*a*) *hippocoon*, which mimics the Danaine *Amauris niavius*; (*b*) *trophonius*, which mimics the Danaine *Limnas chrysippus*; (*c*) *planemoides*, which mimics the Acraeine *Planema poggei*. Oddly enough one or more of these forms may occur in other sub-species. For example, the sub-species *cenea* which occurs in south and south-east Africa not only has the form *cenea* mimicking two Danaines, *Amauris echeria* and *A. albimaculata*, but also the *hippocoon* form which resembles a local race of *Amauris niavius*, known as *dominicanus*. The sub-species *polytrophus* from the Kikuyu Escarpments also has the *planemoides* and *cenea* forms and another form *trimeni*, which is intermediate between the unmodified female of *antinorii* and *hippocoon*, and like the latter is mimetic of *Amauris niavius dominicanus*. Finally the sub-species *tibullus* from the east coast has the *cenea*-form, the *trimeni*-form and probably the *planemoides*-form. The study of this intricate case is not yet completed and it is at present unknown whether it is an instance of Batesian or Müllerian mimicry. Special attention may be drawn to two phenomena connected with it, both of not uncommon occurrence in mimetic Lepidoptera. The first is the occurrence of mimicry only in the female sex. The reason for this is to be found in the greater need of protection of the female which is slower in flight than the male and is exposed to special danger of attack when resting to lay her eggs. The second noteworthy phenomenon is the mimicry of more than one protected species by members of a single species. This is a not uncommon occurrence, and in the case of Batesian mimicry the explanation is probably this. When an edible species gains protection by mimicking a distasteful one, there is a likelihood of its increasing in numbers until it equals or surpasses its model in this respect. Were this to take place the purpose of the mimicry would be abortive, because enemies would probably not refrain from slaughter if even every alternate capture proved palatable. It is advantageous therefore that the numbers of the mimetic species should be fewer than those of the model; and this appears to be achieved in some cases by the individuals of the mimetic species dividing themselves between two or more models

Spiders furnish numerous instances of mimicry. Though simple in kind, many of these are as perfect illustrations of the phenomenon as any found in the animal kingdom.

Amongst the orbweavers of the family Argyopidae there are species belonging to the genera *Cyclosa* and *Cyrtophora* which closely resemble small snail-like gastropods as they cling to the underside of leaves with their legs drawn up. Other members of the same family—like *Araneus coccinella*, and *Paraplectana thorntoni*—imitate beetles of the family Coccinellidae which are known to be distasteful; and certain genera of the family Salticidae (*Homalattus* and *Rhanis*) closely resemble small hard-shelled beetles.

The most perfect cases, however, are exhibited by those species which imitate ants. The structural modifications required to convert a spider into the image of an ant are of a more complicated character than those that serve the same purpose in an insect. All insects have the same regional division of the body into head, thorax and abdomen, the same number of legs, a pair of antennae and a segmented abdomen. Spiders on the contrary have no antennae, no separate "head," an unsegmented abdomen and an additional pair of legs. In the majority of ant-imitating spiders the forepart of the cephalothorax is constricted on each side to resemble the neck of the insect, and in many cases the similarity is increased by the presence of a stripe of white hairs which has the optical effect of cutting out an extra piece of integument, exactly as occurs in analogous cases in insects. Narrowing of the posterior portions of the spider's cephalothorax and sometimes of the anterior end of the abdomen reproduces the slender waist of the ant, and frequently transverse bands of hairs represent the segmentation of this region in the insect. The legs become slender and those of the first or of the second pairs are held up and carried in front of the head to simulate the antennae of the ant. Added to this the spiders commonly copy to the life the mode of progression and the restless activities of their models.

The likeness presented varies considerably in degree from a general resemblance to several species, such as is seen in the Salticid spider (*Peckhamia picata*) of North America, to a close similarity to particular species. To this category belong *Myrmarachne plataleoides*, one of the Salticidae, and *Amyciaea forticeps*, one of the Thomisidae which in India imitate and live with the vicious little red ant (*Oecophylla smaragdina*); also *Myrmarachne providens*, which mimics the red and black Indian ant (*Sima rufonigra*); and the South American species of Clubionidae, *e.g. Myrmecium nigrum*, which is an accurate copy of the large black ant (*Pachycondyla villosa*).

Sometimes it is only the males of a species of spider that mimic ants, as in the case of *Ildebaha mutilloides* and *I. myrmicaeformis*, two South American species of the family Argyopidae, in which the females are protected by strong spine-armature. The males are without these protective spines and are exposed to special dangers as they wander in search of the webs of the females. In South Africa too the males of a species of Eresidae (*Seothyra*) resemble and are found in company with a large ant (*Camponotus fulvopilosus*), which is common on the veld. Like the males of *Ildebaha*, those of *Seothyra* wander about by day in search of the females which live concealed in burrows. Many other spiders belonging to the Theridiidae and Linyphiidae also mimic ants; but it is needless to enumerate them, the most perfect examples of this phenomenon being found in the families Clubionidae and Salticidae.

Ant-mimicking spiders have been seen now and again to devour their models. It has therefore been suggested by some and taken for granted by others that the resemblance comes under the category of aggressive mimicry and that the ants are deluded by this resemblance into regarding the spiders as members of their own species. That the ants do not destroy them is certain; but that they are deceived by the superficial similarity of the spiders to themselves is highly improbable, for these insects are capable of distinguishing a strange ant belonging to the same species if it comes from another colony. Moreover, the above-suggested explanation does not coincide with the explanation of the likeness to ants shown by certain insects such as *Myrecophana fallax*, the ant and leaf-like Membracid Homopteron and the larvae of the lobster-moth (*Stauropos fagi*), which are plant-eaters. It is probable that one explanation—namely, that of protection—covers all cases of ant-mimicry; and this explanation lies in all probability in the immunity from the attacks of most insectivorous enemies that ants enjoy, and especially from predaceous wasps of the family Pompilidae which annually destroy thousands upon thousands of spiders to feed their larvae; and since more than one observer has testified to the fear and abhorrence these wasps have of ants, it is needless to look farther for the benefit ant-mimicry is to spiders. These wasps, moreover, also provision their nurseries with caterpillars, grasshoppers and other insects. Hence it may be inferred that the insects which imitate ants profit in the same way that spiders do from this form of mimicry.

In the above-cited historical instance of mimicry amongst some South American Lepidoptera which formed the foundation of Bates' theory, species of butterflies, belonging to the Ithomiine genus *Itura* and the Danaine genus *Thyridia*, both unpalatable forms, resemble each other. This is a very simple case of the possession of the same type of coloration by two or more protected insects inhabiting the same district. The significance of this phenomenon, as already stated, was first explained by Fritz Müller; but although the term "Müllerian mimicry" has been assigned to this and similar instances, they are not strictly speaking cases of mimicry at all but of warning coloration. Poisonous or noxious animals usually have some special advertising attribute, sometimes the display of conspicuous coloration, as in the skunk; sometimes the emission of sound as in the rattlesnake; sometimes a combination of the two, as in the common porcupine and the large black scorpions of Africa and India. Such characters have been termed by Professor Poulton "aposematic." Neither of the above-mentioned animals is mimicked; but where two or more noxious animals, inhabiting the same district, resemble each other, both being aposematically or warningly coloured, the likeness is said to be "synaposematic." Synaposemasy is Müllerian mimicry. Finally, the likeness of an edible species to a warningly coloured inedible one in the same locality is termed "pseudaposematic," in allusion to the pretentiousness or falsity of the warning signal. Pseudaposemasy is Batesian mimicry.

An important phenomenon connected with insect mimicry is the convergence of several species in the same area towards a common type of coloration and shape, exhibited by one or more than one protected form. The resemblance shows various grades of completeness; and the convergent mimics may be themselves noxious, or edible and innocuous. In other words the insects entering into the combination may furnish instances of Batesian and of Müllerian mimicry. Very commonly different species of aculeate Hymenoptera, inhabiting the same district, form the centres of mimetic attraction for insects of various orders, so that a considerable percentage of the insect-fauna can be arranged in groups according to the pattern of the particular model the species have copied. Good illustrations of this law have been discovered by Guy Marshall in Mashonaland. He found on the same day on a bud of vetch, specimens of black ants (*Camponotus sericeus* and *C. cosmicus*), black ant-like Hemipterous insects (*Megapetus atratus*) and the ant-like Orthopteron (*Myrmecophana fallax*) (cf. *supra*). In this little coterie the ants are beyond question the models towards which the bug and the grasshopper have converged in appearance. Since many of the insects of the order Hemiptera are distasteful, the mimicry of the bug (*Megapetus*) is in this case probably Müllerian or synaposematic; the grasshopper (*Myrmecophana*), on the other hand, is probably edible and the mimicry is Batesian or pseudaposematic. This is a simple case consisting of a small number of component species. Others are more complex, numerous species being involved. In Mashonaland, for instance, a large number of genera and species of Hymenoptera belonging to the Apidae, Eumenidae, Sphegidae, Pompilidae, Scoliidae, Tiphiidae and Mutillidae, resemble each other in having black bodies and dark blue wings. The same style of coloration is found in Coleoptera of the families Cetoniidae and Cantharidae; in Diptera of the families Asilidae, Bombylidae, Tabanidae and Tachinidae; in Hemiptera of the family Reduviidae and in Lepidoptera of the family Zygaenidae. In this instance the Hymenoptera, of which the coloration is synaposematic, form together a composite model which the other insects have mimicked. Of the latter, the Lepidopteron (*Tascia homochroa*) is distasteful, as also are the beetles of the family Cantharidae (*e.g Lytta moesta*). Probably the bugs too (*e.g. Harpactor tristis*) are protected. The mimicry of these insects therefore is synaposematic; but some, at all events, of the flies like the Bombylid *Exoprosopa umbrosa*, probably form pseudaposematic elements in the group. Into another category Hymenoptera enter not as models but as mimics, the models being inedible Malacodermatous beetles mostly belonging to the genus *Lycus* and characterized by orange coloration set off by a large black patch upon the posterior end of the elytra and a smaller black spot upon the thorax. Towards this Lycoid centre have converged Coleoptera (beetles) of the sub-order Lamellicornia (Copridae), Phytophaga; Heteromera (Cantharidae) and Longicornia; Hemiptera of the families Pyrrhocoridae, Lygaeidae and Reduviidae; Lepidoptera of the families Arctiidae and Zygaenidae; Diptera of the family Asilidae; and lastly Hymenoptera of the families Braconidae, Pompilidae, Crabronidae and Eumenidae. With the exception of the Asilid fly and perhaps some of the Longicorn and Phytophagous beetles, which are probably protected Batesian mimics, all the other species constituting the above-mentioned assemblage are, it is believed, Müllerian or synaposematic mimics. In the three cases cited above, with the exception of the first, the synaposematic mimics are vastly in excess of the pseudaposematic; this appears to be the general rule elsewhere. Frequently the groups are composed solely of protected species, so far as is at present known; and sometimes solely, in all probability, of unprotected species with exception of course of the model. An example of the latter occurs in Singapore where the vicious red spinning-ant (*Oecophylla smaragdina*) is mimicked by the larva of a Noctuid moth and by spiders belonging to two distinct families, namely, *Saltiicus plataleoides* (Salticidae) and *Amyciaea forticeps* (Thomisidae), there being no reason to suppose that either the moth larva or the spiders are protected forms. Mimetic aggregations of species similar to those mentioned above have been found in other countries; but the instances cited are sufficient to show how widespread are the influences of mimicry and how profoundly it has modified the insect fauna of various parts of the world.

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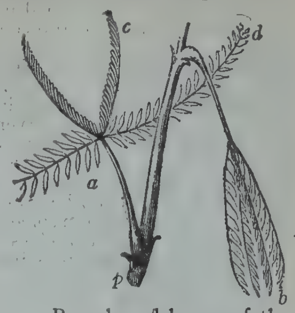
MIMNERMUS of Colophon, Greek elegiac poet, flourished about 630–600 B.C. His life fell in the troubled time when the Ionic cities of Asia Minor were struggling to maintain themselves against the rising power of the Lydian kings. One of the extant fragments of his poems refers to this struggle, and contrasts the present effeminacy of his countrymen with the bravery of those who had once defeated the Lydian king Gyges. But his most important poems were a set of elegies addressed to a flute-player named Nanno, collected in two books called after her name. Mimnermus was the first to make the elegiac verse the vehicle for love-poetry. He set his own poems to the music of the flute, and the poet Hipponax says that he used the melancholy νόμος κραδίης, "the fig-branch strain," said to be a peculiar melody, to the accompaniment of which two human purificatory victims were led out of Athens to be sacrificed during the festival of Thargelia (Hesychius, *s.v.*).

Edition of fragments in T. Bergk, *Poetae lyrici Graeci*; see also G. Vanzolini, *Mimnermo* (1883), a study of the poet, with notes and a metrical version of the fragments.

MIMOSA (so named from the movements of the leaves in many species which "mimic" animal sensibility), a genus of the natural order Leguminosae, which gives its name to the large sub-order *Mimoseae* (characterized by usually small regular flowers with valvate corolla), to which belongs also the nearly allied genus *Acacia*. They are distributed throughout almost all tropical and subtropical regions, the acacias preponderating in Australia and the true mimosas in America. The former are of considerable importance as sources of timber, gum and tannin, but the latter are of much less economic value, though a few, like the ṭalḥ (*M. ferruginea*) of Arabia and Central Africa, are important trees. Most are herbs or undershrubs, but some South American species are tall woody climbers. They are often prickly The roots of some Brazilian species are poisonous, and that of *M. pudica*, has irritating properties. The mimosas, however, owe their interest and their extensive cultivation, partly to the beauty of their usually bipinnate foliage, but still more to the remarkable development in some species of the sleep movements manifested to some extent by most of the pinnate Leguminosae, as well as many other (especially seedling) plants. In the so-called "sensitive plants" these movements not only take place under the influence of light and darkness, but can be easily excited by mechanical and other stimuli. When stimulated—say, at the axis of one of the secondary petioles—the leaflets move upwards on each side until they meet, the movement being propagated centripetally. It may then be communicated to the leaflets of the other secondary petioles, which close (the petioles, too, converging), and thence to the main petiole, which sinks rapidly downwards towards the stem, the bending taking place at the pulvinus (*p* in figure) or swollen base of the leafstalk. When shaken in any way, the leaves close and droop simultaneously, but if the agitation be continued, they reopen as if they had become accustomed to the shocks. The common sensitive plant of hothouses is *M. pudica*, a native of tropical America, but now naturalized in corresponding latitudes of Asia and Africa, but the hardly distinguishable *M. sensitiva* and others are also cultivated. Species of the closely allied genus *Schrankia* are known as sensitive-briar in the southern United States.



Branch and leaves of the sensitive plant (*Mimosa pudica*), showing the petiole in its erect state, *a*, and in its depressed state, *b*; also the leaflets closed (*c*), and the leaflets expanded (*d*); *p*, pulvinus.

MIMULUS, in botany, a genus (nat. order Scrophulariaceae), of showy, hardy or half-hardy, herbaceous, rarely shrubby plants, natives of the extra-tropical or mountainous parts of both old and new worlds excepting Europe, but chiefly American. The plants have opposite, undivided leaves, and axillary, generally solitary flowers with a two-lipped, gaping corolla. The herbaceous species thrive best in damp situations; the shrubby species, of which *M. glutinosus* (formerly called *Diplacus*) is best known, are adapted for pot culture in the greenhouse. *M. luteus*, the monkey-flower of gardens, has yellow flowers with two dark marks in the mouth of the corolla; *M. Langsdorfii*, an American species, has become naturalized by river-sides in many parts of Britain.

M. moschatus, musk, a native of north-western America, with small, nearly regular, yellow flowers, diffuse hairy stem and hairy scented leaves, is a well known and favourite perennial for pot culture and outside borders.

MINA, FRANCISCO ESPOZ Y (1781–1836) Spanish guerrillero leader and general, was born at Ydozin in Navarre on the 17th of June 1781. His father, Juan Esteban Espoz y Mina, and his mother Maria Teresa Hundain y Ardaiz, belonged to the class of yeomen. Mina remained working on the small family inheritance till 1808. When Napoleon endeavoured to seize Spain in that year he enlisted in the regiment of Doyle, and then passed to the guerrilla band commanded by his nephew Xavier Mina. When Xavier was captured by the French on the 21st of March 1810, seven men of the band elected to follow Francisco; and on the 1st of April of the same year the Junta of Aragon gave him the command of the guerrilleros of Navarre. His first act was to arrest and shoot at Estella, one Echevarria, who, under pretence of being a patriotic guerrillero, was in fact a brigand. The national government at Cadiz gave him rank, and by the 7th of September 1812, he had been promoted to be commander-in-chief in Upper Aragon, and on the left bank of the Ebro. In the interval he claimed that he had fought 143 actions big and little, had been repeatedly wounded with bullet, sword and lance, had taken 13 fortified posts, and 14,000 prisoners, and had never been surprised by the French. Though some maintain that he was not at his best as a leader in battle, as a strategist he was very successful, and he displayed great organizing capacity. The French authorities were compelled to allow him to levy customs dues on all goods imported into Spain, except contraband of war, which he would not allow to pass without fighting. The money thus obtained was used to pay his bands a regular salary. He was able to avoid levying excessive contributions on the country and to maintain discipline among his men, whom he had brought to a respectable state of efficiency in 1812. Mina claimed that he immobilized 26,000 French troops which would but for him have served with Marmont in the Salamanca campaign. In the campaign of 1813 and 1814 he served with distinction under the duke of Wellington. After the restoration of Ferdinand he fell into disfavour. On the 25th and 26th of September he attempted to bring about a rising at Pamplona in favour of the Liberal party, but failed, and went into exile. His political opinions were democratic and radical, and as a yeoman he disliked the hidalgos (nobles). The revolution of 1820 brought him back, and he served the Liberal party in Galicia, Leon and Catalonia. In the last district he made the only vigorous resistance to the French intervention in favour of Ferdinand VII. On the 1st of November 1823 he was compelled to capitulate, and the French allowed him to escape to England by sea. In 1830 he took part in an unsuccessful rising against Ferdinand. On the death of the king he was recalled to Spain, and the government of the regent Christina gave him the command against the Carlists in 1835, though they feared his Radicalism. By this time, years, exposure and wounds had undermined his health. He was also opposed to Thomas Zumalacarregui (*q.v.*), an old officer of his in the War of Independence, and an even greater master of irregular mountain warfare. His health compelled him to resign in April 1835, and his later command in Catalonia was only memorable for the part he took in forcing the regent to grant a constitution in August 1836. He died at Barcelona on the 24th of December 1836. Mina was a brave and honest man, who would have conducted the war against the French in 1810–12 with humanity if they had allowed him, but as they made a practice of shooting those of his men whom they took, he was compelled to retaliate. He finally forced the French to agree to an exchange of prisoners.

Authorities.—In 1825 Mina published *A Short Extract from the Life of General Mina*, in Spanish and English, in London. Mention is made of him in all histories of the affairs of Spain during the first third of the 19th century. His full Memoirs were published by his widow at Madrid in 1851–1852. (D. H.)

MINARET (from the Arabic *manārat*; *manar* or *minar* is Arabic for a lighthouse, a tower on which *nar*, fire, is lit), a lofty turret peculiar to Mahommedan architecture. The form is derived from that of the Pharos, the great lighthouse of Alexandria, in the top storey of which the Mahommedan conquerors in the 7th century placed a small praying chamber. The lighthouse form is perpetuated in the minarets which are found attached to all Mahommedan mosques, and probably had considerable influence on the evolution of the Christian church tower (see an exhaustive study in Hermann Thiersch, *Pharos Antike, Islam und Occident*, 1909). The minaret is always square from the base to the height of the wall of the mosque to which it is attached, and very often octangular above. The upper portion is divided into two or three stages, the wall of the upper storey being slightly set back behind the one below, so as to admit of a narrow balcony, from which the *azan*, or call to prayer, is chanted by the *muazzin* (*muezzin*, *moeḍḍin*). In order to give greater width to the balcony it is corbelled out with stalactitic vaulting. The balconies are surrounded with stone balustrades, and the upper storeys are richly decorated; the top storey being surmounted with a small bulbous dome. The earliest minaret known is that which was built by the caliph Walid (A.D. 705) in the mosque of Damascus, the next in date being the minaret of the mosque of Tulun, at Cairo (A.D. 879), with an external spiral flight of steps like the observatory towers in Assyrian architecture. This minaret as also the example of El Hakim (996), is raised on great square towers. The more remarkable of the other Cairene minarets are those of Imam esh-Shafi (1218), Muristan al Kalaun (1280), Hassan (1354), Barkuk (A.D. 1382) and Kait Bey (A.D. 1468). Of the same type are the two minarets added to the mosque of Damascus in the 15th century. In Persia the minarets are generally circular, with a single balcony at the top, corbelled out and covered over. In India, at Ghazni, there are no balconies, and the upper part of the tower tapers upwards; the same is noticeable at Delhi, where the minaret of Kutab is divided into six storeys with balconies at each level. In the well-known tomb of the Taj Mahal the four minarets are all built in white marble, in three storeys with balconies to each storey, and surmounted by open lanterns. The minarets of Constantinople are very lofty and wire-drawn, but contrast well with the domes of the mosques, which are of slight elevation as compared with those at Cairo.

MINAS [MINOÏDES] (*c.* 1790–1860), Greek scholar, was a native of Macedonia. During the Greek War of Independence he migrated to Paris, where he tried to enlist the sympathies of Europe on behalf of his countrymen and to promote the study of ancient and modern Greek. But his chief claim to recognition consists in his discovery of two important MSS. (amongst others) in the monastery of Mt Athos during his exploration of the libraries of Turkey and Asia, at the instance of M. Villemain, minister of public instruction in France. One of these contained the last part of a treatise on the *Refutation of all Heresies*, now generally admitted to be the work of Hippolytus (*q.v.*), the other the greater portion of the Fables of Babrius.

MINAS GERAES (*i.e.* "general mines"), popularly Minas, an inland state of Brazil, bounded N. by Goyaz and Bahia, E. by Bahia, Espirito Santo and Rio de Janeiro, S. by Rio de Janeiro and São Paulo, and W. by São Paulo, Matto Grosso and Goyaz. It is very irregular in outline and covers an area of 221,861 sq. m. upon the great Brazilian plateau. Among the Brazilian states it is fifth in size and first in population—3,184,099 in 1890, and 3,594,471 in 1900.

The surface of Minas Geraes is broken by mountain ranges and deeply eroded rivercourses, the latter forming fertile valleys shut in by partly barren uplands, or campos. The reckless destruction of forests along the watercourses also adds to the barren aspect of the country. The principal mountain ranges are the Serra da Mantiqueira on its southern frontier and its N. extension, the S. do Espinhaço, which runs parallel to the Serra do Mar, or coast-range, and separates the inland or campo region from a lower forested zone between the two ranges. Most of the wooded district south of the Mantiqueira belongs to the states of São Paulo and Rio de Janeiro, but east of the Espinhaço it belongs to Minas Geraes and extends eastward to the Serra das Aymores, on the frontier of Espirito Santo. This zone has an abundant rainfall, dense forests and a fertile soil. It is drained by the Doce, Mucury, Jequitinhonha and Pardo, which have their sources on the eastern slopes of the Espinhaço and cut their way through the Aymores to the sea. The tributaries of the Rio Doce cover the slopes of the Serra do Espinhaço for a distance north and south of about 200 m. The southern part of this region is well populated, and is covered with coffee and sugar plantations. On the western frontier a northern extension of the great central chain of Goyaz forms the water-parting between the drainage basins of the São Francisco and Tocantins, and is known at different points as the Serra do Paranan, Serra de São Domingos and Serra das Divisões. South-east of this chain, between the headwaters of the Paraná and São Francisco, are the Serra da Canastra and Serra da Matta da Corde, an irregular chain of moderate elevation running north and south. The highest elevations in the state, so far as known, are Itatiaya (8898 ft.) in the Serra da Mantiqueira, and Caraça (6414 ft.), near Ouro Preto, in the Serra do Espinhaço. The hydrography of the campo region of Minas Geraes is extremely complicated. The Mantiqueira-Espinhaço chain shuts out the streams flowing directly east to the Atlantic, and the boundary ranges on the west shut out the streams that flow into the Tocantins, though their sources are on the actual threshold of the state. Between these two mountain chains the head streams of the Paraná and São Francisco are intermingled—the one flowing inland and southward to the great La Plata estuary, the other northward and eastward across the arid highlands of Brazil to the Atlantic coast in 10° 30′ S. lat. Less than 100 m. from the city of Rio de Janeiro and about 60 m. from the coast is the source of the Rio Grande, the larger of the two rivers that form the Paraná. It rises near the peak of Itatiaya, on the northern slopes of the Mantiqueira, and flows north-west and west across the Minas plateau, receiving several large tributaries from the south. North and parallel with its course is a low watershed, which separates its drainage basin both from that of the São Francisco and from that of the Parnahyba, the northern confluent of the Paraná. The latter rises on the western slopes of the Serra da Matta da Corde, and one of its northern tributaries has its source in a "knot" of the Serra dos Pyreneos, from which streams flow eastward to the São Francisco and northward to the Tocantins. The central and greater part of the state, however, is included in the drainage basin of the upper São Francisco. Its source is in the Serra da Canastra, and its general course across the state is north by east, during which it receives the Paracatú, Urucuia, Pardo and Carinhanha from the west and the Verde Grande and das Velhas from the east. Part of these rivers are navigable for small steamers, and the São Francisco must some day be of great importance in the development of Central Brazil. All these rivers of the Brazilian plateau are interrupted by falls and rapids. The climate of Minas Geraes is characterized by high sun temperatures and cool nights, the latter often dropping below the freezing point on the higher campos. The mean annual temperature is about 85° in the São Francisco valley, 77° on the campos of the S.E., and 70° on the campos of the W. The year is divided into two seasons—wet and dry—the former lasting from November to May. This division is not so clearly marked in the south, especially in the "matta" (forest) regions, where the rainfall ranges from 59 to 65 in. There is much malaria in the wooded districts of the east and on the higher campos, where the daily extremes of temperature are great, lung and bronchial diseases are common. Some of the high plains, however, as at Barbacena, serve as health resorts for the coast districts.

Minas Geraes is a mining state, though the mining industry has lost much of its importance through the decline in the output of gold and diamonds. Gold is widely diffused, and abandoned "washings" all over the state show how general the industry was at one time. There were in 1908 five deep mines worked by English companies and one by a French company. One of these, the Morro Velho mine, belonging to an English company, is not only the deepest gold-mine in existence (over 2000 ft.), but it has been worked since 1725, and since 1835 by its present owners. Silver is not mined by itself, but is found in combination with gold. In 1908 a rich goldfield was discovered in the northern part of the state, 5 m. from Montes Claros, in the valley of the Verde Grande River, and attracted large numbers of miners. There are many rich deposits of iron ores in the state, but they only produce a small quantity of charcoal iron for local consumption. Manganese ore is mined for export, and bismuth is reported to have been discovered. Minas Geraes is most widely known for its diamonds, which are found in widely separated parts of the state. The largest and most productive field is that of Diamantina (*q.v.*) on the head-waters of the Jequitinhonha River, where diamonds were discovered about 1725, and where the celebrated "diamond reservation"—an oval-shaped territory 8 leagues wide by 16 leagues long (Mawe), with Tejuco, now Diamantina, very nearly in the centre—was established in 1730. The mines became crown property, gold-mining was forbidden, and no one was permitted to enter the reservation without a licence. The state monopoly was abolished in 1832, and mining has since been carried on by private enterprise. John Mawe estimates that the annual product was 1000 oz. during the first twenty years, and Castelnau estimates the value of the total output down to 1849 at 300,000,000 fr. No estimate can be made of the contraband, which must have been large. A great decline in the output occurred during the last half of the 19th century; but a new field was discovered in 1908 at Abbadia dos Dourados, in the western part of the state. Other valuable stones, the topaz, chrysolite, aquamarine amethyst and tourmaline are found.

Agriculture and grazing have become the main dependence of the population—the former in the lower, forested region of the south-east, where coffee and sugar-cane are the principal products, and the latter on the higher campos and river valleys, and on the mountain slopes, where large herds of cattle are to be found, and milk, butter and cheese are produced. The shipping of fresh milk to Rio de Janeiro and butter-making are comparatively new industries. The river valleys of the campo region are also cultivated to some extent. Among the general products are Indian corn, tobacco, mandioca, beans, pork and cotton. Wheat has been produced in some localities, but not on a paying basis, and experiments have also been made with tea. There is a large variety of fruits, and the cultivation of grapes for wine-making is developing into a profitable industry. Railway communication with Minas Geraes includes the following lines: the Central do Brazil (formerly known as the Dom Pedro II.), which starts from Rio de Janeiro and penetrates nearly to Pirapora (its objective point), at the head of navigation of the São Francisco River, with branches into neighbouring districts; the Leopoldina, from Rio de Janeiro into the forested region of eastern Minas; the Minas and Rio, from Cruzeiro, on the São Paulo branch of the Central do Brazil, into southern Minas; the Mogyana, from Campinas, São Paulo, and runs to Uberaba in western Minas, and is intended to cross into Goyas; and the Bahia & Minas, from the port of Caravellas, in southern Bahia, which runs a short distance into Minas Geraes, and is planned to extend to Philadelphia and beyond. Another line from the port of Victoria, Espirito Santo, northward to Diamantina, Minas Geraes, was under construction in 1908. River transport has some local value on the upper São Francisco and its larger tributaries, and this will be greatly increased when the Central do Brazil railway reaches the head of navigation on that river.

The population of Minas Geraes is chiefly of Portuguese origin, which has been constantly strengthened by immigrants from the mother country. A considerable admixture from other nationalities has resulted from the influx of mining adventurers, and some German colonies have been established in the state. The negro population is large, and there is a still larger contingent of mixed races. The capital is Bello Horizonte (*q.v.*), or Cidade de Minas; other important cities and towns are: the former capital, Ouro Preto, Barbacena, Diamantina, Baependy (pop. 22,817 in 1890), on the head-waters of the Rio Verde, the centre of a rich tobacco-producing district; Curvello (8071), north of Sabará in the Rio das Velhas Valley, the centre of a cotton-growing district and cotton manufactures; Entre Rios (7681), in the coffee district of south-east Minas; Januaria (5888), a river port of the São Francisco in northern Minas; Juiz de Fóra; Marianna (4751), an episcopal town east of Ouro Preto, Mar de Hespanha (18,712), the centre of a productive and populous agricultural municipality of south-east Minas; Paracatú (21,418), an important commercial centre of western Minas near the Goyaz frontier; Queluz (12,600), on the Central do Brazil railway; Congonhas do Campo (10,902), in the municipality of Queluz, celebrated for its miracle-working image, its great church and chapels, and the pilgrimages to its shrine; Sabará (4959), a railway junction on the Central do Brazil, and port on the Rio das Velhas; Congonhas de Sabará (14,066), in the municipality of Sabará, where the celebrated Morro Velho gold-mine is situated; São João d' El-Rei (15,820) an important commercial mining and pastoral centre, near the Rio das Mortes, connected with the Central do Brazil railway by a branch called the Oeste de Minas; and Uberaba (12,231), a commercial town of the western campos of Minas, connected with São Paulo by the Mogyana and São Paulo railways.

Minas Geraes was first explored by Fernando Dias Paes Leme between 1664 and 1677, though he was not the first European to penetrate it. The discovery of gold in 1692–1695 by bands of adventurers from the São Paulo settlements, led to every occupation and profession being abandoned in the mad rush for the new mines. Minas Geraes at first formed part of the capitania of São Paulo, but in 1720 it became a separate government and was brought more directly under the Portuguese crown. The arbitrary restrictions imposed upon the colonists aroused dissatisfaction among them and eventually led to conspiracy in 1789, inspired by a fear that the Portuguese government was about to enforce the collection of its "fifths" of the mining output, which had largely fallen into arrears. Among the conspirators was one José Alves Maciel, who had just returned from France where he had met Thomas Jefferson and had become infected with French revolutionary ideas. A number of residents became involved, among them the poet Thomaz Antonio Gonzaga. Reckless talk in public places led to the arrest of the conspirators. Only one was executed, a poor, uneducated subaltern militia officer Joaquim José da Silva Xavier, nicknamed *O Tiradentes* (the Tooth-puller), the others being imprisoned or banished. Tiradentes has since been glorified as the pro-martyr of Brazilian independence. In 1822 Minas became a province of the empire created by Dom Pedro I., though a revolutionary outbreak had occurred in Ouro Preto the year before. In 1842 a long series of quarrels in Rio de Janeiro culminated in a revolution in Minas Geraes and São Paulo, which was suppressed at Santa Luzía, Minas Geraes, on the 20th of August of that year. The abolition of slavery in 1888 caused much discontent among the planters and in the following year Minas Geraes promptly adhered to the declaration of the republic in Rio de Janeiro.

MINBAR, or MIMBAR, a term in Mahommedan architecture for the pulpit in a mosque from which the Friday or Mahommedan Sabbath sermon is given (see PULPIT).

MINBU, a district and division of Upper Burma. The district has an area of 3299 sq. m., and a population (1901) of 233,377, showing an increase of 8% in the decade and a density of 71 inhabitants to the sq. m. The district may be said to consist of low plain-land towards the Irrawaddy, and of undulating country inland rising higher and higher westwards towards the Arakan hills. Between the plain and the Arakan Yoma range is a distinct line of hills running north and south, and usually called the Nwa-Madaung hills. The submontane valleys are largely cultivated, but are deadly except to those born in them. The chief streams besides the Irrawaddy are the Môn, the Maw, and the Salin, which are largely used for irrigation. At Minbu town the Irrawaddy is 3 miles wide, with many islands and sandbanks. There are considerable fisheries along the Irrawaddy and on the Paunglin lake, which is a lagoon fed from the Irrawaddy. The rights are sold yearly by public auction, and realize an average of £1000. Oil has been discovered near the mud volcanoes of Minbu, but it seems to lie at too great a depth to be profitably worked.

There is a large area of reserved forest in the district. The chief crops raised are rice, gram, millet, beans, peas, sesamum and tobacco. The betel-vine is largely cultivated along the Môn River. The district, which was in a chronically disturbed state before the annexation, was not reduced till two years afterwards, many officers losing their lives, among them Phayre, the first deputy-commissioner. The annual rainfall varies greatly over the district. It is very considerable on and under the Arakan Yomas, and very slight towards the Irrawaddy. The thermometer rises to over 100° in the hot months, and the mean of minimum in December is about 49°. MINBU, the district headquarters, stands on the Irrawaddy. It had a population of 5780 in 1901. The river steamers in the dry season can come no nearer than two miles to the south of the town.

The division includes the districts of Thayetmyo, Pakôkku, Minbu and Magwe. It has a total area of 17,172 sq. m. and a population (1901), of 1,076,280, showing an increase of 8% in the decade and giving a density of 63 inhabitants to the square mile. It bestrides the Irrawaddy. (J. G. Sc.)

MINCHINHAMPTON, a town in the Stroud parliamentary division of Gloucestershire, England, 4 m. S.E. of Stroud. Pop. (1901), 3737. It lies high on a slope of the Cotswold Hills; Minchinhampton Common being a fine open upland. The church of Holy Trinity, largely reconstructed, contains many brasses and memorials. The manufacture of woollen cloth is the long-established staple of Minchinhampton. Prehistoric remains have been discovered on the common, and earthworks are also seen; while the name of Woeful Dane Bottom, a neighbouring valley, perhaps indicates the scene of a defeat of the Danes (*c.* 918).

MINDEN, a town of Germany, in the Prussian province of Westphalia, 44 m. by rail to the W.S.W. of Hanover, on the left bank of the Weser, which is spanned by two bridges. Pop. (1905), 25,428. The older parts of the town retain their narrow and crooked streets. The cathedral tower dating from the 11th century, illustrates the first step in the growth of the Gothic spire in Germany. The nave was erected at the end of the 13th century, and the choir in 1377–1379. Among the chief edifices are the old church of St Martin; the town hall, with a Gothic façade; the law courts and the government offices, constructed, like many of the other buildings, of a peculiar veined brown sandstone found in the district. The town has a statue of Frederick William I., the great elector of Brandenburg. Minden contains a gymnasium and several hospitals, besides other charitable institutions. Its industries include linen and cotton weaving, dyeing, calico printing, brewing, ship-building and the manufacture of tobacco, glass, soap, chocolate, leather, lamps, chicory and chemicals. There is also some activity in the building of small craft.

Minden (Mindun, Mindo), apparently a trading place of some importance in the time of Charlemagne, was made the seat of a bishop by that monarch, and subsequently became a flourishing member of the Hanseatic League. In the 13th century it was surrounded with walls. Punished by military occupation and a fine for its reception of the Reformation, Minden underwent similar trials in the Thirty Years' War. In 1648 the bishopric was converted into a secular principality under the elector of Brandenburg. From 1807 to 1814 Minden was included in the kingdom of Westphalia, and in the latter year it passed to Prussia. In 1816 the fortifications, which had been razed by Frederick the Great after the Seven Years' War, were restored and strengthened, and as a fortress of the second rank it remained the chief military place of Westphalia down to 1873, when the works were finally demolished. About 3 m. to the south of Minden is the so-called "Porta Westfalica," a narrow defile by which the Weser quits the mountains. The bishopric of Minden embraced an area of about 400 sq. m. and had about 70,000 inhabitants.

The battle of Minden was fought on the 1st of August 1759 between the Anglo-Allied army commanded by duke Ferdinand of Brunswick and the French under Marshal Coutades, the latter being defeated. The most brilliant episode of the battle was the entire defeat of the French cavalry by the British infantry (with whom there were some Hanoverian troops), but Minden, though it is one of the brightest days in the history of the British army, has its dark side also, for the British cavalry commander Lord George Sackville (see SACKVILLE, VISCOUNT) refused to obey the order to advance, several times sent by Duke Ferdinand, and thereby robbed the victory of the decisive results which were to be expected from the success of the infantry. For an account of the battle and of the campaign of which it is the centre, see SEVEN YEARS' WAR.

See Stoy, *Kurzer Abriss der Geschichte Mindens* (Minden, 1879); Bölsche, *Skizzen aus Mindens Vergangenheit* (Minden, 1897); Holscher, *Beschreibung des vormaligen Bistumes Minden* (Münster, 1877).

MINEHEAD, a market town and seaside resort in the Wellington parliamentary division of Somersetshire, England, 188 m. W. by S. of London by the Great Western railway. Pop. of urban district (1901), 2511. The town has three parts: the Upper, built on the sides of a lofty foreland known as North Hill; the Lower; and the Quay Town, with many ancient houses, stretching for about a mile beside the harbour. It is much visited for the sake of its mild climate, the grand cliffs, moors and hills of the neighbourhood, and the beach, admirably suited for bathing. St Michael's, the parish church, has a striking Perpendicular tower, an arch of carved oak dividing its nave and chancel, a magnificent rood-loft, and a 13th-century monument doubtfully described as the tomb of Bracton, the famous lawyer, whose birthplace, according to local tradition, was Bratton Court in the vicinity. Coaches for Porlock and Lynton start from the town.

There is no evidence of the existence of Minehead (*Mannheve*, *Manehafd*, *Mynneheved*) in Roman or Saxon times. The town owed its origin and growth to its position on the shores of the Bristol Channel, and its good harbour developed an oversea trade with Bristol, South Wales and the Irish ports. The De Mohun family were overlords of the town from 1086 to the 14th century, when they were followed by the Luttrells, who are the present owners. It is possible that Minehead had a corporate existence during the 15th century, as certain documents executed by the portreeve and burgesses at that date are preserved, but no record of the grant of a charter has been found. A charter of incorporation given by Elizabeth in 1558 vested the government in a portreeve, a steward and twelve burgesses, the continuance of the corporation being subject to the port and harbour being kept in repair. This condition being unfulfilled, the charter lapsed in the reign of James I., and an attempt to obtain its renewal in the 18th century failed. The corporation was replaced by two constables chosen annually in the court leet of the manor until 1894, when an urban district council was appointed. The borough returned two members to parliament from 1558 until disfranchised by the Reform Act of 1832. A weekly market on Tuesdays and a fair (Sept. 29 to Oct. 2) were held by the lord of the manor from the 15th century, but the date of the grant has not been found. In 1465 a second annual fair on the 1st of May was granted by Edward IV., which is still held on the Wednesday in Whitsun week. The other fair has been discontinued, and the market day has been changed to Wednesday. During the 16th, 17th and 18th centuries Minehead had a considerable coastwise trade in wool, grain and wine, but began to decline owing to the migration of the woollen industry to the north of England, and to the decay of the herring fishery. A renewal of prosperity began when it acquired a reputation as a watering-place.

See *Victoria County History: Somerset*; F. Handcock, *Parish and Borough of Minehead* (1903).

MINEO, a town of the province of Catania, Sicily, 34 m. S.W. of Catania by rail. Pop. (1901), 9828. It occupies the site of the ancient *Menaenum*, founded by Ducetius in 459 B.C. There is some doubt as to whether this town was also the birthplace of Ducetius, owing to confusions in nomenclature (see E. A. Freeman, *History of Sicily*, ii. 361). Remains of ancient fortifications still exist, though it seems uncertain whether they are of Greek or of Byzantine origin (*Notizie degli Scavi*, 1899, p. 70). Four miles to the north is the Lacus Palicorum, a small lake in a crater, which still sends up carbonic acid gas. By it was the temple of the Palici, twin Sicel gods, the most holy place in Sicily, where an oath taken was especially binding, and an inviolable asylum for fugitive slaves. There is now nothing to suggest twin deities; in ancient times there were probably two craters, whereas now there is only one. It was here that Ducetius, a few years later, founded a new seat for his power, the city of Palica.

MINERAL DEPOSITS. The subject of mining (*q.v.*) can only be properly understood after the general features of mineral deposits have been elucidated. In this article deposits of all kinds of useful minerals are included, whether they are metalliferous or earthy. In general practice it is customary to treat the former under the name "ore-deposits" and the latter as the "non-metallics." This is warranted because in a large degree different geological problems are presented and different methods of mining are pursued. Nevertheless there are other important similar or common features and they may be classed together without great disadvantage.

Ore.

The word "ore" is used in several meanings, each of which depends for its special significance upon the connexion. In purely scientific applications "ore" implies simply a metalliferous mineral, and in this sense it appears in works on mineralogy and petrology. In former years and in connexion with practical mining an ore was defined as a compound of metal or of metals with one or more non-metallic elements, called mineralizers, of which oxygen and sulphur were the chief. The ore must, in addition, be sufficiently rich to be mined at a profit. Native metals not being compounds were not considered ores. The product of the copper mines on Keweenaw Point, Lake Superior, was, and to a great extent is still, called copper rock rather than copper ore, and native gold in quartz is often described as gold quartz rather than gold ore, but these restrictions are gradually disappearing. An ore may therefore be defined as a metalliferous mineral or aggregate of metalliferous minerals mingled with a greater or less amount of barren materials called the "gangue," and yet rich enough to be mined at a profit. When not proved to be sufficiently rich to be remunerative, the aggregate is called "mineral." The "mineral" of to-day may be changed by the advent of a railway or the rise in the price of metal into the "ore" of to-morrow. The question has repeatedly appeared in litigation involving contracts or property rights.

Since the greater number of the ores are believed to have been precipitated from aqueous solution, or to have been otherwise formed through the agency of water, the term "ore-deposit" has resulted; and inasmuch as nearly all the other useful minerals owe their origin to the same agent, the term "mineral deposit" is equally well justified. A few, however, have been produced in a different way, such as certain iron ores of igneous origin; certain igneous rocks used for building stone, as in the case of granite; and the accumulations of vegetable material in coal beds. These latter, the igneous masses and the vegetable accumulations, being placed in two divisions by themselves, we may group the larger number into two main classes, depending on their precipitation from solution or from suspension. In the case of solution we will further subdivide on the place, and therefore in large part on the cause, of precipitation, since these are the questions chiefly involved in actual development.

Especially in connexion with ore-deposits widening experience has modified the older conceptions of relative values in the several types. In the early days of geology, Cornwall and Saxony were the two regions where the most active and influential students of ore-deposits were trained and where the principal books relating to mining originated. The pronounced and characteristic fissure veins of England and Germany became the standards to which the phenomena met elsewhere were referred, and by means of which they were described. This particular form, the fissure vein along a fault, assumed a predominating importance, both in the thought and in the literature of the day. Widening experience, however, especially in the Cordilleran region of North America, in the Andes of South America, in Australia and in South Africa, has brought other types into equally great and deserved prominence. Comprehensive treatment to-day therefore departs somewhat from earlier standards.

Occurrence.

As far as analyses and estimates permit, the common useful metals occur in the earth's crust in approximately the following percentages:—

1. Aluminium	8·13	7. Copper .	0·0000x
2. Iron . .	4·71	8. Lead .	0·0000x
3. Manganese	0·07	9. Zinc . .	0·0000x
4. Nickel . .	0·01	10. Silver . .	0·000000x
5. Cobalt . .	0·0005	11. Gold . .	0·0000000x
6. Tin . .	0·000x–·0000x	12. Platinum	0·00000000x

By the letter x is meant some undetermined digit in the corresponding place of decimals. Apart from aluminium, iron, manganese and nickel, the figures show how small is the contribution made by even the commoner metals to that portion of the mass of the globe which is open to observation and investigation.

As compared with the earth's crust at large certain of the metals are known to be locally present in favourable, usually igneous, rocks in richer amounts, according to the following determinations which have been made upon large samples of carefully selected materials. Copper, 0·009%; lead, 0·0011–0·008; zinc, 0·0048–0·009; silver, 0·00007–0·00016; gold, 0·00002–0·00004. Iron and aluminium seldom fail, and vary from 1 to 2% as a minimum, up to 25% as a maximum.

In order that the several metals may constitute ores, their percentages must be the following—the percentages of each vary with favourable or unfavourable conditions at the mine, and can therefore be expressed only in a general way; ores favourable to milling and concentration may go below these limits, and the mingling of two metals of which one facilitates the extraction of the other may also reduce the percentages:—

Aluminium	30	Nickel	2–5
Copper	2–10	Platinum	0·00005
Gold	0·003–·00016	Silver	0·03–0·16
Iron	35–65	Tin	1·5–3
Lead	2–25	Zinc	5–25
Manganese	40–50		

Cobalt is a by-product in the metallurgy of nickel and is usually in much inferior amount to the latter.

When we compare the first and second tabulations with the third it is at once apparent that with the possible although only occasional exception of iron the production of an ore-body from the normal rocks which constitute the outer mass of the earth requires the local concentration of each of the metals by one or several geological processes, and to a degree that is only occasionally developed in the ordinary course of nature. It is, therefore, an instance of somewhat exceptionally good fortune when one is discovered, and it is only the part of ordinary prudence to develop and utilize it as one would treat a resource which is limited and subject to exhaustion.

Classes of Mineral.

The minerals which constitute ore-bodies are divided into two great classes: the *ores proper*, which contain the metals; and the *barren minerals* or *gangue*, which reduce the yield.

The ores are generally and naturally subdivided into two groups: first, the sulphides and related compounds containing arsenic, antimony, tellurium and selenium; and, second, the oxidized compounds embracing oxides, carbonates, sulphates, silicates, phosphates, arsenates, chromates, &c. With the oxides are placed, because of related geological occurrence, a few rare compounds with chlorine, bromine and iodine into which silver more than any other metal enters, and to the same group we may add a few metals which occur in the native state. Iron, manganese, aluminium and tin differ from the rest of the metals in their original occurrence in the oxidized form, whereas the others with the exception of gold, platinum, and possibly copper, in their first precipitation in ore-bodies are in the form of sulphides or related compounds. Only by subsequent changes, characteristic of the upper parts of the deposits, do they pass by oxidation into the minerals of the second group.

With regard to the nature and source of the water which serves to gather up the widely disseminated metals and concentrate them in ore-bodies two contrasted views are now current, not necessarily antagonistic but applied in different degrees by different observers. The older view attributes the water primarily to the rainfall, and therefore it is called meteoric water. After falling upon the surface the meteoric water divides into three parts. The first, and smallest, evaporates; the second, the largest portion, joins the surface drainage and is called the run-off; while the third, intermediate in amount, sinks into the ground and mingles with the ground-waters. The ground-waters rise in springs, usually fed from no great depth, and themselves pass into the surface drainage after a small subterranean journey. While as a rule the ground-water level is fairly definite, yet it sometimes displays even in the same mining district great irregularity.

The section of active circulation and work of the descending meteoric waters between the surface and the ground-water level was called by Franz Posepny (1836–1895) the vadose or shallow region ("Genesis of Ore-deposits," *Trans. Amer. Inst. Min. Eng.*, xxiii., xxiv., 1893; reprinted as a book, 2nd ed., 1902). It has been long recognized by miners as the home of the oxidized ores, and the place of the work of the descending waters. The deep-waters are relatively motionless and their movements as far as visible are comparatively slow. But the really important feature of the ground-water as regards the filling of veins is the depth to which it extends. This remained a somewhat indefinite matter until L. M. Hoskins showed mathematically that cavities in the firmest rocks became impossibilities at about 10,000 metres. Down to some such limiting depth as an extreme the ground-water was believed by many to descend; to migrate laterally; to experience the normal increase of temperature with depth; the effect of pressure; the increased efficiency as a solvent peculiar to the conditions; and finally with a burden of dissolved gangue and ore to rise again, urged on by the "head" of the descending column. In its ascent it was supposed to fill the veins. Mining experience has, however, indicated that the known ground-waters are comparatively shallow and seldom extend lower than 500–600 metres. It is conceivable that during faulting and the formation of great dislocations this upper reservoir might be tapped into greater depths and set in limited circulations through deeper-seated rocks. But so far as these objections have weight they have greatly restricted the vertical range of the meteoric ground-waters as they were formerly believed to exist.

In contrast with the meteoric waters outlined above, other waters are believed by many geologists to be given off by the deep-seated intrusive rocks, and are generally called magmatic. We are led to this conclusion by observing the vast quantities of steam and minor associated vapours which are emitted by volcanoes; by the difficulty of accounting in any other way for the amount and composition of certain hot springs; and by the marked and characteristic association of almost all ore-deposits in the form of veins with eruptive rocks. That igneous masses have been connected with the formation of veins is further brought out by the following general consideration, which has hitherto received too little attention. Aside from pegmatites, veins rich enough to be mined and even large veins of the barren gangue-minerals are exceptional phenomena when we compare the regions containing them with the vast areas of the earth which have been carefully searched for them and which have failed to reveal them. As components of the earth's crust the useful metals except iron and aluminium are extremely rare. Some sharply localized, exceptional, and briefly operative cause must have brought the veins into being. The universal circulation of the ground-water of meteoric origin fails to meet this test, since if it is effective we ought at least to find veins of quartz and calcite fairly universal in older rocks. In North America, moreover, by far the greater number of veins which have been studied date from the Mesozoic and Tertiary times. The ore deposits of older date are chiefly of iron and manganese and can be satisfactorily explained in many cases by the reactions of the vadose region, or by crystallization from molten masses.

In summary it may be stated that the meteoric waters are of great importance and of unquestioned efficiency in the shallow vadose region, or, as named by C. R. van Hise, "the zone of weathering." In it the disintegration of rocks exposes them to the searching action of solutions, and the portions of ore-bodies already deposited undergo great modifications. The deeper and far more immovable ground-water probably extends to but moderate depth and is chiefly affected as regards movement by the head of waters entering heights of land and by local intrusions of igneous rocks. It is very doubtful if the normal increase of temperature with depth produces much effect. The meteoric waters are of altogether predominant importance in all surface concentrations of a mechanical character. The magmatic waters, on the other hand, seem to be of paramount importance and of great efficiency in producing the deposits of ores in the contact zones next eruptives, and in the formation of veins which are reasonably to be attributed to uprising heated waters in regions of expiring vulcanism. They start with their burden of dissolved metals and minerals under great heat and pressure, amid conditions favouring solution, and migrate to the upper world into cooling and greatly contrasted conditions which favour precipitation. Undoubtedly they are responsible for many low-grade deposits which have later been enriched by the action of descending meteoric waters. They are more copiously yielded, so far as we may judge, by acidic magmas than by basic ones.

The natural waterways are furnished by the cavities in rocks. They vary in size from very minute pores, where movement is slow because of friction, but where solution takes place, through others of all dimensions up to great fault-zones. The smallest cavities are the natural pores of minerals; cleavage cracks; the voids along the contacts of different minerals; cracks from crushing during dislocation; cellular lavas; volcanic necks; voids among the grains, pebbles, or boulders of fragmental rocks; joints; caves, and faults. So far as waters have deposited ores and yielded ore-bodies by subterranean circulations the latter are guided by some such controlling influence as these in all cases, and they will be selected as the governing principle in a large part of the scheme of classification. The types will be reviewed in the following order:—

I.—Of Igneous Origin.

A. Eruptive masses of non-metalliferous rock.
B. Basic segregations from fused and cooling magmas.
C. Deposits produced in contact metamorphism, most commonly by the action of intrusive masses on limestones.
D. Pegmatites.

II.—Precipitated from Solution.

A. Surface deposits.
B. Impregnations in naturally open-textured rocks.
C. Impregnations and replacements of naturally soluble rocks.
D. Deposits along broken anticlinal summits and in synclinal troughs.
E. Deposits in shear zones.
F. Deposits in faults.
G. Deposits in volcanic necks.

III.—Deposited from Suspension.

A. Placers.
B. Residual deposits.

IV.—Carbonaceous Deposits from Vegetation.

I. Of Igneous Origin.—A. *Eruptive Masses of Non-metalliferous Rock.*—Among the non-metallic objects of mining and quarrying which are of igneous nature, building stone is the chief. Granites, syenites, and other light-coloured rocks are the most important. These rocks occur as intrusive masses called bosses when of limited extent and diameter, and bathyliths when of vast, irregular area. The main point of importance is the jointing and cleavage, which should in each case yield blocks as nearly rectangular as possible so as to save tool treatment. Dark, basic igneous rocks in dikes, sills and surface flows are employed for macadam, and are often of excellent quality for this purpose.

B. *Basic Segregations from Fused and Cooling Magmas.*—A few ore-bodies, of which the best-known involve iron, are believed to result directly in the igneous processes by which molten rock cools and crystallizes. Thus magnetite, one of the common iron ores, is a widely distributed component in the eruptive rocks, rarely if ever failing in any variety. It is one of the first minerals to crystallize, and it possesses a much higher specific gravity than the other constituents. There is reason, therefore, to believe that, forming in some molten magmas in relatively large quantity, it sinks to or toward the bottom of the mass until the latter is at least greatly enriched with it, if not actually changed to iron ore. If the molten rock, after passing through a stage of partial crystallization, moves toward the surface of the earth, the body of ore may occupy almost any position in it other than the bottom. The flowing of the magma in original movements or from pressure sustained in subsequent metamorphic processes, or both, may give the ore the lenticular shape which is quite characteristic of magnetite bodies the world over. Almost all iron ores of recognized eruptive origin contain titanium oxide in amounts from a few units to over 40%. They are most frequently found in dark basic rocks. These ores are not at present of much commercial value because of the difficulties of treating titaniferous varieties in the modern blast furnace practice, but there is little doubt that in the near future they will be extensively mined.

Non-titaniferous magnetites, which often form lenses in gneissoid rocks of more acidic character than those with which the titaniferous are associated, are likewise believed by some observers to be of igneous origin, but there are equally positive believers in sedimentary deposition followed by metamorphism.

Besides magnetite, chromite is a characteristically igneous mineral and is always found in the richly magnesian rocks. Whether the relatively large masses which appear in serpentine are direct crystallizations from fusion, or whether they have segregated from a finely disseminated condition during the change of the original eruptive to serpentine, is a matter of dispute, but the general trend of later opinion is toward an original igneous origin. Although not strictly an ore, corundum is another mineral which is the direct product of igneous action.

A form of ore-body which marks a connecting and transitional member between those just treated and those of the next group is furnished by the sulphides of iron, nickel and copper which are found in the outer borders of basic igneous intrusions. Observers differ somewhat as to the relative importance to be attributed to reactions purely of the nature of crystallization from fusion or those brought about by the agency of gases or other highly heated solvents in the cooling stages. The most important example is afforded by the mingled ores of nickel and copper which are developed in their largest form in the region of Sudbury, Ontario, Canada, and are now the principal source of nickel for the world.[1] The ores are chalcopyrite and pyrrhotite, the latter containing throughout its mass at Sudbury the mineral pentlandite, a rich nickel-iron sulphide and the real source of the nickel. With the base metal there are also found minute traces of the metals of the platinum group. Wherever these ore-bodies have been observed they invariably occur in the borders of intrusive masses. The sulphides constitute an integral part of the rocky mass, which shows almost no signs of alteration or vein production in the ordinary sense. Only some slight rearrangements have subsequently taken place through the agency of water, but all this is a small factor in the total.

C. *Ore-Bodies produced by Contact Metamorphism.*—Great bodies of igneous rock have often been forced in a molten and highly heated condition through other rocks when at a distance below the surface of the earth. After coming to rest they have remained during the cooling stages for long periods in contact with the surrounding walls. All molten igneous magmas are more or less richly charged with aqueous vapour, doubtless in a dissociated state; with carbonic acid and probably with other gases, especially those involving sulphur. During the cooling stages the gases are emitted and carry with them silica, iron, alumina and metallic elements in less amount, of which copper is the commonest, but among which are also numbered lead, zinc, gold and silver. If the rock standing next the intrusive mass is limestone, the silica and iron, and to a less degree the alumina, combine with the lime to the elimination of the carbonic acid and produce extensive zones of lime silicates, of which garnet is the most abundant. Disseminated throughout these garnet-zones are large and small masses of pyrite and chalcopyrite, oftentimes in amounts sufficient to yield large ore-bodies. Again in the limestone outside the garnet-zones, but none the less closely associated with them, are bodies of sulphides containing copper. The copper ores of Bisbee and Morenci, Arizona, of Aranzazu near Concepcion del Oro, Mexico, and of many other parts of the world not yet studied in detail are of this type. The eruptive which most frequently produces contact zones is of a marked acidic or siliceous character, since among eruptives these are the ones most richly charged with gases. When the copper ores are of low-grade in their original deposition it often happens that processes of secondary enrichment, which are later described, are required to bring them up to a richness which warrants mining. Less often than copper appear lead, zinc or gold ores in the same relations.

D. *Pegmatites.*—One other phase of eruptive activity needs also to be briefly mentioned before passing to the discussion of the ore-bodies, which have hitherto chiefly occupied students of the subject. In the regions surrounding intrusive masses of granite we almost always see dikes or veins of coarsely crystalline quartz, felspar and mica radiating outward, it may be, for very long distances. They are believed to be produced by emissions from the eruptive similar to those which yield the garnet-zones just mentioned. The veins are technically called pegmatites. They are characteristic carriers of tin and of minerals containing the rare earths, and less commonly are known to yield gold or copper.

II. Precipitated from Solution.—A. *Surface Deposits.*—The chief ore-body under this type is furnished by iron. The peculiar chemical property possessed by this metal of having two oxides, a ferrous, which is relatively soluble, and a ferric, which is insoluble, leads to its frequent precipitation from bodies of standing or comparatively quiet waters. Ferruginous minerals of all sorts, but more particularly pyrite and siderite, pass into solution in the descending oxidizing or carbonated surface waters, either as ferrous sulphate, or as salts of organic acids, or ferrous carbonate, the last-named dissolved in an excess of carbonic acid. On being exposed to the atmosphere when the solutions come to rest, or to the breaking up of organic acids, or to alkaline reagents, or sometimes to fresh-water algae, the hydrated sesquioxide $2Fe_2O_3, 3H_2O$ is precipitated as the familiar beds of bog ore. The ore usually forms earthy aggregates or crusts and cakes, but may also, as in the interesting case of the Swedish lake deposits, yield small concretions. Bog ores are not very rich in iron and are apt to have much sand and clay intermingled. If subsequently buried under later sediments they may become dehydrated and changed to red hematite, as in the case of some of the Clinton iron ores of the eastern United States. These widely extended beds in the lower strata of the Upper Silurian are often oolitic red hematites, consisting of concentric shells of iron oxide and chalcedonic silica, deposited around grains of sand. The most extensive of all ore-beds of this type and the mainstay of the German and Belgian smelting industry, are the Jurassic ores, locally called minette, of Luxemburg and the neighbouring territories. Three principal and several subordinate beds are distinguished, which furnish a product ranging from 30 to 40 % of iron and between 1 and 2 % of phosphoric oxide (P_2O_5). They are generally believed to have been deposited on the bottoms of embayments of the Jurassic sea. The iron was furnished by the drainage of the land and was precipitated, according to Van Werweke, as silicate, carbonate, sulphide and as several forms of oxide. More than two billions of tons are believed to be available. Very similar deposits occur in the Cleveland district, England, in the Middle Lias.

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[1] A. H. Barlow, "On the Sudbury Deposits," *Geol. Survey of Canada Ann. Rept.*, vol. xiv., part H; A. P. Coleman, *Ann. Report of the Ontario Bureau of Mines*, vol. xiv., part iii. (1905).

In the presence of much organic matter which creates reducing conditions, concretions and even beds of spathic ore or black-band may result and afford the ores of this type extensively utilized in the Scottish iron industry and formerly of some importance in the eastern United States.

The brown hematites often have more or less manganese, and manganese ores themselves may result by closely related reactions, since manganese is very similar to iron in its chemical properties. Aluminium is yielded by deposits of bauxite, the hydrated oxide, which in the states of Georgia and Alabama, of the United States, are the result of surface precipitations. In the depths it is believed that pyritous shales exist. The oxidation of the pyrite supplies sulphuric acid which takes into solution the alumina of the shales. Rising to the surface along a marked series of faults, the aluminium sulphate meets calcium carbonate in an overlying limestone, and the aluminium hydrate is precipitated as concretions at the vents of the springs.

Of scientific importance but as yet not of commercial value are the siliceous sinters deposited around the vents of hot springs which yield appreciable amounts of both the precious and the base metals. While surface precipitations in every particular, they are yet chiefly important in casting light on the processes of vein formation in the depths.

Non-metallic minerals which are deposited from solution on the surface of the earth are the salines, rock-salt, related potassium salts, gypsum and the rarer nitrates. The alkaline chlorides and gypsum are derived, in nearly all cases, from impounded bodies of sea-water, which, exposed to evaporation with or without constant renewal, finally yield beds of rock-salt and related minerals. Shallow estuaries cut off from the sea, it may be by the sudden rising of a bar during a heavy storm or brines impounded in deep bays with a shallow connexion as in the "bar theory" of Ochsenius, have given rise to the great stores of these minerals which are so extensively mined. The potassium compounds have only been found as yet in large quantities in the Stassfurt region of Germany, and seem to be due to the fact that in this locality the mother-liquors of the rock-salt deposits failed to escape, and were evaporated to dryness. The nitrates are chiefly obtained in northern Chile and are the result of the reaction of nitrogenous organic matter, upon alkaline minerals and under conditions where there is enough but not too much water.

Another very important mineral found in surface deposits formed from solution is asphalt. It has happened in various parts of the world, but especially in the island of Trinidad, in the Carribean Sea, that petroleum with an asphalt base has reached the surface, has evaporated, and has become oxidized so as to leave a residuum of asphalt suitable for street-paving or other purposes. So-called pitch-lakes are afforded which may be of great commercial value.

Again, if large sheets, crusts, stalactites and stalagmites are deposited from calcareous water by the escape of the solvent carbonic acid, beautiful ornamental stones are afforded, generally known as Mexican onyx.

B. *Impregnations in Open-textured Rocks.*—In a number of instances in various parts of the world naturally open-textured rocks have been discovered so richly impregnated with the metalliferous minerals as to be ores. The enriching minerals have been introduced in solution, and the solvent has found its way through the rock because of its natural character, and not because geological movements have opened it. Porous sandstones are one of the most common cases. Deposits of silver ores have been extensively mined at St George in southern Utah, consisting of films of argentite and cerargyrite, which have been precipitated upon fossil leaves, sticks, and in the sandstone itself. Over wide areas in the northern United States, copper in various minerals has been discovered in sandstones of Permian or Triassic age. At Silver Cliff, Colorado, silver ores have impregnated a volcanic tuff, while at the Boleo mines in Lower California tuffs yield copper ores. In at least two of the great copper mines on Lake Superior the native metal impregnates a conglomerate, and in a number of others it has enriched a cellular basalt, filling the blow-holes with shots and pellets. In the Commern district between Bonn and Aachen, sandstones of the Triassic Buntersandstein contain knots of galena, distributed over wide areas as impregnations. Organic matter is believed to have precipitated the galena by a reducing action upon percolating solutions of lead.

All these porous rocks have been fed by solutions which have entered along waterways, clearly due to faults or some extensive breaks which have provided introductory conduits. The solutions have then been tapped off from the main passages by the porous rock. They are, therefore, closely connected with faults.

Non-metallic minerals in the form of petroleum and asphalt may also impregnate sedimentary beds or other rocks of open texture. Many oil wells derive their supplies from lenticular beds of sandstone in the midst of impervious shales, and others, as those in the Mexican fields near Tampico, from volcanic tuffs. Asphalt may saturate both sandstones and limestones in such richness as to furnish a natural paving material when crushed, heated and laid. Brines are also yielded by porous strata and supply much of the salt of the world.

C. *Impregnations and Replacements of Naturally Soluble Rocks.*—Ore-deposits of great importance appear in different regions which can only be interpreted as having been formed by the replacement of some or all of a rock with the metallic minerals. The most common rock to yield in this way is limestone, because of its soluble nature, but important cases occur of others composed of silicates. Replacement implies the precipitation of the ore and gangue, molecule by molecule, in the position of the original minerals but without, as in pseudomorphs, the necessary reproduction of crystalline forms. Some waterway must of course introduce the ore-bearing solutions, but it may be slight compared with the great size of the resulting ore-bodies. Lead and zinc ores, often carrying some silver, are those most widely distributed, as they were also the earliest recognized in deposits of this character. More than any other metals their association with limestone is pronounced. The replacements may be found near the supply fissure as in the great zinc deposits near Aachen, or the supply fissures may be obscure as at Leadville, Colorado. While ores occur in the limestone, they are often close along its contact with some relatively impervious stratum, which seems partly to have directed the circulations, partly to have checked or stagnated them, while precipitation took place. With the lead and zinc sulphides, pyrites and chalcopyrite are commonly associated in greater or less degree, the copper increasing locally. All the sulphides are exposed to oxidation above the ground-waters and mining in the upper levels has been often directed against the carbonate and sulphate of lead, or the mingled carbonate and hydrated silicate of zinc.

A non-metallic deposit formed by replacement and of much scientific interest is furnished by sulphur when derived from gypsum, as in the Sicilian and other localities of Europe.

D. *Deposits along Anticlinal Summits and in Synclinal Troughs.*—When strata experience folding they are violently strained at the bends, and, if stiff or brittle like limestone, often crack in limited fissures, which in anticlines open upward and in synclines downward. They thus yield joints in relatively great numbers. Softer rocks, such as shales, are moulded by the strains without fracturing. Very gentle folds seem to have yielded such abundance of cracks in the lead and zinc district of the Upper Mississippi Valley as to cause the so-called "gash veins" which have been worked for many years. The crevices are not all vertical, but often run horizontally and are due to the parting and buckling of individual beds. The resulting ore-bodies are chiefly limited to a single great stratum, and are believed to have been formed by the infiltration of galena, blende and pyrite from overlying formations.

When strata are stiff enough to buckle under violent folding and part so as to produce openings of a crescentic cross-section which afterwards become filled, there result the "saddle-reefs" so remarkably illustrated in the gold veins of Victoria, Australia, and in pitching anticlines of a much larger character in Nova Scotia.

Of far the greatest importance of all the ore-bodies in troughs are the iron ores of the Lake Superior region, now the most productive of all the iron-mining districts. In a series of sedimentary formations, generally of Huronian age, and with associated eruptives, there occur strata consisting of a cherty iron carbonate, which were probably originally marine deposits akin to glauconite. They rest upon relatively impervious rocks, and are often penetrated by basaltic dikes. The entire series has been folded, so that the cherty carbonates, shattered by the strains, have come to rest in troughs of relatively tight, impervious rocks. The descending surface waters have next altered them, have taken the iron into solution, and have redeposited it in the troughs as a slightly hydrated red hematite. The silica has usually been precipitated elsewhere.

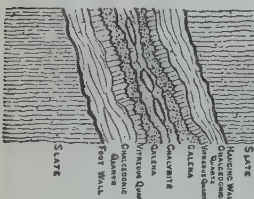
The most important of the non-metallics which occur along anticlinal summits are petroleum and natural gas, but it is true only in a very limited sense that they are introduced in solution. The general cause of the accumulation is, however, the same as that of the metallic minerals, *i.e.* that storage cavities are afforded. In the most productive oil-fields it is the general experience to find the oil and gas impounded in porous rocks, either sandstones or limestones, at the crests of anticlines and beneath impervious shales which do not shatter or crack with gentle folding.

E. *Deposits in Shear-Zones.*—It sometimes happens both in massive rocks and in sediments that strains of compression have been eased by local crushing along comparatively narrow belts without appreciable or measurable displacement of the sides such as would be required by a pronounced fault. The word shear-zone has become quite widely used in recent years as a descriptive term applicable to these cases.

The gold-bearing reefs of the Transvaal present a good illustration. Beds of conglomerate consisting chiefly of quartz and quartzite pebbles have experienced crushing and shattering, and have had their natural porosity much enhanced by these after-effects. Solutions of gold, coming through, have encountered pyrites and have had the gold precipitated upon the pyrites, which is itself often broken and granulated. In other regions shearing has led to sheeting and opening of the rocks by many parallel cracks but almost always with such marked displacement that the next type most correctly describes them. From any point of view the shear-zone is a natural transition to the fault and closely related to it.

F. *Deposits in Faults.*—This type of ore-body was one of the earliest established, and has always figured very prominently in the minds of students of the subject since the first systematic formulations of our knowledge. The dislocation of the earth's crust by faults has furnished either clean-cut fissure or else lines of closely set parallel fractures, whose combined displacement has been comparatively great. The faults go to relatively profound depths and they furnish therefore waterways of extended character, which may reach from regions of heat and pressure in depth to regions of cold and diminishing pressure above; thus from conditions favourable to solution below to conditions favouring precipitation toward the surface. Faults often occur, moreover, in connexion with eruptive outbreaks, and therefore in circumstances especially favourable to ore deposition. From all these reasons it is not surprising that the "true fissure vein" based on a profound fault has been the ideal of the prospector's search in many parts of the world, and has often been his reward. The historic veins of Cornwall and of Saxony are of this type, also the great silver veins of Mexico, the gold veins of California, the great silver-gold deposits of the Comstock lode, and many in South America.

Faulting often leads to great shattering of the country rock, and instead of being a clean-cut open cavity, there results a brecciated belt which may then be cemented by infiltrating ore and gangue. In the midst of this the richer ore occurs as bonanzes or chutes, which are succeeded by leaner stretches. The movement of the walls produces the polished surfaces specifically called "slickensides," parallel to which the ore-chutes often run. The change in the character of the entering solutions from time to time gives a banded character to the deposit, so that from both walls toward the centre corresponding layers succeed one another. At the centre the last layers may meet as interlocking crystals in the familiar comb-in-comb structure or they may leave cavities called "vugs" into which beautiful and perfectly formed crystals project (see fig.). Fault fissures swell and pinch affording wide and narrow places in the resulting ore-body. They often intersect each other and one may throw or heave another, according to the mechanics of faulting as set forth under the article on GEOLOGY.



While fault-fissures have in no way failed in later years to be appreciated by mining geologists, yet they do not hold that predominant place which in the days of more limited experience was theirs. On the contrary, other types such as contact zones, replacements and impregnations are found to be of scarcely inferior importance. Nevertheless the last two, at least, must usually owe to the fault-fissure the waterway which has brought in the solutions.

A very peculiar non-metallic deposit found in fault-fissures and imitating the ordinary veins in all essentials is furnished by the asphaltic minerals, often described as asphaltic coals and known in mineralogy as "grahamite," "albertite," "uintaite," "gilsonite," &c. Petroleums with asphaltic bases have percolated into fault-fissures and have there deposited on evaporation and oxidation their dissolved burdens. The black coaly mineral presents all the geological relations of a fissure vein and is mined like so much ore.

G. *Volcanic Necks.*—A very unusual ore-body is furnished by this type, which is only known in a few instances. In two mines, however, in Colorado, the Bassick and the Bull-Domingo, there occur chimneys of elliptical cross-section filled with rounded boulders, and believed with much reason to be the tubes of small explosive volcanoes. After brief periods of activity they became waterways for uprising heated solutions which filled the interstices with ore.

III. DEPOSITED FROM SUSPENSION.—The ores which result from this process are all formed upon the surface of the earth and through the action of water. They are primarily the result of the weathering of rocks and of the removal of the loose products thus afforded in the ordinary processes of erosion.

A. *Placers.*—Many useful minerals, including some of a metallic character, are very resistant to the agents of decomposition which cause the disintegration of the common rocks. Thus magnetite is a mineral present in a minor capacity in all eruptives and in fairly large percentage in many of the basic types. It is proof against protracted exposure to natural reagents, and it is heavy. Becoming freed by the disintegration of the containing rock it is mingled with the transported materials of running streams, and settles with other heavy minerals wherever the current slackens to a sufficient degree. Concentration may thus ensue and beds of black sand result. If again deposits of loose sand containing more or less magnetite are exposed to the surf of the ocean, or even to the waves of lakes, a similar sorting action takes place on the beach. The magnetite remains behind while the undertow removes the lighter materials. Iron sands of either of these varieties are usually too rich in titanium to be of commercial value, but with the magnetite may be gold or platinum in sufficient amount to be of value.

While magnetite is the commonest of the ores to be found in placers, gold is the metal which usually gives them value. Wherever systems of drainage have eroded gold-bearing rocks, the gold has passed into the streams with the other detrital materials, and, even though in very fine flakes, being yet very heavy has sunk to the bottom in the slackened water and has there enriched the gravel. The gold tends to work its way through the gravels even to the bed-rock, or to some bed of interstratified and impervious clay, and there to be relatively rich. It favours also the insides of bends and the heads of quiet reaches. When a small tributary stream joins a larger one and is both checked itself and checks the current of the large one, the gold, as in the Klondike, tends to settle in relatively great abundance.

Pot-holes, strangely enough, or related rock-cavities, often fail to yield the nuggets, apparently because the swirl of the water and grit has ground them to impalpable powder. The particles have then been washed elsewhere.

When the gold-bearing gravels are panned down a small residue is obtained of all the heavy minerals in the gravel. Magnetite is the commonest and gives the technical name of "black sand" to the concentrate. With it, however, there are almost always found garnet and other less familiar minerals. If the stream valley has been hunted over by sportsmen with shot-guns or rifles, the lost shot and bullets are commonly caught in the pan. Even diamonds have been rarely noted and they may, indeed, be specially sought in gravels.

Along sea-beaches where great beds of auriferous gravel have been attacked by the surf, concentrated bars carrying nuggets and flakes of gold in workable quantity have not infrequently resulted. Cape Nome, Alaska, is perhaps the most productive of all. The gold in the beach-placers is usually worn by the constant attrition into extremely fine particles, and the flakes or colours are more difficult to save than in the case of stream-placers.

In some regions of gold-bearing rocks, as in the south-eastern United States, the products of superficial decay of rocks may remain *in situ* and be sufficiently charged with gold to be washed for the yellow metal. They are different from the usual placer deposit although hydraulicked in the same way. They might be properly considered residual deposits under the next head.

Auriferous stream-gravels of ancient and long-abandoned systems of drainage may remain beneath lava flows or later sedimentary accumulations and be the objects of underground mining. Both in Australia, where they are called "deep leads," and in California, where they are called "buried channels" or "deep gravels," they have been for many years the objects of mining. In California the bed-rock is usually slate or schist and a series of technical terms have resulted descriptive of the rich streaks. The bed-rock is called the rim-rock; the pay-streaks which appear on its sides, bench-gravels, and the lowest one the channel-gravel. Tunnels are often very skilfully driven through the rim-rock to strike the channel-gravel and at the same time preserve the proper slope for drainage and extraction. The buried channels in California have proved of much scientific interest from the remains of prehistoric man, skulls, mortars and pestles which they have yielded.

Among the non-metallic minerals sought from placers, phosphates for fertilizers hold a position of great importance.

B. *Residual Deposits.*—As contrasted with the placers whose materials are derived by transport from a distance, we sometimes find heavy and resistant minerals, once contained in the rock but freed by the process of decay and disintegration. The lighter loose materials are washed away and deposited elsewhere. The heavy remain behind in a concentrated condition. Iron ores of this character are known, and chromite is set free in the same way by the decomposition of serpentine.

In the decay of ferruginous rocks like limestones the iron may be changed to the insoluble ferric hydrate, brown hematite, and remain as veinlets and crusts throughout a mantle of clay. The brown hematite may be freed by artificial washing and used as an iron ore.

IV. CARBONACEOUS DEPOSITS FROM VEGETATION.—Far the most important of the non-metallic minerals are those composing the coal series. They yield entire strata analogous to other sedimentary rocks, but in most cases from vegetation which has grown *in situ*. They are found in all stages from nearly carbonized leaves and woody tissue in peat, through much more altered materials in lignite and bituminous coal to extremes in anthracite and graphite. The prime necessity for their preservation from decay is furnished by water, in or near which they must grow, and beneath which they must be deposited, so that oxidation may be retarded. In instances they have been heaped together by rivers, especially when at flood. The method of origin is fully discussed under COAL and under

Mining, but it may be remarked here that once formed they undergo all the foldings, faultings and disturbances which have affected the sedimentary rocks of other kinds.

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MINERALOGY, the science which describes and classifies the different kinds of mineral matter constituting the material of the earth's crust and of those extra-terrestrial bodies called meteorites. The study of minerals is thus a branch of natural history, but one in which certain of the exact sciences find an application. The determination of the composition and constitution of minerals is a chemical problem; their optical and other physical properties are determined according to the principles of physics; the study of their crystalline form and structure belongs to crystallography; their modes of occurrence, origins, associations and changes come within the province of geology and petrology; while a consideration of the localities at which they are found requires some acquaintance with geography. Finally, there is the economic side, dealing with the mining and application of useful minerals, the extraction of metals from their ores, and the uses of minerals for building, decoration and jewelry.

In this article we shall treat only of the general characters of minerals; their special characters will be found in the articles on the individual minerals.

After a brief historical sketch the subject will be treated under the following headings:—

I. Characters of Minerals.
    1. Morphological Characters.
        a. Crystalline Form.
        b. State of Aggregation: Structure.
    2. Physical Characters.
        a. Optical Characters (Colour, &c.).
        b. Magnetic, Electrical and Thermal Characters.
        c. Characters depending on Cohesion (Hardness, &c.).
        d. Specific Gravity.
        e. Touch, Taste and Smell.
    3. Chemical Characters.
        Synthesis of Minerals.
II. Occurrence and Origin of Minerals.
    Alteration of Minerals: Pseudomorphs.
III. Nomenclature and Classification of Minerals.

History.—Owing to their numerous applications for useful and decorative purposes, minerals have attracted the attention of mankind from the earliest times. The stone and bronze implements of prehistoric man and many of his personal ornaments and charms were directly or indirectly of mineral origin. The oldest existing treatise on minerals is that written about 315 B.C. by Theophrastus (περὶ τῶν λίθων—*On Stones*, English version by John Hill, 1746), of which only a portion is now in existence. Minerals were then classed as metals, stones and earths. The last five books of Pliny's *Historia naturalis*, written about A.D. 77, treat of metals, ores, stones and gems. Some of the Arabian philosophers devoted themselves to the study of minerals, and about 1262 Albertus Magnus wrote his *De mineralibus*. In the 16th century Georgius Agricola published several large volumes, dealing more especially with the mining and metallurgy of metalliferous minerals, in which more exact descriptions were given of the external characters: he mentioned several minerals by names (*e.g.* blende, fluor, quartz) which are now in common use. About the same period there appeared the systematic treatise on minerals of K. Gesner (1565), and that on precious stones by Anselm Boethius de Boodt (1609). The remarkable researches of Erasmus Bartholinus on Iceland-spar were published in 1669, and J. F. Henckel's *Pyritologia* in 1725. Later came the *Systema naturae* of C. Linnaeus (1735). Although the importance of chemical properties was recognized by the Swedish chemists—J. G. Wallerius (1747) and A. F. Cronstedt (1758)—the external characters of minerals formed the basis of the mixed systems of classification of A. G. Werner (1774) and of other authors, and even as late as the *Natural History System of Mineralogy* of F. Mohs (1820).

It was not until the end of the 18th and beginning of the 19th century, when the foundations of crystallography were laid by Romé de l'Isle and R. J. Haüy, and chemistry had assumed its modern phase, that any real advance was made in scientific mineralogy. It was then recognized that chemical composition and crystalline form were characters of the first importance, and that external (natural history) characters were often more or less accidental. During this period numerous mineral substances were analysed by Scheele, Klaproth, Charles Hatchett, Vauquelin, Kirwan, Berzelius, Rose and other chemists, and many new mineral-species and chemical elements discovered. After W. H. Wollaston's invention of the reflecting goniometer in 1809, exact measurements of the crystalline forms of many minerals were made. The principles of isomorphism and dimorphism enunciated by E. Mitscherlich in 1819 and 1821 respectively cleared up many difficulties encountered in the definition of mineral-species. About the same time also the discovery by E. L. Malus of the polarization of light gave an impetus to the optical examination, by Sir David Brewster and others, of natural crystals. Later, the investigation of rocks in thin section under the microscope led to the exact determination, particularly by A. Des Cloizeaux (1867), of the optical constants of rock-forming minerals.

For a detailed account of the history of mineralogy (including crystallography), see F. von Kobell, *Geschichte der Mineralogie von 1650–1860* (München, 1864). The recent history of mineral-species may be well traced in the six editions of J. D. Dana's *System of Mineralogy* (1837–1892).

I.—Characters of Minerals.

A distinction is to be made between essential and non-essential characters. Essential characters are those relating to chemical composition, crystalline form, crystallo-physical properties and specific gravity; these are identical, or vary only within certain defined limits, in all specimens of the same mineral-species. Non-essential characters—such as colour, lustre, hardness, form and structure of aggregates—depend largely on the presence of impurities, or on the state of aggregation of imperfectly formed crystalline individuals. In an absolutely pure and perfectly developed crystal all the characters may be said to be essential, but such crystals are of exceptional occurrence in nature, and certain of the characters are subject to modification under different conditions of growth. For example: a well-formed crystal of haematite ("specular iron ore"), with its smooth black faces and brilliant metallic lustre, is strikingly different in appearance from a piece of massive haematite ("red iron ore"), which is dull and earthy and bright red in colour; the former is so hard that it can only with difficulty be scratched with a knife, while the latter is quite soft and soils the fingers. Both specimens will, however, be found on analysis to have the same chemical composition (Fe_2O_3), the same crystalline structure (as determined by the optical characters under the microscope in the case of the massive variety), and very nearly the same specific gravity (especially if this be determined upon finely powdered material, the effect of cavities being thus eliminated). The essential characters being identical, the difference between the two specimens lies in the state of aggregation of the material: with "specular iron ore" we have a single crystal, while with the "red iron ore" we are dealing with a confused aggregate of minute crystalline individuals, which have interfered with each other's growth to such an extent that no crystal-faces have been developed. Such differences do not therefore depend on the nature of the material, but only on the conditions which prevailed during its growth. (See *e.g.* QUARTZ and CALCITE.)

In the following enumeration of the more salient characters of minerals it is to be noted that many of the terms used for non-essential characters are purely descriptive and have no exact definition; on the other hand, essential characters can be expressed numerically and are therefore perfectly definite.

1. *Morphological Characters.*

a. Crystalline Form.—This most important character of minerals can, of course, be determined only when the material available is in the form of crystals (*i.e.* crystallized), which is not always the case. Massive aggregates of crystalline material are of much more frequent occurrence; when small fragments or thin sections of such material are transparent, the crystalline symmetry may be determined, within certain limits, by the help of the optical characters (see below). External crystalline form must not, however, be considered alone apart from all other characters, for crystals of substances quite different chemically, *e.g.* silver iodide, zinc oxide and zinc sulphide, are sometimes almost identical in crystalline form; further, in groups of isomorphously related minerals the degree of symmetry will usually be the same and the angles vary only slightly, and unless the crystals are perfectly developed and suitable for exact goniometric measurement no crystallographic distinction can be made between two such species.

All the six systems of crystals and most of the thirty-two symmetry-classes are represented amongst minerals (see CRYSTALLOGRAPHY). Crystals of the same mineral-species may differ very widely in general form or habit; *e.g.* crystals of calcite (*q.v.*) may be rhombohedral, prismatic, scalenohedral or tabular in habit. Other descriptive terms of the habit of crystals are pyramidal, acicular or needle-shaped (from the Lat. *acicula*, a needle), capillary or hair-like (from the Lat. *capillus*, hair), &c.; and these peculiarities of habit may sometimes be characteristic of certain minerals. Sometimes also there are characteristic kinds of groupings of crystals: thus parallel, divergent or radiating (*e.g.* scolecite), rosette-shaped (*e.g.* haematite—*Eisenrosen*), reticulated (*e.g.* rutile), or matted. The faces of natural crystals may be smooth, rough, striated, curved or drusy,[1] *i.e.* studded with small crystal faces and angles.

b. State of Aggregation: Structure.—According to the particular state of aggregation of a number of imperfectly developed crystals, which have grown together, various kinds of structure may be presented even by the same mineral species. The descriptive terms applied to these structures are almost self-explanatory: thus the structure may be granular (*e.g.* marble), fibrous (asbestos), radio-fibrous or stellated (wavellite), columnar (beryl), laminar or lamellar (talc), bladed (cyanite), &c., according to the relative shape and sizes of the individual crystals composing the aggregate. When the constituent crystals are invisible to the unaided eye the material is described as compact; incoherent aggregates are powdery or earthy. Minerals which are really amorphous, *i.e.* without any crystalline structure, are comparatively few in number (*e.g.* opal); many which are apparently amorphous are really microcrystalline (*e.g.* turquoise). The term massive is often used loosely for a crystalline mineral not showing crystal-faces. Crystal-aggregates often assume more or less accidental and imitative external forms to which the following descriptive terms are applied: dendritic or arborescent (*e.g.* copper, pyrolusite), mossy (copper), leafy (gold), wiry or filiform (silver), capillary (millerite), coralloidal (aragonite), globular (aragonite, with concentric structure; wavellite, with radiated structure), mamillary or with breast-like protuberances (arsenic), nodular (malachite), warty (menilite), botryoidal or resembling a bunch of grapes (from *βότρυς*, a bunch of grapes) (dolomite), reniform or kidney-shaped (menilite), amygdaloidal or almond-shaped (agate), stalactitic (calcite, chalcedony), &c.

2. *Physical Characters.*

a. Optical Characters.—The action of crystallized matter on transmitted light is a character of the highest importance in mineralogy. Even when the substance is opaque in large masses, it may be sufficiently transparent when in small splinters or in thin sections for the determination of the optical characters. The refractive indices, strength of the double refraction, optic axial angle, extinction angles on certain faces, &c., are characters capable of exact measurement and numerical expression, and are constant for each mineral-species. (See CRYSTALLOGRAPHY.)

In their "diaphaneity," or degree of transparency, minerals differ very widely even in the same species. Some, such as metals and most metallic sulphides are always opaque; while others may vary in different specimens from perfect transparency to perfect opacity (in the latter case, however, minute fragments will, as a rule, still be transparent). A good example of this is afforded by the varieties of quartz: rock-crystal is water-clear, chalcedony is translucent, and jasper opaque.

The "colour" of minerals is the character which first arrests attention; but being a character which may vary almost indefinitely in one and the same kind of mineral, it affords a typical example of a non-essential character. Thus, fluor-spar and quartz, when in well-formed and chemically pure crystals, are quite colourless and transparent; but it would be easy to collect a series of each of these minerals in which almost every shade of colour is represented. Crystals of fluor-spar of an emerald-green, purple, golden-yellow, bright pink or other colour are at first sight very different in appearance, and yet the difference is due solely to the presence of traces of colouring matters so small in amount that their exact nature is difficult or impossible to determine. The value of diamond, corundum and other gemstones depends largely on these accidental differences in colour. Such substances, which are essentially colourless and owe their colour to the presence of colouring matter as an impurity, are said to be "allochromatic": any colour they may possess is non-essential. In some other substances, known as "idiochromatic," the colour is a definite and essential character; for example, the yellow colour of gold, the red of cinnabar, &c.; but even here, owing to differences in the state of aggregation and the presence of various impurities, they may be wide variations in colour. Colour is thus a character of little determinative value, especially in minerals which are allochromatic; but it is sometimes a useful guide when taken in conjunction with other characters. An elaborate list of colour-names for descriptive use was drawn up by A. G. Werner in 1774.

An important character of transparent crystals is that of unequal absorption in different directions; so that light will, as a rule, be differently coloured according to the direction in which it has travelled through the crystal: this is known as dichroism or pleochroism (see CRYSTALLOGRAPHY). Certain minerals (*e.g.* zircon, almandine and those containing cerium) when examined with a spectroscope by transmitted light exhibit characteristic absorption spectra.

The colours of minerals may also be due to the interference of rays of white light at the surfaces of thin crevices or minute inclusions, either tabular or fibrous in form, in the mineral; for example, the play of colours of opal; the change of colours of labradorite; the bands of rainbow colours (Newton's rings) seen along cleavage cracks and irregular internal fractures (*e.g.* in quartz); the iridescent tarnish due to a superficial film of a decomposition product (*e.g.* "peacock copper ore"); or the bluish opalescence of moon-stone and cat's-eye.

The true colour of a mineral is best revealed by its "streak," *i.e.* the colour of its powder. This is obtained by scratching the mineral, or by crushing a fragment of it on a sheet of white paper, or rubbing it upon unglazed porcelain. The streak of allochromatic minerals is white, while that of idiochromatic minerals is coloured and is often of determinative value. Ores of iron may, for example, generally be distinguished by their streaks: that of magnetite being black; haematite, blood-red;

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[1] This is from a German word, *druse*, originally meaning "brush," and applied by miners to hollow stones, lined with minute projecting crystals.

limonite, yellow; and chalybite, white. The streak of a mineral may be either shining (*e.g.* argentite) or dull.

Another character depending on light is that of lustre, which is often very characteristic in certain minerals, though it may be considerably modified by the state of aggregation. For example, the usual adamantine lustre of diamond is not exhibited by the compact aggregate known as carbonado; while earthy masses of any mineral will be devoid of lustre. Descriptive terms applied to the kinds of lustre are: metallic (*e.g.* pyrites), adamantine (diamond), vitreous (quartz), resinous (pyromorphite), greasy (elaeolite), waxy (chalcedony), pearly (talc, heulandite and other minerals with a perfect cleavage), silky (satin-spar), &c. The degrees of intensity of lustre are described as splendent, shining, glistening, glimmering and dull, and depend usually on the smoothness of the crystal-faces.

The phenomena of phosphorescence (*q.v.*), fluorescence (*q.v.*) and radio-activity (*q.v.*) are strikingly exhibited by some minerals. (See FLUOR-SPAR, DIAMOND, &c.)

b. Magnetic, Electrical and Thermal Characters.—These, as far as related to crystalline form, are discussed under crystallography (*q.v.*). Magnetite ("lode-stone") is the only mineral which is strongly magnetic with polarity; a few others, such as pyrrhotite and native platinum, possess this character to a much less degree. Many minerals are, however, attracted by the pole of a strong electro-magnet, while a few (diamagnetic) are repelled.

Most minerals with a metallic lustre are good conductors of heat and electricity; others are bad conductors. For example, graphite is a good conductor, while diamond is a bad conductor. Non-conductors of electricity become electrified by friction, some positively (*e.g.* quartz and topaz), others negatively (*e.g.* sulphur and amber). The length of time during which different gem-stones retain their charge of frictional electricity was made use of by R. J. Haüy as a determinative character. For the pyro-electrical and thermo-electrical characters of crystals see CRYSTALLOGRAPHY. Some minerals—for example, salt, sylvite and blende—are highly diathermanous, *i.e.* transparent for heat-rays.

The specific heat and melting point of minerals are essential characters capable of exact measurement and numerical expression, but they are not often made use of. Different minerals differ widely in their "fusibility": the following scale of fusibility was proposed by F. von Kobell:—

1. Stibnite	(525° C.)
2. Natrolite	(965° C.)
3. Almandine	(1265° C.)
4. Actinolite	(1296° C.)
5. Orthoclase	(1175° C.)
6. Bronzite	(1300° C.)
7. Quartz	(1430° C.)

The melting points given above in parentheses were determined by J. Joly. Stibnite readily fuses to a globule in a candle-flame, while quartz is infusible even on the thinnest edges before the ordinary blowpipe.

c. Characters depending on Cohesion.—Some minerals (*e.g.* a sheet of mica) are highly elastic, springing back to their original shape after being bent. Others (*e.g.* talc) may be readily bent, but do not return to their original form when released; these are said to be pliable or flexible. Sectile minerals (*e.g.* chlorargyrite) may be cut with a knife without being fractured: related characters are malleability (*e.g.* argentite) and ductility (*e.g.* silver). The tenacity, or degree of frangibility of different minerals varies widely: they may be brittle, tough, soft or friable. The fractured surface produced when a mineral is broken is called the "fracture," and the kind of fracture is often of determinative value; descriptive terms are: conchoidal (*e.g.* quartz, which may often be recognized by its glassy conchoidal fracture), sub-conchoidal, uneven, even, splintery (*e.g.* jade), hackly or with short sharp points (*e.g.* copper), &c.

In many cases when a crystallized mineral is broken it separates in certain definite directions along plane surfaces. This property of "cleavage" (see CRYSTALLOGRAPHY) is an important essential character of minerals, and one which is often of considerable assistance in their recognition. For example, calcite, with its three directions of perfect cleavage parallel to the faces of a rhombohedron, may always be readily distinguished from aragonite or quartz; or again, the perfect cubical cleavage of galena renders this mineral always easy of recognition.

"Hardness," or the resistance which a substance offers to being scratched by a harder body, is an important character of minerals, and being a test readily applied it is frequently made use of. It must, however, be remembered that the hardness of an incoherent or earthy aggregate of small crystals will be very different from that of a single crystal. A comparative "scale of hardness" was devised by F. Mohs in 1820 for the purpose of giving a numerical statement of the hardness of minerals.

Mohs's Scale of Hardness.

1. Talc.
2. Gypsum.
3. Calcite.
4. Fluor-spar.
5. Apatite.
6. Orthoclase.
7. Quartz.
8. Topaz.
9. Corundum.
10. Diamond.

These minerals, arbitrarily selected for standards, are successively harder from talc the softest, to diamond the hardest of all minerals: a piece of talc is readily scratched by gypsum, and so on throughout the scale. A mineral which is capable of scratching calcite and itself be as easily scratched by fluor-spar is said to have a hardness of $3\frac{1}{2}$. Some care is required to avoid error in the determination of hardness: it is best to select a smooth crystal-face, cleavage-surface or fracture on which to rub a sharp corner of the scratching mineral; the powder should be wiped off and the surface examined with a lens to see if a scratch has really been produced or only powder rubbed off the corner of the mineral with which the scratching was attempted. With a little practice a fair idea of the hardness of a mineral may be obtained with the use of a knife or file, which will scratch all minerals with a hardness of 6 or less. Thus iron-pyrites (H. = $6\frac{1}{2}$) and copper-pyrites (H. = $3\frac{1}{2}$), apatite (H. = 5) and beryl (H. = $7\frac{1}{2}$), or gem-stones and their paste imitations may be readily distinguished by this test. Talc and gypsum can be readily scratched with the finger-nail.

Planes of parting, etching figures, pressure- and percussion-figures are sometimes characters of importance in describing and distinguishing minerals. (See CRYSTALLOGRAPHY.)

d. Specific Gravity.—The density or specific gravity of minerals is an essential character of considerable determinative value. In minerals of constant composition it has a definite value, but in isomorphous groups it varies with the composition: it also, of course, varies with the purity of the material. It is a character which has the advantage of numerical expression: minerals range in specific gravity from 1·01 for copalite to 22·84 for iridium. The exact determination of the specific gravity of minerals is therefore a matter of some importance. Three methods are in common use, viz. hydrostatic weighing, the pycnometer, and the use of heavy liquids. The first two methods are only applicable when a weighable amount of pure material can be selected or picked out; this is, however, generally a laborious operation, since impurities are often present and usually several species of minerals are closely associated, and in selecting material it is often necessary to determine some other character to make certain that only one kind is being selected. For exact determinations the pycnometer method is usually to be recommended, using for material the pure fragments which have been selected for quantitative chemical analysis. With a single pure crystal or a faceted gem-stone the method of hydrostatic weighing is usually applicable, providing the stone is not too small. The most ready method, however, is that afforded by the use of a heavy liquid, and the most convenient liquid for this purpose is methylene iodide. This is a clear, mobile liquid with a specific gravity of 3·33, and by the addition of benzene, drop by drop, the specific gravity may be reduced to any desired amount. With such a liquid the specific gravity of the minutest fragment, the purity of which has previously been scrutinized under the microscope, may be rapidly determined. The liquid is diluted with benzene until the fragment just remains suspended, neither floating nor sinking; the specific gravity of the fragment will then be the same as that of the liquid, and the latter may be determined by hydrostatic weighing or, more conveniently, by means of indicators. Small recognizable crystals of the following minerals may be kept at hand as a set of indicators: gypsum (sp. gr. 2·32), colemanite (2·42), orthoclase (2·56), quartz (2·65), calcite (2·72), aragonite (2·93), rubellite (3·02), apatite (3·20), dioptase (3·32), &c. With a series of tubes containing mixtures of methylene iodide and benzene of different densities and suitable indicators, specific gravities may be rapidly and accurately determined. Values intermediate between those of the indicators may be estimated by a diffusion column of the liquid, or by noting the rate at which the benzene evaporates and the specific gravity of the liquid increases. For use with minerals of specific gravity greater than 3·33 various other heavy liquids have been suggested; the best being thallium silver nitrate ($TlAg(NO_3)_2$), which melts at 75° C. to a clear liquid with a density of 4·8, and is miscible with water.

e. Touch, Taste and Smell.—In their action on the senses of touch, taste and smell a few minerals possess distinctive characters. Talc is unctuous or soapy to the touch; tripolite and trachyte are respectively meagre and harsh. Some porous minerals (*e.g.* clays and hydrophane) adhere to the tongue. Gem-stones may often be distinguished from their glass imitation by the fact that they feel colder, since they are better conductors of heat. Bitumen and clays, when moistened, have a characteristic smell; pyrites and some other sulphides when rubbed emit a sulphurous odour. Minerals which are soluble in water have taste: *e.g.* saline (salt), alkaline (natron), bitter (epsomite), astringent (chalcanthite), &c.

3. *Chemical Characters.*

Chemical composition is the most important character of minerals, and on it all modern systems of classification are based. A mineral-species cannot, however, be defined by chemical composition alone, since many instances are known in which the same chemical element or compound is dimorphous or polymorphous (see CRYSTALLOGRAPHY). Thus both the minerals diamond and graphite consist of the element carbon; both calcite and aragonite consist of calcium carbonate; and rutile, anatase and brookite consist of titanium dioxide. In such cases a knowledge of some other essential character, preferably the crystalline form, is necessary, before the mineral can be determined.

All the known chemical elements have been found in minerals; and of many of them minerals are the only source. On the other hand, nitrogen, which is frequently present in organic substances, is rare in minerals; carbon has a wide distribution in mineral carbonates. It is estimated that the minerals of the earth's crust consist of about 47% by weight of oxygen, 27 of silicon and 8 of aluminium; silicates, and especially aluminosilicates, therefore predominate, these being the more important rock-forming minerals.

The chemical composition of minerals is determined by the ordinary methods of analytical chemistry. Since, however, minerals of different kinds usually occur intimately associated, it is often a matter of some difficulty to select a sufficiency of pure material for analysis. For this reason the exact composition and the empirical formulae of several minerals, particularly amongst the silicates, still remain doubtful. There are even cases on record in which the chemical composition and the crystalline form have been determined on different materials in the belief that they were the same. Whenever possible, therefore, the chemical analysis should be made on small pure crystals which have been previously determined crystallographically. For the qualitative chemical examination of minerals, when only a small amount of material is available, the methods of blowpipe analysis and microchemical analysis are often convenient. (See G. J. Brush, *Manual of Determinative Mineralogy*, 16th ed., by S. L. Penfield, New York, 1903; H. Behrens, *Manual of Microchemical Analysis*, London, 1894.)

The principle of isomorphism (see CRYSTALLOGRAPHY) is of the highest importance in mineralogy, and on it the classification of minerals largely depends. In some minerals (*e.g.* quartz) isomorphous or vicarious replacement is not known to occur; but in the majority of minerals one or other of the predominating elements (generally the base, rarely that of the acid radicle) may be isomorphously replaced by equivalent amounts of other chemically-related elements. In some isomorphous groups of minerals replacement takes place to only a limited extent, and the element which is partly replaced always predominates; while in other groups the replacement may be indefinite in extent, and between the ends of the series the different members may vary indefinitely in composition, with no sharp demarcation between species. Thus in the group of rhombohedral carbonates the different species are usually sharply defined. In well-formed crystals of calcite the calcium is replaced by only small amounts of magnesium, iron, lead, &c.; in chalybite, however, iron is often more largely replaced by calcium, magnesium, manganese, &c., and the "brown spars" are not always readily distinguishable. In the dimorphous group of orthorhombic carbonates isomorphous replacement is less frequent, and the different species (aragonite, cerussite, &c.) are quite sharply defined. In other groups of minerals, particularly amongst the silicates, isomorphous replacement of the basic elements is so general that the several members of the series vary almost indefinitely in chemical composition, and will scarcely be the same for any two specimens, though it may be reduced to the same type of formula. For example, the formula of all varieties of garnet may be expressed generally as $R''_3R'''_2(SiO_4)_3$, where $R'' = $ Ca, Mg, Fe, Mn, and $R''' = $ Al, Fe, Mn, Cr, Ti. Tourmaline affords another good example. In the plagioclase felspars (see PLAGIOCLASE) we have an example of the isomorphous mixing of two end-members, albite ($NaAlSi_3O_8$) and anorthite ($CaAl_2(SiO_4)_2$) in all proportions and with no sharp line between the several sub-species. In some other similar cases the end-members of the series are purely hypothetical: *e.g.* in the scapolite group (mixtures of $Ca_4Al_6Si_6O_{25}$ and $Na_4Al_3Si_9O_{24}Cl$) and in the micas and chlorites. In such instances, where the formulae of the two end-members differ in type, "mass effect" may have some influence on the isomorphism.

In addition to isomorphous series, there are amongst minerals several instances of double salts, which contain the same constituents as the members of isomorphous series: *e.g.* dolomite (*q.v.*) and barytocalcite (*q.v.*).

The manner in which water enters into the composition of minerals is often difficult to determine. In some cases, *e.g.* in the zeolites (*q.v.*), it is readily expelled at a low temperature, even at the ordinary temperature over sulphuric acid, and may be reabsorbed from a moist atmosphere or replaced by some other substances: it is then regarded as "water of crystallization." In other cases, when expelled only at a higher temperature, it is to be regarded as "water of constitution," forming either a basic salt (*e.g.* malachite, $Cu(OH)_2CO_3$) or an acid salt (*e.g.* dioptase, H_2CuSiO_4, and mica, *q.v.*). When present as hydroxyl it is often isomorphously replaced by fluorine (*e.g.* topaz, $[Al(F,OH)]_2SiO_4$). Sometimes the water is partly water of crystallization and partly water of constitution.

As to the actual chemical constitution of minerals the little that is at present known is mainly speculative. Dimorphous minerals, which have the same empirical formula may be expected to differ in constitution; and experiments have been made, for example on pyrites and marcasite, with the object of discovering a difference, but the conclusions of various investigators are not in agreement. More promising results have been obtained (by F. W. Clarke and others) by the action of various reagents on silicates, particularly on the more readily decomposed zeolites, and several substitution-derivatives have been prepared.

Synthesis of Minerals.—The production of minerals by artificial means is a branch of chemical mineralogy which has been pursued with considerable success, especially by French chemists. Most minerals have been obtained artificially in a crystallized condition, and many related compounds, not as yet found in nature, have also been prepared. Crystals of artificially prepared minerals, though usually quite small in size, possess all the essential characters of natural crystals, differing from these only in origin. The following are the principles of some of the methods which have been used: simple sublimation (*e.g.* arsenolite); interaction of gases (*e.g.* haematite, from steam and ferric chloride; cassiterite, from steam and stannic chloride or fluoride); action of gases on liquids and solids; slow cooling of fused masses, either with or without the presence of *agents minéralisateurs* (*e.g.* minerals in furnace slags); from aqueous solution sometimes at a high temperature and under pressure (*e.g.*, quartz); electrolysis; or even by subjecting dry amorphous material to enormous pressure. The chemical reactions by which various minerals have been obtained are often of considerable help in speculating as to their mode of origin in nature, though it must be born in mind that the same mineral may have been formed, both naturally and artificially, by more methods than one. In this direction important results have been obtained experimentally by J. H. van't Hoff and his pupils on the formation of oceanic salt deposits, and by J. H. L. Vogt with slags. Many minerals used as gem-stones have been prepared artificially, *e.g.* diamond and ruby (see GEMS: *Artificial*).

II.—Occurrence and Origin of Minerals.

While some minerals are of rare and sporadic occurrence in rock-cavities and mineral-veins, others are widely distributed as important constituents of rocks. The same mineral species may have several distinct modes of occurrence and origin, and be associated with different minerals in each case; facts which are well illustrated by quartz (*q.v.*).

Minerals of Igneous Rocks.—The rock-forming minerals of primary origin in igneous rocks have crystallized out from the magma, or fused silicate-mass, which on consolidation gave rise to the rock-mass. Magmas sometimes contain a considerable amount of water and are then in a state of aqueo-igneous fusion, rather than of dry fusion: in such cases very coarsely crystalline rocks (pegmatites) often result, and under these conditions minerals of many kinds are formed as well-developed crystals. Those minerals which are present in large amount in igneous rocks are distinguished as essential constituents, since it is on these that the classification of igneous rocks is largely based: the most important are quartz, felspars, pyroxenes, amphiboles, micas and olivines. Felspars of different composition are present in almost all kinds of igneous rocks, while quartz and olivine are characteristic of acid (*e.g.* granite, rhyolite) and basic (*e.g.* basalt, peridotite) rocks respectively. When the magma contains alkalies in relatively large amount the "felspathoid" minerals, nepheline and leucite, are formed (*e.g.* in nepheline-syenite, leucite-basalt, &c.). Other minerals occurring as primary constituents, but only in small amounts, are distinguished as accessory; thus small crystals of magnetite, apatite, zircon, &c., are of frequent occurrence disseminated in igneous rocks (see PETROLOGY). Sometimes these accessory constituents are concentrated by magmatic differentiation, important ore-deposits sometimes resulting in this manner (*e.g.* of chromite, or nickel-bearing pyrrhotite). The alteration of igneous rocks by weathering and other processes results in the alteration of some or all of the primary minerals with the production of others, which are spoken of as secondary minerals: thus felspars are often partly or wholly altered to kaolin, olivine to serpentine, pyroxene and mica to epidote, chlorite, &c.

Minerals are also formed by the vapours given off by igneous magmas. The gases emitted by volcanoes and solfataras may deposit directly by sublimation, or by their chemical interaction, such minerals as sulphur, sal-ammoniac, haematite, which occur, for instance, as incrustations on Vesuvian lava: the boric acid of the Tuscan lagoons has also originated in this way. The effects produced by the exhalations of deep-seated magmas are more complex in character, since the vapours, being more confined, have more opportunity of acting chemically not only on the surrounding rocks but also on the igneous rock-mass itself before its final consolidation. A good example of the "pneumatolytic" action produced by the vapours from a mass of granitic magma is afforded by veins of tin-ore, in which the ore (cassiterite) is associated with minerals containing boron and fluorine, such as topaz, tourmaline, lepidolite, fluor-apatite and fluor-spar. The production of such minerals may be accounted for by assuming the presence of stannic fluoride in the vapours, which by reacting on water vapour would deposit cassiterite with the liberation of hydrofluoric acid, and this would again react on other minerals. The topaz and tourmaline crystals often found in the cavities of granites and pegmatites have doubtless been formed in this manner. In a similar way the exhalations of basic magmas have given rise to chlor-apatite with associated sphene and ilmenite, as, for example, in the extensive apatite veins in connexion with gabbro in southern Norway.

Minerals of Metamorphic Rocks.—By the baking action of a deep-seated igneous mass on the surrounding rocks or on included rock-fragments, various new minerals are developed. By this process of thermal or contact-metamorphism well-crystallized examples of many minerals have often been formed; *e.g.* in calcareous rocks (limestones), especially those containing some magnesia and silica, vesuvianite, garnet, diopside, tremolite, wollastonite, &c., are developed; in argillaceous rocks (slates), chiastolite and staurolite are characteristic products; and in arenaceous rocks (sandstones), cordierite and sillimanite often result. The effects of pressure (dynamo-metamorphism) on rocks of various kinds, especially those of igneous origin, also result in the production of new minerals: *e.g.* pyroxene is transformed to amphibole, orthoclase to muscovite, plagioclase to zoisite, olivine to tremolite, &c. In gneisses and crystalline schists, quartz, felspar, mica, talc, amphibole, &c. are important constituents.

Minerals of Sedimentary Rocks.—By the weathering and disintegration of igneous and metamorphic rocks the various minerals set free and the products of decomposition of others supply the material of sedimentary rocks; thus sandstones consist largely of quartz, shales of kaolin and other clay minerals. Those minerals (*e.g.* gem-stones and gold) which resist the action of weathering processes are found as water-worn pebbles and grains in detrital deposits. Other sedimentary rocks consist of minerals deposited from solution either by chemical or organic agencies, from sea-water, lakes or springs: *e.g.* the calcite of limestones, deposits of bog-iron-ore (limonite), gypsum, rock-salt, &c.

Minerals Segregated in Veins and Rock-cavities.—Water percolating through rock-masses takes up mineral matter in solution, and the solutions so formed may further react on the minerals composing the rocks. Such solutions will deposit some of their dissolved material in rock-cavities with the production of various minerals. For instance, the amygdaloidal cavities of basic volcanic rocks (*e.g.* basalt, melaphyre), especially when the rocks are somewhat weathered, are frequently partly or completely filled with agate or beautifully crystallized zeolites, calcite, &c. The crevices and joint-planes of limestone become in this way coated with crystals of calcite, and those of siliceous rocks with quartz, giving rise to the abundantly occurring quartz-veins. In sedimentary rocks, pyrites, flint and other minerals become segregated round a nucleus of organic matter. The beautiful crystal-lined crevices in the crystalline rocks of the Alps have much the same origin, and so have the various types of ore-deposits, including metalliferous veins or lodes. In the latter cases, however, the solutions are no doubt sometimes of deep-seated origin and often connected with igneous and metamorphic processes. Metalliferous veins are storehouses of crystallized minerals of almost every kind, some being the ores themselves and others, such as quartz, calcite, barytes, fluor-spar, being gangue minerals. By the weathering of the metallic minerals of mineral-veins numerous other finely crystallized minerals result: for example, in the upper oxidized portion of veins of lead-ore (galena), crystals of anglesite, cerussite and pyromorphite are often met with; in veins of copper-ore the alteration of chalcopyrite gives rise to malachite, chessylite and cuprite.

Alteration of Minerals: Pseudomorphs.—Crystals which have been formed under one set of conditions of temperature and pressure and in the presence of certain solutions, will in many cases be unstable under another set of conditions. The crystals may then be corroded or even completely redissolved, or the substance may undergo a chemical or physical change and give rise to the formation of other minerals which are stable under the new conditions. The results of such changes and alterations of minerals are very frequently to be observed in nature, and several instances have already been cited in the preceding section. A good example of the secondary products which may result by the decomposition of a mineral is afforded by pyrites (FeS_2), of which two types of alteration may be distinguished. By oxidation in the presence of pure water it gives rise to ferrous sulphate (melanterite), free sulphur and sulphuric acid; the melanterite by further alteration gives various basic ferric sulphates (copiapite, &c.); and the sulphuric acid by acting on surrounding rocks (limestone, clay, &c.) gives rise to the formation of gypsum, aluminite and other sulphates. By the action of water containing oxygen and calcium carbonate in solution, pyrites suffers another kind of alteration: the sulphur is carried away in solution as gypsum and the iron is left behind as a ferric hydroxide (limonite) which preserves the original form of the crystals. We have then a pseudomorph (from ψευδής, false and μορφή, form) of limonite after pyrites; *i.e.* limonite with the external form of a crystal of pyrites.

Pseudomorphs are frequently met with in nature, and they are of considerable importance in studying the changes which minerals undergo. Several kinds of pseudomorphs are to be distinguished. When the alteration has involved no change in chemical composition of the material, but only in the internal crystalline structure and physical properties, the altered crystal is called a "paramorph." For example, crystals of aragonite are often altered to a confused granular aggregate of crystalline individuals of calcite, the change being accompanied by an increase in specific gravity but without change in external form: such a change may be effected artificially by simply heating a crystal of aragonite. Other examples of paramorphs are rutile with the form of anatase, and hornblende with the form of augite. An "epimorph" results from the encrustation of one mineral by another; the first may be afterwards partly or wholly dissolved out, leaving the second as a hollow shell (*e.g.* chalybite after fluor-spar). As instances of pseudomorphs in which there has been some chemical change the following may be cited: by the gain of chemical constituents, *e.g.* malachite after cuprite; by the loss of material, *e.g.* native copper after cuprite; or by an interchange of constituents, *e.g.* galena after pyromorphite and limonite after pyrites. In other cases there may be no evident chemical relationship between the two minerals, as, for example, in pseudomorphs of native copper after aragonite or quartz after calcite. Different minerals may also take the form of various organic remains.

III.—Nomenclature and Classification of Minerals.

A mineral species, or simple mineral, is completely defined by the statement of its chemical composition and crystalline form. When we are dealing with a definite chemical compound the limitation of species is easy enough; thus corundum, cassiterite, galena, blende, &c. are quite sharply defined mineral species. But with isomorphous mixtures the division into species, or into sub-species and varieties, must be to a certain extent arbitrary, there being no sharp lines of demarcation in many isomorphous groups of minerals. Thus in the mineral tourmaline the chemical composition varies indefinitely between wide limits, but no corresponding difference can be traced in the crystalline form or in the external characters save colour and specific gravity. Some authors have therefore questioned the advisability of separating minerals into species each with distinctive names, and they have attempted to devise chemical names for the different kinds of minerals. Owing, however, to the frequency of polymorphism and isomorphism amongst mineral substances such a system presents many practical difficulties. Thus the three modifications of titanium dioxide are more simply and conveniently referred to as rutile, anatase and brookite, while to give a purely chemical designation to such a mineral as tourmaline would be quite impracticable. Further, later investigations often show that such chemical names require revision, and hence confusion may arise.

The practice of giving distinct names to different kinds of minerals dates from very early times (*e.g.* diamond). The common termination *ite* (originally *itis* or *ites*) was adopted by the Greeks and Romans for the names of stones, the names themselves indicating some character, constituent, or use of the stone, or the locality at which it was found. For example, haematite, because of the blood-red colour; siderite, containing iron; alabaster (originally alabastritis), a stone from which a vessel called an *alabastron* was cut; magnesite, from the locality Magnesia. The custom of naming minerals after persons is of modern origin; *e.g.* prehnite, biotite, haüyne, zoisite. Unfortunately there is a lack in uniformity in the termination of mineral names, many long-established names being without the termination *ite*, *e.g.* beryl, blende, felspar, garnet, gypsum, quartz, zircon, &c. The termination *ine* is also often used, *e.g.* nepheline, olivine, serpentine, tourmaline, &c.; and many others were introduced by R. J. Haüy without much reason, *e.g.* anatase, dioptase, epidote, analcime, sphene, &c. (see A. H. Chester, *A Dictionary of the Names of Minerals*, New York, 1896).

The number of known mineral species differs, of course, according to different authors; roughly there may be said to be about a thousand. The total number of mineral names (apart from chemical names), many of them being applied to trivial varieties or given in error, amount to about 5000.

Minerals may be classified in different ways to suit different purposes; thus they may be classified according to their uses, modes of occurrence, system of crystallization, &c. The earlier systematic classifications, being based solely on the external characters of minerals, were on natural history principles and too artificial to be of any value. J. J. Berzelius, in 1815, was the first to propose a purely chemical system of classification: his primary divisions depended on the basic (electro-positive) element and the sub-divisions on the acid (electro-negative) element. Such a method of classification, though still in use for metallic ores, must be quite arbitrary or give rise to much duplication; since, apart from isomorphous replacement, many minerals contain more than one metal. The systematic classifications in use at the present day are modifications in detail of the crystallo-chemical system published by G. Rose in 1852. Here there are four main divisions, viz. elements; sulphides, arsenides, &c.; halogen compounds; and oxygen compounds: the last, and largest, division is subdivided into oxides and according to the acid (carbonates, silicates, sulphates and chromates, phosphates and arsenates, &c.); in each section isomorphous minerals are grouped together. The classifications adopted by different authors differ much in detail, especially in the large section of the silicates, which presents many difficulties and for which no satisfactory classification has yet been devised.

As an example of a systematic classification of minerals the following may be given. Except in a few details it is the classification of Dana's *System of Mineralogy* (6th ed., 1892). Only those minerals which are described under their respective headings in these volumes are included: the list therefore serves, at the same time, as an enumeration of the more common and important species and varieties of minerals, and as a system of classification it is necessarily incomplete. Species belonging to the same isomorphous group are bracketed together: varieties are given in parentheses after the species to which they belong. The chemical composition of each species is given by the formula; and the crystal-system by the initial letters C (cubic), T (tetragonal), O (orthorhombic), M (monoclinic), A (anorthic), H (hexagonal) and R (rhombohedral): when the crystal class is definitely known to be some other than the holosymmetric this is indicated by a number corresponding to those used in the article Crystallography, *e.g.* C2 for the tetrahedral class of the cubic system.

I.—NATIVE ELEMENTS.

1. Non-Metals.

Diamond (Bort, Carbonado)	C	C2
Graphite	C	R
Sulphur	S	O

2. Semi-Metals.

Arsenic	As	R
Antimony	Sb	R
Bismuth	Bi	R

3. Metals.

Gold	Au	C
Silver	Ag	C
Copper	Cu	C
Platinum	Pt	C

II.—SULPHIDES, ARSENIDES, TELLURIDES, ETC.

1. Of the Semi-Metals.

Realgar	AsS	M
Stibnite	Sb_2S_3	O
Bismuthite	Bi_2S_3	O
Tetradymite	Bi_2Te_2S	R
Molybdenite	MoS_2	R

2. Of the Metals.

A. Monosulphides, &c.

Argentite	Ag_2S	C
Galena	PbS	C
Copper-glance	Cu_2S	O
Blende	ZnS	C2
Cinnabar	HgS	R3
Covellite	CuS	H
Greenockite	CdS	R2
Millerite	NiS	R
Niccolite	NiAs	R
Pyrrhotite	$Fe_{11}S_{12}$	R

B. Intermediate Division.

Erubescite	Cu_5FeS_4	C
Chalcopyrite	$CuFeS_2$	T2

C. Disulphides, &c.

Pyrites	FeS_2	C3
Smaltite	$CoAs_2$	C3
Cobaltite	CoAsS	C3
Marcasite	FeS_2	O
Mispickel	FeAsS	O
Sylvanite	$AuAgTe_4$	M

III.—SULPHO SALTS.

Freieslebenite	$(Pb,Ag_2)_5Sb_4S_{11}$	M
Bournonite	$PbCuSbS_3$	O
Pyrargyrite	Ag_3SbS_3	R2
Proustite	Ag_3AsS_3	R2
Tetrahedrite	Cu_3SbS_3	C2
Stephanite	Ag_5SbS_4	O2
Stannite	Cu_2FeSnS_4	T2
Argyrodite	Ag_8GeS_6	C

IV.—HALOIDS.

1. Anhydrous.

Salt	NaCl	C
Sylvite	KCl	C4
Cerargyrite	Ag(Cl,Br,I)	C
Fluor-spar	CaF_2	C
Cryolite	Na_3AlF_6	M

2. Oxychlorides.

Atacamite	$Cu_2Cl(OH)_3$	O

V.—OXIDES.

1. Oxides of Silicon.

Quartz (Agate, Amethyst, Avanturine, Bloodstone, Cairngorm, Carnelian, Cat's-eye, Chalcedony, Chrysoprase, Heliotrope, Jasper, Mocha-stone, Onyx, Rock-crystal, Sard, Sardonyx.)	SiO_2	R3
Tridymite	SiO_2	O(?)
Opal	SiO_2+nH_2O	Amorphous

2. Oxides of the Semi-Metals.

3. Oxides of the Metals.

A. Anhydrous Oxides.

a. Monoxides.

Cuprite	Cu_2O	C4
Zincite	ZnO	R2
Melaconite	CuO	M

b. Sesquioxides.

Corundum (Asteria, Emery, Ruby, Sapphire.)	Al_2O_3	R
Haematite	Fe_2O_3	R
Ilmenite[1]	$FeTiO_3$	R4

c. Intermediate Oxides.[2]

Spinel	$MgAl_2O_4$	C
Magnetite	$FeFe_2O_4$	C
Franklinite	$(Fe,Zn,Mn)(Fe,Mn)_2O_4$	C
Chromite	$(Fe,Mg)(Cr,Fe)_2O_4$	C
Chrysoberyl (Alexandrite, Cymophane)	$BeAl_2O_4$	O

d. Dioxides.

Cassiterite	SnO_2	T
Rutile	TiO_2	T
Anatase	TiO_2	T
Brookite	TiO_2	O
Pyrolusite	MnO_2	?
Pitchblende[3]	$(U,Th)O_2$	C

B. Hydrous Oxides.

Diaspore	AlO(OH)	O
Goethite	FeO(OH)	O
Manganite	MnO(OH)	O
Limonite	$Fe_2O_3 . 3H_2O$	Amorphous
Bauxite	$Al_2O_3 . 2H_2O$?	,,
Brucite	$Mg(OH)_2$	R
Psilomelane (Wad)	$xMnO_2+yBaO+H_2O$	Amorphous

VI.—OXYGEN SALTS.

1. Carbonates.

A. Anhydrous.

Calcite (Satin-spar)	$CaCO_3$	R
Dolomite	$CaMg(CO_3)_2$	R4
Ankerite	$Ca(Mg,Fe)(CO_3)_2$	R
Magnesite	$MgCO_3$	R
Chalybite	$FeCO_3$	R
Rhodochrosite	$MnCO_3$	R
Calamine	$ZnCO_3$	R
Aragonite	$CaCO_3$	O
Alstonite	$(Ca,Ba)CO_3$	O
Witherite	$BaCO_3$	O
Strontianite	$SrCO_3$	O
Cerussite	$PbCO_3$	O
Barytocalcite	$CaBa(CO_3)_2$	M
Parisite	$(CeF)_2Ca(CO_3)_3$	H
Phosgenite	$(PbCl)_2CO_3$	T

B. Basic Carbonates.

Malachite	$Cu_2(OH)_2CO_3$	M
Azurite	$Cu_3(OH)_2(CO_3)_2$	M

2. Silicates.

A. Anhydrous Silicates.

a. Disilicates, $R''Si_2O_5$; *Polysilicates*, $R''Si_3O_8$.

		Petalite	$LiAl(Si_2O_5)_2$	M
Felspar Group.		Orthoclase (Moon-stone)	$KAlSi_3O_8$	M
		Microcline (Amazon-stone)	$KAlSi_3O_8$	A
	Plagioclase.	Albite	$NaAlSi_3O_8$	A
		Oligoclase (Sun-stone)	Ab_6An_1 to Ab_3An_1	A
		Andesine	Ab_3An_1 to Ab_1An_1	A
		Labradorite	Ab_1An_1 to Ab_1An_3	A
		Bytownite	Ab_1An_3 to Ab_1An_6	A
		Anorthite	$CaAl_2Si_2O_8$	A

b. Metasilicates, $R''SiO_3$.

	Leucite	$KAl(SiO_3)_2$	Pseudo-C
	Pollux	$H_2Cs_4Al_4(SiO_3)_9$	C
Pyroxene Group.	Enstatite	$MgSiO_3$	O
	Bronzite	$(Mg,Fe)SiO_3$	O
	Hypersthene	$(Fe,Mg)SiO_3$	O
	Diopside	$CaMg(SiO_3)_2$	M
	Augite (Diallage)	$Ca(Mg,Fe)(SiO_3)_2$ with $(Mg,Fe)(Al,Fe)_2SiO_6$	M
	Acmite	$NaFe'''(SiO_3)_2$	M
	Spodumene (Hiddenite, Kunzite)	$LiAl(SiO_3)_2$	M
	Jadeite	$NaAl(SiO_3)_2$	M
	Wollastonite	$CaSiO_3$	M
	Rhodonite	$MnSiO_3$	A
Amphibole Group.	Tremolite	$CaMg_3(SiO_3)_4$	M
	[Actinolite] (Asbestos, Nephrite)	$Ca(Mg,Fe)_3(SiO_3)_4$	M
	Hornblende	$Ca(Mg,Fe)_3(SiO_3)_4$ with $NaAl(SiO_3)_2$ and $(Mg,Fe)(Al,Fe)_4(SiO_6)_2$	M
	Crocidolite	$NaFe(SiO_3)_2 . FeSiO_3$	M
	Beryl (Aquamarine, Emerald)	$Be_3Al_2(SiO_3)_6$	H

c. Intermediate.

Iolite	$H_2(Mg,Fe)_4Al_8Si_{10}O_{37}$	O

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[1] Often classed with the titanates.

[2] Often classed as aluminates.

[3] Usually classed as a uranate.

	d. *Orthosilicates*, R''_2SiO_4.		
	Nepheline	$K_2Na_6Al_8Si_9O_{34}$	H5
	Sodalite	$Na_4(AlCl)Al_2(SiO_4)_3$	C
	[Lazurite] (Lapis-lazuli)	$Na_4(NaS_3.Al)Al_2(SiO_4)_3$	C
	[Grossularite] (Cinnamon-stone)	$Ca_3Al_2(SiO_4)_3$	C
	Pyrope	$Mg_3Al_2(SiO_4)_3$	C
	Almandine	$Fe_3Al_2(SiO_4)_3$	C
	[Andradite] (Demantoid)	$Ca_3Fe_2(SiO_4)_3$	C
	Olivine (Chrysolite, Peridot)	$(Mg,Fe)_2SiO_4$	O
	Phenacite	Be_2SiO_4	R4
	Willemite	Zn_2SiO_4	R4
	Dioptase	H_2CuSiO_4	R4
	Scapolite	$mCa_4Al_6Si_6O_{25}$ $nNa_4Al_3Si_9O_{24}Cl$	T3
	Vesuvianite	$H_2Ca_6(Al,Fe)_3Si_5O_{18}$	T
	Zircon (Hyacinth, Jacinth, Jargoon)	$ZrSiO_4$	T
	Thorite	$ThSiO_4$	T
	Danburite	$CaB_2(SiO_4)_2$	O
	Topaz	$[Al(F,OH)]_2SiO_4$	O
	Andalusite	Al_2SiO_5	O
	Sillimanite	Al_2SiO_5	O
	Cyanite	Al_2SiO_5	A
	Datolite	$HCaBSiO_5$	M
	Euclase	$HBeAlSiO_5$	M
	Zoisite	$Ca_2(AlOH)Al_2(SiO_4)_3$	O
	Epidote	$Ca_2(AlOH)\ (Al,Fe)_2(SiO_4)_3$	M
	Axinite	$HCa_3BAl_2(SiO_4)_4$	A
	Prehnite	$H_2Ca_2Al_2(SiO_4)_3$	O2
	e. *Subsilicates.*		
	Humite	$Mg_5[Mg(F,OH)]_2(SiO_4)_3$	O
	Hemimorphite	$H_2Zn_2SiO_5$	O2
	Tourmaline (Rubellite)	$(H_2,Na_2,Mg)_3(Al,Fe)_6(BOH)_4Si_8O_{38}$	R2
	Staurolite	$HFeAl_5Si_2O_{13}$	O
	B. Hydrous Silicates.		
	Apophyllite	$H_7KCa_4(SiO_3)_8+4\frac{1}{2}H_2O$	T
Zeolite Group.	Heulandite	$H_4CaAl_2(SiO_3)_6+3H_2O$	M
	Phillipsite	$(K_2.Ca)Al_2(SiO_3)_4+4H_2O$	M
	Harmotome	$H_2(K_2,Ba)Al_2(SiO_3)_5+5H_2O$	M
	Stilbite	$(CaAl_2(SiO_3)_6+6H_2O$	M
	Chabazite	$(Ca,Na_2)Al_2(SiO_4)_2+4H_2O$,&c.	R
	Analcite	$NaAl(SiO_3)_2+H_2O$	C
	Natrolite	$Na_2Al_2Si_3O_{10}+2H_2O$	O
	Scolecite	$CaAl_2Si_3O_{10}+3H_2O$	M3
Mica Group.	Muscovite	$H_2KAl_3(SiO_4)_3$	M
	Lepidolite	$KLi[Al(OH,F)_2]Al(SiO_3)_3$	M
	Biotite	$(H,K)_2(Mg,Fe)_2Al_2(SiO_4)_3$,&c.	M
	Phlogopite	$[H,K,(MgF)]_3Mg_3Al(SiO_4)_3$	M
	Clintonite	$H_2(Fe,Mg)Al_2SiO_7$,&c.	M
	Chlorite	$H_8(Mg,Fe)_5Al_2Si_3O_{18}$,&c.	M
	Serpentine	$H_4Mg_3Si_2O_9$	M
	Talc	$H_2Mg_3(SiO_3)_4$	M
	Meerschaum	$H_4Mg_2Si_3O_{10}$	Amorphous
	Kaolin (Bole, Clay)	$H_4Al_2Si_2O_9$	M
	Pyrophyllite	$HAl(SiO_3)_2$	M?
	Allophane	$Al_2SiO_5+5H_2O$	Amorphous
	Chrysocolla	$CuSiO_3+2H_2O$	,,
	C. Titano-silicates, Titanates.		
	Sphene	$CaTiSiO_5$	M
	Perofskite	$CaTiO_3$	Pseudo-C
	3. NIOBATES, TANTALATES.		
	Columbite	$(Fe,Mn)(Nb,Ta)_2O_6$	O
	4. PHOSPHATES, ARSENATES, &c.		
	A. Anhydrous Phosphates, &c.		
	Monazite	$(Ce,La,Di)PO_4$	M
	Beryllonite	$NaBePO_4$	O
	Apatite (Phosphorite)	$[Ca(F,Cl)]Ca_4(PO_4)_3$	H2
	Pyromorphite	$(PbCi)Pb_4(PO_4)_3$	H2
	Mimetite	$(PbCl)Pb_4(AsO_4)_3$	H2
	Vanadinite	$(PbCl)Pb_4(VO_4)_3$	H2
	Amblygonite	$Li(AlF)PO_4$	A
	B. Basic Phosphates, &c.		
	Olivenite	$Cu_2(OH)AsO_4$	O
	Descloizite	$(Pb,Zn)_2(OH)VO_4$	O
	Clinoclasite	$Cu_3(OH)_3AsO_4$	M
	C. Hydrous Phosphates, &c.		
	Vivianite	$Fe_3(PO_4)_2+8H_2O$	M
	Erythrite	$Co_3(AsO_4)_2+8H_2O$	M
	Annabergite	$Ni_3(AsO_4)_2+8H_2O$	M
	Wavellite	$Al_3(OH)_3(PO_4)_2+4\frac{1}{2}H_2O$	O
	Turquoise	$[Al(OH)_2,Cu(OH),H]_3PO_4$	Amorph.
	Pharmacosiderite	$Fe_3(OH)_3AsO_4+5H_2O$	C2
	Childrenite	$(Fe,Mn)Al(OH)_2PO_4+H_2O$	O
	Liroconite	$Cu_3Al_4(OH)_{15}(AsO_4)_5+20H_2O$	M
	Torbernite	$Cu(UO_2)_2(PO_4)_2+12H_2O$	T
	Autunite	$Ca(UO_2)_2(PO_4)_2+12H_2O$	O
	5. BORATES.		
	Boracite	$Mg_7Cl_2B_{16}O_{30}$	Pseudo-C2
	Colemanite	$Ca_2B_6O_{11}+5H_2O$	M
	Borax	$Na_2B_4O_7+10H_2O$	M
	6. NITRATES.		
	Nitre	KNO_3	O
	7. SULPHATES AND CHROMATES.		
	A. Anhydrous Sulphates, &c.		
	Barytes	$BaSO_4$	O
	Celestite	$SrSO_4$	O
	Anglesite	$PbSO_4$	O
	Anhydrite	$CaSO_4$	O
	Crocoite	$PbCrO_4$	M
	B. Basic Sulphates.		
	Brochantite	$Cu_4(OH)_6SO_4$	O
	C. Hydrous Sulphates.		
	Gypsum	$CaSO_4+2H_2O$	M
	Alunite	$KAl_3(SO_4)_2(OH)_6$	R
	Jarosite	$KFe_3(SO_4)_2(OH)_6$	R
	D. Sulphates with Chlorides, Carbonates, &c.		
	Connellite	$Cu_{15}(Cl,OH)_4SO_{16}+15H_2O$	H
	Leadhillite	$Pb_4SO_4(CO_3)_2(OH)_2$	O
	8. TUNGSTATES, MOLYBDATES.		
	Wolframite	$(Fe,Mn)WO_4$	M
	Scheelite	$CaWO_4$	T3
	Wulfonite	$PbMoO_4$	T4

VII.—HYDROCARBON COMPOUNDS.

1. SIMPLE HYDROCARBONS.
Hatchettine, Ozocerite.

2. OXYGENATED HYDROCARBONS.
Amber, Retinite, Copaline, Bathvillite, Dopplerite.

3. APPENDIX TO HYDROCARBONS.
Petroleum, Asphaltum, Bitumen, Elaterite, Albertite, Coal, Anthracite, Jet, Lignite.

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MINERAL WATERS. No absolute line of demarcation can be drawn between ordinary and mineral waters. There is usually in the latter an excess of mineral constituents or of temperature, but some drinking waters contain more mineral constituents than others that are called mineral waters, and many very pure waters, both cold and warm, have been regarded for ages as mineral springs.

As to the origin of mineral waters, there is much in what the elder Pliny said, that waters are such as the soil through which they flow. Thus in limestone and chalk districts an excess of lime is usually present; and the waters of a particular district have much resemblance to each other—as in the Eifel, in Auvergne, and in the Pyrenees. But this is only a partial explanation, for waters are by no means necessarily uniform throughout a particular geological formation. We do not know with any certainty the depth from which various mineral waters proceed, nor the various distances from the surface at which they take up their different mineral constituents.

The source of the temperature of thermal waters remains a subject of much uncertainty. Among the assigned causes are the internal heat of the globe, or the development of heat by chemical or electrical agencies in the strata through which they arise.

Their occasional intermittence is doubtless often dependent on the periodical generation of steam, as in the case of the Geysers. A few geological facts are certain, which bear on the origin of mineral waters. Such springs are most abundant in volcanic districts, where many salts of soda and much carbonic acid are present. They occur most frequently at meetings of stratified with unstratified rocks, in saddles, and at points where there has been dislocation of strata.

The diffusion of mineral waters is very extended. Pliny was quite correct in observing that they are to be found on alpine heights and arising from the bottom of the ocean. They are found at the snow in the Himalayas and they rise from the sea at Baiae and Ischia. They are to be found in all quarters of the globe, but more particularly in volcanic regions, as in the Eifel and Auvergne, in the Bay of Naples, and parts of Greece, in Iceland, New Zealand and Japan. But there are few countries in which they are not to be found, except in very flat ones, and in deltas of rivers—for instance, in the north of France, where they are very few, and in Holland, from which they are absent. France, Germany, Italy and Spain, as well as Greece, Asia Minor, and the Caucasus, are all rich in mineral waters. The British Isles have a fair though not very large proportion of them. There are a few in Sweden and Norway. They are abundant in the United States, less so in Canada. They are found in the Azores and in the West India Islands. Of their occurrence in the interior of Africa or of Australia we know little; and the same is true of South America. But they are met with in Algiers, in Egypt, and in the Holy Land. The vast Indian peninsula has for its size a comparatively small supply.

Mineral waters, when analysed, are found to contain a great many substances, although some of them occur only in very minute quantities: soda, magnesia, calcium, potash, alumina, iron, boron, iodine, bromine, arsenic, lithium, caesium, rubidium, fluorine, barium, copper, zinc, manganese, strontium, silica, phosphorus, besides extractive matters, and various organic deposits known under the name of glairin or baregin. Of gases, there have been found carbonic acid, hydrosulphuric acid, nitrogen, hydrogen, oxygen and ammonia. Of all these by far the most important in a therapeutic point of view are sodium, magnesia and iron, carbonic acid, sulphur, and perhaps hydrosulphuric acid. These substances, detected separately by chemists, are in their analyses combined by them into various salts, if not with absolute certainty, undoubtedly with a close approximation to it. Those combinations are very numerous, and some waters contain ten to twenty of them; but there are always some predominating ones which mark their character, while many of them, such as caesium, rubidium, or fluorine, occur in mere traces, and cannot be assumed to be of any real importance. Mineral waters therefore resolve themselves into weaker or stronger solutions of salts and gases in water of higher or lower temperature. For medical purposes they are used either externally or internally. As the quantity of salts present commonly bears but a very small proportion to that of the fluid containing them, water becomes a very influential agent in mineral-water treatment, about which it is therefore necessary to say something.

For the action of mineral-water baths see BALNEOTHERAPEUTICS. According to the most generally received opinion, the cutaneous surface does not absorb any portion of the salts in a mineral-water bath, although it may absorb a little gas (and alkaline water, for instance, at most acting as a slight detergent on the skin), and that neither salts nor gases have any action on the system, except as stimulants of the skin, with partial action on the respiratory organs.

It seems to be ascertained that drinking considerable amounts of cold water reduces the temperature of the body, diminishes the frequency of the pulse, and increases the blood pressure temporarily. Water when introduced into the stomach, especially if it be empty, is quickly absorbed; but, although much of the water passes into the veins, there is no proof that it ever produces in them, as is sometimes supposed, a state of fluidity or wateriness. Therapeutically, the imbibition of large quantities of water leads to a sort of general washing out of the organs. This produces a temporary increase of certain excretions, augmented diuresis, and a quantitative increase of urea, of chloride of sodium, and of phosphoric and sulphuric acids in the urine. Both the sensible and the insensible perspirations are augmented. A draught of cold water undoubtedly stimulates the peristaltic action of the intestines. On the whole water slightly warm is best borne by the stomach, and is more easily absorbed by it than cold water; and warm waters are more useful than cold ones when there is much gastric irritability. In addition to the therapeutic action of mineral waters, there are certain very important subsidiary considerations which must not be overlooked. An individual who goes from home to drink them finds himself in a different climate, with possibly a considerable change in altitude. His diet is necessarily altered, and his usual home drinks are given up. There is change in the hours of going to bed and of rising. He is relieved from the routine of usual duties, and thrown into new and probably cheerful society. He takes more exercise than when at home, and is more in the open air, and this probably at the best season of the year. So important has this matter of season and climate been found that it is an established axiom that waters can be used to the greatest advantage during the summer months and in fine weather, and during the periods most convenient for relaxation from business. Summer is therefore the bath season, but of late years provision has been made in many places, with the aid of specially constructed rooms and passages, for carrying out cures satisfactorily during the winter season, *e.g.* at Aix-la-Chapelle, Wiesbaden, Baden Baden, Baden in Switzerland, Dax, Vichy and Bath. The ordinary bath season extends from the 15th of May to the 20th or 30th of September. The season for baths situated at considerable elevations commences a month later and terminates some ten days earlier. Mineral waters may be employed at home, but patients seldom so use them; and this necessarily limits the time of their use. It is common to declare that the treatment should last for such or such a period. But the length of time for which any remedy is to be used must depend on its effect, and on the nature of the particular case. It is found, however, that the continued use of mineral waters leads to certain disturbances of the system, which have been called crises, such as sleeplessness, colics and diarrhoea, and to skin eruptions known as *la poussée*. This cause, and also certain peculiarities of the female constitution, have led to the period of three weeks to a month being considered the usual period for treatment. A certain after-treatment is often prescribed—such as persistence in a particular diet, visiting springs or climates of a different and usually of a tonic character, or continuing for a certain time to drink the waters at home. It may be added that the advantage of having recourse to mineral waters is often felt more after than during treatment.

Since improved methods of bottling have been discovered, and the advantage of an additional supply of carbonic acid has been appreciated, the export of waters from their sources has increased enormously, and most of the principal waters can now be advantageously used at home. It may be added that many of the artificial imitations of them are excellent.

TABLE I.—*Typical Mineral Waters.*

	Indifferent. Gastein. 95°–118°.	*Earthy.* Leuk. 123·8°.	*Salt.* Kissingen.	*Salt.* Sea-Water.	*Sulphur.* Aix-la-Chapelle. 113°–140°.	*Iron.* Schwalbach.	*Alkaline.* Vichy. 105·8°.	*Alkaline-Saline.* Carlsbad. 119°–138°.	*Table Water.* Seltzers.	*Purging Water.* Hunyadi Janos.
Solids.										
Bicarbonate of soda	—	—	—	—	0·6449	0·0206	4·883	1·92	1·2	—
" potash	—	—	—	—	—	—	0·352	—	—	—
" magnesia	0·0017	0·013	0·017	0·45	0·0506	0·2122	0·303	0·18	—	—
" calcium	0·0195	0·012	1·06	2·38	0·157	0·2213	0·434	0·428	—	—
Sulphate of soda	0·0208	0·050	—	—	0·2831	0·0079	0·292	2·37	—	15·9
" potash	0·0135	0·038	—	—	0·1527	0·0037	—	0·16	—	—
" magnesia	—	0·308	0·588	2·96	—	—	—	—	0·46	16·0
" calcium	—	1·520	0·389	0·25	—	—	—	—	—	—
Sulphide of sodium	—	—	—	—	0·0136	—	—	—	—	—
Chloride of sodium	0·0428	—	5·52	25·21	2·616	—	0·534	1·03	2·2	1·3
" potash	—	—	0·286	—	—	—	—	—	—	—
" magnesia	—	—	0·303	3·39	—	—	—	—	—	—
Carbonate of iron	0·0005	0·023	0·277	—	—	0·0837	—	0·003	0·01	—
Silicic acid	0·0496	0·036	—	—	—	0·0320	—	—	—	—
Gases.										
Carbonic acid	—	—	3·19	—	—	5·35	2·6	0·76	2·24	0·45
Hydrosulphuric acid	—	—	—	—	trace	—	—	—	—	—

The history of the use of mineral waters can only just be alluded to. They have been employed from the earliest periods, and traces of Roman work have been found at most of the European baths which are now in favour—at almost all the thermal ones. Occasionally new springs are discovered in old countries, but the great majority of them have been long known. Warm waters, and those containing small quantities of mineral constituents, appear to have remained more steadily in favour than any other class within the appropriate sphere of mineral waters, which is limited to the treatment of chronic disease.

The attempt has been made to range mineral waters according to their therapeutic action, according to their internal or external use, but most generally according to their chemical constituents so far as they have been from time to time understood; and a judicious classification undoubtedly is a help towards their rational employment. But their constituents are so varied, and the gradations between different waters are so finely shaded off, that it has been found impossible to propose any one definite scientific classification that is not open to numberless objections. Thus a great many of the sulphur waters are practically earthy or saline ones. Yet because they contain very minute amounts of such a gas as hydrosulphuric acid, an ingredient so palpable as always to attract attention, it is considered necessary to class them under the head of sulphur. The general rule is to attempt to class a water under the head of its predominant element; but if the amount of that be extremely small, this leads to such waters as those of Mont Dore being classified as alkaline or arseniated, because they contain a very little soda and arsenic. The classification in the following table, which is that usually adopted in Germany, has the merit of comparative simplicity, and of freedom from theoretical considerations which in this matter influence the French much more than the German writers. The more important constituents only are given. The amount of solid constituents is the number of parts to one thousand parts of the water; the temperature of thermal springs is added. The waters are classified as indifferent, earthy, salt, sulphuretted, iron, alkaline, alkaline-saline—with subvarieties of table waters and purging waters.

In addition to their solid constituents, gas is present in many waters in considerable quantity. There is a little oxygen and a good deal of nitrogen in some of them; the quantity of hydrosulphuric acid, even in strong sulphuric waters, is wonderfully small; but the volume of carbonic acid present is often very large—for instance, in the case of Kissingen, Schwalbach and Selters. The immediate effect of the carbonic acid which they contain is that of pleasant stimulation to the stomach and system. Extremely little appears to be known of its actual operation on the system: a part of what is swallowed is returned by eructation, and a part passes on to the intestines; whether any appreciable quantity reaches the blood is doubtful. There is no question that carbonic acid increases diuresis. Practically it is found to aid digestion, helping the functions of the stomach, and in a slight degree the peristaltic action of the intestines. The increased flow of urine may be caused by its favouring the absorption of water by the stomach. In some baths carbonic acid is so abundant that precautions have to be taken to prevent its tendency to accumulate on account of its heavy specific gravity. Carbonic acid gas, used as a bath, proves stimulating to the skin and to the general system; but its employment has not answered the expectations formed of it.

TABLE II.[1]—*Indifferent Waters.*

Locality.	Height in Ft.	Temp. °Fahr.	For what prescribed.
Evian, Lake of Geneva	1100	—	Nervous cases, dyspepsia, urinary affections.
Badenweiler, Baden	1425	—	For mild rheumatic treatment; a health resort.
Buxton, England	980	82	Gout and rheumatism (nitrogen present).
Schlangenbad, Nassau	800	80–87	Nervous cases, female disorders, skin.
Sacedon, Spain	1500	85	Rheumatism, gout, cutaneous affections.
Wildbad, Württemberg	1320	90–101	Gout and rheumatism, neuralgia, thickenings.
Pfeffers, Switzerland	2115	99	Do. do. do.
Ragatz, do.	1570	95	Do. do. do.
Panticosa, S. Pyrenees	5110	85–95	Do. (nitrogen present); special action in phthisis.
Teplitz, Bohemia	648	101–120	Gout, rheumatism, old injuries, joints or bones.
Gastein, Austria	3315	95–118	Do. do.; soothes nervous system.

Indifferent Waters scarcely vary in chemical qualities from ordinary drinking water; but they are usually of higher temperature. Their therapeutic action, which is mainly exercised through baths, has been explained on the theory of peculiarities of their electric or thermal condition, about which we know nothing definite, and on the presence in some of them of a large quantity of nitrogen. It has also been ascribed to the various organic substances in some of them; such as glairin, which when collected is sometimes useful as a cataplasm. These waters are not often much drunk, but any efficiency they may have in dyspepsia and perhaps in neuralgic diarrhoeas must be attributed to the favourable action of hot water on the digestion. The waters of this class, especially the hotter ones in the form of baths, are extremely useful in resolving the effects of inflammation, in thickenings of the joints and in chronic rheumatism and gout. They also are often effective, especially the cooler ones, in neuralgia and in some hysterical affections. They are sometimes prescribed in urinary affections, in which case they probably assist by dilution. The effects of many of these waters are aided by the baths often being situated at considerable elevations and in out-of-the-way spots, whence the Germans called them *Wildbäder*. They are very widely diffused, being found in all quarters of the globe, especially in volcanic districts. There are many in New Zealand; in America the hottest are in the west and in California.

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[1] In this and the following tables a selection is given of some of the best-known mineral waters in various European countries that possess establishments. Their chief peculiarities of elevation, of temperature and constituents are briefly noted. The curative effects, necessarily alluded to very generally, are those usually attributed to them.

Earthy Waters.—These differ chiefly from the indifferent waters in containing an appreciable quantity of salts, among which sulphate or carbonate of lime or of magnesia predominates. The great majority of them are of high temperature. They produce the same effects as the indifferent waters, but are perhaps less efficacious in neuralgic affections, while they are more employed in some of the chronic scaly eruptions. There was formerly a tendency to consider these waters useful in urinary affections; but at the present day it is only the colder ones that have come into repute for the expulsion of gravel and biliary calculi and in the treatment of affections of the bladder generally. Some of them have also of late years been considered to exercise a favourable influence on scrofula, and to be useful in the early stages of pulmonary phthisis. This has been attributed to the salts of lime present in them, although it is known that most of its salts pass through the system unaltered. Many of these baths, such as Leuk and Bormio, enjoy the advantages of great elevation, but Bath, otherwise one of the best of them, lies low.

TABLE III.—*Earthy Waters*.

	Locality.	Height in Ft.	Temp. ° Fahr.	Therapeutic Action.
Cold.	Contrexéville, Vosges	1050	—	Special action in calculous affections.
	Lippspringe, N. Germany	—	—	Supposed to be useful in phthisis.
	Wildungen, do.	—	—	Special use in urinary complaints; contains iron.
	Weissenberg, Switzerland	2600	—	Resorted to for pulmonary affections.
	Pougues, France	600	—	Dyspepsia, diabetes, hepatic and urinary concretions.
Warm.	Baden, Switzerland	1180	117–122	Rheumatism, gout, paralysis, scaly eruptions.
	Leuk, do.	4400	93–123	Do., some female complaints.
	Bormio, North Italy	4400	86–104	Do. do.; old sprains.
	Lucca, Italy	—	108–122	Do. do. do.
	Bath, England	—	108–122	Do. do. do.
	Dax, south of France	1400	139	Do. do.
	B. de Bigorres, Pyrenees	1800	64–123	Do.; chlorosis, neuralgia.

Salt Waters are so called from containing a predominant amount of chloride of sodium. They also generally contain chlorides of magnesia and of lime, and occasionally small amounts of lithium, bromine and iodine. They further often contain a little iron, which is an important addition. The great majority of the drinking wells have a large supply of carbonic acid. There are cold and hot salt springs. Sometimes they are used for drinking, sometimes for bathing; and the double use of them is often resorted to.

The normal quantity of common salt consumed daily by man is usually set down at about 300 grains. The maximum quantity likely to be taken at any well may be 225 grains, but commonly not more than half of that amount is taken. The increase to the usual daily amount is therefore probably not much more than one-third. Still it may be presumed that the action of a solution of salt on an empty stomach is different from that of the same amount of salt taken with food. Salt introduced into the stomach excites the secretion of gastric juice and favours the peristaltic actions, and when taken in considerable quantity is distinctly aperient. We thus see how it is useful in dyspepsia, in atony of the stomach and intestines, and sometimes in chronic intestinal catarrh. Salt when absorbed by the stomach appears again in the urine, of which it increases the amount both of fluid and of solid constituents, especially of the urea. It seems, therefore, to be pretty certain that considerable quantities of salt taken into the circulation increase the excretion of nitrogenous products through the urine, and on the whole accelerate the transformation of tissue. Salt is thus useful in scrofula by stimulating the system, and also in anaemia, especially when iron is also present. In some German stations, as at Soden, carbonated salt waters are considered to be useful in chronic laryngitis or granular pharyngitis.

Baths of salt water, as usually given, rarely contain more than 3% of chloride of sodium, some of the strongest perhaps from 8 to 10%. Their primary action is as a stimulant to the skin, in which action it is probable that the other chlorides, especially that of calcium, and still more the carbonic acid often present, co-operate. In this way, and when aided by various processes of what may be termed water poultices and packing, they are often useful in removing exudations, in chronic metritis and in some tumours of the uterus, and generally in scrofula and rachitis, and occasionally in some chronic skin affections.

The French accord high praise to some of their thermal salt waters in paralysis, and some German ones are used in a similar way in spinal affections. The salt waters are sometimes so strong that they must be diluted for bathing. In other cases concentrated solutions of salt are added to make them sufficiently strong. These waters are widely diffused, but on the whole Germany is richest in them, especially in such as are highly charged with salt. The Kissingen springs may be considered as typical of the drinking wells, and sea-water of bathing waters. The air of salt-works and pulverization of the water are employed in German baths as remedial agents.

Salt springs are found in many quarters of the world, but the chief carbonated groups for drinking purposes occur in Germany, and at Saratoga in America, where very remarkable wells indeed are to be found. France and England have no springs of this class. The stronger wells, used chiefly for bathing, occur where there are salt-bearing strata, as in Germany, Galicia, Italy, Switzerland, France and England. Very powerful waters of this class are those of St Catherines in Canada.

TABLE IV.—*Salt Springs*.

	Locality.	Temp. ° Fahr.	Therapeutic Action.
Cold.	Soden, near Frankfort	—	Dyspepsia, anaemia, scrofula, special for throat and phthisis.
	Homburg, do.	—	Dyspepsia, slighter hepatic affections, chlorosis, gout.
	Kissingen, Bavaria	—	In all essentials the same.
	Pyrmont, North Germany	—	Better known for its iron; has a good salt drinking spring.
	Kreuznach, near Bingen	—	A salt well without carbonic acid; used in scrofula and anaemia; bathing more important.
Warm.	Wiesbaden, Nassau	155	Used in dyspepsia and gout; the bathing is most important.
	Baden-Baden	156	Still milder water; uses similar; gout.
	Bourbonne, Haute-Marne	114–149	Rheumatism, neuralgia, effects of malaria.
	Balaruc, South France	116·6	Do.; special for treatment of paralysis.
	Salins, Moutiers, Savoy (1480 ft.)	96	Scrofula, anaemia, loss of power, sexual disorders.
	Brides, Savoy (1700 ft.)	95	Act on liver and digestive canal; used for obesity.
	Acqui, North Italy	169	Rheumatism; special treatment with the bath deposit.
	Abano, do	185	Chiefly as baths; mud of bath used for poultice.
	Caldas de Mombuy, near Barcelona	153–158	Rheumatism, sciatica, old injuries.
	Cestona, Guipuzcoa, Spain	88–94	Rheumatism, indigestion, bronchitis.

Almost all the above stations have several springs of various strengths: the cold may be said to vary from 14 to 5·8% of chloride of sodium; the warm are generally weaker, perhaps varying from 6·8 to 1·6.

The presence of minute portions of *iodine* or *bromine* in salt waters is by no means infrequent, and they appear in considerable quantity in some few. It is, however, extremely doubtful whether any known spring contains a sufficient quantity of iodine, still more of bromine, to act specially on the system, even if that action were not necessarily superseded by the presence of the large quantity of other salts with which they are associated. Some of the best-known springs of the kind are: Challes, Wildegg, Castrocaro, Hall, Adelheid's Quelle, Krankenheil, Kreuznach, Woodhall Spa.

Iron or Chalybeate Waters.—Iron usually exists in waters in the state of protoxide or its carbonate, less frequently as sulphate or crenate, and very rarely, if at all, as chloride. The quantity present is usually extremely small. It may be said to vary from 0·12 to 0·03 in the 1000 parts of water. Some wells considered distinct chalybeates contain less than 0·03. Many wells, especially in Germany, have a rich supply of carbonic acid, which is unfortunately wanting in French and English ones.

It has long been the prevalent idea that want of iron in the blood is the main cause of chlorosis and of other anaemic conditions, and that these conditions are best relieved by a supply of that metal. Since the detection of it in haemoglobuline this view has been still more popular. It is pretty certain that the blood contains 37 to 47 grains and the whole system 70 to 74 grains of iron; and it has been calculated that in normal conditions of the system somewhat more than one grain of iron is taken daily in articles of food, and that the same amount is passed in the faeces; for although the stomach takes the iron up it is excreted by the alimentary canal mainly, it being doubtful whether any is excreted in the urine. It is possible by drinking several glasses to take in more than a grain of carbonate of iron in the day, equivalent to half that amount of metallic iron. It has further been ingeniously reckoned from practice that 10 to 15 grains of metallic iron suffice to supply the deficiency in the system in a case of chlorosis. It is thought probable that a portion of the iron taken up in water is in certain pathological states not excreted, but retained in the system, and goes towards making up the want of that metal. But whether this or any other explanation be satisfactory, there is no question as to the excellent effects often produced by drinking chalybeate waters (especially when they are carbonated), and by bathing in those which are rich in carbonic acid after they have been artificially heated. As regards the drinking cure we must not, however, forget that carbonate and chloride of sodium, and also the sulphate, are often present and must be ascribed a share in the cure. Thus chloride of sodium is a powerful adjuvant in the strong Stahl Quelle of Homburg and in the Putnam Well at Saratoga. A whole category of female complaints is treated successfully with these waters. Indeed, anaemia from any source, as after fever or through loss of blood, and enlargements of the spleen, are benefited by them. The stimulating action of the copious supply of carbonic acid in steel baths is a very important adjuvant; no one now believes in direct absorption of iron from the bath. Iron waters are scarcely ever thermal. They are extremely common in all countries—frequently along with sulphuretted hydrogen in bogs and near coal-measures. But such springs and non-carbonated wells generally are weak, and not now held in much esteem.

TABLE V.—*Stronger Salt Waters.*

Locality.	Chloride of Sodium in 1000 parts of Water	Therapeutic Application.
Rheinfeld, Aargau, Switzerland	311	Scrofula, effects of inflammation, chronic exudations, some chronic exanthemas, rheumatism, uterine infiltrations.
Salzungen, North Germany	256	Do. do.
Ischl, Austria (1440 ft.)	256	Do. do.
Hall, Tyrol (1700 ft.)	255	Do. do.
Reichenhall, near Salzburg (1800 ft.)	224	Do. do.
Bex, Rhone Valley (1400 ft.)	156	Do. do.
Castrocaro, Tuscany	36	Do. do.
Droitwich, near Worcester	233·6	Do. do.
Sea Water	30·4	
Rehme, Westphalia (92° F.)	24–85	Do.; special use in locomotor ataxia.
Nauheim, Wetterau (80°–103° F.)	29	Do. do.

TABLE VI.—*Iron Waters.*

Locality.	Height in Ft.	Carb. of Iron.	Therapeutic Use.
Rippoldsau, Black Forest	1886	0·12	For anaemic conditions; laxative.
Homburg, near Frankfort	—	0·10	Do. do.
Elster, Saxony	1465	0·08	Do. do.
Liebenstein, North Germany	911	0·08	
Schwalbach, Nassau	900	0·08	Do.; much of a ladies' bath.
Bocklet, near Kissingen	600	0·08	Do.
Griesbach, Black Forest	1614	0·07	Do.; laxative; a ladies' bath.
Franzensbad, Bohemia	1293	0·07	Do. do.
Pyrmont, Germany	—	0·07	Do.
Spa, Belgium	1000	0·06	Do.
Petersthal, Black Forest	1333	0·04	Do.; laxative.
St Moritz, Engadine, Switzerland	5464	0·03	Do.; sought for its air.
Forges-les-Eaux, France	—	0·06	Do.
La Malou, Hérault, France (temp. 88°)	—	0·08	Do.
Recoaro, North Italy	1943	0·04	Do.
Tunbridge Wells, England	—	0·06	Do.; deficient in carbonic acid.
Muspratt Spring, Harrogate (chloride)	600	0·15	

It may be added that some of the strongest known iron wells are *sulphated* or *aluminated*. They are styptic and astringent, and can only be used diluted. They are sometimes useful as an application to ulcers and sores. Such springs have often been brought into notice, but never retain their popularity. They are known in the Isle of Wight, in Wales, in Scotland, as well as in Elba, &c.; and of late years the Bedford Alum and Oak Orchard Springs, U.S., have been brought into notice, the latter containing 10 grains of free sulphuric acid in the pint. All such springs have been considered useful in scrofula, anaemia and chronic diarrhoeas.

Sulphur Springs.—Waters having the odour of hydrosulphuric acid, however slightly, are usually called sulphur ones. They owe their smell sometimes to the presence of the free acid, sometimes to sulphides of sodium, calcium or magnesia, and sometimes to both. Sulphuretted hydrogen is absorbed more freely by cold than by hot water, and is therefore most abundant in cold springs. The sulphides decompose and give off the gas. Most of these springs occur near coal or shale measures, or strata containing fossils, or in moors and in places generally where organic matter is present in the soil or strata. Many of them contain so little mineral impregnation that they might as well be classed among the indifferent or earthy waters. One group contains a considerable amount of chloride of sodium, another of sulphate of lime, while a third has little mineral impregnation, but contains sulphides.

Sulphuretted hydrogen is a strong poison, and its action on the system has been pretty well ascertained. It has been assumed that the gas in mineral waters acts similarly, though in a modified degree; but there is next to nothing absolutely known of the action of the small quantities of the gas that are present in mineral waters, and which certainly have no toxic effect. It has been assumed that this gas has some special action on the portal system and so on the liver. On the connexion of metallic poisoning with the liver has been founded the idea that sulphur waters are useful in metallic intoxication. Drinking large quantities of these waters, especially of such as contain sulphates or chlorides of sodium or magnesia, combined with hot baths and exercise, may help to break up albuminates, but there is no proof of the action of the sulphur.

For similar reasons, and primarily to counteract mercurial poison, sulphur waters have been considered useful in syphilis. But it may be well to remember that at most baths mercury is used along with them. No doubt they are frequently, like other warm waters, useful in bringing out old eruptions, acting in this way as a test for syphilitic poison, and in indicating the treatment that may be required. Sulphur waters, both hot and cold, are used in gout and rheumatism, in dyspepsia, in hepatic and cutaneous affections; and of late years inhalation of them has been popular in phthisis and in laryngeal affections. They have long been popular remedies in cutaneous affections. While so much doubt has been cast on the action of the sulphur of these waters, it may be admitted that the sulphides are probably decomposed in the stomach and sulphuretted hydrogen generated. That gas is probably a slight stimulant

TABLE VII.—*Cold Sulphur Springs.*

Locality.	Sulphuretted Hydrogen dissolved in Water.	Sulphide of Sodium.
Eilsen, Schaumburg-Lippe	42·3	—
Meinberg, Lippe-Detmold	23·1	0·008
Gurnigel, Switzerland (3600 ft.)	15·1	—
Leuk, do. (3593 ft.)	44·5	—
Challes, Savoy (900 ft.)	—	0·478
Enghien, near Paris	—	0·106
Uriage, Isère, France (1500 ft.)	7·34	—
Harrogate, England	—	0·207
Strathpeffer, Scotland	—	0·026
Lisdoonvarna, Clare, Ireland	—	—

to the intestine. What sulphuretted hydrogen reaches the blood is eliminated by the lungs. There seems to be no doubt that the gas is absorbed in small quantities by the skin.

It is in sulphur waters chiefly that glairin and baregin occur. This peculiar organic substance has been found both in American and in European springs. Cold sulphur springs are very widely diffused throughout the world. Thermal ones are not so common. Perhaps the largest though not the strongest group of the latter is to be found in the Pyrenees. We may remark again how very little hydrosulphuric acid there is in many of the most favourite sulphur springs, including the very popular White Sulphur ones of Virginia. There seems to be something peculiarly unsatisfactory in the analysis of sulphur waters, and there has been difficulty in constructing the following imperfect tables.

TABLE VIII.—*Warm Sulphur Springs.*

Locality.	Height in Ft.	Temp. ° Fahr.	Hydrosulphuric Acid absorbed in Water.	Sulphide of Sodium.
Aix-la-Chapelle, Germany	534	131–140	0·3	0·01
Baden, near Vienna	—	95–115	2·5	0·052
Schinznach, Switzerland	1060	80–92	37·8	—
Lavey, Rhone Valley	1350	92–113	3·5	—
Hercules Bad, Banat	500	110	42·6	—
Aix-les-Bains, Savoy	765	108·5	27·2	—
Luchon, Pyrenees	2000	135·5	—	0·07
Baréges, do.	4100	113	—	0·04
Amélie-les-Bains, Pyrenees	810	87–147	—	0·01
Cauterets, do.	3254	71–134	—	0·02
Eaux Bonnes, do.	2400	90·5	—	0·02
Archena, Murcia, Spain	—	126	—	—

Some of the most powerful cold wells are those of Challes (with its very peculiar water), Leuk and Harrogate. Uriage has a very large amount of chloride of sodium in its springs. Cold sulphur waters are on the whole more used in liver and indigestion than warm ones. The general effects of warm sulphur waters differ so little at the various baths as to make it difficult to mention anything special to particular localities. Schinznach has a reputation in skin complaints, Cauterets, Eaux Bonnes and Challes in laryngeal affections, the two Aix, Luchon and Archena in syphilis.

Alkaline Waters are such as contain carbonate (chiefly bicarbonate) of soda, along with an excess of carbonic acid. Of the action of those carbonates it is known that when taken into the stomach they are neutralized by the gastric juice, and converted into chloride of sodium. On their introduction into the stomach they produce an increased flow of gastric juice. If given during or immediately after meals in any quantity, they impede digestion. They slightly increase peristaltic action, but only feebly, unless assisted by other salts. They act slightly as diuretics. Of the connexion between the biliary system and alkalies, which undoubtedly exists, not much is known with certainty. The alkalization of the blood by them is assumed by many, but not proved. It is very doubtful whether they reduce the quantity of fibrine in the blood, and thus induce a lowered state of the system, or whether they have any direct tendency to combine with fat and carry off a portion of superfluous adipose tissue. Their excess of carbonic acid, through its action on the stomach, favours the operation of alkaline waters. They have been classed as follows: (1) simple alkalines, where carbonate of soda is the main agent; (2) waters containing in addition some chloride of sodium; (3) waters containing sulphates of soda or of magnesia. All these classes may be said to be used in gout, lithiasis, affections of the liver, catarrh and obstructions of the gall ducts, in dyspepsia, chronic catarrh of the stomach and diarrhoea, in obesity and in diabetes. Some of the waters of the second class are supposed to influence bronchial catarrhs and incipient phthisis, while the more powerful sulphated waters of the third class are especially useful in catarrh of the stomach, and in affections of the biliary organs; of these only one of importance (Carlsbad) is thermal. The rival cold waters of Tarasp contain twice as much carbonate of soda. The cold ones are chiefly used internally, the thermal ones both internally and externally. The latter, besides acting as warm water, slightly stimulate the skin when the carbonic acid is abundant, and the carbonate of soda has some slight detergent effect on the cutaneous surface like soap. These waters are unknown in England. They are most abundant in countries of extinct volcanoes.

Classes I. and II. of alkaline waters may be said to have a subvariety in *acidulated* springs or carbonated waters, in which the quantity of salts is very small, that of carbonic acid large. These table waters are readily drunk at meals. They have of late years been so widely exported as to be within the reach almost of every one. Their practical importance in aiding digestion is in reality much greater than one could expect from their scanty mineralization. They are drunk by the country people, and also largely exported and imitated. They are very abundant on the Continent, and, although some of the best-known ones enumerated below are German and French, they are common in Italy and elsewhere: Heppingen, Roisdorf, Landskro, Apollinaris, Selters, Brückenau, Gieshübel, all German; St Galmier, Pougues, Chateldon, French.

Associated with Class III. is that of the strongly *sulphated* waters known in Germany as bitter or purging waters, which have of late deservedly come into use as purgative agents. They are almost wanting in France and in America, and there are no very good ones in England. The chief supply is from Bohemia and Hungary. The numerous waters of Ofen are the best known, and some of them are stronger than the Hunyadi, of which an analysis has been given in Table I. They are easily imitated. Some of the best-known are Ofen, Püllna, Saidschütz, Friedrichshall, Birmerstorff, Kissingen.

TABLE IX.—*Alkaline Waters.*

CLASS I.—*Simple Alkaline.*

Locality.	Carb. Soda.	Therapeutic Uses.
Vals, South France	7·1	Catarrh of stomach, gout, renal and biliary calculi, liver complaints, diabetes.
Bilin, Bohemia	4·2	Do. do. do.
Vichy, France (105° F.)	5·1	Do. do. do.
Neuenahr, Rhineland (92°–97° F.)	1·0	Mucous catarrh; diabetes specially.
La Malou, France (97° F.)	—	Do.; sedative effect on nervous system.
Vidago, Portugal	—	Do., gout, urinary affections—"The Portuguese Vichy."

CLASS II.—*With Chloride of Sodium varying from 4·3 to 1 in amount.*

Locality.	Height in Ft.	Temp. ° Fahr.	Carb. Soda.	Therapeutic Uses.
Luhatschowitz, Moravia	1600	—	8·4	Springs rich both in carb. soda and chl. sodium.
Tönnistein, Rhine Valley	—	—	2·5	Light antacid tonic to stomach.
Ems, Nassau	—	85–115	2·0	Special in female complaints and mucous membrane.
Ischia, Italy	—	up to 170	2·0	Specially rheumatism and female complaints.
Royat, Auvergne	1400	80–95	1·3	Do. and some skin affections.
Mont Dore, do.	3300	100–114	—	Asthma, chronic laryngitis.
Bourboule, do.	2800	107–125	—	Scrofula, rachitis, cutaneous affections.

CLASS III.—*With Sulphate of Soda varying from 5·2 to 2 in amount, and Carbonate of Soda varying from 3·55 to 0·51 in amount.*

Locality.	Height in Ft.	Therapeutic Uses.
Elster, Saxony	1460	Action on abdominal organs, female complaints.
Marienbad, Bohemia	1012	Do.; special use in obesity.
Franzensbad, do.	1293	Do.; specially a ladies' bath.
Tarasp, Lower Engadine	4000	Powerful action on abdominal viscera.
Carlsbad, Bohemia (121°–164° F.)	1200	Gout, liver affections, biliary and renal calculi, diabetes.

Two other classes of waters demand a few words of notice. The French have much faith in the presence of minute quantities of arsenic in some of their springs, and trace arsenical effects in those who drink them, and some French authors have established a class of *arsenical* waters. Bourboule in Auvergne is the strongest of them, and is said to contain $\frac{1}{12}$th of a grain of arseniate of soda in 7 oz. of water. Baden-Baden, according to Bunsen's latest analysis, has a right to be considered an arsenical water. It is, however, extremely doubtful whether the small amounts of arseniate of soda which have been detected, accompanied as they are by preponderating amounts of other salts, have any actual operation on the system. The following are among the most noted springs:

Bourboule, Mont Dore, Royat, Salies (Bigorres), Plombières, Baden-Baden.

Of late years *lithium* has been discovered in the waters of Baden-Baden; and various other places boast of the amount of that substance in their springs. Indeed a new bath has been established at Assmannshausen on the Rhine in consequence of the discovery of a weak alkaline spring containing some lithium. Not very much is known of the action of lithium in ordinary medicine, and it undoubtedly does not exist in medicinal doses even in the strongest springs. Among these springs are those of Baden-Baden, Assmannshausen, Elster, Royat, Ballston Spa, and Saratoga (U.S.).

	Designation and Locality.	Therapeutic Application.
Indifferent (Thermal).	Lebanon, Columbia co., N.Y. (73° F.)	
	Healing, Bath co., Va. (88° F.)	Scrofulous ulcers and ophthalmia, ozoena, chronic diarrhoea and dysentery, secondary and tertiary syphilis.
	Warm, Bath co., Va. (98° F.)	Chronic and subacute rheumatism, gout, neuralgia, nephritic and calculous diseases.
	Hot, Bath co., Va. (110° F.)	Chronic rheumatism, gout, diseases of liver, neuralgia, contractions of joints.
	Paso Robles, San Luis Obispo co., Cal. (122° F.)	
	Hot, Garland co., Ark. (93–150° F.)	Dartrous diseases of skin, functional diseases of uterus, chronic mercurial and lead poisoning.
Calcareous and Earthy.	Gettysburg, Adams co., Penn.	Calculus, gravel, catarrh of stomach or bladder, dyspepsia.
	Sweet, Monroe co., W. Va. (74° F.)	Gravel, dyspepsia (diuretic, diaphoretic).
	Berkeley, Morgan co., W. Va. (74° F.)	Neuralgia (restorative).
	Alleghany, Montgomery co., Va.	Purgative, diuretic.
	Bethesda, Waukesha co., Wis.	Diabetes mellitus, gravel, inflammation of bladder, dropsy, albuminuria (diuretic).
Sulphur.	Lower Blue Lick, Nicholas co., Ky.	Aperient and alterative.
	Sharon, Schoharie co., N.Y.	Do. do.
	White Sulphur, Greenbrier co., Va.	Dartrous skin diseases, diseases of the bladder, jaundice, dyspepsia.
	Salt Sulphur, Monroe co., W. Va.	Do.; scrofula and syphilis.
Epsom Salt.	Bedford, Bedford co., Penn.	Anaemia, gravel, calculus (strongly diuretic).
Common Salt.	St Catharines, Ontario, Canada	Rheumatism, gout, scrofula, neuralgia.
	Caledonia, Ontario, Canada	Rheumatism, gout.
	Hathorne, Saratoga, N. Y.	Dyspepsia, jaundice, abdominal plethora.
	Ballston, Saratoga co., N. Y.	Do. do. do.
Iron.	Oak-Orchard Acid, Genesee co., N. Y.	Ulcers, diseases of the skin, passive haemorrhages, atonic diarrhoea (has 10 grains of free sulphuric acid in the pint).
	Rawley, Rockingham co., Va.	Chlorosis and anaemia generally; tonic.
	Sweet Chalybeate, Alleghany co., Va.	Do. do. do.
	Rockbridge Alum, Rockbridge co., Va.	Scrofula, chronic diarrhoea.
	Cooper's Well, Hinds co., Miss.	Anaemia, chlorosis, chronic diarrhoea, dropsy.
Glauber Salt.	Crab Orchard, Lincoln co., Ky.	
	Midland, Midland co., Mich.	
Alkaline.	Bladen, Choctaw co., Ala. (carbonated alkaline)	
	Congress, Santa Clara co., Cal. (saline-alkaline)	
	St Louis, Gratiot co., Mich. (simple alkaline)	Dyspepsia, neuralgia, chronic and subacute rheumatism.

American Mineral Waters.—The number of springs in the United States and Canada to which public attention has been called on account of their supposed therapeutic virtues is very large, amounting in all to more than three hundred. Of this number comparatively few are in Canada, and of these not more than six (St Catharines, Caledonia, Plantagenet, Caxton, Charlottesville and Sandwich) have attained general celebrity. The first three belong to the saline class, the Caxton is alkaline-saline, and the last two are sulphur waters. The St Catharines is remarkable for the very large amounts of sodium, calcium and magnesium chlorides which it contains, its total salts (450 grains in the pint) being more than three times the quantity contained in the brine-baths of Kreuznach in Prussia. The Charlottesville and Sandwich springs likewise surpass the noted sulphur-waters of Europe in their excessive percentages of sulphuretted hydrogen, the former containing more than 3 and the latter 4·72 cub. in. of this gas in the pint.

The mineral springs in the United States are very unequally distributed, by far the larger number of those which are in high medical repute occurring along the Appalachian chain of mountains, and more especially on or near this chain where it passes through the States of Virginia, West Virginia and New York. The Devonian and Silurian formations which overlie the Eozoic rocks along the course of the Appalachian chain have been greatly fissured—the faulting of the strata being in some places of enormous magnitude—by the series of upheavals which gave rise to the many parallel mountain ridges of the Appalachians. In many places the springs occur directly along the lines of fault. The various classes of mineral waters are likewise very unequally represented, the alkaline springs, and those containing Glauber and Epsom salts, being much inferior to their European representatives. On the other hand, the very numerous and abundant springs of Saratoga compare very favourably with the Selters and similar saline waters, and among the many American chalybeate springs the subclass represented by the Rockbridge Alum is unequalled in regard to the very large percentages of alumina and sulphuric acid which it contains. Besides its greater amount of mineral constituents (135 grains per pint), the Ballston spring surpasses the similar saline waters of Homburg, Kissingen, Wiesbaden and Selters, in its percentage of carbonic acid (53 cub. in.). It is also remarkable for the very large proportion of carbonate of lithia, amounting to 0·701 grains. Thermal springs are specially numerous in the territories west of the Mississippi and in California. Those in the east mostly occur in Virginia along the southern portion of the Appalachian chain; in the middle and New England States Lebanon is the only important thermal spring. Subjoined is a list of thirty American springs, the design being to represent as many of the more noted spas as possible, while at the same time enumerating the best representatives of the classes and subclasses into which mineral waters are divided according to the German method of classification.

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MINERVA, an Italian goddess, subsequently identified with Athena. She presided over all handicrafts, inventions, arts and sciences. Her oldest sanctuary at Rome was in the temple built by Tarquin on the Capitol, where she was worshipped with Jupiter and Juno. She had also a temple on the Aventine, which was the meeting-place for dramatic poets and actors, whose organization into gilds under her patronage dated from the time of Livius Andronicus (*q.v.*). The dedication day of the temple was the 19th of March, the great festival of Minerva, called *quinquatrus*, because it fell on the fifth day after the ides. All the schools had holidays at this time, and the pupils on reassembling brought a fee (*minerval*) to the teachers. In every house also the *quinquatrus* was a holiday, for Minerva (like Athena Erganē) was patron of the women's weaving and spinning and the workmen's craft. At a later time the festival extended over five days, the last four being chiefly occupied with gladiatorial shows—because Minerva was the goddess of war (Ovid, *Fasti*, iii. 809–834; Juvenal x. 115, with Mayor's note). The erection of a temple to her by Pompey out of the spoils of his eastern conquests shows that she was the bestower of victory, like Athena Nikē, and the dedication of a vestibule in the senate house by Augustus recalls Athena the goddess of counsel (βουλαία). Under Domitian, who claimed her special protection, the worship of Minerva attained its greatest vogue in Rome. The emperor Hadrian founded an educational institution, named after her the Athenaeum. The 23rd of March had always been the day of the *tubilustrium*, or purification of the trumpets used in the sacred rites, so that the ceremony came to be on the last day of Minerva's festival, but it is very doubtful whether it was really connected with her. There was another temple of Minerva on the Caelian Hill, where she was worshipped under the name of Capta, the "captive," the origin of which is unknown. Here a festival called the lesser *quinquatrus* was celebrated on the 13th–14th of June, chiefly by the flute-players (Livy ix. 30; Ovid, *Fasti*, vi. 651). As the Romans learnt the use of the flute from the Etruscans, the fact of Minerva being the patron goddess of flute-players is in favour of her Etruscan origin, although it may merely be a reminiscence of the Greek story which attributed the invention of the flute to Athena. A carved image of the goddess called the Palladium, said to have been brought from Troy to Lavinium, and thence to Rome by the family of the Nautii, was kept in the temple of Vesta and carefully guarded as necessary to the prosperity of the city. The older form of the name Minerva is Menerva (=Menes-va, Gr. μένος); it probably means "thinker."

MINGHETTI, MARCO (1818–1886), Italian economist and statesman, was born at Bologna on the 18th of November 1818. In 1846 he signed the petition to the Conclave for the election of a Liberal pope, and was appointed member of the state council summoned to prepare the constitution for the papal states. With Antonio Montanari and Rodolfo Audinot he founded at Bologna a paper, *Il Felsineo*. In the first constitutional cabinet, presided over by Cardinal Antonelli, Minghetti held the portfolio of public works, but after the allocution by Pius IX. against the Italian war of independence he resigned, and joined the Piedmontese army as captain on the general staff. Returning to Rome in September 1848, he refused to form a cabinet after the assassination of Pellegrino Rossi, and spent the next eight years in study and travel. Summoned to Paris by Cavour in 1856 to prepare the memorandum on the Romagna provinces for the Paris congress, he was in 1859 appointed by Cavour secretary-general of the Piedmontese Foreign Office. In the same year he was elected president of the assembly of the Romagna after the rejection of pontifical rule by those provinces, and prepared their annexation to Piedmont. Appointed Piedmontese minister of the interior, he resigned office shortly after Cavour's death, but was subsequently chosen to be minister of finance by Farini, whom he succeeded as premier in 1863. With the help of Visconti-Venosta he concluded (Sept. 15, 1864) the "September Convention" with France, whereby Napoleon agreed to evacuate Rome, and Italy to transfer her capital from Turin to Florence. The convention excited violent opposition at Turin, in consequence of which Minghetti was obliged to resign office. He took little part in public life until 1869, when he accepted the portfolio of agriculture in the Menabrea Cabinet. Both in and out of office he exercised his influence against an Italo-French alliance and for an immediate advance upon Rome, and in 1870 was sent to London and Vienna by the Lanza-Sella Cabinet to organize a league of neutral powers on the outbreak of the Franco-Prussian War. In 1873 he overthrew the Lanza-Sella Cabinet and regained the premiership, which, with the portfolio of finance, he held until the fall of the Right from power on the 18th of March 1876. During his premiership he inaugurated the *rapprochement* between Italy, Austria and Germany, and reformed the naval and military administration; and before his fall he was able, as finance minister, to announce the restoration of equilibrium between expenditure and revenue for the first time since 1860. After the advent of the Left, Minghetti remained for some years in Opposition, but towards 1884 joined Depretis in creating the "Trasformismo," which consisted in bringing Conservative support to Liberal cabinets. Minghetti, however, drew from it no personal advantage, and died at Rome on the 10th of December 1886 without having returned to power.

His writings include: *Della economia pubblica e delle sue attinenze con la morale e col diritto* (Bologna, 1859), and *La Chiesa e lo Stato* (Milan, 1878).

MINGRELIA, a former principality of Transcaucasia, which became subject to Russia in 1804, and since 1867 has belonged to the government of Kutais. The country corresponds to the ancient Colchis; and Sukhum Kaleh on the Black Sea coast, which was the capital under the Dadian dynasty (1323–1694), is to be identified with the ancient Dioscurias, a colony of Miletus. The Mingrelians, who are closely akin to the Georgians, numbered 241,000 in 1902, and belong to the Orthodox Greek Church (see further KUTAIS and CAUCASIA).

MINIATURE. The word "miniature," derived from the Latin *minium*, red lead, has been technically employed, in the first instance, to describe a picture in an ancient or medieval manuscript; the simple decoration of the early codices having been "miniated" or delineated with that pigment. The generally small scale of the medieval pictures has led secondly to a pseudo-etymological confusion of the term with "minuteness" and to its application to "paintings in little"; it is now used mainly in this sense, and is ordinarily applied to a painting on a very small scale, usually a portrait, and by analogy to anything on a very small scale.

1. *Miniatures in Ancient and Medieval MSS.*—The part played by the miniature in the scheme of the ornamentation of MSS., in the early centuries of the Christian era and in the middle ages, is dealt with in the article on ILLUMINATED MSS. In the present article will be discussed the development and changes which it underwent, in different ages and in different countries, both in its technical treatment and in its leading characteristics. The subject divides itself into two distinct portions, the classical and the medieval, between which there lies the great separating space of the early middle ages, which affords but scanty material to connect them. When, however, we have advanced into the middle ages, we are no longer at a loss; and we can follow the later development of the miniature through all its changes in the various schools of western Europe down to its transition into the modern picture.

The importance of the study of the miniature has perhaps hardly received in the past the recognition which it merits. The history of painting cannot be perfectly understood without a knowledge of the rise and progress of the art of miniature-painting in MSS; and examples of the art still survive in an abundance which frescoes and paintings in the large cannot rival. Modern methods of photography have brought within the reach of the student material which in earlier generations was not accessible; and consequently a juster conception can be formed of the position which the miniature holds in the history of art than was possible before.

The earliest examples that have descended to us are closely connected in style and treatment with the pictorial art of the later Roman classical period. In fact they are separated from that period by only two or three centuries, and they still follow its traditions. The oldest specimens of all are the series of coloured drawings or miniatures cut from an illustrated MS.

of the *Iliad* and now in the Ambrosian Library at Milan, which there is good reason for placing as early as the 3rd century. In these pictures there is a considerable variety in the quality of the drawing, but there are many notable instances of fine figure-drawing, quite classical in sentiment, showing that the earlier art still exercised its influence. Such indications, too, of landscape as are to be found are of the classical type, not conventional in the sense of medieval conventionalism, but still attempting to follow nature, even if in an imperfect fashion; just as in the Pompeian and other frescoes of the Roman age.

Of even greater value from an artistic point of view are the miniatures of the Vatican MS. of Virgil, known as the "Schedae Vaticanae," of the 4th century. They are in a more perfect condition and on a larger scale than the Ambrosian fragments, and they therefore offer better opportunity for examining method and technique. The drawing is quite classical in style, and the idea is conveyed that the miniatures are direct copies from an older series. The colours are opaque: indeed, in all the miniatures of early MSS. the employment of body colour was universal. The method followed in placing the different scenes on the page is highly instructive of the practice followed, as we may presume, by the artists of the early centuries. It seems that the background of the scene was first painted in full, covering the whole surface of the page; then, over this background were painted the larger figures and objects; and over these again the smaller details in front of them were superimposed. Again, for the purpose of securing something like perspective, an arrangement of horizontal zones was adopted, the upper ones containing figures on a smaller scale than those below.

It was reserved for the Byzantine school to break away more decidedly from the natural presentment of things and to develop convention. Yet in the best early examples of this school the classical sentiment still lingers, as the relics of the miniatures of the Cottonian Genesis, in the British Museum, and the best of the miniatures of the Vienna Dioscorides testify; and in the miniatures of the later Byzantine MSS., which were copied from earlier examples, the reproduction of the models is faithful. But on comparing the miniatures of the Byzantine school generally with their classical predecessors, one has a sense of having passed from the open air into the cloister. Under the restraint of ecclesiastical domination Byzantine art became more and more stereotyped and conventional. The tendency grows to paint the flesh-tints in swarthy hues, to elongate and emaciate the limbs, and to stiffen the gait. Browns, blue-greys and neutral tints are in favour. Here we first find the technical treatment of flesh-painting which afterwards became the special practice of Italian miniaturists, namely the laying on of the actual flesh-tints over a ground of olive, green or other dark hue. Landscape, such as it was, soon became quite conventional, setting the example for that remarkable absence of the true representation of nature which is such a striking attribute of the miniatures of the middle ages.

And yet, while the ascetic treatment of the miniatures obtained so strongly in Byzantine art, at the same time the Oriental sense of splendour shows itself in the brilliancy of much of the colouring and in the lavish employment of gold. In the miniatures of Byzantine MSS. are first seen those backgrounds of bright gold which afterwards appear in such profusion in the productions of every western school of painting.

The influence of Byzantine art on that of medieval Italy is obvious. The early mosaics in the churches of Italy, such as those at Ravenna and Venice, also afford examples of the dominating Byzantine influence. But the early middle ages provide but few landmarks to guide the student; and it is only when he emerges into the 12th century, with its frescoes and miniatures still bearing the impress of the Byzantine tradition, that he can be satisfied that the connexion has always existed during the intervening centuries.

When we turn to the farther-west of Europe, there also we find under the Carolingian monarchs a school of painting obviously derived from classical models, chiefly of the Byzantine type, but whether derived directly from the East, or, what is more probable, transmitted through Italian channels, must remain doubtful. The interest of that school for our present purpose is that it was the parent of the later miniature-painting in the countries of the West. For in the native schools of those countries decoration only was the leading motive. In the MSS. of the Merovingian period, in the school which connected Frankland and northern Italy, and which is known as Lombardic or Franco-Lombardic, in the MSS. of Spain, in the productions of the Celtic school of our own islands, figure-drawing was scarcely known, and where it was practised it was of a barbarous character, serving rather as a feature of decoration than as a representation of the human form. Hence in those native schools the miniature, in its true sense of a picture, may be regarded as non-existent.

From these native schools we exclude the Anglo-Saxon school, developed especially at Canterbury and Winchester, which probably derived its characteristic free-hand drawing from classical Roman models, scarcely influenced by the Byzantine element. The highest qualities of the miniatures of the 10th and 11th centuries of this school lie in fine outline drawing, which had a lasting influence on the English miniature of the later centuries. But the southern Anglo-Saxon school rather stands apart from the general line of development of the western medieval miniature. How far it was affected by Continental influence will be presently noticed.

Turning to the productions of the Carolingian school, which owed its origin to the encouragement of Charlemagne, it is seen that the miniature appears in two forms. First, there is the truly conventional miniature following the Byzantine model, the subjects being generally the portraits of the Evangelists, or portraits of the emperors themselves: the figures stiff and formal; the pages brilliantly and often coarsely coloured and gilded, generally set in architectural surroundings of a fixed type, and devoid of landscape in the real sense of the word. On the other hand, there is also the miniature in which there is an attempt at illustration, as, for example, the depicting of scenes from Bible history. Here there is more freedom; and we trace the debased classical style which copies Roman, as distinguished from Byzantine, models. The figure-drawing is sufficiently clumsy, but the type is Roman, or debased Roman, and the costumes are clearly derived from the same source. Here, too, there is a better attempt at landscape, which is not of the absolutely conventional deadness of the Carolingian-Byzantine type. But this second style of illustrative miniature appears only occasionally. The other was the characteristic miniature of the Carolingian school, and, accompanied as it was with profuse decoration in border and initial, it set the pattern for the later Continental schools of the West.

The influence which the Carolingian school exercised on the miniatures of the southern Anglo-Saxon artists shows itself in the extended use of body-colour and in the more elaborate employment of gold in the decoration. Such a MS. as the Benedictional of Aethelwold, bishop of Winchester, 963 to 984, with its series of miniatures drawn in the native style but painted in opaque pigments, exhibits the influence of the foreign art. But the actual drawing remained essentially national, marked by its own treatment of the human figure and by the peculiar disposition of the drapery with fluttering folds. Its fault was over-refinement, tending to an affected exaggeration and disproportion of the limbs. With the Norman Conquest this remarkable native school passed away.

The period immediately succeeding the Carolingian school in western Europe was one of extreme decadence in the miniatures of MSS. In the 10th and 11th centuries they were mere lifeless copies of earlier types. But with the awakening of art in the 12th century the decoration of MSS. received a powerful impulse. Although the artist of the time excels in the border and the initial, still in the miniature also there is vigorous drawing, with bold sweeping lines and careful study of the draperies. The artist now grows more practised in figure-drawing, and while there is still the tendency to repeat the same subjects in the same conventional manner, individual effort produced in this century many miniatures of a very noble character. The Norman Conquest had brought England directly within the fold of Continental art; and now began that grouping of the French and the English and the Flemish schools, which, fostered by growing intercourse and moved by common impulses, resulted in the magnificent productions of the illuminators of north-western Europe from the latter part of the 12th century onwards. But of natural landscape there is nothing, unless rocks and trees of a stereotyped character can be so regarded. Hence the background of the miniature of the 12th and immediately succeeding centuries became the field for decoration to throw into stronger relief the figures in the scene. And thus arose the practice of filling in the entire space with a sheet of gold, often burnished: a brilliant method of ornament which we have already seen practised in the Byzantine school. We have also to notice the conventional treatment of the sacred figures, which continue henceforward, from a sense of veneration, to be clad in the traditional robes of the early centuries, while the other figures of the scene wear the ordinary dress of the period.

It will be convenient, at this point, to follow the development of the miniature in the northern schools of England and France and the Low Countries, occasionally glancing at Germany, during the next three centuries, and to leave aside for the moment consideration of the Italian school and the schools allied therewith.

Entering the 13th century, we reach the period when the miniature may be said to justify the modern false etymology which has connected the title with minuteness. The broad, bold style of the 12th century gives place to the precise and minute. Books in general exchanged their form from the large folio to the octavo and smaller sizes. There was a greater demand for books; and vellum was limited in quantity and had to go further. The handwriting grew smaller and lost the roundness of the 12th century. Contractions and abbreviations in the texts largely increased in number. Everywhere there is an effort to save space. And so with the miniature. Figures were small, with delicate strokes in the features and with neat slim bodies and limbs. The backgrounds blaze with colour and burnished gold; and delicate diaper patterns of alternate gold and colour abound. Frequently, and especially in English MSS., the drawings are merely tinted or washed with transparent colours. In this century, too, the miniature invades the initial. Whereas in the earlier periods bold flowering scrolls are the fashion, now a little scene is introduced into the blank spaces of the letter. To compare the work of the three schools, the drawing of the English miniature, at its best, is perhaps the most graceful; the French is the neatest and the most accurate; the Flemish, including that of western Germany, is less refined and in harder and stronger lines. As to colours, the English artist affects rather lighter tints than those of the other schools: a partiality is to be observed for light green, for grey-blue, and for lake. The French artist loved deeper shades, especially ultramarine. The Fleming and the German painted, as a rule, in less pure colours and inclined to heaviness. A noticeable feature in French MSS. is the red or copper-hued gold used in their illuminations, in strong contrast to the paler metal of England and the Low Countries.

It is remarkable how the art of the miniature throughout the 13th century maintains its high quality both in drawing and colour without any very striking change. Throughout the century the Bible and the Psalter were in favour; and naturally the same subjects and the same scenes ran through the period and were repeated by artist after artist; and the very character of those sacred books would tend to restrain innovation. But towards the close of the period such secular works as the romances were growing in popularity, and afforded a wider field for the invention of the illustrating artist. Therefore with the opening of the 14th century a palpable change of style supervenes. We pass to more flowing lines; not to the bold sweeping strokes and curves of the 12th century, but to a graceful, delicate, yielding style which produced the beautiful swaying figures of the period. In fact the miniature now begins to free itself from the rôle of an integral member of the decorative scheme of illumination and to develop into the picture, depending on its own artistic merit for the position it is to hold in the future. This is shown by the more prominent place that the miniature now assumes, and by its growing independence of the decorative border and initial. But, at the same time, while the miniature of the 14th century thus strives to dissociate itself from the rest of the illuminated details of the MS., within itself it flourishes in decoration. Besides the greater elasticity of the figure-drawing, there is a parallel development in the designs of the backgrounds. The diapers become more elaborate and more brilliant; the beauty of the burnished gold is enhanced by the stippled patterns which are frequently worked upon it; the gothic canopies and other architectural features which it became the practice to introduce naturally followed the development of the architecture of the period. In a word, the great expansion of artistic sentiment in decoration of the best type, which is so prominent in the higher work of the 14th century, is equally conspicuous in the illuminated miniature.

In the early part of the century, English drawing is very graceful, the figures bending with a waving movement which, if they were not so simple, would be an affectation. Both in the outline specimens, washed with transparent colour, and in the fully painted examples, the best English work of this time is unsurpassed. French art still maintains its neat precision, the colours more vivid than those of England and the faces delicately indicated without much modelling. The productions of the Low Countries, still keeping to the heavier style of drawing, appear coarse beside the works of the other schools. Nor does German miniature art of this period hold a high position, being generally mechanical and of a rustic character. As time advances the French miniature almost monopolizes the field, excelling in brilliancy of colouring, but losing much of its purity of drawing although the general standard still remains high. The English school gradually retrogrades and, owing no doubt to political causes and to the wars with France, appears to have produced no work of much value. It is only towards the end of the century that there is a revival.

This revival, which is referred to in the article on ILLUMINATED MSS., has been attributed, with some reason, to a connexion with the flourishing school of Prague—a school which in the scheme of colouring suggests a southern influence—following on the marriage of Richard II. with Anne of Bohemia in 1382. The new style of English miniature painting is distinguished by richness of colour, and by the careful modelling of the faces, which compares favourably with the slighter treatment by the contemporary French artists. Similar attention to the features also marks the northern Flemish or Dutch school at this period and in the early 15th century; and it may therefore be regarded as an attribute of Germanic art as distinguished from the French style. The promise of the new development in English miniature painting, however, was not to be fulfilled. In the first quarter of the 15th century, examples of great merit were produced, but at a standstill in drawing and fettered by medieval convention. The native art practically came to a close about the middle of the century, just when the better appreciation of nature was breaking down the old conventional representation of landscape in European art, and was transforming the miniature into the modern picture. Whatever miniature painting was to be produced in England after that time was to be the work of foreign artists or of artists imitating a foreign style. The condition of the country during the Wars of the Roses sufficiently accounts for the abandonment of art. Thus the history of the miniature in the 15th century must be sought in the manuscripts of the Continental schools.

First we have to consider northern France and the Low Countries. As it passes out of the 14th and enters the 15th century, the miniature of both schools begins to exhibit greater freedom in composition; and there is a further tendency to aim rather at general effect by the colouring than neatness in drawing. This was encouraged by the wider field opened to the miniaturist. Books of all kinds were illustrated, and sacred books, Bibles and Psalters and liturgical books, were no longer the chief, if not the only, MSS. which were illuminated. And yet there was one class of MSS. which came into the greatest prominence and which was at the same time liturgical. This was the *Horae*, or Hours of the Virgin, &c., devotional books for individual use, which were multiplied in vast numbers and contained some of the finest work of the miniaturists. The decoration of these little volumes escaped in great measure from the conventional restraints which their religious character might have imposed. Futhermore, the demand for illuminated MSS. had by this time established a regular trade; and their production was not confined, as formerly, to the cloister with its narrow and limited views.

Early in the century the old conventional treatment of landscape still held its own; nor did the diapered and gilded background pass out of use. Indeed, in some of the finest French specimens of the time the diapered patterns are more brilliant than ever. But natural scenery in the second quarter of the century asserts itself more decidedly, although with faults in perspective. It was not until another generation had arisen that there was a true appreciation of the horizon and of atmospheric effect.

The miniatures of the French and Flemish schools run fairly parallel for a time, but after the middle of the century national characteristics become more marked and divergent. The French miniature began to deteriorate, though some very fine examples were produced by the more gifted artists of the school. The figure-drawing was more careless, and the painting tended to hardness without depth, which the artist endeavoured to relieve by an excess of gilt shading. The close of the century brought with it the end of the French miniature; for the extravagant productions of the 16th century cannot be counted as worthy of consideration.

The French miniature went down before the Flemish school, which in the latter part of the 15th century attained to its highest excellence. The Flemish miniature affected extreme softness and depth of colour; also an ever-increasing carefulness in the treatment of details, of the draperies, of the expression of the features: the Flemish type of the Virgin's face, for example, with its full, high forehead, can never be mistaken. In the best Flemish miniatures of the period the artist succeeds in presenting a wonderful softness and glow of colour; nor did the high standard cease with the 15th century, for many excellent specimens still remain to attest the favour in which it was held for a few decades longer.

In the foregoing remarks what has been said in regard to the careful treatment of details applies still more to the miniatures executed in *grisaille*, in which the absence of colour invited an even stronger accentuation of that treatment. This is perhaps most observable in the *grisaille* miniatures of northern Flanders, which often suggest, particularly in the strong angular lines of the draperies, a connexion with the art of the wood-engraver.

The Flemish miniature did not, however, hold the favour of western Europe without a rival. That rival had arisen in the south, and had come to perfection concurrently with the miniature of the Low Countries in the 15th century. This was the Italian miniature; and the history of its development now claims a brief notice. We return to the 13th century, where we suspended examination of the work of the school of the miniature painters of Italy; but we are not in a position, from lack of material, to follow so closely the development of the Italian miniature. Yet there is enough to show that it passed through the same stages as the miniatures of England and France and the Low Countries. Intercommunication between the countries of Europe was too well established for the case to be otherwise. In Italian MSS. of the normal type the influence of Byzantine art is very manifest during the 13th and 14th centuries. The old system of painting the flesh tints upon olive green or some similar pigment, which is left exposed on the lines of the features, thus obtaining a swarthy complexion, continued to be practised in a more or less modified form into the 15th century. As a rule, the pigments used are more opaque than those employed in the northern schools; and the artist trusted more to colour alone to obtain the desired effect than to the mixture of colour and gold which gave such brilliant results in the diapered patterns of France. The vivid scarlet of the Italian miniaturists is peculiarly their own. The figure-drawing does not bear comparison with the contemporary art of English and French MSS., the human form being often stunted and thick-set. In general, the Italian miniature, before its great expansion in the 14th century, is far behind the miniatures of the north. But with the 15th century, under the influence of the Renaissance, it advanced into the front rank and rivalled the best work of the Flemish school. The use of thicker pigments enabled the miniaturist to obtain the hard and polished surface so characteristic of his work, and to maintain sharpness of outline, without losing the depth and richness of colour which compare with the same qualities in the Flemish school.

The Italian style was followed in the MSS. of Provence in the 14th and 15th centuries. It had its effect, too, on the school of northern France, by which it was also influenced in turn. In the MSS. of southern Germany it is also in evidence. But the principles which have been reviewed as guiding the development of the miniature in the more important schools apply equally to all. Like the miniature of the Flemish school, the Italian miniature was still worked to some extent with success, under special patronage, even in the 16th century; but with the rapid displacement of the manuscript by the printed book the miniaturist's occupation was brought to a close.

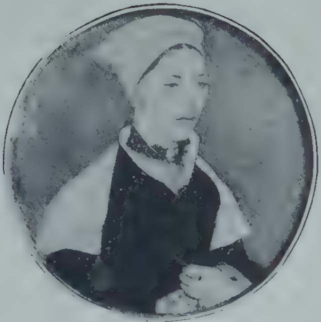
For *Authorities* see under Illuminated MSS. (E. M. T.)

2. *Miniatures as separate Small Pictures.*—In Europe the later development of the miniature, applied almost exclusively to portraits, is to a large extent English, and the greater number of the chief masters in the art have been Englishmen or have lived in England. Several great portrait painters are said to have worked occasionally in miniature, and there are paintings, small in size attributed with good reason to Holbein, Antonio Moro, John Shute, Cleef, Stretes, Teerlinck, Zucchero, John and T. Betts, and with less probability even to Van Dyck. There is a fine signed work by Shute (see Lomazzo's *Trattato dell' arte della pittura*, trans. Heydock, 1598) in the Pierpont Morgan collection; examples by Betts at Montagu House and Madresfield Court, and portraits, by Lavina Teerlinck in the collections of Mr George Salting and Mr J. Pierpont Morgan.

The first portrait miniaturist about whom anything definite is known was Nicholas Hilliard (*c.* 1547–1619), whose work partakes of the characteristics of illuminated manuscripts. The colours are opaque; gold is used to heighten the effect; while the paintings are on card. They are often signed, and have frequently also a Latin motto upon them. It has recently been proved that Hilliard worked for a while in France, and he is probably identical with the painter alluded to in 1577 as "Nicholas Belliart." Nicholas Hilliard was succeeded by his son Lawrence (d. 1640), some works by whom are in the Pierpont Morgan and Madresfield Court collections. His technique was similar to that of his father, but bolder, and his miniatures richer in colour. Isaac and Peter Oliver succeeded Hilliard. Isaac (*c.* 1567–1617) is said to have been the pupil of Hilliard and Zucchero. Peter (1594–1647) was the pupil of Isaac. The two men were the earliest to give roundness and form to the faces they painted. They signed their best works in monogram, and painted not only very small miniatures, but larger ones measuring as much as 10 in. by 9 in. They copied for Charles I. on a small scale many of his famous pictures by the old masters. Several of these copies are at Windsor and at Montagu House. At about the same date Gerbier, Poelemberg, Jamesone, Penelope Cleyn and her brothers, were workers in the art. John Hoskins (d. 1664) was the master of Samuel Cooper, the greatest English miniaturist. The work of Cooper can best be studied in the collection at Ham House. He was followed by a son of the same name, who was known to have been living in 1700, since a miniature signed by him and bearing that date is in the Pierpont

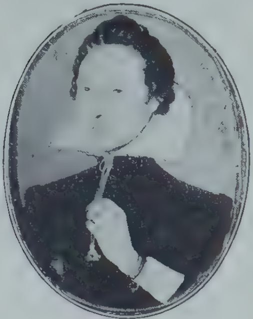
MINIATURES

PLATE I.



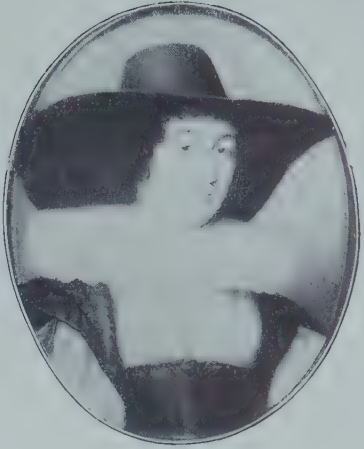
Collection of Mr J. Pierpont Morgan.

Fig. 1.—MRS PEMBERTON. By Holbein.



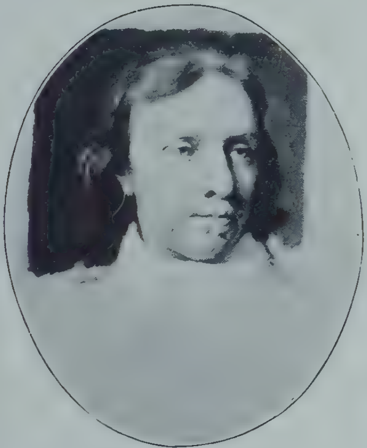
Collection of the Duke of Portland, K.G.

Fig. 2.—A YOUNG MAN IN DEEP MOURNING (1616). By Nicolas Hilliard.



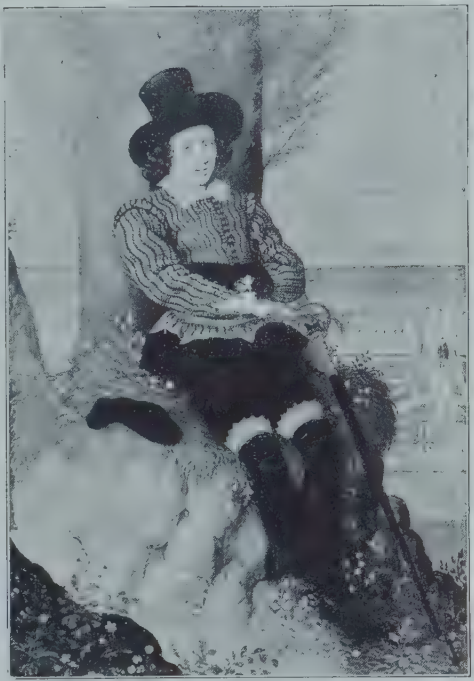
Collection of Wingfield Digby, Esq.

Fig. 3.—LADY LUCY STANLEY. By Isaac Oliver.



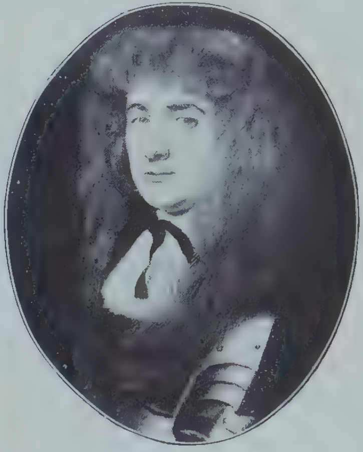
Collection of the Duke of Buccleuch and Queensberry, K.G.

Fig. 4.—OLIVER CROMWELL (unfinished). By Samuel Cooper.



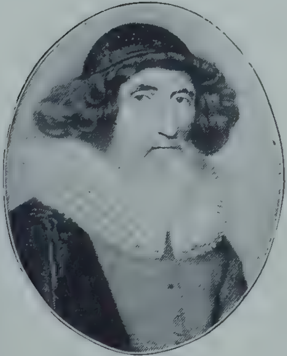
Collection of H.M. the King.

Fig. 5.—SIR PHILIP SIDNEY. By Isaac Oliver.



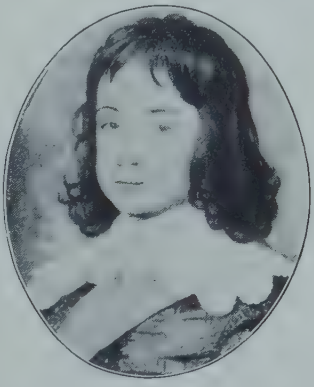
Collection of the Duke of Portland, K.G.

Fig. 6.—COL. HENRY SIDNEY (1665). By Samuel Cooper.



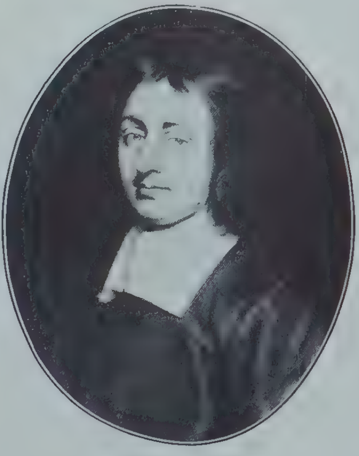
Collection of the Duke of Portland, K.G.

Fig. 7.—INIGO JONES. By David Des Granges.



Collection of the Marquis of Exeter.

Fig. 8.—CHARLES II. AS A BOY. By John Hoskins.

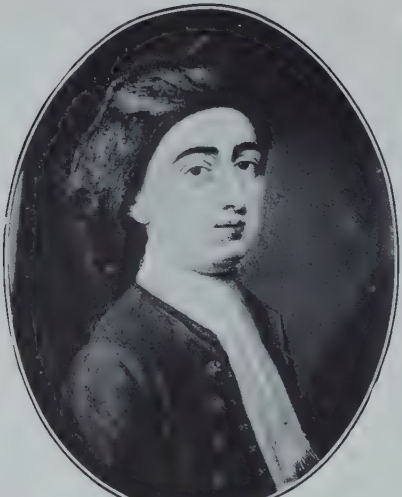


Collection of the Duke of Portland, K.G.

Fig. 9.—"MR SYMPSON, MASTER OF MUSICK." By Thomas Flatman.

PLATE II.

MINIATURES



Collection of the Duke of Portland, K.G.

FIG. 1.—BERNARD LENS. By himself, 1718.

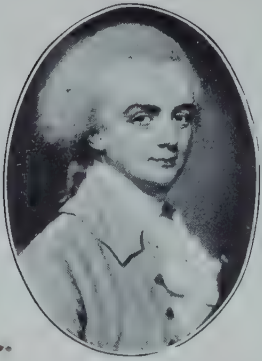


FIG. 2.—SIR CHARLES OAKELEY. By JOHN SMART.

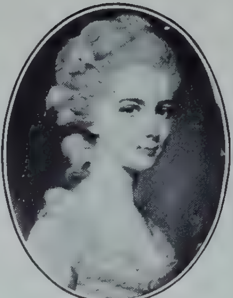


FIG. 3.—UNKNOWN LADY (1781). By JOHN SMART.

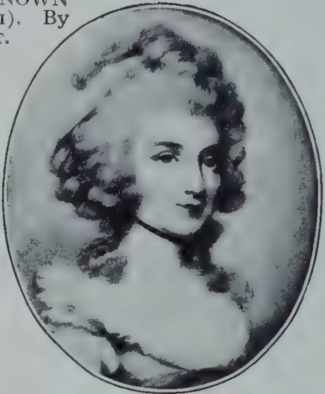


FIG. 6.—MISS MARY BERRY. By GEORGE ENGLEHEART.

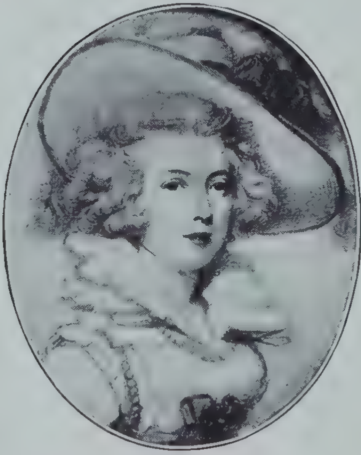


FIG. 4.—MRS PARSONS. By RICHARD COSWAY, R.A.

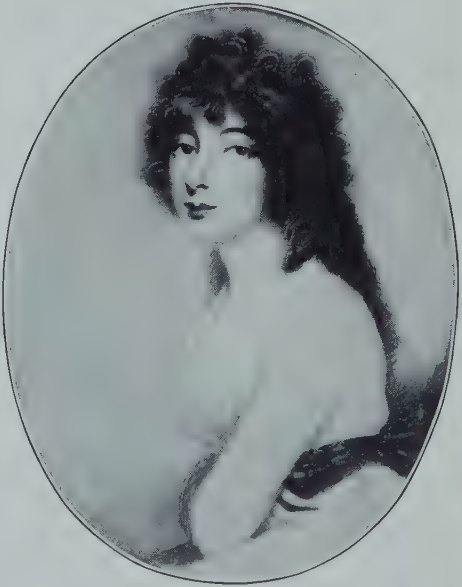
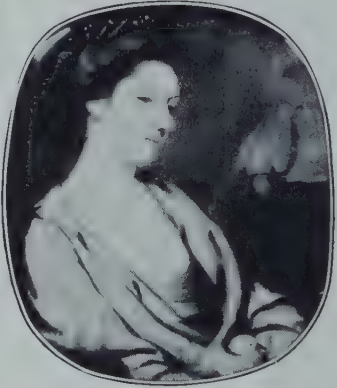


FIG. 5.—MISS FREE. By ANDREW PLIMER.



Collection of Mr E. M. Hodgkins.

FIG. 7.—KITTY FISHER. By OZIAS HUMPHRY.

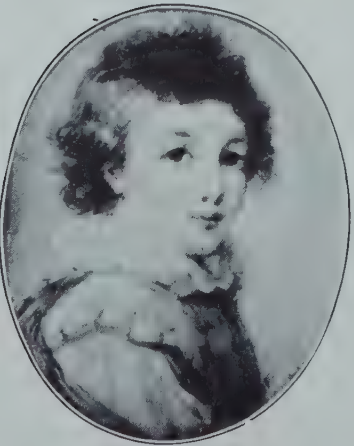
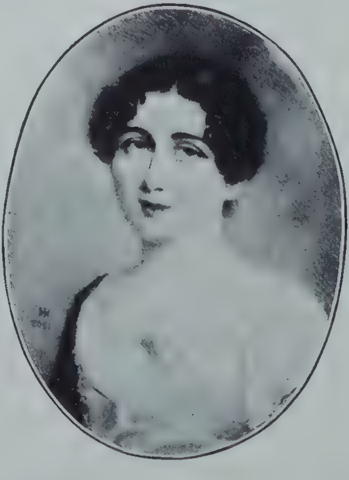
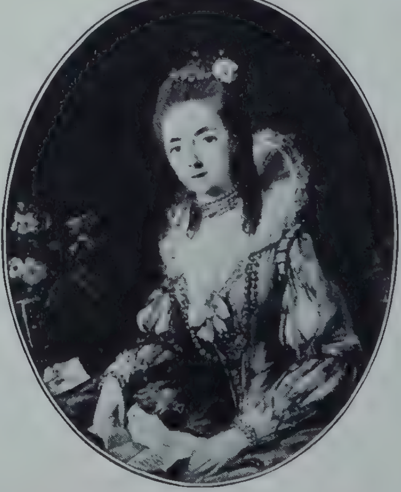


FIG. 8. —A BOY. By J. H. FEAGONARD.



Marshall Hall Collection.

FIG. 9.—LADY. By HORACE HONE.



Collection of the King of Sweden.

FIG. 10.—THE COUNTESS D'EGMONT. By P. A. HALL

Nos. 2, 3, 4, 5, 6 and 8 are all from the Collection of Mr J. Pierpont Morgan.

Morgan collection. It represents the duke of Berwick. Samuel Cooper (1609–1672) was a nephew of Hoskins. He spent much of his time in Paris and Holland, and very little is known of his career. His work has a superb breadth and dignity, and has been well called "life-size work in little." His portraits of the men of the Puritan epoch are remarkable for their truth to life and strength of handling. He painted upon card, chicken skin and vellum, and on two occasions upon thin pieces of mutton bone. The use of ivory was not introduced until long after his time. His work is frequently signed with his initials, generally in gold, and very often with the addition of the date. Flatman (d. 1688); Alexander Cooper (d. 1660), who painted a series of portraits of the children of the king and queen of Bohemia, now belonging to the German emperor, and several of whose best miniatures are in the collections of the queen of Holland and the king of Sweden; David des Granges (1611–1675) whose work can be seen at Ham House and Windsor Castle; R. Gibson (1615–1690); Mrs Rosse, his daughter, who so cleverly imitated the work of Samuel Cooper, and Charles and Mary Beale, deserve notice at this period. They are followed by such artists as Lawrence Crosse (d. 1724), Gervase Spencer (d. 1763), Lens, Nathaniel Hone and Jeremiah Meyer, the latter two notable in connexion with the foundation of the Royal Academy. The workers in black lead (plumbago, as it was called at that time) must not be overlooked, especially David Loggan, Faithorne, White, Forster and Faber. They drew with exquisite detail and great effect on paper or vellum. The 18th century produced a great number of miniature painters, of whom Richard Cosway (1742–1821) is the most famous. His works are of great beauty, and executed with a dash and brilliance which no other artist equalled. His best work was done about 1799. His portraits are generally on ivory, although occasionally he worked on paper or vellum, and he produced a great many full-length pencil drawings on paper, in which he slightly tinted the faces and hands, and these he called "stayned" drawings. Cosway's finest miniatures are signed on the back; there is but one genuine signed on the face; very few bear even his initials on the front. George Engleheart (1750–1829) painted 4900 miniatures, and his work is stronger and more impressive than that of Cosway; it is often signed "E" or "G.E." Andrew Plimer (1763–1837) was a pupil of Cosway, and both he and his brother Nathaniel produced some lovely portraits. The brightness of the eyes, wiriness of the hair, exuberance of colour, combined with forced chiaroscuro and often very inaccurate drawing, are characteristics of Andrew Plimer's work. John Smart (1741–1811) was in some respects the greatest of the 18th-century miniaturists. His work excelled in refinement, power and delicacy; its silky texture and elaborate finish, and the artist's love for a brown background, distinguish it. Other notable painters were Ozias Humphry (1742–1810), Nixon (1741–1812), Shelley (*c.* 1750–1808), whose best pictures are groups of two or more persons, William Wood, a Suffolk artist (1768–1808), Edridge (1769–1821), Sullivan, Sheriff, Crosse, Bogle, Daye. In the 19th century J. C. D. Engleheart (1784–1862), nephew of George: Andrew Robertson (1777–1845), Beaumont, Behnes, Harlow, Heaphy and Mrs Mee must be mentioned. Sir Thomas Lawrence painted a few miniatures, and Raeburn some in his early days; but the art may be said to have died out with Sir William Ross, the Chalons and Newton, although some works by Landseer in this form are in existence, some small paintings of flowers by George Lance, and one portrait by Rossetti. Towards the end of the 19th century came a revival of miniature painting, but without producing any masters of the same calibre. Alyn Williams and Lloyd amongst Englishmen, J. W. von Rehling-Quistgaard, the talented Danish miniature painter, and Bess Norris, an Australian artist, deserve mention.

From about 1650 onwards many fine miniatures were executed in enamel. Petitot (1607–1691) was the greatest worker in this material, and painted his finest portraits in Paris for Louis XIV. His son succeeded him in the same profession. Other artists in enamel were Boit (d. 1727), Zincke (d. 1767), Hurter (1734–1790), Thouron (1737–1789), Liot, Prieur, Spicer, Dinglinger, Vouquer, Bain and Thienpondt. Many of these artists were either Frenchmen or Swiss, but most of them visited England and worked there for a while. The greatest English enamel portrait painter was Henry Bone (1755–1839), the finest of whose productions are now at Kingston Lacy. A great collection of his small enamel reproductions of celebrated paintings is in Buckingham Palace.

The earliest French miniature painters were Jean Clouet (d. *c.* 1540), his son François, Jean Fouquet, Jean Perreal and others; but of their work in portraiture we have little trace at the present day, although there are many portraits and a vast number of drawings attributed to them with more or less reason. The seven portraits in the manuscript of the *Gallic War* (Bibliothèque Nationale) are assigned to the elder Clouet; and to them may be added a fine work, in the Pierpont Morgan collection, representing the Maréschal de Brissac. Following these men we find the two Strèsors, St André, Cotelle and Massé; the fine draughtsmen Picart, Vauthier and Chéron; and then, later on, we know of miniatures by Largillière, Boucher, Nattier, Montpetit, Desfosses, Drouais, Charlier, Thouron, Perrin and Dubourg; but the greatest names are those of Hall the Swede, Dumont the Frenchman, and Füger the Austrian. The tiny pictures painted by the von Blarenberghe family are by many persons grouped as miniatures, and some of the later French artists, as Prud'hon, Constance Meyer and Dubois, executed miniature portraits, while others whose names might be mentioned were Werner (1637–1710), Rosalba (1675–1757), Chatillon, Pasquier, Marsigli, Garriot, Sicardi and Festa. The most popular artists in France, however, were Augustin (d. 1832) and Isabey (d. 1855). Their portraits of Napoleon and his court are exceedingly fine, and perhaps no other Frenchman painted miniatures so well as did Augustin. The Spanish painter Goya is known to have executed a few miniatures.

Miniatures are painted in oil, water-colour and enamel, but chiefly in water-colour. Many Dutch and German miniatures were painted in oil, and as a rule these are on copper; and there are portraits in the same medium, and often on the same material, attributed to many of the great Italian artists, notably those of the Bologna school. Samuel Cooper is said to have executed a few paintings in oil on copper, but we know little about the artists who prepared the numerous oil portraits in foreign collections.

The work of the 18th century on ivory is, of course, in water-colour. The use of ivory came into general adoption in the early part of the reign of William III., miniatures previous to that time having been painted on vellum, chicken-skin or cardboard, a few on the backs of playing cards, and many more on very thin vellum closely mounted on to playing cards.

The most important collections of miniatures in England in 1907 were those in the possession of the king, the duke of Buccleuch, Mr J. Pierpont Morgan, the duke of Rutland, the earls of Exeter, Ilchester, Dysart, Dartrey (notable for enamel work, some examples of which are of the greatest rarity) and Ancaster (especially notable for works by Cosway), of Earl Beauchamp, the late Baroness Burdett-Coutts, Sir Gardner Engleheart (remarkable for containing almost exclusively works by the Engleheart family), Lord Weardale, and Messrs Drake, Digby, Williams, Whitehead, and Usher of Lincoln. There is a remarkable collection, principally of works in enamel, in the University Gallery, Oxford, a few fine miniatures at South Kensington, and in the same museum in the Jones collection some splendid works by Petitot, and there are also some famous foreign portrait and picture miniatures in the Wallace Collection, Hertford House, London. The collection at the Louvre is of importance, especially as regards the works of Petitot; that belonging to the queen of Holland of very high merit, and includes some choice works by Holbein and Alexander Cooper; and there is also a very fine collection at Amsterdam, including some of the largest works by Samuel Cooper and the largest known by Hoskins; some very fine ones belong to the Crown of Sweden, and there is a superb but very mixed collection in Peter the Great's Gallery in St Petersburg, unfortunately in great confusion and needing rearrangement. Many fine miniatures, including some very scarce enamel work by Prieur, are at the Rosenborg Palace in Copenhagen; the German emperor and the Crown of Prussia both own some remarkable examples, and there are important collections at Vienna, Florence and Stockholm, and in private hands in Berlin, Moscow and Helsingfors.

For fuller information see also J. L. Propert, *History of Miniature Art* (London, 1887); G. C. Williamson, *History of Portrait Miniatures* (2 vols., folio, 1904), *Portrait Miniatures* (London, 1897); *Richard Cosway* (London, 1897); *George Engleheart* (London, 1902); *Andrew Plimer, &c.* (London, 1902); *How to Identify Miniatures* (London, 1904); *Richard Cosway* (London, 1905), and the privately printed catalogue of the *Pierpont Morgan Collection* (1906, 1907, 1908); *Les Émaux de Petitot du Louvre* (Paris, 1862–1864); catalogues of the Buccleuch Gallery, Welbeck Gallery, Ward Usher Collection, Bemrose Collection, Woburn Abbey Collection, all privately printed, the catalogue of the collection exhibited at South Kensington, and the privately issued catalogue at the Burlington Fine Arts Club, with illustrations. (G. C. W.)

MINIM (adapted from Lat. *minimus*, the smallest; a superlative formed from the Indo-Germanic root *min-*, small), the smallest possible part of a thing, a particle. In music the name "minim" (*nota minima*) was given by medieval musicians to a note whose value was half a semibreve. It was, as its name implies, the note of the shortest duration then in use. In modern music several notes of lesser value, as the "crotchet" and "quaver," have been added, and the minim is now about halfway in the scale of "values." According to Thomas Morley (*A Plaine and Easie Introduction to Practical Music*, 1597), its introduction into manuscript music is ascribed to Phillipus de Vitriaco, a musician of the 14th century.

In medicine a minim is the smallest fluid measure, being equal to one drop. Sixty minims make a fluid drachm.

For the religious Order known as "Minims" see FRANCIS OF PAOLA, ST.

MINING, the general term for the working of deposits of valuable mineral. The term[1] is not limited to underground operations, but includes also surface excavations, as in placer mining and open-air workings of coal and ore deposits by methods similar to quarrying, and boring operations for oil, natural gas or brine. Mining may be subdivided into the operations of prospecting or search for minerals, exploration and development, work preparatory to active operations, and working. The latter includes not only the actual excavation of the mineral, but also haulage and hoisting by which it is brought to the surface, timbering and other means of supporting the excavations, and the drainage and ventilation of mines. Finally, under the heads of administration, mine valuation, mining education, accidents, hygiene and mining law, will be discussed matters having important bearing on mining operations. Special methods of mining are dealt with in the separate articles on COAL, GOLD, and other minerals and metals. QUARRYING and ORE-DRESSING, which may be considered as branches of mining, are also discussed in separate articles.

Prospecting.—In the article on MINERAL DEPOSITS (*q.v.*) the distribution and mode of occurrence of the useful minerals and ores are fully discussed. The work of prospecting is usually left to adventurous men who are willing to undergo privation and hardship in the hope of large reward though the chances of success are small. The prospector is guided in his search by a knowledge of the geological conditions under which useful minerals occur. When the rocks are concealed by detrital material he looks for outcroppings on steep hillsides, on the crests of hills or ridges, in the beds of streams, in landslides, in the roots of overturned trees, and in wells, quarries, road-cuttings and other excavations. When the solid rock is not exposed the soil sometimes furnishes an indication of the character of the underlying rock. Sometimes the vegetation, shrubs, trees, &c., as characteristic of certain soils, may furnish evidence as to rock or minerals below. Search should be made in the beds of streams and on the hillsides for "float mineral" or "shoad stones," fragments of rocks and minerals known to be associated with and characteristic of the deposits. Fragments of coal, or soil stained black with coal, will be found near the outcrop of coal beds. Grains of gold or particles of ore may be detected by washing samples of gravel in a prospector's pan. By tracing such indications up the stream or up the hillside the outcrop may sometimes be found, or at least approximately located. The outcrop of a metalliferous vein frequently manifests itself as a line of rocks stained with oxide of iron, often honeycombed and porous, the "gossan" or "eisen-hut," the iron oxide of which results from the decomposition of the pyrites, usually present as a constituent of such veins. Other metals, such as manganese, copper, nickel, may show their presence by characteristic colours. Finally, the surface topography will often throw much light on the underground structure. The shape of the hills and ridges is necessarily influenced by the inclination of the strata, by the relative hardness of different rock-beds, and by the presence of folds and fissures and other lines of weakness. A quartz vein or bed of hard rock may show itself as a sharp ridge or as a well-defined bench; a stratum of soft rock or the line of a great fissure, or the weakening of the strata by an anticlinal fold, may produce a ravine or a deep valley. The bed of fire-clay under a coal seam, being impervious to water, frequently determines the horizon of numerous springs issuing from the hillsides. As the coal and the associated rocks usually contain pyrites, these springs are often chalybeate. When the location of the deposit has been determined approximately, further search is made by trenches or pits or borings through the surface soil.

Exploratory Work.—Before opening and working a mine it is necessary to have as full and accurate information as possible as to the following:—

1. The probable extent and area of the deposit, its average thickness, and the probable amount and value of the mineral;
2. The distribution of the workable areas of mineral in the deposit;
3. Conditions affecting the cost of opening, developing and working the mine or determining the methods to be adopted.

Work undertaken to secure this information must be distinguished from prospecting, which is the search for mineral deposits and from development, work undertaken to prepare for actual mining operations. Exploratory work is associated intimately both with prospecting and with development, but the purpose is quite distinct from either prospecting, development or working, and it is of importance that this should be clearly recognized. It must be remembered that the line between a workable deposit and one that cannot be profitably worked is often very narrow and that the majority of mineral deposits are not workable. The money that is spent in prospecting and in development is therefore liable to prove a loss. This is a recognized and legitimate business risk, differing only in degree from the risks attending all business operations. The risk of failure in mining enterprises is offset by the chances of more than ordinary profits. If the property proves valuable the returns may be very great. While the risk of loss of capital is not to be avoided, it is of the utmost importance to limit the amount of money expended while the extent and value of the deposit are still uncertain and to do the necessary work by the cheapest methods consistent with thoroughness. As the information as to the character and extent of the deposit becomes more definite, and as the prospects of success become more favourable, money may be spent more freely. The risk will vary with the character of the deposit. In the case of the cheaper and more abundant minerals, such as coal and iron ore, and of large deposits of low-grade ores, the extent and character of the deposit can generally be determined by surface examinations at comparatively small expense. On the other hand, in the case of less regular deposits, including most metalliferous veins, and especially those of the precious metals, the uncertainty is often very great, and it is sometimes necessary to work on a small scale for months before any considerable expenditure of money is justified.

The quickest and cheapest method is by surface explorations. The work of the prospector frequently furnishes much of the information required. By sinking additional pits or by extending the costeaning trenches and uncovering the outcrop of the deposit more fully it is sometimes possible to obtain all the

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[1] Of doubtful origin. "Mine," both verb and substantive, come from the Fr., and is usually connected with Lat. *minare*, to drive or lead; but this would normally result in Fr. *mener*, not *miner*. Skeat, following Thurneysen, accepts a Celtic origin (cf. Irish *mein*, ore), but the *New Eng. Dict.* doubts this.

Surface Exploration.

information required for the most extensive and important mining operations. Even when the outcrop is oxidized, and the mineral character and richness of the deposit is altered thereby, it is possible to determine variations in thickness and the extent and distribution of the rich and barren areas by outcrop measurements. Information of this sort obtained by surface exploration is often as conclusive as similar information obtained from underground workings. If the deposit shows great variations in thickness in its outcrop along the surface it is probable that a drift or a slope would show the same thing in depth. If the workable areas are poor, and appear only at long intervals along the outcrop, the chances of discovering richer areas by a shaft are very small.

Boring.

In many cases underground exploration is necessary. For example, the deposit does not outcrop as in the case of blind veins and flat deposits below the general level of the country; or the outcrop lies beyond the limits of the property or under water or water-bearing formations, or is covered by quicksand, or is deeply buried. For such buried deposits boring is cheaper than sinking. In the case of coal, salt, iron ore, pyrite and other homogeneous minerals, boring may give all the information required. With a number of holes the average thickness and probable extent of the deposit may be determined, at least approximately. When the deposit is vertical or steeply inclined, horizontal or inclined bore-holes will be necessary. This will increase the cost of boring and will render the holes more likely to swerve from the true direction. In the case of metalliferous deposits of varying thickness or irregular distribution the information from bore-holes is less satisfactory. A large number of holes must be bored to obtain, even approximately, the average thickness and value of the ore and the shape and size of the ore bodies. In extreme cases the results from boring are likely to be untrustworthy and misleading unless the work is done on such a scale that the cost becomes prohibitory.

Underground Exploration.

While the information obtained by surface explorations is always valuable, and sometimes conclusive, as to the value of the deposit, it is usually necessary to supplement and confirm it by underground work. The outcrop of a metalliferous vein is generally more or less altered by oxidation, and often a part of the valuable mineral has been converted into a soluble form and leached out. These conditions sometimes extend to a considerable depth. Below the oxidized outcrop the vein is often increased in value by secondary enrichment, sometimes to a depth of several hundred feet. In the case of such altered deposits surface exploration alone is likely to be misleading, and it is important to push the underground exploration far enough to reach the unaltered part of the deposit, or at least deep enough to make it certain that there is a sufficient quantity of altered or enriched ore to form the basis of profitable mining operations. As the sinking of shafts or the driving of narrow entries or drifts is expensive, and as the mineral extracted rarely pays more than a small fraction of the cost, it is usual to plan this exploratory work so that the openings made shall serve some useful purpose later. The mistake is often made of sinking large and expensive shafts, or driving costly tunnels, before it is fully proved that the deposit can be worked on a scale to warrant such developments, and, indeed, too often before it is known that the deposit can be worked at all; and in too many cases large amounts of money are thus unnecessarily lost by over-sanguine mine managers. It is, however, often advisable that the money spent in surface or underground exploration should at the beginning be spent for information alone. The information so gained not only determines the value of the deposit, but also serves to indicate the best methods of development and of working. The money so spent, if judiciously used, insures the undertaking against loss by diminishing the mining risk, and is thus analogous to premiums paid to insure against fire or other sources of loss.

Development.—As soon as it appears reasonably certain that the property is workable the mine will be opened by one or more shafts, drifts or tunnels, and the underground passages for active mining operations will be started. A drift or entry is a horizontal passageway starting from the outcrop and following the deposit. The former term is used in metal-mines and the latter in coal-mining. A tunnel differs from a drift in that it is driven across the strata to intersect the deposit. Either may be used for drainage of the mine workings, in which case it becomes an adit. A mine should always be opened by drift or entry if practicable, as thereby the expense of hoisting and pumping is avoided. Drifts, entries and tunnels find their chief application in mining regions cut by deep valleys. When, however, the deposit lies below the surface the mine must be opened by a shaft. If the outcrop of the vein or bed is accessible the shaft may be inclined and sunk to follow the deposit. This is in general a cheaper and quicker method of development for inclined deposits than by a vertical shaft, and it has the added advantage that much information as to the character of the deposit is obtained as the shaft is sunk. When the deposit lying below the surface is horizontal, or nearly so, or when the outcrop of an inclined deposit is not accessible, a vertical shaft will be necessary. Vertical shafts are better adapted to rapid hoisting, and have therefore somewhat greater capacity, than inclined shafts. They are to be preferred also for very deep shafts, or for sinking in difficult ground. Drifts and inclined shafts following the deposit may prove difficult of maintenance when the workings become large and settlement of the overlying strata begins. Large pillars of mineral should be left for the protection of the main openings, whether these be shafts or adits. In the case of very thick beds and mass deposits the main shaft or tunnel will preferably be located in the foot-wall.

Figs. 1 and 2 illustrate the development of a metal-vein by two adits, two inclined shafts in the lode, and by a deep vertical shaft connected with the lode by horizontal cross cuts. The stippled areas represent the ore shoots and the white areas the barren portions of the lode. The levels are supposed to be 10 fathoms (60 ft.) apart. As the mine is opened the deposit is subdivided into blocks of convenient size by parallel passages, which form later the main haulage roads, and by transverse openings for ventilation. In metal-mines the main passages are known as levels, and these are connected at intervals by winzes or small shafts. In coal mines, entries and headings, bords and walls serve similar purposes. The size of the blocks or the distance between the main passages is determined mainly by considerations of convenience and economy in excavating and handling the

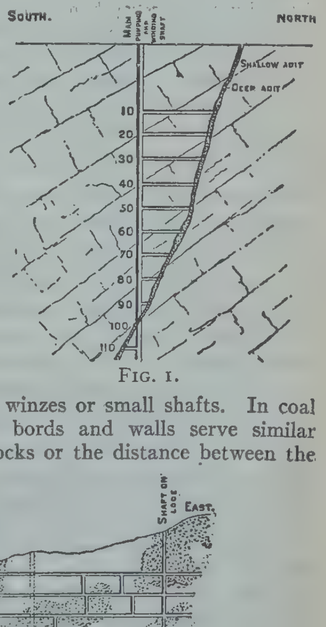


Fig. 1.

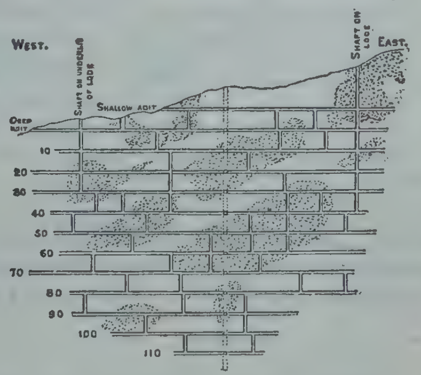


Fig. 2.

mineral, and by the possibility of supporting the roof long enough to permit the excavation of the mineral without unnecessary risk or expense. In metal mining, when the workable portions of the deposit are small and separated by unworkable areas, the levels serve also the purpose of exploration, and in such cases must not be so far apart as to risk missing valuable mineral. In coal-mines main entries are often 100 yds. apart, while in metal-mines the distance between levels rarely exceeds 50 yds. and sometimes is but 50 or 60 ft. In irregular and uncertain deposits this work of development should be kept at all times so far in advance of mining operations as to ensure a regular and uniform output. In some cases, where the barren areas are large, it may be necessary to have two or three years' supply of ore thus blocked out in advance. A mine, however, may be over-developed, which results in loss of interest on the capital unnecessarily locked up for years by excessive development, and involves additional cost for the maintenance of such openings until they are needed for active mining operations.

Working.—When the development of a mine has advanced sufficiently the operation of working or extracting the mineral begins. The method to be adopted will vary with the thickness and character of the deposit, with its inclination, and to some extent with the character of the enclosing rocks, the depth below the surface, and other conditions. The safety of the men must be one of the first considerations of the mine operator. In most civilized countries the safety of mine workers is guarded by stringent laws and enforced by the careful supervision of mine inspectors on behalf of the government. The method of mining adopted must secure the extraction of the mineral at a minimum cost. The principal item in mining cost is that of labour, which is expended chiefly in breaking down the mineral, either by the use of hand tools or with the aid of powder. Labour is also expended in handling the mineral in the working-places and in bringing it to the mine-cars in which it is brought to the surface. Narrow and contracted working-places are to be avoided, as in such places the cost of breaking ground is always large. Economy in handling makes it desirable to bring the mine-cars as near as may be to the point where the mineral is broken. This can be done in inclined deposits, it can often be done by the aid of mechanical appliances, though sometimes at an expense not warranted in the saving in the labour of loading. In steeply inclined beds the working-place can be so arranged that the mineral will fall or slide from the place where it is broken down to the main haulage road. The greatest difficulty is found where the inclination of the deposit is too great to permit the mine-cars to be brought into the working-place and yet not great enough to allow the mineral to fall or slide to a point where it can be loaded.

Size of Working-Places.

While it is always desirable to provide large working-places, the size of the working-place is limited by the thickness and strength of the overlying beds forming the roof or hanging wall of the mine. With thick and strong rocks the working-places may sometimes exceed 100 or even 200 ft. in width. Indeed in metal-mines 100 ft. is the usual distance from one level to the next. With weak and thin beds forming the roof the working-places are often not wider than 20 or 30 ft. as in most coal-mines. While the width of the working-place is thus limited by the strength of the roof, its length is determined by other considerations—namely, the rapidity with which the mining work can be conducted and the length of time it is practicable to keep the working-place open, and also by the increased difficulty of handling the minerals sometimes experienced when the workings reach undue length. In long-wall and in the work of mining pillars the roof will be supported on one side only, the overhanging beds acting as cantilevers. The working-place in such case is considerably narrower than in rooms or stopes, and there is also greater difficulty in supporting the roof because the projecting beds tend to break close to the point of support where the strain is greatest. This tendency is overcome by the use of timber supports so disposed as to ensure the breaking of the overhanging roof at a safe distance from the working-face and prevent the interruption of the work that might otherwise result.

Complete Extraction of Mineral.

While it is always desirable to work the deposit so as to extract the mineral completely, it frequently happens that this can only be done at greatly increased cost. In the case of cheap and abundant minerals and low-grade ore deposits it is sometimes necessary to sacrifice a considerable proportion of the mineral, which is left for the support of the overlying strata. A similar sacrifice in the shape of pillars is often necessary to support the surface, either to avoid injury to valuable structures or to prevent a flooding of the mine. As already noted large pillars must always be left to protect shafts, adits and the more important mine-passages necessary for drainage, ventilation and the haulage of mineral. In the early history of mining there was but little attempt at systematic development and working, and the mines were often irregular and tortuous. Fig. 3 is an old Mexican silver-mine of this type. In such mines the mineral was carried out on the backs of men, and the water was laboriously raised by a long line of suction-pumps, operated by hand, each lifting the water a few feet only. With but slight modifications permitting the use of pumps and hoisting-machinery equally simple methods of mining may be seen to-day when the deposit is of small extent.

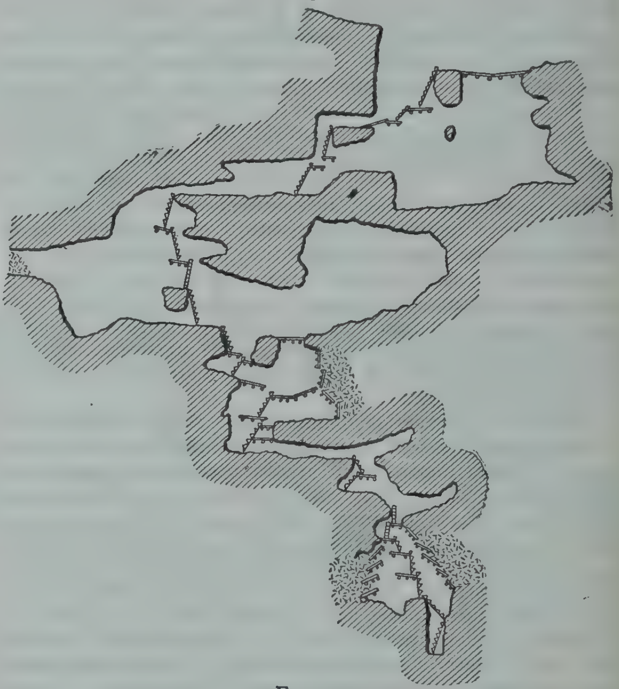


FIG. 3.

Fig. 4 is a portion of a mine which consists of a series of irregular chambers with the roof supported on small pillars left at intervals for the purpose. In the systematic mining of larger deposits, the simplest plan consists in mining large areas by means of numerous working-places under the protection of pillars of mineral left for the purpose, and later mining these pillars systematically, allowing the overlying rock beds to fall and fill the abandoned workings. In shallow mines the pillars are small and the saving of the mineral of minor importance. In deep mines the pillars may furnish the bulk of the product, and the control of the fall of the roof, so as to permit the successful extraction of the mineral, demands a well-schemed plan of operation. In the robbing of pillars, timber is necessary for the support of

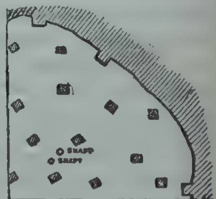


FIG. 4.

the roof in the working-places, and later to control the fall of the roof while the pillars are mined. More effective support and control of the roof may be secured by the use of rock-filling alone or with timber. By the use of rock-filling it is even possible to dispense with pillars of mineral; or, if pillars are left, the use of rock-filling greatly facilitates subsequent robbing operations. Rock-filling will be used whenever a large proportion of barren material must be mined with the ore. If rock-filling must be brought from the surface its use will generally be confined to mines in which it is difficult to support the roof in any other way. Rock-filling yields and becomes consolidated under heavy pressure, and therefore does not furnish a rigid support of the overlying strata, but rather a cushion to control and equalize the subsidence.

Room- and Pillar-Mining.

With soft material, pillars must be large, even at moderate depths below the surface, and it involves less labour to leave long rectangular pillars than to form numerous square ones. This leads to the adoption of the room and pillar system so common in coal-mining. Fig. 5 is a mine in a bed of soft iron ore worked by a series of inclined shafts, from which long horizontal rooms branch off right and left.

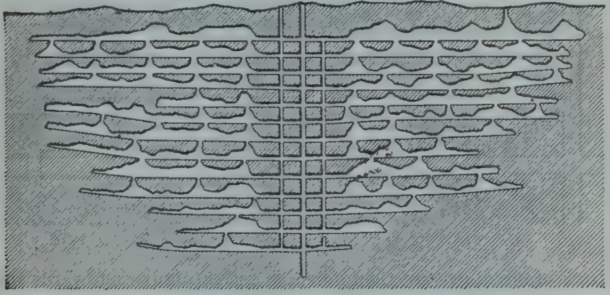


FIG. 5.

Stoping.

The usual method of working metal-mines is by overhand and underhand stoping, using rock-filling or pillars of mineral to support the roof. Fig. 6 represents a portion of one of the Lake Superior copper-mines worked by overhand stoping. A stope is that portion of the working assigned to a party of miners, and the block of ground is usually divided into three or four stopes at varying heights above the main level, the lowest being known as the cutting-out stope, the others as the first and second back stopes in ascending order. In steep pitching beds sufficient excavated material is allowed to remain in the stope for the support of the machines and men, the excess being drawn out from time to time and loaded into cars. The rest of the mineral is allowed to remain until the stope has so far advanced that its support is no longer needed. This method of mining requires but little timbering, only a single line of timber and lagging over the level, called the stull. When the roof is weak, or when it is undesirable to leave so much ore in the stopes, false stulls are sometimes erected in the upper part of the stope. The ore below the false stulls can then be drawn out without waiting for the completion of the top stope. When the mineral does not stand well in the pillar it will be necessary to erect a line of timbers with lagging so as to sheathe the under-side of the pillar and prevent its falling. It is not desirable to leave large areas standing upon pillars in the mine, and as soon as the work on any level is completed the pillar below should be mined out as far as is safe, and the abandoned portion of the mine allowed to cave in and lessen the weight on the pillars elsewhere. The block or ground between levels is sometimes mined by underhand stoping (fig. 7.). In this case the advanced drift is run underneath the pillar, and the ground below is mined in descending steps. This plan has the advantage of requiring little or no timbering when the mineral is strong enough to stand well in the pillars and when the hanging wall is good. The main haulage tracks are laid at the bottom of the stope, which thus forms the level. In this method of mining the different stopes must be kept close together; otherwise there is much added labour in shovelling the broken ore down to the main level. This method has the advantage of permitting the ore to be sent to the surface as fast as it is mined instead of being left for some months in the stopes for the men to stand upon. It has the disadvantage that the distance from one level to the next cannot usually be more than fifty feet without increasing greatly the chances of injury to the men from falling rock. The method is then practicable and safe only with exceptionally strong mineral and roof. In metal-mines producing abundant rock-filling the overhand method of stoping, illustrated in fig. 8, is used. In this the stoping contracts run vertically, and each party of contractors has one or more mills or timbered chutes through which the rich ore is conveyed to the level below and loaded in cars. The ore as mined is hand-picked and the barren material allowed to remain in the stope where it

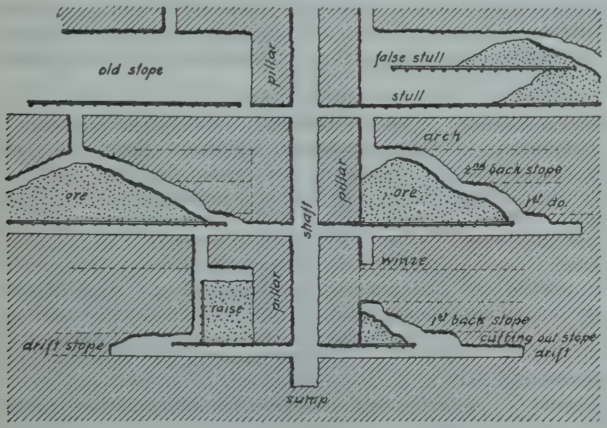


FIG. 6.

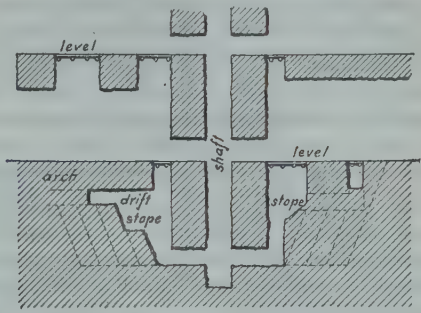


FIG. 7

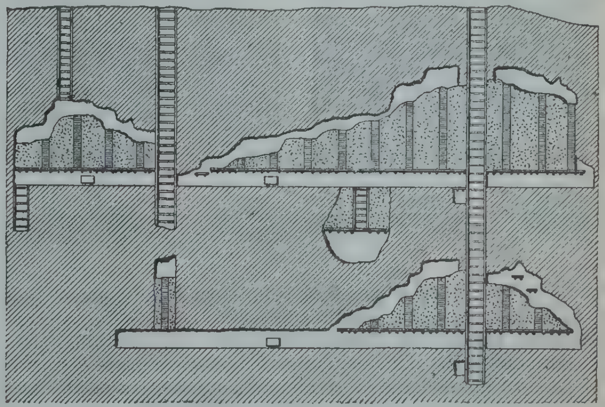


FIG. 8.

falls. In this method of mining no pillars need be left under the levels, as the rock-filling gives sufficient support to the roof. This method of mining affords the maximum of safety to the miners.

Working of Thick Deposits.

In the working of thick deposits the block of ground between two levels is divided into horizontal sections or floors which are worked either from above downward or from the bottom upward; in the first case the separate floors are worked by one of the caving systems; in the second, generally with the aid of filling. Fig. 9 illustrates the working of a block of ground by the top-slice caving system. Above, the ground has been completely worked out from the surface, and the space formerly occupied by ore is now filled with the débris of the overlying strata which has caved in above the block of ore now being worked. There is considerable thickness of old timber left from the working of the upper levels. This mat of timber forms a roof under the protection of which the mining of the ore proceeds downward floor by floor. The working-floors are connected by winzes with the main haulage roads below. These winzes serve for ventilation, for the passage of the workmen, and for chutes through which the ore is dumped to the level below. The working out of each floor is conducted much as if it were a bed of corresponding thickness. Haulage roads are driven in the ore so as to divide the floor into areas of convenient size. These separate areas are then mined in small rooms, each room being timbered as in mining under a weak roof rock. The room is driven in this way from one haulage road to another or to the boundary of the ore body. On completion of any room the timbers are withdrawn and the overlying mass of timber and rock is allowed to fall and a new room is started immediately alongside of the one just completed. In this way the whole floor is worked out and the mat of timber and overlying rock is gradually lowered and rests upon the top of the ore forming the floor below. Before abandoning a room it is usual to cover the bottom of the working-place with lagging-poles, which facilitate the mining of the floor below. In this manner one floor after another is worked until the floor containing the main haulage roads of the level below is reached. In the meantime a new level and a system of haulage roads have been driven a hundred feet below, and winzes have been driven upward to connect with the old level which is to be abandoned. The floor containing these old haulage roads now becomes the top slice of the one hundred-foot block of ground below and is mined out as described. Several floors may be mined simultaneously, the workings in the upper floor being kept in advance of those below, so as to allow the broken mass above to become consolidated before it is again disturbed by the working places of the next floor. This system permits the complete extraction of the ore at moderate cost and without danger to the men.

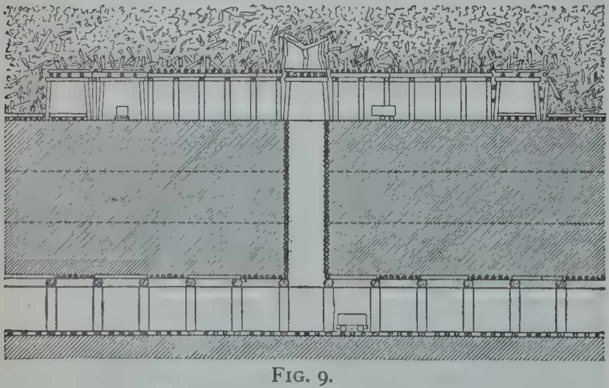


Fig. 9.

The subdrift caving system, fig. 10, differs from the top-slice system mainly in the greater thickness given to the working floors, which may be from 12 to 40 ft. in thickness, whereas in the top-slice system the height of the floor is limited by the length of the timbers used in the working-rooms, rarely over 8 or 10 ft. The subdrift system requires a smaller amount of narrow work in excavating the necessary haulage roads, and is therefore better adapted to hard ores in which such narrow work is expensive. The mining of each floor is carried on in sections with small working-places which are first driven of moderate height to their full length and width, leaving a back of ore above and pillars of ore between to support the upper portion of the upper layer or floor. These pillars and the back of ore above are then mined in retreating back towards the haulage road. The subdrift system is somewhat cheaper than the top-slice system, the output per man being greater.

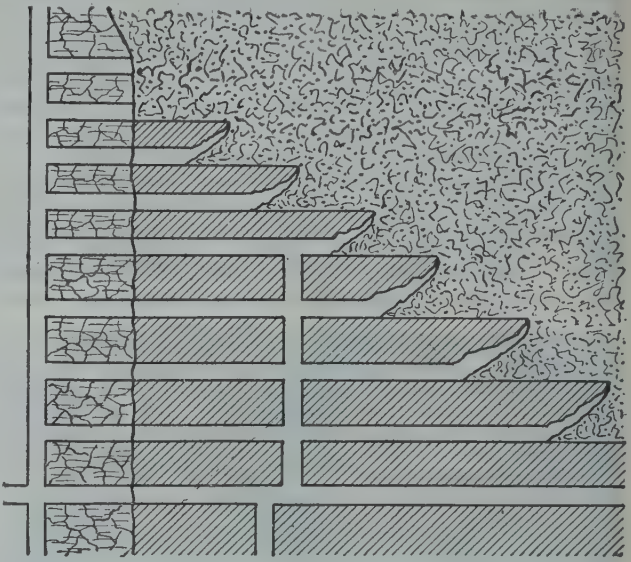


Fig. 10.

The bottom-slice caving system of mining begins at the bottom of a hundred-foot block of ground, a floor being excavated under the whole area, leaving pillars of sufficient size to support the ground above. These pillars are then filled with blast holes which are fired simultaneously, permitting the whole block of ground to the level above to drop. A floor is then reopened in this fallen ore, leaving pillars for temporary support which are blasted out as before. This is the cheapest of the three caving systems, but is applicable only when the deposit lies between walls of very solid rock, as otherwise wall rock is liable to cave with and become mixed with ore, which adds greatly to the expense of handling.

When rock filling is available, as when the ore contains much barren material to be left behind in mining, the ore body is divided into blocks of convenient height as above, and these blocks are divided into floors, the bottom floor of each block however being attacked. Each floor is opened up by subsidiary haulage roads and worked out in small rooms which are timbered and filled with broken rock when completed. An adjoining room is next excavated and filled, and thus the whole floor is worked out and replaced with rock-filling. Work is then started on the floor above, the upper floors being connected with the main haulage roads by winzes which are maintained through the filled ground. Several floors can be mined simultaneously, the work in the lower floors being kept well in advance. Instead of mining in horizontal floors the filling method permits the ore to be mined in vertical chambers or slices which extend from one level to the next above and from one wall of the deposit to the other. When a chamber has been excavated and completely filled the slice adjoining is mined out, or at times a block of ground may be left untouched between two filled chambers and then mined out. In the latter case the top-slice caving method will usually be employed for the working of such intervening pillars. In order to lessen the cost of handling the rock-filling, the excavation sometimes takes the form of inclined working-places, parallel to the slope naturally taken by the rock when dumped from above into the working place. This method of mining and filling can be used when the work is done in horizontal floors or in transverse chambers. In the United States the Nevada square set system of timbering is used in connexion with rock filling (fig. 11). The use of the heavy timbers and continuous framing which characterize this system facilitates greatly the work of mining and maintaining the haulage roads on the different floors, and gives more rigid support to the unmined portions of the block of ground above. These advantages compensate for the greater first cost. Where each floor is timbered by itself with light timbers, as is the practice on the continent of Europe, the consolidation of the rock-filling under pressure gives rise to considerable subsidence of the unmined ore, which has frequently settled 20 ft. or more before the upper part of the block is reached. This occasions much added expense in the maintenance and retimbering of the haulage roads on the upper floors. The shrinkage of the rock-filling and the settlement of the workings can be greatly lessened by the use of hard rock with a minimum of fine stuff; but even so the advantage lies with the American system of timbering.

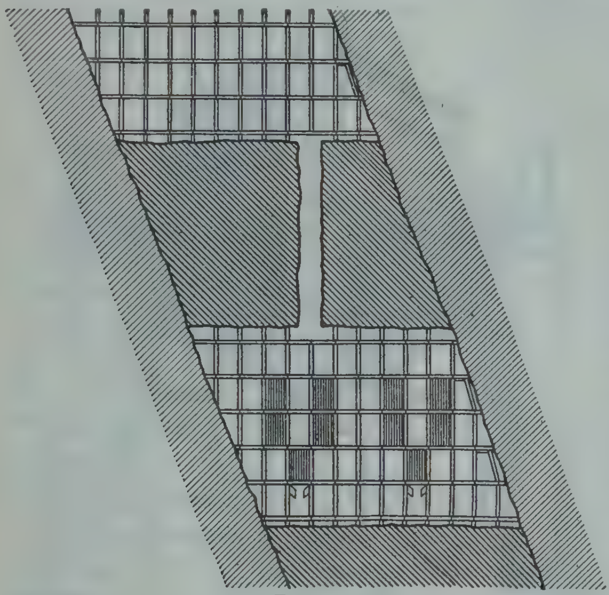


Fig. 11.

Sand Flushing.

The cost of filling has been greatly reduced by the system of flushing culm, sand, gravel and similar material, through pipes leading from the surface into mine workings. Material as coarse as 1 in. in diameter may be carried long distances underground with the use of little more than an equal volume of water. This method originated in the Pennsylvania anthracite mines in 1887, but has been employed in recent years on a large scale in Silesia, Westphalia and other European coalfields. In some cases it has been found advantageous to quarry and crush rock for the purpose of using it in this way. Examples of other mining methods will be found under Coal.

Open Workings.

Where mineral deposits lie near the surface underground mining may be replaced by open excavations, and the reduced cost of mining makes it possible to remove the overlying soil and rock to considerable depths. The depth to which open working can be pushed depends upon the size and value of the mineral deposit and upon the expense of removing the over-burden. Open excavations several hundred feet in depth are not uncommon. Where practicable steam shovels are employed, even when it is necessary to break up the material beforehand by blasting. Steam shovels are not well adapted to deep excavation unless provision is made for the rapid handling of the cars when filled. For deep workings the milling method is usually employed, in which the ore is excavated in funnel-shaped pits, each of which connects with underground haulage roads by a shaft. The ore is mined in the ordinary way, by pick and shovel if soft, or by the aid of powder if necessary, and the funnel-shaped bottom of the pit is maintained at such an angle that little or no shovelling is required to bring the excavated material to the shaft. Before the bottom of these pits reaches the level of the haulage roads below, a new set of roads will have been driven at a lower level and connected with the excavations above by the shafts. The cost of mining by the milling method does not greatly exceed the cost of steam-shovel work. For the special methods by which placer deposits are mined see Gold.

Underground Haulage.—The excavated material is brought to the hoisting shaft, or sometimes directly to the surface, in small mine cars, moved by men or by animals, or by locomotives or wire-rope haulage. The size, shape and design of the cars depend on the size of the mine passage and of the hoisting compartments of the shafts; on whether the cars are to be trammed by hand or hauled in trains; whether they are loaded by shovel or by gravity from a chute; and whether they are to be hoisted to the surface or used only for underground transport. The cost of underground haulage is lessened by the use of cars of large capacity. In the United States cars in the coal and iron mines hold from 2 to 4 tons. In Europe the capacity ranges from 1000 to 1500 ℔, though the tendency is to increase the size of the cars used. In mines of copper, lead and the precious metals, in which the cars are moved by hand, the usual load is from 1200 to 3000 ℔. These small cars are constructed so that the load may be dumped by pivoting the car bodies on the trucks. Larger cars are usually dumped by means of rotating or swinging cradles, the car bodies being rigidly attached to the axles or trucks. When loaded by shovel the car is made low to economize labour. Wooden rails, protected by iron straps, are sometimes used on underground roads for temporary traffic; but steel rails, similar to, though lighter than, those employed for railways are the rule. For hand tramming, animal and rope haulage, the rails weigh from 8 to 24 ℔ per yard, for locomotive haulage 30 to 40 ℔. Grades are made, whenever possible, in favour of the load, and of such degree that the power required to haul out the loaded cars shall be approximately equal to that for hauling back the empties, viz. about ½ of 1%. Sharp curves should be avoided, especially for mechanical haulage. Switches for turnouts and branches, &c., are similar to but simpler than those for railways.

Man and Animal Haulage.

In metal mines, where, as a rule, mechanical haulage is inapplicable, the cars are moved by men (trammers). This is expensive, but is made necessary by the small amount of material to be handled at any given point. The average speed is about 200 ft. per minute, and the distances preferably but a few hundred feet. Animal haulage is employed chiefly in collieries and large metal mines; sometimes for main haulage lines, but oftener for distributing empty cars and making up trains for mechanical haulage. In mines operated through shafts the animals are stabled underground, and when well fed and cared for, thrive notwithstanding their rather abnormal conditions of life. Mine cars are sometimes run long distances, singly or in trains, over roads which are given sufficient grade to impart considerable speed by gravity, say from 1 to 2½%. The grades must not be too great for brake control nor for the hauling back of the empty cars. Cars may thus be run through long adits or through branch gangways to some central point for making up into trains. Near the top and bottom of hoisting shafts the tracks are usually graded to permit the cars to be run to and from the shaft by gravity.

Locomotive haulage is applicable to large mines, where trains of cars are hauled long distances on flat or undulating roads of moderate gradients. Steam locomotives have been largely superseded by compressed air or electric locomotives. Compressed air locomotives are provided with cylindrical

Locomotive Haulage.

steel tanks charged from a special compressor with air at a pressure of 500 to 700 ℔ per sq. in. The capacity of the tank depends on the power required and the distance to be traversed by a single charge of air. The air passes through a reducing valve from the main to an auxiliary tank, in which the pressure is, say, 125 ℔, and thence to the driving cylinders. By using compressed air vitiation of the mine air is avoided, as well as all danger of fire or explosion of gas. Electric locomotives usually work on the trolley system, though a few storage battery locomotives have been successfully employed. Trolley haulage lacks the flexibility of steam or compressed air haulage, and is limited to main lines because the wires must be strung throughout the length of the line. By adopting modern non-sparking motors there is but little danger of igniting explosive gas. Electric and compressed air locomotives are durable, easily operated, and can be built to run under the low roofs of thin veins. Their power is proportioned to requirements of load and maximum gradient; the speed is rarely more than 6 or 8 m. per hour. Electric locomotives are in general more economical then either steam or compressed air.

Rope Haulage.

For heavy gradients rope haulage has no rival, though for moderate grades it is often advantageously replaced by electric and compressed air haulage. Gravity or self-acting planes are for lowering loaded cars, one or more at a time, from a higher to a lower level. The minimum grade is that which will enable the loaded cars in travelling down the plane to pull up the empty cars. At the head of the plane is mounted a drum or sheave, and around it passes a rope, one end of which is attached to the loaded cars at the top, the other to the empty cars at the foot. The speed due to the excess of weight on the loaded side is controlled by a brake on the drum. The rope is carried on rollers between the rails. There may be two complete lines of track or three lines of rails, one being common to both tracks, and the cars passing on a middle turnout or "parting"; or a single track with a parting. An engine plane is an inclined road, up which loaded cars are hauled by a stationary engine and rope, the empty cars running down by gravity, dragging the rope after them. This is similar to shaft hoisting, except that the grades are often quite flat. In the tail-rope system of haulage, best adapted for single track roads, there are two ropes—a main and a "tail" rope—winding on a pair of drums operated by an engine. The loaded train is coupled to the main rope, and to the rear end is attached the tail-rope, which reaches to the end of the line, passing there around a large grooved sheave and thence back to the engine. By winding in the main rope the loaded cars are hauled towards the engine, dragging behind them the tail-rope, which unwinds from its drum. The trip being completed, the empty train is hauled back by reversing the engine. The ropes are supported between the rails and guided on curves by rollers and sheaves. High speeds are often attained. Branches, operated from the main line, are readily installed. In the endless rope system the rope runs from a grip wheel on the driving engine to the end of the line, round a return sheave, and thence back to the engine. Chains are occasionally used. The line is double track and the rope constantly in motion, the cars being attached at intervals through its length by clips or clutches; the loaded cars move in one direction, the empties in the other. There are two modes of installing the system: either the rope passes above the cars and is carried by them, resting in the clips, or it is carried under the cars on rollers, the cars being attached by clips or a grip-carriage. (For details see Hughes, *Text-book of Coal Mining*, pp. 236–272; Hildenbrand, *Underground Haulage by Wire Rope*.) Rope haulage is widely used in collieries, and sometimes in other mines having large lateral extent and heavy traffic. With the tail-rope system, cars are run in long trains at high speed, curves and branches are easily worked, and gradients may be steep, though undulating gradients are somewhat disadvantageous. In the endless-rope systems cars run singly or in short trains, curves are disadvantageous, unless of long radius, speed is relatively slow, and branch roads not so easily operated as with tail-rope. The tail-rope plant is the more expensive, but for similar conditions the cost of working the two systems is nearly the same. An advantage of the endless system is that the cars may be delivered at regular intervals.

Winding Engine.

Hoisting.—When the mine is worked through shafts, hoisting plant must be installed for raising the ore and handling men and supplies. On a smaller scale hoisting is also necessary for sinking shafts and winzes and for various underground services. As ordinarily constructed, a pair of horizontal cylinders is coupled to a shaft on which are mounted either one or two drums (fig. 12). The diameter of the cylinders is such that each alone is capable of starting the load. As the cranks are set 90° apart, there is no dead centre, and the engine is able to start under full load from any point of the stroke. This is important in mine hoisting, which is intermittent in character and variable as to power and speed required. The cylinders are generally single-expansion, though compound engines are occasionally used for heavy work. The engine is direct-acting, the drums making one revolution for each double stroke. In geared hoists the drums are on a separate shaft, driven from the crank-shaft by tooth or friction gearing, and make one revolution for, say, 4 or 5 double strokes. The hoisting speed is therefore slower, and as less engine power is required for a given load the cylinders are smaller, though making more strokes per minute. Large and powerful geared hoists are not uncommon. The dimensions of the drum depend on the hoisting speed desired and the depth of shaft or length of rope to be wound. Drums are either cylindrical or conical. Conical drums (fig. 12) tend to equalize the varying load on the engine due to the winding and unwinding of the rope. On starting to hoist, the rope winds from the small towards the large end of the drum, the lever arm, or radius of the coils, increasing as the weight of

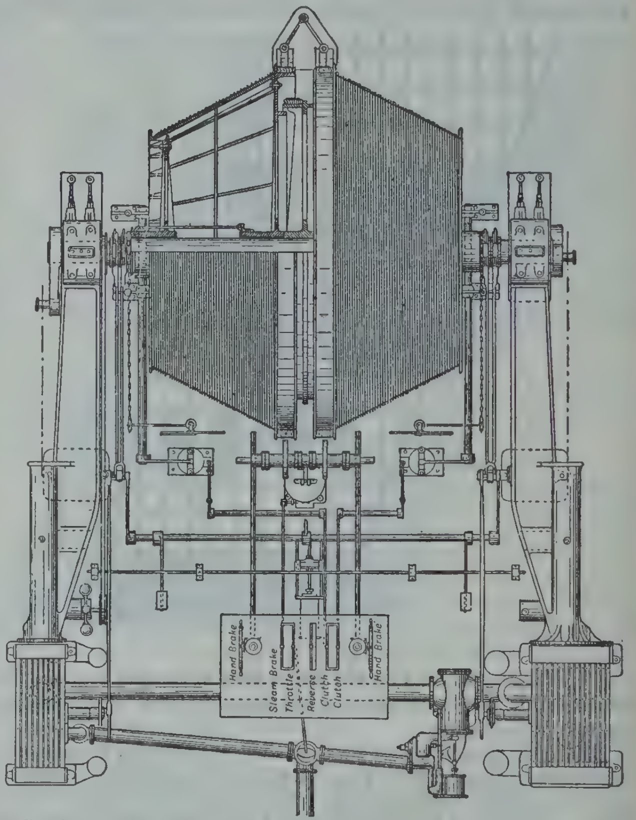


Fig. 12.—Plan of direct-acting hoisting engines, compound Corliss engines and conical drums. Wellman-Seaver-Morgan Co., Cleveland, Ohio, makers.

rope decreases. A similar equalizing effect is obtained by the use of flat rope and reel, the rope winding on itself like a ribbon. Tapering ropes, tail-ropes suspended from the cages, and other means of equalization, are also employed. If, for a two-compartment shaft, a pair of drums (or a single wide drum) be keyed to the engine shaft, with the ropes wound in opposite directions, the hoisting is "in balance," that is, the cages and cars counterbalance each other, so that the engine has to raise only the useful load of mineral, plus the rope. This arrangement allows no independence of movement: when the loaded cage is being hoisted the empty must be lowered. Independent drums, on the contrary, are loose upon their shaft, and are thrown on or off by tooth or friction clutches. The maximum load on the engine is thus greater and more power is required than for fixed drums. Steam consumption is economized, whenever possible, by throwing in the clutches of both drums and hoisting in balance. Fixed drums are best for mines in which the hoisting is done chiefly from one level; independent drums when there are a number of different levels. Hoisting engines are provided with powerful brakes and frequently with reversing gear. In deep shafts hoisting speeds of 3000 or 3500 ft. per minute are often attained, occasionally as much as 5000 ft.

Hoisting Ropes.

Formerly hemp and also fibre ropes were commonly used. Except in a few instances these were long ago superseded by iron-wire ropes, which in turn have been replaced by steel because of its greater strength. For hoisting in deep shafts, and to reduce the weight of rope, tempered-steel wire of very high tensile strength (up to 250,000 or 275,000 ℔ ultimate strength per sq. in.) is advantageously employed. A 1-in. ordinary steel rope has a breaking strength of about 32 tons, which, with a factor of safety of six gives a safe working load of 5¼ tons. A 1-in. plow-steel rope has breaking and working strengths respectively of at least 48 and 8 tons. Standard round rope (fig. 13) has six strands of 19 wires each and a hemp core. Flat rope is in favour in some districts. It is composed of several four-stranded ropes, without hemp centres, laid side by side, and sewed together by wire (fig. 14). It is not as durable as round rope and is heavier for the same working strength. As the sewing wires soon begin to break, a flat rope must usually be ripped apart and resewed every six or eight months. Numerous patent ropes, some having wires and strands of special shapes, have been introduced with the idea of improving the wearing properties. Such, for example, are the Lang-lay, locked-coil and flattened strand rope. Hoisting ropes are weakened by deterioration and breakage of the wires, due to corrosion and repeated bending, and should be kept under careful inspection. To prevent excessive bending stresses the diameter of drum and sheave must bear a proper ratio to that of the rope. A ratio of 48 to 1 is the minimum allowable; better 60 to 75 to 1, and for highly-tempered steel ropes ratios of 150 to 1 or more are desirable. To prevent corrosion the rope should be treated at intervals with hot lubricant. With proper care a steel rope should last from two to three years.

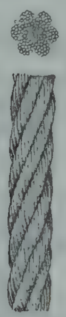


FIG. 13.—Standard round Rope.

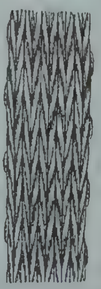
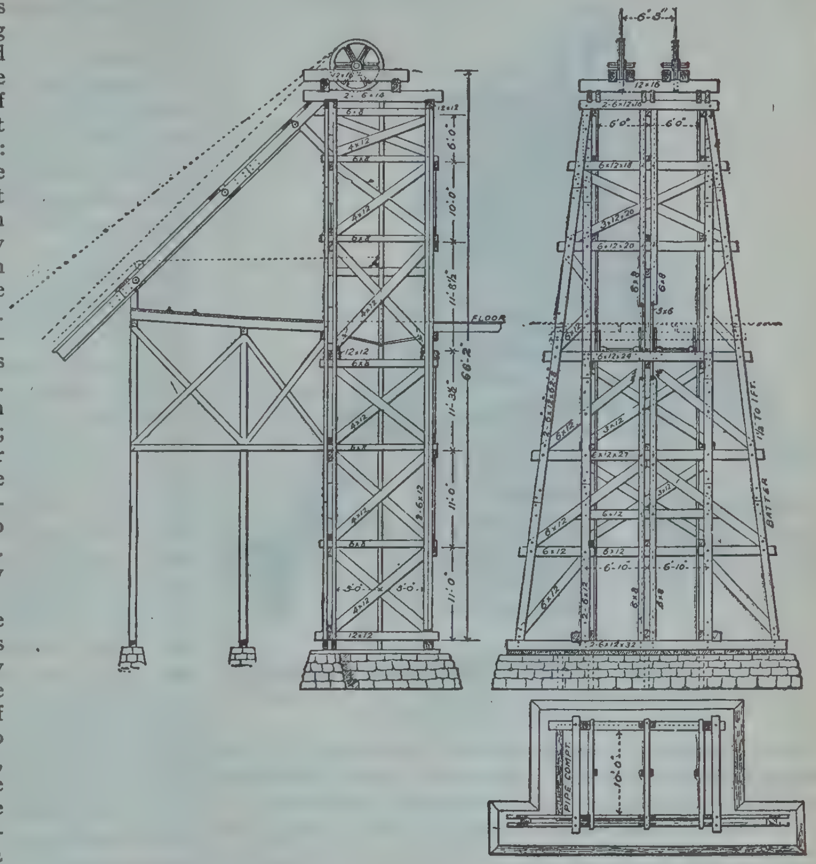


FIG. 14.—Flat Rope.

Head-gear.

A frame of wood or steel, erected at the shaft mouth, and carrying the grooved sheaves over which the hoisting ropes pass, is known as the head-gear (fig. 15). In Great Britain and her colonies it is also called the poppet-head or pit-head frame; in the United States head-frame or gallows-frame. Though it is small and simple in construction for light work, for heavy hoisting at high speeds massively framed towers, often 80 to 100 ft. in height, are built. Steel frames are more durable than those of wood, and have become common in nearly all mining countries, especially where timber is scarce. A German design is shown in fig. 16. The head-gear is often combined with ore-bins and machinery for breaking and sizing the lump ore previous to shipment to the reduction works.



(From *The Colliery Engineer*, May 1897.)

FIG. 15.—Head-gear.

Cages and Skips.

Cages, running in guides in the shaft, are used for raising the cars of mineral to the surface (fig. 17). They may have one, two or more decks, usually carrying one or two cars on each deck. Multiple-deck cages are rarely employed except for deep shafts of small cross-section or when the mine cars (tubs) are small, as in many parts of Europe. In many mines the mineral is raised in skips (fig. 18), filled from cars underground and dumping automatically on reaching the surface. Skips are sometimes of very large capacity, holding 5, 7, and even 10 tons of ore; such are used, for example, in several shafts at Butte, Montana, in the Lake Superior copper district, and in South Africa. Fig. 18 is a small skip; the upper illustration showing position for dumping. The lower cut is of a skip for either ore or water; note valve in bottom. Hoisting buckets or kibbles are employed for small scale work or temporary service, such as raising the material blasted in sinking shafts. They hold from a few hundred pounds up to 1 ton. In hoisting from great depths the weight of the rope, which may exceed that of the cage and contents, produces excessive variations in the load on the engine difficult to deal with. Moreover, the limit of vertical depth at which rope of even the best quality will support its own weight only, with a proper margin of safety, is, say, 10,000 to 12,000 ft.; and with the load the safe working limit of depth would be reached at 7000 to 8000 ft. A number of shafts in South Africa, the United States and elsewhere, are already approximating depths of 5000 ft., a few being even deeper. Ropes of tapering section may be used for great depths, but are not satisfactory in practice.[1] Stage hoisting is applicable to any depth. Instead of raising the load in one lift from the bottom of the shaft, one or more intermediate dumping and loading stations are provided. Each stage has its own engine, rope and cage. The variations in engine load are thus reduced, and incidentally hoisting time is saved.

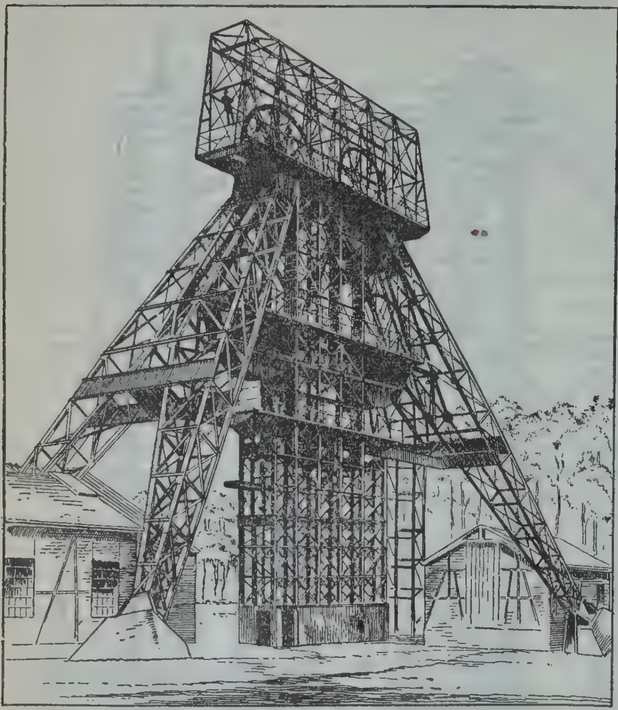


FIG. 16.—Steel head-gear, modern German type, constructed by Aug. Klönne, Dortmund.

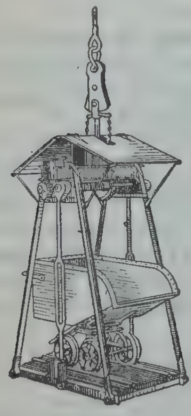


FIG. 17.—Light steel safety mining cage and car for gold and silver mines. Wellman-Seaver-Morgan Co., Cleveland, Ohio, makers.

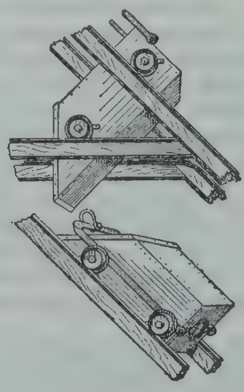


FIG. 18.—Ore and water skips for inclined shaft. Allis-Chalmers Co., Milwaukee, Wisconsin, makers.

Raising and Lowering Men. In shallow mines the men use the ladder-way in going to and from their work. This is sometimes the case also for considerable depths. It is more economical to save the men's strength, however, by raising and lowering them with the hoisting engines.

At mines with vertical shafts this is a simple operation. Cages of the size generally used in metal mines will hold from ten to fifteen and occasionally twenty men. The time consumed in lowering the men is shortened by the use of cages having two or more decks. These are common in Europe, and are sometimes employed in the United States and elsewhere in mines where the output is large and the shafts deep and of small cross section. While a shift of men is being lowered the miners of the preceding shift are usually raised to the surface in the ascending cages, the entire shift being thus changed in the time required for lowering. Nevertheless, in very deep and large mines the time consumed in handling the men may make serious inroads on the time available for hoisting ore. At a few mines special man-cages are operated in separate compartments by their own engines for handling part of the men, and for tools, supplies, &c. For inclined shafts, where the mineral is hoisted in skips, the operation of raising and lowering men may not be so simple. Even a large skip will hold but a few men, the speed is slower, and more time is required for the men to get into and out of the skip than to step on and off a cage. Moreover, skips are rarely provided with safety attachments, so that the danger is greater. When the shafts are deep and the number of miners large man-cars are sometimes employed. These are long frames on four wheels, with a series of seats like a section of a theatre gallery. Ordinarily 4 or 5 men occupy each seat, the car accommodating from 20 to 36 men. Such cars are in use at a number of deep inclined shafts in the Lake Superior copper district, where the depths range from 3000 to 5000 ft. or more. At a few mines (since safety catches cannot be successfully applied to man-cars) these conveyances are raised and lowered by separate engines and ropes. To replace the ore-skip expeditiously by the man-car when the shifts are to be changed a crane is often erected over the shaft mouth. At the end of a shift the ore-skip is lifted from the shaft track—the hoisting rope being uncoupled—and the man-car put in its place and attached to the rope. This change may be made in a few minutes.

Formerly, at many deep European mines, and at a few in the United States, men were raised by means of "man-engines."

Man-Engines. A man-engine consists of two heavy wooden rods (like the rods of a Cornish pumping plant), placed parallel and close to each other in a special shaft compartment, and suspended at the surface from a pair of massive walking beams (or "bobs"). The rods are caused to oscillate slowly by an engine, one rising while the other is falling. Thus they move simultaneously in opposite directions through a fixed length of stroke, say from 10 to 12 ft. At intervals on the rods are attached small horizontal platforms, only large enough to accommodate two men at a time. As the rods make their measured strokes one of the miners, starting from the surface, steps on the first platform as it rises to the surface landing and is then lowered on the down stroke. At the end of the stroke, when his platform comes opposite to a corresponding platform on the other rod, he steps over on to the latter during the instant of rest prior to the reversal of the stroke, descends with the second rod on this down stroke, steps again at the proper time to a platform of the first rod and so on to the bottom. The men follow each other, one by one, so that in a few minutes all the rod platforms in a deep shaft may be simultaneously occupied by men stepping in unison but in opposite directions from platforms of one rod to the other. Meantime, the men quitting work are ascending in a similar way, as there is room on each platform for two men at a time when passing each other. Man-engines were long used, but are now practically abandoned in both Great Britain and the United States, and few remain in any of the mining regions of the world. Their first cost is great and they are dangerous for new men, as they require constant alertness, presence of mind, and a certain knack in using them. See *Trans. Inst. Min. and Met.* xi. 334, 345, 380, &c.; also *Eng. and Min. Jour.* (April 4, 1903), pp. 517 and 518.

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[1] A full discussion of this subject is given in *Trans. Ins. Min. and Met.*, vol. xi.

Surface Handling, Storage and Shipment of Minerals.—To mine ore or coal at minimum cost it is necessary to work the mine plant at nearly or quite its full capacity and to avoid interruption and delays. When the mineral is transported by rail or water to concentration or metallurgical works for treatment, or to near or distant markets for sale, provision must be made for the economical loading of railway wagons or vessels, and for the temporary storage of the mineral product. For short periods the mineral may remain in the mine cars, or may be loaded into railway wagons held at the mine for this purpose. Cars, however, are too valuable to be used in this way for more than a few hours, and it is usual to erect large storage bins at the mine, at concentration works and metallurgical establishments, in which the mineral may be stored, permitting cars, wagons and vessels to be quickly emptied or loaded. In mining regions where water transportation is interrupted during certain months of the year the mineral must be stored underground, or in great stock-piles on the surface. In coal mining the market demand varies in different seasons, and surface storage is sometimes necessary to permit regular work at the mines. For coal, iron ore and other cheap minerals, mechanical handling by many different methods is used in loading and unloading railway wagons and vessels, and in forming the stock-piles and reloading the mineral therefrom. (See CONVEYOR and DOCKS; also G. F. Zimmer, *Mechanical Handling of Materials*, and *Engineering Magazine*, xiv. 275, xx. 157 and xxi. 657.)

Mine Drainage.—A mine which has been opened by an adit tunnel or drift drains itself, so far as the workings above the adit level are concerned. In many mining regions long tunnels have been driven at great expense to secure natural drainage. Under modern mining conditions drainage tunnels have lost much of their former importance. Taking into account the risk attending all mining operations, which make necessary large interest and amortization charges on the cost of a tunnel, it will in most cases be advisable to raise the water to the surface by mechanical means. Drainage channels are provided, usually along the main haulage roads, by which the water flows to a sump excavated at the pump shaft. In driving mine passages that are to be used for drainage, care is taken to maintain sufficient gradient. Siphons are sometimes used to carry the water over an undulating grade and thereby save the expense of a deep rock cutting. As the larger part of the water in a mine comes from the surface, the cost of drainage may be reduced by intercepting this surface water, and collecting it at convenient points in the pump shaft from which it may be raised at less cost than if permitted to go to the bottom. Water may be raised from mines by buckets, tanks or pumps. Wooden or steel buckets, holding from 35 to 200 gallons, are employed only for temporary or auxiliary service or for small quantities of water in shallow shafts. Tanks operated by the main hoisting engines, and of capacities up to 1500 gallons or more, are applicable under several conditions: (1) When the shaft is deep, the quantity of water insufficient to keep a pump in regular operation, and the hoisting engine not constantly employed in raising mineral, the tank is worked at intervals, being attached temporarily to the hoisting rope in place of the cage. (2) For raising large volumes of water from deep shafts pairs of tanks are operated in balance in special shaft compartments by their own hoisting engine. With an efficient engine the cost per gallon of water is often less than for pumping. (3) For clearing flooded mines. As the water level falls the tanks readily follow it while at work, whereas pumps must be lowered to new positions to keep within suction distance. Self-acting tanks are occasionally built underneath the platforms of hoisting cages. Mine pumps are of two classes: (1) those in which the driving engine is on the surface and operates the pumps by a long line of rods passing down the shaft, commonly known as the Cornish system; (2) direct-acting pumps, in which the engine and pumping cylinders form a single unit, placed close to the point underground from which the water is to be raised. Cornish pumps are the oldest of the machines for draining mines; in fact, one of the earliest applications of the old Woolf and Newcomen engines in the 18th century was to pumps for deep mines. The engine works a massive counter-balanced walking-beam from which is suspended in the shaft a long wooden (or steel) rod, made in sections and spliced together. Attached to the rod by offsets are one or more plunger or bucket pumps, set at intervals in the shaft. All work simultaneously, each raising the water to a tank or sump above, whence it is taken by the next pump of the system, and finally discharged at the surface. The individual pumps are placed several hundred feet apart, so that a series is required for a deep shaft. The speed is slow—from 4 to 10 strokes per minute—but the larger sizes, up to 24 in. or more in diameter by 10 or 12 ft. stroke, are capable of raising millions of gallons per day. Cornish pumps are economical in running expenses, provided the driving engine is of proper design and the disadvantages incurred in conveying steam underground are avoided. Their first cost, however, is high and the cumbersome parts occupy much space in the shaft. Direct-acting pumps, first introduced (1841) by an American, Henry R. Worthington, are made of many different designs. Typically they are steam pumps, the steam and water cylinders being set tandem on the same bed frame, generally without fly-wheel or other rotary parts; they may be single cylinder or duplex, simple, compound or triple expansion, and having a higher speed of stroke are smaller in all their parts than Cornish pumps. For high heads the water cylinders, valves and valve chambers are specially constructed to withstand heavy pressures, water being sometimes raised in a single lift to heights of more than 2000 ft. Condensers are always required for underground pumps. Sinking pumps, designed for use in shafts in process of sinking, are suspended by wire ropes so as to be raised before blasting and promptly lowered again to resume pumping. Electrically driven pumps, now widely used, are convenient and economical. Mine pumps of ordinary forms may be operated by compressed air, and air-lift pumps have been successfully employed. Hydraulic pumping engines, while not differing essentially from steam pumps, must have specially designed valves in the power cylinder on account of the incompressibility of water. They can be used only when a supply of water under sufficient pressure is available for power. Centrifugal pumps, constructed with several stages or sets of vanes, and suitable for high lifts, have been introduced for mine service. When mine water is acid the working parts of the pump must be lined with or made of bronze or other non-corrosive material; or the acid may be neutralized by adding lime in the sump.

Ventilation.—The air of a mine is vitiated by the presence of large numbers of men and animals and of numerous lights, each of which may consume as much air as a number of men. In mining operations explosives are used on a large scale and the powder gases contain large quantities of the very poisonous gas, carbon monoxide, a small percentage of which may cause death, and even a minute percentage of which in the air will seriously affect the health. In addition to these sources of contamination the air of the mine is frequently charged with gas issuing from the rocks or from the mineral deposit. For example, carbon dioxide occurs in some mines, and hydrogen sulphide, which is a poisonous gas, in others. In coal-mines we have to deal with "fire-damp" or marsh gas, and with inflammable coal dust, which form explosive mixtures with air and frequently lead to disastrous explosions resulting in great loss of life. The gases produced by such fire-damp or dust explosions contain carbon dioxide and carbon monoxide in large proportion, and the majority of the deaths from such explosions are due to this "after-damp" rather than to the explosion itself. The terrible effects of fire-damp have led to the adoption of elaborate systems of ventilation, as the most effective safeguard against these explosions is the dilution and removal of the fire-damp as promptly and completely as possible. Very large volumes of air are necessary for this purpose, so that in such mines other sources of vitiation are adequately provided against and need not be considered. In metal mines, however, artificial ventilation is rarely attempted, and natural ventilation often fails to furnish a sufficient quantity of air. The examination of the air of metal mines has shown that in most cases it is much worse than the air of crowded theatres or other badly ventilated buildings. This has a serious effect on the health and efficiency of the workmen employed, and in extreme cases may even result in increased cost of mining operations. The ventilation of a mine must in general be produced artificially. In any case whether natural or artificial means be employed, a mine can only be ventilated properly when it has at least two distinct openings to the surface, one an intake or "downcast," the other a chimney serving as an "upcast." Two compartments of a shaft may be utilized for this purpose, but greater safety is ensured by two separate openings, as required by law in most mining countries.

Natural Ventilation.

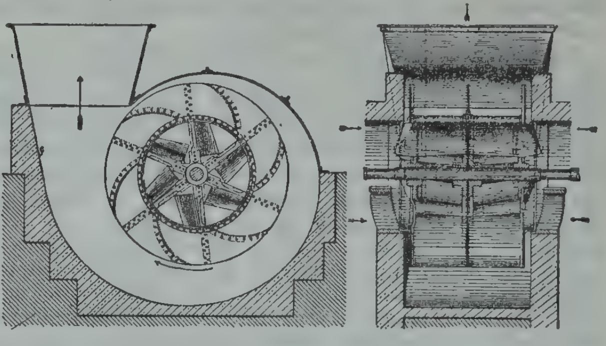
The air underground remains throughout the year at nearly the same temperature, and is warmer in winter and cooler in summer than the outside air. If the two openings to the mine are at different levels the difference in weight of the inside and outside air due to difference in temperature causes a current, and in the winter months large volumes of air will be circulated through the mine from this cause alone. In summer there will be less movement of air and the current will frequently be reversed. In a mine with shafts opening at the same level, natural ventilation once established will be effective during cold weather, as the downcast will have the temperature of the outside air, while the upcast will be filled with the warm air of the mine. In summer this will occur only on cool days and at night. When the temperature of outside and inside air becomes equal or nearly so natural ventilation ceases or becomes insignificant. In a mine with two shafts a ventilating current may result from other conditions creating a difference in the temperature of the air in either shaft—for example, the cooling effect of dropping water or the heating effect of steam pipes. Natural ventilation is impracticable in flat deposits worked by drifts and without shafts.

Ventilating Furnaces.

Ventilation may be produced by heating the air of the mine, as for example, by constructing a ventilating furnace at the bottom of an air shaft. The efficiency of such ventilating furnaces is low, and they cannot safely be used in mines producing fire-damp. They are sometimes the cause of underground fires, and they are always a source of danger when by any chance the ventilating current becomes reversed, in which case the products of combustion, containing large quantities of carbon dioxide, will be drawn into the mine to the serious danger of the men. On account of their dangerous character furnaces are prohibited by law in many countries.

Mechanical Ventilators.

Positive blowers and exhausting apparatus of a great variety of forms have been used in mines for producing artificial ventilation. About 1850, efficient ventilators of the centrifugal type were first introduced, and are now almost universally employed where the circulation of large volumes of air is necessary, as in collieries. The typical mine fan consists of a shaft upon which are mounted a number of vanes enclosed in a casing; the air entering a central side inlet is caught up by the revolving vanes and thrown out at the periphery by the centrifugal force thus generated. "Open-running" fans have no peripheral casing, and discharge freely throughout their entire circumference; in "closed" fans the revolving part is completely enveloped by a spiral casing opening at one point into a discharge chimney. Fans either force air into or exhaust it from the mine. The inlet opening of the pressure fan is in free communication with the outside air, the discharge connecting with the mine air-way; in the more generally used exhaust fan the inlet is connected with the air-way, the fan discharging into the atmosphere. Among the exhaust fans most widely employed is the Guibal. Many others have been introduced, such as the Capell (fig. 19), Rateau, Schiele, Pelzer, Hanarte, Ser, Winter, Kley, and Sirocco fans. The Waddle may be instanced as an example of the open fans. Slow-speed fans are sometimes of large dimensions, up to 30 and even 45 ft. diameter, discharging hundreds of thousands of cubic feet of air per minute. Occasionally, at very gassy and dangerous collieries, two fans and driving engines are erected at the same air shaft, and in case of accident to the fan in operation the other can be started within a few minutes.



(From *Mines and Minerals*, March, 1905.)

Fig. 19.—Capell Fan.

Circulation of Air.

Opposed to the motive force producing the air current is the frictional resistance developed in passing through the mine workings. This resistance is equal to the square of the velocity of the current in feet per minute, multiplied by the total rubbing or friction surface of the air-ways in square feet and by the coefficient of friction. The latter, determined experimentally, varies with different kinds of surfaces of mine workings, whether rough or smooth, timbered or unlined; it ranges from 0·000000001872 to 0·0000000217 lb per sq. ft., the latter being the value usually adopted. A certain pressure of air is required to maintain circulation against the resistance, and for a given volume per minute the smaller and more irregular the mine openings the greater must be the pressure. The pressure is measured by a "water-gauge" and the velocity of flow by an "anemometer." The power required to circulate the air through a mine increases as the cube of the velocity of the air current. To decrease the velocity, when large volumes of air are required, the air passages are made larger, and the mine is divided into sections and the air current subdivided into a corresponding number of independent circuits. This splitting of the air not only lessens the cost of ventilating, but greatly increases its efficiency by permitting the circulation of much larger volumes, and has the added advantage that the effect of an explosion or other accident vitiating the air current is often confined to a single division of the mine, and affects but a small part of the working force. The adjustment of the air currents in the different splits is affected by regulators which are placed in the return air-ways, and act as throttle valves to determine the volume of air in each case. The circulation of air in any given division of the mine is further controlled and its course determined by temporary or permanent partitions ("brattices"), by the erection of stoppings, or by the insertion of doors in the mine passages and by the use of special air-ways (see Coal). In devising a system of ventilation it is customary to subdivide the workings so that the resistance to the ventilating current in each split shall be nearly equal, or so that the desired amount of air shall be circulated in each without undue use of regulating appliances which add to the friction and increase the cost of removing the air. In addition to this it is desirable to take advantage of the natural ventilation, that is, to circulate the air in the direction that it goes naturally, as otherwise the resistance to the movement of the air may be greatly increased. So far as possible, vitiated air is led directly to the shaft instead of passing through other workings; for example, mine stables when used are placed near the upcast shaft and ventilated by an independent split of the ventilating current.

Deep Mining.—There has been much speculation as to the depth to which it will be practicable to push the work of mining. The special difficulties which attend deep mining, in addition to the problems of hoisting ore and raising water from great depths, are the increase of temperature of the rocks and the pressure of the overlying strata. The deepest mine in the world is No. 3 shaft of the Tamarack mine in Houghton county, Michigan, which has reached a vertical depth of about 5200 ft. Three other shafts of the Tamarack Company, and three of the neighbouring Calumet and Hecla mine, have depths of between 4000 and 5000 ft. vertical. The Quincy mine, also in Houghton county, has reached a vertical depth of nearly 4000 ft. In England are several collieries over 3000 ft., and in Belgium two are nearly 4000 ft. deep. In Austria three shafts in the silver mines at Prizbram have reached the depth of over 1000 metres. At Bendigo in Australia are several shafts between 3000 and 4000, and one, the Victoria Quartz mine, 4300 ft. deep. In the Transvaal gold region (South Africa), a number of shafts have been sunk to strike the reef at about 4000 ft. In most cases the deposits worked are known to extend to much greater depths than have been reached. The possibility of hoisting and pumping from great depths has been discussed, and it remains now to consider the other conditions which will tend to limit mining operations in depth—namely, increase of temperature and increase of rock pressure. Observations in different parts of the world have shown that the increase of temperature in depth varies: in most localities the rise being at the rate of one degree for 50 to 100 feet of depth; while in the deep mines of Michigan and the Rand, an increase as low as one degree for each 200 ft. or more has been observed. In the Comstock mines at Virginia City, Nevada, it is possible to continue mining operations at rock temperatures of 130° F. In these mines a constant supply of pure air, about 1900 cub. ft. per minute, was blown into the hot working places through light iron pipes. The air issuing from these pipes was dry and warm, and served to keep the temperature of the air below 120°, at which temperature it was possible for men to work continuously for half an hour at a time, and for four hours in the day. In some places work was conducted with rock temperatures as high as 158° F., with air 135° F. In these very hot drifts the fatality was large. In the Alpine tunnels, where the air was moist and probably not as pure as in the Comstock mines, great difficulty was experienced in prosecuting the work at temperatures of 90° F. and less. The mortality was large, and it was believed by the engineers that temperatures over 104° would have proved fatal to most of the workmen. Deep mines, however, are generally dry, so that in most cases it will be possible to realize the more favourable conditions of the Comstock mines. Assuming an initial mean temperature of 50° F., and increments of one degree for 100 and for 200 ft., a rock temperature of 130° will be reached at 8000 to 16,000 ft. In many deep mines to-day "explosive rock" has been encountered. This condition manifests itself, for example, in mine pillars which are subjected to a weight beyond the limit of elasticity of the mineral of which they are composed. Under such conditions the pillar begins to yield, and fragments of mineral fly off with explosive violence, exactly as a specimen of rock will splinter under pressure in a testing machine. The flying fragments of rock have frequently injured and sometimes killed miners. A similar condition of strain has been observed in deep mines in different parts of the world—perhaps due to geological movements. Assuming a weight of 13 cub. ft. to the ton, then at 6500 ft. the pressure per sq. ft. will be 500 tons, and at 13,000 ft. 1000 tons; and as the mineral is mined the weight on the pillars left will be proportionately greater. At such pressures all but the strongest rocks will be strained beyond their limit of elasticity. At depths of 1000 ft. and less some of the softer rocks show a tendency to flow, as exhibited by the under-clay in deep coal-mines, which not infrequently swells up and closes the mine passages. In the Mont Cenis tunnel a bed of soft granite was encountered that continued to swell with almost irresistible force for some months. The pressure developed was sufficient to crush an arched lining of two-foot granite blocks. Similar swelling ground is not infrequently met with in metal mines, as, for example, in the Phoenix copper mine in Houghton county, Michigan, where the force developed was sufficient to crush the strongest timber that could be used. In very deep mines this flowing of soft rock will doubtless add greatly to the difficulty of maintaining openings. What may happen in some cases is illustrated by the curious form of accident locally known as a "bump," which occurs in some of the deep coal-mines of England. In one instance (described by F. G. Meacham, *Trans. Fed. Inst. M.E.* v. 381), the force developed by the swelling under-clay broke through and lifted with the force and suddenness of an explosion a lower bench of coal 8 ft. thick in the bottom of a gangway 12 ft. wide for a length of 200 ft., throwing men and mine cars violently against the roof and producing an air-wave which smashed the mine doors in the vicinity. It is apparent that the combined effect of internal heat and rock pressure will greatly increase the cost of mining at depths of 8000 or 10,000 ft., and will probably render mining impracticable in many instances at depths not much greater.

Mine Administration.—In organizing a mining company it must be recognized that mining is of necessity a temporary business. When the deposit is exhausted the company must be wound up or its operations transferred to some other locality. Mining is also subject to the risks of ordinary business enterprises, and to additional risks and uncertainties peculiar to itself. The vast majority of mineral deposits are unworkable, and of those that are developed a large proportion prove unprofitable. In addition mining operations are subject to interruption and added expense from explosions, mine fires, flooding, and the caving-in of the workings. To provide for the repayment from earnings of the capital invested in a mining property and expended in development, and to provide for the depreciation in value of the plant and equipment, an amortization fund must be accumulated during the life of the mine; or, if it be desired to continue the business of mining elsewhere, a similar fund must be created for the purchase, development and equipment of a new property to take the place of the original deposit when that shall be exhausted. If, for example, we assume the life of a given mine at ten years and the rate of interest at 5%, it will be necessary that the property shall earn nearly 13% annually—viz., 5% interest and 8% for the annual payment to the amortization or the reserve fund. To cover the special risks of mining, capital should earn a higher interest than in ordinary business, and if we assume that the sinking-fund be safely invested, we must compute the amortization on a lower basis than 5%. Assuming, for example, the life of the mine at ten years as before, and taking the interest to be earned by the amortization fund at 3%, and that on the investment at 10%, we shall find that the annual income should amount to 18·7% per year. These simple business principles do not seem to be generally recognized by the investing public, and mines, whose earning capacity is accurately known, are frequently quoted on the stock markets at prices which cannot possibly yield enough to the purchaser to repay his investment during the probable life of the mine.

Mine Valuation.—The value of any property is measured by its annual profits. In the case of mining properties these profits are more or less uncertain, and cannot be accurately determined until the deposit has been thoroughly explored and fully developed. In many instances, indeed, profits are more or less uncertain during the whole life of the mine, and it is evident that the value of the mining property must be more or less speculative. In the case of a developed mine its life may be predicted in many cases with absolute certainty—as when the extent of the mineral deposit and the volume of mineral can be measured. In other cases the life of the mine, like the value of the mineral, is more or less uncertain. Further, both time and money are required for the development of the mining property before any profit can be realized. Mathematically we have thus in all cases to compute present value on the basis of a deferred as well as a limited annuity. The valuation of mines then involves the following steps: (1) The sampling of the deposit so far as developed, and assaying of the samples taken; (2) The measurement of the developed ore; (3) estimates of the probable amount of ore in the undeveloped part of the property; (4) estimates of probable profits, life of the mine, and determination of the value of the property. Where the deposit is a regular one and the mineral is of fairly uniform richness, the taking of a few samples from widely separated parts of the mine will often furnish sufficient data to determine the value of the deposit. On the other hand in the case of uncertain and irregular deposits, the value of which varies between very wide limits, as, for example—in most metal mines and especially mines of gold and silver—a very large number of samples must be taken—sometimes not more than two or three feet apart—in order that the average value of the ore may be known within reasonable limits of error. The sampling of a large mine of this character may cost many hundreds of pounds. This applies with even greater force to estimates of undeveloped portions of the property. If the deposit is regular and uniform, the value of undeveloped areas may sometimes be predicted with confidence. In the majority of instances, however, the estimates of undeveloped ore contain a large element of uncertainty. In order to determine the probable profit and life of the mine a definite scale of operations must be assumed, the money required for development and plant and for working capital must be estimated, the methods of mining and treating the ore determined, and their probable cost estimated. Where the deposit is uncertain and the element of risk is large, we must adopt a high rate of interest on investments of capital in our computations of value—in some cases as high as 10, 15 or even 20%. Where the deposit is regular and the future can be predicted with some degree of certainty, we may be justified in adopting in some cases possibly as low as 5%. The interest on the annual contribution to the sinking-fund or its equivalent should be reckoned at a low rate of interest, for such funds are assumed to be invested in perfectly safe securities. Allowance must be made for the period of development during which there are no contributions to the sinking-fund and within which no interest is earned on invested capital.

Mining Education.—It is necessary to have the work directed by men thoroughly familiar with the characteristics of mineral deposits, and with wide experience in mining. For the purpose of training such men special schools of mining engineering (*écoles des mines*, *Bergakademie*) have been established in most mining countries. A student of mining must receive thorough instruction in geology; he must study mining as practised in different countries, and the metallurgical and mechanical treatment of minerals; and he should have an engineering education, especially on mechanical and electrical lines. As he is called upon to construct lines of transport, both underground and on the surface, works for water-supply and drainage, and buildings for the handling, storage and treatment of ore, he must be trained to some extent as a civil engineer. As a foundation his education must be thorough in the natural and physical sciences and mathematics. In addition there have been established in many countries schools for the education of workmen, in order to fit them for minor positions and to enable them to work intelligently with the engineers. These miners' schools (*Bergschule*, *écoles des mineurs*) give elementary instruction in chemistry, physics, mechanics, mineralogy, geology and mathematics and drawing, as well as in such details of the art of mining as will best supplement the practical information already acquired in underground work. The training of a mining engineer merely begins in the schools, and mining graduates should serve an apprenticeship before they accept responsibility for important mining operations. It is especially necessary that they should gain experience in management of men, and in the conduct of the business details, which cannot well be taught in schools.

Accidents.—Mining is an extra-hazardous occupation, and the catastrophes, which from time to time have occurred, have caused the enactment of laws to protect the lives of the men engaged in underground work. These laws are enforced by mine inspectors who are empowered to call upon the courts and other government agencies to enforce their authority. While in some cases these laws are unnecessarily stringent and tend to restrict the business of mining yet on the whole they have had the effect of reducing greatly the loss of life and injuries of miners where they have been well enforced. This is evident from fig. 20, which shows the number of men killed in the coal and metal mines of Great Britain for a series of years. As will be seen from this diagram the most serious source of death and injury is not found in mine explosions, but in the fall of rocks and mineral in the working places. This danger can be reached only in small degree by laws and inspection; but the safety of the men must depend upon the skill and care of the miners themselves and the officers in charge of the underground work. Great loss of life and injury occur through the ignorance, carelessness and recklessness of the men themselves, who fail to take the necessary precautions for their own safety, even when warned to do so. Mining laws have proved chiefly serviceable in securing the introduction of efficient ventilation, the use of safety-lamps, and of proper explosives, to lessen the danger from fire-damp and coal-dust in the coal-mines, the inspection of machinery for hoisting and haulage, and prevention of accidents due to imperfection in design or in working the machinery.

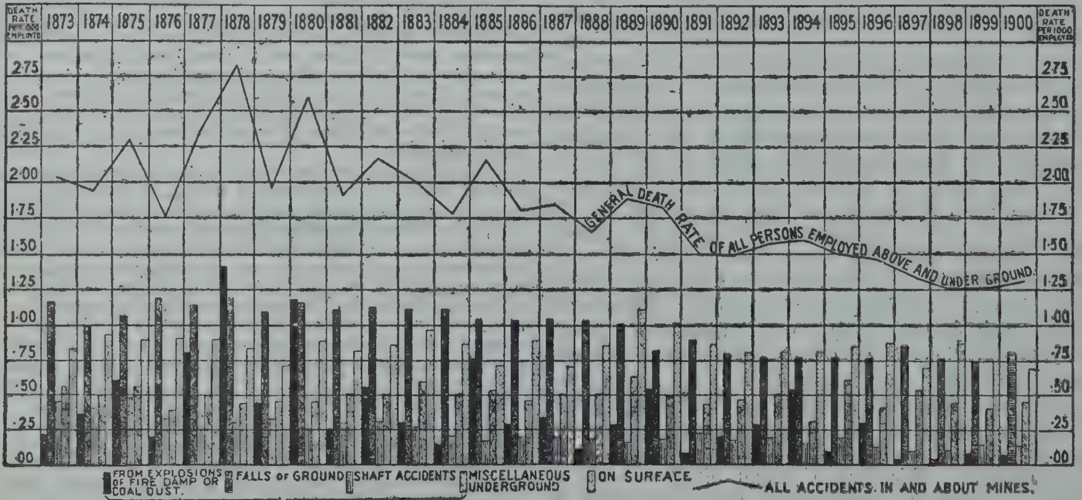


FIG. 20.—Death-rate from various classes of accidents in and about all mines in the United Kingdom from 1873 to 1900.

Explosions. Fire-damp and dust explosions are caused by the presence of marsh-gas in sufficient quantity to form an explosive mixture, or by a mixture of small percentages of marsh-gas and coal-dust, and in some cases by the presence of coal-dust alone in the air of the mine. Explosive mixtures of marsh-gas and air may be fired by an unprotected light. But when coal-dust is present, and little or no marsh-gas, an initial explosion—such as is produced by a blown-out shot—is required. To guard against explosions from this cause it is necessary to use explosives in moderate quantities and to see that the blast-holes are properly placed, so that the danger of blown-out shots may be lessened. In dry and dusty mines the danger may be greatly lessened by sprinkling the working places and passages, and the removal of the accumulated dust and fine coal. Where large quantities of fire-damp are present, safety-lamps of approved pattern must be used and carefully inspected daily. The use of matches and naked lights of any kind must be prohibited. To lessen the danger from blasting operations the use of special safety explosives is required in Great Britain and some European countries. The use of such explosives decreases to some extent the danger from dust explosions; but experiment shows that no efficient explosive is absolutely safe, if used in excessive quantity, or in an improper manner. Absolute security is impossible, as is proved by the many and serious disasters under the most stringent laws and careful regulations that can be devised.

Mine Fires. Mine fires may originate from ordinary causes, but in addition they may result from the explosion of fire-damp or from the accidental lighting of jets of fire-damp issuing from the coal. In some mining districts the coal is liable to spontaneous combustion. A fire underground speedily becomes formidable, not only in coal but also in metal mines, on account of the large quantity of timber used to support the excavations. Underground fires may sometimes be extinguished by direct attack with water. The difficulty of extinguishing an underground fire in this way is, however, very great, as on account of the poisonous products of combustion it is impossible to attack it except in the rear, and even there the men are always in great danger from the reversal of the air current, or back-draught from the fire. Further, the burning of the timber produces falls of ground, making necessary the excavation and removal at times of hundreds of tons of heated rock and burning coal, in order to reach the fire. When direct attack is no longer practicable, it is possible to extinguish the fire by sealing the mine workings, and exhausting the supply of oxygen. It is necessary, however, to keep the mine sealed until the burning timbers, or coal, and the red-hot rocks have become cool, or the fire will again break out. This sometimes requires two or three months. Where an effective sealing of the mine is impracticable it is sometimes possible to extinguish the fire from the outside of the mine by constructing a large reservoir or tank in the upper part of the mine-shaft and suddenly releasing a large volume of water by opening discharge-doors. The mass of water falling down the shaft is converted into spray, which is carried by the force of the fall long distances into the workings. Where the fire is in or near the shaft this method has proved very effective. Mine fires may sometimes be reached by bore-holes sunk for the purpose from the surface, and the burning workings below filled by flushing with culm and water. As a last resort the mine may be flooded with water. This is an expensive operation as it entails the cost of pumping the water out again and repairing the resulting damage. If the fire is in working places to the rise the water may not reach the burning portions of the mine, but will effectually seal them. But sufficient time must be allowed to elapse before pumping out the water, as otherwise the fire may break out again.

Flooding of Mines.

Mines may become flooded by the inrush of surface waters in times of great rainfall or sudden floods, or by the undermining of surface waters. The mine workings may also be flooded by large bodies of underground water. The surface floods must be provided with channels of sufficient size to carry them safely past the mine openings, and intercepting ditches should be excavated for this purpose, and dams and embankments constructed to divert the flood waters. That it is possible to work with safety beneath rivers, lakes and even the ocean has been proved in numerous instances; mines in different parts of the world having been extended long distances under the sea. In such cases preliminary surveys should be made to determine the thickness of rock over the proposed workings. Under favourable conditions mining may be conducted under the protection of a few yards of solid rock only, as in the submarine work for the removal of reefs in the harbours of San Francisco and New York. At Silver Islet, Lake Superior, mining was successfully carried on for years under the protection of a coffer dam and an arch of rich silver ore less than 20 ft. thick. At Wheal Cock near St Just in Cornwall the protecting roof was so thin that holes bored for blasting more than once penetrated to the bed of the ocean, and wooden plugs were kept on hand to drive into such holes when this occurred. In storms the boulders could be heard striking each other overhead. When large areas are undermined, as in submarine coal mining, it is best to have several hundred feet of protecting rock. In Great Britain the law requires that the workings shall be protected by 120 ft. of solid strata. When the presence of underground bodies of water is known or suspected, advance bore-holes should radiate from the end of the advancing working place so as to give warning of the position of the body of water, these holes being of such length as to ensure a safe thickness of solid rock.

Caving of Mine Workings.

The caving in of mine workings results from the excavation of large areas supported upon pillars of insufficient size. While the mine workings are small the overlying rocks support themselves and the full pressure does not come upon the mine pillars. As the workings increase in size the pillars support an increasing weight until finally they are strained beyond the limit of elasticity. When this occurs, the pillars begin to crack and splinter with a noise like musketry firing, and the roof of the mine shows signs of subsidence. This may continue for weeks before the final crash takes place. At first a fall of the roof occurs locally, here and there throughout the mine, and these falls may succeed one another until the settlement of portions of the roof has so far relieved the strain that the remaining areas are supported by the stronger pillars, and by the fallen rock masses. While abundant warning of the caving-in of the workings is thus given in advance it may happen that men are unexpectedly imprisoned by the closing of the main passage ways. The caving-in of the mine, however, is rarely so complete that avenues of escape are not open. In many cases, however, it has been found necessary to reopen the mine through the fallen ground, and even to excavate openings through the solid mineral. The history of mining is full of dramatic episodes of this character.

Accidents from Explosives.

Accidents from the misuse and careless handling of explosives are unfortunately too frequent in mines. The conditions under which explosives may be stored, handled and used are carefully formulated in the mining laws of most states, but it is almost impossible to secure obedience to these regulations on the part of the miners, who are, as a rule, both careless and reckless in their use of powder. In some states it has become necessary to provide for fines and even imprisonment of men disobeying the regulations regarding explosives.

Mine Hygiene.—While mining is not necessarily an unhealthy occupation, miners are subject to certain diseases resulting from vitiated air, and from unusual or special conditions under which at times they are forced to work. Recent investigations have shown an alarming increase in mortality from miners' phthisis in Cornwall, South Africa and elsewhere. This seems to be due to the dust abundantly produced in mining operations, and especially by machine drills when boring "dry" (rising) blast holes. Drill runners, who are compelled to breathe this dusty air daily, furnish most of the sufferers from phthisis. The increased mortality seems to be due to the general tendency toward forced speed in development work, which is secured by rapid drilling, and by an increase in the number of machine drills used in a single working-place. The miners, to save time, often return to their work after blasting before the powder-smoke and dust have been sufficiently removed. It is probable that the carbon monoxide seriously affects the general health and vitality of the men, and renders them more likely to succumb to phthisis. More effective ventilation will materially lessen the death-rate. In the metal mines of Cornwall and Devon special rules are now in force requiring the use of water in drilling, and other precautions, to lessen this danger from dust. In some mines dust seems to have but little effect on the health of the miners; indeed it is even claimed by some that coal dust decreases the mortality from phthisis. On the other hand, as in mining ores containing lead, arsenic and mercury, the dust may be poisonous. The climbing of ladders from deep mines not only lessens the efficiency of the men by reason of fatigue, but often tends to increase the mortality from diseases of the heart. In cold climates men coming from the warm atmosphere of a mine, often in wet clothing, are liable to suffer in health unless proper provision is made for the necessary change of clothing. In such cases the establishment of dressing-rooms, properly heated, and connected with the mine by covered passages will be necessary. These "change-houses" are provided with washing and bathing facilities, and arrangements for drying wet clothing. Ankylostomiasis (*q.v.*) is a disease which finds a congenial habitat in the warm damp atmosphere of mines, and has become a veritable scourge in some mining regions. The disease yields readily to treatment, but is difficult to eradicate from a mine without stringent sanitary regulations to prevent its spread. The care of the health of the working force should be entrusted to competent mine physicians, thoroughly familiar with the conditions under which the miners work, and with the special diseases to which they are subject. The men should be instructed in the laws of sanitation, and in the proper care of injured men.

Mine Law.—Mine law is that branch of the law of real property relating to mineral and mining rights as distinct from rights pertaining to the surface of the ground. Under the common law the owner of the surface possesses all mining rights as well, unless these have been reserved by some previous owner of the property. From very ancient times deposits of gold and silver have in most countries been held as the property of the crown. In public or government land the minerals as well as surface belong to the state, and not infrequently these rights have been separated by law and granted or otherwise disposed of to different owners. It is to the public interest that deposits of mineral should not be permitted to remain idle and undeveloped. This has been recognized from the earliest times, and laws have been framed in all countries for the encouragement of mining enterprise. In many cases the state or the ruler has sought to obtain a share in the profits of mining, or even to work mines for the individual profit of the ruler or of the state. But in most cases it has been found better policy for the state to divest itself of all interest in mining property, and to extend all possible encouragement to those who undertake the development of the mineral wealth of the nation. The mining laws of most civilized states grant the right of free prospecting over the public lands, protect the rights of the discoverer of the mineral deposit during the period of exploration, and provide for the acquisition of mineral property on favourable terms. Striking examples of the far-reaching effect of such laws is shown in the history of the Rocky Mountain region and western coast of the United States, the colonization and development of Australia, and the development of Alaska.

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MINION, a favourite, pet or spoiled person. The word is adapted from the Fr. *mignon* (Ital. *mignone*), of which the origin is doubtful. Connexions with the O.H. Ger. *minna*, love, and with a Celtic root *min-*, meaning small, have been suggested. "Minion" is chiefly applied in a derogatory sense to the "creatures" of a royal court, and thus has been used of the favourites of Edward II. and James I. of England, and of Henry III. of France. In the sense pretty, delicate, dainty, the French form *mignon* or *mignonne* is often used in English. During the 17th century "minion" was the name of a type of cannon with a small bore. In typography, it is still used for the type which comes between "nonpareil" and "brevier."

MINISTER (Lat. *minister*, servant), an official title both civil and ecclesiastical. The word *minister* as originally used in the Latin Church was a translation of the Greek *διάκονος*, deacon; thus Lactantius speaks of *presbyteri et ministri*, priests and deacons (*De mort. persecutorum*, No. 15), and in this sense it is still technically used; thus canon vi., Sess. xxiii. of the council of Trent speaks of the hierarchy as consisting "*ex episcopis, presbyteris et ministris.*" But the equivocal character of the word soon led to the blurring of any strictly technical sense it once possessed. Bishops signed themselves *minister* in the spirit of humility, priests were "servants of the altar" (*ministri altaris*), while sometimes the phrase *ministri ecclesiae* was used to denote the clergy in minor orders (see *Lex Bajwar. tit.* 8, quoted in Du Cange). A similar equivocal character attaches to the word minister as used in the Anglican formularies: "Oftentimes it is made to express the person officiating in general, whether priest or deacon; at other times it denoteth the priest alone, as contradistinguished from the deacon" (Burn's *Eccl. Law*, ed. Phillimore, iii. 44). Thus the 33rd canon of 1603 orders that "no bishop shall make any person a deacon and minister both together upon one day." Generally, however, it may be said that in the use of the Church of England "minister" means no more than *executor officii*, a sense in which it was used long before the Reformation. As the most colourless of all official ecclesiastical titles, it is easy to see how the word minister has come to be applied to the clergy of Protestant denominations. The phrase "minister of religion" is wide enough to embrace any evangelical office, and has about it more of the savour of humility than "pastor."

The civil title of minister originates in the same exact sense of servant, *i.e.* servants of the royal household (*ministri aulae regis*). This origin is still clearly traceable in the titles of some ministers in Great Britain, *e.g.* chancellor of the exchequer, first lord of the treasury, and in the official style of "his majesty's servants" applied to all. Practically, however, the word minister has in modern states come to be applied to the heads of the great administrative departments who as such are members of the government. On the continent there are, besides, "ministers without portfolio," *i.e.* ministers who, without being in charge of any special department, are members of the government. In general it is distinctive of constitutional states that any public act of the sovereign must bear the countersignature of the minister responsible for the department concerned. (See the articles MINISTRY and CABINET. For the history and meanings of the word "minister" in diplomacy, see DIPLOMACY.) (W. A. P.)

MINISTRY, the office of a minister (*q.v.*), in all its meanings, political and religious, or the body of persons holding such an office and performing its duties; more particularly the body of persons who, in theory the servants at the head of the state, act as the responsible executive over the whole sphere of government, as in the United Kingdom. On the continent of Europe, on the other hand, the word "ministry" is most usually applied to the responsible head of a particular department together with his subordinates, including the permanent officials or staff. In England, ever since the introduction of monarchical institutions the sovereign has always been surrounded by a select body of confidential advisers to assist the crown in the government of the country. At no period could a king of England act, according to law, without advice in the public concerns of the kingdom; the institutions of the crown of England and the institution of the privy council are coeval. At the Norman Conquest the king's council, or as it is now called, the privy council, was composed of certain members of the aristocracy and great officers of state, specially summoned by the crown, with whom the sovereign usually advised in matters of state and government. In the earlier stages of English constitutional history the king's councillors, as confidential servants of the monarch, were present at every meeting of parliament in order to advise upon matters judicial in the House of Lords; but in the reign of Richard II. the privy council dissolved its judicial connexion with the peers and assumed an independent jurisdiction of its own. It was in the reign of Henry VI. that the king's council first assumed the name of privy council, and it was also during the minority of this sovereign that a select council gradually emerged from the larger body of the privy council, which ultimately became the modern cabinet. Since the Revolution of 1688, and the development of parliamentary government, the privy council has dwindled into comparative insignificance. The power once swayed by the privy council is now exercised by that unrecognized select committee of the council known as the cabinet (*q.v.*). The practice of consulting a few confidential advisers instead of the whole privy council had been resorted to by English monarchs from a very early period; but the first mention of the term cabinet council in contradistinction to privy council occurs in the reign of Charles I., when the burden of state affairs was entrusted to the committee of state which Clarendon says was enviously called the "cabinet council." At first government by cabinet was as unpopular as it was irregular. Until the formation of the first parliamentary ministry by William III. the ministers of the king occupied no recognized position in the House of Commons; it was indeed a moot point whether they were entitled to sit at all in the lower chamber, and they were seldom of one mind in the administration of matters of importance. Before the Revolution of 1688 there were ministers, but no ministry in the modern sense of the word; colleague schemed against colleague in the council chamber, and it was no uncommon thing to see ministers opposing one another in parliament upon measures that in modern times would be supported by a united cabinet. As the change from government by prerogative to government by parliament, consequent upon the Revolution of 1688, developed, and the House of Commons became more and more the centre and force of the state, the advantage of having ministers in the legislature to explain and defend the measures and policy of the executive government began to be appreciated. The public authority of the crown being only exercised through the medium of ministers, it became absolutely necessary that the advisers of the sovereign, who were responsible for every public act of the Crown as well as for the general policy they had been called upon to administer, should have seats in both Houses of Parliament. Still nearly a century had to elapse before political unanimity in the cabinet was recognized as a political maxim. From the first parliamentary ministry of William III. until the rise of the second Pitt, divisions in the cabinet were constantly occurring, and a prime minister had more to fear from the intrigues of his own colleagues than from the tactics of the opposition. In 1812 an attempt was made to form a ministry consisting of men of opposite political principles, who were invited to accept office, not avowedly as a coalition government, but with an offer to the Whig leaders that their friends should be allowed a majority of one in the cabinet. This offer was declined on the plea that to construct a cabinet on "a system of counteraction was inconsistent with the prosecution of any uniform and beneficial course of policy." From that date it has been an established principle that all cabinets are to be formed on some basis of political union agreed upon by the members when they accept office together. It is now also distinctly understood that the members of a cabinet are jointly and severally responsible for each other's acts, and that any attempt to distinguish between a particular minister and his colleagues in such matters is unconstitutional.

During the 19th century the power of ministers was greatly extended, and their duties became more distinctly marked out. As now interpreted, the leading principles of the British constitution are the personal irresponsibility of the sovereign, the responsibility of ministers, and the inquisitorial and controlling power of parliament. At the head of affairs is the prime minister (*q.v.*), whose duties are more general than departmental, and the other members of the administration, whose work is exemplified by the titles of their offices (the more important of which are treated separately), are the lord high chancellor, the lord president of the council, the lord privy seal, the first lord of the treasury, the five secretaries of state (home, foreign affairs, colonies, war, India), the chancellor of the exchequer, the secretary for Scotland, the chief secretary to the lord-lieutenant of Ireland, the postmaster-general, the presidents of the board of trade, the local government board, the board of agriculture and the board of education (all of which were originally committees of the privy council), the chancellor of the duchy of Lancaster and the first lord of the admiralty. These are the more important members of the administration, and they are generally in the cabinet. The subordinate members of the administration, some of whom are occasionally invited to join the cabinet, while others are never in it, are the parliamentary and financial secretary to the admiralty, the parliamentary under-secretaries of the home, foreign, war, colonial and India offices, the board of trade, local government and board of education, the junior lords of the treasury (assistant "whips"), the financial secretary and patronage secretary to the treasury (the senior "whip"), the first commissioner of works, the paymaster-general, and the attorney-general and solicitor-general. There are in addition the lord advocate and the solicitor-general for Scotland, the lord-lieutenant and lord chancellor of Ireland (who are sometimes members of the cabinet), and the attorney-general and solicitor-general for Ireland.

TABLE OF LORD TREASURERS OR FIRST LORDS OF THE TREASURY

[The title was at first lord treasurer, except when the treasury was put in commission. Ultimately special rank was given to one of the commissioners as first lord of the treasury. From the time of the earl of Essex (1679) the name given is that of the first lords, with the exception of the three printed in italics. In modern times the first lord of the treasury has usually, but not invariably, been the head of the government or prime minister. A list of the Prime Ministers is given in the article PRIME MINISTER.

1603. Lord Buckhurst, cr. Earl of Dorset 1604.
1608. Earl of Salisbury.
1612. Earl of Northampton and others. (Commissioners.)
1614. Earl of Suffolk.
1618. Archbishop Abbot and others. (Commissioners.)
1620. Sir H. Montagu, cr. Viscount Mandeville 1620.
1621. Lord Cranfield, cr. Earl of Middlesex 1622.
1624. Sir J. Ley, cr. Lord Ley 1625, and Earl of Marlborough 1626.
1628. Lord Weston, cr. Earl of Portland 1633.
1635. Archbishop Laud and others. (Commissioners.)
1636. W. Juxon, Bishop of London.
1641. Sir E. Littleton and others. (Commissioners.)
1643. Lord Cottington.
1649. Interregnum.
1660. Sir E. Hyde and others. (Commissioners.)
1660. Earl of Southampton.
1667. Duke of Albemarle and others. (Commissioners.)
1672. Lord Clifford.
1673. Viscount Dunblane, cr. Earl of Danby 1674.
1679. Earl of Essex.
1679. Lord Hyde, cr. Earl of Rochester 1682.
1684. Lord Godolphin.
1687. Lord Bellasyse.
1689. Earl of Monmouth.
1690. Viscount Lonsdale.
1690. Lord Godolphin.
1697. C. Montagu, cr. Earl of Halifax 1700.
1699. Earl of Tankerville.
1700. Lord Godolphin.
1701. Earl of Carlisle.
1702. *Lord Godolphin.*
1710. Earl Poulett.
1711. *Earl of Oxford.*
1714. *Duke of Shrewsbury.*
1714. Earl of Halifax.
1715. Earl of Carlisle.
1715. Sir R. Walpole.
1717. Lord Stanhope.
1718. Earl of Sunderland.
1721. Sir R. Walpole.
1742. Earl of Wilmington.
1743. H. Pelham.
1754. Duke of Newcastle.
1756. Duke of Devonshire.
1757. Duke of Newcastle.
1762. Earl of Bute.
1763. G. Grenville.
1765. Marquess of Rockingham.
1766. Duke of Grafton.
1770. Lord North.
1782. Marquess of Rockingham.
1782. Earl of Shelburne.
1783. Duke of Portland.
1783. W. Pitt.
1801. H. Addington.
1804. W. Pitt.
1806. Lord Grenville.
1807. Duke of Portland.
1807. S. Perceval.
1812. Earl of Liverpool.
1827. G. Canning.
1827. Viscount Goderich.
1828. Duke of Wellington.
1830. Earl Grey.
1834. Viscount Melbourne.
1834. Sir R. Peel.
1835. Viscount Melbourne.
1841. Sir R. Peel.
1846. Lord J. Russell, cr. Earl Russell 1861.
1852. Earl of Derby.
1852. Earl of Aberdeen.
1855. Viscount Palmerston.
1858. Earl of Derby.
1859. Viscount Palmerston.
1865. Earl Russell.
1866. Earl of Derby.
1868. B. Disraeli.
1868. W. E. Gladstone.
1874. B. Disraeli, cr. Earl of Beaconsfield 1876.
1880. W. E. Gladstone.
1885. Sir Stafford Northcote, cr. Earl of Iddesleigh 1885 (prime minister, Marquess of Salisbury).
1886. W. E. Gladstone.
1886. Marquess of Salisbury.
1887. W. H. Smith (prime minister, Lord Salisbury).
1891. A. J. Balfour (prime minister, Lord Salisbury).
1892. W. E. Gladstone.
1894. Earl of Rosebery.
1895. A J. Balfour (prime minister, Lord Salisbury till 1902).
1905. Sir H. Campbell-Bannerman.
1908. H. H. Asquith.

TABLE OF LORD CHANCELLORS (C.) OR LORD KEEPERS (L.K.)

1603. Sir T. Egerton, L.K., cr. Lord Ellesmere 1603, and Viscount Brackley 1616.
1617. Sir F. Bacon, L.K., cr. Lord Verulam 1618, and Viscount St Albans 1621.
1621. J. Williams, Bishop of Lincoln, L.K.
1625. Sir T. Coventry, L.K., cr. Lord Coventry 1628.
1640. Sir J. Finch, L.K., cr. Lord Finch 1640.
1641. Sir E. Littleton, L.K., cr. Lord Lyttelton 1641.
1645. Sir R. Lane, L.K.
1649. Interregnum.
1660. Sir E. Hyde, C., cr. Lord Hyde 1660, and Earl of Clarendon 1661.
1667. Sir O. Bridgeman, L.K.
1672. Earl of Shaftesbury, C.
1673. Sir H. Finch, L.K., cr. Lord Finch 1674, C. 1675, cr. Earl of Nottingham 1681.
1682. Sir F. North, L.K., cr. Lord Guilford 1683.
1685. Lord Jeffreys, C.
1690. Sir J. Maynard and others. (Commissioners.)
1690. Sir J. Trevor and others. (Commissioners.)
1693. Sir J. Somers, L.K., C., cr. Lord Somers 1697.
1700. Sir N. Wright, L.K.
1705. W. Cowper, L.K., cr. Lord Cowper 1706, C. 1707.
1710. Sir T. Trevor and others. (Commissioners).
1710. Sir S. Harcourt, L.K., cr. Lord Harcourt 1711, C. 1713.
1714. Lord Cowper, C.
1718. Sir R. Tracy and others. (Commissioners.)
1718. Lord Parker, C., cr. Earl of Macclesfield 1721.
1725. Sir J. Jekyll and others. (Commissioners.)
1725. Lord King, C.
1733. Lord Talbot of Hensol, C.
1737. Lord Hardwicke, C., cr. Earl of Hardwicke 1754.
1756. Sir J. Willes and others. (Commissioners.)
1757. Sir R. Henley, L.K., cr. Lord Henley and C. 1760, Earl of Northington 1764.
1766. Lord Camden, C.
1770. Charles Yorke, C.
1770. Sir S. S. Smythe and others. (Commissioners.)
1771. Lord Apsley, C., succeeded as Earl Bathurst 1775.
1778. Lord Thurlow, C.
1783. Lord Loughborough and others. (Commissioners.)
1783. Lord Thurlow, C.
1792. Sir J. Eyre and others. (Commissioners.)
1793. Lord Loughborough, C., cr. Earl of Rosslyn 1801.
1801. Lord Eldon, C.
1806. Lord Erskine, C.
1807. Lord Eldon, C.
1827. Lord Lyndhurst, C.
1830. Lord Brougham, C.
1834. Lord Lyndhurst, C.
1835. Sir C. C. Pepys and others. (Commissioners.)
1836. Lord Cottenham, C.
1841. Lord Lyndhurst, C.
1846. Lord Cottenham, C.
1850. Lord Langdale and others. (Commissioners.)
1850. Lord Truro, C.
1852. Lord St Leonards, C.
1852. Lord Cranworth, C.
1858. Lord Chelmsford, C.
1859. Lord Campbell, C.
1861. Lord Westbury, C.
1865. Lord Cranworth, C.
1866. Lord Chelmsford, C.
1868. Lord Cairns, C.
1868. Lord Hatherley, C.
1872. Lord Selborne, C.
1874. Lord Cairns, C., cr. Earl Cairns 1878.
1880. Lord Selborne, C., cr. Earl of Selborne 1882.
1885. Lord Halsbury, C.
1886. Lord Herschell, C.
1886. Lord Halsbury, C.
1892. Lord Herschell, C.
1895. Lord Halsbury, C., cr. Earl of Halsbury 1898.
1905. Lord Loreburn, C.

TABLE OF SECRETARIES OF STATE

[The substitution of two secretaries for one was the consequence of the increase of business. There was no distinction of departments, each secretary taking whatever work the king saw fit to entrust him with During the reigns of the first two Stuarts, however, there was a tendency to entrust one secretary with the correspondence with Protestant states and their allies, and the other with the correspondence with Catholic states. Probably in the reign of Charles II., and certainly as early as 1691, two departments, the Northern and the Southern, were instituted. In 1782 the departments were changed to Home and Foreign. A third secretary of state was appointed in 1794, and he was called the Secretary for War and the Colonies from 1801 to 1854, when the work was divided, and the War and Colonial Secretaryships were instituted. The Secretary of State for India was appointed in 1858.]

1603.	Sir R. Cecil, cr. Lord Cecil 1603, Viscount Cranborne 1604, Earl of Salisbury 1605	
1612.	Vacant.	
1614.	Sir R. Winwood.	
1615.		Sir T. Lake.
1618.	Sir R. Naunton.	
1619.		Sir G. Calvert.
1623.	Sir E. Conway, cr. Lord Conway 1625.	
1625.		Sir A. Morton.
1625.		Sir J. Coke.
1628.	Viscount Dorchester.	
1632.	Sir F. Windebank.	
1640.		Sir H. Vane.
1641.	Sir E. Nicholas.	
1642.		Viscount Falkland.
1643.		Lord Digby.
1643.	Interregnum.	
1660.	Sir E. Nicholas.	Sir W. Morrice.
1662.	Sir H. Bennet, cr. Earl of Arlington 1665.	
1668.		Sir J. Trevor.
1672.		Henry Coventry
1674.	Sir J. Williamson.	
1678.	Earl of Sunderland.	
1680.		Sir L. Jenkins.
1681.	Lord Conway.	
1683.	Earl of Sunderland.	
1684.		S. Godolphin.
1684.		Earl of Middleton.
1688.		Viscount Preston.
1689.	Earl of Shrewsbury.	Earl of Nottingham.
1690.	Viscount Sidney.	
1692.	Sir J. Trenchard.	
1694.		Earl of Shrewsbury.
1695.	Sir W. Trumbull.	
1697.	J. Vernon.	
1700.	Sir C. Hedges.	Earl of Jersey.
1701.		Earl of Manchester.
1702.		Earl of Nottingham.
1704.		R. Harley, cr. Earl of Oxford 1711
1706.	Earl of Sunderland.	
1708.		H. Boyle, cr. Baron Carleton 1714.
1710.	Lord Dartmouth, cr. Earl of Dartmouth 1711.	H. St. John, cr. Viscount Bolingbroke 1712.
1713.	W. Bromley.	
1714.	J. Stanhope, cr. Earl Stanhope 1718	Viscount Townshend.
1717.	Earl of Sunderland.	J. Addison.
1718.	Earl Stanhope.	J. Craggs.
1721.	Viscount Townshend.	Lord Carteret.
1724.		Duke of Newcastle.
1730.	Lord Harrington.	
1742.	Lord Carteret, became Earl Granville 1744.	
1744.	Earl of Harrington.	
1746.	Earl Granville.	
1746.	Earl of Harrington.	
1746.	Earl of Chesterfield.	
1748.	Duke of Bedford.	
1751.	Earl of Holderness.	
1754.		Sir T. Robinson, cr. Baron Grantham 1761
1755.		H. Fox.
1756.		W. Pitt.
1761.	Earl of Bute.	
1761.		Earl of Egremont.
1762.	G. Grenville.	
1763.	Earl of Halifax.	Earl of Sandwich.
1765.	Duke of Grafton.	H. S. Conway.
1766.	Duke of Richmond.	
1766.	Earl of Shelburne.	
1768.		Viscount Weymouth.
1768.	Earl of Hillsborough, *Colonies.*	
1768.	Earl of Rochford.	
1770.		Earl of Sandwich.
1771.		Earl of Halifax.
1771.		Earl of Suffolk.
1772.	Earl of Dartmouth, *Colonies.*	
1775.	Viscount Weymouth, cr. Marquess of Bath 1789.	
1776.	Lord G. S. Germaine, *Colonies.*	
1779.		Viscount Stormont.
1779.	Earl of Hillsborough, cr. Marquess of Downshire 1789	
1782.	W. Ellis, cr. Baron Mendip, 1794, *Colonies.*	

	Home Department.	*Foreign Department.*
1782.	Earl of Shelburne.	C. J. Fox.
1782.	Lord Grantham.	T. Townshend, cr. Baron Sydney 1783
1783.	Lord North.	C. J. Fox.
1783.	Marquess of Carmarthen.	Earl Temple.
1783.		Lord Sydney.
1789.	W. W. Grenville, cr. Baron Grenville 1790.	
1791.	H. Dundas.	Lord Grenville.

	Home Department.	*Foreign Department.*	*War and Colonial Department.*
1794.	Duke of Portland	Lord Grenville	H. Dundas, cr. Visct. Melville 1802.
1801.	Lord Pelham, aft. Earl of Chichester	Lord Hawkesbury	Lord Hobart, aft. Earl of Buckinghamshire.
1803.	C. P. Yorke		
1804.	Lord Hawkesbury	Lord Harrowby	Earl Camden.
1805.		Lord Mulgrave	Viscount Castlereagh.
1806.	Earl Spencer	C. J. Fox	W. Windham.
1807.	Lord Hawkesbury, aft. Earl of Liverpool	G. Canning	Viscount Castlereagh.
1809.	R. Ryder	Earl Bathurst	
1809.		Marquess Wellesley	
1812.	Viscount Sidmouth (H. Addington)	Viscount Castlereagh, aft. Marquess of Londonderry	Earl Bathurst.
1822.	R. Peel	G. Canning	
1827.	W. S. Bourne	Earl of Dudley	Viscount Goderich.
1827.	Marquess of Lansdowne		W. Huskisson.
1828.	R. Peel	Earl of Aberdeen	Sir G. Murray.
1830.	Viscount Melbourne	Viscount Palmerston	Viscount Goderich, aft. Earl of Ripon.
1833.			E. G. S. Stanley, aft. Lord Stanley and Earl of Derby.
1834.	Viscount Duncannon, aft. Earl of Bessborough		T. Spring-Rice, aft. Lord Monteagle.
1834.	H. Goulburn	Duke of Wellington	Earl of Aberdeen.
1835.	Lord J. Russell	Viscount Palmerston	Lord Glenelg.
1839.			Marquess of Normanby.
1839.	Marquess of Normanby		Lord J. Russell.
1841.	Sir J. Graham, Bart.	Earl of Aberdeen	Lord Stanley.
1845.			W. E. Gladstone.
1846.	Sir G. Grey	Viscount Palmerston	Earl Grey.
1852.	Spencer H. Walpole	Earl of Malmesbury	Sir J. S. Pakington, aft. Lord Hampton.
1852.	Viscount Palmerston	Lord J. Russell	Duke of Newcastle.

	Home Department.	Foreign Department.	Colonial Department.	War Department.
1855.	Sir G. Grey	Earl of Clarendon	Sidney Herbert	Lord Panmure.
1855.	. . .	. . .	Lord J. Russell.	
1855.	. . .	. . .	H. Labouchere, aft. Lord Taunton	
1858.	S. H. Walpole	Earl of Malmesbury	Lord Stanley	Jonathan Peel.

	Home Department.	Foreign Department.	Colonial Department.	War Department.	India Department.
1858.	S. H. Walpole	Earl of Malmesbury	Sir E. G. E. L. Bulwer Lytton, cr. Baron Lytton 1866	Jonathan Peel	Lord Stanley.
1859.	T. H. S. Sotheron-Estcourt.	. . .	. . .		
1859.	Sir G. Cornewall Lewis	Lord J. Russell, cr. Earl Russell 1861	Duke of Newcastle	S. Herbert, cr. Lord Herbert of Lea 1861	Sir C. Wood, cr. Viscount Halifax 1866.
1861.	Sir G. Grey	. . .	. . .	Sir G. C. Lewis.	
1863.	. . .	. . .	. . .	Earl de Grey and Ripon, aft. Marquess of Ripon	
1864.	. . .	. . .	E. Cardwell		
1865.	. . .	Earl of Clarendon.			
1866.	S. H. Walpole	Lord Stanley, aft. Earl of Derby	Earl of Carnarvon	Jonathan Peel	Viscount Cranborne.
1867.	. . .	. . .	Duke of Buckingham	Sir J. S. Pakington, aft. Baron Hampton	Sir S. H. Northcote, cr. Earl of Iddesleigh 1885
1868.	H. A. Bruce, cr. Baron Aberdare 1873	Earl of Clarendon	Earl Granville	E. Cardwell, cr. Viscount Cardwell 1874	Duke of Argyll.
1870.	. . .	Earl Granville	Earl of Kimberley.		
1874.	Sir R. A. Cross	Earl of Derby	Earl of Carnarvon	G. Hardy	Marquess of Salisbury.
1878.	. . .	Marquess of Salisbury	Sir M. Hicks Beach, cr. Viscount St Aldwyn 1906	F. A. Stanley	G. Hardy, cr. Viscount Cranbrook 1878.
1880.	Sir W. Vernon Harcourt	Earl Granville	Earl of Kimberley	H. C. E. Childers	Marquess of Hartington.
1882.	. . .	. . .	Earl of Derby	Marquess of Hartington, aft. D. of Devonshire	Earl of Kimberley.
1885.	Sir R. A. Cross, cr. Viscount Cross 1886	Marquess of Salisbury	Sir F. A. Stanley, cr. Baron Stanley of Preston 1886, aft. Earl of Derby	W. H. Smith	Lord R. Churchill.
1886.	. . .	. . .	. . .	Viscount Cranbrook.	
1886.	H. C. E. Childers	Earl of Rosebery	Earl Granville	H. Campbell-Bannerman	Earl of Kimberley.
1886.	H. Matthews, cr. Viscount Llandaff 1895	Earl of Iddesleigh	E. Stanhope	W. H. Smith.	Viscount Cross.
1887.	. . .	Marquess of Salisbury	Sir H. T. Holland, cr. Viscount Knutsford 1895.	E. Stanhope.	
1892.	H. H. Asquith	Earl of Rosebery	Marquess of Ripon	H. Campbell-Bannerman	Earl of Kimberley.
1894.	. . .	Earl of Kimberley	. . .	. . .	H. H. Fowler, cr. Viscount Wolverhampton 1908.
1895.	Sir M. White Ridley, cr. Viscount Ridley 1900	Marquess of Salisbury	J. Chamberlain	Marquess of Lansdowne	Lord G. Hamilton.
1900.	C. T. Ritchie, cr. Baron Ritchie of Dundee 1905	Marquess of Lansdowne	. . .	Hon. W. St J. Brodrick, aft. Viscount Midleton	
1902.	A. Akers-Douglas.				
1903.	. . .	. . .	Hon. A. Lyttelton	H. O. Arnold-Forster	Hon. W. St J. Brodrick.
1905.	H. J. Gladstone, cr. Viscount Gladstone 1910	Sir E. Grey	Earl of Elgin	R. B. Haldane	J. Morley, aft. Viscount Morley of Blackburn.
1908.	. . .	. . .	Earl of Crewe.		
1910.	Winston S. Churchill.				

MINK, a name for certain large species of the zoological genus *Putorius* (Polecat), distinguished by slight structural modifications and semi-aquatic habits. The two best-known species, so much alike in size, form, colour and habits that, although they are widely separated geographically, some zoologists question their specific distinction, are *P. lutreola*, the *Nörz* or *Sumpfotter* (marsh-otter) of eastern Europe, and *P. vison*, the mink of North America. The former inhabits Finland, Poland and the greater part of Russia, though not found east of the Ural Mountains. Formerly it extended westward into central Germany, but it is now very rare, if not extinct, in that country. The latter is found in places which suit its habits throughout the whole of North America. Another form, *P. sibiricus*, from eastern Asia, of which much less is known, appears to connect the true minks with the polecats.

The name may have originated in the Swedish *maenk* applied to the European animal. Captain John Smith, in his *History of Virginia* (1626), at p. 27 speaks of "Martins, Powlecats, Weesels and Minkes," showing that the animal must at that time have been distinguished by a vernacular appellation from its congeners. By later authors, as Lawson (1709) and Pennant (1784), it is often written "Minx." For the following description, chiefly taken from the American form (though almost equally applicable to that of Europe) we are mainly indebted to Dr Elliott Coues's *Fur-bearing Animals of North America*, 1877.

In size it much resembles the English polecat—the length of the head and body being usually from 15 to 18 in., that of the tail to the end of the hair about 9 in. The female is considerably smaller than the male. The tail is bushy, but tapering at the end. The ears are small, low, rounded, and scarcely project beyond the adjacent fur. The pelage consists of a dense, soft, matted under fur, mixed with long, stiff, lustrous hairs on all parts of the body and tail. The gloss is greatest on the upper parts; on the tail the bristly hairs predominate. Northern specimens have the finest and most glistening pelage; in those from southern regions there is less difference between the under and over fur, and the whole pelage is coarser and harsher. In colour different specimens present a considerable range of variation, but the animal is ordinarily of a rich dark brown, scarcely or not paler below than on the general upper parts; but the back is usually the darkest, and the tail is nearly black. The under jaw, from the chin about as far back as the angle of the mouth, is generally white. In the European mink the upper lip is also white, but, as this occasionally occurs in American specimens, it fails as an absolutely distinguishing character. Besides the white on the chin, there are often other irregular white patches on the under parts of the body. In very rare instances the tail is tipped with white. The fur is important in commerce.

The principal characteristic of the mink in comparison with its congeners is its amphibious mode of life. It is to the water what the other weasels are to the land, or martens to the trees, being as essentially aquatic in its habits as the otter, beaver, or musk-rat, and spending perhaps more of its time in the water than it does on land. It swims with most of the body submerged, and dives with perfect ease, remaining long without coming to the surface to breathe. It makes its nest in burrows in the banks of streams, breeding once a year about the month of April, and producing five or six young at a birth. Its food consists of frogs, fish, fresh-water molluscs and crustaceans, as well as mice, rats, musk-rats, rabbits and small birds. In common with the other animals of the genus, it has a very peculiar and disagreeable effluvium, which, according to Dr Coues, is more powerful, penetrating and lasting than that of any animal of the country except the skunk. (W. H. F.)

MINNEAPOLIS, the largest city of Minnesota, U.S.A., and the county-seat of Hennepin county, situated on both banks of the Mississippi river at the Falls of St Anthony and immediately above St Paul. Pop. (1870), 13,066; (1880), 46,887; (1890), 164,738; (1900), 202,718; (1910 census) 301,408. Of the total population in 1900, those of foreign parentage (both parents foreign-born) numbered 118,946, and there were 61,021 of foreign birth, including 20,035 Swedes, 11,532 Norwegians, 7335 Germans, 5637 English-Canadians, 3213 Irish, 2289 English, 1929 Russians, 1706 French-Canadians and 1133 Austrians. Minneapolis is served by the Chicago, Burlington & Quincy, the Chicago, Great Western, the Chicago, Milwaukee & St Paul, the Chicago & Northwestern, the Chicago, Rock Island & Pacific, the Great Northern, the Minneapolis & St Louis, the Minneapolis, St Paul & Sault Sainte Marie, and the Northern Pacific railways. It has also three terminal switching lines and the belt line of the Minnesota Transfer Company, serving both Minneapolis and St Paul. With St Paul, which is served by the same system of railways, Minneapolis is the chief railway centre of the Northwest and one of the greatest in the United States, being the principal gateway to the commerce of the Canadian and Pacific north-west. There are a Union passenger station, and separate stations for the Chicago, Milwaukee & St Paul, the Chicago, Great Western and the Minneapolis & St Louis railways.

The city is situated on a high plateau (800–850 ft. above sea-level) above the river, and covers an area of about 53 sq. m. It has an extensive system of boulevards, parkways and parks (aggregating 2465 acres in 1908). Among the parks are Loring, near the centre of the city, in which is a statue of Ole Bull; Lyndale, in the south-west part of the city; Interlachen, just north-west of Lyndale; Glenwood, in the west of the city; Van Cleve, Logan, Windom and Columbia in the part of the city east of the Mississippi river; Riverside, on the south-west bank of the Mississippi; and Minnehaha Park, in which are the Minnehaha Falls, a beautiful cascade of the Minnehaha Creek (the outlet of Lake Minnetonka), near the Mississippi, with a fall of 50 ft., well known from Longfellow's poem "Hiawatha." The numerous small lakes in the city (there are about 200 lakes in Hennepin county) have been incorporated in the park system; among them are Lake Harriet (353 acres; in Lake Harriet Park), Lake Calhoun (on which are extensive public baths), Lake Amelia (295 acres), Lake of the Isles (100 acres), Cedar Lake, Powder Horn Lake (in the park of that name) and Sandy Lake (in Columbia Park). Adjoining Minnehaha Park are the grounds (51 acres, given to the state by the city) and buildings of the Minnesota state soldiers' home (1887); and 2 m. beyond the Falls, at the junction of the Minnesota and Mississippi rivers, is the Fort Snelling Military Reservation (1819). Seven miles south-west of the limits of the city is Lake Minnetonka, one of the most famous summer resorts in the Northwest, a beautiful body of water 15 m. long, with a shore line of 150 m. encircled by undulating wooded hills. Among the most fashionable streets are Mount Curve, Clifton and Park avenues, all in the "West Division" or south-western quarter of the city. The streets in all parts of the city are of exceptional width and heavily shaded in the residential districts. There are handsome residential suburbs. The court-house and city-hall, constructed of red Minnesota granite and completed in 1902 at a cost of about $3,500,000, is one of the finest municipal buildings in America. Other prominent buildings are the Masonic Temple, the Chamber of Commerce, the Lumber Exchange, the Bank of Commerce, the Auditorium; the buildings of the Metropolitan Life (formerly the Guaranty), the Security Bank, the Northwestern National Bank, the First National Bank, the Andrus, the New York Life, and the Young Men's Christian Association; Hotel Radisson and West Hotel. Minneapolis is the see of a Protestant Episcopal bishopric. On the east side of the river are the buildings of the university of Minnesota (*q.v.*). In Minneapolis are the Minneapolis College of Physicians and Surgeons (1883), the medical school of Hamline University; Augsburg Seminary (Norwegian Lutheran, 1869), the United Church Seminary (1890), the Minnesota College (Swedish, 1905), the Minneapolis Normal School for Kindergartners, the Froebellian Kindergarten Normal School, Graham Hall and Stanley Hall, the Minneapolis School of Music, Oratory and Dramatic Art, and the Northwestern Conservatory of Music. Between Minneapolis and St Paul are the main buildings of Hamline University (Methodist Episcopal, co-educational, 1854). The public library (more than 180,000 volumes in 1908) grew out of a private library, the Athenaeum (1860), was reorganized by Herbert Putnam (librarian from 1887 to 1891), and has several branches, the most notable of which is the Pillsbury Library (1904) on the east side; in its main building (Hennepin Avenue and 10th Street) are the offices of the Minnesota Academy of Natural Sciences (1873), which, with the Society of Fine Arts, assisted in erecting the building in 1884. Among the hospitals and charitable institutions are the Minneapolis city hospital, the state hospital for crippled and deformed children, and Asbury Methodist, the Northwestern, the Deaconess', the Swedish, the St Mary's, the Maternity and the St Barnabas hospitals, Bethany Home, the Catholic orphan asylum, the Washburn orphans' home, the Pillsbury House (1906) where settlement work is carried on by the Plymouth Congregational Church, and several free dispensaries. The first newspaper in the city was the St Anthony *Express*, which began publication in 1851; it is no longer in existence. In 1906 the city had, in addition to numerous weekly and monthly periodicals (English, Norwegian-Danish, Swedish, German, French), four dailies, the *Tribune* (1867), the *Journal* (1878), and the *News* (1903), all in English, and the *Tidende* (Norwegian-Danish), established as a weekly in 1851.

The Mississippi river, which here has an average width of about 1200 ft., is crossed by 17 bridges (9 highway and 8 railway bridges). The Federal government undertook to deepen the channel by dredging and by making two dams and two locks between the Chicago, St Paul, Minneapolis & Omaha railway bridge in St Paul and the Washington Avenue bridge in Minneapolis—a distance of 11·4 m.—from 2 or 3 ft. to 6 ft., and to make the river regularly navigable as far as the Washington Avenue bridge, Minneapolis; the project, first adopted in 1894 and modified in 1907, was 70% completed in July 1908, and up to that time $1,061,397 had been spent on the work. The enormous water-power of the Falls of St Anthony, yielding about 40,000 h.p., has been the principal factor in making Minneapolis a great manufacturing centre. The rapid erosion of the soft limestone bed at one time threatened the destruction of the power, but this has been prevented by an enormous apron and an artificial concrete floor (completed in 1879). Additional water-power (25,000 h.p.) is derived from Taylor's Falls on the St Croix river. The proximity of the rich wheatfields of the north-west, and the extensive timber forests, have made Minneapolis the greatest lumber and flour centre in the world. The importance of the flour manufacturing industry was originally due to the excellent water-power available, and dates from the introduction of improved roller-mill methods in the early 'seventies, although there were successful mills in operation twenty years earlier. The enormous flour-mills of Minneapolis (22 in 1907) are perhaps the most interesting sights of the city. Their aggregate daily capacity is over 80,000 barrels, the largest of them having a capacity of 15,000 to 16,500 daily. In 1905 the value of the city's flour and grist mill products was $62,754,446, 51·6 % of the total value of the city's factory product, and 8·8 % of the value of the flour and grist mill products of the entire United States. Food preparations were valued in 1905 at $1,361,492. Minneapolis is also the greatest primary wheat market in the world, its 40 or more elevators (of which those of the Washburn-Crosby Company, erected in 1907, are the largest) having a net capacity of about 35,000,000 bushels, and handling more than 90,000,000 bushels in 1908. Its commerce in other grains is also extensive; in the amount of barley received and shipped Minneapolis surpasses any other city in the United States, and in receipts and shipments of rye is second only to Chicago. The Mississippi river above Minneapolis is made to serve, by means of a series of extensive log-booms, as the principal source of supply to the great saw-mills, of which there are here some of the largest in the world, with a combined capacity of 3,500,000 ft. a day, and with an average annual cut of 575,000,000 ft. The total value of the lumber products in 1905 was $9,960,842 (lumber and timber, $5,816,726; planing-mill products, including sash, doors and blinds, $4,144,116). Other important manufactures with the product-value of each in 1905 were malt liquors ($1,185,525), foundry and machine shop products ($2,820,697), structural iron-work ($1,991,771), steam railway car construction and repairing ($2,027,248), patent medicines ($1,715,889), furniture ($1,238,324), cooperage ($1,415,360), and hosiery and knit goods ($957,455). The total value of the factory product was $94,407,774 in 1900, and $121,593,120 in 1905, an increase of 28·8 %; in 1905 the value of the factory product was 39·5 % of that of the entire state.

Minneapolis is governed under a charter adopted in 1872 (when St Anthony and Minneapolis were consolidated) and frequently amended. It provides for the election of a mayor, treasurer and comptroller for two-years terms; for elected boards of control for library, parks and education, and for a unicameral city council, half of which is chosen every two years for a term of four years. The mayor, whose veto may be nullified by an adverse vote of two-thirds of the council, has very limited appointing powers, the head of the police department being the most important of his appointees. The city council elects the city clerk, city attorney, city engineer, chief of the fire department and most of the minor officers. Under a provision of the charter adopted in 1887 saloons are not permitted outside the "patrol limits of the business district"; so that there are no saloons in the residential districts of the city. The municipality owns the waterworks system, the water supply being obtained from the Mississippi river.

History.—The first recorded visit of a European to the site of Minneapolis was that of Father Louis Hennepin, the French Jesuit missionary, who discovered and named the Falls of St Anthony in 1680; but it is almost certain that he was preceded by some of the adventurous *coureurs des bois*, few of whom left records of their extensive wanderings, and Radisson and Groseilliers seem to have visited this region two decades before Hennepin. The land on which the city lies, being divided by the Mississippi river, was for many years under different sovereignties, the east side becoming United States territory at the close of the War of Independence, while the west side, after being under Spanish and French rule, did not become a part of the United States until the purchase of Louisiana in 1803. In 1766 the site was visited by the American traveller, Jonathan Carver, and in 1805 by Lieut. Zebulon M. Pike; the military reserve which Pike bought from the Indians included a greater portion of the west side of the present city. After the erection of Fort St Anthony (1819; later called Fort Snelling), a water-power saw-mill was erected (1822) to saw lumber for the fort on the east bank of the river at the Falls of St Anthony. Later flour was also ground in this mill, which thus became the forerunner of the greatest of the city's industries. Gradually as the Indian land titles became extinguished the east bank was settled. The first settlement on the west bank was made by Colonel John H. Stevens in 1850, but the land was not opened to settlers until 1855. The village of St Anthony, on the east side of the river, was incorporated in 1855; Minneapolis, on the west bank, was incorporated in 1856. St Anthony became a city in 1860, and Minneapolis, which then had only 2564 inhabitants, soon outstripped its neighbour after the Civil War, and received a city charter in 1867. In 1870 Minneapolis alone had 13,066 inhabitants (18,079 with St Anthony), and in 1872 the two cities were united under the name of Minneapolis. The Republican National Convention met in Minneapolis in 1892 and renominated President Benjamin Harrison.

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MINNESINGERS (Ger. *Minnesänger* from *Minne*, love), the name given to the German lyric poets of the 12th and 13th centuries. The term *Minnesang*, strictly applicable to the poems expressing the homage (*Minnedienst*) rendered by the knight to his mistress, is applied to the whole body of lyric poetry of the period, whether dealing with love, religion or politics. The idea of *amour courtois*, with its excessive worship of woman, its minute etiquette and its artificial sentiment, was introduced into German poetry from Provençal literature; but the German *Minnesang* was no slavish imitation of the poetry of the troubadours. Its tone was, on the whole, far healthier and more sincere, reflecting the difference between the simple conditions of German life and the older and corrupt civilization of Provence. The minnesinger usually belonged to the lower ranks of the nobility, and his verses were addressed to a married woman, often above him in rank; consequently the commonest lyric themes are the lover's hopeless devotion and complaints of the lady's cruelty, expressed with a somewhat wearisome iteration. That real passion was sometimes present may be safely assumed, but it was not within the rules of the game, which corresponded fairly closely to the later sonneteering conventions. The poet was not permitted to give the lady's name, or to betray her identity; and a direct expression of passion would also have contravened the rules. The poems were from the first sung in open court to a melody (*Weise*) of the poet's own composing, with the accompaniment of a fiddle or small harp. That the minnesinger was no improvisatore is evident from the complicated forms of his verse, which were partly borrowed from the Provençal, but possibly owed something to the Latin rhymed verse[1] of the wandering scholars. The older songs consisted of a single strophe cast in three divisions, two (known as *Stollen* or doorposts) identical in form, stating and developing the argument, the third (*Abgesang*) of different form, giving the conclusion. Later on, two or more strophes were used in a single poem, but the principle of their structure was retained. In this form were cast the *Tagelied*, a dialogue describing the parting of lovers at dawn; and the crusading song. Side by side with these existed the *Spruch*, written in a single undivided stanza, destined for recitation and often cast in the form of a fable. The lay (*Leich*) was written in unequal strophes, each formed of two equal divisions. It was applied in the first instance to sacred lyrics, and was first used in love poems by the Alsatian minnesinger Ulrich von Gutenberg.

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[1] See the *Carmina Burana*, ed. J. A. Schmeller, 4th ed., Breslau, 1904.

The origin of the native lyric, which flourished especially in Austria and Bavaria, is perhaps to be sought in the songs which accompanied dancing. These were not necessarily love songs, but celebrated the coming of spring, the gloom of winter &c., the commonplaces of *Minnesang* throughout the two centuries of its existence. The older lyrics, which date from the middle of the 12th century, are simple in form and written in the ordinary epic metres. The earliest minnesinger whose name has come down to us is Der von Kürenberg (*fl.* *c.* 1160), a scion of an Austrian knightly family whose castle lay on the Danube, west of Linz. These songs, however, contradict the root idea of *Minnedienst*, since the lady is the wooer, and the poet, at the most, an acquiescent lover. They take the form of laments for an absent lover, complaints of his faithlessness and the like. Among the other Austrian and south German lyrists who show small trace of foreign influence was Dietmar von Aist (d. *c.* 1171), though some of the songs attributed to him seem to be of later date. While the love-song remained in the hands of noble singers, the *Spruch* was cultivated by humbler poets. The elder of the two or three poets concealed under the name of Spervogel was a wandering singer who found patronage at the court of the burgraves of Regensburg, one of whom himself figures among the earlier minnesingers.

The characteristic period of German *Minnesang* begins at the close of the 12th century with the establishment of the Provençal tradition in western Germany through the poems of Heinrich von Veldeke and Friedrich von Hausen. National elements abound in Veldeke's songs, although the *amour courtois* dominates the whole; Friedrich von Hausen (d. 1190) followed Provençal models closely. The long crusading song *Sie darf mich des Zîhen niet*, is a good example of his powers. A close disciple of the troubadours Peire Vidal and Folquet de Marseille was the Swiss Count Rudolf von Fenis.[1] The greatest name among the earlier minnesingers is that of Heinrich von Morungen, a Thuringian poet who lived on in popular story in the ballad of "The Noble Moringer." He brought great imaginative power to bear on the common subjects of *Minnesang*, and his poetry has a very modern note. The formal art and science of *Minnesang* reached full development in the subtle love-songs of Reinmar, the Alsatian "nightingale of Hagenau." Uhland aptly called him the "scholastic philosopher of unhappy love." As a metrist he developed a greater correctness of rhyme, and a better handling of German metres. He became a member of the court of Duke Leopold V. (d. 1194) of Austria, and there Walther von der Vogelweide (*q.v.*) was first his disciple, and then perhaps his rival. Walther, the greatest of medieval German lyric poets, had Reinmar's technical art, but in feeling was more nearly allied to Morungen. He raised the *Spruch* to the dignity of a serious political poem, which proved a potent weapon against the policy of Innocent III. In 1202 at the court of Hermann, landgrave of Thuringia, he met Wolfram von Eschenbach, who is said to have taken part in the tourney of poets known as the *Wartburgskrieg*, made world-famous through Wagner's *Tannhäuser*. The *Tagelieder* of Wolfram give him a high place in *Minnesang*, although his fame, like that of Heinrich von Veldeke and Hartmann von Aue, chiefly rests on his epics. A new style—called by Lachmann *höfische Dorfpoesie*—was marked out by Neidhart von Reuental (d. *c.* 1240), who belonged to the lesser Bavarian nobility. He wrote songs to accompany the dances of the village beauties, and comic and realistic descriptions of village life to please the court. He was acknowledged by the Meistersinger as one of the twelve masters of song. Nevertheless, with him the decadence may be said to have begun.

The Styrian poet Ulrich von Lichtenstein (d. *c.* 1275) unconsciously caricatured chivalry itself by his *Frauendienst*, in which he relates the absurd feats which he had undertaken at his lady's command, while Steinmar (*fl.* 1276) deliberately parodied court poetry in his praises of rustic beauty and good living. In the lays, songs and proverbs of Tannhäuser something of both elements, of the court and the village, is to be found. He seems to have lived as a wandering singer until 1268, and there very soon grew up round his name the Tannhäuser myth which has so little foundation in his life or poetry. The Austrian poet Reinmar von Zweter (d. *c.* 1260) left some hundreds of *Sprüche* political or social in their import. Among the princes who practised *Minnesang* were the emperor Henry VI., though the two songs preserved under his name are of doubtful authenticity, Duke Henry IV. of Breslau (*fl.* 1270–1290), King Wenceslaus II. of Bohemia, the margrave Otto IV. of Brandenburg, Wizlaw IV., prince of Rügen and the unhappy Conradin, the last of the house of Hohenstaufen, beheaded by the order of Charles of Anjou before he reached his seventeenth year.

The didactic motive came more and more to the front in the 13th century. The wandering Swabian poet Marner (d. *c.* 1270) cultivated especially the *Spruch*, laughed at the Provençal and courtly tradition, and there is no very great step from his learning and his feuds to the conditions of *Meistersang*. Heinrich von Meissen (1250–1319), known as "Frauenlob" ("ladies' praise"), was one of the last minnesingers, and his pedantry and virtuosity entitle him to be called the first meistersinger.

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MINNESOTA, a North Central State of the United States of America. It is bounded on the S. by Iowa, on the W. by South and North Dakota—the Red River (commonly called the Red River of the North) separating it from the latter state—on the N. by the Canadian provinces of Manitoba and Ontario, being separated from the latter by the Lake of the Woods, Rainy River and Rainy Lake, and certain of their tributaries and outlets, and on the E. by Lake Superior and by Wisconsin, from which it is separated for the greater part of the distance by the Mississippi and St Croix rivers. It is the tenth state in size in the Union, with a total area of 84,682 sq. m., of which 3824 sq. m. are water surface.[2] From north to south it is about 400 m. in length, extending from 43° 30′ to 49° 23′ 55″ N. lat., and from east to west its width is about 354 m., lying between long. 89° 29′ and 97° 15′ W.

The north-east part of the state is included in the Great Lakes Province, and the southern and western parts are in the Prairie Plains Province. The whole area of the state was formerly a complexly folded mountainous region of strong relief, which was afterwards worn down to a more nearly level surface, except in the extreme north-east corner, where ridges of harder rock resisted erosion. Marine deposits were laid down over the south of the state after a submergence of the region; an uplift afterwards made of these deposits a coastal plain. The rather level surface of the "worn down mountains" of the north of the state and the coastal plain beds of the southern and western parts are now dissected by rivers, which make most of the state a rolling or hilly country, without strong relief. The average elevation is about 1275 ft. above sea-level or 600 ft. above the surface of Lake Superior. An extensive water-parting in the north central part of the state, an elevation whose inclination is almost imperceptible, determines the course of three great continental river systems. From this central elevation the land slopes off in all directions, rising again in the extreme north-east corner, where the rugged granite uplift in Cook county, known as the Misquah Hills, reaches an altitude of 2230 ft., the highest point in the state; and in the south-west corner, where an altitude of 1800 ft. is reached in the Coteau des Prairies. Only in the valleys of the Red, Minnesota and Mississippi rivers does the elevation fall below 800 ft. In the southern and central portions of the state open rolling prairies interspersed with groves and belts of oak and other deciduous hard-wood timber predominate. A little north of the centre the state is traversed from north-west to south-east by the extensive forest known as the "Big Woods," in which also oak occurs most frequently. In the northern part of the state the great pine belt stretches from the head of Lake Superior westward to the confines of the Red River Valley, while along the north border and in the north-east the forest growth is almost exclusively tamarack and dwarf pine. More than three-fourths of the area of the state is arable, the small percentage of non-arable land lying principally in the north-eastern regions, which afford compensation in the form of rich mineral deposits. Of the three great continental river systems above mentioned, the Red River and its tributaries drain the western and west central slope northward through Lake Winnipeg into Hudson Bay; the other two being the St Lawrence system, to which the St Louis River and its branches and several smaller streams flowing into Lake Superior contribute their waters by way of the Great Lakes and the Mississippi, which with its tributaries drains about two-thirds of the state into the Gulf of Mexico. A few rivers in the south drain into the Mississippi through Iowa, while a smaller area in the extreme north is drained through the Lake of the Woods and Rainy Lake into Hudson Bay. These river systems serve the threefold purpose of drainage, providing water communications (there being about 3000 m. of navigable waters in the state), and, by falls and rapids caused by glacial displacement of rivers, furnishing a magnificent volume of water-power. The Mississippi river, which flows for about 800 m. within or along the borders of the state, has its principal sources in and near Lake Itasca. It affords facilities for the transport of logs by means of booms above Minneapolis, and is navigable below St Paul; being half a mile broad where it reaches the border of the state at Hastings. At the Falls of St Anthony, St Cloud, Little Falls and other places, it provides ample water-power for manufacturing purposes. Its two principal tributaries are the St Croix and the Minnesota. The first, after having for about 135 m. (about 50 being navigable) formed the boundary between Wisconsin and Minnesota, enters the Mississippi at Hastings; the second, rising in Big Stone Lake on the western border, but 1 m. from Lake Traverse, the source of the Red River, enters the Mississippi from the south-west between St Paul and Minneapolis after a course of about 450 m., about 240 of which are navigable at high water. Both furnish valuable water-power, which is true also of the Cannon and Zumbro rivers flowing into the Mississippi below Hastings. The Red River, which forms the western boundary of the state for more than half its distance, has its source in Lake Traverse. Its most important branch is the Red Lake River, and both are navigable for vessels of light draught at high water. In the south the western fork of the Des Moines River, flowing for 125 m. through the state, is navigable for 20 m. Glacial action determined the direction and character of the rivers, made numerous swamps, and, by scouring out rock basins, damming rivers and leaving morainal hollows, determined the character and formation of the lakes, of which Minnesota has upwards of 10,000, a number probably exceeding that of any other state in the Union. The general characteristics of the lakes in the north differ from those of the south, the former being generally deep, with ragged rocky shores formed by glacial scouring which caused rock basins, the latter being mostly shallow. The most interesting feature of the glacial epoch is the extinct Lake Agassiz, which the receding ice of the later glacial period left in the Red River Valley of Minnesota, North Dakota and Manitoba. This lake drained southward into the Gulf of Mexico via the Minnesota and Mississippi rivers, until the ice sheet which had prevented its natural drainage to the north had melted sufficiently to allow it to be drained off into Hudson Bay by way of the Nelson River. The remarkably level character of the Red River district is due to horizontal deposits in the bottom of this lake, which have been little dissected by river erosion. The largest of the present lakes, Red Lake, in Beltrami county, has an area of 342 sq. m. Other large lakes are Mille Lacs (198 sq. m.) in Mille Lacs and Aitkin counties; Leech Lake (184 sq. m.) in Cass county; Lake Winnibigashish (82 sq. m.) in Itasca county; and Vermilion Lake (66 sq. m.) in St Louis county. On the northern boundary are the Lake of the Woods (612 sq. m.) and Rainy Lake (148 sq. m.), draining northwards into Hudson Bay. The beautiful "Park Region," centring in Ottertail county, contains several thousand lakes. Several large lakes such as Pepin, Traverse and Big Stone are river expansions. The state supports three parks—Itasca state park (22,000 acres, established in 1891), about the sources of the Mississippi, in Clearwater, Becker and Hubbard counties; the St Croix (established in 1895), in Chicago county, across the St Croix from the Wisconsin state park of the same name, and including the beautiful Dalles of the St Croix; and the Minneopa state park (established in 1905), containing Minneopa Falls, near Mankato.

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[1] Rudolf II., count of Neuenburg (d. 1196), or, according to some, a nephew of his who died in 1257.

[2] In addition the state contains approximately 2514 sq. m. of Lake Superior.

Flora and Fauna.—The flora and fauna are similar to those of the other states of the same latitude. The rapid settling of the state drove its native fauna, which comprised buffalo, deer, moose, bear, lynx and wolves, in great numbers into the northern sections, westward into Dakota, or across the Canadian border. Deer and moose are still found in the state. The preservation of game is now enforced by stringent game laws, administered by an efficient state Game and Fish Commission. The fisheries, which are of great value, are carefully supervised and systematically replenished from the State Fish Hatchery at St Paul, and the Federal Fish Hatchery maintained at Duluth, in which particular attention is devoted to the fish of Lake Superior. Minnesota ranked third among the states of the Union in 1900 in the production of lumber, but in 1905 was fifth, the supply having diminished and the industry having been developed in the states of Washington and Louisiana. The danger of loss from forest fires, such as that of 1894, emphasized the necessity of forest preservation, and resulted (1895) in the creation of a special state department with a forest commissioner and five wardens with power to enforce upon corporations and individuals a strict observance of the forestry laws, the good effects of the law being evidenced by the fact that the fire losses in forest lands for the first twelve years of its operation averaged only $31,000 a year. Furthermore, in order to encourage the growth and preservation of the forests, and to create systematically forest reserves, the legislature established in 1899 a State Forestry Board. There are two national forest reserves, with an aggregate area of 1882 sq. m.

Climate.—Minnesota has the characteristic climate of the North Central group of states, with a low mean annual temperature, a notably rarefied atmosphere that results in an almost complete absence of damp foggy weather, and an unusual dryness which during the rather long winters considerably neutralizes the excessive cold. The cold increases not only from south to north, but to some extent from east to west. The mean annual temperature, according to the reports of the U.S. Weather Bureau, varies from 45° F. at St Paul and points in the south of the state to 37° F., at points in the north-east and as far south-west as Moorhead, Clay county. In the south the season is usually without killing frost from early in May to late in September, but in the north it is not uncommon late in May or early in September. The amount of rain decreases from east to west, the mean annual rainfall being 32·7 in. at Grand Meadow in the south-east and 33·3 in. at Mount Iron in the north-east, but less than 25 in. at several points of observation in the western half of the state. In all sections about as much, or even more, rain falls in summer as in both autumn and winter, and the summer rains, together with the long summer days, are very favourable to a rapid growth and early maturity of crops. Nearly the whole state is usually covered with snow during the greater part of winter, and the mean annual fall of snow varies from about 52 in. at points in the north-east to less than 25 in. in the south-west. In most localities the prevailing winds are north-west in winter and southerly in summer, but at Duluth, on the shore of Lake Superior, they are south-west during November, December and January and north-east during all other months.

Soil and Minerals.—The surface drifts of the greater part of the state, which are almost wholly of glacial origin, have provided Minnesota with a remarkably fertile soil. It consists largely of a dark brown or black sandy loam, finely comminuted, the richness of which in organic matter and mineral salts induces rapidity of growth, and the strength and durability of which render it capable of a long succession of crops. This soil prevails throughout the southern counties and the Minnesota and Red River valleys, in which sections cereal crops predominate. Toward the east central part of the state there is a somewhat less fertile sandy soil, which is devoted more largely to potatoes and similar crops. The non-arable north-east portion of the state is covered with a coarse granite drift. Underneath the surface are beds of sand, gravel and clays, the last affording material for the manufacture of brick, tiles and pottery. The rock formations of the state furnish building stones of great value.

Minnesota ranked first among the states in 1902 in the production of iron ore. Although the iron ranges in the north-east had been explored about 1860 and were known to contain a great wealth of ore, it was not until 1884 that mining was actually begun on the Vermilion Range. Since that date the development of iron mining in Minnesota has been remarkable, and the increase both in volume and value of the output has been practically uninterrupted. Eight years later (1892) the much richer Mesabi Range, the most productive iron range in the world, was opened up; it soon surpassed the Vermilion in its output, and by 1902 the product was nearly ten times greater. The ore, which in many places is found in an almost pure state, is at or near the surface and the process of mining is one of great simplicity and ease. The quality of ore in the two ranges differs somewhat, that mined from the Vermilion Range being a hard specular or red haematite, while that taken from the Mesabi Range, largely red haematite, is much softer and in many localities quite finely comminuted.

Agriculture.—The principal industry of Minnesota is agriculture. Large areas of swamp lands in the central and north central parts of the state once counted non-arable have been drained and reclaimed. There were in 1900 154,659 farms aggregating 26,248,498 acres, of which 70·3% was improved land; the total value of farm property was $788,684,642, an increase in value of $373,983,016, or more than 90%, for the decade 1890–1900. The value of domestic animals on farms and ranges was $86,620,643. The total value of farm products for the year 1899 (census of 1900) was $161,217,304. Geographically the wheat-raising area extends across the entire south of the state—the Minnesota Valley and the Red River Valley—the rich glacial loam of which renders it one of the most productive wheat regions in the world. Other important crops in the order of their value are oats, hay and forage, Indian corn, barley, flax-seed, potatoes, rye, grass seeds, wild grass, clover, beans, peas, and miscellaneous vegetables and orchard products. Both fruit-raising and dairying interests are centred principally in the southern half of the state.

Manufactures and Commerce.—The extraordinary numbers of utilizable water-powers, the unusual transport facilities affording ample means of reaching the great markets, and finally the proximity to the raw materials of manufacture, have made Minnesota of great importance as a manufacturing state. The federal census showed for the decades 1880–1890 and 1890–1900 an increase in the number of manufacturing establishments from 3493 in 1880 to 7505 in 1890, and 11,114 in 1900. During the same period the capital invested increased from $31,004,811 in 1880 to $127,686,618 in 1890 and $165,832,246 in 1900, and the value of the manufactured products increased from $76,065,198 in 1880 to $192,033,478 in 1890 and $262,655,881 in 1900. The wonderful development of Minnesota as a flour-producing state began with the introduction of improved roller processes after 1870. Minneapolis is the chief flour-making centre of the world, and the cities at the "Head of the Lakes" (Duluth, Minnesota, and Superior, Wisconsin, considered industrially as one place) constitute the second largest centre. The towns of the Red River Valley, which are nearer to the great wheat belt, give promise of developing into great flouring cities. Next to flour, lumber and timber products rank in importance. Other manufactures of importance are butter, cheese and condensed milk, packed meats and other slaughter-house products, steam railway cars, foundry and machine-shop products, linseed oil, malt liquors, planing-mill products, sash, doors and blinds, boots and shoes, and agricultural implements. As compared with other states of the Union Minnesota ranked third in 1900 and fifth in 1905 in lumber; sixth in 1900 and fifth in 1905 in cheese, butter and condensed milk; eighth in 1900 and in 1905 in agricultural implements; and fourteenth in 1900 and eighth in 1905 in planing-mill products.

For an inland state Minnesota is exceptionally well situated to play a chief part in the commercial life of the country, and various causes combine to make it important in respect to its interstate and foreign trade. It is the natural terminal of three great northern transcontinental railway lines—the Northern Pacific, the Great Northern, and the Chicago, Milwaukee & Puget Sound (the extension of the Chicago, Milwaukee & St Paul system); and the Chicago, Burlington & Quincy and the connecting lines of the Canadian Pacific form lines of communication with the middle Northwest and the Pacific provinces of Canada. Seven navigable rivers within or on the borders of the state—the Red River of the north, the Red Lake River, Rainy River, the Minnesota, the Mississippi, the St Croix and the St Louis[1]—give facilities for transport by water that exert an important competing influence on freight charges; and at the "Head of the Lakes" (Duluth-Superior) many lines of steamships on the Great Lakes, providing direct or indirect connexion with the Eastern and Southern states, make that port in respect to tonnage the first in the United States. This combination of natural and artificial highways of commerce derives an additional importance from the character of the regions thus provided with transport facilities, which renders its cities the principal distributing centres both for the entire Northwest for coal shipped via the Great Lakes, and also for the eastern and middle Western states for the great staples, wheat and lumber, derived either from Minnesota itself or by means of its great transcontinental railways from the neighbouring Northwestern states and Canadian provinces. Iron shipments from the Mesabi and Vermilion ranges, cereals from the Northwest, fruits and vegetables from the Pacific coast, and Oriental products obtained via the great northern railways, are also elements of great importance in the state's commerce. There were on the 31st of December 1908 8438·73 m. of railway within the state. St Paul and Duluth are ports of entry.

Population.—The population of Minnesota at the first Federal census (1860) after its admission into the Union was 172,023, and by the succeeding Federal enumerations it was: (1870), 439,706; (1880), 780,773; (1890), 1,301,826, excluding Indians (10,096); (1900), 1,751,394; (1910) 2,075,708.[2] Of the total population in 1900, 932,490, or 53·2 %, were males, and 818,904, or 46·8 %, females; 1,246,076 were native-born; 505,318, or 28·9 %, were foreign-born, and 1,312,019 were of foreign parentage (*i.e.* having either one or both parents foreign-born). Of the 14,358 coloured inhabitants, 4959 were negroes and 9182 Indians, 8457 of whom lived on reservations. The urban population (*i.e.* inhabitants of cities of 8000 or over) was 26·8 % of the total population, as compared with 28·2 % in 1890. By the state census of 1905 the population of the principal cities was as follows: Minneapolis, 261,954; St Paul, 197,023; Duluth, 64,942; Winona, 20,334; Stillwater, 12,435; and Mankato, 10,996; by the same census four other cities, all in the mining region in the north-east, had passed the 5000 limit, viz. Hibbing, 6566; Cloquet, 6117; Virginia, 5056; and Eveleth, 5332. The density of population increased from 16·5 per sq. m. in 1890 to 22·1 in 1900. The largest religious denomination in the state in 1906 was the Roman Catholic, with 378,288 communicants out of a total of 834,442 members of all religious denominations; there were 267,322 Lutherans, 47,637 Methodists, 27,569 Presbyterians, 24,309 Baptists, 22,264 Congregationalists, and 18,763 Protestant Episcopalians.

Government.—The state is governed under the constitution adopted on the 13th of October 1857 and frequently amended. By an amendment of 1898 an amendment may be suggested by a majority of both houses of the legislature and comes into effect if approved by a majority of all electors voting at the general election at which the amendment is voted upon; if two or more amendments are submitted at the same election voters shall vote for or against each amendment separately. For the revision of the constitution it is necessary that two-thirds of the members elected to each house of the legislature vote for the call of a constitutional convention, that a majority of all electors voting at the next general election approve the call for the convention, and that the convention consist of as many members as the house of representatives, who shall be chosen in the same manner, and shall meet within three months after the general

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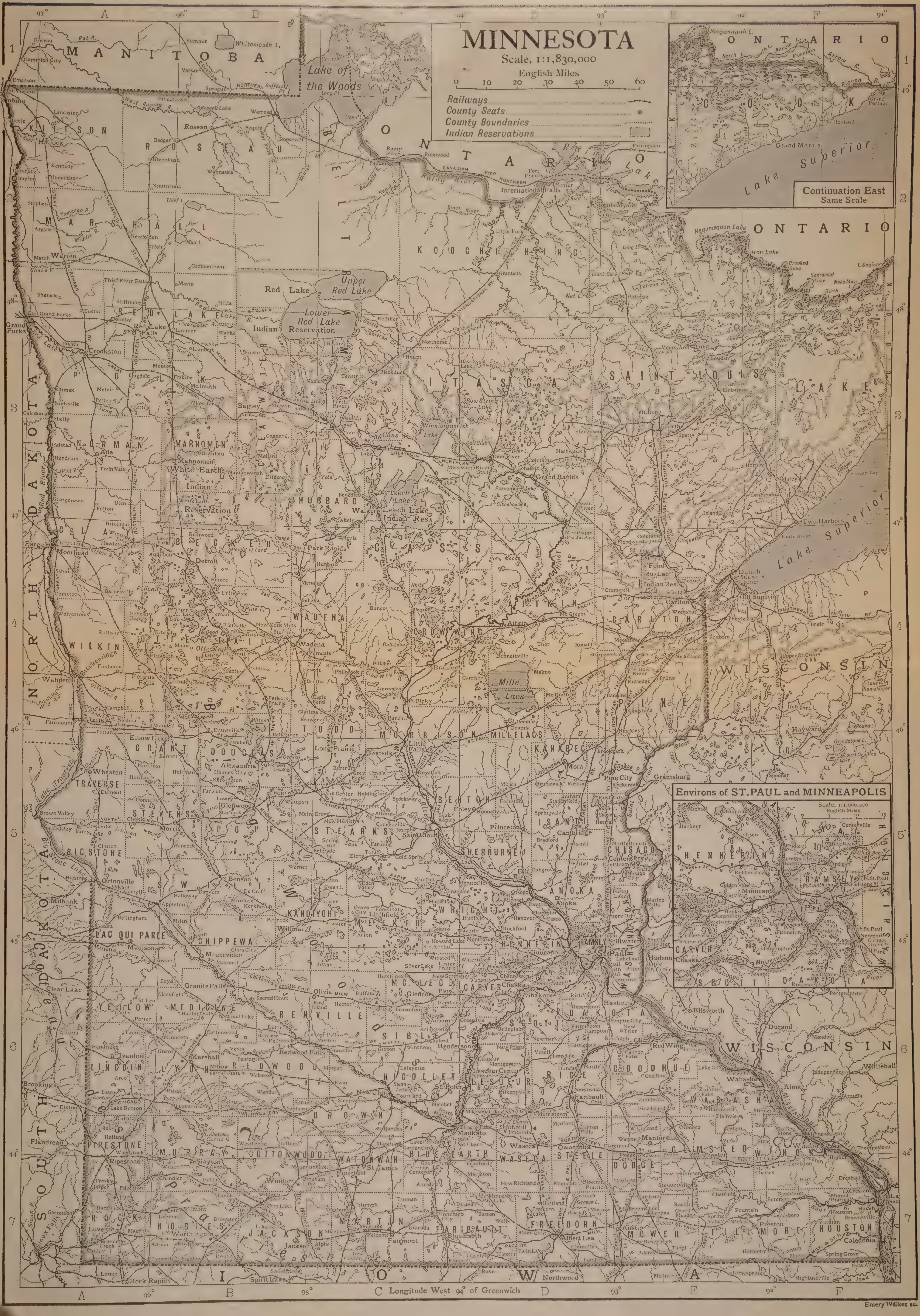
[1] At International Falls on Rainy River and at Duluth on the St Louis immense water-power is utilized for manufacturing.

[2] By the state census of 1905 the total population was 1,979,912 (1,060,412 males and 909,275 females—excluding Indians from the sex classification), of whom 537,041 were foreign-born, 10,929 were Indians, 5113 were negroes, 171 were Chinese, and 50 were Japanese.


MINNESOTA
Scale, 1:1,830,000
English Miles
0 10 20 30 40 50 60
Railways
County Seats
County Boundaries
Indian Reservations
Continuation East
Same Scale
Environs of ST. PAUL and MINNEAPOLIS
Scale, 1:1,000,000
English Miles
MANITOBA
ONTARIO
NORTH DAKOTA
SOUTH DAKOTA
IOWA
WISCONSIN
Lake of the Woods
Lake Superior
Upper Red Lake
Lower Red Lake
Red Lake Indian Reservation
White Earth Indian Reservation
Leech Lake Indian Res.
Fond du Lac Indian Res.
Mille Lacs
KITTSON
ROSEAU
MARSHALL
BELTRAMI
KOOCHICHING
COOK
LAKE
SAINT LOUIS
ITASCA
RED LAKE
POLK
NORMAN
MARNOMEN
CLEARWATER
HUBBARD
CASS
CLAY
BECKER
WILKIN
OTTER TAIL
WADENA
CROW WING
AITKIN
CARLTON
PINE
GRANT
DOUGLAS
TODD
MORRISON
MILLE LACS
KANABEC
TRAVERSE
STEVENS
POPE
STEARNS
BENTON
SHERBURNE
ISANTI
CHISAGO
BIG STONE
SWIFT
KANDIYOHI
MEEKER
WRIGHT
ANOKA
LAC QUI PARLE
CHIPPEWA
HENNEPIN
RAMSEY
WASHINGTON
YELLOW MEDICINE
RENVILLE
MC LEOD
CARVER
SCOTT
DAKOTA
LINCOLN
LYON
REDWOOD
SIBLEY
NICOLLET
LESUEUR
RICE
GOODHUE
WABASHA
BROWN
PIPESTONE
MURRAY
COTTONWOOD
WATONWAN
BLUE EARTH
WASECA
STEELE
DODGE
OLMSTED
WINONA
ROCK
NOBLES
JACKSON
MARTIN
FARIBAULT
FREEBORN
MOWER
FILLMORE
HOUSTON
Mississippi River
Minnesota River
Red River
Rainy River
Duluth
St. Paul
Minneapolis
97° 96° 95° 94° 93° 92° 91°
49° 48° 47° 46° 45° 44°
A B C D E F
1 2 3 4 5 6 7
Longitude West 94° of Greenwich

Emery Walker sc.

election at which it is voted. The executive department consists of a governor, lieutenant-governor, secretary of state, treasurer and attorney-general, elected biennially in November of the even-numbered years, and an auditor elected at the same time every four years. The veto power of the governor (since 1876) extends to separate sections of appropriation bills. The judicial department comprises a supreme court consisting of a chief justice and (since 1881) four associate justices elected for terms of six years, and lower courts consisting of district courts with original jurisdiction in civil cases in law and equity, and in criminal cases upon indictments by grand juries; justices' courts, in which the amount in litigation cannot exceed $100, or the punishment cannot exceed three months' imprisonment or a fine of $100; and of municipal and probate courts with the usual jurisdictions. The legislative department consists of a senate of sixty-three members elected for four years, and a house of representatives of one hundred and nineteen members, elected for two years, the remuneration being mileage and $500 a year. The reapportionment of congressional, senatorial and representative districts is made in the first legislative session after the state census, which has been taken in every tenth year since 1865. The legislature meets biennially in odd-numbered years, the session being limited to ninety days by a constitutional amendment of 1888. A majority of all the members elected to each house is required for the passage of a bill, and a two-thirds majority is necessary to pass a bill over the governor's veto. All bills for raising revenue must originate in the House of Representatives, but the senate may propose and concur with amendments as on other bills. Expenditures from the fund known as "The Internal Improvement Land Fund," derived from the sale of state lands, can be made only after the enactment for that purpose has been approved by the voters of the state; in 1881 the legislature, and in 1884 the popular vote, pledged the proceeds of this fund to the payment of Minnesota state railway adjustment bonds. Taxation must be uniform only within classes of property prescribed by the legislature. An Australian ballot law was enacted in 1891; the qualifications for electors (adopted in 1896) require that the voter be at least twenty-one years old, that he shall have been a full citizen of the United States for three months prior to the election, and shall have lived in the state six months and in the election district thirty days. Women (since 1898) may vote for school officers and members of library boards, and are eligible for election to any office pertaining to the management of schools or libraries. A constitutional amendment in regard to local government adopted in 1898 provides that any city or village, by a four-sevenths vote of its electors, may adopt a charter drawn by a commission (appointed by the local district judges) and proposed by such commission within six months of its appointment.

An amendment to the constitution adopted in November 1888 declares that any combination or pool to affect the markets for food products is a "criminal conspiracy, and shall be punished in such manner as the legislature may provide."

A homestead which is owned and occupied by a debtor as his dwelling place is exempt from seizure or sale for debts other than taxes, those secured by a mortgage on it, or those incurred for its improvement or repair, or for services performed by labourers or servants. But a homestead so exempted may not be larger than one-fourth of an acre if it is in an incorporated place having a population of 5000 or more, than half an acre if it is in an incorporated place having a population of less than 5000, or than eighty acres if it is outside an incorporated place. In case the owner is married the homestead cannot be sold or mortgaged, except for an unpaid portion of the purchase money, without the joinder of husband and wife, and if the owner dies leaving a spouse or minor children, the homestead with its exemptions descends to the surviving member or members of the family. If the owner is a husband and he deserts his family, the wife and minor children may retain the homestead. Under the laws of the state the legal existence and legal personality of a woman are not affected by marriage, and the property rights of a husband and wife are nearly equal. A husband may, however, convey his real estate, other than a homestead, by his separate deed, whereas a wife's deed for her real estate is void without the joinder of her husband. If either husband or wife dies intestate and there are no descendants the whole of the estate passes to the survivor; if there are descendants the surviving spouse has the use of the homestead for the remainder of his or her life, an absolute title to one-third of the other real estate of the deceased, and to personal property limited to $1000 besides wearing apparel. The grounds for an absolute divorce in Minnesota are adultery, impotence, cruel and inhuman treatment, sentence to state prison or state reformatory subsequent to the marriage, desertion or habitual drunkenness for one year next preceding the application for a divorce. Before applying for an absolute divorce the plaintiff must have resided in the state for the year next preceding, unless the cause of action is adultery committed while the plaintiff was a resident of the state. A wife may at any time sue for a limited divorce from her husband on the ground of cruel and inhuman treatment, of such conduct as to render life with him unsafe and improper, or of abandonment and refusal or neglect to provide for her, if both parties are inhabitants of the state or their marriage took place in the state. A law of 1909 provides for a women's and children's department in the state bureau of labour.

The sale of intoxicating liquors is for the most part regulated by licences, but the granting of licences may be prohibited within any town or incorporated village by its legal voters, and the question must be submitted to popular vote upon the request of ten legal voters.

Penal and Charitable Institutions.—The charitable and correctional institutions of Minnesota have been since 1901 under the supervision of a State Board of Control consisting of three paid members appointed by the governor and serving for terms of six years; this board supplanted an unpaid Board of Corrections and Charities established in 1883, and the boards of managers of separate institutions (except the schools for the deaf and the blind at Faribault, and the state public school at Owatonna) and of groups of institutions were abolished. The state institutions consist of state hospitals for the insane at St Peter (1866), at Rochester (1877), established originally as a state inebriate asylum under a law taxing liquor dealers for that purpose, which was subsequently held to be unconstitutional, at Fergus Falls (1887), at Anoka (1900) and at Hastings (1900); the state institute for defectives at Faribault, consisting of the schools for the deaf (1863), blind (1874) and feeble-minded (1879); the state public school for dependent and neglected children at Owatonna (1886); a sanatorium for consumptives at Walker; a hospital for indigent, crippled or deformed children (1907) at St Paul; the state training school for boys near Red Wing; a similar industrial school for girls (established separately in 1907) at Sauk Center; the state reformatory at St Cloud (1887), intermediate between the training school and the state prison, for first offenders between the ages of sixteen and thirty years, in which indeterminate sentences and a parole system are in operation; the state prison at Stillwater (1851), in which there is a parole system and a graded system of diminution of sentence for good conduct, and in which, up to 1895, prisoners were leased under contract (especially to the Minnesota Thresher Company), and since 1895 have been employed in the manufacture of shoes and of binding twine, and in providing for the needs of the prison population; and the state soldiers' home occupying fifty-one acres adjoining Minnehaha Park in Minneapolis. By an act of 1907 the Board of Control was empowered to establish a hospital for inebriates.

Education.—The state supports a highly efficient public school system, organized through all the grades from the primary district and rural schools to the state university. At the head of the system stands the state superintendent of public instruction, appointed by the governor; there are also county superintendents; and a state high school board, consisting of the governor, state superintendent and the president of the state university, has general supervision of the schools and apportions the state aid. The schools are supported by a state tax, and by the proceeds of a permanent school fund amounting (in 1908) to $19,709,383; in the same year the total value of all public school property was $28,297,420, with an aggregate debt of $6,329,794, and $13,463,211 was spent for public educational purposes. There are state normal schools at Winona (1860), Mankato (1868), St Cloud (1869), Moorhead (1888) and Duluth (1902). The university of Minnesota at Minneapolis was projected by the Territorial Legislature of 1851. Some ground was purchased for its campus in 1854, but it was actually founded by an act of 1864, amended in 1866, 1868 and 1872. It is governed by a board of twelve regents, of whom the president of the university, the governor of the state and the state superintendent of public instruction are members *ex officio*, and the other nine, holding office for six years, are appointed by the governor with the advice and consent of the senate. The university is supported by a state tax of 0·23 mills per dollar on the taxed property of the state, by special appropriations from the state (for "deficiency," for School of Mines, and for salaries of teachers in the department of mines and engineering), by the interest on state bonds and land contracts purchased with the proceeds of Federal land grants under the Morrill Act of 1862, by Federal appropriations under the Morrill Act of 1890 and the Hatch Act, and by students' fees, &c.; the total of this income was estimated in 1906–1907 at $628,500. The Act of 1872 provided for five or more colleges or departments: a college of science, literature and the arts, which offers (for the degree of Bachelor of Arts) a four-years course, is entirely elective (except that a certain number of "long courses" must be selected) after the first year, and in which the only restriction is upon the range of subjects from which the student's choice may be made; a college of agriculture (including military tactics), which is now a "department," including a college and a school of agriculture, a short course for farmers, a dairy school, the Crookston school of agriculture, a main experiment station at St Anthony Park, between Minneapolis and St Paul, and sub-stations 1 m. north of Crookston and 2 m. east of Grand Rapids; a college of mechanic arts, now called the college of engineering and the mechanic arts, which offers four-year courses in civil, mechanical, electrical and municipal engineering, a four-year course in science and technology, leading to the degree of Bachelor of Science, and graduate work leading to the degree of Master of Science; the college of law, a three-years course, with evening classes and graduate courses; a college of medicine, which is now the college of medicine and surgery (1888), and the college of homoeopathic medicine and surgery (1889), each with four-year courses, and each (since 1903) with a course of six years partly in the college of science, literature and the arts, and partly in the medical college and leading to the degrees of Bachelor of Science and Doctor of Medicine. In addition to these departments provided for in the organic act, the university included in 1909 colleges of dentistry (three-year course), pharmacy (two-year and three-year courses), a school of mines (1891; four-year course, leading to the degree of Engineer of Mines or Metallurgical Engineer), a school of analytical and applied chemistry (four-year courses, leading to the degree of Bachelor in Science in Chemistry or in Chemical Engineering), a college of education (1906; three-year course, after two years of college work, leading to a Master's degree), a graduate school (with courses leading to the degrees of Master of Arts, of Science and of Laws, and of Doctor of Philosophy, of Science and of Civil Law), and a university summer school. The growth and development of the university have been almost entirely under the administration of Cyrus Northrop (b. 1834), who graduated at Yale College in 1857 and at Yale Law School in 1859, and was professor of rhetoric and English literature at Yale from 1863 until 1884, when he became president of the university of Minnesota. The university is one of the largest in the country. In 1907 there were twenty-three buildings valued at more than $1,475,000. The university library of 110,000 volumes is supplemented by the libraries of Minneapolis and St Paul. In 1908-1909 the faculty numbered about 325 and the total enrolment of students was 4421. Other higher educational institutions in Minnesota are Hamline University (Methodist Episcopal), with a college of liberal arts at St Paul, and a college of medicine at Minneapolis; Macalester College (Presbyterian) at St Paul; Augsburg Seminary (Lutheran) at Minneapolis; Carleton College (non-sectarian, founded in 1866) and St Olaf College (Lutheran, founded in 1874) at Northfield; Gustavus Adolphus College (Lutheran) at St Peter; Parker College (Free Baptist, 1888) at Winnebago City; St John's University (Roman Catholic) at Collegeville, Stearns county; and Albert Lea College for women (Presbyterian, founded 1884) at Albert Lea.

History.—The first European visitors to the territory now embraced in the state of Minnesota found it divided between two powerful Indian tribes, the Ojibways or Chippewas, who occupied the heavily wooded northern portion and the region along the Mississippi river, and the Sioux or Dakotas, who made their homes on the more open rolling country in the south and west and in the valley of the Minnesota. The first known white explorers were Radisson and Groseilliers, who spent the winter of 1658–1659 among the Sioux in the Mille Lacs region. At Sault Sainte Marie in 1671, before representatives of fourteen Indian nations, the Sieur de St Lusson read a proclamation asserting the French claim to all the territory in the region of the Great Lakes. Two years afterwards the upper course of the Mississippi was explored by Joliet and Marquette. In 1679 Daniel Greysolon, Sieur du Lhut (Duluth), as agent for a company of Canadian merchants which sought to establish trading posts on the Lakes, explored the country from the head of Lake Superior to Mille Lacs and planted the arms of Louis XIV. in a large Sioux village. In the following year the Franciscan friar Father Louis Hennepin, acting as an agent of the Sieur de la Salle, discovered and named the Falls of St Anthony; and in 1686 Nicholas Perrot, the commandant of the west, built Fort St Antoine on the east bank of Lake Pepin, in what is now Pepin county, Wisconsin, and in 1688 formally took possession of the region in the name of the French king. A few years later (1694) Le Sueur, who had as early as 1684 engaged in trade along the upper Mississippi, established a trading post on Isle Pelée (Prairie Island) in the Mississippi between Hastings and Red Wing, and in 1700 he built Fort L'Huillier at the confluence of the Blue Earth and the Le Sueur rivers. In 1762 the Sieur de la Perrière, acting as an agent of the French government, established on the west bank of Lake Pepin a fortified post (Fort Beauharnois), which was to be a headquarters for missionaries, a trading post and a starting-point for expeditions in search of the "western sea." But none of the French posts was permanent, and in 1763 French rule came to an end, the Treaty of November (1762) and the Treaty of Versailles (1763) transferring respectively the western portion of the state to Spain and that part east of the Mississippi river to Great Britain. In 1766 the region was visited by the Connecticut traveller Jonathan Carver (1732–1780). Great Britain surrendered its title to the eastern portion by the Treaty of Paris (1783), and after the surrender of Virginia's colourable title had been accepted by Congress in 1784, this eastern part was made a part of the Northwest Territory by the ordinance of 1787, although the British held possession and did some trading there until 1796. The western part remained under Spanish control until 1803, when it, too, after being retransferred to France, became a part of the United States with the rest of the Louisiana Purchase. In 1805–1806, at the instance of President Thomas Jefferson, Lieut. Zebulon M. Pike led an exploring expedition as far north as Leech Lake and took formal possession of the Minnesota region for the United States. He obtained from the Sioux for military reservations one tract 9 m. square at the mouth of the St Croix River and another containing about 100,000 acres at the confluence of the Minnesota and Mississippi rivers. On the latter tract a military post was established by Lieut.-Colonel Henry Leavenworth (1783–1834) in 1819, and in the following year the construction was begun of a fort at first named Fort St Anthony but renamed Fort Snelling in 1824 (two years after its completion) in honour of its builder and commander Colonel Josiah Snelling (1782–1829). In 1819 Michigan Territory was extended westward to the Mississippi river, and in 1820 General Lewis Cass, its governor, conducted an exploring expedition in search of the source of the Mississippi, which he was satisfied was in the body of water named Lake Cass in his honour. Further search for the true source of the Mississippi was made in 1823 by Giacomo Constantio Beltrami (1779–1855), an Italian traveller and political refugee, and in 1832 by Henry Rowe Schoolcraft, who had accompanied Cass's expedition and traced the Mississippi from Lake Cass to Lake Itasca. In 1823 extensive explorations of the Minnesota and Red River valleys were conducted by Major Stephen Harriman Long (1784–1864), and subsequently (1834–1836) knowledge of the region was extended by the investigations of the artist George Catlin (1796–1872), the topographer George William Featherstonhaugh (1780–1866), and the geologist Jean Nicholas Nicollett (1786–1843). Meanwhile, the country was slowly being settled. In 1823 the first river steamboat reached St Paul; the Mississippi was soon afterwards opened to continuous if irregular navigation; and in 1826 a party of refugees from Lord Selkirk's colony on the Red River settled near Fort Snelling. On the erection of Wisconsin Territory in 1836 the whole of Minnesota, which then extended westward to the Missouri river, was incorporated with it, but on the erection of Iowa Territory in 1838 Minnesota was divided and the part west of the Mississippi became a part of Iowa Territory. In 1837, by two important treaties, the one (July 29) between the Chippewas and Governor Henry Dodge of Wisconsin at St Peters, and the other (Sept. 29) between some Sioux chiefs and Joel R. Poinsett at Washington, the Indian titles to all lands east of the Mississippi were practically extinguished. The first county, St Croix, was established in 1839, and in the succeeding years thriving settlements were established at St Paul and Stillwater. The admission of Wisconsin as a state in 1848 left that part of the former territory west of the St Croix and north of the Mississippi rivers, which was not included in the new state, practically without a government. On the 26th of August a convention met at Stillwater, where measures were taken for the formation of a separate territorial government, and Henry Hastings Sibley (1811–1891) was sent to Congress as a delegate of "Wisconsin Territory." Upon his admission to a seat the curious situation was presented of representatives of the state and of the territory of Wisconsin sitting in the same body. This situation did not last long, however, for on the 3rd of March 1849 the bill organizing the territory of Minnesota was passed, and on the 19th President Zachary Taylor appointed Alexander Ramsey of Pennsylvania the first territorial governor. The territorial boundaries extended to the Missouri river, including a greater part of the present North and South Dakota. The first territorial legislature met at St Paul on the 3rd of September following. By the Federal census of 1850 the territory had a population of 6077, most of whom lived east of the Mississippi, or along the Red river in the extreme north-west. Two treaties negotiated with the Sioux by Luke Lea, commissioner, and Governor Alexander Ramsey in 1851 opened to settlement the greater part of the land within the territory west of the Mississippi, and such an unparalleled rush to the new lands took place that a census taken in 1857 showed a population of 150,037. In July 1857 a convention chosen to form a state constitution was found on assembling to be so evenly divided between the Republican and Democratic parties that organization was impossible, and the members proceeded to their work in two separate bodies. By means of conference committees, however, identical constitutions were formed, which in the following October were adopted by an almost unanimous popular vote. The state was admitted to the Union with its present boundaries on the 12th of May 1858, and the federal census of 1860 showed that the population had increased to 172,023, despite the fact that the financial panic of 1857 had severely checked the state's growth. Minnesota furnished more than 25,000 troops for the Federal armies during the Civil War. But even more pressing than the call of the nation was the need of defending her own homes against the uprisings of the Indians within her borders. The settlements bordering on the Indian reservations had experienced more or less trouble with the Sioux for several years, the most serious outbreak having occurred in March 1857, when Ink-pa-du-ta led his band to massacre the settlers at Spirit Lake. The absence of a large proportion of the able-bodied young settlers in the northern armies was taken advantage of by the Indians, and in the summer of 1862 there was delay in paying them their yearly allowance. Suddenly towards the end of August, as if by previous understanding (although nothing of the sort was ever proved), small bands of Sioux scattered along the frontier for 200 m. and began a systematic massacre of the white settlers. Beginning with the first outbreak at Acton, Meeker county (Aug. 17), the attacks continued with increasing fury (nearly 1000 whites losing their lives) until the 23rd of September, when hastily-raised volunteer forces under Colonel H. H. Sibley decisively defeated Little Crow, the principal leader of the Kaposia band, at Wood Lake. Three days later more than 2000 of the Indians were surrounded and captured, Little Crow with a few of his companions alone escaping beyond the Missouri. A military commission tried 425 of the captives for murder and rape, of whom 321 were found guilty and 303 were condemned to death. Of these 38 were hanged at Mankato on the 26th of December 1862. Little Crow and his followers kept up desultory raids from the Dakota country, during one of which in July 1863 he lost his life. Expeditions of Sibley in 1863, and General Alfred Sully (1821–1879) in 1864, eventually drove the hostile Indians beyond the Missouri and terminated the war, which in two years had cost upwards of a thousand lives of settlers and volunteers. The opening of the Chippewa lands in the north-west and the coming of peace marked the beginning of a new period of rapid growth, the Federal census of 1870 showing a population of 439,706, or a gain of 75·8 % in five years. During the same half-decade railway construction, which had begun with the opening of the railway between St Paul and Minneapolis in 1862, reached a total of more than 1000 m. For a period of five years after the financial panic of 1873 the growth was comparatively slow, but in the succeeding two years the recuperation was rapid. During the decade, 1880–1890, more than 2300 m. of railway were completed and put in operation. In September 1894 disastrous forest fires, starting in the neighbourhood of Hinckley in Pine county, destroyed that village and several neighbouring towns, causing the death of 418 people, rendering 2200 others homeless, and devastating about 350 sq. m. of forest land, entailing a loss of more than $1,000,000. The state furnished four regiments (a total of 5313 officers and men) to the volunteer army during the Spanish-American War (1898), the service of the 13th Regiment for more than a year in the Philippines being particularly notable. In October 1898 there was an uprising of the Pillager band of Chippewa Indians at Leech Lake, which was quelled by the prompt action of Federal troops. Since the first state election, which was carried by the Democratic party, the state has been generally strongly Republican in politics; but the Republican candidate for governor was defeated in 1898 by a "fusion" of Democrats and Populists, and in 1904, 1906 and 1908 a Democratic governor, John Albert Johnson, was elected, very largely because of his personal popularity.

GOVERNORS OF MINNESOTA.

Territorial.		
Alexander Ramsey	Whig	1849–1853
Willis Arnold Gorman	Democrat	1853–1857
Samuel Medary	,,	1857–1858
State.		
Henry Hastings Sibley	Democrat	1858–1860
Alexander Ramsey	Republican	1860–1863
Henry A. Swift	,,	1863–1864
Stephen Miller	,,	1864–1866
William Rogerson Marshall	,,	1866–1870
Horace Austin	,,	1870–1874
Cushman Kellogg Davis	,,	1874–1876
John Sargent Pillsbury	,,	1876–1882
Lucius Fairchild Hubbard	,,	1882–1887
Andrew Ryan McGill	,,	1887–1889
William Rush Merriam	,,	1889–1893
Knute Nelson	,,	1893–1895
David Marston Clough	,,	1895–1899
John Lind	Democrat-Populist	1899–1901
Samuel R. Van Sant	Republican	1901–1905
John Albert Johnson	Democrat (died in office)	1905–1909
Adolph Olson Eberhart	Republican	1909–

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(New York, 1901); Sanford Niles, *History and Civil Government of Minnesota* (Chicago, 1897); and the *Legislative Manual*, published biennially by the state at St Paul.

MINNOW (*Leuciscus phoxinus*), the smallest British fish of the Cyprinoid family, readily distinguished by its very minute scales. The ordinary name is derived from the common Indo-European word for "little" (cf. Lat., *minor*), and "minnow" is popularly identified with any tiny fish; in America it is given to small forms of the *Gambusia* and *Notropis* genera, &c. The British minnow abounds in lakes, rivers and brooks, swimming in schools, and shifting its ground in search of food, in the shape of every kind of animal and vegetable substance. It ranges from Scandinavia to south Europe, and from Ireland to north-east Asia, attaining an elevation of nearly 8000 ft. in the Alps. Its size varies from between 2 and 3 in. to as much as 4 or 5 in. The minnow is commonly used by anglers for bait, and is useful in ponds as food for trout, perch or pike.

MINO DI GIOVANNI (1431–1484), called Da Fiesole, Italian sculptor, was born at Poppi in the Casentino. He had property at Fiesole. Vasari's account of him is very inaccurate. Mino was a friend and fellow-worker with Desiderio da Settignano and Matteo Civitale, all three being about the same age. Mino's sculpture is remarkable for its finish and delicacy of details, as well as for its spirituality and strong devotional feeling. Of Mino's earlier works, the finest are in the duomo of Fiesole, the altarpiece and tomb of Bishop Salutati, executed before 1466. In the Badia of Florence are an altarpiece and the tombs of Bernardo Giugni (1466) and the Margrave Hugo (1481), all sculptured in white marble, with life-sized recumbent effigies and attendant angels. The pulpit in Prato Cathedral, in which he collaborated with Antonio Rossellino, finished in 1473, is very delicately sculptured with bas-reliefs of great minuteness, but somewhat weakly designed. Soon after the completion of this work Mino went to Rome, where he executed the tomb of Pope Paul II. (now in the crypt of St Peter's), the tomb of Francesco Tornabuoni in S. Maria sopra Minerva, and a beautiful little marble tabernacle for the holy oils in S. Maria in Trastevere. There can be little doubt that he was also the sculptor of several monuments in S. Maria del Popolo, especially those of Bishop Gomiel and Archbishop Rocca (1482), and the marble reredos given by Pope Alexander VI. Some of Mino's portrait busts and profile bas-reliefs are preserved in the Bargello at Florence; they are full of life and expression, though without the extreme realism of Verrocchio and other sculptors of his time.

See Vasari, Milanesi's ed. (1878–1882); Perkins's *Italian Sculptors*, Winckelmann and D'Agincourt, *Storia della scultura* (1813); Hans Semper, *Architekten der Renaissance* (Dresden, 1880); Wilhelm Bode, *Die italienische Plastik* (Berlin, 1893).

MINOR, ROBERT CRANNELL (1839–1904), American artist, was born in New York city on the 30th of April 1839, and received his art training in Paris under Diaz, and in Antwerp under Joseph Van Luppen. His paintings are characteristic of the Barbizon school, and he was particularly happy in his sunset and twilight effects; but it was only within a few years of his death that he began to have a vogue among collectors. In 1897 he was elected a member of the National Academy of Design, New York. After 1900 he lived at Waterford, Connecticut, where he died on the 4th of August 1904.

MINOR (Lat. for smaller, lesser), a word used both as an adjective and as a substantive for that which is less than or inferior to another, and often correlatively opposed to that to which "major" is applied in the same connotation. Among the numerous special uses of the word the following may be mentioned: "Minor Friars," sometimes known as "Minorites," *i.e.* the name (fratres minores, lesser brothers) given by St Francis to the order he founded (see Franciscans); "minor canons" are clergymen attached to a cathedral or collegiate church who read and sing the daily service. In some cathedrals they are known as "vicars choral"; they are not members of the chapter. (For the distinction between holy and minor orders in Christian hierarchy see Orders.). The name "Minor Prophets" is used collectively of the twelve prophetical books of the Old Testament from Hosea to Malach inclusive. (For the distinction in music between major and minc intervals, and for other applications of the correlative term, se Music and Harmony.) In the categorical syllogism (*q.v.*) i logic, the minor term is that term which forms the subject of th conclusion, the minor premiss is that which contains the minc term. In law, a "minor" is a person under legal age (se Infant).

In mathematics, the "minor of a determinant" is the determinant formed by erasing an equal number of the rows an columns of the original determinant. If one column and row b erased there is formed the first minor; if two rows and columr the second minor, and so on. The minor axis of a central coni section is the shorter of the two principal axes; it may also b regarded as the line joining the two imaginary foci. In astronomy, the term minor planets is given to the members of th solar system which have their orbits between those of Mars an Jupiter (see Planets, Minor).

MINORCA (Menorca), the second in size of the group of Spanis islands in the Mediterranean Sea, known as the Balearic Island (*q.v.*), 27 m. E.N.E. of Majorca. Pop. (1900), 371,512; area 260 sq. m. The coast is deeply indented, especially on the north with numerous creeks and bays—that of Port Mahon (17,144 being one of the finest in the Mediterranean, if not the best c them all, according to the popular rhyme—

> "Junio, Julio, Agosto y puerto Mahon
> Los mejores puertos del Mediterraneo son"—

"June, July, August and Port Mahon are the best harbours c the Mediterranean" (see Port Mahon). The ports Addaya Fornelle, Ciudadela and Nitja may also be mentioned. Th surface of the island is uneven, flat in the south and rising irregularly towards the centre, where the mountain El Toro—probabl so called from the Arabic *tor*, a height, though the natives have legend of a *toro* or bull—has an altitude of 1207 ft. The climat is not so equable as that of Majorca, and the island is exposed i autumn and winter to the violence of the north winds. Its so is of very unequal quality; that of the higher districts being ligh fine, and fertile, and producing regular harvests without muc labour, while that of the plains is chalky, scanty, and unfit fo pasture or the plough. Some of the valleys have a good alluvia soil; and where the hills have been terraced they are cultivate to the summit. The wheat and barley raised in the island ar sometimes sufficient for home consumption; there is rarely surplus. The *Hedysarum coronarium*, or *zulla*, as it is calle by the Spaniards, is largely cultivated for fodder. Wine, oi potatoes, hemp and flax are produced in moderate quantitie fruit of all kinds, including melons, pomegranates, figs an almonds, is abundant. The caper plant is common throughou the island, growing on ruined walls. Horned cattle, sheep ar goats are reared, and small game abound. Stone of variou kinds is plentiful. In the district of Mercadal and in Mour Santa Agueda are found fine marbles and porphyries; lime ar slate are also abundant. Lead, copper and iron might be worke were it not for the scarcity of fuel. There are manufactures the wool, hemp and flax of the island; and formerly there was good deal of boat-building; but agriculture is the chief industr An excellent road, constructed in 1713–1715 by Brigadie General Richard Kane, to whose memory a monument wa erected at the first milestone, runs through the island fro south-east to north-west, and connects Port Mahon wi Ciudadela. Ciudadela (8611), which was the capital of th island till Port Mahon was raised to that position by th English, still possesses considerable remains of its form importance.

MINOS, a semi-legendary king of Crete, son of Zeus ar Europa. By his wife, Pasiphaë, he was the father of Ariadn Deucalion, Phaedra and others. He reigned over Crete and th islands of the Aegean three generations before the Trojan Wa He lived at Cnossus for periods of nine years, at the end of whi he retired into a sacred cave, where he received instruction fro Zeus in the legislation which he gave to the island. He was th author of the Cretan constitution and the founder of its nav supremacy (Herodotus iii. 122; Thucydides i. 4). In Attic tradition and on the Athenian stage Minos is a cruel tyrant, the heartless exactor of the tribute of Athenian youths to feed the Minotaur (*q.v.*). It seems possible that tribute children were actually exacted to take part in the gruesome shows of the Minoan bull-rings, of which we now have more than one illustration (see CRETE: *Archaeology*). To reconcile the contradictory aspects of his character, two kings of the name of Minos were assumed by later poets and mythologists. Since Phoenician intercourse was in later times supposed to have played an important part in the development of Crete, Minos is sometimes called a Phoenician. There is no doubt that there is a considerable historical element in the legend; recent discoveries in Crete (*q.v.*) prove the existence of a civilization such as the legends imply, and render it probable that not only Athens, but Mycenae itself, was once subject to the kings of Cnossus, of whom Minos was greatest. In view of the splendour and wide influence of Minoan Crete, the age generally known as "Mycenaean" has been given the name of "Minoan" by Dr Arthur Evans as more properly descriptive (see CRETE). Minos himself is said to have died at Camicus in Sicily, whither he had gone in pursuit of Daedalus, who had given Ariadne the clue by which she guided Theseus through the labyrinth. He was killed by the daughter of Cocalus, king of Agrigentum, who poured boiling water over him in the bath (Diod. Sic. iv. 79). Subsequently his remains were sent back to the Cretans, who placed them in a sarcophagus, on which was inscribed: "The tomb of Minos, the son of Zeus." The earlier legend knows Minos as a beneficent ruler, legislator, and suppressor of piracy (Thucydides i. 4). His constitution was said to have formed the basis of that of Lycurgus (Pausanias iii. 2, 4). In accordance with this, after his death he became judge of the shades in the under-world (*Odyssey*, ix. 568); later he was associated with Aeacus and Rhadamanthus.

The solar explanation of Minos as the sun-god has been thrown into the background by the recent discoveries. In any case a divine origin would naturally be claimed for him as a priest-king, and a divine atmosphere hangs about him. The name of his wife, Pasiphaë ("the all-shining"), is an epithet of the moon-goddess. The name Minos seems to be philologically the equivalent of Minyas, the royal ancestor of the Minyans of Orchomenus, and his daughter Ariadne ("the exceeding holy") is a double of the native nature-goddess. (See CRETE; *Archaeology*.)

On Cretan coins Minos is represented as bearded, wearing a diadem, curly-haired, haughty and dignified, like the traditional portraits of his reputed father, Zeus. On painted vases and sarcophagus bas-reliefs he frequently occurs with Aeacus and Rhadamanthus as judges of the under-world and in connexion with the Minotaur and Theseus.

MINOT, LAURENCE (fl. 1333–1352), English poet, the author of eleven battle-songs, first published by Joseph Ritson in 1795 as *Poems on Interesting Events in the reign of King Edward III.* They had been discovered by Thomas Tyrwhitt in a MS. (Cotton Galba, E. IX., British Museum) which bore on the fly-leaf the misleading inscription: "Chaucer, Exemplar emendate scriptum." It dates from the beginning of the 15th century. The authorship of Laurence Minot's eleven songs is fixed by the opening of the fifth: "Minot with mowth had menid to make," and in VII. 20, "Now Laurence Minot will begin." The poems were evidently written contemporaneously with the events they describe. The first celebrates the English triumph at Halidon Hill (1333), and the last the capture of Guines (1352). The writer is animated by an ardent personal admiration for Edward III. and a savage joy in the triumphs of the English over their enemies. The technical difficulty of his metres and the comparatively even quality of the work led to the inference that Minot had written other songs, but none have come to light. Nothing whatever is known of his life, but the minuteness of his information suggests that he accompanied Edward on some of his campaigns. Though his name proves him to have been of Norman birth, he writes vigorous and idiomatic English of the northern dialect with some admixture of midland forms. His poems are instinct with a fierce national feeling, which has been accepted as an index of the union of interests between the Norman and English elements arising out of common dangers and common successes.

There are excellent editions of Minot's poems by Wilhelm Scholle (*Quellen und Forschungen*, vol. lii., Strasburg, 1884), with notes on etymology and metre, and by Mr J. Hall (Clarendon Press, 2nd ed., 1897). Mr Hall is inclined to include as his work the "Hymn to Jesus Christ and the Virgin" (*Religious Pieces*, Early English Text Society, No. 26, p. 76), on the grounds of similarity of style and language. See also T. Wright, *Political Poems and Songs* (Rolls series, 1859).

MINOTAUR (Gr. Μινώταυρος, from Μίνως, and ταῦϝος, bull), in Greek mythology, a fabulous Cretan monster with the body of a man and the head of a bull. It was supposed to be the offspring of Pasiphaë, the wife of Minos, and a snow-white bull, sent to Minos by Poseidon for sacrifice. Minos, instead of sacrificing it, spared its life, and Poseidon, as a punishment, inspired Pasiphaë with an unnatural passion for it. The monster which was born was shut up in the Labyrinth (*q.v.*). Now it happened that Androgeus, son of Minos, had been killed by the Athenians, who were jealous of the victories he had won at the Panathenaic festival. To avenge the death of his son, Minos demanded that seven Athenian youths and seven maidens should be sent every ninth year to be devoured by the Minotaur. When the third sacrifice came round Theseus volunteered to go, and with the help of Ariadne (*q.v.*) slew the Minotaur (Plutarch, *Theseus*, 15–19; Diod. Sic. i. 16, iv. 61; Apollodorus iii. 1, 15). Some modern mythologists regard the Minotaur as a solar personification and a Greek adaptation of the Baal-Moloch of the Phoenicians. The slaying of the Minotaur by Theseus in that case indicates the abolition of such sacrifice by the advance of Greek civilization.

According to A. B. Cook, Minos and Minotaur are only different forms of the same personage, representing the sun-god Zeus of the Cretans, who represented the sun as a bull. He and J. G. Frazer both explain Pasiphaë's monstrous union as a sacred ceremony (ἱερὸς γάμος), at which the queen of Cnossus was wedded to a bull-formed god, just as the wife of the ἄρχων βασιλεύς in Athens was wedded to Dionysus. E. Pottier, who does not dispute the historical personality of Minos, in view of the story of Phalaris (*q.v.*) considers it probable that in Crete (where a bull-cult may have existed by the side of that of the double axe) victims were tortured by being shut up in the belly of a red-hot brazen bull. The story of Talos, the Cretan man of brass, who heated himself red-hot and clasped strangers in his embrace as soon as they landed on the island, is probably of similar origin. The contest between Theseus and the Minotaur was frequently represented in Greek art. A Cnossian didrachm exhibits on one side the labyrinth, on the other the Minotaur surrounded by a semicircle of small balls, probably intended for stars; it is to be noted that one of the monster's name was Asterius.

See A. Conze, *Theseus und Minotauros* (1878); L. Stephani, *Der Kampf zwischen Theseus und Minotauros* (1842), with plates and history of the legend; L. Preller, *Griechische Mythologie*; Helbig in Roscher's *Lexicon der Mythologie*; F. Durrbach in Daremberg and Saglio's *Dictionnaire des antiquités*; A. B. Cook in *Classical Review*, xvii. 410; J. G. Frazer, *Early History of the Kingship* (1905); E. Pottier in *La Revue de Paris* (Feb. 1902); the story is told in Kingsley's *Heroes*.

MINSK, a government of western Russia, bounded by the governments of Vilna, Vitebsk, Mogilev and Chernigov on the N. and E. and by Kiev, Volhynia and Grodno on the S. and W. It has an area of 35,283 sq. m. The surface is undulating and hilly in the north-west, where a narrow plateau and a range of hills (800–1000 ft.) of tertiary formation separate the basin of the Niemen, which flows into the Baltic, from that of the Dnieper, which sends its waters into the Black Sea. The remainder of the government is flat, 450 to 650 ft. above sea-level, and covered with sands and clays of the glacial and post-glacial periods. Two broad shallow depressions, drained by the Berezina and the Pripet, cross the government from north to south and from west to east; and these, as well as the triangular space between them, are occupied by immense marshes (often as much as 200 to 600 sq. m. each), ponds and small lakes, peat-bogs and moving sands, intermingled with dense forests. This country, and especially its south-western part, is usually known under the name of Polyesie ("The Woods"). Altogether, marshes and moors take up 22% and marshy forests no less than 40¼% of the entire area of the province. It is only in the north-west that the forests consist of full-grown trees; those which grow on the marshy ground are small, stunted pine, birch and aspen. The climate of the Polyesie is extremely unhealthy; malarias and an endemic disease of the hair (*plica Polonica*) are the plagues of these tracts. Communication is very difficult. The railway from Poland to Moscow has taken advantage of the plateau above mentioned; but still it has to cross the broad marshy depression of the Berezina. A successful attempt was made to drain the marshes of the Polyesie by a system of canals, and more than 4,500,000 acres have thus been rendered suitable for pasture and agriculture. Two tributaries of the Dnieper—the Berezina and the Pripet—both navigable, with numberless subtributaries, many also navigable, are the natural outlets for the marshes. The Dnieper flows along its south-eastern border for 160 m. and the Niemen on the north-western for 130 m. The affluents of the Baltic, the Dvina and the Vistula, are connected by canals with tributaries of the Dnieper. The estimated population in 1906 was 2,581,400. The peasants constitute 65% of the population, who are mostly White Russians (71%); there are also Poles (12%), Jews (16%), Little Russians and Great Russians. About 70,000 are considered to be Lithuanians; there are also 4500 Tatars and 2000 Germans.

The principal occupation of the inhabitants is agriculture, which is very unproductive in the lowlands; in the Polyesie the peasants rarely have pure bread to eat. Only 23·5 % of the area is under crops. Cattle-breeding is very imperfectly developed. Hunting and bee-keeping are sources of income in the Polyesie, and fishing gives occupation to about 20,000 persons. Gardening is carried on in some parts. The chief source of income for the inhabitants of the lowlands is the timber trade. Timber is floated down the rivers, and tar, pitch, various products of bark, potash, charcoal and timber-ware (wooden dishes, &c.) are manufactured in the villages to a great extent; and ship-building is carried on along the Dnieper, Pripet and Niemen. Shipping is also an important source of income. The industrial arts are almost entirely undeveloped, but there are several distilleries, flour-mills, saw-mills and tanneries, and woollen-stuffs, candles, tobacco, matches and sugar are manufactured. The great highway from Warsaw to Moscow crosses the government in the south, and its passage through the Berezina is protected by the first-class fortress of Bobruisk. The government is divided into nine districts, of which the chief towns and populations in 1897 are: Minsk, capital of the government (*q.v.*), Bobruisk (35,177), Igumeñ (4579), Mozyr (10,762), Novogrudok (7700), Pinsk (27,938), Ryechitsa (10,681) and Slutsk (14,180).

This region was originally inhabited by Slavs. That portion of it which was occupied by the Krivichi became part of the Polotsk principality, and so of White Russia; the other portion, occupied by the Dregovichi and Drevlyans, became part of Black Russia; whilst the south-western portion was occupied by Yatvyags or Lithuanians. During the 12th, 13th and 14th centuries it was divided among several principalities, which were successively incorporated with Lithuania, and later annexed to Poland. Russia took possession of this country in 1793. In 1812 it was invaded by the army of Napoleon I. Archaeological finds of great value, dating from the Neolithic and subsequent ages, have lately been made. (P.A.K.; J.T.Be.)

MINSK, a town of Russia, capital of the government of the same name, on the Svisloch, a tributary of the Berezina, at the intersection of the Moscow-Warsaw and Libau-Kharkov railways, 430 m. by rail W. from Moscow. It had, in 1897, 91,494 inhabitants, of whom one-third were Jews of the poorest class; the others were White Russians, Poles and Tatars. Amongst its public buildings is a cathedral, built in 1611. Minsk is the headquarters of the IVth Army Corps and the see of a bishop of the Orthodox Greek Church, and from 1798 to 1853 it was a see of the Roman Catholic Church. The manufactures are few and insignificant. Since the introduction of railways the commercial importance of the place, which formerly was slight, has begun to increase.

Minsk is mentioned in Russian annals in the 11th century under the name of Myen'sk, or Menesk. In 1066 and 1096 it was devastated, first by Izyazlav and afterwards by Vladimir, prince of Kiev. It changed rulers many times until the 13th century, when it became a Lithuanian fief. In the 15th century it was part of Poland, but as late as 1505 it was ravaged by Tatars, and in 1508 by Russians. In the 18th century it was taken several times by Swedes and Russians. Russia annexed it in 1793. Napoleon I. took it in 1812.

MINSTER, two towns of Kent, England.

1. Minster-in-Thanet, in the Isle of Thanet parliamentary division, lies on the southern slope of the isle, above the Minster marshes, in the low, flat valley of the river Stour, 4 m. west of Ramsgate, on the South-Eastern & Chatham railway. Pop. (1901), 2338. Its church, dedicated to St Mary, is cruciform, with a western tower, the nave a fine example of Norman work, the transepts and chancel a beautiful Early English addition. The carved choir-stalls are a notable feature. The church belonged to a nunnery, founded at the close of the 7th century. The abbey, a residence close to the church, incorporates portions of the ancient buildings. Fruit-growing is largely carried on in the neighbourhood.

2. Minster-in-Sheppey, in the north-eastern parliamentary division, lies in the Isle of Sheppey, near the north coast. Pop. (1901), 1306. It is served by the Sheppey light railway from Sheerness, 2 m. west. The village has in modern times become a seaside resort. It has a fine church, dedicated to St Mary and St Sexburga, originally attached to a convent of the 7th century, founded by Sexburga, widow of Erconberht, king of Kent. The building as it stands is only a portion of the conventual church founded in the early part of the 12th century by William de Corbeuil, archbishop of Canterbury; it retains also traces of pre-Norman work. It contains some interesting early monuments. The abbey gatehouse remains, and other fragments may be traced. There are oyster beds in the neighbouring shallow sea.

MINSTER (from Lat. *monasterium*; cf. German *Münster*), the church of a monastery, or one to which a monastery has been attached. In the 10th century the name was applied to the churches of outlying parishes, and is now given to some of the English cathedrals, such as York, Lincoln, Ripon and Southwell, and to large churches or abbeys, like those of Sherborne, Wimborne or Westminster.

MINSTREL. The word "minstrel," which is a derivative from the Latin *minister*, a servant, through the diminutives *ministellus*, *ministrallus* (Fr. *menestrel*), only acquired its special sense of household entertainer late in the 13th century. It was the equivalent of the Low Latin *joculator*[1] (Prov. *joglar*, Fr. *jougleur*, Mid. Eng. *jogclour*), and had an equally wide significance.

The minstrel of medieval England had his forerunners in the Teutonic *scôp* (O.H.G. *scôpf* or *scof*, a shaper or maker), and to a limited extent in the *mimus* of the later Roman empire. The earliest record of the Teutonic *scôp* is found in the Anglo-Saxon poem of *Widsith*, which in an earlier form probably dates back before the English conquest. Widsith, the far-traveller, belonged to a tribe which was neighbour to the Angles, and was sent on a mission to the Ostrogoth Eormanric (Hermanric or Ermanaric, d. 375), from whom he received a collar of beaten gold. He wandered from place to place singing or telling stories in the mead-hall, and saw many nations, from the Picts and Scots in the west to the Medes and Persians in the east. Finally he received a gift of land in his native country. *The Complaint of Deor* and *Beowulf* give further proof that the Teutonic *scôp* held an honourable position, which was shaken by the advent of Christianity. The *scôp* and the gleeman (the terms appear to have been practically synonymous) shared in the general condemnation passed by the Church on the dancers, jugglers, bear-leaders and tumblers. Saxo Grammaticus (*Historia danica*, bk. v.) condemns the Irish king Hugleik because he spent all his bounty on mimes and jugglers. That the loftier tradition of the *scôpas* was preserved in spite of these influences is shown by the tales of Alfred and Anlaf disguised as minstrels. With the Normans came the *joculator* or *jogleur*, who wore gaudy-coloured coats and the flat shoes of the Latin mimes, and had a shaven face and close-cut hair. Jogleurs were admitted everywhere, and enjoyed the freedom of speech accorded to the professional jester. Their impunity, however, was not always maintained, for Henry I. is said to have put out the eyes of Luc de la Barre for lampooning him. A fairly defined class distinction soon arose. Those minstrels who were attached to royal or noble households had a status very different from that of the motley entertainers, who soon came under the restrictions imposed on vagabonds generally. A *joculator regis*, Berdic by name, is mentioned in Domesday Book. The king's minstrels formed part of the royal household, and were placed under a *rex*, a fairly common term of honour in the craft (cf. Adenès li rois). Edward III. had nineteen minstrels in his pay, including three who bore the title of waits. The large towns had in their pay bodies of waits, generally designated in the civic accounts as *histriones*. A wait under Edward III. had to "pipe the watch" four times nightly between Michaelmas and Shere Tuesday, and three times nightly during the remainder of the year. In spite of the repeated prohibitions of the Church, the matter was compromised in practice. Even religious houses had their minstrels, and so pious a prelate as Robert Grosseteste had his private harper, whose chamber adjoined the bishop's. St Thomas Aquinas (*Summa theologia*) said that there was no sin in the minstrel's art if it were kept within the bounds of decency. Thomas de Cabham, bishop of Salisbury (d. 1313), in a *Penitential* distinguished three kinds of minstrels (*histriones*)—buffoons or tumblers; the wandering *scurrae*, by whom he probably meant the goliardi (see GOLIARD); and the singers and players of instruments. In the third class he discriminated between the singers of lewd songs and those *joculatores* who took their songs from the deeds of princes and the lives of saints. The performances of these *joculatores* were permissible, and they themselves were not to be excluded from the consolations of the Church. The Parisian minstrels were formed into a gild in 1321, and in England a charter of Edward IV. (1469) formed the royal minstrels into a gild, which minstrels throughout the country were compelled to join if they wished to exercise their trade. A new charter was conferred in 1604, when its jurisdiction was limited to the city of London and 3 m. round it. This corporation still exists, under the style of the Corporation of the Master, Wardens and Commonalty of the Art or Science of the Musicians of London.

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[1] Used by John of Salisbury (*Polycraticus*, i. 8) as a generic term to cover *mimi*, *salii* or *salicres*, *balatrones*, *aemiliani*, *gladiatores*, *palaestritae*, *gignadii*, *praestigiatores*.

During the best time of minstrelsy—the 10th, 11th and 12th centuries—the minstrel, especially when he composed his own songs, was held in high honour. He was probably of noble or good bourgeois birth, and was treated by his hosts more or less as an equal. The distinction between the troubadour and the jogleur which was established in Provence probably soon spread to France and England. In any case it is probable that the poverty which forms the staple topic of the poems of Rutebeuf (*q.v.*) was the commonest lot of the minstrel.

Entries of payments to minstrels occur in the accounts of corporations and religious houses throughout the 16th century; but the art of minstrelsy, already in its decline, was destroyed in England by the introduction of printing, and the minstrel of the entertainments given to Elizabeth at Kenilworth was little more than a survival.

The best account of the subject is to be found in E. K. Chambers's *Medieval Stage* (1903), i. 23-86 and ii. 230-266. See also L. Gautier in *Épopées françaises* (vol. ii., 2nd ed., 1892); A. Schultz, *Das höfische Leben zur Zeit der Minnesinger* (2nd ed., 1889); T. Percy, *Reliques of English Poetry* (ed. H. B. Wheatley, 1876); J. Ritson, *Ancient English Metrical Romances* (1802); J. J. Jusserand, *English Wayfaring Life in the Middle Ages* (4th ed., 1892).

MINT, botanically *Mentha*, a genus of labiate plants, comprising about twenty species of perennial herbs, widely distributed throughout the temperate and sub-tropical portions of the globe, but chiefly in the temperate regions of the Old World. The species have square stems, opposite, aromatic leaves, and a stoloniferous creeping rootstock. The flowers are arranged in axillary clusters (cymes), which either form separate whorls or are crowded together into a terminal spike. The corolla is usually small and of a pale purple or pinkish colour; it has four nearly equal lobes, and encloses two long and two short stamens. Nearly three hundred intermediate forms have been named and described. Many of these varieties are permanent, in consequence of being propagated by stolons.

In Britain ten species are indigenous or naturalized. *Mentha viridis*, or spearmint, grows in marshy meadows, and is the species commonly used for culinary purposes; it is distinguished by its smooth, sessile leaves and lax tapering flower-spikes. It is probably a cultivated race of the next species, *Mentha sylvestris*, or horsemint, which chiefly differs from the above in its coarser habit and hairy leaves, which are silky beneath, and in its denser flower-spikes. This plant is supposed to be the mint of Scripture, as it is extensively cultivated in the East; it was one of the bitter herbs with which the paschal lamb was eaten. *M. rotundifolia* resembles the last in size and habit, but is distinguished by its rounded wrinkled leaves, which are shaggy beneath, and by its lanceolate bracts. The last two species usually grow on damp waste ground. *M. aquatica* grows in ditches, and is easily recognized by its rounded flower-spikes and stalked hairy leaves. *M. piperita*, or peppermint (*q.v.*), has stalked smooth leaves and an oblong obtuse terminal spike of flowers; it is cultivated for its volatile oil. *M. pratensis* belongs to a group which have the flowers arranged in axillary whorls and never in terminal spikes; it otherwise bears some resemblance to *M. viridis*. *M. sativa* grows by damp roadsides, and *M. arvensis* in cornfields; they are distinguished from *M. pratensis* by their hairy stalked leaves, which in *M. arvensis* are all equally large, but in *M. sativa* are much smaller towards the apex of the stem. *M. Pulegium*, commonly known as pennyroyal, more rarely as fleamint, has small oval obtuse leaves and flowers in axillary whorls, and is remarkable for its creeping habit and peculiar odour. It differs from all the mints above described in the throat of the calyx being closed with hairs. It is met with in damp places on grassy commons, and was formerly popular for medicinal purposes.

All the genus *Mentha* abound in a volatile oil, contained in resinous dots in the leaves and stems. The odour of the oil is similar in several species, but is not distinctive, the same odour occurring in varieties of distinct species. Thus the peppermint flavour is found in *M. piperita*, in *M. incana*, and in Chinese and Japanese varieties of *M. arvensis*. Other forms of the last-named species growing in Ceylon and Java have the flavour of the common garden mint, *M. viridis*, and the odour is found in *M. sylvestris*, *M. rotundifolia* and *M. canadensis*. A bergamot scent is met with in a variety of *M. aquatica* and in forms of other species. Most mints blossom in August.

The name mint is also applied to plants of other genera, *Monarda punctata* being called horsemint, *Pycnanthemum linifolium* mountain mint, and *Nepeta cataria* catmint.

MINT (Lat. *moneta*; Mid. Eng. *mynt*), a place where coins are manufactured with the authority of the state. Coins are pieces of metal, of weight and composition fixed by law, with a design upon them, also fixed by law, by which they are identified, their value made known and their genuineness certified. The origin of the word "mint" is ascribed to the manufacture of silver coin at Rome in 269 B.C. at the temple of Juno Moneta.[1] This goddess became the personification of money, and her name was applied both to money and to its place of manufacture. Metals were used for money at an early stage of civilization, and are well suited to the purpose, owing to their great intrinsic value and their durability, indestructibility, divisibility and rarity. The best metals for coinage are gold, silver, platinum, copper, tin, nickel, aluminium, zinc, iron, and their alloys; certain alloys of gold, silver, copper and nickel have the best combination of the required qualities.

History of Minting.—The earliest metallic money did not consist of coins, but of unminted metal in the form of rings and other ornaments or of weapons, which were used for thousands of years by the Egyptian, Chaldean and Assyrian Empires (see NUMISMATICS). According to Herodotus, the first mint was probably that established by Gyges in Lydia towards the end of the 8th century B.C. for the coining of gold, silver and electrum, an alloy of gold and silver found in a natural state.[1] Silver was coined in the island of Aegina soon afterwards. The art of coining was introduced by the Greeks into Italy and other countries bordering on the Mediterranean and into Persia and India. Subsequently the Romans laid the foundations of modern minting. Coining originated independently in China at a later date than in the western world, and spread from China to Japan and Korea. Coins may be made by casting in moulds or by striking between engraved dies. The Romans cast their larger copper coins, in clay moulds carrying distinctive markings, not because they knew nothing of striking, but because it was not suitable for such large masses of metal. Casting is now used only by counterfeiters. The most ancient coins were cast in bullet-shaped or conical moulds and marked on one side by means of a die which was struck with a hammer. The "blank" or unmarked piece of metal was placed on a small anvil (*ambos*), and the die was held in position with tongs. The reverse or lower side of the coin received a rectangular mark made by the sharp edges of the little anvil. Subsequently the anvil was marked in various ways, and decorated with letters and figures of beasts, and later still the ambos was replaced by a reverse die. The spherical blanks soon gave place to lenticular-shaped ones. The blank was made red-hot and struck between cold dies. One blow was usually insufficient, and the method was similar to that still used in striking medals in high relief, except that the blank is now allowed to cool before being struck. With the substitution of iron for bronze as the material for dies, about A.D. 300, the practice of striking the blanks while they were hot was gradually discarded.[2] In the middle ages bars of metal were cast and hammered out on an anvil. Portions of the flattened sheets were then cut out with shears, struck between dies and again trimmed with shears. A similar method had been used in Egypt under the Ptolemies (*c.* 300 B.C.) but had been forgotten. Square pieces of metal were also cut from cast bars, converted into round disks by hammering and then struck between dies. In striking, the lower die was fixed into a block of wood, and the blank piece of metal laid upon it by hand. The upper die was then placed on the blank, and kept in position by means of a holder round which was placed a roll of lead to protect the hand of the operator while heavy blows were struck with a hammer. An early improvement was the introduction of a tool resembling a pair of tongs, the two dies being placed one at the extremity of each leg. This avoided the necessity of readjusting the dies between blows, and ensured greater accuracy in the impression. Minting by means of a falling weight (*monkey press*) intervened between the hand hammers and the screw press in many places. In Birmingham in particular this system became highly developed and was long in use. A. Olivier introduced screw presses for striking coins, together with rolls for reducing the cast bars and machines for punching-out round disks from flattened sheets of metal, in Paris in 1553. After being discarded in 1585, except for making medals, they were reintroduced by J. Varin in 1640 and the practice of hammering was forbidden in 1645.[3] In England the new machinery was tried in London in 1561, but abandoned soon afterwards; it was finally adopted in 1662, although the old pieces continued in circulation until 1696. At first the rolls were driven by workmen by means of cranks, but later they were worked by horses, mules or water-power. Steam-power was applied to them by Matthew Boulton and Watt in Birmingham in 1788, and was adopted by the Royal Mint, London, in 1810. Recently the practice of driving rolls by electricity has been growing, the advantage being that each pair of rolls can be driven independently without the intervention of cumbrous shafting. Boulton and Watt's screw press, invented in 1788 and used at the Royal Mint until 1881, was worked by atmospheric pressure applied to a piston. The piston was in communication with a vacuum vessel from which the air had been pumped by steam power.

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[1] Lenormant, *La Monnaie dans l'antiquité*, i. 82.

History of British Mints.—In Britain there are evidences of the existence of mints before the arrival of the Romans. Th Romans at first imported their coins, and no Roman mints wer established until about the end of the 3rd century, when coin were being struck at London and Colchester.[4] In Anglo-Saxo times Athelstan appears to have been the first monarch wh enacted regulations for the mints.[5] He promulgated laws abou the year 928, appointing a large number of "moneyers" o "mynteres," London being assigned eight, Canterbury seven other important towns various numbers and all smaller borough one moneyer each. The necessity for so many mints lay i the imperfect means of communication. At an early period probably about A.D. 1000, the dies were made in London an issued to the other mints. The moneyers, who were elected b the burgesses, were responsible for the manufacture of the coin and according to Madox were liable at the time of Henry II. t be summoned to Westminster to take part in the trials of th pyx.[6] If there was any deficiency in the weight of the fineness of the coin the moneyers were punished as traitors. These moneyers appear to have been abolished about 1180,[7] whe officers were appointed to supervise the coinage on behalf of th king, and the name "moneyer" was applied to contractors wh manufactured the coin under superintendence and were no responsible to the king for its weight and fineness. The moneyer continued to manufacture the coin of the realm until the yea 1850, when the work was entrusted to civil servants. In th reign of Henry III. the principal officers of the Mint were th master, who manufactured the coin under a contract, the warde or paymaster who acted on behalf of the Crown, the assay maste (also a king's officer) who was responsible for the fineness of th coin, the cuneator or superintendent of the engravers of the dies and the moneyer. One of the most important duties of th warden was the collection from the contractor of the seigniorag which was claimed by the sovereign by virtue of his prerogativ as a source of revenue to the Crown. In 1718 Sir Isaac Newto was made master of the Mint, and in that capacity as contracto for the coinage he amassed a considerable fortune.[8] As the work of the Mint became more extensive and more complicated othe officers were added and their duties were varied from time t time. The present administration of the English Mint is base on arrangements made in 1870, when the establishment was reorganized. The office of master of the Mint is held by the chancellor of the exchequer for the time being, without salary, but th actual administrative work of the department is entrusted t the deputy master and comptroller. The receipt of bullion an the delivery of coin from the Mint is under the charge of the chie clerk, the manufacture of coin is in the hands of the superintendent of the operative department, and the valuation of th bullion by assay, and matters relating to the fineness of th coin are entrusted to the chemist and assayer. The date of th establishment of the Mint in the Tower of London is unknown There is a reference to it dated 1229 and a clear reference date 1329.[9] According to Ruding, there were over fifty mints in th reign of Edward the Confessor. After the Norman Conques the mints increased to about seventy, a greater numbe than now exists in the world, but they were gradually reduce and in the reign of Edward I. there were only twelve Ruding enumerates 128 mints operated at various times in th United Kingdom, including some established by usurpation, a in the reign of Stephen by certain barons, and also mints established by grants to ecclesiastics to be worked for their own profit The provincial mints were all closed just before the reign o Mary, who coined in London only. Charles I. set up small mint in various towns, and for the great re-coinage in the reign o William III. mints were established at York, Chester, Exeter Bristol and Norwich, but were soon abandoned. Wood's coppe money for Ireland and America was coined at Wolverhampto (1700–1722), and the tradesmen's tokens were struck at variou towns. Copper coins were struck by Boulton at Soho, Birmingham in 1788, and a colonial bronze coinage was executed at this establishment as recently as the year 1875. There is another mint in Birmingham worked by a private company ("The Mint, Birmingham, Limited"), where coinages for foreign governments are executed and in addition silver and bronze colonial coins are occasionally manufactured under the supervision of the London Mint. The existing London Mint was erected on Tower Hill in 1810. Minting in Scotland began in the reign of David I. (1124–1153) and ceased in 1709, two years after the Act of Union, in which it had been expressly stipulated that a mint should be continued in Scotland.[1] Coinage in Dublin began in Anglo-Saxon times and came to an end in the reign of William III.[2] The other Irish mints were of little importance.

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[1] *Op. cit.* i. 136. Herodotus i. 94.

[2] E. Dumas, *L'Émission des monnaies décimales de bronze*, p. 14.

[3] Ibid. p. 19.

[4] H. A. Grueber, *Coins of Great Britain and Ireland*, p. viii.

[5] Rogers Ruding, *Annals of the Coinage*, 3rd ed. ii. 135.

[6] Grueber, *op. cit.* p. xxv.

[7] Ibid. p. xxvi.

[8] Ruding, *op. cit.* i. 35.

[9] Ibid. ii. 192, 194.

British Dominions.—Turning to mints in British Dominions beyond the Seas, Ruding enumerates twenty-six mints in France and Flanders used by British monarchs between 1186 and 1513, and Anglo-Hanoverian coins were struck at Clausthal, Zellerfeld and Hanover in the period 1714–1837. In India[3] the earliest English mint was that at Madras which was bought by the East India Company in 1620, reorganized more than once and finally closed in 1869. The Calcutta mint was established by the East India Company in 1757, but other mints in Bengal continued to be used till about 1835, when the Calcutta mint was rebuilt. The Bombay mint was set up about the year 1671, but the coins were made by hammer and anvil until 1800. The Calcutta and Bombay mints are still in operation. A mint was opened in Hong-Kong in 1866 but was closed in 1868 and the machinery sold to Japan. In Australia there are three mints, Sydney, opened in 1855, Melbourne, opened in 1872, and Perth, opened in 1899. Up to 1909 only sovereigns and half-sovereigns were struck at these establishments, but in 1910 arrangements were made for a Commonwealth silver coinage. A mint at Ottawa was opened in 1908 for the manufacture of all Canadian coins as well as English sovereigns.

Other Countries.—In the United States the Philadelphia mint was opened in 1792, but only manual or horse power was used until 1836, when steam was introduced. Other mints are now in operation at New Orleans, San Francisco and Denver. In most European countries a single mint situated at the capital is found to be sufficient, but there are six mints in the German Empire and two in Austria-Hungary. In China 26 mints were at work in 1906. There are also mints at Osaka, Bangkok and Teheran, and the Seoul mint was at work in 1904. In Mexico 11 mints formerly existed, but one only, in the city of Mexico, remained open in 1907. In South America there are mints at Lima, Santiago, Buenos Ayres and Tegucigalpa. No mints are in operation in Africa. In all there are nearly 70 mints in the world.

The Supply of Bullion to Mints.—In England, in the middle ages, the king was accustomed to send in to the mint the produce of his own silver mines, and claimed the exclusive privilege of purchasing the precious metals. The right of levying seigniorage, however, was sometimes waived by the king to encourage his subjects to bring gold and silver to the mint, and several instances are recorded in which the aid of alchemists was called in to effect the transmutation of baser metals into gold. Seigniorage was abolished for both gold and silver in 1666, when it was provided that no charge should be made at the Mint for coining and assaying. Finally in 1816 the free coinage of silver was brought to an end. At present all gold bullion brought to the Mint is weighed and portions are cut off for assay. The amount of gold in standard ounces (916·6 fine) corresponding to the "imported" bullion is thus ascertained, and on the application of the importer the gold is coined and delivered to him in the form of sovereigns and half-sovereigns at the rate of £3, 17s. 10½d. per standard ounce troy, no deduction being made for wastage, seigniorage, the purchase of alloy metal, or the expense of manufacture. As a considerable time elapses between the receipt of bullion by the Mint and the delivery of the coin, it is generally more profitable for the holder of gold bullion to sell it to the Bank of England or dispose of it in some other way. The result is that the gold presented for coinage is almost always sent from the Bank of England, which suffers no loss of interest during the coinage of the bullion, because bank-notes have already been issued against it. Silver bullion, and the copper, tin and zinc required to make up bronze, are bought by the Mint and manufactured into coin, which is kept in stock and issued as it may be required. One ounce of standard silver, which contains 925 parts of silver and 75 of copper per 1000, is converted into 5s. 6d. in silver coin, whatever may be the market price of silver bullion. This seldom exceeded 30d. per ounce in the years 1893–1907. Coinage bronze consists of copper 95 parts, tin 4 parts and zinc 1 part, and a ton yields £448 in pence or £373, 6s. 8d. in halfpence or farthings. The difference between the nominal value of silver and bronze coin and its intrinsic value is retained by the state to cover the expenses of manufacture and as a source of profit. It corresponds to the seigniorage levied by the king on all coinages down to the reign of Charles II. In return, the Mint receives at its nominal value for recoinage the worn gold and silver coin which is withdrawn from circulation by the Bank of England and some other banks. In spite of the cost of this recoinage, however, the profit on the issue of new silver and bronze usually exceeds in each year the total expenditure of the Mint. Gold and silver are delivered in a refined state suitable for immediate conversion into coin. In general, only old coin, ingots resulting from the melting of coin, and "fine" ingots are received. Fine gold ingots (the "bar gold" of commerce) are usually about 400 oz. troy in weight, and contain from 990 to 999·5 parts of gold per 1000, the remainder being chiefly silver. Fine silver ingots usually weigh from 1000 to 1200 oz. troy and contain from 995 to 999 parts of silver per 1000. The ingots are valued by weighing and assaying, and a calculation is made as to the amount of copper required for melting with them to produce the standard alloy. The two standard alloys consist respectively of gold 916·6, copper 83·3 and of silver 925, copper 75. All gold coins received at the Bank are weighed on automatic balances (see below) and those below the lowest legal current weight are separated. The lowest current weight is 122·5 grains for sovereigns and 61·125 grains for half-sovereigns corresponding to losses by wear of about 0·6% and 0·8% respectively. The average age on withdrawal is about 24 years for sovereigns and 15 years for half-sovereigns. Silver coins are not weighed but are selected for withdrawal when they present a worn appearance. The average deficiency in weight of worn silver coin received at the Mint is from 8 to 10%, and the mean age somewhat less than 50 years. In European mints generally little difficulty is experienced in procuring refined gold and silver for coinage. In Australia, the United States, Japan and some other countries, the Mints receive unrefined gold from the mines and refine it before it is coined. A charge for refining is made in all cases. A refinery was attached to the London Mint from 1816 to 1851, but was then let on lease and left to private enterprise. The operations employed in the manufacture of gold and silver coin are as follow:—

(1) Melting the metal and casting it into bars. (2) Rolling the bars into strips or "fillets." (3) Cutting out disks or blanks from the fillets. (4) Adjusting the weight of the blanks (this is omitted in some mints). (5) "Marking" or edge-rolling the blanks to produce a raised rim or to impress a design on the edge. (6) Annealing the blanks and (in some mints) cleaning them in acid. (7) Striking the blanks between dies surrounded by a collar. (8) Weighing each coin. Among the incidental operations are (*a*) the valuation of the bullion by weighing and assaying it; (*b*) "rating" the bullion, or calculating the amount of copper to be added to make up the standard alloy; (*c*) recovering the values from ground-up crucibles, ashes and floor sweepings (the Mint "sweep"); (*d*) assaying the melted bars; (*e*) "pyxing" the finished coin or selecting specimens to be weighed and assayed; (*f*) "telling" or counting the coin.

Melting.—Formerly bullion was melted in crucibles made of refractory clay, but they are liable to crack and require careful handling

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[1] Grueber, *op. cit.* p. liv.

[2] Ruding, *op. cit.* ii. 245.

[3] W. J. Hocking, *Catalogue of Coins in the Royal Mint*, i. 272, 275 and 279.

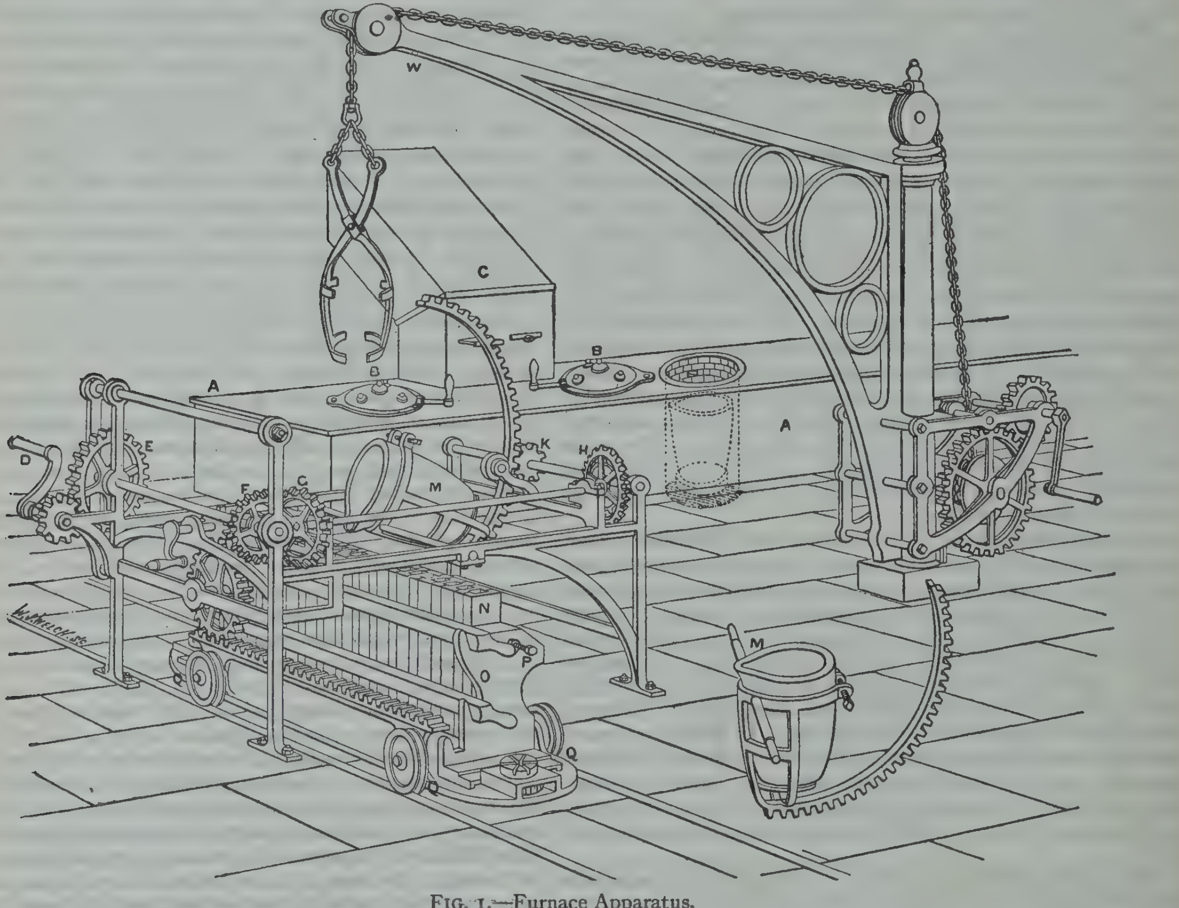

FIG. 1.—Furnace Apparatus.

These were succeeded by iron crucibles, especially for melting silver, and these have now been generally replaced by graphite (plumbago) crucibles made of a mixture of clay and graphite. Good graphite crucibles can be used many times in succession if they are heated gradually each time, but they are usually discarded after about fifteen or twenty meltings. At the Royal Mint gold is melted in crucibles about 10 in. in height and 8½ in. in diameter at the widest part. The charge is from 1200 to 1300 oz. (37·3 to 40·5 kilograms) of metal. The furnace is 12 in. square and 2 ft. deep from the fire-bars to the cover. An old crucible is cut off about 2 in. from the bottom and the bottom piece is inverted and placed on the fire-bars as a support for the crucible. The "muffle," a graphite cylinder 6 in. in height, is placed on the crucible to allow room for long bars to be melted in the crucible and to prevent the surrounding coke from falling into it. The flue, of about 5 in. square, communicates with a stack 60 ft. high. In many mints the flues pass into condensing chambers where volatilized gold and silver are recovered. The crucible is at a red heat when the gold is charged in, the copper being added last, and a graphite lid put on the crucible to check loss by volatilization. The charge is completely melted in about half an hour, and it is then thoroughly mixed by stirring with a graphite rod. The crucible is then lifted out by circular tongs suspended in such a way that two men can take part in the operation. The contents are poured by hand into moulds which are contained side by side in an iron carriage running on wheels, fig. 1, OP. The molten gold, which is of a pale green colour, solidifies at once in the iron moulds, and the bars can be taken out immediately. Bars from which sovereigns are to be coined are 22 in. long, 1⅝ in. wide and ⅓ in. thick, and about seven such bars are cast from one pot. The rough edges of the bars are removed by a circular revolving file, and the hollow ends are cut off. Pieces are cut out for assay, and the bars are then ready for rolling. The amount of gold melted in an ordinary day's work is two tons to two and a half tons, of the value of £250,000 to £300,000. For silver larger crucibles are used, containing about 5000 oz. troy (155 kilograms). They are heated in circular furnaces 21 in. in diameter and lifted out with circular tongs suspended from a travelling crane which is worked by electricity. The crucible is placed in the pouring cradle, which has been in use since 1816, and is shown in fig. 1. Here A is the iron cover surrounding the furnaces, B is the revolving lid of a furnace, and C is the flue, common to two furnaces and leading to the stack. The handle D, acting through the gear wheels E, F, G and H, turns the cogwheel K, which moves the curved rack of the cradle and tips the crucible M. The molten metal is poured into the moulds N, which are carried on wheels running on rails Q. The parts of the range of moulds are brought tightly together and held in position by the bars O and the screw P, and when one mould is filled the carrier is moved forward on its rails by wheels worked by a handle also shown in the figure. In some other mints still larger crucibles are used, containing various amounts up to about 1000 kilograms or over 30,000 oz. In foreign mints the molten metal is generally transferred from the crucible to the moulds by dipping crucibles or iron ladles covered with clay. Gas is used as fuel for the melting furnaces at Philadelphia. It is cleaner than coke and is said to save time and to reduce the loss of the precious metals. At Denver and Ottawa the fuel used is "first distillate" oil, which is found to be cheaper than either naphtha or gas. The oil is pumped from buried tanks and warmed to about 90° F. before it reaches the burners at the furnaces. At the Denver mint the crucibles are used for from twelve to fifteen meltings with oil fuel, whereas they were soon destroyed when gas was employed. A charge of 6000 oz. of gold is melted in about an hour. The melting losses amount to about 0·2 per 1000 of gold and 0·6 per 1000 of silver in the Royal Mint. The losses are caused by volatilization, by the absorption of metal by the crucible, stirring rod, &c., and by occasional projection of particles from the pot into the furnace. The ash-pit is lined with iron plates to facilitate the recovery of metal accidentally spilt. All crucibles and other materials which might contain precious metal are ground up and washed in a pan, and the pannings together with a selection from the floor sweepings are remelted. The residues (the Mint "sweep") are sold to refiners or ore-smelters.

Rolling.—The cast bars are reduced to the thickness of the coin by repeated passages between rolls. These are cylinders of cast iron or steel from 6 in. to 15 in. in diameter set parallel to one another with a small interval between, and revolved by electric or steam power. They are divided into breaking-down and finishing rolls, the latter being of smaller diameter than the former. The power is usually transmitted through toothed wheels, each roll being driven independently in some cases, while sometimes power is applied to the lower roll only, the upper roll being coupled to it. The of many foreign coins, are put on by the marking machine, and a plain collar is used in striking.

The coining presses now used are all modifications of the lever press invented by Uhlhorn of Grevenbroich near Cologne in 1839. The press in use at the Royal Mint since 1882 is shown in figs. 6 and 7. The lever M worked from the front of the machine causes the fly-wheel to be connected with the driving-wheel and the machine starts. The blanks are placed in the slide J and the lowest one is carried forward to the die in two successive movements of the "layer-on" K, a rod working backwards and forwards on a horizontal plate and actuating the finger L, fig. 8. The lower die is firmly fixed to the bed of the machine, and the blank is placed exactly upon it. The collar A′ is then raised by the lever G so as to encircle the blank, and the upper die which is held at A is brought down. This is done by the little crank B on the axle of the fly-wheel, acting through the rod C, and the bent lever D, which forms a toggle-joint at E with the vertical piece of metal below it. The straightening of the toggle-joint when C is pushed forward forces A down to strike the coin. The reverse movement of D lifts up the upper die and the collar drops simultaneously so that its upper surface is level with the face of the lower die on which the finished coin lies. Another blank moved on by the finger L pushes off the finished coin which falls down the tube N. The diagram, fig. 9, shows the relative position of the dies and levers more clearly. The dies and collar are shaded. The presses at the Mint strike from 90 to 125 coins per minute, most of them working at the rate of 110 coins per minute. There are 19 presses and it is possible with these to strike between 700,000 and 800,000 pieces in an ordinary working day.

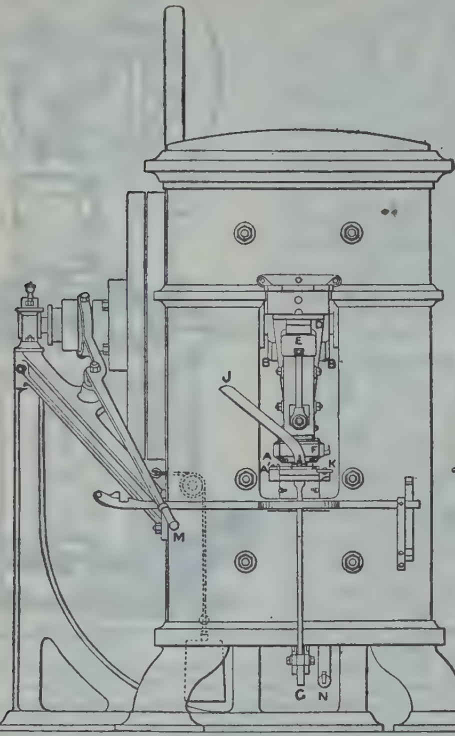

Fig. 6.

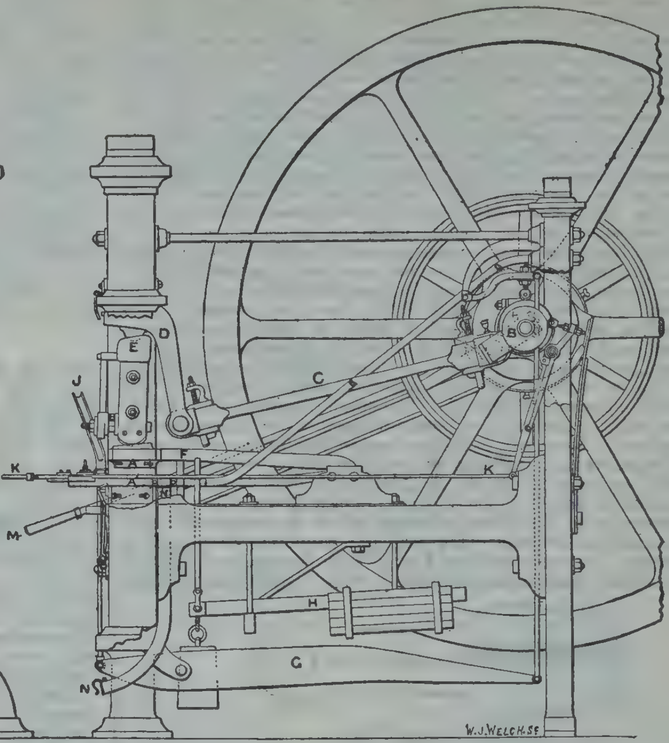

Fig. 7.

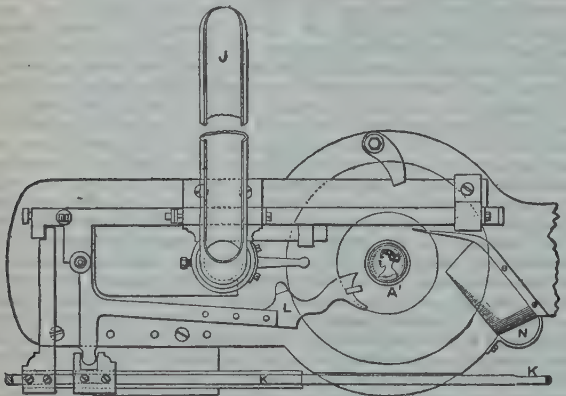

Fig. 8.

Weighing the Coins.—Gold and silver coins are examined and tested by ringing, and each coin is then weighed separately by being passed over delicate automatic balances. The first automatic balance for weighing single coins was introduced at the Bank of England in 1843, and was designed by William Cotton, the deputy governor of the Bank. In 1851 these balances, improved by Richard Pilcher, were introduced at the Royal Mint, and modifications of them are now used at most foreign mints. For mint use it is necessary that they shall distinguish between "light," "heavy" and "good" coins which do not differ from standard by more than the small weight known as the "remedy" (see above). The balances used in the Royal Mint were further improved by J. T. Butler in the year 1889. The balance consists essentially of a beam with two scale pans, one for the coin and the other for the counterpoise. The beam is released and in the course of a second or so takes up a certain position dependent on the relative weights of the coin and counterpoise. Its position is then fixed by an automatic grip, and the coin falling down a shoot enters one of three compartments of a box, according to the position of the beam when it is arrested. The chief working parts are shown in fig. 10. The beam A is of steel made in one piece, about 11 in. long. Its centre and end knife edges are shown in fig. 11. The scale pan for the coin is shown in fig. 12. B is the pan on which the coin rests, at a point above the beam. The coins are placed in a rouleau in the hopper C and the lowest one is pushed on to the pan B by a slide not shown in the figure. While the coin is being moved the hanger D is held firmly by the forceps E to prevent the pan from being pushed sideways. The forceps are then opened and the beam released, but at this moment the levelling bar F is allowed to drop momentarily by a bent lever G acting on the pin G′, until the ends of F press down on a stirrup in each hanger at H, H. This brings the beam to a horizontal position. The lever G at once

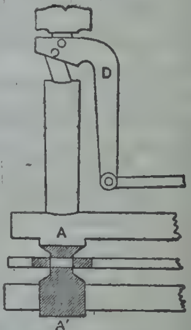

Fig. 9.

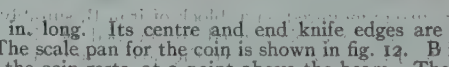

Fig. 10

lifts the bar F again by acting on the pin G′ so that the bar F does not touch the stirrups at H and the beam and hangers are free to move. The coin is balanced by the brass counterpoise J on the left-hand hanger and by little weights made of wire attached to the right-hand hanger at K. If the coin is heavier than the lowest legal weight (that is, the standard weight less the remedy) the right-hand side of the beam begins to fall and the left-hand one is raised. This movement proceeds until the stirrup L below the left-hand hanger is raised far enough to touch the rod M, which is equal in weight to twice the remedy. The movement is then stopped provided that the weight of the coin is not greater than the standard weight plus the remedy. If it is heavier than this, it raises the weight M, and the movement of the beam and its hangers proceeds farther in the same direction. After about a second from the time of the final release of the beam, the forceps E again close and the hanger D is held firmly in its new position. The rod N is then lowered and allows the indicating finger O, which is pivoted at P, to fall until it rests on the stirrup R, which is part of the hanger D. The extension of O holds down the right-hand end of the rod S which is also pivoted at P, and enables its end to fit into one of the three inverted steps on the bottom of the shoot Q. The position of the shoot is thus determined. It stops over one of three orifices in the bottom plate of the balance. If the coin is light the rod S fits into the uppermost step and the shoot stops over the right-hand slot. If the coin is heavy, S fits into the lowest step and the shoot stops over the left-hand slot. The middle step and slot are for coins within the remedy. The movement of the slide now pushes another coin forward, and the weighed coin is displaced by it and falls down the shoot, through one of the slots. Each slot leads into a separate compartment and the coins are consequently sorted into three classes, light, correct weight and heavy. The balance turns to 0·01 grain. The driving power is applied by shafting through a number of cams. In the Royal Mint both light and heavy coins are returned to the melting pot. The proportion of rejected gold coin varies with the quality of the bullion, and frequently exceeds 10%. The percentage of rejected silver is often no more than 1%. In most foreign mints the blanks are weighed by the automatic balances before being struck, and those which are too heavy are reduced by filing or planing. A workman sitting at a balance files the edges of the piece and weighs it until it is within the remedy. The blank is then again passed through the automatic balance and is sent forward to the coining press if the correctness of the weight is confirmed. Since 1870 no adjusting of the weight of coins has been attempted at the Royal Mint. Heavy blanks have also been reduced chemically by making them part of the anode in a cyanide bath through which a current of electricity is passed. Some metal from the surface of each blank then passes into solution, and the blanks are reduced in weight with remarkable uniformity. This system was introduced into the Indian mints in 1873.

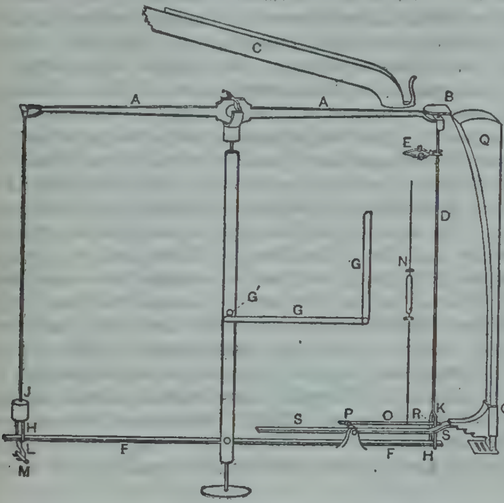

FIG. 11.

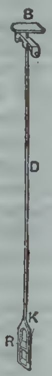

FIG. 12.

Telling.—The coin is counted and packed into bags for despatch from the Mint. The counting or telling is now carried out in the case of bronze and silver coins by ingenious machines introduced in 1891. The coins are spread on an inclined table by hand. They slide down the table and enter a narrow passage where only one can pass at a time, jamming being prevented by the joggling action of an eccentric rotating disk at the entrance to the passage. The coins are then gripped by a pair of india-rubber driving wheels, which force them past the rim of a thin disk with notches in its edge to fit the coins. As the disk is thus made to revolve, the coins are pushed forward, and falling down a shoot are received in a bag. The machine can be set to deliver a certain number of coins, after which the counting wheel stops automatically.

Trial of the Pyx.—Periodical examinations of the coins issued by the Mint have been made from very early times in England by persons appointed by the Crown. Specimens are selected from the finished coin and are put into a box or "pyx." At intervals these coins are weighed and assayed by a jury of skilled persons and the results reported to the Crown. A trial of the pyx is mentioned in the Lansdowne MSS. as having taken place in the reign of Henry II., but the practice had probably originated much earlier. The trial is now held annually by a jury consisting of freemen of the Company of Goldsmiths. Coins from the London and Australian mints are examined. The Company has been entrusted with the duty since the time of James I. Coins of foreign mints are generally submitted to examination by a committee of eminent chemists and metallurgists whose report is published in the official journals.

A full account of the work of the Mint, with valuable tables giving the amount of the coinage of gold and silver and bronze in the United Kingdom and the colonies in detail, and a *résumé* of the coinages of foreign countries, will be found in the *Annual Reports of the Deputy Master and Comptroller of the Mint*, which have been published since 1870. (T. K. R.)

MINTO, EARLS OF. The Scottish border family of Elliot which has held the earldom of Minto since 1813 has had many distinguished members. Sir Gilbert Elliot, bart. (1651–1718), and his son and successor, another Sir Gilbert Elliot (1693–1766), were both celebrated Scottish judges and both took the official title of Lord Minto. The elder Sir Gilbert was sentenced to death for his share in the rising of the earl of Argyll in 1685, but was afterwards pardoned; the younger Sir Gilbert was a scholar and an agriculturist. Among the children of the latter were John Elliot (d. 1808), a naval officer, who served as governor of Newfoundland and was made an admiral; Andrew Elliot, the last English governor of New York; and the poetess Jean, or Jane, Elliot (*c.* 1727–1805), who wrote the popular ballad "Flowers of the Forest." The eldest son, Sir Gilbert Elliot (1722–1777), who became the third baronet in April 1766, was a member of parliament from 1753 to 1777, and a friend and follower of the earl of Bute. He filled several public offices, and Horace Walpole said he was "one of the ablest members of the House of Commons." His second son was the diplomatist, Hugh Elliot (1752–1830), who represented his country at Munich, at Berlin, at Copenhagen and at Naples. He was governor of Madras from 1814 to 1820, and he died on the 10th of December 1830.

See the *Memoirs of the Right Hon. Hugh Elliot*, by the countess of Minto (Edinburgh, 1868).

The third baronet's eldest son was GILBERT ELLIOT, 1st earl of Minto (1751–1814). About 1763 Gilbert and his brother Hugh were sent to Paris, where their studies were supervised by David Hume and where they became intimate with Mirabeau. Having passed the winters of 1766 and 1767 at Edinburgh University, Gilbert entered Christ Church, Oxford, and on quitting the university he was called to the bar. In 1776 he entered parliament as an independent Whig. He became very friendly with Burke, whom he helped in the attack on Warren Hastings and Sir Elijah Impey, and on two occasions was an unsuccessful candidate for the office of speaker. In 1794 Elliot was appointed to govern Corsica, and in 1797 he assumed the additional names of Murray-Kynynmond and was created Baron Minto. From 1799 to 1801 he was envoy-extraordinary to Vienna, and having been for a few months president of the board of control he was appointed governor-general of India at the end of 1806. He governed with great success until 1813. He was then created Viscount Melgund and earl of Minto. He died at Stevenage on the 21st of June 1814 and was buried in Westminster Abbey.

The earl's second son was Admiral Sir George Elliot (1784–1863), who as a youth was present at the battles of Cape St Vincent and the Nile, and who was secretary to the admiralty from 1830 to 1834. A nephew of the earl was Sir Charles Elliot (1801–1875) also an admiral, who took a prominent part in the war with China in 1840. Afterwards he was governor of Bermuda, of Trinidad and of St Helena.

GILBERT ELLIOT-MURRAY-KYNYNMOND, 2nd earl of Minto (1782–1859), eldest son of the 1st earl, was ambassador to Berlin from 1832 to 1834, first lord of the admiralty from 1835 to 1841 and lord privy seal from 1846 to 1852. His influence in the Whig party was partly due to the fact that his daughter, Frances, was the wife of Lord John Russell.

His son William Hugh, the 3rd earl (1814–1891), was the father of the 4th earl, Gilbert John Elliot-Murray-Kynynmond (1845–), who joined the Scots Guards in 1867. In 1874, in the capacity of a newspaper correspondent, he witnessed the operations of the Carlists in Spain; he took service with the Turkish army in the war with Russia in 1877 and served under Lord Roberts in the second Afghan War (1878–79), having narrowly escaped accompanying Sir Louis Cavagnari Kabul. He acted as private secretary to Lord Roberts during his mission to the Cape in 1881; as military secretary to Lord Lansdowne during his governor-generalship of Canada from 1883 to 1885; and as chief of the staff to General Middleton in the Riel Rebellion in Canada (1885). Having succeeded to the earldom in 1891 he was appointed governor-general of Canada in 1898. His term of office (1898–1904) was distinguished by a visit of the prince and princess of Wales to the colonies. In 1905, on the resignation of Lord Curzon, Lord Minto was appointed viceroy and governor-general of India, retiring in 1910.

The 4th earl's brother, the Hon. Arthur Ralph Douglas Elliot (b. 1846), editor of the *Edinburgh Review*, was a member of parliament from 1880 to 1892 and again from 1898 to 1906, and from 1903 to 1906 he was financial secretary to the treasury. Sir Francis Edmund Hugh Elliot (b. 1851), a grandson of the 2nd earl, became British minister at Athens in 1903.

See Hon. G. F. S. Elliot, *The Border Elliots and the Family of Minto* (Edinburgh, 1897); the article India; *History*; also the *Life and Letters of the first Earl of Minto, 1751–1806* (1874) and *Lord Minto in India, 1807–1814* (1880), both edited by the countess of Minto; and Sir J. F. Stephen, *The Story of Nuncomar and the Impeachment of Sir E. Impey* (1885).

MINTO, WILLIAM (1845–1893), Scottish man of letters, was born at Auchintoul, Aberdeenshire, on the 10th of October 1845. He was educated at Aberdeen University, and spent a year at Merton College, Oxford. He was assistant professor under Alexander Bain at Aberdeen for some years; from 1874 to 1878 he edited the *Examiner*, and in 1880 he was made full professor of logic and English at Aberdeen. In 1872 he published a *Manual of English Prose Literature*, which was distinguished by sound judgment and sympathetic appreciation; and his *Characteristics of English Poets from Chaucer to Shirley* (1874) showed the same high qualities. His other works include: *The Literature of the Georgian Era* (1894) edited with a biographical introduction by W. Knight a monograph on Defoe in the *English Men of Letters* series (1879); three novels of small importance, and numerous articles on literary subjects in the 9th edition of the *Encyclopaedia Britannica*. He died on the 1st of March 1893.

MINTURNAE, an ancient city of the Aurunci, in Italy, situated on the N.W. bank of the Liris with a suburb on the opposite bank 1½ m. from its mouth, at the point where the Via Appia crossed it by the Pons Tiretius. It was one of the three towns of the Aurunci which made war against Rome in 314 B.C., the other two being Ausona (see Sessa Aurunca) and Vescia; and the Via Appia was made two years later. It became a colony in 295 B.C. In 88 B.C. Marius in his flight from Sulla hid himself in the marshes of Minturnae. The ruins consist of an amphitheatre (now almost entirely demolished, but better preserved in the 18th century), a theatre, and a very fine aqueduct in *opus reticulatum*, the quoins of which are of various colours arranged in patterns to produce a decorative effect. Close to the mouth of the river was the sacred grove of the Italic goddess Marica. It is still mentioned in the 6th century, but was probably destroyed by the Saracens, and its low site, which had become unhealthy, was abandoned in favour of that of the modern town of Minturno (known as Traetto until the 19th century), 459 ft. above sea-level. A tower at the mouth of the river, erected between 961 and 981, commemorates a victory gained by Pope John X. and his allies over the Saracens in 915. It is built of Roman materials from Minturnae, including several inscriptions and sculptures.

See T. Ashby in *Mélanges de l'École française de Rome* (1903), 413; R. Laurent-Vibert and A. Piganol, ibid. (1907), p. 495; G. Q. Giglioli, *Notizie degli Scavi* (1908) p. 396. (T. As.)

MINUCIUS, FELIX MARCUS, one of the earliest if not the earliest, of the Latin apologists for Christianity. Of his personal history nothing is known, and even the date at which he wrote can be only approximately ascertained. Jerome (*De vir. ill* 58) speaks of him as "Romae insignis causidicus," but in this he is probably only improving on the expression of Lactantius (*Inst. div.* v. 1) who speaks of him as "non ignobilis inter causidicos loci." He is now exclusively known by his *Octavius*, a dialogue on Christianity between the pagan Caecilius Natalis[1] and the Christian Octavius Januarius, a provincial lawyer, the friend and fellow-student of the author. The scene is pleasantly and graphically laid on the beach at Ostia on a holiday afternoon, and the discussion is represented as arising out of the homage paid by Caecilius, in passing, to the image of Serapis. His arguments for paganism (possibly modelled on those of Celsus) are taken up seriatim by Octavius, with the result that the assailant is convinced. Minucius himself plays the part of umpire. The form of the dialogue is modelled on the *De natura deorum* and *De divinatione* of Cicero and its style is both vigorous and elegant if at times not exempt from something of the affectation of the age. Its latinity is not of the specifically Christian type. If the doctrines of the Divine unity, the resurrection, and future rewards and punishments be left out of account, the work has less the character of an exposition of Christianity than of a philosophical and ethical polemic against the absurdities of polytheism. While it thus has much in common with the Greek Apologies it is full of the strong common sense that marks the Latin mind. Its ultimate appeal is to the fruits of faith.

The *Octavius* is admittedly earlier than Cyprian's *Quod idola dii non sint*, which borrows from it; how much earlier can be determined only by settling the relation in which it stands to Tertullian's *Apologeticum*. Since A. Ebert's exhaustive argument in 1868, repeated in 1889, the priority of Minucius has been generally admitted; the objections are stated in the *Dict. Chr. Biog.* article by G. Salmon. Editions: F. Sabaeus-Brixianus, as Bk. viii. of Arnobius (Rome, 1543); F. Balduinus, first separate edition (Heidelberg, 1560); Migne, *Patrol. Lat.* iii. 239; Halm in *Corp. Scr. Eccl. Lat.* (Vienna, 1867); H. A. Holden. Translations: R. E. Wallis, in *Ante-Nic. Fathers*, vol. iv.; A. A. Brodribb's *Pagan and Puritan*. Literature: In addition to that already cited see H. Boenig's art. in Hauck-Herzog's *Realencyk.* vol. 13, and the various histories of early Christian Literature by A. Harnack, G. Krüger, A. Ehrhard and O. Bardenhewer.

MINUET (adapted, under the influence of the Italian *minuetto*, from Fr. *menuet*, small, pretty, delicate, a diminutive of *menu*, from Lat. *minutus*; the word refers probably to the short steps, *pas menus*, taken in the dance), a dance for two persons, in $\frac{3}{4}$ time. At the period when it was most fashionable it was slow, ceremonious, and graceful (see Dance). The name is also given to a musical composition written in the same time and rhythm, but when not accompanying an actual dance the pace was quicker. An example of the true form of the minuet is to be found in Don Giovanni. The minuet is frequently found as one of the movements in the Suites of Handel and Bach. Haydn introduced it into the symphony, with little trace of the slow grace and ceremony of the dance. In the hands of Beethoven it becomes the scherzo.

MINUSINSK, a town of Russia, in East Siberia, and the government of Yeniseisk, 180 m. S.S.W. of Krasnoyarsk railway station, and 5 m. from the right bank of the Yenisei, in a fertile prairie region. Pop. (1897), 10,255. It is a centre for trade with the native populations of the Sayan Mountains and north-western Mongolia. It has an excellent natural history, ethnographical and archaeological museum (1877), with a library and a meteorological station. Coal and iron abound in the vicinity.

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[1] This name occurs in six inscriptions of the years 211–217 found at Constantine (Cirta), North Africa (*C.I.L.* vol. viii.). Like the other North African fathers Tertullian, Cyprian, Arnobius and Lactantius, he was a lawyer. Some use may have been made of rhetorical expressions of M. Cornelius Fronto of Cirta (d. *c.* A.D. 170).

MINUTE (Lat. *minutus*, small; *minuere*, to make less), an adjective meaning of very small size, petty or trifling; also extremely precise. In this sense the word is pronounced *mī-nūte*. As a substantive and pronounced *minnit* the word (usually in the plural) is applied to a written summary of the transactions of a meeting of a public or other body, or to a memorandum of instructions, &c. A Treasury minute in the United Kingdom is an official memorandum authorizing certain procedure. "To minute" is to draw up such a summary or memorandum. More particularly, "minute" is used of the sixtieth part of any unit); in time, of an hour; and in astronomy, geometry, geography, &c., of a degree in the measurement of a circle. The sexagesimal system of division was originally used by the ancient Babylonian astronomers, was adopted by Ptolemy; and the sixtieth part of a degree, and its further subdivision into sixty parts, was called in Latin *pars minutae primae*, and *pars minutae secundae* respectively, hence the English "minute" and "second."

MINUTE MEN: in the American War of Independence, militiamen who had undertaken to turn out for service at a minute's notice. In Massachusetts the minute men were enrolled by an act of the provincial congress of the 23rd of November 1774, and in Boston alone they numbered 16,000 prior to the outbreak of the war. The Americans who fought in the opening action of Lexington were "minute men."

MIOCENE, in geology, the system of strata which occurs between the Oligocene and the Pliocene. The term, derived from the Greek μεῖον, less, and καινός, recent, was introduced by Sir Charles Lyell, as indicating palaeontologically a less percentage of recent species than is found in the Pliocene. Variable lacustrine, estuarine and marine deposits, especially characterized by soft calcareous sandstones and conglomerates ("molasse") and sandy shell-beds ("faluns"), make up the Miocene system of the Neogene or newer Tertiary in Europe and western Asia, where it attains its fullest development.

A. de Lapparent's classification is here adopted:—

V. *Pontian* or *Pannonian*.—Brackish- and fresh-water marls, limestones and gravels: occurring at Vienna, in the Caspian and eastern Mediterranean basins, and in southern France; mammalian deposits of Pikermi and the Siwalik Hills, with *Hipparion gracile*, *Mastodon longirostris*, *Rhinoceros schleiermachi*, numerous ruminants, *Congeria subglobosa*. Marine beds of Belgium (Black Crag) and north Germany.

IV. *Sarmatian*.—More or less salt-water sands and marls of the same basins with *Mastodon angustidens*, *Anchitherium aurelianense*, *Cerithium pictum*, *C. rubiginosum*, *Ostrea gingensis*, *Mactra podolica*, *Tapes gregarius*. Stages IV. and V. represented in north-western France by marine sands (*Cardita striatissima*), and in Algeria and Morocco by marine marls and limestones.

III. *Vindobonian*.—Sub-stages:—

(*b*) *Tortonian*: Marine marls with *Ancillaria glandiformis*, *Conus antiquus*, *Ranella marginata*, *Trochus patulus*, *Voluta rarispina*. Laminated fresh-water limestones of Oeningen with fish, countless insects, and plants showing seasonal changes of the year in their successive layers (*Acer trilobatum*, *Populus mutabilis*, *Juglans acuminata*, *Camphora*, *Podogonium*); and the lacustrine deposits of central Spain.

(*a*) *Helvetian*: Marine shelly sandstones and conglomerates ("molasse" of Switzerland) with *Ostrea gingensis*, *Cardita jouanneti*, *Panopaea menardi*, *Conus ventricosus*; the "faluns" of Touraine and Aquitaine; and the marine beds of Black Sea basin. At the base of the marine Helvetian in the Vienna basin clays ("Schlier") with rock-salt and gypsum, and the lacustrine beds of Gascony (*Calcaire de Simorre* with *Mastodon tapiroides*, *M. simorrensis*, *Dinotherium giganteum*) occur.

II. *Burdigalian* or *Langhian*.—Marine "faluns" of Bordeaux (*Oliva basteroti*, *Turritella terebralis*); marls of Langhe in Liguria (*Pecten burdigalensis*); marine deposits of Vienna basin, Caspian region, Tunis and Algeria; fresh-water sands and marls of Orleans with *Mastodon angustidens*, *M. tapiroides*, *Dinotherium cuvieri*, *Anthracotherium onoideum*; *Littorinella* clays of Mainz basin with *Acerotherium incisivum Littorinella acuta*, *Dreyssenia brardi*; fresh-water grey "molasse" of Switzerland, with acacias, laurels, palms and sequoias.

I. *Aquitanian*.—Limestones, sands and marls of lakes and lagoons, with *Anthracotherium*, *Anchitherium*, *Acerotherium incisivum*, *Palaeochoerus typus*, *Helix ramondi*, *Limnaea pachygaster*, *Planorbis cornu*, *Potamides lamarcki*; *Quercus*, *Acacia*, *Ficus*, *Camphora*, *Cinnamomum*, *Taxodium*, *Glyptostrobus*, *Sequoia*, *Sabal*, *Phoenix*, occur in central France (*Calcaire de la Beauce*); the plant-beds of Manosque; Mainz basin; lower "molasse" of Switzerland with lignite, gypsum, red marls and conglomerates; "brown-coal series" of north Germany with lignite. Intercalated marine sandstones occur in Aquitaine and near Marseilles; other marine developments occur in the "faluns" of Gascony (*Lepidocyclina mantelli*, *Miogypsina burdigalensis*), the upper Aquitanian of Bavaria and Austria-Hungary (*Ostrea crassiassima*, *Pectunculus pilosus*), and in southern Spain, Italy and Malta (*Lepidocyclina* and *Lithothamnium*). Basic tuffs and lavas occur in Auvergne.

Some authors assign Stage I. to the Oligocene, Stage V. to the Pliocene; Stages I. and II. correspond to the first, and III. to the second Mediterranean Stage of E. Suess.

In Europe a general emergence of land in late Oligocene time resulted at the beginning of the Miocene (Aquitanian) in widespread lacustrine conditions throughout the western part of that continent, upon which the sea encroached at few points, though it had gained access to the Vienna basin and extended westward into Bavaria. Otherwise, marine Aquitanian deposits are confined to the Mediterranean basin and the south-west corner of France. Most of northern Europe, including the British Isles, remained dry land throughout Miocene time. During the Burdigalian period, with increasing elevation of the mountain regions and depression of the Mediterranean and Caspian basins, a marine invasion began, which passed its maximum in the Vindobonian. The Mediterranean reached eastward to Persia, and, still open to the Atlantic, submerged north Africa, most of Italy and the neighbouring islands. It ascended the Rhone valley, penetrated to the Mainz basin, and skirting the north flank of the Alpine region passed into the Vienna basin and thence around the Carpathian tract into the Pontic and Caspian depression. The waters of the Atlantic further invaded the regions of the Garonne and the Loire, isolated Brittany and encroached upon north Europe between Belgium and Denmark.

The elevation of the Alps, and probably of the whole Alpine system of mountain folds from Morocco to Indo-China, though initiated by earlier Miocene and late Oligocene movements, took place mainly during the latter part of the Vindobonian period, and was completed in the Sarmatian. The waters of the ocean were then excluded from the Caspian and eastern Mediterranean basins, and replaced by vast fresh-water lakes; while brackish-water lagoons occupied much of the western Mediterranean. This great retreat of the sea culminated in the Pontian stage, and land-connexion was established between North and South America. Outside the Eurasian region, Aquitanian deposits occur in Formosa, Java, Borneo and Madagascar; while Burdigalian deposits are found in Mongolia. The Vindobonian ranges from Greenland, Iceland and Spitzbergen, where it contains lignite and plants denoting a temperate climate, by Japan, Java and India, to Victoria. It recurs in the Azores and the Antilles, and at intervals along the American continent from Patagonia to Alaska, where all three lower stages are represented, as also in the West Indies. Along the Atlantic slope of the United States and around the Gulf of Mexico the complete Miocene series is present, the Sarmatian and Pontian also occur in California.

The Miocene was a period of change, of mountain-building, climatic differentiation hitherto unprecedented, and of moderation in organic life, especially on land. The rich European flora indicates an equable and moist sub-tropical climate, slowly cooling, as witnessed by the gradual increase of trees with deciduous foliage amongst those characteristic of more tropical conditions. Oaks, maples, poplars, planes, willows, *Cinnamomum*, *Camphora*, *Myrica*, *Sequoia*, *Taxodium*, *Glyptostrobus* and palms, flourished together. The marine calcareous alga *Lithothamnium* became an important reef-building organism. Nummulites gave place to *Lepidocyclina*; lamellibranchs and particularly gasteropods abounded in the shallow seas, of which the shark *Carcharodon* and the marine mammals *Squalodon* and *Halitherium* were amongst the largest denizens. The mammalian land-fauna of Europe made striking advances, and assumed a decidedly African aspect. Marsupials had disappeared from it before the Burdigalian period, during which primitive genera like *Palaeochoerus*, *Hyopotamus*, and the hornless ruminants *Anthracotherium* and *Brachyopus*, became extinct, while proboscideans (*Mastodon*, *Dinotherium*), rhinoceros and apes (*Oreopithecus*, *Pliopithecus*) came in, followed by antelopes, beavers and probably *Machaerodus* in the Vindobonian. The spread of turf-forming grasses was succeeded in the Pontian by an enormous increase of herbivorous mammals, including *Hipparion* and horned ruminants (*Helladotherium*, *Antilope*, *Cervus*, *Camelopardalis*, *Palaeotragus*), whose migrations were facilitated by the desiccation of the Mediterranean basin. (C. B. W.*)

MIOT DE MÉLITO, ANDRÉ FRANÇOIS, Comte (1762–1841), French statesman and scholar, was born at Versailles (Seine-et-Oise) on the 9th of February 1762. He was a high official in the war office before the Revolution, and under the Republic he eventually became secretary-general for foreign affairs. That he was not denounced under the Terror was due to the fact that he was indispensable in his department. In 1795 he was sent as French envoy to Florence; then to Rome, and on his return to Florence received orders to proceed to Corsica, which, after its evacuation by the British, was in a state of anarchy. In Corsica he allied himself with Joseph Bonaparte, and after pacifying the island returned to Italy. Recalled by their Dectory in 1798 because of his refusal to foment insurrection in Italy, he spent some time in retirement, but he was in the diplomatic service in Holland at the revolution of 18. Brumaire (Nov. 9, 1799). Under the consulate he was secretary-general at the ministry of war, and a member of the council of state, and was sent on a second mission (1801–1802) for the pacification of Corsica. In 1806 he joined Joseph Bonaparte in Naples as minister of the interior, afterwards following him to Spain as comptroller of the household, but he returned to France in the retreat of 1813. Next year he was created comte de Mélito, and during the Hundred Days he served as commissary extraordinary with the XII. Army division. He took no part in politics after Waterloo, where his son-in-law, General J. B. Jamin, was killed, and his own son mortally wounded. He visited Joseph Bonaparte in America in 1825, and then spent some years in Germany with his daughter, whose second husband, General von Fleischmann, represented the king of Württemburg in Paris in 1831. He was admitted in 1835 to the French Academy on the merits of his translations of Herodotus (Paris, 1822) and Diodorus (Paris, 1835–1838). He died in Paris on the 5th of January 1841.

Miot de Mélito had kept a diary which, arranged for publication by his son-in-law, General von Fleischmann, covers the years from 1788 to 1815, and is of interest for the history of the Bonaparte family and of Joseph's dominion in Spain. Published in France in 1858, it was translated into English by Mrs C. Hoey and J. Lillie (2 vols., 1881); and also into German (Stuttgart, 1866–1867). See Albert Gaudin, *Les Arrêtés Miot* (Ajaccio, 1896).

MIQUEL, JOHANN VON (1829–1901), German statesman, was born at Neuenhaus, Hanover, on the 19th of February 1829, being descended from a French family which had emigrated during the Revolution. He learnt law at the universities of Heidelberg and Göttingen. Studying the writings of Karl Marx he became a convert to an extreme revolutionary, socialistic and atheistic creed; but though he entered into correspondence with Marx, with the object of starting a revolutionary movement, he does not appear to have taken any overt part in the events of 1848–1849. Further study of political economy soon enabled him to pass out of this phase, and in 1850 he settled down to practise as an advocate at Göttingen. He acquired repute as an able lawyer and a rising politician, and especially for his knowledge of financial questions. He was one of the founders of the German *Nationalverein*, and in 1864 he was elected a member of the Hanoverian parliament as a Liberal and an opponent of the government. He accepted the annexation of Hanover by Prussia without regret, and was one of the Hanoverians whose parliamentary abilities at once won a commanding position in the Prussian parliament, which he entered in 1867. For some reason—perhaps because Bismarck did not entirely trust him—he did not at this time attain quite so influential a position as might have been anticipated; nevertheless he was chairman of the parliamentary committee which in 1876 drafted the new rules of legal procedure, and he found scope for his great administrative abilities in the post of burgomaster of Osnabrück. He held this position from 1865 to 1870, and again from 1876 to 1879, being in the meantime (1870–1873) a director of the Discontogesellschaft. In 1879 he was elected burgomaster of Frankfort-on-Main, where he gained a great reputation for the energy with which he dealt with social questions, especially that of the housing of the poor. Probably owing to his early study of socialism, he was very ready to support the new state socialism of Bismarck. He was the chief agent in the reorganization of the National Liberal party in 1887, in which year he entered the imperial Reichstag. After Bismarck's fall in 1890 he was chosen Prussian minister of finance, and held this post for ten years. He distinguished himself by his reform of the Prussian system of taxation, the one really successful measure of the new reign in internal affairs. An attempt, however, to reform the system of imperial finance in 1893–1894 failed, and much injured his reputation. Miquel had entirely given up his Liberalism, and aimed at practical measures for improving the condition of the people irrespective of the party programmes; yet some of his measures—such as that for taxing "Waarenhäuser" (stores)—were of a very injudicious nature. He professed to aim at a union of parties on the basis of the satisfaction of material interests, a policy to which the name of *Sammlung* was given; but his enemies accused him of constantly intriguing against the three chancellors under whom he served, and of himself attempting to secure the first place in the state. The sympathy which he expressed for the Agrarians increased his unpopularity among Liberals and industrials; but he pointed out that the state, which for half a century had done everything to help manufactures, might now attempt to support the failing industry of agriculture. In June 1901 the rejection of the canal bill led to a crisis, and he was obliged to send in his resignation. His health was already failing, and he died on the 8th of September of the same year at his house in Frankfort.

MIQUELETS (MIQUELETES or MIGUELETES) were irregular local troops in Catalonia who derived their name, it is said, from Miguel or Miquelot de Prats, a Catalan mercenary captain in the service of Cesare Borgia. They enjoyed a certain prominence in the minor wars of Spain during the 17th and 18th centuries, and in peace seem to have plundered travellers. In the War of the Spanish Succession (*q.v.*) the Miquelets continued the struggle against the French claimant until long after the peace. During the Peninsular War they were exceedingly successful in harassing the French invaders in the mountains of Catalonia. Sometimes they even attempted operations in large bodies, as in the operations round Gerona in 1808 and 1809. They were maintained by the several parishes, not by the central or the provincial governments, and as they had to turn out for duty on sound of the village alarm-bell (*somaten*) they are frequently called *somatenes*.

MIRABEAU, ANDRÉ BONIFACE LOUIS RIQUETI, VICOMTE DE (1754–1792), brother of the orator Mirabeau, was one of the reactionary leaders at the opening of the French Revolution. Sent to the army in Malta in 1776 he spent part of his two years there in prison for insulting a religious procession. During the War of American Independence he was in several sea-fights with the English, and was at the taking of Yorktown in 1781. In the following year he had two narrow escapes from drowning. In 1789, with his debts paid up by his father, he was elected by the noblesse of Limoges a deputy to the States General. He was a violent Conservative and opposed everything that threatened the old régime. His drunkenness produced a corpulency which brought him the nickname Mirabeau Tonneau ("Barrel Mirabeau"); but he was not lacking in some of that insight which marked his brother. He shared fully in the eccentric family pride; and boasted of his brother's genius even when bitterly opposing him. He emigrated about 1790, and raised a legion which was to bear his name; but his insolence alienated the German princes, and his command was taken from him. He died in August 1792—of apoplexy or from a duel—in Freiburg im Breisgau. He wrote some verse as well as various pamphlets.

See Joseph Sarrazin, *Mirabeau Tonneau, ein Condottiere aus der Revolutionszeit* (Leipzig, 1893); and *La Révolution française*, vols. xxi. and xxiv.; Eugène Berger, *Le Vicomte de Mirabeau* (*Mirabeau Tonneau*), *1754–1792* (1904); and for a list of contemporary pamphlets, &c., M. Tourneux, *Bibliographie de la ville de Paris* . . ., vol. iv. (1906).

MIRABEAU, HONORÉ GABRIEL RIQUETI, COMTE DE (1749–1791), French statesman, was born at Bignon, near Nemours, on the 9th of March 1749. The family of Riquet, or Riqueti, originally of the little town of Digne, won wealth as merchants at Marseilles, and in 1570 Jean Riqueti bought the château and seigniory of Mirabeau, which had belonged to the great Provençal family of Barras. In 1685 Honoré Riqueti obtained the title of marquis de Mirabeau. His son Jean Antoine served with distinction through all the later campaigns of the reign of Louis XIV., and especially distinguished himself in 1705 at the battle of Cassano, where he was so severely wounded in the neck that he had ever after to wear a silver stock; yet he never rose above the rank of colonel, owing to an eccentric habit of speaking unpleasant truths to his superiors. On retiring from the service he married Françoise de Castellane, and left at his death, in 1737, three sons—Victor marquis de Mirabeau, Jean Antoine, bailli de Mirabeau, and Comte Louis Alexandre de Mirabeau. The great Mirabeau was the eldest surviving son of the marquess. When but three years old he had a virulent attack of small-pox which left his face disfigured, and contributed to his father's dislike of him. Being destined for the army, he was entered at a pension militaire at Paris. Of this school, which had Lagrange for its professor of mathematics, we have an amusing account in the life of Gilbert Elliot, 1st earl of Minto, who with his brother Hugh, afterwards British minister at Berlin, there made the acquaintance of Mirabeau. On leaving this school in 1767 he received a commission in a cavalry regiment which his grandfather had commanded years before. He at once began love-making, and in spite of his ugliness succeeded in winning the heart of the lady to whom his colonel was attached; this led to such scandal that his father obtained a *lettre de cachet*, and the young scapegrace was imprisoned in the isle of Rê. The love affairs of Mirabeau form a well-known history, owing to the celebrity of the letters to Sophie. Yet it may be asserted that until the more durable and more reputable connexion with Mme de Nehra these love episodes were the most disgraceful blemishes in a life otherwise of a far higher moral character than has been commonly supposed. As to the marquess, his use of *lettres de cachet* is perfectly defensible on the theory of *lettres de cachet*, and Mirabeau, if any son, surely deserved such correction. Further, they had the effect of sobering the culprit, and the more creditable part of his life did not begin till he left Vincennes. Mirabeau did not develop his great qualities of mind and character until his youthful excesses were over, and it was not till 1781 that these began to appear. On being released, the young count obtained leave to accompany as a volunteer the French expedition to Corsica. After his return, he tried to keep on good terms with his father, and in 1772 he married a rich heiress, Marie Emilie, daughter of the marquess de Marignane, an alliance procured for him by his father. His wild extravagance, however, forced his father to forestall his creditors by securing his detention in semi-exile in the country, where he wrote his earliest extant work, the *Essai sur le despotisme*. His violent disposition now led him to quarrel with a country gentleman who had insulted his sister, and his semi-exile was changed by *lettre de cachet* into imprisonment in the Château d'If. In 1775 he was removed to the castle of Joux, to which, however, he was not very closely confined, having full leave to visit in the town of Pontarlier. Here he met Marie Thérèse de Monnier, his Sophie as he called her. Of his behaviour nothing too strong can be said: he was introduced into the house as a friend, and betrayed his trust by inducing Mme de Monnier to fall in love with him. The affair ended by his escaping to Switzerland, where Sophie joined him; they then went to Holland, where he lived by hack-work for the booksellers; meanwhile Mirabeau had been condemned to death at Pontarlier for *rapt et vol*, and in May 1777 he was seized by the French police, and imprisoned by a *lettre de cachet* in the castle of Vincennes.

During his imprisonment he seems to have learnt to control his passions from their very exhaustion, for the early part of his confinement is marked by the indecent letters to Sophie (first published in 1793), and the obscene *Erotica biblion* and *Ma conversion*, while to the later months belongs his political work of any value, the *Lettres de cachet*, published after his liberation (1782). It exhibits an accurate knowledge of French constitutional history skilfully applied in an attempt to show that an existing actual grievance was not only philosophically unjust but constitutionally illegal. It shows, though in rather a diffuse and declamatory form, that application of wide historical knowledge, keen philosophical perception, and genuine eloquence to a practical purpose which was the great characteristic of Mirabeau, both as a political thinker and as a statesman.

With his release from Vincennes (August 1782) begins the second period of Mirabeau's life. He found that his Sophie was an idealized version of a rather common and ill-educated woman, and she consoled herself with the affection of a young officer, after whose death she committed suicide. Mirabeau first set to work to get the sentence of death still hanging over him reversed, and by his eloquence not only succeeded in this but got M. de Monnier condemned in the costs of the whole law proceedings. From Pontarlier he went to Aix, where he claimed the court's order that his wife should return to him. She naturally objected, but his eloquence would have won his case, even against Jean Etienne Marie Portalis, the leader of the Aix Bar, had he not in his excitement accused his wife of infidelity, on which the court pronounced a decree of separation. He then intervened in the suit pending between his father and mother before the parlement of Paris, and attacked the ruling powers so violently that he had to leave France and again go to Holland, and try to live by literary work. About this time began his connexion with Mme de Nehra, the daughter of Zwier van Haren, a Dutch statesman and political writer, and a woman of a far higher type than Sophie, more educated, more refined, and more capable of appreciating Mirabeau's good points. His life was strengthened by the love of his *petite horde*, Mme de Nehra, his adopted son, Lucas de Montigny, and his little dog Chico. After a period of work in Holland he betook himself to England, where his treatise on *lettres de cachet* had been much admired, being translated into English in 1787, and where he was soon admitted into the best Whig literary and political society of London, through his old schoolfellow Gilbert Elliot, who had now inherited his father's baronetcy and estates, and become a leading Whig member of parliament. Of all his English friends none seem to have been so intimate with him as the 1st marquess of Lansdowne, better known as Lord Shelburne, and Mr, afterwards Sir Samuel, Romilly. The latter became particularly attached to him, and really understood his character; and it is strange that his remarks upon Mirabeau in the fragment of autobiography which he left, and Mirabeau's letters to him, should have been neglected by French writers. Romilly was introduced to Mirabeau by Sir Francis D'Ivernois (1757–1842), and readily undertook to translate into English the *Considérations sur l'ordre de Cincinnatus*, which Mirabeau had written in 1785. Romilly writes thus of him in his autobiography:—

> "The count was difficult enough to please; he was sufficiently impressed with the beauties of the original. He went over every part of the translation with me, observed on every passage in which justice was not done to the thought or the force of the expression lost, and made many useful criticisms. During this occupation we had occasion to see one another often, and became very intimate; and, as he had read much, had seen a great deal of the world, was acquainted with all the most distinguished persons who at that time adorned either the royal court or the republic of letters in France; had a great knowledge of French and Italian literature, and possessed very good taste, his conversation was extremely interesting and not a little instructive. I had such frequent opportunities of seeing him at this time, and afterwards at a much more important period of his life, that I think his character was well known to me. I doubt whether it has been so well known to the world, and I am convinced that great injustice has been done him. This, indeed, is not surprising, when one considers that, from the first moment of his entering upon the career of an author, he had been altogether indifferent how numerous or how powerful might be the enemies he should provoke. His vanity was certainly excessive; but I have no doubt that, in his public conduct as well as in his writings, he was desirous of doing good, that his ambition was of the noblest kind, and that he proposed to himself the noblest ends. He was, however, like many of his countrymen, who were active in the calamitous Revolution which afterwards took place, not sufficiently scrupulous about the means by which those ends were to be accomplished. He indeed to some degree professed this; and more than once I have heard him say that there were occasions upon which 'la petite morale était ennemie de la grande.' It is not surprising that with such maxims as these in his mouth, unguarded in his expressions and careless of his reputation, he should have afforded room for the circulation of many stories to his disadvantage."

This luminous judgment, it must be noted, was written by a man of acknowledged purity of life, who admired Mirabeau in early life not when he was a statesman, but when he was only a struggling literary man. The *Considérations sur l'ordre* *de Cincinnatus* which Romilly translated was the only important work Mirabeau wrote in the year 1785, and it is a good specimen of his method. He had read a pamphlet published in America attacking the proposed order, which was to form a bond of association between the officers who had fought in the American War of Independence against England; the arguments struck him as true and valuable, so he re-arranged them in his own fashion, and rewrote them in his own oratorical style. He soon found such work not sufficiently remunerative to keep his *petite horde* in comfort, and then turned his thoughts to employment from the French foreign office, either in writing or in diplomacy. He first sent Mme de Nehra to Paris to make peace with the authorities, and then returned himself, hoping to get employment through an old literary *collaborateur* of his, Durival, who was at this time director of the finances of the department of foreign affairs. One of the functions of this official was to subsidize political pamphleteers, and Mirabeau had hoped to be so employed, but he ruined his chances by a series of writings on financial questions. On his return to Paris he had become acquainted with Étienne Clavière, the Genevese exile, and a banker named Panchaud. From them he heard plenty of abuse of stock-jobbing, and seizing their ideas he began to regard stock-jobbing, or agiotage, as the source of all evil, and to attack in his usual vehement style the Banque de St Charles and the Compagnie des Eaux. This last pamphlet brought him into a controversy with Caron de Beaumarchais, who certainly did not get the best of it, but it lost him any chance of literary employment from the government. However, his ability was too great to be neglected by a great minister such as Charles Gravier, Comte de Vergennes undoubtedly was, and after a preliminary tour to Berlin at the beginning of 1786 he was despatched in July 1786 on a secret mission to the court of Prussia, from which he returned in January 1787, and of which he gave a full account in his *Histoire secrète de la cour de Berlin* (1789). The months he spent at Berlin were important in the history of Prussia, for while he was there Frederick the Great died. The letters just mentioned show clearly what Mirabeau did and what he saw, and equally clearly how unfit he was to be a diplomatist. He certainly failed to conciliate the new king Frederick William; and thus ended Mirabeau's one attempt at diplomacy. During his journey he had made the acquaintance of Jakob Mauvillon (1743–1794), whom he found possessed of a great number of facts and statistics with regard to Prussia; these he made use of in a great work on Prussia published in 1788. But, though his *De la monarchie prussienne sous Frédéric le Grand* (London, 1788) gave him a general reputation for historical learning, he had in the same year lost a chance of political employment. He had offered himself as a candidate for the office of secretary to the Assembly of Notables which the king had just convened, and to bring his name before the public published another financial work, the *Dénonciation de l'agiotage*, which abounded in such violent diatribes that he not only lost his election, but was obliged to retire to Tongres; and he further injured his prospects by publishing the reports he had sent in during his secret mission at Berlin. But 1789 was at hand; the states-general was summoned; Mirabeau's period of probation was over.

On hearing of the king's determination to summon the states-general, Mirabeau started for Provence, and offered to assist at the preliminary conference of the noblesse of his district. They rejected him; he appealed to the *tiers état*, and was returned both for Aix and for Marseilles. He elected to sit for the former city, and was present at the opening of the states-general on the 4th of May 1789. From this time the record of Mirabeau's life forms the best history of the first two years of the Constituent Assembly, for at every important crisis his voice is to be heard, though his advice was not always followed. He possessed at the same time great logical acuteness and the most passionate enthusiasm. From the beginning he recognized that government exists in order that the bulk of the population may pursue their daily work in peace and quiet, and that for a government to be successful it must be strong. At the same time he thoroughly comprehended that for a government to be strong it must be in harmony with the wishes of the majority of the people. He had carefully studied the English constitution in England, and he hoped to establish in France a system similar in principle but without any slavish imitation of the details of the English constitution. In the first stage of the history of the states-general Mirabeau's part was very great He was soon recognized as a leader, to the chagrin of Jean Joseph Mounier, because he always knew his own mind, and was prompt in emergencies. To him is to be attributed the successful consolidation of the National Assembly. When the taking of the Bastille had assured the success of the Revolution, he warned the Assembly of the futility of passing fine-sounding decrees and urged the necessity for acting. He declared that the famous night of the 4th of August was but an orgy, giving the people an immense theoretical liberty while not assisting them to practical freedom, and overthrowing the old régime before a new one could be constituted. His failure to control the theorizers showed Mirabeau, after the removal of the king and the Assembly to Paris, that his eloquence would not enable him to guide the Assembly by himself, and that he must therefore try to get some support. He wished to establish a strong ministry, which should be responsible like an English ministry, but to an assembly chosen to represent the people of France better than the English House of Commons at that time represented England. He first thought of becoming a minister at a very early date, if we may believe a story contained in the *Mémoires* of the duchesse d'Abrantes, to the effect that in May 1789 the queen tried to bribe him, but that he refused this and expressed his wish to be a minister. The indignation with which the queen repelled the idea may have made him think of the duke of Orleans as a possible constitutional king, because his title would of necessity be parliamentary. But the weakness of Orleans was too palpable, and in a famous remark Mirabeau expressed his utter contempt for him. He also attempted to form an alliance with Lafayette, but the general was as vain and as obstinate as Mirabeau himself, and had his own theories about a new French constitution. Mirabeau tried for a time, too, to act with Necker, and obtained the sanction of the Assembly to Necker's financial scheme, not because it was good, but because, as he said, "no other plan was before them, and something must be done."

Hitherto weight has been laid on the practical side of Mirabeau's political genius; his ideas with regard to the Revolution after the 5th and 6th of October must now be examined, and this can be done at length, thanks to the publication of Mirabeau's correspondence with the Comte de la Marck, a study of which is indispensable for any correct knowledge of the history of the Revolution between 1789 and 1791. Auguste Marie Raymond, prince d'Arenberg, known as the Comte de la Marck, was a Flemish nobleman who had been proprietary colonel of a German regiment in the service of France; he was a close friend of the queen, and had been elected a member of the states-general. His acquaintance with Mirabeau, begun in 1788, ripened during the following year into a friendship, which La Marck hoped to turn to the advantage of the court. After the events of the 5th and 6th of October he consulted Mirabeau as to what measures the king ought to take, and Mirabeau, delighted at the opportunity, drew up an admirable state paper, which was presented to the king by Monsieur, afterwards Louis XVIII. The whole of this *Mémoire* should be read to get an adequate idea of Mirabeau's genius for politics; here it must be summarized.

The main position is that the king is not free in Paris; he must therefore leave Paris and appeal to France. "Paris n'en veut que l'argent; les provinces demandent des lois." But where must the king go? "Se retirer à Metz ou sur toute autre frontière serait déclarer la guerre à la nation et abdiquer le trône. Un roi qui est la seule sauvegarde de son peuple ne fuit point devant son peuple; il le prend pour juge de sa conduite et de ses principes." He must then go towards the interior of France to a provincial capital, best of all to Rouen, and there he must appeal to the people and summon a great convention. It would be ruin to appeal to the noblesse, as the queen advised: "un corps de noblesse n'est point une armée, qui puisse combattre." When this great convention met the king must show himself ready to recognize that great changes have taken place, that feudalism and absolutism have for ever disappeared, and that a new relation between king and people has arisen, which must be loyally observed on both sides for the future. "Il est certain, d'ailleurs, qu'il faut une grande révolution pour sauver le royaume, que la nation a des droits, qu'elle est en chemin de les recouvrer tous, et qu'il faut non seulement les rétablir, mais les consolider." To establish this new constitutional position between king and people would not be difficult, because "l'indivisibilité du monarque et du peuple est dans le cœur de tous les Français; il faut qu'elle existe dans l'action et le pouvoir."

Such was Mirabeau's programme, from which he never diverged, but which was far too statesmanlike to be understood by the poor king, and far too positive regarding the altered condition of the monarchy to be palatable to the queen. Mirabeau followed up his *Mémoire* by a scheme of a great ministry to contain all men of mark—Necker as prime minister, "to render him as powerless as he is incapable, and yet preserve his popularity for the king," the duc de Liancourt, the duc de la Rochefoucauld, La Marck, Talleyrand, bishop of Autun, at the finances, Mirabeau without portfolio, G. J. B. Target, mayor of Paris, Lafayette generalissimo to reform the army, Louis Philippe, comte de Ségur (foreign affairs), Mounier and I. R. G. le Chapelier. This scheme got noised abroad, and was ruined by a decree of the Assembly of the 7th of November 1789, that no member of the Assembly could become a minister; this decree destroyed any chance of that necessary harmony between the ministry and the majority of the representatives of the nation which existed in England, and so at once overthrew Mirabeau's hopes. The queen utterly refused to take Mirabeau's counsel, and La Marck left Paris. However, in April 1790 he was suddenly recalled by the comte de Mercy-Argenteau, the Austrian ambassador at Paris, and the queen's most trusted political adviser, and from this time to Mirabeau's death he became the medium of almost daily communications between the latter and the queen. Mirabeau at first attempted again to make an alliance with Lafayette, but it was useless, for Lafayette was not a strong man himself and did not appreciate "la force" in others. From the month of May 1790 to his death in April 1791 Mirabeau remained in close and suspected, but not actually proved, connexion with the court, and drew up many admirable state papers for it. In return the court paid his debts; but it ought never to be said that he was bribed, for the gold of the court never made him swerve from his political principles—never, for instance, made him a royalist. He regarded himself as a minister, though an unavowed one, and believed himself worthy of his hire.

Before Mirabeau's influence on foreign policy is discussed, his behaviour on several important points must be noticed. On the great question of the veto he took a practical view, and seeing that the royal power was already sufficiently weakened, declared for the king's absolute veto and against the compromise of the suspensive veto. He knew from his English experiences that such a veto would be hardly ever used unless the king felt the people were on his side, and that if it were used unjustifiably the power of the purse possessed by the representatives of the people would, as in England in 1688, bring about a bloodless revolution. He saw also that much of the inefficiency of the Assembly arose from the inexperience of the members and their incurable verbosity; so, to establish some system of rules, he got his friend Romilly to draw up a detailed account of the rules and customs of the English House of Commons, which he translated into French, but which the Assembly, puffed up by a belief in its own merits, refused to use. On the great subject of peace and war he supported the king's authority, and with some success. Again Mirabeau almost alone of the Assembly held that the soldier ceased to be a citizen when he became a soldier; he must submit to be deprived of his liberty to think and act, and must recognize that a soldier's first duty is obedience. With such sentiments, it is no wonder that he approved of the vigorous conduct of François Claude Amour, marquis de Bouillé, at Nancy, which was the more to his credit as Bouillé was the one hope of the court influences opposed to him. Lastly, in matters of finance he showed his wisdom: he attacked Necker's "caisse d'escompte," which was to have the whole control of the taxes, as absorbing the Assembly's power of the purse; and he heartily approved of the system of assignats, but with the reservation that they should not be issued to the extent of more than one-half the value of the lands to be sold.

Of Mirabeau's attitude with regard to foreign affairs it is necessary to speak in more detail. He held it to be just that the French people should conduct their Revolution as they would, and that no foreign nation had any right to interfere with them while they kept themselves strictly to their own affairs. But he knew also that neighbouring nations looked with unquiet eyes on the progress of affairs in France, that they feared the influence of the Revolution on their own peoples, and that foreign monarchs were being prayed by the French emigrés to interfere on behalf of the French monarchy. To prevent this interference, or rather to give no pretext for it, was his guiding thought as to foreign policy. He had been elected a member of the *comité diplomatique* of the Assembly in July 1790, and became its reporter at once, and in this capacity he was able to prevent the Assembly from doing much harm in regard to foreign affairs. He had long known Armand Marc, comte de Montmorin, the foreign secretary, and, as matters became more strained from the complications with the princes and counts of the empire, he entered into daily communication with the minister, advised him on every point, and, while dictating his policy, defended it in the Assembly. Mirabeau's exertions in this respect are not his smallest title to the name of statesman; and how great a work he did is best proved by the confusion which ensued in this department after his death. For indeed in the beginning of 1791 his death was very near; and he knew it to be so. The wild excesses of his youth and their terrible punishment had weakened his strong constitution, and his parliamentary labours completed the work. So surely did he feel its approach that some time before the end he sent all his papers over to Sir Gilbert Elliot, who kept them under seal until claimed by Mirabeau's executors. In March his illness was evidently gaining on him, to his great grief, because he knew that he alone could yet save France from the distrust of her monarch and the present reforms, and from the foreign interference, which would assuredly bring about catastrophes unparalleled in the history of the world. Every care that science could afford was given by his friend and physician, Cabanis, to whose brochure on his last illness and death the reader may refer. The people kept the street in which he lay quiet; but medical care, the loving solicitude of friends, and the respect of all the people could not save his life. When he could speak no more he wrote with a feeble hand the one word "dormir," and on the 2nd of April 1791 he died.

No man ever so thoroughly used other men's work, and yet made it all seem his own. "Je prends mon bien où je le trouve," is as true of him as of Molière. His first literary work, except the bombastic but eloquent *Essai sur le despotisme* (Neufchâtel, 1775), was a translation of Robert Watson's *Philip II.*, done in Holland with the help of Durival; his *Considérations sur l'ordre de Cincinnatus* (London, 1788) was based on a pamphlet by Aedanus Burke (1743–1802), of South Carolina, who opposed the aristocratic tendencies of the Society of the Cincinnati, and the notes to it were by Target; his financial writings were suggested by the Genevese exile, Clavière. During the Revolution he received yet more help; men were proud to labour for him, and did not murmur because he absorbed all the credit and fame. Etienne Dumont, Clavière, Antoine Adrien Lamourette and Etienne Salomon Reybaz were but a few of the most distinguished of his collaborators. Dumont was a Genevese exile, and an old friend of Romilly's, who willingly prepared for him those famous addresses which Mirabeau used to make the Assembly pass by sudden bursts of eloquent declamation; Clavière helped him in finance, and not only worked out his figures, but even wrote his financial discourses; Lamourette wrote the speeches on the civil constitution of the clergy; Reybaz not only wrote for him his famous speeches on the assignats, the organization of the national guard, and others, which Mirabeau read word for word at the tribune, but even the posthumous speech on succession to the estates of intestates, which Talleyrand read in the Assembly as the last work of his dead friend. Yet neither the gold of the court nor another man's conviction would make Mirabeau say what he did not himself believe, or do what he did not himself think right. He took other men's labour as his due, and impressed their words, of which he had suggested the underlying ideas, with the stamp of his own individuality; his collaborators themselves did not complain—they were but too glad to be of help in the great work of controlling and forwarding the French Revolution through its greatest thinker and orator. As an orator his eloquence has been likened to that of both Bossuet and Vergniaud, but it had neither the polish of the old 17th century bishop nor the flashes of genius of the young Girondin. It was rather parliamentary oratory in which he excelled, and his true compeers are rather Burke and Fox than any French speakers. Personally he had that which is the truest mark of nobility of mind, a power of attracting love and winning faithful friends. (H. M. S.)

Authorities.—The best edition of Mirabeau's works is that published by Blanchard in 1819–1822, in ten volumes, of which the first two contain his *Œuvres oratoires*; from this collection, however, many of his less important works and the *De la monarchie prussienne* are omitted. For details of his life consult Peuchet, *Mirabeau: Mémoires sur sa vie littéraire et privée* (1824); and the *Mémoires biographiques, littéraires et politiques de Mirabeau, écrits par lui-même, par son père, son oncle et son fils adoptif*, which was issued by his adopted son, Lucas de Montigny (8 vols., Paris, 1834–1835). See also Etienne Dumont, *Souvenirs sur Mirabeau* (1832), a work which has been translated into English by Lady E. R. Seymour as *The Great Frenchman and the Little Genevese* (1904); Louise Colet, *La Jeunesse de Mirabeau* (1841); and Alfred Bégis, *Mirabeau, son interdiction judiciaire* (1895). The publication of the *Correspondance entre Mirabeau et le comte de la Marck*, by A. de Bacourt (2 vols., 1851) marks an epoch in our exact knowledge of Mirabeau and his career; some additional letters appeared in the German edition (3 vols., Leipzig, 1851–1852). Other published correspondence is *Lettres de Mirabeau à Chamfort* (1796); *Lettres du comte de Mirabeau à Jacques Mauvillon* (Brunswick, 1792); *Lettres originales de Mirabeau, écrites du donjon de Vincennes, 1777–1780*, published by L. P. Manuel (4 vols., 1792); and, on the same subject, Paul Cottin, *Sophie de Monnier et Mirabeau d'après leur correspondance inédite* (1903); *Lettres à Julie*, edited by D. Meunier and G. Selois (Paris, 1903); *Lettres inédites* (1806), edited by J. F. Vitry. The *Histoire secrète* forms the basis of H. Welschinger's *La Mission secrète de Mirabeau à Berlin* (Paris, 1900). The most useful modern books are Louis and Charles de Loménie, *Les Mirabeau* (5 vols., 1878 and 1889); Alfred Stern, *Das Leben Mirabeaus* (1889). See also E. Rousse, *Mirabeau* (1891) in the Grands Ecrivains Français series; P. Plan, *Un Collaborateur de Mirabeau* (Paris, 1874), treating of Reybaz and throwing infinite light on Mirabeau's mode of work; and H. Reynald, *Mirabeau et la constituante* (1873). On his eloquence and the share his collaborators had in his speeches see F. A. Aulard, *Orateurs de l'assemblée constituante* (1882). For his death see the curious brochure of his physician, Cabanis, *Journal de la maladie et de la mort de Mirabeau* (Paris, 1791, ed. H. Duchenne, Paris, 1890). There is a good sketch summarizing modern opinion by E. Charavay in *La Grande Encyclopédie*. English works include P. F. Willert, *Mirabeau* (1898) in the "Foreign Statesman" series; C. F. Warwick, *Mirabeau and the French Revolution* (1905); W. R. H. Trowbridge, *Mirabeau, the demi-god* (1907); H. E. von Holst, *The French Revolution Tested by Mirabeau's Career* (Chicago, 1894); and F. Fling, *Mirabeau and the French Revolution* (London and New York, 1908). Other works are Victor Hugo, *Étude sur Mirabeau* (1834); Jules Barni, *Mirabeau* (1882); Albert Sorel, "Mirabeau" in *Essais d'histoire et de critique* (1883); G. Leloir, *Mirabeau à Pontarlier* (1886); Ferdinand Schwartz, *Mirabeau und Marie Antoinette* (Basel, 1891); and Alfred Mézières, *Vie de Mirabeau* (1892).

MIRABEAU, VICTOR RIQUETI, Marquis de (1715–1789), French author and political economist, father of the great Mirabeau, was born at Pertuis, near the old château de Mirabeau, on the 4th of October 1715. He was brought up very sternly by his father, and in 1728 joined the army. He took keenly to campaigning, but never rose above the rank of captain, owing to his being unable to get leave at court to buy a regiment. In 1737 he came into the family property on his father's death, and spent some pleasant years till 1743 in literary companionship with duc Clapiers, marquis de Vauvenargues and the poet Lefranc de Pompignan, which might have continued had he not determined to marry—not for money, but for landed estates. The lady whose property he fancied was Marie Geneviève, daughter of a M. de Vassan, a brigadier in the army, and widow of the marquis de Saulveboef, whom he married without previously seeing her on the 21st of April 1743. While in garrison at Bordeaux Mirabeau had made the acquaintance of Montesquieu, and after retiring from the army he wrote his first work, his *Testament Politique* (1747), which demanded for the prosperity of France a return of the French noblesse to their old position in the middle ages. This work was followed in 1750 by a book on the *Utilité des états provenciaux*, which was attributed to Montesquieu himself. In 1756 Mirabeau made his first appearance as a political economist by the publication of his *Ami des hommes ou traité de la population*. This work has been often attributed to the influence, and in part even to the pen, of Quesnay, the founder of the economical school of the physiocrats, but was really written before the marquis had made the acquaintance of the physician of Madame de Pompadour. In 1760 he published his *Théorie de l'impôt*, in which he attacked with all the vehemence of his son the farmers-general of the taxes, who got him imprisoned for eight days at Vincennes, and then exiled to his country estate at Bignon. At Bignon the school of the physiocrats was really established, and the marquis in 1765 bought the *Journal de l'agriculture, du commerce, et des finances*, which became the organ of the school. He was recognized as a leader of political thinkers by Prince Leopold of Tuscany, afterwards emperor, and by Gustavus III. of Sweden, who in 1772 sent him the grand cross of the order of Vasa. But his marriage had not been happy; he had separated from his wife in 1762, and had, he believed, secured her safely in the provinces by a lettre de cachet, when in 1772 she suddenly appeared in Paris, and commenced proceedings for a separation. One of his own daughters had encouraged his wife to take this step. He was determined to keep the case quiet, if possible, for the sake of Mme de Pailly, a Swiss lady whom he had loved since 1756. But his wife would not let him rest; her plea was rejected in 1777, but she renewed her suit, and, though the great Mirabeau had pleaded his father's case, was successful in 1781. This trial quite broke the health of the marquis, as well as his fortune; he sold his estate at Bignon, and hired a house at Argenteuil, where he lived quietly till his death on the 11th of July 1789.

The marquis's younger brother, Jean Antoine Riqueti, "the bailli" (d. 1794), served with distinction in the navy, but his brusque manners made success at court impossible. In 1763 he became general of the galleys of Malta. In 1767 he returned to France and took charge of the château de Mirabeau, helping the marquis in his disastrous lawsuits.

See Louis de Loménie's *Les Mirabeau* (2 vols., 1879). Also Henri Ripert, *Le Marquis de Mirabeau, ses théories politiques et économiques*, [*thèse pour le doctorat*] Paris (1901); Oncken, *Der ältere Mirabeau und die oekonomische Gesellschaft in Bern* (Berne, 1886); De Lavergne, *Les Économistes français du 18^{me} siècle.*

MIRACLE (Lat. *miraculum*, from *mirari*, to wonder), anything wonderful, beyond human power, and deviating from the common action of the laws of nature, a supernatural event. The term is particularly associated with the supernatural factors in Christianity. To the Lat. *miraculum* correspond Gr. *τέρας* in the New Testament, and Heb. פֶּלֶא (Exod. xv. 11; Dan. xii. 6) in the Old Testament. Other terms used in the New Testament are *δύναμις* "with reference to the power residing in the miracle worker" (cf. גבורה Deut. iii. 24 and בריאה Num. xvi. 30), and *σημεῖον* "with reference to the character or claims of which it was the witness and guarantee" (cf. אות Exod. iv. 8); that the power is assumed to be from God is shown by the phrases *πνεύματι θεοῦ* (Matt. xii. 28; cf. Luke iv. 18) and *δακτύλῳ θεοῦ* (Luke xi. 20).

While Augustine describes miracles as "contra naturam quae nobis est nota," Aquinas without qualification defines them as "praeter naturam," "supra et contra naturam." Löscher affirms in regard to miracles that "solus Deus potest tum supra naturae vires tum contra naturae leges agere"; and Buddaeus argues that in them a "suspensio legum naturae" is followed by a *restitutio*. Against the common view that miracles can attest the truth of a divine revelation Gerhard maintained that "per miracula non possunt probari oracula"; and Höpfner returns to the qualified position of Augustine when he describes them as "praeter et supra naturae ordinem." The two conceptions, once common in the Christian church, that on the one hand miracles involved an interference with the forces and a suspension of the laws of nature, and that, on the other hand, as this could be effected only by divine power, they served as credentials of a divine revelation, are now generally abandoned. As regards the first point, it is now generally held that miracles are exceptions to the order of nature as known in our common experience; and as regards the second, that miracles are constituent elements in the divine revelation, deeds which display the divine character and purpose; but they are *signs* and not merely *seals* of truth. Some of the theories regarding miracles which have been formulated may be mentioned. Bonnet, Euler, Haller, Schmid and others "suppose miracles to be already implanted in nature. The miraculous germs always exist alongside other germs in a sort of sheath, like hidden springs in a machine, and emerge into the light when their time comes." Similar is the view of Paracelsus and Jerome Cardan, who "suppose a twofold world, existing one in the other; beside or behind the visible is an inner, ideal world, which breaks through in particular spots" (Dorner's *System of Christian Doctrine*, ii. 155, 156). The 8th duke of Argyll (*Reign of Law*) maintains that "miracles may be wrought by the selection and use of laws of which man knows and can know nothing, and which, if he did know, he could not employ." These theories endeavour to discover the means by which the exceptional occurrence is brought about; but the explanation is merely hypothetical, and we are not helped in conceiving the mode of the divine activity in the working of miracles. The important consideration from the religious standpoint is that God's activity should be fully recognized.

An attempt has been made to discover a natural law which will explain some at least of the miracles of Jesus. "In one respect alone," says Matthew Arnold, "have the miracles recorded by the evangelists a more real ground than the mass of miracles of which we have the relation. Medical science has never gauged, perhaps never enough set itself to gauge the intimate connexion between moral fault and disease. To what extent or in how many cases what is called illness is due to moral springs having been used amiss, whether by being over-used, or by not being used sufficiently, we hardly at all know, and we too little inquire. Certainly it is due to this very much more than we commonly think, and the more it is due to this the more do moral therapeutics rise in possibility and importance" (*Literature and Dogma*, pp. 143–144). The moral therapeutics consists in the influence of a powerful will over others. Harnack accepts this view. "We see that a firm will and a convinced faith act even on the bodily life and cause appearances which appeal to us as miracles. Who has hitherto here with certainty measured the realm of the possible and the real? Nobody. Who can say how far the influences of one soul on another soul and of the soul on the body reach? Nobody. Who can still affirm that all which in this realm appears as striking rests only on deception and error? Certainly no miracles occur, but there is enough of the wonderful and the inexplicable" (*Das Wesen des Christentums*, p. 18). As regards the theory, it may be pointed out: (1) that the *nature* or *cosmical* miracles—feeding of the five thousand, stilling of the storm, withering of the fig-tree—are as well-attested as the miracles of healing; (2) that many of the diseases, the cure of which is reported, are of a kind with which *moral therapeutics* could not effect anything;[1] (3) that Christ's own insight regarding the power by which He wrought His works is directly challenged by this explanation, for He never failed to ascribe His power to the Father dwelling in Him.

The divine agency is recognized as combining and controlling, but not as producing, in the teleological notion of miracles. "In miracle no new powers, instituted or stimulated by God's creative action, are at work, but merely the general order of nature"; but "the manifold physical and spiritual powers in actual existence so blend together as to produce a startling result" (Dorner's *System of Christian Doctrine*, ii. 157). While we cannot deny, we have no ground for affirming the truth of this theory. Whether God's action is creative, or only selective and directive in miracles, is beyond our knowledge; we at least do not know the powers exercised, whether new or old.

An attempt is made to get rid of the distinctive nature of miracle when the exceptionalness of the events so regarded is reduced to a *new subjective mode* of regarding natural phenomena. H. E. G. Paulus dismisses the miracles as "exaggerations or misapprehensions of quite ordinary events." A. Ritschl has been unjustly charged with this treatment of miracles. But what he emphasizes is on the one hand the close connexion between the conception of miracles and the belief in divine providence, and on the other the compatibility between miracles and the order of nature. He declines to regard miracles as divine action contrary to the laws of nature. So for Schleiermacher "miracle is neither explicable from nature alone, nor entirely alien to it." What both Ritschl and Schleiermacher insist on is that the belief in miracles is inseparable from the belief in God, and in God as immanent in nature, not only directing and controlling its existent forces, but also as initiating new stages consistent with the old in its progressive development.

We may accept Dorner's definition as adequate and satisfactory. "Miracles are sensuously cognizable events, not comprehensible on the ground of the causality of nature as such, but essentially on the ground of God's free action alone. Such facts find their possibility in the constitution of nature and God's living relation to it, their necessity in the aim of revelation, which they subserve" (p. 161). By the first clause, inward moral and religious changes due to the operation of the Spirit of God in man are excluded, and rightly so (see INSPIRATION). The negative aspect is presented in the second clause. This is prominent in J. S. Mill's definition of miracles: "to constitute a miracle, a phenomenon must take place without having been preceded by any antecedent phenomenal conditions sufficient again to reproduce it. . . . The test of a miracle is, were there present in the case such external conditions, such second causes we may call them, that wherever these conditions or causes reappear the event will be reproduced. If there were, it is not a miracle; if there were not, it is" (*Essays*, p. 224). The positive aspect is presented in the third clause. When the existence of God is denied (atheism), or His nature is declared unknowable (agnosticism), or He is identified with nature itself (pantheism), or He is so distinguished from the world that His free action is excluded from the course of nature (deism), miracle is necessarily denied. Thus Spinoza, identifying God and nature, declares "nothing happens in nature which is in contradiction with its universal laws." The deists, compelled by their view of the relation of God to nature to regard miracles as interventions, disposed of the miracles of the Bible either as "mistaken allegory" or even as conscious fraud on the part of the narrators. It is only the theistic view of God as personal power—that is as free-will ever present and ever active in the world, which leaves room for miracles.

The *possibility* of miracles is often confidently denied. "We are of the unalterable conviction," says Harnack, "that what happens in time and space is subject to the universal laws of movement; that accordingly there cannot be any miracles in this sense, *i.e.* as interruptions of the continuity of nature" (*Das Wesen des Christentums*, p. 17). Huxley expresses himself much more cautiously, as he recognizes that we do not know the continuity of nature so thoroughly as to be able to declare that this or that event is necessarily an interruption of it. "If a dead man did come to life, the fact would be evidence, not that any law of nature had been violated, but that these laws, even when they express the results of a very long and uniform experience, are necessarily based on incomplete knowledge, and are to be held only on grounds of more or less justifiable expectation" (*Hume*, p. 135).

Lotze has shown how the possibility of miracle can be conceived. "The whole course of nature becomes intelligible only by supposing the co-working of God, who alone carries forward the reciprocal action of the different parts of the world. But that view which admits a life of God that is not benumbed in an unchangeable sameness will be able to understand his eternal co-working as a variable quantity, the transforming influence of which comes forth at particular moments and attests that the course of nature is not shut up within itself. And this being the case, the complete conditioning causes of the miracle will be found in God and nature together, and in that eternal action and reaction between them which perhaps, although not ordered simply according to general laws, is not void of regulative principles. This vital, as opposed to a mechanical, constitution of nature, together with the conceptions of nature as not complete in itself—as if it were dissevered from the divine energy—shows how a miracle may take place without any disturbance elsewhere of the constancy of nature, all whose forces are affected sympathetically, with the consequence that its orderly movement goes on unhindered" (*Mikrokosmos*, iii. 364).

The mode of the divine working in nature is in another passage more clearly defined.

"The closed and hard circle of mechanical necessity is not immediately accessible to the miracle-working fiat, nor does it need to be; but the inner nature of that which obeys its laws is not determined by it but by the meaning of the world. This is the open place on which a power that commands in the name of this meaning can exert its influence; and if under this command the inner condition of the elements, the magnitudes of their relation and their opposition to each other, become altered, the necessity of the mechanical cause of the world must unfold this new state into a miraculous appearance, not through suspension but through strict maintenance of its general laws" (*op. cit.* ii. 54).

If we conceive God as personal, and His will as related to the course of nature analogously to the relation of the human will to the human body, then the laws of nature may be regarded as habits of the divine activity, and miracles as unusual acts which, while consistent with the divine character, mark a new stage in the fulfilment of the purpose of God.

The doctrine of Evolution, instead of increasing the difficulty of conceiving the possibility of miracle, decreases it; for it presents to us the universe as an uncompleted process, and one in which there is no absolute continuity on the phenomenal side; for life and mind are inexplicable by their physical antecedents, and there is not only room for, but need of, the divine initiative, a creative as well as conservative co-operation of God with nature. Such an absolute continuity is sometimes assumed without warrant; but Descartes already recognized that the world was no continuous process, "Tria mirabilia fecit Dominus; res ex nihilo, liberum arbitrium et hominem Deum." That life cannot be explained by force is recognized by Sir Oliver Lodge. "Life may be something not only ultra-terrestrial, but even immaterial, something outside our present categories of matter and energy; as real as they are, but different, and utilizing them for its own purpose" (*Life and Matter*, p. 198). The theory of *psychophysical parallelism* recognizes that while there is a correspondence between mental and material phenomena, changes in the mind and changes in the brain, the former cannot be explained by the latter, as the transition from the one to the other is unthinkable. William James distinguishes the *transmissive* function of the brain from the *productive* in relation to thought, and admits only the former, and not the latter (*Human Immortality*, p. 32). Thus as life is transcendent and yet immanent in body, and mind in brain, and both utilize their organs, so God, transcendent and immanent, uses the course of nature for His own ends; and the emergence both of life and mind in that course of nature evidences such a divine initiative as is assumed in the recognition of the possibility of miracles. For such an initiative there must be adequate reason; it must be prepared for in the previous process, and it must be necessary to further progress.

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[1] See also R. J. Ryle, "The Neurotic Theory of the Miracles of Healing," *Hibbert Journal*, v. 586.

The proof of the possibility of miracle leads us inevitably to the inquiry regarding the *necessity* of miracle. The necessity of miracles is displayed in their connexion with the divine revelation; but this connexion may be conceived in two ways. The miracles may be regarded as the *credentials* of the agents of divine revelation. "It is an acknowledged historical fact," says Butler, "that Christianity offered itself to the world, and demanded to be received, upon the allegation—*i.e.* as unbelievers would speak—upon the pretence of miracles, publicly wrought to attest the truth of it, in such an age; and that it was actually received by great numbers in that very age, and upon the professed belief of the reality of miracles" (*Analogy*, part ii. ch. vii.). This view is now generally abandoned; for it is recognized that acts of superhuman power, even if established by adequate historical evidence, do not necessarily certify their divine origin. Their moral quality must correspond with the character of God; and they must be connected with teaching which to reason and conscience approves itself divine. "Miracula sine doctrina nihil valent" is the principle now generally recognized. The miracle and the doctrine mutually illuminate one another. "Les miracles discernent la doctrine, et la doctrine discerne les miracles" (Pascal's *Pensées des miracles*). Accordingly, the *credentials* must also be *constituents* of the revelation. Of the miracles of Jesus, Bushnell says, "The character of Jesus is ever shining with and through them, in clear self-evidence leaving them never to stand as raw wonders only of might, but covering them with glory as tokens of a heavenly love, and acts that only suit the proportions of His personal greatness and majesty" (*Nature and the Supernatural*, p. 364). If it be asked why the character may not be displayed in ordinary acts instead of miracles, the answer may be given, "Miracle is the certificate of identity between the Lord of Nature and the Lord of Conscience—the proof that He is really a moral being who subordinates physical to moral interests" (Lidden's *Elements of Religion*, p. 73). As God is the Saviour, and the chief end of the revelation is redemption, it is fitting that the miracles should be acts of divine deliverance from physical evil. This congruity of the miracle with divine truth and grace is the answer to Matthew Arnold's taunt about turning a pen into a pen-wiper or Huxley's about a centaur trotting down Regent Street. The miracles of Jesus—the relief of need, the removal of suffering, the recovery of health and strength—reveal in outward events the essential features of His divine mission. The divine wisdom and goodness are revealed in the course of nature, but also obscured by it. The existence of physical evil, and still more of moral evil, forbids the assumption without qualification that the real is the rational. God in nature as well as history is fulfilling a redemptive as well as perfective purpose, of which these miracles are appropriate signs. It is an unwarranted idealism and optimism which finds the course of nature so wise and so good that any change in it must be regarded as incredible. On the problem of evil and sin it is impossible here to enter; but this must be insisted on, that the miracles of Jesus at least express divine benevolence just under those conditions in which the course of nature obscures it, and are therefore, proper elements in a revelation of grace, of which nature cannot give any evidence.

Having discussed the possibility and necessity of miracles for the divine revelation, we must now consider whether there is sufficient historical evidence for their occurrence. Hume maintains that no evidence, such as is available, can make a miracle credible. Mill states the position with due care. "The question can be stated fairly as depending on a balance of evidence, a certain amount of positive evidence in favour of miracles, and a negative presumption from the general course of human experience against them" (*Essays on Religion*, p. 221). The existence of "a certain amount of positive evidence in favour of miracles" forbids the sweeping statement that miracles are "contrary to experience." The phrase itself is, as Paley has pointed out, ambiguous. If it means *all* experience it assumes the point to be proved; if it means only *common* experience then it simply asserts that the miracle is unusual—a truism. The *probability* of miracles depends on the conception we have of the free relation of God to nature, and of nature as the adequate organ for the fulfilment of God's purposes. If we believe in a divine revelation and redemption, transcending the course of nature, the miracles as signs of that divine purpose will not seem improbable.

For the Christian Church the miracles of Jesus are of primary importance; and the evidence—external and internal—in their favour may be said to be sufficient to justify belief. The Gospels assumed their present form between A.D. 60 and 90. Their representation of the moral character, the religious consciousness, the teaching of Jesus, inspires confidence. The narratives of miracles are woven into the very texture of this representation. In these acts Jesus reveals Himself as Saviour. "The Jesus Christ presented to us in the New Testament would become a very different person if the miracles were removed" (Temple's *Relations between Religion and Science*). In His sinless perfection and filial relation to God He is unique, and His works are congruous with His Person. Of the supreme miracle of His resurrection there is earlier evidence than of any of the others (1 Cor. xv. 3–7, before A.D. 58). His conquest of death is most frequently appealed to in the apostolic teaching. The Christian Church would never have come into existence without faith in the Risen Lord. The proof of the supernaturalness of His Person sets the seal to the credibility of His supernatural works. In Christ, however, was the fulfilment of law and prophecy. This close connexion invests the antecedent revelation in some degree with the supernaturalness of His Person: at least, we are prepared to entertain without prejudice any evidence that may be presented in the Old Testament. That this evidence is not as good as that for the miracles of Jesus must be conceded, as much of it is of much later date than the events recorded. The miracles connected with the beginnings of the national history—the period of the Exodus—appear on closer inspection to have been ordinarily natural phenomena, to which a supernatural character was given by their connexion with the prophetic word of Moses. The miracles recorded of Elijah and Elisha lie somewhat apart from the main currents of the history, the narratives themselves are distinct from the historical works in which they have been incorporated, and the character of some of the actions raises serious doubts and difficulties. In some cases suspense of judgment seems necessary even from the standpoint of Christian faith. The supernatural element that is prominent in the Old Testament is God's providential guidance and guardianship of His people, and His teaching and training of them by His prophets. The Apostolic miracles, to which the New Testament bears evidence, were wrought in the power of Christ, and were evidences to His church and to the world of His continued presence. When the Church had established itself in the world, and possessed in its moral and religious fruits evidence of its claims, these outward signs appear gradually to have ceased, although attempts were made to perpetuate them. It is true that in Roman Catholicism, in medieval as in modern times, the working of miracles has been ascribed to its saints; but the character of most of these miracles is such as to lack the *a priori probability* which has been claimed for the Scripture miracles on account of their connexion and congruity with the divine revelation. The *a posteriori evidence* as regards both its moral and religious quality and its date is altogether inferior to the evidence of the Gospels. Further, these records are imitative. As Christ and the apostles worked miracles, it is assumed that those who in the Church were distinguished for their sanctity would also work miracles; and there can be little doubt that the wish was often father to the thought. There may be cases which cannot be explained in this way; but "whatever may be thought about them, it is plain that even if these and their like are really to be traced to the intervention of the divine mercy which loves to reward a simple faith (and it does not seem to us that the evidence is sufficient to establish such a conclusion), yet they do not serve as vehicles of revelation as the miracles of the Gospel did" (H. J. Bernard in Hastings's *Bible Dictionary*, iii. 395). (A. E. G.*)

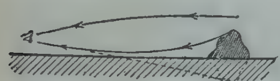
MIRA DE AMESCUA, ANTONIO (1578?–1636?), Spanish dramatist, was born at Guadix (Granada) about 1578. He is said, but doubtfully, to have been the illegitimate son of one Juana Perez; he took orders, obtained a canonry at Guadix, and settled at Madrid early in the 17th century. He is mentioned as a prominent dramatist in Rojas Villandrando's *Loa* (1603), which was written several years before it was published. In 1610, being then arch-dean of Guadix, he accompanied the count de Lemos to Naples, and on his return to Spain was appointed (1619) chaplain to the cardinal Infante Ferdinand of Austria; he is referred to as still alive in Montalbán's *Para todos* (1632), and he collaborated with Montalbán and Calderón in *Polifemo y Circe*, printed in 1634. The date of his death is not known. Mira de Amescua's plays are dispersed in various printed collections, and the absence of a satisfactory edition has prevented his due recognition. He has an evenness of execution which indicates an artistic conscience uncommon in Spanish playwrights; he resisted the temptation to write too much, and he unites a virile dignity of expression to impressive conception of character.

Two of his plays—*La Adversa fortuna de Don Bernado de Cabrera* and *El ejemplo mayor de la desdicha*—are respectively the sources of Rotrou's *Don Bernardo de la Cabrère* and *Belisaire*; Moreto's *Caer para levantar* is simply a recast of Mira's *El Esclavo del demonio*, a celebrated drama which clearly influenced Calderón when composing *La Devoción de la cruz*; and there is manifestly a close relation between Mira's *La Rueda de la fortuna* on the one hand and Corneille's *Héraclius* and Calderón's *En esta vida todo es verdad y todo es mentira*. A few of Mira de Amescua's plays are reprinted in the *Biblioteca de autores españoles*, vol. xlv.

MIRAGE (a French word, from *mirer*, to look at, *se mirer*, to be reflected), an optical illusion due to variations in the refractive index of the atmosphere. It embraces the phenomena of the visionary appearance of lakes in arid deserts, the images of ships and icebergs, frequently seen as if inverted and suspended in the atmosphere in the Polar Regions, the *Fata Morgana*, and "looming" as witnessed in mists or fogs.

In the article Refraction it is shown that a ray of light traversing a homogeneous medium is deviated from its rectilinear path when it enters a medium of different refractive index; it is therefore readily seen that the path of a ray through continuously varying media is necessarily curvilinear, being compounded of an infinite number of infinitesimally small rectilinear deviations. Our atmosphere is a medium of continuously varying refractive index. Meteorological optical phenomena, due to variations in the refractive index of the atmosphere, may be divided into groups: (1) those due to the permanent or normal variation experienced as one ascends in the atmosphere, and (2) those due to sporadic variations occasioned by irregular heating. The first variation must be taken into account in correcting geodetic observations of heights and astronomical observations of the heavenly bodies; it also has a considerable bearing on the phenomena of the twilight and the afterglow (see Refraction: § *Astronomical*; and Twilight). The second (or temperature) variation gives rise to phenomena which we proceed to discuss.

A common type of mirage is the appearance of an isolated lake frequently seen in hot sandy deserts, as in the Sahara, Turkestan, &c. The explanation is as follows: The sand, being abnormally heated by the solar rays, causes the neighbouring air to expand, consequently its density, and therefore its refractive index, is diminished, and attains a minimum value in the lowest layers. It increases as we ascend and reaches a maximum at a certain height, and then decreases according to the normal variation. Any object viewed across such an area is seen by two sets of rays: one set passing near the earth and assuming a curved path convex to the horizon, the second set more remote from the earth and concave to the horizon. The object thus appears double, an image being seen mirrored in the sand. The sky appears as a shining lake; mountains or palms may be similarly reflected, but it is to be noted that the images are inverted (see fig.). Similar atmospheric conditions sometimes prevail in the air over large bodies of water on cold autumn mornings. These phenomena have been experimentally realized by R. W. Wood (*Phil. Mag.*, 1899, vol. xlvii.), who viewed objects over a series of heated slate slabs.



Another type of mirage, frequently observed at sea in the northern latitudes, is presented in the appearance of ships and icebergs as if inverted and suspended in the clouds. This is due to a stratum of hot air at some distance above the sea level, the rays of light near the horizon being practically horizontal, while those at greater elevations are fairly concave. It may happen that the change in density is so great that only the upper rays reach the eye; we are then met with the curious illusion of seeing inverted ships in the clouds, although nothing is visible on the ocean.

The *Fata Morgana*, frequently seen in the Straits of Messina, consists of an apparent vertical elongation of an object situated on the opposite shore. The distribution of density is similar to that attending a desert mirage, but the transition is not so abrupt. The object is really viewed through a horizontally stratified medium consisting of a central sheet of maximum refractive index, over- and under-laid by sheets of decreasing refractive power. The system consequently acts as a continuous lens, magnifying the object in a vertical direction.

If, in addition to this horizontal stratification, the atmosphere varies similarly in vertical planes, then the object would be magnified both horizontally and vertically. These conditions sometimes prevail in misty or foggy weather, more particularly at sea, and thus give rise to the phenomena known as "looming." A famous example is the *Brockengespenst* or "spectre of the Brocken." The chromatic halos which frequently encircle these images are due to diffraction. (See Corona.)

It is interesting to note that lenses formed on non-homogeneous material, having the maximum refractive index along the central axis, have been prepared, and reproduce the effects caused by abnormal distribution of the density of the atmosphere.

The mathematical investigation of this subject was worked out by Gaspard Monge. For this aspect and further details, both descriptive and experimental, see J. Pernter, *Meteorologische Optik* (1906); E. Mascart, *Traité d'optique* (1899–1903); R. W. Wood, *Physical Optics* (1905); R. S. Heath, *Geometrical Optics*.

MIRAJ, a native state of India, in the Deccan division of Bombay, forming part of the southern Mahratta Jagirs. Since 1820 it has been subdivided between a senior and a junior branch. The territory of both is widely scattered among other native states and British districts. Area of the senior branch, 339 sq. m.; pop. (1901), 81,467; revenue £23,000; tribute £800. Area of the junior branch, 211 sq. m.; pop. (1901), 35,806; revenue £27,000, tribute £400. The chiefs are Brahmans of the Patwardhan family. The town of Miraj, at which the chief of the senior branch resides, is situated near the river Kistna; it is a junction of the Southern Mahratta railway for the branch to Kolhapur. Pop. (1901), 18,425. The chief of the junior branch has his residence at Bhudgaon (pop. 3591).

MIRAMON, MIGUEL (1832–1867), Mexican soldier of French extraction, was born in the city of Mexico, on the 29th of September 1832, and shot with the Emperor Maximilian at Queretaro on the 19th of June 1867. While still a student he helped to defend the military academy at Chapultepec against the forces of the United States; and, entering the army in 1852, he rapidly came to the front during the civil wars. It was largely due to Miramon's support of the ecclesiastical party against Alvarez and Comonfort that Zuloaga was raised to the presidency; and in 1859 he was called to succeed him in that office. Decisively beaten by the Liberals in 1860, he spent some time in Europe advocating foreign intervention in Mexican affairs; and returned as a partisan of Maximilian. His ability as a soldier was shown by his double defence of Puebla in 1856.

MIRANDA, FRANCESCO (*c.* 1754–1816), Spanish-American soldier and adventurer, was born at Carácas, Venezuela, about 1754. He entered the army, and served with the French in the American War of Independence. The success of that war inspired him with a belief that the independence of Spanish America would increase its prosperity. He began to scheme a revolution, but was discovered and had only just time to escape to the United States. Thence he went to England, where he was introduced to Pitt, but chiefly lived with the leading members of the opposition—Fox, Sheridan and Romilly. Finding no help, he travelled through Austria and Turkey to Russia, where he was warmly received, but was dismissed with rich presents, at the demand of the Spanish ambassador, backed up by France. The news of the dispute between England and Spain about Nootka Sound in 1790 recalled him to England, where he saw a good deal of Pitt, but the peaceful arrangement of the dispute again destroyed his hopes. In April 1792 he went to Paris, with introductions to Pétion and the leading Girondists, hoping for aid in South America. France had too much to do to help others; but Miranda's friends sent him to the front as general of brigade. He distinguished himself under Dumouriez, was entrusted in February 1793 with the siege of Maestricht, and commanded the left wing of the French army at the disastrous battle of Neerwinden. Although he had given notice of Dumouriez's treachery, he was put on his trial on the 12th of May, unanimously acquitted, but again imprisoned, and not released till after the 9th Thermidor. He was sentenced to be deported after the struggle of Vendémiaire, yet he continued in Paris till the *coup d'état* of Fructidor caused him to take refuge in England. He now found Pitt and Dundas ready to listen, but, as neither of them would or could give him substantial help, he went to the United States, where President Adams only gave him fair words. Addington might have done something for him but for the peace of Amiens in 1802. Though in no way amnestied, he returned to Paris, but was expelled by the First Consul, who was eager to be on good terms with Spain. Disappointed in England and the United States, he decided to make an attempt at his own expense. Aided by two American citizens, Colonel W. S. Smith and Mr S. G. Ogden, he equipped the "Leander," in 1806, and with the help of the English admiral Sir A. Cochrane made a landing near Carácas, and proclaimed the Colombian republic. He had some success, but a false report of peace between France and England caused the English admiral to withdraw his support. At last, in 1810, the events in Spain which brought about the Peninsular War had divided the authorities in Spanish America, some of whom declared for Joseph Bonaparte, others for Ferdinand VII., others for Charles IV., and Miranda again landed, and got a large party together who declared a republic both in Venezuela and New Granada or Colombia. But Miranda's desire—that all the South American colonies should form a federal republic—awoke the selfishness of provincial administrations, and the cause was believed to be hateful to heaven owing to a great earthquake on the 26th of March 1812. The count of Monte Verde, the Bourbon governor, had little difficulty in defeating Miranda, and on the 26th of July the general capitulated on condition that he should be deported to the United States. The condition was not observed; Miranda was moved from dungeon to dungeon, and died on the 14th of July 1816 at Cadiz.

There are allusions to Miranda's early life in nearly all memoirs of the time, but they are not generally very accurate. For his trial see Buchez et Roux, *Histoire parlementaire*, xxvii. 26–70. For his later life see J. Biggs, *History of Miranda's Attempt in South America* (London, 1809); and Veggasi, *Revolucion de la Colombia.* Prof. William S. Robertson has recently devoted considerable research in the Spanish archives and elsewhere to Miranda, his monograph on *F. de M. and the revolutionizing of Spanish America* being awarded a prize of the American Historical Association in 1908. See also Marqués de Rojas, *El General Miranda* (Paris, 1884), and his *Miranda dans la révolution française* (Carácas, 1889); and R. Becerra, *Ensayo historico documentado de la vida de Don F. de M.* (Carácas, 1896).

MIRANDE, a town of south-western France, capital of an arrondissement in the department of Gers, on the left bank of the Grande Baise, 17 m. S.S.W. of Auch by the Southern railway. Pop. (1906), 2368. Mirande is laid out on the uniform plan typical of the *bastide.* Its church, built at the beginning of the 15th century, is chiefly remarkable for its porch which bestrides the Rue de l'Évêché and is surmounted by two flying buttresses supporting a belfry of Flemish appearance. The remains of ramparts are still to be seen and the principal street is bordered by ancient arcades. The town has a sub-prefecture and a tribunal of first instance. The trade is in live-stock and agricultural products. Tanning and wood-turning are carried on.

Mirande was founded in 1286 by the monks of Berdones and the seneschal of Toulouse acting on behalf of Philip IV. During the 14th century it was the capital of the counts of Astarac.

MIRANDOLA, a town of Emilia, Italy, in the province of Modena, 19½ m. N. by E. of it by rail, 59 ft. above sea-level. Pop. (1901), 15,162. The Palazzo del Commune is a 15th-century edifice of Gothic style. The castle of the Pico family, who held the town from the 14th century to 1710, when the last member was deprived of his dominions by Joseph I. of Austria, is almost entirely destroyed. The height of the fortunes of this family was from about 1450 to 1550, Giovanni (b. 1463, d. 1494) being its ablest and most learned member (see Pico). The cathedral, dating from the end of the 16th century, has been restored. S. Francesco is a fine Gothic church.

MIRANZAI VALLEY, or Hangu, a mountain valley on the Kohat border of the North-West Frontier Province of India. Miranzai comprises two valleys draining S.W. into the Kunam and N.E. into the Kohat Toi. It is thus divided into upper and lower Miranzai, and extends from Thal to Raisan, and from the Zaimukht and Orakzai hills to those of the Khattaks. Its length is about 40 m., and its breadth varies from 3 to 7 m. Area, 546 sq. m.; pop. (1901), 43,901. The portion of Miranzai east of Hangu village consists of numerous small and well-cultivated valleys, in which orchard trees flourish abundantly. To the west of Hangu, including the whole of Upper Miranzai, the country is a broad, open, breezy valley. The plain is bare of trees, but the hills are generally covered with scrub. The country is full of ravines towards Thal. The wealth of the inhabitants consists principally in cattle, goats and sheep; of these the cows are of a lean and dwarf breed, and give but little milk. Miranzai forms the meeting place of many different tribes; but its chief inhabitants are the Bangash and Orakzais. Disturbances have necessitated British expeditions in 1851, 1855, and twice in 1891.

MIRBEAU, OCTAVE HENRI MARIE (1850–), French dramatist and journalist, was born at Trevières (Calvados) on the 16th of February 1850. He was educated in a Jesuit school at Vannes, and studied law in Paris. He began his journalistic career as dramatic critic of the Bonapartist paper, *L'Ordre.* For a short time before 1877 he was *sous-préfet* and then *préfet* of Saint-Girons, but from that time he devoted himself to literature. He was one of the earliest defenders of the Impressionist painters. His witty articles in the anti-republican papers, and his attacks on established reputations, involved him in more than one duel. He gradually developed extreme individualist views. In 1890 he began to write for the *Révolte,* but his anarchist sympathies were definitely checked by the murder of President Carnot in 1894. He was one of the early and consistent defenders of Captain Alfred Dreyfus. He married in 1887 the actress Alice Regnault. His first novel, *Jean Marcellin* (1885), attracted little attention, but he made his mark as a *conteur* with a series of tales of the Norman peasantry, *Lettres de ma chaumière* (1886). *Le Calvaire* (1887), a chapter of which on the defeat of 1870 aroused much discussion, was followed by *L'Abbé Jules* (1888), the story of a mad priest; by *Sebastien Roch* (1890), a bitter picture of the Jesuit school in which his own early years were spent; *Le Jardin des supplices* (1899), a Chinese story; *Les Mémoires d'une femme de chambre* (1901); and *Les Vingt-et-un jours d'un neurasthénique* (1902). In 1897 his five-act piece, *Les Mauvais Bergers,* was played at the Renaissance by Sarah Bernhardt, and he followed this up with *Les Affaires sont les affaires* (Théâtre Français, 1903), which was adapted by Sydney Grundy for Sir H. Beerbohm Tree in 1905. Some of his short pieces are collected as *Farces et moralités* (1904).

MIRFIELD, an urban district in the Morley parliamentary division of the West Riding of Yorkshire, England, 3 m. S.W. of Dewsbury, on the Lancashire & Yorkshire and London & North-Western railways. Pop. (1901), 11,341. The church of St Mary was completed in 1874, from designs of Sir Gilbert Scott. The tower of the ancient church remains. The large industrial population is employed in woollen, cotton, carpet and blanket manufactures, and in the numerous collieries in the vicinity.

MIRKHOND (1433–1498). Mohammed bin Khāwandshāh bin Mahmūd, commonly called Mīrkhwānd or Mīrkhāwand, more familiar to Europeans under the name of Mirkhond, was born in 1433, the son of a very pious and learned man who, although belonging to an old Bokhara family of Sayyids, or direct descendants of the Prophet, lived and died in Balkh. From his early youth he applied himself to historical studies and literature in general. In Herāt, where he spent the greater part of his life, he gained the favour of that famous patron of letters, Mīr 'Alīshīr (1440–1501), who served his old schoolfellow, the reigning sultan Husain (who as the last of the Tīmūrides in Persia ascended the throne of Herāt in 1468), first as keeper of the seal, afterwards as governor of Jurjān. At the request of

Mīr ʿAlīshīr, himself a distinguished statesman and writer, Mirkhond began about 1474, in the quiet convent of Khilāsīyah, which his patron had founded in Herāt as a house of retreat for literary men of merit, his great work on universal history, *Rauẓat-ussafā fi sīrat-ulanbiā walmulūk walkhulafā* or *Garden of Purity on the Biography of Prophets, Kings and Caliphs*. He made no attempt at a critical examination of historical traditions, and wrote in a flowery and often bombastic style, but in spite of this drawback, Mirkhond's *Rauẓat* remains one of the most marvellous achievements in literature. It comprises seven large volumes and a geographical appendix; but the seventh volume, the history of the sultan Husain (1438–1505), together with a short account of some later events down to 1523, cannot have been written by Mirkhond himself, who died in 1498. He may have compiled the preface, but the main portion of this volume is probably the work of his grandson, the historian Khwāndamīr (1475–1534), to whom also a part of the appendix must be ascribed.

For accounts of Mirkhond's life see De Sacy's "Notice sur Mirkhond" in his *Mémoires sur diverses antiquités de la Perse* (Paris, 1793); Jourdain's "Notice de l'histoire universelle de Mirkhond" in the *Notices et extraits*, vol. ix. (Paris, 1812); Elliot, *History of India*, iv. 127 seq.; Morley, *Descriptive Catalogue* (London, 1854), p. 30 seq.; Rieu, *Cat. of Persian MSS. of the Brit. Mus.* (vol. i. London, 1879), p. 87 seq. Besides the lithographed editions of the whole work in folio (Bombay, 1853, and Teheran, 1852–1856) and a Turkish version (Constantinople, 1842), the following portions of Mirkhond's history have been published by European Orientalists: *Early Kings of Persia*, by D. Shea (London, 1832) (Oriental Translation Fund); *L'Histoire de la dynastie des Sassanides*, by S. de Sacy (in the above-mentioned *Mémoires*); *Histoire des Sassanides* (*texte Persan*), by Jaubert (Paris, 1843); *Historia priorum regum Persarum*, Persian and Latin, by Jenish (Vienna, 1782); *Mirchondi historia Taheridarum*, Persian and Latin, by Mitscherlik (Göttingen, 1814, 2nd ed., Berlin, 1819); *Historia Samanidarum*, Persian and Latin, by Wilken (Göttingen, 1808); *Histoire des Samanides*, translated by Defrémery (Paris, 1845); *Historia Ghaznevidarum*, Persian and Latin, by Wilken (Berlin, 1832); *Geschichte der Sultane aus dem Geschlechte Bujeh*, Persian and German, by Wilken (Berlin, 1835); followed by Erdmann's *Erläuterung und Ergänzung* (Kazan, 1836); *Historia Seldschuckidarum*, ed. Vullers (Giessen, 1837); and a German trans. by the same; *Histoire des Sultans du Kharezm*, in Persian, by Defrémery (Paris, 1842); *History of the Atabeks of Syria and Persia*, in Persian, by W. Morley (London, 1848); *Historia Ghuridarum*, Persian and Latin, by Mitscherlik (Frankfort, 1818); *Histoire des Sultans Ghurides*, trans. into French by Defrémery (Paris, 1844); *Vie de Djenghiz-Khan*, in Persian, by Jaubert (Paris, 1841) (see also extracts from the same 5th vol. in French trans. by Langlès in vol. vi. of *Notices et extraits*, Paris, 1799, p. 192 seq.), and by Hammer in *Sur les origines russes*, St Petersburg, 1825, p. 52 seq.); "Tīmūr's Expedition against Tuktamish Khān," Persian and French, by Charmoy, in *Mémoires de l'acad. impér. de St Pétersbourg* (1836), pp. 270–321 and 441–471. (H. E.)

MIRROR (through O. Fr. *mirour*, mod. *miroir*, from a supposed Late Lat. *miratorium*, from *mirari*, to admire), an optical instrument which produces images of objects by reflection. In its usual forms it is simply a highly polished sheet of metal or of glass (which may or may not be covered, either behind or before, with a metallic film); a metallic mirror is usually termed a speculum. The laws relating to the optical properties of mirrors are treated in the article REFLECTION OF LIGHT.

Ancient Mirrors.—The mirror (*κάτοπτρον, ἔσοπτρον, ἔνοπτρον, speculum*) of the Etruscans, Greeks and Romans consisted of a thin disk of metal (usually bronze) slightly convex and polished on one side, the other being left plain or having a design incised upon it. A manufactory of mirrors of glass at Sidon is mentioned by Pliny (*Nat. Hist.* xxxvi. 66, 193), but they appear to have been little used (one has been found at San Remo). Glass mirrors were coated, but with tin; some silver mirrors have also been found. They are said to have been in use as early as the time of Pompey, and were common under the empire. Homer knows nothing of mirrors, but they are frequently mentioned in the tragedians and onwards. The usual size was that of an ordinary hand-mirror, but in imperial times some appear to have been large enough to take in the whole figure (Seneca, *Nat. quaest.*, i. 17, 8), being either fixed to the wall or working up and down like a window sash. The first specimen of a Greek mirror was not discovered till 1867, at Corinth, and the number extant is comparatively small. They are usually provided with a handle, which sometimes took the form of a statuette (especially of Aphrodite) supported on a pedestal, or consist of two metallic circular disks (the "box" mirrors) fitting in to each other, and sometimes fastened together by a hinge. The upper disk or cover was ornamented on the outside with a design in low relief; inside it was polished to reflect the face. The lower disk was decorated inside with engraved figures. The best specimens of both kinds of mirrors date from a little before 400 B.C. and last for some time after that. Of the reliefs, one of the best examples is "Ganymede carried away by the eagle"; amongst the incised mirrors may be mentioned one representing Leucas and Corinthus, inscribed with their names (both the above in Collignon, *L'Archéologie grecque*, 1907, figs. 212, 213); the Genius of the Cock-fights (*Revue archéologique*, new ser. xvii., 1868, Pl. 13). A bronze mirror-case, found at Corinth, has attached on the outside a relief representing an Eros with two girls; on the inside is incised a design of a nymph seated on a bench and playing with Pan at a game resembling the Italian *mora* (*Classical Review*, Feb. 1889, p. 86). On the back of another mirror in the British Museum (*Gazette archéologique*, ii. Pl. 27) is a figure of Eros which has been silvered over. With this was found the bronze case used to contain it, on the back of which is a group of Aphrodite and Eros in repoussé. It was found in Crete; but most of the Greek mirrors and mirror-cases having designs are from Corinth.

The principal feature of the Etruscan mirrors, the extant examples of which far outnumber the Greek, is the design incised on the back. Belonging chiefly to the 4th and 3rd centuries, they mostly resemble the Greek disk-mirrors in form, box-mirrors being rare. As a rule the subjects incised are taken from Greek mythology and legend (Trojan War, birth of Athena, Aphrodite and Adonis), the names of the persons represented being frequently added in Etruscan letters and orthography (Apul = Apollo, Achle = Achilles, Achmemrum = Agamemnon). Scenes from daily life, the toilet, the bath, the palaestra, also occur. In most cases the style of drawing, the types of the figures, and the manner of composing the groups are true to the characteristics of Greek art. Some may have been imported from Greece, but the greater number appears to have been more or less faithfully imitated from such designs as occurred on the Greek vases which the Etruscans obtained from Greece. Even where distinctly Etruscan figures are introduced, such as the heroes Aelius and Caelius Vibenna on a mirror in the British Museum, Greek models are followed. Although the work is frequently rough and careless, certain very fine and beautiful specimens have been found: the famous Semele-mirror, and the healing of Telephus, in which Achilles is shown scraping the healing rust from the lance with a crescent-shaped knife (Baumeister, *Denkmäler*, figs. 557, 1774). Roman mirrors are usually disk-mirrors, the back of the disk, if engraved, being generally ornamented with decorative patterns, not with any subject design.

Plain mirrors are found wherever Greek and Roman civilization spread, and a specimen found in Cornwall (now in the British Museum) shows that the Celtic population of England had adopted the form and substance of the mirror from their conquerors. This specimen is enriched with a Celtic pattern incised. The shape of the handle exhibits native originality. Mirrors were sometimes used in Greece for purposes of divination (Pausanias vii. 21, 5). The mirror was let down into a well by means of a string until it grazed the surface of the water with the rim; after a little while it was pulled up, and when looked into showed the face of the sick person, alive or dead, on whose behalf the ceremony had been performed. This took place at Patrae.

See J. J. de Witte, "Les miroirs chez les anciens," in *Extrait des annales de l'académie*, xxviii. (Antwerp, 1872); Mylonas, Ἑλληνικὰ κάτοπτρα (Athens, 1876); M. Collignon, *L'Archéologie grecque* (new ed., 1907; Eng. tr. by J. H. Wright, 1886); E. Gerhard, *Etruskische Spiegel* (1840–1867), continued by K. Klugmann and G. Körte (1884–1897); article in Smith's *Dictionary of Greek and Roman Antiquities* (3rd ed., 1891). (J. H. F.)

Medieval and Modern Mirrors.—Small metallic mirrors with a highly polished surface were largely used during the middle ages: pocket mirrors or small hand mirrors carried at the girdle being indispensable adjuncts to ladies' toilets. The pocket mirrors consisted of small circular plaques of polished metal, usually steel or silver, fixed in a shallow circular box covered with a lid. Mirror-cases were chiefly made of ivory, carved with relief representations of love or domestic scenes, hunting and games, and sometimes illustrations of popular poetry or romance. Gold and silver, enamels, ebony and other costly materials were likewise used for mirror cases, on which were lavished the highest decorative efforts of art workmanship and costly jewelling. The mirrors worn at the girdle had no cover, but were furnished with a short handle. In 625 Pope Boniface IV. sent Queen Ethelberga of Northumbria a present of a silver mirror; and in early Anglo-Saxon times mirrors were well known in England. It is a remarkable fact that on many of the sculptured stones of Scotland, belonging probably to the 7th, 8th or 9th century, representations of mirrors, mirror-cases and combs occur.

The method of backing glass with thin sheets of metal for mirrors was well known in the middle ages, at a time when steel and silver mirrors were almost exclusively employed. Vincent of Beauvais, writing about 1250, says that the mirror of glass and lead is the best of all, "quia vitrum propter transparentiam melius recipit radios"; and a *verre à mirer* is mentioned in the inventories of the dukes of Burgundy, dating from the 15th century. A gild of glass-mirror makers existed at Nuremberg in 1373, and small convex mirrors were commonly made in southern Germany before the beginning of the 16th century; and these continued to be in demand, under the name of bull's-eyes (*Ochsen-Augen*), till comparatively modern times. They were made by blowing small globes of glass into which while still hot was passed through the pipe a mixture of tin, antimony and resin or tar. When the globe was entirely coated with the metallic compound and cooled it was cut into convex lenses, which formed small but well-defined images. As early as 1317 a "Magister de Alemania," who knew how to work glass for mirrors, broke an agreement he had made to instruct three Venetians, leaving in their hands a large quantity of mixed alum and soot for which they could find no use. It was, however, in Venice that the making of glass mirrors on a commercial scale was first developed; and the republic enjoyed a much-prized monopoly of the manufacture for about a century and a half. In 1507 two inhabitants of Murano, representing that they possessed the secret of making perfect mirrors of glass, a knowledge hitherto confined to one German glass-house, obtained an exclusive privilege of manufacturing mirrors for a period of twenty years. In 1564 the mirror-makers of Venice, who enjoyed peculiar privileges, formed themselves into a corporation. The products of the Murano glass-houses quickly supplanted the mirrors of polished metal, and a large and lucrative trade in Venetian glass mirrors sprang up. They were made from blown cylinders of glass, which were slit, flattened on a stone, carefully polished, the edges frequently bevelled, and the backs "silvered" by an amalgam. The glass was remarkably pure and uniform, the "silvering" bright, and the sheets sometimes of considerable dimensions. In the inventory of his effects, made on the death of the French minister Colbert, a Venetian mirror, 46 by 26 in., in a silver frame, is valued at 8016 livres, while a picture by Raphael is put down at 3000 livres.

The manufacture of glass mirrors, with the aid of Italian workmen, was practised in England by Sir Robert Mansel early in the 17th century, and about 1670 the duke of Buckingham was concerned in glass-works at Lambeth where flint glass was made for looking-glasses. These old English mirrors, with bevelled edges in the Venetian fashion, are still well known. The Venetians guarded with the utmost jealousy the secrets of their manufactures, and gave exceptional privileges to those engaged in such industries. By their statutes any glass-maker carrying his art into a foreign state was ordered to return on the pain of imprisonment of his nearest relatives, and should he disobey the command emissaries were delegated to slay him. In face of such a statute Colbert attempted in 1664 to get Venetian artists transported to France to develop the two great industries of mirror-making and point-lace working. The ambassador, the bishop of Béziers, pointed out that this was to court the risk of being thrown into the Adriatic, and, further, that Venice was selling to France mirrors to the value of 100,000 crowns and lace to three or four times that value. Nevertheless, twenty Venetian glass-mirror makers were sent to France in 1665, and the manufacture was begun in the Faubourg St Antoine, Paris. But previous to this the art of blowing glass for mirrors had been practised at Tour-la-Ville, near Cherbourg, by Richard Lucas, Sieur de Nehou, in 1653; and by the subsequent combination of skill of both establishments French mirrors soon excelled in quality those of Venice. The art received a new impulse in France on the introduction of the making of plate glass in 1691. The St Gobain Glass Company attribute the discovery to Louis Lucas of Nehou, and over the door of the chapel of St Gobain they have placed an inscription in memory of "Louis Lucas qui inventa en 1691 le méthode de couler les glaces et installa la manufacture en 1695 dans le château de Saint Gobain."

Manufacture.—The term "silvering," as applied to the formation of a metallic coating on glass for giving it the properties of a mirror, was till quite recently a misnomer, seeing that till about 1840 no silver, but a tin amalgam, was used in the process. Now, however, a large proportion of mirrors are made by depositing on the glass a coating of pure silver, and the old amalgamation process is comparatively little used.

The process of amalgamation consists in applying a thin amalgam of tin and mercury to the surface of glass. A sheet of thin tin-foil, somewhat larger than the glass to be operated on, is spread out on a flat table, and after all folds and creases have been completely removed a small quantity of mercury is rubbed lightly and quickly over the whole surface, and the scum of dust, impure tin and mercury is taken off. Mercury is then poured upon the "quickened" foil until there is a body of it sufficient to float the glass to be silvered (about $\frac{1}{4}$ in. deep), and the glass (scrupulously cleaned simultaneously with the above operations) is slid over the surface of the mercury. Weights are placed over the surface until the greater part of the amalgamated mercury is pressed out, and the table is then tilted so that all superfluous mercury finds its way to the gutter. The glass is left twenty-four hours under weights; it is then turned over, silvered side up and removed to a drainer, where it dries and hardens. This process, when elaborated, yields excellent results, producing a brilliant silver-white metallic lustre, which is only subject to alteration by exposure to high temperatures or by contact with damp surfaces; but the mercurial vapours to which the workmen are exposed give rise to the most distressing and fatal affections.

The "silver on glass" mirror may be regarded as a discovery of J. von Liebig, who in 1835 observed that by heating aldehyde with an ammoniacal solution of silver nitrate in a glass vessel a brilliant deposit of metallic silver was formed on the surface of the glass. In practice the process was introduced about 1840; and it is now carried on, with several modifications, in two distinct ways, called the hot and the cold process respectively. In the former method there is employed a horizontal double-bottomed metallic table, which is heated with steam to from 35° to 40° C., and the reduction of the ammoniacal silver solution is effected with tartaric acid.

In silvering by the cold process advantage is taken of the power of sugar to reduce the silver nitrate. This method has been generally adopted for the silvering of mirrors for astronomical telescopes. G. W. Ritchey ("The Modern Reflecting Telescope," *Smithsonian Contributions to Knowledge*, xxxiv. 40) used the process devised by Brashear in 1884. The glass disk is mounted on a rocking-table, and most carefully cleaned with nitric acid, potash, and finally with distilled water. The reducing solution (which improves on keeping) is made up from 200 parts of water, 20 of loaf sugar, 20 of alcohol and 1 of nitric acid (commercial pure). The silver solution is prepared as follows: 2 parts of silver nitrate are dissolved in 20 parts of water, and strong ammonia added until the brown solution becomes clear. A solution of $1\frac{1}{2}$ parts of potash (pure by alcohol) in 20 of water is now added, and then ammonia until the solution is again clear. A solution of $\frac{1}{4}$ part of silver nitrate in 16 of water is added until the liquid is straw-coloured; it is then filtered. Quantities of the solutions, such that the sugar equals one half the nitrate, are taken, then diluted, mixed, and poured on to the plate, which is gently rocked. The liquid goes muddy-brown, and in 3 to 4 minutes it begins to clear, a thick deposit being formed in about 5 minutes. The solution is poured off, and water run on, the streaks of precipitate being removed by lightly held cotton wool. The washing is repeated, and then water is allowed to remain on the film for one hour. The water is then run off, and the plate is washed several times with alcohol, and then dried by an air fan. The film is now burnished with a chamois leather pad, and finally with the finest jewellers' rouge, the silver surface being the reflecting surface of the mirror.

The deposit of silver on glass is not so adherent and unalterable under the influence of sunlight and sulphurous fumes as the tin-mercury amalgam, and, moreover, real silvered glass has in many cases a slightly yellowish tinge. These defects have been overcome by a process introduced by Lenoir, which consists of brushing over the silvered surface with a dilute solution of cyanide of mercury, which, instantaneously forming a kind of amalgam, renders the deposit at once much whiter and more firmly adherent than before. To protect the thin metallic film from mechanical injury and the chemical action of gases and vapours it is coated with shellac or copal varnish, over which, when dry, are applied two coatings of red-lead paint or an electrolytically-deposited film of copper. This precaution only applies when the silver forms the back of the mirror.

Platinum Mirrors.—A cheap process of preparing mirror glass was to some extent prosecuted in France, whereby a thin but very adherent deposit of platinum is formed on the glass. A solution of chloride of platinum with a proportion of litharge and borate of lead dissolved in essential oil of spike is applied with a brush to well-cleaned glass, which is then placed on edge in a muffle furnace, and the platinum is thus burned in, forming an exceedingly thin but brilliant metallic backing having a somewhat grey lustre. It was used only for the lids of cheap boxes, toys, ornamental letters, &c.

Magic Mirrors.—Hand mirrors of metal are still in common use in Oriental countries, and in Japan bronze mirrors possess a religious significance. They have been known and used from the most remote period, mention of them being found in Chinese literature of the 9th century. The (reputed) first made Japanese mirror, preserved at Isé, is an object of the highest veneration in Japan, and an ancient mirror, connected with which is a tradition to the effect that it was given by the sun-goddess at the foundation of the empire, is a principal article of the Japanese regalia. The mirrors of Japan in general consist of thin disks, from 3 to 12 in. in diameter, of speculum metal with handles, cast in one piece. The polished face of the mirror is slightly convex in form, so that a reflected image is seen proportionately reduced in size; the back of the disk is occupied with ornamentation and inscriptions in bold relief, and its rim is also raised to the back. Much attention has been attracted to these mirrors by a singular physical peculiarity which in a few cases they are found to possess. These are known as magic mirrors from the fact that when a strong beam of light is reflected from their smooth and polished surface, and thrown on a white screen, an image of the raised ornaments and characters on the back of the mirror is formed with more or less distinctness in the disk of light on the screen. This peculiarity has at no time been specially observed by the Japanese, but in China it attracted attention as early as the 11th century, and mirrors possessed of this property sell among the Chinese at ten or even twenty times the price sought for the ordinary non-sensitive examples. The true explanation of the magic mirror was first suggested by the French physicist Charles Cléophas Person in 1847, who observed that the reflecting surface of the mirrors was not uniformly convex, the portions opposite relief surfaces being plane. Therefore, as he says, "the rays reflected from the convex portion diverge and give but a feebly illuminated image, while, on the contrary, the rays reflected from the plane portions of the mirror preserve their parallelism, and appear on the screen as an image by reason of their contrast with the feebler illumination of the rest of the disk." Such differences of plane in the mirror surface are accidental, being due to the manner in which it is prepared, a process explained by W. E. Ayrton and J. Perry (*Proc. Roy. Soc.*, 1878, vol. xxviii.), by whom ample details of the history, process of manufacture and composition of Oriental mirrors have been published. A preliminary operation in polishing the surface consists of scoring the cast disk in every direction with a sharp tool. The thicker portions with relief ornament offer more resistance to the pressure of the tool than the thin flat portions, which tend to yield and form at first a concave surface, but this by the reaction of its elasticity rises afterwards and forms a slightly convex surface, while the more rigid thick portions are comparatively little affected. This irregularity of surface is inconspicuous in ordinary light, and does not visibly distort images; but when the mirror reflects a bright light on a screen the unequal radiation renders the minute differences of surface obvious.

MIRZAPUR, a city and district of British India, in the Benares division of the United Provinces. The city is on the right bank of the Ganges; a station on the East Indian railway, about halfway between Allahabad and Benares, 509 m. N.W. from Calcutta. Pop. (1901), 79,862. The river front, lined with stone ghats or flights of stairs, mosques, Hindu temples and dwelling-houses of the wealthier merchants, is handsome; but the interior of the town is mainly composed of mud huts. Formerly it was the emporium of trade between central India and Bengal, which has now been diverted to the railways. It has European and native lace factories, and manufactures brass vessels and woollen carpets. The London Mission manages a high school and an orphanage. The municipal limits include the town of Bindhachal, an important centre of pilgrimage, with the shrine of Vindhyeshwari.

The DISTRICT OF MIRZAPUR extends into the Sone valley. Area, 5238 sq. m. It is crossed from east to west by the Vindhya and Kaimur ranges. A central jungly plateau connects these and separates the valley of the Ganges from that of the Sone. The part north of the Vindhyas is highly cultivated and thickly peopled, but the rest of the district consists largely of ravines and forests with a sparse population. The population in 1901 was 1,082,430, showing a decrease of 6·8% in the decade. The district comprises a large part of the hereditary domains of the raja of Benares, which are revenue-free. It is traversed, near the Ganges, by the main line of the East Indian railway. The Great Southern road used to start from the city.

MISCARRIAGE, in its widest sense a going astray, a failure. In law, the word is used in several phrases; thus, a miscarriage of justice is a failure of the law to attain its ends. In the Statute of Frauds (29 Car. II., c. 3) in the expression "debt, default or miscarriage of another," the word has sometimes been interpreted as equivalent in meaning to default, but it is more usually considered to mean a species of wrongful act for the consequence of which the law makes a party civilly responsible. The term is also used (see ABORTION) for the premature expulsion of the contents of the womb before the period of gestation is complete.

MISCEGENATION (from Lat. *miscere*, to mix, and *genus*, race), a mixture or blending of two races, particularly of a white with a black or negro race.

MISCELLANY, a term applied to a single book containing articles, treatises or other writings dealing with a variety of different subjects. It is a common title in the literature of the 17th and 18th centuries. The word is an adaptation of Lat. *miscellanea* (from *miscellaneus*, mixed, *miscere*, to mix), used in this sense by Tertullian, *Miscellanea Ptolemaei* (Tert. *adv. Val.* 12); the ordinary use of the word in Latin was for a dish of broken meats, applied by Juvenal (xi. 20) to the coarse food of gladiators.

The Lat. *miscellaneus* has affected the form of a word which is now usually spelled "maslin," applied to a mixture of various kinds of grain, especially rye and wheat. This, however, is really from the O. Fr. *mesteillon*; Late Lat. *mistilio*, formed from *mistus*, past participle of *miscere*, to mix, mingle.

MISCHIEF, a term meaning originally calamity, trouble; now used particularly of annoying injuries or damage done in play or through petty spite. The word is derived through O. Fr. *meschef*, mod. *méchef*, from *meschever*, to do wrong, *mes-*, amiss, and *chever*, bring to a head (*chef*, Lat. *caput*).

MISDEMEANOUR (from O. Fr. *mes-* and *demener*, to conduct oneself ill), the generic term used in English law to include all those offences against the criminal law which are not by common law or statute made treason or felony. In *Russell on Crimes* it is defined as a crime for which the law has not provided a particular name (6th ed., i. 193). The term misprision, at one time applied to the more heinous offences of this class, is now almost obsolete. The term misdemeanour includes not only all indictable offences below the degree of felony, some of them grave crimes, such as sedition, riot and perjury, but also the petty misdemeanours, which may be dealt with summarily by justices of the peace, and the most trifling breaches of local by-laws.

As a matter of legal history, many misdemeanours now represent what were originally described as trespasses against the peace, a phrase which is equivalent to a "tort" or delict, accompanied by circumstances calling for prosecution in the interest of the Crown and the public as well as for civil proceedings by the injured parties. Such acts as riot, public nuisance, sedition and the different forms of libel naturally came to be regarded as wrongs against the king's peace. Many of the early statutes anent justices are particularly concerned with the punishment of rioters; and some offences now treated as misdemeanours belonged to the spiritual and not to the temporal courts, *e.g.* perjury.

While it is true that almost all crimes which in the middle ages were considered heinous fall into the categories of treason or felony, many statutory misdemeanours differ so little, if at all, from felony in character or in the mode of punishment that, in the absence of a code, no logical line of division can now be drawn, inasmuch as few felonies are now capital and none involve the forfeitures of land or goods, which at one time afforded an appreciable distinction between the two categories of crime. The result is that it is impossible to distinguish without enumerating the specific crimes falling under each head.

Among the chief *misdemeanours* are: (1) Assault on the sovereign; (2) unlawful assembly; (3) riot and sedition; (4) forcible entries; (5) perjury, which until 1563 was mainly, if not solely, cognizable by the spiritual courts; (6) blasphemy; (7) extortion; (8) bribery; (9) obtaining property by false pretences (which is nearly cognate to the felony of larceny); (10) assault; (11) public nuisance; (12) libel; (13) conspiracy to defraud, &c.; (14) attempts to commit other crimes.

Numerous acts or omissions are punishable as "misdemeanours by interpretation." In other words, disobedience to the command or prohibition of a statute as to a matter of public concern is indictable as a misdemeanour, even if the statute does not so describe it, unless the terms of the statute indicate that some other remedy alone is to be pursued. For some misdemeanours penal servitude may be imposed by statute. But as a rule the appropriate punishment is by fine or imprisonment without hard labour or both, at the discretion of the court unless limited by a particular statute. The offender may also be put under recognizance to keep the peace and be of good behaviour. Theoretically, whipping may be imposed; but this is not now done except under specific statutory authority: and the like authority is necessary to authorize the addition of hard labour to a sentence of imprisonment.

At the present time the practical difference in English law between misdemeanour and felony lies in matters of procedure, in which a trial for misdemeanour closely resembles an ordinary civil trial.

1. An arrest for misdemeanour may not be made without judicial authority except under specific statutory authority.
2. A person charged with misdemeanour is entitled to bail (see ARREST), *i.e.* to release on the obtaining of sureties, or even on his own recognizance without sureties to appear and take his trial. Bail is obligatory in all misdemeanours, with the exception of misdemeanours where the costs of the prosecution are payable out of the county or borough rate or fund.
3. A misdemeanour may be tried on an information filed by the attorney-general or by leave of the high court without the indictment essential in cases of treason and felony.
4. The same indictment or information may include a number of charges of misdemeanour committed at different times and even against different persons. See INDICTMENT.
5. A trial for misdemeanour may proceed in the absence of the defendant, who is not "given in charge" to the jury, as in the case of felony.
6. On a charge of misdemeanour a trial by special jury may be ordered.
7. There is no right to challenge peremptorily any of the jurors summoned to try the case; any challenge made must be for cause. The jury is sworn collectively (four men to a book), and not poll by poll as in felony, and their oath is to try the issues joined between the king and the defendant. They may separate during adjournments of the trial, like a jury in a civil case.
8. The costs of prosecuting certain misdemeanours are recoverable out of public funds under specific statutory provisions; but in very few cases can the court make the misdemeanant himself pay them.
9. There are no accessories after the fact to misdemeanour. (See ACCESSORY.)

Under French law and systems based thereon or having a common origin a distinction is drawn between *crime* (*verbrechen*), *délit* (*vergehen*) and *contravention*. The English term misdemeanour roughly corresponds to the two classes of *délit* and *contravention* but includes some offences which would be qualified as "crime." In the criminal code of Queensland the term "misdemeanour" is retained, while that of "felony" is abolished; and offences are classified as crimes, misdemeanours and simple offences, the two former punishable on indictment, the latter on summary conviction only; the more serious offences described in English law as misdemeanours are in that code described as crimes (*e.g.* perjury). In the United States the English common law as to misdemeanour is generally followed, but in New York and other states a statutory distinction has been made between misdemeanour and felony by defining the latter as a crime punishable by death or by imprisonment in a state prison. (W. F. C.)

MISE, an Anglo-French term (from Fr. *mettre*, to place) signifying a settlement of accounts, disputes, &c., by agreement or arbitration. As an English legal term it was applied to the issue in a writ of right; and in history to the payment, in return for certain privileges, made by the county palatine of Chester to each new earl, and by the Welsh to each new lord of the Marches, or to a prince or king on his entry into the country. In its more general sense of agreement the term is familiar in English history in the "Mise of Amiens," in January, and that of Lewes, in May of 1264, made between Henry III. and the barons.

MISENUM, an ancient harbour town of Campania, Italy, about 3 m. S. of Baiae (*q.v.*) at the western extremity of the Gulf of Puteoli (Pozzuoli). Until the end of the Republic it was dependent on Cumae, and was a favourite villa resort. Agrippa made the fine natural harbour into the main naval station of the Mediterranean fleet, and founded a colony there probably in 31 B.C. The emperor Tiberius died in his villa here. Its importance lasted until the decline of the fleet in the 4th century A.D. It was at first an independent episcopal see: Gregory the Great united it with that of Cumae. In 890 it was destroyed by the Saracens. The name was derived from one of the companions of Ulysses, or from Aeneas' trumpeter, an account of whose burial is given in Virgil, *Aeneid*, vi. 232.

The harbour consisted of the outer basin, or Porto di Miseno, protected by moles, of which remains still exist, and the present Mare Morto, separated from it by a comparatively modern embankment. The town lay on the south side of the outer harbour, near the village of Miseno, where remains of a theatre and baths and the inscriptions relating to the town have been found. Remains of villas can also be traced, and to the largest of these, which occupied the summit of the promontory, and belonged first to Marius, then to Lucullus, and then to the imperial house, probably belongs the subterranean Grotta Dragonara. Roads ran north to Baiae and north-west past the modern Torre Gaveta to Cumae: along the line of both are numerous columbaria.

See J. Beloch, *Campanien*, ed. ii. (Breslau, 1890), 190 sqq. (T. As.)

MISER, a term originally meaning (as in Latin) miserable or wretched, but now used for an avaricious person who hoards up money and who spends the smallest possible sum on necessities.

MISERERE (the imperative of Lat. *misereri*, to have mercy or pity), the name of one of the penitential psalms (*li.*), from its opening words, *Miserere mei, Deus*. The word is frequently used in English as equivalent to "Misericord" (Lat. *misericordia*, pity, compassion) for various forms in which the rules of a monastic order or general discipline of the clergy might be relaxed; thus it is applied to a special chamber in a monastery for those members who were allowed special food, drink, &c., and to a small bracket on the under side of the seat in a stall of a church made to turn up and afford support to a person in a position between sitting and standing. "Misericord" and "miserere" are also used of a small dagger, the "dagger of mercy," capable of passing between the joints of armour, with which the *coup de grâce* might be given to a wounded man.

MISHAWAKA, a city of St Joseph county, Indiana, U.S.A., on the St Joseph river of Michigan, about 80 m. E. by S. of Chicago. Pop. (1900), 5560 (821 foreign-born); (1910) 11,886. It is served by the Grand Trunk and the Lake Shore & Michigan Southern railways, and by inter-urban electric lines. It has an extensive trade in grain and other agricultural products. Two miles up the river is the Hen Island dam, which, with the Mishawaka hydraulic dam nearer the city, is the source of much of the power used by the city's manufactories. St Joseph Iron Works was laid out on the south side of the river, in 1833, and in 1835 was organized as a village and two additions were platted. In 1836 Indiana City was laid out on the north side of the river;

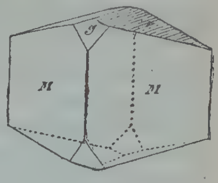
and in 1839 St Joseph Iron Works, with its two additions, and Indiana City were incorporated as one town named Mishawaka—the name of an Indian village formerly occupying a part of the present site. Mishawaka was chartered as a city in 1899.

MISHMI, a hill-tribe on the frontier of Eastern Bengal and Assam. The Mishmis occupy the hills from the Dihong to the Brahmakund, in the north-eastern corner of the Brahmaputra valley. In 1854 M. Krick and M. Bourry, two French missionaries, were murdered in the Mishmi country, but their death was avenged by a small expedition which took the murderer prisoner. In 1899 another British expedition was sent against the Mishmis, owing to the murder of some British subjects.

MISIONES, a territory of northern Argentina, bounded N. by Paraguay and Brazil, E. and S. by Brazil and W. by Paraguay and the Argentine province of Corrientes. Its boundary lines are formed by the upper Paraná and Iguassú rivers on the N., the San Antonio and Pequiry-guassu streams on the E. and the Uruguay River on the S. Area, 11,282 sq. m.; pop. (1904, estimate), 38,755, chiefly Indians and *mestizos*. The territory is a region of roughly-broken surfaces, divided longitudinally by low mountains, called the Sierra Iman and Sierra Grande de Misiones, which form the water-parting for many small streams flowing northward to the Paraná and southward to the Uruguay. The greater part of the country is covered with forest and tropical jungle. The climate is sub-tropical, the temperature ranging from 40° to 95° F. The soil is described as highly fertile, but its products are chiefly confined to *yerba mate* or Paraguay tea (*Ilex paraguayensis*), tobacco and oranges and other fruits. Communication with the capital is maintained by two lines of steamboats running to Corrientes and Buenos Aires, but a railway across Paraguay from Asunción is planned to Encarnación, opposite Posadas. Some of the Jesuit missions of the 17th and 18th centuries were established in this territory, and are to-day represented by the lifeless villages of Candelaria, Santa Ana, San Ignacio and Corpus along the Paraná River, and Apóstoles, Concepción, and San Javier along the Uruguay. Posadas (estimated pop. in 1905, 8000), the capital, on the Paraná, officially dates from 1865. It was also a Jesuit settlement called Itapua, though the large mission of that name was on the Paraguayan side of the river. It is at the extreme west of the territory, and is the terminal port for the steamers from Corrientes.

MISKOLCZ, capital of the county of Borsod, Hungary, 113 m. N.E. of Budapest by rail. Pop. (1900), 40,833. It is situated in a valley watered by the Szinva in the east of the Bükk mountains, and opens towards the south to the plain of the Sajó, an affluent of the Hernád. Miskolcz is a thriving town, and among its buildings are a Roman Catholic church of the 13th century in Late Gothic style, a Minorite convent, and Greek Catholic, Lutheran and Calvinist churches. It manufactures snuff, porcelain, boots and shoes, and prepared leather, and has both steam and water mills. It trades in grain, flour, wine, fruit, cattle, hides, honey, wax and agricultural products, while four well-attended fairs are held annually. About 5 m. west of the town in the Szinva valley is Diósgyör (pop. 11,520), which possesses important iron-works, and the ruined castle of Diósgyör, formerly a shooting residence of the kings of Hungary. About 4 m. to the south-west of Miskolcz are the baths of Tapolcza, containing warm springs. To the south-west of the town lies Onod (pop. 2087), to the south of which, on the banks of the Sajó, is the heath of Mohi or Muhi, famous as the scene of the great defeat of the Hungarians by the Mongols in 1241. About 85,000 Hungarians fell, and the whole country was devastated for the next two years by the Mongolian hordes. During the 16th and 17th centuries Miskolcz suffered much from the Ottomans, and from the troops of George Rákóczy and Emeric Tökölyi. In 1781, 1843 and 1847 it was devastated by fire, and on the 30th of August 1878 a great portion of the town was ruined by a terrific storm.

MISPICKEL, a mineral consisting of iron sulpharsenide, $FeAsS$; it contains 46% of arsenic, and is of importance as an ore of this element. It is known also as arsenopyrite or arsenical pyrites (Ger. *Arsenikkies*): mispickel is an old name of German origin, and in the form *Mistpuckel* was used by G. Agricola in 1546. The crystals are orthorhombic, with angles similar to those of marcasite; they are often prismatic in habit, and the prism *M* is usually terminated by the deeply striated faces of an obtuse dome *r*. Twinning is not uncommon, the twin-planes *M* (110) and *g* (101) being the same as in marcasite. The colour of the mineral is silver-white or steel-grey, with a metallic lustre, but it is often tarnished yellow; the streak is greyish-black. The hardness is 5$\frac{1}{2}$–6, and the specific gravity 5·9–6·2.



Mispickel occurs in metalliferous veins with ores of tin, copper, silver, &c. It is occasionally found as embedded crystals, for example, in serpentine at Reichenstein, Silesia. In Cornwall and Devon it is associated with cassiterite in the tin-lodes, but is also found in the copper-lodes: well crystallized specimens have been obtained from the neighbourhood of Tavistock, Redruth and St Agnes. Mispickel is the principal source of arsenious oxide or the "white arsenic" of commerce (see ARSENIC). The chief supplies are from Cornwall and Devon, and Freiberg in Saxony, and from Canada and the United States.

Danaite is a cobaltiferous variety of mispickel, containing up to 9% of cobalt replacing iron; it was first noticed by J. F. Dana in 1824 at Franconia in New Hampshire. This variety forms a passage to the species glaucodote, $(Co,Fe)AsS$, which is found as well-developed orthorhombic crystals in copper ore at Håkansboda in Ramberg parish, Vestmanland, Sweden. Other species belonging to this isomorphous group of orthorhombic minerals are marcasite (FeS_2), löllingite ($FeAs_2$), safflorite ($CoAs_2$) and rammelsbergite ($NiAs_2$). (L. J. S.)

MISPRISION (from O. Fr. *mesprendre*, mod. *méprendre*, to misunderstand), a term in English law, almost obsolete, used to describe certain kinds of offence. Writers on criminal law usually divide misprision into two kinds (*a*) negative, (*b*) positive.

(*a*) Negative misprision is the concealment of treason or felony. By the common law of England it was the duty of every liege subject to inform the king's justices and other officers of the law of all treasons and felonies of which the informant had knowledge, and to bring the offender to justice by arrest (see Sheriffs Act 1887, s. 8). The duty fell and still falls primarily on the grand jurors of each county borough or franchise, and is performed by indictment or presentment, but it also falls in theory on all other inhabitants (see Pollock and Maitland, *Hist. Eng. Law*, ii. 505). Failure by the latter to discharge this public duty constitutes what is known as misprision of treason or felony (see 3 Co. Inst., 139).

Misprision of Treason, in the words of Blackstone, "consists in the bare knowledge and concealment of treason, without any degree of assent thereto, for any assent makes the party a principal traitor." According to Bracton, *de Coronâ*, seq. 118, failure to reveal the treason of another was in itself high treason, but statutes of 1551–1552 and 1554–1555 made concealment of treason misprision only. Most of the statutes regulating procedure on trials for treason also apply to misprision of treason. The punishment is loss of the profit of the lands of the offender during life, forfeiture of all his goods and imprisonment for life. These punishments are not affected by the Forfeiture Act 1870.

Misprision of Felony is the concealment of a felony committed by another person, but without such previous concert with, or subsequent assistance of the offender, as would make the concealer an accessory before or after the fact. The offence is a misdemeanour punishable on indictment by fine and imprisonment.

(*b*) Positive misprision is the doing of something which ought not to be done; or the commission of a serious offence falling short of treason or felony, in other words of a misdemeanour of a public character (*e.g.* maladministration of high officials, contempt of the sovereign or magistrates, &c.). To endeavour to dissuade a witness from giving evidence, to disclose an examination before the privy council, or to advise a prisoner to stand mute, used to be described as misprisions (Hawk. P. C. bk. I. c. 20).

The old writers say that a misprision is contained in every felony and that the Crown may elect to prosecute for the misprision instead of the felony. This proposition merely affirms the right of the Crown to choose a more merciful remedy in certain cases, and has no present value in the law. Positive misprisions are now only of antiquarian interest, being treated as misdemeanours.

In the United States, misprision of treason is defined to be the crime committed by a person owing allegiance to the United States, and having knowledge of the commission of any crime against them, who conceals and does not, as soon as may be, disclose and make known the same to the president or to some judge of the United States, or to the governor, or to some judge or justice of a particular state. The punishment is imprisonment for not more than seven years and a fine of not more than one thousand dollars.

MISRULE, LORD OF, in medieval times the master of the Christmas revels. Probably J. G. Frazer (*Golden Bough* III.) is right in suggesting that the lord or abbot of misrule is the successor of the king of the ancient Roman Saturnalia, who personated Saturn and suffered martyrdom at the end of the revels. Compare, too, the burlesque figure at the carnival, which is finally destroyed. Stow (*Survey*) writes: "In the feast of Christmas there was in the King's House, wheresoever he lodged, a Lord of Misrule or Master of merry disports, and the like had ye in the house of every nobleman of honour or good worship, were he spiritual or temporal." The mayor and sheriffs of London also had Lords of Misrule. These mock-monarchs began their reign on Allhallows Eve, and misruled till Candlemas. In Scotland they were known as "Abbots of Unreason," and in 1555 a special act suppressing them was passed. In Tudor times their reign was marked by much display and expense. In Henry VIII.'s reign an order for a fool's coat is signed by six of the Privy Council. By an Act of Common Council (1555) the city expenses of the Lords of Misrule were severely curtailed. Machyn speaks of a Lord of Misrule who in 1561 rode through London followed by a hundred gentlemen on horseback hung with gold chains (see also REVELS, MASTER OF).

MISSAL, the book containing the liturgy, or office of the mass (*missa*), of the Roman Catholic Church. This name (*e.g.* Missale gothicum, francorum, gallicanum vetus) began to supersede the older word *Sacramentary* (sacramentarium, liber sacramentorum) from about the middle of the 8th century.[1] At that period the book so designated contained merely the fixed canon of the mass or consecration prayer (actionem, precem canonicam, canonem actionis), and the variable collects, secretae or orationes super oblata, prefaces, and post-communions for each fast, vigil, festival or feria of the ecclesiastical year; for a due celebration of the Eucharist they required accordingly to be supplemented by other books, such as the *Antiphonarium*, afterwards called the *Graduale*, containing the proper antiphons (introits), responsories (graduals), tracts, sequences, offertories, communions and other portions of the communion service designed to be sung by the schola or choir, and the *Lectionarium* (or *epistolarium* and *evangelistarium*) with the proper lessons.[2] Afterwards missals contained more or less fully the antiphons and lessons as well as the prayers proper to the various days, and these were called *missalia plenaria*. All modern missals are of this last description. The *Missale romanum ex decreto ss. concilii tridentini restitutum*, now in almost exclusive use throughout the Latin obedience, owes its present form to the council of Trent, which undertook the preparation of a correct and uniform liturgy, and entrusted the work to a committee of its members. This committee had not completed its labours when the council rose, but the pope was instructed to receive its report when ready and to act upon it. The "reformed missal" was promulgated by Pius V. on the 14th of July 1570, and its universal use enjoined, the only exceptions being churches having local liturgies which had been in unbroken use for at least two centuries.[3] It has subsequently undergone slight revisions under Clement VIII. (1604), Urban VIII. (1634) and Leo XIII. (1884), and various new masses, both obligatory and permissive, universal and local, have been added. Although the Roman is very much larger than any other liturgy, the communion office is not in itself inordinately long. The greater part of it is contained in the "ordinary" and "canon" of the mass, usually placed about the middle of the missal, and occupies, though in large type, only a few pages. The work owes its bulk and complexity to two circumstances. On the one hand, in the celebration of the sacrifice of the mass practically nothing is left to the discretion of the officiating priest; everything—what he is to say, the tone and gestures with which he is to say it, the cut and colour of the robe he is to wear—is carefully prescribed in the rubrics.[4] On the other hand, the Roman, like all the Western liturgies, is distinguished from those of the Eastern Church by its flexibility. A distinctive character has been given to the office for each ecclesiastical season, for each fast or festival of the year, almost for each day of the week; and provision has also been made of a suitable communion service for many of the special occasions both of public and of private life.

The different parts of the Roman communion office are not all of the same antiquity. Its essential features are most easily caught, and best understood, by reference to the earliest *Sacramentaries* (particularly the Gregorian, which was avowedly the basis of the labours of the Tridentine committee), to the Gregorian *Antiphonary*, and to the oldest redaction of the *Ordo romanus*.[5] The account of the mass (qualiter Missa Romana celebratur) as given by the *sacramentarium gregorianum* is to the effect that there is in the first place "the *Introit* according to the time, whether for a festival or for a common day; thereafter *Kyrie eleison*. (In addition to this *Gloria in excelsis Deo* is said if a bishop be [the celebrant], though only on Sundays and festivals; but a priest is by no means to say it, except only at Eastertide. When there is a litany (quando letania agitur) neither *Gloria in excelsis* nor *Alleluia* is sung.) Afterwards the *Oratio* is said, whereupon follows the *Apostolus*, also the *Gradual* and *Alleluia*. Afterwards the *Gospel* is read. Then comes the *Offertorium*,[6] and the *Oratio super oblata* is said." Then follow the *Sursum corda*, the *Preface*, *Canon*, Lord's Prayer and "embolism" (ἐμβόλισμα or insertion, *Libera nos, Domine*), given at full length precisely as they still occur in the Roman missal.

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[1] It first occurs in Ecgbert of York's *De remediis peccatorum*, where it refers to the sacramentary of Gregory the Great.

[2] One of the most celebrated of early missals is the Stowe missal of the 6th century in the British Museum. It contains the litany of the saints, the *gloria* with the collects, the part of the Epistle to the Corinthians relating to the Eucharist, the *credo* and the *consecratio* and *memento* corresponding exactly to the Roman canon. After the daily mass follow the *missa apostolorum*, *missa sanctorum*, *missa pro poenitentibus vivis* and the *missa pro mortuis*. To the 7th century belong the *Missale francorum* and the *Missale gothicum*, originally in the abbey of Fleury. In the 8th century we find in Ecgbert of York's *De remediis peccatorum*, i., that those who devote their lives to sacred orders are supposed to furnish themselves with a psalter, lectionary, antiphonary, missal, baptismal office and martyrology. The adoption of the Roman liturgy by Charlemagne explains the great quantity of missals within this period; *e.g.* the missal of Worms in the library of the Arsenal at Paris. From the 10th century we have the missal of St Vougay, although badly mutilated, and several others. From the 12th century missals became common, and more so with the invention of printing.

[3] The English missal consequently continued to be used by English Roman Catholics until towards the end of the 17th century, when it was superseded by the Roman through Jesuit influence. The Gallican liturgy held its ground until much more recently, but has succumbed under the Ultramontanism of the bishops.

[4] In all the older liturgies the comparative absence of rubrics is conspicuous and sometimes perplexing. It is very noticeable in the Roman *Sacramentaries*, but the want is to some extent supplied by the very detailed directions for a high pontifical mass in the various texts of the *Ordo Romanus* mentioned below. That there was no absolutely fixed set of rubrics in use in France during the 8th century is shown by the fact that each priest was required to write out an account of his own practice ("libellum ordinis") and present it for approbation to the bishop in Lent (see Baluze, *Cap. Reg. Franc.* i. 824, quoted in Smith's *Dict. of Chr. Antiq.* ii. 1521).

[5] For the genealogical relationships of the Roman with other liturgies, see LITURGY. For the doctrines involved in the "sacrifice of the mass," see EUCHARIST.

[6] Some editions do not mention the Offertory here.

In every liturgy of all the five groups a passage similar to this occurs, beginning with *Sursum corda*, followed by a *Preface* and the recitation of the *Sanctus* or Angelic Hymn. The "canon" or consecration prayer, which in all of them comes immediately after, invariably contains our Lord's words of institution, and (except in the Nestorian liturgy) concludes with the Lord's Prayer and "embolism." But there are certain differences of arrangement, by which the groups of liturgies can be classified. Thus it is distinctive of the liturgy of Jerusalem that the "great intercession" for the quick and the dead follows the words of institution and an Epiklesis (ἐπίκλησις τοῦ πνεύματος ἁγίου) or petition for the descent of the Holy Spirit upon the gifts; in the Alexandrian the "great intercession" has its place in the *Preface*; in the East Syrian it comes between the words of restitution and the Epiklesis; in the Ephesine it comes before the *Preface*; while in the Roman it is divided into two, the commemoration of the living being before, and that of the dead after, the words of institution. Other distinctive features of the Roman liturgy are (1) the position of the "Pax" after the consecration, and not as in all the other liturgies at a very early stage of the service, before the *Preface* even; and (2) the absence of the Epiklesis common to all the others.[1] The words of its "canonical prayer" are of unknown antiquity; they are found in the extant manuscripts of the *Sacramentarium gelasianum*, and were already old and of forgotten authorship in the time of Gregory the Great, who, in a letter to John, bishop of Syracuse (*Registr. Epist.* vii. 64), speaks of it as "the prayer composed by a 'scholastic'" (precem quam scholasticus composuerat). The same letter is interesting as containing Gregory's defence, on the ground of ancient use, of certain parts of the Roman ritual to which the bishop of Syracuse had taken exception as merely borrowed from Constantinople. Thus we learn that, while at Constantinople the *Kyrie eleison* was said by all simultaneously, it was the Roman custom for the clergy to repeat the words first and for the people to respond, *Christe eleison* being also repeated an equal number of times. Again, the Lord's Prayer was said immediately after the consecration aloud by all the people among the Greeks, but at Rome by the priest alone.

The meagre liturgical details furnished by the *Sacramentarium gregorianum* are supplemented by the texts of the *Ordo romanus*, the first of which dates from about the year 730. The ritual they enjoin is that for a pontifical high mass in Rome itself; but the differences to be observed by a priest "quando in statione facit missas" are comparatively slight. Subjoined is a précis of *Ordo Romanus I.*

It is first of all explained that Rome has seven ecclesiastical regions, each with its proper deacons, subdeacons and acolytes. Each region has its own day of the week for high ecclesiastical functions, which are celebrated by each in rotation. [This accounts for the Statio ad S. Mariam Majorem, ad S. Crucem in Jerusalem, ad S. Petrum, &c., prefixed to most of the masses in the *Gregorian Sacramentary*, and still retained in the "Proprium de Tempore" of the Roman missal.] The regulations for the assembling and marshalling of the procession by which the pontiff is met and then escorted to the appointed station are minutely given, as well as for the adjustment of his vestments "ut bene sedeant," when the sacristy has been reached. He does not leave the sacristy until the *Introit* has been begun by the choir in the church. Before the *Gloria* he takes his stand at the altar, and after the *Kyrie Eleison* has been sung (the number of times is left to his discretion) he begins the *Gloria in excelsis*, which is taken up by the choir. During the singing he faces eastward; at its close he turns round for a moment to say "Pax vobis," and forthwith proceeds to the *Oratio*.[2] This finished, all seat themselves in order while the subdeacon ascends the ambo and reads [the *epistle*]. After he has done, the cantor with his book (cantatorio) ascends and gives out the response (*Responsum*) with the *Alleluia* and *Tractus* in addition if the season calls for either. The deacon then silently kisses the feet of the pontiff and receives his blessing in the words "Dominus sit in corde tuo et in labiis tuis." Preceded by acolytes with lighted candles and subdeacons burning incense, he ascends the ambo, where he reads the *Gospel*. At the close, with the words "Pax tibi" and "Dominus vobiscum," the pontiff,[3] after another *Oratio*, descends to the "senatorium" accompanied by certain of the inferior clergy, and receives in order the oblations of the rulers (oblationes principum), the archdeacon who follows taking their "amulas" of wine and pouring them into a larger vessel; similar offerings are received from the other ranks and classes present, including the women. This concluded, the pontiff and archdeacon wash their hands, the offerings being meanwhile arranged by the subdeacons on the altar, and water, supplied by the leader of the choir (archiparaphonista), being mingled with the wine. During this ceremony the schola have been engaged in singing the *Offertorium*; when all is ready the pontiff signs to them to stop, and enters upon the *Preface*, the subdeacons giving the responses. At the Angelic Hymn (*Sanctus*) all kneel and continue kneeling, except the pontiff, who rises alone and begins the *Canon*. At the words "per quem haec omnia" the archdeacon lifts the cup with the oblates, and at "Pax Domini sit semper vobiscum," he gives the peace to the clergy in their order, and to the laity. The pontiff then breaks off a particle from the consecrated bread and lays it upon the altar; the rest he places on the paten held by the deacon. It is then distributed while *Agnus Dei* is sung. The pontiff in communicating puts the particle into the cup, saying, "Fiat commixtio et consecratio corporis et sanguinis Domini nostri Jesu Christi accipientibus nobis in vitam aeternam." Those present communicate in their order under this species also. As the pontiff descends into the senatorium to give the communion, the schola begins the communion *Antiphon*, and continues singing the *Psalm* until, all the people having communicated, they receive the sign to begin the *Gloria*, after which, the verse having been again repeated, they stop. The celebrant, then, facing eastward, offers the *Oratio ad complendum*, which being finished the archdeacon says to the people, "Ite, missa est," they responding with "Deo gratias."

To complete our idea of the Roman communion office as it was prior to the end of the 8th century we must now turn to the Gregorian *Antiphonarius sive gradualis liber ordinatus per circulum anni*, which as its name implies contains those variable portions of the mass which were intended to be sung by the schola or choir. It gives for each day for which a proper mass is provided: (1) the *Antiphona* (Antiphona ad Introitum) and *Psalmus*; (2) the *Responsorium* and *Versus*, with its *Alleluia* and *Versus*; (3) the *Offertorium* and *Versus*; (4) the *Communio* and *Psalmus*. Some explanation of each of these terms is necessary. (1) The word *Antiphon* (ἀντίφωνον, O.Eng. *Antefn*, Eng. *Anthem*) in its ecclesiastical use has reference to the very ancient practice of relieving the voices of the singers by dividing the work between alternate choirs. In one of its most usual meanings it has the special signification of a sentence (usually scriptural) constantly sung by one choir between the verses of a psalm or hymn sung by another. According to the Roman liturgiologists it was Pope Celestine who enjoined that the Psalms of David should be sung (in rotation, one presumes) antiphonally before mass; in process of time the antiphon came to be sung at the beginning and end only, and the psalm itself was reduced to a single verse. In the days of Gregory the Great the introit appears to have been sung precisely as at present—that is to say, after the antiphon proper, the *Psalmus* with its *Gloria*, then the antiphon again. (2) The *Responsorium*, introduced between the epistle and gospel, was probably at first an entire psalm or canticle, originally given out by the cantor from the steps from which the epistle had been read (hence the later name *Graduale*), the response being taken up by the whole choir. (3) The *Offertorium* and *Communio* correspond to the "hymn from the book of Psalms" mentioned by early authorities (see, for example, Augustine, *Retr.* ii. 11; *Ap. Const.* viii. 13) as sung before the oblation and also while that which had been offered was being distributed to the people. A very intimate connexion between these four parts of the choral service can generally be observed; thus, taking the first Sunday in the ecclesiastical year, we find both in the *Antiphonary* and in the modern *Missal* that the antiphon is Ps. xxv. 1-3, the psalmus Ps. xxv. 4, the responsorium (graduale) and versus Ps. xxv. 3 and xxv. 4, the offertorium and versus Ps. xxv. 1-3 and xxv. 5. The communio is Ps. lxxxv. 12, one of the verses of the responsorium being Ps. lxxxv. 7. In the selection of the introits there are also traces of a certain rotation of the psalms in the Psalter having been observed.

The first pages of the modern Roman missal are occupied with the *Calendar* and a variety of explanations relating to the year and its parts, and the manner of determining the movable feasts. The general rubrics (*Rubricae generales missalis*) follow, explaining what are the various kinds of mass which may be celebrated, prescribing the hours of celebration, the kind and colour of vestments to be used, and the ritual to be followed (ritus celebrandi missam), and giving directions as to what is to be done in case of various defects or imperfections which may arise. The *Praeparatio ad missam*, which comes next, is a short manual of devotion containing psalms, hymns and prayers to be used as opportunity may occur before and after celebration. Next comes the proper of the season (*Proprium missarum de tempore*), occupying more than half of the entire volume. It contains the proper introit, collect (one or more), epistle, gradual (tract or sequence), gospel, offertory, secretae (one or more), communion and post-communion for every Sunday of the year, and also for the festivals and ferias connected with the ecclesiastical seasons, as well as the offices peculiar to the ember days, Holy Week, Easter and Whitsuntide. Between the office for Holy Saturday and that for Easter Sunday the ordinary of the mass (*Ordo missae*), with the solemn and proper prefaces for the year, and the canon of the mass are inserted. The proper of the season is followed by the proper of the saints (*Proprium sanctorum*), containing what is special to each saint's day in the order of the calendar, and by the *Commune sanctorum*, containing such offices as the common of one martyr and bishop, the common of one martyr not a bishop, the common of many martyrs in paschal time, the common of many martyrs out of paschal time, and the like. A variety of masses to be used at the feast of the dedication of a church, of masses for the dead, and of votive masses (as for the sick, for persons journeying, for bridegroom and bride) follow, and also certain benedictions. Most missals have an appendix also containing certain local masses of saints to be celebrated "ex indulto apostolico."

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[1] This was one of the points discussed at the council of Florence, and Cardinal Bessarion for a time succeeded in persuading the Greeks to give up the Epiklesis.

[2] Quam collectam dicunt, *Ord. Rom. II.*

[3] After singing "Credo in unum Deum," *Ord. Rom. II.*

Masses fall into two great subdivisions: (1) ordinary or regular (secundum ordinem officii), celebrated according to the regular rotation of fast and feast, vigil and feria, in the calendar; (2) extraordinary or occasional (extra ordinem officii), being either "votive" or "for the dead," and from the nature of the case having no definite time prescribed for them. Festival masses are either double, half-double or simple, an ordinary Sunday mass being a half-double. The difference depends on the number of collects and secretae; on a double only one of each is offered, on a half-double there are two or three, and on a simple there may be as many as five, or even seven, of each. Any mass may be either high (missa solennis) or low (missa privata). The distinction depends upon the number of officiating clergy, certain differences of practice as to what is pronounced aloud and what inaudibly, the use or absence of incense, certain gestures and the like. Solitary masses are forbidden; there must be at least an acolyte to give the responses. The vestments prescribed for the priest are the amice, alb, cingulum or girdle, maniple, stole and chasuble (planeta). There are certain distinctions of course for a bishop or abbot. The colour of the vestments and of the drapery of the altar varies according to the day, being either white, red, green, violet or black. This last custom does not go much further back than Innocent III., who explains the symbolism intended (see VESTMENTS).

Subjoined is an account of the manner of celebrating high mass according to the rite at present in force.

1. The priest who is to celebrate, having previously confessed (if necessary) and having finished matins and lauds, is to seek leisure for private prayer (fasting) and to use as he has opportunity the "prayers before mass" already referred to. How the robing in the sacristy is next to be gone about is minutely prescribed, and prayers are given to be used as each article is put on. The sacramental elements having previously been placed on the altar or on a credence table, the celebrant enters the church and takes his stand before the lowest step of the altar, having the deacon on his right and the subdeacon on his left. After invoking the Trinity (In nomine Patris, &c.) he repeats alternately with those who are with him the psalm "Judica me, Deus," which is preceded in the usual way by an antiphon (Introibo ad altare Dei), and followed also by the Gloria and Antiphon.[1] The versicle "Adjutorium nostrum," with its response "Qui fecit," is followed by the "Confiteor,"[2] said alternately by the priest and by the attendants, who in turn respond with the prayer for divine forgiveness, "Misereatur." The priest then gives the absolution ("Indulgentiam"), and after the versicles and responses beginning "Deus, tu conversus" he audibly says, "Oremus," and ascending to the altar silently offers two short prayers, one asking for forgiveness and liberty of access through Christ, and another indulgence for himself, "through the merits of the saints whose relics are here." Receiving the thurible from the deacon he censes the altar, and is thereafter himself censed by the deacon. He then reads the Introit, which is also sung by the choir; the *Kyrie eleison* is then said, after which the words *Gloria in excelsis*[3] are sung by the celebrant and the rest of the hymn completed by the choir.

2. Kissing the altar, and turning to the people with the formula "Dominus vobiscum," the celebrant proceeds with the collect or collects proper to the season or day, which are read secretly. The epistle for the day is then read by the subdeacon, and is followed by the gradual, tract, alleluia or sequence, according to the time.[4] This finished, the deacon places the book of the gospels on the altar, and the celebrant blesses the incense. The deacon kneels before the altar and offers the prayer "Munda cor meum," afterwards takes the book from the altar, and kneeling before the celebrant asks his blessing, which he receives with the words "Dominus sit in corde tuo." Having kissed the hand of the priest, he goes accompanied by acolytes with incense and lighted candles to the pulpit, and with a "Dominus vobiscum" and minutely prescribed crossings and censings gives out and reads the gospel for the day, at the close of which "Laus tibi, Christe" is said, and the book is brought to the celebrant and kissed with the words "Per evangelica dicta deleantur nostra delicta." The celebrant then standing at the middle of the altar sings the words "Credo in unum Deum," and the rest of the Nicene creed is sung by the choir.[5]

3. With "Dominus vobiscum" and "Oremus" the celebrant proceeds to read the offertory, which is also sung by the choir. This finished he receives the paten with the host from the deacon, and after offering the host with the prayer beginning "Suscipe, Sancte Pater" places it upon the corporal. The deacon then ministers wine and the subdeacon water, and before the celebrant mixes the water with the wine he blesses it in the prayer "Deus qui humanae." He then takes the chalice, and having offered it ("Offerimus tibi, Domine") places it upon the corporal and covers it with the pall. Slightly bowing over the altar, he then offers the prayer "In spiritu humilitatis," and, lifting up his eyes and stretching out his hands, proceeds with "Veni sanctificator." After blessing the incense ("Per intercessionem beati Michaelis archangeli") he takes the thurible from the deacon and censes the bread and wine and altar, and is afterwards himself censed as well as the others in their order. Next going to the epistle side of the altar he washes his fingers as he recites the verses of the 26th Psalm beginning "Lavabo." Returning and bowing before the middle of the altar, with joined hands he says, "Suscipe, sancta Trinitas," then turning himself towards the people he raises his voice a little and says, "Orate, fratres" ("that my sacrifice and yours may be acceptable to God the Father Almighty"), the response to which is "Suscipiat Dominus sacrificium de manibus tuis," &c. He then recites the secret prayer or prayers, and at the end says, with an audible voice, "Per omnia saecula saeculorum" (*R.* "Amen").

4. Again saluting with a "Dominus vobiscum," he lifts up his hands and goes on to the *Sursum corda* and the rest of the *Preface*. A different intonation is given for each of the prefaces.[6] At the Sanctus the handbell is rung. If there is a choir the *Sanctus* is sung while the celebrant goes on with the canon.[7] After the words of consecration of the wafer, which are said "secretly, distinctly and attentively," the celebrant kneels and adores the host, rising elevates it, and replacing it on the corporal again adores

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[1] This antiphon is not to be confounded with the Antiphona ad Introitum further on. This use of the 43rd Psalm goes as far back at least as the end of the 11th century, being mentioned by Micrologus (1080). It is omitted in masses for the dead and during Holy Week.

[2] A form very similar to the present is given by Micrologus, and it is foreshadowed even in liturgical literature of the 8th century.

[3] During Lent and Advent, and in masses for the dead, this is omitted. In low masses it is of course said, not sung (if it is to be said). It may be added that this early position of the *Gloria in excelsis* is one of the features distinguishing Roman from Ephesine use.

[4] The tract is peculiar to certain occasions, especially of a mournful nature, and is sung by a single voice. By a sequence is understood a more or less metrical composition, not in the words of Scripture, having a special bearing on the festival of the day. See, for example, the sequence, "Lauda Sion Salvatorem," on Corpus Christi day.

[5] On certain days the *Credo* is omitted.

[6] Now eleven; they were at one time much more numerous.

[7] The approved usage appears to be in that case that it is sung as far as "Hosanna in excelsis" before the elevation, and "Benedictus qui venit" is reserved till afterwards. In France it was a very common custom, made general for a time at the request of Louis XII., to sing "O salutaris hostia" at the elevation.

it (the bell meanwhile being rung).[1] The same rite is observed when the chalice is consecrated. Immediately before the Lord's Prayer, at the words " per ipsum et cum ipso et in ipso," the sign of the cross is made three times over the chalice with the host, and towards the close of the " embolism " the fraction of the host takes place. After the words " Pax Domini sit semper vobiscum " the emission of the particle into the cup takes place with the words " Haec commixtio et consecratio," &c. The celebrant then says the *Agnus Dei* three times.

5. While the choir sings the *Agnus Dei* and the Communion, the celebrant proceeds, still " secrete," with the remainder of the office, which though printed as part of the canon is more conveniently called the communion and post-communion. After the prayer for the peace and unity of the Church (" Domine Jesu Christe, qui dixisti ") he salutes the deacon with the kiss of peace, saying, " Pax tecum "; the subdeacon is saluted in like manner, and then conveys the " pax " to the rest of the clergy who may be assisting. The celebrant then communicates under both species with suitable prayers and actions, and afterwards administers the sacrament to the other communicants if there be any. Then while the wine is poured into the cup for the first ablution he says, " Quod ore sumpsimus "; having taken it he says, " Corpus tuum, Domine." After the second ablution he goes to the book and reads the Communion. Then turning to the people with " Dominus vobiscum " he reads the post-communion (one or more); turning once more to the congregation he uses the old dismissal formula " Dominus vobiscum " (*R.* " Et cum spiritu tuo "), and " Ite, missa est " or " Benedicamus Domino," in those masses from which *Gloria in excelsis* has been omitted (*R.* " Deo Gratias "). Bowing down before the altar he offers the prayer " Placeat tibi, sancta Trinitas," then turning round he makes the sign of the cross over the congregation with the words of the benediction (" Benedicat ").[2] He then reads the passage from the gospel of John beginning with " In principio erat Verbum," or else the proper gospel of the day.[3] (J. S. Bl.)

MISSI DOMINICI, the name given to the officials commissioned by the Frankish kings and emperors to supervise the administration of their dominions. Their institution dates from Charles Martel and Pippin the Short, who sent out officials to see their orders executed. When Pippin became king in 754 he sent out *missi* in a desultory fashion; but Charlemagne made them a regular part of his administration, and a *capitulary* issued about 802 gives a detailed account of their duties. They were to execute justice, to enforce respect for the royal rights, to control the administration of the counts, to receive the oath of allegiance, and to supervise the conduct and work of the clergy. They were to call together the officials of the district and explain to them their duties, and to remind the people of their civil and religious obligations. In short they were the direct representatives of the king or emperor. The inhabitants of the district they administered had to provide for their subsistence, and at times they led the host to battle. In addition special instructions were given to various *missi*, and many of these have been preserved. The districts placed under the *missi*, which it was their duty to visit four times a year, were called *missatici* or *legationes*. They were not permanent officials, but were generally selected from among persons at the court, and during the reign of Charlemagne personages of high standing undertook this work. They were sent out in twos, an ecclesiastic and a layman, and were generally complete strangers to the district which they administered. In addition there were extraordinary *missi* who represented the emperor on special occasions, and at times beyond the limits of his dominions. Even under the strong rule of Charlemagne it was difficult to find men to discharge these duties impartially, and after his death in 814 it became almost impossible. Under the emperor Louis I. the nobles interfered in the appointment of the *missi*, who, selected from the district in which their duties lay, were soon found watching their own interests rather than those of the central power. Their duties became merged in the ordinary work of the bishops and counts, and under the emperor Charles the Bald they took control of associations for the preservation of the peace. About the end of the 9th century they disappeared from France and Germany, and during the 10th century from Italy. It is possible that the itinerant justices of the English kings Henry I. and Henry II., the itinerant *baillis* of Philip Augustus king of France, or the royal *enquêteurs* of St Louis originated from this source.

See G. Waitz, *Deutsche Verfassungsgeschichte* (Kiel, 1844); E. Bourgeois, *Le Capitulaire de Kiersy-sur-Oise* (Paris, 1885); V. Krause, *Geschichte des Institutes der missi dominici* in the *Mittheilungen des Instituts für österreichische Geschichtsforschung*, Band XI. (Innsbruck, 1880). E. Dobbert, *Über das Wesen und den Geschäftskreis der missi dominici* (Heidelberg, 1861); N. D. Fustel de Coulanges, *Histoire des institutions politiques de l'ancienne France* (Paris, 1889–1890); L. Beauchet, *Histoire de l'organization judiciaire en France, époque franque* (Paris, 1865).

MISSIONS (Lat. *missio*, a sending) the term used specially for the propagandist operations of the Christian Church among the heathen, the executants of this work being missionaries. Both " mission " and " missionary " have hence come to be used of similar works in other spheres. The history of Christian missions may, for practical purposes, be divided into three chief periods: (1) the primitive, (2) the medieval and (3) the modern.

The Primitive Period

There can be little doubt that the Christian Church derived its missionary impulse from the teaching of its founder. Even though we may feel some hesitancy, in the light of modern criticism, about accepting as authentic the specific injunctions ascribed to Jesus by Matthew (ch. xxviii. 19) and Luke (ch. xxiv. 47; Acts i. 8), it must be admitted that the teaching of Jesus, in the emphasis which it laid on the Fatherhood of God and the brotherhood of man, was bound sooner or later to break away from the trammels of Judaism, and assert itself in the form of Christian missions. The triumph of this " universalistic " element in the teaching of Christ is vividly portrayed in the Acts of the apostles. At the beginning of the Acts the Christian Church is a little Jewish sect; long before the end is reached it has become a world-conquering spiritual force. The transformation was due in its initial stages to broad-minded men like Stephen, Philip and Barnabas who were the first pioneers of missionary work. Their efforts, however, were soon completely eclipsed by the magnificent achievements of the apostle Paul, who evangelized a large part of Asia Minor and the most important cities of Greece. The success which attended the work of the great apostle to the Gentiles stamped Christianity as a missionary religion for ever. From this point onwards Christianity pushed its way into all the great centres of population. We know very little about the missionaries of the first three centuries. We suddenly find province after province christianized though there is nothing to show how and by whom the work was done. The case of Bithynia is an excellent illustration of this. When Pliny wrote his famous letter to Trajan (A.D. 112), Christianity had taken such a firm hold of the province that its influence had penetrated into remote country districts, pagan festivals were almost entirely neglected, and animals for sacrifice could scarcely find purchasers. Yet the history of the conversion of Bithynia is absolutely buried in oblivion. By the time of Constantine, Christianity had practically covered the whole empire. Harnack has tabulated the results which our scanty data allow us to reach in his *Expansion of Christianity*. He divides the countries which had been evangelized by the close of the 3rd century into four groups: (1) Those countries in which Christianity numbered nearly one-half of the population and represented the standard religion of the people, viz. most of what we now call Asia Minor, that portion of Thrace which lay over against Bithynia, Armenia, the city of Edessa. (2) Those districts in which Christianity formed a very material portion of the population, influencing the leading classes and being able to hold its own with other religions, viz. Antioch and Coele-Syria, Cyprus, Alexandria together with Egypt and the Thebais, Rome and the lower parts of Italy, together with certain parts of middle Italy, Proconsular Africa and Numidia, Spain, the maritime parts of Greece, the southern coasts of Gaul.

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[1] The history of the practice of elevating the host seems to have arisen out of the custom of holding up the oblations, as mentioned in the *Ordo Romanus* (see above). The elevation of the host, as at present practised, was first enjoined by Pope Honorius III. The use of the handbell at the elevation is still later, and was first made general by Gregory XI.

[2] The benediction is omitted in masses for the dead.

[3] The reading of the passage from John on days which had not a proper gospel was first enjoined by Pius V.

(3) Those districts in which Christianity was sparsely scattered, viz. Palestine, Phoenicia, Arabia, certain parts of Mesopotamia, the interior districts of Greece, the provinces on the north of Greece, the northern districts of middle Italy, the provinces of Mauretania and Tripolis. (4) Those districts in which Christianity was extremely weak or where it was hardly found at all: the districts to the north and north-west of the Black Sea, the western section of upper Italy, middle and upper Gaul, Belgica, Germany, Rhaetia, the towns of ancient Philistia. It is not possible to obtain even an approximate estimate of the numbers of the Christians at the time of Constantine. Friedländer, for instance, does not think that they exceeded by much Gibbon's estimate for the reign of Decius, viz. one-twentieth of the population. La Bastie and Burckhardt put the ratio at one-twelfth, Matter at a fifth and Stäudlin even at a half (see Harnack ii. 453).

After the end of the 3rd century missionary enterprise was mainly concentrated on the outlying borders of the empire. In the 4th and 5th centuries may be mentioned Gregory the Illuminator, the "apostle of Armenia" (about 300), Ulfilas, the "apostle of the Goths," about 325; Frumentius,[1] a bishop of Abyssinia, about 327; Nino, the Armenian girl who was the means of converting the kingdom of Iberia (now Georgia), about 330;[2] Chrysostom, who founded at Constantinople in A.D. 404 an institution in which Goths might be trained to preach the Gospel to their own people;[3] Martin of Tours, who evangelized the central districts of Gaul; Valentinus, the "apostle of Noricum," about 440; Honoratus, who from his monastic home in the islet of Lerins, about 410, sent missionaries among the masses of heathendom in the neighbourhood of Arles, Lyons, Troyes, Metz and Nice; and St Patrick, who converted Ireland into "the isle of saints" (died either in 463 or 495).

The Medieval Period

With the 5th century the Church was confronted with numberless hordes, which were now precipitated over the entire face of Europe. Having for some time learnt to be aggressive, she girded herself for the difficult work of teaching the nations a higher faith than a savage form of nature-worship, and of fitting them to become members of an enlightened Christendom.

(*a*) *The Celtic Missionaries.*—The first pioneers who went forth to engage in this difficult enterprise came from the secluded Celtic Churches of Ireland and the Scottish Highlands. Of many who deserve mention in connexion with this period, the most prominent were: Columba, the founder of the famous monastery of Iona in 563 and the evangelizer of the Albanian Scots and northern Picts; Aidan, the apostle of Northumbria; Columbanus, the apostle of the Burgundians of the Vosges (590); Callich or Gallus (d. 646), the evangelizer of north-eastern Switzerland and Alemannia; Kilian, the apostle of Thuringia; and Trudpert, the martyr of the Black Forest. The zeal of these men seemed to take the world by storm. Travelling generally in companies, and carrying a simple outfit, these Celtic pioneers flung themselves on the continent of Europe, and, not content with reproducing at Annegray or Luxeuil the willow or brushwood huts, the chapel and the round tower, which they had left behind in Derry or in the island of Hy (Iona), they braved the dangers of the northern seas, and penetrated as far as the Faroes and even far distant Iceland.[4] "Their zeal and success," to quote the words of Kurtz, "are witnessed to by the fact that at the beginning of the 8th century, throughout all the district of the Rhine, as well as Hesse, Thuringia, Bavaria and Alemannia, we find a network of flourishing churches bearing the impress of Celtic institutions."

(*b*) *The English Missionaries.*—Thus they laid the foundations, aweing the heathen tribes by their indomitable spirit of self-sacrifice and the sternness of their rule of life. But, marvellous as it was, their work lacked the element of permanence; and it became clear that a more practical system must be devised and carried out. The men for this work were now ready, and the sons of the newly evangelized English Churches were ready to go forth. The energy which warriors were accustomed to put forth in their efforts to conquer was now "exhibited in the enterprise of conversion and teaching"[5] by Wilfrid on the coast of Friesland,[6] by Willibrord (658–715) in the neighbourhood of Utrecht,[7] by the martyr-brothers Ewald or Hewald amongst the "old" or continental Saxons,[8] by Swidbert the apostle of the tribes between the Ems and the Yssel, by Adelbert, a prince of the royal house of Northumbria, in the regions north of Holland, by Wursing, a native of Friesland, and one of the disciples of Willibrord, in the same region, and last, not least, by the famous Winfrid or Boniface, the "apostle of Germany" (680–755), who went forth first to assist Willibrord at Utrecht, then to labour in Thuringia and Upper Hessia, then with the aid of his kinsmen Wunibald and Willibald, their sister Walpurga, and her thirty companions, to consolidate the work of earlier missionaries, and finally to die a martyr on the shore of the Zuider Zee.

(*c*) *Scandinavian Missions.*—Devoted, however, as were the labours of Boniface and his disciples, all that he and they and the emperor Charlemagne after them achieved for the fierce untutored world of the 8th century seemed to have been done in vain when, in the 9th "on the north and north-west the pagan Scandinavians were hanging about every coast, and pouring in at every inlet; when on the east the pagan Hungarians were swarming like locusts and devastating Europe from the Baltic to the Alps; when on the south and south-east the Saracens were pressing on and on with their victorious hosts. It seemed then as if every pore of life were choked, and Christendom must be stifled and smothered in the fatal embrace."[9] But the devoted Anskar (801–865) went forth and sought out the Scandinavian viking, and handed on the torch of self-denying zeal to others, who saw, after the lapse of many years, the close of the monotonous tale of burning churches and pillaged monasteries, and taught the fierce Northman to learn respect for civilized institutions.[10] The gospel was first introduced into Norway in the 10th century by an Englishman named Hacon, though the real conversion of the country was due to Olaf Tryggvasön. About the same time, and largely owing to the exertions of Olaf, Iceland, Greenland and the Orkney and Shetland islands were also evangelized.

(*d*) *Slavonic Missions.*—Thus the "gospel of the kingdom" was successively proclaimed to the Roman, the Celtic, the Teutonic and the Scandinavian world. A contest still more stubborn remained with the Slavonic tribes, with their triple and many-headed divinities, their powers of good and powers of evil, who could be propitiated only with human sacrifices. Mission work commenced in Bulgaria during the latter part of the 9th century; thence it extended to Moravia, where in 863 two Greek missionaries—Cyril and Methodius—provided for the people a Slavonic Bible and a Slavonic Liturgy; thence to Bohemia and Poland, and so onwards to the Russian kingdom of Ruric the Northman, where about the close of the 10th century the Eastern Church "silently and almost unconsciously bore into the world her mightiest offspring."[11] But, though the baptism of Vladimir (*c.* 956–1015) was a heavy blow to Slavonic idolatry, mission work was carried on with but partial success; and it taxed all the energies of Adalbert, bishop of Bremen, of Vicilin, bishop of Oldenburg, of Bishop Otto of Bamberg the apostle of the Pomeranians, of Adalbert the martyr-apostle of Prussia, to spread the word in that country, in Lithuania, and in the territory of the Wends. It was not till 1168 that the gigantic four-headed image of Swantevit was destroyed at Arcona, the capital of the island of Rügen, and this Mona of Slavonic superstition was included in the advancing circle of Christian civilization. As late as 1230 human sacrifices were still being offered up in Prussia and Lithuania, and, in spite of all the efforts of the Teutonic Knights, idolatrous practices still lingered amongst the people, while amongst the Lapps, though successful missions had been inaugurated as early as 1335, Christianity cannot be said to have become the dominant religion till at least two centuries later.

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[1] Socrates, *H.E.* i. 15; Sozomen ii. 24; Theodoret i. 22.

[2] Socrates, *H.E.* i. 20; Sozomen ii. 7; Theodoret i. 24.

[3] Theodoret, *H.E.*, v. 30.

[4] See A. W. Haddan, "Scots on the Continent," *Remains*, p. 256.

[5] Church, *Gifts of Civilization*, p. 330.

[6] Bede, *H.E.* v. 19.

[7] "Annal. Xantenses," Pertz, *Mon. Germ.* ii. 220.

[8] Bede, *H.E.* v. 10.

[9] See Lightfoot, *Ancient and Modern Missions.*

[10] See Hardwick, *Middle Ages*, pp. 109-114.

[11] Stanley, *Eastern Church*, p. 294.

(*e*) *Moslem Missions.*—The mention of the order of the Teutonic Knights reminds us how the crusading spirit had affected Christendom. Still even then Raimon Lull protested against propagandism by the sword, urged the necessity of missions amongst the Moslems, and sealed his testimony with his blood outside the gates of Bugiah in northern Africa (June 30, 1315). Out of the crusades, however, arose other efforts to develop the work which Nestorian missionaries from Bagdad, Edessa and Nisibis had already inaugurated along the Malabar coast, in the island of Ceylon, and in the neighbourhood of the Caspian Sea. In 1245 the Roman pontiff sent two embassies—one, a party of four Dominicans, sought the commander-in-chief of the Mongol forces in Persia; the second, consisting of Franciscans, made their way into Tartary, and sought to convert the successor of Oktai-Khan. Their exertions were seconded in 1253 by the labours of another Franciscan whom Louis IX. of France sent forth from Cyprus,[1] while in 1274 the celebrated traveller Marco Polo, accompanied by two learned Dominicans, visited the court of Kublai-Khan, and at the commencement of the 14th century two Franciscans penetrated as far as Peking, even translating the New Testament and the Psalter into the Tatar language, and training youths for a native ministry.[2]

(*f*) *Missions to India and the New World.*—These tentative missions were now to be supplemented by others on a larger scale. In 1488 the Cape of Good Hope was rounded by Diaz, and in 1508 the foundations of the Portuguese Indian empire were laid by Albuquerque. Columbus also in 1492 had landed on San Salvador, and the voyages of the Venetian Cabot along the coast of North America opened up a new world to missionary enterprise. Thus a grand opportunity was given to the churches of Portugal and Spain. But the zeal of the Portuguese took too often a one-sided direction, repressing the Syrian Christians on the Malabar coast, and interfering with the Abyssinian Church,[3] while the fanatic temper of the Spaniard consigned, in Mexico and Peru, multitudes who would not renounce their heathen errors to indiscriminate massacre or abject slavery.[4] Las Casas has drawn a terrible picture of the oppression he strove in vain to prevent.[5] Some steps indeed were taken for disseminating Christian principles, and the pope had induced a band of missionaries, chiefly of the mendicant orders, to go forth to this new mission field.[6] But only five bishoprics had been established by 1520, and the number of genuine converts was small. However, every vestige of the Aztec worship was banished from the Spanish settlements.[7]

(*g*) *The Jesuit Missions.*—It was during this period that the Jesuits came into existence. One of the first of Loyola's associates, Francis Xavier, encouraged by the joint co-operation of the pope and of John III. of Portugal, disembarked at Goa on the 6th of May 1542, and before his death on the Isle of St John (Hiang-Shang), on the 2nd of December 1552, roused the European Christians of Goa to a new life, laboured with singular success amongst the Paravars, a fisher caste near Cape Comorin, gathered many converts in the kingdom of Travancore, visited Malacca, and founded a mission in Japan.

The successor of Xavier, Antonio Criminalis, was regarded by the Jesuits as the first martyr of their society (1562). Matteo Ricci, an Italian by birth, was also an indefatigable missionary in China for twenty-seven years, while the unholy compromise with Brahminism in India followed by Robert de' Nobili was fatal to the vitality of his own and other missions. Others of the same order evangelized Paraguay in 1582, while the Huguenots sent forth under a French knight of Malta a body of devoted men to attempt the formation of a Christian colony at Rio Janeiro. By the close of the 16th century a committee of cardinals was appointed under the name of the "Congregatio de propaganda fide," to give unity and solidity to the work of missions. The scheme originated with Gregory XIII., but was not fully organized till forty years afterwards, when Gregory XV. gave it plenary authority by a bull dated the 2nd of June 1622. Gregory's successor, Urban VIII., supplemented the establishment of the congregation by founding a great missionary college, where Europeans might be trained for foreign labours, and natives might be educated to undertake mission work. At this college is the missionary printing-press of the Roman Church, and its library contains an unrivalled collection of literary treasures bearing on the work.

MODERN MISSIONS

Missionary Societies.—Modern missionary activity is distinguished in a special degree by the exertions of societies for the development of mission work.

As contrasted with the colossal display of power on the part of the Church of Rome, it must be allowed that the churches which in the 16th century broke off from their allegiance to the Latin centre at first showed no great anxiety for the extension of the gospel and the salvation of the heathen. The causes of this are not far to seek. The isolation of the Teutonic churches from the vast system with which they had been bound up, the conflicts and troubles among themselves, the necessity of fixing their own principles and defining their own rights, concentrated their attention upon themselves and their own home work, to the neglect of work abroad.[8]

Still the development of the maritime power of England, which the Portuguese and Spanish monarchies noted with fear and jealousy, was distinguished by a singular anxiety for the spread of the Christian faith. Edward VI. in his instructions to the navigators in Sir Hugh Willoughby's fleet, Sebastian Cabot in those for the direction of the intended voyage to Cathay, and Richard Hakluyt, who promoted many voyages of discovery in addition to writing their history, agree with Sir Humphrey Gilbert's chronicler that "the sowing of Christianity must be the chief intent of such as shall make any attempt at foreign discovery, or else whatever is builded upon other foundation shall never obtain happy success or continuance." When on the last day of the year 1600 Queen Elizabeth granted a charter to George, earl of Cumberland, and other "adventurers," to be a body-corporate by the name of "The Governor and Company of Merchants of London trading with the East Indies," the expressed recognition of higher duties than those of commerce may by some be deemed a mere matter of form, and, to use the words of Bacon, "what was first in God's providence was but second in man's appetite and intention." Yet a keen sense of missionary duty marks many of the chronicles of English mariners. Notably was this the case with the establishment of the first English colony in America, that of Virginia, by Sir Walter Raleigh. The philosopher Thomas Harriot (1560–1621), one of his colleagues, laboured for the conversion of the natives, amongst whom the first baptism is recorded to have taken place on the 13th of August 1587.[9] Raleigh himself presented as a parting gift to the Virginian Company the sum of £100 "for the propagation of the Christian religion" in that settlement.[10] When James I. granted letters patent for the occupation of Virginia it was directed that the "word and service of God be preached, planted and used as well in the said colonies as also as much as might be among the savages bordering among them"; and the honoured names of Nicolas Ferrar, John Ferrar, John Donne and Sir John Sandys, a pupil of Hooker, are all found on the council by which the home management of the colony was conducted.

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[1] Neander vii. 69; Hakluyt 171; Huc i. 207.

[2] Neander vii. 79; Gieseler iv. 259, 260; Hardwick, *Middle Ages*, p. 337.

[3] Geddes, *History of the Church of Malabar*, p. 4; Neale, *Eastern Church*, ii. 343.

[4] Prescott, *Conquest of Mexico*, i. 318, iii. 218.

[5] *Relacion de la destrucción de las Indias.*

[6] Prescott, *Mexico*, iii. 218 n. [7] Prescott iii. 219.

[8] We must not, however, overlook the remarkable appeal made by Erasmus in the first book of his treatise on the art of preaching (*Ecclesiastes sive concionator evangelicus*). The salient passages are quoted in G. Smith, *Short History of Christian Missions*, pp. 116–118; Gustavus Vasa in 1559 made an effort to educate and evangelize the Lapps.

[9] Hakluyt, *Voyages*, iii. 345.

[10] Oldy, *Life of Raleigh*, p. 118.

In the year 1618 was published *The True Honour of Navigation and Navigators*, by John Wood, D.D., dedicated to Sir Thomas Smith, governor to the East India Company, and about the same time appeared the well-known treatise of Hugo Grotius, *De veritate religionis christianae*, written for the express use of settlers in distant lands. Grotius also persuaded seven law students of Lübeck to go to the East as missionaries; the best known of them was Peter Heiling, who worked for 20 years in Abyssinia. A good deal of work was done by Dutch evangelists in Java, the Moluccas, Formosa and Ceylon, but it was not permanent.

The wants, moreover, of the North American colonies did not escape the attention of Archbishop Laud during his official connexion with them as bishop of London, and he was developing a plan for promoting a local episcopate there when his troubles began and his scheme was interrupted. During the Protectorate, in 1649, an ordinance was passed for "the promoting and propagating of the gospel of Jesus Christ in New England" by the erection of a corporation, to be called by the name of the President and Society for the Propagation of the Gospel in New England, to receive and dispose of moneys for the purpose, and a general collection was ordered to be made in all the parishes of England and Wales; and Cromwell himself devised a scheme for setting up a council for the Protestant religion, which should rival the Roman Propaganda, and consist of seven councillors and four secretaries for different provinces.[1] On the restoration of the monarchy, through the influence of Richard Baxter with Lord Chancellor Hyde, the charter already granted by Cromwell was renewed, and its powers were enlarged. For now the corporation was styled "The Propagation of the Gospel in New England and the parts adjacent in America," and its object was defined to be "not only to seek the outward welfare and prosperity of those colonies, but more especially to endeavour the good and salvation of their immortal souls, and the publishing the most glorious gospel of Christ among them." On the list of the corporation the first name is the earl of Clarendon, while the Hon. Robert Boyle was appointed president. Amongst the most eminent of its missionaries was the celebrated John Eliot, the Puritan minister of Roxbury, Massachusetts, who, encouraged and financially assisted by Boyle, brought out the Bible in the Indian language in 1661–1664. Boyle displayed in other ways his zeal for the cause of missions. He contributed to the expense of printing and publishing at Oxford the four Gospels and the Acts of the Apostles in the Malay language, and at his death left £5400 for the propagation of the gospel in heathen lands.

The needs of the colonial church soon excited the attention of others. George Fox, the Quaker, wrote to "All Friends everywhere that have Indians or blacks, to preach the Gospel to them and their servants." Great efforts were made by William Beveridge (1637–1708), bishop of St Asaph, William Wake (1657–1737), archbishop of Canterbury, John Sharp (1645–1714), archbishop of York, Edmund Gibson (1669–1748), bishop of London, and afterwards by the philosophic Bishop Berkeley, and Bishop Butler, the famous author of the *Analogy*, to develop the colonial church and provide for the wants of the Indian tribes. In 1696 Dr Thomas Bray, at the request of the governor and assembly of Maryland, was selected by the bishop of London as ecclesiastical commissary; and, having sold his effects, and raised money on credit, he sailed for Maryland in 1699, where he promoted, in various ways, the interests of the Church. Returning to England in 1700–1701, and supported by all the weight of Archbishop Tenison and Henry Compton, bishop of London, he was graciously received by William III., and received letters patent under the great seal of England for creating a corporation by the name of the "Society for the Propagation of the Gospel in Foreign Parts" on the 16th of June 1701.

Meanwhile, in 1664, Von Welz, an Austrian baron, issued a stirring appeal to the Church at large for a special association devoted to extending the evangelical religion and converting the heathen. He was told that each Christian country should be responsible for its non-Christian neighbours, *e.g.* the Greeks for the Turks, and that as for the heathen it was no good casting pearls before swine. Finding no better response, he went himself as a missionary to Dutch Guiana. The opening of the 18th century saw other movements set on foot. Thus in 1705 Frederick IV. of Denmark founded a mission on the Coromandel coast, and inaugurated the labours of Bartholomew Ziegenbalg, Henry Plutschau and C. F. Schwartz, whose devotion and success told with such remarkable reflex influence on the Church at home. Again in 1731 the Moravians (*q.v.*) illustrated in a signal degree the growing consciousness of obligation towards the heathen. Driven by persecution from Moravia, hunted into mountain-caves and forests, they had scarcely secured a place of refuge in Saxony before, "though a mere handful in numbers, yet with the spirit of men banded for daring and righteous deeds, they formed the heroic design, and vowed the execution of it before God, of bearing the gospel to the savage and perishing tribes of Greenland and the West Indies, of whose condition report had brought a mournful rumour to their ears." And so, literally with "neither bread nor scrip," they went forth on their pilgrimage, and, incredible as it sounds, within ten years they had established missions in the islands of the West Indies, in South America, Surinam, Greenland, among the North American tribes, in Lapland, Tartary, Algiers, Guinea, the Cape of Good Hope and Ceylon.[2] Up till this time all missionary enterprises had been more or less connected with the state. The era of modern missions, based on associate organizations, begins with William Carey (*q.v.*), and is closely connected with the great evangelical revival of the latter part of the 18th century. That revival had intensified the idea of the worth of the individual soul, whether Christian or heathen, and "to snatch even one brand from the burning" became a dominant impulse. In 1792, Carey, a Baptist, who was not only a cobbler, but a linguist of the highest order, a botanist and zoologist, published his *Enquiry into the Obligations of Christians to use Means for the Conversion of the Heathens*, and the book marks a distinct point of departure in the history of Christianity. Under its influence twelve ministers at Kettering in October 1792 organized the Baptist Society for Propagating the Gospel among the Heathen, and subscribed £13, 2s. 6d. In June 1793 Carey was on his way to India. Letters from him quickened interest outside his own communion, and in the autumn of 1794 a meeting of Evangelical ministers of all denominations resolved to appeal to their churches, especially with a view to work being started in the South Sea Islands. The chief movers in the enterprise were the Congregationalist, David Bogue of Gosport, and the Episcopalian, Thomas Haweis, rector of Aldwinkle, Northamptonshire. With them were associated Wesleyan and Presbyterian divines, and in September 1795 the London Missionary Society, emphasizing no one form of church government, was formed. £10,000 was subscribed by June 1796, and in August 29 missionaries sailed for Tahiti. Societies formed in Glasgow and Edinburgh in the spring of the same year gave their attention to the continent of Africa.

The need of this continent was also the means of creating the distinctively Anglican organization known as the Church Missionary Society. The evangelical movement had produced philanthropists like Wilberforce and Granville Sharp, and the Eclectic Society, a group of clergy and laymen who fell to discussing the new missionary movements. In April 1799, under the guidance of John Venn and Thomas Scott, was established the Church Missionary Society, originally known as the "Society for Missions to Africa and the East." Its promoters declared their intention of maintaining cordial relations with Nonconformist missionary societies, and this has largely been done, the older Society for the Propagation of the Gospel, manned by "High" Churchmen, standing more aloof. In 1814 the Wesleyan Missionary Society was formed, Methodist effort of this kind having previously been left to the individual enterprise of Dr Thomas Coke. Thus shorn of two chief bodies of supporters, and Presbyterians in England being then comparatively few, the London Missionary Society became in effect a Congregationalist organization, though it has never departed from the broad spirit of its founders. In Scotland Robert Haldane sold his estate and devoted £25,000 to the cause; with others he would have gone to India himself but for the prohibition of the East India Company, one of whose directors said he would rather see a band of devils in India than a band of missionaries. What Carey did for England was largely done for Scotland by Alexander Duff, who settled in Calcutta in 1830, and was a pioneer of higher education in India. On the Continent the Basel Mission (1815) grew out of a society founded in 1780 to discuss the general condition of Christianity; "Father" Jänicke, a Bohemian preacher in Berlin, founded a training school which supplied many men to the Church Missionary Society and the London Missionary Society; and Van der Kemp, who pioneered the London Missionary Society work in South Africa, organized in 1797 the Netherland Missionary Society, which turned its attention chiefly to Dutch Colonial possessions.

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[1] Neale, *History of New England*, i. 260; Burnet, *History of his own Times*, i. 132 ("Everyman's Library" ed., p. 27).

[2] J. B. Holmes, *Hist. Sketches of the Missions of the United Brethren*, p. 3; A. Grant, *Bampton Lectures* (1843), p. 190.

In America as in England the sense of individual responsibility had been developed. In 1796 and 1797 respectively the New York and the Northern societies were formed for work among Indians by Presbyterians, Baptists and Reformed Dutch, acting in concert. News of the London Society stimulated interest in New England, and in 1806 Andover Seminary was founded as a missionary training college. In the same year Samuel J. Mills, Gordon Hall and James Richards, three students at Williams College, Massachusetts, formed themselves into a mission band which ultimately became the American Board of Commissioners for Foreign Missions (June 1810), an organization which, like the London Mission, originally undenominational and still catholic, has become practically Congregational. The first offshoot from it was the American Baptist Missionary Union in 1814.

The following chronological lists illustrate the growth of missionary societies in Britain and the United States:—

Great Britain and Ireland.

1691. Christian Faith Society for the West Indies.
1698 Society for Promoting Christian Knowledge.
1701 Society for the Propagation of the Gospel in Foreign Parts.
1732. Moravian Missions.
1792. Baptist Missionary Society.
1795. London Missionary Society.
1796. Scottish Missionary Society.
1799. Church Missionary Society.
1799. Religious Tract Society.
1804. British and Foreign Bible Society.
1808. London Society for Promoting Christianity among the Jews.
1813. Wesleyan Missionary Society.
1817. General Baptist Missionary Society.
1823. Colonial and Continental Church Society.
1825. Church of Scotland Mission Boards.
National Bible Society of Scotland.
1831. Trinitarian Bible Society.
1832. Wesleyan Ladies' Auxiliary for Female Education in Foreign Countries.
1835. United Secession (afterwards United Presbyterian) Foreign Missions.
1836. Colonial Missionary Society.
1840. Irish Presbyterian Missionary Society.
1840. Welsh Calvinistic Methodist Missionary Society.
1841. Colonial Bishoprics Fund.
1841. Edinburgh Medical Missionary Society.
1843. British Society for the Propagation of the Gospel among the Jews.
1843. Free Church of Scotland Missions.
1843. Primitive Methodist African and Colonial Missions.
Methodist New Connexion in England Foreign Missions.
1844. South American Missionary Society.
1847. Presbyterian Church in England Foreign Missions.
1858. Christian Vernacular Education Society for India.
1860. Central African Mission of the English Universities.
1862. China Inland Mission.
1865. Friends' Foreign Mission Association.
1866. Delhi Female Medical Mission.
1867. Friends' Mission in Syria and Palestine.
1876. Cambridge Mission to Delhi.
1880. Church of England Zenana Missionary Society.
1884. Presbyterian Mission to Korea.
1892. Student Volunteer Missionary Union.

United States of America.

1733. Corporation for the Propagation of the Gospel in New England.
1787. Society for Propagating the Gospel among the Indians at Boston.
1795. Friends' Missionary Society.
1800. New York Missionary Society.
Connecticut Missionary Society for Indians.
1803. United States Mission to the Cherokees.
1806. Western Missionary Society for Indians.
1810. Board of Commissioners for Foreign Missions.
1814. Baptist Missionary Union.
1819. Methodist Episcopal Church Missionary Society.
1833. Free-will Baptist Foreign Missionary Society in India.
1835. Foreign Missions of the Protestant Episcopal Church.
1837. Board of Foreign Missions of the Presbyterian Church (North).
1837. Evangelical Lutheran Foreign Missionary Society.
1842. Seventh Day Baptist Missionary Society.
Strict Baptist Missionary Society.
1843. Baptist Free Missionary Society.
1845. Methodist Episcopal Church (South).
1845. Southern Baptist Convention.
1846. American Missionary Association.
1857. Board of Foreign Missions of (Dutch) Reformed Church.
1859. Board of Foreign Missions of United Presbyterian Church.
1862. Board of Foreign Missions of the Presbyterian Church (South).
1878. Evangelical Association Missionary Society.
1886. Student Volunteer Missionary Union.

It is not possible to follow in detail the history of the hundred or more organized societies of some size that have thus come into being since the end of the 18th century, still less that of the three or four hundred smaller agencies.[1] It may be noted, however, that the enterprise has followed certain more or less clearly defined lines. These are described as follows by Dr E. M. Bliss, editor of the *Encyclopaedia of Missions.*

1. *The Denominational.*—The course of denominational work may be seen in the way in which the London Society and the American Board were gradually left to the Congregationalists, it being recognized that while fraternity was maintained, the widest results could only be obtained as appeal was made directly to the members of each separate denomination. To some extent a similar development is traceable in other lands. In Germany the Rhenish Society (1825) became independent of the Basel Mission, but like it and the Berlin Society founded by Neander and Tholuck has preserved a broad basis and includes both Lutheran and Reformed constituents. The North German or Bremen Society split into a strict Lutheran or Leipzig agency and the Hermannsburg Mission, which aimed at a more primitive and apostolic method. In Denmark, the Danish Missionary Society, founded by Pastor Bone Falck Ronne in 1821, worked through the Moravian and Basel societies until 1862, when it began independent work and concentrated on the Tamil population of South India. In Norway and Sweden missionary activity kept pace with the development of the national life; in the former country the Free Church, in the latter the State Church has been the most successful agency.

In Holland a religious revival in 1846 led to the foundation of several organizations which supplemented the work of the original Netherland Missionary Society. In France protestant missionary effort began after the overthrow of the empire, and in 1822 several isolated committees united to form the Société des Missions Évangéliques, better known as the Paris Evangelical Society. In Tahiti, Madagascar and other fields this society has largely taken over work begun by the London Society, whose operations were viewed with suspicion by the French government.

2. *Collateral Aid.*—Side by side with the founding of the great missionary societies, Bible and Tract societies sprang up. The dates are significant: Society for Promoting Christian Knowledge (1698), Religious Tract and Book Society of Scotland (1793), Religious Tract Society in London (1799), British and Foreign Bible Society (1804), American Bible Society (1816), American Tract Society (1823). (See further BIBLE SOCIETIES.) Medical Missions have not been so much collateral organizations as departments of the work of the general societies, and the same is generally true of women's missions. Both of these will be discussed in more detail.

3. *Independent and Special Agencies.*—The individual element that was so marked a feature in Carey's generation has never vanished, in spite of the tendency to central control. J. Hudson Taylor in 1853 went to China as the agent of a number of folk in England who feared that missionary work was becoming too mechanical. His aim was to push inland and to work through native evangelists. Out of his endeavours sprang a new organization, the China Inland

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[1] For complete directory see *Statistical Atlas of Foreign Missions* (1910).

Mission; and similar undenominational societies, *e.g.* the Regions Beyond Missionary Union in England, and the Christian and Missionary Alliance in America, have since been founded. Other individual enterprises have been launched by persons or single churches, but such have not usually flourished for any length of time, their workers gradually attaching themselves to the larger associations.

I. British.

Protestant Missions.—It is generally agreed that the period since 1885 has witnessed a very marked increase of missionary zeal and interest in Great Britain, both in the Church of England and among the Nonconformists. The improvement, indeed, dates back somewhat earlier. So far as the Church of England is concerned it may fairly be said to have started afresh in the year following the first observance of the Day of Intercession for Missions, on the 20th of December 1872. Both the Society for the Propagation of the Gospel and the Church Missionary Society were at that time suffering from a general coldness which, in the case of the latter society, had led in that very year to the committee reporting "a failing treasury and a scanty supply of men." The observance of that first Day of Intercession was followed by an immediate change, and unquestionably there has been progress ever since. Then, less than five months afterwards, David Livingstone died at Ilala; and no event of the whole century did so much to wake up Protestant Christendom. Most of the missions in Central Africa owe their origin to the spirit it aroused. But the year 1884 was also an epoch to be marked. In that year Bishop Hannington went to Africa; and his murder in 1885 (first reported in England on New Year's Day, 1886) deeply touched the Christian conscience. The speedy publication of E. C. Dawson's biography of him worked a revolution in the circulation of missionary literature. Another event of 1884–1885 was the going forth to China of "The Cambridge Seven," in connexion with the China Inland Mission. All were men of good family; some of them went at their own charges; and among them were the stroke-oar of the University Eight (Mr Stanley Smith) and the captain of the University Eleven (Mr C. T. Studd). Probably no event of recent years has exercised a wider influence in the cause of missions. In particular, university graduates have since then gone out as missionaries in much larger numbers than before. There are now five missions definitely linked with the universities. The Central African Mission (1858), indeed, is not for the most part manned by graduates, though it is led by them; but the Cambridge Mission at Delhi (1878), the Oxford Mission at Calcutta (1880), and the Dublin Missions in Chota Nagpur (Society for the Propagation of the Gospel, 1891) and the Fuh-Kien Province of China (Church Missionary Society, 1887) consist of university men. Moreover, the older and larger societies have much increased the proportion of graduates on their staffs.

The cause of missions in the universities has been fostered greatly by the Student Volunteer Missionary Movement, initiated in America in 1886, and organized in England in 1892. The Union has over 3000 members (of whom 1400 have gone to the field), and has adopted as its watchword, "The Evangelization of the World in this Generation"; and this motto has been approved by several bishops and other Christian leaders. Another influence upon university men and others who have taken holy orders is that of the Younger Clergy Union of the Church Missionary Society (1885) and the Junior Clergy Association of the Society for the Propagation of the Gospel (1891). At the same time there has been a great accession of men to the missionary ranks from among other classes of society. The Anglican societies and the regular and older Nonconformist societies (Methodist, Baptist, Presbyterian and the London Missionary Society, which is virtually Congregationalist) have shared in these humbler recruits; but a large proportion of them have joined several younger "non-denominational" or "inter-denominational" missions. Of these the China Inland Mission is the largest and most influential; and while it has sent forth many of this class, it has also enrolled not a few men and women of considerable wealth, education and social status. The South Africa General Mission, the North Africa Mission, and the Congo Balolo Mission come next in importance; but there are several smaller bodies working in different countries. The Salvation Army also has missions in India, Ceylon and Japan; but these cannot be called "non-denominational," because the Army has gradually become a very strict denomination itself. There is one Anglican society working, like some of those just mentioned, in one particular field, viz. the South American Missionary Society, founded in 1844. Many foreign dioceses also have associations in England for their help and support. Medical men have come forward in increasing numbers for missionary service, and medical missions are now regarded as a very important branch of the work of evangelization. They are especially valuable in Mahommedan countries, where open preaching is difficult and sometimes impossible, and also in works of mercy among barbarous tribes; while in China, which comes under neither of these two categories, they have been largely developed. There are 980 doctors (most of them fully qualified) labouring in British and American missions; and in 1910 it was calculated that the in-patients in mission hospitals exceeded 160,000, while the visits of out-patients in a year were about 5,000,000. In several of the great London hospitals there are missionary associations, the members of which are medical students; but a chief source of supply in the past has been the Edinburgh Medical Mission, founded in 1841, which, while working among the poor in that city, has trained many young doctors for missionary service.

The most remarkable development of missionary enterprise has been the employment of women. From an early date many of the wives of missionaries have done good service; but the going forth of single women in any appreciable number has only been encouraged by the societies in the last quarter of the 19th century. The Society for Promoting Female Education in the East (now absorbed by others, chiefly by the Church Missionary Society) was founded in 1834; the Scottish Ladies' Association for the Advancement of Female Education in India (which subsequently became two associations, for more general work, in connexion with the Established and Free Churches of Scotland respectively) in 1837; the Indian Female Normal School Society (now the Zenana Bible and Medical Mission) in 1861 (taking over an association dating from 1852); the Wesleyan Ladies' Auxiliary in 1859; the Women's Association of the Society for the Propagation of the Gospel, and the Baptist Zenana Mission, in 1867; The London Society's Female Branch, in 1875; the Church of England Zenana Society (an offshoot from the Indian Female Society) in 1880. But the earlier of these organizations only contemplated employing women for educational work on a very small scale. Out of it grew the visitation of Indian zenanas. The employment of women in general evangelistic work, such as village itineration, house-to-house visiting in towns, classes for female inquirers, training of native female workers, &c., although recent, has rapidly extended. The Church Missionary Society, besides relying on the above-named Zenana Bible and Medical Mission and Church of England Zenana Missionary Society for women's work at several of its stations in India and China, sent out 500 single women in the fifteen years ending 1900; and the non-denominational missions above referred to have (including wives) more women than men engaged in their work—especially the China Inland Mission, which has sent out several hundreds to China. Women's work and medical work are combined in the persons of nearly 300 fully-qualified lady doctors in various missions. Although nearly half the male missionaries (Protestant) are unmarried, these are exceeded in number by the unmarried women; and consequently, the husbands and wives being equal, the aggregate of women in the Missions is greater than the aggregate of men.

The home organization of missions is a subject that has been much considered. The bulk of the work has been done by voluntary societies, membership in which depends upon a pecuniary subscription, and the administration of which is entrusted to elected committees. These committees comprise not only real experts, such as retired veteran missionaries, and retired civil and military officers who have been active friends of missions while on foreign service, but also leading clergymen and laymen who, though not personally acquainted with the mission fields, become almost equal experts by continuous attendance and careful study. In the case of the two leading Church of England societies, the bishops (being members) are *ex officio* on all executive committees; but their labours in other directions prevent their ordinarily attending. The numerous non-denominational missions previously referred to are differently worked. There is no membership by subscription, nor any elected committee. The "mission" consists of the missionaries themselves, and they are governed by a "director," with possibly small advisory councils in the field and at home, the latter undertaking the duty of engaging missionaries and raising funds.

On the other hand, there is a growing sense that missions should be the work of the Church in its corporate capacity, and not of voluntary associations. This is the system of the Presbyterian Churches, the missions of which are entirely controlled by the General Assemblies in Edinburgh, Belfast and London respectively. The Wesleyan Society also is under the authority of the Conference. In the Church of England the question was broached in Convocation, shortly after the revival of that body, in 1859; and during the next few years many suggestions were put forth for the establishment of a Board of Missions which should absorb the societies, or at least direct their work. It soon appeared, however, that neither the Society for the Propagation of the Gospel nor the Church Missionary Society was willing to be absorbed; and it was urged by some that in a great comprehensive national Church, comprising persons of widely different views, more zeal was likely to be thrown into voluntary than into official enterprises. Eventually, in 1887, the Canterbury Convocation and Archbishop Benson formed a Board of Missions; and York followed shortly afterwards. These boards, however, were not to supersede the societies, but to supplement their work, by collecting information, fostering interest, registering results and acting as referees when required. They have already done some useful work, and will probably do more. Their most active members are men who are also leaders in their respective societies, and have thus gained experience in missionary administration. But the Church of England has not yet put missions in the prominent place they occupy in the Nonconformist denominations.

The closing years of the 19th century were remarkable for the centenary commemorations of the older missionary societies. The Baptist Society celebrated its centenary in 1892; the London Missionary Society (Congregational) did the same in 1895; the Society for Promoting Christian Knowledge kept its bicentenary in 1898; the Church Missionary Society its centenary in 1899; the Society for the Propagation of the Gospel its bicentenary in 1900–1901; and the British and Foreign Bible Society its centenary in 1904. Considerable special funds have been raised in connexion with these commemorations. A good deal of interest has also been awakened and maintained by missionary exhibitions, and by a more intelligent type of missionary literature.

2. Colonial.

Colonial missions next claim attention. By "colonial" is meant, not missions to the British colonial population, but missions from the colonial population to the heathen. The former have been very largely the work of the Society for the Propagation of the Gospel, and, in a smaller degree, of the Colonial Church Society (Church of England) and the Colonial Missionary Society (Congregational). Those missions, however, are more properly an outlying branch of home missions, being to the professing Christian settlers or their descendants. But these Christian settlers have their own missions to the heathen—both to the heathen at their doors and to the great heathen lands beyond.

In Canada and Australia, the Anglican, Presbyterian, Methodist, Baptist and other communities have regular organizations for foreign missions. The non-episcopal missions thus formed and supported are worked quite independently of the home societies of the denominations respectively. The Australian Presbyterians have important agencies in the South Seas and in Korea, the Australian Baptists in Bengal, the Canadians of various denominations in the Far North-West of the Dominion, and in India and China. The Anglican Church in Canada has its Domestic and Foreign Missionary Society, working in the North-West and in Japan; and in Australia it has a Board of Missions, working amongst the Australian aborigines and in New Guinea. The Melanesian Mission, associated with the names of Selwyn and Patteson, is officially connected with the Church of New Zealand, but is also largely supported in Australia. In New South Wales, Victoria, New Zealand and Canada there are also Church missionary associations which supply missionaries, and support them, for the mission fields of the Church Missionary Society.

3. Continental.

The *German* societies are numerous and important, and have increased in number and in vigorous work. The *Moravian Church*, whose missions are the oldest (1732), is itself a missionary organization in a sense in which no other Christian community rivals it. Its total membership is under 100,000, and it has some 350 missionaries, labouring in the most unpromising fields—Greenland, Labrador, Alaska, Central America, Tibet, and among the Hottentots. The *Basel Society*, with its famous seminary at Basel, which formerly supplied many able German missionaries to the Church Missionary Society, has extensive work in India, West Africa and South China. The *Berlin Society* and the *Rhenish Society* labour in South Africa and China, the *Hermannsburg Mission* (Hanover) in South Africa and India; *Gossner's Mission* (Berlin) and the *Leipzig Lutherans* in India. At least two of these societies, and other new associations formed for the purpose, and the Moravians, have taken up work in German East Africa. The principal organizations in Holland are the Netherlands Missionary Society and the Utrecht Missionary Society, working mainly in the Dutch colonies. A *Danish* society has a mission in South India. The old *Swedish* and *Norwegian* missionary societies work in South Africa, Madagascar and India; but large numbers of Scandinavians have been stirred up in missionary zeal, and have gone out to China in connexion with the China Inland Mission; several were massacred in the Boxer outbreaks. The *French* Protestants support the *Société des Missions Évangeliques*, founded in 1822. Its chief mission has been in Basutoland, since extended to the Zambesi; but it has also followed French colonial extension, establishing missions in Senegambia, the French Congo, Madagascar and Tahiti.

4. American.

The newer American organizations are, as in England, non-denominational and "free-lance," especially the Christian and Missionary Alliance (1897), developed from the International Missionary Alliance (1887), which has sent many missionaries to India and China. The older societies attribute to these new agencies more zeal than discretion, while the newer credit the older with a discretion that cripples zeal. The Student Volunteer Movement, already referred to, has had large influence in the United States, where it arose; and its leaders have proved themselves men of rare intellectual and practical capacity. In a journey round the world in 1895–1897, J. R. Mott succeeded in forming students' associations in universities and colleges in several European countries, as well as in Turkey in Asia, Syria, India, Ceylon, China, Japan and Australia; and all these associations, over 150 in number, are now linked together in a great International Student Federation. The older American societies, especially the American Board (Congregational), the Presbyterian Boards, the Methodist Episcopal Church Society, the Baptist Missionary Union, and the Missionary Society of the Protestant Episcopal Church, have much extended their work. The "Ecumenical Missionary Conference," held at New York in April 1900, was an astonishing revelation to the American public of the greatness of missions generally and of the missions of their own churches in particular. The Laymen's Missionary movement is a significant outcome of the interest then awakened.

Missions to the Jews are worked by distinct organizations. There are several societies in England, Scotland, Germany and America. No special development has to be reported, except the great extension of John Wilkinson's *Mildmay Mission to* *the Jews*, and its energy in the free distribution of Hebrew New Testaments.

5. Missions to the Jews.

Converted Jews are commonly supposed to be very few, and in numbers they do not compare with converted heathen; but they are more numerous than is usually imagined, especially if the second and third generations of Christians of Hebrew race are included. A number of them find in Unitarianism a form of Christianity that appeals to them. It is estimated that 250 Anglican clergymen are converted Jews or the sons of converted Jews. The London Society for Promoting Christianity among the Jews includes among its missionaries about 80 who are converts. Professor Delitzsch estimated that 100,000 Jews had embraced Christianity in the first three quarters of the 19th century; and Dr Dalman of Leipzig says that "if all those who have entered the Church and their descendants had remained together, instead of losing themselves among the other peoples, there would now be a believing Israel to be counted by millions, and no one would have ventured to speak of the uselessness of preaching the Gospel to the Jews."

Interesting as is the story of Protestant mission work in Austria, Spain, Italy and Russia, it does not fall within the scope of this article. Nor do the proselytizing enterprises of Seventh Day Adventists, Christian Scientists, Mormons and other American bodies rightly find a place here.

Roman Catholic Missions.—At the beginning of the 19th century the Roman Communion seems to have shared to some extent in the torpor and stagnation as regards missions that characterized the Protestant churches. There was little of the zeal which had carried the Franciscans all over Asia in the 13th century, and the Jesuits to South America, India and Japan in the 16th. But the 19th century witnessed a great change, and Roman Catholic missions have been extended *pari passu* with Protestant. The revival was not a little due to the foundation in 1822, by a few earnest but (as they called themselves) "humble and obscure" Catholics at Lyons, of a new voluntary society, called the Institution for the Propagation of the Faith. It collected in its first year about £2000 from the shopkeepers and artisans of Lyons. Thirty years later its income was £200,000 a year; and now it is £300,000. It has sent out no missionaries of its own. It merely makes grants to the various missionary parties sent forth, and it has done much in this direction. Roman missions are carried on both by missionary societies and by religious orders, all under the supreme direction of the pope, and also more or less under the general supervision of the Sacra Congregatio de Propaganda Fide at Rome since its foundation by Gregory XV. in 1622. This important congregation has been described as corresponding pretty much in the Catholic Church to the colonial office in the British empire, and its head, the "Prefect of Propaganda," to the secretary of state for the colonies. It holds supreme control over all the foreign missions in heathen countries, and also over large and important parts of the church in Christian countries whose governments are not Catholic—including the British empire, the United States, Holland, the Norse kingdoms, Greece, and some parts of Germany and Switzerland. A special section (erected by Pius IX.) has charge of the affairs of all the Oriental rites in union with the Roman see. Confining our attention at present to the missions strictly understood under "foreign," *i.e.* to heathen or non-Christian countries, we shall find the whole of these parts of the globe carefully mapped and parcelled out by propaganda to a variety of missionary agencies or religious orders. The government of the various mission fields is generally carried on by "Vicars-Apostolic" (*i.e.* titular bishops acting as vicars or delegates of the Apostolic see) or "Prefects-Apostolic" (*i.e.* priests with similar powers, but without episcopal rank). In some few cases (notably India and Japan) a regular territorial hierarchy has been established, just as in the United Kingdom and the Netherlands. Of the religious societies engaged in the evangelization of these many fields of labour, some have been established exclusively for foreign missionary work among the heathen—notably the famous Société des Missions Étrangères of Paris, the oldest and greatest of all (dating from 1658, and consisting of 34 bishops, 1200 European missionaries and 700 native priests); the German "Society of the Divine Word," whose headquarters are at Steyl in Holland; the Belgian Society of Scheat; the celebrated French Society of the "White Fathers," founded by the late Cardinal Lavigerie for African missions; the English Society of St Joseph, founded at Mill Hill by Cardinal Vaughan; and some others. The other missions are entrusted to the care of various religious orders and congregations, which take up foreign missionary work in addition to their labours in Christian countries. Such are the Franciscans, Dominicans, Jesuits, Lazarists, Augustinians, Marists, &c. Besides the above orders of priests, an immense number of religious societies of women are engaged in works of education and charity throughout the whole of the foreign mission field. These have been reckoned at about 42,000 European and 10,000 native sisters. Again, there are some 20 congregations of "Brothers" (not priests) engaged in teaching, and numbering some 4500 members.

By far the greater part of the Roman missionary work is done by France. The majority of the missionaries are French (over 7000); the bulk of the money—so far as it is voluntary contribution (but the propaganda at Rome has large endowments)—is raised in France. The French government, anti-clerical as it is at home, is the watchful and strenuous protector of the missions abroad; and it is evident that not a little political influence in foreign countries is gained thereby. *L'Année de l'Église*, in reporting on the missions in all parts of the world, dwells continually on this with satisfaction. Protestant missionaries are opposed, not merely because they are heretical, but because they are English or (if American) English-speaking; and the Greek Church missionaries in Persia and Japan, not only because they are schismatic, but because they are Russian—the Franco-Russian alliance notwithstanding. This is a feature in French Catholic missions which cannot be overlooked in the briefest account of them.

The following list shows the principal foreign Roman Catholic missionary societies and their fields of work:—

I. *Société des Missions Étrangères* (Paris, 1658).—*Missions*: Manchuria, Korea, Tibet, Japan, China (Sze-Chuen, Kui-Chow, Kwang-tong, Yunnan), Indo-China (W., S. and Upper Tongking, E., W. and N. Cochin-China; Cambodia, Siam), Malay Peninsula, Burma (S. and N.), S. India (dioceses of Pondicherry, Kombakonam, Mysore, Coimbatore).

II. *Society of "White Fathers"* (founded by Cardinal Lavigerie, 1868).—*Missions*: Algeria, Sahara, Nyasa, Victoria Nyanza, Tanganyika, Unyanyembe, Upper Congo.

III. *Lyons Seminary for Foreign Missions* (1856).—*Missions*: Nile Delta, Benin, Ivory Coast, Gold Coast, Dahomey, Upper Niger.

IV. *Congregation of the Holy Ghost* (1703 and 1848).—*Missions*: Senegambia, Gambia, Sierra Leone, Lower Niger, Gaboon, French Congo, Lower Congo, Mayotte, Nossibé and Comoro Islands.

V. *Milan Seminary for Foreign Missions* (1850).—*Missions*: China (Hong Kong, N. and S. Ho-nan), East Burma, India (dioceses of Kishnagar and Haidarabad).

VI. *Steyl Society of Foreign Missions* (German, 1875).—*Missions*: S. Shan-tung, China; Togo, W. Africa.

VII. *Scheat Society of Foreign Missions* (Belgian, 1863).—*Missions*: Mongolia, Kang-Su (China), Belgian Congo.

VIII. *Picputian Society*[1] (Paris, 1817).—*Missions*: Hawaii, Tahiti, Marquesas Islands.

IX. *Mill Hill Society* (English, 1866).—*Missions*: N. Borneo and Labuan; N. Punjab, Kashmir and Ladak; Telugu missions of Madras; Maori missions of N. New Zealand; N. Uganda.

X. *Congregation of the Sacred Heart* (Issoudun, France, 1855).—*Missions*: New Guinea, New Pomerania, Gilbert Islands.

XI. *Society of the Divine Saviour* (Rome, 1881).—*Mission*: Assam.

XII. *Verona Society for African Missions.*—*Mission*: The Sudan, Upper Egypt.

The following societies are engaged in home as well as foreign missions:—

XIII. *Marists* (French, 1816).—*Missions*: Fiji, Navigator's Island, New Caledonia, Central Oceania, Solomon Islands, parts of New Zealand (dioceses of Wellington and Christchurch).

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[1] Father Damien belonged to this society, which takes its popular name from the Rue de Picpus, Paris.

XIV. *Lazarists* (founded by St Vincent de Paul, 17th century).—*Missions*: Abyssinia, Persia, China (Peking or N. Chih-li, S.-W. Chih-li, Kiang-si, Che-Kiang), S. Madagascar.
XV. *Oblates of Mary Immaculate* (1840).—*Missions*: Ceylon (nearly all), S. Africa (Basutoland, Natal, Transvaal, Orange River Colony), the "Great North-West" of Canada (Athabasca-Mackenzie, Saskatchewan, St Boniface, New Westminster).
XVI. *Salesians* (founded by Don Bosco).—*Missions*: Patagonia and Tierra del Fuego, Falkland Islands, Indians of S. America (Ecuador, Brazil, Argentine); some missions in Palestine.
XVII. *Pallottines.—Missions*: Cameroon, W. Africa; Australia (Beagle Bay, native settlement).
XVIII. *Jesuits.—Missions*: India (dioceses of Bombay, Poona, Calcutta, Madura, Mangalore, Trichinopoly), Ceylon (dioceses of Galle and Trincomalee), China (Kiang-nan, S.-E. Chih-li), Madagascar, Koango (W. Africa), Zambezia, Jamaica, British Guiana, British Honduras, Alaska.
XIX. *Dominicans.—Missions*: Asiatic Turkey (Mosul), Tongking (N., E. and Central), China (Amoy, Fokien), Curaçao, Trinidad.
XX. *Franciscans.—Missions*: Egypt, Tripoli, Morocco, China (N. and S. Shan-si, N. and E. Shan-tung, N. Shen-si, E., N.-W. and S.-W. Hu-pe). *Capuchins*: Aden and Arabia, India (dioceses of Agra, Allahabad, Lahore), Seychelles, Eritrea (Red Sea), Gallas, Cephalonia, Trebizond, Mardin, Crete, Caroline Islands, Araucania, Brazil, Bulgaria. *Conventuals*: Jassy (Rumania).
XXI. *Benedictines.—Missions*: Ceylon (diocese of Kandy), New Zealand (diocese of Auckland), N. American Indians (Indian Territory and Oklahoma), Australian natives (New Nursia).
XXII. *Trappists.—Missions*: Settlements in Natal (Marianhill), West Africa (Congo), China, Japan.
XXIII. *Augustinians.—Missions*: Philippines, China (N. Hu-nan), Balkan Peninsula, Asia Minor ("Assumptionists").
XXIV. *Carmelites.—Missions*: Bagdad, India (dioceses of Verapoly and Quilon).
XXV. *Redemptorists.—Missions*: Dutch Guiana.
XXVI. *Passionists.—Missions*: Bulgaria (diocese of Nicopolis).

These missions are largely supported by the Society of the Propagation of the Faith (est. in Lyons, 1822), Society of the Holy Childhood (est. 1843 as auxiliary to the former; "children for children") and Society of the Schools of the East (est. 1855).

On figures given in H. A. Krose's *Katholische Missionsstatistik* (1908), the following totals of Roman Catholic Missions amongst non-Christians have been compiled: European priests, 7933; native priests, 5837; lay brothers, 5270; sisters, 21,320; catechists, 24,524; native membership, 7,441,215; catechumens, 1,517,909. The annual baptisms of adult heathen are 190,000; those of heathen children at the point of death, 450,000. Over 840,000 children are in lower schools, 66,000 in middle schools, and 90,000 in orphanages. The total number of schools is 24,000, of churches and chapels 28,000, and of mission stations 43,000.

Note.—Where figures for 1910 are quoted in this article they are really those of two or three years earlier, collected for the World Conference of 1910.

Orthodox Eastern Church.[1]—When the tsar Ivan the Terrible (1533–1584) began the great advance of Russia into Northern Asia, a large number of missionaries accompanied the troops, and during the 17th century many thousands of Tatars were baptized, though from lack of fostering influences they lapsed into heathenism. Very little was done until 1824, when John Veniaminov (d. 1879), a priest of Irkutsk, afterwards Archbishop Innocent, began a career of evangelistic activity which has few parallels. He founded missions in Alaska and the Aleutian Islands, Kamtchatka and throughout Eastern Siberia, and established the Orthodox Missionary Society at Moscow. In Altai (Central Siberia) the Archimandrite Macarius, and among the Tatars in south-east Russia with headquarters at Kazan the great linguist Ilminski, did similar work. In addition to the nine distinct missions (300 workers) in Siberia and the six (with 50 workers) in European Russia, the Orthodox Church (Russian) has three foreign missions: (1) in China, founded at Pekin 1714, in the face of Jesuit opposition; (2) in Japan, established about 1863 by Bishop Nicolai, a chaplain at Nagasaki; (3) in Alaska and the Aleutian Islands, the bishop residing at San Francisco and having jurisdiction also over members of the church settled in the United States of America. Altogether the Russian Church spends over £30,000 annually on these missions, and works with the British and Foreign Bible Society in translating and distributing the Scriptures. In Japan the mission has become a practically independent branch of the Church.

History of Mission Fields

The continuity of missionary enthusiasm maintained through the primitive, the medieval, and the modern periods of the Church's history, operating at every critical epoch, and surviving after periods of stagnation and depression, is a very significant fact. It is true that other religions have been called missionary religions, and that one of them long held first place in the religious census of mankind. The missionary activity of Buddhism is a thing of the past, and no characteristic rite distinguishing it has found its way into a second continent. Mahommedanism indeed is active, and is the chief opponent of Christianity to-day, but the character of its teaching is too exact a reflection of the race, time, place and climate in which it arose to admit of its becoming universal. It is difficult to trace the slightest probability of its harmonizing with the intellectual, social and moral progress of the modern world. With all its deficiencies, the Christian church has gained the "nations of the future," and whereas in the 3rd century the proportion of Christians to the whole human race was only that of one in a hundred and fifty, this has now been exchanged for one in three, and it is indisputable that the progress of the human race at this moment is identified with the spread of the influence of the nations of Christendom.

Side by side with this continuity of missionary zeal, a noticeable feature is the immense influence of individual energy and the subduing force of personal character. Around individuals penetrated with Christian zeal and self-denial has centred not merely the life, but the very existence of primitive, medieval and modern missions. What Ulfilas was to the Gothic tribes, what Columba and his disciples were to the early Celtic missions, what Augustine or Aidan was to the British Isles, what Boniface was to the churches of Germany and Anskar to those of Denmark and Sweden, that, on the discovery of a new world of missionary enterprise, was Xavier to India, Hans Egede to Greenland, Eliot to the Red Indians, Martyn to the church of Cawnpore, Marsden to the Maoris, Carey, Heber, Wilson, Duff and Edwin Lewis to India, Morrison, Gilmour, Legge, Hill, Griffith John to China, Gray, Livingstone, Mackenzie, Moffat, Hannington, Mackay to Africa, Broughton to Australia, Patteson to Melanesia, Crowther to the Niger Territory, Chalmers to New Guinea, Brown to Fiji.[2] At the most critical epochs such men have ever been raised up, and the reflex influence of their lives and self-denial has told upon the Church at home, while apart from their influence the entire history of important portions of the world's surface would have been altered.

If from the agents themselves we turn to the work that has been accomplished, it will not be disputed that the success of missions has been marked amongst rude and aboriginal tribes. What was true in the early missions has been found true in these latter times. The rude and barbarous northern peoples seemed to fall like "full ripe fruit before the first breath of the gospel." The Goths and the Vandals who poured down upon the Roman Empire were evangelized so silently and rapidly that only a fact here and there relating to their conversion has been preserved. This is exactly analogous to modern experience in the South Seas, Asia and Africa, to a survey of which we now turn.

The South Seas.—Missionary work in the Pacific began with Magellan (1521), when in a fortnight he converted all the inhabitants of Cebú and the adjacent Philippine Islands! The Jesuits, Recollets and Augustinians also worked in Mariana, Pelews and Caroline Islands, though the two latter were soon abandoned. The beginning of modern effort was made by the London Missionary Society in 1797.

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[1] See E. Smirnoff, *Russian Orthodox Missions*; an article in *The East and the West* (April, 1904); and the *Statistical Atlas* (1910), p. 99.

[2] E. Stock's *Short Handbook of Missions* has a chapter on "Some Notable Missionaries" and another on "Some Prominent Native Christians."

Australia and New Zealand.—The earliest attempt to evangelize the aborigines of Australia by a separate mission was that of the Church Missionary Society in 1825. This work centred at Wellington Valley and Moreton Bay, but was given up in 1842. A new beginning was made in 1850 by the Anglican Board of Missions for Australia and Tasmania, and now each diocese is responsible for its own area. At Bellenden Ker, near Cairns, in North Queensland (diocese of Carpentaria), many natives have settled upon a reserve granted by government to the Anglican Church, and at another reserve, Fraser Island, the diocese of Brisbane has also undertaken successful work. Nomadic aborigines have hardly been touched. Apart from Queensland most of the black population is in West Australia; here the Roman Catholic Church is the main evangelizing agency. In the north and central districts the German missions have been active. Both in Australia (especially in Sydney and Melbourne) and at Thursday Island there is work among the Chinese.

In Tasmania the aborigines are extinct, the last pure-blooded native dying in 1876. The half-castes settled in the Bass Straits are ministered to by the bishop of Tasmania. The Maoris of New Zealand first came under Christian influence through the efforts of Samuel Marsden, a colonial chaplain in New South Wales about 1808. In 1822 Wesleyan missionaries reached the island. The first baptism was in 1825 but during the next five years there was a great mass movement. In 1840 the country became a British colony, and soon afterwards George Selwyn was consecrated bishop. He was so impressed with the work of native evangelists that he founded a college in Auckland where such teachers could be trained. In this he was helped by J. C. Patteson, and out of it grew the Melanesian Mission. The Maori rebellion, fomented by French Catholics, was an outbreak against everything foreign, and the strange religion Hau-hauism, a blend of Old Testament history, Roman Catholic dogmas, pagan rites and ventriloquism, found many adherents. Yet the normal missionary organization suffered very little. Later came Mormon missionaries, and these have to some extent further depleted the Christian ranks.

New Guinea.—In this large island some Gossner missionaries (1854) were the pioneers. They could not do much, but their successors, the Utrecht Missionary Union, who began work when the Dutch took possession of the north-west of the island, are making themselves felt through their six stations. In German New Guinea the Neuendethelsau (1886) and Rhenish (1887) Societies have fourteen stations. In British New Guinea, the south-east portion of the island, the London Mission (1871), the Australian Wesleyans (1892) and the Anglican Church of Australia (1892), have arranged a friendly division of the field and met with gratifying success. Work was begun in 1871–1872 when under the oversight of S. Macfarlane and A. W. Murray a number of native teachers from the Loyalty Islands Rarotonga and Mare settled on the island. The first converts were baptized in 1882 and the establishment of a British Protectorate (1884–1888) gave the work a new impetus. The name of W. G. Lawes and James Chalmers (who with O. Tompkins was killed by cannibals, 1901) of the London Missionary Society, and that of Maclaren, the pioneer of the Church Missionary Society's work, are immortally associated with Papua. The history of mission work here is one of exploration and peril amongst savage peoples, multitudinous languages and an adverse climate, but it has been marked by wise methods as well as enthusiastic devotion, industrial work being one of the basal principles. Besides the Protestant agencies already named, the Roman Catholic Order of the Sacred Heart has been working in the island since 1886; its centre is at Yule Island, and it works up the St Joseph's river.

Other Islands.—The London Mission ship "Duff" in 1797 landed eighteen missionaries (mainly artisans) at Tahiti, ten more in the Tonga or Friendly Islands, and one on the Marquesas. Those in Tahiti had a varying experience, and their numbers were much reduced, but in July 1812 King Pomare II. gave up his idols and sought baptism. By 1815 idolatry was abolished in the larger islands of the group and there ensued the task of building up a Christian community. Foremost in this work were William Ellis (*q.v.*) and John Williams (*q.v.*), who formed a native agency to carry the gospel to their fellow islanders, and so inaugurated what has since been a characteristic feature of South Sea Missions. In 1818 two Tahiti teachers settled in the Tonga islands, which the "Duff" pioneers had abandoned after half of them had been killed for a cannibal feast. When the Wesleyans came in 1821 the way had been prepared, and soon after, led by their king, George, the people turned to the new faith. About the same time Rurutu in the Austral Islands and Aitutaki in the Cook Islands were evangelized, also by natives, and Christianity spread from island to island. John Williams himself removed in 1827 to Rarotonga and from there influenced Samoa, the Society Islands and Fiji. To Fiji in 1834 came James Calvert and other Wesleyan missionaries beginning a work which under them and their successors had extraordinary success. Williams met his death at Erromanga in 1839, but he had established a training school on Rarotonga, and bought a ship, the "Camden," which was of the greatest service for the work. In 1841 work was begun in New Caledonia, in 1842 in the Loyalty Isles and in the New Hebrides, associated from 1857 with the memorable name of John G. Paton. In 1846 a teacher was placed on Niué, Savage Island, and in ten years it was evangelized. Meanwhile the original work in Tahiti had been taken over by missionaries of the Paris Society, though the last London Missionary Society agent did not leave that group till 1890. In 1861 Patteson was consecrated bishop of Melanesia, and the Auckland training school was removed to Norfolk Island. By arrangement with the Presbyterians the area of the mission includes the Northern New Hebrides, Banks, Torres, Santa Cruz and Solomon Islands. Patteson was murdered in 1871, a victim of the mistrust engendered in the natives by kidnapping traders. In 1877 John Selwyn was consecrated bishop. Wesleyan native evangelists from Fiji and Tonga carried Christianity in 1875 to the Bismarck Archipelago.

The solitary worker (W. P. Crook) on the Marquesas did not remain long, and after he went nothing was done till 1833–1834, when first some American and then some English missionaries arrived, but met with scant success and gave it up in 1841. Since 1854 teachers from the Hawaiian Islands have worked in the Marquesas, but results here have been less fruitful than anywhere else in the South Seas. In Hawaii itself much was accomplished by American missionaries, the first of whom were H. Bingham and A. Thurston (1820), and the most successful, Titus Coan, under whose leadership over 20,000 people were received into the churches between 1836 and 1839. Under the reign of Kalakaua (1874–1891) there was a strong reaction towards heathenism, but since the annexation of the islands by the United States of America the various churches of that land have taken up the task of evangelization and consolidation.

In the Micronesian Islands, while animism and tabu were strong, there was not the cannibalism of the southern islands. Work was begun in the Caroline Isles in 1852 and in time spread to the Gilbert and Marshall groups. In the Carolines and Marshalls it has now largely passed to German missionaries, the Americans having enough to do in the Philippines, where there are already over 27,000 Protestants.

The outstanding features of missionary work in the South Seas are (1) its remarkable success: cannibalism, human sacrifice and infanticide have been suppressed, civilization and trade have marvellously advanced; (2) the evangelical devotion of the natives themselves; (3) the need of continued European supervision, the natives being still in many ways little better than grown-up children.

Africa.[1]—In Africa, as in the South Seas, mission work has gone hand in hand with geographical discovery. It is in every sense a modern field, or rather a collection of fields, varying in physical, racial, social and linguistic character. The unaccustomed conditions of life and the fatal influence of the climate have claimed as many victims here as did savagery in the Pacific

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[1] See F. P. Noble, *The Redemption of Africa*; J. Stewart, *Dawn in the Dark Continent*; Sir Harry Johnston, "The Negro and Religion" in *Nineteenth Century*, June 1910.

Islands. The partition of the continent among the various European nations has been on the whole favourable to mission work. The nature of the task and of the results may be best approached by considering the different divisions—North, South, East, West and Central Africa.

North Africa, along the Mediterranean from Morocco to Egypt, is distinctly Mahommedan. To these regions came St Louis and Raimon Lull, and one may in passing remember the strength of Christianity in Proconsular Africa in the days of Tertullian and Cyprian, and in Egypt under Clement of Alexandria, Origen and Athanasius. To-day Islam is supreme, though the North Africa Mission, working largely on medical lines, has penetrated into many cities. In Egypt the United Presbyterians of America have met with considerable success among the Copts, and their fine educational work has proved a valuable asset both to themselves and the country. The Church Missionary Society is doing steady work in Cairo and in Upper Egypt. In the Eastern Sudan a promising beginning has been made, but the regions south of Kordofan have hardly been touched. In Nigeria the Hausa tribes are coming to be better known, and to respond to the Christian teaching. In the Sahara and at Suakin there are Roman Catholic missions. There is a Roman mission to the Gallas in Abyssinia. That country has its own crude form of Christianity, and is much the same today as when Peter Heiling in the 17th century endeavoured to propagate a purer faith. A mission undertaken by the Church Missionary Society in 1830 was closed by French Jesuit intrigue in 1838.

South Africa.—The Moravians, represented by George Schmidt, who arrived at Cape Town in July 1737, were the first to undertake mission work in South Africa. Schmidt won the confidence of the Hottentots, but the Dutch authorities stopped his work. In 1798 John T. Vanderkemp, an agent of the London Missionary Society, founded a mission to the Kaffirs east of Cape Town, and Robert Moffat (1818) went to the Bechuanas. David Livingstone was as determined to open the interior as the Boers were to keep it shut, and he succeeded, pushing north, discovering Lake Ngami, and consecrating a remarkable life to the evangelization of Central Africa. The London Mission has also largely evangelized the Matabele. In 1814 the Wesleyans began work among the Namaquas and Hottentots, and afterwards went into Kaffraria, Bechuanaland and Natal. They were followed by the Glasgow Missionary Society (1821), the Paris Evangelical Society (1829), the Moravian, Rhenish and Berlin Societies, and the American Board. The Society for the Propagation of the Gospel came in 1819, mainly for colonists, the Church Missionary Society in 1837. The province of South Africa has ten dioceses, the bishop of Cape Town being metropolitan. The Glasgow Society's work was ultimately taken over by the Free Church of Scotland, whose great achievement is the Lovedale Institute, combining industrial and mission work. The Germans and Scandinavians have also been ardent workers in South Africa, and the Dutch Reformed Church has not entirely neglected the natives. One Dutch society gives its attention to the northern part of the Transvaal. The chief difficulties in the way of evangelization have been (1) the hostility of natives races aroused by European annexations, (2) the introduction of European vices, (3) the movement known as Ethiopianism. The British Wesleyans refused to confer full rights on negro pastors, who then appealed to the African Methodist Episcopal Church, a product of American evangelization. One of them, J. M. Dwane, was made Vicar-Bishop, and a large and powerful independent negro church organized. Dwane afterwards approached the Anglicans, and in 1900 that church formed the "Ethiopian Order," ordaining Dwane a deacon and making him Provincial of the Order. Each bishop now deals with the Ethiopians in his own diocese. The South African governments foresaw dangerous developments in the Ethiopian movement, and steps were taken to restrain its growth. Ethiopianism, if ecclesiastical in its origin, gained strength from racial base. The task of averting the racial bitterness so dominant in the United States of America is a most formidable one. There are in South Africa several vicariates and prefectures of the Roman Church, the principal missions being French, those of the Congregation of the Holy Ghost and the Oblates of Mary.

West Africa was first visited by the Society for the Propagation of the Gospel in 1752. Its agent, T. Thompson, trained Philip Quaque, said to be "the first convert who ever received ordination since the Reformation in the Reformed Church." The Church Missionary Society came in 1804 and has worked heroically and successfully, though the largest mission now is that of the Wesleyans, who came in 1811, settling first at Sierra Leone. The American Baptists in Liberia (1821) and the Basel Mission in the Gold Coast (1827), the Congregationalists of the United States of America and Canada in Angola, and the English and American Baptists on the Congo (since 1875) have also extensive and prospering agencies. West Africa has taken heavy toll not only in money but in life, but the lesson has now been learned, and a system of frequent furloughs combined with a better understanding of the climatic requirements have appreciably lessened the peril. This region is linked with the name of the Anglican negro Bishop, Samuel Crowther, and with one phase of the ceaseless strength of Islam, which has so far failed to reach the west coast, finding itself confronted by the Christian influences which are at work among the great Hausa tribes and other peoples within the area of the Niger mission. The Portuguese in Angola and the agents of King Leopold in the Congo State have not been conspicuous friends of missionary enterprise, and the light-hearted childishness of the native character, so well portrayed in Miss Kingsley's writings, shows how difficult it is to build up a strong and stable Christian church. Bishop Taylor's effort at creating a self-supporting mission proved fruitless. The American Lutherans are attempting the same task on rather different lines, and with more promise. The Roman Catholic missions are chiefly French, and organized by the Congregation of the Holy Ghost and the Lyons African Mission.

Central Africa.—The upper Congo region opened up by Livingstone and Stanley has been a favourite sphere for what are known as "faith societies," *e.g.* the Plymouth Brethren, the Christian and Missionary Alliance, the Regions Beyond Missionary Union. The American Baptists continue the work started by the Livingstone Inland Mission in 1878, and the Southern Presbyterian Board (American) have done notable work. The Paris Society, represented especially by François Coillard, has been successful along the Zambezi, and Scottish, German, Moravian and Jesuit agencies are also well represented. Northward, Central and East African organizations, following the Cape to Cairo route, are in touch with North African agencies working up the Nile.

East Africa.—When the Abyssinia mission was closed in 1838 one of the missionaries, Krapf, went among the Gallas and then on to Mombasa, working in company with Rebmann. Since H. M. Stanley's appeal (1875) most satisfactory work, extensive and intensive, has been accomplished in Uganda, by the Church Missionary Society. The names of Mackay, Hannington and Pilkington, who lived and died here, are amongst the greatest in the roll of missionary heroes. The Roman Mission too has been very successful; for some years a French agency, the White Fathers of Algeria, carried it on, but they were afterwards joined by English helpers from St Joseph's Society at Mill Hill. The White Fathers also work in the Great Lakes region, and on the Zanzibar coast are the French Congregation of the Holy Ghost and German Benedictines. Zanzibar is also one of the centres of the Universities Mission, another being Likoma on Lake Nyasa. Near this lake the Scottish churches are also doing noble work. Besides Uganda the Church Missionary Society is responsible for Mombasa. The London Mission is meeting with success at the south end of Lake Tanganyika in North-east Rhodesia. The English United Methodists and some Swedish societies have begun work among the Gallas. German Missionary agencies have also come in with German colonization. In East Africa, as in the West, Christian missionaries fear most the aggressive Moslem propaganda.

Madagascar[1] is one of the most interesting mission fields. Work was begun by the London Mission in 1819, and the work of civilization and evangelization went steadily forward till 1835, when a period of repression and severe persecution set in, which lasted till 1861. When the work was recommenced it was found that the native Christians had multiplied and developed during the harsh treatment of the 25 years. In 1869 the idols were publicly destroyed and the island declared Christian by royal proclamation. The Society for the Propagation of the Gospel (1864), the Norwegian Missionary Society (1866), and the Friends' Foreign Missionary Association joined in the work, the prosperity of which received a severe check by the French annexation in 1896. The French authorities were hostile to the English missionaries, and even the handing over of part of the field to the Paris Evangelical Society did not do much to ease the situation. Laws were first enacted against private schools, then against elementary schools, and in 1906–1907 measures were passed which practically closed all mission schools. Family prayers were forbidden if any outside the immediate family were present, and religious services at the graveside were prohibited. Missionary work in the island has thus passed through a peculiarly trying experience, but happier conditions are now likely to prevail. In Mauritius and the Seychelles the Church Missionary Society and the Society for the Propagation of the Gospel are at work, especially among the coolies on the sugar plantations.

The outstanding problem of African missions at least north of the Equator (south there is the Ethiopian question) is not the degradation of the black races, nor the demoralizing influences of heathen Christians, nor even the slave dealer, though all these obstacles are present and powerful. The all-decisive conflict is that between Christianity and Islam, and the Christian agencies must show much more co-operation if they are to be successful. The lines of missionary work have been, generally speaking, simple gospel preaching followed by education and industrial work. So rare were the ordinary comforts, and even necessities of life, that the latter had to take a prominent place from the beginning: the missionary had to be farmer, carpenter, brickmaker, tailor, printer, house and church builder, not only for himself but for his converts. The work of Bible translation has been particularly long and difficult; for the innumerable peoples who did not speak some form of Arabic the languages had first to be reduced to writing, and many Christian terms had to be coined.

India.[2]—The earliest missionaries to India, with the possible exception of Pantaenus of Alexandria (*c.* A.D. 180), were the Nestorians from Persia. The record of their work is told elsewhere (see NESTORIUS and NESTORIANS). The Jesuits came in the 16th century, but were more successful quantitatively than qualitatively; in the 18th century the Danish coast mission on the coast of Tranquebar made the first Protestant advance, Bartholomäus, Ziegenbalg (1683–1719), Plutschau and Christian Friedrich Schwartz (1726–1798) being its great names. Up to this time the chief results were that (1) Christianity had gained a footing, (2) it had continued the monotheistic modification of Indian thought begun by Mahommedanism, and (3) the futility of sporadic and fanatical proselytism had been shown. A new era began with the arrival of William Carey and the founding of the Serampur Mission (15 m. north of Calcutta), though the hostility of the East India Company made the early years of the 19th century very unproductive. When Carey died in 1834 he and his colleagues Marshman and Ward had translated the Bible into seven languages, and the New Testament into 23 more, besides rendering services of the highest kind to literature, science and general progress. They founded agricultural societies and savings' banks, and helped to abolish suttee, infanticide and other cruelties. At Travancore in the south, Ringeltaube, an agent of the London Missionary Society, had begun a work, especially among the Shanars or toddy drawers, which by 1840 had 15,000 Christians; and the Church Missionary Society, led by Rhenius, had equal success in Tinnevelly. The Baptists, drawn by the fame of the temple of Jagannath at Puri on the east coast, established a mission in Orissa in 1821 which soon bore fruit; the Wesleyans were in Ceylon, Mysore and the Kaveri valley, the London Missionary Society at the great military centres Madras, Bangalore and Bellary, agents of the American Board at Ahmednagar and other parts of the Mahratta country around Bombay. The headquarters of Hinduism, the Ganges valley, was occupied by the Baptists, the Church Missionary Society and the London Missionary Society, these entering Benares in 1816, 1818 and 1820 respectively. Alexander Duff, a Scottish Presbyterian, had begun his great educational work in Calcutta, and Bible tract and book societies were springing up everywhere. Chaplains and bishops of the Anglican Church like James Hough in Tinnevelly, Henry Martyn in the north, Daniel Corrie in Agra, T. F. Middleton in Calcutta, and Reginald Heber all over India, were eagerly using their opportunities. In 1830 ten societies with 106 stations and 147 agents were at work; 1834 saw the founding of the Basel Mission on the west coast, the American Mission in Madura, the American Presbyterian Mission in Ludhiana. It would be impossible to trace in detail the work done by the different societies since Carey's time. The task as it presented itself may be analysed as follows: (1) to replace the caste system and especially the oppressive supremacy of the Brahmins by a spirit of universal brotherhood and the establishment of social and religious liberty; (2) to correct and raise the standard of conduct; (3) to attack polytheistic idolatry with its attendant immoralities; (4) to replace the pantheistic by a theistic standpoint; (5) to elevate woman and the pariah. Besides these matters which concerned Hinduism there was the problem of converting sixty million Mahommedans. The chief methods adopted have been the following: (1) vernacular preaching in the large towns and on itineraries through the rural districts, a work in which native evangelists guided by Europeans and Americans played a large part. (2) Medical missions, which have done much to break down barriers of prejudice, especially in Kashmir under Dr Elmslie of the Church Missionary Society, and in Rajputana at Jaipur under Dr Valentine of the United Presbyterians. (3) Orphanages, in which the Roman Catholics led the way and have maintained their lead. (4) Vernacular schools, a good example of which is seen in the American Board's Madura Mission. (5) English education, in which the missionary societies have amply supplemented the efforts of the government, outstanding examples being the Madras Christian College (Free Church of Scotland), so long connected with the name of Dr William Miller, the General Assembly of Scotland's Institution at Calcutta, founded by Duff, Wilson College, Bombay (Free Church of Scotland), and St Joseph's College (Roman Catholic) at Trichinopoly. Work of this kind is followed up in some centres by lectures and conversations with educated Hindus. The Haskell Lectureship, which grew out of the Parliament of Religions in Chicago, belongs here. (6) Female education and zenana work. (7) Uplifting work among the Panchamas or low-castes, which has been strikingly successful among the Malas (American Baptists) and the Madigas (London Missionary Society) of the Telugu-speaking country, who come in mass movements to the Christian faith. (8) Missions among aboriginal tribes, *e.g.* the Kols and Santals of Chota Nagpur (Berlin Gossner Mission and the Society for the Propagation of the Gospel), and the tribes of the Khassia Mountains east of Bengal (Welsh Calvinistic Methodists) (9) Christian literature, in which connexion the name of Dr John Murdoch will always be honourably remembered. (10) Pastoral work and the care of the churches.

The great changes that have been wrought in India, politically, commercially, intellectually and religiously, by the combined action of the British government and the Christian missions, are evidenced among other tokens by the growth of such societies as the Arya Samaj and the Brahmo Samaj. Orthodox Hindus, especially those whose social status and very livelihood are imperilled by the revolution, have shown their alarm either by open opposition, subjecting converts to every sort of caste coercion, or by methods of defence, *e.g.* Hindu tract societies and young men's associations, which are modelled on

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[1] See T. T. Matthews, *Thirty Years in Madagascar*.

[2] See E. P. Rice in *A Primer of Modern Missions*, ed. R. Lovett (London, 1896); J. Richter, *A History of Missions in India* (1908); *The Church Missionary Review* (July 1908); *Contemporary Review* (May 1908 and June 1910).

Christian organizations. A counter reformation can also be traced which attempts to revive Hinduism by purging it of its grossness and allegorizing its fables and legends. A new Islam is also a factor of the situation. Comparatively few converts have been made from Mahommedanism to Christianity, and these have been chiefly among the learned. But there is a wide prevalence of free-thinking, especially among the younger and educated classes of the community.

The special difficulties of mission work in India may be thus summarized. (1) Racial antipathy. (2) The speculative rather than experimental and practical nature of the Hindu consciousness—historical proofs make no appeal to him. (3) The lack of initiative: in a land where the joint family system is everywhere and all powerful, individualism and will-power are at a discount. (4) The ignorance and conservatism of the women. (5) An inadequate sense of sin. (6) The introduction of European forms of materialism and anti-Christian philosophy. Perhaps, too, the methods adopted by missionaries have not always been the wisest, and they have sometimes failed to remember the method of their Master, who came "not to destroy, but to fulfil." In spite, however, of all the difficulties, permanent and increasing results have been achieved along all the lines indicated above. The establishment of a strong native church is far from being the only fruit of the enterprise, but it is a fruit that can be gauged by statistics, and these are sufficiently striking. In a necessarily inadequate sketch it is impossible to give more than the barest mention to one or two other features of modern missionary achievement in India, *e.g.* the development of industrial schools, the establishment of a South India United Church, in which the Congregationalist agencies (London Missionary Society and American Board) and the Presbyterians have joined forces, and the endeavour to train an efficient and educated native ministry, which is being promoted especially at Serampur, where an old Danish degree-granting charter has been revived in what should become a Christian university, and at Bangalore, where Presbyterians, Congregationalists and Wesleyans collaborate to staff and maintain a united theological college. The government census for India and Burma (1901) gives a Christian population of 2,923,241 (native Christians 2,664,313) out of a total population of 294,361,056, or about 3%. The inclusion of Portuguese and French possessions would add about 350,000 to the Christian total. Though the number does not seem relatively high, it is significant when compared with that of former censuses—in 1872, 1,517,997; in 1881, 1,862,525 (increase 22·7%); in 1891, 2,284,380 (increase 22·6%); in 1901, 2,923,241 (increase of 28%). The increase of 28% between 1891 and 1901 has often been compared with the fact that the total population of India only registered an increase of 2½% in that decade. In the words of *The Pioneer*, "this is a hard fact which cannot be explained away", and "the most remarkable feature of the returns." The increase was shared by every province and state in India. In 1910 there were 4614 missionaries (including wives), representing 122 societies, 1272 Indian ministers, and 34,095 other native workers, including teachers and Bible-women.

The growth of the Protestant Native Christian community between 1851 and 1910 is shown in the following table:—

	Native Christian Community.		Communicants.			Native Agents.	
	Number.	Rate of Increase.	Number.	Rate of Increase.	Proportion of the Community.	Ordained.	Unordained Preachers.
		%		%	%		
1851	91,092	—	14,661	—	16·0	21	493
1861	138,731	52·3	24,976	70·3	18·0	97	1266
1871	224,258	61·6	52,816	111·4	23·5	225	1985
1881	417,372	86·1	113,325	114·5	27·1	461	2488
1890	559,661	34·0	182,722	61·2	32·6	797	3491
1900	854,867	52·8	301,699	65·1	35·3	—	—
1910	1,472,448	72·2	522,743	73·3	—	1,272	—

The Protestant community in India in 1910 was over a million strong, well distributed among the chief provinces, a fine spiritual force, easily first in female education, and rapidly growing in wealth, position and influence. A recent report of the Director of Public Instruction for the Madras Presidency says: "I have frequently called attention to the educational progress of the native Christian community. There can be no question, if the community pursues with steadiness the present policy of its teachers, that in the course of a generation it will have secured a preponderating position in all the great professions."

What India wants (as Nobili 300 years ago saw, and attempted, though by fatal methods of deceit, to supply) is a Christianity not foreign but native, not dissociated from the religious life of the land but its fulfilment. Though there are many Christians in India to-day, the Hindu still looks askance at Christianity, not because it is a religion but because it is foreign. "India is waiting for her own divinely appointed apostle, who, whether Brahmin or non-Brahmin, shall connect Christianity with India's religious past, and present it as the true Vedanta or completion of the Veda and thus make it capable of appealing to the Hindu religious nature."

It only remains to be said that the work of the missionaries individually and collectively has over and over again received the warmest recognition and praise from the highest officials of the Indian government.

China.[1]—The earliest Christian missionaries to China, as to India, were the Nestorians (*q.v.*). Their work and that of the Roman Church, begun as the result of Marco Polo's travels about 1290, faded away under the persecution of the Ming dynasty which came to power about 1350. The next attempt was that of the French Jesuits, following on the visit and death of Xavier. They established themselves at Canton in 1582, and on the accession of the Manchu dynasty (1644) advanced rapidly. In 1685 there were three dioceses, Peking, Nanking and Macao, with a hundred churches. The Orthodox Eastern Church gained a footing in Peking in the same year, and established a college of Greek priests. Friction between Jesuits and Dominicans led to the proscription of Christianity by the emperor in 1724, missionaries and converts being banished. The story of modern missions in China begins with Robert Morrison (*q.v.*) of the London Missionary Society, who reached Canton in 1807, and not being allowed to reside in China entered the service of the East India Company. In 1813 he was joined by a colleague, William Milne, and in 1814 baptized his first convert. In 1829 came representatives of the American Board, in 1836 Peter Parker began his medical mission, and on the opening of the Treaty Ports the old edicts were withdrawn, and other societies crowded in to a field more than ample. After the war of 1856 a measure of official toleration was obtained, and the task of evangelizing the country was fairly begun. Though the missionaries were chiefly concentrated in the treaty ports they gradually pushed inland, and here the names of W. C. Burns, a Scottish evangelist, J. Hudson Taylor, the founder of the China Inland Mission, and James Gilmour, the apostle of Mongolia, are pre-eminent. But for more than half a century China seemed the most hopeless of mission fields. The upper classes were especially anti-foreign, and the whole nation vaunted its superiority to the rest of mankind. In 1857 there were only about 400 baptized Protestant Christians in the whole of China. Even after the removal of the edicts the old prejudices remained, and the missionaries were regarded as political emissaries, the forerunners of military aggression. Native Christians were stigmatized as traitors, "followers of the foreign devils." In 1870 there was a great outbreak concentrating in the massacres at Hankow and Tientsin; in 1891 at Hunan and in 1895 at Ku Cheng there were other attacks which were only preliminary to the Boxer uprising of 1899–1900, when 135 missionaries, besides 52 children and perhaps 16,000 native Christians, whose heroism will always be memorable, perished, often after horrible tortures. There is little doubt that this savage outburst was directed not against religious teaching as such, but against the introduction of customs and ideas which tended to weaken the old power of the mandarins over the people. These leaders skilfully seized upon every breach of tradition to inflame popular passion, attacking especially the medical work as a pretext for mutilation, the schools as hotbeds of vice, and the orphanages as furnishing material for witchcraft. Out of the agony, however, a new China was born. The growing power of Japan, seen in her wars with China and Russia, and the impotence of the Boxers against the European allies, made all classes in China realize their comparative impotence, and the central government began a series of reforms, reorganizing the military, educational, fiscal and political systems on Western lines. Educational reforms became especially insistent, and modern methods and studies supplanted the immemorial Confucian type. Students went in great numbers to Japan, Europe and America, and the old contempt and hostility toward things Western gave place to respect and friendliness. Early in the 19th century the missionaries had not been able to do much by way of education, but the new openings were seized with such power as was possible, and while in 1876 there were 289 mission schools with 4909 pupils, in 1910 there were 3129 schools with 79,823 scholars. More significant still is the way in which the foremost Chinese officials have turned to missionaries like Timothy Richard and Griffith John for assistance in guiding the new impulse. The universities of Oxford and Cambridge, under the inspiration of Lord William Cecil, were interesting themselves in 1910 in a scheme for establishing a Christian university in China.

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[1] See A. H. Smith, *Chinese Characteristics*; *Village Life in China*; and J. C. Gibson, *Mission Problems and Mission Methods in South China*.

One of Morrison's contemporaries hoped that after a century of mission work there might possibly be 2000 Christians in China. That number was reached in 1865, and in 1910 there was a Protestant community of 214,546 church members and baptized Christians. These numbers are more than double what they were in 1900. In addition there are more than as many adherents.[1] The excellence of the converts, upon the whole, is testified to by travellers who really know the case; particularly by Mrs Bishop, who speaks of the "raw material" out of which they are made as "the best stuff in Asia." The total number of Protestant missionaries (including wives) in China in 1910 was 4175, one to about 1100 sq. m., or to more than 100,000 Chinese. There are over 12,000 Chinese evangelists, Bible-women, teachers, &c. The Roman Catholic returns give 902,478 members and 390,617 catechumens. The work is carried on by eleven societies or religious orders with over 40 bishops and 1000 European priests, mostly French. A large feature of the work is the baptism of children. An important concession was obtained in 1899 by the French minister at Peking, with a view to the more effective protection of the Roman missions. The bishops were declared "equal in rank to the viceroys and governors," and the priests "to the prefects of the first and second class"; and their influence and authority were to correspond. The Anglican bishops agreed to decline these secular powers, as also did the heads of other Protestant missions. It is alleged by some that the exercise of the powers gained by the Roman hierarchy was one cause of the Boxer outbreaks. Certainly their native adherents had their full share of persecution and massacre.

The Anglican Church is not so strong in China as in some other fields; the American Episcopalians were first in the field in 1835, followed by the Church Missionary Society (in 1844), which has had stirring success in Fu-Kien, and the Society for the Propagation of the Gospel in 1874. There are five dioceses, and in 1897 an episcopal conference was held in Shanghai. Since the Japanese War the Scottish and Irish Presbyterians have made wonderful progress in Manchuria; native evangelists do an increasing share of the work, and there is hardly any town or village without Christians. The London Mission has always been conspicuous for the contribution made by its agents to linguistic and literary knowledge, the name of James Legge being an outstanding example; it is now, in co-operation with other societies, earnestly taking up the new educational and medical openings. One of the most interesting features of missionary work in China is the comity that prevails among the workers of different societies and agencies. Thus in 1907 at the Centenary Conference in Shanghai, when many topics were discussed centring in the question of the native Chinese Church, a general declaration of faith and purpose was adopted, which, after setting out the things held in common, proceeded, "We frankly recognize that we differ as to methods of administration and of church government; that some among us differ from others as to the administration of baptism; and that there are some differences as to the statement of the doctrine of predestination, or the election of grace. But we unite in holding that these exceptions do not invalidate the assertion of our real unity in our common witness to the Gospel of the Grace of God." The conference reported, "We have quite as much reason to be encouraged by the net result of the progress of Christianity in China during the 19th century as the early Christians had with the progress of the Gospel in the Roman Empire during the first century."

Japan and Korea.—The Christian faith was brought to Japan by Portuguese traders in 1542, followed by Xavier in 1549. This great missionary was well received by the daimios (feudal lords), and though he remained only 2½ years, with the help of a Japanese whom he had converted at Malacca he organized many congregations. In 1581 there were 200 churches and 150,000 Christians; ten years later the converts numbered 600,000, in 1594 a million and a half. Then came a time of repression and persecution under Iyeyasu, whose second edict in 1614 condemned every foreigner to death, forbade the entry of foreigners and the return of Japanese who had left the islands, and extinguished Christianity by fire and sword. The reopening of the country came in 1859, largely through American pressure, and in May of that year two agents of the Protestant Episcopal Church began work at Nagasaki. They were followed by others from the Presbyterian and Reformed Churches, and by their great intellectual ability, patience and tact these pioneers (S. R. Brown, J. C. Hepburn and G. F. Verbeck), as the Marquis Ito said, contributed very largely to the progress and development of Japan in the days when she was first studying the outer world. They did an immense amount of preparatory work along evangelistic, medical and educational lines, and skilfully gathered the youths of the country around them. The accession of a new mikado in 1868 finally ended the old seclusion; financiers, engineers, artisans poured in from Western Europe, and from America came bands of teachers, largely under missionary influence. In 1869 the American Board (Congregational) sent its first band; in 1870 Verbeck was called on to organize a scheme for national education. In 1872 the first Japanese church was formed; in 1875 Joseph Neesima, who had been converted by a Russian missionary and then educated in America, founded a Christian Japanese College, the Doshisha, in the sacred city of Kyoto. Meanwhile the Christian calendar had been adopted and the old anti-Christian edicts removed. By 1889 there were 30,000 Protestant communicants. It was at this time that the nation, conscious of its new life, began to be restive under the supercilious attitude of foreign nations, and the feeling of irritation was shared by the native Christian communities. It showed itself in a desire to throw off the governance of the missionaries, in a criticism of Protestant creeds as not adapted to Japanese needs, and in a slackened growth numerically and intensively. After a period of stress and uncertainty, due very largely to the variety of denominational creed and polity, matters assumed an easier condition, the missionaries recognizing the national characteristics and aiming at guidance rather than control. The war with China in 1894 marked a new chapter and initiated a time of intense national activity; education and work for women went forward rapidly. Missionaries went through the island as never before, and their evangelistic work was built upon by Japanese ministers. In the war with Russia Japanese Christianity found a new opportunity; on the battlefield, in the camp, at home, Christian men were pre-eminent. In 1902 there were 50,000 church members; in 1910, 67,043; the total Protestant community in 1910 was about 100,000, and had an influence out of all proportion to its numbers; the Roman Church was estimated at 79,000, and the Orthodox Eastern Church (Russian) at 30,000.

No sketch, however brief, can omit a reference to the Anglican bishop of South Tōkyō, Edward Bickersteth (1850–1897), who from his appointment in 1886 guided the joint movement of English and American Episcopalians which issued in the Nippon Sei Kokwai or Holy Catholic Church of Japan, a national church with its own laws and its own missions in Formosa. In April 1907 the Conference of the World's Student Christian Federation (700 students from 25 different countries) met in Tōkyō, and received a notable welcome from the national leaders in administration, education and religion.

In Korea, the "Hermit Nation," or as the Koreans prefer to say, "The Land of the Morning Calm," Christianity was introduced at the end of the 18th century by some members of the Korean legation at Pekin who had met Roman Catholic missionaries. It took root and spread in spite of opposition until 1864, when an anti-foreign outbreak exterminated it. The door was re-opened by the treaties of 1882–1886, and even before that copies of the gospels had been circulated from the Manchuria side. The Methodist Episcopal Church and the Presbyterian Board, both of America, entered the country in 1885, and were soon joined by similar agencies from Canada and Australia. The Anglican Church began work in 1890, the work was thoroughly planned, the characteristics of the people were carefully considered, and the successes and failures of other mission-fields were studied as a guide to method. The medical work won the favour of the government, and so wisely did the missionaries act, that during all the turbulent changes since 1884 they escaped entanglement in the political disturbances and yet held the confidence of the people. The persistence and growth of Christianity among the Koreans is largely due to the fact that Christianity had not been superimposed on them as a foreign organization. They had built their own churches and schools, adopted their own forms of worship and phrased their own beliefs. Korea vies with Uganda as a triumph of modern missionary enterprise. In 1866 there were not more than 100 Christians; official returns in 1910 show 178,686 Protestants, including 72,000 church members and probationers; and 72,290 Roman Catholics. Theological colleges, normal training colleges and higher and lower grade schools bear witness to an activity and a success which are truly remarkable.

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[1] See *Contemporary Review* (Feb. 1908), "Report on Christian Missions in China," by Mr F. W. Fox, Professor Macalister and Sir Alex. Simpson.

South-East Asia and the East Indies.—The work of Christian missions in this area has had the double advantage of freedom from political and social unrest, and of comparatively little overlapping, each country as a rule being taken over by a single society. In Burma the American Baptists, whose work began with Adoniram Judson in 1813, are conspicuous, and have had marked success among the Karens or peasant class, where the pioneer was George Dana Boardman (1827). The Karen Christian communities are strong numerically and have a good name for self-support. The Baptists have also stations in Arakan and Assam where they link up with the Welsh Calvinistic Methodists (1845). The Society for the Propagation of the Gospel and the Methodist Episcopal Church work in and around Rangoon. In Siam again the Americans, especially the Presbyterians, have been most prominent. Medical work made an impression on the people and won the favour of the government, which has always been cordial and has employed missionaries as court-tutors. Buddhism is at its best at Siam, and this and the enervating climate are responsible for the comparatively small direct success of Christian propaganda in Siam proper. In the Laos country to the north, however, much more has been done, and a healthy type of Christian community established. Native workers have done something to carry the Gospel into the French colonies of Tongking and Annam. Here the Roman missions are very extensive, and have over a million adherents, despite violent persecution before the French occupation.

The peninsula and archipelago known as *Malaysia* presents a remarkable mingling of races, languages and beliefs. Tatar, Mahommedan and Hindu invasions all preceded the Portuguese who brought Roman Catholicism, and the Dutch who brought Protestantism. This last resulted in a great number of nominal conversions, as baptism was the passport to government favour, and church membership was based on the learning of the Decalogue and the Lord's Prayer, and on the saying of grace at mealtimes. In the Straits Settlement the foundations of modern missionary effort were laid by the London Missionary Society pioneers who were waiting to get into China; they were succeeded by the Society for the Propagation of the Gospel (1856), English Presbyterians (1875), Methodist Episcopalians (1884), who have a fine Anglo-Chinese College at Singapore, and the Church of England Zenana Society (1900).

In the *Archipelago* most of the work has naturally been in the hands of the Netherlands Missionary Society (1812) and other Dutch agencies, who at first were not encouraged by the colonial government, but have since done well, especially in the Minahassa district of Celebes (150,000 members) and among the Bataks of Sumatra (Rhenish Mission). In Celebes and the Moluccas the work is now under the Colonial State Church. In Java the government has favoured Mahommedans (there is active intercourse between the island and Mecca), but there are some 25,000 Christians and a training school and seminary at Depok near Batavia. In Dutch Borneo the Rhenish Society is slowly making headway among the Dyaks; in British Borneo the Society for the Propagation of the Gospel (1848) and the Methodist Episcopalians occupy the field. The total number of Christians in British Malaysia and the Dutch East Indies is about 600,000 (including 57,000 Roman Catholics).

Western Asia and the Turkish Empire.[1]—The American Presbyterians and Congregationalists have the largest Protestant missions in these lands, working, however, mainly for the enlightenment and education of the Oriental Christians. With the same object, though on different lines, the archbishop of Canterbury's Assyrian Mission seeks to influence the Nestorians. The Roman Catholics have extensive missions in these countries, directed at winning adherents to the unity of the Holy See from the Oriental Churches, which are regarded as schismatic and heretical. In this enterprise there has been great advance in Egypt among the Copts, and in 1899 the Pope signalized "the resurrection of the Church of Alexandria" by appointing a Patriarch for Egypt, Libya and Nubia. Farther east, on the borders of Turkey and Persia, the Roman and Russo-Greek Churches compete for the adhesion of the Nestorians, Chaldeans and Armenians. The Franciscans, Dominicans, Lazarists and Jesuits are engaged in all these works. Direct work among Mahommedans is done, though with small result, by the North Africa Mission (non-denominational) and the Church Missionary Society. The Egypt, Palestine and Persia missions of the latter society have been largely reinforced and extended since 1884, medical work and women's work being especially prominent. Four cities in southern Persia are now occupied. Three missions just touch the border of *Arabia*, viz. the United Free Church of Scotland at Aden, founded by Ion Keith-Falconer (1856–1887) son of the 9th earl of Kintore and Arabic professor at Cambridge; an American Presbyterian Mission on the Persian Gulf; and the Church Missionary Society's Mission at Bagdad. The American Robert College at Constantinople and the work of the Friends' Missionary Association in Syria are honourable and successful enterprises. The chief difficulties have been (1) the antagonism of the officials of the Oriental churches, (2) the suspicion and hostility of Islam, (3) the jealousies, religious and political, connected with the Eastern Question.

Missions in Christian Lands.—Australia has been referred to already (see *South Seas*, above). In the Western Hemisphere we may distinguish the following: (1) *Early Roman Missions* began with the discovery of the continent and practically ceased in the middle of the 18th century. Conspicuous among their achievements was the conversion of Mexico, 200,000 converts being enrolled within six years after the capture of the capital (1521), and a million baptized by the Franciscans alone within thirty years. In South America the passive character of the population made them submissive alike to the Spanish government and the Roman faith. Their natural devotion and their susceptibility to pomp and ritual was a factor skilfully used by the priests, but hardly anything was done to strengthen their moral power. The influx of base European strata helped to reduce the whole continent south of Mexico in about a century to a level as low as that preceding the first mission. About 1600 the Franciscans and French Jesuits began their work in North America and among the Indians did a successful work marked by much heroism. They also enabled the Roman Church to keep its hold on the French colonists of Quebec and Montreal, and were pioneers in California. (2) *Modern Missions in North America.*—Missions among the Red Indian tribes in the North-West Territories of both the United States and Canada have long been carried on by several societies. The first workers were Thomas Mayhew, junior and John Eliot at Martha's Vineyard (1643) and Roxbury (1646). Bishop Whipple of Minnesota was justly called the Apostle of the Indians, so far as the work of the American Episcopal Church was concerned. In the Canadian North-West the Church Missionary Society's Missions have reached many tribes up to the shores of the Polar sea, and made some thousands of converts. Even the wandering Eskimos, thanks to the Moravians, are mainly Christians. The Anglican Church has nine dioceses in the province of Rupert's Land. The Roman Catholic missionaries also are scattered over these immense territories, and have a large number of Indian adherents. Besides the Oblates many are Jesuits from French Canada. The Russo-Greek Church has a mission in Alaska, dating from the time when it was Russian territory, and various American societies are also represented. The total number of Indians in British North America is 99,000, of whom about 27,000 are still pagan, and the rest are about equally divided between the Protestant and Roman Catholic Missions. (3) *Central and South America.*—Protestant missions to Indians here have been very limited. Von Weltz did something in Dutch Guiana (*c.* 1670), and the Moravians among the Arrawak Indians of Surinam (1738–1808). Since 1847 they have worked on the Mosquito coast of Central America. American Missions are at work in Mexico and adjacent countries. In the West India Islands the negro population has been reached by most of the larger British societies. The South American Missionary Society, founded by the ill-fated Captain Allen Gardiner, has much extended its work among the Indians of the interior of what has been well called "the Neglected Continent"; it has been specially successful among the Araucanians of Chile and the Paraguayan Chaco. Their work among the Fuegians drew a warm tribute from Charles Darwin. Several American missions are also at work. The Society for the Propagation of the Gospel has an important mission in British Guiana. But there are numerous heathen tribes never yet reached. The Roman Church, which is dominant throughout the continent, has been engaged in serious struggles with the anti-religious tendencies of the Republican governments, and *L'Année de l'Église* makes no mention of missions among the Indians. In fact the Pope in 1897 was obliged to send a severe rebuke to the clergy for their lack of consistency and zeal. Protestant societies have done much to bring the Bible to the knowledge of the nominally Roman Catholic population.

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[1] See J. Richter, *A History of Protestant Missions in the Near East* (1910).

RESULTS OF MISSIONS

The Christian Church bases its missionary enterprise upon the spirit, the example, and the commandment of its Founder, and regards the duty as just the same whether the results be large or small. It appeals to common sense, saying in effect, "If it be a fact that a Divine Person came into the world to bless mankind, all men ought to know it, and have a right to know it. However much or (if you will) little a Buddhist or a Moslem may *need* to know of Christ, he certainly has a *claim* to be told of Him. The responsibility, if there be any, of believing, rests with the individual told; the responsibility of telling him rests with the Christian Church." On this view of the matter, results, however desirable, are no certain test of a mission doing its work. A mission in Persia, with its handful of converts, has, on this view, as much right to support and appreciation as a mission in southern India with its tens of thousands. Again, on the hypothesis that Christianity is true, the statistics at a particular period are no test of success at all. For in them *the dead are not counted*; and the converts who are already dead are—at least in respect of individual salvation—the surest of results. If, however, we are to take statistical returns for what they are worth, it is estimated that the Christians in heathen lands gathered by Protestant missions probably amount to five millions, and a similar total may be ascribed to Roman Catholic missions, making ten millions in all. This, however, includes adherents still under instruction for baptism, and their children. The inner circle of communicant members is hardly more than one-third of the total.

Missions are however a far greater thing after all than simple proselytism. It would require many a volume to tell of what they have done for civilization, freedom, the exploration of unknown regions, the bringing to light of ancient literatures, the founding of the science of comparative religion, the broadening of the horizon of Christian thought in the homelands, and the bringing of distant peoples into the brotherhood of nations. These are results that cannot be put into figures. While it is true that very diverse opinions are held concerning missions, it is indisputable that the most favourable testimonies come from those who have really taken the most pains to examine and understand their work. The one discouraging feature, from the Christian point of view, is the backwardness of Christendom in its great enterprise. If the Churches did their foreign work with the same energy which they throw into their home work, the results would be very different.

I.—STATISTICS OF THE GREAT RELIGIONS OF THE WORLD.

(From *The Blue Book of Missions*, 1907).

	Christians.			Jews.	Mohammedans.	Buddhists.	Hindus.	Confucianists and Taoists.	Shintoists.	Animists, Fetishists, &c.	Unclassed.	Totals.
	Protestants.	Roman Catholics.	Eastern Churches.									
Africa	2,665,000	2,493,000	3,799,000	381,000	50,810,000	11,000	277,000	31,000	—	97,179,500	125,500	157,722,000
America, N.	64,488,000	36,693,000	1,000,000	1,069,000	15,000	5,000	94,000	85.00	—	20,000	8,002,000	111,651,000
America, S.	362,000	36,125,000	—	22,000	10,000	—	108,000	4,000	—	1,262,000	63,000	37,956,000
Asia	1,542,000	5,385,000	17,144,000	482,000	141,456,000	137,900,000	209,152,000	291,030,000	24,900,000	41,436,000	5,693,000	876,120,000
Australasia	3,424,000	964,000	1,000	17,000	3,000	4,000	1,000	31,000	—	40,000	70,000	4,555,000
Europe	92,922,000	183,754,000	98,213,000	9,247,000	3,576,000	—	—	—	—	—	1,319,000	389,031,000
Malaysia	416,500	7,095,500	—	3,000	20,760,000	—	27,000	570,000	—	16,445,000	62,000	45,379,000
Oceania	247,000	129,000	—	1,000	—	15,000	—	65,000	—	507,000	18,000	982,000
Aggregate	166,066,500	272,638,500	120,157,000	11,222,000	216,630,000	137,935,000	209,659,000	291,816,000	24,900,000	157,069,500	15,352,500	1,623,446,000
	558,862,000											

The figures given below are taken from a table compiled by Dr D. L. Leonard, and refer only to Protestant missions to non-Christian and non-Protestant peoples. The figures are for 1907, and should be compared with those in the *Statistical Atlas.* This list gives a total of 69 Foreign Missionary Societies, of which 34 are American, 19 British, 10 German, and 6 other societies. The statistics for these 69 societies may be grouped as follows:—

II.—SUMMARY OF PROTESTANT MISSIONARY WORK.

	AMERICAN.	BRITISH.	GERMAN.	OTHER SOCIETIES, viz. Paris Society, Swiss Romande, Netherlands Societies, Scandinavian Societies, &c.	Totals for Christendom.	Totals for 1895 (showing growth between 1895 and 1907).
Ordained Missionaries	1,911	1,980	932	912	5,735	4,028
Laymen	535	1,738	168	361	2,802	1,477
Unmarried women	1,527	2,332	150	378	4,387	2,578
Ordained natives	2,312	2,141	197	623	5,273	4,295
Communicants (full members)	545,180	565,179	240,883	466,208	1,817,450	995,793
Numbers added in 1906	63,916	38,614	25,983	12,336	140,849	63,081
Adherents	1,286,259	1,398,306	540,073	1,136,500	4,361,138	2,770,801
Schools	8,855	11,789	2,878	5,346	28,868	19,384
Scholars	344,213	619,399	139,891	199,402	1,302,905	786,002

III.—PROTESTANT MISSIONARY INCOME.

1895	£2,724,194	1906	£4,256,029
1900	£3,095,915	1907	£4,473,933[1]
1905	£3,932,377		

A world missionary conference was held at Edinburgh in June 1910, which aimed at making, on a scale far more comprehensive than had been previously attempted, a thorough and scientific study of the problems involved in the relation of Christianity to the non-Christian world. For two years preceding the conference eight representative commissions investigated the following questions:

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[1] The *Statistical Atlas* (1910) puts it at £5,071,225, of which British and American societies each find about £2,000,000, and German societies £427,455.

(1) Carrying the Gospel to all the non-Christian world; (2) the Church in the mission field; (3) education in relation to the Christianization of national life; (4) the missionary message in relation to non-Christian religions; (5) the preparation of missionaries; (6) the home base of missions; (7) missions and governments; (8) co-operation and the promotion of unity. The reports on these subjects in eight volumes, together with a ninth volume giving the proceedings of the conference itself, and a statistical atlas, will for some time be the *vade mecum* of information on Christian missions, and precludes the need of any attempt at a bibliography here, an attempt which would indeed be doomed to failure. It may not, however, be out of place to call attention, in addition to literature already cited, to a few recent books, chiefly manuals, in several of which full lists of missionary books are given.

E. M. Bliss, *The Missionary Enterprise* (1908); E. Stock, *A Short Handbook of Missions* (1904); H. H. Montgomery, *Foreign Missions* (1904); T. Moscrop, *The Kingdom Without Frontiers* (1910); W. T. Whitley, *Missionary Achievement* (1908); S. L. Gulick, *The Growth of the Kingdom of God* (1897); B. Lucas, *The Empire of Christ*, a study of the missionary enterprise in the light of modern religious thought (1907); R. H. Malden, *Foreign Missions*, a study of some principles and methods (1910); G. Smith, *Short History of Christian Missions* (1897); G. Warneck, *Outline of a History of Protestant Missions* (1901; new German ed., 1910). See also J. S. Dennis, *Centennial Survey of Foreign Missions* (1902), *Christian Missions and Social Progress* (3 vols., 1897); G. Warneck, *Modern Missions and Culture* (1882); E. Stock, *History of the Church Missionary Society* (3 vols., 1899); J. B. Myers, *Centenary Volume of the Baptist Missionary Society* (1892); R. Lovett, *History of the London Missionary Society* (2 vols., 1899); J. Lowe, *Medical Missions, Their Place and Power*. A somewhat overlooked side of missions, viz. the "attempt to estimate the contribution of great races to the fulness of the Church of God," is presented in *Mankind and the Church*, edited by Bishop H. H. Montgomery (1907). *The Encyclopaedia of Missions* (2nd ed., 1904) edited by Bliss, Dwight and Tupper; *The Blue Book of Missions* by H. O. Dwight (1907); and the already mentioned *Statistical Atlas of Missions* (1910) by H. P. Beach, are all of the highest value. For Roman Catholic Missions see *Missiones Catholicae cura S. Congregationis de Propaganda Fide descriptae* (Romae, ex Typographia polyglotta S. C. de Prop. Fid. [official biennial publication]); Louvet, *Les Missions Catholiques* [*au*] *xix*ᵉ. *Siècle* (Lyon, Bureau des Missions Catholiques, 14 Rue de la Charité, 1900); Piolet, *Les Missions Catholiques Françaises* [*au*] *xix*ᵉ. *Siècle* (6 vols., Paris, A. Colin, 5 Rue des Mézières); H. A. Krose, *Katholische Missionsstatistik* (1908); K. Streit, *Katholischen Missionsatlas* (1908).

(E. St.; H. T. A.; A. J. G.)

MISSISSIPPI, a South Central state of the United States, situated between 35° N. lat. and 31° N. lat., with its S.E. part extending to the Gulf of Mexico, the extreme southern point being in 30° 13′ N. lat. near the mouth of the Pearl River. On the E. the line is mostly regular, its extreme E. point being at 88° 7′ W. long. in the N.E. corner of the state; the W. boundary has its extreme W. point at 91° 41′ W. long. in the S.W. corner of the state. Mississippi is bounded N. by Tennessee, E. by Alabama, S. by the Gulf of Mexico and Louisiana, W. by Louisiana, from which it is separated by the Pearl River and by the Mississippi, and by Arkansas, from which also it is separated by the Mississippi. The total area is 46,865 sq. m., of which 503 sq. m. are water surface.

Physical Features.—Mississippi lies for the most part in the Mississippi embayment of the Gulf Coastal Plain. A feature of its surface is a strip of bottom land between the Mississippi and Yazoo rivers, known as the Yazoo Delta; it extends from north to south about 175 m., and has an average width of more than 60 m., and covers an area of about 7000 sq. m. With the exception of a few flat ridges running from north to south, it is so low that it requires, to protect it from overflows, an unbroken line of levees averaging 15 ft. in height; these were built and are maintained by the state in part from a special tax on the land and in part from the sale of swamp lands of the United States (under an act of 1850). Along the eastern border of this delta, and southward of it, along the Mississippi itself, extends a belt of hills or bluffs (sometimes called "cane-hills"), which is cut by deep ravines and, though very narrow in the north, has in the south an average width of about 10 m. East of the belt are level or gently rolling prairies, and along the Gulf Coast is a low, marshy tract. The highest elevations, from 800 to 1000 ft. above the sea, are on the Pontotoc ridge in Tippah and Union counties; and from this ridge there is an almost imperceptible slope south and west from the Appalachian Mountain system. Along the margins of valleys there are hills rising from 30 to 120 ft., but farther back from the water courses the differences of elevation are much less. The coast-line, about 85 m. long, is bordered by a beach of white sand, and broken by several small and shallow indentations, among which are St Louis, Biloxi, Pascagoula and Point aux Chenes bays; separated from it by the shallow and practically unnavigable Mississippi Sound is a chain of low, long and narrow sand islands, the largest of which are Petit Bois, Horn, Ship and Cat. The principal rivers are: the Mississippi on the western border, and its tributaries, the Yazoo and the Big Black; the Pearl and Pascagoula, which drain much of the southern portion of the state and flow into the Gulf; and the Tombigbee, which drains most of the north-eastern portion. The Pontotoc ridge separates the drainage system of the Mississippi from that of the Tombigbee; extending from the north-eastern part of the state southward, this ridge divides in Choctaw county, the eastern branch separating the drainage basin in the Pascagoula from that of the Pearl, and the western branch separating the drainage basin of the Pearl from that of the Big Black and the Mississippi. The Delta is drained chiefly by the Yazoo. A small area in the north-eastern corner of the state is drained northward by the Tennessee and the Hatchie. Each of the larger rivers is fed by smaller streams; their fall is usually gentle and quite uniform. The valleys vary in width from a few hundred yards to several miles. In the east of the state much of the valley of each of the larger streams is several feet above the stream's present high-water mark and forms the "hommock" or "second bottom" lands. Most of the rivers flowing into the Gulf are obstructed by sand-bars and navigable only during high-water from January to April. Oxbow lakes and bayous are common only in the Delta.

Geology.—The older formations are nearly all overlaid by deposits of the Quaternary period, which will be described last. In the extreme north-east are found the oldest rocks in the state—lower Devonian (the New Scotland beds of New York) and, not so old, an extension of the Lower Carboniferous which underlies the Warrior coalfields of Alabama, and which consists of cherts, limestones, sandstones and shales, with a depth of 800 to 900 ft. The strata here show some traces of the upheaval which formed the Appalachian Mountain chain. When this chain formed the Atlantic mountain-border of the continent excepting this north-eastern corner, Mississippi had not emerged from the waters of the ancient Gulf of Mexico. As the shore line of the Gulf slowly receded southward and westward, the sediment at its bottom gradually came to the surface, and constituted the Cretaceous and Tertiary formations. Wherever stratification is observed in these formations in Mississippi, it shows a dip west and south of 20 or 30 ft. to the mile.

The Cretaceous region includes, with the exception of the Lower Carboniferous, all that part of the state eastward of a line cutting the Tennessee boundary in 88° 50′ W. long., and drawn southward and eastward near Ripley, Pontotoc, and Starkville, crossing into Alabama in latitude 32° 45′. There are four formations of Cretaceous strata in Mississippi, defined by lines having the same general direction as the one just described. The oldest, bordering the Lower Carboniferous, is the Tuscaloosa formation of clays and sands arranged as follows: dark clays, thin lignite seams, lignitic clays, sands and chert, and light clays; this formation is 5–15 m. wide and reaches from about 33° 30′ on the Alabama boundary north to the Tennessee boundary. It is about 270 ft. thick. Tuscaloosa clays are used in the manufacture of pottery. Overlying the Tuscaloosa are the Eutaw sands, characterized by sandy laminated clays, and yellow, orange, red and blue sands, containing lignite and fossil resin. The Eutaw formation is a strip about 5 to 12 m. wide with a maximum depth of 300 ft. Westward to Houston and southward to about 32° 48′ on the Alabama boundary and occupying a much larger area than the other Cretaceous formations, is the Selma chalk, called "Rotten Limestone" by Hilgard; it is made up of a material of great uniformity,—a soft chalky rock, white or pale blue, composed chiefly of tenacious clay, and white carbonate of lime in minute crystals. Borings show that the thickness of this group varies from 350 ft. in the north to about 1000 ft. at Starkville. Fossils are abundant, and forty species are recorded. The latest Cretaceous is the Ripley formation, which lies west of the northern part of the last-named, and, about Scooba, in a small strip, the most southerly of the Cretaceous—it is composed of coarse sandstones, hard crystalline white limestones, clays, sands, phosphatic greensands, and dark-coloured, micaceous, glauconitic marls; its greatest thickness is about 280 ft. Its marine fossils are admirably preserved, and one hundred and eight species have been described.

Deposits of the Tertiary period form the basis of more than half the state, extending from the border of the Cretaceous westward nearly to the Yazoo Delta and the Mississippi Bottom, and southward to within a few miles of the Gulf coast. Seven formations (or groups) of the Tertiary strata have been distinguished in Mississippi. The oldest is the Midway limestone and clays in a narrow strip whose western limit is nearly parallel to the western boundary of the Selma chalk; it includes: the Clayton formation, characterized by the hard blue Turritella limestone (so named from the frequent fossil (*Turritella mortoni*); and Porters Creek (previously called Flatwoods) clay, which is grey, weathering white, and is occasionally overlain by grey fossiliferous sandstone. The Wilcox formation (called Lignitic by Hilgard, and named by Safford the Lagrange group) lies to the west of the last, and its western limit is from about 32° 12′ on the Alabama boundary about due north-west; in its north-westernmost part it is on the western edge of the Tertiary in this state. Its minimum depth is 850 ft. It is marked by grey clays and sands, lignitic fossiliferous clays, beds of lignite or brown coal, sometimes 8 ft. in thickness, and brownish clays. The siliceous Claiborne (or Tallahatta Buhrstone) formation lies south-westward from the last-named in a strip 10–30 m. wide, whose south-eastern extremity is the intersection of the 32nd meridian with the Alabama boundary, is characterized by beds of aluminous grey and white sandstone, aluminous and siliceous clay-stone, quartzitic sandstone, and green sand and marls. The calcareous Claiborne or Claiborne-Lisbon formation-group lies south of the last, in a wedge-like strip with the apex on the Alabama boundary; it is a series of clays and sands, richly fossiliferous. The Jackson formation south-west of the Lisbon beds, is made up chiefly of grey calcareous clay marls, bluish lignitic clays, green-sand and grey siliceous sands. *Basilosaurus* (or *Zeuglodon*) bones are found only in the Jackson marls, and other marine fossils are abundant. The minimum thickness of the formation is 240 ft. The Vicksburg formation lies next in order south-west, in a narrow strip of fairly regular width which alone of the Tertiary formations runs as far west as the Mississippi River; it is probably nowhere more than 110 ft. deep. It is characterized by semi-crystalline limestones and blue and white sandy marls. Marine fossils are very abundant in the marl. The Grand Gulf group, of formations of different ages, consisting of sands, sandstones and clays, and showing a few fossil plants, but no marine fossils, extends southward from the last to within a few miles of the coast, and is 750–800 ft. deep.

The older formation of the Quaternary period is the Lafayette (also called "Orange-sand" or "stratified drift"), which immediately overlies all the Cretaceous groups except the prairies of the Selma chalk, and all the Tertiary except the Porters Creek and Vicksburg formations and parts of the Jackson. Its depth varies from a few feet to over 200 ft. (in the southern part of the state), and it forms the body of most of the hills in the state. Its materials are pebbles, clays and sands of various colours from white to deep red, tinged with peroxide of iron, which sometimes cements the pebbles and sands into compact rocks. The shapes of these ferruginous sandstones are very fantastic—tubes, hollow spheres, plates, &c., being common. The name stratified drift has been used to indicate its connexion with the northern drift. The fossils are few, and in some cases probably derived from the underlying formations. Well-worn pebbles of amorphous quartz (agate, chalcedony, jasper, &c.) are found in the stratified drift along the western side of the Tertiary region of the state, and from Columbus northward. The second Quaternary formation is the Port Hudson, occurring within 20 m. of the Gulf coast, and, with alluvium, in the Yazoo Delta. Heavy clays, gravel and sands, containing cypress stumps, drift-wood and mastodon bones, are characteristic. The loess or bluff formation lies along the bluffs bordering the Bottom, nearly continuously through the state. Its fine-grained, unstratified silt contains the remains of many terrestrial animals, including fifteen mammals.

Fauna.—Among the more common species of game are squirrels, opossums, musk-rats, rabbits, racoons, wild turkeys, "partridges" (quail, or Bob White), geese, and ducks; deer, black bears, grey (or timber) wolves, black wolves and "wild cats" (lynx), once common, have become rare. Alligators inhabit the southern river-bottoms, and there are some rattlesnakes on the uplands. Among a great variety of song-birds the mocking-bird is prominent; the parakeet is found in the southern part of the state. Buffalo-fish, paddle-fish, cat-fish, drum, crappie, black bass, rock bass, German carp, sturgeon, pike, perch, eels, suckers and shrimp inhabit the waters of the Mississippi and its tributaries, and oysters, shrimp, trout, Spanish mackerel, channel bass, black bass, sheepshead, mullet, croakers, pompano, pin-fish, blue-fish, flounders, crabs and terrapin are obtained from the Mississippi Sound and the rivers flowing into it.

Flora.—Originally Mississippi was almost entirely covered with a growth of forest trees of large size, mostly deciduous; and in 1900 about seven-tenths of its area was still classed as timber-land. The north central part of the state, known as the "flat woods," is level and heavily forested. There are more than 120 species of trees in the state, 15 of oak alone. The most valuable species for lumber are the long-leaf pine which is predominant in the low southern third of the state, sometimes called the "cow-country"; the short-leaf pine, found farther north; the white oak, quite widely distributed; cotton-wood and red gum, found chiefly on the rich alluvial lands; and the cypress, found chiefly in the marshes of the Delta. The beautiful live oaks and magnolias grow only in the south of the state; the holly in the lowlands; and the finest species of pecan, in the Delta. The sassafras, persimmon, wild cherry and Chickasaw plum are found in all parts of the state. The grape, Ogeechee lime (*Nyssa capitata*) and pawpaw are also native fruits. Among indigenous shrubs and vines are the blackberry, dewberry, strawberry, yellow jasmine, mistletoe and poison-oak; and among medicinal herbs are horehound, ginger and peppermint. Here, too, grows Spanish moss, used by upholsterers.

Climate.—The southern latitude, the low elevation and the proximity to the Gulf of Mexico produce in southern Mississippi a rather mild and equable climate, but to the northward the extremes increase. The normal annual temperature for the state is 64° F.; on the coast it is 67° F., and on the northern border it is 61° F. During a period of twenty years, from January 1887 to December 1906, extremes of temperature at Biloxi, on the coast, ranged from 1° F. to 100° F.; during nearly the same period at Pontotoc, in the north-eastern part of the state, they ranged from −11° F. to 105° F. The greatest extremes recorded were −15° F. at Aberdeen, Monroe county, on the 13th of February 1899, and 107° F. at several places in July and August of different years. January is the coldest month, and July is the warmest. During the winter the normal temperature decreases quite steadily from south to north; thus the mean temperature in January at Biloxi is 51° F., at Meridian, in the east central part, it is 46° F., and at Pontotoc it is 43° F. But during the summer, temperatures are affected as much by altitude as by latitude, and the coast is cooled at night by breezes from the Gulf. The July mean is 82° F. at several places in the southern part of the state, and at Yazoo city, in the west central part, it is 83° F. The normal annual precipitation for Mississippi is about 51 in.; for the southern half, 54 in., and for the northern half, 49 in. An average of 4 in. of snow falls in the northern half, but south of Natchez snow is seldom seen. Nearly one-third of the rain falls in January, February and March; July, also, is one of the wet months. The driest season is in September and October. The prevailing winds are from the south-east; but the rain-bearing winds are chiefly from the south-west, and the high winds from the west and north-west.

Soils.—The most fertile soil is the alluvium of the Delta, deposited during the overflows of the Mississippi. Others that are exceedingly productive are the black calcareous loam of the prairies, the calcareous silt of the bluff belt along the eastern border of the Delta, and the brown loam of the tableland in the central part of the state. Of inferior quality are the yellow loam of the hills in the north-east and the sandy loam in the pine belt of the south. Throughout the southern portion sand is a large ingredient, and to the northward there is more or less lime.

Agriculture.—Mississippi is devoted largely to the cultivation of cotton. Of the total land area of the state, 18,240,736 acres (61·3 %) were, in 1900, included in farms, and the improved farm land increased from 4,209,146 acres in 1870 to 7,594,428 acres (41·6 % of all farm land) in 1900. After the abolition of slavery, farms greatly decreased in size and increased in number; the number grew from 68,023 in 1870 to 220,803 in 1900; the average size fell from 369·7 acres in 1860 to 82·6 acres in 1900. Of the total number of farms in 1900, 81,412 were worked by owners or part owners (60,585 by whites and 20,827 by negroes); 70,699 were worked by cash tenants (13,505 by whites and 57,194 by negroes); and 67,153 were worked by share tenants (16,748 by whites and 50,405 by negroes).

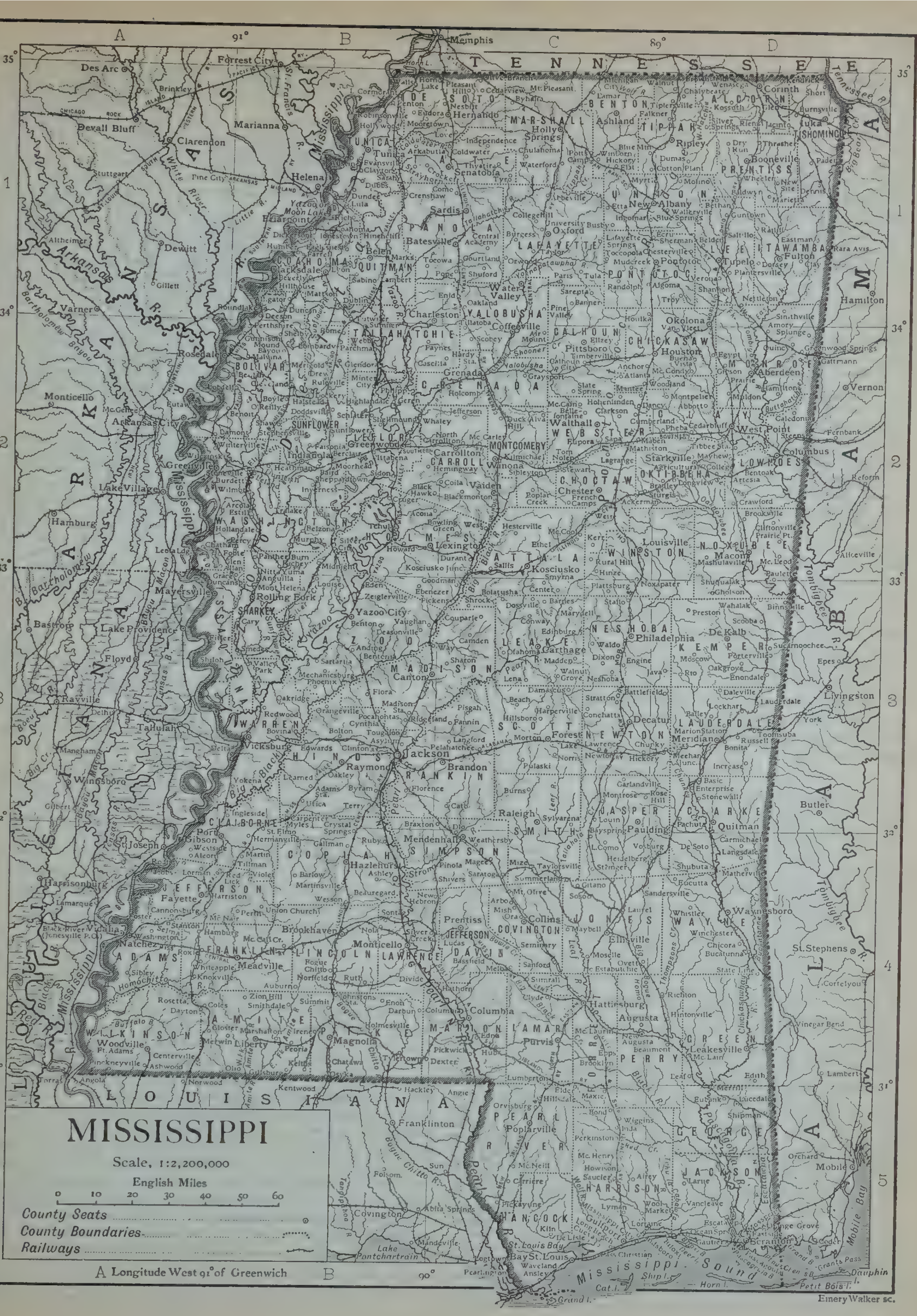
The acreage of cotton increased from 2,106,215 acres in 1879 to 3,220,000 in 1907; the yield increased from 936,111 bales in 1879 to 1,468,177 bales in 1907. Cotton is grown in every county of the state, but the large yields are in the Delta (Bolivar, Coahoma, Washington, Yazoo and Leflore counties), the greatest cotton-producing region of the world, and in Monroe, Lowndes and Noxubee counties on the Alabama border. The acreage of Indian corn in 1907 was 2,500,000 acres and the crop 42,500,000 bushels. The production of other cereals decreased during the latter half of the 19th century: oats, from 1,959,620 bushels in 1879 to 1,611,000 bushels in 1907; wheat, from 587,925 bushels in 1859 to 22,000 in 1907; rye, from 39,474 bushels in 1859 to 963 bushels in 1899, after which year the crop has been negligible; and rice, from 2,719,856 ℔ in 1849 to about 1,080,000 ℔ in 1907. The largest Indian-corn producing districts are nearly the same as those which produce the most cotton; oats and wheat are grown chiefly in the north-eastern quarter of the state, and rice in the south-western quarter.

Between 1850 and 1907 dairy cows increased from 214,231 to 330,000; other neat cattle from 519,739 to 589,000; sheep decreased from 304,929 to 181,000; swine decreased from 1,582,734 to 1,316,000; horses increased from 115,460 to 260,000, and mules from 54,547 to 279,000.

Sugar-cane is grown principally in the southern part of the state, but sorghum-cane is grown to some extent in nearly every county. Sweet potatoes, white potatoes and onions also are important crops. The greatest relative advance between 1889 and 1899 in any branch of agriculture was made in the growth of market-garden produce and small fruits; for old pine lands, formerly considered useless, had been found valuable for the purpose. The number of orchard trees increased nearly 100 % within the same decade. At Crystal Springs tomatoes were first successfully grown for the market (1874–1876). Orchard trees and grape-vines are widely distributed throughout the state, but with the exception of peaches their yield is greater in the northern portion.

Lumber.—Mississippi ranks high among the southern states in the production of lumber. Its timber-land in 1900 was estimated at 32,300 sq. m. From the extreme south most of the merchantable timber had been cut, but immediately north of this there were still vast quantities of valuable long-leaf pine; in the marshes of the Delta was much cypress, the cotton-wood was nearly exhausted, and the gum was being used as a substitute for it; and on the rich upland soil were oak and red gum, also cotton-wood, hickory and maple. The lumber and timber product increased in value from $1,920,335 in 1880 to $24,035,539 in 1905. Pine stumps and waste limbs are utilized, notably at Hattiesburg, for the manufacture of charcoal, tar, creosote, turpentine, &c.

Fisheries.—Fishing is a minor industry, confined for the most part to the Mississippi Sound and neighbouring waters and to the Mississippi and Yazoo rivers. The most valuable branch is the oyster


A
91°
B
Memphis
C
89°
D
35°
T E N N E S S E E
A R K A N S A S
L O U I S I A N A
A L A B A M A
Mississippi R.
Jackson
Vicksburg
Natchez
Meridian
Columbus
Hattiesburg
Biloxi
Gulfport
Mississippi Sound
34°
33°
32°
31°
1
2
3
4
5
A Longitude West 91° of Greenwich
B
90°

MISSISSIPPI

Scale, 1:2,200,000

English Miles

0 10 20 30 40 50 60

County Seats
County Boundaries
Railways

Emery Walker sc.

fishery on the reefs in the Sound, much developed since 1880. The shrimp fishery, too, grew during the same period. About 40% of the total catch of the state is made by the inhabitants of Harrison county on the Gulf of Mexico.

Minerals.—The mineral wealth of the state is limited. Clays and mineral waters are, however, widely distributed. Large quantities of mineral water, sulphur, chalybeate and lithia, bottled at Meridian, Raymond and elsewhere, are sold annually. The state contains deposits of iron, gypsum, marl, phosphate, lignite, ochre, glass-sand, tripoli, fuller's earth, limestones and sandstones; and there are small gas flows in the Yazoo Delta.

Manufactures.—The lack of mineral resources, especially of coal and iron, of a good harbour (until the improvement of Gulfport), and of an adequate supply of labour has discouraged most kinds of manufacturing. The value of the total factory product was $57,451,445 in 1905, when a little more than three-fourths was represented by lumber and timber products, cotton-seed oil and cake, and cotton goods. The leading manufacturing centres are Meridian, Vicksburg, Jackson, Natchez and Biloxi.

Transport.—Along the entire western border of the state the Mississippi River is navigable for river steamboats. On the southern border, the Mississippi Sound affords safe navigation for small coasting vessels, and from Gulfport (13 m. W.S.W. of Biloxi) to Ship Island, which has one of the best harbours on the entire Gulf Coast, the Gulf & Ship Island Railroad Company, with the co-operation of the United States Government, in 1901 began to dredge a channel 300 ft. wide and 19 ft. at mean low water, and to construct an anchorage basin (completed in 1906) at Gulfport, ½ m. long and ¼ m. wide, and 19 ft. deep. In June 1908 the maximum low-water draft of the channel and the basin was 19 ft. The Gulfport project reduced freight rates between Gulfport and the Atlantic seaboard cities and promoted the trade of Gulfport, which is the port of entry for the Pearl River customs district. Its imports for 1909 were valued at $82,028 and its exports at $8,581,471. The Yazoo, Tallahatchie, Yalobusha, Sunflower, Big Black, Pascagoula and Pearl rivers are also navigable to a limited extent. The first railway in Mississippi was completed from Vicksburg to Clinton in 1840, but the state had suffered severely from the panic of 1837, and in 1850 it had only 75 m. of railway. This was increased to 862 m. by 1860. The Civil War then interfered, and in 1880 the mileage was only 1127 m. During the next decade it was a little more than doubled, and at the close of 1908 it was 3916·85 m. The principal lines are the Illinois Central, the Yazoo & Mississippi Valley, the Southern, the Mobile & Ohio, the New Orleans & North-eastern, the Kansas City, Memphis & Birmingham, the Mobile, Jackson & Kansas City, the Alabama & Vicksburg, and the Gulf & Ship Island.

Population.—The population increased from 1,131,597 in 1880[1] to 1,289,600 in 1890, of 14% within the decade, and by 1900 it had grown to 1,551,270 (99·48% native-born), and by 1910 to 1,797,114. The density of population in 1900 was 33.5 per sq. m.; 641,200, or 41·3%, were whites; 907,630, or 58·5%, were negroes; 2203 were Indians, and 237 were Chinese; in eight counties of the Delta the ratio of negroes to whites was almost 7 to 1. The Indians are descendants of the Choctaw tribe; they are all subject to taxation, and most of them live in the east central part of the state. The principal religious denominations are the Baptist (371,518 in 1906) and the Methodist (212,105 in 1906). The cities and towns having a population in 1900 of 4000 or more were: Vicksburg, Meridian, Natchez, Jackson, Greenville, Columbus, Biloxi, Yazoo City, McComb and Hattiesburg.

Government.—The chief special object of the present constitution, adopted on the 1st of November 1890, was to preserve in a legal manner the supremacy of the whites over the ignorant negro majority. In addition to the ordinary suffrage qualifications of age, sex, and residence, the voter must have paid all taxes due from him for the two years immediately preceding the election, and he must be able to read any section of the constitution or "be able to understand the same when read to him, or give a reasonable interpretation thereof." The former provision, strengthened by a poll-tax for school purposes assessed on adult males, affects both white and blacks; the latter, owing to the discretion vested in the election officers, affects (in practice) mainly the blacks. The chief executive officials are the governor, lieutenant-governor, secretary of state, treasurer, auditor, attorney-general, and superintendent of education. All are chosen for terms of four years, and the governor, treasurer, and auditor are ineligible for immediate re-election. The method of election is peculiar, being based in part upon the national presidential model. Each county or legislative district casts as many electoral votes as it has members in the state house of representatives, and a majority of both the electoral and the popular vote is required. If no one has such a majority, the house of representatives chooses one of the two who have received the highest number of popular votes; but this is really a provision never executed, as the Democratic nominees are always elected without any serious opposition. The governor is empowered to call extraordinary sessions of the legislature, to grant pardons and reprieves, and to exercise a power of veto which extends to items in appropriation bills; a two-thirds majority of the legislature is necessary to pass a bill over his veto. His appointing power is not very extensive, as nearly all officials, except judges, are elected by popular vote.

The legislature consists of a senate and a house of representatives, chosen every four years. It meets in regular session quadrennially, in special sessions in the middle of the interval to pass the appropriation and revenue bills, and in extraordinary session whenever the governor sees fit to call it. Revenue measures may originate in either house, but a three-fifths vote in each is necessary to their enactment. The constitution goes into minute detail in prohibiting local, private and special legislation.

The judiciary consists of a supreme court of three judges, thirteen (1908) circuit courts, seven (1908) chancery courts, county courts and justice of the peace courts. Under the constitution of 1890 the governor, with the consent of the senate, appoints supreme court judges for a term of nine years, and circuit and chancery judges for four years. The local judicial authorities are the county board of supervisors of five members and the justices of the peace.

The other county officials are the sheriff, coroner, treasurer, assessor, surveyor and superintendent of education. The superintendent is chosen by the state board of education except in those counties (now all or nearly all) in which the legislature has made the office elective. The courts have interpreted this to mean that the manner of selection need not be uniform (*Wynn* v. *State*, 67 Miss. 312), a rule which would possibly apply to other local offices. The intention seemed to be to permit the appointment of officials in counties and districts where there was any likelihood of negro supremacy.

Mississippi has taken a leading part in the movement to bring about the removal of the common law disabilities of married women, the first statute for that purpose having been passed in 1839. Under the present constitution they are "fully emancipated from all disability on account of coverture," and are placed on an equality with their husbands in acquiring and disposing of property and in making contracts relative thereto. A divorce may be granted only to one who has lived for at least one year in the state; among the recognized causes for divorce are desertion for two years, cruelty, insanity or physical incapacity at time of marriage, habitual drunkenness or excessive use of opium or other drugs, and the conviction of either party of felony. The homestead of a householder (with a family) who occupies it may be held exempt from sale for the collection of debts other than those for purchase-money, taxes, or improvements, or for the satisfaction of a judgment upon a forfeited recognizance or bail-bond, but a homestead so exempted is limited to $3000 in value and to 160 acres of land. A considerable amount of personal property, including furniture, a small library, provisions, tools, agricultural implements, livestock and the proceeds of a life insurance policy, is also exempt from seizure for the satisfaction of debts. Since 1909 the sale of intoxicating liquors has been prohibited by statute.

Penal and Charitable Institutions.—The penitentiary at Jackson was established under an Act of 1836, was erected in 1838–1839, was opened in 1840, was burned by the Federals in 1863, and was rebuilt in 1866–1867. The board of control is composed of the governor, attorney-general and the three railroad commissioners. The convict lease system was abolished by the constitution of 1890 (the provision to take effect on the 31st of December 1894), and state farms were purchased in Rankin, Hinds and Holmes counties. As these were insufficient to give employment to all the prisoners, some were put to work on Yazoo Delta plantations on partnership contracts. Under an act of 1900, however, 13,889 acres of land were purchased in Sunflower county; and there and at Tchula, Holmes county, and at Oakley, Hinds county, the negro convicts—the white convicts are on the Rankin county farm—are kept on several large plantations, with saw-mills, cotton gins, &c. Under a law of 1906 these farm penitentiaries are controlled by a board of three trustees, elected by the people; they are managed by a superintendent.

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[1] The population at each of the preceding censuses was: 8850 in 1800; 40,352 in 1810; 75,448 in 1820; 136,621 in 1830; 375,651 in 1840; 606,526 in 1850; 791,305 in 1860; and 827,922 in 1870.

appointed once every four years by the governor. The charitable institutions of the state are supervised by separate boards of trustees appointed by the governor. The state insane hospital, opened at Jackson in 1856 (act of 1848), in time became overcrowded and the East Mississippi insane hospital was opened, 2 m. west of Meridian in 1885 (act of 1882). The state institution for the education of the deaf and dumb (1854) and the state institution for the blind (1848) are at Jackson. State aid is given to the hospitals at Vicksburg and Natchez.

Education.—Educational interests were almost entirely neglected during the colonial and territorial periods. The first school established in the state was Jefferson College, now Jefferson Military College, near Natchez, Adams county, incorporated in 1802. Charters were granted to schools in Claiborne, Wilkinson and Amite counties in 1809–1815, and to Port Gibson Academy and Mississippi College, at Clinton, in 1826. The public school system, established in 1846, never was universal, because of special legislation for various counties; public education was retarded during the Civil War and the Reconstruction period (when immense sums appropriated for schools were grossly mismanaged), but conditions gradually improved after 1875, especially through the concentration of schools. The sessions are still too short, teachers are poorly paid and attendance is voluntary. The long lack of normal training for white teachers (from 1870 to 1904 there was a normal school for negroes at Holly Springs) lasted until 1890, when a teacher's training course was introduced into the curriculum of the state university. There are separate schools for whites and blacks, and the equipment and service are approximately equal, although the whites pay about nine-tenths of the school taxes. The schools are subject to the supervision of a state superintendent of public education and of a board of education, composed of the superintendent, the secretary of state, and the attorney-general, and within each county to a county superintendent. The schools are supported by a poll-tax, by general appropriations, by local levies, and by the Chickasaw school fund. An act of Congress of the 3rd of March 1803 reserved from sale section sixteen of the public lands in each township for educational purposes. When the Chickasaws ceded their lands to the national government, in 1830 and in 1832, the state made a claim to the sixteenth sections, and finally in 1856 received 174,550 acres —one thirty-sixth of the total cession of 6,283,804 acres. The revenue derived from the sales and leases of this land constitutes an endowment fund upon which the state as trustee pays 6% interest. It is used for the support of the schools in the old Chickasaw territory in the northern part of the state.

Among the institutions for higher education are the university of Mississippi (chartered 1844; opened 1848), at Oxford, which was opened to women in 1882; the Agricultural and Mechanical College (opened 1880), at Agricultural College, near Starkville, Oktibbeha county; the Industrial Institute and College for Girls (opened 1885), at Columbus; and the Alcorn Agricultural and Mechanical College for negroes (1871; reorganized in 1878), at Westside. In 1819 Congress granted thirty-six sections of public land for the establishment of a university. This land was sold in 1833 for $277,332.52, but the entire sum was lost in the failure of the Planters' Bank in 1840. In 1880 the state assumed liability for the full amount plus interest, and this balance, $544,061.23, now constitutes an endowment fund, upon which the state pays 6% interest. Congress granted another township (thirty-six sections) for the university in 1892, and its income is supplemented by legislative appropriations for current expenses and special needs. The two agricultural and mechanical colleges were founded by the sale of public lands given by Congress under the Morrill Act of 1862. An agricultural experiment station established in 1887 under the Hatch Act, is at Agricultural College; and there are branch experiment stations at McNeill, Pearl River county (1906), near Holly Springs, and at Stoneville, near Greenville.

Finance.—The chief sources of revenue are taxes on realty, personalty and corporations, a poll-tax, and licences. The more important expenditures are for public schools, state departments, educational and charitable institutions and pensions for Confederate veterans. The early financial history of the state is not very creditable. The Bank of Mississippi, at Natchez, incorporated by the Territorial legislature in 1809, was rechartered by the state in 1818, and was guaranteed a monopoly of the banking business until 1840. In violation of this pledge, and in the hope that a new bank would be more tractable than the Bank of Mississippi, the Planters' Bank was established at Natchez, in 1830, with a capital of $3,000,000, two-thirds of which was subscribed by the state. During the wild era of speculation which followed (especially in 1832—upon the opening of the Chickasaw Cession to settlement) a large number of banks and railroad corporations with banking privileges were chartered. The climax was reached in 1838 with the incorporation of the Union Bank. This, the most pretentious of all the state banks of the period, was capitalized at $15,500,000. The state subscribed $5,000,000, which was raised on bonds sold to Nicholas Biddle, president of the United States Bank of Pennsylvania. As the Union Bank was founded in the midst of a financial panic and was mismanaged, its failure was a foregone conclusion. Agitation for repudiation was begun by Governor A. G. McNutt (1801–1848), and that question became the chief issue in the gubernatorial campaign of 1841, Tilghman M. Tucker (1802–1859), the Democratic candidate, representing the repudiators and David O. Shattuck, Whig, representing the anti-repudiators. The Democrats were successful, and the bonds were formally repudiated in 1842. In 1853 the High Court of Appeals and Errors of the state in the case of *Mississippi* v. *Hezion Johnson* (35 *Miss. Reports*, 625) decided unanimously that nothing could absolve the state from its obligation. The decision was disregarded, however, and in the same year the Planters' Bank bonds were also repudiated by popular vote. These acts of repudiation were sanctioned by the constitution of 1890. The $7,000,000 saved in this manner has doubtless been more than offset by the additional interest charges on subsequent loans, due to the loss of public confidence. Mississippi suffered less than most of the other Southern states during the Reconstruction period; but expenditures rose from $463,219.71 in 1869 to $1,729,046.34 in 1871. At the close of the Republican régime in 1876 its total indebtedness was $2,631,704.24, of which $814,743 belonged to the Chickasaw fund (see above) and $718,946.22 to the general school fund. As the principal of these funds is never to be paid, the real debt was slightly over $1,000,000. On the 1st of October 1907 the payable debt was $1,253,029.07, the non-payable $2,336,197.58,[1] a total of $3,589,226.65. Since the Civil War the banking laws have become more stringent and the national banks have exercised a wholesome influence. There were, in 1906, 24 national banks and 269 state banks, but no trust companies, private banks or savings banks.

History.—At the beginning of the 16th century the territory included in the present state of Mississippi was inhabited by three powerful native tribes: the Natchez in the south-west, the Choctaws in the south-east and centre, and the Chickasaws in the north. In addition, there were the Yazoos in the Yazoo valley, the Pascagoulas, the Biloxis, and a few weaker tribes on the borders of the Mississippi Sound. The history of Mississippi may be divided into the period of exploration (1540–1699), the period of French rule (1699–1763), the period of English rule (1763–1781), the period of Spanish rule (1781–1798), the territorial period (1798–1817), and the period of statehood (1817 seq.).

Hernando de Soto (*q.v.*) and a body of Spanish adventurers crossed the Tombigbee river, in December 1540, near the present city of Columbus, marched through the north part of the state, and reached the Mississippi river near Memphis in 1541. In 1673 a French expedition organized in Canada under Jacques Marquette and Louis Joliet sailed down the Mississippi to the mouth of the Arkansas, and nine years later (1682) René Robert Cavelier, sieur de la Salle, reached the mouth of the river, took formal possession of the country which it drains, and named it Louisiana in honour of Louis XIV. The first European settlement in Mississippi was founded in 1699 by Pierre Lemoyne, better known as Iberville, at Fort Maurepas (Old Biloxi) on the north side of Biloxi Bay, in what is now Harrison county. The site proving unfavourable, the colony was transferred to Twenty-seven Mile Bluff, on the Mobile River, in 1702, and later to Mobile (1710). The oldest permanent settlements in the state are (New) Biloxi (*c.* 1712), situated across the bay from Old Biloxi and nearer to the Gulf, and Natchez or Fort Rosalie (1716). During the next few years Fort St Peter and a small adjoining colony were established on the Yazoo River in Warren county, and some attempts at settlement were made on Bay St Louis and Pascagoula Bay. The efforts (1712–1721) to foster colonization and commerce through trading corporations established by Antoine Crozat and John Law failed, and the colony soon came again under the direct control of the king. It grew very slowly, partly because of the hostility of the Indians and partly because of the incapacity of the French as colonizers. In 1729–1730 the Natchez tribe destroyed Fort St Peter, and some of the small outposts, and almost destroyed the Fort Rosalie (Natchez) settlement.

At the close of the Seven Years' War (1763) France ceded to Great Britain all her territory east of the Mississippi except New Orleans, and Spain ceded Florida to Great Britain. By a royal proclamation (Oct. 7, 1763) these new possessions were divided into East Florida and West Florida, the latter lying S. of the 31st parallel and W. of the Chattahoochee and Apalachicola rivers. Crown orders of 1764 and 1767 extended the limits N. to a line due E. from the mouth of the Yazoo at about 32° 28′ N. lat. Under English rule there was an extensive immigration into this region from England, Ireland, Georgia and South Carolina. A settlement was made on the Big Black, 17 m. from its mouth, in 1774 by Phineas Lyman (1716–1774) of Connecticut and other "military adventurers," veterans of the Havana campaign of 1762; this settlement was loyal during the War of Independence. Spain took military possession in 1781, and in the Treaty of Paris (1783) both of the Floridas were ceded back to her. But Great Britain recognized the claims of the United States to the territory as far south as the 31st parallel, the line of 1763. Spain adhered to the line of 1764–1767, and retained possession of the territory in dispute. Finally, in the treaty of San Lorenzo el Real (ratified 1796) she accepted the 1763 (31°) boundary, and withdrew her troops in 1798. Mississippi Territory was then organized, with Winthrop Sargent as governor. The territorial limits were extended on the north to the state of Tennessee in 1804 by the acquisition of the west cessions of South Carolina and Georgia, and on the south to the Gulf of Mexico by the seizure of West Florida in 1810–1813,[1] but were restricted on the east by the formation of the Territory of Alabama in 1817. Just after the uprising of 1729–1730 the French, with the help of the Choctaws, had destroyed the Natchez nation, and the shattered remnants were absorbed by the neighbouring tribes. The Chickasaws ceded their lands to the United States in 1816 and the Choctaws theirs in 1830–1832; and they removed to the Indian Territory. The smaller tribes have been exterminated, absorbed or driven farther west.

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[1] The increase is due mainly to the assumption of the university obligations in 1880.

An Enabling Act was passed on the 1st of March 1817, and the state was formally admitted into the Union on the 10th of December. The first state constitution (1817) provided a high property qualification for governor, senator and representative, and empowered the legislature to elect the judges and the more important state officials. In 1822 the capital was removed to Jackson from Columbia, Marion county.[2] The constitution of 1832 abolished the property qualification for holding office and provided for the popular election of judges and state officials. Mississippi thus became one of the first states in the Union to establish an elective judiciary.[3] The same constitution prohibited the importation of negro slaves from other states; but this prohibition was never observed, and the United States Supreme Court held that it was ineffective without an act of the legislature. On the death of John C. Calhoun in 1850 the state, under the leadership of Jefferson Davis, began to rival South Carolina as leader of the extreme pro-slavery States' Rights faction. There was a brief reaction: Henry Stuart Foote (1800–1880), Unionist, was elected governor in 1851 over Davis, the States' Rights candidate, and in the same year a Constitutional Convention had declared almost unanimously that "the asserted right of secession" . . . "is utterly unsanctioned by the Federal Constitution." But the particularistic sentiment continued to grow. An ordinance of secession was passed on the 9th of January 1861, and the constitution was soon amended to conform to the new constitution of the Confederate States. During the Civil War battles were fought at Corinth (1862), Port Gibson (1863), Jackson (1863) and Vicksburg (1863). In 1865 President Johnson appointed as provisional governor William Lewis Sharkey (1797–1873), who had been chief justice of the state in 1832–1850, and a convention which assembled on the 14th of August recognized the "destruction" of slavery and declared the ordinance of secession null and void. The first reconstruction legislature met on the 16th of October 1865, and at once proceeded to enact stringent vagrancy laws and other measures against the freedmen; these laws the North interpreted as an effort to restore slavery. Under the Reconstruction Act of the 2nd of March 1867 Mississippi with Arkansas formed the fourth military district, commanded successively by Generals E. O. C. Ord (1867), Alvan C. Gillem (1868) and Irvin McDowell (June–July 1868), and by Gillem (1868–1869) and Adelbert Ames (1869–1870). The notorious "Black and Tan Convention" of 1868 adopted a constitution which conferred suffrage upon the negroes and by the imposition of test oaths disfranchised the leading whites. It was at first rejected at the polls, but was finally ratified in November 1869 without the disfranchising clauses. The fourteenth and fifteenth amendments to the Federal Constitution were ratified in 1870, and the state was formally readmitted into the Union on the 23rd of February of that year.

From 1870 to 1875 the government was under the control of "carpet-baggers," negroes and the most disreputable element among the native whites. Taxes were increased—expenditure increased nearly threefold between 1869 and 1871—and there was some official corruption; but the state escaped the heavy burden of debt imposed upon its neighbours, partly because of the higher character of its reconstruction governors, and partly because its credit was already impaired by the repudiation of obligations contracted before the war. The Democrats carried the legislature in 1875, and preferred impeachment charges against Governor Adelbert Ames (b. 1835), a native of Maine, a graduate of the United States Military Academy (1861), a soldier in the Union army, and military governor of Mississippi in 1868–1870. The lieutenant-governor, A. K. Davis, a negro, was impeached and was removed from office; T. W. Cardoza, another negro, superintendent of education under Ames, was impeached on twelve charges of malfeasance, but was permitted to resign. Governor Ames, when the impeachment charges against him were dismissed on the 29th of March 1876, immediately resigned. The whites maintained their supremacy by very dubious methods until the adoption of the constitution of 1890 made it no longer necessary. The state has always been Democratic in national politics, except in the presidential elections of 1840 (Whig) and 1872 (Republican). The electoral vote was not counted in 1864 and 1868.

GOVERNORS

Territorial Period (1798–1817).		
Winthrop Sargent		1798–1801
William C. C. Claiborne		1801–1805
Robert Williams		1805–1809
David Holmes		1809–1817
Statehood Period (1817 seq.).		
David Holmes	Democrat	1817–1820
George Poindexter	,,	1820–1822
Walter Leake	Democrat (died in office)	1822–1825
Gerard C. Brandon (ad int.)	Democrat	1825–1826
David Holmes	Democrat (resigned)	1826
Gerard C. Brandon (ad int. 1826–1828)		1826–1832
Abram M. Scott	Democrat (died in office)	1832–1833
Charles Lynch [4] (ad. int.)	Democrat	1833
Hiram G. Runnels	,,	1833–1835
John Anthony Quitman (ad int.)	Whig	1835–1836
Charles Lynch	Democrat	1836–1838
Alexander Gallatin McNutt	,,	1838–1842
Tilghman M. Tucker	,,	1842–1844
Albert Gallatin Brown	,,	1844–1848
Joseph W. Matthews	,,	1848–1850
John Anthony Quitman [5]	,,	1850–1851
John Isaac Guion [6] (ad int.)	,,	1851
James Whitfield (ad int.)	,,	1851–1852
Henry Stuart Foote	Unionist	1852–1854
John Jones Pettus [7] (ad int.)	Democrat	1854
John J. McRae	,,	1854–1857
William McWillie	,,	1857–1859
John Jones Pettus	,,	1859–1863

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[1] South Carolina ceded its western lands to the United States in 1787 and Georgia in 1802. The government added them to Mississippi in 1804. The seizure of West Florida was supplemented by the treaty of 1819–1821, in which Spain surrendered all of her claims.

[2] The seats of government have been Natchez (1798–1802), Washington (1802–1817), Natchez (1817–1821), Columbia (1821–1822), Jackson (1822 seq.).

[3] This system proved unsatisfactory, and in 1869 was abandoned.

[4] Under the constitution of 1832 the president of the senate succeeded the governor in case of a vacancy.

[5] Governor Quitman resigned because of charges against him of aiding Lopez's expedition against Cuba.

[6] On the 4th of November the term for which Guion had been elected as a senator expired and he was succeeded in the governorship by Whitfield, elected by the senate to be its president.

[7] Served from the 5th of January (when Foote resigned) to the 10th, when McRae was inaugurated.

Charles Clark[1]	Democrat	1863–1865
William Lewis Sharkey	Provisional	1865
Benjamin Grubb Humphreys[2]	Republican	1865–1868
Adelbert Ames	Republican (Military Governor)	1868–1870
James Lusk Alcorn[3]	Republican	1870–1871
Ridgley Ceylon Powers (ad int.)	,,	1871–1874
Adelbert Ames[4]	,,	1874–1876
John Marshall Stone (ad int. 1876–78)	Democrat	1876–1882
Robert Lowry	,,	1882–1890
J. M. Stone	,,	1890–1896
Anselm Joseph McLaurin	,,	1896–1900
Andrew Houston Longino	,,	1900–1904
James Kimble Vardaman	,,	1904–1908
Edmund Favor Noel	,,	1908

See T. A. Owen, "A Biography of Mississippi," in the *Annual Report of the American Historical Association, 1899*, i. 633-828 (Washington, 1900); "Report of the Mississippi Historical Commission" in the *Publications of the Mississippi Historical Society*, v. 52-310 (Oxford, Miss., 1902). J. F. H. Claiborne's *Mississippi as a Province, Territory and State* (Jackson, 1880), gives the best account of the period before the Civil War. R. Lowry and W. H. McCardle, *History of Mississippi* (New York, 1893), is useful for local history. Of most value for the history are the writings of P. J. Hamilton, J. W. Garner and F. L. Riley. Hamilton's *Colonial Mobile* (Boston and New York, 1898), and the *Colonization of the South* (Philadelphia, 1904) are standard authorities for the French and English periods (1699–1781). Garner's *Reconstruction in Mississippi* (New York, 1902) is judicial, scholarly and readable. Most of Riley's work is in the *Publications of the Mississippi Historical Society* (Oxford, 1898 seq.), which he edited; see his *Spanish Policy in Mississippi after the Treaty of San Lorenzo*, i. 50-66; *Location of the Boundaries of Mississippi*, iii. 167-184; and *Transition from Spanish to American Rule in Mississippi*, iii. 261-311. There is much material in the *Encyclopaedia of Mississippi History* (2 vols., Madison, Wisconsin, 1907), edited by Dunbar Rowland. There is a state Department of Archives and History.

MISSISSIPPI[5] RIVER, the central artery of the river system which drains the greater part of the United States of America lying between the Appalachian Mountains on the east and the Rocky Mountains on the west. It rises in the basin of Itasca Lake, in northern Minnesota, and flows mostly in a southerly direction to the Gulf of Mexico. In the region of its headwaters are numerous lakes which were formed by glacial action, but the river itself was old before the glacial period, as is shown by the crumbling rocks on the edges of the broad and driftless valley through which it flows along the S.E. border of Minnesota and the S.W. border of Wisconsin, in contrast with the precipitous bluffs of hard rock on the edges of a valley that is narrow and steep-sided farther down where the river was turned from its ancient course by the glacier. So long as the outlet of the Great Lakes through the St Lawrence Valley was blocked by the icy mass, they were much larger than now and discharged through the Wabash, Illinois and other rivers into the Mississippi. Below the glaciated region, that is from southern Illinois to the Gulf, the river had carved before the close of the glacial period a flood-plain varying in width from 5 to 80 m., but this has been filled to a depth of 100 ft. or more with alluvium, and in the post-glacial period an inner valley has been formed within the outer one. The total length of the river proper from the source near Lake Itasca to its mouth in the Gulf of Mexico is 2553 m.; but the true source of the river is at the fountain-head of the Missouri, in the Rocky Mountains, on the S.W. border of Montana, 8000 ft. above the sea, and from this source there is a continuous stream to the Gulf which is 4221 m. long—the longest in the world. The Mississippi and its tributaries have more than 15,000 m. of navigable waterways and drain an area of approximately 1,250,000 sq. m. The system extends through the heart of the continent and affords a direct line of communication between temperate and tropical regions. Certain physical and hydrographic features, however, make the regulation and control of the Mississippi below the influx of the Missouri an exceedingly difficult problem.

The Upper Mississippi, that is the Mississippi from its source to the mouth of the Missouri, drains 173,000 sq. m., over which the annual rainfall averages 34·7 in., and its discharge per second into the Lower Mississippi varies from 25,000 cub. ft. to 550,000 cub. ft. The Missouri drains 528,000 sq. m., over which the annual rainfall averages 19·6 in., and its discharge per second into the Mississippi varies from 25,000 cub. ft. to 600,000 cub. ft. The Ohio drains 214,000 sq. m., over which the annual rainfall averages 43 in., and its discharge per second varies from 35,000 cub. ft. to 1,200,000 cub. ft. The Arkansas drains 161,000 sq. m., over which the annual rainfall averages 28·3 in., and its discharge per second varies from 4000 cub. ft. to 250,000 cub. ft. The Red drains 97,000 sq. m., over which the annual rainfall averages 38·3 in., and its discharge per second varies from 3500 cub. ft. to 180,000 cub. ft. These and a few smaller tributaries produce a river which winds its way from Cape Girardeau, Missouri, to the passes through a flood plain averaging about 40 m. in width and having a general southern slope of 8 in. to the mile. The general lateral slope towards the foothills is about 6 in. in 5000 ft., but the normal fall in the first mile is about 7 ft. Thus the river sweeps onward with great velocity, eroding its banks in the bends and rebuilding them on the points, now forming islands by its deposits, and now removing them. Chief among the changes is the formation of cut-offs. Two eroding bends gradually approach each other until the water forces a passage across the narrow neck. As the channel distance between these bends may be many miles, a cascade perhaps 5 or 6 ft. in height is formed, and the torrent rushes through with a roar audible for miles. The checking of the current at the upper and lower mouths of the abandoned channel soon obstructs them by deposit, and forms in a few years one of the crescent lakes which are so marked a feature on the maps. At the mouth of the Red river, 316 m. above the passes, the water surface at the lowest stage is only 5½ ft. above the level of the Gulf, where the mean tidal oscillation is about 1½ ft. The river channel in this section is therefore a fresh-water lake. At the flood stage the surface rises 50 ft. at the mouth of Red river, but of course retains its level at the Gulf, thus giving the head necessary to force forward the increased volume of discharge. Above the mouth of the Red river the case is essentially different. The width increases and the depth decreases. Hence the general slope in long distances is here nearly the same at all stages. The effect of these different physical conditions appears in the comparative volumes which pass through the channel. At New Orleans the maximum discharge hardly reaches 1,200,000 cub. ft. per second, and a rising river at high stages carries only about 100,000 cub. ft. per second more than when falling at the same absolute level; but just below the mouth of the Ohio the maximum flood volume reaches 1,400,000 cub. ft. per second, and at some stages a rising river may carry one-third more water than when falling at the same absolute level. The river is usually lowest in October. It rises rapidly until checked by the freezing of the northern tributaries. It begins to rise again in February, as a consequence of the storms from the Gulf which traverse the basin of the Ohio, and attains its highest point about the 1st of April. It then falls a few feet, but the rains in the Upper Mississippi basin cause it to rise again and high water is maintained until some time in June by the late spring and early summer rains in the Missouri basin. As a rule the river is above mid-stage from January to August inclusive, and below that level for the remainder of the year.

Engineering Works.—Below Cape Girardeau there are at least 29,790 sq. m. of rich bottom lands which require protection from floods, and this has been accomplished to a great extent by the erection of levees. The first levee was begun in 1717, when the engineer, Le Blond de La Tour (d. about 1725) erected one a mile long to protect the infant city of New Orleans from overflow. Progress at first was slow. In 1770 the settlements extended only 30 m. above and 20 m. below New Orleans; but in 1828 the levees, although quite insufficient in dimensions, had become continuous nearly to the mouth of the Red river. In 1850 a great impulse was given to systematic embankment by the United States government, which turned over to the several states all unsold swamps and overflowed lands within their limits, to provide a fund for reclaiming the districts liable to inundation. The action resulting from this caused alarm in Louisiana. The aid of the government was invoked, and Congress immediately ordered the necessary investigations and surveys. This work was placed in charge of Captain (later General) Andrew A. Humphreys (1810–1883), and an elaborate report covering the results of ten years of investigation was published, just after the outbreak of the Civil War in 1861. In this report it was demonstrated that the great bottom lands above the Red river before the construction of their levees did not, as had been supposed, in Louisiana, serve as reservoirs to diminish the maximum wave in great flood seasons. Furthermore, the report argued that no diversion of tributaries was possible; that no reservoirs artificially constructed could keep back the spring freshets which caused the floods; that the making of cut-offs, which had sometimes been advocated as a measure of relief, was in the highest degree injurious; that outlets were impracticable from the lack of suitable sites; and, finally, that levees properly constructed and judiciously placed would afford protection to the entire alluvial region.

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[1] Removed from office by Federal troops, 22nd of May 1865; W. L. Sharkey was appointed provisional governor by President Johnson.

[2] Removed from office by U.S. troops 15th of June 1868.

[3] Resigned 30th of November 1871.

[4] Resigned 29th of March 1876; succeeded by the president of the senate.

[5] The name is from the Algonkin *missi-sepe*, literally "father of waters."

During the Civil War (1861–65) the artificial embankments were neglected; but after its close large sums were expended by the states directly interested in repairing them. The work was done without concert upon defective plans, and a great flood early in 1874 inundated the country, causing terrible suffering and loss. Congress, then in session, passed an act creating a commission of five engineers to determine and report on the best system for the permanent reclamation of the entire alluvial region. Their report, rendered in 1875, endorsed the conclusions of that of 1861, and advocated a general levee system on each bank. This system comprised: (1) a main embankment raised to specified heights sufficient to restrain the floods; and (2) where reasonable security against caving required considerable areas near the river to be thrown out, exterior levees of such a height as to exclude ordinary high waters, but to allow free passage to great floods, which as a rule occur only at intervals of five or six years. An engineering organization was proposed for constructing and maintaining these levees, and a detailed topographical survey was recommended to determine their precise location. Congress promptly approved and ordered the survey; but strong opposition on constitutional grounds was raised to the construction of the levees by the government.

In the meantime complaints began to be heard respecting the low-water navigation of the river below the mouth of the Ohio. A board of five army engineers, appointed in 1878 to consider a plan of relief, reported that a depth of 10 ft. could probably be secured by narrowing the wide places to about 3500 ft. with hurdle work, brush ropes or brush dykes designed to cause a deposit of sediment, and by protecting caving banks by light and cheap mattresses. Experiments in these methods were soon begun and they proved to be effective.

The bars at the efflux of the passes at the mouth of the Mississippi were also serious impediments to commerce. The river naturally discharges through three principal branches, the south-west pass, the south pass and the north-east pass, the latter through two channels, the more northern of which is called Pass à l'Outre. In the natural condition the greatest depth did not exceed 12 or 13 ft. After appropriations by Congress in 1837, 1852 and 1856, a depth of 18 ft. was finally secured by dredging and scraping. The report of 1861 discussed the subject of bar formation at length, and the stirring up of the bottom by scrapers during the flood stages of the river (six months annually) was recommended by it. After the war this recommendation was carried into effect for several years, but experience showed that not much more than 18 ft. could be steadily maintained. This depth soon became insufficient, and in 1873 the subject was discussed by a board of army engineers, the majority approving a ship canal. In 1874 Congress constituted a special board which, after visiting Europe and examining similar works of improvement there, reported in favour of constructing jetties at the south pass, substantially upon the plan used by Pieter Caland (b. 1826) at the mouth of the Meuse; and in 1875 Captain James B. Eads (1820–1887) and his associates were authorized by Congress to open by contract a deep channel through the south pass upon the general plan proposed by this board. As modified in 1878 and 1879 the contract called for the maintenance for twenty years of a channel through the pass and over the bar not less than 26 ft. in depth throughout, a width of not less than 200 ft. and with a middle depth of 30 ft. The work was begun on the 2nd of June 1875. The required depth was obtained in 1879, and with few interruptions has been maintained. In 1902 Congress authorized preparations for the construction of a deeper (35 ft.) and a wider channel through the south-west pass; the work was begun in 1903 and virtually completed in 1909.

In the year in which Captain Eads opened the south pass of deep-water navigation Congress created a commission of seven members to mature plans for correcting and deepening the channel of the river, for protecting its banks and for preventing floods, and since then large expenditures for improvement between the head of the passes and the mouth of the Ohio have been under the control of this commission. In protecting the banks, mattresses of brush or small trees, woven like basket-work, were sunk on the portion of the bank at the time under water, by throwing rubble stone upon them, an excess of stone being used. A common size of mattress was 800 ft. long, counted along the bank, by 250 ft. wide. Sometimes a width of 300 ft. was used, and lengths have reached 2000 ft. The depth of water was often from 60 to 100 ft. At first these mats were light structures, but the loss of large quantities of bank protection by the caving of the bank behind them, or by scour at their channel edges, forced the commission steadily to increase the thickness and strength of the mattress, so that the cost of the linear foot of bank protection, measured along the bank, rose from $8 or $10 to $30 in the later work. The contraction works adopted were systems of spurs or pile dykes, running out from the shore nearly to the line of the proposed channel. Each dyke consisted of from one to four parallel rows of piles, the interval between rows being about 20 ft. and between piles in a row 8 or 10 ft. The piles and rows were strongly braced and tied together, and in many cases brush was woven into the upper row, forming a hurdle, in order further to diminish the velocity of the water below the spur. By 1893 it was evident that the cost, which had been estimated at $33,000,000 in 1881, would really be several times that amount, and that the works would require heavy expense for their maintenance and many years for their execution. Navigation interests demanded more speedy relief. The commission then began experimenting with hydraulic dredges, and in 1896 it adopted a project for maintaining a channel from the mouth of the Ohio to the passes that should be at least 9 ft. deep and 250 ft. wide throughout the year. Centrifugal pumps are used, the suction pipes being at the bow and the discharge at the stern through a line of pipes about 1000 ft. long, supported on pontoons. Water jets or cutters stir up the material to be dredged before it enters the suction pipes. The later dredges have a capacity of about 1000 cub. yds. of sand per hour, the velocity in the 32- to 34-in. discharge pipes being from 10 to 15 ft. per second. They cost from $86,000 to $120,000, and their working during a low-water season costs about $20,000. These dredges begin work on a bar where trouble is feared before the river reaches its lowest stage, and make a cut through it. A common cut is 2000 ft. long by 250 ft. wide, and 3 or 4 ft. deep. Since 1903 a channel of the proposed depth or more has been maintained.

In 1882 occurred one of the greatest floods known on the Mississippi, and extensive measurements of it were made. A maximum flood of 1,900,000 cub. ft. per second crossed the latitude of Cairo. Much of it escaped into the bottom lands, which are below the level of the great floods, and flowed through them to rejoin the river below. The flow in the river proper at Lake Providence, 542 m. below Cairo, was thus reduced to about 1,000,000 cub. ft. per second, while if the river had been confined by levees the flow between them would have been double, or about 2,000,000 cub. ft. per second. The volume of the levees in 1882 was about 33,000,000 cub. yds., and by the 30th of June 1908 had been increased to 219,621,594 cub. yds., of which the United States had built about one-half, and has expended on them $22,562,544. The length of the levees is about 1486 m., and they are continuous save where interrupted by tributaries or by high lands, from New Madrid, or 80 m. below Cairo, to Fort Jackson, 1039 m. below Cairo. The width of the interval between levees on the opposite banks of the river varies greatly; in many places the levees are built much nearer the normal margin of the river than is consistent with keeping the flood heights as low as possible. This has arisen from two causes: firstly, to give protection to lands already cultivated, which lie usually near the bank of the river; secondly, to avoid the lower ground, which, owing to the peculiar formation, is found as one goes back from the river. Another bad result of this nearness of the levees to the bank of the river is the loss of levees by caving, which was nearly 5,000,000 cub. yds. in 1904–1905, and can only be prevented by bank protection, costing $150,000 per mile, to protect a levee perhaps 16 ft. high costing about $30,000 per mile. The levees have top widths of 8 ft., side slopes of one-third, and banquettes when their heights exceed about 10 ft. The grades of the levees are usually 3 ft. above the highest water, and have to be raised from year to year as greater confinement of water gives greater flood heights. When this system is completed there will probably be hundreds of miles of levee with heights exceeding 14 ft. In 1899, after about $28,000,000 had been spent on levees by the United States and by the local authorities, the commission submitted an estimate for additional work on levees, amounting to 124,000,000 cub. yds. and costing $22,000,000. The effect of the levees has been to increase flood heights. Though the

Mississippi River Commission was forbidden by Congress to build levees to protect lands from overflow, a majority of its members believed them useful for the purpose of navigation improvement. They have, however, effected no sensible improvement in the navigation of the river at low stages, and at other stages no improvement was needed for the purposes of navigation. Neither did they prevent a destructive flood in 1897 and again in 1903. By the 30th of June 1908, $57,510,216.81 had been appropriated for the commission's work below the mouth of the Ohio.

From the mouth of the Ohio to the mouth of the Missouri, a distance of about 210 m., the river is affected by back water from the Ohio which increases the deposit of sediment, and although the banks increase in height above Cape Girardeau the channel was in its natural state frequently a mile or more in width, divided by islands, and obstructed by bars on which the low-water depth was only 3½ to 4 ft. The improvement was begun in 1872, and in 1881 a project was adopted for narrowing the channel to approximately 2500 ft. In 1896 dredging was begun and in 1905 the further execution of the original project of 1881 was discontinued, because of a new plan for a channel 14 ft. deep from the Great Lakes to the Gulf.

The Upper Mississippi carries only a small amount of sediment and was navigable in its natural state to St Paul, although at low water the larger river boats could ascend no farther than La Crosse, Wisconsin. In 1879 Congress adopted a project for obtaining a channel with a minimum depth at low water of 4½ ft., chiefly by means of contraction works. In 1907 Congress authorized further contraction, dredging, the construction of a lateral canal at Rock Island Rapids, and the enlargement of that at Des Moines Rapids with a view to obtaining a channel nowhere less than 6 ft. in depth at low water. By means of two locks and dams, which were begun in 1894 and were about three-fourths complete in 1908, a navigable channel of the same depth will be extended from St Paul to Minneapolis. The United States government has constructed dams at the outlets of lakes Winnibigashish, Cass, Leech, Pine, Sandy and Pokegama, and thereby created reservoirs having a total storage capacity of about 95,000,000,000 cub. ft. This reservoir system, which may be much enlarged, is also beneficial in that it mitigates floods and regulates the flow for manufacturing purposes and for logging.

Although the United States government has expended more than $70,000,000 on the Mississippi river between the mouth of the Missouri and the head of the passes, the improvement of navigation thereon has not been great enough to make it possible for river freighters to force down railway rates by competition. But it is no longer merely a question of competition. The productivity of this region has become so enormous that railways alone cannot meet the requirements of its commerce, and a persistent demand has arisen for a channel 14 ft. deep from the Great Lakes to the Gulf. The first great impetus to this demand was given in 1900, when a canal 24 ft. in depth, and known as the Chicago Drainage Canal, was opened from the Chicago river to Lockport, Illinois, on the Des Plaines river, 34 m. from Lake Michigan. Two years later Congress appropriated $200,000 for the Mississippi River Commission to make a survey and prepare plans, with estimates of cost, for a navigable waterway 14 ft. in depth from Lockport to St Louis. The commission reported favourably in 1905, and in 1907 Congress provided for another commission, which in June 1909 reported against the 14 ft. channel, estimating that it would cost $128,000,000 for construction and $6,000,000 annually for maintenance, and considered a 9-ft. channel (8 ft. between Ohio and St Louis) sufficient for commercial purposes.

The Ohio is commercially the most important tributary, and in flood time most of the commerce on the Lower Mississippi consists of coal and other heavy freight received from the mouth of this river. Its navigation at low water has also been improved by dredging, rock excavation and contraction works. In its upper reaches a channel 9 ft. in depth had been obtained before 1909 by the construction of a number of locks with collapsible dams which are thrown down by a flood. It is the plan of the government to extend this system to the mouth of the river, and it has been estimated that a channel 12 to 14 ft. in depth may ultimately be obtained by a system of mountain reservoirs. Furthermore, the government has given to a corporation a franchise for the connexion of the Ohio at Pittsburg with Lake Erie near Ashtabula, Ohio, by means of a canal 12 ft. in depth. The Missouri is navigable from its mouth to Fort Benton, a distance of 2285 m., and it had become a very important highway of commerce when the first railway, the Hannibal & St Joseph, reached it in 1859. Its commerce then rapidly disappeared, but regular navigation between Kansas City and St Louis was re-established in 1907 and a demand has arisen for a 12-ft. channel from the mouth of the river to Sioux City, Iowa. The Red, Arkansas, White, Tennessee, and Cumberland rivers, which are parts of the Mississippi system, have each a navigable mileage exceeding 600 m.

History.—Although the Mississippi river was discovered in its lower course by Hernando de Soto in 1541, and possibly by Alonso Alvarez de Pineda in 1519, Europeans were not yet prepared to use the discovery, and two Frenchmen, Louis Joliet and Father Jacques Marquette, first made it generally known to the civilized world by a voyage down the river from the mouth of the Wisconsin to the mouth of the Arkansas in 1673.[1] In 1680 Louis Hennepin, sent by La Salle, who planned to acquire for France the entire basin drained by the great river and its tributaries, explored the river from the mouth of the Illinois to the Falls of St Anthony, where the city of Minneapolis now stands, and two years later La Salle himself descended from the mouth of the Illinois to the Gulf, named the basin "Louisiana," and took formal possession of it in the name of his king, Louis XIV. By the war which terminated (1763) in the Treaty of Paris, Great Britain wrested from France all that part of the basin lying east of the middle of the river (except the island of New Orleans at its mouth), together with equal rights of navigation; and the remainder of the basin France had secretly ceded to Spain in 1762. During the War of Independence the right to navigate the river became a troublesome question. In 1779 the Continental Congress sent John Jay to Spain to negotiate a treaty of commerce, and to insist on the free navigation of the Mississippi, but the Spanish government refused to entertain such a proposition, and new instructions that he might forego that right south of 31° N. latitude reached him too late. While the commissioners from Great Britain and the United States were negotiating a treaty of peace at Paris, Spain, apparently supported by France, sought to prevent the extension of the western boundary of the United States to the Mississippi, but was unsuccessful, and the United States acquired title in 1783 to all that portion of the basin east of the middle of the river and north of 31° N. lat. In 1785 Congress appointed John Jay to negotiate a commercial treaty with Don Diego de Gardoqui, the Spanish minister to the United States, but the negotiations resulted in nothing. For the next ten years the Spaniards imposed heavy burdens on the American commerce down the Mississippi, but in 1794 James Monroe, the United States minister to France, procured the aid of the French government in further negotiations, for which Thomas Pinckney had been appointed envoy extraordinary, and in 1795 Pinckney negotiated a treaty which granted to the United States the free navigation of the river from its source to the Gulf and the privilege of depositing American merchandise at the port of New Orleans or at some other convenient place on the banks. Spain retroceded Louisiana to France in 1800, but the Louisiana Purchase in 1803 left very little of the Mississippi basin outside of the United States.

As the headwaters of the river were not definitely known, the United States government sent Zebulon M. Pike in 1805 to explore the region, and on reaching Leech Lake, in February 1806, he pronounced that the main source. In 1820 Lewis Cass, governor of Michigan territory, which then had the Mississippi for its western boundary, conducted an expedition into the same region as far as Cass Lake, where the Indians told him that the true source was about 50 m. to the W.N.W., but as the water was too low to proceed by canoe he returned, and it remained for Henry Schoolcraft, twelve years later, to discover Lake Itasca, which occupies a low depression near the centre of the basin in which the river takes its rise. Jean N. Nicollet, while in the service of the United States government, visited Lake Itasca in 1836, and traced its principal affluent, since known as Nicollet's Infant Mississippi river, a few miles S.S.W. from the lake's western arm. Jacob Vradenberg Brower (1844–1905), who was commissioned by the Minnesota Historical Society in 1889 to make a more detailed survey, traced the source from Nicollet's Infant Mississippi to the greater ultimate reservoir, which contains several lakelets, and lies beyond Lake Itasca, 2553 m. by water from the Gulf of Mexico, and 1558 ft. above the sea. Soon after this survey the state of Minnesota created Itasca State Park, which contains both Itasca Lake and its affluents from the south.

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[1] It seems probable that Joliet and Marquette were preceded by two other Frenchmen, Pierre Esprit Radisson and Menard Chouart des Groseilliers, who apparently reached the Upper Mississippi in or about 1665; but their claim to priority has been the subject of considerable controversy, and, at all events, there was no general knowledge of the river until after the voyage of Joliet and Marquette.

From the close of the 17th century until the building of the first railways in the Mississippi basin, in the middle of the 19th century, the waterways of the Mississippi system afforded practically the only means of communication in this region. During the early years of the French occupancy trade with the Indians was the only important industry, and this was carried on almost wholly with birch canoes and a few pirogues; but by 1720 immigrants were coming in considerable numbers both by way of the Great Lakes and the mouth of the Mississippi, and to meet the demands of a rapidly expanding commerce barges and keelboats were introduced. The development of the Mississippi Valley must have been slow until the railways came had it not been for the timely application of the power of steam to overcome the strong current of the Lower Mississippi. Even without the steamboat, however, the Mississippi was indispensable to the early settlers, and the delay of the United States in securing for them its free navigation resulted in threats of separation from the Union. The most formidable movement of this kind was that of 1787–1788, in which James Wilkinson, who had been an officer in the War of Independence, plotted for a union with Spain. Steamboat navigation on this river system was begun in 1811, when the "New Orleans," which had been built by Nicholas Roosevelt (1767–1854), made the trip from Pittsburg to New Orleans, but it was six years later before the steamboat was sufficiently improved to ascend to St Louis. In 1817 the commerce from New Orleans to the Falls of the Ohio, at Louisville, was carried in barges and keel-boats having a capacity of 60 to 80 tons each, and 3 to 4 months were required to make a trip. In 1820 steamboats were making the same trip in 15 to 20 days, by 1838 in 6 days or less; and in 1834 there were 230 steamboats, having an aggregate tonnage of 39,000 tons, engaged in trade on the Mississippi. Large numbers of flat boats, especially from the Ohio and its tributaries, continued to carry produce down stream; an extensive canal system in the state of Ohio, completed in 1842, connected the Mississippi with the Great Lakes; these were connected with the Hudson river and the Atlantic Ocean by the Erie Canal, which had been open since 1825. Before the steamboat was successfully employed on the Mississippi the population of the valley did not reach 2,000,000, but the population increased from approximately 2,500,000 in 1820 to more than 6,000,000 in 1840, and to 14,000,000 or more in 1860. The well-equipped passenger boats of the period immediately preceding the Civil War were also a notable feature on the Ohio and the Lower Mississippi.

In the Civil War the Lower Mississippi, the Ohio, and its two largest tributaries—the Cumberland and the Tennessee—being still the most important lines of communication west of the Appalachian Mountains, determined largely the movements of armies. The adherence of Kentucky to the Union excluded the Confederacy from the Ohio, but especially disastrous was the fall of Vicksburg and Port Hudson, whereby the Confederacy was cut in two and the entire Mississippi became a Federal highway. Under Federal control it was closed to commerce, and when the war was over the prosperity of the South was temporarily gone and hundreds of steamboats had been destroyed. Moreover, much of the commerce of the West had been turned from New Orleans, via the Mississippi, to the Atlantic seaboard, via the Great Lakes and by new lines of railways, the number of which rapidly increased. There was, of course, some revival of the Mississippi commerce immediately after the war, but this was checked by the bar at the mouth of the south-west pass. Relief was obtained through the Eads jetties at the mouth of the south pass in 1879, but the facilities for the transfer of freight were far inferior to those employed by the railways, and the steamboat companies did not prosper. But at the beginning of the 20th century the prospects of communication with the western coast of North America and South America, and with the Orient by way of an isthmian canal, the inadequate means of transportation afforded by the railways, the efficiency of competing waterways in regulating freight rates, and the consideration of the magnificent system of inland waterways which the Mississippi and its tributaries would afford when fully developed, have created the strong demand for river improvement.

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MISSOLONGHI, or Mesolonghi (*Μεσολόγγιον*), the chief town of the monarchy of Acarnania and Aetolia, Greece. It is on the N. side of the Gulf of Patras, about 7 m. from the coast; pop., about 8300. The place is notable for the siege which Mavrocordato and Botzaris sustained in 1822 and 1823 against a Turkish army 11,000 strong, and for the more famous defence of 1825–26. Byron died here in 1824, and is commemorated by a cenotaph and a statue.

MISSOULA, a city and the county-seat of Missoula county, Montana, U.S.A., on the Clark Fork of the Columbia (here called the Missoula river), about 125 m. W.N.W. of Helena. Pop. (1900), 4366 (1020 foreign-born); (1910), 12,869. It is served by the Chicago, Milwaukee & Puget Sound railway, and by the Northern Pacific railway, which has shops here and of which Missoula is a division headquarters. There is an electric railway from Missoula to Hamilton, about 48 m. south. The Northern Pacific railway maintains a large hospital here, and St Patrick's hospital is maintained by sisters of charity. Missoula is about 3200 ft. above sea-level, with Mount Jumbo immediately north, and University Mountain immediately south of the Clark Fork, and the Bitter Root range to the west. The city is situated on the bed of a prehistoric lake. Missoula is the seat of the Sacred Heart academy (for girls), of a Christian Brothers' school (for boys), of the Garden City commercial college, and of the state university (founded in 1893, and opened in 1895), which occupies a campus of 40 acres. On the Bitter Root river, 4 m. distant, is the United States army post, Fort Missoula. Missoula has considerable trade with the surrounding country in farming, fruit-growing, lumbering and mining. The Clark Fork furnishes water power, and at Bonner, 6 m. east, is the Clark dam (28 ft.), which furnishes electric power. Missoula was founded in 1864, and chartered as a city in 1887.

MISSOURI, a north-central state of the United States of America, and one of the greatest and richest, and economically one of the most nearly independent, in the Union, lying almost midway between the two oceans, the Gulf of Mexico and Canada. It is bounded N. by Iowa; E. by Illinois, Kentucky and Tennessee; S. by Arkansas; and W. by Oklahoma, Kansas and Nebraska. Its N. and S. limits are mainly coincident with the parallels of 40° 35′ and 36° 30′ N. lat.—the southernmost boundary, in the S.E. corner, is the meridian of 36° N. lat.—and much of the western border is the meridian of 94° 43′ W. long. respectively; but natural boundaries are afforded on the extreme N.E. by the Des Moines river, on the E. by the Mississippi, on the S.E. by the St Francis and on the N.W. by the

Missouri. Altogether, about 850 m., or considerably more than half of the entire boundary, is water-front: about 560 m. along the Mississippi, about 208 m. along the Missouri, and about 100 m. along the St Francis and Des Moines. The length of the state from north to south, disregarding the St Francis projection southward, is 282 m.,[1] the width from west to east varies from 208 to 308 m., and the total area is 69,420 sq. m., of which 693 sq. m. are water surface.

Physical Features.—Missouri has three distinct physiographic divisions: a north-western upland plain, or prairie region; a lowland, in the extreme south-east; and, between these, the Missouri portion of the Ozark uplift. The boundary between the prairie and Ozark regions follows the Missouri river from its mouth to Glasgow, running thence south-westward, with irregular limits, but with a direct trend, to Jasper county at the south-east corner of Kansas; and the boundary between the Ozark and embayment regions runs due south-west from Cape Girardeau.

1. The prairie region embraces, accordingly, somewhat more than "northern" Missouri—*i.e.* the portion of the state north of the Missouri river—and somewhat more than a third of the state. It is a beautiful, rolling country, with a great abundance of streams; more hilly and broken in its western than in its eastern half. The elevation in the extreme north-west is about 1200 ft. and in the extreme north-east about 500 ft., while the rim of the region to the south-east, along the border of the Ozark region, has an elevation of about 900 ft. The larger streams have valleys 250 to 300 ft. deep and sometimes 8 to 10 m. broad, the country bordering them being the most broken of the region. The smaller streams have so eroded the whole face of the country that little of the original surface plain is to be seen. The Mississippi river is skirted throughout the length of the state by contours of 400 to 600 ft. elevation.

2. The Ozark region is substantially a low dome, with local faulting and minor undulations, dominated by a ridge—or, more exactly, a relatively even belt of highland—that runs from near the Mississippi about Ste Genevieve county to Barry county on the Arkansas border; the contour levels falling with decided regularity in all directions below this crest. High rocky bluffs that rise precipitously on the Mississippi, sometimes to a height of 150 ft. or so above the water, from the mouth of the Meramec to Ste Genevieve, mark where that river cuts the Ozark ridge, which, across the river, is continued by the Shawnee Hills in Illinois. The elevations of the crest in Missouri (the highest portion of the uplift is in Arkansas) vary from 1100 to 1600 ft. This second physiographic region comprehends somewhat less than two-thirds of the area of the state. The Burlington escarpment, which in places is as much as 250 to 300 ft. in height, runs along the western edge of the Cambro-Ordovician formations and divides the region into an eastern and a western area, known respectively to physiographers as the Salem Upland and the Springfield Upland.[2] Superficially, each is a simple rolling plateau, much broken by erosion (though considerable undissected areas drained by underground channels remain), especially in the east, and dotted with hills; some of these are residual outliers of the eroded Mississippian limestones to the west, and others are the summits of an archaean topography above which sedimentary formations that now constitute the valley-floor about them were deposited and then eroded. There is no arrangement in chains, but only scattered rounded peaks and short ridges, with winding valleys about them. The highest points in the state are Tom Sauk Mountain (more than 1800 ft.), in Iron county and Cedar Gap Plateau (1683 ft.), in Wright county. Few localities have an elevation exceeding 1400 ft. Rather broad, smooth valleys, well degraded hills with rounded summits, and—despite the escarpments—generally smooth contours and sky-lines, characterize the whole of this Ozark region.

3. The third region, the lowlands of the south-east, has an area of some 3000 sq. m. It is an undulating country, for the most part well drained, but swampy in its lowest portions. The Mississippi is skirted with lagoons, lakes and morasses from Ste Genevieve to the Arkansas border, and in places is confined by levees.

The drainage of the state is wholly into the Mississippi, directly or indirectly, and almost wholly into either that river or the Missouri within the borders of the state. The latter stream, crossing the state and cutting the eastern and western borders at or near St Louis and Kansas City respectively, has a length between these of 430 m. The areas drained into the Mississippi outside the state through the St Francis, White and other minor streams are relatively small. The larger streams of the Ozark dome are of decided interest to the physiographer. Those of the White system have open-trough valleys bordered by hills in their upper courses and canyons in their lower courses; others, notably the Gasconade, exhibit remarkable differences in the drainage areas of their two sides, with interesting illustrations of shifting water-partings; and the White, Gasconade, Osage and other rivers are remarkable for upland meanders, lying, not on flood-plains, but around the spurs of a highland country.[3]

Caves, chiefly of limestone formation, occur in great numbers in and near the Ozark Mountain region in the south-western part of Missouri. More than a hundred have been discovered in Stone county alone, and there are many in Christian, Greene and McDonald counties. The most remarkable is Marble Cave, a short distance south-east of the centre of Stone county. The entrance is through a large sink-hole at the top of Roark Mountain, from which there is a passage-way to an open chamber. This extraordinary hall-like room is about 350 ft. long and about 125 ft. wide, has bluish-grey limestone walls, and an almost perfectly vaulted roof, rising from 100 to 195 ft. Its acoustic properties are said to be almost perfect, and it has been named "the Auditorium." At one end is a remarkable stalagmitic formation of white and gold onyx, about 65 ft. in height and about 200 ft. in girth, called "the White Throne." Jacob's Cavern (*q.v.*), near Pineville, McDonald county, disclosed on exploration skeletons of men and animals, rude implements, &c. Crystal Cave, near Joplin, Jasper county, has its entire surface lined with calcite crystals and scalenohedron formations, from 1 ft. to 2 ft. in length. Knox Cave, in Greene county, and several caverns near Ozark, in Christian county, are also of interest. Other caves include Fried's Cave, about 6 m. north-east of Rolla, Phelps county, Hannibal Cave (in Ralls county, about 1 m. south of Hannibal), which has a deep pool containing many eyeless fish; and various caverns in Miller, Ozark, Greene and Parry counties.

Geology.—The geological history of the state covers the period from Algonkian to late Carboniferous time, after which there is a gap in the record until Tertiary time, except that there was apparently a temporary depression of the north-western and south-western corners in the Cretaceous age. Northern Missouri is covered with a mantle of glacial deposits, generally thick, although in the stream valleys of the north-east the bed-rocks are widely exposed. The southern limit of these glacial deposits is practically the bluffs bordering the Missouri river, except for a narrow strip along the Mississippi below St Louis. These Pleistocene deposits include bouldery drift, loess, terrace deposits and alluvium. The till is generally less than 5 ft. and rarely more than 40 ft. deep, but in some localities it reaches a thickness of 200 ft., or even more. Modified drift and erratics were also widely deposited. The loess, however—reddish-brown, buff or grey in colour, according to the varying proportions of iron oxide—is almost everywhere spread above the drift. It is exposed in very deep cuts along the bluffs of the Missouri. Southern Missouri is covered, generally speaking, with residuary rocks. The embayment region is of Tertiary origin, containing deposits of both neocene and eocene periods. Regarding now the outcrops of bed-rock, there are exposures of Algonkian (doubtful, and at most a mere patch on Pilot Knob), Archean, Cambrian, Ordovician, Silurian, Devonian, sub-Carboniferous and Carboniferous. The St François Mountains and the neighbouring portion of the Ozark region are capped with Archean rocks. All the rest of the Ozark region except the extreme south-western corner of the state is Cambro-Ordovician. Along the margin of this great deposit, on the Mississippi river below St Louis and along the northern shore of the Missouri near its mouth, is an outcrop of Silurian. Parallel to this in the latter locality, and lying also along the Mississippi near by to the north, as well as in the intervening country between the two rivers, are strips of Devonian. Both this and the Silurian are mere fringes on the great area of Cambro-Ordovician. Next, covering the north-eastern and south-western corners of the state, and connecting them with a narrow belt, are the lower Carboniferous measures (which also appear in a very narrow band along the Mississippi for some distance below St Louis). The western edge of these follows an irregular line from Schuyler county, on the northern border, to Barton county, on the western border, of the state, but with a great eastward projection north of the Missouri river, to Montgomery county. This line defines the eastern limit of the Coal Measures proper, which cover a belt 20 to 80 m. in width. Finally, to the west of these, and covering the north-western corner of the state, are the upper coal-measures. Thus the state is to be conceived, in geological history, as gradually built up around an Archean island in successive seas, the whole of the state becoming dry land after the post-Carboniferous uplift. Until the post-Mesozoic uplift of the Rocky Mountain region the north-western portion of the state drained westward.

Fauna.—Excepting the embayment region, Missouri lies wholly within the Carolinian area of the Upper Austral life-zone; the

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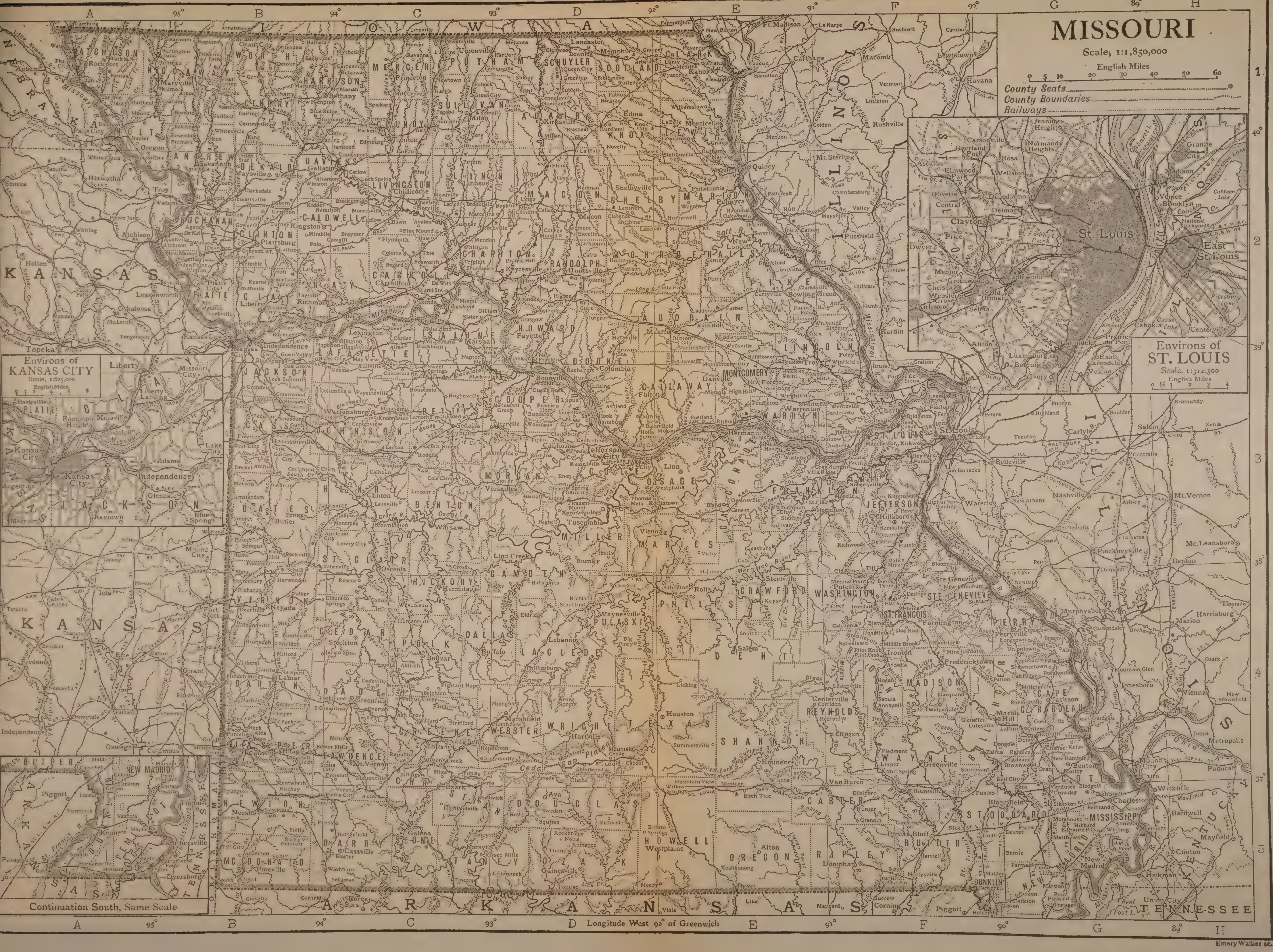
[1] Counting the St Francis projection the length is 328 m.

[2] Both the Ozark region and the prairie region are divided by minor escarpments into ten or twelve sub-regions.

[3] There has been some controversy as to whether this condition is due to the elevation and corrosion of original flood-plain meanders after their development in a past base-level condition—which theory is probably correct—or to the natural, simultaneous lateral and vertical cut of an originally slightly sinuous stream, under such special conditions of stream declivity and horizontal bed-strata (conditions supposed by some to be peculiarly fulfilled in this region) as would be favourable to the requisite balance of bank cutting and channel incision.


MISSOURI
Scale; 1:1,850,000
English Miles
0 5 10 20 30 40 50 60
County Seats
County Boundaries
Railways
Environs of ST. LOUIS
Scale, 1:312,500
English Miles
Environs of KANSAS CITY
Scale, 1:625,000
English Miles
Continuation South, Same Scale
NEW MADRID
Longitude West 92° of Greenwich
A B C D E F G H
95° 94° 93° 92° 91° 90° 89°
40° 39° 38° 37° 36°
1 2 3 4 5
IOWA
NEBRASKA
KANSAS
ILLINOIS
KENTUCKY
TENNESSEE
ARKANSAS
ATCHISON
NODAWAY
WORTH
HARRISON
MERCER
PUTNAM
SCHUYLER
SCOTLAND
CLARK
HOLT
ANDREW
GENTRY
DEKALB
DAVIESS
GRUNDY
SULLIVAN
ADAIR
KNOX
LEWIS
BUCHANAN
CLINTON
CALDWELL
LIVINGSTON
LINN
MACON
SHELBY
MARION
PLATTE
CLAY
RAY
CARROLL
CHARITON
RANDOLPH
MONROE
RALLS
PIKE
JACKSON
LAFAYETTE
SALINE
HOWARD
BOONE
AUDRAIN
LINCOLN
MONTGOMERY
CALLAWAY
CASS
JOHNSON
PETTIS
COOPER
MONITEAU
MORGAN
COLE
OSAGE
WARREN
ST. CHARLES
ST. LOUIS
GASCONADE
FRANKLIN
JEFFERSON
BATES
HENRY
BENTON
MILLER
MARIES
ST. CLAIR
HICKORY
CAMDEN
PHELPS
CRAWFORD
WASHINGTON
ST. FRANCOIS
STE. GENEVIEVE
VERNON
CEDAR
POLK
DALLAS
LACLEDE
PULASKI
DENT
IRON
PERRY
BARTON
DADE
GREENE
WEBSTER
WRIGHT
TEXAS
SHANNON
REYNOLDS
MADISON
BOLLINGER
CAPE GIRARDEAU
JASPER
LAWRENCE
CHRISTIAN
DOUGLAS
HOWELL
CARTER
WAYNE
STODDARD
SCOTT
NEWTON
BARRY
STONE
TANEY
OZARK
OREGON
RIPLEY
BUTLER
MISSISSIPPI
NEW MADRID
MC DONALD
DUNKLIN
PEMISCOT
Missouri R.
Mississippi R.
St. Louis
Kansas City
Jefferson City
St. Joseph
Springfield
Hannibal
Sedalia
Joplin
Cape Girardeau

Emery Walker sc.

embayment lies in the Austro-riparian area of the same zone. Among wild animals, deer and bear are not uncommon. Opossums, raccoons, woodchucks, foxes, grey squirrels and fox-squirrels are common. The game birds include quail ("Bob White") and partridges. Prairie chickens (pinnated grouse), pheasants and wild turkeys, all very common as late as 1880, are no longer to be found save in remote and thinly-settled districts. A state fish commission has laboured to increase the common varieties of river fish. So far as these are an article of general commerce, they come, like frogs, terrapin and turtles, mainly from the counties of the embayment region. Mussel fisheries, an industry confined to the Mississippi river counties from Lincoln to Lewis, are economically important, as the shells are used in the manufacture of pearl buttons. There are state fish-hatcheries at St Louis and St Joseph.

Flora.—The most valuable forests are in the southern half of the state, which, except where cleared for farms, is almost continuously wooded. An almost entire absence of underbrush is characteristic of Missouri forests. The finest woods are on the eastern upland and on the Mississippi lowlands. The entire woodland area of the state was estimated at 41,000 sq. m. by the national census of 1900. Ash, oaks, black and sweet gums, chestnuts, hickories, hard maple, beech, walnut and short-leaf pine are noteworthy among the trees of the Carolinian area; the tupelo and bald cypress of the embayment region, and long-leaf and loblolly pines, pecans and live oaks of the uplands, among those characteristic of the Austro-riparian. But the habitats overlap, and persimmons and magnolias of different species are common and notable in both areas. The heavy timber in the south-eastern counties (cypress, &c.), and even scattered stands of such valuable woods as walnut, white oak and red-gum, have already been considerably exploited.

Climate.—Missouri has a continental climate, with wide range of moisture and temperature. The Ozark uplift tempers very agreeably the summers in the south, but does not affect the climate of the state as a whole. The normal mean annual temperature for the entire state is about 54° F.; the normal monthly means through the year are approximately 29·6, 30·3, 42, 55·4, 64·6, 73·2, 77·1, 75·7, 68·2, 57, 42·8 and 33·1° F. The south-eastern corner is crossed by an annual isotherm of 60°, the north-western by one of 50°; and although in the former region sometimes not a day in the year may show an average temperature below freezing-point, at Jefferson City there are occasionally two months of freezing weather, and at Rockport three. Nevertheless, the yearly means of the five districts into which the state is divided by the national weather service exhibit very slight differences: approximately 52·1, 52·7, 54·4, 56·1 and 55·7° F. respectively for the north-west, north-east, central, south-east and south-west. On the other hand, the range in any month of local absolute temperatures over the state is habitually great (normally about 50° in the hottest and 100° or more in the coldest months), and likewise the annual range for individual localities (90° to 140°). Temperatures as high as 100° to 105° and as low as −20° or −30° are recorded locally almost every year, and the maximum range of extremes shown by the records is from 116° at Marble Hill, Bollinger county, in July 1901, to −40° at Warsaw, Benton county, in February 1905. The average fall of snow, which is mostly within the months from November to March inclusive, ranges from about 8 in. in the south-east counties to 30 in. in the north-west counties. The Missouri river is often closed by ice, and the Mississippi at St Louis, partly because it is obstructed by bridges, sometimes freezes over so that for weeks together horses and wagons can cross on the ice.

The average yearly rainfall for the state as a whole is about 39 in., ranging from 53·7 in. in 1898 to 25·3 in. in 1901. The prevailing winds are southerly, although west winds are common in winter. Winds from the north and west are generally dry, cool, clear and invigorating; winds from the south and east warm, moist and depressing. Rainfall comes from the Gulf of Mexico. The south-east winds blow from the arid lands and carry rising temperatures across the state; and the winter anti-cyclones from the north-west carry low temperatures even to the southern border. Missouri lies very frequently in the dangerous quadrant of the great cyclonic storms passing over the Mississippi valley—indeed, northern Missouri lies in the area of maximum frequency of tornadoes.

Agriculture.—Few states have so great a variety of soils. This variety is due to the presence of different forms of glacial drift, and to the variety of surface rocks. The northern half of the state is well watered and extremely fertile. The south-eastern embayment is rich to an exceptional degree. Speaking generally, the Ozark region is characterized by reddish clays, mixed with gravels and stones, and cultivable in inverse proportion to the amount of these elements; northern Missouri by a generally black clay loam over a clay subsoil, with practically no admixture of stones; the southern prairies, above referred to, share the characteristics of those north of the Missouri. The Mississippi embayment is in parts predominantly sandy, in others clayey; it is mainly under timber. The state as a whole is devoted predominantly to agriculture. Within its borders or close about them are the centres of total and of improved farm acreage, of total farm values, of gross farm income, of the growth of Indian corn, of wheat, and of oats. In 1900 agriculture absorbed the labour of 41·3% of the total working population of the state. Of the area of the state 77·3% was included in that year in farm land (33,997,873 acres); and of this, 67·4% was improved. The average size of a farm was 119·3 acres; 39·9% of all farm families owned a home clear of all incumbrance; and the percentages of farms operated by owners, cash tenants and share tenants were respectively 69·5, 11·0 and 19·5. Negroes worked 1·7% of the total acreage. The total value of farm-property was $1,033,121,897. The aggregate values of farm products in 1899 was $219,296,970, and this total consisted of $117,012,895 in crops (area in crops, 14,827,620 acres), $97,841,944 in animal products, and $4,442,131 of forest by-products of farm operations. Indian corn is the most prominent single crop; in 1899 it was valued at $61,246,305. Of other cereals none except wheat is produced in any quantity as compared with other states. Tobacco is grown over half the area of the state, but especially in the central and north-central counties, and cotton along the Arkansas border counties, but especially in the embayment lowlands. Orchard fruits, small fruits and grapes are produced in large quantities, and a fruit experiment station, the only institution of its kind in the country in 1900, is maintained by the state at Mountain Grove, in Wright county. To a slight extent it is possible to grow fruit of distinctively southern habitat, but even pears (a prominent and valuable crop) are uncertain in returns. Apples are grown to best advantage in the north-west quarter; peaches on the Arkansas border; pears along the Mississippi; melons in the sandy regions of the embayment; small fruits in the south-west. Grapes are mainly grown in the Ozark region, and wine is produced in Gasconade and other central and north-central counties in amounts sufficient to place Missouri, California aside, in the front rank of wine states in the Union. Indian corn and abundant grasses give to Missouri, as to the other central prairie states, a sound basis for her live-stock interests. In 1900 the value of her live stock was $160,540,004. Two of the four remount purchasing stations of the United States Army are at St Louis and Kansas City. As a mule market Missouri has no rival. Sheep are herded in the southern Ozarks.

Minerals.—Coal, lead, zinc, clays, building stones and iron are the most important minerals. Cobalt and nickel are associated with lead in the St François field; but though the American ouput is almost exclusively derived from Missouri the production is small in comparison with the amount derived from abroad. Practically the whole comes from Mine La Motte, in Madison county. Missouri is also the largest producer in the Union of tripoli and of barytes. Copper occurs in various localities, but is of economic importance only in the Ozark uplift; it was first mined in small quantities in 1837. The value of the copper mined in 1906 (based on smelter returns) was $54,347. Mineral waters—muriatic, alkaline chalybeate and sulphuric—occur widely. Various mineral paint bases (apart from lead, zinc, baryta and kaolin) are produced in small quantities. Iron, once an extremely important product, has ceased since about 1880 to be significant in the general production of the country. But it is of great importance to the state, nevertheless, and its production has possibilities much beyond present realization. The ore occurs in two forms, haematites and limonites; the specular hematites often being grouped, for practical purposes, into two classes—those occurring in porphyry and those occurring in sandstone. The haematites are found not only in the archean porphyries but in Cambrian limestone and sandstone, and in the sub-Carboniferous formations; while the limonites are confined almost exclusively to the Cambrian. The bedded haematites and limonites have been little exploited. Mining was begun in Iron and Crawford counties in the second decade of the 19th century; at Iron Mountain in 1846, and at Pilot Knob in the next year. Since 1880 the output of the state has been falling, and the total production up to 1902 did not exceed 9,000,000 tons of ore; in 1906 the output was 80,910 tons. Iron pyrites, which occurs widely and abundantly, has become of value as material for the preparation of sulphuric acid.

The limits of the coal belt have already been defined. The area of the Coal Measures is about 23,000 sq. m., and that of those classed by the National Geological Survey as probably productive is about 14,000 sq. m., or nearly the entire area of the lower measures. The coal is almost wholly bituminous, with very little cannelite. The seams are generally from one to five feet in thickness. Macon, Lafayette and Adair are the leading counties in output; Lexington and Bevier are the leading mining centres. The total output from 1840 to 1902 was about 78,500,000 short tons; the annual output first passed 1,000,000 tons in 1876, and 2,000,000 tons in 1882; and from 1901 to 1905 the yearly output, steadily increasing, averaged 4,196,688 tons, of a value at the mines of $6,266,154; the output in 1908 was 3,317,315 tons, with a spot value of $5,444,907. Superficial evidences of natural gas and petroleum are abundant in western and north-western Missouri, but these have not been found in commercially profitable quantities. The total value of natural gas from wells in Missouri in 1908 was $22,592. A few small oil wells are open near the Kansas line. Both crude oil and natural gas are drawn from Kansas for the supply of Kansas City and other parts of western Missouri.

Lead occurs in three areas in southern Missouri. In the first, of which St François county is the centre, it occurs generally alone disseminated in Cambrian limestone; in the second, of which the counties immediately south-west of Jefferson City are the centre, it occurs with zinc in reticulated deposits and fissure veins in clays and clastic limestones; and in the third, of which Jasper county is much the most important county, the two metals occur in pockets and joints in the Burlington-Keokuk beds of the sub-Carboniferous. The first is the great lead area, the third the great zinc area; the second is no longer of relative importance. The lead ores are galena and carbonate; the zinc ores, calamine, smithsonite and blende. The mines in the St François field were worked by the French from early in the 18th century. The oldest, Mine La Motte (Madison county), discovered in 1715 by De la Motte Cadillac, is still a heavy producer. St François county alone produces about nine-tenths the yield of the field; Madison, Washington, Jefferson and Franklin counties furnish most of the remainder. Large quantities of lead are also obtained from the zinc field of the south-west. Both the St François and Jasper ores yield from 70 to 75% of metal in final product, and assay even higher. It has been estimated that down to 1893 1,100,000 tons of ore, yielding metal worth $74,000,000, had been taken from the state, fully half of this having been mined in the preceding twenty years. The total output for the state in 1908 was 114,459 tons, valued at $12,134,556; of this 116,531 tons came from the central and south-east field, and of the remainder 15,240 tons from the Webb City—Prosperity camp. Zinc was originally a hindering by-product of lead mining in the south-west, and was thrown away; but it long ago became the chief product in value in this field. The so-called "Joplin district" of south-western Missouri and south-eastern Kansas—three-fourths of it being in Missouri—produces nine-tenths of all the zinc mined in the United States. Mining in south-western Missouri began about 1851, but zinc was of no importance in the output until 1872. In the next thirty-one years the aggregate product was about 3,000,000 tons of ore, worth some $100,000,000. The output from 1894 to 1905 averaged 219,874 tons of ore yearly; in 1908 it was 107,404 tons. The history of the St François, Granby and Joplin districts has been sensational. The fortunes of the last have largely revolutionized the conditions and prospects of the south-western counties. Silver is found in connexion with lead and zinc mining; in 1908 the total output was 49,131 oz., valued at $26,039. Clays occur in amounts and varieties surpassed by the deposits in very few if any states of the Union. They are in every form from the rare to the common—glass pot clay, ball clays, kaolins, flint fireclays, plastic fireclays, stone-ware clays, paving-brick shales, building-brick and gumbo clays. Plastic fireclays, paving and brick clays are available in seemingly limitless quantities. The loess, the re-sorted residual clays, and the glacial clays are all used for the production of brick. Clays occur, in short, all over the state; and their use is almost as general. In 1905 and 1907 the rank of Missouri was sixth in the Union in the value of clay products—namely, $6,203,411 in 1905 and $6,898,871 in 1907. There has been no more than the slightest beginning made in the utilization of these resources. Stone resources are also large. Limestones are by far the most important; red and gray granites, sandstones and marble (Ste Genevieve county) being of little more than local importance. In 1908 the total value of stone quarried was $2,306,058. Tripoli is quarried particularly in Newton county, where it has been produced since 1872, and though not produced in great quantities has value from its general scarcity. This Missouri tripoli is a finely decomposed light rock, about 98% silica, and is used for filter stones and as an abrasive. "Chat"—finely crushed flint and limestone yielded as tailings in the lead and zinc mines—finds many uses. Limestone is quarried all over the state (except in the embayment region). There are unlimited supplies of clay, shale and limestone, the three essential constituents of Portland cement, and the manufacture of this, begun in 1902, at once assumed important proportions. Quicklime manufacture is also an important industry. In 1908 the product of quicklime was 167,060 tons.

Manufactures.—Manufacturing and mechanical pursuits absorbed in 1900 the labours of 19·5% of all persons engaged in gainful occupations, less than half as many as were engaged in agriculture. Though an agricultural state, Missouri had in 1900 three cities with populations of above 100,000, whose wealth is based on manufactures and trade. Missouri is the leading manufacturing state west of the Mississippi. Between 1880 and 1900 the value of the product increased from $165,386,205 to $385,492,784, of which $316,304,095 was the value of products of the "factory system"; in 1905 the factory product was valued at $439,548,957. Of the total output in 1900, three-fourths were made up by the output of St Louis ($233,629,733; of which $193,732,788 was from establishments under the "factory system"), Kansas City ($36,527,392; $23,588,653 being "factory product"), St Joseph ($31,690,736, including the product of some establishments outside the city limits; $11,361,939 being "factory product" within the city limits), and Springfield ($4,126,871; $3,433,800 being "factory product"); for the same four cities in 1905 the proportion of the state's total product ($439,548,957) manufactured under the "factory system" is smaller, and less than three-fourths was made up by the following seven cities: St Louis ($267,307,038), Kansas City ($35,573,049), St Joseph ($11,573,720), Springfield ($5,293,315), Hannibal ($4,442,099), Jefferson City ($3,926,632), and Joplin ($3,006,203). In 1905 the eleven municipalities with a population of at least 8000 each (including the seven above, and Carthage, Moberly, Sedalia and Webb City) produced, under the "factory system,") goods valued at $335,431,978. Eighteen industries in 1905 employed nearly three-fifths of the wage-earners in factories and were represented by nearly two-thirds ($293,882,705) of the total product. The most prominent items in this were slaughtering and meat-packing products (value $60,031,133 in 1905); tobacco (in 1905, $30,884,182), flour and grist-mill products (in 1905, $38,026,142),[1] malt liquors (in 1905, $24,154,264), boots and shoes (in 1905, $23,493,552), lumber and timber products (in 1905, $10,903,783), men's factory-made clothing (in 1905, $8,872,831), and cars and general shop construction and repairs by steam railways (1905, $8,720,433). The increase in the slaughtering industry between 1890 and 1900 (134·9%) was chiefly due to remarkable growth in St Joseph—or, to be more precise, just outside the city limits of St Joseph; between 1900 and 1905 the increase was 39·5%. Although Missouri is not a great tobacco state, St Louis is one of the greatest centres of the country in the output of tobacco products. It is also, for the state, the great centre of all the leading interests with the exception of slaughtering. The boot and shoe industry is new west of the Mississippi, but Missouri holds in it a high and rising rank. In the Joplin mining region a considerable amount of ores is smelted, but the bulk of the ores is sent into Kansas for smelting. The finer clays, also, are mainly shipped from the state in natural form, but in the manufacture of sewer-pipe and fire-brick, Missouri is a very prominent state. St Louis and Kansas City are the centres of the clay industries.

Communications.—In 1900 rather under a fifth of the working population were engaged in trade and transportation. In commerce as well as in manufactures St Louis is first among the cities of the state, but Kansas City also is one of the greatest railway centres of the country, and the trade with the south-west, which St Louis once held almost undisputed, has been greatly cut into by Kansas City, as well as by Galveston and other ports on the Gulf. There is still considerable commerce on the Mississippi from St Louis to New Orleans, and a few passenger steamers are still in service. In 1906-1907 there was a notable agitation for improvement, following trial voyages that proved the navigability of the Missouri up to Kansas City. For this part of the river the maximum draft at mean low water was 4 ft. in 1908. In 1907 the amount of freight carried from the mouth of the Missouri to Sioux City, Iowa, was 843,863 tons, and river rates were about 60% of railway rates. In 1907 estimates were made for 6 ft. and 12 ft. channels from Sioux City to Kansas City, and from Kansas City to the mouth of the river. The improvement of the Missouri—which is far more difficult to navigate than the Mississippi—was begun by Congress in 1832, and (in addition to large joint appropriations for the Missouri, Mississippi, Arkansas and Ohio rivers from 1832 to 1882) cost $11,130,560 between 1876 and 1900. Also $65,000 was expended from 1852 to 1876. In nothing except the freighting of bulky and imperishable products, like cotton, coal and cereals, was the river ever able to contest the monopoly of the railways. The mileage of these within the state rose from 3960 in 1880 to 6142 in 1890, and to 8023·94 in 1908; the Missouri Pacific being far the greatest system of the state. St Louis, Kansas City and St Joseph are ports of entry for foreign commerce.

Population.—The total population of Missouri in 1900 was 3,106,665 and in 1910, 3,293,335. The population in 1810 was 20,845; in 1820, 66,586; in 1830, 140,455; in 1840, 383,702; in 1850, 682,044; in 1860, 1,182,012; in 1870, 1,721,295; in 1880, 2,168,380; and in 1890, 2,679,184. Thus, even in the years of the Civil War, there was no apparent set-back. Of the aggregate of 1900, 63·7 % lived in "rural districts" (*i.e.* those outside all places of a population of 2500 or upwards), and 27·1 % in the three great cities of the state, St Louis (pop. 575,238), Kansas City (163,752) and St Joseph (102,979); 5·2 % were negroes—their increase from 1890 to 1900 being less than half as rapid as that of the whites; and 7·0 % only were foreign-born. Slightly more than half of all foreigners are Germans; Irish, English and Scotch, French and English Canadians, Swiss and Scandinavians following. The German element is, and has been since about 1850, of great importance—an importance not indicated at all by its apparently small strength in the population to-day. The German immigration began about 1845, and long ago passed its maximum, so that in 1900 more than half of all the foreign-born (not only the Germans, but also the later-coming nationalities) had lived within Missouri for more than twenty years, and more than three-fourths of all had been residents of the state for ten years or more. Thus the foreign element is an old one, and other statistics show that it is being effectively absorbed into the native mass by intermarriage.[1] The German influence has been felt in education and in the anti-slavery cause. The early settlers of the state were practically all from Kentucky, Tennessee, Virginia and the old slave-states of the south-east, and their influence was easily dominant in the state until well after the Civil War (about 1875), when northerners first began to enter the state in large numbers. The south-western Ozarks were settled originally by mountaineers from Kentucky and Tennessee, and retained a character of social primitiveness and industrial backwardness until after the Civil War. This region has been industrially regenerated by the mine development. In addition to St Louis,[2] Kansas City and St Joseph, the leading cities in 1900 were Joplin, Springfield, Sedalia, Hannibal, Jefferson City, Carthage, Webb City and Moberly.

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[1] Omitting here printing and publishing, and foundry and machine-shop products, which (like carpentering, bakery products, &c., in cities) have little distinctive in them to set Missouri off from other states. But it is to be noted that St Louis is one of the leading producers of street-railway cars.

As Missouri was originally a French colony the Roman Catholic is its oldest church; and it is still the strongest with 382,642 communicants in 1906 out of a total of 1,199,239 for all denominations. In the same year there were 218,353 Baptists, 214,004 Methodists, 166,137 Disciples of Christ, 71,599 Presbyterians, 45,018 Lutherans, and 32,715 members of the German Evangelical Synod of North America.

Administration.—Three constitutions, framed by conventions in 1820, 1865 and 1875, have been adopted by the people of the state, and a fourth (1845) was rejected, principally because it provided for popular election of the state judiciary, which was then appointed. In addition to these four constitutional conventions, mention should be made of the special body chosen in 1861 to decide the question of secession, which retained supreme though irregular control of the state during the Civil War, and some of whose acts had all the force of promulgated constitutional amendments. Universal manhood suffrage was established by the first constitution. The constitution of 1865 was a partisan and intolerant document, a part of the evil aftermath of war; it was adopted by an insignificant majority and never had any strength in public sentiment.[3] The present constitution (that of 1875) was a notable piece of work when framed. The term of the governor and other chief executive officers, which had been four years until the adoption of the constitution of 1865, under which it was two years, was restored to the long term (unusual in American practice). The legislature (or, as it is called in Missouri, General Assembly) had been permitted to hold adjourned sessions under the constitution of 1865. This expensive practice was abolished; various checks were placed upon legislative extravagance, and upon financial, special and local legislation generally; and among reform provisions, common enough to-day, but uncommon in 1875, were those forbidding the General Assembly to make irrevocable grants of special privileges and immunities; requiring finance officials of the state to clear their accounts precedent to further eligibility to public office; preventing private gain to state officials through the deposit of public moneys in banks, or otherwise; and permitting the governor to veto specific items in general appropriation bills. The grand jury was reduced to twelve members, and nine concurring may indict. The township system may be adopted by county option, but has not been widely established, though purely administrative (not corporate) "townships" are an essential part of state administration. St Louis and Kansas City have adopted their own charters under constitutional provision. Up to 1909 37 constitutional amendments were submitted to the people for adoption or rejection, and 22 were adopted. Three of these (1900) restrict the calling of the grand jury, permit two-thirds of a petit jury to render verdicts in courts not of record, and three-fourths to give verdict in civil cases in courts of record. Cities have been allowed (1892), upon authorization by the General Assembly, to organize pension systems for disabled firemen, but not allowed (1904) to organize the same for police forces. An amendment which was adopted (177,615 for; 147,290 against) in November 1908, and came in effect on the 4th of December 1908, provides for initiative and referendum applying to statutory law and to constitutional amendments, but emergency measures, and appropriations for the state government, for state institutions, and for public schools are exempt from referendum. Initiative petitions, signed by at least 8% of the legal voters in each of two-thirds (at least) of the congressional districts of the state, must be filed not later than four months before the election at which the measure is to be voted upon. The referendum may be ordered by the legislature or by a petition signed by at least 5% of the legal voters in each of two-thirds (at least) of the congressional districts of the state; such petition must be filed not more than 90 days after the final adjournment of the legislature; referred measures become law upon receiving a favourable majority of the popular vote. Among defeated amendments that are indicative of socio-political tendencies was one (1896) to authorize cities of a population of 30,000 or more to purchase, erect or maintain waterworks or lighting plants.

There is nothing extraordinary in the general judicial system. The civil law seems to have had only a tacit, and as soon as American immigration began a limited, application. The common law was introduced with the American settler, and after 1804 was the explicitly declared basis of judicature. Practically no trace of French and Spanish administration was left except in the land registers. The metropolitan primacy of St Louis and Kansas City is reflected in the general organization of the courts. The Bureau of Labor Statistics maintains free employment-bureaus in St Louis, Kansas City and St Joseph. There is also a State Board of Mediation and Arbitration to settle labour disputes. A Board of Railroad and Warehouse Commissioners, elected by the people, was established in 1875, under a provision of the constitution requiring the General Assembly to establish maximum rates and provide against discriminations.[4]

The homestead of a housekeeper or head of a family, together with the rents and products of the same, is exempt from levy and attachment except to satisfy its liabilities at the time he acquired it. A homestead so exempted is, however, limited to 18 sq. rods of ground and to $3000 in value if it is in a city having a population of 40,000 or more, to 30 sq. rods and $1500 in value if it is in a city having a population of 10,000 and less than 40,000, to 5 acres and $1500 in value if it is in an incorporated place having a population of less than 10,000, and to 160 acres and $1500 in value if it is in the country. A husband owning a homestead is debarred from selling or mortgaging it without the joinder of his wife, and if the husband dies leaving a widow or minor children the homestead passes to either or to both jointly, and may be so held until the youngest child is twenty-one years of age or until the marriage or death of the widow. The principal grounds for divorce are impotence, bigamy, adultery, conviction of felony or other infamous crime subsequent to the marriage or before the marriage if unknown to the other party, desertion or habitual drunkenness for one year, such cruel or barbarous treatment as to endanger the life of the other, such conduct as to render the condition of the other intolerable, and vagrancy of the husband; but before applying for a divorce the plaintiff must reside in the state for one year immediately preceding, unless the cause of action was given within the state or while the plaintiff was a resident of the state. A married woman may hold and manage property as if she were single. She is entitled to the wages for her separate labour and that of her children, and is not liable for her husband's debts. A widow has a dower right to one-third of her husband's real estate and to the share of a child in his personal estate. If a husband dies without leaving children or other descendants, the widow is entitled to all the real and personal estate which came to him by marriage, to what remains of the personal property which came into his possession by the written consent of his wife, and to one-half his other real and personal property at the time of his death. If a husband dies leaving descendants only by a former marriage, the widow may take in lieu of dower the personal property that came to him by means of marriage, or if there be children by both marriages she may take in lieu of her dower right to his real estate an absolute right therein equivalent to the share of a child. Her dower is not lost by a divorce resulting from the fault or misconduct of the husband. A widower is entitled to a share in his wife's personal estate equal to the share of a child, and if there are no descendants he has an absolute right to one-half of her property, both real and personal.

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[1] In 1900 only one person in six had both parents of foreign birth.

[2] St Louis was the capital in 1812–1820, St Charles in 1820–1826, and Jefferson City since 1826.

[3] After the proscriptive features of this constitution were abolished by amendments in 1870, however, there was no great discontent, and the vote for holding a constitutional convention in 1875 was very close: 111,299 to 111,016.

[4] In 1907, in Missouri, as in various other states, passenger rates were reduced by law to 2 cents per mile; but this law was declared unconstitutional in 1909.

Finance.—Revenue is drawn mainly from a general property tax. In 1904 the gross valuation of all taxable wealth was put at $1,155,402,647, and taxation for state purposes aggregated $0.17 per $1000.[1] In the years 1851–1857 a debt of $23,701,000 was incurred in aiding railways, and all the roads made default during the Civil War. The state could not meet its guarantee obligations (hence the strict bonding provisions of the constitution of 1875), and in 1865 had a bonded debt of above $36,000,000. This was reduced to $21,675,000 by 1869, and in 1903 was wholly extinguished, every obligation having been fully discharged. A small debt[2] (at the close of 1906, $4,398,839) is carried in the form of non-negotiable state certificates of indebtedness issued in exchange for money taken from the educational funds of the state, and is intended as a permanent obligation to those funds. An amendment to the constitution adopted in 1908 permitted counties to make an extra levy of 25 cents on each 100 dollars valuation for the construction and repair of roads and bridges.

Charitable and Penal Institutions.—The charitable and penal institutions of the state include the penitentiary at Jefferson City, opened in 1836, which is self-supporting; a training school for boys at Boonville (opened 1889), an industrial home for girls at Chillicothe (established 1887), hospitals for the insane at Fulton (1847), St Joseph (opened 1874), Nevada (1887), and Farmington (1899); a school for the blind at St Louis (opened 1851); a school for the deaf at Fulton (opened 1851); a colony for the feeble-minded and epileptic at Marshall (established 1899); a state sanitorium, for consumptives, at Mount Vernon (established 1905, opened 1907); a Federal soldiers' home at St James, and a Confederate soldiers' home at Higginsville (both established 1897).

Education.—The expenditure upon public schools is much greater in Missouri than in any other of the old slave states. Most of the total expenditure (in 1908, $12,769,690) is made possible by local taxation. The percentage of the enumerated school-population (children 6 to 20 years of age) attending school in 1908 was 48, and the percentage of the total enumeration enrolled was about 71; the general showing being excellent, and that for negroes remarkably so. Blacks and whites are segregated in all schools. Various high-schools scattered over the state are given over to the negroes; and in 1904 the number of pupils attending these was exceeded only by the corresponding numbers in Texas and Mississippi—states with five- and sixfold the negro population of Missouri. Illiterate persons above 10 years of age constituted in 1900 6·4% of the total population—28·1% of the negroes, 7·1% of the natives, 6·9% of the foreign-born. The idea of providing a university and free local schools as parts of a public school system occurs in the constitution of 1820 (and in the Acts of Congress that prepared the way for statehood), and the occurrence is noteworthy; but the real beginnings of the system scarcely go back further than 1850. Nor was very much progress made until a law was passed in 1853 requiring a quarter of the general yearly revenue of the state to be distributed among the counties for schools. This appropriation was made regularly after 1855 (save in 1861–1867), and since 1875 has rested on a constitutional provision. The maintenance of a free public school system was placed on a firm and broad foundation by the constitution adopted in that year. In the years after 1887 one-third of the total revenue was appropriated to the public common schools; and in 1908 the total appropriation for public schools, normal schools and the state university was about three-fifths of the entire state revenue. Local taxation is another source of the school funds. In 1908 the total school fund, including state, county, township and special district funds, was about $14,000,000, of which the state fund was nearly one-third. The schools of St Louis have a very high reputation.

Among institutions of higher learning the university of Missouri at Columbia is the chief one maintained by the state. It was opened to students in 1841, received aid for the first time from the state in 1867; women were first admitted to the mormal department in 1869, to the academic department in 1870, and soon afterwards to all departments. In addition to the academic department or college proper, the university embraces special schools of pedagogics (1868), agriculture and mechanic arts (1870), mines and metallurgy (1870, at Rolla), law (1872), medicine (1873), fine arts (1878), engineering (1877), military science, commerce, a graduate school of arts and sciences (1896), and a department of journalism (1908). An experiment station supported by the national government was established in 1888, and is part of the school of agriculture. The state Board of Agriculture organizes educational farmers' institutes; and agriculture is taught, moreover, in the normal schools of the state. Of these five are maintained as follows: at Kirksville (1870), at Warrensburg (established 1870), at Cape Girardeau (established 1873), at Springfield (established 1905), at Maryville (established 1905), and there is a normal department in connexion with the Lincoln Institute, for negroes, at Jefferson City. Lincoln Institute (opened in 1866) is for negro men and women. The basis of its endowment was a fund of $6379 contributed in 1866 by the 62nd and 65th regiments U.S. Colored Infantry upon their discharge from the service; it has agricultural, industrial, sub-normal, normal and collegiate departments. Among privately endowed schools the greatest is Washington University in St Louis; it is non-sectarian and was opened in 1857. Noteworthy, too, is the St Louis University, opened in 1829, the oldest institution for higher learning west of the Mississippi; it is a Jesuit college and the parent school of six other Jesuit institutions in the states of the middle west. There are many minor colleges and schools, most of them co-educational, and special colleges or academies for women are maintained by different religious sects. Finally, there are various professional schools, most of them in St Louis and Kansas City.

History.—The early French explorers of the Mississippi valley left the first trace of European connexion in the history of Missouri. Ste Genevieve was settled in 1735; Fort Orleans, two-thirds of the way across the state up the Missouri river, had been temporarily established in 1720; the famous Mine La Motte, in Madison county, was opened about the same time; and before the settlement of St Louis, the Missouri river was known to trappers and hunters for hundreds of miles above its mouth. It was in 1764 that St Louis (*q.v.*) was founded. Two years before, the portion of Louisiana west of the Mississippi had secretly passed to Spain, and in 1763 the portion east passed to England. When the English took possession a large part of the people in the old French settlements removed west of the river. Not until 1770, after O'Reilly had established Spanish rule by force at New Orleans, did a Spanish officer at St Louis take actual possession of the upper country; another on the ground, in 1768–1769, had forborne to assert his powers in the face of the unfriendly attitude of the inhabitants. Spanish administration began in 1771. French remained the official language, and administration was so little altered that the people quickly grew reconciled to their changed allegiance. Settlement was confined to a fringe of villages along the Mississippi. French-Canadian hunters and trappers, and soon the river boatmen, added an element of adventure and colour in the primitive life of the colony. Lead and salt and peltries were sent to Montreal, New Orleans, and up the Ohio river to the Atlantic cities.

The Americans were hospitably received; the immigrants, even Protestant clergymen, enjoyed by official goodwill complete religious toleration; and after about 1796 lavish land grants to Americans were made by the authorities, who wished to strengthen the colony against anticipated attacks by the British, from Canada. Kentucky, Tennessee and Virginia furnished most of the new-comers. The French had lived in villages and maintained considerable communal life; the Americans scattered on homesteads. With them came land speculation, litigiousness, the development of mines and mining-camp law, and the passion of politics, of which duels were one feature of early days. In 1804 there were some 10,000 inhabitants in Upper Louisiana (mainly in Missouri), and of these three-fifths were Americans and their negroes. Racial antipathies were unimportant, and all parties were at least passively acquiescent when Louisiana became a part of the United States. On the 9th of March 1804, at St Louis, Upper Louisiana was formally transferred. In 1818, after passing meanwhile through four stages of limited self-government,[3] that portion of the Purchase now included in the state of Missouri made application for admission to the Union as a state.[4] In 1812–1813 a remarkable earthquake devastated the region about New Madrid. A large region was sunken, enormous fissures were opened in the earth, the surface soil was displaced and altered, and great lakes were formed along the Mississippi. One of these, Reelfoot Lake, east of the river, is 20 m. long and 7 wide, and so deep that boats sail over the submerged tops of tall trees. Indian troubles again disturbed the peace during the second war with Great Britain. By 1808 the Indian title was extinguished to two-thirds of the state, though actual settlement did not extend more than a few miles westward from the Mississippi; in 1825, by a treaty with the Shawnee made at St Louis on the 7th of November, the title to the rest of the state was cleared, and a general removal of the Indians followed. Meanwhile, after the peace of 1815 a great immigration had set in, many settlers coming from the free states north of the Ohio. The application for statehood precipitated one of the most famous and significant episodes of national history—the Missouri Compromise (*q.v.*). In August 1821, after three years of bitter controversy, Missouri was formally admitted to statehood.

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[1] The constitutional provision requiring assessments at cash valuations is not at all observed; according to the State Revenue Commission of 1902 the average tax valuation was 40 to 50% of the real value. The national censuses of 1880 and 1890 (no estimate being made in 1900) put the total value of all property at $1,562,000,000 and $2,397,902,945 respectively.

[2] In 1902 the bonded debts of counties and townships aggregated $8,066,878; that of towns and cities (mostly that of St Louis), $31,193,870.

[3] In 1804, the District of Louisiana, in the administrative system of the Territory of Indiana; in 1805, an independent government, renamed the Territory of Louisiana; in 1812, the Territory of Missouri; in 1816, another grade of territorial government.

[4] Until 1836 the state boundary in the north-west was the meridian of the mouth of the Kansas river drawn due north to the Iowa line. The addition of the triangle west of that line—the so-called Platte Purchase—violated the Missouri Compromise.

In the four decades before the Civil War, two matters stand out as most distinctive in the history of the state: the trouble with the Mormons, and the growth of river and prairie trade. In 1831–1832 Joseph Smith, the Mormon leader, selected a tract at the mouth of the Kansas river as the site of the New Jerusalem, to which his followers came from Ohio in 1832. They were not welcome. Their "revelations" in their papers predicted dire things for the Gentiles; they were thrifty and well-to-do, and were rapidly widening their lands: they were accused of disregard for Gentile property titles, and they obstructed the processes of Gentile law within their lands. In 1833 the Missourians, in mass meeting, resolved to drive them from the country. The five years thereafter were marked by plunder and abuse of the sect. The militia and the courts gave them no protection. They were driven out, and went to Illinois, but continued to hold part of their abandoned lands. First St Louis, and then other towns on the Missouri river in succession westward, as they were settled and became available as dépôts, served as the outfit points for the Indian trade up the Missouri and the trade with Mexico through Santa Fé. The trail followed by the latter had its beginning about 1812, and (beginning in 1825) was surveyed by the national government. In early days Mexican and American military detachments escorted the caravans on either side of the international line. Independence, Missouri (after about 1831) and Kansas City (after 1844) were the great centres of this trade, which by 1860 was of national importance.[1] After the Civil War the railways gradually destroyed it, the Atchison Topeka & Santa Fé railroad running along the old wagon trail. No steamer traversed the Mississippi above the Ohio until 1817, nor was a voyage made between New Orleans and St Louis, nor the lower Missouri entered, until 1819. In 1832 a steamer ran to the mouth of the Yellowstone, and in 1890 the last commercial trip was made to old Fort Benton (Great Falls), Montana. The interval of years witnessed the growth of a river trade and its gradual decline as point after point on the river—Kansas City, St Joseph, Council Bluffs (Iowa), Sioux Falls (South Dakota) and Helena (Montana)—was reached and commanded by the railways. In 1906–1907 an active campaign was begun at Kansas City for improving the channel of the Missouri and stimulating river freighting below that point.

Among events leading up to the Civil War, first the annexation of Texas and then the war with Mexico left special impress on Missouri history. Since 1828, when national political parties were first thoroughly organized in the state, the Democrats had been supreme, and carried Missouri on the pro-slavery side of every issue of free and slave territory. But there was always a strong body of anti-slavery sentiment,[2] nevertheless; and this took organized form in 1849, when Senator Benton repudiated certain ultra pro-slavery instructions, breathing a secession spirit, passed by the General Assembly for the guidance of the representatives of the state in Congress. From that time until his death he organized and led the anti-disunion party of the state, Francis Preston Blair, jun., succeeding him as leader. The struggle over Kansas (*q.v.*) aroused tremendous passion in Missouri. Her border counties furnished the bogus citizens who invaded Kansas to carry the first territorial elections, and soon guerrilla forays back and forth gave over the border to a carnival of crime and plunder. Political conditions were chaotic. In the presidential election of 1860, Douglas received the electoral vote of the state, the only one he carried in the Union. The Republicans had little strength outside St Louis, where the German element was strong. A party led by Claiborne F. Jackson, the governor-elect, was resolved to carry the state out of the Union. Such secession, it was supposed, would carry the other border states out also. With equal blindness the Secessionists favoured, and the Republicans opposed, the calling of a special state convention to decide the issue of secession. The election showed that popular sentiment was overwhelmingly hostile to secession; and the convention, by a vote of 80 to 1, resolved (March 4, 1861) that Missouri had "no adequate cause" therefor. Governor Jackson thereupon sought to attain his ends by intrigue, and the national arsenal at St Louis became the objective of both parties. It was won by the unconditional-union men, but a smaller arsenal at Liberty was seized by the Secessionists. Governor Jackson refused point-blank to contribute the quota of troops from Missouri called for by President Lincoln. Aggressive conflict really opened at St Louis on the 10th of May, and armed hostilities began in June. On the 10th of August 1861 at Wilson's Creek, near Springfield, General Nathaniel Lyon was defeated by a superior Confederate force in one of the bloodiest battles of the war. After this the Confederates held much of southern Missouri until the next spring, when they were driven into Arkansas, never afterward regaining foothold in the state. In the autumn of 1864 Sterling Price led a brilliant but rather bootless Confederate raid across the state, along the Missouri River, and was only forced to retreat southward by defeat at Westport (Kansas City). The western border was rendered desolate and deserted by guerrilla forays throughout the war. Probably 25,000 or 30,000 soldiers served in the Confederate armies, and 109,111 were furnished to the Union arms.[3] This was a remarkable showing. There was more or less internecine conflict throughout the war, and local disaffection under Union rule; and Confederate recruiting was carried on even north of the Missouri.

Altogether, the state offered a difficult civil and military problem throughout the Civil War. An emancipation proclamation issued by General J. C. Frémont at St Louis in August 1861, though promptly disavowed by President Lincoln, precipitated the issue. The state convention, after voting against secession, had adjourned, and after various sessions was dissolved in October 1863. Assuming revolutionary powers, it deposed Governor Jackson and other state officers, appointed their successors, declared vacant the seats of members of the Assembly, and abrogated the disloyal acts of that body. In October 1861 a rump of the deposed Assembly passed an act of secession, which the Confederate States saw fit to regard as legitimate, and under which they admitted Missouri to their union by declaration of the 28th of November. In 1862 the convention rejected the President's suggestion of gradual emancipation, disfranchised Secessionists, and prepared a strong oath of allegiance. In the summer of 1863 the convention decreed emancipation with compensation to owners. This did not satisfy the Radical Republicans, and on the issue of immediate and unconditional emancipation they swept the state in November 1864. By the constitution of 1865 slavery was abolished outright.[1] The convention of 1861, by maintaining continuous government, had saved the state from anarchy and from reconstruction by the national power; but an ironclad test oath (it required denial of forty-five distinct offences) was provided, to be taken by all voters, state, county and municipal officers, lawyers, jurors, teachers and clergymen. Its attempted enforcement was a grave error of judgment, and was attended by great abuses, and it was finally held unconstitutional by the United States Supreme Court. The legislature, however, maintained its ends by registration laws that reduced to impotence the Democratic electorate. The Radical Republicans held control until 1870, when they were defeated by a combination of Liberal Republicans and Democrats,[2] and the test-oath and the rest of the intolerant legislation of the war period were swept away. In 1872 the Democrats gained substantial control, and after 1876 their power was established beyond challenge. The constitution of 1875 closed the war period with blanket amnesties. Though in politics habitually Democratic, Missouri has generally had a strong opposition party—Whig in antebellum days, and since the war, Republican—which in recent years has made political conditions increasingly unstable. This instability is shown in congressional and local rather than in general state elections. In 1908 a Republican governor was elected, the first for more than thirty years.

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[1] In 1855 its value was estimated at $5,000,000. In 1860 it was much greater. In the latter year the trade employed 3000 wagons, 62,000 oxen and mules, and 7000 men.

[2] Under the constitution of 1820 the General Assembly had power to emancipate the slaves with the consent of their masters. In 1828 Senator T. H. Benton and others prepared a plan for educating the slaves and gradually emancipating them under state law; and undoubtedly a considerable party would have supported such a project, for the Whigs and Democrats were not then divided along party lines on the slavery issue; but nothing came of the plan, and the manner of its defeat proves that it could not possibly have been pushed to success. The trouble over Lovejoy's printing office at St Louis (1833–1836) put an effectual end to the movement for emancipation.

[3] Compare the vote of 1861. The Union death-roll of Massachusetts (troops furnished, 159,165) was 13,942, that of Missouri 13,887.

The Governors of Missouri since 1804 have been as follow:—

Territorial Period.

	Party Affiliation.	Service.
James Wilkinson	Appointed	1805–1806
Joseph Brown (acting governor)		1806–1807
Frederick Bates " "		1807
Meriwether Lewis	Appointed	1807–1809
Frederick Bates (acting governor)		1809–1810
Benjamin Howard	Appointed	1810–1812
Frederick Bates (acting governor)		1812–1813
William Clark	Appointed	1813–1820
State Period.		
Alexander McNair	Democrat	1820–1824[3]
Frederick Bates (died in office)	"	1824–1825
Abraham J. Williams (acting governor)		1825
John Miller (special election to fill out term)	Democrat	1825–1828
John Miller	"	1828–1832
Daniel Dunklin (resigned office)	"	1832–1836
Lilburn W. Boggs (acting governor)		1836
Lilburn W. Boggs	Democrat	1836–1840
Thomas Reynolds (died in office)	"	1840–1844
M. M. Marmaduke (acting governor)		1844
John C. Edwards	Democrat	1844–1848
Austin A. King	"	1848–1853
Sterling Price	"	1853–1857
Trusten Polk (elected to United States Senate)	"	1857
Hancock Jackson (acting governor)		1857
Robert M. Stewart (elected to serve out term)	Democrat	1857–1861
Claiborne F. Jackson (deposed by state convention)	"	1861
Hamilton R. Gamble (appointed by state convention; died in office), provisional governor		1861–1864
Willard P. Hall (Lieut.-governor by same power, acting provisional governor)		1864–1865
Thomas C. Fletcher	Republican	1865–1869
Joseph W. McClurg	"	1869–1871
B. Gratz Brown	Liberal Republican (and Democrat)	1871–1873
Silas Woodson	"	1873–1875
Charles H. Hardin	Democrat	1875–1877
John S. Phelps	"	1877–1881
Thomas T. Crittenden	"	1881–1885
John S. Marmaduke (died in office)	"	1885–1887
Albert P. Morehouse (acting governor)		1887–1889
David R. Francis	Democrat	1889–1893
William J. Stone	"	1893–1897
Lon V. Stephens	"	1897–1901
Alexander M. Dockerey	"	1901–1905
Joseph W. Folk	"	1905–1909
Herbert S. Hadley	Republican	1909

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MISSOURI COMPROMISE, an agreement (1820) between the pro-slavery and anti-slavery factions in the United States, involving primarily the regulation of slavery in the public territories. A bill to enable the people of Missouri to form a state government preliminary to admission into the Union came before the House of Representatives in Committee of the Whole, on the 13th of February 1819. An amendment offered by James Tallmadge (1778–1853) of New York, which provided that the further introduction of slaves into Missouri should be forbidden, and that all children of slave parents born in the state after its admission should be free at the age of twenty-five, was adopted by the committee and incorporated in the Bill as finally passed (Feb. 17) by the house. The Senate refused to concur in the amendment and the whole measure was lost. During the following session (1819–1820), the house passed a similar bill with an amendment introduced on the 26th of January 1820 by John W. Taylor (1784–1854) of New York making the admission of the state conditional upon its adoption of a constitution prohibiting slavery. In the meantime the question had been complicated by the admission in December of Alabama, a slave state (the number of slave and free states now becoming equal), and by the passage through the house (Jan. 3, 1820) of a bill to admit Maine, a free state. The Senate decided to connect the two measures, and passed a bill for the admission of Maine with an amendment enabling the people of Missouri to form a state constitution. Before the bill was returned to the house a second amendment was adopted on the motion of J. B. Thomas (1777–1850) of Illinois, excluding slavery from the "Louisiana Purchase" north of 36° 30′ (the southern boundary of Missouri), except within the limits of the proposed state of Missouri. The House of Representatives refused to accept this and a conference committee was appointed. There was now a controversy between the two houses not only on the slavery issue, but also on the parliamentary question of the inclusion of Maine and Missouri within the same bill. The committee recommended the enactment of two laws, one for the admission of Maine, the other an enabling act for Missouri without any restrictions on slavery but including the Thomas amendment. This was agreed to by both houses, and the measures were passed, and were signed by President Monroe respectively on the 3rd and on the 6th of March 1820. When the question of the final admission of Missouri came up during the session of 1820–1821 the struggle was revived over a clause in the new constitution (1820) requiring the exclusion of free negroes and mulattoes from the state. Through the influence of Henry Clay an act of admission was finally passed, to come into operation as soon as the state legislature would pledge itself not to pass any legislation to enforce this clause. This is sometimes known as the second Missouri Compromise.

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[1] Thus liberating about 114,000 blacks, of a tax valuation of $40,000,000.

[2] The Liberals were those who thought unjust the proscriptionary legislation passed against the Secessionists and Democrats; and to this issue of local politics were added the issues of national reform which the course of President Grant's administration had forced upon his party. A convention of Liberals that met at Jefferson City in January 1872 issued to all Republicans favourable to reform within the party an invitation to meet at Cincinnati in May; and this was the convention of revolters against General Grant that nominated Horace Greeley of New York and B. Gratz Brown of Missouri as Liberal Republican candidates for the presidency and vice-presidency respectively. The first definite organization of the Liberal Republican party may therefore be said to have been made in Missouri in 1870.

[3] From 1820–1844 the elections were in August and inaugurations in November; Governor King served from the 27th of December 1848 till January 1853; thereafter the inauguration was in January, and beginning with 1864 the election was in November. The term was four years except under the constitution of 1865.

These disputes, involving as they did the question of the relative powers of Congress and the states, tended to turn the Democratic-Republicans, who were becoming nationalized, back again toward their old state sovereignty principles—to prepare the way for the Jacksonian-Democratic Party. On the other hand, the old Federalist nationalistic element was soon to emerge first as National Republicans, then as Whigs, and finally as Republicans. On the constitutional side the Compromise of 1820 was important as the first precedent for the congressional exclusion of slavery from public territory acquired since the adoption of the Constitution, and also as a clear recognition that Congress has no right to impose upon a state asking for admission into the Union conditions which do not apply to those states already in the Union. The compromise was specifically repealed by the Kansas-Nebraska Bill of 1854.

See J. A. Woodburn, "The Historical Significance of the Missouri Compromise" in the *Annual Report of the American Historical Association* for 1893 (Washington, D.C.); Dixon, *History of the Missouri Compromise* (Cincinnati, 1899); Schouler's and McMaster's *Histories of the United States.* (W. R. S*.)

MISSOURI RIVER, the principal western tributary of the Mississippi river, U.S.A. It is formed at Gallatin City, in the Rocky Mountain region of south-western Montana, by the confluence of the Jefferson, Madison and Gallatin forks; thence it flows N. into the plains, which it traverses in a course at first N.E., then E. Entering North Dakota, the river turns gradually to the S.E., then S., and again S.E., traversing both North and South Dakota. It forms the eastern boundary of Nebraska and in part of Kansas, and crosses Missouri in an easterly course to its junction with the Mississippi 20 m. above St Louis, and 2547 m. below the confluence of the three forks. The stream which is known as the Jefferson Fork in its lower course, Beaver Head River in its middle course, and Red Rock Creek in its upper course, is really the upper section of the Missouri; it rises on the border between Montana and Idaho, 20 m. west of the western boundary of the Yellowstone National Park, near the crest of the Rocky Mountains, 8000 ft. above the sea, and 398 m. beyond Gallatin City; and with this and the Lower Mississippi the Missouri forms a river channel 4221 m. in length, the longest in the world. The Madison and Gallatin forks rise within the Yellowstone Park, where the former is fed by geysers and hot springs and the latter by both hot springs and melting snow. The Yellowstone river, which is the principal tributary of the Missouri, traverses the park. The Missouri drains a basin having an area of about 580,000 sq.m.; this includes the eastern slope of the Rocky Mountains from the northern border of the United States to the middle of Colorado, and its larger tributaries take their rise in those mountains. Besides the Yellowstone and the three forks there are the Platte, which rises in two large branches in Colorado, and the Milk, which rises in north-western Montana. The Kansas in Kansas, the James and Big Sioux in the Dakotas, and the Niobrara in Nebraska, are the principal tributaries wholly of the plains. In the mountain region the Missouri flows through deep canyons and over several cascades. Below Great Falls the slower current is unable to carry all the silt brought down from the mountains and plains; and consequently a winding and unstable channel has been formed on deposits of silt 50 to 100 ft. or more in depth. Bends in the river continue to develop by erosion until the neck between two of them is cut off, and in the process numerous islands, sand-bars, and crescent-shaped lakes are formed. Cottonwood, willow, cedar and walnut trees grow upon the banks that are for a time left undisturbed, but years later the eroding current returns to undermine these banks, the trees fall in and are carried down stream as snags (or "sawyers"), which are especially dangerous to navigation. The variation of level is great and it varies greatly in different parts of the river's course: it is about 19 ft. at Kansas City, about 25 ft. at St Charles, Missouri, and about 8 ft. at Fort Benton, Montana. It is estimated that the Missouri's average discharge per second amounts to about 94,000 cub. ft., and that each year it carries into the Mississippi 550,000 tons of silt. The waters of the Missouri begin to rise in March, and a high-water stage is reached in April as a result of the spring rains and the melting snow on the plains; a second high stage is produced in June by the melting of snow on the mountains, and the river is navigable from early spring to midsummer as far as Fort Benton, within 40 m. of the Great Falls and 2285 m. above the mouth. Above Great Falls the river is navigable to Three Forks.

The mouth of the Missouri was discovered in 1673 by Marquette and Joliet, while they were coming down the Mississippi. Early in the 18th century French fur-traders began to ascend the river, and in 1764 St Louis was established as a dépôt; but the first exploration of the river from its mouth to its headwaters was made in 1804–1805 by Meriwether Lewis and William Clark. Until many years later the commerce on the river was restricted to the fur trade and was carried on with such primitive craft as the canoe (made from the log of a cottonwood tree); the pirogue (usually two canoes side by side and with a floor over them on which to place the cargo); the bullboat (made by covering a framework of willow poles with the hides of bison bulls); the mackinaw boat (made of boards and having a flat bottom); and the keelboat (a vessel of some pretensions, with a keel from bow to stern, 60 to 70 ft. in length, with a breadth of beam from 15 to 18 ft., and drawing 20 to 30 in. of water). A canoe, pirogue, bullboat, or mackinaw boat was propelled by two or more men with paddles, poles, or oars; but to propel a keelboat up the river required 20 to 40 men who walked along the shore and pulled a *corvelle*, a line about 1000 ft. long and fastened to the mast. An average of about 15 m. a day was made with a keelboat going up the river. The first attempt to navigate the Missouri with steamboats was made in the spring of 1819, when the "Independence" made a trip from St Louis to the mouth of the Chariton river and back. The American Fur Company began to use steamers in 1830, and from then until the advent of railways the steamboat on the Missouri was one of the most important factors in the development of the Northwest. The traffic was at its height in 1858, when no fewer than 60 regular packets were engaged in it, but its decline began in the following year with the completion of the Hannibal & St Joseph railway to St Joseph, Missouri, and 20 years later it had nearly disappeared. In an attempt to regulate railway rates, however, four boats were run between Kansas City and St Louis between 1890 and 1894 by the Kansas City & Missouri Transportation Company, and in 1906 the Missouri River Valley Improvement Association was formed at Kansas City. Congress began to make appropriation for the removal of snags about 1838, and forty years later appropriations were begun for a general improvement which in 1884 was placed under the charge of the Missouri River Commission. In 1890 its work was restricted to that part of the river below Sioux City and in 1902 the Commission was abolished. Up to the 30th of June 1908 the Federal government had expended $11,398,881 for the improvement of the river.

See H. M. Chittenden, *History of Early Navigation on the Missouri River* (New York, 1903); P. E. Chappel, *A History of the Missouri River* (Kansas City, 1905); J. V. Brower, *The Missouri River and* *its Utmost Source* (St Paul, 1896); J. M. Hanson, *The Conquest of the Missouri* (New York, 1909); L. M. Jones, "The Improvement of the Missouri River and its Usefulness as a Traffic Route," in *Annals of the American Academy of Political and Social Science* (Jan. 1908), and the *Annual Reports* of the Chief of Engineers, U.S. Army.

MISTAKE (*i.e.* take amiss), a misconception or error in thought or action. In law, the word is often used in the sense of ignorance or error, as when it is said that mistake of law affords no excuse for crime. In the law of contract, mistake is of special importance, and may occur either in a matter of law or in a matter of fact. In general, a mistake of law cannot be alleged in avoidance of the consequences of contracts or acts, although there are exceptions in which relief may be given. Mistake of fact, however, may be ground for avoidance, provided the mistake was not due to negligence. (See further CONTRACT.)

MISTLETOE[1] (*Viscum album*), a species of *Viscum*, of the botanical family Loranthaceae. The whole genus is parasitical, and contains about twenty species, widely distributed in the warmer parts of the old world; but only the mistletoe proper is a native of Europe. It forms an evergreen bush, about 4 ft. in length, thickly crowded with forking branches and opposite leaves, which are about 2 in. long, obovate-lanceolate in shape and yellowish-green; the dioecious flowers, which are small and nearly of the same colour but yellower, appear in February and March; the white berry when ripe is filled with a viscous semi-transparent pulp (whence bird-lime is derived). The mistletoe is parasitic both on deciduous and evergreen trees and shrubs. In England it is most abundant on the apple-tree, but rarely found on the oak. Poplars, willows, lime, mountain-ash, maples, are favourite habitats, and it is also found on many other trees, including cedar of Lebanon and larch. The fruit is eaten by most frugivorous birds, and through their agency, particularly that of the species which is accordingly known as missel-thrush or mistle-thrush, the plant is propagated. The Latin proverb has it that "Turdus malum sibi cacat"; but the sowing is really effected by the bird wiping its beak, to which the seeds adhere, against the bark of the tree on which it has alighted. The viscid pulp soon hardens, affording a protection to the seed; in germination the sucker-root penetrates the bark, and a connexion is established with the vascular tissue of the first plant. The growth of the plant is slow, and its durability proportionately great, its death being determined generally by that of the tree on which it has established itself. The mistletoe so extensively used in England at Christmas is largely derived from the apple orchards of Normandy; a quantity is also sent from the apple orchards of Herefordshire.

Pliny (*H. N.*, xvi. 92–95; xxiv. 6) has a good deal to tell about the *viscum*, a deadly parasite, though slower in its action than ivy. He distinguishes three "genera." "On the fir and larch grows what is called *stelis* in Euboea and *hyphear* in Arcadia." Viscum, called *dryos hyphear*, is most plentiful on the esculent oak, but occurs also on the robur, *Prunus sylvestris* and terebinth. Hyphear is useful for fattening cattle if they are hardy enough to withstand the purgative effect it produces at first; viscum is medicinally of value as an emollient, and in cases of tumour, ulcers and the like. Pliny is also our authority for the reverence in which the mistletoe when found growing on the robur was held by the Druids. Prepared as a draught, it was used as a cure for sterility and a remedy for poisons. The mistletoe figures also in Scandinavian legend as having furnished the material of the arrow with which Balder (the sun-god) was slain by the blind god Höder. Most probably this story had its origin in a particular theory as to the meaning of the word mistletoe.

MISTRAL, FRÉDÉRIC (1830–), Provençal poet, was born at Maillane (Bouches-du-Rhône) on the 8th of September 1830. In the autobiographical sketch prefixed to the *Isclo d'or* (1876) he tells us, with great simplicity and charm, all that is worth knowing of his early life. His father was a prosperous farmer, and his mother a simple and religious woman of the people, who first taught him to love all the songs and legends of the country. In these early days on the farm he received those first impressions which were destined to constitute one of the chief beauties of *Mirèio*. In his ninth year Mistral was sent to a small school at Avignon, where he was very wretched at first, regretting the free outdoor life of the country. Gradually, however, his studies attracted him, above all the poetry of Homer and Virgil; and he translated the latter's first eclogue, showing his efforts to a young schoolfellow, A. Mathieu, who was destined to play a part in the foundation of the Félibrige. When Roumanille (see PROVENÇAL LITERATURE) became an usher at Mistral's school, the two, fired by the same love of poetry and of their native Provence, soon became close friends. "Voilà l'aube que mon âme attendait pour s'éveiller à la lumière," he exclaimed, on reading Roumanille's first dialect poems; and he goes on to say: "Embrasés tous les deux du désir de relever le parler de nos mères, nous étudiâmes ensemble les vieux livres Provençaux, et nous nous proposâmes de restaurer la langue selon ses traditions et caractères nationaux." On leaving school (1847) he returned to Maillane, where he sketched a pastoral poem in four cantos (*Li Meissoun*). With all his love for the country, he soon realized that life on a farm did not satisfy his ambition. So he went to study law at Aix, where he contributed his first published poems to Roumanille's *Li Prouvençalo* (1852). He had become *licencié en droit* the year before, but now decided on a literary career. The Félibrige was founded in 1854, and five years later appeared *Mirèio*, the masterpiece not only of Mistral, but so far of the entire school. The tale itself was nothing—the old story of a rich girl and her poor lover, kept apart by the girl's parents. Mireille, in despair, wanders along a wide tract of country to the church of the Trois-Maries, in the hope that these may aid her. But the effort was too great: she sinks exhausted, and dies in the presence of her stricken parents and her frenzied lover. Into this simple web Mistral has woven descriptions of Provençal life, scenery, character, customs and legends that raise the poem to the dignity of a rustic epic, unique in literature. Nothing is forced: every detail is filled into the framework of the whole with a cunning which the poet was never again to attain. There is no deep psychology in the characters, but then the people depicted are simple rustic folk, who wear their hearts on their sleeve. *Calendau* (1867), the story of a princess held in bondage by a ruthless brigand, and eventually rescued by a youthful hero, is a comparative failure. The description of scenery is again masterly; but the old lore, which had charmed all readers in *Mirèio*, here becomes forced, not inevitable. The characters are mere symbols—indeed the whole poem is obviously an allegory, the princess standing for Provence, the brigand for France, and the young lover for the Félibrige. Mistral lavished enormous labour on this work, which probably accounts for its lack of spontaneity, as also for the love he bears it. In 1876 (the same year in which he married Mlle Marie Rivière, of Dijon) was published the volume *Lis Isclo d'Or*—a collection of the shorter poems Mistral had composed from the year 1848 onwards. Here he is again at his very best. Old legends, *sirventes* (mostly, as in medieval times, poems with a tendency), and lyrics—all are admirable. Even the *pièces d'occasion* may be reckoned with the best of their kind. Two pieces, the *Coupe* and the *Princesse*, aroused violent controversy on their first appearance. They reproduce, in effect, the theme of *Calendau*, and Mistral was accused of trying to sow discord between the north and south of France. Needless to say he was altogether innocent of such a design. *Nerto* (1884) is a charming tale of Avignon in the olden days, in which a girl's purity triumphs over her lover's base designs and leads him to nobler thoughts. There is little individuality in the characters, which should rather be regarded as types; and we feel no terror or pity at the tragic close. But we are carried along by Mistral's art and by the brilliancy of his episodes; and he achieved the object he had in view: a pretty tale imbued with the proper touch of local colour and with the true spirit of romance. The play *La Rèino Jano* (1890) is a complete failure, if judged from the dramatic standpoint: it is rather a brilliant panorama, a series of stage pictures, and the characters neither live nor arouse our sympathy. In the great epic on the Rhone (*Lou Pouèmo dóu Rouse*, 1897) the poet depicts the former barge-life of that river, and intertwines his narrative with the legends clustering round its banks, and with a graceful love episode. For the first time he employs blank verse, and uses it with great mastery, but again the ancient lore is overdone. A splendid piece of work is *Lou Tresor dóu Félibrige* (1886). In these two volumes Mistral has deposited with loving care every word and phrase, every proverb, every scrap of legend, that he had gathered during his many years' journeyings in the south of France. In 1904 he was awarded one of the Nobel prizes for literature.

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[1] Gr. ἰξία or ἰξός, hence Lat. *viscum*, Ital. *vischio* or *visco*, and Fr. *gui*. The English word is the O.E. *misteltan*, Icelandic *mistelteinn*, in which *tan* or *teinn* means a twig, and *mistel* may be associated either with *mist* in the sense of fog, gloom, because of the prominence of mistletoe in the dark season of the year, or with the same root in the sense of dung (from the character of the berries or the supposed mode of propagation).

An excellent literary appreciation of the poet is that by Gaston Paris, "Frédéric Mistral" (originally in the *Revue de Paris* (Oct. and Nov. 1894); then in *Penseurs et Poètes* (Paris, 1896). More elaborate accounts are Welter, *Frédéric Mistral* (Marburg, 1899); and Downer, *Frédéric Mistral* (New York, 1901), with a full bibliography. (H. O.)

MISTRAL, a local wind similar to the bora (*q.v.*), met with on the French Mediterranean coast. The warm Gulf of the Lion (Golfe du Lion) has to the north the cold central plateau of France, which during winter is commonly a centre of high barometric pressure, and the resulting pressure gradient causes persistent currents of cold dry air from the north-west in the intermediate zone. The mistral occurs along the coast from the mouth of the Ebro to the Gulf of Genoa, but attains greatest strength and frequency in Provence and Languedoc, *i.e.* the district of the Rhone delta, where it blows on an average one day out of two; the record at Marseilles is 175 days in the year. It is usually associated with cloudless skies and brilliant sunshine, intense dryness and piercing cold. With the passage of a cyclone over the gulf, or a rapid rise of pressure following a fall of snow on the central plateau, the mistral develops into a stormy wind of great violence.

MISTRESS (adapted from O. Fr. *maistresse*, mod. *maîtresse*, the feminine of *maistre*, *maître*, master), a woman who has authority, particularly over a household. As a form of address or term of courtesy the word is used in the same sense as "madam." It was formerly used indifferently of married or unmarried women, but now, written in the abbreviated form "Mrs" (pronounced "missis"), it is practically confined to married women and prefixed to the surname; it is frequently retained, however, in the case of spinster cooks or housekeepers, as a title of dignity; as the female equivalent of "master" the word is used in other senses by analogy, *e.g.* of Rome as "the mistress of the world," Venice "the mistress of the Adriatic," &c. From the common use of "master" as a teacher, "mistress" is similarly used. The old usage of the word for a lady-love or sweetheart has degenerated into that of paramour. "Miss" a shortened form of "mistress," is the term of address for a girl or unmarried woman; it is prefixed to the surname in the case of the eldest or only daughter of a family, and to the Christian names in the case of the younger daughters.

MITAU (Russian, *Mitava*; Lettish, *Yelgava*), a town of Russia, capital of the government of Courland, 29 m. by rail S.W. of Riga, on the right bank of the river Aa, in a fertile plain which rises only 12 ft. above sea level, and has probably given its name to the town (*Mitte in der Aue*). Pop. (1897), 35,011 inhabitants, mainly Germans, but including also Jews (6500), Letts (5000) and Russians. At high water the plain and sometimes also the town are inundated. Mitau is surrounded by a canal occupying the place of former fortifications. It has regular, broad streets, bordered with the mansions of the German nobility, who reside at the capital of Courland. Mitau is well provided with educational institutions, and is also the seat of the Lettish Literary Society. The old castle (1266) of the dukes of Courland, situated on an island in the river, was destroyed by Duke Biren, who erected in its place (1738–1772) a spacious palace, now occupied by the governor and the courts. Manufactures are few, those of wax-cloth, linen, soap, ink and beer being the most important.

Mitau is supposed to have been founded in 1266 by Conrad Mandern, grand-master of the order of the Brethren of the Sword. In 1345, when it was plundered by the Lithuanians, it was already an important town. In 1561 it became the residence of the dukes of Courland. During the 17th century it was thrice taken by the Swedes. Russia annexed it with Courland in 1795. It was the residence (1798–1801 and 1804–1807) of the count of Provence (afterwards Louis XVIII.). In 1812 it was taken by Napoleon I.

MITCHAM, a suburb of London, in the Wimbledon parliamentary division of Surrey, England, 10 m. S. of London Bridge by the London, Brighton & South Coast railway. Pop. (1901), 14,903. Mitcham Common covers an area of 480 acres, and affords one of the best golf courses near London. The neighbourhood abounds in market gardens and plantations of aromatic herbs for the manufacture of scents and essences.

MITCHEL, ORMSBY MACKNIGHT (1809–1862), American astronomer, was born at Morganfield, Kentucky, on the 28th of July, 1809. He began life as a clerk, but, obtaining an appointment to a cadetship at West Point in 1825, he graduated there in 1829, and acted as assistant professor of mathematics 1829–1832. He was then called to the bar, but in 1836 became professor of mathematics and natural philosophy at Cincinnati College. In 1845 he was made director of an observatory established there through his initiative, and also in 1859 superintendent of the Dudley observatory at Albany. In 1861 he took part in the war as brigadier-general of volunteers, and for his skill in seizing certain important strategic points was on the 11th of April 1862 made major-general. He died of yellow fever at Beaufort, South Carolina, on the 30th of October 1862. He founded the *Sidereal Messenger* in 1846, was one of the first to adopt (in 1848) the electrical method of recording observations, and published besides other works, *The Orbs of Heaven* (1848, &c.), and *Popular Astronomy* (1860), both reissued at London in 1892.

See *Ormsby MacKnight Mitchel; a Biographical Narrative*, by his son, F. A. Mitchel (1887); P. C. Headley, *The Patriot Boy* (1865); *Amer. Journal of Science*, xxiv. 451 (1862); *Month. Notices Roy. Astr. Society*, xxiii. 133, xxxvii. 121 (C. Abbe); *Astr. Nach.*, No. 1401 (G. W. Hough).

MITCHELL, DONALD GRANT (1822–1908) American author, was born in Norwich, Connecticut, on the 12th of April 1822. He graduated at Yale College in 1841; studied law, but soon took up literature. Throughout his life he showed a particular interest in agriculture and landscape-gardening, which he followed at first in pursuit of health. He produced books of travel, volumes of essays on rural themes, of which *My Farm of Edgewood* (1863) is the best; sketchy studies of English monarchs and of English and American literature; and a character-novel entitled *Doctor Johns* (1866), &c.; but is best known as the author (under the pseudonym of "Ik Marvel"), of the sentimental essays contained in the volumes *Reveries of a Bachelor, or a Book of the Heart* (1850), and *Dream Life, a Fable of the Seasons* (1851).

MITCHELL, MARIA (1818–1889), American astronomer, was born of Quaker ancestry on the island of Nantucket on the 1st of August 1818. Her father, William Mitchell (1791–1869), was a school teacher and self-taught astronomer, who rated chronometers for Nantucket whalers, was an overseer of Harvard University (1857–1865), and for a time was employed by the United States Coast Survey. As early as 1831 (during the annular eclipse of the sun) she had been her father's assistant in his observations. On the 1st of October 1847 she discovered a telescopic comet (seen by De Vico Oct. 3, by W. R. Dawes Oct. 7, by Madame Rümker Oct. 11), and for this discovery she received a gold medal from the King of Denmark, and was elected (1848) to the American Academy of Arts and Sciences, and (1850) to the American Association for the Advancement of Science. In 1861 she removed from Nantucket to Lynn, where she used a large equatorial telescope presented to her by the women of America; and there she lived until 1865, when she became professor of astronomy and director of the observatory at Vassar College; in 1888 she became professor emeritus. In 1874 she began making photographs of the sun, and for years she made a special study of Jupiter and Saturn. She died at

Lynn on the 28th of June 1889. In 1908 an observatory was established in her honour at Nantucket.

See Phebe Mitchell Kendall, *Maria Mitchell: Life, Letters and Journals* (Boston, 1896); *In Memoriam* (Poughkeepsie, 1889), by her pupil and successor at Vassar, Mary W. Whitney; and a sketch by her brother, Henry Mitchell (1830–1902), himself a well-known hydrographer, in the *Proceedings* of the American Academy of Arts and Sciences, vol. xxv. (1889–1890), pp. 331–343.

MITCHELL, SILAS WEIR (1830—), American physician and author, son of a Philadelphia doctor, John Kearsley Mitchell (1798–1858), was born in Philadelphia on the 15th of February 1830. He studied at the university of Pennsylvania in that city, and received the degree of M.D. at Jefferson Medical College in 1850. During the Civil War he had charge of nervous injuries and maladies at Turner's Lane Hospital, Philadelphia, and at the close of the war became a specialist in nervous diseases. In this field Weir Mitchell's name became prominently associated with his introduction of the "rest cure," subsequently taken up by the medical world, for nervous diseases, particularly hysteria; the treatment consisting primarily in isolation, confinement to bed, dieting and massage. In 1863 he wrote a clever short story, combining physiological and psychological problems, entitled "The Case of George Dedlow," in the *Atlantic Monthly*. Thenceforward Dr Weir Mitchell, as a writer, divided his attention between professional and literary pursuits. In the former field he produced monographs on rattlesnake poison, on intellectual hygiene, on injuries to the nerves, on neurasthenia, on nervous diseases of women, on the effects of gunshot wounds upon the nervous system, and on the relations between nurse, physician, and patient; while in the latter he wrote juvenile stories, several volumes of respectable verse, and prose fiction of varying merit, which, however, gave him a leading place among the American authors of the close of the 19th century. His historical novels, *Hugh Wynne, Free Quaker* (1897), *The Adventures of François* (1898) and *The Red City* (1909), take high rank in this branch of fiction.

MITCHELL, SIR THOMAS LIVINGSTONE (1792–1855), Australian explorer, was born at Craigend, Stirlingshire, Scotland, on the 16th of June 1792. From 1808 to the end of the Peninsular War he served in Wellington's army, and was raised to the rank of major. He was appointed to survey the battlefields of the Peninsula, and his map of the Lower Pyrenees is still admired. In 1827 he was appointed deputy surveyor-general, and afterwards surveyor-general of New South Wales. He made four exploring expeditions between 1831 and 1846, and discovered the Peel, the Namoi, the Gwyder and other rivers, traced the course of the Darling and Glenelg, and was the first to penetrate into that portion of the country which he named Australia Felix. His last expedition was mainly devoted to the discovery of a route between Sydney and the Gulf of Carpentaria, and during the journey he explored the Fitzroy Downs, and discovered the Balonne, Victoria, Warrego and other streams. In 1838, while in England, Mitchell published his *Three Expeditions into the Interior of East Australia*. In 1839 he was knighted and made a D.C.L. of Oxford. During this visit he took with him some of the first specimens of gold and the first diamond found in Australia. In 1848 the narrative of his second expedition was published in London, *Journal of an Expedition into the Interior of Tropical Australia*. In 1851 he was sent to report on the Bathurst goldfields, and in 1853 he again visited England and patented his boomerang propeller for steamers. He died at Darling Point, Sydney, on the 5th of October 1855.

Besides the above works, Mitchell wrote a book on *Geographical and Military Surveying* (1827), an *Australian Geography*, and a translation of the *Lusiad* of Camoens. During his tenure of office as surveyor-general he published an admirable map (still in use) of the settled districts of New South Wales.

MITCHELL, a city and the county-seat of Davison county, South Dakota, U.S.A., about 70 m. W.N.W. of Sioux Falls. Pop. (1905), 5719; (1910), 6515. Mitchell is served by the Chicago, Milwaukee & St Paul and the Chicago, St Paul, Minneapolis & Omaha railways. Among its buildings and institutions are the city hall, the Federal building, a Carnegie library, a hospital, and a sanitorium. Mitchell is the seat of the Dakota Wesleyan University (1885; Methodist Episcopal). At Mitchell is a "corn palace," which is decorated each autumn with split ears of Indian corn, and is the centre of an annual festival, held in September and October. The city is an important shipping point for grain and livestock, and has a large wholesale trade. There are railway repair shops of the Chicago, Milwaukee & St Paul railway, machine shops, and manufactories of bricks and dressed lumber. Mitchell was settled in 1879 and chartered as a city in 1883.

MITCHELSTOWN, a market town of Co. Cork, Ireland, situated between the Kilworth and Galty Mountains, on a branch of the Great Southern & Western railway. Pop. (1901), 2146. Here is the Protestant Kingston College, a home for poor gentlefolk, founded by James, Lord Kingston, in 1760. The seat of the earls of Kingston was built in 1823. It is a massive castellated structure, among the finest of its kind in Ireland. The Mitchelstown limestone caves, exhibiting beautiful stalactite formations, are 6 m. distant in Co. Tipperary (*q.v.*). On the 9th of September 1887 Mitchelstown was the scene of a riot in connexion with the Irish Nationalist "plan of campaign." The police were compelled to fire on the rioters, and two men were killed, after which the coroner's jury brought in a verdict of wilful murder against the police. This verdict was ignored by the government, and subsequently quashed by the Queen's Bench in Dublin, but additional feeling was roused in respect of the incident owing to a message later sent by Mr Gladstone ending with the words "Remember Mitchelstown."

MITE, a name applied to an order of small Arachnida, with which this article deals, and to a coin of very slight value. The origin of both would appear to be ultimately the same, viz. a root *mei-*, implying something exceedingly small. It has been suggested that the name for the animal comes from a secondary root of the root *mei-*, to cut, whence come such words as Goth. *maitan*, to cut, and Ger. *messer*, knife. In this case mite would mean "the biter" or "cutter." The coin was originally a Flemish copper coin (Dutch *mijt*) worth one-third or, according to some authorities, a smaller fraction of the Flemish *penning*, penny. It has become a common expression in English for a coin of the smallest value, from its use to translate Gr. λεπτόν, two of which make a κοδράντης, translated "farthing" (Mark xii. 43).

In zoology, "mite" is the common name for minute members of the class Arachnida (*q.v.*), which, with the ticks, constitute the order Acari. The word "mite," however, is merely a popular and convenient term for certain groups of Acari, and does not connote a natural assemblage as contrasted with the ticks (*q.v.*). Mites are either free-living or parasitic throughout their lives or parasitic at certain periods and free-living at others. They are almost universally distributed, and are found wherever terrestrial vegetation, even of the lowliest kind, occurs. They are spread from the arctic to the antarctic hemisphere, and inhabit alike the land, fresh-water streams and ponds, brackish marshes and the sea. The largest species, which occur in the tropics, reach barely half an inch in length; while the smallest, the most diminutive of the Arthropoda, are invisible to the naked eye.

Mites are divided into a considerable number of families. The Bdellidae (*Bdella*) are free-living forms with long antenniform palpi. The large tropical forms above mentioned belong to the genus *Trombidium* of the family Trombidiidae. The members of this genus are covered with velvety plush-like hairs, often of an exquisite crimson colour. The legs are adapted for crawling or running, and the palpi are raptorial. They are non-parasitic in the adult stage; but immature individuals of a British species (*T. holosericeum*) are parasitic upon various animals (see HARVEST BUG). The Tetranychidae are nearly related to the last. A well-known example, *Tetranychus telarius*, spins webs on the backs of leaves, and is sometimes called the money spider. The fresh-water mites or Hydrachnidae are generally beautifully coloured red or green, and are commonly globular in shape. Their legs are furnished with long hairs for swimming. The marine mites of the family Halacaridae, on the contrary, are not active swimmers but merely creep on the stems of seaweeds and zoophytes. The Gamasidae are mostly free-living forms with a thick exoskeleton, and are allied to the Ixodidae or ticks (*q.v.*). A common species is *Gamasus coleoptratorum*, the females and young of which may be found upon the common dung-beetle. The Oribatidae or beetle-mites, so called from their resemblance to minute beetles, are non-parasitic, and often go through remarkable metamorphoses during development. The Sarcoptidae, as stated below, are mostly parasitic forms. Some members of this family, however, live in decaying animal substances, the best known perhaps being the cheese-mite (*Tyroglyphus siro*) which infests cheese, especially Stilton, in thousands. An allied species (*T. entomophagus*) often causes great damage to collections of insects by destroying the dried specimens. They may be easily exterminated by application of benzine, which does not harm the contents of the cabinet.

From the economic standpoint the most important mites are those which are parasitic upon mammals and birds. They belong to the four families, Gamasidae, Trombidiidae, Sarcoptidae and Demodicidae. Most of the Gamasidae are free-living mites. The family, however, contains an aberrant genus, *Dermanyssus*, of which several species have been described, although they are all perhaps merely varieties of one and the same species commonly known as *D. gallinae* or *D. avium*. This species is found in fowl-houses, dovecotes and bird-cages. During the day they lurk in cracks in the floor, walls or perches, and emerge at night to attack the roosting birds. They are a great pest, and frequently do much damage to birds both by sucking their blood and by depriving them of rest at night. They are sometimes transferred from birds to mammals. The Trombidiidae also are mostly free-living predaceous mites. A few, however, are parasitic upon mammals and birds, the best-known being *Trombidium holosericeum*, the larva of which attacks human beings, as well as chickens and other birds, sometimes producing considerable mortality amongst them (see HARVEST BUG). Another genus, *Cheyletiella*, affects rabbits as well as birds. Birds are also attacked by many species of Sarcoptidae, which according to the organs infected are termed plumicolae (Analgesinae), epidermicolae (Epidermoptinae), and cysticolae (Cytoditinae). The Analgesinae (*Pterolichus*, *Analges*) live almost wholly upon and between the barbules of the feathers. They are found in nearly every species of bird without apparently affecting the health in any way. The Epidermoptinae (*Epidermoptes*) occur on diseased fowls and live, as their name indicates, upon the skin at the base of the feathers, where their presence gives rise to an accumulation of yellowish scales. The Cytoditinae (*Cytodites*), on the other hand, live in the subcutaneous or intermuscular connective tissue round the respiratory organs, or in the air sacs, especially of gallinaceous species. They also penetrate to certain internal organs, and may become encysted and give rise to tubercle-like nodules. Sometimes they exist in such quantities in the air passages as to cause coughing and asphyxia.

The cutaneous mites, mentioned above, and others akin to them, produce no very marked disturbance in the skin of the species they infest. They merely suck the blood or feed upon the feathers, scurf and desquamating epidermis. Hence they are termed "non-psoric" mites. A certain number of species, however, called in contradistinction "psoric" mites, give rise by their bites, by the rapidity of their multiplication, and by the excavation of galleries in the skin, to a highly contagious disease known as scabies or mange, which if not treated in time produces the gravest results. These mites belong exclusively to the Sarcoptidae and Demodicidae. A variety of species are responsible for Sarcoptic mange, *Sarcoptes mutans* producing it in the feet of gallinaceous and passerine birds by burrowing beneath the scales and giving rise to a crusted exudation which pushes up beneath and between the scales. Feather scabies or depluming scabies of poultry is caused by another species, *S. laevis*. Three genera of Sarcoptidae, namely *Sarcoptes* *Chorioptes* and *Psoroptes* cause mange or scabies in mammals, the mange produced by *Sarcoptes* being the most serious form of the disease, because the females of the species which produces it, *Sarcoptes scabiei*, burrow beneath the skin and are more difficult to reach with acaricides. A considerable number of varieties of this species have been named after the hosts upon which they most commonly and typically occur, such as *S. scabiei hominis*, *equi*, *bovis*, *caprae*, *ovis*, *cameli*, *lupi*, *vulpis*, &c.; but they are not restricted to the mammals from which their names have been derived and structural differences between them are often difficult to define and sometimes non-existant. Under favourable conditions the multiplication of this species is very rapid. It has been computed indeed that a single pair may give rise to one million and a half individuals in about three months. *Psoroptes* lives in the epidermic incrustations to which it gives rise, without, however, excavating subcutaneous burrows. One species, *P. communis*, is known to affect various domestic animals. Of the genus *Chorioptes* two species have been described on domestic animals, viz. *Ch. symbiotes*, which has the same mode of life as *Psoroptes communis* and *Ch. cynotis*, which has been detected only in the ears of certain carnivora such as dogs, cats and ferrets. Mange, if taken in time, can be cured by applications of sulphur ointment or of sulphur mixed with an animal or vegetable oil. Mites of the family Demodicidae give rise to a skin disease called "Demodecic or follicular mange," which is often serious and always difficult to cure on account of the deep situation taken up by the parasites. These infest the hair follicles and sebaceous glands, and are therefore termed *Demodex folliculorum*. These mites differ greatly from those previously noticed—in the reduction of their legs to short three-jointed tubercles, and in the great elongation of the abdomen to form an annulated flexible postanal area to the body. They live not uncommonly in small numbers in the skin of the human face and their presence may never be detected. They also occur on dogs, pigs and other domesticated animals, as well as on mice and bats, and numerous varieties named after their hosts, *hominis*, *bavis*, *canis*, *cati*, &c., have been described, but they apparently differ from each other, principally in size.

The mites of the family Eriophyidae or Phytoptidae produce in various plants pathological results analogous to those produced in animals by parasitical Sarcoptidae and by Demodicidae. As in the Demodicidae the abdomen is elongate and annulate, but the Eriophyidae differ from all other mites in having permanently lost the last two pairs of legs. The excrescences and patches they produce on leaves are called "galls," the best known of which are perhaps the nail-galls of the lime caused by *Eriophyes tiliae*. A very large number of species have been described and named after the plants upon which they live. They often inflict very considerable loss upon fruit-growers by destroying the growing buds of the trees. (R. I. P.)

MITFORD, MARY RUSSELL (1787–1855), English novelist and dramatist, only daughter of Dr George Mitford, or Midford, was born at Alresford, Hampshire, on the 16th of December 1787. She retains an honourable place in English literature as the authoress of *Our Village*, a series of sketches of village scenes and characters unsurpassed in their kind, and as fresh as if they had been written yesterday. Her father was a curious character. He first spent his wife's fortune in a few years; then he spent the greater part of £20,000, which in 1797 his daughter, then at the age of ten, drew as a prize in a lottery; then he lived on a small remnant of his fortune and the proceeds of his daughter's literary industry. The father kept fresh in his daughter the keen delight in incongruities, the lively sympathy with self-willed vigorous individuality, and the womanly tolerance of its excess, which inspire so many of her sketches of character. Miss Mitford lived in close attendance on him, refused all holiday invitations because he could not live without her, and worked incessantly for him except when she broke off her work to read him the sporting newspapers. Her writing has all the charm of perfectly unaffected spontaneous humour, combined with quick wit and exquisite literary skill. Miss Mitford met Elizabeth Barrett (Mrs Browning) in 1836, and the acquaintance ripened into a warm friendship. The strain of poverty began to tell on her work, for although her books sold at high prices, her income did not keep pace with her father's extravagances. In 1837, however, she received a civil list pension, and five years later her father died. A subscription was raised to pay his debts, and the surplus increased the daughter's income. Miss Mitford eventually removed to a cottage at Swallowfield, near Reading, where she died on the 10th of January 1855.

Miss Mitford's youthful ambition had been to be "the greatest English poetess," and her first publications were poems in the manner of Coleridge and Scott (*Miscellaneous Verses*, 1810, reviewed by Scott in the *Quarterly*; *Christine*, a metrical tale, 1811; *Blanche*, 1813). Her play *Julian* was produced at Covent Garden, with Macready in the title-rôle, in 1823; *The Foscari* was performed at Covent Garden, with Charles Kemble as the hero, in 1826; *Rienzi*, 1828, the best of her plays, had a run of thirty-four nights, and Miss Mitford's friend, Talfourd, imagined that its vogue militated against the success of his own play *Ion*. *Charles the First* was refused a licence by the Lord Chamberlain, but was played at the Surrey Theatre in 1834. But the prose, to which she was driven by domestic necessities, has rarer qualities than her verse. The first series of *Our Village* sketches appeared in 1824, a second in 1826, a third in 1828, a fourth in 1830, a fifth in 1832. *Our Village* was several times reprinted; *Belford Regis*, a novel in which the neighbourhood and society of Reading were idealized, was published in 1835.

Her *Recollections of a Literary Life* (1852) is a series of *causeries* about her favourite books. Her talk was said by her friends, Mrs Browning and Hengist Horne, to have been even more amusing than her books, and five volumes of her *Life and Letters*, published in 1870 and 1872, show her to have been a delightful letter-writer.

MITFORD, WILLIAM (1744–1827), English historian, was the elder of the two sons of John Mitford, a barrister, who lived near Beaulieu, at the edge of the New Forest. Here, at Exbury House, his father's property, Mitford was born on the 10th of February 1744. He was educated at Cheam School, under the picturesque writer William Gilpin, but at the age of fifteen a severe illness led to his being removed, and after two years of idleness Mitford was sent, in July 1761, as a gentleman commoner to Queen's College, Oxford. In this year his father died, and left him the Exbury property and a considerable fortune. Mitford, therefore, being "very much his own master, was easily led to prefer amusement to study." He left Oxford (where the only sign of assiduity he had shown was to attend the lectures of Blackstone) without a degree, in 1763, and proceeded to the Middle Temple. But when he married Miss Fanny Molloy in 1766, and retired to Exbury for the rest of his life, he made the study of the Greek language and literature his hobby and occupation. After ten years his wife died, and in October 1776 Mitford went abroad. He was encouraged by French scholars whom he met in Paris, Avignon and Nice to give himself systematically to the study of Greek history. But it was Gibbon, with whom he was closely associated when they both were officers in the South Hampshire Militia, who suggested to Mitford the form which his work should take. In 1784 the first of the volumes of his *History of Greece* appeared, and the fifth and last of these quartos was published in 1810, after which the state of Mitford's eyesight and other physical infirmities, including a loss of memory, forbade his continuation of the enterprise, although he painfully revised successive new editions. While his book was progressing, Mitford was a member of the House of Commons, with intervals, from 1785 to 1818, and he was for many years verderer of the New Forest and a county magistrate; but it does not appear that he ever visited Greece. After a long illness, he died at Exbury on the 10th of February 1827. In addition to his *History of Greece*, he published a few smaller works, the most important of which was an *Essay on the Harmony of Language*, 1774. The style of Mitford is natural and lucid, but without the rich colour of Gibbon. He affected some oddities both of language and of orthography, for which he was censured and which he endeavoured to revise. But his political opinions were still more severely treated, since Mitford was an impassioned anti-Jacobin, and his partiality for a monarchy led him to be unjust to the Athenians. Hence his *History of Greece*, after having had no peer in European literature for half a century, faded in interest on the appearance of the work of Grote. Clinton, too, in his *Fasti hellenici*, charged Mitford with "a general negligence of dates," though admitting that in his philosophical range "he is far superior to any former writer" on Greek history. Byron, who dilated on Mitford's shortcomings, nevertheless declared that he was "perhaps the best of all modern historians altogether." This Mitford certainly is not, but his pre-eminence in the little school of English historians who succeeded Hume and Gibbon it would be easier to maintain.

William Mitford's cousin, the Rev. John Mitford (1781–1859), was editor of the *Gentleman's Magazine* and of various editions of the English poets. For the Freeman-Mitfords, who were also relatives, see REDESDALE, EARL OF.

MITHILA, an ancient kingdom of India, corresponding to that portion of Behar lying N. of the Ganges, with an extension into Nepal, where was the capital of Janakpur. Its early history is obscure, but it has always been noted for its peculiar conservatism and the learning of its Brahmans. They form to this day one of the five classes of northern Brahmans, and their head is the Maharaja of Darbhanga. The language, known as Maithili, is a dialect of Bihari, with an archaic system of grammar and a literature of its own.

MITHRADATES, less correctly MITHRIDATES, a Persian name derived from Mithras (*q.v.*), the sun-god, and the Indo-European root *da*, "to give," *i.e.* "given by Mithras." The name occurs also in the forms Mitradates (Herod. i. 110) and Meherdates (Tac. *Ann.* xii. 10). It was borne by a large number of Oriental kings, soldiers and statesmen. The earliest are Mithradates, the eunuch who helped Artabanus to assassinate Xerxes I. (Diod. xi. 69), and the Mithradates who fought first with Cyrus the Younger and after his death with Artaxerxes against the Greeks (Xen. *Anab.* ii. 5, 35; iii. 3, 1–10; iii. 4, 1–5), and is the ancestor of the kings of Pontus. The most important are three kings of Parthia of the Arsacid dynasty, and six (or four) kings of Pontus. There were also two kings of Commagene, two of the Bosporus and one of Armenia (A.D. 35–51).

MITHRADATES I. (Arsaces VI.), successor of his brother, Phraates I., came to the Parthian throne about 175 B.C. The first event of his reign was a war with Eucratides of Bactria, who tried to create a great Greek empire in the East. At last, when Eucratides had been murdered by his son about 150, Mithradates was able to occupy some districts on the border of Bactria and to conquer Arachosia (Kandahar); he is even said to have crossed the Indus (Justin 41, 6; Strabo xi. 515, 517; cf. Orosius v. 4, 16; Diod. 33, 18). Meanwhile the Seleucid kingdom was torn by internal dissensions, fostered by Roman intrigues. Phraates I. had already conquered eastern Media, about Rhagae (Rai), and subjected the Mardi on the border of the Caspian (Justin 41, 5; Isidor. *Charac.* 7). Mithradates I. conquered the rest of Media and advanced towards the Zagros chains and the Babylonian plain. In a war against the Elymaeans (in Susiana) he took the Greek town Seleucia on the Hedyphon, and forced their king to become a vassal of the Parthians (Justin 41, 6; Strabo xv. 744). About 141 he must have become master of Babylonia. By Diodorus 33, 18 he is praised as a mild ruler; and the fact that from 140 he takes on his coins the epithet *Philhellen* (W. Wroth, *Catalogue of the Coins of Parthia*, p. 14 seq.; till then he only calls himself "the great king Arsakes") shows that he tried to conciliate his Greek subjects. The Greeks, however, induced Demetrius II. Nicator to come to their deliverance, although he was much pressed in Syria by the pretender Diodotus Tryphon. At first he was victorious, but in 138 he was defeated. Mithradates settled him with a royal household in Hyrcania and gave him his daughter Rhodogune in marriage (Justin 36, 1, 38, 9; Jos. *Ant.* 13, 5, 11; Euseb. *Chron.* I. 257; Appian *Syr.* 67). Shortly afterwards Mithradates I. died, and was succeeded by his son Phraates II. He was the real founder of the Arsacid Empire.

Kings of Parthia.

MITHRADATES II. the Great, king of Parthia (*c.* 120–88 B.C.), saved the kingdom from the Mongolian Sacae (Tochari), who had occupied Bactria and eastern Iran, and is said to have extended the limits of the empire (Justin 42, 2, where he is afterwards confused with Mithradates III.). He defeated King Artavasdes of Armenia and conquered seventy valleys; and the prince Tigranes came as hostage to the Parthians (Justin 42, 2; Strabo, xi. 532). In an inscription from Delos (Dittenberger, *Or. gr. inscr.* 430) he is called "the great King of Kings Arsakes." He also interfered in the wars of the dynasts of Syria (Jos. *Ant.* xiii. 14, 3). He was the first Parthian king who entered into negotiations with Rome, then represented by Sulla, praetor of Cilicia (92 B.C.).

Mithradates III. murdered his father Phraates III. about 57 B.C., with the assistance of his brother Orodes. He was made king of Media, and waged war against his brother, but was soon deposed on account of his cruelty. He took refuge with Gabinius, the Roman proconsul of Syria. He advanced into Mesopotamia, but was beaten at Seleucia by Surenas, fled into Babylon, and after a long siege was taken prisoner and killed in 54 by Orodes I. (Dio Cass. 39, 56; Justin 42, 4; Jos. *Bell.* i. 8, 7, *Ant.* 14, 6, 4).

A Parthian king Mithradates, who must have occupied the throne for a short time during the reign of Phraates IV., is mentioned by Jos. *Ant.* xvi. 8, 4, in 10 B.C.; another pretender Meherdates was brought from Rome in A.D. 49 by the opponents of Gotarzes, but defeated (Tac. *Ann.* xi. 10, xii. 10 sqq.). The name of another pretender Mithradates (often called Mithradates IV.) occurs on a coin of the first half of the 2nd century, written in Aramaic, accompanied by the Arsacid titles in Greek (Wroth, *Catal. of the Coins of Parthia*, p. 219); he appears to be identical with Meherdotes, one of the rival kings of Parthia who fought against Trajan in 116; he died in an attack on Commagene and appointed his son Sanatruces successor, who fell in a battle against the Romans (Arrian *ap.* Malalas, *Chron.* pp. 270. 274). (Ed. M.)

Kings of Pontus.

The kings of Pontus were descended from one of the seven Persian conspirators who put the false Smerdis to death (see Darius I.). According to Diodorus Siculus, three members of his family—Mithradates, Ariobarzanes, Mithradates—were successively rulers of Cius on the Propontis and Carinē in Mysia. The last of these was put to death in 302 B.C. by Antigonus, who suspected him of having joined the coalition against him. He was succeeded by his son Mithradates I. or III. (if the two dynasts of Cius be included[1]) the founder (κτίστης) of the Pontic kingdom, although this distinction is by some attributed to the father. Warned by his friend Demetrius, the son of Antigonus, that he was threatened with the same fate as his father, he fled to Paphlagonia, where he seized Cimiata, a fort at the foot of the Olgassys range. Being joined by the Macedonian garrison and the neighbouring populations, he conquered the Cappadocian and Paphlagonian territories on both sides of the Halys and assumed the title of king. Before his death he further enlarged Pontic Cappadocia. He was succeeded by Ariobarzanes, who left the throne to Mithradates II. (*c.* 256–190, according to Meyer, *Mithradates II. and III.*), a mere child. Early in his reign the Gauls of Galatia invaded his territory. Mithradates was at the battle of Ancyra (*c.* 241), in which he assisted Antiochus Hierax against his brother Seleucus Callinicus, in spite of the fact that he had married the daughter of the latter with Greater Phrygia as her dowry. His two daughters, both named Laodice, were married, one to Antiochus the Great, the other to his cousin Achaeus, a dynast of Asia Minor. He unsuccessfully attacked Sinope, which was taken by his successor Pharnaces, the brother (not the son) of Mithradates III. (169–121), surnamed *Philopator*, *Philadelphus*, and *Euergetes*. According to Meyer, however, there were two kings (Mithradates IV. *Philopator* and V. *Euergetes*). He was the first king of Pontus to recognize the suzerainty of the Romans, of whom he was a loyal ally. He assisted Attalus II. of Pergamum to resist Prusias II. of Bithynia; furnished a contingent during the Third Punic War; and aided the Romans in obtaining possession of Pergamum, bequeathed to them by Attalus III., but claimed by Aristonicus, a natural son of Eumenes II. Both Mithradates and Nicomedes of Bithynia demanded Greater Phrygia in return for their services. It was awarded to Mithradates, but the senate refused to ratify the bargain on the ground of bribery. For several years the kings of Pontus and Bithynia bid against each other, till in 116 Phrygia was declared independent, although in reality it was treated as part of the province of Asia. Mithradates appears to have taken it without waiting for the decision of the senate. He invaded Cappadocia, and married his daughter to the young king, Ariarathes Epiphanes; bought the succession from the last king of Paphlagonia, and obtained a kind of protectorate over Galatia. He was a great admirer of the Greeks, who called him Euergetes; he removed his capital from Amasia to Sinope, and bestowed liberal gifts upon the temples of Delos and Athens. At the height of his power he was assassinated by his courtiers during a banquet in his palace at Sinope.

Mithradates VI. *Eupator*, called the Great, a boy of eleven, now succeeded his father. Alarmed at the attempts made upon his life by his mother, he fled to the mountains and was for many years a hunter. In 111 he returned to Sinope, threw his mother into prison, and put his younger brother to death. Having thus established himself on the throne, he turned his attention to conquest. In return for his assistance against the Scythians, the Greeks of the Cimmerian Bosporus and the Tauric Chersonese recognized his suzerainty. He occupied Colchis, Paphlagonia and part of Galatia; set his son Ariarathes on the throne of Cappadocia and drove out Nicomedes III., the young king of Bithynia. The Romans restored the legitimate kings, and, while apparently acquiescing, Mithradates made preparations for war. He had long hated the Romans, who had taken Phrygia during his minority, and he aimed at driving them from Asia Minor. The cause of rupture was the attack on Pontic territory by Nicomedes at the instigation of the Romans. Mithradates, unable to obtain satisfaction, declared war (88 B.C.). He rapidly overran Galatia, Phrygia and Asia, defeated the Roman armies, and ordered a general massacre of the Romans in Asia. He sent large armies into European Greece, and his generals occupied Athens. But Sulla in Greece and Fimbria in Asia defeated his armies in several battles; the Greek cities were disgusted by his severity, and in 84 he concluded peace, abandoning all his conquests, surrendering his fleet and paying a fine of 2000 talents. During what is called the Second Mithradatic War, Murena invaded Pontus without any good reason in 83, but was defeated in 82. Hostilities were suspended, but disputes constantly occurred, and in 74 a general war broke out. Mithradates defeated Cotta, the Roman consul, at Chalcedon; but Lucullus worsted him, and drove him in 72 to take refuge in Armenia with his son-in-law Tigranes. After two great victories at Tigranocerta (69) and Artaxata (68), Lucullus was disconcerted by mutiny and the defeat of his lieutenant Fabius (see Lucullus). In 66 he was superseded by Pompey, who completely defeated both Mithradates and Tigranes. The former established himself in 64 at Panticapaeum, and was planning new campaigns against the Romans when his own troops revolted, and, after vainly trying to poison himself, he ordered a Gallic mercenary to kill him. So perished the greatest enemy that the Romans had to encounter in Asia Minor. His body was sent to Pompey, who buried it in the royal sepulchre at Sinope.

Ancient authorities have invested Mithradates with a halo of romance. His courage, his bodily strength and size, his skill in the use of weapons, in riding, and in the chase, his speed of foot, his capacity for eating and drinking, his penetrating intellect and his mastery of 22 languages are celebrated to a degree which is almost incredible. With a surface gloss of Greek education, he united the subtlety, the superstition, and the obstinate endurance of an Oriental. He collected curiosities and works of art; he assembled Greek men of letters round him; he gave prizes to the greatest poets and the best eaters. He spent much of his time in practising magic, and it was believed that he had so saturated his body with poisons that none could injure him. He trusted no one; he murdered his mother, his sons, the sister whom he had married; to prevent his harem from falling to his enemies he murdered all his concubines, and his most faithful followers were never safe. For eighteen years he showed himself no unworthy adversary of Sulla, Lucullus and Pompey.

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[1] There is much difference of opinion in regard to the kings of Pontus called Mithradates to the accession of Mithradates Eupator. Ed. Meyer reckons five, T. Reinach three.

See T. Reinach, *Mithridate Eupator* (1890; Ger. trans. by A. Goetz, 1895, with the author's corrections and additions); also E. Meyer, *Geschichte des Königreichs Pontos* (1879).

MITHRAS, a Persian god of light, whose worship, the latest one of importance to be brought from the Orient to Rome, spread throughout the empire and became the greatest antagonist of Christianity.

I. *History and Distribution.*—The cult goes back to a period before the separation of the Persians from the Hindus, as is shown by references in the literatures of both stocks, the Avesta and the Vedas. Though but faintly pictured in the Vedic hymns, he is there invoked with Ormazd, or Ahuramazda, the god of the sky, and is clearly a divinity of light, the protector of truth and the enemy of error and falsehood. In the Avesta, after the separation of the Iranian stock from the Hindu and the rise of Zoroastrianism, which elevated Ormazd to the summit of the Persian theological system, his rôle was more distinct, though less important; between Ormazd, who reigned in eternal brightness, and Ahriman, whose realm was eternal darkness, he occupied an intermediate position as the greatest of the *yazatas*, beings created by Ormazd to aid in the destruction of evil and the administration of the world. He was thus a deity of the realms of air and light, and, by transfer to the moral realm, the god of truth and loyalty. Because light is accompanied by heat, he was the god of vegetation and increase; he sent prosperity to the good, and annihilated the bad; he was the god of armies and the champion of heroes; as the enemy of darkness and of all evil spirits, he protected souls, accompanying them on the way to paradise, and was thus a redeemer. Animals and birds were sacrificed and libations poured to him, and prayers were addressed to him by devotees who had purified themselves by ablution and repeated flagellation. As a god who gave victory, he was prominent in the official cult of Persia, the seventh month and the sixteenth day of other months being sacred to him. His worship spread with the empire of the Persians throughout Asia Minor, and Babylon was an important centre. Its popularity remained unimpaired after the fall of Persia, and it was during the ferment following the conquests of Alexander that the characteristics which mark it during the Roman period were firmly fixed. Mithraism was at full maturity on its arrival at Rome, the only modifications it ever suffered having been experienced during its younger days in Asia.

Modified though never essentially changed, (1) by contact with the star-worship of the Chaldaeans, who identified Mithras with Shamash, god of the sun,(2) by the indigenous Armenian religion and other local Asiatic faiths and (3) by the Greeks of Asia Minor, who identified Mithras with Helios, and contributed to the success of his cult by equipping it for the first time with artistic representations (the famous Mithras relief originated in the Pergamene school towards the 2nd century B.C.), Mithraism was first transmitted to the Roman world during the 1st century B.C. by the Cilician pirates captured by Pompey. It attained no importance, however, for nearly two centuries. The lateness of its arrival in the West was due to the fact that its centres of influence were not in immediate contact with Greek and Roman civilization. It never became popular in Greek lands, and was regarded by Hellenized nations as a barbarous worship. It was at rivalry with the Egyptian religion. As late as the time of Augustus it was but little known in Roman territory, and gained a firm foothold in Italy only gradually, as a result of the intercourse between Rome and Asia consequent upon the erection of the Eastern provinces and the submission and colonization of Mesopotamia. It seems at first to have had relations with the cult of the Great Mother of the Gods at Rome, whose influence served to protect it and facilitate its growth. The cult of Mithras began to attract attention at Rome about the end of the 1st century A.D. Statius (*c.* A.D. 80) mentions the typical Mithraic relief in his *Thebaid* (i. 719,720); from Plutarch's (A.D. 46–125) *Vita Pompei* (24) it is apparent that the worship was well known; and the first Roman reliefs show the characteristics of about the same time.

Towards the close of the 2nd century the cult had begun to spread rapidly through the army, the mercantile class, slaves and actual propagandists, all of which classes were largely composed of Asiatics. It throve especially among military posts, and in the track of trade, where its monuments have been discovered in greatest abundance. The German frontiers afford most evidence of its prosperity. Rome itself was a favourite seat of the religion. From the end of the 2nd century the emperors encouraged Mithraism, because of the support which it afforded to the divine right of monarchs. The Persian belief that the legitimate sovereign reigned by the grace of Ormazd, whose favour was made manifest by the sending of the *Hvarenō*, a kind of celestial aureole of fire, resulted in the doctrine that the sun was the giver of the *Hvarenō*. Mithras, identified with Sol Invictus at Rome, thus became the giver of authority and victory to the imperial house. From the time of Commodus, who participated in its mysteries, its supporters were to be found in all classes. Its importance at Rome may be judged from the abundance of monumental remains—more than 75 pieces of sculpture, 100 inscriptions, and ruins of temples and chapels in all parts of the city and suburbs.

Finally, philosophy as well as politics contributed to the success of Mithraism, for the outcome of the attempt to recognize in the Graeco-Roman gods only forces of nature was to make the Sun the most important of deities; and it was the Sun with whom Mithras was identified.

The beginning of the downfall of Mithraism dates from A.D. 275, when Dacia was lost to the empire, and the invasions of the northern peoples resulted in the destruction of temples along a great stretch of frontier, the natural stronghold of the cult. The aggression of Christianity also was now more effective. The emperors, however, favoured the cult, which was the army's favourite until Constantine destroyed its hopes. The reign of Julian and the usurpation of Eugenius renewed the hopes of its devotees, but the victory of Theodosius (394) may be considered the end of its existence. It still survived in certain cantons of the Alps in the 5th century, and clung to life with more tenacity in its Eastern home. Its legitimate successor was Manichaeism, which afforded a refuge to those mystics who had been shaken in faith, but not converted, by the polemics of the Church against their religion.

II. *Sources, Remains, Ritual.*—The sources of present knowledge regarding Mithraism consist of the Vedas, the Avesta, the Pahlevi writings, Greek and Latin literature and inscriptions, and the cult monuments. The monuments comprise the remains of nearly a score of temples and about 400 statues and bas reliefs. The Mithraic temples of Roman times were artificial grottoes (*spelaea*) wholly or partially underground, in imitation of the original selcuded mountain caverns of Asia. The Mithraeum hewn in the tufa quarries of the Capitoline Hill at Rome, still in existence during the Renaissance, is an example. The main room of the ordinary temple was rectangular, with an elevated apsidal arrangement, like a choir, containing the sacred relief on its wall, at the end opposite the entrance, and with continuous benches (*podia*) of masonry, about 5 ft. wide and inclining slightly towards the floor, built against the wall on its long sides. The ceiling was made to symbolize the firmament. There were arrangements for the brilliant illumination of the choir and its relief, which was sometimes sculptured on both sides and reversible, while the *podia* were intentionally more obscure. The choir and the long space between the *podia* were for ministrants, the *podia* themselves for kneeling worshippers. Two altars, to the Sun and the Moon, stood before the former, and cult statues along the latter. The approach to the grotto lay through a portico on the level with and fronting the street, and a *pronaos*, in communication with which was a kind of sacristy. Steps led to the lower level of the sanctuary. The simplicity and smallness of the Mithraic temples are to be accounted for by structural and financial reasons; an underground temple was difficult to construct on a large scale, and the worshippers of Mithras were usually from the humbler classes. The average grotto held from fifty to a hundred persons. The size of the sanctuaries, however, was compensated for by their number; in Ostia alone there were five.

The typical bas relief, which is found in great abundance in the museums of Europe, invariably represents Mithras, under the form of a youth with conical cap and flying drapery, slaying the sacred bull, the scorpion attacking the genitals of the animal, the serpent drinking its blood, the dog springing towards the wound in its side, and frequently, in addition, the Sun-god, his messenger the raven, a fig-tree, a lion, a ewer, and torch-bearers. The relief is in some instances enclosed in a frame of figures and scenes in relief. The best example is the monument of Osterburken (Cumont, *Textes et monuments figurés*, No. 246). With this monument as a basis, Franz Cumont has arranged the small Mithraic reliefs into two groups, one illustrating the legend of the origin of the gods, and the other the legend of Mithras. In the first group are found Infinite Time, or Cronus; Tellus and Atlas supporting the globe, representing the union of Earth and Heaven; Oceanus; the Fates; Infinite Time giving into the hand of his successor Ormazd the thunderbolt, the symbol of authority; Ormazd struggling with a giant of evil—the Mithraic gigantomachy. The second group represents, first, the birth of Mithras; then the god nude, cutting fruit and leaves from a fig-tree in which is the bust of a deity, and before which one of the winds is blowing upon Mithras; the god discharging an arrow against a rock from which springs a fountain whose water a figure is kneeling to receive in his palms; the bull in a small boat, near which again occurs the figure of the animal under a roof about to be set on fire by two figures; the bull in flight, with Mithras in pursuit; Mithras bearing the bull on his shoulders; Helios kneeling before Mithras; Helios and Mithras clasping hands over an altar; Mithras with drawn bow on a running horse; Mithras and Helios banqueting; Mithras and Helios mounting the chariot of the latter and rising in full course over the ocean. Few of the Mithraic reliefs are of even mediocre art. Among the best is the relief from the Capitoline grotto, now in the Louvre.

Cumont's interpretation of the main relief and its smaller companions involves the reconstruction of a Mithraic theology, a Mithraic legend, and a Mithraic symbolism. Paucity of evidence makes the first difficult. The head of the divine hierarchy of Mithras was Infinite Time—Cronus, Saturn; Heaven and Earth were his offspring, and begat Ocean, who formed with them a trinity corresponding to Jupiter, Juno, and Neptune. From Heaven and Earth sprang the remaining members of a circle analogous to the Olympic gods. Ahriman, also the son of Time, was the Persian Pluto. Owing to Semitic influence every Persian god had in Roman times come to possess a twofold significance—astrological and natural, Semitic and Iranian—the earlier and deeper Iranian significance being imparted by the clergy to the few intelligent elect, the more attractive and superficial Chaldaean symbolism being presented to the multitude. Mithras was the most important member of the circle. He was regarded as the mediator between suffering humanity and the unknowable and inaccessible god of all being, who reigned in the ether.

The Mithras legend has been lost, and can be reconstructed only from the scenes on the above described relief. Mithras was born of a rock, the marvel being seen only by certain shepherds, who brought gifts and adored him. Chilled by the wind, the new-born god went to a fig-tree, partook of its fruit, and clothed himself in its leaves. He then undertook to vanquish the beings already in the world, and rendered subject to him first the Sun, with whom he concluded a treaty of friendship. The most wonderful of his adventures, however, was that with the sacred bull which had been created by Ormazd. The hero seized it by the horns and was borne headlong in the flight of the animal, which he finally subdued and dragged into a cavern. The bull escaped, but was overtaken, and by order of the Sun, who sent his messenger the raven, was reluctantly sacrificed by Mithras. From the dying animal sprang the life of the earth, although Ahriman sent his emissaries to prevent it. The soul of the bull rose to the celestial spheres and became the guardian of herds and flocks under the name of Silvanus. Mithras was through his deed the creator of life. Meanwhile Ahriman sent a terrible drought upon the land. Mithras defeated his purpose by discharging an arrow against a rock and miraculously drawing the water from it. Next Ahriman sent a deluge, from which one man escaped in a boat with his cattle. Finally a fire desolated the earth, and only the creatures of Ormazd escaped. Mithras, his work accomplished, banqueted with the Sun for the last time, and was taken by him in his chariot to the habitation of the immortals, whence he continued to protect the faithful.

The symbolism employed by Mithraism finds its best illustration in the large central relief, which represents Mithras in the act of slaying the bull as a sacrifice to bring about terrestrial life, and thus portrays the concluding scenes in the legend of the sacred animal. The scorpion, attacking the genitals of the bull, is sent by Ahriman from the lower world to defeat the purpose of the sacrifice; the dog, springing towards the wound in the bull's side, was venerated by the Persians as the companion of Mithras; the serpent is the symbol of the earth being made fertile by drinking the blood of the sacrificial bull; the raven, towards which Mithras turns his face as if for direction, is the herald of the Sun-god, whose bust is near by, and who has ordered the sacrifice; various plants near the bull, and heads of wheat springing from his tail, symbolize the result of the sacrifice; the cypress is perhaps the tree of immortality. There was also an astrological symbolism, but it was superficial, and of secondary importance. The torch-bearers sometimes seen on the relief represent one being in three aspects—the morning, noon and evening sun, or the vernal, summer and autumn sun.

Owing to the almost absolute disappearance of documentary evidence, it is impossible to know otherwise than very imperfectly the inner life of Mithraism. Jerome (*Epist.* cvii.) and inscriptions preserve the knowledge that the mystic, *sacratus*, passed through seven degrees, which probably corresponded to the seven planetary spheres traversed by the soul in its progress to wisdom, perfect purity, and the abode of the blest: *Corax*, Raven, so named because the raven in Mithraic mythology was the servant of the Sun; *Cryphius*, Occult, a degree in the taking of which the mystic was perhaps hidden from others in the sanctuary by a veil, the removal of which was a solemn ceremonial; *Miles*, Soldier, signifying the holy warfare against evil in the service of the god; *Leo*, Lion, symbolic of the element of fire; *Perses*, Persian, clad in Asiatic costume, a reminiscence of the ancient origin of the religion; *Heliodromus*, Courier of the Sun, with whom Mithras was identified; *Pater*, Father, a degree bringing the mystic among those who had the general direction of the cult for the rest of their lives. One relief (Cumont, vol. i. p. 175, fig. 10) shows figures masked and costumed to represent *Corax*, *Perses*, *Miles* and *Leo*, indicating the practice on occasion of rites involving the use of sacred disguise, a custom probably reminiscent of the primitive time when men represented their deities under the form of animals, and believed themselves in closer communion with them when disguised to impersonate them. Of the seven degrees, those mystics not yet beyond the third, *Miles*, were not in full communion, and were called ὑπηρετοῦντες (servants); while the fourth degree, *Leo*, admitted them into the class of the fully initiate, the μετέχοντες (participants). No women were in any way connected with the cult, though the male sex could be admitted even in childhood. The time requisite for the several degrees is unknown, and may have been determined by the *Patres*, who conferred them in a solemn ceremony called *Sacramentum*, in which the initial step was an oath never to divulge what should be revealed, and for which the mystic had been specially prepared by lustral purification, prolonged abstinence, and severe deprivations. Special ceremonies accompanied the diverse degrees: Tertullian speaks of "marking the forehead of a *Miles*," which may have been the branding of a Mithraic sign; honey was applied to the tongue and hands of the *Leo* and the *Perses*. A sacred communion of bread, water and possibly wine, compared by the Christian apologists to the Eucharist, was administered to the mystic who was entering upon one of the advanced degrees, perhaps *Leo*. The ceremony was probably commemorative of the banquet of Mithras and Helios before the former's ascension, and its effect strength of body, wisdom, prosperity, power to resist evil, and participation in the immortality enjoyed by the god himself. Other features reminiscent of the original barbarous rites in the primitive caverns of the East, no doubt also occupied a place in the cult; bandaging of eyes, binding of hands with the intestines of a fowl, leaping over a ditch filled with water, witnessing a simulated murder, are mentioned by the Pseudo-Augustine; and the manipulation of lights in the crypt, the administration of oaths, and the repetition of the sacred formulae, all contributed toward inducing a state of ecstatic exaltation. What in the opinion of Albrecht Dieterich (*Eine Mithrasliturgie*, Leipzig, 1903) is a Mithras liturgy is preserved in a Greek MS. of Egyptian origin of about A.D. 300. It is the ritual of a magician, imbedded in which, and alternating with magic formulae and other occult matter, are a number of invocations and prayers which Dieterich reconstructs as a liturgy in use by the clergy of Mithras between A.D. 100 and 300, and adapted to this new use about the latter date.

The Mithraic priest, *sacerdos* or *antistes*, was sometimes also of the degree of *pater*. Tertullian (*De praescr. haeret.* 40) calls the chief priest *summus pontifex*, probably the *pater patrum* who had general supervision of all the initiates in one city, and states that he could marry but once. According to the same author, there were Mithraic, as well as Christian, *virgines et continentes*. Besides the administration of sacraments and the celebration of offices on special occasions, the priest kept alight the eternal fire on the altar, addressed prayers to the Sun at dawn, midday and twilight, turning towards east, south and west respectively. Clad in Eastern paraphernalia, he officiated at the numerous sacrifices indicated by the remains of iron and bronze knives, hatchets, chains, ashes and bones of oxen, sheep, goats, swine, fowl, &c. There was pouring of libations, chanting and music, and bells and candles were employed in the service. Each day of the week was marked by the adoration of a special planet, the sun being the most sacred of all, and certain dates, perhaps the sixteenth of each month and the equinoxes, in conformity with the character of Mithras as mediator, were set aside for special festivals.

The Mithraic community of worshippers, besides being a spiritual fraternity, was a legal corporation enjoying the right of holding property, with temporal officials at its head, like any other *sodalitas*: there were the *decuriones* and *decem primi*, governing councils resembling assembly and senate in cities; *magistri*, annually elected presidents; *curatores*, financial agents; *defensores*, advocates; and *patroni*, protectors among the influential. It may be that a single temple was the resort of several small associations of worshippers which were subdivisions of the whole community. The cult was supported mainly by voluntary contribution. An abundance of epigraphic evidence testifies to the devotion of rich and poor alike.

III. *Moral Influence*.—The rapid advance of Mithraism was due to its human qualities. Its communities were bound together by a sense of close fraternal relation. Its democracy obliterated the distinctions between rich and poor; slave and senator became subject to the same rule, eligible for the same honours, partook of the same communion, and were interred in the same type of sepulchre, to await the same resurrection. The reward of title and degree and the consequent rise in the esteem of his fellows and himself was also a strong incentive; but the Mithraic faith itself was the greatest factor. The impressiveness and the stimulating power of the mystic ceremonies, the consciousness of being the privileged possessor of the secret wisdom of the ancients, the sense of purification from sin, and the expectation of a better life where there was to be compensation for the sufferings of this world—were all strong appeals to human nature. The necessity of moral rectitude was itself an incentive. Courage, watchfulness, striving for purity, were all necessary in the incessant combat with the forces of evil. Resistance to sensuality was one aspect of the struggle, and asceticism was not unknown. Mithras was ever on the side of the faithful, who were certain to triumph both in this world and the next. The worthy soul ascended to its former home in the skies by seven gates or degrees, while the unworthy soul descended to the realms of Ahriman. The doctrine of the immortality of the soul was accompanied by that of the resurrection of the flesh; the struggle between good and evil was one day to cease, and the divine bull was to appear on earth, Mithras was to descend to call all men from their tombs and to separate the good from the bad. The bull was to be sacrificed to Mithras, who was to mingle its fat with consecrated wine and give to drink of it to the just, rendering them immortal, while the unjust, together with Ahriman and his spirits, were to be destroyed by a fire sent from Heaven by Ormazd. The universe, renewed, was to enjoy eternal happiness.

IV. *Relation to Christianity*.—The most interesting aspect of Mithraism is its antagonism to Christianity. Both religions were of Oriental origin; they were propagated about the same time, and spread with equal rapidity on account of the same causes, viz. the unity of the political world and the debasement of its moral life. At the end of the 2nd century each had advanced to the farthest limits of the empire, though the one possessed greatest strength on the frontiers of the Teutonic countries, along the Danube and the Rhine, while the other throve especially in Asia and Africa. The points of collision were especially at Rome, in Africa, and in the Rhône Valley, and the struggle was the more obstinate because of the resemblances between the two religions, which were so numerous and so close as to be the subject of remark as early as the 2nd century, and the cause of mutual recrimination. The fraternal and democratic spirit of the first communities, and their humble origin; the identification of the object of adoration with light and the Sun; the legends of the shepherds with their gifts and adoration, the flood, and the ark; the representation in art of the fiery chariot, the drawing of water from the rock; the use of bell and candle, holy water and the communion; the sanctification of Sunday and of the 25th of December; the insistence on moral conduct, the emphasis placed upon abstinence and self-control; the doctrine of heaven and hell, of primitive revelation, of the mediation of the Logos emanating from the divine, the atoning sacrifice, the constant warfare between good and evil and the final triumph of the former, the immortality of the soul, the last judgment, the resurrection of the flesh and the fiery destruction of the universe—are some of the resemblances which, whether real or only apparent, enabled Mithraism to prolong its resistance to Christianity. At their root lay a common Eastern origin rather than any borrowing.

On the other hand, there were important contrasts between the two. Mithraism courted the favour of Roman paganism and combined monotheism with polytheism, while Christianity was uncompromising. The former as a consequence won large numbers of supporters who were drawn by the possibility it afforded of adopting an attractive faith which did not involve a rupture with the religion of Roman society, and consequently with the state. In the middle of the 3rd century Mithraism seemed on the verge of becoming the universal religion. Its eminence, however, was so largely based upon dalliance with Roman society, its weakness so great in having only a mythical character, instead of a personality, as an object of adoration, and in excluding women from its privileges, that it fell rapidly before the assaults of Christianity. Manichaeism, which combined the adoration of Zoroaster and Christ, became the refuge of those supporters of Mithraism who were inclined to compromise, while many found the transition to orthodox Christianity easy because of its very resemblance to their old faith.

See Franz Cumont, *Textes et monuments figurés relatifs aux mystères de Mithra* (Brussels, 1896, 1899), which has superseded all publications on the subject; Albrecht Dieterich, *Eine Mithrasliturgie* (Leipzig, 1903). See also the translation of Cumont's *Conclusions* (the second part of vol. i. of the above work, published separately 1902, under the title *Les Mystères de Mithra*), by T. J. McCormack (Chicago and London, 1903). Extended bibliography in Roscher's *Lexicon der Mythologie.* (G. Sn.)

MITRA, RAJENDRA LALA (1824–1891), Indian Orientalist, was born in a suburb of Calcutta on the 15th of February 1824, of a respectable family of the Kayasth or writer caste of Bengal. To a large extent he was self-educated, studying Sanskrit and Persian in the library of his father. In 1846 he was appointed librarian of the Asiatic Society, and to that society the remainder of his life was devoted—as philological secretary, as vice-president, and as the first native president in 1885. Apart from very numerous contributions to the society's journal, and to the series of Sanskrit texts entitled "Bibliotheca indica," he published three separate works: (1) *The Antiquities of Orissa* (2 vols., 1875 and 1880), illustrated with photographic plates, in which he traced back the image of Jagannath (Juggernaut) and also the car-festival to a Buddhistic origin; (2) a similarly illustrated work on *Bodh Gaya* (1878), the hermitage of Sakya Muni, and (3) *Indo-Aryans* (2 vols., 1881), a collection of essays dealing with the manners and customs of the people of India from Vedic times. He received the honorary degree of LL.D. from the university of Calcutta in 1875, the companionship of the Indian Empire when that order was founded in 1878, and the title of raja in 1888. He died at Calcutta on the 26th of July 1891.

MITRE (Lat. *mitra*, from Gr. *μίτρα*, a band, head-band, head-dress), a liturgical head-dress of the Catholic Church, generally proper to bishops.

1. *Latin Rite.*—In the Western Church its actual form is that of a sort of folding cap consisting of two halves which, when not worn, lie flat upon each other. These sides are stiffened, and when the mitre is worn, they rise in front and behind like two horns pointed at the tips (*cornua mitrae*). From the lower rim of the mitre at the back hang two bands (*infulae*), terminating in fringes. In the Roman Catholic Church mitres are divided into three classes: (1) *Mitra pretiosa*, decorated with jewels, gold plates, &c.; (2) *Mitra auriphrygiata*, of white silk, sometimes embroidered with gold and silver thread or small pearls, or of cloth of gold plain; (3) *Mitra simplex*, of white silk damask, silk or linen, with the two falling bands behind terminating in red fringes. Mitres are the distinctive head-dress of bishops; but the right to wear them, as in the case of the other episcopal insignia, is granted by the popes to other dignitaries—such as abbots or the heads and sometimes all the members of the chapters of cathedral or collegiate churches. In the case of these latter, however, the mitre is worn only in the church to which the privilege is attached and on certain high festivals. Bishops alone, including of course the pope and his cardinals, are entitled to wear the *pretiosa* and *auriphrygiata*; the others wear the *mitra simplex*.

The proper symbol of episcopacy is not so much the mitre as the ring and pastoral staff. It is only after the service of consecration and the mass are finished that the consecrating prelate asperses and blesses the mitre and places on the head of the newly consecrated bishop, according to the prayer which accompanies the act, "the helmet of protection and salvation," the two horns of which represent "the horns of the Old and New Testaments," a terror to "the enemies of truth," and also the horns of "divine brightness and truth" which God set on the brow of Moses on Mount Sinai. There is no suggestion of the popular idea that the mitre symbolizes the "tongues of fire" that descended on the heads of the apostles at Pentecost.

According to the Roman *Caeremoniale* the bishop wears the *mitra pretiosa* on high festivals, and always during the singing of the *Te Deum* and the *Gloria* at mass. He is allowed, however, "on account of its weight," to substitute for the *pretiosa* the *auriphrygiata* during part of the services, *i.e.* at Vespers from the first psalm to the *Magnificat*, at mass from the end of the *Kyrie* to the canon. The *auriphrygiata* is worn during Advent, and from Septuagesima to Maundy Thursday, except on the third Sunday in Advent (*Gaudete*), the fourth in Lent (*Laetare*) and on such greater festivals as fall within this time. It is worn, too, on the vigils of fasts, Ember Days and days of intercession, on the Feast of Holy Innocents (if on a week-day), at litanies, penitential processions, and at other than solemn benedictions and consecrations. At mass and vespers the *mitra simplex* may be substituted for it in the same way as the *auriphrygiata* for the *pretiosa*. The *simplex* is worn on Good Friday, and at masses for the dead; also at the blessing of the candles at Candlemas, the singing of the absolution at the coffin, and the solemn investiture with the pallium. At provincial synods archbishops wear the *pretiosa*, bishops the *auriphrygiata*, and mitred abbots the *simplex*. At general councils bishops wear white linen mitres, cardinals mitres of white silk damask; this is also the case when bishops and cardinals *in pontificalibus* assist at a solemn pontifical function presided over by the pope.

Lastly, the mitre, though a liturgical vestment, differs from the others in that it is never worn when the bishop addresses the Almighty in prayer—*e.g.* during mass he takes it off when he turns to the altar, placing it on his head again when he turns to address the people (see 1 Cor. xi. 4).

Origin and Antiquity.

The origin and antiquity of the episcopal mitre have been the subject of much debate. Some have claimed for it apostolical sanction and found its origin in the liturgical head-gear of the Jewish priesthood. Such proofs as have been adduced for this view are, however, based on the fallacy of reading into words (*mitra*, *infula*, &c.) used by early writers a special meaning which they only acquired later. *Mitra*, even as late as the 15th century, retained its simple meaning of cap (see Du Cange, *Glossarium*, *s.v.*); to Isidore of Seville it is specifically a woman's cap. *Infula*, which in late ecclesiastical usage was to be confined to mitre (and its dependent bands) and chasuble, meant originally a piece of cloth, or the sacred fillets used in pagan worship, and later on came to be used of any ecclesiastical vestment, and there is no evidence for its specific application to the liturgical head-dress earlier than the 12th century. With the episcopal mitre the Jewish *miznephet*, translated "mitre" in the Authorized Version (Exod. xxviii. 4, 36), has nothing to do, and there is no evidence for the use of the former before the middle of the 10th century even in Rome, and elsewhere than in Rome it does not make its appearance until the 11th.[1]

The first trustworthy notice of the use of the mitre is under Pope Leo IX. (1049–1054). This pope invested Archbishop Eberhard of Trier, who had accompanied him to Rome, with the Roman *mitra*, telling him that he and his successors should wear it *in ecclesiastico officio* (*i.e.* as a liturgical ornament) according to Roman custom, in order to remind him that he is a disciple of the Roman see (Jaffé, *Regesta pont. rom.*, ed. Leipzig, 1888, No. 4158). This proves that the use of the mitre had been for some time established at Rome; that it was specifically a Roman ornament; and that the right to wear it was only granted to ecclesiastics elsewhere as an exceptional honour.[2] On the other hand, the Roman *ordines* of the 8th and 9th centuries make no mention of the mitre; the evidence goes to prove that this liturgical head-dress was first adopted by the popes some time in the 10th century; and Father Braun shows convincingly that it was in its origin nothing else than the papal *regnum* or *phrygium* which, originally worn only at outdoor processions and the like, was introduced into the church, and thus developed into the liturgical mitre, while outside it preserved its original significance as the papal tiara (*q.v.*). From Leo IX.'s time papal grants of the mitre to eminent prelates became increasingly frequent, and by the 12th century it had been assumed by all bishops in the West, with or without papal sanction, as their proper liturgical head-dress. From the 12th century, too, dates the custom of investing the bishop with the mitre at his consecration.

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[1] Father Braun, S. J., has dealt exhaustively with the supposed evidence for its earlier use—*e.g.* he proves conclusively that the *mitra* mentioned by Theodulph of Orleans (*Paraenes. ad episc.*) is the Jewish *miznephet*, and the well-known miniature of Gregory the Great (not St Dunstan, as commonly assumed) wearing a mitre (Cotton MSS. Claudius A. iii.) in the British Museum, often ascribed to the 10th or early 11th century, he judges from the form of the pallium and dalmatic to have been produced at the end of the 11th century "at earliest." The papal bulls granting the use of mitres before the 11th century are all forgeries (*Liturgische Gewandung*, 431–448).

[2] That it had been already so granted is proved by a miniature containing the earliest extant representations of a mitre, in the *Exultete rotula* and baptismal *rotula* at Bari (reproduced in Berteaux, *L'Art dans l'Italie méridionale*, I., Paris, 1904).

Non-bishops.

It was not till the 12th century that the mitre came to be regarded as specifically episcopal, and meanwhile the custom had grown up of granting it *honoris causa* to other dignitaries besides bishops. The first known instance of a mitred abbot is Egelsinus of St Augustine's, Canterbury, who received the honour from Pope Alexander II. in 1063. From this time onward papal bulls bestowing mitres, together with other episcopal *insignia*, on abbots become increasingly frequent. The original motive of the recipients of these favours was doubtless the taste of the time for outward display; St Bernard, zealous for the monastic ideal, denounced abbots for wearing mitres and the like *more pontificum*, and Peter the Cantor roundly called the abbatial mitre "inane, superfluous and puerile" (*Verb. abbrev.* c. xliv. in Migne, *Patrolog. lat.* 205, 159). It came, however, to symbolize the exemption of the abbots from episcopal jurisdiction, their quasi-episcopal character, and their immediate dependence on the Holy See. No such significance could attach to the grant of the *usus mitrae* (under somewhat narrow restrictions as to where and when) to cathedral dignitaries. The first instance is again a bull of Leo IX. (1051) granting to Hugh, archbishop of Besançon, and his seven cardinals the right to wear the mitre at the altar as celebrant, deacon and subdeacon, a similar privilege being granted to Bishop Hartwig of Bamberg in the following year. The intention was to show honour to a great church by allowing it to follow the custom doubtless already established at Rome. Subsequently the privilege was often granted, sometimes to one or more of the chief dignitaries, sometimes to all the canons of a cathedral (*e.g.* Campostella, Prague).

Mitres were also sometimes bestowed by the popes on secular sovereigns, *e.g.* by Nicholas II. (1058–1061) on Spiteneus (Spytihněw) II., duke of Bohemia; by Alexander II. on Wratislaus of Bohemia; by Lucius II. (1144–1145) on Roger of Sicily; and by Innocent III., in 1204, on Peter of Aragon. In the coronation of the emperor, more particularly, the mitre played a part. According to the 14th Roman *ordo*, of 1241, the pope places on the emperor's head first the *mitra clericalis*, then the imperial diadem. Father Braun (*Liturgische Gewandung*, p. 457) gives a picture of a seal of Charles IV. representing him as wearing both.

Development of Form.

The original form of the mitre was that of the early papal tiara (*regnum*), *i.e.* a somewhat high conical cap. The stages of its general development from this shape to the high double-horned modern mitre are clearly traceable (see fig. 1), though it is impossible exactly to distinguish them in point of date. The most characteristic modifications may be said to have taken place from the 11th to the middle of the 13th century. About 1100 the conical mitre begins to give place to a round one; a band of embroidery is next set over the top from back to front, which tends to bulge up the soft material on either side; and these bulges develop into points or horns. Mitres with horns on either side seem to have been worn till about the end of the 12th century, and Father Braun gives examples of their appearances on episcopal seals in France until far into the 13th. Such a mitre appears on a seal of Archbishop Thomas Becket (Father Thurston, *The Pallium*, London, 1892, p. 17). The custom was, however, already growing up of setting the horns over the front and back of the head instead of the sides (the mitre said to have belonged to St Thomas Becket, now at Westminster Cathedral, is of this type),[1] and with this the essential character of the mitre, as it persisted through the middle ages, was established. The exaggeration of the height of the mitre, which began at the time of the Renaissance, reached its climax in the 17th century. This ugly and undignified type is still usually worn in the Roman Catholic Church, but in some cases the earlier type has survived, and many bishops are also now reverting to it.

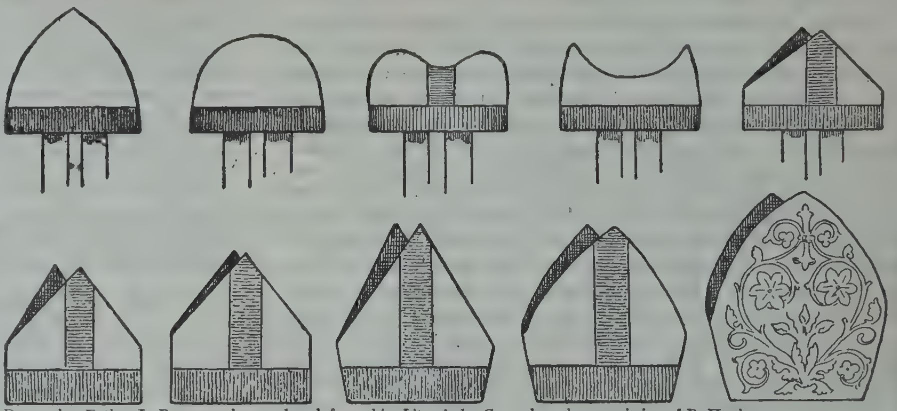

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FIG. 1.—Evolution of the Mitre from the 11th century to the present day.

The decoration of mitres was characterized by increasing elaboration as time went on. From the first the white conical cap seems to have been decorated round the lower edge by a band or orphrey (*circulus*). To this was added later a vertical orphrey (*titulus*), usually from the centre of the front of the *circulus* to that of the back, partly in order to hide the seam, partly to emphasize the horns when those were to left and right. When the horns came to be set before and behind, the vertical orphrey retained its position. Of the surviving early mitres the greater number have only the orphrey embroidered, the body of the mitre being left plain. Very early, however, the custom arose of ornamenting the triangular spaces between the orphreys with embroidery, usually a round medallion, or a star, set in the middle, but sometimes figures of saints, &c. (*e.g.* the early example from the cathedral of Anagni, reproduced by Braun, p. 469). The richness and variety of decoration increased from the 14th century onwards. Architectural motives even were introduced, as frames to the embroidered figures of saints, while sometimes the upper edges of the mitre were ornamented with crockets, and the horns with architectural finials. Finally, the traditional *circulus* and *titulus* seem all but forgotten, the whole front and back surfaces of the mitre being ornamented with embroidered pictures or with arabesque patterns. The latter is characteristic of the mitre in the modern Roman Catholic Church, the tradition of the local Roman Church having always excluded the representation of figures on ecclesiastical vestments.

2. *Reformed Churches.*—In most of the reformed Churches the use of mitres was abandoned with that of the other vestments. They have continued to be worn, however, by the bishops of the Scandinavian Lutheran Churches.

Church of England.

In the Church of England the use of the mitre was discontinued at the Reformation. There is some evidence to show that it was used in consecrating bishops up to 1552, and also that its use was revived by the Laudian bishops in the 17th century (*Hierurgia anglicana* ii. 242, 243, 240). In general, however, there is no evidence to prove that this use was liturgical, though the silver-gilt mitre of Bishop Wren of Ely (d. 1667), which is preserved, is judged from the state of the lining to have been worn. The instances of the use of the mitre quoted in *Hier. anglic.* ii. 310, as carried by the bishop of Rochester at an investiture of the Knights of the Bath (1725), and by the archbishops and bishops at the coronation of George II. (1727), have no liturgical significance. The tradition of the mitre as an episcopal ornament has, nevertheless, been continuous in the Church of England, "and that on three lines: (1) heraldic usage; (2) its presence on the head of effigies of bishops, of which a number are extant, of the 16th, 17th, 18th and 19th centuries; (3) its presence in funeral processions, where

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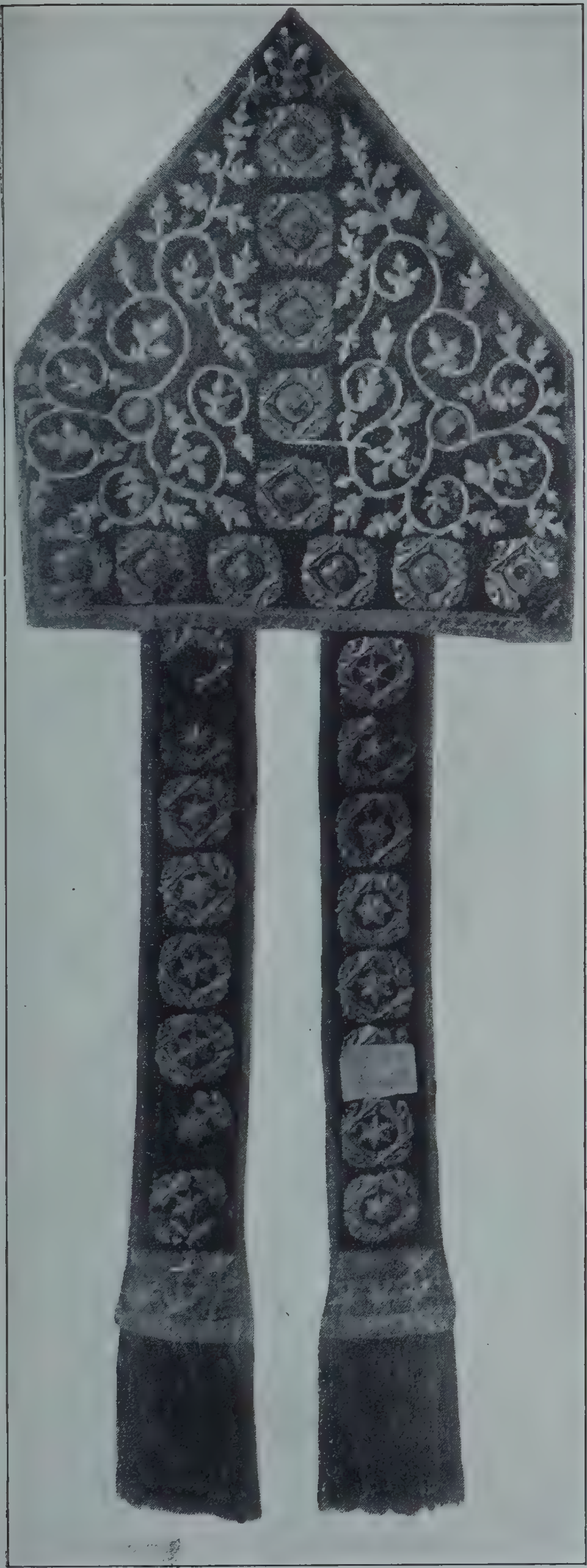
[1] In Father Braun's opinion, expressed to the writer, this mitre which was formerly at Sens, belongs probably to the 13th century.



From a photograph by Father Joseph Braun, S. J., by kind permission.

FIG. 5.—German Mitre, of red velvet embroidered with pearls and silver gilt plaques. 15th century. In the cathedral at Halberstadt.

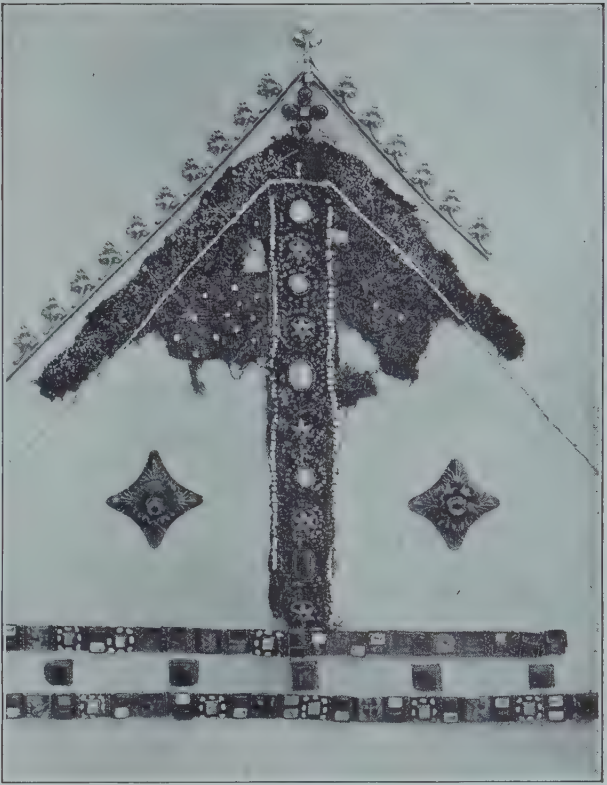


FIG. 6.—Mitre (restored) of William of Wykeham, Bishop of Winchester (d. 1404), preserved at New College, Oxford.

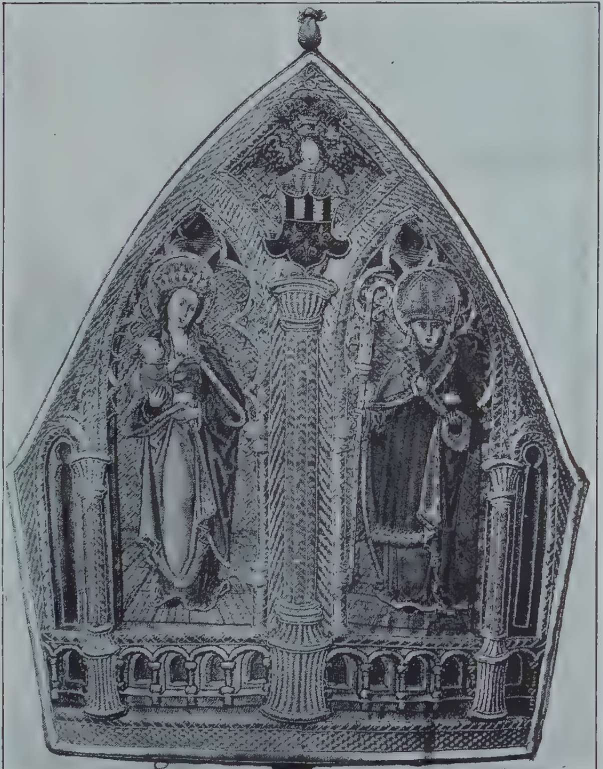


FIG. 7.—Flemish Mitre, embroidered in gold thread, and the panels in colours, with figures of the Virgin and St. Augustine. The other side is similar, with figures of St. Leonard and St. Mary Magdalene. It is dated 1592, repaired in 1766.

In the Victoria and Albert Museum.

an actual mitre or the figure of one was sometimes carried, and sometimes suspended over the tomb" (*Report on the Ornaments of the Church*, p. 106). The liturgical use of the mitre was revived in the Church of England in the latter part of the 19th century, and is now fairly widespread.

3. *Oriental Rites.*—Some form of liturgical head-dress is common to all the Oriental rites. In the Orthodox Eastern Church the mitre (Gr. μίτρα; Slav. *mitra*) is, as in the Western Church, proper only to bishops. Its form differs entirely from that of the Latin Church. In general it rather resembles a closed crown, consisting of a circlet from which rise two arches intersecting each other at right angles. Circlet and arches are richly chased and jewelled; they are filled out by a cap of stiff material, often red velvet, ornamented with pictures in embroidery or *appliqué* metal. Surmounting all, at the intersection of the arches is a cross. In Russia this usually lies flat, only certain metropolitans, and by prescription the bishops of the eparchy of Kiev, having the right to have the cross upright (see fig. 2). In the Armenian Church priests and archdeacons, as well as the bishops, wear a mitre. That of the bishops is of the Latin form, a custom dating from a grant of Pope Innocent III.; that of the priests, the *sagvahart*, is not unlike the Greek mitre (see fig. 3). In the Syrian Church only the patriarch wears a mitre, which resembles that of the Greeks. The *biruna* of the Chaldaean Nestorians, on the other hand, worn by all bishops, is a sort of hood ornamented with a cross. Coptic priests and bishops wear the *ballin*, a long strip of stuff ornamented with crosses &c., and wound turban-wise round the head; the patriarch of Alexandria has a helmet-like mitre, the origin of which is unknown, though it perhaps antedates the appearance of the *phrygium* at Rome. The Maronites, and the uniate Jacobites, Chaldaeans and Copts have adopted the Roman mitre.

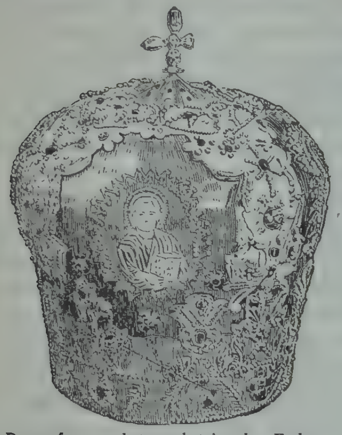


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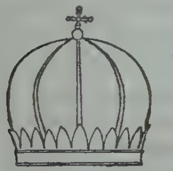
FIG. 2.—Greek Mitre.



From Braun's *Liturgische Gewandung*. By permission of B. Herder.

FIG. 3.—Mitre of Armenian Priest.

The mitre was only introduced into the Greek rite in comparatively modern times. It was unknown in the earlier part of the 15th century, but had certainly been introduced by the beginning of the 16th. Father Braun suggests that its assumption by the Greek patriarch was connected with the changes due to the capture of Constantinople by the Turks. Possibly, as its form suggests, it is based on the imperial crown and symbolized at the outset the quasi-sovereignty over the *rayah* population which Mahommed II. was content to leave to the patriarch. In 1589 it was introduced into Russia, when the tsar Theodore erected the Russian patriarchate and bestowed on the new patriarch the right to wear the mitre, sakkos and mandyas, all borrowed from the Greek rite. A hundred years later the mitre, originally confined to the patriarch, was worn by all bishops.

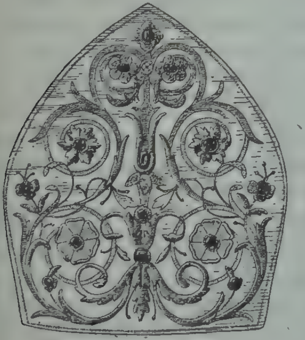


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FIG. 4.—*Mitra pretiosa* of the late Cardinal Vaughan, Roman Catholic Archbishop of Westminster.

See J. Braun, S.J., *Die liturgische Gewandung* (Freiburg-im-Breisgau, 1907), pp. 424–498. The question of the use of the mitre in the Anglican Church is dealt with in the *Report of the Sub-Committee of the Convocation of Canterbury on the Ornaments of the Church and its Ministers* (1908). See also the bibliography to the article VESTMENTS. (W. A. P.)

MITROVICA (Hungarian, *Mitrovicz*; German, *Mitrowitz*), a town of Croatia-Slavonia, Hungary, situated on the river Save, in the county of Syrmia. Pop. (1900), 11,518. Mitrovica is on the railway from Agram, 170 m. W.N.W. to Belgrade, 38 m. E. by S. Roman remains have been discovered in its neighbourhood, and it occupies the site of *Sirmium* or *Syrmium*, the chief city of Lower Pannonia under Roman rule. The emperor Probus (232–282) was born and buried at Sirmium, where, according to some authorities, the emperor Marcus Aurelius (121–180) also died; but this is uncertain. In 351, 357 and 358, ecclesiastical councils of some importance met at Sirmium, which became an episcopal see about 305, and was united with the diocese of Bosnia in 1773. The city was sacked by the Huns in 441, and by the Turks, who destroyed all its ancient buildings, in 1396 and 1521.

MITSCHERLICH, EILHARDT (1794–1863), German chemist, was born on the 7th of January 1794 at Neuende near Jever, in the grand duchy of Oldenburg, where his father was pastor. His uncle, CHRISTOPH WILHELM MITSCHERLICH (1760–1854), professor at Göttingen, was in his day a celebrated scholar. He was educated at Jever under the historian F. C. Schlosser, when he went to Heidelberg in 1811, devoted himself to philology, giving special attention to the Persian language. In 1813 he went to Paris to obtain permission to join the embassy which Napoleon I. was to send to Persia. The events of 1814 put an end to this, and Mitscherlich resolved to study medicine in order that he might enjoy that freedom of travel usually allowed in the East to physicians. He began at Göttingen with the study of chemistry, and this so arrested his attention that he gave up the journey to Persia. From his Göttingen days dates the treatise on certain parts of Persian history, compiled from MSS. in the university library and published in Persian and Latin in 1814, under the title *Mirchondi historia Thaheridarum historicis nostris hucusque incognitorum Persiae principum*. In 1818 he went to Berlin and worked in the laboratory of H. F. Link (1767–1851). There he made analyses of phosphates and phosphites, arsenates and arsenites, confirming the conclusions of J. J. Berzelius as to their composition; and his observation that corresponding phosphates and arsenates crystallize in the same form was the germ from which grew the theory of isomorphism which he communicated to the Berlin Academy in December 1819. In that year Berzelius suggested Mitscherlich to the minister Altenstein as successor to M. H. Klaproth at Berlin. Altenstein did not immediately carry out this proposal, but he obtained for Mitscherlich a government grant to enable him to continue his studies in Berzelius's laboratory at Stockholm. He returned to Berlin in 1821, and in the summer of 1822 he delivered his first lecture as extraordinary professor of chemistry in the university, where in 1825 he was appointed ordinary professor. In the course of an investigation into the slight differences discovered by W. H. Wollaston in the angles of the rhombohedra of the carbonates isomorphous with calc-spar, he observed that the angle in the case of calc-spar varied with the temperature. On extending his inquiry to other aelotropic crystals he observed a similar variation, and was thus led, in 1825, to the discovery that aelotropic crystals, when heated, expand unequally in the direction of dissimilar axes. In the following year he discovered the change, produced by change of temperature, in the direction of the optic axes of selenite. His investigation (also in 1826) of the two crystalline modifications of sulphur threw much light on the fact that the two minerals calc-spar and aragonite have the same composition but different crystalline forms, a property which Mitscherlich called dimorphism. In 1833 he made a series of careful determinations of the vapour densities of a large number of volatile substances, confirming Gay-Lussac's law. He obtained selenic acid in 1827 and showed that its salts are isomorphous with the sulphates, while a few years later he proved that the same thing is true of the manganates and the sulphates, and of the permanganates and the perchlorates. He investigated the relation of benzene to benzoic acid and to other derivatives. In 1829–1830 he published his *Lehrbuch der Chemie*, which embodied many original observations. His interest in mineralogy led him to study the geology of volcanic regions, and he made frequent visits to the Eifel with a view to the discovery of a theory of volcanic action. He did not, however, publish any papers on the subject, though after his death his notes were arranged and published by Dr J. L. A. Roth in the *Memoirs* of the Berlin Academy (1866). In December 1861 symptoms of heart-disease made their appearance, but he was able to carry on his academical work till December 1862. He died at Schönberg near Berlin, on the 28th of August 1863.

Mitscherlich's published papers are chiefly to be found in the *Abhandlungen* of the Berlin Academy, in *Poggendorff's Annalen*, and in the *Annales de chimie et de physique*. The 4th edition of the *Lehrbuch der Chemie* was published in 1844–1847, a 5th was begun in 1855, but was not completed.

MITTEN, a covering for the hand, with a division for the thumb only, and reaching to the lower joint of the fingers; it is made of silk, lace, wool or other material. The word is of obscure origin; it has been connected with Ger. *mitte*, middle, half, in the sense of that which half covers the hand. There are several Celtic words which may be cognate, *e.g.* Irish *miotag*, *mutan*, a thick glove, mitten, such as is worn by hedgers and ditchers. The 16th-century French word *miton* meant a gauntlet. A fine mitten made of lace or open network and extending well up the forearm was much worn by ladies in the early part of the 19th century, and has been fashionable at various times since that date.

MITTWEIDA, a town of Germany in the kingdom of Saxony, on the Zschopau, 12 m. by rail N. of Chemnitz on the railway to Döbeln and Riesa. Pop. (1905), 17,465. It has a handsome Evangelical church, a classical, a modern and a technical school, and cotton and spinning mills. Other industries are the making of furniture, machinery, cigars and cement.

MIVART, ST GEORGE JACKSON (1827–1900), English biologist, was born in London on the 30th of November 1827, and educated at Clapham grammar-school, Harrow, and King's College, London, and afterwards at St Mary's, Oscott, since his conversion to Roman Catholicism prevented him from going to Oxford. In 1851 he was called to the bar, but he devoted himself to medical and biological studies. In 1862 he was appointed lecturer at St Mary's Hospital medical school, in 1869 he became a fellow of the Zoological Society, and from 1874 to 1877 he was professor of biology at the short-lived Roman Catholic University College, London. In 1873 he published *Lessons in Elementary Anatomy*, and an essay on *Man and Apes*. In 1881 appeared *The Cat: an Introduction to the Study of Back-boned Animals*. The careful and detailed work he bestowed on Insectivora and Carnivora largely increased our knowledge of the anatomy of these groups. In 1871 his *Genesis of Species* brought him into the controversy then raging. Though admitting evolution generally, Mivart denied its applicability to the human intellect.

His views as to the relationship existing between human nature and intellect and animal nature in general were given in *Nature and Thought* (1882); and in the *Origin of Human Reason* (1889) he stated what he considered the fundamental difference between men and animals. In 1884, at the invitation of the Belgian episcopate, he became professor of the philosophy of natural history at the university of Louvain, which had conferred on him the degree of M.D. in 1884. Some articles published in the *Nineteenth Century* in 1892 and 1893, in which Mivart advocated the claims of science even where they seemed to conflict with religion, were placed on the *Index expurgatorius*, and other articles in January 1900 led to his excommunication by Cardinal Vaughan, with whom he had a curious correspondence vindicating his claim to hold liberal opinions while remaining in the Roman Catholic Church. Shortly afterwards he died, in London, on the 1st of April 1900. Mivart was also the author of many scientific papers and occasional articles, and of *Castle and Manor: a Tale of our Time* (1900), which originally appeared in 1894 as *Henry Standon*, by "D'Arcy Drew."

MIZPAH, or Mizpeh, the name of several places referred to in the Old Testament, in each case probably derived from a "commanding prospect," the Hebrew name having that significance. (1) Mizpah of Gilead, where Jacob was reconciled to Laban (Gen. xxxi. 49); apparently the site of the camp of the Israelites when about to attack the Ammonites under Jephthah's leadership (Judges x. 17). This ancient sanctuary was probably the scene of Jephthah's vow (Judges xi. 29; cf. *v.* 11). The identification of this Mizpeh is a difficult problem: it is supposed to be the same as Ramoth Gilead, but the evidence is scarcely conclusive. It is referred to in Hos. v. 1. (2) Mizpah of Benjamin. It has been suggested, on hardly sufficient grounds, that the Mizpeh where the Hebrews assembled before the extermination of the Benjamites (Judges xx. 1) was not the shrine where Samuel made his headquarters (1 Sam. vii. 5). It was fortified by Asa (1 Kings xv. 22), and after the destruction of Jerusalem was the seat of government under the viceroy Gedaliah (2 Kings xxv. 23): here Gedaliah was murdered (ibid. 25). After the exile it retained the tradition of being a seat of government (Neh. iii. 7) and a holy place (1 Macc. iii. 46). It is probably to be identified with the mountain, Neby Samwil, north of Jerusalem, still considered sacred by the Moslems: a Crusaders' church (now a mosque), covers the traditional tomb of Samuel. (3) A territory near Mount Hermon, a seat of the Hivites, which joined the coalition of Jabin against Joshua (Joshua xi. 3). In the territory was the "valley of Mizpeh" (*v.* 8) where the Canaanites were routed. (4) A town in the tribe of Judah (Joshua xv. 38). (5) Mizpeh of Moab, where David interviewed the king of Moab and found an asylum for his parents (1 Sam. xxii. 3). (R. A. S. M.)

MIZRAIM, the biblical name for Egypt (Gen. x. 6, 13, Hebrew *Miṣrayim*; the apparently dual termination *-aim* may be due to a misunderstanding); there is an alternative poetical form Māṣōr (2 Kings xix. 24, &c.). In Isa. xi. 11 the name is kept distinct from Pathros or Upper Egypt, and represents some portion at least of Lower Egypt. It perhaps means "boundary" or "frontier," a somewhat ambiguous term, which illustrates the topographical problems. First (*a*), E. Schrader pointed out in 1874 that the Assyrians knew of some Muṣri (*i.e.* Mizraim) in North Syria, and it is extremely probable that this land is referred to in 2 Kings vii. 6 (mentioned with the Hittites), and in 1 Kings x. 28 seq., 2 Chron. i. 16 seq., where the word for "droves" (Heb. *m-q-v-h*) conceals the contiguous land Kuë (Cilicia).[1] Next (*b*), C. T. Beke, as long ago as 1834, concluded in his *Origines biblicae* (p. 167 *et passim*) that "Egypt" in the Old Testament sometimes designates a district near Midian and the Gulf of 'Akaba, and the view restated recently and quite independently by H. Winckler on later evidence (1893) has been the subject of continued debate. Egypt is known to have laid claim to the southern half of Palestine from early times, and consequently the extension of the name of Egypt beyond the limits of Egypt and of the Sinaitic peninsula, is inherently probable. When, for example, Hagar, the "Egyptian," is the ancestress of Ishmaelite tribes, the evidence makes it very unlikely that the term is to be understood in the strict ethnical sense; and there are other passages more suitably interpreted on the hypothesis that the wider extension of the term was once familiar. In the second half of the 8th century B.C., Assyrian inscriptions allude to a powerful Muṣri at a time when the Nile empire was disintegrated and scarcely in a position to play the part ascribed to it (*i.e.* if by Muṣri we are to understand Egypt).[2] Not until the supremacy of Tirhakah does the ambiguity begin to disappear, and much depends upon the unbiased discussion of the related biblical history (especially the writings of Isaiah and Hosea) and the Egyptian data. But even in the period of disintegration the minor princes of the Delta were no doubt associated with their eastern neighbours, and although the Assyrian Muṣri stands in the same relation to the people of Philistia as do the Edomites and allied tribes of the Old Testament, Philistia itself was always intimately associated with Egypt. (See PHILISTINES.)

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[1] See further, H. Winckler, *Alt. test. Untersuch.* (1892), pp. 168-174.

[2] So, too, according to one passage, Tiglath-pileser IV. appoints a governor over Muṣri before Egypt itself had actually been conquered.

The problem is complicated by the obscurity which overhangs the history of south Palestine and the Delta (see EDOM; MIDIAN). The political importance of Egypt was not constant, and the known fluctuations of geographical terms combine with the doubtful accuracy of early writers to increase the difficulties. The Assyrian evidence alone points very strongly to a Muṣri in north-west Arabia; the biblical evidence alone suggests an extra-Egyptian Miṣrayim. On the whole the result of discussion has been to admit the probability that Miṣrayim could refer to a district outside the limits of Egypt proper. But it has not justified the application of this conclusion to all the instances in which some critics have relied upon it, or the sweeping inferences and reconstructions which have sometimes been based upon it. Each case must be taken on its merits.

See further, H. Winckler, *Altorient. Forschungen*, i. 24 seq; *Mitteil. d. vorderasiat. Gesell.* (1898), pp. 1 sqq., 169 sqq.; *Hibbert Journal* (April 1904); *Keilinschr. u. das alte Test.*, 3rd ed., 136 sqq.; and *Im Kampfe um den alten Orient*, ii. (1907); T. K. Cheyne, especially *Kingdom of Judah* (1908), pp. xiv. sqq.; F. Hommel, *Vier neue arab. Landschaftsnamen in A.T.* For criticisms (many of them somewhat captious) see König's reply to Hommel (Berlin, 1902), A. Noordtzij, *Theolog. Tijdsch.* (1906, July, September), and E. Meyer, *Israeliten u. ihre Nachbarstämme*, pp. 455 sqq. A valuable survey of the geographical and other conditions is given by N. Schmidt, *Hibbert Journal* (January 1908). (S. A. C.)

MNEMONICS (from Gr. *μνᾶσθαι*, remember; whence *μνήμων*, mindful; *τὸ μνημονικόν*, *sc.* *τέχνημα*, that which mechanically aids the memory), the general name applied to devices for aiding the memory. Such devices are also described as *memoria technica*. The principle is to enable the mind to reproduce a relatively unfamiliar idea, and specially a series of dissociated ideas, by connecting it, or them, in some artificial whole, the parts of which are mutually suggestive. A pupil is far more likely to remember the cities which claimed to be the birthplace of Homer when he remembers that their names can be made to form the hexameter line, "Smyrna, Chios, Colophon, Salamis, Rhodos, Argos, Athenae." Among the most famous examples of metrical mnemonics are the "gender rhymes" of the Latin grammars, the hexameter lines (especially that beginning "Barbara Celarent") invented by logicians (for a list see Baldwin's *Dict. of Philos.*, vol. ii., *s.v.* "Mnemonic Verses"), the verse for remembering the number of days in the months ("Thirty days hath September, April, June and November"). Other devices are numerous. Thus the name and lights of the sides of a ship may be remembered because the three shorter words "port," "left," "red," go together, as compared with the longer, "starboard," "right," "green."

Memory is commonly classified by psychologists according as it is exercised (*a*) *mechanically*, by attention and repetition; (*b*) *judiciously*, by careful selection and co-ordination; and (*c*) *ingeniously*, by means of artifices, *i.e.* mnemotechny, mnemonics. It must, however, be observed that no mnemonic is of any value which does not possess the qualities of (*a*) and (*b*). A mnemonic is essentially a device which uses attention and repetition, and careful selection is equally necessary. A more accurate description of mnemonics is "mediate" or "indirect" memory. In the technical sense the word "mnemonic" is confined to the systems of general application which have been elaborated by various writers.

Systems.—Mnemonic devices were much cultivated by Greek sophists and philosophers, and are repeatedly referred to by Plato and Aristotle. In later times the invention was ascribed to the poet Simonides,[1] perhaps for no other reason than that the strength of his memory was famous. Cicero, who attaches considerable importance to the art, but more to the principle of order as the best help to memory, speaks of Carneades (or perhaps Charmades) of Athens and Metrodorus of Scepsis as distinguished examples of the use of well-ordered images to aid the memory. The latter is said by Pliny to have carried the art so far "ut nihil non iisdem verbis redderet auditum." The Romans valued such helps as giving facility in public speaking. The method used is described by the author of *Rhet. ad Heren.*, iii. 16–24; see also Quintilian (*Inst. Or.* xi. 2), whose account is, however, somewhat incomplete and obscure. In his time the art had almost ceased to be practised. The Greek and Roman system of mnemonics was founded on the use of mental places and signs or pictures, known as "topical" mnemonics. The most usual method was to choose a large house, of which the apartments, walls, windows, statues, furniture, &c., were severally associated with certain names, phrases, events or ideas, by means of symbolic pictures; and to recall these it was only necessary to search over the apartments of the house till the particular place was discovered where they had been deposited by the imagination. In accordance with this system, if it were desired to fix an historic date in the memory, it was localized in an imaginary town divided into a certain number of districts, each with ten houses, each house with ten rooms, and each room with a hundred quadrates or memory-places, partly on the floor, partly on the four walls, partly on the roof. Thus, if it were desired to fix in the memory the date of the invention of printing (1436), an imaginary book, or some other symbol of printing, would be placed in the thirty-sixth quadrate or memory-place of the fourth room of the first house of the historic district of the town. Except that the rules of mnemonics are referred to by Martianus Capella, nothing further is known regarding the practice of the art until the 13th century. Among the voluminous writings of Roger Bacon is a tractate *De arte memorativa*. Raimon Lull devoted special attention to mnemonics in connexion with his *ars generalis*. The first important modification of the method of the Romans was that invented by the German poet Konrad Celtes, who, in his *Epitoma in utramque Ciceronis rhetoricam cum arte memorativa nova* (1492), instead of places made use of the letters of the alphabet. About the end of the 15th century Petrus de Ravenna (b. 1448) awakened such astonishment in Italy by his mnemonic feats that he was believed by many to be a necromancer. His *Phoenix artis memoriae* (Venice, 1491, 4 vols.) went through as many as nine editions, the seventh appearing at Cologne in 1608. An impression equally great was produced about the end of the 16th century by Lambert Schenkel (*Gazophylacium*, 1610), who taught mnemonics in France, Italy, and Germany, and, although he was denounced as a sorcerer by the university of Louvain, published in 1593 his tractate *De memoria* at Douai with the sanction of that celebrated theological faculty. The most complete account of his system is given in two works by his pupil Martin Sommer, published at Venice in 1619. In 1618 John Willis (d. 1628?) published *Mnemonica; sive ars reminiscendi* (Eng. version by Leonard Sowersby, 1661; extracts in Feinaigle's *New Art of Memory*, 3rd ed., 1813), containing a clear statement of the principles of topical or local mnemonics. Giordano Bruno, in connexion with his exposition of the *ars generalis* of Lull, included a *memoria technica* in his treatise *De umbris idearum*. Other writers of this period are the Florentine Publicius (1482); Johann Romberch (1533); Hieronimo Morafiot, *Ars memoriae* (1602); B. Porta, *Ars reminiscendi* (1602).

In 1648 Stanislaus Mink von Wenussheim or Winckelmann made known what he called the "most fertile secret" in mnemonics—namely, the use of consonants for figures, so as to express numbers by words (vowels being added as required); and the philosopher Leibnitz adopted an alphabet very similar to that of Winckelmann in connexion with his scheme for a form of writing common to all languages. Winckelmann's method, which in fact is adopted with slight changes by the majority of subsequent "original" systems, was modified and supplemented in regard to many details by Richard Grey (1694–1771), who published a *Memoria technica* in 1730. The principal part of Grey's method (which may be compared with the Jewish system by which letters also stand for numerals, and therefore words for dates) is briefly this: "To remember anything in history, chronology, geography, &c., a word is formed, the beginning whereof, being the first syllable or syllables of the thing sought, does, by frequent repetition, of course draw after it the latter part, which is so contrived as to give the answer. Thus, in history, the Deluge happened in the year before Christ two thousand three hundred forty-eight; this is signified by the word Del-*etok*, Del standing for Deluge and *etok* for 2348." To assist in retaining the mnemonical words in the memory they were formed into memorial lines, which, however, being composed of strange words in difficult hexameter scansion, are by no means easy to memorize. The vowel or consonant, which Grey connected with a particular figure, was chosen arbitrarily; but in 1806 Gregor von Feinaigle, a German monk from Salem near Constance, began in Paris to expound a system of mnemonics, one feature (based on Winckelmann's system) of which was to represent the numerical figures by letters chosen on account of some similarity to the figure to be represented or some accidental connexion with it. This alphabet was supplemented by a complicated system of localities and signs. Feinaigle, who apparently published nothing himself, came to England in 1811, and in the following year one of his pupils published *The New Art of Memory*, which, beside giving Feinaigle's system, contains valuable historical material about previous systems. A simplified form of Feinaigle's method was published by Aimé Paris (*Principes et applications diverses de la mnémonique*, 7th ed., Paris, 1834), and the use of symbolic pictures was revived in connexion with the latter by a Pole, Antoni Jaźwińsky, of whose system an account was published by the Polish general J. Bem, under the title *Exposé général de la méthode mnémonique polonaise, perfectionnée à Paris* (Paris, 1839). Various other modifications of the systems of Feinaigle and Aimé Paris were advocated by subsequent mnemonists, among them being the *Phrenotypics* of Major Beniowsky, a Polish refugee, the *Phreno-Mnemotechny* (1845) of François Fauvel Gouraud the *Mnemotechnik* of Karl Otto Reventlow (generally known as Karl Otto), a Dane, and the *Mnemotechny* of the American Pliny Miles.

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[1] Pliny, *H.N.* vii. 24. Cicero, *De or.* ii. 86, mentions this belief without committing himself to it.

The more complicated mnemonic systems have fallen almost into complete disuse; but methods founded chiefly on the so-called laws of association (see Association of Ideas) have been taught with some success in Germany by, among others, Hermann Kothe, author of *Lehrbuch der Mnemonik* (2nd ed., Hamburg, 1852), and *Katechismus der Gedächtnisskunst* (6th ed. by Montag, Leipzig, 1887); and Hugo Weber-Rumpe, author of *Mnemonische Zahlwörterbuch* (Breslau, 1885) and *Mnemonische Unterrichtsbriefe* (1887–1888); in England by Dr Edward Pick, whose *Memory and the Rational Means of Improving it* (5th ed., 1873) and *Lectures on Memory Culture* (1899) obtained a wide circulation. Passing over the work of William Day (*New Mnemonical Chart and Guide to the Art of Memory*, 1845), Rev. T. Brayshaw (*Metrical Mnemonics*, a very rare work), Fairchild and W. Stokes, the next name of any importance is the Rev. J. H. Bacon, a pupil of Edward Pick. His book (*A Complete Guide to the Improvement of the Memory*, 3rd ed., rev. 1890) contains a good summary of the history of mnemonics and a very reasonable account of the principles; it gains in value by its comparative simplicity. More or less successful systems were issued by Lyon Williams (1866), T. Maclaren (1866), Thomas A. Sayer (1867), Rev. Alexander Mackay (1869), George Crowther (1870), F. Appleby (1880), John Sambrook, who made use of similarities in sounds (gun, 1; Jew, 2), the French scientist Abbé Moigno, J. H. Noble, and Allan Dalzell. Considerable interest was roused both in London and in America by the controversy which raged round the system of "Alphonse Loisette," who taught his "art of never forgetting" successively in London and Washington. It claimed to be original in system, but was attacked in England by F. Appleby and in America by George S. Fellows, and is generally regarded as both unoriginal and inferior on the whole to preceding systems (for the litigation in America see *e.g.* Part II. of Middleton's *Memory Systems*, pp. 96 sqq.). An interesting work (*Memoranda mnemonica*) was published by James Copner in 1893, containing a system based partly on the use of letters for figures and words for dates, as well as a large number of rhymes for remembering facts in biblical, Roman, Greek and English history. He made use of Grey's system, but endeavoured as far as possible to invent, where necessary, words and terminations which in themselves had some special fitness in place of Grey's monstrosities. More complicated systems are the *Keesing Memory System* (Auckland, 1896), the Smith-Watson *System of Memory and Mental Training* (Washington), and the Pelman memory system.

Bibliography.—A large number of the works referred to in the text contain historical material. Among histories of the subject, see C. F. von Aretin, *Systematische Anleitung zur Theorie und Praxis der Mnemonik* (Sulzberg, 1810); A. E. Middleton, *Memory Systems, Old and New* (espec. 3rd rev. ed., New York, 1888), with bibliography of works from 1325 to 1888 by G. S. Fellows and account of the Loisette litigation; F. W. Colegrove, *Memory* (1901), with bibliography, pp. 353–361. (J. M. M.)

MNESICLES, the architect of the great Propylaea of the Athenian Acropolis, set up by Pericles about 437 B.C.

MOA, apparently the Maori name of the extinct Ratite birds in New Zealand, comprising the group Dinornithes (cf. Bird: *Classification*; and Ratitae). The earliest account of these birds is that of Polack (*New Zealand*, London, 1838), who speaks of the former existence of some struthious birds in the north island as proved by fossil bones which were shown to him. "The natives added that, in times long past, they received the tradition that very large birds had existed, but the scarcity of food, as well as the easy method of entrapping them, had caused their extermination." In the North Island the moas seem to have died out soon after the arrival of the Maoris, according to F. W. Hutton, some 700-500 years ago. In the South Island they seem to have lingered much longer, possibly, according to H. O. Forbes (*Nat Sci.* II. 1893, pp. 374–380), "down even to the time that Captain Cook visited New Zealand." But these are only surmises, based upon the fact that in various dry caves limbs still surrounded by the mummified flesh and skin, feathers, and even eggs with the inner membrane, have been found. Great quantities of bones have been found in caves and in swamps, so that now nearly every part of the skeleton, of some kind or other, is known.

The most striking feature of the moas, besides the truly gigantic size of some species, is the almost complete absence of the wings. In fact, the whole skeletons of the wings and of the shoulder girdle seem to have been lost, excepting *Anomalopteryx dromaeoides*, which, according to Hutton,[1] had still some vestiges. Such a complete reduction of the whole anterior limb and girdle is unique among birds, but the cassowaries indicate the process. In conformity with these reductions the breastbone of the moas is devoid of any coracoidal facets; there is no trace of a keel, and the number of sternal ribs is reduced to three or even two pairs. The hind limbs are very strong; the massive femur has a large pneumatic foramen; the tibia has a bony bridge on the anterior surface of the lower portion, a character in which the moas agree only with *Apteryx* amongst the other Ratitae. The number of toes is four, unless the hallux is more or less reduced. The pelvis much resembles that of the kiwis.

The skull has been monographed by T. J. Parker ("On the Cranial Osteology, Classification and Phylogeny of the Dinornithidae," *Tr. Z. Soc.* (1893), xiii. 373–431, pls. 56–62); it resembles in its general configuration that of the emeus and cassowaries, while it differs from that of *Apteryx* most obviously by the short and stout bill.

The feathers have a large after-shaft which is of the size of the other half, likewise in agreement with the Australian Ratitae, while in the others, including the kiwis, the after-shaft is absent. Another important point, in which the moas agree with the other Ratitae and differ from the kiwis, are the branched, instead of simple, porous canals in the eggshell.

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[1] "The Moas of New Zealand," *Tr. N. Zea. Inst.* (1892), xxiv. 93–172, pls. xv.–xvii.

The affinities of the moas are undoubtedly with the Australian Ratitae, and, in spite of the differences mentioned above, with the kiwis. In this respect Max Fürbringer and T. J. Parker are in perfect agreement. The relationship with *Aepyornis* of Madagascar is still problematic. Whilst the moas seem to have been entirely herbivorous, feeding not unlikely upon the shoots of ferns, the kiwis have become highly specialized worm-eaters. In this respect cassowaries and emeus hold an intermediate position, their occasional zoophagous (especially piscivorous) inclination being well known. Unmolested by enemies (*Harpagornis*, a tremendous bird of prey, died out with the Pleistocene), living in an equable insular climate, with abundant vegetation, the moas flourished and seem to have reached their greatest development in specialization, numbers, and a bewildering variety of large and small kinds, within quite recent times. Unfortunately no fossil moas, older than the Pleiocene, are known. Parker recognizes five genera, with about twenty species, which he combines into three sub-families: Dinornithinae with *Dinornis*, Anomalopteryginae with *Pachyornis*, *Mesopteryx* and *Anomalopteryx*, comprising the comparatively least specialized forms; and Emeinae with the genus *Emeus*, not to be confounded with the vernacular emeu. The moas ranged in size from that of a turkey to truly colossal dimensions, the giant being *Dinornis maximus*, which, with a tibial length of 39 in., stood with its small head about 12 ft. above the ground.

(H. F. G.)

MOAB, the name of an ancient people of Palestine who inhabited a district E. of the Jordan and the Dead Sea, lying N. of Edom and S. of Ammon (*q.v.*) and the Israelite Transjordanic districts. There is little material for its earlier history outside the Old Testament, and the various references in the latter are often of disputed reference and date. The national traditions of Israel recognize a close relationship between Moab and Ammon, "sons" of Lot, and the "brothers" Esau (Edom) and Jacob (Israel), and Moab is represented as already a powerful people when Israel fled from Egypt (Exod. xv. 15). The detailed narratives, however, give conflicting views of the exodus and the conquest of Palestine. It was supposed that Moab, having expelled the aboriginal giants, was in turn displaced by the Amorite king Sihon, who forced Moab south of the Arnon (Wadi Mōjib, a natural boundary) and drove Ammon beyond the Jabbok. The Israelites at Kadesh, almost at the gate of the promised land, incurred the wrath of Yahweh, and, deterred by a defeat at Hormah from pursuing their journey northwards, were obliged to choose another route (Num. xiv. 40-45; contrast xxi. 1-3). (See EXODUS, THE.) Messengers to Edom were repulsed (Num. xx. 14-18), or Israel was met by Edom with force (*v.* 19 seq.); consequently a great détour was made from Kadesh round by the south of Edom (Num. xiv. 25, xxi. 4; Judges xi. 18). At length the people safely reached Pisgah in Moab (Num. xxi. 16-20; cf. Deut. iii. 27, xxxiv. 1), or, according to another view, passed outside Moab until they reached the border of Sihon's kingdom (Num. xxi. 13, 26; Judges xi. 17 seq.). There are other details in Deut. ii., and the late list in Num. xxxiii. even seems to assume that the journey was made from Kadesh across the northern end of Edom. Apparently no fixed or distinct tradition existed regarding the journeys, and it extremely probable that some of the most characteristic features belong to much later periods than the latter half of the second millennium B.C., the age to which they are ascribed (*e.g.* the poem on the fall of Heshbon, Num. xxi. 27-30).

The account of Balaam (*q.v.*), the son of Beor, the soothsayer, of the children of Ammon (xxii. 5, some MSS.), or of Aram or of Edom (see Cheyne, *Ency. Bib.*, col. 3685 and below), is noteworthy for the prophecies of Israel's future supremacy; but he is passed over in the historical sketch, Deut. ii.; and even the allusion, ibid. xxiii. 4 seq., belongs to a context which on independent grounds appears to be a later insertion. Israel's idolatry in *Moab* is supplemented by a later story of the vengeance upon *Midian* (xxv. 6-18, xxxi.). In Joshua xiii. 21 the latter is associated with both Sihon and Balaam, and in some obscure manner Midian and Moab are connected in Num. xxii. 4-7 (cf. xxv. 18, xxxi. 8). An Edomite list of kings includes Bela (cf. Bil'am, *i.e.* Balaam), son of Beor, and states that a Hadad, son of Bedad, smote Midian in the field of Moab (Gen. xxxvi. 32, 35); these events, assigned to an early age, have been connected with the appearance of Moabite power west of the Jordan in the days of the "judge" Ehud (*q.v.*). However, all that is recorded in Num. xxii. sqq., together with various legal and other matter, now severs the accounts of the Israelite occupation of east Jordan (Num. xxi. 33-35, xxxii. 39-42). For full details see G. B. Gray, "Numbers" (*Internat. Critical Comment.*).

Although Moab and Ammon were "brothers," their history was usually associated with that of Judah and Israel respectively, and naturally depended to a considerable extent upon these two and their mutual relations. Jephthah (*q.v.*), one of the Israelite "judges," delivered Gilead from Ammon, who resumed the attack under its king Nahash, only to be repulsed by Saul (*q.v.*). Ehud (*q.v.*) of Benjamin or Ephraim freed Israel from the Moabite oppression. To the first great kings, Saul and David, are ascribed conquests over Moab, Ammon and Edom. The Judaean David, for his part, sought to cultivate friendly relations with Ammon, and tradition connects him closely with Moab. His son Solomon contracted marriages with women of both states (1 Kings xi. 5, 7), thus introducing into Jerusalem cults which were not put down until almost at the close of the monarchy (2 Kings xxiii. 13). In the 9th century B.C. the two states appear in more historical surroundings, and the discovery of a lengthy Moabite inscription has thrown valuable light upon contemporary conditions.

This inscription, now in the Louvre, was found at Dhībān, the biblical Dībōn, in 1868 by the Rev. F. Klein, a representative of the Church Missionary Society stationed at Jerusalem. It contains a record of the successes gained by the Moabite king Mesha against Israel.[1] Omri (*q.v.*) had previously seized a number of Moabite cities north of the Arnon, and for forty years the Moabite national god Chemosh was angry with his land. At length he roused Mesha; and Moab, which had evidently retreated southwards towards Edom, now began to take reprisals. "The men of Gad had dwelt in the land of 'Ataroth from of old; and the king of Israel built 'Ataroth for himself." Mesha took the city, slew its people in honour of Chemosh, and dragged before the god the altar-hearth (or the priests?) of D-v-d-h (apparently a divine name, but curiously similar to David). Next Chemosh roused Mesha against the city of Nebo. It fell with its thousands, for the king had "devoted" it to the deity 'Ashtar-Chemosh. Yahweh had been worshipped there, and his . . . (? vessels, or perhaps the same doubtful word as above) were dragged before the victorious Chemosh. With the help of these and other victories (at Jahaz, Aroer, &c.), Moab recovered its territory, fortified its cities, supplied them with cisterns, and Mesha built a great sanctuary to his god. The inscription enumerates many places known elsewhere (Isa. xv.; Jer. xlviii.), but although it mentions the "men of Gad," makes no allusion to the Israelite tribe Reuben, whose seat lay in the district (Num. xxxii.; Josh. xiii. 15-23; see REUBEN). The revolt will have followed Ahab's death (see 2 Kings i. 1) and apparently led to the unsuccessful attempt by Jehoram to recover the lost ground (ibid. iii.).

The story of Jehoram in 2 Kings iii. now gives prominence to Elisha, his wonders, his hostility to the ruling dynasty and his regard for the aged Jehoshaphat of Judah. Following other synchronisms, the Septuagint (Lucian's recension) names Ahaziah of Judah; from 2 Kings i. 17, the reigning king could only have been Jehoram's namesake. The king of Edom appears as an ally of Israel and Judah (contrast 1 Kings xxii. 47; 2 Kings viii. 20), and hostile to Moab (comp. above, and the obscure allusion in Amos ii. 1-2). But the king of Moab's attempt to break through unto him suggests that in the original story (there are several signs of revision) Moab and Edom were in alliance. In this case the object of Jehoram's march round the south of the Dead Sea was to drive a wedge between them, and the result hints at an Israelite disaster. Singularly enough, Jehoram of Judah suffered some defeat from Edom at Zair, an unknown name for which Ewald suggested (the Moabite) Zoar (2 Kings viii. 21; see JEHORAM).

Moab thus retained its independence, even harrying Israel with marauding bands (2 Kings xiii. 20), while Ammon was perpetrating cruelties upon Gilead (Am. i. 13 sqq.). But under Jeroboam II. (*q.v.*) Israelite territory was extended to the Wadi of the ʻArabah or wilderness (probably south end of the Dead Sea), and again Moab suffered. If Isa. xv. seq. is to be referred to this age, its people fled southwards and appealed for protection to the overlord of Edom (see Uzziah). During the Assyrian supremacy, its king Salamannu (probably not the Shalman of Hos. x. 14) paid tribute to Tiglath-Pileser IV., but joined the short-lived revolt with Judah and Philistia in 711. When Sennacherib besieged Jerusalem in 701, Kamus(Chemosh)-nadab also submitted, and subsequently both Esarhaddon and Assur-bani-pal mention the Moabite king Muṣuri ("the Egyptian," but cf. Mizraim) among their tributaries. In fact, during the reign of Assur-bani-pal Moab played the vassal's part in helping to repulse the invasion of the Nabayati and nomads of Kedar, a movement which made itself felt from Edom nearly as far as Damascus. It had its root in the revolt of Samas-sum-yukin (Shamash-shun-ukin) of Babylonia, and coming at a time immediately preceding the disintegration of the Assyrian Empire, may have had most important consequences for Judah and the east of the Jordan.[1] (See Palestine: *History*.)

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[1] See edition by M. Lidzbarski, *Altsemitische Texte*, Bd. I. (Giessen, 1907); also G. A. Cooke, *North Semitic Inscr.*, pp. 1-14, and the articles on "Moab" in Hasting's *Dict. Bible* (by W. H. Bennett), and "Mesha" in *Ency. Bib.* (by S. R. Driver).

Moab shares with Ammon and Edom in the general obscurity which overhangs later events. If it made inroads upon Judah (2 Kings xxiv. 2), it joined the coalition against Babylonia (Jer. xxvii. 3); if it is condemned for its untimely joy at the fall of Jerusalem (Isa. xxv. 9 seq.; Jer. xlviii.; Ezek. xxv. 8–11; Zeph. ii. 8-10), it had offered a harbour to fugitive Jews (Jer. xl. 11). The dates of the most significant passages are unfortunately uncertain. If Sanballat the Horonite was really a native of the Moabite Horonaim, he finds an appropriate place by the side of Tobiah the Ammonite and Gashmu the Arabian among the strenuous opponents of Nehemiah. Still later we find Moab part of the province of Arabia in the hands of fresh tribes from the Arabian desert (Jos. *Ant.* xiii. 13, 5); and, with the loss of its former independent power, the name survives merely as a type (Dan. xi. 41). (See Jews; Nabataeans.)

A populous land commanding the trade routes from Arabia to Damascus, rich in agricultural and pastoral wealth, Moab, as Mesha's inscription proves, had already reached a high state of civilization by the 9th century B.C. Its language differed only dialectically from Hebrew; its ideas and religion were very closely akin to the Israelite, and it may be assumed that they shared in common many features of culture.[2] The relation of Chemosh, the national god, to his "children" (Num. xxi. 29) was that of Yahweh to Israel (see especially Judges xi. 24). He had his priests (Jer. xlviii. 7), and Mesha, perhaps himself a priest-king, receives the oracles direct or through the medium of his prophets. The practice of devoting, banning or annihilating city or community was both Moabite and Israelite (cf. above, also Deut. ii. 34, iii. 6, xx. 10–20; 2 Chron. xxv. 12, &c.), and human sacrifice, offered as an exceptional gift to Chemosh in 2 Kings iii. 27, in Israel to Molech (*q.v.*), was a rite once less rare. Apart from the religious cult suggested in the name Mount Nebo, there were local cults of the Baal of Peor and the Baal of Meon, and Mesha's allusion to ʻAshtar-Chemosh, a compound deity, has been taken to point to a corresponding consort whose existence might naturally be expected upon other grounds (see Astarte). The fertility of Moab, the wealth of wine and corn, the temperate climate and the enervating heat supply conditions which directed the form of cult. Nature-worship, as in Israel, lay at the foundation, and the impure rites of Shittim and Baal-Peor (Num. xxxi. 16; Ps. cvi. 28) would not materially differ from practices which Israelite prophets were called upon to condemn. Much valuable evidence is to be obtained also from the survival of ancient forms of cult in Moab and east of the Jordan (*e.g.* sacrifices on the house roofs) and from a survey of epigraphical and other data from the Greek, Roman, and later periods, allowance being made for contamination. The whole question deserves careful investigation in the light of comparative religion.[3]

The relationship felt between Israel and the external states (Moab, Edom, and Ammon) is entirely justified. It extends intermittently throughout the history, and certain complicated features in the traditions of the southern tribes point to affinities with Moab which find a parallel in the traditions of David (see Ruth) and in the allusions to intercourse between Moab and Benjamin (1 Chron. viii. 8) or Judah (ibid. iv. 21 seq.). But the obscure historical background of the references makes it uncertain whether the exclusiveness of orthodox Judaism (Neh. xiii. 1–3; cf. Deut. xxiii. 3–6; Ezra ix. 1, 12) was imposed upon an earlier catholicity, or represented only one aspect of religious spirit, or was succeeded by a more tolerant attitude. Evidence for the last-mentioned has been found in the difficult narrative in Josh. xxii. But Israel remained a great power in religious history while Moab disappeared. It is true that Moab was continuously hard pressed by desert hordes; the exposed condition of the land is emphasized by the chains of ruined forts and castles which even the Romans were compelled to construct. The explanation of the comparative insignificance of Moab, however, is not to be found in purely topographical considerations. Nor can it be sought in political history, since Israel and Judah suffered as much from external movements as Moab itself. The explanation is to be found within Israel itself, in factors which succeeded in re-shaping existing material and in imprinting upon it a durable stamp, and these factors, as biblical tradition recognizes, are to be found in the work of the prophets.

See the articles on Moab in Hastings's *Dict. Bible* (W. H. Bennett), *Ency. Bib.* (G. A. Smith and Wellhausen), and Hauck's *Realencyklopädie* (F. Buhl) with their references; also the popular description by W. Libbey and F. E. Hoskins, *Jordan Valley and Petra* (1905), and the very elaborate and scientific works by R. E. Brünnow and A. von Domaszewski, *Die Provincia Arabia* (1904–1905), and A. Musil, *Arabia Petraea* (1907–1908). Mention should be made of the mosaic map of Palestine found at Medaba, dating perhaps from the 5th century A.D.; for this, see A. Jacoby, *Das geograph. Mosaik von M.* (1905), and P. Palmer and Guthe (1906). For language and epigraphy see Nabataeans, Semitic Languages; for topography, &c., Palestine; and for the later history, Jews. (S. A. C.)

MOʻALLAKĀT (Moʻallaqāt or Muʻallaqāt). *Al-Moʻallaqāt* is the title of a group of seven longish Arabic poems, which have come down to us from the time before Islam. The name signifies "the suspended" (pl.), the traditional explanation being that these poems were hung up by the Arabs on or in the Kaʻba at Mecca. The oldest passage known to the present writer where this is stated occurs in the *ʻIqd* of the Spanish Arab, Ibn ʻAbd-Rabbihi (A.D. 860–940), Būlāq ed. of 1293 A.H. vol. iii. p. 116 seq. We read there: "The Arabs had such an interest in poetry, and valued it so highly, that they took seven long pieces selected from the ancient poetry, wrote them in gold on pieces of Coptic linen folded up, and hung them up (*ʻallaqat*) on the curtains which covered the Kaʻba. Hence we speak of 'the golden poem of Amra'al Qais,' 'the golden poem of Zuhair.' The number of the golden poems is seven; they are also called 'the suspended' (*al-Moʻallaqāt*)." Similar statements are found in later Arabic works. But against this we have the testimony of a contemporary of Ibn ʻAbd-Rabbihi, the grammarian Nāḥḥās (d. A.D. 949), who says in his commentary on the Moʻallaqāt: "As for the assertion that they were hung up in [*sic*] the Kaʻba, it is not known to any of those who have handed down ancient poems."[4] This cautious scholar is unquestionably right in rejecting a story so utterly unauthenticated. The customs of the Arabs before Mahomet are pretty accurately known to us; we have also a mass of information about the affairs of Mecca at the time when the Prophet arose; but no trace of this or anything like it is found in really good and ancient authorities. We hear, indeed, of a Meccan hanging up a spoil of battle on the Kaʿba (Ibn Hishām, ed. Wüstenfeld, p. 431). Less credible is the story of an important document being deposited in that sanctuary (ibid. p. 230), for this looks like an instance of later usages being transferred to pre-Islamic times. But at all events this is quite a different thing from the hanging up of poetical manuscripts. To account for the disappearance of the Moʿallaqāt from the Kaʿba we are told, in a passage of late origin (De Sacy, *Chrestom.* ii. 480), that they were taken down at the capture of Mecca by the Prophet. But in that case we should expect some hint of the occurrence in the circumstantial biographies of the Prophet, and in the works on the history of Mecca; and we find no such thing. That a series of long poems was *written* at all at that remote period is improbable in the extreme. Up to a time when the art of writing had become far more general than it was before the spread of Islam, poems were never—or very rarely—written, with the exception, perhaps, of epistles in poetic form. The diffusion of poetry was exclusively committed to *oral* tradition. Moreover, it is quite inconceivable that there should have been either a gild or a private individual of such acknowledged taste, or of such influence, as to bring about a consensus of opinion in favour of certain poems. Think of the mortal offence which the canonization of one poet must have given to his rivals and their tribes. It was quite another thing for an individual to give his own private estimate of the respective merits of two poets who had appealed to him as umpire, or for a number of poets to appear at large gatherings, such as the fair of ʿOqāẓ (Okad) as candidates for the place of honour in the estimation of the throng which listened to their recitations. No better is the modifications of the legend, which we find, at a much later period, in the *Moqaddima* of Ibn Khaldūn (A.D. 1332–1406), who tells us that the poets themselves hung up their poems on the Kaʿba (ed. Paris iii. 357). In short, this legend, so often retailed by Arabs, and still more frequently by Europeans, must be entirely rejected.[1] The story is a pure fabrication based on the name "suspended." The word was taken in its literal sense; and as these poems were prized by many above all others in after times, the same opinion was attributed to "the [ancient] Arabs," who were supposed to have given effect to their verdict in the way already described. A somewhat simpler version, also given by Naḥḥās in the passage already cited, is as follows: "Most of the Arabs were accustomed to meet at ʿOqāẓ and recite verses; then, if the king was pleased with any poem, he said, 'Hang it up, and preserve it among my treasures.'" But, not to mention other difficulties, there was no king of all the Arabs; and it is hardly probable that any Arabian king attended the fair at ʿOqāẓ. The story that the poems were written in gold has evidently originated in the name "the golden poems" (literally "the gilded"), a figurative expression for excellence. We may interpret the designation "suspended" on the same principle. It seems to mean those (poems) which have been raised, on account of their value, to a specially honourable position. Another derivative of the same root is *ʿilq*, "precious thing." A clearer significance attaches to another name sometimes used for these poems—*assumūt*, "the strings of pearls." The comparison of artificially elaborated poems to these strings is extremely apt. Hence it became so popular that, even in ordinary prose, to speak in rhythmical form is called simply *naẓm*—"to string pearls."

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[1] See G. Smith, *Ashurbanipal* (p. 288, cyl. A. viii. 51, B. viii. 37); L. B. Paton, *Syria and Palestine*, p. 269 seq.; R. F. Harper, *Ass. and Bab. Lit.*, pp. 118 sqq.; H. Winckler, *Keilinschr. u. das alte Test.*, 3rd ed., p. 151.

[2] Excavation alone can supplement the scanty information which the present evidence furnishes. For a representation of a Moabite warrior (-god ?), see G. Perrot and C. Chipiez, *Art in Phoenicia*, ii. 45 seq.

[3] See W. R. Smith, *Religion of the Semites* (2nd ed.), which may be supplemented by the scattered gleanings in Clermont-Ganneau's *Recueil d'archéologie orientale*; and more especially by P. Antonin Jaussin's valuable monograph, *Coutumes des Arabes au pays de Moab* (Paris, 1908). (See also Hebrew Religion.)

[4] Ernst Frenkel, *An-Naḥḥās' Commentar zur Muʻallaqa des Imruul-Qais* (Halle, 1876), p. viii.

The selection of these seven poems can scarcely have been the work of the ancient Arabs at all. It is much more likely that we owe it to some connoisseur of a later date. Now Naḥḥās says expressly in the same passage: "The true view of the matter is this: when Ḥammād ar-Rāwiya (Ḥammād the Rhapsodist) saw how little men cared for poetry, he collected these seven pieces, urged people to study them, and said to them: 'These are the [poems] of renown.'" And this agrees with all our other information. Ḥammād (who lived in the first three quarters of the 8th century A.D.) was perhaps of all men the one who knew most Arabic poetry by heart. The recitation of poems was his profession. To such a rhapsodist the task of selection is in every way appropriate; and it may be assumed that he is responsible also for the somewhat fantastic title of "the suspended."

There is another fact which seems to speak in favour of Ḥammād as the compiler of this work. He was a Persian by descent, but a client of the Arab tribe, Bakr ibn Wāīl. For this reason, we may suppose, he not only received into the collection a poem of the famous poet Ṭarafa, of the tribe of Bakr, but also that of another Bakrite, Ḥārith, who, though not accounted a bard of the highest rank, had been a prominent chieftain; while his poem could serve as a counterpoise to another also received—the celebrated verses of Ḥārith's contemporary ʿAmr, chief of the Taghlib, the rival brethren of the Bakr. ʿAmr praises the Taghlib in glowing terms: Ḥārith, in a similar vein, extolls the Bakr—ancestors of Ḥammād's patrons. The collection of Ḥammād appears to have consisted of the same seven poems which are found in our modern editions, composed respectively by Amra'al-Qais, Ṭarafa, Zuhair, Labīd, ʿAntara ibn Shaddād, ʿAmr ibn Kulthūm, and Ḥārith ibn Ḥilliza. These are enumerated both by Ibn ʿAbd-Rabbihi, and, on the authority of the older philologists, by Naḥḥās; and all subsequent commentators seem to follow them. We have, however, evidence of the existence, at a very early period, of a slightly different arrangement. Certainly we cannot now say, on the testimony of the *Jamharat ashʿār al ʿArab*, that two of the most competent ancient authorities on Arabic poetry, Mofaḍḍal (d. *c.* 790) and Abū ʿUbaida (d. A.D. 824, at a great age), had already assigned to the "Seven" (viz. "the seven Moʿallaqāt") a poem each of Nābigha and Aʿshā in place of those of ʿAntara and Ḥārith. For meanwhile it has been discovered that the compiler of the above-mentioned work—who, in order to deceive the reader, issued it under a false name—is absolutely untrustworthy. But the learned Ibn Qotaiba (9th century A.D.), in his book *Of Poetry and Poets*, mentions as belonging to the "Seven" not only the poem of ʿAmr, which has invariably been reckoned among the Moʿallaqāt (ed. de Goeje, p. 120), but also a poem of ʿAbīd ibn Abraṣ (ibid. 144). In place of which poem he read this we do not know; and we are equally ignorant as to whether he counted other pieces than those indicated above among the seven.

Now Nābigha and Aʿshā enjoyed greater celebrity than any of the poets represented in the Moʿallaqāt, with the exception of Amra'al-Qais, and it is therefore not surprising that scholars, of a somewhat later date, appended a poem by each of these to the Moʿallaqāt, without intending by this to make them an integral part of that work. This is clear, for instance, from the introductory words of Tibrīzī (d. A.D. 1109) to his commentary on the Moʿallaqāt. Appended to this he gives a commentary to a poem of Nābigha, to one of Aʿshā, and moreover one to that poem of ʿAbīd which, as we have just seen, Ibn Qotaiba had counted among the seven. It is a pure misunderstanding when Ibn Khaldūn (*loc. cit.*) speaks of *nine* Moʿallaqāt; and we ought hardly to lay any stress on the fact that he mentions not only Nābigha and Aʿshā, but also ʿAlqama, as Moʿallaqa-poets. He was probably led to this by a delusive recollection of the Collection of the "Six Poets," in which were included these three, together with the three Moʿallaqa-poets, Amra'al-Qais, Zuhair and Ṭarafa.

The lives of these poets were spread over a period of more than a hundred years. The earliest of the seven was AMRA'AL-QAIS (*q.v.*), regarded by many as the most illustrious of Arabian poets. His exact date cannot be determined; but probably the best part of his career fell within the midst of the 6th century. He was a scion of the royal house of the tribe Kinda, which lost its power at the death of King Ḥārith ibn ʿAmr in the year 529.[1] The poet's royal father, Ḥojr, by some accounts a son of this Ḥārith, was killed by a Bedouin tribe, the Banū Asad. The son led an adventurous life as a refugee, now with one tribe, now with another, and appears to have died young. The anecdotes related of him—which, however, are very untrustworthy in detail—as well as his poems, imply that the glorious memory of his house and the hatred it inspired were still comparatively fresh, and therefore recent. A contemporary of Amra'al-Qais was **ʿAbīd ibn Abraṣ**, one poem of whose, as we have seen, is by some authorities reckoned among the collection. He belonged to the Banū Asad, and is fond of vaunting the heroic dead of his tribe—the murder of Ḥojr— in opposition to the victim's son, the great poet.

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[1] Doubts had already been expressed by various scholars, when Hengstenberg—rigid conservative as he was in theology—openly challenged it, and Sprenger (*Das Leben des Mohammad*, i. 14, Berlin, 1861) declared it a fable. Since then it has been controverted at length in Nöldeke's *Beiträge zur Kenntniss der Poesie der alten Araber* (Hanover, 1864), p. xvii. sqq. Ahlwardt concurs in this conclusion; see his *Bemerkungen über die Aechtheit der alten arabischen Gedichte* (1872), pp. 25 seq.

The Moʿallaqa of **ʿAmr** hurls defiance against the king of Ḥīra, ʿAmr son of Mundhir, who reigned from the summer of 554 till 568 or 569, and was afterwards slain by our poet.[2] This prince is also addressed by **Ḥārith** in his Moʿallaqa. Of **Ṭarafa**, who is said to have attained no great age, a few satirical verses have been preserved, directed against this same king. This agrees with the fact that a grandson of the Qais ibn Khālid, mentioned as a rich and influential man in Ṭarafa's Moʿallaqa (v. 80 or 81), figured at the time of the battle of Dhū-Qār, in which the tribe Bakr routed a Persian army. This battle falls between A.D. 604 and 610.[3]

The Moʿallaqa of **ʿAntara** and that of **Zuhair** contain allusions to the feuds of the kindred tribes ʿAbs and Dhobyān. Famous as these contests were, their time cannot accurately be ascertained. But the date of the two poets can be approximately determined from other data. Kaʿb, son of Zuhair, composed first a satire, and then, in the year 630, a eulogy on the Prophet; another son, Bujair, had begun, somewhat sooner, to celebrate Mahomet. ʿAntara killed the grandfather of Aḥnaf ibn Qais, who died at an advanced age in A.D. 686 or 687; he outlived ʿAbdallāh ibn Ṣimma, whose brother Duraid was a very old man when he fell in battle against the Prophet (early in A.D. 630); and he had communications with Ward, whose son, the poet ʿOrwa, may perhaps have survived the flight of Mahomet to Medina. From all these indications we may place the productive period of both poets in the end of the 6th century. The historical background of ʿAntara's Moʿallaqa lies somewhat earlier than that of Zuhair's.

To the same period appears to belong the poem of **ʿAlqama**, which, as we have seen, Ibn Khaldūn reckons amongst the Mo ʿallaqāt. This too is certainly the date of **Nābigha**, who was one of the most distinguished of Arabic poets. For in the poem often reckoned as a Moʿallaqa, as in many others, he addresses himself to Noʿmān, king of Ḥīra, who reigned in the two last decades of the 6th century. The same king is mentioned as a contemporary in one of ʿAlqama's poems.

The poem of **Aʿsha**, sometimes added to the Moʿallaqāt, contains an allusion to the battle of Dhū Qār (under the name "Battle of Ḥinw," v. 62). This poet, not less famous than Nābigha, lived to compose a poem in honour of Mahomet, and died not long before A.D. 630.

Labīd is the only one of these poets who embraced Islam. His Moʿallaqa, however, like almost all his other poetical works, belongs to the Pagan period. He is said to have lived till 661, or even later; certainly it is true of him, what is asserted with less likelihood of several others of these poets, that he lived to a ripe old age.

The seven Moʿallaqāt, and also the poems appended to them, represent almost every type of ancient Arabian poetry in its excellences and its weaknesses. In order rightly to appreciate these, we must translate ourselves into the world of the Bedouin, and seek to realize the peculiar conditions of his life, together with the views and thoughts resulting from those conditions. In the Moʿallaqa of Ṭarafa we are repelled by the long, anatomically exact description of his camel; but such a description had an extraordinary charm of its own for the Bedouins, every man of whom was a perfect connoisseur on this subject down to the minutest points; and the remaining parts of the poem, together with the other extant fragments of his songs, show that Ṭarafa had a real poetic gift. In the Moʿallaqāt of ʿAmr and Ḥārith, for the preservation of which we are especially grateful to the compiler, we can read the haughty spirit of the powerful chieftains, boastfully celebrating the splendours of their tribe. These two poems have also a certain historical importance. The song of Zuhair contains the practical wisdom of a sober man of the world. The other poems are fairly typical examples of the customary *qaṣīda*, the long poem of ancient Arabia, and bring before us the various phases of Bedouin life. But even here we have differences. In the Moʿallaqa of ʿAntara, whose heroic temperament had overcome the scorn with which the son of a black slave-mother was regarded by the Bedouins, there predominates a warlike spirit, which plays practically no part in the song of Labīd.

It is a phenomenon which deserves the fullest recognition, that the needy inhabitants of a barren country should thus have produced an artistic poetry distinguished by so high a degree of uniformity. Even the extraordinary strict metrical system, observed by poets who had no inkling of theory and no knowledge of an alphabet, excites surprise. In the most ancient poems the metrical form is as scrupulously regarded as in later compositions. The only poem which shows unusual metrical freedom is the above-mentioned song of ʿAbīd. It is, however, remarkable that ʿAbīd's contemporary Amra'al-Qais, in a poem which in other respects also exhibits certain coincidences with that of ʿAbīd (No. 55, ed. Ahlwardt), presents himself considerable licence in the use of the very same metre—one which, moreover, is extremely rare in the ancient period. Presumably, the violent deviations from the *schema* in ʿAbīd are due simply to incorrect transmission by compilers who failed to grasp the metre. The other poems ascribed to ʿAbīd, together with all the rest attributed to Amra'al-Qais, are constructed in precise accord with the metrical canons. It is necessary always to bear in mind that these ancient poems, which for a century or more were preserved by oral tradition alone, have reached us in a much mutilated condition. Fortunately, there was a class of men who made it their special business to learn by rote the works either of a single poet or of several. The poets themselves used the services of these rhapsodists (rāwī). The last representative of this class is Ḥammād, to whom is attributed the collection of the Moʿallaqāt; but he, at the same time, marks the transition of the rhapsodist to the critic and scholar. The most favourable opinion of these rhapsodists would require us to make allowance for occasional mistakes: expressions would be transposed, the order of verses disarranged, passages omitted, and probably portions of different poems pieced together. It is clear, however, that Ḥammād dealt in the most arbitrary fashion with the enormous quantity of poetry which he professed to know thoroughly. The seven Moʿallaqāt are indeed free from the suspicion of forgery, but even in them the text is frequently altered and many verses are transposed. The loose structure of Arabic poems was extremely favourable to such alterations. Some of the Mo'allaqāt have several preambles: so, especially, that of ʿAmr, the first eight verses of which belong not to the poem, but to another poet. Elsewhere, also, we find spurious verses in the Moʿallaqāt. Some of these poems, which have been handed down to us in other exemplars besides the collection itself, exhibit great divergences both in the order and number of the verses and in textual details. This is particularly the case with the oldest Moʿallaqa—that of Amra'al-Qais—the critical treatment of which is a problem of such extreme difficulty that only an approximate solution can ever be reached. The variations of the text, outside the Moʿallaqāt collection, have here and there exercised an influence on the text of that collection. It would be well if our manuscripts at least gave the Moʿallaqāt in the exact form of Ḥammād's days. The best text—in fact, we may say, a really good text—is that of the latest Moʿallaqa, the song of Labīd.

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[1] See *Tabarî's Geschichte der Perser und Araber . . . übersetzt von Th. Nöldeke* (Leiden, 1879), p. 171.

[2] See Nöldeke's *Tabarî*, pp. 170,172.

[3] Ibid. p. 311.

The Moʿallaqāt exist in many manuscripts, some with old commentaries, of which a few are valuable. They have also been several times printed. Especial mention is due to the edition of Charles (afterwards Sir Charles) Lyall with the commentary of *Tibrīzī* (Calcutta, 1894). Attempts to translate these poems, verse for verse, in poetical form, could scarcely have a happy result. The strangeness, both of the expression and of the subjects, only admits of a paraphrastic version for large portions, unless the sense is to be entirely obliterated. An attempt at such a translation, in conjunction with a commentary based on the principles of modern science, has been made by the present author: "Fünf Moʿallaqāt übersetzt und erklärt," in the *Sitzungsberichte der kais. Akad. d. Wiss. in Wien. Philos.-hist. Classe.* Bde. cxl.–cxiv. A supplement to this is formed by an article, by Dr Bernh. Geiger, on the Moʿallaqa of Ṭarafa, in the *Wiener Zeitschrift für die Kunde des Morgenlands*, xix. 323 sqq. See further the separate articles on the seven poets.

(Th. N.)

MOAT, a ditch filled with water surrounding a castle, town or other fortified place for purposes of defence. The word is taken from the O. Fr. *mote*, or *motte*, a mound or embankment of earth used as a means of defence; the transition in meaning from the heap of earth to the trench left by excavating the earth is parallel with the similar interchange of meaning in dike and ditch (see Dike). In mod. Fr. *motte* means a lump or clod of earth. The word is probably of Teutonic origin, and may be connected with Eng. "mud." (See Fortification and Siegecraft.)

MOB. (1) A disorderly crowd, a rabble, also a contemptuous name for the common people, the lower orders, the Greek ὄχλος, (whence "ochlocracy," mob-rule). The word is a shortened form of Lat. *mobile* (*sc. vulgus*), the movable or mutable emotional, easily stirred crowd. "Mobile" in the sense of rabble was used in the 17th century, and was still used after the shortened form, for some time considered a vulgarism, had become common. Thus Addison (*Spectator*, No. 135) writes, "It is perhaps this humour of speaking no more than we needs must which has so miserably curtailed some of our words. . . . I dare not answer that 'mob' . . . 'incog.' and the like will not in time be looked at as part of our tongue." Roger North's *Examen*, vii., 574 (1740), dates the beginning of the use of the shortened form "mob." "I may note that the rabble first changed their title and were called the 'mob' in the assemblies of this club. It was their beast of burden, and called first *mobile vulgus*, but fell naturally into the contraction of one syllable, and ever since is become proper English." The club alluded to is the Green Ribbon Club (*q.v.*), and the date would be about 1680. (2) A kind of head-dress for women, usually called a "mob cap," worn during the 18th and early part of the 19th centuries. It was a large cap covering all the hair, with a bag-shaped crown, a broad band and frilled edge. It seems to have been originally an article of wear for the mornings. It is probably connected with words such as "mop," "mab," meaning untidy, *négligé*.

MOBERLY, GEORGE (1803–1885), English divine, was born on the 10th of October 1803, and educated at Winchester and Balliol. After a distinguished academic career he became head master of Winchester in 1835. This post he resigned in 1866, and retired to Brightstone Rectory, Isle of Wight. Mr. Gladstone, however, in 1869 called him to be bishop of Salisbury, in which see he kept up the traditions of his predecessors, Bishops Hamilton and Denison, his chief addition being the summoning of a diocesan synod. Though Moberly left Oxford at the beginning of the Oxford movement, he fell under its influence: the more so that at Winchester he formed a most intimate friendship with Keble, spending several weeks every year at Otterbourne, the next parish to Hursley. Moberly, however, retained his independence of thought, and in 1872 he astonished his High Church friends by joining in the movement for the disuse of the damnatory clauses in the Athanasian Creed. His chief contribution to theology is his Bampton Lectures of 1868, on *The Administration of the Holy Spirit in the Body of Christ.* He died on the 6th of July 1885.

MOBERLY, ROBERT CAMPBELL (1845–1903), English theologian, was born on the 26th of July 1845. He was the son of George Moberly, bishop of Salisbury, and faithfully maintained the traditions of his father's teaching. Educated at Winchester and New College, Oxford, he was appointed senior student of Christ Church in 1867 and tutor in 1869. In 1876 he went out with Bishop Copleston to Ceylon for six months. After his return he became the first head of St Stephen's House, Oxford (1876–1878), and then, after presiding for two years over the Theological College at Salisbury, where he acted as his father's chaplain, he accepted the college living of Great Budworth in Cheshire in 1880, and the same year married Alice, the daughter of his father's predecessor, Walter Kerr Hamilton. In 1892 Lord Salisbury made him Regius Professor of Pastoral Theology of Oxford; and after a long period of delicate health he died at Christ Church on the 8th of June 1903. His chief writings were: An essay in *Lux Mundi* on "The Incarnation as the Basis of Dogma" (1889); a paper, *Belief in a Personal God* (1891); *Reason and Religion* (1896), a protest against the limitation of the reason to the understanding; *Ministerial Priesthood* (1897); and *Atonement and Personality* (1901). In this last work, by which he is chiefly known, he aimed at presenting an explanation and a vindication of the doctrine of the Atonement by the help of the conception of personality. Rejecting the retributive view of punishment, he describes the sufferings of Christ as those of the perfect "Penitent," and finds their expiatory value to lie in the Person of the Sufferer, the God-Man.

MOBERLY, a city of Randolph county, Missouri, U.S.A., in the north central part of the state, about 130 m. E. by N. of Kansas City. Pop. (1890), 8215; (1900), 8012, (923 negroes); (1910), 10,923. It is served by the Missouri, Kansas & Texas and the Wabash railways, and is a division headquarters of the latter. The city is regularly laid out on a level prairie site. There are two public parks, a Carnegie library, a commercial college, a Y.M.C.A. building, and a hospital maintained by the Wabash Employees Hospital Association. The most important industrial establishments are the large machine shops (established here in 1872) of the Wabash railway. Moberly was platted in 1866, was incorporated as a town and became the county-seat in 1868, and in 1873 secured a special city charter, which it surrendered in 1889 for city status under the general statute.

MOBILE, a city and the county-seat of Mobile county, Alabama, U.S.A., in the S.W. part of the state, at the mouth of Mobile River, and the head of Mobile Bay. Pop. (1890), 31,076; (1900), 38,469, of whom 17,045 were negroes and 2111 foreign-born (562 German, 492 Irish, 202 English); (1910 census), 51,521. It is served by the Southern, the Louisville & Nashville, the Mobile & Ohio, the Mobile, Jackson & Kansas City, and the Tombigbee Valley railways; by steamboat lines to ports in Europe, Cuba, Mexico, Central America (especially Panama) and South America; by a coastwise steamboat line to New York; and by river boats on a river system embracing nearly 2000 m. of navigable waters in Alabama, Mississippi, and Georgia. The city occupies about 17 sq. m. of a sandy plain, which rises gradually from a low water front along the river to a range of hills a few miles to the westward. Among the principal buildings are the customs-house and post-office, the court-house, the Battle House (a hotel), the United States marine hospital, the city hospital, the Providence infirmary, Barton Academy (a part of the public school system), a Young Men's Christian Association building, St Joseph's church (Roman Catholic), the cathedral of the Immaculate Conception, the Van Antwerp office building, and the southern market and armoury. Mobile is the see of a Roman Catholic bishopric and the headquarters of the United States district court for the southern district of Alabama. In the city are a public library; the departments of medicine and pharmacy of the university of Alabama; the academy of the Visitation, and the

Immaculate Conception school, both for girls and both Roman Catholic; the Convent of Mercy; the Emerson normal and industrial school (for negroes), McGill Institute, the University military school, and the Mobile military institute; and 5 m. from Mobile, at Spring Hill, is Spring Hill college (Roman Catholic, founded in 1830, chartered 1836), controlled by the Jesuits. There is an annual celebration in Mobile on Mardi Gras (Shrove Tuesday), conducted by the Order of Myths and the Mystics, two social organizations, successors of the Cowbellion de Rakin Society, which was organized in 1830 and long conducted a somewhat similar celebration annually on New Year's Eve.

Mobile is the only seaport of Alabama. In 1826 the channel from it to the Gulf, about 30 m. distant, had a minimum depth of only 5½ ft. through Choctaw Pass and 8 ft. through Dog River bar; but subsequently the channel has been greatly improved by the United States government, and in June 1908[1] vessels drawing 23 and 24 ft. could pass at low-water to the mouth of Chickasaw Creek above the city. While the channel was still shallow, and rapidly growing railway systems were serving other ports, much foreign commerce was lost to Mobile, the value of the exports falling off from $12,784,171 in 1877 to $3,258,605 in 1882, and the value of the imports, during the same period, from $648,404 to $396,573; but after the improvement of the channel the value of the exports increased from $8,140,502 in 1897 to $26,815,279 in 1908, and the value of the imports rose from $956,712 in 1897 to $4,242,169 in 1908. The foreign commerce consists largely in the export of cotton, lumber, timber, cotton-seed oil, coal, provisions and clothing, and in the import of tropical fruits (especially bananas), sisal grass, coffee, mahogany, asphalt, and manganese and sulphur ores. Vegetables, particularly beans and cabbage, and small fruits are grown extensively in the vicinity, and the city has an important domestic trade in market-garden produce, fish and oysters, hardware, dry goods, grain and groceries. In manufacturing Mobile was second (Birmingham being first) among the cities of the state in 1905, when the value of the factory product was $4,942,331, 41·8% more than in 1900. In 1905 it ranked first in the state in the value of fertilizer, lumber and timber, and in the construction of railway cars; and the manufacture of flour and grist mill products and machinery for lumber mills were important industries.

Founded by Pierre Lemoyne, Sieur d'Iberville (1661–1706), and his brother Jean Baptiste Lemoyne, Sieur de Bienville (1680–1768), in 1702, Mobile[2] was the capital of the French province of Louisiana until 1720, when the seat of government was transferred to Biloxi, in the present Mississippi. The original settlement was at Twenty-seven Mile Bluff, about 20 m. above the present site, to which it was removed in 1710 as a consequence of floods in 1709. By the Treaty of Paris (1763) Mobile, as a part of Louisiana east of the Mississippi, was ceded to Great Britain; but on the 14th of March 1780 it was captured by a Spanish force under Don Bernardo de Galvez (1755–1786), the governor at New Orleans, and Spain was confirmed in its possession by the treaty of 1783. Spanish civil institutions were introduced, and new names, such as Conception, St Emanuel and St Joseph, which still survive, were given to the streets. Yet neither the English nor the Spanish occupation made any substantial change in the tone of the place or the habits of its people, even the negroes holding to their French jargon. The alliance between Great Britain and Spain, at the outbreak of the war of 1812, gave Mobile strategic importance for the military operations in the south-west. Hence, on the 15th of April 1813 General James Wilkinson, acting on President James Madison's instructions, which were based on the claim that Mobile was a part of Louisiana sold by France to the United States in 1803, seized Mobile for the United States. In August 1814 General Andrew Jackson made Mobile his headquarters. He repaired Fort Bowyer, on Mobile Point at the mouth of the bay, and garrisoned it just in time for it to resist attack by the British on the 15th of September. On the 11th of February 1815, forty-two days after peace had been declared and thirty-four days after the battle of New Orleans, a British force captured Fort Bowyer; but it made no move against Mobile, and withdrew on the 1st of April. Now began the Americanization of Mobile, a tide of immigration from the up-country setting in and rapidly changing the character of the place, which had previously been distinctly French. A town charter had been granted by the territorial legislature of Mississippi on the 20th of January 1814, and an interesting feature under the town government was the "tariff for bakers," which fixed the weight of loaves of bread in accordance with the price of flour. A city charter, dated the 17th of December 1819, was granted by the first state legislature of Alabama, and Mobile became the commercial emporium for Alabama and Mississippi, its cotton exports increasing from 7000 bales in 1818 to 100,000 in 1830 and 450,000 in 1840. In 1826 Barton Academy, still one of the landmarks of the city, was built; but it was not until 1852 that common schools were opened in Mobile county. Branches of the United States Bank and of the State bank were established at Mobile, and in the panic of 1837 the Bank of Mobile was one of the few banks in the United States that did not suspend payment. The Mobile & Ohio railroad, begun in 1848, provided ampler communication with the Mississippi valley, and Mobile's export of cotton rose to 1,000,000 bales in 1861.

During the Civil War Mobile was an important seaport of the Confederacy. A Federal blockade was begun as early as the 26th of May 1861, but trade with West Indian and European ports was continued by a line of swift vessels, which regularly escaped the blockading squadron. On the 5th of August 1864 Admiral David G. Farragut (*q.v.*), with a Federal fleet of four iron monitors, seven wooden sloops of war, and several gunboats, entered the channel by passing the Confederate defences, Fort Gaines on Dauphin Island and Fort Morgan occupying the site of old Fort Bowyer on Mobile Point, captured the formidable Confederate ironclad ram "Tennessee," destroyed one gunboat and drove another aground. One of the Federal monitors, the "Tecumseh," was destroyed by torpedoes. The Confederate fleet was commanded by Admiral Franklin Buchanan (1800–1874). Fort Gaines surrendered on the 7th, and Fort Morgan on the 23rd of the same month. In the spring of 1865 General E. R. S. Canby (1819–1873), with a Federal force of about 45,000, laid siege to Fort Blakely and Spanish Fort, on the east side of the bay (opposite the city), defended by General Randall L. Gibson (1832–1892) with 5000 men. After twenty-five days of resistance the Confederates evacuated the fortifications and then the city, the Federals entering on the 12th of April 1865. Losses from railway enterprises and the panic of 1873 resulted in the bankruptcy of the municipality in 1879, whereupon its charter was vacated, its property vested in certain trustees acting under the Chancery Court to adjust its debt, and a municipal government under the name of Port of Mobile succeeded the city of Mobile until 1887, when the latter was again chartered. On the 27th of September 1906 Mobile was swept by a hurricane, which destroyed property valued at $5,000,000 or more.

See Peter J. Hamilton, *Colonial Mobile* (Boston, 1897); and a chapter by the same writer in L. P. Powell's *Historic Towns of the Southern States* (New York, 1900).

MÖBIUS, AUGUST FERDINAND (1790–1868), German astronomer and mathematician, was born at Schulpforta on the 17th of November 1790. At Leipzig, Göttingen and Halle he studied for four years, ultimately devoting himself to mathematics and astronomy. In 1815 he settled at Leipzig as privatdocent, and the next year became extraordinary professor of astronomy in connexion with the university. Later he was chosen director of the university observatory, which was erected (1818–1821) under his superintendence. In 1844 he was elected ordinary professor of higher mechanics and astronomy, a position which he held till his death on the 26th of September 1868. His doctor's dissertation, *De computandis occultationibus fixarum per planetas* (Leipzig, 1815), established his reputation as a theoretical astronomer. *Die Hauptsätze der Astronomie* (1836), *Die Elemente der Mechanik des Himmels* (1843), may be noted amongst his other purely astronomical publications. Of more general interest, however, are his labours in pure mathematics, which appear for the most part in *Crelle's Journal* from 1828 to 1858. These papers are chiefly geometrical, many of them being developments and applications of the methods laid down in his great work, *Der barycentrische Calcul* (Leipzig, 1827), which, as the name implies, is based upon the properties of the mean point or centre of mass (see ALGEBRA: *Universal*). This work abounds in suggestions and foreshadowings of some of the most striking discoveries in more recent times—such, for example, as are contained in H. Grassmann's *Ausdehnungslehre* and Sir W. R. Hamilton's *Quaternions*. Möbius must be regarded as one of the leaders in the introduction of the powerful methods of modern projective geometry.

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[1] Between 1826 and 1908 the Federal government expended $5,148,179 on the improvement of the harbour. The bar channel also has been improved.

[2] The city was named from the Mobile or Maubila Indians, a Muskhogean tribe, now extinct, who occupied the neighbouring region and were Christianized by the French.

His *Gesammelten Werke* have been published in four volumes at Leipzig (1885–1887).

MOCATTA, FREDERICK DAVID (1828–1905), English Jewish philanthropist, was a member of the London financial firm, Mocatta and Goldsmid, but retired from business in 1874 and devoted himself to works of public and private benevolence. Besides this he was a patron of learning and himself an author of historical works, the chief of which was *The Jews and the Inquisition*. On occasion of his 70th birthday, he was presented with a testimonial from more than 200 philanthropic and literary institutions. The Anglo-Jewish Historical Exhibition (1887) owed its inception to him. He bequeathed his fine library to the Jewish Historical Society of England, of which he was at one time president. This library formed the basis of the collections which are now included in the Mocatta Library and Museum, founded in his memory, and located at the University of London (University College, Gower Street).

See *Trans. Jewish Hist. Soc. Eng.* vol. v. (I. A.)

MOCCASIN (a North-American Indian word, of which the spelling and pronunciation vary in different dialects), a shoe made of deerskin or other soft leather. It is made in one piece; the sole is soft and flexible and the upper part is often adorned with embroidery, beading or other ornament. It is the footwear of the North American Indian tribes and is also worn by hunters, traders and settlers. In botany, the lady's slipper is known in the United States of America, as the "moccasin flower," from its resemblance to a shoe or moccasin. The name moccasin is also given to a venomous snake, found as far north as North Carolina and westward to the Rocky Mountains, and popularly called "cottonmouth," from the white rim around the mouth. It belongs to the family *Crotalidae*, species *Ancistrodon* (or *Cenchris*) *piscivorus*, is about two feet long, and is often found in marshy land. It is sometimes called the *water moccasin* to distinguish it from the upland moccasin (*Ancistrodon contortrix* or *atrofuscus*), which is commonly called "copperhead" and is found further north in dry and mountainous regions. The name is possibly a distinct word of which the origin has not been traced.

MOCENIGO, the name of a noble and ancient Venetian family which gave many doges, statesmen and soldiers to the republic. TOMMASO MOCENIGO (1343–1423) commanded the crusading fleet in the expedition to Nicopolis in 1396, and also won battles against the Genoese. While he was Venetian ambassador at Cremona he was elected doge (1414), and he escaped in secret, fearing that he might be held a prisoner by Gabrino Fondolo, tyrant of that city. He made peace with the Turkish sultan, but when hostilities broke out afresh his fleet defeated that of the Turks at Gallipoli. During his reign the patriarch of Aquileia was forced to cede his territories to the republic (1420), which also acquired Friuli and Dalmatia. Tommaso greatly encouraged commerce, reconstructed the ducal palace and commenced the library. PIETRO MOCENIGO, doge from 1474 to 1476, was one of the greatest Venetian admirals, and revived the fortunes of his country's navy, which had fallen very low after the defeat at Negropont in 1470. In 1472 he captured and destroyed Smyrna; the following year he placed Catherine Cornaro, queen of Cyprus, under Venetian protection, and by that means the republic obtained possession of the island in 1475. He then defeated the Turks who were besieging Scutari, but he there contracted an illness of which he died. GIOVANNI MOCENIGO, Pietro's brother, who was doge from 1478 to 1485, fought against Mohammed II. and Ercole I., duke of Ferrara, from whom he recaptured Rovigo and the Polesine. LUIGI MOCENIGO was doge from 1570 to 1577. During his reign Venice lost the fortresses Nicosia and Famagosta in Cyprus. He took part in the battle of Lepanto, but after the loss of Cyprus he was forced to make peace with the Turks and to hand them back his conquests. ANDREA MOCENIGO, who flourished in the 15th and 16th centuries, was a senator of the republic and a historian; he composed a work on the league of Cambrai entitled *Belli memorabilis Cameracensis adversus Venetos historiae libri vi.* (Venice, 1525). Another LUIGI MOCENIGO was doge from 1700 to 1709, and his brother SEBASTIANO from 1722 to 1732. ALVISE MOCENIGO (1701–1778), who was doge from 1763 until his death, restricted the privileges of the clergy, and in consequence came into bitter conflict with Pope Clement XIII.

MOCHA STONE, a name applied to chalcedony with dendritic markings, said to have been obtained originally from Mocha in Arabia. The markings which sometimes simulate with curious fidelity the form of miniature trees and shrubs, are caused by the infiltration of solutions carrying iron and manganese, which are deposited as thin films of oxide along the cracks of the stone, producing black, brown or red dendrites, effectively disposed on a ground of grey or white chalcedony. Most of the Mocha stones of commerce are obtained from India, where they are found among the agate-pebbles resulting from the disintegration of the trap rocks of the Deccan. In recent years the formation of dendrites has been artificially effected at the agate-works of Oberstein, so as to imitate the true Mocha stones.

MOCK, an adjective meaning sham, feigned, spurious, falsely imitative. As a verb it means to deride or imitate contemptuously. The derivation of O. Fr. *mocquer*, mod. *moquer*; Ital. *moccare*, from which the English word is adopted, is disputed. Some authorities refer it to Ger. *mucken*, *mucksen*, to growl, grumble, which is probably echoic in origin; others to a supposed Late Lat. *muccare*, formed from *mucus*—mucus, in the sense of "to wipe the nose at."

MOCKING-BIRD, or MOCK-BIRD (as W. Charleton, J. Ray and M. Catesby called it), the popular name of birds belonging to the American sub-family *Miminae* of the thrushes, *Turdidae*, differing by having the tarsus scutellate in front, while the typical thrushes have it covered by a single horny plate. *Mimus polyglottus*, the northern mocking-bird, inhabits the southern part of the United States, being in the north only a summer visitant; it breeds rarely in New England, is seldom found north of the 38th parallel, and migrates to the south in winter, passing that season in the Gulf States and Mexico. It appears to be less numerous on the western side of the Alleghanies, though found in suitable localities across the continent to the Pacific coast, but seldom farther north than Virginia and southern Illinois, and it is said to be common in Kansas. J. J. Audubon states that the mocking-birds which are resident all the year round in Louisiana attack their travelled brethren on the return of the latter from the north in autumn. The names of the species, both English and scientific, have been bestowed from its capacity of successfully imitating the cry of many other birds, to say nothing of other sounds, in addition to uttering notes of its own which possess a varied range and liquid fullness of tone that are unequalled, according to its admirers, even by those of the nightingale (*q.v.*).

Plain in plumage, being greyish brown above and dull white below, while its quills are dingy black, variegated with white, there is little about the mocking-bird's appearance beyond its graceful form to recommend it; but the lively gesticulations it exhibits are very attractive, and therein its European rival in melody is far surpassed, for the cock-bird mounts aloft in rapid circling flight, and, alighting on a conspicuous perch, pours forth his ever-changing song to the delight of all listeners; while his actions in attendance on his mate are playfully demonstrative and equally interest the observer. The mocking-bird is moreover of familiar habits, haunting the neighbourhood of houses, and is therefore a general favourite. The nest is placed with little regard to concealment, and is not distinguished by much care in its construction. The eggs, from three to six in number, are of a pale bluish-green, blotched and spotted with light yellowish-brown. They, as well as the young, are much sought after by snakes, but the parents are often successful in repelling these deadly enemies, and are always ready to wage war against any intruder on their precincts, be it man, cat or hawk. Their food is various, consisting of berries, seeds and insects.

Some twelve or fourteen other species of *Mimus* have been recognized, mostly from South America; but *M. orpheus* seems to be common to some of the Greater Antilles, and *M. hilli* is peculiar to Jamaica, while the Bahamas have a local race in *M. bahamensis.* The so-called mountain mocking-bird (*Oreoscoptes montanus*) is a form not very distant from *Mimus*; but it inhabits exclusively the plains overgrown with sage-brush (*Artemisia*) of the interior tableland of North America, and is not at all imitative in its notes, so that it is an instance of a misnomer. Of the various other genera allied to *Mimus*, the best known are the thrashers (genus *Harporhynchus*) of which six or eight species are found in North America, which are thrush-like and shy in their habits and do not mimic; and the cat-bird (*Galeoscoptes carolinensis*), which in addition to having an attractive song, utters clucks, whistles and mewing sounds. The sooty-grey colour that, deepening into blackish-brown on the crown and quills, pervades the whole of its plumage—the lower tail-coverts, which are of a deep chestnut, excepted—renders it a conspicuous object; and though, for some reason or other, far from being a favourite, it is always willing when undisturbed to become intimate with men's abodes. It has a much wider range on the American continent than the mocking-bird, and is one of the few species that are resident in Bermuda, while on more than one occasion it is said to have appeared in Europe.

The name mocking-bird, or more frequently mock-nightingale, is in England occasionally given to some of the warblers (*q.v.*), especially the blackcap (*Sylvia atricapilla*), and the sedge-bird (*Acrocephalus schoenobaenus*). In India and Australia the same name is sometimes applied to other species. (A. N.)

MODEL (O. Fr. *modelle*, mod. *modèle*; It. *modello*, pattern, mould; from Lat. *modus*, measure, standard), a tangible representation, whether the size be equal, or greater, or smaller, of an object which is either in actual existence, or has to be constructed in fact or in thought. More generally it denotes a thing, whether actually existing or only mentally conceived of, whose properties are to be copied. In foundries, the object of which a cast is to be taken, whether it be for engineering or artistic purposes, is usually first formed of some easily workable material, generally wood. The form of this model is then reproduced in clay or plaster, and into the mould thus obtained the molten metal is poured. The sculptor first makes a model of the object he wishes to chisel in some plastic material such as wax, ingenious and complicated contrivances being employed to transfer this wax model, true to nature, to the stone in which the final work is to be executed. In anatomy and physiology, models are specially employed as aids in teaching and study, and the method of *moulage* or chromoplastic yields excellent impressions of living organisms, and enables anatomical and medical preparations to be copied both in form and colour. A special method is also in use for making plastic models of microscopic and minute microscopic objects. That their internal nature and structure may be more readily studied, these are divided by numerous parallel transverse cuts, by means of a microtome, into exceedingly thin sections. Each of these shavings is then modelled on an enlarged scale in wax or pulp plates, which are fixed together to form a reproduction of the object.

Representation in Thought.

Models in the mathematical, physical and mechanical sciences are of the greatest importance. Long ago philosophy perceived the essence of our process of thought to lie in the fact that we attach to the various real objects around us particular physical attributes—our concepts—and by means of these try to represent the objects to our minds. Such views were formerly regarded by mathematicians and physicists as nothing more than unfertile speculations, but in more recent times they have been brought by J. C. Maxwell, H. v. Helmholtz, E. Mach, H. Hertz and many others into intimate relation with the whole body of mathematical and physical theory. On this view our thoughts stand to things in the same relation as models to the objects they represent. The essence of the process is the attachment of one concept having a definite content to each thing, but without implying complete similarity between thing and thought; for naturally we can know but little of the resemblance of our thoughts to the things to which we attach them. What resemblance there is lies principally in the nature of the connexion, the correlation being analogous to that which obtains between thought and language, language and writing, the notes on the stave and musical sounds, &c. Here, of course, the symbolization of the thing is the important point, though, where feasible, the utmost possible correspondence is sought between the two—the musical scale, for example, being imitated by placing the notes higher or lower. When, therefore, we endeavour to assist our conceptions of space by figures, by the methods of descriptive geometry, and by various thread and object models; our topography by plans, charts and globes; and our mechanical and physical ideas by kinematic models—we are simply extending and continuing the principle by means of which we comprehend objects in thought and represent them in language or writing. In precisely the same way the microscope or telescope forms a continuation and multiplication of the lenses of the eye; and the notebook represents an external expansion of the same process which the memory brings about by purely internal means. There is also an obvious parallelism with representation by means of models when we express longitude, mileage, temperature, &c., by numbers, which should be looked upon as arithmetical analogies. Of a kindred character is the representation of distances by straight lines, of the course of events in time by curves, &c. Still, neither in this case nor in that of maps, charts, musical notes, figures, &c., can we legitimately speak of models, for these always involve a concrete spatial analogy in three dimensions.

So long as the volume of matter to be dealt with in science was insignificant, the need for the employment of models was naturally less imperative; indeed, there are self-evident advantages in comprehending things without resort to complicated models, which are difficult to make, and cannot be altered and adapted to extremely varied conditions so readily as can the easily adjusted symbols of thought, conception and calculation. Yet as the facts of science increased in number, the greatest economy of effort had to be observed in comprehending them and in conveying them to others; and the firm establishment of ocular demonstration was inevitable in view of its enormous superiority over purely abstract symbolism for the rapid and complete exhibition of complicated relations. At the present time it is desirable, on the one hand, that the power of deducing results from purely abstract premisses, without recourse to the aid of tangible models, should be more and more perfected, and on the other that purely abstract conceptions should be helped by objective and comprehensive models in cases where the mass of matter cannot be adequately dealt with directly.

Models in Mathematics and Physics.

In pure mathematics, especially geometry, models constructed of papier-mâché and plaster are chiefly employed to present to the senses the precise form of geometrical figures, surfaces and curves. Surfaces of the second order, represented by equations of the second degree between the rectangular co-ordinates of a point, are very simple to classify, and accordingly all their possible forms can easily be shown by a few models, which, however, become somewhat more intricate when lines of curvature, loxodromics and geodesic lines have to appear on their surfaces. On the other hand, the multiplicity of surfaces of the third order is enormous, and to convey their fundamental types it is necessary to employ numerous models of complicated, not to say hazardous, construction. In the case of more intricate surfaces it is sufficient to present those singularities which exhibit variation from the usual type of surface with synclastic or anticlastic curvatures, such as, for example, a sharp edge or point, or an intersection of the surface with itself; the elucidation of such singularities is of fundamental importance in modern mathematics.

In physical science, again, models that are of unchangeable form are largely employed. For example, the operation of the refraction of light in crystals can be pictured if we imagine a point in the centre of the crystal whence light is dispersed in all directions. The aggregate of the places at which the light arrives at any instant after it has started is called the wave-front. This surface consists of two cups or sheets fitting closely and exactly one inside the other. The two rays into which a single ray is broken are always determined by the points of contact of certain tangent-planes drawn to those sheets. With crystals possessing two axes these wave-surfaces display peculiar singularities in the above sense of the term, in that the inner sheet has four protuberances, while the outer has four funnel-like depressions, the lowest point of each depression meeting the highest point of each protuberance. At each of these funnels there is a tangent-plane that touches not in a single point, but in a circle bounding the depression, so that the corresponding ray of light is refracted, not into two rays, but into a whole cone of light—the so-called conical refraction theoretically predicted by Sir W. R. Hamilton and experimentally detected by Humphrey Lloyd. These conditions, which it is difficult to adequately express in language, are self-evident so soon as the wave-surface formed in plaster lies before our eyes. In thermodynamics, again, similar models serve, among other purposes, for the representation of the surfaces which exhibits the relation between the three thermodynamic variables of a body, *e.g.* between its temperature, pressure and volume. A glance at the model of such a thermodynamic surface enables the behaviour of a particular substance under the most varied conditions to be immediately realized. When the ordinate intersects the surface but once a single phase only of the body is conceivable, but where there is a multiple intersection various phases are possible, which may be liquid or gaseous. On the boundaries between these regions lie the critical phases, where transition occurs from one type of phase into the other. If for one of the elements a quantity which occurs in calorimetry be chosen—for example, entropy—information is also gained about the behaviour of the body when heat is taken in or abstracted.

After the stationary models hitherto considered, come the manifold forms of moving models, such as are used in geometry, to show the origin of geometrical figures from the motion of others—*e.g.* the origin of surfaces from the motion of lines. These include the thread models, in which threads are drawn tightly between movable bars, cords, wheels, rollers, &c. In mechanics and engineering an endless variety of working models are employed to convey to the eye the working either of machines as a whole, or of their component and subordinate parts. In theoretical mechanics models are often used to exhibit the physical laws of motion in interesting or special cases—*e.g.* the motion of a falling body or of a spinning-top, the movement of a pendulum on the rotating earth, the vortical motions of fluids, &c. Akin to these are the models which execute more or less exactly the hypothetical motions by which it is sought to explain various physical phenomena—as, for instance, the complicated wave-machines which present the motion of the particles in waves of sound (now ascertained with fair accuracy), or the more hypothetical motion of the atoms of the aether in waves of light.

Theories of Nature.

The varying importance which in recent times has been attached to models of this kind is intimately connected with the changes which have taken place in our conceptions of nature. The first method by which an attempt was made to solve the problem of the universe was entirely under the influence of Newton's laws. In analogy to his laws of universal gravitation, all bodies were conceived of as consisting of points of matter—atoms or molecules—to which was attributed a direct action at a distance. The circumstances of this action at a distance, however, were conceived as differing from those of the Newtonian law of attraction, in that they could explain the properties not only of solid elastic bodies, but also those of fluids, both liquids and gases. The phenomena of heat were explained by the motion of minute particles absolutely invisible to the eye, while to explain those of light it was assumed that an impalpable medium, called luminiferous aether, permeated the whole universe; to this were attributed the same properties as were possessed by solid bodies, and it was also supposed to consist of atoms, although of a much finer composition. To explain electric and magnetic phenomena the assumption was made of a third species of matter—electric fluids which were conceived of as being more of the nature of fluids, but still consisting of infinitesimal particles, also acting directly upon one another at a distance. This first phase of theoretical physics may be called the direct one, in that it took as its principal object the investigation of the internal structure of matter as it actually exists. It is also known as the mechanical theory of nature, in that it seeks to trace back all natural phenomena to motions of infinitesimal particles, *i.e.* to purely mechanical phenomena. In explaining magnetic and electrical phenomena it inevitably fell into somewhat artificial and improbable hypotheses, and this induced J. Clerk Maxwell, adopting the ideas of Michael Faraday, to propound a theory of electric and magnetic phenomena which was not only new in substance, but also essentially different in form. If the molecules and atoms of the old theory were not to be conceived of as exact mathematical points in the abstract sense, then their true nature and form must be regarded as absolutely unknown, and their groupings and motions, required by theory, looked upon as simply a process having more or less resemblance to the workings of nature, and representing more or less exactly certain aspects incidental to them. With this in mind, Maxwell propounded certain physical theories which were purely mechanical so far as they proceeded from a conception of purely mechanical processes. But he explicitly stated that he did not believe in the existence in nature of mechanical agents so constituted, and that he regarded them merely as means by which phenomena could be reproduced, bearing a certain similarity to those actually existing, and which also served to include larger groups of phenomena in a uniform manner and to determine the relations that held in their case. The question no longer being one of ascertaining the actual internal structure of matter, many mechanical analogies or dynamical illustrations became available, possessing different advantages; and as a matter of fact Maxwell at first employed special and intricate mechanical arrangements, though later these became more general and indefinite. This theory, which is called that of mechanical analogies, leads to the construction of numerous mechanical models. Maxwell himself and his followers devised many kinematic models, designed to afford a representation of the mechanical construction of the ether as a whole as well as of the separate mechanisms at work in it: these resemble the old wave-machines, so far as they represent the movements of a purely hypothetical mechanism. But while it was formerly believed that it was allowable to assume with a great show of probability the actual existence of such mechanisms in nature, yet nowadays philosophers postulate no more than a partial resemblance between the phenomena visible in such mechanisms and those which appear in nature. Here again it is perfectly clear that these models of wood, metal and cardboard are really a continuation and integration of our process of thought; for, according to the view in question, physical theory is merely a mental construction of mechanical models, the working of which we make plain to ourselves by the analogy of mechanisms we hold in our hands, and which have so much in common with natural phenomena as to help our comprehension of the latter.

Although Maxwell gave up the idea of making a precise investigation into the final structure of matter as it actually is, yet in Germany his work, under G. R. Kirchhoff's lead, was carried still further. Kirchhoff defined his own aim as being to describe, not to explain, the world of phenomena; but as he leaves the means of description open his theory differs little from Maxwell's, so soon as recourse is had to description by means of mechanical models and analogies. Now the resources of pure mathematics being particularly suited for the exact description of relations of quantity, Kirchhoff's school laid great stress on description by mathematical expressions and formulae, and the aim of physical theory came to be regarded as mainly the construction of formulae by which phenomena in the various branches of physics should be determined with the greatest approximation to the reality. This view of the nature of physical theory is known as mathematical phenomenology; it is a presentation of phenomena by analogies, though only by such as may be called mathematical.

Another phenomenology in the widest sense of the term, maintained especially by E. Mach, gives less prominence to mathematics, but considers the view that the phenomena of motion are essentially more fundamental than all the others to have been too hastily taken. It rather emphasizes the prime importance of description in the most general terms of the various spheres of phenomena, and holds that in each sphere its own fundamental law and the notions derived from this must be employed. Analogies and elucidations of one sphere by another —*e.g.* heat, electricity, &c.—by mechanical conceptions, this theory regards as mere ephemeral aids to perception, which are necessitated by historical development, but which in course of time either give place to others or entirely vanish from the domain of science.

All these theories are opposed by one called energetics (in the narrower sense), which looks upon the conception of energy, not that of matter, as the fundamental notion of all scientific investigation. It is in the main based on the similarities energy displays in its various spheres of action, but at the same time it takes its stand upon an interpretation or explanation of natural phenomena by analogies which, however, are not mechanical, but deal with the behaviour of energy in its various modes of manifestation.

Experimental Models.

A distinction must be observed between the models which have been described and those experimental models which present on a small scale a machine that is subsequently to be completed on a larger, so as to afford a trial of its capabilities. Here it must be noted that a mere alteration in dimensions is often sufficient to cause a material alteration in the action, since the various capabilities depend in various ways on the linear dimensions. Thus the weight varies as the cube of the linear dimensions, the surface of any single part and the phenomena that depend on such surfaces are proportionate to the square, while other effects—such as friction, expansion and conduction of heat, &c., vary according to other laws. Hence a flying-machine, which when made on a small scale is able to support its own weight, loses its power when its dimensions are increased. The theory, initiated by Sir Isaac Newton, of the dependence of various effects on the linear dimensions, is treated in the article Units, Dimensions of. Under simple conditions it may often be affirmed that in comparison with a large machine a small one has the same capacity, with reference to a standard of time which must be diminished in a certain ratio.

Of course experimental models are not only those in which purely mechanical forces are employed, but also include models of thermal, electro-magnetic and other engines—*e.g.* dynamos and telegraphic machines. The largest collection of such models is to be found in the museum of the Washington Patent Office. Sometimes, again, other than purely mechanical forces are at work in models for purposes of investigation and instruction. It often happens that a series of natural processes—such as motion in liquids, internal friction of gases, and the conduction of heat and electricity in metals—may be expressed by the same differential equations; and it is frequently possible to follow by means of measurements one of the processes in question—*e.g.* the conduction of electricity just mentioned. If then there be shown in a model a particular case of electrical conduction in which the same conditions at the boundary hold as in a problem of the internal friction of gases, we are able by measuring the electrical conduction in the model to determine at once the numerical data which obtain for the analogous case of internal friction, and which could only be ascertained otherwise by intricate calculations. Intricate calculations, moreover, can very often be dispensed with by the aid of mechanical devices, such as the ingenious calculating machines which perform additions and subtractions and very elaborate multiplications and divisions with surprising speed and accuracy, or apparatus for solving the higher equations, for determining the volume or area of geometrical figures, for carrying out integrations, and for developing a function in a Fourier's series by mechanical means. (L. Bo.)

MODELS, ARTISTS', the name given to persons who pose to artists as models for their work. The Greeks, who had the naked body constantly before them in the exercises of the gymnasium, had far less need of professional models than the moderns; but it is scarcely likely that they could have attained to the high level reached by their works without constant study from nature; and the story told of Zeuxis by Valerius Maximus, who had five of the most beautiful virgins of the city of Crotona offered him as models for his picture of Helen, proves their occasional use. The remark of Eupompus, quoted by Pliny, who advised Lysippus, "Let nature be your model, not an artist," directing his attention to the crowd instead of to his own work, also suggests a use of models which the many portrait statues of Greek and Roman times show to have been not unknown. In Egypt, too, although the priesthood had control of both sculpture and painting as used for the decoration of temples and palaces, and imposed a strict conventionalism, there are several statues of the early periods which are so lifelike in their treatment as to make it certain that they must have been worked from life. At the period of the Renaissance, painters generally made use of their relations and friends as models, of which many examples might be quoted from Venice, Florence, Rome and other places, and the stories of Titian and the duchess of Ferrara, and Botticelli and Simonetta Vespucci, go to show that ladies of exalted rank were sometimes not averse from having their charms immortalized by the painter's brush. But paid models were not unknown, as the story of the unfortunate contadino used by Sansovino as model for his statue of the little Bacchus will show. Artists' models as a special class appear when the establishment of schools for the study of the human figure created a regular demand, and since that time the remuneration offered has ensured a continual supply. The prices and the hours of work vary in different art centres. In England seven shillings is generally paid for a day of six hours, but models of exceptional beauty or talent frequently obtain more from successful artists or wealthy amateurs.

MODEL-YACHTING, the pastime of building and racing model-yachts. It has always been customary for ship-builders to make a miniature model of the vessel under construction; which is in every respect a copy of the original on a small scale; whether steam-ship or sailing-vessel (there is a fine collection in the Victoria and Albert Museum, London). Many of these models are of exquisite workmanship, every rope, pulley or portion of the engine being faithfully reproduced. In the case of sailing yachts these models were often pitted against each other on small bodies of water, and hence arose the modern pastime. It was soon seen that elaborate fittings and complicated rigging were a detriment to rapid handling, and that, on account of the comparatively stronger winds in which models were sailed, they needed a greater draught. For these reasons modern model yachts, which usually have fin-keels, are of about 15% or 20% deeper draught than full-sized vessels, while rigging and fittings have been reduced to absolute simplicity. This applies to models built for racing and not to elaborate copies of steamers and ships, made only for show or for "toy cruising."

Model-yacht clubs have existed for many years in Great Britain, Ireland and the United States, most of them holding a number of regattas during each season. The rules do not generally require the owner or skipper of a model to build his own craft, but among model-yachtsmen the designing and the construction of the boats constitute as important and interesting a part of the sport as the actual sailing. Models are constructed of some light, seasoned wood—such as pine (preferably white), white cedar or mahogany—free from knots. The hull may either be hollowed out of a solid block of wood, or cut from layers of planks in the so-called "bread-and-butter" style, or planked over a frame of keel and cross-sections. The first two methods are used in constructing "dug-out" models. Hollowing out from the solid block entails a great deal of labour and has therefore fallen into disfavour. In the "bread-and-butter" style a number of planks, which have been shaped to the horizontal sections of the model and from which the middle has been sawn out, are glued together and then cut down to the exact lines of the design, templates being used to test the precision of the curves. In the planked, or "built-up" model, which is generally chosen by more expert builders, the planks are tacked to the frame, as in the construction of large vessels. Models now are generally exaggerated cutters, so far as their underbodies are concerned, or, more often, are fitted with fin-keels weighted with lead, after the manner of full-sized yachts. They may have any rig, but schooner and sloop rigs are most common, the latter being the favourite for racing on account of its simplicity. Two kinds of steering-gear are used, the weighted swinging rudder and the "main-sheet balance gear," the object of both being to keep the model on a true course, either before or against the wind. Models are often sailed without rudders, but though a perfectly built boat will sail readily against the wind without steering-gear, it is almost impossible to keep it on its course before the wind without some contrivance to check divergence. This is accomplished by the weighted rudder, which falls over when the vessel heels and tends to counteract the force of the breeze. There are two varieties of the weighted rudder, in the first of which the weight, usually lead, is fixed to the edge of the rudder, while in the second the weight, usually a ball of lead, is made to run on the tiller above the deck, so that it can be placed further forward or aft, according to the force needed to overcome the influence of the wind. While the weighted rudder is almost universal in the British Isles, the chief model-yachtsmen in America use the "main-sheet balance gear," in which the boom is connected with the tiller in such a manner that, when it swings out with a pressure of wind, the rudder is automatically pulled round sufficiently to keep the yacht in its course. This apparatus is particularly efficient in sailing before the wind.

Model-yacht regattas are very different from the toy-boat matches indulged in by children from one side of a pond to the other. They take place upon sufficiently large bodies of water to allow a course at least a quarter of a mile in length, which is generally sailed twice or three times over to windward and backward. Triangular courses are also sailed. Racing rules correspond generally to those controlling regattas of large boats, and there is full scope to exhibit all the proofs of good seamanship. The yachts are followed in light skiffs, and may not be touched more than a certain number of times during a race, on penalty of a handicap. Racing measurements differ in the various clubs, but all are based upon length and sail-area. In Great Britain the regular Yacht Racing Association rule has been generally adopted, and handicaps deducted from it. In America models are divided into a single schooner with a maximum load water-line of 63 in., and three classes of sloops, the first class including yachts with water-lines between 48 and 53 in., the second class those between 42 and 48 in. and the third and smallest class those between 35 and 42 in. A yacht with a shorter water-line than 35 in. must race in the third class. It has been found that yachts of smaller dimensions possess too little resistance to the wind.

See *Model Sailing Yachts*, in Marshall's Practical Manuals series, 1905; and *How to Build a Model Yacht*, by Herbert Fisher (New York, 1902).

MODENA (ancient *Mutina*), one of the principal cities of Emilia, Italy, the chief town of the province of Modena and the seat of an archbishop, 31 m. E.S.E. of Parma by rail. Pop. (1906), 26,847 (town); 66,762 (commune). It is situated in a damp, low plain in the open country in the south side of the valley of the Po, between the Secchia to the west and the Panaro to the east. Some of its main streets (as their names indicate) follow the lines of canals, which still (though now covered) traverse the city in various directions. The observatory stands 135 ft. above the level of the sea. Dismantled since 1816, and now largely converted into promenades, the fortifications give the city an irregular pentagonal contour, modified at the north-west corner by the addition of a citadel also pentagonal Within this circuit there are various open areas—the spacious Ippodromo in front of the citadel, the public gardens in the north-east of the city, the Piazza Grande in front of the cathedral, and the Piazza Reale to the south of the palace. The Via Aemilia passes obliquely right through the heart of the city, from the Bologna Gate in the east to that of Sant' Agostino in the west.

Begun by the Countess Matilda of Tuscany in 1099, after the designs of Lanfranc, and consecrated in 1184, the Romanesque cathedral (S Geminiano) is a low but handsome building, with a lofty crypt, under the choir (characteristic of the Tuscan Romanesque architecture), three eastern apses, and a façade still preserving some curious sculptures of the 12th century. The interior was restored in 1897. The graceful bell-tower, erected in 1224–1319, named La Ghirlandina from the bronze garland surrounding the weathercock, is 335 ft. high; in the basement may be seen the wooden bucket captured by the Modenese from the Bolognese in the affray at Zappolino (1325), and rendered famous by Tassoni's *Secchia Rapita*. Of the other churches in Modena, the church of S Giovanni Decollato contains a *Pieta* in painted terra-cotta by Guido Mazzoni (1450–1518). The so-called Pantheon Estense (the church of S. Agostino, containing works of sculpture in honour of the house of Este) is a baroque building by Bibbiena; it also contains the tombs of Sigonio and Muratori. San Pietro and San Francesco have terra-cottas by Begarelli (1498–1565). The old ducal palace, begun by Duke Francis I. in 1635 from the designs of Avanzini, and finished by Francis Ferdinand V., is an extensive building with a fine courtyard, and now contains the military school and the observatory. The Albergo d' Arti, built by Duke Francis III., accommodates the civic collections, comprising the Museo Lapidario (Roman inscriptions, &c.); the valuable archives, the Biblioteca Estense, with 90,000 volumes and 3000 MSS.; the Museo Civico, with large and good palaeo-ethnological and archaeological collections; a fine collection of textile fabrics, and the picture gallery, a good representative collection presented to the city by Francis V. and since augmented by the addition of the collection of the Marchese Campori. Many of the best pictures in the ducal collection were sold in the 18th century and found their way to Dresden. The town hall is a noteworthy building, with arcades dating from 1194, but in part rebuilt in 1826. The university of Modena, originally founded in 1683 by Francis II., is mainly a medical and legal school, but has also a faculty of physical and mathematical science. The old academy of the *Dissonanti*, dating from 1684, was restored in 1814, and now forms the flourishing Royal Academy of Science and Art. In industrial enterprise silk and linen goods and iron wares are almost the only products of any note. Commerce is chiefly agricultural and is stimulated by a good position in the railway system, and by a canal which opens a water-way by the Panaro and the Po to the Adriatic. Modena is the point at which the railway to Mantua and Verona diverges from that between Milan and Bologna, and has several steam tramways to neighbouring places. It is also the starting-point of a once important road over the Apennines to Pistoia by the Abetone Pass.

Modena is the ancient *Mutina* in the territory of the Boii, which came into the possession of the Romans probably in the war of 215–212 B.C. In 183 B.C. Mutina became the seat of a Roman colony. The Roman town lay immediately to the south-east of the modern; its north-western wall is marked by the modern Corso Umberto I. (formerly Canal Grande) It appears to have been a place of importance under the empire, but none of its buildings is now to be seen. The Roman level, indeed, is some 15 to 20 ft. below the modern town. Its vineyards and potteries are mentioned by Pliny, the latter doing a considerable export trade. Its territory was coterminous with that of Bononia and Regium, as its diocese is now, and to the south it seems to have extended to the summit of the Apennines. During the civil wars Marcus Brutus, the lieutenant of Lepidus, held out within its walls against Pompeius in 78 B.C., and in 44 B.C. the place was successfully defended by D. Brutus against Mark Antony for four months. The 4th century found Mutina in a state of decay; the ravages of Attila and the troubles of the Lombard period left it a ruined city in a wasted land. In the 7th century, perhaps owing to a terrible inundation,[1] its exiles founded, at a distance of 4 m. to the north-west, a new city, Città Geminiana (still represented by the village of Cittanova); but about the close of the 9th century Modena was restored and refortified by its bishop, Ludovicus. When it began to build its cathedral (A.D. 1099) the city was part of the possessions of the Countess Matilda of Tuscany; but when, in 1184, the edifice was consecrated by Lucius III., it was a free community. In the wars between Frederick II. and Gregory IX. it sided with the emperor, though ultimately the papal party was strong enough to introduce confusion into its policy. In 1288 Obizzo d'Este was recognized as lord of the city; after the death of his successor, Azzo VIII. (1308), it resumed its communal independence; but by 1336 the Este family was again in power. Constituted a duchy in 1452 in favour of Borso d'Este, and enlarged and strengthened by Hercules II., it became the ducal residence on the incorporation of Ferrara with the States of the Church (1598). Francis I. (1629–1658) erected the citadel and commenced the palace, which was largely embellished by Francis II. Rinaldo (*ob.* 1737) was twice driven from his city by French invasion. To Francis III. (1698–1780) the city was indebted for many of its public buildings. Hercules III. (1727–1803) saw his states transformed by the French into the Cispadine Republic, and, having refused the principality of Breisgau and Ortenau, offered him in compensation by the treaty of Campo Formio, died an exile at Treviso. His only daughter, Maria Beatrice, married Ferdinand of Austria (son of Maria Theresa), and in 1814 their eldest son, Francis, received back the *Stati Estensi*. His rule was subservient to Austria, reactionary and despotic. On the outbreak of the French Revolution of 1830, Francis IV. seemed for a time disposed to encourage the corresponding movement in Modena; but no sooner had the Austrian army put an end to the insurrection in Central Italy than he returned to his previous policy. Francis Ferdinand V., who succeeded in 1846, followed in the main his father's example. Obliged to leave the city in 1848, he was restored by the Austrians in 1849; ten years later, on the 20th of August 1859, the representatives of Modena declared their territory part of the kingdom of Italy, and their decision was confirmed by the plebiscite of 1860.

See Vedriani, *Storia di Modena* (1666); Tiraboschi, *Mem. storiche modenesi* (1793); Scharfenberg, *Gesch. des Herzogth. Modena* (1859); Oreste Raggi, *Modena descritta* (1860); Baraldi, *Storia di Modena*; Valdrighi, *Diz. Storico, &c., delle contrade di Modena* (1798–1880); Crespellani, *Guida di Modena* (1879); Cavedoni, *Dichiarazione degli antici marmi Modenesi* (1828).

MODERATOR (from Lat. *moderare*, to impose a *modus*, limit), a judge or umpire, one who acts the part of mediator, and so a term used of the person chosen to be president of a meeting (as in America, of a town meeting). In academic use, the word was formerly applied to the public officer who presided over the exercises, &c., prescribed for candidates for degrees in the university schools; it is now used at Cambridge of one or two officers who are appointed each year to preside over the examination for the mathematical tripos, at Oxford of an examiner in the first public examination, known as "moderations," and at Dublin of a candidate for honours in the examination for degree of Bachelor of Arts. In the Presbyterian churches the name is applied to the minister elected to preside over ecclesiastical meetings or assemblies, as the synod, presbytery or general assembly (see PRESBYTERIANISM). The name was historically given to a party of people who joined together to oppose the "Regulators," another party who professed to administer justice in the Carolinas (1767–1771). Technically, the word is also used of a particular form of lamp, in which the flow of oil from the reservoir to the burner is regulated by a mechanical arrangement to which the name is applied.

MODERATUS OF GADES, a Greek philosopher of the Neo-Pythagorean school, contemporary with Apollonius of Tyana. He wrote a great work on the doctrines of the Pythagoreans, and tried to show that the successors of Pythagoras had made no additions to the views of their founder, but had merely borrowed and altered the phraseology. He has been given a fictitious importance by recent commentators, who have regarded him as the forerunner of the Alexandrian School of philosophy. Zeller has shown that the authority on which this view is based is entirely unsound. Moderatus is thus left as an unimportant though interesting representative of a type of thought which had almost disappeared since the 5th century B.C.

Stobaeus, *Eclogae*, p. 3, preserves a fragment of his writings.

MODESTINUS, HERENNIUS, a celebrated Roman jurist, who flourished about 250 B.C. He appears to have been a native of one of the Greek-speaking provinces, probably Dalmatia, and was a pupil of Ulpian. In Valentinian's *Law of Citations* he is classed with Papinian, Paulus, Gaius and Ulpian. He is mentioned in a rescript of Gordian in the year 240 B.C. in connexion with a *responsum* which he gave to the party to whom the rescript was addressed. No fewer than 345 passages in the *Digest* are taken from his writings.

MODICA, a town of Sicily, in the province of Syracuse, 57 m. W.S.W. of Syracuse by rail and 33 m. direct. Pop. (1901), 48,962. It lies on a hill between two valleys; the hill, crowned by the church of S. Giorgio, reconstructed in the 17th century, was the site of the Sicel town of Motyca, while the modern part of the town extends along the river Mauro, an inundation of which did much damage in September 1902. Remains of megalithic buildings, apparently, however, houses of the Byzantine period, are described in *Notizie degli Scavi*, 1896, 242 seq. Six miles to the south-east is the valley known as the Cava d'Ispica, with hundreds of grottoes cut in its rocky sides; of these only a few are Sicel tombs, the majority being catacombs or open tombs of the early Christian and Byzantine periods, or even cave-dwellings of the latter age.

See P. Orsi in *Notizie degli Scavi* (1905), 431.

MODILLION (a French word, probably from Lat. *modulus*, a measure of proportion), a term in architecture for the enriched block or horizontal bracket generally found under the cornice and above the bedmould of the Corinthian entablature. It is probably so called because of its arrangement in regulated distances.

MODJESKA, HELENA (1844–1909), Polish actress, was born at Cracow on the 12th of October 1844. Her father, Michael Opido, was a musician, and her tastes soon declared themselves strongly in favour of a dramatic career; but it was not until after her marriage in 1861 that she first attempted to act, and then it was with a company of strolling players. Her husband (whose name, Modrzejewski, she simplified for stage purposes) died in 1865. In 1868 she married Count Bozenta Chlapowski, a Polish politician and critic, and almost immediately afterwards received an invitation to act at Warsaw. There she remained for seven or eight years, and won a high position in her art. Her chief tragic rôles were Ophelia, Juliet, Desdemona, Queen Anne in *Richard III.*, Louisa Miller, Maria Stuart, Schiller's Princess Eboli, Marion Delorme, Victor Hugo's Tisbé and Slowacki's Mazeppa. In comedy her favourite rôles were Beatrice in *Much Ado About Nothing*, and Donna Diana in the Polish translation of an old Spanish play of that name. Madame Modjeska was also the Polish interpretress of the most prominent plays of Legouvé, Dumas, father and son, Augier, Alfred de Musset, Octave Feuillet and Sardou. In 1876 she went with her husband to California, where they settled on a ranch. This new career, however, proved a failure, and Madame Modjeska returned to the stage. She appeared in San Francisco in 1877, in an English version of *Adrienne Lecouvreur*, and, in spite of her imperfect command of the language, achieved a remarkable success. She continued to act principally in America, but was also seen from time to time in London and elsewhere in the United Kingdom, her repertory including several Shakespearian rôles and a variety of emotional parts in modern drama. She died on the 9th of April 1909 at her home near Los Angeles, California.

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[1] Some authorities (of whom Tiraboschi was the first) attribute its desertion entirely to a succession of inundations, denying that it was even among the cities destroyed by Attila.

See Mabel Collins, *The Story of Helena Modjeska* (London, 1883), and the (autobiographical) *Memories and Impressions* (New York, 1910).

MÖDLING, an old town of Austria, in Lower Austria, 10 m. S. of Vienna by rail. Pop. (1900), 15,304. It is situated at the entrance of the Brühl valley and is a popular summer resort, possessing iron and sulphur baths. It possesses a Gothic church, with a crypt dating from the 15th century, and a still older Romanesque burial chapel. It has a considerable iron and metal industry, and manufactures of shoes, varnish, &c.

MODOC (*i.e.* "southerners"), a tribe of North American Indians of the Lutuamian stock, who formerly lived around Lower Klamath Lake, south-western Oregon. They were always an aggressive people, and constantly at war with their neighbours. They are known mainly from their stubborn resistance to the United States government in 1872 and 1873. This is called the Modoc War, and was caused by an attempt to place them on a reservation. After some preliminary fighting the Modocs retreated to the "Lava Beds," a basaltic region, seamed and crevassed, and rich in caves. Here they made a stand for several months. During the war two members of a peace commission were treacherously massacred by them while under a flag of truce. On their final submission the leaders were hanged and part of the tribe was removed to Indian Territory (now Oklahoma), and the others were sent back to a reservation on the Klamath.

MODULE (Lat. *modulus*, a measure), in architecture, the semi-diameter of the column at its base; the term was first set forth by Vitruvius (iv. 3), and was generally employed by the architects of the Italian revival to determine the relative proportions of the various parts of a columnar ordinance. The module was divided by the revivalists into thirty parts, called minutes, allowing of much greater accuracy than was thought necessary by Vitruvius, whose subdivision was usually six parts. The tendency now is to adopt the whole diameter instead of the semi-diameter when determining the height of the column or entablature or any of their subdivisions. The term module is also applied in hydraulics (*q.v.*) to a contrivance for regulating the supply of water from an irrigation channel.

MOERIS, AELIUS, Greek grammarian, surnamed *Atticista* ("the Atticist"), probably flourished in the 2nd century A.D. He was the author of an extant (more or less alphabetical) list of Attic forms and expressions (Ἀττικαὶ λέξεις), accompanied by the Hellenistic parallels of his own time, the differences of gender, accent and meaning being clearly and succinctly pointed out.

Editions by J. Hudson (1711); J. Pierson (1759); A. Koch (1830); I. Bekker (1833); with Harpocration.

MOERIS, LAKE OF, the lake which formerly filled the deep depression of the Fayum to the Nile level, now shrunken and sunk more than 200 ft. to the shallow Birket el Kerūn. In remote prehistoric times the Fayum depression was probably dry, but with the gradual rise of the river bed the high Nile reached a level at which it could enter through the natural or artificial channel now known as the Bahr Yusuf. The borders of the lake were occupied by a neolithic people, and the town of Crocodilopolis grew up very early on the eastern slope south of the channel, where the higher ground formed a ridge in the lake. The rise continuing (at the rate of about 4 in. to the century) the waters threatened to flood the town; consequently under the XIIth Dynasty great embankments were made to save the settled land from encroachment. The line of the embankment is still traceable in places and marked by monuments of the XIIth Dynasty kings, an obelisk of Senwosri I. at Ebgig, and colossi of Amenemhê III. at Biahmu. The latter ornamented the quay of the port of Crocodilopolis, and projected into the lake on high bases. As the Nile fell the broad expanse of the lake lowered, and the water pouring back through the channel was of value for summer irrigation; the inflow and outflow were regulated by sluices, and the capture of fish here and in the lake was enormous. The channel which was of such importance was called the "Great Channel," Mewêr, in Greek Moeris. The native name of the lake was Shei, "the lake," later Piôm, "the sea" (whence Fayum); Teshei, "the land of the lake," was the early name of the region. At its capital Crocodilopolis and elsewhere the crocodile god Sobk (Suchus) was worshipped. Senwosri II. of the XIIth Dynasty built his pyramid at Illahun at the outer end of the channel, Amenemhê III. built his near the inner end at Hawara, and the vast labyrinth attached to it was probably his funerary temple. This king was afterwards worshipped in more than one locality about the lake under the name Marres (his praenomen Nemarē) or Peremarres, *i.e.* Pharaoh Marres. The mud poured in at high Nile made rich deposits on the eastern slope; in the reign of Philadelphus large reclamations of land were made, veterans from the Syrian War were settled in the "Lake" (Λίμνη), and the latter quickly became a populous and very fertile province. Strabo's account of the Lake of Moeris must be copied from earlier writers, for in his day the outflow had been stopped probably for two centuries, and the old bed of the lake was dotted with flourishing villages to a great depth below the level of the Nile. Large numbers of papyri of the Ptolemaic and Roman periods have been found in and about the Fayum, which continued to flourish through the first two centuries of the Roman rule.

See W. M. F. Petrie, *Hawara Biahmu and Arsinoe* (London, 1889); R. H. Brown, *The Fayûm and Lake Moeris* (London, 1892); B. P. Grenfell, A. S. Hunt and D. G. Hogarth, *Fayum Towns and their Papyri* (London, 1900); H. J. C. Beadnell, *The Topography and Geology of the Fayum Province of Egypt* (Cairo, 1905). (F. Ll. G.)

MOESIA (Gr. Μυσία and Μυσία ἡ ἐν Εὐρώπῃ, to distinguish it from Mysia in Asia), in ancient geography, a district inhabited by a Thracian people, bounded on the S. by the mountain ranges of Haemus and Scardus (Scordus, Scodrus), on the W. by the Drinus, on the N. by the Danube and on the E. by the Euxine. It thus corresponded in the main to the modern Servia and Bulgaria. In 75 B.C., C. Scribonius Curio, proconsul of Macedonia, penetrated as far as the Danube, and gained a victory over the inhabitants, who were finally subdued by M. Licinius Crassus, grandson of the triumvir and also proconsul of Macedonia, during the reign of Augustus *c.* 29 B.C. (see Mommsen, *Provinces of the Roman Empire*, Eng. trans., i. 12–14). The country, however, was not organized as a province until the last years of the reign; in A.D. 6 mention is made of its governor, Caecina Severus (Dio Cassius lv. 29). The statement of Appian (*Illyrica*, 30) that it did not become a Roman province until the time of Tiberius, is therefore incorrect. Originally one province, under an imperial consular legate (who probably also had control of Achaea and Macedonia), it was divided by Domitian into Upper (*superior*) and Lower (*inferior*, also called *Ripa Thracia*) Moesia, the western and eastern portions respectively, divided from each other by the river Cebrus (Ciabrus; mod. Cibritza or Zibru). Some, however, place the boundary further west. Each was governed by an imperial consular legate and a procurator. As a frontier province, Moesia was strengthened by stations and fortresses erected along the southern bank of the Danube, and a wall was built from Axiopolis to Tomi as a protection against Scythian and Sarmatian inroads. After the abandonment of Dacia (*q.v.*) to the barbarians by Aurelian (270–275) and the transference of its inhabitants to the south of the Danube, the central portion of Moesia took the name of Dacia Aureliani (again divided into Dacia *ripensis* and *interior*). The district called Dardania (in Upper Moesia), inhabited by the Illyrian Dardani, was formed into a special province by Diocletian with capital Naissus (Nissa or Nish), the birthplace of Constantine the Great. The Goths, who had already invaded Moesia in 250, hard pressed by the Huns, again crossed the Danube during the reign of Valens (376), and with his permission settled in

Moesia. But quarrels soon took place, and the Goths under Fritigern defeated Valens in a great battle near Adrianople (378). These Goths are known as Moeso-Goths, for whom Ulfilas made the Gothic translation of the Bible. In the 7th century Slavs and Bulgarians entered the country and founded the modern kingdoms of Servia and Bulgaria. The chief towns of Upper Moesia were: Singidunum (Belgrade), Viminacium (sometimes called municipium Aelium; Kostolatz), Bononia (Widdin), Ratiaria (Artcher): of Lower Moesia; Oescus (colonia Ulpia, Gigen), Novae (near Sistova, the chief seat of Theodoric), Nicopolis ad Istrum (Nikup), really on the Iatrus or Yantra, Odessus (Varna), Tomi (Kustendje), to which the poet Ovid was banished. The last two were Greek towns, which, with Istros, Mesambria and Apollonia, formed a pentapolis.

See Orosius v. 23, 20; Livy, *Epit.* 92, 134, 135; Dio Cassius li. 25–27; E. R. Rösler, *Romänische Studien* (Leipzig, 1871); T. Mommsen, *Corpus inscriptionum latinarum*, iii. 141, 263; J. Marquardt, *Römische Staatsverwaltung* (1881), i. 301; H. Kiepert, *Lehrbuch der alten Geographie* (1878), §§ 298, 299; article in Smith's *Dictionary of Greek and Roman Geography* (1873). (J. H. F.)

MOFAḌḌALĪYĀT, strictly MUFAḌḌALĪYĀT, an anthology of ancient Arabic poems, which derives its name from al-Mufaḍḍal, son of Muḥammad, son of Ya'lā, a member of the tribe of Ḍabba, who compiled it some time between A.D. 762 and 784 in the latter of which years he died. Al-Mufaḍḍal was a contemporary of Ḥammād ar-Rāwiya and Khalaf al-Aḥmar, the famous collectors of ancient Arab poetry and tradition, and was somewhat the junior of Abū 'Amr ibn al-'Alā, the first scholar who systematically set himself to preserve the poetic literature of the Arabs. He died about fifty years before Abū 'Ubaida and al-Aṣma'ī, to whose labours posterity is largely indebted for the arrangement, elucidation and criticism of ancient Arabian verse; and his anthology was put together between fifty and sixty years before the compilation by Abū Tammām of the *Ḥamāsa* (*q.v.*).

Al-Mufaḍḍal was a careful and trustworthy collector both of texts and traditions, and is praised by all authorities on Arabian history and literature as in this respect greatly the superior of Ḥammād and Khalaf, who are accused (especially the latter) of unscrupulous fabrication of poems in the style of the ancients. He was a native of Kūfa, the northernmost of the two great military colonies founded in 638 by the caliph 'Omar for the control of the wide Mesopotamian plain. In Kūfa and Baṣra were gathered representatives of all the Arabian tribes who formed the fighting force of the Islamic Empire, and from these al-Mufaḍḍal was able to collect and record the compositions of the poets who had celebrated the fortunes and exploits of their forefathers. He, no doubt, like al-Aṣma'ī and Abū 'Ubaida, also himself visited the areas occupied by the tribes for their camping grounds in the neighbouring desert; and adjacent to Kūfa was al-Ḥīra, the ancient capital of the Lakhmid kings, whose court was the most celebrated centre in pre-Islamic Arabia, where, in the century before the preaching of the Prophet, poets from the whole of the northern half of the peninsula were wont to assemble. There is indeed a tradition that a written collection (*dīwān*) existed in the family of an-Nu'mān, the last Lakhmid king, containing a number of poems by the *Fuḥūl*, or most eminent poets of the pagan time, and especially by those who had praised the princes of the house, and that this collection passed into the possession of the Omayyad caliphs of the house of Marwān; to this, if the tradition is to be believed, al-Mufaḍḍal probably had access.

The date of al-Mufaḍḍal's birth is unknown; but he lived for many years under the caliphs of the Omayyad line until their overthrow by the 'Abbasids in 749. In 762 he took part in the rising led by Ibrāhīm ibn 'Abdallāh ibn al-Ḥasan, the 'Alid, called "The Pure Soul," against the caliph al-Manṣūr, and after the defeat and death of Ibrāhīm was cast into prison. Al-Manṣūr, however, pardoned him on the intercession of his fellow-tribesman Musayyab ibn Zuhair of Ḍabba, and appointed him the instructor in literature of his son, afterwards the caliph al-Mahdī. It was for this prince that, at al-Manṣūr's instigation, al-Mufaḍḍal compiled the *Mufaḍḍalīyāt*.

The collection, in its present form, contains 126 pieces of verse, long and short; that is the number included in the recension of al-Anbārī, who had the text from Abū 'Ikrima of Ḍabba, who read it with Ibn al-A'rābī, the stepson and inheritor of the tradition of al-Mufaḍḍal. We know from the *Fihrist* of Muḥammad an-Nadīm (A.D. 988) that in his time 128 pieces were counted in the book; and this number agrees with that contained in the Vienna MS., which gives an additional poem, besides those annotated by al-Anbārī, to al-Muraqqish the Elder, and adds at the end a poem by al-Ḥārith ibn Ḥilliza. The *Fihrist* states (p. 68) that some scholars included more and others fewer poems, while the order of the poems in the several recensions differed; but the correct text, the author says, is that handed down through Ibn al-A'rābī. It is noticeable that this traditional text, and the accompanying scholia, as represented by al-Anbārī's recension, are wholly due to the scholars of Kūfa, to which place al-Mufaḍḍal himself belonged. The rival school of Baṣra, on the other hand, has given currency to a story that the original collection made by al-Mufaḍḍal included a much smaller number of poems. The Berlin MS. of al-Marzūqī's commentary states that the number was thirty, but a better reading of the passage, found elsewhere,[1] mentions eighty; and that al-Asma'ī and his school added to this nucleus poems which increased the number to a hundred and twenty. It is curious that this tradition is ascribed by al-Marzūqī and his teacher Abū 'Alī al-Fārisī to Abū 'Ikrima of Ḍabba, who is represented by al-Anbārī as the transmitter of the correct text from Ibn al-A'rābī. There is no mention of it in al-Anbārī's work, and it is in itself somewhat improbable, as in al-Aṣma'ī's time the schools of Kūfa and Baṣra were in sharp opposition one to the other, and Ibn al-A'rābī in particular was in the habit of censuring al-Aṣma'ī's interpretations of the ancient poems. It is scarcely likely that he would have accepted his rival's additions to the work of his step-father, and have handed them on to Abū 'Ikrima with his annotations.

The collection is one of the highest importance as a record of the thought and poetic art of Arabia during the time immediately preceding the appearance of the Prophet. Not more than five or six of the 126 poems appear to have been composed by poets who had been born in Islam. The great majority of the authors belonged to the days of "the Ignorance," and though a certain number (*e.g.* Mutammim ibn Nuwaira, Rabī'a ibn Maqrūm, 'Abda ibn aṭ-Ṭabīb and Abū Dhu'aib), born in paganism, accepted Islām, their work bears few marks of the new faith. The ancient virtues—hospitality to the guest and the poor, profuse expenditure of wealth, valour in battle, faithfulness to the cause of the tribe—are the themes of praise; wine and the game of *maisir*, forbidden by Islām are celebrated by poets who professed themselves converts and if there is no mention of the old idolatry, there is also little spirituality in the outlook on life. The 126 pieces are distributed between 68 poets, and the work represents a gathering from the compositions of those who were called *al-Muqillūn*, "authors of whom little has survived," in contrast to the famous poets whose works had been collected into *dīwāns* At the same time many of them are extremely celebrated, and among the pieces selected by al-Mufaḍḍal several reach a very high level of excellence. Such are the two long poems of 'Alqama ibn 'Abada (Nos. 119 and 120), the three odes by Mutammim ibn Nuwaira (Nos. 9, 67, 68), the splendid poem of Salāma ibn Jandal (No. 22), the beautiful *nasīb* of ash-Shanfarā (No. 20) and the death-song of 'Abd-Yaghūth (No. 30). One of the mos admirable and famous is the last of the series (No. 126), the long elegy by Abū Dhu'aib of Hudhail on the death of his sons almost every verse of this poem is cited in illustration of some phrase or meaning of a word in the national lexicons. Only one of the poets of the *Mu'allaqāt* (see MO'ALLAKĀT), al-Ḥārith, son of Ḥilliza, is represented in the collection. Of others (such as Bishr ibn Abī Khāzim, al-Ḥādira, 'Āmir ibn aṭ-Ṭufail, 'Alqamah ibn 'Abadah, al-Muthaqqib, Ta'abbaṭa Sharrā and Abū Dhu'aib) *dīwāns* or bodies of collected poems exist, but it is doubtfu how far these had been brought together when al-Mufaḍḍal made his compilation. An interesting feature of the work is the treatment in it of the two poets of Bakr ibn Wā'il, uncle and nephew, called al-Muraqqish, who are perhaps the most ancient in the collection. The elder Muraqqish was the great-uncle of Ṭarafa of Bakr, the author of the *Muʽallaqa*, and took part in the long warfare between the sister tribes of Bakr and Taghlib, called the war of Basūs, which began about the end of the 5th century A.D. Al-Mufaḍḍal has included ten pieces (Nos. 45–54) by him in the collection, which are chiefly interesting from an antiquarian point of view. One, in particular (No. 54), presents a very archaic appearance. It is probable that the compiler set down all he could gather of this ancient author, and that his interest in him was chiefly due to his antiquity. Of the younger Muraqqish, uncle of Ṭarafa, there are five pieces (Nos. 55–59). The only other authors of whom more than three poems are cited are Bishr ibn Abī Khāzim of Asad (Nos. 96–99) and Rabīʽa ibn Maqrūm of Ḍabba (Nos. 38, 39, 43 and 113).

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[1] In the *dhail* or supplement to the *Amālī* of al-Qālī. (Edn Cairo 1324 H., p. 131).

The *Mufaḍḍalīyāt* differs from the *Ḥamāsa* in being a collection of complete odes (*qaṣīdas*), while the latter is an anthology of brilliant passages specially selected for their interest or effectiveness, all that is prosaic or less striking being pruned away. It is of course not the case that all the poems of al-Mufaḍḍal's collection are complete. Many are mere fragments, and even in the longest there are often *lacunae*; but the compiler evidently set down all that he could collect of a poem from the memory of the *rāwīs*, and did not, like Abū Tammām, choose only the best portions. We are thus presented with a view of the literature of the age which is much more characteristic and comprehensive than that given by the brilliant poet to whom we owe the *Ḥamāsa*, and enables us to form a better judgment on the general level of poetic achievement.

The *Mufaḍḍalīyāt* is not well represented by MSS. in the libraries of the West. There is an imperfect copy of the recension of al-Marzūqī (died 1030), with his commentary, in the Berlin collection. A very ancient fragment (dated 1080) of al-Anbārī's recension, containing five poems in whole or part, is in the Royal Library at Leipzig. In the British Museum there is a copy made about a century ago for C. J. Rich at Bagdad of a MS. with brief glosses; and at Vienna there is a modern copy of a MS. of which the original is at Constantinople, the glosses in which are taken from al-Anbārī, though the author had access also to al-Marzūqī. In the mosque libraries at Constantinople there are at least five MSS.; and at Cairo there is a modern copy of one of these, containing the whole of al-Anbārī's commentary. In America there are at Yale University a modern copy of the same recension, taken from the same original as the Cairo copy, and a MS. of Persian origin, dated 1657, presenting a text identical with the Vienna codex. Quite recently a very interesting MS., probably of the 6th century of the Hegira, but not dated, has come to light. It purports to be the second part of a combination of two anthologies, the *Mufaḍḍalīyāt* of al-Mufaḍḍal and the *Aṣmaʽīyāt* of al-Aṣmaʽī, but contains many more poems than are in either of these collections as found elsewhere. The commentary appears to be eclectic, drawn partly (perhaps chiefly) from Ibn as-Sikkīt (died 858), and partly from Abū-Jaʽfar Aḥmad ibn ʽUbaid ibn Nāṣih, one of al-Anbārī's sources and a pupil of Ibn al-Aʽrābī; and the compilation seems to be older in date than al-Anbāri, since its glosses are often quoted by him without any name being mentioned. This MS. (which is the property of Mr F. Krenkow of Leicester) appears to represent one of the recensions mentioned by Muḥammad an-Nadīm in the *Fihrist* (p. 68), to which reference has been made above.

In 1885 Professor Heinrich Thorbecke began an edition of the text based on the Berlin codex, but only the first fasciculus, containing forty-two poems, had appeared when his work was cut short by death. In 1891 the first volume of an edition of the text, with a short commentary taken from al-Anbārī, was printed at Constantinople. In 1906 an edition of the whole text, with short glosses taken from al-Anbārī's commentary, was published at Cairo by Abū Bakr b. ʽOmar Dāghistānī al-Madanī; this follows generally the Cairo codex above mentioned, but has profited by the scholarship of Professor Thorbecke's edition of the first half of the work. A complete edition of al-Anbārī's text and commentary, with a translation of the poems, undertaken by Sir C. J. Lyall (see *J. R. A. S.*, April 1904) was in the press in 1910. (C. J. L.)

MOFETTA (Ital. from Lat. *mephitis*, a pestilential exhalation), a name applied to a volcanic discharge consisting chiefly of carbon dioxide, often associated with other vapours, representing the final phase of volcanic activity. The word is used frequently in the plural as mofette, or, following the French, *mofettes*. The volcanic vents yielding the emanations are themselves called mofette. They are not uncommon in Auvergne and in the Eifel, notably on the shore of the Laacher See; whilst other examples are furnished by the Grotta del Cane, near Puzzuoli, the Valley of Death in Java, and the Death Gulch in the Yellowstone Park.

MOFFAT, ROBERT (1795–1883), Scottish Congregationalist missionary to Africa, was born at Ormiston, Haddingtonshire, on the 21st of December 1795, of humble parentage. He began as a gardener, but in 1814, when employed at High Leigh in Cheshire, offered himself to the London Missionary Society, and in 1816 was sent out to South Africa. After spending a year in Namaqua Land, with the chief Afrikaner, whom he converted, Moffat returned to Cape Town in 1819 and married Mary Smith (1795–1870), the daughter of a former employer, a remarkable woman and most helpful wife. In 1820 Moffat and his wife left the Cape and proceeded to Griqua Town, and ultimately settled at Kuruman, among the Bechuana tribes living to the west of the Vaal river. Here he worked as a missionary till 1870, when he reluctantly returned finally to his native land. He made frequent journeys into the neighbouring regions as far north as the Matabele country. The results of these journeys he communicated to the Royal Geographical Society (*Journal* xxv.–xxxviii. and *Proceedings* ii.), and when in England on furlough (1839–1843) he published his well-known *Missionary Labours and Scenes in South Africa* (1842). He translated the whole of the Bible and *The Pilgrim's Progress* into Sechwana. Moffat was builder, carpenter, smith, gardener, farmer, all in one, and by precept and example he succeeded in turning a horde of bloodthirsty savages into a "people appreciating and cultivating the arts and habits of civilized life, with a written language of their own." He met with incredible discouragement and dangers at first, which he overcame by his strong faith, determination and genial humour. It was largely due to him that David Livingstone, his son-in-law, took up his subsequent work. On his return to England he received a testimonial of £5000. He died at Leigh, near Tunbridge Wells, on the 9th of August 1883.

See *Lives of Robert and Mary Moffat*, by J. S. Moffat (1885); and C. S. Horne, *The Story of the L. M. S.* (1894).

MOFFAT, a burgh of barony, and police burgh, of Upper Annandale, Dumfriesshire, Scotland. Pop. (1901), 2153. It is situated 21 m. N.N.E. of Dumfries by road and 63 m. distant by the Caledonian railway, from both Edinburgh and Glasgow. It is the terminus of a branch line from Beattock, 2 m. distant. It has been famous for its sulphur and saline waters since the middle of the 18th century, and also enjoys great vogue as a holiday resort. The hills in the locality range from the adjacent Gallow Hill (832 ft.) to Hartfell (2651 ft.); about 5 m. north there is abundance of beautiful and varied scenery on the Annan, the Evan, the Birnock and the Moffat. The spa, a mile to the north of the town, was acquired by the burgh commissioners in 1898, and there are also spas at Hartfell (3½ m. north) and Garpel (2 m. south-west). Dumcrieff House, 2 m. south-west, is the seat of Lord Rollo.

MOGADOR (*Es-Sueira*), the most southern seaport on the Atlantic coast of Morocco, in 31° 50′ N., 9° 20′ W., the capital of the province of Háhá. Pop. (1908), about 20,000, of whom nearly a half are said to be Jews, and about 100 Europeans. The town stands from 10 to 20 ft. above high water on a projecting ridge of calcareous sandstone. In certain states of wind and sea it is turned almost into an island, and a sea-wall protects the road to Saffi. On the land side stretch miles of sand-dunes studded with broom, and beyond, the argan forests, distinctive of southern Morocco. Approached from this side the city bursts on the view like a mirage between sky and sea, and this perhaps entitles it to its name—Es-Sueira—"the picture." It is the best planned and cleanest town in the empire, and this combined with the climate, which is very equable, makes it a health resort, especially for consumptive patients. The mean temperature of the hottest month is 71°·06, and of the coldest month 58°·69. The rainfall varies between 13 and 20 in. annually. The water supply is carried by an overground conduit from a spring near

Diabat. The prosperity of Mogador is due to its commerce. The harbour is well sheltered from all winds except the south-west, but escape is difficult with the wind from that quarter, as the channel between the town and Mogador Island is narrow and hazardous. It is the best-built port of the sultanate and is generally second in point of trade, which is carried on mainly with Marseilles, London, Gibraltar and the Canaries, the principal exports being almonds, goat-skins, gums and olive-oil, and the principal imports cotton goods, sugar and tea. The exports were valued at £407,000 in 1900 and at £364,000 in 1906. The imports were worth £246,000 in 1900 and £368,000 in 1906. Shipping, 1900, 132,000 tons; 1906, 140,000 tons.

A place called Mogador is marked in the 1351 Portulan of the Laurentian library, and the map in Hondius's *Atlas minor* shows the island of Mogador, *I. Domegador*; but the origin of the present town is much more recent. Mogador was founded by Mohammed XVII. (bin Abd Allah) in 1760, and completed in 1770. The Portuguese called it after the shrine of Sidi Megdul, which lies towards the south half-way to the village of Diabat, and forms a striking landmark for seamen. In 1844 the citadel was bombarded by the French.

See A. H. Dyé, "Les Ports du Maroc," in *Bull. Soc. Geog. Comm. Paris* (1908), xxx. 313 sqq., and British Consular reports.

MOGILA, PETER (*c.* 1596–1647), metropolitan of Kiev from 1632, belonged to a noble Wallachian family. He studied for some time at the university of Paris, and first became a monk in 1625. He was the author of a *Catechism* (Kiev, 1645) and other minor works, but is principally celebrated for the *Orthodox Confession*, drawn up at his instance by the Abbot Kosslowski of Kiev, approved at a provincial synod in 1640, and accepted by the patriarchs of Constantinople, Jerusalem, Alexandria and Antioch in 1642–1643, and by the synod of Jerusalem in 1672. (See ORTHODOX EASTERN CHURCH.)

There are numerous editions of the *Confession* in Russian; it has been edited in Greek and Latin by Panagiotes (Amsterdam, 1662), by Hofmann (Leipzig, 1695), and by Kimmel (Jena, 1843), and there is a German translation by Frisch (Frankfort, 1727).

MOGILEV, a government of western Russia, situated on the upper Dnieper, between the governments of Vitebsk and Smolensk on the north and east, and Chernigov and Minsk on the south and west. In the north it is occupied by the watershed which separates the basins of the Dvina and the Dnieper, an undulating tract 650 to 900 ft. above sea-level, and covered nearly everywhere with forests. This watershed slopes gently to the south, to the valley of the Dnieper, which enters the government from the north-east and flows due south. The southern part of the government is flat and has much in common with the Polyesie of the government of Minsk; it is, however, more habitable, the marshes being less extensive. Mogilev is built up of Devonian deposits in the north, of Cretaceous in the east, and of Tertiary elsewhere, but generally is covered with a thick layer of Glacial and later alluvial deposits. Interesting finds from the Stone Age, as well as remains of the mammoth, have been made.

The soil is mostly sand, clay (brick-clay and potter's-clay are not uncommon), and peat-bogs, with a few patches of "black earth." The climate is harsh and wet, the average yearly temperature at the Gorki meteorological observatory being 40°·4 F. (14°·2 in January and 63°·8 in July); cold nights in summer are often the cause of bad crops. The government had 947,625 inhabitants in 1870, and in 1897, 1,706,511, of whom 861,533 were women, and 146,752 lived in towns. The estimated population in 1906 was 2,024,300. The population is mostly White Russian. Agriculture is their chief occupation. Out of the total area of 18,546 sq. m. 40 % is held in communal ownership by the peasants, 48 % is owned by landlords possessing more than 270 acres each, and 3½ % by small owners. Most of the private owners belong to the nobility. The principal crops are rye, oats, barley, buckwheat, potatoes, though wheat, beetroot, flax, hemp and tobacco are also grown. Paper, spirits, wire and nails, leather and tiles are the chief products of the manufactures. The government is divided into eleven districts, of which the chief towns with their populations in 1897 were: Mogilev-on-Dnieper, or Mogilev Gubernskiy (47,591 in 1900), Chausy (5550), Cherikov (5250), Homel or Gomel (45,081 in 1900), Gorki (6730), Klimovichi (4706), Mstislavl (10,382 in 1900), Orsha (13,161), Rogachev (9103), Staryi Bykhov (6354), and Syenno (4061).

This government was inhabited in the 10th century by the Slav tribes of the Krivichi and Radimichi. In the 14th century it became part of Lithuania, and afterwards of Poland. Russia annexed it in 1772.

MOGILEV ON THE DNIEPER, a town of Russia, capital of the government of Mogilev. Pop. (1900), 47,591, two-thirds Jews. It is situated on a hilly site on both banks of the Dnieper, 120 m. by rail S.W. of Smolensk. It is the see of an archbishop of the Orthodox Greek Church. The public buildings include the cathedral of the Orthodox Greek Church (founded by Catherine II. of Russia and Joseph II. of Austria in 1780), a Roman Catholic cathedral (built in 1692), an old castle, a museum, a church dating from 1620, and an old Tatar tower. The principal industries are tanneries. The commerce is mostly in the hands of Jews. Corn, salt, sugar and fish are brought from the south, whilst skins and manufactured wares, imported from Germany, are sent to the southern governments.

Mogilev is mentioned for the first time in the 14th century as a dependency of the Vitebsk, or of the Mstislavl principality. At the beginning of the 15th century it became the personal property of the Polish kings. But it was continually plundered—either by Russians, who attacked it six times during the 16th century, or by Cossacks, who plundered it three times. In the 17th century its inhabitants, who belonged to the Orthodox Greek Church, suffered much from the persecutions of the United Greek Church. In 1654 it surrendered to Russia, but in 1661 the Russian garrison was massacred by the inhabitants. In the 18th century the town was taken several times by Russians and by Swedes, and in 1708 Peter the Great ordered it to be destroyed by fire. It was annexed to Russia in 1772. Near here the French under Davoût defeated the Russians under Bagration on the 23rd of July 1812.

MOGILEV ON THE DNIESTER, a town of Russia, in the government of Podolia, on the left bank of the Dniester, 57 m. E.S.E. of Kamenets-Podolsk. Pop. (1900), 25,141, nearly one-half Jews; the remainder are Little Russians, Poles and a few Armenians. The Little-Russian inhabitants carry on agriculture, gardening, wine-growing and mulberry culture. The Jews and Armenians are engaged in a brisk trade with Odessa, to which they send corn, wine, spirits and timber, floated down from Galicia, as well as with the interior, to which they send manufactured wares imported from Austria.

Mogilev, named in honour of the Moldavian hospodar Mohila, was founded by Count Potocki about the end of the 16th century. Owing to its situation on the highway from Moldavia to the Ukraine, at the passage across the Dnieper, it developed rapidly. For more than 150 years its possession was disputed between the Cossacks, the Poles and the Turks. It remained in the hands of the Poles, and was annexed to Russia in 1795.

MOGUL, MOGHAL, or MUGHAL, the Arabic and Persian form of the word Mongol, usually applied to the Mahommedan Empire in India, which was founded by Baber. In consequence the name is applied to all foreign Mahommedans from the countries on the west and north-west of India, except the Pathans. The Great Mogul is the name given to the Mogul emperors of Delhi by the Portuguese and subsequently by Europeans generally.

MOHÁCS, a market town of Hungary, in the county of Baranya, 115 m. S. of Budapest. Pop. (1900), 15,812. It is situated on the right bank of the Danube, and carries on a brisk trade in wine and the agricultural produce of the neighbourhood. Amongst its principal buildings are an old castle and the summer palace of the bishop of Pécs. Mohács is famous in the history of Hungary by the two fateful battles which took place in the plain situated about 3 m. south-west of the town, and marked the beginning and the close of the Turkish dominion in Hungary. In the first (Aug. 29, 1526) the Hungarian army under Louis II.

was annihilated by the Ottoman forces led by Soliman the Magnificent. In the second (Aug. 12, 1687) the Austrians under Charles of Lorraine gained a decisive victory over the Turks, whose power was afterwards still further broken by Prince Eugene of Savoy.

MOHAIR, the hair of a variety of goat originally inhabiting the regions of Asiatic Turkey of which Angora is the centre, whence the animal is known as the Angora goat. The Arabic *muḥayyar*, from which the word came into English probably through the Ital. *moccacaro* or Fr. *mocayart*, meant literally, "choice" or "select," and was applied to cloth made of goats' hair. In the 17th century the word, which before appears in such forms as *mocayare* or *mokaire*, became corrupted by connexion with "hair," cf. "cray-fish" from *écrevisse*. From the English "mohair" the French adapted *moire*, a watered silk fabric.

The typical mohair fibre is 7 to 8 in. long, very lustrous owing to its physical structure (which although akin to wool is different in that the wool scales are indicated only instead of being fully developed, while the fibre is always solid), $\frac{1}{600}$ to $\frac{1}{800}$ of an inch in diameter, of a soft elastic handle, and usually of a clear white transparent colour. The staples of which the fleece is formed should be uniform in length and clearly defined, naturally lending themselves to a good "spin"—a difficult attainment in the case of mohair (see Woollen and Worsted Manufactures). There are many varieties of mohair, from the first qualities as here defined to lower qualities, of a kempy, unsatisfactory character. Thus, in Constantinople, the chief centre of the Turkey mohair trade, a large variety of fleeces is recognized. For example, from the Lake Van district a distinctly inferior kind known as "Van" mohair is obtained, while other districts produce varieties ranging from Van up to the typical quality described above.

The animal from which mohair was originally obtained was a finely-bred Angora goat. Owing to the demand for raw material exceeding the supply, from 1820 onwards there has been a great deal of crossing of the well-bred Angora with the common kind of goat: in fact it has been said that by 1863 the original Angora had practically disappeared. The growing demand for mohair further resulted in attempts on a commercial scale to introduce the goat into South Africa—where it was crossed with the native goat—the United States, Australia, and later still New Zealand. Perhaps the introduction of the Angora into Australia and New Zealand may in part be due to its value as a scrub and blackberry browser; these growths being the "pests" of the two respective countries.

The manufacture of fabrics from mohair—as in the case of alpaca and cashmere—was in the first instance due to the genius of the rearers of the goat. It would, indeed, be interesting to know if the present day mohair goods—often styled "alpacas" really had their origin in the earlier products of Asia Minor. That fabrics of mohair were in use in England early in the 18th century is obvious from Pope's allusion:—

> "And, when she sees her friend in deep despair,
> Observes how much a chintz exceeds mohair."

Raw mohair was first exported from Turkey to England about 1820, and from that date onwards marked strides were made in its manufacture into useful yarns and fabrics. England has always had, and still maintains, supremacy in this manufacture. Practically the whole of both the Turkish and Cape clips is at least converted into yarn in Yorkshire mills. Quantities of these yarns are also woven into dress goods, dust cloakings, pile fabrics, imitation furs, &c., in Yorkshire, but even greater quantities of mohair yarn are exported to Russia, Germany, Austria, &c., to be converted into astrakans, ordinary braids, brush braids, &c. In the first decade of the 20th century the mohair braid trade received a blow from the introduction of artificial silk.

The history of the introduction of the Angora goat from Asia Minor into the other countries mentioned is as follows. In 1838 pure bred Angoras were introduced into Cape Colony—cashmeres having been previously tried and found unsatisfactory. These pure-bred goats crossed with the common goat laid the basis of the Cape flocks. In 1856–1857 other importations of pure-bred goats were made. From 1868 to 1897 further importations were made, but these were not of the pure-bred goat and consequently were not so valuable. It should here be noted that the Cape flock-owner clips twice—the summer clip yielding a staple which should be of not less than 7 in., and the winter clip a staple which should be of not less than 3 in. to 4 in. Bradford from time to time has objected to the winter clip as being too short, but this clip seems to have established itself and at least once during recent years has been as saleable as the summer clip. The introduction of Angoras into the United States took place in 1849. Other importations of goats from Asia Minor were made between 1857 and 1880, and interchanges of blood also took place between the United States and Cape Colony. Between 1856 and 1875 some three hundred goats were introduced into Australia. Other importations from Cape Colony and the United States have also been made from time to time, and it seems at least possible, if not probable, that Australia may yet find the Angora goat an important asset.

From the following statistics relating to mohair it will be realized that the mohair supply practically comes from two sources, viz. Turkey in Asia and South Africa:—

Country.	*No. of Goats.*	*Yield of Hair.*
Asia Minor	3½ to 4 millions.	11 to 12,000,000 lb.
South Africa	4 millions.	12 to 14,000,000 lb.
United States	800,000	1,600,000 lb.
Australia	30,000	——

The price per lb of mohair has varied from 4s. 1d. in 1870 to 13d. or 14d. in 1903, and it is interesting to note that the shipments from Turkey to England follow these price fluctuations in a most curious manner.

Of the consumers of English mohair yarns Russia takes from 15 to 25%, and the continent of Europe as a whole a very large percentage of the total mohair yarn production of Bradford.

MOHAVE (corrupted from *hamok-habi*, "three mountains," their native name, with reference to three peaks, which form a prominent feature of their country), a tribe of North American Indians of Yuman stock. They have always lived along both banks of the lower Colorado river, in Arizona and California.

MOHAWK, a tribe of North American Indians, the chief people of the Iroquois confederacy. The name probably means "man-eaters"; they call themselves *Kaniengehaga*, "flint people." Their villages were in the valley of the Mohawk river, New York. Their territory extended northward to the St Lawrence and southward to the Delaware river and Catskill Mountains. They were thus early in touch with Dutch and English, and were the first Indians to obtain firearms. In the War of Independence they fought with the English, and finally took refuge in Canada, where most of them have remained.

See Indians, North American. For Mohawk cosmology see *21st Annual Report Bureau Amer. Ethnol.* (1899–1900).

MOHICAN, MAHICAN AND MOHEGAN, the first two the alternative names of an important tribe and confederacy of North American Indians of Algonquian stock, and the last a dialectic form of the name applied to a branch tribe. The Mohicans inhabited the Hudson valley, and their domain extended into Massachusetts. The Mohicans were called by the French *Loups* (wolf Indians), a translation of "Mohican." At first their council-fire was at Schodac, on an island near Albany, and they were grouped in forty villages. In consequence of attacks by the Mohawks, they moved their council-fire to what is now Stockbridge, Massachusetts, in 1664; in 1730 many migrated to the Susquehanna valley, Pennsylvania, and became absorbed into the Delawares. In 1736 those left in Massachusetts were placed on a reservation at Stockbridge, and called by that name. A few of these Stockbridge Indians, who may be truly called "the last of the Mohicans," are now settled, with some of the Munsees, on a reservation at Green Bay, Wisconsin. The Mohegans, originally an offshoot of the Mohican, lived on Thames river, Connecticut, their county extending into Massachusetts and including Rhode Island. In 1637, on the destruction of the Pequots, an offshoot of the Mohegans, the Mohegans claimed their country too, and thus the territorial power of the two tribes was consolidated under one Mohegan chief. For some time the Mohegans remained the supreme Indian people of southern New England. Eventually they sold most of their lands and centred in a small reservation on Thames river. They have now practically become extinct.

MOHL, HUGO VON (1805–1872), German botanist, was born at Stuttgart on the 8th of April 1805. He was a son of the Württemberg statesman Benjamin Ferdinand von Mohl (1766–1845), the family being connected on both sides with the higher class of state officials of Württemberg. While a pupil at the gymnasium he pursued botany and mineralogy in his leisure time, till in 1823 he entered the university of Tübingen. After graduating with distinction in medicine he went to Munich, where he met a distinguished circle of botanists, and found ample material for research. This seems to have determined his career as a botanist, and he started in 1828 those anatomical investigations which continued till his death. In 1832 he was appointed professor of botany in Tübingen, a post which he never left. Unmarried, his pleasures were in his laboratory and library, and in perfecting optical apparatus and microscopic preparations, for which he showed extraordinary manual skill. He was largely a self-taught botanist from boyhood, and, little influenced in his opinions even by his teachers, preserved always his independence of view on scientific questions. He received many honours during his lifetime, and was elected foreign fellow of the Royal Society in 1868. Von Mohl's writings cover a period of forty-four years; the most notable of them were republished in 1845 in a volume entitled *Vermischte Schriften*. (For lists of his works see *Botanische Zeitung*, 1872, p. 576, and *Royal Soc. Catalogue*, 1870, vol. iv.) They dealt with a variety of subjects, but chiefly with the structure of the higher forms, including both rough anatomy and minute histology. The word "protoplasm" was his suggestion; the nucleus had already been recognized by R. Brown and others, but von Mohl showed in 1844 that the protoplasm is the source of those movements which at that time excited so much attention. He recognized under the name of "primordial utricle" the protoplasmic lining of the vacuolated cell, and first described the behaviour of the protoplasm in cell-division. These and other observations led to the overthrow of J. M. Schleiden's theory of origin of cells by free-cell-formation. His contributions to knowledge of the cell-wall were no less remarkable; he held the view now generally adopted of growth of cell-wall by apposition. He first explained the true nature of pits, and showed the cellular origin of vessels and of fibrous cells; he was, in fact, the true founder of the cell theory. Clearly the author of such researches was the man to collect into one volume the theory of cell-formation, and this he did in his treatise *Die vegetabilische Zelle* (1851), a short work translated into English (Ray Society, 1852). Von Mohl's early investigations on the structure of palms, of cycads, and of tree-ferns permanently laid the foundation of all later knowledge of this subject: so also his work on *Isoetes* (1840). His later anatomical work was chiefly on the stems of dicotyledons and gymnosperms; in his observations on cork and bark he first explained the formation and origin of different types of bark, and corrected errors relating to lenticels. Following on his early demonstration of the origin of stomata (1838), he wrote a classical paper on their opening and closing (1850). In 1843 he started in conjunction with F. Schlechtendal the weekly *Botanische Zeitung*, which he jointly edited till his death. He was never a great writer of comprehensive works; no text-book exists in his name, and it would indeed appear from his withdrawal from co-operation in W. F. B. Hofmeister's *Handbuch* that he had a distaste for such efforts. In his latter years his productive activity fell off, doubtless through failing health, and he died suddenly at Tübingen on the 1st of April 1872.

See Sachs, *History of Botany*, p. 292, &c.; De Bary, *Botanische Zeitung* (1872), p. 561; *Proc. Roy. Soc.*, xxiii. 1; *Allgemeine Deutsche Biographie*, xxii. 55. (F. O. B.)

MOHL, JULIUS VON (1800–1876), German Orientalist, brother of Hugo von Mohl (*q.v.*), was born at Stuttgart on the 25th of October 1800. Having studied theology at Tübingen (1818–1823), he abandoned the idea of entering the Lutheran ministry, and in 1823 went to Paris, at that time, under Silvestre De Sacy, the great European school of Eastern letters. From 1826 to 1833 he was nominally professor at Tübingen, but had permission to continue his studies abroad, and he passed some years in London and in Oxford. In 1826 he was charged by the French government with the preparation of an edition of the *Shah Nama* (*Livre des rois*), the first volume of which appeared in 1838, while the seventh and last was left unfinished at his death, being completed by Barbier de Meynard. Discerning this to be his life's work, he resigned his chair at Tübingen in 1834, and settled permanently in Paris. In 1844 he was nominated to the academy of inscriptions, and in 1847 he became professor of Persian at the Collège de France. But his knowledge and interest extended to all departments of Oriental learning. He served for many years as secretary, and then as president of the Société Asiatique. His annual reports on Oriental science, presented to the society from 1840 to 1867, and collected after his death in Paris on the 3rd of January 1876, under the title *Vingt-sept ans d'histoire des études orientales* (Paris, 1879), are an admirable history of the progress of Eastern learning during these years. Concerning the discoveries at Nineveh he wrote *Lettres de M. Botta sur les découvertes à Khorsabad* (1845). He also published anonymously, in conjunction with Justus Olshausen (1800–1882), *Fragments relatifs à la religion de Zoroastre* (Paris, 1829); *Confucii Chi-king sive liber carminum, ex latina P. Lacharmi interpretatione* (Stuttgart, 1830); and an edition of Y-King, *Antiquissimus Sinarum liber, ex interpretatione P. Regis* (Stuttgart, 1834–1839).

His wife Mary (1793–1883), daughter of Charles Clarke, had passed a great part of her early life in Paris, where she was very intimate with Madame Récamier, before their marriage in 1847, and for nearly forty years her house was one of the most popular intellectual centres in Paris. Madame Mohl's friends included a large number of Englishmen and Englishwomen. She died in Paris on the 14th of May 1883. Madame Mohl wrote *Madame Récamier, with a Sketch of the History of Society in France* (London, 1862).

See Kathleen O'Meara, *Madame Mohl, her Salon and Friends* (1885); and M. C. M. Simpson, *Letters and Recollections of Julius and Mary Mohl* (1887).

Mohl's elder brother, Robert von Mohl (1799–1875), was a well-known jurist and statesman. From 1824 to 1845 he was professor of political sciences at the university of Tübingen, losing his position because of some frank criticisms which brought him under the displeasure of the authorities of Württemberg. In 1847 he was a member of the parliament of Württemberg, and in the same year he was appointed professor of law at Heidelberg; in 1848 he was a member of the German parliament which met at Frankfort, and for a few months he was minister of justice. His later public life was passed in the service of the grand-duke of Baden, whom he represented as ambassador in Munich from 1867 to 1871. He died in Berlin on the 5th of November 1875. Among his numerous writings may be mentioned, *Die deutsche Polizeiwissenschaft nach den Grundsätzen des Rechtsstaats* (Tübingen, 1832–1834, and again 1866); *Geschichte und Literatur der Staatswissenschaften* (Erlangen, 1855–1858); *Encyklopädie der Staatswissenschaften* (Tübingen, 1859, again 1881); and *Staatsrecht, Völkerrecht und Politik* (Tübingen, 1860–1869).

See Mohl's own *Lebenserinnerungen* (Leipzig, 1901); and H. Schulze, *Robert von Mohl, Ein Erinnerungsblatt* (Heidelberg, 1886).

Another brother, Moritz von Mohl (1802–1888), entered official life at an early age and was a member of the Frankfort parliament, and later of the parliament of Württemberg and of the imperial Reichstag. He was a voluminous writer on economic and political questions.

MÖHLER, JOHANN ADAM (1796–1838), German theologian, was born at Igersheim in Württemberg on the 6th of May 1796, and after studying philosophy and theology in the lyceum at Ellwangen, entered the university of Tübingen in 1817. Ordained to the priesthood in 1819, he was appointed to a curacy at Riedlingen, but speedily returned as "repetent" to Tübingen, where he became *privatdozent* in 1822, extraordinary professor of theology in 1826 and ordinary professor in 1828. His lectures drew large audiences, including many Protestants. The controversies excited by his *Symbolik* (1832) proved so unpleasant that in 1835 he accepted a call to the university of Munich. In 1838 he was appointed to the deanery of Würzburg, but died shortly afterwards (April 12, 1838).

Möhler wrote *Die Einheit in der Kirche oder das Prinzip des Katholicismus* (Tübingen, 1825); *Athanasius der Grosse u. d. Kirche seiner Zeit* (2 vols., Mainz, 1827); *Symbolik, oder Darstellung der dogmatischen Gegensätze der Katholiken u. Protestanten nach ihren öffentlichen Bekenntnissschriften* (Mainz, 1832; 8th ed., 1871–1872; Eng. trans. by J. B. Robertson, 1843); and *Neue Untersuchungen der Lehrgegensätze zwischen den Katholiken u. Protestanten* (1834). His *Gesammelte Schriften u. Aufsätze* were edited by Döllinger in 1839; his *Patrologie* by Reithmayr, also in 1839; and a *Biographie* by B. Wörner was published at Regensburg in 1866. It is with the *Symbolik* that his name is chiefly associated; the interest excited by it in Protestant circles is shown by the fact that within two years of its appearance it had elicited three replies of considerable importance, those namely of F. C. Baur, P. K. Marheineke and C. J. Nitzsch. But, although characterized by learning and acuteness, as well as by considerable breadth of spiritual sympathy, it cannot be said to have been accepted by Catholics themselves as embodying an accurate objective view of the actual doctrine of their church. The liberal school of thought of which Möhler was a prominent exponent was discouraged in official circles, while Protestants, on the other hand, complain that the author failed to grasp thoroughly the significance of the Reformation as a great movement in the spiritual history of mankind, while needlessly dwelling on the doctrinal shortcomings, inconsistencies and contradictions of its leaders.

MOHMAND, a Pathan tribe who inhabit the hilly country to the north-west of Peshawar, in the North-West Frontier Province of India. They are one of the strongest tribes on the border after the Afridis and Waziris, and have given much trouble to the government of India. The country of the Mohmands may be defined roughly as bounded on the E. by British districts from near Jamrud to Fort Abazai, and thence by the Utman Khel country; on the N. by Bajour; on the W. by Kunar; and on the S. by the territories of the Shinwari and Afridi; area, about 1200 sq. m. The Indo-Afghan boundary line now runs through the Mohmand country; but the amir of Afghanistan formerly claimed allegiance from all the Mohmands, and only handed over the greater part of this tract to the British by the Durand Agreement of 1893. The government has given assurances to the Burhan Khel, Dawezai, Halimzai, Isa Khel, Tarakzai and Utmanzai sections of the Mohmands that they will not suffer by the severance of their ancient connexion with Afghanistan; and these are known as the Assured Clans. The tribe are Afghans by descent, and are more akin to the Yusafzais than any of their neighbours. The aspect of the Mohmand hills is exceedingly dreary, and the eye is everywhere met by dry ravines between long rows of rocky hills and crags, scantily clothed with coarse grass, scrubwood and the dwarf palm. In summer great want of water is felt, and the desert tracts radiate an intolerable heat. This, coupled with the unhealthiness of the lowlands, probably accounts for the inferior physique of the Mohmands as compared with their Afridi and Shinwari neighbours, who in summer retire to the cool highlands of Tirah and the Safed Koh. The crops in the Mohmand hills are almost entirely dependent on the winter and autumn rains, and should these fail there is considerable distress; but the Mohmands supplement this source of livelihood by a through trade on rafts along the Kabul river between the British districts and the hill-country beyond them. The exports are wax, hides, ghi and rice from Kunar, and iron from Bajour; the imports are salt, cloth, paper, soap, tea, indigo, sugar, grain, tobacco, needles, scissors and other manufactures of civilization. The Mohmands are characterized by great pride and haughtiness, they bear a bad reputation for treachery and ruthless cruelty, and are not as brave as their Afridi neighbours. They number some 18,000 fighting men, giving roughly a population of 65,000; but all the clans would never act together under any circumstances. British punitive expeditions have been sent against the Mohmands in 1851–52, 1854, 1864, 1879, 1880, but the principal operations were those of 1897. (T. H. H.*)

Campaign of 1897.—The year 1897 witnessed an almost general outbreak among the tribes on the north-west frontier of India. The tribes involved were practically independent, but the new frontier arranged with the amir of Afghanistan, and demarcated by Sir Mortimer Durand's commission of 1893–1894, brought them within the British sphere of influence. The great dread of these high-spirited mountaineers was annexation, and the hostility shown during the demarcation led to the Waziri expedition of 1894. Other causes, however, contributed to bring about the outbreak of 1897. The easy victory of the Turks over the Greeks gave rise to excitement throughout the Mahommedan world, and the publication by the amir of Afghanistan, in his assumed capacity of king of Islam, of a religious work, in portions of which fanatical antipathy to Christians was thinly veiled, aroused a warlike spirit among the border Mahommedans. The growing unrest was not recognized, and all appeared quiet, when, on the 10th of June 1897, a detachment of Indian troops escorting a British frontier officer was suddenly attacked during the mid-day halt in the Tochi valley, where, since the Waziri expedition of 1894–95, certain armed posts had been retained by the government of India. On the 29th of July, with equal suddenness, the fortified posts at Chakdara and Malakand, in the Swat valley, which had been held since the Chitral expedition of 1895, were for several days fiercely assailed by the usually peaceful Swatis under the leadership of the Mad Mullah. On the 8th of August the village of Shabkadar (Shankarghar), within a few miles of Peshawar, and in British territory, was raided by the Mohmands, while the Afridis besieged the fortified posts on the Samana ridge, which had been maintained since the expeditions of 1888 and 1891. Finally, the Afridis, within a few days, captured all the British posts in the Khyber Pass. A division commanded by Major-General Sir Bindon Blood was assembled at Nowshera. The post at Malakand was reached on the 1st of August, and on the following day Chakdara was relieved. The punishment of the Afridis was deferred till the preparations for the Tirah campaign (see TIRAH) could be completed. The Mohmands, however, could be immediately dealt with, and against them the two brigades of Sir Bindon Blood's division advanced from Malakand simultaneously with the movement of another division under Major-General (afterwards Sir Edmund) R. Elles from Peshawar; it was intended that the two columns should effect a junction in Bajour. About the 6th of September the two forces advanced, and Major-General Blood reached Nawagai on the 14th of September, having detached a brigade to cross the Rambat Pass. This brigade being sharply attacked in camp at Markhanai at the foot of the pass on the night of the 14th, was ordered to turn northwards and punish the tribesmen of the Mamund valley. On the 15th Brigadier-(afterwards Major-) General Jeffreys camped at Inayat Killa, and on the following day he moved up the Mamund valley in three columns, which met with strong resistance. A retirement was ordered, the tribesmen following, and when darkness fell the general, with a battery and a small escort, was cut off, and with difficulty defended some buildings until relieved. The casualties in this action numbered 149. This partial reverse placed General Blood in a position of some difficulty. He determined, however, to remain at Nawagai, awaiting the arrival of General Elles, and sent orders to General Jeffreys to prosecute the operations in the Mamund valley. From the 18th to the 23rd these operations were carried on successfully, several villages being burned, and the Mamunds were disheartened. Meanwhile, the camp at Nawagai was heavily attacked on the night of the 20th by about 4000 men belonging to the Hadda Mullah's following. The attack was repulsed with loss, and on the 21st Generals Blood and Elles met at Lakarai. The junction having been effected, the latter, in accordance with the scheme, advanced to deal with the Upper Mohmands in the Jarobi and Koda Khel valleys, and they were soon brought to reason by his well-conducted operations. The work of the Peshawar division was now accomplished, and it returned to take part in the Tirah campaign. Its total casualties were about 30 killed and wounded. On the 22nd General Blood joined General Jeffreys, and on the 24th he started with his staff for Panjkora. On the 27th General Jeffreys resumed punitive operations in the Mamund valley, destroying numerous villages. On the 30th he encountered strong opposition at Agrah, and had 61 casualties. On the 2nd of October General Blood arrived at Inayat Killa with reinforcements, and on the 11th the Mamunds tendered their submission. The total British loss in the Mamund valley was 282 out of a force which never exceeded 1200 men. After marching into Buner, and revisiting the scenes of the Umbeyla expedition of 1863, the Malakand field-force was broken up on the 21st of January. The objects of the expedition were completely attained, in spite of the great natural difficulties of the country. The employment of imperial service troops with the Peshawar column marked a new departure in frontier campaigns.

(C. J. B.)

MOHONK LAKE, a summer settlement at the northern end of Lake Mohonk, Ulster county, New York, U.S.A., about 14 m. N.W. of Poughkeepsie. It is served from New Paltz, about 1 m. S.E. (about 5½ m. by stage), by the Wallkill Valley railway, a branch of the West Shore. The lake is a small body of water, picturesquely situated 1245 ft. above the sea-level, on Sky Top Mountain (1542 ft.), one of the highest peaks of the Shawangunk range. The highest point of Sky Top lies just east of the south end of the lake; close by, to the west, Eagle Cliff rises to a height of 1412 ft. The development of this beautiful region into a summer resort and the holding of Indian and arbitration conferences here have been due to Albert Keith Smiley (b. 1828), a graduate of Haverford College (1849), who conducted an English and classical academy in Philadelphia in 1853–1857, was principal of the Oak Grove academy at Vassalboro, Maine, in 1858–1860, was principal and superintendent of the Friends' school at Providence, Rhode Island, in 1860–1879, and became a member of the United States Board of Indian Commissioners in 1879. In 1869 he bought, at the northern end of Lake Mohonk, a tract of land on which he built a large hotel. Here, in October 1883, the first Conference of the Friends of the American Indian met; these conferences have since been held annually, their scope being enlarged in 1904 to include consideration of the condition of "other dependent peoples"—*i.e.* the natives of the Philippines, Porto Rico and Hawaii. The first conference on international arbitration was held here in June 1895.

MOHR, KARL FRIEDRICH (1806–1879), German pharmacist, son of a well-to-do druggist in Coblentz, was born on the 4th of November 1806. Being a delicate child he received much of his early education at home, in great part in his father's laboratory. To this may be traced much of the skill he showed in devising instruments and methods of analysis. At the age of twenty-one he began to study chemistry under Leopold Gmelin, and, after five years spent in Heidelberg, Berlin and Bonn, returned with the degree of Ph.D. to join his father's establishment. On the death of his father in 1840 he succeeded to the business, retiring from it for scientific leisure in 1857. Serious pecuniary losses led him at the age of fifty-seven to become a *privatdozent* in Bonn, where in 1867 he was appointed, by the direct influence of the emperor, extraordinary professor of pharmacy. He died at Bonn on the 28th of September 1879. Mohr was the leading scientific pharmacist of his time in Germany, and he was the author of many improvements in analytical processes. His methods of volumetric analysis were expounded in his *Lehrbuch der chemisch-analytischen Titrirmethode* (1855), which won the special commendation of Liebig and has run through many editions. His *Geschichte der Erde, eine Geologie auf neuer Grundlage* (1866), also obtained a wide circulation. In a paper "Über die Natur der Wärme," published in the *Zeitschrift für Physik* in 1837, he gave one of the earliest general statements of the doctrine of the conservation of energy in the words: "besides the 54 known chemical elements there is in the physical world one agent only, and this is called Kraft (energy). It may appear, according to circumstances, as motion, chemical affinity, cohesion, electricity, light and magnetism; and from any one of these forms it can be transformed into any of the others."

MOHS, FRIEDRICH (1773–1839), German mineralogist, was born at Gernrode in the Harz Mountains, on the 29th of January 1773. He was educated at Halle, and at the mining academy at Freiburg. He spent much time in Austria in studying mineralogy and mining, and became professor of mineralogy at Gratz in 1812. On the death of Werner in 1817, he was appointed to the chair of mineralogy in the mining academy of Freiburg, and in 1826 he became professor of mineralogy and superintendent of the Imperial Cabinet at Vienna. His great work was the *Grundriss der Mineralogie* (Eng. trans. *Treatise on Mineralogy*, by Wilhelm Haidinger, 1825). He died at Agardo, near Belluno, Italy, on the 29th of September, 1839.

MOHUN, CHARLES MOHUN, 4th Baron (*c.* 1675–1712), was the son of the 3rd Baron Mohun, who died in October 1677 as the result of a wound received while acting as second in a duel. The boy had no regular guardian, and before he was seventeen he had earned an unpleasant notoriety in London for rowdyism and brawling, had fought a duel and had been tried on a charge of murder. His friend, Captain Richard Hill, a roystering young officer, was in love with the actress Mrs Bracegirdle, and thought William Mountfort, the actor, to be his successful rival. On the night of the 9th of December 1692 Mohun assisted Hill to attempt the actress's abduction. The attempt failed, and Mohun and Hill then escorted Mrs Bracegirdle to her house, and subsequently remained together outside drinking till the appearance of Mountfort, who lived close at hand. Greetings were exchanged between Mohun and Mountfort, and the latter made a disparaging remark about Hill, who either without warning (according to Mountfort's deathbed statement) or in fair fight (according to other evidence) ran Mountfort through the body, and then absconded. Mohun was arrested and put on trial in Westminster Hall before his peers for murder as an accessory before the fact (1693), but by an overwhelming majority the peers found him not guilty. This verdict has been severely criticized, notably by Macaulay, who saw in it merely a gross instance of class favouritism. But a careful examination of the evidence (in the *State Trials*) justifies the decision, and establishes the presumption that the fight was a fair one. In 1699 Mohun was put on his trial for another alleged murder, but was unanimously and quite justly acquitted. His boon companion, Edward Rich, earl of Warwick (1673–1701), who was tried on a separate indictment for the same crime, was found guilty of manslaughter. On this occasion Mohun expressed regret for his past life, and he seems subsequently to have made a genuine attempt to alter his ways and to have taken a practical interest in public affairs. But in 1712 his violent temper again got the better of him, and he forced the 4th duke of Hamilton, with whom he had been at law for some years, into a desperate duel in Hyde Park in the early hours of the 15th of November, in which both combatants were killed. Thackeray has utilized this incident in *Esmond*. Lord Mohun had no issue, and on his death the barony, which was created in 1628 in favour of his great-grandfather John Mohun (*c.* 1592–1640), became extinct.

See *The Whole Life and History of My Lord Mohun and the Earl of Warwick* (London, 1711); J. Evelyn, *Diary and Correspondence*; Historical Manuscripts Commission, 11th report, appendix v. (Dartmouth MSS.); G. C. Boase and W. P. Courtney, *Bibliotheca cornubiensis* (1874–1882); Howell, *State Trials*; and Colley Cibber, *Apology*, edited by R. W. Lowe (1889).

MOHUN, MICHAEL (*c.* 1625–1684), English actor, played at the Cockpit in Drury Lane before the Civil War. He served on the king's side with credit and was promoted captain, and subsequently, in Flanders, major. At the Restoration he returned with Charles II. and took up his former profession, playing a great variety of parts, usually as second to Charles Hart.

MOHUR, the name of a Persian gold coin, used in India from the 16th century. The word is taken from the Persian *muhr*, a seal or ring. Between 1835 and 1891 a gold coin, also called a "mohur," was struck by the government of British India and was of the nominal value of 15 rupees. On the establishment of a gold standard in India in 1899, on the basis of 16d. a rupee, the British sovereign was declared legal tender and the mohur was thus superseded.

MOIDORE, (a corruption of the Portuguese *moeda d'ouro*, literally, money of gold), the name of a gold Portuguese coin, coined from 1640 to 1732. This was of the sterling value of 13s. 5½d. It is the double *moida d'ouro*, of the value of 4800 reis in 1688, that was current in western Europe and the West Indies for a long period after it ceased to be struck. It was the principal coin current in Ireland at the beginning of the 18th century, and spread to the west of England. At the same period it was current in the West Indies, particularly in Barbados. It was rated in English money at 27s.

MOIR, DAVID MACBETH (1798–1851), Scottish physician and writer, was born at Musselburgh on the 5th of January 1798. He studied medicine at Edinburgh University, taking his degree in 1816. Entering into partnership with a Musselburgh doctor he practised there until his death on the 6th of July 1851. He was a contributor of both prose and verse to the magazines, and particularly, with the signature of "Delta," to *Blackwood's*. A collection of his poetry was edited in 1852 by Thomas Aird. Among his publications were the famous *Life of Mansie Wauch, Tailor* (1828), which shows his gifts as a humorist, *Outlines of the Ancient History of Medicine* (1831), and *Sketch of the Poetical Literature of the Past Half Century* (1851).

MOISSAC, a town of south-western France, capital of an arrondissement in the department of Tarn-et-Garonne, 17 m. W.N.W. of Montauban on the Southern railway between Bordeaux and Toulouse. Pop. (1906) town, 4523; commune, 8218. Moissac stands at the foot of vine-clad hills on the right bank of the Tarn; it is divided into two parts by the lateral canal of the Garonne, which crosses the Tarn by way of an aqueduct a short distance above the town. It contains little of note except the abbey-church of St Pierre, a building of the 15th century with a porch of the 12th century which is decorated with elaborate Romanesque carving unsurpassed in France. The cloister of the early 12th century adjoining the north side of the church is also one of the finest of its kind. Romanesque in character, it has pointed arches resting alternately on single and clustered columns with sculptured capitals. Among other remains of the abbey is the abbot's palace, which contains two halls of the Romanesque period. St Martin, the oldest of the other churches of Moissac, dates from before the year 1000. The town has a sub-prefecture, a tribunal of first instance, a communal college for boys, a library and a museum. Trade is in oil, wine, eggs, wool, poultry and fruit (peaches, apricots, &c.).

The town owes its origin to an abbey probably founded in the 7th century by St Amand, the friend of Dagobert. After being devastated by the Saracens, the abbey was restored by Louis of Aquitaine, son of Charlemagne. Subsequently it was made dependent on Cluny, but in 1618 it was secularized by Pope Paul V., and replaced by a house of Augustinian monks, which was suppressed at the Revolution. The town, which was erected into a commune in the 13th century, was taken by Richard Cœur de Lion and by Simon de Montfort.

MOISSAN, HENRI (1852–1907), French chemist, was born at Paris on the 28th of September 1852. Educated at the Museum of Natural History, he was successively professor of toxicology (1886) and of inorganic chemistry (1889) at the School of Pharmacy, and of general chemistry at the Sorbonne (1900). In 1886 he succeeded in obtaining the element fluorine in the free state by the electrolysis of potassium fluoride and anhydrous hydrofluoric acid at a low temperature. Thence he was led to study the production of carbon in its three varieties and to attempt the artificial preparation of diamond, of which he was able to make some minute specimens (see GEMS, § *Artificial*). In connexion with these experiments he developed the electric furnace as a convenient means of obtaining very high temperatures in the laboratory; and by its aid he prepared many new compounds, especially carbides, silicides and borides, and melted and volatilized substances which had previously been regarded as infusible. For his preparation of fluorine he was awarded the Lacase prize in 1887, and in 1906 he obtained the Nobel prize for chemistry. He died in Paris on the 20th of February 1907.

His published works include *Le four électrique* (1897), and *Le fluor et ses composés* (1900), besides numerous papers in the *Comptes rendus* and other scientific periodicals. A *Traité de chimie minérale* in five volumes was published under his direction in 1904–1906.

MOJI, a town of Japan, on the Kiushiu side of the Shimonoseki Strait. The strait being only 1 m. in width, Moji and Shimonoseki would be practically the same port did not the swiftness of the current along the latter shore make it convenient for vessels to anchor off Moji. Moji is one of the places voluntarily opened by the Japanese for purposes of direct export. It is the starting-point of the Kiushiu railway, and as there is abundance of coal in its neighbourhood, it has become a town of considerable importance. In 1890 it was little more than a hamlet, but it had in 1901 a population of 25,274, and a considerable foreign trade.

MOJSISOVICS VON MOJSVAR, JOHANN AUGUST GEORG EDMUND (1839–1907), Austro-Hungarian geologist and palaeontologist, son of the surgeon Georg Mojsisovics von Mojsvar (1799–1860), was born at Vienna on the 18th of October 1839. He studied law in Vienna University, taking his doctor's degree in 1864, and in 1867 he entered the Geological Institute, becoming chief geologist in 1870 and vice-director in 1892. He retired in 1900, and died at Mallnitz on the 2nd of October 1907. He paid special attention to the cephalopoda of the Austrian Trias, and his publications include *Das Gebirge um Hallstatt* (1873–1876); *Die Dolomitrisse von Südtirol und Venetien* (1878–1880); *Grundlinien der Geologie von Bosnien-Herzegowina* (1880) with E. Tietze and A. Bittner; *Die Cephalopoden der mediterranen Triasprovinz* (1882); *Die cephalopoden der Hallstätter Kalke* (1873–1903); and *Beiträge zur Kenntniss der obertriadischen Cephalopodenfaunen des Himalaya* (1896). With Melchior Neumayr (1845–1890) he conducted the *Beiträge zur Paläontologie und Geologie Oesterreich-Ungarns*. In 1862, with Paul Grohmann and Dr Guido von Sommaruga, he founded the Austrian Alpine Club, and he also took part in establishing the German Alpine Club, which combined with the former in 1873.

MOKANNA (*al-Moqanna‘*, the Veiled), the name given to Ḥakīm, or ‘Aṭā, a man of unknown parentage, originally a fuller in Merv, who posed as an incarnation of Deity, and headed a revolt in Khorāsān against the caliph Mahdī. For about three years he sustained himself in the field against the troops of the caliph and for two years longer in his fortress of Sanam; then, reduced to straits in 779, he and his followers took poison and set fire to the fortress. Much is related to his magical arts, especially of a moonlike light visible for an enormous distance which he made to rise from a pit near Nakhshab. He is the hero of the first part of Moore's *Lalla Rookh*.

MOKHA (Mocha, properly Makha), a town in Arabia on the Red Sea coast in 13° 19′ N. and 43° 12′ E. Formerly the chief port for the Yemen coffee export, it has much diminished in importance. The coffee grown in the mountain districts of Haraz, Uden, and Ta‘iz is now shipped at Hodeda or Aden, though the article retains the trade name of "Mocha." The town lies in a small bay 40 m. N. of Perim at the southern entrance to the Red Sea. The anchorage is not good, and the port is only used by native vessels. Seen from the sea the town has rather an imposing appearance, but a near review shows that the houses though large and built of stone are mostly in ruins. The neighbouring country is an arid plain without fresh water, the town being supplied by an aqueduct from the village of Muza, situated 16 m. to the east. This is probably identical with the Muza of the Periplus, a great seat of the Red Sea trade in antiquity, which like Betel Fakih, Zubed and other old Tehama towns, formerly seaports, has long since been left by the receding sea. There is a Turkish kaimakam and a small garrison at Mokha, which is part of the civil district of Taiz in the vilayet of Yemen.

MOKSHANY, a town of Russia, in the government of Penza, 24 m. N.W. of the city of Penza. Pop. (1900), 10,710. The inhabitants are engaged in agriculture, or work in flour-mills, oilworks, tanneries and potash-works. Mokshany, which was built in 1535 as a fort to protect the country from the raids of the Tatars and the Kalmucks, is supposed to occupy the site of the Meshcheryak town of Murunza, mentioned as early as the 9th century.

MOLASSES, the syrup obtained from the drainings of raw sugar or from sugar during the process of refining. In American usage the word usually applies to both forms of the syrup, but in English usage the second form is more usually known as "treacle" (see SUGAR). The word, which in early forms appears as *melasses*, *molassos*, &c., is from the Port. *melaço*, or Fr. *mélasse*, cf. the Late Lat. *mellaceum*, syrup made from honey (*mel*). The geological term "molasse" must be distinguished; this word, applied to the soft greenish sandstone of the district between the Jura and the Alps, is French, meaning "soft," Lat. *mollis*.

MOLAY, JACQUES DE (d. 1314), last grand master of the Knights Templars, was born of a noble but impoverished family, at a village of the same name in the old province of Franche-Comté (mod. department of Haute-Saône), about the middle of the 13th century. The family property being the inheritance of an elder brother, Jacques was thrown upon his own resources. Having been brought up in the neighbourhood of a commandery of the Temple, he entered the order in 1265 at Beaune in the diocese of Autun. It is probable that he at once set out for the East to take part in the defence of the Holy Land against the Saracens. About 1295 he was elected grand master of the order. After the Templars had been driven out of Palestine by the Saracens, De Molay took refuge with the remnant of his followers in the island of Cyprus. Here, while attempting to get together a force to retrieve the disasters to the Christian arms, he received a summons (in 1306) from Pope Clement V. to repair to Paris. The pope's pretext for the summons was his desire to put an end to the quarrels between the Templars and the Knights of St John, and to concert plans for a new crusade; in reality he had entered into a secret agreement with the king of France for the suppression of the Templars. Molay left Cyprus with a retinue of 60 followers, and made a triumphal entry into Paris. On the 13th of October 1307 every Templar in France was arrested, and a prolonged examination of the members of the order was held. De Molay, probably under torture, confessed that some of the charges brought against the order were true. He was kept in prison for several years, and in 1314 he was brought up with three other dignitaries of the Temple before a commission of cardinals and others to hear the sentence (imprisonment for life) pronounced. Then, to the surprise of the commission, De Molay withdrew his confession. Immediately the king heard of it he gave orders that De Molay and another of the four, who had also recanted, should be burnt as lapsed heretics. The sentence was carried out on the 11th (or 19th) of March 1314. De Molay's ashes were gathered up by the people, and it is said that with his last breath he summoned the king and the pope to appear with him before the throne of God.

For the charges brought against the Templars and the famous process in connexion with them, see TEMPLARS; J. Michelet, *Procès des Templiers* (1841–1851) and Lavocat, *Procès des frères et de l'ordre du Temple d'après des pièces inédites publiées par M. Michelet* (1888); E. Besson, "Étude sur Jacques de Molay" in *Mémoires de la soc. d'émulation du Doubs* (Besançon, 1876); H. H. Milman, *Hist. of Latin Christianity*, bk. xii., chs. 1 and 2; H. Prutz, *Entwickelung und Untergang des Tempelherrenordens* (Berlin, 1888).

MOLD (formerly *Mould*, Welsh *Y Wyddgrug*, a conspicuous barrow, Lat. *Mons altus*, the translation of the Welsh name), a market town, contributory parliamentary borough of Flintshire, N. Wales; on the London & North-Western railway (Chester and Denbigh branch), 182 m. from London and 11 m. from Chester. Pop. of urban district (1901), 4263. The locality is populous owing to the collieries and lead-smelting works in the vicinity. At the north end of the town there is a height, Bailey Hill (perhaps from *ballia*, the architectural term applied to fortified castle courts). This hill, partly natural and partly artificial, was once the site of a Roman fortification, and in old records is known as Moaldes, Monhault, or Monthault (*de monte alto*). Mold Castle was probably built by Robert Monthault (*temp.* William Rufus), was taken and destroyed by Owen Gwynedd in 1144–1145, its site lost to the English and retaken by Llewelyn ap Iowerth in 1201, and by Gruffydd Llwyd in 1322. On this site, too, where there are now no remains of any fortress, were found, in 1849, some 15 skeletons, supposed to be of the 13th or 14th centuries. Maes Garmon (the battlefield of Germanus) is about a mile west of Mold. Here, as is supposed, the "Alleluia Victory" was gained over the Picts and Scots by Lupus and Germanus, bishop of Auxerre, according to some about A.D. 430, but others give A.D. 448, the date of the saint's death. A commemorative obelisk was erected on the Maes by N. Griffith of Rhual (1736). Over a mile south of Mold, on the right of the road to Nerquis, is the "Tower" (15th century, but perhaps restored in the 18th), where, in 1465 or 1475, the royal chieftain, Rheinallt ab Gruffyd ad Bleddyn, hanged Robert Byrne, mayor of Chester, and subsequently burned alive some 200 Chester folk who tried to arrest him. Many tumuli are visible round Mold.

Mold county gaol, bought in 1880 by Jesuits expelled from France, was by them named St Germanus's House. St Mary's church, a Gothic building, is mentioned as early as the time of Henry VII. Its important collieries and lead mines; fire-brick, tile, earthenware, mineral oil, tinplate and nail manufactures, tanneries, breweries and malt-houses, have made Mold the business centre of the county. About 4 m. distant is Cilcain village, of which the church has a carved oak roof, stolen from Basingwerk Abbey at the dissolution of the monasteries. Among the neighbouring Clwyd hills Moel Fammau and Moel Arthur are specially noticeable. On the summit of the former is George III.'s jubilee pyramid. The Ordovices and the Romans fortified Moel Arthur. The sites of seven posts established against Rome may be traced along the hills bounding Flintshire and Denbighshire.

MOLDAVIA, a former principality of south-eastern Europe, constituting, after its union with Wallachia on the 9th of November 1859, a part of Rumania (*q.v.*).

MOLDAVITE, an olive-green or dull greenish vitreous substance, named by A. Dufrénoy from Moldauthein in Bohemia, where it occurs. It is sometimes cut and polished as an ornamental stone under the name of pseudo-chrysolite. Its bottle-glass colour led to its being commonly called *Bouteillenstein*, and at one time it was regarded as an artificial product, but this view is opposed to the fact that no remains of glass-works are found in the neighbourhood of its occurrence: moreover pieces of the substance are widely distributed in Tertiary and early Pleistocene deposits in Bohemia and Moravia. For a long time it was generally believed to be a variety of obsidian, but its difficult fusibility and its chemical composition are rather against its volcanic origin. Dr F. E. Suess pointed out that the nodules or small masses of moldavite presented curious pittings and wrinkles on the surface, which could not be due to the action of water, but resembled the characteristic markings on many meteorites. Boldly attributing the material to a cosmic origin, he regarded moldavite as a special type of meteorite for which he proposed the name of tectite (Gr. τηκτός, melted). To this type are also referred the so-called obsidian bombs and buttons from Australia and Tasmania, known sometimes as australite, and called by R. H. Walcott obsidianites. Similar bodies have been found in Malaysia and have been termed billitonite, from the isle of Billiton where they occur in tin-bearing gravels. Usually they are flat, rounded or ellipsoidal bodies, sometimes surrounded by an equatorial girdle or rim, and often with a brilliant black superficial lustre, as though varnished. Moldavite has been reported also from Scania in Sweden.

See Franz E. Suess, *Jahrbuch der k.-k. geolog. Reichsanstalt* (Vienna), 1901, p. 193; E. Weinschenk, *Centralblatt f. Mineralogie* (Stuttgart), 1908, p. 737. (F. W. R.*)

MOLDE, a small seaside town of Norway, in Romsdal *amt* (county), 204 m. by sea N.N.E. of Bergen, in 62° 45′ N. (that of the Faroe Islands). It has little trade, but is the principal tourist centre on this part of the coast, and the steamers from Hull and Newcastle, the Norwegian ports, Hamburg, Antwerp, &c., call here. The town fronts the broad Molde Fjord, with its long low islands, and to the east and south a splendid panorama of jagged mountains is seen, reaching 6010 ft. in Store Troldtinder of the Romsdal group. Molde is the port for the tourist route through the Romsdal.

MOLÉ, LOUIS MATHIEU, Comte (1781–1855), French statesman, was born in Paris on the 24th of January 1781. His father, a president of the parlement of Paris, who came of the family of the famous president noticed below, was guillotined during the Terror, and Count Molé's early days were spent in Switzerland and in England with his mother, a relative of Lamoignon-Malesherbes. On his return to France he studied at the école centrale des travaux publics, and his social education was accomplished in the salon of Pauline de Beaumont, the friend of Châteaubriand and Joubert. A volume of *Essais de morale et de politique* introduced him to the notice of Napoleon, who attached him to the staff of the council of state. He became master of requests in 1806, and next year prefect of the Côte d'Or, councillor of state and director-general of bridges and roads in 1809, and count of the empire in the autumn of the same year. In November 1813 he became minister of justice. Although he resumed his functions as director-general during the Hundred Days, he excused himself from taking his seat in the council of state and was apparently not seriously compromised, for Louis XVIII. confirmed his appointment as director-general and made him a peer of France. Molé supported the policy of the duc de Richelieu, who in 1817 entrusted to him the direction of the ministry of marine, which he held until December 1818. From that time he belonged to the moderate opposition, and he accepted the result of the revolution of 1830 without enthusiasm. He was minister for foreign affairs in the first cabinet of Louis Philippe's reign, and was confronted with the task of reconciling the European powers to the change of government. The real direction of foreign affairs, however, lay less in his hands than in those of Talleyrand, who had gone to London as the ambassador of the new king. After a few months of office Molé retired, and it was not until 1836 that the fall of Thiers led to his becoming prime minister of a new government, in which he held the portfolio of foreign affairs. One of his first actions was the release of the ex-ministers of Charles X., and he had to deal with the disputes with Switzerland and with the Strassburg *coup* of Louis Napoleon. He withdrew the French garrison from Ancona, but pursued an active policy in Mexico and in Algeria. Personal and political differences rapidly arose between Molé and his chief colleague Guizot, and led to an open rupture in March 1837 in face of the general opposition to a grant to the duc de Nemours. After some attempts to secure a new combination Molé resonstructed his ministry in April, Guizot being excluded. The general election in the autumn gave him no fresh support in the Chamber of Deputies, while he had now to face a formidable coalition between Guizot, the Left Centre under Thiers, and politicians of the Dynastic Left and the Republican Left. Molé, supported by Louis Philippe, held his ground against the general hostility until the beginning of 1839, when, after acrid discussions on the address, the chamber was dissolved. The new house showed little change in the strength of parties, but Molé resigned on the 31st of March 1839. A year later he entered the Academy, and though he continued to speak frequently he took no important share in party politics. Louis Philippe sought his help in his vain efforts to form a ministry in February 1848. After the revolution he was deputy for the Gironde to the Constituent Assembly, and in 1849 to the Legislative Assembly, where he was one of the leaders of the Right until the *coup d'état* on the 2nd of December 1851 drove him from public life. He died at Champlâtreux (Seine-et-Oise) on the 23rd of November 1855.

See P. Thureau-Dangin, *Histoire de la monarchie de juillet* (1884–1892); and Robert Cougny, *Dict. des parlementaires français* (1891).

MOLÉ, MATHIEU (1584–1656), French statesman, son of Edouard Molé (d. 1614), who was for a time *procureur-général*, was educated at the university of Orleans. Admitted *conseiller* in 1606, he was *président aux requêtes* in 1610, *procureur-général* in succession to Nicolas de Bellièvre in 1614, and he took part in the assembly of the Notables summoned at Rouen in 1617. He fought in vain against the setting up of special tribunals, or commissions, to try prisoners charged with political offences, and for his persistence in the case of the brothers Louis and Michel de Marillac he was suspended in 1631, and ordered to appear at Fontainebleau in his own defence. Hitherto Molé's relations with Richelieu had been fairly good, but his inclination to the doctrines of Port Royal increased the differences between them, and it was not until after Richelieu's death that he was able to secure the release of his friend, the abbé de St Cyran. In 1641 he was appointed first president of the parlement, with the preliminary condition that he should not permit the general assembly of the chambers except by express order of the king. After Richelieu's death the pretensions of the parlement increased; the hereditary magistrature arrogated to itself the functions of the states-general, and in 1648 the parlement with the other sovereign courts (the *cour des aides*, the *grand conseil*, and the *cour des comptes*) met in one assembly and proposed for the royal sanction twenty-seven articles, which amounted in substance to a new constitution. In the long conflict between Anne of Austria and the parlement, Molé, without yielding the rights of the parlement, played a conciliatory part. In the popular tumult known as the day of the barricades (Aug. 26, 1648) he sought out Mazarin and the queen to demand the release of Pierre Broussel and his colleagues, whose seizure had been the original cause of the outbreak. Next day the parlement marched in procession to repeat Molé's demand. On their way back they were stopped by the crowd. "Turn, traitor," said one of the rebels to Molé, seizing him by the beard, "and unless you wish to be massacred, either bring back Broussel, or bring Mazarin as a hostage." Many magistrates fled; the remnant, headed by the intrepid Molé, returned to the Palais Royal, where Anne of Austria was induced to release the prisoners.

Molé's moderating counsels failed to prevent the outbreak of the first Fronde, but he negotiated the peace of Rueil in 1651, and averted a conflict between the partisans of Condé and of the Cardinal de Retz within the precincts of the Palais de Justice. He refused honours and rewards for himself or his family, but became keeper of the seals, in which capacity he was compelled to follow the court, and he therefore retired from the presidency of the parlement. He died on the 3rd of January 1656.

The *Mémoires* of Molé were edited for the Société de l'histoire de France (4 vols., 1855) by Aimé Champollion-Figeac, and his life was written by Baron A. G. P. de Barante in *Le Parlement et la Fronde* (1859). See also the memoirs of Omer Talon and of De Retz.

MOLE. (1) A small animal of the family *Talpidae* (see below). (2) A mark, or stain, and particularly a dark-coloured raised spot on the human skin. This word, O. Eng. *mál*, appears in such forms as *meil* or *mail*, in old forms of Teutonic languages, and in *mæl*, a sign; cf. Ger. *Denkmal*, a monument. It is probably cognate with Lat. *maculus*, spot. Its meaning of stain is seen in the corrupted form "iron-mould," properly "iron-mole," a stain produced on linen or cloth by rust or ink. (3) A large structure of rubble, stone or other material, used as a breakwater or pier (see Breakwater), or the space of water so enclosed, forming a harbour or anchorage. This word comes through the French from Lat. *moles*, a mass, large structure. The name of the "Mole of Hadrian" (*moles Hadriani*) is sometimes given to the mausoleum of that emperor, now the castle of St Angelo at Rome.

In zoology the name of *mole* (a contracted form of mouldwarp, *i.e.* mould-caster), is properly applicable to the common mole (*Talpa europaea*), a small, soft-furred, burrowing mammal, with minute eyes, and broad fossorial fore-feet, belonging to the order Insectivora and the family *Talpidae*. In a wider sense may be included under the same term the other Old World moles, the North American star-nosed and other moles, and the

African golden moles of the family *Chrysochloridae.* In a still wider sense the name is applied to the Asiatic zokors and the African strand-moles, belonging to the order Rodentia, as well as to the Australian marsupial mole.

The common mole is an animal about six inches in length, with a tail of one inch. The body is long and cylindrical, and, owing to the forward position of the front limbs, the head appears to rest between the shoulders; the muzzle is long and obtusely pointed, terminated by the nostrils, which are close together in front; the minute eye is almost hidden by the fur; the ear is without a conch, opening on a level with the surrounding skin; the fore-limbs are rather short and very muscular, terminating in broad, naked, shovel-shaped feet, the palms normally directed outwards, each with five sub-equal digits armed with strong flattened claws; the hind-feet, on the contrary, are long and narrow; and the toes are provided with slender claws. The body is densely covered with soft, erect, velvety fur—the hairs uniform in length and thickness, except on the muzzle and short tail, the former having some straight bristles on its sides, whilst the latter is clothed with longer and coarser hairs. The fur is generally black, with a more or less greyish tinge, or brownish-black, but various paler shades up to pure white have been observed.

The food of the mole consists chiefly of earthworms, in pursuit of which it forms its well-known underground excavations. The mole is one of the most voracious of mammals, and, if deprived of food, is said to succumb in from ten to twelve hours. Almost any kind of flesh is eagerly devoured by captive moles, which have been seen, as if maddened by hunger, to attack animals nearly as large as themselves, such as birds, lizards, frogs, and even snakes; toads, however, they will not touch, and no form of vegetable food attracts their notice. If two moles be confined together without food, the weaker is invariably devoured by the stronger. Moles take readily to the water—in this respect, as well as in external form, resembling their North American representatives. Bruce, writing in 1793, remarks that he saw a mole paddling towards a small island in the Loch of Clunie, 180 yds. from land, on which he noticed molehills.

The sexes come together about the second week in March, and the young—generally from four to six in number—which are brought forth in about six weeks, quickly attain their full size.

Much misconception has prevailed with regard to the structure of the mole's "fortress," *i.e.* the large breeding hillock, which is generally placed in bushes, or amid the roots of a tree; but a trustworthy account, by Mr L. E. Adams, will be found in the *Memoirs* of the Manchester Literary and Philosophical Society for 1903, vol. xlvii., pt. 2.

The geographical distribution of the mole exceeds that of all the other species of the genus taken together. It extends from England to Japan, and from the Dovre-Fjeld Mountains in Scandinavia and the Middle Dwina region in Russia to southern Europe and the southern slopes of the Himalaya, where it occurs at an elevation of 10,000 ft. In Great Britain it is found as far north as Caithness, but in Ireland and in the Western Isles of Scotland (except Mull) it is unknown. (See INSECTIVORA.) (G. E. D.; R. L.*)

MOLECULE (from mod. Lat. *molecula*, the diminutive of *moles*, a mass), in chemistry and physics, the minutest particle of matter capable of separate existence. The word appears to have been invented during the 17th century, and remained synonymous with "atom" (Gr. ἄτομος, from α-, privative, and τέμνειν, to cut) until the middle of the 19th century, when a differentiation was established. "Atom" has mainly a chemical import, being defined as the smallest particle of matter which can take part in a chemical reaction; a "molecule" is composed of atoms, generally two or more. For the detailed chemical significance of these terms, see CHEMISTRY; and for the atomic theory of the chemist (as distinguished from the atomic or molecular theory of the physicist) see ATOM; reference may also be made to the article MATTER.

The doctrine that matter can be divided into, or regarded as composed of, discrete particles (termed "atoms" by early writers, and "molecules" by modern ones) has at all times played an important part in metaphysics and natural science. The leading historical stages in the evolution of the modern conception of the molecular structure of matter are treated in the following passage from James Clerk Maxwell's article ATOM in the 9th edition of the *Ency. Brit.*

"Atom[1] (ἄτομος) is a body which cannot be cut in two. The atomic theory is a theory of the constitution of bodies which asserts that they are made up of atoms. The opposite theory is that of the homogeneity and continuity of bodies, and asserts, at least in the case of bodies having no apparent organization, such, for instance, as water, that as we can divide a drop of water into two parts which are each of them drops of water, so we have reason to believe that these smaller drops can be divided again, and the theory goes on to assert that there is nothing in the nature of things to hinder this process of division from being repeated over and over again, times without end. This is the doctrine of the infinite divisibility of bodies, and it is in direct contradiction with the theory of atoms.

"The atomists assert that after a certain number of such divisions the parts would be no longer divisible, because each of them would be an atom. The advocates of the continuity of matter assert that the smallest conceivable body has parts, and that whatever has parts may be divided.

"In ancient times Democritus was the founder of the atomic theory, while Anaxagoras propounded that of continuity, under the name of the doctrine of homoeomeria ('Ομοιομέρια), or of the similarity of the parts of a body to the whole. The arguments of the atomists, and their replies to the objections of Anaxagoras, are to be found in Lucretius.

"In modern times the study of nature has brought to light many properties of bodies which appear to depend on the magnitude and motions of their ultimate constituents, and the question of the existence of atoms has once more become conspicuous among scientific inquiries.

"We shall begin by stating the opposing doctrines of atoms and of continuity. The most ancient philosophers whose speculations are known to us seem to have discussed the ideas of number and of continuous magnitude, of space and time, of matter and motion, with a native power of thought which has probably never been surpassed. Their actual knowledge, however, and their scientific experience were necessarily limited, because in their days the records of human thought were only beginning to accumulate. It is probable that the first exact notions of quantity were founded on the consideration of number. It is by the help of numbers that concrete quantities are practically measured and calculated. Now, number is discontinuous. We pass from one number to the next *per saltum.* The magnitudes, on the other hand, which we meet with in geometry, are essentially continuous. The attempt to apply numerical methods to the comparison of geometrical quantities led to the doctrine of incommensurables, and to that of the infinite divisibility of space. Meanwhile, the same considerations had not been applied to time, so that in the days of Zeno of Elea time was still regarded as made up of a finite number of 'moments,' while space was confessed to be divisible without limit. This was the state of opinion when the celebrated arguments against the possibility of motion, of which that of Achilles and the tortoise is a specimen, were propounded by Zeno, and such, apparently, continued to be the state of opinion till Aristotle pointed out that time is divisible without limit, in precisely the same sense that space is. And the slowness of the development of scientific ideas may be estimated from the fact that Bayle does not see any force in this statement of Aristotle, but continues to admire the paradox of Zeno (Bayle's *Dictionary*, art. 'Zeno'). Thus the direction of true scientific progress was for many ages towards the recognition of the infinite divisibility of space and time.

"It was easy to attempt to apply similar arguments to matter. If matter is extended and fills space, the same mental operation by which we recognize the divisibility of space may be applied, in imagination at least, to the matter which occupies space. From this point of view the atomic doctrine might be regarded as a relic of the old numerical way of conceiving magnitude, and the opposite doctrine of the infinite divisibility of matter might appear for a time the most scientific. The atomists, on the other hand, asserted very strongly the distinction between matter and space. The atoms, they said, do not fill up the universe; there are void spaces between them. If it were not so, Lucretius tells us, there could be no motion, for the atom which gives way first must have some empty place to move into.

> 'Quapropter locus est intactus, inane, vacansque
> Quod si non esset, nulla ratione moveri
> Res possent; namque, officium quod corporis exstat,
> Officere atque obstare, id in omni tempore adesset
> Omnibus: haud igitur quicquam procedere posset,
> Principium quoniam cedendi nulla daret res.'
>
> *De rerum natura*, i. 335.

"The opposite school maintained then, as they have always done, that there is no vacuum—that every part of space is full of matter, that there is a universal plenum, and that all motion is like that of a fish in the water, which yields in front of the fish because the fish leaves room for it behind.

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[1] It will be noted that Clerk Maxwell's "atom" and "atomic theory" have the significance which we now attach to "molecule" and "molecular theory."

> 'Cedere squamigeris latices nitentibus aiunt
> Et liquidas aperire vias, quia post loca pisces
> Linquant, quo possint cedentes confluere undae.'
>
> Ibid. i. 373.

"In modern times Descartes held that, as it is of the essence of matter to be extended in length, breadth and thickness, so it is of the essence of extension to be occupied by matter, for extension cannot be an extension of nothing.

"'Ac proinde si quaeratur quid fiet, si Deus auferat omne corpus quod in aliquo vase continetur, et nullum aliud in ablati locum venire permittat? respondendum est, vasis latera sibi invicem hoc ipso fore contigua. Cum enim inter duo corpora nihil interjacet, necesse est ut se mutuo tangant, ac manifeste repugnat ut distent, sive ut inter ipsa sit distantia, et tamen ut ista distantia sit nihil; quia omnis distantia est modus extensionis, et ideo sine substantia extensa esse non potest.'—*Principia*, ii. 18.

"This identification of extension with substance runs through the whole of Descartes's works; and it forms one of the ultimate foundations of the system of Spinoza. Descartes, consistently with this doctrine, denies the existence of atoms as parts of matter, which by their own nature are indivisible. He seems to admit, however, that the Deity might make certain particles of matter indivisible in this sense, that no creature should be able to divide them. These particles, however, would be still divisible by their own nature, because the Deity cannot diminish his own power, and therefore must retain his power of dividing them. Leibniz, on the other hand, regarded his monad as the ultimate element of everything.

"There are thus two modes of thinking about the constitution of bodies, which have had their adherents both in ancient and in modern times. They correspond to the two methods of regarding quantity—the arithmetical and the geometrical. To the atomist the true method of estimating the quantity of matter in a body is to count the atoms of it. The void spaces between the atoms count for nothing. To those who identify matter with extension, the volume of space occupied by a body is the only measure of the quantity of matter in it.

"Of the different forms of the atomic theory that of R. J. Boscovich may be taken as an example of the purest monadism. According to Boscovich matter is made up of atoms. Each atom is an indivisible point, having position in space, capable of motion in a continuous path, and possessing a certain mass, whereby a certain amount of force is required to produce a given change of motion. Besides this the atom is endowed with potential force, that is to say, that any two atoms attract or repel each other with a force depending on their distance apart. The law of this force, for all distances greater than say the thousandth of an inch, is an attraction varying as the inverse square of the distance. For smaller distances the force is an attraction for one distance and a repulsion for another, according to some law not yet discovered. Boscovich himself, in order to obviate the possibility of two atoms ever being in the same place, asserts that the ultimate force is a repulsion which increases without limit as the distance diminishes without limit, so that two atoms can never coincide. But this seems an unwarrantable concession to the vulgar opinion that two bodies cannot co-exist in the same place. This opinion is deduced from our experience of the behaviour of bodies of sensible size, but we have no experimental evidence that two atoms may not sometimes coincide. For instance, if oxygen and hydrogen combine to form water, we have no experimental evidence that the molecule of oxygen is not in the very same place with the two molecules of hydrogen. Many persons cannot get rid of the opinion that all matter is extended in length, breadth and depth. This is a prejudice of the same kind with the last, arising from our experience of bodies consisting of immense multitudes of atoms. The system of atoms, according to Boscovich, occupies a certain region of space in virtue of the forces acting between the component atoms of the system and any other atoms when brought near them. No other system of atoms can occupy the same region of space at the same time, because before it could do so the mutual action of the atoms would have caused a repulsion between the two systems insuperable by any force which we can command. Thus, a number of soldiers with firearms may occupy an extensive region to the exclusion of the enemy's armies, though the space filled by their bodies is but small. In this way Boscovich explained the apparent extension of bodies consisting of atoms, each of which is devoid of extension. According to Boscovich's theory, all action between bodies is action at a distance. There is no such thing in nature as actual contact between two bodies. When two bodies are said in ordinary language to be in contact, all that is meant is that they are so near together that the repulsion between the nearest pairs of atoms belonging to the two bodies is very great.

"Thus, in Boscovich's theory, the atom has continuity of existence in time and space. At any instant of time it is at some point of space, and it is never in more than one place at a time. It passes from one place to another along a continuous path. It has a definite mass which cannot be increased or diminished. Atoms are endowed with the power of acting on one another by attraction or repulsion, the amount of the force depending on the distance between them. On the other hand, the atom itself has no parts or dimensions. In its geometrical aspect it is a mere geometrical point. It has no extension in space. It has not the so-called property, of Impenetrability, for two atoms may exist in the same place. This we may regard as one extreme of the various opinions about the constitution of bodies.

"The opposite extreme, that of Anaxagoras—the theory that bodies apparently homogeneous and continuous are so in reality—is, in its extreme form, a theory incapable of development. To explain the properties of any substance by this theory is impossible. We can only admit the observed properties of such substance as ultimate facts. There is a certain stage, however, of scientific progress in which a method corresponding to this theory is of service. In hydrostatics, for instance, we define a fluid by means of one of its known properties, and from this definition we make the system of deductions which constitutes the science of hydrostatics. In this way the science of hydrostatics may be built upon an experimental basis, without any consideration of the constitution of a fluid as to whether it is molecular or continuous. In like manner, after the French mathematicians had attempted, with more or less ingenuity, to construct a theory of elastic solids from the hypothesis that they consist of atoms in equilibrium under the action of their mutual forces, Stokes and others showed that all the results of this hypothesis, so far at least as they agreed with facts, might be deduced from the postulate that elastic bodies exist, and from the hypothesis that the smallest portions into which we can divide them are sensibly homogeneous. In this way the principle of continuity, which is the basis of the method of Fluxions and the whole of modern mathematics, may be applied to the analysis of problems connected with material bodies by assuming them, for the purpose of this analysis, to be homogeneous. All that is required to make the results applicable to the real case is that the smallest portions of the substance of which we take any notice shall be sensibly of the same kind. Thus, if a railway contractor has to make a tunnel through a hill of gravel, and if one cubic yard of the gravel is so like another cubic yard that for the purposes of the contract they may be taken as equivalent, then, in estimating the work required to remove the gravel from the tunnel, he may, without fear of error, make his calculations as if the gravel were a continuous substance. But if a worm has to make his way through the gravel, it makes the greatest possible difference to him whether he tries to push right against a piece of gravel, or directs his course through one of the intervals between the pieces; to him, therefore, the gravel is by no means a homogeneous and continuous substance.

"In the same way, a theory that some particular substance, say water, is homogeneous and continuous may be a good working theory up to a certain point, but may fail when we come to deal with quantities so minute or so attenuated that their heterogeneity of structure comes into prominence. Whether this heterogeneity of structure is or is not consistent with homogeneity and continuity of substance is another question.

"The extreme form of the doctrine of continuity is that stated by Descartes, who maintains that the whole universe is equally full of matter, and that this matter is all of one kind, having no essential property besides that of extension. All the properties which we perceive in matter he reduces to its parts being movable among one another, and so capable of all the varieties which we can perceive to follow from the motion of its parts (*Principia*, ii. 23). Descartes's own attempts to deduce the different qualities and actions of bodies in this way are not of much value. More than a century was required to invent methods of investigating the conditions of the motion of systems of bodies such as Descartes imagined. But the hydrodynamical discovery of Helmholtz that a vortex in a perfect liquid possesses certain permanent characteristics has been applied by Sir W. Thomson (Lord Kelvin) to form a theory of vortex atoms in a homogeneous, incompressible and frictionless liquid."

THE MOLECULAR STRUCTURE OF MATTER

An enormous mass of experimental evidence now shows quite conclusively that matter cannot be regarded as having a continuous structure, but that it is ultimately composed of discrete parts. The smallest unit of matter with which physical phenomena are concerned is the *molecule*. When chemical phenomena occur the molecule may be divided into *atoms*, and these atoms, in the presence of electrical phenomena, may themselves be further divided into *electrons* or *corpuscles*. It ought accordingly to be possible to explain all the non-electrical and non-chemical properties of matter by treating matter as an aggregation of molecules. In point of fact it is found that the properties which are most easily explained are those connected with the gaseous state; the explanation of these properties in terms of the molecular structure of matter is the aim of the "Kinetic Theory of Gases." The results of this theory have placed the molecular conception of matter in an indisputable position, but even without this theory there is such an accumulation of electrical and optical evidence in favour of the molecular conception of matter that the tenability of this conception could not be regarded as open to question.

The Scale of Molecular Structure.—Apart from speculation, the first definite evidence for the molecular structure of matter occurs when it is found that certain physical phenomena change their whole nature as soon as we deal with matter of which the linear dimensions are less than a certain amount. As a single instance of this may be mentioned some experiments of Lord Rayleigh (*Proc. Roy. Soc.*, 1890, 47, p. 364), who found that a film of olive oil spread over the surface of water produced a perceptible effect on small floating pieces of camphor, at places at which the thickness of the film was $10{\cdot}6\times10^{-8}$ cms., but produced no perceptible effect at all at places where the thickness of the film was $8{\cdot}1\times10^{-8}$ cms. Thus a certain phenomenon, of the nature of capillary action, is seen to depend for its existence on the linear dimensions of the film of oil; the physical properties of a film of thickness $10{\cdot}6\times10^{-8}$ cms. are found to be in some way qualitatively different from those of a film of thickness $8{\cdot}1\times10^{-8}$ cms. Here is proof that the film of oil is not a continuous homogeneous structure, and we are led to suspect that the scale on which the structure is formed has a unit of length comparable with 8×10^{-8} cms. The probability of this conjecture is strengthened when it is discovered that in all phenomena of this type the critical length connected with the stage at which the phenomenon changes its nature is of the order of magnitude of 10^{-8} cms.

Lord Rayleigh (*Phil. Mag.* 1890 [5], 30, p. 474) has pointed out that the earliest known attempt to estimate the size of molecules, made by Thomas Young in 1805, was based upon the consideration of phenomena of the kind just mentioned. Discussing the theory of capillary attractions, Young[1] found that at a rough estimate "the extent of the cohesive force must be limited to about the 250-millionth of an inch" ($=10^{-8}$ cms.), and then argues that "within similar limits of uncertainty we may obtain something like a conjectural estimate of the mutual distance of the particles of vapours, and even of the actual magnitude of the elementary atoms of liquids. . . . It appears tolerably safe to conclude that, whatever errors may have affected the determination, the diameter or distance of the particles of water is between the two thousand and the ten thousand millionth of an inch" (=between $\cdot125\times10^{-8}$ and $\cdot025\times10^{-8}$ cms.).

The best estimates which we now possess of the sizes of molecules are provided by calculations based upon the kinetic theory of gases. In the following table are given the values of the diameters of the molecules of six substances with which it is easy to experiment in the gaseous state, these values being calculated in different ways from formulae supplied by the kinetic theory.

Gas.	Diameter calculated by the kinetic theory of gases.				
	From deviations from Boyle's law.	From coefficient of viscosity.	From coefficient of conduction of heat.	From coefficient of diffusion.	Mean value.
Hydrogen	$2{\cdot}05\times10^{-8}$	$2{\cdot}05\times10^{-8}$	$1{\cdot}99\times10^{-8}$	$2{\cdot}02\times10^{-8}$	$2{\cdot}03\times10^{-8}$
Carbon monoxide	—	$2{\cdot}90\times10^{-8}$	$2{\cdot}74\times10^{-8}$	$2{\cdot}92\times10^{-8}$	$2{\cdot}85\times10^{-8}$
Nitrogen .	$3{\cdot}12\times10^{-8}$	$2{\cdot}90\times10^{-8}$	$2{\cdot}74\times10^{-8}$	—	$2{\cdot}92\times10^{-8}$
Air . .	$2{\cdot}90\times10^{-8}$	$2{\cdot}86\times10^{-8}$	$2{\cdot}72\times10^{-8}$	—	$2{\cdot}83\times10^{-8}$
Oxygen .	—	$2{\cdot}81\times10^{-8}$	$2{\cdot}58\times10^{-8}$	$2{\cdot}70\times10^{-8}$	$2{\cdot}70\times10^{-8}$
Carbon dioxide .	$3{\cdot}00\times10^{-8}$	$3{\cdot}47\times10^{-8}$	$3{\cdot}58\times10^{-8}$	$3{\cdot}28\times10^{-8}$	$3{\cdot}33\times10^{-8}$

The agreement of the values obtained for the same quantity by different methods provides valuable confirmation of the truth of the molecular theory and of the validity of the methods of the kinetic theory of gases. That the results do not agree even better need not cause surprise when it is stated that the quantities are calculated on the hypothesis that the molecules are spherical in shape. This hypothesis is introduced for the sake of simplicity, but is known to be unjustifiable in fact. What is given by the formulae is accordingly the mean radius of an irregularly shaped solid (or, more probably, of the region in which the field of force surrounding such a solid is above a certain intensity), and the mean has to be taken in different ways in the different phenomena. This and the difficulty of obtaining accurate experimental results fully account for the differences *inter se* in the values of the quantities calculated.

Heat a Manifestation of Molecular Motion.—An essential feature of the modern view of the structure of matter is that the molecules are supposed to be in rapid motion relatively to one another. We are led to this conception by a number of experimental results, some of which will be mentioned later. We are compelled also to suppose that the motion assumes different forms in different substances. Roughly speaking, it is found that there are three main types of molecular motion corresponding to the three states of matter—solid, liquid and gaseous. That the distances traversed by the molecules of a solid are very small in extent is shown by innumerable facts of everyday observation, as for instance, the fact that the surface of a finely-carved metal (such as a plate used for steel engraving) will retain its exact shape for centuries, or again, the fact that when a metal body is coated with gold-leaf the molecules of the gold remain on its surface indefinitely: if they moved through any but the smallest distances they would soon become mixed with the molecules of the baser metal and diffused through its interior. Thus the molecules of a solid must make only small excursions about their mean positions. In a gas the state of things is very different; an odour is known to spread rapidly through great distances, even in the stillest air, and a gaseous poison or corrosive will attack not only those objects which are in contact with its source but also all those which can be reached by the motion of its molecules.

As a preliminary to examining further into the nature of molecular motion and the differences of character of this motion, let us try to picture the state of things which would exist in a mass of solid matter in which all the molecules are imagined to be at rest relatively to one another. The fact that a solid body in its natural state is capable both of compression and of dilatation indicates that the molecules of the body must not be supposed to be fixed rigidly in position relative to one another; the further fact that a motion of either compression or of dilatation is opposed by forces which are brought into play in the interior of the solid suggests that the position of rest is one in which the molecules are in stable equilibrium under their mutual forces. Such a mass of imaginary matter as we are now considering may be compared to a collection of heavy particles held in position relatively to one another by a system of light spiral springs, one spring being supposed to connect each pair of adjacent particles. Let two such masses of matter be suspended by strings from the same point, and then let one mass be drawn aside, pendulum-wise, and allowed to impinge on the other. After impact the two masses will rebound, and the process may be repeated any number of times, but ultimately the two masses will be found again hanging in contact side by side. At the first impact each layer of surface molecules which takes the shock of the impact will be thrust back upon the layer behind it: this layer will in this way be set into motion and so influence the layer still further behind; and so on indefinitely. The impact will accordingly result in all the molecules being set into motion, and by the time that the masses have ceased impinging on one another the molecules of which they are composed will be performing oscillations about their positions of equilibrium. The kinetic energy with which the moving mass originally impinged on that at rest is now represented by the energy, kinetic and potential, of the small motions of the individual molecules. It is known, however, that when two bodies impinge, the kinetic energy which appears to be lost from the mass-motion of the bodies is in reality transformed into heat-energy. Thus the molecular theory of matter, as we have now pictured it, leads us to identify heat-energy in a body with the energy of motion of the molecules of the body relatively to one another. A body in which all the molecules were at rest relatively to one another would be a body devoid of heat. This conception of the nature of heat leads at once to an absolute zero of temperature—a temperature of no heat-motion—which is identical, as will be seen later, with that reached in other ways, namely, about − 273° C.

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[1] "On the Cohesions of Fluids," *Phil. Trans.* (1805); Young's *Coll. Works*, i. 461.

The point of view which has now been gained enables us to interpret most of the thermal properties of solids in terms of molecular theory. Suppose for instance that two bodies, both devoid of heat, are placed in contact with one another, and that the surface of the one is then rubbed over that of the other. The molecules of the two surface-layers will exert forces upon one another, so that, when the rubbing takes place, each layer will set the molecules of the other into motion, and the energy of rubbing will be used in establishing this heat-motion. In this we see the explanation of the phenomenon of the generation of heat by friction. At first the heat-motion will be confined to molecules near the rubbing surfaces of the two bodies, but, as already explained, these will in time set the interior molecules into motion, so that ultimately the heat-motion will become spread throughout the whole mass. Here we have an instance of the conduction of heat.[1] When the molecules are oscillating about their equilibrium positions, there is no reason why their mean distance apart should be the same as when they are at rest. This leads to an interpretation of the fact that a change of dimensions usually attends a change in the temperature of a substance. Suppose for instance that two molecules, when at rest in equilibrium, are at a distance a apart. It is very possible that the repulsive force they exert when at a distance $a-\epsilon$ may be greater than the attractive force they exert when at a distance $a+\epsilon$. If so, it is clear that their mean distance apart, averaged through a sufficiently long interval of their motion, will be greater than a. A body made up of molecules of this kind will expand on heating.

As the temperature of a body increases the average energy of the molecules will increase, and therefore the range of their excursions from their positions of equilibrium will increase also. At a certain temperature a stage will be reached in which it is a frequent occurrence for a molecule to wander so far from its position of equilibrium, that it does not return but falls into a new position of equilibrium and oscillates about this. When the body is in this state the relative positions of the molecules are not permanently fixed, so that the body is no longer of unalterable shape: it has assumed a plastic or molten condition. The substance attains to a perfectly liquid state as soon as the energy of motion of the molecules is such that there is a constant rearrangement of position among them.

A molecule escaping from its original position in a body will usually fall into a new position in which it will be held in equilibrium by the forces from a new set of neighbouring molecules. But if the wandering molecule was originally close to the surface of the body, and if it also happens to start off in the right direction, it may escape from the body altogether and describe a free path in space until it is checked by meeting a second wandering molecule or other obstacle. The body is continually losing mass by the loss of individual molecules in this way, and this explains the process of evaporation. Moreover, the molecules which escape are, on the whole, those with the greatest energy. The average energy of the molecules of the liquid is accordingly lowered by evaporation. In this we see the explanation of the fall of temperature which accompanies evaporation.

When a liquid undergoing evaporation is contained in a closed vessel, a molecule which has left the liquid will, after a certain number of collisions with other free molecules and with the sides of the vessel, fall back again into the liquid. Thus the process of evaporation is necessarily accompanied by a process of recondensation. When a stage is reached such that the number of molecules lost to the liquid by evaporation is exactly equal to that regained by condensation, we have a liquid in equilibrium with its own vapour. If the whole liquid becomes vaporized before this stage is attained, a state will exist in which the vessel is occupied solely by free molecules, describing paths which are disturbed only by encounters with other free molecules or the sides of the vessel. This is the conception which the molecular theory compels us to form of the gaseous state.

At normal temperature and pressure the density of a substance in the gaseous state is of the order of one-thousandth of the density of the same substance in the solid or liquid state. It follows that the average distance apart of the molecules in the gaseous state is roughly ten times as great as in the solid or liquid state, and hence that in the gaseous state the molecules are at distances apart which are large compared with their linear dimensions. (If the molecules of air at normal temperature and pressure were arranged in cubical order, the edge of each cube would be about $2{\cdot}9\times10^{-7}$ cms.; the average diameter of a molecule in air is $2{\cdot}8\times10^{-8}$ cms.) Further and very important evidence as to the nature of the gaseous state of matter is provided by the experiments of Joule and Kelvin. These experiments showed that the change in the temperature of a gas, consequent on its being allowed to stream out into a vacuum, is in general very slight. In terms of the molecular theory this indicates that the total energy of the gas is the sum of the separate energies of its different molecules: the potential energy arising from intermolecular forces between pairs of molecules may be treated as negligible when the matter is in the gaseous state.

These two simplifying facts bring the properties of the gaseous state of matter within the range of mathematical treatment. The kinetic theory of gases attempts to give a mathematical account, in terms of the molecular structure of matter, of all the non-chemical and non-electrical properties of gases. The remainder of this article is devoted to a brief statement of the methods and results of the kinetic theory. No attempt will be made to follow the historic order of development, but the present theory will be set out in its most logical form and order.

The Kinetic Theory of Gases.

A number of molecules moving in obedience to dynamical laws will pass through a series of configurations which can be theoretically determined as soon as the structure of each molecule and the initial position and velocity of every part of it are known. The determination of the series of configurations developing out of given initial conditions is not, however, the problem of the kinetic theory: the object of this theory is to explain the general properties of all gases in terms only of their molecular structure. We are therefore called upon, not to trace the series of configurations of any single gas, starting from definite initial conditions, but to search for features and properties common to all series of configurations, independently of the particular initial conditions from which the gas may have started.

Dynamical Basis.

We begin with a general dynamical theorem, whose special application, when the dynamical system is identified with a gas, will appear later. Let $q_1, q_2, \ldots q_n$ be the generalized co-ordinates of any dynamical system, and let $p_1, p_2, \ldots p_n$ be the corresponding momenta. If the system is supposed to obey the conservation of energy and to move solely under its own internal forces, the changes in the co-ordinates and momenta can be found from the Hamiltonian equations

$$\dot{q}_r=\frac{\partial E}{\partial p_r},\ \dot{p}_r=-\frac{\partial E}{\partial q_r}, \qquad (1)$$

where $\dot{q}_r$ denotes dq_r/dt, &c., and E is the total energy expressed as a function of $p_1, q_1, \ldots p_n, q_n$. When the initial values of $p_1, q_1 \ldots p_n, q_n$, are given, the motion can be traced completely from these equations.

Let us suppose that an infinite number of exactly similar systems start simultaneously from all possible values of $p_1, q_1, \ldots p_n, q_n$, each moving solely under its own internal forces, and therefore in accordance with equations (1). Let us confine our attention to those systems for which the initial values of $p_1, q_1, \dots p_n, q_n$ lie within a range such that

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[1] Other processes also help in the conduction of heat, especially in substances which are conductors of electricity.

$$\begin{array}{l} p_1 \text{ is between } p_1 \text{ and } p_1+dp_1 \\ q_1 \;\;\text{,,}\;\;\;\text{,,}\;\;\; q_1 \;\;\text{,,}\;\; q_1+dq_1, \text{ and so on.} \end{array}$$

Let the product $dp_1\,dq_1 \dots dp_n\,dq_n$ be spoken of as the "extension" of this range of values.

After a time dt the value of p_1 will have increased to p_1+p_1dt, where p_1 is given by equations (1), and there will be similar changes in $q_1, p_2, q_2, \dots q_n$. Thus after a time dt the values of the co-ordinates and momenta of the small group of systems under consideration will lie within a range such that

$$\begin{array}{l} p_1 \text{ is between } p_1+\dot{p}_1dt \text{ and } p_1+dp_1+\left(\dot{p}_1+\dfrac{\partial\dot{p}_1}{\partial p_1}dp_1\right)dt \\ q_1 \;\;\text{,,}\;\;\;\text{,,}\;\;\; q_1+\dot{q}_1dt \;\;\text{,,}\;\; q_1+dq_1+\left(\dot{q}_1+\dfrac{\partial\dot{q}_1}{\partial q_1}dq_1\right)dt, \end{array}$$

and so on. Thus the extension of the range after the interval dt is

$$dp_1\left(1+\frac{\partial\dot{p}_1}{\partial p_1}dt\right)dq_1\left(1+\frac{\partial\dot{q}_1}{\partial q_1}dt\right)\dots$$

or, expanding as far as first powers of dt,

$$dp_1dq_1 \dots dp_ndq_n\left\{1+\Sigma_1^n\left(\frac{\partial\dot{p}_1}{\partial p_1}+\frac{\partial\dot{q}_1}{\partial q_1}\right)dt\right\}.$$

From equations (1), we find that

$$\frac{\partial\dot{p}_1}{\partial p_1}+\frac{\partial\dot{q}_1}{\partial q_1}=0,$$

so that the extension of the new range is seen to be $dp_1dq_1 \dots dp_ndq_n$, and therefore equal to the initial extension. Since the values of the co-ordinates and momenta at any instant during the motion may be treated as "initial" values, it is clear that the "extension" of the range must remain constant throughout the whole motion.

This result at once disposes of the possibility of all the systems acquiring any common characteristic in the course of their motion through a tendency for their co-ordinates or momenta to concentrate about any particular set, or series of sets, of values. But the result goes further than this. Let us imagine that the systems had the initial values of their co-ordinates and momenta so arranged that the number of systems for which the co-ordinates and momenta were within a given range was proportional simply to the extension of the range. Then the result proves that the values of the co-ordinates and momenta remain distributed in this way throughout the whole motion of the systems. Thus, if there is any characteristic which is common to all the systems after the motion has been in progress for any interval of time, this same characteristic must equally have been common to all the systems initially. It must, in fact, be a characteristic of all possible states of the systems.

It is accordingly clear that there can be no property common to all systems, but it can be shown that when the system contains a gas (or any other aggregation of similar molecules) as part of it there are properties which are common to all possible states, except for a number which form an insignificant fraction of the whole. These properties are found to account for the physical properties of gases.

Let the whole energy E of the system be supposed equal to E_1+E_2, where E_2 is of the form

$$\begin{aligned} E_2 = {} & \tfrac{1}{2}\sum_s(mu^2+mv^2+mw^2+a_1\theta_1^2+a_2\theta_2^2+ \dots +a_n\theta_n^2) \\ & +\tfrac{1}{2}\sum_{s'}(m'u'^2+m'v'^2+m'w'^2+\beta_1\phi_1^2+\beta_2\phi_2^2+ \dots +\beta_{n'}\phi_{n'}^2) \qquad (2) \end{aligned}$$

where $\theta_1, \theta_2, \dots \theta_n$ and similarly $\phi_1, \phi_2, \dots \phi_{n'}$ are any momenta or functions of the co-ordinates and momenta or co-ordinates alone which are subject only to the condition that they do not enter into the coefficients a_1, a_2, &c.

In this expression the first line may be supposed to represent the energy (or part of the energy) of s similar molecules of a kind which we shall call the first kind, the terms $\frac{1}{2}(mu^2+mv^2+mw^2)$ being the kinetic energy of translation, and the remaining terms arising from energy of rotation or of internal motion, or from the energy, kinetic and potential, of small vibrations. The second line in E_2 will represent the energy (or part of the energy) of s' similar molecules of the second kind, and so on. It is not at present necessary to suppose that the molecules are those of substances in the gaseous state. Considering only those states of the system which have a given value of E_2, it can be proved, as a theorem in pure mathematics,[1] that when $s, s', \dots$ are very large, then, for all states except an infinitesimal fraction of the whole number, the values of u, v, w lie within ranges such that

(i) the values of u (and similarly of v, w) are distributed among the s molecules of the first kind according to the law of trial and error; and similarly of course for the molecules of other kinds:

(ii)
$$\frac{\sum_s\frac{1}{2}mu^2}{s}=\frac{\sum_s\frac{1}{2}mv^2}{s}=\frac{\sum_s\frac{1}{2}mw^2}{s}=\frac{\sum_s\frac{1}{2}a_1\theta_1^2}{s}=\dots$$
$$=\frac{\sum_{s'}\frac{1}{2}m'u'^2}{s'}=\dots=\frac{\sum_{s'}\frac{1}{2}\beta\phi_1^2}{s'}=\dots \qquad (3)$$

The Normal State.

A state of the system in which these two properties are true will be called a "normal state"; other states will be spoken of as "abnormal." Let all possible states of the system be divided into small ranges of equal extension, and of these let a number P correspond to normal, and a number p to abnormal, states. What is proved is that, as $s, s', \dots$ become very great, the ratio P/p becomes infinite. Considering only systems starting in the p abnormal ranges, it is clear, from the fact that the extensions of the ranges do not change with the motion, that after a sufficient time most of these systems must have passed into the P normal ranges. Speaking loosely, we may say that there is a probability $P/(P+p)$, amounting to certainty in the limit, that one of these systems, selected at random, will be in the normal state after a sufficient time has elapsed. Again, considering the systems which start from the P normal ranges, we see that there is a probability $p/(P+p)$ which vanishes in the limit, that a system selected at random from these will be in an abnormal state after a sufficient time. Thus, subject to a probability of error which is infinitesimal in the limit, we may state as general laws that—

A system starting from an abnormal state tends to assume the normal state; while

A system starting from the normal state will remain in the normal state.

It will now be found that the various properties of gases follow from the supposition that the gas is in the normal state.

Law of Distribution of Velocities.

If each of the fractions (3) is put equal to $1/4h$, it is readily found, from the first property of the normal state, that, of the s molecules of the first kind, a number

$$s\sqrt{(h^3m^3/\pi^3)}e^{-hm(u^2+v^2+w^2)}dudvdw \qquad (4)$$

have velocities of which the components lie between u and $u+du$, v and $v+dv$, w and $w+dw$, while the corresponding number of molecules of the second kind is, similarly,

$$s'\sqrt{(h^3m'^3/\pi^3)}e^{-hm'(u^2+v^2+w^2)}dudvdw. \qquad (5)$$

If c is the resultant velocity of a molecule, so that $c^2=u^2+v^2+w^2$, it is readily found from formula (4) that the number of molecules of the first kind of which the resultant velocity lies between c and $c+dc$ is

$$4\pi s\sqrt{(h^3m^3/\pi^3)}e^{-hmc^2}c^2dc. \qquad (6)$$

These formulae express the "law of distribution of velocities" in the normal state: the law is often called *Maxwell's Law of Distribution.*

Equipartition of Energy.

If $\frac{1}{2}\overline{mu^2}$ denote the mean value of $\frac{1}{2}mu^2$ averaged over the s molecules of the first kind, equations (3) may be written in the form

$$\tfrac{1}{2}\overline{mu^2}=\tfrac{1}{2}\overline{mv^2}=\tfrac{1}{2}\overline{mw^2}=\tfrac{1}{2}\overline{a_1\theta_1^2}=\dots=1/4h, \qquad (7)$$

showing that the mean energy represented by each term in E_2 (formula 2) is the same. These equations express the "law of equipartition of energy," commonly spoken of as the *Maxwell-Boltzmann Law.*

Temperature.

The law of equipartition shows that the various mean energies of different kinds are all equal, each being measured by the quantity $1/4h$. We have already seen that the mean energy increases with the temperature: it will now be supposed that the mean energy is exactly proportional to the temperature. The complete justification for this supposition will appear later: a partial justification is obtained as soon as it is seen how many physical laws can be explained by it. We accordingly put $1/2h=RT$, where T denotes the temperature on the absolute scale, and then have equations (7) in the form

$$\overline{mu^2}=\overline{mv^2}=\dots=RT. \qquad (8)$$

When a system is composed of a mixture of different kinds of molecules, the fact that h is the same for each constituent [cf. formulae (5) and (6)] shows that in the normal state the different substances are all at the same temperature. For instance, if the system is composed of a gas and a solid boundary, some of the terms in expression (2) may be supposed to represent the kinetic energy of the molecules of the boundary, so that equations (7) show that in the normal state the gas has the same temperature as the boundary. The process of equalization of temperature is now seen to be a special form of the process of motion towards the normal state: the general laws which have been stated above in connexion with the normal state are seen to include as special cases the following laws:—

Matter originally at non-uniform temperature tends to assume a uniform temperature; while

Matter at uniform temperature will remain at uniform temperature.

It will at once be apparent that the kinetic theory of matter enables us to place the second law of thermodynamics upon a purely dynamical basis. So far it has not been necessary to suppose the matter to be in the gaseous state. We now pass to the consideration of laws and properties which are peculiar to the gaseous state.

Pressure of a Gas.

A simple approximate calculation of the pressure exerted by a gas on its containing vessel can be made by supposing that the molecules are so small in comparison with their distances apart that they may be treated as of infinitesimal size. Let a mixture of gases contain per unit volume ν molecules of the first kind, ν' of the second kind, and so on. Let us fix our attention on a small area dS of the boundary of the vessel, and let co-ordinate axes be taken such that the origin is in dS, and the axis of x is the normal at the origin into the gas. The number of molecules of the first kind of gas, whose components of velocity lie within the ranges between u and $u+du$, v and $v+dv$, w and $w+dw$, will, by formula (5), be

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[1] See Jeans, *Dynamical Theory of Gases* (1904), ch. v.

$$\nu\sqrt{(h^3m^3/\pi^3)}e^{-hm(u^2+v^2+w^2)}dudvdw \qquad (9)$$

per unit volume. Construct a small cylinder inside the gas, having dS as base and edges such that the projections of each on the co-ordinate axes are udt, vdt, wdt. Each of the molecules enumerated in expression (9) will move parallel to the edge of this cylinder, and each will describe a length equal to its edge in time dt. Thus each of these molecules which is initially inside the cylinder, will impinge on the area dS within an interval dt. The cylinder is of volume $u\,dt\,dS$, so that the product of this and expression (9) must give the number of impacts between the area dS and molecules of the kind under consideration within the interval dt. Each impinging molecule exerts an impulsive pressure equal to mu on the boundary before the component of velocity of its centre of gravity normal to the boundary is reduced to zero. Thus the contribution to the total impulsive pressure exerted on the area dS in time dt from this cause is

$$mu \times udtdS \times \nu\sqrt{(h^3m^3/\pi^3)}e^{-hm(u^2+v^2+w^2)}dudvdw \qquad (10)$$

The total pressure exerted in bringing the centres of gravity of all the colliding molecules to rest normally to the boundary is obtained by first integrating this expression with respect to u, v, w, the limits being all values for which collisions are possible (namely from $-\infty$ to 0 for u, and from $-\infty$ to $+\infty$ for v and w), and then summing for all kinds of molecules in the gas. Further impulsive pressures are required to restart into motion all the molecules which have undergone collision. The aggregate amount of these pressures is clearly the sum of the momenta, normal to the boundary, of all molecules which have left dS within a time dt, and this will be given by expression (10), integrated with respect to u from 0 to ∞, and with respect to v and w from $-\infty$ to $+\infty$, and then summed for all kinds of molecules in the gas. On combining the two parts of the pressure which have been calculated, the aggregate impulsive pressure on dS in time dt is found to be

$$\Sigma dt\, dS \iiint_{-\infty}^{+\infty} \nu\sqrt{(h^3m^3/\pi^3)}e^{-hm(u^2+v^2+w^2)}mu^2dudvdw,$$

where Σ denotes summation over all kinds of molecules. This is equivalent to a steady pressure p_1 per unit area where

$$p_1 - \Sigma \iiint_{-\infty}^{+\infty} \nu\sqrt{(h^3m^3/\pi^3)}e^{-hm(u^2+v^2+w^2)}mu^2dudvdw.$$

Clearly the integral is the sum of the values of mu^2 for all the molecules of the first kind in unit volume, thus

$$p = \nu\,\overline{mu^2} + \nu'\,\overline{m'u^2} + \dots \qquad (11)$$

On substituting from equations (7) and (8), this expression assumes the forms

$$\begin{aligned} p &= (\nu+\nu'+\dots)/2h \qquad (12)\\ &= (\nu+\nu'+\dots)\mathrm{RT} \qquad (13)\end{aligned}$$

Molecular Velocities.

The number of molecules per unit volume in a gas at normal temperature and pressure is known to be about $2{\cdot}75\times 10^{19}$. If in formula (13) we put $p=1{\cdot}013\times 10^6$, $(\nu+\nu'+\dots)=2{\cdot}75\times 10^{19}$ $\mathrm{T}=273$, we obtain $\mathrm{R}=1{\cdot}35\times 10^{-16}$ and this enables us to determine the mean velocities produced by heat motion in molecules of any given *mass*. For molecules of known gases the calculation is still easier. If ρ is the density corresponding to pressure p, we find that formula (11) assumes the form

$$p = \tfrac{1}{3}\rho \mathrm{C}^2,$$

where C is a velocity such that the gas would have its actual translational energy if each molecule moved with the same velocity C. By substituting experimentally determined pairs of values of p and ρ we can calculate C for different gases, and so obtain a knowledge of the magnitudes of the molecular velocities. For instance, it is found that

for hydrogen at	0° Cent.	C = 183,900	cms.	per sec.
,, air ,,	15° ,,	C = 49,800	,,	,, ,,
,, mercury vapour at	0° ,,	C = 18,500	,,	,, ,,

and other velocities can readily be calculated.

"Brownian Movements."

From the value $\mathrm{R}=1{\cdot}35\times 10^{-16}$ it is readily calculated that a molecule, or aggregation of molecules, of mass 10^{-12} grammes, ought to have a mean velocity of about 2 millimetres a second at 0° C. Such a velocity ought accordingly to be set up in a particle of 10^{-12} grammes mass immersed in air or liquid at 0° C., by the continual jostling of the surrounding molecules or particles. A particle of this mass is easily visible microscopically, and a velocity of 2 mm. per second would of course be visible if continued for a sufficient length of time. Each bombardment will, however, change the motion of the particle, so that changes are too frequent for the separate motions to be individually visible. But it can be shown that from the aggregation of these separate short motions the particle ought to have a resultant motion, described with an average velocity which, although much smaller than 2 mm. a second, ought still to be microscopically visible. It has been shown by R. von. S. Smoluchowski (*Ann. d. Phys.*, 1906, 21, p. 756) that this theoretically predicted motion is simply that seen in the "Brownian movements" first observed by the botanist Robert Brown in 1827. Thus the "Brownian movements" provide visual demonstration of the reality of the heat-motion postulated by the kinetic theory.

Pressure, Volume and Temperature Relations.

Dalton's Law.—The pressure as given by formula (12) can be written as the sum of a number of separate terms, one for each gas in the mixture. Hence we have Dalton's law: *The pressure of a mixture of gases is the sum of the pressures which would be exerted separately by the several constituents if each alone were present.*

Avogadro's Law.—From formula (13) it appears that $\nu+\nu'+\dots$, the total number of molecules per unit volume, is determined when p, T and the constant R are given. Hence we have Avogadro's law: *Different gases, at the same temperature and pressure, contain equal numbers of molecules per unit volume.*

Boyle's and Charles' Laws.—If v is the volume of a homogeneous mass of gas, and N the total number of its molecules, $\mathrm{N}=v(\nu+\nu'+\dots)$, so that

$$pv = \mathrm{RNT}. \qquad (14)$$

In this equation we have the combined laws of Boyle and Charles: *When the temperature of a gas is kept constant the pressure varies inversely as the volume, and when the volume is kept constant the pressure varies as the temperature.*

Since the volume at constant pressure is exactly proportional to the absolute temperature, it follows that the coefficients of expansion of all gases ought, to within the limits of error introduced by the assumptions on which we are working, to have the same value 1/273.

Van der Waals's Equation.—The laws which have just been stated are obeyed very approximately, but not with perfect accuracy, by all gases of which the density is not too great or the temperature too low. Van der Waals, in a famous monograph, *On the Continuity of the Liquid and Gaseous States* (Leiden, 1873), has shown that the imperfections of equation (14) may be traced to two causes:—

(i.) The calculation has not allowed for the finite size of the molecules, and their consequent interference with one another's motion, and

(ii.) The calculation has not allowed for the field of inter-molecular force between the molecules, which, although small, is known to have a real existence. The presence of this field of force results in the molecules, when they reach the boundary, being acted on by forces in addition to those originating in their impact with the boundary.

To allow for the first of these two factors, Van der Waals finds that v in equation (14) must be replaced by $v-b$, where b is four times the aggregate space occupied by all the molecules, while to allow for the second factor, p must be replaced by $p+a/v^2$. Thus the pressure is given by the equation

$$(p+a/v^2)\,(v-b) = \mathrm{RNT},$$

which is known as Van der Waals's equation. This equation is found experimentally to be capable of representing the relation between p, v, and T over large ranges of values. (See CONDENSATION OF GASES.)

Calorimetry.

Let us consider a single gas, consisting of N similar molecules in a volume v, and let the energy of each molecule, as in formula (2) be given by

$$\begin{aligned} \mathrm{E} &= \tfrac{1}{2}\sum_{\mathrm{N}}(mu^2+mv^2+mw^2+a_1\theta_1{}^2+\dots a_n\theta_n{}^2) \qquad (15)\\ &= \mathrm{N}(n+3)/4h \text{ by equation (7)}\\ &= \tfrac{1}{2}(n+3)\mathrm{RNT}. \qquad (16)\end{aligned}$$

Let a quantity dQ of energy, measured in work units, be absorbed by the gas from some external source, so that its pressure, volume and temperature change. The equation of energy is

$$dQ = dE + pdv, \qquad (17)$$

expressing that the total energy dQ is used partly in increasing the internal energy of the gas, and partly in expanding the gas against the pressure p. If we take $p=\mathrm{RNT}/v$ from equation (14) and substitute for E from equation (16), this last equation becomes

$$dQ = \tfrac{1}{2}(n+3)\mathrm{RN}d\mathrm{T} + \mathrm{RNT}dv/v, \qquad (18)$$

which may be taken as the general equation of calorimetry, for a gas which accurately obeys equation (14).

Second Law of Thermodynamics.—If we divide throughout by T, we obtain

$$\frac{dQ}{\mathrm{T}} = \tfrac{1}{2}(n+3)\mathrm{RN}\frac{d\mathrm{T}}{\mathrm{T}} + \mathrm{RN}\frac{dv}{v},$$

showing that dQ/T is a perfect differential. This not only verifies that the second law of thermodynamics is obeyed, but enables us to identify T with the absolute thermodynamical temperature.

Specific Heats.

If the volume of the gas is kept constant, we put $dv=0$ in equation (18) and $dQ=\mathrm{JC}_v\mathrm{N}md\mathrm{T}$, where C_v is the specific heat of the gas at constant volume and J is the mechanical equivalent of heat. We obtain

$$\mathrm{C}_v = \tfrac{1}{2}(n+3)\mathrm{R/J}m. \qquad (19)$$

On the other hand, if the pressure of the gas is kept constant throughout the motion, T/v is constant and $dQ=JC_pNmdT$, whence

$$C_p=\tfrac{1}{2}(n+5)R/Jm. \qquad (20)$$

By division of the values of C_p and C_v we find for γ, the ratio of the specific heats.

$$\gamma=1+2/(n+3). \qquad (21)$$

The comparison of this formula with experiment provides a striking confirmation of the truth of the kinetic theory but at the same time discloses the most formidable difficulty which the theory has so far had to encounter.

On giving different values to n in formula (21), we obtain the values for γ:

$$\begin{array}{lllllll} n = & 0, & 1, & 2, & 3, & 4, & 5, \\ \gamma = & 1{\cdot}66, & 1{\cdot}5, & 1{\cdot}4, & 1{\cdot}33, & 1{\cdot}28, & 1{\cdot}25,\ \&c. \end{array}$$

Thus, to within the degree of approximation to which our theory is accurate, the value of γ for every gas ought to be one of this series. The following are the values of γ for gases for which γ can be observed with some accuracy;—

Mercury	1·66	Nitrogen	1·40
Krypton	1·66	Carbon monoxide	1·41
Helium	1·65	Hydrogen	1·40
Argon	1·62	Oxygen	1·40
Air	1·40	Hydrochloric acid	1·39

It is clear that for the first four gases $n=0$, while for the remainder $n=2$. To examine what is meant by a zero value of n we refer to formula (15). The value of n is the number of terms in the energy of the molecule beyond that due to translation. Thus when $n=0$, the whole energy must be translational: there can be no energy of rotation or of internal motion. The molecules of gases for which $n=0$ must accordingly be spherical in shape and in internal structure, or at least must behave at collisions as though they were spherical, for they would otherwise be set into rotation by the forces experienced at collisions. In the light of these results it is of extreme significance that the four gases for which $n=0$ are all believed to be monatomic: the molecules of these gases consist of single atoms. Moreover, these four are the only monatomic gases for which the value of γ is known, so that the only atoms of which the shape can be determined are found to be spherical. It is at least a plausible conjecture, until the contrary is proved, that the atoms of all elements are spherical.[1]

The next value which occurs is $n=2$. The kinetic energy of the molecules of these gases must contain two terms in addition to those representing translational energy. For a rigid body the kinetic energy will, in general, consist of three terms $(A\omega_1^2+B\omega_2^2+C\omega_3^2)$ in addition to the translational energy. The value $n=2$ is appropriate to bodies of which the shape is that of a solid of revolution, so that there is no rotation about the axis of symmetry. We must accordingly suppose that the molecules of gases for which $n=2$ are of this shape. Now this is exactly the shape which we should expect to find in molecules composed of two spherical atoms distorting one another by their mutual forces, and all gases for which $n=2$ are diatomic.

No molecule could possibly be imagined for which n had a negative value or the value $n=1$. The theory therefore passes a crucial test when it is discovered that no gases exist for which n is either negative or unity. On the other hand, the theory encounters a very serious difficulty in the fact that all molecules possess a great number of possibilities of internal motion, as is shown by the number of distinct lines in their spectra both of emission and of absorption. So far as is known, each line in the spectrum of, say, mercury, represents a possibility of a distinct vibration of the mercury atom, and accordingly provides two terms (say $\alpha\dot{\phi}^2+\beta\phi^2$, where ϕ is the normal co-ordinate of the vibration) in the expression for the energy of the molecule. There are many thousands of lines in the mercury spectrum, so that from this evidence it would appear that for mercury vapour n ought to be very great, and γ almost equal to unity. Instead of this we have $n=0$, and $\gamma=1\frac{2}{3}$. As a step towards removing this difficulty we notice that the energy of a vibration such as is represented by a spectral line has the peculiarity of being unable to exist (so far as we know) without suffering dissipation into the ether. This energy, therefore, comes under a different category from the energy for which the law of equipartition was proved, for in proving this law conservation of energy was assumed. The difficulty is further diminished when it is proved, as it can be proved,[2] that the modes of energy represented in the atomic spectrum acquire energy so slowly that the atom might undergo collisions with other atoms for centuries before being set into oscillations which would possess an appreciable amount of energy. In fact the proved tendency for the gas to pass into the "normal state" in which there is equipartition of energy, represents in this case nothing but the tendency for the translational energy to become dissipated into the energy of innumerable small vibrations. We find that this dissipation, although undoubtedly going on, proceeds with extreme slowness, so that the vibrations pass their energy on to the ether as rapidly as they acquire it, and the "normal state" is never established. These considerations suggest that the difficulty which has been pointed out may be apparent rather than real. At the same time this difficulty is only one aspect of a wider difficulty which cannot be lightly passed over; Maxwell himself regarded it as the principal obstacle in the way of the full acceptance of the theory of which he was so largely the author. (J. H. JE.)

MOLE-RAT, the name of a group of blind burrowing rodents, typified by the large grey *Spalax typhlus* of eastern Europe and Egypt, which represents the Old World family *Spalacidae*. All the mole-rats of the genus *Spalax* are characterized by the want of distinct necks, small or rudimentary ears and eyes, and short limbs provided with powerful digging claws. There are three pairs of cheek-teeth which are rooted, and show folds of enamel on the crown. Mole-rats are easily recognized by the peculiarly flattened head, in which the minute eyes are covered with skin, the wart-like ears, and rudimentary tail; they make burrows in sandy soil, and feed on bulbs and roots. Bamboo-rats, of which one genus (*Rhizomys*) is Indian and Burmese, and the other (*Tachyoryctes*) East African, differ by the absence of skin over the eyes, the presence of short ears, and a short, sparsely-haired tail. They burrow either among tall grass, or at the roots of trees (see RODENTIA).

MOLE-SHREW, any individual of the genera *Urotrichus* and *Uropsilus* (see INSECTIVORA). These animals, which are sometimes called shrew-moles, are not moles with shrew-like habits, but shrews with the burrowing habits of moles and resembling them in appearance.

MOLESKIN, a term employed not only for the skin of a mole but also, from a real or fancied resemblance, for a stout heavy cotton fabric of leathery consistence woven as a satin twill on a strong warp. It is shorn before being dyed or bleached. Being of an exceedingly durable and economical texture, it has been much worn by working-men, especially outdoor labourers. It is also used for gun-cases, carriage-covers, and several purposes in which a fabric capable of resisting rough usage is desirable.

MOLESWORTH, MARY LOUISA (1839–), Scottish writer, daughter of Major-General Stewart, of Strath, N.B., was born in Rotterdam on the 29th of May 1839, and was educated in Great Britain and abroad. In 1861 Miss Stewart married Major R. Molesworth. Her first novels, *Lover and Husband* (1869) to *Cicely* (1874), appeared under the pseudonym of "Ennis Graham." Mrs Molesworth is best known as a writer of books for the young, such as *Tell Me a Story* (1875), *Carrots* (1876), and *The Cuckoo Clock* (1877).

MOLESWORTH, ROBERT MOLESWORTH, 1ST VISCOUNT (1656–1725), came of an old Northamptonshire family. His father Robert (d. 1656) was a Cromwellian who made a fortune in Dublin, and he himself supported William of Orange and in 1695 became a prominent member of the Irish privy council. In 1716 he was created a viscount. He was succeeded by his two sons, John, 2nd viscount (1679–1726), and Richard 3rd viscount (1680–1758), the latter of whom saved Marlborough's life at the battle of Ramillies and rose to be a field-marshal. The 3rd viscount's son Richard Nassau (1748–1793) succeeded to the title, which has descended accordingly.

A great-grandson of the 1st viscount, JOHN EDWARD NASSAU MOLESWORTH (1790–1877), vicar of Rochdale, was a well-known High Churchman and controversialist; and two of his sons became prominent men—WILLIAM NASSAU MOLESWORTH (1816–1890), author of *History of England 1830–1871* (1871–1873), *History of the Reform Bill* (1865), and *History of the Church of*

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[1] Very significant confirmation of this conjecture is obtained from a study of the specific heats of the elements in the solid state. If a solid body is regarded as an aggregation of similar atoms each of mass m, its specific heat C is given, as in formula (19) by $C=\frac{1}{2}(n+3)R/Jm$. From Dulong and Petit's law that Cm is the same for all elements, it follows that $n+3$ must be the same for all atoms. Moreover, the value of Cm shows that $n+3$ must be equal to six. Now if the atoms are regarded as points or spherical bodies oscillating about positions of equilibrium, the value of $n+3$ is precisely six, for we can express the energy of the atom in the form

$$E=\tfrac{1}{2}\left(mu^2+mv^2+mw^2+x^2\frac{\partial^2V}{\partial x^2}+y^2\frac{\partial^2V}{\partial y^2}+z^2\frac{\partial^2V}{\partial z^2}\right),$$

where V is the potential and x, y, z are the displacements of the atom referred to a certain set of orthogonal axes.

[2] J. H. Jeans, *Dynamical Theory of Gases*, ch. ix.

England (1882); and **Sir Guilford Molesworth** (b. 1828), an eminent engineer and economist.

MOLESWORTH, SIR WILLIAM, Bart. (1810–1855), English politician, son of the 7th baronet, was born in London on the 23rd of May 1810, and in 1823 succeeded to the baronetcy. At Cambridge he fought a duel with his tutor, and for some time studied abroad. On the passing of the Reform Act of 1832 he was returned to parliament for the eastern division of Cornwall, to support the ministry of Lord Grey. Through Charles Buller he made the acquaintance of Grote and James Mill, and in April 1835 he founded, in conjunction with Roebuck, the *London Review*, as an organ of the "Philosophic Radicals." After the publication of two volumes he purchased the *Westminster Review*, and for some time the united magazines were edited by him and J. S. Mill. From 1837 to 1841 Sir William Molesworth sat for Leeds, and acquired considerable influence in the House of Commons by his speeches and by his tact in presiding over the select committee on transportation. But his Radicalism made little impression either on the house or on his constituency. From 1841 to 1845 he had no seat in parliament, occupying his leisure time in editing the works in Latin and English of Thomas Hobbes of Malmesbury, a recreation which cost him no less than £6000. In 1845 he was returned for Southwark, and retained that seat until his death. On his return to parliament he devoted special attention to the condition of the colonies, and was the ardent champion of their self-government. In January 1853 Lord Aberdeen included him in the cabinet as first commissioner of works, the chief work by which his name was brought into prominence at this time being the construction of the new Westminster Bridge; he also was the first to open Kew Gardens on Sundays. In July 1855 he was made colonial secretary, but he died on the 22nd of October. Molesworth was for many years a great friend of Mr and Mrs Grote, and Mrs Grote's privately printed work on *The Philosophical Radicals* (1866) contains an account of his life. He married in 1844, but had no children, and the baronetcy passed to a cousin. His sister (d. 1910) married Richard Ford, famous for his *Handbook of Spain.*

A *Life* by Mrs Fawcett was published in 1903. A full pedigree of the Molesworth family is printed in Sir John Maclean's *Trigg Minor*, vol. i.; the titles of his speeches and works may be found in the *Bibl. Cornubiensis*, vol. i. and iii.

MOLFETTA, a seaport and episcopal see of Apulia, Italy, in the province of Bari, from which it is 16 m. N.N.W. by rail. Pop. (1901), 42,363. The old cathedral of S. Conrad is a Romanesque structure. The old town is surrounded by walls, and has medieval houses; the new town is more spacious, and is an active seaport. The origin of Molfetta is uncertain, though there was a neolithic settlement here. The town was given by Charles V. to the duke of Termoli in 1522, and during his lordship it was sacked by the French under Lautrec. In 1631 Cesare Gonzaga took the title of duke of Guastalla and prince of Molfetta; but in 1640 the fief was sold to the Spinola family, and in 1798 incorporated with the royal domain. The bishopric is directly subject to the papal see.

MOLIÈRE (1622–1673), the *nom de théâtre* chosen, for some undiscovered reason, by the great French dramatist Jean Baptiste Poquelin, and ever since substituted for his family name. He was born in Paris, probably in January 1622. The baptismal certificate which is usually, and almost with absolute certainty, accepted as his is dated 15th January 1622, but it is not possible to infer that he was born on the day of his christening. The exact place of his birth is also disputed, but it seems tolerably certain that he saw the light in a house of the Rue St Honoré. His father was Jean Poquelin, an upholsterer, who, in 1631, succeeded his own uncle as "valet tapissier de chambre du roi." The family of Poquelin came from Beauvais, where for some centuries they had been prosperous tradesmen. The legend of their Scotch descent seems to have been finally disproved by the researches of M. E. Révérend du Mesnil. The mother of Molière was Marie Cressé; and on his father's side he was connected with the family of Mazuel, musicians attached to the court of France. In 1632 Molière lost his mother; his father married again in 1633. The father possessed certain shops in the covered Halle de la Foire, Saint Germain des Prés, and the biographers have imagined that Molière might have received his first bent towards the stage from the spectacles offered to the holiday people at the fair. Of his early education little is known; but it is certain that his mother possessed a Bible and Plutarch's *Lives*, books which an intelligent child would not fail to study. In spite of a persistent tradition, there is no reason to believe that the later education of Molière was neglected. "Il fit ses humanitez au collège de Clermont," says the brief life of the comedian published by his friend and fellow-actor, La Grange, in the edition of his works printed in 1682. La Grange adds that Molière "eut l'advantage de suivre M. le Prince de Conti dans toutes ses classes." As Conti was seven years younger than Molière, it is not easy to understand how Molière came to be the school contemporary of the prince. Among more serious studies the Jesuit fathers encouraged their pupils to take part in *ballets*, and in later life Molière was a distinguished master of this sort of entertainment. According to Grimarest, the first writer who published a life of Molière in any detail (1705), he not only acquired "his humanities," but finished his "philosophy" in five years. He left the Collège de Clermont in 1641, the year when Gassendi, a great contemner of Aristotle, arrived in Paris. The *Logic* and *Ethics* of Aristotle, with his *Physics* and *Metaphysics*, were the chief philosophical textbooks at the Collège de Clermont. But when he became the pupil of Gassendi (in company with Cyrano de Bergerac, Chapelle, and Hesnaut), Molière was taught to appreciate the atomic philosophy of Lucretius. There seems no doubt that Molière began, and almost or quite finished, a translation of the *De natura rerum.* According to a manuscript note of Trallage, published by M. Paul Lacroix, the manuscript was sold by Molière's widow to a bookseller. His philosophic studies left a deep mark on the genius of Molière. In the *Jugement de Pluton sur les deux parties des nouveaux dialogues des morts* (1684), the verdict is "que Molière ne parleroit point de philosophie." To "talk philosophy" was a favourite exercise of his during his life, and his ideas are indicated with sufficient clearness in several of his plays. There seems no connexion between them and the opinions of "Molière le Critique" in a dialogue of that name, published in Holland in 1709. From his study of philosophy, too, he gained his knowledge of the ways of contemporary pedants: of Pancrace the Aristotelian, of Marphorius the Cartesian, of Trissotin, "qui s'attache pour l'ordre au Péripatétisme," of Philaminte, who loves Platonism, of Belise, who relishes "les petits corps," and Armande, who loves "les tourbillons." Grimarest has an amusing anecdote of a controversy in which Molière, defending Descartes, chose a lay-brother of a begging order for umpire, while Chapelle appealed to the same expert in favour of Gassendi. His college education over, Molière studied law, and there is even evidence—that of tradition in Grimarest, and of Le Boulanger de Chalussay, the libellous author of a play called *Élomire hypochondre*—to prove that he was actually called to the bar. More trustworthy is the passing remark in La Grange's short biography (1682), "*au sortir des écoles de droit*, il choisit la profession de comédien." Before joining a troop of half-amateur comedians, however, Molière had some experience in his father's business. In 1637 his father had obtained for him the right to succeed to his own office as "valet tapissier de chambre du roi." The document is mentioned in the inventory of Molière's effects, taken after his death. When the king travelled the *valet tapissier* accompanied him to arrange the furniture of the royal quarters. There is very good reason to believe (Loiseleur, *Points obscurs*, p. 94) that Molière accompanied Louis XIII. as his *valet tapissier* to Provence in 1642. It is even not impossible that Molière was the young *valet de chambre* who concealed Cinq Mars just before his arrest at Narbonne, on the 13th of June 1642. But this is part of the romance rather than of the history of Molière. Our next glimpse of the comedian we get in a document of 6th January 1643. Molière acknowledges the receipt of money due to him from his deceased mother's estate, and gives up his claim to succeed his father as "valet de chambre du roi." On the 28th of December of the same year we learn, again from documentary evidence, that Jean Baptiste Poquelin, with Joseph Béjard, Madeleine Béjard, Geneviève Béjard, and others, have hired a tennis-court and fitted it up as a stage for dramatic performances. The company called themselves L'Illustre Théâtre, *illustre* being then almost a slang word, freely employed by the writers of the period.

We now reach a very important point in the private history of Molière, which it is necessary to discuss at some length in defence of the much maligned character of a great writer and a good man. Molière's connexion with the family of Béjard brought him much unhappiness. The father of this family, Joseph Béjard the elder, was a needy man, with eleven children at least. His wife's name was Marie Hervé. The most noted of his children, companions of Molière, were Joseph, Madeleine, Geneviève, and Armande. Of these, Madeleine was a woman of great talent as an actress, and Molière's friend, or perhaps mistress, through all the years of his wanderings. Now, on the 14th of February 1662 (for we must here leave the chronological order of events), Molière married Armande Claire Élisabeth Grésinde Béjard. His enemies at that time, and a number of his biographers in our own day, have attempted to prove that Armande Béjard was not the sister, but the daughter of Madeleine, and even that Molière's wife may have been his own daughter by Madeleine Béjard. The arguments of M. Arsène Houssaye in support of this abominable theory are based on reckless and ignorant confusions, and do not deserve criticism. But the system of M. Loiseleur is more serious, and he goes no further than the idea that Madeleine was the mother of Armande. This, certainly, was the opinion of tradition, an opinion based on the slanders of Montfleury, a rival of Molière's, on the authority of the spiteful and anonymous author of *La Fameuse comédienne* (1688), and on the no less libellous play, *Élomire hypochondre*. In 1821 tradition received a shock, for Beffara then discovered Molière's "acte de mariage," in which Armande, the bride, is spoken of as the sister of Madeleine Béjard, by the same father and mother. The old scandal, or part of it, was revived by M. Fournier and M. Bazin, but received another blow in 1863. M. Soulié then discovered a legal document of the 10th of March 1643, in which the widow of Joseph Béjard renounced, in the name of herself and her children, his inheritance, chiefly a collection of unpaid bills. Now in this document all the children are described as minors, and among them is "une petite non encore baptisée." This little girl, still not christened in March 1643, is universally recognized as the Armande Béjard afterwards married by Molière. We reach this point, then, that when Armande was an infant she was acknowledged as the sister, not as the daughter, of Madeleine Béjard. M. Loiseleur refuses, however, to accept this evidence. Madeleine, says he, had already become the mother, in 1638, of a daughter by Esprit Raymond de Moirmoron, comte de Modène, and chamberlain of Gaston duc d'Orléans, brother of Louis XIII. In 1642 Modène, who had been exiled for political reasons, "was certain to return, for Richelieu had just died, and Louis XIII. was likely to follow him." Now Madeleine was again—this is M. Loiseleur's hypothesis—about to become a mother, and if Modène returned, and learned this fact, he would not continue the liaison, still less would he marry her—which, by the way, he could not do, as his wife was still alive. Madeleine, therefore, induced her mother to acknowledge the little girl as her own child. In the first place, all this is pure unsupported hypothesis. In the second place, it has always been denied that Béjard's wife could have been a mother in 1643, owing to her advanced age, probably fifty-three. But M. Loiseleur himself says that Marie Hervé was young enough to make the story "sufficiently probable." If it was probable, much more was it possible. M. Loiseleur supports his contention by pointing out that two of the other children, described as legally minors, were over twenty-five, and that their age was understated to make the account of Armande's birth more probable. Nothing is less likely than that Modène would have consulted this document to ascertain the truth about the parentage of Armande, yet M. Loiseleur's whole theory rests on that extreme improbability. It must also be observed that the date of the birth of Joseph Béjard is unknown, and he *may* have been, and according to M. Jal (*Dictionnaire critique*, p. 178) *must* have been, a minor when he was so described in the document of the 10th of March 1643, while Madeleine had only passed her twenty-fifth birthday, her legal majority, by two months. This view of Joseph's age is supported by Bouquet (*Molière à Rouen*, p. 77). M. Loiseleur's only other proof is that Marie Hervé gave Armande a respectable dowry, and that, as we do not know whence the money came, it must have come from Madeleine. The tradition in Grimarest, which makes Madeleine behave *en femme furieuse*, when she heard of the marriage, is based on a juster appreciation of the character of women. It will be admitted, probably, that the reasons for supposing that Molière espoused the daughter of a woman who had been his mistress (if she had been his mistress) are flimsy and inadequate. The affair of the dowry is insisted on by M. Livet (*La Fameuse comédienne*, reprint of 1877, p. 143). But M. Livet explains the dowry by the hypothesis that Armande was the daughter of Madeleine and the comte de Modène, which exactly contradicts the theory of M. Loiseleur, and is itself contradicted by dates, at least as understood by M. Loiseleur. Such are the conjectures by which the foul calumnies of Molière's enemies are supported in the essays of modern French critics.

Michelet accepted the scandal apparently as a buttress to his charges against Louis XIV. and Madame (*Histoire de France*, 1879, xv. 63, 64, 332).

To return to the order of events, Molière passed the year 1643 in playing with and helping to manage the Théâtre Illustre. The company acted in various tennis-courts, with very little success. Molière was actually arrested by the tradesman who supplied candles, and the company had to borrow money from one Aubrey to release their leader from the Grand Châtelet (Aug. 13, 1645). The process of turning a tennis-court into a theatre was somewhat expensive, even though no seats were provided in the pit. The troupe was for a short time under the protection of the duc d'Orléans, but his favours were not lucrative. The duc de Guise, according to some verses printed in 1646, made Molière a present of his cast-off wardrobe. But costume was not enough to draw the public to the tennis-court theatre of the Croix Noire, and empty houses at last obliged the Théâtre Illustre to leave Paris at the end of 1646.

"Nul animal vivant n'entra dans nôtre salle," says the author of the scurrilous play on Molière, *Élomire hypochondre*. But at that time some dozen travelling companies found means to exist in the provinces, and Molière determined to play among the rural towns. The career of a strolling player is much the same at all times and in all countries. The *Roman comique* of Scarron gives a vivid picture of the adventures and misadventures, the difficulty of transport, the queer cavalcade of horses, mules, and lumbering carts that drag the wardrobe and properties, the sudden metamorphosis of the tennis-court, where the balls have just been rattling, into a stage, the quarrels with local squires, the disturbed nights in crowded country inns, all the loves and wars of a troupe on the march. Perrault tells us what the arrangements to the theatre were in Molière's early time. Tapestries were hung round the stage, and entrances and exits were made by struggling through the heavy curtains, which often knocked off the hat of the comedian, or gave a strange cock to the helmet of a warrior or a god. The lights were candles stuck in tin sconces at the back and sides, but luxury sometimes went so far that a chandelier of four candles was suspended from the roof. At intervals the candles were let down by a rope and pulley, and any one within easy reach snuffed them with his fingers. A flute and tambour, or two fiddlers, supplied the music. The highest prices were paid for seats in the *dedans* (cost of admission fivepence); for the privilege of standing up in the pit twopence-halfpenny was the charge. The doors were opened at one o'clock, the curtain rose at two.

The nominal director of the Théâtre Illustre in the provinces was Du Fresne; the most noted actors were Molière, the Béjards, and Du Parc, called Gros René. It is extremely difficult to follow exactly the line of march of the company. They played at Bordeaux, for example, but the date of this performance, when Molière (according to Montesquieu) failed in tragedy and was pelted, is variously given as 1644–1645 (Trallage), 1647 (Loiseleur), 1648–1658 (Lacroix). Perhaps the theatre prospered better elsewhere than in Paris, where the streets were barricaded in these early days of the war of the Fronde. We find Molière at Nantes in 1648, at Fontenay-la-Compte, and in the spring of 1649 at Agen, Toulouse, and probably at Angoulême and Limoges. In January 1650 they played at Narbonne, and between 1650 and 1653 Lyons was the headquarters of the troupe. In January 1653, or perhaps 1655, Molière gave *L'Étourdi* at Lyons, the first of his finished pieces, as contrasted with the slight farces with which he generally diverted a country audience. It would be interesting to have the precise date of this piece, but La Grange (1682) says that "in 1653 Molière went to Lyons, where he gave his first comedy, *L'Étourdi*," while in his *Registre* La Grange enters the year as 1655. At Lyons de Brie and his wife, the famous Mlle de Brie, entered the troupe, and du Parc married the "marquise" de Gorla, better known as Mlle du Parc. The libellous author of *La Fameuse comédienne* reports that Molière's heart was the shuttlecock of the beautiful du Parc and de Brie, and the tradition has a persistent life. Molière's own opinion of the ladies and men of his company may be read between the lines of his *Impromptu de Versailles.* In 1653 Prince de Conti, after many political adventures, was residing at La Grange, near Pézénas, in Languedoc, and chance brought him into relations with his old schoolfellow Molière. Conti had for first gentleman of his bed-chamber the abbé Daniel de Cosnac, whose memoirs now throw light for a moment on the fortunes of the wandering troupe. Cosnac engaged the company "of Molière and of La Béjart"; but another company, that of Cormier, nearly intercepted the favour of the prince. Thanks to the resolution of Cosnac, Molière was given one chance of appearing on the private theatre of La Grange. The excellence of his acting, the splendour of the costumes, and the insistence of Cosnac, and of Sarrasin, Conti's secretary, gained the day for Molière, and a pension was assigned to his company (Cosnac, *Mémoires*, i. 128; Paris, 1852). As Cosnac proposed to pay Molière a thousand crowns of his own money to recompense him in case he was supplanted by Cormier, it is obvious that his profession had become sufficiently lucrative. In 1654, during the session of the estates of Languedoc, Molière and his company played at Montpellier. Here Molière danced in a *ballet* (*Le Ballet des incompatibles*) in which a number of men of rank took part, according to the fashion of the time. Molière's own *rôles* were those of the Poet and the Fishwife. The sport of the little piece is to introduce opposite characters, dancing and singing together. Silence dances with six women, Truth with four courtiers, Money with a poet, and so forth. Whether the ballet, or any parts of it, are by Molière, is still disputed (*La Jeunesse de Molière, suivie du ballet des incompatibles*, P. L. Jacob, Paris, 1858). In April 1655 it is certain that the troupe was at Lyons, where they met and hospitably entertained a profligate buffoon, Charles d'Assoucy, who informs the ages that Molière kept open house, and "une table bien garnie." November 1655 found Molière at Pézénas, where the estates of Languedoc were convened, and where local tradition points out the barber's chair in which the poet used to sit and study character. The longest of Molière's extant autographs is a receipt, dated at Pézénas, on the 4th of February 1656, for 6000 livres, granted by the estates of Languedoc. This year was notable for the earliest representation, at Béziers, of Molière's second finished comedy, the *Dépit amoureux.* Conti now (1656) began to "make his soul." Almost his first act of penitence was to discard Molière's troupe (1657), which consequently found that the liberality of the estates of Languedoc was dried up for ever. Conti's relations with Molière must have definitively closed long before 1666, when the now pious prince wrote a treatise against the stage, and especially charged his old schoolfellow with keeping a new school, a school of atheism (*Traité de la comédie,* p. 24; Paris, 1666). Molière was now (1657) independent of princes and their favour. He went on a new circuit to Nismes, Orange and Avignon, where he met another old class-mate, Chapelle, and also encountered the friend of his later life, the painter Mignard. After a later stay at Lyons, ending with a piece given for the benefit of the poor on the 27th of February 1658, Molière passed to Grenoble, returned to Lyons, and is next found in Rouen, where, we should have said, the Théâtre Illustre had played in 1643 (F. Bouquet, *La Troupe de Molière à Rouen*, p. 90; Paris, 1880). At Rouen Molière must have made or renewed the acquaintance of Pierre and Thomas Corneille. His company had played pieces by Corneille at Lyons and elsewhere. The real business of the comedian in Rouen was to prepare his return to Paris. "After several secret journeys thither he was fortunate enough to secure the patronage of Monsieur, the king's only brother, who granted him his protection, and permitted the company to take his name, presenting them as his servants to the king and the queen mother" (Preface to La Grange's edition of 1682). The troupe appeared for the first time before Louis XIV. in a theatre arranged in the old Louvre (Oct. 24, 1658).

Molière was now thirty-six years of age. He had gained all the experience that fifteen years of practice could give. He had seen men and cities, and noted all the humours of rural and civic France. He was at the head of a company which, as La Grange, his friend and comrade, says, "sincerely loved him." He had the unlucrative patronage of a great prince to back him, and the jealousy of all playwrights, and of the old theatres of the Hôtel de Bourgogne and the Marais, to contend against. In this struggle we can follow him by aid of the *Registre* of La Grange (a brief diary of receipts and payments), and by the help of notices in the rhymed chronicles of Loret.

The first appearance of Molière before the king was all but a failure. *Nicomède*, by the elder Corneille, was the piece, and we may believe that the actors of the Hôtel de Bourgogne, who were present, found much to criticize. When the play was over, Molière came forward and asked the king's permission to act "one of the little pieces with which he had been used to regale the provinces." The *Docteur amoureux*, one of several slight comedies admitting of much "gag," was then performed, and "diverted as much as it surprised the audience." The king commanded that the troupe should establish itself in Paris (Preface, ed. 1682). The theatre assigned to the company was a *salle* in the Petit Bourbon, in a line with the present Rue du Louvre. Some Italian players already occupied the house on Tuesdays, Fridays, and Sundays; the company of Molière played on the other days. The first piece played in the new house (Nov. 3, 1658) was *L'Étourdi.* La Grange says the comedy had a great success, producing seventy pistoles for each actor. The success is admitted even by the spiteful author of *Élomire hypochondre* (Paris, 1670):—

> "Je jouai *l'Étourdi*, qui fut une merveille."

The success, however, is attributed to the farcical element in the play and the acting—the cuckoo-cry of Molière's detractors. The original of *L'Étourdi* is the Italian comedy (1629) *L'Inavvertito*, by Nicolò Barbieri detto Beltrame; Molière pushed rather far his right to "take his own wherever he found it." Had he written nothing more original, the contemporary critic of the *Festin de Pierre* might have said, not untruly, that he only excelled in stealing pieces from the Italians. The piece is conventional: the stock characters of the prodigal son, the impudent valet, the old father occupy the stage. But the dialogue has amazing rapidity, and the vivacity of M. Coquelin to Mascarille made *L'Étourdi* a favourite on the modern stage, though it cannot be read with very much pleasure. The next piece, new in Paris, though not in the provinces, was the *Dépit amoureux* (first acted at Béziers, 1656). The play was not less successful than *L'Étourdi*. It has two parts, one an Italian *imbroglio*; the other, which alone keeps the stage, is the original work of Molière, though, of course, the idea of *amantium irae* is as old as literature. "Nothing so good," says Mr Saintsbury, "had yet been seen on the French stage, as the quarrels and reconciliations of the quartette of master, mistress, valet and soubrette." Even the hostile Le Boulanger de Chalussay (*Élomire hypochondre*) admits that the audience was much of this opinion:—

> "Et de tous les côtés chacun cria tout haut:
> 'C'est la faire et jouer les pièces comme il faut.'"

The same praise was given, perhaps even more deservedly, to *Les Précieuses ridicules* (Nov. 18, 1659). Doubts have been raised as to whether this famous piece, the first true comic satire of contemporary foibles on the French stage, was a new play. La Grange calls it *pièce nouvelle* in his *Registre*; but, as he enters it as the third *pièce nouvelle*, he may only mean that, like *L'Étourdi*, it was new to Paris. The short life of 1682, produced under La Grange's care, and probably written by Marcel the actor, says the *Précieuses* was "made" in 1659. There is another controversy as to whether the ladies of the Hôtel Rambouillet, or merely their *bourgeoises* and rustic imitators, were laughed at. Ménage, in later years at least, professed to recognize an attack on the over-refinement and affectation of the original and, in most ways, honourable *précieuses* of the Hôtel Rambouillet. But Chapelle and Bachaumont had discovered provincial *précieuses*, hyper-aesthetic literary ladies, at Montpellier before Molière's return to Paris; and Furetière, in the *Roman bourgeois* (1666), found Paris full of middle-class *précieuses*, who had survived, or, like their modern counterparts, had thriven on ridicule. Another question is: Did Molière copy from the earlier *Précieuses* of the abbé de Pure? This charge of plagiarism is brought by Somaize, in the preface to his *Véritables précieuses*. De Pure's work was a novel (1656), from which the Italian actors had put together an acting-piece in their manner—that is, a thing of "gag," and improvised speeches. The reproach is interesting only because it proves how early Molière found enemies who, like Thomas Corneille in 1659, accused him of being skilled only in farce, or, like Somaize, charged him with literary larceny. These were the stock criticisms of Molière's opponents as long as he lived. The success of the *Précieuses ridicules* was immense; on one famous occasion the king was a spectator, leaning against the great chair of the dying Cardinal Mazarin. The play can never cease to please while literary affectation exists, and it has a comic force of deathless energy. Yet a modern reader may spare some sympathy for the poor heroines, who do not wish, in courtship, to "begin with marriage," but prefer first to have some less formidable acquaintance with their wooers. Molière's next piece was less important, and more purely farcical, *Sganarelle; ou le cocu imaginaire* (May 28, 1660). The public taste preferred a work of this light nature, and *Sganarelle* was played every year as long as Molière lived. The play was pirated by a man who pretended to have retained all the words in his memory. The counterfeit copy was published by Ribou, a double injury to Molière, as, once printed, any company might act the play. With his habitual good-nature, Molière not only allowed Ribou to publish later works of his, but actually lent money to that knave (Soulié, *Recherches*, p. 287).

On the 11th of October 1660 the Théâtre du Petit Bourbon was demolished by the superintendent of works, without notice given to the company. The king gave Molière the Salle du Palais Royal, but the machinery of the old theatre was maliciously destroyed. Meanwhile the older companies of the Marais and the Hôtel de Bourgogne attempted to lure away Molière's troupe, but, as La Grange declares (*Registre*, p. 26), "all the actors loved their chief, who united to extraordinary genius an honourable character and charming manner, which compelled them all to protest that they would never leave him, but always share his fortunes." While the new theatre was being put in order, the company played in the houses of the great, and before the king at the Louvre. In their new house (originally built by Richelieu) Molière began to play on the 20th of January 1661. Molière now gratified his rivals by a failure. *Don Garcie de Navarre*, a heavy tragi-comedy, which had long lain among his papers, was first represented on the 4th of February 1661. Either Molière was a poor actor outside comedy, or his manner was not sufficiently "stagy," and, as he says, "demoniac," for the taste of the day. His opponents were determined that he could not act in tragi-comedy, and he, in turn, burlesqued their pretentious and exaggerated manner in a later piece. In the *Précieuses* (sc. ix.) Molière had already rallied "les grands comédiens" of the Hôtel Bourgogne. "Les autres," he makes Mascarille say about his own troupe, "sont des ignorants qui récitent comme l'on parle, ils ne savent pas faire ronfler les vers." All this was likely to irritate the *grands comédiens*, and their friends, who avenged themselves on that unfortunate jealous prince, Don Garcie de Navarre. The subject of this unsuccessful drama is one of many examples which show how Molière's mind was engaged with the serious or comic aspects of jealousy, a passion which he had soon cause to know most intimately. Meantime the everyday life of the stage went on, and the doorkeeper of the Théâtre St Germain was wounded by some revellers who tried to force their way into the house (La Grange, *Registre*). A year later, an Italian actor was stabbed in front of Molière's house, where he had sought to take shelter (Campardon, *Nouvelles pièces*, p. 20). To these dangers actors were peculiarly subject: Molière himself was frequently threatened by the marquises and others whose class he ridiculed on the stage, and there seems even reason to believe that there is some truth in the story of the angry marquis who rubbed the poet's head against his buttons, thereby cutting his face severely. The story comes late (1725) into his biography, but is supported by a passage in the contemporary play, *Zélinde* (Paris, 1663, scene viii.). Before Easter, Molière asked for two shares in the profits of his company, one for himself, and one for his wife, if he married. That fatal step was already contemplated (La Grange). On the 24th of June he brought out for the first time *L'École des maris*. The general idea of the piece is as old as Menander, and Molière was promptly accused of pilfering from the *Adelphi* of Terence. One of the *ficelles* of the comedy is borrowed from a story as old, at least, as Boccaccio, and still amusing in a novel by Charles de Bernard. It is significant of Molière's talent that the grotesque and baffled paternal wooer, Sganarelle, like several other butts in Molière's comedy, does to a certain extent win our sympathy and pity as well as our laughter. The next new piece was *Les Fascheux*, a *comédie-ballet*, the Comedy of Bores, played before the king at Fouquet's house at Vaux le Vicomte (Aug. 15–20, 1661). The comedians, without knowing it, were perhaps the real "fascheux" on this occasion, for Fouquet was absorbed in the schemes of his insatiable ambition (*Quo non ascendam?* says his motto), and the king was organizing the arrest and fall of Fouquet, his rival in the affections of La Vallière. The author of the prologue to *Les Fascheux*, Pellisson, a friend of Fouquet's, was arrested with the superintendent of finance. Pellisson's prologue and name were retained in the later editions. In the dedication to the king Molière says that Louis suggested one scene (that of the Sportsman), and in another place he mentions that the piece was written, rehearsed, and played in a fortnight. The fundamental idea of the play, the interruptions by bores, is suggested by a satire of Régnier's, and that by a satire of Horace. Perhaps it may have been the acknowledged suggestions of the king which made gossips declare that Molière habitually worked up hints and *mémoires* given him by persons of quality (*Nouvelles nouvelles*, 1663).

In February 1662 Molière married Armande Béjard. The date is given thus in the *Registre* of La Grange: "Mardy 14, Les Visionnaires, L'École des M.

"Part. Visite chez Mᵉ d'Equeuilly."

And on the margin he has painted a blue circle—his way of recording a happy event—with the words, "mariage de M. de Molière au sortir de la Visite." M. Loiseleur gives the date in one passage as the 29th of February; in another as the 20th of

February. But La Grange elsewhere mentions the date as "Shrove Tuesday," which was, it seems, the 14th of February. Elsewhere M. Loiseleur makes the date of the marriage a vague day "in January." The truth is that the marriage contract is dated the 23rd of January 1662 (Soulié, *Documents*, p. 203). Where it is so difficult to establish the date of the marriage, a simple fact, it must be infinitely harder to discover the truth as to the conduct of Mme Molière. The abominable assertions of the anonymous libel, *Les Intrigues de Molière et celles de sa femme; ou la fameuse comédienne* (1688), have found their way into tradition, and are accepted by many biographers. But M. Livet and M. Bazin have proved that the alleged lovers of Mme Molière were actually absent from France, or from the court, at the time when they are reported, in the libel, to have conquered her heart. A conversation between Chapelle and Molière, in which the comedian is made to tell the story of his wrongs, is plainly a mere fiction, and is answered in Grimarest by another dialogue between Molière and Rohault, in which Molière only complains of a jealousy which he knows to be unfounded. It is noticed, too, that the contemporary assailants of Molière counted him among jealous, but not among deceived, husbands. The hideous accusation brought by the actor Montfleury, that Molière had married his own daughter, Louis XIV. answered by becoming the godfather of Molière's child. The king, indeed, was a firm friend of the actor, and, when Molière was accused of impiety on the production of *Don Juan* (1665) Louis gave him a pension. We need not try to make Mme Molière a *vertu*, as French ladies of the theatre say, but it is certain that the charges against her are unsubstantiated. It is generally thought that Molière drew her portrait in *Le Bourgeois gentilhomme* (acte III. sc. ix.), "elle est capricieuse, mais on souffre tout des belles."

From 1662 onwards Molière suffered the increasing hatred of his rival actors. La Grange mentions the visit of Floridor and Montfleury to the queen mother, and their attempt to obtain equal favour, "la troupe de Molière leur donnant beaucoup de jalouzie" (Aug. 12, 1662). On the 26th of December was played for the first time the admirable *École des femmes*, which provoked a literary war, and caused a shower of "paper bullets of the brain." The innocence of Agnes was called indecency; the sermon of Arnolphe was a deliberate attack on Christian mysteries. We have not the space to discuss the religious ideas of Molière; but both in *L'École des femmes* and in *Don Juan* he does display a bold contempt for the creed of "boiling chaldrons" and of physical hell. A brief list of the plays and pamphlets provoked by *L'École des femmes* is all we can offer in this place.

December 26, 1662.—*École des femmes.*

February 9, 1663.—*Nouvelles nouvelles*, by De Visé. Molière is accused of pilfering from Straparola.

June 1, 1663.—Molière's own piece, *Critique de l'école des femmes.* In this play Molière retorts on the critics, and especially on his favourite butt, the critical marquess.

August 1663.—*Zélinde*, a play by De Visé, is printed. The scene is in the shop of a seller of lace, where persons of quality meet, and attack the reputation of "Élomire"—that is, Molière. He steals from the Italian, the Spanish, from Furetière's *Francion*, "il lit tous les vieux bouquins," he insults the *noblesse*, he insults Christianity, and so forth.

November 17, 1663.—*Portrait du peintre* is printed—an attack on Molière by Boursault. This piece is a detailed criticism, by several persons, of *L'Ecole des femmes.* It is pronounced dull, vulgar, farcical, obscene and (what chiefly vexed Molière, who knew the danger of the accusation) impious. Perhaps the only biographical matter we gain from Boursault's play is the interesting fact that Molière was a tennis-player. On the 4th November 1663, Molière replied with *L'Impromptu de Versailles*, a witty and merciless attack on his critics, in which Boursault was mentioned by name. The actors of the Hôtel de Bourgogne were parodied on the stage, and their art was ridiculed.

The next scenes in this comedy of comedians were:—

November 30.—The *Panégyrique de l'école des femmes*, by Robinet.

December 7.—*Réponse à l'impromptu; ou la vengeance des marquis*, by De Visé.

January 19, 1664.—*L'Impromptu de l'hôtel de Condé.* It is a reply by a son of Montfleury.

March 17, 1664.—*La Guerre comique; ou défense de l'école des femmes.*

1664.—*Lettre sur les affaires du théâtre*, published in *Diversités galantes*, by the author of *Zélinde.*

In all those quarrels the influence of Corneille was opposed to Molière, while his cause was espoused by Boileau, a useful ally, when "les comédiens et les auteurs, depuis le cèdre [Corneille?] jusqu'à l'hysope, sont diablement animés contre lui" (*Impromptu de Versailles*, sc. v.).

Molière's next piece was *Le Mariage forcé* (Feb. 15, 1664), a farce with a ballet. The comic character of the reluctant bridegroom excites contemptuous pity, as well as laughter. From the end of April till the 22nd of May the troupe was at Versailles, acting among the picturesque pleasures of that great festival of the king's. The *Princesse d'Élide* was acted for the first time, and the three first acts of *Tartuffe* were given. Molière's natural hatred of hypocrisy had not been diminished by the charges of blasphemy which were showered on him after the *École des femmes.* *Tartuffe* made enemies everywhere. Jansenists and Jesuits, like the two marquesses in *L'Impromptu de Versailles*, each thought the others were aimed at. Five years passed before Molière got permission to play the whole piece in public. In the interval it was acted before Madame, Condé, the legate, and was frequently read by Molière in private houses. The *Gazette* of the 17th of May 1664 (a paper hostile to Molière) says that the king thought the piece inimical to religion. Louis was not at that time on good terms with the *dévots*, whom his amours scandalized; but, not impossibly, the queen mother (then suffering from her fatal malady) disliked the play. A most violent attack on Molière, "that demon clad in human flesh," was written by one Pierre Roullé (*Le Roy glorieux au monde*, Paris, 1664). This fierce pamphlet was suppressed, but the king's own copy, in red morocco with the royal arms, remains to testify to the bigotry of the author, who was curé of Saint Barthélemy. According to Roullé, Molière deserved to be sent through earthly to eternal fires. The play was prohibited, as we have seen, but in August 1665 the king adopted Molière's troupe as his servants, and gave them the title of "troupe du roy." This, however, did not cause Molière to relax his efforts to obtain permission for *Tartuffe* (or *Tartufe*, or *Tartufle*, as it was variously spelled), and his perseverance was at length successful. That his thoughts were busy with contemporary hypocrisy is proved by certain scenes in one of his greatest pieces, the *Festin de Pierre*, or *Don Juan* (Feb. 15, 1665). The legend of *Don Juan* was familiar already on the Spanish, Italian and French stages. Molière made it a new thing: terrible and romantic in its portrait of *un grand seigneur mauvais homme*, modern in its suggested substitution of *la humanité* for religion, comic, even among his comedies, by the mirthful character of Sganarelle. The piece filled the theatre, but was stopped, probably by authority, after Easter. It was not printed by Molière, and even in 1682 the publication of the full text was not permitted. Happily the copy of De la Regnie, the chief of the police, escaped obliterations, and gave us the full scene of Don Juan and the Beggar. The piece provoked a virulent criticism (*Observations sur le festin de Pierre*, 1665). It is allowed that Molière has some farcical talent, and is not unskilled as a plagiarist, but he "attacks the interests of Heaven," "keeps a school of infidelity," "insults the king," "corrupts virtue," "offends the queen-mother" and so forth. Two replies were published, one of which is by some critics believed to show traces of the hand of Molière. The king's reply, as has been shown, was to adopt Molière's company as his servants, and to pension them. *L'Amour médecin*, a light comedy, appeared on the 22nd of September 1665. In this piece Molière, for the second time, attacked physicians. In December there was a quarrel with Racine about his play of *Alexandre*, which he treacherously transferred to the Hôtel de Bourgogne. The 4th of June 1666 saw the first representation of that famous play, *Le Misanthrope* (*ou L'Atrabiliaire amoureux*, as the original second title ran). This piece, perhaps the masterpiece of Molière, was more successful with the critics, with the court, and with posterity than with the public. The rival comedians called it "a new style of comedy," and so it was. The eternal passions and sentiments of human nature, modified by the influence of the utmost refinement of civilization, were the matter of the piece. The school for scandal kept by Célimène, with its hasty judgments on all characters, gave the artist a wide canvas. The perpetual strife between the sensible optimism of a kindly man of the world (Philinte) and the *saeva indignatio* of a noble nature soured (Alceste) supplies the intellectual action. The humours of the joyously severe Célimène and of her court, especially of that deathless minor poet Oronte, supply the lighter comedy. Boileau, Lessing, Goethe have combined to give this piece the highest rank even among the comedies of Molière. As to the "keys" to the characters, and the guesses about the original from whom Alceste was drawn, they are as valueless as other contemporary tattle.

A briefer summary must be given of the remaining years of the life of Molière. The attractions of *Le Misanthrope* were reinforced (Aug. 6) by those of the *Médecin malgré lui*, an amusing farce founded on an old *fabliau*. In December the court and the comedians went to St Germain, where, among other diversions, the pieces called *Mélicerte*, *La Pastorale comique* (of which Molière is said to have destroyed the MS.) and the charming little piece *Le Sicilien* were performed. A cold and fatigue seem to have injured the health of Molière, and we now hear of the consumptive tendency which was cruelly ridiculed in *Élomire hypochondre*. Molière was doubtless obliged to see too much of the distracted or pedantic physicians of an age when medicine was the battlefield of tradition, superstition, and nascent chemical science. On the 17th of April 1667 Robinet, the rhyming gazetteer, says that the life of Molière was thought to be in danger. On the 10th of June, however, he played in *Le Sicilien* before the town. In the earlier months of 1667 Louis XIV. was with the army in Flanders. There were embassies sent from the comedy to the camp, and on the 5th of August it was apparent that Molière had overcome the royal scruples. *Tartuffe* was played, but Lamoignon stopped it after the first night. La Grange and La Torillière hastened to the camp, and got the king's promise that he would reconsider the matter on his return. Molière's next piece (Jan. 13, 1668) was *Amphitryon*, a free—a very free—adaptation from Plautus, who then seems to have engaged his attention; for not long afterwards he again borrowed from the ancient writer in *L'Avare*. There is a controversy as to whether *Amphitryon* was meant to ridicule M. de Montespan, the husband of the new mistress of Louis XIV. Michelet has a kind of romance based on this probably groundless hypothesis. The king still saw the piece occasionally, after he had purged himself and forsworn sack under Mme de Maintenon, and probably neither he nor that devout lady detected any personal references in the coarse and witty comedy. As usual, Molière was accused of plagiarizing, this time from Rotrou, who had also imitated Plautus. The next play was the immortal *George Dandin* (July 10), first played at a festival at Versailles. Probably the piece was a rapid palimpsest on the ground of one of his old farces, but the addition of these typical members of a county family, the De Sotenville, raises the work from farce to satiric comedy. The story is borrowed from Boccaccio, but is of unknown age, and always new—Adolphus Crosbie in *The Small House at Allington* being a kind of modern George Dandin. Though the sad fortunes of this peasant with social ambition do not fail to make us pity him somewhat, it is being too refined to regard *George Dandin* as a comedy with a concealed tragic intention. Molière must have been at work on *L'Avare* before *George Dandin* appeared, for the new comedy after Plautus was first acted on the 9th of September. There is a tradition that the piece almost failed; but, if unpopular in the first year of its production, it certainly gained favour before the death of its author. *M. de Pourceaugnac* (Sept. 17, 1669) was first acted at Chambord, for the amusement of the king. It is a rattling farce. The physicians, as usual, bore the brunt of Molière's raillery, some of which is still applicable. Earlier in 1669 (Feb. 5) *Tartuffe* was played at last, with extraordinary success. *Les Amants magnifiques*, a comedy-ballet, was acted first at St Germain (Feb. 10, 1670). The king might have been expected to dance in the ballet, but from Racine's *Britannicus* (Dec. 13, 1669) the majestical monarch learned that Nero was blamed for exhibitions of this kind, and he did not wish to out-Nero Nero. Astrology this time took the place of medicine as a butt, but the satire has become obsolete, except, perhaps, in Turkey, where astrology is still a power. The *Bourgeois gentilhomme*, too familiar to require analysis, was first played on the 23rd of October 1770. The lively *Fourberies de Scapin* "saw the footlights" (if footlights there were) on the 24th of May 1671, and on the 7th of May we read in La Grange, "les Repetitions de Spsyche ont commancé." La Grange says the theatre was newly decorated and fitted with machines. A "concert of twelve violins" was also provided, the company being resolute to have everything handsome about them. New singers were introduced, who did not refuse to sing unmasked on the stage. Quinault composed the words for the music, which was by Lulli; Molière and Pierre Corneille collaborated in the dialogue of this magnificent opera, the name of which (*Psyche*) La Grange eventually learned how to spell. The *Comtesse d'Escarbagnas* (Feb. 2, 1672) was another piece for the amusement of the court, and made part of an entertainment called *Le Ballet des ballets*. In this play, a study of provincial manners, Molière attacked the financiers of the time in the person of M. Harpin. The comedy has little importance compared with *Les Femmes savantes* (Feb. 11), a severer *Précieuses*, in which are satirized the vanity and affectation of sciolists, pedants and the women who admire them. The satire is never out of date, and finds its modern form in *Le Monde où l'on s'ennuie*, by M. Pailleron. On the 17th of February Madeleine Béjard died, and was buried at St Paul. She did not go long before her old friend or lover Molière. His *Mariage forcé*, founded, perhaps, on a famous anecdote of Gramont, was played on the 18th of July. On the 7th of August La Grange notes that Molière was indisposed, and there was no comedy. Molière's son died on the 11th of October. On the 22nd of November the preparations for the *Malade imaginaire* were begun. On the 10th of February 1673 the piece was acted for the first time. What occurred on the 17th of February we translate from the *Registre* of La Grange:—

"This same day, about ten o'clock at night, after the comedy, Monsieur de Molière died in his house, Rue de Richelieu. He had played the part of the said Malade, suffering much from cold and inflammation, which caused a violent cough. In the violence of the cough he burst a vessel in his body, and did not live more than half an hour or three-quarters after the bursting of the vessel. His body is buried at St Joseph's, parish of St Eustache. There is a gravestone raised about a foot above the ground."

Molière's funeral is thus described in a letter, said to be by an eyewitness, discovered by M. Benjamin Fillon:—

"Tuesday, 21st February, about nine in the evening, was buried Jean Baptiste Poquelin Molière, *tapissier valet de chambre*, and a famous actor. There was no procession, except three ecclesiastics; four priests bore the body in a wooden bier covered with a pall, six children in blue carried candles in silver holders, and there were lackeys with burning torches of wax. The body . . . was taken to St Joseph's churchyard, and buried at the foot of the cross. There was a great crowd, and some twelve hundred livres were distributed among the poor. The archbishop had given orders that Molière should be interred without any ceremony, and had even forbidden the clergy of the diocese to do any service for him. Nevertheless a number of masses were commanded to be said for the deceased."

When an attempt was made to exhume the body of Molière in 1792, the wrong tomb appears to have been opened. Unknown is the grave of Molière.

Molière, according to Mlle Poisson, who had seen him in her extreme youth, was "neither too stout nor too thin, tall rather than short; he had a noble carriage, a good leg, walked slowly, and had a very serious expression. His nose was thick, his mouth large with thick lips, his complexion brown, his eyebrows black and strongly marked, and it was his way of moving these that gave him his comic expression on the stage." "His eyes seemed to search the deeps of men's hearts," says the author of *Zélinde*. The inventories printed by M. Soulié prove that Molière was fond of rich dress, splendid furniture, and old books. The charm of his conversation is attested by the names of his friends, who were all the wits of the age, and the greater their genius the greater their love of Molière. As an actor, friends and enemies agreed in recognizing him as most successful in comedy. His ideas of tragic declamation were in advance of his time, for he set his face against the prevalent habit of ranting. His private character was remarkable for gentleness, probity, generosity and delicacy, qualities attested not only by anecdotes but by the evidence of documents. He is probably the greatest of all comic writers within the limits of social and refined, as distinguished from romantic, comedy like that of Shakespeare, and political comedy like that of Aristophanes. He has the humour which is but a sense of the true value of life, and now takes the form of the most vivacious wit and the keenest observation, now of melancholy and pity and wonder at the fortunes of mortal men. In the literature of France his is the greatest name, and in the literature of the modern drama the greatest after that of Shakespeare. Besides his contemplative genius he possessed an unerring knowledge of the theatre, the knowledge of a great actor and a great manager, and hence his plays can never cease to hold the stage, and to charm, if possible, even more in the performance than in the reading.

The best biography of Molière on a level with the latest researches into his life is that in vol. x. of his works in *Grands écrivains de la France* (Eugène Despois and Paul Mesnard). The next best is probably that of M. Taschereau, prefixed to an edition of his works (*Œuvres complètes*, Paris, 1863). To this may be added Jules Loiseleur's *Les Points obscurs de la vie de Molière* (Paris, 1877). We have seen that M. Loiseleur is not always accurate, but he is laborious. For other books it is enough to recommend the excellent *Bibliographie moliéresque* of M. Paul Lacroix (1875), which is an all but faultless guide. The best edition of Molière's works for the purposes of the student is that published in *Les Grands écrivains de la France* (Hachette, Paris, 1874–1882). It contains reprints of many contemporary tracts, and, with the *Registre* of La Grange, and the *Collection moliéresque* of M. Lacroix, is the chief source of the facts stated in this notice, in cases where the rarity of documents has prevented the writer from studying them in the original texts. Another valuable authority is the *Recherches sur Molière et sur sa famille* of Ed. Soulié (1863). Lotheisen's *Molière, sein Leben und seine Werke* (Frankfurt, 1880), is a respectable German compilation. *Le Moliériste* (Tresse, Paris, ed. by M. Georges Monval) was a monthly serial, containing notes on Molière and his plays, by a number of contributors. The essays, biographies, plays and poems on Molière are extremely numerous. The best guide to these is the indispensable *Bibliographie* of M. Lacroix. (A. L.)

MOLINA, LUIS (1535–1600), Spanish Jesuit, was born at Cuenca in 1535. Having at the age of eighteen become a member of the Society of Jesus, he studied theology at Coimbra, and afterwards became professor in the university of Evora, Portugal. From this post he was called, at the end of twenty years, to the chair of moral theology in Madrid, where he died on the 12th of October 1600. Besides other works he wrote *Liberi arbitrii cum gratiae donis, divina praescientia, providentia, praedestinatione et reprobatione, concordia* (4to, Lisbon, 1588); a commentary on the first part of the *Summa* of Thomas Aquinas (2 vols., fol., Cuenca, 1593); and a treatise *De justitia et jure* (6 vols., 1593–1609). It is to the first of these that his fame is principally due. It was an attempt to reconcile, in words at least, the Augustinian doctrines of predestination and grace with the Semipelagianism which, as shown by the recent condemnation of Baius (*q.v.*), had become prevalent in the Roman Catholic Church. Assuming that man is free to perform or not to perform any act whatever, Molina maintains that this circumstance renders the grace of God neither unnecessary nor impossible: not impossible, for God never fails to bestow grace upon those who ask it with sincerity; and not unnecessary, for grace, although not an efficient, is still a sufficient cause of salvation. Nor, in Molina's view, does his doctrine of free-will exclude predestination. The omniscient God, by means of His "scientia media" (the phrase is Molina's invention, though the idea is also to be found in his older contemporary Fonseca), or power of knowing future contingent events, foresees how we shall employ our own free-will and treat His proffered grace, and upon this foreknowledge He can found His predestinating decrees. These doctrines, although in harmony with the prevailing feeling of the Roman Catholic Church of the period, and further recommended by their marked opposition to the teachings of Luther and Calvin, excited violent controversy in some quarters, especially on the part of the Dominicans, and at last rendered it necessary for the pope (Clement VIII.) to interfere. At first (1594) he simply enjoined silence on both parties so far as Spain was concerned; but ultimately, in 1598, he appointed the "Congregatio de auxiliis Gratiae" for the settlement of the dispute, which became more and more a party one. After holding very numerous sessions, the "congregation" was able to decide nothing, and in 1607 its meetings were suspended by Paul V., who in 1611 prohibited all further discussion of the question "de auxiliis," and studious efforts were made to control the publication even of commentaries on Aquinas. The Molinist subsequently passed into the Jansenist controversy (see Jansenism).

A full account of Molina's theology will be found in Schneeman's "Entstehung der thomistisch-molinistischen Controverse," published in the Appendices (Nos. 9, 13, 14) to the Jesuit periodical, *Stimmen aus Maria-Laach*. To the lay reader may be recommended Ernest Renan's article, "Les congrégations *de auxiliis*" in his *Nouvelles études d'histoire religieuse*.

MOLINE, a city of Rock Island county, Illinois, U.S.A., in the north-west part of the state, on the Mississippi river, adjoining the city of Rock Island and opposite the upper end of Rock Island. Pop. (1900), 17,248, of whom 5699 were foreign-born, principally Swedes and Belgians; (1910 census), 24,199. It is served by the Chicago, Burlington & Quincy, the Chicago, Milwaukee & St Paul, the Chicago, Rock Island & Pacific, and the Davenport, Rock Island & North-Western railways. A channel in the Mississippi river here, 250 ft. wide and 4 ft. deep at low water, projected in 1905, was completed in 1908; and in 1907 a lock was finished which affords a draught of 6 ft. and is a part of the 6 ft. channel improvement of Rock Island Rapids. The city has large and varied manufacturing industries; water-power is derived from a dam maintained by the Moline Water-Power Company; and there is a large electric-power plant. The most important industry is the manufacture of agricultural implements (particularly steel ploughs, which seem to have been made here first in the United States, and corn-planters). Among the other manufactures are boilers and gasolene engines, wagons and carriages, automobiles, and pianos and organs. The Chicago, Rock Island & Pacific railway has a 900-acre yard and machine shop east of the city limits, and there is a large U.S. arsenal on Rock Island. Moline was settled in 1832, laid out as a town in 1842, and was chartered as a city in 1855 and rechartered in 1872.

MOLINET, JEAN (1433–1507), French poet and chronicler, was born at Desvres (Pas de Calais). In 1475 he succeeded Georges Chastellain as historiographer of the house of Burgundy, and Margaret of Austria, governor of the Low Countries, made him her librarian. His continuation of Chastellain's chronicle, which covers the years from 1474 to 1504, remained unpublished until 1828 when it was edited (Paris, 5 vols.) by J. A. Buchon. It is far from possessing the historical value of his predecessor's work. A selection from his voluminous poetical works was published at Paris in 1531, *Les Faictz et Dictz de feu . . . Jehan Molinet. . . .* He also translated the *Roman de la rose* into prose (pr. Lyons, 1503). He became, in 1501, canon of the church of Notre-Dame at Valenciennes, where he died on the 23rd of August 1507. He is noteworthy as the head of the vicious Burgundian school of poetry known as the *rhétoriqueurs*, characterized by the excessive use of puns and of puerile metrical devices. His chief disciple was his nephew, Guillaume Crétin (d. 1525), ridiculed by Rabelais as Raminagrobis, and Jean Lemaire des Belges was his friend.

See A. Wauters in the *Biographie nationale de Belgique* (vol. xv., 1899).

MOLINIER, AUGUSTE (1851–1904), French historian, was born at Toulouse on the 30th of September 1851. He was a pupil at the École des Chartes, which he left in 1873, and also at the École des Hautes Études; and he obtained appointments in the public libraries at the Mazarine (1878), at Fontainebleau (1884), and at St Geneviève, of which he was nominated librarian in 1885. He was a good palaeographer and had a thorough knowledge of archives and manuscripts; and he soon won a first place among scholars of the history of medieval France. His thesis on leaving the École des Chartes was his *Catalogue des actes de Simon et d'Amauri de Montfort* (inserted in vol. xxxiv. of the *Bibliothèque de l'école*, an important contribution to the history of the Albigenses. This marked him out as a capable editor for the new edition of *L'histoire générale de Languedoc* by Dom Vaissète: he superintended the reprinting of the text, adding notes on the feudal administration of this province from 900 to 1250, on the government of Alphonso of Poitiers, brother of St Louis from 1226 to 1271, and on the historical geography of the province of Languedoc in the middle ages. He also wrote a *Bibliographie du Languedoc*, which was awarded a prize by the *Académie des inscriptions et belles-lettres*, but remained in manuscript. He also published several documents for the Société de l'Orient Latin (*Itinera hierosolymitana*, in collaboration with Ch. Kohler, 1885); for the Société de l'Histoire de France (*Chronique normande du xiv^{e} siècle*, assisted by his brother Émile, 1883); for the *Collection de textes relatifs à l'enseignement de l'histoire* (*Vie de Louis le Gros*, by Suger, 1887); for the *Collection des documents inédits* (*Correspondance administrative d'Alfonse de Poitiers*, 1894–1900); for the *Recueil des historiens de la France* (*Obituaires de la province de Sens* 1904, 1906), &c., and several volumes in the *Recueil des catalogues des bibliothèques publiques de France*. Applying to the French classics the rigorous method used with regard to the texts of the middle ages, he published the *Pensées* of Pascal, revised with the original manuscript (1887–1889), and the *Provinciales* (1891), edited with notes. In 1893 he was nominated professor at the École des Chartes, and gave a successful series of lectures which he published (*Manuel des sources de l'histoire de France au moyen âge*, 1902–1906). He also taught at the École des Hautes Études. He died on the 19th of May 1904, after a short illness, leaving in manuscript a criticism on the sources of the *Speculum historiale* of Vincent de Beauvais.

His elder brother, CHARLES (b. 1843), is also of some importance as an historian, particularly on the history of art and on the heresies of the middle ages. He was appointed professor of history at the university of Toulouse in 1886.

A younger brother, ÉMILE (1857–1906), became an assistant in the print-room at the Bibliothèque Nationale, and afterwards joined the staff at the Musée du Louvre, of which he eventually became keeper, retiring in 1902. He was a well-known connoisseur of art. He organized the famous Exposition Rétrospective held at the Petit Palais in 1900, and published a number of expert volumes on enamels, ceramics and furniture.

MOLINOS, MIGUEL DE (*c.* 1640–1697), Spanish divine, the chief apostle of the religious revival known as Quietism, was born about 1640 near Saragossa. He entered the priesthood and settled in Rome about 1670. There he became well known as a director of consciences, being on specially friendly terms with Cardinal Odescalchi, who in 1676 became Pope Innocent XI. In the previous year Molinos had published a volume, *Guida spirituale, che disinvolge l'anima e la conduce per l'interior camino all' acquisito della perfetta contemplazione e del ricco tesoro della pace interiore.* This was shortly followed by a brief *Trattato della cotidiana communione.* No breath of suspicion arose against Molinos until 1681, when the Jesuit preacher, Segneri, attacked his views, though without mentioning his name, in his *Concordia tra la fatica e la quiete nell' orazione.* The matter was referred to the Inquisition. It pronounced that the *Guida spirituale* was perfectly orthodox, and censured the intemperate zeal of Segneri. But the Jesuits set Father La Chaise to work on his royal penitent, Louis XIV., who prided himself on being a pillar of orthodoxy; but he was on very bad terms with Innocent XI., and soon yielded to the pleasure of discovering heresy in an intimate friend of the pope. Following on official representations by the French ambassador in Rome, who happened to be a cardinal, Molinos was arrested in May 1685. At first his friends were confident of an acquittal, but in the beginning of 1687 a number of his penitents of both sexes were examined by the Inquisition, and several were arrested. A report got abroad that Molinos had been convicted of moral enormities, as well as of heretical doctrines; and it was seen that he was doomed. On the 3rd of September 1687 he made public profession of his errors, and was sentenced to imprisonment for life. In the following November, Innocent signed a bull condemning sixty-eight propositions from the *Guida spirituale* and other unpublished writings of its author. At some date unknown in 1696 or 1697 Molinos died in prison.

Contemporary Protestants saw in the fate of Molinos nothing more than a persecution by the Jesuits of a wise and enlightened man, who had dared to withstand the petty ceremonialism of the Italian piety of the day. But Molinos was much more than the enlightened semi-Protestant that his English admirers took him to be; and his Quietism, had it been suffered to run its course would have swept aside beliefs and practices more important than the rosaries of nuns, though it is most unlikely that he realized the consequence of his own theories. Segneri and La Chaise were not so easily deceived. They were Jesuits; and Jesuitism is built up on the double assumption that God reveals Himself wholly and only through Jesus, and that Jesus reveals Himself wholly and only through the Church of Rome Luther had already broken through one link in this chain, when he taught the Protestant world to come directly to Jesus, without troubling about the Church; but Luther still assumed that God could only be reached through the intermediacy o Jesus. Molinos wished to find a royal road to God without any intermediaries at all. The Reformation maintained that the Church, so far from being a help, was a hindrance, to union with Jesus; whereas Molinos welcomed both Church and Jesus as helps to union with God, always provided that the believer treated both as means to an end beyond themselves. In other words, he held that there was a triple stage in piety. Beginners gave themselves wholly to the Church. At the second step came devotion to Jesus. At the third and highest stage both Church and Jesus were left behind as *deiformes, sed non Deus* and God remained alone.

But how could a finite being bring himself into direct relation with Infinity? Following very ancient precedents, Molinos fel back on those phenomena of our consciousness which seem least within our own power. The less sense of proprietorship we had in a thought or action—the less it was the fruit of our deliberate will—the more certain might we be that it was divinely inspired But what state of mind is most likely to be visited by these spontaneous illuminations? Plainly the state that Molinos calls the " soft and savoury sleep of nothingness," where the soul is content to fold its hands, and wait in dreamy musing till the message comes; meanwhile it will think, do, will as little as it can. For this reason disinterested love became the great hall-mark of Quietist sanctity. Why it is unfitted to be a test of sanctity in general has been explained at length by Bossuet in a remarkable *Instruction sur les états d'oraison*, published while the Quietist controversy was at its height. But, although Molinos's system did not long survive him, he had at least the double merit of courage and tenacity. Few writers have struggled so long and so hard to disengage the essence of religion from its transitionary embodiment in an historical creed.

The *Guida spirituale* was published in Italian in 1675, and ha been reprinted. An English translation appeared in 1688; it ha been re-edited by Mrs Arthur Lyttelton. French, Spanish and Latin translations have also appeared. For the history of it author see C. E. Scharling, *Michael de Molinos* (Ger. trans. from Danish; Gotha, 1855). H. Heppe, *Geschichte der quietistischen Mystik* (Berlin, 1875). On the whole subject of Quietism se H. Delacroix, *Études d'histoire et de psychologie du mysticism* (Paris, 1908). There is a brilliant, but very fanciful, account o Molinos and his doctrines in J. H. Shorthouse's romance, *Joh Inglesant.* (St C.)

MOLIQUE, WILHELM BERNHARDT (1802—1869), Germa violinist and composer, was born at Nuremberg on the 7th o October, 1802, and learnt the violin at Munich under Pietro

Rovelli. In 1826 he became music-director at Stuttgart. As a composer for the violin Molique was commonly compared with Spohr. He also wrote some charming songs. He died at Cannstadt in 1869.

MOLKO (1500–1532), a Marano kabbalist, who proclaimed the advent of the Messiah. He was associated with David Reubeni, who also made Messianic claims. Molko, after a chequered career, was condemned to death by the ecclesiastical court at Mantua. He was offered his life by the emperor Charles V. if he would return to Christianity, in which he had been educated. He refused, and died at the stake. (I. A.)

MÖLLENDORF, RICHARD JOACHIM HEINRICH VON (1724–1816), Prussian soldier, began his career as a page of Frederick the Great in 1740. The outbreak of the Silesian wars gave him his first opportunity of seeing active service, and the end of the second war saw him a captain. In the Seven Years' War his brilliant conduct at the churchyard of Leuthen (1757) and at Hochkirch won him his majority. In 1760 his exertions retrieved the almost lost battle of Torgau, and the last success of the great king was won by the brigades of Prince Wied and Möllendorf (now major-general) at the Burkersdorf heights. Seventeen years later, as lieutenant-general, he won at Brix one of the few successes of the Bavarian Succession (or "Potato") War. In the years of peace he occupied considerable posts, being made governor of Berlin in 1783. Promoted general of infantry in 1787, and general field marshal in 1793, he commanded the Prussian army on the Rhine in 1794. In the disastrous campaign of Jena (1806) Möllendorf played a considerable part, though he did not actually command a corps. He was present with the king at Auerstädt, falling into the hands of the French in the *débâcle* which followed. After his release he passed the remainder of his life in retirement. He died in 1816.

MOLLIEN, NICOLAS FRANÇOIS, COUNT (1758–1850), French financier, was born at Paris on the 28th of February 1758. The son of a merchant, he early showed ability, and entered the ministry of finance, where he rose rapidly; in 1784, at the time of the renewal of the arrangements with the farmers-general of the taxes, he was practically chief in that department and made terms advantageous to the national exchequer. Under Calonne he improved the returns from the farmers-general; and he was largely instrumental in bringing about the erection of the *octroi* walls of Paris in place of the insufficient wooden barriers. He, however, advocated an abolition of some of the restrictions on imports, as came about in the famous Anglo-French commercial treaty of 1786, to the conclusion of which he contributed in no small measure. The events of the French Revolution threatened at times to overwhelm Mollien. In 1794 he was brought before the revolutionary tribunal of Evreux as a suspect, and narrowly escaped the fate that befell many of the former farmers-general. He retired to England, where he observed the financial measures adopted at the crisis of 1796–1797. After the *coup d'état* of Brumaire (November 1799) he re-entered the ministry of finance, then under Gaudin, who entrusted to him important duties as director of the new *caisse d'amortissement*. Napoleon, hearing of his abilities, frequently consulted him on financial matters, and after the Proclamation of the Empire (May 1804) made him a councillor of state. The severe financial crisis of December 1805 to January 1806 served to reveal once more his sound sense. Napoleon, returning in haste not long after Austerlitz, dismissed Bargé-Marbois from the ministry of the treasury and confided to Mollien those important duties. He soon succeeded in freeing the treasury from the interference of great banking houses. In other respects, however, he did something towards curbing Napoleon's desire for a precise regulation of the money market. The conversations between them on this subject, as reported in Mollien's *Memoirs*, are of high interest, and show that the ministry had a far truer judgment on financial matters than the emperor, who often twitted him with being an *idéologue*. In 1808 Mollien was awarded the title of count. He soon came to see the impossibility of the measures termed collectively "the continental system"; but his warnings on that subject were of no avail. After the first abdication of the emperor (April 11, 1814), Mollien retired into private life, but took up his ministerial duties at the appeal of Napoleon during the Hundred Days (1815), after which he again retired. Louis XVIII. wished to bring him back to office, but he resisted these appeals. Nominated a peer in 1819, he took some part in connexion with the annual budgets. He lived to see the election of Louis Napoleon as president of the Second Republic, and died in April 1850, with the exception of Pasquier, the last surviving minister of Napoleon I.

See Mollien's *Mémoires d'un ministre du trésor public 1780–1815*, 4 vols. (Paris 1845; new ed., Paris, 3 vols., 1898); A. G. P. Barante, *Études historiques et biographiques*; Salvandy, *Notice sur Mollien*; also M. M. C. Gaudin (duc de Gaëte), *Notice historique sur les finances de la France 1800–1814* (Paris, 1818). (J. HL. R.)

MOLLUSCA, one of the great "phyla," or sub-kingdoms, of the animal pedigree or kingdom. The shell-bearing forms belonging to this group which were known to Linnaeus were placed by him (in 1748) in the third order of his class Vermes under the name "Testacea," whilst the Echinoderms, Hydroids and Annelids, with the naked Mollusca, formed his second order termed "Zoophyta." Ten years later he replaced the name "Zoophyta" by "Mollusca," which was thus in the first instance applied, not to the Mollusca at present so termed, but to a group consisting chiefly of other organisms. Gradually, however, the term Mollusca became used to include those Mollusca formerly placed among the "Testacea," as well as the naked Mollusca.

It is important to observe that the term μαλακια, of which Mollusca is merely a latinized form, was used by Aristotle to indicate a group consisting of the cuttle-fishes only.

As now classified, the Mollusca consist of the following subdivisions:—

- Grade A.—Isopleura.
  - Class I.—Amphineura (see CHITON).
- Grade B.—Prorhipidoglossomorpha.
  - Class II.—Gastropoda (*q.v.*).
  - Class III.—Scaphopoda (*q.v.*).
  - Class IV.—Lamellibranchia (*q.v.*).
- Grade C.—Siphonopoda.
  - Class V.—Cephalopoda (*q.v.*).

History of Classification.—The definite erection of the Mollusca into the position of one of the great primary groups of the animal kingdom is due to George Cuvier (1788–1800), who largely occupied himself with the dissection of representatives of this type.[1]* An independent anatomical investigation of the Mollusca had been carried on by the remarkable Neapolitan naturalist Poli (1791), whose researches[2] were not published until after his death (1817), and were followed by the beautiful works of another Neapolitan zoologist, the illustrious Delle Chiaje.[3]

The *embranchement* or sub-kingdom Mollusca, as defined by Cuvier, included the following classes of shellfish: (1) the cuttles or poulps, under the name CEPHALOPODA; (2) the snails, whelks and slugs, both terrestrial and marine, under the name GASTROPODA; (3) the sea-butterflies or winged-snails, under the name PTEROPODA; (4) the clams, mussels and oysters, under the name ACEPHALA; (5) the lamp-shells, under the name BRACHIOPODA; (6) the sea-squirts or ascidians, under the name NUDA; and (7) the barnacles and sea-acorns, under the name CIRRHOPODA.

The main limitations of the sub-kingdom or phylum Mollusca, as laid down by Cuvier, and the chief divisions thus recognized within its limits by him, hold good to the present day. At the same time, three of the classes considered by him as Mollusca have been one by one removed from that association in consequence of improved knowledge, and one additional class, incorporated since his day with the Mollusca with general approval, has, after more than forty years, been again detached and assigned an independent position owing to newly acquired knowledge.

The first of Cuvier's classes to be removed from the Mollusca was that of the Cirrhopoda. Their affinities with the lower Crustacea were recognized by Cuvier and his contemporaries, but it was one of the brilliant discoveries of that remarkable and too-little-honoured naturalist, J. Vaughan Thompson, of Cork, which decided their position as Crustacea. The metamorphoses of the Cirrhopoda were described and figured by him in 1830 in a very complete manner, and the legitimate conclusion as to their affinities was formulated by him.[4] Thus it is to Thompson (1830), and not to Burmeister (1834), as erroneously stated by Keferstein, that the merit of this discovery belongs. The next class to be removed from Cuvier's

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* These figures refer to the Bibliography at the end of the article.

Mollusca was that of the Nuda, better known as Tunicata. In 1866 the Russian embryologist Kowalewsky startled the zoological world with a minute account of the developmental changes of *Ascidia*, one of the Tunicata,[5] and it became evident that the affinities of that class were with the Vertebrata, whilst their structural agreements with Mollusca were only superficial. The last class which has been removed from the Cuvierian Mollusca is that of the Lamp-shells or Brachiopoda. The history of its dissociation is connected with that of the class, viz. the Polyzoa or Bryozoa, which has been both added to and again removed from the Mollusca between Cuvier's date and the present day. The name of J. Vaughan Thompson is again that which is primarily connected with the history of a Molluscan class. In 1830 he pointed out that among the numerous kinds of "polyps" at that time associated by naturalists with the Hydroids, there were many which had a peculiar and more elaborate type of organization, and for these he proposed the name Polyzoa. Subsequently[6] they were termed Bryozoa by Ehrenberg (1831).

Henri Milne-Edwards in 1844 demonstrated the affinities of the Polyzoa with the Molluscan class Brachiopoda, and proposed to associate the three classes Brachiopoda, Polyzoa and Tunicata in a large group "Molluscoidea," co-ordinate with the remaining classes of Cuvier's Mollusca, which formed a group retaining the name Mollusca. By subsequent writers the Polyzoa have in some cases been kept apart from the Mollusca and classed with the "Vermes"; whilst by others they have, together with the Brachiopoda, been regarded as true Mollusca. Increase of knowledge has now, however, established the conclusion that the agreement of structure supposed to obtain between Polyzoa and true Mollusca is delusive; and accordingly they, together with the Brachiopoda, were removed from the Molluscan phylum by Lankester in his article in the 9th edition of this work (on the which present article is based). Further details in regard to this, the last revolution in Molluscan classification, will be found in the article POLYZOA.

As thus purified by successive advances of embryological research, the Mollusca were reduced to the Cuvierian classes of Cephalopoda, Pteropoda, Gastropoda and Acephala. Certain modifications in the disposition of these classes are naturally enough rendered necessary by the vast accumulation of knowledge as to the anatomy and embryology of the forms comprised in them. Foremost among those who between 1840 and 1880 laboured in this field are the French zoologists Henri Milne-Edwards[9] and Lacaze Duthiers,[10] to the latter of whom we owe the most accurate dissections and beautiful illustrations of a number of different types. To Kölliker,[11] Gegenbaur,[12] and more recently Spenger,[13] amongst German anatomists, we are indebted for epoch-making researches of the same kind. In England, Owen's anatomy of the pearly nautilus,[14] Huxley's discussion of the general morphology of the Mollusca,[17] and Lankester's embryological investigations,[19] have aided in advancing our knowledge of the group. Two remarkable works of a systematic character dealing with the Mollusca deserve mention here—the *Manual of the Mollusca*, by Dr S. P. Woodward, a model of clear systematic exposition, and the exhaustive treatise on the Malacozoa or Weichthiere by Professor Keferstein of Göttingen, published as part of Bronn's *Klassen und Ordnungen des Thier-Reichs*.

The arrangement adopted by Ray Lankester in the 9th edition of the *Ency. Brit.* (art. "Mollusca"; 1883) was as follows: Of the four Cuvierian classes mentioned above, the Pteropoda were united with the Cephalopoda, on account of the apparent similarity of the cephalic tentacles in some of the former to the arms of the latter. An additional class was instituted for the reception of *Dentalium* and its few allies, and for this class Bronn's name Scaphopoda was used. The Chitons and their allies were placed under the Gastropoda, as a distinct branch called Isopleura, and for the Acephala de Blainville's name Lamellibranchia was substituted. The latter were regarded as forming a distinct branch, equivalent in rank to the other three classes together, the latter all possessing the radula which is wanting in Lamellibranchs.

Since the 9th edition of the *Ency. Brit.* was published important advances have been made in our knowledge of the Mollusca, as the result of researches largely due to the interest excited in the subject by Lankester's article. Attention has been especially directed to the investigation of the most primitive forms in each group, and accordingly we can now form much more definite conceptions of the phylogeny and evolution of the various classes. The most important and extensive contributions to this progress have been made by the Belgian zoologist, Dr Paul Pelseneer, who has made the Mollusca his special study.

The *Chitonidae* and the Aplacophora are now separated from the Gastropoda and raised to the rank of a distinct class, under the name of Amphineura. On the other hand, Boas and Pelseneer have shown that the Pteropoda have nothing to do with the Cephalopoda, but are Gastropoda modified for a pelagic life; they are therefore now united with the Gastropoda. The Lamellibranchia are no longer regarded as a distinct branch in contrast to the remaining Mollusca; according to Pelseneer they are allied to the Gastropoda and Scaphopoda, all three classes being derived from a common hypothetical ancestor, called *Prorhipidoglossum*. These three classes have therefore been united by Grobben into one branch or grade, the Prorhipidoglossomorpha.

General Characters of the Mollusca.—The forms comprised in the various groups, whilst exhibiting an extreme range of variety in shape, as may be seen on comparing an oyster, a cuttle-fish, and a sea-slug such as *Doris*; whilst adapted, some to life on dry land, others to the depths of the sea, others to rushing streams; whilst capable, some of swimming, others of burrowing, crawling or jumping, some, on the other hand, fixed and immobile; some amongst the most formidable of carnivores, others feeding on vegetable mud, or on the minutest of microscopic organisms—yet all agree in possessing in common a very considerable number of structural details which are not possessed in common by any other animals.

The structural features which the Mollusca do possess in common with other animals belonging to other great phyla of the animal kingdom are those characteristic of the Coelomata, one of the two great grades (the other and lower being that of the Coelentera) into which the higher animals, or Metazoa as distinguished from the Protozoa, are divided. The Metazoa all commence their individual existence as a single cell or plastid, which multiplies itself by transverse division. Unlike the cells of Protozoa, these embryonic cells of the Metazoa do not remain each like its neighbour and capable of independent life, but proceed to arrange themselves into two layers, taking the form of a sac. The cavity of the two-cell-layered sac or diblastula thus formed is the primitive gut or arch-enteron. In the Coelentera, whatever subsequent changes of shape the little sac may undergo as it grows up to be polyp or jelly-fish, the original arch-enteron remains as the one cavity pervading all regions of the body. In the Coelomata, on the other hand, there is another cavity, dividing the body-wall into two layers: an internal layer surrounding the gut, and an external layer. This cavity is excavated in a third mass of cells distinct from the cells lining the gut, forming the endoderm, and the cells covering the surface of the body, the ectoderm. This third mass of cells is the mesoderm. The Mollusca agree in being coelomate with the phyla Vertebrata, Platyhelmia (flat-worms), Echinoderma, Appendiculata (insects, ringed-worms, &c.), and others—in fact, with all the Metazoa except the sponges, corals, polyps, and medusae.

In common with all other Coelomata, the Mollusca are at one period of life possessed of a prostomium or region in front of the mouth, which is the essential portion of the "head," and is connected with the property of forward locomotion in a definite direction and the steady carriage of the body (as opposed to rotation of the body on its long axis). As a result, the Coelomata, and with them the Mollusca, present (in the first instance) the general condition of body known as bilateral symmetry; the dorsal is differentiated from the ventral surface, whilst a right and a left side similar to, or rather the complements of, one another are permanently established. In common with all other Coelomata, the Mollusca have the mouth and first part of the alimentary canal which leads into the met-enteron formed by a special invagination of the outer layer of the primitive body-wall, not to be confounded with that which often, but not always, accompanies the antecedent formation of the arch-enteron; this invagination is termed the stomodaeum. Similarly an anal aperture is formed in connexion with a special invagination which meets the hinder part of the met-enteron, and is termed the proctodaeum.

The coelom is primarily and essentially the generative cavity: the reproductive cells arise from its walls, *i.e.* from the coelomic epithelium. True nephridia do not primarily open into the coelom, as was formerly taught, but are intra-cellular ducts in the mesoderm. Such organs are absent in Mollusca in the adult state, but a pair of nephridia usually occurs in the larva. The coelom opens to the exterior by ducts which are primarily genital ducts by which the ova or sperms are discharged. These ducts, however, as well as the coelomic epithelium, may assume excretory functions. In Mollusca the coelom is reduced and consists of two parts, the pericardial cavity which surrounds the heart, and the cavity of the gonads or generative organs. There is usually one pair of coelomic ducts leading from the pericardium to the exterior, and these are the excretory organs or kidneys, formerly known as the organs of Bojanus. The walls of the pericardium are also excretory in parts, these parts forming the pericardial glands. In the majority of Mollusca the gonads are provided with a pair of ducts of their own. There are thus two pairs of coelomic ducts. This fact gives rise to the question whether the Mollusca are to be regarded as primitively segmented animals or not. In animals which exhibit typical segmentation or metamerism, such as segmented worms (Chaetopoda), each segment or metamere possesses its own coelomic cavity, a pair of coelomic ducts, and a pair of nephridia. The structure of the Mollusca in the greater number of cases agrees with the hypothesis that the primitive form was unsegmented, and therefore had but one pair of coelomic ducts and one pair of nephridia. In existing forms the latter disappear in the adult. In the most primitive forms of several classes there are no distinct genital ducts, the gonads when mature discharging into or through the kidneys. Among the Gastropoda, in the Aspidobranchia, there is no genital duct, and the gonad opens into the right kidney; in the more modified forms the left kidney alone is functional, the right has been converted into the genital duct. Among the Lamellibranchia again the kidneys serve as genital ducts in the Protobranchia and some Filibranchia. In the higher forms the opening of the gonad is shifted more and more towards the external aperture of each kidney until finally it is situated on the external surface, and thus the gonad secondarily acquires an independent aperture. In the Scaphopoda there is no distinct genital duct, the relations are as in Aspidobranchia. Among the Amphineura we find one pair of coelomic ducts in the Aplacophora, two pairs in the Chitons. In the former the genital coelom and the pericardial coelom are continuous and the reproductive cells escape by the renal ducts. In the Chitons or Polyplacophora, on the other hand, the two cavities are separate, and there are independent genital ducts. It is possible therefore to regard the latter condition as secondary, and to conclude that the separate genital ducts have been derived from the original single pair of coelomic ducts, as in Lamellibranchs.

The Cephalopoda, however, do not harmonize so well with this view. The earliest forms of this class geologically are the Nautiloidea. Assuming that these ancestral forms resembled the existing *Nautilus* in their internal anatomy, they had two pairs of renal ducts and one pair of genital ducts, which would apparently indicate, not a single metamere or unsegmented body, but three metameres. There are however only two pairs of branchiae. The Dibranchia, with only one pair of branchiae, one pair of renal organs, and one pair of genital ducts, are much more recent, not appearing till the end of the Secondary epoch, and therefore must be regarded as descended from the Tetrabranchia. The latter are represented in the Upper Cambrian formations, together with Lamellibranchia and Gastropoda, and there are no earlier Molluscan fossils than these. Palaeontology therefore throws no light on the question whether the metameric or the unsegmented Mollusca were the earlier. The development of the Cephalopoda affords at present no better evidence that the metamerism is secondary. That of *Nautilus*, which would be most important in this inquiry, is unfortunately still unknown. In the Dibranchia true nephridia have not been detected in the embryo, nor has it been shown that the genital ducts are derived from the renal tubes. On the other hand, there is no evidence that the forms which show no metamerism, such as the Gastropoda, are descended from metameric ancestors. On the whole, then, the most probable conclusion is that the original ancestral form of the Mollusca was unsegmented, possessed one pair of true nephridia, and one pair of coelomic ducts whose function was to conduct the generative products to the exterior. The chief types of Mollusca were already differentiated at the beginning of the geological record, and the metamerism which occurs in the Cephalopoda has been evolved within the limits of that class.

External Characters.—The characteristic organs of Mollusca are the mantle and shell, the foot, the ctenidia and the radula, of which all but the last are external. The original form was bilaterally symmetrical, and this symmetry is retained in all the classes except the Gastropoda. At the anterior end the head is differentiated; it bears the sense-organs, and contains the muscular pharynx within which is the radular apparatus. The rest of the body consists of the foot ventrally and the visceral mass dorsally. The foot is a muscular mass without cuticle or skeleton, excepting certain cuticular structures such as the byssus of Lamellibranchs and the operculum of Gastropods, which do not aid in locomotion. The foot is usually the only organ of locomotion. It corresponds to the ventral part of the body-wall in other animals. The muscular tissue of the dorsal body-wall is much reduced and the integument here is thin and soft. The external epithelium of the dorsal region secretes the shell. Between the edge of the shell and the foot there is a groove or cavity, chiefly developed laterally and posteriorly. The dorsal border of this groove is extended outwards and downwards as a fold of the integument. There is some confusion of terms here: some writers call the free fold the mantle or pallium, and this is the proper use of the term; but others apply the term to the whole of the dorsal integument, including both the projecting fold and the part covering the viscera. The shell extends to the edge of the mantle-fold, and the cavity between the mantle and the side of the body is the pallial chamber. This chamber serves two purposes: it is primarily

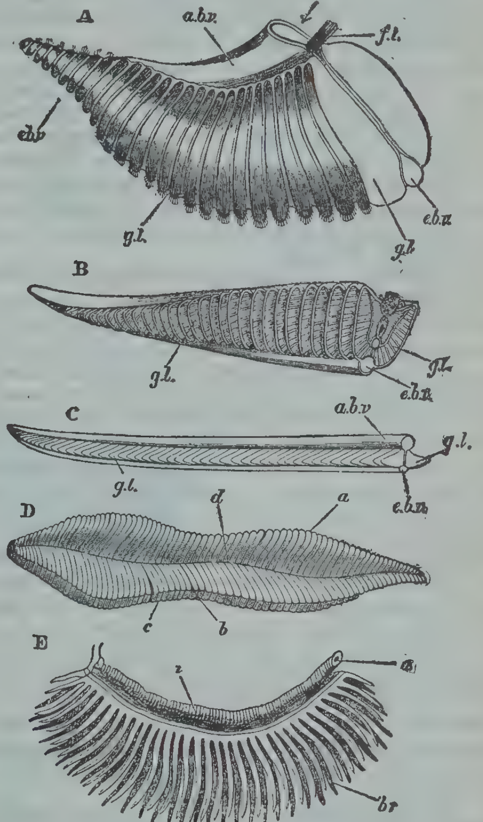


FIG. 1.—Ctenidia of various Mollusca (original).

A, Of *Chiton*: *f.t.*, fibrous tissue; *a.b.v.*, afferent blood-vessel; *e.b.v.*, efferent blood-vessel; *g.l.*, laterally paired lamellae.
B, Of *Sepia*: letters as in A.
C, Of *Fissurella*: letters as in A.
D, Of *Nucula*: *d*, position of axis with blood-vessels; *a*, inner: *b* and *c*, outer row of lamellae.
E, Of *Paludina*: *i*, intestine running parallel with the axis of the ctenidium and ending in the anus *a*; *br.*, rows of elongate processes corresponding to the two series of lamellae of the upper figures.

the respiratory cavity containing the gills, but it also serves to enclose the body so that the latter is surrounded by the shell, from which the head and foot can be protruded at the will of the animal.

The shell consists of an organic basis the substance of which is called conchiolin, impregnated with carbonate of lime, with a small proportion, 1–2 %, of phosphate of lime. On the outside of the shell is a non-calcified layer of conchiolin called the periostracum, secreted by the thickened edge of the mantle. The zone of the external surface of the mantle within the edge secretes a layer formed of prisms of calcite; the rest of the epithelium from this zone to the apex secretes the inner layer of the shell, composed of successive laminae; this is the nacreous layer, and in certain species has a commercial value as nacre or mother-of-pearl. Thus the growth of the shell in extent is due to additions to the prismatic layer at the edge, its growth in thickness to new layers of nacre deposited on its inner surface. In many cases in various classes the mantle is reflected over the edges of the shell, so as to cover more or less completely its outer surface. When this covering is complete the shell is contained in a closed sac and is said to be "internal," but the sac is lined by ectoderm and the shell is always morphologically external. In one or two cases the epithelium of the foot secretes a calcified shell, which is either free as in *Argonauta* or adherent as in *Hipponyx*.

The ctenidia (fig. 1) are the branchial organs of the Mollusca. In the primitive condition there is one on each side in the mantle cavity, towards the posterior end of the body. Each is an outgrowth of the body-wall at the side of the body, and consists of an axis containing two main vessels, an afferent and efferent, and bearing on either side a series of transverse plates whose blood-sinuses communicate with the vessels of the axis. The afferent vessel of the ctenidium receives blood from the vena cava or principal blood-sinus of the body, the efferent vessel opens into the auricle of its own side. Near the base of the ctenidium is a patch of sensory epithelium innervated from the branchial nerve, forming a sense-organ called the osphradium, whose function is to test the water entering the branchial cavity. The branchial current is maintained by the cilia which cover the surface of the ctenidia, except in Cephalopoda, in which cilia are absent and the current is due to muscular action. Thus in the primitive mollusc the mantle-cavity contains a symmetrical group of structures at the posterior end of the body, and this group of structures is called the pallial complex. It consists of the anus in the middle, a renal organ and renal aperture on each side of this, and a ctenidium outside or anterior to the renal organ, an osphradium being situated at the base of the ctenidium.

Internal Anatomy: Digestive Tube.—In primitive Mollusca the mouth and anus are the two extremities of the body, but the anus may be brought to an anterior position by a ventral flexure, complicated in Gastropoda by a lateral torsion. The alimentary tube consists of three regions: firstly, the anterior buccal mass with the oesophagus, of ectodermic origin, and therefore bearing cuticular structures, namely the jaws and radula; secondly, the mid-gut, of endodermic origin and including the stomach and liver; and, thirdly, the hind-gut or intestine. The radula consists of a chitinous band bearing teeth, secreted by a ventral caecum of the pharnyx and moved by an apparatus of cartilage and muscles. It was present in the ancestral mollusc, occurs in nearly all archaic types, and is only absent in the most specialized forms, in which it has evidently been lost; these forms are certain Neomeniomorpha, all the Lamellibranchia, various degenerate Gastropoda, and the *Cirrhoteuthidae* among Cephalopods. The teeth are secreted by a small number of cells at the closed end of the caecum, the basal membrane by a transverse row of cells in front of these. The teeth are disposed in transverse rows, and in each row they are arranged symmetrically on either side of a central tooth. In Polyplacophora there are eight on each side (8.I.8); in Scaphopoda two on each side (2.I.2); in almost all Cephalopoda three on each side (3.I.3); in Gastropoda the number varies very much in different subdivisions. Beneath the anterior parts of the radula where it emerges from the caecum are a pair of cartilages, and attached to these a number of special muscles by which the radula is moved backwards and forwards to act as a rasp. The secretion of the radula at the closed end of the caecum is continuous, so that it is constantly growing forward as fast as its exposed anterior portion is worn away by use, just as a finger-nail is pushed forward by constant growth at its posterior end, and is worn away or has to be cut short from time to time at its outer end.

Circulation.—The system of blood-vessels is entirely separate from the coelomic cavities. It consists of arteries, veins and sinuses, but ramified capillaries are usually absent except in the integuments of Cephalopods. The arteries and veins have proper endothelial walls; they pass abruptly into the sinuses and in some cases communication is effected by orifices in the walls of the vessels, as for example in the vena cava of *Nautilus*. The heart is situated in the pericardium on the dorsal side of the intestine and at the posterior end of the animal. The pericardium never contains blood, as is well shown in those forms which have red corpuscles in their blood; these corpuscles are never found in the pericardium.

The heart receives blood from the gills and mantle, and pumps it through arteries to the body. It consists of a median ventricle with muscular walls and a cavity traversed by muscular strands. On either side of the ventricle, in the primitive condition, is a thin-walled auricle, opening into the ventricle by a valved opening. Each auricle forms the terminal enlargement of the efferent vein of the ctenidium of its own side. In *Nautilus* two pairs of auricles are present, corresponding with the two pairs of ctenidia. In the primitive form a single anterior aorta is given off from the ventricle, the two together representing the dorsal blood-vessel of Chaetopods. In more specialized forms a posterior aorta passes backwards from the ventricle, as in Gastropods and the majority of Lamellibranchs. The ramifications of the arteries convey the blood to all parts of the body, and it finally reaches the venous sinuses, the chief of which are the pedal, the pallial and the median-ventral. The last is between the pericardium and the foot; from it the blood passes through the renal organs to the ctenidia. Some blood, however, enters the auricles directly from the mantle, without passing through the ctenidia. In the majority of Gastropoda one gill and one auricle are lost.

The blood is usually a colourless liquid containing amoeboid cells and sometimes other corpuscles called haematids. It may be coloured blue by haemocyanin, a respiratory compound containing copper. In a few forms the blood contains haemoglobin, either in solution or in haematids (red blood-corpuscles). In the Gastropoda the muscular tissue of the buccal mass is coloured red by haemoglobin.

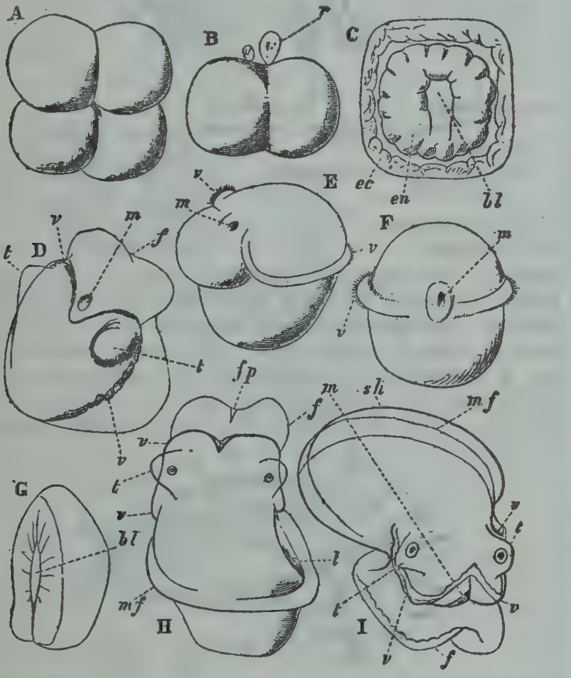
Nervous System.—The central nervous system may be described as consisting of a collar surrounding the oesophagus, and two pairs of cords arising from the collar and passing backwards. The two pairs of cords arise from the same point of the collar. The ventral cords are the pedal, the dorso-lateral, the pleural, the former innervating the foot; the latter the mantle. The dorsal half of the collar is the cerebral commissure, the ventral the labial commissure. The pedal cords are connected by commissures, and the pedal and pleural of each side are similarly connected. The pallial cords are united to one another posteriorly, dorsal to the rectum. This is the condition of the nervous system found in *Chiton* and the other Amphineura, but may not be in all respects the ancestral condition. Generally the system is differentiated into ganglia connected by nerve-cords consisting of nerve-fibres only. At the point of the collar whence the nerve-cords arise are the cerebral ganglia; from these one pair of connectives passes to a pair of pedal ganglia, and another pair of connectives to a pair of pleural ganglia. Pedal and pleural on each side are connected by a pleuro-pedal connective Each pleural ganglion gives off a long nerve which supplies the viscera, and the two unite posteriorly below the intestine. There are usually three small ganglia on the course of this visceral commissure, namely, the right and left visceral ganglia and the abdominal. The perioesophageal nerve-ring of Chaetopoda and Arthropoda is represented, not by the collar first mentioned in the above description, but by the commissures connecting the cerebral and pedal ganglia. The labial commissure supplies only the buccal mass and the oesophagus and stomach.

The special sense-organs are a pair of eyes on the head, a pair of otocysts or statocysts, and a pair of osphradia which have already been mentioned. In certain cases accessory eyes are also present, *e.g.* the pallial eyes of *Pecten* and other Lamellibranchs, and of Chitons. The otocysts are invaginations of the epithelium of the foot, but are innervated from the cerebral ganglia, and the same innervation has been proved in some cases for the osphradia.

Reproduction and Development.—Molluscs are usually of separate sexes, but sexual dimorphism is seldom highly developed. Hermaphroditism is secondary, and occurs in one sub-class of Gastropoda, in some Lamellibranchs, and in one sub-order of Amphineura. In Cephalopods and the majority of Gastropods copulation occurs. As a rule no parental care is exhibited, but incubation of the developing ova within some part of the parental body, or receptacles attached to the parent, occurs in some Lamellibranchs, some Gastropods, and in *Argonauta* among the Cephalopods. True viviparity, that is the development of the ova within the oviduct, is very rare, occurring only in one case among the Amphineura and in some aquatic and pulmonate Gastropoda.

The egg-cell of Mollusca is either free from food-material—a simple protoplasmic corpuscle—or charged with food-material to a greater or less extent. Those cases which appear to be most typical —*i.e.* which adhere to a procedure which was probably common at one time to all then existing Mollusca and has been departed from only in later and special lines of descent—show approximately the following history. By division of the egg-cell a mulberry-mass of embryonic-cells is formed (morula), which dilates, forming a one-cell-layered sac (blastula). By invagination one portion of this sphere becomes tucked into the other—as in the preparation of a woven night-cap for the head. The orifice of invagination (blastopore) narrows, and we now have a two-cell-layered sac—the gastrula. The invaginated layer is the enteric cell-layer or endoderm; the outer cell-layer is the dermic cell-layer or ectoderm. The cavity communicating with the blastopore and lined by the endoderm is the archenteron. The blastopore, together with the whole embryo, now elongates. The blastopore then closes along the middle portion of its extent, which corresponds with the later developed foot. At the same time the stomodaeum, or oral invagination, forms around the anterior remnant of the blastopore, and the proctodaeum, or anal invagination, forms around the posterior remnant of the blastopore. There are, however, variations in regard to the relation of the blastopore to the mouth and to the anus which are probably modifications of the original process described above.

In eggs which contain a larger quantity of food-yolk, the process by which the endoderm is enveloped by the ectoderm is somewhat different. Segmentation in these is very unequal, and results in the formation of small cells called micromeres and large cells called megameres, as in fig. 4. As the micromeres become more numerous they gradually envelop the megameres until the latter are completely enclosed. The gastrula is in these cases said to be formed by epibole. Between ectoderm and endoderm a third intermediate cell-layer is formed, which is called the mesoderm, and gives rise to the muscular and connective tissues to the vascular system, and to the excretory and generative organs. The mesoderm arises for the most part from the endoderm. When the segmentation is unequal one of the megameres gives rise by successive divisions to two primary mesoderm cells called mesomeres; these divide to form two masses of cells called mesoblastic bands. The coelom is formed as a cavity or cavities in the interior of these cell-masses. In some cases the coelom is formed as a single cavity, and renal and generative organs are formed from its walls. This is the primitive method, but in other cases the organs mentioned may be formed separately in the mesoderm. The renal organs are tubular outgrowths of the pericardial parts of the coelom; the reproductive cells are derived from cells lining the generative portion.



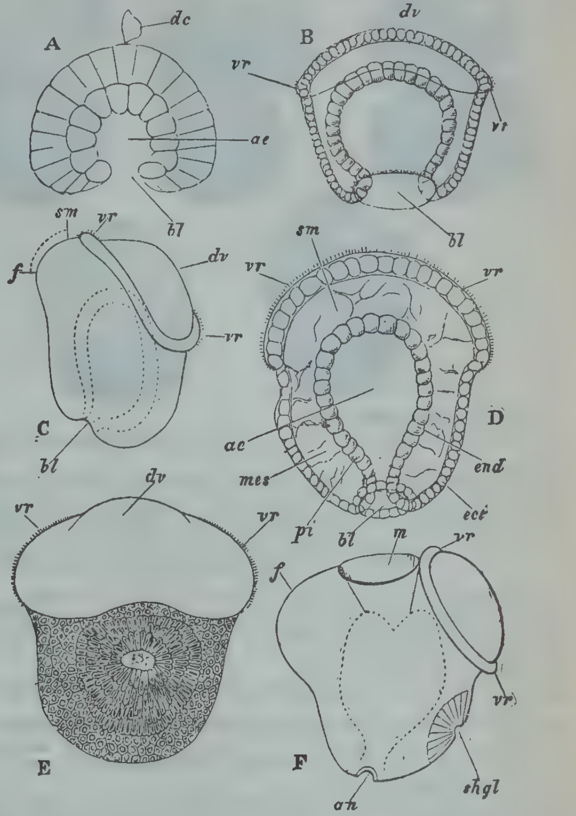
(After Lankester, 15.)

FIG. 2.—Development of the Pond-Snail, *Limnaeus stagnalis*.

r, Directive corpuscle.
bl, Blastopore.
en, Endoderm or enteric cell layer.
ec, Ectoderm or deric cell-layer.
v, Velum.
m, Mouth.
f, Foot.
t, Tentacles.
fp, Pore in the foot (belonging to the pedal gland?).
mf, The mantle-flap or limbus pallialis.
sh, The shell.
l, The sub-pallial space, here destined to become the lung.

A, First four cells resulting from the cleavage of the original egg-cell.
B, Side-view of the same.
C, Diblastula stage showing the two cell-layers and the blastopore.
D, E, F, Trochosphere stage, D older than E or F.
G, Three-quarter view of a Diblastula, to show the orifice of invagination of the endoderm or blastopore, (*bl*).
H, I, Veliger stage later than D.

The external form of the embryo meanwhile passes through highly characteristic changes, which are on the whole fairly constant throughout the Mollusca. A circlet of cilia forms when the embryo is still nearly spherical in an equatorial position. As growth proceeds, one hemisphere remains relatively small, the other elongates and enlarges. Both mouth and anus are placed in the larger area; the smaller area is the prostomium simply; the ciliated band is therefore in front of the mouth. The larval form thus produced is known as the trochosphere. It exactly agrees with the larval form of many Chaetopod worms and other Coelomata. Most remarkable is its resemblance to the adult form of the Wheel animalcules, or Rotifera, which retain the prae-oral ciliated band as their chief organ of locomotion and prehension throughout life. So far the young mollusc has not reached a definitely molluscan stage of



(After Lankester, 17.)

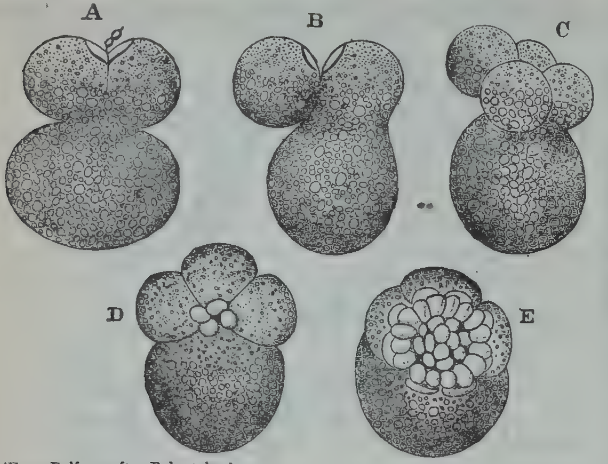
FIG. 3.—Development of the River-Snail, *Paludina vivipara*.

dc, Directive corpuscle (outcast cell).
ae, Arch-enteron or cavity lined by the enteric cell-layer or endoderm.
bl, Blastopore.
vr, Velum or circlet of ciliated cells.
dv, Velar area or cephalic dome.
sm, Site of the as yet unformed mouth.
f, Foot.
mes, Rudiments of the skeletotrophic tissues.
pi, The pedicle of invagination, the future rectum.
shgl, The primitive shell-sac or shell-gland.
m, Mouth. *an*, anus.

A, Gastrula phase (optical section).
B, The Gastrula has become a Trochosphere by the development of the ciliated ring *vr* (optical section).
C, Side view of the Trochosphere with commencing formation of the foot.
D, Further advanced Trochosphere (optical section).
E, The Trochosphere passing to the Veliger stage, dorsal view showing the formation of the primitive shell-sac.
F, Side view of the same, showing foot, shell-sac (*shgl*), velum (*vr*), mouth and anus.

N.B.—In this development the blastopore is not elongated; it persists as the anus. The mouth and stomodaeum form independently of the blastopore.

development, being only in a condition common to it and other Coelomata. It now passes to the veliger phase, a definitely molluscan form, in which the disproportion between the area in front of the ciliated circlet and that behind it is very greatly increased, so that the former is now simply an emarginated region of the head fringed with cilia. It is termed the "velum," and is frequently drawn out into lobes and processes. As in the Rotifera, it serves the veliger larva as an organ of locomotion. The body of the veliger is characterized by the development of the visceral hump on one surface, and by that of the foot on the other. Growth is greater in the vertical dorso-ventral axis than in the longitudinal oro-anal axis; consequently the foot is relatively small and projects as a blunt process between mouth and anus, which are not widely distant from one another, whilst the antipedal area projects in the form of a great hump or dome. In the centre of this antipedal area there has appeared (often at a very early period) a gland-like depression or follicle of the integument. This is the primitive shell-sac discovered by Lankester in 1871, and shown by him to precede the development of the permanent shell in a variety of molluscan types. The shell-gland is bounded by a ridge of ectodermic cells. This ridge forms the edge of the shell-secreting epithelium, and therefore of the mantle, since the shell extends to the edge of the mantle. The shell-gland, as development proceeds, extends from its point of origin as an ectodermic thickening, which may be only slightly concave or may be deeply invaginated and then evaginated.



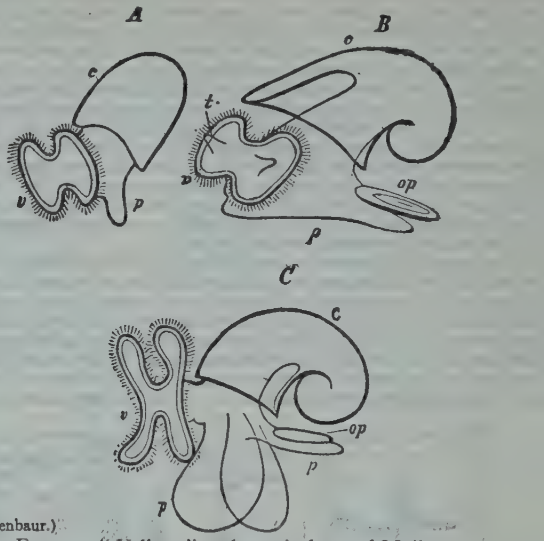
(From Balfour, after Bobretzky.)

FIG. 4.—Early Stages of division of the Fertilized Egg-cell in *Nassa mutabilis.*

- A, The egg-cell has divided into two spheres, of which the lower contains more food-material, whilst the upper is again incompletely divided into two smaller spheres. Resting on the dividing upper sphere are the eight-shaped "directive corpuscles," better called "praeseminal outcast cells or apoblasts," since they are the result of a cell-division which affects the egg-cell before it is impregnated, and are mere refuse, destined to disappear.
- B, One of the two smaller spheres is reunited to the larger sphere.
- C, The single small sphere has divided into two, and the reunited mass has divided into two, of which one is oblong and practically double, as in B.
- D, Each of the four segment-cells gives rise by division to a small pellucid cell.
- E, The cap of small cells has increased in number by repeated formation of pellucid cells in the same way, and by division of those first formed. The cap will spread over and enclose the four segment-cells.

In the larvae of several Gastropoda and Lamellibranchia occur excretory organs which have the characters of true nephridia. There is a single pair of these organs situated immediately behind the velum. They agree with primitive nephridia in being of ectodermic origin, in consisting of perforated cells in linear series, and in having no communication with the coelom. The inner end of each of these organs consists of a flame-cell, *i.e.* a cell with an internal cavity containing a vibrating filament or flagellum. They are best developed in the Pulmonata; in some cases they are very rudimentary and may be destitute of an external opening. They invariably disappear before the adult stage is reached, but their presence in the larva is evidence that the ancestral mollusc possessed a pair of true nephridia quite distinct from the coelomic excretory organs, which are so characteristic of existing forms in the adult condition.

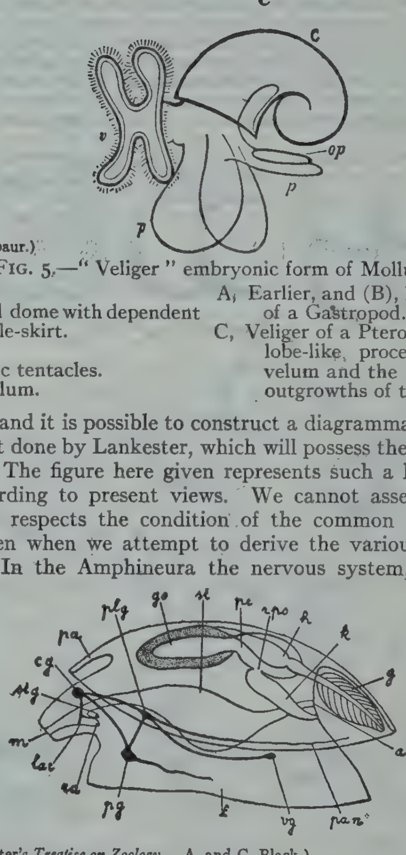
The ctenidia, it will be observed, have not yet been mentioned, and they are indeed the last of the characteristic Molluscan organs to make their appearance. They arise as outgrowths of the sides of the body within the cavity formed by the development of the mantle. The veliger, as soon as its shell has attained some extent and begins to assume definite shape, is no longer of a form common to Mollusca generally, but acquires characters peculiar to the particular class to which its parents belong. For the later development therefore the articles on the several classes must be consulted.



(From Gegenbaur.)

FIG. 5.—"Veliger" embryonic form of Mollusca.

v, Velum.
c, Visceral dome with dependent mantle-skirt.
p, Foot.
t, Cephalic tentacles.
op, Operculum.
A, Earlier, and (B), later, Veliger of a Gastropod.
C, Veliger of a Pteropod showing lobe-like processes of the velum and the great paired outgrowths of the foot.



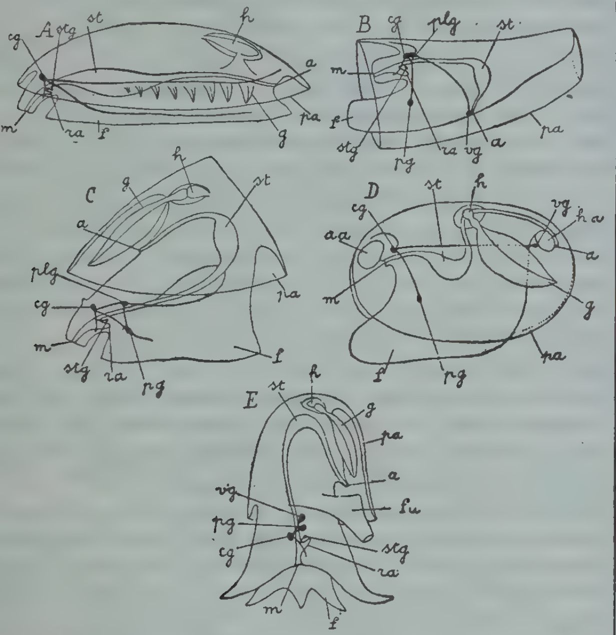
(From Lankester's *Treatise on Zoology.* A. and C. Black.)

FIG. 6.—Diagram of a primitive Mollusc, viewed from the left side.

a,	Anus.	*pa.n*,	Pallial nerve.
cg,	Cerebral ganglion.	*pe*,	Pericardium.
f,	Foot.	*p.g*,	Pedal ganglion.
g,	Gill, in the pallial cavity.	*pl.g*,	Pleural ganglion.
go,	Gonad.	*ra*,	Radula.
h,	Heart.	*r.p.o*,	Reno-pericardial orifice.
k,	Kidney.	*st*,	Stomach.
la.c,	Labial commissure.	*st.g*,	Stomato-gastric ganglion.
m,	Mouth.	*v.g*,	Visceral ganglion.
pa,	Mantle.		

Relations between the Classes.—From the preceding discussion an idea may be formed of the primitive characters of the Phylum Mollusca, and it is possible to construct a diagrammatic mollusc, as was first done by Lankester, which will possess these primitive features. The figure here given represents such a hypothetical form according to present views. We cannot assert that this was in all respects the condition of the common ancestor, as will be seen when we attempt to derive the various sub-types from it. In the Amphineura the nervous system, having no separate ganglia and no ventral visceral commissure, may be still more primitive. The metameric repetition of the shell-plates and of the ctenidia are probably special modifications, but it is difficult to explain the spicules of the dorsal integument except as a condition more primitive than the shell itself. The Prorhipidoglossomorpha are distinguished by the separation of the genital coelom from the pericardium, and by the long visceral commissure passing ventral to the intestine. The Lamellibranchia have markedly diverged from the original type by the adoption of filtration as a method of feeding. This has ed to the loss of the radula, and is accompanied by the division of the shell into two valves. The peculiarities of the Gastropoda are all due to the torsion of the shell and body. The Cephalopoda can be derived without much difficulty from the schematic Mollusc, if we assume that some metameric repetition of organs has occurred, as explained above in reference to the coelom. The foot has been developed into long processes which have extended in a circle round the mouth; all the ganglia, including the visceral, have been concentrated around the oesophagus.

Habits and Distribution.—More than 28,000 species of living Molluscs have been distinguished, of which more than half are Gastropods. They are essentially aquatic animals, and the majority live in the sea. Some, like many Cephalopods and the Pteropods, are pelagic or free-swimming; others creep or lie on the sea bottom. Some are littoral, living between tide-marks; others are found at very various depths, up to 2800 fathoms. A few species have invaded the fresh waters, while the pulmonate and terrestrial Gastropods are distributed over the whole surface of the land in all latitudes and to a height of 15,000 ft. As a rule Molluscs are free and more or less active, but many Lamellibranchs are sedentary, and a few of these and of Gastropods are permanently fixed to their habitat. Commensalism occurs in a few instances, but parasitism either external or internal is rare. The latter is confined to certain Gastropods which live in Echinoderms and are extremely degenerate in structure. Protective resemblance is exhibited by some Nudibranch Gastropods which have assumed the colour and appearance of their habitat.



From Lankester's *Treatise on Zoology*. A. and C. Black.)

FIG. 7.—Diagrams of the five classes of Mollusca, from the left side.

A,	Amphineura.	*h,*	Heart, in the pericardium.
B,	Scaphopoda.	*h.a,*	Posterior adductor.
C,	Gastropoda.	*m,*	Mouth.
D,	Lamellibranchia.	*pa,*	Pallium or mantle.
E,	Cephalopoda.	*p.g,*	Pedal ganglion.
,	Anus.	*pl.g,*	Pleural ganglion.
.a,	Anterior adductor.	*ra,*	Radula.
.g,	Cerebral ganglion.	*st,*	Stomach.
,	Foot.	*st.g,*	Stomato-gastric ganglion.
u,	Funnel.	*v.g,*	Visceral ganglion.
,	Ctenidium.		

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MOLLUSCOIDA, a name long employed to denote a division of the animal kingdom which contained *Brachiopods* (*q.v.*), *Polyzoa* (*q.v.*), and *Tunicata* (*q.v.*), the members of the three groups having been supposed to resemble the *Mollusca*. As it is now known that these groups have no relation to molluscs, and very little to one another, the name Molluscoida has been abandoned.

MOLLY MAGUIRES, an Irish American secret society which maintained numerous branches in the anthracite coal regions of Pennsylvania, U.S.A., from 1854 to 1877, and perhaps later. The name was imported from Ireland, where it had been used to designate one of the Ribbon societies that devoted its energies to intimidating and maltreating process servers and the agents of landlords, and whose greatest activity was between 1835 and 1855. The Irish society of Molly Maguires seems to have been organized in 1843 in the barony of Farney, Co. Monaghan, to co-operate with the ribbonmen, and its membership seems to have been confined to the very lowest classes. The Molly Maguires of Pennsylvania consisted of similar classes of Irishmen, but there seems to have been no connexion between the two societies. Every member of the American organization was also a member of the Ancient Order of Hibernians, an association organized for benevolent purposes, and having branches throughout the United States and Great Britain. To the Ancient Order of Hibernians none might be admitted but persons of Irish birth or descent, who were Roman Catholics, and whose parents were Roman Catholics; but notwithstanding this requirement, the organization—being a secret society—was under the ban of the Catholic Church. At the head of each division or lodge there was a "body master," who communicated directly with a county delegate; the county delegates reported to the state delegate, and the state delegates to a national delegate. The supervision of the whole order was vested in a "Board of Erin," meeting quarterly in England, Ireland or Scotland, and at each meeting arranging a new code of signals and passwords, which were communicated to the national delegate in the United States by the steward of a transatlantic steamship, and thence were transmitted to the various subdivisions. In the mining districts of Pennsylvania the organization fell under the control of a lawless element, which created the inner order of "Molly Maguires," with the object, it appears, of intimidating the Welsh, English, and German miners, and of ridding the region of mine superintendents, bosses and police who should make themselves in any way objectionable to members of the order. Any member having a grievance might lay a formal complaint before his "body master," who thereupon conferred with the officers of the neighbouring divisions and secured members from a distance to make away with the offending person. Under this system the crimes in a given district were always committed by strangers rendering identification of the criminal difficult and escape easy. The society grew in strength during the Civil War, when the increased demand for coal caused an influx of miners, many of them lawless characters, into the coal-fields, and in 1862–1863 it opposed enlistments in the Federal Army and roughly treated some of the enlisting officers. After the war its activity was shown by an increasing number of assassinations, burnings and other outrages, until by 1875 it completely dominated the mining classes and forced a general strike in the coal regions. After repeated efforts to bring the criminals to justice had failed, Franklin B. Gowen (1836–1889), president of the Philadelphia and Reading Coal and Iron Company, sent James McParlan, an Irish Catholic and a Pinkerton detective (who some thirty years later attracted attention in the investigation of the assassination of Governor Steunenberg of Idaho), to the mining region in 1873; he joined the order, lived among the "Molly Maguires" for more than two years, and even became secretary of the Shenandoah division, one of the most notoriously criminal lodges of the order. The evidence he secured led to the arrest, conviction, and execution or imprisonment of a large number of members during the years 1876–1877, and subsequently the outrages ceased and the society was disbanded.

See F. P. Dewees, *The Molly Maguires* (Philadelphia, 1877); Allan Pinkerton, *The Molly Maguires and the Detectives* (New York, 1877); E. W. Lucy, *The Molly Maguires of Pennsylvania;* (London, n.d.); *The Commonwealth versus John Kehoe et al.* (Pottsville, Pa., 1878); and an article by J. F. Rhodes in *Amer. Hist. Review*, April, 1910.

MOLOCH, or Molech (in Hebrew, with the doubtful exception of 1 Kings xi. 7, always "*the* Molech"), the name or title of the divinity which the men of Judah in the last ages of the kingdom were wont to propitiate by the sacrifice of their own children. According to the Hebrew consonants it might simply be read "the king" (*mélek*), an appellation for the supreme deity of a Semitic state or tribe. The traditional pronunciation (Μολόχ), which goes back as far as the Septuagint version of Kings, probably means that the old form was perverted by giving it the vowels of *bōsheth* "shame," the contemptuous name for Baal (*q.v.*). In 1 Kings xi. 7 (see above) it is the name of the god of the Ammonites, elsewhere called Milcom or Malcam; but it appears from 2 Kings xxiii. 10, 13 that the worship of Milcom at the shrine set up by Solomon was distinct from Molech worship, and the text should probably therefore be emended to the longer form (so the Septuagint).

The phrase employed in speaking of these sacrifices is that of dedication—"to make one's son or daughter pass through (or by means of) fire to (the) Molech" (2 Kings xxiii. 10; but elsewhere without the words "through fire" Lev. xviii. 21); and it appears from Jer. vii. 31, xix. 5; Ezek. xvi. 20 seq., that this phrase denotes a human holocaust,[1] and not, as sometimes has been thought, a mere consecration to Molech by passing through or between fires, as in the Roman *Palilia* and similar rites elsewhere (on which see Frazer, *Golden Bough*, 2nd ed., ii. 40 sqq., iii. 237 sqq.). Human sacrifice was common in Semitic heathenism, and at least the idea of such sacrifices was not unknown to Israel from early times (see Isaac; Jephthah).[2] We learn from 2 Kings iii. 27 that the piacular sacrifice of his son and heir was the last offering which the king of Moab made to deliver his country. Even the Hebrew historian ascribes to this act the effect of rousing divine indignation against the invading host of Israel; it would not, therefore, be surprising if under the miseries brought on Palestine by the westward march of the Assyrian power, the idea of the sacrifice of one's own son, as the most powerful of atoning rites, should have taken hold of those kings of Judah (Ahaz and Manasseh, 2 Kings xvi. 3 xxi. 6) who were otherwise prone, in their hopelessness of help from the old religion (Isa. vii. 12), to seek to strange peoples and their rites. Ahaz's sacrifice of his son (which indeed rests on a somewhat late authority) was apparently an isolated act of despair, since human sacrifices are not among the corruptions of the popular religion spoken of by Isaiah and Micah. In the 7th century, however, when the old worship had sustained rude shocks, and all religion was transformed into servile fear (Mic. vi. 1 seq.), the example of Manasseh did not stand alone, and Jeremiah and Ezekiel made frequent and indignant reference to the "high places" for the sacrifice of children by their parents which rose beneath the very walls of the temple from the gloomy ravine of Hinnom or Tophet.[3] (Jer. vii. 31, xix., xxxii. 35; Ezek. xvi. 18 sqq., xxiii. 37). The children apparently were not burned alive; they were slain and burned like any other holocaust (Ezek. *loc. cit.*; Isa. lvii. 5), their blood was shed at the sanctuary (Jer. xix. 4; Ps. cvi. 38). Thus the late Rabbinical picture of the calf-headed brazen image of Molech within which children were burned alive is pure fable, and with it falls the favourite comparison between Molech and the Carthaginian idol from whose brazen arms children were rolled into an abyss of fire, and whom Diodorus (xix. 14) naturally identifies with the child-eater Kronos, thus leading many moderns to make Molech the planet Saturn.

It is with these sacrifices that the name of "the Molech" is always connected; sometimes "the Baal" (lord) appears as a synonym. At the same time, the horrid ritual was so closely associated with Yahweh worship (Ezek. xxiii. 39) that Jeremiah more than once finds it necessary to protest that it is not of Yahweh's institution (vii. 31, xix. 5). So too it is the idea of sacrificing the firstborn to Yahweh that is discussed and rejected in Micah vi. It is indeed plain that such a sacrifice—for we have here to do, not with human victims in general, but with the sacrifice of the dearest earthly thing—could only be paid to the supreme deity; and Manasseh and his people never ceased to acknowledge Yahweh as the God of Israel. Thus the way in which Jeremiah (Jer. xix. 5) and the legislation of Leviticus (xviii. 21, xx. 2–5) and the author of Kings, seem to mark out the Molech or Baal as a false god, distinct from Yahweh, is precisely parallel to the way in which Hosea speaks of the golden calves or Baalim. In each case the people thought themselves to be worshipping Yahweh under the title of Molech or Baal; but the prophet refuses to admit that this is so, because the worship itself is an apostasy to heathenism. Note, also the attitude of Ezekiel in xx. 25 seq., 31, references which cannot be explained away.

Although the motive came from within, the *form* taken by the cult has appeared to many to be of non-Israelite origin. Babylonia and Assyria, however, seem to be out of the question: *malik*, "arbiter, decider," is there an epithet of various gods, and as an appellative means "prince" and not king; further, little vidence for the prevalence of human sacrifice has as yet been ound in those lands (A. Jeremias, *Das Alte Test. im Lichte d. alten rients*, 2nd ed., p. 454). Among the Canaanite branch, the ing-god is more prominent, and apart from the Ammonite ariant Milcom, numerous names compounded with Milk- are ound on Phoenician inscriptions and among western Semites entioned in cuneiform literature (H. Zimmern, *Keilinschr. u. as Alte Test.*, 3rd ed. pp. 470 sqq.). It is true that child-crifice in connexion with fire prevailed among the Phoenicians, nd, according to the Greeks, the deity honoured with these risly rites was Kronos (identified with the Phoenician El, God"). On the other hand, the seat of the cult appears to ave been at Jerusalem, and the period during which it flourished oes not favour any strong Phoenician influence. Again, the rm of the word Tophet and Ahaz's association with Damascus ight point to an Aramaean origin for the cult; but it would ot be safe to support this view by the statements and names 2 Kings xvii. 31. On the whole, the biblical tradition that e Molech-cult was Canaanite and indigenous (Deut. xii. 29 sqq., viii. 9 seq.) holds the ground. There was a tendency in time misfortune to revert to earlier rites (illustrated in some ncient mourning customs), and it may have been some old isused practice revived under the pressure of national distress.

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[1] In 2 Chron. xxviii. 3 (parallel to 2 Kings xvi. 3) a single letter is transposed in the phrase, changing the sense from "caused to pass through the fire" to "caused to burn with fire." Geiger (*Urschrift und Uebersetzung*, p. 305) very unnecessarily supposed that this was everywhere the original reading, and that it had been changed to soften the enormity ascribed to the ancient Hebrews. The phrase "to give one's seed to Molech" (Lev. xx. 2 seq.), and the fact that these victims were (like other sacrifices) regarded as food for the deity (Ezek. xvi. 20) explain and justify the common reading.

[2] In Hos. xiii. 2, the interpretation "they that sacrifice men" is improbable, and 2 Kings xvii. 17 and Lev. xviii., xx. are of too late date by themselves to prove the immolation of children to Moloch in old Israel. The "ban" (חרם), which was a religious execution of criminals or enemies, was common to Israel with its heathen neighbours (cf. the inscription of Mesha), but lacked the distinctive character of a sacrifice in which the victim is the food of the deity conveyed to him through fire.

[3] The etymology of the word Tophet is obscure; it is possibly o Aramaic origin and means "fire-place," cf. *tophteh*, "pyre," (Isa. xxx 33). The vocalization is artificial, the Masoretes having given i the vowel-points of *bōsheth*. See W. R. Smith, *Religion of the Semites* 2nd ed., 377.

See, generally, G. F. Moore, *Ency. Bib.*, *s.v.*; Lagrange, *Études sur s religions sémitiques* 2nd ed. pp. 99–109; B. Stade, *Bib. Theol. d. lt. Test.* i. 232 seq., 244 seq.; J. G. Frazer, *Adonis*, &c., 2nd ed. o. 144 seq. 401 sqq; and J. A. Montgomery, *Journ. Bib. Lit.*, 1908, 40 sqq. On archaeological evidence for human sacrifice from alestinian soil, see H. Vincent, *Canaan d'après l'exploration cente*, pp. 50, 116, 189 sqq. (W. R. S.; S. A. C.)

MOLSHEIM, a town of Germany, in the imperial province of lsace-Lorraine at the foot of the Vosges, on the Breusch and the junction of railways to Zabern and Strassburg. Pop. 905), 3164. It contains a beautiful Roman Catholic and a rotestant church, a handsome new town-hall and an agricultural hool. Its industries embrace the manufacture of iron and eel goods, tanning and organ-building. There is also some ade in wine. Molsheim was known in the 9th century as olleshem, and formerly was the seat of a famous Jesuit college, hich in 1702 was removed to Strassburg and united with the niversity of that city.

MOLTKE, ADAM GOTTLOB, COUNT (1710–1792), Danish ourtier, was born on the 10th of November 1710, at Riesenhof Mecklenburg. Though of German origin, many of the oltkes were at this time in the Danish service, which was onsidered a more important and promising opening for the oung north German noblemen than the service of any of the ative principalities; and through one of his uncles, young oltke became a page at the Danish court, in which capacity e formed a life-long friendship with the crown prince Frederick, fterwards Frederick V. He never had any opportunity of nriching his mind by travel or study, but he was remarkable or a strongly religious temperament and seems for some time have been connected with the Moravians. Immediately fter his accession, Frederick V. made him hofmarskal (court arshal), and overwhelmed him with marks of favour, making im a privy councillor and a count and bestowing upon him regentved and other estates. As the inseparable companion the king, Moltke's influence soon became so boundless that the oreign diplomatists declared he could make and unmake inisters at will. Fortunately he was no ordinary favourite. aturally tactful and considerate, he never put difficulties in e way of the responsible ministers. Especially interesting Moltke's attitude towards the two distinguished statesmen ho played the leading parts during the reign of Frederick V., ohan Sigismund Schulin and the elder Bernstorff. For Schulin e had a sort of veneration. Bernstorff irritated him by his rand airs of conscious superiority. But though a Prussian ntrigue was set up for the supersession of Bernstorff by Moltke, he latter, convinced that Bernstorff was the right man in the ight place, supported him with unswerving loyalty. Moltke as far less liberal in his views than many of his contemporaries. e looked askance at all projects for the emancipation of the serfs, but, as one of the largest landowners of Denmark, he did much service to agriculture by lightening the burdens of the countrymen and introducing technical and scientific improvements which greatly increased production. His greatest merit, however, was the guardianship he exercised over the king, whose sensual temperament and weak character exposed him to many temptations which might have been very injurious to the state. Frederick had the good sense to appreciate the honesty of his friend and there was never any serious breach between them. On the death of Queen Louisa the king would even have married one of Moltke's daughters had he not peremptorily declined the dangerous honour. On the decease of Frederick V., who died in his arms (Jan. 14, 1766), Moltke's dominion was at an end. The new king, Christian VII., could not endure him, and exclaimed, with reference to his lanky figure: "He's stork below and fox above." He was also extremely unpopular, because he was wrongly suspected of enriching himself at the public expense.[1] In July 1766 he was dismissed from all his offices and retired to his estate at Bregentved. Subsequently, through the interest of Russia, to whom he had always been favourable, he regained his seat in the council (Feb. 8, 1768), but his influence was slight and of brief endurance. He was again dismissed without a pension, on the 10th of December 1770, for refusing to have anything to do with Struensee. He lived in retirement till his death on the 25th of September 1792.

His memoirs, written in German and published in 1870, have considerable historical importance. See H. H. Langhorn, *Historische Nachricht über die dänischen Moltkes* (Kiel, 1871). (R. N. B.)

MOLTKE, ADAM WILHELM, COUNT (1785–1864), Danish statesman, son of the minister Joachim Godske Moltke (1746–1818), and grandson of Adam Gottlob Moltke, was born at Einsiedelsborg in Funen, on the 25th of August 1785. Under the influence of the agricultural reformer Christian Colbjörnsen he abandoned the legal career he had adopted and entered the administrative service of the state, to which he devoted the remainder of his life. In 1831 he succeeded Johan Sigismund Mösting (1789–1843), as minister of finance. On the death of Christian VIII. he was one of the most prominent members of the Council of State, and when the constitutional crisis came in 1848 he seemed marked out as the man who could bridge over the gap between the old era and the new. The services which Count Moltke rendered to Denmark cannot be too highly appreciated. The mere fact that a distinguished statesman who had served the last two absolute kings of Denmark now voluntarily placed himself at the head of a ministry which included the most advanced of the popular agitators, gave the new government the hall-mark of stability and trustworthiness, whilst the fact that he still retained the ministry of finance was of itself a guarantee of security during the earlier years of a troublesome and costly war. It was this, his first administration, which introduced the constitution of the 5th of June 1849, and he also presided over the third constitutional ministry which was formed in July 1851; but he resigned on the 27th of January 1852, because he could not approve of the decree which aimed at transforming Denmark into a composite, indivisible, monarchy. Moltke continued to take part in public life as a member of the Landsting, or Upper House, but henceforth kept in the background. On the 2nd of October 1855 he was elected a member of the consultative Rigsraad, a position he continued to hold till 1863. He died on the 15th of February 1864.

See Swalin, *Det danske Staatsraad* (Stockholm, 1881); Madvig, *Livserindringer* (Copenhagen, 1887). (R. N. B.)

MOLTKE, HELMUTH CARL BERNHARD, COUNT VON (1800–1891), Prussian field marshal, for thirty years chief of the staff of the Prussian army, the greatest strategist of the latter half of the 19th century, and the creator of the modern method of directing armies in the field, was born on the 26th of October 1800, at Parchim in Mecklenburg, of a German family of ancient nobility. His father in 1805 settled in Holstein and became a Danish subject, but about the same time was impoverished by the burning of his country house and the plunder by the French of his town house in Lübeck, where his wife and children were. Young Moltke therefore grew up in straitened circumstances. At the age of nine he was sent as a boarder to Hohenfelde in Holstein, and at the age of eleven to the cadet school at Copenhagen, being destined for the Danish army and court. In 1818 he became a page to the king of Denmark and second lieutenant in a Danish infantry regiment. But at twenty-one he resolved to enter the Prussian service, in spite of the loss of seniority. He passed the necessary examination with credit, and became second lieutenant in the 8th Infantry Regiment stationed at Frankfort-on-Oder. At twenty-three, after much less than the regulation term of service, he was allowed to enter the general war school, now the war academy, where he studied the full three years and passed in 1826 a brilliant final examination. He then for a year had charge of a cadet school at Frankfort-on-Oder, after which he was for three years employed on the military survey in Silesia and Posen. In 1832 he was seconded for service on the general staff at Berlin, to which in 1833 on promotion to first lieutenant he was transferred. He was at this time regarded as a brilliant officer by his superiors, and among them by Prince William, then a lieutenant-general, afterwards king and emperor. He was well received at court and in the best society of Berlin. His tastes inclined him to literature, to historical study and to travel. In 1827 he had published a short romance, *The Two Friends*. In 1831 it was followed by an essay entitled *Holland and Belgium in their Mutual Relations, from their Separation under Philip II. to their Reunion under William I.*, in which were displayed the author's interest in the political issues of the day, and his extensive historical reading. In 1832 appeared *An Account of the Internal Circumstances and Social Conditions of Poland*, a second study of a burning question based both on reading and on personal observation of Polish life and character. In 1832 he contracted to translate Gibbon's *Decline and Fall* into German, for which he was to receive £75, his object being to earn the money to buy a horse. In eighteen months he had finished nine volumes out of twelve, but the publisher failed to produce the book and Moltke never received more than £25, so that the chief reward of his labour was the historical knowledge which he acquired. He had already found opportunities to travel in south Germany and northern Italy, and in 1835 on his promotion as captain he obtained six months' leave to travel in south-eastern Europe. After a short stay in Constantinople he was requested by the sultan to enter the Turkish service, and being duly authorized from Berlin he accepted the offer. He remained two years at Constantinople, learned Turkish and surveyed for the sultan the city of Constantinople, the Bosporus and the Dardanelles. He travelled in the sultan's retinue through Bulgaria and Rumelia, and made many other journeys on both sides of the Strait. In 1838 he was sent as adviser to the Turkish general commanding the troops in Armenia, who was to carry on a campaign against Mehemet Ali of Egypt. During the summer he made extensive reconnaissances and surveys, riding several thousand miles in the course of his journeys, navigating the dangerous rapids of the Euphrates, and visiting and mapping many districts where no European traveller had preceded him since Xenophon. In 1839 the army moved south to meet the Egyptians, but upon the approach of the enemy the general became more attentive to the prophecies of the mollahs than to the advice of the Prussian captain. Moltke resigned his post of staff officer and took charge of the artillery, which therefore, in the ensuing battle of Nezib or Nisib, was the last portion of the Turkish army to run away. The Turks were well beaten and their army dispersed to the four winds. Moltke with infinite hardship made his way back to the Black Sea, and thence to Constantinople. His patron Sultan Mahmoud was dead, so he returned to Berlin where he arrived, broken in health, in December 1839. When he left Berlin in 1834 he had already "the courtier's, soldier's, scholar's eye, tongue, sword." When he returned it was with a mind expanded by a rare experience, and with a character doubly tempered and annealed. While away, he had been a constant letter-writer to his mother and sisters, and he now revised and published his letters as *Letters on Conditions and Events in Turkey in the Years 1835 to 1839*. No other book gives so deep an insight into the character of the Turkish Empire, and no other book of travels better deserves to be regarded as a German classic. One of his sisters had married an English widower named Burt, who had settled in Holstein. Her step-daughter, Mary Burt, had read the traveller's letters, and when he came home as a wooer was quickly won. The marriage took place in 1841, when Mary was just turned sixteen. It was a very happy union, though there were no children, and Moltke's love-letters and letters to his wife are among the most valuable materials for his biography. On his return in 1840 Moltke had been appointed to the staff of the 4th army corps, stationed at Berlin; he was promoted major on his wedding day. The fruits of his Eastern travels were by no means exhausted. He published his maps of Constantinople, of the Bosporus and of the Dardanelles, and, jointly with other German travellers, a new map of Asia Minor and a memoir on the geography of that country, as well as a number of periodical essays on various factors in the Eastern Question. In 1845 appeared *The Russo-Turkish Campaign in Europe, 1828–29, described in 1845 by Baron von Moltke, Major in the Prussian Staff*, a volume which was recognized by competent judges as a masterpiece of military history and criticism. Moltke at this period was much occupied with the development of railways. He was one of the first directors of the Hamburg–Berlin railway, and in 1843 published a review article entitled *What Considerations should determine the Choice of the Course of Railways?* which reveals a mastery of the technical questions involved in the construction and working of railway lines.

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[1] He was said to be worth 10 million rix-dollars, but proved that he had less than one million.

In 1845 Moltke was appointed personal adjutant to Prince Henry of Prussia, a Roman Catholic who lived at Rome. He thus had the opportunity of a long stay in the Eternal City, with no more than nominal duties to perform. It was a life which he and his wife much enjoyed, and he spent much of his leisure in a survey, of which the result was a splendid map of Rome, published at Berlin in 1852. In 1846 Prince Henry died, and Moltke was then appointed to the staff of the 8th army corps at Coblenz. In 1848, after a brief return to the great general staff at Berlin, he became chief of the staff of the 4th army corps, of which the headquarters were then at Magdeburg, where he remained seven years, during which he rose to lieutenant-colonel (1850), and colonel (1851). In 1855 he was appointed first adjutant to Prince Frederick William (afterwards crown prince and emperor), whom he accompanied to England on his betrothal and marriage, as well as to Paris and to St Petersburg to the coronation of Alexander II. of Russia. Prince Frederick William was in command of a regiment stationed at Breslau, and there as his adjutant Moltke remained for a year, becoming major-general in 1856. On the 23rd of October 1857, owing to the serious illness of King Frederick William IV., Prince William became prince regent. Six days later the regent selected Moltke for the then vacant post of chief of the general staff of the army. The appointment was made definitive in January 1858. Moltke's posthumously published military works disclose a remarkable activity, beginning in 1857, devoted to the adaptation of strategical and tactical methods to changes in armament and in means of communication, to the training of staff officers in accordance with the methods thus worked out, to the perfection of the arrangements for the mobilization of the army, and to the study of European politics in connexion with the plans for campaigns which might become necessary. In 1859 came the war in Italy, which occasioned the mobilization of the Prussian army, and as a consequence the reorganization of that army, by which its numerical strength was nearly doubled. The reorganization was the work not of Moltke but of the king, and of Roon, minister of war; but Moltke watched the Italian campaign closely, and wrote a history of it, published in 1862, and attributed on the title-page to the historical division of the Prussian taff, which is the clearest account of the campaign and contains he best criticism upon it. In December 1862 Moltke was asked or an opinion upon the military aspect of the quarrel with Denmark then becoming acute. He thought the difficulty vould be to bring the war to an end, as the Danish army would f possible retire to the islands, where, as the Danes had the ommand of the sea, it could not be attacked. He sketched plan for turning the flank of the Danish army before the ttack upon its position in front of Schleswig, and hoped that y this means its retreat might be intercepted. When the var began in February 1864, Moltke was not sent with the Prussian forces, but kept at Berlin. The plan was mismanaged n the execution, and the Danish army escaped to the fortresses f Düppel and Fredericia, each of which commanded a retreat cross a strait on to an island. The allies were now checked; Düppel and Fredericia were besieged by them, Düppel taken y storm, and Fredericia abandoned by the Danes without ssault; but the war showed no signs of ending, as the Danish rmy was safe in the islands of Alsen and Fünen. On the 30th f April Moltke was sent to be chief of the staff to the commander-n-chief of the allied forces, and, so soon as the armistice of May and June was over, persuaded Prince Frederick Charles to ttempt to force the passage of the Sundewitt and attack the Danes in the island of Alsen. The landing was effected on the 9th of June, and the Danes then evacuated Alsen. Moltke ext proposed a landing in Fünen, but it was unnecessary. The Danes no longer felt safe in their islands, and agreed to the German terms. Moltke's appearance on the scene had quickly ransformed the aspect of the war, and his influence with the ing had thus acquired a firm basis. Accordingly, when in 866 the quarrel with Austria came to a head, Moltke's plans vere adopted and he was almost invariably supported in their xecution. A disciple rather of Clausewitz, whose theory of war vas an effort to grasp its conditions, than of Jomini, who exounded a system of rules, Moltke regarded strategy as a practical rt of adapting means to ends, and had developed the methods of Napoleon in accordance with the altered conditions. He had een the first to realize the great defensive power of modern rearms, and had inferred from it that an enveloping attack had ecome more formidable than the attempt to pierce an enemy's ront. He had pondered the tactics of Napoleon at Bautzen, vhen the emperor preferred to bring up Ney's corps, coming rom a distance, against the flank of the allies, rather than to nite it with his own force before the battle; he had also drawn moral from the combined action of the allies at Waterloo. t the same time he had worked out the conditions of the march nd supply of an army. Only one army corps could be moved long one road in the same day; to put two or three corps on he same road meant that the rear corps could not be made use f in a battle at the front. Several corps stationed close together n a small area could not be fed for more than a day or two. Accordingly he inferred that the essence of strategy lay in rrangements for the separation of the corps for marching and heir concentration in time for battle. In order to make a large rmy manageable, it must be broken up into separate armies or roups of corps, each group under a commander authorized to egulate its movements and action subject to the instructions f the commander-in-chief as regards the direction and purpose f its operations. In the strategy of 1866 the conspicuous oints are: (1) The concentration of effort. There were two roups of enemies, the Austro-Saxon armies, 270,000; and the orth and south German armies, 120,000. The Prussian forces vere 64,000 short of the adverse total, but Moltke determined o be superior at the decisive point against the Austro-Saxons; e therefore told off 278,000 men for that portion of the struggle, nd employed only 48,000 men in Germany proper. His brilliant direction enabled the 48,000 to capture the Hanoverian rmy in less than a fortnight, and then to attack and drive sunder the south German forces. (2) In dealing with Austro-Saxony the difficulty was to have the Prussian army first ready —no easy matter, as the king would not mobilize until after the Austrians. Moltke's railway knowledge helped him to save time. Five lines of railway led from the various Prussian provinces to a series of points on the southern frontier on the curved line Zeitz-Halle-Görlitz-Schweidnitz. By employing all these railways at once, Moltke had the several army corps moved simultaneously from their peace quarters to points on this curved line. When this first move was finished the corps then marched along the curve to collect into three groups, one near Torgau (Elbe army), another at the west end of Silesia (first army, Prince Frederick Charles), the third between Landshut and Waldenburg (second army, crown prince). The first army when formed marched eastwards towards Görlitz. The small Saxon army at Dresden now had the Elbe army in its front and the first army on its right flank, and as it was outnumbered by either of them, its position was untenable, and so soon as hostilities began fell back into Bohemia, where it was joined by an Austrian corps, with which it formed an advance guard far in front of the Austrian main army concentrated near Olmütz. The Elbe army advanced to Dresden, left a garrison there, and moved to the right of Prince Frederick Charles, under whose command it now came. (3) Moltke now had two armies about 100 miles apart. The problem was how to bring them together so as to catch the Austrian army between them like the French at Waterloo between Wellington and Blücher. If, as was thought likely, the Austrians moved upon Breslau, the first and Elbe armies could continue their eastward march to co-operate with the second. But on the 15th of June Moltke learned that on the 11th of June the Austrian army had been spread out over the country between Wildenschwerdt, Olmütz and Brünn. He inferred that it could not be concentrated at Josefstadt in less than thirteen days. Accordingly he determined to bring his own two armies together by directing each of them to advance towards Gitschin. He foresaw that the march of the crown prince would probably bring him into collision with a portion of the Austrian army; but the crown prince had 100,000 men, and it was not likely that the Austrians could have a stronger force than that within reach of him. The order to advance upon Gitschin was issued on the 22nd of June, and led to one of the greatest victories on record. The Austrians marched faster than Moltke expected, and might have opposed the crown prince with four or five corps; but Benedek's attention was centred on Prince Frederick Charles, and he interposed against the crown prince's advance four corps not under a common command, so that they were beaten in detail, as were also the Saxons and the Austrian corps with them, by Prince Frederick Charles. On the 1st of July Benedek collected his already shaken forces in a defensive position in front of Königgrätz. Moltke's two armies were now within a march of one another and of the enemy. On the 3rd of July they were brought into action, the first against the Austrian front and the second against the Austrian right flank. The Austrian army was completely defeated and the campaign decided, though an advance towards Vienna was needed to bring about the peace upon Prussia's terms. Moltke was not quite satisfied with the battle of Königgrätz. He had tried to have the Elbe army brought up to the Elbe above Königgrätz so as to prevent the Austrian retreat, but its general failed to accomplish this. He also tried to prevent the first army from pushing its attack, hoping in that way to keep the Austrians in their position until retreat should be cut off by the crown prince, but he could not restrain the impetuosity of Prince Frederick Charles and of the king. During the negotiations Bismarck, who dared not risk the active intervention of France, opposed the king's wish to annex Saxony and perhaps other territory beyond what was actually taken. Moltke would not have hesitated; he was confident of beating both French and Austrians if the French should intervene, and he submitted to Bismarck his plans in case of need for the opening moves against both French and Austrians.

After the peace, the Prussian Diet voted Moltke the sum of £30,000, with which he bought the estate of Creisau, near Schweidnitz, in Silesia. In 1867 was published *The Campaign of 1866 in Germany*, a history produced under Moltke's personal supervision, and remarkable for its combination of accuracy with reticence. On the 24th of December 1868 Moltke's wife died at Berlin. Her remains were buried in a small chapel erected by Moltke as a mausoleum in the park at Creisau.

In 1870 suddenly came the war with France. The probability of such a war had occupied Moltke's attention almost continuously since 1857, and a series of memoirs is preserved in which from time to time he worked out and recorded his ideas as to the best arrangement of the Prussian or German forces for the opening of the campaign. The arrangements for the transport of the army by railway were annually revised in order to suit the changes in his plans brought about by political conditions and by the growth of the army, as well as by the improvement of the Prussian system of railways. The great successes of 1866 had strengthened Moltke's position, so that when on the 15th of July 1870 the order for the mobilization of the Prussian and south German forces was issued, his plans were adopted without dispute and five days later he was appointed "Chief of the general staff of the army at the headquarters of his Majesty the King" for the duration of the war. This gave Moltke the right to issue in the king's name, though of course not without his approval, orders which were equivalent to royal commands. Moltke's plan was to assemble the whole army to the south of Mainz, this being the one district in which an army could best secure the defence of the whole frontier. If the French should disregard the neutrality of Belgium and Luxemburg, and advance on the line from Paris to Cologne or any other point on the Lower Rhine, the German army would be able to strike at their flank, while the Rhine itself, with the fortresses of Coblenz, Cologne and Wesel, would be a serious obstacle in their front. If the French should attempt to invade south Germany, an advance of the Germans up either bank of the Rhine would threaten their communications. Moltke expected that the French would be compelled by the direction of their railways to collect the greater part of their army near Metz, and a smaller portion near Strassburg. The German forces were grouped into three armies: the first of 60,000 men, under Steinmetz, on the Moselle below Trèves; the second of 131,000 men, under Prince Frederick Charles, round Homburg, with a reserve of 60,000 men behind it; the third under the crown prince of 130,000 men, at Landau. Three army corps amounting to 100,000 men were not reckoned upon in the first instance, as it was desirable to keep a considerable force in north-eastern Germany, in case Austria should make common cause with France. If, as seemed probable, the French should take the initiative before the German armies were ready, and for that purpose should advance from Metz in the direction of Mainz, Moltke would merely put back a few miles nearer to Mainz the points of debarcation from the railway of the troops of the second army. This measure was actually adopted, though the anticipated French invasion did not take place. Moltke's plan of operations was that the three armies while advancing should make a right wheel, so that the first army on the right would reach the bank of the Moselle opposite Metz, while the second and third armies should push forward, the third army to defeat the French force near Strassburg, and the second to strike the Moselle near Pont-à-Mousson. If the French army should be found during this advance in front of the second army, it would be attacked in front by the second army and in flank by the first or the third or both. If it should be found on or north of the line from Saarburg to Lunéville, it could still be attacked from two sides by the second and third armies in co-operation. The intention of the great right wheel was to attack the principal French army in such a direction as to drive it north and cut its communications with Paris. The fortress of Metz was to be observed, and the main German forces, after defeating the chief French army, to march upon Paris. This plan was carried out in its broad outlines. The battle of Wörth was brought on prematurely, and therefore led, not to the capture of MacMahon's army, which was intended, but only to its total defeat and hasty retreat as far as Châlons. The battle of Spicheren was not intended by Moltke, who wished to keep Bazaine's army on the Saar till he could attack it with the second army in front and the first army on its left flank, while the third army was closing towards its rear. But these unintended or unexpected victories did not disconcert Moltke, who carried out his intended advance to Pont-à-Mousson, there crossed the Moselle with the first and second armies, then faced north and wheeled round, so that the effect of the battle of Gravelotte was to drive Bazaine into the fortress of Metz and cut him off from Paris. Nothing shows Moltke's insight and strength of purpose in a clearer light than his determination to attack on the 18th of August, when many strategists would have thought that, the strategical victory having been gained, a tactical victory was unnecessary. He has been blamed for the last local attack at Gravelotte, in which there was a fruitless heavy loss; but it is now known that this attack was ordered by the king, and Moltke blamed himself for not having used his influence to prevent it. During the night following the battle Moltke made his next decision. He left one army to invest Bazaine and Metz, and set out with the two others to march towards Paris, the more southerly one leading, so that when MacMahon's army should be found the main blow might be delivered from the south and MacMahon driven to the north. On the 25th of August it was found that MacMahon was moving north-east for the relief of Bazaine. The moment Moltke was satisfied of the accuracy of his information, he ordered the German columns to turn their faces north instead of west. MacMahon's right wing was attacked at Beaumont while attempting to cross the Meuse, his advance necessarily abandoned, and his army with difficulty collected at Sedan. Here the two German armies were so brought up as completely to surround the French army, which on the 1st of September was attacked and compelled to raise the white flag. After the capitulation of Sedan, Moltke resumed the advance on Paris, which was surrounded and invested. From this time his strategy is remarkable for its judicious economy of force, for he was wise enough never to attempt more than was practicable with the means at his disposal. The surrender of Metz and of Paris was a question of time, and the problem was, while maintaining the investment, to be able to ward off the attacks of the new French armies levied for the purpose of raising the siege of Paris. Metz surrendered on the 27th of October, and on the 28th of January 1871 an armistice was concluded at Paris by which the garrison became virtually prisoners and the war was ended.

On the 29th of October 1870 Moltke was created graf (coun or earl), and on the 16th of June 1871, field marshal. Afte the war he superintended the preparation of its history, which was published between 1874 and 1881 by the great general staff In 1888 he resigned his post as chief of the staff. In 186 Moltke was elected to the North German Diet, and in 1871 to the Reichstag. His speeches, dealing mostly with military questions, were regarded as models of conciseness and relevancy He died suddenly on the 24th of April 1891, and after a magnificent funeral ceremony at Berlin his remains were laid besid those of his wife in the chapel which he had erected as her tomb at Creisau.

As a strategist Moltke cannot be estimated by compariso with Frederick or Napoleon, because he had not the authorit either of a king or of a commander-in-chief. While it is doubtfu whether he can be convicted of any strategical errors, it seem beyond doubt that he never had to face a situation which place any strain on his powers, for in the campaigns of 1866 and 187 his decisions seemed to be made without the slightest effort and he was never at a loss.

He had a tall spare figure, and in his latter years his tanne features had received a set expression which was at once har and grand. He was habitually taciturn and reserved, thoug a most accomplished linguist, so that it was said of him tha he was "silent in seven languages." The stern school of hi early life had given him a rare self-control, so that no indiscree or unkind expression is known to have ever fallen from him Long before his name was on the lips of the public he was know n the army and in the staff as the "man of gold," the ideal haracter whom every one admired and who had no enemies.

AUTHORITIES.—*Gesammelte Schriften und Denkwürdigkeiten des General Feldmarschalls Grafen Helmuth von Moltke* (8 vols., Berlin, 892–1893); *Moltke's militärische Werke* (Berlin, 9 vols., 1892–1900); *Feldmarschall Moltke*, by Max Jähns (3 vols., Berlin, 1894–1900); *Feldmarschall Graf Moltke: Ein militärisches Lebensbild*, by W. Bigge, Oberst, &c. (2 vols., Munich, 1901). (H. S. W.)

MOLUCCAS, or SPICE ISLANDS, a name which in its wider ense includes all the islands of the Malay Archipelago between Celebes on the W., New Guinea on the E., Timor on the S., and he open Pacific Ocean on the N. They are thus distributed ver an area between 2° 43′ N. and 8° 23′ S. and 124° 22′ nd 135° E., and include: (1) the Moluccas proper or Ternate roup, of which Halmahera is the largest and Ternate the capital; 2) the Bachian, Obi, and Xulla groups; (3) the Amboyna group, f which Ceram (Serang) and Buru are the largest; (4) the Banda slands (the spice or nutmeg islands *par excellence*); (5) the south-astern islands, comprising Timor-Laut or Tenimber, Larat, &c.; (6) the Kei Islands and the Aru Islands, of which the former re sometimes attached to the south-eastern group; and (7) he south-western islands or the Babar, Sermata, Leti, Damar, Roma and Wetar groups. At the close of the 16th century his part of the archipelago was divided among four rulers ettled at Ternate, Tidore, Halmahera and Bachian. The orthern portion belongs to the Dutch residency of Ternate, he southern portion to that of Amboyna.

The name Moluccas is said to be derived from the Arabic or "king." Argensola (1609) uses the forms *islas Malucas, Maluco*, and *el Maluco*; Coronel (1623), *islas del Moluco*; and Camoens, *Maluco*. Since 1867, when the political unity, under governor, was dissolved, the Moluccas are often named by he Dutch the "Great East" (*Groote Oost*). Most of the islands re mountainous, with still active volcanoes. As they lie near r under the equator, the monsoons blowing over them are less egular, and the rainfall, of large volume throughout the year, s dependent on the height and direction of the chains. The vegetation of the small and narrow islands, all encompassed y the sea, is very luxuriant, and the products, principally utmegs, mace, and other spices, include also rice and sago. The inhabitants are of mixed descent. In some islands are eople of obvious Papuan blood, while in others are Polynesian r Malayan tribes. With these three main races have crossed raders and colonists, Macassars, Buginese, Javanese and Europeans.

The geology of the Moluccas is very imperfectly known. The reat chain of volcanoes which runs through Sumatra and Java is ontinued eastwards into the Moluccas, and terminates in a hook-ke curve which passes through the Damar Islands to the Banda roup. Outside this hook lies a concentric arc of non-volcanic slands, including Tenimber, the Lesser Kei Islands, Ceram and Buru; and beyond is still a third concentric arc extending from Taliabu to the Greater Kei Islands. The islands of these outer rcs consist chiefly of crystalline schists and limestones, overlaid y Jurassic, Cretaceous and Tertiary deposits. On the whole it ppears that the older rocks are found more particularly towards he interior of the curve, and the newer rocks towards the exterior. Eruptive rocks of supposed Cretaceous age are met with in these uter islands, but Tertiary and recent volcanic lavas are confined to he innermost arc. Halmahera lies outside these arcs. It appears o consist chiefly of gabbro, peridotite, serpentine and other very asic eruptive rocks, which are believed to be of Cretaceous age. Nummulitic limestone occurs in the south-east. Upon the floor of lder rock rise a number of volcanoes, some of which are now extinct while others are still active. Most of them lie near the west coast or n the islands off this coast; and they are arranged in lines which un approximately from north to south, with, generally, a slight onvexity towards the west.

See further MALAY ARCHIPELAGO, and separate articles on the principal islands and groups.

MOLY (Gr. *μῶλυ*), a mysterious plant with magical powers escribed in Homer, *Odyssey*, x. 302–306. Hermes pulls it up nd gives it to Odysseus as a protection against the arts of Circe. It is further described as "having a black root and a ower like milk, and hard for mortals to pull up." There has een much controversy as to the identification. Philippe Champault—*Phéniciens et Grecs en Italie d'après l'Odyssée* (1906), pp. 504 seq.—decides in favour of the *Peganum harmala* (of the order Rutaceae), the Syrian or African rue (Gr. *πήγανον*), from the husks of which the vegetable alkaloid harmaline ($C_{13}H_{14}N_2O$) is extracted. The flowers are white with green stripes. Victor Bérard—*Les Phéniciens et l'Odyssée*, ii. 288 seq.—relying partly on a Semitic root, prefers the *Atriplex halimus* (*atriplex*, a Lat. form of Gr. *ἀτράφαξυς*, and *ἅλιμος*, marine), order Chenopodiaceae, a herb or low shrub common on the south European coasts. These identifications are noticed by R. M. Henry in *Class. Rev.* (Dec. 1906), p. 434, who illustrates the Homeric account by passages in the Paris and Leiden magical papyri, and argues that *moly* is probably a magical name, derived perhaps from Phoenician or Egyptian sources, for a plant which cannot be certainly identified. He shows that the "difficulty of pulling up" the plant is not a merely physical one, but rather connected with the peculiar powers claimed by magicians. In Tennyson's *Lotus Eaters* the moly is coupled with the amaranth ("propt on beds of amaranth and moly").

MOLYBDENITE, a mineral consisting of molybdenum disulphide, MoS_2. It closely resembles graphite in appearance, but may readily be distinguished from this by its greater density (4·7) and by its behaviour before the blowpipe. Crystals have the form of six-sided plates or scales, but they are never sharply defined, and their reference to the hexagonal system is doubtful. They have a perfect cleavage parallel to the large surface of the plates, and the flakes are readily bent, but are not elastic. The mineral is very soft ($H=1$ to $1\frac{1}{2}$) and unctuous, and makes a bluish-grey mark on paper: it is opaque and has a bright metallic lustre. The colour is lead-grey differing slightly from that of graphite in having a bluish tinge. The name molybdenite is from the Greek *μόλυβδος*, meaning lead or lead ore, with which graphite (black-lead) and molybdenite were confused; the latter was distinguished by P. J. Hjelm, who in 1782 discovered the element molybdenum in this mineral.

Molybdenite occurs as disseminated scales in crystalline rocks—such as granite, gneiss, schist and marble—and also in quartz-veins. It has been found in small amounts at many localities, but only those which have yielded large crystals need be specially mentioned here, viz. in a pyroxene-rock at Aldfield in Pontiac county, Quebec; with native bismuth at Kingsgate in Gough county, New South Wales; with wolframite and scheelite in quartz-veins at Caldbeck Fells in Cumberland; and recently, as crystals 6 in. across, at Slangsvold near Raade in Norway.

Molybdenite has been used mainly for the preparation of molybdates for use as chemical reagents. Recently, however, it has been used in the manufacture of molybdenum steel (ferro-molybdenum), which by reason of its hardness and toughness is specially suitable for tools. (L. J. S.)

MOLYBDENUM [symbol, Mo; atomic weight, 96 ($O=16$)] a metallic chemical element. The name is derived from Gr. *μόλυβδος*, lead, and was originally employed to denote many substances containing or resembling lead; ultimately the term was applied to graphite and to molybdenum sulphide. The difference between these two latter substances was first pointed out by Cronstedt, and in 1778 C. Scheele prepared molybdic acid from the sulphide. Molybdenum occurs in nature chiefly as the minerals molybdenite (MoS_2) and wulfenite ($PbMoO_4$), and more rarely as molybdic ochre (MoO_3) and ilsemannite; it also occurs in many iron ores. The metal may be obtained by heating the trioxide with carbon in the electric furnace (H. Moissan, *Comptes rendus*, 1893, 116, p. 1225), or by the Goldschmidt method (Rosenheim and Braun, *Zeit. anorg. Chem.*, 1905, p. 311) or by dissociating the tetra- and pentachloride in a graphite crucible with an electric current below 1330° (J. N. Pring and W. Fielding, *Jour. Chem. Soc.*, 1909, 95, p. 1497). It forms a grey coloured powder of specific gravity 9·01; it is malleable, and not as hard as glass. It is rapidly oxidized on heating to a temperature of 500°–600° C., and also when fused with nitre or potassium chlorate. It is soluble in dilute nitric acid, and in concentrated sulphuric acid; in the latter case with the formation of a blue solution which on heating becomes colourless, molybdenum trioxide being formed with the liberation of sulphur dioxide.

Molybdenum combines with oxygen to form many oxides, the most important of which are: the monoxide, $MoO.n(H_2O)$, the sesquioxide, Mo_2O_3, the dioxide, MoO_2, and the trioxide, MoO_3. *Molybdenum monoxide*, $MoO.n(H_2O)$, is a black powder obtained when the dichloride is boiled with concentrated potash solution. According to W. Muthmann and W. Nagel (*Ber.*, 1898, 31, p. 2009), this oxide does not exist, the reaction leading to the formation of an hydroxide according to the equation: $Mo_3Cl_4(OH)_2 + 4KHO + 3H_2O = 3Mo(OH)_3 + 4KBr + 3H$. *Molybdenum sesquioxide*, Mo_2O_3, a black mass insoluble in acids, is formed by heating the corresponding hydroxide *in vacuo*, or by digesting the trioxide with zinc and hydrochloric acid. *Molybdenum dioxide*, MoO_2, is formed by heating sodium trimolybdate, $Na_2Mo_3O_{10}$, to redness in a current of hydrogen (L. Svanberg and H. Struve, *Jour. prak. Chem.*, 1848, 44, p. 301), or by long fusion of a mixture of ammonium molybdate, potassium carbonate, and boron trioxide (W. Muthmann, *Ann.*, 1887, 238, p. 114). It forms quadratic prisms, having a violet reflex and insoluble in boiling hydrochloric acid. *Molybdenum trioxide*, MoO_3, is prepared by oxidizing the metal or the sulphide by heating them in air, or with nitric acid. It is a white powder, which turns pale yellow on heating, and melts at a red heat. It sublimes in small rhombic tables or needles, and is slightly soluble in cold water, the solution possessing an acid reaction. Several hydrated forms of the oxide are known, and a colloidal variety may be obtained by the dialysis of a strong hydrochloric acid solution of sodium molybdate. Molybdenum trioxide, like chromium trioxide, is an acidic oxide, and forms salts known as molybdates. The normal molybdates show a tendency to pass into polymolybdates. The molybdates are also capable of combining with other oxides (such as phosphorus and arsenic pentoxides) yielding very complex salts. The ordinary *ammonium molybdate*, used as a test reagent for phosphates, is a salt of composition $(NH_4)_{10}MO_{12}O_{41}$; it has been examined physicochemically by J. Sand and F. Eisenlohr (*Abst. J.C.S.*, 1907, ii. pp. 178, 179). The molybdates may be recognized by the fact that they give a white precipitate on the addition of hydrochloric or nitric acids to their solutions, and that with reducing agents (zinc and sulphuric acid) they give generally a blue coloration which turns to a green and finally to a brown colour.

Molybdenum combines with the halogen elements in varying proportions, forming with chlorine a di-, tri-, tetra- and penta-chloride, and similar compounds with bromine and iodine. *Molybdenum dichloride* $(MoCl_2)_3$ or $Cl_4Mo_3Cl_2$ (chlormolybdenum chloride), is prepared (together with some tetrachloride) by heating the trichloride in a stream of carbon dioxide (C. W. Blomstrand, *Jour. f. prak. Chem.*, 1857, 71, p. 449; 1861, 82, p. 433). It is a yellow amorphous powder which is soluble in dilute alkalis, the solution on acidification giving an hydroxide, $Cl_4Mo_3(OH)_2$, which is soluble in nitric acid, and does not give a reaction with silver nitrate. The molecular weight determinations of W. Muthmann and W. Nagel (*Ber.*, 1898, 31, p. 2009) show the salt to possess the composition Mo_3Cl_6. *Molybdenum trichloride*, $MoCl_3$, is obtained when the pentachloride is heated to a temperature of about 250° C. in a current of hydrogen. It forms red crusts, is insoluble in cold water, but is decomposed by boiling water. It is easily soluble in hot nitric acid. *Molybdenum pentachloride*, $MoCl_5$, is obtained when molybdenum is gently heated in dry chlorine (L. P. Liechti and B. Kempe, *Ann.*, 1873, 169, p. 345). It is a dark-coloured crystalline solid which melts at 194° C. and boils at 268° C. It fumes in moist air and deliquesces gradually. It is occasionally used as a chlorine carrier. It is soluble in absolute alcohol and in ether. *Molybdenum disulphide*, MoS_2, is found as the mineral molybdenite, and may be prepared by heating the trioxide with sulphur or sulphuretted hydrogen. It is a black crystalline powder, resembling graphite in appearance. It is readily oxidized by nitric acid, and when strongly heated in a current of hydrogen is reduced to the metallic condition. *Molybdenum trisulphide*, MoS_3, is obtained by saturating a solution of an alkaline molybdate with sulphuretted hydrogen and adding a mineral acid. It is a brown powder which on heating in air loses sulphur and leaves a residue of the disulphide. A *tetrasulphide*, MoS_4, has also been described.

Many varying values have been given for the atomic weight of molybdenum. J. J. Berzelius (*Pogg. Ann.*, 1826, 8, p. 23), by converting lead molybdate into lead nitrate, obtained the value 95·2; while J. B. A. Dumas (*Ann.*, 1860, 113, p. 32), by converting the trioxide into the metal, obtained the value 95·65. K. Seubert and W. Pollard (*Zeit. anorg. Chem.*, 1895, 8, p. 434) using this second method obtained the value 96·28; whilst E. F. Smith and P. Maas (*Zeit. anorg. Chem.*, 1894, 5, p. 280), by heating pure sodium molybdate in hydrochloric acid and estimating the amount of sodium chloride formed, obtained the value 96·087.

MOLYNEUX. This historic English name came into the country from France at the time of the Norman Conquest through William de Molines (Moleyns, Molyneux), who obtained a grant of Sefton, in Lancashire, whence come the earls of Sefton to-day. His descendant Adam de Molyneux (Moleyns or Molins), who died in 1450, was bishop of Chichester and keeper of the privy seal; he was a son of Sir Richard Molyneux of Sefton, and uncle of the Sir Richard Molyneux (d. 1459), the Lancastrian and favourite of Henry VI., whose descendant Richard Molyneux (1593–1636) was created in 1628 1st Viscount Molyneux of Maryborough, a title now merged in that of Sefton (created 1771). Another Molyneux family of some importance is the Irish one, descended from Sir Thomas Molyneux (1531–1597), Irish chancellor of the exchequer, who, born at Calais, settled in Ireland in 1576. He was the great-grandfather of Sir Thomas Molyneux, Bart. (1661–1733), a well-known physician and zoologist, and of William Molyneux (1656–1698), the philosopher, astronomer and politician, the friend of Locke, and author of *Dioptrica nova* (1692), whose famous work on the legislative independence of Ireland (*The Case of Ireland*, &c. 1698) created much stir at the time. The latter's son Samuel Molyneux (1689–1728), was also a well-known astronomer.

MOMBASA, the principal seaport of British East Africa, in 4° 4′ S., 39° 43′ E., 150 m. N. of Zanzibar. Pop. about 30,000. Mombasa is built on a coralline island which nearly fills the mouth of a deep arm of the sea. The channel on either side of the island—Mombasa to the N.E., Kilindini to the S.W.—affords safe harbourage, and each leads to a deeper ramification of the sea, Mombasa Harbour to Port Tudor, Kilindini Harbour to Port Reitz. Mombasa town is on the N.E. side of the island, 2 m. from Kilindini, with which it is connected by rail and tramways. Viewed from the sea Mombasa has a picturesque appearance, the most conspicuous object being the fort, built on a coral hill 40 ft. high. Except for the main street and Government Square (close to the harbour and containing the customs-house and other official buildings), Mombasa proper presents the usual aspect of an Oriental city—a maze of narrow, irregular streets and lanes. To the south, overlooking the sea, is the European suburb. There are Anglican and Roman Catholic churches (the Roman Catholic church and mission house is one of the finest buildings in Mombasa), mission schools, Hindu, Parsee, and Mahommedan temples, and hospitals and law courts, the last named completed in 1902. Built into the façade of the courts is a stone with an inscription recording the building of a fort, dedicated to St Joseph, by the Portuguese at Kilindini in 1666. This stone was found in the ruins of Fort St Joseph. Mombasa Fort, or citadel, quadrangular in form, was built by the Portuguese in 1593–1595 (as an inscription in the interior testifies), was dedicated to the Saviour, and known as the Jesus Fort. It bears the symbol I.H.S. The fort was repaired by Seixas de Cabreira in 1635, the restoration being recorded in an inscription over the gateway. By the British authorities the fort is used as a military store and central gaol. In the public garden on the point of the town facing the sea a bronze statue of Sir William Mackinnon—to whom Mombasa owes its renaissance—has been placed. The population of the city is cosmopolitan, with three well-marked racial distinctions: the Arab (Swahili), the Indian and the European. The climate is fairly healthy, and Europeans live there with comfort.

The harbour at Mombasa is more than a mile in length but only 1200 ft. in width. It is consequently not so suitable for large ships as Kilindini ("the place of deep water"), which possesses the finest land-locked harbour on the East Coast o Africa. The entrance is about the same width as that o Mombasa, but Kilindini Harbour widens to ½ m. and is 3 m. long, the depth of water varying from 25 to 30 fathoms. Kilindini is a depot of the British navy. Port Reitz, which opens out of Kilindini Harbour westward, is 4 m. long and 1 m. broad, with excellent anchorage. At Kilindini is a pier alongside which ships 450 ft. in length and drawing 27 ft. can load and unload cargo. Here is the virtual terminus of the Uganda railway, and the offices, workshops and hospita connected therewith, also a branch customs-house. The Uganda railway crosses to the mainland on a bridge, ½ m. long, buil over the shallow channel which on the north-west separates the island from the continent. Mombasa is the outlet for the produce of a large tract of territory, including the European settlements in the highlands of the protectorate, and by means of the railway to Victoria Nyanza taps the rich regions of the Nile sources. German, British, French and Austrian mail-boats call regularly at the port, which is connected by submarine cable with Zanzibar. Trade statistics are included in those of British East Africa (*q.v.*).

Mombasa Island (named after the town) is 3 m. long by 2½ m. broad, with an area of 9 sq. m. Except at the western end, the coast of the island consists of cliffs from 40 ft. to 60 ft. high. The island contains many fertile plantations, chiefly of coco-nut palms, except on the side facing the ocean, where there is little vegetation, the coral reefs being but thinly covered with earth. There are no springs and the island is dependent for water on rain collected in tanks or drawn from wells—the latter brackish. Ruins of Arab, Portuguese and Turkish buildings are found in various parts of the island. At Ras Serani are the ruins of a chapel "Nossa Senhora das Merces," built by the Portuguese in the 17th century on the site of a Turkish fort, and afterwards turned into a fort again by the Arabs.

Mombasa takes its name from Mombasa in Oman. A Perso-Arabic settlement was made here about the 11th century. It is mentioned by Ibn Batuta in 1331 as a large place, and at the time of Vasco da Gama's visit (1498) it was the seat of considerable commerce, its inhabitants including a number of Calicut Banyans and Oriental Christians. The ruler of the city tried to entrap da Gama (or so the Portuguese navigator imagined), and with this began a series of campaigns which gave full force to its Swahili name *Mvita* (war). The principal incidents are the capture and burning of the place by Almeida (1505), Nuno da Cunha (1529), and Duarte de Menezes (1587)—this last as a revenge for its submission to the sultan of Constantinople—the revolt and flight (1631) of Yusuf ibn Ahmed (who murdered all the Portuguese in the town—over 100), and the three-years' siege by the imam of Omam 1696–98(the garrison being reduced to eleven men and two women), ending in the expulsion of the Portuguese. From the 12th of March 1728 to the 29th of November 1729 a Portuguese force from Goa again held Mombasa, when they were finally driven out by the Muscat Arabs. In December 1823 the Mazrui family, who had ruled in Mombasa from the early part of the 18th century, first as representatives of Oman, afterwards as practically independent princes, placed the city under British protection; and in February 1824 Lieut. J. J. Reitz was appointed commandant or resident at the city by Captain (afterwards Vice-Admiral) W. F. W. Owen. Reitz, after whom Port Reitz is named, died at Mombasa either in 1824 or 1825. The protectorate was repudiated by the British government, which left the place to be bombarded and captured by Seyyid Said of Oman, who made repeated attacks between 1829 and 1833, and only got possession in 1837 by treachery. Said thereafter made Zanzibar his capital, Mombasa becoming of secondary importance. A revolt against Zanzibar in 1875 was put down with British assistance. The British government in the following year vetoed a proposal by the khedive Ismail to annex Mombasa and its hinterland up to the equatorial lakes to Egypt—a project which originated with General C. G. Gordon, when that officer administered the Upper Nile provinces. In 1887 the city was handed over by the sultan of Zanzibar to the British for administration. It became the capital of the province of Seyyidie and of the East Africa protectorate. In 1907, however, the seat of the central government was removed to Nairobi (*q.v.*). Mombasa still forms, nominally, part of the sultanate of Zanzibar. The city, together with Malindi, is mentioned in *Paradise Lost.*

MOMEIN, the Burmese name of the Chinese city Têng-yueh-chow, in the S.W. of the province of Yunnan, China. It was opened to foreign trade by the Burmese Convention of 1897, but so far no advantage has been taken of the permission. It lies close to the Burmese frontier and on the old trade route from Bhamo to Yunnan, but its importance as an outpost of the British Empire is political rather than commercial. The distance from Têng-yueh to Bhamo by the usual trade route is 160 m., and is generally traversed by pack-animals in seven or eight days. In a straight line the two towns are only 80 m. apart. Near Momein and within its jurisdiction is the frontier town of Manwyne, where A. R. Margary was assassinated in January 1875.

MOMMSEN, THEODOR (1817–1903), German historian and archaeologist, was born on the 30th of November 1817 at Garding, in Schleswig. After being educated at the university of Kiel he devoted himself to the study of Roman law and antiquities. In 1843 a grant from the Danish government enabled him to undertake a journey to Italy, which was to be decisive for his future career. There he began the study of Roman inscriptions, in association with other Italian and German scholars, especially Borghesi, de Rossi and Henzen. His first work was directed to the restoration of the old Italian dialects, and the French government, which at one time proposed to undertake the task of compiling a complete collection of all extant Roman inscriptions, asked for his co-operation. When they gave up the project it was taken up by the Berlin Academy, which had recently completed the collection of Greek inscriptions edited by Boeckh. They had already made a grant to Mommsen, and in 1844 Savigny proposed that he should be appointed to carry out the great work. Many years, however, passed before the plan was finally approved. Meanwhile Mommsen continued his work in Italy: he drew up a full memorandum explaining the principles on which a *Corpus inscriptionum* should be compiled, and on which alone he could undertake the editorship. As a specimen he collected the inscriptions of Samnium, and in 1852 published those of the kingdom of Naples. These works caused him to be recognized as the first authority in this field of learning. In 1847, however, he was obliged to return to Germany: he first went to Schleswig, where during the Revolution he edited a paper in which he supported the claims of the Elbe Duchies; at the end of 1848 he was appointed professor of civil law at Leipzig. His work there was interrupted by his political opinions. During 1848, when the extreme party was in the ascendant, Mommsen supported the monarchy against the Republicans. With characteristic courage and independence, next year, when the Revolution had spent its force and Beust executed his *coup d'état*, he protested, with many of his colleagues, against this act. In consequence he was summoned before a disciplinary court, and, together with Haupt and Jahn, dismissed from his professorship.

Mommsen found an asylum in Switzerland, and became professor at Zurich: he repaid the hospitality of the Republic by writing exhaustive monographs on Roman Switzerland. His spare time was occupied with the *Roman History*, the three volumes of which appeared between 1854 and 1856. His name at once became known throughout Europe. In this work, with a true insight into the relative importance of things, he passed over with a few strong broad touches the antiquarian discussions on the origins of the city, on which previous historians had laboured so long; but in place of this he painted with astonishing vigour the great political struggle that accompanied the fall of the republic. It was, above all, his new reading of old characters which demanded attention, if not always approval: Cicero, the favourite of men of letters, was for him "a journalist in the worst sense of the word"; Pompey, the hero of Plutarch and the Moralists, was brushed aside as a mere drill-sergeant; and the book culminated in the picture of Caesar, who established absolute rule in the name of democracy, "the complete and perfect man."

The three volumes ended with the dictatorship of Caesar. The book has never been continued, for the volume on the *Roman Provinces under the Empire*, which appeared in 1884, is in reality a separate work. Mommsen was henceforward fully occupied with work of a more technical nature. In 1854 the definite offer was made to him by the Academy that he should be chief editor of a *Corpus inscriptionum*, with full control, and in order that he might carry on the work he was appointed in 1858 to a professorship at Berlin. The first volume appeared in 1861; five of the succeeding volumes he edited himself, and the whole was executed under his immediate supervision and with the co-operation of scholars whom he had himself trained.

Enormous as was the labour, this task occupied only a small part of his extraordinary intellectual energy. He found time to write two larger works, the *History of the Roman Coinage* and the *Römisches Staatsrecht*, a profound analysis of Roman constitutional law, and *Römisches Strafrecht*, on Roman criminal jurisdiction. His *Roman Provinces* already mentioned gives a singularly interesting picture of certain aspects of social life under the empire. His smaller papers amount to many hundreds in number, and there is no department of Roman life and learning, from the earliest records of the Roman law to the time of Jornandes, which he has not illuminated. As secretary to the Berlin Academy for over twenty years he took a leading part in their deliberations, and was their spokesman on great occasions. His interest in political problems of the present was as keen as in those of the past. He was one of the founders of the *Preussische Jahrbücher*, the most influential of German political periodicals. For many years he was a member of the Prussian Parliament. His political opinions were strong but ill-regulated. Intensely nationalist, he acquiesced in the annexation of his native land to Prussia, and in a public letter to the Italian nation in 1870 defended the German cause before the nation which had become to him a second fatherland; but he was of too independent a character ever to be quite at ease under Prussian government. Loving liberty, he hated its consequences; a democrat, he had and always expressed a profound contempt for the mob. Like many idealists, he was a severe critic of the faults of his own and other countries, and he added something to the increasing Chauvinism in Germany.

It was, however, above all, German scholarship which remained his first interest. There is probably no other instance in the history of scholarship in which one man has established so complete an ascendancy in a great department of learning. Equally great as antiquary, jurist, political and social historian, he lived to see the time when among students of Roman history he had pupils, followers, critics, but no rivals. He combined the power of patient and minute investigation with a singular faculty for bold generalization and the capacity for tracing out the effects of thoughts and ideas on political and social life. Partly, perhaps, owing to a philosophical and legal training, he had not the gift of clear and simple narrative, and he is more successful in discussing the connexion between events than in describing the events themselves. Though his *History* ends with the fall of the republic, his most enduring work has been that on the empire; and if he has not written the history of the empire, he has made it possible for others to do so.

Mommsen died at Charlottenburg on the 1st of November 1903. His brothers, Carl Johann Tycho (1819–1900), a great authority on Pindar and Shakespeare, and August (b. 1821), who wrote chiefly on ancient chronology and Greek festivals, were also prominent among German scholars in their day.

The *History of Rome* (including the volumes of the provinces) has been translated into English by W. P. Dickson (the *Provinces*, revised by F. Haverfield, 1909); there is a French edition of his work on *Roman Coinage*. Many of his pamphlets and articles have been collected under the title *Römische Forschungen*. Of his other works, the more important are the *Roman Chronology to the Time of Caesar* (1858), a work written in conjunction with his brother August; his editions of the *Monumentum Ancyranum* and of the *Digest* in the *Corpus juris civilis*, and of the *Chronica* of Cassiodorus in *Monumenta Germaniae historica*, the *Auctores antiquissimi* section of which was under his supervision. A great part of his work is to be found in the German learned publications such as *Hermes*, *Rheinisches Museum*, &c. His *Reden und Aufsätze* and *Gesammelte Schriften*, i. ii., were published after his death. A full list of his works is given by Zangemeister, *Mommsen als Schriftsteller* (1887; continued by Jacobs, 1905). See also monographs by C. Bardt (1903) and Gradenwitz (1904, in the *Zeitschrift der Savigny-Stiftung für Rechtsgeschichte*), and O. Hirschfeld, *Gedächtnisrede auf Theodor Mommsen* (1904).

MOMORDICA, in botany, a genus of annual or perennial climbing herbs belonging to the natural order Cucurbitaceae, natives of the tropics, especially Africa, and known in cultivation chiefly as hothouse plants. They are grown for their ornamental fleshy fruits, which are oblong to cylindrical in shape, orange to red in colour, prickly or warted externally, and burst when ripe, generally with elastic force, into irregular valves. *M. Balsamina*, known as balsam apple, is a very pretty annual, well adapted for trellises, &c., in warm outside situations.

MOMUS, in Greek mythology, the son of Νύξ (Night), the personification of censoriousness. He is frequently mentioned in Lucian as the lampooner of the gods. It is said that Pallas, Hephaestus, and Poseidon entered into a competition as to which of them could create the most useful thing. Hephaestus made a man, Poseidon an ox, Pallas a house. Momus, being called upon to pronounce an opinion as to the merits of these productions, expressed dissatisfaction with all: with the man, because a window ought to have been made in his breast, through which his heart could be seen; with the ox, because its horns were in the wrong place; with the house, because it ought to have been portable, so as to be easily moved to avoid unpleasant neighbours. Momus is reported to have burst with chagrin at being unable to find any but the most trifling defects in Aphrodite. He is represented sometimes as a young, sometimes as an old man, wearing a mask, and carrying a fool's bauble.

Hesiod, *Theogony*, 214; Lucian, *Hermotimus*, 20, and especially *Deorum Concilium*; Philostratus, *Epistolae*, 37.

MONA, the name used by classical writers, and in particular by Tacitus, to denote Anglesey (*q.v.*). This island was raided by the Roman general Suetonius about A.D. 60 and conquered by Agricola about A.D. 79. The Romans probably mined coppe there, but no trace has yet been found of any Roman military post, and the villages of the inhabitants which have been recently excavated show only mediocre traces of Roman civilization. The name Mona seems also to have been occasionally used, perhaps from ignorance, for the other large island lying betwee England and Ireland, Man. The ancient name of this latte was probably not unlike that of Mona, but is not accuratel known to us (? Monapia, Manavia). (F. J. H.)

MONACO, a territory of south-eastern France, the smallest o the sovereign principalities of Europe. Area about 8 sq. m., the length being 2¼ m. and the width varying from 165 to 1100 yds. Pop. (1900), 15,180. Monaco is situated on the coast of the Mediterranean, 9 m. east of Nice, and is bounded on all sides by the French department of Alpes-Maritimes. It includes the towns of Monaco (3292), Condamine (6218) and Monte Carl (3794). The principality at one time included Mentone an Roccabruna, now known as Roquebrune, which towns, however were ceded to France in 1861 for a sum of four million francs The town of Monaco occupies the level summit of a rocky headland, rising about 200 ft. from the shore, and still defende by ramparts. Though largely modernized, the palace is an interesting specimen of Renaissance architecture; the "cathedral" (Romanesque-Byzantine style), and the oceanographical museum may also be mentioned. For this museum a fine building appropriately decorated, was opened in March 1910 by the princ of Monaco. It stands on the edge of the cliff rising from the se at the gardens of St Martin, and was designed to house th collections made by the prince during twenty-five years o oceanographical research, and others. Behind the rock, betwee Mont Tête de Chien and Mont de la Justice, the high grounds ris towards La Turbie, the village on the hill which takes its nam from the *tropaea* with which Augustus marked the boundar between Gaul and Italy. On the north lies the bay of Monac along the lower ground on the west of the bay stretches the healt and bathing resort of Condamine, with orange-gardens, manufactures of perfumes and liqueurs, and the chapel of Ste Dévot the patron saint of Monaco; to the north of the bay on the rock slopes of the Spélugues (speluncae) are grouped the variou buildings of the Casino of Monte Carlo with the elaborate garden and the numerous villas and hotels which it has called int existence. Adjoining the Casino terrace and overlooking th sea is the pigeon-shooting ground, the competitions on which ar celebrated.

There appear to have been gambling-tables at Monte Carl the year 1856, but it was in 1861 that François Blanc, seeing is tenancy at Homburg coming to an end, with no hope of enewal, obtained a concession for fifty years from Charles III. his concession passed into the hands of a joint-stock company, hich in 1898 obtained an extension to 1947, in return for a ayment to the prince of £400,000 in 1899 and of £600,000 in 913, together with an increase of the annual tribute of £50,000 £70,000 in 1907, £80,000 in 1917, £90,000 in 1927, and £100,000 1937. None of the inhabitants of Monaco have access to the bles; and their interest in the maintenance of the *status quo* secured by their complete exemption from taxation and the rge prices paid for their lands. The ruler of the principality, rince Albert, born 1848, succeeded his father, Prince Charles II., in 1889. He married in 1869 Lady Mary Douglas Hamilton, y whom in 1870 he had a son, Prince Louis: that marriage was, owever, annulled in 1880, and subsequently Prince Albert arried Alice, dowager-duchess of Richelieu, from whom he was ivorced in 1902. The prince is absolute ruler, as there is no arliament in the principality. He is advised by a small council state, the members of which are appointed by himself. The aire and other municipal authorities are also appointed by the rince. A governor-general presides over the administration. he judicial system is the same as that of France, there being a ourt of first instance and a juge de paix. By arrangement, wo Paris judges form a court of appeal. Monaco is the seat of a oman Catholic bishop.

A temple of Heracles seems to have been built on the Monaco eadland by the Phoenicians at a very early date, and the same od was afterwards worshipped there by the Greeks under the urname of Μόνοικος, whence the name Monaco. Monoeci ortus or Portus Herculis is frequently mentioned by the later atin writers. From the 10th century the place was associated ith the Grimaldi, a powerful Genoese family who held high ffices under the republic and the emperors; but not till a much ter date did it become their permanent possession and residence. the beginning of the 14th century it was notorious for its iracies. Charles I. (a man of considerable mark, who, after oing great service by sea and land to Philip of Valois in his nglish wars, was severely wounded at Crecy) purchased entone and Roccabruna, and bought up the claims of the pinola to Monaco. The princes of Monaco continued true to rance till 1524, when Augustin Grimaldi threw in his lot with harles V. Honoré I., Augustin's successor, was made marquis Campagna and count of Canosa, and people as well as rulers ere accorded various important privileges. The right to xact toll from vessels passing the port continued to be exercised ll the close of the 18th century. Honoré II. in 1641 threw off he supremacy of Spain and placed himself under the protec-orate of France; he was compensated for the loss of Canosa, &c., ith the duchy and peerage of Valentinois and various lesser rdships; and "duke of Valentinois" long continued to be the tle of the heir-apparent of the principality. In 1731 Antoine, s great-grandson, was succeeded by his daughter Louise ippolyte; she had married Jacques Goyon, count of Matignon nd Thorigny, who took the name of Grimaldi and succeeded is wife. The National Convention annexed the principality France in 1793; restored to the Goyon Grimaldis by the reaty of Paris in 1814, it was placed by that of Vienna under the rotection of Sardinia. The Sardinian government took the pportunity of disturbances that occurred in 1848 to annex entone and Roccabruna, which were occupied by a Sardinian arrison till 1859. With the transference of Nice to France in 860 the principality passed again under French protection.

See H. Métivier, *Monaco et ses princes*, La Flèche (1862).

MONAD (Gr. μονάς, unit, from μόνος, alone), a philosophic rm which now has currency solely in its connexion with the hilosophy of Leibnitz. In the earlier Greek philosophy the rm meant unity as opposed to duality or plurality; at a later me it meant an individual, or, with the Atomists, an atom. It as first used in a sense approximate to that of Leibnitz by runo, who meant by it a primary spiritual element as opposed the material atom. Leibnitz, however, seems to have borrowed the term not directly from Bruno, but from a contemporary, Van Helmont the younger. Leibnitz's view of things is that the world consists of monads which are immaterial centres of force, each possessing a certain grade of mentality, self-contained and representing the whole universe in miniature, and all combined together by a pre-established harmony. Material things, according to Leibnitz, are in their ultimate nature composed of monads, each soul is a monad, and God is the *monas monadum*. Thus monadism, or monadology, is a kind of spiritual atomism. The theory has been revived in recent years by C. B. Renouvier.

MONADNOCK, a term derived from Mount Monadnock in New Hampshire, U.S.A., to denote the "isolated remnants of hard rock which remain distinctly above their surroundings in the late stages of an erosion cycle" (T. C. Chamberlin, R. D. Salisbury). Examples are frequently found where a hard pipe of igneous rock surrounded by softer rock is gradually exposed by the washing away of the softer rock and becomes a conspicuous feature of the landscape, forming a volcanic "neck," and finally, in the later stages of erosion, a stump. The Peak Downs, Queensland, furnish many examples, and Mato Tepee, Wyoming, is a remarkably conspicuous instance of this type of formation.

MONAGHAN, a county of Ireland in the province of Ulster, bounded E. by Armagh, S.E. by Louth, S. by Meath, S.W. by Cavan, W. by Fermanagh, and N. by Tyrone. The area is 319,741 acres, or about 496 sq. m. The north-western part of the country is included in the great central plain of Ireland; but to the south and east the surface is irregular, although none of the hills is of great elevation. The principal range is that of Slievebeagh, a rugged and barren tract extending into the county Fermanagh, its highest summit being 1254 ft. above sea-level. The principal rivers are the Finn, which rises near the centre of the county and passes into Fermanagh, and the Blackwater, which forms the boundary with Tyrone. The Ulster Canal passes the towns of Monaghan and Clones, affording communication between Lough Neagh and Lough Erne. In geological structure the county drops from the Upper Carboniferous outlier of Slievebeagh in the north-west to a Carboniferous Limestone area towards Monaghan town; but south of this a tumbled Silurian area stretches across the Cavan and Armagh borders. At Carrickmacross, an outlier of Carboniferous Limestone, Coal Measures (with poor seams of coal) and Trias is encountered. Gypsum has been quarried in the Trias, and lead ore was formerly mined in many places in the Silurian area. The Triassic clay furnishes excellent bricks. Eskers or glacial ridges occur at several places. The limestone is not only abundant and good, but from the position of the rocks it can be obtained at small expense in working. Freestone and slates are quarried in considerable quantities. The soil in the more level portions of the county is fertile where it rests on limestone, and there is also a mixed soil of deep clay, which is capable of high cultivation; but in the hilly regions a strong retentive clay prevails, which could be made productive only by careful draining and culture. Spade husbandry generally prevails. The proportion of tillage to pasturage is roughly as 1 to 1½. Oats, potatoes and turnips are the principal crops, but the quantity grown decreases. The number of cattle, sheep, pigs, goats and poultry, on the other hand, increases or is well maintained. Linen is the only manufacture of consequence, but the cultivation of flax has almost died out. The Belfast and Clones line of the Great Northern railway crosses the county from north-east to west, passing the town of Monaghan, and the Dundalk and Clones line of the same company runs from south-east to west, with branches to Carrickmacross and to Cootehill (county Cavan).

The population (86,206 in 1891; 74,611 in 1901) decreases as rapidly as any county population in Ireland, and emigration is very heavy. The total includes about 73% of Roman Catholics, and about 12% each of Protestant Episcopalians and of Presbyterians. The principal towns are Monaghan (the county town, pop. 2932), Clones (2068), Carrickmacross (1874), Castleblayney (1576) and Ballybay (1208). The county includes five baronies. Assizes are held at Monaghan, and quarter sessions at Carrickmacross, Castleblayney, Clones and Monaghan. The two county members sit for the north and south divisions respectively. The county is in the Protestant and Roman Catholic dioceses of Clogher.

The district now called the county Monaghan was included in the district of Uriel or Orgial, and long known as Macmahon's country. It was made shire ground under its present name by Sir John Perrot in the reign of Elizabeth. At Clones there is a round tower in good preservation, but very rude in its masonry, another at Inishkeen is in ruins. Near Clones there are two large raths. Although there are several Danish forts there are no medieval castles of importance The only monastic structure of which any vestiges remain is the abbey of Clones, which was also the seat of a bishopric. The abbey dates from the 6th century, but was rebuilt in the 14th century after destruction by fire.

MONAGHAN, a market town and the county town of county Monaghan, Ireland, on the Ulster Canal and the Belfast and Clones line of the Great Northern railway, by which it is 52 m. S.W. by W. of Dublin. Pop (1901), 2932. There is a modern Roman Catholic cathedral (1862–1892) for the diocese of Clogher, a convent of the Sisters of St Louis, and a Protestant church (1836), and the public and county buildings include court-house, gaol, workhouse, asylum, hospital and barracks. Educational establishments include a national model school and the college of St Macartan, preparatory for the Roman Catholic priesthood. The town takes its name (Muinechan, the town of monks) from an early monastery. It was incorporated by James I., but was little more than a hamlet until the close of the 18th century. Rossmore Park, the fine demesne of Lord Rossmore, is the most noteworthy of several neighbouring residences. The town is governed by an urban district council.

MONA MONKEY, a West African representative of the group of monkeys generally known as guenons, and scientifically as *Cercopithecus*. The mona (*C. mona*) typifies a sub-genus of the same name (*Mona*) characterized, among other features, by the presence of a black band running from the angle of each eye to the ear. In the mona itself the general colour of the upper parts is black, with a pair of oval white spots near the root of the tail, while a band across the forehead and the whole under surface are likewise white. (See PRIMATES.)

MONARCHIANISM, a theological term designating the view taken by those Christians who, within the Church, towards the end of the 2nd century and during the 3rd, opposed the doctrine of an independent personal subsistence of the Logos. During the middle of the 2nd century a number of varying christological views began to germinate, growing for a time side by side. They fall into two great classes: (*a*) Christ was a man in whom the Spirit of God had dwelt; (*b*) Christ was the Divine Spirit who had assumed flesh. Each class based its position on Scripture, but the latter (which prevailed) had the advantage of being able easily to combine with cosmological and theological propositions current in the religious philosophy of the time. The opposition to it arose out of a fear that it threatened monotheism. The representatives of the extreme monotheistic view, which while regarding Christ as Redeemer, clung tenaciously to the numerical unity of the Deity, were called Monarchians, a term brought into general use by Tertullian It has to be remembered (1) that the movement originated within the pale of the Church, and had a great deal in common with that which it opposed; (2) that it was ante-Catholic rather than anti-Catholic, *e.g.* the Canon of the New Testament had not yet been established. It is usual to speak of two kinds of monarchianism—the dynamistic and the modalistic, though the distinction cannot be carried through without some straining of the texts. By monarchians of the former class Christ was held to be a mere man, miraculously conceived indeed, but constituted the Son of God simply by the infinitely high degree in which he had been filled with Divine wisdom and power. This view was represented in Asia Minor about the year 170 by the anti-Montanistic Alogi, so called by Epiphanius on account of their rejection of the Fourth Gospel it was also taught at Rome about the end of the 2nd century b Theodotus of Byzantium, a currier, who was excommunicate by Bishop Victor, and at a later date by Artemon, excommunicated by Zephyrinus About the year 260 it was again propounded within the Church by Paul of Samosata (*q.v.*), who hel that, by his unique excellency, the man Jesus gradually rose t the Divine dignity, so as to be worthy of the name of God Modalistic monarchianism, conceiving that the whole fullnes of the Godhead dwelt in Christ, took exception to the "subordinatianism" of some Church writers, and maintained that th names Father and Son were only two different designations o the same subject, the one God, who "with reference to the relations in which He had previously stood to the world is called th Father, but in reference to His appearance in humanity is calle the Son." It was first taught, in the interests of the "monarchia" of God, by Praxeas, a confessor from Asia Minor, i Rome about 190, and was opposed by Tertullian in his well known controversial tract. The same view—the "patripassian as it was also called, because it implied that God the Father ha suffered on the cross—obtained fresh support in Rome about 21 from certain disciples of Noetus of Smyrna, who received modified support from Bishop Callistus. It was on this accoun that Hippolytus, the champion of hypostasian subordinatianism along with his adherents, withdrew from the obedience o Callistus, and formed a separate community. In Carthag Praxeas for a time had some success, but was forced by Tertullian not only to desist but to retract. A new and conciliator phase of patripassianism was expounded at a somewhat late date by Beryllus of Bostra, who, while holding the divinity o Christ not to be *ἰδία*, or proper to Himself, but *πατρική* (belongin to the Father), yet recognized in His personality a new *πρόσωπο* or form of manifestation on the part of God. Beryllus, howeve was convinced of the wrongness of this view by Origen (*q.v.* and recanted at the synod which had been called together i 244 to discuss it. (For the subsequent history of modalisti monarchianism see SABELLIUS.)

See the Histories of Dogma by A. Harnack, F. Loofs, R. Seeberg also R. L. Ottley, *The Doctrine of the Incarnation.*

MONARCHY (Fr. *monarchie*, from Lat. *monarchia*, G *μοναρχία*, rule of one, *μόνος*, alone, *ἀρχή*, rule), strictly, th undivided sovereignty or rule of a single person. Hence th term is applied to states in which the supreme authority vested in a single person, the monarch, who in his own righ is the permanent head of the state. The character of tr monarchy is well defined in the well-known lines of Cowp (*Verses supposed to be written by Alexander Selkirk*):

> "I am monarch of all I survey,
> My right there is none to dispute."

The word "monarchy" has, however, outlived this origin meaning, and is now used, when used at all, somewhat loosel of states ruled over by hereditary sovereigns, as distinct fro republics with elected presidents; or for the "monarchic principle," as opposed to the republican, involved in this di tinction.

The old idea of monarchy, viz. that of the prince as represen ing within the limits of his dominions the monarchy of God ov all things, culminated in the 17th century in the doctrine of t divine right of kings, and was defined in the famous dictum Louis XIV.: *L'état c'est moi!* The conception of monarchy w derived through Christianity from the theocracies of the East; was the underlying principle of the medieval empire and al of the medieval papacy, the rule of the popes during the peri of its greatest development being sometimes called "the pap monarchy." The monarchical principle was shaken to i foundations by the English revolution of 1688; it was shatter by the French revolution of 1789; and though it survives as political force, more or less strongly, in most European countrie "monarchists," in the strict sense of the word, are everywhere small and dwindling minority. To express the change phras were invented which have come into general use, thou involving a certain contradiction in terms, viz. "limited" constitutional monarchy," as opposed to "absolute" or autocratic monarchy."

Finally, a distinction is drawn between "elective" and hereditary" monarchies. Of the former class the most nspicuous was the Holy Roman Empire; but in Europe all onarchies were, within certain limits, originally elective; and, ter the introduction of Christianity, the essential condition the assumption of sovereign power was not so much kinship ith the reigning family as the "sacring" by the divine thority of the Church. The purely hereditary principle ıs of comparatively late growth, the outcome of obvious nvenience, exalted under the influence of various forces into religious or quasi-religious dogma. (See also GOVERNMENT d SOVEREIGNTY.)

MONASSIR (MONASIR), an African tribe of Semitic stock, ring in the Nile valley (Berber mudiria) between Birti (their adquarters) and Dar Robatab. They are a prosperous, dentary tribe, claim kinship with the Ababda, and speak abic, but are of very mixed blood. Next to Birti their ief settlement is at Salamat. Both places are on the left nk of the Nile. It was by Monassir tribesmen that Colonel D. H. Stewart, Gordon's comrade at Khartum, was murred in 1884.

MONASTICISM (Gr. *μοναστικός*, living alone, *μόνος*), a system living which owes its origin to those tendencies of the human ul which are summed up in the terms "asceticism" and mysticism." Mysticism may broadly be described as the fort to give effect to the craving for a union of the soul with the eity already in this life; and asceticism as the effort to give fect to the hankering after an ever-progressive purification of e soul and an atoning for sin by renunciation and self-denial things lawful. These two tendencies may well be said to be neral instincts of humanity; because, though not always lled into activity, they are always liable to be evoked, and in ages and among all races they frequently have asserted themlves. (See ASCETICISM and MYSTICISM.) Indeed the history of ligion shows that they are among the most deep-rooted and despread instincts of the human soul; and monasticism is e attempt to develop and regulate their exercise. Thus onasticism is not a creation of Christianity; it is much der, and before the Christian era a highly organized onasticism existed in India. (See the articles on BRAHMANISM; UDDHISM; and LHASA.)

1. *Pre-Christian Monasticism.*—Greek asceticism and mystism seem never to have produced a monastic system; but among e Jews, both in Judaea and in Alexandria, this development ok place. In Judaea the Essenes before the time of Christ ed a fully organized monastic life (see Schürer, *Jewish People*, § 30); and the same is true in regard to the Therapeutae in e neighbourhood of Alexandria (the authenticity of Philo's *e Vita contemplativa*, which describes their manner of life, is ain recognized by scholars).

A general sketch of pre-Christian asceticism and monasticism, th indication of the chief authorities, is given in O. Zöckler's *skese und Mönchtum* (1897), pp. 32–135. This account is epitoized by J. O. Hannay, *Spirit and Origin of Christian Monasticism* 903), app. i: the view now common among scholars is there aintained, that these pre-Christian realizations of the monastic ea had little, and indeed no, influence on the rise and development Christian monasticism.

2. *Beginnings of Christian Monasticism.*—The practice of ceticism asserted itself at an early date in Christian life: men d women abstained from marriage, from flesh meat, from the e of intoxicating drink, and devoted themselves to prayer, ligious exercises and works of charity (S. Schiwietz, *Das orgenländische Mönchtum*, 1904, pt. i.; J. O. Hannay, *op. cit.* s. 2, 3). This they did in their homes, without withdrawing om their families or avocations. In time, however, the tenncy to withdraw from society and give oneself up wholly to e practice of religious and ascetical exercises set in; and at any te in Egypt, at the middle of the 3rd century, it was the custom r such ascetics to live in solitary retirement in the neighbourod of the towns and villages. This was the manner of life which St Anthony (*q.v.*) began to lead, *c.* 270; but after fifteen years he withdrew to a deserted fort on the east bank of the Nile, opposite the Fayum. Here he enclosed himself and led a life cut off from all intercourse with man. There are reasons for doubting that Anthony was the first Christian hermit: probably there is some historical foundation for the tradition that one of those who fled to the desert in the Decian persecution continued to dwell in a cave by the shore of the Red Sea, unknown to men, till visited by St Anthony long years afterwards (see E. C. Butler, *Lausiac History of Palladius*, 1898, pt. i. p. 230). But this was a single case which does not affect the fixed tradition of monastic Egypt in the 4th century that Anthony was the father of Christian monachism.

During twenty years Anthony lived a life of seclusion, never coming forth from his fort, never seeing the face of man. But his fame went abroad and a number of would-be disciples came and took up their abode in the caves and among the rocks that surrounded his retreat, and called on him to guide them in the path of life they had chosen. In response to these appeals Anthony came forth and set himself to organize the life of the multitude of ascetics that had grown up around him. This act, which took place in the first years of the 4th century, must be regarded as the inauguration of Christian monachism.

3. *St Anthony's Monachism.*—The form of monastic life directly derived from St Anthony was the type that prevailed in middle and northern Egypt up to the middle of the 5th century. The chief authorities for the study of this type of monastic life are the *Vita Antonii* (probably by Athanasius), the *Historia monachorum* (ed. E. Preuschen), the *Historia lausiaca* of Palladius (ed. E. C. Butler)—these works are to be found in Latin in Rosweyd's *Vitae Patrum* (*Migne, Patrol Lat.* LXXIII., LXXIV.)—and the writings of Cassian (English translation by Gibson in "Nicene and Post-Nicene Library"). A generation ago all this literature was in disrepute; but it has been revindicated, and its substantially historical character is now recognized on all hands (see E. C. Butler, *op. cit.* pt. ii. § 1).

Antonian monachism grew out of the purely eremitical life, and it retained many of the characteristic features inherited from its origin. The party of travellers whose journey in 394 is narrated in the *Historia monachorum* found at the chief towns along the Nile from Lycopolis (Assiut or Siut) to Alexandria, and in the deserts that fringed the river, monastic habitations, sometimes of hermits, sometimes of several monks living together but rather the life of hermits than of cenobites. It is at the great monastic settlements of Nitria and Scete that we are best able to study this kind of Egyptian monasticism. Here in one portion of the desert, named Cellia, the monks lived a purely eremitical life; but in Nitria (the Wadi Natron) they lived either alone, or two or three together, or in communities, as they preferred. The system was largely voluntary; there was no organized community life, no living according to rule, as it is now understood. In short the life continued to be semi-eremitical. (See Butler, *op. cit.* pt. i. p. 233; Hannay, *op. cit.* chs. 4, 5; Schiwietz, *op. cit.* pt. ii. §§ 1–11.)

4. *St Pachomius's Monachism.*—Very different was the type of monastic life that prevailed in the more southerly parts of Egypt. Here, at Tabennisi near Dendera, about 315–320, St Pachomius (*q.v.*) established the first Christian cenobium, or monastery properly so called. (On St Pachomius and his monastic institute see P. Ladeuze, *Cénobitisme Pakhomien* (1898); Schiwietz, *op. cit.* pt. ii. §§ 12–16; E. C. Butler, *op. cit.* pt. i. p. 234, pt. ii. notes 48, 49, 54, 59). Before his death in 346 Pachomius had established nine monasteries of men and one of women, and after his death other foundations continued to be made in all parts of Egypt, but especially in the south, and in Abyssinia. Palladius tells us that *c.* 410 the Pachomian or Tabennesiot monks numbered some seven thousand. The life was fully cenobitical, regulated in all details by minute rules, and with prayer and meals in common. As contrasted with the Antonian ideal, the special feature was the highly organized system of work, whereby the monastery was a sort of agricultural and industrial colony. The work was an integral part

of the life, and was undertaken for its own sake and not merely for an occupation, as among the Antonian monks. This marks a distinctly new departure in the monastic ideal.

In another respect too St Pachomius broke new ground: not only did he inaugurate Christian cenobitical life, but he also created the first "Religious Order." The abbot of the head monastery was the superior-general of the whole institute; he nominated the superiors of the other monasteries; he was visitor and held periodical visitations at all of them; he exercised universal supervision, control and authority; and every year a general chapter was held at the head house. This is a curious anticipation of the highly organized and centralized forms of government in religious orders, not met with again till Cluny, Citeaux, and the Mendicant orders in the later middle ages.

A passing reference should be made to the Coptic abbot Shenout, who governed on similar lines the great "White Monastery," whereof the ruins still survive near Akhmim; the main interest of Shenout's institute lies in the fact that it continued purely Coptic, without any infiltration of Greek ideas or influence. (See J. Leipoldt, *Schenute von Atripe*, 1903.)

Egyptian monachism began to wane towards the end of the 5th century, and since the Mahommedan occupation it has ever been declining. Accounts of its present condition may be found in R. Curzon's *Monasteries of the Levant* (1837), or in A. J. Butler's *Ancient Coptic Churches* (1884). Hardly half a dozen monasteries survive, inhabited by small and ever dwindling communities.

5. *Oriental Monachism.*—The monastic institute was imported early in the 4th century from Egypt into Syria and the Oriental lands. Here it had a great vogue, and under the influence of the innate Asiatic love of asceticism it tended to assume the form of strange austerities, of a kind not found in Egyptian monachism in its best period. The most celebrated was the life of the Stylites or pillar hermits (see SIMEON STYLITES). Monastic life here tended to revert to the eremitical form, and to this day Syrian and Armenian monks are to be found dwelling in caverns and desert places, and given up wholly to the practice of austerity and contemplation (see E. C. Butler, *Lausiac History of Palladius*, pt. i. p. 239, where the chief authorities are indicated). Before the close of the 4th century monachism spread into Persia, Babylonia and Arabia.

6. *Basilian and Greek Monachism.*—Though Eustathius of Sebaste was the first to introduce the monastic life within the confines of what may be called Greek Christianity in Asia Minor (*c.* 340), it was St Basil who adapted it to Greek and European ideas and needs. His monastic legislation is explained and the history of his institute sketched in the article BASILIAN MONKS. Here it will suffice to say that he followed the Pachomian rather than the Antonian model, setting himself definitely against the practice of the eremitical life and of excessive asceticism, and inculcating the necessity and superiority of labour. The lines laid down by St Basil have continued ever since to be the lines in which Greek and Slavonic monasticism has rested, the new multitudinous modifications of the monastic ideal, developed in such abundance in the Latin Church, having no counterpart in the Greek. But the element of work has decreased, and Greek and Slavonic monks give themselves up for the most part to devotional contemplation.

7. *Early Western Monachism.*—The knowledge of the monastic life was carried to western Europe by St Athanasius, who in 340 went to Rome accompanied by two monks. The *Vita Antonii* was at an early date translated into Latin and propagated in the West, and the practice of monastic asceticism after the Egyptian model became common in Rome and throughout Italy, and before long spread to Gaul and to northern Africa. A *résumé* of the chief facts will be found in E. C. Butler, *op. cit.* pt. i. p. 245; see also Hannay, *op. cit.* ch. 7. The monastic ideals prevalent were those of the Antonian monachism, with its hankering after the eremitical life and the practice of extreme bodily austerities. But climatic conditions and racial temperament rendered the Oriental manner of monasticism unattainable, as a rule, in the West. Hence it came to pass that by the end of the 5th century the monastic institute in western Europe, and especially in Italy, was in a disorganized condition, sinking under the weight of traditions inherited from the East. It was St Benedict who effected a permanently working adaptation of the monastic ideal and life to the requirements and conditions of the western races.

8. *St Benedict's Monachism.*—St Benedict (*c.* 500) effected his purpose by a twofold break with the past: he eliminated from the idea of the monastic life the element of Oriental asceticism and extreme bodily austerity; and he put down the tendency, so marked in Egypt and the East, for the monks to vie with one another in ascetical practices, commanding all to live according to the rule. The life was to be self-denying and hard, but not one of any great austerity (for details see BENEDICT OF NURSIA; and E. C. Butler, *op. cit.* pt. i. pp. 237 and 251). The individual monk was sunk in the community whose corporate life he had to live. St Benedict's rule was a new creation in monastic history; and as it rapidly supplanted all other monastic rules in western Europe, and was for several centuries the only form of monasticism in Latin Christianity (outside of Ireland), it is necessary to speak in some little detail of its spirit and inner character.[1] It has to be emphasized at the outset that the monasteries in which the Benedictine rule was the basis of the life did not form a body or group apart within the great "monastic order," which embraced all monasteries of whatever rule; nor had Benedictine monks any special work or object beyond that common to all monks—viz. the sanctifying of their souls by living a community life in accordance with the Gospel counsels. St Benedict defines his monastery as "a school of the service of the lord" (*Reg.*, *Prol.*). The great act of service is the public common celebration of the canonical office, the "work of God" he calls it, to which "nothing is to be preferred" (*Reg.* c. 43). The rest of the day is filled up with a round of work and reading. Work, and in St Benedict's time it was predominantly field work, took an even more recognized and integral place in the life than was the case under St Pachomius or St Basil, occupying notably more time than the church services. St Benedict introduced too into the monastic life the idea of law and order, of rule binding on the abbot no less than on the monks; thus he reduced almost to a vanishing point the element of arbitrariness, or mere dependence on the abbot's will and whim, found in the earlier rules. Lastly, he introduced the idea of stability, whereby monk and community were bound to each other for life, the normal thing for the Benedictine being to live and die in the monastery of his profession: thus the power hitherto enjoyed by monks, of wandering from monastery to monastery, was cut away, and the Benedictine community was made into a family whose members were bound to one another by bonds that could not be severed at will.

9. *Western Monachism in the Early Middle Ages.*—It is easy to understand that a form of monastic life thus emptied of distinctively Oriental features and adapted to the needs of the West by a great religious genius like St Benedict, should soon have distanced all competitors and have become the only monastic rule in western Europe. The steps in the propagation of the Benedictine rule are traced in the article BENEDICTINES. The only serious rival was the Irish rule of Columban; and here it will be in place to say a word on Irish monasticism, which, in its birthplace, stood aloof to the end from the general movement The beginnings of Celtic monachism are obscure, but it seems to have been closely connected with the tribal system.[2] When however, Irish monachism emerges into the full light of history it was in its manifestations closely akin to the Egyptian, or even to the Syrian type: there was the same love of the eremitical life, the same craving after bodily austerities of an extraordinary kind, the same individualistic piety. The Irish monks were great missioners in the north of England and the northern and

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[1] This topic is dealt with by F. A. Gasquet, *Sketch of Monastic Constitutional History* (pp. viii.–xxii.), the Introduction to 2nd edition of the translation of Montalembert's *Monks of the West* (1895).

[2] See Willis Bund, *Celtic Church in Wales* (1897); H. Zimmer, art "Keltische Kirche" in Herzog-Hauck, *Realencyklopädie* (3rd ed.) translated into English by Kuno Meyer (1902).

central parts of Europe, and in the course of the 7th century the Irish rule of St Columban and the Roman rule of St Benedict met in the monasteries in central Europe that had been founded by Columban and his Irish monks. The Benedictine rule supplanted the Irish so inevitably that the personnel ceased to be Irish, that even in St Columban's own monastery of Luxeuil his rule was no longer observed, and by Charlemagne's time all remembrance of any other monastic rule than the Benedictine had died out.

During the 7th and 8th centuries the Benedictine houses were the chief instrument in the christianizing, civilizing and educating of the Teutonic races. In spite of the frequent pillage and destruction of monasteries by Northmen, Saracens, Arabs and other invaders; in spite of the existence of even widespread local abuses, St Benedict's institute went on progressing and consolidating; and on the whole it may be said that throughout the early middle ages the general run of Benedictine houses continued to perform with substantial fidelity the religious and social functions for which they were created.

10. *Offshoots and Modifications of Benedictine Monachism: the Rise of "Orders."*—Up to the beginning of the 10th century we do not meet in the West such a thing as an "order"—an organized corporate body composed of several houses, diffused through various lands, with centralized government and objects and methods of its own. As stated above, St Pachomius's monasteries formed an order—a curious anticipation of what six centuries later was to become the vogue in Western monasticism. The Benedictine houses never coalesced in this manner; even when, later on, a system of national congregations was introduced, they were but loose federations of autonomous abbeys; so that to this day, though the convenient expression "Benedictine order" is frequently used, the Benedictines do not form an order in the proper sense of the word. But with the 10th century we reach the period of orders, and it is on this line that all subsequent developments in Western monasticism have run.

The first order was that of Cluny, founded in 910; in rule and manner of life it continued purely Benedictine, and it wielded extraordinary power and religious influence up to the middle of the 12th century. (See CLUNY.)

The chief offshoot from the Benedictine institute were the Cistercians (*c.* 100); their ground idea was a return to the letter of St Benedict's rule, and a reproduction, as close as could be, of the exterior conditions of life as they existed in St Benedict's own monastery; consequently field work held a prominent place in the Cistercian ideal. This ideal it has not been possible permanently to maintain in the great body of the order, but only in limited circles, as Trappists (*q.v.*). But for a century (1125–1225) Citeaux supplanted Cluny as the spiritual centre of western Europe. The Cistercians were an organized, centralized order in the full sense of the word. (See CISTERCIANS.)

Towards the end of the 10th century and during the 11th a strong tendency set in to revert to the eremitical life, probably owing to the example of the Greek monks, who at this time entered Sicily and south Italy in great numbers. This tendency produced the orders of the Camaldulians or Camaldolese (*c.* 975) in Italy, and in France the Grandmontines (1076) and Carthusians (1084), all leading practically eremitical lives, and assembling ordinarily only for the church services. The Vallombrosians (1038) near Florence maintained a cenobitical life, but eliminated every element of Benedictine life that was not devoted to pure contemplation. At Fontevrault (founded in 1095) the special feature was the system of "double monasteries" *i.e.* neighbouring, but rigorously separated, monasteries of men and of women—the government being in the hands of the abbesses.

In all these lesser orders may be discerned the tendency of a return to the elements of Eastern monasticism discarded by St Benedict—to the eremitical life; to the purely contemplative life with little or no factor of work; to the undertaking of rigorous bodily austerities and penances—it was at this time that the practice of self-inflicted scourgings as a penitential exercise was introduced. All this was a reaction from St Benedict's reconstruction of the monastic life—a reaction which in the matter of austerities and individualistic piety has made itself increasingly felt in the later manifestations of the monastic ideal in the West.

11. *New Kinds of Religious Orders.*—Up to this point we have met only with monasticism proper; and if the term were taken strictly, the remainder of this article would be concerned only with the later history of the institutes already spoken of; for neither canons regular, friars, nor regular clerks, are in the strict sense monks. But it is usual, and it will be convenient here, to use the term monasticism in a broader sense, as equivalent to the technical "religious life," and as embracing the various forms that have come into being so prolifically in the Latin Church at all periods since the middle of the 11th century.

The first of these new forms was that of the canons regular or Augustinian canons (*q.v.*) who about the year 1060 arose out of the older semi-monastic canonical institute, and lived according to the so-called "Rule of St Augustine." The essential difference between monks and regular canons may be explained as follows: monks, whether hermits or cenobites, are men who live a certain kind of life for its own sake, for the purpose of leading a Christian life according to the Gospel's counsel and thus serving God and saving their own souls; external works, either temporal or spiritual, are accidental; clericature or ordination is an addition, an accession, and no part of their object, and, as a matter of fact, till well on in the middle ages it was not usual for monks to be priests; in a word, the life they lead is their object, and they do not adopt it in order the better to compass some other end. But canons regular were in virtue of their origin essentially clerics, and their common life, monastery, rule, and the rest, were something additional grafted on to their proper clerical state. The difference manifested itself in one external point: Augustinian canons frequently and freely themselves served the parish churches in the patronage of their houses; Benedictine monks did so, speaking broadly, hardly at all, and their doing so was forbidden by law, both ecclesiastical and civil. In other respects the life of canons regular in their monasteries, and the external policy and organization among their houses, differed little from what prevailed among the Black Benedictines; their superiors were usually provosts or priors, but sometimes abbots. As contrasted with the friars they are counted among the monastic orders. Alongside of the local federations or congregations of houses of Augustinian canons were formed the Premonstratensian order (1120) (*q.v.*), and the English "double order" of St Gilbert of Sempringham (1148) (*q.v.*), both orders, in the full sense of the word, composed of Augustinian canons.

Two special kinds of orders arose out of the religious wars waged by Christendom against the Mahommedans in the Holy Land and in Spain: (1) the Military orders: the Knights Hospitallers of St John and the Knights Templars, both at the beginning of the 12th century, and the Teutonic Knights at its close; (2) the orders of Ransom, whose object was to free Christian prisoners and slaves from captivity under the Mahommedans, the members being bound by vow even to offer themselves in exchange; such orders were the Trinitarians (*q.v.*) founded in 1198, and the order of Our Lady of Ransom (de Mercede), founded by St Peter Nolasco in 1223; both were under the Augustinian rule.

At the beginning of the 13th century arose the series of great Mendicant orders. Their nature and work and the needs that called them into being are explained in the article MENDICANT MOVEMENT, and in the separate articles on ST FRANCIS OF ASSISI and FRANCISCANS (1210), ST DOMINIC and DOMINICANS (1215), CARMELITES (1245), AUGUSTINIAN HERMITS (1256)—these were the four great orders of Mendicant friars—to them were added, in 1487, the Servites (*q.v.*) founded in 1233.

It will be in place here to explain the difference between friars, monks, and canons regular. The distinction between the two last has already been brought out; but they agree in this that the individual monk and canon alike belongs to his house of profession and not to any greater or wider corporation. They are bound by place and the unit is the individual community. Thus among monks and canons regular each monastery has its own fixed community, which is in a real sense a family; and the monk or canon, no matter where he may be, looks on his monastery as his "home," like the ancestral home of a great family. With the friars this is all changed: the friar does not belong to any particular house, but to the province or order, so that there is no reason, beyond the command of his superiors, why he should be living in one house rather than another. In the monk attachment to his own one monastery is a virtue; in the friar detachment is the ideal. The monk, or the canon, normally exercises his influence on the world in and through his community, not as an individual but as a member of a corporate body. The friar's sphere of work is normally outside his convent, and he works and influences directly and as an individual. Lastly, in regard to the object aimed at there was an important difference, for the professed object of the friars was to be clerical helpers of the parochial clergy in meeting the specifically religious needs of the time. Already, in St Francis's lifetime, his friars had grown into an order dedicated to spiritual ministrations among the poor, the sick, the ignorant, the outcasts of the great cities; while by the very conception of their institute the Dominicans were dedicated to the special work of preaching, especially to heretics and heathens. Here, too, should be mentioned St Francis's other great creation, the Tertiaries (*q.v.*), or devout men and women living in the world, who while continuing their family life and their ordinary avocations, followed a certain rule of life, giving themselves up to more than ordinary prayer and the pursuit of good works, and abstaining from amusements of a worldly kind.

12. *The Religious Orders in the Later Middle Ages.*—The 13th century was the heyday of monasticism in the West; the Mendicant orders were in their first fervour and enthusiasm; the great abbeys of Benedictines, Cistercians and Augustinian canons reflected the results of the religious reform and revival associated with Hildebrand's name, and maintained themselves at a high and dignified level in things religious and secular; and under the Benedictine rule were formed the new congregations or orders of Silvestrines (1231), Celestines (*c.* 1260) and Olivetans (1319), which are described under their several headings. But towards the end of the century a period of decline set in, which ran its course in increasing volume throughout the 14th century. A great wave of secularity rolled over the Church, engulfing the religious orders with the rest; love waxed cold, fervour languished, learning declined, discipline was relaxed, bitter rivalries broke out, especially between Franciscans and Dominicans. The great schism was reflected in the Mendicant orders which were divided into two obediences, to the destruction of discipline. The great wealth of the old monastic orders exposed them, especially in France and Italy, to the vicious system of commendation, whereby a bishop, an ecclesiastic, or even a layman was appointed "commendatory abbot" of a monastery, merely for the purpose of drawing the revenues (see ABBOT); the monasteries were often deprived even of necessary maintenance, the communities dwindled, and regular observance became impossible. There is reason to believe that in England a relatively good level was maintained throughout, thanks in great measure to the fact that the kings resolutely refused to allow the introduction of commendation—Wolsey was the first and last commendatory abbot in England. In the German lands, the lowest level was touched, and the writings of the Augustinian canon Johann Busch, and of the Benedictine abbot Trithemius reveal a state of things in the first half of the 15th century that urgently called for reform. The first move in this direction was made in the Netherlands and north Germany under the influence of Gerhard Groot (*q.v.*), and issued in the formation of the Windesheim congregation of Augustinian canons and the secular congregation of Brothers of Common Life (*q.v.*) founded *c.* 1384, both of which became centres of religious revival. During the first half of the 15th century numerous and effective efforts at reform were initiated in all the orders without exception, and in every part of Europe. These movements, promoted by the councils of Constance and Basel, partook of the spirit of the time and were characterized by an extreme austerity of life and a certain hardness of spirit, and a sort of police regulation easily understandable at a time of reaction from grave abuses. At this time arose the Hieronymites (*q.v.*) founded in 1375, under the Augustinian rule, the Observants (1415) among the Franciscans (*q.v.*), and the Minims (founded *c.* 1460 by St Francis of Paola, *q.v.*), whose programme was to outdo the Minors or Franciscans. These various reform movements among the orders were widely but not universally successful; and so the Reformation found religious houses in an unsatisfactory state in sufficient numbers to afford the reformers one of their chief handles against the old religion. The Reformation and the religious wars that followed in its wake destroyed the monasteries and religious orders of all kinds in northern Europe and crippled them in central Europe.

13. *The Modern Orders.*—During the Reformation period there sprang up, to meet the needs of the time, a new kind of religious order, called Regular Clerks. These are religious orders in the full sense of the word, as the members take the solemn religious vows. Regular clerks are by their institute clerics and priests, and they are devoted to some particular work or works as their own special object—as education, the preaching of missions and retreats, or the going on missions to the heathen. They carry still further the tendencies that differentiate the friars from the monks; and in particular, in order to be more free in devoting themselves to their special works, the orders of regular clerks have commonly given up the choral celebration of the canonical office, which had been maintained by the friars.

Of regular clerks by far the most important are the Jesuits (*q.v.*), founded in 1540; there are also the Theatines (founded 1524 by St Cajetan and Caraffa, afterwards Paul IV.); the Barnabites (founded 1530, by St Antonio Zaccaria) and others (see Max Heimbucher, *Orden u. Kongregationen* (1897), II., §§ 108–114). Strictly speaking the "religious congregations" should be distinguished from the orders of regular clerks, the difference being that in the former the vows, though taken for life, are only "simple vows" and more easily dispensable by authority; but the character and work of the two institutes is very similar. The chief of these congregations are the Passionists (founded by St John of the Cross, 1725) and the Redemptorists (founded by St Alfonsus Liguori, 1749), both dedicated to giving missions and retreats. The Christian Brothers, devoted to primary education, founded by St Jean Baptiste de la Salle in 1679, are not in orders (Heimbucher, *op. cit.* §§ 115–118).

Besides the religious congregations there are a number of "secular congregations," composed of secular priests living together under temporary vows and free to leave at will; the following deserve mention: Oblates of St Charles (founded by St Charles Borromeo, 1578); Oratorians (founded by St Philip Neri, *c.* 1570); the French Oratory (founded by Cardinal Berulle, 1613), a similar but distinct institution, which produced a number of scholars of the highest distinction—Thomassin, Morin, Marlebranche, Richard Simon, Juénin, Lebrun, Masillon, and others; Lazarists (founded by St Vincent de Paul, 1624); Sulpicians (founded by M. Olier, 1642), and a vast number of others, including several for the mission to the heathen (see Heimbucher *op. cit.* §§ 124–140).

During the period under review, from the Reformation to the French Revolution, the old orders went on alongside of the new, and many notable revivals and congregations arose among them: the most noteworthy were the Capuchins (*q.v.*) among the Franciscans (1528); the Discalced Carmelites (*q.v.*) of St Teresa and St John of the Cross (1562); the Trappists (*q.v.*) among the Cistercians (1663); and, most famous of all, the Maurists (*q.v.*) among the Benedictines of France (1621).

14. *The Religious Orders in Recent Times.*—At the end of the 18th century and the opening of the 19th the religious orders received a succession of blows in those countries in which they had survived the Reformation from which they have only

in the present generation recovered. The Jesuits were suppressed by Pope Clement XIV. in 1773, and restored by Pius VII. in 1814. As the result of the ecclesiastical policy of the emperor Joseph II. nearly all religious houses of all kinds were suppressed throughout the Austrian dominions (1780). The French Revolution swept them out of France and caused the secularization of the great majority in central Europe and Italy. In Portugal and Spain they were dissolved in 1834–1835; in Italy in 1866; in the Prussian dominions in 1871. The last half of the 19th century, and more especially the last quarter, witnessed a remarkable revival of vitality and growth in most of the older orders in nearly every country of western Europe, and besides, an extraordinary number of new congregations, devoted to works of every sort, were founded in the 19th century: Heimbucher (*op. cit.*, §§ 118, 134–140) numbers no fewer than seventy of these new congregations of men. In the new countries, especially in the United States and Australia, but also in South Africa, orders and congregations of all kinds are most thriving. The chief set-back has come again in France, where, by the Association Laws of 1903, the religious orders have nearly all been suppressed and expelled and their property confiscated.

15. *The Nuns.*—In the foregoing sketch nothing has been said concerning the nuns; and yet in all ages women, hardly less than men, have played their part in monasticism. In the earliest Christian times the veiled virgins formed a grade or order apart, more formally separated from the community than were the male ascetics. There is reason for believing that there were organized convents for women before there were any for men; for when St Anthony left the world in 270 to embrace the ascetic life, the *Vita* says he placed his sister in a nunnery (*παρθενών*). We learn from Palladius that by the end of the 4th century nunneries were numerous all over Egypt, and they existed also in Palestine, in Italy and in Africa—in fact throughout the Christian world. It is a curious coincidence that the sister of each of the three great cenobitical founders, Pachomius, Basil and Benedict, was a nun and ruled a community of nuns according to an adaptation of her brother's rule for monks. In the West the Benedictine nuns played a great part in the Christian settlement of north-western Europe. As the various monastic and mendicant orders arose, a female branch was in most cases formed alongside of the order; and so we find canonesses, and hermitesses, and Dominicanesses, and Franciscan nuns [or Clares (*q.v.*)]—requisite information will be found in the respective articles. Then there were the "double orders" of Sempringham (see St Gilbert) and Fontevrault, in which the nuns were the predominant, or even the dominant, element. Of the modern orders of men only a few include nuns. But on the other there are a vast number of purely female orders and congregations. The great majority of these modern congregations of women follow the Augustinian rule, supplemented by special constitutions or by-laws; such are the Brigittines, the Ursulines and the Visitation nuns: others follow the rule of the third order of the Franciscans or other Mendicants (see Tertiaries). In early times nuns could go out of their enclosure on occasion; but in the later middle ages, up to the council of Trent, the tendency was to keep them more and more strictly confined within their convent precincts. In 1609 an English lady, Mary Ward, founded at Munich the "Institute of Mary," the nuns of which were not bound to enclosure. This new departure, or rather, return to old ideas, encountered vehement opposition and difficulties that nearly wrecked it; but it has survived, and has been the pioneer in the extraordinary development of institutes of women devoted to external good works of every kind. St Vincent of Paul soon followed; in 1633 he established the Sisters of Charity, bound only by yearly vows, and wholly given up to works of charity—chiefly nursing in hospitals and in the homes of the poor, and primary education in poor schools.

As women are debarred from exercising the spiritual functions of the ministry, it follows that nuns have to devote themselves either to a more purely contemplative life, or else to a more wholly active one, than is usual among the orders of men, who commonly, in virtue of their priesthood, have been able to find a mixed form of life between the two extremes. The nuns belonging to the older orders tend to the contemplative idea, and they still find recruits in sufficient numbers, in spite of the modern rush to the active congregations. These latter exist in wondrous number and variety, exercising every imaginable form of good work—education, both primary and secondary; the care of hospitals, orphanages, penitentiaries, prisons; of asylums for the blind, the deaf and dumb, the insane; of refuges for the aged poor and the destitute.

See the works of Helyot and Heimbucher, referred to below under "Literature"; also Lina Eckenstein, *Woman under Monasticism* (1896); and for information on the various orders of women, J. N. Murphy, *Terra incognita* (1873); and F. M. Steele, *Convents of Great Britain and Ireland* (1902).

16. *Conclusion.*—Few phenomena are more striking than the change that has come over educated Protestant opinion in its estimate of monasticism. The older Protestantism uncompromisingly judged the monastic ideal and life to be both unchristian and unnatural, an absolute perversion deserving nothing but condemnation. But now the view of the critico-historical school of Protestant thought, of which Dr Adolf Harnack is so representative a spokesman, is that the preservation of spiritual religion in Catholic Christianity, both Eastern and Western, has been mainly, if not wholly, due to monasticism (see Harnack's early tractate *Das Mönchtum*, translated under the title *Monasticism*, by E. E. Kellett, 1901; also the lectures on Greek and Roman Catholicism in *Das Wesen des Christentums*, translated by Bailey Saunders, 1902; the first-named work is the most suggestive general *aperçu* of the whole subject—though written from a frankly hostile standpoint, it is in large measure a panegyric).

The views of the new Protestantism concerning monasticism are probably no less excessive than those of the old. The truth probably lies somewhere between them. It may perhaps be agreed that not the least of the services rendered to the Christian people at large by monasticism is this: Into every life the spirit of renunciation must enter; in most lives there are crises in which the path of mere duty can be followed only in virtue of a great renunciation; if we are able to make these ordinary and necessary renunciations, it is in some measure owing to the fact that the path has been made easier for us by those who (like the author of the *Imitation of Christ*) have shown the example, and thereby been able to formulate the theory, of renunciation in a supreme degree.

Literature.—The literature on monasticism is immense. The chief repertory for information on the historical side is Helyot's *Histoire des ordres religieux* (8 vols., 1714; 2nd ed. 1792; digested in dictionary form by Migne, 1860). This information has been condensed and brought up to date by Max Heimbucher, *Orden und Kongregationen* (2 vols., 1896–1897; a 2nd ed. in 3 vols., 1907)—this most useful handbook is equipped throughout with an excellent and well chosen bibliography. Otto Zöckler's *Askese und Mönchtum* (1897), also covers the whole ground, and is written more from the point of view of theory. The inner spirit and working of the older monasticism is well portrayed in F.A. Gasquet's *English Monastic Life* (1904); more popular accounts are given in H. J. Feasy's *Monasticism* (1898), and F. M. Steele's *Monasteries and Religious Houses of Great Britain and Ireland* (1903). The rules of the various orders are collected in Brockie's edition of Holsten's *Codex regularum* (6 vols., 1759). The article *Mönchtum* in Herzog-Hauck *Realencyklopädie* (3rd ed.), and in Wetzer und Welte *Kirchenlexicon* (2nd ed.) go over the same general ground as the present article, in the earlier portion entering into greater detail as to facts, but in the later dealing much more summarily. The relevant separate articles in these two great dictionaries, Protestant and Catholic respectively, will supply adequate information and ample references on most points. The *Catholic Dictionary* contains useful articles on most of the subjects here touched on; and an extensive *Catholic Encyclopaedia* is in course of preparation at the Catholic University of Washington. The habits and dress of the various orders may be seen in Helyot's *Histoire*, which abounds in plates, coloured, in the ed. of 1792. There are plates representing members of the chief orders in Dugdale's *Monasticon*, and in the books of Gasquet and Steele mentioned above; also (coloured) in Tuker and Malleson, *Handbook to Christian Rome*, pt. iii. (1900). (E. C. B.)

MONASTIR, or Bitolia, the second city of Macedonia, and the capital of the vilayet of Monastir in European Turkey, on the Salonica-Monastir railway, 400 m. W. of Constantinople. Pop. (1905), about 60,000. Monastir is situated at an altitude of 2019 ft. on the eastern versant of the richly wooded mountains which culminate in the Peristeri (8300 ft.) and sever Lake Prespa from the valley of the Kara-Su or Tzerna. A tributary of this river, the Dragor or Drahor, traverses Monastir through a rocky channel which is rarely filled except after a thaw or heavy rain. The city possesses many mosques, churches and schools, baths and a military hospital. It is the seat of numerous consulates, an American Protestant mission, and a Lazarist mission. The annual value of its trade is about £400,000. Grain, flour, cloth, hides and bones are exported, and a large amount of gold and silver ornaments is manufactured, though this industry tends to decline.

The military advantages of its position at the meeting-place of roads from Salonica, Durazzo, Uskub, and Adrianople led the Turks, about 1820, to make Monastir the headquarters of an army corps. Since then the general and commercial importance of the city has greatly increased, and in 1898 it was made the see of a Bulgarian bishop. The ancient diocese of its Greek archbishop is known as Pelagonia, from the old name of the Kara-Su Plain. Monastir itself has been identified with the ancient Heraclea Lyncestis on the Via Egnatia; its modern name is derived from the monastery of Bukova (" the beeches ") near the southern outskirts of the city.

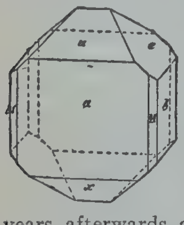
MONAZITE, a mineral consisting of anhydrous phosphate of the cerium metals (Ce, La, Di)PO_4, together with small and variable amounts of thorium (ThO_2, 1–10%) and yttrium. It is of considerable commercial importance as a source of thoria for the manufacture of the Welsbach and other mantles for incandescent gas-lighting: the cerium is used to a limited extent in pharmacy.

The following analyses are of monazite from: (I.) Burke county, North Carolina; (II.) Arendal, Norway; (III.) Emmaville, Gough county, New South Wales.

	I.	II.	III.
Phosphorus pentoxide (P_2O_5)	29·28	27·55	25·09
Cerium oxide (Ce_2O_3)	31·38	29·20	36·64
Lanthanum oxide (La_2O_3) Didymium oxide (Di_2O_3)	30·88	26·26	30·21
Yttrium oxide (Yt_2O_3)	—	3·82	—
Thorium oxide (ThO_2)	6·49	9·57	1·23
Silica (SiO_2)	1·40	1·86	3·21
Alumina (Al_2O_3)	—	—	3·11
Iron oxide (Fe_2O_3)	—	1·13	—
Lime (CaO)	—	0·69	—
Water (H_2O)	0·20	0·52	—
	99·63	100·60	99·49
Specific gravity	5·10	5·15	5·001

Thoria and silica being often present in the molecular ratio 1 : 1, it has been suggested that they exist as thorite ($ThSiO_4$) as a mechanical impurity in the monazite.

Crystals of monazite belong to the monoclinic system, and are usually flattened parallel to the ortho-pinacoid (*a* in the figure). The large (up to 5 in. in length) reddish-brown, dull and opaque crystals from Norway and the Urals are simple in form, whilst the small, translucent, honey-yellow crystals from the Alps are bounded by numerous bright faces. Crystals of the latter habit were described in 1823 from Dauphiné under the name turnerite, and owing to their rarity were not until many years afterwards analysed chemically and proved to be identical with monazite. Monazite from the Urals was described by A. Breithaupt in 1829, and named by him from Gr. *μονάζειν*, to be solitary, because of the rarity of the singly occurring crystals. The hardness is 5½, and the specific gravity 5·1–5·2. Light which has traversed a crystal or grain of monazite exhibits a characteristic absorption spectrum, and this affords a ready means of detecting the mineral.



As minute idiomorphic crystals monazite is of wide distribution in granites and gneisses, being present in very small amounts as an accessory constituent of these rocks. By powdering the rock and washing away the lighter minerals in a stream of water the heavy minerals (zircon, anatase, rutile, magnetite, garnet, monazite, xenotime, &c.) may be collected. This separation has been effected naturally by the weathering and disintegration of the rocks and the accumulation of the heavier minerals in the beds of streams. Under these conditions monazite has been found as rounded water-worn grains in the alluvial gold-washings of the Urals, Finland, Siberia, the United States, Brazil, Colombia, New South Wales, &c., and in tin-gravels in Swaziland, South Africa. Larger crystals of monazite are found embedded in pegmatite veins in the Ilmen Mountains (southern Urals); at Arendal and other places in southern Norway, where it is collected in the feldspar quarries to the extent of about one ton per annum; and in the mica mines at Villeneuve in Quebec, where masses of monazite weighing 20 ℔ have been found. The small crystals of the " turnerite " habit occur implanted, often with anatase and rutile, on the crystallized quartz and albite, which line crevices in the crystalline schists of the French, Swiss and Tirolese Alps; similar crystals with the same associations occur very exceptionally in the clay-slate at Tintagel in Cornwall. Microscopic crystals of monazite (cryptolite, from *κρυπτός*, concealed) have been observed embedded in the crystallized apatite of Arendal in Norway.

The deposits worked commercially are the monazite-bearing sands of North Carolina and Brazil, and to a smaller extent those of South Carolina. In North Carolina it occurs over a wide area in the streams rising in the South Mountains, an eastern outlier of the Blue Ridge. The rocks of the district are granitic biotite-gneiss and hornblende-gneiss, and are intersected by veins of auriferous quartz. The percentage of monazite in the river-gravels varies from very small amounts up to 1 or 2%. The heavy minerals contained in the gravels are collected in the same manner as in washing for gold (which is often also present); magnetite is separated with a magnet; but other minerals, such as zircon, rutile, garnet, corundum, &c., cannot be separated by mechanical means. The product is a fine-grained yellowish sand containing 65–85% of monazite and 3–9% of thoria. In Brazil it occurs in river-gravels and also in the sand on the sea-beaches; an extensive accumulation of very rich monazite sand occurs on the seashore near Alcobaça in Bahia, and this has been shipped as ballast in the natural state.

See H. B. C. Nitze, " Monazite " (*16th Annual Report of the United States Geological Survey*, pt. iv. (1895), pp. 667–693). (L. J. S.)

MONBODDO, JAMES BURNETT, Lord (1714–1799), Scottish judge and anthropologist, was born in 1714 at Monboddo in Kincardineshire. He studied at Aberdeen, and, after passing his law examinations in Edinburgh, he quickly took a leading position at the Scottish bar, being made a Lord of Session in 1767 with the title of Lord Monboddo. Many of his eccentricities, both of conduct and opinion, appear less remarkable to us than they did to his contemporaries; moreover, he seems to have heightened the impression of them by his humorous sallies in their defence. He may have had other reasons than the practice of the ancients for dining late and performing his journeys on horseback instead of in a carriage. He is remembered more particularly for his writings on human origins. In his *Antient Metaphysics* (1779–1799), Monboddo conceived man as gradually elevating himself from an animal condition, in which his mind is immersed in matter, to a state in which mind acts independently of body. In his equally voluminous work, *The Origin and Progress of Language* (1773), he brought man under the same species as the orang-outang. He traced the gradual elevation of man to the social state, which he conceived as a natural process determined by " the necessities of human life." He looked on language (which is not " natural " to man in the sense of being necessary to his self-preservation) as a consequence of his social state. His views about the origin of society and language and the faculties by which man is distinguished from the brutes have many curious points of contact with Darwinism and neo-Kantianism. His idea of studying man as one of the animals, and of collecting facts about savage tribes to throw light on the problems of civilization, bring him into contact with the one, and his intimate knowledge of Greek philosophy with the other. In both respects Monboddo was far in advance of his neighbours. His studied abstinence from fine writing—from " the rhetorical and poetical style fashionable among writers of the present day "—on such subjects as he handled confirmed the idea of his contemporaries that he was only an eccentric concocter of supremely absurd paradoxes. He died on the 26th of May 1799.

Boswell's *Life of Johnson* gives an account of the lexicographer's visit to Burnett at Monboddo, and is full of references to the natural contemporary view of a man who thought that the human race could be descended from monkeys.

MONCEY, BON ADRIEN JEANNOT DE, Duke of Conegliano (1754–1842), marshal of France, was the son of a lawyer of Besançon, where he was born on the 31st of July 1754. In his boyhood he twice enlisted in the French army, but his father procured his discharge on both occasions. His desire was at last gratified in 1778, when he received a commission. He was a captain when, in 1791, he embraced the principles of the French Revolution. Moncey won great distinction in the campaigns of 1793 and 1794 on the Spanish frontier (see French Revolutionary Wars), rising from the command of a battalion to the command in chief of the Army of the Western Pyrénées in a few months, and his successful operations were largely instrumental in compelling the Spanish government to make peace. After this he was employed in the highest commands until 1799, when the government, suspecting him of Royalist views, dismissed him. But the *coup d'état of* 18. Brumaire brought him back to the active list, and in Napoleon's Italian campaign of 1800 he led a corps from Switzerland into Italy, surmounting all the difficulties of bringing horses and guns over the then formidable pass of St Gothard. In 1801 Napoleon made him inspector-general of gendarmerie, and on the assumption of the imperial title created him a marshal of France. In 1805 Moncey received the grand cordon of the legion of honour, and in 1808 the title of duke of Conegliano. In the latter year, the first of the Peninsular War, Moncey was sent to Spain in command of an army corps. He signalized himself by his victorious advance on Valencia, the effect of which was, however, destroyed by the disaster to Dupont at Baylen, and took a leading part in the emperor's campaign on the Ebro and in the second siege of Saragossa in 1809. He refused to serve in the invasion of Russia, and therefore had no share in the campaign of the *grande armée* in 1812 and 1813. When, however, France was invaded (1814) Marshal Moncey reappeared in the field and fought the last battle for Paris on the heights of Montmartre and at the barrier of Clichy. He remained neutral during the Hundred Days, feeling himself bound to Louis XVIII. by his engagements as a peer of France, but after Waterloo he was punished for refusing to take part in the court-martial on Ney by imprisonment and the loss of his marshalate. He was reinstated in 1816, and re-entered the chamber of peers three years later. His last active service was as commander of an army corps in the short war with Spain, 1823. In 1833 he became governor of the Invalides. He died on the 20th of April 1842.

MONCHIQUE, a town of southern Portugal, in the district of Faro (formerly the province of Algarve); 13 m. S. of Saboia station on the Lisbon-Faro railway, and 12 m. N. of Villa Nova on the Atlantic. Pop. (1900), 7345. Monchique is one of the principal Portuguese health-resorts, finely situated among the wooded heights of the Serra de Monchique, which rise on the west to 2963 ft. There are hot sulphur springs, with baths and a sanatorium 4 m. south. Wheat, millet, rye, beans, oranges, wine, olive oil and chestnuts are the chief products, and there is a woollen factory.

MONCTON, a city and port of entry in Westmoreland county, New Brunswick, Canada, 89 m. by rail N.E. of St John, at the head of navigation on the Petitcodiac river, the seat of the workshops and general offices of the Inter-Colonial railway and the eastern terminus of the new Grand Trunk Pacific railway. Pop. (1901), 9026. It has large stove factories, engine and boiler works, and is a flourishing manufacturing town. The workshops of the railway and great part of the town were swept away by fire in February 1906, but have been rebuilt on a larger and more modern scale.

MOND, LUDWIG (1839–1909), British chemist, was born at Cassel in Germany on the 7th of March 1839. After studying at Marburg under Hermann Kolbe and at Heidelberg under Robert Bunsen, he came to England in 1862 and obtained a position in a chemical works at Widnes, where he elaborated the practical application of a method he had devised for recovering the sulphur lost as calcium sulphide in the black ash waste of the Leblanc alkali process. He became a naturalized British subject in 1867. In 1873 he entered into partnership with Sir John Tomlinson Brunner (b. 1842–   ), whom he had met when he was at Widnes, and thus founded the great chemical manufacturing firm of Brunner, Mond & Co. They began to make alkali by the ammonia-soda process, under licence from the Belgian chemist, Ernest Solvay, but at first the venture threatened to prove a failure. Gradually, however, the technical difficulties were overcome and success assured, largely as a result of improved methods worked out by Mond for the recovery of the ammonia. About 1879 he began experiments in the economical utilization of fuel, and his efforts led him to the system of making producer-gas, known by his name (see Gas: II. *For Fuel and Power*). Later, while attempting to utilize the gas for the production of electricity by means of a Grove gas battery, he noticed that the carbon monoxide contained in it combined with nickel. The resulting compound, nickel carbonyl, which was described to the Chemical Society in 1890, is both formed and decomposed within a very moderate range of temperature, and on this fact he based a successful process for the extraction of nickel from its ores. A liberal contributor to the purposes of scientific research, Mond founded in 1896 the Davy-Faraday Research Laboratory in connexion with the Royal Institution. On his death, which occurred in London on the 11th of December 1909, he bequeathed a large part of his collection of pictures to the nation.

MONDAY (in O.E. *Monandaeg*, the moon's day, a translation of the Late Lat. *Lunae dies*, from which the French *lundi* is taken), the second day of the week (see Calendar). The day has been humorously canonized as St Monday, the festival of cobblers, who seldom work on Mondays, and were supposed not to know exactly on which day St Crispin's (their patron saint) festival fell, save that it should be a Monday, and thus celebrated each Monday in the year as a holiday so as to be certain to honour the day. In some parts of Yorkshire any holiday is called Cobblers' Monday. Collop Monday, in the north of England, is the Monday before Shrove Tuesday, so called in allusion to the dish of fried eggs and bacon, and slices of salted, dried meat, called collops, taken on that day preparatory to the Lenten fast. Plough Monday in England is the Monday after Twelfth Day, the first Monday after Epiphany, in allusion to the fact that in medieval times the ploughmen had their fête-day and went around the villages begging plough-money. The lord mayor of London holds a Grand Court of Wardmote at the Guildhall on Plough Monday of each year, to receive returns from the wards of the election of common councilmen and to hear petitions against such returns.

MONDOÑEDO, a city of northern Spain, in the province of Lugo, 27 m. N.N.E. of the city of Lugo, on the river Masma. Pop. (1900), 10,590. Mondoñedo occupies a sheltered valley among the northern outliers of the Cantabrian Mountains. The principal buildings are the cathedral, a Corinthian structure of the 17th century, an ex-convent of Franciscan friars of Alcantara, which is used for a theatre and a public school, and the civil hospital. The industries include lace-making, linen-weaving, and leather manufacture.

According to local tradition, the bishopric of Dumium, near Braga, was transferred to San Martin de Mondoñedo (10 m. from Mondoñedo) in the 8th century; it was brought to Mondoñedo itself in the beginning of the 12th century. After having been for nearly a century and a half in the hands of the Moors, Mondoñedo was recaptured by Ordoño I. in 858; and the Christian possession was made permanent by Alphonso III. in 870. It was taken by surprise by the French in 1809.

MONDOVÌ, a town and episcopal see of the province of Cuneo, Piedmont, Italy, 17 m. by rail E. of Cuneo. Pop. (1901), 5379 (town); 18,982 (commune). The lower town is 1283 ft.

above sea-level, the upper 1834 ft. There is a school of the industrial arts and handicrafts, and majolica, paper, and silk cocoons are produced. The upper town contains the hexagonal piazza, a citadel, erected in 1573 by Emanuel Philibert, the cathedral of S. Donatus, a spacious episcopal palace, and higher up is a tower, the Belvedere, with a fine view. At the foot of the hill along the banks of the Ellero (a tributary of the Po) lie the industrial and commercial suburbs of Breo, Borgatto, Pian della Valle and Carassone, with their potteries, tanneries, paper-mills, marble-works, &c. The mansion of Count San Quintino in Pian della Valle was the seat of the printing-press which from 1472 issued books with the imprint Mons Regalis.

Mondovì—Mons Vici, Mons Regalis, Monteregale—did not take its rise till about A.D. 1000. The bishopric dates from 1388. About 2 m. to the east is the sanctuary of Vico, a church designed by Ascanio Vittozzi in 1596 and crowned by a famous dome (1730–1748), which has been declared a national monument. In the square before it is a monument (1891) to Charles Emmanuel I. of Savoy.

See L. Melano Rossi, *The Sanctuario of the Madonna di Vico* (London, 1907).

MONET, CLAUDE (1840–), French painter, was born in Paris on the 14th of November 1840. His youth was passed at Hâvre, where his father had settled in 1845. Until he was fifteen years old he led a somewhat irregular life, learning little at school, and spending all his time in decorating his books with drawings and caricatures which gave him notoriety in Hâvre. At the same time he became acquainted with Boudin, a clever sea-painter, under whose guidance he learned to love and to understand nature. At the age of twenty he became a soldier, and spent two years of his military time with the regiment of the Chasseurs d'Afrique in the desert. Falling ill with fever, he was sent home, and entered the studio of Gleyre. This classical painter tried in vain to keep him to conventional art and away from truth and nature, and Monet left his studio, where he had become acquainted with two other "impressionistic" painters—Sisley and Renoir. At that time he also knew Manet (*q.v.*), and in 1869 he joined the group of Cézanne, Degas, Duranty, Sisley, and became a *plein air* painter. During the war of 1870 he withdrew to England, and on his return was introduced by Daubigny to a dealer, M. Durand-Ruel, in whose galleries almost all his works have been exhibited. In 1872 he exhibited views of Argenteuil, near Paris; in 1874 a series entitled "Cathedrals," showing the cathedral of Rouen under different lights. He afterwards painted views of Vétheuil (1875, see Plate), Pourville and cliffs of Etretat (1881), of Bordighera (1886), of the Creuse (1889), Le Meules (1891), and some further views of cathedrals (1894). In December 1900 he exhibited some pictures called "Le Bassin des Nymphéas," and was engaged at the beginning of 1901 in painting views of London. Several of Monet's paintings, bequeathed by M. Caillebotte, are in the Luxembourg Museum, Paris. (See IMPRESSIONISM.)

MONETARY CONFERENCES (INTERNATIONAL). These assemblies were one of the features of the latter half of the 19th century, due to the decided tendency towards securing reforms by concerted international action. The disorganized state of the European currencies, which became more serious in consequence of the great expansion in trade and industry, came into notice through the great gold discoveries and their effect on the relations between the two precious metals. Both by its situation and its currency system, France was the country that was first led to aim at the establishment of a currency union, in which French ideas and influences would be predominant. A preliminary step was the formation of the Latin union, whereby the currencies of France, Italy, Belgium and Switzerland were—in respect to their gold and silver coins—assimilated. In 1867 the Paris Exhibition furnished the occasion for summoning a monetary conference, to which the principal countries of the world sent representatives. The guiding spirit of this assembly was the eminent economist, De Parieu, who had originated the Latin Union. By his advice a scheme was approved recommending the adoption of the single gold standard, the use of the decimal system, and the co-ordination of the various currencies with the French system. Difficulties as to the mode of bringing these principles into practical operation were discussed, and full liberty had to be given to the several nations to carry out the proposals in the way that seemed best. The result proved that the obstacles were insurmountable, *e.g.* the British government could not obtain the assent of a Royal Commission to the assimilation of the sovereign to the 25-franc piece; and the course of political events soon completely altered the relative position of the leading countries, even in their monetary relations. Germany and the United States reformed their currencies, without reference to any international considerations.

The meeting of the next international conference took place under very different conditions. A great fall in the value of silver as measured in gold, in progress from 1873, had affected the relations of silver-using countries, and disturbed the level of prices. Indian interests as well as those of American producers of silver suffered, while the management of all double-standard currencies became a task of increasing difficulty. The government of the United States invited the representatives of the leading powers to meet in Paris for the purpose of considering (1) the desirability of retaining the unrestricted use of silver for coinage, (2) the adoption of international bimetallism (*q.v.*), by the acceptance of a ratio to be fixed by agreement. Eleven nations sent delegates, Germany being the only great power unrepresented. After somewhat protracted discussion and the presentation of a large number of documents the European states accepted the American proposition "that it is necessary to maintain in the world the monetary functions of silver"; but declined to bind the discretion of particular states as to the methods to be employed. They further declared it impossible to enter into an agreement for a common ratio. The conference, therefore, separated without any result being obtained.

In consequence of the continuing fall in the value of silver, which stimulated the bimetallic agitation, a third conference was convened by the joint action of France and the United States; it also met in Paris, and was more influential than its predecessor, since Germany sent representatives, as did Spain, Portugal, Denmark and India. The characteristic of this conference was the greater strength of the support given to the bimetallic proposal by France and the United States, together with the opposition of the delegates of the smaller European countries, and the refusal of Germany to promise any co-operation. The inevitable consequence of this situation was the adjournment of the conference to obtain fresh instructions, which, however, were never furnished.

After several abortive attempts the fourth (and last) of the conferences of this class was brought together at Brussels in November 1892 on the initiative of the United States. A full representation of the powers attended, but delay arose from the absence of definite proposals by the American government. These, when they were presented, proved to be only a reaffirmation of the bimetallic policy, and showed no advance. The conference, therefore, proceeded to consider the plans of Levy, Baron de Rothschild and Sotbeer for the more extended use of silver. Such devices, being merely alleviations, failed to gain any effective support. Appeals to England and Germany to grant some concessions likewise failed. Thus, like its Paris forerunners, the Brussels conference adjourned, but never resumed its sittings.

After 1892 the currency problem passed into a new stage, in which action was national rather than international. The method of procedure by conference was for the time abandoned.

The proceedings of the several conferences have been issued by the governments taking part in them. Those of the United States are the most convenient for English and American readers. See also H. B. Russell, *International Monetary Conferences* (New York, 1898). (C. F. B.)

MONEY. 1. *Definition and Functions.*—The difficult question as to the best definition of money has been complicated by the efforts of writers so to define the term as to give support to their particular theories. It is hard to frame a precise account which will hold good of the many objects that have served for monetary use. From denoting coined metal, money has come to include anything that performs the money work: though there has been considerable hesitation in extending the term to those forms of credit that are in modern societies the chief instrument of exchange. It is therefore best to avoid a formal definition; and, instead, to bring out the character of money by describing the functions that it performs in the social system. The most important is, clearly, that of facilitating exchange. It is not necessary to dwell on the great importance of this office. The slightest consideration of industrial organization shows that it is based on the division of employments; but the earliest economic writers saw plainly that division of employments was only possible through the agency of a medium of exchange. They recognized that the result of increasing specialization of labour was to establish a state of things in which each individual produced little or nothing for the direct satisfaction of his own wants, and had therefore to live by exchanging his product for the products of others. They saw, further, that this only became feasible by the existence of an article that all would be willing to accept for their special products; as otherwise the difficulty of bringing together persons with reciprocal wants would prove an insurmountable obstacle to that development of exchange, which alone made division of labour possible. A *second* function hardly inferior in importance to the one just mentioned is that of affording a ready means for estimating the comparative values of different commodities. Without some common object as a standard of comparison this would be practically impossible. "If a tailor had only coats and wanted to buy bread or a horse, it would be very troublesome to ascertain how much bread he ought to obtain for a coat or how many coats he should give for a horse"; and as the number of commodities concerned increased the problem would become harder, "for each commodity would have to be quoted in terms of every other commodity." There is, indeed, a good deal to be said for the view that the conception of general exchange value could never have been formed without the previous existence of money; it has certainly support from the evidence of competent observers respecting the methods of exchange followed by savage communities. The selection of some particular article as the criterion makes the comparison of values easy. "The chosen commodity becomes a *common denominator*, or *common measure of value* in terms of which we estimate the value of all other goods," and in this way money, which in its primary function renders exchange possible by acting as an intermediate term in each transfer, also makes exchanges easier by making them definite. Still another function of money comes into being with the progress of society. One of the most distinctive features of advancing civilization is the increasing tendency of people to trust each other. There is thus a continuous increase in relations arising from contract, as can be seen by examining the development of any legal system. Now, a contract implies something to be done in the future, and for estimating the value of that future act a standard is required; and here money which has already acted as a *medium of exchange* and as a *measure of value* at a given time, performs a *third* function, by affording an approximate means of estimating the present value of the future act; in this respect it may be regarded as a *standard of value*, or as some prefer to say, of *deferred payments.* Nor does this exhaust the list of services that money renders. In the earlier stages of economic life it acts as a *store of value*; for in no other way could a large body of wealth be concentrated. Though this is no longer needed by individuals, even at the present day the great banks find that their reserves must take the form of a monetary store. Again, money in its various forms has been the great agency for transmitting values from place to place. Its international function in this respect still continues. The balance of debt between countries is ultimately settled by the passage of bullion from the debtor to the creditor nation. But, though money has these powers, it is nevertheless correct to say that its essential functions are three in number, *i.e.* it supplies: (1) the common medium by which exchanges are made possible; (2) the common measure by which the comparative values of those exchanges are estimated; (3) the standard by which future obligations are determined.

2. *The Value of Money, its Determining Causes. The Quantity of Money required by a Country.*—The value of money is in principle only a special case of the general problem of value; but owing to its peculiar position the medium of exchange has in this respect become surrounded by difficulties that need to be removed. The very phrase "value of money" is employed in two senses, which on the surface seem to have no connexion with each other, and are the cause of much confusion to those who have not looked into the matter. In mercantile phraseology the value of money means the interest charged for the use of loanable capital. When the market rate of interest is high, money is said to be dear; when it is low, money is regarded as cheap. Without entering into the reasons for this use of the term, it is sufficient to state the other and for our present purpose more correct meaning of the phrase. As the value of a thing is what it will exchange for; so "the value of money is what money will exchange for, or its purchasing power. If prices are low, money will buy much of other things, and is of high value; if prices are high, it will buy little of other things, and is of low value. The value of money is inversely as general prices, falling as they rise and rising as they fall." Now the *proximate* condition under which value is determined is admittedly the establishment of an equation between demand and supply. In the case of money, however, some explanation as to the nature of both these elements in the problem becomes necessary. In what forms is the supply of, and the demand for, money exhibited? The supply of a commodity is the quantity of it which is offered for sale. But in what shape does the sale of money take place? Plainly, by being offered for goods. The supply of money is the quantity of it which people are wanting to lay out, *i.e.* all the money in circulation at the time. Demand, in like manner, means the quantity of a commodity desired, or, according to another mode of expression, the amount of purchasing power offered for it. Taking the latter as the more convenient for the case of money, we can say that the demand for it consists in all goods offered for sale. The position of money as the medium of exchange introduces a further novel feature; for the market in its case is world-wide and the demand is unceasing; money is consequently in a constant state of supply and demand. It thus appears that the factors determining the value of money at a given time are: (1) the amount of money in circulation, and (2) the amount of goods on sale. Closer examination reveals other influencing conditions. The mere quantity of money is not the only element on the supply side. The varying circulation of the monetary units must be taken into account. Some coins do not make a single purchase in a year, while others change hands in transactions hundreds of times. By averaging, we may estimate the effect of the rapidity with which money does its work, or, to employ a technical term, the "efficiency of money." Similarly, the amount of sales rather than the quantity of commodities is the determining element on the demand side. Thus, if the influence of credit be omitted, it is true to say that the value of money varies inversely as its quantity multiplied by its efficiency, the amount of transactions being assumed to be constant. Some additional explanation is required before this formula can be accepted as an expression of the whole truth on the subject. It must be noticed that it is not commodities only that are exchanged for money. Services of all kinds constitute a large portion of the demand for the circulating medium, while the payment of interest on the many kinds of obligations makes a further call on it. The potent influence of credit must also be recognized. The latter force is indeed the chief agency to be considered in dealing with the variations of prices; though so far as it is based on deposits of metallic money it may be regarded as a form of increased monetary efficiency, and therefore as coming within the formula given above. In its wider aspect, credit acts as a substitute for ordinary money, and may be interpreted as equivalent to a system of perfected barter, or, better, as a new currency development. An interesting but paradoxical conclusion should be noticed: it is that increased

trade and expanding business are causes which operate not to raise, but to lower prices; for by enlarging the work that money has to do they raise its value, *i.e* provided that other things remain the same. Another more obvious deduction is that a large addition to the stock of money does not necessarily raise prices, since money is only effective when brought into circulation.

The chief topic of dispute in respect to the theory of money-value has been concerned with the question as to the ultimate regulating influence. The value of freely produced commodities is—according to economic theory—determined by "cost of production," or, where the article is produced at different costs, by the cost of production under the most unfavourable circumstances. As demand varies with price, it follows that an adjustment of value takes place through the interaction of cost and demand, the latter indicating the influence of the utility of the commodity on the quantity required. In applying the theory to the special case of money, the first consideration is the fact that gold and silver, the principal money materials, are the products of mines, and are produced at different costs, so that their values depend on the portions raised at greatest cost. We thus obtain the proposition that has figured in so many text-books; viz. that "the value of money depends on its cost of production." The theory of normal value, however, involves certain assumptions, which are significant in this connexion. Competition is conceived as absolutely free; it is assumed that there are accurate *data* for computing costs, and that the determination of value by cost is effective only "in the long run." It is recognized, also, that cost operates on value through its power in regulating supply. "The latent influence," says Mill, "by which the value of things are made to conform in the long run to the cost of production is the variation that would otherwise take place in the supply of the commodity." From such considerations it follows that the influence of cost on the value of money is not so predominant as a rigid interpretation of the theory of value seems to suggest.

In earlier times it has been a common proceeding on the part of governments to restrict or stimulate both mining for the precious metals and the business of coining. At all times the working of gold and silver mines has been rather a hazardous speculation than a legitimate business. "When any person undertakes to work a new mine in Peru," says Adam Smith, "he is universally looked upon as a man destined to bankruptcy and ruin, and is upon that account shunned and avoided by everybody. Mining, it seems, is considered there in the same light as here, as a lottery in which the prizes do not compensate the blanks." The modern capitalistic organization of gold mining has not done much to alter this condition. As regards the adjustment of supply to meet an altered cost of production the difficulties are, if possible, greater. The actual supply of money is so large, when compared with the annual production of the precious metals, that a change in output can operate but slowly on its value. The total stoppage of fresh supplies from the mines would not be sensibly felt for some years; and though increased production is more rapid in its operation, it takes some time to produce a decided effect. Hence the conclusion is reached that "the effects of all changes in the conditions of production of the precious metals are at first, and continue to be for many years, questions of quantity only, with little reference to cost of production." This is the position which is usually known as that of the "quantity" theory; though very different degrees of doctrine are comprised under the general title. With due qualification and comment it may be taken as the prevalent theory. At all events it is beyond dispute that the cost of production is not for short periods the controlling force which governs the value of money; while even for long periods its influence is very hard to ascertain, in consequence of the speculative nature of the industries of gold and silver mining. Another peculiar feature of the problem of money value arises from the fact that it is only through an actual change in the supply of money that its value can be altered. With other commodities the knowledge that they can be produced at lower cost will bring about a reduction in their value. In the case of money, this does not hold. There must be an adjustment of the amount, or of the efficiency, of the money stock, since, as explained above, it is in a constant state of supply and demand. Its value is established in the very process of carrying on exchanges, and that process is influenced by the available supply. In regard to another form of money the effect of the amount in existence is still more decisive. This is paper money, not immediately redeemable in coin. In this case the idea of cost is manifestly inapplicable; the quantity in circulation is evidently, as proved by abundant experience, the ruling influence on value. In fact, the "quantity" theory receives its simplest illustration in the case of inconvertible paper. The truth that the theory is but an instance of the action of supply and demand is equally shown by this prominent class of instances. Where metallic coinage is artifically limited the same principle holds good. The value of such currencies plainly depends on the conditions of supply and demand.

The immense growth of credit and its embodiment in instruments that can be used as substitutes for money has led to the promulgation of a view respecting the value of money which may be called the "credit" theory. According to the upholders of this doctrine, the actual amount of metallic money has but a trifling effect on the range of prices, and therefore on the value of money. What is really important is the volume of credit instruments in circulation. It is on their amount that price movements depend. Gold has become only the small change of the wholesale markets, and its quantity is comparatively unimportant as a determinant of prices. The theory has some connexion with the view of "money" as consisting in the loanable capital of the market, taking shape in the cheques that transfer liabilities. Thus the rate of interest comes to form a factor in the creation of "money," and the mercantile use of the phrase "value of money" receives a justification. Like the pure "cost" theory of money value, the "credit" theory gives too one-sided a view of the facts. In particular, it fails to recognize the ultimate dependence of all kinds of credit on the stock of money in the full sense, *i.e.* on metallic legal-tender money. The truths adumbrated in the theory are better expressed in the statement of the quantity theory in its developed form, as set forth above. It is necessary to take into account the varying quantities of the precious metals, the modes of use in respect to them; the influence of cost of production, and the way in which credit expedients replace standard money. A complete theory must include all these elements, while not unduly emphasizing any one of them.

At the beginning of statistical inquiry much attention was given to the question: What quantity of money does a country require for the proper working of its industrial system? Petty and Locke were ready to give definite answers; but modern inquirers decline making any quantitative statement, and content themselves with indicating the conditions to be considered. Amongst these are: Population, amount of transactions, the efficiency of money, the development of credit, and the height to which banking organization has attained. Other elements in the problem are the disposition towards hoarding, and the employment of some form of barter in transactions. The contrast between India and the United States in monetary and industrial habits supplies an effective series of illustrations on this matter. The conclusion is obvious that economic progress is accompanied by a more sparing use of money. The most important aspect of the question in modern times is in relation to the division of money between countries. Regarded from this point of view, the quantity of money that a country needs is that which will keep its prices in due level with those of the countries with which it has commercial relations. For, this is the condition of equilibrium; there would otherwise be an excess of either exports or imports, involving a transfer of money to adjust the balance. It may be added that the organization works automatically, since fluctuations in the stock of money are corrected by the action of trade. The best estimates place the gold circulation of the United Kingdom at somewhat under £100,000,000, the token currency at about £15,000,000, and the note circulation as nearly £43,000,000. The French use of metallic money is much larger; probably over £200,000,000, and the note circulation is also over £200,000,000.

3. *Early Forms of Currency.*—Up to the present we have considered money as being fully established and properly adapted to fulfil its various functions. We have now to trace the steps by which a suitable system of currency was evolved from a state of barter. It is important for a right understanding of the question to grasp the fact that exchanges took place originally between groups, and not between individuals. The slow growth of exchanges is thus explained, as each group produced most of the articles necessary for itself, and such acts of barter as took

place were rather reciprocal presents than mercantile exchanges. Such is actually the case among modern savages. "It is instructive to see trade in its lowest form among such tribes as the Australians. The tough greenstone valuable for making hatchets is carried hundreds of miles by natives, who receive from other tribes in return the prized products of their districts, such as red ochre to paint their bodies with; they have even got so far as to let peaceful traders pass unharmed through tribes at war, so that trains of youths might be met, each lad with a slab of sandstone on his head to be carried to his distant home and shaped into a seed-crusher. When strangers visit a tribe they are received at a friendly gathering or corrobboree, and presents are given on both sides. No doubt there is a general sense that the gifts are to be fair exchanges, and if either side is not satisfied there will be grumbling and quarrelling; but in this roughest kind of barter we do not yet find that clear notion of a unit of value which is the great step in trading." This vivid description of E. B. Tylor's enables us to realize the way in which money came into existence. When any commodity becomes an object of desire, not merely from its use to the persons desiring it, but from their wanting it as being readily exchangeable for other things, then that article may be regarded as rudimentary money. Thus the greenstone and ochre are on their way to being promoted to the position of currency, and the idea of a "unit of value" is all that is needed to complete the invention. "This higher stage is found among the Indians of British Columbia, whose strings of haiqua-shells worn as ornamental borders to their dresses serve them also as currency to trade with—a string of ordinary quality being reckoned as worth one beaver's skin." Such shells are in reality money, inasmuch as they discharge its functions.

On a review of existing savage tribes and ancient races of more or less civilization we are surprised at the great variety of objects which have been used to supply the need of a circulating medium. Skins, for instance, seem to be one of the earliest forms of money. They have been found among the Indians of Alaska performing this service, while accounts of leather money seem to show that their use was formerly more general. As the hunting stage gives place to the pastoral, and animals become domesticated, the animal itself, instead of its skin, becomes the principal form of currency. There is a great mass of evidence to show that, in the most distant regions and at very different times, cattle formed a currency for pastoral and early agricultural nations. Alike among existing barbarous tribes, and in the survivals discovered among classical nations, sheep and oxen both appear as units of value. Thus we find that at Rome, and through the Italian tribes generally, "oxen and sheep formed the oldest medium of exchange, ten sheep being reckoned equivalent to one ox. The recognition of these objects as universal legal representatives of value, or, in other words, as money, may be traced back to the epoch of a purely pastoral economy." The Icelandic law bears witness to a similar state of things; while the various fines in the different Teutonic codes are estimated in cattle. The Latin word *pecunia* (*pecus*) is an evidence of the earliest Roman money being composed of cattle. The English *fee* and the famous term *feudal*, according to its most probable etymology, are derived from the same root. In a well-known passage of the *Iliad* (vi. 235-6) the value of two different sets of armour is estimated in terms of oxen. The Irish law tracts bear evidence as to the use of cattle as one of the measures of value in early Irish civilization. Similarly, oxen from the principal wealth and the circulating medium among the Zulus and Kaffirs. On the testimony of an eye-witness we are assured that, "as cattle constitute the sole wealth of the people, so they are their only medium of such transactions as involve exchange, payment or reward." So also we find that cattle-rents are paid by the pastoral Indian tribes to the United States government. From the prominence of slavery in early societies it is reasonable to suppose that slaves would be adopted as a medium of exchange, and one of the measures of value in the Irish law tracts, *cumhal*, is said to have originally meant a female slave. They are at present applied to this purpose in Central Africa, and also in New Guinea. On passing to the agricultural stage a greater number of objects are found capable of being applied to currency purposes. Among these are corn—used even at present in Norway—maize, olive oil, coco-nuts and tea. The most remarkable instance of an agricultural product being used as currency is to be found in the case of tobacco, which was adopted as legal tender by the English colonists in North America. Another class of articles used for money consists of ornaments, which among all uncivilized tribes serve this purpose. The haiqua-shells mentioned before are an instance, cowries in India, whales' teeth among the Fijians, red feathers among some South Sea Island tribes, and finally, any attractive kinds of stone which can be easily worked. Mineral products, so far as they do not come under the preceding head, furnish another class. Thus salt was used in Abyssinia and Mexico; while the metals—a phenomenon which will require a more careful examination—have succeeded in finally driving all their inferior competitors out of the field, and have become the sole substances for money.

4. *The Metals as Money. Reasons for their Adoption. Superiority of Silver and Gold.*—The employment of metals as money material can be traced far back in the history of civilization; but as it is impossible to determine the exact order of their appearance in this capacity, it will be convenient to take them in the order of their value, beginning with the lowest. Iron—to judge from the statement of Aristotle—was widely used as currency. One remarkable instance is the Spartan money, which was clearly a survival of a form that had died out among the other Greek states; though it has often been attributed to ascetic policy. In conjunction with copper, iron formed one of the constituents of early Chinese currency, and at a later time was used as a subsidiary coinage in Japan. Iron spikes are used as money in Central Africa, while Adam Smith notes the employment of nails for the same purpose in Scotland. Lead has served as money, *e.g.* in Burma. The use of copper as money has been more extensive than is the case in respect to the metals just mentioned. It, as stated, was used in China along with iron—an early instance of bimetallism—and it figured in the first Hebrew coins. It was the sole Roman coinage down to 269 B.C. and it has lingered on to a comparatively recent date in the backward European currencies. It even survives as a part of the token coinage of the present. Tin has not been a favourite material for money: the richness of the Cornish mines accounts for its use by some British kings. Silver holds a more prominent place than any of the preceding metals. Down to the close of the 18th century it was the chief form of money, and often looked on as forming the necessary standard substance. It was the principal Greek money material, and was introduced at Rome in 269 B.C. The currencies of medieval Europe had silver as their leading constituent; while down almost to the present day Eastern countries seemed to prefer silver to gold.

The pre-eminence of gold as money is now beyond dispute; there, is, however, some difficulty in discovering its earliest employment. It is, perhaps, to be found in "the pictures of the ancient Egyptians weighing in scales heaps of rings of gold and silver." According to W. Ridgeway's ingenious theory gold comes into use as a currency in due equation to the older cattle-unit, the ox. It was certainly employed by the great Eastern monarchs; its further development will be considered later on. Metals of modern discovery—such as nickel and platinum—are only used by the fancy of a few governments, though the former makes a good token coinage.

The preceding examination of the varied materials of currency, metallic and non-metallic, suggests some conclusions respecting the course of monetary evolution, viz.: (1) that the metals tend to supersede all other forms of money among progressive communities; and (2) that the more valuable metals displace the less valuable ones. The explanation of these movements is found in the qualities that are specially desirable in the articles used for money. There has been a long process of selection and elimination in the course of monetary history.

First, it is plain that nothing can serve as money which has not the attributes of wealth; *i.e.* unless it is useful, transferable and limited in supply. As these conditions are essential to the existence of value, the instrument for measuring and transferring values must possess them. A second requisite of great effect is the amount of value in proportion to weight or mass. High value in small bulk gives the quality of portability, want of which has been a fatal obstacle to the continued use of many early forms of money. Skins, corn and tobacco were defective in this quality, and so were iron and copper. Sheep and oxen, though technically described as "self-moving," are expensive to transport from place to place. That the material of money shall be the same throughout, so that one unit shall be equal in value to another, is a further desideratum, which is as decidedly lacking in cattle-currency as it is prominent in the metals. It is, further, desirable that the substance used as money shall be capable of being divided without loss of value, and, if needed, of being reunited. Most of the articles used in primitive societies—such as eggs, skins and cattle—fail in this quality. Money should also be durable, a requirement which leads to the exclusion of all animal and most vegetable substances from the class of suitable currency materials. To be easily recognized is another very desirable quality in money, and moreover to be recognized as of a given value. Articles otherwise well fitted for money-use, *e.g.* precious stones, suffer through the difficulty of estimating their value. Finally, it results from the function of money as a standard of value that it should alter in its own value as little as possible. Complete fixity of value is from the nature of things unattainable; but the nearest approximation that can be secured is desirable. In early societies this quality is not of great importance; for future obligations are few and inconsiderable. With the growth of industry and commerce and the expansion of the system of contracts, covering a distant future, the evil effects of a shifting standard of value attract attention, and lead to the suggestion of ingenious devices to correct fluctuations. These belong to the later history of money and currency movements. It is enough for the ordinary purposes of money that it shall not alter within short periods, which is a characteristic of the more valuable metals, and particularly of silver and gold, while in contrast such an article as corn changes considerably in value from year to year.

From the foregoing examination of the requisites desirable in the material of money it is easy to deduce the empirical laws which the history of money discloses, since metals, as compared with non-metallic substances, evidently possess those requisites in a great degree. They are all durable, homogeneous, divisible and recognizable, and in virtue of these superior advantages they are the only substances now used for money by advanced nations. Nor is the case different when the decision has to be made between the different metals. Iron has been rejected because of its low value and its liability to rust, lead from its extreme softness, and tin from its tendency to break. All these metals, as well as copper, are unsuitable from their low value, which hinders their speedy transmission so as to adjust inequalities of local prices.

The elimination of the cheaper metals leaves silver and gold as the only suitable materials for forming the principal currency. Of late years there has been a very decided movement towards the adoption of the latter as the sole monetary standard, silver being regarded as suitable only for a subsidiary coinage. The special features of gold and silver which render them the most suitable materials for currency may here be noted. "The value of these metals changes only by slow degrees; they are readily divisible into any number of parts which may be reunited by means of fusion without loss; they do not deteriorate by being kept; their firm and compact texture makes them difficult to wear; their cost of production, especially of gold, is so considerable that they possess great value in small bulk, and can of course be transported with comparative facility; and their identity is perfect." The possession by both these metals of all the qualities needed in money is more briefly but forcibly put by Cantillon when he says that "gold and silver alone are of small volume, of equal goodness, easy of transport, divisible without loss, easily guarded, beautiful and brilliant and durable almost to eternity." This view has even been pushed to an extreme form in the proposition of Turgot, that they became universal money by the nature and force of things, independently of all convention and law, from which the deduction has been drawn that to proscribe silver by law from being used as money is a violation of the nature of things.

5. *The Introduction and Development of Coinage. The State and Money.*—The earliest metallic currencies passed by weight; they were, in fact, commodities, though used in a special way. The Hebrew records, as well as the Greek writers, bear witness to the prevalence of this primitive system. Thus, Aristotle, after explaining the circumstances that led to the invention of money, points out how it was at first defined simply by size and weight, although finally men went further and set a stamp on every coin to relieve them from the trouble of weighing it." (*Pol.* i. 9, 8.) Coinage systems have had a long period of growth, in which two distinct stages can be noted. In the first only the quality or fineness of the metal is denoted by the stamp, no attempt being made to fix the weight. The stamp, so to speak, acts as a kind of *hall-mark*. The cubes of gold employed by the Chinese may have been the earliest coins. Modern authorities accept the view of Herodotus that gold and silver coins were first used by the Lydians; the same author mentions that the first Greek coinage was at Aegina by Pheidon of Argos. In order to complete the invention it became necessary to certify the weight of metal in the coin as well as its fineness. A further result was the establishment of a regular shape for the purpose of preventing any tampering with the coin after its manufacture. Though various experiments in form were made, by the production of hexagonal and octagonal coins, the universally accepted shape came to be that of a flat circle, each side of which is stamped, as also in many cases the edge. The great number of the Greek city states afforded ample opportunities for experiment and competition, and rapid progress in the direction of securing good currencies was made. The improvement in the Greek coinages may be regarded as the consequence, and in some degree a cause, of their growing commerce. From Greece the art of coining was introduced into Italy by the Hellenic settlers and traders, and became one of the essential features of a civilized society. Progress, however, did not stop with the establishment of the institution of coined money. A number of practical questions had to be decided respecting the best way of overcoming the difficulties that certain technical problems presented. In spite of early experience, it has at times been suggested that the circular form might be replaced by some other, *e.g.* the square or oblong. Practice has confirmed the wisdom of the old-established shape. Another question was in respect to the limits of size that were most suitable for coins. Here the lower limit is prescribed by the convenience of the users. Coins that are easily lost, or picked up with trouble, such as the British threepenny piece and the American gold dollar, ought not to be issued. The determination of the upper limit presents greater difficulties. Very large pieces are hard to coin, and they give facilities for improper treatment by drilling holes and filling them up with cheaper metal, or even for the entire removal of the interior, the faces being preserved. The attractive appearance of large gold coins is no compensation for this danger. The English sovereign and, in silver, the half-crown seem to come near the upper limit of safe issue. The comparative wear of coins of different sizes must be considered. A long series of experiments, supported by ordinary experience, goes to show that the smaller coins wear more rapidly. The English mint in 1833 estimated the loss per cent. per annum at 2s. 6d. on half-crowns, 4s. on shillings, and 7s. 6d. on sixpences. There are accordingly reasons for adopting a medium size in preference to large or small coins. The actual coins issued have, of course, to be adapted to the requirements of the particular community. Even prejudices must be taken into due account. The designs employed in connexion with coinage have proved a fruitful field for the student of Numismatics (*q.v.*). From the monetary standpoint the aim of the design is to prevent either counterfeiting or the abstraction of any portion of the metal. For the former purpose careful execution in designing and the use of powerful machinery are the really effective safeguards. The latter is best obviated by protecting the edges by the process of milling, to which a raised inscription has sometimes been added. Great advances have been made in the organization of the modern Mint (*q.v.*) by the use of new appliances and scientific methods. The question of the proper alloy in coins has received a great deal of attention. As gold and silver are both by nature soft, some other metal, such as copper or tin, has to be added, in order to secure the necessary hardness. The English gold coins have an alloy of one-twelfth; the silver coins one of three-fortieths. Far more general is the alloy of one-tenth, which is probably due to the sentiment in favour of a decimal system; but at any rate is simple for calculations. There does not appear to be any strong technical reason for preferring either of these alloys to the other. The French mint authorities are in favour of their one-tenth; while the English ones adhere to the alloy of one-twelfth. There is agreement only on the point that a very small amount of alloy, *e.g.* that of one in seventy-two, as used in the Austrian ducat, does not give the requisite hardness.

A question of far more importance, both politically and economically, is that of the issue of money, and the power of the state in regard to it. In the ruder societies, where money was not sharply distinguished from commodities, no difficulty presented itself. Skins, shells or cattle were money—so to speak—by the force of things; and the same condition persisted as long as crude metals were employed. But with the introduction of coinage the idea of a regulating authority came into being. The necessity of enforcing contracts and the parallel system of penalties made it incumbent on the ruler and judges to provide due standards of payment. The combined effect of these influences was reinforced by the establishment of the rudimentary forms of state revenue, which made it a matter of interest to the ruler to provide a good medium of payment. Accordingly, with the origin of the organized state we find the coinage as a special prerogative of the king, though private persons often exercised the privilege of coining. The very large number of the autonomous cities of Greece, which possessed the right of issuing money, was the cause of the competition between different currencies, each having legal tender power only within its own city. In its practical outcome this "free coinage" system proved beneficial, for it compelled the maintenance of the true standard in order to gain wider circulation. With the establishment of larger states the control over the issue of money grew more stringent. In the later Roman Empire the right of coining was reserved to the emperor exclusively. After the fall of the empire the traditions of prerogative passed on to the medieval kings, a right carefully guarded by the English sovereigns. In France and Germany the principal nobles claimed this seignorial right, but in the modern state the regulation money has been definitely vested in the supreme authority, *i.e.* the sovereign.

One reason for the close connexion of money with the state is the fact that there is one attribute of currency which comes within the area of work specially allotted to the public authority. Money ought to have the power finally to close a transaction, *i.e.* to say it should be "legal tender." This "liberating power," as the French call it, might be regarded as one of the money functions. Those who look on money as a purely legal institution naturally take this view; it seems, however, better to take the economic conditions as the really fundamental ones. It is only on account of their economic effects that legal regulations require consideration. These effects are, indeed, very far-reaching. By prescribing the standard and amount of penalties, by their power of selecting the substances to be used as money, and by their frequent interferences with existing currencies, the governments of the world have guided—as well as very often disturbed—the normal course of development. What Aristotle regarded as the "unnatural" character of money is mainly attributable to state intervention. But it is important to remember that the sphere of governmental action in respect to money is limited. A currency system is never an arbitrary creation; it must grow slowly out of the habits and customs of the community, and must subserve its economic needs. No sudden change at the caprice of the state is likely to continue. Further, it is clear that no government can determine the results of its interference; these will depend on the existing conditions and will conform to economic law. Monetary history is rich in examples of the failure of legal enactment to direct the course of events, and of the disasters that have followed on the ill-advised measures of public authority.

One result of the close connexion of the state with the business of coining has been the establishment of regulations in reference to the expense of the process. As coins are manufactured articles it seems evident that a charge sufficient to cover the cost may rightly be imposed. Such a charge is described by the term Seigniorage (*q.v.*). It has in many cases been so fixed as to bring in a large profit to the government; but then it amounts to a depreciation of the currency; for the levy of a charge on coining is the same as the substraction of so much metal from the coins issued. English policy is peculiar in its adoption of gratuitous coinage of gold, an anomaly due in its origin to the prejudices of the mercantile doctrines, but defended on the ground of the convenience to trade from the equivalence of gold bullion and coin. The heavy seigniorage on the silver coins—at present over 60%—is a source of considerable profit; in some years exceeding £800,000. All other countries levy moderate charges on their gold coinages, and make profit on their silver issues, though in different ways. As it has become the duty of the state to maintain the currency in a sound condition, it has to deal with the question of its expense. This is composed of several elements, viz. (1) the cost of manufacture, just mentioned; (2) the loss through the wear which money undergoes in the work of circulating; and (3) the interest on the capital sunk in the monetary stock. A country with a metallic circulation of £100,000,000 incurs a loss of the interest which that amount of capital would produce by investment, *i.e.* at 4% £4,000,000. The expense is amply justified by the services that a good currency renders; but, at the same time, it proves the desirability of any economies that do not detract from efficiency. The great economizing agency is the use of representative money and the various forms of credit, in which so much of the latest advances consist.

6. *Representative Money; its Introduction and Development. The Mode in which Credit is used as Money.*—Economy in the employment of the precious metals is naturally suggested by ordinary experience; but the way in which states have profited by the expedient of depreciation affords a special inducement to follow what is practically the same course, and issue paper documents in place of the more costly metallic medium. In theory, as Ricardo explained, a paper currency is one in which the whole value has been appropriated as seigniorage. The cost of keeping a stock of valuable money is obviated, and the new instrument of exchange is supported by state authority. Here the action of economic conditions is instructively illustrated; for though a government can set up a paper currency, it is not within its power to prescribe its value. The quantity theory (§ 2) is confirmed by the inevitable decline in value when issue passes a definite point. The only effective mode of preventing depreciation is by limiting the amount of paper money to that of the metallic money previously in circulation. The easiest way to accomplish this is to leave the use of the paper currency optional by making it convertible into coin at the will of the holder. The amount of the circulation is thus automatically fixed by the action of the community. An evident disadvantage is the necessity of keeping an adequate reserve of coin to meet actual and prospective demands. For ideal security the whole amount of paper issue should be covered by an equal value of metal. In practice the reserve may be much smaller; but so far as it is required, it means a deduction from the gain of issue. The temptation to reduce the reserve to an inadequate amount and then to escape the difficulty by resorting to the expedient of refusing to pay coin for notes, *i.e.* making the notes inconvertible, has proved too strong for nearly all governments at times of pressure. The history of state dealings with paper money may broadly be described as a history of inconvertibility. Hard-bought experience has only now forced on the notice of governments the loss that follows from a disturbance of the standard used in ordinary payments. They are evident to all careful observers, and may be concisely summarized as consisting in: (1) the injustice to creditors through being paid in a much lower standard than that in which they lent; (2) the disturbance to trade, both domestic and foreign, by the fluctuations in the value of money; (3) the pressure on the working classes from the slower rise of money wages, in contrast with the quicker movement of the prices of commodities, resulting in a fall of *real* wages; and (4) the check to dealings in relation with the international money market, due to the risk of exchange fluctuations. The only gains are the temporary stimulus to certain branches of trade, and the advantage to the state by contracting a forced loan without paying interest.

The origination of paper money by state direction is the easiest to consider and explain. It does not follow that it is the most important or the earliest kind of representative currency. As W. Bagehot has pointed out, the real origin of economic institutions is often very different from the apparent one. In truth, representative money seems to have grown up out of the elementary contrivances of early credit. A claim could be expressed and transferred by a document, which might be used for facilitating exchanges. The rigid formalism of early law hindered the extensive use of this convenient machinery. It was not till the institution of *banking* that the coining of credit was made easy. Thus the bank-note comes into use, resting, not on the fiat of the state, but on the repute of the issuer. At this stage the history of the two distinct forms of representative money becomes mixed, owing to the control exercised over banks by government and to the fact that banking companies were in many cases the agents by which what was virtually state money was issued. There is, however, the fundamental difference that bank money finds its way into use through the ordinary system of granting credit; while government money is used in the purchase of commodities and the hire of services. The former, therefore, returns in a short time; the latter remains in circulation and displaces metallic currency. In the long controversy over the Bank Charter Act 1844 this distinction was brought into prominence. Since that date the extraordinary development of deposit banking in both Great Britain and the United States has furnished these countries with by far the most flexible form of currency yet known in the cheques that transfer claims on the capital held by the banking institutions. The confusion so often shown regarding the relation of credit to money is connected with this latest progress. When it is remembered that in its origin money is only an instrument to facilitate exchange—we might even say to render it possible—it follows that from its earliest to its latest form the ruling influence is the need of society for the best mechanism of exchange.

7. *Production and Consumption of the Precious Metals in their Economic Aspects.*—In considering various monetary questions it is essential to have some acquaintance with the economic

aspects of the production of gold and silver. The first point to which attention may be directed is the field over which production extends. At one time or other these two metals have been found in every continent. Asia Minor in early times possessed its goldfields, or rather auriferous sands. Ceylon also undoubtedly contained gold-mines. China and India both produced silver to a considerable extent. Egyptian remains show that gold was commonly known in that country, probably procured from Nubia and Abyssinia. On the opposite side of Africa, too, the name of Gold Coast shows that that metal was thence exported. The mines of Laurium in Attica were a source of supply to the Athenians, and were worked as a state monopoly. At an earlier date the Babylonian and Assyrian empires had each accumulated large stores of gold. The Phoenician importations of gold from the Red Sea coasts (Ophir) are known from Scripture. The Persian kings from the time of Darius levied tribute on all their provinces—in gold from India, in silver from the remaining districts, the larger part of which was stored up in the royal treasuries. This tendency of despotic rulers to accumulate treasure had all through ancient history important effects on the economic structure of society. At present it is quite natural to assume that the materials of money are distributed by means of international trade, and tend to keep at an equal level all the world over—an assumption which is in general well grounded, though an important exception exists. Ancient history presents a widely different set of forces in operation. Gold and silver were produced by slaves under the pressure of fear, and were drawn towards the ruling parts of the great empires; in a word, war, not commerce, was the distributing agency. From this condition of affairs it is easy to see that, whatever may be the reasons for assigning to cost of production a potent influence over the value of money in modern times (and grounds have been already advanced for the belief that its influence has been exaggerated), no such reasons then existed. The production of the precious metals was carried on in similar manner to the great buildings and other works of those periods, on non-economic grounds, and therefore produced quite different effects. The whole history of the Persian monarchy to its overthrow by Alexander (330 B.C.) shows that the hoarded mass of the precious metals continued constantly to increase. On the capture of Persepolis by the Grecian army an enormous treasure was found there, some estimates placing it as high as 120,000 talents of gold and silver (£27,600,000). All the temples, too, were receptacles for the precious metals, so that the stock accumulated at about 300 B.C. must have been very great. The only causes which tended to diminish the store were the losses arising from wars, when the various treasuries were liable to be plundered and their contents dispersed. There was therefore a more unequal distribution of the material of money than at present. The growth of the Roman dominion led to important results, since under their rule the Spanish mines were developed and became a leading source of supply. The great masses of treasure set towards Rome, so that it became the monetary centre of the world. The overthrow of the republican government and the peace which followed also affected the conditions of production. The inefficiency of the Roman administration made it advantageous to let out the mines to farmers, who worked them in a wasteful and improvident manner, while the supply of slaves was reduced, thus depriving the lessees of their principal agency for carrying on production. The result was a continuous decline in the store of money. W. Jacob has made an attempt to estimate the amount at the death of Augustus (A.D. 14), and arrives at the conclusion that it was £358,000,000. (*Precious Metals*, i. 225.) Without placing much value on this necessarily conjectural estimate, it is safe to assume that this period marked the highest point of accumulation.

The succeeding centuries exhibit a steady decline, though it is of course impossible to attach any value to even the most carefully guarded numerical estimates. The phenomenon which has since so often attracted notice—the drain of the precious metals to the East—began at this time, and was a subject of complaint by the Roman writers, while the stock of gold and silver being thrown into general circulation suffered from abrasion, and was more likely to be lost than when stored up in the royal treasure-houses and temples. These causes tended to depress the scale of prices, while the barbarian invasions produced a strong effect on the supply by drawing off the mining population and damaging the various erections used for working the mines. The conjectural estimate is that about A.D. 800 the total supply had been reduced to £33,000,000 (or about one-eleventh of what it had been at the death of Augustus). A new period in the history of gold and silver production may be fixed at this date. The Moors, now firmly established in Spain, began to reopen the mines in that country which had been allowed to fall into disuse. Other European mines also were opened, notably those of Saxony and the Harz Mountains, as well as the Austrian mines—the chief medieval sources of supply. The international system of currency, based on the pound of silver as a unit, which was introduced by Charlemagne, must have tended to economize the wear of the metals. We may therefore conclude that from this date (A.D. 800) the supply was sufficient to counteract the loss by wear and exportation, and accordingly regard the metallic supply as fixed in amount until the next change in the conditions of production, which was the result of the discovery of America. Though 1492 is the date of the first landing, yet for some time no important additions were made to the supply of money. The conquest of Mexico (1519) gave opportunities of working the silver-mines of that country, while the first mines of Chile and Peru were almost simultaneously discovered, and in 1545 those of Potosi were laid open. From this latter date we may regard the American supply as an influential factor in causing a continuous increase in the stock of money. The annual addition to the store of money has been estimated as £2,100,000 for the period from 1545 to 1600. At this date the Brazilian supply began. The course of distribution of these fresh masses of the precious metals deserves some notice. The flow of the new supplies was first towards Spain and Portugal, whence they passed to the larger commercial centres of the other European countries, the effect being that prices were raised in and about the chief towns, while the value of money in the country districts remained unaltered. The additions to the supply of both gold and silver during the two centuries 1600–1800 continued to be very considerable; but, if Adam Smith's view be correct, the full effect on prices was produced by 1640, and the increased amount of money was from that time counterbalanced by the wider extension of trade. At the commencement of the 19th century the annual production of gold had been estimated as being from £2,500,000 to £3,000,000. The year 1809 seems to mark an epoch in the production of these metals, since the outbreak of the revolts of the various Spanish dependencies in South America tended to check the usual supply from those countries, and a marked increase in the value of money was the consequence. During the period 1809–1849 the value of gold and silver rose to about two and a half times its former level, notwithstanding fresh discoveries in Asiatic Russia, which became considerable from 1823. The annual yield in 1849 was estimated at £8,000,000. The next important date for our present purpose is the year 1848, when the Californian mines were opened, while in 1851 the Australian discoveries took place. By these events an enormous mass of gold was added to the world's supply. The most careful estimates fix the addition during the years 1851–1871 at £500,000,000, or an amount nearly equal to the former stock in existence. The problems raised by this phenomenon have received careful study. The main features of interest may be briefly summed up. (1) The additional supply was almost entirely of *gold*, thus tending to produce a distinction between the two principal monetary metals and an alteration in the currency of bimetallic countries. Under this influence France, from being a silver-using, became a gold-using country. (2) The contemporaneous development of the continental railway systems, and the partial adoption of free trade, with the consequent facilities for freer circulation of commodities, led to the course of distribution being different from that of the 16th century. The more backward districts were the principal gainers, and a more general equalization of prices combined with a slight elevation in value was the outcome. (3) The increased supply of gold rendered a general currency reform possible, and made the use of a gold monometallic standard appear feasible. The movements for currency reform, as will be seen, all arose after these discoveries. (4) The change in the value of money, which may for the period 1849–1869 be fixed at 20 %, enabled a general increase of wages to be carried out, thus improving the condition of the classes living on manual labour. It may be added that the difficulty of tracing the effects of this great addition to the money stock is a most striking proof of the complexity of modern economic development. (5) The last point to be noticed is the very small influence exercised on the value of silver by the new gold. The gold price of silver in London rose only from 59¾d. per oz. to 62½d. per oz.—*i.e.* between 4 and 5%. Hardly had the gold discoveries of 1848–1851 ceased to produce a decided effect when new silver mines of unusual fertility came into working. During the period immediately succeeding the gold discoveries the production of silver remained at an annual amount of from £8,000,000 to £9,000,000. This amount suddenly, about 1870, increased to £15,000,000, and remained at that amount for the next five years. More than half of the supply came from new mines opened in Nevada. This increased supply was accompanied by a marked depreciation in the gold price of silver, though the prices of commodities in countries having a silver standard did not rise. The disturbances resulting from the combined effect of the new silver and the diminution in the annual output of gold which began about 1870 and continued for nearly twenty years were the cause of much controversy and led to the propounding of novel monetary theories. *Bimetallism* came into prominence; and the modes of relieving trade depression caused by the fall in prices were keenly discussed. Before any monetary adjustment took place the situation again changed in consequence of a renewal of the Australian gold production, soon followed by the great gold discoveries in South Africa. The annual output of gold, which had fallen below £20,000,000, in 1884 rose rapidly to £60,000,000, and in 1908 reached the prodigious figure of over £80,000,000, with the prospect of still larger yields in the near future. By this change the difficulties that had led to the agitations for "free silver" in the United States, and for "international bimetallism" in Europe and in India were removed, showing the close connexion between the production of the precious metals and the economic, especially the monetary, policy of all periods.

The modes of consumption of the precious metals—under which their use is included—are of equal importance with those of their production. Classed roughly, they come under three heads, viz. (1) their use as merchandise, (2) their use as money, (3) the "drain" to the East. With regard to the first, though precise data are not available, it may be said with some confidence that the demand for personal use tends, after society has made some progress, to decline in strength. The desire for adornment is not a keen one with most civilized persons; and, so far as it exists, is gratified in other ways than by using silver or gold. For purposes of manufacture their use is large and increasing. The second head is that with which we are principally concerned. It is evidently connected with the need for metallic currency; and this again depends on the level of prices and the monetary organization, including in the latter the banking system. Currency requirements still form the largest part of the demand for the precious metals. Under the third head a remarkable exception to the tendency towards the equal diffusion of the precious metals is presented. For nearly two thousand years the movement of silver from west to east has been noticed. Humboldt has made the ingenious remark that the course of these metals is in the opposite direction to that of civilization, and history supports his view. During the middle ages the chief Eastern products used in Europe were luxuries, such as silk and spices, and silver was sent from Europe to pay for them. Eastern trade increased, owing to the discovery of the passage round the Cape of Good Hope, and the flow of silver became greater. Special circumstances have from time to time influenced the movement. Thus, the new supplies of gold in the middle of the last century caused by their action on the bi-metallic currencies of Europe an acceleration in the flow, the amount exported between 1851–1862 reaching £110,000,000. To this drain of silver a more recent one of gold has been added. India takes year by year a considerable amount of gold bars, which may in the future have a monetary use, but up to the present appear to be hoarded or used for ornament. With the complete reconstruction of Eastern currencies that now seems probable there may come a decided change in the character of the demand. Another influencing condition is also undergoing change; the tendency to fix prices on a customary basis is bound to yield to the pressure of competition. The inevitable result will be to make the price level alter with each influx of money, and thus to limit the demand for bullion through the action of the exchanges.

One of the technical features of the production of the precious metals should be noted, in consequence of its economic effect. Gold has more frequently been found near the surface; silver is usually obtained by deep mining. It follows that the amount of the former metal produced depends more on accidental circumstances, in contrast to that of silver, which is affected by the standard of mining skill. The mines of Nevada were exceptional in their possessing both metals and in nearly equal value. The gold-mines of South Africa have come to be worked at deep levels and therefore are technically in the same class as silver ones. In fact, there is a pronounced tendency all the world over towards the system of capitalistic working.

8. *Review of the History of Some Important Currencies.*—Monetary theory requires to be elucidated by the constant reference to history; just as in turn the history of currency has to be interpreted by the aid of general principles. Each country has its peculiar problems, which call for special treatment; though at the same time there is no way of avoiding the operation of those economic conditions and forces that are to be found in all countries. The first decisive fact that emerges from the vast material presented by the history of money is the tendency at most periods towards deterioration. In the time of purely metallic currency debasement is the most serious danger; when representative money has come into being extravagant issues of paper are chosen as the readiest way of evading the limits of a sound currency. It is perhaps too extreme to say that monetary history is altogether made up of accounts of debasements and over-issues. The truth is better expressed in the proposition that there has been a constant struggle between the influences that make for deterioration and those that give support to the maintenance of a good currency condition. There is also the cheering circumstance that in spite of much popular ignorance there has on the whole been a steady improvement in the treatment of monetary systems. Expert knowledge has more effect in the later than in the earlier periods. The crude expedients of the Tudors would not be tolerated in modern England. There is much fuller recognition of the danger of over-issue in paper money; and this is accompanied by greater care in the treatment of credit institutions in their relation to the modern *media* of circulation. It is also noteworthy that mere popular agitation has lost a great deal of its power, as shown in the failure of both the "soft money" and the "free silver" movements in the United States. On the other hand the tendency to accept scientific methods is illustrated in the treatment of the Indian currency question.

Greek Currencies.—As already noticed the political conditions of Greek life supplied a varied field for monetary experiments. Unfortunately the details are very incompletely known, and the subject of Hellenic money has not been sufficiently studied from the economic side. Certain broad facts are prominent. The Athenian use of silver as the standard substance, coupled with the later employment of gold to serve for an extra or commercial currency, is a characteristic feature. The alteration of the standard by Solon appears in the light of an exceptional revolutionary expedient. It amounted to the creation of a new standard unit—the Attic—which was imitated by other states, *e.g.* Corinth. Only one doubtful instance of debasement can be found in the subsequent history of Athens. This honesty in respect to the monetary standard seems on the whole to have prevailed in the Greek states. Some despots, as Dionysius, issued adulterated coins, but these were isolated cases. The use of gold and silver in an amalgam, known as electrum, was an admissible device; it, however, had the evil effect of suggesting the use of poorer alloys.

Roman Money.—The history of money in Rome is rather different. Beginning with copper, the currency was changed into a double standard one by the introduction of silver (269 B.C.). Gold came in for commercial use with the extension of the Roman dominions, and copper was reduced to a token coinage. In the stress of the Punic Wars debasement was one of the financial devices of the magistrates. The conquest of the Greek territories brought about the regulation of their currencies. Silver was prescribed as the money substance. The establishment of the empire led to the definite concentration of the right of coining in the sovereign; though concessions were made in various localities, where the smaller coinages were allowed to continue. But the principal interest of the money of the Roman Empire is due to the remarkable way in which it illustrates the tendency of despotic and bureaucratic rule to lower the condition of good administration. A long course of debasement is the characteristic aspect of the currency system. "Under the empire," we are told, "the history of the silver coinage is one of melancholy debasement. The most extensive frauds in connexion with money were perpetrated by the Romans." The gold *aureus*, which in the time of Augustus was one forty-fifth of a pound, was under Constantine only one seventy-second of a pound. The alloy in the silver coins gradually rose to three-fourths of the weight. Plated coins came into extensive use. The practice of debasement was in accordance with the theories of the jurists, who seem to have regarded money as simply the creature of the state, *i.e.* the personal ruler.

Medieval Money.—After the overthrow of the Western Empire, though the invaders were in the condition of what has been called "natural economy," the state in which money has not come into being, they soon were disposed to carry on the Roman tradition, and their rulers adopted some form of silver currency. With the temporary revival of the empire under Charlemagne there comes the effort to found a general standard money on the basis of the silver pound. From this new starting-point it is possible to trace the course of some of the leading currency systems of Europe. For purposes of illustration it will be sufficient to sketch the movements in England and France, which are typical of the general course of monetary development. The systems of these countries are moreover remarkable (1) in the contrasts that they present to each other, and (2) in the widespread influence that they have exercised on the monetary arrangements of other nations.

English Monetary History.—The English currency begins with the pound of silver (troy weight) as the standard unit, subdivided into 20 shillings, each containing 12 pennies. The only coin at first in use was the silver penny. This system, in force before the Conquest, is the direct descendant of the Carlovingian system, and it continued without change until about 1276, when a slight depreciation was introduced by coining the pound into 243 pennies, instead of the original 240. This was the first of a series of changes, generally in the direction of lowering the weight of the coin. Two periods are remarkable for the operation of this tendency, viz. (1) the reign of Edward I., when the silver was debased by 20% in the period 1344–1351; and (2) the close of the reign of Henry VIII. and that of Edward VI., 1543–1552. In this short space of ten years the expedient of degrading the quality of the coinage by bringing the alloy up to three-fourths of the mass was practised for the only time in English history. The substitution of the pound troy for the Tower pound in 1527 was accompanied by a lowering in weight which far exceeded the gain from the higher weight of the new pound (5760 instead of 5400 grains). The reformation of the silver coinage under Elizabeth (1560), and its definite settlement in 1601 on the basis of coining 62 shillings from the pound troy also deserve mention. Turning to the gold currency, we find some gold pennies issued in 1257, probably in imitation of the issue of the Italian cities, which were due to the opening of eastern trade and the example of the Greek Empire, which had always retained its gold currency. The regular series of English gold coins begins in 1343, when Edward III. ordered the coinage of florins—the title is significant—at 50 to the Tower pound. The "noble" soon followed. The "sovereign" was first issued in 1489. But gold was treated as a commercial money, to be used as subsidiary to the standard silver. Its value was therefore varied from time to time to meet the difficulty that local bimetallism is certain to cause, in consequence of the undervaluing of one or other metal. During the 17th century the most noticeable monetary events are: the proposals for depreciation, of which the most remarkable was that of W. Lowndes (1652–1724), for lowering the standard by some 25%; the introduction of the guinea as the leading gold coin, and the frequent readjustment of the values of the two metals by proclamation. The great recoinage of 1696, carried out on the principles advocated by Locke, reformed the silver currency. In the 18th century the establishment of the guinea at 21s. by Newton's advice made the adoption of gold as the standard inevitable, since it was overvalued in an appreciable degree. The position of gold as the practical standard is clearly recognized by Adam Smith (1776) and is regarded as settled by Ricardo (1809). The full legal establishment of the present metallic currency took place in 1816, when the guinea made way for the present pound or "sovereign," and silver was formally reduced to the level of a token coinage, being slightly lowered by the coinage of the pound of silver into 66 shillings. Thus, by a course of development extending over 700 years, the English currency has been transformed from a crude silver standard system into one resting on gold, but employing both silver and representative money for the greater part of the actual work.

French Money: its Development.—Though the monetary system of Charlemagne soon disappeared in Germany and Italy, it continued in the part of his empire that became France. The extreme confusion of the time of his successors enabled the feudal lords to claim the right of coinage. No less than 150 seigneurs are said to have exercised this power at the accession of the first Capet. With the growth of the royal authority the freedom of private coining was restricted, in order to reserve to the Crown the profitable right of seigniorage. Unfortunately the legitimate profit from this source was not sufficient to satisfy the wants of the royal treasury. Therefore French monetary history is marked by a long series of debasements, extending from the time of Philip I. to that of Louis XV. (1060–1774). In sharp contrast to English policy the tampering with the currency was persistent, so that Louis IX. was looked on as quite exceptional. "In later days his management of the royal mint was always appealed to as the equitable standard for the observance of his successors." Yet in his time the livre had been debased to less than one-fourth of its primitive level. The Hundred Years' War presented the occasion for still further degradation. At the accession of Louis XI. (1461) the livre had been brought down to one-fifteenth of its original value. The 16th century is equally an age of depreciation, no less than nineteen occurring between 1497 and 1602. Again, in contrast to the English system, the absolute monarchy continued the process of debasing the standard under Louis XIV., and the livre was only one-half what it had been under Henri IV. At the Revolution the decline had proceeded so far that the livre had been reduced to one seventy-eighth of its primitive value. The new spirit of reform produced an entire change. The franc was substituted for the livre at the equation: 80 francs, 81 livres. In fact, until the establishment of constitutional government the French people had to depend on popular violence to procure any temporary reform in their currency. Since the Revolution the course of development has been essentially orderly and regular. All through the time of the *ancien régime* silver was the principal money and the standard, as the use of the word "argent" as a synonym for money shows. Just as England got a gold currency by overvaluing gold, so did France get a silver one by overvaluing silver. Indeed, it may be said that the different ratios chosen by the two countries necessarily caused a reciprocal drain, affording a good example of the action of local bimetallic systems with different ratios between the two metals. A further result from the comparison of the systems of England and France is the greater maturity of the former. England gained an honest currency before France; she led the way in the adoption of the gold standard, while in her treatment of representative money she has held as decided a priority. The difference in economic conditions in the nations in part explains the contrast. There is no doubt that in both cases a high degree of development has been reached. Finally, it should be remarked, that as England has worked out in practice the system of "composite legal tender," so has France, with its monetary allies, been the first to show effectively the operation of the "limping standard" (*étalon boiteux*). Each nation has thus supplied a type, which recent monetary changes give evidence of having been used as the pattern for other less advanced countries.

9. *Some General Questions respecting the Constitution of Money.*—The consideration of the history of currency systems naturally suggests the general problems that the more advanced countries have had to encounter. Of these, some may be described as *formal*, *i.e.* they relate to the arrangement and the definition of coinage and standards. Others are in essence issues of principle involving the most complicated theoretical doctrines, on which there is even yet sharp differences of opinion between competent students of economics. In some instances an intermediate class may be found, *e.g.* the question of subdivision of the coins does raise some difficult matters of application; though it clearly belongs of right to the group of formal questions. But the distinction is a valid one. Whether a country should adopt the "gold standard" or prefer a "bimetallic" standard is obviously very different from the elementary points about units and the different classes of coins. We will therefore begin by noticing some of the characteristics that are found in all modern currencies and some of which are implied in the idea of money. Thus it is true that every currency system must be based on a *standard unit of value* which consists of a "fixed quantity of some concrete substance defined by reference to the units of weight or space." The English unit, for example, is the *pound*, which consists of a definite quantity of gold (123·27447 grs. standard fineness) while the French unit is the *franc* (composed of 5 grammes of silver nine-tenths fine). It is not necessary, though it is usually the case, that there shall be a coin corresponding to the standard unit, all that is needed is that the current coins shall be multiples or submultiples of the unit, or at the least easily reducible to it. The Portuguese *rei* is too small to be coined, and the pound of silver that formed the unit of the

early English and French currencies was too large. Quite distinct from both the actual coins and the unit of value is the *money of account*, though in practice it is usually identical with one of them. In Russia in early times the *rouble* was an imaginary money of account not coined, while the copper *copeck* was the unit of value. Connected with the distinction between the coins and the unit is the highly important one between *standard* and *token* money, the former being of full power for discharging debts, and in the case of most systems only of equal value to the metal out of which it is made, while the latter is rated at a nominal value higher than that of its material. The silver and copper coinage in England and the smaller coins in the Latin union are only tokens; in the case of English silver coins, the cost value is less than 40% of the nominal one. The French tokens are made of inferior fineness (835 per 1000) to the full tender silver. Two restrictions are applied to token issues: (1) they are only legally available to discharge small debts—in England silver is limited to the payment of 40s.; (2) they can be coined only by the permission of the state. Thus in England the Bank of England is the state agent for the silver coinage. The limitations are evidently required to prevent the expulsion of standard money, and to avoid the flooding of the circulation with coinage that is not needed for the purpose of the limited exchanges to which it is confined. Intermediate between standard and token currency are those forms of coinage that are free from the first limitation, but restricted by the second. They have this further point of resemblance to tokens in that their nominal value is higher than that of their material—the French 5-franc pieces and the Indian *rupees* are prominent examples. Similarly, the analogy between representative money and token money is deserving of attention, and suggests the desirability of the latter being regarded as in some respects a fiduciary issue, for which the issuing authority incurs responsibility.

A class of considerations already referred to (§ 5) requires explicit notice here, viz. the influence of popular sentiment on the character and forms of a country's currency. The fact that money has to circulate amongst all classes of society makes it indispensable that it should be suited to the wants and even the prejudices of the users. Many curious instances of preferences for particular coins or special forms of paper money can be given. The Austrian Maria Theresa dollar of 1780 is a favourite on the African coasts and has been frequently reissued for use there. Reasons of convenience and of security combine with sentiment; as in the determined rejection of the U.S. "greenbacks" by the inhabitants of California during the inconvertibility of that currency. Recognition of the desires and tastes of the community is almost essential in carrying out any monetary reform. It is only by building on the habits and customs that have become established that improvements in the monetary system can be effectively completed. Not only is this careful observance of the disposition of the mass of society expedient; there is still greater need for taking account of the methods and interests of those sections of the business world that deal specially with money. A currency change that was bitterly opposed by the banking interest would certainly be difficult to introduce in either England or the United States; traders have great influence as to the forms of money that they will accept and facilitate the use of. In another aspect the study of the interest of dealers in the arrangement of the monetary system presents itself. One of the features that caused much surprise in the infancy of economic study was the disappearance of good coins from the circulation, while inferior ones remained in use indefinitely. To the first observers there seemed to be something perverse in the preference apparently shown towards debased or worn coins. In business transactions inferior articles are taken only at a lower price. The explanation is easily understood, when furnished; it consists in stating the difference between a commodity which is sought for its use, and money which is taken as merely a medium of exchange. Provided that coin is not too bad for further circulation it will be accepted without difficulty. Still less will there be any trouble if the difference is only in the relative value of two metals, such as silver and gold. The great majority of any population will give and take money without particularly observing it. It is enough if the coin conforms to the usual type. There exists, however, in all mercantile communities a class of dealers in money, who make a profit by selecting the best coins for exportation, or if two metals are in concurrent use, the coins of that metal which is undervalued in the proportion fixed. In the case of inconvertible paper issues the withdrawal is also for the purpose of hoarding to secure the profit expected when there is a high premium on bullion. The action of self-interest under these conditions produces an effect which has been briefly formulated in the statement "that bad money tends to drive out good money." The proposition has been styled "Gresham's Law" (*q.v.*). Abundant illustrations of its working are available. The establishment of the English *gold* currency and the French *silver* one in the 18th century, already mentioned (§ 8), is an effective one. Quite as good is the transition of France from the silver to the gold currency form after the great gold discoveries of the middle of the 19th century. In truth it may be said that most of the monetary transitions have been due to the operation of the force indicated in Gresham's Law. The importance of the law lies in the warning that it gives against the attempt to reform a degraded currency by the issue of better money. Such "operations of the mint are," in Adam Smith's judgment, "somewhat like the web of Penelope." The caution holds equally in respect to the reform of a depreciated paper currency or to an effort to force an undervalued metal into circulation. The success of so many monetary reforms in the last forty years has been in great measure due to the better appreciation of the working of the principle. Its aid can also be obtained by setting up the suitable conditions; while it can be counteracted through the use of the principle of limitation, so clearly expounded by Ricardo. Some of the constituent parts of the French and American currencies rest altogether on the maintenance of an overvalued coinage, along with one of higher value by the limitation of the quantity of the former to the amount that can be employed without expelling the remaining part of the circulating medium from monetary use.

Another part of the structure of any currency is the scale on which its accounts, and by consequence the degrees of its coins, are arranged. The pound, the shilling, and the penny in the older English system represented so many grades in the subdivision of value. All other currencies have the same need for divisions. The simplest scale would be what is called the "binary"; in which each coin is the half of the next higher, and double the one immediately below it. Most actual systems have series of coins on the binary scale. The penny, the halfpenny, the farthing; the 4s. piece, the florin, the shilling, the sixpence, the threepenny; at a higher level the sovereign, the half-sovereign, the crown, the half-crown, are English examples. The Latin and Scandinavian unions, as also Germany and the United States, have several binary coinage series. But no country adopts a purely binary scale. England in part retains the old "duodecimal" division in the relation of the shilling and the penny. Nearly all civilized nations have come to accept the system of *Decimal Coinage* (*q.v.*), though in their actual currencies they admit certain divergences from the strict decimal system. The convenience of having the monetary scale of accounts in accordance with the arithmetical scale will probably secure the ultimate victory of the decimal system everywhere, in spite of the objections to it on the ground of its having only two factors—2 and 5—as against the larger number of the duodecimal scale (2, 3, 4 and 6). The immense trouble involved in altering accounts and the difficulty of overcoming the hostility to change felt by the ordinary members of the community are the obstacles that prevent the adoption of the decimal system in England.

Connected with the composition of a currency and the scale on which it is based is the question of its relation to other currencies. From a very early time the conception of a money that should not be confined by a political limit appears to have existed. In fact until the state took over the control of money its more important forms had a wide diffusion. The talent, equated to the ox, is a prominent instance. Even when the city-state provided its particular coinage we can still perceive the circulation of the better coinages outside their legal area. The effect on the Greek currencies has been noted above (§ 8). Under the Roman hegemony and the empire that arose out of it there was the equivalent of an international currency in the wide circulation of the coinages adopted from the conquered states. Such coins as the drachma and the denarius were of general use in the then civilized world. In later times the Carolingian silver currency for a short period supplied an international medium, which vanished in the confusion of the middle ages. Owing to the rise of national governments money became a national distinction peculiar to each state. It is only in the last sixty years that the idea of international money has been revived in a practical form. Unfortunately the revival was speedily checked by the reaction in favour of nationalism that followed the Franco-German War (1870–71) and by the controversies as to the proper standard. (See BIMETALLISM and MONETARY CONFERENCES for further discussion of this topic.)

10. *Typical Currency Systems: their Evolution and Governing Principles.*—At first sight it appears that the systems of currency are almost infinite in their variety. They have grown up in different nations under the influence of local conditions and reflect the customs of the particular society. But, underlying these superficial differences, there are certain general principles that permit of a grouping into a small number of clearly marked types. The classification, though resting on logical grounds, is very largely in conformity with the course of historical development.

Better forms have come into being as social progress has become more pronounced; and further improvement may be expected in the future. The condition of things when money is coming into being is characterized by the weighing or measuring of the substances used for aiding the course of exchanges. It has therefore been called the system of "currency by weight." In strictness, it is better regarded as the stage before the introduction of real money; and thus outside the field of currency systems proper. The simplest system of currency seems to be that in which the state coins ingots of different metals and allows them to circulate without assigning any ratio for their respective values. Such an inconvenient form is not likely to be of long continuance; but it has sometimes arisen at a later time through the introduction of foreign coinages. Holland at the end of the 16th century, Turkey down to the present day may be given as countries approaching this state. The title of "currency by tale" is Jevons's apt denomination for such a currency system. The next form in logical order is that in which a single metal is definitely appointed as the sole standard money. In early ages this is the most natural arrangement, and it has, therefore, been widely adopted. Silver has been the metal generally used in this way; as the instances previously given (§ 8) prove. The title of "single legal tender" system is the obvious one for this form. With the growth of transactions a difficulty soon presents itself. If the chosen metal is not of high value it is cumbrous for making large payments; if on the other hand its value is high, it is unsuitable for use in small transactions. Hence there almost inevitably follows the use of other metals, which are better suited for certain particular uses. Thus silver is at once too heavy and too light. To pay £1000 in silver at its present value would take 800 ℔ troy, while a silver penny would be under the convenient limit of size. Partly for these reasons, but also to a large extent through the persistence of currency by tale, we find that along with the standard money other kinds are brought into or retained in use. Copper long survives beside silver; and gold is employed for the more important commercial transactions. Public convenience leads to the valuation of these subsidiary forms of money, and in this easy manner another currency system—that of "multiple legal tender"—comes into being. Though, theoretically, several substances might be valued for use as money, in practice some kind of bimetallism is used, and generally gold and silver are the constituents of the system. Thus for over three centuries England had a currency in which the values of gold and silver were fixed from time to time by royal proclamation. France and the United States, as well as many other countries, have had long experience of national bimetallism. The great problem in such a form of currency has always been that of keeping the two metals in effective circulation. As the values of the precious metals fluctuate, the principle of Gresham's Law is exemplified by the expulsion of the undervalued one. Each change in the conditions of production or in the ratios fixed by other countries tends to disturb the balance and is harassing to trade. Local or national bimetallism comes to be unsustainable, and is replaced by other currency types. The most remarkable is that known as the "composite legal tender" system. Its object is to combine any advantages of multiple legal tender with the maintenance of the single standard principle. One metal is selected as the standard and is legal tender to any amount; other metals are utilized for the purpose of token currency. Thus in the system of the United Kingdom gold is the only standard coinage; but silver and copper are employed for the lower coins and for smaller payments. The establishment of this ingenious arrangement is rather the outcome of the circumstances that governed the English monetary situation in the 18th century than any refined considerations of theory; but its justification on grounds of principle is furnished in Lord Liverpool's *Coins of the Realm* (1805). The extent to which the system has been copied by other nations and the stability of the English currency are strong confirmations of its merits as a solution of currency difficulties. Though the composite legal tender system has been a decided success, it does not follow that it supplies the only mode of dealing with the troubles that attend on the use of the local double standard. Other methods have been evolved from the monetary experiences of France and India, which take distinct forms according to the special features of the case. There is the currency system known as the "limping standard," the essence of which is the concurrent use of two metals, one being overvalued and coined only by state authority. The quantity of this favoured metal is necessarily limited in amount, to avoid depreciation or the ejection of the other metal from the circulation. It, however, has the position of money in the fullest sense, in that it is legal tender for any amount. The 5-franc pieces issued by the Latin union are the best known specimen of such coinage. In this case also the origin of the system was not theoretical, it was the result of the fall in the value of silver and the fear entertained by the French government that gold would be displaced by the cheaper metal. The temporary expedient of limiting the coinage of standard silver has developed into the maintenance during more than thirty-five years of the limping standard, which derives its name from the shortness of one limb of the currency body. Equally suggestive for monetary theory is another phase or system, usually described as the "gold-exchange standard" system, in which the ordinary currency is of a metal coined only by the state, and so limited as to keep it in a prescribed value ratio to another metal (gold) which does not circulate, but acts as the *standard* of value. This variation on the limping standard has been produced by the effort of the Indian government to meet the embarrassment caused by the continuous fall in the gold value of silver. Under the pressure of failing revenue and of persons suffering from the rupee depreciation in gold, the limitation on silver coinage was first enacted (1893); to be followed some years later (1899) by the establishment of gold as the standard, with a definite parity assigned for the state silver issues. The success of the Indian experiment—for such it avowedly was—has led to its imitation by the American administration in the Philippine Islands and by Mexico. It may be looked on as the natural product of the condition in which the single legal tender system is proving unfit, while the material for the composite legal tender system is wanting. The employment and theoretic explanation of these methods of currency adjustment mark the greatest advance made in monetary science and practice in recent years. Whether the limping, or the gold-exchange standards will be permanent forms is difficult to determine; but they are beyond doubt of much importance in meeting the risks of a period of transition. In any case they are entitled to recognition as distinct forms of currency organization, resting on a scientific basis.

The types presented by purely metallic currencies can be considered by themselves for the purpose of theoretical exposition. In actual working they are now affected by the existence of representative money. The state issues paper money which may be either convertible or inconvertible, or if it refrains from so doing, the banks take up the task and supply a medium of exchange in the form of notes, or by a later development through providing for the use of cheques by their customers. An inconvertible paper currency has some pronounced affinities with overvalued metal; a duly regulated issue of this kind is quite on the lines of the gold-exchange system, and the difficulties of the two forms are very similar. But, just as the cruder systems of metallic money have gradually given way to the higher ones, so it may be said that the grosser forms of mismanagement in representative money are being removed, notwithstanding the recurrence of such monetary crises as that of 1907 in the United States. The great instance of government paper money is the United States notes, known, as "greenbacks," which are fixed at the amount of $346,681,016. The most prominent case of bank issue of notes is that of the Bank of France, with somewhat over £200,000,000 in circulation. Examples of the cheque currency are more difficult to state in quantitative shape; as the constituent parts are continually being created and cancelled, but the clearing-house returns give some idea of its extent in England. The figure for 1909 was

£13,525,446,000. It seems highly probable that the next stage in improvement will be the extension of currency based on credit, after the Anglo-American pattern, to the other commercial countries of the world. But this movement can only be slow, it will not affect Eastern countries. For a long time they will remain in the metallic currency stage, with the moderate use of a guaranteed note circulation.

There are several plans which have been advocated as superior to any of the systems actually in use. Most of these schemes are undeserving of notice; a few, however, claim attention on the ground of theoretical or practical importance. The most conspicuous is that known as "international bimetallism," which was designed to obviate the evils said to result from the demonetization of silver and the overflow of the established ratio between the precious metals. Its central idea was the creation of a monetary league, composed, if not of all, at least of the leading states (the larger the number the better), the members being bound to coin any amount of gold and silver at an agreed ratio. By such an agreement an adequate field for the use of both metals would be provided, and fluctuations in the relative value of silver and gold would be completely prevented. The expulsion of the cheaper metal would be impossible, owing to the absence of any place to which it could be driven. Variations in the production of the precious metals would act on both metals, not on one. Another plan for meeting the same set of difficulties is the composition of the monetary standard by taking assigned amounts of both metals in combination as the unit—say 1 oz. of gold with 10 oz. of silver. The title "symmetallism" has been given to this ingenious mode of trying to obtain a more stable standard than that afforded by the employment of a single metal. Amongst the many devices that the use of paper money has suggested the most noticeable are those that aim at the replacement of metallic money by some other basis. The socialist conception of a "labour note" may be paralleled by the idea of "commodity notes," resting on a development of the clearing system. Viewed from the practical standpoint it may be said that the double standard in any form is condemned by the course of events; it has been defeated by the gold standard. In respect to the other proposed methods there is the almost insurmountable difficulty of making them in any way sufficiently popular to overcome the resistance that they must necessarily encounter. This criticism holds good, quite apart from the objections of principle to which they are all open, in very different degree it is true. The influence of custom in relation to money can never be set aside. For this reason it is certain that very gradual change is the only possible kind of monetary reform that can hope for success. It is essential to preserve as far as possible the old surroundings and avoid the intrusion of novel devices. The adoption of what Sir R. Giffen has styled "fancy monetary standards" is reserved for a distant future.

In the course of the development of monetary systems important theoretical problems have presented themselves. For the middle ages the great question was the best mode of securing an honest metallic currency. At the beginning of the modern national states the problem of keeping a parity between silver and gold was the most serious issue which each state attempted to solve independently. With the rise of credit there followed debate on the proper management of paper money in its various forms, which has not yet been completely closed. But the tendency in the last fifty years has been to concentrate attention on the meaning and due constitution of the monetary standard. In particular, the difficulties that result from an alteration in general prices, and the inconvenience to foreign trade from different currency standards have been exhaustively considered. It is therefore desirable to present in a concise form what appears to be the outcome of these discussions. The first established conclusion is the impossibility of obtaining an absolute and invariable standard. The best that can be hoped is a near approximation by balancing the elements of fluctuation. The construction of the most suitable monetary system is a work of practical adjustment. The influence of the actual conditions, which has been already emphasized, helps to indicate the limits of profitable inquiry. In respect to the metallic basis the choice is between the single standard—gold or silver, and some combination of these. The single standard of silver can be set aside, though it has had influential supporters. On the other hand the only combinations that need be considered are those indicated above by the titles "bimetallism" and "symmetallism."

The theory of the gold standard rests on the principle that one metal is a better criterion for measuring values than two, since the fluctuations that occur by the substitution of one metal for the other are certain to be disturbing. There is the further difficulty that no ratio can be permanently fixed between two metals, as their values must vary with the alterations in production. The inherent simplicity, and, so to speak, "naturalness," of the single standard is best realized by embodying it in gold, which is universally desired, of high cost and yet found in sufficient amount to discharge the money work of the standard. The verdict of history is appealed to as confirming the theoretic presumption, for gold has been gaining ground from century to century. The struggles to reverse this process have only made it more pronounced (see MONETARY CONFERENCES). Most of the objections to the gold standard rest on ideas which are the support of other economic fallacies. The attempts to supersede it involve the rejection of the rule of economic law. The foundation of the doctrine of "bimetallism" is the theory that the value of money is determined, not simply by cost of production, nor by unregulated supply and demand, but by the action of regulated demand, in conjunction with the actual conditions of production. States are the demanders of metal for monetary use, and by adjusting that demand they can powerfully influence the course of production, especially as the cost at which either

TABLE I.—*Estimated Production of Gold and Silver, 1493–1900.*

Period.	No. of Years.	Amount in Kilos.		Value in Millions of Francs.		Ratio of Value of Gold to Silver.
		Gold.	Silver.	Gold.	Silver.	
1493–1520	28	162,400	1,316,000	560	292	11·3
1521–1544	24	171,800	2,165,000	592	481	11·2
1545–1580	36	273,000	10,976,000	940	2,439	11·5
1581–1600	20	147,600	8,378,000	508	1,862	11·9
1601–1620	20	170,400	8,458,000	587	1,880	13·0
1621–1640	20	166,000	7,872,000	572	1,749	13·4
1641–1660	20	175,400	7,326,000	604	1,628	13·8
1661–1680	20	185,200	6,740,000	638	1,498	14·7
1681–1700	20	215,300	6,838,000	742	1,520	15·0
1701–1720	20	256,400	7,112,000	883	1,580	15·2
1721–1740	20	381,600	8,624,000	1,314	1,916	15·1
1741–1760	20	492,200	10,663,000	1,695	2,370	14·8
1761–1780	20	414,100	13,055,000	1,426	2,900	14·8
1781–1800	20	355,800	17,581,000	1,226	3,906	15·1
1801–1810	10	177,800	8,942,000	612	1,987	15·6
1811–1820	10	114,400	5,408,000	394	1,202	15·5
1821–1830	10	142,200	4,606,000	490	1,023	15·8
1831–1840	10	202,900	5,964,000	699	1,325	15·7
1841–1850	10	547,600	7,804,000	1,886	1,734	15·8
1851–1855	5	987,600	4,431,000	3,402	985	15·4
1856–1860	5	1,030,000	4,525,000	3,549	1,006	15·3
1861–1865	5	925,600	5,506,000	3,188	1,223	15·4
1866–1870	5	959,500	6,695,000	3,305	1,488	15·6
1871–1875	5	869,500	9,847,000	2,985	2,188	16·0
1876–1880	5	862,100	12,251,000	2,960	2,522	17·8
1881–1885	5	745,700	14,308,000	2,579	2,640	18·6
1886–1890	5	796,800	17,362,000	2,743	2,832	21·1
1891	1	196,600	4,266,000	677	669	20·9
1892	1	220,900	4,893,000	761	659	23·7
1893	1	236,700	5,165,000	815	640	26·5
1894	1	273,200	5,121,000	941	512	32·6
1895	1	301,500	5,234,000	1,045	544	31·6
1896	1	305,700	4,908,000	1,049	549	30·7
1897	1	356,900	5,013,000	1,215	499	34·0
1898	1	433,200	5,413,000	1,486	530	35·2
1899	1	463,500	5,225,000	1,590	520	33·9
1900	1	384,600	5,377,000	1,325	556	33·4
1493–1850	358	4,752,100	149,828,000	16,368	33,292	14·05
1851–1885	35	6,380,000	57,563,000	21,968	12,052	16·3
1886–1900	15	3,969,600	53,070,000	13,647	8,510	27·2
1493–1900	408	15,101,700	260,461,000	51,983	53,854	14·72

gold or silver is obtained varies with the productiveness of the poorest mine in working. Thus by directing consumption, states are controlling production, and therefore—within limits—fixing the relative value of the two metals. This power has been shown in the stability of the ratio during the continuance of the French double-standard (1803–1873). The possibility of maintaining a given ratio being thus established, the argument proceeds to show the advantages of the system. (i.) It secures the concurrent use of the precious metals and avoids throwing all the money work on gold. (ii.) Greater stability in value may be expected, since the fluctuations of either metal will be compensated by those of the other. At the worst the variation can only be as great. (iii.) The larger stock of money tends to keep up prices to the benefit of trade; for falling prices hamper production. (iv.) The fixed ratio provides a stable par of exchange between silver-using and gold-using countries; though universal bimetallism would remove this distinction. (v.) The establishment of a world-currency would be facilitated by allowing both metals a well-defined relation. This enumeration of the heads of the "bimetallic" case shows that its working depends on the area of its operation. It must be "international" and the states composing the union must be "great powers" in the monetary sense. Otherwise, their action would be comparatively ineffective. The crucial difficulty has been the determination of the common ratio. The risk of failure in carrying out the policy has proved a deterrent to such great powers as England and Germany, who are in possession of the gold standard. On the theoretic side the chief weakness of bimetallism has been its failure to supply any clear account of the limits within which states can regulate the ratio of gold to silver. If the ratio 15·5:1 can be set up why should not the ratio 100:1, or that of equality? Its practical failure has resulted partly from political conditions, partly from the removal of most of the difficulties which it was

TABLE II.—*The Coinage Systems of Continental Europe, exhibiting the gold and silver coins, their weight, fineness, remedy and approximate value in English and United States money.*

Coins.	Material.	Weight in Grammes.	Millesimal Fineness.	Rem. p. 1000		Approximate Money Value.	
				In Fineness.	In Weight.	English.	United States.
AUSTRIA HUNGARY [1]—						£ s. d.	$ c.
100 *Kreutzer* 20 Kronen piece	Gold	6·775067	900·0	2·0	2·5	0 16 8	4 05
=1 *Gulden.* 10 ,, ,,	,,	3·387534	900·0	2·0	2·5	0 8 4	2 02
8 Gulden ,,	,,	6·45161	900·0	2·0	2·5	0 15 10	3 86
4 ,, ,,	,,	3·22580	900·0	2·0	2·5	0 7 11	1 93
4 Ducat ,,	,,	13·9636	986·1	—	—	1 17 7	9 15
1 ,, ,,	,,	3·4909	986·1	—	—	0 9 5	2 29
1 Krone ,,	Silver	5·0	835·0	—	—	0 0 10	0 20
1 Dollar ,, (Maria Theresa)	,,	28·0668	833·3	—	—	—	—
2 Gulden ,,	,,	24·6914	900·0	2·0	2·5	0 3 11½	0 96
1 ,, ,,	,,	12·3457	900·0	2·0	2·5	0 1 11½	0 48
20 Kreutzer ,,	,,	2·666	500·0	2·0	2·5	0 0 5	0 10
10 ,, ,,	,,	1·666	400·0	2·0	2·5	0 0 2½	0 5
BELGIUM. See FRANCE.							
DENMARK [2]—							
100 *Öre*=1 20 Kroner piece	Gold	8·960572	900·0	1·5	1·5	1 2 1	5 36
Krone. 10 ,, ,,	,,	4·480286	900·0	1·5	2·0	0 11 0½	2 68
2 ,, ,,	Silver	15·000	800·0	3·0	3·0	0 2 2⅔	0 53
1 Krone ,,	,,	7·500	800·0	3·0	3·0	0 1 1⅓	0 27
50 Öre piece .	,,	5·000	600·0	3·0	3·0	0 0 6⅔	0 13
40 ,, . .	,,	4·000	600·0	3·0	3·0	0 0 5⅓	0 10
25 ,, . .	,,	2·420	600·0	3·0	3·0	0 0 3⅓	0 6½
10 ,, . .	,,	1·450	400·0	3·0	3·0	0 0 1⅓	0 2½
FRANCE [3]—							
100 *Centimes* 100 Franc piece	Gold	32·25806	900·0	2·0	1·0	3 19 3½	19 30
=1 *Franc.* 50 ,, ,,	,,	16·12903	900·0	2·0	1·0	1 19 7¾	9 65
20 ,, ,,	,,	6·45161	900·0	2·0	2·0	0 15 10	3 86
10 ,, ,,	,,	3·22580	900·0	2·0	2·0	0 7 11	1 03
5 ,, ,,	,,	1·61290	900·0	2·0	3·0	0 3 11½	0 96
5 ,, ,,	Silver	25·0	900·0	2·0	3·0	0 3 11½	0 96
2 ,, ,,	,,	10·0	835·0	3·0	5·0	0 1 7	0 38
1 ,, ,,	,,	5·0	835·0	3·0	5·0	0 0 9½	0 19
50 Centimes . .	,,	2·5	835·0	—	—	0 0 4¾	0 10
20 ,, . .	,,	1·0	835·0	—	—	0 0 2	0 4
GERMANY [4]—							
100 *Pfennige* 20 Mark piece .	Gold	7.964954	900·0	—	—	0 19 7	4 76
=1 *Mark.* 10 ,, .	,,	3.982477	900·0	—		0 9 9½	2 38
5 ,, .	,,	1.991239	900·0		—	0 4 10¾	1 19
5 ,, .	Silver	27·7777̇	900·0	—	—	0 4 10¾	1 19
2 ,, .	,,	1·1111̇	900·0	—		0 1 11½	0 48
1 ,, .	,,	5·5555̇	900·0	—	—	0 0 11¾	0 24
50 Pfennige .	,,	2·7777̇	900·0	—	—	0 0 6	0 12
20 ,, .	,,	1·1111̇	900·0	—	—	0 0 2½	0 5
GREECE.* See FRANCE.							
ITALY. See FRANCE.							
NETHERLANDS [5]—						£ s. d.	$ c.
100 *Cents* = 10 Guilder piece	Gold	6·720	900·0	1·5	2·0	0 16 6	4 2
1 *Guilder.* 5 ,, ,,	,,	3·360	900·0	1·5	2·0	0 8 3	2 1
2½ ,, ,,	Silver	25·000	945·0	2·5	2·5	0 4 2	1 0
1 ,, ,,	,,	10·000	945·0	2·5	2·5	0 1 8	0 40
½ ,, ,,	,,	5·000	945·0	2·5	2·5	0 0 10	0 20
25 Cents . . .	,,	3·575	640·0	2·5	2·5	0 0 5	0 10
10 ,, . . .	,,	1·400	640·0	2·5	2·5	0 0 2	0 4
5 ,, . . .	,,	0·685	640·0	2·5	2·5	0 0 1	0 2
NORWAY. See DENMARK.							
PORTUGAL * [6]—							
1000 *Reis*=1 Crown or $10·000	Gold	17·735	916·666̇	2·0	2·0	2 4 5	10 80
Milrei. Half-Crown or $5·000	,,	8·867	916·666̇	2·0	2·0	1 2 2½	5 40
One-fifth Crown or $2·000	,,	3·547	916·666̇	2·0	2·0	0 8 10	2 16
One-tenth Crown or $1·000	,,	1·773	916·666̇	2·0	2·0	0 4 5	1 8
500 Reis . . .	Silver	12·500	916·666̇	2·0	3·0	0 2 2½	0 54
200 ,, . . .	,,	5·000	916·666̇	2·0	3·0	0 0 10½	0 21
100 ,, . . .	,,	2·500	916·666̇	2·0	3·0	0 0 5¼	0 11
50 ,, . . .	,,	1·250	916·666̇	2·0	3·0	0 0 2⅝	0 5
RUMANIA. See FRANCE.							
RUSSIA [7]—							
100 *Copecks* 15 Rouble piece (Imperial)	Gold	12·902	900·0	*nil*	2·0	1 11 8	7 72
=*Rouble.* 10 ,, ,,	,,	8·601	900·0	,,	2·0	1 1 3	5 14
7½ ,, ,, (½-Imperial)	,,	6·451	900·0	,,	2·0	0 15 10	3 86
5 ,, ,,	,,	4·301	900·0	,,	2·0	0 10 8	2 57
1 ,, ,,	Silver	19·995	900·0	,,	2·0	0 2 1½	0 51
½ ,, ,,	,,	9·997	900·0	,,	2·0	0 1 0¾	0 25
¼ ,, ,,	,,	4·998	900·0	,,	2·0	0 1 6½	0 13
20 Copecks . .	,,	3·599	500·0	—	—	0 0 5	0 10
15 ,, . .	,,	2·699	500·0	—	—	0 0 3¾	0 7
10 ,, . .	,,	1·799	500·0	—	—	0 0 2½	0 5
SERVIA. See FRANCE.							
SPAIN. * [8] See FRANCE.							
SWEDEN. See DENMARK.							
SWITZERLAND. See FRANCE.							
TURKEY * [9]—							
100 *Piastres* Medjidie or Lira	Gold	7·216	916·666̇	2·0	2·0	0 18 0	4 40
=1 *Medjidie.* ½ ,, ,,	,,	3·608	916·666̇	2·0	2·0	0 9 0	2 20
¼ ,, ,,	,,	1·804	916·666̇	2·0	2·0	0 4 6	1 10
20 Piastres . .	Silver	24·055	830·0	3·0	3·0	0 3 7	0 88
10 ,, ,,	,,	12·027	830·0	3·0	3·0	0 1 9½	0 44
5 ,, ,,	,,	6·013	830·0	3·0	3·0	0 0 10½	0 22
2 ,, . .	,,	2·405	830·0	3·0	3·0	0 0 4	0 9
1 ,, . .	,,	1·202	830·0	3·0	3·0	0 0 2	0 4

* Inconvertible paper currency.

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[1] Present system introduced in 1894, in place of the system adopted in 1870. The Maria Theresa dollar is only used as a commercial money in Levantine trade.

[2] The system of the Scandinavian union came into force on the 1st of January 1875. It is based on gold monometallism.

[3] The coinage system of France came into force on the 6th of May 1799. It was extended to the countries forming the Latin union in 1865; it has been adopted by Greece, Rumania, Servia and Spain. It is the most widely extended system in Europe. The Austrian 8 and 4 gulden pieces were equivalent to the 20 and 10 franc pieces. In 1879 it was estimated that the system was used by populations amounting to 148,000,000. In its origin a double standard (with ratio of 15·5:1) it has become a limping standard by the limitation of the silver coinage. The unit is the same value all through the union, but receives different names in different countries. The titles are: in France, Belgium and Switzerland, *franc* and *centime*; in Italy, *lîra* and *centesimo*; in Greece, *drachme* and *lepta*; in Rumania, *lĕu* and *ban*; in Servia, *dinar* and *para*; in Spain, *peseta* and *centesimo*.

[4] The German coinage law came into force on the 1st of January 1875. It was modelled on the English system, but it is only in the last few years that the old silver has been completely withdrawn.

[5] The Dutch standard has been changed more than once. In 1847 a silver standard was introduced, and retained till 1872, the unit being the silver guilder. In 1875 the free coinage of gold was decreed; silver coinage having been restricted since 1872. Thus the limping standard is in force.

[6] The nominal standard of Portugal is gold. The English sovereign is legal tender at 4500 reis.

[7] The Russian currency until 1897 was nominally a silver standard one; but really was inconvertible. The currency was improved in 1885; and in 1897 the gold standard was adopted, provision being made for the withdrawal of the paper money. Finland, which had a currency on the French model, is now being compelled to accept the Russian currency.

[8] The Spanish coinage was assimilated to that of the Latin union in 1871. Spain, differing from the other countries of the group, coins a 25 peseta piece.

[9] The Medjidie coinage was introduced in 1844. English sovereigns circulate at 125 piastres; 20 franc pieces at 100 piastres.

intended to meet by the subsequent economic development. The proposal for a joint standard formed by using a unit in which the two metals are combined has the advantage of escaping the risk of failure to maintain the ratio, for it makes the employment of both silver and gold essential. Its influence in causing stability is also likely to be greater; but it is open to the danger that a shortage of one metal would not be compensated by the abundance of the other. The further advantage that it does not need international agreement (for each country could settle its own combination) is counterbalanced by the strangeness of the plan and by its necessitating the use of representative money. The suggestion of "goloid" coins on the model of the Greek electrum would hardly be acceptable.

11. *The Present Money Systems of the World: Changes of the last Half Century.*—The facts as to the money of the leading countries of the world are given in Tables II. and III. It is, however, necessary to explain the way in which this position has been reached by the reforms of the last fifty years. Since 1860 the alterations in standards and in coin denominations have been of a very extensive nature. England is one of the

TABLE III.—*Currencies of the more important non-European States.*

Coins.		Material.	Weight in Grammes.	Millesimal Fineness.	Rem. p. 1000.		Approximate Money Value.	
					In Fineness.	In Weight.	English.	United States.
A.—NORTH AMERICA.								
BRITISH DOMINIONS [1]—								
100 *Cents* = 1 *Dollar*.								
MEXICO [2]—							£ s. d.	$ c.
100 *Centavos*	10 Dollar piece.	Gold	8·333	900·0	1·5	3·0	1 0 5	4 98
= 1 *Dollar*	5 ,,	,,	4·166	900·0	1·5	5·0	0 10 3	2 49
(*Piastre*).								
	1 ,,	Silver	27·073	902·7	3·0	3·6	0 2 0½	0 49
	50 Cent piece	,,	12·5	800·0	4·0	6·0	0 1 0¼	0 25
	20 ,,	,,	5·0	800·0	4·0	8·0	0 0 5	0 10
	10 ,,	,,	2·5	800·0	4·0	8·0	0 0 2½	0 5
UNITED STATES [3]—								
100 *Cents* = 1 *Dollar*.	20 Dollar piece (Double Eagle)	Gold	33·436	900·0	2·0	1·0	4 2 6	—
	10 Dollar piece (Eagle)	,,	16·718	900·0	2·0	2·0	2 1 3	—
	5 Dollar piece.	,,	8·359	900·0	2·0	2·0	1 0 7½	—
	3 ,,	,,	5·015	900·0	2·0	2·0	0 12 4½	—
	2½ ,,	,,	4·179	900·0	2·0	3·0	0 10 4	—
	1 ,,	,,	1·671	900·0	2·0	3·0	0 4 1½	–
	1 ,,	Silver	26·729	900·0	3·0	5·0	0 4 1½	—
	50 Cent piece	,,	12·500	900·0	3·0	5·0	0 2 0½	—
	25 ,,	,,	6·250	900·0	3·0	5·0	0 1 0¼	—
	10 ,,	,,	2·500	900·0	3·0	—	0 0 5	—
	5 ,,	,,	1·250	900·0	3·0	—	0 0 2½	—
	3 ,,	,,	0·802	750·0	3·0	—	0 0 1½	—
B.—SOUTH AMERICA.								
ARGENTINE REPUBLIC * [4]—								
100 *Centesimos*	20 Peso piece	Gold	33·333	900·0	—	—	4 1 8	19 94
= 1 *Dollar*	10 ,,	,,	16·666	900·0	—	—	2 0 10	9 97
(*Peso*).	5 ,,	,,	8·533	900·0	—	—	1 0 5	4 98
	1 ,,	Silver	25·000	900·0	—	—	0 3 11½	0 96
BRAZIL.* [5]—								
1000 *Reis*	20 Milreis piece.	Gold	17·929	916·6	—		2 4 10½	10 91
= 1 *Milrei*.	10 ,,	,,	8·964	916·6	—	—	1 2 5	5 45
	2 ,,	Silver	25·500	916·6	—	—	0 4 5	1 9
	1 ,,	,,	12·250	916·6		–	0 2 2½	0 55
	½ ,,	,,	6·375	916·6		—	0 1 1	0 27
CHILE * [6]—							£ s. d.	$ c.
100 *Centavos* = 1 *Peso*.	20 Peso piece (Condor)	Gold	11·982	916·6	—	—	1 10 0	7 20
	10 ,,	,,	5·991	916·6	—	—	0 15 0	3 60
	5 ,,	,,	2·995	916·6	—	—	0 7 6	1 80
	1 ,,	Silver	20·0	835·0	—	—	0 1 6	0 36
	50 Cent piece	,,	10·0	835·0	—	—	0 0 9	0 18
	20 ,,	,,	5·0	835·0	—	—	0 0 3½	0 7
	10 ,,	,,	2·5	835·0	—	—	0 0 2	0 4
COLOMBIA* [7]—								
100 *Centavos*	20 Peso piece	Gold	32·258	900·0	—	—	3 19 3½	19 30
= 1 *Peso*.	10 ,, (Condor)	,,	16·129	900·0	—	—	1 19 8	9 65
	5 Peso piece	,,	8·065	900·0	—	—	0 19 10	4 82
	[illegible] ,,	,,	3·225	900·0	—	—	0 7 11¼	1 93
	1 ,,	Silver	25·0	900·0	—	—	0 3 11½	0 96
	20 Centavos	,,	5·0	835·0	—	—	0 0 9¾	0 19
	10 ,,	,,	2·5	835·0	—	—	0 0 5	0 10
	5 ,,	,,	1·25	835·0	—	—	0 0 2½	0 5
PERU [8]—								
10 *Soles*	1 Libra piece	Gold	7·988	916·6	2·0	2·0	1 0 0	4 86
= 1 *Libra*.	5 Soles (½ Libra)	,,	3·994	916·6	2·0	2·0	0 10 0	2 43
	1 Sol piece	Silver	25·0	900·0	2·0	3·0	0 2 0	0 48
	50 Centavos	,,	12·5	900·0	2·0	3·0	0 1 0	0 24
	20 ,,	,,	5·0	835·0	3·0	5·0	0 0 2½	0 5
ECUADOR. See PERU.								
C.—ASIA.								
INDIA (BRITISH) [9]—								
3 *Pie* = 1 *Pice*.	1 Rupee piece	Silver	11·665	916·6	—	—	0 1 4	0 32
4 *Pice* = 1 *Anna*.	½ ,,	,,	5·832	916·6	—	—	0 0 8	0 16
16 *Annas* = 1 *Rupee*.	¼ ,,	,,	2·916	916·6	—	—	0 0 4	0 8
(15 *Rupees* = 1 *Pound*).	⅛ ,,	,,	1·458	916·6	—	—	0 0 2	0 4
JAPAN [10]—								
100 *Sen* = 1 *Yen*.	20 Yen piece.	Gold	16·666	900·0	1·0	·2	2 1 0	9 97
	10 ,,	,,	8·333	900·0	1·0	·3	1 0 6	4 98
	5 ,,	,,	4·166	900·0	1·0	·4	0 10 3	2 49
	50 Sen ,,	Silver	13·478	800·0	3·0	·35	0 1 0¼	0 25
	20 ,,	,,	6·391	800·0	3·0	·5	0 0 5	0 10
	10 ,,	,,	2·695	800·0	3·0	·6	0 0 2½	0 5

* Inconvertible paper currency.

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[1] Until 1906 there was no mint in Canada. English and American coins circulate. The standard is gold (£1 = 4·866 dollars). There were formerly different methods of counting, viz. English sterling, Halifax currency and Canadian sterling; the respective ratios being 100: 120: 108.

[2] The Mexican currency has been entirely altered in its standard by the legislation of 1905. The gold-exchange system has been brought into force. The old-established dollar, which is called *piastre*, is reduced so as to represent a ratio of about 33·1.

[3] The dollar was introduced in 1787 as the unit. In 1792 the ratio of gold to silver was fixed at 1 to 15. This valuation underrated gold, consequently silver became the standard. In 1834 the ratio was altered to 1 to 16, and it was again changed in 1837. In these changes gold was overrated, and silver was driven out of circulation. This led, in 1853, to the reduction of the metal in the silver coins, which therefore became a token-currency. The suspension of cash payments took place in 1861. In 1873 silver was demonetized, and gold became the standard. In 1878 the "Bland Bill" was passed, making the silver dollar a legal tender, but confining its coinage to the executive, and fixing the amount at from two to four million dollars per month. The difficulties that resulted from this measure led to the Sherman Act of 1890, providing for the coinage of silver to the annual amount of 54,000,000 oz. Owing to the critical situation created by these efforts to aid silver, the repeal of the Sherman Act was carried in 1893. Since then the chief problem has been to maintain an effective gold reserve.

[4] The Argentine currency is, in practice, one of inconvertible paper. The gold coins were altered in 1881. The old South American *onza* weighed 27 grammes, was 875 fine and worth £3, 4s. 6d.

[5] The Brazilian currency is greatly depreciated. It is derived from the Portuguese.

[6] The Chilean coinage was reformed in 1895, when the gold standard was adopted, and the system brought into relation to the English one. Two Chilean *Condors* (20 peso pieces) being equal to £3.

[7] In 1904 Colombia adopted the gold standard by taking the equivalent of the U.S. dollar as the unit; but the inconvertible paper is the main currency; and the old coins pass as commercial money.

[8] After attempting a parity with the Latin union, and passing through a period of inconvertible paper, Peru has adopted the English gold standard and coinage, but keeps her own silver denominations.

[9] The silver standard was prescribed in India in 1835, with the use of the gold mohurs. The latter was demonetized in 1853. In consequence of the fall in the gold value of silver, the Indian mints were closed to the coinage of silver, otherwise than by the government, in 1893. The amount of currency was so limited as to bring the rupee to the value of 1s. 4d. On the realization of this position, English sovereigns were made legal tender at the ratio of 15 rupees = 1 sovereign. India has, by these measures joined the class, now becoming numerous, of gold-exchange standard countries.

[10] The old Japanese currency consisted of gold cobangs and silver itzibus, with a ratio of 4 to 1. This antique system was replaced in 1871 by a double-standard one on the French plan, the ratio being 16·17: 11. The system passed first into one of silver monometallism; and then became one of inconvertible paper. The great reform of 1897, aided by the Chinese War indemnity, placed the currency on the gold basis.

few countries that has not found change desirable. France has reorganized her token coins (1864), entered into the Latin union (1865) and adopted the limping standard in 1874. Germany has completely transformed the monetary system hitherto existing in the German States (1873). The Scandinavian union has been set up (1875). Holland has changed her system more than once. Still later, Austria-Hungary (1892) and Russia (1897) have come over from the silver standard with the practical use of inconvertible paper to new currencies on the gold basis. In America the United States, after a series of monetary experiences, has made the gold dollar its standard unit, though the silver complication still exists. Mexico has succeeded in establishing a gold-exchange standard at such a ratio as to induce the import of gold. British India has had its rupee currency put into relation to the English gold unit, and has been followed by the Straits Settlements. Japan first abandoned its ancient currency (1871). It then adopted a double standard system which became in practice a silver one and later passed into inconvertible paper. Finally, it has (1897) established a composite legal tender system on the gold basis. The Dutch Indies have the gold-exchange standard on the same plan as British India.

Remarks.—In addition to the tabular statements, the following points respecting the currencies of less advanced countries may be indicated. Though there is a tendency to establish the money of the mother-country in colonies, some of the British possessions, acquired by conquest, have kept their former currency. There has been a widespread movement in the backward countries of the world towards reforming their money; chiefly by setting up some line of connexion with the gold standard. In South and Central America the dollar has been retained as the unit; but the movement for co-ordination with the French system has ceased. The English standard has been preferred as a model by Chile and Peru. In Asia the currency of the Philippines has been reorganized under American control. China is considering monetary reform, and Siam has made progress in the direction of the gold-exchange standard. Probably the most defective currencies are now those of Turkey and her tributary states.

BIBLIOGRAPHY.—The literature on the subject of money has been well described as "almost measureless." The list of writers who have contributed to it begins with Aristotle, and includes such famous names as Copernicus, Locke and Newton. A full enumeration would fill a volume of no slight size. All that can be done here is to give a short classified list of the most serviceable books.

I. Economic text-books: English and American—J. S. Mill, *Principles of Political Economy* (London, 1848; new ed. by Ashley, 1909); Sidgwick, *Principles of Political Economy* (London, 1883; 3rd ed., 1901); J. S. Nicholson, *Principles of Political Economy* (3 vols., London, 1893–1901); F. A. Walker, *Political Economy* (New York, 1883; 2nd ed., 1887, often reprinted); A. T. Hadley, *Economics* (New York, 1896); E. R. A. Seligman, *Principles of Economics* (New York, 1905); H. R. Seager, *Introduction to Economics* (New York, 1904; 3rd ed., 1908). French: M. Chevalier, *Cours d'économie politique* (vol. iii. "La Monnaie," Paris, 1850); P. Leroy-Beaulieu, *Traité d'économie politique* (4 vols., Paris, 1896); C. Gide, *Cours d'économie politique* (Paris, 1909). German: H. Mangoldt, *Grundriss der Volkswirtschaftslehre* (2nd ed., Stuttgart, 1871); G. Schonberg, *Handbuch der politischen Oeconomie* (Tübingen, 1882; 4th ed., 1904); G. Schmoller, *Grundriss der allgemeinen Volkswirtschaftslehre* (Leipzig, 1900–1904). The Dutch work by N. G. Pierson has been translated into English with the title *Principles of Economics* (London, 1902).

II. Special treatises on "Money": W. S. Jevons, *Money and the Mechanism of Exchange* (London, 1875); F. A. Walker, *Money* (New York, 1878); J. S. Nicholson, *Money and Monetary Problems* (London, 1888; 6th ed., 1902); C. A. Conant, *The Principles of Money and Banking* (2 vols., New York, 1905); A. Arnaune, *La Monnaie, le crédit et le change* (Paris, 1894; 2nd ed., 1902); A. de Foville, *La Monnaie* (Paris, 1907); C. Knies, *Geld und Kredit* (Berlin, 1873–1879); G. F. Knapp, *Staatliche Theorie des Geldes* (Leipzig, 1905).

III. Works on special questions: See BIMETALLISM; BANKING; and MONETARY CONFERENCES for writings on the problems of the standard and depreciation. For the history of money—F. Lenormant, *La Monnaie dans l'antiquité* (Paris, 1876); W. A. Shaw, *History of Currency, 1252–1894* (London, 1895). For the history of the English currency, besides the works on the numismatic side—Lord Liverpool, *Coins of the Realm* (1805; reprinted 1880). For America—W. G. Sumner, *History of American Currency* (New York, 1874). On the production and consumption of money materials, W. Jacob, *Production and Consumption of the Precious Metals* (2 vols., London, 1831); and A. Del Mar, *History of the Precious Metals* (London, 1880). Technical details in Tate's *Cambist* (many editions).

(C. F. B.)

MONEY-LENDING, the lending of money on usury (*q.v.*). The business of the professional money-lender is one which, as tyranny and abuse are likely to appear, all countries have at different times endeavoured to regulate. In England the lessons of experience have shown that the abuses of this business are best regulated by a system of registration coupled with relief to debtors against harsh and unconscionable bargains. Other countries however still appear to cling to the belief that it is wisest to fix a maximum rate of legal interest. Thus in Germany the commercial code fixes the legal rate of interest on commercial transactions at 5%. Moreover in that country traders can demand interest on commercial debts from the day on which the debts fall due. In France, again, the Code fixes the rate of interest on ordinary loans at 5%, and on commercial transactions at 6%. In the United States of America the law relating to the lending of money on usury varies in the different states. All the states have what is called a "legal rate" of interest; and when no rate of interest is specified in the contract between the parties, there is a presumption that the borrower has agreed to pay the legal rate. This legal rate varies from 5% in Louisiana to 8% in Wyoming; in the Eastern states it is generally 6%. Some of the states have usury laws giving relief to borrowers in cases where circumstances have compelled them to agree to extortionate rates; but other states have no such laws, except that a contract in writing is invariably required in all cases where the "legal rate" is exceeded.

Practically every form of investment in which a man is capable of indulging involves the lending and borrowing of money, the interest exacted being the profit which the lender receives for the use of his capital. The existence of the professional lender, as apart from the ordinary facilities for borrowing money on good security, is obviously due to the fact that it is not every borrower who is in a position to give good security for a loan. Where the security is bad the market is narrowed; the individuals who are prepared to lend the money on merely personal security require a high rate of interest.

The first people to practise the profession of money-lending in England regularly were the Jews, and the business has remained largely in their hands, though they are in the habit of trading under assumed names. The Norman and Angevin kings were fully alive to the advantages which accrued to the people through borrowing at usury from the Jews, but they were also alive to the advantages which they themselves were able to reap by extorting from the Jews the wealth which the latter had acquired from the people. The Jews were regarded as the king's serfs, and squeezing them was but a popular form of taxing the people. Indeed in the reign of Henry II. the Scaccarium Judaeorum was established as a separate branch of the exchequer and used for the purpose of filling the royal coffers. The English people on the other hand were not so prone to foster the money-lending business. Sections 10 and 11 of Magna Carta provided that when a person died owing money to a Jew no interest should accrue during the minority of the heir, and further that the widow should be entitled to her dower, and any children who were minors should be provided with necessaries before the repayment of the loan. Then followed a large number of statutes known generally as the Usury Laws (see also USURY). The first of these was passed in 1235 (20 Hen. III. c. 5). The acts were directed to restrain the lending of money at usurious rates. The earlier ones in some cases prohibited the lending of money on usury at all, as in a statute of Jewry of the reign of Edward I.; but the later statutes were chiefly confined to limiting the rate of interest. Thus 21 Jac. I. c. 17 declared void all contracts where the interest was more than 8%. In 1818 a select committee of the House of Commons was appointed to consider the Usury Laws and in 1841 a similar committee of the House of Lords was appointed. As a result an act was passed in 1854 (17 & 18 Vict. c. 90) whereby all the existing laws against usury were repealed.

The question whether any interest is payable or not, and also the amount of such interest, depends on whether the parties to the transaction have expressly or impliedly agreed to the payment of interest by the borrower; for apart from such agreement no interest can lawfully be demanded on a loan.

Although in general there is no limit on the amount of interest which a borrower may agree to pay, equity has always been ready to grant relief from unconscionable bargains. This equitable relief is still available, though it is not so wide as the relief now given to borrowers under the Money-lenders Act 1900. This act provides that where proceedings are taken in any court by a money-lender for the recovery of money lent, and there is evidence which satisfies the court that the interest charged on the loan, or the amounts charged for expenses, inquiries, fines, bonus, premium, renewals, &c., are excessive, and that in either case the transaction is harsh and unconscionable, or is otherwise such that a court of equity would grant relief, the court may reopen the transaction and take an account between the money-lender and the person sued, and may, notwithstanding any statement or settlement of account or any agreement purporting to close previous dealings and create a new obligation, reopen any account already taken between them and relieve the person sued from payment of any sum in excess of the sum adjudged by the court to be fairly due in respect of such principal, interest and charges as the court, having regard to the risk and all the circumstances, may adjudge to be reasonable.

The Money-lenders Act of 1900 was passed in consequence of grave abuses which had arisen. It had been the practice of a certain class of lender to trade under a variety of names; so that under one name the same individual would lend money to a person who borrowed from him under another name; the second loan would be spent in liquidating the first, and the borrower finding it always easy to obtain more money would continue borrowing until he became hopelessly involved. The act struck at the root of this pernicious system by providing that every money-lender, as defined by the act, must register himself as such, under his own or usual trade name, and in no other name, and with the address, or all the addresses if more than one, at which he carries on his business of a money-lender. If a money-lender fails to register himself, or if he carries on a money-lending business otherwise than in his registered name, or in more names than one, or elsewhere than at his registered address, he is liable on summary conviction to a fine, not exceeding one hundred pounds. For the purposes of the act "money-lender" is defined as including every person whose business is that of money-lending, but it does not include pawnbrokers, in respect of business carried on by them under the Pawnbrokers Act, Registered Friendly, Loan or Building Societies, coporate bodies incorporated or empowered by special act of parliament to lend money, persons *bona fide* carrying on the business of banking or insurance, or *bona fide* carrying on any business not having for its primary object the lending of money, or bodies corporate for the time being exempted from registration by order of the Board of Trade.

The act is not confined to providing for the registration of money-lenders and for the reopening of harsh and unconscionable bargains. A check is placed on false representations and promises made with the intention of inducing a borrower to enter into a loan transaction. If any money-lender, or any manager, agent or clerk of a money-lender, or any person being a director, manager or other officer of a corporation carrying on the business of a money-lender, by any false, misleading or deceptive statement, representation or promise, or by any dishonest concealment of material facts, fraudulently induces, or attempts to induce, any person to borrow money or to agree to the terms on which money is to be borrowed, he is declared by the act to be guilty of a misdemeanour and is liable on indictment to imprisonment with or without hard labour for a term not exceeding two years, or to a fine not exceeding five hundred pounds, or to both.

The act further provides that if any one for the purpose of earning interest, commission, reward or other profit sends or causes to be sent to a person whom he knows to be an infant any circular or other document which invites the person receiving it to borrow money or to apply to any person or at any place with a view to obtaining information or advice as to borrowing money, he shall be liable, if convicted on indictment, to imprisonment with or without hard labour, or to a fine, or to both imprisonment and fine. If any such circular or document sent to an infant purports to issue from any address named therein or indicates any address as the place at which application is to be made with reference to the subject matter of the document, and at that place there is carried on any business connected with loans, every person who attends such place for the purpose of taking part in or assisting in the carrying on of such business will be deemed to have sent or caused to be sent such circular or document, unless he proves that he was not in any way a party to and was wholly ignorant of the sending of such document. Moreover, by section 5 of the Money-lenders Act 1900, where any proceedings are taken against the senders of these circulars to infants, if it is proved that the person to whom the document was sent is an infant, the person charged will be deemed to have been cognisant of the fact unless he proves that he had reasonable grounds for believing the infant to be of full age. Under the act of 1892 this shifting of the burden of proof only occurred if the circular had been sent to any person at any university, college, school or other place of education.

As for the recovery of money lent; if the loan is not tainted with illegality or immorality, or made for a purpose contrary to public policy, the amount may be recovered by a common law action. Where an intending borrower breaks his agreement to borrow, specific performance will not be granted, and the damages recoverable must be measured by the loss sustained through the breach and not by the sum agreed to be lent (*The South African Territories, Limited* v. *Wallington* (1897), 1 Q.B. 692).

Authorities.—On equitable relief to borrowers reference should be made to Bellot and Willis's *Bargains with Money-lenders*. On the law under the act of 1900 see Hastings's *Law relating to Money-lenders and Unconscionable Bargains*; and Edmondson's *Money-lenders Act 1900.* For the taxation of the Jews in the middle ages, see Bridges, *The Jews of Europe in the Middle Ages*, and Gneist's *History of the English Constitution*. For American law relating to Usury, see Stimson's *American Statute Law*, and the statutes of the various states. For France and Germany, see the codes of those countries. (C. G. Ala.)

MONFORTE, or Monforte de Lemos, a town of north-western Spain, in the province of Lugo, on the Cabe, a small right-hand tributary of the Sil, and at the junction of the railways from Tuy and Astorga to Corunna. Pop. (1900), 12,912. Monforte is built on a hill surmounted by a ruined medieval citadel; it contains an ancient Benedictine monastery converted into a hospital, a Jesuit college, and a fine Renaissance parish church, besides several convents and palaces of the Leonese nobility. Monforte has manufactures of soap and linen, and some trade in timber and livestock.

MONGE, GASPARD (1746–1818), French mathematician, the inventor of descriptive geometry, was born at Beaune on the 10th of May 1746. He was educated first at the college of the Oratorians at Beaune, and then in their college at Lyons—where, at sixteen, the year after he had been learning physics, he was made a teacher of it. Returning to Beaune for a vacation, he made, on a large scale, a plan of the town, inventing the methods of observation and constructing the necessary instruments; the plan was presented to the town, and preserved in their library. An officer of engineers seeing it wrote to recommend Monge to the commandant of the military school at Mézières, and he was received as a draftsman and pupil in the practical school attached to that institution; the school itself was of too aristocratic a character to allow of his admission to it. His manual skill was duly appreciated: "I was a thousand times tempted," he said long afterwards, "to tear up my drawings in disgust at the esteem in which they were held, as if I had been good for nothing better." An opportunity, however, presented itself: being required to work out from data supplied to him the "défilement" of a proposed fortress (an operation then only performed by a long arithmetical process), Monge, substituting for this a geometrical method, obtained the result so quickly that the commandant at first refused to receive it—the time necessary for the work had not been taken; but upon examination the value of the discovery was recognized, and the method was adopted. And Monge, continuing his researches, arrived at that general method of the application of geometry to the arts of construction which is now called descriptive geometry (see Geometry, Descriptive). But such was the system in France before the Revolution that the officers instructed in the method were strictly forbidden to communicate it even to those engaged in other branches of the public service; and it was not until many years afterwards that an account of it was published.

In 1768 Monge became professor of mathematics, and in 1771 professor of physics, at Mézières; in 1778 he married Mme Horbon, a young widow whom he had previously defended in a very spirited manner from an unfounded charge; in 1780 he was appointed to a chair of hydraulics at the Lyceum in Paris (held by him together with his appointments at Mézières), and was received as a member of the *Académie*; his intimate friendship with C. L. Berthollet began at this time. In 1783, quitting Mézières, he was, on the death of É. Bézout, appointed examiner of naval candidates. Although pressed by the minister to prepare for them a complete course of mathematics, he declined to do so, on the ground that it would deprive Mme Bézout of her only income, from the sale of the works of her late husband; he wrote, however (1786), his *Traité élémentaire de la statique.*

Monge contributed (1770–1790) to the *Memoirs* of the Academy of Turin, the *Mémoires des savantes étrangers* of the Academy of Paris, the *Mémoires* of the same Academy, and the *Annales de chimie*, various mathematical and physical papers. Among these may be noticed the memoir "Sur la théorie des déblais et des remblais" (*Mém. de l'acad. de Paris*, 1781), which, while giving a remarkably elegant investigation in regard to the problem of earth-work referred to in the title, establishes in connexion with it his capital discovery of the curves of curvature of a surface. Léonhard Euler, in his paper on curvature in the Berlin *Memoirs* for 1760, had considered, not the normals of the surface, but the normals of the plane sections through a particular normal, so that the question of the intersection of successive normals of the surface had never presented itself to him. Monge's memoir just referred to gives the ordinary differential equation of the curves of curvature, and establishes the general theory in a very satisfactory manner; but the application to the interesting particular case of the ellipsoid was first made by him in a later paper in 1795. A memoir in the volume for 1783 relates to the production of water by the combustion of hydrogen; but Monge's results had been anticipated by Henry Cavendish.

In 1792, on the creation by the Legislative Assembly of an executive council, Monge accepted the office of minister of the marine, but retained it only until April 1793. When the Committee of Public Safety made an appeal to the savants to assist in producing the *matériel* required for the defence of the republic, he applied himself wholly to these operations, and distinguished himself by his indefatigable activity therein; he wrote at this time his *Description de l'art de fabriquer les canons*, and his *Avis aux ouvriers en fer sur la fabrication de l'acier.* He took a very active part in the measures for the establishment of the normal school (which existed only during the first four months of the year 1795), and of the school for public works, afterwards the polytechnic school, and was at each of them professor for descriptive geometry; his methods in that science were first published in the form in which the shorthand writers took down his lessons given at the normal school in 1795, and again in 1798–1799. In 1796 Monge was sent into Italy with C. L. Berthollet and some artists to receive the pictures and statues levied from several Italian towns, and made there the acquaintance of General Bonaparte. Two years afterwards he was sent to Rome on a political mission, which terminated in the establishment, under A. Masséna, of the short-lived Roman republic; and he thence joined the expedition to Egypt, taking part with his friend Berthollet as well in various operations of the war as in the scientific labours of the Egyptian Institute of Sciences and Arts; they accompanied Bonaparte to Syria, and returned with him in 1798 to France. Monge was appointed president of the Egyptian commission, and he resumed his connexion with the polytechnic school. His later mathematical papers are published (1794–1816) in the *Journal* and the *Correspondance* of the polytechnic school. On the formation of the Senate he was appointed a member of that body, with an ample provision and the title of count of Pelusium; but on the fall of Napoleon he was deprived of all his honours, and even excluded from the list of members of the reconstituted Institute. He died at Paris on the 28th of July 1818.

For further information see B. Brisson, *Notice historique sur Gaspard Monge*; Dupin, *Essai historique sur les services et les travaux scientifiques de Gaspard Monge* (Paris, 1819), which contains (pp. 162–166) a list of Monge's memoirs and works; and the biography by F. Arago (*Œuvres*, t. ii., 1854).

Monge's various mathematical papers are to a considerable extent reproduced in the *Application de l'analyse à la géométrie* (4th ed., last revised by the author, Paris, 1819); the pure text of this is reproduced in the 5th éd. (revue, corrigée et annotée par M. Liouville) (Paris, 1850), which contains also Gauss's Memoir, "Disquisitiones generales circa superficies curvas," and some valuable notes by the editor. The other principal separate works are *Traité élémentaire de la statique, 8e édition, conformée à la precédente, par M. Hachette, et suivie d'une note &c., par M. Cauchy* (Paris, 1846); and the *Géométrie descriptive* (originating, as mentioned above, in the lessons given at the normal school). The 4th edition, published shortly after the author's death, seems to have been substantially the same as the 7th (*Géométrie déscriptive par G. Monge, suivie d'une théorie des ombres et de la perspective, extraite des papiers de l'auteur, par M. Brisson* (Paris, 1847). (A. Ca.)

MONGHYR, a town and district of British India, in the Bhagalpur division of Bengal. The town is on the right bank of the Ganges, and has a railway station, with steam ferry to the railway on the opposite bank of the river. Pop. (1901), 35,880. In 1195 Monghyr, a fortress of great natural strength, appears to have been taken by Mahommed Bakhiyar Khilji, the first Moslem conqueror of Bengal. Henceforth it is often mentioned by the Mahommedan chroniclers as a place of military importance, and was frequently chosen as the seat of the local government. After 1590, when Akbar established his supremacy over the Afghan chiefs of Bengal, Monghyr was long the headquarters of his general, Todar Mal; and it also figures prominently during the rebellion of Sultan Shuja against his brother, Aurangzeb. In more recent times Nawab Mir Kasim, in his war with the English, selected it as his residence and the centre of his military preparations. Monghyr is famous for its manufactures of iron: firearms, swords, and iron articles of every kind are produced in abundance but are noted for cheapness rather than quality. The art of inlaying sword-hilts and other articles with gold and silver affords employment to a few families.

The District of Monghyr has an area of 3922 sq. m. The Ganges divides it into two portions. The northern, intersected by the Burhi Gandak and Tiljuga, two important tributaries of the Ganges, is always liable to inundation during the rainy season, and is a rich, flat, wheat and rice country, supporting a large population. A considerable area, immediately bordering the banks of the great rivers, is devoted to permanent pasture. Immense herds of buffaloes are sent every hot season to graze on these marshy prairies; and the *ghi*, or clarified butter, made from their milk forms an important article of export to Calcutta. To the south of the Ganges the country is dry, much less fertile, and broken up by fragmentary ridges. Irrigation is necessary throughout the section lying on the south of the Ganges. The population in 1901 was 2,068,804, showing an increase of 1·6% in the decade. The principal exports sent to Calcutta, both by rail and by river, are oil-seeds, wheat, rice, indigo, grain and pulse, hides and tobacco; and the chief imports consist of European piece-goods, salt and sugar. The southern portion of the district is well provided with railways. At Lakhisarai junction the arc and chord lines of the East Indian railway divide, and here also starts the branch to Gaya. At Jamalpur, which is the junction for Monghyr, are the engineering workshops of the company. In the early years of British rule Monghyr formed a part of Bhagalpur, and was not created a separate district till 1832.

See *Monghyr District Gazetteer* (Calcutta, 1909).

MŌNG NAI (called by the Burmese and on most old maps *Monē*), one of the largest and most important of the states in the eastern subdivision of the southern Shan States of Burma. The state of Kēng Tawng (Burmese Kyaing Taung) is a dependency of Mōng Nai. It lies approximately between 20° 10′ and 21° N. and between 97° 30′ and 98° 45′ E., and occupies an area of 2717 sq. m.; pop. (1901), 44,252, of whom more than five-sixths are Shans. The Salween river bounds it on the east. The main state and the sub-state of Kēng Tawng consist of two plains with a ridge between them. There is much flat rice bottom, but a considerable portion consists of gently undulating plainland. In the central plain rice is the only crop. Outside this considerable quantities of sugar are produced. Tobacco of a quality highly esteemed by the Shans is grown in the Nawng Wawp circle at an altitude of 3100 ft. above sea-level; gram, *thanatpet* (a leaf used for cigar-wrappers), and garden crops are the chief produce otherwise. In the outlying tracts quantities of coarse native paper are manufactured from the bark of a species of mulberry, and much is exported to other parts of the Shan States.

MONGOLIA, a vast territory belonging to the Chinese empire, the administrative limits of which cannot be determined with precision. On the N. it is bounded by the frontier of Russia, beginning at Mount Kalas or Kanas (49° 5′ N., 87° 40′ E.) in the Altai, and running to the S.E. corner of Transbaikalia in the vicinity of Dalai-nor, thus having on the N. the Siberian provinces of Tomsk, Yeniseisk, Irkutsk and Transbaikalia. In the E. the boundary line which separates Mongolia from Manchuria runs past Dalai-nor and Lake Buir, crossing the Great Khingan in 47° 30′ N., towards Tsitsihar in Manchuria; then, crossing the Nonni river, it strikes the Sungari at Khulanchen, where it turns westwards up this river, reaching the Shara-muren river in 123° 30′ E. From China proper on the S. Mongolia is separated by a line running in a south-westward direction up the Shara-muren and across the Mongolian plateau to the bending of the Hwang-ho or Yellow river in about 40° N. and 110° 30′ E. Thence the boundary describes a sinuous line, following the Great Wall, and thus includes the Ordos (Ho-tau) and Alashañ (Si-tao), and reaches its most southern point in 36° 40′ N., 104° 20′ E. Thence it turns north-west, following the Great Wall for over 300 m.; it then crosses the plateau so as to separate Mongolia from the Chinese province of Sin-Kiang (*Hañ-su-sin-tsiang*, which includes the Nan-shan highlands and eastern Turkestan), and from Dzungaria, reaching the Chinese or Ektagh Altai in 46° 30′ N., 92° 50′ E. From that point the boundary coincides with the main water-parting of the Altai Mountains till it reaches Mount Kalas.

Geographically, Mongolia may thus be said to occupy both terraces of the great plateau of east Asia, which stretches in the south of Siberia, between the Sailughem range of the Great Altai and the Great Khingan—with the exception of the Dzungarian depression. From Manchuria and China it is separated by the border ridge of the plateau—the Great Khingan, while in the south-west it runs up to the foot of the high northern border ridges of the Tibetan plateau—an artificial frontier separating it from east Turkestan and Dzungaria. Broadly speaking, Mongolia may be divided naturally into three parts: (1) north-western Mongolia, which occupies the high terrace of the plateau; (2) the Gobi, in its wide sense, covering the lower terrace of the plateau, together with a slightly more elevated and better-watered zone along the western slope of the Great Khingan and its south-western continuation; and (3) south-eastern Mongolia, on the eastern slope of the Khingan. Of these parts, the second is considered in detail under the heading GOBI.

North-western Mongolia.

North-western Mongolia was formerly represented as a region intersected by lofty mountain chains. It appears, however, from Russian explorations during the last third of the 19th century, that it has all the characteristics of an elevated plateau, of a rhomboid shape (like Bohemia), bounded by four mountain ranges; namely, the Russian Altai on the N.W., the Sayans on the N.E., the Kentei range on the S.E., and the Ektagh Altai on the S.W. The border-ridge character of the Sayans (Ergik-targak-taiga) is well established, and the same orographic character is confirmed by recent explorers with regard to the Sailughem range of the Altai. The only point still remaining undecided is whether the valleys of the Bom-kemchik (a tributary of the Yenisei) and its left-hand tributaries do not belong geographically to the Altai region. At any rate, throughout the whole of north-west Mongolia, which covers an area of nearly 370,000 sq. m., the altitude nowhere falls below 2370 ft. (Ubsa-nor), and the area round this lake which has less than 3000 ft. of altitude covers only 6600 sq. m. The remainder of this extensive territory ranges at altitudes of 3000 to 4500 ft., even in the bottoms of the river valleys and in the lower plains; while the ridges which constitute the water-partings rise about 2000 ft. above the general level of the plateau. Along the south-western border of this division of Mongolia a gigantic border-ridge, the Ektagh (or Mongolian) Altai, runs in an E.S.E. direction from the Russian Altai to 99° E. and is probably continued even farther by the Artsa-bogdo, the Saikhat and other ranges as far as the northern loop of the Yellow river. The passes across the Ektagh Altai lie at altitudes of 10,000 ft. in the north-west and 9250 ft. in 93° 20′ E.; farther east they become much lower. But while its southern foot stands in the Dzungarian trench, *i.e.* at altitudes of 1550 ft. only near Lake Ulungur, and at 3000 ft. in 94° E., its north-eastern foot rests on the high plateau, *i.e.* at 4260 ft. at Kobdo, 5410 at Oshku, 4070 at Orok-nor on the route from Kiakhta to Su-chow, and so on. Thus the Ektagh Altai is a true border-range—that is, a lofty and steep escarpment facing the Dzungarian depression, with a gentle and relatively short slope towards the plateau.

In the same way the Kentei (or Gentei) Mountains, as they are called, to the north of Urga, and the Yablonoi Mountains of Transbaikalia, separate the higher terrace of north-west Mongolia (drained by the tributaries of the Selenga) from the lower terrace of the Gobi, which is drained by the upper tributaries of the Onon and the Kerulen, both belonging to the basin of the Amur. It is also very probable that the Tannu-ola Mountains north-east of Ubsa-nor, and the Khangai Mountains between Ulyasutai and the upper Orkhon, both running W.N.W. to E.S.E., border another slightly higher terrace of the same great plateau of north-west Mongolia, upon which Lake Kossogol lies, at an altitude of 5320 ft. On this vast upper terrace even the bottoms of the river valleys are at altitudes of 4200 to 5500 ft., with one single exception—the narrow gorge of the Khua (Khi)-khem, or upper Yenisei; while the highest pass across the Tannu-ola Mountains is 7090 ft., though the others are much lower. The conception of north-west Mongolia as a region filled with mountain ranges radiating from the Altai must thus be abandoned. It is a massive swelling of the earth's crust, representing the northern counterpart of the plateau of Tibet. This massive swelling is cut into, between the Ektagh Altai and the eastern T'ien-shan, by the relative depression of Tarbagatai and Dzungaria, 1500 to 3000 ft. in altitude; while to the south of the eastern T'ien-shan comes the Tarim depression, from 2200 to 3000 ft. high, and occupying an area of about 88,000 sq. m. Neither of these "depressions," however, penetrates beyond 94° E., and on the route from Kiakhta to Su-chow, in 100° E., there is only one single place (42° N.) in which the altitude drops as low as 3300 ft.; everywhere else it varies between 4000 and 5000 ft.

Lakes and Rivers.—North-western Mongolia is well watered, and has in its western part a group of lakes which possess no outlet to the ocean, being in reality the rapidly desiccating remains of what were formerly much larger basins. The chief of them is Ubsa-nor (2370 ft.), which receives the large river Tes. It lies in the middle of a large plain, and has to the west of it a smaller but much higher lake, Urga-nor, besides several smaller ones. Farther south on the same wide plain lie the sister lakes Kirghiz-nor and Airyk-nor, which receive another large river, the Dzap'hyn, and the Kungui. Many small lakes are scattered over the plain to the east of them. A third group of lakes occur in the neighbourhood of Kobdo. The Kobdo river, which rises in the Dain-gol (7060 ft.) in the Ektagh Altai, winds in great curves across the plateau, and enters Lake Kara-usu (3840 ft.), which also receives the Buyantu, an outflow from Lake Kobdo, and is connected by a small river with another large lake, Durga-nor, situated a score of miles to the east. There are also many smaller lakes fed by the glaciers of the Sailughem (Achit-nor, 4650 ft., and Uryu-nor), and others scattered through the Ektagh Altai. The largest lake of this region is, however, Kosogol (Khubsu-gul), which lies at an altitude of 5320 ft., close to the Russian frontier, at the foot of the snow-clad Munku-sardyk. Besides the rivers just mentioned, there are others belonging to the basin of the Yenisei (Khua-or Khi-khem, Bei-khem and Bom-kemchik); while yet others belong to the Selenga, a river formed by the junction of the Eder with the Telghir. The Selenga receives the Orkhon, at the head of which remarkable inscriptions were discovered in the end of the 19th century, and cleverly deciphered by Professor V. Thomsen of Copenhagen.[1] The rivers which flow down the outer slopes of the border-ridges become lost in the Gobi shortly after entering it.

A very large portion of north-west Mongolia constitutes a high plain, 3000 to 4200 ft. in altitude, which penetrates from the south-east in a north-western direction between the Ektagh Altai and the Khangai Mountains. It has a true Mongolian character, *i.e.* it is covered with gravel, and presents the appearance of a dry prairie devoid of forests. This same character is also exhibited by the bottoms of the broad valleys, while the more elevated and hilly portions of the territory, especially on their northern slopes, are covered with larch, cedar, pine and deciduous trees belonging to the Siberian flora; where the forests fail they are marshy or assume the character of Alpine meadows—*e.g.* in the Khangai, the Tannu-ola, and on the slopes of the border-ridges. The whole of this region is covered with excellent pasture. The forests decrease as one travels southwards. For instance, while both slopes of the Sayans are covered with forests, the Tannu-ola and the Khangai Mountains have woods on their northern faces only, and the Ektagh Altai is quite devoid of woods, even on its northern slope.

Climate.—Owing to its high altitude, north-western Mongolia is very cold, and the severity of the winter is intensified by the prevalence of cold but dry north-western winds. The north-east wind brings more moisture. In summer the warm winds come from the south and south-east, but having first to cross the Gobi, they are dried before they reach north-western Mongolia. The yearly amount of rain at Urga (altitude 4350 ft., at the northern foot of the Kentei Mountains) is only 9½ in., and the average temperatures are: year 27° F., January −18°, July 64°; a minimum of −35° F. has been observed. The climate of Ulyasutai (5400 ft.) may be taken as typical, its average temperatures being: year 31·6°, January −12°, July 66°.

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[1] See V. Thomsen, *Inscriptions de l'Orkhon* (Helsingfors, 1900)

The *geology* is still very imperfectly known. The plateau is built up of granites, gneisses and crystalline schists of Archean and probably Primary age. Coal is known to exist to the south-east of Kobdo, in the Tannu-ola, and in the basin of the Yenisei, but its age is unknown (fresh-water Jurassic ?). Graphite and some silver ores have also been found.

The *fauna* is a mixture of the Siberian and the Daurian—the latter penetrating up the valleys of the Selenga basin. The chief towns of north-west Mongolia are Urga, Ulyasutai, Kobdo and Ulankom.

South-eastern Mongolia.

South-eastern Mongolia is the part of Mongolia which lies on the eastern slope of the Great Khingan Mountains, entering like a wedge between the lower course of the Nonni river and the middle Sungari. Chiefly owing to the dryness of climate, its physical characteristics are similar to those of Mongolia proper, except that the altitude of the plains is much lower. This portion of Mongolia is also much better watered, namely, by the Khatsyr, the Lao-ho and the Shara-muren, all flowing from the Khingan Mountains eastwards, and the last making the frontier between Mongolia and the Chinese province of Chihli.

Population.—The population of the whole of Mongolia is estimated at about 5,000,000. It consists of Mongols—Eastern Mongols and Kalmucks in the west—various Turkish tribes, Chinese and Tunguses. The Mongols proper, with the exception of those who inhabit north-west Mongolia, may be divided into northern and southern (more properly north-western and south-eastern) Mongols. The former, belonging to the Khalkas, occupy the Gobi and the regions of the Kentei Mountains and Khingan Mountains, while the second, divided into numerous minor branches, roam over south-eastern and southern Mongolia. The principal occupation of the Mongols is cattle-breeding, and Russian writers estimate that on an average each *yurta*, or family, has about 50 sheep, 25 horses, 15 horned cattle and 10 camels. The transport of goods is their next most important occupation. It is calculated that 100,000 camels are used for the transport of tea only from Kalgan to Siberia, and that no less than 1,200,000 camels and 300,000 ox-carts are employed in the internal caravan trade. Agriculture is only carried on sporadically, chiefly in the south, where the Mongols have been taught by the Chinese. Various domestic industries are also carried on. The trade is chiefly concentrated at Urga, Ulyasutai and Kobdo in north-west Mongolia; Kalgan, Kuku-khoto, Kuku-erghi, Dolon-nur and Biru-khoto in southern and south-eastern Mongolia; and at Kerulen in the north-east.

Administration.—Before the Manchurian conquest the Mongols were governed by their own feudal princes, who regarded themselves as being descended from seven different ancestors, all, however of the same kin. Each group of principalities constituted a separate *aimak*, and each principality a separate *hoshun*. Under Manchu rule the *aimaks* became converted into the same number of military corps, each composed of so many *hoshuns* as military units. Each of these again was divided into *sumuns* or squadrons, each containing 150 families. In case a *hoshun* contained more than 6 *sumuns*, every 6 of the latter were organized into a regiment—*tsalan*. Four Manchu *tsian-tsuns*, or governor-generals, acted as chiefs of the troops, and the prince of each *aimak*, nominated from Peking, was considered as the lieutenant or assistant of his respective Manchu chief. The *hoshuns* were subject to their own princes, each of whom had a military adviser, generally a Manchu. Their internal or tribal affairs were in the hands of the princes, those which concerned a whole *aimak* being settled at gatherings of the princes under the eldest of them, named khan. This organization was maintained by the Manchu rulers, the khan being elected from among the princes, and the latter having each an adviser, *tusalakchi*, nominated from Peking.

Mongolia is now administered by a *Lifan Yuen* or superintendency with headquarters at Peking. Excluding the territory to which the name of Mongolia is geographically applied, but which is included in the provinces of Shansi and Chihli, Mongolia is divided into inner and outer divisions. Inner Mongolia, lying between the desert of Gobi, China proper and Manchuria, is divided into 24 *aimaks*. There are two military governors-general and two commissaries of the viceroy of Chihli, having control of civil matters. One of each pair of officials is stationed at Kalgan, and the other at Jehol. Outer Mongolia, the remainder of the territory, has 4 *aimaks*, three of which are under hereditary *khans*. There is a Chinese imperial agent at Urga.

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MONGOLS, the name of one of the chief ethnographical divisions of the Asiatic peoples (see also Turks). The early history of the Mongols, like that of all central-Asian tribes, is extremely obscure. Even the meaning of the name "Mongol" is a disputed point, though a general consent is now given to Schott's etymology of the word from *mong*, meaning brave. From the earliest and very scanty notice we have of the Mongols in the history of the T'ang dynasty of China (A.D. 619–690) and in works of later times, it appears that their original camping-grounds were along the courses of the Kerulen, Upper Nonni and Argun rivers. But in the absence of all historical particulars of their origin, legend, as is usual, has been busy with their early years. The Mongol historian Sanang Setzen gives currency to the myth that they sprang from a blue wolf; and the soberest story on record is that their ancestor Budantsar was miraculously conceived of a Mongol widow. By craft and violence Budantsar gained the chieftainship over a tribe living in the neighbourhood of his mother's tent, and thus left a heritage to his son. Varying fortunes attended the descendants of Budantsar, but on the whole their power gradually increased, until Yesukai, the father of Jenghiz Khan, who was eighth in descent from Budantsar, made his authority felt over a considerable area. How this dominion was extended under the rule of Jenghiz Khan is shown in the article Jenghiz Khan, and when that great conqueror was laid to rest in the valley of Kilien in 1227 he left to his sons an empire which stretched from the China Sea to the banks of the Dnieper.

Ogdai Khan.

Over the whole of this vast region Jenghiz Khan set his second surviving son Ogotai or Ogdai as khakan, or chief khan, while to the family of his deceased eldest son Juji he assigned the country from Kayalik and Khwarizm to the borders of Bulgar and Saksin "where'er the hoofs of Mongol horse had tramped"; to Jagatai, his eldest surviving son, the territory from the borders of the Uighur country to Bokhara; while Tulé, the youngest, received charge of the home country of the Mongols, the care of the imperial encampment and family, and of the archives of the state. The appointment of Ogdai as his successor being contrary to the usual Mongol custom of primogeniture, gave rise to some bitterness of feeling among the followers of Jagatai. But the commands of Jenghiz Khan subdued these murmurs, and Ogdai was finally led to the throne by his dispossessed brother amid the plaudits of the assembled Mongols. In accordance with Mongol customs, Ogdai signalized his accession to the throne by distributing among his grandees presents from his father's treasures, and to his father's spirit he sacrificed forty maidens and numerous horses. Once fairly on the throne, he set himself vigorously to follow up the conquests won by his father. At the head of a large army he marched southwards into China to complete the ruin of the Kin dynasty, which had already been so rudely shaken, while at the same time Tulē advanced into the province of Honan from the side of Shensi. Against this combined attack the Kin troops made a vigorous stand, but the skill and courage of the Mongols bore down every opposition, and over a hecatomb of slaughtered foes they captured Kai-fēng Fu, the capital of their enemies. From Kai-fēng Fu the emperor fled to Ju-ning Fu, whither the Mongols quickly followed. After sustaining a siege for some weeks, and enduring all the horrors of starvation, the garrison submitted to the Mongols, and at the same time the emperor committed suicide by hanging. Thus fell in 1234 the Kin or "Golden" dynasty, which had ruled over the northern portion of China for more than a century.

But though Ogdai's first care was to extend his empire in the rich and fertile provinces of China, he was not forgetful of the obligation under which Jenghiz Khan's conquests in western Asia had laid him to maintain his supremacy over the kingdom of Khwarizm. This was the more incumbent on him since Jelāl ed-dīn, who had been driven by Jenghiz into India, had returned, reinforced by the support of the sultan of Delhi, whose daughter he had married, and, having reconquered his hereditary domains, had advanced westward as far as Tiflis and Kelat. Once more to dispossess the young sultan, Ogdai sent a force of 300,000 men into Khwarizm. With such amazing rapidity did this army march in pursuit of its foe that the advanced Mongol guards reached Amid (Diarbekr), whither Jelāl ed-dīn had retreated, before that unfortunate sovereign had any idea of their approach. Accompanied by a few followers, Jelāl ed-dīn fled to the Kurdish Mountains, where he was basely murdered by a peasant. The primary object of the Mongol invasion was thus accomplished; but, with the instinct of their race, they made this conquest but a stepping-stone to another, and without a moment's delay pushed on still farther westward. Unchecked and almost unopposed, they overran the districts of Diarbekr, Mesopotamia, Erbīl and Kelat, and then advanced upon Azerbāijān. In the following year (1236) they invaded Georgia and Great Armenia, committing frightful atrocities. Tiflis was among the cities captured by assault, and Kars was surrendered at their approach in the vain hope that submission would gain clemency from the victors. Meanwhile, in 1235, Ogdai despatched three armies in as many directions. One was directed against Korea, one against the Sung dynasty, which ruled over the provinces of China south of the Yangtsze Kiang, and the third was sent westward into eastern Europe. This last force was commanded by Batu, the son of Juji, Ogdai's deceased eldest brother, who took with him the celebrated Sabutai Bahādur as his chief adviser. Bolgari, the capital city of the Bulgars, fell before the force under Sabutai, while Batu pushed on over the Volga. With irresistible vigour and astonishing speed the Mongols made their way through the forests of Penza and Tambov, and appeared before the "beautiful city" of Ryazan. For five days they discharged a ceaseless storm of shot from their balistas, and, having made a breach in the defences, carried the city by assault on the 21st of December 1237. "The prince, with his mother, wife, sons, the boyars and the inhabitants, without regard to age or sex, were slaughtered with the savage cruelty of Mongol revenge; some were impaled, some shot at with arrows for sport, others were flayed or had nails or splinters of wood driven under their nails. Priests were roasted alive, and nuns and maidens ravished in the churches before their relatives. 'No eye remained open to weep for the dead.'" Moscow, at this time a place of little importance, next fell into the hands of the invaders, who then advanced against Vladimir. After having held out for several days against the Mongol attacks, the city at length succumbed, and the horrors of Ryazan were repeated. If possible, a more dire fate overtook the inhabitants of Kozelsk, near Kaluga, where, in revenge for a partial defeat inflicted on a Mongol force, the followers of Batu held so terrible a "carnival of death" that the city was renamed by its captors Mobalig, "the city of woe." With the tide of victory thus strong in their favour the Mongols advanced against Kiev, "the mother of cities," and carried it by assault. The inevitable massacre followed, and the city was razed to the ground.

Victorious and always advancing, the Mongols, having desolated this portion of Russia, moved on in two divisions, one under Batu into Hungary, and the other under Baidar and Kaidu into Poland. Without a check, Batu marched to the neighbourhood of Pest, where the whole force of the kingdom was arrayed to resist him. The Hungarian army was posted on the wide heath of Mohi, which is bounded by "the vine-clad hills of Tokay," the mountains of Lomnitz, and the woods of Diosgyor. To an army thus hemmed in on all sides defeat meant ruin, and Batu instantly recognized the dangerous position in which his enemies had placed themselves. To add to his chances of success he determined to deliver his attack by night, and while the careless Hungarians were sleeping he launched his battalions into their midst. Panic-stricken and helpless, they fled in all directions, followed by their merciless foes. Two archbishops, three bishops, and many of the nobility were among the slain, and the roads for two days' journey from the field of battle were strewn with corpses. The king, Bēla IV., was saved by the fleetness of his horse, though closely pursued by a body of Mongols, who followed at his heels as far as the coast of the Adriatic, burning and destroying everything in their way. Meanwhile Batu captured Pest, and on Christmas Day 1241, having crossed the Danube on the ice, took Esztergom by assault. While Batu had been thus triumphing, the force under Baidar and Kaidu had carried fire and sword into Poland. While laying waste the country they received the announcement of the death of Ogdai, and at the same time a summons for Batu to return eastwards into Mongolia.

While his lieutenants had been thus carrying his arms in all directions, Ogdai had been giving himself up to ignoble ease and licentiousness. Like many Mongols, he was much given to drink, and it was to a disease produced by this cause that he finally succumbed on the 11th of December 1241. He was succeeded by his son Kuyuk, who reigned only seven years. Little of his character is known, but it is noticeable that his two ministers to whom he left the entire conduct of affairs were Christians, as also were his doctors, and that a Christian chapel stood before his tent. This leaning towards Christianity, however, brought no peaceful tendencies with it. On the death of Kuyuk dissensions which had been for a long time smouldering between the houses of Ogdai and Jagatai broke out into open war, and after the short and disputed reigns of Kaidu and Chapai, grandsons of Ogdai, the lordship passed away for ever from the house of Ogdai. It did not go, however, to the house of Jagatai, but to that of Tulē.

Mangu Khan.

On the 1st of July 1251 Mangu, the eldest son of Tulē, and nephew to Ogdai, was elected khakan. With perfect impartiality, Mangu allowed the light of his countenance to fall upon the Christians, Mahommedans and Buddhists among his subjects although Shamanism was recognized as the state religion. Two years after his accession his court was visited by Rubruquis (*q.v.*) and other Christian monks, who were hospitably received. The description given by Rubruquis of the khakan's palace at Karakorum shows how wide was the interval which separated him from the nomad, tent-living life of his forefathers. It was "surrounded by brick walls. . . . Its southern side had three doors. Its central hall was like a church, and consisted of a nave and two aisles, separated by columns. Here the court sat on great occasions. In front of the throne was placed a silver tree, having at its base four lions, from whose mouths there spouted into four silver basins wine, kumiss, hydromel and terasine. At the top of the tree a silver angel sounded a trumpet when the reservoirs that supplied the four fountains wanted replenishing." On his accession complaints reached Mangu that dissensions had broken out in the province of Persia, and he therefore sent a force under the command of his brother Hulagu to punish the Ismailites or Assassins (*q.v.*), who were held to be the cause of the disorder. Marching

Hulagu.

by Samarkand and Karshi, Hulagu crossed the Oxus and advanced by way of Balkh into the province of Kuhistan or Kohistan. The terror of the Mongol name induced Rukneddin Gurshah II. (Rokn al-din), the chief of the Assassins, to deprecate the wrath of Hulagu by offers of submission, and he was so far successful that he was able to purchase a temporary immunity from massacre by dismantling fifty of the principal fortresses in Kohistan. But when once the country had thus been left at the mercy of the invaders, their belief in the old saying "Stone dead hath no fellow" sharpened their battle-axes, and, sparing neither man, woman, nor child, they exterminated the unhappy people. Rukneddin having been killed, 1256 (see ASSASSINS), Hulagu marched across the snowy mountains in the direction of Bagdad to attack the last Abbasid caliph and his Seljuk protectors. On arriving before the town he demanded its surrender. This being refused, he laid siege to the walls in the usual destructive Mongol fashion, and at length, finding resistance hopeless, the caliph was induced to give himself up and to open the gates to his enemies. On the 15th of February 1258 the Mongols entered the walls and sacked the city (see CALIPHATE *ad fin*). While at Bagdad Hulagu gave his astronomer, Nāsir al-dīn permission to build an observatory. The town of Maragha was the site chosen, and, under the superintendence of Nāsir al-dīn and four western Asiatic astronomers who were associated with him, a handsome observatory was built, and furnished with "armillary spheres and astrolabes, and with a beautifully-executed terrestrial globe showing the five climates." The fall of Bagdad was almost contemporaneous with the end of the Seljuks of Konia as an independent power, though their actual destruction did not take place until 1308 (see SELJUKS). One terrible result of the Mongol invasion was a fearful famine, which desolated the provinces of Irak-Arabi, Mesopotamia, Syria and Rūm. But, though the inhabitants starved, the Mongols had strength and energy left to continue their onward march into Syria. Aleppo was stormed and sacked, Damascus surrendered (1260) and Hulagu was meditating the capture of Jerusalem with the object of restoring it to the Christians when he received the news of Mangu's death, and, as in duty bound, at once set out on his return to Mongolia, leaving Kitboga (Kitubuka) in command of the Mongol forces in Syria.

Hitherto a vassal of Mangu, as is shown by his striking coins bearing the name of Mangu as well as his own, Hulagu was now recognized as ruler of the conquered provinces. He assumed the title of ilkhan, and, although acknowledging the khakan as supreme lord, was practically independent. The title of ilkhan was that borne by his successors, who ruled over Persia for about a century (see *infra*, "The Ilkhans of Persia").

While Hulagu was prosecuting these conquests in western Asia, Mangu and his next brother Kublai were pursuing a like course in southern China. Southward they even advanced into Tong-king, and westward they carried their arms over the frontier into Tibet. But in one respect there was a vast difference between the two campaigns. Under the wise command of Kublai all indiscriminate massacres were forbidden, and probably for the first time in Mongol history the inhabitants and garrisons of captured cities were treated with humanity. While carrying on the war in the province of Szech'uen Mangu was seized with an attack of dysentery, which proved fatal after a few days' illness. His body was carried into Mongolia on the backs of two asses, and, in pursuance of the custom of slaughtering every one encountered on the way, 20,000 persons were, according to Marco Polo, put to the sword.

At the Kuriltai, or assembly of notables, which was held at Shang-tu after the death of Mangu, his brother Kublai (see KUBLAI KHAN) was elected khakan. For thirty-five years he sat on the Mongol throne, and at his death in 1294, in his seventy-ninth year, he was succeeded by his son Timur Khan, or, as he was otherwise called, Oldjeitu or Uldsheitu Khan (Chinese Yuen-chĕng). The reign of this sovereign was chiefly remarkable for the healing of the division which had for thirty years separated the families of Ogdai and Jagatai from that of the ruling khakan. Uldsheitu was succeeded by his nephew Khaissan, who was gathered to his fathers in February 1311, after a short reign, and at the early age of thirty-one. His nephew and successor, Buyantu (Chinese Yen-tsung), was a man of considerable culture, and substantially patronized Chinese literature. Among other benefits which he conferred on letters, he rescued the celebrated inscription-bearing "stone drums," which are commonly said to be of the Chow period (1122–255 B.C.), from the decay and ruin to which they were left by the last emperor of the Kin dynasty, and placed them in the gateway of the temple of Confucius at Peking, where they now stand. After a reign of nine years, Buyantu was succeeded by his son Gegen (Chinese Ying-tsung), who perished in 1323 by the knife of an assassin. Yissun Timur (Chinese Tai-ting-ti), who was the next sovereign, devoted himself mainly to the administration of his empire. He divided China, which until that time had been apportioned into twelve provinces, into eighteen provinces, and rearranged the system of state granaries, which had fallen into disorder. His court was visited by Friar Odoric, who gives a minute description of the palace and its inhabitants. Speaking of the palace this writer says:—

> "Its basement was raised about two paces from the ground, and within there were twenty-four columns of gold, and all the walls were hung with skins of red leather, said to be the finest in the world. In the midst of the palace was a great jar more than two paces in height, made of a certain precious stone called merdacas (jade); its price exceeded the value of four large towns. . . . Into this vessel drink was conducted by certain conduits from the court of the palace, and beside it were many golden goblets, from which those drank who listed. . . . When the khakan sat on his throne the queen was on his left hand, and a step lower two others of his women, while at the bottom of the steps stood the other ladies of his family. All those who were married wore upon their heads the foot of a man as it were a cubit and a half in length, and at the top of the foot there were certain cranes' feathers, the whole foot being set with great pearls, so that if there were in the whole world any fine and large pearls they were to be found in the decoration of those ladies."

The following years were years of great natural and political convulsions. Devastating floods swept over China, carrying death and ruin to thousands of homes; earthquakes made desolate whole districts; and in more than one part of the empire the banners of revolt were unfurled. Under various leaders the rebels captured a number of cities in the provinces of Kiang-nan and Honan, and took possession of Hang-chow, the capital of the Sung emperors. At the same time pirates ravaged the coasts and swept the imperial vessels off the sea.

In 1355 a Buddhist priest named Chu Yuen-chang became so impressed with the misery of his countrymen that he threw off his vestments and enrolled himself in the rebel army. His military genius soon raised him to the position of a leader, and with extraordinary success he overcame with his rude levies the trained legions of the Mongol emperor. While unable to defeat or check the rebels in the central provinces, Toghon Timur Khan was also called upon to face a rebellion in Korea. Nor were his arms more fortunate in the north than in the south. An army which was sent to suppress the revolt was cut to pieces almost to a man. These events made a dream which the emperor dreamt about this time of easy interpretation. He saw in his sleep "a wild boar with iron tusks rush into the city and wound the people, who were driven hither and thither without finding shelter. Meanwhile the sun and the moon rushed together and perished." "This dream," said the diviner, "is a prophecy that the khakan will lose his empire." The fulfilment followed closely on the prophecy. By a subterfuge the rebels, after having gained possession of most of the central provinces of the empire, captured Peking. But Toghon Timur by a hasty flight escaped from his enemies, and sought safety on the shores of the Dolon-nor in Mongolia. For a time the western provinces of China continued to hold out against the rebels, but with the flight of Toghon Timur the Mongol troops lost heart, and in 1368 the ex-Buddhist priest ascended the throne as the first sovereign of the Ming or "Bright" dynasty, under the title of Hung-wu.

Thus ended the sovereignty of the house of Jenghiz Khan in China, nor need we look far to find the cause of its fall. Brave

The Mongols expelled from China.

and hardy the Mongols have always shown themselves to be; but the capacity for consolidating the fruits of victory, for establishing a settled form of government, and for gaining the allegiance of the conquered peoples, have invariably been wanting in them.

Not content with having recovered China, the emperor Hungwu sent an army of 400,000 men into Mongolia in pursuit of the forces which yet remained to the khakan. Even on their own ground the disheartened Mongols failed in their resistance to the Chinese, and at all points suffered disaster. Meanwhile Toghon Timur, who did not long survive his defeat, was succeeded in the khakanate by Biliktu Khan, who again in 1379 was followed by Ussakhal Khan. During the reign of this last prince the Chinese again invaded Mongolia, and inflicted a crushing defeat on the khan's forces in the neighbourhood of Lake Buyur. Besides the slain, 2994 officers and 77,000 soldiers are said to have been taken prisoners, and an immense booty to have been secured. This defeat was the final ruin of the eastern branch of the Mongols, who from this time surrendered the supremacy to the western division of the tribe. At first the Keraits or Torgod, as in the early days before Jenghiz Khan rose to power, exercised lordship over the eastern Mongols, but from these before long the supremacy passed to the Oirad, who for fifty years treated them as vassals. Notwithstanding their subjection, however, the Keraits still preserved the imperial line, and khakan after khakan assumed the nominal sovereignty of the tribe, while the real power rested with the descendants of Toghon, the Oirad chief, who had originally attached them to his sceptre. Gradually, however, the Mongol tribes broke away from all governing centres, and established scattered communities with as many chiefs over the whole of eastern Mongolia. The discredit of having finally disintegrated the tribe is generally attached to Lingdan Khan (1604–1634), of whom, in reference to his arrogant and brutal character, has been quoted the Mongolian proverb: "A raging khakan disturbs the state, and a raging saghan (elephant) overthrows his keepers."

The Chakhars.

At this time the Mongols, though scattered and in isolated bodies, had recovered somewhat from the shock of the disaster which they had suffered at the hand of the first Ming sovereign of China. When first driven northwards, they betook themselves to the banks of the Kerulen, from whence they had originally started on their victorious career; but gradually, as the Chinese power became weaker among the frontier tribes, they again pushed southwards, and at this time had established colonies in the Ordus country, within the northern bend of the Yellow River. The Mongol royal family and their immediate surroundings occupied the Chakhar country to the north-west of the Ordus territory, where they became eventually subjugated by the Manchus on the overthrow of the Ming dynasty in 1644 by the present rulers of China. At times the old vigour and strength which had nerved the arm of Jenghiz Khan seemed to return to the tribe, and we read of successful expeditions being made by the Ordu Mongols into Tibet, and even of invasions into China. The relations with Tibet thus inaugurated brought about a rapid spread of Buddhism among the Mongolians, and in the beginning of the 17th century the honour of having a Dalai Lama born among them was vouchsafed to them. In 1625 Toba, one of the sons of Bushuktu Jinung Khan, went on a pilgrimage to the Dalai Lama, and brought back with him a copy of the Tanjur to be translated into Mongolian, as the Kanjur had already been. But though the prowess of the Ordu Mongols was still unsubdued, their mode of living was as barren and rugged as the steppes and rocky hills which make up their territory. Their flocks and herds, on which they are entirely dependent for food and clothing, are not numerous, and, like their masters, are neither well fed nor well favoured. But though living in this miserable condition their princes yet keep up a certain amount of barbaric state, and the people have at least the reputation of being honest.

Several of the tribes who had originally migrated with those who finally settled in the Ordu territory, finding the country to be so inhospitable, moved farther eastward into richer pastures. Among these were the Tumeds, one of whose chiefs, Altan Khan (Chinese Yen-ta), is famous in later Mongol history for the power he acquired. For many years during the 16th century he carried on a not altogether unsuccessful war with China, and finally, when peace was made (1571), the Chinese were fain to create him a prince of the empire and to confer a golden seal of authority upon him. In Tibet his arms were as successful as in China; but, as has often happened in history, the physical conquerors became the mental subjects of the conquered. Lamaism has always had a great attraction in the eyes of the Mongols, and, through the instrumentality of some Lamaist prisoners whom Altan brought back in his train, the religion spread at this time rapidly among the Tumeds. Altan himself embraced the faith, and received at his court the Bogda Sodnam Gyamtso Khutuktu, on whom he lavished every token of honour. One immediate effect of the introduction of Buddhism among the Tumeds was to put an end to the sacrifices which were commonly made at the grave of their chieftains. In 1584 Altan died, and was succeeded by his son Senge Dugureng Timur. The rich territory occupied by the Tumeds, together with the increased intercourse with China which sprang up after the wars of Altan, began to effect a change in the manner of life of the people. By degrees the pastoral habits of the inhabitants became more agricultural, and at the present day, as in Manchuria, Chinese immigrants have so stamped their mark on the fields and markets, on the towns and villages, that the country has become to all intents and purposes part of China proper.

The Kalkas.

Passing now from the inner division of the Mongols who live in the southern and eastern portions of the desert we come to the outer division, which occupies the territory to the north of the desert. Of these the chief are the Kalkas, who are divided into the Western and Eastern Kalkas. These people form the link of communication between Europe and eastern Asia. Early in the 17th century the Russians sent an embassy to the court of the Golden Khan with the object of persuading the Mongol khan to acknowledge allegiance to the tsar. This he did without much hesitation or inquiry, and he further despatched envoys to Moscow on the return of the Russian embassy. But the allegiance thus lightly acknowledged was lightly thrown off, and in a quarrel which broke out between the Khirghiz and the Russians the Kalkas took the side of the former. The breach, however, was soon healed over, and we find the Golden Khan sending an envoy again to Moscow, asking on behalf of his master for presents of jewels, arms, a telescope, a clock, and "a monk who had been to Jerusalem that he might teach the Kalkas how the Christians prayed." Their submission to Russia on the north did not save them, however, from the Chinese attacks on the south. At that time the present Manchu dynasty ruled in China, and to the then reigning sovereign the Kalkas gave in their submission. For some time the Chinese yoke sat lightly on their consciences, but difficulties having arisen with the Kalmucks, they were ready enough to claim the protection of China. To cement the alliance the emperor K'ang-hi invited all the Kalka chiefs to meet him at the plain of Dolon-nor. This ceremony brought the separate history of the Kalkas to a close, since from that time they have been engulfed in the Chinese Empire.

During the Kin dynasty of China the Keraits, as has been pointed out, were for a time supreme in Mongolia, and it was during that period that one of the earliest recognized sovereigns, Merghus Buyuruk Khan, sat on the throne. In an engagement with a neighbouring Tatar tribe their khan was captured and sent as a propitiatory present to the Kin emperor, who put him to death by nailing him on a wooden ass. On the treacherous Tatar chief the widow determined to avenge herself, and chose the occasion of a feast as a fitting opportunity. With well-disguised friendship she sent him a present of ten oxen, a hundred sheep and a hundred sacks of koumiss. These, last, however, instead of being filled with skins of the liquor which Mongolians love so well, contained armed men, who, when the Tatar was feasted, rushed from their concealment and killed him.

The Torgod.

A grandson of Merghus was the celebrated Wang Khan, who was sometimes the ally and sometimes the enemy of Jenghiz Khan, and has also been identified as the Prester John of early western writers. In war he was almost invariably unfortunate, and it was with no great difficulty, therefore, that his brother Ki Wang detached the greater part of the Kerait tribes from his banner, and founded the Torgod chieftainship, named probably from the country where they settled themselves. The unrest peculiar to the dwellers in the Mongolian desert disturbed the Torgod as much as their neighbours. Their history for several centuries consists of nothing but a succession of wars with the tribes on either side of them, and it was not until 1672, when Ayuka Khan opened relations with the Russians, that the country obtained an even temporarily settled existence. Its position, indeed, at this time made it necessary that Ayuka should ally himself either with the Russians or with his southern neighbours the Turks, though at the same time it was obvious that his alliance with the one would bring him into collision with the other. His northern neighbours, the Cossacks of the Yaik and the Bashkirs, both subject to Russia, had the not uncommon propensity for invading his borders and harassing his subjects. This gave rise to complaints of the tsar's government and a disposition to open friendly relations with the Krim khan. A rupture with Russia followed, and Ayuka carried his arms as far as Kazan, burning and laying waste the villages and towns on his route and carrying off prisoners and spoils. Satisfied with this vengeance, he advanced no farther, but made a peace with the Russians, which was confirmed in 1722 at an audience which Peter the Great gave him at Astrakhan. On Ayuka's death shortly after this event, he was succeeded by his son Cheren Donduk, who received from the Dalai Lama a patent to the throne. But this spiritual support availed him little against the plots of his nephew Donduk Ombo, who so completely gained the suffrages of the people that Cheren Donduk fled before him to St Petersburg, where he died, leaving his nephew in possession. With consummate impartiality the Russians, when they found that Donduk Ombo had not only seized the throne but was governing the country with vigour and wisdom, formally invested him with the khanate. At his death he was succeeded by Donduk Taishi, who, we are told, went to Moscow to attend the coronation of the empress Elizabeth, and to swear fealty to the Russians. After a short reign he died, and his throne was occupied by his son Ubasha. The position of the Torgod at this time, hemmed in as they were between the Russians and Turks, was rapidly becoming unbearable, and the question of migrating "bag and baggage" was very generally mooted. In the war between his two powerful neighbours in 1769 and 1770, Ubasha gave valuable assistance to the Russians. His troops took part in the siege of Ochakov, and gained a decided victory on the river Kalaus. Flushed with these successes, he was in no mood to listen patiently to the taunts of the governor of Astrakhan, who likened him to a "bear fastened to a chain," and he made up his mind to break away once and for all from a tutelage which was as galling as it was oppressive. He determined, therefore, to migrate eastward with his people, and on the 5th of January 1771 he began his march with 70,000 families. In vain the Russians attempted to recall the fugitives, who, in spite of infinite hardships, after a journey of eight months reached the province of Ili, where they were welcomed by the Chinese authorities. Food for a year's consumption was supplied to each family; and land, money and cattle were freely distributed. It is believed that 300,000 persons survived to receive the hospitality of the Chinese. By this desperate venture the Torgod escaped, it is true, the oppression of the Russians, but they fell into the hands of other masters, who, if not so exacting, were equally determined to be supreme. The Chinese, flattered by the compliment implied by the transference of allegiance, settled them on lands in the province of Ili, in the neighbourhood of the Altai mountains, and to the west of the desert of Gobi. But the price they were made to pay for this liberality was absorption in the Chinese empire.

The Kalmuck.

Galdan Khan.

Among the Mongol chiefs who rose to fame during the rule of the Ming dynasty of China was Toghon, the Kalmuck khan, who, taking advantage of the state of confusion which reigned among the tribes of Mongolia, established for himself an empire in north-western Asia. Death carried him off in 1444, and his throne devolved upon his son Ye-seen, who was no degenerate offspring. Being without individual foes in Mongolia he turned his arms against China, which through all history has been the happy hunting-ground of the northern tribes, and had the unexampled good fortune to take prisoner the Chinese emperor Chēng-t'ung. But victory did not always decide in his favour, and after having suffered reverses at the hands of the Chinese, he deemed it wise to open negotiations for the restoration of his imperial prisoner. Thus, after a captivity of seven years Chēng-t'ung re-entered his capital in 1457, not altogether to the general satisfaction of his subjects. On the death of Yi-sien, shortly after this event, the Kalmucks lost much of their power in eastern Asia, but retained enough in other portions of their territory to annoy the Russians by raids within the Russian frontier, and by constant acts of pillage. In the 17th century their authority was partly restored by Galdan, a Lama, who succeeded by the usual combination of wile and violence to the throne of his brother Senghē. Having been partly educated at Lhasa, he was well versed in Asiatic politics, and, taking advantage of a quarrel between the Black and White Mountaineers of Kashgar he overran Little Bokhara, and left a viceroy to rule over the province with his capital at Yarkand. At the same time he opened relations with China, and exchanged presents with the emperor. Having thus secured his powerful southern neighbour, as he thought, he turned his arms against the Kalkas, whose chief ground of offence was their attachment to the cause of his brothers. But his restless ambition created alarm at Peking, and the emperor K'ang-hi determined to protect the Kalkas against their enemy. The emperor, in person commanding one of the two forces, marched into Mongolia. After enduring incredible hardships during the march through the desert of Gobi the imperial army encountered the Kalmucks at Chao-modo. The engagement was fiercely contested, but ended in the complete victory of the Chinese, who pursued the Kalmucks for ten miles, and completely dispersed their forces. Galdan, with his son, daughter and a few followers, fled westward and escaped; and thus collapsed a power which had threatened at one time to overshadow the whole of Central Asia. For a time Galdan still maintained resistance to his powerful enemy, but death overtook him while yet in the field against the Chinese.

But though Galdan was dead the Chinese did not enjoy that complete immunity from war at the hand of his successor that they had looked for. Tsi-wang Arabtan was, however, but the shadow of his brother and predecessor, and a dispute which arose with the Russians during his reign weakened his power in other directions. Little Bokhara was said to be rich in gold mines, and therefore became a coveted region in the eyes of the Russians. Under the vigorous administration of Peter the Great an expedition was despatched to force a passage into the desired province. To oppose this invasion the Kalmucks assembled in force, and after a protracted and undecided engagement the Russians were glad to agree to retire down the Irtish and to give up all further advance.

To Tsi-wang Arabtan succeeded Amursama owing to the support he received from the Chinese emperor K'ien-lung, who nominated him khan of the Kalmucks and chief of Dzungaria. But, though to the ear these titles were as high-sounding as those of his predecessors, in reality the power they represented was curtailed by the presence of Chinese commissioners, in whose hands rested the real authority. The galling weight of this state of dependence drove Amursama before long into revolt. He dispersed the Chinese garrisons stationed in Ili (Kulja), killed the generals, and advanced his own forces as far as Palikun on the river Ili. To punish this revolt, K'ien-lung sent a large force into the rebellious province. As on the previous occasion, the

Chinese were everywhere victorious, and Amursama fled into Siberia, where he died of small-pox after a short illness.

While China was thus absorbing the Mongols within her reach, Russia was gathering within her borders those with whom she came into contact. Among these were the Buriats, who occupied a large territory on both sides of Lake Baikal. As usual in such cases, disputes arose out of disturbances on the frontier, and were ended by the Buriats and the neighbouring Mongol tribes becoming one and all tributary to Russia.

The House of Jagatai.

The dominions given by Jenghiz Khan to his son Jagatai were involved in the quarrels between Kaidu and Kublai for the khakanate, but at the beginning of the 14th century Dua, a great-great-grandson of Jagatai, made himself undisputed lord of the whole region. Shortly after Dua's death the Mongols of Eastern Turkestan, descendants of those who had favoured the pretensions of Kaidu to be khakan, separated from their western brethren and chose a son of Dua as their khan. Henceforth the Jagataids were divided into two dynasties, the western reigning at Samarkand, the eastern first at Kashgar and later at Yarkand and Aksu. Kazan (1343–1346) was the last independent khan of the western Jagataids; thereafter power fell into the hands of amirs, who, however, continued to place a titular khan on the throne. In 1360 Toghluk-Timur, a grandson of Dua and khan of the eastern Jagataids (the kingdom called by the Persian historians Mogolistan), invaded the territories of the western Jagataids. About this time Timur (*q.v.*), otherwise Timur-i-leng (Tamerlane), a young amir at the court of the western Jagataids, allied himself with the leaders who had dethroned Kazan, and after the death of Toghluk-Timur became by right of conquest khan of both sections of the Jagataids. After Timur's death the two sections again divided, while a third kingdom, Ferghana, was held by the Timurids (descendants of Timur). At the beginning of the 16th century all three dynasties were swept away by Mahommed Shaībani, head of the Uzbeg Mongols (see *infra*, *Uzbegs*).

The Ilkhans of Persia.

The empire of the Ilkhans established by Hulagu lasted nominally until 1353, but after the death of the Ilkhan Abu Said in 1335 the real power was divided between five petty dynasties which had been formed out of the provinces conquered by Hulagu. Meantime Islam had made great progress among the Mongols, the third Ilkhan, Nikudar Ahmed (reigned 1281–1284) having embraced that faith. The western frontiers of their empire bordering on the Syrian possessions of Egypt there was frequent intercourse, sometimes friendly, sometimes warlike, between the Ilkhans and the sultans of Egypt (*q.v.*). Of the petty dynasties which supplanted that of Hulagu, one known as the Jelairids held Bagdad until about 1400. Another dynasty which reigned in Azerbaijan was overthrown in 1355 by the western Kipchaks (see *infra*, *Golden Horde*). Between 1369 and 1400 Timur had made himself master of the greater part of Persia and established there a second Mongol dynasty, which in turn gave place to that of the Ak Kuyunli (see PERSIA).

The Golden Horde.

Of the Mongol tribes who became entirely subject to Russia the principal are those of the Crimea, of Kazan, and Astrakhan; of these the Tatars of Kazan are the truest representatives of the Golden Horde or western Kipchaks, who originally formed the subjects of Batu and Orda. Batu, whose victorious campaign in Russia has already been sketched, was finally awarded as his fief the vast steppes which stretch from the Carpathian Mountains to Lake Balkash. He fixed his headquarters on the Volga, and there set up his Golden Tent from which the horde acquired the name of the Golden Horde. In 1255 Batu died and was succeeded by his brother Bereke Khan. During the reign of this sovereign the exactions which were demanded from the Russian Christians by the Mongols aroused the Christian world against the barbarian conquerors, and at the command of Pope Alexander IV. a general crusade was preached against them. But though the rage of the Christians was great, they lacked that united energy which might have availed them against their enemies; and, while they were yet breathing out denunciations, a Tatar host, led by Nogai and Tulabagha, appeared in Poland. After a rapid and triumphant march the invaders took and destroyed Cracow, and from thence advanced as far as Bythom (Beuthen) in Oppeln, from which point they eventually retired, carrying with them a crowd of Christian slaves. From this time the Mongols became for a season an important factor in European politics. They corresponded and treated with the European sovereigns, and intermarried with royal families. Hulagu married a daughter of Michael Palaeologus; Toktu Khan took as his wife Maria, the daughter of Andronicus II.; and to Nogai Michael betrothed his daughter Irene. Toktu, the second khan in succession to Bereke, is the first Mongol ruler whom we hear of as having struck coins. Those issued during his reign bear the mint marks of Sarai, New Sarai, Bulgar, Ukek, Khwarizm, Krim, Jullad and Madjarui, and vary in date from 1291 to 1312.

The adoption of Islam by the rulers of the Golden Horde had as one result the drawing closer of the relations of the Mongols with Constantinople and Egypt. Embassies passed between the three courts, and so important was the alliance with the Mongols deemed by the sultan Nāṣir, ruler of Egypt, that he sent to demand in marriage a princess of the house of Jenghiz Khan. At first his request was refused by the proud Mongols, but the present of a million gold dinars, besides a number of horses and suits of armour, changed the refusal into an acquiescence, and in October 1319 the princess landed at Alexandria in regal state. Her reception at Cairo was accompanied with feasting and rejoicing, and the members of her escort were sent back laden with presents. With that religious toleration common to his race, Uzbeg Khan, having married one princess to Nāṣir, gave another in marriage to George the prince of Moscow, whose cause he espoused in a quarrel existing between that prince and his uncle, the grand-prince Michael. Assuming the attitude of a judge in the dispute, Uzbeg Khan summoned Michael to appear before him, and, having given his decision against him, ordered his execution. The sentence was carried out with aggravated cruelty in sight of his nephew and accuser. From this time Uzbeg's sympathies turned towards Christianity. He protected the Russian churches within his frontiers, and put his seal to his new religious views by marrying a daughter of the Greek emperor, Andronicus III. He died in 1340, after a reign of twenty-eight years. His coins were struck at Sarai, Khwarizm, Mokshi, Bulgar, Azak and Krim, and are dated from 1313 to 1340. His son and successor, Tinibeg Khan, after a reign of only a few months, was murdered by his brother Janibeg Khan, who usurped his throne, and, according to the historian Ibn Haidar, proved himself to be "just, God-fearing, and the patron of the meritorious." These excellent qualities did not, however, prevent his making a raid into Poland, which was conducted in the usual Mongol manner, nor did they save his countrymen from being decimated by the black plague. The throne Janibeg had seized by violence was, in 1357, snatched from him by violence. As he lay ill on his return from a successful expedition against Persia he was murdered by his son Berdibeg, who in his turn was, after a short reign, murdered by his son Kulpa. With the death of Berdibeg the fortunes of the Golden Horde began rapidly to decline. As the Uzbeg proverb says, "The hump of the camel was cut off in the person of Berdibeg."

The White Horde, or Eastern Kipchak.

But while the power of the Golden Horde was dwindling away, the White Horde or Eastern Kipchak, which was the inheritance of the elder branch of the family of Juji, remained prosperous and full of vitality. The descendants of Orda, Batu's elder brother, being far removed from the dangerous influences of European courts, maintained much of the simplicity and vigour of their nomad ancestors, and the throne descended from father to son with undiminished authority until the reign of Urus Khan (1360), when complications arose which changed the fortunes of the tribe. Like many other opponents of the Mongol rulers, Khan Tuli Khoja paid with his life for his temerity in opposing the political schemes of his connexion Urus Khan. Toktamish, the son of the murdered man, fled at the news of his father's death and sought refuge at the court of Timur, who received him with honour and at once agreed to espouse his cause. With this intention he despatched a force against Urus Khan, and gained some advantage over him, but, while fitting out another army to make a fresh attack, news reached him of the death of Urus. Only at Sighnak are coins known to have been struck during the reign of Urus, and these bear date from 1372 to 1375.

The Reign of Toktamish.

Moscow Sacked.

Wars with Timur.

He was followed on the throne by his two sons, Tuktakia and Timur Malik, each in turn; the first reigned but for a few weeks, and the second was killed in a battle against Toktamish, the son of his father's enemy. Toktamish now (1378) seized the throne, not only of Eastern Kipchak but also of the Golden Horde, over which his arms had at the same time proved victorious. He reigned as Nāṣir ed-din Jetal ed Mahmud Ghujas Toktamish. His demands for tribute from the Russian princes met with evasions from men who had grown accustomed to the diminished power of the later rulers of the Golden Horde, and Toktamish therefore at once marched an army into Russia. Having captured Serpukhov, he advanced on Moscow. On the 23rd of August 1382 his troops appeared before the doomed city. For some days the inhabitants bravely withstood the constant attacks on the walls, but failed in their resistance to the stratagems which were so common a phase in Mongolian warfare. With astonishing credulity they opened the gates to the Mongols, who declared themselves the enemies of the grand-prince alone, and not of the people. The usual result followed. The Russian general, who was invited to Toktamish's tent, was there slain and at the same time the signal was given for a general slaughter. Without discriminating age or sex, the Mongol troops butchered the wretched inhabitants without mercy, and, having made the streets desolate and the houses tenantless, they first plundered the city and then gave it over to the flames. The same pitiless fate overtook Vladimir, Zvenigorod, Yuriev, Mozhaisk and Dimitrov. With better fortune, the inhabitants of Pereslavl and Kolomna escaped with their lives from the troops of Toktamish, but at the expense of their cities, which were burned to the ground. Satisfied with his conquests, the khan returned homewards, traversing and plundering the principality of Ryazan on his way. Flushed with success, Toktamish demanded from his patron Timur the restoration of Khwarizm, which had fallen into the hands of the latter at a period when disorder reigned in the Golden Horde. Such a request was not likely to be well received by Timur, and, in answer to his positive refusal to yield the city, Toktamish marched an army of 90,000 men against Tabriz. After a siege of eight days the city was taken by assault and ruthlessly ravaged. In the meantime Timur was collecting forces to punish his rebellious protégé. When his plans were fully matured, he advanced upon Old Urgenj and captured it. More merciful than Toktamish, he transported the inhabitants to Samarkand, but in order to mark his anger against the rebellious city he levelled it with the ground and sowed barley on the site where it had stood. On the banks of the Oxus he encountered his enemy, and after a bloody battle completely routed the Kipchaks, who fled in confusion. A lull followed this victory, but in 1390 Timur again took the field. To each man was given "a bow, with thirty arrows, a quiver, and a buckler. The army was mounted, and a spare horse was supplied to every two men, while a tent was furnished for every ten, and with this were two spades, a pickaxe, a sickle, a saw, an axe, an awl, a hundred needles, 8½ ℔ of cord, an ox's hide, and a strong pan." Thus equipped the army set forth on its march. After a considerable delay owing to an illness which overtook Timur his troops arrived at Kara Saman. Here envoys arrived from Toktamish bearing presents and a message asking pardon for his past conduct; but Timur was inexorable, and, though he treated the messengers with consideration, he paid no attention to their prayer. In face of innumerable difficulties, as well as of cold, hunger, and weariness, Timur marched forward month after month through the Kipchak country in pursuit of Toktamish. At last, on the 18th of June, he overtook him at Kandurcha, in the country of the Bulgars, and at once forced him to an engagement. For three days the battle lasted, and, after inclining now to this side and now to that, victory finally decided in favour of Timur. The Kipchaks were completely routed and fled in all directions, while it is said as many as 100,000 corpses testified to the severity of the fighting.

Toktamish, though defeated, was not subdued, and in 1395 Timur found it necessary again to undertake a campaign against him. This time the armies met upon the Terek, and after a fiercely-contested battle the Kipchaks again fled in confusion. Timur, threatened by the advancing autumn, gave up further pursuit, and retired with a vast booty of gold ingots, silver bars, pieces of Antioch linen and of the embroidered cloth of Russia, &c. On his homeward march southwards he arrived before Azak, which was then the entrepôt where the merchants of the east and west exchanged their wares. In vain the natives, with the Egyptian, Venetian, Genoese, Catalan and Basque inhabitants, besought him to spare the city. His answer was a command to the Moslems to separate themselves from the rest of the people, whom he put to the sword, and then gave the city over to the flames. Circassia and Georgia next felt his iron heel, and the fastnesses of the central Caucasus were one and all destroyed. After these successes Timur gave himself up for a time to feasting and rejoicing, accompanied by every manifestation of Oriental luxury. "His tent of audience was hung with silk, its poles were golden, or probably covered with golden plates, the nails being silver; his throne was of gold, enriched with precious stones; the floor was sprinkled with rose water." But his vengeance was not satisfied, and, having refreshed his troops by this halt, he marched northwards against Astrakhan, which he utterly destroyed. The inhabitants were driven out into the country to perish with the cold, while the commander of the city was killed by being forced beneath the ice of the Volga. Sarai next shared the same fate, and, Timur, having thus crushed for the second time the empire of Toktamish, set out on his return home by way of Derbent and Azērbāijān.

The power in the hands of the successors of Toktamish never revived after the last campaign of Timur. They were constantly engaged in wars with the Russians and the Krim Tatars, with whom the Russians had allied themselves, and by degrees their empire decayed, until, on the seizure and death of Ahmed Khan at the beginning of the 16th century, the domination of the Golden Horde came to an end.

The Krim Tatars.

The fate which thus overtook the Golden Horde was destined to be shared by all the western branches of the great Mongol family. The khans of Kazan and Kasimov had already in 1552 succumbed to the growing power of Russia, and the Krim Tatars were next to fall under the same yoke. In the 15th century, when the Krim Tatars first appear as an independent power, they attempted to strengthen their position by allying themselves with the Russians, to whom they looked for help against the attacks of the Golden Horde. But while they were in this state of dependence another power arose in eastern Asia which modified the political events of that region. In 1453 Constantinople was taken by the Osmanli Turks, who, having quarrelled with the Genoese merchants who monopolized the trade on the Black Sea, sent an expedition into the Crimea to punish the presumptuous traders. The power which had captured Constantinople was not likely to be held in check by any forces at the disposal of the Genoese, and without any serious opposition Kaffa, Sudak, Balaklava and Inkerman fell before the troops of the sultan Mahommed. It was plain that, situated as the Crimea was between the two great powers of Russia and Turkey, it must of necessity fall under the direction of one of them. Which it should be was decided by the invasion of the Turks, who restored Mengli Girai, the deposed khan, to the throne, and virtually converted the khanate into a dependency of Constantinople. But though under the tutelage of Turkey, Mengli Girai, whose leading policy seems to have been the desire to strengthen himself against the khans of the Golden Horde, formed a close alliance with the grand-prince Ivan of Russia. One result of this friendship was that the Mongols were enabled, and encouraged, to indulge their predatory habits at the expense of the enemies of Russia, and in this way both Lithuania and Poland suffered terribly from their incursions. It was destined, however, that in their turn the Russians should not escape from the marauding tendencies of their allies, for, on pretext of a quarrel with reference to the succession to the Kazan throne, Mahommed Girai Khan in 1521 marched an army northwards until, after having devastated the country, massacred the people, and desecrated the churches on his route, he arrived at the heights of Vorobiev overlooking Moscow. The terror of the unfortunate inhabitants at the sight once again of the dreaded Mongols was extreme; but the horrors which had accompanied similar past visitations were happily averted by a treaty, by which the grand-prince Basil undertook to pay a perpetual tribute to the Krim khans. This, however, proved but a truce. It was impossible that an aggressive state like Russia should live in friendship with a marauding power like that of the Krim Tatars. The primary cause of contention was the khanate of Kazan, which was recovered by the Mongols, and lost again to Russia with that of Astrakhan in 1555. The sultan, however, declined to accept this condition of things as final, and instigated Devlet Girai, the Krim khan, to attempt their recovery. With this object the latter marched an army northwards, where, finding the road to Moscow unprotected, he pushed on in the direction of that ill-starred city. On arriving before its walls he found a large Russian force occupying the suburbs. With these, however, he was saved from an encounter, for just as his foremost men approached the town a fire broke out, which, in consequence of the high wind blowing at the time, spread with frightful rapidity, and in the space of six hours destroyed all the churches, palaces and houses, with the exception of the Kremlin, within a compass of 30 miles. Thousands of the inhabitants perished in the flames. "The river and ditches about Moscow," says Horsey, "were stopped and filled with the multitudes of people, laden with gold, silver, jewels, chains, ear-rings and treasures. So many thousands were there burned and drowned that the river could not be cleaned for twelve months afterwards." Satisfied with the destruction he had indirectly caused, and unwilling to attack the Kremlin, the khan withdrew to the Crimea, ravaging the country as he went. Another invasion of Russia, a few years later (1572), was not so fortunate for the Mongols, who suffered a severe defeat near Molodi, 50 versts from Moscow. A campaign against Persia made a diversion in the wars which were constantly waged between the Krim khan and the Russians, Cossacks and Poles. So hardly were these last pressed by their pertinacious enemies in 1649 that they bound themselves by treaty to pay an annual subsidy to the khan. But the fortunes of war were not always on the side of the Tatars, and with the advent of Peter the Great to the Russian throne the power of the Krim Mongols began to decline. In 1696 the tsar, supported by a large Cossack force under Mazeppa, took the field against Selim Girai Khan, and gained such successes that the latter was compelled to cede Azov to him. By a turn of the wheel of fortune the khan had the satisfaction in 1711 of having it restored to him by treaty; but this was the last real success that attended the Tatar arms. In 1735 the Russians in their turn invaded the Crimea, captured the celebrated lines of Perekop, and ravaged Bakhchi-sarai, the capital. The inevitable fate which was hanging over the Krim Tatars was now being rapidly accomplished. In 1783 the Krim, together with the eastern portion of the land of the Nogais, became absorbed into the Russian province of Taurida.

The Uzbegs.

It will now only be necessary to refer briefly to the Uzbegs, who, on the destruction of the Golden Horde, assumed an important position on the east of the Caspian Sea. The founder of their greatness was the khan Abulkhair, who reigned in the 15th century, and who, like another Jenghiz Khan, consolidated a power out of a number of small clans, and added lustre to it by his successful wars. Shaibani Khan, his grandson, proved himself a worthy successor, and by him Baber (*q.v.*), the Timurid khan of Ferghana, who afterwards founded the Mogul Empire in India, was driven from his ancestral dominions. In 1500 he inflicted a severe defeat on Baber's forces, and captured Samarkand, Herat and Kandahar. By these and other conquests he became possessed of all the country between the Oxus and the Jaxartes, of Ferghana, Khwarizm and Hissar, as well as of the territory of Tashkent from Kashgar to the frontiers of China. In the following year, by a dashing exploit, Baber recovered Samarkand, but only to lose it again a few months later. During several succeeding years Shaibani's arms proved victorious in many fields of battle, and but for an indiscreet outrage on the territories of the shah of Persia he might have left behind him a powerful empire. The anger, however, of Shah Ismail roused against him a force before which he was destined to fall. The two armies met in the neighbourhood of Merv, where, after a desperate encounter, the Uzbegs were completely defeated. Shaibani, with a few followers, sought refuge in a cattle-pound. But finding no exit on the farther side, the refugees tried to leap their horses over the wall. In this attempt Shaibani was killed (1510). When his body was recognized by his exultant enemies they cut off the head and presented it to the shah, who caused the skull to be mounted in gold and to be converted into a drinking-cup. After this defeat the Uzbegs withdrew across the Oxus and abandoned Khorāsān. Farther east the news aroused Baber to renewed activity, and before long he reoccupied Samarkand and the province "Beyond the River," which had been dominated by the Uzbegs for nine years. But though the Uzbegs were defeated they were by no means crushed, and ere long we find their khans reigning, now at Samarkand, and now at Bokhara. As time advanced and European powers began to encroach more and more into Asia, the history of the khanates ceases to be confined to the internecine struggles of rival khans. Even Bokhara was not beyond the reach of Russian ambition and English diplomacy. Several European envoys found their way thither during the first half of the 19th century, and the murder of Stoddart and Conolly in 1842 forms a melancholy episode in British relations with that fanatical capital. With the absorption of the khanate of Bokhara and the capture of Khiva by the Russians the individual history of the Mongol tribes in Central Asia comes to an end, and their name has left its imprint only on the dreary stretch of Chinese-owned country from Manchuria to the Altai Mountains, and to the equally unattractive country in the neighbourhood of the Koko-nōr.

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(R. K. D.)

Language.—The Mongol tongue is one of the members of the great stock which recent scholars designate as Ural-Altaic, which also includes the Finno-Ugric, Turkish, Manchu and Samoyede. The members of this group are not so closely related to one another as those of the Indo-European stock; but they are all bound together by the common principle of agglutinative formation, especially the so-called harmony of vowels, by their grammatical structure, and also by certain common elements in the stock of roots which run through them all, or through particular more closely-connected families within the group.[1] The fatherland proper of the Mongols is Mongolia (*q.v.*). The sum total of the Mongol population under Chinese government is calculated at between two and three millions.

Generally the whole Mongol tribe may be divided into three branches: East Mongols, West Mongols and Buriats.

1. The East Mongols are divided into the Kalkas in the borders just mentioned, the Shara Mongols south of the Gobi along the Great Wall north-eastward to Manchuria, and lastly the Shiraigol or Sharaigol in Tangut and in northern Tibet.

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[1] Compare W. Schott, *Versuch über die tatarischen Sprachen* (Berlin, 1836); *Ueber das altai'sche oder finnisch-tatarische Sprachengeschlecht* (Berlin, 1849); *Altajische Studien*, parts i.–v. (Berlin, 1860–1870); and A. Castrén, *Ethnologische Vorlesungen über die Altai'schen Völker*, ed. by A. Schiefner (St Petersburg, 1857).

2. On the signification and employment of the different names of the West Mongols (Kalmucks, Oelōd, Oirad or Dōrbōn Oirad = the four Oirad, Mongol Oirad), and also as regards the subdivision of the tribes, there is much uncertainty. The name Kalmuck, so generally employed among us, is in fact only used by the Volga Kalmucks (Khalimak), but even with them the name is not common, and almost a byname. It is of foreign origin, and most likely a Tataric word which has yet to be explained. *Oirad* means the "near ones," the "related." The usual explanation given is that the single tribes consider themselves as being related to each other—hence *Mongol Oirad*, "the Mongol related tribe." This is the favourite name among Kalmucks. Dōrbōn Oirad, or the four related tribes, comprise (1) Dzungars, (2) Torgod, (3) Koshod, (4) Derbet. The signification of the name *Oelōd*, in the East Mongolian *Oegeled*, now the most widely-spread among the tribes living in China, is likewise very doubtful. Some assert that "Oelōd" is nothing but the Chinese transcription of Oirad, as the ordinary Chinese language does not possess the sound *r*. We have, however, to bear in mind that we have a Mongolian root *ōgelekū*, with the sense "to be inimical," "to bear hatred, ill-will," &c. The main population of the Kalmucks live, or rather drag out, their existence after the usual fashion of nomad tribes in Dzungaria, in the eastern part of the Tian-shan, on the south border of the Gobi, on Kōkō-nōr, and in the province of Kan-suh. All these are under the Chinese government. In consequence, however, of the extension of the Russian empire in Tian-shan and Alatau, many hordes have come under the Russian sway. According to an approximate account we may reckon in the territory Semiryetshensk (Kulja) and Semipalatinsk 34,000 Kalmucks, while in the southern part of the government Tomsk, on the Altai, the Kalmuck population amounted formerly to 19,000. Besides these we find a section of Kalmuck population far in the west, on the banks of the Volga (near Astrakhan). From their original seats in Dzungaria they turned in their migrations to the north, crossed the steppe of the Kirghiz, and thus gradually reached the Emba and the Or. Between these two rivers and the Ural the Torgod settled in 1616; thence they crossed the Volga in 1650, and took possession of the now so-called steppe of the Kalmucks, being followed in 1673 by the Derbet and in 1675 by the Koshod. In 1771 a considerable number returned to the Chinese empire. There is still a not unimportant population in the so-called steppe of the Kalmucks, which extends between the Caspian and the Volga in the east and the Don in the west, and from the town of Sarepta in the north to the Kuma and the Manych in the south. According to modern statistical accounts, this population amounts to 76,000. To these we have to add 25,000 more on the borders of the Cossacks of the Don, and lastly 8000 in the bordering provinces of Orenburg and Saratov.

3. In the southern part of the Russian province of Irkutsk, in a wide circle round Lake Baikal, lies the heirdom proper of the Buriats, which they also call the "Holy Sea"; the country east of the lake is commonly called Transbiakalia. Their country practically extends from the Chinese frontier on the south within almost parallel lines to the north, to the town Kirensk on the Lena, and from the Onon in the east to the Oka, a tributary of the Angara, in the west, and still farther west towards Nizhni-Udinsk. They are most numerous beyond the Baikal Lake, in the valleys along the Uda, the Onon and the Selenga, and in Nertchinsk. These Transbaikalian Buriats came to these parts only towards the end of the 17th century from the Kalkas. While Mongols and Kalmucks generally continue to live after the usual fashion of nomads, we find here agricultural pursuits, most likely, however, due mainly to Russian influence. Christianity is also making its way. The sum total of the Buriats amounts to about 250,000.

Another tribe separated from the rest of the Mongols is the so-called Hazāra (the thousand), and the four Aimak (*i.e.* tribes), who wander about as herdsmen in Afghanistan, between Herat and Kabul. In external characteristics they are Mongols, and in all probability they are the remains of a tribe from the time of the Mongol dynasty. Their language, which shows, of course, Persian influence, is strictly Mongolian, more particularly West Mongolian or Kalmuck, as has been proved by H. C. von der Gabelentz.[1]

Agreeably with this threefold division of the Mongols we have also a threefold division of their respective languages: (1) East Mongolian or Mongolian proper, (2) West Mongolian or Kalmuck, (3) Buriatic.

The dialects just mentioned are found to be in close relation to each other when we examine their roots, inflections and grammatical structure. The difference between them is indeed so slight that whoever understands one of them understands all. Phonetically a characteristic of them all is the "harmony of vowels," which are divided into two chief classes: the hard *a*, *o*, *u* and the soft *e*, *ō*, *ū*, between which *i* is in the middle. All vowels of the same word must necessarily belong to the same class, so that the nature of the first or root-vowel determines the nature of the other or inflection-vowels; now and then a sort of retrogressive harmony takes place, so that a later vowel determines the nature of the former. The consonants preceding the vowels are equally under their influence.

The Mongolian characters, which in a slightly altered form are also in use among the Manchus, are written perpendicularly from above downward, and the lines follow from left to right, the alphabet having signs for seven vowels—*a*, *e*, *i*, *o*, *u*, *ō*, *ū*, and diphthongs derived from them—*ao*, *ai*, *ei*, *ii*, *oi*, *ui*, *ōi ūi*, and for seventeen consonants—*n*, *b*, *kh*, *gh*, *k*, *g*, *m*, *l*, *r* (never initial), *t*, *d*, *y*, *s*, (*ds*), *ts*, *ss*, *sh*, *w*. All these are modified in shape according to their position, in the beginning, middle, or end of a word, and also by certain orthographic rules. In Mongolian and Manchu writing the syllable (*i.e.* the consonant together with the vowel) is considered as a unit, in other words a syllabarium rather than an alphabet. The existing characters are lineal descendants of the original Uighurian forms, which were themselves derived from the Syriac, having been brought to the Uighurs by Nestorian missionaries. An Indian and Tibetan influence may also be noticed, while the arrangement of the characters in perpendicular lines is common to the Chinese. The writing was brought into its present shape by the learned Lamas Saskya Pandita, Phags-pa Lama, and Tshoitshi Odser in the 13th century,[2] but is exceedingly imperfect. To express the frequently-occurring letters borrowed from Sanskrit and Tibetan, which are wanting in the Mongol alphabet, a special alphabet, called Galik, is employed. Every one who has tried to read Mongolian knows how many difficulties have to be overcome, arising from the ambiguity of certain letters, or from the fact that the same sign is to be pronounced differently, according to its position in the word. Thus, there are no means for distinguishing the *o* and *u*, *ō* and *ū*, the consonants *g* and *k*, *t* and *d*, *y* and *s* (*ds*). *A* and *e*, *o* (*u*) and *ō* (*ū*), *a* (*e*) and *n*, *g* and *kh*, *t* (*d*) and *on*, are liable to be mistaken for each other. Other changes will be noticed and avoided by advanced students. It is a great defect that such common words as *ada* (*a fury*) and *ende* (here), *ende* (here) and *nada* (me), *aldan* (fathom) and *altan* (gold), *ordu* (court-residence) and *urtu* (long), *onokhu* (to seize) and *unukhu* (to ride), *tere* (this) and *dere* (pillow), *gebe* (said) and *kebe* (made), *gem* (evil) and *kem* (measure), *ger* (house) and *ker* (how), *naran* (sun) and *nere* (name), *yagon* (what) and *dsagon* (hundred), should be written exactly alike. This list might be largely increased. These defects apply equally to the Mongolian and Buriatic alphabets.

In 1648 the Saya Pandita composed a new alphabet (the Kalmuck), in which these ambiguities are avoided, though the graphic differences between the two alphabets are only slight. The Kalmuck alphabet avoids the angular and clumsy shapes of the Mongolian, and has, on the contrary, a rounded and pleasing shape. The Kalmuck alphabet has also this great advantage—that every sound has its distinct graphic character; a mistake between two characters can scarcely occur. The Kalmuck words once mastered, they can be easily recognized in their Mongolian shape. The dialectical differences are also very slight.

The Kalmuck, therefore, is the key of the Mongolian, and should form the groundwork of Mongolian studies. The Kalmuck and East Mongolian dialects do not differ much, at least in the spoken language; but the Kalmucks write according to their pronunciation, while the Mongols do not. For example, *sōn* (*dsōn*), "hundred," is pronounced alike by the Kalmucks and the East Mongolians; but according to Mongolian orthography the word appears in the form *dsagon*. The dialectic difference between the two dialects very frequently lies only in a different pronunciation of some letters. Thus East Mongolian *ds* is in Kalmuck soft *s*, &c. The chief difference between the two dialects lies in the fact that in Kalmuck the soft guttural *g* between two vowels is omitted, while, through the joining of the two vowels, a long vowel is produced. In the pronunciation of common East Mongolian the *g* is likewise omitted, but it is written, while in Kalmuck, as just now mentioned, the guttural can only be traced through the lengthening of the syllable. Thus we find: Mongol *khagan*, "prince," Kalmuck *khān*: M. *dagon*, "voice, sound," K. *dōn*, *dūn*, M. *dologan*, "seven," K. *dolōn*; M. *agola*, "mountain," K. *ōla*, *ūla*; M. *nagor*, "lake," K. *nōr*, *nūr*; M. *ulagan*, "red," K. *ulān*; M. *yagon*, "what," K. *yōn* (*yūn*); M. *dabagan*, "mountain ridge," K. *dabān*; M. *ssanagan*, "thought," K. *ssanān*; M. *baragon*, "on the right," K. *barōn*, *barūn*; M. *shibagon*, "bird," K. *showōn*; M. *chilagon*, "stone," K. *chilōn* (*chulūn*); M. *jirgogan*, "six," K. *surgān*; M. *degere*, "high, above," K. *dēre*; M. *ugukhu*, "to drink," K. *ūkhu*; M. *togodshi*, "history," K. *tōdshi*, *tūdshi*; M. *egūden*, "door," K. *ōden*; M. *dsegūn*, "left," K. *sōn*; M. *ōgede*, "in the height," K. *ōdo*; M. *ōgeled*, "the Kalmucks," K. *ōlōd*; M. *ūileged*, "if one has done," K. *ūilēd*, M. *kōbegūn*, "son," K. *kōwōn*; M. *gegūn*, "mare," K. *gūn*; M. *kegūr*, "corpse." K. *kūr*; M. *kharigad*, "returned," K. *kharēd*, &c.

The Buriatic, in these peculiarities, is almost always found with East Mongolian, with which it is in every respect closely allied. In the pronunciation of some letters the transition of East Mongolian *tsa*, *tse* into Buriatic *ss* is noticeable; for instance: Mong. *tsetsek* "flower," Buriatic *ssessek*; M. *tsak*, "time," B. *ssak*; M. *tsagan* "white," B. *ssagan*; M. *tsetsen*, "prudent," B. *ssessen*. *Ss* is sometimes pronounced like (the German) *ch*: East M. *ssain*, "good," B

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[1] See his essay, "Ueber die Sprache der Hazāras und Aimaks," in the *Zeitschrift der deutschen morgenländischen Gesellschaft*, xx. 326–335.

[2] Cf. H. C. von der Gabelentz, in the *Zeitschrift f. d. Kunde d Morgenlandes* (Göttingen, 1838), ii. 1–21, "Versuch über eine alte mongolische Inschrift."

chain; M. *ssedkil*, "heart," B. *chedkil*. *K* in the beginning or middle of a word is always aspirated.

The noun is declined by the help of appended particles, some of which are independent post-positions, viz. Gen. *yin*, *u*, *un*; Dat. *dur*, *a*; Acc. *yi*, *i*; Ablat. *etse*; Instrum. *ber*, *yer*; Associative, *luga*, *lūge*. The dative and accusative have also special forms which have at the same time a possessive sense, viz. Dat. *dagan*, *degen*; Accus. *ben*, *yen*. The plural is expressed by affixes (*nar*, *ner*, *od*, *ss*, *d*), or frequently by words of plurality, "all," "many," *e.g.* *kūmūn nogōd* (man, many=men). The oblique cases have the same endings in singular and plural. Gender is not indicated. The adjective is uninflected both as attribute and as predicate; there is no comparative form, this idea being expressed by the construction or by the use of certain particles. The personal pronouns are *bi*, I; *tchi*, thou; *bida*, we; *ta*, ye; their genitives serve as possessives. The demonstratives are *ene*, *tere* (this, that), plural *ede*, *tede*; interrogative *ken*, who? The relative is lacking, and its place is supplied by circumlocutions. The numerals are: 1, *nigen*; 2, *khoyar*; 3, *gurban*; 4, *dōrben*; 5, *tabun*; 6, *jirgugan*; 7, *dologan*; 8, *naiman*; 9, *yisun*; 10, *arban*; 100, *dsagon*; 1000, *minggan*. The ordinals are formed by appending *tugar*, *tūger*. The theme of the verb is seen in the imperative, as *bari*, grasp. The conjugation is rich in forms for tense and mood, but the person and number are with few exceptions unexpressed. The present is formed from the theme by adding *mui* (*barimui*), the preterite by *bai* or *luga* (*baribai*, *bariluga*), the future by *ssugai* or *ssu* (*barissugai*, *barissu*). The preterite has also in the third person the terminations *dsugui* and *run*; the future has in the third person *yu*, and in the first *ya*. The conditional ends in *bassu* (*baribassu*), the precative in *tugai*, *tūgei*, the potential in *sa* (*barimuisa*), the imperative plural in *ktun*, the gerund in the present in *n*, *dsu* (*barin*, *baridsu*) or *tala*, "while, till" (*baritala*, "inter capiendum"), in the preterite it is formed in *gad* (*barigad*); the present part. has *ktchi* (*bariktchi*), the past part. *kssan* (*barikssan*); the supine ends in *ra*, the infinitive in *khu* (*barikhu*, or when used substantively *barikhui*). There is but one perfectly regular conjugation, and derivative forms, derived from the theme by infixes, are conjugated on the same scheme. Thus the passive has infixed *ta* or *kda* (*barikdakhu*, to be grasped), the causative *gul* (*barigulkhu*, to cause to grasp), the co-operative or sociative *ltsa* or *lda* (*bariltsakhu*, to grasp together).

There are no prepositions, only post-positions. Adverbs are either simple particles (affirmative, negative, interrogative, modal, &c.) or are formed by suffixes from other parts of speech. There are very few conjunctions; the relations of clauses and sentences are mainly indicated by the verbal forms (part., sup., conditional, but mainly by the gerund).

The order of words and sentences in construction is pretty much the opposite of that which we follow. In a simple sentence the indication of time and place, whether given by an adverb or a substantive with a post-position, always comes first; then comes the subject, always preceded by its adjective or genitive, then the object and other cases depending on the verb, last of all the verb itself preceded by any adverbs that belong to it. So in the structure of a period all causal, hypothetical, concessive clauses, which can be conceived as preceding the main predication in point of time, or even as contemporary with it, or as in any way modifying it, must come first; the finite verb appears only at the end of the main predication or apodosis. The periods are longer than in other languages; a single one may fill several pages.

Authorities.—Grammars and dictionaries may be divided according to the three dialects. For East Mongolian, I. J. Schmidt gave the first grammar (St Petersburg, 1831), and a Mongolian-German-Russian dictionary (St Petersburg, 1835). Next Jos. Kovalevski published in Russian a Mongolian grammar (Kasan, 1835), a chrestomathy (2 vols., Kasan, 1836, 1837), and his great *Dictionnaire mongol-russe-français* (3 vols., Kasan, 1844, 1846, 1849). We may mention R. Yuille, *Short Mongolian Grammar* (in Mongolian), xylographed at the mission press near Selenginsk beyond Lake Baikal (1838). A. Bobrovnikov's Russian *Grammar of the Mongolian-Kalmuck Language* (Kasan, 1849) is also very good. An abridgment of Schmidt's work is C. Puini, *Elementi della grammatica mongolica* (Florence, 1878). A. Popov's *Mongolian Chrestomathy* appeared in 2 vols. at Kasan (1836). For the Kalmuck we have grammars by Popov (Kasan, 1847), Bobrovnikov, as above, and H. A. Zwick (*s. l. et a.*), autographed at Donaueschingen (1851). Zwick's autographed Kalmuck and German dictionary with a printed German index appeared (*s. l. et a.*) in 1852; B. Jülg's edition of the tales of Siddhi-kūr (Leipzig, 1866) gives a complete glossary to these stories. There are small Russian and Kalmuck vocabularies by P. Smirnov (Kasan, 1857) and C. Golstunskyi (St Petersburg, 1860). For the Buriatic we have Castrén, *Versuch einer burjätischen Sprachlehre*, ed. by Schiefner (1857), and A. Orlov's Russian grammar of the Mongol-Buriatic colloquial language (Kasan, 1878).

Literature.—A clear distinction must be drawn between the higher and nobler written or book-language and the common or conversational language of every-day life. The difference between the two is very considerable, and may be fairly compared to that between the modern High German book-language and the different dialects. All grammars and dictionaries as yet published treat only of the book-language; and so also, with a few exceptions, the published literary documents are written in this higher style. The exceptions are the *Gesser-Khan*, and the *Siddhi-kūr* and *Djangariad* (the last two published by Golstunskyi). The popular or conversational language has been fixed in writing by A. Pozdneev in his Russian work, *Specimens of the Popular Literature of the Mongolian Tribes*, pt. i., "Popular Songs" (St Petersburg, 1880), which contains rich material for the study of the popular literature.

The literature consists mostly of translations from the Tibetan, the holy language of Buddhism, which is still the language of the learned. The Tibetan Buddhist literature is itself translated from the Sanskrit; hence, now and then, through Mongols and Kalmucks we get acquainted with Indian works the originals of which are not known in Sanskrit. Such is the case, for instance, with the tales of Siddhi-kūr. Many books have also been translated from the Chinese. Most of the writings are of a religious, historical, philosophical, medical, astronomical or astrological character. Favourite subjects are folk-lore and fairy tales. Among the religious books, perhaps the most important is that containing the legends entitled *ūliger ūn dalai*, "ocean of comparisons" (ed. by I. Jacob Schmidt under the title, *Der Weise und der Thor*, in Tibetan and German (St Petersburg, 1843). To this may be added the *boddhi mōr*, or "the holy path," the *altan gerel*, "gleaming of gold," the *mani gambo* and *yertüntchü yin toli*, "mirror of the world.". What was known of poetical literature before Pozdneev is scarcely worth mentioning. In some parts of the historical and narrative literature we find, wherever the narrative takes a higher flight, an admixture of poetical diction. The poetry appears in a certain parallelism of the phrases, with a return either of the same endings (rhyme) or of the same words (refrain). Frequently we find, besides the rhyme or refrain, alliteration. The essay of H. C. von der Gabelentz in *Z. f. d. Kunde des Morgenlandes*, i. 20–37, "Einiges über mongolische Poesie," has been superseded by the work of Pozdneev.

Among historical works a high place is due to that composed by the tribal prince, Sanang Setzen, in the middle of the 17th century (*Geschichte der Ost-Mongolen und ihres Fürstenhauses*, Mongolian and German, by I. J. Schmidt, St Petersburg, 1829), and to the *Altan tobtchi*, *i.e.* "golden knob" or "precious contents" (text and Russian trans. by the Lama Galsang Gomboyev, St Petersburg, 1858). Of folk-lore and fairy tales, we have the legend of the hero *Gesser-Khan* (text ed. by I. J. Schmidt, St Petersburg, 1836, and German version, 1839; cf. Schott, *Ueber die Sage v. Geser-Khan*, Berlin, 1851, and B. Jülg in the *Transactions* of the Würzburger Philol. Versam. of 1868, pp. 58 sqq., Leipzig, 1869); and the tales about *Ardshi Bordshi* (Russian version by Galsang Gomboyev, St Petersburg, 1858; text and German trans. by B. Jülg, Innsbruck, 1867, 1868). A favourite book is the tales of Siddhi-kūr, based on the Sanskrit *Vetâla panchavinçati* (Russian trans. by Galsang Gomboyev, St Petersburg, 1865, nine of the tales in Mongolian and German, by B. Jülg, Innsbruck, 1868). The fuller collection of these tales in Kalmuck first became known by the German trans. of B. Bergmann in vol. i. of his *Nomadische Streifereien unter d. Kalmüken* (4 vols., Riga, 1804, 1805); an autographed edition in the vulgar dialect was published by C. Golstunskyi (St Petersburg, 1864); text and German trans. with glossary by B. Jülg (Leipzig, 1866). A poetic heroic story is the *Djangariad*, extracts from which were given by Bergmann (*op. cit.*, iv. 181 sqq.); a complete Russian version by A. Bobrovnikov (St Petersburg, 1854); a German version by F. v. Erdmann in *Z.D.M.G.*, 1857 (Kalmuck text by Golstunskyi, St Petersburg, 1864). A similar poem is the history of Ubasha Khuntaidshi and his war with the Oirad, Kalmuck text and Russian trans. by G. Gomboyev in his Altan tobtchi as above, and text alone autographed by Golstunskyi (St Petersburg, 1864). Some books of religion for the Christian Buriats (transcribed in Russian characters) represent the Buriatic dialect. The Russian and English Bible Societies have given us a translation of the whole Bible. I. J. Schmidt translated the Gospels and the Acts into Mongolian and Kalmuck for the Russian Bible Society (8 vols., St Petersburg, 1819–1821)—a masterly work. The English missionaries, E. Stallybrass and W. Swan, and afterwards R. Yuille, translated the whole Old Testament into Mongolian (1836–1840). This work was printed at a mission press erected at great cost for the purpose near Selenginsk, beyond Lake Baikal in Siberia. In 1846 the New Testament by the same hands appeared at London.

Authorities.—The richest collections of Mongolian and Kalmuck printed books and MSS. are in the Asiatic museum of the St Petersburg Academy, and in the libraries of Kazan and Irkutsk; there is also a good collection in the royal library at Dresden. Consult in general, besides the already-cited works of Bergmann and Pozdneev, P. S. Pallas, *Sammlungen historischer Nachrichten ü. d. mongolischen Völkerschaften* (2 vols., St Petersburg, 1776–1801); I. J. Schmidt, *Forschungen im Gebiete der älteren . . . Bildungsgeschichte der Völker Mittelasiens, vorz. d. Mongolen und Tibeter* (St Petersburg and Leipzig, 1824); B. Jülg, "On the Present State of Mongolian Researches," *Journ. R. As. Soc.*, xiv. (1882), pp. 42–65. (B. J.)

MŌNG PAI (called *Mobyē* by the Burmese), the most southwesterly of the British Shan States of Burma. It has an approximate area of 1000 sq. m., and a population (1901) of 19,351. The general character of the country is hilly, rising westwards in a gentle slope from the chief stream, the Nam Hpilu or Balu.

This is navigable for native boats throughout the year to the point where it sinks underground in Karen-ni. The chief cultivation is rice, with about two acres of dry or hill rice to one of wet bottom. The hill fields are left fallow for ten years after two years' cultivation. The chief, the Sawbwa Hkun Yōn, held charge through the reigns of four Burmese kings, and submitted early in 1887 on the first arrival of British troops. He abdicated in favour of his son in 1890, and died a few years later.

MŌNG PAN (the Burmese *Maingpan*), a state in the eastern division of the southern Shan States, lying approximately between 19° 45′ and 20° 25′ N. and between 98° and 99° E., with an area of 2299 sq. m., and a population (1901) of 16,629. The main state lies, except for a few insignificant circles, entirely west of the Salween, but beyond that river are the four subfeudatory states of Mōng Tun, Mōng Hang, Mōng Kyawt and Mōng Hta. The only considerable area of flat land is round the capital, which lies in a large and fertile plain, marking roughly the centre of the state. From this plain rise on all sides low hills covered with scrub jungle, sloping up to ranges of about 5000 ft. on nearly every side. Rice is the only crop, irrigated where possible; elsewhere dry cultivation prevails. The state has valuable teak forests on both sides of the Salween, which cover a considerable but undetermined area. The general altitude of the valleys is about 2000 ft. The capital is small, and has only about 200 houses. The chief is of Sawbwa rank.

MONGREL (earliest form *mengrel*, probably from the root *meng-*, or *mong-*, to mix, cf. mingle, among), a dog that is the progeny of two different breeds, or one whose breed it is impossible to tell on account of the various crossings. In the case of other animals or plants it is the result of a fertile cross between two varieties of the same species, and so to be distinguished from a "hybrid," the result of a fertile cross between two distinct species (see HYBRIDISM).

MONIER-WILLIAMS, SIR MONIER (1819–1899), British orientalist, son of Colonel Monier-Williams, surveyor-general in the Bombay presidency, was born at Bombay on the 12th of November 1819. He matriculated at Oxford from Balliol College in 1837, but left the university on receiving in 1839 a nomination for the East India Company's civil service, and was completing his course of training at Haileybury when the entreaties of his mother, who had lost a son in India, prevailed upon him to relinquish his nomination and return to Oxford. As Balliol was full, he entered University College and, devoting himself to the study of Sanskrit, he gained the Boden scholarship in 1843. After taking his degree he was appointed professor of Sanskrit, Persian and Hindustani at Haileybury, where he remained until the abolition of the college upon the transfer of the government of India from the Company to the Crown. He taught oriental languages at Cheltenham for ten years, and in 1860 was elected Boden professor of Sanskrit at Oxford after a contest with Professor Max Müller (*q.v.*), which attracted great public interest and severe criticism, the motive of the non-resident voters, whose suffrages turned the scale, being notoriously not so much to put Monier-Williams in as to keep Max Müller out. Although, however, far inferior to his rival in versatility and literary talent, Monier-Williams was in no way inferior in the special field of Sanskrit, and did himself and his professorship much honour by a succession of excellent works, among which may especially be named his Sanskrit-English and English-Sanskrit dictionaries; his *Indian Wisdom* (1875), an anthology from Sanskrit literature; and his translation of *Sakuntala* (1853). In his later years he was especially attracted by the subject of the native religions of India, and wrote popular works on Brahmanism, Buddhism and Hinduism. His principal undertaking, however, was the foundation of the Indian Institute at Oxford, which owes its existence entirely to him. He brought the project before the university in May 1875, and in that year and the following, and again in 1883, visited India to solicit the moral and financial support of the native princes and other leading men. Lord Brassey came to his aid with a donation of £9000, and in November 1880 the institute was adopted by the university, but the purchase of a site and the erection of a building were left to the professor. Upwards of £30,000 was eventually collected; the prince of Wales, in memory of his visit to India, laid the foundation stone in May 1883; and the edifice, erected in three instalments, was finally completed in 1896. Ere this, failing health had compelled Monier-Williams to withdraw from the active duties of his professorship, which were discharged by the deputy-professor, Dr A. Macdonell, who afterwards succeeded him. He continued, nevertheless, to work upon Sanskrit philology until his death at Cannes on the 11th of April 1899. He had been knighted in 1886, and was made K.C.I.E. in 1889, when he adopted his Christian name of Monier as an additional surname.

MONISM (from Gr. *μόνος*, alone), the philosophic view of the world which holds that there is but one form of reality, whether that be material or spiritual. The aim of knowledge is explanation, and the dualism or pluralism which acquiesces in recognizing two or more wholly disparate forms of reality has in so far renounced explanation (see DUALISM). To this extent monism is justified; but it becomes mischievous if it prompts us to ignore important differences in facts as they present themselves to our intelligence. All forms of monism from Plotinus downwards tend to ignore personal individuality and volition, and merge all finite existence in the featureless unity of the Absolute; this, indeed, is what inspires the passion of the protest against monism. Turning to the historical forms of the theory we may class Plotinus as a mystical monist: he attains to the One which is the All by an act of mystic union raising him above the phenomenal sphere. Spinoza is a materialistic monist with an inconsistent touch of mysticism and a certain concession, more apparent than real, to the spiritual side of experience. Hegel's is an intellectualist monism, explaining matter, sensation, personal individuality and will as forms of thought. The doctrine of Schopenhauer and von Hartmann is a monism of cosmic will which submerges the individual no less completely than Hegelianism, though in a different manner. Haeckel's monism is mere materialism dignified by a higher title. Those who maintain that all these forms of synthesis are hasty and superficial stand by the conviction that the right philosophic attitude is to accept provisionally the main distinctions of common sense, above all the distinction of personal and impersonal; but to press forward to the underlying unity so far as experience and reflection justify.

See ABSOLUTE; DUALISM; METAPHYSICS; MATERIALISM; IDEALISM.

MONITION, or ADMONITION (Lat. *monere*, to admonish), in English ecclesiastical law, an order requiring or admonishing the person complained of to do something specified in the monition, or appear and show cause to the contrary, "under pain of the law and penalty thereof." It is the lightest form of ecclesiastical censure, whether to clergymen or laymen, but disobedience to it, after it has been duly and regularly served, entails the penalties of contempt of court. Monitions of a disciplinary character are either for the purpose of enforcing residence on a benefice, or in connexion with suits to restrain ritual alleged to be unlawful.

MONITOR (from Lat. *monere*, to warn, advise), an advisor or counsellor, one who warns another person as to his course of action, also used of things that are more or less personified, as conscience. The word is chiefly applied to senior pupils (also known as "prefects") in some of the great secondary schools in England; in America to senior students in certain colleges to whom special duties are assigned, particularly that of keeping order; and also to pupil teachers in English elementary schools. It is used in a general way of anything that gives warning, and in this sense is applied to a lizard of the family *Monitoridae*, or *Varanidae*, found in Africa and Australia, which is supposed to give warning of the approach of crocodiles. The name of monitor was also given to a particular kind of ironclad invented for the American navy by Captain John Ericsson (*q.v.*) in 1862, which had a very low freeboard and revolving gun-turrets. The letter of Ericsson to the assistant secretary of the navy, of the 20th of January 1862 (quoted in the *Century Dictionary*), gives the inventor's reason for the name. "The impregnable and aggressive character of this structure will admonish the leaders of the Southern Rebellion that the batteries on the banks of their rivers will no longer present barriers to the entrance of the Union forces. The ironclad intruder will thus prove a severe *monitor* to those leaders . . . 'Downing Street' will hardly view with indifference this last 'Yankee notion,' this monitor." It is also the name of an ironclad railway truck used for carrying a big gun. In America the raised part of the roof of a railway carriage or omnibus in which the lights or ventilators are placed is known as a monitor roof or top. In mining the word is applied to a jointed nozzle which may be turned in all directions, and is used in hydraulic mining.

MONK (or Monck), **GEORGE,** 1st Duke of Albemarle (1608–1669), second son of Sir Thomas Monk, a gentleman of good family but in embarrassed circumstances, was born at Potheridge, near Torrington, in Devonshire, on the 6th of December 1608. Having thrashed the under-sheriff of the county in revenge for a wrong done to his father, he had to leave home, and naturally took to the career of arms. He served as a volunteer in the expedition to Cadiz, and the next year did good service at the Isle of Rhé. In 1629 Monk went to the Low Countries, then the school of war, and there he gained a high reputation as a leader and disciplinarian. In 1638 he threw up his commission in consequence of a quarrel with the civil authorities of Dordrecht, and came to England. He obtained the lieutenant-colonelcy of Newport's regiment. During the operations on the Scottish border he showed his skill and coolness in the dispositions by which he saved the English artillery at Newburn, though himself destitute of ammunition. At the outbreak of the Irish rebellion he was appointed colonel of Lord Leicester's regiment. All the qualities for which he was noted through life—his talent of making himself indispensable, his imperturbable temper and his impenetrable secrecy—were fully displayed in this employment. The governorship of Dublin was vacant, and Monk was appointed by Leicester. But Charles I. overruled the appointment in favour of Lord Lambart, and Monk with great shrewdness gave up his claims. Ormonde, however, who viewed him with suspicion as one of the two officers who refused the oath to support the Royal cause in England, sent him under guard to Bristol. But he justified himself to Charles in person, and his soldierly criticisms on the conduct of the Irish War impressed the king, who gave him a command in the corps sent over from Ireland during the English Civil War. Monk was, however, soon taken prisoner, at Nantwich (1644), and spent the next two years in the Tower, where he found it difficult to live owing to his want of means. The king himself sent him £100, a gift for which Monk himself was sincerely grateful. He beguiled his imprisonment by writing his *Observations on Military and Political Affairs*.

Monk's Irish experience, however, led to his release and an invitation to take service in the parliament's army against the Irish rebels. Making a distinction like other soldiers of the time between fighting the Irish and taking arms against the king, he accepted the offer and took the covenant. At first as adjutant-general to the Parliamentary lord-lieutenant, his old friend Lord Lisle, and afterwards as governor of Ulster, he rendered great services to his new masters. In conjunction with Colonel Michael Jones, governor of Leinster, he made head against the rebels for two years, but in the third (1649) the Parliamentarians, weakened by defections brought about by the execution of the king, were no longer able to keep the field. Losing one strong place after another, Monk concluded an armistice with the rebel Owen Roe O'Neill upon terms which he knew the parliament would not ratify. The convention was indeed a military expedient to deal with a military necessity, and although most of his army went over to the Royalist cause, he himself remained faithful to his employers and returned to England. As he expected, parliament "utterly disapproved" of the armistice but exonerated their general. His next service was in Cromwell's army in Scotland. He commanded a brigade at the great victory of Dunbar, and afterwards captured a number of small places. When in 1651 Cromwell with the field army hurried southward into England to bring the invading Scots to battle, Monk was left behind to complete the subjugation of the country. In February 1652 he left Scotland to recruit his broken health at Bath, and in November of the same year he became an admiral, or rather a "general at sea," instead of a soldier. Ten days after hoisting his flag for the first time he was engaged with his colleagues, Blake and Deane, in the battle of Portland (Feb. 18, 1653). In the action of June 2–3 Monk exercised the general command after Deane's death. A third battle followed on the 29th and 30th of July, which was a decisive victory for the Commonwealth's fleet (see Dutch Wars). On his return he married Anne Clarges, a woman of low extraction, often supposed to have been his mistress, "ever a plain homely dowdy," says Pepys, who, like other writers who mention her, is usually still less complimentary. Next year he was back in Scotland, methodically beating down a Royalist insurrection in the Highlands, and when this service was over settled down to a steady government of the country for the next five years. The timely discovery of a plot fomented by Overton, his second in command, in 1654, gave him an excuse for thoroughly purging his army of all Anabaptists, Fifth Monarchy men, and other dangerous enthusiasts. It is improbable that at this time Monk had proposed to himself the restoration of the king, though so astute a diplomatist must have weighed the chances of such an event. His very reticence, however, caused alarm on one side and hope on the other. In 1655 he received a letter from Charles II., a copy of which he at once sent to Cromwell, who is said to have written to him in 1657 in the following terms: "There be that tell me that there is a certain cunning fellow in Scotland called George Monk, who is said to lye in wait there to introduce Charles Stuart; I pray you, use your diligence to apprehend him, and send him up to me." Monk's personal relations with Cromwell were those of sincere friendship on both sides.

During the confusion which followed Cromwell's death Monk remained silent and watchful at Edinburgh, careful only to secure his hold on his troops. At first he contemplated armed support of Richard Cromwell, but gave up this idea on realizing the young man's incapacity for government, and renewed his waiting policy. In July 1659 direct and tempting proposals were again made to him by the king. His brother Nicholas, a clergyman, was employed by Sir J. Grenvil to bring to him the substance of Charles's letter. No bribe, however, could induce him to act one moment before the right time. He bade his brother go back to his books, and refused to entertain any proposal. But when Booth rose in Cheshire for the king, so tempting did the opportunity seem that he was on the point of joining forces with him, and a manifesto was prepared. His habitual caution, however, induced him to wait until the next post from England, and the next post brought news of Booth's defeat.

For a moment he thought of retiring into private life, but soon Fleetwood and Lambart declared against the parliament, and to their surprise Monk not only refused to join them, but (Oct. 20, 1659) at once took measures of active opposition. Securing his hold on Scotland by a small but trusty corps of occupation, he crossed the border with the rest of his army. Holding Lambart in play without fighting until his army began to melt away for want of pay, Monk received the commission of commander-in-chief of the parliament's forces (Nov. 24). The navy, some of the English garrisons and the army in Ireland declared for the parliament, and the army from Scotland crossed the Tweed on the 2nd of January 1660. It was inferior in number, but in all other respects superior to Lambart's, and Monk slowly marched on to London, disbanding or taking over on his way the detachments of Lambart's army which he met, and entered the capital on the 3rd of February. In all this his ultimate purpose remained mysterious. At one moment he secretly encouraged the demands of the Royalist City of London, at another he urged submission to the existing parliament, then again he refused to swear an oath abjuring the house of Stuart, and further he hinted to the attenuated Long Parliament the urgent necessity of a dissolution. Lastly, acting as the stern military agent of the infuriated parliament, he took away the gates and portcullises of the city. This angered not only the citizens but his own army, and gave him the lever that he desired to enforce the dissolution of parliament, while at the same time enabling him to break up as a matter affecting discipline, the political camarillas that had formed in his own regiments. He was now master of the situation, and though he protested his adherence to republican principles, it was a matter of common knowledge that the new parliament, which Monk was imposing on the remnant of the old, would have a strong Royalist colour. Monk himself was now in communication with Charles II., whose Declaration of Breda was based on Monk's recommendations. The new parliament met on the 25th of April, and on the 1st of May voted the restoration of the monarchy.

With the Restoration the historic interest of Monk's career ceases. Soldier as he was, he had played the difficult game of diplomacy with incomparable skill, and had won it without firing a shot. That he was *victor sine sanguine*, as the preamble of his patent of nobility stated, was felt by every one to be the greatest service of all. He was made gentleman of the bedchamber, knight of the Garter, master of the horse and commander-in-chief, raised to the peerage with the titles of Baron Monk, earl of Torrington and duke of Albemarle, and had a pension of £7000 a year allotted to him. As long as the army existed of which he was the idol, and of which the last service was to suppress Venner's revolt, he was a person not to be displeased. But he entirely concurred in its disbandment, and only the regiment of which he was colonel, the Coldstream (Guards), survives to represent the army of the Civil Wars. In 1664 he had charge of the admiralty when James, duke of York, was in command of the fleet, and when in 1665 London was deserted on account of the plague, Monk, with all the readiness of a man accustomed to obey without thinking of risk, remained in charge of the government of the city. Once more, at the end of this year, he was called upon to fight, having a joint commission with Prince Rupert against the Dutch. The whole burden of the preparations fell upon him. On the 23rd of April 1666 the admirals joined the fleet, and on the 1st of June began the great four days' battle, in which Monk showed not only all his old coolness and skill, but also a reckless daring which had seemed hitherto foreign to his character. Later in the same year he maintained order in the city of London during the Great Fire. His last service was in 1667, when the Dutch fleet sailed up the Thames, and Monk, though ill, hastened to Chatham to oppose their farther progress. From that time he lived much in privacy, and died of dropsy on the 3rd of January 1670, "like a Roman general with all his officers about him." The dukedom became extinct on the death of his son Christopher, 2nd duke of Albemarle (1653–1688).

See the *Life* of Monk, by Dr Gumble, his chaplain (London, 1671), and the memoir and bibliography by C. H. Firth in the *Dict. Nat. Biogr.*

MONK, JAMES HENRY (1784–1856), English divine and classical scholar, was born at Buntingford, Herts. He was educated at Charterhouse School and Trinity College, Cambridge, and in 1809 was elected professor of Greek in succession to Porson. The establishment of the classical tripos was in great measure due to his efforts. In 1822 he was appointed dean of Peterborough; in 1830, bishop of Gloucester (with which the see of Bristol was amalgamated in 1836). He is best known as the author of a *Life of Bentley* (1830) and as the editor (with C. J. Blomfield) of Porson's *Adversaria* (1812).

MONK, MARIA (*c.* 1817–1850), an adventuress and impostor, who, coming to New York in 1835, claimed to have escaped from the Montreal nunnery of the Hôtel Dieu, concerning which, and the practices prevalent there, she circulated sensational charges in *Awful Disclosures by Maria Monk* (1836). Over 200,000 copies of this book and a sequel were sold, and a violent anti-Catholic agitation resulted. She was finally exposed as a woman of bad character, and her story proved to be absolutely false, but not until she had deceived many people of good standing.

MONK (O.Eng. *munuc*; this with the Teutonic forms, *e.g.* Du. *monnik*, Ger. *Mönch*, and the Romanic, *e.g.* Fr. *moine*, Ital. *monacho* and Span. *monje*, are from the Lat. *monachus*, adapted from Gr. *μοναχός*, one living alone, a solitary; *μόνος*, alone), a member of a community of men living a life under vows of religious observance; the term is properly confined to a member of a Christian community, but is sometimes applied to members of Buddhist and Mahommedan religious brotherhoods. The Greek and Latin name was first used of the hermits, but was early widened to embrace the coenobites. The term "monk" should not be used either of "friars" or of "canons regular." (See MONASTICISM.)

MONKEY, a term apparently applicable to all members of the order PRIMATES (*q.v.*) except man and perhaps the larger apes. In zoology it may be used in this wider sense, as inclusive of all the Primates except man and lemurs; but it may also be employed in a more restricted application, so as to denote all ordinary "monkeys" as distinct from baboons on the one hand and the tail-less man-like apes on the other. The word appears in English first in the 16th century. The Low-German version of *Reynard the Fox* (*Reinke de Vos*, 1479) calls the son of Martin, the ape, *Moneke*; and the French version has *Monnekin*, *Monnequin*; these are apparently Teutonic diminutives of a word for ape which occurs in several Romanic languages, *e.g.* Fr. *monne*, It. *monna*, &c.

MONKHOUSE, WILLIAM COSMO (1840–1901), English poet and critic, was born in London on the 18th of March 1840. His father, Cyril John Monkhouse, was a solicitor; his mother's maiden name was Delafosse. He was educated at St Paul's School, quitting it at seventeen to enter the board of trade as a junior supplementary clerk, from which grade he rose eventually to be the assistant-secretary to the finance department of the office. In 1870–1871 he visited South America in connexion with the hospital accommodation for seamen at Valparaiso and other ports; and he served on different departmental committees, notably that of 1894–1896 on the Mercantile Marine Fund. He was twice married: first, to Laura, daughter of James Keymer of Dartford; and, secondly, to Leonora Eliza, daughter of Commander Blount, R.N. He died in London on the 20th of July 1901. Cosmo Monkhouse was one of those who have not only a vocation, but an avocation. His first bias was to poetry, and in 1865 he issued *A Dream of Idleness and Other Poems*, a collection strongly coloured by his admiration for Wordsworth and Tennyson. It was marked by exceptional maturity, and scarcely received the recognition it deserved. Owing perhaps to this circumstance, it was not till 1890 that he put forth *Corn and Poppies*, a collection which contains at least one memorable effort in the well-known "Dead March." Five years later appeared a limited edition of the striking ballad of *The Christ upon the Hill*, illustrated with etchings by Mr William Strang. After his death his poetical output was completed by *Pasiteles the Elder and other Poems* (including *The Christ upon the Hill*). In 1868 Monkhouse essayed a novel, *A Question of Honour*. Then, after preluding with a *Life of Turner* in the "Great Artists Series" (1879), he devoted himself almost exclusively to art criticism. Besides many contributions to the *Academy*, the *Saturday Review*, the *Magazine of Art* and other periodicals, he published volumes on *The Italian Pre-Raphaelites* (1887), *The Earlier English Water-Colour Painters* (1890 and 1897), *In the National Gallery* (1895) and *British Contemporary Artists* (1899). He was a contributor to the *Dict. Nat. Biog.* from the beginning. Monkhouse also wrote an excellent *Memoir of Leigh Hunt* in the "Great Writers Series" (1887). As an art critic Monkhouse's judgments were highly valued; and he had the rare gift of differing without offending, while he invariably secured respect for his honesty and ability. As a poet, his ambition was so wide and his devotion to the art so thorough, that it is difficult not to regret the slender bulk of his legacy to posterity.

MONKSWELL, ROBERT PORRETT COLLIER, 1st BARON (1817–1886), English judge, was born at Plymouth, on the 21st of June 1817, and was the son of a prominent merchant of Quaker extraction. He was educated at Oxford, was called to the bar in 1843, and went the western circuit. He obtained a high reputation by his successful defence of Brazilian pirates in 1845;

they were, indeed, convicted at the assizes, but Collier ultimately procured their escape upon a point of law which the judge had refused to reserve. He was elected member of parliament for Plymouth in the Liberal interest in 1852, and in 1859 was appointed counsel to the admiralty and judge-advocate to the fleet. In this capacity he gave in 1862 an opinion in favour of detaining the Confederate rams building in the Mersey, which would have saved his country much money and much credit if it had been acted upon. In 1863 he became solicitor-general, and in 1868 attorney-general, and in 1869 successfully passed a bankruptcy bill. In 1871 he was appointed by Mr Gladstone one of four new judges upon the judicial committee of the privy council, although it was expressly provided by the act creating these offices that none of them should be filled by a law-officer of the Crown. This prohibition was evaded by making Collier a judge of common pleas, and transferring him after a few days to the privy council. This arrangement was unanimously condemned by public opinion, and gave the Gladstone cabinet a serious blow. He officiated, nevertheless, with distinction until his death on the 3rd of November 1886, and was raised to the peerage as Baron Monkswell in 1885. He was a man of many accomplishments, and especially distinguished as an amateur painter, frequently exhibiting landscapes at the Royal Academy and elsewhere. In his younger days he had been noted as a clever caricaturist. He was succeeded in the peerage by his elder son, Robert (b. 1845), who, after taking a first class in law at Cambridge, went to the bar, and became (1871) conveyancing counsel to the treasury, and (1885–1886) an official examiner of the High Court, and, taking to politics as a Liberal, under-secretary for war (1895). The younger son, John Collier (b. 1850), inherited his father's artistic tastes, and became a well-known painter.

MONLUC, or MONTLUC, the name of a French family. The house of Lasséran-Mansencomme, which possessed the estate of Monluc in Agenais, and took its name in the 16th century, is held to be a branch of the family of Montesquiou. Marshal Blaise de Monluc (d. 1577), author of the *Commentaires*, had a son, Pierre Bertrand, called the Capitaine Peyrot, who perished in an expedition to Madeira in 1566, and another son, Fabien de Monluc, whose granddaughter, Jeanne de Monluc (d. 1657), countess of Carmaing, princess of Chabanais, brought the estates of her house to the family of Escoubleau by her marriage with Charles d'Escoubleau, marquess of Sourdis and Alluyes. Jean de Monluc, brother of the marshal, was bishop of Valence and Die, and distinguished himself in several embassies. He died in 1579, leaving a natural son, Jean de Monluc (d. 1603), seigneur de Balagny, who was at first a zealous member of the League, but made his submission to Henry IV., and received from him the principality of Cambrai and the bâton of a marshal of France.

MONMOUTH, JAMES SCOTT, DUKE OF (1649–1685), leader of his abortive insurrection against James II. in 1685, was the son of Lucy Walters, "a brown, beautiful, bold but insipid creature," who became the mistress of Charles II. during his exile at the Hague. He was born at Rotterdam on the 9th of April 1649. That Charles was his father is more than doubtful, for Lucy Walters had previously lived with Robert Sidney (son of the earl of Leicester), brother of Algernon, and the boy resembled him very closely. Charles, however, always recognized him as his son, and lavished on him an almost doting affection. Until the Restoration he was placed under the care, first of Lord Crofts, by whose name he was known, and then of the queen-dowager, receiving his education to the age of nine from Roman Catholics, but thenceforward from Protestant tutors. In July 1662 he was sent for by Charles, and at thirteen was placed under the protection of Lady Castlemaine and in the full tide of the worst influences of the court. No formal acknowledgment of his relation to the king was made until his betrothal to Anne Scott, countess of Buccleuch, the wealthiest heiress of Scotland, whom he married in 1665. During 1663 he was made duke of Orkney, duke of Monmouth and knight of the Garter, and received honorary degrees at both universities; and on his marriage he and his wife were created duke and duchess of Buccleuch, and he took the surname of Scott. At court he was treated as a prince of the blood. In 1665 he served with credit under the duke of York in the sanguinary naval battle off Lowestoft. A captaincy in the Life Guards was given him, and in 1670, on the death of Monk, he was made captain-general of the king's forces. In 1670 Monmouth was with the court at Dover, and it is affirmed by Reresby that the mysterious death of Charles's sister, Henrietta, duchess of Orleans, was due to her husband's revenge on the discovery of her intrigue with the duke. It is certain, from an entry by Pepys, that as early as 1666 he had established a character for vice and profligacy. He was the direct author of the attack in December 1670 on Sir John Coventry, and only a few months later received the royal pardon for his share in the wanton murder of a street watchman.

Hitherto Monmouth had been but the spoiled child of a wicked court. Now, however, by no act or will of his own, he began to be a person politically important. As early as 1662 the king's excessive fondness for him had caused anxiety. Even then the fear of a "difference" between Monmouth and James, duke of York, exercised men's minds, and every caress or promotion kept the fear alive. Who could tell but that, in default of legitimate issue from his queen, Charles might declare Monmouth himself his lawful son? A civil war would be the certain consequence. Soon after 1670 the matter took a more serious aspect. The anti-popery spirit was rapidly becoming a frenzy, and the succession of James a probability and a terror. Charles was urged to legitimize Monmouth by a declaration of his marriage with Lucy Walters. He returned answer that, much as he loved the duke, he would rather see him hanged at Tyburn than own him for his legitimate son. Every attempt, however, was henceforth made, especially by Shaftesbury, to accustom people to this idea, and his position was emphasized by James's second marriage, with the Roman Catholic princess Mary of Modena. From this time his popular title was "the Protestant duke." In 1674 he was made "commander-in-chief"; and in connexion with this another unsuccessful attempt, graphically described in Clarke's *Life of James*, was made to gain from Charles a tacit admission of his legitimacy. At Shaftesbury's instance he was placed in command of the army employed in 1675 against the Scottish Covenanters, and was present at Bothwell Bridge (June 22, 1679). In 1678, when Charles was driven into war with Louis, Monmouth took the command of the English contingent, and again gained credit for personal courage at the battle of St Denis. On his return to London England was in the throes of the popish terror. The idea of securing the Protestant succession by legitimizing Monmouth again took shape and was eagerly pressed on by Shaftesbury; at the time it seemed possible that success would wait on the audacity.

The pensionary parliament was dissolved in January 1678–1679, and was succeeded by one still more determined in its anti-popery spirit. To avoid the storm, and to save, if possible, his brother's interests, Charles instructed him to leave the country. James retired to Brussels, the king having previously signed a declaration that he "never was married, nor gave contract to any woman whatsoever but to my wife Queen Catherine." In the summer of 1679 the king suddenly fell ill, and the dangers of a disputed succession became terribly apparent. The party opposed to Monmouth, or rather to Shaftesbury, easily prevailed upon Charles to consent to his brother's temporary return. When, after the king's recovery, James went back to Brussels, he received a promise that Monmouth too should be removed from favour and ordered to leave the country. Accordingly, in September 1679, the latter repaired to Utrecht, while shortly afterwards James's friends so far gained ground as to obtain for him permission to reside at Edinburgh instead of at Brussels. Within two months of his arrival at Utrecht Monmouth secretly returned to England, arriving in London on the 27th of November. Shaftesbury had assiduously kept alive the anti-popery agitation, and Monmouth, as the champion of Protestantism, was received with every sign of popular delight. The king appeared to be greatly incensed, deprived him of all his offices, and ordered him to leave the kingdom at once. This he refused to do, and the only notice taken of the disobedience was that Charles forbade him to appear at court.

It was at this time that the *Appeal from the Country to the City*, written by Ferguson, was published, in which the legitimacy was tacitly given up, and in which it was urged that "he that hath the worst title will make the best king." Now it was, too, that the exclusionists, who in the absence of parliament were deprived of their best basis for agitation, developed the system of petitioning. So promptly and successfully was this answered by the "abhorrers" that Charles, feeling the ground safer under him, recalled James to London—a step immediately followed by the resignation of the chief Whigs in the council.

Once more, however, a desperate attempt was made, by the fable of the "black box," to establish Monmouth's claims; and once more these claims were met by Charles's public declarations in the *Gazette* that he had never been married but to the queen. Still acting under Shaftesbury's advice, Monmouth now went upon the first of his progresses in the west of England, visiting the chief members of the country party, and gaining by his open and engaging manner much popularity among the people. In August 1680 James returned to Edinburgh, his right to the succession being again formally acknowledged by Charles. Monmouth at once threw himself more vehemently than ever into the plans of the exclusionists. He spoke and voted for exclusion in the House of Lords, and used language not likely to be forgotten by James when an opportunity should come for resenting it. He was ostentatiously feasted by the city, the stronghold of Shaftesbury's influence; and it was observed as he drove to dinner that the mark of illegitimacy had been removed from the arms on his coach.

The year 1681 seemed likely to witness another civil war. The parliament finished a session of hysterical passion by passing a series of resolutions of extreme violence, of which one was that Monmouth should be restored to all his offices and commands; and when Charles summoned a fresh parliament to meet at Oxford the leaders of the exclusionists went thither with troops of armed men. Not until the dissolution of this last parliament, on the 27th of March 1681, did the weakness of Monmouth's cause appear. The deep-seated respect for legitimate descent asserted itself, and a great reaction took place. In November Dryden published *Absalom and Achitophel*. Shaftesbury was attacked, but was saved for the time by a favouring jury. Monmouth himself did not escape insult in the street and from the pulpit. He was forbidden to hold communication with the court; and when he went, in September 1682, on a second progress through the western and north-western counties his proceedings were narrowly watched, and he was at length arrested at Stafford. Severity and extreme lenity were strangely mingled in the treatment he received. He was released on bail, and in February 1683, after the flight and death of Shaftesbury, he openly broke the implied conditions of his bail by paying a third visit to Chichester with Lord Grey and others on pretence of a hunting expedition.

It is probable that Monmouth never went so far as to think of armed rebellion; but there is little doubt that he had talked over schemes likely to lead to this, and that Shaftesbury had gone farther still. The Rye House plot gave an excuse for arresting the Whig leaders; Russell and Sidney were judicially murdered; Monmouth retired to Toddington, in Bedfordshire, and was left untouched. Court intrigue favouring him, he succeeded, by the betrayal of his comrades and by two submissive letters, in reconciling himself with the help of Halifax both to the king and to James, though he had the humiliation of seeing his confessions and declarations of penitence published at length in the *Gazette*. His character for pettishness and folly was thus amply illustrated. Charles heartily despised him, and yet appears to have retained affection for him. His partial return to favour raised the hopes of his partisans; to check these, Algernon Sidney was executed. Monmouth was now subpoenaed to give evidence at the trial of young Hampden. To escape from the difficulties thus opened before him he fled to Holland, probably with Charles's connivance, and though he once more, in November 1684, visited England, it is doubtful whether he ever again saw the king.

The quiet accession of James II. soon brought Monmouth to the crisis of his fate. Within two months of Charles's death he had yielded to the impetuosity of Argyll and others of the exiles and to vague invitations from England. It is curious, as showing the light in which his claims were viewed by his fellow-conspirators, that one of the terms of the compact between them was that, though Monmouth should lead the expedition, he should not assume the title of king without their consent, and should, if the rebellion were successful, resign it and accept whatever rank the nation might offer. Now, as always, he was but a puppet in other men's hands.

On the 2nd of May Argyll sailed with three ships to raise the west of Scotland; and three weeks later, with a following of only eighty-two persons—of whom Lord Grey, Fletcher of Saltoun, Wade, and Ferguson, the author of the *Appeal from the Country to the City*, were the chief—Monmouth himself set out for the west of England, where, as the stronghold of Protestant dissent and as the scene of his former progresses, he could alone hope for immediate support. Even here, however, there was no movement; and when on the 11th of June Monmouth's three ships, having eluded the royal fleet, arrived off Lyme Regis, he landed amid the curiosity rather than the sympathy of the inhabitants. In the market-place his "declaration," drawn up by Ferguson, was read aloud. In this document James was painted in the blackest colours. Not only was he declared to be the murderer of Essex, but he was directly charged with having poisoned Charles to obtain his crown. Monmouth soon collected an undisciplined body of some 1500 men, with whom he seized Axminster, and entered Taunton. Meanwhile the parliament had declared it treason to assert Monmouth's legitimacy, or his title to the crown; a reward of £5000 was offered for him dead or alive, and an act of attainder was passed in unusual haste. Troops had been hurriedly sent to meet him, and when he reached Bridgwater Albemarle was already in his rear. From Bridgwater the army marched through Glastonbury to attack Bristol, into which Lord Feversham had hastily thrown a regiment of foot-guards. The attempt, however, miscarried; and, after summoning Bath in vain, Monmouth, with a disordered force, began his retrograde march through Philips Norton and Frome, continually harassed by Feversham's soldiers. At the latter place he heard of Argyll's total rout in the western Highlands. He was now anxious to give up the enterprise, but was overruled by Grey, Wade and others. On the 3rd of July he reached Bridgwater again, with an army little better than a rabble, living at free quarters and behaving with reckless violence. On Sunday, the 5th, Feversham entered Sedgemoor in pursuit; Monmouth the same night attempted a surprise, but his troops were hopelessly routed. He himself, with Grey and a few others, fled over the Mendip Hills to the New Forest, hoping to reach the coast and escape by sea. The whole country, however, was on the alert, and at midnight on the 8th, within a month of their landing, James heard that the revolt, desperate from the first, was over and that his rival had been captured close to Ringwood in Hampshire.

On the day of his capture Monmouth wrote to James in terms of the most unmanly contrition, ascribing his wrong-doings to the action of others, and imploring an interview. On the 13th the prisoners reached the Tower, and on the next day Monmouth was allowed to see James. No mercy was shown him, nor did he in the least deserve mercy; he had wantonly attacked the peace of the country, and had cruelly libelled James. The king had not, even in his own mind, any family tie to restrain him from exercising just severity, for he had never believed Monmouth to be the son of any one but Robert Sidney. Two painful interviews followed with the wife for whom he bore no love, and who for him could feel no respect; another imploring letter was sent to the king, and abject protestations and beseechings were made to all whom he saw. He offered, as the last hope, to become a Roman Catholic, and this might possibly have proved successful, but the priests sent by James to ascertain the sincerity of his "conversion" declared that he cared only for his life and not for his soul.

He met his death on the scaffold with calmness and dignity. In the paper which he left signed, and to which he referred in answer to the questions wherewith the busy bishops plied him, he expressed his sorrow for having assumed the royal style, and at the last moment confessed that Charles had denied to him privately, as he had publicly, that he was ever married to Lucy Walters. He died at the age of thirty-six, on the 15th of July 1685.

Monmouth had four sons and two daughters by his wife, who in 1688 married the 3rd Lord Cornwallis and died in 1732. The elder of the two surviving sons, James, earl of Dalkeith (1674–1705) had a son Francis (1695–1751), who through his grandmother inherited the title of duke of Buccleuch in 1732, and was the ancestor of the later dukes. The younger son, Henry (1676–1730), was created earl of Deloraine in 1706, and rose to be a major-general in the army.

The best accounts of Monmouth's career, apart from the modern histories, are G. Roberts's detailed *Life* (1844), the articles in the *Dict. Nat. Biog.* (by A. W. Ward) and in Collins's *Peerage*, and the *Correspondence of Lord Clarendon with James, earl of Abingdon*, 1683–1685 (Clarendon Press, 1896). For the rebellion, Lord Grey's *Secret History* (1754) should be consulted. See also Evelyn's and Pepys's *Diaries*, &c.

MONMOUTH, ROBERT CAREY, 1ST EARL OF (*c.* 1560–1639), youngest son of Henry Carey, 1st Baron Hunsdon, chamberlain and first cousin of Queen Elizabeth, by Anne, daughter of Sir Thomas Morgan, of Arkestone in Herefordshire, was born about the year 1560. As a young man he accompanied several diplomatic missions abroad and took part in military expeditions. In 1587 he joined in the attempt to relieve Sluys, in 1588 served as a volunteer against the Spanish expedition, and commanded a regiment in Essex's expedition to Normandy in 1591, taking part in the siege of Rouen. He was knighted by Essex the same year for having by his intercession with the queen procured his recall. In the parliaments of 1586 and 1588 he represented Morpeth; in that of 1593, Callington; and in those of 1596 and 1601, Northumberland. From 1593 till the end of Elizabeth's reign he occupied various posts in the government of the Scottish borders, succeeding to his father's appointment of lord warden of the marches in 1596, which he held till February 1598. In March 1603 he visited the court, and witnessed the queen's last illness, which he described in his *Memoirs*. Anxious to recommend himself to her successor, and disobeying the orders of the council, he started on horseback immediately after the queen's death on the morning of the 24th of March, in order to be the first to communicate the tidings to James, arrived at Holyrood late on the 26th, and was appointed by the king a gentleman of the bedchamber. But his conduct met with general and merited censure as "contrary to all decency, good manners and respect," and on James's arrival in England he was dismissed from his new post. On the 23rd of February 1605, however, he was made governor of Prince Charles, in 1611 his master of the robes, in 1617 his chamberlain, and on the 6th of February 1622, he was created Baron Carey of Leppington. In 1623 he followed Charles to Spain, and after the latter's succession to the throne he was created earl of Monmouth in 1626. He died on the 12th of April 1639. His eldest son HENRY (1596–1661), succeeded him as 2nd earl of Monmouth, and on his death without surviving male issue the peerage became extinct.

His *Memoirs* were published first by the earl of Cork and Orrery in 1759, a new edition, annotated by Sir Walter Scott, being printed in 1808.

MONMOUTH (Welsh *Mynwy*), a municipal and contributory parliamentary borough, and the county town of Monmouthshire, England, 18 m. S. of Hereford, on the Great Western railway. Pop. (1901), 5095. It is picturesquely situated at the confluence of the Wye and the Monnow, between the two rivers, and is almost surrounded by hills. Portions of the town walls remain, and there is a picturesque old gateway on the Monnow bridge; but there are only insignificant ruins of the castle, which was originally a Saxon fortress, and was twice taken by the Parliamentary forces during the Civil War. Besides the churches—that of St Mary, completed in 1882 on an ancient site, and the chapel of St Thomas, a late Norman structure—the principal buildings are the town-hall, the Rolls Hall and the free grammar-school, which was founded in 1614, and educates about 150 boys on the usual lines of a public school. A statue of Henry V., who was born in its castle, stands in the market-place. With Newport and Usk, Monmouth forms the Monmouth parliamentary district of boroughs, returning one member.

Monmouth (*Monemuta*) from the coincidence of position is supposed to be the *Blaestium* of Antoninus. Situated between the Severn and the Wye its strategic importance was early recognized by the Saxons, who fortified it against the Britons, while in later years it played a leading part in Welsh border warfare. At the time of the Domesday Survey the castle was in the custody of William Fitz Baderon. Henry III. granted it, together with the lordship of the borough, to his son Edmund Crouchback, through whose descendants both borough and castle passed into the duchy of Lancaster. Since the 18th century the dukes of Beaufort have been lords of the borough. Monmouth was a borough by prescription as early as 1256, and was governed by a mayor in 1461, but was not incorporated until 1550 under the title of "Mayor, Bailiffs and Commonalty." This charter was confirmed in 1558, 1606 and 1666, a recorder and town clerk being added to the constitution. In accordance with the act of 1535–1536 Monmouth as county town obtained the right of representation in parliament; the earliest returns existing are for 1553, since which date one member has been returned regularly. Wednesday and Saturday markets were confirmed to Monmouth in 1550, with the further proviso that no others were to be held within five miles of the borough. Friday is now the weekly market-day. At the same time an annual three-days' fair, which still exists, was granted on Whit-Tuesday and successive days. During the 16th and 17th centuries the manufacture of Monmouth caps was an important industry, fostered by legislation and mentioned by Fuller in his *Worthies of England*.

See Charles Heath, *The Town of Monmouth* (Monmouth, 1804).

MONMOUTH, a city and the county-seat of Warren county, Illinois, in the W. part of the state, about 40 m. S. of Rock Island. Pop. (1890), 5936; (1900), 7460, (594 foreign-born); (**1910**), **9128**. It is served by the Chicago, Burlington & Quincy and the Iowa Central railways, and by electric railways to Galesburg and to Rock Island. The city is the seat of Monmouth College (1856; United Presbyterian), which in 1908 had 28 instructors and 454 students. Among the public buildings and institutions are the county court-house, the federal building, a hospital and the Warren county library (1836). Monmouth is situated in a good farming region, and cattle, swine and ponies are raised in the vicinity. The city has various manufactures. Monmouth was settled about 1824, first incorporated as a village in 1836, chartered as a city in 1852 and in 1882 reorganized under a general state law.

MONMOUTH, BATTLE OF (1778), a battle in the American War of Independence. The prospect of an alliance between France and America in 1778 induced the British to concentrate their forces. Sir Henry Clinton, who had succeeded Sir W. Howe in command, determined to abandon Philadelphia, captured in the previous year, and move his troops direct to New York through New Jersey. Washington, who had spent the winter at Valley Forge, Pennsylvania, and had materially recruited his army, immediately marched to intercept the British, and overtook them near Monmouth Court House (now Freehold), New Jersey, on the 28th of June 1778. A strong detachment of Americans under General Charles Lee was sent forward to harass the enemy's rear and if possible cut off a portion of their long baggage train. Clinton strengthened his rearguard, which turned upon the Americans and compelled them to retreat. When Washington, who was well up with his main body, heard of Lee's retreat, he spurred forward and exerted himself in forming a strong line of battle in case the British continued their determined attack. Warm words passed between Washington and Lee, which subsequently led to the latter's court-martial and suspension for a year. The readjusted American line was composed of the divisions of Lafayette, Greene, Alexander and Patterson, while Wayne's brigade, which had been in Lee's advance from the first, was posted in a favourable position. The British attacked this line and a warm, though brief, engagement ensued. Both sides encamped at night on the ground occupied. The British, having accomplished their object in delaying Washington's pursuit, continued their march the next day towards New York. Washington turned to the left, crossed the Hudson above, and encamped for the remainder of the season at White Plains, New York, within striking distance of the city. Each side suffered about the same loss in the battle, that of the British being 400 (60 due to sunstroke), the American somewhat less. In this engagement Lieut.-Colonel Henry Monckton (1740–1778) of the British Grenadiers was killed in leading a charge.

MONMOUTHSHIRE, a western border county of England, bounded E. by Gloucestershire, N. E. by Herefordshire, N.W. by Brecknock, W. and S.W. by Glamorganshire (Wales), and S. by the estuary of the river Severn. The area is 534 sq. m. The surface is varied, and in many districts picturesque, especially along the valley of the Wye, and between that river and the Usk. In the west and north the hills rise to a considerable height, and this mountain region encircles a finely undulating country. The highest summits are Sugar Loaf (1955 ft.), Blorenge (1838), and Skirrid Fawr (1601), summits of the hills which almost encircle the town of Abergavenny. On the other hand, along the shore of the Severn estuary on either side of the Usk, are two extensive tracts of marshland, called the Caldicot and Wentlloog levels, stretching from Cardiff to Portskewet, and protected from inundations by strong embankments. The principal rivers are the Wye, which forms the greater part of the eastern boundary of the county with Gloucestershire, and falls into the Severn; the Monnow, which forms a portion of its boundary with Herefordshire, and falls into the Wye at the town of Monmouth; the Usk, which rises in Brecknock, and flows southward through the centre of the county; the Ebbw, which rises in the north-west, and enters the estuary of the Usk below Newport; and the Rhymney, which rises in Brecknock, and, after forming the boundary between Monmouth and Glamorgan, enters the Bristol Channel a little east of Cardiff. Salmon abound especially in the Wye and the Usk, and trout are plentiful in many of the streams.

Geology.—The oldest rocks in the county are the Silurian strata (Wenlock Shale and Limestone, and Ludlow Beds) which form an extensive anticline at Usk; a smaller inlier appears at Rumney on the south-west borders of the county near Cardiff. These beds dip under the Old Red Sandstone, a great series of red marls, sandstones and concretionary limestones (cornstones) which occupies the north-eastern part of the county; the highest beds contain grits and conglomerates which give rise to bold escarpments and lofty plateaux (*e.g.* the Sugar Loaf and Skirrid Fawr) alongside the outcrop of the Carboniferous Limestone. The western part of the county, between Pontypool and the river Rhymney, is occupied by the eastern end of the great South Wales coal-field, where the Carboniferous Limestone, Millstone Grit and Coal Measures (Lower Coal Series, Pennant Sandstone and Upper Coal Series) dip westward and succeed each other from east to west. The Coal Measures abound in coal-seams and ironstone, and their densely populated valleys offer a marked contrast to the agricultural and pastoral districts of the rest of the county. The Carboniferous Limestone comes in again in the south-east near Chepstow, and has imparted its characteristic scenery to the lower reaches of the Wye. After a prolonged interval, during which these older formations were folded, faulted, upheaved and finally carved by erosion into hills and valleys, the southern portion of the region was submerged beneath the waters of the Triassic lake in which the Keuper Marls were deposited. These consist of red conglomerates and marls which wrap round the heights and fill up the hollows among the older rocks to the south-west of Chepstow, and the subsidence continuing, admitted the waters of the Jurassic sea which deposited the fossiliferous Rhaetic and Lias limestones and shales of Llanwern and Goldcliff near Newport. Glacial gravel and boulder-clay are found in the valleys and a broad tract of alluvium borders the shores of the Bristol Channel.

Agriculture.—Along the Severn shore the soil is deep and loamy, and admirably suited for the growth of trees. The most fertile land is that resting on the Red Sandstone, especially along the banks of the Usk, where wheat of fine quality is raised. In the mountainous regions more attention is paid to grazing than to the raising of crops. There are a considerable number of dairy farms, but sheep-farming is much more largely followed. Only about seven-tenths of the total area of the county is under cultivation. There is a large extent of hill pasture, and a considerable acreage under orchards.

Mining.—The coal-mines and iron-works which Monmouthshire shares with South Wales are very important. They occur in the wild and mountainous western part of the county, where a series of upland valleys, running parallel from N.N.W. to S., has each its populous mining townships and railways, which have in many cases necessitated remarkable engineering works—such as the great Crumlin viaduct. These valleys, in order from east to west, with the principal townships in each, are as follows: Afon Lwyd (Panteg, Pontypool, Abersychan and Blaenavon); Ebbw Fach (Abertillery, Nantyglo and Blaina), joining the Ebbw (Risca, Ebbw Vale); Sirhowy (Bedwellty and Tredegar); Rhymney (New Tredegar and Rhymney). Besides coal, a considerable quantity of fire-clay and some iron are raised.

Communications.—The principal railway serving the county is the Great Western, but in the mining districts there are also various branches of the London and North-Western, Rhymney and Brecon and Merthyr systems. The Crumlin Canal from the Ebbw Valley, and the Monmouthshire Canal from Pontypool converge upon Newport, which is the principal port in the county. The Brecon Canal runs north from Pontypool into the valley of the Usk.

Population and Administration.—The area of the ancient county is 341,688 acres, with a population in 1891 of 252,416, and in 1901 of 292,317. The area of the administrative county is 349,712 acres. The county comprises 6 hundreds. The municipal boroughs are Abergavenny (pop. 7795), Monmouth (5095), and Newport, a county borough (67,270). The following are urban districts: Abercarn (12,607), Abersychan (17,768), Abertillery (21,945), Bedwellty (9988), Blaenavon (10,869), Caerleon (1367), Chepstow (3067), Ebbw Vale (20,994), Llanfrechfa, Upper (2979), Llantarnam (5287), Mynyddislwyn (3337), Nantyglo and Blaina (13,489), Panteg (7484), Pontypool (6126), Rhymney (7915), Risca (9661), Tredegar (18,497), and Usk (1476). Monmouthshire is in the Oxford circuit, and assizes are held at Monmouth. It has one court of quarter sessions, and is divided into 11 petty sessional divisions. The boroughs of Monmouth and Newport have commissions of the peace, but no separate court of quarter sessions. The parliamentary divisions are the northern, western and southern, each returning one member; and the Monmouth district of parliamentary boroughs, consisting of the towns of Monmouth, Newport and Usk, returns one member.

History.—The district which is now Monmouthshire formed the Welsh kingdom of Gwent at the time of the Heptarchy, and, owing to the extraordinary courage of the Gwentians in resisting the repeated inroads of the Saxons, no permanent English settlement was effected in the district until close upon the middle of the 11th century. The incursions of the West Saxons began in the 7th century, and, during the reign of Alfred, Brochmael and Fermael, kings of Gwent, acknowledged Alfred as their lord, and sought his protection against their enemies. In the 9th and 10th centuries the district was frequently harried by the Danes, who in 915, under Ohter and Hwald, sailed round Wessex and Cornwall to the mouth of the Severn and plundered all along the banks of the Wye, finally taking prisoner the bishop of Llandaff, whom they only released on a ransom of £40. In 926 Æthelstan obliged the kings of the north Britons to meet him at Hereford and fixed the Wye as the limit of their territory. In 976 the Danes destroyed Caerleon, at this time the chief town of the district. The early 11th century was taken up with a series of interminable contests between the Welsh princes for the succession in South Wales, as a result of which the Welsh Chronicle relates that in 1047 the whole of South Wales lay waste, and in 1049, when a fleet of Irish pirates entered the Severn estuary, Griffith, the king of South Wales, assisted them in plundering the neighbourhood. In 1065 Harold conquered the whole district between the lower reaches of the Wye and the Usk, and gave orders for the construction of a hunting-box at Portskewet for Edward the Confessor, but very shortly after Caradoc ap Griffith, with a large body of followers, killed all the workmen engaged in the building and carried away the provisions prepared for the king's reception.

After the Conquest the district conquered by Harold was bestowed on William Fitz Osborne, earl of Hereford, who built Monmouth Castle, and continued the line of defence against the Welsh frontier along the Wye, while a second line of fortifications along the Usk Valley marked the continued advance of the Normans, who by 1085 had subjugated almost the whole of Gwent. The lordship of Overwent fell to Hamelin de Baladun, who founded the castle and priory of Abergavenny, and from him passed to Brian Fitz Count and later to Walter Fitz Miles, earl of Hereford. The lordship of Netherwent remained for many centuries with the Clare family. Penhow Castle was a stronghold of the family of St Maur or Seymour, from whom are descended the present dukes of Somerset, and Grosmont and Skenfrith Castles of the family of Braose. Gwent still ranked as Welsh territory at the time of the Domesday Survey, but the town of Monmouth, the castle of Caerleon, and the district of Archenfeld, are assessed under Herefordshire, and the three hardwicks of Llanwern, Portskewet and Dinam under Gloucestershire. The Norman lords of the present county held their lands "per baroniam," so that the king's writ did not run in them, and the lives and property of the poorer inhabitants were entirely at the mercy of these lords marchers as they were termed. The county still exhibits remains of no less than twenty-five Norman castles. The province of Gwent was formerly divided into four cantrefs, each comprising several commotes. Cantref Uwchcoed, or Upper Gwent, comprised the commotes of Erging and Ewyas, now principally in Herefordshire, and the greater part of the present hundreds of Skenfrith, Abergavenny and Usk; Cantref Iscoed, or Lower or Nether Gwent, comprised the present hundred of Raglan and parts of Caldecote and Usk; Cantref Gwentlwg comprised the present hundred of Wentlwg; while the fourth cantref, Cantref Coch, now forms the Forest of Dean in Gloucestershire. Leland, writing in the 16th century, describes Gwent as comprising the three divisions of low, middle and high "Venteland," and at this period it included no less than 24 lordship marches, each governed by its own ancient laws and customs and ruled by its own lord. Under the act of 1536 for the abolition of the marches, these 24 lordships were united to form a shire; Monmouth was constituted the shire town, and the sheriff's court was ordered to be held alternately at Monmouth and Newport. A commission was also appointed to divide the shire into hundreds, which were made 6 in number: Abergavenny, Caldecote, Raglan, Skenfrith, Usk and Wentlwg, the bounds being subsequently ratified by act of parliament of 1542–1543. No sheriffs were actually appointed for Monmouthshire until 1541, and the legal authority of the lords marchers was not finally abolished until 1689. The act of 1536 did not expressly separate the county from Wales, and it was only gradually that Monmouthshire came to be regarded as an English county, being included in the Oxford circuit for the first time in the reign of Charles II.

Ecclesiastically Monmouthshire has been almost entirely included in the diocese of Llandaff since the foundation of that diocese in the 6th century. Monmouth, however, was in the diocese of Hereford, and a few parishes formed part of the diocese of St Davids, until under the statute of 1836 the whole county was placed under the jurisdiction of the bishop of Llandaff. It contains, wholly or in part, 134 ecclesiastical parishes.

The river fisheries of Monmouthshire have been famed from very early times, Caerleon with seven fisheries in the Wye and the Usk yielding a return of £7, 10s. at the time of the Domesday Survey. Coal is said to have been worked in the reign of Edward I., but the industry lapsed altogether until it received new life from the construction of the canal between Blaenavon and Newport, begun in 1792 and completed in 1795. The first iron-workers at Pontypool were a family of the name of Grant, who were succeeded in 1565 by Mr Richard Hanbury. In 1740, however, Monmouthshire contained only two furnaces, making 900 tons annually. Fifty years later three new furnaces were constructed at Blaenavon, and from that date the industry steadily improved.

By the act of 1536 two knights were to be returned for the shire and one burgess for the borough of Monmouth, but the first returns for the county were made in 1547 and for the borough in 1553. From 1698 the boroughs of Newport and Usk returned one member each. Under the Redistribution of Seats Act of 1885 the county now returns three members in three divisions.

Antiquities.—Of Norman fortresses in Monmouthshire, either built or taken possession of by the lords of the marches, there are remains of no less than twenty-five. The more interesting and important are: Caldicot, the seat of the De Bohuns, with a round keep of the 13th century, gatehouse and other portions, still partly inhabited; Chepstow, one of the finest examples of the Norman fortress extant, in an imposing situation on a cliff above the Wye; Newport, Abergavenny, the gateway and hall of Grosmont, once the residence of the dukes of Lancaster; and Usk Castle, rebuilt by the Clares in the time of Edward IV. Raglan Castle, begun in the reign of Henry V., is a very extensive ruin, still in good preservation, and of special interest as a very late example of the feudal stronghold. Charles I. resided in it after the battle of Naseby, and in 1646 it was delivered up to the parliamentary forces after a stubborn resistance of ten weeks against Colonel Morgan and General Fairfax.

At the Reformation there were in Monmouth two hospitals and fifteen other religious houses; but of these there are now important remains of only two—Llanthony Abbey and Tintern Abbey, both Cistercian. Llanthony Abbey in the Black Mountains was founded by William de Lacy in 1103, and the church, dating from about 1200, is one of the earliest examples in England of the Pointed style. The ruins consist of portions of the nave, transept, central tower and choir. Tintern Abbey (*q.v.*), founded by Walter de Clare in 1131, occupies a position of great beauty on the Wye, and is among the finest monastic ruins in England. Of the churches, those chiefly worthy of mention are at Abergavenny, belonging to a Benedictine priory, and containing a number of old tombs; Chepstow, partly Norman, and possessing a richly moulded doorway; St Woolos' Church, Newport, also Norman; the Norman chapel of St Thomas, Monmouth; Christchurch, principally Norman; Mathern, Early English, with a tablet to Tewdrig, king of Gwent in the 6th century; and Usk, formerly attached to a Benedictine priory.

See *Victoria County History, Monmouthshire*; William Coxe, *An Historical Tour in Monmouthshire*, 2 pts. (London, 1801); N. Rogers, *Memoirs on Monmouthshire* (London, 1708); David Williams, *History of Monmouthshire* (1796); George Ormerod, *Strigulensia. Archaeological Memoirs relating to the District adjacent to the Confluence of the Severn and the Wye*; M. E. Bagnall-Oakeley, *Account of the Rude Monuments in Monmouthshire* (Newport, 1889); J. A. Bradney, *A History of Monmouthshire* (1904, &c.); also the publications of the Caerleon Antiquarian Association.

MONNIER, MARC (1827–1885), French writer, was born at Florence on the 7th of December 1827. His father was French, and his mother a Genevese; he received his early education in Naples, he then studied in Paris and Geneva, and he completed his education at Heidelberg and Berlin. He became professor of comparative literature at Geneva, and eventually vice-rector of the university. He died at Geneva on the 18th of April 1885. He wrote a series of short, satirical, dramatic sketches collected as *Théâtre de marionettes* (1871), and stories, notably *Nouvelles napolitaines* (1879), numerous works on Italian history, a translation of Goethe's *Faust*, *Genève et ses poètes* (1873), &c. The first volume of his *Histoire de la littérature moderne, La Renaissance, de Dante à Luther* (1884), was crowned by the French Academy.

See E. Rambert, *Écrivains nationaux suisses*, vol. i. (Geneva, 1874).

MONNIKENDAM, a fishing village of Holland, in the province of North Holland, on an inlet of the Zuider Zee known as the Gouw Zee, 12 m. N.N.E. of Amsterdam, with which it is connected by steam tramway. It was once a flourishing town, but its quietness now is only disturbed by the advent of the numerous tourists who visit it in the summer, crossing hence to the island of Marken. Among the notable buildings are the weigh-house (17th century), the bell-tower (1591), formerly attached to the town-hall before this was destroyed in the 18th century, and the church of St. Nicholas, with its beautiful massive tower. Mention is made of this church in a document of 1356, but it was not completed until the beginning of the 15th century. It contains some fine carvings, many interesting old tombs, and a monument of Jan Nieuwenhuizen, the founder of the Society for Public Welfare (*Tot Nut van het Algemeen*) in 1785.

MONOCHORD (Gr. *μονόχορδον, κανὼν μουσικός*; med. Lat. *monochordum*), an instrument having a single string, used by the ancient Greeks for tuning purposes and for measuring the scale arithmetically. The monochord, as it travelled westwards during the middle ages, consisted of a long board, or narrow rectangular box, over which was stretched the single string; along the edge of the sound-board was drawn a line divided according to simple mathematical ratios to show all the intervals of the scale. A movable bridge was so contrived as to slide along over the string and stop it at will at any of the points marked. The vibrating length of string, being thus determined as on the guitar, lute, violin, &c., yielded a note of absolutely correct pitch on being twanged by fingers or plectrum. In order the better to seize the relation of various intervals, a second string tuned to the same note, but out of reach of the bridge, was sometimes added to give the fundamental. (K. S.)

MONOD, ADOLPHE (1802–1856), French Protestant divine, was born on the 21st of January 1802, in Copenhagen, where his father was pastor of the French church. He was educated at Paris and Geneva, and began his life-work in 1825 as founder and pastor of a Protestant church in Naples, whence he removed in 1827 to Lyons. Here his evangelical preaching, and especially a sermon on the duties of communicants ("Qui doit communier"?), led to his deposition by the Catholic Minister of education and religion. Instead of leaving Lyons he began to preach in a hall and then in a chapel. In 1836 he took a professorship in the theological college of Montauban, removing in 1847 to Paris as preacher at the Oratoire. He died on the 6th of April, 1856. Monod was undoubtedly the foremost Protestant preacher of 19th-century France. He published three volumes of sermons in 1830, another, *La Crédulité de l'incrédule* in 1844, and two more in 1855. Two further volumes appeared after his death. His elder brother Frédéric (1794–1863), who was influenced by Robert Haldane, was also a distinguished French pastor, who with Count Gasparin founded the Union of the Evangelical Churches of France; and Frédéric's son Théodore (b. 1836) followed in his footsteps.

MONOD, GABRIEL (1844–), French historian, was born at Havre on the 7th of March, 1844. Adolphe Monod (*q.v.*) was his uncle. Having studied at Havre, he went to Paris to complete his education, and whilst there lived with the family of De Pressensé. The influence of Edmond de Pressensé, a pastor and large-minded theologian, and of Madame de Pressensé, a woman of superior intellect and refined feeling, who devoted her life to educational works and charity, made a great impression on him. In 1865 he left the *école normale supérieure*, and went to Germany, where he studied at Göttingen and Berlin. The teaching of George Waitz definitely directed his studies towards the history of the middle ages. Returning to France in 1868 he was nominated by V. Duruy to give lectures on history, following the method used in German seminaries, at the *école des hautes études*. When the Franco-Prussian War broke out, Gabriel Monod, with his cousins, Alfred and Sarah Monod, organized an ambulance with which he followed the whole campaign, from Sedan to Mans. He wrote a small book of memoirs of this campaign, *Allemands et français* (1871), in which he spoke of the conquerors without bitterness; this attitude was all the more praiseworthy as his mother was an Alsatian, and he was unable to resign himself to the loss of Alsace and Lorraine. The war being over he returned to teaching. At this period of his life he wrote *Grégoire de Tours et Marius d'Avenche* (1872); *Frédégaire*, whose history, taken from original MSS., he published in 1885; a translation of a book of W. Junghans, *Histoire critique des règnes de Childerich et de Chlodovech*, with introduction and notes (1879); *Études critiques sur les sources de l'histoire carolingienne* (1898, 1st part only published); and *Bibliographie de l'histoire de France* (1888). He himself said that his pupils were his best books; he intended to teach them not so much new facts as the way to study, endeavouring to develop in them an idea of criticism and truth. They showed their gratitude by dedicating a book to him in 1896, *Études d'histoire du moyen âge*, and after his retirement in 1905 by having his features engraved on a slab (see *À Gabriel Monod, en souvenir de son enseignement: école pratique des hautes études, 1868–1905, école normale supérieure, 1880–1904. May 26, 1907*). In 1875 he founded the *Revue Historique*, which rapidly became a great authority on scientific education. Some of his articles in this and other periodicals have been put together in book form, *Les Maîtres de l'histoire: Renan, Taine, Michelet* (1894); *Portraits et souvenirs* (1897: on Hugo, Fustel de Coulanges, V. Duruy, &c.).

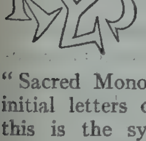
MONODELPHIA (*i.e.* "single uterus,"—in allusion to the fusion of at least the basal portions of this organ, and in contradistinction to their duality in the Didelphia, or Marsupialia), Cuvier's name for the group which includes all the orders of mammals (See MAMMALIA) except the Marsupialia and Monotremata; other titles for this group being Placentalia and Eutheria. With the Monotremata (*q.v.*) this group has no near affinity; and while more nearly related to the Marsupialia (*q.v.*), in which an imperfect allantoic placenta is sometimes developed, it is broadly distinguished therefrom by the invariable presence of a functional placenta by the aid of which the foetus is nourished throughout the greater portion of intra-uterine life. Other distinctive features by which marsupials are separated from monodelphians or placentals will be found in the article last mentioned. (R. L.*)

MONOGENISTS, the term applied to those anthropologists who claim that all mankind is descended from one original stock (μόνος single, and γένος, race), and generally from a single pair; while polygenists (πολύς, many) contend that man has had many original ancestors. Of the older school of scientific monogenists J. F. Blumenbach and J. C. Prichard are eminent representatives, as is A. de Quatrefages of the more modern. The great problem of the monogenist theory is to explain by what course of variation races of man so different have sprung from a single stock. In ancient times little difficulty was felt in this, authorities such as Aristotle and Vitruvius seeing in climate and circumstance the natural cause of racial differences, the Ethiopian having been blackened by the tropical sun, &c. Later and closer observations, however, have shown such influences to be, at any rate, far slighter in amount and slower in operation than was supposed. M. de Quatrefages brings forward (*Unité de l'espèce humaine*, Paris, 1861, ch. 13) his strongest arguments for the variability of races under change of climate, &c. (*action du milieu*), instancing the asserted alteration in complexion, constitution, and character of negroes in America, and Englishmen in America and Australia. But although the reality of some such modification is not disputed, especially as to stature and constitution, its amount is not enough to countervail the remarkable permanence of type displayed by races ages after they have been transported to climates extremely different from that of their former homes. Moreover, physically different races, such as the Bushmen and the pure negroid types in Africa, show no signs of approximation under the influence of the same climate; on the other hand, the coast tribes of Tierra del Fuego and forest tribes of tropical Brazil continue to resemble each other, in spite of extreme differences of climate and food. Darwin, than whom no naturalist could be more competent to appraise the variation of a species, is moderate in his estimation of the changes produced on races of man by climate and mode of life within the range of history (*Descent of Man*, pt. i. chs. 4 and 7). The slightness and slowness of variation in human races having been acknowledged, a great difficulty of the monogenist theory was seen to lie in the shortness of the chronology with which it was formerly associated. Inasmuch as several well-marked races of mankind, such as the Egyptian, Phoenician and Ethiopian, were much the same three or four thousand years ago as now, their variation from a single stock in the course of any like period could hardly be accounted for except by a miracle. This difficulty was escaped by the polygenist theory (see Georges Pouchet, *Plurality of the Human Race*, 1858, 2nd ed., 1864, Introd.). Two modern views have, however, intervened which have tended to restore, though under a new aspect, the doctrine of a single human stock. One has been the recognition of the fact that man has existed during a vast period of time, which has made it easier to assume the continuance of very slow natural variation of races. The other view is that of the evolution or development of species. It does not follow necessarily from a theory of evolution of species that mankind must have descended from a single stock, for the hypothesis of development admits of the argument that several simian species may have culminated in several races of man (Vogt, *Lectures on Man*, London, 1864, p. 463). The general tendency of the development theory, however, is against constituting separate species where the differences are moderate enough to be accounted for as due to variation from a single type. Darwin's summing up of the evidence as to unity of type throughout the races of mankind is as distinctly a monogenist argument as those of Blumenbach, Prichard or Quatrefages:—

> "Although the existing races of man differ in many respects, as in colour, hair, shape of skull, proportions of the body, &c., yet if their whole organization be taken into consideration they are found to resemble each other closely in a multitude of points. Many of these are so unimportant, or of so singular a nature, that it is extremely improbable that they should have been independently acquired by aboriginally distinct species or races. The same remark holds good with equal or greater force with respect to the numerous points of mental similarity between the most distinct races of man. . . . Now when naturalists observe a close agreement in numerous small details of habits, tastes and dispositions, between two or more domestic races, or between nearly allied natural forms, they use this fact as an argument that all are descended from a common progenitor who was thus endowed, and, consequently, that all should be classed under the same species. The same argument may be applied with much force to the races of man." (*Descent of Man*, pt. i. ch. 7.)

A suggestion by A. R. Wallace has great importance in the application of the development theory to the origin of the various races of man; it is aimed to meet the main difficulty of the monogenist school, how races which have remained comparatively fixed in type during the long period of history, such as the white man and the negro, should have, in even a far longer period, passed by variation from a common original. Wallace's view is substantially that the remotely ancient representatives of the human race, being as yet animals too low in mind to have developed those arts of maintenance and social ordinances by which man holds his own against influences from climate and circumstance, were in their then wild state much more plastic than now to external nature; so that "natural selection" and other causes met with but feeble resistance in forming the permanent varieties or races of man, whose complexion and structure still remain fixed in their descendants (*Contributions to the Theory of Natural Selection*, p. 319).

MONOGRAM (from Late Lat. *monogramma*, in Late Gr. *μονόγραμμον*, from *μόνος*, single, *γράμμα*, letter), originally a cipher consisting of a single letter, now a design or mark consisting of two or more letters intertwined together. The letters thus interlaced may be either all the letters of a name, or the initial letters of the Christian and surnames of a person for use upon note-paper, seals, &c. Many of the early Greek and Roman coins bear the monograms of rulers for whom or the towns in which they were struck. The Late Latin and Greek words were first applied to the signatures, which took this form, of the emperors of the Eastern Empire. The signatures of the Frankish kings also took the form of a monogram. The accompanying monogram, from a coin of Charles the Bald, is a good example of a "perfect" monogram, in which all the letters of the name Karolus can be traced (see DIPLOMATIC and AUTOGRAPH). The most famous of monograms is that known as the "Sacred Monogram," formed by the conjunction of the two initial letters of *Χριστός*, Christ. The most usual form of this is the symbol ☧, and sometimes the *α* (alpha) and *ω* (omega) of the Apocalypse were placed on either side of it. The symbol was incorporated in the *Labarum* (*q.v.*) when the imperial standard was Christianized. The interlaced I.H.S. (also called "The Sacred Monogram") apparently possesses no great antiquity; it is said to have been the creation of St Bernard of Siena, in the middle of the 15th century. Monograms or ciphers were often used by the early printers as devices, and are of importance in fixing the identity of early printed books. Similar devices have been used by painters and engravers. The middle ages were, indeed, extremely prolific in the invention of ciphers alike for ecclesiastical, artistic and commercial use. Every great personage, every possessor of fine taste, every artist, had his monogram. The mason's mark also was, in effect, a cipher. As the merchant had as a rule neither right nor authority to employ heraldic emblems, he therefore fell back upon plain simple letters arranged very much in monogram form. These "merchants' marks" generally took the form of a monogram of the owner's initials together with a private device. They nearly always contain a cross, either as a protection against storms or other catastrophes, or as a Christian mark to distinguish their goods from Mahommedan traders in the East. There is a fine example of a 16th century gold ring with a merchant's mark in the British Museum. One of the most famous of secular monograms is the interlaced "H.D." of Henri II. and Diane de Poitiers. Upon every building which that king erected it was sown profusely; it was stamped upon the buildings in the royal library, together with the bow, the quiver and the interlocked crescents of Diana. It has been argued that "H.D." is a misreading of "H.C.," which would naturally point to husband and wife; but the question is set at rest by the fact that Henri II. sometimes signed his letters to Diane with this very monogram. Henri IV. invented a punning cipher for his mistress Gabrielle d'Estrées, the surname being represented by a capital S. with a *trait*, or stroke through it.



See F. Builliot, *Dictionnaire des monogrammes* (1832–1834, 3 parts); G. K. Nagler, *Die Monogrammisten* (1857–1876, 5 parts); Ris-Paquot, *Dictionnaire encyclopédique des marques et monogrammes, chiffres, &c.* (1893); also Du Cange, *Glossarium* (*s.v. Monogramma*), with plates giving examples of the monograms of early popes, the emperors of the Western Empire, and of other kings.

MONOLOGUE (from Gr. *μόνος*, alone, and *λόγος*, speech), a passage in a dramatic piece in which a personage holds the scene to himself and speaks unconsciously aloud. The theory of the monologue is that the audience overhears the thoughts of one who believes himself to be alone, and who thus informs them of what would otherwise be unknown to them. The word is also used in cases when a character on the stage speaks at great length, even though not alone, but is listened to in silence by the other characters. The old-fashioned tragedies of the 17th and 18th centuries greatly affected this convention of the monologue, which has always, however, been liable to ridicule. There is something of a lyrical character about the monologue in verse; and this has been felt by some of the classic poets of France so strongly, that many of the examples in the tragedies of Corneille are nothing more or less than odes or cantatas. The monologues of Shakespeare, and those of *Hamlet* in particular, have a far more dramatic character, and are, indeed, essential to the development of the play. Equally important are those of Racine in *Phèdre* and in *Athalie*. The French critics record, as the most ambitious examples of the monologue in two centuries, that of Figaro in Beaumarchais's *Le Mariage de Figaro* and that of Charles V. in Victor Hugo's *Hernani*, the latter extends to 160 lines. In the Elizabethan drama, the popularity of Kyd's *Spanish Tragedy*, in which Hieronymo spouts interminably, set a fashion for ranting monologues, which are very frequent in Shakespeare's immediate predecessors and contemporaries. After 1600 the practice was much reduced, and the tendency of solitary heroes to pour forth columns of blank verse was held in check by more complex stage arrangements. After the Restoration the classic tragedies of the English playwrights again abused the privilege of monologue to such a degree that it became absurd, and fell into desuetude.

MONOMOTAPA. In old maps of south-east Africa, derived originally from Portuguese and from Dutch sources, an extensive region on the Çuama or Zambezi and to the south of it is styled *regnum monomotapae*. The precise character of the kingdom or empire to which allusion is made has been the subject of much discussion, and some modern historians have gone so far as to relegate the monomotapa to the realm of myth. But such scepticism is unjustifiable in view of the perfect unanimity with which, in spite of variations of detail, all Portuguese writers from the beginning of the 16th century onwards reiterated the assertion that there was a powerful rule known far and wide by that title.

The word " monomotapa " is of Bantu origin and has been variously interpreted. Father J. Torrend, *Comparative Grammar of the South African Bantu Languages* (p. 101) renders it " Lord of the water-elephants," and remarks that the hippopotamus is even to the present day a sacred animal among the Karanga. The earliest recorded bearer of the name is Mokomba Menamotapam, mentioned by Diogo de Alcaçova in 1506 as father of the Kwesarimgo Menamotapam who ruled at that date over Vealanga, a large kingdom that included Sofala. His capital was called Zumubany, an obvious corruption of the term " Zimbabwe," regularly used to describe the residence of any important chief. The title is still found during the 18th century, but had probably become extinct by the beginning of the 19th if not earlier. Possibly its use was not confined to a single tribal section, occurring as it does in conjunction with the distinct dynastic names of Mokomba and Mambo, but the Karanga is the only tribe to which the Portuguese chroniclers attribute it. The latter, indeed, not only refer to the territory and the people of the monomotapa as " Mocaranga " (*i.e.* of the Karanga tribe), but explicitly assert that the " emperor " himself was a " Mocaranga." Consequently, he must have been a negro, and the Dominican who records the baptism of Dom Filippe by a friar of the order in the middle of the 17th century actually states that this " powerful king " was a black man (" com as carnes pretas "). This alone would be sufficient to controvert the baseless assumption that there existed in southern Rhodesia a ruling caste of different racial origin from the general Bantu population. The events following on the murder of the Jesuit father Dom Gonçalo da Silveira (cf. *Lusiads* X. 93) sufficiently demonstrate that the monomotapa, though susceptible to the persuasion of foreigners, was an independent potentate in the 16th century. The state and ceremony of his court, the number of his wives, and the order and organization of his officials, are described by several of the chroniclers.

It is difficult to arrive at an estimate of the extent of territory over which this great negro chief exercised direct or indirect control. The most extravagant theory is naturally that which was expressed by the Portuguese advocates in connexion with the dispute as to the ownership of Delagoa Bay. The crown of Portugal based its case against England on the cession of territory contained in a well-known treaty with the monomotapa (1629), and stated that this monarch's dominions then extended nearly to the Cape of Good Hope. A more moderate and usual view is given by Diogo de Couto, who in 1616 speaks of " a dominion over all Kaffraria from the Cabo das Correntes to the great river Zambezi." Several 17th-century writers extend the " empire " to the north of the Zambezi, Bocarro giving it in all " a circumference of more than three hundred leagues." It was " divided among petty kings and other lords with fewer vassals who are called inkosis or fumos." According to these authors, however, including Dos Santos, the paramountcy of the monomotapa was impaired in the 17th century by a series of rebellions. His zimbabwe, wherever it may have been in earlier days, was now fixed near the Portuguese fort of Masapa, only a short distance south of the Zambezi. A Portuguese garrison was maintained in it, and the monarch himself from the year 1607 onwards was little more than a puppet who was generally baptized by the Dominicans with a Portuguese name.

The only authorities of value are the original Portuguese documents collected, translated and edited by G. McC. Theal under the title *Records of South Eastern Africa* (9 vols., London, 1898–1903). Reference may be made to A. Wilmot's *Monomotapa* (London, 1896), which is, however, to a large extent superseded by Theal's far richer collection of material. (D. R.-M.)

MONONGAHELA, a city of Washington county, Pennsylvania, U.S.A., on the Monongahela river, 31 m. by rail S. of Pittsburg. Pop. (1890), 4096; (1900), 5173 (711 foreign-born and 345 negroes); (1910) 7598. It is served by the Pennsylvania and the Pittsburg & Lake Erie railways, and by electric railways to Pittsburg and Washington, Pa. Monongahela is in a coal region, and the mining of coal is its principal industry. It was laid out as a town in 1792 by Joseph Parkinson, and named by him Williamsport; but it was commonly known as Parkinson's Ferry until 1833, when it was incorporated as a borough. Four years later the present name was adopted, and in 1873 Monongahela was chartered as a city. It was here that the Whisky Insurrection convention met on the 14th of August 1794.

MONOPHYSITES (Gr. μονοφυσῖται), the name given to those who hold the doctrine that Christ had but *one* (μόνος) composite *nature* (φύσις), and especially to those who maintained this position in the great controversies of the 5th and 6th centuries. The synod of Chalcedon (*q.v.*) in 451, following the lines of Pope Leo I.'s famous letter, endeavoured to steer a middle course between the so-called Nestorian and Eutychian positions. But the followers of Cyril of Alexandria, and with them those of Eutyches, saw in the Chalcedon decree of two natures only another form of the " Nestorian " duality of persons in Christ, and rose everywhere in opposition. For a century they were a menace not only to the peace of the Church but to that of the empire.

The first stage of the controversy covers the seventy-five years between the council of Chalcedon and the accession of Justinian in 527. In Palestine the fanatical monks led by Theodosius captured Jerusalem and expelled the bishop, Juvenal. When he was restored, after an exile of twenty months, Theodosius fled to Sinai and continued his agitation among the monks there. In Alexandria an insurrection broke out over the supersession of the patriarch Dioscurus by the orthodox Proterius, who was killed during the struggle. Timothy Aelurus was chosen bishop, and a synod which he called was so powerful as to impress even the emperor Leo I. at Constantinople, who, however, deposed him as well as Peter Fullo, who at Antioch had usurped the see of the orthodox bishop Martyrius. The short reign of Basiliscus (474–476) favoured the Monophysites, but the restoration of the rightful emperor Zeno marked an attempt at conciliation. On the advice of Acacius, the energetic patriarch of Constantinople, Zeno issued the *Henotikon* edict (482), in which Nestorius and Eutyches were condemned, the twelve chapters of Cyril accepted, and the Chalcedon *Definition* ignored. This effort to shelve the dispute was quite in vain. Pope Felix III. saw the prestige of his see involved in this slighting of Chalcedon and his predecessor Leo's epistle. He condemned and deposed Acacius, a proceeding which the latter regarded with contempt, but which involved a breach between the two sees that lasted after Acacius's death (489), through the long and troubled reign of Anastasius, and was only healed by Justin I. in 519. The monophysite cause reached its crowning point in the East when Severus was made bishop of Antioch in 513. This man was the stormy petrel of the period. A law student who had been converted from paganism, he became a monophysite monk at Alexandria. Expelled from that city in 513, he went with his followers to stir up strife in Constantinople, and succeeded in bringing about the deposition of the orthodox bishop, Macedonius, and of Flavian, bishop of Antioch. But Severus himself was deprived in 518: he went back to Alexandria, and became leader of the Phthartolatrai (see below), a subsection of the Monophysites.

Justin I. was only a tool in the hands of his nephew Justinian, who sided with the orthodox and brought about the reconciliation between Rome and Constantinople. In Jerusalem, Tyre, and other centres also, orthodoxy was re-established. In Egypt, however, monophysitism was as strong as ever, and soon at Constantinople the arrogance of Rome caused a reaction, led by Theodora, the wife of the new emperor Justinian (527–565). Justinian himself, with the aid of Leontius of Byzantium (*c.* 485–543), a monk with a decided turn for Aristotelian logic and metaphysics, had tried to reconcile the Cyrillian and

Chalcedonian positions, but he inclined more and more towards the monophysite view, and even went so far as to condemn by edict three teachers (Theodore of Mopsuestia, Theodoret, the opponent of Cyril, and Ibas of Edessa) who were offensive to the monophysites. The Eastern bishops subscribed these edicts, and even Pope Vigilius yielded, in spite of the protests of the Western bishops, and at the 5th General Council (Constantinople, 553) agreed to the condemnation of the "three chapters"[1] and the anathematizing of any who should defend them by an appeal to the Definitions of Chalcedon. In the last years of his life (565) the emperor adopted the extreme Aphthartodocetae position, and only his sudden death prevented this being forced on the Church. His successor, Justin II. took no action either way for six or seven years, and then instituted a quiet but thorough system of suppression, closing monophysite churches and imprisoning their bishops and priests.

Meanwhile monophysitism had split into several factions. Of these that represented by Severus stood nearest to the Christology of Cyril. Their objection to Chalcedon was that it was an innovation, and they fully acknowledged the distinctness of the two natures in Christ, insisting only that they became indissolubly united so that there was only one energy (*μία καινὴ θεανδρικὴ ἐνέργεια*) of Christ's will. Thus, as Harnack points out, "there is no trace of a *theological* difference between Severus and Leontius," only a difference of terminology and of degree of willingness to assent to the formula of Chalcedon. Severus laid such stress on the human infirmities of Christ as proving that His body was like ours, created and corruptible (*φθαρτόν*) that his opponents dubbed him and his followers Phthartolatrae—worshippers of the corruptible.[2] The school of Themistius of Alexandria extended the argument to Christ's human soul, which they said was, like ours, limited in knowledge. Hence their name Agnoetae and their excommunication.

An opposite tendency was that of the Aphthartodocetae or Phantasiastae, represented by Julian, bishop of Halicarnassus, and, in his closing days, by Justinian. They held that Christ's body was so inseparably united with the Logos as not to be consubstantial with humanity; its natural attributes were so heightened as to make it sinless and incorruptible. An extreme school, the Aktistetae or Gaianists (Gaianus was bishop of Alexandria *c.* 550) even held that from the moment the Logos assumed the body the latter was *uncreated*, the human being transmuted into the divine nature; and the Adiaphorites went still further, denying, like Stephen Barsudaili, an Edessan abbot, all distinction of essence not even between the manhood and the Godhead in Christ, but between the divine and the human, and asserting that "all creatures are of the same essence with the Creator."

A third variety of monophysitism was that known as Theopaschitism, a name given to those who accepted the formula that in the death of Christ "God had suffered and been crucified." Peter Fullo introduced these words into the *Trishagion*, and after much controversy the council of Constantinople (553), while disallowing this, gave its sanction to the similar statement—*unum crucifixum esse ex sancta et consubstantiali Trinitate.* The development of this line of thought led in some thinkers like John Philoponus to a kind of tritheism.

There is no doubt that the disintegration caused by monophysitism largely facilitated the rapid and easy victory of Islam in Syria and Egypt. The "ethical complement" of monophysitism is monothelitism (see MONOTHELITES).

See the Histories of Dogma by A. Harnack, F. Loofs and R. Seeberg; also R. L. Ottley, *The Doctrine of the Incarnation.*

MONOPOLI, a seaport town and episcopal see of Apulia, Italy, in the province of Bari, from which it is 25 m. S.E. by rail, 30 ft. above sea-level. Pop. (1901), 22,616. The medieval walls are preserved and the castle dates from 1552. The harbour is small, the principal trade being in agricultural products. Close to it are rock-hewn tombs, possibly belonging to the ancient Gnathia (*q.v.*).

MONOPOLY (Gr. *μονοπωλία* or *μονοπώλιον*, exclusive sale, from *μόνος*, alone, and *πωλεῖν*, to sell), a term which, though used generally in the sense of exclusive possession, is more accurately applied only to grants from the Crown or from parliament, the private act of an individual whereby he obtains control over the supply of any particular article, being properly defined as "engrossing." It was from the practice of the sovereign granting to a favourite, or as a reward for good service, a monopoly in the sale or manufacture of some particular class of goods that the system of protecting inventions arose, and this fact lends additional interest to the history of monopolies (see PATENTS). When the practice of making such grants first arose it does not appear easy to say. Sir Edward Coke laid it down that by the ancient common law the king could grant to an inventor, or to the importer of an invention from abroad, a temporary monopoly in his invention, but that grants in restraint of trade were illegal. Such, too, was the law laid down in the first recorded case, *Darcy* v. *Allen* (the case of monopolies, 1602), and this decision was never overruled, though the law was frequently evaded. The patent rolls of the Plantagenets show few instances of grants of monopolies (the earliest known is temp. Edw. III.), and we come down to the reign of Henry VIII. before we find much evidence of this exercise of the prerogative in the case of either new inventions or known articles of trade. Elizabeth, as is well known, granted patents of monopoly so freely that the practice became a grave abuse, and on several occasions gave rise to serious complaints in the House of Commons. Lists prepared at the time show that many of the commonest necessaries of life were the subjects of monopolies, by which their price was grievously enhanced. That the queen did not assume the right of making these grants entirely at her pleasure is shown, not only by her own statements in answer to addresses from the house, but by the fact that the preambles to the instruments conveying the grants always set forth some public benefit to be derived from their action. Thus a grant of a monopoly to sell playing-cards is made, because "divers subjects of able bodies, which might go to plough, did employ themselves in the art of making of cards"; and one for the sale of starch is justified on the ground that it would prevent wheat being wasted for the purpose. Accounts of the angry debates in 1565 and 1601 are given in Hume and elsewhere. The former debate produced a promise from the queen that she would be careful in exercising her privileges; the latter a proclamation which, received with great joy by the house, really had but little effect in stopping the abuses complained of.

In the first parliament of James I. a "committee of grievances" was appointed, of which Sir Edward Coke was chairman. Numerous monopoly patents were brought up before them, and were cancelled. Many more, however, were granted by the king, and there grew up a race of "purveyors," who made use of the privileges granted them under the great seal for various purposes of extortion. One of the most notorious of these was Sir Giles Mompesson, who fled the country to avoid trial in 1621. After the introduction of several bills, and several attempts by James to compromise the matter by orders in council and promises, the Statute of Monopolies was passed in 1623. This made all monopolies illegal, except such as might be granted by parliament or were in respect of new manufactures or inventions. Upon this excepting clause is built up the entire English system of letters patent for inventions. The act was strictly enforced, and by its aid the evil system of monopolies was eventually abolished. Parliament has, of course, never exercised its power of granting to any individual exclusive privileges of dealing in any articles of trade, such as the privileges of the Elizabethan monopolists; but the licences required to be taken out by dealers in wine, spirits, tobacco, &c., are lineal descendants of the old monopoly grants, while the quasi-monopolies enjoyed by railways, canals, gas and water companies, &c., under acts of parliament, are also representative of the ancient practice.

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[1] *I.e.* (1) The person and writings of Theodore of Mopsuestia, (2) the writings of Theodoret in defence of Nestorius, (3) the letter written by Ibas to the Persian Maris.

[2] *φθαρτός*, corruptible, from *φθείρειν*, destroy.

See W. H. Price, *The English Patents of Monopoly* (1906).

MONOTHELITES (*μονοθελῆται*, *monothelitae*, from Gr. *μόνος*, only, *θέλειν*, to will),[1] in Church history, the name given to those who, in the 7th century, while otherwise orthodox, maintained that Christ had only one will. Their effort, as defined by Dormer, was "an attempt to effect some kind of solution of the vital unity of Christ's person, which had been so seriously proposed by monophysitism, on the basis of the now firmly-established doctrine of the two natures." The controversy had its origin in the efforts of the emperor Heraclius to win back for the church and the empire the excommunicated and persecuted Monophysites or Eutychians of Egypt and Syria. In Egypt especially the monophysite movement had assumed a nationalistic, patriotic character. It was in Armenia, while on his expedition against Persia, in 622 that, in an interview with Paul, the head of the Severians (Monophysites) there, Heraclius first broached the doctrine of the *μία ἐνέργεια* of Christ, *i.e.* the doctrine that the divine and human natures, while quite distinct in His one person, had but one activity and operation.[2] At a somewhat later date he wrote to Arcadius of Cyprus, commanding that "two energies" should not be spoken of; and in 626, while in Lazistan (Colchis), he had a meeting with the metropolitan, Cyrus of Phasis, during which this command was discussed, and Cyrus was at last bidden to seek further instruction on the subject from Sergius, patriarch of Constantinople, a strong upholder of the *μία ἐνέργεια*, and the emperor's counsellor with regard to it. So well did he profit by the teaching he received in this quarter that, in 630 or 631, Cyrus was appointed to the vacant patriarchate of Alexandria, and in 633 succeeded in reconciling the Severians of his province on the basis of *μία θεανδρικὴ ἐνέργεια* (one divine-human energy). He was, however, opposed by Sophronius, a monk from Palestine, who, after vainly appealing to Cyrus, actually went to Constantinople to remonstrate with Sergius himself. Shortly afterwards Sergius wrote to Pope Honorius, and received a friendly reply.[3] Sophronius, however, who meanwhile had been made patriarch of Jerusalem (634), refused to be silenced, and in his *Epistola synodica* strongly insisted on the "two energies." So intense did the controversy now become, that at last, towards the end of 638, Heraclius published an *Ecthesis*, or Exposition of the Faith (composed by Sergius), which prohibited the use of the phrase "one energy," because of its disquieting effects on some minds, as seeming to militate against the doctrine of the two natures; while, on the other hand, the expression "two energies" was interdicted because it seemed to imply that Christ had two wills. That Christ had but one will was declared to be the only orthodox doctrine, and all the faithful were enjoined to hold and teach it without addition or deduction. The document was not acceptable, however, to Popes Severinus and John IV., the immediate successors of Honorius; and Maximus, the confessor, succeeded in stirring up such violent opposition in North Africa and Italy that, in 648, Constans II. judged it expedient to withdraw his grandfather's edict, and to substitute for it his own *Typus* or Precept (*τύπος περὶ πίστεως*), forbidding all discussion of the questions of the duality or singleness of either the energy or the will of Christ. The scheme of doctrine of the first four general councils, in all its vagueness as to these points, was to be maintained; so far as the controversy had gone, the disputants on either side were to be held free from censure, but to resume it would involve penal consequences. The reply of the Western Church was promptly given in the unambiguously dyothelite decrees of the Lateran synod held by Pope Martin I. in 649; but the cruel persecutions to which both Martin and Maximus were exposed, and finally succumbed, secured for the imperial *Typus* the assent at least of silence. With the accession of Constantine Pogonatus in 668 the controversy once more revived, and the new emperor resolved to summon a general council. It met at Constantinople in 680, having been preceded in 679 by a brilliant synod under Pope Agatho at Rome, where it had been agreed to depart in nothing from the decrees of the Lateran synod. The will, Agatho said, is a property of the nature, so that as there are two natures there are two wills; but the human will determines itself ever conformably to the divine and almighty will.

See R. L. Ottley, *The Doctrine of the Incarnation* (pt. vii. §§ 5, 6, 7); A. Harnack, *History of Dogma*, iv. 252-267; art "Monotholeten" in Hauck-Herzog's *Realencyklop. für prot. Theologie* (vol. 13) by W. Möller and G. Krüger.

MONOTREMATA (a name referring to the single outlet for all the excretory channels of the body), the lowest subclass of the Mammalia, represented at the present day solely by the platypus and the echidnas. It has been proposed to replace this name, when used as a subclass, by Prototheria; but it is perhaps on the whole preferable to retain it both for the subclass and for the single order by which it is now represented, distinguishing the latter as Monotremata Vera.

Existing monotremes are characterized by the following features. In the first place they differ broadly from all other mammals in being oviparous, or possibly in the case of one family ovoviviparous; and also in the absence of mammae, or teats, the milk-glands opening on the surface of the skin of the breast by means of a number of fine pores. Moreover, the milk-glands themselves are commonly believed to represent sweat-glands and not those of other mammals, although it has been suggested that this distinction may not prove to be valid. In the strict sense of the term monotremes are not, therefore, mammals at all. Another feature in which these creatures differ from all other living mammals is the presence of a pair of coracoid bones, which articulate with the sternum, or breastbone, as well as of paired precoracoids, or epicoracoids, and an unpaired T-shaped interclavicle, the arms of which overlie the clavicles or collar-bones. In all these respects monotremes closely resemble many reptiles. The brain lacks a *corpus callosum*, or band of nerve-tissue connecting the two hemispheres. Again, the bodies of the vertebrae are for the most part without terminal caps, or epiphyses; and each rib articulates to the vertebral column solely by its head or capitulum, instead of by a capitulum and a tuberculum. More important is the circumstance that the testes, which remain throughout life within the abdominal cavity, do not discharge by means of their ureters into a urinary bladder, but into a urino-genital sinus, which is in close communication with the lower end of the alimentary canal, so that the genital and waste products of the body are discharged by means of a common tube, or cloaca—another reptilian feature, although met with in certain other mammals. As regards other soft parts, the heart has the valve dividing the right auricle and ventricle incomplete and to a great extent fleshy—a feature which may, in some degree, account for the lower temperature of monotremes as compared with higher mammals. The presence of an anterior abdominal vein, or at least its supporting membrane, running right through the abdominal cavity, is another distinctive feature of the group. Of less importance is the presence of a pair of epipubic, or marsupial, bones attached to the front edge of the pelvis. The females have a complete or rudimentary pouch on the abdomen.

In the presence of hair, the relatively high temperature of the blood, the absence of nuclei to the red blood-corpuscles, and the existence of only the left aortic arch, as well as in the absence of a separate quadrate-bone, and the simple structure of the lower jaw, monotremes conform to the ordinary mammalian type. On the other hand the skull of the platypus possesses a peculiar "dumb-bell bone," believed to represent the reptilian prevomer.

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[1] The name seems to occur first in John of Damascus.

[2] Paul, speaking for the monophysite bishops, had said that what was particularly repugnant in the definition of Chalcedon (*q.v.*) was the implication of two wills in Christ. See Hefele, *Conciliengesch.* iii. 124 seq. (1877), who also traces the previous history of the expressions *μία ἐνέργεια*, *θεανδρικὴ ἐνέργεια*, especially as found in the writings of the Pseudo-Dionysius Areopagita, which first appeared in Egypt in the 5th century.

[3] In two letters Honorius expressed himself in accord with the monothelite view, for which he was denounced as heretical by the Sixth General Council and anathematized by Pope Leo II.

The females produce their young from eggs, which are relatively large, and develop in the same manner as those of birds and reptiles, a portion only of the yolk segmenting to form the embryo, while the remainder serves for the nutriment of the latter. In the case of *Ornithorhynchus* it has been said that two eggs are laid in the chamber at the end of the burrow,[1] but those of the *Echidnidae* are carried about in the pouch on the abdomen of the female, which becomes enlarged during the time of incubation. In the adult state neither of the living groups of Monotremata have teeth; but this is evidently only a specialized feature, the young platypus having functional teeth. In the latter, three pairs of these teeth are developed in the upper, and three in the lower jaw; but after being for some time in use, they gradually become worn away, and are finally shed. Under and around the teeth are developed the horny plates, or "cornules," which gradually grow round them and assume their function, the hollows on the surface of the cornules indicating the positions of the teeth. In form these teeth make a distant approximation to the molars of some of the extinct Multituberculata (*q.v.*).

A peculiarity of the males is the presence in the hind-limb of an additional, flat, curved ossicle on the hinder and tibial side of the plantar aspect of the tarsus, articulating chiefly to the tibia, supporting in the adult a sharp-pointed perforated horny spur, with which is connected the duct of a gland situated beneath the skin of the back of the thigh. (A rudimentary spur is found in the young female *Ornithorhynchus*, but this disappears when the animal becomes adult.) The stomach is sub-globular and simple; the alimentary canal has no ileo-caecal valve, or marked distinction between large and small intestine, but is furnished with a small, slender vermiform caecum with glandular walls. The liver is divided into the usual number of lobes, and is provided with a gall-bladder.

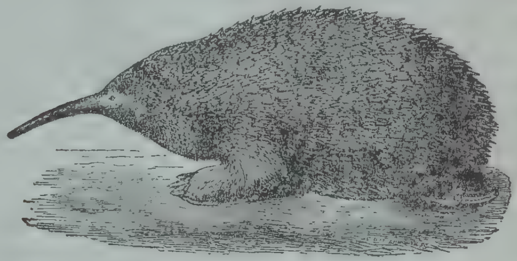
The trunk-vertebrae are nineteen in number. The transverse processes of the cervical vertebrae are independently developed, and remain suturally connected with the bodies of the vertebrae until the animal is full-grown. Though in this respect monotremes present an approximation to reptiles, they differ in that there is not a gradual transition from these transverse processes of the neck-vertebrae (or cervical ribs, as they may be considered) into the thoracic ribs, for in the seventh vertebra the costal element is much smaller than in the other, indicative of a very marked separation of neck from thorax, not seen in reptiles. The sternal ribs are well ossified, and there are distinct, partly ossified, intermediate ribs. The brain-cavity, unlike that of the lower marsupials or reptiles, is large and hemispherical, flattened below, arched above, and about as broad as long. The cribriform plate of the ethmoid is nearly horizontal. The cranial walls are very thin, and smoothly rounded externally, and the sutures become completely obliterated in adults. The broad occipital region slopes upwards and forwards, and the face is produced into a long depressed beak. The bony palate is prolonged backwards, so that the posterior nares are nearly on a level with the glenoid fossa. The lower jaw, or mandible, is without distinct ascending ramus; the coronoid process and angle being rudimentary, and the two halves loosely connected at the symphysis. The fibula has a broad, flattened process, projecting from its upper extremity above the articulation, like an olecranon.

The first family, *Ornithorhynchidae*, is represented solely by the duck-billed platypus, or platypus (*Ornithorhynchus anatinus*), in which the hemispheres of the brain are relatively small and smooth, while the muzzle is expanded to form a spatula-like beak, covered during life with a delicate sensitive skin, which dries in museum-specimens to a horny consistency. Although, as mentioned above, functional teeth are developed in the young, in the adult their function is discharged by "cornules," or horny stuctures—elongated, narrow and sharp-edged, along the anterior part of the sides of the mouth, and broad, flat-topped or molariform behind. The legs are short and adapted for swimming; the feet webbed, each with five well-developed toes armed with large claws, and beyond which in the fore-feet the interdigital membrane is extended. Vertebrae: C. 7, D. 17, L. 2, S. 2, Ca. 21. Acetabulum of pelvis not perforated. Tongue not extensile. Mucous membrane of small intestine covered with delicate, close-set transverse folds or ridges. Tail rather short, broad, and depressed. Eyes very small. Fur close and soft.

The platypus, or water-mole, is common to Australia and Tasmania, and entirely aquatic in habits, diving freely, and making its burrow in the river-banks. It feeds on insects, snails, small bivalve molluscs, and worms. In the adult state bivalves form its chief food; and it is believed that the substitution of horny plates for brittle teeth is an adaptation for cracking the shells of these creatures. (See PLATYPUS.)

The second family, *Echidnidae*, has a wider geographical distribution, including Australia, Tasmania and New Guinea, and is represented by two genera. The hemispheres of the brain are large and convoluted; and the muzzle is produced into a long, tapering, tubular beak, at the end of which the nostrils are situated. The two branches of the lower jaw are slender and rod-like. Opening of mouth small, and placed below the extremity of the beak. No teeth, though the palate and tongue are furnished with spines. Tongue very long, vermiform, slender and protractile. Lining membrane of small intestine villous, but without transverse folds. Feet with long strong claws for scratching and burrowing. The hind-feet with the ends of the toes turned outwards and backwards in the ordinary position of the animal when on the ground. Tail very short. Acetabulum with a large perforation. Calcaneal spur and gland of the male much smaller than in *Ornithorhynchus*. Fur intermixed with strong, sharp-pointed spines. Terrestrial and fossorial in habits, feeding exclusively on ants.

The typical genus *Echidna* is represented by the echidna, or porcupine-anteater (*E. aculeata*), which has a distribution equivalent to that of the family, and includes several local races. It is characterized by the presence of five claws to each foot, the moderately long and straight beak, the tapering tongue, with its spines restricted to the basal portion, and the vertebrae numbering C. 7, D. 16, L. 3, S. 3, Ca. 12. In *Proechidna*, represented by the larger *P. bruijni* and *P. nigroaculeata*, both from New Guinea, on the other hand, terminal phalanges and claws are present only on the three middle toes of each foot, the tongue is somewhat spoon-shaped and carries three rows of spines along its upper surface, and there are 17 dorsal and four lumbar vertebrae. (See ECHIDNA.)



Bruijn's Echidna (*Proechidna bruijni*).

At present no light is shed by palaeontology on the past history of the Monotremata Vera. Species of *Echidna* and *Ornithorhynchus* have indeed been described from the superficial formations of Australia, but they apparently differ in no structural details from their existing representatives.

Possibly some of the extinct Jurassic mammals with a marsupial or insectivorous type of dentition referred to in the article MARSUPIALIA may be monotremes, but there is no definite evidence that this is the case. On the other hand, there is a possibility that another extinct group of mammals, dating from the Trias and continuing till the Lower Eocene, may belong to the present subclass, of which they form a second order. (See MULTITUBERCULATA.)

The most important recent information with regard to the Monotremata will be found in Dr R. Semon's *Reise in Australien*, in the *Denkschrift* of the Jena Natural History Society. (R. L.*)

MONOTRIGLYPH, in architecture, the interval of the intercolumniation of the Doric column, which is observed by the intervention of one triglyph only between the triglyphs which come over the axes of the columns. This is the usual arrangement, but in the Propylaea at Athens there are two triglyphs over the central intercolumniation, in order to give increased width to the roadway, up which chariots and beasts of sacrifice ascended.

MONOTYPIC (Gr. μόνος, alone, single, and τύπος, a type), a term used in biology, &c., for subjects having only one exponent, for example a genus containing only one species.

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[1] There does not appear to be authentic evidence that the eggs in this genus are actually laid. (See PLATYPUS.)

MONREALE (contraction of *monte-reale*, so called from a palace built here by Roger I.), a town of Sicily, in the province of Palermo, 5 m. inland (W.S.W.) from it, on the slope of Monte Caputo, overlooking the beautiful and very fertile valley called "*La Conca d'oro*" (the Golden Shell), famed for its orange, olive and almond trees, the produce of which is exported in large quantities. Pop. (1901), 17,379 (town); 23,556 (commune). The town, which for long was a mere village, owed its origin to the founding of a large Benedictine monastery, with its church, the seat of the metropolitan archbishop of Sicily.[1] This, the greatest of all the monuments of the wealth and artistic taste of the Norman kings in northern Sicily, was begun about 1170 by William II., and in 1182 the church, dedicated to the Assumption of the Virgin Mary, was, by a bull of Pope Lucius III., elevated to the rank of a metropolitan cathedral.

The archiepiscopal palace and monastic buildings on the south side were of great size and magnificence, and were surrounded by a massive precinct wall, crowned at intervals by twelve towers. This has been mostly rebuilt, and but little now remains except ruins of some of the towers, a great part of the monks' dormitory and frater, and the splendid cloister, completed about 1200. This last is well preserved, and is one of the finest cloisters both for size and beauty of detail now extant. It is about 170 ft. square, with pointed arches decorated with diaper work, supported on pairs of columns in white marble, 216 in all, which were alternately plain and decorated by bands of patterns in gold and colours, made of glass tesserae, arranged either spirally or vertically from end to end of each shaft. The marble caps are each richly carved with figures and foliage executed with great skill and wonderful fertility of invention—no two being alike. At one angle, a square pillared projection contains the marble fountain or monks' lavatory, evidently the work of Moslem sculptors.

The church is fortunately well preserved. In plan it is a curious mixture of Eastern and Western arrangement. The nave is like an Italian basilica, while the large triple-apsed choir is like one of the early three-apsed churches, of which so many examples still exist in Syria and other eastern countries. It is, in fact, like two quite different churches put together endwise. The basilican nave is wide, with narrow aisles. Monolithic columns of grey oriental granite (except one, which is of cipollino), evidently the spoils of older buildings, on each side support eight pointed arches much stilted. The capitals of these (mainly Corinthian) are also of the classical period. There is no triforium, but a high clerestory with wide two-light windows, with simple tracery like those in the nave-aisles and throughout the church, which give sufficient (if anything too much) light. The other half, Eastern in two senses, is both wider and higher than the nave. It also is divided into a central space with two aisles, each of the divisions ending at the east with an apse. The roofs throughout are of open woodwork very low in pitch, constructionally plain, but richly decorated with colour, now mostly restored. At the west end of the nave are two projecting towers, with a narthex-entrance between them. A large open atrium, which once existed at the west, is now completely destroyed, having been replaced by a Renaissance portico. The outside of the church is plain, except the aisle walls and three eastern apses, which are decorated with intersecting pointed arches and other ornaments inlaid in marble. The outsides of the principal doorways and their pointed arches are magnificently enriched with carving and coloured inlay, a curious combination of three styles—Norman-French, Byzantine and Arab.

It is, however, the enormous extent (70,400 sq. ft.) and glittering splendour of the glass mosaics covering the interior which make this church so splendid. With the exception of a high dado, itself very beautiful, made of marble slabs with bands of mosaic between them, the whole interior surface of the walls, including soffits and jambs of all the arches, is covered with minute mosaic-pictures in brilliant colours on a gold ground. The mosaic pictures are arranged in tiers, divided by horizontal and vertical bands. In parts of the choir there are five of these tiers of subjects or single figures one above another. The half dome of the central apse has a colossal half-length figure of Christ, with a seated Virgin and Child below; the other apses have full-length colossal figures of St Peter and St Paul. Inscriptions on each picture explain the subject or saint represented; these are in Latin, except some few which are in Greek. The subjects in the nave begin with scenes from the Book of Genesis, illustrating the Old Testament types of Christ and His scheme of redemption, with figures of those who prophesied and prepared for His coming. Towards the east are subjects from the New Testament, chiefly representing Christ's miracles and suffering, with apostles, evangelists and other saints. The design, execution and choice of subjects all appear to be of Byzantine origin, the subjects being selected from the *Menologium* drawn up by the emperor Basilius Porphyrogenitus in the 10th century.

In the central apse at Monreale, behind the high altar, is a fine marble throne for the archbishop. This position of the throne is a survival of the early basilican arrangement, when the apse and altar were at the west end. In that case the celebrant stood behind the altar at mass, and looked over it eastwards towards the people. On the north side, in front of the high altar, is another somewhat similar throne for the use of the king. The tomb of William I., the founder's father—a magnificent porphyry sarcophagus contemporary with the church, under a marble pillared canopy—and the founder William II.'s tomb, erected in 1575, were both shattered by a fire, which in 1811 broke out in the choir, injuring some of the mosaics, and destroying all the fine walnut choir-fittings, the organs, and most of the choir roof. The tombs were rebuilt, and the whole of the injured part of the church restored, mostly very clumsily, a few years after the fire. On the north of the choir are the tombs of Margaret, wife of William I., and her two sons Roger and Henry, together with an urn containing the viscera of St Louis of France, who died in 1270. The pavement of the triple choir, though much restored, is a very magnificent specimen of marble and porphyry mosaic in *opus alexandrinum*, with signs of Arab influence in its main lines. The pavement of the nave, on the other hand, is of the 16th century. Two baroque chapels were added in the 17th and 18th centuries, which are fortunately shut off from the rest of the church.

Two bronze doors, those on the north and west of the church, are of great interest in the history of art. They are both divided into a number of square panels with subjects and single figures, chiefly from Bible history, cast in relief. That on the north is by Barisanus of Trani in southern Italy, an artist probably of Greek origin. It is inscribed BARISANUS TRAN. ME FECIT. The cathedrals at Trani and Ravello also have bronze doors by the same sculptor. The western door at Monreale, inferior to the northern one both in richness of design and in workmanship, is by Bonannus of Pisa, for the cathedral of which place he cast the still existing bronze door on the south, opposite the leaning tower. The one at Monreale is inscribed A.D. MCLXXXVI IND. III. BONANNUS CIVIS PISANVS ME FECIT. It is superior in execution to the Pisan one. The door by Barisanus is probably of about the same time, as other examples of his work with inscribed dates show that he was a contemporary of Bonannus. The effect of the façade is not improved by the Renaissance portico that has been added to it. The monastic library contains some valuable MSS., especially a number of bilingual documents in Greek and Arabic, the earliest being dated 1144. The archbishop now occupies the eastern part of the monastic buildings, the original palace being destroyed.

See D. B. Gravina, *Il Duomo di Monreale* (Palermo, 1859–1865).

(J. H. M.; T. As.)

MONRO, DAVID BINNING (1836–1905), English Homeric scholar, was born in Edinburgh on the 16th of November 1836. He was a grandson of Alexander Monro, tertius (1773–1859), professor of anatomy in Edinburgh University, whose father, Alexander Monro, secundus (1733–1817), and grandfather, Alexander Monro, primus (1697–1767), both filled the same position. He was educated at Glasgow University, and Brasenose and Balliol Colleges, Oxford. In 1859 he was elected fellow, and in 1882 provost of Oriel, which office he held till his death at Heiden, Switzerland, on the 22nd of August 1905. He was a man of varied attainments, an excellent linguist, and possessed considerable knowledge of music, painting and architecture. His favourite study was Homer, and his *Grammar of the Homeric Dialect* (2nd ed., 1891) established his reputation as an authority on that author. He also edited the last twelve books of the *Odyssey*, with valuable appendices on the composition of the poem, its relation to the *Iliad* and the cyclic poets, the history of the text, the dialects, and the Homeric house; a critical text of the poems and fragments (*Homeri opera et reliquiae*, 1896); *Homeri opera* (1902, with T. W. Allen, in *Scriptorum classicorum bibliotheca oxoniensis*); and an edition of the *Iliad* with notes for schools. His article on Homer, written for the 9th edition of the *Encyclopaedia Britannica*, was revised by him for this work before he died. Mention may also be made of his *Modes of Ancient Greek Music* (1894), on which see *Classical Review* for December 1894, with author's reply in the same for February 1895.

See *Memoir* by J. Cook Wilson (Oxford, 1907).

MONROE, JAMES (1758–1831), fifth president of the United States, was born on Monroe's creek, a tributary of the Potomac river, in Westmoreland county, Virginia, on the 28th of April 1758. His father, Spence Monroe, was of Scotch, and his mother, Elizabeth Jones, was of Welsh descent. At the age of sixteen he entered the College of William and Mary, Williamsburg, Virginia, but in 1776 he left college to take part in the War for Independence. He enlisted in the Third Virginia regiment, in which he became a lieutenant, and subsequently took part in the battles of Harlem Heights, White Plains, Trenton (where he was wounded), Brandywine, Germantown, and Monmouth. In November 1777 he was appointed volunteer aide-de-camp to William Alexander ("Lord Stirling"), with the rank of major, and thereby lost his rank in the Continental line; but in the following year, at Washington's solicitation, he received a commission as lieutenant-colonel in a new regiment to be raised in Virginia. In 1780 he began the study of law under Thomas Jefferson, then governor of Virginia, and between the two there developed an intimacy and a sympathy that had a powerful influence upon Monroe's later career.

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[1] An earlier church appears to have existed at Monreale since the 6th century, but no traces of it now remain.

In 1782 he was elected to the Virginia House of Delegates, and though only twenty-four years of age he was chosen a member of the governor's council. He served in the Congress of the Confederation from 1783 to 1786 and was there conspicuous for his vigorous insistence upon the right of the United States to the navigation of the Mississippi River, and for his attempt, in 1785, to secure for the weak Congress the power to regulate commerce, in order to remove one of the great defects in the existing central government. On retiring from Congress he began the practice of law at Fredericksburg, Virginia, was chosen a member of the Virginia House of Delegates in 1787, and in 1788 was a member of the state convention which ratified for Virginia the Federal constitution. In 1790 he was elected to the United States senate to fill the vacancy caused by the death of William Grayson, and although in this body he vigorously opposed Washington's administration, Washington on the 27th of May 1794 nominated him as minister to France. It was the hope of the administration that Monroe's well-known French sympathies would secure for him a favourable reception, and that his appointment would also conciliate the friends of France in the United States. His warm reception in France and his enthusiastic Republicanism, however, displeased the Federalists at home; he did nothing, moreover, to reconcile the French to the Jay treaty (see JAY, JOHN), which they regarded as a violation of the French treaty of alliance of 1778 and as a possible *casus belli.* The administration therefore decided that he was unable to represent his government properly and late in 1796 recalled him.

Monroe returned to America in the spring of 1797, and in the following December published a defence of his course in a pamphlet of 500 pages entitled *A View of the Conduct of the Executive in the Foreign Affairs of the United States*, and printed in Philadelphia by Benjamin Franklin Bache (1769–1798). Washington seems never to have forgiven Monroe for this, though Monroe's opinion of Washington and Jay underwent a change in his later years. In 1799 Monroe was chosen governor of Virginia and was twice re-elected, serving until 1802. At this time there was much uneasiness in the United States as a result of Spain's restoration of Louisiana to France by the secret treaty of San Ildefonso, in October 1800; and the subsequent withdrawal of the "right of deposit" at New Orleans by the Spanish intendant greatly increased this feeling and led to much talk of war. Resolved upon peaceful measures, President Jefferson in January 1803 appointed Monroe envoy extraordinary and minister plenipotentiary to France to aid Robert R. Livingston, the resident minister, in obtaining by purchase the territory at the mouth of the Mississippi, including the island of New Orleans, and at the same time authorized him to co-operate with Charles Pinckney, the minister at Madrid, in securing from Spain the cession of East and West Florida. On the 18th of April Monroe was further commissioned as the regular minister to Great Britain. He joined Livingston in Paris on the 12th of April, after the negotiations were well under way; and the two ministers, on finding Napoleon willing to dispose of the entire province of Louisiana, decided to exceed their instructions and effect its purchase. Accordingly, on the 30th of April, they signed a treaty and two conventions, whereby France sold Louisiana to the United States (see LOUISIANA PURCHASE). In July 1803 Monroe left Paris and entered upon his duties in London; and in the autumn of 1804 he proceeded to Madrid to assist Pinckney in his efforts to secure the definition of the Louisiana boundaries and the acquisition of the Floridas. After negotiating with Don Pedro de Cevallos, the Spanish minister of foreign affairs, from January to May 1805, without success, Monroe returned to London and resumed his negotiations, which had been interrupted by his journey to Spain, concerning the impressment of American seamen and the seizure of American vessels. As the British ministry was reluctant to discuss these vexed questions, little progress was made, and in May 1806 Jefferson ordered William Pinkney of Maryland to assist Monroe. The British government appointed Lords Auckland and Holland as negotiators, and the result of the deliberations was the treaty of the 31st of December 1806, which contained no provision against impressments and provided no indemnity for the seizure of goods and vessels. In passing over these matters Monroe and Pinkney had disregarded their instructions, and Jefferson was so displeased with the treaty that he refused to present it to the senate for ratification, and returned it to England for revision. Just as the negotiations were re-opened, however, the questions were further complicated and their settlement delayed by the attack of the British ship "Leopard" upon the American frigate "Chesapeake." Monroe returned to the United States in December 1807, and was elected to the Virginia House of Delegates in the spring of 1810. In the following winter he was again chosen governor, serving from January to November 1811, and resigning to become secretary of state under Madison, a position which he held until the 3rd of March 1817. The direction of foreign affairs in the troubled period immediately preceding and during the second war with Great Britain thus devolved upon him. On the 27th of September 1814, after the disaster of Bladensburg and the capture of Washington by the British, he was appointed secretary of war to succeed General John Armstrong, and discharged the duties of this office, in addition to those of the state department, until March 1815.

In 1816 Monroe was chosen president of the United States; he received 183 electoral votes, and Rufus King, his Federalist opponent, 34. In 1820 he was re-elected, receiving all the electoral votes but one, which William Plumer (1759–1850) of New Hampshire cast for John Quincy Adams, in order, it is said, that no one might share with Washington the honour of a unanimous election. The chief events of his administration, which has been called the "era of good feeling," were the Seminole War (1817–18); the acquisition of the Floridas from Spain (1819–21); the "Missouri Compromise" (1820), by which the first conflict over slavery under the constitution was peacefully adjusted; the veto of the Cumberland Road Bill (1822)[1] on constitutional grounds; and—most intimately connected with Monroe's name—the enunciation in the presidential message of the 2nd of December 1823 of what has since been known as the Monroe Doctrine (*q.v.*), which has profoundly influenced the foreign policy of the United States. On the expiration of his second term he retired to his home at Oak Hill, Loudoun county, Virginia. In 1826 he became a regent of the university of Virginia, and in 1829 was a member of the convention called to amend the state constitution. Having neglected his private affairs and incurred large expenditures during his missions to Europe, he experienced considerable pecuniary embarrassment in his later years, and was compelled to ask Congress to reimburse him for his expenses in the public service. Congress finally (in 1826) authorized the payment of $30,000 to him, and after his death appropriated a small amount for the purchase of his papers from his heirs. He died in New York City on the 4th of July 1831, while visiting his daughter, Mrs Samuel L. Gouverneur. In 1858, the centennial year of his birth, his remains were reinterred with impressive ceremonies at Richmond, Virginia. Jefferson, Madison, John Quincy Adams, Calhoun, and Benton all speak loudly in Monroe's praise; but he suffers by comparison with the greater statesmen of his time. Possessing none of their brilliance, he had, nevertheless, to use the words of John Quincy Adams, "a mind . . . sound in its ultimate judgments, and firm in its final conclusions." Schouler points out that like Washington and Lincoln he was "conspicuous . . . for patient considerateness to all sides." Monroe was about six feet tall, but, being stoop-shouldered and rather ungainly seemed less; his eyes, a greyish blue, were deep-set and kindly; his face was delicate, naturally refined, and prematurely lined. The best-known portrait, that by Vanderlyn, is in the New York City Hall. Monroe was married in 1786 to Elizabeth Kortwright (1768–1830) of New York, and at his death was survived by two daughters.

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[1] The Cumberland (or National) Road from Cumberland, Maryland, to Wheeling, West Virginia, was projected in 1806, by an appropriation of 1819 was extended to the Ohio River, by an act of 1825 (signed by Monroe on the last day of his term of office) was continued to Zanesville, and by an act of 1829 was extended westward from Zanesville. The appropriation of 1806 for the construction of the road had brought into national politics the question of the authority of the Federal government to make "internal improvements." The bill vetoed by Monroe would in effect have given to the Federal government jurisdiction over the road; and in his elaborate memorandum (May 4, 1822) accompanying his veto message, Monroe discussed at length the constitutional questions involved, argued that the Federal government was empowered by the Constitution to appropriate money for "internal improvements," and in concert with the states through which a road was to pass might supervise the construction of such a road, but might not exercise jurisdiction over it, and advocated the adoption of an amendment to the constitution giving larger power to the Federal government "confined to great national works only, since, if it were unlimited it would be liable to abuse, and might be productive of evil." For the history of the Cumberland Road, see Archer B. Hulbert, *The Cumberland Road* (Cleveland, Ohio, 1904).

See *The Writings of James Monroe* (7 vols., New York, 1898–1903), edited by S. M. Hamilton; Daniel C. Gilman, *James Monroe* (Boston, 1883), in the "American Statesman Series"; J. R. Irelan, *History of the Life, Administration and Times of James Monroe*, being vol. v. of his *Republic* (Chicago, 1887); John Quincy Adams, *The Lives of James Madison and James Monroe* (Buffalo, 1850); B. W. Bond, jun., *Monroe's Mission to France, 1794–1796* (Baltimore, 1907); Henry Adams, *History of the United States* (9 vols., New York, 1889–1891), containing a full but unsympathetic account of Monroe's career as a diplomatist; and James Schouler, *History of the United States*, vols. ii. and iii. (New York, 1894), which estimates his public services highly.

MONROE, a city of Louisiana, U.S.A., the capital of Ouachita parish, in the northern part of the state, on the east bank of the Ouachita river, 72 m. W. of Vicksburg, Mississippi, and 96 m. E. of Shreveport, Louisiana. Pop. (1890), 3256; (1900), 5428 (2834 negroes); (1910), 10,209. It is served by the Arkansas, Louisiana & Gulf, the Little Rock & Monroe, the Vicksburg, Shreveport & Pacific (Queen & Crescent), and the St Louis, Iron Mountain & Southern railways, and by river steamers plying between New Orleans and Camden, Arkansas. Across the Ouachita is the town of West Monroe (pop. in 1910, 1127). The improvement of the river, by the removal of snags and the construction of dams and locks in order to give it a navigable depth of 10 ft. at Monroe and 6½ ft. beyond Camden, was nearly completed by the United States government in 1909. Monroe lies in a level valley, and has broad streets shaded by live oaks. Among the public buildings are a handsome city-hall, a city market-house, a charity hospital and a high school. There are also a parish high school and St Hyacinth's Academy (Roman Catholic). The leading industries are the manufacture of lumber and cotton products.

In 1785, during the Spanish occupation of Louisiana, Juan Filhiol, commandant of the district of Ouachita, founded a settlement on the site of the present Monroe, which was called Ouachita Post until 1790 and then Fort Miró, in honour of the governor-general. In 1819 the place was renamed Monroe, in honour of President James Monroe, and in the following year the town was incorporated. Monroe was chartered as a city in 1871, and received a new charter in 1902.

MONROE, a city and the county-seat of Monroe county, Michigan, U.S.A., on the Raisin river, 2 m. from Lake Erie, near the south-eastern corner of the state. Pop. (1890), 5258; (1900), 5043; (1904), 6128; (1910), 6893. It is served by the Michigan Central, the Lake Shore & Michigan Southern, the Père Marquette, and the Detroit & Toledo Shore Line railways, and by electric lines to Detroit and Toledo. There is a statue here (dedicated in 1910) of Gen. G. W. Custer. Monroe has a German Altenheim and St Mary's academy and college for girls. The city has a large trade in farming-produce and fish, and various manufactures. The place was settled in 1783 by French Canadians and called Frenchtown. In January 1813 the inhabitants, fearing destruction from the British and their Indian allies, pleaded to the Americans for protection, and about 660 men from the army of General James Winchester (1752–1826), sent from the rapids of the Maumee river, on the 18th of January drove a small British force from the village. Three days later General Winchester arrived with 300 more men; but at dawn on the 22nd Colonel Henry A. Proctor (1787–1859) with a force of British and Indians surprised the Americans, defeated their right wing, captured General Winchester and obtained from him an order for the surrender of his entire force. In 1815 Monroe received its present name in honour of James Monroe. In 1817 it was made the county-seat, and in 1827 it was incorporated as a village. It was chartered as a city in 1837 (being rechartered in 1874), and as a city of the fourth class in 1895.

MONROE DOCTRINE. That the United States should avoid entangling itself in the politics of Europe was a policy recommended by Washington. The counterpart of this, that European powers should be prevented from taking a controlling share in the politics of the American continent, grew gradually as the importance and influence of the United States increased. This American attitude towards the European powers became crystallized in what is known as the Monroe Doctrine, since it was first announced officially in a concrete form, though not originated, by President Monroe. His declaration was the result of American apprehension that the combination of European powers known as the Holy Alliance would interfere in South America to restore the Spanish colonies, which had asserted their independence, to the crown of Spain. To meet and check this movement, in his message to Congress on the 2nd of December 1823, Monroe made the following pronouncement:—

> In the wars of the European powers in matters relating to themselves we have never taken any part, nor does it comport with our policy so to do. It is only when our rights are invaded or seriously menaced that we resent injuries or make preparations for our defence. With the movements in this hemisphere we are of necessity more immediately connected, and by causes which must be obvious to all enlightened and impartial observers. The political system of the allied powers is essentially different in this respect from that of America. . . . We owe it, therefore, to candour, and to the amicable relations existing between the United States and those powers, to declare that we should consider any attempt on their part to extend their system to any portion of this hemisphere as dangerous to our peace and safety. With the existing colonies or dependencies of any European power we have not interfered and shall not interfere. But with the governments who have declared their independence and maintained it, and whose independence we have on great consideration and on just principles acknowledged, we could not view any interposition for the purpose of oppressing them or controlling in any other manner their destiny by any European power in any other light than as the manifestation of an unfriendly disposition towards the United States. . . . It is impossible that the allied powers should extend their political system to any portion of either continent without endangering our peace and happiness; nor can any one believe that our Southern brethren, if left to themselves, would adopt it of their own accord. It is equally impossible, therefore, that we should behold such interposition in any form with indifference.

Earlier in the same message, while discussing negotiations for the settlement of the respective claims of Russia, Great Britain, and the United States in the north-west, Monroe also said:—

> In the discussion to which this interest has given rise and the arrangements by which they may terminate, the occasion has been judged proper for asserting as a principle in which the rights and interests of the United States are involved, that the American continents, by the free and independent condition which they have

assumed and maintain, are henceforth not to be considered as subjects for future colonization by any European powers.

With this message Great Britain was in hearty agreement. Indeed it was Canning's policy, summed up three years later by his famous reference to the necessity of calling the New World into existence to restore the balance of the Old.

This announcement of policy, it will be noticed, involved, firstly, a declaration aimed at foreign intervention in the political affairs of independent American states; secondly, a warning against future European colonization on the American continents. The first was avowedly based on the right of self-defence; it was a policy, not a law; it was not to constrain the minor republics, but to protect them. The second, as explained by John Quincy Adams, was intended to state the fact that the American continent was occupied by contiguous states, leaving no room for further colonization and introduction of foreign sovereignty. No legislative sanction was given to Monroe's statement of policy at the time, and in fact none was needed, for the mere announcement served to prevent foreign action in South America. It has never formed part of the body of International Law, being unilateral. Nor has the United States bound itself by compact with the other republics of the American continent to protect them from European aggression. Thus it hesitated to send delegates to the Panama Congress in 1826, and took no part in any congress with the Latin American states until 1889.

Nevertheless, on several occasions since its conception the Monroe Doctrine has been enforced. Its spirit permeated the Clayton-Bulwer Treaty, in which Great Britain and the United States, in 1850, mutually renounced the right of colonizing, fortifying or occupying any porton of Central America. It was enforced against Maximilian, who, by French intervention in Mexico, had been made emperor, and until the close of the American Civil War had perforce been left undisturbed. Its applicability was urged when de Lesseps's Panama Canal was thought possible of completion. Both Cuba and the Hawaiian Islands at various periods have felt its influence, the general, though not consistent policy of the United States being, while disclaiming the desire of annexation itself, to deny the right of any European power (except Spain in Cuba's case, until 1898) to control them. And it was applied to the claims of British Guiana to Venezuelan territory by President Cleveland's message in 1895, which proposed a commission to settle the boundary and threatened war if its line were not accepted. This commission never reported, but the disputants finally agreed to arbitrate, and the British claim was in the main upheld.

Between 1823 and 1895 the development and enlargement of this policy on the part of the United States was very striking. To prevent the overthrow of an independent republic is one thing; to interfere in the settlement of a boundary dispute between two states, also on the ground of self-defence, is quite another. Yet Cleveland's doctrine met with general acceptance, and in fact it had been in a sense anticipated by President Grant, who, in urging the annexation of San Domingo upon the United States Senate in 1870, used this language:—

> The Doctrine promulgated by President Monroe has been adhered to by all political parties, and I now deem it proper to assert the equally important principle that hereafter no territory on this continent shall be regarded as subject of transfer to a European power.

Never having been formulated as law or in exact language, the Monroe Doctrine has meant different things to different persons at different times. It has become deeply rooted in the American heart, and a permanent part of the foreign policy of the United States. It tends to change into the principle that every portion of the American continent must be free from European control. It is still coupled, however, with the converse principle that America takes no part in European politics, as the disclaimer of the American delegates to the first Peace Conference at the Hague proved.

See Tucker's *Monroe Doctrine*; Gilman's *Life of Monroe*; Wharton's *International Law Digest* (title, "Monroe Doctrine"); Snow's *American Diplomacy*; also an article by Sir Frederick Pollock in the *Nineteenth Century and After* (1902). (T. S. W.)

MONROSE (1783–1843), French actor, whose real name was Claude Louis Séraphin Barizain, was born in Besançon on the 6th of December 1783, and was already playing children's parts at the time of the Revolution. He was called to the Comédie Française in 1815, and was received *sociétaire* in 1817. A small, active man, with mobile and expressive features and quick, nervous gestures, he was noted as the rascally servant in such plays as *Le Barbier de Séville* and *Les Fourberies de Scapin.* His son, LOUIS MARTIAL BARIZAIN (1809–1883), also called Monrose, was also an actor. He succeeded Samson as professor at the Conservatoire in 1866.

MONS (Flemish *Bergen*), a town of Belgium situated on a small river called the Trouille in the province of Hainaut of which it is the capital. Pop. (1904), 27,072. Mons was the capital of the ancient countdom of Hainaut, well known in English history from the marriage of Edward III. with its Countess Philippa. The town was founded by the Countess Waudru in the 8th century, whereupon Charlemagne recognized it as the capital of Hainaut, and it has retained the position ever since. It was only in the 11th century, however, that it became the fixed residence of the counts, who had previously occupied the castle of Hornu, leaving Mons to the abbey and the church of St Waudru. Regnier V. moved to Mons at the beginning of that century, and his only child—a daughter—Richilde, married Baldwin VI. of Flanders. The junction of the two countdoms was only temporary, and they again separated in the person of Richilde's sons. In this age Hainaut was known as "the poor land of a proud people," and it was not until the beginning of the 14th century that Mons was converted into a trading town by the establishment of a cloth market. At the same time the count transferred his principal fortress from Valenciennes to Mons. When the Hainaut title became merged in the duchy of Burgundy, Mons was a place of considerable importance on account of its being a stronghold near the French frontier. Its capture, defence and surrender by Louis of Nassau in 1572 was one of the striking incidents of the religious troubles. In the long wars of the 17th and 18th centuries Mons underwent several sieges, but none of the same striking character as those of Namur. Several times dismantled and refortified, Mons was finally converted into an open town in 1862.

The most remarkable building in the city is the cathedral of St Waudru, named after the first countess, which was begun in the middle of the 15th century, but not finished for more than a century and a half later. It is a fine specimen of later Gothic, and contains some good glass as well as a few pictures by Van Thudden. The Hôtel de Ville is about the same age as the cathedral, having been commenced in 1458 and finished in 1606. The tower was added a century later. There is also a fine belfry with a peal of bells. Mons is now a flourishing town with a good trade in cloth, lace, sugar refinery, &c.; but its chief importance is derived from its proximity to the Borinage (place of boring), district containing mines of the finest coal in Belgium. The military engineering college for the Belgian army is here, and not far from Mons are the battle-fields of Malplaquet (1709) and Jemappes (1792).

MONSIEUR (Fr., formed from *mon*, my, and *sieur*, lord), the general title of address in France used vocatively in speaking formally to any male person, like the English "sir" or prefixed to the name like the English "Mr." It is, however, in France also prefixed to nobiliary, official, and other titles, *e.g. Monsieur le president*, *Monsieur le duc d'E.*, &c. It is abbreviated *M.*, not *Mons.* As a specific title "Monsieur" (*tout court*) was used from the time of Louis XIV. of the eldest brother of the king, as "Monseigneur" was of the dauphin; as a general title of address it was given to the princely members of a royal house.

MONSIGNOR (It. *monsignore*, my lord), a title of honour granted by the pope to bishops and to high dignitaries and officials of the papal household. It is abbreviated *Mgr.*

MONSON, SIR WILLIAM (*c.* 1569–1643), British admiral, was the third son of Sir John Monson of South Carlton in Lincolnshire, where the family was of old standing. He matriculated at Balliol College, Oxford, in 1581, but ran away to sea in 1585, being then according to his own account sixteen. His first services were in a privateer in an action with a Spanish ship in the Bay of Biscay, of which he gives a somewhat Munchausen-like account in his *Naval Tracts.* In the Armada year he served as lieutenant of the "Charles," a small ship of the queen's. There being at that time no regular naval service, Monson is next found serving with the adventurous George Clifford, 3rd earl of Cumberland (1558–1605), whom he followed in his voyages of 1589, 1591 and 1593. During the second of these ventures Monson had the ill-luck to be taken prisoner by the Spaniards in a recaptured prize, and was for a time detained at Lisbon in captivity. His cruises must have brought him some profit, for in 1595 he was able to marry, and he thought it worth while to take his M.A. degree. The earl offended him by showing favour to another follower, and Monson turned elsewhere. In the expedition to Cadiz in 1596, he commanded the "Repulse" (50). From this time till the conclusion of the war with Spain he was in constant employment. In 1602 he commanded the last squadron fitted out in the reign of Queen Elizabeth. In 1604 he was appointed admiral of the Narrow Seas, the equivalent of the Channel squadron of modern times. In 1614 he was sent to the coasts of Scotland and Ireland to repress the pirates who then swarmed on the coast. Monson claimed to have extirpated these pests, but it is certain that they were numerous a generation later. After 1614 he saw no further active service till 1635, when he went to sea as vice-admiral of the fleet fitted out by king Charles I. with the first ship-money. He spent the last years of his life in writing his *Tracts*, and died in February 1643.

His claim to be remembered is not based on his services as a naval officer, though they were undoubtedly honourable, but on his *Tracts.* These treatises consist in part of historical narratives, and in part of argumentative proposals for the reform of abuses, or the development of the naval resources of the country. They form by far the best account by a contemporary of the naval life and transactions of the reign of Queen Elizabeth and the beginning of the reign of King James. Monson takes care to do himself full justice, but he is not unfair to his contemporaries. His style is thoroughly modern, and has hardly a trace of the poetry of the Elizabethans. He was the first naval officer in the modern sense of the word, a gentleman by birth and education who was trained to the sea, and not simply a soldier put in to fight, with a sailing-master to handle the ship for him, or a tarpaulin who was a sailor only.

Monson's elder brother, Sir Thomas Monson (1564–1641), was one of James I.'s favourites, and was made a baronet in 1611. He held a position of trust at the Tower of London, a circumstance which led to his arrest as one of the participators in the murder of Sir Thomas Overbury. He was, however, soon released and he died in May 1641. His eldest son was Sir John Monson, Bart. (1600–1683), a member of parliament under Charles I., and another son was Sir William Monson (*c.* 1607–1678), who was created an Irish peer as Viscount Monson of Castlemaine in 1628. Having been a member of the court which tried Charles I. the viscount was deprived of his honours and was sentenced to imprisonment for life in 1661. Sir John Monson's descendant, another Sir John Monson, Bart. (1693–1748), was created Baron Monson in 1728. His youngest son was George Monson (1730–1776), who served with the English troops in India from 1758 to 1763. The baron's eldest son was John, the 2nd baron (1727–1774), whose son William Monson (1760–1807) served in the Mahratta War under General Lake. William's only son William John (1796–1862) became 6th Baron Monson in succession to his cousin Frederick John, the 5th baron, in October 1841. His son William John, the 7th baron (1829–1898), was created Viscount Oxenbridge in 1886. When he died without sons in 1898 the viscounty became extinct, but the barony descended to his brother Debonnaire John (1830–1900), whose son Augustus Debonnaire John (b. 1868) became 9th Baron Monson in 1900. Another of Viscount Oxenbridge's brothers was Sir Edmund John Monson, Bart. (b. 1834), who, after filling many other diplomatic appointments, was British ambassador in Paris from 1896 to 1904.

The one authority for the life of Sir William Monson is his own *Tracts*, but a very good account of him is included by Southey in his *Lives of the Admirals*, vol. v. The *Tracts* were first printed in the third volume of Churchill's *Voyages*, but they have been edited for the Navy Record Society by Mr Oppenheim.

MONSOON (Arabic *Mauṣim*, season), the name given to seasonal winds due to differences of pressure between areas of land and sea, which are primarily caused by seasonal differences of temperature. Monsoons may be regarded as the seasonal analogue of the diurnal land and sea breezes. The term is, however, also applied to seasonal winds which change in direction on account of the migrations of wind-belts in the planetary circulation. During the season of rising temperature the surface of the land warms more quickly, and becomes hotter than that of the sea, and during the season of falling temperature the reverse is the case. Barometric pressure tends to be higher over the colder region than over the warmer, and there is accordingly a tendency for air to flow, in the lower levels of the atmosphere, from the former towards the latter. Thus there is in general a movement from land to sea during the cold season, and from sea to land during the warm season.

Within a belt extending from 10 to 15 degrees on each side of the equator, seasonal changes of temperature are insufficient in range to permit of the occurrence of temperature differences adequate to the development of true monsoons. In the higher latitudes of the west wind-belt, and in the polar zones, the generally low temperature does not favour the occurrence of wide differences between land and sea. Thus the conditions required for the occurrence of monsoonal winds are best satisfied in intermediate latitudes in the neighbourhood of the tropics. But, as in the case of land and sea breezes, the strength and extension of the monsoon produced by the action described depends to a large extent on the configuration of the land surface. When the land area consists of a low plain, or of a plateau having a steep coastal strip of small width, the circulation upon it tends to be local, and to approximate to the typical "continental" climate of the temperate zones. Where, on the other hand, the land slopes upwards gradually to a central *massif* or ridge the effect of the differences of temperature is, as it were, cumulative, and the monsoons may extend over large areas, affecting regions distant from those in which the causes producing them are directly operative, and the monsoon winds may develop great strength. Ferrel (*Popular Treatise on the Winds*) has compared the conditions in the two cases to those of a stove with a long horizontal flue and with a vertical or inclined flue of the same length.

It is of course to be noted that the hot season monsoon is in general of greater strength than that of the cold season, because being usually a sea wind the air is fully charged with moisture, condensation takes place as ascensional movement sets in on reaching the land, and the latent heat set free strengthens the upward current.

The position, outline and relief of the continent of Asia favour the development of monsoons to a much greater extent than any other part of the world; so much so that the climate of the whole of the southern and eastern parts is entirely controlled by these winds, forming what is typically known as "the monsoon region," a region having distinctly characteristic products. Monsoons form an important element in the climate of Australia, western and southern Africa, and the southern part of the United States of America, but with a few exceptions the monsoons of those regions are local in character, modifying the prevailing winds of the planetary circulation (usually the trade winds) for a longer or shorter period every year.

MONSTER (Lat. *monstrum*, from root of *monere*, to warn; *i.e.* something terrible or portentous). In zoology, monsters or monstrous births are the subject of Animal Teratology, a department of morphological science treating of deviations from the normal development of the embryo. The term "embryo" is conventionally limited, in human anatomy, to the ovum in the first three months of its intra-uterine existence, while it is still developing or acquiring the rudiments of its form, the term "foetus" being applied to it in the subsequent months during which the organism grows on the lines of development already laid down. It is mostly in the first or embryonic period that those deviations from the normal occur which present themselves as monstrosities at the time of birth; these early traces of deviation within the embryo may be slight, but they "grow with its growth and strengthen with its strength," until they amount to irreparable defects or accretions, often incompatible with extra-uterine life. The name of "teratology," introduced by Étienne Geoffroy St Hilaire (1822), is derived from *τέρας*, the equivalent of *monstrum*; teratology is a term new enough to have none but scientific associations, while the Latin word has a long record of superstitions identified with it. The myths of siren, satyr, Janus, cyclops and the like, with the corresponding figures in Northern mythology, find a remote anatomical basis in monstrosities which have, for the most part, no life except in the foetal state. The mythology of giants and dwarfs is, of course, better founded. The term monster was originally used in the same sense as portent. Luther[1] speaks of the birth of a monstrous calf, evidently the subject of contemporary talk, as pointing to some great impending change, and he expresses the hope that the catastrophe might be the Last Day itself. The rise of more scientific views will be sketched in the course of the article.

Although monstrosities, both in the human species and in other animals, tend to repeat certain definite types of erroneous development, they do not fall readily into classes. The most usual grouping (originally suggested by G. L. L. Buffon, 1800) is into *monstra per excessum, monstra per defectum*, and *monstra per fabricam alienam*. It seems useful, however, to place the more simple cases of excess and of defect side by side; and it is necessary, above all, to separate the double monsters from the single, the theory of the former being a distinct chapter in teratology.

1. *Monstrosities in a Single Body.*—The abnormality may extend to the body throughout, as in well-proportioned giants and dwarfs; or it may affect a certain region or member, as—to take the simplest case—when there is a finger or toe too many or too few. It is very common for one malformation to be correlated with several others, as in the extreme case of acardiac monsters, in which the non-development of the heart is associated with the non-development of the head, and with other radical defects.

Giants are conventionally limited to persons over 7 ft. in height. The normal proportions of the frame are adhered to more or less closely, except in the skull, which is relatively small; but accurate measurements, even in the best-proportioned cases, prove, when reduced to a scale, that other parts besides the skull—notably the thigh-bone and the foot—may be undersized though overgrown. In persons who are merely very tall the great stature depends often on the inordinate length of the lower limbs; but in persons over 7 ft. the lower limbs are not markedly disproportionate. In many cases the muscles and viscera are not sufficient for the overgrown frame, and the individuals are usually, but not always, of feeble intelligence and languid disposition, and short-lived. The brain-case especially is undersized—the Irish giant in the museum of Trinity College, Dublin, is the single exception to this rule—but the bones of the face, and especially the lower jaw, are on a large scale. Giants are never born of gigantic parents; in fact, sterility usually goes with this monstrosity. Their size is sometimes excessive at birth, but more often the indications of great stature do not appear till later, it may be as late as the ninth year; they attain their full height before the twenty-first year. They have been more frequently male than female.

Dwarfs are conventionally limited to persons under 4 ft. They are more likely than giants to have the modulus of the body perfect. Where disproportion occurs in the true dwarf it takes the form of a large-sized head, broad shoulders and capacious chest, and undersized lower limbs. Dwarfs with rickets are perhaps to be distinguished from true dwarfs; these are cases in which the spine is curved, and sometimes the bones of the limbs bent and the pelvis deformed. As in the case of giants, dwarfs are seldom the progeny of dwarfs, who are, in fact, usually sterile; the unnatural smallness may be obvious at birth, but is more likely to make itself manifest in the years of growth. Dwarfs are much more easily brought up than giants, and are stronger and longer-lived; they have usually also strong passions and acute intelligence. The legends of the dwarfs and giants are on the whole well based on fact. (See DWARF and GIANT.)

Redundancy and Defect in Single Parts.—The simplest case of this redundancy is a sixth digit, well formed, and provided with muscles (or tendons), nerves, and bloodvessels like the others; it is usually a repetition of the little finger or toe, and it may be present on one or both hands, or on one or both feet, or in all four extremities, as in the giant of Gath. The want of one, two, or more digits on hand or foot, or on both, is another simple anomaly; and, like the redundancy, it is apt to repeat itself in the same family. J. F. Meckel saw a girl who had an extra digit on each extremity, while a sister wanted four of the fingers of one hand. Where the supernumerary digits are more than one on each extremity, the whole set are apt to be rudimentary or stunted; they look as if two or more of the embryonic buds had been subject to cleavage down the middle and to arrest of longitudinal growth. There are several authentic instances of a whole lower limb appearing at birth as two withered halves, as if from embryonic cleavage. Other redundancies of the skeleton are extra vertebrae (sometimes the coccygeal, giving the appearance of a rudimentary tail), or an extra rib. A double row of teeth is occasionally met with; the most interesting case of this anomaly is that in which the rudiments of a double row exist from the first, but the phenomenon is sometimes produced by the milk teeth persisting along with the second set. Among redundancies of the soft parts, by far the most frequent relate to the mammary glands and especially to the nipples. These organs are normally paired amongst mammals, and the glands of each pair are placed symmetrically on a curved line running from the axilla towards the pubes. When many pairs occur, the glands of each pair diverge less from the median line than those of the immediately anterior pair, the abdominal glands lying close together, those towards the axilla being farther apart. When only a single pair is normally present, the pair is abdominal, pectoral or axillary; and whether the normal be one pair or many pairs, additional glands are not infrequent, but occupy the expected position on the mammary lines. Accessory glands or nipples in human beings, if anterior to the normal pair, lie farther from the median ventral line, and vice versa. Among the sense-organs there is a remarkable instance recorded of doubling of the appendages of the left eye, but not of the eyeball itself; the left half of the frontal bone is double, making two eye-sockets on that side, and the extra orbit has an eyebrow and eyelid. The external ear (*pinna*) has also been found double on one side and its orifice has frequently been found doubled in man and lower animals, and the additional ears lie in a definite relation to the branchial clefts of the embryo. Doubling of any of the internal organs or parts of organs may occur and innumerable cases have been recorded.

Montrosities from Defective Closure in the Middle Line.—Under this head come some of the commonest congenital malformations, including slight deficiencies such as harelip, and serious defects such as a gap in the crown of the head with absence of the brain. The embryo is originally a circular flattened disk spread out on one pole of the yolk, and it is formed into a cylindrical body (with four appendages) by the free margins of the disk, or rather its ventral laminae, folding inwards to meet in the middle line and so close in the pelvic, abdominal, thoracic, pharyngeal and oral cavities. Meanwhile, and indeed rather earlier, two longitudinal parallel ridges on the top or along the back of the disk have grown up and united in the middle line to form the second barrel of the body—the neural canal—of small and uniform width in the lower three-fourths or spinal region, but expanding into a wide chamber for the brain. This division into neural (dorsal) and haemal (ventral) canals underlies all vertebrate development. Imperfect closure along either of those embryonic lines of junction may produce various degrees of monstrosity. The simplest and commonest form, hardly to be reckoned in the present category, is harelip with or without cleft palate, which results from defective closure of the ventral laminae at their extreme upper end. Another simple form, but of much more serious import, is a gap left in the neural canal at its lower end; usually the arches of the lumbar vertebrae are deficient, and the fluid that surrounds the spinal cord bulges out in its membranes, producing a soft tumour under the skin at the lower part of the back. This is the condition known as *hydrorhachis*, depending on the osseous defect known as *spina bifida*. More rarely the gap in the arches of the vertebrae is in the region of the neck. If it extend all along the back, it will probably involve the skull also. Deficiency of the crown of the head, and in the spine as well, may be not always traceable to want of formative power to close the canal in the middle line; an over-distended condition of the central canal of the cord and brain may prevent the closure of the bones, and ultimately lead to the disruption of the nervous organs themselves; and injuries to the mother, with inflammation set up in the foetus and its appendages, may be the more remote cause. But it is by defect in the middle line that the mischief manifests itself, and it is in that anatomical category that the malformations are included. The osseous deficiency at the crown of the head is usually accompanied by want of the scalp, as well as of the brain and membranes. The bones of the face may be well developed and the features regular, except that the eyeballs bulge forward under the closed lids; but there is an abrupt horizontal line above the orbits where the bones cease, the skin of the brow joining on to a spongy kind of tissue that occupies the sides and floor of the cranium. This is the commonest form of an *anencephalous* or brainless monster. There are generally mere traces of the brain, although, in some rare and curious instances, the hemispheres are developed in an exposed position on the back of the neck. The cranial nerves are usually perfect, with the exception sometimes of the optic (and retina). Vegetative existence is not impossible, and a brainless monster has been known to survive sixty-five days. The child is usually a very large one.

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[1] In a passage quoted by T. L. W. Bischoff from the 19th volume of Luther's works, Halle ed., p. 2416.

Closely allied, as we have seen, to the anencephalous condition is the condition of congenital *hydrocephalus*. The nervous system at its beginning is a neural canal, not only as regards its bony covering, but in its interior; a wide space lined by ciliated epithelium and filled with fluid extends along the axis of the spinal cord, and expands into a series of chambers in the brain. As development proceeds the walls thicken at the expense of the internal spaces, the original tubular or chambered plan of the central nervous system is departed from, and those organs assume the practically solid form in which we familiarly know them. If, however, the spaces persist in their embryonic proportions notwithstanding the thickening of the nervous substance forming their walls, there results an enormous brain which is more than half occupied inside with fluid, contained in spaces that correspond on the whole to the ventricles of the brain as normally bounded. A hydrocephalic foetus may survive its birth, and will be more apt to be affected in its nutrition than in its intelligence. In many cases the hydrocephalic condition does not come on till after the child is born.

Returning to the ventral middle line, there may be defects of closure below the lips and palate, as in the breast-bone (fissure of the sternum), at the navel (the last point to close in any case), and along the middle line of the abdomen generally. The commonest point for a gap in the middle line of the belly is at its lower part, an inch or two above the pubes. At that point in the embryo there issues the allantois, a balloon-like expansion from the ventral cavity, which carries on its outer surface bloodvessels from the embryo to interdigitate with those of the mother on the uterine surface. Having served its temporary purpose of carrying the bloodvessels across a space, the balloon-like allantois collapses, and rolls up into the rounded stem-like umbilical cord through most of its extent; but a portion of the sac within the body of the foetus is retained as the permanent urinary bladder. That economical adaptation of a portion of a vesicular organ, originally formed for purposes of communication between the embryo and the mother, appears to entail sometimes a defect in the wall of the abdomen just above the pubes, and a defect in the anterior wall of the bladder itself. This is the distressing congenital condition of fissure of the urinary bladder, in which its interior is exposed through an opening in the skin; the pubic bones are separated by an interval, and the reproductive organs are ill-formed; the urachus is wanting, and the umbilicus is always placed exactly at the upper end of the gap in the skin. A monstrosity recalling the cloacal arrangement of the bird is met with as a more extreme defect in the same parts.

Hermaphroditism.—Although this anomalous condition does not fall under defective closure in the middle line, it may be said to be due to a similar failure of purpose, or to an uncertainty in the *nisus formativus* at a corresponding stage of development. Strictly speaking, a hermaphrodite is a creature containing ovaries and testes—the essential organs of each sex. Evidence accumulates, however, that at least in all the higher vertebrates, including man, the sex is predetermined in the fertilized ovum, and it is more than doubtful if true hermaphroditism occurs. On the other hand, if there be no such double sex in the essential organs (as in the majority of so-called hermaphrodites) there is a great deal of doubling and ambiguity entailed in the secondary or external organs and parts of generation. Those parts which are rudimentary or obsolete in the male but highly developed in the female, and those parts which are rudimentary in the female but highly developed in the male tend in the hermaphrodite to be developed equally, and all of them badly. Amongst human beings the greater number of so-called hermaphrodites are really females, in which there is an abnormal development of the clitoris, but it also happens that true males may be born with a small clitoris-like penis, with hypospadia—that is to say, with imperfect urethra, open on the ventral side, and with undescended testes. Failure of the development of the testes or ovary, or their removal in the adult condition induces an ambiguous condition of the body in which the secondary sexual characters approach those of the other sex. Experimental removal of the ovaries or testes, followed by implantation of organs of the other sex, has produced an inversion of the secondary sexual characters.

Cyclops, *Siren*, &c.—The same feebleness of the formative energy which gives rise to some at least of the cases of defective closure in the middle line, and to the cases of ambiguous sex, leads also to imperfect separation of symmetrical parts. The most remarkable case of the kind is the cyclops monster. At a point corresponding to the root of the nose there is found a single orbital cavity, sometimes of small size and with no eyeball in it, at other times of the usual size of the orbit and containing an eyeball more or less complete. In still other cases, which indicate the nature of the anomaly, the orbital cavity extends for some distance on each side of the middle line, and contains two eyeballs lying close together. The usual nose is wanting, but above the single orbital cavity there is often a nasal process on the forehead, with which nasal bones may be articulated, and cartilages joined to the latter; these form the framework of a short fleshy protuberance like a small proboscis. The lower jaw is sometimes wanting in cyclopeans; the cheek-bones are apt to be small, and the mouth a small round hole, or altogether absent; the rest of the body may be well developed. The key to the cyclopean condition is found in the state of the brain. The olfactory nerves or lobes are frequently absent; the brain is very imperfectly divided into hemispheres, and appears as a somewhat pear-shaped sac with thick walls, the longitudinal partition of dura mater (falx cerebri) being wanting, the surface almost unconvoluted, the corpus callosum deficient, the basal ganglia rudimentary or fused. The optic chiasma and nerves are usually replaced by a single mesial nerve, but sometimes the chiasma and pair of nerves are present. The origin of this monstrosity dates back to an early period of development, to the time when the future hemispheres were being formed as protrusions from the anterior cerebral vesicle or fore-brain; it may be conceived that, instead of two distinct buds from that vesicle, there was only a single outgrowth with imperfect traces of cleavage. That initial defect would carry with it naturally the undivided state of the cerebrum, and with the latter there would be the absence of olfactory lobes and of a nose, and a single eyeball placed where the nose should have been. A cyclops has been known to live for several days. The monstrosity is not uncommon among the domestic animals, and is especially frequent in the pig.

Another curious result of defective separation of symmetrical parts is the siren form of foetus, in which the lower limbs occur as a single tapering prolongation of the trunk like the hinder part of a dolphin, at the end of which a foot (or both feet) may or may not be visible. The defects in the bones underlying this siren form are very various: in some cases there is only one limb (thigh and leg-bones) in the middle line; in others all the bones of each limb are present in more or less rudimentary condition, but adhering at prominent points of the adjacent surfaces. The pelvis and pelvic viscera share in the abnormality. A much more common and harmless case of unseparated symmetrical parts is where the hand or foot has two, three, or more digits fused together. This syndactylous anomaly runs in families.

Limbs Absent or Stunted.—Allied to these fused or unseparated states of the extremities, or of parts of them, are the class of deformities in which whole limbs are absent, or represented only by stumps. The trunk (and head) may be well formed, and the individual healthy; all four extremities may be reduced to short stumps either wanting hands and feet entirely, or with the latter fairly well developed; or the legs only may be rudimentary or wanting, or the arms only, or one extremity only. Although some of these cases doubtless depend upon aberrant or deficient formative power in the particular directions, there are others of them referable to the effects of mechanical pressure, and even to direct amputation of parts within the uterus.

Acardiac and Acranial Monsters.—It sometimes happens in a twin pregnancy that one of the embryos fails to develop a heart and a complete vascular system of its own, depending for its nourishment upon blood derived from the placenta of its well-formed twin by means of its umbilical vessels. It grows into a more or less shapeless mass, in which all traces of the human form may be lost. Other viscera besides the heart will be wanting, and no head distinguishable; the most likely parts to keep the line of development are the lumbar region (with the kidneys), the pelvis, and the lower limbs. The twin of this monster may be a healthy infant.

Reversed Position of the Viscera.— This is a developmental error associated with the retention of the right aortic arch as in birds, instead of the left as is usual in mammals. The position of all the unsymmetrical viscera is transposed, the spleen and cardiac end of the stomach going to the right side, the liver to the left, the caecum resting on the left iliac fossa, and the sigmoid flexure of the colon being attached to the right. This condition of *situs inversus viscerum* need cause no inconvenience; and it will probably remain undetected until the occasion should arise for a physical diagnosis or post-mortem inspection.

The causes of congenital anomalies are difficult to specify. There is no doubt that, in some cases, they are present in the sperm or germ of the parent; the same anomalies recur in several children of a family, and it has been found possible, through a variation of the circumstances, to trace the influence in some cases to the father alone, and in other cases to the mother alone. The remarkable thing in this parental influence is that the malformation in the child may not have been manifested in the body of either parent, or in the grandparents. More often the malformation is acquired by the embryo and foetus in the course of development and growth, either through the mother or in itself independently. Maternal impressions during pregnancy have often been alleged as a cause, and this causation has been discussed at great length by the best authorities. The general opinion seems to be that it is impossible to set aside the influence of subjective states of the mother altogether, but that there is no direct connexion between the cause of the subjective state and the resulting anomaly. The doctrine of maternal impressions has often been resorted to when any other explanation was either difficult or inconvenient; thus, Hippocrates is said to have saved the virtue of a woman who gave birth to a black child by pointing out that there was a picture of a negro on the wall of her chamber. Injuries to the mother during pregnancy have been unquestionably the cause of certain malformations, especially of congenital hydrocephalus. The embryo itself and its membranes may become the subject of inflammations, atrophies, hypertrophies, and the like; this causation is doubtless accountable for a good many of them. But a very large residue of malformations must still be referred to variation in the embryonic cells and cell-groups. The *nisus formativus* of the fertilized ovum is always subject to morphological laws, but, just as in extra-uterine life, there may be deviations from the beaten track; and even a slight deviation at an early stage will carry with it far-reaching consequences. This is particularly noticeable in double monsters.

2. *Double Monsters.*—Twins are the physiological analogy of double monsters, and some of the latter have come very near to being two separate individuals. The Siamese twins, who died in 1874 at the age of sixty, were joined only by a thick fleshy ligament from the lower end of the breast-bone (xiphoid cartilage), having the common navel on its lower border; the anatomical examination showed, however, that a process of peritoneum extended through the ligament from one abdominal cavity to the other, and that the blood-vessels of the two livers were in free communication across the same bridge. There are one or two cases on record in which such a ligament has been cut at birth, one, at least, of the twins surviving. From the most intelligible form of double monstrosity, like the Siamese twins, there are all grades of fantastic fusion of two individuals into one down to the truly marvellous condition of a small body or fragment parasitic upon a well-grown infant—the condition known as *foetus in foetu.* These monstrosities are deviations, not from the usual kind of twin gestation, but from a certain rarer physiological type of dual development. In by far the majority of cases twins have separate uterine appendages, and have probably been developed from distinct ova; but in a small proportion of (recorded) cases there is evidence, in the placental and enclosing structures, that the twins had been developed from two rudiments arising side by side on a single blastoderm. It is to the latter physiological category that double monsters almost certainly belong; and there is some direct embryological evidence for this opinion. Allen Thomson observed in the blastoderm of a hen's egg at the sixteenth or eighteenth hour of incubation two "primitive traces" or rudiments of the backbone forming side by side; and in a goose's egg incubated five days he found on one blastoderm two embryos, each with the rudiments of upper and lower extremities, crossing or cohering in the region of the future neck, and with only one heart between them. A very large number of similar observations have been published and appear to be found in all cases where a large material is available. The developing ova of fish, available in large numbers in hatcheries, and the laboratory investigation of the chick and the frog have provided cases of almost every degree of blending. The perfect physiological type appears to be two rudiments on one blastoderm, whose entirely separate development produces twins (under their rarer circumstances), whose nearly separate development produces such double monsters as the Siamese twins, and whose less separate development produces the various grotesque forms

of two individuals in one body. There can be no question of a literal fusion of two embryos; either the individuality of each was at no time complete, or, if there were two distinct primitive traces, the uni-axial type was approximately reverted to in the process of development, as in the formation of the abdominal and thoracic viscera, limbs, pelvis or head. Double monsters are divided in the first instance into those in which the doubling is symmetrical and equal on the two sides, and those in which a small or fragmentary foetus is attached to or enclosed in a foetus of average development—the latter class being the so-called cases of "parasitism."

Symmetrical Double Monsters are subdivided according to the part or region of the body where the union or fusion exists—head, thorax, umbilicus or pelvis. One of the simplest cases is a Janus head upon a single body, or there may be two pairs of arms with the two faces. Again, there may be one head with two necks and two complete trunks and pairs of extremities. Two distinct heads (with more or less of neck) may surmount a single trunk, broad at the shoulders but with only one pair of arms. The fusion, again, may be from the middle of the thorax downwards, giving two heads and two pairs of shoulders and arms, but only one trunk and one pair of legs. In another variety, the body may be double down to the waist, but the pelvis and lower limbs single. The degree of union in the region of the head, abdomen or pelvis may be so slight as to permit of two distinct organs or sets of organs in the respective cavities, or so great as to have the viscera in common; and there is hardly ever an intermediate condition between those extremes. Thus, in the Janus head there may be two brains, or only one brain. The Siamese twins are an instance of union at the umbilical region, with the viscera distinct in every respect except a slight vascular anastomosis and a common process of peritoneum; but it is more usual for union in that region to be more extensive, and to entail a single set of abdominal and thoracic viscera. The pelvis is one of the commonest regions for double monsters to be joined at, and, as in the head and abdomen, the junction may be slight or total. The Hungarian sisters Helena and Judith (1701–1723) were joined at the sacrum, but had the pelvic cavity and pelvic organs separate; the same condition obtained in the South Carolina negresses Millie and Christina, known as the "two-headed nightingale," and in the Bohemian sisters Rosalie and Josepha. More usually the union in the pelvic region is complete, and produces the most fantastic shapes of two trunks (each with head and arms) joining below at various angles, and with three or four lower limbs extending from the region of fusion, sometimes in a lateral direction, sometimes downwards. A very curious kind of double monster is produced by two otherwise distinct foetuses joining at the crown of the head and keeping the axis of their bodies in a line. It is only in rare instances that double monsters survive their birth, and the preserved specimens of them are mostly of foetal size.

Unequal Double Monsters, Foetus in Foetu.—There are some well-authenticated instances of this most curious of all anomalies. The most celebrated of these parasite-bearing monsters was a Genoese, Lazarus Johannes Baptista Colloredo, born in 1716, who was figured as a child by Licetus, and again by Bartholinus at the age of twenty-eight as a young man of average stature. The parasite adhered to the lower end of his breast-bone, and was a tolerably well-formed child, wanting only one leg; it breathed, slept at intervals, and moved its body, but it had no separate nutritive functions. The parasite is more apt to be a miniature acardiac and acephalous fragment, as in the case of the one borne in front of the abdomen of a Chinaman figured by I. Geoffroy St Hilaire. Sometimes the parasite is contained in a pouch under the skin of the abdominal wall, and in another class (of which there is a specimen in the Hunterian Museum) it has actually been included, by the closure of the ventral laminae, within the abdominal cavity of the foetus—a true *foetus in foetu*. Shapeless parasitic fragments containing masses of bone, cartilage and other tissue are found also in the space behind the breast-bone (mediastinal teratoma), or growing from the base of the skull and protruding through the mouth ("epignathous teratoma," appearing to be seated on the jaw), and, most frequently of all, attached to the sacrum. These last pass by a most interesting transition into common forms of congenital sacral tumours (which may be of enormous size), consisting mainly of one kind of tissue having its physiological type in the curious gland-like body (coccygeal gland) in which the middle sacral artery comes to an end. The congenital sacral tumours have a tendency to become cystic, and they are probably related to the more perfect congenital cysts of the neck region, where there is another minute gland-like body of the same nature as the coccygeal at the point of bifurcation of the common carotid artery. Other tumours of the body, especially certain of the sarcomatous class, may be regarded from the point of view of *monstra per excessum*; but such cases suggest not so much a question of aberrant development within the blastoderm as of the indwelling spontaneity of a single post-embryonic tissue. (See TUMOUR AND PATHOLOGY.)

Monstrosities in man and animals have attracted attention since the earliest times, and amongst primitive and uncivilized peoples have been regarded as of supernatural origin. Aristotle himself appears to have been the first to examine them as a naturalist, and to explain that although they were outside the usual course of nature they were in the strictest sense of natural origin. Pliny described many well-known forms, but did not distinguish between legendary and actual monstrosities. In the middle ages they were treated in the fullest spirit of superstition, and many relics from such a point of view still survive. The human monstrosities were regarded as having been engendered in women by the devil who had commerce with them either in his own form or in the guise of some animal. The belief still to be found amongst uneducated persons that unnatural union between women and male animals, or between men and female animals, may be fertile and produce monsters, is an attenuated form of the satanic legend. The scientific appreciation of monsters has grown with the study of embryology. William Harvey in *Exercitationes de generatione animalium* (1651) first referred monstrosities to their proper place as abnormalities in embryonic reproduction. The doctrine of pre-formation (see HEREDITY) obsessed biological science until 1759 when C. F. Wolff overthrew it, and Harvey's advance was not pursued, except that a number of anatomists published careful studies and descriptions of monsters or monstrous organs. Those who believed that the normal process of development was an unrolling and expansion of a pre-formed miniature of the adult had to apply a similar theory to monsters, and Sylvain Regis, a contemporary of Malbranche, obtained acceptance of his view that monstrous germs as well as normal germs had been created at the beginning of the world. A discussion almost as memorable as that between E. G. St Hilaire and Cuvier on specific types was pursued in the French Academy from 1724 to 1743, J. B. Winslow, who supported the current pre-formationist view, having the better of the argument with Louis Lémery, who was almost alone in a rational interpretation of monstrosities. From the time of Wolff it was accepted that normal and abnormal embryos alike developed by processes of epigenetic change. Wolff himself, however, and even J. F. Meckel at the beginning of the 19th century, did not recognize the influence of physiological causes in the production of abnormalities; they believed the latter to proceed certainly in an orderly and natural way, but from abnormal ova. E. G. St Hilaire was the first to attempt experimental teratology and to lay down that many monstrosities were the result of influences causing deviations from the normal course of embryonic development. I. G. St Hilaire, the son of E. G. St Hilaire, carried the experimental method little further, but published an elaborate descriptive treatise on anomalies (Paris, 1832–1837) which remains one of the most valuable records of the subject. A similar treatise with an incomparable atlas of illustrations was issued by W. Vrolik, the great Dutch anatomist, between 1840 and 1849, whilst A. Förster issued in 1861 a valuable textbook with a very large number of illustrations chiefly from preparations in the museum at

Würzburg. The great museums devoted much attention to the collection and display of malformations, and no account of the subject can be adequate which does not include reference to the magnificent series in the Museum of the Royal College of Surgeons of England, with the descriptive catalogues of the animal malformations written by B. T. Lowne (1893) and of the vegetable malformations by M. T. Masters (1893).

The work hitherto referred to, as well as a vast bulk of scattered contributions to teratology throughout the 19th century, was chiefly descriptive, anatomical and embryological teratology, and carried the experimental side little beyond where it had been left by the St Hilaires. In 1891 Camille Dareste published his *Recherches sur la production artificielle des monstruosités, ou essais de tératogênie expérimentale*; his experiments, chiefly on the developing egg of the fowl, not only showed the probable cause of many of the most common abnormalities, but practically created a new branch of science, experimental embryology. Teratology has since become a side issue of the general study of the inter-relations between the inherited tendencies of the developing organism and the play of the circumambient media, and must be studied in relation to the work of O. Hertwig, W. Roux, H. Driesch, O. Bütschli, J. Loeb and their school. J. Bland Sutton's popular *Evolution and Disease* (1890) puts in a cogent way the relation between comparative anatomy and common abnormalities, whilst W. Bateson in his *Materials for the Study of Variation* (1894) describes the acquisition of new symmetries by abnormal organs, and discusses the possible relation between abnormalities and the origin of species.

E. Schwalbe's *Morphologie der Missbildungen* (1906–1909) is a very complete study of the most modern developments of teratology, and contains a careful and elaborate list of authorities from the earliest times. (C. C.; P. C. M.)

MONSTRANCE (through the French from Lat. *monstrare*, to show), a vessel used in the Roman Church for the exhibition of the Host at Benediction (*q.v.*) and also when carried in processions. Another name for the vessel is *ostensorium*, from *ostendere*, to exhibit, show; whence the usual French name *ostensoir*. The monstrance was formerly used of a reliquary, exposing the sacred object to view. The earlier monstrances followed the usual shape of these reliquaries, viz. a cylindrical crystal case mounted in metal frames, elaborately ornamented and jewelled. Such often took the form of a turret. There is a 15th-century Italian example in South Kensington Museum of a pilastered turret containing an oblong crystal case, the whole resting on a stemmed base, and surmounted with a cupola. In the 16th century the present shape was adopted, viz. a crystal or glass circular disk, more suited to the shape of the sacred wafer; this is mounted in a frame of golden rays, and the whole is supported by a stem and bases. The exhibition of the Host dates from the institution of the Festival of Corpus Christi (*q.v.*) by Urban IV. in 1264.

MONSTRELET, ENGUERRAND DE (*c.* 1400–1453), French chronicler, belonged to a noble family of Picardy. In 1436 and later he held the office of lieutenant of the *gavenier* (*i.e.* receiver of the *gave*, a kind of church rate) at Cambrai, and he seems to have made this city his usual place of residence. He was for some time bailiff of the cathedral chapter and then provost of Cambrai. He was married and left some children when he died on the 20th of July 1453. Little else is known about Monstrelet except that he was present, not at the capture of Joan of Arc, but at her subsequent interview with Philip the Good, duke of Burgundy. Continuing the work of Froissart, Monstrelet wrote a *Chronique*, which extends to two books and covers the period between 1400 and 1444, when, according to another chronicler, Matthieu d'Escouchy, he ceased to write. But following a custom which was by no means uncommon in the middle ages, a clumsy sequel, extending to 1516, was formed out of various chronicles and tacked on to his work. Monstrelet's own writings, dealing with the latter part of the Hundred Years' War, are valuable because they contain a large number of documents which are certainly, and reported speeches which are probably, authentic. The author, however, shows little power of narration; his work, although clear, is dull, and is strongly tinged with the pedantry of its century, the most pedantic in French history. His somewhat ostentatious assertions of impartiality do not cloak a marked preference for the Burgundians in their struggle with France.

Among many editions of the *Chronique* may be mentioned the one edited for the *Société de l'histoire de France* by M. Douët d'Arcq (Paris, 1857–1862), which, however, is not very good. See A. Molinier, *Les Sources de l'histoire de France*, tomes iv. and v. (Paris, 1904).

MONTAGNAIS (Fr. "mountaineers"), the collective French name (1) for a group of North American Indian tribes of Quebec province, (2) for four tribes of the northern division of the Athabascan stock of North American Indians in the interior of British North America.

MONTAGU (*Family*). Dru of Montaigu or Montagud, the ancestor of the Montagus, earls of Salisbury, came to England with Robert, count of Mortain, half-brother of William the Conqueror. He is found in Domesday among the chief tenants of the count in Somerset, where Dru held the manor of Shepton, afterwards called Shepton Montagu. Upon the hill of Lutgaresburg, in Bishopston, Robert built the castle which he called Montaigu—but there is no reason for believing that Dru's surname was derived from the castle, he being probably a Norman born—from Montaigu or Montaigu-les-bois, both in the neighbourhood of Mortain. The Domesday holding of Dru is represented in the return of 1166 by the ten knights' fee upon which his descendant, another Dru, is assessed. William Montagu of Shepton is among the knights summoned by Henry III. to the Gascon War and to the Welsh border in 1257. His son Simon, the first of the family to make a figure in history, followed Edward I. in 1277 against Llywelyn ap Gruffydd, being then, as it would appear, a minor, and he served again in 1282, when Llywelyn's power was broken for the last time. By a charter dated in 1290 his Somersetshire manors and the manor of Aston Clinton were confirmed to him by a grant from the Crown. In 1296 a ship under his command broke the blockade of Bordeaux. In 1298 he was summoned as a baron; and in 1301, as Simon lord of Montagu, he sealed the famous letter of the barons to the pope with his seal of the arms of Montagu, the counterseal showing a griffon. One of the earliest examples of quartered arms seen in England was afforded when Simon's banner displayed at Falkirk in 1298 quartered this griffon, gold on a blue field, with the Montagu's indented fesse of three fusils. He died in 1317 and was succeeded by his son William (d. 1319), a favourite of Edward II., whose household steward he became, and seneschal of Aquitaine and Gascony. His eldest son, another William, came of age in 1322, and in 1330 led the young king's partisans by the secret way into Nottingham Castle, and carried off the earl of March. The day before Mortimer had denounced Montagu as a traitor, but Montagu struck at once and his success was rewarded by grants from the forfeited lands of March. In 1337 he was created earl of Salisbury, and on the death of Thomas of Brotherton in 1338 he was made marshal of England. His king employed him in missions to France, Scotland, Germany and Castile, but war was, as with most of the men of his house, the chief business of his short life. At some time between 1340 and 1342 he led an expedition of his own against the Isle of Man, winning from the Scots the little kingdom to which he had inherited a claim. His grandfather Simon is said to have married a certain Auffray or "Aufrica," sometimes described as "daughter of Fergus and sister of Orray, king of Man," and sometimes as the grand-daughter and heir of John de Courcy, the conqueror of Ulster, whose wife "Affreca" was sister of King Olaf II. John de Courcy, however, died childless, and in 1287 Simon names his wife as Hawise. The second Aufrica or Affreca claimed the island as heir of Magnus II. (d. 1265), a letter of Edward I. in 1293 citing John of Scotland to answer her appeal to king John's suzerain. By her charter of 1306 the same Aufreca, styling herself "Aufreca of Counnoght, heir of the land of Man," granted the island to Simon, and this grant, rather than the marriage universally asserted by Simon's biographers, was probably the origin of the Montagu claim. The first earl died in 1344 and was buried in the Whitefriars Church in London. His wife, Katherine, daughter of William de Graunson, and co-heir, in her issue, of her brothers, is connected by a legend of no value with the foundation of the Order of the Garter. Between William, his son and heir, the second earl (1328–1397) and Joan of Kent, daughter of Edmund of Woodstock, there was a contract of marriage which was made null by the pope's bull in 1349. William was one of the knights-founders of the Order of the Garter, fought at Crecy, and commanded the rearward battle at Poitiers. According to Froissart he attended the young Richard in Smithfield when the king faced the mob after the death of Wat Tyler. His only son was killed in 1383 at a tournament, and in 1393 the earl sold the lordship and crown of Man to William Scrope of Bolton. He was succeeded by his nephew John, the third earl (c. 1350–1400), son of Sir John Montagu by Margaret, the heir of the barons of Monthermer. The new earl was notorious as a Lollard, and was accused, after Henry IV.'s accession, of a share in Gloucester's death, from which he was to have cleared himself in combat with the Lord Morley. But he joined Kent, Huntingdon and Rutland in their plot against Henry, and was beheaded with the earl of Kent by the Cirencester mob. By his wife Maude, daughter of Sir Adam Francis, he had Thomas (1388–1428), who was summoned as an earl in 1409, his father's dignities being restored to him in 1421, by which time his services at Harfleur and Agincourt had earned him French lordships, the lieutenant-generalship of Normandy and the earldom of Perche. The last of a race of warriors, he ended his service at the famous siege of Orleans, a cannon-ball dashing into his face the stone and ironwork of the window from which he was gazing at the city. By his second wife, the daughter of Thomas Chaucer the Speaker, he had no issue. By his first wife, Eleanor, daughter of Thomas Holand, earl of Kent, he had an only daughter Alice, wife of Richard Neville, a younger son of the first earl of Westmorland, who claimed and was allowed the earldom of Salisbury in right of his marriage. The famous "Richard Make-a-King," earl of Warwick and Salisbury, was the grandson of the last of the Montagu earls.

Sir Edward Montagu of Boughton, a chief justice of the king's bench who died in 1557, was ancestor of three lines of peers, the dukes of Montagu, the dukes of Manchester, and the earls of Sandwich. These Montagus of Boughton claimed, by a false pedigree, descent from the third earl of Salisbury. It is possible that there may have been some kinship between the two families, but none, apparently, that could justify the persistent quartering by these later Montagus of the arms of Monthermer.

AUTHORITIES.—Collinson's *Somerset*; G. E. C.'s *Complete Peerage*; *Victoria County History of Somerset* (J. H. Round's introduction to Domesday); Rymer's *Foedera*; Palgrave's *Parliamentary Writs*; *Rolls of Parliament*; Ramsay's *Lancaster and York*; *Gesta Henrici V.* (English Hist. Soc.); *Chronicles* of Walsingham, Knighton, Capgrave Wavrin, Frousart, Monstrelet, &c. Inquests, Post mortem, Close, Patent, Charter and Fine Rolls; Dugdale's Monasticon Publications of Somerset Record Society; Charters in British Museum and Public Record Office. (O. BA.)

MONTAGU, ELIZABETH ROBINSON (1720–1800), English leader of society, was born at York on the 2nd of October 1720. In 1742 she married Charles Montagu, cousin of Edward Wortley Montagu and son of the earl of Sandwich—a wealthy man, considerably her senior. Thanks to her, his Mayfair house became the social centre of intellectual society in London, and her breakfast parties and evening conversaziones gained for her from her admirers the title of "The Madame du Deffand of the English capital." In other quarters the term "blue-stocking" was applied to her guests. From her husband, who died in 1775, she inherited a considerable fortune and large estates, in the management of which she showed much ability. In 1781 she built Sandleford Priory, near Newbury, and Montagu House, now 22 Portman Square, London, the latter from designs by James Stuart. With the colliers in the north she was extremely popular, and every May-day she entertained the London chimney-sweeps. She died on the 25th of August 1800. There is an admirable portrait of her by Reynolds.

See *Elizabeth Montagu, the Queen of the Blue Stockings: Her Correspondence from 1720 to 1761*, edited by E. J. Climenson (2 vols., 1906); and R. Huchon, *Mrs Montagu and her Friends, 1720–1800* (Eng. trans., 1907).

MONTAGU, LADY MARY WORTLEY (1689–1762), English letter-writer, eldest daughter of Evelyn Pierrepont, afterwards duke of Kingston, was baptized at Covent Garden on the 26th of May 1689. Her mother, who died while her daughter was still a child, was a daughter of William Feilding, earl of Denbigh. Her father was proud of her beauty and wit, and when she was eight years old she is said to have been the toast of the Kit-Kat Club. He took small pains with the education of his children, but Lady Mary was encouraged in her self-imposed studies by her uncle, William Feilding, and by Bishop Burnet. She formed a close friendship with Mary Astell, who was a champion of woman's rights, and with Anne Wortley Montagu, granddaughter of the first earl of Sandwich. With this lady she carried on an animated correspondence. The letters on Anne's side, however, were often copied from drafts written by her brother, Edward Wortley Montagu, and after Anne's death in 1709 the correspondence between him and Lady Mary was prosecuted without an intermediary. Lady Mary's father, now marquess of Dorchester, declined, however, to accept Montagu as a son-in-law because he refused to entail his estate on a possible heir. Negotiations were broken off, and when the marquess insisted on another marriage for his daughter the pair eloped (1712). The early years of Lady Mary Wortley Montagu's married life were spent in rigid economy and retirement in the country. Her husband was M.P. for Westminster in 1715, and shortly afterwards was made a commissioner of the treasury. When Lady Mary joined him in London her wit and beauty soon made her a prominent figure at court. Early in 1716 Montagu was appointed ambassador at Constantinople. Lady Mary accompanied him to Vienna, and thence to Adrianople and Constantinople. He was recalled in 1717, but they remained at Constantinople until 1718. The story of this voyage and of her observations of Eastern life is told in a series of lively letters full of graphic description. From Turkey she brought back the practice of inoculation for small-pox. She had her own children inoculated, and encountered a vast amount of prejudice in bringing the matter forward. Before starting for the East she had made the acquaintance of Alexander Pope, and during her absence he addressed to her a series of extravagant letters, which appear to have been chiefly exercises in the art of writing gallant epistles. Very few letters passed after Lady Mary's return, and various reasons have been suggested for the subsequent estrangement and violent quarrel. Mr Moy Thomas suggests that the cause is to be found in the last of the "Letters during the embassy to Constantinople." It is addressed to Pope and purports to be dated from Dover, the 1st of November 1718. It contains a parody on Pope's "Epitaph on the Lovers struck by Lightning." The MS. collection of these letters was passed round a considerable circle, and Pope may well have been offended at the circulation of this piece of satire. Jealousy of her friendship with Lord Hervey has also been alleged, but Lady Louisa Stuart says Pope had made Lady Mary a declaration of love, which she had received with an outburst of laughter. In any case Lady Mary always professed complete innocence of all cause of offence in public. She is alluded to in the *Dunciad* in a passage to which Pope affixed one of his insulting notes. A *Pop upon Pope* was generally supposed to be from her pen, and Pope thought she was part author of *One Epistle to Mr A. Pope* (1730). Pope attacked her again and again, but with especial virulence in a gross couplet in the "Imitation of the First Satire of the Second Book of Horace," as Sappho. She asked a third person to remonstrate, and received the obvious answer that Pope could not have foreseen that she or any one else would apply so base an insult to herself. *Verses addressed to an Imitator of Horace by a Lady* (1733), a scurrilous reply to these attacks, is generally attributed to the joint efforts of Lady Mary and her sworn ally, Lord Hervey. She had a romantic correspondence with a Frenchman named Rémond, who addressed to her a series of excessively gallant letters before ever seeing her. She invested money for him in South Sea stock at his desire, and as was expressly stated, at his own risk. The value fell to half the price, and he tried to extort the original sum as a debt by a threat of exposing the correspondence to her husband. She seems to have been really alarmed, not at the imputation of gallantry, but lest her husband should discover the extent of her own speculations. This disposes of the second half of Pope's line "Who starves a sister, or forswears a debt" (*Epilogue to the Satires*, i. 113), and the first charge is quite devoid of foundation. She did in fact try to rescue her favourite sister, the countess of Mar, who was mentally deranged, from the custody of her brother-in-law, Lord Grange, who had treated his own wife with notorious cruelty, and the slander originated with him.

In 1739 she went abroad, and although she continued to write to her husband in terms of affection and respect they never met again. At Florence in 1740 she visited Horace Walpole, who cherished a great spite against her, and exaggerated her eccentricities into a revolting slovenliness (see *Letters*, ed. Cunningham, i. 59). She lived at Avignon, at Brescia, and at Lovere, on the Lago d'Iseo. She was disfigured by a painful skin disease, and her sufferings were so acute that she hints at the possibility of madness. She was struck with a terrible "fit of sickness" while visiting the countess Palazzo and her son, and perhaps her mental condition made restraint necessary. As Lady Mary was then in her sixty-third year, the scandalous interpretation put on the matter by Horace Walpole may safely be discarded. Her husband spent his last years in hoarding money, and at his death in 1761 is said to have been a millionaire. His extreme parsimony is satirized in Pope's *Imitations of Horace* (2nd satire of the 2nd book) in the portrait of Avidieu and his wife. Her daughter Mary, countess of Bute, whose husband was now prime minister, begged her to return to England. She came to London, and died in the year of her return, on the 21st of August 1762.

Her son, EDWARD WORTLEY MONTAGU (1713–1776), author and traveller, inherited something of his mother's gift and more than her eccentricity. He twice ran away from Winchester School, and the second time made his way as far as Oporto. He was then sent to travel with a tutor in the West Indies, and afterwards with a keeper to Holland. He made, however, a serious study of Arabic at Leiden (1741), and returned twenty years later to prosecute his studies. His father made him a meagre allowance, and he was heavily encumbered with debt. He was M.P. for Huntingdon in 1747, and was one of the secretaries at the conference of Aix-la-Chapelle. In 1751 he was involved in a disreputable gaming quarrel in Paris, and was imprisoned for eleven days in the Châtelet. He continued to sit in parliament, and wrote *Reflections on the Rise and Fall of the Antient Republics* . . . (1759). His father left him an annuity of £1000, the bulk of the property going to Lady Bute. He set out for extended travel in the East, and George Romney describes him as living in the Turkish manner at Venice. He had great gifts as a linguist, and was an excellent talker. His family thought him mad, and his mother left him a guinea, but her annuity devolved on him at her death. He died at Padua on the 29th of April 1776.

Lady Mary's "Town Eclogues" were published in a pirated edition as *Court Poems* in 1716. Of her famous *Letters* from the East she made a copy shortly after her return to England. She gave the MS. to Benjamin Sowden, a clergyman of Rotterdam, in 1761. After Lady Mary's death this was recovered by the earl of Bute, but meanwhile an unauthenticated edition, supposed to have been prepared by John Cleland, appeared (1763), and an additional volume, probably spurious, was printed in 1767. The rest of the correspondence printed by Lord Wharncliffe in the edition of her letters is edited from originals in the Wortley collection. This edition (1837) contained "Introductory Anecdotes" by Lady Bute's daughter, Lady Louisa Stuart. A more critical edition of the text, with the "Anecdotes," and a "Memoir" by W. Moy Thomas, appeared in 1861. A selection of the letters arranged to give a continuous account of her life, by Mr A. R. Ropes, was published in 1892; and another by R. Brimley Johnson in "Everyman's Library" in 1906. See also George Paston, *Lady Mary Wortley Montagu and her Times* (1907), which contains some hitherto unpublished letters. Lady Mary's journal was preserved by her daughter, Lady Bute, till shortly before her death, when she burnt it on the ground that it contained much scandal and satire, founded probably on insufficient evidence, about many distinguished persons. There is a full and amusing account of Edward Wortley Montagu in Nichols's *Anecdotes of Literature*, iv. 625-656.

MONTAGU, RALPH, 1ST DUKE OF (*c.* 1638–1709), English diplomatist, was the second son of Edward, 2nd Baron Montagu of Boughton (1616–1684), whose peerage was one of several granted in the 17th century to different members of the Montagu family (*q.v.*). Sir Edward Montagu, chief justice of the king's bench in the time of Henry VIII., was grandfather of the first earl of Manchester (see MANCHESTER, EARLS AND DUKES OF), and of Edward, 1st Baron Montagu of Boughton (1562–1644), who was imprisoned in the Tower by the parliament on account of his loyalty to Charles I. The eldest son of the latter, Edward, who succeeded him as 2nd baron, took the side of the parliament in the Civil War, and was one of the lords who conducted the king from Newark to Holmby House after his surrender by the Scots in January 1647. He had two sons, of whom Ralph was the younger. The eldest son, Edward, was master of the horse to Queen Catherine, wife of Charles II., a post from which he is said to have been dismissed by the king for showing attention to the queen of too ardent a nature. Catherine immediately appointed the younger brother, Ralph, to the vacant situation, and the latter soon acquired a reputation for gallantry at the court of Charles II. He took an active part in the negotiations in which Louis XIV. purchased the neutrality of England in the war between France and Holland. Having quarrelled with Danby and the duchess of Cleveland, who denounced him to the king, Montagu was elected member of parliament for Northampton in 1678, with the intention of bringing about the fall of Danby; but, having produced letters seriously compromising the minister, the dissolution of parliament placed him in such danger of arrest that he attempted to fly to France. Foiled in this design, he continued to intrigue against the government, supporting the movement for excluding the duke of York from the succession and for recognizing Monmouth as heir to the crown. His elder brother having predeceased his father, Ralph became Baron Montagu of Boughton on the death of the latter in 1684. Notwithstanding his former intrigues he gained the favour of James II. on his accession to the throne; but this did not deter him from welcoming William of Orange, who created him Viscount Monthermer and earl of Montagu in 1689. Montagu was no less avaricious than unscrupulous. In 1673 he had married the wealthy widow of the earl of Northumberland, Elizabeth Wriothesley, daughter of the earl of Southampton, who brought him a large fortune; and after her death in 1690 he married the still more wealthy Elizabeth Cavendish, daughter of the duke of Newcastle, and widow of Christopher Monk, 2nd duke of Albemarle. Montagu's position was further strengthened in 1705 by the marriage of his son and heir to Mary, daughter of the great duke of Marlborough. In the same year he was raised to the dukedom as duke of Montagu and marquess of Monthermer. He died on the 9th of March 1709. His London residence, Montagu House, Bloomsbury, was bought by the government in 1753 to hold the national collection of antiquities, and on its site was built the British Museum.

The duke was succeeded by his son John, 2nd duke of Montagu (1689–1749), who in 1745 raised a cavalry regiment known as Montagu's Carabineers, which, however, was disbanded after Culloden. He was made a K.G. in 1719, and was a fellow of the Royal Society. As neither of his two sons survived him the title became extinct at his death in 1749, but in 1730 his daughter Mary married George Brudenell, 4th earl of Cardigan (1712–1790), who on his father-in-law's death assumed the name and arms of Montagu, and in 1766 was created duke of Montagu. On his death, in 1790, this second dukedom of Montagu also became extinct; his only son, who was created Baron Montagu of Boughton, having predeceased him. His daughter Elizabeth married Henry, 2nd duke of Buccleuch, who thus acquired all the unentailed property of the dukes of Montagu, the entailed portion passing to the earls of Cardigan.

See Abel Boyer, *History of the Reign of Queen Anne*, vol. viii. (11 vols., London, 1703–1713); Sir J. B. Burke, *Genealogical History of Dormant (&c.) Peerages* (London, 1883).

MONTAGU (or MOUNTAGUE), **RICHARD** (1577–1641), English divine, was born at Dorney, Buckinghamshire, and educated at Eton and Cambridge. In 1613 he was elected fellow of Eton and became rector of Stanford Rivers, Essex. He was appointed to the deanery of Hereford in 1616, but exchanged it next year for a canonry of Windsor, which he held with the rectory of Petworth, Sussex. He was also chaplain to James I. Like Laud, he disliked the extremes of Calvinism and Romanism, and this attitude constantly involved him in difficulties. About 1619 he came into collision with some Roman Catholics in his parish, and Matthew Kellison (1560?–1642) attacked him in a pamphlet entitled *The Gagg of the Reformed Gospell* (Douai, 1623). Montagu replied with *A Gagg for the New Gospell? No. A New Gagg for an Old Goose* (London, 1624). The publication of the *Immediate Addresse unto God alone* (London, 1624) incensed the Puritans, who appealed to the House of Commons, but Montagu was protected by the king. After the appearance of his famous *Appello Caesarem* (London, 1625), his case frequently came before parliament and conferences of bishops, but his influence at court and with Laud enabled him to hold his ground. He was consecrated bishop of Chichester in 1628, and became bishop of Norwich in 1638. He died on the 13th of April 1641.

MONTAIGNE, MICHEL DE (1533–1592), French essayist, was born, as he himself tells us, between eleven o'clock and noon on the 28th of February 1533. The patronymic of the Montaigne family, who derived their title from the château at which the essayist was born and which had been bought by his grandfather, was Eyquem. It was believed to be of English origin, and the long tenure of Gascony and Guienne by the English certainly provided abundant opportunity for the introduction of English colonists. But the elaborate researches of M. Malvézin (*Michel de Montaigne, son origine et sa famille*, 1875) proved the existence of a family of Eyquems or Ayquems before the marriage of Eleanor of Aquitaine to Henry II. of England, though no connexion between this family, who were sieurs de Lesparre, and the essayist's ancestors can be made out. Montaigne is not far from Bordeaux, with which the Eyquem family had for some time been connected. Pierre Eyquem, Montaigne's father, had been engaged in commerce (a herring-merchant Scaliger calls him, and his grandfather Ramon had certainly followed that trade), had filled many municipal offices in Bordeaux, and had served under Francis I. in Italy as a soldier. He married Antoinette de Louppes (Lopez), descended from a family of Spanish Jews. The essayist was the third son. By the death of his elder brothers, however, he became head of the family. He had also six younger brothers and sisters. His father appears, like many other men of the time, to have made a hobby of education. Montaigne was not only put out to nurse with a peasant woman, but had his sponsors from the same class, and was accustomed to associate with it. He was taught Latin orally by servants (a German tutor, Horstanus, is especially mentioned), who could speak no French, and many curious fancies were tried on him, as, for instance, that of waking him every morning by soft music. But he was by no means allowed to be idle. A plan of teaching him Greek by some kind of mechanical arrangement is not very intelligible, and was quite unsuccessful. These details of his education (which, like most else that is known about him, come from his own mouth) are not only interesting in themselves, but remind the reader how, not far from the same time, Rabelais, the other leading writer of French during the Renaissance, was exercising himself, though not being exercised, in plans of education almost as fantastic. At six years old Montaigne was sent to the collège de Guienne at Bordeaux, then at the height of its reputation. Among its masters were Buchanan, afterwards the teacher of James I., and Muretus, one of the first scholars of the age. At thirteen Montaigne left the collège de Guienne and began to study law, it is not known where, but probably at Toulouse. In 1548 he was at Bordeaux during one of the frequent riots caused by the gabelle, or salt-tax. Six years afterwards, having attained his majority, he was made a counsellor in the Bordeaux parlement. In 1558 he was present at the siege of Thionville, in 1559 and 1561 at Paris, and in 1562 at the siege of Rouen. He was also much about the court, and he admits very frankly that in his youth he led a life of pleasure, if not exactly of excess. In 1565 he married Françoise de la Chassaigne, whose father was, like himself, a member of the Bordeaux parlement. Three years later his father died, and he succeeded to the family possessions. Finally, in 1571, as he tells us in an inscription still extant, he retired to Montaigne to take up his abode there, having given up his magistracy the year before. His health, never strong, had been further weakened by the hard living which was usual at the time. He resolved, accordingly, to retire to a life of study and contemplation, though he indulged in no asceticism except careful diet. He neither had nor professed any enthusiastic affection for his wife, but he lived on excellent terms with her, and bestowed some pains on the education of the only child (a daughter, Léonore) who survived infancy. In his study—a tower of refuge, separate from the house, which he has minutely described—he read, wrote, dictated, meditated, inscribed moral sentences which still remain on the walls and rafters, annotated his books, some of which are still in existence, and in other ways gave himself up to a learned ease.

He was not new to literature. In his father's lifetime, and at his request, he had translated the *Theologia naturalis* of Raymund de Sabunde, a Spanish schoolman (published 1569). On first coming to live at Montaigne he edited the works of his deceased friend Étienne de la Boétie, who had been the comrade of his youth, who died early, and who, with poems of real promise, had composed a declamatory and school-boyish theme on republicanism, entitled the *Contr' un*, which is one of the most over-estimated books in literature. But the years of his studious retirement were spent on a work of infinitely greater importance. Garrulous after a fashion as Montaigne is, he gives us no clear idea of any original or definite impulse leading him to write the famous *Essays*. It is very probable that if they were at first intended to have any special form at all it was that of a table-book or journal, such as was never more commonly kept than in the 16th century. It is certainly very noticeable that the earlier essays, those of the first two books, differ from the later in one most striking point, in that of length. Speaking generally, the essays of the third book average fully four times the length of those of the other two. This of itself would suggest a difference in the system of composition. These first two books appeared in 1580, when their author was forty-seven years old.

They contain, as at present published, no fewer than ninety-three essays, besides an exceedingly long apology for the already mentioned Raymund Sabunde, in which some have seen the kernel of Montaigne's philosophy. The book begins with a short *avis* (address to the reader), opening with the well-known words, "*C'est icy un livre de bon foy, lecteur,*" and sketching in a few lively sentences the character of meditative egotism which is kept up throughout. His sole object, the author says, is to leave for his friends and relations a mental portrait of himself, defects and all; he cares neither for utility nor for fame. The essays then begin, without any attempt to explain or classify their subjects. Their titles are of the most diverse character. Sometimes they are proverbial sayings or moral adages, such as "Par divers moyens on arrive à pareille fin," "Qu'il ne faut juger de notre heur qu'après la mort," "Le profit de l'on est le dommage de l'aultre." Sometimes they are headed like the chapters of a treatise on ethics: "De la tristesse," "De l'oisiveté," "De la peur," "De l'amitié." Sometimes a fact of some sort which has awaked a train of associations in the mind of the writer serves as a title, such as "On est puni de s'opiniastrer à une place sans raison." "De la bataille de Dreux," &c. Occasionally the titles seem to be deliberately fantastic, as "Des puces," "De l'usage de se vestir." Sometimes, though not very often, the sections are in no proper sense essays, but merely commonplace book entries of singular facts or quotations, with hardly any comment. These point to the haphazard or indirect origin of them, which has been already suggested. But generally the essay-character—that is to say, the discussion of a special point, it may be with wide digressions and divergences—displays itself. The digressions are indeed constant, and sometimes have the appearance of being absolutely wilful. The nominal title, even when most strictly observed, is rarely more than a starting-point; and, though the brevity of these first essays for the most part prevents the author from journeying very far, he contrives to get to the utmost range of his tether. Quotations are very frequent.

In 1571 he had received the order of Saint-Michel; in 1574 was with the army of the duke de Montpensier; two years later was made gentleman-in-ordinary to Henry III., and next year again to Henry of Navarre. He visited Paris occasionally, and travelled for health or pleasure to Cauterets, Eaux Chaudes and elsewhere. But his health grew worse and worse, and he was tormented by stone and gravel. He accordingly resolved to journey to the baths of Lucca. Late in the 18th century a journal was found in the château of Montaigne giving an account of this journey, and it was published in 1774; part of it is written in Italian and part dictated in French, the latter being for the most part the work of a secretary or servant. Whatever may be the biographical value of this work, which has rarely been reprinted with the *Essays* themselves, and the MS. of which disappeared early, it is almost entirely destitute of literary interest. The course of the journey was first northwards to Plombières, then by Basel to Augsburg and Munich, then through Tirol to Verona and Padua in Italy. Montaigne visited most of the famous cities of the north and centre, staying five months at Rome, where he had an audience of the pope and was made a Roman citizen, and finally establishing himself at the baths of Lucca for nearly as long a time. There he received news of his election as mayor of Bordeaux with a peremptory royal endorsement enjoining residence, and after some time journeyed homewards. The tour contains much minute information about roads, food, travelling, &c., but the singular condition in which it exists and the disappearance of the MS. make it rather difficult to use it as a document. The best argument in its favour is the improbability of anybody having taken the trouble to forge so bald and awkward a heap of details. Of the fact of the journey there is no doubt whatever.

Montaigne was not altogether delighted at his election to the mayoralty, which promised him two years of responsible if not very hard work. The memory of his father, however, and the commands of the king induced him to accept it; and he seems to have discharged it neither better nor worse than an average magistrate. Indeed, he gave sufficient satisfaction to the citizens to be re-elected at the close of his term, and it may be suspected that the honour of the position, which was really one of considerable dignity and importance, was not altogether indifferent to him. Unfortunately, it cannot be said that "nothing in his office became him like the leaving of it." It was his business, if not exactly his duty, to preside at the formal election of his successor, the maréchal de Matignon; but there was a severe pestilence in Bordeaux, and Montaigne writes to the jurats of that town, in one of the few undoubtedly authentic letters which we possess, to the effect that he will leave them to judge whether his presence at the election is so necessary as to make it worth his while to expose himself to the danger of going into the town in its then condition, "which is specially dangerous for men coming from a good air, as he does." It may be urged in his favour that the general circumstances of the time, where they did not produce reckless and foolhardy daring, almost necessarily produced a somewhat excessive caution. However this may be, Montaigne had difficulty enough during this turbulent period, all the more so from his neighbourhood to the chief haunts and possessions of Henry of Navarre, who actually visited him at Montaigne in 1584. He was able, despite the occupations of his journey, his mayoralty, and the pressure of civil war and pestilence, which was not confined to the town, to continue his essay-writing. His second term of office terminated in 1585; and in 1588 after a visit of some length to Paris, the third book of the *Essays* was published, together with the former ones considerably revised. The new essays, as has been remarked, differ strikingly from the older ones in respect of length; and the whimsical unexpectedness of the titles reappears in but two of them: "Des Coches" and "Des Boiteux." They are, however, identical with the earlier ones in spirit, and make with them a harmonious whole—a book which has hardly been second in influence to any of the modern world.

This influence is almost equally remarkable in point of matter and in point of form. The latter aspect may be taken first. Montaigne is one of the few great writers who have not only perfected but have also invented a literary kind. The essay as he gave it had no forerunner in modern literature and no direct ancestor in the literature of classical times. It has been suggested that the form which the essays assumed was in a way accidental, and this of itself precludes the idea of a definite model, even if such a model could be found. Beginning with the throwing together of a few stray thoughts and quotations linked by a community of subject, the author by degrees acquires more and more certainty of hand, until he produces such masterpieces of apparent desultoriness and real unity as the essay "Sur des vers de Virgile." In matter of style and language Montaigne's position is equally important, but the ways which led him to it are more clearly traceable. His favourite author was beyond all doubt Plutarch, and his own explicit confession makes it undeniable that Plutarch's translator, Jacques Amyot, was his master in point of vocabulary and (so far as he took any lessons in it) of style. Montaigne, however, followed with the perfect independence that characterized him. He was a contemporary of Ronsard, and his first essays were published when the innovations of the Pléiade had fully established themselves. He adopted them to a great extent, but with much discrimination, and he used his own judgment in latinizing when he pleased. In the same way he retained archaic and provincial words with a good deal of freedom, but by no means to excess. In the arrangement, as in the selection, of his language he is equally original. He has not the excessive classicism of style which mars even the fine prose of Jean Calvin, and which makes that of some of Calvin's followers intolerably stiff. As a rule he is careless of definitely rhythmical cadence, though his sentences are always pleasant to the ear. But the principal characteristic of Montaigne's prose style is its remarkable ease and flexibility. A few years after Montaigne's death a great revolution, as is generally known, passed over France. The criticism of Malherbe, followed by the establishment of the Academy, the minute grammatical censures of Claude Favre Vaugelas, and the severe literary censorship of Boileau, turned French in less than three-quarters of a century from one of the freest languages in Europe to one of the most restricted. During this revolution only two writers of older date held their ground, and those two were Rabelais and Montaigne—Montaigne being of his nature more generally readable than Rabelais. All the great prose writers of France could not fail to be influenced by the racy phrase, the quaint and picturesque vocabulary, and the unconstrained constructions of Montaigne.

It would be impossible, however, for the stoutest defender of the importance of form in literature to assign the chief part in Montaigne's influence to style. It is the method, or rather the manner of thinking, of which that style is the garment, which has in reality exercised influence on the world. Like all the greatest writers except Shakespeare, Montaigne thoroughly and completely exhibits the intellectual and moral complexion of his own time. When he reached manhood the French Renaissance was at high water, and the turn of the tide was beginning. Rabelais, who died when Montaigne was still in early manhood, exhibits the earlier and rising spirit, though he needs to be completed on the poetical side. With Montaigne begins the age of disenchantment. By the time at least when he began to meditate his essays in the retirement of his country house it was tolerably certain that no golden age was about to return. As the earlier Renaissance had specially occupied itself with the practical business and pleasures of life, so the later Renaissance specially mused on the vanity of this business and these pleasures. The predisposing circumstances which affected Montaigne were thus likely to incline him to scepticism, to ethical musings on the vanity of life and the like. But to all this there had to be added the peculiarity of his own temperament. This was a decidedly complicated one, and neglect of it has led some readers to adopt a more positive idea of Montaigne's scepticism than is fully justified by all the facts. The attitude which he assumed was no doubt ephectic and critical chiefly. In the "Apologie de Raymund Sabunde," he has apparently amused himself with gathering together, in the shape of quotations as well as of reflections, all that can be said against certainty in aesthetics as well as in dogmatics. It is even said by some who have examined the original (*vide infra*) that the text and alterations show a progressively freethinking attitude, side by side with a growing tendency to conceal it by ambiguity and innuendo. But until all the documents are accessible this must remain doubtful. The general tenor of the essays is in complete contrast with this sceptical attitude, at least in its more decided form, and it is worth notice that the motto "*Que scai-je?*" does not appear on the title-page till after the writer's death. Montaigne is far too much occupied about all sorts of the minutest details of human life to make it for a moment admissible that he regarded that life as a whole but as smoke and vapour. And it is almost certainly wrong, though M. Brunetière may have given countenance and currency to the idea, to regard his philosophy as in the main intended as a succour against the fear of death. The reason of the misapprehension of him which is current is due very mainly to the fact that he was eminently a humorist. Perhaps the only actual parallel to Montaigne in literature is Lamb. There are differences between them, arising naturally enough from differences of temperament and experience; but both agree in their attitude—an attitude which is sceptical without being negative and humorous without being satiric. There is hardly any writer in whom the human comedy is treated with such completeness as it is in Montaigne. There is discernible in his essays no attempt to map out a complete plan, and then to fill up its outlines. But in the desultory and haphazard fashion which distinguishes him there are few parts of life on which he does not touch, if only to show the eternal contrast and antithesis which dominate it. The exceptions are chiefly to be found in the higher and more poetical strains of feeling to which the humorist temperament lends itself with reluctance and distrust, though it by no means excludes them. The positiveness of the French disposition is already noticeable in Rabelais; it becomes more noticeable still in Montaigne. He is always charming, but he is rarely inspiring, except in a very few passages where the sense of vanity and nothingness possesses him with unusual strength. As a general rule, an agreeable grotesque of the affairs of life (a grotesque which never loses hold of good taste sufficiently to be called burlesque) occupies him. There is a kind of anticipation of the scientific spirit in the careful zeal with which he picks up odd aspects of mankind and comments upon them as he places them in his museum. Such a temperament is most pleasantly shown when it is least personal. A dozen generations of men have rejoiced in the gentle irony with which Montaigne handles the *ludicrum humani saeculi*, in the quaint felicity of his selection of examples, and in the real though sometimes fantastic wisdom of his comment on his selections.

Montaigne did not very long survive the completion of his book. On his way to Paris for the purpose of getting it printed he stayed for some time at Blois, where he met De Thou. In Paris itself he was for a short time committed to the Bastille by the Leaguers, as a kind of hostage, it is said, for a member of their party who had been arrested at Rouen by Henry of Navarre. But he was in no real danger. He was well known to and favoured by both Catherine de' Medici and the Guises, and was very soon released. In Paris, too, at this time he made a whimsical but pleasant friendship. Marie de Jars de Gournay (1565–1645), one of the most learned ladies of the 16th and 17th centuries, had conceived such a veneration for the author of the *Essays* that, though a very young girl and connected with many noble families, she travelled to the capital on purpose to make his acquaintance. He gave her the title of his "fille d'alliance" (adopted daughter), which she bore proudly for the rest of her long life. She lived far into the 17th century, and became a character and something of a laughing-stock to the new generation; but her services to Montaigne's literary memory were, as will be seen, great. Of his other friends in these last years of his life the most important were Étienne Pasquier and Pierre Charron. The latter, indeed, was more than a friend, he was a disciple; and Montaigne, just as he had constituted Mlle de Gournay his "fille d'alliance," bestowed on Charron the rather curious compliment of desiring that he should take the arms of the family of Montaigne. It has been thought from these two facts, and from an expression in one of the later essays, that the marriage of his daughter Léonore to Gaston de La Tour had not turned out to his satisfaction. But family affection, except towards his father, was by no means Montaigne's strongest point. When Henry of Navarre came to the throne of France, he wished Montaigne, whom he had again visited in 1587, to come to court, but the essayist refused. It would seem that he returned from Paris to his old life of study and meditation and working up his *Essays*. No new ones were found after his death, but many alterations and insertions. His various maladies grew worse; yet they were not the direct cause of his death. He was attacked with quinsy, which rapidly brought about paralysis of the tongue, and he died on the 13th of September 1592, in circumstances which, as Pasquier reports them, completely disprove any intention of displaying anti-Christian or anti-Catholic leanings. He was buried, though not till some months after his death, in a church in Bordeaux, which after some vicissitudes became the chapel of the collége. During the Revolution the tomb, and as it was supposed the coffin, were transferred with much pomp to the town museum; but it was discovered that the wrong coffin had been taken, and it was afterwards restored to its old position. Montaigne's widow survived him, and his daughter left posterity which became merged in the noble houses of Ségur and Lur-Saluces. But it does not appear that any male representative of the family survived.

When Mlle de Gournay heard of the death of Montaigne she undertook with her mother a visit of ceremony and condolence to the widow, which had important results for literature. Mme de Montaigne gave her a copy of the edition of 1588 annotated copiously; at the same time, apparently, she bestowed another copy, also annotated by the author, on the convent of the Feuillants in Bordeaux, to which the church in which his remains lay was attached. Mlle de Gournay thereupon set to work to produce a new and final edition with a zeal and energy which would have done credit to any editor of any date. She herself worked with her own copy, inserting the additions, marking the alterations and translating all the quotations. But when she had got this to press she sent the proofs to Bordeaux, where a poet of some note, Pierre de Brach, revised them with the other annotated copy. The edition thus produced in 1595 has with justice passed as the standard, even in preference to those which appeared in the author's lifetime. Unluckily, Mlle de Gournay's original does not appear to exist and her text was said, until the appearance of MM. Courbet and Royer's edition, to have been somewhat wantonly corrupted, especially in the important point of spelling. The Feuillants copy is in existence, being the only manuscript, or partly manuscript, authority for the text; but access to it and reproduction of it are subjected to rather unfortunate restrictions by the authorities, and until it is completely edited students are rather at the mercy of those who have actually consulted it. It was edited in 1803 by Naigeon, the disciple of Diderot; but, according to later inquiries, considerable liberties were taken with it. The first edition of 1580, with the various readings of two others which appeared during the author's lifetime, was reprinted by MM. Dezeimeris and Burckhausen in 1870. That of Le Clerc (3 vols., Paris, 1826–1828) and in a more compact form that of Louandre (4 vols., Paris, 1854) have been most useful; but that of MM. Courbet and Royer (1872–1900) is at present the standard. The *Journal*, long neglected and still (*vide supra*) doubtful, was re-edited by Professor A. d'Ancona (Città di Castello, 1895) and translated into English by W. G. Waters (1903). The editions of Montaigne in France and elsewhere, and the works upon him during the past three centuries, are innumerable. The most recent books of importance are P. Bonnefon's *Montaigne, l'homme et l'œuvre* (1893) and P. Stapfer's *Montaigne* (1895) in the *Grands écrivains*, the latter a book of remarkable excellence. Edmé Champion's *Introduction aux essais* may also be noticed, and Professor Dowden's *Montaigne* (1905), which has an excellent bibliography. The somewhat earlier *Montaigne* of M. E. Lowndes (Cambridge, 1898) is noteworthy in especial for its attention to his life and character. In England Montaigne was early popular. It was long supposed that the autograph of Shakespeare in a copy of Florio's translation showed his study of the *Essays*. The autograph has been disputed, but divers passages, and especially one in *The Tempest*, show that at first or second hand the poet was acquainted with the essayist. The book best worth consulting on this head is J. Feis's *Shakespeare and Montaigne* (1884). Towards the latter end of the 17th century, Cotton, the friend of Isaac Walton, executed a complete translation, which, though not extraordinarily faithful, possesses a good deal of rough vigour. It has been frequently reprinted with additions and alterations. Reprints of Florio are also numerous. One in the "Tudor Translations" (1893) has an introduction by G. Saintsbury. An English biography of Montaigne by Bayle St John appeared in 1858, and Walter Pater's unfinished *Gaston de Latour* borrows from Montaigne and his story. The most noteworthy critical handling of the subject in English is unquestionably Emerson's in *Representative Men*. (G. SA.)

MONTALBÁN, JUAN PEREZ DE (1602–1638), Spanish dramatist, poet and novelist, was born at Madrid in 1602. At the age of eighteen he became a licentiate in theology, was ordained priest in 1625 and appointed notary to the Inquisition. In 1619 he began writing for the stage under the guidance of Lope de Vega, who is said to have assisted him in composing *El Orfeo en lengua castellana* (1624), a poem obviously intended to compete with Jáuregui's *Orfeo*, published earlier in the same year. The prose tales in *Sucesos y prodigios de amor* (1624) and *Para todos* (1632) were very popular. Montalbán's father, a publisher at Madrid, issued a pirated edition of Quevedo's *Buscón*, which roused an angry controversy. The violence of these polemics, the strain of overwork, and the death of Lope de Vega so affected Montalbán that he became insane; he died at Madrid on the 25th of June 1638. His last work was a eulogistic biography of Lope de Vega in the *Fama póstuma* (1636). His plays, published in 1635–1638, are all in the manner of that great dramatist, and were represented with much success, but, with the exception of *Los Amantes de Teruel*, are little more than clever improvizations. A libellous attack on Quevedo, entitled *El Tribunal de la justa venganza* (1635), is often ascribed to him.

MONTALEMBERT, CHARLES FORBES RENÉ DE (1810–1870), French publicist and historian, was born on the 15th of March 1810. The family was a very ancient one, belonging to Poitou, or rather to Angoumois. Direct descent is said to be traced back to the 13th century, and charters carry the history of the house two centuries further. For some generations before the historian the family had been distinguished, not merely in the army, but for scientific attainments. Montalembert's father, Marc René, emigrated, fought under Condé, and subsequently served in the English army; he married Élise Rosée Forbes, and his eldest son, Charles, was born in London. At the Restoration of 1814 Marc René returned to France, was raised to the peerage in 1819, and became ambassador to Sweden (where Charles completed his education) in 1826. He died in 1831, a year after the overthrow of the legitimate monarchy. Charles de Montalembert was too young to take his seat as a peer (twenty-five being the necessary age), but he retained other rights, and this, combined with his literary and intellectual activity, made him a person of some importance. He was a Liberal, in the English sense, and had he not resolutely separated himself from the new régime on the religious question he would have approved of the policy of the golden mean represented by Louis Philippe. He wished to see the Church free from the control of the state, and passionately attacked the monopoly of public instruction by which the monarchy fortified its position. This latter scheme first brought Montalembert into notice, as he was formally charged with unlicensed teaching. He claimed the right of trial by his peers, and made a notable defence, of course with a deliberate intention of protest (1832). On the other hand, he thought that the Church should not obstinately oppose new ideas. He had eagerly entered into the plans of his friends, Lamennais and Lacordaire, and collaborated with them in the newspaper *l'Avenir*. The Ultramontane party was roused by their boldness, and Montalembert and his two friends then left for Rome. This famous pilgrimage proved useless to mitigate the measures which the Roman curia took against the *l'Avenir*. Its doctrines were condemned in two encyclicals (*Mirari vos*, 1832, and *Singulari vobis*, 1834), and Montalembert submitted. He still clung to his early Liberalism, and in 1848 saw without regret the end of a government towards which he had always been hostile. He had a seat in the Chamber of Deputies till 1857, but to his great regret was then obliged to retire into private life. He was still, however, recognized as one of the most formidable opponents of the empire. Meanwhile his Liberal ideas had made him some irreconcilable enemies among the Ultramontanes. Louis Veuillot, in his paper, *L'Univers*, fought desperately against him. Montalembert answered by reviving a review which had for some time ceased publication, the *Correspondant* (1855), in which he set himself to fight both against the fanatical party of Pius IX. and the *Syllabus*, and the more or less free-thinking Liberals of the *Revue des deux mondes*. He took great interest in the débuts of the Liberal empire, whilst trying to parry the blow which the Ultramontanes were preparing to deal to Liberal ideas by proclaiming in the Vatican council the dogma of papal infallibility. But once again he would not allow himself to be seduced from obedience to the pope; he now severed his connexion with Père Hyacinthe (Loison) as he had with Lamennais, and made the submission expected of him to the council. It was his last fall. Broken down by the trial of these continued fights against people of his own religion, he died prematurely on the 13th of March 1870.

In addition to being an eloquent orator, Montalembert wrote a style at once picturesque, fiery and polished. He was an ardent student of the middle ages, but his medieval enthusiasm was strongly tinctured with religious sentiments. His first historical work, *La Vie de Ste Elisabeth de Hongrie* (1836), is not so much a history as a religious manifesto, which did much to restore the position of hagiography. It met with great success; but Montalembert was not elected a member of the Académie Française till later, after the fall of the July monarchy (Jan. 9, 1851). From this time he gave much of his attention to a great work on monachism in the West. He was at first attracted by the figure of St Bernard, and devoted one volume to him; this was, however, afterwards withdrawn on the advice of his friend Dupanloup, and the whole edition was destroyed. He then enlarged his original plan and published the first volumes of his *Moines d'occident* (1860), an eloquent work which was received with much admiration in those circles where language was more appreciated than learning. The work, which was unfinished at the time of the author's death, was completed later from some long fragments found among his papers (vols. vi. and vii., 1877).

Montalembert married Mlle de Mérode, sister of one of Pius IX.'s ministers. His daughter married the vicomte de Meaux, a Roman Catholic statesman and distinguished writer.

BIBLIOGRAPHY.—Mrs Oliphant, *Memoir of Count de Montalembert, peer of France, deputy for the department of Doubs* (Edinburgh, 1872). Mrs Oliphant, who has also translated into English *Moines d'occident*, has given a most charming account of the youth of Montalembert, and especially the first years passed at Stanmore. See also the vicomte de Meaux, *Montalembert* (1897); see also L. R. P. Lecanuet, *Montalembert, d'après son journal et sa correspondance* (3 vols., 1895–1902) a work filled with important documents; and Léon Lefébure, *Portraits de croyants au XIX*^{m} *siècle: Montalembert, Auguste Cochin, François Rio* (who was Montalembert's professor of philosophy); *A. Guthlin* (1905); and *Lettres d'Alphonse d'Herbelot à Charles de Montalembert et à Léon Cornudet* (1828–1830).

MONTALEMBERT, MARC RENÉ, MARQUIS DE (1714–1800), French military engineer and writer, was born at Angoulême on the 16th of July 1714, and entered the French Army in 1732. He fought in the War of the Polish Succession on the Rhine (1733–34), and in the War of the Austrian Succession made the campaigns of 1742 in Bohemia and Italy. In the years preceding the Seven Years' War, Montalembert (who had become an associate member of the Académie des Sciences in 1747) devoted his energies to the art of fortification, to which Vauban's *Traité de l'attaque* attracted him, and founded the arsenal at Ruelle, near his birthplace. On the outbreak of war he became French commissioner with the allied army of Sweden, with the rank of brigadier-general. He constructed the field fortifications of Anklam and Stralsund. In 1761 he was promoted *maréchal de camp*, and began the works on which his fame rests. Montalembert's fortress has been aptly described by an English author as an "immense battery." The intricacies of trace by which Vauban and Cormontaigne sought to minimize the power of the attack, are abandoned in favour of a simple tenaille plan so arranged that the defenders can bring an overwhelming fire to bear on the works of the besieger. Montalembert, who himself drew his idea from the practice of Swedish and Prussian engineers, furnished the German constructors of the early 19th century with the means of designing entrenched camps suitable to modern conditions of warfare. The "polygonal" method of fortification is the direct outcome of Montalembert's systems. In his own country the caste-spirit of the engineer corps was roused to defend Vauban, and though Montalembert was allowed to construct some successful works at Aix and Oléron, he was forbidden to publish his method, and given but little opportunity for actual building. After fifteen years of secrecy he published in Paris (1776–1778) the first edition of *La Fortification perpendiculaire*. At the time of the Revolution he surrendered a pension, which had been granted him for the loss of an eye, although he was deeply in debt, particularly on account of his Ruelle foundry, on which 6000 livres were due to him from the state, which he never received. Persuaded by his wife, he joined in the emigration of the *noblesse*, and for a time lived in England. All his possessions were thereupon sequestrated by the republican government. He very soon returned, divorced his wife, and married again. He obtained the annulment of the sequestration. Carnot often called him into consultation on military affairs, and, in 1792, promoted him general of division. Proposed as a member of the *Institut* in 1797, he withdrew his candidature in favour of General Bonaparte. He died at Paris on the 29th of March 1800. His wife, Marie Josephine de Comarieu, was the hostess of one of the best-known *salons* of Louis XVI.'s time. She wrote two novels of merit, *Elise Dumesnil* (1798) and *Horace* (1822). She died in 1832.

Besides his masterpiece, he wrote *L'Art défensive supérieure à l'offensif* (1793; in reply to attacks made upon his earliest work, *La Fortification perpendiculaire*, of which in later editions it forms part); *Mémoire historique sur le fonte des canons* (Paris, 1758), and other works on the same subject; *Correspondance pendant la guerre de 1757–1760* (London, 1777); *Rotation des boulets* (Acad., 1755); and *Rélations du siège de S. Jean d'Acre* (Paris, 1789). He also wrote short stories and verse, as well as comedies. He also modelled a complete course of Fortification (92 models), which he offered to the Committee of Public Safety. His bust was sculptured by Bonvallet. Montalembert's position in the history of fortification may be summed up as a realization of his own wish to do for the defence what Vauban had done for the attack. It was the inability of his contemporaries to see that Vauban's strength lay in his parallels and batteries and not in his bastions that vitiated their methods, and it was Montalembert's appreciation of this fact which made him the father of modern fortification. See Tripier, *La Fortification déduite de son histoire* (Paris, 1866).

MONTALIVET, MARTHE-CAMILLE BACHASSON, COMTE DE (1801–1880), French statesman, was born at Valence on the 25th of April 1801, the second son of Jean Pierre Bachasson, comte de Montalivet (1766–1823), who had been made a peer of France in 1819. Both his father and his elder brother Simon Pierre Joseph (1799–1823) had been engineer officers, and he was educated at the École Polytechnique and the École des Ponts et Chaussées. Under Louis Philippe he occupied the ministry of the interior from, with short intervals, 1830 to 1840. After 1840 he was intendant of the civil list, occupying himself with the museums of Versailles and the Louvre, and the restoration of the palaces of Fontainebleau and Saint-Cloud. In 1847 he tried to induce Louis Philippe to adopt electoral reform, and after the catastrophe of the next year undertook the defence of the July monarchy in two works, *Le Roi Louis Philippe et la liste civile* (1851) and *Rien! Dix années de gouvernement parlementaire* (1862). He had become a member of the Academy of Fine Arts in 1840 and in 1843 grand cross of the Legion of Honour. The attitude of the comte de Chambord after 1870 led him to accept the republic, and he entered the Senate a year before his death, on the 4th of January 1880.

MONTANA, a north-western state of the United States, situated between latitudes 44° 26′ and 49° N., and between longitudes 27° and 39° W. from Washington. It is bounded N. by the Canadian provinces of British Columbia, Alberta and Assiniboia; E. by North Dakota and South Dakota; S. by Wyoming and Idaho; W. by Idaho. Montana has an area of 146,572 sq. m., 796 sq. m. of which are water surface. (For map, see IDAHO.)

Physical Features.—The Rocky Mountains cross the state from north-west to south-east, and with their spurs and outlying ranges occupy nearly one-third of its area in the west and south-west; the remaining portion is occupied chiefly by the Great Plains. The main range of the Rockies follows the boundary line between Montana and Idaho west and north-west from Yellowstone Park in Wyoming to Ravalli county, then turns east-north-east to Lewis and Clark county, and from there extends north-north-west into Canada. From where the main range turns east from the Idaho boundary line the crest of the Bitter Root Mountains continues on that line with a downward slope to within one degree of latitude from the Canadian border. This range of mountains, which was formed by a great fault, has a maximum elevation at its southern end of about 9000 ft. above the sea. On its slope, which rises abruptly from the Bitter Root Basin, glaciers have cut cañons between high and often precipitous walls, and between these cañons are steep and rocky ridges having peaked or saw-toothed crest lines. To the east and north-east of the Bitter Root Mountains is a considerable basin or peneplain dissected by short ranges having a north-west and south-west trend. To the south-east of this basin are the greatest mountain masses of the state; lofty and rugged ranges radiate in all directions, and in many instances rise to heights of 10,000–11,000 ft., the highest peak in the state being Granite Peak (12,834 ft.) in Carbon county. Deep and narrow cañons are common, and, at higher levels, glaciers, carved out amphitheatres, or "cirques" and "U"-shaped troughs. In the north the Rocky Mountains consist principally of two parallel ranges, the Lewis and Clark Range to the east, and the Livingston Range to the west, which were formed by a great overthrust; between them is the Waterton-McDonald valley, 8–15 m. wide. The east slope of the Lewis and Clark range is marked by long high spurs, and the valleys between them end in radiating cañons that are crowned with bold cliffs. On the higher summits the range rises to 8500–10,400 ft. above the sea, but in the wind-gaps only to 5500–6500 ft. The Livingston range is less rugged and more massive. Like the Lewis and Clark range, its crest is broken by numerous U-shaped wind-gaps and its west slope is cut by glacial troughs containing long narrow lake basins. Extending far to the eastward, especially in the south of the state, are isolated mountain groups. Among these are the Bear Paw Mountains, in the north central part, which occupy a tract 40 m. long and 20 m. wide that on the western side rises abruptly from the plains and reaches an elevation in Bear Paw Peak of 7040 ft. above the sea. The Great Plains in Montana slope from about 4000 ft. (above the sea), at the foothills of the mountains, to 2000 ft. in the north-east of the state. The valleys of the principal streams are deeply eroded; bluffs are common along their borders, and buttes elsewhere on the plains. The main range of the Rocky Mountains separates that part which is drained west into the Columbia river and the Pacific Ocean from that which is drained east into the Missouri and Mississippi rivers and the Gulf of Mexico, and from a very small part which is drained north-east into Hudson Bay; the water-parting which in Montana separates the drainage into Hudson Bay from the drainage into the Gulf of Mexico crosses only the north-west of Teton county. The principal rivers east of the Rockies are the Missouri and three of its tributaries; the Yellowstone in the south-east, the Musselshell in the middle, and the Milk in the north. The Missouri is formed by a union of the Jefferson, the Madison and the Gallatin. It flows first east-north-east and then nearly east until it passes into North Dakota. Its channel is generally erratic and constantly shifting; its bed is sandy and its water muddy. In contrast, the Yellowstone is a stream of bright clear water running over a gravelly bed and among numerous forest-clad islands. The Missouri is navigable for small boats to Fort Benton in Chouteau county, but farther upstream near Great Falls, Cascade county, to which it is navigable at high water, it falls 512 ft. in 10 m. The Yellowstone is navigable for about 300 m. The principal rivers west of the Main Divide of the Rockies are the Clark Fork of the Columbia and its principal tributary, the Flathead, which rises in British Columbia. Montana has a few mineral springs, the best known being the Lissner Springs at Helena. Small lakes and waterfalls, the result of glacial action, are numerous in the mountains. There is, however, only one large lake in the state—Flathead (or Selish) Lake, which may be regarded as an enlargement of Flathead river; it is 27 m. long, has an average width o 12 m., and a depth of more than 1000 ft.

Geology.—In the Great Plains region the geological structure i very simple, consisting of nearly horizontal strata of Cretaceou rock in the middle and western portions, and of Tertiary rock on th eastern border, but in the mountain region the rocks have bee folded and faulted until the structure is intricate and obscure. Som of the deeper cañons show rocks of nearly all ages. The highe elevations are mostly either Archean or Paleozoic formation projecting above Tertiary deposits. In the Bitter Root Valley is large deposit of Quaternary. Fossil remains of mammals, fish an reptiles found in the Tertiary deposits of south-western Montana a preserved in the Carnegie Museum at Pittsburg, Pennsylvania, an in the museum of the university of Montana. They include th mandible of a mastodon and a portion of a vertebra of a large fish both found in the Lower Madison Valley; the skull and other part of a dog (*Mesocyon drummondanus*), found near Drummond, Granit county; the skull of a *Poatrephes paludicola*, found near New Chicag Granite county; a portion of the skull of a *Mesohippus latiden* found near the confluence of the three forks which form the Missou river; and a portion of the skull of a *Hyrachyus priscus*, found nea Lima, Beaverhead county. In the region east of the Crazy Moun tains, in Sweetgrass county, are marine beds of upper Cretaceou or lower Tertiary formation containing fossils of Dinosaurs an

Mosasaurs, and in the museum of the university of Montana is the greater part of the skeleton of a Dinosaur which was found here. nteresting fossil remains have also been found in Carboniferous ormations in the south-west of the state.

Fauna.—The native fauna is not sharply distinguished from that of the surrounding states. The bison, which once ranged the plains n large herds, have been exterminated; the moose and the elk are ound only occasionally in the wilder regions; mountain sheep, ntelopes, black and grizzly bears, wolves, coyotes and lynx ("wild ats") are also becoming rare. Black-tailed and mule deer are still avourite game for sportsmen. Geese, ducks and grouse are numerous about the lakes and rivers. Several kinds of fish, among which re trout, salmon, grayling and white fish, inhabit many of the lakes, ivers and mountain streams, and a government fish hatchery at Bozeman, Gallatin county, restocks waters in which the supply has been diminished.

Flora.—The Great Plains are covered for the most part only with bunch grass which grows in tufts, leaving the ground visible between, nd except in May and June presents a yellow and withered appearance. Mixed with the bunch grass are occasional patches of sage brush. Most of the bluffs along the principal river valleys, especially those in the south-east, are entirely bare of vegetation, but on he bottom lands along the rivers and streams considerable patches of cottonwood and willows are common. The mountain valleys are covered with little except grasses; on the higher parts of the mountains there are barren rocks or only a scant growth of timber; but many of the lower mountain slopes, especially those along the western border, are clothed with heavy timber, yellow pine, red fir and tamarack being the principal species.

Climate.—The climate is generally dry, although less so on the mountains and in the Flathead river basin than on the Great Plains, and is subject to sudden changes and to great extremes of emperature; but the temperature varies more than the amount of precipitation. In the west the climate is generally delightful, it being there greatly affected by the warm, dry "Chinook" wind which blows from the Pacific Ocean; to some extent the wind modifies the temperature nearly to the eastern border. It is the prevailing wind of winter in the mountains and in consequence the periods of cold, though often severe, are short. In the east the winters are often long and very cold, and the summers dry and hot. The mean annual temperature ranges from 37° F. in the north-east to 47° in the sheltered valleys among the mountains. On the Great Plains a range of extremes within a year from −40° F. to 100° is not unusual, but in the mountain valleys the range is rarely greater than from −20° to 90°. The records from 1880 to 1907 show a maximum range from 117° at Glendive, near the eastern border, in July 1893, to −63° at Poplar, about 80 m. north by west of Glendive, n January 1885. The amount of precipitation is greater in the north-west and on the mountains, because in the one case the mountains of lower elevation are a less obstruction to the moisture-bearing winds from the west, and in the other the mountains condense the moisture; the mountains which stand in isolated groups upon the plains are frequently in summer the focus of local thunder howers. The average annual precipitation ranges from 10 to 15 in. on the Great Plains to 20 in. or more in the north-west, and over imited areas in the higher mountain region. Nearly one-half of he rain falls during the four months from May to August inclusive. Storms endangering life and property occur only in the east, caused by a high north wind with snow or rain and a low temperature.

Soil.—In the river bottoms the soil is for the most part a black layey loam lacking in natural drainage, but on the "bench lands" igher up there is a deep layer of sandy loam beneath which is a bed f gravel. Some of the best soil is in the mountain valleys, for these alleys were once lakes and rich deposits of alluvium were made in hem. The mountain slopes are often bare or covered only with a hin layer of mould.

Agriculture.—The rainfall is sufficient for good grazing, but except in the Flathead valley cultivation was long considered to e dependent on irrigation; and consequently farming was only ncidental to stock raising and mining until after 1870, and as late s 1900 the ratio of improved farm land to the total land area was less han in any other state or territory except New Mexico, Wyoming, rizona and Hawaii. In 1906 the farm area was almost equally ivided between "dry" farming and farming under irrigation, hree-fourths of the wheat produced was grown without irrigation, nd the dry farming was very successful with the comparatively ew and valuable crops of *durum*, or macaroni wheat, and Russian arley, which is used in straw for winter feed to sheep and neat attle. The counties where dry farming had been carried on on the rgest scale were Missoula, Ravalli, Flathead, Cascade, Fergus nd Gallatin, where cereal yields, though not nearly so large as from rigated lands, were high compared with the average for the country. ut even where dry farming was successful, the increase of crops ade possible by cheap irrigation seemed to be inducing farmers abandon it. Among the larger privately irrigated tracts are: ,000 to 18,000 acres in Yellowstone county, fed by a canal built the Billings Land & Irrigation Company; about 35,000 acres of chard land in the Bitter Root Valley, in Ravalli county, irrigated canals from Lake Como, a natural reservoir; and 100,000 acres Missoula county, to be watered from a 28 ft. dam across the Clark Fork (or Missoula River) at Bonner. Private irrigation by pumping was first successfully introduced about 1901, and in 1906 a state report estimated that 125 pumping irrigation plants were in use in the state. Boring for underground water supply to be used in irrigation was tried on a small scale. An area of 16,000 acres in Missoula county is watered by a ditch 10 m. long built in 1902–1905 by the co-operative Grass Valley-Frenchtown Irrigation Company, and the Teton Co-operative Canal Company in 1906 began work on a diversion canal from the Teton River, whose waters are to be stored by a dam 62 ft. high and 2100 ft. long. But more important than private and co-operative undertakings are the Federal irrigation projects. In 1894 Congress passed the Carey Act, under which Montana received title to 1,000,000 acres of arid land on condition that the state would reclaim it by providing an adequate supply of water; the state accepted the offer, created an irrigation commission, and provided means for securing the necessary funds. Furthermore, Congress in 1902 appropriated the receipts from the sales of public lands in the state to the construction of irrigation work. In 1899 there were 6812 m. of irrigation canals and large ditches in the state; the irrigated acreage had increased from 350,582 acres in 1889 to 951,154 acres in 1899, when about 84% of the irrigated area was in the south-west. The great Federal projects were not begun until after 1900. Among them are: the Huntley project in Yellowstone county, begun in 1904 and practically completed in 1908, covering land formerly in the Crow Indian reservation, the irrigable area being 28,921 acres; the Lower Milk river project (and the subsidiary St Mary project), in Chouteau, Valley and Teton counties, by which the water of St Mary river[1] is stored and diverted to the headquarters of the Milk river to irrigate an area of 300,000 acres; the Sun river project (Teton, Lewis and Clark, Chouteau and Cascade counties), by which, as the ordinary flow of that river is already utilized for irrigation, the flood waters are stored and carried to the higher bench lands of the district; in Montana (Dawson county) and North Dakota (McKenzie county), the Lower Yellowstone project; and the Blackfeet project, to irrigate the Blackfeet reservation in Teton county.

In 1900, 11,844,454 acres, or 12·7% of the area, was included in farms; of this, 1,736,701 acres, or 14·7%, was improved; 54·7% of the improved farm land was irrigated; 79·4% of the irrigated land was used for growing crops and 20·6% for pasturage; the total acreage of all crops was 1,151,674, and of this 755,865, or 65·6%, was irrigated. In the same year there were 13,370 farms exclusive of those on Indian reservations; of these, 6665 contained less than 175 acres each; 1289 contained more than 1000 acres each; 8043 contained some irrigated land, the average amount being 118 acres; 11,592 were worked by owners or part owners, 624 by cash tenants, and 606 by share tenants.

Of the total acreage of all crops in 1899, 875,712 acres, or 76%, were hay and forage, and 254,231 acres, or 22·1%, were cereals; of the cereal acreage 52·7% was oats, 36·2% was wheat, 9% was barley, and 1·3% was Indian corn. In 1909 the oat crop was 15,390,000 bushels from 300,000 acres; the acreage of wheat in 1909 was 350,000 and the production 10,764,000 bushels; the acreage of barley in 1909 was 50,000 acres, and 1,900,000 bushels were raised; the acreage of Indian corn in 1909 was 5000 acres, and 175,000 bushels were grown.

Sugar beets were first grown in Montana at Evans, Cascade county, in 1893 without irrigation. In 1906 a refinery (with a daily slicing capacity of 1200 tons) was built at Billings, Yellowstone county. Russians, with experience in beet-growing, and Japanese are furnished by the sugar company to the growers for the bunching, thinning, hoeing and topping of the beets. In 1906 sugar refineries were projected at Hamilton, Kalispell, Chinook, Laurel, Missoula, Dillon and Great Falls; and in 1907 the crop was so large that 12,000 freight cars were needed to carry it and the railways had a car and coal "famine."

The east is devoted chiefly to stock raising; for cattle, horses and sheep thrive well on the bunch grass except when it is covered with snow. The principal sheep-raising counties are Custer, Yellowstone, whither many sheep are brought to be fattened, Rosebud, Beaverhead, Valley, and Meagher. In 1909 the number of sheep in Montana was 5,747,000, being exceeded only by the number in Wyoming; the number of cattle was 922,000, only 80,000 being milch cows, and the number of horses 319,000.

Lumber.—The woodland area was estimated in 1900 at 42,000 sq. m., much of which had been burned over. It is confined mainly to the mountain slopes, and in March 1909 31,858·9 sq. m., more than three-fourths of this total, had been set apart in the following "national forests": Absaroka (980,440 acres), Beartooth (685,293 acres), Beaverhead (1,506,680 acres in Montana; and a smaller area in Idaho), Bitterroot (1,180,900 acres), Blackfeet (1,956,340 acres),

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[1] The St Mary and both forks of the Milk river flow northward into the Dominion of Canada, and as there has been much private irrigation both north and south of the international boundary, the present Federal project and other undertakings in the same region necessitate an international agreement as to the division of the waters, especially of the St Mary, and commissioners representing the Canadian government and the United States conferred in regard to it in May 1908.

Cabinet (1,020,960 acres), Custer (590,720 acres), Deerlodge (1,080,220 acres), Flathead (2,092,785 acres), Gallatin (907,160 acres), Helena (930,180 acres), Jefferson (1,255,320 acres), Kootenai (1,661,260 acres), Lewis and Clark (844,136 acres), Lolo (1,211,680 acres), Madison (1,102,860 acres), Missoula (1,237,509 acres) and Sioux (145,253 acres in Montana; 104,400 acres in South Dakota). A large part of the woodland contains no trees fit for lumber; nevertheless the value of the lumber was $3,024,674 in 1905. More than one-half of the product is yellow pine and the remainder is principally red fir and tamarack. There is scarcely any hardwood timber in the state.

Minerals and Mining.—Mining has been the leading industry of Montana ever since the discovery of gold in 1862. It contains the largest copper producing district in the world, and in 1907 mined more copper than any other state or territory except Arizona; this metal constituted nearly three-fourths in value of the state's mining products in 1907, the total value being $60,663,511 and that of copper $44,852,758. The most important copper mines are in Silverbow, Broadwater, Jefferson and Beaverhead counties. Gold was discovered in Deerlodge county as early as 1852 but very little mining was done until ten years later. In 1863 the famous Alder Gulch in Madison county was discovered and in the next year, Last Chance Gulch in the south of Lewis and Clark county. In 1865 the product reached its maximum, as the value of gold and silver combined (the value of the silver being relatively small) was $18,000,000; the production then decreased and in 1903 the value of the gold was only $1,800,000. Then copper mining rapidly developed and considerable gold was obtained from copper ores. Until the development of copper mining, silver was produced only in small quantities along with gold, but as much more silver than gold was obtained from the copper ores the value of the silver product increased from $2,630,000 in 1881 to $24,615,822 in 1892. The product then fell off, but in 1907, when it amounted to 9,317,605 fine ounces, valued at $6,149,619, more than nine-tenths of it was derived from the copper ores in Silverbow county. It was in 1882 while Marcus Daly was sinking a shaft at Anaconda in preparation for milling gold and silver ores that he discovered the first rich copper ledge. Other discoveries about Butte followed, and the output of copper increased from 11,011 long tons in 1883 to 129,805 long tons in 1906, more than 99·6% from Silverbow county. The industrial and political life of Montana have been strongly influenced by the copper industry and by the tremendous wealth controlled by the copper interests; in the industry three men were long dominant—Marcus Daly, William A. Clark and F. Augustus Heinze; later the Amalgamated Copper Company gained control of a large part of the mines.

Coal was discovered in Montana before 1880, when 224 tons were mined. In 1907 the output was 2,016,857 tons, and in 1908 1,920,190 tons. The coal underlying the east half of the state, the "Great Plains," is lignitic and of inferior quality, but that in the mountain districts is bituminous and generally suitable for coking. The principal fields are: the isolated Bull Mountain deposit, 45 m. north-east of Billings, in Yellowstone county; the large Clark Fork field in Meagher, Sweet Grass, Yellowstone and Carbon counties; the small but valuable Rocky Fork field in the south central part of Carbon county; the Red Lodge field in Carbon county; the Yellowstone field, chiefly in Gallatin and Park counties; the Trail Creek deposits, 10 m. south of Bozeman; the Cinnabar field in south Park county; the Great Falls field in Cascade county; and the West Gallatin, the Toston and the Ruby valley fields. The output steadily increased until 1895 when it was 1,504,193 short tons; but from then to 1905, when it was 1,643,832 short tons, the quantity varied little from year to year. From 1905 to 1907, when the output was valued at $3,907,082, the increase in production was steady.

Granite, sandstone and limestone are abundant in the state, but have been little developed. Granite was quarried in 1907 to the value of $102,050. Limestone quarried in the same year was worth $124,690; and sandstone was valued at $39,216. Some light grey sandstone found in Rocky Cañon, Gallatin county, looks much like the Berea (Ohio) sandstone; and a sandstone quarried at Columbus, Yellowstone county, was manufactured into grindstones equal to those made from the Berea stone. Gypsum in Carbon county and in Cascade county is worked for plaster. Sapphires are found in several gulches, especially on Yogo Creek, 16 m. from Utica, Fergus county, where blue stones are found, and on Rock and Cottonwood creeks, where green, yellow, red and blue sapphires have been found. Many of the sapphires are shipped to Switzerland for watch jewels and for bearings. In 1907 the total value of precious stones was $229,800.

Manufactures.—With the exception of the smelting and refining of copper, manufacturing is in Montana a decidedly minor industry. In 1905 the total value of the "factory" product was $66,415,452, and the value of the copper (by state reports) was $48,165,277. Lumber and timber products, which ranked second, increased in value from $2,846,268 in 1900, to $3,024,674 in 1905. Flour and grist mill products rose during that period from $937,462 to $2,003,136; and malt liquors increased in value from $1,267,331 to $1,731,691. In 1905 the value of the products of the factories of Anaconda and Great Falls was 63·5% of that for the entire state.

Transport.—Montana is served by three transcontinental railways: the Great Northern traversing the north, the Northern Pacific traversing the south-east, south and south-west portions, and, north of the Northern Pacific, the Chicago, Milwaukee & Puget Sound, an extension of the Chicago, Milwaukee & St Paul to Seattle and Tacoma, practically completed in 1909; branch lines of the Great Northern, from the north, connect with the Northern Pacific and the Chicago, Milwaukee & Puget Sound at Butte, and with the Northern Pacific at Laurel. The Oregon Short Line from the south connects with the Northern Pacific, the Great Northern, and the Chicago, Milwaukee & Puget Sound at Butte, and the Burlington system, also from the south, connects with the Northern Pacific at Billings, Yellowstone county. The Butte, Anaconda & Pacific railway carries ore from the mines at Butte to the smelters at Anaconda. The first railway was the Oregon Short Line, which was completed by the Union Pacific Company from Ogden, Utah, to Butte in 1881. The Northern Pacific reached Helena two years later and the railway mileage in the state increased from 106 m. in 1880 to 4012·62 m. in 1909. River transport has been of relatively little importance since the advent of railways.

Population.—The population of the state increased from 39,159 in 1880 to 243,329 in 1900, and to 376,053 in 1910. In 1900, 67,067 were foreign-born, 11,343 were Indians, 2441 Japanese, 1739 Chinese and 1523 negroes; most numerous among the foreign-born were 13,826 Canadians, 9436 Irish, 8077 English, 7162 Germans and 5346 Swedes. The Indians are mostly members of the following tribes: the Piegan, the Crow, the Salish (or Flathead), the Sioux, the Assiniboin, the Arapaho Atsina (miscalled Grosventres) and the Northern Cheyenne. The Piegans, with small remnants of a few other tribes, numbering (1900) about 2060, occupy the Blackfeet reservation in the north-west of Teton county, the Crows, numbering 1857, occupy the Crow reservation in the south central part o the state; the Salish, with small remnants of the Pend Oreille the Spokan, the Lower Kalispell and the Kutenai, numbering 1837, occupy the Flathead reservation in the north of Missoula and the south of Flathead county; Assiniboins and others o Sioux stock, numbering about 1793, occupy Fort Peck reservation in the south-east of Valley county: Atsina and Assiniboins numbering about 1429, occupy Fort Belknap reservation in th east of Chouteau county; and the Northern Cheyennes, numbering about 1357, occupy Northern Cheyenne reservation in th south-east of Rosebud county. Many of the Indians are engage in stock-raising; the Crows have an irrigation system and ar extensively engaged in farming. Roman Catholics are mor numerous in Montana than Protestants, having 72,359 communicants out of a total of 98,984 of all denominations in 1906, whe there were 7022 Methodists, 4096 Presbyterians, 3290 Protestan Episcopalians and 2029 Baptists. In 1900 the urban populatio (*i.e.* population of places having 4000 inhabitants or more) wa 69,989; the semi-urban (*i.e.* population of incorporated place having less than 4000 inhabitants) was 30,270; and the rura (*i.e.* population outside of incorporated places) was 143,07 The rural population was therefore in that year 58·8% of th total, and the urban was only 28·7% of the total, but from 189 to 1900 the urban increased 185% while the rural increase only 55·6%. The principal cities are: Butte, whose populatio increased from 10,723 in 1890 to 30,470 in 1900 and to 39,165 i 1910; Great Falls (1910) 13,948; Helena, the capital, (191 12,515; and Anaconda (1910) 10,134.

Administration.—The state is governed under a constitutio adopted in 1889, a month before Montana's admission into th Union. The requirements for amending this constitution ar an affirmative vote in each house of the legislature of two-thir of its members, followed, not less than three months later, b an affirmative vote of a majority of the electors voting there at a general election; or, by a like vote of each house of the legi lature and of the electorate, a convention may be called to revi or amend it, a revision or amendment in this manner requiri the ratification of the electorate not less than two months n more than six months after the adjournment of the conventio General suffrage is conferred on every male citizen of the Unite States who is twenty-one years of age and who has lived in th state one year, and in the county thirty days immediate preceding an election, the only exceptions being idiots or insa persons; a woman who has the qualifications for suffrage th are required of a man, may vote at any school district electi and if a tax-payer she may vote on all questions submitted to the tax-payers of the state or of any political division thereof.

The officers of the executive department are the governor, lieutenant-governor, secretary of state, attorney-general, treasurer, auditor and superintendent of public instruction, each of whom is elected for a term of four years. No person is eligible to any of these offices who shall not have lived within the state for two years next preceding the election; no person is eligible to the office of governor, lieutenant-governor, attorney-general or superintendent of public instruction who is not thirty years of age; no person is eligible to the office of secretary of state, treasurer or auditor who is not twenty-five years of age; no person is eligible to the office of attorney-general who has not been admitted to practice in the supreme court of the state; and the treasurer is ineligible to his office for the immediately succeeding term. The governor's powers are limited. As in other states he is commander-in-chief of the militia. With the advice and consent of the senate he appoints various administrative officers. With the approval of the majority of a board of pardons (composed of the secretary of state, attorney-general and auditor), he may pardon offences or commute punishment, and remit fines and forfeitures. He may veto any bill passed by the assembly, or in the case of a bill making appropriations of money he may veto any item of it, and no bill or item of an appropriation bill which he vetoes within five days (Sunday excepted) after it has been presented to him, can become a law or part of a law unless passed over his veto in each house by a two-thirds vote of the members present. Under an amendment to the Constitution adopted in 1906 his veto power does not extend to measures referred to the people by the legislative assembly or by initiative and referendum petitions. Without his approval, also, no order or resolution of either House, other than to adjourn or relating solely to the business of the assembly, can take effect until passed again by a two-thirds vote as in case of a bill.

The legislature consists of a senate and a house of representatives. Except when called in special session by the governor it meets (at Helena) on the first Monday of January in odd numbered years only, and the length of its session is limited by the constitution to sixty days. Senators are elected, one from each county, for a term of four years; representatives are elected, one or more from each county according to population, for a term of two years. The qualifications for a senator are that he be at least twenty-four years of age and have resided in his county or district at least one year next preceding his election; for a representative there are no qualifications other than those required for suffrage. The action of the legislature is much restricted by the constitution: a long list of cases is named in which that body is prohibited from passing any local or special laws; it is prohibited from delegating to any special commission power to perform any municipal functions whatever; from making any appropriations for charitable, industrial, educational or benevolent purposes to any person, corporation or community not under the absolute control of the state; and from authorizing the state to contract any debt or obligation in the construction of any railway, or to lend its credit in aid of such railway construction. In 1906 an amendment to art. 5, sec. 1 of the state constitution, authorized the initiative and referendum, but two-fifths of the entire number of counties must each furnish for initiative petitions signatures amounting in number to 8% of the whole number of votes cast for governor at the election last preceding the filing of the petition; for referendum petitions two-fifths of the counties must each furnish as signers 5% of the legal voters; and any measure referred to the people shall be in full force unless the petition for the referendum be signed by 15% of the legal voters (whose number is that of the total votes cast for governor, &c., as above) of a majority of the whole number of counties, but that in such case the law to be referred shall be inoperative until it is passed at the popular election.

The administration of justice is intrusted to a supreme court, an increasing number of district courts, and at least two justices' courts in each organized township, besides police and municipal courts. The supreme court is composed of a chief justice and two associate justices elected for a term of six years. It holds four sessions a year at Helena and has both original and appellate jurisdiction. For most district courts there is only one judge, but for the more populous there are two; they are all elected for four years. These courts have original jurisdiction in cases at law and in equity in which the value in controversy exceeds $50, in criminal cases amounting to felony, in all matters of probate, in actions for divorce, &c., and appellate jurisdiction in cases arising in the inferior courts. Justices of the peace are elected for two years and have civil jurisdiction in several classes of actions in which the amount demanded does not exceed $300, and in such cases as petit larceny, assault in the third degree and breach of the peace.

For purposes of local government the state is divided into counties; each county into townships, school districts and road districts; and there are incorporated cities and towns. The county officers are a board of three commissioners, a treasurer, a sheriff, a county clerk, a clerk of the district court, an attorney, a surveyor, a coroner, a public administrator, an assessor, a superintendent of schools, and in some instances, an auditor. The commissioners are elected for six years, the other officers, for two years. Among the commissioners' powers and duties are: the management of county property; the levying of taxes; the equalizing of assessments; the division of the county into townships, school districts and road districts; the laying out and management of public highways and ferries, and the care of the poor. The township is of minor importance, its principal officers being two justices of peace and two constables. Municipal corporations are classified according to population; those having 10,000 inhabitants or more are cities of the first class; those having less than 10,000 but more than 5000 inhabitants, cities of the second class; those having less than 5000 but more than 1000 inhabitants, cities of the third class, and those having less than 1000 but more than 300 inhabitants towns. In a city of the first class, a mayor, two aldermen from each ward, a police judge, and a treasurer who may be *ex officio* tax-collector are elected, and an attorney, a clerk, a chief of police, an assessor, a street commissioner, a jailer, a surveyor, and, where there is a paid fire department, a chief engineer with one or more assistants, may be appointed by the mayor with the consent of the council. The officers of cities of the second and third class are the same, except that the clerk is *ex officio* assessor. In towns only a mayor and aldermen are elected, and the mayor with the consent of the council appoints a clerk who is *ex officio* assessor, a treasurer who is *ex officio* collector, and a marshal who may be *ex officio* street commissioner. The principal municipal officers hold office for two years.

A wife may hold property and make contracts as if she were single, and neither husband nor wife is accountable for the acts of the other. The husband is required to support himself and his wife if he is able to do so; if he is unable, his wife is required to assist him. On the death of either husband or wife at least one-third of his or her property passes to the other. Recognized causes for divorce are adultery, extreme cruelty, wilful desertion, wilful neglect, habitual intemperance or conviction for felony. The homestead of a head of a family consisting either of a farm not exceeding 160 acres or $2500 in value, or of a house and lot—the lot not exceeding $\frac{1}{4}$ acre, and the house and lot not exceeding $2500 in value—is secured against debtors except in case of judgments obtained before the homestead was recorded as such, in case of labourers', mechanics' or vendors' liens, and in case of a debt secured by mortgage; if the owner is a married person the homestead cannot be mortgaged without the consent of both husband and wife. For the settlement of disputes between labourers and employers there is a state board, appointed by the governor and consisting of an employer of labour, a labourer and a disinterested citizen. Upon application of either or both of the parties, provided the employees be not less than twenty, this board is required to inquire into the cause of the dispute, with the aid of two expert assistants, who shall be nominated by the parties, and to render a decision, which is binding for at least six months upon the parties to the application.

Charitable and Penal Institutions.—These are a state prison at Deer Lodge, managed by contract; a reform school at Miles City, an industrial school at Butte, an orphans' home at Twin Bridges, the soldiers' home at Columbia Falls, a school for deaf and blind at Boulder, and an insane asylum at Warm Springs, managed by contract. They are all under the supervision of a state board of charities and reform. The state also has a bureau of child and animal protection.

Education.—The public school system is administered by state, county and district officers. The common school of each district is under the immediate supervision of a board of trustees; but a state text-book commission determines what text-books shall be used in these schools; the state superintendent of public instruction prepares the questions that are used in examining applicants to teach, passes judgment on publications for use in school libraries, and advises with the county superintendent of schools. A county board of education examines applicants for teachers' positions and pupils applying to enter high schools. The county superintendent advises the teachers, and holds teachers' institutes. Each school district is required by law to keep its school open at least three months a year and all children between the ages of eight and fourteen are required to attend for the full term; if unemployed they are required to continue in school until they have attained the age of sixteen. In 1908 fifteen of the counties had a county high school, and there were also 10 accredited city high schools in 1908. The state educational institutions are the university of Montana (1895), at Missoula, the normal college at Dillon, the college of agriculture and mechanic arts (1893) at Bozeman; and the school of mines (1900) at Butte. They are all under the supervision and control of the state board of education, which consists of the governor, the state superintendent, the attorney-general and eight other members appointed by the governor for a term of four years, two retiring annually. The entire educational system is maintained very largely out of funds derived from lands appropriated by Congress for that purpose.

Finance.—About one-half of the revenue for state and county purposes is derived from a general property tax. All taxable property in each county except that of railways in more than one county is assessed at its full value by the county assessor. The franchise, roadway, roadbed, rails and rolling stock of railways in more than one county are assessed at their full value by the state board of equalization. The assessment rolls of the county assessor are subject to alteration by the board of county commissioners sitting as a county board of equalization and the assessments as between counties are subject to alteration by the state board of equalization. The state legislature biennially fixes the rate of taxes for state purposes; the amount of this levy is now limited by the Constitution to 2½ mills on the dollar. The board of county commissioners fixes the rate of county taxes and levies those taxes; and the county treasurer collects the taxes of the state and those of the county. Among the other sources of revenue are a poll-tax of two dollars on each man between the ages of twenty-one and sixty, licences, an inheritance tax, rent of state lands and the income from invested funds received from the sale of state lands.

The state had a bonded debt in 1909 of $384,000, authorized by popular vote in November 1908; by the constitution the aggregate indebtedness of the state was limited to $100,000 except in case of war, invasion or insurrection, or in case a measure authorizing a greater indebtedness should be submitted by the legislature to the electorate and should receive a majority of the votes cast. The constitution limits the indebtedness of a county to 5% of the value of its taxable property and that of a city, town or school district to 3%, except that the question may be submitted to a vote of the tax-payers affected when it is deemed necessary to construct a sewerage system or procure a water supply.

History.—The first exploration within the borders of Montana was made in 1743 by Sieur de la Verendrye, who in that year led an expedition up the Missouri river to the Great Falls and near where Helena now stands; the first exploration in that part of the state which lies west of the main range of the Rocky Mountains was made by Meriwether Lewis and William Clark in 1805. That part which lies east of the mountains was included in the Louisiana Purchase of 1803 and became successively a part of Missouri Territory in 1812, of Nebraska Territory in 1854, of Dakota Territory in 1861 and of Idaho Territory in 1863; that which lies west of the mountains became successively a part of Oregon Territory in 1848, of Washington Territory in 1853 and of Idaho Territory in 1863. In 1864 Montana Territory was created, and in 1889 this Territory was admitted to statehood. The report of Lewis and Clark attracted many traders and trappers, and within a few years the Missouri Fur Company, the Rocky Mountain Fur Company, the Hudson Bay Company and the American Fur Company had established fortified trading posts on the Missouri, the Yellowstone, the Marias, the Milk and other rivers; the most prominent among these was Fort Benton, which was established in 1846 at the head of navigation on the Missouri, and was made the headquarters of the American Fur Company. In 1841 Father Peter John De Smet (1801–1872), a Belgian Jesuit missionary established Saint Mary's Mission in Bitter Root Valley, but, as the Indians repeatedly attacked the mission, it was abandoned in 1850. Fort Owen was, however, established in its place and continued for several years the chief settlement west of the mountains.

The development of Montana was scarcely begun when the discoveries of gold were made at Bannack, Beaverhead Valley, in 1862, at Virginia city, Alder Gulch, in 1863 and at Helena, Last Chance Gulch, in 1864. Several thousand people now rushed in, and before the Territorial government was created, the gold districts and the roads thereto suffered from a reign of lawlessness. The citizens organized a "vigilance committee" and hanged many of the outlaws. Many traders and trappers were butchered by the Indians, who became still more troublesome after the invasion of the Territory by the gold-seekers, and the surveying of railway routes had been undertaken. Treaties and military operations were at first of no avail, but in 1876 the United States government took steps to reduce them to submission, and Generals George Crook (1828–1890), Alfred Howe Terry (1827–1890) and John Gibbon (1827–1896), with 2700 troops (besides the Crow scouts) were sent against the Sioux under Sitting Bull, Crazy Horse and others. On the 17th of June General Crook with 1000 men defeated a large force of the Indians near the Rosebud river. On the 22nd of June General George A. Custer was sent up the Rosebud, and on the morning of the 25th passed over the divide of the Little Big Horn, where the Sioux were soon discovered. Custer divided his regiment into four commands, his own comprising 262 men. Continuing a few miles down stream, he came upon what was supposed to be a single Sioux village; the Indians, however, proved to number from 8000 to 10,000, including 2500 to 3000 warriors. Custer was soon completely surrounded and the entire command, save a single Crow scout, was slaughtered. This was, however, the beginning of the end of the Indian troubles. On the 29th of September a band under American Horse was defeated and their leader killed; in October some 5000 Indians surrendered; and on the 22nd of April 1877, 2000 more under Crazy Horse laid down their arms. General Crook and Colonel Nelson A. Miles especially distinguished themselves. In October 1877 the Nez Percés under Chief Joseph after a masterly retreat from Idaho of over 1000 m., probably unequalled in Indian warfare, were hemmed in by greatly superior forces and captured in the Bear Paw Mountains in Chouteau county.

In most of the territorial or state elections the Democrats, or the Democrats and Populists united, have been triumphant, a Republican governor having been elected only in 1892; but the contests have often been ardent and bitter. In 1889 the Democrats were charged with fraud in the 34th election precinct of Silverbow county, and, the dispute remaining unsettled, two legislatures were seated. Each legislature elected two senators to the United States Senate, which, having a Republican majority, seated the Republicans. More notable, however, was the feud between W. A. Clark and Marcus Daly, both Democrats. William Andrews Clark (b. 1839) removed in 1856 from Pennsylvania to Iowa, in 1862 to Colorado and in 1863 to Montana, where he became the wealthiest mine-owner. Marcus Daly (1842–1900) went from Ireland about 1857 to New York City, and thence to California and Nevada, and in 1876 reached Butte, Montana. In 1882 he discovered one of the richest copper deposits in the world. Clark aspired to be a United States senator, but by ridiculing Daly, provoked a powerful opposition. Clark was one of the two Democratic claimants who had been denied a seat in the senate in 1890. Three years later he was again nominated, but Daly prevented his election. Clark secured his election to the senate in 1899, but Daly furnished to the Committee on Elections and Privileges such evidence of bribery and fraud that it decided against seating him. Daly died on the 12th of November 1900, and in 1901 Clark was elected senator for the full term, which expired in 1907, when he was succeeded by Joseph Moore Dixon (b. 1867), a Republican.

The governors of Montana have been as follows:—

Territorial.

Sidney Edgerton	1864–1865
Thomas Meagher (acting)	1865–1866
Green Clay Smith	1866–1869
James Monroe Ashley	1869–1870
Benjamin F. Potts	1870–1883
John Schuyler Crosby	1883–1884
B. Platt Carpenter	1884–1885
Samuel Thomas Hauser	1885–1887
Preston Hopkins Leslie	1887–1889
Benjamin F. White	1889–

State.

Joseph Kemp Toole	Democrat	1889–1893
John Ezra Rickards	Republican	1893–1897
Robert Burns Smith	Democrat and Populist	1897–1901
Joseph Kemp Toole	Democrat	1901–1909
Edwin L. Norris	"	1909–

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MONTANELLI, GIUSEPPE (1813–1862), Italian statesman and author, was born at Fucecchio in Tuscany, and in 1840 was appointed law professor at Pisa. He contributed to the *Antologia*, a celebrated Florentine review, and in 1847 founded a newspaper called *L' Italia*, the programme of which was "Reform and Nationality." In 1848 Montanelli served with the Tuscan student volunteers at the battle of Curtatone, where he was wounded and taken prisoner by the Austrians. On being liberated he returned to Tuscany, and the grand duke Leopold II, knowing that he was popular with the masses, sent him to Leghorn to quell the disturbances. In October, Leopold, much against his inclinations, asked him to form a ministry. He accepted, and on the 10th of January 1849, induced the grand duke to establish a national constituent assembly. But Leopold, alarmed at the turn affairs were taking, fled from Florence, and Montanelli, Guerrazzi and Mazzini were elected "triumvirs" of Tuscany. Like Mazzini, Montanelli advocated the union of Tuscany with Rome. But after the restoration of the grand duke, Montanelli, who was in Paris, was tried and condemned by default; he remained some years in France, where he became a partizan of Napoleon III. On the formation of the kingdom of Italy he returned to Tuscany and was elected member of parliament; he died in 1862. He was an enthusiastic, but a fickle and ambitious demagogue, and he achieved a better reputation as a writer.

His most important literary work is his *Memorie sull' Italia e specialmente sulla Toscana dal 1814 al 1850*, in 2 vols. (Turin, 1853); he also wrote *Il Partito nazionale italiano* (Turin, 1856), *L'Impero, il papato, e la democrazia in Italia* (Florence, 1859): and *Dell' ordinamento nazionale in Italia* (Florence, 1862). His dramatic poem *La Tentazione* and his tragedy *Camma* achieved some success in their day. See Assunta Marradi, *G. Toscanelli e la Toscana dal 1815 al 1862* (Rome, 1909).

MONTAÑES, JUAN MARTINEZ (*c.* 1580–1649), Spanish sculptor, was born at Alcala-la-real, in the province of Granada. His master was Pablo de Roxas, his first known work (1607) being a boy Christ, now in the sacristy of the *capella antigua* in the cathedral of Seville. The great altar at Santiponce near Seville, was completed in 1812. Montañes executed most of his sculpture in wood, covered with a surface of polished gold, and coloured. Other works were the great altars at Santa Clara in Seville and at San Miguel in Jerez, the Conception and the realistic figure of Christ crucified, in the Seville cathedral; the figure of St John the Baptist, and the St Bruno (1620); a tomb for Don Perez de Guzman and his wife (1619); the St Ignatius and the St Francis of Borja in the university church of Seville. Montañes died in 1649, leaving a large family. His works are more realistic than imaginative, but this, allied with an impeccable taste, produced remarkable results. The equestrian statue of King Philip IV., caste in bronze by Pietro Tacca in Florence and now in Madrid, was modelled by Montañes. He had many imitators, his son Alonzo Martiñez, who died in 1668, being among them.

See B. Haendeke, *Studien zur Geschichte der spanischen Plastik* (Strassburg, 1900); F. Gómez, *Historia de la escultura en España* (Madrid, 1885).

MONTANISM, a somewhat misleading name for the movement in the 2nd century which, along with Gnosticism, occupied the most critical period in the history of the Early Church. It was the overthrow of Gnosticism and Montanism that made the "Catholic" Church. The credit of first discerning the true significance of the Montanistic movement belongs to Ritschl.[1] In this article an account will be given of the general significance of Montanism in relation to the history of the Church in the 2nd century, followed by a sketch of its origin, development and decline.

1. From the middle of the 2nd century a change began to take place in the outward circumstances of Christianity. The Christian faith had hitherto been maintained in a few small congregations scattered over the Roman Empire. These congregations were provided with only the most indispensable constitutional forms ("Corpus sumus de conscientia religionis, de unitate disciplinae, de spei foedere"). This state of things passed away. The Churches soon found numbers within their pale who stood in need of supervision, instruction and regular control. The enthusiasm for a life of holiness and separation from the world no longer swayed all minds. In many cases sober convictions or submissive assent supplied the want of spontaneous enthusiasm. There were many who did not *become*, but who *were*, and therefore remained, Christians. Then, in addition to this, Christians were already found in all ranks and occupations—in the Imperial palace, among the officials, in the abodes of labour and the halls of learning, amongst slaves and freemen. Should the Church take the decisive step into the world, conform to its customs, and acknowledge as far as possible its authorities? Or ought she, on the other hand, to remain a society of religious devotees, separated and shut out from the world? That this was the question at issue is obvious enough now, although it could not be clearly perceived at the time. It was natural that warning voices should then be raised in the Church against secular tendencies, that the well-known counsels about the imitation of Christ should be held up in their literal strictness before worldly Christians. The Church as a whole, however, under pressure of circumstances rather than by a spontaneous impulse, decided otherwise. She marched through the open door into the Roman state, and settled down there to Christianize the state by imparting to it the word of the Gospel, but at the same time leaving it everything except its gods. On the other hand, she furnished herself with everything of value that could be taken over from the world without overstraining the elastic structure of the organization which she now adopted. With the aid of its philosophy she created her new Christian theology; its polity furnished her with the most exact constitutional forms; its jurisprudence, its trade and commerce, its art and industry, were all taken into her service; and she contrived to borrow some hints even from its religious worship. With this equipment she undertook, and carried through, a world-mission on a grand scale. But believers of the old school protested in the name of the Gospel against this secular Church. They joined an enthusiastic movement which had originated in a remote province, and had at first a merely local importance. There, in Phrygia, the cry for a strict Christian life was reinforced by the belief in a new and final outpouring of the Spirit—a coincidence which has been observed elsewhere in Church history—as, for instance, among the early Quakers and in the Irvingite movement. These

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[1] *Entstehung der altkatholischen Kirche*, 2nd ed. Bonn. (1857).

zealots hailed the appearance of the Paraclete in Phrygia, and surrendered themselves to his guidance. In so doing, however, they had to withdraw from the Church, to be known as "Montanists," or "Kataphrygians," and thus to assume the character of the sect. Their enthusiasm and their prophesyings were denounced as demoniacal; their expectation of a glorious earthly kingdom of Christ was stigmatized as Jewish, their passion for martyrdom as vainglorious and their whole conduct as hypocritical. Nor did they escape the more serious imputation of heresy on important articles of faith; indeed, there was a disposition to put them on the same level with the Gnostics. The effect on themselves was what usually follows in such circumstances. After their separation from the Church, they became narrower and pettier in their conception of Christianity. Their asceticism degenerated into legalism, their claim to a monopoly of pure Christianity made them arrogant. As for the popular religion of the larger Church, they scorned it as an adulterated, manipulated Christianity. But these views found very little acceptance in the 3rd century, and in the course of the 4th they died out.

2. Such is, in brief, the position occupied by Montanism in the history of the ancient Church. The rise and progress of the movement were as follows.

At the close of the reign of Antoninus Pius—probably in the year 156 (Epiphanius)—Montanus appeared at Ardabau in Mysia, near the Phrygian border, bringing revelations of the "Spirit" to Christendom. Montanus claimed to have a prophetic calling in the very same sense as Agabus, Judas, Silas, the daughters of Philip, Quadratus and Ammia, or as Hermas at Rome. At a later time, when the validity of the Montanistic prophecy was called in question, the adherents of the new movement appealed explicitly to a sort of prophetic succession, in which their prophets had received the same gift which the daughters of Philip, for example, had exercised in that very country of Phrygia. The burden of the new prophecy seems to have been a new standard of moral obligations, especially with regard to marriage, fasting and martyrdom. But Montanus had larger schemes in view. He wished to organize a special community of true Christians to wait for the coming of their Lord. The small Phrygian towns of Pepuza and Tymion were selected as the headquarters of his church. Funds were raised for the new organization, and from these the leader and missionaries, who were to have nothing to do with worldly life, drew their pay. Only two women, Prisca and Maximilla, were moved by the Spirit; like Montanus, they uttered in a state of frenzy the commands of the Spirit, which urged men to a strict and holy life. This does not mean that visions and significant dreams may not have been of frequent occurrence in Montanistic circles.[1]

For twenty years this agitation appears to have been confined to Phrygia and the neighbouring provinces. But after the year 177 a persecution of Christians broke out simultaneously in many provinces of the Empire. Like every other persecution it was regarded as the beginning of the end. It would seem that before this time Montanus had disappeared from the scene; but Maximilla, and probably also Prisca, were working with redoubled energy. And now, throughout the provinces of Asia Minor, in Rome, and even in Gaul, amidst the raging of persecution, attention was attracted to this remarkable movement. The desire for a sharper exercise of discipline, and a more decided renunciation of the world, combined with a craving for some plain indication of the Divine will in these last critical times, had prepared many minds for an eager acceptance of the tidings from Phrygia. And thus, within the large congregations where there was so much that was open to censure in doctrine and constitution and morals, conventicles were formed in order that Christians might prepare themselves by strict discipline for the day of the Lord.

Meanwhile in Phrygia and its neighbourhood—especially in Galatia, and also in Thrace—a controversy was raging between the adherents and the opponents of the new prophecy. Between 150 and 176 the authority of the episcopate had been immensely strengthened, and along with it a settled order had been introduced into the Churches. As a rule, the bishops were resolute enemies of the Montanistic enthusiasm. It disturbed the peace and order of the congregations, and threatened their safety. Moreover, it made demands on individual Christians such as very few could comply with. But the disputation which Bishops Zoticus of Cumana and Julian of Apamea arranged with Maximilla and her following turned out disastrously for its promoters. The "spirit" of Maximilla gained a signal victory, a certain Themiso in particular having reduced the bishops to silence. Sotas bishop of Anchialus attempted to refute Prisca, but with no better success (Eusebius, *Hist. eccl.* v. 19). These proceedings were never forgotten in Asia Minor, and the report of them spread far and wide. In after times the only way in which the discomfiture of the bishops could be explained was by asserting that they had been silenced by fraud or violence. This was the commencement of the excommunication or secession of the Montanists in Asia Minor. Not only did an extreme party arise in Asia Minor rejecting all prophecy and the Apocalypse of John along with it, but the majority of the Churches and bishops in that district appear (*c.* 178) to have broken off all fellowship with the new prophets, while books were written to show that the very form of the Montanistic prophecy was sufficient proof of its spuriousness.[2] In Gaul and Rome the prospects of Montanism seemed for a while more favourable. The confessors of the Gallican Church at Lyons were of opinion that communion ought to be maintained with the zealots of Asia and Phrygia; and they addressed a letter to this effect to the Roman bishop, Eleutherus. There was a momentary vacillation even in Rome. Nor is this to be wondered at. The events in Phrygia could not appear new and unprecedented to the Roman Church. If we may believe Tertullian, it was Praxeas of Asia Minor, the relentless foe of Montanism, who succeeded in persuading the Roman bishop to withhold his letters of conciliation.[3]

Early in the last decade of the 2nd century two considerable works[4] appeared in Asia Minor against the Kataphrygians. The first, by a bishop or presbyter whose name is not known, is addressed to Abircius bishop of Hierapolis, and was written in the fourteenth year after the death of Maximilla—*i.e.* apparently about the year 193. The other was written by a certain Apollonius forty years after the appearance of Montanus, consequently about 196. From these treatises we learn that the adherents of the new prophecy were very numerous in Phrygia, Asia and Galatia (Ancyra), that they had tried to defend themselves in writing from the charges brought against them (by Miltiades), that they possessed a fully developed independent organization, that they boasted of many martyrs, and that they were still formidable to the Church in Asia Minor. Many of the small congregations had gone completely over to Montanism, although in large towns, like Ephesus, the opposite party maintained the ascendancy. Every bond of intercourse was broken, and in the Catholic Churches the worst calumnies were retailed about the deceased prophets and the leaders of the societies they had founded. In many Churches outside of Asia Minor a different state of matters prevailed. Those who accepted the message of the new prophecy did not at once leave the Catholic Church in a body. They simply formed small conventicles within the Church. Such, for example, appears to have been the case in Carthage (if we may judge from the Acts of the martyrs Perpetua and Felicitas) at the commencement of the persecution of Septimius Severus about the year 202. But even here it was impossible that an open rupture should be indefinitely postponed. The bishops and their flocks gave offence to the spiritualists on so many points that at last it could be endured no longer. The latter wished for more fasting, the prohibition of second marriages, a frank, courageous profession of Christianity in daily life, and entire separation from the world; the bishops, on the other hand, sought to make it as easy as possible to be a Christian, lest they should lose the greater part of their congregations. And lastly, the bishops were compelled more and more to take the control of discipline into their own hands, while the spiritualists insisted that God Himself was the sole judge in the congregation. On this point especially a conflict was inevitable. It is true that there was no rivalry between the new organization and the old, as in Asia and Phrygia, for the Western Montanists recognized in its main features the Catholic organization as it had been developed in the contest with Gnosticism; but the demand that the "organs of the Spirit" should direct the whole discipline of the congregation contained implicitly a protest against the actual constitution of the Church. Even before this latent antagonism was made plain there were many minor matters which were sufficient to precipitate a rupture in particular congregations. In Carthage, for example, it would appear that the breach between the Catholic Church and the Montanistic conventicle was caused by a disagreement on the question whether or not virgins ought to be veiled. For nearly five years (202–207) the Carthaginian Montanists strove to remain within the Church, which was as dear to them as it was to their opponents. But at length they quitted it, and formed a congregation of their own.

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[1] Theodotus, "the first steward of the New Prophecy," was a fellow-worker with Montanus, and almost certainly a prophet. Later on, Firmilian, writing to Cyprian, mentions a prophetess who appeared in Cappadocia about A.D. 236, and Epiphanius (*Haer.* 49) tells of another called Quintilla.—(Ed.)

[2] Miltiades, *περὶ τοῦ μὴ δεῖν προφήτην ἐν ἐκστάσει λαλεῖν.* At the same time as Miltiades, if not earlier, Apollinaris of Hierapolis also wrote against the Montanists.

[3] It was Zephyrinus in A.D. 202 who took the decisive step of refusing to communicate with the Asiatic Montanists.—(Ed.)

[4] Quoted in Eusebius, *Hist. Eccl.* v. 16–18.

It was at this juncture that Tertullian, the most famous theologian of the West, left the Church whose cause he had so manfully upheld against pagans and heretics. He too had come to the conviction that the Church had forsaken the old paths and entered on a way that must lead to destruction. The writings of Tertullian afford the clearest demonstration that what is called Montanism was, at any rate in Africa, a reaction against secularism in the Church. There are other indications that Montanism in Carthage was a very different thing from the Montanism of Montanus. Western Montanism, at the beginning of the 3rd century, admitted the legitimacy of almost every point of the Catholic system. It allowed that the bishops were the successors of the apostles, that the Catholic rule of faith was a complete and authoritative exposition of Christianity, and that the New Testament was the supreme rule of the Christian life. Montanus himself and his first disciples had been in quite a different position. In his time there was no fixed, divinely instituted congregational organization, no canon of New Testament Scriptures, no anti-Gnostic theology, and no Catholic Church. There were simply certain communities of believers bound together by a common hope, and by a free organization, which might be modified to any required extent. When Montanus proposed to summon all true Christians to Pepuza, in order to live a holy life and prepare for the day of the Lord, there was nothing whatever to prevent the execution of his plan except the inertia and lukewarmness of Christendom. But this was not the case in the West at the beginning of the 3rd century. At Rome and Carthage, and in all other places where sincere Montanists were found, they were confronted by the imposing edifice of the Catholic Church, and they had neither the courage nor the inclination to undermine her sacred foundations. This explains how the later Montanism never attained a position of influence. In accepting, with slight reservations, the results of the development which the Church had undergone during the fifty years from 160 to 210 it reduced itself to the level of a sect. Tertullian exhausted the resources of dialectic in the endeavour to define and vindicate the relation of the spiritualists to the "psychic" Christians; but no one will say he has succeeded in clearing the Montanistic position of its fundamental inconsistency.

Of the later history of Montanism very little is known. But it is at least a significant fact that prophecy could not be resuscitated. Montanus, Prisca, and Maximilla were always recognized as the inspired authorities. At rare intervals a vision might perhaps be vouchsafed to some Montanistic old woman, or a brother might now and then have a dream that seemed to be of supernatural origin; but the overmastering power of religious enthusiasm was a thing of which the Montanists knew as little as the Catholics. Their discipline was attended with equally disappointing results. In place of an intense moral earnestness, we find in Tertullian a legal casuistry, a finical morality, from which no good could ever come. It was only in the land of its nativity that Montanism held its ground till the 4th century. It maintained itself there in a number of close communities, probably in places where no Catholic congregation had been formed; and to these the Novatians at a later period attached themselves. In Carthage there existed down to the year 400 a sect called Tertullianists; and in their survival we have a striking testimony to the influence of the great Carthaginian teacher. On doctrinal questions there was no real difference between the Catholics and the Montanists. The early Montanists (the prophets themselves) used expressions which seem to indicate a Monarchian conception of the person of Christ. After the close of the 2nd century we find two sections amongst the Western Montanists, just as amongst the Western Catholics—there were some who adopted the Logos-Christology, and others who remained Monarchians.[1]

SOURCES.—The materials for the history of Montanism, although plentiful, are fragmentary, and require a good deal of critical sifting. They may be divided into four groups: (1) The utterances of Montanus, Prisca and Maximilla [2] are our most important sources, but unfortunately they consist of only twenty-one short sayings. (2) The works written by Tertullian after he became a Montanist furnish the most copious information—not, however, about the first stages of the movement, but only about its later phase, after the Catholic Church was established. (3) The oldest polemical works of the 2nd century, extracts from which have been preserved, especially by Eusebius (*Hist. Eccles.* bk. v.), form the next group. These must be used with the utmost caution, because even the earliest orthodox writers give currency to many misconceptions and calumnies. (4) The later lists of heretics, and the casual notices of Church fathers from the 3rd to the 5th century, though not containing much that is of value, yet contain a little.[3]

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[1] It is evident that Montanism was by no means homogeneous. Too often the primitive "heresy of the Phrygians" has been studied in the light of the matured system of Tertullian. One great divergence is manifest: Tertullian never himself deviated from orthodoxy and vehemently asserts the orthodoxy of all Montanists, but both Montanus ("I am the Father and the Son and the Holy Ghost") and Maximilla ("I am Word and Spirit and Power") used language which has a distinctly "monarchian" flavour. There were really divided views on the question of the Divine Monarchy among the Montanists as among the Catholics. The orthodox party were known as the Cataproclans, the heterodox as Cataeschinites, and both appealed to the oracles of their prophets. Other influences tending to diversity were the rise of later prophets and visionaries, the personality of prominent members of the sect (like Tertullian himself, who gave to Montanism much more than he received from it), and the power of local environment. An examination of Phrygian as distinct from African Montanism leads to the following conclusions: (1) The Phrygians claimed to have received the prophetic gift by way of succession just as the bishops traced their office back to the apostles; Tertullian seems to ignore the intermediate steps between the apostles and Montanus; (2) the "ecstasy" of the African section was much more restrained than the ravings of the Phrygians; (3) the original Montanists followed the example of the Phrygian native cults in assigning a prominent place to women, Tertullian on the other hand (*De virg. vel.* 9) says, "It is not permitted to a woman to speak in church, nor yet to teach, nor to baptize, nor to offer, nor to assume any office which belongs to a man, least of all the priesthood;" (4) while both sections gave to prophets the power of absolution, the Phrygians extended it to martyrs also—at Carthage the Catholics did this contrary to the views of Tertullian. There is also good reason to doubt whether the Phrygian Montanists were anything like so ascetic and desirous of martyrdom as has been generally considered. Apollonius (Eusebius, *Hist. Eccl.* v. 16) accuses them of covetousness and tells us that Themiso purchased his freedom from imprisonment by a considerable payment. Sir William Ramsay has also shown that martyrdoms in Phrygia were rare during the end of the 2nd and the whole of the 3rd century, a spirit of religious compromise prevailing between the Christian and pagan populations (see a paper by H. J. Lawlor in the *Journal of Theological Studies* for July, 1908, vol. ix. 481).

[2] Collected by Munter and by Bonwetsch, *Geschichte des Montanismus*, p. 197.

[3] On the sources see Bonwetsch, pp. 16–55.

Literature.—Ritschl's investigations, referred to above, supersede the older works of Tillemont, Wernsdorf, Mosheim, Walch, Neander, Baur and A. Schwegler (*Der Montanismus und die christliche Kirche des 2ten Jahrhunderts*, Tübingen, 1841). The later works, of which the best and most exhaustive is that of N. Bonwetsch, *Die Geschichte des Montanismus* (1881), all follow the lines laid down by Ritschl. See also Gottwald, *De montanismo Tertulliani* (1862); Réville, "Tertullien et le montanisme" in the *Revue des deux mondes* (Nov. 1, 1864); Stroelin, *Essai sur le montanisme* (1870); De Soyres, *Montanism and the Primitive Church* (London, 1878); W. Cunningham, *The Churches of Asia* (London, 1880); Renan, "Les Crises du Catholicisme Naissant" in *Rev. d. deux mondes* (Feb. 15, 1881); H. Weinel, *Die Wirkungen des Geistes und der Geister im nachapostol. Zeitalter* (Freiburg, 1899); G. G. Selwyn, *The Christian Prophets* (London, 1900); Bonwetsch, art. "Montanismus" in Hauck-Herzog's *Realencyklopädie*. Special points of importance in the history of Montanism have been investigated by Lipsius, Overbeck, Weizsäcker (*Theol. Lit.-Zeitung*, Nov. 4, 1882), Harnack, *Das Mönchthum, seine Ideale und seine Geschichte*, 2nd ed., 1882; Eng. trans., 1901; and *Z. f. Kirchengesch.* iii. 369–408), and H. J. Lawlor. Weizsäcker's short essays are extremely valuable, and have elucidated several important points previously overlooked. (A. Ha.)

MONTARGIS, a town of central France, capital of an arrondissement in the department of Loiret, 47 m. E.N.E. of Orléans by rail. Pop. (1906), 11,038. The town is traversed by the Vernisson, by numerous arms of the Loing, and by the Briare canal, which unites with the canal of Orléans a little below it. It has a church (Ste Madeleine), dating in part from the 12th century and including a fine choir of Renaissance architecture, and still preserves portions of its once magnificent castle (12th to 15th centuries), which, previous to the erection of Fontainebleau, was a favourite residence of the royal family. A handsome modern building contains the town-hall, public library, and museum; in the courtyard is a bronze group, "The Dog of Montargis"; the town has a statue of Mirabeau, born in the neighbourhood. Montargis is the seat of a sub-prefecture, and has tribunals of first instance and of commerce and colleges for both sexes. It manufactures paper, gold chains, rubber, tar, asphalt, chemical manures, woodwork and leather. The town is an agricultural market, and its port has trade in coal, timber, sheep and farm produce.

Montargis was formerly the capital of the Gâtinais. Having passed in 1188 from the Courtenay family to Philip Augustus, it long formed part of the royal domain. In 1528 Francis I. gave it as dowry to Renée d'Este, daughter of Louis XII., the famous Huguenot princess; from her it passed to her daughter Anne, and through her to the dukes of Guise; it was repurchased for the Crown in 1612. From 1626 till the Revolution the territory was the property of the house of Orléans. Montargis was several times taken or attacked by the English in the 15th century, and is particularly noted for its successful defence in 1427. Both Charles VII. and Charles VIII. held court in the town; it was the latter who set the famous Dog of Montargis to fight a duel with his master's murderer whom he had tracked and captured.

MONTAUBAN, ARTHUR DE (d. 1479), French magistrate and prelate, belonged to one of the great families of Brittany. To satisfy a private grudge against Gilles, brother of Duke Francis II. of Brittany, he intrigued to such good purpose that Gilles was arraigned for treason, and finally assassinated in prison in 1450. When Montauban's duplicity was discovered he was deprived of his office of *bailli* of Cotentin and banished. He then turned monk, and through the support of his brother, John de Montauban (1412–1466), Louis XI.'s favourite, obtained the archbishopric of Bordeaux in 1468. He died in Paris on the 9th of March 1479.

MONTAUBAN, a town of south-western France, capital of Tarn-et-Garonne, 31 m. N. of Toulouse by the Southern railway. Pop. (1906), town, 16,813; commune, 28,688. The town, built mainly of a reddish brick, stands on the right bank of the Tarn at its confluence with the Tescou. Its fortifications have been replaced by boulevards beyond which extend numerous suburbs, while on the left bank of the Tarn is the suburb of Villebourbon, which is connected with the town by a remarkable bridge of the early 14th century. It is a brick structure over 200 yds. in length, and though its fortified towers have disappeared it is otherwise in good preservation. The hôtel de ville, on the site of a castle of the counts of Toulouse and once the residence of the bishops of Montauban, stands at the east end of the bridge. It belongs chiefly to the 17th century, but some portions are much older, notably an underground chamber known as the Hall of the Black Prince. Besides the municipal offices it contains a valuable library, and a museum with collections of antiquities and pictures. The latter comprise most of the work (including his "Jesus among the Doctors") of Jean Ingres, the celebrated painter, whose birth in Montauban is commemorated by an elaborate monument. The Place Nationale is a square of the 17th century, entered at each corner by gateways giving access to a large open space surrounded by houses carried on double rows of arcades. The prefecture, the law-courts and the remaining public buildings are modern. The chief churches of Montauban are the cathedral, remarkable only for the possession of the "Vow of Louis XIII.," one of the masterpieces of Ingres, and the church of St Jacques (14th and 15th centuries), the façade of which is surmounted by a handsome octagonal tower. Montauban is the seat of a bishop, a prefect and a court of assize. It has tribunals of first instance and of commerce, a chamber of commerce and a board of trade arbitration, lycées and a training college, schools of commerce and viticulture, a branch of the Bank of France, and a faculty of Protestant theology. The commercial importance of Montauban is due rather to its trade in agricultural produce, horses, game and poultry, than to its industries, which include nursery-gardening, cloth-weaving, cloth-dressing, flour-milling, wood-sawing, and the manufacture of furniture, silk-gauze and straw hats. The town is a junction of the railways of the Southern and Orléans companies, and communicates with the Garonne by the Canal of Montech.

With the exception of Mont-de-Marsan, Montauban is the oldest of the *bastides* of southern France. Its foundation dates from 1144 when Alphonse Jourdain, count of Toulouse, granted it a liberal charter. The inhabitants were drawn chiefly from Montauriol, a village which had grown up around the neighbouring monastery of St Théodard. In the 13th century the town suffered much from the ravages of the Albigensians and from the Inquisition, but by 1317 it had recovered sufficiently to be chosen by John XXII. as the head of a diocese of which the basilica of St Théodard became the cathedral. By the treaty of Brétigny (1360) it was ceded to the English; but in 1414 they were expelled by the inhabitants. In 1560 the bishops and magistrates embraced Protestantism, expelled the monks, and demolished the cathedral. About ten years later it became one of the Huguenot strongholds, and formed a small independent republic. It was the headquarters of the Huguenot rebellion of 1621, and was vainly besieged by Louis XIII. for eighty-six days; nor did it submit until after the fall of La Rochelle in 1629, when its fortifications were destroyed by Richelieu. In the same year the plague cut off over 6000 of its inhabitants. The Protestants again suffered persecution after the repeal of the Edict of Nantes.

MONTAUSIER, CHARLES DE SAINTE-MAURE, Duc de (1610–1690), French soldier, was born on the 6th of October 1610, being the second son of Léon de Sainte-Maure, baron de Montausier. His parents were Huguenots, and he was educated at the Protestant College of Sedan under Pierre du Moulin. He served brilliantly at the siege of Casale in 1630. Becoming marquis de Montausier by the death of his elder brother in 1635, he was the recognized aspirant for the hand of Mme de Rambouillet's daughter Julie Lucine d'Angennes (1607–1671). Having served under Bernard of Saxe-Weimar in Germany in 1634 he returned to the French service in 1636, and fought in the Rhenish campaigns of the following years. He was taken prisoner at Rantzau in November 1643, and only ransomed after ten months' captivity. On his return to France he became a lieutenant-general. On the 15th of July 1645 he married "the incomparable Julie," thus terminating a courtship famous in the annals of French literature because of the *Guirlande de Julie*, a garland of verse consisting of madrigals by Montausier, Jean Chapelain, Guillaume Colletet, Claude de

Malleville, Georges de Scudéry, Pierre Corneille (if M. Uzanne is correct in the attribution of the poems signed M.C.), Philippe Hubert, Simon Arnauld de Pomponne,[1] Jean Desmarests de Saint Sorlin, Antoine Gombaud (*le nain de la Princesse Julie*) and others. It was copied by the famous calligraphist N. Jarry in a magnificent MS., on each page of which was painted a flower, and was presented to Julie on her fête day in 1641. The MS. is now in possession of the Uzès family, to whom it passed by the marriage of Julie's daughter to Emmanuel de Crussol, duc d'Uzès.

Montausier had bought the governorship of Saintonge and Angoumois, and became a Roman Catholic before his marriage. During the Fronde he remained, in spite of personal grievances against Mazarin, faithful to the Crown. On the conclusion of peace in 1653 the marquis, who had been severely wounded in 1652, obtained high favour at court in spite of the roughness of his manners and the general austerity which made the Parisian public recognize him as the original of Alceste in the *Misanthrope*. Montausier received from Louis XIV. the order of the Saint Esprit, the government of Normandy, a dukedom, and in 1668 the office of governor of the dauphin, Louis. He initiated the series of classics *Ad usum Delphini*, directed by the learned Huet, and gave the closest attention to the education of his charge, who was only moved by his iron discipline to a hatred of learning. Court gossip assigned some part of Montausier's favour to the complaisance of his wife, who, appointed lady-in-waiting to the queen in 1664, favoured Louis XIV.'s passion for Louise de la Vallière, and subsequently protected Mme de Montespan, who found a refuge from her husband with her. He died on the 17th of November 1690.

See Père Nicolas Petit, *Vie du duc de Montausier* (1729); Puget de Saint Pierre, *Histoire du duc de Montausier* (1784); Amédée Roux, *Un Misanthrope à la cour de Louis XIV. Montausier* (1860); O. Uzanne, *La Guirlande de Julie* (1875); E. Fléchier, *Oraisons funèbres du duc et de la duchesse de Montausier* (Paris, 1691); and contemporary memoirs.

MONTBÉLIARD, a town of eastern France, capital of an arrondissement in the department of Doubs, 49 m. N.E. of Besançon on the Paris–Lyon line between that town and Belfort. Pop. (1906), town, 8723; commune, 10,455. Montbéliard is situated 1050 ft. above sea-level on the right bank of the Allaine at its junction with the Luzine (Lizaine or Lisaine). It is an important point in the frontier defences of France since 1871. Forts on outlying hills connect it with Belfort on the one side and (through Blamont and the Lomont fortifications) with Besançon on the other. The old castle of the counts of Montbéliard is now used as barracks; its most conspicuous features, the Tour Bossue and the Tour Neuve, date respectively from 1425 and 1594. Most of the inhabitants are Protestant, and the church of St Martin, built early in the 17th century, now serves as a Protestant place of worship. The old market-hall and some old houses of the 16th century also remain. A bronze statue of George Cuvier, the most illustrious native of Montbéliard, and several fountains adorn the town. Montbéliard is the seat of a sub-prefect and has a tribunal of first instance, a board of trade-arbitrators, a communal college, a practical school of industry, a chamber of arts and manufactures and a museum of natural history. Since 1870 a considerable impetus has been given to its prosperity by the Alsatian immigrants. Its industries include watch and clock making and dependent trades, cotton spinning and weaving, the manufacture of hosiery, textile machinery, tools, nails and wire, and brewing. There is commerce in wine, cheese, wood and Montbéliard cattle.

After belonging to the Burgundians and Franks, Montbéliard (*Mons Peligardi*) was, by the treaty of Verdun (843), added to Lorraine. In the 11th century it became the capital of a countship, which formed part of the second kingdom of Burgundy and latterly of the German Empire. Its German name is Mömpelgard. In 1397 it passed by marriage to the house of Württemberg, to whom it belonged till 1793. It resisted the attacks of Charles the Bold (1473), and Henry I. of Lorraine, (1587 and 1588), duke of Guise, but was taken in 1676 by Marshal Luxemburg, who razed its fortifications. The tolerance of the princes of Württemberg attracted to the town at the end of the 16th century a colony of Anabaptists from Frisia, and their descendants still form a separate community in the neighbourhood. In 1793 the inhabitants voluntarily submitted to annexation by France. In 1871 the battle of the Lisaine between the French and Germans was fought in the neighbourhood and partly within its walls.

MONTBRISON, a town of east-central France, capital of an arrondissement in the department of Loire, France, 21 m. N.W. of St Étienne, on the railway from Clermont to St Étienne. Pop. (1906), 6564. It is situated on a volcanic hill overlooking the Vizezy, a right-hand affluent of the Lignon du Nord. The principal buildings are the once collegiate church of Notre-Dame d'Espérance, founded about 1220 but not finished till the 15th century, and the 14th-century edifice known as the Salle de la Diana (Decana), which was restored by Viollet-le-Duc. There is a statue of the poet Victor de Laprade (d. 1883), a native of the town. Montbrison is the seat of a sub-prefect, of a court of assize and of a tribunal of first instance. There are liqueur-distilleries and flour-mills, and silk ribbons are manufactured; there is considerable commerce in grain.

Montbrison belonged to the counts of Forez during the middle ages. In 1801 it became the capital of its department in place of Feurs, but in 1856 the more important town of St. Étienne was substituted for it.

MONTBRUN, LOUIS PIERRE, Count (1770–1812), French cavalry general, served with great distinction in the cavalry arm throughout the wars of the Revolution and the Consulate, and in 1800 was appointed to command his regiment, having served therein from trooper upwards. At Austerlitz (Dec. 2, 1805) he was promoted general of brigade. He earned further distinction in Germany and Poland as a dashing leader of horse, and in 1808 he was sent into Spain. Here occurred an incident which unfavourably influenced his whole career. He found himself obliged to overstay his leave of absence in order to protect the lady who afterwards became his wife. Napoleon was furious, and deprived him of his command, and Montbrun was awaiting his master's decision when an opportunity came to retrieve his reputation. Some doubt exists as to the events of the famous cavalry charge at the Somosierra, but Montbrun's share in it was most conspicuous. Soon afterwards he was promoted to be general of division, and in 1809 his cavalry took no inconsiderable part in the victories of Eckmühl and Raab. He was employed in the Peninsula, 1810–1811. He was killed, when commanding a cavalry corps, at the beginning of the battle of Borodino (Sept. 7, 1812). Montbrun was considered, as a leader of heavy cavalry, second only to Kellermann of all the generals of the First Empire.

MONTCALM DE SAINT VÉRAN, LOUIS JOSEPH, Marquis de (1712–1759), French soldier, was born at Condiac near Nîmes on the 28th of February 1712,[2] and entered the army in 1721, becoming captain in 1727. He saw active service under Berwick on the Rhine in 1733, and in 1743, having become a colonel of infantry, he served in Bohemia under Maillebois, Broglie and Belleisle. He became intimate with François de Chevert (1695–1769), the gallant defender of Prague, and in Italy repeatedly distinguished himself, being promoted brigadier in 1747, shortly before the disastrous action of Exilles, in which he was severely wounded. In 1749 he received the colonelcy of a cavalry regiment, and in 1756, with the rank of *maréchal de camp*, he was sent to command the French troops in Canada. In the third year of his command, having been meanwhile promoted lieutenant-general, he defended Quebec (*q.v.*) against General Wolfe. The celebrated siege ended with the battle of the Heights of Abraham (Sept. 12, 1759), in which Wolfe was killed and Montcalm mortally wounded. The French commander died two days later, while the place, with which his name and Wolfe's are for ever associated, was still in the hands of the garrison.

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[1] (1618–1699), a son of Arnauld d'Andelly and minister of foreign affairs in succession to Lionne.

[2] A younger brother, Jean Louis Pierre (or Philippe) Elizabeth Montcalm de Condiac (1719–1726), was a child of astonishing precocity. At the age of four he read Latin; at six he understood Greek and Hebrew. It was for his benefit that the *bureau typographique*—a mechanism for teaching children reading, writing and arithmetic at the same time that it amused them—was contrived by their tutor Louis Dumas (1676–1744).

BIBLIOGRAPHY.—See CANADA: *History*; and SEVEN YEARS' WAR, also Parkman's *Montcalm and Wolfe*. The chief French authorities are Pinard, *Chronologie militaire*, v. 616 (1762); *Montcalm et le Canada français*, by F. Joubleau (Paris, 1874) and C. de Bonnechose (Paris, 1877); Le Moine, *La Mémoire de Montcalm vengée* (Montreal, 1889).

MONTCEAU-LES-MINES, a town of east-central France, in the department of Saône-et-Loire, 14 m. S. by W. of Le Creusot on the Paris-Lyon railway. Pop. (1906), town, 9701; commune, 26,305. Its importance is due chiefly to its position as the centre of the Blanzy coal basin, on the Canal du Centre, which, is connected with the coalfield by numerous lines of railway. Its manufacturing establishments include weaving and spinning factories, iron and copper foundries, and engineering workshops.

MONT CENIS, a pass (6893 ft.) in Savoy (France) which forms the limit between the Cottian and Graian Alps. A carriage road was built across it between 1803 and 1810 by Napoleon, while a light railway (named after its inventor, Mr. Fell, and worked by English engine-drivers) was opened alongside the road in 1868, but was destroyed in 1871, on the opening of the tunnel. This tunnel (highest point 4249 ft.) is really 17 m. west of the pass, below the Col de Fréjus. From Chambéry the line runs up the Isère valley, but soon bears through that of the Arc or the Maurienne past St Jean de Maurienne to Modane (61 m. from Chambéry). The tunnel is 8 m. in length, and leads to Bardonnèche, some way below which, at Oulx (18 m. from Modane) the line joins the road from the Mont Genèvre. Thence the valley of the Dora Riparia is followed to Turin (64½ m. from Modane). The carriage road mounts the Arc valley for 16 m. from Modane to Lanslebourg, whence it is 8 m. to the hospice, a little way beyond the summit of the pass. The descent lies through the Cenis valley to Susa (37 m. from Modane) where the road joins the railway. Tc the south-west of the Mont Cenis is the Little Mont Cenis (7166 ft.) which leads from the summit plateau (in Italy) of the main pass to the Étache valley on the French slope and so to Bramans in the Arc valley (7 m. above Modane). This pass was crossed in 1689 by the Vaudois, and by some authors is believed to have been "Hannibal's Pass." (W. A. B. C.)

MONTCHRÉTIEN, ANTOINE DE (1575 or 1576–1621), French dramatist and economist, son of an apothecary at Falaise named Mauchrestien, was born about 1576. In one of his numerous duels he had the misfortune to kill his opponent. He consequently took refuge in England, but through the influence of James I., to whom he dedicated his tragedy, *L'Écossaise*, he was allowed to return to France, and established himself at Auxonne-sur-Loire, where he set up a steel foundry. In 1621 he abandoned this enterprise to serve on the Huguenot side in the civil wars. He raised troops in Maine and Lower Normandy, but was killed in a skirmish near Tourailles on the 8th of October 1621. There is no evidence that he shared the religious opinions of the party for which he fought, and in any case he belonged to the moderate party rallied round Henry IV. In 1615 he published a valuable *Traité de l'économie politique*, based chiefly on the works of Jean Bodin. He had the good fortune to write before the pruning processes of Vaugelas and Balzac had been applied to the language, and M. Lanson praises him as one of the best prose-writers of his time.

His dramas are *Sophonisbe* (1596), afterwards remodelled as *La Cartaginoise*, *L'Écossaise*, *Les Lacènes*, *David*, *Aman* (in 1601); *Hector* (1604). As plays they have little technical merit, but they contain passages of great lyrical beauty. In *L'Écossaise* Elizabeth first pardons Mary Queen of Scots, and no explanation is given of the change that leads to her execution. *Aman* has been compared not too unfavourably with *Esther*, and the hatred of Haman for Mordecai is expressed with more vigour than in Racine's play. All Montchrétien's heroes face death without fear. M. Petit de Julleville finds the characteristic note of his plays in the same cult of heroism which was later to inspire the plays of Corneille. Poet, economist, ironmaster, and soldier, Montchrétien represents the many-sided activity of a time before literature had become a profession, and before its province had been restricted in France to polite topics.

The tragedies were edited in 1901 by M. Petit de Julleville with notice and commentary; the *Traité de l'économie politique* in 1889 by Th. Funck Brentano, whose estimate of Montchrétien is severely criticized by W. I. Ashley in the *Eng. Hist. Rev.* (Oct. 1891). See also Émile Faguet, *La Tragédie au XVI*^{me} *siècle*, ch. xi. (1883); G. Lanson, *Revue des deux mondes* (Sept. 1891).

MONTCLAIR, a town of Essex county, New Jersey, U.S.A., 5 m. N.N.W. of Newark. Pop. (1910 census) 21,550. It is served by the Erie and the Delaware, Lackawanna & Western railways, and by electric lines to Caldwell and Newark. It is situated at the base and on the slopes of the Orange Mountains (its altitude above the sea varying from 217 to about 665 ft.), has an irregular street plan, and is a residential suburb of New York and other neighbouring cities. Montclair has excellent public schools. Among the town's institutions are the Mountainside hospital, a state normal school (1908), Montclair academy (1887), a public library, and two orphan asylums. An annual Bach festival was first held here in June 1905. The lower part of Montclair was settled about 1675 and gradually became known as Cranetown, which name it retained until 1812. In that year Bloomfield, including Cranetown, was organized as a separate township. In 1868 Cranetown, then popularly known as West Bloomfield, with the addition of the Dutch-settled Speertown, was incorporated as Montclair. Montclair became a town in 1894.

See Henry Whittemore, *History of Montclair* (New York, 1894).

MONT-DE-MARSAN, a town of south-west France, capital of the department of Landes at the confluence of the Midou and the Douze, 92 m. S. of Bordeaux on the Southern railway between Morcenx and Tarbes. Pop. (1906), 9059. Most of the buildings are in the older quarter, on the peninsula between the two rivers forming the Midouze. La Pépinière, a beautiful public garden, extends along the right bank of the Douze. A keep of the 14th century, now used for military purposes, was built by Gaston Phoebus, count of Foix, to overawe the inhabitants, and goes by the name of Nou-li-Bos (in modern French "Tu ne l'y veux pas"). The finest of the modern buildings is an officers' club, which contains a small museum. A court of assizes sits in the town; the local institutions comprise a tribunal of first instance, a branch of the Bank of France, and a lycée. The industries include distillation of turpentine and resinous oils, tanning, the founding and forging of metal, wood-sawing, and manufactures of machinery and straw envelopes for bottles. There is trade in resin, wine, brandy, timber, cattle, horses and other live stock.

Mont-de-Marsan, the first of the Bastides (*q.v.*) of the middle ages, dates from 1141, when it was founded by Pierre, vicomte de Marsan, as the capital of his territory. In the 13th century it passed to the viscounts of Béarn, but the harsh rule of Gaston Phoebus and some of his successors induced the people to favour the English. The territory was united to the French Crown on the accession of Henry IV.

MONTDIDIER, a town of northern France, capital of an arrondissement in the department of Somme, 23 m. S.E. of Amiens by rail. Pop. (1906), 4159. The town, situated on an eminence on the right bank of the Don, dates from the Merovingian period, and perhaps owes its name to the imprisonment of the Lombard king Didier in the 8th century. The church of St Pierre, dating chiefly from the 15th century, has a beautiful portal of the 16th century and contains the tomb of Raoul III., count of Crépy (12th century), fonts of the 11th century and other works of art. The church of St Sépulcre belongs, with the exception of the modern portal, to the 15th and 16th centuries. In the interior there is a well-known "Holy Sepulchre" of the latter period. The law-court, once the castle, partly dating from the 12th century, possesses fine tapestries of the 17th century. A statue commemorates the birth at Montdidier of Antoine Parmentier (1737–1813), with whose name are connected the beginnings of potato-culture in France. The town has a sub-prefecture and a tribunal of first instance; its industries include tanning and the manufacture of zinc-white.

Held first by its own lords, afterwards by the counts of Crépy and Valois, Montdidier passed to the Crown in the 12th century, at the end of which it was granted a charter of liberties. The town offered a brave and successful resistance to the Spanish troops in 1636.

MONT-DORE-LES-BAINS, a watering-place of central France in the department of Puy-de-Dôme, situated at a height of 3440 ft., on the right bank of the Dordogne not far from its source, and 31 m. by road S.W. of Clermont-Ferrand. Pop. (1906), 1677. The Monts Dore close the valley towards the south. The thermal springs of Mont Dore, now numbering twelve, were known to the Romans. Bicarbonate of soda, iron and arsenic are the principal ingredients of the waters, which are used both for drinking and bathing, baths of high temperature being characteristic of the treatment; they are efficacious in cases of pulmonary consumption, bronchitis, asthma, and nervous and rheumatic paralysis. From the elevation and exposure of the valley, the climate of Mont-Dore-les-Bains is severe, and the season only lasts from the 15th of June to the 15th of September. The bath-house was rebuilt in 1891–1894. In the "park," along the Dordogne, relics from the old Roman baths have been collected. The surrounding country, with its fir woods, pastures, waterfalls and mountains, is very attractive. To the south is the Puy de Sancy (6188 ft.), the loftiest peak of central France.

MONTEAGLE, THOMAS SPRING-RICE, 1st Baron (1790–1866), English statesman, son of S. E. Rice and Catherine Spring, came of a Limerick family, whose ancestor was Sir Stephen Rice (1637–1715), chief baron of the Irish exchequer and a leading Jacobite. In 1820 he became Whig member for Limerick (from 1832 member for Cambridge); and after holding minor offices became secretary for war and the colonies in 1834 and in 1835–1839 chancellor of the exchequer. He was disappointed in not obtaining the speakership, but in 1839 was created Baron Monteagle of Brandon (a title intended earlier for his ancestor Sir Stephen Rice), and made controller of the exchequer. He differed from the government as regards the exchequer control over the treasury, and the abolition of the old exchequer (*q.v.*) was already determined upon when he died on the 7th of February 1866. His eldest son, Stephen Edmund Spring-Rice (1814–1865), deputy chairman of the board of customs, having predeceased him, he was succeeded in the title by his grandson, Thomas, 2nd baron (b. 1849). Another son was father of S. E. Spring-Rice (1856–1902), of the treasury, and of Sir Cecil A. Spring-Rice (b. 1859), the diplomatist.

MONTEAGLE, WILLIAM PARKER, 4th Baron, and 11th Baron Morley (1575–1622), was the eldest son of Edward Parker, 10th Baron Morley (d. 1618), and of Elizabeth, daughter and heiress of William Stanley, 3rd Baron Monteagle (d. 1581). When quite a youth he married Elizabeth, daughter of Sir Thomas Tresham, and was styled Lord Monteagle in right of his mother. He was allied with many Roman Catholic families, and during the reign of Elizabeth was in sympathy with their cause. He received knighthood when with Essex in Ireland in 1599, and in 1601 took part in the latter's rebellion in London, when he was punished by imprisonment and a fine of £8000. He subsequently in 1602 joined in sending the mission to Spain inviting Philip III. to invade England. He was intimate with Catesby and others, and according to Father Garnet expressed an opinion some few months before gunpowder plot that the Romanists had a good opportunity of making good their claims by taking up arms against the king. It is certain that he was one of those who acquiesced in James I.'s accession and assisted Southampton in securing the Tower for the king. He was taken into favour, and received a summons to attend the parliament of the 5th of November 1605 as Lord Monteagle. On the 26th of October 1605, while sitting at supper at Hoxton, he received the celebrated letter giving warning of the gunpowder plot, probably written by Francis Tresham. After having caused it to be read aloud by Ward, a gentleman in his service and an intimate friend of Winter, one of the chief conspirators, he took it to Whitehall and showed it to Lord Salisbury and other ministers. On the 4th of November he accompanied Lord Suffolk, the lord chamberlain, in his visit to the vault under the parliament house, where Guy Fawkes was found. Monteagle received £700 a year for his services in averting the disaster. In 1609 he was chosen a member of the council of the Virginia Company and subscribed to its funds. The same year "disorders in his house" are reported, probably referring to his harbouring of Roman Catholic students from St Omer (*Cal. of St Pap: Dom:* 1603–1610, p. 533). In 1618, on the death of his father, he was summoned to parliament as Baron Morley and Monteagle. He died on the 1st of July 1622 at Great Hallingbury, Essex, where he was buried. By his marriage with Elizabeth Tresham he had, besides daughters, three sons, the eldest of whom, Henry, (d. 1655) succeeded him as 12th Baron Morley and 5th Baron Monteagle. These baronies fell into abeyance when Henry's son Thomas died about 1686.

MONTE CASSINO, an isolated hill overhanging the town of Cassinum, about midway between Rome and Naples. Hither St Benedict migrated from Subiaco in the early years of the 6th century, and established the monastery that became the metropolis of Western monachism. About 580–590 it was sacked by the Lombards, and the monks fled to Rome, where they were established at the Lateran basilica. The monastery was rebuilt in 720, again destroyed by the Saracens in 884, and restored seventy years later. It reached its highest point of prosperity and influence from 1059 to 1105, under Desiderius (who became Pope Victor III. in 1087) and Oderisius. The abbot became overlord of an extensive territory and bishop of several dioceses: now, though not a bishop, he is ordinary of seven dioceses. At the dissolution of monasteries in 1866 Monte Cassino was spared, owing mainly to a remonstrance by English well-wishers of United Italy. The monastery became a national monument and the monks were recognized as custodians. There is a large secondary school with 250 boys, and rich archives.

See L. Tosti, *Storia della badia di M.C.* (1841; 2nd ed., 1888); Wetzer u. Welte, *Kirchenlexicon* (2nd ed.) and Herzog, *Realencyklopädie* (3rd ed.). (E. C. B.)

MONTECATINI, two much-frequented mineral baths of Tuscany, Italy. (1) Montecatini in Val di Cecina, in the province of Pisa, 5 m. W. of Volterra. Pop. (1901), 5009. The water is saline, with a temperature of 78·8° F. There are copper mines, which have been worked since the 15th century, 1358 ft. above sea-level. (2) Montecatini in Val di Nievole, in the province of Lucca, 7 m. W. by S. of Pistoja, 105 ft. above sea-level. Pop. (1901), 3048 (Bagni di Montecatini); 2856 (Montecatini). The springs, which number ten, are saline, and range in temperature from 82·4° to 86° F. The water is both drunk and used for bathing by some 40,000 visitors annually, and is exported in bottles. There is also a natural vapour bath (80°–95° F.) in the Grotta Giusti (so-called from the satirist Giuseppe Giusti, a native of the place), at Monsummano near by, discovered in 1849. Another attraction of the place is the gardens of Collodi. At the town of Montecatini, on the hill above (951 ft.), the Florentines were defeated by Uguccione della Faggiuola of Pisa in 1315.

MONTE CORVINO, GIOVANNI DI (*c.* 1247–1328), Franciscan missionary, traveller and statesman, founder of the earliest Roman Catholic missions in India and China, and archbishop of Peking. In 1272 he was commissioned by the emperor Michael Palaeologus, to Pope Gregory X., to negotiate for the reunion of Greek and Latin churches. From 1275 to 1289 he laboured incessantly as a missionary in the Nearer and Middle East. In 1289 he revisited the Papal Court, and was sent out as Roman legate to the Great Khan, the Ilkhan of Persia, and other leading personages of the Mongol world, as well as to the "emperor of Ethiopia" or Abyssinian Negus. Arriving at Tabriz, then the chief city of Mongol Persia, and indeed of all Western Asia, Monte Corvino moved down to India to the Madras region or "Country of St Thomas," from which he wrote home, in December 1291 (or 1292), the earliest noteworthy account of the Coromandel coast furnished by any Western European. He next appears in "Cambaliech" or Peking, and wrote letters (of Jan. 8, 1305, and Feb. 13, 1306), describing the progress of the Roman mission in the Far East, in spite of Nestorian opposition; alluding to the Roman Catholic community he had founded in India, and to an appeal he had received to preach in "Ethiopia" and dealing with overland and oversea routes to "Cathay," from the Black Sea and the Persian Gulf respectively. In 1303 he received his first colleague, the Franciscan Arnold of Cologne; in 1307 Pope Clement V. created him archbishop of Peking, and despatched seven bishops to consecrate and assist him; three only of these arrived (1308). Three more suffragans were sent out in 1312, of whom one at least reached East Asia. A Franciscan tradition maintains that about 1310 Monte Corvino converted the Great Khan (*i.e.* Khaishan Kuluk, third of the Yuen dynasty; 1307–1311): this has been disputed, but he unquestionably won remarkable successes in North and East China. Besides three mission stations in Peking, he established one near the present Amoy harbour, opposite Formosa. At his death, about 1328, heathen vied with Christian in honouring him. He was apparently the only effective European bishop in the Peking of the middle ages.

The MSS. of Monte Corvino's *Letters* exist in the Laurentian Library, Florence (for the Indian Epistle) and in the National Library, Paris, 5006 Lat.—viz. the *Liber de aetatibus*, fols. 170, v.-172, *r.* (for the Chinese). They are printed in Wadding, *Annales minorum* (A.D. 1305 and 1306) vi. 69–72, 91–92 (ed. of 1733, &c.), and in the *Münchner gelehrte Anzeigen* (1855), No. 22, part iii. pp. 171–175. English translations, with valuable comments, are in Sir H. Yule's *Cathay*, i. 197–221. See also Wadding, *Annales*, v. 195–198, 199–203, vi. 93, &c., 147, &c., 176, &c., 467, &c.; C. R. Beazley, *Dawn of Modern Geography*, iii. 162–178, 206–210; Sir H. Yule, *Cathay*, i. 165–173. (C. R. B.)

MONTECRISTO, (anc. Oglasa), an island of Italy, belonging to the province of Leghorn, 25 m. S. of Elba. Its highest point is 2126 ft. above sea-level, and its area about 6 sq. m. It contains the ruins of a Camaldulensian monastery, founded in the 13th century and destroyed in the 16th, and is the private property of the king of Italy, who has a shooting-lodge there. The fame of the island is due to the novel, *Le Comte de Montecristo*, by the elder Dumas.

MONTECUCCULI (MONTECUCCOLI), **RAIMONDO,** COUNT OF (1609–1680), prince of the holy Roman Empire and Neapolitan duke of Melfi, Austrian general, was born on the 21st of February 1608/9, at the castle of Montecucculo in Modena. His family was of Burgundian origin and had settled in north Italy in the 10th century. At the age of sixteen Montecucculi began as a private soldier under his uncle, Count Ernest Montecucculi, a distinguished Austrian general (d. 1633). Four years later, after much active service in Germany and the Low Countries, he became a captain of infantry. He was severely wounded at the storming of New Brandenburg, and again in the same year (1631) at the first battle of Breitenfeld, where he fell into the hands of the Swedes. He was again wounded at Lützen in 1632, and on his recovery was made a major in his uncle's regiment. Shortly afterwards he became a lieutenant-colonel of cavalry. He did good service at the first battle of Nördlingen (1634), and at the storming of Kaiserslautern in the following year won his colonelcy by a feat of arms of unusual brilliance, a charge through the breach at the head of his heavy cavalry. He fought in Pomerania, Bohemia and Saxony (surprise of Wolmirstädt, battles of Wittstock and Chemnitz), and in 1639 he was taken prisoner at Melnik and detained for two and a half years in Stettin and Weimar. In captivity he studied, not only military science, but also geometry in Euclid, history in Tacitus, and architecture in Vitruvius, and planned his great work on war. On his release he distinguished himself again in Silesia. In 1643 he went to Italy, by the emperor's request, and made a successful campaign in Lombardy. On his return to Germany he was promoted lieutenant-field-marshal and obtained a seat in the council of war. In 1645–46 he served in Hungary against Prince Rakoczy of Transylvania, on the Danube and Neckar against the French, and in Silesia and Bohemia against the Swedes. The victory of Triebel in Silesia won him the rank of general of cavalry, and at the battle of Zusmarshausen in 1648 his stubborn rearguard fighting rescued the imperialists from annihilation. For some years after the peace of Westphalia Montecucculi was chiefly concerned with the business of the council of war, though he went to Flanders and England as the representative of the emperor, and to Sweden as the envoy of the pope to Queen Christina, and at Modena his lance was victorious in a great tourney. In 1657, soon after his marriage with Countess Margarethe Dietrichstein, he took part in, and after a time commanded, an expedition against Rakoczy and the Swedes who had attacked the king of Poland. He became field-marshal in the imperial army, and with the Great Elector of Brandenburg completely defeated Rakoczy and his allies (peace of Oliva, 1660). From 1661 to 1664 Montecucculi with inferior numbers defended Austria against the Turks; but at St Gotthard Abbey, on the Raab, he defeated the Turks so completely that they made a truce for twenty years (Aug. 1, 1664). He was given the Golden Fleece, and became president of the council of war and director of artillery. He also devoted much time to the compilation of his various works on military history and science. He opposed the progress of the French arms under Louis XIV., and when the inevitable war broke out received command of the imperial forces. In the campaign of 1673 he completely out-manœuvred his great rival Turenne on the Neckar and the Rhine, and secured the capture of Bonn and the junction of his own army with that of the prince of Orange on the lower Rhine. He retired from the army when, in 1674, the Great Elector was appointed to command in chief, but the brilliant successes of Turenne in the winter of 1674 and 1675 brought him back. For months the two famous commanders manœuvred against each other in the Rhine valley, but on the eve of a decisive battle Turenne was killed and Montecucculi promptly invaded Alsace, where he engaged in a war of manœuvre with the great Condé. The siege of Philipsburg was Montecucculi's last achievement in war. The rest of his life was spent in military administration and literary and scientific work at Vienna. In 1679 the emperor made him a prince of the empire, and shortly afterwards he received the dukedom of Melfi from the king of Naples. Montecucculi died at Linz on the 16th of October 1680, as the result of an accident. With the death of his only son in 1698 the principality became extinct, but the title of count descended through his daughters to two branches, Austrian and Modenese. As a general, Montecucculi shared with Turenne and Condé the first place amongst European soldiers of his time. His *Memorie della guerra* profoundly influenced the age which followed his own; nor have modern conditions rendered the advice of Montecucculi wholly valueless.

AUTHORITIES.—The *Memorie della guerra*, &c., was published at Venice in 1703 and at Cologne in the following year. A Latin edition appeared in 1718 at Vienna, a French version at Paris in 1712, and the German *Kriegsnachrichten des Fürsten Raymundi Montecuccoli* at Leipzig in 1736. Of this work there are MSS. in various libraries, and many memoirs on military history, tactics, fortification, &c., written in Italian, Latin and German, remain still unedited in the archives of Vienna. The collected *Opere di Raimondo Montecuccoli* were published at Milan (1807), Turin (1821) and Venice (1840), and include political essays and poetry.

See Campori, *Raimondo Montecuccoli* (Florence, 1876); Spenholtz, *Aureum vellus seu catena*, &c. (Vienna, 1668); memoir prefaced to the *Memorie* (Cologne edition); this appears also in v. der Groeben's *Neuer Kriegsbibliothek*, vi. 230 (Breslau, 1777); Morgenstern, *Oesterreichs Helden* (St Pölten, 1782); Schweigerd, *Oesterreichs Helden* (Vienna, 1853); Paradisi, *Elogio storico del conte Raimondo Montecucculi* (Modena, 1776); Schels, *Oesterreichische militärische Zeitschrift* (Vienna, 1818, 1828 and 1842); Pezzl, *Lebensbeschreibung Montecucculis* (Vienna, 1792); Hormayr, *Oesterreichischer Plutarch*, XIII. (Vienna, 1808); Reilly, *Biographie der berühmtesten Feldherrn Oesterreichs* (Vienna, 1813); Würzbach, *Biographisches Lexikon des Kaiserthums*, &c., pt. 19 (Vienna, 1868); Teuffenbach, *Vaterländisches Ehrenbuch* (Vienna and Teschen, 1877); *Die Hofkriegsraths, präsidenten* (Vienna, 1874); Weingärtner, *Heldenbuch* (Teschen, 1882); Grossmann, *Archiv für öst. Geschichte* (Vienna, 1878); also supplement to *Militär. Wochenblatt* (Berlin, 1878); *Organ des militärwissenschaftl. Vereins* (Vienna, 1881); *Reale instituto veneto di scienze*, viii. 5, 6 (Venice, 1881); *Rivista militare Italiana* (March and April 1882); *Allgemeine deutsche Biographie*, vol. xxii. (Leipzig, 1885). Important controversial works are those of Turpin and Warnery, two distinguished soldiers of the 18th century (*Commentaires sur les mémoires*, &c. (Paris), 1769, and *Commentaires sur les comm. . . . du comte Turpin*, Breslau, 1777). A critical estimate of Montecuculi's works will be found in Jähns *Gesch. der Kriegswissenschaften*, ii. 1162–1178 (Leipzig, 1890).

MONTEFALCO, a town of the province of Perugia, Italy, 6 m. S.W. of Foligno, situated on a hill, 1550 ft. above sea-level. Pop. (1901), 3397 (town); 5726 (commune). Its churches contain a number of pictures of the Umbrian school; S. Francesco has good frescoes (scenes from the life of S. Francis) of 1452, by Benozzo Gozzoli, in the choir. There is also a communal picture-gallery in the picturesque Palezzo Comunale.

MONTEFIASCONE, a town and episcopal see of the province of Rome, Italy, built on a hill (2077 ft.) on the S.E. side of the Lake of Bolsena, 70 m. by rail N.W. of Rome. Pop. (1901), 3041 (town); 9731 (commune). The cathedral (1519) is one of the earliest structures by Sammicheli, S. Maria della Grazie is also by him. The town has in San Flaviano (built in 1032, repaired and enlarged in the Gothic style late in the 14th century), a curious double church of importance in the history of architecture (cf. G. T. Rivoira, *Origini dell' architettura lombarda*, i. 326 sqq.); in its interior some 14th-century frescoes were discovered in 1896. In the crypt is the grave of a traveller, who succumbed to excessive drinking of the local wine known as Est, est, est. The story is that his valet who preceded him wrote "est" on the doors of all the inns where good wine was to be had, and that here the inscription was thrice repeated. It is possible that Montefiascone occupies the site of the Fanum Voltumnae, at which the representatives of the twelve chief cities of Etruria met in the days of their independence: while under the Empire the festival was held near Volsinii.

MONTEFIORE, SIR MOSES HAIM (1784–1885), Jewish philanthropist, eldest son of Joseph Elias Montefiore, a London merchant, and of Rachel, daughter of Abraham Lumbroso de Mattos Mocatta, was born at Leghorn, on the 24th of October 1784. His paternal ancestors were Jewish merchants who settled at Ancona and Leghorn in the 17th century, whilst his grandfather, Moses Haim Montefiore, emigrated from the latter town to London in 1758. Montefiore entered the Stock Exchange, his uncle purchasing for him at a cost of £1200 the right to practise as one of the twelve Jewish brokers licensed by the city of London. Although belonging to the Sephardic or "Spanish" congregation of Jews, he married in 1812 Judith, a daughter of Levi Barent Cohen, of the "German" Jews, another of whose daughters was the wife of Nathan Mayer Rothschild, the head of the great banking firm; this relationship led to a close connexion in business between Montefiore and that house, and his brother Abraham married Henrietta Rothschild, a sister of the financier. In 1824 Montefiore, having amassed a fortune, retired from the Stock Exchange. From his forty-third year Montefiore devoted all his energies to ameliorating the lot of his co-religionists. His first pilgrimage to Palestine was undertaken in 1827, and resulted in a friendship with Mehemet Ali which was to lead to much practical good. Immediately on his return, Montefiore began to take an active part in the struggle which British Jews were then carrying on to obtain full political and civic rights. In 1837 he became the city of London's second Jewish sheriff, and was knighted. In 1838, accompanied by Lady Montefiore, he started on a second voyage to Palestine, in order to submit to Mehemet Ali a scheme for Jewish colonization in Syria. Though political disturbances rendered his efforts again unsuccessful, the year 1840 brought Montefiore once more before Mehemet, this time to plead the cause of some Jews imprisoned at Damascus on a charge of ritual murder. He obtained their release, and on his way back wrung from the Porte a decree giving Jews throughout Turkey the utmost privileges accorded to aliens. In 1846 the threatened re-issue in Russia of an Imperial ukase (first promulgated in 1844) ordering the withdrawal of all Jews from within 50 versts of the German and Austrian frontiers, caused Montefiore to proceed to St Petersburg, where in an interview with the tsar he succeeded in getting the ukase rescinded. On his return, Queen Victoria, on the recommendation of Sir Robert Peel, made him a baronet. In 1859 a case of injustice which attracted the attention of all Europe brought Sir Moses to the gates of the Vatican. A Jewish child named Mortara had been secretly baptized by its nurse and stolen from its mother, who died of grief. Cardinal Antonelli, in the name of the pope, refused to give up the boy, who became a priest. In 1863 we find Montefiore on a mission in Constantinople to obtain from the Sultan, Abdul Aziz, the confirmation of his predecessor's decrees in favour of the Jews; in 1864 in Morocco to combat an outbreak of anti-Semitism; in 1866 in Syria, relieving the distress resulting from a plague of locusts and an epidemic of cholera; and in 1867 in Rumania, once more pleading the cause of the oppressed Jews with Prince Charles. In 1872 Montefiore was deputed by the British Jews to present to Alexander II. their congratulations on the bicentenary of the birth of Peter the Great, and was received by the tsar with great honour at the Winter Palace. His seventh and last pilgrimage to the Holy Land was made in 1875, of which he wrote an account in his *Narrative of a Forty Days' Sojourn in the Holy Land*, published in that year. The last decade of his life was passed in comparative quiet upon his estate near Ramsgate, in Kent; and there, after having received general congratulations on the completion of his hundredth year, he passed peacefully away on the 28th of July 1885. Sir Moses Montefiore was a strictly orthodox Jew, scrupulously observant of both the spirit and the letter of the Scriptures; in his grounds he had a synagogue built where services are still held twice a day, a college where ten rabbis live and expound the Jewish law, and a mausoleum that contains the remains of himself and of Lady Montefiore, who died in 1862.

MONTEFRIO, a town of southern Spain, in the province of Granada, on the river Bilano. Pop. (1900), 10,725. Montefrio is largely Moorish in character, and dominated by a Moorish castle. Being built midway between the Sierra de Priego and Sierra Parapanda, and commanding the open valley between these ranges, it became one of the chief frontier fortresses of the Moors in the 15th century. Its industries include manufactures of cotton stuffs, alcohol and soap.

MONTÉGUT, JEAN BAPTISTE JOSEPH ÉMILE (1825–1895), French critic, was born at Limoges on the 14th of June 1825. He began to write for the *Revue des deux mondes* in 1847, contributing between 1851 and 1857 a series of articles on the English and American novel, and in 1857 he became chief literary critic of the review. Émile Montégut translated *Essais de philosophie américaine* (1850) from Emerson; *Révolution de 1688* (2 vols. 1853) from Macaulay's *History*; and also produced the *Œuvres complètes* (10 vols. 1868–1873) of Shakespeare. Among his numerous critical works are *Écrivains modernes d'Angleterre* (3rd series, 1885–1892) and *Heures de lecture d'un critique* (1891), studies of John Aubrey, Pope, Wilkie Collins and Sir John Mandeville. Montégut died in Paris on the 11th of December 1895.

MONTEIL, AMANS ALEXIS (1769–1850), French historian, was born at Rodez in 1769, and died at Cely (Seine-et-Marne) in 1850. His tastes were historical, and he taught history at Rodez, at Fontainebleau and at St Cyr. He held that a disproportionate importance had been given to kings, their ministers and generals, and that it was necessary rather to study the people. In his *Histoire des français des divers états, ou histoire de France aux cinq derniers siècles* (10 vols., 1828–1844) he undertook to describe the different classes and occupations of the community. For this he made a collection of manuscripts, which he sold in 1835 (many of them passed into the library of Sir Thomas Philipps), drawing up a catalogue under the singular title of *Traité de matériaux manuscrits de divers genres d'histoire*. He boasted of having been the first to write really "national" history, and he wished further to show this in a memoir entitled *L'Influence de l'histoire des divers états, ou comment fût allée la France si elle eût eu cette histoire* (1840; reprinted in 1841 under the title: *Les Français pour la première fois dans l'histoire de France, ou poëtique de l'histoire des divers états*). Monteil did not invent the history of civilization, but he was one of the first in France, and perhaps in Europe, to point out its extreme importance. He revised the third edition of his history himself (5 vols., 1848); a fourth appeared after his death with a preface by Jules Janin (5 vols., 1853).

MONTEITH, the name given to a large bowl, often made of silver, with a movable rim and scalloped edges, from which wine glasses, punch ladle, &c., could be hung, so that they might be cooled in the water with which it was filled. According to Anthony Wood (*Life and Times*, iii. 84, quoted in the *New English Dictionary*) the name was given to the bowl from a "fantastical Scot . . . Monsieur Monteigh who . . . wore the bottome of his cloake or coate so notched," *i.e.* scalloped.

MONTELEONE CALABRO, a city of Calabria, Italy, in the province of Catanzaro, beautifully situated on an eminence gently sloping towards the Gulf of Sta Eufemia, 1575 ft. above sea-level, 70 m. N.N.E. of Reggio di Calabria by rail. Pop. (1901), 10,066 (town); 13,481 (commune). It was almost totally destroyed by earthquake in 1783, but under the French occupation it was rebuilt and made the capital of a province. It suffered, however, considerably in the earthquake of 1905. The castle was built by Frederick II. The principal church contains some sculptures by the Gagini of Palermo.

Monteleone is identical with the ancient Hipponium, said to be a Locrian colony and first mentioned in 388 B.C., when its inhabitants were removed to Syracuse by Dionysius. Restored by the Carthaginians (379), occupied by the Bruttii (356), held for a time by Agathocles of Syracuse (294), and afterwards again occupied by the Bruttii, Hipponium ultimately became as Vibo Valentia a flourishing Roman colony, founded in 239 or 192 B.C. It was important as the point where a branch from Scolacium (Squillace) on the east coast road joined the Via Popillia. The harbour established by Agathocles proved of great service as a naval station to Caesar and Octavian in their wars with Pompeius Magnus and Sextus Pompeius, and remains of its massive masonry still exist at the village of Bivona on the coast, while the fort occupies the site of a temple. Its tunny-fish were famous. In the town itself there are remains of a theatre, of Roman baths (?), a mosaic pavement in the church of St Leoluca (patron saint of Monteleone), and some Latin inscriptions. The town walls too of the Greek city can be traced for their whole extent, about 4 m. They are well constructed of regular parallelograms of a sandy tufa, laid in headers and stretchers. The Roman town occupied only a part of the Greek site, the portion occupied by the modern town, the streets of which still preserve the Roman arrangement. It was supplied with water by an aqueduct, the reservoir of which is situated at the village of Papaglionti. The Capialbi and Cordopatri families have private collections of antiquities.

See V. Capialbi in *Mem. Inst.* (Rome, 1832), pp. 159 sqq.; F. Lenormant, *La Grande-Grèce* (Paris, 1882), iii. 155 sqq. (T. As.)

MONTÉLIMAR, a town of south-eastern France, capital of an arrondissement in the department of Drôme, near the left bank of the Rhone, 93 m. S. of Lyons on the railway to Marseilles. Pop. (1906), town, 9162; commune, 13,554. The ancient castle is now used as a prison. Remains of the ramparts and four old gates are also preserved. The chief public institutions are the sub-prefecture, the tribunal of first instance and the communal college. The industries include flour-milling, silk-throwing and spinning, and the manufacture of hats, lime, farming implements, preserved foods and nougat.

Montélimar was called by the Romans *Acunum.* At a later period it belonged to the family of Adhémar and received the name Monteil d'Adhémar, whence the present name. Towards the middle of the 14th century it was sold by them partly to the dauphins of Viennois and partly to the pope, and in the next century it came into the possession of the Crown. During the religious wars it valiantly resisted Gaspard de Coligny in 1570, but was taken by the Huguenots in 1587.

MONTEMAYOR (or MONTEMÔR), **JORGE** (1520?–1561), Spanish novelist and poet, of Portuguese descent, was born about 1520 at Montemôr o Velho (near Coimbra), whence he derived his name, the Spanish form of which is Montemayor. He seems to have studied music in his youth, and to have gone to Spain in 1543 as chorister in the suite of the Portuguese Infanta Maria, first wife of Philip II. In 1552 he went back to Portugal in the suite of the Infanta Juana, wife of D. João, and on the death of this prince in 1554 returned to Spain. He is said to have served in the army, to have accompanied Philip II. to England in 1555, and to have travelled in Italy and the Low Countries; but it is certain that his poetical works were published at Antwerp in 1554, and again in 1558. His reputation is based on a prose work, the *Diana*, a pastoral romance published about 1559. Shortly afterwards Montemayor was killed in Piedmont, apparently in a love affair; a late edition of the *Diana* gives the exact date of his death as the 26th of February 1561. The *Diana* is generally stated to have been printed at Valencia in 1542; but, as the *Canto de Orfeo* refers to the widowhood of the Infanta Juana in 1554, the book must be of later date. It is important as the first pastoral novel published in Spain; as the starting-point of a universal literary fashion; and as the indirect source, through the translation included in Googe's *Eglogs, epytaphes and sonnets* (1563), of an episode in the *Two Gentlemen of Verona.* Though Portuguese was Montemayor's native language, he only used it for two songs and a short prose passage in the sixth book of the *Diana.* His mastery of Spanish is amazing, and even Cervantes, who judges the verses in the *Diana* with unaccustomed severity, recognizes the remarkable merit of Montemayor's prose style. That he pleased his own generation is proved by the seventeen editions and two continuations of the *Diana* published in the 16th century, by parodies, imitations and renderings in French and English.

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MONTENEGRO, a country of south-eastern Europe, forming an independent kingdom situated upon the western side of the Balkan Peninsula, and possessing a small coast-line on the Adriatic Sea. The name is the Venetian variant of the Italian *Monte Nero*, and together with the Albanian *Mal Esiya*, the Turkish *Kara-dagh*, and the Greek *Mavro Vouno*, reproduces the native, or Serb, *Tzrnágora*, "the Black Mountain"; it is derived from the dark appearance of Mount Lovchen, the culminating summit of Montenegro proper, of which the northern and eastern declivities, those which are viewed from the country itself, are in shadow for the greater part of the day.[1] The dusky pine forests, which once clothed the mountain and of which remnants exist on its northern slope, contributed to its sombre aspect. Up to the end of the 15th century, when its territory became restricted to the mountainous districts immediately north and east of Mount Lovchen, the kingdom was known as the Zenta or Zeta, but the name Tzrnagora was probably used locally in this region from the time of the earliest Slavonic settlements.

Area and Boundaries.

Montenegro extends between 41° 55′ and 43° 21′ N., and between 18° 30′ and 20° E.; its greatest length from north to south is about 100 m.; its greatest breadth from east to west about 80 m. It is bounded by the Adriatic on the S., the seaboard extending for 28 m.; by the Primore, a strip of the Dalmatian littoral, on the S.W. and W.; by the Austrian (formerly Turkish) provinces of Bosnia and Herzegovina on the N.W. and N.; by the Ottoman empire both in the sanjak of Novibazar, on the N. and N.E., and also in the vilayets of Kossovo and Scutari on the N.E., E. and S.E. Its area, as officially estimated after the treaty of Berlin had been enforced in 1880, amounts to 3255 sq. m., or considerably less than half the size of Wales. The present frontier, which was not finally delimited till 1881, ascends the Boyana river from its mouth as far as Lake Sass (Shas), then follows the river Megured to the summit of Mount Bratovitza, reaching Lake Scutari at a spot opposite the island of Goritza Topal. Crossing the lake north-east to a point a little south-east of Plavnitza, and leaving the territory of the Hoti and Klementi tribes to the south, and the districts of Kutchka Kraina to the north, it passes north of the districts of Plava and Gusinye and reaches the western end of the Mokra Planina, where it turns to the north-west. After crossing the Lim at its junction with the Skula, it coincides with the old frontier for some distance; then reaching the Tara at Maikovatz, it follows the course of that river to its junction with the Piva: turning southwards, it reaches the old frontier once more at Klobuk, and, passing between the district of Grahovo and the Krivoshian Mountains, approaches to within a few miles of the Bocche di Cattaro: then, following the maritime mountain ridges for a considerable distance, it rejoins the coast a little south of Spizza.

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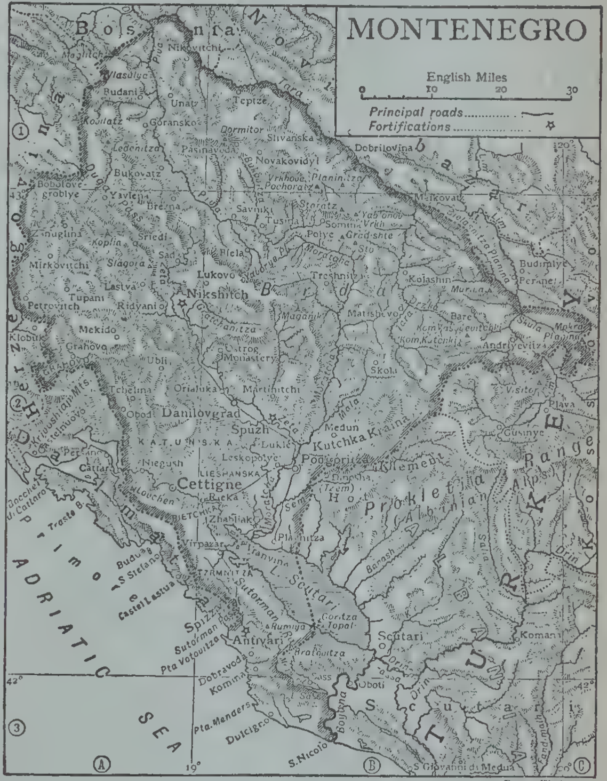
[1] Cf. the similarly-named *Tzrna Planina* in eastern Montenegro, *Tcherni Vrkh*, the culminating summit of Mount Vitosh in Bulgaria, and *Mavro Vouno* in the island of Salamis. Various other explanations of the name Montenegro, mostly of a fanciful character, have been put forward: see Kurt Hassert, "Der Name Montenegro" in *Globus*, No. 67, pp. 111-113 (Leipzig, 1895).

Physical Features.—Montenegro, which forms the meeting-point of the Dalmatian, Bosnian and Albanian ranges, seems at first a mere chaos of mountains. It is, however, naturally divided into three parts, each with its own character. (1) Fertile and well-watered plains, not unlike those of Lombardy, border the river Zeta, and after its junction with the Moratcha extend along the course of that river to Lake Scutari. A fringe of similar lowland forms the maritime plain extending between the Sutorman range and the mouth of the Boyana. (2) Westward, under the shadow of Lovchen, is the Katunska, or "Shepherds' Huts," the cradle of Montenegrin liberty. This region presents a surface of hard crystalline rock, bare and calcined, with strata sinking to the south-west at an angle often of 70°. The rocks have been split by atmospheric agencies into huge prismatic blocks, and the cracks have been gradually worn into fissures several fathoms deep. In some places the interior of the stony mass is hollowed out into galleries and caves, some of great length; during the rainy season subterranean landslips frequently produce local earthquakes, extending over an area of 10 or 12 m. The small basins of Cettigne and Niegush are practically the only cultivable districts in this region. (3) Over the entire north stretch the massive mountain chains which link the Herzegovinian Alps to those of Albania, the scenery recalling that of Switzerland or the Tirol. In the north-west there are finely wooded tracts extending north of Nikshitch to the Dormitor mountain group. The Dormitor district contains rich grassy uplands dotted with numerous small lakes, from which it derives its name of Yezera (the lakes); the rivers Tara and Piva flow through magnificent gorges clothed with rich forests, and unite near the extreme north of the frontier. On the north-east are the high but rounded Brda Mountains, covered with virgin forest or Alpine pastures, and broken here and there by jagged dolomitic peaks. In the district of the Vasoyevitchi, which surrounds the little town of Andriyevitza, is the fine double peak of Kom, and, a little to the south-west, the summit of Maglitch, commanding a magnificent view over the wooded valley of Gusinye to the great Prokletia range in Albania.[1] The contrast between the rich undulating landscape of the northern regions and the sterile calcined rocks of Montenegro proper is very remarkable.

Mountain System and Geological Formation.

The Montenegrin mountain system is divided into four masses: (1) the group enclosed by the Tara and Piva rivers with Dormitor, one of the highest mountains in the peninsula (9146 ft.), Yablonov Vrkh (7113 ft.), and the Vrkhove Pochoratz (6601 ft.); (2) the group between the Zeta and the Moratcha with Ostri-Kuk (7546 ft.), Vlasulya (7533 ft.), Brnik (6860 ft.) and Maganik (6621 ft.); (3) the ranges between the Moratcha and Tara with Sto (7323 ft.) and Gradishte (7156 ft.); and (4) those between the upper Tara and the upper Lim with Kom, the second highest mountain in the country (Kom Kutchki, 8032 ft., Kom Vasoyevitchki, 7946 ft.), separating the districts of the Vasoyevitchi on the north-east from that of the Kutchi on the south-west, and Visi tor (6936 ft.) on the frontier. In Montenegro proper the only prominent summit is Lovchen (5653 ft.), between Cettigne and the western frontier. Between Lake Scutari and the sea is the Sutorman range with the fine pyramidal summit of Rumiya (5148 ft.) overhanging Antivari. The prevailing formations of the north and east are Palaeozoic sandstones and schists, with underlying trap. Throughout Montenegro the following have been identified: (1) Palaeozoic schists, (2) Wirfen strata of Lower Trias, (3) Trap of the Palaeozoic and Wirfen strata, (4) Triassic limestone, (5) Jurassic limestone, (6) Cretaceous limestone, (7) Flysch, in part certainly Eocene, (8) Neogenic or younger Tertiary formations.



Emery Walker sc.

Rivers and Lakes.

The watershed between the Adriatic and the Black Sea crosses the country from west to east in a very irregular line, the southern districts being drained by the Zeta-Moratcha river system, which finds its way to the Adriatic by Lake Scutari and the Boyana, while the streams from the northern districts form the headwaters of the Drina, which reaches the Danube by way of the Save. The Zeta, rising in Lake Slano, near Nikshitch, is remarkable for its subterranean passage beneath a mountain range 1000 ft. high. At Ponor, not far from that town, the water vanishes in a deep chasm, reappearing at a distance of several miles on the other side of the mountains. Its whole course to its junction with the Moratcha is about 30 m. Rising in the Yavorye Planina, the Moratcha sweeps through mountain gorges till it reaches the plain of Podgoritza; then for a space it almost disappears among the pebbles and other alluvial deposits, nor does it again show a current of any considerable volume till it approaches Lake Scutari. In the neighbourhood of Duklé[2] and Leskopolye it flows through a precipitous ravine from 50 to 100 ft. high. In the dry season it is navigable from the lake to Zhabliak. The whole course is about 60 m. Of the left-hand tributaries of the Moratcha the Sem or Tzem deserves to be mentioned for the magnificent cañon through which it flows between Most Tamarui and Dinosha. On the one side rise the mountains of the Kutchi territory on the other the immense flanks of the Prokletia range—the walls of the gorge varying from 2000 to 4000 ft. of vertical height. Lower down the stream the rocky banks approach so close that it is possible to leap across without trouble. The Sem rises in northern Albania, and has a length of 70 m. The Rieka issues full-formed from an immense cave south-east of Cettigne and falls into Lake Scutari. The three tributaries of the Drina which belong in part to Montenegro are the Piva, the Tara, and the Lim, respectively 55, 95 and 140 m. in length. The Tara forms the northern boundary of the kingdom for more than 50 m., but the Lim flows beyond the border after the first 30 m. of its course. The western half of Lake Scutari, or Skodra, belongs to Montenegro;

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[1] This mountain must be distinguished from the higher Maglitch (7699 ft.), on the northern frontier, near the junction of the rivers Tara and Piva.

[2] Duklea is the name still borne by the ruins of the Roman Doclea, often, but wrongly, written Dioclea, from its association with the Emperor Diocletian.

the eastern, with Scutari itself, to Albania. It is a magnificent sheet of water, measuring about 135 sq. m., with an average depth of two to three fathoms. The northern end is studded with picturesque islands. The level of Lake Scutari underwent several changes in the 19th century; notably when the Drin, an Albanian river, which before 1830 entered the Adriatic near San Giovanni di Medua, changed its course so as to join the Boyana just below its exit from the lake. This raised the level of the lake, flooding the lower valleys of its tributary streams and permanently enlarging its area. A few small lakes are scattered among the mountains, and it is evident that their number was formerly much greater. Montenegro proper (*i.e.* the departments of Katunska, Rietchka and Lieshanska) is almost absolutely waterless, the only stream being the Rieka, which probably drains the Cettigne basin by an underground outlet. Its lower course is practically an inlet from Lake Scutari, and is navigable up to the town of Rieka. The upland plain of Cettigne, now waterless, was doubtless the bed of a lake at no very distant (geological) period; it is still sometimes flooded after heavy rains. The scarcity of water largely contributed to the successful defence of the country against Turkish invasion: the few springs are hidden in deep crannies among the rocks, and the inhabitants are accustomed to preserve melted snow for use during the summer. On the other hand, the Brda[1] and north-eastern districts are abundantly watered. The maritime district possesses two small streams.

Climate.—The climate generally resembles that of northern Albania; it is severe in the higher regions, and comparatively mild in the valleys, while in the maritime districts of Antivari and Dulcigno it may be compared with that of central Italy. The mean annual temperature is about 58° F. Snow lies for most of the year on many heights, and in some of the darker gorges it is never thawed. The high basin of Cettigne (2093 ft.) is deeply covered with snow during the winter months, and the capital is sometimes almost inaccessible; in summer the days are hot, but the nights are cool and frequently chilly. The climate is generally healthy except in a few marshy districts.

Flora and Fauna.—The Alpine vegetation of the summits gives way to pine forests in the sub-Alpine zone (about 6000 ft.); below these the beech, and then the oak, the walnut, the wild pear, and wild plum make their appearance; the fig-tree, the mulberry, and the vine grow in the middle Zeta and Moratcha valleys, the myrtle, orange, laurel and olive in the lower Moratcha region, and more abundantly in the Tzrmnitza and maritime districts. In the forest districts the beech is the prevailing tree up to a height of about 5000 ft. The chestnut forms little groves in the country between the sea and Lake Scutari but never ascends more than 1000 ft. Pomegranate bushes grow wild, and in many parts of the south cover the foot of the hills with dense thickets, the crimson blossoms of which are one of the special charms of the spring landscapes. The leaves of the sumach (*Rhus cotinus*), which flourishes in the warmer districts, are exported for use in dye-works; the *Pyrethrum cinerariaefolium* supplies material for the manufacture of insect-powder; the fruit of the wild plum (*Cornus mascula*), as well as the grape, is employed for the production of *raki* or *rakiya*, a mild spirit, which is a favourite beverage with the people. Bears are still found in the higher forests; wolves, and especially foxes, over a much wider area. A few chamois still roam on the loftiest summits, the roebuck is not infrequent in the backwoods, the wild boar may be met with in the same district, and the hare is abundant wherever the ground is covered with herbage. There are one or two species of snakes in the country, including the poisonous Illyrian viper (*Vipera ammodytes*). Esculent frogs, tree frogs, the common tortoise, and various kinds of lizards are all common. Scorpions and numerous reptiles infest the arid rocks of the Katunska. The list of birds includes golden eagles and vultures, twelve species of falcons, several species of owls, nightingales, larks, buntings, hoopoes, partridges, herons, pelicans, ducks (ten species), nightjars, &c. Immense flocks of water-fowl haunt the upper reaches of Lake Scutari. The rivers abound with trout, tench, carp and eels; the trout of the Moratcha are especially fine. More important from an economic point of view is the *scoranze* (*Leuciscus alburnus*: Servian *uklieva*), a kind of sardine, which supplies an article of food and merchandise to a considerable portion of the population. The fish, which enter the Rieka inlet of Lake Scutari during the winter, are taken with nets during a few weeks in the spring, when the fishing season is inaugurated with a religious service; they are salted and exported in large quantities to Trieste and the Dalmatian coast. The annual take is valued at £4000. The sea-fisheries are of less value. As regards mineral resources, traces of iron, copper and coal are said to exist; there is a natural petroleum spring in the neighbourhood of Virbazar.

Agriculture and Stock-farming.—Except in the lowlands, which serve as the granary of Montenegro, furnishing wheat, maize, barley, rye, potatoes and capsicums, there is little tillage. Methods and implements are alike primitive. In the Katunska the peasants are glad to enclose the smallest spaces of the fertile red soil which is left after rain in the crevices of the rocks, and one may see harvests only a few yards square. The vineyards produce excellent grapes, but wine production, which might become an important industry, is at present limited to home consumption. Tobacco is largely cultivated, especially in the neighbourhood of Podgoritza; the annual produce amounts to 550,000 lb. Stock-raising is more largely carried on than agriculture. In the north droves of swine fatten on the mast of the beech woods; goats and large flocks of sheep, celebrated for their thick fleeces, thrive on the high pastures, and the lower slopes afford excellent grazing for larger stock. The native breed of cattle is small, but among other efforts made to improve it a stock-farm is maintained by Prince Nicholas near Nikshitch. The horses, as elsewhere in the Balkan Peninsula, are diminutive, wiry and intelligent. Bee-keeping is practised in the Kutchi districts, and mulberries are grown for silkworms.

Commerce and Industries.—The exports, valued at £80,265 in 1906, include cattle (large and small), smoked and salted meat known as *castradina*, cheese, undressed hides, *scoranze*, sumach, pyrethrum, tobacco and wool. The imports, valued in the same year at £239,505, consist mainly of manufactured articles, such as iron utensils and weapons, soap, candles, &c., and colonial products. In 1904, when Montenegro renounced its commercial treaties, the old 8% *ad valorem* duty levied on imports was in many cases raised to 25%. This caused much discontent among the people, who had been growing steadily poorer since 1900; and many families emigrated. The exportation of cattle is greatly hindered by the high tariff imposed on the Austrian frontier, which is productive of much illicit trading. There are practically no manufactures: the men disdain industrial employment, while the women are occupied by household duties or work in the fields. A brewery and a cloth factory, however, exist at Nikshitch, a soda-water factory at Cettigne, and an olive-oil refinery at Antivari. The coarser cloth worn by the peasants is home-made; the finer kind worn by the wealthier class is imported.

Communications.—The progress of trade and the development of the natural resources of the country must largely depend on improved means of communication. In this direction considerable progress has already been achieved. Montenegro possessed in 1907 228 m. of excellent carriage roads, admirably engineered and maintained. The remarkable zigzag road from Cattaro to Niegush and Cettigne was completed in 1881; it was afterwards prolonged to Rieka, Podgoritza, Danilovgrad (where a fine bridge across the Zeta was erected in 1870), and Nikshitch. Another road connects Podgoritza with its port, Plavnitza, on Lake Scutari; a third runs from Antivari to Rieka, and unites the sea-coasts with the richest districts of the interior. The ports of Antivari and Dulcigno are insufficiently sheltered, but are capable of considerable improvement; both are places of call for the Austrian Lloyd steamers, and a regular service between Antivari and Bari on the Italian coast is maintained by the "Puglia" Steamship Company. The Boyana is navigable by sea-going vessels as far as Oboti (12½ m. from its mouth), where cargoes from Scutari must be transferred to small river craft. Important harbour works were inaugurated in 1905 at Antivari by the Italo-Montenegrin *Compagnia d'Antivari*, which in the same year began the construction of a railway from that port to Virbazar on Lake Scutari. Four steamers belonging to the same company ply on the lake. Postal and telegraphic communication is fairly complete. There were, in 1906, 16 post offices and 20 telegraph stations, with 412 miles of wire. The number of letters posted in that year was 91,250. The telegraph is much used by the people: the number of telegrams sent in 1906 was 54,750.

Population.—In 1882 the population of Montenegro was estimated as low as 160,000 by Schwartz. A more usual estimate is 230,000. According, however, to information officially furnished at Cettigne, the total number of inhabitants in 1900 was 311,564, of whom 293,527 belonged to the Orthodox Church; 12,493 were Moslems and 5544 were Roman Catholics; 71,528, or 23%, were literate and 240,036, or 77%, were illiterate. The total number in 1907 was officially given as 282,000. The population is densest in the fertile eastern districts; Montenegro proper is sparsely inhabited. Emigration is greatly increasing, especially to America; the number of emigrants is given as 6674 in 1905 and 4346 in 1906. The bulk of the inhabitants belongs to the Serbo-Croatian branch of the Slavonic race. There were about 5000 Albanians resident in the country in 1900, besides a small colony of gipsies, numbering about 800, a few of whom have abandoned their nomadic life and settled on the soil. The Moslems, whose thrift and industry have won encouragement from the Crown, greatly decreased for some years after 1880 owing to emigration. The capital of Montenegro is Cettigne (3200 inhabitants in 1900, 5138 in 1907). The chief commercial centres are Podgoritza (12,347) and Nikshitch (6872), with the ports of Antivari (2717) and Dulcigno (5166). These towns are described under separate headings. Danilovgrad (1226) on the

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[1] The name *Brda* (literally "mountains") signifies in ordinary speech the mountain-group east of the Zeta which was incorporated in the principality in 1796. It figures in the prince's title, but is not otherwise used in official documents.

Zeta was founded in 1871 by Prince Nicholas and named after his predecessor, Danilo II. In the vicinity is Orialuka, the prince's palace, with its mulberry nurseries. Spuzh (1000), a little lower on the east bank of the Zeta, possesses a fortified acropolis. Niegush or Nyegosh (1893), on the road from Cettigne to Cattaro, is the ancestral abode of the ruling family, which originally came from Niegush in Herzegovina. Zhabliak (1200), near Lake Scutari, was the capital until late in the 15th century. It was a Venetian stronghold. Rieka (1768), near the northern end of Lake Scutari, derives some commercial importance from its position. Grahovo (1000), in the extreme west, is famous for the Turkish defeats of 1851 and 1876. Other small towns are Kolashin, Virbazar and Andriyevitza.

National Characteristics.

The Montenegrins present all the characteristics of a primitive race as yet but little affected by modern civilization. Society is still in that early stage at which personal valour is regarded as the highest virtue, and warlike prowess constitutes the principal, if not the only, claim to pre-eminence. The chiefs are distinguished by the splendour of their arms and the richness of their costume; women occupy a subject position; the physically infirm often adopt the profession of minstrels and sing the exploits of their countrymen like the bards of the Homeric age. A race of warriors, the Montenegrins are brave, proud, chivalrous and patriotic; on the other hand, they are vain, lazy, cruel and revengeful. They possess the domestic virtues of sobriety, chastity and frugality, and are well-mannered, affable and hospitable, though somewhat contemptuous of strangers. They are endowed in no small degree with the high-flown poetic temperament of the Serb race, and delight in interminable recitations of their martial deeds, which are sung to the strains of the *gûsla*, a rudimentary one-stringed fiddle. Dancing is a favourite pastime. Two characteristic forms are the slow and stately ring-dance (*kolo*),[1] in which women sometimes participate, though it is usually performed by a circle of men; and the livelier measure for both sexes (*oro*), in which the couples face one another, leaping high into the air, while each man encourages his partner by rapid revolver-firing. The *oro* is the traditional dance in the Katunska district. Women chant wild dirges, generally improvised, over the dead; mourners try to excel one another in demonstrations of grief; and funerals are celebrated by an orgy very like an Irish "wake." Like most imaginative peoples, the Montenegrins are extremely superstitious, and belief in the vampire, demons and fairies is almost universal. Among the mountains they can converse fluently at astonishing distances. The physical type contrasts with that of the northern Serbs: the features are more pronounced, the hair is darker, and the stature is greater. The men are tall, often exceeding 6 ft. in height, muscular, and wonderfully active, displaying a cat-like elasticity of movement when scaling their native rocks; their bearing is soldier-like and manly, though somewhat theatrical. The women, though frequently beautiful in youth, age rapidly, and are short and stunted, though strong, owing to the drudgery imposed on them from childhood; they work in the fields, carry heavy burdens, and are generally treated as inferior beings. Like the Albanians, the Montenegrins take great pride in personal adornment. The men wear a red waistcoat, embroidered with gold or black braid, over which a long plaid is sometimes thrown in cold weather; a red girdle, in the folds of which pistols and yataghans are placed; loose dark-blue breeches and white stockings, which are generally covered with gaiters. The *opanka*, a raw-hide sandal, is worn instead of boots; patent leather long boots are sometimes worn by military officers and a few of the wealthier class. The head-dress is a small cap (*kapa*), black at the sides, in mourning for Kossovo; red at the top, it is said, in token of the blood shed then and afterwards. On the top near the side, five semicircular bars of gold braid, enclosing the king's initials, are supposed to represent the five centuries of Montenegrin liberty. There is little authority, however, for this and other fanciful interpretations of the pattern, which was adopted in the reign of Peter I.; the red fez, from which the kapa probably derives its colour, was previously worn. A blue or green mantle is sometimes worn in addition by the chiefs. The poorer mountaineers are often dressed in coarse sacking, but all without exception carry arms. The women, as befits their servile condition, are generally clothed in black, and wear a black head-dress or veil; on Sundays and holidays, however, a white embroidered bodice, silver girdle, and bright silk skirt are worn beneath an open coat. Over this is placed a short, sleeveless jacket of red, blue, or violet velvet, according to the wearer's age. Unmarried girls are allowed to wear the red kapa, but without the embroidered badge. The Vasoyevitch tribe retain the Albanian costume, in which white predominates. Turkish dress is often seen at Antivari, Dulcigno and Podgoritza. The dwelling-houses are invariably of stone, except in the eastern districts, where wooden huts are found. As a rule, only the mansions of cattle-owners have a second storey: the ground floor, which is dark and unventilated, is occupied by the animals; the upper chambers, in which the family reside, are reached by a ladder or stone staircase. Chimneys are rare, and the smoke of the fireplace escapes through the windows (if any exist) or the open doorway. The principal food of the people is rye or maize cake, cheese, potatoes and salted *scoranze*; their drink is water or sour milk; meat is seldom tasted, except on festive occasions, when raki and red wine are also enjoyed. The Montenegrins are great smokers, especially of cigarettes; in the districts which formerly belonged to Turkey the men, whose dignity never permits them to carry burdens, may be seen going to market with the *chibûk*, or long pipe, slung across their backs. The mother possesses little influence over her sons, who are trained from their earliest infancy to cultivate warlike pursuits and to despise the weaker sex. Betrothals often take place in early childhood. Young men who are attached to each other are accustomed to swear eternal brotherhood (*pobratimstvo*); the bond, which receives the sanction of the Church, is never dissolved. Marriages between Montenegrins and converted Turkish girls are a common source of blood-feuds. The *zadruga*, or house-community, under the rule of a *stareshina*, or house-father, is found in Montenegro as in other Slavonic lands (see SERVIA). The tribal system still exists, but possesses less significance than in Albania, owing to the centralization of authority at Cettigne. The tribe (*pleme*, pl. *plemena*) is subdivided into clans (*bratstva*).

Constitution and Government.—Notwithstanding the creation of an elective senate in 1831, the grant of a so-called constitution in 1868, and the establishment of a responsible ministry in 1874, the government remained autocratic till 1905, the whole power, even the control of religion and finance, which the constitution of 1868 had conceded to the senate, being centred in the hands of the prince, who in 1910 assumed the title of king. The senate, instituted by Peter II. with the object of limiting the power of the tribal chieftains, was in 1881 merged in a council of state, the members of which, six in number, were nominated and dismissed by the prince. The council supervises measures to be laid before the *Skupshtina*, or national assembly, and exercises a disciplinary control over officials. The ministry comprises six departments: (1) the interior, with separate sections for public works, posts and telegraphs, commerce and industry, shipping, sanitary service and agriculture; (2) foreign affairs; (3) war; (4) finance; (5) justice; and (6) education. On the 19th of December 1905 a new constitution was proclaimed by Prince Nicholas. A *Skupshtina* was instituted, consisting of 62 elected deputies, 9 *ex officio* members (the higher ecclesiastical and civil dignitaries), and 3 generals nominated by the prince. The Skupshtina is elected by manhood suffrage for a period of four years, and is summoned annually on the 31st of October. In conjunction with the Crown it exercises the legislative power; the ministers are responsible to it as well as to the Crown. The constitution affords financial supervision to the Skupshtina, which elects a board of control and votes an annual budget; it guarantees liberty of the person, of religious belief, and of the press, together with the right of public meeting, and abolishes the death penalty for political offences.

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[1] The ring-dance, known as the *kolo* (literally, "wheel") in all Serb countries, corresponds with the Bulgarian *horo* (to be distinguished from the Montenegrin *oro*), and is almost universal throughout the Balkan Peninsula; it is seldom, however, danced in the rocky Katunska district, where level spaces are rare.

Administration and Justice.—For purposes of local administration the country is divided into 5 departments (*oblasti*), each governed by a prefect (*upravitel*), and 56 districts (*kapetanati*), each under an official styled *kapetan*. The prefects and kapetans are nominated by the king on the recommendation of the minister of the interior. Rural communes, each under an elected *kmet*, or mayor, exist in Montenegro as in all Slavonic countries. The kmets act as justices of the peace, and there is an appeal from their decisions to the courts of first instance (*kapetanski sudove*), of which there is one in each district, the kapetan acting as judge. In each of the five departments there is a superior court (*oblasni sud*), with a president and two judges; at Cettigne there is a high court of justice (*veliki sud*), which is the final court of appeal. The ultimate appeal to the prince was abolished in 1902, when Prince Nicholas laid aside his judicial functions, retaining only the prerogative of pardon. The judges, who are removable, are nominated by the king on the recommendation of the minister of justice. With a single exception there are no professional advocates in Montenegro; each man is his own counsel, bringing his own witnesses. The local gendarmerie, numbering 150 men, is distributed in the five departments. The *kapetanati* have replaced the former local divisions according to *plemena*; in each of the communes there is one or more of the *bratstva*. The codification of the law, which had previously been administered according to unwritten custom, was first undertaken by Peter I. in 1796. An improved code, issued by Danilo II. in 1855, still contained many quaint enactments. The excellent code drawn up by Professor Bogishitch, a native of Ragusa, in 1888, was revised and enlarged in 1899. It contains elements from various foreign systems scientifically adapted to national usages and requirements. A large number of judicial reforms were carried out by Count Voïnovitch, who succeeded Professor Bogishitch in 1899; in 1905 a new code of civil procedure was promulgated, and a criminal code in the following year. The only prison is at Podgoritza. In the old prison at Cettigne, closed after 1902, many of the inmates were free to walk in and out at pleasure. Some were burdened with fetters, rather as a punishment than for restraint. Until the completion of an asylum in 1903, dangerous lunatics were confined in prison. The commonest offences are murder and robbery; despite vigorous measures taken by the king and his predecessors, the blood-feud, or vendetta, cannot be stamped out, being approved, and even enforced, by public sentiment. Only women are held exempt from the duty of avenging their next-of-kin; they have been known, however, to undertake it, disguising themselves in male attire. A man who kills his slanderer, or otherwise avenges his honour, often receives a nominal term of imprisonment. Robbery, if practised by means of raids across the frontier, is popularly regarded as a venal offence. Other forms of crime are rare, and foreigners may traverse all parts of the kingdom, except the neighbourhood of the Albanian border, in perfect safety. The death penalty was first introduced by Peter I. Executions are carried out by a firing party selected from the various tribes, in order to prevent the relatives of the criminal from exacting vengeance. Exceptional severity is shown in the treatment of political offenders, who in some instances have been subjected to solitary confinement for years without trial.

Finance.—Financial statistics are not published. The total receipts were estimated in 1907 at 2,773,690 Austrian krone,[1] the principal sources of income being the taxes on land, houses and cattle, the monopolies of tobacco, salt, petroleum and alcohol, and the customs dues. The total expenditure was estimated at 2,730,994 krone, the principal items being: civil list, &c., 189,586 krone; ministry of interior, 574,822 krone; of foreign affairs, 144,547 krone; of justice, 232,710 krone; of finance, 592,561 krone; of war, 133,696 krone; of worship and education, 269,208 krone; service of national debt, 244,500 krone. The public debt is under £300,000. The contribution of Montenegro to the Ottoman debt has not been fixed. From time to time considerable subventions have been received from Russia and Austria. The annual Russian subsidy, mainly for military and educational purposes, is stated to be about £40,000. Montenegro has no mint; Austrian paper money and coins are generally employed together with Montenegrin nickel and bronze coins struck in Austria. Turkish gold and silver are also in circulation. The former Turkish and Venetian weights and measures have been superseded by the French.

Defence.—The Montenegrin is a born warrior; his weapons, which he never lays aside, are his most precious possession, and distinction in battle is the sole object of his ambition. Persons of all classes wear a revolver in the *kolan* or waistband. "You might as well take from me my brother as my rifle," says a native proverb; and rifles are almost universally carried near the Albanian frontier, where the tribesmen on either side are in a state of chronic hostility. Brave to a fault, an unerring marksman hardy, agile, crafty and enduring, the Montenegrin has few rivals in the practice of guerrilla warfare. The traditional method of fighting is by ambuscade; the enemy is enticed into some intricate defile, surrounded, and harassed by rifle-fire; then the mountaineers, throwing aside their firearms, deliver a swift attack with the *hanjar*, or yataghan, which they wield with terrific effect. A number of heads cut off in battle adorned the parapet of a small tower outside Cettigne, called the "Turks' Tower," as late as 1850. When reduced to extremity the Montenegrins often committed suicide rather than fall into the hands of the enemy, the last cartridge being reserved for this purpose; disabled comrades who could not be removed used to be beheaded, in 1876 a Montenegrin offered to perform this kindly service for a Russian officer who was wounded at Klobuk. Savage methods of warfare, however, have been strongly discountenanced by King Nicholas and his predecessor. Till the middle of the 19th century the forces of the principality consisted of undisciplined bands of tribesmen under local chiefs, whose rivalries often proved injurious to the national cause. The supreme command, however, always rested with the prince. The nucleus of a permanent corps was created by Peter II., who formed a bodyguard of picked men known as *perianiki*, from the feathers (*pera*) which adorned their caps. The name is still borne by a small corps (20 men in 1907) which guards the residences of the king and his sons, but the feathers are no longer worn. In 1853 Danilo II. ordered the enrolment of all persons capable of bearing arms, and instituted a military hierarchy of *voievodes* (generals), *sirdars* (colonels) and *kapetans*; the organization, which was based on the tribal system, was remodelled by Servian officers in 1870, when the chiefs were brought to Cettigne to receive military instruction. In the same year arms of precision were introduced: the cost and complex structure of the new weapons threatened to cause serious difficulty, but Russian aid was soon forthcoming. Since 1870, though arms and ammunition are manufactured on a small scale within the kingdom, the chief supplies have come from Russia. In 1895 the tsar presented Prince Nicholas with 30,000 Berdan rifles, besides ordnance and other war material, and in 1898 sent a further gift of 35,000 Moskovska rifles. Every able-bodied citizen must serve in the army, except Moslems, who are exempt on payment of a capitation tax. The military organization has undergone a gradual transformation under Prince Nicholas in conformity with the changed circumstances of the country and the requirements of modern warfare. The militia system on the tribal basis is maintained, but in 1896 a permanent battalion of 500 men was established at Cettigne, and two years later another at Podgoritza, each under a *komandir*, or major, 4 captains and 15 lieutenants. A permanent brigade of artillery was formed at Nikshitch in 1897. In 1905 these were abolished through motives of economy. There is a standing corps of officers, but no standing army. All young men of military age go through an obligatory period of twelve days' service at the various local military centres. Candidates for a commission afterwards proceed to a military school at Podgoritza for one year; the best and most promising then receive commissions as *pod-ofizieri* or *sous-officiers*, and are sent for a further course of instruction of two years to military schools either at Cettigne for the infantry, or at Nikshitch for the artillery. They then receive full commissions and are sent to the local centres to superintend the training of the militia, thus gradually superseding the old militia officers, and replenishing the standing corps of officers of the regular army. Officers who have completed a course of study abroad are allowed to wear a distinctive emblem on the *kapa*. The war strength is estimated at from 38,000 to 42,000 men, the infantry being composed of about 32,000 men of the first ban and of 5000 or 6000 of the second or reserve (which, however, would scarcely be employed in the field), the artillery of about 1500. Considerable deduction must be made from these numbers in view of the emigration of recent years; according to some authorities between 20,000 and 22,000 men of military age are absent in America and elsewhere. It is expected, however, that many of these would return should the country become involved in war. The infantry is divided into 11 brigades, each containing from 4 to 6 battalions; the total number of battalions is 56. The battalion is composed of a varying number of *tchete*, or companies, each of which belongs to a separate clan and has its own *bairaktar*, or standard-bearer. The younger men of the first ban are occasionally exercised in the neighbourhood of their homes on Sundays and holidays. They are armed with the Moskovska (repeating) rifle, but a Berdan rifle is also kept in each household. The artillery was composed in 1910 of 18 siege, 25 field and 38 mountain guns, with 4 howitzers, 15 mortars and 18 machine-guns (6 Gatling and 12 Maxim-Nordenfeldt); the principal arsenal is at Spuzh, where the heavier guns are kept, the others are distributed among 8 of the 11 local brigades. *The perianiki*, whose numbers were increased by Prince Danilo, were disbanded in 1898, when steps were taken to form a bodyguard of 3000 picked men under Prince Mirko, King Nicholas's second son, but the project was abandoned in view of the jealousies to which the selection gave rise. Owing to the lack of open country there is no cavalry. In 1894 the sultan presented Prince Nicholas with equipment for a small mounted body-guard (32 men), and offered the services of three instructors. This corps, however, ceased to exist in 1898. About 20,000 men can concentrate at a given spot within 48 hours. The signal for mobilization is mainly given by telegraph; bonfires, trumpet-calls and volley-firing are also employed. The warriors were formerly summoned by stentorian couriers, who shouted from the tops of the mountains. An ambulance corps has been formed. Transport is deficient, all draught animals, however, in the country have been registered and a few carts have been provided. The wives and daughters of the troops provide the commissariat, and carry the ammunition.

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[1] The krone = 10d. English.

Religion.—The Montenegrin Church is an autocephalous branch of the Eastern Orthodox communion. In 1894 it formally vindicated its independence against the claims of the Russian synod. The *vladikas*, or prince-bishops, formerly depended on the patriarchate of Ipek. The theocratic system of government which existed from 1516 to 1851 tended to unite the patriotic and the religious instincts of the people. Since the separation of the spiritual and temporal powers in 1851, the see of Cettigne, in which the diocese of Ostrog is included, has been occupied by a metropolitan (*metropolit*), who possesses a nominal jurisdiction over Scutari and the Primore. In judgments relative to divorce his verdicts may be reversed by the king. Otherwise he is supreme in matters spiritual. There are 159 parishes of the Orthodox Church, 10 Roman Catholic parishes under the archbishop of Antivari and 10 Mahommedan parishes under a mufti. The churches are small unpretending structures, almost all exactly alike; a handsome cathedral, however, has been erected at Nikshitch. The principal monasteries, in addition to the convent at Cettigne, are those of St Nicholas, on the Moratcha, and of St Basil at Ostrog. The monastic order is almost extinct; the parochial clergy, who numbered about 400 in 1900, are only distinguishable from the laity by their beards; they wear the national costume, carry weapons, take part in warfare, and follow the ordinary avocations of the peasantry. Even the old vladikas discarded the episcopal robe, except when engaged in sacerdotal duties. The clergy are still for the most part extremely ignorant.

Education.—The *Bogoslovia*, a seminary for the instruction of the young priests and schoolmasters, was established at Cettigne in 1869. It is maintained by a subvention from the emperor of Russia, while the empress supports the Zhenski Tzrnogorski Institut, an excellently managed school for girls (98 pupils in 1907). Government lecturers go on circuit to instruct the older men. They may be seen on Sundays, not only distributing general information, but teaching the shepherds how to safeguard their flocks from disease, and the lowland cultivators how to tend their vines and tobacco crops. An agricultural college at Podgoritza supplements their work. Primary education is compulsory. In the rural districts it is free; in the towns a small fee is charged. In 1906 there were 112 primary schools in the principality with 150 teachers and 9756 pupils; and two secondary schools (at Cettigne and Podgoritza) with 21 professors and about 1000 pupils; the Moslems and Roman Catholics have separate schools. There are also gymnasia, or high schools, at Cettigne and Podgoritza, with about 700 pupils. Students desirous of higher education proceed abroad, for the most part to the university in Belgrade. The progress of education under Prince Nicholas was very remarkable. In the time of his predecessor, Danilo II., who taught the sons of his chieftains in the palace, there were only three schools in the principality. In 1876, at the beginning of the war, there were 52 schools, with 62 teachers and 3159 pupils. The schools were closed during the war, and at its conclusion only 22 could be reopened, owing to want of funds. Elementary education was reorganized in 1878.

Language and Literature.—The Montenegrin language is practically identical with the Serbo-Croatian: it exhibits certain dialectical variations, and has borrowed to some extent from the Turkish and Italian. Existing manuscripts and printed books, chiefly psalters and gospels, bear witness to a period of literary culture among the clergy contemporaneous with the activity of the printing-press at Obod. This was established in 1493, a few years after Caxton set up his first press in Westminster. It was destroyed by the Turks in 1566, after sending out copies of the gospel into all Slavonic countries. The folk-songs, however, of which the first collection was made in the reign of Peter II., constitute the bulk of the national literature. The poems of that ruler are accounted among the classics of the Servian language, especially his *Gorski Vienatz*, or "Mountain Wreath," a drama describing the massacre of the Montenegrin Moslems by their Christian kinsmen in 1702. The reigning family has produced a succession of poets; the songs of Mirko Petrovitch, the father of Prince Nicholas, and the lyrics and dramas of Prince Nicholas himself enjoy great celebrity. The *Grlitze*, or "Turtle-doves," a kind of almanac published at Cettigne by Milakovitch between 1835 and 1839, contained poems, tales, statistics and an abridgment of the Montenegrin annals down to 1830; it was succeeded in the time of Danilo II. by the *Orlitch*, or "Eaglet." The first Montenegrin newspaper, the *Tzrnogoratz*, or "Montenegrin," founded in 1870, was prohibited on the Austrian frontier, and soon disappeared; it was replaced by the *Glas Tzrnogortza*, or "Voice of the Montenegrin," a semi-official publication. There were in 1910 three other journals in the kingdom.

Antiquities.—In Montenegro, as in Albania, the monuments of early civilization bear witness to Roman rather than to Greek influence. Roman remains occur in many parts of the country east of the Zeta, and early Latin churches exist at Dulcigno (*Ulcinium*) and other places. "The organization and forms of the churches, the architecture and ornamentation, point to the West and not to the East." It is evident that Latin civilization was firmly planted in Illyria before the barbarian incursions of the 6th century. Latin sepulchral inscriptions and some finely cut marble blocks have been found at Berane, a little beyond the eastern frontier, and at Budimlye in its neighbourhood. Especially interesting and important are the extensive ruins of Doclea, now known as Duklé, the birthplace of the Emperor Diocletian. The city, which received the franchise under the Flavian emperors, occupied a remarkable site at the junction of the rivers Zeta and Moratcha. The outer walls are standing in many places, and excavations carried out in 1893 by M. Rovinski and Messrs J. A. R. Munro, Milne and Anderson revealed a considerable portion of the ground-plan, including several streets and a forum. Among the buildings are a fine civil basilica, with a great inscription on the architrave, two small temples, an early Christian basilica, and a later church; several inscriptions, columns, richly worked capitals and tracery, and mosaic pavements have been brought to light. At Medun there are remnants of polygonal masonry. Illyrian forts are found in many parts of the country. The ravages of the Turks obliterated almost every trace of medieval culture. The fortress of Obod, the site of the famous printing-press, is a heap of ruins; a fragment of one of the first missals printed here is shown at Cettigne; it bears the date 1494. Other editions are preserved at the monastery of Tzaïnitza, on the Bosnian side of the frontier, and at Moscow. The precious books and relics stored in the monastery of Ivan the Black at Cettigne perished with the destruction of the monastery in 1687. The building, the home of the reigning vladikas, had been previously sacked by the Turks in 1623, and was again destroyed by them in 1714. In the fortress-monastery of St Nicholas (founded in 1252), which overlooks the headwaters of the Moratcha, are some interesting and well-preserved frescoes which date from the 13th century. The monastery of Ostrog, about twelve miles from Nikshitch, is a comparatively recent foundation, dating from the 18th century. It has been styled "the Lourdes of the Balkans," owing to its reputation for miraculous cures, and is visited annually by thousands of Orthodox pilgrims, and even by Roman Catholics and Moslems. The upper portion, situated in the cleft of a precipitous rock, was in 1768 and again in 1862 successfully defended by a handful of men against the Turks.

History.—The history of Montenegro as an independent state begins with the battle of Kossovo (1389), but the country had enjoyed periods of independence or semi-independence at various epochs before that event. It formed a portion of the district of Praevalitana in the Roman province of Illyria, and, lying on the borderland of the empires of the West and East, it alternately shared the fortunes of either till the close of the 5th century. It was then conquered by the Ostrogoths (A.D. 493), but half a century later definitely passed under Byzantine rule, having already acknowledged the ecclesiastical authority of Constantinople, a circumstance which determined the course of its subsequent history. Illyria and Dalmatia succumbed to the great Serbo-Croat invasion of the 6th and 7th centuries; the Serb race by which Montenegro is now inhabited occupied the country about the middle of the 7th century. A confederacy of Serb states was formed under *zhupans*, or feudal princes, dependent on the grand zhupan, who was nominally the vassal of the Greek emperor. The Serb principality of the Zeta, or Zenta, originally included the Herzegovina, Cattaro and Scutari, as well as the Montenegro of to-day, and was ruled by a zhupan resident at Doclea. The principality, though retaining its zhupans, was practically united with the Servian kingdom between 1159 and 1356 under the Nemanya dynasty, which sprang from Doclea. After the death of the great Servian tsar Dushan in 1356 the feudatory princes of his empire became more or less independent, and the powerful family of Balsha established a dynasty in the Zeta, eventually transferring its capital from Doclea to Scutari.

After the fatal defeat of Kossovo, which extinguished the independence of Servia for more than four centuries (see SERVIA), George Balsha, the ruling prince of the Zeta, withdrew to the mountainous portion of his realm, which became an asylum for many of the Servian nobles and for others who had been outlawed or persecuted by the Turkish conqueror. The principality now owned no suzerain, and the history of its heroic struggle with the Turks began. The long record of warfare is varied by conflicts with the Venetians, who at times allied themselves with the mountaineers, but usually deserted them in the hour of need. The Balsha family became extinct in 1421, and a new dynasty was founded by Stephan Tzernoyevitch, or Tzernovitch, who fixed his capital at Zhabliak on the north-east side of Lake Scutari, and joined with his relative, the famous Scanderbeg (*q.v.*) in many campaigns against the Turks. After the Turkish conquest of Bosnia in 1463, of the Herzegovina in 1476 and of Albania in 1478, and the surrender of Scutari by the Venetians in 1479, the Montenegrins found themselves surrounded on all sides by the Ottoman power, and the struggle was henceforth for existence. Abandoned by Venice and unable to obtain succour from any Christian state, Ivan the Black, the son and successor of Stephan, set fire to Zhabliak in 1484, and withdrew with his people to the mountain village of Tzetinye (Cettigne) which has ever since been the capital of the little principality. Here he founded the famous monastery and created a bishopric in order to establish the spiritual power at the seat of government. Ivan was one of the greatest heroes of Montenegrin history: according to the national legend, he still sleeps in a cave near his fortress of Obod—to awake when the hour arrives for the expulsion of the Turks from Europe.

The Elective Vladikas.

The Tzernoyevitch dynasty came to an end in 1516, and from this date till 1696 the mountaineers were ruled by the *vladikas* or bishops of Cettigne, elected by assemblies of the chiefs and people, and consecrated by the patriarch of Ipek. The elective vladikas were aided in matters relating to national defence by a civil governor. The institution of a theocratic sovereignty probably saved the country from absorption in the Turkish Empire, the supreme power being vested in a sacrosanct person, whose position was unattainable by ambitious chieftains, and whose holy office precluded the possibility of his defection to Islam. The earlier vladikas were left comparatively unmolested by the Turks, and were enabled to devote their attention to the issue of numerous psalters, missals and gospels from the printing-press at Obod. But the beginning of the 17th century was marked by renewed Turkish aggression. Cettigne was taken in 1623 and again in 1687, when the monastery of Ivan the Black was blown up by the monks; a tribute was for a time imposed on the mountaineers, but the bolder spirits maintained their resistance in the heights, and the invading armies found it impossible to prolong their stay in these inhospitable regions.

The House of Petrovitch.

In 1696 it was decided to continue the hereditary principle with the theocratic system, and Danilo Petrovitch of Niegush, the first ruler of the present reigning family, was nominated vladika with power to select his successor from among his relatives. The succession was henceforth regularly from uncle to nephew, owing to the rule of celibacy imposed on the monastic order. The reign of Danilo I. was memorable for the massacre of the Moslems settled in the principality (the "Montenegrin vespers") on Christmas Eve 1702, the great defeat of the Turkish invaders at Tzarevlatz (1712), the capture of Cettigne by the Turks and the destruction for the third time of its monastery (1714), and the inauguration of the intimate relations which have ever since existed with Russia by the visit of the vladika to Peter the Great in 1715. With Russian aid Danilo was enabled in some degree to repair the ruin which had overtaken his little realm. In the time of his successor Sava (1737–1782) an impostor named Stephan Mali, who represented himself as the Russian emperor Peter III., won the confidence of the Montenegrins, and governed the country with ability for several years (1768–1773), the mountaineers defeating the combined efforts of the Turks and Venetians to remove him. He was eventually assassinated by a Greek suborned by the pasha of Scutari. Peter I. (1782–1830), the greatest of the vladikas, took part in the war of Austria and Russia against Turkey (1788–92), but was abandoned by his allies in the treaties of Sistova and Jassy. He nevertheless completely routed the Turks in the battle of Krussa (1796), annexed the Brda region to the principality, and obtained a formal recognition of Montenegrin independence from the sultan in 1799. In concert with the Russians he besieged the French in Ragusa (1806), and in 1813–14 expelled them from the Bocche di Cattaro with the aid of a British fleet under Admiral Fremantle. The much-coveted seaport, however, was almost immediately occupied by an Austrian force. Peter I. reorganized the internal administration and promulgated the first Montenegrin code of laws. After his death he was canonized as a saint by the people. His successor Peter II. (1830–1851), a poet, statesman and reformer, as well as a capable military chief, instituted a senate (1831), abolished the office of civil governor (1832), revived the national printing-press, and did much to educate and civilize his people. He was buried by his desire on the summit of Mount Lovchen that his spirit might survey his beloved land. He was the last of the vladikas; his nephew Danilo II. (1851–1860) at once declined the ecclesiastical dignity, and assuming the title of *gospodar*, or prince, settled the succession on his direct male descendants. He defeated the Turks near Ostrog in 1853, but refrained from attacking them during the Crimean War. His pacific policy produced much discontent among the warlike mountaineers, which culminated in an open revolt. His demand for the recognition of Montenegrin independence and other claims were set aside by the Congress of Paris. In 1858 his brother Mirko, "the Sword of Montenegro," routed the Turks with great slaughter at Grahovo. In 1855 Danilo II. promulgated a new code, assuring civil and religious liberty to his subjects. On the 11th of August 1860 he was shot at Persano on the Bocche di Cattaro by a Montenegrin whom he had exiled after the revolt, and died two days afterwards. He left no male offspring, and was succeeded by Nicholas, the son of his brother Mirko.

Prince Nicholas.

Shortly after the accession of Prince Nicholas (Aug. 13, 1860), an insurrection broke out in Herzegovina, and the sympathy which the mountaineers displayed with their Christian kinsmen led to a rupture with Turkey (1862). Notwithstanding the heroic defence of Ostrog by the prince's father, Mirko, the war proved disastrous, owing to the superior armament and discipline of the Turkish troops, and severe terms were imposed on the principality by the convention of Scutari (Aug. 31). During the fourteen years of peace which followed, the country suffered greatly from pestilence and famine. Within this period a series of reforms were carried out by the prince: the army was rearmed and reorganized, an educational system was initiated, and a constitution under which the prince surrendered various prerogatives to the Senate was granted. In 1869 the Krivoshians, or Serb inhabitants of the northern shores of the Bocche di Cattaro, rose against the Austrian government; the excitement in Montenegro was intense, but the prince succeeded in checking the warlike ardour of his subjects. The revolt in Bosnia and Herzegovina in 1875 had more important consequences for the principality. On the 2nd of July 1876 Prince Nicholas, in alliance with Prince Milan of Servia, declared war against Turkey and invaded Herzegovina. A victory was gained at Vuchidol (July 28), and Medun was captured; but the Servian army suffered reverses, and an armistice was arranged in November. In the following spring the determination of Russia to take the field against Turkey encouraged the Montenegrins to renew the war. The Turks succeeded in occupying Ostrog, but were subsequently repulsed; the greater part of their forces was soon withdrawn to Bulgaria, and Prince Nicholas captured successively Nikshitch, Antivari and Dulcigno. The recovery of the seaboard, which had belonged to Montenegro in the middle ages, was perhaps the principal achievement of the war. The enlargement of territory stipulated for by Russia under the treaty of San Stefano (March 3, 1878) would have brought Montenegro into close contiguity with Servia, thus facilitating the eventual union of the Serb race and closing the path of Austria towards the Aegean. The Berlin Treaty (article xxviii.) gave to Montenegro Nikshitch, Spuzh, Podgoritza, Plava, Gusinye and Antivari, but restored Dulcigno to Turkey. The resistance of the Moslem inhabitants of Plava and Gusinye to annexation led to long negotiations, and eventually the "Corti Compromise" was agreed to by a conference of the Powers at Constantinople (April 18, 1880). Plava and Gusinye were to be restored to Turkey, while the Montenegrin frontier was extended so as to include the Hoti and the greater part of the Klementi tribes. This arrangement, which could hardly have proved successful, was not carried out by Turkey, and the Powers subsequently decided to annex Dulcigno to Montenegro in exchange for Plava and Gusinye. The Porte interposed delays, though consenting in principle, and the Albanian League (see ALBANIA) assumed a menacing attitude. On the 28th of September the fleets of the Powers under Admiral Seymour appeared off Dulcigno, and the British government shortly afterwards proposed to occupy Smyrna. On the 11th of November the Porte yielded; on the 22nd the Turkish troops defeated the Albanians, and on the 25th Montenegro obtained possession of Dulcigno. The present frontier, as already described, was shortly afterwards delimited by an international commission. With the exception of some frontier troubles, the years since 1880 have been spent in peace, and the country has advanced in prosperity under the autocratic but enlightened rule of Prince Nicholas. The relations with Turkey, the traditional foe, have improved, while those with Austria have become less friendly. In July 1893 the four-hundredth anniversary of the foundation of the printing-press at Obod was celebrated at Cettigne, several foreign universities and learned bodies being represented at the festivities. In September 1896 the bi-centenary of the Petrovitch dynasty was commemorated. The marriage in the same year of Princess Helen, fourth daughter of Prince Nicholas, with the crown prince of Italy, subsequently King Victor Emmanuel III., led to an increase of Italian influence in the principality. In December 1900 Prince Nicholas assumed the title "Royal Highness." In October 1906 the first Montenegrin parliament assembled at Cettigne; and on the 28th of August 1910, Prince Nicholas (*q.v.*) assumed the title of king.

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MONTE OLIVETO MAGGIORE, a monastery of Tuscany, Italy, 6 m. S. of Asciano. It was founded in 1320, and is mainly celebrated for the beautiful frescoes in the monastery court, which are by Luca Signorelli (1497–1498) and Antonio Bazzi, called Sodoma (1505), representing scenes from the legend of St Benedict. The church and library contain fine inlaid woodwork by Fra Giovanni da Verona.

MONTEPULCIANO, a town and episcopal see of the province of Siena, Tuscany, Italy, 44 m. S.E. of Siena by rail. Pop. (1901) 6288 (town); 15,384 (commune). The town, 6 m. W. of the station, crowns the summit of a hill (1984 ft.), and is surrounded by medieval walls. It is not traceable in history before A.D. 715. It was under the protection of Siena till 1202, when it declared for Florence and thenceforward passed from one mistress to the other, until early in the 16th century when it finally became Florentine. In 1561 it became an episcopal see. Most of the buildings belong to the Renaissance; except the castle, the 14th-century Palazzo Pubblico, and the portals of two or three churches, especially that of S. Maria (13th century). There are a number of fine private houses, some built by Antonio da Sangallo the elder (1455?–1534) and Baldassare Peruzzi (1481–1536) and others by Vignola (1507–1573). The beautiful church of the Madonna di S. Biagio—probably Sangallo's masterpiece—was built in 1518–1537. The cathedral built by Bartolommeo Ammanati (1570), modified by Ippolito Scalza, and completed in 1680 (with the exception of the façade, which is still unfinished) contains a large altar-piece by Taddeo di Bartolo of Siena, and the fragments of an imposing monument erected in 1427–1436 by the Florentine architect Michelozzo in honour of Bartolommeo Aragazzi, secretary of Pope Martin V., which was taken down in the 18th century. The façade of S. Agostino is probably also Michelozzo's work. Montepulciano is famous for its wine, and was the birthplace of the scholar and poet Angelo Anbrogini (1454–1494), generally known as Poliziano (Politian) and of Cardinal Bellarmine (1542–1621).

See F. Bargagli-Petrucci, *Montepulciano, Chiusi, &c.* (Bergamo, 1907).

MONTEREAU, a town of northern France, in the department of Seine-et-Marne at the confluence of the Yonne with the Seine, 21 m. S.E. of Melun by rail. Pop. (1906), 7870. The church dates from the 13th century, with a façade of the Renaissance period. The industries include the manufacture of porcelain, fire-proof and decorative bricks, boots and shoes and agricultural machines and colours, varnish, &c. Among the institutions are a tribunal of commerce and a chamber of arts and manufactures.

Montereau was in the beginning of the 15th century a place of some importance. Here, on the bridge over the Yonne, Jean Sans-Peur, duke of Burgundy was assassinated in the presence of the Dauphin, afterwards Charles VII., in 1419. In 1438 the town was captured by Charles VII., and during the wars of religion it was several times taken and retaken. In 1814 Napoleon gained a victory at Montereau over the Württemberg troops under Schwarzenberg, and in memory of this his statue has been erected on the bridge.

MONTEREY, a city of Monterey county, California, U.S.A., on the Pacific coast, about 90 m. in a straight line S. by E. from San Francisco, at the S.E. extremity of the Gulf of Monterey, a great open bay 22 m. wide from headland to headland and facing S.W. The harbour is protected by a peninsula extending N.W. Pop. (1900), 1748, largely of Spanish descent; (1910) 4923. It is served by the Southern Pacific railroad, and for freight by the Pacific Coast Steamship Co. It is built in an amphitheatre formed by gently sloping pine-clad hills. In 1881 the Southern Pacific Company erected the Del Monte hotel, with beautiful grounds several miles in extent, and since then the city has come to be one of the favourite resorts of the Pacific coast. The difference between the mean temperatures of the coldest and warmest months of the year (rarely below 47° or above 66° F. respectively) is from 10° to 20°; while the thermometer rarely registers below freezing or above 80° F. Within the city limits there is a United States Army post, the Presidio of Monterey, with a musketry school. There are sardine canneries here and good salmon and other fishing; some salmon are shipped to Germany to be smoked. In 1907 the south side of the Gulf of Monterey was made by the state legislature into a preserve for squid and other food for salmon. To San Francisco, Hawaii, Alaska, and elsewhere, Monterey ships annually about 60,000 tons of crude oil, piped here into great steel tanks from the Coalinga oil fields 112 m. away. Sand lime brick is manufactured here.

Before the coming of the Americans, Monterey was the gayest and most ambitious city of California. It was discovered by Sebastian Vizcaino in December 1602, and was named in honour of the then viceroy of New Spain. For a time all trace was lost of Monterey, but in May 1770 the bay was found again by Junípero Serra and Captain Gaspar de Portolá. The San Carlos mission of the Franciscans was founded on the 3rd of June 1770, and a presidio was completed in 1778. Near Monterey, in Carmel Valley, whither the mission was almost immediately removed, Father Junípero built a church, in which his remains now rest. In 1891 a statue, representing Junípero stepping from a boat, was erected on the site of the old Mexican fort, on a hill near the landing-place of both Vizcaino and Junípero. Monterey necessarily played a prominent part in the jealousies that divided the north and south; the rivalry of Los Angeles for the dignity of capital being a powerful influence in politics from 1827–1846. In 1845 Los Angeles gained the prize, but in 1847 the American authorities again made Monterey the capital. Even in these years the treasury, custom-house and military headquarters had remained at Monterey. In 1818 it was captured and momentarily held by a Buenos Aires privateer. Here, in 1842, Commodore T. ap C. Jones raised the flag of the United States for a day, and here on the 7th of July 1846, Commodore J. D. Sloat again raised the same flag, which this time was not to come down again. The first American newspaper on the Pacific coast was published at Monterey; and the convention that framed the first constitution of the state met here in September 1849 in Colton Hall, still standing and originally built for a schoolhouse by Walter D. Colton, the first alcalde under American rule. Monterey was never the capital of the new state, and its importance declined after the discovery of gold near Sacramento, San Francisco becoming the leading city. In 1872 the county-seat was removed from Monterey to Salinas. For many years Monterey remained one of the most Spanish towns of California, and though tourists have somewhat disturbed its peace and checked its decay, it still retains much of the quaint aspect and the drowsy contentment of spirit of Mexican days. Since 1900 the population has considerably increased.

MONTERREY (usually spelled Monterey in English), a city of Mexico and capital of the state of Nuevo León, 606 m. by the old wagon road, and 671 m. by the Mexican National railway N. by W. of the city of Mexico, in lat. 25° 40′ N., long. 100° 25′ W. Pop. (1900), 62,266. Railway communications are provided by the Mexican National with the United States, with the national capital and southern Mexico, and with Matamoros, and by the Belgian line with Tampico on the Gulf coast, and with Treviño, or Venadito, on the Mexican International line, which gives access to the iron deposits of Durango. The city stands 1624 ft. above sea-level, between two spurs of one of the Sierra Madre ranges—the Cerro de la Silla (4149 ft.) on the east, and the Cerro de las Mitras (3618 ft.) on the west. The Santa Catarina river furnishes water-power for some of its industries. The surrounding district is fertile, and the rainfall about 22 in. The climate is dry and mild, and the city is frequented in winter by invalids from the United States. Monterrey is laid out with broad, straight streets crossing each other at right angles, and spreads over a large area. It is the see of the bishop of Linares, and has a large cathedral, a bishop's palace and numerous churches. Among the public edifices are the government palace, municipal hall, national college, girls' college, medical school, public hospital, theatre and penitentiary. Its public works include an interesting old reservoir, called the "Ojo de Agua," and the "Puente Nuevo" (new bridge). Monterrey is the most important centre of northern Mexico, and large sums of foreign capital have been invested in its industries. Among its manufactories are woollen mills, smelting works, brass and iron foundries, a steel producing plant, saw-mills, flour-mills, breweries, and a carriage and wagon factory.

Monterrey was founded in 1560 under the name of Santa Lucía de León; and in 1596, as Monterrey, was raised to the dignity of a city. In 1777 it became the see of a bishop, now suffragan to the archbishop of Guadalajara. During the war between Mexico and the United States General Zachary Taylor arrived before the city on the 19th of September 1846, with about 6600 men. Monterrey was defended by a Mexican force of about 10,000 under General Pedro de Ampudia. On the 20th Colonel John Garland (1792–1861) assaulted the lower (north-eastern) part of the city; he was driven back, but captured one of the forts. The attacks on the other forts on the east were unsuccessful. On the 21st and 22nd General W. J. Worth carried the forts west of Monterrey, and on the 23rd attacked the western part of the city, the troops slowly working their way toward the central plaza. On the same day American troops again advanced from the east, and were again forced back. On the morning of the 24th the terms of a capitulation were agreed upon—the Mexicans were permitted to retire, retaining their small arms and one field battery of six pieces with twenty-one rounds of ammunition, and an armistice of eight weeks was arranged. A disastrous flood, caused by heavy rains and the sudden overflow of the Santa Catarina river on the 28th of August 1909, swept away about one-fourth of the city, drowning 1200–1400 persons, and destroying about $12,000,000 (Mex.) worth of property.

MONTE SAN GIULIANO, a town and episcopal see of Sicily, in the province of Trapani, 2 m. E.N.E. of Trapani, on the summit of an isolated bare hill, 2465 ft. above the sea. Pop. of commune (1901), 28,939; of town, about 3000. The town occupies the site of the ancient *Eryx*, a city of the Elymi, a people who claimed to be sprung from a mixed settlement of Trojans and Phocians after the fall of Troy (E. A. Freeman, *History of Sicily*, i. 195, 542), but regarded as *βάρβαροι* by the Greeks. The city was famous for the temple of Venus Erycina, to the foundations of which a wall of 12 courses of masonry in the castle probably belongs. The worship was a relic of the Phoenician cult of Astarte. In 415 B.C. the Athenian envoys were shown the treasure of the temple at Eryx as available for the expenses of the war, which treasure turned out to be only silver-gilt and not of solid gold (Thucydides vi. 46). The town must have become a part of the Carthaginian dominion in 405 B.C. It was seized by Pyrrhus in 278 B.C., and was ceded to Rome at the end of the First Punic War. In Roman times the temple (like that of Diana Tifatana, near Capua) possessed territory of its own, being dependent neither on the state nor on any neighbouring town, and a considerable number of female slaves. The place was the residence of the quaestor in charge of the western half of the island, and Verres, as praetor, seems to have spent a good deal of time here. Considerable portions of the city wall are preserved on the north-west; on the east and south the precipitous cliffs formed a sufficient defence. The remains date from a reconstruction of Roman times,[1] in which the material of two earlier periods has been used: the large blocks belonging to the original fortifications bear Phoenician masons' marks; but the long line of towers at regular intervals is a thoroughly Roman characteristic. The castle, dating from the middle ages, with three lofty towers guarding the entrance, occupies the south-eastern extremity of the town. The cathedral, founded in 1314, has a fine porch and Gothic façade.

MONTE SAN SAVINO, a town of Tuscany, Italy, in the province of Arezzo, from which it is 12 m. S.W. by road, 1083 ft. above sea-level. Pop. (1901), 4810 (town); 8408 (commune). It was the birthplace of the sculptor and architect Andrea Contucci, generally known as Sansovino (1460–1529), and there are various works in the town by him, a loggia opposite the Palazzo Municipale (itself by Antonio da Sangallo the elder and one of his best works), the monastery courts of S. Agostino and S. Giovanni Battista, and some sculptures.

MONTE SANT' ANGELO, a town of Apulia, Italy, in the province of Foggia, 10 m. N. of Manfredonia by road, 2765 ft. above sea-level, on the southern slopes of Monte Gargano. Pop. (1901), 17,369 (town); 21,997 (commune). It has a castle and a famous sanctuary of S. Michele, founded in 491 over a cave in which the archangel is said to have appeared to S. Laurentius, archbishop of Sipontum; the bronze doors, made in Constantinople, bear the date 1076. The octagonal campanile dates from 1273. The portal of S. Maria Maggiore is noteworthy. The Tomba di Rotari is a domed building of the Norman period. To the north lies the highest point of the Monte Gargano (3460 ft.). Strabo speaks of an oracle of Calchas on the top of the mountain, and a healing spring at Podalirius at the bottom, 12 m. from the sea.

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[1] This has been demonstrated by O. Richter, *Über antike Steinmetzzeichen* (Berlin, 1885), pp. 43–51.

See S. Beltramelli, *Il Gargano* (Bergamo, 1907).

MONTESPAN, FRANÇOISE-ATHENAÏS DE PARDAILLAN, Marquise de (1641–1707), mistress of Louis XIV., was born at the château of Tonnay-Charente (Charente-Inférieure), the daughter of Gabriel de Rochechouart, duc de Mortemart. She was educated at the Convent of St Mary at Saintes, and when she was twenty she became maid-of-honour to Queen Maria Theresa. She married in January 1663 L. H. de Pardaillan de Gondrin, marquis de Montespan, who was a year younger than herself. By him she had two children, L. H. Pardaillan de Gondrin, duc d'Antin, born in 1665, and a daughter. Her brilliant and haughty beauty was only one of the Montespan's charms; she was a cultivated and amusing talker who won the admiration of such competent judges as Saint-Simon and Mme de Sévigné. Nevertheless she was a profound believer in witchcraft, and La Reynie, the chief judge of the court before which the famous poisoning cases were brought, places her first visits to La Voisin (*q.v.*) in 1665. She received from the sorceress love powders concocted of abominable ingredients for Louis XIV., and in 1666 the "black mass" was said by the priest Étienne Guibourg over her with the usual horrible ceremonial. In 1667 she gained her end, becoming Louis XIV.'s mistress in July. Montespan astounded the court by openly resenting his wife's position. He made a scandal by accusing Mme de Montausier of acting as go-between in order to secure the governorship of the dauphin for her husband. He even wore mourning for his wife. Montespan was arrested, but released after a few days' imprisonment. The first of the seven children whom Mme de Montespan bore to the king was born in March 1669, and was entrusted to Mme Scarron, the future Mme de Maintenon, who acted as companion to Mme de Montespan while the king was away at the wars. Her children were legitimatized in 1673 without mention of the mother's name for fear that Montespan might claim them. The eldest, Louis Auguste, became duc de Maine, the second, Louis César, comte de Vexin, and the third, Louise Françoise, demoiselle de Nantes (afterwards duchess of Bourbon). Meanwhile Montespan had been compelled to retire to Spain, and in 1674 an official separation was declared by the *procureur-général* Achille de Harlay, assisted by six judges at the Châtelet. When Louis's affections showed signs of cooling, Mme de Montespan had recourse to magic. In 1675 absolution was refused to the king, with the result that his mistress was driven from the court for a short time. It has been thought that she had conceived the intention of poisoning even as early as 1676, but in 1679 Louis's intrigue with Angélique de Fontanges and her own relegation to the position of superintendent of the queen's household brought matters to a crisis. Mlle de Fontanges died a natural death in 1681, though poisoning was suspected. Meanwhile suspicion was thrown on Mme de Montespan's connexion with La Voisin and her crew by the frequent recurrence of her maid's name, Mlle Desoeillets, in the evidence brought before the Chambre Ardente. From the end of 1680 onwards Louvois, Colbert and Mme de Maintenon all helped to hush up the affair and to prevent further scandal about the mother of the king's legitimatized children. Louis XIV. continued to spend some time daily in her apartments, and apparently her brilliance and charm in conversation mitigated to some extent her position of discarded mistress. In 1691 she retired to the Convent of St Joseph with a pension of half a million francs. Her father was governor of Paris, her brother, the duc de Vivonne, a marshal of France, and one of her sisters, Gabrielle, whose vows were but four years old, became abbess of the wealthy community of Fontevrault. Besides the expenses of her houses and equipage Mme de Montespan spent vast sums on hospitals and charities. She was also a generous patron of letters, and befriended Corneille, Racine and La Fontaine. The last years of her life were given up to penance. When she died at Bourbon l'Archambault on the 27th of May 1707 the king forbade her children to wear mourning for her. Real regret was felt for her by the duchess of Bourbon and by her younger children—Françoise Marie, Mlle de Blois (1677–1749), married in 1692 to the future regent Orleans, then duc de Chartres, and Louis Alexandre, comte de Toulouse (1678–1737).

See P. Clément, *Madame de Montespan et Louis XIV.* (Paris, 1869); monographs by Arsène Houssaye (1865) and by H. Williams (1903); also J. Jair, *Louise de la Vallière* (Eng. trans., 1908); F. Funck-Brentano, *Le Drame des poisons* (1899); A. Durand, "Un épisode du grand règne" in *Rev. des questions hist.* (Paris, 1868); the contemporary memoirs of Mme de Sévigné, of Saint-Simon, of Bussy-Rabutin and others; also the proceedings of the Chambre Ardente preserved in the *Archives de la Bastille* (Arsenal Library) and the notes of La Reynie preserved in the Bibliothèque Nationale. She figured in V. Sardou's play, *L'Affaire des poisons* (1907).

MONTESQUIEU, CHARLES LOUIS DE SECONDAT, Baron de la Brède et de (1689–1755), French philosophical historian, was born at the château of La Brède, about 10 m. south-east of Bordeaux, in January 1689, and was baptized on the 18th of that month. His mother was Marie Françoise de Penel, the heiress of a Gascon-English family. She had brought La Brède as a dowry to his father, Jacques de Secondat, a member of a good if not extremely ancient house, which seems first to have risen to importance in the early days of the 16th century. The title of Montesquieu came from his uncle, Jean Baptiste de Secondat, "président à mortier" in the parliament of Bordeaux—an important office, which, as well as his title, he left to his nephew. Montesquieu was in his youth known as M. de la Brède. His mother died when he was seven years old, and when he was eleven he was sent to the Oratorian school of Juilly, near Meaux, where he stayed exactly five years, and where, as well as afterwards at Bordeaux, he was thoroughly educated. The family had long been connected with the law, and Montesquieu was destined for that profession. His father died in 1713, and a year later Montesquieu was admitted counsellor of the parliament. In little more than another twelvemonth he married Jeanne Lartigue, an heiress and the daughter of a knight of the order of St Louis, but plain, somewhat ill-educated, and a Protestant. Montesquieu does not seem to have made the slightest pretence of affection or fidelity towards his wife, but there is every reason to believe that they lived on perfectly good terms. In 1716 his uncle died, leaving him his name, his important judicial office and his whole fortune.

He continued to hold his presidency for twelve years, and took part in the proceedings of the Bordeaux Academy, to which he contributed papers on philosophy, politics and natural science. He also wrote much less serious things, and it was during the earlier years of his presidency that he finished, if he did not begin, the *Lettres persanes*. They were completed before 1721, and appeared in that year anonymously, with Cologne on the title-page, but they were really printed and published at Amsterdam. In the guise of letters written by and to two Persians of distinction travelling in Europe, Montesquieu not only satirized unmercifully the social, political, ecclesiastical and literary follies of his day in France, but indulged in a great deal of the free writing which was characteristic of the tale-tellers of the time. But what scandalized grave and precise readers naturally attracted the majority, and the *Lettres persanes* were very popular, passing, it is said, through four editions within the year, besides piracies. Then the vogue suddenly ceased, or at least editions ceased for nearly nine years to appear. It is said that a formal ministerial prohibition was the cause of this, and it is not improbable; for, though the regent and Guillaume Dubois must have enjoyed the book thoroughly, they were both shrewd enough to perceive that underneath its playful exterior there lay a spirit of very inconvenient criticism of abuses in church and state. The fact is that the *Lettres persanes* is the first book of what is called the Philosophe movement. It is amusing to find Voltaire describing the *Lettres* as a "trumpery book," a "book which anybody might have written easily." It is not certain that, in its peculiar mixture of light badinage with not merely serious purpose but gentlemanlike moderation, Voltaire could have written it himself, and it is certain that no one else at that time could.

The reputation acquired by this book brought Montesquieu much into the literary society of the capital, and he composed for, or at any rate contributed to, one of the coteries of the day the clever but rather rhetorical *Dialogue de Sylla et d'Eucrate*, in which the dictator gives an apology for his conduct. For Mlle de Clermont, a lady of royal blood, a great beauty and a favourite queen of society, he wrote the curious prose-poem of the *Temple de Gnide.* This is half a narrative, half an allegory, in the semi-classical or rather pseudo-classical taste of the time, decidedly frivolous and dubiously moral, but of no small elegance in its peculiar style. A later *jeu d'esprit* of the same kind, which is almost but not quite certainly Montesquieu's, is the *Voyage à Paphos*, in which his warmest admirers have found little to praise. In 1725 Montesquieu was elected a member of the Academy, but an almost obsolete rule requiring residence in Paris was appealed to, and the election was annulled. It is doubtful whether a hankering after Parisian society, or an ambition to belong to the Academy, or a desire to devote himself to literary pursuits of greater importance, or simple weariness of not wholly congenial work determined him to give up his Bordeaux office. In 1726 he sold the life-tenure of his office, reserving the reversion for his son, and went to live in the capital, returning, however, for half of each year to La Brède. There was now no further formal obstacle to his reception in the Académie Française, but a new one arose. Ill-wishers had brought the *Lettres persanes* specially under the minister André Hercule de Fleury's attention, and Fleury, a precisian in many ways, was shocked by them. There are various accounts of the way in which the difficulty was got over, but all seem to agree that Montesquieu made concessions which were more effectual than dignified. He was elected and received in January 1728.

Almost immediately afterwards he started on a tour through Europe to observe men, things and constitutions. He travelled through Austria to Hungary, but was unable to visit Turkey as he had proposed. Then he made for Italy, where he met Chesterfield. At Venice, and elsewhere in Italy, he remained nearly a year, and then journeyed by way of Piedmont and the Rhine to England. Here he stayed for some eighteen months, and acquired an admiration for English character and polity which never afterwards deserted him. He returned, not to Paris, but to La Brède, and to outward appearance might have seemed to be settling down as a squire. He altered his park in the English fashion, made sedulous inquiries into his own genealogy, arranged an entail, asserted, though not harshly, his seignorial rights, kept poachers in awe and so forth. But these matters by no means engrossed his thoughts. In his great study at La Brède (a hall rather than a study, some 60 ft. long by 40 wide) he was constantly dictating, making abstracts, revising essays, and in other ways preparing his main book. He may have thought it wise to soften the transition from the *Lettres persanes* to the *Esprit des lois*, by interposing a publication graver than the former and less elaborate than the latter. The *Considérations sur les causes de la grandeur et de la décadence des Romains* appeared in 1734 at Amsterdam, without the author's name. This, however, was perfectly well known; indeed, Montesquieu formally presented a copy to the French Academy. But the author's reputation as a jester stuck to him, and the salons affected to consider the *Lettres persanes* and the new book respectively as the "grandeur" and the "décadence de" M. de Montesquieu; but more serious readers at once perceived its extraordinary merit, and it was eagerly read abroad. A copy of it exists or existed which had the singular misfortune to be annotated by Frederick the Great, and to be abstracted from the Potsdam library by Napoleon. It is said, moreover, by competent authorities to have been the most enduringly popular and the most widely read of all its author's works in his own country, and it was certainly been the most frequently and carefully edited. Merely scholastic criticism may of course object to it, as to every other book of the time, the absence of the exactness of modern critical inquiry into the facts of history; but the virtue of Montesquieu's book is in its views, not in its facts. It is (putting Bossuet and Giovanni Vico aside) almost the first important essay in the philosophy of history. The point of view is entirely different from that of Bossuet, and it seems entirely improbable that Montesquieu knew anything of Vico. In the *Grandeur et décadence* the characteristics of the *Esprit des lois* appear with the necessary subordination to a narrower subject. Two things are especially noticeable in it: a peculiarity of style, and a peculiarity of thought. The style has a superficial defect. The page is broken up into short paragraphs of but a few lines each, which look very ugly, which irritate the reader by breaking the sense, and which prepare him to expect an undue and ostentatious sententiousness. On the other hand, the merits of the expression are very great. It is grave and destitute of ornament, but extraordinarily luminous and full of what would be called epigram, if the word epigram had not a certain connotation of flippancy about it. It is a very short book; for, printed in large type with tolerably abundant notes, it fills but two hundred pages in the standard edition of Montesquieu's works. But no work of the century, except Turgot's second Sorbonne *Discourse*, contains, in proportion to its size, more weighty and original thought on historical subjects, while Montesquieu has over Turgot the immense advantage of style.

Although, however, this *ballon d'essai*, in the style of his great work, may be said to have been successful, and though much of that work was, as we have seen, in all probability already composed, Montesquieu was in no hurry to publish it. He went on "cultivating the garden" diligently both as a student and as an improving landowner. He wrote the sketch of *Lysimaque* for Stanislaus Leczinski; he published new and final editions of the *Temple de Gnide*, of the *Lettres persanes*, of *Sylla et Eucrate* (which indeed had never been published, properly speaking). After allowing the *Grandeur et décadence* to be reprinted without alterations some half-dozen times, he revised and corrected it. He also took great pains with the education of his son Charles and his daughter Denise, of whom he was extremely fond. He frequently visited Paris, where his favourite resorts were the salons of Mme de Tencin and Mme d'Aiguillon. Yet it seems that he did not begin the final task of composition till 1743. Two years of uninterrupted work at La Brède finished the greater part of it, and two more the rest. It was finally published at Geneva in the autumn of 1748, in two volumes quarto. The publication was, however, preceded by one of those odd incidents which in literature illustrate Clive's well-known saying about courts-martial in war. Montesquieu summoned a committee of friends, according to a very common practice, to hear and give an opinion on his work. It was an imposing and certainly not an unfriendly one, consisting of Charles Jean François Hénault, Helvétius, the financier Etienne de Silhouette, the dramatist Joseph Saurin, Crébillon the younger, and, lastly, Fontenelle—in fact, all sorts and conditions of literary men. They unanimously advised the author not to publish a book which has been described as "one of the most important books ever written," and which may be almost certainly ranked as the greatest book of the French 18th century.

Montesquieu, of course, did not take his friends' advice. In such cases no man ever does, and in this case it was certainly fortunate. The *Esprit des lois* represents the reflections of a singularly clear, original, and comprehensive mind, corrected by forty years' study of men and books, arranged in accordance with a long deliberated plan, and couched in language of remarkable freshness and idiosyncrasy. In the original editions the full title runs *L'Esprit des lois: ou du rapport que les lois* *doivent avoir avec la constitution de chaque gouvernement, les mœurs, le climat, la religion, le commerce, &c.* It consists of thirty-one books, which in some editions are grouped in six parts. Speaking summarily, the first part, containing eight books, deals with law in general and with forms of government; the second, containing five, with military arrangements, with taxation, &c.; the third, containing six, with manners and customs, and their dependence on climatic conditions; the fourth, containing four, with economic matters; and the fifth, containing three, with religion. The last five books, forming a kind of supplement, deal specially with Roman, French, and feudal law. The most noteworthy peculiarity of the book to a cursory reader lies in the section dealing with effects of climate, and this indeed was almost the only characteristic which the vulgar took in, probably because it was easily susceptible of parody and *reductio ad absurdum.* The singular spirit of moderation which distinguishes its views on politics and religion was indeed rather against it than in its favour in France, and Helvétius, who was as outspoken as he was good-natured, had definitely assigned this as the reason of his unfavourable judgment. On the other hand, if not destructive it was sufficiently critical, and it thus raised enemies on more than one side. It was long suspected, but is now positively known, that the book (not altogether with the goodwill of the pope) was put on the Index, and the Sorbonne projected, though it did not carry out, a regular censure. To all these objectors the author replied in a masterly *défense*; and there seems to be no foundation for the late and scandalous stories which represent him as having used Mme de Pompadour's influence to suppress criticism. The fact was that, after the first snarlings of envy and incompetence had died away, he had little occasion to complain. Even Voltaire, who was his decided enemy, was forced at length to speak in public, if not in private, complimentarily of the *Esprit*, and from all parts of Europe the news of success arrived.

Montesquieu enjoyed his triumph rather at La Brède than at Paris. He was becoming an old man, and, unlike Fontenelle, he does not seem to have preserved in old age the passion for society which had marked his youth. He certainly spent much of his later years in the country, though he sometimes visited Paris, and on one visit procured the release of his admirer Laurent Angliviel de La Beaumelle from an imprisonment which La Beaumelle had suffered at the instance of Voltaire. He is said also to have been instrumental in obtaining a pension for Alexis Piron. Nor did he by any means neglect literary composition. The curious little romance of *Arsace et Isménie*, a short and unfinished treatise on Taste, many of his published *Pensées*, and much unpublished matter date from the period subsequent to the *Esprit des lois.* He did not, however, live many years after the appearance of his great work. At the end of 1754 he visited Paris, with the intention of getting rid of the lease of his house there and finally retiring to La Brède. He was shortly after taken ill with an attack of fever, which seems to have affected the lungs, and in less than a fortnight he died, on the 10th of February 1755, aged sixty-six. He was buried in the church of St Sulpice with little pomp, and the Revolution obliterated all trace of his remains.

The literary and philosophical merits of Montesquieu and his position, actual and historical, in the literature of France and of Europe, are of unusual interest. At the beginning of the next century the vicomte de Bonald classed him with Racine and Bossuet, as the object of a "religious veneration" among Frenchmen. But Bonald was not quite a suitable spokesman for France, and it may be doubted whether the author of the *Esprit des lois* has ever really occupied any such position in his own country. For a generation after his death he remained indeed the idol and the great authority of the moderate reforming party in France. Montesquieu is not often quotable, or quoted, at the present day, and the exact criticism of our time challenges the accuracy of his facts. Although he was really the founder, or at least one of the founders, of the sciences of comparative politics and of the philosophy of history, his descendants and followers in these sciences think they have outgrown him. In France his popularity has always been dubious and contested. It is a singular thing that for more than a century there was no properly edited edition of his works, and nothing even approaching a complete biography of him, the place of the latter being occupied by the meagre and rhetorical *Éloges* of the last century. According to his chief admirers, he is hardly read at all in France to-day, and they attempt to explain the fact by confessing that Montesquieu, great as he is, is not altogether great according to French principles. It is not only that he is an Anglo-maniac, but that he is rather English than French in style and thought. He is almost entirely dispassionate in politics, but he lacks the unswerving deductive consistency which Frenchmen love in that science. His wit, it is said, is quaint and a little provincial, his style irregular and in no definite *genre.*

Some of these things may be allowed to exist and to be defects in Montesquieu, but they are balanced by merits which render them almost insignificant. It is on his three principal works that his fame does and must rest. Each one of these is a masterpiece in its kind. It is doubtful whether the *Lettres persanes* yield at their best either in wit or in giving lively pictures of the time to the best of Voltaire's similar work, though they are more unequal. There is, moreover, the great difference between Montesquieu and Voltaire that the former is a rational reformer, and not a mere *persifleur* or *frondeur*, to whom fault-finding is more convenient than acquiescence for showing off his wit. Of course this last description does not fully or always describe Voltaire, but it often does. It is seldom or never applicable to Montesquieu. Only one of Voltaire's own charges against the book and its author must be fully allowed. He is said to have replied to a friend who urged him to give up his habit of sneering at Montesquieu, "Il est coupable de lèse-poésie," and this is true. Not only are Montesquieu's remarks on poetry childish (he himself occasionally wrote verses, and very bad ones), but he is never happy in purely literary appreciation. The *Considérations* are noteworthy, not only for the complete change of style (which from the light and mocking tone of the *Lettres* becomes grave, weighty and sustained, with abundance of striking expression), but for the profundity and originality of the views, and for the completeness with which the author carries out his plan. These words—except, perhaps the last clause—apply with increasing force to the *Esprit des lois.* The book has been accused of desultoriness, but this arises, in part at least, from a misapprehension of the author's design. At the same time, it is impossible to deny that the equivocal meaning of the word "law," which has misled so many reasoners, has sometimes misled Montesquieu himself. For the most part, however, he keeps the promise of his sub-title (given above) with fidelity, and applies it with exhaustive care. It is only in the last few books, which have been said to be a kind of appendix, that something of irrelevancy suggests itself. The real importance of the *Esprit des lois*, however, is not that of a formal treatise on law, or even on polity. It is that of an assemblage of the most fertile, original and inspiriting views on legal and political subjects, put in language of singular suggestiveness and vigour, illustrated by examples which are always apt and luminous, permeated by the spirit of temperate and tolerant desire for human improvement and happiness, and almost unique in its entire freedom at once from doctrinairism, from visionary enthusiasm, from egotism, and from an undue spirit of system. As for the style, no one who does not mistake the definition of that much used and much misused word can deny it to Montesquieu. He has in the *Esprit* little ornament, but his composition is wholly admirable. Yet another great peculiarity of this book, as well as of the *Considérations*, has to be noticed. The genius of the author for generalization is so great, his instinct in political science so sure, that even the falsity of his premises frequently fails to vitiate his conclusions. He has known wrong, but he has thought right.

The best edition of Montesquieu is that of Edouard Laboulaye (7 vols., Paris, 1875–1879), the best biography that of Louis Vian

(Paris, 2nd ed., 1879). The bibliography of Montesquieu was dealt with by L. Dangeau in 1874. There is known to exist at La Brède a great mass of MS. materials for the *Esprit des lois*, additional *Lettres persanes*, essays, and fragments of all kinds, diaries, letters, notebooks and so forth. The present possessors, however, who represent Montesquieu, long refused permission to examine these to all editors and critics, and they were chiefly known by a paper contributed in 1834 to the *Transactions* of the Academy of Agen. At last in 1891 Baron Charles de Montesquieu published *Deux opuscules* of his ancestors, and in 1899 Baron Gaston de Montesquieu added *Pensées*, &c. Nothing, however, of much interest has yet appeared. For a thorough student *L'Esprit de Montesquieu* by A. Charaux (1885) has value, for it is written, with some ability, from a point of view now very uncommon, that of a convinced Roman Catholic, anti-parliamentarian and anglophobe critic, who regards Montesquieu as an "evangelist of social atheism" and the like. The view is quite untenable but useful as a corrective. An article by Churton Collins on "Montesquieu in England" (*Quarterly Review*, No. 394, April 1903) may be also consulted.

(G. Sa.)

MONTESQUIOU-FÉZENSAC, ANNE PIERRE, Marquis de (1739–1798), French general and writer, was born in Paris on the 17th of October 1739, of an ancient family of Armagnac. He was brought up with the children of the king of France, and showed some taste for letters. He entered the army in 1754, was successively colonel of the Grenadiers and the Royal-Vaissaux regiment, and in 1780 was made *maréchal-de-camp*. Some pieces of verse and several comedies gained him admission to the French Academy in 1784. He was elected deputy to the states general of 1789 by the nobles of Paris, and, animated by Liberal ideas, he soon joined the Third Estate, and seconded Necker's financial schemes. He served on the committee charged with the issue of *assignats*, and was named president of the Constituent Assembly on the 14th of March 1791. In May 1791 he was promoted lieutenant-general, served under Lafayette, and in February 1792 was given the command of the Army of the South. In September of the same year he completed the conquest of Savoy, but in November 1792 he was accused of royalist leanings, and had to take refuge in Switzerland. In 1795 his name was erased from the list of *émigrés* and he returned to Paris, where he died on the 30th of December 1798.

See P. L. Roederer, *Éloge de Montesquiou*, reprinted in Roederer's *Works* (1853–1859).

MONTESSON, CHARLOTTE JEANNE BÉRAUD DE LA HAYE DE RIOU, Marquise de (1737–1805), was born in Paris of an old Breton family. About 1754 she married Jean Baptiste, marquis de Montesson, who died in 1769. Her beauty and intelligence attracted the attention of Louis Philippe, duke of Orleans, whom she secretly married in 1773 with the authorization of the king. For her husband's amusement she set up a little theatre and wrote several plays, in the acting of which she herself took part. She was imprisoned for some time during the Terror, but was released after the fall of Robespierre, became the friend of the empress Josephine, and was a prominent figure at the beginning of the empire.

The best edition of her works appeared under the title of *Œuvres anonymes* in 1782–1785. See Charles Collé, *Journal* (1868); the *Memoirs* of St Simon, Madame de Genlis, the duchesse d'Abrantès and Mme de Levis; G. Strenger, "La Société de la marquise de Montesson," in the *Nouvelle revue* (1902); J. Turquan, *Madame de Montesson douairière d'Orléans* (Paris, 1904); and G. Capon and R. Ive-Plessis, *Les Théâtres clandestins du xviii^e siècle* (1904).

MONTEVERDE, CLAUDIO (1567–1643), Italian priest and musician, was born at Cremona in May 1567; he was engaged at an early age as violist to the duke of Mantua, and studied composition under Ingegneri, the duke's maestro di capella. His bold experiments, while bringing upon him the attacks of Artusi and Banchieri (*q.v.*), led to discoveries which exercised a lasting influence upon the progress of musical art. He was the first to make deliberate use of unprepared dissonances, or what are now known as fundamental discords. These discords constituted a revolution against the laws of 16th century music. He employed them first in his madrigals, where they are a sign of decadence, but afterwards introduced them into music of another kind with such excellent effect that their value was universally recognized. Before 1595 Monteverde was married to the singer Claudia Cattaneo, who died in 1607. In 1602 he succeeded Ingegneri as maestro di capella; and in 1607 he produced, for the marriage of Francesco Gonzaga, his first opera, *Ariana*, in which he employed the newly-discovered discords with irresistible effect. Though he did not invent the lyric drama—Peri's *Euridice* having been produced at Florence in 1600—he raised it to a level which distanced all contemporary competition. His second opera, *Orfeo*, composed in 1608, was even more successful than *Ariana*. In 1613 Monteverde was invited to Venice, as maestro di capella at St Mark's, with a stipend of 300 ducats, which in 1616 was raised to 400. Here he composed much sacred music, the greater part of which is lost. In 1630 he wrote another grand opera, *Proserpina rapita*. He did not become a priest until 1632. In 1639 he produced *L'Adone*, and in 1641 *Le Nozze di Enea* and *Il Ritorno d'Ulisse*. He died in Venice on the 29th of November 1643. Monteverde's harmonic innovations and power of musical rhetoric seemed to put an end to the school of Palestrina, and led the way to modern music. (See Music.)

MONTEVIDEO, SAN FELIPE Y SANTIAGO DE, capital and chief port of Uruguay, and capital of the department of Montevideo, on the northern shore of the Rio de la Plata estuary, 120 m. E.S.E. of Buenos Ayres, in lat. 34° 54′ 33″ S., long. 56° 12′ 18″ W. Pop. (1908, estimate), 312,946. The old city (*ciudad vieja*) occupies a low rocky headland that projects westward between the estuary and an almost circular bay which forms the harbour; it was once enclosed with walls and defended by small forts, all of which have been removed. The new city (*ciudad nueva* and *ciudad novísima*) extends eastward over a beautiful tract of rolling country and is extending northward around the eastern shore of the bay. The site of the old city resembles a whale's back in shape; it slopes gently to its western extremity at Punta Sarandi and to the water's edge on either side. The general plan is that of rectangular squares, except at the western extremity of the old city and its union with the newer or extra-mural city, on the line of the old ramparts, known as Calle de la Ciudadela. The streets are well paved and have sufficient slope at all points to give easy surface drainage; Montevideo has the reputation of being one of the cleanest cities of the world. The rainfall is ample (about 44 in. a year), and the prevailing winds help to clean the streets. The westerly winds, however, sometimes bring across the bay the offensive smells of the great abattoirs and meat-curing establishments (*saladeros*) at the foot of the Cerro. The mean annual temperature is about 62° F. An abundant water supply is brought from the Santa Lucia River, 32 m. distant, with a receiving reservoir at Piedras, 100 ft. above the level of the Plaza de la Independencia. The ciudad vieja is largely devoted to commercial, shipping and financial interests. The government edifices, large retail shops and most of the fine urban residences are in the ciudad nueva, while most of the urban industries, the railway stations and the dwellings of the poorer classes are in the ciudad novísima. Beyond these is a fringe of suburbs (La Union and Paso Molino), and on the western side of the bay is the straggling suburb of Cerro, largely industrial in character. In 1908 eight tramway lines (all electric but one) extended out to these suburbs, some of the lines extending to the bathing resorts of Ramirez and Pocitos and the Buceo cemeteries on the eastern coast.

The principal street, which is considered one of the finest boulevards in South America, is the Calle 18 de Julio, extending eastward from the Plaza de la Independencia to the suburb of Cordon; one of its features is its Sunday morning market, occupying the whole street from the Plaza de la Independencia to the Plaza Libertad, a distance of half a mile—a survival of the old market that existed here at the fortified entrance to the walled town in the earlier years of its history. There are seven plazas, or squares, within the urban limits: Zabala or Rincon, Constitución or Matriz, Independencia, Libertad or Cagancha, Treinte y Tres, Flores and Frutos; and two suburban parks or public gardens: the Paseo del Prado and Parque

Urbano. The Plaza de la Independencia stands at the junction of the old and new towns and is the centre of the city's political and social life. This square is distinguished for a uniform and nearly completed line of colonnades in front of the buildings surrounding it. The Paseo del Prado, which ranks high among the public gardens of South America, is beautifully situated beyond the suburb of Paso Molino, 3 m. from the city. The Paseo was originally the *quinta* of a German of cultivated tastes named Joseph Buschenthal, who spent a fortune in its adornment. The Parque Urbano, at the Playa Ramirez bathing resort, is a modern creation. The buildings of Montevideo are chiefly of brick and broken stone, covered outside with plaster and stucco, of one to three storeys, with flat roofs, usually surmounted by a square tower, or *mirador*. The roofs, or *azoteas*, are largely used for domestic purposes, or roof gardens. The city contains a large number of handsome edifices, both public and private, among which are the Bolsa, Government House, municipal hall, cathedral, Cabildo, Hospital de Caridad, insane asylum, Italian hospital, Teatro Solis, Athenaeum, and the Club Uruguayo. The Bolsa (exchange), custom-house, cathedral, and Cabildo are in the old town; the Bolsa is a copy of the Bordeaux exchange. The cathedral faces on the Plaza de la Constitución. Its two square towers rise 133 ft. above the pavement, and these, with the large dome behind, rise far above the surrounding buildings and make a very conspicuous landmark. The church was consecrated in 1804, and in 1869 was raised to the dignity of a cathedral. Montevideo is now the seat of a small archiepiscopal see with only two suffragan dioceses. Directly across the plaza is the old Cabildo, a plain, heavy-looking two-storeyed edifice of the colonial period, the seat of municipal administration during Spanish rule, but now occupied by the two chambers of the Uruguayan Congress and by the higher police authorities of the city.

The people of Montevideo maintain more than forty charitable associations, including the Caridad (charity) hospital on Calle 25 de Mayo, and the insane asylum in the suburb of La Union, both built and largely supported from the proceeds of frequent lottery drawings. They also maintain a beggars' asylum and a foundlings' asylum. The national museum (founded in 1830) and public library (founded 1833) are in one wing of the Solis theatre. There are a British hospital (founded 1857, the present edifice dating from 1867) chiefly for the use of sailors, an Anglican church in Calle Santa Teresa dating from 1847, and a handsome Italian hospital of modern construction. The university, in Calle Uruguay, has faculties of law, medicine, letters, mathematics, engineering, and some minor groups of studies, including agriculture and veterinary science. The government maintains two normal schools, a school of arts and trades (*artes y oficios*), and a military school.

The harbour of Montevideo consists of a shallow bay, circular in shape and about 2½ m. from shore to shore, and an outer roadstead exposed to the violent winds of this latitude, where the larger ocean-going steamers were compelled to anchor before the construction of the new port works. In 1899 the Uruguayan government entered into a contract for the dredging of the bay, the construction of two long breakwaters, the dredging of a channel to deep water, and the construction of a great basin and docks in front of the city. Surtaxes were imposed on imports and exports to meet the expenditure, and work was begun in 1901. In 1908 the breakwaters and the greater part of the dredging had been completed, and the entrance channel, with a minimum depth of 24½ ft., permitted the admission of large steamers. Another important improvement, for which a concession was given to an English syndicate and work was begun in 1909, is the construction of an embankment and new shore line on the south side of the city, to be finished in five years at a cost of $7,211,116. There are three large dry docks connected with the port, known as the Mauá (275 ft. long, inside) and the Gounouilhou (300 ft.) on the east side of the bay, and Jackson & Cibils (450 ft.) on the west side at the foot of the Cerro. Four railways terminate at Montevideo, one of them (the Central Uruguay) extending to the Brazilian frontier. In 1908 20 lines of ocean-going steamers made regular calls at the port and several lines of river steamers ran to Buenos Aires and the ports of the Paraná, Paraguay and Uruguay rivers. The exports consist chiefly of livestock, jerked beef, hides, wool, and other animal products, wheat, flour, corn, linseed, barley, hay, tobacco, sealskins, fruit, vegetables, and some minor products. Manufactures exist only to a limited extent and chiefly for domestic consumption.

The suburbs of Montevideo include the fashionable bathing resorts of Playa Ramirez and Pocitos on the coast east of the city, the inland suburbs of Paso Molino and La Union, and the industrial town of Cerro, across the bay. The Flores Island quarantine station is 12 m. east of the city. The station was formerly on Rat Island (within the bay), which is now used as a public deposit for inflammables. The chief point of interest in this suburb is the conical hill known as the Cerro, or "mount," from which the city takes its name, on which stands an old Spanish fort, sometimes garrisoned and sometimes used for the incarceration of political prisoners. Its elevation is 486 ft. (Reclus), and a lighthouse rises from within the fort carrying a revolving light that can be seen 25 m. at sea.

Montevideo was founded in 1726 through the efforts of Don Mauricio Zabala, governor of Buenos Aires, who wished to check the advance of the Portuguese on this side of the La Plata. A small military post had existed there since 1717, but efforts to create a town had been fruitless until Zabala offered to make *hidalgos* of the first settlers and to give them cattle and sheep. The first families to accept this offer came from the Canary Islands in 1726 under the direction of Don Francisco Alzeibar; they were followed by others from Andalusia and some of the Spanish-American settlements. Its growth at first was slow, but on the abolition of the Cadiz monopoly in 1778 it became a free port and its trade increased so rapidly that it soon became one of the chief commercial centres of South America. The city was captured in 1807 by a British expedition under Sir Samuel Auchmuty, but was abandoned when the expedition against Buenos Aires under General Whitelocke was defeated. In 1808 the governor of Montevideo established an independent junta, but after the Buenos Aires declaration of independence in 1810 the Spanish forces were concentrated in Montevideo and held it until expelled in 1814 by the Argentine land and sea forces under General Alvear and Admiral Brown. The dissensions following the expulsion of the Spanish and the rivalries of Argentina and Brazil over the possession of Uruguay, then commonly termed the "Banda Oriental," greatly reduced the population of the city and partially destroyed its trade. It was made the capital of the republic in 1828 and had partially recovered its population and trade when the disastrous struggle with Rosas, dictator of Buenos Aires, broke out and the city was subjected to a nine years' siege (1843–52), the investment being conducted by General Oribe, and the defence by General Paz. In 1864–1865 Brazil intervened in the affairs of the republic, blockaded the port, and reinstated ex-president Flores. The war with Paraguay that followed, which lasted until 1870, made Montevideo the base of supplies for the Brazilian army and navy and added largely to its trade and wealth. The valuation of the city and suburbs, which was $14,156,000 in 1860, was $74,000,000 in 1872. In addition to the reckless speculation of this period, there were continued political dissensions, repeated dictatorships and financial mismanagement on the part of the government. Not the least of these burdens were the personal and irregular drafts of some of the executives upon the treasury and revenue officers, particularly the custom-house of this port, upon which the republic depended for the major part of its revenue. The commercial and financial collapse that followed lasted through the greater part of the last three decades of the century; but settled government and improved finances subsequently contributed to a slow but steady recovery in the trade and industrial activities of the city.

MONTE VULTURE (anc. *Vultur*), a mountain of Basilicata, Italy, in the province of Potenza, the summit of which is about

5 m. S. of Melfi. It is an extinct volcano rising to 4365 ft. above sea-level, belonging in Roman times to Apulia, and lying on the boundary between it and Lucania. The crater is densely overgrown with oaks and beeches which harbour wild boars and wolves. There are two small lakes. On the banks of the upper lake stand the Capuchin monastery of San Michele and the picturesque ruined church of Sant' Ippolito. The city of Rionero in Volture is pleasantly situated 27 m. by rail N. of Potenza, at the foot of Monte Vulture. Pop. (1901), 11,834. It does not seem to be older than the first half of the 17th century. In 1851 it suffered severely from an earthquake.

See G. de Lorenzo, *Venosa e la regione del Vulture* (Bergamo, 1906).

MONTFAUCON, BERNARD DE (1655–1741), French scholar and critic, was born at the château of Soulage (now Soulatgé, in the department of Aube, France), on the 13th of January 1655. Belonging to a noble and ancient line, and destined for the army, he passed most of his time in the library of the family castle of Roquetaillade, devouring books in different languages and on almost every variety of subject. In 1672 he entered the army, and in the two following years served in Germany under Turenne. But ill-health and the death of his parents brought him back to his studious life, and in 1675 he entered the cloister of the Congregation of St Maur at La Daurade, Toulouse, taking the vows there on the 13th of May 1676. He lived successively at various abbeys—at Sorèze, where he specially studied Greek and examined the numerous MSS. of the convent library, at La Grasse, and at Bordeaux; and in 1687 he was called to Paris, to collaborate in an edition of Athanasius and Chrysostom, contemplated by the Congregation. From 1698 to 1701 he lived in Italy, chiefly in Rome in order to consult certain manuscripts, those available in Paris being insufficient for the edition of Chrysostom. After a stay of three years he returned to Paris, and retired to the abbey of St-Germain-des-Prés, devoting himself to the study of Greek and Latin MSS. and to the great works by which he established his reputation. He died suddenly on the 21st of December 1741. His first publication, in which he was assisted by Jacques Loppin and Antoine Pouget, was the first volume of a never-completed series of previously unpublished *Analecta graeca* (1688). In 1690 appeared *La Vérité de l'histoire de Judith. Athanasii opera omnia*, still the best edition of that Father, was issued with a biography and critical notes in 1698. In connexion with this may be mentioned *Collectio nova patrum et scriptorum graecorum* (1706), containing some newly discovered works of Athanasius, Eusebius of Caesarea, and the *Topographia christiana* of Cosmas Indicopleustes. His copious *Diarium italicum* (1702) gives an account of the principal libraries of Italy and their contents; this work has been translated into English by J. Henley (1725). The *Palaeographia graeca* (1708), illustrating the whole history of Greek writing and the variations of the characters, has not yet been superseded; in its own field it is as original as the *De re diplomatica* of Mabillon. In 1713 Montfaucon edited *Hexaplorum origenis quae supersunt*, not superseded till the work of Field (1875); and between 1718 and 1738 he completed his edition of *Joannis Chrysostomi opera omnia.* His *L'Antiquité expliquée et représentée en figures* (1719) laid the foundation of archaeological knowledge. It was continued by him in *Les Monumens de la monarchie françoise, 1729–1733*. Both these works have been translated into English. Montfaucon's *Bibliotheca bibliothecarum manuscriptarum* (1739) is a list of the works in MS. in the libraries with which he was acquainted.

A list of his works will be found in *Bibliothèque des écrivains de la congrégation de Saint-Maur*, by C. de Lame (1882), and in the article in the *Nouvelle biographie générale*, which gives an account of their scope and character; see also Emmanuel de Broglie, *La Société de l'abboye de St-Germain-des-Prés au 18e siècle: Bernard de Montfaucon et les bernardins* (2 vols., Paris, 1891).

MONTFERRAT, COUNT OF, a title derived from a territory south of the Po and east of Turin, and held by a family who were in the 12th century one of the most considerable in Lombardy. In 1147 a count of Montferrat took part in the Second Crusade; but the connexion with the Holy Land begins to be intimate in 1176. In that year William Longsword, eldest of the five sons of Count William III., came to the kingdom of Jerusalem, on the invitation of Baldwin IV. and the baronage, and married the heiress of the kingdom, Sibylla. He died within a few months; but his wife bore a posthumous son, who became Baldwin V. Count William III. himself (uncle to Philip of France and brother-in-law to Conrad III.) afterwards came to the Holy Land to watch over the interests of his grandson; and he was among the prisoners taken by Saladin at Hittin in 1187. Shortly after the battle of Hittin there appeared in Palestine the ablest and most famous of the family, Count William's second son, Conrad. Conrad, following the family tradition, and invited by the emperor Isaac Angelus, had gone to serve at the court of Constantinople. He soon became a considerable person; married Isaac's sister, and defeated and killed a usurper; but he was repaid by ingratitude and suspicion, and fled from Constantinople to Palestine in 1187. Putting into Tyre he was able to save the city from the deluge of Mahommedan conquest which followed Saladin's victory at Hittin. He established himself firmly in Tyre (refusing admission to Guy, the king of Jerusalem); and from it he both sent appeals for aid to Europe—which largely contributed to cause the Third Crusade—and despatched reinforcements to the crusaders, who, from 1188 onwards, were engaged in the siege of Acre. His elder brother had been the husband of the heiress Sibylla; and on the death of Sibylla, who had carried the crown to Guy de Lusignan by her second marriage, Conrad married her younger sister, Isabella, now the heiress of the kingdom, and claimed the crown (1190). The struggle between Conrad and Guy paralysed the energies of the Christians in 1191. While Richard I. of England espoused the cause of Guy, who came from his own county of Poitou, Philip Augustus espoused that of Conrad. After the departure of Philip, Conrad fomented the opposition of the French to Richard, and even intrigued with Saladin against him. But he was the one man of ability who could hope to rule the débris of the kingdom of Jerusalem with success; he was the master of an Italian statecraft which gave him the advantage over his ingenuous rival; and Richard was finally forced to recognize him as king (April 1192). In the very hour of success, however, Conrad was struck down by the emissaries of the Old Man of the Mountain (the chief of the Assassins).

Still another son of Count William III. achieved distinction. This was Boniface of Montferrat, the younger brother of Conrad, who was chosen leader of the Fourth Crusade in 1201, on the death of Theobald of Champagne. In the winter of 1201–1202 he went to Germany to visit Philip of Swabia; and there it has been suggested, he arranged the diversion of the Fourth Crusade to Constantinople (see CRUSADES). Yet in the course of the crusade he showed himself not unsubmissive to Innocent III., who was entirely opposed to such a diversion. After the capture of Zara, however, he joined the crusaders, and played a great part in all the events which followed till the capture of Constantinople by the Latins in 1204. But Baldwin of Flanders was elected emperor over his head; and his irritation was not wholly allayed by the grant of Macedonia, the north of Thessaly, and Crete (which he afterwards sold to Venice). In 1207 he died, killed in battle with the Bulgarians. He left a son Demetrius, who assumed the title of king of Thessalonica, which the father had never borne (cf. Luchaire, *Innocent III.: La question d'Orient*, p. 190). In 1222 Demetrius lost his kingdom to Theodore Angelus, and the house of Montferrat its connexion with the East.

See Savio, *Studi storici sul marchese Guglielmo III. di Monferrato* (Turin, 1885); Ilgen, *Markgraf Konrad von Montferrat* (1880); and also the works of Cerrato (Turin, 1884) and Desimoni (Genoa, 1886).

MONTFLEURY (d. 1667), French actor, whose real name was Zacharie Jacob, was born in Anjou during the last years of the 16th century. He was enrolled as one of the pages to the duc de Guise, but he ran away to join some strolling players, assuming the name of Montfleury. About 1635 he was a valued member of the company at the Hôtel de Bourgogne, and he was in the original cast of the *Cid* (1636) and of *Horace* (1640). Richelieu thought highly of him, and when in 1638 Montfleury married the actress Jeanne de la Chalpe (d. 1683), the cardinal desired the ceremony to take place at his own country house at Rueil. Montfleury died in Paris from the rupture of a blood-vessel, while playing the part of Orestes in *Andromaque*, in December 1667. He was the author of a tragedy, *La Mort d'Asdrobal*, performed in 1647.

MONTFORT, the name of a famous French family long seated at Montfort l'Amauri, near Paris, descended from a certain William, a descendant of the counts of Flanders, who flourished during the latter part of the 10th century, and who built a castle at Montfort l'Amauri. Until 1209, when Simon IV. took the title of count, William and his successors were known as barons de Montfort. This Simon IV. de Montfort (*c.* 1160–1218), a son of Simon III. (d. 1181), is chiefly known for the very active part which he took in the crusade against the Albigenses. Twice he went to Palestine as a crusader, and in 1209, answering the call of Pope Innocent III., he joined the host which marched against the enemies of the Church in Languedoc. He became vicomte of Béziers and of Carcassonne, and was soon the leader of the crusaders. He took place after place, defeated Raymond VI., count of Toulouse, at Castelnaudary, and about a year later (September 1213) gained a victory over Raymond's ally, Peter II., king of Aragon, under the walls of Muret. Simon then turned his attention to administering and organizing Languedoc. After a lively discussion in the Lateran Council of 1215, the pope, somewhat reluctantly, confirmed him in the possession of the greater part of the lands of the count of Toulouse, and after two more years of warfare he was killed whilst besieging the city of Toulouse on the 25th of June 1218. The count's eldest son, Amauri de Montfort (1192–1241), was unable to hold his own, although Philip Augustus sent some troops to his assistance in 1222. He abandoned his interests in the south of France in favour of the new king Louis VIII., and in 1239 he went on crusade to the Holy Land, dying soon afterwards at Otranto. In 1230 Amauri was made constable of France. Simon IV. had a brother, Guy de Montfort (d. 1228), who shared his military exploits both in Asia and in Europe, and who was afterwards employed by Louis VIII. to negotiate with the pope at Rome. He was killed before Vareilles on the 31st of January 1228. In 1294 Yolande (d. 1322), the heiress of the Montforts, married Arthur II., duke of Brittany, and the county of Montfort became part of this duchy. Their son, John, count of Montfort, claimed Brittany in opposition to Charles, count of Blois, and at length secured the duchy. Except for one interval his descendants held it until it was united with the French crown at the end of the 15th century.

See A. Molinier, *Catalogue des actes de Simon et d'Amaury de Montfort* (1873); and C. Douais, *La Soumission de la vicomté de Carcassonne par Simon de Montfort et la croisade contre Raimond VI.* (1884).

MONTFORT, SIMON DE, EARL OF LEICESTER (d. 1265), English statesman and soldier, was born in France about the year 1200. He was the fourth and youngest son of Simon IV. de Montfort (see above), the leader of the Albigensian crusade, by Alicia de Montmorenci. Simon IV., whose mother was an heiress of the Beaumont family, claimed in her right, and received from King John, the earldom of Leicester (1207), only to lose it again through espousing the French side in the wars between that sovereign and Philip Augustus. The young Simon, of whose youth and education nothing is recorded, came to England in 1230 and attached himself to Henry III., obtaining with the consent of his sole surviving brother Amauri a re-grant of the family earldom. Simon was for a time unpopular with the English and closely attached to the royal party. He gave, however, an early proof of religious fervour, and of an unbending harshness, by the expulsion of all the Jews who had settled in his borough of Leicester to practise usury. In 1238 he obtained the hand of the king's sister Eleanor, the widow of the younger William Marshal. The king approved of the match, but it was resented by his brother Richard of Cornwall and the baronage, and objections were raised on the ground that Eleanor had previously taken vows of chastity. With some difficulty Earl Richard was pacified; and Montfort obtained the pope's confirmation of the marriage by a personal visit to Rome. In 1239, however, the influence of detractors and a quarrel over some obscure financial transactions in which he appears to have used Henry's name without a formal warrant led to a breach between himself and the king. The earl and his wife went for a time to France; and, though a nominal reconciliation with the king was soon effected, both departed on crusade with Richard of Cornwall in 1240. Eleanor was left behind in Apulia while her husband proceeded to the Holy Land. He acquitted himself with distinction, and there was some thought among the Frankish barons of appointing him to act as regent of the Latin kingdom of Jerusalem. But he returned in 1241, took part in Henry's disastrous French expedition of 1242, and was readmitted to full favour. Between 1243 and 1248 he received many gifts from the king; he stood forward in parliament as a mediator between the court party and the opposition; it is only from the correspondence of his friends Grosseteste and Adam de Marsh that we learn of his dissatisfaction with the condition of church and state. He was keenly interested in Grosseteste's proposals for ecclesiastical reformation, and was considered the mainstay of the reforming party. In 1248 he again took the cross, with the idea of following Louis IX. to Egypt. But, at the repeated requests of the king and council, he gave up this project in order to act as governor in the unsettled and disaffected duchy of Gascony. Bitter complaints were excited by the rigour with which the earl suppressed the excesses of the seigneurs and of contending factions in the great communes. Henry yielded to the outcry and instituted a formal inquiry into the earl's administration. Montfort was formally acquitted on the charges of oppression, but his accounts were disputed by the king, and he retired in disgust to France (1252). The nobles of France offered him the regency of the kingdom, vacant by the death of the Queen-mother Blanche of Castile, but he preferred to make his peace with Henry (1253), in obedience to the exhortations of the dying Grosseteste. He helped the king in dealing with the disaffection of Gascony; but their reconciliation was a hollow one, and in the parliament of 1254 the earl led the opposition in resisting a demand for a subsidy. In 1256 and 1257, when the discontent of all classes was coming to a head, Montfort nominally adhered to the royal cause. He undertook, with Peter of Savoy, the queen's uncle, the difficult task of extricating the king from the pledges which he had given to the pope with reference to the crown of Sicily; and Henry's writs of this date mention the earl in friendly terms. But at the "Mad Parliament" of Oxford (1258) Montfort appeared side by side with the earl of Gloucester at the head of the opposition. It is said that Montfort was reluctant to approve the oligarchical constitution created by the Provisions of Oxford, but his name appears in the list of the Fifteen who were to constitute the supreme board of control over the administration. There is better ground for believing that he disliked the narrow class-spirit in which the victorious barons used their victory; and that he would gladly have made a compromise with the moderate royalists whose policy was guided by the Lord Edward, Henry's eldest son. But the king's success in dividing the barons and in fostering a reaction rendered such projects hopeless. In 1261 Henry revoked his assent to the Provisions, and Montfort left the country in despair.

He returned in 1263, at the invitation of the barons, who were now convinced of the king's hostility to all reform; and raised a rebellion with the avowed object of restoring the form of government which the Provisions had ordained. For a few weeks it seemed as though the royalists were at his mercy; but he made the mistake of accepting Henry's offer to abide by the arbitration of Louis IX. of France. At Amiens, in January 1264, the French king decided that the Provisions were unlawful and invalid. Montfort, who had remained in England to prepare for the worst, at once resumed the war, and thus exposed himself to accusations of perjury, from which he can only be defended on the hypothesis that he had been led to hope for a genuine compromise. Though merely supported by the towns and a few of the younger barons, he triumphed by superior generalship at Lewes (May 14, 1264), where the king, the Lord Edward, and Richard of Cornwall fell into his hands. Montfort used his victory to set up the government by which his reputation as a statesman stands or falls. The weak point in his scheme was the establishment of a triumvirate (consisting of himself, the young earl of Gloucester, and the bishop of Chichester) in which his colleagues were obviously figureheads. This flaw, however, is mitigated by a scheme, which he simultaneously promulgated, for establishing a thorough parliamentary control over the executive, not excepting the triumvirs. The parliament which he summoned in 1265 was, it is true, a packed assembly; but it can hardly be supposed that the representation which he granted to the towns (see Parliament and Representation) was intended to be a temporary expedient. The reaction against his government was baronial rather than popular; and the Welsh Marchers particularly resented Montfort's alliance with Llewellyn of North Wales. Little consideration for English interests is shown in the treaty of Pipton which sealed that alliance (June 22, 1265). It was by the forces of the Marchers and the strategy of Edward that Montfort was defeated at Evesham (Aug. 4). Divided from the main body of his supporters, whose strength lay in the east and south, the earl was outnumbered and surrounded before reinforcements could reach him. For years after his death he was revered by the commons as a martyr, and the government had no little difficulty in reducing the remnants of his baronial supporters. His character has suffered in the past from indiscriminate eulogy as much as from detractors. He was undoubtedly harsh, masterful, impatient and ambitious. But no mere adventurer could have won the friendship of such men as Marsh and Grosseteste; their verdict of approval may be the more unhesitatingly admitted since it is not untempered with criticism.

The original authorities are those for the reign of Henry III. The best biographies are those by R. Pauli (trans. C. M. Goodwin, London, 1876); G. W. Prothero (London, 1877); C. Bémont (Paris, 1884). See also the letters of Adam de Marsh in J. S. Brewer's *Monumenta franciscana*, vol. i (Rolls series, 1858); H. R. Luard, *Epistolae Roberti Grosseteste* (Rolls, series, 1861); F. S. Stevenson, *Robert Grosseteste* (London, 1899); W. H. Blaauw, *The Barons' War* (Cambridge, 1871). (H. W. C. D.)

MONTGAILLARD, JEAN GABRIEL MAURICE ROQUES, Comte de (1761–1841), French political agent, was born at Montgaillard, near Villefranche (Haute Garonne), on the 16th of November 1761. His parents belonged to the minor nobility, and he was educated at the military school of Sorèze, where he attracted the notice of the comte de Provence (afterwards Louis XVIII.). After serving for some years in the West Indies Maurice de Roques returned to France. In 1789 he was established in Paris as a secret diplomatic agent, and though he emigrated to England after the 10th of August 1792, he returned six weeks later to Paris, where his security was most probably purchased by services to the revolutionary government. He was again serving the Bourbon princes when he met Francis II. of Austria at Ypres in 1794 and saw Pitt in London, where he published his *État de la France au mois de mai 1794*, predicting the fall of Robespierre. He was employed by Louis XVIII. to secure Austrian intervention on behalf of Mme Royale (afterwards duchess of Angoulême), still a prisoner in the Temple, and he drew up the proposition made by the prince to Charles Pichegru, the details of which appear in his "Mémoire sur la trahison de Pichegru" (*Moniteur*, April 18, 1804). In June 1796 he made a journey to Italy in the hope of opening direct relations with Bonaparte. On his return to the princes at Blankenburg he was regarded with suspicion, and he departed for Paris to await events. He is thought to have indicated the possession by the comte d'Antraigues, agent of the princes, of documents compromising Pichegru. In April 1798 he surrendered to Claude Roberjot, the Hamburg minister of the Directory, further papers relating to the matter. He followed Roberjot to Holland, and there wrote a memorandum to prove that the only hope for France lay in the immediate return of Bonaparte from Egypt, followed by assumption of the supreme power. This note reached Alexandria by way of Berlin and Constantinople. When he ventured to return to Paris in the hope of recognition from the First Consul he was imprisoned, and on his release he was kept under police supervision. Napoleon, who appreciated his real insight into European politics and his extraordinary knowledge of European courts, attached him to his secret cabinet in spite of his intriguing and mendacious character. He received a salary of 14,000 francs, reduced later to 6000, for reports on political questions for Napoleon's use, and for pamphlets written to help the imperial policy. He tried to dissuade Napoleon from the Austrian marriage and the Russian campaign, and counselled the limitation of the empire within the Rhine, the Alps and the Pyrenees. The Bourbon restoration made no change in his position; he was maintained as confidential adviser on foreign and home politics, and gave shrewd advice to the new government. His career ended with the old monarchy, and he died in obscurity at Chaillot on the 8th of February 1841.

His *Souvenirs*, which must be read with the utmost caution, were edited by Clément de Lacroix (3rd ed., 1895); his *Mémoires diplomatiques* (1805–1819) were published by the same editor in 1896. His *État de la France* was translated into English by Edmund Burke. His other writings include *Ma conduite pendant le cours de la révolution française* (London, 1795); *Histoire secrète de Coblentz dans la révolution des français* (London, 1795); *De La France et de l'Europe sous le gouvernement de Bonaparte* (Lyons, 1904); *Situation de l'Angleterre en 1811* (Paris, 1811); *De la restauration de la monarchie des Bourbons et du retour à l'ordre* (Paris, 1814); and *Histoire de France depuis 1825 jusqu'à 1830* (Paris, 1839).

MONTGELAS, MAXIMILIAN JOSEF GARNERIN, Count von (1759–1838), Bavarian statesman, came of a noble family in Savoy. His father John Sigmund Garnerin, Baron Montgelas, entered the military service of Maximilian Joseph III., elector of Bavaria, and married the countess Ursula von Trauner. Maximilian Josef, their eldest son, was born on the 10th of September 1759. He was educated successively at Nancy, Strassburg and Ingolstadt. Being a Savoyard on his father's side, he naturally felt the French influence, which was then strong in Germany, with peculiar force. To the end of his life he spoke and wrote French more correctly and with more ease than German. In 1779 he entered the public service in the department of the censorship of books. The elector Charles Theodore, who had at first favoured him, became offended on discovering that he was associated with the Illuminati, the supports of the anti-clerical movement called the *Aufklärung*. Montgelas therefore went to Zweibrücken, where he was helped by his brother Illuminati to find employment at the court of the duke, the head of a branch of the Wittelsbach family. From this refuge also he was driven by orthodox enemies of the Illuminati. The brother of the duke of Zweibrücken—Maximilian Joseph—took him into his service as private secretary. When his employer succeeded to the duchy Montgelas was named minister, and in that capacity he attended the conference of Rastadt in 1798, where the reconstruction of Germany, which was the consequence of the French Revolution, was in full swing. In 1799 the duke of Zweibrücken succeeded to the electorate of Bavaria, and he kept Montgelas as his most trusted adviser. Montgelas was the inspirer and director of the policy by which the electorate of Bavaria was turned into a kingdom, and was very much increased in size by the annexation of church lands, free towns and small lordships. As this end was achieved by undeviating servility to Napoleon, and the most cynical disregard of the rights of Bavaria's German neighbours, Montgelas became the type of an unpatriotic politician in the eyes of all Germans who revolted against the supremacy of France. From his own conduct and his written defence of his policy it is clear that such sentiments as theirs appeared to be merely childish to Montgelas. He was a thorough politician of the

18th-century type, who saw and attempted to see nothing except that Bavaria had always been threatened by the house of Habsburg, had been supported by Prussia for purely selfish reasons, and could look for useful support against these two only from France, who had selfish reasons of her own for wishing to counterbalance the power both of Austria and Prussia in Germany. As late as 1813, when Napoleon's power was visibly breaking down, and Montgelas knew the internal weakness of his empire well from visits to Paris, he still continued to maintain that France was necessary to Bavaria. The decision of the king to turn against Napoleon in 1814 was taken under the influence of his son and of Marshal Wrede rather than of Montgelas, though the minister would not have been influenced by any feeling of sentimentality to adhere to an ally who had ceased to be useful. In internal affairs Montgelas carried out a policy of secularization and of administrative centralization often by brutal means, which showed that he had never wholly renounced his opinions of the time of the Enlightenment movement. His enemies persuaded the king to dismiss him in 1817, and he spent the remainder of his life in retirement till his death in 1838. He had married the countess von Arco in 1803, and had eight children; in 1809 he was made a count.

See *Denkwürdigkeiten des bayr. Staatsministers Maximilian Graf von Montgelas*, a German version of the French original, ed. by Ludwig Graf v. Montgelas (Stuttgart, 1887); *Briefe des Stadtsministers Grafen Montgelas*, ed. by Julie von Zerzog (Regensburg, 1853); Dumoulin Eckart, *Bayern unter dem Ministerium Montgelas* (Munich, 1894).

MONT GENÈVRE, a very easy and remarkable pass (6083 ft.) between France and Italy, which is now considered by high authorities to have been crossed by Hannibal, as it certainly was by Julius Caesar, Charles VIII., and in the war of 1859. An excellent carriage-road mounts in 7 m. from Briançon, at the very head of the Durance valley, to the pass. On the French side of the divide is the village of Bourg Mont Genèvre, and on the Italian side that of Clavières, both inhabited all the year round, as the pass runs east and west, and is thus sheltered from the north wind. A descent of 5 m. leads down to Césanne in the Doria Riparia valley, which is followed for 5 m. more to Oulx (17 m. from Briançon), on the Mont Cenis railway.

MONTGOMERIE, ALEXANDER (*c.* 1550–*c.* 1610), Scottish poet, was the second son of Hugh Montgomerie of Hessilhead, Ayrshire, and was born about the middle of the 16th century.[1] He spent some part of his youth in Argyleshire and afterwards lived for a time at Compston Castle, in Galloway. He was in the service of the regent Morton; thereafter, on the regent's demission of office in 1578, in that of the king, James VI. In 1583 the grant by the Crown of a pension of 500 marks was confirmed; and three years later he set out on a tour through France, Flanders and other countries. He appears to have got into trouble, to have been imprisoned abroad, and to have lost favour at the Scottish court, and (for a time) his pension. We have no record of his closing years.

Montgomerie's chief poem is the *Cherry and the Slae*, first printed in 1597 (two impressions). It was frequently reprinted in the 17th and 18th centuries, and appeared twice in Latin guise in 1631, in Dempster's *Cerasum et sylvestre prunum, opus poematicum.* It is included in the collected edition of Montgomerie's Poems, by David Irving (1821), and by James Cranstoun, for the Scottish Text Society (1887). The text in the latter is a composite of 930 lines from the second impression of 1597 (*u.s.*) and 666 lines from the version in Allan Ramsay's (*q.v.*) *Ever Green* (1724); but a better text, from a MS. in the Laing collection in the university of Edinburgh, has been prepared (1907) for the Scottish Text Society by Mr George Stevenson. The poem, written in the complicated alliterative fourteen-lined stanza, is a confused allegory—the confusion being due to the fact that sections of the poem were written at different times—on Youth's choice between a richly laden cherry-tree on a high crag and a sloe "bush" at his feet. His other poems are: *The Flyting betwixt Montgomery and Polwart* (1629; 1st ed., 1621), which reproduces the literary habit of the *Flyting of Dunbar and Kennedie*; a series of 70 sonnets; a large number of miscellaneous poems, amatory and devotional; and *The Mindes Melodie, Contayning certayne Psalmes of the Kinglie Prophete Dayvid, applyed to a new pleasant tune* (Edinburgh, 1605). The formal value of Montgomerie's verse was fittingly acknowledged by James VI. in his early critical essay *Ane Schort Treatise conteining some reulis and cautelis to be observit and eschewit in Scottis Poesie*, where the author makes three quotations from Montgomerie's poems, then in circulation in manuscript. Montgomerie had written a sonnet to his majesty, which is prefixed to the *Essayes of a Prentise.*

Montgomerie stands apart from the courtier-poets Ayton, Stirling, and others, who write in the literary English of the South. He carries on the Middle Scots tradition, and was not without influence in the vernacular revival, in Allan Ramsay and his successors. (G. G. S.)

MONTGOMERY, GABRIEL, SEIGNEUR DE LORGES, COMTE DE (*c.* 1530–1574), French soldier, became a lieutenant in the king of France's Scottish guards, of which his father was captain, and engaged in police operations against the Protestants. Having inadvertently caused the death of King Henry II. in a tournament (June 30, 1559) he was disgraced and retired to his estates in Normandy. He studied theological questions and espoused the cause of the Reformers. In 1562 he allied himself with the prince of Condé, took Bourges, and defended Rouen from September to October 1562 against the royal army. In the third War of Religion he occupied Béarn and Bigorre (1569). Escaping from the massacre of St Bartholomew, he went to England and returned with a fleet for the relief of La Rochelle (1573), but soon had to withdraw to Cornwall. Returning to Normandy in 1574, he defended Domfront, which was being besieged by Marshal de Matignon, but was forced to capitulate on the 25th of May. He was sentenced to death by the parlement, and beheaded in Paris on the 26th of June 1574.

See L. Marlet, *Le Comte de Montgomery* (Paris, 1890).

MONTGOMERY, JAMES (1771–1854), British poet and journalist, son of a Moravian minister, was born on the 4th of November 1771, at Irvine in Ayrshire, Scotland. Part of his boyhood was spent in Ireland, but he received his education in Yorkshire, at the Moravian school of Fulneck near Leeds. He edited the *Sheffield Iris* for more than thirty years. When he began his career the position of a journalist who held pronounced views on reform was a difficult one, and he twice suffered imprisonment (in 1795 and 1796). His *Wanderer of Switzerland* (1806), describing the French occupation, attracted considerable attention. The author was described by Lord Byron in a footnote to *English Bards and Scotch Reviewers*, as "a man of considerable genius," whose *Wanderer of Switzerland* was worth a thousand "Lyrical Ballads." The book had been mercilessly ridiculed by Jeffrey in the *Edinburgh Review* (1807), but in spite of this Montgomery achieved a wide popularity with his later volumes of verse: *The West Indies* (1810); *The World Before the Flood* (1812); *Greenland* (1819); *Songs of Zion* (1822); *The Pelican Island* (1826). On account of the religious character of his poetry, he is sometimes confounded with Robert Montgomery, very much to the injustice of his reputation. His verses were dictated by the inspiring force of humanitarian sentiment, and he was especially eloquent in his denunciation of the slave trade. The influence of Campbell is apparent in his earlier poems, but in the *Pelican Island*, his last and best work as a poet, he evidently took Shelley as his model. His reputation now rests chiefly on his hymns, about a hundred of which are still in current use. His *Lectures on Poetry and General Literature* (1833) show considerable breadth of sympathy and power of expression. A pension of

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[1] Alexander's brother, Robert Montgomerie (d. 1609), was made bishop or archbishop, of Glasgow, in 1581, an appointment which was strongly objected to by the General Assembly. The long struggle which ensued was only terminated by Montgomerie's resignation of the see in 1587.

£150 was bestowed on him by Sir Robert Peel in 1835. He died at Sheffield on the 30th of April 1854.

His poems were collected and edited by himself in 1841. The voluminous *Memoirs*, published in seven volumes (1856–1858) by John Holland and James Everett, contain valuable information on English provincial politics.

MONTGOMERY, RICHARD (1736–1775), American soldier, was born in Co. Dublin, Ireland, in 1736. Educated at St Andrew's and at Trinity College, Dublin, he entered the British army in 1756, becoming captain six years later. He saw war service at Louisbourg in 1757 and in the Lake Champlain expedition of 1759, and as adjutant of his regiment (the 17th foot) he shared in the final threefold advance upon Montreal. Later he was present at Martinique and Havana. In 1772 he left the army, settled in New York, and married a daughter of Robert R. Livingston. Three years later he was a delegate to the first provincial congress of New York, and became brigadier-general in the Continental army. He was sent with Schuyler on the Canadian expedition, and, on Schuyler's falling ill, the command devolved upon him. Hampered by the inclemency of the season and the gross indiscipline of the troops, he went forward, gaining a few minor successes and capturing the colours of the 7th (Royal) Fusiliers, and met Benedict Arnold's contingent at Point aux Trembles. They pushed on to Quebec barely 800 strong, but an assault was made on the 31st of December 1775, and almost at the first discharge Montgomery was killed. The body of the American general was honourably interred by the Quebec garrison. Congress caused a memorial to be erected in St Paul's church, New York, and in 1818 his remains were conveyed thither from Quebec.

MONTGOMERY, ROBERT (1807–1855), English poet, natural son of Robert Gomery, was born at Bath in 1807. He was educated at a private school in Bath, and founded an unsuccessful weekly paper in that city. In 1828 he published *The Omnipresence of the Deity*, which hit popular religious sentiment so exactly that it ran through eight editions in as many months. In 1830 followed *The Puffiad* (a satire), and *Satan*. An exhaustive review in *Blackwood* by John Wilson, followed in the thirty-first number by a burlesque of *Satan*, and two articles in the first volume of *Fraser*, ridiculed Montgomery's pretensions and the excesses of his admirers. But his name was immortalized by Macaulay's famous onslaught in the *Edinburgh Review* for April 1830. As a poet, he deserved every word of Macaulay's severe censure, though the brutality of the attack cannot be defended. This exposure did not, however, diminish the sale of his poems; *The Omnipresence of the Deity* reached its 28th edition in 1858. In 1830 Montgomery entered Lincoln College, Oxford, graduating B.A. in 1833 and M.A. in 1838. Taking holy orders in 1835 he obtained a curacy at Whittington, Shropshire, which he exchanged in 1836 for the charge of the church of St Jude, Glasgow. In 1843 he removed to the parish of St Pancras, London, when he was minister of Percy Chapel. He died at Brighton in 1855. He also wrote *The Messiah* (1832), *Woman, the Angel of Life* (1833), *Oxford* (1831), and many devotional and theological works.

MONTGOMERY, a city of Alabama, U.S.A., the capital of the state and the county-seat of Montgomery county, situated (about 162 ft. above the sea) S.E. of the centre of the state, on the left bank of the Alabama river, which is here navigable. Pop. (1900), 30,346, of whom 17,229 were of negro descent and 666 were foreign-born; (1910, census), 38,136. Montgomery is served by the Louisville & Nashville, the Mobile & Ohio, the Atlantic Coast Line, the Seaboard Air Line, the Central of Georgia, and the Western of Alabama railways, and by freight steamers plying between Montgomery and Mobile. Among the principal buildings are the state capitol, near which is a Confederate soldiers' monument (erected by the women of Alabama), the county court-house, the Federal building, the Carnegie library, the masonic temple and the First National Bank and Bell buildings. The public institutions include the city infirmary and St Margaret's hospital, the latter under the direction of the Sisters of Charity. The city has about 100 acres of parks, Oak Park being the most important. Situated in the "Cotton Belt" of Alabama, Montgomery handles 160,000–200,000 bales annually. Truck-gardening is an important industry. The Alabama state fair is held here annually. Among the manufactures are fertilizers, machine-shop products, cotton goods, lumber products, cigars, harness, beer, stoneware, and bricks. The value of the factory products in 1905 was $3,877,653 (an increase of 31·7% over that in 1900). The leading newspapers are the *Montgomery Advertiser* (morning) and the *Montgomery Journal* (evening).

The site of Montgomery was once occupied by an Indian village known as Ecunchatty. The first permanent white settlement was made in 1814 by Arthur Moore. In 1817 Samuel Dexter of Massachusetts laid out a town and named it New Philadelphia. In 1819 it was united with East Alabama Town, an adjoining settlement on the river, under the present name (in honour of General Richard Montgomery), and a third settlement, Alabama Town, later became a part of Montgomery. Montgomery was first incorporated in 1837. The place soon became the commercial emporium of the Alabama "Cotton Belt." In 1847 it became the capital of the state instead of Tuscaloosa. On the 7th of January 1861, the State Convention through which Alabama seceded from the Union met in the capitol; at the same place delegates from six states met, on the 4th of February, and organized the Confederate States of America. Montgomery was the capital of the new government (hence the popular name "Cradle of the Confederacy") until May 1861, when that honour was transferred to Richmond, Virginia. It was the seat of Confederate military factories, and on the 12th of April 1865 it was captured by Federal troops. Montgomery received a new city charter in 1905.

MONTGOMERY, a town and district of British India, in the Lahore division of the Punjab. The town has a station on the North-Western railway about half-way between Lahore and Multan. Pop. (1901), 6602. It was founded in 1864 on the opening of the railway, and called after Sir Robert Montgomery, then lieutenant-governor. It is situated in a desolate upland, and though not unhealthy is singularly comfortless.

The District of Montgomery lies in the Bari Doab, or tract between the Sutlej and the Ravi, extending also across the latter river. Area, 4771 sq. m. In the former tract a fringe of cultivated lowland skirts the bank of either river, but the whole interior upland consists of a desert plateau partially overgrown with brushwood and coarse grass, and in places with impenetrable jungle. On the farther side of the Ravi, again, the country at once assumes the same desert aspect. The population in 1901 was 463,586, showing an apparent decrease of 0·4% in the decade due to emigration to the Chenab Colony. The principal crops are wheat, pulse, cotton and fodder. Camels are bred for export. The leading manufactures are of cotton and silk, and lacquered woodwork, and there are factories for ginning and pressing cotton. The district is traversed by the main line of the North-Western railway, from Lahore to Multan, and is irrigated by the Upper Sutlej inundation canal system, and also from the Ravi.

From time immemorial the Rechna Doāb has formed the home of a wild race of pastoral Jāts, who have constantly maintained a sturdy independence against the successive rulers of northern India. The sites of Kot Kamalia and Harappa contain large mounds of antique bricks and other ruins, while many other remains of ancient cities or villages lie scattered along the river bank, or dot the now barren stretches of the central waste. The pastoral tribes of this barren expanse do not appear to have paid more than a nominal allegiance to the Moslem rulers, and even in later days, when Ranjit Singh extended the Sikh supremacy as far as Mūltān, the population for the most part remained in a chronic state of rebellion. British influence was first exercised in the district in 1847, when an officer was deputed to effect a summary settlement of the land revenue. Direct British rule was effected on the annexation of the Punjab in 1849. There was a general rising of the wild clans during the Mutiny of 1857, several actions being fought before order was restored.

MONTGOMERY (*Tre' Faldwyn*), a municipal and parliamentary borough, market town, and the county town of Montgomeryshire, Wales, situated on a wooded hill near the east bank of the Severn, 7 m. S. of Welshpool (Cambrian railway). Pop. (1901), 1034. The principal feature of the town is the ruined castle. Not far off are the traces of an extensive British fort, and, about a mile east, the line of Offa's Dyke, forming the Shropshire boundary. The borough was incorporated by Henry III., when the castle was enlarged, and was the scene of frequent contests between that king and Llewelyn the Great. In the 14th century the castle was held by the Mortimers, from whom it passed to the Yorkists. The Crown gave it, in the 15th century, to the Herberts of Cherbury, one of whom, in 1644, surrendered it to the Parliamentarians, who dismantled it.

MONTGOMERYSHIRE (Welsh *Swydd Tre' Faldwyn*, Baldwyn's town shire), a county of Wales, bounded N. by Denbigh, N.E. and E. by Shropshire, S. by Radnor and Cardigan, W. and N.W. by Merioneth. Its length from S.E. to N.W. is about 30 m.; N.E. to S.W. it measures about 35 m. The surface is broken, though the highest hills are only round the county borders—to the north Berwyn (stretching into Denbighshire); to the south-west Plinlimmon (*q.v.*); east, the Breidden hills; south, the Kerry hills. The principal rivers and streams are: the Severn, flowing east and north; the Wye, farther south; the Dyfi, Vyrnwy (Fyrnwy), Clywedog, Tanat and Rhiw. Except the Wye and Dyfi, the principal streams are tributaries of the Severn. Lake Vyrnwy, formed in 1888, is the chief water-supply of Liverpool. The Montgomeryshire canal, some 24 m. long, is connected with the Shropshire Union and Ellesmere canals, The county was formerly a recognized source of oak timber for the navy.

Geologically, the county is occupied almost exclusively by Ordovician and Silurian rocks. The latter, mainly Wenlock beds bordered by a fringe of Llandovery rocks, lie in the form of a complex syncline down the centre of the county from a few miles north of Lake Vyrnwy through Llangadfan, Llanfyllin, Llanfair, Welshpool, Montgomery and Newtown. The boundary is very irregular. Between Newtown and Kerry hill Ludlow beds come in, and on the edge of the forest of Clun the Old Red Sandstone just crosses the boundary into this county. North and south of the Silurian tract the Ordovician rocks occupy the remaining area; they contain bands of andesite and felsite in the Berwyn hills, also east of Criggion and south-west of Corndon. In the last-named hill there is a large laccolitic mass of dolerite and a similar rock occurs at Criggion. At Machynlleth slate is worked in the Ordovician, and numerous metalliferous mines exist in the neighbourhood of Newtown from which lead, silver and zinc are obtained. Glacial deposits are prevalent over much of the county.

The climate is mild, and the soil generally fertile, especially in the Severn valley, though towards Merionethshire there are heath and moss. Small holdings (under about 50 acres) tend to diminish The hardy, small, mountain pony is still to be found here. Hunters and cart-horses are bred. Sheep-breeding is practised, and Shropshire downs are superseding the little *cluns*. Of the relatively few green crops potatoes are the most important; oats are the principal grain. Permanent pasture covers a large area. Hill pasture is also extensive. Woollen cloth and flannel manufacture have revived considerably.

The Cambrian railway, entering Montgomeryshire in the north-east, by Llanymynech, crosses it to the south-west with branches to Llanfyllin, Westbury and Van. There is also a branch from Caersws to Glandyfi (Glandovey) junction, with the coastwise branch of the same company.

The area of the ancient and administrative counties is 510,111 acres, or 797 sq. m., with a population of 54,901 in 1901. Many of the people know no English, and Welsh is everywhere the favourite speech. The county returns one member to parliament, and includes the Montgomery district of parliamentary boroughs: Llanfyllin (pop. 1632), Llanidloes (2770), Montgomery (1034), Machynlleth, Newtown and Welshpool (6121). The first three and last of these are municipal boroughs. The urban districts are: Newtown and Llanllwchaiarn (6500), and Machynlleth (2038). The county is in the North Wales and Chester circuit, assizes being held alternately at Newtown and Welshpool. Welshpool borough has a separate commission of the peace, but no separate court of quarter sessions. The ancient county (in Bangor, Hereford, and St Asaph dioceses) has 59 ecclesiastical parishes or districts, with parts of 11 others.

History and Antiquities.—The Welsh name of Baldwyn's town shire is taken from a Norman who did homage to William the Conqueror for this division of Wales. The English name is from Roger de Montgomery, earl of Shrewsbury (*temp.* William Rufus). At the coming of the Romans this county was part of the Ordovices' territory (*Britannia secunda*), and there are remains of Roman encampments and fortifications at Caersws, Mathrafal, and near Montgomery. The roads connecting these stations can often be traced. Vestiges of a Roman camp are visible near Welshpool. Machynlleth was perhaps the Roman *Maglona*. Remains of old British camps are to be seen at Dolarddyn, on Breidden hill and at Caereinion. There are many cairns and barrows. Crossing the county was the *Via Devana*, joined by other roads. From the Roman evacuation under Flavius Honorius (d. A.D. 423) little is known of Montgomery until Wales was subdivided into three districts at the death of Rhodri Fawr, when Montgomery was included in Powys (*Powys Gwenwynwyn*, Upper Powys). Powys Castle was founded in 1108. About the end of the 11th century, probably, was built Baldwyn's Castle, taken later by the Welsh and retaken by Roger de Montgomery. In 1345 Roger Mortimer held it. At Carno, 11 m. from Newtown and 17 from Machynlleth, a battle decisive of North Wales sovereignty was fought in 946, and in 1081 the rightful heir, Gruffydd ab Cynan, together with Rhys ab Tudur, prince of South Wales, here killed in battle Trahaern ab Caradoc, the usurper, and most of his men. At Machynlleth is seen Owen Glendower's senate house (1402) where he was crowned prince of Wales.

MONTH (a common Teutonic word, cf. Ger. *Mond*, Du. *maand*, Dan. *maaned*, &c., and cognate with Lat. *mensis*, Gr. *μήν*, &c., in other branches of the Indo-Germanic family; all ultimately from the root seen in the word for the moon in nearly all those languages), originally the period between two returns of the new moon; generally called a *lunar* and sometimes a *synodic* or *illuminative month*. The *anomalistic month* is the mean time taken by the moon in passing from one perigee to the next; the *sidereal month* is the mean time in which the moon makes a circuit among the stars; the *tropical month* is the mean time in which the moon traverses 360° of longitude; the *nodical* or *draconic month* is the mean time taken by the moon in passing from one rising node to the next; the *solar month* is one-twelfth of a tropical year. The lengths of the various months are: synodic = 29·53059 days; anomalistic = 27·55460, sidereal = 27·32166, tropical = 27·32156, nodical = 27·21222, solar = 30·43685. (For the *calendar months* see CALENDAR.)

In law a month may mean either a lunar month, that is, a period of twenty-eight days, or a calendar month. At common law, "month" generally means a lunar month, although in mercantile matters it has been generally understood to mean a calendar month, but there is no general exception giving it that meaning in commercial documents. It can only have that meaning where according to the ordinary rules of construction a secondary meaning can be admitted (*Bruner* v. *Moore*, 1904, 1 Ch. 305). In bills of exchange or promissory notes month means a calendar month (Bills of Exchange Act, 1882, s. 14 [4]). Where a servant is engaged subject to a month's notice or payment of a month's wages month is interpreted as a calendar month (*Gordon* v. *Potter*, 1 F. & F. 644). In acts of parliament passed before the year 1850 month, unless otherwise specially interpreted, means lunar month, but in all acts passed since that date, month, unless words be added showing that lunar month was intended, means calendar month (Interpretation Act 1889, s. 3). In the rules of the supreme court and in the county court rules month means a calendar month. In mercantile contracts in computing the period of a month the day from which the time is to begin to run is excluded, but in sentences of imprisonment the day on which the sentence begins is included, so that the numerically corresponding day in the month in which the sentence expires would be excluded.

MONTHOLON, CHARLES TRISTAN, Marquis de (1782–1853), was born at Paris. He was trained for a military career, and in his tenth year shared in the expedition of Admiral Truguet to the coast of Sardinia. Entering the army in 1798, he rose with rapidity and avowed himself, when *chef d'escadron* in Paris at the time of the *coup d'état* of Brumaire (November 1799), entirely devoted to Bonaparte. He served with credit in the ensuing campaigns, and distinguished himself at the battle of Aspern-Essling (May 1809) where he was wounded. At the end of that campaign on the Danube he received the title of count and remained in close attendance on Napoleon, who confided to him several important duties, among others, a mission to the Archduke Ferdinand at Würzburg. At the time of the first abdication of Napoleon at Fontainebleau (April 11, 1814), Montholon was one of the few generals who advocated one more attempt to rally the French troops for the overthrow of the allies. After the second abdication (June 22, 1815) he with his wife accompanied the emperor to Rochefort, where Napoleon and his friends finally adopted the proposal, which emanated from Count Las Cases (*q.v.*), that he should throw himself on the generosity of the British nation and surrender to H.M.S. "Bellerophon." Montholon afterwards, at Plymouth, asserted that the conduct of Captain Maitland of the "Bellerophon" had been altogether honourable, and that the responsibility for the failure must rest largely with Las Cases. Montholon and his wife accompanied the ex-emperor to St Helena. To Montholon chiefly, Napoleon dictated the notes on his career which form so interesting, though far from trustworthy, a commentary on the events of the first part of his life. Montholon is known to have despised and flouted Las Cases, though in later writings he affected to laud his services to Napoleon. With Gourgaud, who was no less vain and sensitive than himself, there was a standing feud, which would have led to a duel but for the express prohibition of Napoleon. Las Cases left the island in November 1816, and Gourgaud in January 1818; but Montholon, despite the departure of his wife, stayed on at Longwood to the end of the emperor's life (May, 1821). In a letter written to his wife he admitted that Napoleon died of cancer, though he afterwards encouraged the belief that death was due to a liver complaint aggravated by the climate and by the restrictions to which Napoleon was subjected. After that event Montholon and Bertrand became reconciled to Sir Hudson Lowe (*q.v.*); but this did not prevent him, on his return to France, from vilifying that much abused man. Colonel Basil Jackson found him very frank as to the *politique de Longwood* which aimed at representing Napoleon as a martyr, and Sir Hudson Lowe as his persecutor. Montholon admitted that an "angel from heaven as governor would not have pleased them." Montholon had to spend many years in Belgium; and in 1840 acted as "chief of staff" in the absurd "expedition" conducted by Louis Napoleon from London to Boulogne. He was condemned to imprisonment at Ham, but was released in 1847; he then retired to England and published the *Récits de la captivité de Napoléon à Ste Hélène.* In 1849 he became one of the deputies for the Legislative Assembly under the Second French Republic. He died on the 21st of August 1853.

See *Recueil de pièces authentiques sur le captif de Ste Hélène: suivi de lettres de MM . . . . le Général Montholon, &c.* (Paris, 1821); *Mémoires pour servir à l'histoire de France sous Napoléon* (ed. Gourgaud and Montholon, Paris, 1823; Eng. ed., London, 1823; new ed., Paris, 1905); *Récits de la captivité de l'empereur Napoléon à Ste Hélène* (2 vols., Paris, 1847). Also the Marquise de Montholon's *Souvenirs de Ste Hélène, 1815–16* (Paris, 1901). Of Montholon's own writings the only one of note is *De l'Armée française* (1834). For the conversations of Montholon with Basil Jackson in 1828, see Lieut.-Colonel Basil Jackson, *Notes and Reminiscences of a Staff Officer* (London, 1903). (J. Hl. R.)

MONTH'S MIND, in medieval and later England a service and feast held one month after the death of anyone in his or her memory. Bede speaks of the day as *commemorationis dies.* These "Minding days" were of great antiquity, and were survivals of the Norse *minne* or ceremonial drinking to the dead. "Minnying Days," says Blount, "from the Saxon Lemynde, days which our ancestors called their Monthes mind, their Year's mind and the like, being the days whereon their souls (after their deaths) were had in special remembrance, and some office or obsequies said for them, as Orbits, Dirges." The phrase is still used in Lancashire. Elaborate instructions for the conduct of the commemorative service were often left in wills. Thus, one Thomas Windsor (who died in 1479) orders that "on my moneth's minde there be a hundred children within the age of sixteen years, to say for my soul," and candles were to be burned before the rood in the parish church and twenty priests were to be paid by his executors to sing *Placebo, Dirige,* &c. In the correspondence of Thomas, Lord Cromwell, one in 1536 is mentioned at which a hundred priests took part in the mass. Commemorative sermons were usually preached, the earliest printed example being one delivered by John Fisher, bishop of Rochester, on Margaret, countess of Richmond and Derby, in 1509.

MONTILLA, a town of southern Spain, in the province of Cordova, 32 m. S. of the city of Cordova, by the Cordova-Bobadilla railway. Pop. (1900), 13,603. The oil of the district is abundant and good; and it is the peculiar flavour of the pale dry light wine of Montilla that gives its name to the sherry known as Amontillado. Montilla was the birthplace of "The Great Captain," Gonzalo or Gonsalvo of Cordova (1453–1515), and contains the ruined castle of his father, Pedro Fernandez de Cordova.

MONTLOSIER, FRANÇOIS DOMINIQUE DE REYNAUD, Comte de (1755–1838), French publicist, was born at Clermont-Ferrand (Puy-de-Dôme) on the 16th of April 1755, the youngest of a large family belonging to the poorer nobility. He was returned in 1791 to the Constituent Assembly, where he sat on the Royalist side, and he emigrated on its dissolution in September 1791. He was received into the emigrant army at Coblenz after some protest against the Liberal leanings he had shown in the Assembly. After the cannonade of Valmy, he withdrew to Hamburg, and thence to London, where he avoided English society, moving exclusively among the French exiles. In his *Courrier de Londres*, published in London, he advocated moderation and the abandonment by the exiles of any idea of revenge. He was recalled to Paris in 1801, with permission to publish his paper in London. The *Courrier* was soon suppressed, nevertheless, its editor being compensated by a comfortable sinecure in the ministry of foreign affairs. Next year he sold his pen to the government to edit the violent anti-English *Bulletin de Paris.* At Napoleon's request he undertook an account of the ancient monarchy of France, which should serve as a justification for the empire. After four years' labour Montlosier submitted his work to a specially appointed committee, by which it was rejected because of the stress laid on the feudal limitations of the royal authority. The work *De la monarchie française . . . ou recherches sur les anciennes institutions françaises . . . et sur les causes qui ont amené la révolution* . . . appeared in 1814 in three volumes, a fourth and supplementary volume in the next year containing a preface hostile to Napoleon. His views were no more acceptable to Louis XVIII. than they had been to the emperor, and he devoted himself to agriculture until he was roused by the clerical and reactionary policy of Charles X. His anti-clerical *Mémoire à consulter sur un système réligieux, politique* . . . (1826) rapidly passed through eight editions. He had no part in the revolution of 1830, but supported Louis Philippe's government and entered the House of Peers in 1832. He died on the 9th of December 1838 at Blois. Ecclesiastical burial was denied him because he had refused to abjure his anti-clerical writings.

Among his works should be mentioned: *Mémoires sur la révolution française, le consulat, l'empire, la restoration, et les principaux évènements qui l'ont suivie* (2 vols., 1829).

MONTLUC (or Monluc), **BLAISE DE LASSARAN-MASSENCÔME,** Seigneur de (*c.* 1502–1577), marshal of France, was born about 1502, at the family seat near Condom in the modern department of Gers. He was the eldest son, and his family was a good one, but, like most gentlemen of Gascony, he had to trust to his sword. He served first as a private archer and man-at-arms in Italy, with Bayard for his captain, fought all through the wars of Francis I., and was knighted on the field of Cérisoles (1544), to which victory he had brilliantly contributed as adviser to the young duke of Enghien. Having apparently enjoyed no patronage, he was by this time a man of middle age. Thenceforward, however, his merits were recognized. His chief feat was the famous defence of Siena (1555), which he has told so admirably. When the religious wars broke out in France, Montluc, a staunch royalist, held Guyenne for the king. Henry III. made him in 1574 marshal of France, an honour which he had earned by nearly half a century of service and by numerous wounds. He died at Estillac near Agen in 1577. Montluc's eminence above other soldiers of his day is due to his *Commentaires de Messire Blaise de Montluc* (Bordeaux, 1592), in which he described his fifty years of service (1521–1574). This book, the "soldier's Bible" (or "breviary," according to others), as Henry IV. called it, is one of the most admirable of the many admirable books of memoirs produced by the unlearned gentry of France at that time. It is said to have been dictated, which may possibly account in some degree for the singular vivacity and picturesqueness of the style.

The *Commentaires* are to be found conveniently in the collection of Michaud and Poujoulat, but the standard edition is that of the *Société de l'histoire de France*, ed. by M. de Ruble (5 vols., 1865–1872). See Rüstow, *Militärische Biographien*, v. i. (Zürich, 1858).

MONTLUÇON, a town of central France, capital of an arrondissement, and the most important industrial centre in the department of Allier. Pop. (1906), 31,888. It is situated on the Cher, 50 m. S.W. of Moulins by the Orléans railway. The upper town, on an eminence on the right bank, consists of steep, narrow, winding streets, and preserves several buildings of the 15th and 16th centuries; the lower town, traversed by the Cher, is the seat of the industries, which embrace the manufacture of glass, chemicals, mirrors, sewing-machines, and iron and steel production. The Commentry coal-mines and Néris, a town with thermal springs, are a few miles distant to the south-east. Of the churches, Notre-Dame is of the 15th century, St Pierre partly of the 12th and St Paul modern. The town-hall, with a library, occupies the site of an old Ursuline convent, and two other convents are used as college and hospital. Overlooking the town is the castle rebuilt by Louis II., duke of Bourbon, and taken by Henry IV. during the religious wars; it serves as a barracks. Montluçon is the seat of a sub-prefect and has tribunals of first instance and of commerce, a board of trade arbitration, a chamber of commerce and a lycée. The town, which formed part of the duchy of Bourbon, was taken by the English in 1171, and by Philip Augustus in 1181; the English were beaten under its walls in the 14th century.

MONTMORENCY, the name of one of the oldest and most distinguished families in France, derived from Montmorency, now in the department of Seine-et-Oise, in the immediate neighbourhood of Enghien and St Denis, and about 9 m. N.N.W. of Paris. The family, since its first appearance in history in the person of Bouchard I., sire de Montmorency in the 10th century, has furnished six constables and twelve marshals of France, several admirals and cardinals, numerous grand officers of the Crown and grand masters of various knightly orders, and was declared by Henry IV. to be, after that of the Bourbons, the first house in Europe. Matthieu I., sire de Montmorency, received in 1138 the post of constable, and died in 1160. His first wife was Aline, the natural daughter of Henry I. of England; his second, Adelaide or Alice of Savoy, widow of Louis VI. and mother of Louis VII., and according to Duchesne, he shared the regency of France with Suger, during the absence of the latter king on the second crusade. Matthieu II. had an important share in the victory of Bouvines (1214), and was made constable in 1218. During the reign of Louis VIII. he distinguished himself chiefly in the south of France (Niort, La Rochelle, Bordeaux). On the accession of Louis IX. he was one of the chief supports of the queen-regent Blanche of Castile, and was successful in reducing all the vassals to obedience. He died in 1230. His younger son, Guy, in right of his mother, became head of the house of Montmorency-Laval. Anne de Montmorency (*q.v.*), so named, it is said, after his godmother Anne of Brittany, was the first to attain the ducal title (1551). His eldest son, François de Montmorency (1530–1579), was married to Diana, natural daughter of Henry II.; another son, Henri I. de Montmorency (1534–1614), who became duc de Montmorency on his brother's death in 1579, had been governor of Languedoc since 1563. As a leader of the party called the *Politiques* he took a prominent part in the French wars of religion. In 1593 he was made constable, but Henry IV. showed some anxiety to keep him away from Languedoc, which he ruled like a sovereign prince. Henry II. (1595–1632), son of duke Henry I., succeeded to the title in 1614, having previously been made grand admiral. He also was governor of Languedoc. In 1625 he defeated the French Protestant fleet under Soubise, and seized the islands of Ré and Oléron, but the jealousy of Richelieu deprived him of the means of following up these advantages. In 1628–1629 he was allowed to command against the duke of Rohan in Languedoc; in 1630 he defeated the Piedmontese, and captured Prince Doria, at Avigliana, and took Saluzzo. In the same year he was created marshal. In 1632 he joined the party of Gaston, duke of Orleans, and placed himself at the head of the rebel army, which was defeated by Marshal Schomberg at Castelnaudary (Sept. 1, 1632); severely wounded, he fell into the enemy's hands, and, abandoned by Gaston, was executed as a traitor at Toulouse on the 30th of October. The title passed to his sister Charlotte-Marguerite, princess of Condé.

From the barons of Fosseux, a branch of the Montmorency family established in Brabant in the 15th century, sprang the seigneurs de Boutteville, among whom was the duellist François de Montmorency-Boutteville, who was beheaded in 1627. His son, François Henri, marshal of France, became duke of Piney-Luxemburg by his marriage with Madeleine Charlotte Bonne Thérèse de Clermont, daughter of Marguerite Charlotte de Luxemburg, duchesse de Piney. Charles François Frédéric, the son of the marshal, was created duke of Beaufort in 1688 and duke of Montmorency in 1689. In 1767 the title of duke of Beaufort-Montmorency passed by marriage to another branch of the Montmorency-Fosseux. This branch becoming extinct in 1862, the title was taken by the duc de Valençay, who belonged to the Talleyrand-Périgord family and married one of the two heiresses of this branch (1864). There were many other branches of the Montmorency family, among others that of the seigneurs of Laval (*q.v.*), a cadet branch of which received the title of duke of Laval and settled on the estate of Magnac in 1758. It is to this branch that Mathieu, duc de Montmorency (1767–1826), diplomatist and writer, and tutor of Charles X.'s grandson, Henri, duke of Bordeaux, belonged.

MONTMORENCY, ANNE, Duc de (1493–1567), constable of France, was born at Chantilly, and was brought up with the future King Francis I., whom he followed into Italy in 1515, distinguishing himself especially at Marignano. In 1516 he became governor of Novara; in 1520 he was present at the Field of Cloth of Gold, and afterwards had charge of important negotiations in England. Successful in the defence of Mézières (1521), and as commander of the Swiss troops in the Italian campaign of the same year, he was made marshal of France in 1522, accompanied Francis into Italy in 1524, and was taken prisoner at Pavia in 1525. Released soon afterwards, he was one of the negotiators of the treaty of Madrid, and in 1530 reconducted the king's sons into France. On the renewal of the war by Charles V.'s invasion of France in 1536, Montmorency compelled the emperor to raise the siege of Marseilles; he afterwards accompanied the king of France into Picardy, and on the termination of the Netherlands campaign marched to the relief of Turin. In 1538, on the ratification of the ten years' truce, he was rewarded with the office of constable, but in 1541 he fell into disgrace, and did not return to public life until the accession of Henry II. in 1547. In 1548 he repressed the insurrections in the south-west, particularly at Bordeaux, with great severity, and in 1549–50 conducted the war in the Boulonnais, negotiating the treaty for the surrender of Boulogne on the 24th of March 1550. In 1551 his barony was erected into a duchy. Soon afterwards his armies found employment in the north-east in connexion with the seizure of Metz, Toul and Verdun by the French king. His attempt to relieve St Quentin resulted in his defeat and captivity (Aug. 10, 1557), and he did not regain his liberty until the peace of Cateau-Cambrésis in 1559. Supplanted in the interval by the Guises, he was treated with coldness by the new king, Francis II., and compelled to give up his mastership of the royal household—his son, however, being appointed marshal by way of indemnity. On the accession of Charles IX. in 1560 he resumed his offices and dignities, and, uniting with his former enemies, the Guises, played an important part in the Huguenot war of 1562. Though the arms of his party were victorious at Dreux, he himself fell into the hands of the enemy, and was not liberated until the treaty of Amboise (March 19, 1563). In 1567 he again triumphed at St Denis, but received the death-blow of which he died at Paris, on the 15th of March, 1567.

See F. Decrue, *Anne de Montmorency* (Paris, 1885), and *Anne, duc de Montmorency* (Paris, 1889).

MONTMORENCY, MATHIEU JEAN FÉLICITÉ DE MONTMORENCY-LAVAL, Duc de (1766–1826), French politician, was born in Paris on the 10th of July 1766. He served with his father, the vicomte de Laval, in America, and returned to France imbued with democratic opinions. Mathieu de Montmorency was governor of Compiègne when he was returned as deputy to the states-general in 1789, where he joined the Third Estate and sat on the left of the Assembly. He moved the abolition of armorial bearings on the 19th of June 1790. The dissolution of the Constituent Assembly in September 1791 set him free to join Lückner's army on the frontier early in the next year. After the revolution of the 10th of August he abandoned his revolutionary principles; and he took no part in politics under the empire. At the Restoration he was promoted maréchal de camp, and accompanied Louis XVIII. to Ghent during the Hundred Days. At the second restoration he was made a peer of France, and two years later received the title of viscount. He adopted strong reactionary and ultramontane views, and became minister of foreign affairs under Villèle in 1821. He recommended armed intervention in Spain at the Congress of Verona in October 1822, but he resigned in December, being compensated by the title of duke and the cross of the Legion of Honour in the next year. He was elected to the French Academy in 1825, though he appears to have had small qualifications for the honour, and in the next year became tutor to the six-year-old Henri, duke of Bordeaux (afterwards known as the comte de Chambord). He died two months after receiving this last appointment, on the 24th of March 1826.

See, Vétillard, *Notice sur la vie de M. le duc Mathieu de Montmorency* (Le Mans, 1826), and, for his curious relations with Mme de Staël, P. Gautier, *Mathieu de Montmorency et Mme de Staël, d'après les lettres inédites de M. de Montmorency à Mme Necker de Saussure* (1908).

MONTMORENCY, a town of northern France in the department of Seine-et-Oise, 2½ m. from the right bank of the Seine and 11 m. N. of Paris by rail. Pop. (1906), 5723. In the middle ages it was the seat of the family of Montmorency. There is a church built for the most part in the 16th century by Anne de Montmorency. The town is a well-known resort of Parisians. To the north-east lies the fine forest of Montmorency. Bleaching and dyeing and the manufacture of lime plaster, bricks and tiles are carried on. About a mile south-west lies Enghien-les-Bains (pop. 4925), the waters of which are used in cases of catarrh and skin disease.

MONTMORILLON, a town of western France, capital of an arrondissement in the department of Vienne, on the Gartempe, 34 m. E.S.E. of Poitiers by rail. Pop. (1906), 3924. The ecclesiastical seminary occupies a building of the 12th century, formerly an Augustinian convent. The convent church is Romanesque in style and there is a curious two-storied chapel of octagonal form, of the same period. The church of Notre-Dame is a combination of Romanesque and Gothic, dating from the 12th and 13th centuries.

MONTMORIN DE SAINT HÉREM, ARMAND MARC, Comte de (1745–1792), French statesman, belonged to a cadet branch of a noble family of Auvergne. He was gentleman-in-waiting to Louis XVI. when dauphin, and was subsequently appointed ambassador at Madrid. From Madrid he was suddenly summoned to the governorship of Brittany, and in 1787 was appointed by the king to succeed Vergennes in the ministry of foreign affairs. Montmorin was a devoted admirer of Necker, whose influence at the court he was mainly instrumental in maintaining. He retired when Necker was dismissed on the 12th of July 1789, but on Necker's recall after the taking of the Bastille again resumed his office, which he continued to hold till October 1791. Mirabeau (*q.v.*) had approached him so early as December 1788, with a plan for the policy to be pursued by the court towards the new states general; but Montmorin, offended by Mirabeau's attacks on Necker and by his *Histoire secrète de la cour de Berlin*, refused to see him. With the progress of the Revolution, however, this attitude was changed. The comte de la Marck was exerting himself to bring Mirabeau into touch with the court (see Mirabeau), and for this purpose it was important to secure the assistance of Montmorin. The convenience of an understanding between the two men was obvious; and they were soon on the closest terms. While Montmorin continued minister in name, Mirabeau became so in fact. Montmorin did not dare to come to a decision without consulting his masterful friend, but on the other hand neither Mirabeau nor La Marck were under any illusions as to the broken character of the reed on which they had perforce to lean. Mirabeau complained bitterly that Montmorin was "slack" (*flasque*) and a "poltroon" (*gavache*). On the other hand, La Marck thought that Montmorin's feebleness was occasionally useful in restraining Mirabeau's impetuosity. The death of Mirabeau in April 1791 was a severe blow to Montmorin, the difficulty of whose position was enormously increased after the flight of the royal family to Varennes, to which he was not privy. He was forced to resign office, but still continued to advise Louis, and was one of the inner circle of the king's friends, called by the revolutionists "the Austrian Committee." In June 1792 his papers were seized at the foreign office, without anything incriminating being discovered; in July he was denounced, and after the 10th of August was proscribed. He took refuge in the house of a washerwoman, but was discovered, haled before the Legislative Assembly, and imprisoned in the Abbaye, where he perished in the September massacres. His relative, Louis Victor Henri, marquis de Montmorin de Saint Hérem, head of the elder branch, also perished in the massacre.

See A. Bardoux, *Pauline de Montmorin, comtesse de Beaumont: Études sur la fin du XVIII*$^{\text{ième}}$ *siècle* (Paris, 1884), for a defence of Montmorin's policy; F. Masson, *Le Département des affaires étrangères pendant la révolution, 1787–1804*, ch. ii. (Paris, 1877); A. de Bacourt, *Correspondance entre Mirabeau et le comte de La Marck, 1789–1791* (3 vols., Paris, 1851), contains many letters of Montmorin; "Correspondence of the Comte de Moustier with the Comte de Montmorin," in the *Amer. Hist. Rev.*, vol. viii. (1902–1903).

MONTORO, a town of southern Spain, in the province of Cordova, 27 m. E. by N. of the city of Cordova, on the Madrid-Cordova railway. Pop. (1900), 14,581. Montoro was the *Epora* of the Romans, and became an important Moorish fortress in the middle ages, but it has been largely modernized. It stands on a rocky peninsula on the south bank of the Guadalquivir, here crossed by a fine bridge of four arches dating from the 16th century. Oil is largely manufactured, and there is considerable trade in timber, agricultural produce and livestock.

MONTPELIER, a city, the capital of Vermont, U.S.A., and the county-seat of Washington county, on the Winooski river, 40 m. (by rail) E.S.E. of Burlington. Pop. (1900), 6266 (952 foreign-born); (1910), 7856. Montpelier is served by the Central Vermont and the Montpelier & Wells River railways. Barre granite is mined extensively in the vicinity, and the city manufactures marble and granite products, flour, lumber, saddlery hardware and wood-working machinery. The principal building is the state house, crowned by a statue of Agriculture by Larkin G. Mead. The state house was first occupied in 1836. It was almost completely destroyed by fire in 1857, and was subsequently rebuilt and enlarged. Other prominent features of the city are the United States government building, the county court house, the Montpelier seminary and the Wood art gallery, a collection consisting principally of paintings by Thomas Waterman Wood (1823–1903), a native of Montpelier. The township of Montpelier, named from the city in France, was granted to a company of sixty proprietors in 1780. The first permanent settlement was made in 1787; and the township was organized in 1791 under a charter of 1781, replaced by another in 1804. In 1805 it was selected as the capital of the state, and in 1808 the legislature met here for the first time. At first the township was a part of Orange county, but in 1810 Washington county was created, and in 1811 Montpelier became the seat of government of the new county. In 1849 East Montpelier was set apart as a separate township, and in 1894 the township of Montpelier was chartered as a city.

MONTPELLIER, a town of southern France, capital of the department of Hérault, about 7 m. from the Mediterranean, and 31 m. S.W. of Nîmes on the Paris-Lyon railway between that town and Cette. Pop. (1906), 65,983. Montpellier, the seat of a university and the principal place of lower Languedoc, is situated in a fruitful plain less than a mile from the right bank of the small river Lez. Composed for the most part of narrow winding streets, the town has at the same time several spacious thoroughfares and some fine squares and promenades, notably the much-frequented Place de la Comédie, the Esplanade and the Peyrou. The last terminates in a terrace commanding a magnificent view of the coasts of the Mediterranean, and of the Pyrenees and Alps. On the terrace is situated the reservoir of the town, the water being brought from a distance of about 8 m. by an aqueduct. In the centre of the square is an equestrian statue of Louis XIV., while opposite the entrance is the Porte de Peyrou, a triumphal arch erected at the end of the 17th century to commemorate the achievements of Louis XIV. The Boulevard Henri IV. to the north leads past the botanical garden, founded in 1593 and thus the oldest in France, the medical college, and the cathedral; to the east the Rue Nationale leads to the palace of justice, the prefecture, and the citadel. The cathedral (14th century), which until 1536 was the church of a Benedictine monastery, suffered severely during the religious wars, and about the middle of the 19th century the choir and one of the four towers at the angles of the nave were rebuilt in the style of the 13th century. The monastery, after being converted into the bishop's palace, has since 1795 been occupied by the famous medical school. A gallery devoted to the portraits of professors since 1239 contains one of Rabelais. Close to the medical school is the Tour des Pins, the chief relic of the medieval fortifications. The museum (Musée Fabre) contains rich collections of Italian, Flemish, Dutch and modern French paintings and of French sculptures. Its nucleus was the collection given to it by the painter F. X. P. Fabre (1766–1837), born at Montpellier. The principal public buildings are the palace of justice—a modern structure, the theatre and the prefecture, also modern. Montpellier possesses old houses of the 15th and 16th centuries. The Lez is canalized so as to connect Montpellier with the canal du Midi and with the sea at Palavas. The town has a considerable trade in wine, brandy, fruit and silk. The principal industrial establishment is a manufactory for candles and soap. There are also tanneries, distilleries and manufactories of cotton and woollen goods, chemicals, casks, hosiery and chocolate. The town is the centre of an *académie* (educational division) and has long been renowned as a seat of learning. Montpellier university comprises faculties of medicine, law, science and letters, and a higher school of pharmacy. Montpellier is also the seat of a bishop and a prefect, of courts of appeal and assizes, tribunals of first instance and of commerce, a chamber of commerce, a board of trade arbitration, and headquarters of the XVI. army corps.

Montpellier first rose into importance after the destruction of Maguelonne by Charles Martel in 737. In the 10th century it consisted of two portions, Montpellier and Montpelliéret, held from the bishops of Maguelonne by the family of Guilhem. The Guilhems were succeeded, through marriage, by the house of Aragon, a member of which in 1349 sold his rights to Philip of Valois, Montpelliéret having already in 1292 been ceded to the Crown by the bishops. In 1141 Montpellier acquired a charter afterwards materially extended, and the same century saw the rise of its school of medicine. Several of the ablest teachers of that school were members of an important Jewish colony established in the town. It had a school of law in 1160, and a university was founded by Pope Nicholas IV. towards the close of the 13th century. Louis IX. granted to Montpellier the right of free trade with the whole of the kingdom, a privilege which greatly increased its prosperity. The importance of the town was enhanced when the bishopric of Maguelonne was transferred thither in 1536. During the wars of religion the town was a stronghold of the Protestants, who captured it in 1567. It strenuously supported the duke of Rohan in his revolts and in 1622 only succumbed to Louis XIII. after a siege of eight months. In 1628 the duke was defeated there and the walls of the town razed, the royal citadel built in 1624 being, however, spared. Louis XIII. made Montpellier the seat of one of the *généralités* of Languedoc, and the states of that province met there during the 17th and 18th centuries.

See A. C. Germain, *Histoire du commerce de Montpellier antérieurement à l'ouverture du port de Cette* (2 vols., Montpellier, 1861), and *Histoire de la commune de Montpellier* (3 vols., Montpellier, 1851); Aigrefeuille, *Histoire de la ville de Montpellier* (4 vols., Montpellier, 1875–1882).

MONTPENSIER, COUNTS AND DUKES OF. The French lordship of Montpensier (department of Puy-de-Dôme), which became a countship in the 14th century, was sold in 1384 by Bernard and Robert de Ventadour to John, duke of Berry, whose daughter Marie brought the countship to her husband, John I., duke of Bourbon, in 1400. The countship was subsequently held by Louis de Bourbon, younger son of Duke John, and by his descendants up to Charles de Bourbon-Montpensier, the famous constable, who became duke of Bourbon by his marriage with his cousin, Suzanne de Bourbon, in 1505. Confiscated by King Francis I., the countship was restored in 1538 to Louise de Bourbon, sister of the constable, and widow of the prince de La Roche-sur-Yon, and to her son Louis (1513–1582), and was erected into a duchy in the peerage of France (*duché-pairie*) in 1539. Marie, daughter and heiress of Henri de Bourbon, duke of Montpensier, brought the duchy to her husband Gaston, duke of Orleans, brother of Louis XIII., whom she married in 1626, and their daughter and heiress (see below), known as "La Grande Mademoiselle," was duchess of Montpensier. The title subsequently remained in the Orleans family, and was borne in particular by Antoine Philippe (1775–1807), son of Philippe "Égalité," and Antoine Marie Philippe Louis (1824–1890), son of King Louis Philippe and father-in-law of King Alphonso XII. of Spain.

MONTPENSIER, ANNE MARIE LOUISE D'ORLÉANS, Duchesse de (1627–1693), French memoir-writer, was born at the Louvre on the 29th of May 1627. Her father was Gaston of Orleans, "Monsieur," the brother of Louis XIII. Her mother was Marie de Bourbon, heiress of the Montpensier family. Being thus of the blood-royal of France on both sides, and heiress to immense property, she appeared to be very early destined to a splendid marriage. It was perhaps the greatest misfortune of her life that "la grande mademoiselle" was encouraged to look forward to the throne of France as the result of a marriage with Louis XIV., who was, however, eleven years her junior. Ill-luck, or her own wilfulness, frustrated numerous plans for marrying her to persons of exalted station, including even Charles II. of England, then prince of Wales. She was just of age when the Fronde broke out; and, attributing as she did her disappointments to Mazarin, she sympathized with it not a little. In the new or second Fronde she not only took nominal command of one of the armies on the princes' side, but she literally and in her own person took Orleans by escalade. However, she had to retreat to Paris, where she practically commanded the Bastille and the adjoining part of the walls. On the 2nd of July 1652, the day of the battle of the Faubourg Saint Antoine, between the Frondeurs under Condé and the royal troops under Turenne, Mademoiselle saved Condé and his beaten troops by giving orders for the gates under her control to be opened and for the cannon of the Bastille to fire on the royalists. In the heat of the *émeute* which followed she installed herself in the Hôtel de Ville, and played the part of mediatrix between the opposed parties. Her political importance lasted exactly six months, and did her little good, for it created a lifelong prejudice against her in the mind of her cousin, Louis XIV. She was for some years in disgrace, and resided on her estates. It was not till 1657 that she reappeared at court, but, though projects for marrying her were once more set on foot, she was now past her first youth. She was nearly forty, and had already corresponded seriously with Mme de Motteville on the project of establishing a ladies' society "sans mariage et sans amour," when a young Gascon gentleman named Puyguilhem, afterwards celebrated as M. de Lauzun (*q.v.*), attracted her attention. It was some years before the affair came to a crisis, but at last, in 1670, Mademoiselle solemnly demanded the king's permission to marry Lauzun. Louis, who liked Lauzun, and who had been educated by Mazarin in the idea that Mademoiselle ought not to be allowed to carry her vast estates and royal blood to anyone who was himself of the blood-royal, or even to any foreign prince, gave his consent, but it was not immediately acted on, as the other members of the royal family prevailed with Louis to rescind his permission. Not long afterwards Lauzun, for another cause, was imprisoned in Pignerol, and it was years before Mademoiselle was able to buy his release from the king by settling no small portion of her estates on Louis's bastards. The elderly lovers (for in 1681, when Lauzun was released, he was nearly fifty, and Mademoiselle was fifty-four) were then secretly married, if indeed they had not gone through the ceremony ten years previously. But Lauzun tyrannized over his wife, and it is said that on one occasion he addressed her thus, "Louise d'Orléans, tire-moi mes bottes," and that she at once and finally separated from him. She lived for some years afterwards, gave herself to religious duties, and finished her *Mémoires*, which extend to within seven years of her death (April 9, 1693), and which she had begun when she was in disgrace thirty years earlier. These *Mémoires* (Amsterdam, 1729) are of very considerable merit and interest, though, or perhaps because, they are extremely egotistical and often extremely desultory. They are to be found in the great collection of Michaud and Poujoulat, and have been frequently edited apart. Her *Eight Beatitudes* has been edited by E. Rodocanachi as *Un Ouvrage de piété inconnu* (1908).

See the series of studies on La Grande Mademoiselle, by "Arvède Barine" (1902, 1905). (G. Sa.)

MONTREAL, a city of the Dominion of Canada, its leading seat of commerce and principal port of entry, as well as the centre of many of its important industries. It is situated on the south-east of the island of Montreal, at the confluence of the Ottawa and St Lawrence rivers, in the county of Hochelaga and province of Quebec. The observatory in the grounds of McGill University, in the city, has been determined to be in 45° 30′ 17″ N. lat., and 73° 34′ 40·05″ W. long. The city holds a fine position at the head of ocean navigation, nearly a thousand miles inland, and at the foot of the great system of rivers, lakes and canals upon which the commerce of the interior is carried to the Atlantic seaboard. The ship channel below Montreal permits the passage of ocean vessels drawing 30 ft. at low water. The deepening of the channel, largely due to the initiative of Montreal merchants, was begun in 1844 by the government of Canada. The work was transferred to the Harbour Commissioners of Montreal in 1850. The depth of the channel was then 11 ft. Fifteen years later it had gradually been increased to 20 ft.; and in 1888, when the work was taken over by the Dominion government, the depth was 27 ft. 6 in. The Lachine canal, with the chain of artificial waterways that succeeded it, opened the way for the shipping of the Great Lakes. The first sod in the digging of the Lachine canal was turned in July 1821 by John Richardson of Montreal. The same public-spirited merchant presided in April of the following year at the preliminary meeting which led to the formation of the committee of trade, itself the forerunner of Montreal's indispensable board of trade. Even before the close of the French régime in Canada efforts had been made to cut a canal across the island of Montreal, and M. de Catalogne succeeded in building a waterway practicable for the canoes of the fur-traders. The more ambitious canal commenced in 1821 was completed four years later, at a cost of $440,000. Before its completion, however, the increasing draught of inland shipping made it practically useless, and in 1843 work was begun on an enlargement. Since then the canal has been repeatedly deepened, to keep pace with the requirements of lake shipping, until to-day a 14-ft. channel is available. In the meantime the rival method of rail transportation was taking shape, and in 1836 the first Canadian railway was opened, between Laprairie, opposite Montreal and St Johns, in the eastern townships. In 1848 a second railway, from Longueuil to St Hyacinthe, was opened; both these projects owing their existence to the enterprise of Montreal citizens. The broad St Lawrence, however, still lay between the city and the outside world. In 1854 work was commenced upon the famous Victoria tubular bridge, designed by Robert Stephenson and A. M. Ross. The bridge was opened by King Edward VII., then prince of Wales, in 1860. In 1898 it was replaced by the Victoria Jubilee bridge, built on the piers of the old bridge. At the foot of Lake St Louis, some distance above the Victoria Jubilee bridge, the Canadian Pacific railway crosses the river on a graceful cantilever bridge with two central spans each 408 ft. long. Montreal is on the Canadian Pacific, Grand Trunk, Intercolonial, Canadian Northern, New York Central, Rutland, Central Vermont and Delaware & Hudson railways. During the season of navigation several lines of well-appointed steamers maintain communication with Liverpool, London, Glasgow, Bristol and other British and European ports, as well as the principal ports on the river and gulf of St Lawrence and the Great Lakes. A system of electric railways covers every section of the city and affords easy communication with the suburbs and neighbouring towns.

Built originally along the water-front, Montreal has in the course of years swept back over a series of terraces—former levels of the river or of a more ancient sea—to the foot of Mount Royal. Held there, it has been forced around the mountain on either side. Mount Royal, from which the city derives its name and so much of its natural beauty, is a mass of trap-rock thrown up through the surrounding limestone strata to a height of 753 ft. above the level of the sea. Under the direction of Frederick Law Olmsted, it was converted into a magnificent park. Between mountain and river the Lachine canal winds through the plain. In the middle of the river lies the beautifully wooded St Helen's island, rising to a height of 150 ft. above the water, and itself commanding an excellent view of the city. The island, named after Helen Boullé, wife of Champlain, belonged at one time to the barons of Longueuil. The British government purchased it for military purposes, and it still contains a battery of guns and barracks, the latter tenantless, since the island has been loaned to the city for use as a public park.

The city is substantially built, grey limestone, quarried from the mountain, predominating in the public and many of the private edifices. On the south of the Place d'Armes, a small enclosure covering the site of an ancient burying-ground, stands the parish church of Notre Dame, whose Gothic outlines form one of the striking features of the city. Designed by James O'Donnell, the church was built in 1824 to take the place of an earlier structure dating back to 1672. The existing church is 255 ft. long and 134 ft. wide, and accommodates 10,000 worshippers. Its twin towers (227 ft.) contain ten bells, one of which, known as "Le Gros Bourdon," weighs 24,780 ℔, the largest in America. Two others weigh respectively 6041 and 3633 ℔. Beside the church stands the historic seminary of St Sulpice, one of the few remaining relics of the days of French rule. This ancient building is now used for the offices of the Order of Sulpicians, founded by the Abbé Olier in the early half of the 17th century. This zealous enthusiast had sent out Paul de Chomedy, sieur de Maisonneuve, in 1641 to establish the missionary enterprise which afterwards developed into the city of Montreal, and six years later the Abbé de Quelus, with three devoted companions, landed at Ville-Marie de Montreal and laid the foundations of the future powerful Order of Sulpicians. The seigneury of Montreal, acquired by Olier in 1640, is still held by the Sulpicians, and as they have retained large blocks of land in the heart of the city as well as elsewhere on the island, these "Gentlemen of the Seminary," as they were locally called, rank among the wealthiest societies in America. The head offices of the Bank of Montreal face Notre Dame church, on the north of the Place d'Armes, and several other of the leading banking institutions of the city have their quarters in the immediate neighbourhood. In the Place d'Armes itself stands a striking figure in bronze erected to the memory of the founder of Montreal, Maisonneuve. At the base are a series of bas-reliefs setting forth historical incidents connected with the early history of the town. The monument is the work of a Canadian sculptor, Louis Philippe Hébert, C.M.G. The Roman Catholic cathedral of St James stands upon Dominion Square. It is an almost exact reproduction, reduced to one-half the scale, of St Peter's at Rome. The building, projected by the late Archbishop Bourget to replace the old church on St Denis street destroyed in the great fire of 1852, was begun in 1868. On the west of the square stand the Windsor Street station of the Canadian Pacific railway; St George's (Anglican) church, which possesses a fine chime of bells; and the Windsor Hotel. A statue of Sir John Macdonald occupies the centre of the square. Close to the historic Bonsecours Market stands the church of Notre Dame de Bonsecours, founded by Sister Marguerite Bourgeois in 1673 as a sanctuary for a miraculous statue of the Virgin. The original church was burned in 1754, and the present building, erected in 1771, an example of Norman architecture transplanted to the New World, narrowly escaped destruction to make room for a railway station. Curiously enough, it remained for a number of English Protestants to secure the preservation of this relic of the French period. Jacques Cartier Square, adjoining Bonsecours Market, is notable for its column and statue of Nelson, erected in 1808. As the Roman Catholic cathedral owes its existence to the energy and enthusiasm of Archbishop Bourget, so Christ Church cathedral must always be associated with the name of the first resident Anglican bishop of Montreal, Dr Fulford. The church is a fine example of the Early English style of architecture. Beside it stands a memorial of Bishop Fulford, modelled after the famous Martyr's Memorial at Oxford.

The mixture of races and creeds, which is so striking a characteristic of Montreal life, has not only endowed the city with many beautiful churches, but also with varieties of philanthropic institutions. Each of the several national societies—St George's, St Andrew's, St Patrick's, and that of the French-Canadian patron saint, St Jean Baptiste, to mention no others—looks after the welfare of its own adherents. Of the several hospitals, the most venerable is the Hôtel Dieu, founded in 1644 by Mme de Bouillon, a French lady of high rank. The original building, in the early days of Ville Marie, stood without the fort, and was fortified to withstand the attacks of the Iroquois. The site is now covered by a block of warehouses on St Paul Street. The present buildings, completed in 1861, contain both a hospital and nunnery. The Order of the Grey Nuns, founded by a Canadian lady, Mme d'Youville, in 1737, cares for hundreds of foundlings and aged and infirm people in the great hospital in Guy Street. The Montreal General hospital was founded in 1819 by public subscriptions, and the Royal Victoria hospital is a monument to the generosity of Lord Strathcona and Lord Mount-Stephen. Besides these should be mentioned the Notre Dame, the Western and the Children's Memorial hospitals. Separate hospitals for contagious diseases are maintained both by the Roman Catholics and Protestants.

Montreal provides for the education of its young people through two distinct systems of public schools, one for Roman Catholics, the other for Protestants, each governed by a board of commissioners. The schools are maintained by an annual tax based upon the assessment, two-fifths of 1 % being levied upon the Protestant section of the community for the support of the Protestant schools, and one-quarter of 1 % upon the Catholics for their schools. Unlike the neighbouring provinces of Ontario, Quebec makes no provision for a state university. But James McGill (1744–1813) left property, valued at the time of his death at £30,000, for the foundation of a university, one college of which was to bear his name. A royal charter conferring university powers was obtained in 1821. During early years slow progress was made, but with the appointment of Sir William Dawson as principal, in 1855, the institution entered on a career of prosperity. It now embraces five faculties: arts, applied science, law, medicine, agriculture, and comprises the following: McGill College, Montreal, the original foundation; the Royal Victoria College for Women, Montreal, built and endowed by Lord Strathcona; four affiliated theological colleges in Montreal; the Macdonald College, erected and endowed by Sir William C. Macdonald, at Ste Anne de Bellevue, 20 m. from the city; the McGill University College of British Columbia, Vancouver, B.C.; and three affiliated colleges: Stanstead Wesleyan College, Stanstead, P.Q.; Victoria College, Victoria, B.C.; Alberta College, Edmonton. The finely-equipped Macdonald scientific laboratories, with the Redpath Museum and University Library (114,000 vols. in 1907), form part of a noble group of buildings on the campus in Montreal. Disastrous fires in April 1907 wiped out two buildings and destroyed the splendid medical museum, but the plans for rebuilding provided for further extension and improvement. Previous to the fires the property of the university in buildings in Montreal, including equipment and endowment, was valued at $6,000,000.

The French university of Laval, the chief seat of which is in the city of Quebec, also maintains a branch at Montreal, established in 1877. It embraces the faculties of arts, law, medicine and theology, the latter conducted through the Seminary of St Sulpice. The college library has been enriched by a rare collection of Canadian books and manuscripts, bequeathed by Judge Louis François Georges Baby (1834–1906), of Montreal. The medical school, which now occupies a portion of the university building, formerly held its sessions in the historic Chateau de Ramesay, built by the Chevalier de Ramesay, governor of Montreal, in 1704, and occupied after the conquest by the British governors of Canada, until the stoning of Lord Elgin and the burning of the Parliament Buildings in 1849 brought about the removal of the seat of government from Montreal. The Chateau de Ramesay is now the fitting home of a public collection of historic relics. Of other educational institutions in the city the most important is St Mary's College, founded in 1848 by the Jesuits, and removed to the present building in 1855. The archives boast a notable collection of early Canadian manuscripts, upon which Francis Parkman drew in preparing his histories of New France.

Montreal's position as the chief doorway of the outgoing and incoming trade of the Dominion is largely due to the foresight of her great merchants. With the gradual opening up of means of communication by land and water, and the development of her facilities for handling the exports and imports of the country, the city has increased rapidly in importance, until to day one-third of the imports of the Dominion come through Montreal, and nearly 30 % of the exports. In shipments of grain Montreal has outstripped all her rivals on the continent except New York and New Orleans, and the building of the Georgian Bay canal will, by materially shortening the distance between the western grainfields and European markets, give her a very considerable advantage over both these ports. In dairy produce she is already the chief export centre of the continent. Montreal is also the financial centre of Canada, and in it are to be found the head offices of more than 25 important banks, of the leading insurance companies, and of the two greatest railways of the country.

Montreal is governed by a mayor and 36 aldermen, elected every two years. The city returns 5 members to the Dominion House of Commons and 6 to the Provincial Legislature of Quebec.

The population of Montreal, according to the census of 1901, was 266,826. With the suburbs, it was estimated in 1907 at over 405,000, about three-fifths French.

The history of the town is steeped in romance. From that first remarkable scene, so graphically described by Francis Parkman, when, on the 18th of May 1642, Maisonneuve and his little band of religious enthusiasts landed upon the spot where the Montreal Custom House now stands, and planted, in the words of the saintly Dumont, a grain of mustard seed destined to overshadow the land, the history of the town was to be intimately associated with missionary enterprise and such missionary heroism as the world has rarely seen. Montreal began as a religious colony, but its very situation, on the outer confines of civilization and at the door of the Iroquois country, forced it to become a military settlement, a fortified town with a military garrison. Similarly its position, even then an ideal one from a commercial point of view, made it the dominating centre of the fur-trade. For a hundred years after its foundation these three influences held sway, more or less mutually antagonistic, the streets of Montreal presenting an animated picture of sombre priests and jovial soldiers, savage hunters in their native finery and more than half-savage fur traders. Within another hundred years, although both priests and soldiers were still to be seen on her streets, they had become but atoms in a larger and more varied population. The fur trader of New France, merged after the conquest in the fur trader of the North West Company—which had its origin in Montreal—remained for a time the one picturesque survival of earlier and more romantic days. Finally, he too disappeared in the multiform and strenuous life of the modern city.

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MONTRÉSOR, CLAUDE DE BOURDEILLE, Comte de (*c.* 1606–1663), French intriguer and memoir-writer, was the grand-nephew of Pierre de Brantôme. He was the second favourite of Gaston, duke of Orleans, the weak brother of Louis XIII., succeeding Antoine de Laage, duc de Puylaurens, in this position in 1635. He planned the assassination of Cardinal Richelieu at the camp of Amiens in 1636, a plan which failed through the cowardice of Orleans. Montrésor was obliged to spend the next six years on his estate, but in 1642 he entered into the plot of Cinq Mars against Richelieu. On its failure he escaped to England, but his estates were confiscated. Returning after Richelieu's death, he entered into the intrigues of the period just preceding the Fronde, and was imprisoned in the Bastille, then in Vincennes, having risked his safety by coming back from exile in Holland to aid the duchess of Chevreuse. Mazarin attempted to win him over in vain, but in 1653 he made his submission to the victorious minister, and from that time on played no part in public life. He had three children by Mlle de Guise, with whom he had a lasting liaison.

His *Mémoires* have preserved his name from the oblivion otherwise awaiting such intriguers; they are written with naïve frankness and are extremely interesting. They are printed by A. Petitot and Monmerqué in *Collection des mémoires relatifs à l'histoire de France* (Paris, 1876).

MONTREUIL, GERBERT DE (*fl.* 13th century), French *trouvère*, author of the *Roman de la violette*. He dedicated his poem (*c.* 1221) to the Countess Marie of Ponthieu, wife of Simon, count of Dammartin and a niece of Philip Augustus. The count Gerard de Nevers of the story stakes his domains on the fidelity of his wife Euriant. Lisiard by calumniating Euriant wins the wager, but in the end the traitor is exposed, and, after many adventures, Euriant is reinstated. Another version of the story is given in the *Roman du comte de Poitiers* and in the tale in the *Decameron* (ii. 9) on which Shakespeare founded *Cymbeline.* Lyrics are inserted in the narrative of the *Roman de la violette,* as they had been in the *Conte de la rose* (1200), known also as *Guillaume de Dole.* A prose version, dating from the early 15th century, provided Wilhelmine de Chézy with the material for her libretto of Weber's opera, *Euryanthe* (1823).

See *Hist. litt. de la France.* xxii. 782, xviii. 760, xxii. 826; *Le comte de Poitiers* (ed. F. Michel, 1831); *Le Roman de la violette* (ed. F. Michel, 1834); *Le Conte de la rose* (ed. Servois, 1893); F. Kraus, *Über Gerbert de Montreuil* (Erlangen, 1897); Rudolf Ohle, *Shakespeares Cymbeline und seine romanischen Vorläufer* (Berlin, 1890).

MONTREUIL-SOUS-BOIS, a town of northern France in the department of Seine, 5 m. E. of Paris, on the slope and summit of a hill, about 1 m. N. of Vincennes. Pop. (1906), 35,831. Montreuil is specially noted for its extensive peach orchards. The manufactures include paint, oils and varnish, glass and chemical products.

MONTREUIL-SUR-MER, a town of northern France, capital of an arrondissement in the department of Pas-de-Calais, 24 m. S. by E. of Boulogne by rail. Pop. (1906), 2883. The town with its old citadel and ramparts, due largely to Vauban, is prettily situated on an eminence on the left bank of the Canche 10 m. from the English Channel. The chief buildings are the church of St Saulve (12th, 13th and 16th centuries), and a hospital founded in 1200 and rebuilt in the 19th century, with a fine chapel in the Flamboyant style. The buildings of the old abbey of Ste Austreberthe, founded originally in the 11th century, still remain. Montreuil is the seat of a sub-prefect and has a tribunal of first instance and a preparatory infantry school. The town owes its origin to a monastery established in the 7th century by St Saulve, bishop of Amiens.

MONTREUX, the general name applied to the villages situated along the shore at the east of the Lake of Geneva in Switzerland, from Clarens to Veytaux: sometimes the name is specially given to Vernex only. These villages form part of 3 communes, those of Le Châtelard (including Clarens and Vernex) and of Les Planches (including Territet), while a bit (not Chillon) of that of Veytaux is alone included. The total population of this "agglomeration" was 14,144 in 1900, mostly French-speaking, while there were 9730 Protestants to 4301 Romanists and 55 Jews. There are railway stations at Clarens (15 m. south-east of Lausanne), at Vernex (½ m. on), and Territet (1 m. on, or ¾ m. from Veytaux, which is 1¼ m. north of Villeneuve), as well as an electric tramway along the shore of the lake, and frequent communication over the lake by steamer. From Territet there is a mountain railway past Glion and Caux nearly to the top of the Rochers de Naye (6710 ft.), while from Vernex the Montreux-Bernese-Oberland railway mounts past Les Avants, pierces the ridge of the Col de Jaman by a tunnel, and so reaches (14 m.) Montbovon in the Gruyère portion of the upper Sarine valley. At first foreigners were attracted by the cheapness and good air of the region, added to the grape cure. As the delights of clear, cold weather in winter and of tobogganing (here called "luging") and skiing became appreciated, the higher hotels (such as Les Avants, Caux, Glion) were frequented at that season, as well as at other times. It is stated that in 1902 31,473 foreigners (in 1903, 39,493) visited Montreux, 7634 being Germans, 7327 English, and 5651 French. Montreux was not a Roman settlement, but otherwise its history is similar to that of Vevey.

MONTROND, CASIMIR, Comte de (1768–1843), French diplomatic agent, was the son of a military officer; his mother, Angélique Marie d'Arlus, comtesse de Montrond (d. 1827), was a royalist writer, said to be the author of the *Troubadour béarnois,* a song which has the refrain "*Louis, le fils de Henri, Est prisonnier dans Paris.*" Casimir was imprisoned in 1794 in St Lazare, where he met the divorced duchesse de Fleury (née Franquetot de

Coigny), the "*jeune captive*" of André Chénier's famous verses. He bought her freedom and his own with 100 louis. They married and crossed to London, but the union proved unhappy, and they were divorced on their return to Paris.

Turning to the fashionable world, Casimir de Montrond became famous for his successes. He was the confidant and political agent of Talleyrand, and his inside knowledge of politics enabled him to make a large fortune on the Bourse. In 1809 he was disgraced for some imprudent comments on the imperial system, and exiled from Paris. After spending some time at Antwerp he removed to Spa, where he was on intimate terms with Pauline Borghése, and in 1811 he returned to Antwerp; here he was arrested by Napoleon's orders and sent to the fortress of Ham. After a month's imprisonment he received permission to reside, under police supervision, at Châtillon-sur-Seine, whence he presently escaped to England. He returned to France at the first Bourbon restoration, and during the Hundred Days was entrusted with a mission to Vienna to convert Talleyrand to Napoleon's interests, to see Metternich and Nesselrode, and to bring back if possible Marie Louise and the king of Rome. The second restoration restored him to his social triumphs, though he was always under police supervision, and on Talleyrand's fall he accompanied him to Valençay and continued to help with his intrigues. He followed Talleyrand to London in 1832. Montrond returned to Paris some time before his death in 1843.

See H. Welschinger, "L'Ami de M. de Talleyrand," in the *Revue de Paris* (Feb. 1895); Lanzac de Laborie, *La Domination française en Belgique* (1895); and Amédée Pichot, *Souvenirs sur M. de Talleyrand* (1870).

MONTROSE, MARQUESSES AND DUKES OF. David Lindsay, 5th earl of Crawford (*c.* 1440–1495), was created duke of Montrose in 1488 (the first dukedom conferred in Scotland on a person not of royal blood), as a reward for remaining loyal to James III. during the rebellion of Angus and Prince James. Montrose was deprived of his dukedom by James IV., but it was restored in 1489 for life only. On his death in 1495 the title therefore became extinct.

In 1505, William, 4th Lord Graham, whose wife Annabella Drummond was the duke's niece, was created earl of Montrose; and this title was held by his descendants till 1644, when James Graham, 5th earl, was created marquess of Montrose and earl of Kincardine. This was the celebrated marquess of Montrose (*q.v.*) of the Civil War, whose son and successor, James (*c.* 1631–1669), was known as "the Good Marquess." The latter refused to vote at the trial of his hereditary enemy the marquess of Argyll in 1661, admitting that he could not act impartially in such a matter; and the two noblemen afterwards became firm friends. The good marquess died in 1669, and was succeeded by his son James, 3rd marquess of Montrose (d. 1684). The 4th marquess, son of the last mentioned, who was also named James (d. 1742), was lord high admiral of Scotland in 1705, and lord president of the council in 1706. He was an ardent supporter of the Hanoverian succession; he also favoured the union of Scotland with England, for his services in regard to which he was created duke of Montrose and marquess of Graham in 1707, becoming in the same year one of the first representative peers of Scotland in the parliament of Great Britain. He was one of the regents of the kingdom on the death of Queen Anne, and was appointed a secretary of state by George I. He took an active part in suppressing the Jacobite rising in 1715, after which he was made keeper of the great seal in Scotland. He died in 1742. During his lifetime his son David was raised to the peerage of Great Britain with the title of Earl Graham; and on David's death without issue in 1731 this earldom passed under a special remainder to his brother William (*c.* 1710–1790), who on his father's death in 1742 succeeded to the dukedom also. William's son James, 3rd duke of Montrose (1755–1836), held office in Pitt's administrations in 1783 and 1804, and in that of the duke of Portland in 1807. He obtained the annulment of the law prohibiting Highlanders from wearing the kilt. He was succeeded by his son James (1799–1874), who held office under the earl of Derby in 1852, and again in 1858 and 1866, and was father of Douglas Beresford Malise Ronald, 5th duke (b. 1852). In 1853 James Lindsay, 24th earl of Crawford, claimed the title of duke of Montrose on the ground that the patent granted to his ancestor David Lindsay in 1488 (see above) had not been effectively rescinded, but his petition was dismissed by the House of Lords.

MONTROSE, JAMES GRAHAM, Marquess of (1612–1650), was born in 1612, and became 5th earl of Montrose (see above) by his father's death in 1626. He was educated at St. Andrews, and at the age of seventeen married Magdalene Carnegie, daughter of Lord Carnegie (afterwards earl of Southesk). Not long after the outbreak of the Scottish troubles in 1637 he joined the party of resistance, and was for some time one of its most energetic champions. He had nothing puritanical in his nature, but he shared in the ill-feeling aroused in the Scottish nobility by the political authority given by Charles to the bishops, and by Hamilton's influence with the king, and also in the general indignation at the scheme of imposing upon Scotland a liturgy which had been drawn up at the instigation of the English court and corrected by Archbishop Laud. He signed the Covenant, and was told off to suppress the opposition to the popular cause which arose around Aberdeen and in the country of the Gordons. Three times, in July 1638, and in March and June 1639, Montrose entered Aberdeen, where he succeeded in effecting his object, on the second occasion carrying off the head of the Gordons, the marquess of Huntly, as a prisoner to Edinburgh, though in so doing, for the first and last time in his life, he violated a safe-conduct.

In July 1639, after the signature of the treaty of Berwick, Montrose was one of the Covenanting leaders who visited Charles. This change of policy on his part, frequently ascribed to the fascination of the king's conversation, arose in reality from the nature of his own convictions. He wished to get rid of the bishops without making presbyters masters of the state. His was essentially a layman's view of the situation. Taking no account of the real forces of the time, he aimed at an ideal form of society in which the clergy should confine themselves to their spiritual duties, and the king, after being enlightened by open communication with the Scottish nation, should maintain law and order without respect of persons. In the Scottish parliament which met in September, Montrose found himself in opposition to Argyll, who had made himself the representative of the Presbyterian and national party, and of the middle classes. Montrose, on the other hand, wished to bring the king's authority to bear upon parliament to defeat this object, and offered him the support of a great number of nobles. He failed, because Charles could not even then consent to abandon the bishops, and because no Scottish party of any weight could be formed unless Presbyterianism were established ecclesiastically.

Rather than give way, Charles prepared in 1640 to invade Scotland. Montrose was of necessity driven to play something of a double part. In August 1640 he signed the Bond of Cumbernauld as a protest against the "particular and direct practising of a few," in other words, against the ambition of Argyll. But he took his place amongst the defenders of his country, and in the same month he displayed his gallantry in action at the forcing of the Tyne at Newburn. After the invasion had been crowned with success, Montrose still continued to cherish his now hopeless policy. On the 27th of May 1641 he was summoned before the Committee of Estates charged with intrigues against Argyll, and on the 11th of June he was imprisoned in Edinburgh Castle. When Charles visited Scotland to give his formal assent to the abolition of Episcopacy, Montrose communicated to him his belief that Hamilton was a traitor. It had indeed been alleged, on Clarendon's authority, that he proposed to murder Hamilton and Argyll; but this is in all probability only one of Clarendon's many blunders. (See S. R. Gardiner, *Hist. of England, 1603–1642*, x. 26). Upon the king's return to England Montrose shared in the amnesty which was tacitly accorded to all Charles's partisans.

For a time Montrose retired, perforce, from public life. After the Civil War began in England (see Great Rebellion) he constantly pressed Charles to allow him to make a diversion in Scotland. Hamilton's impracticable policy of keeping Scotland neutral for long stood in the way of Charles's consent. But in 1644, when a Scottish army entered England to take part against the king, Montrose, now created a marquess, was at last allowed to try what he could do. He set out to invade Scotland with about 1000 men. But his followers deserted, and his condition appeared hopeless. Disguised as a groom, he started on the 18th of August with only two gentlemen to make his way to the Highlands. Highlanders had never before been known to combine together, but Montrose knew that most of the clans detested Argyll, and the clans rallied to his summons. About 2000 disciplined Irish soldiers had crossed the sea to assist him. In two campaigns, distinguished by rapidity of movement, he met and defeated his opponents in six battles. At Tippermuir and Aberdeen he routed Covenanting levies; at Inverlochy he crushed the Campbells, at Auldearn, Alford and Kilsyth his victories were obtained over well-led and disciplined armies. At Dundee he extricated his army from the greatest peril, and actually called his men off from the sack that had begun—a feat beyond the power of any other general in Europe. The fiery enthusiasm of the Gordons and other clans often carried the day, but Montrose relied more upon the disciplined infantry which had followed Alastair Macdonald from Ireland. His strategy at Dundee and Inverlochy, his tactics at Aberdeen, Auldearn and Kilsyth furnished models of the military art, but above all his daring and constancy marked him out as the greatest soldier of the war, Cromwell alone excepted. His career of victory was crowned by the great battle of Kilsyth (Aug. 15, 1645). Now Montrose found himself apparently master of Scotland. In the name of the king, who now appointed him lord-lieutenant and captain-general of Scotland, he summoned a parliament to meet at Glasgow on the 20th of October, in which he no doubt hoped to reconcile loyal obedience to the king with the establishment of a non-political Presbyterian clergy. That parliament never met. Charles had been defeated at Naseby on the 14th of June, and Montrose must come to his help if there was to be still a king to proclaim. David Leslie, the best of the Scottish generals, was promptly despatched against Montrose to anticipate the invasion. On the 12th of September he came upon Montrose, deserted by his Highlanders and guarded only by a little group of followers, at Philiphaugh. He won an easy victory. Montrose cut his way through to the Highlands; but he failed to organize an army. In September 1646 he embarked for Norway.

Montrose was to appear once more on the stage of Scottish history. In June 1649, burning to revenge the death of the king, he was restored by the exile Charles II. to the now nominal lieutenancy of Scotland. Charles however did not scruple shortly afterwards to disavow his noblest supporter in order to become a king on terms dictated by Argyll and Argyll's adherents. In March 1650 Montrose landed in the Orkneys to take the command of a small force which he had sent on before him. Crossing to the mainland, he tried in vain to raise the clans, and on the 27th of April he was surprised and routed at Carbiesdale in Ross-shire. After wandering for some time he was surrendered by Macleod of Assynt, to whose protection, in ignorance of Macleod's political enmity, he had entrusted himself. He was brought a prisoner to Edinburgh, and on the 20th of May sentenced to death by the parliament. He was hanged on the 21st, with Wishart's laudatory biography of him put round his neck. To the last he protested that he was a real Covenanter and a loyal subject.

The principal authorities for Montrose's career are Wishart's *Res gestae, &c.* (Amsterdam, 1647); Patrick Gordon's *Short Abridgment of Britane's Distemper* (Spalding Club); and the comprehensive work of Napier, *Memorials of Montrose*, is abundantly documented, containing Montrose's poetry, in which is included his celebrated lyric "My dear and only love."

MONTROSE, a royal, municipal, and police burgh and seaport of Forfarshire, Scotland. It is situated $30\frac{3}{4}$ m. N.E. of Dundee by the North British railway and is also connected with the Caledonian railway company's system by a branch to Dubton. Pop. (1901), 12,427. The town occupies a considerable area on a sandy peninsula, and is bounded on the E. by the North Sea, on the N. by the North Esk, on the S. by the South Esk, and on the W. by Montrose Basin, a large depression, about 7 m. in circuit. The reclamation of the Basin has been attempted, but an embankment constructed by Dutch dikers for this purpose was demolished in a few hours by a storm. In the mouth of the channel of the South Esk lies the island of Rossie, or Inchbrayock (pop. 160), which in 1829 was connected with the burgh by means of a suspension bridge 432 ft. long and by a drawbridge with the south bank near the fishing village of Ferryden (pop. 1330). The harbour lies between the suspension bridge and the sea, and is provided with a wet dock. The links form one of the best golf-courses in Scotland and are played over by several clubs. Besides the staple industry of flax-spinning, there are manufactures of linen, canvas, sheetings, starch, soap, chemicals, rope and manures, while iron-founding, tanning and brewing are also carried on. The fisheries are of very considerable importance and the shipping is usually brisk. There is a large trade, especially in timber (the chief import), mainly with Baltic ports and Canada. The parish church is a plain structure, but has a handsome steeple 200 ft. high. The principal buildings include the town-hall, the academy on the links, dating from 1820, though its predecessor belonged to the 16th century; the museum, Dorward's house of refuge, erected in 1839; the infirmary and the royal asylum at Sunnyside on the outskirts to the north-west. Panmure barracks are not far from the wet dock. In High Street are statues to Sir Robert Peel and Joseph Hume. Montrose is governed by a provost, bailies and council, and unites with Arbroath, Brechin, Forfar and Inverbervie (the Montrose burghs) in returning one member to parliament, a district group that was represented for many years by John Morley. Montrose received its charter from David I., and was made a royal burgh in 1352. It was destroyed by fire in 1244. Here Edward I. accepted John Baliol's surrender of the kingdom on the 10th of July 1296. Sir James Douglas sailed from the port in 1330 bound for the Holy Land with the heart of Robert Bruce; and here, too, the Old Pretender embarked in 1716 for France after the failure of his cause. In 1745 the town threw in its lot with the Hanoverians, a fact which lent zest to the daring capture of the "Hazard" sloop of war off Ferryden, by Captain David Ferrier of Brechin, a thorough-going Jacobite.

MONT ST MICHEL, a rocky islet of western France, off the coast of the department of Manche, some 6 m. N. of Pontorson. Pop. (1906), 238. It forms a towering mass of granite about 3000 ft. in circumference and 165 ft. in height, rising near the mouth of the Couesnon nearly a mile from the shore, to which it is united by a causeway. The fortress-abbey to which Mont St Michel owes its fame stands upon the more precipitous side of the islet towards the north and west, the sloping portion towards the east and south being occupied by houses. A strong machicolated and turreted wall surrounds the rock, running along its base on the south, ascending halfway up the cliff on the north, on which side it stands close to the abbey wall, and again descending on the west. The northern and oldest portion of the ramparts dates from the 13th century; the single gateway by which they are pierced is on the south and is a good example of the military architecture of the 15th century. The single street of the island curves from the gateway up to the abbey, ending in flights of steps leading to the donjon or châtelet. It is bordered by old houses, among which is one built by Bertrand du Guesclin in 1366, and contains a parish church of the 15th century. The abbey itself consists of an assemblage of buildings in three storeys upon massive foundations around the church, the most important portion, the Merveille, extending to the north. The floor of the church, built partly on the rock, partly upon foundations, and, at the east end, over a crypt, is on a level with the uppermost storey of the monastic buildings. To the north of and below the apse lies the group of buildings known as the Belle-Chaise. It comprises the châtelet (15th century), a square entrance structure strengthened by flanking turrets and machicolation, the adjoining guard-room (13th century) with the salle des officiers above it, and behind all the Tour Perrine. The Merveille (1203–1264) consists of two continuous buildings of three storeys, that on the east containing, one above the other, the hospitium (*aumônerie*), refectory and dormitory, that on the west the cellar, knights' hall (salle des chevaliers) and cloister. Of the apartments, all of the finest Gothic architecture, the chief are the refectory, divided down the centre by columns and lighted by large embrasured windows, and the knights' hall, a superb chamber, the vaulting of which is supported on three rows of cylindrical pillars. The cloister, one of the purest and most graceful works of the 13th century, is surrounded by double lines of slender columns carrying pointed arcades, between which delicate floral designs are carved. The exterior wall of the Merveille is of remarkable boldness; reaching a height of 108 ft., it is supported by twenty buttresses and pierced with a variety of openings. The church, which rises high above the buildings clustering round it, consists of transepts and four bays of the nave of Romanesque architecture and of a fine choir (1450–1521) in the Flamboyant Gothic style with a triforium surmounted by lofty windows. This choir replaced one which collapsed in 1431. In 1776 three of the seven bays of the nave were pulled down, and soon after the incongruous western front was added. The finest part of the exterior is the choir, which is ornamented with a profusion of carved pinnacles and balustrading. The central tower terminates in a Gothic spire surmounted by a gilded bronze statue of St Michael.

Mont St Michel was a sacred place from the earliest times. In the 8th century an oratory was established there by St Aubert, bishop of Avranches, in obedience to the commands of an apparition of St Michael. The place soon became a noted resort of pilgrims, not only from all parts of France, but also from Great Britain, Ireland and Italy. In 966 Richard I., duke of Normandy, founded in place of the oratory a Benedictine monastery, which in the succeeding century received a considerable share of the spoils of the conquest of England. In 1203 the monastery was burnt by the troops of Philip Augustus, who afterwards furnished large sums for its restoration (La Merveille). St Louis made a pilgrimage to Mont St Michel, and afterwards supplied funds which were spent on the fortifications. A garrison and military governor subordinate to the abbot were also installed. During the last thirty years of the Hundred Years' War the abbey offered a persistent resistance to the English. In 1469 Louis XI. instituted the Order of St Michel, which held its meetings in the salle des chevaliers. During the Wars of Religion, the Huguenots repeatedly made unsuccessful attempts to seize the fortress, which opened its gates to Henry IV. in 1595 after his abjuration. In 1622 the Benedictine monks of Mont St Michel were replaced by monks of the Congregation of St Maur. In the 18th and 19th centuries the abbey was used as a prison for political offenders, serving this purpose until 1863, when an extensive restoration, begun in 1838, was resumed. The building is the property of the Commission of Historical Monuments, which has carried on the work of restoration with great architectural and antiquarian ability.

MONTSERRAT, or MONSERRAT, a remarkable mountain and monastery in north-east Spain, 30 m. N.W. of Barcelona. The mountain is of grey conglomerate; its main axis trends from W.N.W. to E.S.E., and its circumference is about 18 m. The loftiest point is the Turó de San Jeronimo, also called Mirador and La Miranda (4070 ft.), which commands a view of the Pyrénées, and the Mediterranean Sea as far as the Balearic Islands. On the east the base of the Montserrat is washed by the river Llobregat. The Montserrat consists of jagged pinnacles and spires (*peñascos*) rising abruptly from the base of the mass, which is cloven by many ravines, and abounds with steep precipices. It is the *mons serratus* of the Romans, the *monte serrado* of the Spaniards, and is thus named either in allusion to its jagged appearance, like the teeth of a saw, or because it is split, as if sawn by the vast fissure of the Valle Malo, which extends from north-west to east. This occurred, say the Spanish legends, at the time of the Crucifixion, when the rocks were rent. In medieval German legends, which located here the castle of the Holy Grail, the mountain is called *Monsalwatsch*, a name analogous to the modern Catalan form *Montsagrat* "sacred mountain." From Monistrol, a village on the north-east, with a station on the Barcelona-Lérida railway, the monastery can be reached either by the carriage road built in 1857, or by the mountain railway opened in 1892. The ascent is also frequently made by a bridle path from the village of Collbató, on the south-west, where there are some interesting caverns.

The monastery stands 2910 ft. above sea-level upon a narrow platform on the edge of the Valle Malo. It owes its existence to an image of the Virgin, said to have been carved by St Luke, and brought to Barcelona by St Peter in A.D. 30. When the Moors invaded the province in 717 the image was taken to Montserrat, where a Benedictine convent appears to have already existed, and hidden in a cave. In 880 Gondemar, bishop of Vich, was attracted to the cave by sweet sounds and smells, and there found the image, which he determined to take to Manresa. But at a certain spot on the mountain the image refused to proceed farther; there it was consequently deposited, and a chapel was erected to contain it. Round the chapel a nunnery was built, and in 976 this was enlarged and converted into a second Benedictine convent. The old monastery (*monasterio antiguo*) is chiefly in ruins. The cloisters, belfry and part of the church were Gothic of the 15th century. The church of the new monastery (*monasterio actual*) was built in Renaissance style under Philip II. (1560–1592); in 1811 it was partially burned, and in 1880 a Romanesque apse was added. New buildings for the monks were erected under Ferdinand VII. (1784–1833), but left partly unfinished. During the Napoleonic wars (1808–14) it was despoiled of the vast treasures which had accumulated during the middle ages. In 1835, as a result of the Carlist insurrection, the convent was deprived of its estates and the number of monks reduced to about twenty. The monks are largely occupied by the management of a school of sacred music. In 1874 the convent, which by a grant of Pope Benedict XIII. had been an independent abbey since 1410, was made subject to the bishops of Barcelona.

Nuestra Señora de Montserrat, Patrona de Cataluña ("Our Lady of Montserrat, Patron Saint of Catalonia"), is one of the most celebrated images in Spain, and her church is visited annually by more than 60,000 pilgrims. The image is small, black, and carved of wood, but possesses magnificent robes and jewels. In September 1881 it was solemnly crowned by Leo XIII., who sent a crown from Rome for that purpose. As the celebrity and sanctity of Montserrat increased, so did the number of devotees. Ignatius Loyola (1491–1556) laid his sword upon the altar of the Virgin, and, placing himself under her protection, started from Montserrat to begin his new life. Many eminent Spaniards, weary of the world, have retired to this monastery to end their days. Some preferred solitary hermitages perched among the rocks. Of these there were fifteen, eleven of which once formed a *via sacra*, ending at the summit of San Jeronimo. They were destroyed by the French, but the ruins of some remain. There are also caves in the mountain, some of which were formerly occupied by monks. The most celebrated of these are the cave of the Virgin, in which the *santa imagen* remained hidden until found by Gondemar, and the cave of Fray Juan Garin, a notorious sinner, who ended his days in the practice of revolting penances at Montserrat.

MONTSERRAT, an island in the British West Indies, one of the five presidencies in the colony of the Leeward Islands. Pop., mostly negroes (1901), 12,215. It lies 27 m. S.W. of Antigua, in 16° 45′ N. and 62° 7′ W.; is 11 m. long and 7 m. broad, and has a total area of 32½ sq. m. The island is a cluster of rugged volcanic peaks rising from the Caribbean Sea, their summits clothed with forests; the still active Soufrière (3000 ft.) in the south being the highest point. The average temperature is 81° F., the hottest weather being usually tempered by cool sea breezes; the rainfall averages 94 in. per annum. There is a plentiful supply of water, and the roads are macadamized and well drained. The principal products are sugar and raw and concentrated lime-juice. Minerals are also found. Montserrat has a local legislature of six members, nominated by the Crown, and sends representatives to the general legislative council of the colony. Education is compulsory, and the majority of the schools are managed by the Church of England, to which most of the islanders belong; but the Wesleyans and the Roman

Catholics also support schools. Plymouth (pop. 1461), the chief town, stands on an open roadstead on the south-west coast.

The island was discovered by Columbus in 1493, who named it after Monserrado, a mountain in Spain. It was colonized by the British under Sir Thomas Warner in 1632, and was taken by the French in 1664. Restored to the British in 1668, it capitulated to the French in 1782, but was again restored in 1784.

MONTT, MANUEL (1809–1880), Chilean statesman, was born on the 5th of September 1809. He had a distinguished career as a scholar, and was introduced into public life during the presidency (1831–1841) of Arieto by Diego Portales. Montt distinguished himself by his courage in the crisis that followed upon Portales' assassination in 1837, though only holding a subordinate post in the government, and afterwards he held several ministerial offices, and during the presidency (1841–1851) of Bulnes he became minister of justice and public instruction, and later of the interior. He was elected president in 1851 and again in 1856, and though the Liberals chafed under his rule, and two revolutions, in 1851 and 1859, took place during his administration, he governed Chile with an energy and wisdom that laid the foundation of her material prosperity. He was ably assisted by his minister of the interior Antonio Varas, and it was from the union of the two statesmen that the well-known ultra-conservative faction, the Montt-Varistas, took their name. His presidency was marked by the establishment of railways, telegraphs, banks, schools and training-colleges. On giving up his post in 1861 he became president of the Supreme Court of Justice, a position which he held up to his death on the 20th of September 1880. His son Jorje (b. 1846) was president of Chile in 1891–1896, and a younger son, Pedro (d. 1910), in 1906–1910.

See P. B. Figueroa, *Diccionario biografico de Chile, 1550–1887* (Santiago, 1888); and J. B. Suarez, *Rasgos biograficos de hombres notables de Chile* (Valparaiso, 1886).

MONTUCLA, JEAN ÉTIENNE (1725–1799), French mathematician, was born at Lyons on the 5th of September 1725. In 1754 he published an anonymous treatise entitled *Histoire des recherches sur la quadrature du cercle*, and in 1758 the first part of his great work, *Histoire des mathématiques*, the first history of mathematics worthy of the name. He was appointed intendant-secretary of Grenoble in 1758, secretary to the expedition for colonizing Cayenne in 1764, and "premier commis des bâtiments" and censor-royal for mathematical books in 1765. The Revolution deprived him of his income and left him in great destitution. The offer in 1795 of a mathematical chair in one of the schools of Paris was declined on account of his infirm health, and he was still in straitened cirumstances in 1798, when he published a second edition of the first part of his *Histoire*. In 1778 he re-edited Jacques Ozanam's *Récréations mathématiques*, afterwards published in English by Charles Hutton (4 vols., London, 1803). He died on the 18th of December 1799. His *Histoire* was completed by J. J. Le F. de Lalande, and published at Paris in 1799–1802 (4 vols.).

MONTYON, ANTOINE JEAN BAPTISTE ROBERT AUGET, Baron de (1733–1820), French philanthropist, was born in Paris on the 23rd of December 1733. His father was a *maître des comptes*; he was educated for the law, and became advocate at the Châtelet in 1755, master of requests to the council of state in 1760, and intendant successively of Auvergne, Provence and La Rochelle. He had repeatedly shown great independence of character, protesting against the accusation of Caradeuc de La Chalotais in 1766, and refusing in 1771 to suppress the local courts of justice in obedience to Maupeou. He was made a councillor of state in 1775 by the influence of Louis de Bourbon, duke of Penthièvre, and in 1780 he was attached to the court in the honorary office of chancellor to the comte d'Artois (afterwards Charles X.). He followed the princes into exile, and lived for some years in London. During the emigration period he spent large sums on the alleviation of the poverty of his fellow immigrants, returning to France only at the second restoration. Between 1780 and 1787 he had founded a series of prizes, the awards to be made by the French academy and the academies of science and medicine. These prizes fell into abeyance during the revolutionary period, but were re-established in 1815. Montyon died on the 29th of December 1820, bequeathing 10,000 francs for the perpetual endowment of each of the following prizes: for the discovery of the means of rendering some mechanical process less dangerous to the workman; for the perfecting of any technical improvement in a mechanical process; for the book which during the year rendered the greatest service to humanity; the "prix de vertu" for the most courageous act on the part of a poor Frenchman—the awards being left as before to the learned academies. He also left 10,000 francs to each of the Parisian hospitals.

Montyon wrote a series of works, chiefly on political economy: *Éloge de Michel de l'hôpital* (Paris, 1777); *Recherches et considérations sur la population de la France* (1778), a share of which is attributed to his secretary, Moheau; *Rapport fait à Louis XVIII.* (Constance, 1796), in which he maintained in opposition to Calonne's *Tableau de l'Europe* that France had always possessed a constitution, which had, however, been violated by the kings of France; *L'état statistique du Tunkin* (1811); and *Particularités . . . . sur les ministres des finances en France* (1812).

See Lacretelle, "Discours sur M. Montyon," in the *Recueil de l'académie* (1820–1829); Quérard, *La France littéraire*, vol. vi. (1834); and, further, F. Labour, *M. de Montyon d'après des documents inédits* (Paris, 1880); G. Dumoulin, *Montyon* (Paris, 1884); and especially L. Guimbaud, *Auget de Montyon* (1909).

MONUMENT (Lat. *monumentum* or *monimentum*; from *monere*, to advise, bring to mind, remind; the German equivalent is *Denkmal*), literally that which serves to keep alive the memory of a person, an event, or a period. The word is thus applied to a column, statue, or building erected for that particular purpose, as "The Monument" (*i.e.* of the Great Fire) in London; to all the various memorials which man throughout the ages has raised over the buried dead, the barrows and cairns of prehistoric times, the representation of the living figure of the dead, brasses, busts, &c., or the varying forms, allegorical or otherwise, taken by the tombstones of the modern cemetery. In a wider sense "monument" is used of all survivals of a past age, in which sense it may include all the vestiges of prehistoric man, dolmens, menhirs, remains of lake-dwellings, stone-circles, and the like, buildings large and small, cities, castles, palaces, and examples of domestic architecture, which have any interest, historic or artistic, as well as movable artistic or archaeological treasures, which exist in private or public collections, or which are discovered by excavation, &c. In a more restricted sense the word "monument" is also applied to a comprehensive treatise on any particular subject—such as the *Monumenta typographica*, or an historical collection such as the *Monumenta Germaniae historica*. In the English law of conveyancing a "monument" is an object fixed in the soil, whether natural or artificial, and referred to in a document, and used as evidence for the delineation of boundaries or the situation of a particular plot of land, &c.

For a description of various kinds of monuments see such articles as Archaeology; Stone Monuments; Effigies, Monumental; Brasses; Sculpture; many particular monuments, such as Stonehenge, are treated under their respective names, or in the articles on the towns, &c., in which they stand.

The present article deals with the preservation, by government action, local or central, of the evidences and remains of past history and civilization, and, incidentally, with similar action extended to sites and places of natural beauty and interest, which the Germans call *Naturdenkmäler*, natural monuments. The important work of G. Baldwin Brown, *The Care of Ancient Monuments*, published in 1905, is practically the only book in English on this subject. It contains a most ample bibliography for each country and gives many references to various periodicals in different languages. In 1897 was issued a report (C. 8443, *Miscell. Reports*, 2) from British representatives abroad as to "the statutory provisions existing in foreign countries for the preservation of historical buildings." Reference also should be made to *The Care of Natural Monuments* (1909), by H. Conwentz, Prussian State Commissioner for the Care of Natural Monuments.

The chief question at issue is, how far does the national artistic or historic interest of a monument, in the widest sense of the word, justify the interference of the state with the right of a private owner, whether corporate body or individual, to do what he likes with his own? Nearly every European country other than the United Kingdom has given a decided answer to this question. It may be noticed, as showing the extreme reluctance to state interference in the United Kingdom, that a clause, laying on an owner of a monument, scheduled under the Monument Act 1882, the obligation of offering it for purchase to the state if he wished to destroy it, was struck out of that act.

The main lines followed by legislation or regulation for the preservation of monuments may be briefly indicated. Central organizations of commissions and conservators, with a staff of architects, inspectors, and archaeological or artistic experts for consultation, are established. These may have large legal powers of enforcing their decisions, or may act chiefly by advice or persuasion. The national treasures are catalogued and scheduled, and the value estimated in an exhaustive inventory, in many cases supplemented by local inventories. In many cases, unfortunately, a valuable monument has been destroyed through ignorance of its value. A special form of inventory, carrying with it legal consequences, is that known as the *classement* system; of this form the French is the typical example. In this only the outstanding monuments find a place, and such either become national property altogether, or the protection and preservation is undertaken by the state, or may be left in the hands of the private owner; but in any case the monument cannot be destroyed, restored or repaired without the consent of the central authority. The *classement* system has been criticized as tending to depreciate the consideration paid to such monuments as do not appear in the list—*monuments non-classés*. The British Monument Acts adopt a narrow kind of *classement* in the schedule attached to the 1882 act. Most states have powers of expropriation or compulsory purchase of private property on grounds of *public utility*, and English law is no exception—as in the case of the compulsory purchase of land for railways. The majority of states have made the protection of monuments such a matter of public utility. Further, the exportation of artistic or historic treasures, *i.e.* movable monuments, has been controlled by the state, notably in the case of Italy and Greece, Turkey and Egypt. Connected with this side of the question is the control by the state of excavations undertaken by private persons, even on their own property. In Germany considerable protection is effected by the powers given to municipalities to make by-laws, respecting not only the preservation of the monuments, but also the erection of new buildings that may interfere with the monuments or with the general characteristic appearance (*Stadtbild*) of the town. This is also the case in Italy, where there are frequent regulations as to town-planning (*piano regolamento*).

The following is a brief account of the measures adopted in the principal countries of the world for the preservation and protection of their artistic and historic treasures.

United Kingdom.—There are four acts: the Ancient Monuments Protection Acts of 1882, 1900 and 1910, and the Ancient Monuments Protection (Ireland) Act 1892. The act of 1882, due primarily to Lord Avebury, then Sir John Lubbock, provided that a list of monuments[1] in Great Britain and Ireland should be made to which the act was to apply; the number of these monuments was sixty-eight, all being of the kind known as prehistoric (barrows, stone-circles, dolmens, &c.). An owner of one of these scheduled monuments may by deed place it in the guardianship of the commissioners of works, who are then responsible for its preservation and can protect it even against the owner. The commissioners may purchase any of the scheduled monuments, but only by agreement, the compulsory clauses of the Lands Clauses Consolidation Acts being expressly excluded, though any purchase is to be made under those acts. An owner of any monument other than those scheduled may place it in the care of the commissioners. The funds for the working of the act are to be provided by parliament, and an inspector of ancient monuments was appointed. General Pitt-Rivers, the first inspector appointed, found that without compulsory powers the act was useless, and for many years did not draw his official salary. After his death in 1900 the office was left unfilled until 1910. The act of 1892 applied to Ireland only, and is supplementary to that of 1882, which applied to the whole of the United Kingdom. The Irish act gave to the commissioners of public works in Ireland powers—only to be exercised with the consent of the owner—of applying the act of 1882 to any monument possessing such public interest as might render it worthy of preservation. It is to be noticed that after the disestablishment of the Irish Church certain unused churches of artistic or historic interest were placed in the charge of the commissioners as national monuments, with a sum of £50,000 to defray expenses. The Irish commissioners have therefore monuments in their care other than those scheduled in the acts, and may apply towards the expenses of the preservation of the scheduled monuments any surplus over from the fund above mentioned. The act of 1900 applied the Irish act to Great Britain, but the powers have not been exercised by the first commissioner of works. The act also gave the powers of the act of 1892 to county councils, allowed the authorities, local or central, to make arrangements for the preservation of monuments with owners or others, including societies, and to receive subscriptions for the same object, and also provided for public access to such monuments as are in the guardianship of the commissioners under the act. The acts of 1892 and 1900, though allowing buildings of historic or other interest to be placed under the care of the commissioners, exclude buildings occupied as a dwelling-place by any person other than a caretaker and his family. The act of 1910 gives to the commissioners of works power to acquire by *bequest* buildings of historic or architectural interest. The act of 1900 had given power to acquire such by gift or purchase, and the act of 1882 had given power by bequest also, but only referred to prehistoric remains. The London County Council possesses powers of purchasing by agreement any building of historic or other interest under a General Powers Act of 1898, and exercised these in 1900 by purchasing a 17th century house in Fleet Street (known as Cardinal Wolsey's palace). It will be seen that the United Kingdom possesses no official commission, no conservators, no consultative official body, and no compulsory powers of expropriation. The acts dealing with the subject are entirely permissive. Towards the making of a national inventory the first step taken was the appointment in 1908 of three royal commissions, for England, Scotland and Wales respectively, "to make an inventory of the ancient and historical monuments and constructions connected with or illustrative of the contemporary culture, civilization and conditions of life of the people from the earliest times"; to the year 1700 in the case of England; 1707 in that of Scotland; for Wales no date is specified; and "to specify those which seem worthy of preservation." The Housing, Town Planning, &c. Act 1909, §45, and the Development and Road Improvement Funds Act, 1909, excepts the sites of ancient monuments or of other objects of historical interest from compulsory acquisition for the purposes of those acts. The Finance Act 1896, §20, granted a qualified exemption from estate duty to pictures, prints, books, MSS., works of art, scientific collections and other things not yielding income, as appear to the Treasury to be of national, scientific or historic interest; this exemption only extends where such property is settled to be enjoyed in kind in succession by different persons; if the property is sold or is in the possession of a person competent to dispose of it, it becomes liable to estate duty. The Finance Act 1909 extends the exemption to legacy and succession duty, removes the restriction to settled property, and adds "artistic" to "national and historic interest."

The Committee for the Survey of the Memorials of Greater London, supported by the London County Council, has begun a complete register and survey of the historic buildings of London. Apart from the numerous national and archaeological societies, whose proceedings contain invaluable accounts of practically every monument of interest throughout the kingdom, there are two societies directly formed with the object of monument preservation in its widest sense, the Society for the Protection of Ancient Buildings, founded in 1877, and the National Trust for Places of Historic Interest and Natural Beauty, constituted in 1894 under the Joint Stock Companies Acts for the purchase and preservation of sites and buildings, which it can hold in perpetuity for the benefit of the public. In 1907 the latter was dissolved and re-incorporated as a statutory body by the National Trust Act 1907. It possesses twenty-eight properties, amounting to 2000 acres, and twelve interesting buildings.

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[1] The names of the monuments so scheduled are given in an appendix to Sir R. Hunter's *Lecture on the Preservation of Places of Interest and Beauty* (1907).

India.—The Archaeological Survey of Upper India was established in 1862, with a director-general at its head, and surveys for other parts of India were also begun later. The chief object of these was the making of an inventory, and the preservation of the monuments was neglected. In 1878 a curator of ancient monuments was appointed. A period of activity with regard to monument preservation set in during the viceroyalty of Lord Curzon; this culminated in the Ancient Monuments Preservation Act of 1904. The main provisions are as follows: The local government of any province may declare any monument to be a "protected monument within the meaning of the act," and when so declared no one may injure, remove or alter it under penalty of a fine or imprisonment. This, however, does not apply to the owner, except when the government has, by purchase or gift, or by taking over the guardianship of the monument, assumed the duty of preserving it. This assumption of guardianship is by agreement with the owner. Power of expropriation under the Land Acquisition Act 1894 is given if a monument protected under the act is threatened with destruction or injury, or if an owner refuse to come to an agreement with the authority for its guardianship. The act includes movable antiquities, and the governor-general in council can prohibit their exportation. Control over excavations is also given.

Egypt.—A Commission of Egyptology (*Comité permanent d'égyptologie*) has the care of the monuments of early Egyptian civilization. The monuments of the Arab occupation are in the charge of a separate commission (*Comité de conservation des monuments de l'art arabe*). The Commission of Egyptology acts under khedival decrees of 1883, 1897 and 1891. By the first the state claims control over all antiquities and declares the contents of the Giza (Gizeh) Museum, now the National Museum of Egyptian Antiquities, and of any future collection, to be the property of the state and inalienable. The second decree penalizes any injury to monuments or attempt to appropriate a monument belonging to the state. The third deals with excavations; permission must be granted by the director-general of museums; objects discovered belong to the state and must go to the museum, but a part of the objects will be granted to the discoverer under special regulations, the government reserving the right to special objects with compensation for the expense of excavation.

France.—The *Commission des monuments historiques* was established in 1837. It is attached to and acts through the department of the minister of public instruction and of the fine arts, who is the president of the commission. There are thirty members, partly nominated by the minister out of names selected by the commission, partly *ex officio*, such as the directors of civil buildings and national palaces and of public worship. The buildings which these officials control are, however, not directly under the commission. The presence of a certain number of deputies on the commission secures its representation in the legislature. Upon the commission fall the following duties: (*a*) The *classement* or selection of the monuments of national interest, artistic, historic, or both, for the schedule of protected monuments. A particular portion of a building, such as a door, window, &c., may be alone protected. (*b*) The restoration and repair of the monuments so classed. (*c*) A general power of giving advice and watching the monuments of the country as a whole. The commission has the charge of the Musée Cluny, and is also the centre for all inquiries, reports, &c. The official staff of the commission consists of four general inspectors, one of whom, since the Monument Act of 1887, has charge of the movable monuments, and of forty architects, who have a subordinate staff of inspectors of works. Since 1830 a sum has been voted yearly for the finances of the commission. The largest sum (£120,000) that has appeared in the budget was voted in 1896; there are, however, other sources of revenue available.

The Monument Act of 1887.—This, together with certain administrative decrees, gave legal powers to the commission, which it had hitherto lacked, or had only been able to enforce by a difficult process of expropriation if owners, whether private or public, of monuments *classés* objected to the work of the commission. If a monument *classé* belong to the state or is under the administration of a minister other than the minister of public instruction and fine arts, or if it belong to any public body, such as a department or commune in whose hands the churches mainly lie, the consent of these controlling bodies must be given, otherwise the decision is left to the *conseil d'état*. If the owner be a private person, his consent is also necessary to the *classement*. If he refuses, the minister may expropriate the monument by compulsory purchase, which must have the consent of the *conseil d'état*. Once a monument has been *classé*, it cannot be destroyed even partially, and no repairs or other work can be effected upon it without the consent of the minister. An action, for damages only, lies against a person infringing the law in this respect. The act deals also with the *classement* and protection of movable objects of national interest, historic or artistic, but only if they belong to the state, when they cannot be alienated, or to public bodies, when the consent of the minister is required for repairs or alienation. The act does not affect movables belonging to private persons. Owing to the numerous thefts from churches, museums, and other places, which attracted particular attention in 1907, proposals have been made for the better protection of such objects, as well as of those in private collections, by gathering together the objects at present scattered in churches, &c., into provincial and local museums, and also by charging an entrance fee for museums, &c. With regard to the discovery of monuments by excavation works or accident, the minister must receive immediate notice from the mayor of the commune through the prefect of the department, and will decide what is to be done. If such discovery is on private property he may proceed to expropriation. The act applies to Algeria. Here all objects of archaeological or artistic interest are reserved to the state, if on ground belonging to the government or granted by it to public bodies or private persons or in military occupation. The act is similarly extended to all French protectorates. Tunis has more stringent regulations; for by a decree of the bey, 1886, the consent of the owner to the *classement* of a monument is not required, and penalties under the French penal code attach to infringements.

There is a strong feeling in France as to the protection and preservation of sites of natural beauty. A *Société pour la protection des paysages* was founded in 1901, and in 1904 the minister of public works issued a circular to the government engineers emphasizing the obligation of preserving and, if possible, enhancing the natural beauties of any locality in which public works were being carried out. An act (*Loi organisant la protection des sites et monuments naturels de caractère artistique*) was adopted in 1906, extending a protection to such sites analogous to that under the Monument Act (Appendix B in Sir R. Hunter's *Lecture*, already cited, gives the regulations under this measure).

A law of 1910 prohibits the affixing of bills or advertisements on monuments and sites officially recognized as historical and in sites recognized as picturesque by the law of 1906. The prefect also fixes a zone near such sites or monuments within which advertisement is prohibited.

Societies, both national and local, are numerous and active in France, but the centralizing policy does not favour any close working with the commission. The most important are the *Société nationale des antiquaires de France*, founded in 1804, and the *Société française d'archéologie pour la conservation et* *description des monuments historiques*, founded in 1834, by the archaeologist Arcisse de Caumont (1802–1873). Its publication, the *Bulletin monumental*, is extremely valuable. In 1887 was founded the *Comité des monuments français*, which confines itself more particularly to the practical side of monument preservation and protection, and publishes an illustrated periodical, *L'Ami des monuments*. Of the numerous local societies the semi-official *Commission du vieux Paris* and the private *Société des amis des monuments parisiens* and the *Commission municipale du vieux Lyon* may be mentioned.

Germany.—Legislation and administration with regard to monuments and their protection are not imperial, but are matters for the various states. Of these Hesse-Darmstadt alone has a Monument Act (1902), but in nearly all the states the system adopted for monument preservation and protection has been the appointment of conservators (*Denkmalpfleger*), with commissions attached, and a careful system of inventory. There are also in many of the states decrees and administrative orders. In Prussia provincial conservators and commissions, appointed in 1891, assist the central conservator. The general absence of special legislation leaves private owners of monuments amenable only to advice and persuasion and to the pressure of public opinion. The official and legal control exercised by the conservators and commissions is restricted to those monuments which belong to the state. The wide powers, however, given to local and municipal authorities in Germany, enable much to be done without state legislation. Many towns have powers to make by-laws regulating building and street-planning with a view not only of the preservation of the actual monuments but also of what is known as *Stadtbild*, the characteristic appearance given to a town by its ancient buildings, walls, gateways, &c. The regulations of many of the Bavarian towns are excellent examples of what can be done in this way.

The final control of the monuments of Hesse-Darmstadt is in the hands of the minister of the interior, who presides over a *Denkmalrat*, or council on monuments, consisting of owners of historical monuments, members of societies interested in such objects, and representatives of the Catholic and Protestant Churches. There is also a general conservator. The act protects *Naturdenkmäler*, such as water-courses, rocks, and even trees. No excavations can be carried on without permission, and all finds must be reported to the local authority.

The principal German society is the *Gesamtverein der deutschen Geschichts- und Altertumsverein*, founded in 1852. This is a general association of all the various societies throughout Germany. There are also many societies in the various towns, as well as local associations more directly concerned with the practical protection and preservation of monuments. The chief periodical—perhaps the most important of any dealing with the subject in Europe—is *Die Denkmalpflege*, published first in 1899. It is connected with the society known as *Heimatschutz*, the "defence of home."

[*Italy*.—There is a long history of monument regulation, dating back to a provision against the destruction of monuments in the statutes of the city of Rome of the 14th century and to the appointment of Raphael by Leo X. as controller of the city's monuments. Throughout the various states of Italy during the 17th, 18th and 19th centuries till the unification of the kingdom, stringent regulations by decree or statute were in force to preserve the relics of the past in which the country is so peculiarly rich. Mariotti (*La Legislazione delle belle arti*, 1892) gives a full account of many of these regulations. It must suffice here to mention the Doria Pamphili Edict of 1802 and the Pacca Edict of 1820, named after the two Cardinal-Camerlenghi subscribing the same. It was not until 1902 that an act was passed for the whole of Italy. This act, with a supplementary act of 1903, and the code of regulations (*Regolamento*) of 1904, has been superseded by the acts of 1907 and 1909 and the Regolamento of 1910, which constitute the whole body of the provisions in force for the protection of monuments. The minister of public instruction is the final authority, and under him the director-general of antiquities and fine arts.

The Superior Council of Antiquities and Fine Arts, created by the law of 1907, consists of 21 members; it is divided into three sections of 7 members each for antiquities, medieval and modern art, and contemporary art respectively. All the members of each are nominated by royal decree, and so are three members of the third, being elected, one by the architects, one by the sculptors, and one by the painters of Italy. This is an advisory body. The minister presides, and the director-general can be present and has a vote. The administrative organization under the director-general consists of the divisional superintendencies (each having a group of provinces under it) divided into three categories: (*a*) 18 superintendencies of monuments (preservation, administration, and surveillance of monuments even in private hands); (*b*) 14 superintendencies of archaeological excavations and museums (with control of objects in private hands and of the offices for exportation); (*c*) 15 superintendencies of galleries, medieval and modern museums and objects of art. Under each superintendent is a staff of directors of monuments, museums and galleries, of inspectors, architects, secretaries, custodians, &c. The nominations to the superior grades are by competition. There are offices for the examination of objects before exportation in those towns in which there reside a superintendent of monuments or a director of a gallery or a museum in which it is necessary. The official organizations are assisted by (*a*) honorary inspectors, nominated by royal decree in any commune or *circondario* where it may seem advisable; (*b*) provincial commissions, meeting in the chief town of each province, composed of not less than 7 members, nominated by royal decree, and including of right the superintendents, and meeting normally twice a year.

The monuments within the purview of the act of 1909 and its administration comprise all movable (including MSS., incunabula, rare engravings and coins) and immovable objects of historical, archaeological, palaeo-ethnological or artistic value and interest, so long as they are not less than fifty years old nor the work of living persons. Such objects, if they belong to the state, a province, a commune, a religious corporation or any recognized corporation (*ente morale*), cannot be parted with at all, except as from one such body to another, and this only with the leave of the ministry; and the authorities of such bodies must present to the ministry an inventory of such objects. Nor may repairs or alterations be made to them without the consent of the ministry, which has the right to interfere by regulations (such as, *e.g.*, the prohibition of the use of tapers, &c., which are liable to damage a picture) for the preservation and restoration (and in extreme cases even the removal) of such objects, if necessary, the latter being at the expense of the body to which they belong in so far as it can afford it. Any private person owning or possessing any object falling under the law, the importance and interest of which has been notified to him as the regulations provide, cannot transfer his property in or abandon his possession of it without informing the ministry, which has the right of pre-emption within two months (or four in case of financial pressure owing to many simultaneous offers) at the price for which he has contracted to sell it; and, if it is subject to damage and the proprietor will not provide for its repair, it may be expropriated by the state, by a province or commune—or even by bodies which have legal personality and aim at the preservation of such objects for the public enjoyment. It has not yet been possible, however, to secure the right of search nor of public access; so long as an object is well kept up by the owner, he may refuse the right of access except to the officials.

The exportation of objects of importance is forbidden, even if their importance has not been notified to the owner, who is under the obligation to advise the government of his intention to export, it having the right of pre-emption within two or four months, as the case may be; and even if the government does not purchase the object, it may still return it to the proprietor, forbidding him to export it. The objects exported are subject to a progressive tax, with a maximun of 20%. Objects temporarily imported from foreign countries, and re-exported within five years, are not subject to tax. Temporary exportation, if permitted, is allowed on deposit of the tax; and if objects of importance are allowed to be sent from one part of Italy to another (especially to the islands), this is done by the government at the owner's expense.

As to excavations, in every case application to excavate must be made to the minister, who has a general supervision over the work and may stop it temporarily or assume the conduct of it. The state can excavate on private ground, but pays compensation; and can expropriate ground on which it wishes to excavate or on which discoveries have been made, the "archaeological value" not being reckoned. As to finds, if the state conducts the excavation, the owner retains one-fourth of the value or of the objects discovered at the choice of the state, the rest belongs to the state. In other cases, and in the case of chance discoveries (notice of which must be given immediately), the state takes one-half, but if the excavation is conducted by foreign institutions or persons, then the discoveries must be given to a public museum, or if part is handed over to the finder, it must be kept in such a way as to be accessible to the Italian public. The ministry gives periodical reports of all work carried out by the authorities in the *Notizie degli Scavi* and the *Bollettino d'arte*, both of which appear every month. The funds at the disposal of the ministry for purchases include (*a*) a sum of £40,000 already invested, (*b*) the interest upon £160,000 rentes regularly paid in, (*c*) other sums from sales of publications, fines, &c.; (*d*) an annual credit voted in the budget (£12,000 in 1909–1910), forming an account called the monte di belle arti.

The regulations issued in 1910 for the execution of the new law consist of some 200 articles in three divisions—one dealing with the artistic and historical patrimony of Italy and its internal administration, a second with the question of exportation, and the third with financial matters. (T. As.)

Greece.—The earliest regulations are those contained in the law of 1837, promulgated by royal decree. This has been replaced by the Monument Act of 1899, but the principles of the earlier law remain, and the later act still lays down "the most extensive claim that any state has ever put forward in the matter of monuments," viz. that "all objects of antiquity in Greece, as the productions of the ancestors of the Hellenic people, are regarded as the common national possession of all Hellenes." The department in charge of the administration of the act is that of the minister of religion and public instruction. There is a central commission working with local commissions and a body of conservators. The control of this executive is in the hands of the ephor-general of antiquities. The act protects medieval monuments as well as those of classical Greece. All immovable monuments are public property, but compensation is to be paid to private owners if such monuments are to be preserved. Movable antiquities, if worthy of preservation by the state, must be placed in public museums. If discovered on private property the owner receives half the value, and may keep those not removed to a museum; all, however, must be registered. Excavations can be made anywhere by the state, and permission for private work must be first obtained. Expropriation is allowed. The export of antiquities is strictly forbidden under severe penalties, and the infringement of the various provisions of the act can be punished by heavy fines or imprisonment.

Austria-Hungary.—There is no legislation for the empire as a whole. In Austria there is a central commission, established 1850, whose authority is regulated by rescripts of 1873 and 1899 of the minister of religion and education. It consists of twenty members selected from experts in history, art and archaeology; there is also a numerous body of conservators who have districts covering the country assigned to them. They have no executive powers, but report on all new works likely to injure monuments, make inventories, influence public opinion, and work with archaeological societies for the general protection of ancient monuments. Hungary, on the other hand, has a Monument Act of 1881. With regard to any existing monument, the minister of religion and education decides whether it is worth preserving. Then the owner, whether public or private, must preserve it at his own cost. If that is impossible the minister may expropriate it. Compulsory purchase may also be resorted to for the purpose of excavation.

Belgium.—There is no monument legislation, but there is a royal commission, resembling that of Austria, founded in 1835, and a royal decree of 1824 prevents alienation of objects of interest contained in churches or alienation or reconstruction of churches without state permission. An inventory has been in progress since 1861, and the commission publishes a *Bulletin.* By a communal law of 1836 local administrations have to submit proposals for the destruction or repair of monuments to the committee of the provincial council, and must obtain royal approval. Expropriation on the ground of public utility may be resorted to for the protection of a threatened monument in the hands of a private owner.

Holland.—A state commission (*Rijkscommissie*) was established in 1903, and began an inventory of all monuments, movable and immovable. Any proposed alteration or demolition of buildings of interest in a town must be reported by the burgomaster to the minister of the interior. The annual budget of the minister of the interior contains sums to be allotted for the repair of specified monuments.

Switzerland.—Legislation is in the hands of the cantons; Vaud, Neuchâtel and Bern have passed Monuments Acts, modelled on that of France. The federal government may allot an annual grant for the acquisition and upkeep of national monuments and for excavations. There is a federal commission, established in 1886, whose functions, mainly those of other countries, are exercised by the Swiss Society for the Preservation of Monuments of Historical Art.

The preservation of scenery and of natural monuments is considered a matter of great importance, and in 1905 was founded a Swiss society which has a branch in the United Kingdom, *La Ligue pour la conservation de la Suisse pittoresque —Die schweizerische Vereinigung für Heimatschutz.* The special object of the society is the prevention of the defacement of Alpine scenery by funicular and other railways, mountain-lifts, power-stations, &c. It was successful in protecting the falls of the Rhine at Schaffhausen from a Zurich electric-power scheme.

Denmark.—The means adopted are an excellent example of what can be done without legislation by appeals made by a central authority working with expert knowledge to an enlightened public opinion and to national sentiment. The authority consists of an inspector of ancient monuments and the directorate of the Museum of Northern Antiquities at Copenhagen, exercising the functions of a royal commission that was established in 1807 and dissolved in 1849. The successful preservation of antiquities is also due to an old law, modified by royal decrees of 1737 and 1752, by which all finds of gold, silver and precious objects belong to the state, and to a declaration of 1848 that all monuments on the Crown domains are national property and are to be specially reserved in case of sale. Many private owners have followed the example of the Crown. G. Baldwin Brown (*op. cit.* p. 188 seq.) gives some interesting examples of the success of the directorate of the museum in preserving monuments by appeals to ecclesiastical owners, projectors of railways and other works, and companies engaged in reclaiming land.

Sweden.—There is a state antiquary (*Riksantikvar*), appointed first by Gustavus Adolphus; the functions of a commission are exercised by the Royal Academy of Science, History and Antiquities, founded in 1786. There is an elaborate and stringent code of regulations protecting monuments, contained in royal decrees of 1867, 1873 and 1886. These are based on the edict of Charles XI. (1666), declaring all ancient monuments under royal protection. Sweden possesses one of the fullest inventories contained in the antiquarian topographical archives.

Norway.—Here there is also a state antiquary, and a state-subsidized society, *Foreningen til norske Fortidsmindesmaerkers Bevaring*, founded in 1844, which acts much as a commission, and advises the state official.

Russia.—The care of ancient monuments is in the charge of the ministry of the imperial court, of which the Imperial Archaeological Commission, founded in 1859, is a department. The Imperial Academy of the Fine Arts is joined in this charge with the commission, whose duties resemble in the main those of the commissions of other countries. By a circular of 1901 a complete inventory of the monuments of the country was ordered to be made by the local authorities.

Spain.—A monument commission was established in 1844; it works under regulations issued in 1865. It is composed of the Royal Academies of Fine Arts and of History, corresponding members of which form commissions for the provinces of the kingdom. A complete inventory of all monuments is being made. The minister in charge is that of public instruction and of the fine arts.

Portugal.—A decree of John V. (1721) protected the monuments of ancient times; in 1840 this protection was extended to medieval monuments. An inventory was begun in 1841. A council of national monuments was established in 1901 by a royal decree, with a code of regulations. The French system of *classement* is adopted, and the regulations under the French act of 1887 are generally followed. The minister responsible is that of public works, commerce and industry.

Turkey.—The regulations, as embodied in an *irade* of 1884, are very stringent, and the principle adopted is that of Greece, that all objects of antiquity belong to the state. The private owner of such has no power of disposition, and must not injure nor destroy them. All excavations are under the control of the government, and permission must be first obtained. The exportation of finds is forbidden, and all movables discovered belong to the Imperial Museum. If these finds are the result of excavations, one-twentieth of the value goes to the discoverer; if of accidental discovery, the owner of the soil and the state divide.

United States.—With regard to the remains of prehistoric man, earthworks, barrows, &c., some of those states, such as Ohio, which are specially rich in such monuments, have particular laws protecting individual remains, *e.g.* the earthworks in Warren county. The state exercises control over other remains of interest, *e.g.* the Eagle earthworks in Licking county. There is also an archaeological and historical society, partly maintained by the state, with the object of the better preservation of the evidences of the prehistoric occupation. In North Dakota a state historical commission was created in 1895 "to collect and preserve the records and relics pertaining to the early history, settlement and development of North Dakota." The sites of the battle-fields, and statues, &c., erected in commemoration of the War of Independence or the Civil War, are preserved by various methods—by state or municipal regulations, by the action of incorporated bodies or trustees, &c. Most of the states rely on statutory prohibitions of malicious damage to protect their monuments and old buildings, &c. (C. WE.)

MONVEL (1745–1812), French actor and dramatic writer, whose real name was Jacques Marie Boutet, was born in Lunéville on the 25th of March 1745. He was a small, thin man without good looks or voice, and yet he became one of the greatest comedians of his time. After some years of apprenticeship in the provinces, he made his début in 1770 at the Comédie Française in *Mérope and Zenaide*; he was received *sociétaire* in 1772. For some reason unknown Monvel secretly left Paris for Sweden about 1781, and became reader to the king, a post which he held for several years. At the Revolution he returned to Paris, embraced its principles with ardour, and in 1791 joined the theatre in the rue Richelieu (the rival of the Comédie Française), which, under Talma, with Dugazon, his sister Mme Vestris, Grandmesnil (1737–1816) and Mme Desgarcins, was soon to become the Théâtre de la République. After the Revolution Monvel returned to the reconstituted Comédie Française with all his old companions, but retired in 1807. Monvel was made a member of the Institute in 1795. He wrote six plays (four of them performed at the Comédie Française), two comedies, and fifteen comic operas, seven with music by N. Dezède (1740–1792), eight by Nicolas d'Alayrac (1753–1809. He also published an historical novel, *Frédégonde et Brunehaut* (1776). He was professor of elocution at the Conservatoire. Monvel's two daughters, Mlles Mars *aînée* and *cadette*, were well-known actresses.

MONZA (locally *Monscia*), a city of Lombardy, Italy, in the province of Milan, 8 m. by rail N.N.E. of that city, with which it is also connected by both steam and electric trams. It lies on the Lambro, a tributary of the Po, 532 ft. above sea-level. Pop. (1906), 32,000 (town); 53,330 (commune). Of the medieval fortifications little remains save the Porta d'Agrate. Near it is the nunnery in which the nun of Monza (see Manzoni's *Promessi sposi*) was enclosed. The cathedral of St John Baptist is the principal object of interest; Theodelinda's basilica of 590 was enlarged at the close of the 13th century by throwing the atrium into the main building, and the present fine black-and-white marble façade was erected about the middle of the 14th by Matteo da Campione, and restored in 1899–1901. On the left-hand side of the front rises an incongruous brick-built tower, 278 ft. high, erected by Pellegrini in 1592–1606. Within the church are the iron crown of Lombardy, supposed to have been beaten out of one of the nails used at the Crucifixion, and the treasury containing the relics of Theodelinda, comprising her crown, fan and comb of gold, and the golden hen and seven chickens, representing Lombardy and her seven provinces, and crosses, reliquaries, &c., of the Lombard and Gothic periods. The interior has been modernized; there is a fine relief by Matteo da Campione in the organ-loft, representing the coronation of a king, and some 15th-century frescoes with scenes from the life of Theodelinda. Next to the cathedral in artistic importance come the church of Santa Maria in Istrada, and the broletto or old palace of the commune, usually styled the Arengario; the former (founded in 1357) has a rich terra-cotta façade of 1393, and the latter is raised on a system of pointed arches, and has a tall square tower terminating in machicolations surrounding a sharp central cone. The royal palace of Monza (built in 1777 for the archduke Ferdinand) lies not far from the town on the banks of the Lambro. Cotton goods and felt hats are the staple products of the flourishing Monza industry; then dyeing, organ-building, and a publishing trade.

Monza (anc. *Modicia*) was not a place of consequence till it attracted the eye of Theodoric; and its first important associations are with Theodelinda. During the period of the republics Monza was sometimes independent, sometimes subject to Milan. The Visconti, who ultimately became masters of the city, built a castle in 1325 on the site now occupied by the Palazzo Durini. In the course of its history Monza stood thirty-two sieges, and was repeatedly plundered—notably by the forces of Charles V. The countship (1499–1796) was purchased in 1546 by the wealthy banker Durini, and remained in his family till the Revolution. At Monza King Humbert was assassinated on the 29th of July 1900.

MONZONITE, the group-name of a type of rocks which have acquired it from their most celebrated occurrence, that of Monzoni in Tirol. The rocks are of granitic appearance, usually rather dark grey in colour and fine to moderately coarse grained. The special characteristic which distinguishes them from granites and ordinary syenites is the presence of plagioclase and orthoclase felspars in nearly equal amounts. Labradorite, andesine and oligoclase are present, usually in well-shaped crystals, often zoned; orthoclase forms large irregular plates in which the other minerals are embedded. There is rarely any considerable amount of quartz, though in a few of these rocks this mineral occurs (the quartz-monzonites). Other features are the abundance of augite, pale green or brownish green, and of large bronze-coloured plates of biotite which are of quite irregular shapes and full of enclosures. Hypersthene or bronzite is less common, but dark brown and green hornblende are sometimes abundant. Olivine also may be present; when the rock contains this in notable quantity it may be called an olivine monzonite. Numerous large prisms of apatite often characterize micro-sections of monzonites, and zircon, iron ores and pyrites are frequent accessory minerals.

The monzonites of Tirol show a great variability in appearance, structure, and the relative proportions of their minerals. They tend to pass into rocks which have been called diabases and gabbros, and near the margins of the outcrop facies very rich in pyroxene (pyroxenites) occur. Many authors believe that this variety of types is associated with the fact that the monzonites occupy a middle place as regards their chemical composition between the acid and the basic igneous rocks, and that such a magma is naturally somewhat unstable, and likely to split up or differentiate into partial magmas of more siliceous and less siliceous character. The monzonites in fact approach rather closely to the calculated mean composition of the outer portion of the earth's crust and from a molten magma of this nature it is natural to suppose that all kinds of igneous rocks have been derived.

Rocks of monzonitic facies occur also in Norway, where they have been described as åkerites. They contain quartz, orthoclase and plagioclase, augite and dark brown biotite; hornblende and hypersthene also may be present. Some of them have porphyritic rather than granitic texture, especially near the margins of the laccolites. From a study of these and other occurrences Brogger proposed to define the monzonites as orthoclase-plagioclase rocks in which the two chief classes of felspar occur in nearly equal quantities (as distinguished from the orthoclase rocks or granites and syenites and the plagioclase rocks or diorites and gabbros).

At Yogo Peak and Beaver Creek in Montana, U.S.A., there are masses of granitoid rock which bear a close resemblance to the monzonites of Tirol. Two main types occur: (*a*) yogoite, which differs little from monzonite, and (*b*) shonkinite, which is a more basic rock richer in plagioclase and augite; this rock contains olivine and in places passes into dark pyroxenites. In shonkinite also a little nepheline may be present. In several places in the west of Scotland (Argyllshire) intrusive bosses are known which consist of an olivine-bearing rock closely related to monzonite. It has been called kentallenite because it is quarried at Kentallen in Argyllshire. Large crystals of pale green augite and irregular plates of biotite which enclose idiomorphic plagioclase felspar are conspicuous in micro-sections of this rock, and the abundance of olivine is rather greater than is usual in the monzonites; it is associated with diorites of lamprophyric character and dark pyroxenites and peridotites.

The following analyses show the chemical peculiarities of the principal rocks of the monzonite group:—

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	K_2O	Na_2O
Monzonite, Monzoni .	54·20	15·73	3·67	5·40	3·40	8·50	4·42	3·07
Yogoite, Yogo Peak .	54·42	14·28	3·32	4·13	6·12	7·72	4·22	3·44
Kentallenite, Argyllshire	52·09	11·93	1·84	7·11	12·48	7·84	3·01	2·04

(J. S. F.)

MOOD. (1) (O. Eng. *mód*, a word common to Teutonic languages; cf. Ger. *Mut*; Du. *moed*, mind, courage), a particular state of mind or feeling. (2) (Adapted from Lat. *modus*, measure), a grammatical term for one of the various forms into which the conjugation is grouped, showing whether the verb is used as a predicate, a wish, a command, &c. In syllogistic logic the term is used of the various classes into which the "figures" of valid syllogisms are divided. (See SYLLOGISM.)

MOODKEE, or MUDKI, a town in the Ferozepore district of the Punjab, India. Pop. (1901), 2977. It is situated 26 m. S. of the Sutlej, on the old road from Ferozepore to Karnal, and is notable as the scene of the first battle (Dec. 18, 1845) in the first Sikh war. (See SIKH WARS.)

MOODY, DWIGHT LYMAN (RYTHER) (1837–1899), American evangelist, was born in the village of East Northfield (Northfield township), Massachusetts, on the 5th of February 1837. His father died in 1841, and young Dwight, a mischievous independent boy, got a scanty schooling. In 1854 he became a salesman in a shoe-store in Boston; in 1855 he was "converted"; and in 1856 he went to Chicago and started business there. Beginning with a class gathered from the streets, he opened (1858) a Sunday school in North Market Hall, which was organized in 1863 as the Illinois Street Church, and afterwards became the Chicago Avenue Church, of which he was layman pastor. In 1860 he gave up business and devoted himself to city missionary work. He was prominent in raising money for Farwell Hall in Chicago (1867), and in 1865–1869 was president of the Chicago Young Men's Christian Association. Ira David Sankey (1840–1908) joined him in Chicago in 1870 and helped him greatly by the singing of hymns; and in a series of notable revival meetings in England (1873–1875, 1881–1884, 1891–1892) and America they carried on their gospel campaign, and became famous for the Moody and Sankey *Gospel Hymns*. In 1879 Moody opened the Northfield seminary for young women, at Northfield, Mass., and in 1881 the adjacent Mount Hermon school for boys; in each a liberal practical education centres about Bible training; the boys do farm-work and the girls house-work. In 1889 he opened in Chicago the Bible Institute, and there trained Christian workers in Bible study and in practical methods of social reform; at Northfield in 1890 he opened a Training School in domestic science in the Northfield Hotel, formerly used only in summer for visitors at the annual conferences, of which the best known are the Bible (or Christian Workers') Conference, first held at Northfield in 1880, and the Students' (or College Men's) Conference, first held in 1887.

Moody died at Northfield on the 22nd of December 1899. His sermons were colloquial, simple, full of conviction and point. In his theology he laid stress on the Gospel and on no sectarian opinions—he was, however, a pre-millenarianite—and he worked with men as much more "advanced" than himself as Henry Drummond, whom he eagerly defended against orthodox attack, and George Adam Smith. Moody's sermons were sold widely in English, and in German, Danish and Swedish versions.

See the (official) *Life of Dwight L. Moody* (New York, 1900), by his son, W. R. Moody (b. 1869), and the estimate in Henry Drummond's *Dwight L. Moody: Impressions and Facts* (New York, 1900), with an introduction by George Adam Smith.

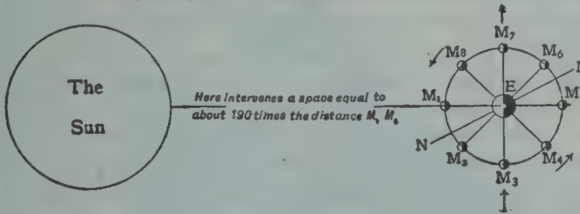
MOOLVIE (an Urdū variant of Arabic *maulavi*, a derivative of *mullah*, a man learned in the law), the name used in India of a man learned in Mahommedan law, and hence used generally of a teacher or as a complimentary title of one learned in any branch of knowledge.

MOON, SIR RICHARD, 1ST BARONET (1814–1899), English railway administrator, was the son of a Liverpool merchant, and was born on the 23rd of September 1814. The history of his life is practically the history of the London & North-Western railway for the period in which he lived. When he first became a member of the board in 1847, the company had just come into existence by the amalgamation of the London & Birmingham, the Manchester & Birmingham, and the Grand Junction lines, and it was during his long connexion with it—first as director and then (from 1862 to 1891) as chairman—that its system was developed substantially into what it is now. The Chester & Holyhead, the Lancaster & Carlisle, and many smaller lines were gradually added to it, either by leasing or by complete absorption, and finally in 1877 an act was obtained consolidating all into one homogeneous whole. Throughout his career, Sir Richard Moon's powers of organization and his genius for what may be called railway diplomacy were of the greatest advantage to the company, and to him it owed in very large measure its commanding position. An extremely hard worker himself, he expected equal diligence of his subordinates; but energy and capacity did not go unrewarded, for he made promotions, not by standing or seniority, but by merit. Sir Richard Moon, who was created a baronet in 1887, died at Coventry on the 17th of November 1899.

MOON (a common Teutonic word, cf. Ger. *Mond*, Du. *maan*, Dan. *maane*, &c., and cognate with such Indo-Germanic forms as Gr. *μήν*, Sans. *mās*, Irish *mī*, &c.; Lat. uses *luna*, i.e. *lucna*, the shining one, *lucere*, to shine, for the moon, but preserves the word in *mensis*, month; the ultimate root for "moon" and "month" is usually taken to be *me-*, to measure, the moon being a measurer of time), in astronomy, the name given to the satellite of any planet, specifically to the only satellite of the earth.

The subject of the moon may be treated as twofold, one branch being concerned with the aspects, phases and constitution of the moon; the other with the mathematical theory of its motion. As the varying phenomena presented by the moon grow out of its orbital motion, the general character of the latter will be set forth in advance.

A luminous idea of the geometrical relations of the moon, earth and sun will be gained from the figure, by imagining the sun to be moved towards the left, and placed at a distance of 20 ft. from the position of the earth, as represented at the right-hand end of the figure. We have here eight positions of the moon, M_1, M_2, &c., as it moves round the earth E. The general average distance of the sun is somewhat less than four hundred times that of the moon. We have next to conceive that, as the earth performs its annual revolution round the sun in an orbit whose diameter, as represented on the diagram, is nearly 40 ft., it carries the orbit of the moon with it. Conceiving the plane of the earth's motion, which is that of the ecliptic, to be represented by the surface of the paper, the orbit of the moon makes a small angle of a little more than 5° with this plane. Conceiving the line NN′ to be that of the nodes at any time, and the earth and lunar orbit to be moving in the direction of the straight arrows, the earth will be on one side of the ecliptic from M_2 to M_5, and on the other side from M_6 to M_1, intersecting it at the nodes. The absolute direction of the line of nodes changes but slowly as the earth and moon revolve; consequently, in the case shown in the figure, the line of nodes will pass through the sun after the earth has passed through an arc nearly equal to the angle M_1 N. Six months later the direction of the opposite node will pass through the sun. Actually, the line of nodes is in motion in a retrograde direction, the opposite of that of the arrows, by 19·3° per year, thus making a revolution in 18.6 years, or 6,793·39 days. (See ECLIPSE.)


The Sun
Here intervenes a space equal to about 190 times the distance M_1 M_5
M_1
M_2
M_3
M_4
M_5
M_6
M_7
M_8
E
N
N′

The varying phases of the moon, due to the different aspects presented by an opaque globe illuminated by the sun, are too familiar to require explanation. We shall merely note some points which are frequently overlooked: (1) the crescent phase of the moon is shown only when the moon is less than 90° from the sun; (2) the bright convex outline of the crescent is then on the side toward the sun, and that the moon is seen full only when in opposition to the sun, and therefore rising about the time of sunset. In consequence of the orbital motion the moon rises, crosses the meridian, and sets, about 48 m. later every successive day. This excess is, however, subject to wide variation, owing to the obliquity of the ecliptic and of the lunar orbit to the equator, and therefore to the horizon. The smaller the angle which the orbit of the moon, when near the point of rising, makes with the horizon the less will be the retardation. Near the autumnal equinox this angle is at a minimum; hence the phenomenon of the "harvest moon," when for several successive days the difference of times of rising on one day and the next may be only from 15 to 20 minutes. Near the vernal equinox the case is reversed, the interval between two risings of the nearly full moon being at its maximum, and between two settings at its minimum. Generally, when the rising is accelerated the setting is retarded, and vice versa.

The moon always presents nearly the same face to the earth, from which it follows that, when referred to a fixed direction in space, it revolves on its axis in the same time in which it performs its revolution. Relatively to the direction of the earth there is really no rotation. The rate of actual rotation is substantially uniform, while the arc through which the moon moves from day to day varies. Consequently, the face which the moon presents to the earth is subject to a corresponding variation, the globe as we see it slightly oscillating in a period nearly that of revolution. This apparent oscillation is called *libration*, and its amount on each side of the mean is commonly between 6° and 7°. There is also a libration in latitude, arising from the fact that the axis of rotation of the moon is not precisely perpendicular to the plane of her orbit. This libration is more regular than that in longitude, its amount being about 6° 44′ on each side of the mean. The other side of the moon is therefore invisible from the earth, but in consequence of the libration about six-tenths of the lunar surface may be seen at one time or another, while the remaining four-tenths are for ever hidden from our view.

It is found that the direction of the moon's equator remains nearly invariable with respect to the plane of the orbit, and therefore revolves with that plane in a nodal period of 18·6 years. This shows that the side of the moon presented to us is held in position as it were by the earth, from which it also follows that the lunar globe is more or less elliptical, the longer axis being directed toward the earth. The amount of the ellipticity is, however, very small.

Two phenomena presented by the moon are plain to the naked eye. One is the existence of dark and bright regions, irregular in form, on its surface; the other is the complete illumination of the lunar disk when seen as a crescent, a faint light revealing the dark hemisphere. This is due to the light falling from the sun on the earth and being reflected back to the moon. To an observer on the moon our earth would present a surface more than ten times as large as the moon presents to us, consequently this earth-light is more than ten times brighter than our moonlight, thus enabling the lunar surface to be seen by us.

The surface of the moon has been a subject of careful telescopic study from the time of Galileo. The early observers seem to have been under the impression that the dark regions might be oceans; but this impression must have been corrected as soon as the telescope began to be improved, when the whole visible surface was found to be rough and mountainous. The work of drawing up a detailed description of the lunar surface, and laying its features down on maps, has from time to time occupied telescopic observers. The earliest work of this kind, and one of the most elaborate, is the *Selenographia* of Hevelius, a magnificent folio volume. This contains the first complete map of the moon. Names borrowed from geography and classical mythology are assigned to the regions and features. A system was introduced by Riccioli in his *Almagestum novum* of designating the more conspicuous smaller features by the names of eminent astronomers and philosophers, while the great dark regions were designated as oceans, with quite fanciful names: *Mare imbrium*, *Oceanus procellarum*, &c. More than a century elapsed from the time of Hevelius and Riccioli when J. H. Schröter of Lilienthal produced another profusely illustrated description of lunar topography.

The standard work on this subject during the 19th century was long the well-executed description and map of W. Beer and J. H. Mädler, published in 1836. It was the result of several years' careful study and micrometric measurement of the features shown by the moon. The volume of text gives descriptive details and measurement of the spots and heights of the mountains.

In recent times photography has been so successfully applied to the mapping of our satellites as nearly to supersede visual observation. The first photograph of the moon was a daguerreotype, made by Dr J. W. Draper of New York in 1840; but it was not possible to do much in this direction until the more sensitive process of photographing on glass was introduced instead of the daguerreotype. The taking of photographs of the moon then excited much interest among astronomical observers of various countries. Bond at the Harvard observatory, De la Rue in England, and Rutherford in New York, produced lunar photographs of remarkable accuracy and beauty. The fine atmosphere of the Lick observatory was well adapted to this work, and a complete photographic map of the moon on a large scale was prepared which exceeded in precision of detail any before produced. The most extended and elaborate work of this sort yet undertaken is that of Maurice Loewy (1833–1907) and Pierre Puiseux at the Paris observatory, of which the first part was published in 1895.

The broken and irregular character of the surface is most evident near the boundary between the dark and illuminated portions, about the time of first quarter. The most remarkable feature of the surface comprises the craters, which are scattered everywhere, and generally surrounded by an approximately circular elevated ring. Yet another remarkable feature comprises bright streaks, branching out in various directions and through long distances from a few central points, especially that known as Tycho.

The height of the lunar mountains is a subject of interest. It cannot be stated with the same definiteness that we can assign heights to our terrestrial mountains, because there is no fixed sea-level on the moon to which elevations can be referred. The only determination that can be made on the moon is that of the height above some neighbouring hollow, crater or plain. The most detailed measures of this sort were made by Beer and Mädler, who give a great number of such heights. These generally range between 500 and 3000 toises, or 3000 and 20,000 English feet. The highest which they measured was Newton, 3727 toises, or 24,000 ft.

The general trend of lunar investigation has been against the view that there is any resemblance between the surfaces of the moon and of the earth, except in the general features already mentioned. No evidence has yet been found that the moon has either water or air. The former, if it existed at all, could be found only in the more depressed portions; and even here it would evaporate under the influence of the sun's rays, forming a vapour which, if it existed in considerable quantity, would in some way make itself known to our scrutiny. The most delicate indication of an atmosphere would be through the refraction of the light of a star when seen coincident with the limb of the moon. Not the slightest change in the direction of such a star when in this position has ever been detected, and it is certain that if any occurs it can be but a minute fraction of a second of arc. As an atmosphere equal to ours in density would produce a deviation of an important fraction of a degree, it may be said that the moon can have no atmosphere exceeding in density the $\frac{1}{5000}$ that of the earth.

Devoid of air and atmosphere, the causes of meteorological phenomena on the earth are non-existent on the moon. The only active cause of such changes is the varying temperature produced by the presence or absence of the sun's rays. The range of temperature must be vastly wider than on the earth, owing to the absence of an atmosphere to make it equable. Elaborate observations of the heat coming from the moon at its various phases were made and discussed in 1871–1872 by Lord Rosse. Among his results was that during the progressive phases from before the first quarter till the full moon the heat received increases in a much greater proportion than the light, from which it followed that the former was composed mainly of heat radiated from the moon itself in consequence of the temperature which it assumed under the sun's rays. So far as could be determined, 86% of the heat radiated was by the moon itself, and 14% reflected solar heat. But it seems probable that this disproportion may be somewhat too great. Rosse's determinations, like those of his predecessors, were made with the thermopile. After S. P. Langley devised his bolometer, which was a much more sensitive instrument than the thermopile, he, in conjunction with F. W. Very, applied it to determine the moon's radiation at the Allegheny observatory. His results for the ratio of the total radiation of the full moon to that of the sun ranged from 1 : 79,000 to 1 : 110,000, which were in substantial agreement with those of Rosse, who found 1 : 82,000. When Langley published his work the law of radiation as a function of the temperature was not yet established. He therefore wrongly concluded that the highest temperature reached by the moon approximated to the freezing-point of water. Stefan's law of radiation, on the other hand, shows that the temperature must have been about the boiling-point in order that the observed amount of heat might be radiated. This is in fair agreement with the computed temperature due to the sun's radiation upon a perpendicular absorbing surface when no temperature is lost through conduction to the interior. The agreement thus brought about between the results deduced from the law of radiation and the most delicate observations of the quantity of heat radiated is of great interest, as showing that the theory of cosmical temperature now rests upon a sound basis. There is, however, still room for improved determinations of the moon's heat by the use of the bolometer in its latest form.

Possibility of Changes on the Moon.—No evidence of life on the moon has ever been brought out by the minutest telescopic scrutiny, nor does life seem possible in the absence of air and water. Some bright spots are visible by the earth-light when the moon is a thin crescent, which were supposed by Herschel to be volcanoes in eruption. But these are now known to be nothing more than spots of unusual whiteness, and if any active volcano exists it is yet to be discovered. Still, the question whether everything on the moon's surface is absolutely unchangeable is as yet an open one, with the general trend of opinion toward the affirmative, so far as any actual proof from observation is concerned. The spot which has most frequently exhibited changes in appearance is near the centre of the visible disk, marked on Beer and Mädler's map as *Linne*. This has been found to present an aspect quite different from that depicted on the map, and one which varies at different times. But the question still remains open whether these variations may not be due wholly to the different phases of illumination by the sunlight as the latter strikes the region from various directions.

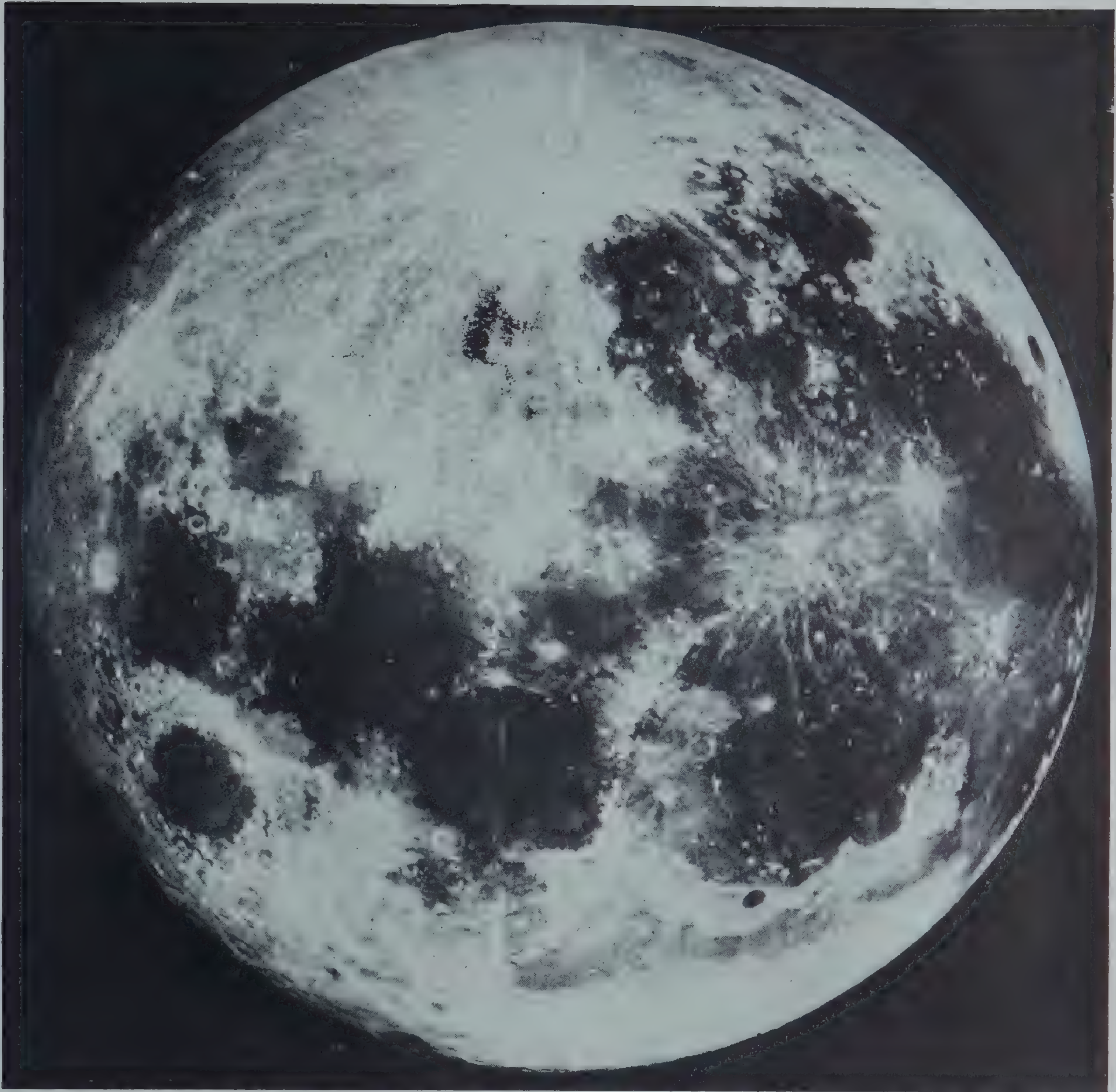
Intensity of Moonlight.—An interesting and important quantity is the ratio of moonlight to sunlight. This has been measured for the full moon by various investigators, but the results are not as accordant as could be desired. The most reliable determinations were made by G. P. Bond at Harvard and F. Zöllner at Leipzig, in 1860 and 1864. The mean result of these two determinations is the ratio 1 : 570,000. We may therefore say that the intensity of sunlight is somewhat more than half a million times that of full moonlight. A remarkable feature of the reflecting power of the moon, which was made known by Zöllner's observations, is that the proportion of light reflected by a region on the moon is much greater when the light falls perpendicularly, which is the case near the time of full moon, and rapidly becomes less as the light is more oblique. This result was traced by Zöllner to the general irregularity of the lunar surface, and the inference was drawn that the average slope of the lunar elevation amounts to 47°.

Motion of the Moon.—The orbit of the moon around the earth, though not a fixed curve of any class, is elliptical in form, and may be represented by an ellipse which is constantly changing its form and position, and has the earth in one of its foci. The eccentricity of the ellipse is in the general average about 0·055, whence the moon is commonly more than $\frac{1}{10}$ further from the earth at apogee than at perigee. The line of apsides is in continual motion, generally direct, and performs a revolution in about 12 years. The inclination to the ecliptic is a little more than 5°, and the line of nodes performs a revolution in the retrograde direction in 18·6 years. The parallax of the moon is determined by observation from two widely separated points; the most accurate measures are those made at Greenwich and at the Cape of Good Hope. The distance of the moon can also be computed from the law of gravity, the problem being to determine the distance at which a body having the moon's mass would revolve around the earth in the observed period. The measures of parallax agree perfectly with the computed distance in showing a mean parallax of 57′ 2·8″, and a mean distance of 238,800 miles. The period of revolution, or the lunar month, depends upon the point to which the revolution is referred. Any one of five such directions may be chosen, that of the sun, the fixed stars, the equinox, the perigee, or the node. The terms synodical, sidereal, tropical, anomalistic, nodical, are applied respectively to these months, of which the lengths are as follow:—

	Length.	Deviation from sidereal month.
Synodic month	29·53059 days.	+2·20893 days.
Sidereal month	27·32166 „	0·00000 „
Tropical month	27·32156 „	−0·00010 „
Anomalistic month	27·55460 „	+0·23294 „
Nodical month	27·21222 „	−0·10944

MOON

PLATE I.



THE MOON (Age 14d. 1h.), 1890, October 27.

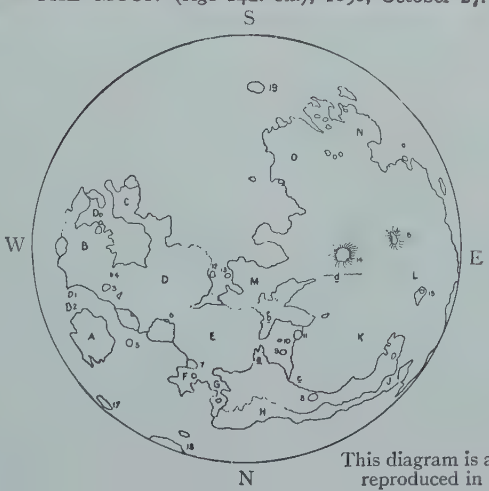
By permission of Lick Observatory.

Maria or Seas.

A. Mare Crisium.
B. " Foecunditatis.
C. " Nectaris.
D. " Tranquillitatis
E. " Serenitatis.
F. Lacus Somniorum.
G. " Mortis.
H. Mare Frigoris.
J. Sinus Roris.
K. Mare Imbrium.
L. Oceanus Procellarum.
M. Mare Vaporum.
N. " Humorum.
O. " Nubium.

Mountains.

(*a*) Caucasus.
(*b*) Apennines.
(*c*) Alps.
(*d*) Carpathians.

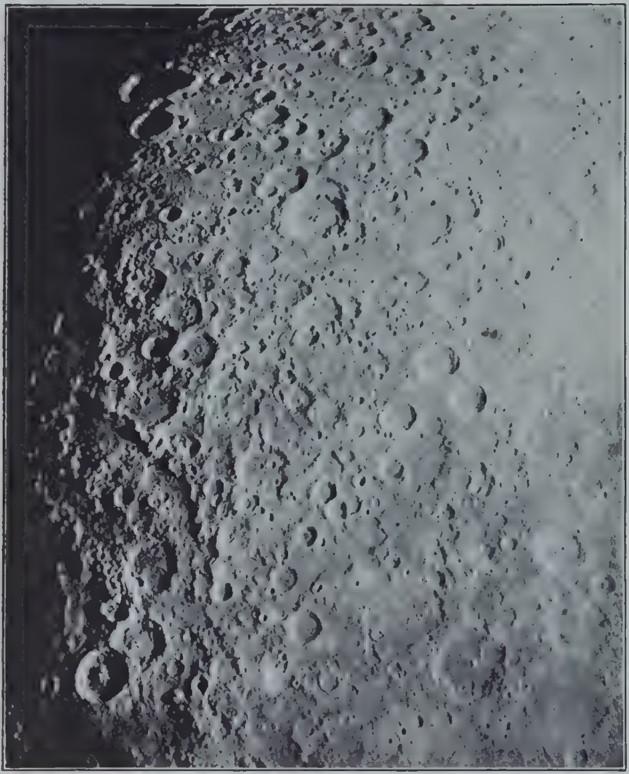


Volcanoes.

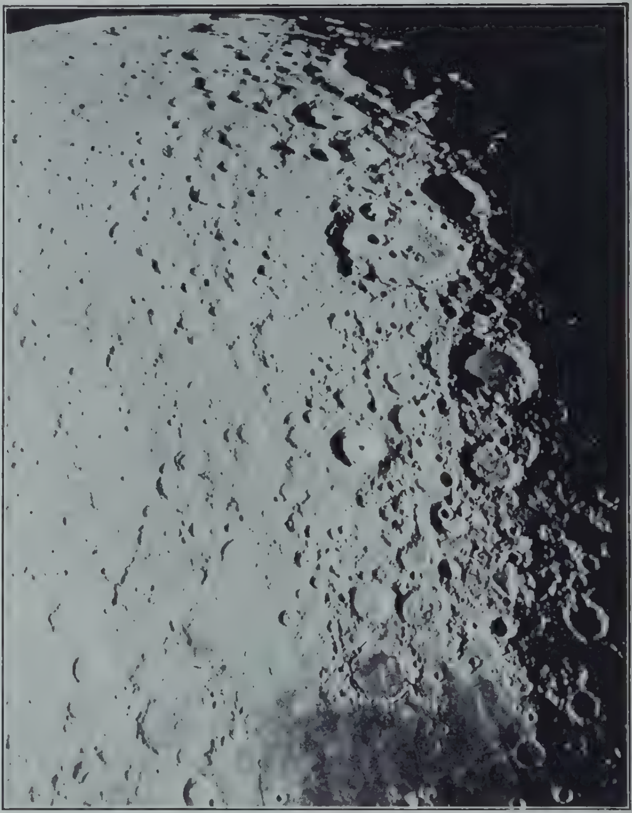
1. Apollonius.
2. Firmicus.
3. Taruntius.
4. Secchi.
5. Macrobius.
6. Vitruvius.
7. Posidonius.
8. Plato.
9. Aristillus.
10. Autolycus.
11. Archimedes.
12. Julius Caesar.
13. Boscovich.
14. Copernicus.
15. Herodotus.
16. Kepler.
17. Borda.
18. Bohnenberger.
19. Tycho.

This diagram is a key to some of the features reproduced in the photograph.

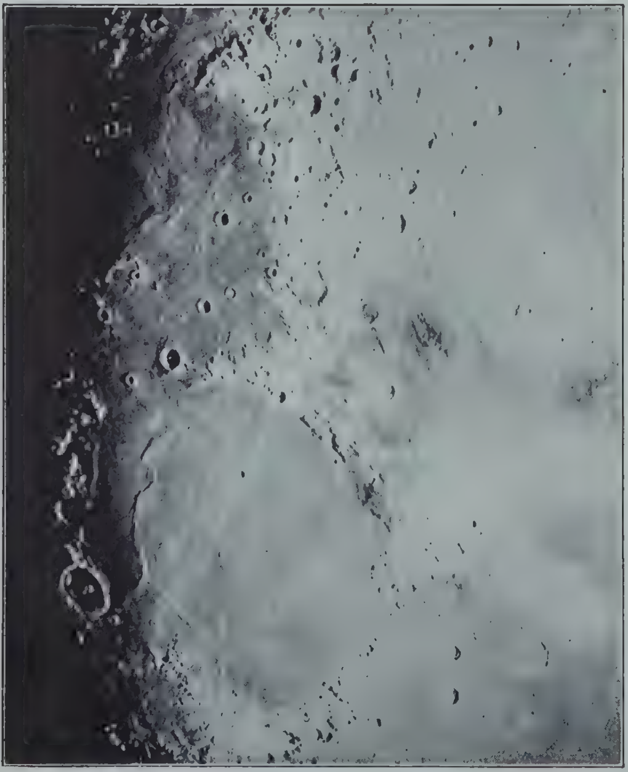
MOON



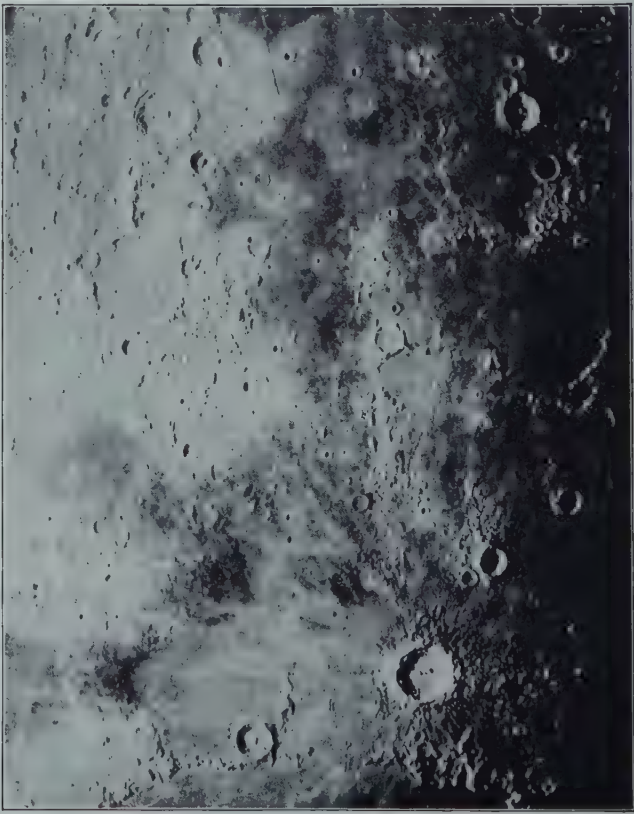
1. TYCHO, THEOPHILUS, 1900, October 12.



2. MARE NUBIUM, &c., 1901, November 21.



3. MARE SERENITATIS, 1901, August 3.



4. BULLIALDUS, COPERNICUS, 1901, November 20.

By permission of Yerkes Observatory.

Other numerical particulars relating to the moon are:—

Mean distance from the earth (earth's radius as 1)	60·2634
Mean apparent diameter	31′ 51·5
Diameter in miles	2159·6
Moon's surface in square miles	14,600,000
Diameter (earth's equatorial diameter as 1)	0·2725
Surface (earth's as 1)	0·0742
Volume (earth's as 1)	0·0202
Ratio of mass to earth's mass[1]	1:81·53 ± ·047
Density (earth's as 1)	0·60736
Density (water's as 1, and earth's assumed as 5)	3·46
Ratio of gravity to gravity at the earth's surface	1:6
Inclination of axis of rotation to ecliptic	1° 30′ 11·3″

The Lunar Theory.

The mathematical theory of the moon's motion does not yet form a well-defined body of reasoning and doctrine, like other branches of mathematical science, but consists of a series of researches, extending through twenty centuries or more, and not easily welded into a unified whole. Before Newton the problem was that of devising empirical curves to formally represent the observed inequalities in the motion of the moon around the earth. After the establishment of universal gravitation as the primary law of the celestial motions, the problem was reduced to that of integrating the differential equations of the moon's motion, and testing the completeness of the results by comparison with observation. Although the precision of the mathematical solution has been placed beyond serious doubt, the problem of completely reconciling this solution with the observed motions of the moon is not yet completely solved. Under these circumstances the historical treatment is that best adopted to give a clear idea of the progress and results of research in this field. Modern researches were developed so naturally from the results of the ancients that we shall begin with a brief mention of the work of the latter.

It is in the investigation of the moon's motion that the merits of the ancient astronomy are seen to the best advantage. In the hands of Hipparchus the theory was brought to a degree of precision which is really marvellous when we compare it either with other branches of physical science in that age or with the views of contemporary non-scientific writers. The discoveries of Hipparchus were:—

1. *The Eccentricity of the Moon's Orbit.*—He found that the moon moved most rapidly near a certain point of its orbit, and most slowly near the opposite point. The law of this motion was such that the phenomena could be represented by supposing the motion to be actually circular and uniform, the apparent variations being explained by the hypothesis that the earth was not situated in the centre of the orbit, but was displaced by an amount about equal to one-twentieth of the radius of the orbit. Then, by an obvious law of kinematics, the angular motion round the earth would be most rapid at the point nearest the earth, that is at perigee, and slowest at the point most distant from the earth, that is at apogee. Thus the apogee and perigee became two definite points of the orbit, indicated by the variations in the angular motion of the moon.

These points are at the ends of that diameter of the orbit which passes through the eccentrically situated earth, or, in other words, they are on that line which passes through the centre of the earth and the centre of the orbit. This line was called the *line of apsides.* On comparing observations made at different times it was found that the line of apsides was not fixed, but made a complete revolution in the heavens, in the order of the signs of the zodiac, in about nine years.

2. *The Numerical Determination of the Elements of the Moon's Motion.*—In order that the two capital discoveries just mentioned should have the highest scientific value, it was essential that the numerical values of the elements involved in these complicated motions should be fixed with precision. This Hipparchus was enabled to do by lunar eclipses. Each eclipse gave a moment at which the longitude of the moon was 180° different from that of the sun. The latter admitted of ready calculation. Assuming the mean motion of the moon to be known and the perigee to be fixed, three eclipses, observed in different points of the orbit, would give as many true longitudes of the moon, which longitudes could be employed to determine three unknown quantities—the mean longitude at a given epoch, the eccentricity, and the position of the perigee. By taking three eclipses separated at short intervals, both the mean motion and the motion of the perigee would be known beforehand, from other data, with sufficient accuracy to reduce all the observations to the same epoch, and thus to leave only the three elements already mentioned unknown. The same three elements being again determined from a second triplet of eclipses at as remote an epoch as possible, the difference in the longitude of the perigee at the two epochs gave the annual motion of that element, and the difference of mean longitudes gave the mean motion.

The eccentricity determined in this way is more than a degree in error, owing to the effect of the *evection*, which was unknown to Hipparchus. The result of the latter inequality is brought out when it is sought to determine the eccentricity of the orbit from the observations near the time of the first and last quarter. It was thus found by Ptolemy that an additional inequality existed in the motion, which is now known as the evection. The relations of the quantities involved may be shown by simple trigonometric formulae. If we put g for the moon's anomaly or distance from the perigee, and D for its elongation from the sun, the inequalities in question as now known are—

$$6{\cdot}29^\circ \sin g \qquad \text{(equation of centre)}$$
$$+1{\cdot}27^\circ \sin (2D-g) \qquad \text{(evection).}$$

During a lunar eclipse we always have $D=180^\circ$, very nearly, and $2D=360^\circ$. Hence the evection is then $-1{\cdot}2^\circ \sin g$, and consequently has the same argument g as the *equation of centre*, so that it is confounded with it. The value of the equation of centre derived from eclipses is thus—

$$6{\cdot}29^\circ \sin g-1{\cdot}27^\circ \sin g=5{\cdot}02^\circ \sin g.$$

Therefore the eccentricity found by Hipparchus was only 5°, and was more than a degree less than its true value. At first quarter we have $D=90^\circ$ and $2D=180^\circ$. Substituting this value of $2D$ in the last term of the above equation, we see that the combined equation of the centre and evection are, at quadrature—

$$6{\cdot}29^\circ \sin g+1{\cdot}27^\circ \sin g=7{\cdot}56^\circ \sin g.$$

Thus, in consequence of the evection, the equation of the centre comes out 2° 30′ larger from observations at the moon's quarters than during eclipses.

The next forward step was due to Tycho Brahe. He found that, although the two inequalities found by Hipparchus and Ptolemy correctly represented the moon's longitude near conjunction and opposition, and also at the quadratures, it left a large outstanding error at the octants, that is when the moon was 45° or 135° on either side of the sun. This inequality, which reaches the magnitude of nearly 1°, is known as the *variation.* Although Tycho Brahe was an original discoverer of this inequality, through whom it became known, Joseph Bertrand of Paris claimed the discovery for Abu 'l-Wefa, an Arabian astronomer, and made it appear that the latter really detected inequalities in the moon's motion which we now know to have been the variation. But he has not shown, on the part of the Arabian, any such exact description of the inequality as is necessary to make clear his claim to the discovery. We may conclude the ancient history of the lunar theory by saying that the only real progress from Hipparchus to Newton consisted in the more exact determination of the mean motions of the moon, its perigee and its line of nodes, and in the discovery of three inequalities, the representation of which required geometrical constructions increasing in complexity with every step.

The modern lunar theory began with Newton, and consists in determining the motion of the moon deductively from the theory of gravitation. But the great founder of celestial mechanics employed a geometrical method, ill-adapted to lead to the desired result; and hence his efforts to construct a lunar theory are of more interest as illustrations of his wonderful power and correctness in mathematical reasoning than as germs of new methods of research. The analytic method sought to express the moon's motion by integrating the differential equations of the dynamical theory. The methods may be divided into three classes:—

1. Laplace and his immediate successors, especially G. A. A. Plana (1781–1864), effected the integration by expressing the time in terms of the moon's true longitude. Then, by inverting the series, the longitude was expressed in terms of the time.

2. By the second general method the moon's co-ordinates are obtained in terms of the time by the direct integration of the differential equations of motion, retaining as algebraic symbols the values of the various elements. Most of the elements are small numerical fractions: e, the eccentricity of the moon's orbit, about 0·055; e', the eccentricity of the earth's orbit, about 0·017; γ, the sine of half the inclination of the moon's orbit, about 0·046; m, the ratio of the mean motions of the moon and earth, about 0·075. The expressions for the longitude, latitude and parallax appear as an infinite trigonometric series, in which the coefficients of the sines and cosines are themselves infinite series proceeding according to the powers of the above small numbers. This method was applied with success by Pontécoulant and Sir John W. Lubbock, and afterwards by Delaunay. By these methods the series converge so slowly, and the final expressions for the moon's longitude are so long and complicated, that the series has never been carried far enough to ensure the accuracy of all the terms. This is especially the case with the development in powers of m, the convergence of which has often been questioned.

3. The third method seeks to avoid the difficulty by using the numerical values of the elements instead of their algebraic symbols. This method has the advantage of leading to a more rapid and certain

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[1] A. R. Hinks, "Mass of the Moon, from Observations of Eros, 1900–1901," *M. N. Roy. Ast. Soc.*, 1909, Nov., p. 73.

determination of the numerical quantities required. It has the disadvantage of giving the solution of the problem only for a particular case, and of being inapplicable in researches in which the general equations of dynamics have to be applied. It has been employed by Damoiseau, Hansen and Airy.

The methods of the second general class are those most worthy of study. Among these we must assign the first rank to the method of C. E. Delaunay, developed in his *Théorie du mouvement de la lune* (2 vols., 1860, 1867), because it contains a germ which may yet develop into the great desideratum of a general method in celestial mechanics.

Among applications of the third or numerical method, the most successful yet completed is that of P. A. Hansen. His first work, *Fundamenta nova*, appeared in 1838, and contained an exposition of his ingenious and peculiar methods of computation. During the twenty years following he devoted a large part of his energies to the numerical computation of the lunar inequalities, the redetermination of the elements of motion, and the preparation of new tables for computing the moon's position. In the latter branch of the work he received material aid from the British government, which published his tables on their completion in 1857. The computations of Hansen were published some seven years later by the Royal Saxon Society of Sciences.

It was found on comparing the results of Hansen and Delaunay that there are some outstanding discrepancies which are of sufficient magnitude to demand the attention of those interested in the mathematical theory of the subject. It was therefore necessary that the numerical inequalities should be again determined by an entirely different method.

This has been done by Ernest W. Brown, whose work may be regarded not only as the last word on the subject, but as embodying a seemingly complete and satisfactory solution of a problem which has absorbed an important part of the energies of mathematical astronomers since the time of Hipparchus. We shall try to convey an idea of this solution. We have just mentioned the four small quantities e, e', γ and m, in terms of the powers and products of which the moon's co-ordinates have to be expressed. Euler conceived the idea of starting with a preliminary solution of the problem in which the orbit of the moon should be supposed to lie in the ecliptic, and to have no eccentricity, while that of the sun was circular. This solution being reached, the additional terms were found, which were multiplied by the first power of the several eccentricities and of the inclination. Then the terms of the second order were found, and so on to any extent. In a series of remarkable papers published in 1877–1888 Hill improved Euler's method, and worked it out with much more rigour and fullness than Euler had been able to do. His most important contribution to the subject consisted in working out by extremely elegant mathematical processes the method of determining the motion of the perigee. John Couch Adams afterwards determined the motion of the node in a similar way. The numerical computations were worked out by Hill only for the first approximation. The subject was then taken up by Brown, who in a series of researches published in the *Memoirs* of the Royal Astronomical Society and in the *Transactions* of the American Mathematical Society extended Hill's method so as to form a practically complete solution of the entire problem. The principal feature of his work was that the quantity m, which is regarded as constant, appears only in a numerical form, so that the uncertainties arising from development in a series accruing to its powers is done away with.

The solution of the main mathematical problem thus reached is that of the motion of three bodies only—the sun, earth and moon. The mean motion of the moon round the earth is then invariable, the longitude containing no inequalities of longer period than that of the moon's node, 18·6 y. But Edmund Halley found, by a comparison of ancient eclipses with modern observations, that the mean motion had been accelerated. This was confirmed by Richard Dunthorne (1711–1775). Corresponding to this observed fact was the inference that the action of the planets might in some way influence the moon's motion. Thus a new branch of the lunar theory was suggested—the determination by theory of the effect of planetary action.

The first step in constructing this theory was taken by Laplace, who showed that the secular acceleration was produced by the secular diminution of the earth's orbit. He computed the amount as about 10″ per century, which agreed with the results derived by Dunthorne from ancient eclipses. Laplace's immediate successors, among whom were Hansen, Plana and Pontécoulant, found a larger value, Hansen increasing it to 12·5″, which he introduced into his tables. This value was found by himself and Airy to represent fairly well several ancient eclipses of the sun, notably the supposed one of Thales. But Adams in 1853[1] showed that the previous computations of the acceleration were only a rude first approximation, and that a more rigorous computation reduced the result to about one-half. This diminution was soon fully confirmed by others, especially Delaunay, although for some time Pontécoulant stoutly maintained the correctness of the older result. But the demonstration of Adam's result was soon made conclusive, and a value which may be regarded as definitive has been derived by Brown. With the latest accepted diminution of the eccentricity, the coefficient is 5·91″.

The question now arose of the origin of the discrepancy between the smaller values by theory, and the supposed values of 12″ derived from ancient eclipses. In 1856 William Ferrel showed that the action of the moon on the ocean tidal waves would result in a retardation of the earth's rotation, a result, at first unnoticed, which was independently reached a few years later by Delaunay. The amount of retardation does not admit of accurate computation, owing to the uncertainty both as to the amount of the oceanic friction from which it arises and of the exact height and form of the tidal wave, the action of the moon on which produces the effect. But any rough estimate that can be made shows that it might well be supposed much larger than is necessary to produce the observed differences of 6″ per century. It was therefore surprising when, in 1877, Simon Newcomb found, by a study of the lunar eclipses handed down by Ptolemy and those observed by the Arabians—data much more reliable than the vague accounts of ancient solar eclipses—that the actual apparent acceleration was only about 8·3″. This is only 2·4″ larger than the theoretical value, and it seems difficult to suppose that the effect of the tidal retardation can be as small as this. This suggests that the retardation may be in great part compensated by some accelerating cause, the existence of which is not yet well established. The following is a summary of the present state of the question:—

The theoretical value of the acceleration, assuming the day to be constant, is	5·91″
Hansen's value in his *Tables de la lune* is	12·19
Hansen's revised, but still theoretically erroneous, result is	12·56
The value which best represents the supposed eclipses —(1) of Thales, (2) at Larissa, (3) at Stikkelstad —is about	11·7
The result from purely astronomical observation is	8·3

Inequalities of Long Period.—Combined with the question of secular acceleration is another which is still not entirely settled—that of inequalities of long period in the mean motion of the moon round the earth. Laplace first showed that modern observations of the moon indicated that its mean motion was really less during the second half of the 18th century than during the first half, and hence inferred the existence of an inequality having a period of more than a century.

The existence of one or more such inequalities has been fully confirmed by all the observations, both early and recent, that have become available since the time of Laplace. It is also found by computation from theory that the planets do produce several appreciable inequalities of long period, as well as a great number of short period, in the motion of the moon. But the former do not correspond to the observed inequalities, and the explanation of the outstanding differences may be regarded to-day as the most perplexing enigma in astronomy. The most plausible explanation is that, like the discrepancy in the secular acceleration, the observed deviation is only apparent, and arises from slow fluctuations in the earth's rotation, and therefore in our measure of time produced by the motion of great masses of polar ice and the variability of the amount of snowfall on the great continents. Were this the case a similar inequality should be found in the observed times of the transits of Mercury. But the latter do not certainly show any deviation in the measure of time, and seem to preclude a deviation so large as that derived from observations of the moon. This suggests that inequalities in the action of the planets may have been still overlooked, the subject being the most intricate with which celestial mechanics has to deal. But this action has been recently worked up with such completeness of detail by Radau, Newcomb and Brown, that the possibility of any unknown term seems out of the question. The enigma therefore still defies solution.

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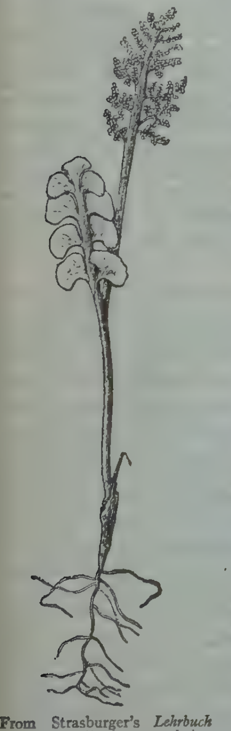
[1] *Philosophical Transactions*, 1853.

The following are among the works relating to the motion of the moon, which are of historic importance or present interest to the student: Clairaut, *Théorie de la lune* (2nd ed., Paris, 1765); L. Euler, *Theoria motuum lunae nova methodo pertractata* (Petropolis, 1772); G. Plana, *Théorie du mouvement de la lune* (3 vols., Turin, 1832); P. A. Hansen, *Fundamenta nova investigationis orbitae verae quam luna perlustrat* (Gotha, 1838); *Darlegung der theoretischen Berechnung der in den Mondtafeln angewandten Störungen* (Leipzig, 1862); C. Delaunay, *Théorie du mouvement de la lune* (2 vols., Paris, 1860–1867); F. F. Tisserand, *Traité de mécanique céleste*, tome iii., *Exposé de l'ensemble des théories relatives au mouvement de la lune* (Paris, 1894); E. W. Brown, "Theory of the Motion of the Moon," *Memoirs* of the Royal Astronomical Society, various vols.; also *Transactions* of the American Mathematical Society, vols. iv. and vi.; E. W. Brown, *Introductory Treatise on the Lunar Theory* (Cambridge University Press, 1896); Hansen, *Tables de la lune* (London, 1857) (Admiralty publication); W. Ferrel, "On the Effect of the Sun and Moon on the Rotary Motion of the Earth," *Astron. Jour.*, vol. iii. (1854); S. Newcomb, "Researches on the Motion of the Moon" (Appendix to *Washington Observations* for 1875, discussion of the moon's mean motion); S. Newcomb, "Transformation of Hansen's Lunar Theory," *Ast. Papers* of the Amer. Ephemeris, vol. i.; R. Radau, "*Inégalités planétaires du mouvement de la lune*" (*Annales*, Paris Observatory, vol. xxi.); S. Newcomb, "Action of the Planets on the Moon," *Ast. Papers* of the Amer. Ephemeris, vol. v., pt. 3 (1896). Also, Publication 72 of the Carnegie Institution of Washington (1907); E. W. Brown, *Inequalities in the Moon's Motion produced by the Action of the Planets* (the Adams prize essay for 1907). (S. N.)

MOONSEED, in botany, a common name for *Menispermum*, a genus of climbing deciduous shrubs, containing one species in North America and another in Eastern Asia. The former, *M. canadense*, is a handsome plant, suited to damp and shady walls, with large reniform peltate leaves and yellowish flowers borne in profusion on long pendulous racemes.

MOONSTONE, a variety of felspar, showing in certain directions a bluish opalescence, whence its value as an ornamental stone. When cut with a convex surface it displays a soft milky reflection, forming a luminous band, but not sharply defined as in cat's-eye. The ordinary moonstone is a translucent variety of orthoclase known as adularia (see ORTHOCLASE), whence the peculiar sheen has been called "adularescence." The effect is probably caused by interference from twin lamellae, or by numerous enclosures of microscopic laminae, definitely orientated, and it has been suggested that these may often be flakes of kaolin due to incipient decomposition of the felspar. Practically all the moonstone of commerce comes from Ceylon, principally from the Dumbara district of the Central Province. It occurs as pebbles and irregular masses in the gem-gravels and clay-deposits, and is also obtained by quarrying an adularia leptynite, as described by Dr. A. K. Coomáraswámy. Very similar in some respects to moonstone is the chatoyant soda-felspar which was called by T. Sterry Hunt peristerite, from Gr. περιστερά, a dove, in allusion to the resemblance of its lustre to that of the bird's neck. The original peristerite was from Bathurst, near Perth, Lanark county, Ontario, but it occurs also at Macomb, St Lawrence county, New York.



From Strasburger's *Lehrbuch der Botanik*, by permission of Gustav Fischer.

Botrychium Lunaria.

MOONWORT, or MOON-FERN, in botany, the popular name of a small fern (*Botrychium Lunaria*), belonging to the order Ophioglossaceae (see FERNS). It has a tuberous root-stock and a stout fleshy glabrous frond 3 to 6 in. long, with a sterile and fertile portion; the former bears several pairs of close-set, semi-circular or moon-shaped pinnae, the latter is pinnately branched and covered, on the face opposed to the sterile portion, with small globose spore-cases which burst transversely. It is a widely distributed plant in the north and south temperate and cold zones, and is found in pastures and grassy banks in Britain.

MOOR. (1) A heath, an unenclosed stretch of waste or uncultivated land, covered with heather; also such a heath preserved for game-shooting, particularly for the shooting of grouse. The O. Eng. *mór*, bog, moor, is represented in other Teutonic languages; cf. Dan. *mor*, Ger. *Moor*, O. Du. *moer*, &c.; from an O. Du. adjectival form *moerasch* comes Eng. *morass*, a bog. Probably *mere*, *marsh*, are not to be connected with these words. (2) The verb "to moor," to fasten a ship or boat to the shore, to another vessel, or to an anchor or buoy, by cables, &c., is probably from the root seen in mod. Du. *meren*, which also gives the English nautical term "marline," small strands of rope used for lashings or seizings, and "marline-spike," a small iron tool for separating the strands of rope, &c.

MOORCROFT, WILLIAM (*c.* 1770–1825), English traveller, was born in Lancashire, about 1770. He was educated as a surgeon in Liverpool; but on completing his course he resolved to devote himself to veterinary surgery, and, after studying the subject in France, began practice in London. In 1795 he published a pamphlet of directions for the medical treatment of horses, with special reference to India, and in 1800 a *Cursory Account of the Methods of Shoeing Horses*. Having been offered by the East India Company the inspectorship of their Bengal stud, Moorcroft left England for India in 1808. Under his care the stud rapidly improved; in order to perfect the breed he resolved to undertake a journey into Central Asia to obtain a stock of Turkoman horses. In company with Captain William Hearsey, and encumbered with a stock of merchandise for the purpose of establishing trade relations between India and Central Asia, Moorcroft left Josimath, well within the mountains, on the 26th of May 1812. Proceeding along the valley of the Dauli, they reached the summit of the frontier pass of Niti on the 1st of July. Descending by the towns of Darba and Gartok, Moorcroft struck the main upper branch of the Indus near its source, and on the 5th of August arrived at the sacred lake of Manasarowar. Returning by Bhutan, he was detained some time by the Ghurkas, and reached Calcutta in November. This journey only served to whet Moorcroft's appetite for more extensive travel, for which he prepared the way by sending out a young Hindu, who succeeded in making extensive explorations. In company with him and George Trebeck, Moorcroft set out on his second journey in October 1819. On the 14th of August the source of the Beas (Hyphasis) was discovered, and subsequently that of the Chenab. Leh, the capital of Ladakh, was reached on the 24th of September, and here several months were spent in exploring the surrounding country. A commercial treaty was concluded with the government of Ladakh, by which the whole of Central Asia was virtually opened to British trade. Kashmir was reached on the 3rd of November 1822, Jalalabad on the 4th of June 1824, Kabul on the 20th of June, and Bokhara on the 25th of February 1825. At Andkhui, in Afghan Turkestan, Moorcroft was seized with fever, of which he died on the 27th of August 1825, Trebeck surviving him only a few days. But according to the Abbé Huc, Moorcroft reached Lhasa in 1826, and lived there twelve years, being assassinated on his way back to India in 1838. In 1841 Moorcroft's papers were obtained by the Asiatic Society, and published, under the editorship of H. H. Wilson, under the title of *Travels in the Himalayan Provinces of Hindustan and the Punjāb, in Ladakh and Kashmir, in Peshawur, Kabul, Kunduz and Bokhara, from 1819 to 1825*.

See Graham Sandberg, *The Exploration of Tibet* (1904).

MOORE, ALBERT JOSEPH (1841–1893), English decorative painter, was born at York on the 4th of September 1841. He was the youngest of the fourteen children of the artist, William Moore, of York who in the first half of the 19th century enjoyed a considerable reputation in the North of England as a painter of portraits and landscape. In his childhood Albert Moore showed an extraordinary love of art, and as he was encouraged in his tastes by his father and brothers, two of whom afterwards became famous as artists—John Collingham Moore, and Henry Moore, R.A.—he was able to begin the active exercise of his profession at an unusually early age. His first exhibited works were two drawings which he sent to the Royal Academy in 1857. A year later he became a student in the Royal Academy schools; but after working in them for a few months only he decided that he would be more profitably occupied in independent practice. During the period that extended from 1858 to 1870, though he produced and exhibited many pictures and drawings, he gave up much of his time to decorative work of various kinds, and painted, in 1863, a series of wall decorations at Coombe Abbey, the seat of the earl of Craven; in 1865 and 1866 some elaborate compositions: "The Last Supper" and "The Feeding of the Five Thousand" on the chancel walls of the church of St Alban's, Rochdale; and in 1868 "A Greek Play," an important panel in tempera for the proscenium of the Queen's Theatre in Long Acre. His first large canvas, "Elijah's Sacrifice," was completed during a stay of some five months in Rome at the beginning of 1863, and appeared at the Academy in 1865. A still larger picture, "The Shunamite relating the Glories of King Solomon to her Maidens," was exhibited in 1866, and with it two smaller works, "Apricots" and "Pomegranates." In these Albert Moore asserted plainly the particular technical conviction which for the rest of his life governed the whole of his practice, and with them he first took his place definitely among the most original of British painters. Of his subsequent works the most notable are "The Quartette" (1869), "Sea Gulls" (1871), "Follow-my-Leader" (1873), "Shells" (1874), "Topaz" (1879), "Rose Leaves" (1880), "Yellow Marguerites" (1881), "Blossoms" (1881), "Dreamers" (1882), "Reading Aloud" (1884), "Silver" (1886), "Midsummer" (1887), "A River Side" (1888), "A Summer Night" (1890), "Lightning and Light" (1892), "An Idyll" (1893), and "The Loves of the Winds and the Seasons," a large picture which was finished only a few days before his death. He died on the 25th of September 1893, at his studio in Spenser Street, Westminster. Several of his pictures are now in public collections; among the chief are "Blossoms," in the National Gallery of British Art; "A Summer Night" in the Liverpool Corporation Gallery; "Dreamers" in the Birmingham Corporation Gallery; and a water-colour, "The Open Book," in the Victoria and Albert Museum, South Kensington. In all his pictures, save two or three produced in his later boyhood, he avoided any approach to story-telling, and occupied himself exclusively with decorative arrangements of lines and colour masses. The spirit of his art is essentially classic, and his work shows plainly that he was deeply influenced by study of antique sculpture; but he was not in any sense an archaeological painter, nor did he attempt reconstructions of the life of past centuries. Artistically he lived in a world of his own creation, a place peopled with robust types of humanity of Greek mould, and gay with bright-coloured draperies and brilliant-hued flowers. As an executant he was careful and certain; he drew finely, and his colour-sense was remarkable for its refinement and subtle appreciation. Few men have equalled him as a painter of draperies, and still fewer have approached his ability in the application of decorative principles to pictorial art.

MOORE, EDWARD (1712–1757), English dramatist and miscellaneous writer, the son of a dissenting minister, was born at Abingdon, Berkshire, on the 22nd of March 1712. He was the author of the domestic tragedy of *The Gamester*, originally produced in 1753 with Garrick in the leading character of Beverley the gambler. As a poet he produced clever imitations of Gay and Gray, and with the assistance of George, 1st Lord Lyttelton, Lord Chesterfield and Horace Walpole, conducted *The World* (1753–1757), a weekly periodical on the model of the *Rambler*. Moore collected his poems under the title of *Poems, Fables and Plays* in 1756. He died in Lambeth on the 1st of March 1757. His *Dramatic Works* were published in 1788.

MOORE, GEORGE (1853–), Irish novelist and poet, was born in Ireland, son of George Henry Moore, M.P., a well-known orator and politician. He studied art in London and finished his education in Paris. He was a regular contributor to various London magazines when he published his first volume, in verse, *The Flowers of Passion* (1877). A second, *Pagan Poems*, appeared in 1881. As a novelist he followed the French school of Flaubert and Zola, and became prominent for deliberate realism. His powerful *Mummer's Wife* (1885) had decidedly repulsive elements. But Zolaism meanwhile was a thing to which the reading public was gradually becoming acclimatized. George Moore's *Esther Waters* (1894), a strong story with an anti-gambling motive, had a more general success, and was followed by *Evelyn Innes* (1898), a novel of musical life, and its sequel, *Sister Teresa* (1901). He interested himself in the Irish Gaelic revival, and was one of the founders of the Irish Literary Theatre. His play, *The Strike at Arlingford* (three acts, in prose, 1893), was written for the Independent Theatre, and his satirical comedy, *The Bending of the Bough* (1900), dealing with Irish local affairs, was played by the Irish Literary Theatre in Dublin. His *Diarmuid and Grania*, written with Mr. W. B. Yeats, was produced by Mr. F. R. Benson's company at the same theatre in 1901. *The Untilled Field* (1903) and *The Lake* (1905) are romantic pictures of Irish life. Moore had originally come to the front in London about 1888 as an art critic, and his published work in that line includes *Impressions and Opinions* (1891) and *Modern Painting* (1893, 2nd ed., 1897). Among his other books are *A Drama in Muslin*, (1886), *A Mere Accident* (1887), *Parnell and His Island* (1887), *Mike Fletcher* (1887), *Spring Days* (1888), *Vain Fortune* (1890), *Celibates* (1895), *Confessions of a Young Man* (1888), *and Memoirs of My Dead Life* (1906).

MOORE, GEORGE FOOT (1851–), American Biblical scholar, was born in West Chester, Pennsylvania, on the 15th of October 1851, the son of William Eves Moore (1823–1899), a prominent Presbyterian minister, long the permanent clerk of the Presbyterian General Assembly. The son graduated at Yale in 1872 and at Union Theological Seminary in 1877, was ordained in 1878, and from 1878 to 1883 was pastor of the Putnam Presbyterian Church, Zanesville, Ohio. He was Hitchcock professor of the Hebrew language and literature in Andover Theological Seminary in 1883–1902, and was president of its faculty in 1899–1901; in 1902 he became professor of theology and in 1904 professor of the history of religion at Harvard University. His chief critical work dealt with the Hexateuch, and more particularly the Book of Judges (Commentary, 1895; text, translation and notes, 1898; text with critical notes, 1900).

MOORE, HENRY (1831–1895), English painter, the ninth son of William Moore, of York, and brother of Albert Joseph Moore, was born in that city on the 7th of March 1831. His artistic education was chiefly supervised by his father, but he also attended the York School of Design, and worked for a short time in the Royal Academy Schools. He first exhibited at the Academy in 1853, and was a constant contributor to its exhibitions till his death. At the outset of his career he occupied himself mostly with landscapes and paintings of animals, executed with extraordinary detail in imitation of the prevailing taste of the Pre-Raphaelite Brotherhood; but in 1857, while on a visit to the West of England, he made his first attempts as a sea-painter. His success was immediate, and it had the effect of diverting him almost entirely from landscapes. Among his most important canvases must be reckoned "The Pilot Cutter" in 1866, "The Salmon Poachers" in 1869, "The Lifeboat" in 1876, "Highland Pastures" in 1878, "The Beached Margent of the Sea" in 1880, "The Newhaven Packet" (bought by the Birmingham Corporation), and "Catspaws off the Land" (bought by the Chantrey Fund trustees); in 1885, "Mount's Bay" (bought by the Manchester Corporation) in 1886, "Nearing the Needles" in 1888, "Machrihanish Bay, Cantyre," in 1892, "Hove-to for a Pilot" in 1893, and "Glen Orchy," a landscape, in 1895. He was elected an associate of the Royal Society of Painters in Water Colours in 1876, and a full member in 1880; an associate of the Royal Academy in 1885, and an academician in 1893; and at Paris, in 1887, where he exhibited "The Newhaven Packet" and "The Clearness after Rain," he received a *grand prix* and was made a knight of the Legion of Honour. He died at Margate on the 22nd of June 1895. His works are marked by admirable appreciation of nature, and by a rare understanding of wave-form and colour and of the subtleties of atmospheric effect; and as a sea-painter he may fairly be regarded as almost without a rival.

MOORE, JOHN (1729–1802), Scottish physician and writer, was born at Stirling in 1729, the son of a clergyman. After taking his medical degree at Glasgow, he served with the army in Flanders, then proceeded to London to continue his studies, and eventually to Paris, where he was attached to the household of the British ambassador. His novel *Zeluco* (1789), a close analysis of the motives of a selfish profligate, produced a great impression at the time, and indirectly, through the poetry of Byron, has left an abiding mark on literature. Byron said that he intended Childe Harold to be "a poetical Zeluco," and the most striking features of the portrait were undoubtedly taken from that character. Moore's other works have a less marked individuality, but his sketches of society and manners in France, Germany, Switzerland, Italy and England furnish valuable materials for the social historian. In 1792 he accompanied Lord Lauderdale to Paris, and witnessed some of the principal scenes of the Revolution. His *Journal during a Residence in France* (1793) is the careful record of an eye-witness, and is frequently referred to by Carlyle. He died in London on the 21st of January 1802, leaving five sons, the eldest of whom was General Sir John Moore. James Moore (1763–1834), who wrote Sir John's *Life*, was also the author of some important medical works, and Sir Graham Moore (1764–1843), saw much active naval service and became an admiral.

MOORE, SIR JOHN (1761–1809), British general, the son of John Moore, was born at Glasgow on the 13th of November 1761. From his early years he intended to become a soldier, learned the Prussian firing exercise, and was "always operating in the field and showing how Geneva could be taken." By the duke of Hamilton's influence he obtained an ensigncy in the 51st foot (1776), learned his drill at Minorca, and in 1778 was appointed captain-lieutenant in a new regiment raised by Hamilton for service in the American War. Moore remained in America to the peace of 1783, after which the Hamilton regiment was disbanded. In 1784 he was returned by the Hamilton interest as member of parliament for the united boroughs of Lanark, Selkirk, Peebles and Linlithgow. In parliament, though he never spoke, he seems to have taken his duties very seriously, and to have preserved an independent position, in which he won the friendship of Pitt and the respect of Burke, and (more important still) the friendship of the duke of York. In 1787 he became major in the 60th (now King's Royal Rifles), but in the following year he was transferred to his old corps, the 51st. In 1792 Moore sailed with his corps to the Mediterranean. He was too late to assist at Toulon, but was engaged throughout the operations in Corsica, and won particular distinction at the taking of Calvi, where he was wounded. Soon after this he became adjutant-general to Sir Charles Stuart, with whom he formed a close friendship. After the expulsion of the French Moore became very intimate with many of the leading Corsican patriots, which intimacy was so obnoxious to Sir Gilbert Elliot (later Lord Minto) that Moore was eventually ordered to leave the island in forty-eight hours, though Elliot wrote in warm terms of his ability. Pitt and the duke of York thought still more highly of Colonel Moore, who was soon sent out to the West Indies in the local rank of brigadier-general. Here he came under the command of Sir Ralph Abercromby, whose most valued adviser and subordinate Moore soon became. In the Santa Lucia expedition he won further distinction by his conduct at the capture of the Vigie and Morne Fortuné, and when Sir Ralph left the island he appointed Moore governor and military commander. In 1798 he accompanied Abercromby to Ireland as a major-general, and during the rebellion was actively engaged in command of a corps in the south, defeating a large force of the Irish, and saving Wexford from destruction after the battle of Vinegar Hill (June 21). His services were in universal request, and Abercromby had him appointed to the command of a brigade destined for the expedition to Holland. At the action of Egmont-op-Zee, on the 2nd of October 1799, his brigade lost very heavily, and he himself was wounded for the fourth time, on this occasion severely. On his return from Holland he was made colonel of the 52nd regiment, with which he was connected for the rest of his career, and which under his supervision became one of the finest regiments in Europe.

Throughout the Egyptian expedition he commanded the reserve. The 28th and 42nd regiments in this corps gained great distinction at the battle of Alexandria, where Moore himself was again wounded. He returned to duty, however, before the surrender of the French forces to General Hutchinson, and added so much to his reputation by his conduct in this brilliant campaign that after the short peace came to an end he was appointed to command the force assembled at Shorncliffe camp (1803) as a part of the army intended to meet the projected invasion of Napoleon. Here were trained some of the best regiments of the service, amongst others the 43rd, 52nd and 95th Rifles, the regiments which afterwards formed the famous "Light Division" and won in the Peninsula an unsurpassed reputation, not only for the skilful performance of the duties of light troops, but also for invincible steadiness in the line of battle. These corps (now represented in the army by the 1st and 2nd battalions of the Oxfordshire Light Infantry and the Rifle Brigade) bore the impress of Moore's training for thirty years and more, and as early as 1804, on account of the "superior state" of the 52nd, the king granted the officers exceptional promotion (August 29, 1804). The system of light infantry tactics taught at Shorncliffe was not invented by Moore; but he had always advocated the creation of these troops, and he supervised the training which produced such great results. While at Shorncliffe he renewed his intimacy with Pitt, who was then residing at Walmer Castle, and his close friendship with Lady Hester Stanhope led to the erroneous belief that he was betrothed to her. On his return to office Pitt caused Moore to be made a Knight of the Bath, and about the same time came his promotion to the rank of lieutenant-general. Fox, when he succeeded to office, showed the same appreciation of Moore, and in 1806 sent him to the Mediterranean as second-in-command to his brother, General H. E. Fox. In the various minor expeditions of the time Moore had a share, at first as a subordinate, but soon, when Fox went home on account of ill-health, as commander-in-chief of the British army employed in the Mediterranean. About this time he formed an attachment for Caroline Fox (afterwards the wife of Sir William Napier), to whom, however, he did not offer marriage, fearing to "influence her," by his high position and intimacy with her father, "to an irretrievable error for her own future contentment" (*Life of Sir C. Napier*, i. 39). In 1808 Moore was ordered to the Baltic, to assist Gustavus IV., king of Sweden, against Russia, France and Denmark. The conduct of the king, who went so far as to place Sir John Moore under arrest when he refused to acquiesce in his plans, ruined any chance of successful co-operation, and the English general returned home, making his escape in disguise. He was at once ordered to proceed with his division to Portugal, where he was to be under the command of Sir Hew Dalrymple and Sir Harry Burrard. To Moore, as a general of European reputation, who had held a chief command, the appointment of two senior officers to be over him appeared as a bitter insult, though his resentment did not divert him from his duty. He met his reward, for when, in the excitement caused by the convention of Cintra, Dalrymple and Burrard were ordered home, Moore was left in command of the largest British army that had been employed since the commencement of the war. Wellesley, who returned home with the other generals, showed his appreciation of Moore, and in an interesting letter (*Wellington Despatches*, Oct. 8, 1808) expressed his desire to use his own great political influence to effect a reconciliation between Moore and the ministers.

It was not long before the Spaniards summoned Sir John Moore's army to assist them against the advance of Napoleon, and the troops were marched into Spain, Salamanca being their rendezvous. There Moore remained for a month, calling up Sir David Baird's corps from Corunna to assist him. Soon, however, the overwhelming success of the emperor's attack threatened to isolate Moore, and it was then that he formed the magnificent resolution of marching northwards against the French line of retreat. The bold and skilful operations which followed this step will be found outlined in the article PENINSULAR WAR. Moore's advance paralysed the Emperor's victorious armies. Napoleon himself turned against the British army, which was soon in grave danger, but Spain was saved. Under these circumstances took place the famous retreat on Corunna. The indiscipline of a large proportion of the troops made it painful and almost disastrous, but the reserve under Edward Paget, in which served Moore's old Shorncliffe regiments, covered itself with glory in the ceaseless rearguard fighting which marked every step of the retreat. The march ended with the glorious battle of Corunna (Jan. 16, 1809), where, early in the day, Sir John Moore received his death wound. He would not suffer his sword to be unbuckled, though the hilt galled his wound, and so he was borne from the field. His last hours were cheered by the knowledge of victory, and his only care was to recommend his friends, and those who had distinguished themselves, to the notice of the government. He died with the name of Lady Hester Stanhope on his lips. By his own wish he was buried, before dawn on the 17th, in the ramparts of Corunna. Marshal Soult designed that a monument should be erected, with an inscription framed by himself, and the Spanish general La Romana afterwards carried out Soult's wishes. The temporary monument thus erected was made permanent in 1811 by Sir Howard Douglas, acting for the prince regent. The duke of York issued to the army on the 1st of February a noble order in which reference was made to the services of the general, and, above all, to the fact that "the life of Sir John Moore was spent among the troops." A memorial was erected in St Paul's Cathedral by order of parliament early in 1809, and his native city of Glasgow erected in George Square a bronze statue by Flaxman. The poem by the Rev. Charles Wolfe, "The Burial of Sir John Moore," became one of the most popular in the language. The best-known portrait of Sir John Moore is that by Sir Thomas Lawrence, P.R.A.

For many years controversy, largely political, raged over the events of the Corunna campaign, and only at a later period has any examination of Sir John Moore's merits and services been made in a dispassionate spirit. Mistakes were doubtless made in the retreat, but it is sufficient to accept Napoleon's view that they were probably inseparable from the difficulties with which Moore was surrounded. His greatest claim to renown is, however, independent of his conduct of armies in the field. He was the finest trainer of men that the British army has ever known. He had the true gift of the great man, judgment of character. While Wellington, whose work would have been vain but for Moore's achievements, perpetually complained of his officers and formed no school, Moore's name is associated with the career of all who made their mark. The history of the Light Division is sufficient in itself to indicate the results of Moore's training on the rank and file. In opposition to the majority, who regarded the lash and the gallows as the source of discipline, he sought always and by every means to develop the moral qualities no less than the physical. Of the senior officers Hope, Graham, Edward Paget, Hill and Craufurd all felt and submitted to his ascendancy. The flower of the younger generation, Colborne, Hardinge and the Napiers, even though they gained their laurels under Wellington and in chief command, were ever proud to call themselves "Sir John Moore's men."

See, besides the works mentioned in the article PENINSULAR WAR, J. C. Moore, *Life of Sir John Moore* (1833); Sir J. F. Maurice, *Sir John Moore's Journal* (1904); and the Records of the 52nd (Oxfordshire Light Infantry). A shorter memoir will be found in *Twelve British Soldiers* (London, 1899).

MOORE, THOMAS (1779–1852), Irish poet, was born in Dublin on the 28th of May 1779. His father was John Moore, a prosperous grocer and wine merchant, and his mother's maiden name was Anastasia Codd. In 1793 Tom Moore's name first appeared in print, as a contributor of some verses "To Zelia," to a Dublin periodical, the *Anthologia Hibernica*. In the same year Roman Catholic students began to be admitted to Trinity College, Dublin, and in 1794 Moore's name was entered on the books, curiously enough, as a Protestant. At Trinity he made friends with Robert Emmet, and was nearly dragged into the plots of the United Irishmen. The events of 1798 and the execution of Emmet in 1803 made a deep impression on him. The words of Emmet's address to his judges, asking the charity of silence—"Let no man write my epitaph"—are enshrined by Moore in one of his lyrics, "Oh, breathe not his name!" (*Irish Melodies*, 1808). The next song in the same collection—"When he who adores thee"—also owes its inspiration to Emmet's fate, and the conscientious Orientalism of *Lalla Rookh* does not conceal the pre-occupation of the writer with the United Irishmen when he writes of "The Fire Worshippers," and with Emmet and Sarah Curran when he describes the loves of Hafed and Hinda, especially in the well-known song, "She is far from the Land where her young Hero sleeps." In 1798 Moore graduated, and in the next year left for England to keep his terms at the Middle Temple.

He rapidly became a social success in London. Joseph Atkinson, secretary in Ireland to the ordnance board, had been attracted to Moore in Dublin at first by his gifts as a singer. He now gave him an introduction to Francis Rawdon-Hastings, 2nd earl of Moira, who invited him to his country seat at Donington Park, Leicestershire. Here Moore became a frequent guest. He had brought with him from Ireland a translation of the *Odes of Anacreon*, and the prince of Wales consented to have the volume dedicated to him. It was issued in 1800 with notes and a list of distinguished subscribers. His social successes involved him in expenses far beyond his means. His publisher had advanced him money, and he resolved to pay his debt by the anonymous publication of his juvenile poems, *The Poetical Works of the Late Thomas Little, Esq.* (1801), a collection of love poems which Moore afterwards regretted. Through Lord Moira's influence he was, in 1803, appointed registrar of the admiralty prize-court at Bermuda. He went there to take possession of the post, but soon tired of the monotonous life, and in 1804, after appointing a deputy, returned to England by way of the United States and Canada. In 1806 he published *Epistles, Odes and other Poems*, chiefly dealing with his impressions of travel. The volume contained the "Canadian Boat Song" ("Faintly as tolls the evening chime"), and some love poems of the same kind as those connected with the name of "Mr Little." Jeffrey made an unjustifiable onslaught on this collection in the *Edinburgh Review* for July 1806. Moore was in his view "the most licentious of modern versifiers, and the most poetical of those who, in our time, have devoted their talents to the propagation of immorality," and the book was a "public nuisance." Moore challenged Jeffrey, and a duel was arranged at Chalk Farm. The police interrupted the proceedings. Jeffrey's pistol was found to be unloaded, and the ludicrous affair ended in a fast friendship between them.

The success of the satirical epistles in the 1806 volume encouraged Moore to produce further work of a similar kind, *Corruption and Intolerance, Two Poems* (1808), and *The Sceptic: a Philosophical Satire* (1809), but the heroic couplet and the manner of Pope did not suit his talents. At the end of 1806 he went to Dublin, and, with the exception of about six months in 1807 spent at Donington Park, the next three years were spent in Ireland. Here he met Miss Elizabeth Dyke, an actress, who became his wife in March 1811. They lived at first in London, but soon removed into the country, to Kegworth, near Lord Moira's seat, and then to Mayfield Cottage, near

Ashbourne, Derbyshire. Moore had to spend much of his time in London, for the popularity of his songs led to an agreement with his publisher to increase the success of these by singing them himself at great houses. The inception of his *Irish Melodies* dates from 1807, and many of the best were written during the three years of his Irish visit. He had already published separate songs, some of them set to music of his own, when William Power suggested to him in 1807 the task of fitting words to a series of Irish airs supplied by Sir John Stevenson. He could not have found a task more exactly suited to his powers, and for a quarter of a century he enjoyed a regular income of £500 a year from Power for writing words to music. The first number of the *Irish Melodies* appeared in 1808, and contained some of his best and most popular work. The rest appeared between 1808 and 1834. In 1816 Stevenson and Moore published *Sacred Songs*, followed by a second number in 1824. In 1818 they began to adapt melodies from other nations. The first number of *National Airs* appeared in 1818, and was followed by others in 1820, 1822, 1826, and 1827.

After 1812 he broke ground in a new field—political squib-writing. His first butt was the prince regent, once his friend and patron, whose foibles, fatness, love for cutlets and curaçoa, for aged mistresses and practical jokes, were ridiculed with the lightest of clever hands. His earlier political poems appeared in the *Morning Chronicle*, but in 1813 he published a thin volume of *Intercepted Letters: The Twopenny Post Bag*. Other volumes of squibs, most of which passed through several editions, followed: *The World at Westminster* (1816), *The Fudge Family in Paris* (1818), *The Journal of a Member of the Pococurante Society* (1820), *Fables for the Holy Alliance* (1823), *Odes on Cash, Corn, Catholics, and other Matters* (1828), *The Fudge Family in England* (1835). The only failure among his satirical writings was *Tom Crib's Memorial to Congress* (1819) for which he had made an elaborate study of thieves' argot.

In 1814 he contracted with the firm of Longmans to supply a metrical romance on an Eastern subject, which should contain at least as many lines as Scott's *Rokeby*, the publishers binding themselves to pay 3000 guineas on delivery. Moore had begun *Lalla Rookh* two years before. He was a careful and laborious writer, and retired to a cottage in the neighbourhood of Donington Park, where with the help of Lord Moira's library he read himself slowly into familiarity with Eastern scenery and manners. He was already far advanced in his work when Byron in *The Giaour* and again in *The Bride of Abydos* largely forestalled him. The depression following on the peace of 1815 deferred the publication of *Lalla Rookh* until 1817. It was an immediate success. The Eastern local colouring which dazzled Moore's contemporaries has, however, faded, and the interest still existing in the poem is chiefly due to the undercurrent of Irish patriotism which he cleverly worked into it. Immediately after the completion of *Lalla Rookh*, Moore removed with his family to Sloperton Cottage, Wiltshire, where he was close to Bowood, Lord Lansdowne's country seat. Moore's plans were interrupted by the embezzlement of some £6000 by the deputy he had left in Bermuda, for whose default he was fully liable. To avoid a debtors' prison Moore retired to the Continent. He visited Byron in Italy, and in October 1819 received from him the first part of the *Memoirs*. The continuation was sent to Moore in Paris the next year, with Byron's suggestion that the reversion of the MS. should be sold. Moore did not remain long in Italy, but made his home in Paris, where he was joined by his wife and children. He was not able to return to England until 1822, when the Bermuda affair was compromised by a payment through Longmans of £1000. Moore had had many offers of help, but preferred to be indebted to his publishers only. During his exile he had written another Oriental poem, *The Loves of the Angels* (1822), which was hardly less popular than *Lalla Rookh*. He now became a contributor of satirical verse to *The Times*, the connexion lasting until 1827. He now wrote his *Memoirs of the Life of Sheridan*, first contemplated in 1814, which appeared, after some delay, in 1825. The *Memoirs of Captain Rock* (1824), in which he gives a humorous but convincing account of English misgovernment in Ireland, was the result of a tour with Lord Lansdowne in western Ireland. His prose tale, *The Epicurean*, appeared in 1827, and the *Legendary Ballads* in 1830. In 1831 he completed his *Life and Death of Lord Edward Fitzgerald*, probably his best piece of prose work.

The death of Byron in 1824 raised the question of the publication of his *Memoirs*. Moore had parted with them in 1821 to John Murray for £2000. After they had come into Murray's possession, Moore began to have doubts about the propriety of publishing them, and an arrangement was therefore made that the £2000 should be regarded as a loan, to be repaid during Byron's lifetime, and that the MS. should be retained as a security. When Byron died the *Memoirs* were still unredeemed, and the right of publication therefore rested with Murray. Moore now borrowed the money from Longmans and induced Murray to give up his claim. The money was paid, and, after a heated discussion with Byron's executors, the MS. was burnt. It was partly the pressure of the debt thus contracted, and partly the expressed wish of Byron, that induced Moore to undertake for Murray *The Letters and Journals of Lord Byron, with Notices of his Life* (1830). The difficult task was executed with great skill and tact, and it remains, with all its defects and omissions, a valuable record.

Moore's countrymen desired him to accept a seat in parliament for Limerick. The offer was accompanied by a scheme to present Moore with an estate in the county worth £300 a year. It was made through the poet Gerald Griffin, who has left on record an account of the interview. Moore declined the honour. In 1830 he allowed himself to be drawn into a project for writing a *History of Ireland* (4 vols., 1835, 1837, 1840 and 1846) for *Lardner's Cyclopaedia*. He hoped that by writing the history of Ireland he might arouse in his own countrymen an interest in their past, and open the eyes of Englishmen to the misgovernment of the country. He had neither the historical training nor the despatch in writing which enabled Scott to scribble off the companion volumes on Scotland, and the history sat like a nightmare on him, and was left unfinished on the melancholy collapse of his powers in 1845. He had, however, the temper of the student, and was always a voracious reader.

Moore's last years were harassed by pecuniary difficulties, and by the weakness and misconduct of his sons, the elder of whom retired from the English army to enter the foreign legion of France. After the death of his last child in 1845, Moore became a total wreck, but he lived until the 25th of February 1852. He left sufficient provision for his wife in the *Diary* which he kept chiefly on her behalf.

His other works are, *A Letter to the Roman Catholics of Dublin* (1810); *A Melologue upon National Music* (1811); an operetta, *M.P. or The Blue Stocking* (1811); *A Set of Glees* (1827); *The Summer Fête* (1831); *Evenings in Greece* (1826–1832); *Travels of an Irish Gentleman in Search of a Religion; Alciphron, a Poem* (1839).

See *Memoirs, Journal and Correspondence of Thomas Moore* (8 vols., 1853–1856), ed. by Lord John Russell, which contains an immense quantity of biographical material; *The Poetical Works of Thomas Moore, Collected by Himself* (10 vols., 1840–1842); also *Notes from the Letters of Thomas Moore to his Music Publisher, James Power* (1854); and *Prose and Verse, Humorous, Satirical and Sentimental, by Thomas Moore, with suppressed passages from the Memoirs of Lord Byron . . .* (1878), which includes Moore's contributions to the *Edinburgh Review* (1814–1834). Among modern editions of Moore's *Poetical Works* may be mentioned that by Charles Kent (the Centenary ed., 1879), and that by W. M. Rossetti (1880). Memoirs of Moore are prefixed to these editions. There are many contemporary references to him, especially in the journals and letters of Byron. There is an excellent life, by Stephen Gwynn, *Thomas Moore* (1905), written for the "English Men of Letters Series." See also monographs on Moore, by G. Vallat (1886 and 1895), an essay on him as the poet "of Irish opposition and revolt" in Georg Brandes, *Main Currents in Nineteenth Century Literature* (vol. iv., 1875; Eng. trans., 1905).

MOORHEAD, a city and the county-seat of Clay county, Minnesota, U.S.A., opposite Fargo, North Dakota, on the E. bank of the Red River and about 215 m. N.W. of Minneapolis. **Pop.** (1890), 2088; (1900), 3730; (1905), 4794; (1910)

4840. Moorhead is served by the Great Northern and the Northern Pacific railways. The city is the seat of one of the state normal schools (1888) and of Concordia College (Norwegian Lutheran; 1891), which in 1907–1908 had 500 students. Moorhead, named in honour of James K. Moorhead (1806–1884), a Republican representative in Congress from Pennsylvania in 1859–1869, was settled in 1871, was incorporated as a village in 1875, and was chartered as a city in 1881.

MOOR-HEN,[1] the name by which a bird, often called water-hen and sometimes gallinule, is most commonly known in England. An earlier name was moat-hen, which was appropriate in the days when a moat was the ordinary adjunct of most considerable houses in the country. It is the *Gallinula chloropus* of ornithologists, about the size of a small bantam-hen, but with the body much compressed (as is usual with members of the family *Rallidae*, to which it belongs), its plumage above is of a deep olive-brown, so dark as to appear black at a short distance, and beneath iron-grey, relieved by some white stripes on the flanks, with the lower tail-coverts of pure white—these last being very conspicuous as the bird swims. A scarlet frontlet, especially bright in the spring of the year, and a red garter on the tibia render it very showy. Though often frequenting the neighbourhood of man, the moor-hen seems unable to overcome the inherent stealthy habits of the *Rallidae*, and hastens to hide itself on the least alarm; but under exceptional circumstances it may be induced to feed, yet always suspiciously, with tame ducks and poultry. It appears to take wing with difficulty, and may be often caught by an active dog; but, in reality, it is capable of sustained flight, its longer excursions being chiefly performed by night, when the peculiar call-note it utters is frequently heard as the bird, itself invisible in the darkness, passes overhead. The nest is a mass of flags, reeds, or other aquatic plants, often arranged with much neatness, almost always near the water's edge, where a clump of rushes is generally chosen; but should a mill-dam, sluice-gate, or boat-house afford a favourable site, advantage will be taken of it, and not unfrequently the bough of a tree at some height from the ground will furnish the place for a cradle. The eggs, from seven to eleven in number, resemble those of the coot but are smaller, lighter, and brighter in colour, with spots or blotches of reddish-brown. The common moor-hen is extensively spread throughout the Old World, being found also at the Cape of Good Hope, in India and in Japan. In America it is represented by a very closely allied form, *G. galeata*, so called from its rather larger frontal helm, and in Australia by another, *G. tenebrosa*, which generally wants the white flank-markings. Both closely resemble *G. chloropus* in general habits, as does also the *G. pyrrhorrhoa* of Madagascar, which has the lower tail-coverts buff instead of white. Celebes and Amboyna possess a smaller cognate species, *G. haematopus*, with red legs; tropical Africa has the smallest of all, *G. angulata*. One of the most remarkable varieties is the *G. nesiotis* of Tristan da Cunha,[2] which has wholly lost the power of flight.[3] Among other forms are the common *Gallinula* (*Erythra*) *phoenicura*, and *Gallicrex cristata* of India, as well as the South American species classed in the genus *Porphyriops*, and the remarkable Australian genus *Tribonyx* contains three species,[4] which seem to be more terrestrial than aquatic in their haunts and habits.

Allied to all these is the genus *Porphyrio*, including the bird so named by classical writers, and perhaps a dozen other species often called sultanas and purple water-hens, for they all have a plumage of deep blue—some becoming violet, green, or black in parts, but preserving the white lower tail-coverts, so generally characteristic of the group; and their beauty is enhanced by their scarlet bill and legs. Two, *P. alleni* of the Ethiopian region and the South American *P. parva*, are of small size. Of the larger species, *P. caeruleus* is the "Porphyrio" of the ancients, and inhabits certain localities on both sides of the Mediterranean, while the rest are widely dispersed within the tropics, and even beyond them, as in Australia and New Zealand. But this last country has produced a more exaggerated form, *Notornis*, which has an interesting and perhaps unique history. First described from a fossil skull by Sir R. Owen,[5] and then thought to be extinct, an example was soon after taken alive,[6] the skin of which (with that of another procured like the first by Walter Mantell) may be seen in the British Museum. Other fossil remains were from time to time noted by Sir R. Owen[7]; but it began to be feared that the bird had ceased to exist,[8] until a third example was taken about the year 1879, the skin and most of the bones of which, after undergoing examination in New Zealand by Sir W. Buller and T. J. Parker,[9] found their way to the museum of Dresden, where A. B. Meyer discovered the recent remains to be specifically distinct from the fossil, and while keeping for the latter the name *N. mantelli* gives the former that of *N. hochstetteri*. What seems to have been a third species of *Notornis* formerly inhabited Lord Howe's Island, but is now extinct. Whether the genus *Aptornis*, of which Owen described the remains from New Zealand, was most nearly allied to *Notornis* and *Porphyrio* cannot here be decided. T. J. Parker considers it a "development by degeneration of an ocydromine type." (See OCYDROME.) (A. N.)

MOORS (Lat. *Mauri*; Gr. Μαυροί, dark men), the name which, as at present used, is loosely applied to any native of Morocco, but in its stricter sense only to the townsmen of mixed descent. In this sense it is also used of the Mahommedan townsmen in the other Barbary states. It has been by some connected with the Hebrew and Phoenician *mahur*, western. Wetzstein derives it from *mahir*, a corruption of *Amāsir* with its plurals *Imāzir* and *Masir*, archaic forms of the Berber native name *Amazigh*, the free. From *Mauri*, the classic name for the north-western African tribes, the north-western districts of that continent came to be called by the Romans Mauretania. The term "Moors" has no real ethnological value. The tribes known to the Romans by that name were undoubtedly of Berber stock (see BERBERS). They first appear in history at the time of the Jugurthine War (110–106 B.C.), when Mauretania west of the Mulucha was under the government of a king called Bocchus, and appears to have constituted a regular and organized state. It retained its independence till the time of Augustus, who in 25 B.C. bestowed the sovereignty of the previously existing kingdom upon Juba II., king of Numidia, at the same time uniting it with the western portion of Numidia, from the Mulucha to the Ampsaga, which received the name of Mauretania Caesariensis, while the province that had previously constituted the kingdom, or Mauretania proper, came to be known as Mauretania Tingitana (see MAURETANIA). With the rest of North Africa Mauretania was overrun by the Arabs in the 7th century. The subsequent conquest of Spain was effected chiefly by Berber tribes, but the Moslems in the peninsula—known to the Christian nations as Moors—always had a strong strain of Arab blood and in most respects became Arabized. The race was also influenced considerably by intermarriage with the natives of Spain, and when the Moors were finally expelled from that country they had become almost entirely distinct from their Berber kinsfolk, to whom they were known as Andalusians. While the mountainous parts of Morocco continued to be occupied by pure Berber people, the Shlûh or Shilluh, the Andalusian Moors flocked to the coast towns and the plains of Morocco, occupied largely by Arabs. The name Moor is however still applied to the populations speaking Arabic who inhabit the country extending from Morocco to the Senegal, and to the Niger as far east as Timbuktu, *i.e.* the western Sahara. In this vast region and in all the towns of Barbary many of the Andalusians settled.

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[1] Not to be confounded with "Moor-cock" or "Moor-fowl," names formerly in general use for the red grouse.

[2] *Proc. Zool. Soc.* (1861), p. 260, pl. xxx.

[3] A somewhat intermediate form seems to be presented by the moor-hen of the island of St Denis, to the north of Madagascar (*Proc. Zool. Soc.*, 1867, p. 1036).

[4] *Ann. Nat. History*, 3rd series, xx. 123.

[5] *Proc. Zool. Soc.*, 1848, p. 7; *Trans.* iii. 336, pl. lvi.

[6] *Proc.* 1850, pp. 209–214, pl. xxi.; *Trans.* iv. 69–74, pl. xxv.

[7] Thus the leg-bones and what appeared to him the sternum were described and figured (*Trans.* iv. pp. 12, 17, pls. ii. iv.), and the pelvis and another femur (vii. pp. 369, 373, pls. xlii., xliii.); but the supposed sternum afterwards proved not to be that of *Notornis*, and Owen (*Proc.* 1882, p. 689) rectified the error, to which his attention had been drawn, and which he had already suspected (*Trans.* viii. 120).

[8] Notwithstanding the evidence, which presented some incongruities, offered by Mr Mackay (*Ibis*, 1867, p. 144).

[9] *Trans. N. Zeal. Inst.* xiv. 238–258.

The Moors are ethnically a very hybrid race with more Arab than Berber blood. A common mistake is to regard them as a black race, as indicated by the old English phrase "Black-a-Moor," *i.e.* black as a Moor. They are a white race, though often sunburnt and bronzed for generations, and both their children and those who have lived in the cities might pass anywhere as Europeans.

The typical Moors of Morocco are a handsome race, with skin the colour of coffee-and-milk, with black eyes and black silky hair, and the features of Europeans. They wear a full beard, and are characterized by a marked dignity of demeanour. There is a general tendency to obesity, which is much admired by the Moors in their women, young girls being stuffed like chickens, with paste-balls mixed with honey, or with spoonfuls of olive oil and sesame, to give them the necessary corpulence. The Moors are an intellectual people, courteous in manner and not altogether unlettered; but they are cruel, revengeful and bloodthirsty. Among the pirates who infested the Mediterranean none were worse than the Moors.

They are fanatical Mahommedans, regarding their places of worship as so sacred that the mere approach of a Jew or a Christian is forbidden. The Moors are temperate in their diet and simple in their dress, though among the richer classes of the towns the women cover themselves with silks, gold and jewels, while the men indulge to excess their love of fine horses and splendid arms. The national fault is gross sensuality. The position of women is little better than a pampered slavery. They are uneducated, indolent and vicious. Such education as the children receive is of a superficial kind. Slavery flourishes, and slave auctions, conducted like those of cows and mules, take place on the afternoons of stated days, affording a lounge for the rich Moors, who discuss the "goods" offered and seek for bargains. This public sale of slaves was prohibited in the coast towns, *c.* 1850, under pressure from European powers, but means are found to evade the prohibition.

Of games the young Moors play a great number; the principal one is a kind of football, more like that of Siam and Burma than that of England; wrestling and fencing are popular, but the chief amusement of the adult Moors is the "powder-play" (*la'ab el bārūd*), which consists of a type of military tournament, the horsemen going through lance and musket exercises or charging in review fashion, firing volleys as they gallop. Other recreations much in favour throughout Morocco are music, singing, jugglery, snake-charming and acrobatic performances. As professional story-tellers many Moors are remarkable, but the national music is monotonous and not very harmonious.

See Dr Arthur Leared, *Morocco and the Moors* (1891); Budgett Meakin, *The Moorish Empire* (1899); and *The Moors* (1902); Frances Macnab, *A Ride in Morocco* (1902); and see under MOROCCO; MAURETANIA; BERBERS, &c.

MOOSE, the North American Indian (Algonquian) name of the North American representative of the European elk (*q.v.*). The word is said to mean "cropper" or "trimmer," from the animal's habit of feeding on the branches of trees.

MOOT, a meeting or assembly, in O. Eng. *môt, gemôt*, a word of which "to meet" is a derivative. "Moot" or its alternative form "mote" is the common term for the assemblies of the people of the hundred, burgh, &c., in the history of early English institutions, and especially for the national assembly or council, the Witenagemot. The name survives in "moot hall," the term still given to town-halls and council buildings in some towns in England, as at Aldeburgh. From its meaning of assembly, the word was applied to a debate or discussion, especially of the discussion of a hypothetical case by law students at the Inns of Court. These moots are still carried on at Gray's Inn. As an adjective, "moot" means doubtful, undecided.

MOP, a bunch of cloth, rags or coarse yarn, fastened to a pole and serving as a broom or brush for swabbing up wet floors or other surfaces and for cleaning generally. The word is usually taken to be an adaptation of Lat. *mappa*, cloth, napkin, cf. "map." A particular application of the term in provincial English is to an annual hiring or statute-fair, a "mop-fair," at which domestic and agricultural servants out of places attended, carrying a broom, a mop or other implement indicative of their calling.

MOPLAH (Malayalam *mappila*), a fanatical Mahommedan sect found in Malabar. The Moplahs, who number upwards of a million, are believed to be descended from Arab immigrants, who landed on the western coast of India in the 3rd century after the Hegira. They are remarkable for the fanaticism displayed in successive attacks upon the Hindus, and they have several times resisted British troops. A regiment of the Indian army was recruited among them, but the experiment proved a failure, and the Moplah Rifles were disbanded in April 1907.

MOPSUS, in Greek legend, the name of two seers. (1) Son of Ampyx (or Ampycus) and the nymph Chloris, a Lapith of Oechalia in Thessaly. He took part in the Calydonian boar hunt and accompanied the Argonauts as their prophet. He died from the bite of a serpent which sprang from the blood of the Gorgon Medusa. He is represented on the chest of Cypselus as boxing with Admetus. He was afterwards worshipped as a hero and an oracle was consecrated to him. (2) Son of Rhacius (or Apollo) and Manto, daughter of Teiresias. The rival seer Calchas is said to have died of chagrin because the predictions of Mopsus were fulfilled, while his own proved incorrect. Together with another seer, Amphilochus, Mopsus founded Mallus in Cilicia after the return from Troy; and in a quarrel for its possession both lost their lives. According to Pausanias (vii. 3, 2) Mopsus expelled the native inhabitants of Caria, and built the town of Colophon. Mopsus was worshipped as a god by the Cilicians, and had two famous oracles at Colophon and Mallus. His name survives in the town of Mopsuestia (Μόψου Ἑστία) and the spring of Mopsucrene. Mopsus appears to be the incarnation of Apollo of Claros.

MOQUEGUA, a maritime province of southern Peru, bounded N. by the departments of Arequipa and Puno, and S. by the republic of Chile. Area, 5550 sq. m.; pop. (1906 estimate), 31,920. The province extends from the Pacific coast eastward to the Cordillera Occidental, which forms the boundary line with Puno and the republic of Bolivia. Eastern Moquegua is volcanic, and is broken by the high range that forms the western rim of the Titicaca basin. Among the volcanoes in the province are Tutupacu, the last eruption of which occurred in 1802, Huaynaputina and Hachalayhua, which were in violent eruption in 1606, Coropuna, Omate, Ubinas and Candarave—the last three still showing signs of activity. This region is also subject to severe earthquake shocks. On the lower slopes of the Cordillera there are fertile irrigated valleys which produce grapes and olives for commercial purposes, and a considerable variety of fruits, cereals and vegetables for local consumption. The best-known grape-producing districts are Moquegua (capital) and Locumba—the product being converted into wine and brandy for export. The capital is Moquegua (pop. about 5000 in 1906), in the upper valley of the Ilo River, 4500 ft. above sea-level, and 65 m. by rail from the small port of Ilo on the Pacific coast.

Moquegua was formerly one of the three provinces forming a department of the same name. The other two provinces (Tacna and Arica) were held for indemnity by Chile after the war of 1879–1883 with the understanding (treaty of Ancon, March 8, 1884) that at the expiration of ten years a *plébiscite* should be taken in the two provinces to determine whether they should remain with Chile, or return to Peru—the country to which they should be annexed to pay the other 10,000,000 pesos. Chile did not comply with this treaty agreement, and in 1910 still held both provinces.

MORA, JOSÉ (1638–1725), Spanish sculptor, was a pupil of Alonzo Cano. He died in Granada in 1725 and was buried in the Albaicin church. His work can be usefully studied in the eight statues in the Capella del Cardenal in the Cordova Cathedral and in the figures of St Bruno and St Joseph in the Cartuja near Granada.

See B. Haendeke, *Studien zur Geschichte der spanischen Plastik* (Strassburg, 1900).

MORA, or MORRA (Ital. *delay*), a game, universally popular in Italy, in which one player endeavours to guess instantly the number of fingers held up by the other. Ancient Egyptian sculptors represent a game of this kind, and it was played by the Romans, who called it *micare digitis*, or finger-flashing. It is known to the Chinese and to certain tribes of the Pacific Islands. There are several methods of playing mora, but in the one most common in Italy the two players, placed face to face, throw out at the same instant one or more fingers of one hand, each crying out simultaneously a number guessed to be that of his adversary's exposed fingers. A correct guess counts one; if both guess correctly or wrongly there is no score. The game, which is generally five or nine points, is played for stakes, and with extraordinary swiftness.

MORACEAE, in botany, an order of dicotyledons, belonging to the series *Urticiflorae*, to which belongs also the nettle family (Urticaceae, *q.v*). It contains about 60 genera with about 1000 species, mostly trees or shrubs, widely distributed in the warmer parts of the earth. The largest genus, *Ficus* (the fig, *q.v.*), contains 600 species spread through tropical and sub-tropical regions, and includes the common fig of the Mediterranean region (*Ficus carica*), the banyan (*F. bengalensis*), and the india-rubber plant (*F. elastica*); many of the species are epiphytic, sometimes clinging so tightly round the host-plant with their roots as to strangle it. *Morus* (mulberry, *q.v.*) contains ten species of trees or bushes in north temperate regions and in the mountains of the tropics. *Artocarpus*, including *A. incisa* (bread-fruit, *q.v.*), and *A. integrifolia* (jack-tree), has forty species, chiefly natives in the Indian Archipelago. The plants are rich in latex which may be very poisonous as in *Antiaris toxicaria*, the Upas-tree (*q.v.*) of Java, or sweet and nutritious as in *Brosimum galactodendron*, the cow-tree (*q.v.*) of Venezuela. The latex often yields caoutchouc as in species of *Ficus* (*e.g. F. elastica*), *Cecropia* (*q.v.*), a tropical American genus with thirty to forty species, and others.

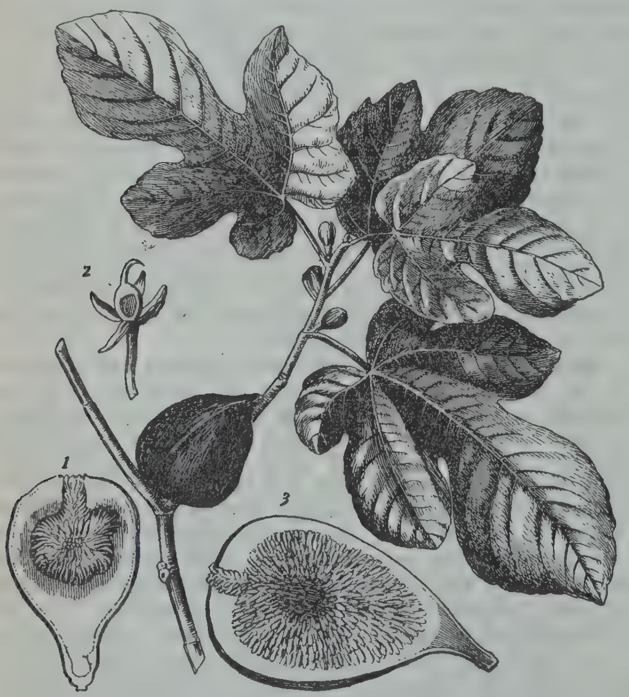
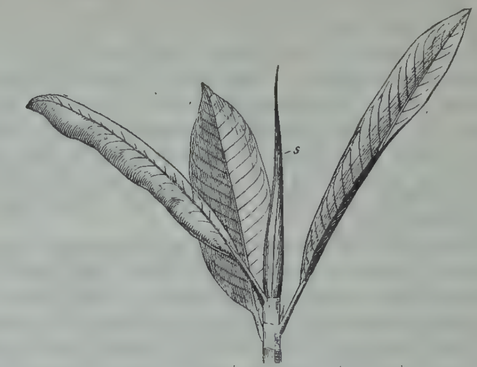


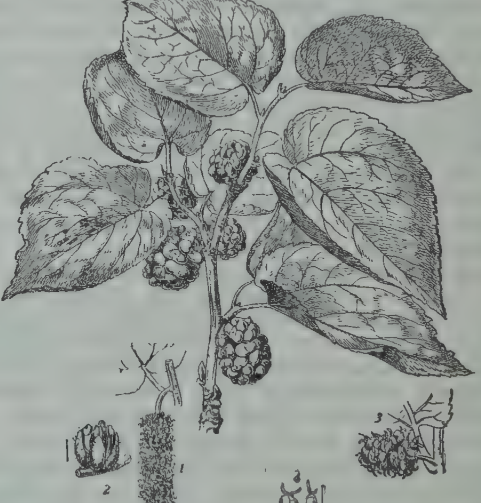
Fig (*Ficus carica*), Shoot bearing Leaves and Fruit.

1, Inflorescence cut lengthwise to show the numerous flowers crowded on the inner surface.
2, A female flower, enlarged. 3, Fruit cut lengthwise.



End of Shoot showing Stipule, *s*, of India-rubber Plant (*Ficus elastica*).

The leaves, which are entire or more or less divided, are stipulate, the stipules being small and lateral as in *Morus* and allied general or intrapetiolar, each pair uniting to form a cap round the younger leaves, as in *Ficus* and allied genera, and very well shown in *F. elastica*, the common india-rubber plant of greenhouses. The plants are monoecious or dioecious, and the small unisexual flowers are borne in cymose inflorescences which are condensed into apparent racemes, spikes or heads. In the fig they coalesce to form a fleshy hollow axis on the inner face of which the flowers are situated, while in *Dorstenia* they form a flat, often lobed, expansion with the flowers sunk on the upper face. The flower resembles that of Urticaceae; there are generally four free or more or less united perianth leaves, with, in the male flower, a stamen opposite each perianth leaf; the filaments are incurved in the mulberry and allied genera and straight in the fig and its allies. *Artocarpus* has only one stamen. The female flower contains two carpels in the median plane, the posterior one of which is often more or less aborted. Each developed ovary chamber contains a solitary pendulous more or less curved ovule. The fruit is an achene or drupe, often surrounded by the fleshy perianth and still further complicated by the union of fruits of different flowers as in mulberry, the development of a fleshy receptacle as in fig, or as in *Artocarpus* (bread-fruit), by the union of fruits, perianth and axis into a solid fleshy mass. The embryo is generally curved and surrounded by a fleshy endosperm.



Mulberry (*Morus nigra*), Shoot bearing Leaves and Fruit.

1, Catkin of male flowers. 3, Spike of female flowers.
2, One male flower. 4, Single female flowers.

From the evidence of leaf-fossils it is probable that the genus *Ficus* existed as far north as Greenland in the Cretaceous era and was generally distributed in North America and Europe in the Tertiary period up to miocene times.

MORADABAD, a city and district of British India, in the Bareilly division of the United Provinces. The city is on the right bank of the river Ramganga, 655 ft. above sea-level, and has a station on the Oudh & Rohilkhand railway, 868 miles from Calcutta. Pop. (1901), 75,128. It was founded in 1625 by Rustam Khan, who built the fort which overhangs the river bank, and the fine Jama Masjid or great mosque (1631). The town forms a large centre of trade in country produce. It has a special industry in ornamental brassware, sometimes plated with lac or tin, which is then engraved. Cotton weaving and printing is also carried on.

The District of Moradabad lies east of the Ganges and west of the native state of Rampur. Area, 2285 sq. m. It lies within the great Gangetic plain, and is demarcated into three subdivisions by the rivers Ramganga and Sot. The eastern tract consists of a submontane country, with an elevation slightly greater than the plain below, and is traversed by numerous streams descending from the Himalayas. The central portion consists of a level central plain descending at each end into the valleys of the Ramganga and Sot. The western section has a gentle slope towards the Ganges, with a rapid dip into the lowlands a few miles from the bank of the great river. In addition to Moradabad the principal towns are Amroha (*q.v.*), Sambhal (39,715) and Chaudansi (25,711).

For the early history of Moradabad see Bareilly. It passed into the possession of the British in 1801. The population in 1901 was 1,191,993, showing an increase of 1·1% in the decade. Mahommedans are more numerous than in any other district of the province, forming more than one-third of the total. The principal crops are wheat, rice, millet, pulse, sugar-cane and cotton. The main line of the Oudh & Rohilkhand railway traverses the district from south to north, with branches towards Aligarh and Rampur. A third branch from Moradabad city towards Delhi crosses the Ganges at Garhmukhteshwar by a bridge of eleven spans of 200 ft. each.

MORAES, FRANCISCO DE (*c.* 1500–1572), Portuguese romance writer, was probably born at the close of the 15th century. We know very little of his life, except that he was treasurer of the household to King John III., and he is first found in Paris in the suite of the Portuguese ambassador, D. Francisco de Noronha, who had gone there in 1540. He was a commander of the Order of Christ, and was called *O Palmeirim* on account of his authorship of the famous romance of chivalry *Palmeirim de Inglaterra*; in 1572 he was assassinated at Evora. He appears to have written his book in France (perhaps in Paris) in 1544, dedicating it to the Infanta D. Maria, daughter of King Manoel, but the first extant Portuguese edition only came out in 1567. A Spanish version was published as early as 1548, and on the strength of this many critics have contended that the book was originally written in that language and that Moraes only translated it into Protuguese. Both tradition and a critical examination of the Portuguese and Spanish texts, however, tell overwhelmingly in favour of the first being the original with Moraes as its author. The episode of the four French ladies shows an intimate acquaintance with the court of Francis I., where Moraes spent some years, and one of these ladies named Torsi is the one he loved and to whom he addressed some verses entitled "Desculpa de huns amores." The *Palmeirim de Inglaterra* belongs to another branch of the same cycle as the *Amadis de Gaula*; the two romances are the best representatives of their class, and for their merits were spared from the *auto da fé* to which Cervantes condemned other romances of chivalry in *D. Quixote*. It has a well-marked plot, clearly drawn characters, and an admirable style, and has been reckoned a Portuguese classic from the time of its issue.

Bibliography.—The *Palmerin of England*, by W. E. Purser (Dublin, 1904), contains an exhaustive study of the romance and the controversy concerning its authorship, with a sketch of the plot. The existing Portuguese editions bear the dates 1567, 1592, 1786 and 1852, while translations exist in Spanish, Italian and French. An English version from the French by A. Munday was first published in 1609. In 1807 Robert Southey issued in 4 vols. 4to an incomplete translation from the Portuguese which is really a revision of Munday. In addition Moraes wrote some *Dialogues*, which were published at Evora in 1624 and are incorporated in the last two editions of *Palmeirim de Inglaterra*. (E. Pr.)

MORAINE, a term adopted from the French for the rocky material carried downwards on the outside of a glacier, and deposited at its sides and foot. The position of the moraine with regard to the glacier is indicated by the names applied to it. The *lateral* moraine is the fringe of rock fragments at the glacier side. The glacier is always slowly moving down the valley. There are always points in the valley where rock falls are more frequent than in other places. The glacier as it moves forward catches this material and carries it onward in a long heaped line distributing it evenly all down the valley sides. When two glacial valleys converge into one valley two lateral moraines unite at the point of junction and form a *median* moraine in the resultant broader glacier, which now has two lateral moraines and one median. All this material carried by the glacier is deposited where the glacier ends, and forms the *terminal* moraine, frequently in the form of a crescentic dam across the valley. This material is carried farther downwards by stream action and distributed; otherwise the end of all glacier valleys would be blocked with débris against which the ice would be piled to a great height, and the glacier would finally become stationary. The material pushed forward beneath the glacier is sometimes called the *ground* moraine, the part left beneath the ice the *lodge* moraine, that carried to the edge and dropped the *dump* moraine, and that carried forward the *push* moraine. (See Glacier.)

MORAN, EDWARD (1829–1901), American artist, was born at Bolton, Lancashire, England, on the 19th of August 1829. He emigrated with his family to America at the age of fifteen, and subsequently settled in Philadelphia, where after having followed his father's trade of weaver, he became a pupil of James Hamilton and Paul Weber. In 1862 he became a pupil of the Royal Academy in London; he established a studio in New York in 1872, and for many years after 1877 lived in Paris. He was a painter of marine subjects and examples of his work are in many prominent collections. Among his canvases are thirteen historical paintings, intended to illustrate the marine history of America from the time of Leif Ericsson to the return of Admiral Dewey's fleet from the Philippines in 1899. He died in New York City on the 9th of June 1901. His sons (Edward) Percy Moran (b. 1862) and Léon Moran (b. 1864), and his brothers Peter Moran (b. 1842) and Thomas Moran (*q.v.*), also became prominent American artists.

MORAN, THOMAS (1837–), American artist, was born at Bolton, Lancashire, England, on the 12th of January 1837, and emigrated with his parents to America in 1844, the family settling in Philadelphia. After having been apprenticed for some years to a wood-engraver, he studied under his brother Edward and under James Hamilton, in Philadelphia, and later studied in London, Paris and Italy. In 1871 he accompanied Professor F. V. Hayden's exploring expedition to the Yellowstone, and in 1873 he went down the Colorado with Major J. W. Powell's famous exploring party; and on these two trips he made sketches for two large pictures, "The Grand Cañon of the Yellow-stone" and "Chasm of the Colorado River," both of which were bought by the United States government and are now in the Capitol at Washington. He became a member of the National Academy of Design in 1884 and of the American Water Color Society. His wife, Mary Nimmo Moran (1842–1899), who was born in Strathaven, Scotland, and emigrated to America in 1852, was also an artist, and was particularly prominent as an etcher.

MORAR, a town of Central India, in the native state of Gwalior, 3 m. E. of Gwalior city. Pop. (1901), 19,179. It was formerly a British military cantonment and residence of a political agent, but in 1886, when the fortress of Gwalior was restored to Sindhia, the troops at Morar were withdrawn to Jhansi, and the extensive barracks were likewise made over to Sindhia. In the Mutiny of 1857 Morar was the scene of the most serious uprising in Central India. It is a centre for local trade, and has an important tanning industry.

MORAT (Ger. *Murten*), a small town on the east shore of the Lake of Morat, in the Swiss canton of Fribourg, and by rail

14 m. N. of Fribourg or 18¼ m. W. of Bern. In 1900 its population was 2263, of whom 1840 were German-speaking and 1969 were Protestants. It is a most picturesque little town, overlooked by the 13th-century castle and the quaint tower of the *Rathhaus*, while it is still surrounded by its 15th century walls that are studded at intervals with watch towers. In 1264 it exchanged its position as a free imperial city (enjoyed since 1218) for the rule of the count of Savoy. In 1475 it was taken by the Swiss at the commencement of their war with Charles the Bold, duke of Burgundy, whose ally was the duchess of Savoy. But in 1476 it was besieged by Charles, though it held out till the Swiss army arrived in haste and utterly defeated (22nd June) the Burgundians. An obelisk a little way south-west of the town stands on the site of the bone-house (destroyed by the French in 1798, wherein the remains of many victims had been collected. Morat was ruled in common from 1475 to 1798 by Bern and Fribourg, being finally annexed to Fribourg in 1814. The Lake of Morat has an area of 10½ sq. m., and is connected with that of Neuchâtel by way of the Broye canal. On its shores many lake dwellings have been found.

See F. L. Engelhard, *Der Stadt Murten Chronik* (Bern, 1828); G. F. Ochsenbein, *Die Urkunden der Belagerung u. Schlacht von Murten* (Freiburg, 1876); H. Wattelet, *Die Schlacht bei Murten* (Fribourg, 1894). (W. A. B. C.)

MORATA, OLYMPIA FULVIA (1526–1555), Italian classical scholar, was born at Ferrara. Her father, who had been tutor to the young princes of the ducal house of Este, was on intimate terms with the most learned men of Italy, and the daughter grew up in an atmosphere of classical learning. At the age of twelve she was able to converse fluently in Greek and Latin. About this time she was summoned to the palace as companion and instructress of the younger but equally gifted Anne, daughter of Renée, duchess of Ferrara. Olympia's father having died a convert to Protestantism, she met with a cold reception at the palace, and withdrew to her mother's house. Olympia now embraced the doctrines of Luther and Calvin. About the end of 1550 she married a young student of medicine and philosophy, Andrew Grunthler of Schweinfurt in Bavaria. In 1554 she accompanied Grunthler to his native place, where he had been appointed physician to the garrison of Spanish troops. In 1553 the margrave Albert of Brandenburg on one of his plundering expeditions took possession of Schweinfurt, and was in turn besieged by the Protestants. At length Albert evacuated the place, and Olympia and her husband made their escape. They finally succeeded in reaching Heidelberg (1554), where a medical lectureship had been obtained for Grunthler through the influence of the Erbach family, by whom they had been hospitably entertained during their flight. Here she died on the 25th of October in the following year.

Bibliography.—The scanty remains of her works—letters, dialogues, Greek verses—were collected and published by Celio Secundo Curione (1558). Monographs by Caroline Bowles, wife of Robert Southey the poet (1834), J. Bonnet (1850; Eng. trans., Edinburgh, 1854), and R. Turnbull (Boston, 1846); see also Caroline Gearey, *Daughters of Italy* (1886).

MORATALLA, a town of eastern Spain, in the province of Murcia, 40 m. W.N.W. of the city of Murcia. Pop. (1900), 12,689. Moratalla is built on a mountainous peninsula, almost surrounded by the Grande and Benamor, small rivers which meet and flow eastward to join the Segura. The town is a labyrinth of narrow, crooked streets, and some of its houses are Moorish in character. Its chief buildings are the modern hospital and theatre, and the 17th-century church. It has manufactures of coarse cloth, spirits and soap. The nearest railway station is Calasparra, 6 m. east, on the Murcia-Albacete railway.

MORATÍN, LEANDRO ANTONIO EULOGIO MELITÓN FERNANDEZ DE (1760–1828), Spanish dramatist and poet, the son of N. F. de Moratín, was born at Madrid on the 10th of March 1760. Though his poetical tastes were early developed, his father apprenticed him to a jeweller. At the age of eighteen Moratín won the second prize of the Academy for a heroic poem on the conquest of Granada, and two years afterwards he attracted more general attention with his *Lección poética*, a satire upon the popular poets of the day. He was appointed secretary to Cabarrús on a special mission to France in 1787. On his return to Spain, Moratín was tonsured and presented to a sinecure benefice in the diocese of Burgos, and in 1786 his first play, *El Viejo y la niña*, was produced at the Teatro del Principe. Owing to the opposition of the clerical party, it was speedily withdrawn. The prose comedy, *El Café ó la comedia nueva*, given at the same theatre six years afterwards, at once became popular. On the fall of Florida Blanca, Moratín found another patron in Godoy, who provided him with a pension and the means for foreign travel; he accordingly visited England, where he began a prose translation of *Hamlet*, printed in 1798 but never performed. From England he passed to the Low Countries, Germany, Switzerland and Italy, and on his return to the Peninsula in 1796 was appointed official translator to the foreign office. In 1803 he produced *El Barón* in its present form; originally written (1791) as a *zarzuela*, it was shamelessly plagiarized by Andrés de Mendoza, but the recast, a far more brilliant work, still keeps the stage. It was followed in 1804 by *La Mogigata*, written between 1797 and 1803. This piece was favourably received, and an attempt to suppress it on religious grounds failed. Moratín's crowning triumph in original comedy was *El Sí de las Niñas* (1806), which was performed night after night to crowded houses, ran through several Spanish editions in a year, and was soon translated into a number of foreign languages. In 1808 Moratín was involved in the fall of Godoy, but in 1811 accepted the office of royal librarian under Joseph Bonaparte—a false step, which alienated from him all sympathy and compelled him to spend his last years in exile. In 1812 his *Escuela de los maridos*, a translation of Molière's *École des maris*, was produced at Madrid, and in 1813 *El Médico á Palos* (a translation of *Le Médecin malgré lui*) at Barcelona. From 1814 to 1828 Moratín lived in Italy and France, compiling a work on the early Spanish drama (*Orígenes del teatro español*). He died at Paris on the 21st of June 1828.

The most convenient edition of his works is that given in vol. ii. of the *Biblioteca de autores españoles*; this is supplemented by the *Obras póstumas* (3 vols., Madrid, 1867–1868).

MORATÍN, NICOLÁS FERNANDEZ DE (1737–1780), Spanish poet and dramatist, was born at Madrid in 1737. He was educated at the Jesuit College in Calatayud and afterwards studied law at the university of Valladolid. In 1772 he was called to the bar; four years afterwards he was nominated to the chair of poetry at the imperial college. He died on the 11th of May 1780. A partisan of French methods, Moratín published in 1762 his *Desengaño al teatro español*, a severe criticism of the national drama, particularly of the *auto sacramental*; and his protests were partly responsible for the prohibition of *autos* three years afterwards (June 1765). In 1762 he also published a play entitled *La Petimetra*. Neither the *Petimetra* nor the *Lucrecia* (1763), an original tragedy still more strictly in accordance with French conventions, was represented on the stage, and two subsequent tragedies, *Hormesinda* (1770) and *Guzmán el Bueno* (1777), were played with no great success. In 1764 Moratín published a collection of pieces, chiefly lyrical, under the title of *El Poeta*, and in 1765 a short didactic poem on the chase (*Diana ó arte de la caza*). His "epic canto" on the destruction of his ships by Cortés (*Las Naves de Cortés destruidas*) failed to win a prize offered by the Academy in 1777, and was published posthumously (1785). But a better idea of Moratín's talent is afforded by his anacreontic verses and by his *Carta histórica sobre el origen y progresos de las fiestas de toros en España*.

His works are included in the *Biblioteca de autores españoles*, vol. ii.

MORATORIUM (from Lat. *morari*, to delay), a term used to express a legal authorization postponing for a specified time the payment of debts or obligations. The term is also sometimes used to mean the period over which the indulgence or period of grace stretches, the authorization itself being called a moratory law. A moratory law is usually passed in some special period of political or commercial stress; for instance, on several occasions during the Franco-German War the French government passed moratory laws. Their international validity was discussed at length and upheld in *Rouquette* v. *Overman*, 1875, L. R. 10 Q. B. 525.

MORAVIA (Ger., *Mähren*; Czech, *Morava*), a margraviate and crownland of Austria, bounded E. by Hungary, S. by Lower Austria, W. by Bohemia and N. by Prussian and Austrian Silesia. Area, 8583 sq. m. Physically Moravia may be described as a mountainous plateau sloping from north to south, just in the opposite direction of the adjoining Bohemia plateau, which descends from south to north, and bordered on three sides by mountain ranges. On the north are the Sudetes, namely the Altvater Gebirge, with the highest peaks the Grosser Schneeberg (4664 ft.) and the Altvater (4887 ft.), which sink gradually towards the west, where the valley of the Oder forms a break between the German mountains and the Carpathians. The latter separate Moravia from Hungary. Parallel to the Carpathians are the Marsgebirge (1915 ft.) and its continuation, the Steinitzer Wald (1450 ft.). On the west are the so-called Bohemian-Moravian Mountains, forming the elevated east margin of Bohemia. The principal passes are those at Iglau and Zwittau to Bohemia and the Wlara Pass to Hungary. Almost the whole of Moravia belongs to the basin of the March or Morava, from which it derives its name and which rises within its territory in the Sudetes. It traverses the whole country in a course of 140 m., and enters the Danube near Pressburg. Its principal tributaries are the Thaya, the Hanna, the Iglawa with the Zwittawa and the Schwarzawa, &c. The Oder also rises among the mountains in the north-east of Moravia, but soon turns to the north and quits the country. With the exception of a stretch of the March, none of the rivers are navigable. Amongst the mineral springs worth mentioning are the sulphur springs at Ullersdorf, the saline ones at Luhatschowitz and the alkaline springs at Töplitz.

Owing to the configuration of the soil, the climate of Moravia varies more than might be expected in so small an area, so that, while the vine and maize are cultivated successfully in the southern plains, the weather in the mountainous districts is somewhat rigorous. The mean annual temperature at Brünn is 48° F. Of the total area 54·8% is occupied by arable land, 7% by meadows, 5·7% by pasturages, 1·2% by gardens, 0·5% by vineyards, while 27·4% are forests. The principal products are corn, oats, barley, potatoes, rye, beetroot, hemp, flax, hay and other fodder. Forestry is greatly developed; the breed of sheep in the Carpathians is of an improved quality, and the horses bred in the plain of the Hanna are highly esteemed. The mineral wealth of Moravia, consisting chiefly of coal and iron, is very considerable. Coals are extracted at Neudorf, Lešitz, Ratiškowitz and Čĕič; lignite at Rossitz, Oslavan and Mährisch-Ostrau. Iron-ore is found at Zöptau, Blansko, Adamsthal, Witkowitz, Rossitz and Stefanau. Other minerals found here are graphite, alum, potter's clay and roofing-slate, and, besides, famous silver-mines were worked at Iglau during the middle ages. From an industrial point of view Moravia belongs to the foremost provinces of the Austrian Empire. The principal manufactures are woollen, linen, cotton, cast-iron goods, beet-sugar, leather and brandy. The cloth industry was introduced in the 14th century at Iglau, where it soon obtained a great reputation; it developed afterwards at Olmütz, and since the middle of the 18th century it has its principal centre at Brünn. The linen industry is concentrated at Schönberg, Mistek, Wiesenberg and Heidenpiltsch; while the cotton industry has its principal seat at Sternberg. The chief iron-foundries are to be found at Witkowitz, Stefanau, Zöptau and Rossitz; while industrial machines are manufactured at Brünn, Blansko and Adamsthal. Large works of earthenware are established at Znaim and Frain.

Moravia had in 1900 a population of 2,435,081 inhabitants, which is equivalent to 284 inhabitants per sq. m. It belongs to the group of old Slavonic states which have preserved their nationality while losing their political independence. Of the total population 71·36% were Slavs, who were scarcely distinguishable from their Bohemian neighbours. The name of Czech, however, is usually reserved for the Bohemians, while the Slavs of Moravia and West Hungary are called Moravians and Slovacs. The Germans form 27·9% of the population, and are found mostly in the towns and in the border districts. Fully 95% of the inhabitants are Roman Catholics, under the ecclesiastical jurisdiction of the archbishop of Olmütz and the bishop of Brünn; 2·7% Protestants and 2% Jews. In educational matters Moravia compares favourably with most of the Austrian provinces. It is well provided with schools of every description, and the number of illiterates is steadily decreasing. The local diet is composed of 100 members, of which the archbishop of Olmütz and the bishop of Brünn are members *ex officio*. To the Reichsrat at Vienna Moravia sends 36 members. For administrative purposes Moravia is divided into 34 districts and 6 towns, with autonomous muncipalities: Brünn (pop., 108,944), the capital, Iglau (24,387), Olmütz (21,933), Znaim (16,261), Kremsier (13,991) and Ungarisch-Hradisch (5137). Other principal towns are Königsfeld (11,022), Göding (10,231), Mährisch-Ostrau (30,125), Witkowitz (19,128), Mährisch-Schönberg (11,636), Zwittau (9063), Neutitschein (11,891), Prerau (16,738), Prossnitz (24,054), Sternberg (15,195) and Trebitsch (10,597).

History.—At the earliest period of which we have any record Moravia was occupied by the Boii, the Celtic race which has perpetuated its name in Bohemia. Afterwards it was inhabited by the Germanic Quadi, who accompanied the Vandals in their westward migration; and they were replaced in the 5th century by the Rugii and Heruli. The latter tribes were succeeded about the year 550 A.D. by the Lombards; and these in their turn were soon forced to retire before an overwhelming invasion of Slavs, who on their settlement there took the name of Moravians (German, *Mehranen* or *Mähren*) from the river Morava. These new colonists became the permanent inhabitants of this district, and in spite of the hostility of the Avars on the east founded the kingdom of Great Moravia, which was considerably more extensive than the province now bearing the name. Towards the end of the 8th century they aided Charlemagne in putting an end to the Avar kingdom, and were rewarded by receiving part of it, corresponding to North Hungary, as a fief of the German emperor, whose supremacy they also acknowledged more or less for their other possessions. After the death of Charlemagne the Moravian princes took advantage of the dissensions of his successors to enlarge their territories and assert their independence, and Rastislaus (*c.* 850) even formed an alliance with the Bulgarians and the Byzantine emperor. The chief result of the alliance with the latter was the conversion of the Moravians to Christianity by two Greek monks, Cyril and Methodius, despatched from Constantinople (863). Rastislaus finally fell into the hands of Louis the German, who blinded him, and forced him to end his days as a monk; but his successor, Svatopluk (d. 894), was equally vigorous, and extended the kingdom of Great Moravia to the Oder on the west and the Gran on the east. At this period there seemed a strong probability of the junction of the north-western and south-eastern Slavs, and the formation of a great Slavonic power to east of the German empire. This prospect, however, was dissipated by the invasions of the Magyar hordes in the 10th century, the brunt of which was borne by Moravia. The invaders were encouraged by the German monarchs and aided by the dissensions and mismanagement of the successors of Svatopluk, and in a short time completely subdued the eastern part of Great Moravia. The name of Moravia was henceforth confined to the district to which it now applies. For about a century the possession of this marchland was disputed by Hungary, Poland and Bohemia, but in 1029 it was finally incorporated with Bohemia, and so became an integral part of the German empire. Towards the close of the 12th century Moravia was raised to the dignity of a margraviate, but with the proviso that it should be held as a fief of the crown of Bohemia. It henceforth shared the fortunes of this country, and was usually assigned as an apanage to younger members of the Bohemian royal house. In 1410 Jobst, margrave of Moravia, was made emperor of Germany, but died a few months after his election. In 1526, on the death of Louis II. of Hungary Moravia came with the rest of that prince's possessions into the hands of the Austrian house. During the Thirty Years' War the depopulation of Moravia was so great that after the peace of Westphalia the states-general published an edict giving every man permission to take two wives, in order to "repeople the country." After the Seven Years' War Moravia was united in one province with the remnant of Silesia, but in 1849 it was made a separate and independent crownland. The most noticeable feature of recent Moravian history has been the active sympathy of its inhabitants with the anti-Teutonic home-rule agitation of the Bohemian Czechs.

See *Die Länder Oesterreich-Ungarns in Wort und Bild*, vol. 8 (Vienna, 1881–1889, 15 vols.); *Die österreichisch-ungarische Monarchie in Wort und Bild*, vol. 17 (Vienna, 1886–1902, 24 vols.); B. Bretholz, *Geschichte Mährens* (Brünn, 1893, &c.).

MORAVIAN BRETHREN, or MORAVIAN CHURCH, a Christian communion founded in the east of Bohemia. For some years after the death of John Huss (1415), the majority of his followers were split into two contending factions: the Hussite Wars began; and the net result of the conflict seemed to be that while the Utraquists, content with the grant of the cup to the laity, were recognized by the pope as the national Church of Bohemia (1433), the more radical Taborites were defeated at the battle of Lipan (1434) and ceased to exist. But with this result some of Huss's followers, who wished to preserve his spiritual teaching, were not content. They laid great stress on purity of morals; and convinced that the Utraquist Church was morally corrupt, they founded a number of independent societies, first at Kremsir and Meseritsch in Moravia, and then at Wilenow, Diwischau and Chelcic in Bohemia. At this crisis Peter of Chelcic became the leader of the advanced reforming party. In ethics he anticipated much of the teaching of Tolstoy; in doctrine he often appealed to the authority of Wycliffe; and in some of his views it is possible to trace the influence of the Waldenses. He interpreted the Sermon on the Mount literally, denounced war and oaths, opposed the union of Church and State, and declared that the duty of all true Christians was to break away from the national Church and return to the simple teaching of Christ and His apostles. His followers were known as the Brethren of Chelcic, and wore a distinctive dress. His most noted supporter was John Rockycana, archbishop-elect of Prague. He was pastor of the Thein Church (1444), preached Peter's doctrines, recommended his works to his hearers, and finally, when these hearers asked him to lead them, he laid their case before King George Podiebrad, and obtained permission for them to settle in the deserted village of Kunwald, in the barony of Senftenberg. It was here that the new community was founded (1457 or 1458). At their head was Gregory, the patriarch; a layman, said later to be Rockycana's nephew; in Michael Bradacius, the priest of Senftenberg, they found a spiritual teacher; and fresh recruits came streaming in, not only from the other little societies at Kremsir, Meseritsch, Chelcic, Wilenow and Diwischau, but also from the Waldenses, the Adamites, the Utraquist Church at Königgratz, and the university of Prague They called themselves Jednota Bratrska, *i.e.* the Church or Communion of Brethren; and this is really the correct translation of their later term, *Unitas fratrum*. At the Synod of Lhota (1467), they broke away entirely from the papacy, elected ministers of their own, and had Michael Bradacius consecrated a bishop by Stephan, a bishop of the Waldenses. At the synod of Reichenau (1495), they rejected the authority of Peter of Chelcic, and accepted the Bible as their only standard of faith and practice. In doctrine they were generally broad and radical. They taught the Apostles' Creed, rejected Purgatory, the worship of saints and the authority of the Catholic Church, practised infant baptism and confirmation, held a view on the Sacrament similar to that of Zwingli, and, differing somewhat from Luther in their doctrine of justification by faith, declared that true faith was "to know God, to love Him, to do His commandments, and to submit to His will." With the Brethren, however, the chief stress was laid, not on doctrine, but on conduct. For this purpose they instituted a severe system of discipline, divided their members into three classes—the Perfect, the Proficient, and the Beginners, and appointed over each congregation a body of lay elders. For the same purpose they made great use of the press. In 1501 Bishop Luke of Prague edited the first Protestant hymn-book; in 1502 he issued a catechism, which circulated in Switzerland and Germany and fired the catechetical zeal of Luther; in 1565 John Blahoslaw translated the New Testament into Bohemian; in 1579–1593 the Old Testament was added; and the whole, known as the Kralitz Bible, is used in Bohemia still. The constitution was practically Presbyterian. At the head of the Church was a body of ten elders, elected by the synod; this synod consisted of all the ministers, and acted as the supreme legislative authority; and the bishops ruled in their respective dioceses, and had a share in the general oversight. The growth of the Brethren was rapid. In 1549 they spread into Great Poland; in the latter half of the century they opened many voluntary schools, and were joined by many of the nobility; and the result was that by 1609, when Rudolph II. granted the *Letter of Majesty*, they were half the Protestants in Bohemia and more than half in Moravia.

At the very height of their power, however, they were almost crushed out of existence. The cause was the outbreak of the Thirty Years' War (1618). At the battle of the White Hill (1620) the Bohemian Protestants were routed; the Brethren were driven from their homes; the Polish branch was absorbed in the Reformed Church of Poland; and then many fled, some to England, some to Saxony, and some even to Texas. For a hundred years the Brethren were almost extinct. But their bishop, John Amos Comenius (1592–1672), held them together. With an eye to the future, he published their *Ratio disciplinae*, collected money for the "Hidden Seed" still worshipping in secret in Moravia, and had his son-in-law, Peter Jablonsky, consecrated a bishop, and Peter passed on the succession to his son Daniel Ernest Jablonsky.

The revival of the Moravian Brethren was German in origin. Of the "Hidden Seed" the greater number were Germans; they were probably descended from a colony of German Waldenses, who had come to Moravia in 1480 and joined the Church of the Brethren; and, therefore, when persecution broke out afresh they naturally fled to the nearest German refuge. With Christian David, a carpenter, at their head, they crossed the border into Saxony, settled down near Count Zinzendorf's estate at Berthelsdorf, and, with his permission, built the town of Herrnhut (1722–1727). But under Zinzendorf the history of the Moravians took an entirely new turn. He was a fervent Lutheran of the Pietist type; he believed in Spener's "ecclesiola" conception; and now he tried to apply the conception to the Moravian refugees. For some years he had a measure of success. Instead of reviving Moravian orders at once, the settlers attended the Berthelsdorf parish church, regarded themselves as Lutherans, agreed to a code of "statutes" drawn up by the count, accepted the Augsburg Confession as their standard of faith, and, joining with some Lutheran settlers in a special Communion service in Berthelsdorf (Aug. 13, 1727), had such a powerful unifying experience that modern Moravians regard that day as the birthday of the renewed Moravian Church. From that period two conflicting ideals were at work among the Moravians. In form the Moravian Church was soon restored. Before long persecution broke out against Herrnhut; the count sent a band of emigrants to Georgia; and as these emigrants would require their own ministers, he had David Nitschmann consecrated a bishop by Jablonsky (1735). In this way the Moravian orders were maintained; the "ecclesiola" became an independent body, and the British parliament recognized the Brethren as "an ancient Protestant Episcopal Church" (1749, 22 Geo. II. cap. 120). And yet, on the other hand, Zinzendorf's conception continued long in force. It hampered the Brethren's progress in Germany, and explains the smallness of their numbers there. Instead of aiming at Church extension, they built settlements on the estates of friendly noblemen, erected Brethren's and Sisters' houses, and cultivated a quiet type of spiritual life. It is true that they evangelized all over Germany; but this part of their work was known as the Diaspora (1 Pet. i. 1); and the idea underlying this word is that the Brethren minister to the "scattered" in other Churches without drawing them into the Moravian Church. In Germany, therefore, the importance of the Moravians must be measured, not by their numbers, but by their influence upon other Christian bodies. It was from the Moravians that Schleiermacher learnt his religion, and they even made a passing impression on Goethe; but both these men were repelled by their doctrine of the substitutionary sufferings of Christ.

In reply to the very natural question why the Moravians began their work in England, the answer given by history is that John Wesley, on his voyage to Georgia (1735) met some Moravian emigrants; that on his return he met Peter Boehler, who was on his way to North Carolina; that through Boehler's influence both John and Charles Wesley were "converted" (1738). For a few years they took an active share in the Evangelical Revival (1738–1755); but Zinzendorf's "ecclesiola" policy prevented their growth, and not till 1853 did the English Moravians resolve to aim at "the extension of the Brethren's Church." In foreign missions the distinctive feature about the Moravians is, not that they were so early in the field (1732), but that they were the first Protestants to declare that the evangelization of the heathen was the duty of the Church as such. Hitherto it had been a part of colonial policy. It was this that made their missions so influential.

Present Condition.—I. *Enterprises*: (1) Foreign missions in Labrador, Alaska, Canada, California, West Indies, Nicaragua, Demerara, Surinam, Cape Colony, Kaffraria, German East Africa, North Queensland, West Himalaya. (2) Leper Home near Jerusalem (1867). (3) Diaspora in Germany, Switzerland, France, Denmark, Norway, Russia, Poland. (4) Church extension in Germany, Great Britain, North America. (5) Boarding Schools: German province, 14; British, 7; American, 5. (6) Church Revival in Bohemia and Moravia, begun in 1869, and sanctioned by the Austrian government (1880).

II. *Orders and Constitution.*—The orders of the ministry are bishops, presbyters, deacons. But the bishops have no dioceses. Their chief function is to ordain, and to act as "intercessors." The supreme legislative board is the General Synod. It consists of delegates elected by each province, certain *ex officio* members, and representatives from the mission field. At present the Moravian Church is divided into four provinces, German, British, American North and American South (North Carolina). In provincial matters each province is independent, holds its own synods, makes its own laws, and elects its own governing board; but the General Synod meets, on the average, every ten years at Herrnhut, and its regulations are binding in all the provinces. The foreign missions are managed by a mission board, elected by the General Synod. There is also a standing court of appeal, known as Unity's Elders' Conference, and consisting of the Mission Board and four provincial boards. It is the Church's representative in the eyes of the law. In Germany the official title of the Church is *Evangelische Brüder-Unität*; in Austria, *Evangelische Brüder-Kirche*; in England and America, *Moravian Church.*

III. *Doctrine.*—At the last General Synod (1909) they repeated their old fundamental principle that "the Holy Scriptures are our only rule of faith and practice"; but at the same time they declared that their interpretation of Scripture agreed substantially with the Nicene Creed, the Westminster and Augsburg Confessions, and the Thirty-nine Articles. Since 1879 their leading doctrines have been formulated as follows: (1) the total depravity of man; (2) the real Godhead and real humanity of Christ; (3) justification and redemption through the sacrifice of Christ; (4) work of the Holy Spirit; (5) good works as fruits of the Spirit; (6) fellowship of believers; (7) second coming of Christ; (8) resurrection of the dead to life or judgment.

IV. *Ceremonies.*—At morning worship the service consists of a litany, scripture lessons, sermon, singing, extempore prayer. At the evening service a litany is rarely used. The Communion is celebrated once a month. Infant Baptism is practised. There are three modes of admission to membership: in the case of the unbaptized, adult baptism (not immersion); in other cases confirmation or reception. Members from other Churches are generally admitted by reception.

V. *Church Policy.*—It is now held by some Moravians that their Church offers a *via media* between Anglicanism and Dissent. At the last meeting of the Lambeth Conference (1907) some overtures, on certain conditions, were made for (*a*) joint consecration of bishops, (*b*) joint ordination of ministers, (*c*) interchange of pulpits. In response the Moravians, at the General Synod (1909), welcomed the offer, but also declared their wish (*a*) to preserve their independence as a "Protestant Episcopal Church"; (*b*) to co-operate freely as heretofore with other Evangelical Churches. On this question negotiations are still in progress.

VI. *Statistics 1909.*

Province.	*Congregations.*	*Communicants.*
German	23	6,213
British	42	3,782
American (N.)	96	13,932
American (S.)	26	4,019
Bohemia	12	684
Foreign Field	245	33,466
Total	444	62,096

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MORAY,[1] THOMAS RANDOLPH, 1ST EARL OF (d. 1332), Scottish warrior and statesman, was the only son of Thomas Randolph of Nithsdale, who had been chamberlain of Scotland, and through his mother Lady Isabel Bruce he was nephew to King Robert the Bruce. Randolph joined Bruce after the murder of the Red Comyn, and was present at his coronation in 1306. In June of that year he was captured by Aymer de Valence in a fight at Methven, and saved his life by becoming Edward's man. He joined in the hunt for Bruce, but in 1308 he was captured by Sir James Douglas and imprisoned. He began by defying his uncle, but presently made his submission, becoming the friendly rival of the exploits of Sir James Douglas and the confidant of Bruce's plans. In 1312 or 1314 the Scottish king made him earl of Moray and lord of Man and Annandale, while the estates held from Edward I. were confiscated. By a brilliant feat of arms he captured and destroyed Edinburgh Castle early in 1314, scaling the rock by a path pointed out by a certain William François who had made use of it in a love intrigue. On the eve of Bannockburn Randolph was posted in a wood in charge of the van with orders to prevent the English from throwing cavalry into Stirling. On the approach of a body of three hundred English horse under Sir Robert Clifford, Sir Henry de Beaumont and Sir Thomas Gray, Randolph came out of cover, and his spearmen, drawn up in a square, were vainly attacked on all sides by the English, who were driven to retreat on the appearance of Sir James Douglas with reinforcements; these, however, took no share in the action, the site of which is still known as Randolph's Field. The next day found Randolph in command of the centre of the Scottish battle. He shared in Edward Bruce's expedition to Ireland in 1315, and returned to Scotland in 1317 with Robert Bruce. With Sir James Douglas Randolph was closely allied and the two were associated in a series of brilliant exploits. In 1318 they seized the town of Berwick by escalade; being aided by the treachery of one of the burgesses, Simon of Spalding, and reinforced by Bruce they became masters of the castle some months later. In the next spring they made a raid on the northern English counties, laying waste the country as far as York, where they hoped to seize the English queen. They routed the militia hastily raised by William de Melton, archbishop of York, in a fight known as the "Chapter of Myton" because of the number of clerics who fell in the battle. Edward II., who was laying siege to Berwick, sought in vain to intercept them on their return journey. Later in the year the two Scottish nobles again raided England, and at length Edward II. signed a truce for two years. In 1322 Moray shared in Douglas's exploit at Byland Abbey. In the next year he was one of the Scottish ambassadors charged to conclude a truce with England, and was further sent to Avignon to persuade the pope to acknowledge

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[1] In general, for "Moray" see MURRAY, the spelling having been constantly interchangeable. The present earls keep the spelling Moray.

Bruce's claims by addressing him as king of Scotland. In the spring of 1326 he was again in France, when he concluded an offensive and defensive alliance between France and Scotland. The death of Bruce in 1329 made Moray regent of Scotland and guardian of the young king David II. in accordance with enactments made by the Scottish parliaments of 1315 and 1318. He died at Musselburgh on the 20th of July 1332, while preparing to resist an invasion by the English barons. Allegations of poisoning are made both by Barbour and Wyntoun, but without substantial grounds.

Moray married Isabel, daughter of Sir John Stewart of Bonkyll. His son Thomas, the 2nd earl, was killed at the battle of Dupplin in 1332; his second son John, the 3rd earl, was killed at Neville's Cross in 1346. The earldom then became extinct and the estates passed to their sister Agnes (*c.* 1312–1369), countess of Dunbar and March, known as "Black Agnes," and celebrated for her gallant defence of Dunbar Castle in 1337 and 1338. (See March, Earls of.)

MORBHANJ, or Mayurbhanj, a native state of India, in the Orissa division of Bengal. Area 4243 sq. m.; pop. (1901), 610,383, showing an increase of 14·7% in the preceding decade; revenue, £64,000. It contains a large proportion of mountain and forest, where wild elephants are numerous, and also some of the richest iron ores in India. The capital is Baripada (pop. 5613), which is connected by a narrow-gauge line with the Bengal-Nagpur railway.

MORBIHAN, a department of western France on the Atlantic seaboard, formed of part of Lower Brittany, and bounded S.E. by the department of Loire-Inférieure, E. by that of Ille-et-Vilaine, N. by Côtes-du-Nord, and W. by Finistère. Area, 2738 sq. m. Pop. (1906), 573,152. From the Montagnes Noires on the northern frontier the western portion of Morbihan slopes southward towards the Atlantic, being watered by the Ellé, the Blavet with its affluent the Scorff, and the Auray; the eastern portion, on the other hand, dips towards the south-east in the direction of the course of the Oust and its feeders, which fall into the Vilaine. Though the Montagnes Noires contain the highest point (974 ft.) in the department, the most striking orographic feature of Morbihan is the dreary, treeless, streamless tract of moorland and marsh known as the Landes of Lanvaux, which extends (W.N.W. to E.S.E.) with a width of from 1 to 3 miles for a distance of 31 miles between the valley of the Claie and that of the Arz (affluents of the Oust). A striking contrast to this district is afforded by the various inlets of the sea, whose shores are clothed with vegetation of exceptional richness, large fig-trees, rose-laurels, and aloes growing as if in Algeria. The coast-line is exceedingly irregular: the mouth of the Vilaine, the peninsular of Ruis, the great gulf of Morbihan (Inner Sea), from which the department takes its name, and the mouth of the Auray, the long Quiberon peninsula attached to the mainland by the narrow isthmus of Fort Penthièvre, the deep-branching estuary of Etel, the mouths of the Blavet and the Scorff uniting to form the port of Lorient, and, finally, on the borders of Finistère the mouth of the Laita, follow each other in rapid succession. Off the coast lie the islands of Groix, Belle-Île (*q.v.*), Houat and Hoedik. Vessels drawing 13 ft. can ascend the Vilaine as far as Redon; the Blavet is canalized throughout its course through the department; and the Oust, as part of the canal from Nantes to Brest, forms a great waterway by Redon, Josselin, Rohan and Pontivy. The climate of Morbihan is characterized by great moisture and mildness. Unproductive heath occupies more than a quarter of the department, about a third of which is arable land. Rye, buckwheat and wheat, potatoes and mangels are the chief crops; hemp and flax are also grown. Horned cattle are the chief livestock and bee-keeping is extensively practised. The sea-ware gathered along the coast helps greatly to improve the soil of the region bordering thereon. Outside of Lorient (*q.v.*), a centre for naval construction, there is little industrial activity in Morbihan. The catching and curing of sardines and the breeding of oysters (Auray, St Armel, &c.) form the business of many of the inhabitants of the coast, who also fish for anchovies, lobsters, &c., for tinning. The forges of Hennebont are of some importance for the production of sheet-tin.

The department is served by the Orleans railway. It is divided into four arrondissements—Vannes, Lorient, Ploermel and Pontivy—with 37 cantons and 256 communes. The capital Vannes is the seat of a bishopric of the province of Rennes. The department belongs to the region of the XIth army corps and to the académie (educational division) of Rennes, where also is its court of appeal. The principal places are Vannes, Lorient, Ploermel, Pontivy, Auray, Hennebont, Carnac and Locmariaquer, the last two famous for the megalithic monuments in their vicinity. Other places of interest are Erdeven and Plouharnel, also well known for their megalithic remains; Elven, with two towers of the 15th century, remains of an old stronghold; Josselin which has the fine château of the Rohan family and a church containing the tomb (15th century) of Olivier de Clisson and his wife; Guern with a chapel of the 15th and 16th centuries and le Faouët with a chapel of the 15th century; Quiberon, which is associated with the disaster of the French *émigrés* in 1795; Sarzeau, near which is the fortress of Sucinio (13th and 15th centuries); Ste Barbe with a chapel, dating from about the end of the 15th century, finely situated, overlooking the Ellé; St Gildas-de-Ruis, with a ruined Romanesque church and other remains of a Benedictine abbey of which Abelard was for a time abbot. The principal *pardons* (religious festivals) of the department are those of Ste Anne-d'Auray and St Nicolas-des-Eaux.

MORCAR, EARL (*fl.* 1066), son of Earl Ælfgar, brother of Edwin, earl of the Mercians. They assisted the Northumbrians to expel Tostig, of the house of Godwin, in 1065 and Morcar was chosen earl by the rebels. Harold, Tostig's brother, consented to this extension of the power of the Mercian house. In spite of this concession, and the help which he gave them against Tostig and Harold Hardrada, the two brothers left him to fight alone at Hastings. After trying to secure the crown for their own house, they submitted to William, but lost their earldoms. They attempted to raise the North in 1068, and failed ignominiously. They were pardoned, but Morcar afterwards joined Hereward in the Isle of Ely (1071), while Edwin perished in attempting to raise a Welsh rebellion. Morcar died in prison; at what date is unknown.

See E. A. Freeman, *Norman Conquest* and *William Rufus*, vol. i.

MORDECAI BEN HILLEL, a German rabbi, who died as a martyr at Nuremberg in 1298. His great legal (Halachic) work is usually cited as "the Mordecai," and its value consists in its thorough use of the medieval authorities. It acquired wide authority, and was one of the sources of the *Code* of Joseph Caro. Mordecai was also the author of *Responsa.*

See L. Ginzberg in *Jew. Ency.* ix. 10–13.

MORDVINIANS, otherwise called Mordva, Mordvs, or Mordvins, a people numbering about one million, belonging to the Ural-Altaic family, who inhabit the middle Volga provinces of Russia and spread in small detached communities to the south and east of these. Their settlement in the basin of the Volga is of high antiquity. One of the two great branches into which they are divided, the Erzya, is perhaps the same as the Aorses mentioned by Ptolemy as dwelling between the Baltic Sea and the Ural Mountains. Strabo mentions also the Aorses as inhabitants of the country between the Don, the Caspian Sea and the Caucasus. The Russians made raids on the Mordvins in the 12th century, and after the fall of Kazan rapidly invaded and colonized their country.

The Mordvins are now found in the governments of Simbirsk, Penza, Samara and Nizhniy-Novgorod, as well as Saratov and Tambov. But their villages are dispersed among those of the Russians, and they constitute only 10 to 12% of the population in the four first-named governments, and from 5 to 6% in the last two. They are unequally distributed over this area in ethnographical islands, and constitute as much as 23 to 44% of the population of several districts of the governments of Tambov, Simbirsk, Samara and Saratov, and only 2 or 3% in other districts of the same provinces. They are divided into two great branches, the Erzya (Erza, or Ersa) and the Moksha, differing somewhat in their physical features and language. The southern branch, or the Moksha, have a darker skin and darker eyes and hair than the northern. A third branch, the Karatays, found in Kazan, appears to be mixed with Tatars. The language is a branch of the Western Finnish family, and most nearly allied to the Cheremissian, though presenting many peculiarities (see FINNO-UGRIC). The Mordvins have largely abandoned their own language for Russian; but they have maintained a good deal of their old national dress, especially the women, whose profusely embroidered skirts, original hair-dress large ear-rings which sometimes are merely hare-tails, and numerous necklaces covering all the chest and consisting of all possible ornaments, easily distinguish them from Russian women. They have mostly dark hair, but blue eyes, generally small and rather narrow. Their cephalic index is very near to that of the Finns. They are brachycephalous or sub-brachycephalous, and a few are mesaticephalous. They are finely built, rather tall and strong, and broad-chested. Their chief occupation is agriculture; they work harder and (in the basin of the Moksha) are more prosperous than their Russian neighbours. Their capacities as carpenters were well known in Old Russia, and Ivan the Terrible used them to build bridges and clear forests during his advance on Kazan. They now manufacture wooden ware of various sorts. They are also masters of apiculture, and the commonwealth of bees often appears in their poetry and religious beliefs. They have a considerable literature of popular songs and legends, some of them recounting the doings of a king Tushtyan who lived in the time of Ivan the Terrible. Nearly all are Christians; they received baptism in the reign of Elizabeth, and the Nonconformists have made many proselytes among them. But they still preserve much of their own mythology, which they have adapted to the Christian religion. According to some authorities, they have preserved also, especially the less russified Moksha, the practice of kidnapping brides, with the usual battles between the party of the bridegroom and that of the family of the bride. The worship of trees, water (especially of the water-divinity which favours marriage), the sun or Shkay, who is the chief divinity, the moon, the thunder and the frost, and of the home-divinity Kardazserko still exists among them; and a small stone altar or flat stone covering a small pit to receive the blood of slaughtered animals can be found in many houses. Their burial customs seem founded on ancestor-worship. On the fortieth day after the death of a kinsman the dead is not only supposed to return home but a member of his household represents him, and, coming from the grave, speaks in his name.

The language is treated of in Ahlquist's *Versuch einer Mokscha-mordwinischen Grammatik nebst Texten und Wörter-Verzeichniss* (St Petersburg, 1861), and their history, customs and religion by Smirnov (trans. by Boyer), "Les Populations finnoises de la Volga" (in *Publications de l'école des langues orientales, vivantes*, 1898). Much valuable information respecting customs, religion, language and folk-lore will be found in papers by Paasonen, Heikel, Ahlquist, Mainof and others printed in the *Journal de la Société Finno-Ougrienne* and the *Finnisch-ugrische Forschungen*. (C. EL.)

MORE, HANNAH (1745–1833), English religious writer, was born at Stapleton, near Bristol, on the 2nd of February 1745. She may be said to have made three reputations in the course of her long life: first, as a clever verse-writer and witty talker in the circle of Johnson, Reynolds and Garrick; next, as a writer on moral and religious subjects on the Puritanic side; and lastly, as a practical philanthropist. She was the youngest but one of the five daughters of Jacob More, who, though a member of a Presbyterian family in Norfolk, had become a member of the English Church and a strong Tory. He taught a school at Stapleton in Gloucestershire. The elder sisters established a boarding-school at Bristol, and Hannah became one of their pupils when she was twelve years old. Her first literary efforts were pastoral plays, suitable for young ladies to act, the first being written in 1762 under the title of *A Search after Happiness* (2nd ed. 1773). Metastasio was one of her literary models; on his opera of *Attilio regulo* she based a drama, *The Inflexible Captive*, published in 1774. She gave up her share in the school in view of an engagement of marriage she had contracted with a Mr Turner. The wedding never took place, and, after much reluctance, Hannah More was induced to accept from Mr Turner an annuity which had been settled on her without her knowledge. This set her free for literary pursuits, and in 1772 or 1773 she went to London. Some verses on Garrick's *Lear* led to an acquaintance with the actor-playwright; Miss More was taken up by Elizabeth Montague; and her unaffected enthusiasm, simplicity, vivacity, and wit won the hearts of the whole Johnson set, the lexicographer himself included, although he is said to have told her that she should "consider what her flattery was worth before she choked him with it." Garrick wrote the prologue and epilogue for her tragedy *Percy*, which was acted with great success at Covent Garden in December 1777. Another drama, *The Fatal Falsehood*, produced in 1779 after Garrick's death, was less successful. The Garricks had induced her to live with them; and after Garrick's death she remained with his wife, first at Hampton Court, and then in the Adelphi. In 1781 she made the acquaintance of Horace Walpole, and corresponded with him from that time. At Bristol she discovered a poetess in Mrs Anne Yearsley (1756–1806), a milkwoman, and raised a considerable sum of money for her benefit. "Lactilla," as Mrs Yearsley was called, wished to receive the capital, and made insinuations against Miss More, who desired to hold it in trust. The trust was handed over to a Bristol merchant and eventually to the poetess.

Hannah More published *Sacred Dramas* in 1782, and it rapidly ran through nineteen editions. These and the poems *Bas-Bleu* and *Florio* (1786) mark her gradual transition to more serious views of life, which were fully expressed in prose in her *Thoughts on the Importance of the Manners of the Great to General Society* (1788), and *An Estimate of the Religion of the Fashionable World* (1790). She was intimate with Wilberforce and Zachary Macaulay, with whose evangelical views she was in entire sympathy. She published a poem on *Slavery* in 1788. In 1785 she bought a house, at Cowslip Green, near Wrington, near Bristol, where she settled down to country life with her sister Martha, and wrote many ethical books and tracts: *Strictures on Female Education* (1799), *Hints towards forming the Character of a Young Princess* (1805), *Coelebs in Search of a Wife* (only nominally a story, 1809), *Practical Piety* (1811), *Christian Morals* (1813), *Character of St Paul* (1815), *Moral Sketches* (1819). The tone is uniformly animated; the writing fresh and vivacious; her favourite subjects the minor self-indulgences and infirmities. She was a rapid writer, and her work is consequently discursive and formless; but there was an originality and force in her way of putting commonplace sober sense and piety that fully accounts for her extraordinary popularity. The most famous of her books was *Coelebs in Search of a Wife*, which had an enormous circulation among pious people. Sydney Smith attacked it with violence in the *Edinburgh Review* for its general priggishness. It is interesting to note that the model Stanley children have been said to be drawn from T. B. Macaulay and his sister. She also wrote many spirited rhymes and prose tales, the earliest of which was *Village Politics* (1792), by "Will Chip," to counteract the doctrines of Tom Paine and the influence of the French Revolution. The success of *Village Politics* induced her to begin the series of "Cheap Repository Tracts," which were for three years produced by Hannah and her sisters at the rate of three a month. Perhaps the most famous of these is *The Shepherd of Salisbury Plain*, describing a family of phenomenal frugality and contentment. This was translated into several languages. Two million copies of these rapid and telling sketches were circulated in one year, teaching the poor in rhetoric of most ingenious homeliness to rely upon the virtues of content, sobriety, humility, industry, reverence for the British Constitution, hatred of the French, trust in God and in the kindness of the gentry.

Perhaps the best proof of Hannah More's sterling worth was her indefatigable philanthropic work—her long-continued exertions to improve the condition of the children in the mining districts of the Mendip Hills near her home at Cowslip Green and Barley Wood. The More sisters met with a good deal of opposition in their good works. The farmers thought that education, even to the limited extent of learning to read, would be fatal to agriculture, and the clergy, whose neglect she was making good, accused her of Methodist tendencies. In her old age, philanthropists from all parts made pilgrimages to see the bright and amiable old lady, and she retained all her faculties till within two years of her death, dying at Clifton, where the last five years of her life were spent, on the 7th of September 1833.

See *The Life of Hannah More, with Notices of Her Sisters* (1838), by the Rev. Henry Thompson. The article in the *Dict. Nat. Biog.* is by Sir Leslie Stephen. Some letters of Hannah More, with a very slight connecting narrative, were published in 1872 by William Roberts as *The Life of Hannah More.* See also *Hannah More* (1888), by Charlotte M. Yonge, in the "Eminent Women" series, and *Hannah More* (New York and London, 1900), by "Marion Harland." *Letters of Hannah More to Zachary Macaulay* were edited (1860) by Arthur Roberts. The contemporary opposition to her may be seen in an abusive *Life of Hannah More, with a Critical Review of Her Writings* (1802), by the "Rev. Archibald Macsarcasm" (William Shaw, rector of Chelvey, Somerset).

MORE, HENRY (1614–1687), English philosopher of the Cambridge Platonist school, was born at Grantham in 1614. Both his father and his mother, he tells us, were "earnest followers of Calvin," but he himself "could never swallow that hard doctrine." In 1631 he was admitted at Christ's College, Cambridge, about the time Milton was leaving it. He immersed himself "over head and ears in the study of philosophy," and fell for a time into a scepticism, from which he was delivered by a study of the "Platonic writers." He was fascinated especially by Neoplatonism, and this fascination never left him. The *Theologia germanica* also exerted a permanent influence over him. He took his bachelor's degree in 1635, his master's degree in 1639, and immediately afterwards was chosen fellow of his college. All other preferment he refused, with one exception. Fifteen years after the Restoration he accepted a prebend in Gloucester Cathedral, but only to resign it in favour of his friend Dr Edward Fowler, afterwards bishop of Gloucester. He would not accept the mastership of his college, to which, it is understood, he would have been preferred in 1654, when Cudworth was appointed. He drew around him many young men of a refined and thoughtful turn of mind, but among all his pupils the most interesting was a young lady of noble family. This lady, probably a sister of Lord Finch, subsequently earl of Nottingham, a well-known statesman of the Restoration, afterwards became Lady Conway, and at her country seat at Ragley in Warwickshire More continued at intervals to spend "a considerable part of his time." She and her husband both appreciated him, and amidst the woods of this retreat he composed several of his books. The spiritual enthusiasm of Lady Conway was a considerable factor in some of More's speculations, none the less that she at length joined the Quakers. She became the friend not only of More and Penn, but of Baron van Helmont and Valentine Greatrakes, mystical thaumaturgists of the 17th century. Ragley became a centre not only of devotion but of wonder-working spiritualism.[1] From this, his genius suffered, and the rationality which distinguishes his earlier is much less conspicuous in his later works. He was a voluminous writer both in verse and in prose, but his works, except the *Divine Dialogues* (1688), are now of little interest. This treatise, animated and sometimes brilliant, is valuable for modern readers in that it condenses his general view of philosophy and religion.

Henry More represents the mystical and theosophic side of the Cambridge movement. The Neoplatonic extravagances which lay hidden in the school from the first came in his writings to a head, and merged in pure phantasy. He can never be spoken of, however, save as a spiritual genius and a significant figure in British philosophy, less robust and in some respects less learned than Cudworth, but more interesting and fertile in thought, and more genial in character. From youth to age he describes himself as gifted with a buoyant temper. His own thoughts were to him a never-ending source of pleasurable excitement. This mystical elevation was the chief feature of his character, a certain radiancy of thought which carried him beyond the common life without raising him to any artificial height, for his humility and charity were not less conspicuous than his piety. The last ten years of his life were uneventful. He died on the 1st of September 1687, and was buried in the chapel of the college he loved.

Before his death More issued complete editions of his works, his *Opera theologica* in 1675, and his *Opera philosophica* in 1678. The chief authorities for his life are Ward's *Life* (1710); the prefatio generalissima prefixed to his *Opera omnia* (1679); and also a general account of the manner and scope of his writings in an *Apology* published in 1664. The collection of his *Philosophical Poems* (1647), in which he has "compared his chief speculations and experiences," should also be consulted. An elaborate analysis of his life and works is given in Tulloch's *Rational Theology*, vol. ii. (1874); see also R. Zimmermann, *Henry More und die vierte Dimension des Raums* (Vienna, 1881). (For his ethical theory, as contained in the *Enchiridion Ethicum*, see ETHICS.)

MORE, SIR THOMAS (1478–1535), English lord chancellor, and author of *Utopia*, was born in Milk Street in the city of London, on the 7th of February 1478. He received the rudiments of education at St Anthony's School in Threadneedle Street, at that time under Nicolas Holt, held to be the best in the city. He was early placed in the household of Cardinal Morton, archbishop of Canterbury. Admission to the cardinal's family was esteemed a high privilege, and was sought as a school of manners and as an introduction to the world by the sons of the best families in the kingdom. Young Thomas More obtained admission through the influence of his father, Sir Thomas, then a rising barrister and afterwards a justice of the court of king's bench. The usual prognostication of future distinction is attributed in the case of More to Cardinal Morton, "who would often tell the nobles sitting at table with him, where young Thomas waited on him, whosoever liveth to trie it shall see this child prove a notable and rare man."[1] At the proper age young More was sent to Oxford, where he is said vaguely to have had Colet, Grocyn and Linacre for his tutors.[2] All More himself says is that he had Linacre for his master in Greek. Learning Greek was not the matter of course which it has since become. Greek was not as yet part of the arts curriculum, and to learn it voluntarily was ill looked upon by the authorities. Those who did so were suspected of an inclination towards novel and dangerous modes of thinking, then rife on the Continent and slowly finding their way to England. More's father, who intended his son to make a career in his own profession, took the alarm; he removed him from the university without a degree, and entered him at New Inn to commence at once the study of the law. After completing a two-years' course in New Inn, an inn of chancery, More was admitted in February 1496 at Lincoln's Inn, an inn of court. "At that time the Inns of Court and Chancery presented the discipline of a well-constituted university, and, through professors under the name of readers and exercises under the name of mootings, law was systematically taught" (CAMPBELL). In his professional studies More early distinguished himself, so that he was appointed reader-in-law in Furnival's Inn; but he would not relinquish the studies which had attracted him in Oxford. We find him delivering a lecture to audiences of "all the chief learned of the city of London."[3] The subject he chose was a compromise between theology and the humanities, being St Augustine's *De civitate.* In this lecture More sought less to expound the theology of his author than to set forth the philosophical and historical contents of the treatise. The lecture-room was a church, St Lawrence Jewry, placed at his disposal by Grocyn, the rector.

Somewhere about this period of More's life two things happened which gave in opposite directions the determining impulse to his future career. More's was one of those highly susceptible natures which take more readily and more eagerly than common minds the impress of that which they encounter on their first contact with men. Two principal forms of thought and feeling were at this date in conflict, rather unconscious than declared, on English soil. Under the denomination of the "old learning," the sentiment of the middle ages and the idea of Church authority was established and in full possession of the religious houses, the universities, and the learned professions. The foe that was advancing in the opposite direction, though without the conscience of a hostile purpose, was the new power of human reason animated with the revived sentiment of classicism. In More's mind both these hostile influences found a congenial home. Each had its turn of supremacy, and in his early years it seemed as if the humanistic influence would gain the final victory. About the age of twenty he was seized with a violent access of devotional rapture. He took a disgust to the world and its occupations, and experienced a longing to give himself over to an ascetic life. He took a lodging near the Charterhouse, and subjected himself to the discipline of a Carthusian monk. He wore a sharp shirt of hair next his skin, scourged himself every Friday and other fasting days, lay upon the bare ground with a log under his head, and allowed himself but four or five hours' sleep. This access of the ascetic malady lasted but a short time, and More recovered to all outward appearance his balance of mind. For the moment the balance of his faculties seemed to be restored by a revival of the antagonistic sentiment of humanism which he had imbibed from the Oxford circle of friends, and specially from Erasmus. The dates as regards More's early life are uncertain, and we can only say that it is possible that the acquaintance with Erasmus might have begun during Erasmus's first visit to England in 1499. Tradition has dramatized their first meeting into the story given by Cresacre More[1]—that the two happened to sit opposite each other at the lord mayor's table, that they got into an argument during dinner, and that, in mutual astonishment at each other's wit and readiness, Erasmus exclaimed, "Aut tu es Morus, aut nullus," and the other replied, "Aut tu es Erasmus, aut diabolus!" Rejecting this legend, which bears the stamp of fiction upon its face, we have certain evidence of acquaintance between the two men in a letter of Erasmus, with the date "Oxford, 29th October 1499." If we must admit the correctness of the date of *Ep.* 14 in the collection of Erasmus's *Epistolae*, we should have to assume that their acquaintance had begun as early as 1497. It rapidly ripened into warm attachment. This contact with the prince of letters revived in More the spirit of the "new learning," and he returned with ardour to the study of Greek, which had been begun at Oxford. The humanistic influence was sufficiently strong to save him from wrecking his life in monkish mortification, and even to keep him for a time on the side of the party of progress. He acquired no inconsiderable facility in the Greek language, from which he made and published some translations. His Latin style, though wanting the inimitable ease of Erasmus and often offending against idiom, is yet in copiousness and propriety much above the ordinary Latin of the English scholars of his time.

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[1] The place and its religious marvels are glanced at in the romance of *John Inglesant* (ch. xv.).

[1] *Life* by B. R. [2] Ibid. [3] Roper, *Life.*

More's attention to the new studies was always subordinate to his resolution to rise in his profession, in which he was stimulated by his father's example. As early as 1502 he was appointed under-sheriff of the city of London, an office then judicial and of considerable dignity. He first attracted public attention by his conduct in the parliament of 1504, by his daring opposition to the king's demand for money. Henry VII. was entitled, according to feudal laws, to a grant on occasion of his daughter's marriage. But he came to the House of Commons for a much larger sum than he intended to give with his daughter. The members, unwilling as they were to vote the money, were afraid to offend the king, till the silence was broken by More, whose speech is said to have moved the house to reduce the subsidy of three-fifteenths which the Government had demanded to £30,000. One of the chamberlains went and told his master that he had been thwarted by a beardless boy. Henry never forgave the audacity; but, for the moment, the only revenge he could take was upon More's father, whom upon some pretext he threw into the Tower, and he only released him upon payment of a fine of £100. Thomas More even found it advisable to withdraw from public life into obscurity. During this period of retirement the old dilemma recurred. One while he devoted himself to the sciences, "perfecting himself in music, arithmetic, geometry and astronomy, learning the French tongue, and recreating his tired spirits on the viol,"[2] or translating epigrams from the Greek anthology; another while resolving to take priest's orders.

From dreams of clerical celibacy he was roused by making acquaintance with the family of John Colt of New Hall, in Essex. The "honest and sweet conversation" of the three daughters attracted him, and though his inclination led him to prefer the second he married the eldest, Jane, in 1505, not liking to put the affront upon her of passing her over in favour of her younger sister. The death of the old king in 1509 restored him to the practice of his profession, and to that public career for which his abilities specially fitted him. From this time there was scarce a cause of importance in which he was not engaged. His professional income amounted to £400 a year, equal to £4000 in present money, and, "considering the relative profits of the law and the value of money, probably indicated as high a station as £10,000 at the present day" (CAMPBELL). It was not long before he attracted the attention of the young king and of Wolsey. The spirit with which he pleaded before the Star Chamber in a case of *The Crown* v. *The Pope* recommended him to the royal favour, and marked him out for employment. More obtained in this case judgment against the Crown. Henry, who was present in person at the trial, had the good sense not to resent the defeat, but took the counsel to whose advocacy it was due into his service. In 1514 More was made master of the requests, knighted, and sworn a member of the privy council. He was repeatedly employed on embassies to the Low Countries, and was for a long time stationed at Calais as agent in the shifty negotiations carried on by Wolsey with the court of France. In 1519 he was compelled to resign his post of under-sheriff to the city and his private practice at the bar. In 1521 he was appointed treasurer of the exchequer, and in the parliament of 1523 he was elected Speaker. The choice of this officer rested nominally with the house itself, but in practice was always dictated by the court. Sir Thomas More was pitched upon by the court on this occasion in order that his popularity with the Commons might be employed to carry the money grant for which Wolsey asked. To the great disappointment of the court More remained firm to the popular cause, and it was greatly owing to his influence that its demands were resisted. From this occurrence may be dated the jealousy which the cardinal began to exhibit towards More. Wolsey made an attempt to get him out of the way by sending him as ambassador to Spain. More defeated the design by a personal appeal to the king, alleging that the climate would be fatal to his health. Henry, who saw through the artifice, and was already looking round for a more popular successor to Wolsey, made the gracious answer that he would employ More otherwise. In 1525 More was appointed chancellor of the duchy of Lancaster, and no pains were spared to attach him to the court. The king frequently sent for him into his closet, and discoursed with him on astronomy, geometry and points of divinity. This growing favour, by which many men would have been carried away, did not impose upon More. He discouraged the king's advances, showed reluctance to go to the palace, and seemed constrained when there. Then the king began to come himself to More's house at Chelsea, and would dine with him without previous notice. William Roper, husband of More's eldest daughter, mentions one of these visits, when the king after dinner walked in the garden by the space of an hour holding his arm round More's neck. Roper afterwards congratulated his father-in-law on the distinguished honour which had been shown him. "I thank our Lord," was the reply, "I find his grace my very good lord indeed; and I believe he doth as singularly favour me as any subject within this realm. Howbeit, son Roper, I may tell thee I have no cause to be proud thereof, for if my head would win him a castle in France it should not fail to go." As a last resource More tried the expedient of silence, dissembling his wit and affecting to be dull. This had the desired effect so far that he was less often sent for. But it did not alter the royal policy, and in 1529, when a successor had to be found for Wolsey, More was raised to the chancellorship. The selection was justified by More's high reputation, but it was also significant of the modification which the policy of the court was then undergoing. It was a concession to the rising popular party, to which it was supposed that More's politics inclined him. The public favour with which his appointment had been received was justified by his conduct as judge in the court of chancery. Having heard causes in the forenoon between eight and eleven, after dinner he sat again to receive petitions. The meaner the suppliant was the more affably he would speak to him and the more speedily he would despatch his case. In this respect he formed a great contrast to his predecessor, whose arrears he soon cleared off. One morning being told by the officer that there was not another cause before the court, he ordered the fact to be entered on record, as it had never happened before. He not only refused all gifts—such as had been usual—himself, but took measures to prevent any of his connexions from interfering with the course of justice. One of his sons-in-law, Heron, having a suit in the chancellor's court, and refusing to agree to any reasonable accommodation, because the judge "was the most affectionate father to his children that ever was in the world," More thereupon made a decree against him.

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[1] *Life*, p. 93.

[2] Roper, *Life*.

Unfortunately for Sir Thomas More, a lord chancellor is not merely a judge, but has high political functions to perform. In raising More to that eminent position, the king had not merely considered his professional distinction but had counted upon his avowed liberal and reforming tendencies. In the *Utopia*, which, though written earlier, More had allowed to be printed as late as 1516, he had spoken against the vices of power, and declared for indifference of religious creed with a breadth of philosophical view of which there is no other example in any Englishman of that age. At the same time, as he could not be suspected of any sympathy with Lutheran or Wickliffite heretics, he might fairly be regarded as qualified to lead the party which aimed at reform in State and Church within the limits of Catholic orthodoxy. But in the king's mind the public questions of reform were entirely sunk in the personal one of the divorce. The divorce was a point upon which Sir Thomas would not yield. And, as he saw that the marriage with Anne Boleyn was determined upon, he petitioned the king to be allowed to resign the Great Seal, alleging failing health. With much reluctance the royal permission was given and the resignation accepted, on the 10th of May 1532, with many gracious expressions of goodwill on the part of the king. The promise held out of future bounty was never fulfilled, and More left office, as he had entered it, a poor man. His necessitous condition was so notorious that the clergy in convocation voted him a present of £5000. This he peremptorily refused, either for himself or for his family, declaring that he "had rather see it all cast into the Thames." Yet the whole of his income after resigning office did not exceed £100 a year.

Hitherto he had maintained a large establishment, not on the princely scale of Wolsey, but in the patriarchal fashion of having all his sons-in-law, with their families, under his roof. When he resigned the chancellorship he called his children and grandchildren together to explain his reduced circumstances. "If we wish to live together," said he, "you must be content to be contributories together. But my counsel is that we fall not to the lowest fare first: we will not, therefore, descend to Oxford fare, nor to the fare of New Inn, but we will begin with Lincoln's Inn diet, where many right worshipful men of great account and good years do live full well; which if we find ourselves the first year not able to maintain, then we will in the next year come down to Oxford fare, where many great learned and ancient fathers and doctors are continually conversant; while if our purses stretch not to maintain neither, then may we after, with bag and wallet, go a-begging together, hoping that for pity some good folks will give us their charity."

More was now able, as he writes to Erasmus, to return to the life which had always been his ambition, when, free from business and public affairs, he might give himself up to his favourite studies and to the practices of his devotion. Of the Chelsea interior Erasmus has drawn a charming picture, which may vie with Holbein's celebrated canvas, "The Household of Sir Thomas More."

> "More has built, near London, upon the Thames, a modest yet commodious mansion. There he lives surrounded by his numerous family, including his wife, his son, and his son's wife, his three daughters and their husbands, with eleven grandchildren. There is not any man living so affectionate to his children as he, and he loveth his old wife as if she were a girl of fifteen. Such is the excellence of his disposition that whatsoever happeneth that could not be helped, he is as cheerful and as well pleased as though the best thing possible had been done. In More's house you would see that Plato's Academy was revived again, only, whereas in the Academy the discussions turned upon geometry and the power of numbers, the house at Chelsea is a veritable school of Christian religion. In it is none, man or woman, but readeth or studieth the liberal arts, yet is their chief care of piety. There is never any seen idle; the head of the house governs it not by a lofty carriage and oft rebukes, but by gentleness and amiable manners. Every member is busy in his place, performing his duty with alacrity; nor is sober mirth wanting."[1]

But More was too conspicuous to be long allowed to enjoy the happiness of a retired life. A special invitation was sent him by the king to attend the coronation of Anne Boleyn, accompanied with the gracious offer of £20 to buy a new suit for the occasion! More refused to attend, and from that moment was marked out for vengeance. A first attempt made to being him within the meshes of the law only recoiled with shame upon the head of the accusers. They were maladroit enough to attack him on his least vulnerable side, summoning him before the privy council to answer to a charge of receiving bribes in the administration of justice. One Parnell was put forward to complain of a decree pronounced against him in favour of the contending party Vaughan, who he said had presented a gilt cup to the chancellor. More stated that he had received a cup as a New Year's gift. Lord Wiltshire, the queen's father, exultingly cried out, "So, did I not tell you, my lords, that you would find this matter true?" "But, my lords," continued More, "having pledged Mrs Vaughan in the wine wherewith my butler had filled the cup, I restored the cup to her." Two other charges of a like nature were refuted as triumphantly. But the very futility of the accusations must have betrayed to More the bitter determination of his enemies to compass his destruction. Foiled in their first ill-directed attempt, they were compelled to have recourse to that tremendous engine of regal tyranny, the law of treason. A bill was brought into parliament to attaint Elizabeth Barton, a nun, who was said to have held treasonable language. Barton turned out afterwards to have been an impostor, but she had duped More, who now lived in a superstitious atmosphere of convents and churches, and he had given his countenance to her supernatural pretensions. His name, with that of Fisher, was accordingly included in the bill as an accomplice. When he came before the council it was at once apparent that the charge of treason could not be sustained, and the efforts of the court agents were directed to draw from More some approbation of the king's marriage. But to this neither cajolery nor threats could move him. The preposterous charge was urged that it was by his advice that the king had committed himself in his book against Luther to an assertion of the pope's authority, whereby the title of "Defender of the Faith" had been gained, but in reality a sword put into the pope's hand to fight against him. More was able to reply that he had warned the king that this very thing might happen, that upon some breach of amity between the crown of England and the pope Henry's too pronounced assertion of the papal authority might be turned against himself, "therefore it were best that place be amended, and his authority more slenderly touched." "Nay," replied the king, "that it shall not; we are so much bound to the see of Rome that we cannot do too much honour unto it. Whatsoever impediment be to the contrary, we will set forth that authority to the utmost; for we have received from that see our crown imperial," "which," added More, "till his grace with his own mouth so told me

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[1] *Ep.* 426, Appendix.

I never heard before.” Anything more defiant and exasperating than this could not well have been said. But it could not be laid hold of, and the charge of treason being too ridiculous to be proceeded with, More's name was struck out of the bill. When his daughter brought him the news, More calmly said, “I' faith, Meg, quod differtur, non aufertur: that which is postponed is not dropt.” At another time, having asked his daughter how the court went and how Queen Anne did, he received for answer, “Never better; there is nothing else but dancing and sporting.” To this More answered, “Alas, Meg, it pitieth me to remember unto what misery, poor soul, she will shortly come; these dances of hers will prove such dances that she will spurn our heads off like footballs; but it will not be long ere her head will dance the like dance.”[1] So the speech runs in the *Life* by More's great-grandson; but in the only trustworthy record, the life by his son-in-law Roper, More's reply ends with the words, “she will shortly come.” In this, as in other instances, the later statement has the appearance of having been an imaginative extension of the earlier.

In 1534 the Act of Supremacy was passed and the oath ordered to be tendered. More was sent for to Lambeth, where he offered to swear to the succession, but steadily refused the oath of supremacy as against his conscience. Thereupon he was given in charge to the abbot of Westminster, and, persisting in his refusal, was four days afterwards committed to the Tower. After a close and even cruel confinement (he was denied the use of pen and ink) of more than a year, he was brought to trial before a special commission and a packed jury. Even so More would have been acquitted, when at the last moment Rich, the solicitor-general, quitted the bar and presented himself as a witness for the Crown. Being sworn, he detailed a confidential conversation he had had with the prisoner in the Tower. He affirmed that, having himself admitted in the course of this conversation “that there were things which no parliament could do—*e.g.* no parliament could make a law that God should not be God,” Sir Thomas had replied, “No more could the parliament make the king supreme head of the Church.” By this act of perjury a verdict of “guilty” was procured from the jury. The execution of the sentence followed within the week, on the 7th of July 1535. The head was fixed upon London Bridge. The vengeance of Henry was not satisfied by this judicial murder of his friend and servant; he enforced the confiscation of what small property More had left, expelled Lady More from the house at Chelsea, and even set aside assignments which had been legally executed by More, who foresaw what would happen before the commission of the alleged treason. More's property was settled on Princess Elizabeth, afterwards queen, who kept possession of it till her death.

Sir Thomas More was twice married, but had children only by his first wife, who died about 1511. His only son, John, married an heiress, Ann Cresacre, and was the grandfather of Cresacre More, Sir Thomas More's biographer. His eldest daughter, Margaret (1505–1544), married to William Roper (1496–1578), an official of the court of king's bench and a member of parliament under Henry VIII., Edward VI. and Mary, is one of the foremost women in the annals of the country for her virtues, high intelligence and various accomplishments. She read Latin and Greek, was a proficient in music, and in the sciences so far as they were then accessible. Her devotion to her father is historical; she gave him not only the tender affection of a daughter but the high-minded sympathy of a soul great as his own.

More was not only a lawyer, a wit, a scholar, and a man of wide general reading; he was also a man of cultivated taste, who delighted in music and painting. He was an intimate friend of Holbein, whose first introduction to England was as a visitor to More in his house at Chelsea, where the painter is said to have remained for three years, and where he probably first met Henry VIII. Holbein painted portraits of Sir Thomas and his family. More was beatified by Leo XIII. in 1886.

The *Epistola ad Dorpium* exhibits More emphatically on the side of the new learning. It contains a vindication of the study of Greek, and of the desirability of printing the text of the Greek Testament—views which at that date required an enlightened understanding to enter into, and which were condemned by the party to which More afterwards attached himself. On the other hand, he can at the most be doubtfully exculpated from the charge of having tortured men and children for heresy. It is admitted by himself that he inflicted punishment for religious opinion. Erasmus only ventures to say in his friend's defence “that while he was chancellor no man was put to death for these pestilent opinions, while so many suffered death in France and the Low Countries.” His views and feelings contracted under the combined influences of his professional practice and of public employment. In the *Utopia*, published in Latin in 1516 (1st English translation, 1551), he not only denounced the ordinary vices of power, but evinced an enlightenment of sentiment which went far beyond the most statesmanlike ideas to be found among his contemporaries, pronouncing not merely for toleration, but rising even to the philosophical conception of the indifference of religious creed. It was to this superiority of view, and not merely to the satire on the administration of Henry VII., that we must ascribe the popularity of the work in the 16th century. For as a romance the *Utopia* has little interest either of incident or of character. It does not, as has been said, anticipate the economical doctrines of Adam Smith, and much of it is fanciful without being either witty or ingenious. The idea of putting forward political and philosophical principles under the fiction of an ideal state was doubtless taken from Plato's *Republic*. The *Utopia* in turn suggested the literary form adopted by Bacon, Hobbes, Filmer, and other later writers; and the name of the book has passed into the language as signifying optimistic but impracticable ideals of reform.

For a bibliography of More's numerous works see the article in the *Dict. Nat. Biog.* and the Catalogue of the Alfred Cock collection of books and portraits of or relating to Sir Thomas More which is preserved in the Guildhall Library, London. The more important of his works and their editions are here given. *Luciani dialogi . . . compluria opuscula ab Erasmo Roterodamo et Thoma Moro . . . traducta* (Paris, 1506 and 1514; Venice, Aldus, 1516, &c.) was accomplished by Erasmus and More in 1505. *The Lyfe of John Picus, earle of Mirandula* . . . printed by Wynkyn de Worde in 1510, translated by More from the Venice ed. of 1498, was edited by J. M. Rigg for the Tudor Library in 1890. *Historie of the pittiful Life and unfortunate Death of Edward the Fifth and the then Duke of York with . . . Richard the Third* was written, according to Rastell, in 1513, and first printed in a corrupt version in Grafton's continuation of Harding in 1543; it is included by Rastell in his 1557 edition of More's *Workes*, but it has been suggested that the Latin original was by Cardinal Morton; as the *History of King Richard III.* it was edited by J. R. Lumby for the Pitt Press in 1883. The *Libellus vere aureus* . . . better known as *Utopia*, was printed at Louvain in 1516, under the superintendence of Erasmus, and appeared in many subsequent editions, many of them of great bibliographical value, the finest being the Basel edition of 1518. It was translated into the chief languages of Europe, and into English by Ralph Robinson as *A fruteful and Pleasaunt Worke of the best State of a Publyque Weale, and of the newe Yle called Utopia* (Abraham Nell, 1551); modern editions are by J. Dibdin (2 vols., 1808), Professor E. Arber (English Reprints, 1869), by J. R. Lumby for the Pitt Press (1879), by William Morris at the Kelmscott Press (1893), by J. Churton Collins for the Clarendon Press (1904), by R. Steele for the King's Classics (1908), &c. Other translations of *Utopia* are by Gilbert Burnet (1684) and by A. Cayley (*Memoirs of More*, 2 vols., 1808). Against Luther and Tyndale Sir T. More wrote *A Dyaloge of Syr Thomas More, Knt.*, written in 1528 and printed by John Rastell in 1529; *Sir Thomas More's Answere to the fyrste parte of the Poyson'd book . . . The Souper of the Lorde* (William Rastell, 1532) with a “Second Parte” in 1533. The *Apologye of Syr Thomas More*, written in 1533, is a defence of his own polemical style and of the treatment of heretics by the clergy. *A Dyaloge of Comfort against Tribulacion*, printed by Rastell in 1533, was destined primarily for More's family.

More's English works were collected by William Rastell and published as *The Worke of Sir Thomas More Knyght* by Cawood, Waly and Tottel in 1557; his Latin works *Thomae Mori . . . Lucubrationes* were partially collected at Basel 1563 and in 1566 (*omnia opera*) at Louvain; a fuller edition drawn chiefly from these two appeared at Frankfort and Leipzig in 1689. Modern selections were edited by W. J. Walter (Baltimore, 1841), by T. E. Bridgett (*Wisdom and Wit of Blessed Thomas More*, London, 1891). His correspondence with Erasmus is partly included in the editions of the Letters of Erasmus, and much of his correspondence is calendared in Gairdner's *Letters and Papers of Henry VIII.*, the letters written to his family in his last days being found in vol. viii.

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[1] Cresacre More, p. 231.

The Mirror of Vertue in Worldly Greatness; or, the Life of Syr Thomas More was written by his son-in-law William Roper about the end of Mary's reign. It was preserved in MS. during the reign of Elizabeth, and handed down in copies, many of which were carelessly made. It was not given to the press till 1626, with the date of Paris. Reprints were made by Hearne (Oxford, 1716), by Lewis (1729, 1731), who added an appendix of documents, and by Singer (1817, 1822) and for the King's Library (1902). Roper's *Life* is the source of all the many subsequent biographies. More's *Life* in MS. (Harleian 6253 and elsewhere), anonymous, but by Nicolas Harpsfield, was also written in Mary's reign. All that is material in this MS. is taken from Roper. Another anonymous *Life*, written in 1599, printed in Wordsworth's *Ecclesiastical Biography*, ii. 43–185, is chiefly compiled from Roper and Harpsfield. The preface is signed Ro. Ba. (Robert Barnstaple?). William Rastell's Life of More, of which fragments are preserved in the Arundel Coll. (Brit. Mus.), is, unhappily, lost. Thomas Stapleton (*Tres Thomae, s. res gestae S. Thomae apostoli, S. Thomae archiepiscopi Cantuariensis, Thomae Mori* (Douay, 1588; Cologne, 1612) and the *Vita Thomae Mori* (separately), (Gratz, 1689) translates Roper, interweaving what material he could find scattered through More's works and letters and the notices of him in the writings of his contemporaries. Cresacre More, great-grandson of Sir Thomas, compiled a new life about the year 1627. It was printed at Paris without date, but, according to the editor, J. Hunter, in 1631. The title of this edition is. *The Life and Death of Sir Thos. More, Lord High Chancellour of England*, and with new title-page, 1642, 1726, 1828. This biography is cited by the subsequent biographers as an independent authority. But it is almost entirely borrowed from Roper and Stapleton. The additions made have sometimes the appearance of rhetorical amplifications of Roper's simple statements. At other times they are decorative miracles. The whole is couched in that strain of devotional exaggeration in which the lives of the saints are usually composed. The author seems to imply that he had received supernatural communications from the spirit of his ancestor. Already, only eighty years after More's execution, hagiography had taken possession of the facts and was transmuting them into an edifying legend. Cresacre More's *Life* cannot be alleged as evidence for any facts which are not otherwise vouched. It has been remarked by Hunter that More's life and works have been all along manipulated for political purposes, and in the interest of the holy see. In Mary's reign, and in the tide of Catholic reaction, Roper and Harpsfield wrote lives of him; Ellis Heywood dedicated his *Il Moro* (Florence, 1556) a fanciful account of More's life at Chelsea, to Cardinal Pole, and Tottell reprinted the folio of his English works. Stapleton prepared his *Tres Thomae* in 1588, when the recovery of England to the see of Rome was looked for by the Spanish invasion. In 1599, when there was a prospect of a disputed succession, the anonymous *Life* by Ro. Ba was composed; and soon after Charles had allied himself with a Catholic, the *Life* by Cresacre More issued from the press. Hunter might have added that Stapleton was being reprinted at Gratz at the time when the conversion of England was expected from James II. The later lives of Sir Thomas More have been numerous, the best being those by G. T. Rudhart *Thomas Morus, aus den Quellen bearbeitet* (Nuremberg, 1829); by T. E. Bridgett, *Life and Writings of Sir Thomas More* (1891); and by W. H. Hutton, *Life and Writings of Sir Thomas More* (1891). Other lives are by J. Hoddesdon (London, 1652, 1662); by Sir A. Cayley (2 vols., London, 1808); by Sir J. Mackintosh, *Lardner's Cab. Cyclop.* (London, 1831, 1844); and in More's *Works* (London, 1845); by Lord Campbell in *Lives of the Chancellors* (vol. i. 1848–1850); by D. Nisard in *Renaissance et Réforme* (Paris, 1855); by Baumstark (Freiburg, 1879); by F. Seebohm in the *Oxford Reformers of 1498* (London, 1867). A biographical study on More's Latin poems is *Philomorus*, by J. H. Marsden (2nd ed., London, 1878). Cf. John Bruce, "Inedited documents rel. to the imprisonment and condemnation of Sir T. More," in *Archaeologia* xxvii. 361–374); Southey, *Sir Thomas More, or Colloquies on the Progress and Prospects of Society* (London, 1829); Anne Manning, *The Household of Sir Thomas More* (1851, reprinted in King's Novels, 1905); S. Lee, *Great Englishmen of the Sixteenth Century* (1904). The tragedy of *Sir Thomas More*, edited by A. Dyce for the Shakespeare Society in 1844, and connected by some commentators with Shakespeare, was written about 1590, and therefore gives a nearly contemporary view of More. A later playwright, James Hurdis, made More's career the subject of a play in 1792. (M. P.)

MORÉAS, JEAN (1856–1910), French poet, born at Athens on the 15th of April 1856, was the grandson of Papadiomontopoulos, one of the heroes of Missolonghi. He was one of the leaders of the symbolist movement in French poetry, advocating a relaxation of the stringent rules governing French verse; but his early volumes of poems, *Les Syrtes* (1884), *Les Cantilènes* (1886), and *Le Pèlerin passionné* (1891) won recognition beyond the limits of this school. In the *XIXe siècle* (August 11, 1885) he formulated the principles of the symbolists, defending them from the appellation of "decadent," and in the literary supplement of the *Figaro* (Sep 18, 1886) he published a manifesto justifying the innovations of the new school as the natural development of the prosody of Baudelaire, Mallarmé and Verlaine. *Le Pèlerin passionné* was sympathetically reviewed by Anatole France. As time went on he repudiated the licence claimed by the symbolists, and became the leader of an offshoot from the main body known as the *école romane*, the chief members of which are Raymond de la Tailhède, Maurice du Plessys, Ernest Raynaud, and the critic Charles Maurras. Moréas and his new followers returned to the traditional severity of French versification, and to the classical and antique tradition. His later volumes are *Poésies, 1886–1896* (1898), and *Stances* (6 vols., complete ed. 1905), *Histoire de Jean de Paris, roi de France* (1902), *Voyage en Grèce en 1897* (1902), *Contes de la vieille France* (1903), and a classic drama in verse, *Iphigénie à Aulis* (1904), in close imitation of Euripides, which was represented on the 24th of August 1903 in the ancient theatre of Orange, and subsequently at the Odéon in Paris. He died on the 31st of March 1910.

See Anatole France, *La Vie littéraire* (4th ser., 1892); A. van Bever and P. Léautaud, *Poètes d'aujourd'hui, 1880–1900* (11th ed., 1905); P. Berthelot, art. "Symbolisme" in *La Grande encyclopédie*; and J. de Gourmont, *Jean Moréas, biographie critique* (1905).

MOREAU, GUSTAVE (1826–1898), French painter, was born in Paris on the 6th of April 1826. His father was an architect, who, discerning the lad's promise, sent him to study under Picot, a second-rate artist but clever teacher. The only influence which really affected Moreau's development was that of the painter Chassériau (1819–1857), with whom he was intimate when they both lived in the Rue Frochot, and of whom we find reminiscences even in his later works. Moreau's first picture was a "Pietà" (1852), now in the cathedral at Angoulême. In the Salon of 1853 he exhibited a "Scene from the Song of Songs" (now in the Dijon Museum) and the "Death of Darius" (in the Moreau Gallery, Paris), both conspicuously under the influence of Chassériau. To the Great Exhibition of 1855 he sent the "Athenians with the Minotaur" (in the Museum at Bourg-en-Bresse) and "Moses putting off his Sandals within Sight of the Promised Land." "Oedipus and the Sphinx," begun in 1862, and exhibited at the Salon of 1864, marked the beginning of his best period, during which he chose his subjects from history, religion, legend and fancy. In 1865 he exhibited "Medea and Jason" and "The Young Man and Death"; in 1866, the "Head of Orpheus" (in the Luxembourg Gallery); "Hesiod and the Muse," a drawing, and "The Peri," a drawing; "Prometheus" (in the Moreau Gallery); "Jupiter and Europa," a "Pietà," and "The Saint and the Poet," in 1869. After working in obscurity for seven years, he reappeared at the Salon in 1876 with "Hercules and the Hydra," "Saint Sebastian," "Salome Dancing" (presented to the Luxembourg by M. Hayem); and in 1878 with "The Sphinx's Riddle solved." "Jacob," and "Moses on the Nile." Moreau exhibited for the last time at the Salon of 1880, when he contributed "Helen" and "Galatea", to the Great Exhibition of 1889 he again sent the "Galatea" and "The Young Man and Death." He took prize medals at the Salon in 1864, 1865, 1869 and 1878. He was made knight of the Legion of Honour in 1875 and officer in 1883. He succeeded Delaunay as professor at the École des Beaux Arts, and his teaching was highly popular. When he died, on the 18th of April 1898, he bequeathed to the state his house, containing about 8000 pictures, water-colours, cartoons and drawings, which form the Moreau Gallery, one of the best organized collections in Paris, arranged by M. Rupp, his executor, and, together with Delaunay and Fromentin, one of his closest friends.

See Ary Renan, *Moreau* (Paris, 1900); Paul Flat, *Le Musée Gustave Moreau* (Paris, 1900).

MOREAU, HÉGÉSIPPE (1810–1838), French lyric poet, was born in Paris on the 9th of April 1810. In his early youth his parents, who were poor, migrated to Provins, where the mother went into service and the father took the post of usher in a public school. He went to Paris before 1830, and lived a Bohemian life. He was habitually houseless, and exposed himself to the dangers of a cholera hospital in the great epidemic of 1832 simply to obtain shelter and food. Then he revisited Provins and published a kind of satirical serial called *Diogène*. Some years of this life entirely ruined his health, and it was only just before his death that he succeeded in getting his collected poems published, selling the copyright for £4 sterling and 80 copies of the book. This volume, *Myosotis*, was received not unfavourably, but the author's death on the 20th of December 1838, in a refuge of the destitute, created an interest in it which was proportionately excessive. Moreau's work has a strong note of imitation, especially in his earlier songs, distinguished from those of his model, Béranger, chiefly by their elegiac note. Some of his poems, such as the elegy *La Voulzie* (1837) and the charming romance *La Fermière* (1835), have great sweetness and show incontestable poetic power. Moreau wrote some charming prose stories: *Le Gui de chêne*, *La Souris blanche*, &c.

MOREAU, JEAN VICTOR MARIE (1763–1813), French general, was born at Morlaix in Brittany on the 14th of February 1763. His father was an *avocat* in good practice, and instead of allowing him to enter the army, as he attempted to do, insisted on his studying law at the university of Rennes. Young Moreau showed no inclination for law, but revelled in the freedom of a student's life. Instead of taking his degree he continued to live with the students as their hero and leader, formed them into a sort of army, which he commanded as their provost; and when 1789 came he commanded the students in the daily affrays which took place at Rennes between the young *noblesse* and the populace. In 1791 he was elected a lieut.-colonel of the volunteers of Ille-et-Vilaine. With them he served under Dumouriez, and in 1793 the good order of his battalion, and his own martial character and republican principles secured his promotion as general of brigade. Carnot, who had an eye for the true qualities of a general, promoted him to be general of division early in 1794, and gave him command of the right wing of the army under Pichegru, in Flanders. The battle of Tourcoing established his military fame, and in 1795 he was given the command of the Army of the Rhine-and-Moselle, with which he crossed the Rhine and advanced into Germany. He was at first completely successful, won several victories and penetrated to the Isar (see FRENCH REVOLUTIONARY WARS), but at last had to retreat before the archduke Charles. However, the skill he displayed in conducting his retreat—which was considered a model for such operations—greatly enhanced his own reputation, the more so as he managed to bring back with him more than 5000 prisoners. In 1797 he again, after prolonged difficulties caused by want of funds and material, crossed the Rhine, but his operations were checked by the conclusion of the preliminaries of Leoben between Bonaparte and the Austrians. It was at this time he found out the traitorous correspondence between his old comrade and commander Pichegru and the émigré prince de Condé. He had already appeared as Pichegru's defender against imputations of disloyalty, and now he foolishly concealed his discovery, with the result that he has ever since been suspected of at least partial complicity. Too late to clear himself, he sent the correspondence to Paris and issued a proclamation to the army denouncing Pichegru as a traitor. He was dismissed, and it was only when in 1799 the absence of Bonaparte and the victorious advance of Suvárov made it necessary to have some tried and experienced general in Italy that he was re-employed. He commanded the Army of Italy, with little success, for a short time before being appointed to the Army of the Rhine, and remained with Joubert, his successor in Italy, till Novi had been fought and lost. Joubert fell in the battle, and Moreau then conducted the retreat of the army to Genoa, where he handed over the command to Championnet. When Bonaparte returned from Egypt he found Moreau at Paris, greatly dissatisfied with the Directory both as a general and as a republican, and obtained his assistance in the *coup d'état* of 18 Brumaire, when Moreau commanded the force which confined two of the directors in the Luxembourg. In reward, the First Consul again gave him command of the Army of the Rhine, with which he forced back the Austrians from the Rhine to the Isar. On his return to Paris he married Mlle Hullot, a Creole of Josephine's circle, an ambitious woman who gained a complete ascendancy over him, and after spending a few glorious weeks with the army in Germany and winning the celebrated victory of Hohenlinden (Dec. 3, 1800) he settled down to enjoy the fortune he had acquired during his campaigns. His wife collected around her all who were discontented with the aggrandisement of Napoleon. This "club Moreau" annoyed Napoleon, and encouraged the Royalists, but Moreau, though not unwilling to become a military dictator to restore the republic, would be no party to an intrigue for the restoration of Louis XVIII. All this was well known to Napoleon, who seized the conspirators. Moreau's condemnation was procured only by great pressure being brought to bear by Bonaparte on the judges; and after it was pronounced the First Consul treated him with a pretence of leniency, commuting a sentence of imprisonment to one of banishment. Moreau passed through Spain and embarked for America, where he lived in quiet and obscurity for some years at Morrisville, New Jersey, till news came of the destruction of the *grande armée* in Russia. Then, probably at the instigation of his wife, he committed the last and least excusable of the series of well-meant political errors that marked his career. Negotiations were set on foot with an old friend in the circle of republican intriguers, Bernadotte, who, being now crown prince of Sweden and at the head of an army opposing Napoleon, introduced Moreau to the tsar Alexander. In the hope of returning to France to re-establish the régime of popular government, Moreau gave advice to the allied sovereigns as to the conduct of the war, but fortunately for his fame as a patriot he did not live to invade France. He was mortally wounded while talking to the tsar at the battle of Dresden on the 27th of August 1813, and died on the 2nd of September. He was buried at St Petersburg. His wife received a pension from the tsar, and was given the rank of maréchale by Louis XVIII., but his countrymen spoke of his "defection" and compared him to Dumouriez and Pichegru.

Moreau's fame as a general stands very high, though he was far from possessing Napoleon's transcendent gifts. His combinations were skilful and elaborate, and his temper always unruffled when most closely pressed. Moreau was a sincere republican, though his own father was guillotined in the Terror. He was fortunate in the moment of his death, though he would have been more so had he died in America. He seems by his final words, "Soyez tranquilles, messieurs; c'est mon sort," not to have regretted being removed from his equivocal position as a general in arms against his country.

The literature on Moreau is copious, the best book being C. Jochmus, *General Moreau—Abriss einer Geschichte seines Lebens und seiner Feldzüge* (Berlin, 1814). A more ordinary work is A. de Beauchamp, *Vie politique, militaire, et privée du Général Moreau*, translated by Philippart (London, 1814); and there is a curious tract on his death in Russian, translated into English under the title, *Some Details Concerning General Moreau and his Last Moments*, by Paul Svinin (London, 1814).

MOREAU DE SAINT MÉRY, MÉDÉRIC LOUIS ÉLIE (1750–1819), French politician, was born at Fort de France, in the island of Martinique, on the 28th of January 1750. He came to Paris at the age of nineteen, and became an *avocat* at the parlement of Paris. He subsequently returned to Martinique to practise law, and in 1780 was appointed member of the colonial council of San Domingo. Returning to Paris in 1784, he received a commission to study the legislation of the French colonies, and published *Lois et constitutions des colonies françaises de l'Amérique sous le Vent de 1550 à 1785*. In 1789 he was president of the assembly of the electors of Paris, played an active part in the early days of the Revolution, and was designated by Martinique deputy to the Constituent Assembly. His moderate ideas were the occasion of his arrest after the 10th of August 1792, but he contrived to escape to the United States, opened a bookseller's shop at Philadelphia, and published *Déscription topographique et politique de la partie espagnole et de la partie française de l'Île de Saint-Domingue* (1796–1798). Returning to France in 1799, he became historiographer to the navy and councillor of state, and drafted in part the colonial and maritime code. In 1802 he was appointed by the First Consul administrator of the duchies of Parma, Piacenza, and Guastalla, but was dismissed in 1806 for slackness in repressing insubordination. From that date until his death he lived on a pension paid him by the Empress Josephine, who was a kinswoman of his.

See Fournier-Tescay, *Discours prononcé aux obsèques de Moreau le 30 Janvier 1819*; Silvestre, *Notice sur Moreau* (Paris, 1819).

MORECAMBE, a municipal borough, watering-place and seaport in the Lancaster parliamentary division of Lancashire, England, on Morecambe Bay, 236 m. N.W. by N. from London by the London & North-Western railway; served also by the Midland railway. Pop. (1901), 11,798. A fine promenade extends along the shore; there are a quay and a pier, a winter garden, and all the appointments of a seaside resort. The Midland railway is the harbour authority. The town was incorporated in 1902, and the corporation consists of a mayor, 6 aldermen and 16 councillors. The former alternative name was Poulton-le-Sands. Area, 1801 acres.

MOREL, the surname of several French classical scholars and printers in the 16th and 17th centuries, known for their editions of classical authors and the Fathers. (1) Guillaume Morel (1505–1564) was born at Tilleul in Normandy. After acting as proof-reader in a Paris firm, he set up for himself, and subsequently succeeded Turnebus as king's printer in 1555. His most important work was *Thesaurus vocum omnium latinarum*, containing a number of quotations from Greek authors, taken from hitherto unpublished MSS. in the Paris library. (2) Fédéric (as he always called himself, not Frédéric) Morel, surnamed the Elder (1523–1583), was born in Champagne. He was of noble family, and was not connected with Guillaume Morel. About 1550 he married the daughter of the famous printer, Michel de Vascosan, in 1557 set up in business in the rue Saint Jean de Beauvais, and in 1571 was appointed printer to the king. His chief publications were the *Declamationes* of Quintilian and *L'Architecture de Philibert Delorme.* (3) Fédéric Morel, son of the preceding, surnamed the Younger (1558–1630), was one of the greatest Greek scholars of his time. In addition to the management of his father's business, to which he succeeded, he held the professorship of eloquence at the Collège de France. The number of his translations and commentaries on the Fathers and classical authors (Aristotle, Dio Chrysostom, Strabo) was very large; special mention may be made of his revised edition of Amyot's translation of *Plutarch* and his Latin translations of some of the dissertations of Maximus of Tyre, of Libanius, Hierocles and Theodoret. His commentary on the Psalms is still considered valuable. (4) Claude Morel (1574–1626), brother of the preceding, also published editions of many of the Fathers and other authors, with learned prefaces and notes. (5) Charles Morel (1602–1640) was printer and secretary to the king. He followed the example of the other members of his family, and issued the works of Clement of Alexandria, Gregory of Nazianzus, Cyril, Synesius and Chrysostom, and the *Concilia generalia et provincialia* of the German theologian Severin Bini. (6) Gilles Morel, brother of the preceding (the dates of his birth and death are unknown), was the last representative of this learned family. The number of his publications was small, but some of them were of great importance, the chief being the *Grande bibliothèque des pères*, in 17 folio vols. (1643).

See M. Maittaire, *Historia typographorum aliquot parisiensium* (1717), for all the above; Fédéric Morel the elder is the subject of a monograph by J. Dumoulin (Paris, 1901).

MORELIA (formerly Valladolid), a city of Mexico and capital of the state of Michoacán, 125 m. direct and 234 m. by rail W. by N. of the city of Mexico, near the southern margin of the great Mexican plateau, 6398 ft. above sea-level, in lat. 19° 42′ N. long., 100° 54′ W. Pop. (1900), 37,278, partly Indians and mestizos. Morelia is served by a branch of the Mexican National railway; its station is outside the city, with which it is connected by a small tramway line. The city is built on a rocky hill rising from the Guayángareo valley, which gives to it a strikingly picturesque appearance. It has the usual rectangular plan, with several pretty squares and straight, clean, well-paved streets. Facing the *plaza mayor*, now called the Plaza de los Martíres because of the execution there of the patriot Matamoros in 1814, is the cathedral, one of the finest specimens of the old Spanish renaissance church architecture in Mexico.

Among its interior adornments is an onyx font, some fine wood carving in the choir, and the silver doors to the shrines of its chapels. Opposite the cathedral is the government palace, which also contains the public library. The municipal government is housed in an ancient tobacco factory converted to public uses, and a fine old Capuchin convent now serves as a public hospital. The Paseo, or public park, is distinguished for its fine trees and flowers. The Morelianos are noted for their love of music, and musical competitions are held each year, the best band being sent to the city of Mexico to compete with similar organizations from other states. The public water-supply is brought into the city over a fine old aqueduct (3 m. in length, carried on arches), which was built in 1785 by the bishop of the diocese as a famine relief work. In common with the state of Michoacán, Morelia is a stronghold of clericalism and conservatism. A large number of private schools are maintained through Church influence in opposition to the public schools. Conspicuous among these is a large girls' school. Another institution is the college of San Nicolas de Hidalgo, which was founded at Patzcuaro in 1540 by Bishop Quiroga (who had been sent into Michoacán to redress the wrongs committed by Nuño de Guzman), was removed to Valladolid (Morelia) a few years later to be combined with a local college, and was rebuilt in 1882. It is the oldest existing collegiate institution in Mexico; in it Hidalgo once taught and Morelos was a student. The city's manufactures include cotton, woollen and silk textiles, cigars and cigarettes, and *dulces*, or sweetmeats, Morelia being noted throughout Mexico for the latter, particularly for a variety called Guayabate.

Morelia, first known as Valladolid, was founded in 1541 by Viceroy Mendoza. In 1582 Valladolid replaced Patzcuaro as the capital of Michoacán. It was the birthplace of both Morelos and Iturbide, and was captured by Hidalgo at the beginning of the revolutionary outbreak of 1810–11, and by Iturbide in 1821 when on his march to Mexico City, where he was crowned emperor. Its name was changed to Morelia in 1828, in honour of the revolutionary leader José María Morelos y Pavón, and in 1863 it was made the see of an archbishop.

MORELL, JOHN DANIEL (1816–1891), British educationalist, was born on the 18th of June at Little Baddow, Essex, where his father was minister of the Congregational church (1799–1852). He proceeded to Homerton College in 1833, where he studied theology under Dr Pye Smith. He then entered Glasgow University, where he took his M.A. degree in 1841. Subsequently he studied philosophy and theology under Fichte at Bonn, and returned to England to undertake the pastorate of the Congregational church at Gosport. After three years' work, he decided to give up the ministry in favour of philosophical work. As early as 1846 he made his name by his *Historical and Critical View of the Speculative Philosophy of Europe in the Nineteenth Century*, which brought him to the notice of Lord Lansdowne, who made him an inspector of schools. From 1848 till 1876 he was active in this capacity. As a result of his experience he published numerous educational works, *e.g. The Analysis of Sentences* (1852), *The Essentials of English Grammar and Analysis* (1855), *Handbook of Logic* (1855), *Grammar of the English Language* (1857). He also published four lectures on *The Philosophical Tendencies of the Age* (1848), *The Philosophy of Religion* (1849), *Fichte's Contributions to Moral Philosophy* (1860), *Philosophical Fragments* (1878), *An Introduction to Mental Philosophy on the Inductive Method* (1884). He died on the 1st of April 1891.

MOREL-LADEUIL, LÉONARD (1820–1888), French goldsmith and sculptor, was born at Clermont-Ferrand. He was apprenticed first to Morel, a manufacturer of bronzes, under whom he became one of the most expert chasers, or *ciseleurs*, in France, and then to Antoine Vechte, to acquire the art of *repoussé* (*q.v.*)—the art in which he was to excel. He studied further under J. J. Feuchère and then attracted the notice of the comte d'Orsay and the duc de Morny, through whose recommendation the French government, desirous of popularizing the idea of the new Imperialism, commissioned him to produce the "Empire Shield." Napoleon III. notified his warm approval, but the trade, annoyed that a craftsman should obtain commissions direct, resented the innovation and thenceforward boycotted the young artist, whose beautiful and poetic vase, "Dance of the Willis" (the spirits dancing round the vase, above the lake represented on a dish below) none would take. He was encouraged nevertheless by a foreign dealer in Paris, Marchi, who employed him on statuettes, mainly religious in character, until 1859, when Messrs Elkington, in view of the great exhibition of 1862, engaged him to work in Birmingham for three years in *repoussé*, assuring him a free hand. Following his silver "Night" came "Day," and then the "Inventions" vase, which placed him at once at the top of his profession. This was followed by the beautiful plateau called "Dreams," which was subscribed for (£1500) by Birmingham as the town wedding-gift to the prince and princess of Wales. Morel-Ladeuil's contract was then renewed for five years, but as a matter of fact he remained with the firm for twenty-three years at their London house, the first result being his masterpiece the "Milton Shield: Paradise Lost" (in *repoussé* steel and silver), which was the sensation of the Paris Exhibition. It was bought by the English government for £3000, and thousands of copies made by "galvanoplastie" or electrotype were sold and spread all over the world. Then after "The Months" came another masterpiece, the "Helicon Vase," in steel, silver, and gold, priced at £6000, which in course of time was presented by the ladies and gentlemen of the royal house to Queen Victoria on her first jubilee. For the Philadelphia Exhibition (1876) Morel-Ladeuil produced "A Pompeian Lady at her Toilet," following it in 1878 with the "Bunyan Shield," a companion to the Milton. After putting forth his reliefs "The Merry Wives of Windsor," "The Merchant of Venice," and "Much Ado about Nothing," in view of his failing health he retired to Boulogne, where he died of angina pectoris on the 15th of March 1888, and was buried with much ceremony at Clermont-Ferrand. His total work, apart from the productions of his youth, numbers 35 pieces, which richly reveal his elegant and refined fancy and grace, his feeling for correct and dainty ornament, and his love of pure art marked by an elevated if rather sentimental taste and a noble style.

See *L'Œuvre de Morel-Ladeuil, sculpteur-ciseleur*, by L. Morel (Paris, 1904).

MORELLET, ANDRÉ (1727–1819), French economist and miscellaneous writer, was born at Lyons on the 7th of March 1727. He was one of the last survivors of the *philosophes*, and in this character he figures in many memoirs, such as Mme de Rémusat's. He was educated by the Jesuits in his native town, and at the Sorbonne; he then took holy orders, but his designation of abbé was the chief thing clerical about him. He had a ready and biting wit, and Voltaire called him "L'Abbé Mord-les." His work was chiefly occasional, and the most notable parts of it were a smart pamphlet in answer to Charles Palissot's scurrilous play *Les Philosophes* (which procured him a short sojourn in the Bastille for an alleged libel on Palissot's patroness, the princesse de Robeck), and a reply to Galiani's *Commerce des blés* (1770). Later, he made himself useful in quasi-diplomatic communications with English statesmen, and was pensioned, being, moreover, elected a member of the Academy in 1785. A year before his death in Paris on the 12th of January 1819 he brought out four volumes of *Mélanges de littérature et de philosophie du XVIII^e siècle*, composed chiefly of selections from his former publications, and after his death appeared his valuable *Mémoires sur le XVIII^e siècle et la Révolution* (2 vols., 1821).

A bibliography of his numerous works is given in Quérard's *La France littéraire*, vol. vi.; see also Sainte-Beuve, *Causeries du lundi*, vol. i.

MORELLI, GIOVANNI (1816–1891), Italian patriot and art critic, was born at Verona on the 16th of February 1816. He was educated first at Bergamo, the home of his mother, who had removed thither on the death of her husband; and then at Aarau in Switzerland. At the age of eighteen he commenced his university career at Munich, being debarred as a Protestant from entering any Italian college, and became the pupil of Ignatius Döllinger, the celebrated professor of anatomy and physiology. Natural philosophy and medicine were the studies to which he specially devoted himself, but he was also keenly interested in all scientific and literary pursuits. At Munich, and later at Erlangen, Berlin and Paris, his brilliant gifts and independence of thought and judgment attracted the attention of the most distinguished men of the day. In Paris he became intimate with Otto Mündler, and his intercourse with that eminent art critic was not without its effect in determining the direction of his future studies; and, during a summer spent in Switzerland, he formed a friendship with Louis Agassiz, whose teaching made a deep and lasting impression upon him. On his return to Italy in 1840 he became associated in Florence with that band of patriots who were strenuously labouring for the deliverance of their country from the oppressive Austrian rule. He took an active part in the war of 1848, and was subsequently chosen by the provisional Lombard government to plead the cause of Italian unity before the German parliament assembled at Frankfort. In 1860, in recognition of the great services rendered to his country by Morelli, Victor Emmanuel named him a citizen of the Sardinian kingdom, and in the following year he was elected deputy for Bergamo to the first free Italian parliament. He was a staunch supporter of Cavour, and, though never a leading politician, exercised a considerable influence over the most prominent statesmen of the Right, who valued his sound judgment, integrity, moderation and foresight. One of his first acts after his election was to draw the attention of parliament to the urgent need of reform in the administration of matters relating to the fine arts. In consequence of his representations, a commission was appointed with the object of bringing under government control all works of art which could be considered public property. The commission, of which Morelli was named president, began its work in Umbria and the Marches, and he appointed as his secretary G. B. Cavalcaselle, who was then engaged in collecting materials for a work on Italian art. According to one who knew Morelli well, much that Cavalcaselle then learned from his chief was embodied in the well-known *History of Painting*, which was published in 1864 in conjunction with Sir Joseph Crowe.

The immediate result of Morelli's first labours in the Marches was the passing of the law, which bears his name, strictly prohibiting the sale of works of art from public and religious institutions. In 1873 he was named a senator of the kingdom of Italy, having voluntarily resigned his seat in the Lower House owing to the increasingly democratic tendencies of the Chamber. In Rome, the seat of the government since 1870, he spent several months of each year; but his settled home was Milan, whither he had removed from Bergamo in 1874. Here he published some of his researches into the history of Italian art. In order to be free to speak his mind unreservedly, he determined to adopt a pseudonym and to write in German. His first contributions, a series of articles on the Borghese Gallery, were published in Lützow's *Zeitschrift für bildende Kunst* between the years 1874 and 1876. Posing as an art-loving Russian, who puts forth his opinions with the utmost diffidence, he adopted the pseudonym of Ivan Lermolieff—an anagram of his own name with a Russian termination—and described his essays as *Ein kritischer Versuch*, translated from the Russian by Johannes Schwarze, this time a Germanized form of Morelli.

The originality of the method recommended by the author for studying art, the general soundness of his critical opinions, and the many new (and apparently correct) attributions suggested for pictures in the Borghese Gallery and elsewhere, attracted the attention of all students of art; but failure attended every attempt to discover the identity of the Russian critic. In 1880 Morelli published a small book under the same pseudonym, entitled, *Die Werke italienischer Meister in den Galerien von München, Dresden und Berlin.* The appearance of this volume, which was cast in so original a form that it was altogether unlike anything which had preceded it in the realm of art scholarship, created an extraordinary sensation. The daring opinions expressed by the author struck at the roots of all existing art criticism, and were often diametrically opposed to the views of the most renowned art historians of the day. The importance of the work could not be denied, and in spite of determined opposition and searching and bitter attacks, it gained general recognition as a standard work which no serious student of art could ignore. It inaugurated a new and more scientific method of criticism, and marks an epoch in the art studies of the 19th century. The book was translated into English in 1883, with Morelli's own name upon the title-page, and a few years later into Italian. In the decade between 1880 and 1890 he contributed three articles to German periodicals: *Perugino oder Raffael, Raffaels Jugendentwickelung, Noch einmal das venezianische Skizzenbuch.* Being addressed to critics who had challenged his opinions, they are somewhat polemical in character, but contain a mass of information, more especially about drawings. He also wrote a skit on art connoisseurship in Europe, intending to publish it in English as the reflections of an American on the follies of art critics in the Old World; but he never carried out his intention, though some portion of the MS. was embodied in the first part of his *Critical Studies.* This volume, the first of a series of three which, under the title of *Kunstkritische Studien*, was to contain all Morelli's contributions to art literature, was published in 1890. The first part, cast in dialogue form, contains a detailed exposition of his method. Then follow *The Borghese Gallery*, a reissue of his former articles with many important additions, and *The Doria Gallery*, an entirely new contribution. The second volume deals with the galleries of Munich and Dresden, and is a revised edition of the first two parts of the original book of 1880; but here again copious additions rendered it practically a new book. The third volume was to treat of the Berlin Gallery, and was also to contain an exhaustive account of the drawings of Italian masters, but it was destined never to be carried out. Morelli was taken seriously ill towards the middle of February 1891, and was found to be suffering from heart disease and other complications; a fortnight later he died at Milan, on the 28th of February. His collection of drawings by the old masters he bequeathed to his pupil, Dr Frizzoni, and his pictures, over 100 in number, to the city of Bergamo, where they are now exhibited as the Galleria Morelli in two rooms of the Accademia Carrara. A striking half-length portrait by Lenbach, who presented it to his friend in 1886, forms part of the collection. In memory of Morelli a bronze bust of him by a Milanese artist has been placed in the Brera; but his features are more worthily presented in a second portrait by Lenbach and in a life-like pastel sketch executed by the Empress Frederick in 1884, when he was her guest at Baveno. After the death of Morelli the first two volumes of his *Critical Studies* were published in English, Sir Henry Layard, one of his most intimate friends, contributing to the first a biographical sketch of the author; and the fragmentary MS. of the third volume was published in German by Dr Frizzoni, under whose editorship an Italian translation of the first volume has also been issued.

Morelli found art criticism uninspired, unscientific and practically worthless. To be of any real value he held that historical, documentary and traditional knowledge respecting works of art was only of secondary importance as compared with the evidence to be derived from the study of the pictures themselves. He contended that art criticism must be conducted on scientific principles and follow a strict course of inductive reasoning. A painting should be subjected to a searching analysis, and its component parts and minutest details submitted to methodical and exact investigation.

The study of the individual parts and forms was, in his estimation, of the highest importance, for they were not mere incidents, but the outward and visible seal of an artist's character stamped upon his work, and obvious to all who had eyes to see. By diligent observation of the forms the rudiments of the language of art might be mastered, and the first step taken towards initiating a methodized system of study. The education of a critic consists chiefly in learning to compare, and Morelli soon recognized the value of systematic comparison in the study of art. By the combined methods of critical analysis and comparative observation he found the clue he had so long been seeking. Studying one day in the Uffizi, it suddenly struck him that in a picture by Botticelli containing several figures the drawing of the hands was remarkably similar in all; that the same characteristic but plebeian type, with bony fingers, broad square nails, and dark outlines, was repeated in every figure. Turning to the ears, he observed that they also were drawn in an individual manner, and that in the numerous figures in which the ear was visible the same typical form recurred. Having noted these fundamental forms, he proceeded to an examination of other works by this painter, and found that the same forms were exactly repeated, together with other individual traits which seemed distinctive of the master: the characteristic type of head and expression, the drawing of the nostrils, the vitality of movement, the disposition of drapery, harmony of colour (where it had not been tampered with by the restorer), and quality of landscape. In all Botticelli's true works the presence of these and other characteristics proclaimed their genuineness. In paintings where the forms and types were those of the painter, but where vitality, movement, and all deeper qualities were absent, Morelli recognized works executed from the master's cartoons; while in pictures where neither types nor forms responded to the test, and where only a general family likeness connected them with Botticelli, he discerned the productions of pupils and imitators. After applying his method to the works of Botticelli, he proceeded to examine those of other Florentine masters, and afterwards of painters of other Italian schools, everywhere meeting with results to him not less convincing. If the drawing of the hand and ear were not always conspicuous, there were other peculiarities of this language of form to aid in the identification of a master: the treatment of the hair, as in Piero dei Franceschi; the indication of the sinews, as in Foppa; the drawing of the eye, as in Liberale da Verona; the modelling of the eyelid and upper lip, as in Ambrogio de Predis; the form of the feet, as in Luini. In short, all apparently insignificant details were of importance in his plan of study, for to him they were like the signature of the master. (C. J. F.*)

MORELOS, an inland state of Mexico on the southern slope of the great Mexican plateau, lying S. of the Federal District, with the states of Puebla on the E. and S.E., Guerrero on the S., and Mexico on the W., N. and N.E. Pop. (1900), 161,697, including a large percentage of Indians and mixed bloods. Area, 2773 sq. m. Its surface is roughly broken by mountain ranges extending southward from the Sierra de Ajusco, forming numerous valleys opening southward. It is drained by the Amacusac river, a northern tributary of the Mescala, or Balsas. There is a wide variation of climate for so small a territory, the higher elevations of the Sierra de Ajusco being cold and humid (the Mexican Central crosses the range at an elevation of 9974 ft.); the lower spurs mild, temperate and healthy, the lower valleys subtropical, hot and unhealthy. The rainfall is light in the lower regions and irrigation is generally employed. Notwithstanding its mountainous character, Morelos is one of the most flourishing agricultural states of Mexico, producing sugar, rice, Indian corn, coffee, wheat, fruit and vegetables. Although the state is supposed to have several of the minerals found in this part of Mexico (silver, cinnabar, iron, lead, gold, petroleum and coal), its mining industries continue undeveloped and neglected. San Antonio, a suburb of Cuernavaca, is noted for its pottery, which is highly attractive in form and colour, and finds a ready market among the visitors to that city. Morelos is traversed by two railway lines—the Interoceanic from N.E. to S.W., and the Mexican Central almost N. and S., the latter affording direct communication between the national and state capitals.

The capital, CUERNAVACA (pop. 9584 in 1900), 47 m. S. of the city of Mexico on the Mexican Central railway, is one of the most picturesque towns in Mexico. It dates from the time of Cortés, who built for himself a residence there, and had the town included in the royal grant to himself in 1529. Maximilian had a villa there, and many of the public men of Mexico, natives of the lowlands, have made their homes there rather than in the national capital. The palace of Cortés is now occupied by the state legislature and by various public offices, and Maximilian's villa by a school.

After the capital the largest city in the state is Cuautla Morelos, or Ciudad Morelos (pop. 6269 in 1900), 27 m. east by south of Cuernavaca, on the Interoceanic railway, and in a rich sugar-producing district. Some of the largest and most modern sugar-mills of Mexico are in the Cuautla district. There are hot sulphur springs here. The town is celebrated in Mexican history for the intrepid defence of the place by José Maria Morelos (1765–1815), the patriot leader, against a greatly superior royalist force, from the 19th of February to the 2nd of May 1812, when he cut his way through the attacking army and escaped. Other important towns are Yautepec (6139 in 1900), 16 m. east of Cuernavaca, on the Interoceanic line; Tetecala, 13 m. south-west of the capital, a characteristic Indian town near the pyramid of Xochicalco, and Jojutla, 21 m. south of the capital, on the Interoceanic railway near the southern boundary of the state. An interesting local phenomenon is that of lake Tequesquiten, which was formed by the subsidence of a large area of ground about the middle of the 19th century, carrying with it an old town of the same name. The hollow filled with water, and the spire of the old church is still to be seen in the middle of the lake.

MORESNET, a small neutral state lying on the borders of Prussia and Belgium, 4 m. S.W. of Aix-la-Chapelle, and embracing an area of nearly 1400 acres. Its only village is that of Neutral Moresnet, also called Kelmis or Kalmis, with 2800 inhabitants. Just over the Prussian frontier is Prussian Moresnet, with 650 inhabitants, and in Belgium is Belgian Moresnet, with about 1200. Moresnet, strictly Montzen-Moresnet, is, as its name implies, a mountain, under which is the extremely valuable zinc mine owned by the "Vieille Montagne Company," which is a Belgian undertaking. The profit of the customs is divided between the two states, but a tendency has been observed to convert it gradually into a German possession. The state of Moresnet owes its origin to the general European settlement of 1815. No agreement could be reached about the ownership of this small district, and it was made a neutral state under the joint government of Prussia and Belgium. This arrangement lasted until 1841, when Moresnet was given an administration of its own, this being composed of a burgomaster and a council of ten members. The inhabitants decide individually whether they will perform military service for Prussia or for Belgium, and also whether they will accept the jurisdiction of the Prussian or of the Belgian courts.

See Hoch, *Un Territoire oublié au centre de l'Europe* (Bern, 1881); Schröder, *Das grenzstreitige Gebiet von Moresnet* (Aix-la-Chapelle, 1902); and Spandau, *Zur Geschichte von Neutral-Moresnet* (Aix-la-Chapelle, 1904).

MORETON BAY CHESTNUT, a tall tree known botanically as *Castanospermum australe* (natural order Leguminosae), native of Queensland and New South Wales. The pods are almost cylindrical, about 9 in. long and 2 in. broad, and are divided interiorly by a spongy substance into three to five cells, each of which contains a large chestnut-like seed. The seeds are roasted and eaten by the natives; the timber, which somewhat resembles walnut, is soft, fine-grained, and takes a good polish, but is not durable.

MORETO Y CAVANA, AGUSTIN (1618–1661), Spanish dramatist and playwright, was baptized at Madrid on the 9th of April 1618. He graduated at Alcalá in December 1639, and resided in Madrid till 1654, when he removed to Toledo, took orders, and became chaplain to the primate Baltasar de Moscoso y Sandoval. He died at Toledo on the 28th of October 1661, while engaged on *Santa Rosa*, a play which was completed by Pedro Francisco Lanini. The first volume of his dramas was published in 1654; the second and third volumes appeared in 1676. The most celebrated of his pieces is *El Desdén con el Desdén*, imitated by Molière in *La Princesse d'Élide*, by Gozzi in *La Principessa filosofa*, and by Schreyvogel in *Donna Diana*. It is characteristic that four episodes in *El Desdén con el Desdén* are taken from four separate plays of Lope de Vega's (*La Vengadora de las mujeres*, *Las Milagros del desprecio*, *De Corsario á corsario*, and *La Hermosa fea*). Moreto borrows from Castro, Tirso de Molina and others to an extent which is indicated at length in Fitzmaurice-Kelley's *Littérature espagnole* (Paris, 1904), but his adaptation shows great dexterity and charm.

MORETTO, IL ("The Blackamoor," a term which has not been particularly accounted for), the name currently bestowed upon ALESSANDRO BONVICINO (1498–1554), a celebrated painter of Brescia, Venetian school. He was born at Rovato, in the Brescian territory, in 1498, and studied, first under Fioravante Ferramola of Brescia, afterwards, still youthful, with Titian in Venice. His own earlier method, specially distinguished by excellent portrait-painting, was naturally modelled on that of Titian. Afterwards he conceived a great enthusiasm for Raphael (though he does not appear to have ever gone to Rome), and his style became partially Raphaelesque. It was, however, novel in its combination of diverse elements, and highly attractive—with fine pencilling, a rich yet not lavish use of perspective and decorative effects, and an elegant opposition of light and shade. The human figure is somewhat slender in Bonvicino's paintings, the expression earnestly religious, the flesh-tints varied, more so than was common in the Venetian school. The backgrounds are generally luminous, and the draperies well modified in red and yellow tints with little intermixture of blue. The depth of Bonvicino's talent, however, was hardly in proportion to its vigour and vivacity; and he excelled more in sedate altarpieces than in subjects of action, and more in oil-painting than in fresco, although some fine series of his frescoes remain, especially that in the villa Martinengo at Novarino, near Brescia. Among his celebrated works in the city are—in the church of S. Clemente, the "Five Virgin Martyrs," and the "Assumption of the Madonna" (this latter may count as his masterpiece); in S. Nazaro e Celso, the "Coronation of the Madonna"; in S. Maria della Grazie, "St Joseph"; in S. Maria de' Miracoli, "St Nicholas of Bari." In the Vienna Gallery is a "St Justina" (once ascribed to Pordenone); in the Städel Institute, Frankfort, the "Madonna enthroned between Sts Anthony and Sebastian"; in the Berlin Museum, a colossal "Adoration of the Shepherds," and a large votive picture (one of the master's best) of the "Madonna and Child," with infant angels and other figures above the clouds, and below, amid a rich landscape, two priests; in the National Gallery, London, St Bernardin and other saints and two impressive portraits. Il Moretto is stated to have been a man of child-like personal piety, preparing himself by prayer and fasting for any great act of sacred art, such as the painting of the Virgin-mother. His dated works extend from 1524 to 1554, and he was the master of the pre-eminent portrait-painter Moroni. He died on the 22nd of December 1554.

MORGAGNI, GIOVANNI BATTISTA (1682–1771), Italian anatomist, was born on the 25th of February 1682 at Forlì.[1] His parents were in comfortable circumstances, but not of the nobility; it appears from his letters to G. M. Lancisi that Morgagni was ambitious of gaining admission into that rank, and it may be inferred that he succeeded from the fact that he is described on a memorial tablet at Padua as "*nobilis forolensis*." At the age of sixteen he went to Bologna to study philosophy and medicine, and he graduated with much *éclat* as doctor in both faculties three years later (1701). He acted as prosector to A. M. Valsalva (one of the distinguished pupils of Malpighi), who held the office of "demonstrator anatomicus" in the Bologna school, and whom he assisted more particularly in preparing his celebrated work on the *Anatomy and Diseases of the Ear*, published in 1704. Many years after (1740) Morgagni edited a collected edition of Valsalva's writings, with important additions to the treatise on the ear, and with a memoir of the author. When Valsalva was transferred to Parma Morgagni succeeded to his anatomical demonstratorship. At this period he enjoyed a high repute in Bologna; he was made president of the Academia Inquietorum when in his twenty-fourth year, and he is said to have signalized his tenure of the presidential chair by discouraging abstract speculations, and by setting the fashion towards exact anatomical observation and reasoning. He published the substance of his communications to the Academy in 1706 under the title of *Adversaria anatomica*, the first of a series by which he became favourably known throughout Europe as an accurate anatomist; the book included "Observations on the Larynx, the Lachrymal Apparatus, and the Pelvic Organs in the Female." After a time he gave up his post at Bologna, and occupied himself for the next two or three years at Padua, where he had a friend in Domenico Guglielmini (1655–1710), professor of medicine, but better known as a writer on physics and mathematics, whose works he afterwards edited (1719) with a biography. Guglielmini desired to see him settled as a teacher at Padua, and the unexpected death of Guglielmini himself made the project feasible, Antonio Vallisneri (1661–1730) being transferred to the vacant chair, and Morgagni succeeding to the chair of theoretical medicine. He came to Padua in the spring of 1712, being then in his thirty-first year, and he taught medicine there with the most brilliant success until his death on the 6th of December 1771.

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[1] His statue was erected at Forlì in 1875, and the town library preserves fourteen manuscript volumes of his writings.

When he had been three years in Padua an opportunity occurred for his promotion (by the Venetian senate) to the chair of anatomy, in which he became the successor of an illustrious line of scholars, including A. Vesalius, G. Fallopius, H. Fabricius, Gasserius, and A. Spigelius, and in which he enjoyed a stipend that was increased from time to time by vote of the senate until it reached twelve hundred gold ducats. Shortly after coming to Padua he married a lady of Forlì, of noble parentage, who bore him three sons and twelve daughters. Morgagni enjoyed an unequalled popularity among all classes. He was of tall and dignified figure, with blonde hair and blue eyes, and with a frank and happy expression; his manners were polished, and he was noted for the elegance of his Latin style. He lived in harmony with his colleagues, who are said not even to have envied him his unprecedentedly large stipend; his house and lecture-theatre were frequented "tanquam officina sapientiae" by students of all ages, attracted from all parts of Europe; he enjoyed the friendship and favour of distinguished Venetian senators and of cardinals; and successive popes conferred honours upon him. Before he had been long in Padua the students of the German nation, of all the faculties there, elected him their patron, and he advised and assisted them in the purchase of a house to be a German library and club for all time. He was elected into the imperial Caesareo-Leopoldina Academy in 1708 (originally located at Schweinfurth), and to a higher grade in 1732, into the Royal Society in 1724, into the Paris Academy of Sciences in 1731, the St Petersburg Academy in 1735, and the Berlin Academy in 1754. Among his more celebrated pupils were Antonio Scarpa (who died in 1832, connecting the school of Morgagni with the modern era), Domenico Cotugno (1736–1822), and L. M. A. Caldani (1725–1813), the author of the magnificent atlas of anatomical plates published in 2 vols. at Venice in 1801–1814.

In his earlier years at Padua Morgagni brought out (1717–1719) five more series of the *Adversaria anatomica*, by which his reputation was first made; but for more than twenty years after the last of these his strictly medical publications were few and casual (on gall-stones, varices of the vena cava, cases of stone, and several memoranda on medico-legal points, drawn up at the request of the curia). Classical scholarship in those years occupied his pen more than anatomical observation. It was not until 1761, when he was in his eightieth year, that he brought out the great work which, once for all, made pathological anatomy a science, and diverted the course of medicine into new channels of exactness or precision—the *De Sedibus et causis morborum per anatomem indagatis*, which during the succeeding ten years, notwithstanding its bulk, was reprinted several times (thrice in four years) in its original Latin, and was translated into French (1765), English (1769, 3 vols. 4to), and German (1771). Some account of this remarkable work remains now to be given.

The only special treatise on pathological anatomy previous to that of Morgagni was the work of Théophile Bonet of Neuchatel, *Sepulchretum: sive anatomia practica ex cadaveribus morbo denatis*, first published (Geneva, 2 vols. folio) in 1679, three years before Morgagni was born; it was republished at Geneva (3 vols., folio) in 1700, and again at Leyden in 1709. Although the normal anatomy of the body had been comprehensively, and in some parts exhaustively, written by Vesalius and Fallopius, it had not occurred to any one to examine and describe systematically the anatomy of diseased organs and parts. Harvey, a century after Vesalius, naively remarks that there is more to be learned from the dissection of one person who had died of consumption or other chronic malady than from the bodies of ten persons who had been hanged. F. Glisson, indeed (1597–1677), shows, in a passage quoted by Bonet in the preface to the *Sepulchretum*, that he was familiar with the idea, at least, of systematically comparing the state of the organs in a series of cadavera, and of noting those conditions which invariably accompanied a given set of symptoms. The work of Bonet was, however, the first attempt at a system of morbid anatomy, and, although it dwelt mostly upon curiosities and monstrosities, it enjoyed much repute in its day; Haller speaks of it as "an immortal work, which may in itself serve for a pathological library." Morgagni, in the preface to his own work, discusses the defects and merits of the *Sepulchretum*: it was largely a compilation of other men's cases, well and ill authenticated; it was prolix, often inaccurate and misleading from ignorance of the normal anatomy, and it was wanting in what would now be called objective impartiality—a quality which was introduced as decisively into morbid anatomy by Morgagni as it had been introduced two centuries earlier into normal human anatomy by Vesalius. Morgagni has narrated the circumstances under which the *De Sedibus* took origin. Having finished his edition of Valsalva in 1740, he was taking a holiday in the country, spending much of his time in the company of a young friend who was curious in many branches of knowledge. The conversation turned upon the *Sepulchretum* of Bonet, and it was suggested to Morgagni by his dilettante friend that he should put on record his own observations. It was agreed that letters on the anatomy of diseased organs and parts should be written for the perusal of this favoured youth (whose name is not mentioned); and they were continued from time to time until they numbered seventy. Those seventy letters constitute the *De sedibus et causis morborum*, which was given to the world as a systematic treatise in 2 vols., folio (Venice, 1761), twenty years after the task of epistolary instruction was begun. The letters are arranged in five books, treating of the morbid conditions of the body *a capite ad calcem*, and together containing the records of some 640 dissections. Some of these are given at great length, and with a precision of statement and exhaustiveness of detail hardly surpassed in the so-called "protocols" of the German pathological institutes of the present time; others, again, are fragments brought in to elucidate some question that had arisen. The symptoms during the course of the malady and other antecedent circumstances are always prefixed with more or less fulness, and discussed from the point of view of the conditions found after death. Subjects in all ranks of life, including several cardinals, figure in this remarkable gailery of the dead. Many of the cases are taken from Morgagni's early experiences at Bologna, and from the records of his teachers Valsalva and H. F. Albertini not elsewhere published. They are selected and arranged with method and purpose, and they are often (and somewhat casually) made the occasion of a long excursus on general pathology and therapeutics. The range of Morgagni's scholarship, as evidenced by his references to early and contemporary literature, is astonishing. It has been contended that he was himself not free from prolixity, the besetting sin of the learned; and certainly the form and arrangement of his treatise are such as to make it difficult to use in the present day, notwithstanding that it is well indexed in the original edition, in that of Tissot (3 vols., 4to, Yverdun, 1779), and in more recent editions. It differs from modern treatises in so far as the symptoms determine the order and manner of presenting the anatomical facts. Although Morgagni was the first to understand and to demonstrate the absolute necessity of basing diagnosis, prognosis and treatment on an exact and comprehensive knowledge of anatomical conditions, he made no attempt (like that of the Vienna school sixty years later) to exalt pathological anatomy into a science disconnected from clinical medicine and remote from practical needs. His orderliness of anatomical method (implying his skill with the scalpel), his precision, his exhaustiveness, and his freedom from bias, are his essentially modern or scientific qualities; his scholarship and high consideration for classical and foreign work, his sense of practical ends (or his common sense), and the breadth of his intellectual horizon prove him to have lived before medical science had become largely technical or mechanical. His treatise was the commencement of the era of steady or cumulative progress in pathology and in practical medicine. Symptoms from that time ceased to be made up into more or less conventional groups, each of which was a disease; on the other hand, they began to be viewed as "the cry of the suffering organs," and it became possible to develop Thomas Sydenham's grand conception of a natural history of disease in a catholic or scientific spirit.

A biography of Morgagni by Mosca was published at Naples in 1768. His life may also be read in A. Fabroni's *Vitae illustr. Italor.*, and a convenient abridgment of Fabroni's memoir will be found prefixed to Tissot's edition of the *De sedibus*, &c. A collected edition of his works was published at Venice in 5 vols. folio, in 1765. (C. C.)

MORGAN, DANIEL (1736–1802), American soldier, was born in Hunterdon county, New Jersey, in the winter of 1736, of Welsh ancestry. In 1753 he removed to Virginia. In June 1775, soon after the outbreak of the War of Independence, he was commissioned a captain of Virginia riflemen, and he marched his company to Boston in 21 days. In the winter of 1775 he accompanied General Benedict Arnold to Canada, and in the assault on Quebec (Dec. 31) he and his riflemen penetrated well into the city, where he was hemmed in and was forced to surrender. On the 7th of August 1776 he was discharged on parole; on the 12th of November he was commissioned colonel of the 11th Virginia; and soon afterwards he was released from his parole. In the summer of 1777 he was engaged in minor skirmishes in New Jersey, and early in September joined General Horatio Gates, then engaged in the campaign against General Burgoyne. At the first battle of Saratoga (Sept. 19) he was, until Arnold's arrival late in the day, the ranking officer on the field; and in the second battle (Oct. 7) also took a prominent part. Morgan rejoined Washington in November near Philadelphia. In March 1779 he was commissioned by Congress colonel of the 7th Virginia; but in July, suffering from poor health and dissatisfied because Congress did not advance him further in rank, he resigned from the army and retired to Virginia. After the battle of Camden, however, he joined Gates (then in command in the South) at Hillsborough, North Carolina, and on the 1st of October took command of a corps. On the 13th of the same month Congress tardily raised him to the rank of brigadier-general. In January 1781 Cornwallis and Tarleton attempted to entrap him, but at the Cowpens (Jan. 17) he defeated Tarleton and then escaped from Cornwallis into North Carolina. Apparently Morgan suggested to Greene (who had superseded Gates) that general's plan of battle at Guilford Court House on the 15th of March. In December 1793 he was commissioned major-general of Virginia militia, and in November 1794 commanded troops sent to suppress the Whisky Insurrection in western Pennsylvania. He was a Federalist representative in Congress in 1797–1799, and died in Winchester, Virginia, on the 6th of July 1802.

See James Graham, *The Life of General Daniel Morgan of the Virginia Line* (New York, 1856); and Rebecca McConkey, *The Hero of Cowpens* (rev. ed., New York, 1885).

MORGAN, EDWIN DENNISON (1811–1883), American merchant and philanthropist, one of the "war governors" of New York state, was born in Washington, Berkshire county, Massachusetts, on the 8th of February 1811. He was first a clerk and then a partner in his uncle's store at Hartford, Connecticut, and became head of the New York firm of E. D. Morgan & Co. (formed in 1847). He engaged in politics, first as a Whig and then as a Republican. In 1849 he was elected president of the Board of Assistant Aldermen of New York City; he was a member of the state senate in 1850–1853 and procured the passage of the bill providing for the establishment of Central Park in New York City; in 1855–1858 he was state commissioner of immigration; from 1859 to 1863 he was governor of New York, being the first Republican executive of the state; in 1863–1869 he was United States senator from New York. He died in New York City on the 14th of February 1883. Morgan was one of the founders of the Republican party, and was chairman of the National Republican Committee in 1856–1864 and in 1872. He was one of the most efficient and able of the war governors; even before the outbreak of the Civil War he did much to prepare the state government for it, and from September 1861 to January 1863 he was in command of the military department of New York, with the rank of major-general of volunteers. He was a liberal donor to Union Theological Seminary, Williams College and other institutions. His collection of paintings and sculpture, much of which had long been loaned to the Metropolitan Museum, was sold in January 1886.

MORGAN, SIR HENRY (*c.* 1635–1688), Welsh buccaneer, and lieutenant-governor of Jamaica, was the eldest son of Robert Morgan of Llanrhymny in Glamorganshire. He is said to have been kidnapped as a boy at Bristol and sold as a slave at Barbadoes, thence making his way to Jamaica, and is possibly to be identified with the Captain Morgan who accompanied the expedition of John Morris and Jackman when Vildemos, Trujillo and Granada were taken. In 1666 he commanded a ship in Edward Mansfield's expedition which seized the island of Providence or Santa Catalina, and when Mansfield was captured and killed by the Spaniards shortly afterwards Morgan was chosen by the buccaneers as their "admiral." In 1668 he was commissioned by Sir Thomas Modyford, the governor of Jamaica, to capture some Spanish prisoners, in order to discover details of the threatened attack on Jamaica; and collecting ten ships with 500 men south of Cuba, he landed and marched to Puerto Principe, which he took and pillaged; and afterwards accomplished the extraordinary feat of taking by storm the fortified and well-garrisoned town of Porto Bello on the mainland. The governor of Panama, astonished at this daring adventure, in vain attempted to drive out the invaders, and finally Morgan consented to evacuate the place on the payment of a large ransom. These exploits had considerably exceeded the terms of Morgan's commission and had been accompanied by frightful cruelties and excesses; but the governor endeavoured to cover the whole under the necessity of allowing the English a free hand to attack the Spaniards whenever possible. Morgan was almost immediately entrusted with another expedition by Modyford against the Spaniards, and proceeded to ravage the coast of Cuba. In January 1669 the largest of his ships was blown up accidentally in the course of a carousal on board, Morgan and his officers narrowly escaping destruction. In March he sacked Maracaibo, and afterwards Gibraltar. Returning to Maracaibo, he found three Spanish ships waiting to intercept him; but these he destroyed or captured, recovered a considerable amount of treasure from one which had sunk, exacted a heavy ransom as the price of his evacuating the place, and finally by an ingenious stratagem eluded the enemy's guns altogether and escaped in safety. On his return to Jamaica he was again reproved, but not punished by Modyford. The Spaniards on their side were moreover acting in the same way, and a new commission was given to Morgan, as commander-in-chief of all the ships of war in Jamaica, to levy war on the Spaniards and destroy their ships and stores, the booty gained in the expedition being the only pay. Accordingly, after ravaging the coast of Cuba and the mainland, Morgan determined on an expedition to Panama. He recaptured the island of Santa Catalina on the 15th of December 1670, and on the 27th gained possession of the castle of Chagres, killing 300 of the garrison. Then with 1400 men he ascended the Chagres river, and after overcoming perils and obstacles of all kinds he appeared before Panama on the 18th of January 1671, defeated a much larger force than his own, and took the city. The fame of this brilliant exploit was, however, again obscured by abominable scenes of cruelty and debauchery, during which a galleon containing a considerable part of the booty escaped. Moreover, on returning to Chagres the members of the expedition found themselves cheated of their fair share of the spoil,[1] while Morgan escaped with a few ships to Jamaica, leaving the rest to get home as best they could. On his return he received the thanks of the governor and council; but meanwhile on the 8th of July, 1670, a treaty had been signed between Spain and England, and both Modyford and Morgan were ordered home under arrest to answer for their conduct. Morgan, however, soon succeeded in gaining the king's favour, and in the autumn of 1674 he was appointed lieutenant-governor of Jamaica and was knighted, leaving England in December. After such a career as his it is not surprising that Morgan's conduct as a responsible official of the government was not very creditable. He was charged by Lord Vaughan, afterwards earl of Carbery, the governor, soon after his appointment, of persisting in encouraging privateering; he intrigued against his colleagues and successive governors of Jamaica, with the hope of superseding them; raised factious dissensions; and supported the outrageous conduct of his brother, Captain Charles Morgan, a terrible ruffian, and his kinsman, Colonel Byndlos, taking part in their brawls and drunken orgies. He was finally, on the 12th of October 1683, suspended in Jamaica from all his employments; a decision which was confirmed by the government at home after hearing Morgan's defence; but he was restored to his place in the council on the 18th of July 1688, shortly before his death, which took place in August.

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[1] *Cal. of St Pap. America & West Indies* 1669–1674, Nos. 580 and 798; Exquemelin (ed. 1898), 237.

See A. O. Exquemelin (one of Morgan's buccaneers), *Buccaneers of America* (1684, reprinted in 1891); A. Morgan, *History of the Family of Morgan* (1901).

MORGAN, JOHN HUNT (1825–1864), American Confederate soldier, was born in Huntsville, Alabama, on the 1st of June 1825, and was brought up on a farm near Lexington, Kentucky, to which his parents removed in 1830. In the Mexican War he was a first lieutenant of a Kentucky cavalry regiment. On the outbreak of the Civil War he was captain of the Lexington Rifles (organized in 1857); in September 1861 he succeeded in getting out of Lexington the company's arms after the issue of the order for the disarming of the state guard, and late in the same month reached the Confederate camp at Woodsonville on the Green river. He proved himself an able scout, and was made captain of a cavalry company and commander of a cavalry "squadron," including two other companies, which in February 1862, with General A. S. Johnston's other forces, withdrew from Kentucky to Corinth, Mississippi. He was commissioned a colonel after the battle of Shiloh, and in July 1862, starting from eastern Tennessee, made the first of his famous raids. He routed a Federal force at Lebanon, destroyed much rolling stock and other railway property, and threatened Louisville and Cincinnati. In August and September he took part in General Braxton Bragg's invasion of Kentucky, and again threatened Ohio. In December he defeated the Union garrison at Hartsville, Tennessee, taking prisoners, valuable stores, and many cattle; was commissioned brigadier-general for this success; and soon afterward again raided Kentucky. To cover Bragg's movement from Tullahoma to Chattanooga Morgan made, in July 1863, his famous raid into Indiana and Ohio. Bragg had instructed him to confine himself to Kentucky, but Morgan hoped to gain recruits in Indiana, where opposition to the war was strong. With 2460 men he crossed the Cumberland near Burkesville, Kentucky, on the 2nd of July; on the 5th captured a garrison at Lebanon; and on the 13th entered Ohio near Harrison. The regular cavalry, under Generals E. H. Hobson and James M. Shackelford, was now close behind him, and his way was beset by quickly gathering militia. He marched through the suburbs of Cincinnati on the night of the 13th and on the 18th got to Portland, near Buffington Island, where he attempted to cross on the next day; but gunboats and steamers prevented him. In a sharp battle he lost 600 or more men. As many more surrendered soon afterwards, and about 300 crossed the river. On the 26th he surrendered to General Shackelford at New Lisbon. He was imprisoned with 70 of his men in the penitentiary at Columbus, from which on the night of the 27th of November he and six of his companions escaped by a tunnel they had dug. In the spring of 1864 he was put in virtual command of the Department of South-western Virginia, which included eastern Tennessee, and late in August he took command at Jonesboro, Georgia. On the 4th of September he was shot in a garden in Greenville, Tennessee, having been betrayed, it appears, to the Federals. Morgan had an excellent eye for topographical details, and by the swiftness of his movements and his sudden blows kept Kentucky in continual alarm. His lieutenant, Basil W. Duke, says that his force at no time reached 4000, but that it "killed and wounded nearly as many of the enemy and captured more than 15,000."

See Basil W. Duke, *History of Morgan's Cavalry* (Cincinnati, 1867).

MORGAN, JOHN PIERPONT (1837–1913), American financier and banker, was born in Hartford, Connecticut, on the 17th of April 1837, a son of Junius Spencer Morgan (1813–1890), who was a partner of George Peabody and the founder of the house of J. S. Morgan & Co. in London. He was educated at the English High School in Boston and at the University of Göttingen. In 1857–1860 he worked in the New York banking house of Duncan, Sherman & Co.; from 1860 to 1864 was agent and attorney in New York for George Peabody & Co. of London, and afterwards for its successor, J. S. Morgan & Co., of which he became head; in 1864–1871 was a member of the firm of Dabney, Morgan & Co.; and in 1871 he entered the firm of Drexel, Morgan & Co., in which he was associated with Anthony J. Drexel, of Philadelphia, upon whose death in 1893 he became senior partner. In 1895 the firm became J. P. Morgan & Co. Closely associated with Drexel & Co. of Philadelphia, Morgan, Harjes & Co. (successors to Drexel, Harjes & Co.) of Paris, and Morgan, Grenfell & Co. (before 1910 J. S. Morgan & Co.) of London, it became, largely owing to Mr Morgan's ability, one of the most powerful banking houses in the world. It carried through the formation of the United States Steel Corporation (which took over the business of Andrew Carnegie and others), harmonized the coal and railway interests of Pennsylvania, and purchased the Leyland line of Atlantic steamships and other British lines in 1902, thus effecting an Atlantic shipping "combine" (See STEAMSHIP LINES); and it, or the banking houses which it succeeded, reorganized the following railways: Albany & Susquehanna (1869); the Chesapeake & Ohio, and the Cleveland, Cincinnati, Chicago & St Louis (1888); the Erie and the Reading (1895); the New York & New England (1896); the Northern Pacific (1897); the Baltimore & Ohio (1899), &c.; and in 1895 it supplied the United States government with $62,000,000 in gold to float a bond issue and restore the treasury surplus of $100,000,000. Mr Pierpont Morgan was a prominent member of the Protestant Episcopal Church; an enthusiastic yachtsman, whose "Columbia" defeated the "Shamrock" in 1899 and 1901 for the "America's" cup; a notable collector of books, pictures, and other art objects, many loaned or given to the Metropolitan Museum of Art (of which he was president), and many housed in his London house and in his private library on 36th Street, near Madison Avenue, New York City; and a generous benefactor of the American Museum of Natural History, the Metropolitan Museum of Art, Harvard University (especially its medical school), the Lying-in Hospital of the city of New York and the New York trade schools.

MORGAN, LEWIS HENRY (1818–1881), American ethnologist, was born near Aurora, New York, on the 21st of November 1818. He graduated in 1840 at Union College, then studied law, was admitted to the bar, and practised his profession with success at Rochester, New York. Soon after leaving college Morgan went among the Iroquois, living as far as he could their life and studying their social organization. In October 1847 he was formally adopted into the Hawk gens of the Seneca tribe, and received the name "Ta-ya-da-wah-kugh." The fruit of his researches was *The League of the Iroquois* (1851; new ed. 1904), which, says J. W. Powell, "was the first scientific account of an Indian tribe ever given to the world." The success of the book encouraged him to further research, resulting in his *Systems of Consanguinity and Affinity of the Human Family* (1869). In 1877 he added to his reputation by publishing

Ancient Society, or Researches in the Lines of Human Progress from Savagery, through Barbarism, to Civilization, in which he divided the progress of culture into seven stages—"lower savagery," "middle savagery," "upper savagery," "lower barbarism," "middle barbarism" and "upper barbarism," and "civilization." The book was in four parts, dealing with (1) the growth of intelligence through inventions and discoveries; (2) the growth of the idea of government; (3) the growth of the idea of the family; and (4) the growth of the idea of property. Morgan was a member of the New York assembly in 1861 and of the New York senate in 1868–1869. In 1880 he was president of the American Association for the Advancement of Science. He died in Rochester, New York, on the 17th of December 1881. In addition to the works above mentioned and many magazine articles, he published *The American Beaver and his Works* (1868) and *Houses and House-life of the American Aborigines* (1881).

MORGAN, SYDNEY, LADY (*c.* 1783–1859), British authoress, daughter of Robert Owenson, an Irish actor, was born in 1783 in Dublin. She was one of the most vivid and hotly discussed literary figures of her generation. She began her career with a precocious volume of poems. She collected Irish tunes, for which she composed the words, thus setting a fashion adopted with signal success by Tom Moore. Her *St Clair* (1804), a novel of ill-judged marriage, ill-starred love, and impassioned nature-worship, in which the influence of Goethe and Rousseau was apparent, at once attracted attention. Another novel, *The Novice of St Dominick* (1806), was also praised for its qualities of imagination and description. But the book which made her reputation and brought her name into warm controversy was *The Wild Irish Girl* (1806), in which she appeared as the ardent champion of her native country, a politician rather than a novelist, extolling the beauty of Irish scenery, the richness of the natural wealth of Ireland, and the noble traditions of its early history. She was known in Catholic and Liberal circles by the name of her heroine "Glorvina." *Patriotic Sketches* and *Metrical Fragments* followed in 1807. Miss Owenson entered the household of the marquess of Abercorn, and in 1812, persuaded by Lady Abercorn, she married the surgeon to the household, Thomas Charles Morgan, afterwards knighted; but books still continued to flow from her facile pen. In 1814 she produced her best novel, *O'Donnell*. She was at her best in her descriptions of the poorer classes, of whom she had a thorough knowledge. Her elaborate study (1817) of *France* under the Bourbon restoration was attacked with outrageous fury in the *Quarterly*, the authoress being accused of Jacobinism, falsehood, licentiousness and impiety. She took her revenge indirectly in the novel of *Florence Macarthy* (1818), in which a *Quarterly* reviewer, Con Crawley, is insulted with supreme feminine ingenuity. *Italy*, a companion work to her *France*, was published in 1821; Lord Byron bears testimony to the justness of its pictures of life. The results of Italian historical studies were given in her *Life and Times of Salvator Rosa* (1823). Then she turned again to Irish manners and politics with a matter-of-fact book on *Absenteeism* (1825), and a romantic novel, *The O'Briens and the O'Flahertys* (1827). From Lord Melbourne Lady Morgan obtained a pension of £300. During the later years of her long life she published *The Book of the Boudoir* (1829), *Dramatic Scenes from Real Life* (1833), *The Princess* (1835), *Woman and her Master* (1840), *The Book without a Name* (1841), *Passages from my Autobiography* (1859). She died on the 14th of April 1859.

Her autobiography and many interesting letters were edited with a memoir by W. Hepworth Dixon in 1862.

MORGAN, THOMAS (d. 1743), English deist, of Welsh extraction, became an independent minister, but soon after 1720 lost his position owing to the growing unorthodoxy of his views. He took up medicine and became a freethinker, though he describes himself as a Christian deist. He was an energetic controversialist. Among his works are *Philosophical Principles of Medicine* (1725); *Collection of Tracts* (1726), essays dealing with the Trinitarian controversy; *The Moral Philosopher* (1737), a dialogue between a Christian Jew, Theophanus, and a Christian deist, Philalethes. He died on the 14th of January 1742/3.

MORGANATIC MARRIAGE, a form of marriage properly peculiar to the German peoples, but also found in the royal families of other European countries. It is one in which the contracting parties are not by birth of equal status or rank (*ebenbürtig*), and under which the wife, if not *ebenbürtig*, does not take the rank of her husband, and the children, whether it be the wife or husband that is of lower rank, have no right of succession to the dignities, fiefs or entailed property of the parent of higher rank. This equality by birth was formerly throughout Germany the necessary condition to a complete and perfect marriage, but it is now only applicable to members of reigning houses or of the higher nobility (*hoher Adel*), and it is thus of force among the "mediatized" princes of the German Empire. In the constitution of the various states, and in the "house laws" (*Hausgesetze*) of the reigning families, the rules are laid down as to what constitutes *ebenbürtigkeit*. Generally it may be said that members of a present or former reigning house, either in Germany or Europe, would be recognized as *ebenbürtig*, but a former morganatic marriage would be taken as destroying the qualification. In Great Britain the regulations as to the marriages of members of the royal family are contained in the Royal Marriage Act 1772 (see MARRIAGE). The term "morganatic marriage" is applied generally to any marriage of a person of royal blood with one of inferior rank. The origin of the term, in medieval Latin *matrimonium ad morganaticam*, is usually taken to refer to the *Morgengabe*, *i.e.* the morning gift, made by a husband to his wife on marriage. The German name is *Ehe zur linken Hand* (marriage by the left hand, whence the phrase a "left-handed marriage"), the husband of such marriage ceremonies giving the left instead of the right hand to the bride. Such marriages are recognized as fully binding by the Church, and the children are legitimate, and no other marriage can take place during the lifetime of the contracting parties.

MORGANTOWN, a city and the county-seat of Monongalia county, West Virginia, U.S.A., on the Monongahela river, about 50 m. S.E. of Wheeling. Pop. (1890), 1011; (1900), 1895; (1910 census), 9150. The city is served by the Baltimore & Ohio and the Morgantown & Kingwood railways, and by several steamboat lines, the Monongahela being navigable to Fairmont, about 25 m. above Morgantown. Morgantown is the seat of the West Virginia University (co-educational), formed from the Monongalia Academy (incorporated, 1814) and the Woodburn Female Seminary (incorporated, 1858), and chartered in 1867 as the Agricultural College of West Virginia; in 1868 the present name was adopted. In 1908 the university had 80 instructors and 1534 students. Coal, glass-sand and limestone are found in the vicinity of Morgantown. The first settlement here was made about 1768 by the brothers David and Zackwill Morgan, and was named in honour of the latter. It was incorporated as Morgan's Town in 1785; and in 1905 a city charter was granted to it after the annexation of Greenmont (pop. 1900, 349), Seneca (pop. 1900, 723), and South Morgantown (pop. 1900, 405).

MORGARTEN, the name of the pasture slopes that descend westwards to the south end of the lake of Aegeri in the Swiss canton of Zug, about 2 m. by road from the Sattel station on the railway line from Schwyz to Zürich. It was at the foot of these slopes and on the shore of the lake that the small Swiss force defeated the large Austrian army, advancing from Zug on Schwyz, on the 15th of November 1315, and so laid the foundations of Swiss liberty. As the lake has shrunk, the exact site of the battle has been disputed. It seems most probable that it took place near the Haselmatt Chapel, in the territory of Zug, where is the official monument, but some hold that the real site was in Schwyz territory, near the old tower and battle chapel of Schornen, in the gorge between the lake and Sattel.

The original accounts of the battle are collected in part iii. (1884) of the *Mitteilungen* of the Historical Society of Schwyz. See also the careful study in K. Bürkli's *Ein Denkmal am Morgarten wo ist sein Platz?* (Zug, 1895).

MORGEN, a unit of measurement of land in Holland and the Dutch colonies, and hence still current in South Africa, equivalent to about 2 acres. It is also used in Prussia, Norway and Denmark, where it equals about two-thirds of an acre. The word is usually taken to be the same as the German and Dutch word for "morning," the area of a "morgen" being equal to that covered by a morning's ploughing.

MORGHEN, RAFFAELLO SANZIO (1758–1833), Italian engraver, was born at Naples on the 19th of June 1758. He received his earliest instructions from his father, himself an engraver; but, in order to be initiated more fully in the art, he was afterwards placed as a pupil under the celebrated Volpato. He assisted this master in engraving the famous pictures of Raphael in the Vatican, and the print which represents the miracle of Bolsena is inscribed with his name. He married Volpato's daughter, and, being invited to Florence to engrave the masterpieces of the Florentine Gallery, he removed thither with his wife in 1782. His reputation now became so great as to induce the artists of Florence to recommend him to the grand duke as a fit person to engrave the "Last Supper" of Leonardo da Vinci; apart, however, from the dilapidated state of the picture itself, the drawing made for Morghen was unworthy of the original, and the print, in consequence, although an admirable production, fails to convey a correct idea of the style and merit of Leonardo. Morghen's fame, however, soon extended over Europe; and the Institute of France, as a mark of their admiration of his talents, elected him an associate in 1803. In 1812 Napoleon invited him to Paris and paid him the most flattering attentions. He died at Florence on the 8th of April 1833.

A list of the artist's works, published at Florence in 1810, comprised 200 compositions; the number was afterwards considerably increased. Amongst the most remarkable, besides those already mentioned, may be noticed the Transfiguration from Raphael, a Magdalen from Murillo, a Head of the Saviour from da Vinci, the Car of Aurora from Guido, the Hours and the Repose in Egypt from Poussin, the Prize of Diana from Domenichino, the Monument of Clement XIII. from Canova, Theseus vanquishing the Minotaur, Francesco Moncado after Van Dyck, portraits of Dante, Petrarch, Ariosto, Tasso, and a number of other eminent men. His prints have hardly maintained the reputation which they enjoyed during the artist's lifetime. Though carefully and delicately executed, they are somewhat mechanical and wanting in force and spirit.

MORHIER, SIMON (d. *c.* 1450), provost of Paris during the English occupation in the 15th century, was seigneur of Gilles, near Nogent-le-Roi, in the Chartrain country. Being a member of the duke of Burgundy's party, he was appointed provost at Paris by John, duke of Bedford, on the 1st of December 1422. He was taken prisoner at the siege of Montargis in 1427, and again at the battle of Rouvrai in 1429; but in September of the latter year he repulsed Joan of Arc's attack upon Paris. After a campaign in Cotentin in 1435, he was once more taken prisoner at the bridge of Charenton in 1436. Remaining faithful to the English party, he became captain of Dreux, a councillor of Henry VI., and treasurer of France and Normandy. He assisted in the defence of Meaux (1439), of Creil and of Pontoise (1441), and must have died between 1450 and 1456.

See the *Nouvelle biographie générale,* vol. xxxvi.; and a note on Simon Morhier in the memoirs of the Antiquarian Society of France, vol. xxv.

MORHOF, DANIEL GEORG (1639–1691), German man of letters, was born at Wismar on the 6th of February 1639. He first studied jurisprudence and then *literae humaniores* at the university of Rostock, where his elegant Latin versification procured for him in 1660 the chair of poetry. In 1665 he went to the new university of Kiel as professor of eloquence and poetry; this chair he exchanged for that of history in 1673. He died at Lübeck on the 30th of July 1691. Of his numerous writings the most important are *Unterricht von der deutschen Sprache und Poesie* (1682; 3rd ed., 1718), the first attempt in Germany at a systematic survey of European literature, and *Polyhistor, sive de auctorum notitia et rerum commentarii* (Lübeck, 1688, not completed till 1707; 4th ed., 1747), a kind of encyclopaedia of the knowledge and learning of his time.

See Eymer, *Morhof und sein Polyhistor* (in the *Xenia Austriaca,* Vienna, 1893); and biography by R. v. Liliencron in *Allgem. Deutsche Biographie* (1885).

MORIAH, an obscure place-name of ancient Palestine with apparently two distinct connotations. (1) A land entirely unknown, on a mountain in which Abraham offered Isaac (Gen. xxii. 2). The text is probably corrupt: some have suggested "land of the Amorites," others "land of Midian." The etymology of the word is equally obscure. Traditionally, of course, "the land of Moriah" is identified with the site of the Temple at Jerusalem,[1] except by the Samaritans and a few western scholars (such as Dean Stanley) who accept their belief that the mountain was Gerizim. (2) The upper part of the hill of Ophel, the threshing floor of Araunah, upon which Solomon erected the Temple, is once called Mount Moriah (2 Chron. iii. 1). Whether this name be derived from the corruption in Genesis or not cannot be definitely decided; it very likely is. The testimony of Josephus, who often names the temple hill "Moriah," is of course not original, and of no weight. (R. A. S. M.)

MORIER, JAMES (1780–1849), English traveller and author, was born in 1780. Through the influence of his uncle, Admiral William Waldegrave, Baron Radstock, he entered the diplomatic service, and as secretary to Lord Elgin followed the grand vizier in the Egyptian campaign. An account of his Eastern experiences was published in 1812, under the title *A Journey through Persia, Armenia and Asia Minor to Constantinople in 1808–9.* From 1810 to 1816 he was the British representative at the court of Persia, and after his return he published *A Second Journey through Persia to Constantinople between the years 1810 and 1816.* His knowledge of Eastern life and manners he also turned to account in the composition of several entertaining romances. The most popular of these were *The Adventures of Hajji Baba of Ispahan* (1824), *The Adventures of Hajji Baba of Ispahan in England* (1828), *Zohrab the Hostage* (1832), and *Ayesha the Maid of Kars* (1834). Morier died at Brighton on the 23rd of March 1849.

MORIER, SIR ROBERT BURNETT DAVID (1826–1893), British diplomatist, was born at Paris on the 31st of March 1826. He was descended from a family of diplomatists of Huguenot origin, the best known of whom were his father David, consul-general for France and minister at Bern, and his uncle James, the author of *The Adventures of Hajji Baba.* After a somewhat defective private education he came up to Balliol College, Oxford. Here he attracted the notice of Jowett, under whose influence his brilliant but wayward mind obtained the discipline of which it stood in need. The relation of tutor and pupil developed into a friendship of rare warmth. Writing towards the close of his life, Jowett, who inspired more devoted friendships than any man of his time, spoke of Morier as his kindest and best friend for forty-five years. On leaving Oxford, Morier at first obtained an appointment in the Education Department, but resigned in 1852, and in the following year became attaché at Vienna. In the succeeding years he was attached in turn to almost every court in Germany. Restless in temperament and unconventional in method, he plunged into the vortex of German politics to a degree that did not always accord with the traditions of diplomacy. The most important years of his career in Germany were from 1866 to 1871, when he was secretary of legation at Darmstadt. Here he became a trusted adviser of the crown princess, and through her acquired an intimate friendship with the crown prince (afterwards the emperor Frederick III.), whose antagonism to Bismarck's reactionary policy met with cordial support from Morier's sturdy Liberalism. Bismarck, already jealous of British influence at court, honoured Morier with a hatred not lessened by the fact that Morier's knowledge of German politics was unrivalled outside Germany. On leaving Darmstadt, Morier became chargé d'affaires, first at Stuttgart and then at Munich, and in 1876 was appointed minister at Lisbon. From 1881 to 1884 he was minister at Madrid. In December 1884 he became ambassador at St Petersburg, and almost immediately had to face the alarming situation created by the Russian advance to Penjdeh. Thanks to his efforts, a war that at one moment seemed inevitable was averted. His great popularity at the Russian court contributed towards a marked improvement in the relations between the two countries. Bismarck took alarm at the lessening influence of Germany over Russia, and tried to procure Morier's downfall. The *Kölnische Zeitung* declared in December 1888 that Morier had made use of his position at Darmstadt during the Franco-German War to betray the movements of the German troops to Marshal Bazaine. The authority for this charge was an alleged declaration made by Bazaine to the German military attaché at Madrid. Bazaine had died in September, but Morier had heard rumours in July of the charge brought against him, and had procured from Bazaine a written denial, which he now published in *The Times*. Apart from this, it was clearly shown that Morier could not have transmitted the information by the alleged date, and that Bazaine, according to the testimony of his own books and of other officers, received the information in question by reports from the front. As a matter of fact, Morier was an ardent champion of the German cause. His correspondence with Jowett shows the latter vainly endeavouring to convince his friend that the French were in the right. Public opinion everywhere, except in the German Conservative press, attributed the charge to political motives. Morier's failing health caused him, at his own request, to be appointed Lord Dufferin's successor at Rome in 1891; but it was felt that he could not be spared from St Petersburg, and there he remained till forced to find a milder climate. It was then too late, and he died at Montreux in Switzerland on the 16th of November 1893.

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[1] Some of the sects transfer the scene of the sacrifice to the "Chapel of Abraham" in the precincts of the Holy Sepulchre Church.

MÖRIKE, EDUARD FRIEDRICH (1804–1875), German poet, was born at Ludwigsburg on the 8th of September 1804. In 1834 he was appointed pastor of Kleversulzbach near Weinsberg, and in 1851 became professor of literature at the Katharinenstift in Stuttgart. This office he held until his retirement in 1866; but he continued to live at Stuttgart until his death on the 4th of June 1875. Mörike is the most lyrically gifted of all the poets belonging to the so-called Swabian school which gathered round Uhland. His poems, *Gedichte* (1838; 22nd ed., 1905), are mostly lyrics, graceful in style, original in conception, often humorous, but expressed in simple and natural language. He also wrote a somewhat fantastic *Idylle vom Bodensee, oder Fischer Martin und die Glockendiebe* (1846; 2nd ed., 1856), and published a collection of hymns, odes, elegies and idylls of the Greeks and Romans, entitled *Klassische Blumenlese* (1840), and several novels and narratives, among the former *Maler Nolten* (1832; 6th ed., 1901), which enjoyed great popularity.

Mörike's *Gesammelte Schriften* were first published in 4 vols. (in 1878); the most recent editions are those edited by R. Krauss (6 vols., 1905), and the *Volksausgabe*, published by Göschen (4 vols., 1905). Selections from his literary remains were published by R. Krauss in *Eduard Mörike als Gelegenheitsdichter* (1895), and his correspondence with Hermann Kurz, Moritz von Schwind, and Theodor Storm, by J. Bächtold (1885–1891); an edition of Mörike's *Ausgewählte Briefe*, in 2 vols., appeared 1903–1904. See F. Notter, *Eduard Mörike* (1875); and H. Fischer, *Eduard Mörike* (1881); K. Fischer, *E. Mörike* (1901); H. Maync, *E. Mörike* (1902); K. Fischer, *Mörikes künstlerisches Schaffen und dichterische Schöpfungen* (1903).

MORILLON, a name commonly given by fowlers to the female or immature male of the GOLDEN-EYE (*q.v.*), the *Clangula glaucion* of modern ornithology, under the belief—which still very generally obtains among them, as it once did among naturalists—that they formed a distinct species of duck. The mistake no doubt originated in, and is partly excused by, the facts that the birds called Morillons were often of opposite sexes, and differed greatly from the adult male Golden-Eye, whose full and beautiful plumage is not assumed until the second year. The word is used in French in precisely the same form, but it is in that language applied to the Tufted Duck, *Fuligula cristata*, and is derived, according to Littré, from *more*, signifying black. (A. N.)

MORIN, JEAN (latinized JOANNES MORINUS) (1591–1659), French theologian, was born in 1591 at Blois, of Protestant parents. He learned Latin and Greek at Rochelle, and continued his studies at Leiden, subsequently removing to Paris. His conversion to the Roman Church is ascribed to Cardinal du Perron. In 1618 he joined the congregation of the Oratory, and in due course took priest's orders. In 1625 he visited England in the train of Henrietta Maria; in 1640 he was at Rome, on the invitation of Cardinal Barberini, and was received with special favour by Pope Urban VIII. He was, however, soon recalled to Paris by Richelieu, and the rest of his life was spent in incessant literary labour. The *Histoire de la délivrance de l'église chrétienne par l'emp. Constantin, et de la grandeur et souveraineté-temporelle donnée à l'église romaine par les rois de France* (1630) gave great offence at Rome, and a *Déclaration* (1654), directed against faults in the administration of the Oratory, was strictly suppressed. So, too, his great work on penance gave equal offence to the Jesuits and to Port-Royal, and even after his death, in 1659, the polemical vehemence of his *Exercitationes biblicae*, and the exaggeration of his assertion "apud neotericos Haereticos verba Scripturarum non esse integra, non superficiem, non folia, nedum sensum, medullam et radicem rationis" long led Protestants to treat his valuable contributions to the history of the Hebrew text as a mere utterance of Popish prejudice.

Morin was a voluminous and prolix writer on ecclesiastical antiquities. His principal works in this field are *Commentarius historicus de disciplina in administratione sacramenti poenitentiae XIII. primis seculis in eccl. occid. et hucusque in orient. observata* (1651), and *Comm. de sacris ecclesiae ordinationibus secundum antiquos et recentiores latinos, graecos, syros et babylonios* (1655), which expresses those irenical views on the subject of ordination which recommended Morin to Urban VIII. The literary correspondence of Morin appeared in 1682 under the title of *Antiquitates ecclesiae orientalis* (edited by R. Simon).

Morin's chief fame, however, rests on his biblical and critical work. By his *editio princeps* of the Samaritan Pentateuch and Targum, in the Paris Polyglott, he gave the first impulse in Europe to the study of this dialect, which he acquired without a teacher (framing a grammar for himself) by the study of MSS. then newly brought to Europe. Not unnaturally he formed a very exaggerated view of the value of the Samaritan tradition of the text (*Exercitationes in utrumque Samaritanorum Pentateuchum*, 1631). A similar tone of exaggerated depreciation of the Massoretic Hebrew text, coloured by polemical bias against Protestantism, mars his greatest work, the posthumous *Exercitationes biblicae de hebraeici graecique textus sinceritate* (1660), in which, following in the footsteps of Cappellus, but with incomparably greater learning, he brings irrefragable arguments against the then current theory of the absolute integrity of the Hebrew text and the antiquity of the vowel points.

MORION (the French form of a word occurring in Spanish as *morrion*, Ital. *morione*, usually connected with the Span. *morra*, top or crown of the head), a light round-shaped head-piece or helmet (*q.v.*). The chief characteristics are a brim, an upright comb running along the crown from back to front, and the absence of guards for the face, ears or neck. The brim was bent sharply upwards at the front and back, and the piece was generally worn tilted backward so as to cover the neck. The morion and the cabasset, a pear-shaped headpiece with a flatter brim and no comb, were the typical infantry helmets of the 16th and early 17th centuries. It was sometimes worn unaccompanied by any body armour.

MORISCOS (*i.e.* little Moors), the name given to the Spanish Mahommedans who accepted baptism and their descendants. Many, if not most, of them were in reality of the same race as the Christians, and were descended from converts to Islam. Those Mahommedans who retained their religion under Christian rulers were known as Mudéjars, a word of Arabic origin which has been interpreted as meaning "those who remained" or "were left." Until the 15th century they were numerous, and enjoyed free exercise of their religion, which was secured to them by capitulations and treaties. Their number had been considerably diminished by the time of the conquest of Granada in 1492. By the terms of the capitulation of the city freedom of worship was secured to the Mahommedans. But the policy of the Catholic sovereigns, who desired to establish unity of faith among their subjects, and the influence of the Church, soon led to violations of the treaty. The first Christian archbishop of Granada, Talavera, made some progress in converting the people peacefully. But at the end of 1499 Cardinal Jimenez insisted on adopting coercive measures. A rebellion ensued, and the Mahommedans were suppressed. Want of power, or other obstacles, delayed the final extinction of tolerated Mahommedanism in all parts of Spain, but by 1525 it was everywhere suppressed. The last remains of it were crushed in Valencia, where the Mahommedans were furiously attacked by the Christian peasantry during the great agrarian revolt known as the Germania, 1520–1521. As they were dependent on the protection of the landlords, the Mahommedans were docile tenants, and their competition weighed heavily on the Christians. The same quality of industry remained to the Moriscos, and excited the envy of their Christian fellow countrymen. The feelings with which they were regarded are admirably shown by Cervantes (who shared them to the full) in his "Conversation of the Two Dogs." In 1568 the government of Philip II. issued an edict, which ordered them to renounce all their Moorish ways of life and to give up their children to be educated by Christian priests. The result was a rebellion in Granada, which was put down with great difficulty. The Moriscos were expelled from Granada and scattered over other parts of Spain. Many fled to Africa, where the more spirited among them took to piracy at Algiers and other ports. They still maintained relations with their kinsfolk in Spain, and the whole coast suffered from their incursions. The Moriscos entered into relations with other enemies of Spain, and notably, with France. Henry IV. included a plan for supporting a Morisco rebellion in the great scheme for the destruction of the Spanish monarchy, which he was about to put into execution when he was murdered on the 14th of May 1610. These intrigues were known to the Spanish government and inspired it with terror. The expulsion of the whole body of Moriscos was decided on in 1608, and the edict was published on the 22nd of September 1609. The expulsion was carried out with great cruelty. The number driven out has been variously estimated at 120,000 or at 3,000,000. In some known cases the expelled Moriscos suffered martyrdom in Africa as Christians. A few were left in Spain as domestic slaves, and some contrived to return in secret. Cases of crypto-Mahommedanism continued to come before the Inquisition till the 18th century.

See *The Moriscos of Spain: their Conversion and Expulsion*, by H. C. Lea (London, 1901).

MORISON, JAMES AUGUSTUS COTTER (1832–1888), British author, was born in London on the 20th of April 1832. His father, who had made a large fortune as the inventor and proprietor of "Morison's Pills," settled in Paris till his death in 1840, and Cotter Morison thus acquired not only an acquaintance with the French language, but a profound sympathy with France and French institutions. In later life he resided for some years in Paris, where his house was a meeting-place for eminent men of all shades of opinion. He was educated at Highgate grammar school and Lincoln College, Oxford. Here he fell under the influence of Mark Pattison, to whom his impressionable nature perhaps owed a certain over-fastidiousness that characterized his whole career. He also made the acquaintance of the leading English Positivists, to whose opinions he became an ardent convert. Yet he retained a strong sympathy with the Roman Catholic religion, and at one time spent several weeks in a Catholic monastery. One other great influence appears in the admirable *Life of St Bernard*, which he published in 1863—that of his friend Carlyle, to whom the work is dedicated, and with whose style it is strongly coloured. Meanwhile he had been a regular contributor, first to the *Literary Gazette*, edited by his friend John Morley, and then to the *Saturday Review* at its most brilliant epoch. In 1868 he published a pamphlet entitled *Irish Grievances shortly stated*. In 1878 he published a volume on *Gibbon* in the "Men of Letters" series, marked by sound judgment and wide reading. This he followed up in 1882 with his *Macaulay* in the same series. It exhibits, more clearly perhaps than any other of Morison's works, both his merits and his defects. Macaulay's bluff and strenuous character, his rhetorical style, his unphilosophical conception of history, were entirely out of harmony with Morison's prepossessions. Yet in his anxiety to do justice to his subject he steeped himself in Macaulay till his style often recalls that which he is censuring. His brief sketch, *Mme de Maintenon: une étude* (1885), and some magazine articles, were the only fruits of his labours in French history. Towards the close of his life he meditated a work showing the application of Positivist principles to conduct. Unfortunately, failing health compelled him to abandon the second or constructive part: the first, a brilliant piece of writing which attempts to show the ethical inadequacy of revealed religion and is marked in parts by much bitterness, was published in 1887 under the title of *The Service of Man*. He died in London on the 26th of February 1888.

MORITZ, KARL PHILIPP (1757–1793), German author, was born at Hameln on the Weser on the 15th of September 1757, of humble parentage. After receiving a scanty schooling, he was apprenticed to a hat-maker, but was later enabled to study philosophy at Erfurt and Wittenberg and in 1777 became teacher in a school at Dessau. While on a tour through Italy in 1786 he became acquainted with Goethe, who interested himself in him. On his return, he was appointed professor of archaeology and aesthetics, at the academy of art in Berlin, and in this city he died on the 26th of June 1793. Of Moritz's writings on aesthetic, archaeological and philosophical subjects, the little treatise *Über die bildende Nachahmung des Schönen* (1788; reprinted 1888) and *Die Götterlehre* (1791; 10th ed., 1855, a reprint in Reclam's *Universalbibliothek*, 1878) are important; interesting, too, are the accounts of his travels, *Reisen eines Deutschen in England* (1788; repr. 1903; also trans. into Eng.) and *Reisen eines Deutschen in Italien* (3 vols., 1792–1793). As an author he is best known by his two novels, *Anton Reiser* (1785-1790; new ed. by L. Geiger, 1886) and *Andreas Hartknopf* (1786), which are mainly autobiographical.

See K. F. Klischnig, *Erinnerungen aus den zehn letzten Lebensjahren meines Freundes Anton Reiser* (1794); Varnhagen von Ense, *Denkwürdigkeiten*, vol. iv. (1838); and M. Dessoir, *Karl Philipp Moritz als Aesthetiker* (1889).

MORLAIX, a town of western France, capital of an arrondissement in the department of Finistère, 37 m. E.N.E. of Brest on the railway to Rennes. Pop. (1906), 13,875. Morlaix lies between 4 and 5 m. from the English Channel in a narrow valley where two small streams unite to form the Dossen, the channel of which forms its port. Below the town the river widens into an estuary, the mouth of which is commanded by an old fortress, the Château du Taureau, built in 1542 to protect the town against the English. The railway from Paris to Brest crosses the valley on a striking two-storeyed viaduct some 200 ft. above the quays. Morlaix contains a considerable number of wooden houses of the 15th, 16th and 17th centuries. These have large covered courts, with huge open fireplaces and carved wooden staircases, supported on pillars, leading from the court to the upper storeys.

Morlaix has a sub-prefecture, tribunals of first instance and of commerce, a chamber of commerce, and colleges for boys and girls. The industries include the manufacture of tobacco occupying about 900 hands, tanning, brewing and the manufacture of casks, wooden shoes and candles; there is an active trade in grain, butter, oil-seeds, vegetables, leather, wax, honey and in horses and other livestock, which are exported by sea. The port, consisting of an outer tidal harbour and an inner basin, admits vessels drawing 17 ft. at spring tides and 12 ft. at neap tides.

Judging by the numerous coins found on the spot, the site of Morlaix was probably occupied in the time of the Romans. The counts of Leon held the lordship in the 12th century, but the dukes of Brittany disputed possession with them, and in 1187 Henry II. of England, guardian of Arthur of Brittany, made himself master of the town after a siege of several weeks. During the Hundred Years' War Morlaix was held by the French and the English in turn, and pillaged by the latter in 1522. Queen

Mary of Scots, on her way to be married to the dauphin, made solemn entry into Morlaix in 1548. The town having joined the League, the castle was taken by storm in the name of Henry IV. in 1594.

MORLAND, GEORGE (1763–1804), English painter of animals and rustic scenes, was born in London on the 26th of June 1763. His grandfather, George H. Morland, was a subject painter, three of whose popular pictures were engraved by Watson and Dawe in 1769. The son, H. R. Morland, father of George, was also an artist and engraver, and picture restorer, at one time a rich man, but later in reduced circumstances. His pictures of laundry-maids especially were very popular in their time, and were reproduced in mezzotint. They represented ladies of some importance who desired to be painted, according to the fashion of the day, engaged in domestic work. Morland's mother was a Frenchwoman, who possessed a small independent property of her own; she is believed to have been the Maria Morland who exhibited twice at the Royal Academy in 1785 and 1786, although some writers have stated that Maria Morland was not the mother, but one of the sisters of George Morland.

At a very early age Morland produced sketches of remarkable promise, exhibiting some at the Royal Academy in 1773, when he was but ten years old, and continuing to exhibit at the Free Society in 1775 and 1776, and at the Society of Artists in 1777, and then sending again to the Royal Academy in 1778, 1779 and 1780. His very earliest work, however, was produced even before that tender age, as his father kept a drawing which the boy had executed when he was but four years old, representing a coach and horses and two footmen. He was a student at the Royal Academy in early youth, but only for a very short time. From the age of fourteen he was apprenticed to his father for seven years, and by means of his talent appears to have kept the family together. He had opportunities at this time of seeing some of the greatest artists of the day, and works by old masters, but even then a strange repugnance for educated society showed itself, and no persuasion, for example, could ever allure him within reach of the Angerstein gallery, where he would have been a welcome visitor. Before his apprenticeship came to an end, Romney offered to take Morland into his studio for three years, with a salary of £300 a year, but the offer was rejected, and as soon as his freedom came, he left his dull, respectable home, with its over-strict discipline, and began a career of reckless prodigality which has hardly a parallel in art biography. In 1785 he was in France, whither his fame had preceded him, and where he had no lack of commissions, and in the following year he married Anne, the sister of William Ward, the engraver, and settled down in High Street, Marylebone.

Mrs Morland was a beautiful and virtuous woman, and throughout the whole of her husband's profligate career was deeply attached to him. It was at this time that he painted the six pictures known as the Laetitia series, engraved by J. R. Smith, and, just preceding his marriage, four other didactic works, "The Idle and the Industrious Mechanic" and "The Idle Laundress and the Industrious Cottager," engraved by Blake, had been produced by him. Shortly after his marriage Morland resided at Pleasant Passage, Hampstead Road, and at that time his reputation was rapidly increasing, while as he was the sole vendor of his own productions, his expenditure, although very extravagant, was not beyond his income. Soon, however, he moved to Warren Place, and there, although he was making a thousand a year by his pictures, he lived at such an expensive rate that he began the series of financial difficulties which finally ruined him. His wild frolics about town, and the prodigal line of conduct upon which he had entered, resulted in a heavy accumulation of debt, but in 1789 he set himself to clear off his encumbrances, and did so in fifteen months. He then removed to Leicester Square, later to Tavistock Row, then to St Martin's Lane, and finally to Paddington, and was at that time at the very height of his reputation.

After moving to a larger house in Winchester Row, his financial position became so embarrassed that he had to fly from his creditors into Leicestershire, where he indulged to the full his delight in animal life. After a year, however, he returned to London and settled in Charlotte Street, when his difficulties increased, and time after time he had to obtain letters of licence, in order to avoid being arrested by his creditors. At last, however, he had to cross the water, and change his place of abode from time to time, keeping it as secret as possible, and we hear of him at Lambeth, at East Sheen, in the Minories, Kentish Town, Soho, Newington, Kennington Green and Hackney, while he had numerous adventures in eluding the attention of those who desired to capture him.

In 1799 he escaped to the Isle of Wight, and settled down for some time at Yarmouth, but returned to London at the end of the year, was arrested and sent to King's Bench prison, where he lived within the rules, occupying a small furnished house in St George's Fields, but keeping his exact residence a secret. In 1802 he was liberated, but in 1803 had to place himself in the custody of the Marshalsea, in order to avoid his creditors. Afterwards he visited Brighton and other places, and by his riotous living brought himself to such a state of health that fits of an apoplectic nature became frequent, and he was for a time paralysed. On the 19th of October 1804 he was arrested by a publican and conveyed to a sponging-house, where, in attempting to make a drawing which could be sold in discharge of the debt, he was seized with a fit which proved the beginning of brain fever. He died on the 29th of the same month. His wife survived him only three days, the news of his death bringing on convulsive fits from which she died on the 2nd of November. Their remains were interred together in the burying-place of St James's Chapel.

The finest of his pictures were executed between 1790 and 1794, and amongst them his picture of the inside of a stable, in the National Gallery, may be reckoned as a masterpiece. His works deal with scenes in rustic and homely life, depicted with purity and simplicity, and show much direct and instinctive feeling for nature. His colouring is mellow, rich in tone, and vibrant in quality, but, with all their charm, his works reveal often signs of the haste with which they were painted and the carelessness with which they were drawn. He had a supreme power of observation and great executive skill, and he was able to select the vital constituents of a scene and depict even the least interesting of subjects with artistic grace and brilliant representation. His pictures are never crowded; the figures in them remarkably well composed, often so cleverly grouped as to conceal any inaccuracies of drawing, and to produce the effect of a very successful composition. As a painter of English scenes he takes the very highest position, and his work is marked by a spirit and a dash, always combined with broad, harmonious colouring. Many of his best works have been well rendered in mezzotint by J. R. Smith, W. Ward, P. Dawe, G. Keating, S. W. Reynolds and other engravers. He exhibited regularly at the Royal Academy from 1784 down to 1804, but few of his academy pictures can be identified owing to the inadequate description of them afforded by their titles.

Four biographies of him appeared shortly after his death, written by W. Collins (1805), F. W. Blagdon (1806), J. Hassell (1806) and George Dawe (1807). Later biographies are those by Ralph Richardson (1895), J. T. Nettleship (1898) and G. C. Williamson (1904 and 1907). (G. C. W.)

MORLANWELZ, a town of Belgium in the province of Hainaut, 15 m. E. of Mons. It lies in the centre of the coal-mines district and has extensive foundries and ironworks. Pop. (1904), 8200.

MORLEY, BARONS AND EARLS OF.—In 1299 William de Morley of Morley in Norfolk was summoned to parliament as a baron, and his son Robert (d. 1360) was a celebrated warrior, being largely responsible for the English victory at Sluys and fighting at Crecy. His descendant Robert, the 6th baron (d. 1443), had no sons, but he left a daughter Alianore, who married William Lovel (d. 1476), and Lovel was summoned to parliament as Lord Morley, ranking as the 7th holder of the title. He left a son Henry, who was killed in 1489, and Henry's heir was his sister Alice, the wife of Sir William Parker (d. 1510), hereditary marshal of Ireland. Their son Henry Parker (1476–1556) became the 10th baron, as he was summoned to the House of

Lords as Lord Morley in 1523. He was a man of literary attainments and translated some of the writings of Plutarch, Boccaccio, Petrarch, Seneca, Cicero and others into English. Most of these are only found in manuscript, but his *Tryumphes of Fraunces Petrarcke* was published a second time in 1887. His eldest son Henry (d. 1553) died during his father's lifetime, leaving a son Henry (d. 1577) who became 11th Baron Morley on his grandfather's death. His son Edward (d. 1618), one of the judges of Mary Queen of Scots, succeeded to the barony; and Edward's son and successor was William Parker, 4th Lord Monteagle (*q.v.*). The barony of Morley remained united with that of Monteagle until the death of William's grandson Thomas about 1686, when it fell into abeyance.

John Parker, 1st earl of Morley (1772–1840), only son of John Parker (1735–1788), who was created Baron Boringdon in 1784, but was no relation of the previous barons Morley, was a prominent supporter of Pitt and of Canning. In 1815 he was created earl of Morley. He was a public benefactor to Plymouth and its neighbourhood. He was succeeded by his son Edmund Henry Parker (1810–1864), whose son, Albert Edmund, the 3rd earl (1843–1905), was chairman of committees in the House of Lords from 1889 to 1905, after having been under-secretary for war and first commissioner of works. In 1905 his son, Edmund Robert (b. 1877), became 4th earl.

MORLEY, GEORGE (1597–1684), English bishop, was born in London and educated at Westminster and Oxford. In 1640 he was presented to the sinecure living of Hartfield, Sussex, and in the following year he was made canon of Christ Church and exchanged to the rectory of Mildenhall, Wiltshire. He preached before the Commons in 1642, but his sermon gave offence, and when in 1647 he took a prominent part in resisting the parliamentary visitation of Oxford University he was deprived of his canonry and living. Leaving England he joined the court of Charles II., and became one of the leading clergy at The Hague. Shortly before the Restoration he came to England on a highly successful mission to gain for Charles the support of the Presbyterians. In 1660 he regained his canonry, and soon became dean of Christ Church. In the same year he was consecrated bishop of Worcester. At the Savoy conference of 1661 he was chief representative of the bishops. He was translated to the see of Winchester in 1662. His works are few and chiefly polemical, *e.g. The Bishop of Worcester's Letter to a friend for Vindication of himself from the Calumnies of Mr Richard Baxter* (London, 1662).

MORLEY, HENRY (1822–1894), British man of letters, was born in London on the 15th of September 1822. After unhappy experiences at English schools, he was sent to the Moravian school at Neuwied, whose system strongly influenced his subsequent theories of education. It was intended that he should follow his father's profession of medicine, and in 1844 he bought a share in a practice at Madeley, Shropshire. Plunged into debt by his partner's dishonesty, he set up a small school for young children at Liscard, near Liverpool. His principle was to abolish all punishment, to make his pupils regard their work as interesting instead of repellent, and to form their character by appealing exclusively to higher motives. This scheme, carried out with much ingenuity, proved a complete success. Meanwhile he had devoted his spare time to writing. His contributions to magazines attracted the notice of Charles Dickens, on whose invitation in 1851 he settled in London as a regular contributor to *Household Words*. He was also on the staff of the *Examiner*, which he edited from 1861 to 1867. Meanwhile he had devoted much research to a life of *Palissy the Potter* (1852), which was at the same time a picture of life in medieval France. Encouraged by its favourable reception, he followed it up with lives of *Jerome Cardan* (1854) and *Cornelius Agrippa* (1856), and subsequently of *Clement Marot* (1870). His dramatic criticisms were reprinted in 1866 under the title of *The Journal of a London Playgoer, 1851–1866.* In 1857 he was appointed evening lecturer in English literature at King's College, and in 1865 became, in succession to David Masson, professor of English literature at University College, London. His *First Sketch of English Literature* (1873), a comprehensive and useful manual, reached its 34th thousand during the author's lifetime. He published in 1864 the first volume of a monumental history of English literature entitled *English Writers*, which he eventually carried in eleven volumes down to the death of Shakespeare. He was indefatigable as a popularizer of good literature. After editing a standard text of Addison's *Spectator*, he brought out a vast number of classics at low prices in Morley's Universal Library, Cassell's National Library, and the Carisbrooke Library. His ready speech, retentive memory, earnest purpose, and bright style made him perhaps the most popular lecturer of his day. His teaching work at University College was marked by equally extraordinary success. In 1882 he accepted a post that made great calls on his time and energy—the principalship of University Hall. This institution was partly a place of residence for students of University College, and partly the home of Manchester New College. During this time he rendered further services to the cause of education in London not only by his work on the council of University College, but by his advocacy of a teaching university for London. In 1889 he resigned the principalship of University Hall and his professorship at University College, and retired to Carisbrooke, Isle of Wight, intending to devote his leisure to the completion of the great task of his life, *English Writers*. But with his work only half achieved he died on the 14th of May 1894.

MORLEY [of Blackburn], **JOHN MORLEY,** Viscount (1838–   ), English statesman and author, was born at Blackburn on the 24th of December 1838, being the son of Jonathan Morley, surgeon. He matriculated at Lincoln College, Oxford, in 1856, and after taking his degree in 1859 came up to London with the determination of seeking distinction by literature. He almost immediately became editor of the moribund *Literary Gazette*, which not all his ability could preserve from extinction. Gradually, however, he became known as a philosopher and a Radical, and as one of the ablest and most incisive contributors to the literary and political press of the day. His sympathies as a thinker seem to have been at this time chiefly with Positivism, though he never embraced Comte's doctrine in its hierarchical aspects; but he acquired a reputation as an agnostic, which became confirmed in the popular mind when he somewhat aggressively spelt God in one of his essays with a small "g." In 1868 he was editor for a short time of the daily *Morning Star*, which came to an end in 1870. In 1867 he succeeded G. H. Lewes in the editorship of the *Fortnightly Review*, which he conducted with brilliant success until 1883, when he was elected to parliament; he then assumed in exchange, but not for long, the lighter duties of the editorship of *Macmillan's Magazine*. He had been connected with Messrs Macmillan since the commencement under his editorship, in 1878, of the "English Men of Letters" series, a collection of biographies of various merit, in which nothing is better than the editor's own contribution in his *Life of Edmund Burke*, itself an extension of his article in the 9th edition of this encyclopaedia (1876). Since 1880 he had also been editor of the *Pall Mall Gazette*, which had been turned into a Liberal paper (see Newspapers).

In 1883 Mr Morley, who had twice unsuccessfully attempted to enter parliament, was returned for Newcastle-upon-Tyne at a by-election. The prestige thus acquired led to his presiding over a great Liberal congress at Leeds in the same year; and, although the platform never seemed his natural element, the literary finish of his style and the transparent honesty of his reasoning rapidly gained him a prominent position in the House of Commons. When, in February 1886, Mr Gladstone returned to office as a Home Ruler, Mr Morley, who had never before held any public appointment, filled one of the most important posts in the cabinet as secretary for Ireland. He had always expressed his sympathy with the Irish Nationalist movement. He had no opinions to recant, no pledges to explain away. He is credited with an especial influence over Mr Gladstone in the matter of Home Rule, and in particular with having kept him steady in the Bill of 1886 to his original purpose of entirely separating the Irish from the British legislature, a provision which pressure from their own party afterwards compelled both of them to abandon. After the severe defeat of the Gladstonian party at the general election of 1886, Mr Morley led a life divided between politics and letters until Mr Gladstone's return to power in 1892, when he resumed his former office. He had been re-elected for Newcastle in circumstances entirely honourable to himself, a determined attempt having been made to exclude him in consequence of his resistance to an Eight Hours' Labour Bill, of which he disapproved as an undue interference in principle with the rights of adult labour. His constituents showed their appreciation of his integrity by returning him with a majority of 1739; but the resistance to his views on the labour question went on in his constituency, and was assisted by Joseph Cowen's persistent campaign in the principal Newcastle newspaper against the general lines of Mr Morley's somewhat doctrinaire and anti-Imperialistic views on politics. The result was that at the election of 1895 he lost his seat, but soon found another in Scotland, for the Montrose Burghs. He had during the interval taken a leading part in parliament, but his tenure of the chief secretaryship of Ireland was hardly a success. The Irish gentry, of course, made things as difficult for him as possible, and the path of an avowed Home Ruler installed in office at Dublin Castle was beset with pitfalls. In the intestine disputes which agitated the Liberal party during Lord Rosebery's administration, and afterwards, Mr Morley sided with Sir William Harcourt, and was the recipient and practically co-signatory of his letter resigning the Liberal leadership in December 1898.

Mr Morley's activities were now again turned to literature, the political views most characteristic of him, on the Boer war in particular, being practically swamped by the overwhelming predominance of Unionism and Imperialism. His occasional speeches, however, denouncing the Government policy towards the Boers and towards the war, though not representing the popular side, always elicited a respectful hearing, if only for the eloquence of their language and the undoubted sincerity of the speaker. As a man of letters his work was practically concluded at this period, and may briefly be characterized. His position as a leading English writer had early been determined by his monographs on *Voltaire* (1872), *Rousseau* (1873), *Diderot and the Encyclopaedists* (1878), *Burke* (1879), and *Walpole* (1889). Burke as the champion of sound policy in America and (as Mr Morley deems) of justice in India, Walpole as the pacific minister understanding the true interests of his country, fired his imagination. His *Life of Oliver Cromwell* (1900) revises Gardiner as Gardiner revised Carlyle. The *Life of Cobden* (1881) is an able defence of that statesman's views rather than a critical biography or a real picture of the period. Mr Morley's contributions to political journalism and to literary, ethical and philosophical criticism were numerous and valuable. They show great individuality of character, and recall the personality of John Stuart Mill, with whose mode of thought he had many affinities. As in letters, so in politics. A philosophical Radical of a somewhat mid-19th-century type, and highly suspicious of the later opportunistic reaction (in all its forms) against Cobdenite principles, he yet retained the respect of the majority whom it was his usual fate to find against him in English politics by the indomitable consistency of his principles and by sheer force of character and honesty of conviction and utterance.

After the death of Mr Gladstone Mr Morley was principally engaged upon his biography, until it was published in 1903. Representing as it does so competent a writer's sifting of a mass of material, the *Life of Gladstone* was a masterly account of the career of the great Liberal statesman; traces of Liberal bias were inevitable but are rarely manifest; and in spite of the a priori unlikelihood of a full appreciation of Mr Gladstone's powerful religious interests from such a quarter, the whole treatment is characterized by sympathy and judgment. Among the coronation honours of 1902, Mr Morley was nominated an original member of the new Order of Merit; and in July 1902 he was presented by Mr Carnegie with the late Lord Acton's valuable library, which, on the 20th of October, he in turn gave to the university of Cambridge.

When Sir Henry Campbell-Bannerman formed his cabinet at the end of 1905 he was made secretary of state for India. In this position he was conspicuous in May 1907 and afterwards for his firmness in sanctioning extreme measures for dealing with the outbreak in India of alarming symptoms of sedition. Though he was bitterly attacked by some of the more extreme members of the Radical party, on the ground of belying his democratic principles in dealing with India, his action was generally recognized as combining statesmanship with patience; and, though uncompromising in his attitude towards revolutionary propaganda, he showed his popular sympathies by appointing two distinguished native Indians to the council, and taking steps for a decentralization of the administrative government. When Sir Henry Campbell-Bannerman resigned in 1908 and Mr Asquith became prime minister, Mr Morley retained his post in the new cabinet; but it was thought advisable to relieve him of the burden imposed by a seat in the House of Commons, and he was transferred to the upper house, being created a peer with the title of Viscount Morley of Blackburn. His subsequent career at the India office will always be associated with his extensive remodelling (1908–1909) of the system of government in India so as to introduce more fully the representative element (see INDIA). Whatever might be the outcome of this crucial reform, the preparation and execution of Lord Morley's scheme were carried through by him with a statesmanlike and philosophic detachment, and in a spirit of balanced reason, which earned for him the increased respect of all parties in the state. (H. CH.)

MORLEY, SAMUEL (1809–1886), English manufacturer and politician, was born at Homerton, not then a part of London, on the 15th of October 1809, the youngest son of a Nottingham hosier. His father, John, and his uncle, Richard, were the founders of the already prosperous Nottingham firm of I. & R. Morley, dealers in hosiery made in the cottages of the local knitters, and as early as 1797 they had opened a London warehouse, in the counting-room of which Samuel Morley began his career at sixteen. On his father's retirement in 1840 he became practical head of the London concern, and when his brothers retired in 1855 sole owner. In 1860 he was sole owner also of the Nottingham business. Under excellent management the business grew rapidly into the largest of the kind in the world, with huge mills at Nottingham and in Leicestershire and Derbyshire employing thousands of hands. In 1865 Morley was elected M.P. for Nottingham, and from 1868–1885 he sat for one of the Bristol divisions. He was a strong Liberal and a whole-hearted supporter of Gladstone, who in 1885 offered him a peerage. He was one of the principal proprietors of the London *Daily News*, the chief Liberal organ of the period, and it was owing to him that its price was reduced from 3d. to 1d. and its losses turned to great gains. Morley was a deeply religious man. Like his father before him, he was a Dissenter, and for many years he strongly opposed every scheme of state interference with education. He was keenly interested in the temperance movement, and during the closing years of his life his public energies were chiefly confined to its promotion. His philanthropy was active, his charity widespread and munificent, and he was a model employer. He died on the 5th of September 1886. His son, Arnold Morley (b. 1849), was Liberal M.P. for Nottingham from 1880–1885, and for East Nottingham from 1885–1895. From 1886–1892 he was chief Liberal whip, and from 1892–1895 postmaster-general.

See Edwin Hodder, *Life of Samuel Morley* (1887); Frederic M. Thomas, *I. & R. Morley: a Record of a Hundred Years* (1900).

MORLEY, THOMAS (1557–1603), English musical composer, was born in 1557, as may be gathered from the date of his motet, "Domine non est," composed "aetatis suae 19 anno domini 1576," and preserved in Sadler's Part-Books (Bodleian Library). He was a pupil of William Byrd, but nothing is known as to his origin and very little as to the incidents of his career. In the account of the entertainments given at Elvetham by the earl of Hertford in 1591 in honour of Queen Elizabeth, it is stated that there was "a notable consort of six Musitions," whose music so pleased the queen "that in grace and favour thereof, she gave a newe name unto one of their Pavans, made long since by Master *Thomas Morley*, then Organist of Paules Church." This statement, however, lacks corroboration, and if Morley ever held the post he must have done so for a very short time. On the 5th of July 1588 he was admitted Mus. Bac. at Oxford. Four years later (July 24, 1592) he entered the Chapel Royal, where he successively filled the offices of epistler and gospeller. From the dedication to his first book of canzonets it seems that in 1595 Morley was married. His wife's Christian name was Margaret, and before her marriage she apparently held some post in the household of Lady Periam, wife of the lord chief baron of the exchequer. On the 11th of September 1598 Morley received a licence for twenty-one years to print ruled music-paper and song-books in English, Latin, French or Italian. His rights under this grant were assigned by him to various publishers. In Burgon's *Life of Gresham* it is stated (ii. 465) that the registers of St Helen's, Bishopsgate, show that Morley lived in that parish. This is inaccurate, and there is no proof that the family of the same name residing in St Helen's between 1594 and 1600 was related to the composer. In the preface to his *Plaine and Easie Introduction to Practicall Musicke* (1597), Morley gives as one of his reasons for undertaking that work that he led a solitary life, "being compelled to keepe at home," presumably owing to ill health. On the 7th of October 1602 his place in the Chapel Royal was filled up, and on the 25th of October 1603 administration of his goods was granted to his widow. This document (*Act Book*, 1603, fol. 171) describes him as "late parishioner of St Botolph's near Billingsgate," but the registers of that parish contain no entries relating to him. Morley was incontestably one of the greatest of the secular Elizabethan composers. His madrigals, canzonets and ballets are as remarkable for their beauty as they are for their admirable workmanship, and his *Introduction to Practicall Musicke*, in spite of its frequent obscurity, is an invaluable source of information as to the state of musical science in England at the end of the 16th century. His works are: (1) *Canzonets to Three Voices* (1593; 2nd ed., 1606; 3rd ed., 1631; Ger. trans., Cassel, 1612, and Rostock, 1624); (2) *Madrigals to Four Voices* (1594; 2nd ed., 1600); (3) *First Book of Ballets to Five Voices* (1595; an Ital. ed. appeared in London in the same year; 2nd ed., 1600; Ger. ed., Nuremberg, 1609); (4) *First Book of Canzonets to Two Voices* (1595; 2nd ed., 1619); (5) *Canzonets or Short Little Songs to Four Voices, selected out of Italian Authors* (1597); (6) *Canzonets to Five and Six Voices* (1597); (7) *A Plaine and Easie Introduction to Practicall Musicke* (1597; 2nd ed., 1608; 3rd ed., 1771); (7) *Madrigals to Five Voices, selected out of Italian Authors* (1598); (8) *The First Book of Consort Lessons, made by divers authors, &c.* (1599; 2nd ed., 1611); (9) *The First Book of Airs to Sing and Play to the Lute with the Base Viol* (1600); (10) *The Triumphs of Oriana to Five and Six Voices, composed by divers several authors* (1601). Besides the above, services, anthems, motets and virginal pieces by Morley are to be found in various collections, both printed and manuscript. (W. B. S.*)

MORLEY, a municipal borough in the Morley parliamentary division of the West Riding of Yorkshire, England, 4 m. S.S.W. of Leeds, on the Great Northern and London & North-Western railways. Pop. (1901), 23,636. The town-hall was opened in 1895; and a park, for which the ground was presented by Lord Dartmouth, in 1890. The chief industries are connected with woollen cloth, machinery for the treatment of wool, coal and stone. The borough, incorporated in 1885, is under a mayor, 7 aldermen and 21 councillors. Area, 3385 acres. In the neighbourhood are ruins of a mansion, Howley Hall, dating from 1590, which, garrisoned for the parliament, sustained a heavy siege from the royalists during the Civil War.

MORMAOR, or MORMAER (from two Gaelic words *mor*, great, and *maor*, a steward or bailiff), a title used to designate the rulers of the seven provinces into which Celtic Scotland, *i.e.* the part of the country north of the Forth and the Clyde, was divided. These seven mormaorships, or original "earldoms" of Scotland, as they were afterwards called, were: Angus, Athole with Gowry, Caithness with Sutherland, Fife, Mar with Buchan, Moray with Ross, and Stratherne with Menteith.

MORMONS, the common name given to the Church of Jesus Christ of Latter-Day Saints, a religious sect founded by Joseph Smith, jun., at Manchester, New York, in 1830, and since 1848 largely concentrated about Salt Lake City, Utah. Smith was born on the 23rd of December 1805 at Sharon, Windsor county, Vermont, from which place in 1815 or 1816 his parents, who like his grandparents were superstitious, neurotic, seers of visions, and believers in miraculous cures and in heavenly voices and direct revelation, removed to New York, where they settled on a small farm near Palmyra, Wayne county (then Ontario). In 1819 they removed to Manchester, in what is still Ontario county, about 6 m. from Palmyra. In Manchester Joseph, a good-natured, lazy boy, suffering from a bad heredity physically and psychically, began to have visions which seem to have accompanied epileptoid seizures (his mother's father had falling fits), from which he recovered apparently before he became of age. The boy's father was a digger for hidden treasure and used a divining rod to find proper places to dig wells, and about this time the son became a crystal gazer and by the use of a "peep-stone" discovered the whereabouts of pretended hidden treasure. He said (in 1838) that on the night of the 21st of September 1823 the angel Moroni appeared to him three times, and told him that the Bible of the western continent, the supplement to the New Testament, was buried on a hill called Cumorah, now commonly known as Mormon Hill. It seems almost certain that he told other and earlier stories of how he came to find the gold plates, and it is possible that before this time there was a story current in Canada of the recovery of a "Gold Bible." It was not until the 22nd of September 1827 that (as he said) he dug up, on the hill near Manchester, a stone box, in which was a volume, 6 in. thick, made of thin gold plates 8 in. by 7 in., and fastened together by three gold rings. The plates were covered with small writing in characters which, it was said, Professor Charles Anthon[1] declared were in the "reformed Egyptian tongue"; with the golden book Smith claimed that he found a breastplate of gold and a pair of supernatural spectacles, consisting of two crystals set in a silver bow, and called "Urim and Thummim"; by aid of these the mystic characters could be read. Being himself unable to read or write fluently, Smith employed as amanuenses: first Martin Harris (1793–1875); then his own wife, Emma; after the middle of April 1829, Oliver Cowdery, a blacksmith and school teacher; and David Whitmer (1805–1888); to them, from behind a curtain, he dictated a translation, for the printing and publishing of which Martin Harris paid, in spite of the continued opposition of his wife to the scheme. An edition of 5000 copies of *The Book of Mormon*[2] was printed early in 1830 in the printing office of the *Wayne Sentinel* at Palmyra. It was accompanied by "The Testimony of the Three Witnesses," a sworn statement of Oliver Cowdery, David Whitmer and Martin Harris that an angel of God had shown them the plates of which the book was a translation, and by "The Testimony of the Eight Witnesses," four of them Whitmers and three of them Smiths (Joseph's father and his brothers Hyrum and Samuel). Soon afterwards, according to Smith, the plates disappeared, being taken away by the angel Moroni.

The Book of Mormon, in which Joseph Smith was declared to be God's "prophet," with all power and entitled to all obedience, professes to give the history of America from its first settlement by a colony of "Jaredites" from among the crowd dispersed by the confusion of tongues at the Tower of Babel down to the year 5 A.D. These settlers in course of time destroyed one another. In 600 B.C. Lehi, his wife, and four sons, with ten friends, all from Jerusalem, landed on the coast of Chile. Upon the death of Lehi, the divine appointment to the leadership of Nephi, the youngest son, roused the resentment of his elder brothers, who were in consequence condemned to have dark skins and to be an idle, mischievous race, the "Lamanites" or North-American Indians. Between the Nephites and the bad Hebrews a fierce war was maintained for centuries, until finally, in spite of divine intervention in the person of the risen Christ, who here founded a Church with the same organization "as was enjoyed on the Eastern Continent," the Nephites fell away from the true faith, and in 384 A.D. were nearly annihilated in a battle at the hill of Cumorah, in Ontario county, New York. Among the handful that escaped were Mormon and his son Moroni, the former of whom collected the sixteen books of records, kept by successive kings and priests, into one volume, which on his death was supplemented by his son with some personal reminiscences and by him buried in the hill of Cumorah, where he was divinely assured that the book would one day be discovered by God's chosen prophet. This is Smith's account of the book: it was a contention of the early anti-Mormons, now however discredited, that *The Book of Mormon* as published by Smith was rewritten with few changes from an unpublished romance, *The Manuscript Found*, written before 1812 by Solomon Spaulding[1] (1761–1816), a minister and iron-founder who had become greatly interested in the prehistoric mounds of Ohio and wrote a romance to explain their origin and the Hebrew origin of the North-American Indians. The style of the book is poor; the speeches of primitive Indian chiefs are filled with the phraseology of the 19th-century campmeeting; there are long extracts from the Westminster Confession, and a speech of Nephi contains a statement of doctrine which corresponds with heretical views held in Smith's own time in the presbytery of Geneva, in which his home lay.

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[1] Martin Harris took a copy in Smith's hand of certain "caractors" (so Smith spelled it) to Dr Anthon, who at first thought it "a hoax upon the learned," but, after hearing the story of the diamond spectacles and that Harris had been asked to pay for the publication of the book, said that it was a fraud on Harris. He recognized the miscellaneous and haphazard nature of the "caractors," of which facsimiles are given by Riley, p. 81, and Linn, p. 40. Riley thinks that the "caractors" were automatic writing, and that "unconscious cerebration played a large part in the evolving of the gold plate scheme."

[2] More than a dozen years afterwards Smith, when asked if "Mormon" was not connected with the Greek word for "hobgoblin" ("Mormo" is thus used in 17th-century English), explained that it meant "more good," from the "Egyptian *mon*," "with the addition of *more*, or the contraction *mor*."

The time was singularly favourable to the founding of a new sect: religious unrest and receptiveness were prevalent; and western New York was the scene of the foundation of various new communities between 1789, when Jemima Wilkinson founded "Jerusalem" in Yates county, New York, and 1848, when the Fox sisters gave their first spiritualistic manifestations about ten miles from Joseph Smith's home. His book and his claim to divine authority, upheld by frequent revelations, soon drew many followers to Smith. A Church was formally organized on the 6th of April 1830 at Fayette, Seneca county, New York; and in June a conference of about thirty members met at Fayette. Smith and Cowdery had previously (May, 1829) baptized each other, in alleged accordance with the instruction of John the Baptist,who had ordained them, conferring "the priesthood of Aaron"; while Peter, James and John afterwards made them priests of "the order of Melchisedec." In October 1830 Smith sent out Parley Parker Pratt (1807–1857), Oliver Cowdery, Ziba Peterson, and Peter Whitmer, jun., as missionaries. One of their first converts, in Mentor, Lake county, Ohio, was Sidney Rigdon (1793–1876), whom Pratt had formerly known, who had preached as a Baptist in 1819–1828—a part of this time in Pittsburg—who had then joined Alexander Campbell and Walter Scott in establishing the Disciples of Christ, and who was pastor of a church in Mentor. Rigdon was baptized, became a Mormon leader, and, after a "revelation" of December 1830, made a new translation of the Bible, in which prophecies of the coming of Joseph Smith and the nature of *The Book of Mormon* are inserted in the 50th chapter of Genesis and the 29th chapter of Isaiah respectively. This translation was not published until 1866 and is not in use in the Mormon churches. In January 1831 Smith, who had been "persecuted" in his New York home, where several lawsuits, all unsuccessful, had been brought against him, accompanied Rigdon to Ohio, where at Kirtland (a few miles south-west of Mentor), Lake county, Ohio, the preaching of the new sect was very successful, partly because Pratt and Rigdon were so well known to the Disciples in north-eastern Ohio. Smith at this time seems to have intended to make the New Jerusalem at Kirtland; there he established a general store, a steam saw-mill and a tannery, bought land, platted a great city, and built a stone temple, which was consecrated in 1836. But the church was "persecuted" again, especially by apostates; on the 25th of March 1832 Smith and Rigdon were tarred and feathered at Hiram,[2] Portage county, where they were then living. In February 1834 the Church was fairly organized; already on the 8th of March 1833 Smith, Rigdon, and Frederick G. Williams had been styled the first presidency, and were entrusted with the keys of the last kingdom. About this time the licentiousness of Smith might have led to the dissolution of the Church but for Brigham Young (1801–1877), a Vermont painter and glazier, who was baptized in 1832 and soon afterwards was ordained elder. Young's indomitable will, persuasive eloquence, executive ability, shrewdness and zeal soon made their influence felt, and, when a further step was taken in 1835 towards the organization of a hierarchy by the institution of the quorum of the "twelve apostles,"[3] who were sent out as proselytizing missionaries among the "gentiles," Young was ordained one of the Twelve and despatched to preach throughout the eastern states. In 1836 the Kirtland Safety Society Bank was organized (in accordance with a "revelation" to Smith); as it was unchartered it issued notes under the name of "The Kirtland Safety Society anti-BANK-ing Co."; but in March 1837 Rigdon and Smith, the secretary and treasurer, were charged with violating the state law against unchartered banks, and they were convicted in October; the society appealed, claiming that it was not a bank but an association, but in November the "bank" suspended payments and in Jan. 1838 Smith and Rigdon left the state for Missouri. In 1836–1837 there had been a determined attempt to depose Smith and make David Whitmer head of the Church; Rigdon and Young successfully opposed this movement, which was backed by Whitmer, Pratt, Williams and Harris. Probably in June 1837 (or in July 1838) there was organized under the leadership of Captain "Fear Not" (David W. Patten) a band called "The Daughter of Zion" (see Mic. iv. 13), the "Big Fan" (Jer. xv. 7), "Brothers of Gideon," and finally "Sons of Dan," or "Danites" (Gen. xlix. 17), bound to secrecy under penalty of death, and formed to punish all who opposed the Church and its supreme head. Numerous crimes and outrages were attributed to them.[4] In the winter of 1830–1831 Pratt, Cowdery and two others had gone as far west as Jackson county, Missouri; in June 1831 Rigdon and Smith joined them there near what is now Independence and (in August) laid corner-stones of Zion and of a Mormon temple; thereafter Mormon immigration to Missouri increased rapidly; and in the early part of 1838 Smith and Rigdon fled to the new settlement called Far West (now Kerr) in Caldwell county, Missouri, which had been made in 1836–1837. Thither many of the saints had taken refuge, having been forcibly driven[1] from Independence and Big Blue in November and December 1833, and having been induced to remove from Clay county after staying there in 1833–1836. In Caldwell and Daviess counties Smith's troubles, however, continued to increase. His profligacy had repelled many of his leading supporters and bred internal dissensions, while from the outside the brethren were harassed and threatened by the steadily growing hostility of the native Missourians. At Far West on the 4th of July 1838 Rigdon preached his "salt sermon" from Matt. v. 13, urging his hearers to wage "a war of extermination" on those who disturbed them. To such a height did the conflicts with the "gentiles" grow that they assumed the proportions of a civil war, and necessitated the calling out of the state militia. A company of Danites from Far West put some Missourian militia to flight but lost their own leader Captain Patten; the gentiles then attacked a Mormon settlement at Hawn's Mill (near Far West) and killed in cold blood about a score of the Mormons. Late in October Far West surrendered to an overwhelming force of militia. Smith and Rigdon with others were arrested and imprisoned on a charge of treason, murder and felony, and their followers to the number of 15,000 crossed over into Illinois and settled near Commerce, Hancock county. Smith, who succeeded in escaping from custody, had rejoined the Mormons in Illinois, and there they were cordially welcomed, especially by the politicians of both parties, who hoped to secure the Mormon vote in the presidential campaign of 1840; and when they founded (on the site of Commerce) the city of Nauvoo, they readily obtained (Dec. 1840) from the state legislature a charter which made the city practically independent of the state government and gave Smith nearly unlimited civil power. He organized a military body called the Nauvoo Legion (also incorporated by the legislature), of which he was commander, being commissioned "lieutenant-general" by the governor of Illinois in 1841; Smith allowed Dr John C. Bennett, an Illinois politician and a new convert, to be the city's first mayor. Foundations of a new temple were laid on the 6th of April 1841 and the temple (83 by 128 ft.) was dedicated on the 1st of May 1846. The city grew very rapidly; a university of the city of Nauvoo was established, among its professors being Rigdon and Orson Pratt (1811–1881), a mathematician, who was called "The Gauge of the Law." In 1842 Smith was charged with instigating an attempt, made by O.P. Rockwell, a Mormon of Nauvoo, to assassinate ex-Governor L. W. Boggs of Missouri; it was impossible to hold either Rockwell or Smith after their indictment and arrest, since the Nauvoo municipal court had the power to determine cases of *habeas corpus*; the influence of Dr Bennett, who had quarrelled with Smith, was not strong enough to outweigh the power of the Mormon vote with the state authorities, and Smith was not held when in June 1843 he was arrested on the old charge of treasonable acts committed in Missouri. His downfall was brought about in a very different manner.

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[1] It was supposed that Sidney Rigdon had been a compositor in a Pittsburg printing-office, that he had stolen Spaulding's manuscript from this office, or had made a surreptitious copy of it, and that he entered into a plot with Smith to use this material for a new Bible. In support of this are vague stories of a mysterious visitor to Smith at the time he was making his translation; and the argument that Smith did not, and Rigdon did, know enough to get the book in shape. But there is no actual proof that Rigdon lived in Pittsburg or was employed in a printer's shop there as early as when Spaulding's "copy" must have been left with the printer; and there is no evidence that Rigdon knew anything of Mormonism until after the publication of *The Book of Mormon*. The discovery by Professor J. H. Fairchild, in 1884, in Honolulu of a manuscript romance by Spaulding (now in the library of Oberlin College, Ohio), which did not agree at all in style or matter with *The Book of Mormon*, does not entirely settle the matter, as this romance is so different in character from the story read by Spaulding to some of his friends in 1811–1812, that if it was really Spaulding's, it must have been a later work than *The Manuscript Found*. Even, however, if it be true that Smith used Spaulding's story, his own additions to it must have been large, for parts of the *Book* seem autobiographic, and one incident seems to be based on the anti-Masonic excitement prevalent in New York state after the disappearance of William Morgan in 1826—ten years after the death of Solomon Spaulding.

[2] Rigdon had formerly been well known and respected in Hiram, which was a stronghold of the Disciples; there he had taught Latin and Greek to the father of Mrs James Abram Garfield.

[3] Young received at this time the title of "The Lion of the Lord"; Lyman Wright and Parley Pratt, who also became apostles, were called respectively "The Wild Ram of the Mountains" and "The Archer of Paradise."

[4] The existence of this organization has been denied by Mormons, but there is abundant evidence that it did exist. See Linn, pp. 212–214, and Bancroft, pp. 124–126; the latter, friendly to the Mormons, says (p. 124) that of the existence of the Danites "there is no question."

The Book of Mormon had forbidden polygamy: "There shall not any man have save it be one wife, and concubines he shall have none, for I the Lord God delighteth[2] in the chastity of women. . . . For if I will, saith the Lord of Hosts, raise up seed unto me, I will command my people, otherwise they shall hearken unto these things." The conditional clause may indicate that Smith from the first had intended to make polygamy a part of the creed of the Church. There is some evidence that even in Ohio polygamy had been secretly practised by Smith and less probably by other elders. In Illinois there seems to have been no secret about Smith's cohabiting with other women. On the 12th of July 1843 he had a revelation expressly establishing and approving polygamy. This revelation was not published officially until 1852, but its purport immediately became known in Nauvoo and aroused great indignation. Dr R. D. Foster, whose wife Smith seems to have coveted, and whom Smith had accused of theft and immorality, William Law and Wilson Law, wealthy Canadian converts, and Sylvester Emmons, a member of the council, established a newspaper the *Expositor*, which was to work for the repeal of the city charter, "to correct the abuse of the unit power, to advocate disobedience to political revelations"; the first and only number (June 7, 1844) told of Hyrum Smith's reading to the council the "revelation on the eternity of the marriage covenant, including plurality of wives," of Joseph Smith's methods and success in winning spiritual wives, and of the prophet's political ambitions. The city council tried the editors of the *Expositor*, the Smiths denying the "revelation" on plural marriage, and on the 10th of June the *Expositor* printing office was razed. Foster and the Laws fled to Carthage. There was a general uprising against the Mormons and Smith put Nauvoo under martial law; but his most able lieutenants were absent,[3] the legion surrendered its arms, and Joseph and Hyrum Smith and others were arrested on the charge of treason (June 25, 1844) and were imprisoned at Carthage. On the night of the 27th a mob, with the collusion of the militia guard, broke into the prison and shot the two brothers dead.

Rigdon, the survivor of the first presidency, and Brigham Young, who were absent from Illinois at the time of Smith's death, were rivals for Smith's place; Young succeeded in having the Council of Twelve, of which he was head, made the supreme authority, and then had Rigdon[4] tried for threatening treason and "cut off from the Church." Young had still to meet the opposition of Joseph Smith's family, who claimed for his son, Joseph, the right of succession, and for a time supported the claims of James J. Strang (1813–1856) of Wisconsin, who had been baptized in February 1844, who told of revelations he had received, who settled with his followers on Beaver Island, Michigan, in 1847, was crowned "King of Zion" there in July 1850, and was killed by some of his followers there in June 1856, when his kingdom broke up. In January 1845 the Nauvoo city charter was repealed; hostility and suspicion against the Mormons increased; there were "burnings" of Mormon property in the outlying country and retaliation by the Nauvoo Legion under a pro-Mormon sheriff; a commission of four members (including Stephen A. Douglas), appointed by the governor, arranged with the Mormon authorities in October 1845 that they should all leave the state next spring. In May and June 1846 most of the Mormons left Nauvoo; in September the city was cannonaded and it again surrendered to the gentiles.

Five companies of Mormon volunteers joined the force under Colonel Stephen W. Kearny which marched to California in the winter of 1846–1847; but this was rather in the nature of assistance from the general government, which provided for their western transportation, than a proof of Mormon patriotism. An exploring party under Brigham Young entered (July 24, 1847) the Great Salt Lake valley and chose it as a place for their new city. Young then returned to Winter Quarters, near what is now Florence, Nebraska, and there on the 5th of December 1847 was chosen president as Smith's successor. Under his leadership, and in accordance with a scheme "revealed" to him and announced in January 1847, the march was organized in a masterly way; the main body, for instance, in its trip across the prairies made flour in a mill built by Young and reaped grain sowed months before by an advance guard. The first migration arrived in Salt Lake City in September, and the population of the new settlement before the close of 1848 was about 5000. The city did not prosper, however, during the first few years of its settlement; but in 1849 and 1850 it became a dépôt and outfitting place for the immigrants to California in the gold excitement. The great improvement of the country under systematic irrigation (here first used on a large scale in the United States) was another factor in the industrial growth of the settlement. As early as 1837 Mormon missionary work had begun in Great Britain, and many foreign converts had immigrated to Ohio, Missouri and Illinois; in December 1847, in a "general epistle" to the Church, Young urged all Mormons in Europe to emigrate as speedily as possible; 120 British saints immigrated in February 1848; a general "emigrating fund" was established in 1849, and the Perpetual Emigration Fund Company was incorporated in 1850; but in 1855 when there were 4425 emigrants, according to the British agency, as a result of an attempt to cut down expenses, proper provision was not made for their transportation from Iowa City, only hand-carts or push-carts being supplied, and one-sixth of a party of 400 died of starvation or exhaustion in a winter march across the plains.

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[1] One of the early charges against the Mormons in Missouri was that they invited free negroes and mulattoes to settle with them; and this rather than any disgust at their religious teachings may have been the first source of opposition to them.

[2] Such solecisms are not infrequent in the Mormon Bible.

[3] Brigham Young, Orson Pratt, and others of the Twelve were campaigning for Smith's candidacy for president of the United States, a campaign which he had undertaken because neither Henry Clay nor John C. Calhoun would give him satisfactory pledges as to the attitude he would take toward the Mormons if elected president.

[4] Rigdon attempted, with brief success, to establish in Pittsburg a Church of Christ, independent of the Latter Day Saints, but based on much the same plan. He spent his last years at Friendship, Allegany county, New York.

When the Mormons first went west they thought they would escape from the jurisdiction of the United States, but the treaty of Guadalupe Hidalgo at the close of the Mexican War transferred the region to the United States. In March 1849 a convention at Salt Lake City organized the "State of Deseret," of which Brigham Young was elected governor; a general assembly meeting in July sent a delegate to the Federal Congress and asked through Stephen A. Douglas for admission into the Union as a state or as a Territory; and on the 9th of September 1850 Utah was admitted as a Territory, of which Young became governor. He forced three non-Mormon district judges to leave the Territory in 1851, and by his open opposition to Lieut.-Colonel Edward Jenner Steptoe, U.S.A., who was stationed in Salt Lake City in the winter of 1854–1855 with about 300 soldiers on the way to California, and who was appointed governor of Utah in December 1854, forced Steptoe to decline the nomination. In 1855–1856 actual violence seems to have been offered to Judges George B. Stiles and W. W. Drummond; and about the same time Federal Indian agents in Utah complained that Mormon missionaries to the Indians were rousing them to hostilities against the United States. The defiant attitude of the Mormon Church towards the United States was thus being continually brought to the notice of the Federal authorities by official reports and by officials fugitive from Utah; and at the same time popular sentiment was stirred against Mormonism by constant rumour of violence in Utah against non-Mormons and apostates and by the official publication, in August 1852, of the "revelation on the eternity of the marriage covenant, including plurality of wives." In 1853 Young put down autocratically the "Gladdenites," followers of Gladden Bishop, who opposed polygamy. In 1856 the Mormon "Reformation" had begun: its principal factors were an elaborate system of confession to missionaries of the Church; the apparent inspiration by the Church of assassination of any suspected of hostility to the Church, of opposition to the ambition of its leaders, or of an intention to escape from Utah and the control of Young; and the doctrine of "blood atonement," which was introduced by Jedediah Morgan Grant (1817–1856) and by which the only remission for certain sins was the shedding of the sinner's blood, so that, according to Brigham Young, "cutting people off from the earth . . . is to save them, not to destroy them." Many outrages were committed by a Mormon band of desperadoes who called themselves "Wolf-hunters." Young's agents doubtless killed William P. Parish of Springville, Utah, early in 1857, apparently because he was planning to remove to California; at about the same time a party of six, including two brothers named Aikin, travelling from San Francisco were arrested as spies, were acquitted, and then were attacked in their camp and murdered, one at least by an assassin who claimed that Young had given him the order; and at Mountain Meadows in Washington county, in the south-western part of Utah, on the 11th of September 1857, about 120 immigrants on their way to southern California, having been attacked four days before by Indians and Mormons and having made a bold defence, were tricked by a flag of truce carried by Mormons who pretended to be a rescuing party, and were killed by armed Mormon troops,[1] seventeen of the younger children being spared.

In 1857 President Buchanan[2] appointed Alfred Cumming (then superintendent of Indian affairs on the Upper Missouri) as governor of the Territory in place of Young, and sent 1500 men to Utah under Colonel Albert Sidney Johnston. On the 15th of September Young issued a proclamation forbidding all armed forces from entering the Territory, calling to arms all forces in the territory, and declaring martial law. On the 5th and 6th of October a band of mounted Mormons under Major Lot Smith captured and burnt three supply-trains of the Federal troops; soon afterwards 800 oxen were cut out from another supply-train and were driven to Salt Lake City. The main body of the Federal troops under Colonel Johnston went into winter quarters in November at Black's Forks, near Fort Bridger. But in the spring of 1858, through the intervention of Thomas L. Kane of Pennsylvania, who had probably been baptized by Young in 1847 and seems to have been a Mormon agent in the East, and who now received letters of authority from President Buchanan, the Mormons were induced to make a merely formal submission to Federal authority. Governor Cumming acquiesced in this settlement of affairs, by which the actual victory was with the Saints. A peace commission sent to Utah in the summer of 1858 carried to the Mormons a presidential proclamation by which they received pardon for their treason. Practically all the Federal troops were withdrawn from Utah in the summer of 1860; soon afterwards Governor Cumming left the Territory to join the Confederate army. One of his immediate successors, John W. Dawson of Indiana, late in 1861 was forced to leave the territory, having been terribly beaten by several Mormons who professed (with apparent truth) to avenge an insult to a woman. In 1862, because the Mormons were suspected of sympathizing with the Confederate States, Colonel P. E. Connor, in command of the military district of Utah (and Nevada), actually marched United States troops into Salt Lake City. Governor Stephen S. Harding, appointed in 1862, proved less tractable than previous governors; a mass meeting in March 1863 undertook to secure his removal; and in June he and a Federal judge were displaced, possibly by the influence of Young (whom Harding had arrested for polygamy but who was not indicted), through capitalists interested in western mail-express and telegraph projects. The Church became less hostile to the Federal government toward the close of the Civil War, as it became apparent that the Confederacy was to be defeated.

Young made a successful effort in 1868–1869 to assure the industrial and commercial control of Utah: after Colonel Connor established Camp Douglas in the immediate vicinity of Salt Lake

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[1] There is no positive proof that this massacre was ordered by the authorities. John Doyle Lee, who was executed in 1877 for the massacre, was a prominent Mormon, had been "adopted" as a spiritual son of Brigham Young in Nauvoo, was one of the founders of Provo and other Mormon settlements in southern Utah, a probate judge, afterwards a member of the Territorial legislature, and his statement implicates the Church. Lee said that he was sacrificed to justice. The only charge against the immigrants seems to have been that they were from Arkansas, and that all Arkansans had forfeited their lives because it was in Arkansas (near Van Buren) that Parley Parker Pratt, the Mormon Isaiah, was killed on the 13th of May 1857 by Hector H. McClean, with whose wife Pratt had eloped. It seems probable that sentiment was aroused against the Arkansans by false stories of their poisoning wells, burning fences, &c.

[2] Buchanan's message (Dec. 8, 1857) stating that Young and his followers apparently intended "to come into collision with the government of the United States" and his sending troops to Utah were considered by his critics as attempts to create an issue which would overshadow the slavery question and to draw away from the army an important force.

City it became increasingly difficult for the Mormon authorities to prevent trade with gentile stores in the city; and in 1869 there was incorporated the Zion Co-operative Mercantile Institution, to which practically all retailers in the territory were forced to sell out. In 1869 the Pacific Railroad reached Salt Lake City and by lessening its isolation, lessened its control by Young. His power was shaken somewhat, and the general tone of Mormonism was improved greatly by the "Godbeite movement," led by W. S. Godbe and E. L. T. Harrison, who with T. B. H. Stenhouse, author of *The Rocky Mountain Saints* (1874), Edward W. Tullidge, who wrote an official *History of Salt Lake City*, and others, had established in 1868 the *Utah Magazine*, which attacked Young's despotism. Although Godbe and Harrison were "cut off" from the Church they succeeded in founding the *Salt Lake Tribune* (1870), the first permanent protest in Utah against Young. At the same time the power of the Latter-Day Saints and Young's autocracy were threatened by the growth of the Reorganized Church of Jesus Christ of Latter-Day Saints, which was formed in 1852 upon the announcement of the doctrine of polygamy, which declared that polygamy had been foisted upon the Church and that Brigham Young was an interloper, and which chose Joseph Smith III. (son of Joseph Smith, jun.; born in 1832) as its head in 1860; in 1863 and in 1869 representatives of the Reorganized Church preached in Salt Lake City.

As early as 1862 Congress had passed the Morrill Act (introduced by Justin S. Morrill) "to punish and prevent the practice of polygamy in the Territories," but in 1867 the presiding officers of the Utah legislature, petitioning for the repeal of this act, declared that "the judiciary of this Territory has not, up to the present time, tried any case under said law." Attempts to pass some extreme measures in 1866 and in 1869–1870 failed. In October 1871 a grand jury in Utah indicted Young and others for violating a Territorial statute against improper cohabitation; but in April 1872 the Supreme Court of the United States (*Chilton* v. *Englebrech*) practically declared the jury incompetent as it had been impanelled by a Federal (and not by a Territorial) marshal; and in October 1873 the same court (*Snow* v. *The United States*) ruled that the attorney-general appointed by the president in a territory could try no cases save those in which the Federal government was a party, thus putting the prosecution of polygamy cases into the hands of the locally elected attorney-general. But on the 23rd of June 1874 President Grant signed the Poland Act,[1] "in relation to courts and judicial officers in the Territory of Utah," which provided for prosecution by the United States attorney-general (not the locally elected official) in criminal cases in Federal courts in the Territory, for the impanelling of grand and petit jurors by the United States marshal, and for the challenge of any juror practising or believing in polygamy on a trial for adultery or polygamy, and otherwise corrected the defects in the Territorial law as pointed out by the Supreme Court, so that prosecutions for polygamy might no longer be a mere farce. But the law was little more than a dead letter: there were few prosecutions, and the only conviction was that of Young's secretary, George Reynolds, whose case dragged on from 1874 to 1879. In 1873 Ann Eliza Young, called "Wife No. 19," brought a suit for divorce against Brigham Young; the defendant was at various times imprisoned and fined for failure to pay alimony *pendente lite*; and in 1877 the judge decided that the marriage was void as polygamous.

Young died in Salt Lake City on the 29th of August 1877; he left an estate of more than $2,000,000, and was survived by about 25 wives and more than 40 children. The Church owes much to him, for he was an able leader. It has been said of him that he was "for daring a Cromwell, for intrigue a Machiavelli, for executive force a Moses, and for utter absence of conscience a Bonaparte." It must be borne in mind that to him, more than to anyone or anything else, was due the long struggle of the Church against the United States. His only doctrinal contribution to the Church was in 1852 when, in a sermon, he said that our Father could be none other than the first Man; that Adam came into the garden of Eden in a celestial body and with one of his wives; and that "He is our Father and our God, and the only God with whom we have to do."

Young's successor in the presidency—acting president until 1880—was John Taylor (1808–1887), an Englishman by birth, who was living at Toronto when P. P. Pratt converted him in 1836; he was a missionary in England in 1840; then went to Nauvoo and was wounded when Smith was killed; preached in France and Germany, and translated *The Book of Mormon* into French. His first counsellor, appointed in 1880, was George Q. Cannon, who was probably the real administrator. On the 22nd of March 1882 President Arthur approved the Edmunds Act, drafted by George F. Edmunds of Vermont, which disfranchised polygamists in the Territories, made ineligible for jury duty in prosecutions for bigamy, polygamy, or unlawful cohabitation all who practised polygamy or believed in it, and made polygamy punishable by a maximum fine of $500 and imprisonment of not more than five years, and cohabitation with more than one woman punishable by a maximum fine of $300, imprisonment for not more than six months, or both. The act was opposed because it was *ex post facto*. Under the Edmunds Act and the Edmunds-Tucker Act of March 1887 about 1200 persons were convicted of polygamy or unlawful cohabitation in Utah, Idaho and Arizona. The law was so rigidly enforced that about 12,000 were disfranchised, and the president of the Church had to spend his last years in hiding, and many other prominent Mormons escaped "on the underground." The Edmunds-Tucker Act of 1887 dissolved the Perpetual Emigration Company and the corporation of the Church of Jesus Christ of Latter-Day Saints; and the Supreme Court in May 1890, on the ground that the Church was an organized rebellion, upheld the constitutionality of the confiscation of the Church property. On the 24th of September 1890 Wilford Woodruff[2] (1807–1898), who had been chosen to succeed President Taylor in 1889, and who was himself a polygamist, issued a manifesto declaring "that my advice to Latter-Day Saints is to refrain from contracting any marriage forbidden by the law of the land"; and on the 6th of October the general conference of the Church approved Woodruff's manifesto and accepted "his declaration concerning plural marriages as authoritative and binding." This apparent rescindment of "revelation" was explained by Mormon scholars as Smith had explained the abandonment of the New Jerusalem in Missouri—the Saints were prevented from carrying out the commands contained in a revelation, but as they had tried to obey, they would not be punished for disobedience.[3] On the 4th of January 1893, in response to a petition from the officials of the Church pledging the membership thereof to faithful obedience to the laws against polygamy, &c., President Harrison issued a general pardon to all liable to the penalties of the Edmunds-Tucker Act, on condition that they had not violated its provisions since the 1st of November 1890 and should not violate them in future. On the 4th of January 1896 Utah was admitted to the Union as a state, one of the conditions made by Congress being that polygamy should be prohibited by the state constitution, and that this prohibition be repealable only with the consent of the United States and of the people of the state; and article iii. of the constitution reads: "The following ordinance shall be irrevocable without the consent of the United States and the people of this state: Perfect toleration of religious sentiment is guaranteed. No inhabitant of this state shall ever be molested in person or property on account of his or her mode of religious worship; but polygamous or plural marriages are for ever prohibited." In March 1896 the escheated property of the Church still in possession of the United States government was restored, but the Church was not again incorporated, its legal business being transacted by its president as trustee-in-trust for the body of religious worshippers known as the Church of Jesus Christ of Latter-Day Saints; each ward of the Church has, however, been incorporated, and its bishop is its executive head. In 1898 President Woodruff died and was succeeded by Lorenzo Snow (1814–1901), a native of Ohio, converted to Mormonism in 1836. In 1898 Brigham Henry Roberts (b. 1857), an Englishman by birth and a Mormon leader, was elected to Congress from Utah; as he had three wives there was objection to his taking his seat in 1899 in the 56th Congress; and on the 25th of January 1900 by a vote of 268 to 50 he was excluded from his seat. In 1903 Reed Smoot (b. 1862), an apostle of the Church, was elected to the United States Senate, where there was an attempt to exclude him (not on the ground that he was a polygamist, for there was no suspicion of his having violated the law, but because the apostles of the Church still advocated polygamy); the Senate Committee on Privileges and Elections reported in favour of his exclusion; but on the 20th of February 1907 the Senate voted against his exclusion (42–28). According to Senator Smoot there were in 1906 not more than 500 householders in Utah who were polygamous; only six of the twelve apostles, and only one chosen since April 1900, were polygamous; and of the fourteen general authorities chosen between 1890 and 1906 twelve were monogamists. Joseph Fielding Smith (b. 1838), a nephew of the prophet, being a son of Hyrum Smith, succeeded to the presidency in 1901; he was a polygamist, and in March 1907, soon after the birth of what was said to be his forty-third child, he pleaded guilty when charged with breaking the law against polygamy and was fined $300.

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[1] This act, introduced by Luke Potter Poland (1815–1887) of Vermont, was bitterly opposed by the Congressional delegate from Utah, George Q. Cannon (1827–1901), an Englishman by birth, a prominent Mormon missionary in Hawaii and Great Britain, and Parley P. Pratt's successor as apostle. He had been elected in 1872, and there was a long fight to prevent his being seated because he was a polygamist.

[2] Woodruff was born in Connecticut, became a Mormon in 1832, in 1839 was made an apostle, in 1840 and in 1845 was a missionary to England, preached throughout the United States; wrote *Leaves from my Journal* (1881), and was called in the Church "Wilford the Faithful."

[3] In 1831 the Order of Enoch, or United Order, was established, providing for a community of goods; when the people proved unable to keep this law, the "lesser law of tithing" was given to them in 1838.

The growth of the Latter-Day Saints has been largely in foreign countries. Missionary work in southern Canada was begun in 1833 by Orson Pratt, and in 1836 his brother, Parley P. Pratt, organized a mission in Toronto; in 1837 the work was begun in Liverpool, which is still the headquarters in Great Britain; in Ireland the work met with little success; from Germany missionaries were expelled in 1851 and in 1853; the *Book of Mormon* was translated into Italian by Lorenzo Snow in 1852; a Hawaiian version was made in 1856 by George Q. Cannon; and the missions in Scandinavia were begun about 1850. In the earlier years of the Church all converts were urged to migrate to Utah, and the glowing accounts of life there doubtless increased their number; the later policy of the Church, to which it was forced after 1887, when the Perpetual Emigration Fund was dissolved and assisted immigration was forbidden by the Federal government, was for converts to remain in their native countries. In England (and to a lesser degree on the Continent) the announcement of the doctrine of plural marriage was a disadvantage to the Church, and many converts transferred their allegiance to the Josephites, or Reorganized Church of Jesus Christ of Latter-Day Saints, who always opposed polygamy and attempted to prove that such doctrines had been foisted on the Church by Brigham Young, who had supplanted Joseph Smith's true successor, Joseph Smith III.

In 1908 the total number of Latter-Day Saints in the United States (chiefly in Utah and the neighbouring states) was estimated at 350,000, and there were besides about 48,000 members of the Reorganized Church. In Utah there are four great Mormon temples—at Salt Lake City (1893), Manti (1888), Logan (1884) and St George (1877). The Reorganized Church has twice been declared by United States Courts the legal successor of the Church founded by Joseph Smith, jun.; it holds that "the doctrines of polygamy, human sacrifice, or killing men to save them, Adam being God, Utah being Zion or the gathering place of the saints, are doctrines of devils"; its headquarters are in Lamoni, Iowa, whither it was removed from Plano, Illinois, in 1881; it has several churches in Canada, the largest being at London, Ontario, and Toronto, and it is the owner of a Temple lot at Kirtland, Illinois. The Temple lot at Independence, Missouri, is owned by the small band of Mormon schismatics (organized in Illinois in 1835) who call themselves "The Church of Jesus Christ," and are known as Hedrickites; the Utah Church considers Independence as the holy city, and made a large settlement there in 1907.

The general morality of the Mormons seems to have been high for a frontier community; there was no gambling nor drunkenness. The Saints, notably in the time of Brigham Young, were fond of dancing, and the Deseret Dramatic Association was formed and a theatre was built in the early years of the settlement in Utah.

Government.—The Mormon hierarchy is highly complicated. At the head of the body is a president, who possesses supreme authority, and is successor to Joseph Smith, jun., "Seer, Translator, Prophet"; the president is supported by two counsellors. These three are supposed to be the successors of Peter, James and John, constitute what is known as the "first presidency," seem to typify the Trinity, and are the head of the priesthood of Melchisedec. Then comes the "patriarch," whose chief duty is to bless and lay on hands, and after him the "twelve apostles," forming a travelling high council. Of these the president is *ex officio* one, and endowed with authority equal to the other eleven. Their duties are important. They ordain all other officers, elders, priests, teachers and deacons, lead all religious meetings, and administer the rites of baptism and sacrament. The "quorum of the twelve" is second in power to the "quorum of the first presidency," and acts in case the president dies or is disabled. Fourth come the seven presidents of the "seventies" or "seventies' quorums," each body comprising seventy elders; there are about 140 seventies in all, each of which has seven presidents, and every seven one president. These seventies make annual reports, and are the missionaries and propagandists of the body. Fifth come the "high priests," whose chief duty is to officiate in all the offices of the church in the absence of any higher authorities. The priesthood of Melchisedec is made up of the officials just named—president, two counsellors, patriarch, apostles, presidents of seventies, elders and high priests. In the Aaronic priesthood, which is subordinate to the priesthood of Melchisedec, and is occupied rather with temporal affairs, the highest office is that of the presiding bishop, who superintends the collection of tithes; other Aaronic officials are styled priests, teachers and deacons. The Church is made up of about 50 stakes (21 in Utah), each having a presidency (a president and two counsellors), and is divided into wards, which are subdivided into districts, each of which has a certain number of teachers, a meeting-house, Sunday school, day school, and dramatic, debating and literary societies.

Doctrine.—A system of polytheism has been grafted on an earlier form of the creed, according to which there are grades among the gods, the place of supreme ruler of all being taken by the primeval Adam of Genesis, who is the deity highest in spiritual rank, while Christ, Mahomet, Joseph Smith and Brigham Young also partake of divinity. The business of these deities is the propagation of souls to people bodies begotten on earth, and the sexual relation permeates the creed. The saints on leaving this world are deified, and their glory is in proportion to the number of their wives and children; hence the necessity and justification of polygamy (although its practice is not now authorized by the Church), and the practice of having many wives sealed to one saint. Marriage, if accompanied by the ecclesiastical ceremony of "sealing," is for eternity, and is a necessary pre-requisite to heavenly bliss. A man may be sealed to any number of women, but no woman may be sealed to more than one man. Both marriage and sealing by proxy are permitted to assure salvation to women who die unsealed. This system of spiritual wives or celestial marriage is based on the idea that a woman cannot be saved except through her husband. Polygamous marriage is supposed to make possible the procreation of enough bodies for thousands of spirits which have long awaited incarnation. Especially in their earlier years the Mormons believed in faith healing, and Joseph Smith bade them "trust in God when sick, and live by faith and not by medicine or poison." Their distinguishing points of faith are: religiously, a belief in a continual divine revelation through the inspired medium of the prophet at the head of the Church; morally, polygamy, though this is condemned in the *Book of Mormon*, as has been noticed above; and, socially, a complete hierarchical organization. They believe in the Bible as supplemented by the *Book of Mormon*, the *Book of Doctrine*, and revelation through the president of the Church; in the gift of prophecy, miracles and casting out devils; in the imminent approach of the end of the world; in their own identity with the apocalyptic saints who shall reign with Christ in a temporal kingdom, either in Missouri (at Independence) or in Utah; in the resurrection of the body; in absolute liberty of private judgment in religious matters; and in the salvation of a man only if he believes in Christ's atonement, repents, is baptized by immersion by a Christ-appointed apostle and receives the laying on of hands for the gift of the Holy Ghost by duly-authorized apostles. Among their minor rules as laid down in *A Word of Wisdom* supposed to have been revealed to Joseph Smith (Feb. 27, 1833), are these recommendations: that it is not good to drink wine or strong drink, except at the Lord's Supper (and even then it should be home-made grape-wine), or to use hot drinks or tobacco—the former being meant for the washing of the body and the latter for the healing of bruises and sick cattle; man's proper food is herbs and fruit; that for beasts and fowls, grain; and, except in winter and in case of famine and severe cold, flesh should not be eaten by man. Infant baptism is also condemned, but the children of saints who have reached their eighth year should be baptized. The deceased, also, can be baptized by proxy, and in this way—"baptism for the dead" (1 Cor. xv. 29)—Washington, Franklin and others have been vicariously baptized into the Church, since, according to the Mormons, there was no valid baptism between the time of the corruption of the primitive Church and the establishment of the Church of Latter-Day Saints.

BIBLIOGRAPHY.—The *Book of Mormon*, first printed in 1830, has been reprinted and translated frequently. Smith also wrote a *History of Joseph Smith*, being extracts from his journal, published in 1842–1846 in *Times and Seasons*, a church periodical, and a *Book of Commandments, for the Government of the Church of Christ* (Zion, Jackson county, Missouri, 1833), and "compiled" a *Book of Doctrine and Covenants of the Church of the Latter-Day Saints* (Kirtland, Ohio, 1835, and often reprinted); and *The Pearl of Great Price: Being a choice Selection from the Revelations, Translations and Narratives of Joseph Smith, First Prophet, and Revelator to the Church of Jesus Christ of Latter-Day Saints* (Liverpool, 1851; Salt Lake City, 1891). The best bibliographies are in H. H. Bancroft's *History of Utah* (San Francisco, 1889), vol. xxi. of the *History of the Pacific States of North America*, in which the effort to avoid bias against the Mormons has made the work biassed in their favour, and in I. Woodbridge Riley's *The Founder of Mormonism, a Psychological Study of Joseph Smith, Jr.* (New York, 1902), the first inquiry by a trained psychologist into Smith's case. More important than either of these works is William Alexander Linn's *The Story of the Mormons from the Date of their Origin to the Year 1901* (New York, 1902); Linn, unlike Riley, thinks it proved that Rigdon used the "Spaulding manuscript" in the preparation of the *Book of Mormon*. E. W. Tullidge's *History of Salt Lake City* (Salt Lake City, 1886) and Orson F. Whitney's *History of Utah* (4 vols., Salt Lake City, 1892–1898) are valuable general works by Mormon writers; the leaders of the Reorganized Saints, Joseph Smith III and Herman C. Smith, wrote *A History of the Church of Jesus Christ of Latter-Day Saints* (Lamoni, Iowa, 1901); and Tullidge, a member of the same branch, wrote a *Life of Joseph the Prophet* (Plano, Illinois, 2nd ed., 1880). Edward H. Anderson's *Brief History of the Church of Latter-Day Saints* (3rd ed., 1905) and J. E. Talmage's *Story of Mormonism* (reprinted, 1907) are regarded by Mormons as authentic. Early attacks on Mormonism are E. D. Howe's *Mormonism Unveiled* (Painesville, Ohio, 1834) and Pomeroy Tucker's *Origin and Progress of the Mormons* (New York, 1867). And among works descriptive of Mormonism in Utah written by Gentiles the more important are: *History of the Mormons of Utah: their Domestic Polity and Theology* (Philadelphia, 1852), by Lieut. J. W. Gunnison of the U.S. Topographical Engineers, who took part in surveys preliminary to building a transcontinental railway; *Utah and the Mormons* (New York, 1854), by B. G. Ferris, secretary of Utah Territory in 1852–1853; Horace Greeley, *Overland Journey from New York to San Francisco in 1859* (New York, 1860); Jules Remy, *Journey to Great Salt Lake City* (London, 1861); and *The City of the Saints, and across the Rocky Mountains to California* (London, 1861), by Richard F. Burton, who spent a month in Salt Lake City in 1860. There is much valuable material in the *Reports* of the Utah Commission appointed under the Edmunds Act, in *Testimony before the Senate Committee* in the Smoot case (1903–1905), and in the *Report of the Committee on Privileges and Elections* (Senate Report 4253, 59th Congress, 1st Session), also in the Smoot case.

MORMYR. The mormyrs (*Mormyridae*) are one of the most remarkable families of the Malacopterygian fishes, confined to the fresh waters of tropical Africa and the Nile. About 100 species, referred to two sub-families and ten genera, are now known, a great number of new forms having recently been discovered in the Congo. They are curious-looking, highly aberrant fishes, very variable in the extent of the vertical fin and in the form of the body, and especially the head, which may be either extremely abbreviated or elongated into a rostrum, with or without a dermal appendage or "feeler." The shape of the head has suggested many of the specific names which have been given to these fish, such as *elephas*, *tapirus*, *tamandua*, *caballus*, *ovis*, *ibis*, *numenius*, &c. Some forms are eel-shaped. The mormyrs are further remarkable for the enormous development of the brain and for the problematic organ which surmounts it; also as being among the few fishes in which an electric organ has been discovered. This organ, situated on each side of the caudal region, is derived from the muscular system and is of feeble power; it was long considered "pseudoelectric."

Very little is known of the habits of these fishes. Professor G. Fritsch, of Berlin, during his stay in Egypt for the purpose of experimenting on electric fishes, observed that they perish very rapidly when removed from the water, and he had the greatest difficulty in keeping some alive in an aquarium for two or three days. Captain S. Flower has recently been more successful, and the mormyrs have proved a great success in the Gezira aquarium, near Cairo, examples of the species having lived from ten to twenty-six months. The species with comparatively large mouths feed principally on fishes and crustaceans, the others on tiny animals and vegetable and more or less decomposed matter. P. Delhez, on the Congo, found that many are attracted to the borders of the river in the neighbourhood of human dwellings, where they feed on the refuse thrown into the water. It is probable that the species with a rostrum use it to procure small prey hidden between stones or buried in the mud, and that the fleshy mental appendage with which they are provided is a tactile organ compensating the imperfection of the vision in the search for food. Until quite recently absolutely nothing was known of the breeding-habits and development. To the late J. S. Budgett we owe some very interesting observations made in the Gambia on *Gymnarchus niloticus*, which makes a nest, and the larvae of which are provided with filamentous external gills.

Venerated by the ancient Egyptians, the mormyrs are often represented on hieroglyphics and mural paintings as well as in bronze models. The "Oxyrhynchus," remarkable for its long, curved snout, is the most frequently depicted. A revision of the *Mormyridae* has been published by G. A. Boulenger in the *Proc. Zool. Soc.* (1898), with a bibliographical index to the various anatomical and physiological contributions. The skull has been minutely studied by W. G. Ridewood, *Journ. Linn. Soc.* (Zool. xxix., 1904, p. 188). Figures of the most remarkable forms will be found in Boulenger's *Poissons nouveaux du Congo*, *Ann. Mus. Congo* (Zool. i. and ii., 1898–1902), and in his *Fishes of the Nile* (London, 1907, 4°). On the breeding habits of *Gymnarchus*, cf. J. S. Budgett, *Trans. Zool. Soc.* (1901), xvi. 126. (G. A. B.)

MORNAY, PHILIPPE DE (1549–1623), seigneur du Plessis-Marly, usually known as Du-Plessis-Mornay or Mornay Du Plessis, French Protestant, was born at Buhy in Normandy on the 5th of November 1549. His mother had leanings toward Protestantism, but his father sought to counteract her influence by sending him to the Collège de Lisieux at Paris. On his father's death in 1559, however, the family formally adopted the reformed faith. Mornay studied law and jurisprudence at Heidelberg in 1565 and the following year Hebrew and German at Padua. On the outbreak of the second religious war in 1567, he joined the army of Condé, but a fall from his horse prevented him from taking an active part in the campaign. His career as Huguenot apologist began in 1571 with the work *Dissertation sur l'église visible*, and as diplomatist in 1572 when he undertook a confidential mission for Admiral de Coligny to William the Silent, prince of Orange. He escaped the St Bartholomew massacre by the aid of a Catholic friend, and took refuge in England. Returning to France towards the end of 1573, he participated during the next two years with various success in the campaigns of Henry of Navarre. He was taken prisoner by the duke of Guise on the 10th of October 1575, but not being recognized was ransomed for a small sum. Shortly afterwards he married Charlotte Arbaleste at Sedan. Mornay was gradually recognized as the right-hand man of the king of Navarre, whom he represented in England from 1577 to 1578 and again in 1580, and in the Low Countries 1581–1582. With the death of the duke of Alençon-Anjou in 1584, by which Henry of Navarre was brought within sight of the throne of France, the period of Mornay's greatest political activity began, and after the death of the prince of Condé in 1588 his influence became so great that he was popularly styled the Huguenot pope. He was present at the siege of Dieppe, fought at Ivry, and was at the siege of Rouen in 1591-92, until sent on a mission to the court of Queen Elizabeth. He was bitterly disappointed by Henry IV.'s abjuration of Protestantism in 1593, and thenceforth gradually withdrew from the court and devoted himself to writing. He founded in 1593 the Protestant academy or university at Saumur, which had a distinguished history until its suppression by Louis XIV. in 1683. In 1598 he published a work on which he had long been engaged, entitled *De L'institution, usage et doctrine du saint sacrement de l'eucharistie en l'église ancienne*, containing about 5000 citations from the scriptures, fathers and schoolmen. Jacques Davy Du Perron, bishop of Evreux, afterwards cardinal and archbishop of Sens, accused him of misquoting at least 500, and a public disputation was held at Fontainebleau on the 4th of May 1600. Decision was awarded to Du Perron on nine points presented, when the disputation was interrupted by the illness of Mornay. His last years were saddened by the loss of his only son in 1605 and of his devoted wife in 1606, and were marked only by perfecting the Huguenot organization. He was chosen a deputy in 1618 to represent the French Protestants at the synod of Dort, and though prohibited from attending by Louis XIII., he contributed materially to its deliberations by written communications. He was deprived of the governorship of Saumur at the time of the Huguenot insurrection in 1621, and died in retirement on his estate of La Forêt-sur-Sèvre on the 11th of November 1623.

His principal works, in addition to *De L'institution, usage et doctrine du saint sacrement de l'eucharistie en l'église ancienne* (La Rochelle, 1598), mentioned above, are *Excellent discours de la vie et de la mort* (London, 1577), a bridal present to Charlotte Arbaleste; *Traité de l'église où l'on traite des principales questions qui ont été mues sur ce point en nostre temps* (London, 1578); *Traité de la verité de la religion chrétienne contre les athées, épicuriens, payens, juifs, mahométans et autres infidèles* (Antwerp, 1581); *Le mystère d'iniquité, c'est à dire, l'histoire de la papauté* (Geneva, 1611). Two volumes of *Mémoires*, from 1572 to 1589, appeared at La Forêt (1624–1625), and a continuation in 2 vols. at Amsterdam (1652); a more complete but very inaccurate edition (*Mémoires, correspondances, et vie*) in 12 vols. was published at Paris in 1624–1625.

See the life of Mornay written by his wife for the instruction of their son, *Mémoires de Mme Duplessis-Mornay*, vol. i. in the ed. of *Mémoires et correspondances de Duplessis-Mornay* (Paris, 1824–1825); E. and E. Haag, *La France protestante*, article "Mornay"; J. Ambert, *Du Plessis-Mornay* (Paris, 1847); E. Stähelin, *Der Übertritt K. Heinrichs IV. von Frankreich zur katholischen Kirche* (Basel, 1856); Weiss, *Du Plessis Mornay comme théologien* (Strassburg, 1867). There is a good article "Du Plessis-Mornay" by T. Schott in Hauck's *Realencyklopädie*, and another by Grube in *Kirchenlexikon*.

MORNING, properly the dawn of day, sunrise, but extended to the whole early part of the day, from the dawn to midday. "Morning" (M. Eng. *morwening*) was formed on the analogy of "evening," from "morn," in M. Eng. *morwen*, and originally meant the coming of the sunrise, as "evening," the coming of the close of the day (O. Eng. *æfnung*, from *æfen*, eve). The O. Eng. *morgen* represents the common Teutonic word for the dawn; the ultimate source has been assigned to the root, seen in "murk," "murky," meaning to be dark, or, with more probability, to the root *mergh*, to twinkle, shine (cf. Lith. *mirga*), and further to the root *mar*, as in Gr. *μαρμαίρειν*, to shine (cf. Lat. *marmor*, marble). The M. Eng. *morwen* dropped the *n* and became *morwe*, "morrow," which properly means "morning," but was soon used of the day following the present.

The "morning-star" (Ger. *Morgenstern*) was a military weapon of the middle ages, consisting of a mace or club with a ball head studded with spikes; the spiked ball was sometimes swung loose from the head of the mace by a chain. The weapon was also known as a "holy water sprinkler." The "morning-gift," earlier "*moryeve*," Ger. *Morgengabe*, was the present given to a bride by her husband on the morning after the marriage. The custom is probably connected with the origin of the term "morganatic marriage" (see MORGANATIC).

MORNY, CHARLES AUGUSTE LOUIS JOSEPH, DUC DE (1811–1865), French statesman, was the natural son of Hortense Beauharnais (wife of Louis Bonaparte, and queen of Holland) and Charles Joseph, comte de Flahaut (*q.v.*), and therefore half-brother of Napoleon III. He was born in Paris on the 21st of October 1811, and his birth was duly registered in a certificate which made him the legitimate son of Auguste Jean Hyacinthe Demorny, described as a landowner of St. Domingo. M. Demorny was in fact an officer in the Prussian army and a native of St Domingo, though he owned no land there or elsewhere. After a brilliant school and college career he received a commission in the army, and next year entered the staff college and became lieutenant. The comte de Morny, as he was called by a polite fiction, served in Algeria in 1834–35 as aide-de-camp to General Camille Alphonse Trezel, whose life he saved under the walls of Constantine. When he returned to Paris in 1838 he secured a solid position in the business world by the establishment of a great beetroot-sugar industry at Clermont in Auvergne, and by writing a pamphlet *Sur la question des sucres* in 1838. In these and other lucrative speculations he was helped by the beautiful and wealthy wife of the Belgian ambassador, Charles Joseph, comte Lehon, until there were few great commercial enterprises in Paris in which he had not an interest. Although he sat as deputy for Clermont-Ferrand from 1842 onwards he took at first no important part in party politics, but he was heard with respect on industrial and financial questions. He supported the government of Louis Philippe, because revolution threatened his commercial interests, but before the catastrophe of 1848, by which he was temporarily ruined, he meditated conversion to the legitimist cause represented by the comte de Chambord. His attitude was expressed by the *mot* with which he is said to have replied to a lady who asked what he would do if the Chamber were "swept out." "Range myself on the side of the broom handle," was his answer. Presently he was admitted to the intimate circle of Louis Napoleon, and he helped to engineer the *coup d'état* of the 2nd of December 1851 on the morrow of which he received the ministry of the interior. After six months of office, during which he had shown commendable moderation and tact to his political opponents, he resigned his portfolio, ostensibly because he disapproved of the confiscation of the Orleans property but really because Napoleon, influenced by Morny's rivals, resented his pretensions to a foremost place in the government and his desire to insist on his claims as a member of the Bonaparte family. He now resumed his financial speculations, and when in 1854 he became president of the Corps Législatif, a position which he filled with consummate dignity and tact for the rest of his life, he used his official rank to assist his schemes.

Politics and high finance with Morny went hand in hand. In 1856 he was sent as special envoy to the coronation of Alexander II. of Russia; he executed his mission with prodigal splendour, and brought home a wife, Princess Sophie Troubetzkoi, who by her connexions greatly strengthened his social position. In 1862 Morny, whose power was at its culminating point, was created a duke. It is said that he aspired to the throne of Mexico, and that the French expedition sent to place Maximilian on the throne was prompted by Napoleon's desire to thwart this ambition. In any case, in spite of occasional dissensions, Morny's influence with the emperor remained very great, and the liberal traditions which he had retained enabled him to serve the imperial cause by his influence with the leaders of the opposition, the most conspicuous of whom, Émile Ollivier, was detached from his colleagues by his efforts. But while he was laying the foundations of the "Liberal Empire" his health, undermined by a ceaseless round of political and financial business, of gaiety and dissipation, was giving way, and was further injured by indulgence in quack medicines. The emperor and the empress visited him just before his death in Paris on the 10th of March 1865.

Morny's valuable collection of pictures was sold after his death. In spite of his undoubted wit and social gifts Morny failed to secure the distinction he desired as a dramatist, and none of his pieces which appeared under the pseudonym of M. de St Rémy—*Sur la grande route*; *Monsieur Choufleury restera chez lui*, and the *Finesses du mari* among others—met with any considerable success on the stage.

The figure of the duc de Morny is familiar to the general reader in the duc de Mora of *Le Nabab* of Alphonse Daudet, who had been one of his secretaries. See F. Loliée, *Le Duc de Morny et la société du second empire* (1909). Earlier accounts are by H. Castille, *M. de Morny* (1859), and Arthur de la Guéronnière, *Études et portraits* *politiques* (1856). See the literature dealing with Napoleon III., and the article on Flahaut de la Billarderie; also F. Loliée, *Le Duc de Morny*, adapted by B. O'Donnell. A volume, *Extraits des mémoires de Morny: Une Ambassade en Russie 1856*, was published in 1892.

MORO, ANTONIO (*c.* 1512–1575), otherwise known as Sir Anthony More, the eminent portrait-painter, was born at Utrecht in 1512 according to some, but in 1525 according to Karl van Mander in his *Het Leven der Schilders.* He studied his art under Jan Schoorel; and after making a professional visit to Italy he commenced to paint portraits in the style of Hans Holbein. His rise to eminence was rapid. In 1552 he was invited to Madrid by the emperor Charles V. to execute a likeness of Prince Philip. Two years afterwards he was in London painting the portrait of Queen Mary. For this picture an annual salary and, as some suppose, the honour of knighthood were conferred upon him. On the death of Mary in 1558 Moro returned to Spain, and lived there for two years in great honour with Philip II., executing, in addition to portraits, several copies after Titian. His death took place at Antwerp about 1575. Among his figure-pictures Van Mander specifies the "Circumcision of Christ," executed for Antwerp Cathedral, as one of the most notable. His portraits are full of individuality, and characterized by firm and solid rendering of flesh. Several admirable examples are preserved in Madrid; among the rest the portrait of Queen Mary of England, which has been excellently etched by Milius (*L'Art*, Dec. 8, 1878). "Moro's style," says Stanley in his *Dutch and Flemish Painters*, "so much resembles that of Holbein as to frequently create a doubt to which of them a portrait is to be attributed; but he is not so clear and delicate in his colouring (perhaps from having painted so much in Spain) as that master."

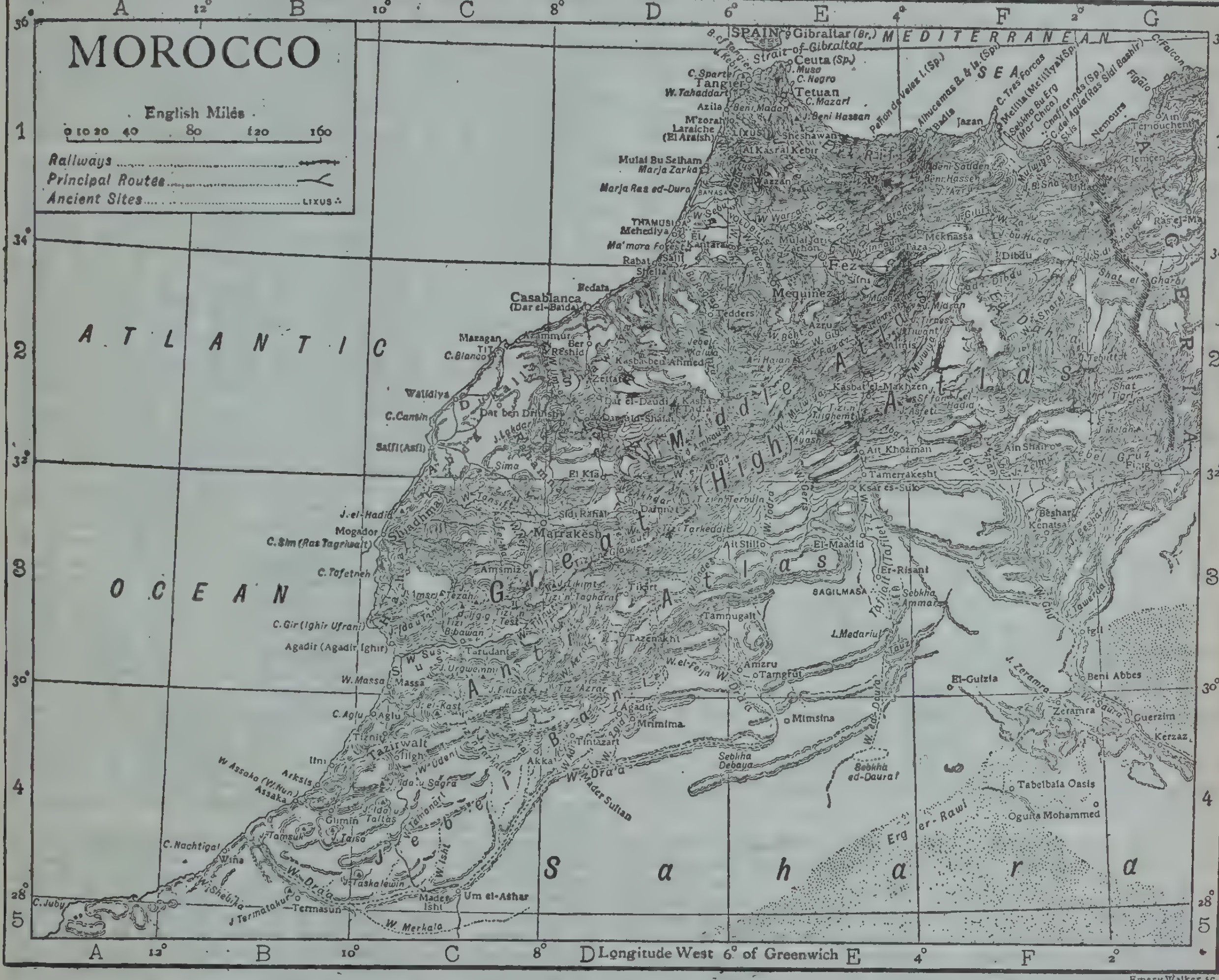
MOROCCO (El Maghrib el Aksa, "The Farthest West," *i.e.* of the Mahommedan world), an independent state of North Africa, bounded on the N. by the Mediterranean, on the E. by Algeria, on the S. (indefinitely) by the Sahara, and on the W. by the Atlantic as far south as Wad Dra'a. Its landward limits can only be vaguely defined. The eastern frontier towards Algeria, determined by the treaty of 1844, is a purely conventional line starting from the mouth of a small stream called the Skis and running across country in a general S.S.E. direction. In 1900 this was given a westerly trend to the south of the Atlas by the annexation of the Figig, Igli and Tūat oases by France. The southern boundaries expand and contract according to the power and acivity of the central authorities. Behm and Wagner, who included Figig, Tūat, Kenatsa and other oases, estimated (in 1882) the then area of the sultanate at 305,548 sq. m. The allegiance of many of the tribes within this compass is questionable and intermittent, and the loss of the district from Figig to Tūat, which is not accurately defined, has considerably reduced the area. Morocco is still the portion of Northern Africa about which European information is most defective, and all maps are still to a considerable extent composed of unscientific material eked out by probabilities and conjecture.

The Mediterranean Coast Lands.—The seaward aspect of Morocco only is known in detail. To the Mediterranean it presents for about 200 m. the rugged profile of the Rīf hills (still unexplored), which generally end in lines of cliff broken at intervals by narrow sweeps of sandy beech, but occasionally open up into beautiful and fertile valleys. About 6 m. west of the Skis lies the mouth of the river Mulwiya; and 10 m. farther on, opposite Cabo del Agua (Ras Sidi Bashir), is a group of dry and barren islands, owned by Spain, known as Chaffarinas or Jazair Zafrān (Spanish las Chafarinas), which protect the best roadstead on the Rīf coast. Between Point Quiviana and Melilla runs a low and sandy shore in front of a great salt marsh, the Mar Chica of the Spaniards. Melilla (Melilīya) is a fortified rock convict station or *presidio*, held by the Spaniards since 1497, forming a peninsula connected by lines of rampart with Fort Rosario on the heights behind. The fine semicircular bay of Alhucemas is the seaward end of one of the most beautiful valleys in the Rīf, clothed with verdure and dotted with hamlets. A Spanish *presidio* occupies one of the larger of the Alhucemas islands (Al-Mazemma), which are identified with the Ad Sex Insulas of the itineraries. Another Spanish *presidio* crowns the island rock Peñon de Velez; and in the valley off which it lies stood a town known to the Spaniards as Velez de Gomera, to the Arabs as Bādis, which continued to be a place of importance in the 16th century. The so-called Bay of Tetuan (Teṭṭāwan)—the town is just visible from the sea—is little more than the straight stretch of coast between Cape Mazari on the south and Cape Negro or Negrete on the north; but the prominence of these two headlands gives it an appearance of depth. From Cape Negro northwards to Ceuta the most notable object is the summit of Jebel Mūsa, which, though situated on the Strait of Gibraltar, towers above the intervening hills. Ceuta (Sibta), the most important of the Spanish settlements in Morocco, occupies a peninsula—the head, Mt Acho, standing about 4 m. out to sea, and the neck being low and narrow. It marks the eastern end of the strait. Westwards, the first point of interest is again Jebel Mūsa, the Elephas of Strabo, and the Apes' Hill of English charts. About 20 m. farther along the coast lies the Bay of Tangier (Tanja), one of the finest harbours in Morocco. West from Tangier runs the Jebel Kebīr (rising to a little over 1000 ft.), the seaward extremity of which forms Cape Spartel, the north-west angle of the African continent, known to the ancients as Ampelusia or Cotes Promontorium. The lighthouse, 312 ft. above sea-level, built in 1865 at the cost of the sultan of Morocco, and maintained at the joint expense of England, France, Italy and Spain, is the only one on the western coast. It is provided with a fixed intermittent white light, visible for 36 m.

The Atlantic Coast Line.—The Atlantic coast of Morocco is remarkable for its regularity; it has not a single gulf or noteworthy estuary; the capes are few and for the most part feebly marked. Southward from Cape Spartel the shore sinks rapidly till it is within a few feet of the sea-level. In the low cliff which it forms about 4½ m. from the lighthouse there is a great quarry, which from remote antiquity has yielded the hand-mills used in the Tangier district. A stretch of low marshy ground along the Tahaddārt estuary—W. Muharhar and W. el-Kharrūb—agrees with Scylax's Gulf of Cotes (*Tissot*). Eight m. farther lies Azīla, the ancient Colonia Julia Constantia Zilis, with a Moorish and Jewish population of about 1200. For the next 16 m., between Azīla and Laraish (Laraiche), the coast has a tolerably bold background of hills, Jebel Sarsar forming an important landmark for the latter town which, with its Phoenician, Roman and medieval remains, is historically one of the most interesting places in Morocco. A line of reddish cliffs about 300 ft. high runs south for about 10 m. from the W. Lekkus, at whose mouth the town is built; then the coast sinks till it reaches the shrine of Mūlāi Bū Selhām on an eminence 220 ft. high. Between Mūlāi Bū Selhām (often wrongly called "Old Māmora") and a similar height crowned by the tomb of Sidi 'Abd Allah Jelāli lies the outlet of the Blue Lake (Marja Zarkạ), 10 or 12 m. long. Farther south, and separated from the sea by an unbroken line of rounded hills (230–260 ft.), is the much more extensive lagoon of Rās ed-Dūra, which in the dry season becomes a series of marshy meres, but in the rainy season fills up and discharges into the Sebū. Eastward it is connected with the Marjat el-Gharb, fed by the W. Meda. On the south side of the outlet of the Sebū lies Mehedīya (otherwise misnamed New Māmora or Mehduma) founded by 'Abd el-Mūmin, and named after the Muwaḥḥadi Mahdi. It was held by Spain from 1614 to 1681. Twenty miles farther is the mouth of the Bū Ragrag, with Salli (Sla) on the north side, long famous for its piracies, and still one of the most fanatical places in the empire, and on the south side Rabat, with its conspicuous Hassan tower, and Shella with its interesting ruins. Onward for 100 m. to Point Azammur and the mouth of the Um er-Rabī'a river a line of hills skirts the sea; the shore is for the most part low, and, with the exception of capes at Fedāla (a small village, originally a port, partly rebuilt by Mulai Ismā'il, and completed by Mahommed XVII., who opened it to Europeans between 1760 and 1773) and Dār el-Baida or Casablanca, it runs in a straight line west-south-west. Azammur (Berber for "The Wild Olives," viz. of the Sheikh Bū Shaib)—once the frontier town of the kingdom of Fez—stands on an eminence about 1½ m. from the sea on the south side of the Um er-Rabī'a, here some 150 ft. wide, deep and red, with an obstructing bar. The bay of Mazagan, a few miles to the south, curves westward with a boldness of sweep unusual on this coast. About 8 m. to the south, and less than 1 m. inland, lie the extensive ruins of Tīt, a town which proved a thorn in the side of the Portuguese of Mazagan till they destroyed it. At Cape Blanco (so called from its white cliffs) the coast, which bulged out at Cape Mazagan, again bends south to resume much the same general direction for 55 m. to Cape Cantin. On this stretch the only point of interest is the site of the vanished Walīdīya, formerly El-Ghait, with an excellent harbour, formed by an extensive lagoon, which by a little dredging would become the safest shipping station on the whole Morocco seaboard. About 18 m. farther lies Saffi (Asfi), the most picturesque spot on the west coast, with the high walls and quare towers of its Portuguese fortifications shown to advantage by the ruggedness of the site. Sixty miles farther south lies Mogador, beyond which the coast becomes more and more inaccessible and dangerous in winter, being known to navigators as the "Iron Coast." From Cape Sim (Ras Tagriwalt), 10 m. south of Mogador, the direction is due south to Cape Ghīr (Ighīr Ufrani), the termination of Jebel Ida ū Tanān, a spur of the Atlas. Beyond this headland lies Agadīr (Agadīr Ighīr), the Santa Cruz Mayor or Santa Cruz de Berberia of the Spaniards, formerly known as the Gate of the Sudan.[1] It is a little town with white battlements three-quarters of a mile in circumference, on a steep eminence 600 ft. high. In the 16th century it was seized by the Portuguese; but in 1536 it was captured by Mulai Ahmad, one of the founders of the Sa'adi dynasty. Some 60 m. farther south, at the mouth of a river known by the same name, is the roadstead of Māssa, with a mosque popularly reputed the scene of Jonah's restoration to terra firma. This port[2] was regularly visited by the Genoese traders in the 16th century, who exported skins, gum, wax, gold and indigo. Another 50 m. farther south lies Ifni, a landing-place easily recognizable by the shrine of Sidi Worzek, a few miles to the south of which is the Cape Non[3] of the Portuguese. The better known Cape Nūn lies 5 or 6 m. north of the W. Nūn, at the mouth of which is Assāka, a port which the sultan of Morocco opened to foreign trade in 1882, but closed after six months. From Assāka to the mouth of the Dra'ā the country continues broken and fertile, but farther south it is flatter and more sandy, so that with the Dra'ā the Sahara may be said to begin.

Character of the Interior.—The backbone of the country is the Great Atlas (Dāren of the Berbers), for which see ATLAS. The principal rivers take their rise in the Atlas Mountains, and the headwaters of the Mulwiya, the Sebū, the Um er-Rabī'a, the Dra'ā and the Zīz all rise between 32° 20′ and 32° 30′ N., and between 3° 30′ and 5° W. The Mulwiya (Mulucha and Malva of Pliny, &c.) is the river which the French have long wished to make the western boundary of Algeria. Its course is largely unexplored save by native French officials. About 34° 20′ N. General Colvile found it some 200 yds. wide but quite shallow; about 25 m. east of its source, where it is crossed by the route to Zīz, it is already a powerful stream with a deep bed cut in the granite rock, and shortly afterwards it is joined by the W. Sgimmel, a still larger affluent (*Rohlfs*). Of the lesser streams which flow into the Mediterranean it is enough to mention the W. Martīl or Martīn (otherwise W. Bū Sfiha, W. Rās, W. Mejeksa), which falls into the Bay of Tetuan, and is identified with the Tamuda of Pliny and Thaluda of Ptolemy.

On the Atlantic seaboard there are a number of comparatively small streams north of the Sebū, the chief of which is the winding W. Lekkus, with several tributaries. The Sebū (the *Subur magnificus et navigabilis* of Pliny) may be compared to the Thames in length and width, though not in steadiness and depth of current. At Meshra'at el-Ksiri, about 70 m. from its mouth, it is about 10 ft. deep in the month of May and more than 460 ft. wide; and, though its banks are 21 ft. high, extensive inundations occur. The tide ascends as far as El-Kanṭara, 15 m. above Ma'mora, and steam barges with a small draught of water could make their way to the ford just mentioned, and


MOROCCO
English Miles
0 10 20 40 80 120 160
Railways
Principal Routes
Ancient Sites LIXUS
A B C D E F G
1 2 3 4 5
36° 34° 32° 30° 28°
12° 10° 8° 6° 4° 2°
Longitude West 6° of Greenwich
A T L A N T I C
O C E A N
M E D I T E R R A N E A N
S E A
S a h a r a
SPAIN
Gibraltar (Br.)
Strait of Gibraltar
Ceuta (Sp.)
Tangier
C. Spartel
Tetuan
Azila
Laraiche (El Araish)
Al Kasr al Kebir
Sheshawan
Wazzan
Mulai Bu Selham
Marja Zarka
Marja Ras ed-Dura
THAMUSIDA
Mehedīya
Ma'mora Forest
Rabat
Shella
Casablanca (Dar el-Baida)
Fedala
Fez
Mequinez
Taza
Mazagan
C. Blanco
Walidiya
C. Cantin
Saffi (Asfi)
El Kla
Marrakesh
Mogador
C. Sim (Ras Tagriwalt)
C. Tafetneh
C. Gir (Ighir Ufrani)
Agadir (Agadir Ighir)
W. Massa
Massa
C. Aglu
Aglu
Ifni
Tiznit
Tazirwalt
Iligh
Akka
Assaka
Arksis
Gumin
Taisa
C. Nachtigal
Wina
C. Juby
Termasun
W. Merkala
Um el-Ashar
W. Dra'a
Middle Atlas
High Atlas
Great Atlas
Anti Atlas
Jebel Bani
Tamerrakesht
Ksar es-Suk
Er-Risani
SAGILMASA
Tafilalt
Tazenakht
Amzru
Tamegrut
Mimsina
Mrimima
Sebkha Debaya
Sebkha ed-Daura
El-Gulzia
Beni Abbes
Zeramra
Guerzim
Kerzaz
Tabelbala Oasis
Oguila Mohammed
Erg
er-Rawi
Igli
Figuig
Tlemçen
Lalla Maghnia
Nemours
Melilla (Sp.)
Alhucemas
Peñon de Velez
Jazan
Tebulbat
Shat Tigri
Beshar
Kenatsa
Ain Shair
W. Mulwiya
W. Sebu
W. Um er-Rabī'a
W. Tensift
W. Sus
W. Ziz
W. Guir
Emery Walker sc.

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[1] This must not be confounded with Santa Cruz de Mar Pequeña, a post established in 1476 somewhere on this coast by Herrera, lord of the Canary Islands. After obtaining permission to reoccupy the post in 1861, the Spanish government was unable to identify it, though in all probability the original site was the lagoon known as Puerto Cansado, much farther south. But this is now too remote a spot to be worth colonizing, hence the desire to substitute some other. Ifni, on old maps Gueder, was chosen (1878), there being some evidence to show that it was possibly the true site of the ancient fort.

[2] See Valentin Ferdinand, *Beschreibung West Afrikas* (Mem. of the Acad. of Munich, 3rd Class, pt. viii.).

[3] No, Non, Nor, Naum, Não, are among the various readings. It was another Cape Non to the south of Cape Bojador which seems to have given rise to the proverb, *Quem pasar o cabo de Não ou tornara ou não.* See *Bol. de la Soc. Geogr.* (Madrid, 1880), p. 316.

possibly even as far as Fez. Affluents of the Sebū are W. Mikkes and W. Redem (90 m. long). The swift and muddy current of W. Beht usually loses itself in a swamp before it reaches the main stream. The Bū Ragrag, which debouches between Rabat and Salli, is about the same length as the Beht, but of much more importance. It and the Um er-Rabīʽa (mother of grass), although their mouths are widely separated, drain the northern slopes of the central Atlas. The impetuous Um er-Rabīʽa, with a rocky bed and many rapids, is perhaps as large as the Sebū. W. el-Abiāḍ, W. Akhdar and W. Tessaūt are the principal affluents. This last is separated by about 10 m. only from the valley of the Tansīft, the river which flows to the north of the city of Marrākesh; and by the W. Nefīs, the Asif el-Māl (Asif is Berber for river), the W. Usbi, and other smaller tributaries, receives the waters of about 180 m. of the Atlas range.

The valley between the Atlas and the Anti-Atlas is traversed by the W. Sūs, whose ever-flowing stream is sufficient to turn the whole district into a garden. The Māssa or W. al-Ghās, though its headwaters drain only one or two of the lesser valleys at the south-west end of the Anti-Atlas, is "about 50 yds. from bank to bank at the mouth, with a depth at high water and in the proper channel of something over a fathom." Farther south is the Assāka, known to European geographers as the W. Nūn; and finally the W. Draʽā is reached, which in length exceeds all the rivers of Morocco, but, except in spring, when the snows are melting in the highlands, remains throughout its lower reaches a dry sandy channel. In the upper valleys however innumerable streams from the south side of the main chain of the Atlas, the W. Dādes from the east, and the Asif Marghen, W. el-Molah, or Warzazet from the west, flow through populous and fertile valleys, and uniting to form the Draʽā cut their way southward through a gorge in the Jebel Soghār, which, as the name implies, is a lower range running parallel to the Atlas proper. For the next 130 m. the stream holds S.S.E., drained at every step by the irrigation canals which turn this region into a green oasis, till at last its dwindling current bends westward to the sebkha (salt marsh) of Debāya. For a few weeks once a year the thaw-floods fill this shallow but extensive basin and rush onwards to the Atlantic; but in summer it dries up, and, like the bed of the river for some distance below, is covered with flourishing crops. From the south of the Atlas still farther east descend other streams, the W. Zīz (with its tributaries the W. Todgha and W. Gheris), the W. Ghīr, the W. Kenatsa, &c., which, after watering the oases of Medghara, Tafīlālt (Sajilmāsa), Kenatsa, &c., lose themselves in the sands of the Sahara.

[*Geology.*—The Atlas Mountains, which are built up of a series of ridges rising to 12,000 ft. to the east of Morocco, form the backbone of the country. The central and highest portions consist of slates, crystalline limestones and schists of Archean, Pre-Cambrian and possibly of Cambrian ages. They are much folded and broken through by numerous intrusions of basalts and diorites. The mass of Jebel Tezah is composed of mica-schists and porphyries which appear to bear closer resemblances to the metamorphic rocks of Egypt than to the Archean crystalline formation of Central Africa. The strata of the central ridges are succeeded by a great thickness of purple marls, red sandstones, conglomerates and calcareous rocks, occurring in faulted, folded and detached areas and recently considered to range from Silurian to Trias. Later palaeozoic rocks of Devonian and Carboniferous ages also form a broad zone extending into the Sahara on the southern and south-eastern flanks. The whole of the Cretaceous system is represented by the shales and limestones occurring between the coast and the edge of the plateau above Morocco, but do not enter into the composition of the High Atlas.

Moraines, made up largely of unstriated blocks of porphyry, have been reported from the Upper Atlas. At the foot of the mountains, extensive mounds of boulder beds are developed on an immense scale and were considered by Maw to belong to the Glacial Epoch. Between Damnāt and the sea, however, the signs of a former glaciation appear to be insignificant. No moraines occur here, and consequently the glacial origin of the boulder beds described by Maw has been disputed. They are probably alluvial cones brought down from the High Atlas and mountainous regions. From Mogador to 60 m. inland, and over the plains around Marrākesh, a tufaceous deposit forming a hard crust, several feet thick, follows every undulation of the ground. Immense accumulations of tufa are met with in the limestone areas of the mountains. The chief tectonic structures which trend N. 20° E. belong to the Alpine and Mediterranean systems. The Cretaceous and Tertiary rocks are involved in these movements, which, however, were moulded on an earlier folding affecting the palaeozoic rocks of the Atlas region. The sundering of Africa from Europe at the Straits of Gibraltar took place in late Tertiary times; while the elevation of the Barbary coast to a height of 50 to 70 ft. is of Recent date.]

Climate.—The climate is good, and produces a hardy race. Shielded by the Atlas from the hot winds of the Sahara, the coast of the Atlantic offers great attractions to those suffering from chest complaints. Tangier is a recognized health resort, and Mogador and Rabat await development as such. Rain falls only between September and April; on the Atlantic coast it is brought by the south-west wind, and on the Mediterranean sometimes also by the east wind, or *sharki*, otherwise dry and somewhat trying to invalids. The wonderfully temperate climate of Mogador is due in a great measure to trustworthy trade-winds. In Tangier and Mogador the thermometer seldom rises over 80° F. or sinks below 40°, although inland the extremes are much greater; and while on the plains or in low-lying cities the heat grows intense, snow gleams on the Atlas nearly all the year round. The best months for visiting the interior are September (if rain has fallen), October, November and the early part of December, or May and June.

Fauna.—The absence of woodland keeps wild animals in check. Besides the lion, which exists in very limited numbers—and, according to local proverbs, with diminished courage—the spotted leopard, panther, hyaena, jackal, lynx, fox, wild boar, porcupine, antelope and gazelle are the most important. The *audād* or wild sheep is found in the more inaccessible parts of the Atlas. Rabbits swarm in the country to the north of the Bū Ragrag, and since 1870 they have crossed this stream, which used to be their southern limit. Hares are generally common. Rats are from time to time a plague to agriculturists, and the jerboa is frequently met with. A kind of ground-squirrel, the *sibsib*, occurs in the southern provinces. Monkeys of the same species as those of Gibraltar frequent the neighbourhood of Jebel Mūsa or Apes' Hill. The common wild birds include blackbirds, goldfinches, linnets, greenfinches, robins, wagtails, skylarks and crested larks, swifts, magpies, cuckoos, lapwings, rollers, several shrikes, as well as turtle-doves, nightingales, jays and buff-backed egrets. The house-sparrow is not found; between Marrākesh and Mogador its place is taken by a beautiful bird (*Emberiza striolata*), locally called *tabīb*, or "doctor." The birds of prey include eagles, vultures, ospreys, buzzards, falcons, harriers, kestrels, kites, ravens and hawks. Hawking is still indulged in by some of the country governors, and the Moors are very fond of hunting, many keeping greyhounds. The Barbary partridge is the main resource of the sportsman, though he may also bag several other varieties of partridge, bustards, guinea-fowl, plovers, grouse, snipe, quail, curlew, ducks and other water-fowl. Along the coast there is no lack of gulls, gannets, pelicans, flamingoes, herons, whimbrel, oyster-catchers, &c. Most towns have their colony of storks. Several venomous snakes and two vipers are found, but are not common, and the same may be said of scorpions and tarantulas, but centipedes are more numerous. Human parasites are, however, most to be guarded against. Mosquitos give little trouble save in towns or near water. Invasions of locusts are serious, but intermittent. Lizards, chameleons, tortoises and frogs are familiar objects; it is from Morocco that the small tortoises hawked about the streets of London are usually obtained.

Of domestic animals the mule is the great beast of burden, though camels, mares and asses are also employed. The horse is usually a sturdy little animal, but far below the ancient reputation of the Barbary steed. It is seldom used as a draught animal. Roughly broken when young, his mouth is soon spoiled by barbarous bits, and his feet by square shoes. The finest animals are said to be bred in Shiādhma and Abda. In form and size the mules are much superior and usually fetch two or three times the price of the horse. The horned cattle are not unlike Alderneys; but being practically untended, and the oxen having to do the ploughing, they furnish a very different quality of milk, yielding it only while the calf looks on; the sheep, for the improvement of which, also, nothing is done, have spiral horns (not infrequently four), rounded foreheads and long, fine wool; the goats, which furnish the famous leather, needing even less care are still more abundant. Domestic fowls are kept in great numbers; they are of the Spanish type, small and prolific.

The bonito and mackerel fishery off the coast of Casablanca and Tangier attracts fishers from Spain, Portugal and other parts of Europe. Occasionally a small shoal may be found as far south as Mogador. Soles, turbot, bream, bass, conger eel and mullet are common along the coast, and southern Morocco is visited occasionally by shoals of a large fish called the *azlimzah* (*sciaena aquila*), rough scaled and resembling a cod, and the *tasargelt* (*Temnodon saltator*), the "blue fish" of North America. Crayfish, prawns, oysters and mussels swarm in the rocky places, but the natives have no proper method of catching them, and edible crabs seem unknown. The tunny, pilchard and sardine, and a kind of shad known as the "Mogador herring," all prove at times of practical importance. The catching of the shabel, a species of shad, mis-called "Barbary salmon" is a great industry on the principal rivers of the coast, and vast numbers of the fish, which are often from 5 to 15 ℔ in weight are dried and salted. They ascend from the sea in spring. Barbels and a few other small fish swarm in the streams, but for the angler there is little real sport.

Flora.—From the presence of a large proportion of plants of central and northern Europe (none of the northern plants, however, being of alpine or arctic type) and the absence of southern types characteristic of the sub-tropical zone, Ball concluded that "the Morocco flora is altogether a portion of that great Mediterranean flora which, with local peculiarities, one finds from the Indus to the Atlantic Islands," but that "the mountain flora of Morocco is a southern extension of the European temperate flora, with little or no admixture of extraneous elements, but so long isolated from the neighbouring regions that a considerable number of new specific types have been developed." Of the individual plants none are more remarkable than the *arār* and the *ārgān*. The former (*Callitris quadrivalvis*, or *Thuja articulata* of Shaw) is a cypress-like tree that grows on the Atlas both in Morocco and Algeria. It furnishes gum sandarach; and its beautiful and enduring timber has been identified with the *alerce* with which the Cordova cathedral (mosque) was roofed, and with the citrus-wood, *arbor vitae*, of the ancient Romans. The ārgān, *Elaeodendron argan* (*Argania sideroxylon*) is confined to a tract of country extending about 150 m. along the coast, from the river Tansīft almost to the river Sūs, and about 30 m. in breadth; and it is found nowhere else in the world. The fruit, which ripens between May and August, is an olive-looking nut, greedily eaten by camels, mules, goats, sheep and horned cattle (but not by horses) for the sake of the fleshy pericarp, and crushed by the natives to extract the oil from the kernel. Though "its strong and fulsome savour" renders it nauseous to the European palate, this oil is largely used in the cookery of southern Morocco. The "prickly pear" and the aloe form part of the features of the landscape from the coast up to the slopes of the mountains, but neither is indigenous. The cork tree has lost ground enormously though it probably forms the staple of the Maʻmora forest, which extends for some 20 m. between the Bū Ragrag and the Sebū. The palmetto is often locally very abundant, but the most common wild tree on the plains is the thorny lotus or *mimosa*: in the mountainous regions it is reduced to a mere scrub. Lentisks, arbutus, oleanders, junipers and broom are also common, but vast stretches of country are devoid of either trees or shrubs. Citrons, lemons, limes (sweet and sour), apricots, plums, melons, mulberries, walnuts and chestnuts are common in many parts. Tetuan and Laraish are famous for oranges, Mequinez for quinces, Marrākesh for pomegranates, Fez for figs, Tafīlālt and Akka for dates, Sūs for almonds, Dukālla for melons, Tagodast, Edanan and Rabāt for grapes, and Tarudant for olives. The grape is extensively cultivated, but principally for eating; the Jews manufacture crude but palatable wines. Sugar, once grown in Sūs, to supply the demands of the whole of Morocco, has disappeared as have also cotton and indigo. Indian hemp and tobacco are cultivated under the restrictions of an imperial monopoly—the former (of prime quality) being largely used as hashish, the latter, though never smoked, as snuff. Barley is the most usual cereal; but excellent crops of wheat, maize, millet, rye, beans, peas, chick-peas and canary seed are also obtained. Potatoes, tomatoes, cabbages and beets have been introduced from abroad; otherwise the ordinary vegetables are peas, beans, turnips, onions, garlic, capsicums, cucumbers, marrows and carrots. Sweet herbs are extensively grown for use in cooking and in the preparation of tea.

In some of the Atlas valleys there is a wealth of timber, enormous conifers, 10 to 12 ft. in girth of stem, oaks, &c., but the greater part of the country has been cleared of forest, exhibiting only brushwood, and the lesser fruit-trees. Cowan, writing more immediately of the country between Morocco and Mogador, speaks of "drifts of asphodel, white lilies, blue convolvuli, white broom flowers, thyme and lavender, borage, marigold, purple thistles, colossal daisies and poppies"; and Trotter tells how for miles the undulating plateau of Kaṣar Farāʻōn was covered with wild flowers, whose varied colours, and the partiality with which each species confined itself to certain ground, gave to the landscape a brilliant and unique appearance. Dark blue, yellow and red—iris, marigold and poppy—occurred in patches an acre in size; farther on whole hills and valleys were of a delicate blue tint from convolvulus and borage. At times the traveller's tent is pitched on a carpet of mignonette—indigenous to the country—at times on a carpet of purple bugloss. In the country of the Benī Haṡan squills are so abundant that the fibres of the bulbs are used instead of hair in making tent-cloth; and in the north of Al Ḳaṣar al-Kebīr the moors are covered for miles with a beautiful white heather. From such gorgeous combinations of colour one can well imagine that the Moors drew the inspiration of their chromatic art; but the season of floral splendour is brief, and under the hot sun everything soon sinks into the monotony of straw.[1]

Inhabitants.—No well-founded estimate exists as to the number of inhabitants within the Moorish Empire, and the suggestions vary between five and ten millions. The majority of the inhabitants are pastoral and agricultural in their pursuits; but while large stretches of country are inhabited sparsely or not at all, other parts, especially along the Atlas slopes, are closely dotted with considerable villages whose hardy occupants cultivate every foot of level surface which it is possible to till and irrigate. Three races inhabit Morocco, and the members of two others are continually being introduced. The most numerous and important are the aboriginal Berbers (*q.v.*)—known locally also as Amazīgh—who inhabit the mountainous districts, and whose blood to a greater or less extent permeates the whole population. These were the people who thrice conquered Spain—once from the Visigoths, and twice from their less stalwart co-religionists. It has been its constant reinforcement by this Berber element that has maintained the independence of Morocco alone among the countries of North Africa. The plains are for the most part occupied by Arabs (*q.v.*), introduced in the 11th and 12th centuries, long after the so-called "Arab invasion" of the 7th century, which would have left few traces but for the Moslem missionaries who came after them. A large number of the plainsmen are, however, composite Arabicized Berbers, known to foreigners as "Moors" (*q.v.*), to which division also the mixed race of the towns belongs. Arabs are never found in the mountains save as religious teachers or authorities, but only a small proportion of them continue nomadic.

The third race which may be considered native is the Jewish, consisting of two distinct sections: those settled among the Berbers from time immemorial, speaking their language, and in addition a hideously corrupt Arabic; and those expelled from Europe within comparatively modern times, who have got little farther than the ports, where they speak Spanish with the addition of Arabic. These latter are the most progressive and flourishing of all the inhabitants of Morocco, and in their hands is much of the foreign trade. It is a remarkable fact that several of the so-called Berber tribes are believed to have been of Jewish origin, having embraced Islām on the coming of Mulai Idrīs. To these white races constant additions of a negro element are being added by the slave-trade with the western Sudān, while inter-marriages between negro and Arab or Berber have produced a proportion of mulattos.

The last class consists of the small colonies of Europeans settled at the ports, for the most part engaged in trade. The largest of these colonies, in this case principally Spanish, is found in Tangier. All such foreigners are under the local jurisdiction of their own consular courts. They possess moreover the right of claiming the protection of their authorities for natives entrusted with their interests, without which, in the absence of justice, commerce with the interior would be impossible.

Language.—The language of Morocco is Berber, of which several dialects are spoken, notably that of the Rīf, towards Algeria, and the Shilha of central Morocco and the Sūs. Of these very little is known; but they do not essentially differ from one another or from those of Algeria, notwithstanding considerable variations of pronunciation and a varying proportion of Arabic or other admixtures, there being no written standard to maintain. On the plains and coast of central Morocco, however, Arabic has superseded Berber, as the language of creed and court. Since the 15th century, when Ibn Khaldun found the Arabic of Morocco very corrupt, it has made great strides, and having always been a foreign tongue with the Korān as its model, it has escaped many of the faults into which Eastern Arabic outside Arabia has fallen. This is especially noticeable in the correct Arab value given to the alphabet and in the strictly classical use of many terms, especially among the litterati of Fez.

Provinces and Towns.—Political divisions can hardly be said to exist in the Moorish Empire to-day, although it is formed of what were at one time or other the independent kingdoms of Fez and Marrākesh, and the important provinces of Sūs, Tafīlālt and the Rīf, together with the Saharan oases. As administrative units the various subdivisions change according to the relative strength of tribesmen and government. Central Morocco, between the two spurs of the Atlas ending towards Rabat and at Cape Ghir, is, however, naturally parcelled out by its rivers into the districts of Tamsna, Shāwīya, Dukālla, Abda, Shiādhma and Ḥāḥā, running from north to south along the coast, and Sraghna and Rahāmna lying inland from the last three.

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[1] The botany of Morocco has been explored by Balansa (1867), Hooker, Ball and Maw (1871), Rein and Fritsch (1873), Ibrahim Ammeribt (a Berber collector, 1873, 1876), the Rabbi Mardochēe Abi Serur (1872–1873); and the results have been systematically arranged in Cosson's *Compendium florae atlanticae: ou Flore des états barbaresques* (Paris, 1881, &c.).

There are only three great inland cities, each of which in turn serves as metropolis: Fez, Mequinez and Marrākesh. The towns next in importance are the seaports of Tangier, Casablanca (Dar el Baida), Mogador, Mazagan, Saffi, Salli-Rabat, Laraish and Tetuan. All these places are separately noticed. The ports of Agadir Ighīr, Azammūr and Azīla being closed to trade, are in a decayed condition. On the Mediterranean shore, along the coast of Er-Rīt, the Spaniards have for centuries possessed Ceuta, Peñon de Velez, Alhucemas and Melilla; in 1848 they appropriated the Chaffarinas Islands. Inland, besides the three cities named, are the sacred towns of Mulai Idris, Zarhōn, Sheshāwan and Wazzān (the last-named of which alone is open to Europeans), and the minor towns of Al Kaṣar, Sifrū, Tāza, Dibdū and Ujda in northern Morocco (once the kingdom of Fez); Damnāt, El Klā, Sidi Rahal, Zettāt and Amzmiz in central Morocco (once the kingdom of Marrākesh); Tarudant, Ilīgh, Ṭiznīt and Glīmīn in southern Morocco (once the kingdom of Sūs.)

The town of Mulai Idrīs Zarhōn lies to the north of Mequinez. James Jackson, who in 1801 managed to pay a hurried visit, is the only European known to have entered its gates. It is a place of apparently 1500 to 2000 inhabitants, compact, and with several large buildings, the principal of which is the shrine of Mulai Idrīs, the founder of the Moorish Empire, round which the place has grown. Wazzān is the seat of a sharif or noble descended from Mulai Idrīs, whose family has been greatly reverenced for over two hundred years. It was built by Mulai Abd Allāh es-Sharīf (d. 1675), and is open to European visitors, which Sheshāwan (or Shefshāwan), another sacred city of sharīfs, founded in 1471, a day's ride into the mountains south of Tetuan, is not. Sifru is picturesquely situated amidst gardens, a short day's ride from Fez. Tāza is a considerable trading centre on the route between Fez and the Algerian frontier. The population, in Leo's time 20,000, is now 5000, of whom 800 are Jews. Dibdū, to the east of Tāza, is a small but important Jewish centre. About 120 m. east of Tāza, and only 10 from the frontier, is Ujda (Oudjda of the French), in the midst of an orange grove. Marrākesh is the only really large city of central Morocco. Damnāt is a walled town of magnificent situation in the Atlas, east of Marrākesh, between which and the Um er-Rabīʻa are the less important Sidi Rāhal and El Klā. Amzmiz lies in the Atlas, south-west of Marrākesh. Tārudant, the capital of Sūs, is situated between the Atlas and the river Sūs; it is a place of from 30,000 to 40,000 inhabitants, already a flourishing town in the 12th century, rebuilt by the Saʻadi Dynasty early in the 16th, and refortified by El Hasan IV. in 1882. Tīznīt, which lies to the south, until then but a village, was in 1882 converted into a town by El Hasan IV., and walled. Iligh (1300 ft.) above a stream which joins the Māssa, is the chief town of Tazirwālt, the state of Sidi Hishām, an independent principality founded by Sidi Ahmed ū Mūsa; and Glīmīn or Agelmin, in like manner is the chief town of the Wād Nun district. Tagaōst, about 40 m. inland from Ifni, was formerly a large city, and in the 16th century the seat of a Spanish factory trading in archil.

Communications.—Regular and fairly frequent steamship services link Morocco with the principal ports of the world, though in some instances transshipment at Gibraltar is necessary. The tourist traffic has grown greatly since the last quarter of the 19th century. Great Britain, Spain, France and Germany have postal agencies, running competing courier mails along the coast and to the capitals, while Great Britain, France and Spain have laid telegraphic cables from Gibraltar, Oran and Tarifa respectively to Tangier; but the extension of wires inland, save for telephones and electric light, was prohibited up to 1909. A railway about 24 m. long, connecting Casablanca and Ber Reshid, was opened in September 1908. This was the first line built in Morocco. There is also a railway from Melilla to some neighbouring mines. In general travelling in the interior is what it was a thousand years ago. There being practically no made roads and few bridges, vehicular traffic is out of the question, and even the transport of goods and persons on the backs of animals lacks the facilities provided in some Eastern lands—as Persia, for instance—in regular posting stations and caravanserais, here known as *fandaks.* Travellers have therefore to carry tents and all conveniences desired. Throughout the central Moroccan plains it is generally perfectly safe to travel unguarded, but in mountainous districts it is customary to be accompanied by a mounted policeman (*makhazni*) whose duty is as much to prevent travellers attempting exploration as to afford them protection.

Resources of the Country.—The natural products of the country remain almost entirely undeveloped. In applications for concessions for mining and other exploitation, the government has seen the possibility of further complications with Europe: so that if, by wholesale bribery, any grant was obtained a nullifying clause was inserted, or the first occasion seized to raise anew insuperable obstacles. After the conference at Algeciras in 1906, however, the government was obliged to grant various concessions. The breeding of horses or cattle and the rearing of birds for European markets increase in spite of restriction and heavy dues. One of the most promising of recent developments has been the growing supply of chickens, eggs, and fruit to Europe—even to England. The fisheries also are capable of great expansion, and are at present almost entirely in the hands of Portuguese and Spaniards.

Agriculture.—It is still true, as in the time of Addison, that the Moors "seldom reap more than will bring the year about," and the failure of a single harvest causes inevitable dearth. Only a small part of the available land is cultivated; and the cultivated portion possessed by each tribe is divided into three parts, one only of which is sown each year. With a plough of the most primitive description the Moorish peasant scarcely scratches the surface of the soil; his harrow is a few branches of trees weighted with heavy stones. The corn is cut close to the ear with short serrated sickles, and the straw is left standing. Underground granaries or *matmoras* are excavated beneath the tufaceous crust which covers much of the lowlands, sometimes capable of holding 2000 quarters; they preserve their contents in good condition for many years.

Mineral Wealth.—That mineral deposits of great value exist in Morocco there is little doubt. At Jebel Hadīd or the Iron Mountain, in Abda, disused mines may still be visited, and in Sūs iron has long been worked. In the Benī Madan hills near Tetuan are mines, closed, it is said, by the sultan ʻAbd er-Raḥmān; but whether they furnished copper or lead authorities differ. On the road to Kenatsa, Rohlfs saw lead and antimony worked. Antimony especially seems to be abundant to the south of the Atlas; Rohlfs found it in a very pure state near Tesna, and Dr Allen saw splendid veins of it north of the Draʻa. That gold existed in Sūs was long suspected; Gatell proved it. Rock-salt occurs in the mountains north of Fez, in the valley of the W. Martil, and probably in Jebel Zarhōn. In several places, as in the route from Saffi to Morocco, are brine lakes, from which the salt is collected and exported as far as Central Africa.

Manufactures.—The manufactures are few, and the most famous—leather—is now either exported undressed to Marseilles or Philadelphia, or is counterfeited by machinery in London or Paris. With the exception of slippers and shawls supplied to Moors established in the Levant, manufactured exports consist principally of carpets, rugs, trays, arms and "curios" for decorative purposes. For home use the Moors do much spinning, weaving, and dyeing, chiefly of wool; but although it is possible to dress superbly in native-made articles, every year sees an increasing importation of Manchester and Yorkshire goods, rivalled by the cheaper products of Barcelona and Austria—in the last case with great success.

Commerce.—The external trade of Morocco is mainly with Great Britain, France, Germany and Spain. The proportion of trade taken by Britain, formerly fully 50 % of the whole, had decreased in 1905 to 32 %, in which year France's share was 39 %, that of Germany nearly 12 % and that of Spain 5 %. Statistics as to its value are difficult to obtain, and not altogether trustworthy; the British consul at Tangier, writing in 1906, declared: "No information is to be obtained from the Moorish custom-houses and no statistics whatever are published by the Moorish government." From such sources as were available the exports in 1873 (a year of phenomenally good crops) were valued at about £1,500,000 and the imports at £934,000. Twenty years later (1903) the exports were valued at £1,601,000 and the imports at £2,656,000. A British consular return gave the value of the trade in 1906 as: Exports £1,756,109, imports £2,976,900. According to French official returns the value of trade fell in 1907 to £3,200,000, but had risen in 1908 to £4,400,000. This includes the trade through the eight open Moroccan ports (Tangier, Tetuan, Laraish, Rabat, Casablanca, Mazagan, Saffi and Mogador), the trade through Melilla, and that by the land frontier with Algeria. The trade with Algeria is valued at from £300,000 to £500,000 a year. Statistics as to the considerable trade done by caravans crossing the Sahara are entirely lacking.

The chief articles of exports are skins and hides, sheep, oxen and goats, wool, barley, eggs, beeswax, almonds and slippers. Maize, peas and chick-peas are also considerable exports in years of good crops. Cotton goods form the chief articles of import (exceeding £800,000 in value in 1906), sugar, tea, flour and semolina coming next. Other imports include cloth, candles, iron and hardware, wines and spirits. Wheat and oxen are imported overland from Algeria.

Finance.—The only part of the revenue which can be estimated with any degree of accuracy are the customs, which during the early years of the 20th century yielded about £500,000 per annum. Under the provisions of the act of Algeciras the Morocco State Bank was established in 1907. It is a limited liability company and subject to the law of France. The capital of the bank is £800,000 and the head office is at Tangier. The directors represent the various groups subscribing the capital, French financiers contributing a share twice as large as that of any other group in return for the relinquishment of the right of France to take up all new loans at the rate of the lowest tender. The bank holds a concession from the state for forty years, and acts as its treasurer and financial agent. It alone has the power of issuing notes. A Moorish high commissioner and four censors (representing the Bank of England, the Bank of France, the Bank of Spain and the German Imperial Bank) watch over the working of the bank. In all legal disputes in which the bank is concerned the Federal Court at Lausanne is the final authority. There is a Moorish coinage based on that of the Latin Union; Spanish money is also legal tender.

Moorish weights and measures vary from town to town, but in the foreign trade the decimal system has almost entirely superseded the native chaos. Credit is allowed by European houses at their peril, and in some lines profits are cut ruinously fine or done away with altogether by dishonest practices, many arising out of the long credit in vogue.

Government.—The Moorish government is a limited autocracy, the theoretically absolute power of the sultan being greatly circumscribed by the religious influences which in a measure support him, and by the official proletariat with which he is surrounded. The central government is known as the *maghzen* or *makhzan* (an Arabic word primarily meaning storehouse), a term also applied to the whole administrative body and collectively to the privileged tribes from whose ranks the state officials are recruited. At the head of the administration are wazirs or ministers of state, who possess no power independent of the sultan's will. The wazirs in general accompany the court, but the minister for foreign affairs is stationed at Tangier. Local administration is directed by the governors of provinces and towns, who are nominated by the *wazir ed dakhalāni* (minister of the interior). The subordinate town officials are appointed by the governor, and sheiks direct the affairs of the villages. All appointments are practically without pay, office holders being expected to obtain remuneration from "presents," *i.e.* bribes and extortion. Attached to the government service are a number of tribes (called maghzen tribes), who furnish the sultan's body-guard, garrison certain towns, and perform other duties in return for exemption from taxation. There was no regular assessment for taxation, but such organized spoliation as might be required for public or private ends. That part of the empire where the sultan's authority is supreme is known as *blad el-maghzen* (government country); those regions where the sultan's authority is precarious are called *blad es-siba* (the unsubmissive country).

All the powers are represented in Tangier by diplomatic and consular officials, whose independent jurisdiction over their respective fellow-subjects leads to the frequent confusion of justice. The evidence of non-Mahommedans is not accepted in Moorish courts, where venality reigns, and unprotected Jews suffer constant injustice, besides daily indignities, for which they repay themselves by superior astuteness.

Army.—A half-organized army—service in which is partly hereditary, partly forced—is periodically employed in collecting taxes at sword-point, and in "eating up" the provinces; with it the custom is (or was) for the sultan to go forth to war each summer, spending the winter in one of his capitals. The only approach to a regular army consists of certain hereditary troops furnished by the maghzen tribes, the Bokhārā (black), the Udāīa (mulatto), the Ashragah and Ashrārdah (white), and the Gaīsh, who form a body of police, Makhhāznīa (mixed), all of whom are horsemen. The infantry (Askārīa) are mostly rough levies; only a small portion being well trained under European officers. No accurate estimate can be formed of the total available forces, and the arms are of every pattern. There is no navy, but the government possesses several small steamers, one or two mounting guns.

Religion.—The religion of Morocco is Islam, the Moors being among the strictest followers of Mahomet. The divisions of the East are unknown, and their tenets include the principal teachings of both Shias and Sunnis, but, as employing the Māleki ritual, they must be classed with the latter. Recognizing their own sultan as Amir el Mu'minin ("Commander of the Faithful") and Khalifa of God on earth, they acknowledge no other claimant to that position, and have few dealings with the Turks, whom they consider corrupt. They have not yet given way extensively to strong drink.

Missions.—The Franciscans for six and a half centuries did brave work in the country, since the founder of their order offered himself for that task in 1214, and many of them, including several British and Irish missionaries, suffered martyrdom; but they have long abandoned attempts to convert the Moors. The London Jewish Society was established in Mogador in 1875, and since 1883 various Protestant agencies support a considerable number of missionaries, men and women, including doctors and nurses.

Education.—The level of education could hardly be lower, although most males have an opportunity of learning to recite or read the Korān, if not to write. Only traders trouble about arithmetic. Youths who desire to pursue their studies attend colleges in Fez or elsewhere to acquire some knowledge of Mahommedan theology, logic, composition and jurisprudence.

Literature and Travel.—Journalism is entirely foreign, and was introduced in 1883, at the same time as the printing-press, Spanish, French and English newspapers being established in quick succession. The sultan el Hasan III. set up a lithographic establishment in Fez, from which a valuable series of Arabic theological, legal and historical works have been issued, but most noteworthy of all is the publication in Cairo in 1895 of an Arabic history of Morocco, in four volumes, by a native of Salli, Ahmad bin Khalīd en-Nāsiri. A most practical step was taken by the French, on the conclusion of the agreement with Great Britain in 1904, in the establishment of a state-subventioned *Mission scientifique au Maroc*, which, in addition to establishing at Tangier the only public library in the empire, engaged a number of able students in research work, the results of which are embodied in the periodical publications *Archives marocaines* (6 vols., 1904–1906) and *L'Afrique française.*

Other forward steps have been taken in the production of several important volumes on the country and in serious attempts to explore the Atlas. The vicomte de Foucauld attained the first place by his intrepid journeys as a Jew through the forbidden regions and by his workman-like geographical records; Joseph Thomson did good work in the Great Atlas, though within a limited area; the vicomte de la Martinière excavated some of the Roman remains; Mr Walter B. Harris made a bold journey to Tafīlālt; and the marquis de Segonzac and Louis Gentil added to the knowledge of the Atlas by interesting expeditions.[1] A hydrographic mission under A. H. Dyé also did valuable work (1905–1909). An equally important service was rendered by the compilation by Sir R. Lambert Playfair and Dr Robert Brown of an invaluable *Bibliography of Morocco to the end of 1891* (1893), containing over two thousand entries.

History.—The prehistoric antiquities of Morocco are of considerable interest. In the cave at Cape Spartel Tissot found regularly shaped arrow-heads, and in the north of the country he met with dolmens, barrows and cromlechs, just as in Algeria or Tunisia. The dolmens usually form a trapezium, and the body seems to have been buried with the knees drawn up to the chin. At M'zōrah, a quaint little village of widely-scattered houses built of rough blocks of yellow soft sandstone, about 8 or 10 m. south-east from Azīlā, stands a group of megalithic monuments of some interest. They have been visited and described by many travellers, but Watson's account is the most detailed. Round the base of a mound (15 ft. high) of yellow sandstone lies a circle of sixty-seven large stones, one of which (at the west side) is more than 20 ft. high. In the vicinity are several other groups, some of still larger blocks. Roman roads (see Africa, Roman) seem to have run from Tangier southwards to the neighbourhood of Mequinez (Miknāsa), and from Azīlā to the south of Rabāt; and Roman sites are in several instances marked by considerable remains of masonry. At Kaṣar Farā'on (Pharaoh's Castle), on the western slope of J. Zarhōn, are the ruins of Volubilis. The *enceinte*, constructed of large stones and flanked by round towers, is 12,000 ft. in extent. Four gates are still recognizable, and a triumphal arch erected in A.D. 216 in honour of Caracalla and Julia Domna. The stones of this site have been used for Mequinez Miknās. Banasa (Colonia Aelia, originally Valentia) is identified with the ruins of Sidi Ali Bū Jenun, and Thamusida with those of Sidi Ali b. Hamed. At Shammish, up the river from Laraish, the city of Lixus (Trinx of Strabo) has splendid specimens of Punic and Roman stonework, and the similar remains on the headland of Mūlaī Bū Selham probably belong to the Mudelacha of Polybius. Of early Moorish architecture good examples are comparatively few and badly preserved. Besides those in Fās, Miknās, and Marrākesh, it is sufficient to mention the mausoleum of the Benī-Marīn (13th to 16th centuries) at Shella, which, with the adjoining mosque, is roofless and ruined, but possesses a number of funeral inscriptions.

The earliest records touching on Morocco are those of Hanno's *Periplus*, which mentions that Carthaginian colonies were planted along the coast. The savage and inhospitable tribes with whom they came in contact included cave-dwellers; but megalithic remains point to a yet earlier race. It is not till the last century B.C. that Moroccan Berbers are found supplying troops to Pompey or Sertorius, and later, under Augustus, becoming themselves incorporated in the Roman province of Mauretania (*q.v.*, and also Africa, Roman). But the Roman province reached only to the Bū Ragrāg, on which Sala, now Salli, was its outpost; Volubilis, near Mequinez, being its principal, if not its only, inland city. In the fifth century A.D. the country became subject to the Vandals and, about 618, to the Goths.

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[1] Gentil, in *La Géographie*, No. 3 (1908), describes the Siroua region, which, N.N.W. of Tikirt, connects the Anti Atlas and the High Atlas. The Siroua volcano compares with the finest volcanoes of Europe.

The Arab Invasion, 682–710.

The coming of the Arabs under ’Oqba (’Okba) in 682 was of far greater moment, though it was not till twenty years later that his successor, Mūsa ibn Nōsair, undertook a successful expedition as far as Tafīlālt and the Dra‘a. The force of ten thousand Arabs and Egyptians with whom Tariq (Tārik) ibn Zāid held the Tangier district in 710 was trebled by the enrolment of the Berbers, who enabled him next year to invade Spain, burning his boats behind him (see Caliphate, § C. Abbasids). But the Moroccan Berbers chafed beneath the Arab rule, and in 739 successfully revolted, setting up their first independent ruler, Maisara. Their kinsmen in Spain followed suit with equal success, and though subdued for a time, they retained their independence in certain parts till the 11th century, when, as masters of Granáda, they subjugated their implacable foes, the Arabs; and finally, under the Murabti and Muwaḥḥadi dynasties, conquered all Mahommedan Spain.

Early Dynasties.

The recorded history of the Moorish Empire commences with the settlement near the Roman ruins of Volubilis in A.D. 788 of Idrīs the elder (Idrīs b. Abdallah), one of the fugitive descendants of Mahomet during the struggles between rival claimants of the caliphate. Islām had then been established in these parts for eighty years, but Idrīs and his son, Idrīs II., the builder of Fez, extended its influence, uniting the Berbers into a kingdom. Their line controlled a limited portion of northern Morocco for nearly two centuries, in part supplanted by the Miknāsā in 922, until displaced by the Maghrāwā in 988. These two dynasties were exterminated in 1061 by Yūsef I. (bin Tashfīn), founder of the Murābti dynasty of Berbers (Almoravides), who added the remainder of Morocco, most of Spain and Portugal, and Tlemçen. Their principal existing monument is the city of Marrākesh. In 1149 the Murābti power was overthrown by another religious leader, ‘Abd el Mumin at the head of the Muwāḥḥadi—*i.e.* “ Unitarian ”—horde (Almohades), under whom the Moorish Empire reached its zenith at the close of the 12th century. It then included, in addition to the Murābti realm, what now are Algeria, Tunisia and Tripoli, extending to the frontier of Egypt, which they were prevented from occupying by the rise of Saladin. Before the middle of the 13th century they had been driven out of Spain, and had lost all but what is now known as Morocco, whence, between 1217 and 1269, they were ousted by the Beni Marīn (Marinides). To them we owe the Giralda, Hasan and Kūtūbīya towers of Seville, Rabat and Marrākesh respectively, the Torre de Oro at Seville, Gibraltar Castle, and the towns of Rabat and Al ḳaṣar. It was under their rule that Francis of Assisi despatched to Morocco the first Christian missionaries of modern times. (See Almoravides and Almohades.)

Beni Marīn Period, 1213–1524.

The new dynasty differed from the two which had preceded it in being frankly part of a Berber tribe, the Zenāta, who carved out a kingdom for themselves. Having assisted the Murābtis and Muwāḥḥadis respectively at the battles of El Arcos (1195) and Las Navas (1212), the defection of their amīr on that occasion offered an opportunity for Abd-el-Haḳḳ, the son of their general, to attempt the overthrow of the reigning house. At first the Beni Marīn professed allegiance to Tunis, where the Hafsis, a branch of the Muwāḥḥadis, had thrown off the Moorish yoke and secured acknowledgement in northern Morocco and parts of Spain. But they were soon in a position to proclaim complete independence, and by the time that Abu Bakr, the third son of Abd-el-Haḳḳ to succeed him, died, in 1258, they held sway over all that is now known as Morocco, and 1269 saw the death of the last Muwāḥḥadi prince.

On the death of Abu Bakr there succeeded Yākūb II., one of the few amīrs of Morocco who have left a name for just administration and for philanthropic undertakings. Although of strict religious habits, he displayed no bigotry, studying philosophy, and entering into friendly intercourse with Europeans, whom he encouraged to trade with Salli. In 1261, 1275 and 1277–1279, he undertook successful expeditions to Spain, and again in 1284, this time, in alliance with Alphonso of Leon, against his rebel son Sancho. But Alphonso dying during the struggle, Yākūb found himself master of his country, and Sancho had to acknowledge his suzerainty. All Mahommedans within his realm were freed from all taxes, and all the Arabic manuscripts of the country—thirteen loads—were despatched to the college Yākūb had built in Fez.

But Yākūb did not live to reap the benefits of his conquest, which were enjoyed by his son, Yūsef IV. (1286), who was courted by his father’s old foes, entering into amicable relations with Tunis, Egypt, Arabia and the neighbouring European states. With the contemporaneous Beni Zeiyan dynasty of Tlemçen, sworn foes of his house, however, he was still at war when stabbed (1307) in the new town of Tlemçen, which he had built while conducting a siege of the old town. A second siege was begun in 1335, and Tlemçen fell in 1337 to the fourth ruler of the dynasty, Ali V., Abu ’l Hasan, better known as “ The Black Sultan.” Unsuccessful in his invasion of Spain and Tunisia, Ali had eventually to abdicate in 1351 in favour of his rebel son, the famous “ Abu Ainān,” Fāris I., who during a short reign recovered Algeria and Tunisia.

The Beni Marīn were soon driven back, till a few years later Tlemçen alone remained to them, and this they held only till 1359 (see Tlemçen). Thereafter their empire became habitually divided between rival claimants, and the Portuguese began to obtain footholds on the coast, Ceuta being lost to them in 1415, Al Kasar in 1458, and Azilā and Tangier in 1471.

Waṭṭāsi Dynasty, 1471–1548.

On the failure of the Beni Marīn the amīrate was seized by Sa‘id III., “ El Waṭṭās,” head of another branch, founder of the short-lived Waṭṭāsi dynasty. His reign is memorable as that in which the “ Catholic Princes ” expelled his co-religionists from Spain, the last amīr of Granáda and many others taking refuge in Morocco, where in 1492 they built for themselves Tetuan. His son, Mahomet VIII., surnamed “ the Portuguese,” because so long a prisoner of that people, had to suffer the loss to Portugal of practically all his Atlantic ports but Salli-Rabat, and of Peñon de Velez to Spain, which had a few years previously captured Melilla. Although two more reigns carried the dynasty down to 1550, it has barely left its mark upon the country. From the beginning of the new century a rising power had been making itself felt in the south, over which the Waṭṭāsis never held sway.

Sa‘adi Dynasty, 1524–1668.

The family of sharīfs or “ nobles ”—that is, descendants of Mahomet—popularly known as the Sa‘adi or Hasani (Hosaini), settled in the Dra‘a district, but originally came from Yanboa, near Medina. Their opportune religious leadership rallied the disjointed members of the empire for a *jehād* against the Portuguese, but ultimately, on the death of Mahomet VIII., when in possession of the kingdom of Marrākesh, the sharīfs defeated his successor and arranged a formal division of the country at the Um er-Rabi‘a. At the head of the movement were then the two sons of the sharīf who had started it, Ahmed III. and Mahomet IX., between whom rivalry broke out, resulting in the success of the latter, who by 1550 found himself the master of the whole empire on carrying off the last Waṭṭāsi amīr Mahomet and espousing his daughter.

On the assassination of Mahomet IX. in 1557, the succession passed by a previous agreement to his brother’s son, ‘Abd-Allah IV., who secured himself against the possible rivalry of his brothers by putting ten of the twelve to death. One of the survivors, however, Abd-el-Mālek I., deposed Abd-Allah’s son, Mahomet XI., whose appeal to Sebastian of Portugal for assistance, brought about the celebrated “ battle of the three kings,” in which they all perished in 1578 near Al Kasar. This opened the way to the most famous of his line, Ahmed IV., Ed-Dhāhebi, or “ the Golden,” who proclaimed himself caliph, the last (nominal) Abbasid holder of that office having been superseded by the Turks on their conquest of Egypt in 1517. He entered into friendly relations with Queen Elizabeth and other European potentates, and the oases of Tūat, &c., were added to his dominions, which embraced also Timbuktu, whence came gold and tobacco. Ahmed fell a victim of the plague in 1603, and the succession was disputed by three of his sons. In 1608 one of them, Zīdān, became supreme and reigned twenty years. To subdue rebellions Zīdān twice obtained the assistance of English troops from Charles I., and, like his father, employed large numbers of European artificers in the various palaces he built or completed. The two sons who succeeded him had both become drunkards from intercourse with these foreigners, but a third, Mahomet XIII., called from prison to reign in 1636, proved himself a wise and beneficent ruler. But his friendship for Europeans displeased the more fanatical among his subjects, and after a futile attempt on the part of a central Moroccan "saint" of great reputation to oust him, and the "Christians" on the coast as well, another family of sharīfs was invited from Tafīlālt to undertake the task, and by 1649 they were masters of Fez.

European Relations with Morocco.

Before tracing the history of the Fīlāli dynasty, which still holds its own, it will be convenient to refer briefly to the relations which subsisted then (17th century) and for many years afterwards, apart from wars with Spain and Portugal, between the Moors and Europeans. From the early part of the 13th century there are records of Christian mercenaries and others in the Moorish service, while intermittent trading expeditions had already brought the principal European ports of the Mediterranean into touch with Morocco. The settlement of European traders in Moorish ports does not appear to have commenced till later; but it soon became an important factor, for the Moors have always appreciated the advantages of foreign commerce, and thus the way was opened up for diplomatic intercourse and treaty privileges. Even while their rovers were scouring the seas and making slaves of the foreigners captured, foreign merchants were encouraged to trade among them under guarantees and safe-conducts. Thus originated all the rights enjoyed by foreigners in Morocco to-day, as subsequently confirmed by treaties. France was the first to appoint a consul to Morocco, in 1577, Great Britain only doing so a century later. For centuries the treatment of foreign envoys in Morocco was most humiliating, the presents they brought being regarded in the light of tribute. It was not till the year 1900 that the custom was abolished of mounted sultans under umbrellas receiving ambassadors on foot and bareheaded.

The Sallee Rovers.

While, from the European point of view, the pirates of the Barbary coast were a bloodthirsty set of robbers, in no way to be distinguished from the sweepings of Western civilization who scoured the seas farther east, from the standpoint of the Moors they were the pious religious warriors for the faith, who had volunteered to punish the Nazarenes for rejecting Mahomet, and it is difficult to realize the honour in which their memory is held save by comparison with that of the Crusaders, in which the positions were exactly reversed. The Moorish rovers approached as nearly to an organized navy as anything the country ever possessed, and at times they were fitted out by the state, to whom their prizes therefore belonged. They made descents on the opposite coasts, even as far as Devon and Cornwall, carrying off the population of whole hamlets.

Salli, Maʿmora (Mehediya), Laraish, Tangier, Ceuta, Tetuan, and Bādis were their principal rendezvous in Morocco, and their vessels, an assortment of almost every known build and rig of the day, varied greatly in numbers and size. It is probable, however, that contemporary writers greatly over-estimated their importance. They appear to have flourished chiefly throughout the 16th, 17th and 18th centuries, and to have attained the zenith of their power during the latter part of the 17th century. A great impetus was given to their raids by the expulsion of the Moors from Spain in 1610, and their operations were facilitated later by the recovery of most of the Moorish ports from foreign hands. The varying influence of the different European states could be gauged at first by the prices they were compelled to pay to ransom their captive subjects, and later by the annual tribute which they were willing to present to protect their vessels. Some countries continued the payment well into the 19th century, although the slavery of Christians in Morocco had been abolished by treaty in 1814.

Christian Slaves.

During the time that piracy flourished hundreds of thousands of foreigners suffered captivity, torture and death in Morocco rather than abjure their faith, the one condition on which a measure of freedom within Morocco was offered to them. The horrors of that time were keenly felt in Christendom, and collections were constantly made at church doors for the ransom of Moorish captives. Frequent expeditions for that purpose were undertaken by members of religious brotherhoods, not a few of whom themselves became martyrs. The lot of the European slave was infinitely worse than that of the negro who indifferently embraced Islām, and was at once admitted to equality in all points save freedom. They were principally employed on public works or in galleys under the task-master's lash, both men and women being subjected to every indignity.

Fīlāli Dynasty, (1649—.)

The record of the Fīlāli dynasty may now be considered. The first of this line proclaimed in Fez was Mahomet XIV., but the first of European fame was his brother, Rashid II., "The Great Tafīlātta," as he was styled by the English, who then occupied Tangier, sultan from 1664 to 1672. With him opened a terrible epoch of bloodshed and cruelty, only once revived since—during the short reign of El Yāzīd (1790–1792)—the horrors of which for both natives and Europeans, are often indescribable. It reached its climax under his brother Ismāʿīl. A man of wonderful vitality, his reign lasted 55 years (1672–1727), during which his fierce grasp never relaxed. Many hundreds of sons and countless daughters were born to him in a harem rivalling that of Solomon, for which he even asked a daughter of Louis XIV. Having, as he supposed, driven the English from Tangier, he laid unsuccessful siege to Ceuta for 26 years, but otherwise his military measures were confined to subduing internal enemies, in which he was supported by his faithful black troops, the Bokhāris, and also by a foreign legion of renegades.

For 30 years after Ismāʿīl's death one son after another was set up by the Bokhāris, seven succeeding—some of them more than once—till one, Abd-Allah V., who partook of his father's bloodthirsty nature, ended his sixth turn of power in 1757. Then, at last, this dynasty provided a beneficent sovereign in the person of his son, Mahomet XVI., during whose reign of 33 years the land prospered. By him Mogador was built and Mazagan, the last hold of the Portuguese, recovered. He was followed by the wretch Yāzīd, his son by an English or Irish woman, whose reign was fortunately cut short while contending with four rival brothers, two of whom in turn succeeded him, the second, Sulaiman II., proving as wise a ruler as his father. Under his reign (1795–1822) piracy was abolished, but the policy, maintained till the end of the century, of having as little as possible to do with foreigners was initiated.

By Sulaiman's direction the imperial umbrella passed to his nephew, Abd-er-Rahmān II., on whom he could rely to maintain his policy. Although disposed to promote foreign trade, he made a futile attempt in 1828 to revive piracy, which the Austrians frustrated by reprisals next year. Following this was the war of 1830 with France over the partition of Algeria, as a result of which the Moors renounced all claim to Tlemçen and entered into agreements the infraction of which led to a second war between the two in 1844, during which Tangier and Mogador were bombarded. A bombardment of Salli in 1851 secured for the French the settlement of various claims, and when Abd-er-Rahman died, in 1859, the Spaniards were threatening Tetuan.

War being declared, the Spaniards marched on the town, which they captured after two months, and held till peace was signed six months later on their own terms. The vanquished sultan, Mahomet XVII., reigned till his death in 1873, when his son, El Hasan III., succeeded, having the usual fight to secure the supremacy. In comparison with his predecessors El Hasan was mild and gentle, too much so to maintain continual peace among the more turbulent of his subjects. From early in the century Sūs had practically maintained independence, but in 1882 was reduced to submission, as also were subsequently the other great Berber centres, one by one, till the land had rest. Fighting between the Rīfians and Spaniards in 1894 having involved the sultan in the payment of some £650,000 indemnity, he was on his way to recover this from the culprits when he died in camp and was interred at Rabat.

The Reign of 'Abd-el-'Azīz IV.

El-Hasan's death was kept secret till the coffin reached its destination, so that a peaceful proclamation was secured for 'Abd-el-'Azīz IV., his son by a Circassian slave who possessed great influence over him. His trusted chamberlain, Si Ahmed ben Mūsa, became Wazīr regent, and put down all opposition, ruling with a firm, wise hand till 1900, when he died just as his ward attained his majority. Drastic changes thereon took place, and a new set of ministers came into power. The young sultan now showed himself desirous of acquiring and practising foreign arts and of introducing foreign reforms. Under his mother's advice he sought especially the friendship and advice of Great Britain, on whose disinterested friendship he believed he could rely. But lack of training and experience frustrated his praiseworthy efforts, and he became the prey of schemers and speculators, who pandered to his worst traits and squandered his treasure.

This turn of affairs aroused the fanaticism of his people, and in 1902 the Berber tribes of the Algerian frontier rose in rebellion under Jelāli Zarhōni, nicknamed "Bu Hamāra," who claimed to be fighting on behalf of the sultan's brother Mahomet, already imprisoned in Mequinez for revolt.[1] Unable to subdue the rebellion, which did not, however, affect the rest of the empire, 'Abd-el-'Azīz borrowed money from France to reorganize his army, but failed to effect his purpose. Meanwhile a local sharīf, Mulai Ahmed er-Raisūli, made himself master of the district round Tangier, holding even foreigners to ransom, and creating a false impression abroad as to the general state of the empire.

The end appeared near when by a declaration, signed in London on the 8th of April 1904, Great Britain, in return for concessions in Egypt, agreed not to interfere with French action in Morocco. In this declaration, one of the series of arrangements marking the establishment of the *entente cordiale*, France declared that she had no intention of changing the political status of Morocco. She designed, however, a system of "pacific penetration," and administrative, economic, financial and military reforms—reforms which the Moorish court did not desire. By a separate convention with Spain in October 1904 the interests of that country were safeguarded, and it seemed that the Anglo-French agreement had the approval of all the powers. Some weeks before its conclusion its terms had been communicated to Germany, and four days after its signature Count Bülow had stated in the Reichstag that there was no ground to apprehend that German interests ("essentially economic") in Morocco would be disregarded. During the remaining months of 1904, however, and in the opening months of 1905, the international situation was changed. Germany had viewed with concern the increased influence of France in Europe, but remained quiescent until after the reverses to the Russian arms in Manchuria, when it was judged in Berlin that the time had arrived for Germany to become the arbiter of European policy; and the means to demonstrate her position were found in the Moroccan question. After having turned a deaf ear to the demands of the Pan-Germanic party for the "vindication" of German rights in Morocco, after in fact nearly a year of acquiescence in the predominant position of France in that country[2] the German government now complained of being ignored in the Anglo-French arrangement and proceeded to extend its patronage to 'Abd-el-'Azīz. On the 31st of March 1905 the German emperor landed at Tangier and had conferences with the sultan's representatives. The emperor was reported to have declared that he had come to enforce the sovereignty of the sultan, the integrity of Morocco, and the equality of commercial and economic interests. The effect of this intervention was soon apparent. The sultan rejected the scheme of reforms proposed by France, and at the suggestion of Germany issued invitations to the powers to meet his representatives and advise him concerning the reforms needed. The French foreign minister, M. Delcassé, held that there was no need for a conference, but Prince Bülow used menacing language and after a period of much stress M. Delcassé resigned (June, 1905), the French government thereupon agreeing to the holding of a conference. So far the German policy had triumphed; the conference met at Algeciras on the 16th of January 1906 and engaged in the delicate task of reconciling French claims for predominance with the German demand of equality for all. The British delegates gave firm support to their French colleagues, while Austria proved "a brilliant second" to Germany. With great difficulty a scheme of reforms was elaborated, Germany having previously acknowledged the privileged position of France along the Moroccan-Algerian frontier. The general act embodying the resolutions of the conference was signed on the 7th of April; it was accepted by the sultan on the 18th of June, and the ratifications of the act by the other powers were deposited at the Spanish Foreign Office on the 31st of December 1906. The act provided for a Moorish police force from 2000 to 2500 strong, distributed among the eight open ports of Morocco, to be commanded by Moorish kaids, assisted by French and Spanish instructors and officers, with a Swiss inspector-general—the arrangement to continue for five years. The act provided also for the institution of a state bank (see *supra* § *Finance*). Other provisions dealt with (*a*) the acquisition of land round the ports by foreigners, and the consequent payment by them of the regulated or *tertib* taxes; (*b*) the more efficient control of the customs administration, first by an annual assessment of the average values of all imports as a basis for the tariff during the following year, and, secondly, by a strict supervision of the administration itself; and (*c*) the authority of the state over the public services and public works, tenders for which were to be adjudicated impartially without reference to the nationality of the bidder.

The Algeciras Conference.

France occupies Ujda.

Throughout 1906 the country was in a disturbed condition, and while a Franco-Spanish demonstration off Tangier succeeded in obtaining the removal of Raisūli from the governorship of the town, various outrages occurred (including the murder of a Frenchman in the suburbs of Tangier) for which no satisfaction could be obtained. At length the murder of Dr. Emile Mauchamp at Marrakesh on the 19th of March 1907 determined the French to take prompt action, and Ujda was occupied (March 29) by Algerian troops, the French government determining to hold the town until satisfaction had been given to their demands. This satisfaction 'Abd-el-'Azīz promised in May, and some progress was made towards carrying out the Algeciras programme, the state bank being organized in July 1907. Meantime the weakness of the sultan's rule was illustrated in many quarters: near Tangier by the continued activity of Raisūli, that chieftain securing in June another European captive—Sir Harry Maclean,[3] who after over seven months' detention had to be ransomed by the British government for £20,000.

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[1] Mulai Mahomet, eldest son of El Hasan and a generally popular prince, was released from prison by 'Abd-el-'Azīz early in 1908 and placed in command of his army. On the defeat of 'Azīz by Mulai Hafid, Mahomet contemplated seizing the throne. He was, however, imprisoned by Hafid in the palace at Fez, where he was reported to have died, in mysterious circumstances, in June 1909.

[2] Shown *inter alia* by the landing of 500 Algerian troops at Tangier (a step taken to secure the release of Ion Perdicaris and his stepson, captives of Raisūli), and of a detachment at Rabat.

[3] Kaid Sir Harry Maclean (b. 1848) after serving in the British army became instructor to the Moorish army, which he accompanied in several expeditions. He was also colonel of the sultan's bodyguard. For services rendered to the British government he was made a C.M.G. in 1898 and a K.C.M.G. in 1901. On the occasion of his capture he had gone, as he thought, to receive the submission of Raisūli, and had with him one or two attendants only. The sum paid for his ransom was subsequently refunded—as to £15,000 by Raisūli himself and the remainder by Mulai Hafid.

Casablanca.

At Casablanca at this time works were in progress, with the sanction of the sultan, for improving the harbour. The works were beyond the ramparts, close to the Moslem cemetery; and the neighbouring tribesmen (the Shawia) were excited by reports that the cemetery had been desecrated. On the 30th of July they attacked the European labourers and killed nine of them (three French, three Spaniards, and three Italians), afterwards entering the town and raiding the Jewish quarter. Refugees fled by boat to Tangier with news of the massacre. The French government decided to occupy Casablanca, and a strong naval and military force was sent thither. Before the arrival of the troops the commander of the cruiser "Galilée" landed a party (Aug. 5) to guard the French consulate. The passage of the detachment was opposed, whereupon the "Galilée," aided by the "Du Chayla" bombarded the town. Casablanca was at the same time entered by the tribesmen, who began a general pillage. On the 7th the French troops arrived and were landed, and further fighting took place. Before order was restored nearly every inhabitant had been killed or wounded or had fled; the dead alone numbered thousands. The European colony was, however, saved. Though masters of the town, the French found the Shawia tribes still full of fight, and, first under General Drude and afterwards (Jan. 1908) under General Amadé, the French proceeded to the reduction of the Shawia country. At one time the expeditionary force numbered 15,000 men.[1] By June 1908 the district was quiet and thereafter the strength of the force was gradually reduced.[2]

The action of France at Casablanca aroused the fanaticism of the tribes of Tafīlālt and those dwelling near the Algerian border. In November 1907 the Beni Snassen crossed the frontier and were not reduced to submission until after hard fighting. Another outbreak occurred in April 1908, when a French column in the Guir district, west of Figig was surprised, and had difficulty in beating back the enemy. In that and a subsequent engagement, which resulted in the dispersal of the foe in May, the French casualties were over 200. French and Moorish commissioners were then appointed to preserve order along the frontier.

Fall of ʿAbd-el-ʿAzīz.

While thus engaged on the eastern frontier and on the Atlantic coast of Morocco France had given financial and moral support to ʿAbd-el-ʿAzīz, whose position was threatened by his brother Mulai Hafid. On the 16th of August 1907, within a fortnight of the bombardment of Casablanca, the ulema of Marrākesh had declared ʿAbd-el-ʿAzīz deposed and Hafid sultan; and from September onwards the tribes round Casablanca opposing the French were supported by troops sent from Marrākesh. Azīz having been furnished with money by the state bank, he was enabled to reach the seaport of Rabat at the head of his army in September 1907. There he was visited by the French minister and appeared willing to grant all the demands of France in return for help against his brother. A loan was forthcoming but no military assistance save that some of ʿAbd-el-ʿAzīz's troops were taken by a French warship to Mazagan. While desultory fighting between the supporters of the rival brothers was proceeding Hafid was proclaimed sultan at Fez on the 4th of January 1908; Hafid now sought support from France, Germany, and other powers, and moving from Marrākesh passed the French lines in the Shawia country, entered Mequinez in May and Fez in June 1908. At length ʿAbd-el-ʿAzīz made an effort to reassert his authority and with a force numbering 4000 he left Rabat in July for Marrākesh. He reached the neighbourhood of that city on the 2nd of August, having received the adhesion of numerous tribes, including the Shawia. On the 19th he started for the final march on Marrākesh. He appears to have been betrayed, for hardly had his force started when it was assailed on all sides, whereupon the tribesmen deserted in a body and the "regulars" ran away. The day was irretrievably lost and ʿAbd-el-ʿAzīz sought safety in flight. On the 22nd he arrived at Settat in the Shawia country, and within the French lines, with only a handful of followers. For a short time he talked of continuing the struggle, but ended by accepting a pension from his brother Hafid and was assigned a residence in Tangier. That town, the last in Morocco to acknowledge Hafid, did so on the 23rd of August; the change of sultans being accomplished without any disturbance of public order.

Mulai Hafid Sultan.

Germany was anxious for the immediate recognition of Hafid and caused some perturbation in France by a circular to the powers to that effect dated the 2nd of September; the French and Spanish governments replied by proposals for guarantees that Hafid would respect the Act of Algeçiras. This course received general assent and Hafid having given the guarantees demanded he was formally recognized as sultan at the beginning of 1909. His relations with Europe were made easier by the conclusion, in February 1909, of a Franco-German agreement designed to avoid all cause of misunderstanding between those powers in Morocco. Germany put on record that her interests in the sultanate were "only economic," and France agreeing to "safeguard economic equality" Germany undertook not to impede the political interests of France in the country.

The weakness of the central government was exemplified by the inability of Mulai Hafid to control the Rif tribesmen, who in July 1909 killed a number of European labourers in the neighbourhood of the Spanish fortress of Melilla (*q.v.*). Spain sent an army of 50,000 men to vindicate its authority. After a severe campaign the Riffians were reduced to submission (Nov. 1909). Though powerless in the Rif, Mulai Hafid's army succeeded in defeating Bu Hamāra's force and in capturing (Aug. 1909) that pretender, otherwise known as el Roghi.[3] Bu Hamāra and many of his followers were taken to Fez. The tortures inflicted upon them evoked strong protests from the European powers. In 1910 Mulai Hafid obtained a loan, chiefly from France, of £4,000,000; the greater part of the loan went to liquidate claims by Europeans against the *maghzen*.

AMIRS AND SULTANS[4] OF MOROCCO

I.—Idrisi Dynasty (Arab), A.D. (Capital, Fez.)

788.	Idrīs I.
791.	Rashīd (regent).
804.	Idrīs II.
828.	Mahomet I.
836.	ʿAli I.
848.	Yahya I.
881.	Yahya II.
894.	ʿAli II.
	Yahya III.
904.	Yahya IV.
	(Interregnum from 917.)
922.	El Hasan I. "El Hajjām." (Fez lost to the Miknāsa 925.)
935.	El Kennūn (at Hajrat en-Nasr).
948.	ʿAbu'l ʿAish Ahmed.
954	El Hasan II. (at Basra).
961.	ʿAbd-Allah I.
970.	Mahomet II. (Subjugated by the Maghrāwa 985.)

II.—Miknāsa Dynasty (Berber). (Capital, Fez.)

925.	Musa I. "Ibn Abd-el-ʿAafīa."
938.	Mādīn.
952.	Ibrāhīm I.
973.	El Būrī.
1014.	El Kāsem I.

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[1] A Spanish force of 600 men was also sent to Casablanca. Throughout the crisis Spain, with some misgiving, co-operated in the actions of France.

[2] In September 1908 the German consul at Casablanca gave safe-conduct to six deserters from the Foreign Legion, of whom three were Germans. On the way to embark for Hamburg, and while under guard from the German consulate, all six deserters were forcibly arrested by a French patrol. The matter created great excitement both in Germany and France, chiefly from the demand of the German government that France should express regret for the action of its agents before the facts were fully established. A way of escape was found in the formula "the two governments, regretting the events which occurred at Casablanca, . . . refer the matter to arbitration . . . and agree to express regret . . . according to the judgment of the court." The case then went to The Hague Court of Arbitration, which gave its decision in May 1909, substantially in favour of France. In July the French government pardoned the deserters.

[3] For an account of Bu Hamāra's career see *Questions diplomatiques* (Oct. 16, 1909).

[4] Title of sultan adopted about 1640.

III.—Maghrāwa Dynasty (Berber). (Capital, Fez.)

988. Zīri ibn 'Atīa.
1000. El Mūāz.
1026. Hammāma.
1039. Dūnas.
1060. El Fatūh and 'Ajīsa.
1065. El Moānnasir.
1067. Tamīm.

IV.—Murābti Dynasty (Berber). (Capital, Marrākesh.)

1061. Yūsef I. (Bin Tashfīn.)
1106. 'Ali III.
1143. Tashfīn I.
1145. Ibrāhīm II.
1146. Ishāk.

V.—Muwāhhadi Dynasty (Berber). (Capitals, Marrākesh and Seville.)

1145. 'Abd-el-Mūmin.
1163. Yūsef II., "Abu Ya'kūb."
1184. Yā'kūb I., "Abu Yūsef el Mansūr."
1199. Mahomet III., "En-Nāsir."
1214. Yūsef III., "Abu Yākūb el Mustansir."
1223. 'Abd-el-Wāhid, "El Makhlūwi."
1224. 'Abd-Allah II., "Abu Mahomet."
1226. Yahya V., "El Mu'tasim."
1229. Idrīs III., "El Māmun."
1232. Rashīd I., "Abd-el-Wāhīd."
1242. 'Ali IV., "Es-Said el Mu'tadīd." (Mequinez lost to Beni Marīn 1245.)
1248. 'Omar I., "El Mortada." (Fez lost to Beni Marīn, 1248.)
1266. Idrīs IV., "Abu Dabbūs el Wāthik." (Marrākesh lost to Beni Marīn, 1269.)

VI.—Beni Marīn Dynasty (Berber). (Capitals, Fez, Mequinez and Marrākesh.)

1213. 'Abd-el-Hakk.
1217. 'Othmān I., "Abu Said I."
1239. Mahomet IV., "Abu Marrāf."
1244. Abu Bakr.
1258. Yākūb II., "bin 'Abd-el-Hakk."
1286. Yūsef IV.
1307. 'Amr, "Abu Thābit."
1308. Sulaimān I., "Abu Rebī'a."
1310. 'Othmān II., "Abu Said II."
1320. 'Omar II. (at Sajilmāsa).
1331. 'Ali V., "Abu'l Hasan."
1351. Fāris I., "Abu'Aīnān."
1358. Sa'īd I. (a child).
1359. Ibrāhīm III., "Abu Salem."
1361. Tashfīn II., "Abu 'Omar."
'Abd-el-Halīm (in Sajilmāsa).
Mahomet V.
1366. 'Abd-el-'Azīz I.
1372. Mahomet VI., "Es-Saīd."
1374. Ahmed I., "Abu'l'Abbās" (in Fez).
'Abd-er-Rahman I. (in Marrākesh).
1384. Mūsa II. and Ahmed II., "Es Mustansir."
1386. Mahomet VII., "El Wāthik."
1387. Ahmed I. (2nd reign).
1393. 'Abd-el-'Azīz II., "Abu Fāris."
1396. Fāris II., "El Mutawakkil."
1408. Abu Sa'īd III.
1416. Sa'īd II. and Yākūb III.
1425. 'Abd-Allah III. (after whom the record of this dynasty ceases).

VII.—Wattāsi Dynasty (Berber). (Capital, Fez.)

1471. Sa'īd III., "Es-Sheikh el Wattās."
1500. Mahomet VIII., "The Portuguese."
1530. Ahmed III. (in Fez).
1548. Mahomet X. (Defeated by the Sharīfs, 1550.)

VIII.—Sa'adi Dynasty (Arab). (Capitals, Fez, Mequinez and Marrākesh.)

1524. Ahmed III. (in Marrākesh).
Mahomet IX. (in Tarudānt).
1557. 'Abd-Allah, "El Ghālib."
1574. Mahomet XI., "El Mutawakkil."
1576. 'Abd-el-Mālek I., "El Muatāsim."
1578. Ahmed IV., "El Mansur" or "Dhahebi."
1603. Mahomet XII., "Es-Sheikh."
'Abd-el-'Azīz III., "Abu Fāris."
1608. Zīdān.
1628. 'Abd-el-Mālek II.
1631. El Walīd.
1636. Mahomet XIII., "Es-Sheikh Es-Saghir." (Fez lost to the Filālis, 1649.)
1654. Ahmed V., "El Abbās."
1658. 'Abd-el-Karīm in Marrākesh. (Overthrown by Filālis, 1668.)

IX.—Filālī Dynasty (Arab). (Capitals, Fez, Mequinez and Marrākesh.)

1649. Mahomet XIV., "Es-Sharīf."
1664. Rashīd II.
1672. Ismā'īl, "The Bloodthirsty."
1727. Ahmed VI., "Ed-Dhahebi II."
1728. 'Abd-el-Mālek III., "Abu Merwān."
1729. 'Abd-Allah V., "El Mortada."
1734. 'Ali VI.
1736. Mahomet XV., "Uld er-Riba."
1738. El Mustadi.
1745. Zīn el 'Abdīn.
1757. Mahomet XVI.
1790. El Yazīd.
1792. El Hishām.
1795. Sulaimān II.
1822. 'Abd-er-Rahman II.
1859. Mahomet XVII.
1873. El Hasan III.
1894. 'Abd-el-'Azīz IV.
1908. Hafid.

NOTE.—The dates given are those in which the various rulers acquired sovereign power. Many had already secured the allegiance of certain provinces some time before, and many retained such allegiance long after the greater portion of the empire had accepted a successful rival. European nations in several instances treated with men who were not at the time actual sovereigns, and in some cases were never such.

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MORÓN DE LA FRONTERA, or MORÓN (anc. Arumi), a town of southern Spain, in the province of Seville; 32 m. S.E. of the city of Seville. Pop. (1900) 14,190. Morón occupies an irregular site upon broken chalk hillocks near the right bank of the Guadaira. It is connected by rail with Utrera on the Cadiz & Seville line. On the highest elevation to the eastward are the ruins of the ancient castle, of considerable importance during the Moorish period, when Morón, as its full name implies, was a frontier fortress; the castle was afterwards used as a palace by the counts of Ureña. In 1810–1811 it was fortified by the French, but blown up by them in the following year. The chief public building of Morón is the large parish church, which dates from the 16th century. Morón is also famous throughout Spain for its marble and its chalk (*cal de Morón*), from which the whitewash extensively used in the Peninsula is derived.

MORONE, GIOVANNI (1509–1580), Italian cardinal, was born on the 25th of January 1509 at Milan, where his father, Count Ieronimo Morone (d. 1529), was grand chancellor. His father, who had been imprisoned for opposing encroachments on the liberties of Milan by Charles V. (whom he afterwards cordially supported), removed to Modena, where his youngest son had most of his early education. Proceeding to Padua he studied jurisprudence with distinction. In return for important service rendered by his father, he was in 1527 nominated by Clement VIII. to the see of Modena, and consecrated in 1533 after a contest. From 1535 he was constantly entrusted by Paul III. with diplomatic missions; he was nuncio (1536) to Ferdinand, king of the Romans, and legate to the diet of Spires (1542) having successfully resisted the transfer of the diet to Hagenau on account of the plague (1540). On the 31st of May 1542 he was created cardinal, and was further nominated protector of England, Hungary, Austria, of several religious orders, and of the *santa casa* at Loreto. With the cardinals Paul Parisio and Reginald Pole he was deputed to open the Council of Trent (Nov. 1, 1542), the place of meeting having been a concession to his diplomacy. The legates arrived on the 22nd of November, but no council assembled. The death of Paul III. (1549) deprived him of a good friend. The views of the Reformers had spread in his diocese, and he was suspected of temporizing with them. He resigned his see (1550) in favour of the Dominican Egidio Foscherari, reserving to himself an annual pension and the patronage of livings. Julius III., at the instance of the duke of Milan, gave him (1553) the rich see of Novara (which he resigned in 1560 for the see of Albano) and sent him as nuncio to the diet of Augsburg (1555), from which he was immediately recalled by the death of Julius (March 23). In June 1557 Paul IV. imprisoned him in the castle of St Angelo (with others, including Pole, and Foscherari), on suspicion of Lutheran heresy. The prosecution entirely failed, and Morone might have had his liberty, but refused to leave prison unless Paul IV. publicly acknowledged his innocence. He remained incarcerated till the pope's death (Aug. 18, 1559), and took part in the election of Pius IV. Ochino, in the twenty-eighth of his *Dialogi XXX.*, 1563 has a colloquy on the treatment of heretics, between Pius IV. and Morone, in which the latter maintains: "Errantes in viam revocandi, non occidendi." This really hits the position of Morone, a sincere Catholic, to whom persecution was abhorrent. He presided at the Tridentine Council from the 10th of April to the 4th of December 1563, and endeavoured to exercise a conciliatory influence. At the end of 1564 Foscherari died, and Morone was reinstated in the see of Modena. On the death of Pius IV. (1565) he came near to being elected pope. His last days were easy; he died at Rome on the 1st of December 1580, and was buried at S. Maria sopra Minerva. His writings comprise a few letters and orations. His career is that of a good man, struggling for the welfare of his Church against corruptions not essential to the system to which he was devoted.

See J. G. Frick, "De Joanne Morono," in J. G. Schelhorn's *Amoenitates literariae*, vol. xii. (1730); "G. Moroni," *Dizionario di erudizione* (1847); N. Bernabei, *Vita del cardinale G. Moroni* (1885); M. Young, *Life and Times of Aonio Paleario* (1860); C. Benrath, in Hauck's *Realencyklopädie* (1903). (A. Go.*)

MORONI, GIAMBATTISTA (*c.* 1510–1578), Italian portrait-painter of the Venetian school, was born at Albino near Bergamo about 1510 (or perhaps a few years later), and became a pupil of Bonvicino named Il Moretto. Beyond the record of his works very few particulars regarding him have reached us. Titian, under whom also Moroni, while still very young, is said to have studied (but this appears hardly probable), had at any rate a high opinion of his powers; he said that Moroni made his portraits "living" or "actual" (*veri*). In truthful and animated portraiture Moroni ranks near Titian himself. His portraits do not indeed attain to a majestic monumental character; but they are full of straightforward life and individuality, with genuine unforced choice of attitude, and excellent texture and arrangement of draperies. There is a certain tendency to a violet-tint in the flesh, and the drawing and action of the hands are not first-rate. The earliest inscribed date discovered for any of his works is 1553. As leading samples may be mentioned—in the Uffizi Gallery, Florence the "Nobleman pointing to a Flame," inscribed "Et quid volo nisi ut ardeat?"; in the National Gallery, London, the portraits of a Tailor, a member of the Fenaroli family, Canon Ludovico de' Terzi, and others; in the Berlin Gallery, his own portrait; and in Stafford House, the seated half-figure of the Jesuit Ercole Tasso, currently termed "Titian's Schoolmaster"—not as indicating any real connexion between the sitter and Titian, but only the consummate excellence of the work. Besides his portraits, Moroni painted, from youth to his latest days, the ordinary round of sacred compositions; but in these he falls below his master Il Moretto. One of the best is the "Coronation of the Virgin," in S. Alessandro della Croce, Bergamo; also in the cathedral of Verona, "SS Peter and Paul," and in the Brera of Milan, the "Assumption of the Virgin." Moroni was engaged upon a "Last Judgment," in the church of Corlago, when he died on the 5th of February 1578. (W. M. R.)

MOROSINI, a noble Venetian family, probably of Hungarian extraction, which gave many doges, statesmen, generals and admirals to the Venetian Republic, and cardinals to the Church. It first became prominent at the time of the emperor Otho II. owing to its rivalry with the Caloprini family, whom it succeeded in subjugating by the end of the 10th century. Domenico Morosini (d. 1156), elected doge in 1148, waged war with success against the Dalmatian corsairs, recapturing Pola and other Istrian towns from them. Marino Morosini (d. 1252) was elected doge in 1249; Michele was doge from June 1382, until his death in October of the same year.

ANDREA MOROSINI (1558–1618) was a famous historian and was entrusted by the Venetian senate with the task of continuing Paolo Paruta's *Annali Veneti*, in Latin. His history of Venice was published by his brother in 1623 (Venice), and translated into

Italian by Senator Girolamo Molin (Venice, 1782). Among his other works are: *Le Imprese ed espeditioni di terra santa, &c.* (Venice, 1627); *De iis quae veneta respublica ad Istriae oras gessit, &c.* (in the Corner-Duodo collection of MSS.; *De forma reipublicae venetae* in MS. in the Bibliothèque Nationale in Paris. His life has been written by Luigi Lollin (1623), by Niccolo Crasso (1621), and by Antonio Palazzoli (1620).

Francesco Morosini (1618–1694) was one of the greatest captains of his time. As a young man he fought against the Turks and the pirates, and after signally distinguishing himself at the battle of Naxos in 1650 he was appointed commander-in-chief of the Venetian navy. He then conducted a series of successful campaigns against the Turks, but was recalled in consequence of the intrigues of his rival the Provveditore Antonio Barbaro (1661). But when Candia was attacked by a large force, under the terrible vizir Keuprili, Morosini was sent to relieve the fortress in 1667; the siege lasted eighteen months, but Morosini, in spite of his prodigies of valour, was forced to surrender to save the surviving inhabitants. He was tried, but acquitted of all blame, and on the renewal of the war with the Turkish Empire in 1684 he was again appointed commander-in-chief, and after several brilliant victories he reconquered the Peloponnesus and Athens; on his return to Venice he was loaded with honours and given the title of "Peloponnesiaco." In 1688 he was elected doge, and in 1693 he took command of the Venetian forces against the Turks for the fourth time; the enemy which had been cruising in the archipelago withdrew at his approach, so great was the terror inspired by his name. While wintering at Napoli di Romania (Nauplia) he died on the 6th of January 1694.

Bibliography.—Barbaro, *Genealogia delle famiglie patrizie venete*, MS., clas. vii., cod. 927, in the Marcian Library, Venice; Cappellari, *Campidoglio veneto*, MS., clas. vii., cod. 17, ibid.; Romanin, *Storia documentata di Venezia*, also other general Venetian histories; G. Dalla Santa, *Due Lettere di umanisti veneziani a Paolo Morosini* (in *Nuovo archivio veneto*, xix. 92); G. Graziani's life of F. Morosini in Latin (Padua, 1698); A. Arrighi, *Vita di F. M.* (Padua, 1449). (See also Venice.)

MORPETH, a market town and municipal and parliamentary borough of Northumberland, England, situated in a fine valley on the Wansbeck, $17\frac{1}{2}$ m. N. of Newcastle by the North Eastern railway the junction of several branches with the main line. Pop. (1901), 6158. The Wansbeck winds round the town on the west, south and east, and a rivulet, the Cottingburn, bounds it on the north. The parish church of St Mary, a plain building of the 14th century, is situated on Kirk Hill, a short distance from the town. It has a good example of a Jesse window. Nothing remains of the old castle except the gateway. The valley of the Wansbeck above Morpeth is well wooded and very picturesque. By its side are fragments of Newminster Abbey, a wealthy foundation of the 12th century, occupied by monks from Fountains in Yorkshire; and Mitford, with its Norman and Early English church, and ruins of a Norman castle and a manor-house of the 17th century. To the north of Morpeth a good specimen of the peel tower of the 15th century is seen at Cockley Park. Industries of Morpeth include tanning, brewing, malting, iron and brass founding, and the manufacture of flannels, agricultural implements, and bricks and tiles. The parliamentary borough, within the Wansbeck division of the county, returns one member and extends 8 m. eastward to the coast, including the town of Blyth. Morpeth is governed by a mayor, 4 aldermen and 12 councillors. Area, 328 acres.

The manor of Morpeth is said to have been granted to William de Merlay soon after the Conquest and passed with the borough from his family to those of Graystock, Dacre and Howard, earls of Carlisle, with whom it remains. The town is a borough by prescription and grew up round the castle attributed to the above William de Merlay. About the end of the 12th century Roger de Merlay the younger granted the burgesses right to hold of him and his heirs "as freely as the charter of the king purported which he held of the king by gift." Charles II. incorporated the town in 1662 under the government of two bailiffs who were chosen every year in the following manner: the bailiffs for the time being chose two juries from whom the commonalty elected four burgesses, and from these four the steward of the lord of the manor appointed the bailiffs for the ensuing year. This was continued until the Municipal Reform Act of 1835. In 1200 a market on Wednesday and a fair on the Feast of St Mary Magdalene were granted to Roger de Merlay, and in 1285 the fair was extended for two days. The market rights still belong to the lord of the manor.

MORPHEUS, in Roman mythology, one of the sons of Somnus, the god of sleep. He was a personification, apparently invented by Ovid (*Metam.* xi. 635), of the power that calls up human shapes (μορφαί) of all kinds to the dreamer. His brothers Phobetor and Phantasus assumed the forms of all kinds of animals and inanimate things.

MORPHINE, the chief alkaloid of opium (*q.v.*), to which the medicinal action of the former is mainly due. It is not used itself in medicine owing to its insolubility in water and ether. The preparations of morphine are incompatible with salts of iron, copper and mercury, also with lime water and alkaline earths and substances containing tannin. With ferric chloride it forms a deep red colour.

The preparations of morphine in the British Pharmacopoeia are as follow: from *Morphinae Hydrochloridum* are made five sub-preparations: (1) *Liquor Morphinae Hydrochloridi*, strength 1% or about $4\frac{1}{2}$ grs. of the hydrochloride to the fl. oz.; (2) *Suppositoria Morphinae*, made with a basis of oil of theobroma, strength $\frac{1}{4}$ gr. of morphine hydrochloride in each; (3) *Tinctura Chloroformi et Morphinae*, strength $\frac{1}{11}$ gr. in 10 minims; (4) *Trochiscus Morphinae*, $\frac{1}{36}$ gr. in each; (5) *Trochiscus Morphinae et Ipecacuanhae*, strength $\frac{1}{36}$ gr. of morphine hydrochloride and $\frac{1}{12}$ gr. ipecacuanha in each. From *Morphinae Acetas*, a white soluble amorphous powder, is made *Liquor Morphinae Acetatis*, strength 1% or $4\frac{1}{2}$ grs. of the acetate to 1 fl. oz. From *Morphinae Tartras*, a white crystalline powder, are prepared, *Injectio Morphinae Hypodermica*, containing 5% of morphine tartrate, and *Liquor Morphinae Tartratis*. *Morphinae Sulphatis* is not official in the British Pharmacopeia but is official in the United States, the U.S.P. *Trochisci Morphinae et Ipecacuanhae* and *Pulvis Morphinae Compositus* (Tully's powder) being made from it. Hypodermic tabloids of morphine sulphate either alone or combined with atropine are much in use. Various non-official preparations of morphine are in use, such as dionin, heroin, glycaphorm and peronin.

Therapeutics.—Morphine is an analgesic and hypnotic, relieving pain and producing deep sleep. As contrasted with opium it differs in being less astringent and constipating. Morphine is the greatest anodyne we possess, and no drug yet discovered equals it in pain-relieving power. The most frequent mode of administration is the hypodermic method, on account of the extreme rapidity with which it is absorbed. In pain due to violent sciatica relief and even permanent cure has been obtained by the injection of morphine directly into the muscle of the affected part, and in the treatment of renal and hepatic colic morphine given subcutaneously will relieve the acute pain consequent on the passage of biliary and urinary calculi. A violent paroxysm of asthma may be arrested by the administration of morphine subcutaneously, but the practice should not be continued, as there is great danger in a chronic disease that the patient may become the victim of morphinism. Morphine is recognized as one of the most useful drugs in the treatment of eclampsia, early injection often arresting the fits. In the cough of phthisis minute doses are of service, but in this particular disease morphine is frequently better replaced by codeine or by heroin, which checks irritable coughs without the narcotism following upon the administration of morphine. In bronchitis with profuse expectoration the use of morphine is particularly dangerous, as it is likely to check the cough so necessary for getting rid of the secretion, but in the converse condition it usefully allays the harassing cough by diminishing the excitability of the respiratory centre. In the dyspnoea of advanced valvular disease of the heart morphine relieves the distress and restlessness, and induces sleep. It should however be withheld if the heart has undergone fatty degeneration. Morphine is a sheet anchor in the later stages of cancer and other painful diseases, rendering the life of the patient one of comparative comfort. If given in excess the drug is eliminated by way of the intestines and kidneys. It is also excreted in the milk; hence the danger in the administration of large doses of morphine to nursing mothers.

Morphine-scopolamine anaesthesia was introduced in 1902 by Steinbückel. It has been used by some surgeons for the production of anaesthesia previous to the administration of ether or chloroform, but the use of the method is now more usually relegated to obstetric practice.

Morphinism (Morphinomania).—Chronic morphine poisoning is very common, as morphine taken constantly creates a habit. Once acquired the habitué depends on the drug for a comfortable existence, and as the organism becomes quickly tolerant of the alkaloid the original dose no longer suffices. The total amount of morphine indulged in by the habitual morphinist may reach an astonishing figure; 15 grs. a day is said to be common, and some medical writers record quantities such as 60 to 70 grs. in the 24 hours in extreme cases. The early stages of morphinism are marked by moral degeneration; the patient seems to lose all sense of right and wrong, and will lie most plausibly and even thieve to obtain the drug; personal disorderliness, disregard of time, neglect of business and decline of family affection become soon evident. Physical symptoms also appear; the face assumes an earthy colour, the body wastes, constipation is usually present to an extreme degree, the secretions become arrested, loss of appetite and indigestion follow and the mouth is parched. The nails become brittle and the skin dry, sterility shows itself in women and sexual impotence in men. While not directly causing death, morphinism so lowers the bodily powers that the patient is easily carried off by some intercurrent malady. The sudden withdrawal of the drug from a morphine habitué is followed by a train of alarming symptoms. As the time approaches for the usual dose there is marked restlessness, followed by excitement and later by chills, pallor, sinking, nausea, with perhaps vomiting and diarrhoea. Horrible mental depression and melancholia are present, and there may be hallucinations of vision and hearing passing into violent delirium. At this stage collapse may set in, the patient become faint, the limbs twitch, the radical pulse become imperceptible, and unconsciousness supervene. The condition may even go on to a fatal result should morphine be continuously withheld, but injection of even a small quantity of morphine causes these symptoms to cease abruptly. The sudden withdrawal of morphine should therefore never be practised with takers of large quantities of the drug, but gradually diminishing doses given by the physician should be substituted. For the successful treatment of morphinism, complete isolation of the patient is necessary in a place where he is supervised so that he can obtain no morphine. Isolation in a home is far the best, as friends may give way to entreaties and servants be bribed. The "tapering off" of the dose is the best method. Absence from home and strict supervision lasting over a long period, usually a year, are necessary to prevent relapse. The lowered bodily health requires to be built up, and a long sea voyage under adequate supervision is usually recommended.

MORPHOLOGY, (Gr. μορφή, form), a term introduced by Goethe to denote in biology the study of the unity of type in organic form (for which the Linnaean term "Metamorphosis" had formerly been employed). It now usually covers the entire science of organic form. There are numerous restricted senses of the term in various sciences, but here we shall deal with it as a substantive side of zoology and botany.

Historical Outline.—If we disregard such vague likenesses as those expressed in the popular classifications of plants by size into herbs, shrubs and trees, or of terrestrial animals by habit into beasts and creeping things, the history of morphology begins with Aristotle. Founder of comparative anatomy and taxonomy, he established eight great divisions (to which are appended certain minor groups)—*Viviparous Quadrupeds, Birds, Oviparous Quadrupeds and Apoda, Fishes, Malakia, Malacostraca, Entoma,* and *Ostracodermata*—distinguishing the first four groups as *Enaima* ("with blood") from the remaining four as *Anaima* ("bloodless"). In these two divisions we recognize the Vertebrata and Invertebrata of J. B. P. A. Lamarck, the first four groups corresponding with the Mammals, Birds, Reptiles, Fishes, whilst the others agree more loosely with the Cephalopods, Crustacea, Insecta, and Echinoderms with Mollusca other than the Cephalopods. Far from committing the mistake attributed to him of reckoning Bats as Birds, or Cetaceans as Fishes, he discerned the true affinities of both, and erected the latter into a special γένος beside the Viviparous Quadrupeds, more on account of their absence of limbs than of their aquatic habit. Not only is his method inductive, and his groups founded on the aggregate of known characters, but he foreshadows such generalizations as those of the correlation of organs, and of the progress of development from a general to a special form afterwards established by G. L. Cuvier and K. E. von Baer respectively. In the correspondence he suggests between the scales of Fishes and the feathers of Birds, or in that hinted at between the fins of Fishes and the limbs of Quadrupeds, the idea of homology is nascent; and from the compilation of his disciple Nicolaus of Damascus, who regards leaves as imperfectly developed fruits, he seems almost to have anticipated the idea of the metamorphosis of plants. Even after the reappearance of Aristotle's works in the 13th century, little can be recorded but revivals of his conclusions. Monographs on groups of plants and animals frequently appeared, those of P. Belon on Birds and G. Rondelet on Fishes being among the earliest; and in the former of these (1555) we find a comparison of the skeletons of Bird and Man in the same posture and as nearly as possible bone for bone—an idea which, despite the contemporaneous renaissance of human anatomy initiated by Vesalius, disappeared for centuries, unappreciated save by the surgeon Ambroise Paré. B. Palissy, like Leonardo da Vinci before him, discerned the true nature of fossils; and such flashes of insight continued to appear from time to time during the 17th century. Thus, Joachim Jung recognized "the distinction between root and stem, the difference between leaves and foliaceous branches, the transition from the ordinary leaves to the *folia floris*," and W. Harvey anticipated the generalizations of modern embryology by his researches on development and his theory of epigenesis.

The encyclopaedic period of which Gesner is the highest representative was continued by Aldrovandi and others in the 17th century; but, aided by the Baconian movement, then influencing all scientific minds, it developed into one of genuinely systematic aim. At this stage of progress the most important part was taken by John Ray, whose classificatory labours among plants and animals were crowned with success. He first expelled the fabulous monsters and prodigies of which the encyclopaedists had handed on the tradition from medieval times, and succeeded, particularly among plants, in distinguishing many natural groups, for which his own terms sometimes survive—*e.g.* Dicotyledons and Monocotyledons, Umbelliferae and Leguminosae. The true precursor of Linnaeus, he introduced the idea of *species* in natural history, and reformed the practice of definition and terminology. Of the works which followed up Ray's systematic labours, none can be even named until we come to those of his great successor Linnaeus, whose grasp of logical method and lucidity of thought and expression enabled him to reform and reorganize the whole labours of his predecessors into a compact and definite "systema naturae." The very genius of order, he established modern taxonomy, not only by the introduction of the binomial nomenclature and the renovation of descriptive terminology and method, but by the subordination of the species under the successive higher categories of genus, order and class, so reconciling the analytic and synthetic tendencies of his predecessors. Although the classification of plants by the number of their essential organs is highly artificial, it must be remembered that this artificiality is after all only a question of degree, and that he not only distinctly recognized its provisional character but collected and extended those fragments of the natural system with which A. de Jussieu soon afterwards began to build. His classification of animals, too, was largely natural, and, though on the whole he lent his authority to maintain the notion of three kingdoms of nature, he at least at one time discerned the fundamental unity of animals and vegetables, and united them in opposition to the non-living world as *Organisata*. At the same time he was still far more a scholastic naturalist than a modern investigator.

While the artificial system was at the zenith of its usefulness, Bernard de Jussieu was arranging his gardens on the lines afforded by the fragmentary natural system of Linnaeus. His ideas were elaborated by his nephew Antoine de Jussieu, who published diagnoses of the natural orders, so giving the system its modern character. Its subsequent elaboration and definite establishment are due mainly to the labours of Pyrame de

Candolle and Robert Brown. The former concentrated his own long life and that of his son upon a new "systema naturae," the colossal *Prodromus systematis naturalis* (20 vols., 1818–1873), in which 80,000 species were described and arranged. Meanwhile the penetrative genius of Brown enabled him to unravel such structural complexities as those of Conifers and Cycads, Orchids and Proteaceae, thus demonstrating the possibility of ascertaining the systematic position of even the most highly modified floral types. Both Candolle and Brown were thus no mere systematists, but genuine morphologists of the modern school.

The labours of Bernard and Antoine de Jussieu initiated a parallel advance in zoology, the joint memoir on the classification of mammals with which Cuvier and Geoffroy St-Hilaire almost began their career receiving its dominant impulse from the "genera" of Antoine. Cuvier's works correspond in zoology to those of the whole period from the Jussieus to Brown, and epitomize the results of that line of advance. Although in some respects preceded by A. von Haller and J. Hunter, who compared, though mainly with physiological aim, the same parts in different organisms, and much more distinctly by Vicq d' Azyr, the only real comparative anatomist of the 18th century, he opens the era of detailed anatomical research united with exact comparison and clear generalization. The *Règne animal* (1817) and the theory of types (vertebrate, molluscan, articulate, and radiate) are the results of this union of analysis and synthesis and mark the reconstitution of taxonomy on a new basis, henceforth to be no longer a matter of superficial description and nomenclature but a complete expression of structural resemblances and differences. In Germany, L. H. Bojanus, J. F. Meckel, C. T. E. von Siebold and Johannes Müller, with his many pupils, carried on the work; in France, too, a succession of brilliant anatomists, such as A. De Quatrefages, A. Milne-Edwards and H. de Lacaze-Duthiers, were his intellectual heirs; and in England he has been admirably represented by Sir R. Owen.

It is now necessary to return to Linnaeus, whose more speculative writings contain, though encumbered by fantastic hypotheses, the idea of floral metamorphosis. About the same time, and quite independently, C. F. Wolff, the embryologist, stated the same theory with greater clearness, for the first time distinctly reducing the plant to an axis bearing appendages—the vegetative leaves—which become metamorphosed into bud-scales or floral parts through diminution of vegetative force. Thirty years later the same view was again independently developed by Goethe in his now well-known pamphlet (*Versuch die Metamorphose der Pflanzen zu erklären*, Gotha, 1790). In this brilliant essay the doctrine of the fundamental unity of floral and foliar parts is clearly enunciated, and supported by arguments from anatomy, development and teratology. All the organs of a plant are thus modifications of one fundamental organ—the leaf—and all plants are in like manner to be viewed as modifications of a common type—the *Urpflanze*. Whether, as some historians hold, his "Urpflanze" was a mere ideal archetype, bringing forth as its fruit the innumerable metaphysical abstractions of the Naturphilosophie, and leading his countrymen into all the extravagances of that system; or whether, as E. H. Haeckel maintains, it represented a concrete ancestral form, so anticipating the view of modern evolutionists, it is certain that to him F. W. S. von Schelling was indebted for the foundation upon which he erected his philosophic edifice, as also that Goethe shared the same ideas. It must be remembered that he lived and made progress for forty years after the publication of this essay, that he was familiar with the whole scientific movement, and warmly sympathized with the evolutionary views of Lamarck and Geoffroy St-Hilaire; it is not therefore to be wondered at that his writings should furnish evidence in favour of each and every interpretation of them. His other morphological labours must not be forgotten. Independently of Vicq d' Azyr, he discovered the human premaxillary bone; independently of L. Oken, he proposed the vertebral theory of the skull; and before S. C. Savigny, he discerned that the jaws of insects were the limbs of the head.

In 1813 A. P. de Candolle published his *Théorie élémentaire de la botanique*, which he developed into the classic *Organographie végétale* (1827). He established his theory of symmetry, reducing all flowers to "symmetrical" groupings of appendages on an axis and accounting for their various forms by cohesion and adhesion, by arrested or excessive development. The next advance was the investigation by W. P. Schimper and A. Braun of *phyllotaxis*—the ascending spiral arrangement of foliar and floral organs—thus further demonstrating their essential unity.

The term *morphology* was first introduced by Goethe in 1817, in a subsequent essay (*Zur Naturwissenschaft überhaupt, besonders zur Morphologie*). It did not come into use in botany until its popularization by Auguste de St-Hilaire in his *Morphologie végétale* (1841), and in zoology until later, although De Blainville, who also first employed the term *type*, had treated the external forms of animals under "morphologie." Though the Naturphilosophie of Schelling and its countless modifications by his followers, its mystic theories of "polarization" and the like, its apparatus of assumption and abstraction, hypothesis and metaphor, cannot here be discussed, its undoubted services must not be forgotten, since it stimulated innumerable reflective minds to the earnest study of natural science, gave a powerful impulse to the study of comparative anatomy and vindicated the claims of philosophic synthesis over those of analytic empiricism. Among its many adherents, some are of more distinctly theological type; others metaphysical, others mystical or poetic, others, again, more especially scientific; but its most typical and picturesque figure is Lorenz Oken, who epitomizes alike the best and the worst features of the school, and among whose innumerable pseudo-morphological dreams there occasionally occurred suggestions of the greatest fruitfulness—notably, for instance, the independent statement of the vertebral theory of the skull.

By far the most distinguished anatomist of the transcendental school is Geoffroy St-Hilaire, who being comparatively free from the extravagances of Oken, and uniting a depth of morphological insight scarcely inferior to that of Goethe with greater knowledge of facts and far wider influence and reputation in the scientific world, had greater influence on the progress of science than either. He started from the same studies of anatomical detail as Cuvier, but, influenced by Buffon's view of unity of plan and by the evolutionary doctrines of Lamarck, diverged into new lines, and again reached that idea of serial homology of which we have so frequently noted the independent origin. His greatest work, the *Philosophie anatomique* (1818–1823), contains his principal doctrines. These are: (1) the theory of unity of organic composition, identical in spirit with that of Goethe; (2) the theory of analogues, according to which the same parts, differing only in form and in degree of development, should occur in all animals; (3) the "principe des connexions," by which similar parts occur everywhere in similar relative positions; and (4) the "principe du balancement des organes," upon which he founded the study of teratology, and according to which the high development of one organ is allied to diminution of another. The advance in morphological theory is here obvious; unfortunately, however, in eager pursuit of often deceptive homologies, he wandered into the transcendentalism of the Naturphilosophie, and seems utterly to have failed to appreciate either the type theory of Cuvier or the discoveries of Von Baer. He defended Buffon's and Bonnet's earlier view of unity of plan in nature; and the controversy reached its climax in 1830, when he maintained the unity of structure in Cephalopods and Vertebrates against Cuvier before the Academy of Sciences. On the point of fact he was of course utterly defeated; the type theory was thenceforward fully accepted and the Naturphilosophie received its death-blow. Such was the popular view; only a few, like the aged Goethe, whose last literary effort was a masterly critique of the controversy, discerned that the very reverse interpretation was the deeper and essential one, that a veritable "scientific revolution" was in progress, and that the supremacy of homological and synthetic over descriptive and analytic studies was thenceforward assured. The irreconcilable feud between the two leaders really involved a reconciliation for their followers; theories of homological anatomy had thenceforward to be strictly subjected to anatomical and embryological verification, while anatomy and embryology acquired a homological aim. This union of the solid matter and rigorous method of Cuvier with the generalizing spirit and philosophic aims of Geoffroy is well illustrated in the works of Owen.

The further evolution of the idea of homology is sketched below, while the extent and rapidity of the subsequent progress of the knowledge of all the structural aspects of plants and animals alike make a historical survey impossible up to the appearance of the *Origin of Species* (1859). The needful solution was effected by Darwin. The "Urpflanze" of Goethe, the types of Cuvier, and the like, at once became intelligible as schematic representations of ancestral organisms, which in various and varying environments, have undergone differentiation into the vast multitude of existing forms. All the enigmas of structure become resolved; "representative" and "aberrant," "progressive" and "degraded," "synthetic" and "isolated," "persistent" and "prophetic" types no longer baffle comprehension; conformity to type represented by differentiated or rudimentary organs in one organism is no longer contradicted by their entire disappearance in its near allies, while systematist and morphologist become related simply as specialist and generalizer, all through this escape from the Linnaean dogma of the fixity of species. The phenomena of individual development receive interpretation in terms of ancestral history; and embryology thus becomes divided into ontogeny and phylogeny—the latter, too, coming into intimate relation with palaeontology—while classification seeks henceforth the reconstruction of the genealogical tree. All these results were clearly developed in Haeckel's *Generelle Morphologie* (1866), while the valuable contemporaneous *Principles of Biology* of Herbert Spencer also gave special attention to the relation of morphology to physiology.

Individuality.—Probably no subject in the whole range of biology has been more extensively discussed than that of the nature of organic individuality. The history of the controversy is of interest, since besides leading up to solid results it serves, perhaps better than any other case, to illustrate the slow emergence of the natural sciences from the influence of scholastic thought. Starting from the obvious unity and indivisibleness of Man and other higher animals, and adopting some definition such as that of C. F. B. Mirbel, "Tout être organisé, complet dans ses parties, distinct et séparé des autres êtres, est un individu," it was attempted times without number to discover the same conception elsewhere in nature, or rather to impose it upon all other beings, plants and animals alike. The results of different inquirers were of course utterly discrepant. It seemed easy and natural to identify a tree or herb corresponding to the individual animal, yet difficulties at once arose. Many apparently distinct plants may arise from a common root, or a single plant may be decomposed into branches, twigs, shoots, buds or even leaves, all often capable of separate existence. These, again, are decomposable into tissues and cells, the cells into nucleus, &c., and ultimately into protoplasmic molecules, these finally into atoms—the inquiry thus passing outside organic nature altogether and meeting the old dispute as to the ultimate divisibility of matter. In short, as Haeckel remarks, scarcely any part of the plant can be named which has not been taken by some one for the individual. It is necessary, therefore, briefly to notice some of the principal works on the subject, and these may conveniently be taken in descending order.

While H. Cassini practically agreed with Mirbel in attempting to regard separate plants as individuals, the widest interpretation of the individual is that of G. Gallesio (1816), who proposed to regard as an individual the entire product of a single seed, alike whether this developed into a uni-axial plant extended continuously like a banyan, or multiplied asexually by natural or artificial means like the weeping-willow or the Canadian pondweed, of each of which, on this view, there is only a single individual in Britain, happily discontinuous.

At once the oldest and most frequently maintained view is that which regards the bud or shoot consisting of a single axis with appendages as the plant-individual, of which the tree represents a colony, like a branched hydroid polyp. This conception, often attributed to Aristotle, but apparently without foundation, appears distinctly in the writings of Hippocrates and Theophrastus—the latter saying, "The bud grows on the tree like a plant in the ground." The aphorism of Linnaeus, "Gemmae totidem herbae," is well known; and in this view C. F. Wolff and Humboldt concurred, while Erasmus Darwin supported it by an appeal to the facts of anatomy and development. The most influential advocate of the bud theory during the first half of the 19th century was, however, Du Petit-Thouars, who, although starting much as usual with a "principe unique d'existence," supported his theory on extensive though largely incorrect observations on stem structure and growth. For him the tree is a colony of *phytons*, each being a bud with its axillant leaf and fraction of the stem and root. Passing over numerous minor authors, we come to the central work of Alex. Braun (1853), in which, as Sachs has clearly pointed out, the illegitimate combination of Naturphilosophie with inductive morphology reaches its extreme. He reviews, however, all preceding theories, admits the difficulty of fixing upon any as final, since the plant, physiologically considered, is rather a *dividuum* than an *individuum*, and proposes as a compromise, or indeed as a partial cutting of the knot, the adoption of the shoot, as the morphological individual, comparable to an animal, especially because, unlike the cell, leaf, &c., it includes all the representative characters of the species. Darwin and Spencer on the whole also accept the bud or shoot as at any rate the most definite individual.

The theory of metamorphosis naturally led Goethe, Oken and others to regard the leaf as the individual, while Johannes Müller, J. J. S. Steenstrup and others adopted the same view on various physiological grounds. C. Gaudichaud elaborated a theory intermediate between this view and that of Du Petit-Thouars, according to which the plant was built up of individuals, each consisting of a leaf with its subjacent internode of stem, which was regarded as the leaf-base, and this was supported by Edward Forbes and others, while the nominally converse view—that of the leaf as a mere outward expansion of the stem-segment—was proposed by C. F. Hochstetter.

Though sundry attempts at identifying various tissues, such as the fibro-vascular bundles, as the constituent individuals may be passed over, those associated with the cell theory are of great importance. T. Schwann decided in favour of the cell and regarded the plant as a cell-community, in which the separate elements were like the bees of a swarm—a view virtually concurred in in all essential respects by M. Schleiden, R. Virchow and other founders of the cell theory. Yet, although the structure and functions of the plant are ultimately and specially cellular, it is impossible to ignore the fact that, save in the very lowest organisms, these are subordinated and differentiated into larger aggregates, and form virtually but the bricks of a building, and hence the later theories outlined above. Of attempts to find the individual in the nucleus or the protoplasm granules it is unnecessary to speak further.

So far the theories of absolute individuality. The conception of relative individuality was first clearly expressed by Alphonse de Candolle and Schleiden, both of whom take the cell, the shoot and the multi-axial plant as forming three successive and subordinated categories. K. W. von Nägeli too recognized not only the necessity of establishing such a series (cell, organ, bud, leafy axis, multi-axial plant) but the distinction between morphological and physiological individualities afterwards enunciated by Haeckel.

Passing over the difficulties which arise even among the Protozoa we find that a similar controversy (fully chronicled in Haeckel's *Kalkschwämme*) has raged over the individuality of sponges. While the older observers were content to regard each sponge-mass as an individual, a view in which J. N. Lieberkühn and other monographers substantially concurred, the application of the microscope led to the view suggested by James Clark, and stoutly supported by Saville Kent, that the sponge is a city of amoeboid or infusorian individuals. H. J. Carter looked upon the separate ampullaceous sacs as the true individuals, while others, defining the individual by the possession of a single exhalent aperture, distinguish sponges into solitary and social.

For the higher animals the problem, though perhaps really even more difficult, is less prominent. As Haeckel points out, the earlier discussions and even the comparatively late essay of Johannes Müller take an almost purely psychological or at least a physiological point of view; and the morphological aspect of the inquiry only came forward when the study of much lower forms, such as Cestoid worms (see PLATYELMIA) or Siphonophores (see HYDROZOA), had raised the difficulties with which botanists had so long been familiar. With the rapid progress of embryology, too, arose new problems; and in 1842 Streenstrup introduced the conception of an "alternation of generations" as a mode of origin of distinct individuals by two methods, for him fundamentally similar, the sexual from impregnated females and the asexual from unimpregnated "nurses"—a view adopted by Edward Forbes and many other naturalists, but keenly criticized by W. B. Carpenter and T. H. Huxley. In R. Leuckart's remarkable essay on polymorphism (1853) the Siphonophora were analysed into colonies, and their varied organs shown to be morphologically equivalent, while the alternate generations of Steenstrup were reduced to a case of polymorphism in development. Leuckart further partly distinguished individuals of different orders, as well as between morphological and physiological individuals.

In 1852 Huxley, starting from such an undoubted homology as that of the egg-producing process of *Hydra* with a free-swimming Medusoid, pointed out that the title of individual, if applied to the latter, must logically be due to the former also, and avoided this confusion between organ and individual by defining the individual animal, as Gallesio had done the plant, as the entire product of an impregnated ovum—the swarm of Aphides or free Medusae which in this way might belong to a single individual being termed *Zooids*.

In Carus's *System of Animal Morphology* (1853) another theory was propounded, but the problem then seems to have fallen into abeyance until 1865, when it formed the subject of a prolonged and fruitful discussion in the *Principles of Biology*. Adopting the cell (defined as an aggregate of the lowest order, itself formed of physiological units) as the morphological unit, H. Spencer points out that these may either exist independently, or gradually exhibit unions into aggregates of the second order, like the lower Algae, of which the individuality may be more or less pronounced. The union of such secondary aggregates or compound units into individuals of a yet higher order is then traced through such intermediate forms as are represented by the higher seaweeds or the liverworts, from the thallus of which the axes and appendages of Monocotyledons and Dicotyledons are ingeniously derived. The shoot of a flowering plant is thus an aggregate of the third order; it branches into an aggregate of the fourth or higher order, and finally as a tree "acquires a degree of composition too complex to be any longer defined." Proceeding to animals, the same method is applied. The Protozoa are aggregates of the first order. These, like plants, exhibit transitions, of which Radiolarians, Foraminifera and sponges are taken as examples, to such definite compound wholes as *Hydra*; and such secondary aggregates multiply by gemmation into permanent aggregates of the third order, which may exhibit all degrees of integration up to that of the Siphonophora, where the individualities of the Polyps are almost lost in that of the aggregate form. The whole series of articulated animals are next interpreted as more or less integrated aggregates of the third order, of which the lower Annelids are the less developed forms, the Arthropods the more highly integrated and individualized. Molluscs and vertebrates are regarded as aggregates of the second order.

In 1866 appeared a morphological classic, the *Generelle Morphologie* of Haeckel. Here pure morphology is distinguished into two sub-sciences—the first purely structural, *tectology*, which regards the organism as composed of organic individuals of different orders; the second essentially stereometric, *promorphology*. To tectology, defined as the science of organic individuality, a large section of the work is devoted. Dismissing the theory of absolute individuality as a metaphysical figment, and starting from the view of Schleiden, De Candolle and Nägeli of several successive categories of relative individuals, he distinguishes more clearly than heretofore the physiological individual (or *bion*), characterized by definiteness and independence of function, from the morphological individual (or *morphon*), characterized similarly by definiteness of form; of the latter he establishes six categories, as follows:—

1. *Plastides* (cytodes and cells), or elementary organisms.
2. *Organs* (cell-stocks or cell-fusions), simple or homoplastic organs (tissues), or heteroplastic organs. Organ-systems, organ-apparatuses.
3. *Antimeres* (opposite or symmetrical or homotypic parts), *e.g.* rays of radiate animals, "halves of bilaterally symmetrical animals."
4. *Metameres* (successive or homodynamous parts), *e.g.* stem-segments of Phanerogams, segments or zoonites of Annelids or vertebrates.
5. *Personae*, shoots or buds of plants, polyps of Coelenterates, &c., "individuals" in the narrowest sense among the higher animals.
6. *Corms* (stocks or colonies), *e.g.* trees, chains of Salpae, polyp-stocks, &c.

In his subsequent monograph on calcareous sponges, and in a final paper, he somewhat modifies these categories by substituting one category of extreme comprehensiveness, that of the *idorgan*, in place of the three separate orders of organs, antimeres and metameres. The idorgan (of course clearly distinguished from the physiological organ or biorgan) is finally defined as a morphological unit consisting of two or more plastids, which does not possess the positive character of the person or stock. These are distinguished into *homoplasts* or *homo-organs* and *alloplasts* or *alloe-organs*, the former including, as subdivisions, plastid-aggregates and plastid-fusions, the latter idomeres, antimeres and metameres. The former definition of the term antimere, as denoting at once each separate ray of a radiate, or the right and left halves of a bilaterally symmetrical animal, is corrected by terming each ray a *paramere*, and its symmetrical halves the antimeres. Thus an ordinary Medusoid has four parameres and eight antimeres, a starfish five and ten. The conception of the persona is largely modified, not only by withdrawing the comparison of the animal with the vegetable shoot and by omitting the antimere and metamere as necessary constituents, but by taking the central embryonic form of all the Metazoa—the gastrula (fig. 1) and its assumed ancestral representative, the gastraea—as the simplest and oldest form of persona. The different morphological stages to which it may attain are classified into three series: (1) Monaxonial inarticulate personae, *i.e.* uniaxial and unsegmented without antimeres or metameres, as in sponges or lowest Hydroids; (2) Stauraxonial inarticulate personae with antimeres, but without metameres, *e.g.* coral, medusa, turbellarian, trematode, bryozoon; (3) Stauraxonial articulate personae with antimeres and metameres, *e.g.* annelids, arthropods, vertebrates. The colonies of protozoa are mere idorgans. True corms, composed of united personae, occur only among sponges, hydroids, siphonophores, corals, bryozoa, tunicates and echinoderms, of which the apparent parameres are regarded as highly centralized personae of a radially budded worm colony; and these can be classified according to the morphological rank of their constituent personae. They usually arise by gemmation from a single persona, yet in sponges and corals occasionally by fusion of several originally distinct persons or corms. The theory of successive subordinate orders of individuality being thus not only derived from historical criticism of previous theories but brought into conformity with the actual facts of development and descent—various groups of organisms being referred to their several categories—the remaining problem of tectology, that of the relation of the morphological to the physiological individuality, is finally discussed. Of the latter, three categories are proposed: (1) the "actual bion or complete physiological individual," this being the completely developed organic form which has reached the highest grade of morphological individuality proper to it as a representative of, *e.g.* its species; (2) the "virtual bion or potential physiological individual," including any incompletely developed form of the former from the ovum upwards; and (3) the "partial bion or apparent physiological individual," such fragments of the actual or virtual bion as may possess temporary independence without reproducing the species—this latter category having, however, inferior importance.

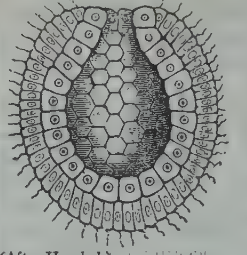
(After Haeckel.)

FIG. 1.—Gastrula in optical section, showing primitive opening and digestive cavity (blastopore and arch-enteron), as also outer and inner layers, ectoderm and endoderm.

Haeckel's theory, indeed in its earlier form, has been adopted by C. Gegenbaur and other morphologists, also in its later form by G. Jäger, who, however, rejects the category of idorgan on the ground of the general morphological principle that every natural body which carries on any chemical changes with its environment becomes differentiated into more or less concentric layers; but the subject, especially as far as animals are concerned, was again discussed in a large work by E. Perrier. Starting from the cell or plastid, he terms a permanent colony a *méride*, and these may remain isolated like *Sagitta* or Rotifer, or may multiply by gemmation to form higher aggregates which he terms *zoides*. Such zoides may be irregular, radiate or linear aggregates, of which the two former classes especially are termed *demes*. The organ—Haeckel's idorgan—is excluded, since tissues and organs result from division of labour in the anatomical elements of the mérides, and so have only a secondary individuality, "carefully to be distinguished from the individuality of those parts whose direct grouping has formed the organism, and which live still, or have lived, isolated from one another." Perrier further points out that the undifferentiated colonies are sessile, as sponges and corals, while a free state of existence is associated with the concentration and integration of the colony into an individual of a higher order.

So far the various theories of the subject; detailed criticism is impossible, but some synthesis and reconciliation must be attempted. Starting from the cell as the morphological unit, we find these forming homogeneous aggregates in some Protozoa and in the early development of the ovum. But integration into a whole, not merely aggregation into a mass, is essential to the idea of individuality; the earliest secondary unit, therefore, is the gastrula or méride. This stage is permanently represented by an unbranched hydroid or sponge or by a planarian. These secondary units may, however, form aggregates either irregular as in most sponges, indefinitely branched as in the hydroids and actinozoa, or linear as in such planarians as *Catenula*. Such aggregations, colonies or demes, not being aggregated, do not fully reach individuality of the third order. This is attained, however, for the branched series by such forms as Siphonophores among Hydrozoa, or *Renilla* or *Pennatula* among Actinozoa; for linear aggregates again by the higher worms, and still more fully by arthropods and vertebrates. Aggregates of a yet higher order may occur, though rarely. A longitudinally dividing *Nais* or laterally branched *Syllis* are obviously aggregates of these tertiary units, which, on Haeckel's view, become integrated in the Echinoderm, which would thus reach a complete individuality of the fourth order. A chain of Salps or a colony of *Pyrosoma* exhibits an approximation to the same rank, which is more nearly obtained by a radiate group of *Botryllus* around their central cloaca, while the entire colony of such an ascidian would represent the individual of the fifth order in its incipient and unintegrated state—these and the preceding intermediate forms being, of course, readily intelligible, and indeed, as Spencer has shown, inevitable on the theory of evolution.

The exclusion of tissues and organs from rank in this series is thus seen to necessarily follow. Ectoderm and endoderm cannot exist alone; they and the organs into which they differentiate arise merely, as Jäger expresses it, from that concentric lamination, or, with Perrier, from that polymorphism of the members of the colony, which is associated with organic and social existence. The idea of the antimere is omitted, as being essentially a promorphological conception (for a medusoid or a starfish, though of widely distinct order of individuality, is equally so divisible); that of the metamere is convenient to denote the secondary units of a linear tertiary individual; the term persona, however, seems unlikely to survive, not only on account of its inseparable psychological connotations, but because it has been somewhat vaguely applied alike to aggregates of the second and third order; and the term colony, corm or deme may indifferently be applied to those aggregates of primary, secondary, tertiary or quaternary order which are not, however, integrated into a whole, and do not reach the full individuality of the next higher order. The term zooid is also objectionable as involving the idea of individualized organs, a view natural while the medusoid gonophores of a hydrozoon were looked at as evolved of its homologue in *Hydra*, whereas the latter may be a degenerate form of the former. Passing to the vegetable world, here, as before, the cell is the unit of the first order, while aggregates representing almost every stage in the insensible evolution of a secondary unit are far more abundant than among animals. Complete unity of the second order can hardly be allowed to the thallus, which Spencer proposes to compound and integrate into tertiary aggregates—the higher plants; as in animals, the embryological method is preferable, both as avoiding gratuitous hypothesis and as leading to direct results. Such a unit is clearly presented by the embryo of higher plants in which the cell-aggregate is at once differentiated into parts and integrated into a whole. Such an embryo possesses axis and appendages as when fully developed (fig. 2). The latter, however, being as organs mere lateral expansions of the concentric layers into which the plant embryo, like the animal, is differentiated, and so neither stages of evolution nor capable of separate existence, are not entitled to individual rank. The embryo, the bud, shoot or uniaxial plant, all thus belong to the second order of individuality, like the hydroid they resemble. Like the lower coelenterates, too, aggregates of such axes are formed by branching out from their low degree of integration. Such colonies can hardly be termed individuals of the third, much less of higher, order, at least without somewhat abandoning that unity of treatment of plants and animals without which philosophical biology disappears. Individuality of the second order is most fully reached by the flower—the most highly differentiated and integrated form of axes and appendages. Such a simple inflorescence as a raceme or umbel approximates to unity of the third order, to which a composite flower-head must be admitted to have attained while a compound inflorescence is on the way to a yet higher stage.

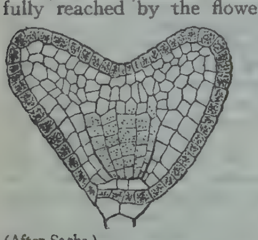
(After Sachs.)

FIG. 2.—Embryo of Dicotyledon, showing incipient axis and appendages, as also the three concentric embryonic layers.

If, as seems probable, a nomenclature be indispensable for clear expression, it may be simply arranged in conformity with this view. Starting from the unit of the first order, the plastid or *monad*, and terming any undifferentiated aggregate a deme, we have a *monad-deme* integrating into a secondary unit or *dyad*, this rising through *dyad-demes*, into a *triad*, this forming *triad-demes*, and these when differentiated becoming *tetrads*, the botryllus-colony with which the evolution of compound individuality terminates being a *tetrad-deme*. The separate living form, whether monad, dyad, triad, or tetrad, requires also some distinguishing name, for which persona will probably ultimately be found most appropriate, since such usage is most in harmony with its inevitable physiological and psychological connotations, while the genealogical individual of Gallesio and Huxley, common also to all the categories, may be designated with Haeckel the *ovum-product* or *ovum-cycle*, the complete series of forms needed to represent the species being the *species-cycle* (though this coincides with the former save in cases where the sexes are separate, or polymorphism occurs). For such a peculiar case as *Diplozoon paradoxum*, where two separate forms of the same species coalesce, and still more for such heterogeneous individuality as that of a lichen, where a composite unit arises from the union of two altogether distinct forms—fungus and alga—yet additional categories and terms are required.

Promorphology.—Just as the physiologist constantly seeks to interpret the phenomena of function in terms of mechanical, physical, and chemical laws, so the morphologist is tempted to inquire whether organic as well as mineral forms are not alike reducible to simple mathematical law. And just as the crystallographer constructs an ideally perfect mathematical form from an imperfect or fragmentary crystal, so the morphologist has frequently attempted to reduce the complex-curved surfaces of organic beings to definite mathematical expression. Canon Moseley (*Phil. Trans.*, 1838) succeeded in showing, by a combination of measurement and mathematical analysis, that the curved surface of any turbinated or discoid shell might be considered as generated by the revolution, about the axis of the shell, of a curve, which continually varied its dimensions according to the law of the logarithmic spiral. For Goodsir this logarithmic spiral, now carved on his tomb, seemed a fundamental expression of organic curvature and the dawn of a new epoch in natural science—that of the mathematical investigation of organic form—and his own elaborate measurements of the body, its organs, and even its component cells seemed to yield, now the triangle, and again the tetrahedron, as the fundamental form. But such supposed results, savouring more of the Naturphilosophie than of sober mathematics, could only serve to discourage further inquiry and interest in that direction. Thus we find that even the best treatises on botany and zoology abandon the subject, satisfied with merely contrasting the simple geometrical ground-forms of crystals with the highly curved and hopelessly complicated lines and surfaces of the organism.

But there are other considerations which lead up to a mathematical conception of organic form, those namely of symmetry and regularity. These, however, are usually but little developed, botanists since Schleiden contenting themselves with throwing organisms into three groups—first, absolute or regular; second, regular and radiate; third, symmetrical bilaterally or zygomorphic—the last being capable of division into two halves only in a single plane, the second in two or more planes, the first in none at all. H. C. C. Burmeister, and more fully H. G. Bronn, introduced the fundamental improvement of defining the mathematical forms they sought not by the surfaces but by axes and their poles; and Haeckel has developed the subject with an elaborateness of detail and nomenclature which seems unfortunately to have impeded its study and acceptance, but of which the main results may, with slight variations chiefly due to Jäger (*Lehrb. d. Zool.* i. 283), be briefly outlined.

A. *ANAXONIA*: Forms destitute of axes, and consequently wholly irregular in form, *e.g.* Amoebae and many sponges.

B. *AXONIA*: Forms with definite axes.

I. HOMAXONIA, all axes equal.

(*a*) Spheres, where an indefinite number of equal axes can be drawn through the middle point, *e.g. Sphaerozoum*.

(*b*) Polyhedra, with a definite number of like axes.

Of these a considerable number occur in nature, for example, many radiolarians (fig. 3), pollen-grains, &c., and they are again classifiable by the number and regularity of their faces.

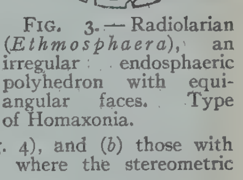
FIG. 3.—Radiolarian (*Ethmosphaera*), an irregular endosphaeric polyhedron with equiangular faces. Type of Homaxonia.

II. PROTAXONIA, where all the parts are arranged round a main axis, and of these we distinguish—

1. *Monaxonia*, with not more than one definite axis. Here are distinguished (*a*) those with similar poles, spheroid (*Coccodiscus*) and cylinder (*Pyrosoma*) and (*b*) those with dissimilar poles, cone (*Conulina*).

2. *Stauraxonia*, where, besides the main axes, a definite number of secondary axes are placed at right angles, and the stereometric ground-form becomes a pyramid. Here, again, may be distinguished (*a*) those with poles similar, *Stauraxonia homopola*, where the stereometric form is the double pyramid (fig. 4), and (*b*) those with poles dissimilar, *Stauraxonia heteropola*, where the stereometric form is the single pyramid, and where we distinguish a basal, usually oral, pole from an apical, aboral or anal pole. The bases of these may be either regular or irregular polygons, and thus a new classification into *Homostaura* and *Heterostaura* naturally arises.

The simpler group, the Homostaura, may have either an even or an odd number of sides, and thus among the Homostaura we have even-sided and odd-sided, single and double pyramids. In those Homostaura with an even number of sides, such as medusae, the radial and inter-radial axes have similar poles; but in the series with an odd number of sides, like most echinoderms, each of the transverse axes is half radial and half semi-radial (fig. 5). Of the group of regular double pyramids the twelve-sided pollen-grain of *Passiflora* (fig. 4) may be taken as an example, having the ground-form of the hexagonal system, the hexagonal dodecahedron. Of the equal even-sided single pyramids (Heteropola homostaura), *Alcyonium*, *Geryonia*, *Aurelia* may be taken as examples of the eight-sided, six-sided, and four-sided, pyramids while those with an odd number of sides may be illustrated by *Ophiura* or *Primula* with five sides, and the flower of lily or rush with three sides.

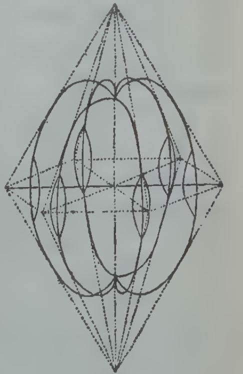
FIG. 4.—Pollen of Passion Flower, as example of Stauraxonia homopola. Ground-form a regular double pyramid of six sides.

In the highest and most complicated group, the Heterostaura, the basal polygon is no longer regular but amphithect (ἀμφιθηκτso =double-edged). Such a polygon has an even number of sides, and can be divided into symmetrical halves by each of two planes intersecting at right angles in the middle point, and thus dividing the whole figure into four congruent polygons. The longer of these axes may be termed lateral, the shorter the equatorial or dorso-ventral; and these two axes, along with the main axes, always define the three dimensions of space. Ctenophores (fig. 6) furnish examples of eight-sided amphithect pyramids, some Madrepore Corals of six-sided, Crucifers, some Medusae, and Cestodes of four-sided amphithect pyramids.

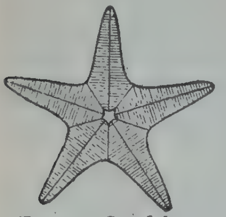
FIG. 5.—Starfish, an example of Heteropola homostaura. Ground-form a regular single pyramid of five sides.

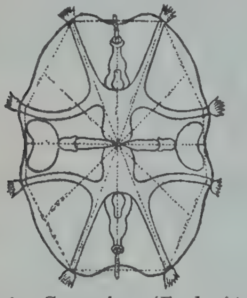
FIG. 6.—Ctenophore (*Eucharis*). Ground-form an eight-sided double amphithect pyramid.

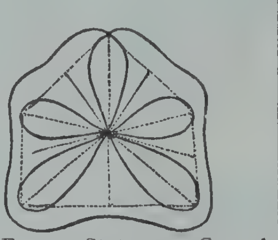
FIG. 7.—*Spatangus*. Ground form a five-sided half amphithect pyramid.

In these forms the poles of the dorso-ventral and lateral axes are similar, and, as in the preceding Monaxonia and Stauraxonia, the centre of the body is defined by a line; and they are therefore termed *Centraxonia*, while the Protaxonia which are defined by their central point are called *Centrostigma*. There are, however, other forms, and these the most complicated, in which the poles of at least the dorso-ventral axis are unlike, and in which the body is thus defined not with reference to a line but to a median plane, and these have accordingly received the name of *Centropipeda*. Their ground-form is a polygon with an even number of sides, which can only be divided into two symmetrical halves by the one median plane. It can be obtained by halving an amphithect pyramid of double the number of sides, and is consequently termed a half amphithect pyramid (fig. 7). The whole amphithect pyramid may be most conveniently obtained by the reduplication of the ground-form as if in a mirror. Of half amphithect pyramids there are again two forms, termed by Haeckel *Amphipleura* and *Zygopleura*, the former including the "bilaterally symmetrical" or irregularly radiate forms of previous authors, such as *Spatangus Viola*, *Orchis*, while the Zygopleura include forms bilaterally symmetrical in the strictest sense, in which not more than two radial planes, and these at right angles to each other, are present. The sterometric ground-form is a half rhombic pyramid. Haeckel again divides these, according to the number of antimeres, into *Tetrapleura* and *Dipleura*.

Promorphology has thus shown that the reigning dogma of the fundamental difference of organic and mineral forms is false, and that a crystallography of organic forms is possible—the form of the cell or the cell-aggregate differing from the crystal merely by its more or less viscous state of aggregation, its inherited peculiarities, and its greater adaptability to the environment. The classification into *bilateral* and *radiate* forms which usually does duty for more precise promorphological conceptions must be abandoned as hopelessly confusing essentially different forms, or at least must be rigidly restricted—the term radial to regular and double pyramids, the term bilateral to the Centropipeda if not indeed to dipleural forms. Similarly the topographical and relative terms, anterior and posterior, upper and under, horizontal and vertical, must be superseded by the terms above applied to the axes and their poles, oral and aboral, dorsal and ventral, right and left.

Nature of Morphological Changes.—The main forms of organic structure being analysed and classified and their stage of individuality being ascertained, the question next arises, by what morphological changes have they arisen, and into what categories can these modes of differentiation be grouped? They at first sight seem innumerable, yet in reality are few. Goethe somewhat vaguely generalized them for the flower as ascending and descending metamorphosis, expansion and contraction of organs, &c.; but the first attempt at careful enumeration seems to be that of Auguste de St Hilaire, who recognized defects of development, adherences, excesses of production or "dédoublements," metamorphosis and displacement of organs. Subsequent authors have variously treated the subject; thus Asa Gray enumerates as modifications of the flower—coalescence, adnation, irregularity, abortion, non-alternation or anteposition, multiplication, enation, unusual development of the axis, and other morphological modifications connected with fertilization. These are obviously too numerous, as may be best shown by a single comparison with the view of an animal morphologist. Thus Huxley, in discussing the arrangement of the Vertebrata, recognizes only three processes of modification, not only in the ancestral evolution of the *Equidae*, but in the individual development of animals generally; these are "(1) excess of development of some parts in relation to others, (2) partial or complete suppression of certain parts, (3) coalescence of parts originally distinct." The particular form of excess of development which results in the repetition of parts, and the morphological changes due to partial or complete fusion of such repeated parts receive special treatment in the article METAMERISM.

Nature of Morphological Correspondence—Categories of Homology.—To indicate all the steps by which the idea of morphological resemblance has been distinguished from that of physiological would be to examine the whole history of morphology; it must suffice to discuss the terminology of the subject which has, as ever, served not only as an index but as an engine of progress. For these two distinct forms of resemblance the terms *homology* and *analogy* gradually became specialized, and were finally established and clearly defined by Owen in 1843—"the former as the same organ in different animals under every variety of form and function (*e.g.* fore-limbs of *Draco volans* and wings of Bird); the second as a part or organ in one animal which has the same function as another part or organ in a different animal (*e.g.* parachute of *Draco* and wings of Bird)." He further distinguishes three kinds of homology: (1) *special*, being "that above defined, namely, the correspondence of a part or organ determined by its relative position and connexions with a part or organ in a different animal, the determination of which homology indicates that such animals are constituted on a common type," *e.g.* basilar process of human occipital with basi-occipital of fish; (2) *general*, that "higher relation in which a part or series of parts stands to the fundamental or general type, involving a knowledge of the type on which the group in question is constituted," *e.g.* the same human bone and centrum of the last cranial vertebra; (3) *serial* homology, "representative or repetitive relation in the segments of the same skeleton" (demonstrated when general and special homologies have been determined); thus usually the basi-occipital and basi-sphenoid are "homotypes." These terms were henceforth accepted by naturalists; but the criterion of analogy and homology became for L. Agassiz and other embryologists developmental as well as comparative, reference to the ideal archetype becoming less and less frequent. Passing over the discussions of L. Agassiz and Bronn, of which the latter is criticized and partly incorporated by Haeckel, we find the last-named (1) placing serial under general homology; (2) erecting categories of homology partially corresponding to those of individuality—(*a*) *homotypy* (of antimeres), hence distinct from that of Owen, (*b*) *homodynamy* (of metameres), (*c*) *homonomy* (of parts arranged on transverse axes); (3) defining special homology in terms of identity of embryonic origin. In 1870 this latter point was more fully insisted upon by Ray Lankester, who, decomposing it into two others, proposed to supersede the term homology by *homogeny*, being the correspondence of common descent, and *homoplasy*, denoting any superinduced correspondence of position and structure in parts embryonically distinct. Thus, the fore-limb of a mammal is *homogenous* with that of a bird, but the right and left ventricles of the heart in both are only *homoplastic*, these having arisen independently since the divergence of both groups from a uni-ventriculate ancestor in relation to similarity of physiological needs. St G. Mivart next proposed to retain homology as a generic term, with homogeny and homoplasy as two species under it, and carried the analysis into great detail, distinguishing at first twenty-five, but later fifteen, kinds of correspondence: (1) parts similar in function only, *e.g.* legs of lizard and lobster; (2) parts similar both in function and relative position, wings of bat and bird; (3) parts of common descent, fore-limb of horse and rhinoceros; (4) parts of similar embryonic origin, whatever be their racial genetic relations, *e.g.* occipitals of panther and perch; (5) parts of dissimilar embryonic origin, whatever be their racial genetic relations, *e.g.* legs of Diptera; (6, 7, 8, 9, 10) laterally, vertically, serially, antero-posteriorly and radially homologous parts; (11) subordinate serial homologues, *e.g.* joints of antenna; (12 and 13) secondary and tertiary subordinate serial homologues; (14 and 15) special and general homologies (in Owen's sense). In his *Kalkschwämme* Haeckel proposed to term *homophyly* the truly phylogenetic homology in opposition to *homomorphy*, to which genealogic basis is wanting; and finally Von Jhering has published a repetition of Lankester's view.

In this discussion, as in that of individuality, it is evident that we are dealing with numerous logical cross-divisions largely corresponding, no doubt, to the complex web of inter-relations presented by nature, yet remaining in need of disentanglement. Though we must set aside analogies of functional activity, the resemblances in external shape or geometric ground-form which correspond to these, *e.g.* Hydrozoa and Bryozoa, Fishes and Cetaceans, mimetic organisms, are nevertheless, as our historic survey showed, the first which attract attention; and these homoplastic or homomorphic forms, as Haeckel has shown, come as fairly within the province of the promorphologist as do isomorphic crystals within that of his an-organological colleague the crystallographer. Here, too, would be considered "radial," "vertical," "lateral" homology, "homotypy of antimeres," and all questions of symmetry, for which Haeckel's nomenclature of *homaxonial*, *homopolic*, &c., is distinctly preferable. Entering the field of tectology or morphology in the ordinary sense, we may next consider whether two organisms compared are of the same category of individuality—are *homocategoric*; and under this serial homology, for instance, would come as a minor division, the correspondence between the units or parts of units of a linear dyad-deme or triad. From a third point of view, that of the embryologist, we trace the development of each multicellular organism (1) from the embryonic layers and systems into which the secondary unit (gastrula or plant embryo) differentiates, (2) from a unit-deme or unit of the inferior order or orders of individuality. The parts and units thus recognized by ontogenetic research, respectively or successively *homodermic*, *homosystemic* and *homodemic*, may then conveniently be termed (indifferently save for considerations of priority) either "specially homologous," "homogenous," "homophylic," or "homogenetic," in the language of phylogenetic theory. These three great classes of morphological correspondence—promorphological, tectological and embryological—may or may not coincide. But the completest homology, in which all forms of resemblance unite and from which they differentiate, is that expressed in the cell theory, or rather in that ovum theory which underlies it, and which Agassiz therefore not unjustly regarded as "the greatest discovery in the natural sciences of modern times."

Orientation and Subdivisions of Morphology.—The position of morphology in the classification of the sciences and the proper mode of subdividing it cannot be discussed within these limits, although the latter is especially the subject of much disagreement. The position above assumed, that of including under morphology the whole statical aspects of the organic world, is that of Haeckel, Spencer, Huxley and most recent animal morphologists; botanists frequently, however, still use the term under its earlier and more limited significance (see Plants: *Morphology*).

(P. Ge.; P. C. M.)

MORPHY, PAUL CHARLES (1837–1884), American chess player, was born in New Orleans, Louisiana, on the 22nd of June 1837, the son of Alonzo Morphy (1798–1856) and his wife, whose maiden name was Le Carpentier. The father, the son of a well-to-do Spanish immigrant, was a prominent jurist and legislator and, like his brother Ernest, passionately fond of chess. Learning the moves from his father at the age of ten, Paul gave evidence of such extraordinary precocity that in less than two years he was able to defeat all the amateurs of his native city. While still at school he competed successfully with such strong players as Eugène Rousseau and the Hungarian master J. Löwenthal. He attended the Jesuit college of St Joseph at Spring Hill, Alabama, and applied himself to the study of the law, being admitted to the bar of Louisiana in 1858. During the autumn of 1857 he took part in the first American chess congress at New York, winning the first prize from sixteen competitors, including the well-known L. Paulsen. Morphy went to Europe in the spring of 1858 and entered upon a series of triumphs, both in regular matches and in blindfold play, that proved him to be one of the best players of the time. The winter of 1858–1859 was passed in Paris, where he was destined to gain his greatest triumphs, practically winning the championship of the world by beating Adolf Anderssen, champion of Germany, by a score of 7–2, with two games drawn. Another feat was his simultaneous blindfold match against eight strong French players, six of whom he defeated. At this time he was in his twenty-second year. Returning to the United States in 1859, he intended to establish himself in the practice of the law at New Orleans, but the outbreak of the Civil War frustrated these plans. His devotion to chess had already begun to affect his health. He spent the year 1863 in Paris, returning to New Orleans in 1864, but his health was now permanently impaired. He became insane, and at last he died in New Orleans in 1884.

See *Exploits and Triumphs of Paul Morphy*, by F. M. Edge (New York, 1859); *Morphy's Games*, edited by J. Löwenthal (New York, 1860); *Paul Morphy*, by Max Lange (Leipzig, 1881).

MORRILL, JUSTIN SMITH (1810–1898), American political leader and financier, was born at Strafford, Vermont, on the 14th of April 1810. He was a clerk in a store at Strafford in 1825–1828, and at Portland, Maine, in 1828–1831, and was a merchant and then a farmer in his native town in 1831–1855. He was elected to the national house of representatives as an anti-slavery Whig in 1854, soon afterwards joining the new Republican party, and served in the house from 1855 until 1867. From 1867 until his death in Washington on the 28th of December 1898 he represented Vermont in the Senate. In the house he was continuously a member of the ways and means committee (of which he was chairman in 1865–1867), and in the Senate of the finance committee (of which he was chairman in 1877–1879, 1881–1893 and 1893–1898). Soon after entering Congress he became the acknowledged leader of the protectionists, and at the request of John Sherman, then chairman of the ways and means committee, he prepared a new tariff bill, which was introduced in the house in March 1860. To this relatively conservative bill, which substituted in many instances *ad valorem* for specific duties, and was intended by its author to be a revenue as well as a protective measure, were added many amendments which made the bill more strongly protectionist, and in some cases were vigorously opposed by Morrill. The bill was finally passed by the Senate on the 20th of February 1861, and was signed by President Buchanan on the 2nd of March following. Morrill is probably best known as the author of the Land Grant Act of 1862, which led to the development of the highly important system of state educational institutions, aided by the Federal government. On the 14th of December 1857, Morrill introduced in the house a bill "donating public lands to the several states and Territories which may provide colleges for the benefit of agriculture and the mechanic arts." This bill passed both houses, but was vetoed in February 1859 by President Buchanan on the ground that it would cause friction between the states, that it would be uneconomical, that it might encourage fraudulent speculation, that it would injure existing institutions, and that it was unconstitutional. A similar bill was introduced by Morrill on the 16th of December 1861, and five months afterwards was presented to the Senate by Benjamin Wade of Ohio. The measure had a negative report from committee in the house, and was strongly opposed in the Senate; but it passed both branches, and on the 2nd of July 1862 was signed by President Lincoln. This measure provided for the foundation and maintenance of colleges "where the leading object shall be, without excluding other scientific and classical studies, and including military tactics [which had not been included in the original bill], to teach such branches of learning as are related to agriculture and the mechanic arts. . . in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life." In 1890 Morrill introduced in the Senate the so-called "Second Morrill Act," under which $25,000 is given annually by the Federal government to each of the "land-grant" colleges.

MORRIS [Morrison], **CLARA** (1849–), American actress, was born in Toronto, Ontario, and at the age of seventeen joined a stock company in Cleveland, Ohio. Her first New York appearance (1870) was under Augustin Daly in an adaptation of Wilkie Collins's *Man and Wife*; and she won considerable success as Cora in *L'Article 47*, Camille, Miss Multon and similar emotional parts. In 1874 she married Frederick C. Harriott, and soon afterwards began to write novels and to contribute to magazines. She published her *Life on the Stage* in 1901, and *Life of a Star* in 1906.

MORRIS, GOUVERNEUR (1752–1816), American statesman, was born in the old Morrisania manor house, in what is now the city of New York, on the 31st of January 1752. He graduated at King's College (now Columbia University) in 1768, studied law, and was admitted to the bar in 1771. New York, then in the midst of the political disturbances which preceded the outbreak of the War of American Independence, offered a good opportunity for a public career, and Morris had the aristocratic connexions which tradition required.[1] An extreme aristocrat

[1] His great grandfather, Richard Morris, having fought in Cromwell's armies, emigrated to America on the restoration of Charles II., and founded the manor of Morrisania, in what was then New Netherland. His grandfather, Lewis Morris (1671–1746), inherited this

in his political views, he distrusted the democratic tendencies of the Whigs, but a firm belief in the justice of the American cause led him to join their ranks. His half-brother, Staats Long Morris (1728–1800), was a Tory, fought in the British army, and became a major-General. Gouverneur served in the New York Provincial Congress in 1776–1777, was perhaps the leading advocate in that body of a declaration of independence, and after the Congress had become (July 1776) the "Convention of the Representatives of the state of New York," he served on the committee of that body which prepared the first draft of the state constitution. He served in the Continental Congress in 1777–1779, and was enthusiastic in his support of Washington. In 1778 he was selected chairman of the committee to treat with Lord North's conciliation commissioners, and as such presented the famous report, adopted by a unanimous vote of Congress, which declared that the recognition of independence must precede any negotiations for peace. He settled in Philadelphia as a lawyer, and in February 1780 he published in Philadelphia a series of essays on finance, in which he criticized the issue of legal-tenders, denounced laws passed for the benefit of the debtor class, and urged the people to tax themselves for the common good. From 1781 to 1785 he was assistant to Robert Morris (*q.v.*), superintendent of finance. In 1782 he prepared an elaborate report on the coinage, suggesting the use of the decimal system and of the terms *dollar* and *cent*. With some modifications introduced by Jefferson, notably the adoption of a higher unit of value (the dollar instead of one-tenth of a cent), this plan constitutes the basis of the present American system. Morris was one of Pennsylvania's representatives in the constitutional convention of 1787, and took an active part in the debates. His influence was weakened, however, by his cynicism and by his ultra-aristocratic views. He favoured a strong executive holding during good behaviour, an aristocratic senate appointed by the president for life, and the restriction of the suffrage to freeholders. The struggle which the frontier settlers of Pennsylvania had made in the state legislature to secure unlimited issues of paper money and the enactment of laws favourable to the debtor class prejudiced him against the West, and he tried to introduce into the constitution a clause guaranteeing forever the political supremacy of the states east of the Alleghanies. He was instrumental in securing the executive veto and in defeating the proposal that the legislature should elect the president. He also gave able support to the nationalistic and anti-slavery factions in the convention. He was the member of the committee of revision selected to draft the constitution in its final form, and that document is a monument to the vigour and simplicity of his literary style. In 1787 he bought Morrisania from Staats Long Morris, and returned to New York to live.

He went to France in February 1789 on private business, and remained abroad for nine years, passing most of the time in Paris, London, and the German capitals. In 1792 he acted as financial agent in a daring attempt to secure the escape of the king and queen from Paris. He was appointed United States minister to France in 1792, and was the only representative of a foreign country who remained at his post throughout the Reign of Terror; but his ill-concealed attitude of hostility to the Revolution gave offence, and in return for the recall of Genet, at the request of the United States, the French government, in 1794, asked for the recall of Morris. Business and pleasure, however, still detained him in Europe for four years longer. He returned to New York in 1798, resumed the practice of his profession, re-entered politics, and sat in the United States Senate as a Federalist from 1800 to 1803. As early as 1801 Morris became interested in projects for improving the communication between the Hudson river and Lake Erie, and from 1810 to 1816 he was chairman of the board of canal commissioners, which after exploring the country prepared plans for the Erie Canal. He was bitterly opposed to the war of 1812, and openly advocated the formation of a northern confederacy to escape the rule of the "Virginia dynasty." He died at Morrisania on the 6th of November 1816.

His half-brother, Lewis Morris (1726–1798), a signer of the Declaration of Independence, was educated at Yale, served in the Continental Congress from 1775 until early in 1777, and went on a mission to the western frontier in 1775 to win over the Indians from the British to the American side. He joined the army as brigadier-general of militia in June 1778, and served in the New York Senate in 1777–1781 and 1784–1790.

See *The Diary and Letters of Gouverneur Morris* (2 vols., New York, 1888), edited by Anne Cary Morris; Jared Sparks, *Life of Gouverneur Morris* (3 vols., Boston, 1832), the first volume being a biography and the second and third containing Morris's miscellaneous writings and addresses; and Theodore Roosevelt, *Gouverneur Morris* (Boston, 1888), in the "American Statesmen" series.

MORRIS, JOHN (1810–1886), English geologist and palaeontologist, was born at Homerton, London, on the 19th of February 1810. He was brought up to the business of a pharmaceutical chemist. Early in life he published observations on the Tertiary and Post-Tertiary deposits in the Thames valley, and on fossil plants and various invertebrata, in the *Magazine of Natural History*, the *Annals of Nat. Hist.* and other journals. In 1845 he issued his *Catalogue of British Fossils* (2nd ed., 1854), a work of essential service to geology. He was also author (with John Lycett) of *A Monograph of the Mollusca from the Great Oolite* (Palaeontographical Soc., 1850–1853). In 1855 he became professor of Geology in University College, London, a post which he held until 1877. In 1868–1870 and 1877–1878 he was president of the Geologists' Association. He was awarded the Lyell medal by the Geological Society in 1876, and was made Hon. M.A. of Cambridge in 1878 in acknowledgment of his services as deputy Woodwardian professor during the final illness of Sedgwick. He died in London on the 7th of January 1886.

MORRIS, SIR LEWIS (1833–1907), British poet, eldest son of Lewis Edward William Morris and Sophia, daughter of John Hughes of Carmarthen, was born at Penbryn in 1833. His great grandfather, Lewis Morris (1700–1765), had been a well-known Welsh poet and antiquary. He was educated at Sherborne School and Jesus College, Oxford, where he took first classes in classics (1853 and 1855). He won the chancellor's prize for an English essay in 1858, was called to the bar in 1861, and elected hon. fellow of his old college in 1877. He practised for twenty years as a conveyancing counsel, retiring from active legal work in 1881. He was energetic on behalf of educational movements in Wales, and contested Welsh constituencies in the Liberal interest, but without success. He was knighted in 1896, and became also a Jubilee-medallist and Knight of the Redeemer of Greece. Comparatively late in life Sir Lewis Morris made his appearance as a writer of verse with three series of miscellaneous poems, called *Songs of Two Worlds*, published respectively in 1872, 1874 and 1875. These little volumes proved him to have a refined taste and a gentle metrical fluidity, which soon won for his work considerable popularity. In 1876 and 1877 he made a more important venture with *The Epic of Hades*, an attempt to re-tell the stories of Hellenic mythology with a certain modern and allegorical setting. This work, though it is somewhat strained in sentiment and is not free from artistic infelicities, contains his best verse and has passages of undeniable force and effect. His later work follows too closely upon the influence of Tennyson, from which he is never altogether free; but his earnest

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manor and also a large estate from his uncle in Monmouth county, East Jersey. He was an influential advocate of the surrender of the proprietary government of the Jerseys to the Crown (1702), became a member of the New Jersey Council in 1703, was suspended by Governor Cornbury in 1704, was elected a member of the Assembly in 1707 and led that body in opposition to Cornbury, was reappointed to the Council under Governor Lovelace in 1708, was again suspended in 1709 by Lieut.-Governor Ingoldsby, was made President of the Council in 1710 under Governor Hunter, and in 1711, during Hunter's administration (1710–1719), of which he was a staunch supporter, was made a justice of the supreme court of New Jersey. He was chief justice of New York from about 1720 until 1733, was sent to England by the popular party late in 1734 to present their grievances to the king, and was governor of New Jersey from 1738 until his death on the 21st of May 1746. Gouverneur Morris's father, Lewis Morris (1698–1762), closed a long public career as judge of the vice-admiralty court of New York; his mother was descended from a French Protestant refugee, who had come to America to escape the persecution of Louis XIV.

didacticism, genial optimism and evident sincerity have given his work a thoroughly wholesome moral influence. Among his other books were *Gwen* (1880), *Songs Unsung* (1883), *Gycia* (1886), *A Vision of Saints* (1890), *Idylls and Lyrics* (1896) and *The New Rambler* (1906). He died at Carmarthen on the 13th of November 1907.

MORRIS, RICHARD (1833–1894), English philologist, was born in London on the 8th of September 1833. In 1871 he was ordained in the Church of England, and from 1875–1888 was head master of the Royal Masonic Institution for Boys, near London. His first published work was *The Etymology of Local Names* (1857). Between 1862 and 1880 he prepared twelve volumes for the Early English Text Society, edited Chaucer (1866) and Spenser (1869) from the original manuscripts, and published *Specimens of Early English* (1867). His educational works, *Historical Outlines of English Accidence* (1872), *Elementary Lessons in Historical English Grammar* (1874) and *English Grammar* (1874), had a large sale and exercised a real influence. The rest of his life he devoted to the study of Pali, on which he became a recognized authority. He died at Harold Wood, Essex, on the 12th of May 1894.

MORRIS, ROBERT (1734–1806), American financier, a signer of the Declaration of Independence, was born in Liverpool, England, on the 31st of January 1734. He emigrated to America in 1747, entered a mercantile house, and in 1754 became a member of a prosperous firm, which was known successively as Willing, Morris & Co., Willing, Morris & Inglis and Willing, Morris & Swanwick. In the conflict with the mother country Morris took the side of the colonists, but associated himself with the conservative group of Pennsylvania Whigs who followed the lead of John Dickinson and James Wilson, rather than with the more radical faction represented by Thomas Paine. He was vice-president of the Pennsylvania Committee of Safety (1775–1776), and a member of the Continental Congress (1775–1778). At first he disapproved of the Declaration of Independence, but he joined the other members in signing it on the 2nd of August. He retired from Congress in 1778, and was at once sent to the legislature, serving in 1778–1779 and in 1780–1781. His greatest public service was the financing of the War of Independence. As chairman or member of various committees he practically controlled the financial operations of Congress from 1776 to 1778, and when the board system was superseded in 1781 by single-headed executive departments he was chosen superintendent of finance. With the able co-operation of his assistant, Gouverneur Morris—who was in no way related to him—he filled this position with great efficiency during the trying years from 1781 to 1784. For the same period he was also agent of marine, and hence head of the navy department. Through requisitions on the states and loans from the French, and in large measure through money advanced out of his own pocket or borrowed on his private credit, he furnished the means to transfer Washington's army from Dobbs Ferry to Yorktown (1781). In 1781 he established in Philadelphia the Bank of North America, chartered first by Congress and later by Pennsylvania, the oldest financial institution in the United States, and the first which had even partially a national character. A confusion of public and private accounts, due primarily to the fact that his own credit was superior to that of the United States, gave rise to charges of dishonesty, of which he was acquitted by a vote of Congress. He was a member of the Federal Convention of 1787, but took little part in its deliberations beyond making the speech which placed Washington in nomination for the presidency of the body. On the formation of the new government he was offered, but declined, the secretaryship of the treasury, and urged Hamilton's appointment in his stead. As United States senator, 1789–1795, he supported the Federalist policies and gave Hamilton considerable assistance in carrying out his financial plans, taking part, according to tradition, in arranging a bargain by which certain Virginia representatives were induced to vote for the funding of the state debts in return for the location of the Federal capital on the Potomac. After the war he gradually disposed of his mercantile and banking interests and engaged extensively in western land speculation. At one time or another he owned wholly or in major part nearly the entire western half of New York state, two million acres in Georgia and about one million each in Pennsylvania, Virginia and South Carolina. The slow development of this property, the failure of a London bank in which he had funds invested, the erection of a palatial residence in Philadelphia, and the dishonesty of one of his partners, finally drove him into bankruptcy, and he was confined in a debtors' prison for more than three years (1798–1801). He died in Philadelphia on the 7th of May 1806.

The best biography is E. P. Oberholtzer's *Robert Morris, Patriot and Financier* (New York, 1903), based upon the Robert Morris papers in the Library of Congress; see also W. G. Sumner's *The Financier and the Finances of the American Revolution* (New York, 1891).

MORRIS, WILLIAM (1834–1896), English poet and artist, third child and eldest son of William Morris and Emma Shelton, was born at Elm House, Walthamstow, on the 24th of March 1834. His grandfather was a respected tradesman in Worcester, and his father, who was born in that town in 1797, came up to London in 1820, and entered the office of a firm of discount brokers, in which he afterwards assumed a partnership. As a child the poet was delicate but studious. He learnt to read very early, and by the time he was four years old was familiar with most of the Waverley novels. When he was six the family moved to Woodford Hall, where new opportunities for an out-of-door life brought the boy health and vigour. He rode about Epping Forest, sometimes in a toy suit of armour, became a close observer of animal nature, and was able to recognize any bird upon the wing. At the same time he continued to read whatever came in his way, and was particularly attracted by the stories in the *Arabian Nights* and by the designs in Gerard's *Herbal*. He studied with his sisters' governess until he was nine, when he was sent to a school at Walthamstow. In his thirteenth year his father died, leaving the family well-to-do; the home at Woodford was broken up, as being unnecessarily large; and in 1848 William Morris went to Marlborough, where his father had bought him a nomination. Morris was at the school three years, but got very little good from it beyond a taste for architecture, fostered by the school library, and an attraction towards the Anglo-Catholic movement. He made but slow progress in school work, and at Christmas 1851 was removed and sent to a private tutor for a year. In June 1852 he matriculated at Exeter College, Oxford, but, as the college was full, he did not go into residence till January 1853. He at once made friends, who stood him in good stead all his life, foremost among whom were Edward Burne-Jones, who was a freshman of his year, and a little Birmingham group at Pembroke. They were known among themselves as the "Brotherhood"; they read together theology, ecclesiastical history, medieval poetry, and, among moderns, Tennyson and Ruskin. They studied art, and fostered the study in the long vacations by tours among the English churches and the Continental cathedrals. Moreover, Morris began at this time to write poetry, and many of his first pieces, afterwards destroyed, were held by sound judges to be equal to anything he ever did. Both Morris and Burne-Jones had come to Oxford with the intention of taking holy orders, but as they felt their way they both came to the conclusion that there was more to be done in the direction of social reform than of ecclesiastical work, and that their energies would be best employed outside the priesthood. So Morris decided to become an architect, and for the better propagation of the views of the new brotherhood a magazine was at the same time projected, which was to make a speciality of social articles, besides poems and short stories.

At the beginning of 1856 the two schemes came to a head together. Morris, having passed his finals in the preceding term, was entered as a pupil at the office of George Edmund Street, the well-known architect; and on New Year's Day the first number of *The Oxford and Cambridge Magazine* appeared. The expenses of this very interesting venture were borne entirely by Morris, but after the issue of No. 1 he resigned the formal editorship to his friend Fulford. Many distinguished compositions appeared in its pages, but it gradually languished, and was given up after a year's experiment. The chief immediate result was the friendship between Morris and Dante Gabriel Rossetti (*q.v.*), which sprang up from a successful attempt to secure Rossetti as a contributor. In the summer of 1856 Street removed to London, and Morris accompanied him, working very hard both in and out of office hours at architecture and painting. But Rossetti persuaded him that he was better suited for a painter, and after a while he devoted himself exclusively to that branch of art. It was in the summer that the two friends visited Oxford, and finding the new Union debating-hall in course of construction, offered to paint the bays. Seven artists volunteered help, and the work was hastily begun. Morris worked with feverish energy, and on finishing the portion assigned to him proceeded to decorate the roof. The work was done too soon and too fast, the colours began to fade at once, and are now barely decipherable; but the broken designs, so long as any vestige remains, will always be interesting as a relic of an important aesthetic movement and as the first attempt on Morris's part towards decorative art (see ROSSETTI). Early in 1858 Morris published *The Defence of Guenevere*, which was almost unnoticed by contemporary criticism, but is now recognized as one of the pearls of Victorian poetry.

On 26th April 1859 Morris married Jane Burden, a beautiful Oxford girl, who had sat to him as a model, and settled temporarily at 41 Great Ormond Street, London. Meanwhile he set about building for himself at Upton a house which was to be the embodiment of all his principles of decorative art. Furniture, decorations, household utensils and every article of daily use were specially designed, and in the summer of 1860 the house was ready for occupation. The furnishing of it had suggested a fresh activity; Morris now determined to embark upon decoration as a career. A small company was formed, consisting of D. G. Rossetti, Philip Webb, Burne-Jones, Madox Brown, Faulkner and Marshall, and in January 1862 started business under the title of Morris, Marshall, Faulkner & Co., with offices at 8 Red Lion Square. The prospectus set forth that the firm would undertake church decoration, carving, stained glass, metal-work, paper-hangings, chintzes and carpets. The business, after inevitable vicissitudes, flourished, but the " house beautiful " at Upton proved to be unhealthily situated. Serious illness obliged the family to remove to town, and in November 1865 they resettled at 26 Queen Square, Bloomsbury. Morris was now unceasingly busy, but he found time also for literature. In June 1867 he published *The Life and Death of Jason*, which was at once successful; and in April 1868 the first two parts of *The Earthly Paradise*. The rest of this wonderful storehouse of poetic romance appeared in two volumes in 1869 and 1870. In the following year he was again looking for a country house, and lighted upon Kelmscott manor house, in the Upper Thames valley, which he took at first in joint-tenancy with Rossetti and used principally as a holiday home. In 1872 appeared *Love is Enough*, structurally the most elaborate of his poems for its combination of the epic and dramatic spirits; and in the autumn he began to translate the shorter Icelandic sagas, to which his enthusiasm had been directed by two inspiring journeys to Iceland. Business worries, however, interrupted him; it was found necessary to reconstruct the company owing to its having grown out of proportion with the existing division of profit and labour. Long negotiations ensued, and in March 1875 the old firm was dissolved. Morris now became sole manager and proprietor, although the other members of the old firm continued, in varying degrees, to give him the advantage of their assistance and advice.

Meanwhile the epic mood had possessed Morris very strongly, and, in addition to his work upon the sagas, he had actually finished and (in 1875) published a verse translation of the *Aeneid*, which is interesting rather for its individuality than for any fidelity to the spirit of the original. In the following year appeared *Sigurd the Volsung*, a version full of heroic vigour, movement and vitality, but somewhat too lengthy and incoherent in design to preserve the epic interest intact to the British taste. This splendid burst of poetic activity, however, had raised him to a place among the first poets of his time; and in 1877 an attempt was made to induce him to accept the professorship of poetry at Oxford. But he felt himself lacking in the academic spirit, and wisely declined. At this time a fresh outlet for his energy was furnished by his foundation in 1877 of the Society for the Protection of Ancient Buildings, which sprang into being as a practical protest against a scheme for restoring and reviving Tewkesbury Abbey. He began, too, to take an active interest in politics over the Eastern Question, but his enthusiasm was at the moment a flash in the pan. Finding that events were going against his judgment, Morris, as was so often the case with him, shrugged his shoulders and broke free from the movement.

Still, although he found it hard to sit close to a definite party, Morris continued to be spasmodically interested in political movements. During the next few years, indeed, the interest gained ground with him steadily. He became treasurer of the National Liberal League in 1879, but after the Irish coercive measures of 1881 he finally abandoned the Liberal party, and drifted further and further into Socialism. For ten or twelve years this movement had been gaining ground in England, and the Social Democratic Federation was formed in 1881. In January 1883, within a week of his election to an honorary fellowship at Exeter, Morris was enrolled among its members. Thenceforward for two years his advocacy of the cause of Socialism absorbed not only his spare time, but the thought and energy of all his working hours. For it he even neglected literature and art. In March 1883 he gave an address at Manchester on " Art, Wealth and Riches "; in May he was elected upon the executive of the federation. In September he wrote the first of his *Chants for Socialists*. About the same time he shocked the authorities by pleading in University Hall for the wholesale support of Socialism among the undergraduates at Oxford. Nevertheless, the federation began to weaken. At the franchise meeting in Hyde Park in 1884 it was unable to get a hearing. Morris, however, had not yet lost heart. Internal dissensions in 1884 led to the foundation of the Socialist League, and in February 1885 a new organ, *Commonweal*, began to print Morris's splendid rallying-songs. Still, differences of opinion and degree prevented concerted action; and when, after the Trafalgar Square riots in February 1886, Morris remonstrated with the anarchic section he was denounced by the advanced party and ever afterwards was regarded with suspicion. In 1889 he was deposed from the management of *Commonweal*, and gradually lost all confidence in the movement as an active force.

Long before that time, however, Morris had returned to the paramount interests of his life—to art and literature. When his business was enlarged in 1881 by the establishment of a tapestry industry at Merton, in Surrey, Morris found yet another means for expressing the medievalism that inspired all his work, whether on paper or at the loom. In 1887 he published his translation of the *Odyssey*, which had many of the qualities and defects of his *Aeneid*, and is much more interesting as an experiment than valuable as a " Homeric echo." In the *Commonweal* appeared *News from Nowhere*, published in book form in 1891, describing an England in which the principles of communism have been realized. He then added another to his many activities; he assumed a direct interest in typography. In the early seventies he had devoted much attention to the arts of illumination and calligraphy. He himself wrote several manuscripts, with illuminations of his own devising. From this to attempts to beautify the art of modern printing was but a short step. *The House of the Wolfings*, printed in 1889 at the Chiswick Press, was the first essay in this direction; and in the same year, in *The Roots of the Mountains*, he carried his theory a step further. Some fifteen months later he added a private printing-press to his multifarious occupations, and started upon the first volume issued from the Kelmscott Press, his own *Glittering Plain.* For the last few years of his life this new interest remained the absorbing one. A series of exquisite books, which gain in value every year, witnesses to the thorough and whole-hearted fashion in which he invariably threw himself into the exigencies of his life-work.

The last years of his life were peacefully occupied. He was sounded as to whether he would accept the laureateship upon the death of Tennyson, but declined, feeling that his tastes and his record were too remote from the requirements of a court appointment. His last piece of work, the crowning glory of his printing-press, was the *Kelmscott Chaucer*, which had taken nearly two years to print, and fully five to plan and mature. It was finished in June 1896, and before it was in his hands he already knew that his working day was over. His vigour had been slowly declining for some time, and he sank gradually during the autumn, dying on the 3rd of October 1896. He was buried in Kelmscott churchyard, followed to the grave by the workmen whom he had inspired, the members of the league which he had supported, the students of the art gild he had founded, and the villagers who had learnt to love him.

Essentially the child of the Gothic revival, he had put an ineffaceable stamp on Victorian ornament and design, his place being that of a follower of Ruskin and Pugin, but with a greater practical influence than either. In house decoration of all kinds—furniture, wall-papers and hangings (which he preferred to paper), carpet-weaving, and the painting of glass and tiles, needlework, tapestry—he formed a school which was dominated by his protest against commercialism and his assertion of the necessity for natural decoration and pure colour, produced by hand work and inspired by a passion for beauty irrespective of cheapness or quickness of manufacture (see ARTS AND CRAFTS).

The truest criticism of William Morris is that attributed to his friend, the poet Swinburne, who said that he was always more truly inspired by literature than by life. His Socialism, though it made a brave show at times, was at heart a passionate enthusiasm for an inaccessible artistic ideal. Morris, indeed, was not primarily interested in men at all, but in objects. His poetry deals, it is true, with the human passions, but the emotion is always seen as in a picture; he is more concerned with the attitude of the group than with the realization of a character. He had very little adaptability in dealing with his fellows; the crowd, as a crowd, fired his enthusiasm, but he was unable to cope with the individuals that composed it. Many of his colleagues bear witness to his generosity and magnanimity, but as a general principle he certainly lacked the wider humanity. This is the one failing of his art: it is also the shortcoming of his poetry. Granted this, there is left an immense amount that will always command admiration. The spirit of beauty breathes in every line; a sense of music and of colour is everywhere abundant; the reader moves, as it were, under a canopy of apple-blossom, over a flower-starred turf, to the faint harmony of virginals. Nor does the poet lack power and vigour when an adventurous story is to be told. The clash of arms breaks upon his pagan paradise with no uncertain sound; he is swift in narrative, breathless in escapade. And over all hangs the faint atmosphere of medievalism, of an England of green gardens and grey towers, of a London "small and white and clean," of chivalry and adventure in every brake. The critic has also to remember the historical value of Morris's literary influence, following upon the prim domesticities of early Victorian verse, and breaking in upon Tennyson's least happy phase of natural homeliness.

See the *Life and Letters*, in 2 vols. (Longmans), by J. W. Mackail. An article on "William Morris and his Decorative Art," by Lewis F. Day, appeared in the *Contemporary Review* for June 1903. (A. WA.)

MORRIS, a city and the county-seat of Grundy county, Illinois, U.S.A., on the north bank of the Illinois river, about 62 m. S. W. of Chicago. Pop. (1900), 4273; (1910) 4563. Morris is served by the Chicago, Rock Island & Pacific railway, and by the Illinois & Michigan canal. Electric power is derived from the Illinois river at Marseilles, Ill. (pop. in 1910, 3291), about 15 m. west. Morris (named in honour of Isaac P. Morris, a commissioner of the Illinois & Michigan canal) was settled in 1834, and was chartered as a city in 1857.

MORRIS-DANCE, or MORRICE-DANCE (Span. *Morisco*, Moorish), an old English dance, which is said by various authorities to have been introduced by John of Gaunt from Spain or borrowed from the French or Flemings. That it was a development of the morisco-dance or Spanish fandango is not invalidated by the fact that the morisco was for one person only, for, although latterly the morris-dance was represented by various characters, uniformity in this respect was not always observed. There are few references to it earlier than the reign of Henry VII., but it would appear that in the reign of Henry VIII. it was an almost essential part of the principal village festivities. In earlier times it was usually danced by five men and a boy dressed in a girl's habit, who was called Maid Marian. There were also two musicians; and, at least sometimes, one of the dancers, more gaily and richly dressed than the others, acted as "foreman of the morris." The garments of the dancers were ornamented with bells tuned to different notes so as to sound in harmony. Robin Hood, Friar Tuck and Little John were characters extraneous to the original dance, and were introduced when it came to be associated with the May-games. At Betley, in Staffordshire, there is a painted window, of the time of Henry VIII. or earlier, portraying the morris—the characters including Maid Marian, Friar Tuck, the hobby-horse, the piper, the tabourer, the fool and five other persons apparently representing various ranks or callings. The hobby-horse, which, latterly at least, was one of the principal characters of the dance, consisted of a wooden figure attached to the person of the actor, who was covered with trappings reaching to the ground, so as to conceal his feet. The morris-dance was abolished along with the May-games and other festivities by the Puritans, and, although revived at the Restoration, the pageant gradually degenerated in character and declined in importance. Maid Marian latterly was personated by a clown, who was called Malkin or Marykin. The interest of the subject has revived in recent years in connexion with the new movements associated with folk-music generally.

See *The Morris Book*, by Cecil J. Sharp and H. C. MacIlwaine. Among older authorities see Douce, "Dissertations on the Ancient Morris Dance," in his *Illustrations of Shakespeare* (1839); Strutt, *Sports and Pastimes of the People of England*; Brand, *Popular Antiquities* (1849).

MORRISON, ARTHUR (1863–), English novelist, was born in Kent on the 1st of November 1863. He was for a short time a clerk in the civil service, and in 1890 took to journalism. He had already published scattered tales and sketches of low life in London when W. E. Henley, with whom he was connected as a contributor to the *National Observer*, suggested their publication in volume form. *Tales of Mean Streets* (1894) immediately attracted attention, and this was followed by *A Child of the Jago* (1896), the scene of which is laid between High Street, Shoreditch, and Bethnal Green Road. *Cunning Murrell* (1900), *The Hole in the Wall* (1902), and the detective stories, *Martin Hewitt, Investigator* (1894), which had sequels in 1894 and 1896, and *The Green Eye of Gorma*, are among his other works.

MORRISON, RICHARD JAMES (1795–1874), English astrologer, commonly known by his pseudonym "Zadkiel," was born on the 15th of June 1795. He served in the Royal Navy, but resigned with the rank of lieutenant in 1829. He then devoted himself to the study of astrology, and in 1831 issued *The Herald of Astrology*, subsequently known as *Zadkiel's Almanac*. In this annual pamphlet Morrison, over the signature "Zadkiel Tao-Sze," published predictions of the chief events of the coming year. In 1863 Morrison brought a libel action against Admiral Sir Edward Belcher, who had accused him of obtaining money by charlatanism in the form of crystal-gazing. He was awarded twenty shillings damages, but was deprived of his costs. Morrison died on the 5th of April 1874.

MORRISON, ROBERT (1782–1834), the first Protestant missionary to China, was born of Scottish parents at Buller's Green, near Morpeth, on the 5th of January 1782. After receiving an elementary education in Newcastle, he was apprenticed to a lastmaker, but his spare hours were given to theology, and in 1803 he was received into the Independent Academy at

Hoxton. In the following year he offered his services to the London Missionary Society, and after he had attended David Bogue's college at Gosport and studied Chinese under a native teacher, he was appointed to Canton in 1807. After a year of much hardship he became translator to the East India Company's factory there in 1809, and worked at a *Chinese Grammar* and a translation of the New Testament, both published in 1814. In 1817 he published *A View of China for Philological Purposes*, and his translation of the Old Testament (in which William Milne collaborated) was completed in the following year. His next enterprise was the establishment (1820) of an Anglo-Chinese college at Malacca for "the reciprocal cultivation of Chinese and European literature." Here too were trained native Chinese evangelists who could proceed to the mainland and carry on Christian work with comparative immunity. In 1821 Morrisons's *Chinese Dictionary*, in six 4to volumes, a monumental work, was published by the East India Company, at a cost of £12,000. Leaving China at the close of 1823, Morrison spent two years in England, where he was elected a fellow of the Royal Society. Returning to China in 1826, he set himself to promote education and to prepare a Chinese commentary on the Bible and other Christian literature. He died at Canton on the 1st of August 1834. Morrison was admirably fitted for the pioneering work accomplished by his grammar and dictionary; and his establishment of a dispensary, manned by a native who had learned the main principles of European treatment, marks him out as the forerunner of modern medical missions.

His *Memoirs*, compiled by his widow, were published in 1839. See also R. Lovett, *History of the London Missionary Society*, vol. ii. ch. xix.; C. S. Horne, *The Story of the L. M. S.* ch. v.; Townsend, *Robert Morrison* (1888).

MORRISTOWN, a town and the county-seat of Morris county, New Jersey, U.S.A., on the Whippany river, 31 m. (by rail) W. of New York City. Pop. (1890) 8156; (1900) 11,267; (1910 census) 12,507. It is served by the Delaware, Lackawanna & Western, the New Jersey & Pennsylvania and the Morristown & Erie railways. Morristown is situated on a table-land surrounded by picturesque hills. It is primarily a residential suburb of New York, and has many handsome residences and a number of large estates. Near its centre is a public park, in which is a soldiers' monument (59 ft. in height). At Morris Plains, about 4 m. to the north, is a state hospital for the insane (1876).

Morristown, officially named in 1740 in honour of Lewis Morris (1671–1746), then governor of New Jersey, and grandfather of Gouverneur Morris, was settled about 1710, under the name of West Hanover, by Puritans, who were attracted here by the presence of iron ore. From January to May 1777, and again from December 1779 to June 1780, Morristown was occupied by the American army under Washington. Behind the court-house is the site of Fort Nonsense, built at Washington's orders, largely to keep his soldiers employed. In December 1779–January 1780 General Benedict Arnold was tried before a court martial presided over by General Robert Howe (1732–1785) in the Dickerson tavern here, still standing. In Morristown, at the old Speedwell ironworks (almost completely destroyed by fire in 1909), was made a part of the machinery of the "Savannah," the first steamboat that crossed the Atlantic, and here Samuel F. B. Morse and Alfred Vail completed the invention of the electric telegraph. Morristown was incorporated as a town in 1865.

See A. M. Sherman, *Historic Morristown, New Jersey; The Story of its First Century* (Morristown, 1905) and Julia K. Colles, *Authors and Writers Associated with Morristown* (Morristown, 1893).

MORSE, SAMUEL FINLEY BREESE (1791–1872), American artist and inventor, was born at Charlestown, Massachusetts, on the 27th of April 1791, son of Jedidiah Morse (1761–1826), Congregational minister there and a writer on geography, and a grandson of Samuel Finley, president of the college of New Jersey. At the age of fourteen he entered Yale College, where he graduated in 1810 and where under the instruction of Jeremiah Day and Benjamin Silliman he received the first impulse towards electrical studies. In 1811 Morse, whose tastes during his early years led him more strongly towards art than towards science, became the pupil of Washington Allston, and accompanied his master to England, where he remained four years. His success at this period as a painter was considerable. In 1825 he was one of the founders of the National Academy of Design, and was its first president, from 1826 until 1845. The year 1827 marks the revival of Morse's interest in electricity. It was at that time that he learned from J. F. Dana of Columbia College the elementary facts of electromagnetism. As yet, however, he was devoted to his art, and in 1829 he again went to Europe to study the old masters.

The year of his return, 1832, may be said to close the period of his artistic and to open that of his scientific life. On board the packet-ship "Sully," while discussing one day with his fellow-passengers the properties of the electromagnet, he was led to remark: "If the presence of electricity can be made visible in any part of the circuit, I see no reason why intelligence may not be transmitted by electricity." In a few days he had completed rough drafts of the necessary apparatus, which he displayed to his fellow-passengers.[1] During the twelve years that followed Morse was engaged in a painful struggle to perfect his invention and secure for it a proper presentation to the public. In poverty he pursued his new enterprise, making his own models, moulds and castings, denying himself the common necessaries of life. It was not until 1836 that he completed any apparatus that would work, and finally, on the 2nd of September 1837, the instrument was exhibited to a few friends in the building of the university of the City of New York, where a circuit of 1700 ft. of copper wire had been set up, with such satisfactory results as to awaken the practical interest of the Messrs Vail, iron and brass workers in New Jersey, who thenceforth became associated with Morse in his undertaking. Morse's petition for a patent was soon followed by a petition to Congress for an appropriation to defray the expense of subjecting the telegraph to actual experiment over a length sufficient to establish its feasibility and demonstrate its value. The committee on commerce, to whom the petition was referred, reported favourably. Congress, however, adjourned without making the appropriation, and meanwhile Morse sailed for Europe to take out patents there. The trip was not a success. In England his application was refused, and, while he obtained a patent in France, it was subsequently appropriated by the French government without compensation to himself. His negotiations also with Russia proved futile, and after a year's absence he returned to New York. In 1843 Congress passed the long-delayed appropriation, steps were at once taken to construct a telegraph from Baltimore to Washington, and on the 24th of May 1844 it was used for the first time. In 1847 Morse was compelled to defend his invention in the courts, and successfully vindicated his claim to be called the original inventor of the electromagnetic recording telegraph. In 1858 the representatives of Austria, Belgium, France, the Netherlands, Piedmont, Russia, the Holy See, Sweden, Tuscany and Turkey appropriated the sum of 400,000 francs in recognition of the use of his instruments in those countries. He died on the 2nd of April 1872, at New York, where his statue in bronze now stands in the Central Park. (See TELEGRAPH.) He introduced into America Daguerre's process of photography, patented a marble-cutting machine in 1823, and in 1842 made experiments with telegraphy by a submarine cable.

See S. Irenaeus Prime, *Life of S. F. B. Morse* (New York, 1875).

MORSE, the ornamented brooch by which a cope is fastened. The usual form is a large circular clasp made of gold or silver and studded with jewels. A 14-century "morse" ornamented with translucent enamel is in the British Museum. The word comes through the O. Fr. *mors*, from the Lat. *morsus*, the catch of a buckle, from *mordere*, to bite.

MORSHANSK, a town of Russia, in the government of Tambov, 50 m. N. of the city of Tambov, on the Tsna river. Pop. (1900), 25,913. The village of Morsha was founded in the middle of the 17th century, and received municipal institutions in 1779; but within a very few years it became a wealthy town, owing to its situation in a very fertile district. Since it was brought into railway communication with Ryazhsk (81 m. west on the railway between Moscow and Ryazan) it has become the chief centre for the trade in wheat raised in the governments of Tambov, Penza, Saratov and in the eastern districts of the government of Ryazan. There are also extensive dealings in flour, hemp-seed, tallow and potash.

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[1] Five years later the captain of the ship identified under oath Morse's completed instrument with that which Morse had explained on board the "Sully" in 1832.

MORTAGNE, a town of northern France, capital of an arrondissement in the department of Orne, 24 m. E.N.E. of Alençon by rail. Pop. (1906), 3383. A vaulted entrance (15th century), relic of an old stronghold, and the church of Notre-Dame (15th and 16th centuries) with a fine northern portal are of interest. The town is the seat of a sub-prefecture and of a tribunal of first instance, and is a celebrated market for horses of the Perche breed. Mortagne, once capital of the Perche, dates from the 10th century.

MORTAIN, a small town in the department of La Manche, France, the chief town of an arrondissement and seat of a sub-prefect. It is beautifully situated on a rocky hill rising above the gorge of the Cance, a tributary of the Sélune. The parish church of St Évroult is a magnificent example of the transitional style of the early 13th century, with a massive tower of the 14th and a Norman doorway dating from the original collegiate church (1058). Close to the town is the Abbaye-Blanche, founded as a Benedictine convent in 1105 and soon afterwards affiliated to Cîteaux. The church is a perfect example of a Cistercian monastic church of the late 12th century, and portions of the 12th-century cloisters also survive. The population is between 2000 and 3000.

Mortain was, in the middle ages, the head of an important *comté*, reserved for the reigning house of Normandy. In or about 1049 Duke William took it from his cousin William, "the warling," and bestowed it on his half-brother, Robert, thenceforth known as "count of Mortain," whose vast possessions in England after the Conquest (1066) gave name to "the small fees of Mortain," which owed less (knight) service than others. Robert was succeeded as count by his son William, who rebelled against Henry I., was captured at the battle of Tinchebrai (1106) and forfeited his possessions. Some years later, Henry bestowed the *comté* on his nephew Stephen, who became king in 1135. On Stephen's death (1154) his surviving son William became count of Mortain, but when he died childless in 1159 the *comté* was resumed by Henry II. On the accession of Richard I. (1889) he granted it to his brother John, who was thenceforth known as count of Mortain till he ascended the throne (1199). With his loss of Normandy the *comté* was lost, but after the recapture of the province by the House of Lancaster, Edmund Beaufort, a grandson of John of Gaunt, was created count of Mortain and so styled till 1441, when he was made earl of Dorset.

As the counts are often described as "earls" of Mortain (or even of "Moreton") the title is sometimes mistaken for an English one. It has also, through erroneous spelling, been sometimes wrongly derived from Mortagne-en-Perche. (J. H. R.)

MORTAR, the name (1) of a vessel in which any material may be crushed or pounded, and (2) given to various compositions used in building and consisting of lime and cement with sand or other fine aggregate, well mixed by manual labour or machinery with a proper quantity of clean water (see below, and also BRICKWORK). The Latin name both for such a vessel and for the material as mixed in it, is *mortarium*. The earlier English form *morter*, from Fr. *mortier*, has been in modern English more closely adapted to the spelling of the Latin original. As applied to a vessel, the name is chiefly used for one employed in the preparation of drugs, which are pounded or triturated in the "mortar" by means of a pestle (Lat. *pistillum*; *pinsere*, to pound). The name has also been given, from a resemblance in shape to the vessel, to a short thick piece of ordnance, resting on a "bed" formerly used for high-angle fire. The barrel was always very short, normally even shorter than it was wide, and sometimes even resembled a bowl in shape. The place of the mortar in artillery is now taken by the howitzer. In modern times the name "mortar" is occasionally used for a particularly short howitzer. (See ORDNANCE.)

Building Mortar.—The sand forming the aggregate is placed on the mixing platform and formed into a ring within which lime in the required proportion is placed; it is then gently but thoroughly sprinkled with clean water through the rose of a watering-can or hose-pipe. The lime is covered with the sand and left undisturbed for a day or two to slake, and the whole mass is then turned over and well mixed with the larry. The mortar is often used immediately the materials are thoroughly incorporated, but it should rather be kept covered over with sacks until well tempered. For large works a mortar mill working by hand, steam, or other power effects a considerable economy. Stone chippings, clean, hard, broken bricks or furnace clinkers may take the place of sand when the mill is employed, as the action of grinding reduces any large pieces to small sandlike particles.

The remarks above apply to ordinary lime mortar. Mortar of hydraulic lime, cement mortar, or mortar gauged with cement, must be mixed up in quantities sufficient only for immediate use. Any material not used at the time, or at least the same day, will be wasted; cement cannot be reworked after it has begun to set as its setting properties are destroyed.

Slaking.

Slaking is a most important part in the process of making mortar. There are three methods of slaking lump lime—the first by immersion, the second by sprinkling with water, and the third by exposing the lime to the atmosphere and leaving it to absorb moisture. Different qualities of lime require varying amounts of water, but the average quantity is about a gallon and a half to every bushel of lime. It should be all added at one time and the mass then left to slake undisturbed. Hot limes are often used for mortar. These are unsuitable for plastering unless slaked for a long period. It will at once be seen that when mortars composed of these limes are used immediately after mixing, slaking must continue for a long time, drying up the moisture necessary for setting, and causing the mortar to crumble to dust in the joints of the brickwork. This fact gives us the reason for the old Roman enactment which set forth that lime should be slaked for three years before using. In the south of Europe it is the custom to slake lime the season before it is used.

The practical application of mortar to building work, and the methods of pointing the joints of brickwork and stonework, are described and fully illustrated in the article on BRICKWORK.

Hardening of Mortar.

The results of many careful tests and experiments serve to show that the hardening of mortar is due to several causes acting collectively. With ordinary lime mortars the chief causes of hardening are the absorption of carbonic acid from the air and the combination of part of the water with the lime, which unites with some of the silica of which the sand is composed and forms silicate of lime. The initial setting is due to the evaporation of the excess of water and to the production of minute crystals of hydrate of lime which slowly absorbs carbonic acid gas from the air. With mortar of rich lime an outer crust is thus formed on the exposed parts which prevents ready access of air to the interior and retards setting. In illustration of this peculiar property of lime to remain soft, some remarkable cases may be mentioned. One of the bastions erected by Vauban in 1666 was removed by General Treissart, in 1822, a hundred and fifty six years after erection. The lime in the interior of the masonry, where it was inaccessible to the action of the atmosphere, was found to be quite soft. Dr John of Berlin mentions that in removing a pillar 9 ft. in diameter in the church of St Peter, Berlin, eighty years after erection, the mortar in the interior was found to be quite soft. Sir C. W. Pasley, in removing the old wharf wall at Chatham dockyard in 1834, found that the work executed in lime mortar was easily removable, the mortar being in a state of pulp. The brickwork, built with Roman cement, it was found necessary to blast.

The Romans were convinced that it was owing to prolonged and thorough slaking that their works in plaster became so hard and were not defaced by cracks. L. B. Alberti mentions in his writings that he once discovered in an old trough some lime which had been left there five hundred years and that it was quite soft and fit for use.

The setting and hardening of hydraulic limes and cements are due mainly to crystallization brought about by the action of water on the silicate of lime, and not by mere absorption of carbonic acid gas from the atmosphere. As a consequence we find that this variety of limes and cements has the valuable property of setting hard while immersed in water and in many cases growing increasingly hard with the lapse of time.

Magnesia in Mortar.

Opinions differ very widely on the question of the suitability for building purposes of limes or cements which contain an appreciable proportion of magnesia, many experts holding the view that the expansion which often occurs in floors and other works of concrete from one to four years after laying may be justly attributed to the presence of this substance. For mortars, however, it may be assumed that the presence of magnesia is not detrimental to the value of the matrix, but on the contrary may be a source of strength, for experiments show that it reduces the energy of slaking and increases that of the setting processes. Cements containing magnesia are pronounced both by Vicat and Chatoney to resist the dissolving action of sea-water better than those in which no magnesia is present, and it is pretty well established by experience that cements derived from argillo-magnesian limestones furnish a durable cement for construction in the sea.

The old mortar of the Romans, which proves its great property of endurance by many of their works still remaining, was in all probability composed of lime mixed with pozzolana or "trass." These materials are similar in character and are obtained from extinct volcanoes—in the case of the Romans from the Italian volcanoes, but also from extinct volcanoes in the valleys of the Rhine and in Holland. Good as these mortars undoubtedly were, it may be safely asserted that no cement or mortar has been discovered to excel in strength, or in durability in all climates, the Portland cement of the present day. The best varieties of this material are made in England, the country of its origin, much of the continental and American product being deficient in the qualities which combine to make a good cement. (For the properties of Portland cement and the method of its manufacture see CEMENT.)

The comparative strengths under tensile stress of grey-lime mortar, Portland-cement mortar, and Portland-cement mortar with the addition of lime, are given in the following table, which is the result of a series of tests by G. R. Redgrave.

Proportions by Measure.				Breaking Weight per sq. in. in lb.
Sand.	Cement.	Lime.	Water.	
2	—	1	1·33	36·89 (average of three tests)
6	1	—	1·25	103·79 ,,
10	1	—	2·00	50·16 ,,
6	1	0·50	1·50	73·47 ,,
10	1	0·83	2·50	42·34 ,,

It is a good plan, where the question of cost precludes the use of mortar made entirely of cement, to add to lime mortar mixed in the usual proportions a small quantity of Portland cement. This is termed "gauged" lime mortar. By this addition the strength is greatly increased and the extra cost is but slight.

Adhesion of Mortar.

The following table shows the force required to tear apart common stock bricks bedded in mortar, mixed in proportions commonly used, and left to set and harden for four weeks.

Adhesive Strengths of Lime and Cement Mortars.		
	Proportions.	
White chalk, lime and sand .	1 to 3	4¾ lb. per sq. in.
Barrow lias do. .	1 to 3	9 ,, ,,
Do. do. .	1 to 4	6¾ ,, ,,
Portland cement	1 to 4	23 ,, ,,
Do.	1 to 6	15½ ,, ,,

These results show clearly that the adhesive strength of mortar varies according to the proportion of sand used, the power of resistance of the mortar to the force brought to bear upon it decreasing as the proportion of sand is increased.

Decay of Mortar.

The primary cause of the premature decay which sometimes takes place in mortars and like material is due to the presence of mud and decayed vegetable and animal matter in the sand, or possibly in the lime or cement itself. It is therefore of great importance to use a perfectly clean sand for the aggregate, and to select a lime or cement of good quality for the matrix, care being taken that no foreign matters detrimental to the mortar be introduced during the processes of preparation.

Effects of Salt and Frost on Mortar.

The effect of salt in mortars as a preventive of the destructive effects of frost has not as yet been thoroughly determined, and the few experiments that have been carried out show varying results. In some German experiments, cubes of stone were joined together with cement mixed with water of different characters, ranging from pure rain-water to water containing from 2 to 8% of salt. Before the cement was set the blocks were exposed in air at a temperature varying from 20° F. to freezing-point, after which they were kept for seven days in a warm room. The samples were then examined with these results: The cement mixed with pure water was quite crumbled, having lost all its tenacity. The cement made with water containing 2% of salt was in rather better condition, while that containing 8% of salt had not suffered from its exposure to frost. The use of salt causes much efflorescence on the face of the work, and should therefore not be used where this would be undesirable. Nor should salt be employed for work that is to be subsequently painted. The mortar for the brick facing of the Forth Bridge below water was composed of one part of Portland cement and one part of sand mixed with salt water in a mill. Briquettes made from this compound withstood a tensile stress of an average of 365 lb per square inch when a week old, and of 510 lb at five weeks after mixing. Salt has no effect upon the strength of a mortar, although it retards the setting process somewhat.

Sugar in Mortar.

Cement mixed with a percentage of sugar (usually 2% and under) has been used with varying success. In India sugar is a frequent ingredient in mortar, probably because it has the effect of preventing too rapid setting; it also retards the drying of the material. The sugar must be dissolved in the water used for gauging, as the results obtained when the sugar is mixed with the other ingredients in a dry state are not good. The addition of sugar to water enables it to take up about fourteen times more lime than pure water. It is supposed by many writers who have studied the methods of the ancients that old Roman mortars contained strong ale, wort or other saccharine matter, and it is probable that the use of sugar with lime passed from India to Egypt and Rome. The following is an extract from the *Roorkee Treatise on Engineering*, a work of reference published in India: "It is common in this country to mix a small quantity of the coarsest sugar, 'goor' or 'jaghery,' as it is termed, with the water used for mixing up mortar. Experiments were made with bricks joined together by mortar consisting of one part of common shell lime to one and a half parts of sand, one pound of 'jaghery' being mixed with each gallon of water. The bricks were left for thirteen hours and after that time the average breaking weight of the joints in twenty trials was 6½ lb per square inch. In twenty-one specimens joined with the same mortar without the 'jaghery' the breaking weight was 4½ lb per square inch."

Of the saccharine matters used in mortar treacle seems to give the best results, rough cane sugar being next in effectiveness; beetroot sugar is not a good material to use.

By-Laws affecting the Composition of Mortar.

The by-laws made by the London County Council in 1891 under sec. 16 of the Metropolis Management and Buildings Act Amendment Act 1878 require that "the mortar to be used in the construction of walls must be composed of freshly burned lime and clean, sharp sand or grit without earthy matter, in the proportions of one of lime to three of sand or grit." The cement to be used must be Portland cement or other cement of equal quality to be approved by the district surveyor, mixed with clean, sharp sand or grit in proportions of one of cement to four of sand or grit. Burnt ballast or broken brick may be substituted for sand or grit, provided such material be properly mixed with lime in a mortar mill.

The varieties of lime and cement chiefly used for mortar in the British Isles are set forth below:—

Limes and Cements for Mortar.

Pure or fat limes should not be used for mortar. Grey stone lime, feebly hydraulic, makes a good mortar, but should not be employed for work below ground or in other damp situations. It is obtained chiefly at Dorking, Halling, Lewes and Merstham. It is used in the proportion of one part to two or three parts of sand. An analysis of the lime from Castle Bytham gives the following composition:—

Silica	14·00
Iron oxide and alumina	4·25
Lime	77·00
Magnesia	1·25
Carbon dioxide	0·90
Water and loss	2·60
	100·00

Blue lias lime is eminently hydraulic and should be used in good class work. Its use is a necessity for foundations and work in damp situations where Portland cement is not employed. It is used in the proportions of one part to one or two parts of sand. The best-known varieties are obtained from Watchet in Somersetshire, Barrow-on-Soar in Leicestershire, Rugby in Warwickshire, and Lyme Regis in Dorsetshire. A typical lias lime shows on analysis the following composition:—

Silica	17·53
Iron oxide	2·87
Alumina	6·83
Lime	65·84
Magnesia	1·00
Sulphuric anhydride	1·36
Water and carbon dioxide	3·85
Insoluble matter and loss	0·72
	100·00

Portland cement is the best matrix known, since it is the most powerful and the most durable. It is used for mortar wherever great strength, hard-wearing properties, and resistance to damp are required. It should weigh 112 lb per striked bushel and be ground fine enough to pass through a sieve having 2500 meshes to the square inch and leave not more than 10% residue. Test briquettes after setting under water for seven days should stand a tensile strain of 350 lb on a square inch. It is used in the proportions of one part of cement to from one to five parts of sand.

Portland cement of a similar character to the English cement, but somewhat less powerful, is largely made in America. The principal seat of manufacture is Coplay, Pa., where the first

American Portland cement was manufactured in 1874 by Mr. David O. Saylor.

The chief works of reference on this subject are G. R. Burnell, *Limes, Cements, Mortars*; Rivington, *Notes on Building Construction*; F. W. Taylor and S. E. Thompson, *A Treatise on Concrete, Plain and Reinforced*. (J. Bt.)

MORTARA, EDGAR, an Italian Jew, of a Bologna family, whose abduction in early childhood (1858) by the Inquisition occupied for several years the attention of European diplomacy. Edgar Mortara, when between five and six years of age, fell ill. His nurse, a Catholic, arranged with her priest for his baptism in that faith, unknown to his parents, on the 24th of June 1858. She had acted in the same way with his elder brother, who had been ill a year or two previously, but on his recovery the boy continued to be educated as a Jew. This time she determined to make sure of her convert. Everything was concerted in advance with the ecclesiastical authorities, and immediately after the baptism both child and nurse disappeared. The story became public property, and protest was aroused in nearly every European country. The English and French governments made representations to the Vatican, but Pius IX., through the medium of the *Civiltà Cattolica*, maintained that the question at issue was a spiritual one, outside his temporal jurisdiction. He accordingly declined to take any action, meanwhile indicating the direction of his sympathies by making Mortara his ward. In 1861 the Mortara family induced the Italian government to demand the prosecution of the nurse. The Vatican replied that she had entered a nunnery, and subsequently, on the threat of intervention by Prussia, induced the Mortara family to withdraw their plaint. After the capture of Rome by the Italian troops in 1870 Edgar Mortara had the opportunity of reverting to Judaism, but he refused to do so, and not long afterwards became an Augustinian.

MORTARA, a town of Lombardy, Italy, in the province of Pavia, 354 ft. above sea-level, a railway junction situated between the Ticino and the Po, 32 m. by rail S.W. of Milan. Pop. (1901), 7298 (town); 8697 (commune). Lines run to Milan, Pavia, Alessandria, Casale Monferrato and Vercelli. The church of San Lorenzo is in the Gothic style of the 14th century with a brick façade. Outside the town is the Lombard Romanesque church of S. Albino. Mortara has iron-works and manufactures of hats and cheese. Here the Austrians defeated the Piedmontese in 1849.

MORTGAGE (an old French legal word, meaning "dead pledge," translated in medieval Latin *mortuum vadium*),[1] the securing "money or money's worth" by making it a charge upon property, real or personal, so that if the debt be not paid by a time agreed upon by the parties, the creditor may foreclose or sell the property and pay himself out of the proceeds. In English law this is done by an actual or executory conveyance of the property to the creditor, subject only to its being defeated if the debt should be paid at the time fixed—an arrangement to which the law has attached peculiar incidents designed to carry out its real object.

The history of mortgage transactions in Roman law shows three well-marked stages. In the beginning the estate was conveyed absolutely to the creditor, who made a covenant (*fiducia*) to reconvey it when the debt should be paid. All the interest, however, in the meantime passed from the debtor to the creditor, and should the latter refuse to reconvey there was no remedy to the original owner except a personal action. In the second stage (that of *pignus*) the property did not pass to the creditor; he merely received possession of the thing pledged, together with certain rights of sale, &c., in the event of payment not being made at the time appointed. Lastly, without parting with the possession even of the pledge the debtor could create a lien or charge (*hypotheca*) over it in favour of the creditor, who acquired thereby a right on failure of payment to follow the thing by real action against the possessor, whosoever he might be, and to repay himself from the proceeds of his sale.

The mortgage of English law is the result of two distinct influences. Its origin and form belong to the common law; the restrictions by which it is made to serve the purpose of a security only, and nothing more, belong to the courts of equity. In the eye of the common law the mortgagee was the owner of the estate conveyed in the mortgage; in equity the mortgagor remains the real owner, and the mortgagee is merely an encumbrancer. A, the owner of land in freehold, conveys to B and his heirs, with a proviso that on repayment of money lent by B to A, on a future day, with interest until payment, B or his heirs will reconvey the estate to A and his heirs, and that, until default be made in payment, A and his heirs may hold without interruption from B and his heirs. This is a common mortgage of land, and at law, after failure of payment, the land belonged absolutely to the mortgagee, while in the meantime, before payment, the legal estate was considered to be vested in him, subject only to being defeated by payment at the proper time. The court of chancery first interfered in the reign of James I. to decree a redemption after forfeiture, and a case in the reign of Charles I. decides that payment after forfeiture has the same effect as payment before. The right of the mortgagor to redeem his estate after it has been forfeited, according to the terms of the deed, is called his *equity of redemption*. No agreement between the parties was suffered to oust the jurisdiction of the court, or to deprive the debtor of his equity of redemption. And this equity, at first regarded as a mere right of the debtor, became established in course of time as an estate in land which descended to the heirs of the mortgagor. On the other hand, the interest of the mortgagee is part of his personal estate, and passes to his executor and not to his heir. In spite of the terms of the mortgage, the owner of the land is still the owner, and the mortgagee is a creditor for the money he advanced and the interest thereon. It may be a question whether a given deed is a conveyance or a mortgage, and the court, in deciding, will look at all the circumstances of the case, and will treat it as a mortgage when it was the real intention of the parties that it should operate as a security only. Thus, if the price was grossly inadequate, if the purchaser was not let into immediate possession, if he accounted for the rents to the grantor, retaining an amount equivalent to interest, if the expense of the deed was borne by the grantor, there would be reason to believe that the conveyance was only meant to be a mortgage. And "once a mortgage, always a mortgage"; no subsequent agreements can change its character.

A mortgagee may, however, on default of payment file a bill of foreclosure requiring the mortgagor to pay the amount of the debt with interests or costs by an appointed day, or submit to be deprived of his equity of redemption. The effect of failure to pay by the time appointed would be to make the mortgagee absolute owner of the estate; but the court in any foreclosure suit may, at the request of either side, order a sale instead of a foreclosure. And a power of sale is now implied as one of the incidents of the mortgage, unless forbidden or varied by express destination. The mortgagee is entitled to retain out of the proceeds of the sale the amount of his principal, interest and costs, the surplus belonging to the mortgagor. A mortgagor cannot require the creditor to receive payment before the time appointed in the deed; and, on default of payment at the appointed time, he must give the creditor six months' notice of his intention to pay off the mortgage, so that the creditor may have time "to look out for a fresh security for his money."

When the same land is successively mortgaged to different persons, their rights take priority according to their chronological order. But the operation of equitable doctrines in the formation of the law of mortgage leads to an important modification of this rule. Of the successive mortgagees, the first only takes the legal estate, and this, according to the maxim of the court of chancery, will turn the scale when there is an equality of equitable rights between two contracting parties. Thus, if the third mortgagee had no notice at the time of making his advance of the existence of the second mortgagee, the equities of the two claimants are supposed to be equal, and if nothing else intervened priority of time would decide the order of their rights. But if the third mortgagee gets an assignment of the first mortgage, he can *tack* his third mortgage to the first, and so postpone the second mortgagee. And if the first mortgagee himself makes an additional advance after the date of the second mortgage, but without notice of it, his whole debt will take precedence of the second mortgage. A similar result of equitable rules is seen in the consolidation of securities. Two separate estates, mortgaged at different times and for different sums of money by the same mortgagor to the same mortgagee, are regarded as consolidated, so that the whole of the land becomes security for the whole of the money, and the owner cannot redeem either mortgage without redeeming the other. If the mortgagor should have mortgaged another estate for more than its value, the holder of the deficient security may buy in the first mortgage, consolidate it with his own, and exclude the second mortgagee.

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[1] *Coke on Littleton* gives the following explanation of the meaning: "It seemeth that the cause why it is called mortgage is, for that it is doubtful whether the feoffor will pay at the day limited such summe or not, and if he doth not pay, then the land which is put in pledge upon condition for the payment of the money is taken from him for ever, and so dead to him upon condition, &c. And if he doth pay the money, then the pledge is dead as to the tenant, &c."

An *equitable* mortgage is constituted simply by the deposit of title-deeds in security for money advanced. The enactment of the Statute of Frauds that no action shall be brought on "any contract or sale of lands," &c., or any interests in or concerning them unless the agreement be in writing and signed by the party to be charged, has been cited as incompatible with the recognition of equitable mortgages, but it is argued by Lord Abinger that the act was never meant to affect such a transaction. The deeds which are the evidence of title could not be recovered in an action at law, and, if they were claimed in equity, the court would require the claimant to do equity by repaying the money borrowed on the deposit. Any subsequent legal mortgagee, having notice of the deposit, will be postponed to the equitable mortgagee, and when the legal mortgagee has not inquired as to the title-deeds the court will impute to him such knowledge as he would have acquired if he had made inquiry. A Welsh mortgage is one in which an estate is conveyed to a creditor, who takes the rents and profits in lieu of interest and without account, the estate being redeemable at any time on payment of the principal. Any form of property, with few exceptions, may be mortgaged.

United States.—In the United States there has been express legislation dealing with mortgages of land in most of the states. For the most part legislation has followed the lines of the English law, but there is a great variation in the extent to which the principles of equity have been substituted for the rules of common law. In some states, the mortgage deed is held to create a seizin of and an estate in the premises, with all its common law incidents, to be enforced if need be by ejectment. In others, the mortgagee's rights are limited to such as the rules of equity prescribe, and may not be enforced by a suit at law. In yet others, the mortgagee's interest is not deemed an *estate* at all, but is here only to be enforced by the sale of the premises as a means of paying the debt.

See Fisher on *Mortgages*; Coote on *Mortgages*; Ashburner on *Mortgages*; L. A. Jones, *Treatise on the Law of Corporate Bonds and Mortgages* (Indianapolis, 1907).

MORTIER, EDOUARD ADOLPHE CASIMIR JOSEPH, DUKE OF TREVISO (1768–1835), marshal of France, was born at Cateau Cambrésis on the 13th of February 1768, and entered the army as a sub-lieutenant in 1791. He served in the campaigns of 1792 and 1793 on the north-eastern frontier and in the Netherlands, and subsequently on the Meuse and the Rhine. In the war against the second coalition in 1799 he was promoted successively general of brigade and general of division. His conduct of the French occupation of Hanover led Napoleon to include Mortier in the first list of marshals created in 1804. He commanded a corps of the *grande armée* in the Ulm campaign in which he distinguished himself particularly by his brilliant action of Dürrenstein; in 1806 he was again in Hanover and north-western Germany, and in 1807 he served with the *grande armée* in the Friedland campaign. In 1808 he was created duke of Treviso, and shortly afterwards he commanded an army corps in Napoleon's campaign for the recapture of Madrid. He remained in Spain for two campaigns, winning the victory of Ocaña in November 1809. In 1812 and 1813 he commanded the Young Guard, and in the "defensive" campaign of 1814 he rendered brilliant services in command of rearguards and covering detachments. In 1815, after the flight of Louis XVIII., he rejoined Napoleon and was given a high command, but at the opening of the Waterloo campaign he fell ill. After the second restoration he was for a time in disgrace, but in 1819 he was readmitted to the Chamber of Peers and in 1825 received the Order of the Saint Esprit. In 1830–1831 he was ambassador of France at St Petersburg, and in 1834–1835 minister of war and president of the council of ministers. In 1835, while accompanying Louis Philippe to a review, the marshal with eleven other persons was killed by the bomb aimed at the king by Fieschi (July 28, 1835).

MORTIFICATION, a term used in pathology and surgery, signifying a local death (Lat. *mors*) in the animal body. A portion of the body may die in consequence of the disturbance of its nutrition by inflammation, or of a cutting off of the blood-supply, as by pressure upon, or injury to, the blood-vessels. A comparatively slight injury affecting a portion of the body imperfectly supplied with blood may give rise to an inflammatory condition which in a healthy part might pass unnoticed, but which, in consequence of imperfect nutrition, may end in mortification. If the flow of arterial blood only is arrested, the part depending upon it for nutrition becomes numb, cold and shrivelled, and the form of mortification known as *dry gangrene* occurs. This is apt to be met with in oldish persons with diseased vessels and feeble heart-action, especially if the blood is rendered less nutritious by the presence of diabetes or of kidney disease. The rule of treatment in all cases of threatened mortification is to keep the part warm by flannel or cotton-wool, but to avoid all methods which unduly hurry the returning circulation. Such increase would give rise to excessive reaction, which, in tissues already weakened, might actually produce mortification. When the part is dead it should be wrapped up in dry antiseptic dressings to prevent putrefaction. The surgeon should then wait until the "line of demarcation," a linear ulceration, between the living and the dead part is evident, and then, if the case permits, should amputate at a higher level. In *spreading gangrene*, in which acute sepsis is present, and in which no line of demarcation forms, the best chance for the patient is promptly to amputate high up in sound tissues. In these cases the blood is generally poisoned, and if the patient recovers from the primary shock of the operation, the disease may reappear in the stump, and lead to a fatal result.

Frost-bite.—Under the influence of cold, the blood-vessels contract, and less blood is conveyed to the tissues. Frost-bite is particularly apt to attack the feet, the hands, and the tips of the ears. The condition is unassociated with pain, for the reason that the nerves are benumbed. As no blood is passing into the skin, the parts look like tallow, and thus attract the attention of the companions of the frost-bitten man, who perhaps has no thought of there being anything amiss. But because the tissues are frost-bitten it does not follow that they will not recover. The great danger is that, as the blood in the vessels becomes thawed, there will be so much reactionary flow through the tissues that acute inflammation will follow. And this inflammation of the damaged tissues is very likely to cause mortification. The re-establishment of the circulation, therefore, should be undertaken with the greatest possible care. The frost-bitten individual must not be brought near a fire nor even into a warm room. Nothing warm should come in contact with the affected parts. The best thing to do is to rub them with snow or with cold water. The thawing is associated with much pain, and in the case of the hand or foot this may be diminished by raising the part, so as to help the return of the venous blood to the heart. If mortification follows, the parts become black, and care should be taken to prevent their becoming invaded by the germs of putrefaction. (E. O.*)

MORTILLET, LOUIS LAURENT GABRIEL DE (1821–1898), French anthropologist, was born at Meylau, Isère, on the 29th of August 1821. He was educated at the Jesuit college of Chambéry and at the Paris Conservatoire. Becoming in 1847 proprietor of *La Revue indêpendante*, he was implicated in the Revolution of 1848 and sentenced to two years' imprisonment. He fled the country and during the next fifteen years lived abroad, chiefly in Italy. In 1858 he turned his attention to ethnological research, making a special study of the Swiss lake-dwellings. He returned to Paris in 1864, and soon afterwards was appointed curator of the museum at St. Germain. He became mayor of the town, and in 1885 he was elected deputy for Seine-et-Oise. He had meantime founded a review, *Matériaux pour l'histoire positive et philosophique de l'homme*, and in conjunction with Broca assisted to found the French School of Anthropology. He died at St Germain-en-Laye on the 25th of September 1898. Of his published works the best known are *Le Préhistorique* (1882); *Origines de la chasse, de la pêche et de l'agriculture* (1890); *Les Nègres et la civilisation égyptienne* (1884).

MORTIMER (*Family*). The Mortimers of Wigmore, earls of March and Ulster, were of a stock akin to the dukes of Normandy and to many great houses of the duchy. Their ancestor Hugh, bishop of Coutances in 990, had at least three sons by a niece of Herfast the Dane, forefather of the Norman earls of Hereford, and brother-in-law of Duke Richard I. The eldest of these sons was Ralph, father of William of Warenne, earl of Surrey. The second was Roger of Mortemer-en-Brai, in the Pays de Caux, who, like his elder brother, is called *filius episcopi*. If we assume that Roger was born before his father's consecration, he must have lived to a great age. In the battle fought within his own village of Mortemer, Roger was a leader of the force which defeated the French, but, releasing an enemy of his duke, he was punished by the loss of his castle, which was given to his nephew, William of Warenne. The chronicle of Ordericus Vitalis makes the Conqueror relate in a long death-bed speech how he had thrust Roger out of Normandy, and, though reconciled to him, had not restored the castle "in which he saved my enemy." It is somewhat remarkable that the Mortemers, thus early deprived of the castle at the source of the Eaulne, yet handed down a surname derived from it. Here also it may be noted that although Mortimer and Warenne branch off from their common stock before the beginnings of armorial bearings, the two houses assumed arms, which speak plainly enough of their common origin. The Mortimers' chief seat in Normandy became St Victor-en-Caux, where in 1074, by the last recorded act of Roger and his wife Hawise, the priory became an abbey. Roger's age would have forbidden him to be with the duke at Hastings, but, according to Wace, his son Hugh was in the fight, and Ralph the third son was probably among the knights.

By the deaths of his elder brothers, Ralph de Mortemer became heir to his father's lands. He followed his kinsman, William Fitz-Osbern, the earl of Hereford, to the marches of Wales, and the Domesday book for Hereford and Shropshire marks the growth of the Mortimer power in those countries. He remained loyal during the rising of the 2nd earl of Hereford, and was enriched by grants of many of the earl's forfeited estates, among them the castle town of Wigmore, which became the chief seat of Mortimer and Cleobury, thereafter called Cleobury Mortimer. His Domesday lands lie in eleven counties, but the most important are found in North Hereford and South Shropshire. Although keeping apart from the treason of Earl Roger, Ralph rose in 1188 with the other barons of the March, but was reconciled to William II., whom he afterwards supported in Normandy. He was living in 1104 a partisan of Henry I., and must have died soon afterwards. Hugh de Mortimer, who is found as his successor, a great Herefordshire baron in 1140, may have been either the son of Ralph's old age, or a grandson, the son of another Ralph. During the reign of Stephen, Hugh occupied himself with local feuds, but seized the royal castle of Bridgnorth. So great was his power in the marches, that he alone, deserted by the earl of Hereford, armed and held his three castles against Henry II. Although forced at last to submit, he was allowed to keep Wigmore and the ruins of Cleobury. This proud baron died at Cleobury (*c.* 1181) in the habit of a canon of the abbey which he had founded at Wigmore.

Ralph de Mortimer, the 5th baron of Wigmore (d. 1246), married Gwladys the Swart, daughter of Llewelyn the Great, prince of Wales, and by her was father of Roger, whose bride, Maude de Breuse, daughter and co-heir of that William de Breuse whom Llewelyn had hanged, brought in a third of the honour of Breuse of Brecknock, and a share of the honour of the earls marshal. So came the lordship of Radnor with other lands, and, as Eyton justly remarks, the history of the Mortimers ceases to be a provincial record. The last-named Roger stood steadfast for the Crown during Henry III.'s struggle with his barons. He found the fleet horse that carried Edward from his captivity. He led the rear-guard at Evesham, where his marchers hacked the head from earl Simon, and sent it to their lady at Wigmore. "After that victory," says Eyton, "no privilege, reward or honour was too great for Mortimer to ask." Dying in 1282, he was succeeded by Edmund, the eldest surviving son (d. 1304), Roger, a third son, founding the line of Mortimer of Chirk.

By Margaret de Fiennes, a kinswoman of Queen Eleanor of Castile, Edmund Mortimer had, with other issue, a son and heir, Roger (b. 1287), whose great inheritance was increased on his marriage with Joan, daughter and heir of Peter de Geneville, her grandmother being a co-heir of Lacy. The whole of the Geneville lands, with the half of the Lacy fief in England and Ireland, came through her to the Mortimers, who now added the castle town of Ludlow and half Meath to their estates. As the king's lieutenant in Ireland during Edward Bruce's invasion of 1316, Roger Mortimer defeated the Lacys, his wife's jealous kinsfolk, and made her inheritance secure. With the aid of his uncle Roger Mortimer of Chirk, he assured the Mortimer power on the Welsh marches. During the war with the Despensers, the force of the Mortimers was cast against the king and his favourites, but after Bridgnorth Castle had been taken and fired, uncle and nephew submitted and suffered a harsh captivity for two years in the Tower of London. The uncle died in his prison, whence the nephew made a famous escape to France. At the court of Charles IV. the exile met Isabel, the queen of England, and early in 1326 the scandal of her close friendship with the lord of Wigmore had reached England. When the queen and her mercenaries from Germany and Hainaut landed at an English port in September, Mortimer was with her, and he followed the flight of the king to Wales. He was among the judges of the elder Despenser at Bristol, and of the younger, his chief enemy, at Hereford. After the parliament had deposed Edward II. and made the young Edward king in his stead, Roger, as the queen's paramour, ruled England. Enriched by the lands of the Despensers, and by those of the earl of Arundel, beheaded at his command, Mortimer, who was created earl of March in 1328, never ceased to add greedily to his possessions and offices. When he held a Round Table, he summoned to it, with the young king and the queen-mother, almost all the nobles of the kingdom, and was, says Robert of Avesbury, "as it were, king over them all." But his fate followed suddenly upon these doings. Lancaster turned in vain upon the aggrandized march-lord, but the young king, impatient of his own puppet-like place in Mortimer's polity, worked secretly and surely for his fall. Montague's men-at-arms entered Nottingham Castle by night, and joining the king, seized the favourite in his chamber next the queen. Mortimer, with the courage of his race, turned to bay and struck dead a knight who was the king's steward. But he was hurried to London and condemned by the peers; his death followed suddenly. Like any foot-pad, he was drawn at the horse-tail to the elms of Tyburn, where his body hung two days upon the common gallows.

The earl's son and heir, Edmund Mortimer, had been married to Elizabeth of Badlesmere, heir of her brother Giles. He died the year after his father's fall, and his young son Roger, as he grew up, was restored to a great part of their forfeited inheritance. This Roger fought at Crécy in "the king's battle." A founder of the Order of the Garter, he was summoned as a baron and obtained a reversal of his grandfather's attainder. In 1355 he was summoned as earl of March. On the death of his grandmother, Ludlow Castle became the chief seat of his house. But following his king in the invasion of Burgundy, he died suddenly at Rouvray in 1360. His wife, a grand-daughter of that William Montague, earl of Salisbury, who had captured his grandfather at Nottingham, survived him two-and-twenty years.

His only son, Edmund, a boy nine years old, succeeded him as 3rd earl of March (1351–1381). A bride was found for him in the royal house. His marriage with Philippa, daughter of Lionel of Antwerp, duke of Clarence, by Elizabeth de Burgh, the heir of Ulster, added the earldom of Ulster to his style, and brought his issue into the direct succession of the Crown. Like so many of his race, he died young, of a chill caught in fording a Munster river on a winter's day, and his countess was dead before him. Elizabeth, their eldest child, became the wife of the famous Harry Percy, called Hotspur. Their second was Roger, who succeeded to his father's two earldoms as a boy of seven, and was at once appointed lieutenant of Ireland. His marriage was given to the earl of Kent, who married him to his daughter, Eleanor Holand, the niece of King Richard. In the parliament of 1385 the king named him as heir-presumptive to the throne. The panegyrists of his family are loud in their praise of his knightly doings and his great beauty, but they speak also of his lion-like ferocity, of his lasciviousness, and of his neglect of divine things. When in Ireland he defied the statute of Kilkenny, and ordered his garments and horse-harness after the fashion of an Irish chieftain. He wore the Irish mantle on the day in 1398 when, in one of his petty wars with the Leinster men, he was struck down at Kells as he charged far before his horsemen. The body, mangled by Irish skenes and axes, was brought home to be laid by his fathers in their abbey of Wigmore.

Once more a child succeeded to the earldoms. Edmund, 4th earl of March, was six years old at his father's death, and was, for the king's party, the heir-presumptive of the kingdom. But in 1399 the boy's fate was changed by the coming to power of the Lancastrian party, and Henry IV.'s first parliament recognized Henry's son as heir-apparent. Although Edmund and his brother Roger were brought up honourably with the new king's younger children, they were in strict custody until the king's death, broken only by the attempt of their uncle, Sir Edmund Mortimer, and his father-in-law, Owen Glyndwyr, to carry them off from Windsor to Wales, where the young earl would have been proclaimed king. Henry V., however, released the earl and restored his lands, and absolved March from any share in the plot of the earl of Cambridge, who had married Anne, sister of the earl. March served the king in his French wars, although a dysentery caught in the camp at Harfleur seems to have kept him from his share in the glory of Agincourt. On the accession of Henry VI. the earl was appointed to the lieutenancy of Ireland which had been held by his father and grandfather, and in Ireland, on the 19th of January 1425, he died suddenly of the plague. His wife, Anne, daughter of Edmund, earl of Stafford, had borne him no child, and thus, his brother being dead before him, the illustrious house of the Mortimers, earls of March and Ulster, became extinct. Their lands and earldoms passed to Richard, duke of York, son of Richard of Cambridge, by the last earl's sister, and the great name of Mortimer disappeared from the English baronage.

AUTHORITIES.—*Victoria History of the Counties of England*—Introductions to Domesday book for Hereford and Shropshire; Eyton's *Antiquities of Shropshire*; *Dictionary of National Biography*; Dugdale's *Monasticon*; Stapleton's *Rotuli Scaccarii Normanniae*; G. E. C.'s *Complete Peerage*; Rymer's *Foedera*; *Journal of the British Archaeological Association*, vol. xxiv. Inquests, post mortem, close, patent and charter rolls, &c. (O. BA.)

MORTISE, or MORTICE (adapted from the Fr. *mortaise*; cf. Ital. *mortise* and Spanish *mortaja*; the origin is unknown; Celtic equivalents, such as Gaelic *moirteis*, are of French origin), a term for a socket or cavity cut in a piece of wood, or other material, into which a corresponding projecting end, a "tenon," fits, the two when fitted together forming a "mortise-joint," for fastening two beams or other pieces of timber together.

MORTLAKE, a village in the Kingston parliamentary division of Surrey, England, on the Thames, 6½ m. W. of London. Pop. of parish, which includes East Sheen (1901), 7774. It has been associated with the Oxford and Cambridge boat-race since 1845, the race finishing here. The village appears in Domesday, and the manor belonged to the Archbishops of Canterbury until the time of Henry VIII., when it passed by exchange to the Crown. From the early part of the 17th century until after the civil wars Mortlake was celebrated for a manufacture of tapestry.

MORTMAIN (O. Fr. *mortemain*; med. Lat. *mortua manus*, dead hand), the state or condition of lands or tenements when held by a corporation in perpetual or inalienable tenure. Alienation in mortmain having the effect of depriving the lord of the incidents of seignory, which arose through the death or felony of the tenant or failure of his heirs, many English statutes were passed directed against such alienation. The earliest is that of Henry III. 36 (Magna Carta); others being 7 Edward I. 13 (De Viris Religiosis); 13 Edward I. 32; 15 Richard II. 5; and 23 Henry VIII. 10. The present law is regulated by the Mortmain and Charitable Uses Act 1888, as amended by the act of 1891.

MORTON, JAMES DOUGLAS, 4TH EARL OF (*c.* 1525–1581), Scottish statesman, was the second son of Sir George Douglas of Pittendriech. Before 1543 he married Elizabeth (d. 1574), daughter of James Douglas, 3rd earl of Morton, a grandson of James Douglas (d. *c.* 1500), who was created earl of Morton in 1458. The 3rd earl's wife was Catherine, an illegitimate daughter of James IV. In 1553 James Douglas succeeded to the title and estates of his father-in-law, and in 1563 he became lord high chancellor of Scotland. Though his sympathies were with the reformers, he took no part in the combination of Protestant barons in 1565, but he headed the armed force which took possession of Holyrood palace in March 1566 to effect the assassination of Rizzio, and it was to his house that the leading conspirators adjourned while a messenger was sent to obtain Mary's signature to the "bond of security." The queen, before complying with the request, escaped to Dunbar, and Morton and the other leaders fled to England. Having been pardoned, Morton returned to Scotland early in 1567, and with 600 men appeared before Borthwick Castle, where the queen after her marriage with Bothwell had taken refuge. He was present at the remarkable conference at Carberry Hill, and he also took an active part in obtaining the consent of the queen at Lochleven to an abdication. He led the army which defeated the queen's forces at Langside in 1568, and he was the most valued counsellor of the earl of Murray during the latter's brief term of office as regent. On the death of the earl of Mar (Oct. 28, 1572), Morton, who had been the most powerful noble during this regency, and also during that of the earl of Lennox, at last reached the object of his ambition by being elected regent. In many respects Morton was an energetic and capable ruler. He effected at Perth, in February 1573, with the aid of Elizabeth's envoy, a pacification with Huntly, the Hamiltons, and the Catholic nobles who supported Mary. Only the castle of Edinburgh held out, and this, aided by English artillery, he succeeded in taking after a brave resistance by Kirkcaldy of Grange and Maitland of Lethington.

The ensuing execution of these men, the bravest and the ablest Scotsmen of that age, put an end to the last chance of Mary's restoration by native support. But while all seemed to favour Morton, there were under-currents which combined to procure his fall. The Presbyterian clergy were alienated by his leaning to Episcopacy, and all parties in the divided Church by his seizure of its estates. Andrew Melville, who had succeeded to the leadership of Knox, was more decided than Knox against any departure from the Presbyterian model, and refused to be won by a place in his household. The powerful earl of Argyll and Atholl, a Stuart and Roman Catholic, united with Alexander Erskine, governor of Stirling, who now had the custody of the young king, and others in a league which received so much support that Morton bent before the storm and offered to resign. He surrendered the castle of Edinburgh, the palace of Holyrood, and the royal treasures, retiring to Lochleven, where he busied himself in laying out gardens. But his ambition could not deny itself another stroke for power. Aided by the young earl of Mar, he got possession of Stirling Castle and the person of the king. Civil war was avoided only by the influence of Sir Robert Bowes, the English ambassador. A nominal reconciliation was effected, and a parliament at Stirling introduced a new government. Morton, who secured an indemnity, was president of the council, but Atholl remained a privy councillor in an enlarged council with the representatives of both parties. Shortly afterwards Atholl died of poison, it was said, and suspicion pointed to Morton. His return to power was brief, and the only important event was the prosecution of the two Hamiltons, who still supported Mary and saved their lives by flight to England. The final fall of Morton came from an opposite quarter. In September 1579 Esmé Stuart, the king's cousin, came to Scotland from France, gained the favour of James by his courtly manners, and received the lands and earldom of Lennox, the custody of Dumbarton Castle, and the office of chamberlain. One of his dependants, Captain James Stuart, son of Lord Ochiltree and brother-in-law of Knox, had the daring to accuse Morton at a meeting of the council in Holyrood of complicity in the murder of Darnley, and he was at once committed to custody. Some months later Morton was condemned by an assize for having taken part in that crime, and the verdict was justified by his confession that Bothwell had revealed to him the design, although he denied participation in its execution. He was executed by the maiden—a guillotine he had himself brought from England—on the 2nd of June 1581.

The attainted earldom of Morton passed by charter at his death to a grandson of the 3rd earl, John, 7th Lord Maxwell (1553–1593), who had previously claimed the title. In 1586, however, the attainder was rescinded in favour of Archibald Douglas, 8th earl of Angus (*q.v.*), a nephew of the 4th earl. Various earls of Morton have now to be distinguished.

Sir William Douglas (d. 1606), who ranks as 6th or 7th earl of Morton, was the 4th earl's near kinsman, being the son of Sir Robert Douglas of Lochleven (d. 1547), and was closely associated with him in his career, the two men being occasionally confused in the histories. He was the custodian at Lochleven Castle of Queen Mary. By the 4th earl's will he succeeded in 1588 to the earldom of Morton, on the death of Archibald, 8th earl of Angus; but Lord Maxwell's title of Morton, which had been revoked in 1585, was revived in 1587 and 1592, so that both men were in possession, and a conflict arose. Sir William Douglas was succeeded by his grandson William (1582–1649), known as 7th or 8th earl of Morton, lord high treasurer of Scotland, a zealous Royalist, who on the outbreak of the Great Rebellion provided £100,000 for the cause by selling his Dalkeith estates to the Buccleuch family; and though John, 8th Lord Maxwell (*c.* 1586–1613), also claimed the earldom, he was attainted in 1609 and his rights then failed, his titles and estates being restored in 1618 to his brother Robert, with the title of earl of Nithsdale (1620) in lieu of Morton. Among later earls of Morton mention may be made of James (1702–1768), 14th earl (or, as sometimes numbered, 16th), who became president of the Royal Society (1764), and was a distinguished patron of science, and particularly of astronomy. In 1746 he visited France, and was imprisoned in the Bastille, probably as a Jacobite. The present earl of Morton is his descendant.

MORTON, JOHN (*c.* 1420–1500), archbishop of Canterbury, cardinal and statesman, belonged to a family which had migrated from Nottinghamshire into Dorset, and was born either at Bere Regis or Milborne St Andrew. Educated at the neighbouring Benedictine abbey of Cerne and at Balliol College, Oxford, he graduated in law, and followed that profession in the ecclesiastical courts in London, where he attracted the notice of Archbishop Bourchier. He is said (*Dict. Nat. Biog.*) to have been "at once admitted to the privy council"; but probably this is a mistake for the ordinary council, of which Morton might well have been made a member when he was appointed master in chancery and chancellor of the duchy of Cornwall. He received a good deal of ecclesiastical preferment from the Lancastrian party, was present, if he did not fight on the losing side, at the battle of Towton in 1461, and was subsequently attainted by the victorious Yorkists. He lived with the exiled court of Margaret of Anjou at Bar until 1470, and took an active part in the diplomacy which led to the coalition of Warwick and Clarence with the Lancastrians and Louis XI., and indirectly to Edward IV.'s expulsion from the throne. Morton landed with Warwick at Dartmouth on the 13th of September 1470, but the battle of Tewkesbury finally shattered the Lancastrian hopes, and Morton made his peace with Edward IV., probably through the mediation of Archbishop Bourchier.

In March 1473 Morton was made master of the rolls, and Edward found employment for his diplomatic talents; he was sent on a mission to Hungary in 1474, and was one of the negotiators of the Treaty of Pecquigny in 1475. In 1479, after receiving a number of minor ecclesiastical promotions, he was elected bishop of Ely. He was one of the executors of Edward IV.'s will in 1483, and the story of the future Richard III., while preparing Morton's arrest, joking with him about the strawberries the bishop grew in his garden at Holborn is well known and apparently authentic. Oxford University in vain petitioned for Morton's release, and after some weeks in the Tower he was entrusted to the duke of Buckingham's charge at Brecknock. Here Morton encouraged Buckingham's designs against Richard, and put him into communication with the queen dowager, Elizabeth Woodville, and with Henry Tudor, earl of Richmond. He escaped from Brecknock Castle to Flanders, avoided Buckingham's fate, and devoted his energies during the next two years to creating a party in England and abroad in the interests of the earl of Richmond.

When Richmond secured the crown as Henry VII. Morton became his principal adviser. He succeeded Bourchier as archbishop of Canterbury in 1486 and Alcock as lord chancellor in 1487; and he was responsible for much of the diplomatic, if not also of the financial, work of the reign, though the ingenious method of extortion popularly known as "Morton's fork" seems really to have been the invention of Richard Fox (*q.v.*), who succeeded to a large part of Morton's influence. Morton no doubt impressed Lancastrian traditions upon Henry VII., but he cannot be credited with any great originality as a statesman, and Henry's policy was as much Yorkist as Lancastrian. The fact that parliament continued to meet fairly often so long as Morton lived, and was only summoned once by Henry VII. after the archbishop's death, may have some significance; but more probably it was simply due to the circumstance that Morton's death synchronized with Henry's achievement of a security in which he thought he could almost dispense with parliamentary support and supplies. As an ecclesiastic Morton followed orthodox Lancastrian lines: in 1489 he obtained a papal bull enabling him to visit and reform the monasteries, and he proceeded with some vigour against the abuses in the abbey of St Albans. In 1493 he was created a cardinal, and in 1495 was elected chancellor of the university of Oxford. He encouraged learning to the extent of admitting Sir Thomas More into his household, and writing a Latin history of Richard III., which More translated into English. He constructed "Morton's Dyke" across the fens from Wisbech to Peterborough, repaired the episcopal palace at Hatfield and the school of canon law and St Mary's Church at Oxford. He died at Knole on the 12th of October 1500, and was buried in the crypt of Canterbury Cathedral.

Besides the authorities cited in the *Dict. Nat. Biogr*, see the recently published calendar of Patent Rolls, 1461–1485, *passim*; W. Busch, *England under the Tudors* (1892); J. Gairdner, *Henry VII.* (1889) and *Lollardy and the Reformation* (1908), and *Political History of England*, vols. iv. and v. (Longmans). (A. F. P.)

MORTON, JOHN MADDISON (1811–1891), English playwright, was born at Pangbourne, on the 3rd of January 1811. He was the author of *Box and Cox* (1847) and a number of other farces. In later life, however, he failed to maintain his success, and eventually became a Charterhouse pensioner, dying on the 19th of December 1891.

His father, Thomas Morton (1764?–1838), also a well-known dramatist, was the author of *Columbus, or a World Discovered* (1792); *Speed the Plough* (1798); *The School of Reform, or How to Rule a Husband* (1805); *A Roland for an Oliver* (1819); and other pieces.

MORTON, LEVI PARSONS (1824–), American banker and politician, was born at Shoreham, Vermont, on the 16th of May 1824.[1] He was in business at Hanover, New Hampshire, in 1843–1849 and in Boston in 1849–1854. He then became a partner in a New York dry-goods house. He established in 1863 the banking house of L. P. Morton & Company (dissolved 1899), with a London branch which had Sir John Rose (1820–1888) as its principal member. The American firm assisted in funding the national debt at the time of the resumption of specie payments, and the London house were fiscal agents of the United States government in 1873–1884, and as such received the $15,500,000 awarded by the Geneva Arbitration Court in settlement of the "Alabama Claims" against Great Britain. In 1899 Morton became president of the Morton Trust Company in New York City. He was a Republican representative in Congress in 1879–1881, United States minister to France in 1881–1885, vice-president of the United States during the presidency of Benjamin Harrison in 1889–1893, and in 1895–1896 was governor of New York, signing as such the "Greater New York" bill and the liquor-tax measure known as the "Raines law." In 1896 he was a candidate for the presidential nomination in the Republican national convention.

MORTON, OLIVER PERRY (1823–1877), American political leader, "war governor" of Indiana, was born in Salisbury, Wayne county, Indiana, on the 4th of August 1823. After studying for two years (1843–1845) at Miami University, he practised law at Centerville, Indiana, and in 1852 was judge of the sixth judicial circuit of Indiana. In February 1856 he was a member of the Pittsburg convention which led to the organization of the national Republican party, and in the same year he was a candidate for governor of Indiana; he was defeated, but his campaign resulted in the effective organization of the new party in his state. He was elected lieutenant-governor in 1860, and when Henry S. Lane (1811–1881), the governor, resigned, on the 16th of January 1861, Morton became governor. In 1864 he was re-elected. In meeting all the extraordinary demands resulting from the Civil War he displayed great energy and resourcefulness, and was active in thwarting the schemes of the secessionists in the neighbouring state of Kentucky, and of the Knights of the Golden Circle, the Order of American Knights, and the Sons of Liberty (secret societies of Southern sympathizers and other opponents of the war) in Indiana. In 1863 a hostile legislature sought to deprive him of all control over the militia, and failing in this, adjourned without making the appropriations necessary for carrying on the state government. In this predicament Morton appointed a bureau of finance, and appealed for financial aid to private individuals, bankers, the counties, and even the Federal government. The response was so prompt that he was able to conduct affairs practically single-handed until 1865, when a legislature more favourable to his policies assembled. In 1865, when Morton had a paralytic stroke and went to Europe for treatment, the president entrusted him with a confidential mission to Napoleon III. concerning the withdrawal of the French troops from Mexico. Morton resigned as governor in January 1867 to accept a seat in the United States Senate, in which he served during the rest of his life. He was recognized as one of the leaders of the Radical wing of his party, voting in favour of Johnson's impeachment, and being especially active on behalf of negro suffrage. In 1870 Grant offered to appoint him minister to Great Britain, but he declined the honour on perceiving that a Democrat would succeed him in the Senate. He was a candidate for the Republican nomination for the presidency in 1876, and at the national convention of his party received 124 votes on the first ballot; the nomination, however, finally went to Rutherford B. Hayes. He died at Indianapolis on the 1st of November 1877.

See William D. Foulke, *Life of Oliver P. Morton* (2 vols., Indianapolis, 1899).

MORTON, THOMAS (1564–1659), English bishop, was born at York, and was educated at York and Halifax grammar-schools and St John's College, Cambridge, where he became fellow on taking his degree. He was ordained in 1592, and held the office of university lecturer in logic till in 1598 he was presented to the living of Long Marston, Yorkshire. He gained a considerable reputation as a Protestant controversialist, and published numerous works against Roman Catholicism, chief among them being the *Apologia catholica* (1605) and *A Catholicke Appeale* (1609). He held successively the deaneries of Gloucester (1606), Winchester (1609), and a canonry at York (1610). In 1616 he became bishop of Chester, in 1618 bishop of Lichfield and Coventry, and in 1632 bishop of Durham. On the abolition of the episcopate in 1646 he was assigned a pension, but it was never paid, and the remainder of his life was passed in retirement.

MORTON, THOMAS (*c.* 1590–1646), usually called Thomas Morton of Merrymount, English adventurer in America, was a lawyer of Clifford's Inn, London, and seems to have practised in the west of England. He spent three months in America in 1622; returned in 1625, and settled at Mount Wollaston, in what is now Quincy, Massachusetts; and in 1626, when most of the settlers removed to Virginia, he assumed command of the settlement, and renamed it Merrymount.[2] Morton, a Royalist rake, soon became a thorn in the flesh of the sober colonists at Plymouth. On May-Day in 1627 his companions erected a May-pole, and, assisted by Indians, indulged in all the revelry and licence then customary in England. "The setting up of this May-pole was a lamentable spectacle to the precise Separatists that lived at New Plimmouth," says Morton. "They termed it an Idoll; yea, they called it the Calf of Horeb, and stood at defiance with the place, ... threatening to make it a woefull mount and not a merry mount." In disregard of a royal proclamation, Morton sold rum and fire-arms to the natives, not only injuring the trade of Plymouth, but also endangering the safety of the colonists. Morton was therefore arrested and sent to England; and when John Endecott, with a patent from the council for New England, arrived soon afterward he visited Merrymount, which lay within his jurisdiction, rebuked the inhabitants, cut down the May-pole, and renamed the place Mount Dagon. In 1629 Morton returned to America, but was arrested on trivial charges by the Massachusetts authorities, and was confined in the stocks. Later his house was burned and he was sent to England, where he spent a term in the Essex gaol. After his release he wrote his *New English Canaan* (1637), in which he describes the Indians and the natural features of the country, and heaps ridicule upon the New England colonists. In 1643 Morton returned to America. He was imprisoned in Boston in the following year, and was tried before the general court for complaining against the colony before the Privy Council; he was recommitted to gaol pending the gathering of further evidence, and after a year's confinement was fined £100 and released. He retired to Agamenticus (now York), Maine, and in 1646 died poverty-stricken.

See the *New English Canaan*, edited by Charles Francis Adams (Publications of the Prince Society, vol. ix., Boston, 1883); C. F. Adams, *Three Episodes of Massachusetts History* (Boston, 1896); and, for a more favourable view of Morton, *A Few Observations on the Prince Society's Edition of the New English Canaan*, revised and reprinted from the *Churchman* (New York, 1883). Morton's adventures have furnished material for Nathaniel Hawthorne's short story, *The Maypole of Merrymount*, and for John Lothrop Motley's novels, *Morton's Hope* (1839) and *Merry Mount* (1849).

MORTUARY (Med. Lat. *mortuarium*, from *mortuus*, dead), of or belonging to the dead, or, in particular, to the burial of the dead. The chief modern use of the word is for a building in which dead bodies awaiting burial may be temporarily kept, for the purpose of inquiry, identification, post-mortem examination, &c. But it has also been applied to many subjects connected with death and burial. In monastic institutions it was the duty of the almoner to send round to other monastic houses notice of the death of a member, asking for prayers for the soul of the dead. This notice was often beautifully illuminated. On being returned with the endorsement of the monastery to which it had been sent, it would be copied into the roll. Both the notice and the roll were known as a *mortuarium*, or mortuary (see Abbot F. H. Gasquet's *English Monastic Life*, 1904). In the English Church a "mortuary" was in certain places a customary oblation or offering paid out of the estate of a deceased person to the church to which he belonged. An act of 1529 (21 Hen. VIII. c. 6) limited the amount to be paid in mortuaries, the highest being of the value of 10s. in estates above £40. Mortuaries, where customary, can only be enforced in the ecclesiastical courts. The custom has entirely died out, though claims have been made from time to time.

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[1] His earliest ancestor in America was George Mourt, or Morton (d. 1624), a merchant of York, England, who seems to have been in London in 1621–1622 as financial agent for the Plymouth colonists. He published *Mourt's Relation, or Journal of the Beginning and Proceedings of the English Plantation at Plimoth* (1622), apparently written by William Bradford and Edward Winslow, and went to Plymouth, Mass., in the "Anne" in 1623.

[2] In his book Morton indulges his fondness for punning and display of Latinity by calling the place Mare-Mount (Hill by the sea).

MORVAN, an elevated region forming the northern continuation of the central plateau of France, and extending over a large part of the department of Nièvre, and over portions of those of Yonne, Côte-d'Or and Saône-et-Loire. Its area is a little over 1000 sq. m. The average elevation is about 1600 ft., the culminating point the Bois-du-Roi, attaining 2959 ft. It is traversed by the Yonne, which has its source on Mt Prénelay (2789 ft)., by the Cure and by several affluents of the Arroux. Geologically it consists chiefly of gneiss and granite. It contains much good pasturage and is abundantly wooded, the exploitation of its forests affording employment to large numbers of the inhabitants.

MORVI, a native state of India, in Kathiawar, within the Gujarat division of Bombay. Area, 822 sq. m.; pop. (1901), 87,496, showing a decrease of 17% in the decade, due to famine; estimated revenue, £48,000; tribute, £4000. The chief, whose title is Thakur sahib, is a Jadeja rajput, of the same clan as the rao of Cutch. The chief products are cotton and grain. The town of Morvi is situated on the river Machhu, 22 m. from the sea and 35 from Rajkot; pop. (1901) 17,820.

MORVILE, HUGH DE, one of the four English knights who perpetrated the murder of Becket. He appears in the service of Henry II. from 1158. His principal estate was at Burgh-on-Sands. After the archbishop's murder Hugh and his associates at first took refuge in Knaresborough Castle; afterwards the king sent them to obtain absolution from the pope. The story runs that all four were enjoined to go on pilgrimage to the Holy Land, but it is not known whether Hugh made his expiation in this way. The date of his death is unknown, but it was in or before 1202/3, when we find his English lands in the hands of his two daughters as co-heiresses.

See Eyton's *Itinerary of Henry II.*; Ramsay, *Angevin England.*

MORYSON, FYNES (1566–1630), English traveller and writer, was the son of a Lincolnshire gentleman, Thomas Moryson, member of parliament for Grimsby. After being educated at Cambridge, where he gained a fellowship at Peterhouse, Fynes Moryson spent many years in travel on the continent of Europe, in Palestine, and in Asia Minor. In 1600 he became secretary to Sir Charles Blount, lord-deputy of Ireland, in which country his brother, Sir Richard Moryson, held an important government appointment. In 1617 Moryson published an account of his travels and of his experiences in Ireland, where he witnessed O'Neill's rebellion, in a voluminous work entitled *An Itinerary.* He died on the 12th of February 1630. The *Itinerary* was originally intended to consist of five parts; but only three were printed, a fourth being preserved in manuscript in the library of Corpus Christi College, Oxford (partially printed in 1903 in Charles Hughes's *Shakespeare's Europe*). Another part of the *Itinerary* was republished in 1735 with the title *History of Ireland 1599–1603, with a short Narrative of the State of the Kingdom from 1169*; and in 1890 Henry Morley included in the "Carisbrooke Library" a volume, *Ireland under Elizabeth and James I., described by Spenser, Sir John Davies and Fynes Moryson.* The *Itinerary* is a work of great value to the historian as a truthful picture of the social conditions prevailing in Europe at the beginning of the 17th century.

MOSAIC (corresponding to Lat. *opus musivum*, from Gr. *μουσεῖον*, an artificial grotto often decorated with mosaics; the word is only found in the sense of mosaic in late Greek, which generally uses *ψηφολόγημα*), the fitting together of many, generally small, pieces of marble, opaque glass, coloured clays, or other substances, so as to form a pattern.

Ancient Mosaic.—The earliest existing specimens of mosaic belong to one of the less important branches of the art—namely, the ornamentation on a small scale of jewellery, ivory thrones, and other furniture, or more rarely of some elaborate architectural ornament. Most of this sort of mosaic resembles in execution what are called cloisonné enamels. In the Louvre and in the British Museum are preserved some very beautiful ivory carvings in low relief, some from Nineveh and others from Egypt, in which figures of deities, ornaments formed of the lotus and papyrus plants and royal cartouches are enriched by small pieces of glass or lapis-lazuli and other gem-like stones, which are let into holes made in the ivory. Each minute piece is separated from the next by a thin wall or cloison of ivory, about as thick as cardboard, which thus forms a white outline and sets off the brilliance of the coloured stones.

Excavations at Tel-el-Yehudia in Lower Egypt have brought to light some mosaics on a larger scale, but treated in the same way. These are caps of columns, wall tiles, and other objects, either of white limestone or earthenware, in which designs, chiefly some forms of the papyrus, are formed by bits of glass or enamelled earthenware, let into a sinking in the tile or column. This form of mosaic was employed by the Greeks: the Erechtheum at Athens, built in the middle of the 5th century B.C., had the bases of some of its white marble columns ornamented with a plait-like design, in which pieces of coloured glass were inserted to emphasize the main lines of the pattern.

Another, quite different, sort of mosaic was known to the Egyptians of the Ptolemaic and Roman periods. This is made entirely of glass and is extremely minute. The finest known specimen is in the British Museum: it is a small tablet about $\frac{3}{8}$ in. square, apparently the bezel of a ring, on which is represented the sacred hawk—every feather on the bird's wing being produced with a great number of colours and tints, each quite distinct, and so minute that a strong magnifying glass is required to distinguish its details,

The way in which this mosaic was produced is extremely ingenious. Numbers of long sticks of various-coloured glass were arranged in such a way that their ends produced the figure of the hawk; other sticks of blue glass were placed all round so as to form the ground. The whole bundle of sticks of glass when looked at endwise now presented the figure of the hawk with a blue background, immensely larger than it afterwards became. The bundle was then heated till the sticks melted together, and the whole thick rod, softened by fire, was drawn out to a greatly diminished thickness. A slice of the rod was then cut off and its faces polished—the design, much reduced in size, of course being equally visible at both sides of the slice; and thus the microscopic minuteness of the mosaic was produced with astonishing delicacy and refinement; many slices, each showing the same mosaic. could be cut from the same rod.

Far more important was the use of mosaic on a large scale, either for pavements or for walls and vaulted ceilings. We are told by Pliny (*H. N.* xxxvi. 184) that the practice of decorating pavements "after the fashion of painting" was due to the Greeks, and there is no reason to doubt the truth of this statement, although no mosaic pavement discovered in Greece can be dated with certainty to a period preceding the Roman occupation. This is true even of the pavement in the temple of Zeus at Olympia (fig. 1; *Olympia, Baudenkmäler*, vol. ii. pl. cv.).

The simplest classification of mosaics is that of Gauckler (Daremberg and Saglio, *Dictionnaire des antiquités, s.v.* "Musivum Opus"), who distinguishes the following:—

a. Opus tessellatum, consisting of cubes of marble or stone, regularly disposed in simple patterns. This was largely used for pavements, especially in Roman times.

b. Opus vermiculatum, consisting of cubes (not always regularly shaped) generally of coloured marble[1] or more precious materials, when these were obtainable, disposed so as to obtain a pictorial effect. The *art* of mosaic is mainly concerned with this branch of work.

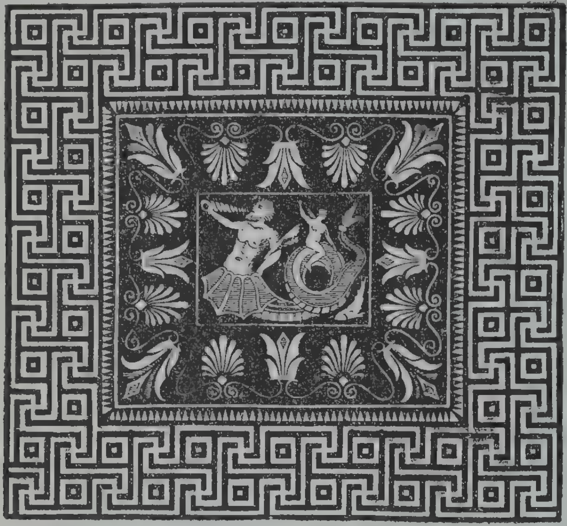
FIG. 1.—Greek Pavement from the Temple of Zeus at Olympia.

c. Opus musivum, properly applied to the mosaic decoration of walls and vaulted ceilings (*camerae*), in which cubes of glass or enamel were used. The glass was rendered opaque by the addition of oxide of tin, and coloured with other metallic oxides; when melted it was cast into flat slabs, generally about ½ in. thick, and then broken into small cubes.

d. Opus sectile, a species of marqueterie in marble or other coloured materials used to produce pictures and patterns. Under the later empire a particular variety of this, called *opus alexandrinum*[2] mainly composed of porphyry, red and green,[3] was much in use.

Judging from the description given by Vitruvius (vii. 1), and an examination of numerous specimens of Roman tessellated mosaics, the process of manufacture was the following. The earth was first carefully rammed down to a firm and even surface; on this was laid a thick bed of stones, dry rubbish, and lime, called "rudus," from 6 to 9 in. deep, and above this another layer, 4 to 6 in. thick, called "nucleus," of one part of lime to three of pounded brick, mixed with water; on this, while still soft, the pattern could be sketched out with a wooden or metal point, and the tesserae or small bits of marble stuck into it, with their smoothest side uppermost. Lime, pounded white marble, and water were then mixed to the consistency of cream, forming a very hard-setting cement, called *marmoratum*. This cement, while fluid, was poured over the marble surface, and well brushed into all the interstices between the tesserae. When the concrete and cement were both set, the surface of the pavement was rubbed down and polished.

The usual Roman pavement was made of pieces of marble, averaging from half to a quarter of an inch square, but rather irregular in shape. A few other, but quite exceptional, kinds of mosaic pavements have been found, such as that at the Isola Farnese, 9 m. from Rome, made of tile-like slabs of green glass, and a fine "sectile" pavement on the Palatine Hill, made of various-shaped pieces of glass, in black, white, and deep yellow. In some cases—*e.g.* in the "House of the Faun" at Pompeii—glass tesserae in small quantities have been mixed with the marble ones, for the sake of greater brilliance of colour.

Few countries are richer than England in remains of Roman mosaics; the great pavements of York, Woodchester, Cirencester, and many other places are as elaborate in design and as skilfully executed as any that now exist even in Rome itself. In whatever country these mosaics are found, their style and method of treatment are always much the same; the materials only of which the tesserae are made vary according to the stone or marble supplied by each country. In England, for instance, limestone or chalk often takes the place of the white marble so common in Italian and North African mosaics; while, instead of red marble, a fine sort of burnt clay or red sandstone is generally used; other makeshifts had to be resorted to, and many of the Romano-British mosaics are made entirely without marble. It is perhaps partly owing to the great wealth of Northern Africa in marbles of many colours and of varying shades that the finest of all Roman mosaics have been found in Algeria and Tunis, especially those from Carthage, some of which have been brought to the British Museum. See *Archaeologia*, xxxviii. 202.

The range of colour in the marble tesserae is very great, and is made use of with wonderful taste and skill: there are three or four different shades of red, and an equal number of yellows and greens, the last colour in all its tints being almost peculiar to this part of Africa, and one of the most pleasant and harmonious in almost any combination. Deep black, browns and bluish-greys are also abundant. The mosaics from Carthage are no less excellent in design than in the richness and beauty of their materials. Large spaces are filled by grand sweeping curves of acanthus and other leaves, drawn with wonderful boldness and freedom of hand, and varied with great wealth of invention. Without the use of very small tesserae, much richness of effect is given by gradations of tints, suggesting light and

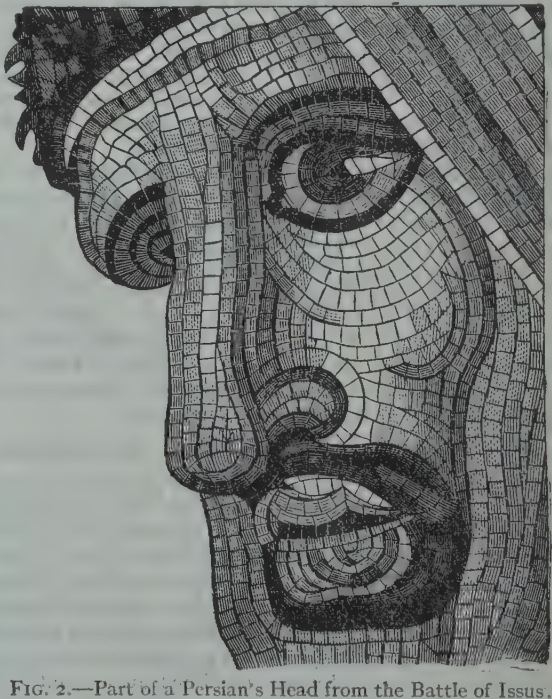
FIG. 2.—Part of a Persian's Head from the Battle of Issus.

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[1] In the less prosperous provinces of the empire, such as Britain, these costly materials could not be obtained, and native sandstone, &c., was used.

[2] The biographer of Severus Alexander (*Hist. Aug.*, c. 25, 7) attributes the invention of *opus alexandrinum* to that emperor; but this is clearly a false derivation. This technique was doubtless invented at Alexandria.

[3] This latter is often, but wrongly, called serpentine.

shade, without a painful attempt to represent actual relief. The colours of the marbles used here and elsewhere by the Romans are so quiet and harmonious that it would have been almost impossible to produce with them a harsh or glaring design, and when used with the skill and strong artistic feeling of the mosaic workers at Carthage the result is a real masterpiece of decorative design.

The finest of the later examples in Rome is that which decorates the vault of the ambulatory of the circular church of S. Costanza, built by Constantine the Great, outside the walls of Rome. This very interesting mosaic might from its style and materials have been executed in the 1st century, and is equal in beauty to any work of the kind in Italy. It shows no trace whatever of the Byzantine influence which, in the next century, introduced into Italy a novel style of mosaic, in materials of the most glittering splendour. Survivals of this classical style of mosaic are found in North Africa and the East. At Kabr-Hiram, near Tyre, Renan discovered among the ruins of a small three-apsed Christian church of the 4th century A.D. a fine mosaic pavement, covering the nave and aisles, thoroughly classical in style. A very similar mosaic, of about the same date, was discovered at Nebi Yūnas, near Sidon.

Medieval Mosaics.—These may be divided into four principal classes: (1) those used to decorate walls and vaults, made of glass cubes; (2) those for pavements, made of marble, partly in large shaped pieces, and partly in small tesserae; (3) glass in small pieces, either rectangular or triangular, used to enrich marble pulpits, columns, and other architectural features; (4) wood mosaics.

1. In the Byzantine period the glass cube mosaic was exclusively employed in mural decoration. At first natural colouring was used, and backgrounds, if not in local colour, were generally blue; but the use of gold, both for backgrounds and for the high lights on drapery, &c., gradually prevailed. Owing to the intense conservatism of Byzantine art, no regular stages of progression can be traced in this class of mosaic. Some of the 5th-century mosaics at Ravenna are, in every way, as fine as those of the 12th, and it was not till the end of the 13th century that any important change in style took place. The mosaics of the 9th century are inferior in drawing and general treatment to those both of the earlier and later time, while in Italy at least this art was almost entirely extinct during the 10th and 11th centuries. Extreme splendour of colour and jewel-like brilliance combined with the most stately grandeur of form are the main characteristics of this sort of decoration.

A "majesty," or colossal central figure of Christ with saints standing on each side, is the most frequent motive. In many cases, especially in the 5th and 6th centuries, Christ was represented as a lamb, to whom the twelve apostles, in the form of sheep, are paying adoration. Christ, the Good Shepherd, is sometimes depicted as a beardless youth, seated among a circle of sheep—the treatment of the motive being obviously taken from Pagan representations of Orpheus playing to the beasts. The tomb of Galla Placidia has a good example of this subject, with much of the old Roman grace in the drawing and composition. Frequently the Virgin Mary, or the patron saint of the church, occupies the central space in the apse, with ranges of other saints on each side.

The "Doom," or Last Judgment, is a favourite subject for domes and sanctuary arches; the Florence baptistery has one of the grandest mosaic pictures of this subject, executed in the 13th century. The earlier baptisteries usually have the scene of Christ's baptism—the river Jordan being sometimes personified in a very classical manner, as an old man with flowing beard, holding an urn from which a stream pours forth. S. Vitale at Ravenna has in the sanctuary a very interesting representation of Justinian and his empress Theodora (see fig. 3), attended by a numerous suite of courtiers and ladies; these mosaics are certainly of the 6th century, and may be contemporary with Justinian, though the fact that he and Theodora are each represented with a circular nimbus appears to indicate that they were not then alive.

In mosaics of the best periods the treatment of the forms and draperies is broad and simple, a just amount of relief being expressed by delicate gradations of tints. In mosaics of the 9th century the drawing is very awkward, and the folds of the robes are rudely expressed in outline, with no suggestion of light and shade.

A further application of this work was to the decoration of broad bands over the columns of the nave, as at S. Maria Maggiore in Rome, 4th century, and in the two churches of S. Apollinare at Ravenna, 6th century. In some cases almost the whole interior of the church was encrusted in this magnificent way, as at Monreale Cathedral, the Capella Palatina of Palermo, and S. Mark's at Venice.

In these churches the mosaics cover soffits and angles entirely, and give the effect of a mass of solid gold and colour producing the utmost conceivable splendour of decoration.[1] In many cases vaulted ceilings were covered with these mosaics, as the tomb of Galla Placidia, A.D. 450, and the two baptisteries at Ravenna, 5th and 6th centuries. For exteriors, the large use of mosaic was usually confined to the west façade, as at S. Miniato, Florence; S. Maria Maggiore, Rome; and S. Mark's, Venice. In almost all cases the figures are represented on a gold ground, and gold is freely used in the dresses and ornaments—rich jewels and embroidery being represented in gold, silver, sparkling reds, blues and other colours, so as to give the utmost splendour of effect to the figures and their drapery.

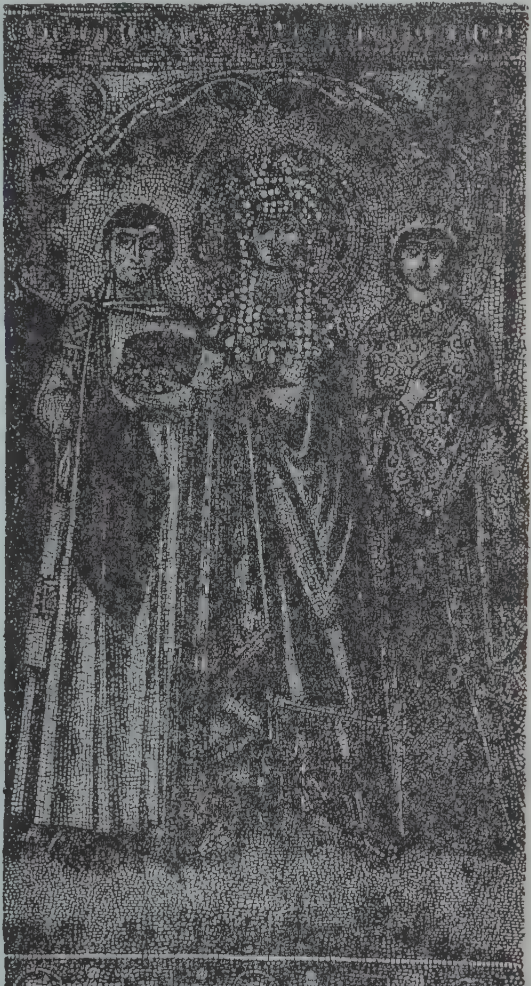
FIG. 3.—Mosaic of Theodora and Attendants, from S. Vitale, Ravenna; over life size.

The revival of the art of painting in Italy and the introduction of fresco work in the 14th century gave the deathblow to the true art of wall-mosaics. Though at first the simple and archaic style of Cimabue and his pupils Jacopo da Turrita, Giotto, and Taddeo Gaddi was equally applicable to painting or mosaic, yet soon the development of art into greater realism and complexity required a method of expression unfettered by the necessities and canons of mosaic work. Pietro Cavallini, a Roman artist, was one of the last who worked according to the old traditions. His mosaic of the birth of the Virgin in S. Maria in Cosmedin, Rome, executed about the middle of the 14th century, is not without merit, though his superior knowledge of form has only caused his composition to be somewhat feeble and insipid compared with the works of the earlier artists. Even in the 15th century a few good mosaics were produced at Venice and elsewhere. The mosaics from Titian's pictures on the west end of S. Mark's at Venice, Raphael's in the Chigi Chapel in S. Maria del Popolo, and many large pictures in S. Peter's in Rome are the most striking examples of these.

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[1] Unfortunately the world-wide fame of S. Mark's and the other great churches of Italy has subjected these extraordinary works to the fatal process of "restoration," and wherever any sign of decay in the cement backing (the tesserae themselves are quite indestructible) has given the least excuse the "restorers" have destroyed whole masses of ancient work, and supplied its place with worthless modern copies. The mosaics of the S. Mark's baptistery, and of the apses at S. Miniato, at Pisa, and many other places have in this way been wantonly renewed in recent times.

The following list, in chronological order, comprises a selection from among the most important glass wall-mosaics during the period when mosaic-working was a real art.[1]

	4th Century.
Rome.	S. Costanza.
	S. Maria Maggiore—square panels over the columns of the nave.
	S. Pudenziana.
	S. Giovanni in Laterano—chapel of SS. Rufina e Seconda.
Naples.	S. Restituta—baptistery.
	5th Century.
Ravenna.	Orthodox Baptistery—vault.
	Tomb of Galla Placidia—vault, 450.
	Archbishop's Chapel—vault.
Rome.	S. Paolo fuori le mura—triumphal arch.
	S. Maria Maggiore—square pictures over nave columns, and triumphal arch (?).
	S. Sabina—figures on west wall.
Milan.	S. Ambrogio, Chapel of S. Satiro—vault.
Fundi.	Cathedral—apse.
Nola.	Cathedral—apse.
	6th Century.
Ravenna.	Arian Baptistery—vault.
	S. Apollinare Nuovo—apse and nave, with 9th-century additions.
	S. Vitale—apse and whole sanctuary, *c.* 547.
	S. Apollinare in Classe—apse and nave, 549.
Rome.	SS. Cosmas and Damian—apse.
Milan.	S. Lorenzo, Chapel of S. Aquilinus—vault.
Constantinople.	S. Sophia—walls and vault, *c.* 550.
Thessalonica.	Church of St George—apse, &c.; and S. Sophia—dome and apse.
Trebizond.	S. Sophia—apse.
	7th Century.
Rome.	S. Agnese fuori le mura—apse, 626.
	S. Teodoro.
	S. Stefano Rotondo.
	S. Venanzio, baptistery of Lateran.
Jerusalem.	"Dome of the Rock"—arches of ambulatory, 688.
	8th Century.
Rome.	Baptistery of S. Giovanni in Laterano.
	SS. Nereus and Achilles.
Jerusalem.	Mosque of Al-Aksa—on dome.
Mount Sinai.	Chapel of the Transfiguration.
	9th Century.
Rome.	S. Cecilia in Trastevere—apse.
	S. Marco—apse.
	S. Maria della Navicella—apse, and "Chapel of the Column."
	S. Prassede—triumphal arch.
Milan.	S. Ambrogio—apse, 832.
	10th Century.
Cordova.	Mihrab (sanctuary) of Mosque.
	11th Century.
Jerusalem.	"Dome of the Rock"—base of cupola, 1027.
Constantinople.	Church of S. Saviour—walls and domes.
	12th Century.
Venice.	S. Mark's—narthex, apse and walls of nave and aisles.
Capua.	Cathedral—apse.
Torcello.	Cathedral—apse.
Murano.	Cathedral—apse.
Salerno.	Cathedral—apse.
Palermo.	Capella Palatina, begun 1132—the whole walls.
	Church of La Martorana—vault.
Monreale.	Cathedral—the whole walls, 1170–1190.
Bethlehem.	Church of the Nativity, 1169.
Cefalu.	Cathedral—apse, 1148.
Rome.	S. Clemente—apse.
	S. Francesca Romana—apse.
	S. Maria in Trastevere—apse.
	13th Century.
Florence.	Baptistery vault, begun *c.* 1225 by Fra Jacopo.
	S. Miniato—apse and west front.
Rome.	S. Paolo fuori le mura—apse.
	S. Clemente—triumphal arch, 1297.
	S. Giovanni in Laterano—apse by Jacopo da Turrita, 1290.
	S. Maria Maggiore—apse and west end by Jacopo da Turrita and Taddeo Gaddi.
	S. Maria in Trastevere—apse by Pietro Cavallini, 1291.
	14th Century.
Florence.	Baptistery, finished by Andrea Tafi.
Pisa.	Cathedral—east apse by Cimabue, 1302, north and south apses by his pupils.
Rome.	S. Peter's—navicella, in atrium by Giotto.
	S. Maria in Cosmedin—on walls by Pietro Cavallini, *c.* 1340.
Venice.	SS. Giovanni e Paolo—in arch over effigy of Doge Morosini.

The Byzantine origin of these great wall-mosaics, wherever they are found, is amply proved both by internal and documentary evidence. The gorgeous mosaics of S. Sophia and S. Saviour's in Constantinople, 6th century, and the later ones in the monasteries of Mount Athos, at Salonica and at Daphne near Athens, are identical in style with those of Italy of the same date. Moreover, the even more beautiful mosaic work in the "Dome of the Rock" at Jerusalem, 7th and 11th centuries, and that in the sanctuary of the great mosque of Cordova, of the 10th century, are known to be the work of Byzantine artists, in spite of their thoroughly Oriental design. The same is the case with the rarer mosaics of Germany, such as those in S. Gereon at Cologne and at Parenzo.

A very remarkable, almost unique, specimen of Byzantine mosaic is now preserved in the "Opera del Duomo," Florence. This is a diptych of the 11th century, of extremely minute, almost microscopic work, in tesserae of glass and metal, perhaps the only example of tesserae made of solid metal. It has figures of saints and inscriptions, each tessera being scarcely larger than a pin's head. This beautiful diptych originally belonged to the imperial chapel in Constantinople, and was brought to Florence in the 14th century.

2. The second medieval class, mosaic pavements, though of great beauty, are of less artistic importance. This so-called *opus alexandrinum* is very common throughout Italy and in the East, and came to greatest perfection in the 13th century. It is made partly of small marble tesserae forming the main lines of the pattern, and partly of large pieces used as a ground or matrix. It is generally designed in large flowing bands which interlace and enclose circles, often of one stone sliced from a column. The finest example is that at S. Mark's, Venice, of the 12th century. The materials are mainly white marble, with green and red porphyry, and sometimes glass.

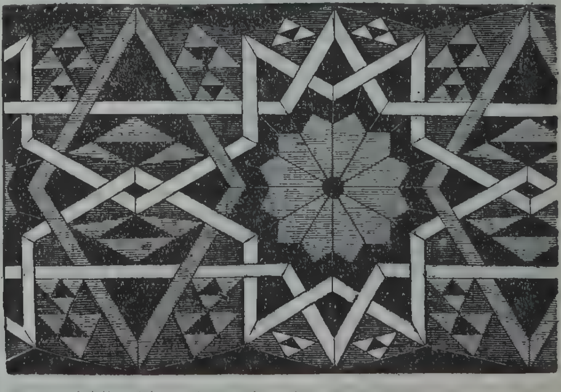

FIG. 4.—Marble Mosaic at Monreale Cathedral.

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[1] It must be remembered that the earlier mosaics have in most cases suffered much from restoration.

Besides the countless churches in Italy possessing these beautiful pavements, such as S. Lorenzo, S. Marco, S. Maria Maggiore, and S. Maria in Trastevere, in Rome, there are in England, in the Chapel of the Confessor, and in front of the high altar at Westminster, very fine specimens of this work, executed about 1268 by a Roman artist called Odericus, who was brought to England by Abbot Ware, on the occasion of a visit made by the latter to Rome. Another English example is the mosaic pavement in front of the shrine of Becket at Canterbury; this is probably the work of an Englishman, though the materials are foreign, as it is partly inlaid with bronze, a peculiarity never found in Italy. Palermo and Monreale are especially rich in examples of sectile mosaic, used both for pavements and walls —in the latter case generally for the lower part of the walls the upper part being covered with the glass mosaics. Fig. 4 gives a specimen of this mosaic from Monreale cathedral. Its chief characteristic is the absence of curved lines, so largely used in the splendid opus Alexandrinum of Italy, arising from the fact that this class of Oriental design was mainly used for the delicate panelling in wood on their pulpits, doors, &c.—wood being a material quite unsuited for the production of large curves.

3. Glass mosaic, used to ornament ambones, pulpits, tombs, bishops' thrones, baldacchini columns, architraves, and other marble objects, is chiefly Italian. The designs, when it is used to enrich flat surfaces, such as panels or architraves, are very similar to those of the pavements last described. The white marble is used as a matrix, in which sinkings are made to hold the glass tesserae; twisted columns are frequently ornamented with a spiral band of this glass mosaic, or flutings are suggested by parallel bands on straight columns. The cloisters of S. Giovanni in Laterano and S. Paolo fuori le mura have splendid examples of these enriched shafts and architraves.

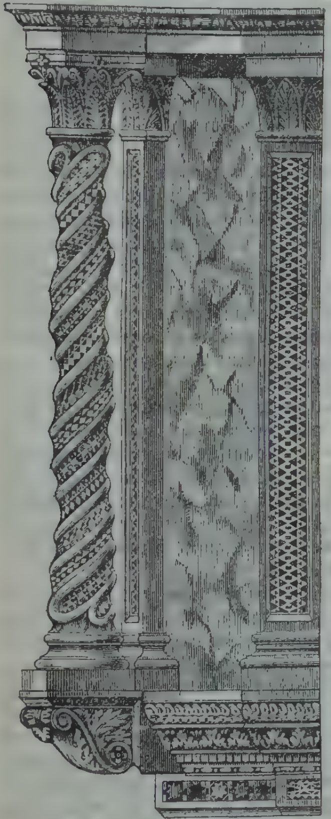

FIG. 5.—Part of Marble Pulpit with glass mosaic, church of Ara Coeli, Rome.

This style of work was largely employed from the 6th to the 14th centuries. One family in Italy, the Cosmati, during the whole of the 13th century, was especially skilled in this craft. The pulpit in S. Maria in Ara Coeli, Rome, is one of the finest specimens (see fig. 5), as are also the ambones in S. Clemente and S. Lorenzo, and that in Salerno cathedral. The tomb of Henry III. (1291), and the shrine of the Confessor (1269) at Westminster are the only examples of this work in England. They were executed by "*Petrus civis Romanus*," probably a pupil of the Cosmati.

In India, especially during the 17th century, many Mahommedan buildings were decorated with fine marble inlay of the class now called "Florentine." This is *sectile* mosaic, formed by shaped pieces of various coloured marbles let into a marble matrix. A great deal of the Indian mosaic of this sort was executed by Italian workmen; the finest examples are at Agra, such as the Taj Mahal.

4. Mosaics in wood are largely used in Mahommedan buildings, especially from the 14th to the 17th centuries. The finest specimens of this work are at Cairo and Damascus, and are used chiefly to decorate the magnificent pulpits and other woodwork in the mosques. The patterns are very delicate and complicated, worked in inlay of small pieces of various coloured woods, often further enriched by bits of mother-of-pearl and minutely carved ivory. This art was also practised largely by the Copts of Egypt, and much used by them to ornament the magnificent iconostases and other screens in their churches.

Another application of wood to mosaic work, called "intarsiatura," was very common in Italy, especially in Tuscany and Lombardy, during the 15th and early 16th centuries. Its chief use was for the decoration of the stalls and lecterns in the church choirs. Very small bits of various coloured woods were used to produce geometrical patterns, while figure subjects, views of buildings with strong perspective effects, and even landscapes, were very skilfully produced by an inlay of larger pieces. Ambrogio Borgognone, Raphael, and other great painters, often drew the designs for this sort of work. The mosaic figures in the panels of the stalls at the Certosa near Pavia were by Borgognone, and are extremely beautiful. The stalls in Siena cathedral and in S. Pietro de' Casinensi at Perugia, the latter from Raphael's designs, are among the finest works of this sort, which are very numerous in Italy. It has also been used on a smaller scale to ornament furniture, and especially the "*Cassoni*," or large trousseau coffers, on which the most costly and elaborate decorations were often lavished.

AUTHORITIES.—*Classical.* An excellent account of the subject, with full references, is given by Gauckler in Daremberg and Saglio, *Dictionnaire des antiquités, s.v.* "Musivum opus"; the translations there given of the *loci classici* of Pliny are, however, inaccurate. Amongst earlier works the following are important: G. Ciampini, *Vetera monumenta* (1690–1699); A. Furietti, *De musivis* (1752); S. Lysons, *Roman Antiquities of Woodchester* (1797) and *Reliquiae britannico-romanae* (1813); F. Mazois, *Ruines de Pompéi* (1812–1838); *Real museo borbonico* (1824–1857); F. Artaud, *Histoire de la peinture en mosaïque* (1835); *Monumentos arquitectonicos de España* (1859–1883); Wilmowsky, *Römische Mosaiken aus Trier und dessen Umgegend* (1888).

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Wood Mosaic-Tarsia.—*Ornati del coro di S. Pietro Cassinense di Perugia* (1830); Caffi, various works on Rafaello de Brescia and other intarsiatori (1851); *Tarsie ed intagli di S. Lorenzo in Genova* (1878); and Scherer, *Technik und Geschichte der Intarsia* (1891).

(J. H. M.; H. S. J.)

Modern Mosaic.—The art of mosaic for mural decoration has never been deeply implanted in the artistic sensibilities of the north of Europe, nor has it been employed much either in France, or Germany, or England. It ceased to be generally adopted in Italy when fresco, oil and tempera painting came into vogue. Gothic architecture is ill-suited to its robust claims as a decorative art; and the incoming fashion for the latest and least interesting development of classical architecture, "Palladian," divorced not only it, but mural painting also, from all architectural schemes. To be properly consequent and effective, buildings, ecclesiastical or public, should be constructed with the intention of being covered almost entirely by mosaics, which demand rich environment, marble or other colour; mosaic is essentially a colour medium. It is therefore scarcely surprising that when mural decoration became pre-eminently pictorial, and gestures and expression grew complicated, elaborate, and naturalistic, an art limited in its powers of presenting such manifestation of realistic design was relegated into the limbo of obscurity.

There are no instances of the use of mosaic in England after the Roman occupation. The Normans, who derived it from the Greeks and Saracens, and adopted it in Sicily, did not import it either to France or England. Although English churches, and French also, were highly decorated with polychromy from early times up to the 16th century, there is no evidence of mosaic ever having been used. The revival of a school of mosaicists in Rome during the 17th century, employed in the decoration of St Peter's, and here and there sparsely engaged in other churches, led to the idea which Wren would have carried into effect, namely, making use of mosaic for the cathedral of St Paul's in London; but his scheme, if it was ever really entertained, was not carried out, as we all know; and the art, which might have become the fashion in England, remained an exotic. Even late into the years of the 19th century mosaic decoration was regarded by classical purists as a barbarous art, and the glorious decorations in that material to be seen in Sicily, Italy, Greece, Asia Minor and Russia were disregarded as works of high art. They were in many cases cut out to provide room for extravagant and vulgar designs in fresco or tempera, unmeaning, undecorative, and wholly abominable as decoration. Those Roman mosaics over the altars in St Peter's, being copies of celebrated oil pictures, while they cannot be denied excellence as such and marvellous dexterity, reveal the worst possible taste, for they attempt to represent adequately, in cubes, touches of the brush which were spontaneous, fluid, thick and thin, and as sensitive and spontaneous as the finger pressure on the violin string, so accurate that the least deviation from absolute position produces discord.

The restrictions on mosaic are many, and some are obvious. In the first place, mosaic is not suited for a small scale of design. It is true that in the Opera del Duomo in Florence there is a miniature mosaic (executed in the 12th century) of extraordinary beauty, which must have taken a lifetime to execute; but still this remains a curiosity, a bit of craftsmanship rather than a great work of art. There is also a copy of Mr Holman Hunt's "Finding the Saviour in the Temple," executed for Clifton College by assistants in Messrs Powell's establishment in Whitefriars, London; it is admirably done, no doubt, but it is a long way behind the original, which is a design wholly ill adapted to mosaic. There are several other instances, notably one by Mr H. Holiday of "The Last Supper," where mosaic has been employed to translate a beautiful design which would have been more satisfactorily executed either in oil or water colours. The primal and most obvious limitation is in matters of detail—detail as regards a multiplicity of forms, many gradations either of colour or tone and naturalistic accidents. In this respect good mosaic is like good *basso relievo*; it is accomplished by firmly pronounced outlines, unconfused masses, large planes unbroken up by small adjuncts, and generalized and conventionalized forms and simple colour. So all small curves, as well as small tints, should be eliminated, because it is not in the nature of the material to do them justice. One can scarcely conceive a choice less happy for mosaic than the centre group taken out of the upper portion of the Disputa fresco in the Vatican by Raphael, yet this florid piece of work, so facile in creation, was chosen to be executed on the eastern wall of the morning chapel in St Paul's.

It is useless to illustrate the many similar mistakes that have been made. They were made in some of the earlier work in the choir of St Paul's. The best example of mosaic on a small scale is in Ravenna, the tomb of Galla Placidia; the best upon a large scale is the great Christ at the east end of the cathedral at Monreale. These two works absolutely justify the means to the end. Interesting are the designs made by Sir Edward Burne-Jones for the mosaics for the American church in Rome, but the execution and colour are alike monotonous. The cathedral of Chester contains a series of mosaic pictures designed by Mr Clayton. The Guards' chapel in St James's is adorned likewise by the same artist, under the direction of the late Sir Arthur Blomfield. In the chapel for the school at Giggleswick are mosaics designed by T. G. Jackson, R.A., admirably and broadly treated in true mosaic character; these were executed *in situ*, and not, according to the modern habit, upon paper, away from their environment and by a foreign firm. Those mosaic *pictures* which are placed in niches in the great gallery of South Kensington Museum are failures *quâ* mosaic, though the designs in many instances are fine, notably those by Lord Leighton and Val Prinsep; but their execution is uninteresting, because the cubes are laid so flatly and so evenly that they suggest an oil picture *appliqué* upon a flat ground.

Messrs Powell have been employed on several occasions to decorate churches with mosaic. This firm has adopted the old style, and rejected the new one initiated by Dr Salviati of Venice. If we observe the surface of a fine Greek mosaic, such as that of Andrea Tafi in the Baptistery of Florence, or the few remains of unrestored mosaic in St Mark's, Venice, or indeed other works scattered over Italy, we shall see that it is rough, not smooth; that the cubes are irregular in shape; that there is always a space of the ground colour left, red or white, and visible between each cube. In modern mosaic, with rare exceptions, restoration or other, the cubes have been jammed up closely together, and the surface is as smooth as a piece of paper; thereby is engendered a mechanical and uninteresting surface, over which light plays with monotony, and hence that brilliant and scintillating effect so essentially the character of true mosaic is absent. This defect—and it is a grave one—is evident in the works in mosaic more or less recently set up in Paris, notably in the apse of the Pantheon, the east end of the Madeleine, and the vaulting of the great staircase of the Louvre. Those in the apse are finely designed, but scarcely look like mosaic, those in the Madeleine still less so, and the last not at all.

The artist who designs for this material must set aside all the principles he has learned to estimate in paint, either of oil or tempera. As an instance of a painter, pre-eminently delicate in his colour and tone, failing as a mosaic designer we may quote Cimabue, whose beautiful designs in the cathedral at Pisa would have been far more effective had the artist painted them upon the wall with the medium in the requirements of which he was so great a master. The same criticism may apply to the mosaics in recent years set up on the west front of Santa Maria del Fiore in Florence. The very first principles which go to make a fine picture are just those which should be avoided in mosaic—elaborate modelling, delicate transitions of light and shade and picturesque effects of dark and light, materialistic resemblance indeed. The designer for mosaic should ever bear in mind his material, and in his designs for it he should accentuate those characteristics which belong essentially and specifically to mosaic and to *no other technique.* If he is a painter, he must forget his lessons in that art and take up with new ones—those which teach broad masses of colour obtained in lines. He will find that effects gained by a technique employed in oil colour look bald and ridiculous when translated into mosaic. Water-colour and pastel are by far the best media for cartoons to be copied in mosaic. We do not know how these were executed in ancient days; probably the design was drawn on the wall, and there were no cartoons. The master not only invented, but he was the master-workman also, and that is how it should be. The probability is that the custom of drawing the design upon the wall practised by the early frescanti was the survival of a method adopted by the mosaicists, just as their method repeated that of Roman and Greek wall-painters. Of course this direct method leads to a large style, a style harmonizing with environment, scale, &c.; the tendency is to draw large in a large building, to draw small in a small one. Anyhow, this is quite certain, that all the fine Byzantine and 13th century mosaics, as well as wall paintings, were executed *in situ* and not away, as was the usual custom in England and elsewhere until recently.

Mr Harry Powell has permitted the writer to make use of some of his reflections upon the mosaicist's art in the following notes. The mosaicist should not separate the artistic from the technical details of his craft. He must study not only the decorative effect, form, colour and spacing of his design, but the surface to be covered as well as the materials with which he builds.

Surface.—Good brick-work, the mortar joints slightly cut back, affords the best foundation for mosaic. The hollow and sharp-edged joints provide a key for the cement into which the cubes will be set, and they diminish the risk of sagging, a not uncommon event if the cement is not welded to the wall by being well pressed into the joints. If the mosaic is to be applied on stone, the stone must be notched and well roughened to provide support. Whether the surface is brick or stone, it must be well saturated with boiled oil to prevent suction, because if too much suction takes place the powder only of the cement will remain and the cubes will drop out.

Cement.—A cement suitable for mosaic is one which retains its tenacity, which can be applied in layers, which sets slowly, and which is not liable to change colour after long exposure. These conditions are best met by an oil cement. One consisting of equal weights of white oxide of zinc and carbonate of zinc, mixed with double boiled oil and containing small proportions of wax, gold size and slacked lime gives good results. This cement can either be white or red, white where greyness of tone is desirable, red where a richer effect is desirable. It is generally mixed with a small portion of oxide of iron or oxide of manganese, which prevents the whiteness of the joints from rendering adjacent tints grey from a distance.

Atmospheric Corrosion.—As the atmosphere of modern towns is more corrosive than that of medieval Venice or medieval Rome, it is important that, in choosing the cement and the materials to be imbedded in it, the mosaicist should be certain that they are impervious to atmospheric impurities.

Glass.—Although marble, mother of pearl, and other substances have been, and are still, occasionally used, the predominant material in ancient as well as modern mosaics is glass. When prepared with due regard to the continuing proportions of its ingredients, glass is impervious to the action of ordinary acids, and is practically indestructible. It can be made to assume almost every shade and tint of colour (see GLASS). There are many kinds of glass, but for mosaic work either a potash-lead or a soda-lime glass is usually employed. Both of these glasses can be rendered opaque by mixing with the ingredients either oxide of tin or a mixture of felspar and fluorspar. Glass rendered opaque by the admixture of felspar and fluorspar has a bright, vitreous, easily cleaned surface, and readily develops brilliant colours.

Production of Colours.—Colours are obtained by mixing and melting with the ingredients of the opaque glass small proportions of certain metallic oxides. Oxide of chalk gives a purple blue; oxide of copper gives a peacock blue; oxide of copper with oxide of iron gives a green; oxide of copper mixed with oxide of iron and a strong reducing agent gives a red; oxide of chromium a green; oxide of nickel a purple; oxide of uranium a yellow; and oxide of manganese a violet—or a black if a larger quantity of oxide is used.

Manufacture of Glass Slabs.—The mixtures, in a state of powder, are shovelled into crucibles standing round the grate of a furnace, and when fusion is complete the viscous glass can be coiled upon the heated end of an iron rod and removed for use, very much in the way that thick treacle may be coiled round the bowl of a spoon. A mass of molten glass, thus collected, is allowed to fall upon a flat iron table, and is pressed into a slab about 6 in. square and ½ in. thick. The slabs are removed to an oven, where they are allowed to cool slowly, and when cool are removed and broken by a hammer or a miniature guillotine into tesserae or cubes The fractured edge of the tesserae is used for the surface of the mosaic.

Gold and Silver Slabs.—The tesserae containing gold or silver leaf are as impervious to surface corrosions from the effects of atmosphere as the solid colours. The process of manufacturing a gold or silver slab for mosaic work is to spread the metallic leaf on a very thin tray of transparent glass, about 5 in. in diameter, and after it has been heated to press upon the surface of the leaf a mass of molten glass, so as to create cohesion between the molten glass and the glass tray through the pores of the metallic leaf. The slabs thus formed contain gold, silver or platinum leaf hermetically imprisoned between two layers of glass. The slabs are cut up into tesserae or cubes by means of a diamond or glass-cutter's wheel. Only one surface can be used for mosaic work.

Tinted Metals.—By using coloured glass for the thin glass trays which form the surface of the metallic slabs a variety of tinted metallic effects are obtained. Moreover, if the glass which is to form the background is coloured, and if the slab after it has been cooled is strongly reheated, the leaf becomes sufficiently disintegrated to allow the colour of the background to show through, with the result that the colour effect of the metallic leaf is modified.

Palette and Tools.—The palette of the mosaic worker is a shallow box with many partitions, each division containing different-coloured tesserae. The only tools required are clippers, for shaping the tesserae, and a pointed awl for pricking through the cartoon into the cement the outlines of the design. Although the process and tools are simple, it requires prolonged training of mind, hand, eye and fingers to enable a workman to create in mosaic a living representation as distinguished from a lifeless copy of the master craftsman's design.

Drawing directly on the Wall. Curved Surfaces.—If the mosaicist desires to draw his cartoon directly upon the wall, a necessary procedure where curved surfaces are presented, he goes to work in the following manner. He causes a model to be made to scale of a dome, semi-dome or spandrel and upon it he draws his design with a brush in strong red pigment, having previously squared up the whole surface to scale. This done, he causes the dome, semi-dome or spandrel to be covered over with thick brown paper. This being attached to the wall with white lead sufficient only to give temporary adhesion, the brown paper is squared up to the scale of the small sketch; each square being relatively numbered. The master then sets his pupils to work to draw mechanically and copy accurately from the small design on to the full-sized dome, semi-dome or spandrel. This done, the master follows on, correcting with charcoal or brush until the whole design is developed in strong outline. Having made a slightly coloured sketch, the master with the aid of his pupils proceeds to mix all the tints in water-colour, adding *colla di pesce* or fish glue, and a little honey to prevent cracking. He then applies every tint separately, keeping each distinct, and above all minding that the local colours of all half-tints are different from the colour of all shadows. This done, he dips his brush in black and draws all the outlines, the thickness of which depends upon the distance which will intervene between his work and the spectator; in order that the black may not appear cold from a distance, he will add to one side of the line, a red line, thicker or thinner than the black, according to the effect he wishes to produce. It is sometimes effective to add upon the other side of the black line a green line, so that the purple effect of the black and red shall be modified.

Colour.—We now come to the great question of colour and how to obtain it simply, and so that from a distance a blurred and woolly effect is not obtained. There should be a marked and sharp definition between all tints; they should not be *fused*; they should look sharply defined, as the squares upon a chess-board, and appear crude and brutal. The work which looks least refined near at hand looks more finished at a distance. Red and blue lines alternately laid, either more red or more blue as the purple is intended to tend towards red or blue, make the best purple. Green is best made with yellow and blue lines, the masses being separated by red lines, and the shadows of green should be red or blue: if red, they should be outlined with blue; if blue, with red. Red should be treated flatly, shaded with a deeper red, which should be of a warmer tone than the lights. Blue should be shaded with blue or red; and it is well to mix green tesserae with the blue in the lights, and again green tesserae with the blue or red shades to modify crudity. Pure white should be very sparingly used: it expands greatly at a distance. The best white is that which is of the tone of Naples yellow. Whenever it is necessary to use pure white, either a yellow or pink line should be set on one side of it.

It is impossible to keep the *flesh* too simple. The local colour, *i.e.* a red orange, is the staple colour. Features should be drawn in strong red or burnt sienna, or a rich brown. The outlines of limbs or the contours of faces should be made first with a green line, a little darker than the local tints, then a red line darker still, then a black or brown line. *White draperies* are capable of being treated with endless variety. Their shadows may be green, red, blue, grey or yellow. If the white drapery is to take a neutral tone when seen from a distance, all these tints should be employed, because when mixed those positive colours appear neutral when seen from afar.

Gold drapery has a fine effect. Bright gold expands to four times the width of the line, so that the lines of gold should be thin. It may be that the gold drapery is to appear greenish; when that is desirable the folds should be drawn in green outlined with red. All deep shades should be treated with red and hot browns. As gold expands so considerably, a larger interval should be left between the tesserae than between any other colour, even white. Each tessera should have a thin space of the ground colour round it. The tesserae should never be jammed: it is that which causes so many modern mosaics to look like oil-cloth or chromo-lithographs.

The Finished Cartoon.—The finished cartoon, having been coloured in lines, should look exactly like the finished mosaic as regards effect; and the master, in making his cartoon, should always bear in mind that he is designing for mosaic, and not making a finished picture. The cartoon, when complete, is taken off the wall and cut up in pieces. Each piece is then carefully traced. The space upon the wall corresponding to each section is then covered with cement, but only upon that portion of the space which can be worked in mosaic in a day. The mosaic worker then applies the portion of the tracing upon the wet cement, and with a sharp point he pricks through the paper upon the lines thereon drawn; on removing the tracing he will find indents within the surface of the cement, which give him his cue to all the forms. Setting up the coloured design by his side, he takes the tesserae, which exactly correspond in colour and tone with those on the drawing, and begins his work, commencing from the outline and working inwards towards the centre, the lightest portion being left to the last. Here comes in the real test whether the craftsman is capable or the reverse. This is soon judged by the master, who will put the work in and out until he is satisfied with the result. Unless the master has himself gone through the drudgery of laying the cubes he can be no teacher. He must be a craftsman as well as a designer, and must know by experience and practice in a very difficult craft what the material can do with ease and what it is not called upon to do by reason of its inherent limitations. If he has not so trained himself he is certain to pictorialize what he should conventionalize; and, moreover, he will set technical difficulties in the way which are impossible to overcome. He must aim at the greatest simplicity without dullness, at producing the greatest effect by the simplest means, and to do that he must *know his material or fail.* (W. B. Ri.)

MOSBY, JOHN SINGLETON (1833–), American soldier, was born in Edgemont, Powhatan county, Virginia, on the 6th of December 1833. He graduated at the university of Virginia in 1852, was admitted to the bar in 1855, and practised law in Bristol, Washington county, Virginia, until the beginning of the Civil War, when he joined the cause of the South. He enlisted as a private in the Washington Mounted Rifles, which became a part of General J. E. B. Stuart's 1st Virginia Cavalry, and of which he was adjutant for a time. In June 1862, after having gone over the ground alone on scouting duty, he accompanied Stuart in his ride round McClellan's entire army. Early in 1863 he secured Stuart's permission to undertake a quasi-independent command. In Fairfax county and then in Fauquier and Loudoun counties (known as Mosby's Confederacy), within the Federal lines, he raised, mounted, armed and equipped a force of irregulars. On the night of the 8th of March 1863, with about 30 men, he penetrated the Federal lines at Fairfax Court-House and took 33 prisoners, including Brigadier-General Edwin H. Stoughton, commanding the 2nd Vermont brigade; and he became famous for other such exploits. In the North he was regarded as a guerilla who disregarded the rules of war, and in the autumn of 1864, Sheridan, acting under orders from Grant, shot and hanged seven of Mosby's men without trial; in November Mosby retaliated by hanging seven of Custer's cavalrymen. Eventually, on the 21st of April 1865, twelve days after the surrender of General Lee, he disbanded his men and surrendered; and through the influence of General Grant, who later became his personal friend, he was paroled. He returned to his legal practice, joined the Republican party, canvassed Virginia in 1872 for General Grant, in 1878–1885 was United States consul at Hong-Kong, and after practising law in San Francisco, was assistant attorney in the Federal Department of Justice from 1904 to 1910. He wrote *Mosby's Reminiscences and Stuart's Cavalry Campaigns* (Boston, 1887), and—a defence of Stuart and of Lee—*Stuart's Cavalry in the Gettysburg Campaign* (New York, 1908).

See J. Marshall Crawford, *Mosby and his Men* (New York, 1867); A. Monteiro, *War Reminiscences by the Surgeon of Mosby's Command* (Richmond, Virginia, 1890); James J. Williamson, *Mosby's Rangers* (New York, 1909); John W. Munson, *Reminiscences of a Mosby Guerrilla* (New York, 1906); John H. Alexander, *Mosby's Men* (New York, 1907); and *Partisan Life with Mosby* (New York, 1867), by John Scott, who drafted the Partisan Ranger Law, under which Mosby's command operated.

MOSCHELES, IGNAZ (1794–1870), Bohemian pianist, was born at Prague on the 30th of May 1794, and studied music at the Conservatorium under the direction of Dionys Weber. At the age of fourteen he made his first appearance before the public in a pianoforte concerto of his own composition with marked success. In 1814 he prepared, with Beethoven's consent, the pianoforte arrangement of *Fidelio*, afterwards published by Messrs Artaria. In the following year he published his celebrated *Variationen über den Alexandermarsch*, a concert piece of great difficulty, which he played with so great effect that he was at once recognized as the most brilliant performer of the day. He then started on a tour, during the course of which he visited most of the great capitals of Europe, making his first appearance in London in 1822, and there securing the friendship of Muzio Clementi and John Cramer. For a concert given by the latter he wrote his famous *Hommage à Händel*, a duet for two pianofortes, which afterwards became a lasting favourite with the public. During a visit to Berlin in 1824 he first became acquainted with Mendelssohn, then a boy of fifteen; and a friendship sprang up between them which was severed only by Mendelssohn's early death (see *Briefe von Mendelssohn-Bartholdy an Ignaz und Charlotte Moscheles*, 1888). In 1826 Moscheles married Charlotte Embden at Hamburg, and settled permanently in London. He was undoubtedly for some considerable time the greatest executant of his age; but, using his brilliant touch as a means and not as an end, he consistently devoted himself to the further development of the true classical school, interpreting the works of the great masters with conscientious fidelity, and in his extempore performances, which were of quite exceptional excellence, exhibiting a fertility of invention which never failed to please the most fastidious taste. In 1837 Moscheles conducted Beethoven's Ninth Symphony at the Philharmonic Society's concerts with extraordinary success, and by his skilful use of the baton contributed to the prosperity of this association. During the course of his long residence in London he laboured incessantly in the cause of art, until the year 1846, when, at Mendelssohn's earnest solicitation, he removed to Leipzig to carry on a similar work at the Conservatorium, then recently founded. In this new sphere he worked with unabated zeal for many years, dying on the 10th of March 1870. Moscheles' numbered works extend to 142, apart from minor pieces; his most important compositions are his Pianoforte Concertos, Sonatas and Studies (*Études*, op. 70; and *Characteristische Studien*, op. 95); *Hommage à Händel*; and his three *Allegri di bravura*.

See *The Life of Moscheles* (1873), a translation by A. D. Coleridge of Mme Moscheles' *Aus Moscheles Leben* (1872).

MOSCHEROSCH, JOHANN MICHAEL (1601–1669), German satirist, was born at Willstädt, near Strassburg, on the 5th of March 1601. He received a careful early education at the

Latin School at Strassburg, and in 1620 began his academic career as a student of jurisprudence. After being for some years tutor in the family of the Graf von Leiningen-Dachsburg, he finally became privy councillor to the landgravine of Hesse-Cassel. He died at Worms on the 4th of April 1669. Under the name of "Der Träumende," Moscherosch was a member of the *Fruchtbringende Gesellschaft*, a society founded by Prince Ludwig of Anhalt-Cöthen, in 1617, for the purification of the German language and the fostering of German literature. His most famous work is the *Wunderliche und wahrhafftige Gesichte Philanders von Sittewald* (anagram of Willstädt) (1642–1643), for which he took as his model the *Sueños* (visions) of the famous Spaniard Francisco Gomez de Quevedo y Villegas (1580–1645). Hardly inferior to the "visions" is the *Insomnis cura parentum*, *Christliches Vermächtnis eines Vaters*, which was published at Strassburg in 1643 and again in 1647. Noteworthy is also *Die Patientia*, discovered in 1897 in MS. in the municipal library at Hamburg.

Selections from Moscherosch's writings have been published by W. Dittmar (1830), F. Bobertag (in Kürschner's *Deutsche Nationalliteratur*, xxxii., 1884), and K. Müller (in Reclam's *Universalbibliothek*). Reprints of the *Insomnis cura parentum* and *Patientia* have been published by L. Pariser (1893 and 1897), who is also the author of *Beiträge zu einer Biographie von Moscherosch* (1891). See also M. Nickels, *Moscherosch als Pädagog* (1883); J. Wirth *Moscherosch's Gesichte* (1888).

MOSCHOPULUS ("little calf," probably a nickname), **MANUEL**, Byzantine commentator and grammarian, lived during the end of the 13th and the beginning of the 14th century. His chief work is Ἐρωτήματα γραμματικά, in the form of question and answer, based upon an anonymous epitome of grammar, and supplemented by a lexicon (συλλογή) of Attic nouns. He was also the author of *scholia* on the first and second books of the *Iliad*, on Hesiod, Theocritus, Pindar and other classical and later authors; of riddles, letters, and a treatise on the magic squares. His grammatical treatises formed the foundation of the labours of such promoters of classical studies as Manuel Chrysoloras, Theodorus Gaza, Guarini, and Constantine Lascaris.

A selection from his works under the title of *Manuelis Moschopuli opuscula grammatica* was published by F. N. Titze (Leipzig, 1822); see also C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897) and M. Treu, *Maximi monachi Planudis epistulae* (1890), p. 208.

MOSCHUS, Greek bucolic poet and friend of the Alexandrian grammarian Aristarchus, was born at Syracuse and flourished about 150 B.C. He was the author of a short epic poem, *Europa*, and a pretty little epigram, *Love, the Runaway*, imitated by Torquato Tasso and Ben Jonson. The epitaph on Bion of Smyrna, wrongly supposed to have been his tutor, was in all probability written about the time of Sulla (see F. Bücheler in *Rheinisches Museum*, xxx., 1875). The poem on *Megara* (the wife of Heracles) is probably not his, but a few other pieces, undoubtedly genuine, have been preserved. His poems are nearly all in hexameters. They are usually printed in editions of Bion and Theocritus, and have been translated into many European languages.

The text has been edited by U. von Wilamowitz-Möllendorff, in the Oxford *Scriptorum classicorum bibliotheca* (1905); there are English translations by J. Banks in Bohn's *Classical Library* (1853), and by Andrew Lang (1889), together with Bion and Theocritus. See F. Susemihl, *Geschichte der griechischen Litteratur in der Alexandrinerzeit*. i. 231 (1891), and article BION.

MOSCOW (Russian *Moskva*), a government of Central Russia, bounded by the governments of Tver on the N.W., Vladimir and Ryazan on the E., Tula and Kaluga on the S., and Smolensk on the W., and having an area of 12,855 sq. m. The surface is undulating, with broad depressions occupied by the rivers, and varies in elevation from 500 to 850 ft. The government is situated in the centre of the Moscow coal-basin, which extends into the neighbouring governments. Its geology has been carefully studied, and it appears that in the Tertiary period the surface of this province was already continental; but during the Cretaceous period it was to some extent overflowed by the sea. Jurassic deposits are represented by their upper divisions only; the lower ones, as well as Triassic and Permian deposits, are wanting. The Carboniferous deposits are of a deep-sea origin, and are only represented by the upper division which lies upon Devonian deposits, discovered in an artesian well at Moscow at a depth of 1508 ft. The pendulum anomaly, mentioned by Kaspar Gottfried Schweitzer (1816–1873), has been investigated. It appears in a zone 10 m. wide and about 95 m. long from west to east, and is positive (+10·6″) to the north of Moscow and negative (−2·7″) to the south.

The government is drained by the Volga, which skirts it for a few miles on its northern boundary, by the navigable Sestra, which brings it into communication with the canals leading to St Petersburg, by the Oka, and by the Moskva. The Oka and Moskva from a remote period have been important channels of trade, and continue to be so notwithstanding the development of the railways. The Oka brings the government into water communication with the Volga. Extensive forests (39% of the entire area) still exist. The soil is somewhat unproductive; agriculture is carried on everywhere, but only two districts export corn, all the others being more or less dependent on extraneous supplies. The principal crops are rye, oats, barley, potatoes, with some flax, hemp and hops.

The population, 1,913,700 in 1873, numbered 2,430,549 in 1897, and 2,733,300 in 1906. They are nearly all Great-Russians and belong to the Greek Church (4% Nonconformists). The importance of the Moscow government as a manufacturing centre is steadily increasing, and it now stands first in Russia. The chief factories are for cottons, woollens, silks, clothing, chemicals, sugar refineries, distilleries, iron-works. There is besides a very great variety of minor industries—such as those concerned with gold thread and gold brocades, gold and silver jewelry, bronze, perfumery, sweets, tobacco, tanneries, gutta-percha, furniture, carriages, wall-paper, toys, baskets, lace, and papier-mâché. The government is divided into 13 districts.

The prehistoric archaeology of Moscow has been carefully studied. This district has been inhabited since the Stone Age. Bronze implements are rare, and there are places where instruments of stone, bone and iron are found together. The inhabitants who constructed the burial mounds in the 10th to 12th centuries seem to have been of Finnish origin, and were poorer, as a rule, than their contemporaries on the Volga.

MOSCOW, (Russian *Moskva*), the second capital of the Russian empire, and chief town of the government of the same name, in 55° 45′ N. and 37° 37′ E., on both banks of the river Moskva, a tributary of the Oka. It is by rail 400 m. from St Petersburg, 1017 from Odessa, and 814 from Warsaw. It lies to the north of the most densely peopled parts of Russia (the "black-earth region"), whilst the country to the north of it is rather thinly peopled as far as the Volga, and very sparsely beyond that. The space between the middle Oka and the Volga, however, was the cradle of the Great-Russian nationality (Novgorod and Pskov excluded); and four or five centuries ago Moscow had a quite central position with regard to that region.

The present city covers an area of 32 sq. m. (about 40 when the suburbs are included). In the centre, on the left bank of the Moskva, stands the *Kreml* or Kremlin, occupying the Borovitsky hill. To the east of the Kremlin is the Kitay-Gorod, formerly the Great Posad, the chief centre of trade. The Byelyi-Gorod, which was formerly enclosed by a stone wall (whence the name), surrounds the Kremlin and the Kitay-Gorod on the west, north, and north-east. A line of boulevards now occupies the place of its wall (destroyed in the 18th century), and forms a first circle of streets round the centre of Moscow. The Zemlyanoy-Gorod (earthen enclosure) surrounds the Byelyi-Gorod, including the Zamoskvoryechie on the right bank of the Moskva. The earthen wall and palisade that formerly enclosed it no longer exist, their place being taken by a series of broad streets with gardens on both sides—the Sadovaya, or Gardens Street. The fourth enclosure (the Kamer College earthen wall) was made during the reign of Catherine II.; it is of irregular shape, and encloses the outer parts of Moscow, whilst the suburbs and the villages which have sprung up on the highways extend some miles beyond.

The Kremlin is an old fort of pentagonal (nearly triangular) shape, about 100 acres in extent, occupying a hill 130 ft. above the level of the Moskva. It is enclosed by a high stone battlemented wall 2430 yds. in length, restored during the 19th century, and having nineteen towers. Its five gates are surmounted by towers and are all noteworthy. The Spaskiya (Saviour's) Gate was erected in 1491 by a Milanese architect; the Gothic tower (203 ft.) that surmounts it was added in 1626 by the English architect, Holloway. A sacred picture of the Saviour (the "palladium of Moscow") was placed upon it in 1647, and all who pass through the gate uncover. The towers surmounting the other four gates were erected by order of Ivan III. Of the sacred buildings of the Kremlin the most venerated is the Uspenskiy cathedral. The former church of this name was erected in 1326 by the tsar, Ivan Kalita, but, on its falling into disrepair, a new one was built on the same place in 1475–1479, by the Bolognese architect, Fioraventi, in the Lombardo-Byzantine style, with Indian cupolas. It was restored each time after being pillaged or burnt in 1493, 1547, 1682 and 1812. It contains the oldest and most venerated holy pictures in Russia, one of which is attributed to the metropolitan Peter, another to St Luke. The cathedral possesses also the throne of Vladimir I., and numerous relics of saints, some of which date from the 14th century. The Russian metropolitans and patriarchs were consecrated in this cathedral, as well as the tsars after Ivan IV. The Arkhangel cathedral, on the opposite side of the square, was originally built in 1333, and a new one was erected in its place in 1505–1508. It contains the tombs of the tsars from Ivan Kalita (1340) to Ivan Alexeivich (1696), and possesses vast wealth. The Blagovyeshchensk cathedral, recalling the churches of Mount Athos (in Turkey), was first built in 1397, rebuilt in 1484–1489, and restored in 1883–1896; the remarkable pictures of Rublev (1405) are still preserved. It was the private chapel of the tsars, and in it they are baptized and married. Vestiges of a very old church, that of the Saviour in the Wood, contemporaneous with the foundation of Moscow, still exist in the yard of the palace. A stone church took the place of the old wooden structure in 1330, and was rebuilt in 1527. The Voznesensky convent, erected in 1389–1393, and restored in the end of the 19th century, is the burial-place of wives and sisters of the tsars. The Chudov monastery, erected in 1358–1365 and rebuilt in 1771, was the residence of the metropolitans of Moscow and a state prison. Close by, the great campanile of Ivan Veliky, erected in the Lombardo-Byzantine style by Boris Godunov, in 1600, rises to the height of 271 ft. (318 ft. including the cross), and contains many bells, one of which weighs 64⅓ tons. Close by is the well-known Tsar-Kolokol (king of the bells), 65 ft. in circumference round the rim, 19 ft. high, and weighing 198⅓ tons. It was cast in 1735, and broken during the fire of 1737 before being hung. The treasury of the patriarchs in the campanile of Ivan Veliky contains not only such articles of value as the *sakkos* (episcopal robes) of the metropolitans with 70,000 pearls, but also very remarkable monuments of Russian archaeology. The library has 500 Greek and 1000 very rare Russian MSS., including a Gospel of the 8th century.

The great palace of the tsars, erected in 1838–1849, is a fine building in white stone with a gilded cupola. It contains the *terems*, or rooms erected by Tsar Michael Feodorovich for the young princes his sons in 1636 (restored in 1836–1849, their former character being maintained), a remarkable memorial of the domestic life of the tsars in the 17th century. In the treasury of the tsars, in the Orujeynaya Palata, now public museums, the richest stores connected with old Russian archaeology are preserved—crowns, thrones, dresses, various articles of household furniture belonging to the tsars, Russian and Mongolian arms, carriages, &c. The Granovitaya Palata, another wing of the great palace, consists of a single-vaulted apartment built in 1473–1490, and is used as a state banqueting hall.

The four sides of the Senate Square are occupied by buildings of various dates, from the 15th century onwards. Among them is the imposing senate, now the law courts, erected by Catherine II. (1771–1785). Facing it is the arsenal (1701–1736). The temple of the Saviour, begun in 1817 in commemoration of the events of the French campaign of 1812, was abandoned in 1827, and a new one was built during 1838–1883 on a hill on the bank of the Moskva, at a short distance from the Kremlin. Its style is Lombardo-Byzantine, with modifications suggested by the military taste of Nicholas I.

The Kitay-Gorod, which covers 121 acres, is the chief commercial quarter of Moscow. It contains the new bazaars, a triple block of buildings erected in 1888–1893 in sandstone, at a cost of over £1,630,800, and the Gostinoy Dvor, consisting of several stone buildings divided into 1200 shops. The Red Square, 900 yds. long, with a stone tribunal in the middle, which was formerly the forum, market cross and place of execution separates the bazaar from the Kremlin. At its lower end stands the fantastic Pokrovsky Cathedral (usually known as Vasili Blazhennyi), one of the wonders of Moscow, on account of its towers, all differing from each other and representing, in their variety of colours, pine-apples, melons and the like. It was begun by Ivan the Terrible in 1554 to commemorate the conquest of Kazan, but not completed until 1679. It was plundered and desecrated by the French in 1812, but restored in 1839–1845. The exchange, built in 1838 and restored in 1873, is very lively, and its "exchange *artels*" (associations of nearly 2000 brokers) are worthy of remark. Banks, houses of great commercial firms, streets full of old book-shops carrying on a very large trade, and finally the Tolkuchy rynok, the market of the poorest dealers in old clothes, occupy the Kitay-Gorod, side by side with restaurants of the highest class. In this quarter are also situated the house of the Romanovs, the reigning dynasty of Russia, rebuilt and refurnished in 1859 in exact conformity with its former shape; and the printing-office of the synod of the Orthodox Greek Church, founded in 1563 and containing about 600 MSS. and 10,000 very old printed books, together with a typographical museum. At the entrance to the Kitay-Gorod stands the chapel of the highly venerated Virgin of Iberia, a copy made in 1648, of a holy picture placed on the chief gate of the monastery of Mt Athos.

The northern parts of the Byelyi-Gorod are also the centre of a lively trade. Here are situated the Okhotnyi Ryad (poultry and game market) and the streets Tverskaya, Petrovka and Kuznetsky-Most the rendezvous of the world of fashion. Here also are the theatres, the industrial art museum, imperial bank (1894), and Rozhdestvensky convent (founded in 1386). In the south-west of the Byelyi-Gorod, opposite the Alexander Garden on the west side of the Kremlin, stand the university (see below), museum of domestic industries, Rumyantsev Museum and church of the Redeemer. This last, built in the form of a Greek cross in 1837–1883 at a cost of nearly £1,600,000, is dominated by five gilded domes and faced externally with marble. The interior is harmoniously decorated with gold and marble, and adorned with pictures by Verestctagin and other Russian artists. In the east of the city are three monasteries all dating from the 14th century.

The Zemlyanoy-Gorod, which has arisen from villages that surrounded Moscow, exhibits varied characteristics. In the neighbourhood of the railway stations it has busy centres of traffic; other parts are manufacturing quarters, whilst others—for instance, the small quiet streets on the west of the boulevard Prechistenka, called the old Konushennaya, with their wooden houses and spacious courtyards—are the true abodes of the families of the old, for the most part decayed, but still proud, nobility. The Zamoskvoryechie, on the right bank of the Moskva, is the abode of the patriarchal merchant families.

The climate of Moscow is cold and continental, but healthy. The average annual temperature is 40·1° F. (Jan., 14°; July, 66·5°). The summer is warm (64·2°), and the winter cold and dry (15·8°), great masses of snow lying in the streets. The spring, as is usually the case in cold continental climates, is beautiful. The prevailing winds are south-west and south.

The river Moskva is frozen, on the average, for 153 days (from Nov. 12 to April 13).

The Moskva is crossed by five bridges; a branch of it, or rather a channel, makes an elongated island in the middle of the city. Water of excellent quality, principally from the Mytishchi springs and pounds, 11 m. distant, has since 1893 been led to fountains in different parts of the city, whence it is distributed by watermen.

The population was estimated at only 150,000 in the middle of the 18th century, and at 250,000 in 1812. Since 1870 it has been growing at the rate of about 2½ % per annum; (1872), 601,969; (1882), 753,469; (1902), 1,092,360, or including the suburbs 1,173,427; (est. 1907), 1,359,254. The housing problem is of great importance in Moscow, as it appears that over 10% of the domiciles are underground. And while the average for the city is two occupants to each room, there are more than 10,000 domiciles which have more than four occupants to each room, representing one-fourth of the population. The average mortality is consequently high, namely 28 per 1000 (33 per 1000 if the children inmates of the Foundling House be included). Fires occur very frequently. The inhabitants are mostly Great-Russians. They belong chiefly to the Orthodox Greek Church, or are Nonconformists; the Lutherans number 2% and the Roman Catholics 1%.

Since the 14th century Moscow has been an important commercial city. About the end of the 15th century its princes transported to Moscow, Vladimir, and other Russian towns no fewer than 18,000 of the richest Novgorod merchant families, and took over the entire trade of that city, entering into direct relations with Narva and Livonia. The annexation of Kazan (1552) and the conquest of Siberia (1580–1600) gave a new importance to Moscow, bringing it into direct commercial relations with Khiva, Bokhara and China, and supplying it with Siberian furs. The fur-trade had a great fascination for all European merchants in the 16th century, and an English company, having received the monopoly of the Archangel trade, caused their merchandise to be sent by the White Sea instead of by the Baltic. Moscow thus became the centre for nearly the entire trade of Russia, and the tsar himself engaged in large commercial operations. Situated at the intersection of six important highways, Moscow was the storehouse and exchange-mart for the merchandise of Europe and Asia. The opening of the port at St Petersburg affected its commercial interest unfavourably at first; but the Asiatic trade and internal trade of Moscow have since then enormously increased. Here are concentrated the traffic in grain, in hemp and in oils sent to the Baltic ports; in tea, brought both by way of Siberia and of St Petersburg; in sugar, refined here in large quantities; in grocery wares for the supply of more than half Russia and all Siberia; in tallow, skins, wool, metals, timber, wooden wares, iron and steel goods, wine, drugs, raw cotton, silk and all other produce of the manufactures of middle Russia. As a railway centre the city plays so predominant a part that ⅙ to ⅕ of all the goods carried by the railways of European Russia are loaded or unloaded at Moscow. The banks, including the mortgage banks, are the most important in Russia.

From the 15th century onwards the villages around Moscow were renowned for the variety of small industries which they carried on; the first large manufactures in cottons, woollen fabrics, silk, china and glass in Great-Russia were established at Moscow in the 17th and 18th centuries. After 1830, in consequence of protection tariffs, the manufactories in the government of Moscow rapidly increased in number; but two-thirds of them are now concentrated in the capital. Moscow is in fact the principal manufacturing city in the empire, employing about 100,000 operatives in her mills and factories. Nearly one-half of them are engaged in the textile industries, especially calico-printing. Next in importance comes the preparation of food-stuffs, followed by the metal and metallurgical industries and the chemical works.

Moscow has many educational institutions and scientific societies. The university, founded in 1755, exercised a powerful influence on the intellectual life of Russia during the years 1830–1848; and it still continues to be the most frequented Russian university. In 1904 it had over 5000 students, who are mostly poor. The library contains some 286,000 volumes, and has rich collections in mineralogy, geology and zoology. Among the museums the Rumyantsev, now connected with the so-called public museum, occupies the first rank. It contains a library of 700,000 volumes and 2300 MSS., remarkable collections of old pictures, sculptures and prints, as well as an extensive mineralogical collection, and an ethnographical collection representing very accurately the various races of Russia. The private museum of Prince Golitsui contains a good collection of paintings and MSS. The Shchukin Museum contains Russian antiquities, pictures and objects of industrial art. A number of excellent free libraries have been opened, two of them containing valuable collections of books and MSS. The remarkable Tretyakov gallery of pictures, chiefly of the Russian school, has been presented (1892) by its owner to the city. The philanthropic institutions include the vast foundling hospital (1764). The municipal relief of the poor was entirely reorganized in 1894, partly on the Elberfeld system and partly on quite new and original lines.

Moscow is surrounded by beautiful parks and picturesque suburbs. Of the former one of the most frequented is the Petrovsky Park, to the north-west, with a castle built in 1776, burnt by the French in 1812, but rebuilt in 1840. A little farther out is the Petrovskoye Razumovskoye estate, with an agricultural academy (1865) and its dependencies (botanical garden, experimental farm, &c.). Another large park and wood surround an imperial palace (1796) in the village of Ostankino. The private estates of Kuzminski, Kuskovo and Kuntsevo are also surrounded by parks; the last has remains of a very old graveyard, supposed to belong to the pagan period. In the south-west, on the right bank of the Moskva, which here makes a great loop to the south, are the Vorobyevy hills, which are accessible by steamer from Moscow, and afford one of the best views of the capital. In the loop of the Moskva is situated the Novo-Dyevichy or Virgins' convent, erected in 1524 and connected with Sophia, sister of Peter the Great, and many events of Russian history. In the south, on the road to Serpukhov, is the village of Kolomenskoye, founded in 1237, a favourite residence of Ivan the Terrible and Peter the Great, with a church built in 1537, a striking monument of Russian architecture, restored in 1880. The monastery Nikolo-Ugryeshskiy, 12 m. from the city, between the Kursk and Ryazan railways, occupies a beautiful site and is much visited by Moscow merchants, to venerate a holy picture by which Dmitry Donskoi is said to have been blessed before going to fight (1380) the Mongols. In the north, the forest of Sokolniki, covering 4½ sq. m., with its radial avenues and numerous summer residences, is the part of Moscow most frequented by the middle classes.

History.—The Russian annals first mention Moscow in 1147 as a place where Yuri Dolgoruki, prince of Suzdal, met Svyatoslav of Syeversk and his allies. The site was inhabited from a very remote antiquity by the Merya and Mordvinians, whose remains are numerous in the neighbourhood, and it was well peopled by Great-Russians in the 12th century. To the end of the 13th century Moscow remained a dependency of the princes of Vladimir, and suffered from the raids of the Mongols, who burned and plundered it in 1237 and 1293. Under Daniel, son of Alexander Nevsky (1261–1302), the prince of Moscow first acquired importance for the part he took in the wars against the Lithuanians. He annexed to his principality Kolomna, situated at the confluence of the Moskva with the Oka. His son in 1302 annexed Pereyaslavl Zalesky, and in the following year Mozhaisk (thus taking possession of the Moskva from its source to its mouth), and so inaugurated a policy which lasted for centuries, and consisted in the annexation by purchase and other means of the neighbouring towns and villages. In 1300 the Kremlin, or fort, was enclosed by a strong wall of earth and timber, offering a protection to numerous emigrants from the

Tver and Ryazan principalities. Under Ivan Kalita (1325–1341) the principality of Vladimir—where the princes of Kiev and the metropolitan of Russia had taken refuge after the wars that desolated south-western Russia—became united with Moscow; and in 1325 the metropolitan Peter established his seat at Moscow, thus giving new importance and powerful support to the young principality. In 1367 the Kremlin was enclosed within stone walls, which proved strong enough to resist the Lithuanians under Olgierd (1368 and 1371). Kalita's grandson, Dmitry Donskoi, annexed the dominions of Starodub and Rostov, and took part in the renowned battle of Kulikovo (1380), on the Don in the government of Tula, where the Russians ventured for the first time to oppose the Mongols in a great pitched battle. Two years after the battle of Kulikovo Moscow was taken and plundered (for the last time) by Toktamish, khan of the Golden Horde of the Mongols.

The increase of the principality continued during the first half of the 15th century, and at the death of Vasili (or Basil) the Blind, in 1462, it included not only the whole of what is now the government of Moscow, but also large parts of the present governments of Kaluga, Tula, Vladimir, Nijniy-Novgorod, Kostroma, Vyatka, Vologda, Yaroslav and Tver. It was not however until the reign (1462–1505) of Ivan III. that the prince of Moscow set up claims to other parts of Russia, and called himself "Ruler of all Russia." In 1520 Moscow was said to contain 45,000 houses and 100,000 inhabitants. Ivan IV. annexed Novgorod and Pskov to Moscow, and subdued Kazan and Astrakhan. But after his reign Moscow suffered from a long series of misfortunes. In 1547 two conflagrations destroyed nearly the whole of the city, and a few days later the Tatar khan of the Crimea advanced against it with 100,000 men. He was compelled to retire from the banks of the Oka, but in 1571, taking advantage of the state into which Russia was brought by the extravagances of Ivan, he took Moscow and burned all the city outside the Kremlin. The gates of the Kremlin having been shut, thousands of people perished in the flames, and the annals record that of the 200,000 who then formed the population of Moscow, only 30,000 remained. In 1591 the Tatars of the Crimea were again in Moscow and avenged their repulse from the Kremlin on the inhabitants of the unfortified town. Meanwhile the political influence of the boyars had gradually increased. The peasants, who settled on their lands, or on the estates which the prince bestowed upon his boyars, had become serfs; and the political tendency of the boyars, supported by the wealthier middle classes (which had also a rapid development in the same century), was to become rulers of Russia, like the noblesse of Poland. During the reign of Feodor or Theodore (1584–1598), Boris Godunov, the regent, ordered the murder of the heir to the throne, Demetrius, son of Ivan IV., and himself became tsar of Russia. Moscow suffered severely in the struggle which ensued, especially when the populace rose and exterminated the Polish garrison, on which occasion the whole of the city outside the Kremlin was again burned and plundered. But in compensation it acquired in the eyes of the nation a greatly increased importance, as a stronghold against foreign invasions. The Novo-dyevichy or Virgins' nunnery, which the Poles besieged (1610) without taking, was invested with a higher sanctity. The city also by-and-by recovered its commercial importance, and this the more as other commercial cities were ruined, or fell into the hands of foreigners; and thirty years later Moscow was again a wealthy city. Owing, however, to the ever-increasing concentration of power in the hands of the tsar, and the steady development of autocracy, it lost much of its political importance, and assumed more and more, especially under Alexis Mikhailovich (1645–1676), the character of a private estate of the tsar, its suburbs becoming mere dependencies of his vast household.

During the whole of the 17th century Moscow continued to be the scene of many troubles and internal struggles. The people several times revolted against the favourites of the tsar, and were subdued only by cruel executions, in which the *streltzy*—a class of citizens and merchants rendering hereditary military service—supported the tsar. Afterwards appeared the *raskol* or nonconformist movement, and in 1648, when the news spread that Stenka Razin was advancing on Moscow "to settle his accounts with the boyars," the populace was kept from rising only by severe repressive measures and by the defeat of the invader. Later on, the *streltzy* themselves engaged in a series of rebellions, which led the youthful Peter the Great to suppress them (1698) amid streams of blood. The opposition encountered at Moscow to his plans of reforming Russia according to his ideal of military autocracy, the conspiracies of the boyars and merchants, the distrust of the mass of the people, all compelled him afterwards to leave (1703) the city, and to seek, as his ancestors had done, a new capital. This he founded at St Petersburg on the very confines of the military empire he was trying to establish.

In the course of the 18th century Moscow became the seat of a passive and discontented opposition to the St Petersburg government. Peter the Great, wishing to see Moscow like other capitals of western Europe, ordered that only stone houses should be built within the walls of the town, that the streets should be paved, and so on; but his orders were only partially executed. In 1722 the Kremlin was restored. In 1739 the city became once more the prey of a great conflagration; two others followed in 1748 and 1753, and gave an opportunity for enlarging some streets and squares. Catherine II. tried to conciliate the nobility, and applied herself to benefit the capital with new and useful buildings, such as the senate house, the foundlings' and several other hospitals, salt stores, &c.

The last public disaster was experienced by Moscow in 1812. On the 13th of September, six days after the battle of Borodino, the Russians troops evacuated Moscow, and the next day the French occupied the Kremlin. The same night, while Napoleon was waiting for a deputation of Moscow notables, and received only a deputation of the rich *raskolnik* merchants, the capital was set on fire through the carelessness of its own inhabitants (it was no heroic deed of Roztopchin's), the bazaar, with its stores of wine, spirits and chemical stuffs, becoming the prey of the flames. The inhabitants abandoned the city, and it was pillaged by the French troops, as well as by Russians themselves, and the burning of Moscow became the signal of a general rising of the peasants against the French. The want of supplies and the impossibility of wintering in a ruined city, continually attacked by cossacks and peasants, compelled Napoleon to leave Moscow on the 19th of October, after he had unsuccessfully attempted to blow up certain parts of the Kremlin.

(P. A. K.; J. T. Be.)

MOSEL (Fr. *Moselle*), a river of France and Germany, a left-bank tributary of the Rhine. It rises at an altitude of 2411 ft. on the west flank of the Vosges, close to the Franco-German frontier, and a little N. of the Ballon d'Alsace. It flows first N.W. through the French department of Vosges, bends towards N. through that of Meurthe-et-Moselle, forms the Franco-German frontier for a short distance below Pagny, and enters Lorraine. From Sierck to Wasserbillig it forms the frontier between the Rhine Province and Luxemburg, then, turning N.E., it follows a sinuous course and reaches the Rhine at Coblenz. The principal towns on the banks of the Mosel are, in France: Remiremont, Épinal, Toul and Pont-à-Mousson; in Germany: Metz, Diedenhofen, Trier (Trèves) and Coblenz. The Mosel receives the waters of the Moselotte, Meurthe, Seille and Saar (its principal tributary) on the right, and the Madon, Orne and Sauer on the left. Navigation for small vessels extends downwards from Fronard, a little below Nancy, the Mosel canal affording communication from a point above Metz to the frontier. In the lower part of the valley are the vineyards from which the well-known Mosel wines are produced. The valley of the Mosel, especially the part between Trier and Kochem, is noted both for picturesque scenery and for many sites of antiquarian interest. The length of the river is 314 m.

MOSELLE-LINE, the designation of a line of French barrier forts (*forts d'arrêt*) on the upper Moselle between the fortresses of Épinal and Belfort (see these articles, also Meuse Line and articles referred to therein). The purpose of this line, the separate forts of which command the relatively few lines of advance from upper Alsace through the Vosges, is to deflect a possible German invasion from Alsace either towards Belfort or towards the open gap between Épinal and Toul called the Trouée d'Épinal.

MOSEN, JULIUS (1803–1867), German poet and author, was born at Marieney in the Saxon Vogtland on the 8th of July, 1803. He studied law at Jena, and, after two years in Italy, at Leipzig. In 1834 he settled in Dresden as an advocate. He had meanwhile shown great literary promise by his *Lied vom Ritter Wahn* (1831). This was followed by the more philosophical *Ahasver* (1838), and by a volume of poems, *Gedichte* (1836, 2nd ed., 1843), among which *Andreas Hofer* and *Die letzten Zehn vom vierten Regiment* have become popular. He wrote the historical plays *Heinrich der Finkler* (Leipzig, 1836), *Cola Rienzi, Die Bräute von Florenz, Wendelin und Helene* and *Kaiser Otto III.* (the four last being published in his *Theater* 1842), and a politico-historical novel, *Der Kongress von Verona* (1842), which was followed by a charming collection of short stories (*Bilder im Moose*, 1846). In 1844 Mosen accepted the appointment of dramaturge at the Court Theatre in Oldenburg, but he was soon afterwards stricken with paralysis, and after remaining an invalid for many years, died at Oldenburg on the 10th of October 1867. Of his later works may be mentioned *Die Dresdner Gemäldegallerie* (1844), and the tragedies *Herzog Bernhard* (1855) and *Der Sohn des Fürsten* (1858).

A collection of his works, *Sämtliche Werke*, appeared in 8 vols. (1863; new ed., by his son, with a biography; 6 vols., 1880).

MOSER, JOHANN JAKOB (1701–1785), German jurist, was born at Stuttgart on the 18th of January 1701. He studied at the university of Tübingen, where, at the early age of nineteen, he was appointed extraordinary professor of law. In 1729 he became ordinary professor, and in 1736 he accepted a chair and directorship in the university of Frankfort-on-the-Oder. On account, however, of differences with King Frederick William I. of Prussia, he resigned these offices in 1739 and retired to Ebersdorf, a village in the principality of Reuss, where for several years he devoted himself wholly to study, and especially to the production of his *Deutsches Staatsrecht*. In 1751 he was recalled to Würtemberg as district counsellor, and in 1759 was imprisoned at Hohentwiel on account of the steps he had taken in connexion with this office against certain tyrannical proceedings of the duke. In 1764 he received his liberty and was restored to office. He died on the 30th of September 1785. Moser was the first to discuss in an adequate form the subject of European international law. He wrote more than 500 volumes, his principal works being *Deutsches Staatsrecht* (1737–1754), *Neues deutsches Staatsrecht* (1766–1775), *Deutsches Staatsarchiv* (1751–1757), *Grundriss der heutigen Staatsverfassung von Deutschland* (1754).

See Schmid, *Das Leben J. J. Mosers* (1868); Schulze, *J. J. Moser, der Vater des deutschen Staatsrechts* (1869).

MÖSER, JUSTUS (1720–1794), German publicist and statesman, was born at Osnabrück on the 14th of December, 1720. Having studied jurisprudence at the universities of Jena and Göttingen, he settled in his native town as a lawyer. The confidence he inspired among his fellow citizens soon led to his being appointed *advocatus patriae* (state attorney). On the appointment of the duke of York (son of George III. of England) to the lay Protestant bishopric of Osnabrück, he was attached to the person of the new ruler as legal adviser, and continued in this office of trust for twenty years. From 1762 to 1768 he was *justiciarius* (chief justice) of the criminal court in Osnabrück; and in 1768 was made *Geheimer Referendar* (privy councillor of justice). He died at Osnabrück on the 8th of January 1794. Not only as a statesman and administrator, but also as a publicist, Möser occupied a leading position among the men of his time. His history of Osnabrück (1768; 2nd ed. 1780; 3rd ed. 1819) is a masterly work. In his *Patriotische Phantasien* (1775–1786; 2nd ed. by his daughter, I. W. J. von Voigts, 1804; new ed. by R. Zöllner, 1871) he shows himself in advance of his times, pleading as he does for a national organic development of a state in the place of arbitrary laws imposed by the sovereign. His *Vermischte Schriften* (published by F. Nicolai with a biography, 1797–1798) also display a deep insight into human nature and sparkle with humour and witty sallies. Möser was also a poet of some repute and wrote a tragedy, *Arminius* (1749). A statue of him by Drake was unveiled in Osnabrück in 1836.

His collected works, *Sämtliche Werke*, were published by B. R. Abeken (10 vols., 1842–1844). See J. Kreyssig, *Justus Möser* (1857); L. Rupprecht, *Justus Mösers soziale und volkswirtschaftliche Anschauungen* (1892); K. Mollenhauer, *Mösers Anteil an der Wiederbelebung des deutschen Geistes* (1896).

MOSES (Gr. Μωυσῆς, Μωσῆς), the great Jewish lawgiver, prophet and mediator, and leader of the Israelites from Egypt to the eastern borders of the promised land. The records of his life and work are noticed in the articles Exodus, Numbers, Deuteronomy, where the several sources of the narratives are described. He appears in Midian at the "Mount of God" (Horeb) dwelling with its priest Jethro (*q.v.*), one of whose seven daughters he married, thus becoming the father of Gershom and Eliezer. Of his earlier life it was said that he was born in Egypt of Levite parents, and when the Pharaoh commanded that every new-born male child of the Hebrews should be killed, he was put into a chest and cast upon the Nile. He was found by Pharaoh's daughter, and his (step-)sister Miriam contrived that he should be nursed by his mother; on growing up he killed an Egyptian who was oppressing an Israelite, and this becoming known, he sought refuge in flight.

The story of the youth of Moses is, as is commonly the case with great heroes, of secondary origin; moreover, the circumstances of his birth as related in Exod. ii. find numerous parallels in legend elsewhere, *e.g.* in the story of the historical Sargon (L. W. King, *Early Bab. Kings*, ii. 87 sqq.), in the myths of Osiris and many others (see, at length, A. Jeremias's *Das Alte Test. im Lichte des alten Orients*, 1906, pp. 408 sqq.; *Bab. im N. Test.* p. 30 seq.). The story of the adoption of Moses by the Egyptian princess appealed to later imagination (Josephus, *Ant.* ii. 9, 10; Acts vii. 20–22), and many fanciful fables grew up around this and the other biblical statements. The name Mōsheh, explained by the fact that the princess "drew him" (*māshāh*) out of the waters, means properly "one who draws"; a derivation from Eg. *mes*(*u*), "child," finds more favour, but is not certain.

At the holy mount, Moses received the divine revelation and was commissioned to bring the people a three-days' journey out of Egypt to sacrifice at this spot (Exod. iii. 12, 18; v. 3; viii. 27). The deity revealed himself in a new name, Yahweh, and with signs and wonders fortified Moses for his task. On his return he experienced a remarkable incident which is obscurely associated with the rite of circumcision.[1] The plagues with which the reluctant Pharaoh was coerced culminated in the destruction of all the first-born, and Israel escaped to the Red Sea. The pursuing Egyptians were drowned, and the miraculous preservation of the chosen people at the critical moment marks the first stage in the national history.[2] (See Exodus, The.)

The other events need not be detailed. Kadesh (holy) was the chief centre. This was the scene of the "strife" at Meribah (striving) where Yahweh "shewed himself holy" (Num. xx. 1–13); a parallel account joins the name with Massah (trial, proof) where Yahweh "proved" the people (Exod. xvii. 1–7). These two names (Deut. ix. 22, xxxii. 51) with their significant meanings recur with varying nuances (Ps. lxxxi. 7, xcv. 8 seq.). Here also in the wilderness of Shur, and possibly at En-mishpat (well of judgment, *i.e.* Kadesh, Gen. xiv. 7), Yahweh made for Israel "statute and judgment" and "proved them." This is apparently viewed as the goal of the three-days' journey (Exod. xv. 22–25). In this district the defeat of the Amalekites is more naturally located (Exod. xvii.; cf. 1 Sam. xxvii. 8) and here, finally, for some cause, now obscured, Moses and his brother Aaron (*q.v.*) incurred Yahweh's displeasure (Num. xx. 12, xxvii. 14; Deut. xxxii. 51; Ps. cvi. 3). Pisgah or Mt Nebo (the name suggests a foreign god), to the north-east of the Dead Sea became the scene of the death of Moses; his burial-place was never known (Deut. xxxiv.).

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[1] Exod. iv. 24–26; it possibly explains the transference of the rite from the bridegroom to the new-born son. For a recent discussion, see H. P. Smith, *Journ. Bib. Lit.* (1906), pp. 14–24; and the article Circumcision (with J. G. Frazer's essay in the *Independent Review* 1904, pp. 204–218).

[2] The plagues appear to have been amplified. In Exod. iv. three signs are given: the hand of Moses is stricken with leprosy and restored (the sign for Moses); his rod becomes a serpent (cf. vii. 8–13; the sign for Pharaoh); and the water is turned into blood (cf. vii. 17 sqq.). If Pharaoh still remains obdurate his first-born is threatened (iv. 21 sqq.). As regards the crossing of the Red Sea, a perfectly rationalizing explanation can be found: with a strong east wind its waters could temporarily recede and permit a passage (see *Journ. Vict. Inst.* xxvi. 28; xxviii. 268, 277). To the Israelites, however, it was a miracle, an unexpected intervention on the part of Yahweh, and the first of many marvels which he performed on behalf of the people of his choice. To rationalize this or any of the series misses the whole point of the religious history.

In estimating the work of one who stands at the head of the religious and legal institutions of Israel, it is necessary to refrain from interpreting the traditions from a modern legal standpoint or in the light of subsequent ideas and beliefs for which the sources themselves give no authority. Much confusion has been caused by attributing to Moses more than the Pentateuch itself claims, and by misunderstanding the meaning of later references (Mat. xix. 8; Mark vii. 10, x. 5, xii. 26; Luke xx. 37; John vii. 22). Moreover, it is necessary to allow that the traditions relating to both Moses and Aaron underwent change. The priesthoods of Shiloh and Dan could boast of an illustrious origin (1 Sam. ii. 27 seq., Judges xviii. 30), but the religious practices associated with the former especially were not those of the purest type. When Aaron himself is connected with the worship of the golden calf, and when to Moses is attributed a brazen serpent which the reforming king Hezekiah was the first to destroy, it is evident that religious conceptions developed in the course of ages. Although Moses was venerated as a prophet (Hos. xii. 13), a mediator (Jer. xv. 1) and a leader (Mic. vi. 4; Isa. lxiii. 11), much of the legal procedure ascribed to him must belong on internal grounds (religious, ethical and sociological evidence) to a post-Mosaic age. Many of the Mosaic laws find parallels and analogies in all ages outside the sphere of Israelite influence, notably in the laws codified several centuries previously by the Babylonian king Khammurabi (see BABYLONIAN LAW). The practice of finding in ancient authority a precedent for institutions new and old (cf. the law of booty, 1 Sam. xxx. 25, with that ascribed to Moses in Num. xxxi. 25 sqq.) is quite in accordance with Oriental custom and explains the growth of the present extremely complex sources. But this very development of Mosaism implies the existence of an original nucleus or substratum, although the recovery of its precise extent is very difficult. The legislation on Mt Sinai (Horeb) which apparently occupies a very important place in tradition (Exod. xx. sqq.) is really secondary (cf. W. R. Smith, *Prophets of Israel*, p. 111); more prominence is evidently to be ascribed to the influence of the half-Arabian Jethro or Hobab, and this must be taken into consideration with what is known of Kenite and kindred clans (Exod. xviii.; Num. x. 29–33; see JETHRO; KENITES).[1] Yahweh appears to have been known to them before he revealed himself to Moses, and the ancestors of the Israelites are recognized as worshippers of Yahweh, but are on another level (Exod. vi. 3). The traditions would seem to point to the institution of new principles in the religion of Yahweh, and would associate with it not merely Moses but those foreign elements which are subsequently found in Israel and Judah. See JEWS, §§ 5, 14, 20.

BIBLIOGRAPHY.—See further articles, AARON; DECALOGUE; HEBREW RELIGION; LEVITES. For the introductory questions, W. Robertson Smith's *Old Test. in Jewish Church* and *Prophets of Israel* are most helpful; see also J.-M. Lagrange, *Hist. Crit. and the Old Testament* (Eng., E. Myers, 1905), pp. 148–179; Wellhausen's *Prolegomena* is a conclusive elaboration of the initial stages of criticism. All subsequent studies vary according to the writer's standpoint; W. R. Harper, *Amos and Hosea* (*Internat. Critical Commentary*), pp. 84 sqq., gives a convenient summary. Among particular discussions may be named Cheyne, *Ency. Bib. s.v.*, E. Meyer, *Israeliten*, pp. 1–103; and the mythological treatment by H. Winckler, *Gesch. Isr.*, ii. 86–95; A. Jeremias, *Alte Test.*, *loc. cit.*; and Ed. Stucken, *Astralmythen d. Hebräer*, &c., pp. 431 sqq. For Jewish and other legends (to which Jude 9 alludes), see Beer, *Leben Moses* (1863), M. Grünbaum, *Neue Beiträge z. sem. Sagenkunde* (1893), pp. 152 sqq.; the *Assumption of Moses*, ed. R. H. Charles (1897); W. Tisdall, *Sources of the Qur'an* (1905); and *Ency. Bib.* col. 3218, § 21 (with references). For the stories of Manetho, &c., Ewald, *Hist. Isr.*, ii. 76 sqq.; Kittel, *Hist.* i. 26 seq., may be supplemented by Willrich, *Juden u. Griechen vor d. makkab. Erhebung* (1895), pp. 53 sqq.; G. Maspero, *Rec. de travaux* (1905), xxvii. 13 sqq., 22 seq. (S. A. C.)

MOSES, ASSUMPTION OF, an extra-canonical apocalyptic work of the Old Testament. The *Assumption* or *Ascension of Moses* (Ἀνάληψις Μωυσέως) is a prophecy of the future relating to Israel, put into the mouth of Moses, and addressed to Joshua just before the great lawgiver died. Founded upon the book of Deuteronomy, it is brief and unpoetical. But it seems to have been large at first, for according to Nicephorus it consisted of 1400 stichs. It contains a brief history of Israel from Moses to the Messianic age. The most striking feature in this work is the writer's scathing condemnation of the priesthood before, during, and after the Maccabean period, and an unsparing depreciation of the Temple services.

This book was lost for many centuries till a large fragment of it was discovered and published by Ceriani in 1861 (*Monumenta sacra* I. i. 55–64) from a palimpsest of the 6th century. Very little was known about the contents of this book prior to this discovery. One passage found in this fragment is quoted in the *Acta synodi Nicaenae*, ii. 18. Most of the other references relate to the strife of Michael and Satan about the body of Moses, and ascribe it to the Ascensio Mosis, *i.e.* Ἀνάληψις Μωυσέως.

Various other works have been attributed to Moses, such as the *Petirath Moshe*, the βίβλος λόγων μυστικῶν Μωυσέως, *The Exodus of Moses* (in Slavonic), &c. See Charles, *Assumption of Moses*, pp. xiv.–xvii.; Schürer, *Gesch. des jüd. Volkes*, iii. 220–221.

Date.—The book has been assigned to most dates between the death of Herod the Great and that of Bar-Cochba. But this text precludes any date after A.D. 70. The true date appears to lie between 4 B.C. and A.D. 30. Herod is already dead (vi. 6), hence it is after 4 B.C.; and Herod's sons are to rule for shorter periods than their father, hence it must have been composed before these princes had reigned thirty-four years—*i.e.* before A.D. 30. But there are grounds for assuming that A.D. 7 is probably the earlier limit (see Charles, *op. cit.* **lv.–lviii.**).

Author.—The author was not an Essene, for he recognizes animal sacrifices and cherishes the Messianic hope. He was not a Sadducee, for he looks forward to the establishment of the Messianic Kingdom **(x.)**. Nor yet was he a Zealot, for the quietistic ideal is upheld (ix.), and the kingdom is established by God Himself **(x.)**. He was clearly a Pharisaic Quietist, a Pharisee of a fast disappearing type, recalling in all respects the Chasid of the early Maccabean times, and upholding the old traditions of quietude and resignation. His object is to protest against the growing secularization of the Pharisaic party through its adoption of popular Messianic beliefs and political ideals. But his appeal was in vain, and so the secularization of the Pharisaic movement culminated in due course in the fall of Jerusalem.

The Latin Version a Translation from the Greek.—That our Latin text is derived from the Greek there can be no question. Thus Greek words are transliterated, as "chedrio" from κεδρόω, "heremus" from ἔρημος; Greek idioms are reproduced, as "usque nos duci captivos," = ἕως τοῦ ἡμᾶς αἰχμαλωτισθῆναι, and retranslation into Greek is frequently necessary in order to correct the misrenderings of the translator or the corruptions already inherent in the Greek. Finally, fragments of the Greek version are still preserved.

The Greek a Translation from the Hebrew.—That the Greek was in turn derived from a Semitic original was denied by Hilgenfeld, Volkmar and others. But Ewald, Schmidt-Merx, Colani, Carrière, Hausrath, Dalman, Rosenthal and Burkitt decide in favour of a Semitic. R. H. Charles (*op. cit.* xxxviii.–xlv.) is of opinion that it is possible to prove that the Greek goes back not to an Aramaic but to a Hebrew original, on the following grounds: (1) Hebrew idiomatic phrases survive in the text. Thus *circumibo* (ii. 7) = "I will protect," *i.e.* אסובב (cf. Deut. xxxii. 10), and *in sacerdotes vocabuntur* = εἰς ἱερεῖς κληθήσονται, על פתנים יִקָּרְאוּ (cf. 1 Chron. xxiii. 14, and Isa. xlviii.2), = "they will call themselves priests." (2) Frequently it is only through retranslation that we can understand the source of corruptions in the text. (3) In some cases we must translate not the Latin but the Hebrew presupposed by it. Thus in i. 7, *successor* = διάδοχος = משרת, must be rendered "minister."

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[1] See K. Budde, *Religion of Israel to the Exile*, ch. i. According to Gen. iv. 26, so far from the name Yahweh having been made known to Israel by Moses (Exod. iii. 13 sqq., vi. 2 sqq.), the worship goes back to the earliest ages.

The Book may be the lost Testament of Moses.—The present book is possibly the long lost Διαθήκη Μωυσέως mentioned in some of the ancient lists, for it never speaks of the assumption of Moses, but always of his natural death (i. 15, iii. 13, x. 14). About a half of the original Testament is preserved in the Latin Version. The latter half probably dealt with questions about the Creation (see Fabric. *Cod. pseud. V. T.*, ii. 844; *Acta synodi Nicaenae*, ii. 20). With this "Testament" the "Assumption," to which almost all the patristic references and that of Jude are made, was subsequently edited.

Some views of Author.—Our author's views on Moses are remarkable. He writes that Moses was prepared from before the foundation of the world to be the mediator of God's covenant with his people (i. 14, iii. 12). During his life he was Israel's intercessor with God (xi. 11, 17). Praying on their behalf as a "great angel" (xi. 17), "a sacred spirit who was worthy of the Lord manifold and incomprehensible" (xi. 16). Apparently his relation to Israel did not cease with death, as he was to be their intercessor in the spiritual world (xii. 6). His death was an ordinary one (i. 15, iii. 13, x. 12, 14), but no single place was worthy to mark the place of his burial, for his sepulchre was from the rising to the setting sun, and from the south to the confines of the north—yea, the whole world was his sepulchre (xi. 8). On the doctrine of good works our author's views are allied to Old Testament conceptions rather than to the rabbinic doctrine of man's righteousness, which bulks so largely in Jewish literature from A.D. 50 onwards. So far from representing man's righteousness as involving merit over against God, our author represents the greatest hero of Israel as declaring "Not for any virtue or strength of mine, but in His compassion and long-suffering was He pleased to call me" (xii. 7.)

LITERATURE.—Editions of the Latin text: Ceriani *Monumenta sacra et profana*, I. i. 55–64 (1861); Hilgenfeld, *Nov. test. extra canonem receptum*, 107–135 (1876); Volkmar, *Mose Prophetie und Himmelfahrt* (1867); Schmidt and Merx, *Die Assumptio Mosis* (Merx, *Archiv. f. wissensch. Erf. des A. Ts.* I. ii. 111–152; 1868); Charles, *The Assumption of Moses* (translation, with notes and introduction, 1897); Clemen, in Kautzsch's *Apocr. und Pseud.*, II. 311–331. *Critical inquiries.*—For a full account of these see Schürer iii. 222; Charles *op. cit.* xxi–xxviii. (R. H. C.)

MOSES OF CHORENE, Armenian historian, was a native of Khorʻni in Tarōn, a district of the Armenian province of Turuberan. According to the *History of Armenia* which bears his name he was a pupil of the two fathers of Armenian literature, the patriarch or catholicos Sahak the Great and the vartabed Mesrōb. Shortly after 431 he was sent by these men to Alexandria to study the Greek language and literature, and thus prepare himself for the task of translating Greek writings into Armenian. Moses took his journey by Edessa and the sacred places of Palestine. After finishing his studies in the Egyptian capital he set sail for Greece; but the ship was driven by contrary winds to Italy, and he seized the opportunity of paying a flying visit to Rome. He then visited Athens, and towards the end of winter (440) arrived in Constantinople, whence he set out on his homeward journey. On his arrival in Armenia he found that his patrons were both dead. The *History of Armenia* speaks of its author as an old, infirm man, constantly engaged in the work of translating. In the later Armenian tradition we find other notices of this celebrated man[1]—such as, that he was the nephew of Mesrōb, that he was publicly complimented by the emperor Marcian, that he had been ordained bishop of Bagrewand by the patriarch Giut, and that he was buried in the church of the Apostolic Cloister at Mush in the district of Tarōn; but these accounts must be received with great caution. This remark applies especially to the statement of Thomas Ardsruni,[2] that Moses, like his Hebrew prototype, lived to the age of 120 years, and recorded his own death in a fourth book of his great work. The same caution must be extended to another tradition, based on an arbitrary construction of a passage in Samuel of Ani, which places his death in the year 489.

The *History of Armenia*,[3] or, as the more exact title runs, the *Genealogical Account of Great Armenia*, consists of three books, and reaches down to the death of Saint Mesrōb, in the second year of Yazdegerd II. (Feb. 17, 440).[4] It is dedicated to Sahak Bagratuni (who was afterwards chosen to lead the revolted Armenians in the year 481), as the man under whose auspices the work had been undertaken. This work, which in course of time acquired canonical authority among the Armenians, is partly compiled from sources which we yet possess, viz. the *Life of Saint Gregory* by Agathangelos, the Armenian translation of the Syriac *Doctrine of the Apostle Addai*, the *Antiquities* and the *Jewish War* of Josephus, and above all the *History of Mar Abas Katina* (still preserved in the extract from the book of Sebēos),[5] who, however, did not write, as Moses alleges, in Syriac and Greek, at Nisibis, about 131 B.C., but was a native of Medsurch, and wrote in Syriac alone about A.D. 383, or shortly thereafter. Besides these, Moses refers to a whole array of Greek authorities, which were known to him from his constant use of Eusebius, but which cannot possibly have related all that he makes them relate.[6] Although Moses assures us that he is going to rely entirely upon Greek authors, the contents of his work show that it is mainly drawn from native sources. He is chiefly indebted to the popular ballads and legends of Armenia, and it is to the use of such materials that the work owes its permanent value. Its importance for the history of religion and mythology is, in truth, very considerable, a fact which it is the great merit of Emin[7] and Dulaurier[8] to have first pointed out. For political history, on the other hand, it is of much less value than was formerly assumed. In particular, it is not a history of the people or of the country, but a history of the Armenian aristocracy, and, in opposition to the Mamikonian tendency which pervades the rest of the older Armenian historical literature, it is written in the interest of the rival Bagratunians. Down to the 3rd century it is proved by the contemporary Graeco-Roman annals to be utterly untrustworthy—but even for the times of Armenian Christianity it must be used far more cautiously than has been done, for example, by Gibbon. The worst feature is the confusion in the chronology, which, strange to say, is most hopeless in treating of the contemporaries of Moses himself. What can be thought of a writer who assigns to Yazdegerd I. (399–420) the eleven years of his predecessor Bahrām IV., and the twenty-one years of Yazdegerd I. to his successor Bahrām V. (420–439)? A. von Gutschmid[9] at one time attempted to explain this unhistorical character of the narrative from a tendency arising out of the peculiar ecclesiastical and political circumstances of Armenia, situated as it was between the eastern Roman and the Persian empires, circumstances which were substantially the same in the 5th as they were in the two following centuries. In the course of further investigations, however, he came to the conclusion that, besides the many false statements which Moses of Khorʻni makes about his authorities, he gives a false account of himself. That is to say, the author of the *History of Armenia* is not the venerable translator of the 5th century, but some Armenian writing under his name during the years between 634 and 642. The proof is furnished on the one hand by the geographical and ethnographical nomenclature of a later period and similar anachronisms,[1] which run through the whole book and are often closely incorporated with the narrative itself, and on the other hand by the identity of the author of the *History* with that of *Geography*, a point on which all doubt is excluded by a number of individual affinities,[2] not to speak of the similarity in geographical terminology. The critical decision as to the authorship of the *Geography* must settle the question for the *History* also.

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[1] Collected by Langlois, *Collection des historiens de l'arménie*, ii. 47 seq.

[2] In Brosset, *Collection d'historiens arméniens*, i. 68.

[3] The oldest MS. is that of S. Lazaro of the 12th century. Collations of MSS. of Etchmiadzin and Jerusalem are given by Agop Garinian, Tiflis (1858), 4to. The book has been edited and translated by Whiston (London, 1736, 4to); and by Le Valliant de Florival (Venice and Paris, s.a., 1841), 2 vols. 8vo.

[4] The commencement of this king's reign has been fixed by Nöldeke (*Geschichte der Sassaniden aus Tabari*, p. 423) as 4th August 438; and this date has subsequently been established by documentary evidence from the fact of the martyrdom of Pethion (see Hoffmann, *Auszüge aus syrischen Akten persischer Märtyrer*, p. 67).

[5] Translated in Langlois, i. 195 seq.

[6] For the following statements, the evidence may be found in the article "Ueber die Glaubwürdigkeit der Armenischen Geschichte des Moses von Khoren," by Alfred von Gutschmid, in the *Berichte der phil. histor. Classe der königl. sächs. Gesellschaft der Wissenschaften* (1876), p. 1 seq.

[7] *The Epic Songs of Ancient Armenia* (Arm.) (Moscow, 1850).

[8] "Études sur les chants historiques et les traditions populaires de l'ancienne Arménie," in the *Journ. asiat.*, iv., sér. 19 (1852) p. 5 seq.

[9] "Ueber die Glaubwürdigkeit," &c., p. 8 seq.

The *Geography* is a meagre sketch, based mainly on the *Chorography* of Pappus of Alexandria (in the end of the 4th century), and indirectly on the work of Ptolemy. Only Armenia, the Persian Empire, and the neighbouring regions of the East are independently described from local information, and on these sections the value of the little work depends. Since the first published text[3] contains names like "Russians" and "Crimea," Saint Martin in his edition[4] denied that it was written by Moses, and assigned its origin to the 10th century. It was shown, however, by L. Indjidjean[5] that these are interpolations, which are not found in better manuscripts. And in fact it is quite evident that a book which gives the division of the Sassanid Empire into four spahbehships in pure old Persian names cannot possibly have been composed at a long interval after the time of the Sassanidae. But of course it is equally clear that such a book cannot be a genuine work of Moses of Khorʽni; for that division of the empire dates from the early part of the reign of King Chosroes I. (531–579).[6] Accordingly K. P. Patkanow,[7] to whom we are indebted for the best text of the *Geography*, is of opinion that we have in it a writing of the 7th century. If the limits within which the *Geography* was composed are to be more nearly defined, we may say that, from isolated traces of Arab rule[8] (which in Armenia dates from 651), it must have been written certainly after that year, and perhaps about the year 657.[9]

Another extant work of Moses is a *Manual of Rhetoric*, in ten books, dedicated to his pupil Theodorus. It is drawn up after Greek models, in the taste of the rhetoric and sophistry of the later imperial period. The examples are taken from Hermogenes, Theon, Aphthonius, and Libanius; although the author is also acquainted with lost writings—*e.g.* the *Peliades* of Euripides. On account of the divergence of its style from that of the *History of Armenia*, Armenian scholars have hesitated to ascribe the *Rhetoric* to Moses of Khorʽni; but, from what has been said above, this is rather to be regarded as a proof of its authenticity.

Smaller works bearing the same honoured name are—the *Letter to Sahak Arderuni*; the *History of the Holy Mother of God and her Image* (in the cloister of Hogotsvanch in the district Andzevatsi of the province of Vaspurakan), which is also addressed to Sahak; and the *Panegyric on Saint Rhipsime*. Of the sacred poems attributed to him, there is only one short prayer, contained in the hymnal of Sharakan, which can really claim him as its author.

Of works passing under the name of Moses of Khorʽni, the following are regarded by the historians of Armenian literature as spurious: a *History* (distinct from the *Panegyric*) *of the wanderings of Saint Rhipsime and her Companions; a Homily on the Transfiguration of Christ; a Discourse on Wisdom* (*i.e.*, the science of grammar); the *Commentaries on grammar* (an exposition of Dionysius Thrax). In the case of the grammatical writings, it has been suggested that there may have been some confusion between Moses of Khorʽni and a Moses of Siunich, who lived in the 7th century.

Literature.—The date of the *History* of Moses has been discussed in many monographs. See especially the brochure of A. Carrière, *Nouvelles sources de Moïse de Khoren* (Vienna, 1893), who sets it in the 8th century. A Russian critic, J. Khalateants, arrives at a similar conclusion in his *Armianskie Epos* (Moscow, 1896). F. C. Conybeare, in an article on "The date of Moses of Khoren," in the *Byzantinische Zeitschrift*, vol. x., and in a second in vol. ii, entitled "The Relation of the Paschal Chronicle to Malalas," challenges Professor Carrière's arguments, and contends that the *History* of Moses is a late 5th-century work, much interpolated in the immediately succeeding centuries. (A. v. G.; F. C. C.)

MOSHEIM, JOHANN LORENZ VON (*c.* 1694–1755), German Lutheran divine and Church historian, was born at Lübeck on the 9th of October, 1694 or 1695. After studying at the gymnasium of his native place, he entered the university of Kiel (1716), where he took his master's degree in 1718. In 1719 he became *assessor* in the philosophical faculty at Kiel. His first appearance in the field of literature was in a polemical tract against John Toland, *Vindiciae antiquae christianorum disciplinae* (1720), which was soon followed by a volume of *Observationes sacrae* (1721). These works, along with the reputation he had acquired as a lecturer and preacher, secured for him a call to Helmstädt as professor ordinarius in 1723. The *Institutionum historiae ecclesiasticae libri IV*. appeared in 1726, and in the same year he was appointed by the duke of Brunswick abbot of Marienthal, to which dignity and emolument the abbacy of Michaelstein was added in the following year. Mosheim was much consulted by the authorities when the new university of Göttingen was being formed; especially in the framing of the statutes of the theological faculty, and the provisions for making the theologians independent of the ecclesiastical courts. In 1747 he was made chancellor of the university. He died at Göttingen on the 9th of September. Among his other works were *De rebus christianorum ante Constantinum commentarii* (1753), *Ketzer-Geschichte* (2nd ed. 1748), and *Sittenlehre der heiligen Schrift* (1735–53). His exegetical writings, characterized by learning and good sense, include *Cogitationes in N. T. loc. select.* (1726), and expositions of 1 Cor. (1741) and the two Epistles to Timothy (1755). In his sermons (*Heilige Reden*) considerable eloquence is shown, and a mastery of style which justifies the position he held as president of the German Society.

There are two English versions of the *Institutes*, that of Archibald Maclaine, published in 1764, and that of James Murdock (1832), which is the more correct. Murdock's translation was revised and re-edited by James Seaton Reid in 1848, and by H. L. Hastings in 1892 (Boston). An English translation of the *De rebus christianorum* was published by Murdock in 1851.

MOSLER, HENRY (1841–), American artist, was born at New York, on the 6th of June 1841, the family removing to Cincinnati when he was about ten years old. Studying drawing by himself, he became a draughtsman for a comic paper, the *Omnibus* (Cincinnati), in 1855; in 1859–1861 he studied under James H. Beard, and in 1862–63, during the Civil War, was an art correspondent of *Harper's Weekly*. In 1863 he went to Düsseldorf, where for almost three years he was at the Royal Academy schools; he subsequently went to Paris, where he studied for a short time under Ernest Hébert. His "Le Retour," from the Paris Salon of 1879, was the first American picture ever bought for the Luxembourg. He received a silver medal in Paris 1889, and gold medals at Paris, 1888, and Vienna, 1893. Examples of his work are in the Sydney Art Museum, N.S.W., and the art museums of Springfield, Mass., Cincinnati, Ohio and New York. His son, GUSTAVE HENRY MOSLER (1875–1906), a pupil of his father and of Léon Bonnat, exhibited at the Salon in Paris, receiving a medal for his "De Profundis" in 1891; his portrait of Governor J. W. Stewart is in the State House, Montpelier, Vermont, and his "Empty Cradle" is in the Toledo Art Club.

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[1] Instances of these may be found in i. 14, where the arrangement of Armenian provinces, I., II., III., IV., introduced in the year 536, is carried back to Aram, an older contemporary of Ninus; and in the passage iii. 18, according to which Shāpūr II. penetrated to Bithynia, although the Persians did not reach that till 608.

[2] See the confusion, common to both books, between Cappadocia I. and Armenia I., in consequence of which Mazaca and Mt Argaeus are transferred to the latter locality (*Hist.* i. 14; *Geogr.* Saint Martin's ed., ii. 354); also the passages which treat of China and Dchenbakur (*Hist.* ii. 81; *Geogr.* ii. 376), &c.

[3] Edition with translation by Whiston (London, 1736, 4to).

[4] In the *Mémoires historiques et géographiques sur l'Arménie* (Paris, 1819, 8vo), ii. 310 seq.

[5] *Antiquities of Armenia* (Arm.), iii. 303 seq.

[6] See Nöldeke's *Tabari*, p. 155 seq.

[7] *Armjanskaja geographija vii. wäka por. Ch.* (pripisiw awschajasja Moiseju Chorenskomu) (St Petersburg, 1877, 8vo). Before him Kiepert (in the *Monatsb. d. Berliner Akad.* (1873, p. 599 seq.) had substantially arrived at the right conclusion when he assigned the portions of the *Geography* referring to Armenia to the time between Justinian and Maurice. (See also *Abhandlungen der königlichen Gesellschcft der Wissenschaften zu Göttingen*, philol. hist. Klasse, Neue Folge, Band iii. Nro. 2, 1901) (in which Dr J. Marquart edits with commentary under the title Erānšahr the sections of the geography relating to Persia)

[8] The passage about the trade of Basra, which was founded in 635, is decisive on this point (Saint Martin's edition, ii. 368).

[9] The peculiar interest which the author (Saint Martin, ii. 340) takes in the origin of the Slavs in Thrace is best explained by the war against them which called the emperor Constans II. away from the East in the year 657. In other respects the writer displays the most complete indifference and even ignorance, with regard to the state of affairs in the West.

MOSQUE (through Fr. *mosquée*; Span. *mezquita*, from Arab. *masjid*, *sajada*, to adore), the house of prayer in the Mahommedan religion, consisting generally of a large open court (*sahn*) surrounded by arcades (*liwan*), with a fountain (*mida-a*) in the centre of the court, for the ablutions necessary before prayer. The principal feature in the mosque is the niche (*mihrab*), which is sunk in a wall built at right angles to a line drawn from Mecca, and indicates the direction towards which the Moslem should turn when engaged in prayer. The arcades in front of the Mecca niche were sometimes of considerable depth, and constituted the prayer chamber (*maksura*), portions of which were occasionally enclosed with lattice work. By the side of the niche was the pulpit (*minbar*), and sometimes in front of the latter a platform (*dikka*) raised on columns, from which chapters from the Koran were read to the people.

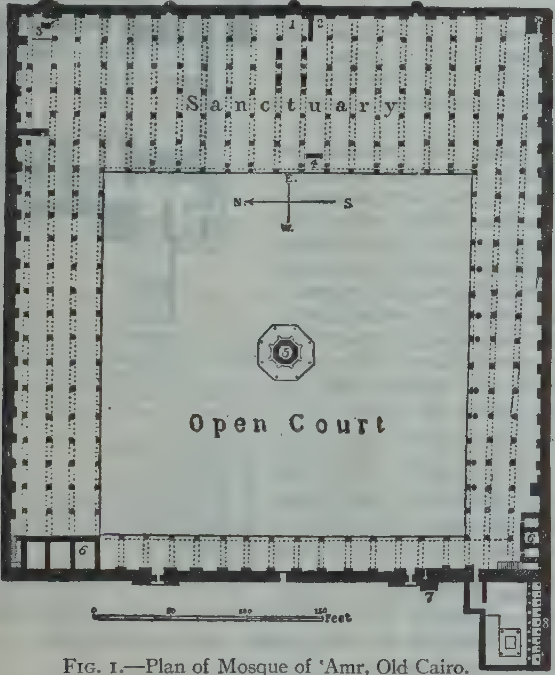

FIG. 1.—Plan of Mosque of ʿAmr, Old Cairo.
1, Ḳibleh. 5, Fountain for ablution.
2, Minbar. 6, 6, Rooms built later.
3, Tomb of ʿAmr. 7, Minaret.
4, Dikka. 8, Latrines.

Most mosques have endowed property, which is administered by a warden (*nazir*), who also appoints the imams and other officials. The larger mosques have two imams: one is called (in Arabia and Egypt) the *khatib*, and he preaches the sermon on Fridays (the Moslem Sabbath); the other, the *rátib*, reads the Koran, and recites the five daily prayers, standing close to the *mihrab*, and leading the congregation, who repeat the prayers with him, and closely follow his postures. The imams do not form a priestly sect; they generally have other occupations, such as teaching in a school or keeping a shop, and may at any time be dismissed by the warden, in which case they lose the title of imam. Moslem women, as a rule, are expected to say their prayers at home, but in some few mosques they are admitted to one part specially screened off for them.

The earliest mosque erected was that at Mecca, which consisted of a great court, in the centre of which was the Kaʿba or Holy Stone. The court was surrounded with arcades, all of which constituted the prayer chamber, so that its plan is necessarily different to the normal type; the existing buildings date only from the first half of the 17th century, as the whole mosque was destroyed by a torrent in 1626.

The normal type referred to is best represented in the mosque of ʿAmr (see ʿAMR-IBN-EL-ASS) at Fostat, Cairo; built in A.D. 643 it still retains its original arrangement, though partly rebuilt and increased in its dimensions. The mosque (see fig. 1), now in a somewhat ruined condition, covers an area of about 130,000 sq. ft. with an open court, 240 ft. sq., and a sanctuary or prayer chamber, 106 ft. deep, there being a central avenue and ten aisles on either side. The columns and capitals were all taken from ancient buildings, Egyptian, Roman and Byzantine, and they carry arches of different forms, semicircular, pointed and horseshoe.

The columns and other materials of the mosque of el-Aksa at Jerusalem were taken by Abdalmalik (A.D. 690) from the ruins of Justinian's church of St Mary on Mount Sion, and the central avenue or nave built with them presents the appearance of a Christian church; it however runs north and south, the Mecca niche being at the south end; originally there were seven aisles on each side, now reduced to three. The Kubbet-es-Sakhra, or Dome of the Rock, at Jerusalem, is only a shrine erected over the sacred rock, so that the title often ascribed to it as "the mosque of Omar" is misleading.

The mosque of the Omayyads in Damascus was built by the Caliph Walid in A.D. 705 on the foundations of the basilican church of St John: its plan differs therefore from the normal type in that its arcades run east and west, and the transept in the centre becomes the prayer chamber. The Mecca niche is sunk in the doorway of a Roman temple which formerly occupied the same site, and the substructure of the minaret at the south-west angle is of still more ancient date. The great court on the north side has a lofty cloister round it, so that in many respects it follows the normal type.

The mosque of Aḥmad Ibn Tulun, in Cairo (A.D. 879), is the first mosque erected in which the materials were not taken from ancient buildings; it has therefore a special interest as being the earliest genuine example of the Mahommedan style (see ARCHITECTURE: *Mahommedan*). The walls, piers and arches, are all built in brick, covered with stucco, a great portion of which is preserved down to the present day. The plan is of the normal type, with a great court in the centre, a prayer chamber four aisles deep on the Mecca side (south-east), and a double aisle on the other three sides. All the arches are pointed and slightly horseshoe, preceding therefore by about two and a half centuries the introduction of the pointed arch into Europe. The piers carrying the arches have shafts at their angles, the earliest examples known, and the decoration of the walls consists of friezes, borders, and impost-bands, all enriched with conventional patterns interwoven with cufic characters and modelled in stucco. The windows in the outer walls are filled with pierced stone screens of geometrical design. The architect is said to have been a Coptic Christian who deprecated the destruction of ancient buildings to obtain columns and blocks of stone, and who undertook to design a mosque which should be built entirely in brick, which when coated with stucco and appropriate decorative designs would rival its predecessors.

The next important mosque is that of Kairawan in Tunisia, which was founded by Sidi Okba in A.D. 675, but was partly rebuilt and added to in the following two centuries. Its court covers an area of 38,000 sq. ft., and its prayer chamber is 150 ft. deep, having a central avenue and eight aisles on each side.

The chief interest of the mosque at Kairawan lies in its being the prototype of the great mosque at Cordova, which was built by Abdarrahman in A.D. 780; the earliest portion of the mosque is the prayer chamber (135 ft. wide by 220 ft. deep), which is in front of the entrance gateway to the great court, and consists of a central avenue with five aisles on each side. In A.D. 961 this portion was extended 150 ft. in the rear by Hakim II., the mihrab and Mecca wall being rebuilt; about 20 years later a further enlargement was made, and eight more aisles were added along the whole eastern side, so that the prayer chamber covered an area of over 148,000 sq. ft. In the 13th century a portion of Hakim's addition was pulled down to make way for the first cathedral, which was dedicated to the Virgin. The most beautiful portion of the mosque, however, still exists in the prayer chamber of Hakim, where are to be found the earliest examples of the cusped arch and the origin of many of the geometrical patterns in stucco at the Alhambra.

The mosque of el Azhar, "the splendid," was begun about A.D. 970 by Jauhar, the general of the Fatimite Caliph Moizz, who captured Fostat and founded el Kahira, the present town of Cairo. It was based, therefore, on the great mosque at Kairawan, and although more or less rebuilt, it still preserves its original plan. It has a special interest in being the chief university of the Moslem world, containing some thousands of students (*mujawirin*), for whom certain parts of the mosque (*riwaq*) are screened off, according to the country from which they come. Thus special parts are reserved for natives of the various provinces of Egypt, of Morocco, Syria, Arabia, India, Turkey, &c. Each student can, if he is too poor to hire lodgings, live, eat and sleep in the mosque. Each has a large chest in which to keep his clothes and books; these are piled against the walls to a height of seven or eight feet. The students pay no fees, but the richer ones give presents to the lecturers, who sit on the matting in various parts of the sanctuary or cloister, while the students sit round each lecturer in a circle. The usual course of study lasts for three years, though some students remain for much longer. The chief of the lecturers, called the *Sheik el-Azhar*, receives about £100 a year, the others little or nothing, as regular pay. The Koran, sacred and secular law, logic, poetry, arithmetic, with some medicine and geography, are the chief subjects of study.

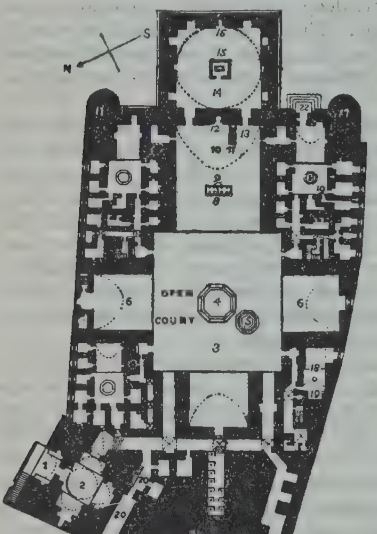

FIG. 2.—Plan of Mosque of Sultan Hasan, Cairo.

1, 2, Main entrance.
3, Court open to sky.
4, 5, Fountains.
6, 6, North and south vaulted transepts (the dotted lines show the curve of the vault).
8, 9, Dikka.
10, Sanctuary.
11, Minbar.
12, Kibleh.
13, Door to tomb.
14, Domed tomb-chamber.
15, Tomb within screen.
16, Kibleh.
17, 17, Minarets.
18, 19, 20, Various entrances to mosque.
21, Small rooms connected with service of the mosque.
22, Sultan's private entrance.

Of other mosques in Cairo, the finest is that of Sultan Hasan (fig. 2), completed in A.D. 1360. It differs from the normal type in many respects, as it includes residences for various sects, so that portions of it, with the several storeys externally, resemble an immense mansion or warehouse, and this would seem to have led to an important change inside, as instead of a cloister of two or more aisles there are four immense halls all covered with pointed barrel vaults. Beyond the Mecca wall is the tomb of the founder, covered with an immense dome. The entrance doorway on the north-east side is over 80 ft. in height, its summit being decorated with stalactite vaults, one of the grandest features in Mahommedan architecture, only equalled by the magnificent portals of the mosques in India. The central square court, of moderate dimensions, with halls and great recesses, is followed in other examples in Cairo, among which the Tomb Mosque of Kait-Bey (*c.* A.D. 1470) is the most graceful (fig. 3). In this case the central court is roofed over, and has an octagon lantern in the centre; the recesses are covered with horizontal ceilings carried on great beams, the whole being elaborately carved, coloured and gilded; the tomb is covered with the later type of dome, built in stone, and elaborately carved outside with delicate conventional patterns in relief.

Although the conquest of Persia by the Arabs took place in A.D. 641 there are no remains of mosques there earlier than the 13th century, and the oldest example at Tabriz is evidently, as far as its plan is concerned, a copy of a Byzantine church, departing entirely therefore from the normal plans.[1] The great mosque at Isfahan, built by Shah Abbas the Great (1585–1629), has one great court (225 ft. by 170 ft.) and two smaller ones, all with fountains in them. The prayer chamber is a lofty structure, quite unlike those of Egypt and Kairawan, with a dome 75 ft. in diameter and halls on each side divided into two aisles, each compartment being covered with a dome, in this respect also not following the early normal type, in which domes were only found over tombs.

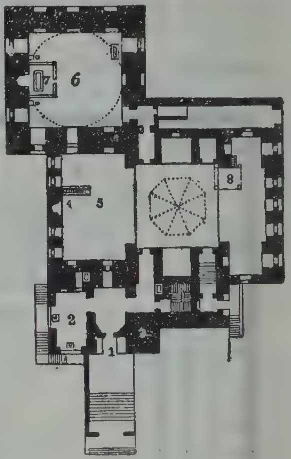

FIG. 3.—Mosque-tomb of Sultan Kait-Bey, Cairo.

1, Main entrance.
2, Lobby and cisterns for ablution.
3, Great minaret.
4, Kibleh.
5, Minbar.
6, Sultan's tomb-chamber.
7, The tomb within a screen.
8, Dikka.

(For views of interior and exterior, see ARCHITECTURE.)

The mosques of Constantinople are all copies more or less of S. Sophia: they have courts in front with a range of arcades round, and the centre portion forms the prayer chamber, the side aisles serving as passages. The central dome has but a slight elevation outside, but with the numerous cupolas round, and the minarets, it forms a picturesque group which is wanting in the mosques of Kairawan, Cordova, and other examples in North Africa.

In India as in other countries the Mahommedans took possession of the ancient buildings and adapted them to their religious requirements. The materials of the native styles of India, however, did not lend themselves to their utilization as in Syria, Egypt and North Africa, where the columns and capitals formed the substructure of the arcades which surrounded their courts. In the earliest mosque at old Delhi, they adopted the piers and bracketed capitals of the Jaina builders, whom they probably employed to build their mosque. They, however, had no confidence in the arch, which, as the Hindu says, "never sleeps but is always tending to its own destruction," so that the pointed arch, which had almost become the emblem of the Mahommedan religion, had to be dispensed with for the covered aisles which surrounded the great court, and in the triple entrance gateway the form of an arch only was retained, as it was constructed with horizontal courses of masonry for the haunches, and with long slabs of stone resting one against the other at the top. A similar construction was employed in the great mosque at Ajmere, built A.D. 1200–1211 at the same time as the Delhi mosque. The objection to the arch is more clearly shown in the entrance gateway of the Lal Dārwaza or Red Gate mosque at Jaunpur, where an arch (of two rings of ogee shape) is carried by a solid wall, built under it, which is pierced with three doorways with bracket-capitals and architraves, returning therefore to trabeated construction. The covered aisles of the court of the Jumma Musjid at Jaunpur are in three storeys with piers, bracket-capitals and architraves, bearing therefore no resemblance to the arcades of Kairawan and Cordova, and constituting a different style. There is however one feature which throughout the Mahommedan mosques in India is always found, viz. the dome. But this also in India is built in horizontal courses, so that the form only and not the construction of the Cairene domes is followed. The chief peculiarity of the mosques at Ahmedabad is that, as the style progressed, it became more Indian; in the Jumma Musjid (A.D. 1420) and the Queen's mosque at Mirzapur, the pointed arch exists only in the façades of the prayer chambers; in the mosques built 30 to 40 years later the whole is constructed without a single arch, all the pillars have bracket-capitals, and the domes, which are of very slight elevation, are all built in the trabeated style. As a contrast to the Ahmedabad mosques, the Kadam Rasul mosque at Gaur in Bengal possesses some characteristics which resemble those of the mosque of Tulun in Cairo, possibly due to the fact that it is entirely built in brick, with massive piers carrying pointed arches.

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[1] It is very generally held that this "Blue Mosque" dates only from the 15th century (see TABRIZ).

The climax of Mahommedan work in India is reached in that of the Mogul emperors at Agra, Delhi and Fatehpur-Sikri, in which there is a very close resemblance in design to the mosques of Syria, Egypt, and Persia; the four-centred arch, which is in the Mogul style, finds general acceptance, and was probably derived from Persian sources. The mosque at Fatehpur-Sikri possesses in its great southern gateway, built by Akbar in the second half of the 16th century, the masterpiece of Indo-Saracenci architecture. As a rule, the mosques of India followed the normal plan, with a great central court and aisles round and a prayer chamber in front of the Mecca wall, which in India is always at the west end. (R. P. S.)

MOSQUITO (Span. *mosquito*, a gnat, diminutive of *mosca*, a fly), a term originally applied to many species of small blood-sucking DIPTERA (*q.v.*), belonging to various families, but now by common consent restricted to those known to naturalists as *Culicidae*, or gnats. Before the year 1899 mosquitoes had never been collected systematically, and had received little notice from entomologists, so that but few genera and comparatively few species were known. Although it had long been suspected that these insects were in some way connected with malaria and other diseases, while that the species now called *Stegomyia calopus* was the carrier of yellow fever had been asserted by Finlay as early as 1881, it was not until the closing years of the 19th century that the brilliant researches of Ross in India, and of Grassi and others in Italy, directed the attention of the whole civilized world to mosquitoes as the exclusive agents in the dissemination of malarial fever. The result has been that in subsequent years mosquitoes have been collected, studied and described by naturalists and medical men in all parts of the globe. Nearly 100 genera and about 700 species of mosquitoes are now recognized, but in all probability the total number of species is not less than 1000.

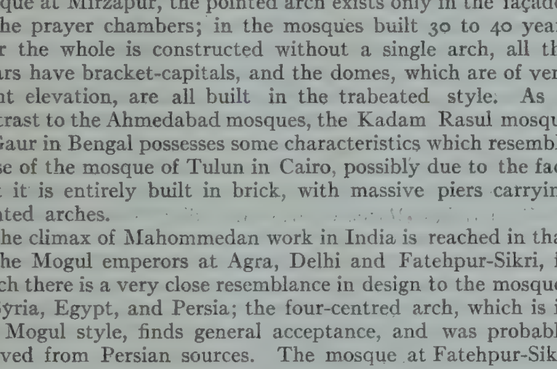


FIG. 1.

A, Larva of *Anopheles*.
B, Pupa of *Anopheles*,
C, Larva of *Stegomyia*.
D, Pupa of *Culex*.
E, Egg-float and further enlarged detached egg of *Culex*.
F, Female *Anopheles costalis*, Loew.
G, Head of ♀ *Culex*.
H, Head of ♂ *Anopheles*.
J, Head of ♂ *Culex*.
K, Eggs of *Anopheles*.

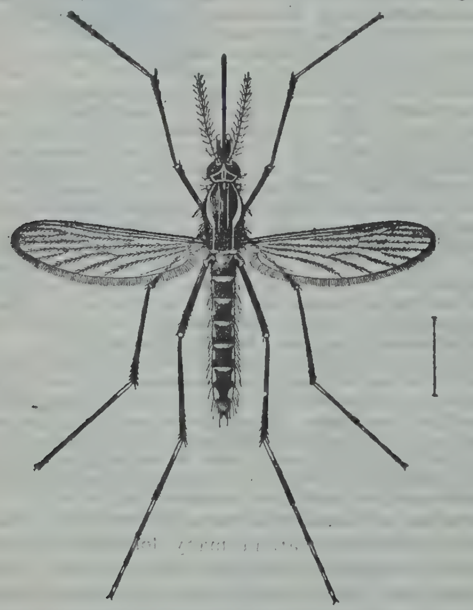
In general appearance mosquitoes resemble many harmless midges (*Chironomidae*), but may be distinguished by the following characters. (1) The prolongation of the lower lip or labium into a prominent proboscis, which in the female sex contains the full complement of piercing organs found in blood-sucking Diptera, namely paired mandibles, paired maxillae, a tubular hypopharynx (the common outlet of the salivary glands), and an upper lip or labrum. (2) The presence of variously formed scales on the body and its appendages: the head is clothed with scales, the thorax with hairs or scales, and the abdomen with either hairs or scales, or both; the legs and veins of the wings are always covered with scales, and the palpi are often (as in some *Anophelinae*) conspicuously scaly. (3) The fact that the costal or marginal vein runs completely round the wing. The wings exhibit six longitudinal veins (seven in *Heptaphlebomyia*), two of which are characteristically forked. The antennae, usually bottle-brush shaped (plumose) in the male sex, are less hairy in the female. The palpi vary in form and in the number of their component segments, and the proboscis, though usually straight, may be curved (as in *Megarhinus*) or otherwise modified in shape.

In dividing the *Culicidae* into genera reliance is placed chiefly upon characters derived from the scales on the three divisions of the body and on the wings. A fairly satisfactory attempt at grouping the genera has been made by Lutz (1904), who divides the family in the first place into the *Euculicidae*, with a piercing proboscis (*i.e.* all ordinary mosquitoes), and the *Culicimorphae* or forms without a piercing proboscis (*Mochlonyx*, *Corethra*, &c.). It has since been proposed to treat the *Culicimorphae* as a distinct family under the title *Corethridae*, and it is probable that with this modification Lutz's scheme will meet with general acceptance. The *Euculicidae* are divided into the *Asiphonatae* (=*Anophelinae*), the larvae of which have no respiratory siphon, and the *Siphonatae*, or forms in which a respiratory siphon is present in the larval state. The divisions of the *Siphonatae* are the *Ankylorhynchae* (genera with curved proboscis, *e.g.* *Megarhinus* and *Toxorhynchites*) and *Orthorhynchae* (genera with straight proboscis). The latter again are divided into *Metanopsilae* (in which the metanotum or posterior region of the thorax is bare) and *Metanotrichae* (in which the metanotum is clothed with bristles or scales). The *Metanopsilae* are made up of the *Heteropalpae* [palpi long in the male, short in the female; sub-families *Culicinae* (*Culex*, &c.) and *Heptaphlebomyinae* (*Heptaphlebomyia*)] and *Micropalpae* [palpi short in both sexes; sub-families *Aedinae* (*Aedes*, &c.) and *Haemagoginae* (*Haemagogus*, *Uranotaenia*, &c.)]. The *Metanotrichae* are similarly divided on the basis of the palpal characters into two groups, the *Heteropalpae* or *Hyloconopinae* (*Joblotia*, *Rhynchomyia*, &c.) and *Micropalpae* or *Dendromyinae* (*Wyeomyia*, *Sabethes*, *Limatus*, &c.).

The old genus *Anopheles* (characterized by the palpi being long in both sexes) is now divided into a number of genera according to the character and shape of the scales on the different regions of the body and on the wings. These genera make up the sub-family *Anophelinae*, and together include over 100 species. The genus *Culex*, from which the family takes its name, though it has been similarly split up, is still in its restricted sense larger than any other, and some 200 species are comprised in it alone.

Mosquitoes are found in all parts of the world. Even within the Arctic Circle they are in many localities abundant and excessively bloodthirsty during the short summer. Under such conditions the deeply-rooted nature of the blood-sucking instinct is most remarkable; for insects whose ancestors for many generations may not have tasted blood will seek for it with the utmost keenness and pertinacity so soon as an opportunity presents itself. Some species are normally phytophagous, and the vast majority, at any rate, appear to be capable of continuing to exist and reproducing their kind upon a purely vegetarian diet. As a rule the blood-sucking habit is confined to the females, but in the case of a few species it is said to be common to both sexes. The thirst for blood is stimulated by heat, and in temperate climates it is only during hot weather that mosquitoes are troublesome. Some species of mosquitoes, such as the common gnat (*Culex pipiens*), are rarely found away from human habitations; others seldom or never enter houses, but are met with either in more or less open country, or in the recesses of forests and woods. In Europe and North America the continued existence of species is ensured by the hibernation of impregnated females, or else the winter is passed in the egg or occasionally in the larval state. In tropical climates with a well-marked dry season mosquitoes pass into a semi-dormant condition during the period when there is little water in which to deposit their eggs. *Culicidae* are by no means confined to lowlying districts, and have even been met with in the Himalayas at an altitude of 13,000 feet. The wide distribution of certain species is undoubtedly attributable to the agency of ships and trains; under natural conditions mosquitoes seldom travel far from their breeding grounds, although the powers of flight of some species are greater than has been supposed.

The preliminary stages of all mosquitoes are passed in water, either fresh or salt, stagnant or slightly moving. The nature of the breeding-place varies greatly according to the species, and while many of the mosquitoes that infest houses will breed even in the smallest accidental accumulation of water such as may have collected in a discarded bottle or tin, the larvae of other species less closely associated with man are found in natural pools or ditches, at the margins of slow-moving streams, in collections of water in hollow trees and bamboo-stumps, or even in the water-receptacles of certain plants. The eggs are usually deposited on the water itself, and while in the case of certain species, such as *Culex pipiens* or the widely distributed *C. fatigans*, they are agglutinated together in masses known as "boats" or "rafts" containing from 50 to 400 ova, those of others, such as the *Anophelinae* and many *Culicinae* (*e.g. Stegomyia calopus*), are laid separately. The larvae are active and voracious little grub-like creatures (known in the United States as "wrigglers"), with large heads and jaws provided with a pair of brushes, which sweep food-particles into the mouth. Their food consists of minute animal and vegetable organisms, algae, and probably decaying vegetable matter; they are often cannibals, and feed on their own species. The larvae of species belonging to the *Culicinae* have a prominent breathing tube, or respiratory siphon, on the penultimate (eighth) abdominal segment, and when taking in air hang head downwards (often nearly vertically) from the surface film. Larvae of *Anophelinae*, on the other hand—which are grey, green or brown in colour, and often extremely difficult to see—have no respiratory siphon and lie almost horizontally at the surface; they frequently appear as though anchored by the tail to a weed or other object, and possess the curious faculty of completely rotating the head so as to browse on the surface film. Mosquito pupae are comma-shaped (see fig. 1), and breathe by means of a pair of respiratory trumpets on the thorax.



(Redrawn by permission from *Farmers Bulletin* 155, Bureau of Ent., U.S. Dept. of Agriculture.)

FIG. 2.—*Stegomyia calopus* (*Culex fasciatus*, *Stegomyia fasciata*).

The majority of mosquitoes are dull in hue, but certain species are brilliantly coloured or conspicuously banded or spotted with white. The *Anophelinae* have narrow bodies, and generally spotted wings, and when at rest keep body and proboscis in a straight line, often at a considerable angle with the supporting surface; in this way they can be distinguished from *Culicinae*, which have a humped-up thorax with which the proboscis forms an angle, and in the resting position keep the body parallel to the support.

The disseminators of malaria are exclusively *Anophelinae*, but even among these it is only certain species that are dangerous, since the others appear to be incapable of acting as hosts of the parasites. *Stegomyia calopus*, on the other hand, a very widely distributed species and the almost certain carrier of yellow fever, belongs to the *Culicinae*. In the case of filariasis due to *Filaria bancrofti*, which is common throughout the Tropics, the embryos of the parasite are disseminated by various *Culicinae* and *Anophelinae* (*Culex pipiens* in Queensland; *C. fatigans* in the West Indies; *Myzomyia rossii* in India; *Pyretophorus costalis* in a large portion of tropical Africa; &c.). Six or seven species of mosquitoes are also the intermediate hosts of *Filaria immitis*, which infests the right auricle and pulmonary artery of the dog, and occurs throughout the tropics, in southern Europe, the United States of America, and elsewhere. There is reason to believe that malaria, yellow fever and filariasis are not the only diseases disseminated by mosquitoes. (E. E. A.)

MOSQUITO COAST AND RESERVE (MOSQUITÍA or RESERVA MOSQUITA), a division of the republic of Nicaragua, officially styled the department of Zelaya. Pop. (1905), about 15,000. Although its name is sometimes applied to the whole eastern seaboard of Nicaragua—and even to Mosquitía in Honduras, *i.e.* the coast region as far west as the Rio Negro or Tinto—the Mosquito Coast is more accurately defined as a narrow strip of territory, fronting the Caribbean Sea, and extending from about 11° 45′ to 14° 10′ N. It stretches inland for an average distance of 40 m., and measures about 225 m. from north to south. In the north, its boundary skirts the river Wawa; in the west, it corresponds with the eastern limit of the Nicaraguan highlands; in the south, it is drawn along the river Rama. The chief towns are Bluefields or Blewfields, Magdala on Pearl Cay, Prinzapolca on the river of that name, Vounta near the mouth of the Cuculaia, and Carata near the mouth of the Wawa. Bluefields (pop. about 2000) is the capital and the largest town. It is the seat of a Moravian mission, and has a good harbour, with regular steamship services to Greytown in Nicaragua, and to New Orleans. It exports bananas and other fruit.

The Mosquito Coast is so called from its principal inhabitants, the Misskito Indians, whose name was corrupted into Mosquito by European settlers and has been entirely superseded by that form except in the native dialects. The Mosquito Indians, of whom there are several tribes, are an unusually intelligent people, short of stature and very dark-skinned. Their colour is said to be due to intermarriage with shipwrecked slaves.

The first white settlement in the Mosquito country was made in 1630, when the agents of an English chartered company—of which the earl of Warwick was chairman and John Pym treasurer—occupied two small cays, and established friendly relations with the Indians. From 1655 to 1850 Great Britain claimed a protectorate over the Mosquito Indians; but little success attended the various endeavours to plant colonies, and the protectorate was disputed by Spain, the Central American republics, and the United States. The opposition of the United States was due very largely to the fear that Great Britain would acquire a privileged position in regard to the proposed interoceanic canal. In 1848, the seizure of Greytown (San Juan del Norte) by the Mosquito Indians, with British support, aroused great excitement in the United States, and even involved the risk of war. But by the Clayton-Bulwer Treaty of 1850 both powers pledged themselves not to fortify, colonize or exercise dominion over any part of Central America; and in November 1859 Great Britain delegated its protectorate to Honduras. This caused great dissatisfaction among the Indians, who shortly afterwards revolted; and on the 28th of January 1860 Great Britain and Nicaragua concluded the treaty of Managua, which transferred to Nicaragua the suzerainty over the entire Caribbean coast from Cape Gracias à Dios to Greytown, but granted autonomy to the Indians in the more limited Mosquito Reserve (the area described above). The local chief accepted this change on condition that he should retain his local authority, and receive a yearly subvention of £1000 until 1870. But on his death in 1864 Nicaragua refused to recognize his successor. The reserve nevertheless continued to be governed by an elected chief, aided by an administrative council, which met in Bluefields; and the Indians denied that the suzerainty of Nicaragua connoted any right of interference with their internal affairs. The question was referred for arbitration to the emperor of Austria, whose award published in 1880, upheld the contention of the Indians, and affirmed that the suzerainty of Nicaragua was limited by their right of self-government. After enjoying almost complete autonomy for fourteen years, the Indians voluntarily surrendered their privileged position, and on the 20th of November 1894 their territory was formally incorporated in that of the republic of Nicaragua, as the department of Zelaya.

Bibliography.—See "A Bibliography of the Mosquito Coast of Nicaragua," by Courtney de Kalb, in *Bulletin of the American Geog. Soc.*, vol. xxvi. (1894); and "Studies of the Mosquito Shore in 1892," by the same author, and in the same publication, vol. xxv. (1893). "A Forgotten Puritan Colony," in No. 165 of *Blackwood's Magazine* (Edinburgh, 1898), described the attempt at colonization made in 1630. See also "Die Streit um die Mosquito-Küste," by J. Richter, in *Zeitschr. f. Gesellschaft d. Erdkunde*, No. 30 (Berlin, 1895).

MOSS, a seaport of Norway, in Smaalenene *amt* (county), on the east shore of Christiania Fjord, 37 m. S. of Christiania by the Gothenburg railway. Pop. (1900), 8941. Here was signed, on the 14th of August 1814, the convention which united Norway to Sweden. Timber and wood pulp are chief exports, grain and coal are imported. The port affords 13 to 22 ft. of water beside the quays.

MOSSAMEDES, a town of Portuguese West Africa, capital of the district of Mossamedes, on the south side of Little Fish Bay (Bay of Mossamedes or Angra do Negro). Pop. about 5000. The harbour affords excellent anchorage. A railway (over 100 m. long) starts from the harbour and crosses the semi-desert coast region to the fertile Chella plateau. Mossamedes is the headquarters of an important fishing industry (see *La Géographie*, March 1908).

MOSSEL BAY, the name of a bay, town and division of the Cape province, South Africa. The bay lies midway between Table Bay (Cape Town) and Port Elizabeth roadstead. Like most of the South African bays it does not afford good anchorage. Westward, however, it is sheltered by Cape St Blaize, on which is a lighthouse. The town lies on the west side of the bay, Cape St Blaize stretching beyond to the S.E. Mossel Bay is 250 m. by sea and 312 m. by rail E. by S. of Cape Town. Pop. (1904), 4500. The port ranks fourth in importance among the seaports of the Cape and does a large forwarding trade. Vessels load and discharge by means of lighters. Mossel Bay is a station on the direct Cape Town–Port Elizabeth railway. The Mossel Bay division of the province has an area of 707 sq. m., and a population (1904) of 10,700, of whom 49 % were whites.

MOSSLEY, a market town and municipal borough in the Prestwich parliamentary division of Lancashire, England, 10½ m. E.N.E. from Manchester, by the London & North-Western railway. Pop. (1901), 13,452. It lies in the valley of the Tame, close to the junction of the boundaries of Lancashire, Cheshire and Yorkshire, and is surrounded by sharply-rising high ground, especially eastward. The Huddersfield canal passes it. Across the river from the town ancient earthworks (Bucton Castle), of British origin, are seen, and a Roman road passing them, and running north and south is also traceable. Mossley has foundries, mill-works, woollen factories, and large cotton-spinning mills. It was incorporated in 1885, and the corporation consists of a mayor, 6 aldermen, and 16 councillors. Area, 3622 acres.

MOSSOP, HENRY (1729–1774), Irish actor, was born in Dublin, and made his first stage appearance there, at the Smock Alley Theatre, as Zanga in Young's tragedy, *The Revenge*, in 1749. His first London appearance was made in 1751 under Garrick's management, as Richard III. He returned to Ireland in 1759, and, playing with Barry, added to his laurels, but when he attempted management on his own account, he ruined Barry and went bankrupt himself, dying in poverty on the 27th of December 1774.

MOST, JOHN [JOSEPH] (1846–1906), German-American anarchist, was born in Augsburg, Bavaria, on the 5th of February 1846. He was apprenticed to a bookbinder, worked at this trade in Germany, Austria, Italy and Switzerland in 1863–1868, and then became a writer of Socialist pamphlets and paragraphs, and editor of Socialist sheets in Chemnitz and Vienna, both suppressed by the authorities, and of the *Freie Presse* in Berlin, being repeatedly arrested for his violent and cynical attacks on patriotism and conventional religion and ethics, and for his gospel of terrorism, preached in prose and in many songs such as those in his *Proletarier-Liederbuch* (5th ed., 1875). Some of his experiences in gaol were recounted in *Die Bastille am Plötzensee: Blätter aus meinem Gefängniss-Tagebuch* (1876). In 1874–1878 he was a member of the German Reichstag, but he failed to be re-elected, was expelled by the Socialist organization, went to France but was forced to leave in 1879, and then settled in London. There he founded the "red" organ—it was printed in red—*Die Freiheit*, in which he expressed his delight in June 1881 over the assassination of Alexander II. of Russia and for this was imprisoned for a year and a half. He then resumed the publication of *Die Freiheit* in New York. He was imprisoned in 1886, again in 1887, and in 1902, the last time for two months for publishing after the assassination of President McKinley an editorial in which he argued that it was no crime to kill a ruler. He died in Cincinnati on the 17th of April 1906.

See his *Memoiren* (New York, 1903).

MOSTAGANEM, chief town of an arrondissement in the department of Oran, Algeria, 44 m. E.N.E. of Oran, on a plateau 278 ft. high, half a mile from the Mediterranean coast. The town is separated into European and native quarters by a deep ravine, the Ain Sefra, through which passes a considerable stream. The native quarter, called Tijit, occupies the eastern slopes of the ravine and the level ground above, and is dominated by the kubbas of two marabouts. A railway line, completed in 1889, 122 m. long, connects Mostaganem with Tiaret, the most convenient place for visiting the Jedars monuments. (See Algeria.)

Mostaganem occupies the site of a Roman town. The ancient harbour was destroyed by earthquake in the reign of the emperor Gallien. The present port is entirely artificial. The existing town appears to date from the time of the Almoravides, who built the citadel, now turned into a prison. It passed into the possession of the rulers of Tlemçen and was captured by Arouj Barbarossa in 1516, and became part of his brother Khair-ed-Din's kingdom. In the 16th century the town enjoyed a period of great commercial prosperity, and its population rose to 40,000. The re-awakening of the town dates from the French occupation in 1833. Pop. (1906) of the town, 19,528, of the commune 22,011, of the arrondissement, comprising 27 communes, 332,684.

In the vicinity of Mostaganem are the Dahra mountains, honeycombed with caves. In 1845, in one of these caves, a French force, commanded by Colonel Pélissier, afterwards commander-in-chief of the French army in the Crimea, destroyed over 800 Arabs—men, women and children—by suffocation, by filling the mouths of the cave with faggots and then setting them on fire.

MOSTAR, the capital of Herzegovina, situated 81 m. S.W. of Serajevo, on the river Narenta, and on the railway from Serajevo to Ragusa. Pop. (1900), about 14,500 including the garrison. Mostar is the seat of Roman Catholic and Orthodox bishops, a district court, and an Austrian garrison. Half Turkish, half Italian in character, it commands the gateway through which all heavy traffic must pass on the seaward road. A single arch of great beauty, 89½ ft. in span, and 61 ft. high, leads to the Roman Catholic quarter, on the right bank of the river. This bridge has been the theme of many legends, and its origin has been much debated. Probably it was built by the Turks, in the 15th or 16th century, after Italian designs; but some antiquaries ascribe its foundation to the Romans. Since 1881, when an iron bridge was opened, its use has been confined to foot passengers. Mostar possesses a gymnasium, a school of viticulture, and a massive Orthodox cathedral.

The present name of the city has been derived from the Serbo-Croatian *most*, a bridge, and *star*, old. Its earlier Slavonic name was *Vitrinicha*. Whether it may be identified with *Pons Vetus*, *Andretium*, *Bistuae*, *Saloniana*, or *Sarsenterum*, it certainly dates from Roman times. Mostar was enlarged in 1440 by Radivoi Gost, mayor of the palace to Stephen, first duke of St Sava. Immediately on their conquest of Herzegovina it was chosen by the Turks as their headquarters. The environs of the city are interesting. Within a few miles are the sources of the Buna, a small affluent of the Narenta, which issues from a cavern at the foot of Podvelež, amid scenery celebrated for its wild grandeur.

See Sir G. Wilkinson, *Dalmatia and Montenegro* (London, 1848), vol. ii. (view and plan at pp. 59, 60); J. Asboth, *An Official Tour through Bosnia and Herzegovina* (London, 1890), pp. 255–262; and R. Munro, *Bosnia and Herzegovina* (Edinburgh, 1900), pp. 179–188.

MOSUL, a town of Mesopotamia, capital of a Turkish vilāyet and sanjak of the same name, on the right bank of the Tigris, in 36° 35′ N., 43° 3′ E. Pop. 40,000 (Moslems 31,500, Christians 7000, Jews 1500). In Mosul, as in Bagdad, only part of the space within the walls is covered with buildings and the rest is occupied by cemeteries; even the solid limestone walls of the ancient town are half in ruins, being serviceable only in the direction of the river, where they check inundations. Of the town gates at present in use, five are on the south, two on the west, two on the north, and the great bridge gate on the east. Leaving Mosul by the last named, the traveller first crosses a stone bridge, 157 ft. long; then a kind of island (140 ft.), which is overflowed only in spring and summer by the Tigris; next a stretch of the river which, at such times as it is not fordable, is spanned by a bridge of boats, the bridge proper covering only one-sixth of the full width of the stream. During the season of low water excellent vegetables, particularly water-melons, are grown upon the islands and dry portions of the river-bed.

The interior of Mosul has an insignificant appearance, only a few of the older buildings being left, among which may be mentioned the Great Mosque, with its leaning minaret, formerly a church dedicated to St Paul. The streets are for the most part badly paved and very narrow, a small square in the market-place, overlooked by airy coffee-booths, being almost the only open space. The shops are few and poor. The industry in comparison with former times, when the town had so considerable a manufacture in muslin as to give its name to that fabric, is very unimportant; trade also, which is almost exclusively in the hands of native merchants, has fallen off greatly, although the town remains the collecting and distributing centre for the north Mesopotamian desert and Kurdistan. The exports and most of the imports pass through Bagdad. Mosul is the meeting-point of roads from Aleppo, Diarbekr, Bitlis, north and west Persia and Bagdad; and it is on the projected line of railway from Constantinople to the Persian Gulf. Gall nuts, gathered on the neighbouring Kurdish mountain slopes, are mostly exported, but are also made use of by native dyers; and hides, wax, cotton and gum are sold. Christians and Moslems have lived together on better terms here than elsewhere. Both are animated by an active local patriotism, and both honour the same patron saints, Jirjis (St George) and Jonah; the grave of the latter is pointed out on an artificial mound on the left bank of the Tigris.

The language of the people of Mosul is a dialect of Arabic, partly influenced by Kurdish and Syriac. The Moslems call themselves either Arabs or Kurds, but the prevalent type, very different from the true Arabian of Bagdad, proves the Aramaean origin of many of their number. Of the Christians the community of the Chaldaeans, *i.e.* those who have gone over from Nestorianism to Catholicism, seems to be the most important; there are also Syrian Catholics and Jacobites. Mosul has for several centuries been a centre of Catholic missionary activity, the Dominicans especially, by the foundation of schools and printing-offices, having made a marked impression upon an intelligent and teachable population. There are very few Protestants. The town is the seat of British, French and Russian consulates.

Mosul shares the severe alternations of temperature experienced by upper Mesopotamia. The summer heat is extreme, and in winter frost is not unknown. Nevertheless the climate is considered healthy and agreeable; copious rains fall in general in winter. The drinking water is got from the muddy Tigris. At the north-east corner of the town is a sulphur spring, and 4 leagues to the south there is a hot sulphur spring (Ḥammām ʽAli), much frequented by invalids.

Mosul probably occupies the site of a southern suburb of ancient Nineveh (*q.v.*) but it is very doubtful whether the older name of Mespila can be traced in the modern Al-Mauṣil (Arab., "the place of connexion"); it is, however, certain that a town with the Arabic name Al-Mauṣil stood here at the time of the Moslem conquest (636 A.D.). The town reached its greatest prosperity towards the beginning of the decline of the caliphate, when it was for a time an independent capital. The dynasty of the Hamdanids reigned in Mosul from 934, but the town was conquered by the Syrian Okailids in 990. In the 11th century it belonged to the Seljuks, and in the 12th, under the sway of the Atabegs, particularly of Zenki, it had a short period of splendour. Saladin besieged it unsuccessfully in 1182. The Persians occupied Mosul for a short time in 1623, until it was, soon afterwards, recovered by sultan Murad IV. The governorship of the pashalik was long hereditary in the originally Christian family of the ʽAbd-al-Jalīl, until the Porte, during the course of the 19th century, succeeded after a long and severe contest in establishing a more centralized system of government.

The Vilayet of Mosul lies mainly east of the Tigris. It is divided into three sanjaks, Mosul, Shehrizor and Suleimanieh, and has an area of 29,000 sq. m. Pop. 295,000 (Moslems 245,000, Yezidis 15,000, Christians 30,000 and Jews 5000).

See Karl Ritter, "Asien," vol. vii. in *Die Erdkunde* (Berlin, 1844) A map of the town accompanies J. Černik's paper, "Studienexpedition durch die Gebiete des Euphrat und Tigris," in Ergänzungsheft No. 45 of *Petermanns Mitteilungen* (Gotha, 1876); Parry, *Six Months in a Syrian Monastery* (1895); E. Sachau, *Am Euphrat und Tigris* (Berlin, 1899); Baron von Oppenheim, *Vom Mittelmeer zum Persischen Golf* (Berlin, 1900).

MOSZKOWSKI, MORITZ (1854–   ), Polish musical composer, was born at Breslau, and studied at Dresden and Berlin. He started as a pianist, and had a great success at the chief European centres. He was made a member of the Berlin Academy in 1899. In 1897 he settled in Paris. He became a prolific composer both for pianoforte and for orchestra, but is best known by his Spanish dances, written for four hands on the piano, and his waltzes. His opera *Boabdil* was performed at Berlin in 1892.

MOTALA, a town of Sweden, in the district (*län*) of Östergötland, on the east side of Lake Vetter at the outflow of the river Motala, 175 m. S.W. by W. of Stockholm by rail. Pop. (1900), 3047. It is on the Göta canal route (*q.v.*). The town was founded in 1880, but the Motala mechanical works, 2 m. east, were founded in 1823 by the Göta Canal Company under the direction of Daniel Fraser, an Englishman. Iron war-ships, railway locomotives, iron bridges, machinery, &c., are built; the company has branches in Norrköping, Gothenburg, and elsewhere.

MOTANABBI, strictly Al Mutanabbī[1] (Abū-ṭ-Tayyib Aḥmad ibn al-Ḥusain of Kufa) (915/6–965), the most famous representative of the last period of Arabic poetry, was the son of a water-carrier, and is said to have picked up much of the literary knowledge for which he was afterwards famous by haunting the book-stalls of his native city. He spent too, some years of his youth among the nomads of the Syro-Arabian desert, learning their purer dialect, and becoming imbued with their self-reliant spirit. Thus he grew up a brave proud man, a gallant warrior as well as a poet, not easily satisfied either with wealth or honours, indifferent to the Korān and to the fasts and prayers of Islām, but untainted by the looseness of morals common to the poets of those days. At first he essayed a perilous road to distinction, appearing in the character of a prophet in the desert between the Euphrates and Syria, where he formed a considerable party, but was arrested by the governor of Emesa (Homs). A prison cooled his enthusiasm. The name of *al-Mutanabbī* clung to him, however, and is that by which he is still commonly known. Regaining his liberty, he had to struggle for a time with poverty and neglect. But his poetical talents at length found him patrons, and in 948 he became attached to the court of the famous warrior and patron of letters, Saif ad-daulā, prince of Aleppo, to whom many of the best fruits of his muse were dedicated, and by whose side he approved his valour in the field. But he had rivals who knew how to inspire jealousy between him and the prince, and an angry scene with the grammarian Khālawaih, in which the latter closed a philological dispute by striking Motanabbī, in the very presence of the prince and without rebuke from him, led the poet to leave the court and seek a new career in the realm of the Ikshīds (957). He now took as his patron and the object of his eulogies Kāfūr, the regent of Egypt—a black eunuch who knew how to open the poet's lips by great gifts and honours. Motanabbī, however, sought a higher reward, the government of Sidon, and at length broke with Kāfūr, wrote satires against him, and had to fly for his life to Kufa (961). His next great patron was 'Aḍod ad-daulā of Shirāz, and on a journey from Shirāz to Kufa he was waylaid and slain by a chieftain of the Asad, whose kinsfolk he had satirized (September 965).

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[1] *I.e.* "he who plays the prophet."

The poetry of Motanabbī is to European taste much less attractive than the verses of the ancient Arab poets, being essentially artificial and generally unreal, though it has great technical merits and displays lively fancy and considerable inventive power.

Oriental taste places him on a very high pedestal, as may be judged from the fact that more than forty commentaries were written on his *Dīwān* (H. Khal., iii. 306). Dieterici's edition of the poet (Berlin, 1858–1861), gives the commentary of Wāḥidī (d. 1075); the Egyptian edition of 1870 has the commentary of 'Ukbarī (d. 1219). A convenient edition is that published with a commentary of Nāṣīf ul-Yazījī at Beirut (1882). See R. A. Nicholson, *A Literary History of the Arabs* (London, 1907), pp. 304–313.

MOTET, a musical art-form of paramount importance in the 16th century. The word is of doubtful etymology, and probably its various uses and forms in the 13th and 14th centuries connect with more than one origin. Thus *motulus* suggests *modulus* or melody; and probably represents the notion underlying the use of the term *motetus* or *motellus* to designate one of the middle parts in a vocal combination. On the other hand the obvious connexion between the Italian word *mottetto* (diminutive of motto) with the French *mot* (in the sense of *bon mot*) is in conformity with the use of a profane art-form contemporary with the *conductus* and *rondel* of these early epochs of music.

The only really definite and mature art-form denoted by the word motet is that of the 16th-century pieces of ecclesiastical music in one or two (rarely more) continuous movements, for the most part on Biblical or other ecclesiastical prose texts. The word is, however, used for any single Latin-text composition in continuous form, not set sectionally verse by verse, and not forming a permanent part of the mass. Thus Palestrina's *Stabat mater* is included among his motets; though the text is metrical and rhymed, and the style, though continuous, is far from being that of the typical polyphonic motet. The title of motet is also occasionally loosely used for non-ecclesiastical works, such as many of the numbers in the *Magnum opus musicum* of Orlando di Lasso and the dedicatory motet at the beginning of Palestrina's fifth book. And in this way it is sometimes applied to compositions not to Latin text; as in Josquin's *Déploration de Jehan Okenheim*, where all except the *canto fermo* is in French.

The most important kind of motet is that which is intimately connected with the solemn mass for a particular holy day. Such motets are sung between the *Credo* and the *Sanctus* of the mass. They are, in typical cases, founded on the Gregorian tones of their texts, and the mass is founded on the same themes, thus giving the whole service a musical unity which has never since been approached in any church music even under Bach. When a motet was not founded on Gregorian tones it was still possible for the composer to design a mass on the same themes, and most of the titles of 16th-century masses, when they do not indicate a secular origin, indicate either the motet or the Gregorian tones on which they are founded. Thus Palestrina's masses *Assumpta est Maria*; *O admirabile commercium*; *Dum complerentur*; *Hodie Christus natus est*; *Dies santificatus*; *Veni sponsa Christi*, and the second *Missa Tu es Petrus*, are magnificent examples selected almost at random from the masses which the composer has founded on his own motets of the same name. When such masses are performed, whether in a concert-room or church, it is indisputable that the motet ought always to be included. Sometimes one composer founded a mass on another composer's motet; thus Soriano's fine *Missa, Nos autem gloriari*, is based upon a motet by Palestrina. When a motet was in two movements the second movement almost always ended with the last clauses of the first, both in text and in music, thereby sometimes producing a distinctly modern impression of *da capo* form.

In later times the term motet is little more than a name for any choral composition of clearly single design; and the fact that such compositions have often been sung, like the 16th-century motet, between the *Credo* and *Sanctus* of High Mass, has nothing to do with their character as an art-form. Bach's motets are great German choral works in several movements, with no written accompaniment, though there is internal and external evidence that they were accompanied from score by the organ. Handel's motets belong to his Italian period and are simply Latin cantatas of various kinds, with instrumental accompaniment. The later meanings attached to the word are quite indefinite, and have no common idea, except that the motet is nowadays the shortest kind of sacred choral music.

(D. F. T.)

MOTH, in entomology, any lepidopterous insect belonging to the division *Heterocera*, as distinguished from the *Rhopalocera*, or butterflies; formerly confined to the small nocturnal insect (belonging to the genus *Tinea*), which breeds in fur, clothes, &c. (see LEPIDOPTERA). The word in O Eng. is *moþþe*, and corresponds to Ger. *Motte*.

MOTHER, the term for the female parent of a child. The word, like father, is common to Indo-European languages, cf. in Teutonic languages, Ger. *Mutter*, Du. *moeder*, Swed. and Dan. *moder*; Gothic is the exception in Teutonic languages, the word being *aithei*, cf. *atta*, father; from Lat. *mater* come, in Romanic, Fr. *mère*, Ital., Span. and Port., *madre*. Greek has *μήτηρ*, (Attic and Ionic), *μάτηρ* (Doric). The Russian word is *mat*. The Sansk. *mata* points to an original derivation from a stem *ma*, to measure, or make. Of the many transferred applications of "mother" may be mentioned those to the church, to nature, to the earth, and to a city or nation, as the parent of other cities, nations, colonies, &c. As a title "mother" is particularly applied to the head of a religious community of women. For "mother-of-pearl" see PEARL. There is a particular application of "mother" to the scum which rises to the surface of a liquor during the process of fermentation, and also to a mass of gummy stringy consistency formed in vinegar in the process of acetous fermentation, hence known as "mother of vinegar" (see VINEGAR). This is usually, however, taken to be another word altogether, and connected with Du. *modder*, mud, mire.

MOTHERWELL, WILLIAM (1797–1835), Scottish poet, antiquary and journalist, was born at Glasgow on the 13th of October 1797, the son of an ironmonger. At the age of fifteen he was apprenticed in the office of the sheriff-clerk at Paisley, and appointed sheriff-clerk depute there in 1819. He spent his leisure in collecting materials for a volume of local ballads which he published in 1819 under the title of *The Harp of Renfrewshire.* In 1827 he published a further instalment in *Minstrelsy Ancient and Modern,* prefaced by an excellent historical introduction. He contributed verses to newspapers and magazines, *Jeanie Morrison, My Heid is like to rend, Willie,* and *Wearie's Cauld Well* being his best-known poems. He became editor of the *Paisley Advertiser* in 1828, and of the *Glasgow Courier* in 1830.

A small volume of his poems was published in 1832, and a larger volume with a memoir in 1846, reissued, with additions, in 1848.

MOTHERWELL, a municipal and police burgh of Lanarkshire, Scotland. Pop. (1851), 900; (1901), 30,418. It is situated near the right bank of the Clyde, 13 m. S.E. of Glasgow by the Caledonian railway. It takes its name from an old well dedicated to the Virgin, and owes its rapid increase to the coal and iron mines in the neighbourhood. It has large iron and steel works, bridge-building being a distinctive industry. Boilers, steam-cranes and ironmongers' ware are also made, and there are brick, tile and fireclay works. The public buildings include the town-hall, theatre and hospital; the park was presented in commemoration of Queen Victoria's Jubilee.

MOTION (Lat. *motio,* from *movere,* to move), in English law, an application made to a court during the progress of an action, and either before or after judgment has been pronounced. The object of a motion is to invoke the assistance of the court in matters that are of a pressing character, and require to be speedily dealt with. A motion differs from a petition in that it is made viva voce in open court and is founded on a written statement. Motions are either motions of course or special motions. A motion of course is made *ex parte* without notice, and is not mentioned in court, the party being entitled as of right. Motions of course are confined to the chancery division of the High Court. A special motion is made in open court, and must be supported by proper evidence. Special motions are made either *ex parte* or on notice. On all *ex parte* applications the utmost good faith must be observed. *Ex parte* motions, in the king's bench division, are usually made to a divisional court. A motion for judgment is a proceeding whereby a party to an action moves for judgment of the court in his favour. See *Rules of the Supreme Court,* Ors. xl., lii.

MOTION, LAWS OF. Before the time of Galileo (1564–1642) hardly any attention had been paid to a scientific study of the motions of terrestrial bodies. With regard to celestial bodies, however, the case was different. The regularity of their diurnal revolutions could not escape notice, and a good deal was known 2000 years ago about the motions of the sun and moon and planets among the stars. For the statement of the motions of these bodies uniform motion in a circle was employed as a fundamental type, combinations of motions of this type being constructed to fit the observations. This procedure—which was first employed by the great Greek astronomer Hipparchus (2nd century B.C.), and developed by Ptolemy three centuries later—did not afford any law connecting the motions of different bodies. Copernicus (1473–1543) employed the same system, and greatly simplified the application of it, especially by regarding the earth as rotating and the sun as the centre of the solar system. Kepler (1571–1630) was led by his study of the planetary motions to reject this method of statement as inadequate, and it is in fact incapable of giving a complete representation of the motions in question. In 1609 and 1619 Kepler published his new laws of planetary motion, which were subsequently shown by Newton to agree with the results obtained by experiment for the motion of terrestrial bodies.

Acceleration of Gravity.

The earliest recorded systematic experiments as to the motion of falling bodies were made by Galileo at Pisa in the latter years of the 16th century. Bodies of different substances were employed, and slight differences in their behaviour accounted for by the resistance of the air. The result obtained was that any body allowed to fall from rest would, in a vacuum, move relatively to the earth with constant acceleration; that is to say, would move in a straight line, in such a manner that its velocity would increase by equal amounts in any two equal times. This result is very nearly correct, the deviations being so small as to be almost beyond the reach of direct measurement. It has since been discovered, however, that the magnitude of the acceleration in question is not exactly the same at different places on the earth, the range of variation amounting to about ½ %. Galileo proceeded to measure the motion of a body on a smooth, fixed, inclined plane, and found that the law of constant acceleration along the line of slope of the plane still held, the acceleration decreasing in magnitude as the angle of inclination was reduced; and he inferred that a body, moving on a smooth horizontal plane, would move with uniform velocity in a straight line if the resistance of the air, and friction due to contact with the plane, could be eliminated. He went on to deal with the case of projectiles, and was led to the conclusion that the motion in this case could be regarded as the result of superposing a horizontal motion with uniform velocity and a vertical motion with constant acceleration, the latter identical with that of a merely falling body; the inference being that the path of a projectile would be a parabola except for deviations attributed to contact with the air, and that in a vacuum this path would be accurately followed. The method of superposition of two motions may be illustrated by such examples as that of a body dropped from the mast of a ship moving at uniform speed. In this case it is found that the body falls relatively to the ship as if the latter were at rest, and alights at the foot of the mast, having consequently pursued a parabolic path relatively to the earth.

The importance of these results, limited though their scope was, can hardly be overrated. They had practically the effect of suggesting an entirely new view of the subject, namely, that a body uninfluenced by other matter might be expected to move, relatively to some base or other, with uniform velocity in a straight line; and that, when it does not move in this way, its acceleration is the feature of its motion which the surrounding conditions determine. The acceleration of a falling body is naturally attributed to the presence of the earth; and, though the body approaches the earth in the course of its fall, it is easily recognized that the conditions under which it moves are only very slightly affected by this approach. Moreover, Galileo recognized, to some extent at any rate, the principle of simple superposition of velocities and accelerations due to different sets of circumstances, when these are combined (see MECHANICS). The results thus obtained apply to the motion of a small body, the rotation of which is disregarded. When this case has been sufficiently studied, the motion of any system can be dealt with by regarding it as built up of small portions. Such portions, small enough for the position and motion of each to be sufficiently specified by those of a point, are called "particles."

Centrifugal Force.

Descartes helped to generalize and establish the notion of the fundamental character of uniform motion in a straight line, but otherwise his speculations did not point in the direction of sound progress in dynamics; and the next substantial advance that was made in the principles of the subject was due to Huygens (1629–1695). He attained correct views as to the character of centrifugal force in connexion with Galileo's theory; and, when the fact of the variation of gravity (Galileo's acceleration) in different latitudes first became known from the results of pendulum experiments, he at once perceived the possibility of connecting such a variation with the fact of the earth's diurnal rotation relatively to the stars. He made experiments, simultaneously with Wallis and Wren, on the collision of hard spherical bodies, and his statement of the results (1669) included a clear enunciation of the conservation of linear momentum, as demonstrated for these cases of collision, and apparently correct in certain other cases, mass being estimated by weight. But Huygens's most important contribution to the subject was his investigation, published in 1673, of the motion of a rigid pendulum of any form. This is the earliest example of a theoretical investigation of the rotation of rigid bodies. It involved the adoption of a point of view as to the relation between the motions of bodies of different forms, which practically amounted to a perception of the principle of energy as applied to the case in question.

Galileo-Newton Theory.

We owe to Newton (1642–1727) the consolidation of the views which were current in his time into one coherent and universal system, sometimes called the Galileo-Newton theory, but commonly known as the "laws of motion"; and the demonstration of the fact that the motions of the celestial bodies could be included in this theory by means of the law of universal gravitation. A full account of his results was first published in the *Principia* in 1687.

Such statements as that a body moves in a straight line, and that it has a certain velocity, have no meaning unless the base, relative to which the motion is to be reckoned, is defined. Accordingly, in the extension of Galileo's results for the purpose of a universal theory, the establishment of a suitable base of reference is the first step to be taken. Newton assumed the possibility of choosing a base such that, relatively to it, the motion of any particle would have only such divergence from uniform velocity in a straight line as could be expressed by laws of acceleration dependent on its relation to other bodies. He used the term "absolute motion" for motion relative to such a base. Many writers on the subject distinguish such a base as "fixed." The name "Newtonian base" will be used in this article. Assuming such a base to exist, Newton admitted at the outset the difficulty of identifying it, but pointed out that the key to the situation might be found in the identification of forces; that is to say, in the mutual character of laws of acceleration as applied to any given body and any other by whose presence its motion is influenced. In this connexion he took an important step by distinguishing clearly the character of "mass" as a universal property of bodies distinct from weight.

There can be no doubt that the development of correct views as to mass was closely connected with the results of experiments with regard to the collision of hard bodies. Suppose two small smooth spherical bodies which can be regarded as particles to be brought into collision, so that the velocity of each, relative to any base which is unaffected by the collision, is suddenly changed. The additions of velocity which the two bodies receive respectively, relative to such a base, are in opposite directions, and if the bodies are alike their magnitudes are equal. If the bodies though of the same substance are of different sizes, the magnitudes of the additions of velocity are found to be inversely proportional to the volumes of the bodies. But if the bodies are of different substances, say one of iron and the other of gold, the ratio of these magnitudes is found to depend upon something else besides bulk. A given volume of gold is found to count for this purpose for about two and a half times as much as the same volume of iron. This is expressed by saying that the density of gold is about two and a half times that of iron. In fact, experiments upon the changes of velocity of bodies, due to a mutual influence between them, bring to light a property of bodies which may be specified by a quantity proportional to their volumes in the case of bodies which are perceived by other tests to be of one homogeneous substance, but otherwise involving also another factor.

The product of the volume and density of a body measures what is called its "mass." The mass of a body is often loosely defined as the measure of the quantity of matter in it. This definition correctly indicates that the mass of any portion of matter is equal to the sum of the masses of its parts, and that the masses of bodies alike in other respects are equal, but gives no test for comparison of the masses of bodies of different substances; this test is supplied only by a comparison of motions. When, as in the case of contact, a mutual relation is perceived between the motions of two particles, the changes of velocity are in opposite directions, and the ratio of their magnitudes determines the ratio of the masses of the particles; the motion being reckoned relative to any base which is unaffected by the change. It is found that this gives a consistent result; that is to say, if by an experiment with two particles A and B we get the ratio of their masses, and by an experiment with B and a third particle C we get the ratio of the masses of B and C, and thus the ratio of the masses of A and C, we should get the same ratio by a direct experiment with A and C. For the numerical measure of mass that of some standard body is chosen as a unit, and the masses of other bodies are obtained by comparison with this. Masses of terrestrial bodies are generally compared by weighing; this is found by experiment to give a correct result, but it is applicable only in the neighbourhood of the earth. Familiar cases can readily be found of the perception of the mass of bodies, independently of their tendency to fall towards the earth. The mass of any portion of matter is found to be permanent under chemical and other changes, and this fact adds to its importance as a physical quantity. The study of the structure of atoms has suggested a connexion of mass with electrical phenomena which implies its dependence on motion; but this is not inconsistent with the observed fact of its practical constancy, to a high degree of accuracy, for bodies composed of atoms.

The Galileo-Newton theory of motion is that, relative to a suitably chosen base, and with suitable assignments of mass, all accelerations of particles are made up of mutual (so-called) actions between pairs of particles, whereby the two particles forming a pair have accelerations in opposite directions in the line joining them, of magnitudes inversely proportional to their masses. The total acceleration of any particle is that obtained by the superposition of the component accelerations derived from its association with the other particles of the system severally in accordance with this law. The mutual action between two particles is specified by means of a directed quantity to which the term "force" is appropriated. A force is said to act upon each of two particles forming a pair, its magnitude being the product of mass and component acceleration of the particle on which it acts, and its direction that of this component acceleration. Thus each mutual action is associated with a pair of equal forces in opposite directions. Instead of the operation of superposing accelerations, we may compound the several forces acting on a particle by the parallelogram law (see MECHANICS) into what may be called the resultant force, the total acceleration of the particle being the same as if this alone acted. The theory depends for its verification and application upon the fact that forces can be identified and classified. They can be recognized by their reciprocal character, and it is found to be possible to connect them by permanent laws with the recognizable physical characteristics of the systems in which they occur. A generalization of Galileo's results takes the form that under constant conditions of this kind, force (defined in terms of motion) is constant, and that the superposition of two sets of conditions, if their independence can be secured, results in superposition of the forces associated with them separately. Particular laws of force may be suggested by a study of the simplest cases in which they are manifested, and from them results may be obtained by calculation as to the motions of systems of any given structure. Such results may be tested by direct observation.

Application of the Theory.

Statics.

It should be noted that, within a limited range of application to terrestrial mechanics, the most convenient way of attacking the question of the relations of forces to the physical conditions of their occurrence may be by balancing their several effects in producing motion; thus avoiding in the first instance both the choice of a base and the consideration of mass. This procedure is useful as a preliminary step in the study of the subject. It does not, however, afford a convenient starting-point for a general theory, because it is apt to involve some confusion of phenomena which, from the point of view of the Galileo-Newton theory, are distinct in character.

Newton's law of gravitation affords the most notable example of the process of verification of a law of force, and incidentally of the Galileo-Newton theory. As a law of acceleration of the planets relatively to the sun, its approximate agreement with

Gravitation.

Kepler's third law of planetary motion follows readily from a consideration of the character of the acceleration of a point moving uniformly in a circle. Newton tells us that this agreement led him to adopt the law of the inverse square of the distance about 1665–1666, before Huygens's results as to circular motion had been published. At the same time he thought of the possibility of terrestrial gravity extending to the moon, and made a calculation with regard to it. Some years later he succeeded in showing that Kepler's elliptic orbit for planetary motion agreed with the assumed law of attraction; he also completed the co-ordination with terrestrial gravity by his investigation of the attractions of homogeneous spherical bodies. Finally, he made substantial progress with more exact calculations of the motions of the solar system, especially for the case of the moon. The work of translating the law of gravitation into the form of astronomical tables, and the comparison of these with observations, has been in progress ever since. The discovery of Neptune (1846), due to the influence of this planet on the motion of Uranus, may be mentioned as its most dramatic achievement. The verification is sufficiently exact to establish the law of gravitation, as providing a statement of the motions of the bodies composing the solar system which is correct to a high degree of accuracy. In the meantime some confirmation of the law has been obtained from terrestrial experiments, and observations of double stars tend to indicate for it a wider if not universal range. It should be noticed that the verification was begun without any data as to the masses of the celestial bodies, these being selected and adjusted to fit the observations.

The case of electro-magnetic forces between two conductors carrying electric currents affords an example of a statement of motion in terms of force of a highly artificial kind. It can only be contrived by means of complicated mathematical analysis. In this connexion a statement in terms of force is apt to be displaced by more direct and more comprehensive methods, and the attention of physicists is directed to the intervention of the ether. The study of such cases suggests that the statement in terms of force of the relations between the motions of bodies may be only a provisional one, which, though it may summarize the effect of the actual connexions between them sufficiently for some practical purposes, is not to be regarded as representing them completely. There are indications of this having been Newton's own view.

Newtonian Base.

The Newtonian base deserves some further consideration. It is defined by the property that relative to it all accelerations of particles correspond to forces. This test involves only changes of velocity, and so does not distinguish between two bases, each of which moves relatively to the other with uniform velocity without rotation. The establishment of a true Newtonian base presumes knowledge of the motions of all bodies. But practically we are always dealing with limited systems, so any actual determination must always be regarded as to some extent provisional. In the treatment of the relative motions of a limited system, we may use a confessedly provisional base, though it may be necessary to introduce corrections, either exact or approximate, to take account either of the existence of bodies outside the system, or of the rotation of the base employed relative to a more correct one. Such corrections may be made by the device of applying additional unpaired, or what we may call external, forces to particles of the system. These are needed only so far as they introduce differences of accelerations of the several particles. The earth, which is commonly employed as a base for terrestrial motions, is not a very close approximation to being a Newtonian base. Differences of acceleration due to the attractions of the sun and moon are not important for terrestrial systems on a small scale, and can usually be ignored, but their effect (in combination with the rotation of the earth) is very apparent in the case of the ocean tides. A more considerable defect is due to the earth having a diurnal rotation relative to a Newtonian base, and this is never wholly ignored. Take a base attached to the centre of the earth, but without this diurnal rotation. A small body hanging by a string, at rest relatively to the earth, moves relatively to this base uniformly in a circle; that is to say, with constant acceleration directed towards the earth's axis. What is done is to divide the resultant force due to gravitation into two components, one of which corresponds to this acceleration, while the other one is what is called the "weight" of the body. Weight is in fact not purely a combination of forces, in the sense in which that term is defined in connexion with the laws of motion, but corresponds to the Galileo acceleration with which the body would begin to move relatively to the earth if the string were cut. Another way of stating the same thing is to say that we introduce, as a correction for the earth's rotation, a force called "centrifugal force," which combined with gravitation gives the weight of the body. It is not, however, a true force in the sense of corresponding to any mutual relation between two portions of matter. The effect of centrifugal force at the equator is to make the weight of a body there about ·35% less than the value it would have if due to gravitation alone. This represents about two-thirds of the total variation of Galileo's acceleration between the equator and the poles, the balance being due to the ellipticity of the figure of the earth. In the case of a body moving relatively to the earth, the introduction of centrifugal force only partially corrects the effect of the earth's rotation. Newton called attention to the fact that a falling body moves in a curve, diverging slightly from the plumb-line vertical. The divergence in a fall of 100 ft. in the latitude of Greenwich is about $\frac{1}{11}$ in. Foucault's pendulum is another example of motion relative to the earth which exhibits the fact that the earth is not a Newtonian base.

For the study of the relative motions of the solar system, a provisional base established for that system by itself, bodies outside it being disregarded, is a very good one. No correction for any defect in it has been found necessary; moreover, no rotation of the base relative to the directions of the stars without proper motion has been detected. This is not inconsistent with the law of gravitation, for such estimates as have been made of planetary perturbations due to stars give results which are insignificant in comparison with quantities at present measurable.

Measurement of Time.

For the measurement of motion it must be presumed that we have a method of measuring time. The question of the standard to be employed for the scientific measurement of time accordingly demands attention. A definition of the measurement dependent on dynamical theory has been a characteristic of the subject as presented by some writers, and may possibly be justifiable; but it is neither necessary nor in accordance with the historical development of science. Galileo measured time for the purpose of his experiments by the flow of water through a small hole under approximately constant conditions, which was of course a very old method. He had, however, some years before, when he was a medical student, noticed the apparent regularity of successive swings of a pendulum, and devised an instrument for measuring, by means of a pendulum, such short periods of time as sufficed for testing the pulse of a patient. The use of the pendulum clock in its present form appears to date from the construction of such a clock by Huygens in 1657. Newton dealt with the question at the beginning of the *Principia*, distinguishing what he called "absolute time" from such measures of time as would be afforded by any particular examples of motion; but he did not give any clear definition. The selection of a standard may be regarded as a matter of arbitrary choice; that is to say, it would be possible to use any continuous time-measurer, and to adapt all scientific results to it. It is of the utmost importance, however, to make, if possible, such a choice of a standard as shall render it unnecessary to date all results which have any relation to time. Such a choice is practically made. It can be put into the form of a definition by saying that two periods of time are equal in which two physical operations, of whatever character, take place, which are identical in all respects except as regards lapse of time. The validity of this definition depends on the assumption that operations of different kinds all agree in giving the same measure of time, such allowances as experience dictates being made for changing conditions. This assumption has successfully stood all tests to which it has been subjected. All clocks are constructed on the basis of this method of measurement; that is to say, on the plan of counting the repetitions of some operation, adopted solely on the ground of its being capable of continual repetition with a certain degree of accuracy, and possibly also of automatic compensation for changing conditions. Practically clocks are regulated by reference to the diurnal rotation of the earth relatively to the stars, which affords a measurement on the repetition principle agreeing with other methods, but more accurate than that given by any existing clock. We have, however, good reasons for regarding it as not absolutely perfect, and there are some astronomical data the tendency of which is to confirm this view.

Theory of Energy.

The most important extension of the principles of the subject since Newton's time is to be found in the development of the theory of energy, the chief value of which lies in the fact that it has supplied a measurable link connecting the motions of systems, the structure of which can be directly observed, with physical and chemical phenomena having to do with motions which cannot be similarly traced in detail. The importance of a study of the changes of the *vis viva* depending on squares of velocities, or what is now called the " kinetic energy " of a system, was recognized in Newton's time, especially by Leibnitz; and it was perceived (at any rate for special cases) that an increase in this quantity in the course of any motion of the system was otherwise expressible by what we now call the " work " done by the forces. The mathematical treatment of the subject from this point of view by Lagrange (1736–1813) and others has afforded the most important forms of statement of the theory of the motion of a system that are available for practical use. But it is to the physicists of the 19th century, and especially to Joule, whose experimental results were published in 1843–1849, that we practically owe the most notable advance that has been made in the development of the subject—namely, the establishment of the principle of the conservation of energy (see ENERGETICS and ENERGY). The energy of a system is the measure of its capacity for doing work, on the assumption of suitable connexions with other systems. When the motion of a body is checked by a spring, its kinetic energy being destroyed, the spring, if perfectly elastic, is capable of restoring the motion; but if it is checked by friction no such restoration can be immediately effected. It has, however, been shown that, just as the compressed spring has a capacity for doing work by virtue of its configuration, so in the case of the friction there is a physical effect produced—namely, the raising of the temperature of the bodies in contact, which is the mark of a capacity for doing the same amount of work. Electrical and chemical effects afford similar examples. Here we get the link with physics and chemistry alluded to above, which is obtained by the recognition of new forms of energy, interchangeable with what may be called mechanical energy, or that associated with sensible motions and changes of configuration.

Such general statements of the theory of motion as that of Lagrange, while releasing us from the rather narrow and strained view of the subject presented by detailed analysis of motion in terms of force, have also suggested a search for other forms which a statement of elementary principles might equally take as the foundation of a logical scheme. In this connexion the interesting scheme formulated by Hertz (1894) deserves notice. It is important as an addition to the logic of the subject rather than on account of any practical advantages which it affords for purposes of calculation.

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(W. H. M.)

MOTIVE (from Lat. *movere*, to move), in psychology, a general term signifying any element of consciousness which prompts an agent to a decision. The older psychology usually regarded motives as strictly analogous to mechanical forces exerting pressure or tension, and explained human action as necessarily determined by the resultant of various, possibly conflicting, motives. Contemporary psychological research tends to show with increasing clearness that we must recognize a power of decision in the self, and that the analogy of mechanical forces is inadequate to explain the facts. On this view motives will be regarded as solicitations to act in a certain direction, while the self decides by throwing its volitional weight on the side of the motive which it regards as preferable. The solicitations may come from the most diverse sources: they may be mere desires to avoid some pain or to gratify some appetite; or they may be of higher origin, such as the motive of patriotism, or the desire to advance knowledge. Purposes or ends are often termed motives. " Conflict of motives " means sometimes a conflict of purposes, when the agent has adopted two different lines of action and has difficulty in combining them; or it may mean a conflict of solicitations. It is better to call purposes or ends by those names when they have been definitely adopted by the agent: while they are still under deliberation the term " motive " may be used.

MOTLEY, JOHN LOTHROP (1814–1877), American historian, son of Thomas Motley, was born on the 15th of April 1814 at Dorchester (now a part of Boston), Massachusetts, and graduated at Harvard in 1831. He then studied at Göttingen and Berlin, becoming a friend of Bismarck at Göttingen, and after a period of European travel returned in 1834 to America, where he continued his legal studies. In 1837 he married Mary Benjamin (d. 1874), a sister of Park Benjamin, and in 1839 he published anonymously a novel entitled *Morton's Hope, or the Memoirs of a Provincial*. In 1841 he entered the diplomatic service as secretary of legation in Russia, but resigned his post within three months. Returning to America, he soon entered definitely upon a literary career. Besides contributing various historical and critical essays to the *North American Review*, including a remarkable essay on the *Polity of the Puritans*, he published in 1849, again anonymously, a second novel, entitled *Merry Mount, a Romance of the Massachusetts Colony*. About 1846 the project of writing a history of Holland had begun to take shape in his mind, and he had already done a large amount of work on this subject when, finding the materials at his disposal in the United States inadequate, he went to Europe in 1851. The next five years were spent at Dresden, Brussels and the Hague in investigation of the archives, which resulted in 1856 in the publication of *The Rise of the Dutch Republic*, which became very popular. It speedily passed through many editions, was translated into French, and also into Dutch, German and Russian. In 1860 Motley published the first two volumes of its continuation, *The United Netherlands*. This work was on a larger scale, and embodied the results of a still greater amount of original research. It was brought down to the truce of 1609 by two additional volumes, published in 1867. In 1861, just after the Civil War had broken out in America, Motley wrote two letters to *The Times* defending the Federal position, and these letters, afterwards reprinted as a pamphlet entitled *Causes of the Civil War in America*, made a favourable impression on President Lincoln. Partly owing to this essay, Motley was appointed United States minister to Austria in 1861, a position which he filled with great success until his resignation in 1867. Two years later he was sent to represent his country in London, but in November 1870 he was recalled by President Grant. After a short visit to Holland, he again took up his residence in England, where the *Life and Death of John Barneveld* appeared in two volumes in 1874. Ill health now began to interfere with his literary work, and he died at Frampton Court, near Dorchester, Dorset, on the 29th of May 1877, leaving three daughters. The merits of Motley as an historian are undeniably great. He has told the story of a stirring period in the history of the world with full attention to the character of the actors and strict fidelity to the vivid details of the action. But it may safely be said that his tale is best where most unvarnished, and probably no writer of the same rank has owed less to the mere sparkle of highly polished literary style.

An excellent edition of his historical works was published in nine volumes in London in 1903–1904. See the *Correspondence of John Lothrop Motley*, edited by G. W. Curtis (New York, 1889); O. W. Holmes, *John Lothrop Motley, a Memoir* (Boston, 1878); M. D. Conway, *Biographical Introduction to The Rise of the Dutch Republic* (London, 1896); and *John Lothrop Motley and his Family: Further Letters and Records* (1910), edited by his daughter, Mrs Susan St John Mildmay.

MOTLEY, *i.e.* of many colours, a term particularly used of the parti-coloured dress of the professional "fool" (*q.v.*) of the middle and later ages. The origin of the word is probably to be found in "mote" (O. Eng. *mot*), a particle of dust, &c., hence a spot or patch. "Mottle," a blotch or spot, is probably a back formation of motley.

MOTMOT. According to Hernandez in his *Historia avium Novae Hispaniae* (p. 52), published at Rome in 1651, this is the Mexican name of a bird which he described well enough to leave no doubt as to what he meant; but the word being soon after printed *Momot* by Nieremberg and others gave rise to the Latinized *Momotus*, invented by M. J. Brisson as a generic term, which has since been generally adopted by ornithologists, though motmot has been retained as the English form. Linnaeus knew of only one species of motmot, and referred it to his genus *Ramphastos* (properly *Rhamphastus*) under the name of *R. momota*. This is the *Momotus brasiliensis* of modern ornithologists, and from its geographical range cannot be the original *Motmot* of Hernandez, but is most likely the "*Guira guainumbi*" of Marcgrave.

The motmots form the sub-family *Momotinae*, which with the *Todinae* (see TODY) form the family *Momotidae* of Coraciiform birds, the nearest allies being rollers (*q.v.*) and kingfishers (*q.v.*). In outward appearance the motmots have an undoubted resemblance to bee-eaters, but, though beautiful birds, various shades of blue and green predominating in their plumage, they do not exhibit such decided and brilliant colours; and, while the bee-eaters are only found in the Old World, the motmots are a purely Neotropical form, extending from southern Mexico to Paraguay, and the majority of species inhabit Central America. Their ordinary food is small reptiles and fruits, and insects caught on the wing. The nest of one species, as observed by Robert Owen, is at the end of a hole bored in the bank of a watercourse, and the eggs are pure white and glossy (*Ibis*, 1861, p. 65). Little else has been recorded of their ways.

The *Momotidae* form but a small group, containing about six genera, of which the best known are: *Momotus*, *Baryphthengus*, *Hylomanes*, *Eumomota*, *Aspatha* and *Prionorhynchus*, and the number of species is very small. While all have a general resemblance in the serrated edges of the bill and many other characters, *Momotus* has the normal number of twelve rectrices, while the rest have only ten, which in *Hylomanes* have the ordinary configuration, but in adult examples of all the others the shaft of the median pair is devoid of barbs for the space of about an inch a little above the extremity, so as to produce a spatulate appearance, such as is afforded by certain humming-birds known as "racquet-tails" (see HUMMING-BIRD), kingfishers of the genus *Tanysiptera* (see KINGFISHER), and parrots of the group *Prioniturus*. C. Waterton (*Wanderings*, Journey 2, chap. iii.), mentioning the species *M. brasiliensis* by its native name "houtou," long ago asserted that this peculiarity was produced by the motmot itself nibbling off the barbs, and this extraordinary statement, though for a while doubted, has since been shown by O. Salvin (*Proc. Zool. Society*, 1873, pp. 429–433), on A. Bartlett's authority, to be perfectly true. (A. N.)

MOTORS, ELECTRIC. Fundamentally, electric motors are electric generators reversed in function: they convert into mechanical energy the continued stresses between two electromagnetic fields relatively movable, just as generators convert into electromagnetic stresses the mechanical energy applied to them. Since no transformation of energy is ever absolutely quantitative, the conversions just considered are not accomplished without loss of energy to about the same extent in both cases. The sources of this loss are ohmic loss in the conductors, hysteresis, friction of bearings and brushes, air friction and eddy currents; the sum of these losses in large modern machines does not exceed 5 or 6%. The torque of the motor is the dynamical result of the electromagnetic stresses between the magnetic field of the motor and that due to the armature currents, the latter field being proportional to the strength of the current sheet due to the numerical strength of the current and the number of its effective convolutions. This applies to all types of motors, if one remembers that whenever either of these two stress factors is a periodic variable, as in the case of alternating motors, the torque is proportional to their geometrical co-directed product and not merely to their numerical product. At this point it will be convenient to distinguish between the various types of motors. The first broad distinction is between continuous-current and alternating-current motors, a distinction rather of convenience than of necessity, for in point of fact the two depend upon the same broad principles and can be considered on precisely the same lines.

Electric motors may be conveniently divided as follows:—

(A) *Continuous Current.*
  1. Separately excited.
  2. Series-wound constant current.
  3. Series-wound constant potential.
  4. Series-wound interdependent current and potential.
  5. Shunt-wound constant potential.

(B) *Alternating Current.*
  1. Synchronous constant potential.
  2. Induction-polyphase constant potential.
  3. Induction-monophase constant potential.
  4. Repulsion-commutating.
  5. Series-commutating.

Of these, the series-wound constant potential, shunt-wound constant potential, and polyphase induction motors do a very large proportion of the active work of power transmission: the first mentioned furnish power for electric railways; the second chiefly power distribution from public electric supply stations; while the third are mainly relied upon in long-distance transmission systems. The fourth and fifth groups of class (B) are old in principle but have been slow in practical development. They include many modifications and transition forms not involving radical changes in the principles or properties of the machines. Their chief use has been for electrical traction, with reference to which they have, in the main, been developed, and their performance is best at low frequency, 15 to 25 cycles per second.

In class (A) in general, for a certain value of the torque current must be forced through the armature against the motor electromotive force which results from the rotation of the armature in a given field. This demands a certain greater applied electromotive force to produce the current required, which is determined by the effective electromotive force, equal to the geometrical difference between the applied and motor electromotive forces, and by the impedance of the armature. For steady currents this last is of course the same as the ohmic resistance, just as for steady electromotive force the geometrical and the numerical difference of the applied and motor electromotive forces are coincident. The torque depends, as heretofore noted, on the field strength and the strength of the current sheet due to the current thus determined. For small values of the torque the speed practically depends upon the applied electromotive force and the field, so that if the former and the latter be constant the speed is also sensibly constant. This is likewise the case if the armature resistance be very small; and in general the variations of speed at constant potential are determined by the product of this resistance and the torque, while the absolute speed depends essentially upon the field strength. Motors for low speed or high electromotive force must have both a strong field and many turns upon the armature, so that both the fundamental stresses may be large. As the field is generally strong—to secure economy of iron—low-voltage and high-voltage machines differ principally in the number of armature turns. For variable speed, this latter factor being fixed, field strength and applied electromotive force are the factors easily altered, and most of the speed variation is accomplished by changing one or both of them. Torque, neglecting field distortion, is at a maximum when the current is the greatest possible at the given applied voltage—that is, when the motor is at rest. With a small armature resistance this current is generally far too great for convenience; hence the motors are usually started with a rheostat in series with the winding if the current is not limited by the generator itself. The torque then depends on the sum of the resistances in circuit, and can be made just sufficient to start the motor under the required load. By the same device the motor can run at reduced speed, although with a considerable loss of energy in the rheostat; it is indeed, as a rule, difficult to get effective speed variation in motors of any kind without serious loss of energy. The field can be changed within wide limits only by a considerable increase of the iron in the magnetic circuit, the applied electromotive force cannot usually be varied except by increasing the resistances in circuit, and the number of armature turns cannot be varied without complication, although the effective number can be modified by shifting the brushes, probably at the expense of sparking. Altogether, if the speed variation demanded be more than 15 or 20%, it causes, in one way or another, considerable expense and trouble, particularly if each speed must be closely held irrespective of load. No large change in absolute speed can readily be made without considerable change in the percentage variation of speeds at various loads. Practically, the best results are obtained from motors of very low armature resistance, in which the field or the applied electromotive force, or both, are varied. The whole problem is nearly identical with the production of constant potential or constant current from generators driven at constant speed, and is solved by similar means. For any one absolute speed a generator can be made to give constant potential, nearly irrespective of load, by compound winding. Similarly, a motor may give a very nearly constant speed at constant potential by a differential winding in series with the armature, weakening the field as the armature current rises. This device, however, obviously increases the energy required for magnetization, and decreases the effective torque at starting. Practically, the best continuous-current motors can be made to hold their speed to within 1 or 2% from no load to full load. Commercial machines, however, generally vary from 5 to 10% in speed. With respect to the direction or rotation of a motor, the torque changes sign with a change of sign in either field or armature current, but not with a change of sign in both. The input of the motor is numerically equal to the product of the current and the applied electromotive force, while the output is determined by the product of the current and motor electromotive force; hence the efficiency of the motor as a transformer of energy is the ratio between these two quantities. The output is a maximum when the applied electromotive force is double the motor electromotive force, and the efficiency is a maximum when the motor and applied electromotive forces are substantially equal. At the point of maximum output the speed is that sufficient to reduce the current to one-half its static value. No motor is worked at or near this point, except momentarily, on account of the low efficiency and severe heating in the armature. These theoretical values are slightly modified in practical machines by the small miscellaneous losses subject to independent variations.

The practical output of electric motors is limited in machines of normal design by the temperature they can safely endure. As a rule the working temperature, which is commonly reached only after six hours or more of continuous running, should not rise more than 40° to 50° F. above the temperature of the surrounding air. In case of traction motors and others subjected to occasional severe overloads, separated by periods of rest or of subnormal load, the temporary rise of temperature tolerated may be much higher, say 60° to 75° F., after a run of an hour or so. The temperature of the air is assumed at 70° F. in most cases, and the temperature of the motor-windings is preferably ascertained by the rise in electrical resistance due to the heating. Thermometers can seldom be so applied as to measure the full heating effect.

The actual output obtainable from a motor structure of given dimensions under these conditions with respect to heating depends chiefly upon the practicable rotative speed of the armature, since the chief losses are proportional to the torque, while the mechanical output at given torque is approximately proportional to the speed. Most makers utilize a single structure for several standard motors varying in speed and output, a 15 h.p. machine at, say, 1200 r.p.m. becoming a 10 h.p. at 800 r.p.m. or a 20 h.p. at 1600 r.p.m. There is no practically fixed relation between the rating and the speed, although it is approximately linear, for in winding the same carcass for different speeds the ratings are settled rather by commercial convenience than by exact determinations. Motors generally have approximately the same efficiencies as the corresponding sizes of generators. Small motors, say from 1 to 5 h.p., are commonly of 70–80% efficiency at full load, medium sized machines of 5 to 50 h.p. about 80 to 90%, and the larger sizes run up to 95% or thereabouts. In the effort to get low-speed motors without immoderately increasing the cost they are generally dropped a little in efficiency and allowed to run hotter than if wound for higher speeds.

The weight of motors per h.p. of output is therefore very variable. In machines of medium size and speed it is likely to be 50 to 75 ℔ per h.p., falling to 30 or 40 in large or specially high speed machines, and rising to 80 or 100 ℔ in small or very low speed motors. High-voltage motors, particularly if small, lose somewhat in relative output on account of the space taken up by the necessary insulation.

In all ordinary motors the magnetization of the iron is, for economy of material, pushed high; and hence the field, even at heavy loads, is fairly stable and the conditions of commutation remain good. When, however, motors are designed to stand severe overloads, or to admit of a wide range of speed regulation by varying the field strength, the commutation is likely to be unstable, and severe sparking may result. To meet this condition the commutating-pole motor—really a recrudescence of an old idea—has been introduced on a considerable scale. In this construction auxiliary pole pieces, excited by series coils from the motor circuit, are set midway between the ordinary field poles. The office of these poles is to neutralize the magnetomotive force due to the armature winding, thus checking field distortion, and also to ensure the proper reversal of the current in the armature coil directly under the brush. Of the total magneto-motive force due to the windings of the commutating pole, the major part, perhaps three-fourths, is devoted to the former work and the remainder to the latter, the proportion varying widely according to the design of the motor. The result of this construction is excellent, sparkless commutation being ensured over a wide range of load and field strength. The commutating-pole motor is intrinsically more expensive and slightly less efficient than the ordinary type, but for the particular kind of service it is designed to perform is extremely effective. It gives promise of especial value in high-voltage traction motors.

(A) 1. *Separately excited Motors* are interesting principally on account of the very efficient method of speed regulation possible by their use. In this method the field of the motor is excited from the supply mains, and the armature current is furnished by a motor-generator running at constant speed. A rheostat in the shunt field of the latter element enables the applied electromotive force to be varied to any desired extent, and hence the working motor can be given full torque at any speed up to that assigned by the maximum value of the electromotive force which can be applied to the armature. Moreover, if the armature resistance be small, the motor is fairly self-regulating at all speeds. The effect is rather startling, since the motor may be giving a very great torque when it is merely turning over at a few revolutions per minute; and although the process is complicated, it leads to excellent results and is widely used where delicate speed regulation is required.

(A) 2. *Series-wound Constant-current Motors* were early worked to a considerable extent on arc-lights circuits, but have now passed out of use save in a small number of constant-current power-transmission systems on the continent of Europe. In these motors the motor electromotive force is directly proportional to the output, the torque being constant. They will not start with more than a certain definite load, but once started the speed will increase until added work (internal or external) balances the torque. The type is intrinsically bad in speed regulation, and must be treated by the same methods as are adopted to secure constant current in arc machines. The most successful device in most cases is to vary the field strength by shunting the field coils or to vary the number of effective armature conductors by shifting the brushes. Both methods are carried out mechanically rather than by purely electrical means—in the first case by an automatic rheostat, and in the second by an automatic brush shifter, but neither is wholly satisfactory. Nevertheless, such motors have proved capable of excellent commercial service in some of the European plants, especially in the larger sizes.

(A) 3. *Series-wound Constant-potential Motors* comprise nearly all motors used for electric traction—aggregating not less, probably, than one and a half million horse-power; hence they are of great practical importance. These traction motors are usually highly specialized machines with very powerful armatures and fields strongly saturated at all working values of the current. The brushes have an invariable position. Such motors behave much like separately-excited motors, having a rather large armature resistance. Speed regulation has to be obtained by varying the applied electromotive force. In early traction motors this variation depended upon inserting a rheostat; in modern practice it is customary to employ two, or even four, identical motors on each car, operated in series for low speeds and in parallel for full speed. In practice, however, resistances are inserted when necessary, to prevent too sudden changes of speed and to secure intermediate steps between those obtained by the series-parallel connexions. In rare instances a still further variation is secured by the use of a field only partially saturated at ordinary loads.

(A) 4. *Series-wound Motors with Interdependent Current and Potential* are used only in connexion with generators of similar design, motor and generator forming a dynamical unit. This system is occasionally used with good results in power transmission. Assuming the motor field to be saturated, if the speed is to be constant the applied electromotive force must rise with the load to an amount depending on the resistances in circuit. If the corresponding generator has a field less fully saturated, the increase in current demanded by the increment of torque in the motor can be made not only to raise the applied electromotive force enough to compensate for armature resistance, but for the total resistances in circuit, including the line. With this difference in saturation the motor will automatically maintain constant speed. The fields of the machines need not be designed for a given saturation, since shunting them with a suitable resistance will give the same result.

(A) 5. *Shunt-wound Motors at Constant Potential* are the mainstay of continuous-current distributions for industrial purposes. At constant potential the field remains sensibly constant and the torque is directly proportional to the current. The motor then behaves much like a separately-excited motor, and the armature resistance being generally very small, the speed is very nearly constant, varying less than 5% from no load to full load in the best commercial machines. Operating on a compound-wound generator, a single motor of this type can be made to regulate with great precision, as in the previous case. If the motor field be only moderately saturated, its strength, and hence the motor electromotive force, rises and falls with the applied electromotive force; and therefore at constant load these motors run at very nearly constant speed, in spite of small variations of voltage. If speed variation be required, it can be obtained to a moderate extent by a rheostat in the field circuit. At starting a rheostat is necessary in the armature circuit. The differentially wound modification is now seldom used.

(B) 1. *Synchronous Alternating-current Motors.*—The simplest starting point in the consideration of this class is the continuous-current generator. This machine actually generates within the armature alternating currents; and if the commutator be replaced by two or more slip-rings connected symmetrically to two or more points on the armature winding, alternating currents, monophase or polyphase, according to the number of connexions and the points touched, can be withdrawn therefrom. The simplest case involves only two slip-rings, joined to the winding at diametrically opposite points. Consider two such modified machines as motor and generator. The condition of complete reversibility is that the instantaneous values of the currents, and the instantaneous values of the angular displacements between poles and armature coils, shall be equal throughout. This evidently requires that the rotation of the motor should be synchronous, pole for pole, with that of the generator. Here, as before, the torque depends on the two fundamental stresses, but the torque has no determinate sign in the absence of an initial rotation. The instantaneous value of the torque depends on the instantaneous value of the current and on its angular displacement. The speed of the motor being invariable, its motor electromotive force depends only on the effective excitation, including the armature reactions, and it may or may not, according to the conditions of load, be in phase with the impressed electromotive force. In the case of the continuous-current motor, the motor output is numerically equal to the product of current and motor electromotive force; and since, in the alternating circuit, these quantities are usually not in phase, in alternating motors the activity is determined by the co-directed part of their product. The current in the alternating motor depends, not on the ohmic resistance alone, but upon the impedance and upon the geometrical difference between the applied and motor electromotive forces. At a given applied electromotive force, and an armature impedance assumed constant, the fundamental variables in the motor are the output, motor electromotive force, and motor current. The two last factors are interdependent, so that the current may have a wide range of values, according to the excitation, while the output remains constant, or, itself remaining constant, may cover a variety of values of the power corresponding to different excitations. These changes involve changes in the phase angle between the motor electromotive force and the current, so that at given output the power-factor of the motor—that is, the ratio between the numerical and geometrical products of current and electromotive force—may be given various values at will by changing the field excitation of the motor, a most unique and valuable property. If the motor electromotive force be fixed and the output varied, the phase angle between current and motor electromotive force varies by reason of the armature taking up a new angular position with respect to the field, backward for increasing load, forward for decreasing load. The minimum value of the current for a given load is reached when the excitation is such that the applied electromotive force and current are in phase, at which point the real and the apparent energy in the circuit coincide. The input can then be accurately measured by voltmeter and ammeter readings, and the motor is working at its best efficiency for the given load. For greater values of the motor electromotive force the current leads in phase with respect to the applied electromotive force; for less values it lags. The former condition is accompanied by the rising of the electromotive force at the motor terminals, the latter by its fall. It therefore becomes possible to use a synchronous motor, if the necessary current due to the load be not too great, as a voltage and phase regulator upon an alternating circuit, a function very valuable in power-transmission work. If the excitation be set to produce leading phase at small loads, the phase angle will gradually diminish as the load rises, and then, passing through zero, increase again with the lagging current, thus holding the power-factor near to unity at all working loads. In a well-designed synchronous motor, by proper initial adjustment of the field, the power-factor can easily be kept between 0·95 and 1 from quarter load to full load, and very close to unity within the ordinary working range. Save for its inability to start independently, the synchronous motor is a highly desirable addition to a transmission system. Starting is generally accomplished by the help of an induction motor or other auxiliary power, and the motor is treated exactly like an alternator, to be thrown in parallel with the supply circuit. A synchronous motor will pull itself up to synchronism if brought near to its synchronous speed, but this requires a very large amount of current. Operating from a generator of its own, it can be brought to speed by giving it a small initial rotation and raising the generator speed very carefully and gradually, when the two machines will accelerate in synchronism. Polyphase synchronous motors obey these same general laws; they can, however, be started as quasi-induction motors with an open field circuit, the pole faces serving as secondary conductors, but require so large currents in thus starting themselves that it is better practice to bring them to speed by extraneous means.

Synchronous motors sometimes cause serious trouble by "pumping," a phenomenon closely allied to the surging of current between alternators in parallel, and due to similar causes. If not due to defective governing of the prime mover, it usually starts with a change of load or of phase, producing fluctuations in the electromotive force in the system great enough to interfere seriously with incandescent lighting, and continuing with nearly uniform amplitude and frequency for hours if unchecked. The amplitude varies with the conditions, but in the same machine the frequency is nearly constant. The fluctuation affects both the armature and the field circuits, the latter inductively by changes in the armature magnetomotive force, but it can as a rule be controlled by varying the excitation until a neutral point is found, usually when the phase angle is near to zero. Motors with solid pole pieces give little trouble of this sort, the oscillations being rapidly damped by the eddy currents. In motors with laminated fields the most effective remedy is chamfering away the edges of the pole pieces so as to admit heavy copper shoes running along and under the edges, and even bridging the spaces between the pole pieces. The eddy currents in these shoes completely check the "pumping."

Synchronous and other Converters.—It seems here appropriate to refer to these converting devices, not in their general functions, but merely in so far as they are directly related to motor practice. The synchronous converter proper is in effect a synchronous motor, in spite of its commutating function. Owing to the fact that the direct current voltage is dependent on the alternating current voltage of supply, the converter cannot advantageously be used to control the power factor by variation of the field strength, but the field can be adjusted once for all to hold the power factor reasonably near unity, provided independent means are available for so adjusting the applied alternating voltage as to give the required result at the commutator. If close regulation of the direct-current voltage is not demanded the converter field can be used more freely. As a matter of fact the synchronous converter finds its chief use in electric traction where close regulation is not important, and motor-generators in one form or another have been found more suitable for electric-lighting work. The synchronous converters have the liability to "pumping" or "hunting," to which reference has already been made, sometimes even of sufficient amplitude to throw the machine out of step, and are often provided with the shoes or bridges found useful with ordinary synchronous motors.

Synchronous motor-generators, so far as the motor function is concerned, present no peculiarities at all. Synchronous commutators, "permutators," and the like, usually have motor-parts of very moderate capacity, and must be kept rigorously free of hunting in order to preserve the conditions of commutation.

In many instances, particularly in American practice, motor generators with induction motors have been used for ease of starting and to secure immunity from hunting. A modification of interest from the motor standpoint is found in the "cascade converter." In this machine the rotor of an induction motor is directly coupled to the armature of a commuting converter of equal output, the windings of the two being in series and approximately equivalent. In this case the normal motor-electromotive force is reached at approximately half synchronous speed, and half the energy is delivered to the output end of the machine by the rotor acting as frequency changer, the rest by torque on the shaft. Commutation takes place therefore at half the initial frequency, which is often a great advantage.

(B) 2. *Polyphase Induction Motors.*—Speaking broadly, an induction motor is one in which the armature current is introduced into the armature windings by electromagnetic induction instead of by brushes. It is at once an alternating current transformer and an alternating current motor, operating in the latter function by virtue of the current received from the former. In the commonest form the alternating currents are of two or more phases interacting in carrying on these duplicate functions. Induction motors consist of two concentric masses of laminated iron taking the form of short hollow cylinders, of which the outer is fixed and the inner fitted to revolve. The outer surface of the inner drum and the inner surface of the outer drum are slotted or perforated to receive the primary and secondary windings of the apparatus. The outer winding is usually the primary, and the inner (or armature) winding the secondary. The primary winding is almost universally a multipolar drum in character; the secondary is, in the most highly developed motors, of the same character, but very often consists merely of numerous insulated armature bars united at each end of the drum by a common end-plate or end-ring, forming the structure usually known as a "squirrel-cage" winding. In polyphase motors of the usual type the primary drum winding is in duplicate or triplicate, resembling very closely the armature winding in a two- or three-phase generator. The actions which go on in these motors have been the subject of much debate; most of the theoretical discussions of the matter have been based upon the concept of a rotary magnetization produced by two simple sinusoidal magnetisms superimposed in quadrature upon the same core, or, in the case of a three-phase motor, three superimposed in a similar symmetrical manner. This hypothesis is often most convenient, being merely an application of the general physical thesis that two equal simple harmonic motions in quadrature produce circular motion, as in the case of the conical pendulum. All the results of this hypothesis follow, however, from the introduction of two alternating magnetizations, acting in quadrature in time but independently; and one or the other view of the matter is convenient according as, in the structure considered, the effective magnetizations do or do not produce a definite physical resultant. There is no discrepancy between the two hypotheses; they are merely two points of view of the same phenomena. In the general case, one need make no supposition as to the existence or non-existence of the physical resultant rotary magnetization; it is merely necessary to note that if one phase-winding predominately produce a magnetic field, and the other a current in the rotary member fitted to react with that field, torque will result, whether the two phase-windings act upon the same magnetic structure or upon two entirely separate magnetic structures merely connected by the leads which deliver current from one to the other.

Induction motors having both these forms of structure are in successful use. If one considers the latter case, the two-phase-windings have exchanged functions every 90° in the two-phase structure, each phase-winding serving to produce a magnetic field and to deliver, almost as if it were merely a pair of brushes, current to react with this field alternately, and the two halves of the motor structure exchange functions every 90°. Considering the motor in which the two-phase-windings are superimposed on the same core, there is a virtual magnetic resultant rotating at a speed determined by the frequency of the current and the number of poles, and setting up induced currents in the secondary member, which currents are so disposed as to react with the field to produce rotary motion. At rest, the secondary electromotive force produced by the machine as a transformer is a maximum; when the motor is running at speed, unloaded, it is a minimum, and an increment of load causes the secondary member merely to slip behind synchronous speed far enough to receive an increment of transformed energy sufficient to carry the new load. If the secondary member is of very low resistance, the slip behind synchronism is very small, even at full load—less than 2% in motors developed for this particular property. An increase of secondary resistance produces increased falling behind from synchronous speed; and if resistance be added to the secondary member by interpolating rheostats in its circuits, the motor can be made to produce uniform torque over a very wide range of speed, as is the case with continuous current motors. The percentage of slip is the percentage of energy lost in the secondary member, as likewise in continuous-current motors if one regards their synchronous speed as that at which the motor electromotive force would equal that impressed. Polyphase induction motors start, when properly designed, with a very powerful torque, even up to three or four times the full load running torque of the same motor. With a very low-resistance secondary member this torque demands an immensely large current, the structure acting almost like a short-circuited transformer, and the lag in the secondary circuit is considerable. In motors in which this large starting current is objectionable, it may be reduced very greatly by interpolating resistances in the secondary circuits at starting, the effect of these being to diminish the lag in the secondary circuit and to decrease the demand for primary current. A certain critical value of this resistance gives a maximum torque per ampere in the primary circuit with a given motor, being approximately that total secondary resistance which equals the secondary reactance. For maximum torque obviously both resistance and reactance should be equal and as small as possible. Where a small primary current in starting is of considerable importance, this extra resistance is frequently introduced at starting and cut out afterwards, particularly in cases where large torque is necessary. If great starting torque is not necessary, the primary electromotive force is often diminished by inductive resistances, or a change in the connexions of the transformer from which the motor is fed. Both methods of starting are in commercial use on a very large scale.

In efficiency and closeness of speed regulation and good general running properties polyphase induction motors approximate very closely to the best continuous-current practice. They produce, however, a certain amount of lag between primary electromotive force and current, which causes the apparent input to be larger than the real input, as generally happens in alternating-current work. The ratio between the real and the apparent watts input is the power factor of the motor. In well-designed modern machines this is usually from 85 to 90% at rated load; it should seldom fall below the former figure, and rarely rises more than 1 or 2% above the latter, though in rare instances power-factors as high as 94 or 95% have been obtained. Condensers have sometimes been employed in connexion with such motors to increase the power-factor, and with considerable success, particularly in maintaining the power-factor at low and moderate loads; but their use is generally unnecessary, and condensers of sufficient capacity at any reasonable value of the voltage have proved troublesome to build and maintain. The weakest point in these polyphase induction motors is the importance of employing a very small clearance between armature and field, in order to increase the power-factor by making the structure more efficient, considered merely as a transformer. The clearances in ordinary use are seldom greater than $\frac{1}{16}$ in., even in motors as large as 100 h.p., and in smaller machines are frequently not more than $\frac{1}{32}$ in. Induction motors, however, possess many valuable properties, and are the mainstay of long-distance power-transmission work at the present time.

(B) 3. *Monophase Induction Motors* closely resemble the polyphase motor in construction, but have only a single-phase winding in the primary. The theories of their action are very similar to those of polyphase motors. The essential point of difference is that the stable angular displacement between the field magnetization and the armature currents which co-act with it is obtained in the polyphase motor by the time-displacements in the several phase windings, while in the single-phase motor it is obtained by the angular space-displacement of the armature, which has to be set up by an initial rotation. Single-phase motors therefore are not inherently self-starting, and run in either direction equally well when once started. The torque is always in the direction of the initial rotation. This rotation is sometimes given by hand and sometimes by auxiliary phase-windings supplied by derived current from the main circuit, or merely short-circuited on themselves and receiving induced currents from the main winding. Both these devices give a small initial torque in a definite direction, setting up a so-called elliptical rotary field, *i.e.* one produced by the composition of two unequal magnetizations, in this case at some indeterminate angle, seldom large. Once up to speed, the single-phase motors act much like the polyphase. They are conspicuously weak in the matter of power-factor, however, as well as in that of starting-torque, and have as yet not come into very extensive commercial use, although under special conditions they have been and are successfully employed. A theoretically interesting form of induction motor is a modification which runs at absolutely synchronous speed, receiving the necessary energy in the secondary not in virtue of slip behind synchronous speed, but from great difference in wave form between the primary and secondary circuits, so that energy due to harmonics of the fundamental frequency is periodically received by the armature in spite of synchronism in speed. Such motors are not employed commercially, but sometimes find a field for usefulness in the laboratory.

(B) 4. *Repulsion-commutating Motors* constitute a class of single-phase alternating-current motors which has risen to considerable commercial importance. They are fundamentally induction motors in the sense that the armature currents are supplied by the inductive action of the field. The armature winding is, however, provided with a commutator and (for a two-pole motor) two diametrically opposite brushes, which are short-circuited on each other and placed at an angle with the line of field magnetization. By this device the magnetic axis of the armature is held at a fixed angle with the field flux, so that the condition for steady torque is always fulfilled, its amount depending on the position of the brushes. Were these either in line with, or exactly at right angles to, the field poles, the torque would be zero—in the first case from lack of angular displacement, in the second from lack of secondary current. The brushes being skewed, however, the secondary current is maintained at a suitable value, and the motor runs in a definite direction. The general principle is merely that of a transformer with a movable secondary under magnetic thrust. During reversal of the current the torque relation remains fixed, since the primary and secondary currents both change sign, preserving the magnetic relations as in a series-wound continuous-current machine.

If such a motor is of moderate reactance, the currents are large and the torque very considerable. The repulsion-commutating connexion is considerably used as a starting device for single-phase induction motors, the commutator being short-circuited as a whole when the armature reaches synchronous speed. Thereafter the machine operates as a pure induction motor of the sort just described. The advantage of this change is that the commutator is eliminated, save at starting, and the motor becomes practically a constant speed machine like any other properly-designed simple induction motor. Such motors can be made to start if necessary with several times the normal running torque and a nearly proportionate increase of current. The short-circuiting of the commutator is generally performed automatically by a centrifugal governor. When at speed, efficiency and power factor are those of the typical motor of class(B)3.

The pure repulsion-commutating motor, worked as such, on the other hand, resembles a series-wound motor in its characteristics, having no fixed speed and being capable of running far above nominal synchronism. This results from the fixed angular relation maintained by the brushes between the armature and field magnetizations, whereby the torque conditions are preserved. Above the nominal synchronous speed, however, difficulties of commutation set in, so that some modifications of this simple type are desirable for wide ranges of speed. The power factors of these motors compare well, both in starting and in running, with those of the best pure induction motors, and their efficiencies are similar. These machines are reversible, serving as alternating generators when driven mechanically at "negative" speed.

Instead of simply skewing the brush line in the repulsion motor, an entirely analogous effect may be produced by dividing the field coils into pairs placed in quadrature, the brush line being parallel to one pair and at right angles to the other. This merely amounts to dividing the function of the original field physically into its components, a change which sometimes tends to improve the stability of the running conditions.

A more radical departure is found in the group of so-called "compensated-repulsion" motors, of which there are several members, due to various inventors, all material improvements on the pure repulsion type just described. Their common characteristic is that while possessing like simple commutator-repulsion motors, a transformer field acting upon the armature as secondary, and a pair of short-circuiting brushes holding the resulting armature magnetization in definite alignment, they also send the primary current in series through the armature via a second pair of brushes in quadrature with the first. The substantial effect of this series connexion is to cut down the virtual reactance of the armature as the speed rises, practically annulling it at synchronous speed. In alternating motors the motor-electromotive force is not merely that due to the motion of the armature conductors but the geometrical resultant of this and the reactance E.M.F.'s. In the motor here considered and analogous machines an auxiliary E.M.F. is applied either as here, conductively or inductively, in such direction as to compensate more or less perfectly the armature reactance E.M.F. The result is to secure, at least for a certain speed, a power factor near unity, as in the motor under discussion, although the starting conditions are not particularly good and the performance deteriorates above synchronism. In some motors of this type the compensating E.M.F. is introduced by an auxiliary winding in series and in quadrature with the main field, instead of by supplementary brushes. The modifications of the general scheme are rather numerous, and out of them have come some excellent single-phase motors now widely used for traction purposes.

(B) 5. *Series Commutating Motors.*—This important and interesting type is derived directly from the ordinary series motor for continuous current. The torque in these does not change sign with reversal of the current in both field and armature, and consequently alternating current can still produce in them unidirectional torque. Practically the first step toward an alternating current series motor is lamination of the field to reduce parasitic currents; the second is to keep down the reactance. A laminated field motor performs fairly well at a frequency of 10 periods or thereabouts, but to render it useful at ordinary frequencies requires modification in design. The motor E.M.F. being as before the geometrical sum of the reactance E.M.F. and that due to motion of the armature conductors, the first improvement can be made by making the latter dominant, *i.e.* by making the armature relatively very powerful. The plain series commutating motor has then a relatively weak laminated field and a powerful armature. To check trouble with commutation due to short-circuiting coils under a brush, it usually has high resistance commutator leads, and thus equipped is capable of very fair performance, having the same general characteristics as the continuous-current series motor. Even so the armature reactance is somewhat excessive, so that with this simple construction the power factor is apt to be bad. Practically the plain series commutating motor is hardly used at all, but rather modifications of it corresponding very closely to those mentioned in connexion with the repulsion motor. In other words, an auxiliary electromotive force tending to annul the reactance E.M.F. of the armature is imposed upon the armature circuit. This is accomplished generally by a "compensating coil" in series and in space-quadrature with the main field. In another modification the compensating coil is closed upon itself, forming a short-circuited secondary, to which the armature itself acts as primary. The end to be attained is the addition of an E.M.F. such that the vector sum of the E.M.F.'s in the armature shall reduce as nearly as may be to the E.M.F. due to the motion of the armature conductors, as in a continuous-current motor. Obviously it is difficult to secure full compensation for all loads and speeds, but it can be made nearly complete for some particular load and speed.

These "series-compensated" motors behave much like continuous-current series motors, and, when properly designed, run well on continuous current. They have been developed particularly for heavy traction purposes, to which they are well adapted, owing to their ability to work well at all speeds. They give a very high maximum power factor and a reasonably good one over a considerable range of speed and load. Obviously both the field proper and the compensating field can be made subject to regulation to increase the range of successful action. Motors of this type have already come into successful use for fast and heavy railway service. Commutation appears to be reasonably good, although it is a far more difficult problem than with continuous-current machines.

The efficiency and output for unit weight in all alternating-current motors is a little less favourable than with continuous-current motors. In the last resort the supply of energy to a single-phase motor is essentially discontinuous, and there is inevitable extra loss from hysteresis and parasitic currents, whether the motor is single phase or polyphase. The result is that an alternating-current motor requires, other things being similar, more or better material, and loses a little more energy than a continuous-current motor of equal output. Motor design is a compromise, and while any one property can be exaggerated, it will be at the expense of others. One could probably build, for instance, a series-compensated motor of as high efficiency or as large output per unit weight as any commercial motor, but there would be sacrifice somewhere, in cost if not conspicuously elsewhere. As a matter of fact, the difference in efficiency usually amounts only to a very few per cents., and the difference in output per unit weight to a few more. The gain in the use of alternating-current motors is in facility and economy of distribution, which in many cases is far more than enough to overweigh any inherent disabilities in the machines themselves. Hence they are coming steadily into extended use. (L. Bl.)

MOTOR VEHICLES. The term "motor-car" is one which was primarily employed in America to denote the car or carriage containing the electro-motor used for propelling an electric tramcar or train of carriages on rails, but of late years it has been more usually applied in Great Britain to light automobile or mechanically-propelled carriages running on common roads. On the continent of Europe and in the United States the usual expression for these vehicles is "automobile"; the term "autocar" has also been employed. We shall deal here first with the history of mechanically propelled carriages, and with the evolution of the lighter type used for conveying people for pleasure and sport; and secondly with the heavier type used for the carriage of goods.

Light Vehicles.—The first practical steam carriage was made by Richard Trevethick in 1802 (fig. 1), though Cugnot had produced a rudimentary one in France in 1769; but very little was done in this direction until 1824, from which date a number of these vehicles were constructed and used with considerable success, taking the form of stage coaches propelled by steam, and weighing some 3 or 4 tons unloaded. Some of these ran regular passenger services, notably between Cheltenham and Gloucester, attaining average speeds of 10 to 14 m. per hour; but great opposition was met with owing to the narrow prejudice of those whose interests related to horse-haulage, and every obstruction was offered in the shape of prohibitive tolls and legislative enactments. The result was that steam carriages were driven off the roads in favour of railways, although the select committee of the House of Commons appointed in 1831 to inquire into the subject reported completely in favour of their adoption (as did also that of 1873). In 1861 the first Locomotives on Highways Act was passed, but the crushing blow came in 1865, when the legislature prescribed (1) that the number of persons required to drive the locomotive should be increased to three; (2) that a man should precede with a red flag; (3) that the maximum limit of speed should be reduced to 4 m. per hour; and (4) that they should be forbidden ever to blow off steam, &c. These restrictions were confirmed rather than relieved by the 1878 act. Although these acts were created to deal with heavy traction, the famous 1881 appeal in the court of queen's bench placed every type of self-propelled vehicle, from a traction engine down to Bateman's steam tricycle, under their narrow limitations. This resulted in the development of the heavy traction engine, and light motor vehicles were little more heard of in Great Britain. There were a few exceptions, however, notably the steam vehicles of Rickett (1860), Carrett (1861), Tangye (1862), Yarrow (1862), Holt (1866), Todd (1870), Perkins (1870), Mackenzie (1875) and Blackburn (1878), and some electrical carriages made by Elwell (1884), Ward (1886) and Volk (1888). An important departure was that of Butler, who constructed in 1885 what is believed to be the first vehicle (a tricycle) propelled by an internal combustion engine in England (fig. 2); he used the vapour of benzoline exploded electrically. Later, Roots successfully employed heavy oil, as did Knight. The chief prohibitory clauses of the acts were repealed in 1896, when the development of the internal-combustion engine had opened up entirely new prospects and suggested new possibilities.

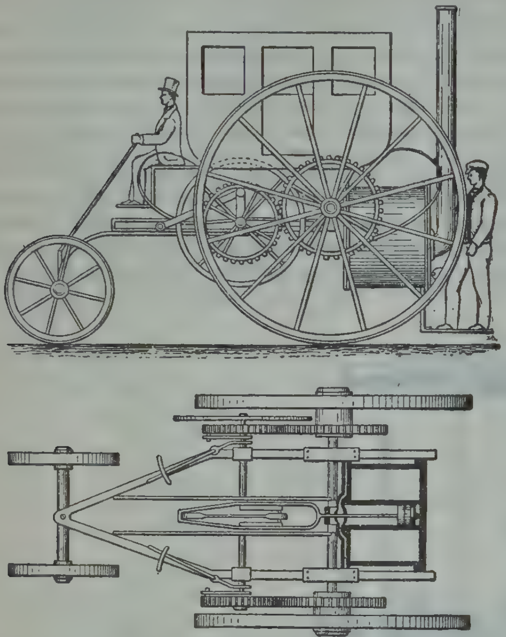


FIG. 1.—Trevethick's Steam Carriage of 1802: side view and plan.

Gottlieb Daimler's invention in 1885 of the internal-combustion motor using petroleum spirit was the first step towards the production of the modern self-propelled road vehicle, the next step being the recognition in 1887 of the advantages of Daimler's system by M. Levassor and his application of that system to the propulsion of a carriage. In the nine years that immediately followed French manufacturers spent large sums of money in experimenting with and developing the motor-car, and by 1896, when the Enabling Act was passed, there were a few practical vehicles in England but, perhaps, fewer probable buyers. British makers, starting as they did in the wake of the French manufacturers, were able to profit by the experience gained by the latter, and thus to avoid many otherwise inevitable mistakes; they may not be able to claim to have originated many of the fundamental details of the modern motor-car, but their experience was gained at a comparatively small cost.

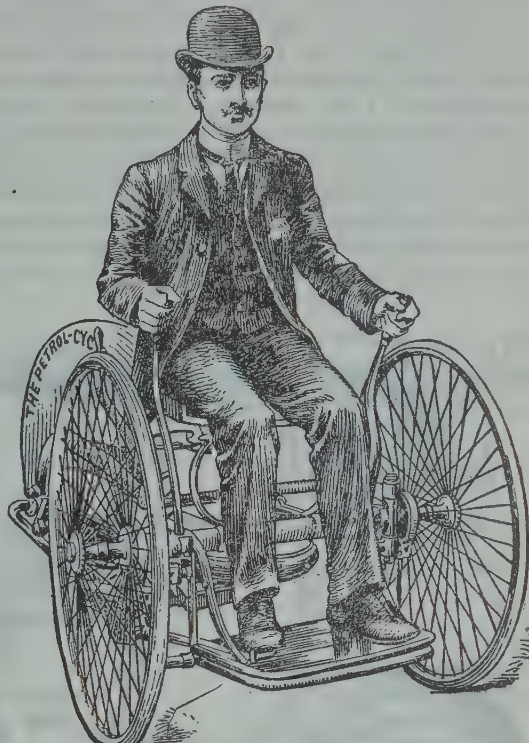


FIG. 2.—Butler's Motor Tricycle of 1885.

Gottlieb Daimler's engine marked a great advance in the production of a source of motive power, for its efficiency was large as compared with its total weight, whilst the simplicity of its fuel system brought it within the scope of the person of average mechanical instincts and intelligence, for, even in its early days, the internal-combustion motor did not demand that its user should possess an intimate knowledge of engineering. Daimler fitted one of his motors to a bicycle in 1885, and afterwards applied the system to the propulsion of boats, one or more of which were running on the river Seine in connexion with the Paris Exhibition of 1887. It was this fact that brought the invention to the notice of M. Levassor, of the firm of Panhard & Levassor, makers of wood-working machinery, who saw the possibilities of its application to the propulsion of a road carriage. MM. Panhard & Levassor secured the French patents from Daimler, and M. Levassor devised the transmission system which, as far as its general scheme is concerned, is unaltered to-day, despite many efforts on the part of skilful inventors and designers to secure something better. M. Levassor placed the engine in front, the axis of the crank-shaft being parallel with the side members of the frame of the vehicle. The drive was taken through a clutch to a set of reduction gears and thence to a differential gear on a countershaft from which the road wheels were driven by chains. With all the modifications of details, the combination of clutch, gear-box and transmission remains unaltered, so that to France, in the person of M. Levassor, must be given the honour of having led in the development of the motor-car.

Progress in the improvement of design was slow until the year 1894, when a great impetus was given to the French industry by the organization, by the *Petit Journal*, of a trial run of motor vehicles from Paris to Rouen. The measure of success attained by the cars caused considerable surprise, and in the year 1895 a race was organized from Paris to Bordeaux and back, a distance of 744 m., when the winning vehicle covered the journey at a mean speed of 15 m. per hour. From that date onward, until 1908, racing played an important part in the development of the motor-car; in fact, it is not going too far to say that, up to 1904, it played a vitally important part therein. The effect was a rapid development in speed, efficiency and reliability, and others besides the sportsman and the individual seeking for new sensations were attracted towards the new vehicle. Racing was not indulged in in England or Scotland, the authorities having no power to close the roads for the purpose.

In July 1902, Mr S. F. Edge, driving a 50 h.p. Napier car, won the Gordon-Bennett Cup in the course of the open race from Paris to Vienna. This trophy has played an important part in the history of the motor-car. It was offered for competition among cars, entered by recognized National Automobile Clubs, no more than three cars being permitted to represent a country, and every car had to be built entirely in the country of its origin. The length of the race had to be not less than 500 kilometres ($310\frac{1}{2}$ m.). The first two races in 1900 and 1901 had been won by French cars and, as these contests had been run concurrently with the big city-to-city races, the importance of the Gordon-Bennett race was overshadowed. But it stood out in bold relief when an English car wrested the international trophy from its French rivals in 1902. The Automobile Club of Great Britain and Ireland (now the Royal Automobile Club) at once secured parliamentary sanction for the use of certain roads in Ireland for a limited period, and proceeded to organize a race worthy of the issue at stake. The race was won by the Mercédès car, the latest production of the famous house of Daimler.

The Mercédès car set quite a new fashion, for it showed advancement in a large number of its mechanical details, and many of these details were either copied or used as the basis for radical changes in previously-existing designs. So far as British makers were concerned, the Mercédès fashion was allowed to predominate, but some of the older French makers were less willing to follow the lead of the great German house. This fact assisted the British makers to forge ahead in their competition with the French. But the great factor in the triumph of British motor engineering arose from the fact that, in England, there was a great wealth of knowledge concerning the properties of steels and steel alloys, and that knowledge, which was advancing all the time, was turned to such good use that it is safe to say that, in only the very best of French cars is the same strength and efficiency obtained from the same weight of metal as would be used in the construction of quite a number of British cars. Lightness of moving parts has led to increased engine efficiency and to economy of fuel, whilst the inert parts of the mechanism—the frame and other fixed details—by being lighter, call for a smaller expenditure of power to overcome their inertia. Apart from the employment of special steels for motor-car construction, in which England took a leading part, many improvements in design and method have originated in Great Britain. For instance, the multiple-disk clutch, which permits a car to be started without shock, is an English invention, as are the detachable wheel, the spare wheel and the six-cylindered engine. The latter, introduced by the Napier Company and employed extensively by them, by Rolls-Royce and others, has exerted a great influence upon British tastes, because it created a growing dislike to noise, one of the consequences being the rapid development of the silent car.

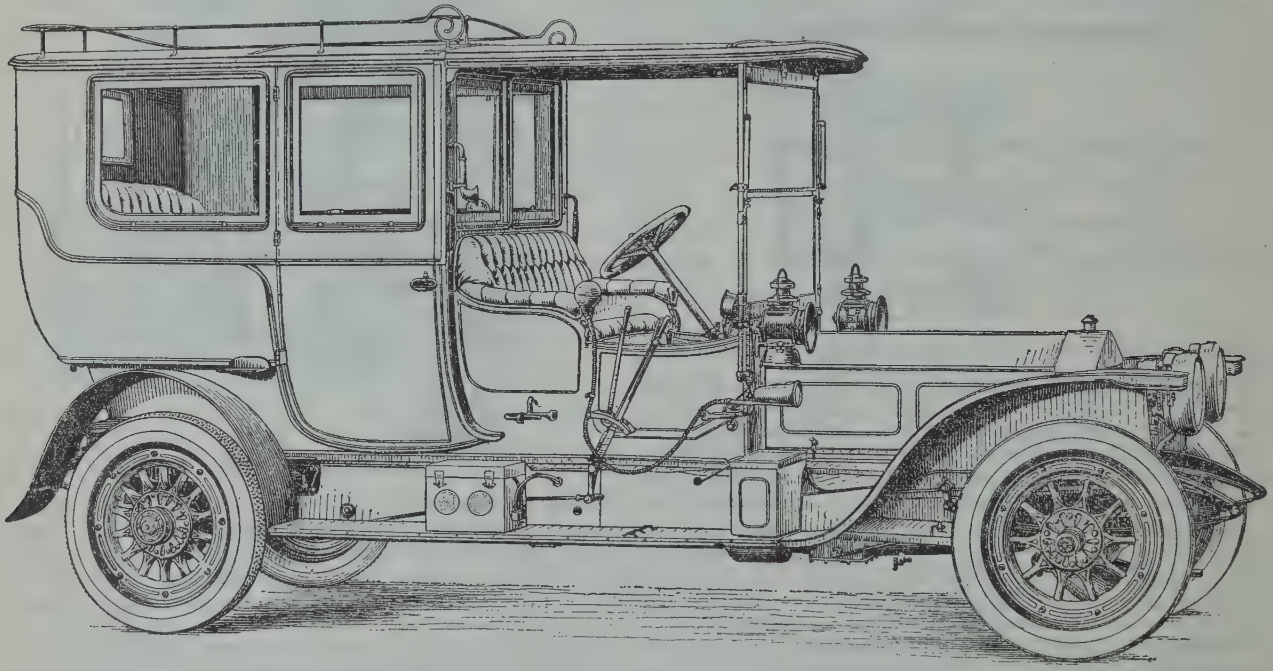


FIG. 3.—The 40–50 h.p. Six-cylinder Rolls-Royce Pullman-Limousine.

The representatives of Great Britain in the Gordon-Bennett race of 1903 were selected by means of a series of eliminating trials, and in 1904 and 1905 races were held annually in the Isle of Man for the same purpose. In the years 1906, 1907 and 1908 races were held in that island with such limitations on fuel or on the diameter of the cylinders as were calculated to encourage the development of small but efficient transmissions, and it has been conceded generally that these races served an extremely useful purpose.

Concurrently with its development into a reliable, silent, odourless and smokeless power-propelled vehicle, the motor-car gradually came into more general use. It no longer appealed only to a few but gained converts daily, and its final triumph came when it began seriously to displace the horsed vehicle.

becoming the private carriage of the wealthier classes to be used on all occasions.

If the motor-car in the guise of a private carriage has developed at an astonishing rate, its adaptation to the needs of the community, as a public service vehicle, has been even more rapid. The first cabs placed on the streets of London in 1903 were by no means a success, but the cabs constructed by the French house of Renault and first introduced in London in 1906 rapidly effected a revolutionary change in the means of individual transport. Apart from the improved speed of the motor-cabs, they gained popularity because of the use, on each one of them, of the taximeter, showing at a glance the amount of the fare, thus preventing overcharge on the part of the driver. One effect of the employment of motor-cabs and motor-omnibuses has been to reduce slightly the total number of vehicles, and to quicken a large volume of the traffic; it is now being recognized that to increase the speed of the whole of the traffic of London by about 5 m. an hour is practically equivalent to doubling the width of the whole of the main streets.

The new British act of 1903, which was enacted for three years only, was, during the parliamentary session of 1906 and subsequent sessions, continued from year to year because of the difficulty that was experienced in reconciling conflicting views about the control of motor-cars. The 1903 act raised the speed limit to 20 m. per hour and gave the local government board power to close to motor traffic such roads as, on inquiry, might be deemed unsuited therefor, and to impose a speed limit of 10 m. an hour or less in dangerous places, such as narrow streets in a town or through a village. A few serious accidents in England, and many abroad, have kept alive the fear that the motor-car is a dangerous vehicle that should be restrained or held in check by stringent legislation. Thus from 1904 onwards, the motorist was under continuous police supervision. Police traps, or measured distances, over which the motor-car is timed by the police, were established in most of the counties of England, and, whilst, without a doubt, many real offenders were caught, it is equally true that many an innocent driver was unfairly accused, whilst motorists guilty merely of technical infringements of the law were summoned.

The attitude of the police in showing little or no leniency in the application of the law probably, however, did good in other directions, although these were not contemplated either by the law-givers or the police themselves. It considerably limited the use of excessively powerful cars (for example, a 60 or 90 h.p. car that could easily attain 60 m. an hour), and experience has demonstrated the fact that, intersected as England is with a network of narrow roads carrying considerable traffic, there is little opportunity for the full power of such a car to be used. The result has been that the comparatively low-powered vehicle has been developed in efficiency, bringing with it the advantages of economy in running, simplicity of mechanical details, cheapness of maintenance and ease of control and management.

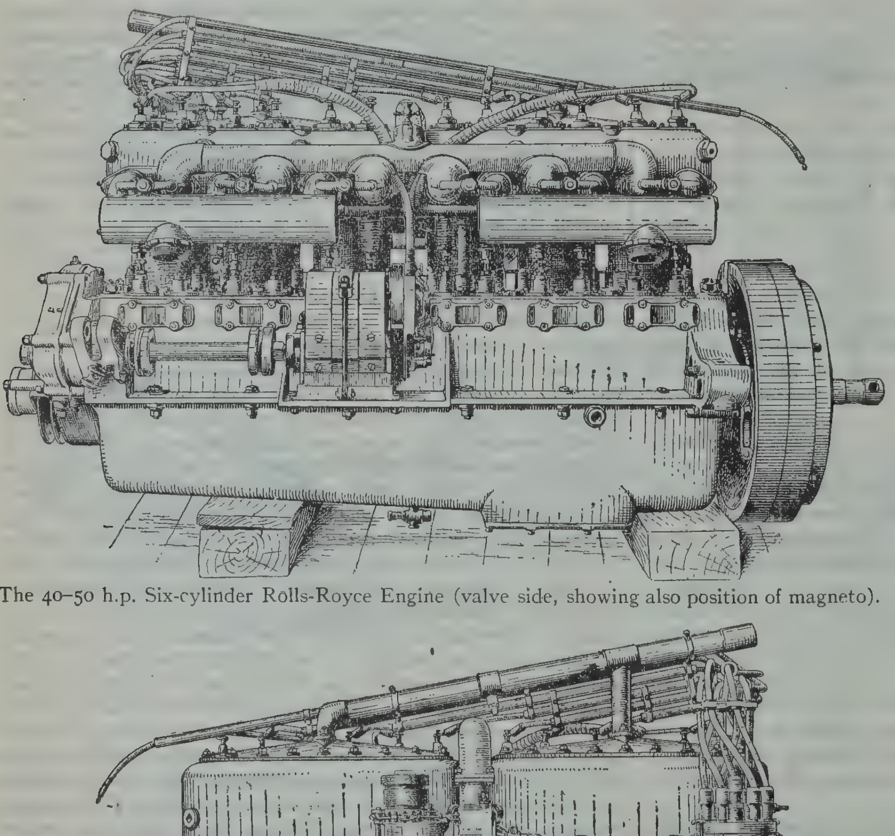
The principle of the internal-combustion engine has not been altered since Daimler's day, but the mechanical details of the engine have undergone constant revision and improvement, until in 1910 it was safe to say that a four-cylindered engine, with a cylinder bore of 4 in., constructed, we will presume, in 1899, might have developed 20 h.p. or less, whereas engines of the same cylinder bore made in 1908 and 1909 actually developed 60 h.p. and more, and the attainment of even greater efficiency was in sight in 1910. Experience showed that the saving of weight meant greater economy in fuel and also in tires, the two principal items in the upkeep of the motor-car. Engine design has undergone unceasing improvement, and constructional methods have been continuously advanced, with the end in view of attaining lightness, not only in the moving parts, but in the inert parts. Lightness in reciprocating parts, such as the pistons, connecting rods and valves, has enormously improved crank-shaft speed. Cylinder castings are now made far lighter, whilst the water jacketing, for dissipating the excess of heat from the cylinder walls, is now of sufficiently ample proportions and, in consequence, better lubrication of the cylinder walls can be maintained. This again conduced to piston speed. The induction valves of engines of the earlier types were opened under atmospheric pressure, the reduced pressure in the cylinder, caused by the downward movement of the piston, enabling the pressure of the outer atmosphere to open the valve against its light spring, and to carry in a charge of the carburetted air that constituted the explosive mixture. But it was found that the automatic or atmospheric inlet valve opened late on the induction stroke and closed early, so that the engine only received an attenuated charge. One of the earliest improvements in engine design, therefore, was the employment of the mechanically-operated inlet valve operated by a cam exactly as the exhaust valve is operated. This valve could be fully opened as soon as the piston had begun its downward or induction stroke, and could be held open during the momentary period when the piston was at rest at the bottom of the stroke, thus ensuring a full charge of explosive mixture. The method of exploding the charge in the cylinder has undergone revolutionary changes. The first method, that of heating the exterior of a closed tube connected with the cylinder, quickly gave way to electric ignition because it was found that the charges could not be exploded by the hot tube until the piston had reached the top of its stroke, and, at the comparatively high piston speed of these engines, the piston had moved some distance on its downward stroke before the exploded gas had begun to expand. Electric ignition was an improvement because it enabled a "lead" to be given to the explosion, a low voltage current (from four to six volts of about one ampere being sufficient for the purpose) being automatically switched on to the primary circuit of a coil, the induced current in the secondary circuit being of a voltage sufficiently high (calculated at from 5000 to 10,000 volts of a very small amperage) to jump across a gap left in a sparking plug inserted in the cylinder. By rotating the body of the switch (called the contact breaker) the ignition could be timed to suit exactly the speed of the pistons and, in this way, greater piston speed was obtainable. The great development of this system was the introduction by Mr F. R. Simms, in conjunction with Herr Bosch, of the magneto machine, known as the Simms-Bosch magneto, the prototype for many such appliances. This machine, in its simplest elements, produces a low voltage current (assumed to be of about eight or ten volts) by the rotation of an armature in the magnetic field of a set of magnets, the rotation being effected through the timing-gear wheels of the engine. The low tension current is conveyed through a primary circuit inducing the secondary current which is employed for igniting the charges. The advantages of the magneto are, firstly, that the primary current is created by the engine, and that the need for an accumulator as a source of that current is avoided and, secondly, that the spark is more efficient because the faster the armature is revolved the more intense is the primary current and the induced current, consequently, the charge is ignited more rapidly. The magneto machine has almost entirely displaced the accumulator system for ordinary running, although, as the latter makes for easier starting, it is often fitted as an addition.

Great gain in power has been secured from improvements in the lubrication of the internal-combustion engine. It is now recognized that a small supply of oil to the journals and bearings of such an engine is insufficient, but in the early days it was found difficult to give the journals and bearings more oil without too much getting on to the cylinder walls, because the latter were lubricated by the oil that was thrown on to them by the spinning action of the webs of the crank-shaft and by the connecting-rod ends, these latter dipping into a well of oil in the lower part of the crank-case. The modern method has overcome this difficulty. The cranks and connecting-rod ends no longer dip into the oil, for the latter drains away into a sump or reservoir below the base of the crank chamber. Thence it is passed through a filter and pumped to ducts which convey the oil under pressure to the crank-shaft journals. Sometimes it is conducted thence along ducts bored in the crank-shaft and through the webs and crank-pins, whence it feeds the connecting-rod bearings, enough squirting out to splash on to the cylinder walls. Sometimes, a shallow trough is placed under each connecting-rod end, to hold oil to a certain depth and no more, and a scoop on the big end collects enough oil to effect the lubrication of the connecting-rod bearings and cylinder walls. The aim has been to secure definite lubrication of all moving parts, and, at the same time, to prevent oil being present on the cylinder walls in such quantities as will permit the piston to carry it up into the combustion chamber. Any oil present in the combustion chamber is burnt during the explosion, but, its combustion being imperfect, smokiness of the exhaust is the result. By reducing the oil on the cylinder walls to the minimum necessary for lubrication, smoking has been abolished, whilst clogging, or carbonizing, of the valves has been materially reduced.

Methods of carburation have also undergone improvement, so that the carburation shall not materially vary with varying engine speed. The only other feature in the engine that calls for mention is the method of cooling. With the introduction of the honeycomb type of radiator, by which the water is made to flow through canals an eighth or a sixteenth of an inch wide, the efficiency of the cooling system has been doubled because of the large amount of surface, in a given size of radiator, for dissipating the heat. A fan is generally employed, either situated behind the radiator and driven by the engine, or the flywheel is vaned so as to induce a current of air through the radiator.

To deal now with the transmission mechanism, the drive is taken through a clutch and gear-box as in the earliest days, but, for the final drive, chain transmission to the road wheels running on a fixed axle has largely given place to propeller drive on to a live axle. The leather-faced conical clutch, although still employed, has in many cases given way to the multiple-disk clutch in which a number of disks bearing against each other, either flat in section, or (as in the Hele-Shaw clutch) having annular tapered grooves, are contained in an oil-tight box. These plates are capable of being separated laterally from each other when "out of gear," or brought into frictional contact with each other when it is desired to start the car. Metal-to-metal cone clutches, expanding metal shoe clutches, single metal plate clutches and coil spring clutches have all at some time found favour with designers wishing to avoid a leather clutch. Hydraulic and electro-magnetic clutches have also been tried, but these have not gained any vogue. In the matter of the gear-box, the sliding into mesh of the gear-wheels as employed by Levassor is still the standard practice, although that pioneer himself regarded the method as barbarous, and looked upon it as a mere temporary expedient. But details of the gear-box have materially improved. A single lever is usually employed for engaging any of the forward gears or the reverse, so that the mistake of simultaneously engaging a reverse and a forward gear is not possible. The spur-wheels are generally mounted in pairs on two sleeves, so that, by means of a selector mechanism that compels one sleeve to be brought to the neutral position before the other can be moved, no two gears can ever be engaged together. By means of "dog clutches," the clutch shaft can generally be coupled direct with the bevel-wheel driving the back axle, the "drive" on the highest gear being thus transmitted without passing through any spur-wheels. This reduces noise and frictional losses. Except for cars of great weight, chain transmission is fast dying out, the power being generally transmitted through a propeller shaft (with universal joints at one or both ends) to a bevel-drive on the back axle; such axle being divided into two revolving or "live" axles carrying the differential gear between them. The bevel-wheels, differential gear and live axles are enclosed and run in a lubricant.

Wire suspension wheels are growing considerably in favour, a saving in weight being thus effected. The liability of the pneumatic tire to deflation, through a puncture or burst.



The 40–50 h.p. Six-cylinder Rolls-Royce Engine (valve side, showing also position of magneto).

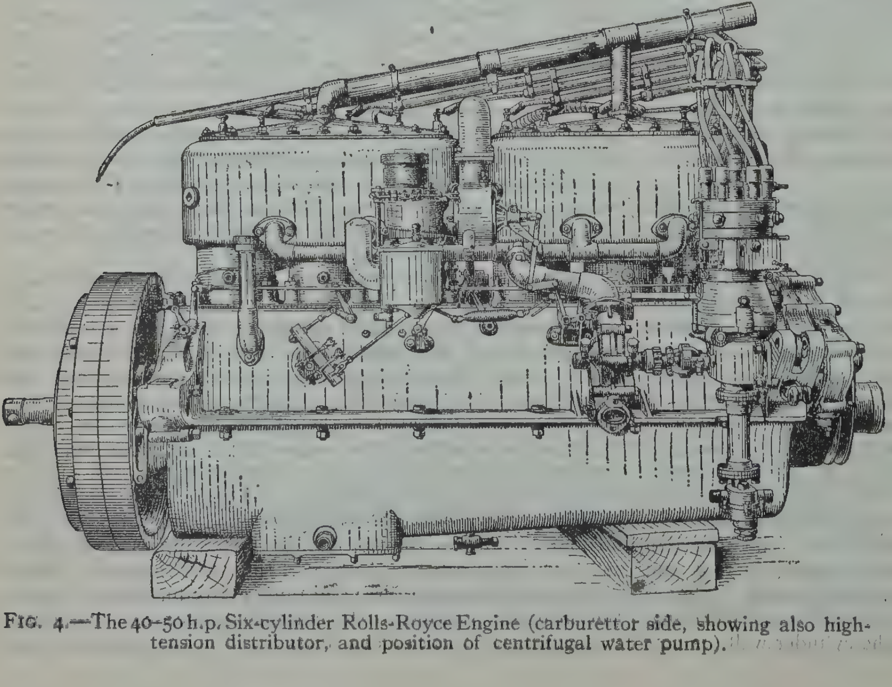


Fig. 4.—The 40–50 h.p. Six-cylinder Rolls-Royce Engine (carburettor side, showing also high-tension distributor, and position of centrifugal water pump).

has led to the introduction of detachable rims and detachable wheels. The detachable rim is borne on the periphery of the wheel (which is bonded) and secured in position by various methods. When the tire is punctured or damaged the rim and tire are removed bodily and replaced by a spare rim with its tire already in position and inflated, a change capable of being effected in five minutes or less. The detachable wheel is mounted upon a shell which fits over and is secured to a sleeve, which latter turns and is secured upon the fixed axle. In the case of tire trouble, the wheel intact is removed from the sleeve (which in the case of a driving-wheel carries the driving fittings, the brake-drums, &c.) and a duplicate wheel is substituted. The pneumatic tire has undergone continuous improvement, particularly in the matters of the selection of the material and the proportioning of the strength of the "body" to the work which the tire is to be called upon to perform. Various methods have been devised for the prevention of skidding or "side-slip" on greasy surfaces, and, whilst certain mouldings on the rubber treads have proved advantageous, the method most adopted is that in which a large number of steel studs stand about a quarter of an inch above the surface of the tire.

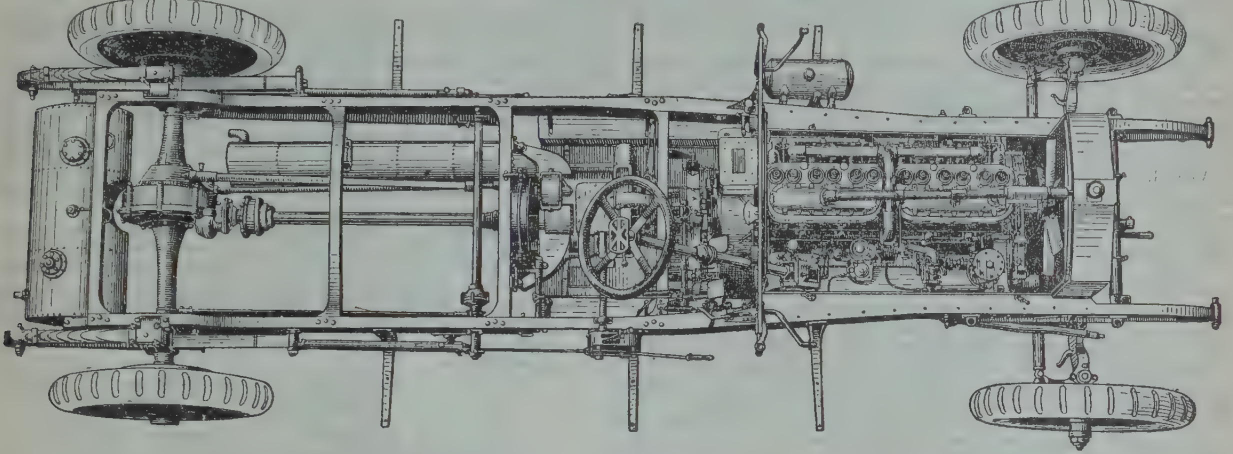


Fig. 5.—Plan View of the 40–50 h.p. Six-Cylinder Rolls-Royce Chassis (1910 type).

It will be seen that the general lines of the car of 1889 have not required to be radically altered. Every detail has been improved so that the cars are more efficient, easier to control and manage, and infinitely more comfortable, but, in essence, Levassor's scheme is as good to-day as it was when planned by him.

The steam car is made by five or six British manufacturers at the most, whereas the actual manufacturers of petrol cars in Great Britain numbered at the end of the year 1909 about seventy, whilst some four hundred other firms were actively engaged in the construction of cars and their parts, accessories and sundries. But the steam car appeals to those men who are or have been steam engineers, and to them the management of the steam generator and the burners constitutes no difficulty. The limitations under which the early steam car laboured have, in the main, disappeared, for the modern steamer can travel nearly as far without requiring to refill the boiler as a petrol car can travel without replenishment of the fuel tank. The electric car is still the luxury to be employed in towns and in covering short distances, for the weight of the accumulators has not been greatly reduced, despite sensational announcements made from time to time.

An interesting feature of the motor movement has been the steady growth in popularity of the motor cycle. The motor tricycle was developed up to the year 1903, and then gradually became displaced by the motor bicycle, which had been introduced in 1901. Motor bicycles gradually increased in popularity, until in numbers they were in excess of cars. The standard machines of 1909 had an air-cooled motor of one, two or even four cylinders (according to the choice of the riders) developing some 3 to 8 h.p. with magneto ignition and belt drive. The engine was usually started by the rider running alongside the machine, and causing the machine to rotate the crank-shaft through the belt and pulley until the initial explosion was obtained, when he would jump into the seat. Trailers were employed at first for carrying passengers, but, the length of the combined vehicle being between nine and ten feet, a side-car, placed at the side of the cycle and secured thereto by detachable fittings, largely displaced the trailer and also the "fore-car," in which the passenger was carried in a body placed in front of three- and four-wheeled cycles.

The rapid growth of the motor movement in Great Britain may be judged from the fact that by the 30th of September 1905 the number of motor vehicles of all kinds registered had totalled to 74,038, and by the 30th of September 1908, three years afterwards, to no less than 154,415. Of these, 137,323 were registered in England and Wales, 10,907 in Scotland, and 6185 in Ireland. 71,405 were private motor-cars; 12,104 were trade motor-cars; 5880 were public service vehicles and 65,026 were motor cycles.

A year later (Sept. 30, 1909) the figures showed a further remarkable increase, the total number of vehicles registered in the United Kingdom being 183,773, giving an increase of 29,358 in the year. Of these, private motor-cars numbered 84,840; trade motor-cars 15,181; public service vehicles 8752; and motor cycles 75,000. The numbers registered in England and Wales were: 74,748 private motor-cars; 13,961 trade motor-cars; 8131 public service vehicles and 66,341 motor cycles, or 163,181 in all. The figures for Scotland were: 6157 private motor-cars; 1056 trade motor-cars; 584 public service vehicles and 5296 motor cycles or 13,093 in all. The figures for Ireland were: 3935 private motor-cars; 164 trade motor-cars; 37 public service vehicles and 3363 motor cycles, or 7499 in all. In the year private motor-cars in the United Kingdom increased by 18·8%; trade motor-cars by 25·4%; public service vehicles by 48·8%, and motor-cycles by 15·3%.

It is possible to obtain a better idea of the number of motor vehicles in use from the returns of the commissioners of inland revenue. The total number of privately-owned cars for which licences were issued in 1908 was 48,019, of motor cycles 35,784, and of motor-driven hackney carriages 17,300. These figures may be compared with the registration figures already given for the year ending the 30th of September 1908. As accounting partly for the difference, a certain proportion of the registered vehicles (seeing that the figures include all vehicles in use on and after the 1st of January 1904, less those in respect of which the registrations have been cancelled) must have fallen into disuse and some vehicles will have been sold out of the country, whilst others will have been sold and re-registered with different authorities. But the life of the mechanism of a car, in one form or another, is of considerable length (there were, for instance, in use in 1910, as commercial vehicles, motor chassis that were put on the road in 1896), and it is considered that many registered but unlicensed cars remain for years capable of rendering useful service in emergencies or on special occasions, such as at election periods.

In 1906 an act of parliament authorized a census of production, which was taken in 1908, the statistics relating to 1907. These figures show that the output of complete motor vehicles in the United Kingdom in that year was 11,700 completed cars and chassis, and 3600 motor cycles, the total value of the productive work done in the motor trade being £6,327,000 inclusive of repair work and the production of parts and accessories.

The number of cars and chassis imported into and retained in the country (those imported and afterwards re-exported being excluded from the statistics) in 1909 was 7747 as compared with 6530 in 1908. The absence of a classification, in 1907 and previous years, for chassis prevents further comparison in the matter of numbers, but taking the value of the motor-cars, parts and accessories imported into and retained in the United Kingdom, there is a total of £4,170,121 in 1907, £3,753,140 in 1908, and £3,922,781 in 1909; the average value per car falling from £432 in 1907 to £333 in 1909. The value of the motor cycles and their parts imported into and retained in the country was £71,101 in 1907, £52,206 in 1908, and £48,327 in 1909.

The number of British made cars and chassis exported in 1909 was 2802 as compared with 2441 in 1908, and of British made motor cycles 1893 in 1909 as compared with 1048 in 1908 and 800 in 1907; the total value of the exports of cars, parts, chassis and motor cycles in 1909 being £1,669,361 as compared with £1,315,913 in 1908 and £1,378,180 in 1907.

With the growth of the motor-car movement there have, naturally, been great developments in the outside industries catering for the motorist. Most affected by that movement has been the oil trade, considerable changes having taken place. In the distillation of crude petroleum for the production of lamp oils, &c., quantities of volatile spirit were obtained, the outlet for which, formerly, was small, as the spirit was mainly used for cleaning purposes. With the introduction of the petrol motor this spirit came into demand, and, as the demand increased, the situation changed and the crude petroleum had to be distilled mainly for spirit, thus leaving a surplus of the heavier oils. The situation was largely met by a gradual conversion of the petrol-consumers from spirit of ·680 specific gravity to a spirit of ·715 specific gravity, whilst for commercial motors even heavier grades were employed. The quantity of ·715 spirit obtainable from a given quantity of crude oil is considerably greater than the quantity of ·680 that could be produced, so that a better balance between the demand for motor spirit and that for lamp oil has been effected. The total quantity of motor spirit used in the United Kingdom in 1909 was 60,000,000 gallons, of which about one-half came from the Dutch East Indies, whilst a third came from America. Rumania supplied about 6,000,000 gallons and Russia about 3,000,000 gallons. Large quantities of lubricating oil were obtained from America, whilst the remainder (about one-tenth of the total) came from Russia.

France is the centre of the motor-car industry in Europe, and up to the year 1906 it undoubtedly led in the production of motor vehicles, but in that year the United States of America, as we shall have occasion to note, took the lead. The number of private cars in use in France had risen from 1438 in 1899 to about 23,000 in the year 1909, whilst industrial vehicles have increased even more rapidly in number. The following figures are obtained from the taxation schedules:—

Year.	Number of Vehicles in use.		Total.
	Pleasure Cars.	Industrial Cars.	
1899	1,438	234	1,672
1900	2,354	543	2,897
1901	4,427	959	5,386
1902	7,358	1,849	9,207
1903	9,922	3,062	12,984
1904	12,519	4,588	17,107
1905	15,011	6,532	21,543
1906	17,358	8,904	26,262
1907	19,601	11,685	31,286
1908	22,252	15,334	37,586
1909	26,000	20,000	46,000

The figures for the year, in the absence of the official return, are estimated.

The average h.p. per car (pleasure vehicles) has steadily risen from 5·06 in 1901 to 13·28 in 1908, the number of cars seating more than two persons having increased in greater proportion than those seating one or two persons.

The export of French motor vehicles had risen in value from 4,259,000 francs in 1899 to 144,352,000 francs in 1907. In 1908 the exports fell to 127,300,000 francs, and in 1909 an improvement to about 145,594,000 francs had taken place. The imports of foreign motor vehicles to France rose from 473,000 francs in 1899 to 8,676,000 francs in 1907, and since that period there has been an annual decrease.

In Germany the number of motor vehicles of all kinds in use on the first of January in each year is shown in the following table:—

Year.	Number of motor vehicles.
1907	27,026
1908	36,022
1909	41,729
1910	41,941

In 1910 45% of the total consisted of motor cycles, 49·3% consisted of pleasure vehicles and 5·7% consisted of commercial vehicles, the proportion of pleasure vehicles having consistently risen in the four years.

The development of motoring and of the motor industry in the United States has been exceedingly rapid. As good roads multiply and extend the use of cars must be still further developed. The American farmer has discovered that he can make considerable use of the motor-car in connexion with his industry, and this fact largely accounts for the demand for high-wheeled buggies, and for vehicles having ample clearance between the machinery and the road level.

In the early days of the movement the American taste inclined towards steam cars, and the mistaken view that the vehicle driven by an internal-combustion engine could never be made to run as silently as a steam car was generally held. But in Europe the petrol engine became refined so rapidly that its equality with the steam engine in the matter of silence, together with its superiority in the matter of simplicity and suitability for the man who is not an engineer, soon created for it a popularity that prevented any material expansion of the business in steam cars. The makers of steam cars in America are able to cope with the major portion of the world's demand for this particular type of vehicle.

The introduction of the Dingley tariff, assessing an import duty of 45% *ad valorem* on motor-cars (in the classification of "manufactured metal"), added to a further charge of about 5% for freight, encouraged American capitalists to embark upon the manufacture of motor-cars, and in 1899 thirty manufacturers produced 600 cars. In 1909 the number produced by 200 concerns was 114,891. Set out in tabular form such figures as are obtainable are very striking:—

Cars Produced.		
Year.	Number.	Value.
		$
1899	600	1,290,000
1903	10,576	16,000,000
1904	13,766	24,500,000
1905	20,787	42,000,000
1906	23,000	50,000,000
1907	42,694	105,000,000
1908	49,952	83,000,000
1909	114,891	135,000,000
1910	200,000	225,000,000

The number of cars for 1906 is approximated and the number of cars and their value for the year 1910 are based upon the estimated output of the various manufacturers. In 1908, whilst the number of cars constructed showed an increase over the number for 1907, the total value had decreased owing to the commercial crisis of that year. In 1909 those manufacturers who had formed the Association of Licensed Automobile Manufacturers, and who agreed to recognize the validity of the Selden patents, paid licence fees upon 94,891 cars, the remaining 20,000 cars being estimated as the output of the concerns that did not belong to the association.

Of the 200,000 motor vehicles estimated to be constructed in 1910, 165,000 were to be petrol-driven pleasure cars, 30,000 were to be petrol-driven high-wheeled buggies, and 5000 steam and electric carriages and commercial vehicles.

The history of the Selden patent may be given briefly A patent was applied for on the 8th of May 1879 by George B. Selden, of Rochester, New York, for a gas compression engine for propelling road vehicles. A patent was granted to him on the 5th of November 1895 for an improvement in road engines, and he claimed that any vehicle propelled by an internal-combustion engine, manufactured since that time, was an infringement of his rights under the patent. At the commencement of the year 1910, 71 manufacturers admitted this claim and paid to the Association of Licensed Automobile Manufacturers 1½% of the catalogue price of their products as licence fees.

The imports of motor vehicles into the United States of America are not numerous, as will be seen from the following figures:—

1902	265 cars imported	1906	1433 cars imported
1903	267 " "	1907	1017 " "
1904	605 " "	1908	1387 " "
1905	1054 " "		

The exports rose from $599,927 in value in the year 1902 to $5,502,241 in 1907 with a falling off to $5,277,847 in 1908.

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HEAVY COMMERCIAL VEHICLES

Heavy types of motor-cars are now widely employed for commercial purposes. The earliest British-built type was the steam-propelled wagon, and its evolution was largely encouraged and hastened by important competitive trials, at Liverpool, in the years 1898, 1899 and 1901, which were conducted by the Self-Propelled Traffic Association. Other series of trials were held by the Royal Agricultural Society of England and the Royal Automobile Club.

From the end of 1896 to early in 1905 no commercial motor vehicle was legal in England if its unladen weight exceeded 3 tons, and this limitation caused much financial loss to purchasers who overloaded them. The Heavy Motor Car Order of 1904, which came into force on the 1st of March 1905, increased the maximum unladen weight to 5 tons, whilst limiting the gross weight to 12 tons; by the same order, the combined unladen weight of a motor wagon and the single trailer which it is allowed to draw was fixed at 6½ tons. In effect, the gross weight of a trailer and its load may not exceed 8 tons, thus yielding a total gross weight, for loaded wagon and loaded trailer, of 20 tons. Excesses in any particular cause a commercial motor to be treated as a "heavy locomotive," or traction engine, when its freedom of movement, speed, &c., are restricted more severely.

Miniature traction engines, constructed to comply with the requirements of the Motor Car Acts and Orders, have progressed since 1905; they are chiefly used where it is a convenience to separate the power and carrying units, as by furniture-removal and other contractors.

The working cost of a steam wagon with a 5-ton load, in Great Britain, inclusive of provision for interest on capital, depreciation and maintenance, varies from 7½d. to 9d. per mile run, on an average basis of 180 m. a week; with a trailer carrying another 3 tons the corresponding figures vary from 9d. to 1s. per mile run, according to nature of roads, gradients and fuel available. The inclusive working cost of a tractor, on macadamized roads, is generally about 15% less than for a 5-ton wagon, but a standard tractor cannot haul more than a gross load of 8 tons behind the drawbar—except on dry and level roads. On granite setts the extra vibration often causes undue wear and tear, unless the suspension of the tractor be very good.

Vehicles in which the power is derived from internal-combustion engines are commonly known as "petrol" vehicles. Petroleum spirit of 0·700 specific gravity is usually the fuel, but many are now supplied with spirit of 0·760 specific gravity; the range of boiling points is the criterion of satisfactory use—not the density. Petrol vehicles are, practically, stoutly-built motor-cars, and some of the models now in use have been developed from accepted designs of lighter types. There are, however, numerous manufacturers who construct solely for utility purposes. Below net loads of 2 tons, the petrol-propelled vehicle has a virtual monopoly of use in England; above that, it shares the trade with steam. A tabular statement of current working costs of approved petrol vehicles is published herewith.

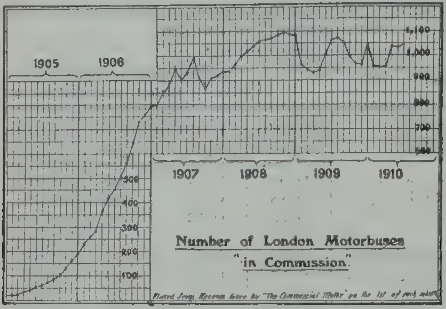
Summary of Working Costs for Petrol-driven Vehicles (Exclusive of Management) in England.

Particulars.	Net loads carried: Costs in pence per vehicle-mile.				
(Petrol at 10d. per gall.) Average weekly mileage	10 cwt. 400	1 ton 400	2 tons 390	3 tons 350	5 tons 300
Driver's wages	0·84	0·84	1·00	1·09	1·60
Fuel (petroleum spirit)	0·55	0·77	0·95	1·25	1·67
Oils and grease	0·12	0·12	0·14	0·16	0·24
Rubber tires	0·50	0·75	1·15	1·50	2·60
Repairs (material and wages)	0·55	0·85	1·03	1·17	1·55
Rent, rates and lighting	0·12	0·15	0·25	0·40	0·50
Insurance and claims	0·12	0·24	0·35	0·42	0·65
Depreciation	0·65	0·90	1·06	1·36	1·60
Interest on capital	0·15	0·25	0·33	0·47	0·64
Totals	3·60	4·87	6·26	7·82	11·05

Before proceeding to describe and illustrate representative types of vehicles, tractors and special machines, a brief summary of the outstanding points in the English statutes and orders which apply to heavy motor-cars may well be given. Any motor-car with an unladen weight in excess of 2 tons is held to be a "heavy motor-car," and a "trailer" means a vehicle drawn by a heavy motor-car. The expression "axle weight" means the aggregate weight transmitted to the surface of the road or other base whereon the heavy motor-car or the trailer moves or rests by the several wheels attached to that axle when the heavy motor-car or trailer is loaded. The expression "weight," in relation to a heavy motor-car or trailer *when unladen*, means the weight exclusive of the weight of any water, fuel or accumulators used for the purpose of propulsion. All heavy motor-cars have to be registered with a county council, county borough, or other registering authority, and owners have to declare, on suitable forms, the unladen weight, the axle weight of each axle, and the diameter of each wheel. When a registration certificate is issued it bears these data, in addition to a statement of the width and the material of the tyre on each wheel, and the highest rate of speed at which the heavy motor-car may be driven. The owner, after registration, must cause to be painted, or otherwise plainly marked, upon some conspicuous part of the offside of the heavy motor-car, the registered weight unladen, and the registered axle weight of each axle, whilst, upon the near side of the heavy motor-car, he must similarly cause to be painted the highest rate of speed at which it may travel. Width of tires, which in no case may be less than 5 in., varies in relation to imposed load and wheel diameter, and a table of these is issued by the local government board. It is specified that "the width shall not be less than that number of half-inches which is equal to the number of units of registered axle weight of the axle to which the wheel is attached." Taking a wheel 3 ft. in diameter as a basis, the unit of registered axle weight is $7\frac{1}{2}$ cwt.: this unit increases in the proportion of 1 cwt. per 12 in. increase of diameter, and decreases at the rate of 1 cwt. for every 6 in. reduction in diameter below 3 ft. The speeds at which heavy motor-cars may travel vary from 5 m. an hour to 12 m. an hour. Heavy motor-cars fitted with tires of a soft or elastic material may travel at higher rates of speed than if they were not so fitted.

Any motor-car used for trade purposes, but whose unladen weight does not exceed 2 tons, is allowed to travel as fast as 20 m. an hour, and is regarded as an ordinary motor-car.

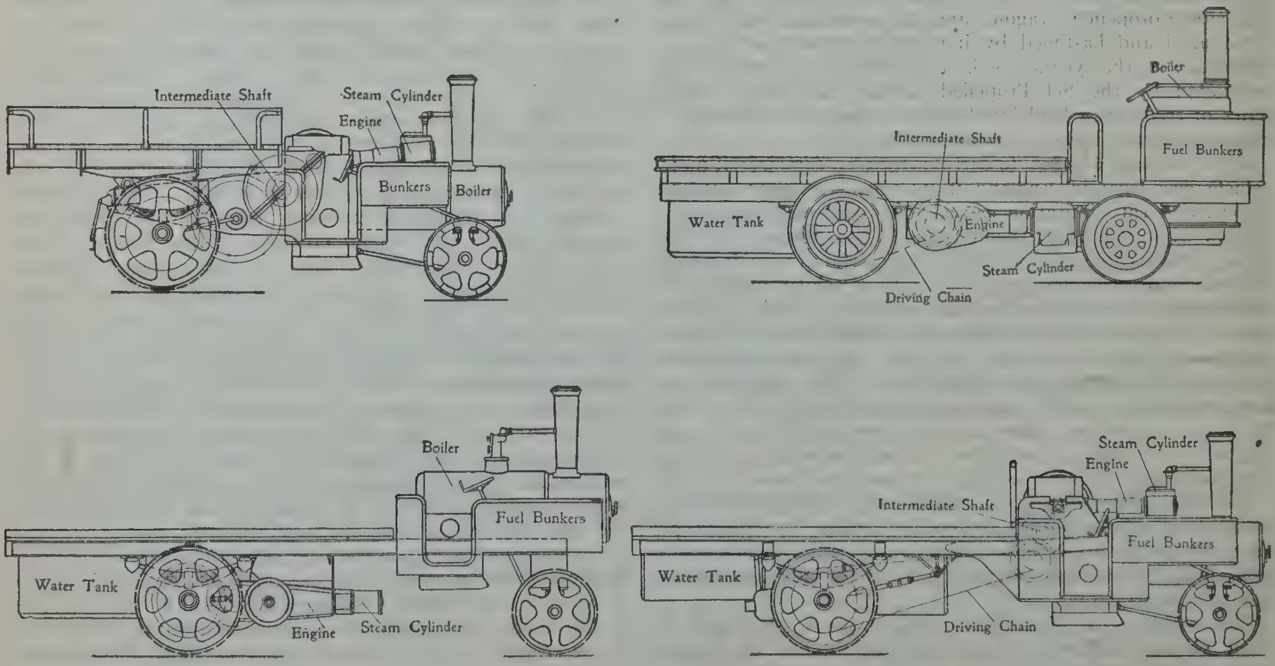
Motor-buses.—The first double-deck motor-bus, of the type of which upwards of 1000 are in regular service in London, was licensed by the police authorities in September of 1904. The type of chassis employed is practically identical with those used for loads of 3 tons in the goods-haulage branches of the industry, and the accompanying chart, which is prepared from data exclusively collected by the *Commercial Motor* (London), indicates the growth in the totals since the inception of this departure in the public conveyance of passengers. The growth of motor-bus traffic has resulted in the displacement of some 25,000 horses and 2200 horse omnibuses, during the five years ending the 30th of June 1910, and it is estimated that there will be practically no horse omnibuses in London, except upon a few suburban routes, by the end of 1911. The inclusive working cost of a London motor-bus, with good management, varies between 9d. and 10d. per mile, which figures cover interest, depreciation and administration.



Successful provincial motor-bus undertakings, in the United Kingdom, are numerous, and those at Eastbourne, Keighley and Hull may be particularly mentioned of municipal undertakings, whilst the Great Western Railway Company alone has 130 such vehicles at work.

Motor-cabs.—Spasmodic efforts to introduce motor-cabs in London were made during the years 1905 and 1906. It was, however, only in the month of March 1907 that the General Motor-cab Company put the first 100 vehicles of its present large fleet into regular service. The growth of motor-cabs is indicated by the following numbers, for which the author is indebted to the *Commercial Motor* (London), and these are of vehicles licensed at the dates given: December 31, 1905, 19; December 31, 1906, 96; December 31, 1907, 723; December 31, 1908, 2805; April 30, 1909, 3203; April 30, 1910, 4941. It is estimated that, at the 30th of June 1910, there are only 1200 horse-drawn hansoms in regular use, and not more than 2500 horse-drawn four-wheelers, in London. In 1904 London had a total of 11,055 horse-drawn hackney carriages, and two self-propelled hackney carriages. The London hiring rate for motor-cabs fitted with taximeters is: for the first mile or part thereof, 8d., subject to an additional charge at the rate of 2d. per $2\frac{1}{2}$ minutes for any waiting time or travelling below the rate of 6 m. per hour; 2d. per additional 440 yds., or $2\frac{1}{2}$ minutes of waiting or of travelling below 6 m. an hour; with the addition of 2d. per package for any package carried outside, and 6d. for a bicycle and 6d. each for each passenger above two, for any distance. The horse-drawn hansom-cab is 1s. for the first 2 m., with 6d. for each additional mile or part of a mile, and with a charge of 8d. per 15 minutes of waiting, after the first 15 minutes completed. Taximeter cabs cannot be engaged by time in London, but horse-drawn cabs may be so engaged at 2s. 6d. per hour for a hansom, and at 2s. per hour for a four-wheeler. The taxicab rates apply throughout the Metropolitan Police area, which in some directions extends as far as 20 m. from Charing Cross, but horse-vehicle rates (except those of time) are doubled for any distance beyond a four-mile radius.

Steam Vehicles.—Steam wagons may, generally speaking, now be divided into three distinct types, and these are distinguished chiefly by the particular form of final drive adopted by the designer. There are in general use by the well-known



FIGS. 6–9.—Standard and Representative Types of Present-day Steam-wagon Construction.

makers, at the present day, only three methods of effecting such a drive: (1) by means of spur or double-helical gear to a live back axle, as illustrated in figs. 6 and 7; (2) with two side chains transmitting the drive from a differential intermediate countershaft to the wheels on a fixed back axle, as shown in fig. 8; and (3) by means of a single chain transmitting the drive from an intermediate shaft to a differential gear on a live back axle, as depicted in fig. 9.

The transmission on the first type of vehicle (figs. 6 and 7) is by means of gearing throughout, and is completely enclosed, thus ensuring protection from dust, and more perfect lubrication. Change gears to give two speeds are provided. This form of drive necessitates a special disposition of the spring mounting, in order to ensure that there shall be no sliding motion taking place between the teeth of the reducing gear, due to the distance between the centres of the countershaft and the back axle varying with the changes in the spring deflexion. The gear drive offers advantages which, for heavy loads, are not offered by any other form of drive.

The features which are common to all steam wagons of the second of these types are: vertical fire-tube or water-tube boiler; horizontal compound engine; two-speed gear; differential countershaft; and two sprockets which transmit the final drive, through chains, to the rear road wheels. The exact form which the boiler takes is a point which has considerably exercised the ingenuity of individual designers, in order to arrive at one that can be cheaply produced, efficient, simple of construction, easy to clean and repair, strong and reliable, and one which will not prime. The vertical type of boiler lends itself admirably to the general design of a steam wagon, because it takes up so little of the total length of the vehicle, whilst the fittings can be mounted in much more accessible positions than are possible with the majority of loco-type boilers. The efficiency is not, however, so high as is the case with the latter type. It may be generally stated that boilers of the vertical class, as used on 5-ton or 6-ton steam wagons, have a total heating surface of about 90 to 95 sq. ft., with about 4 sq. ft. of grate area, and the working pressure is from 200 lb to 225 lb per square inch. The usual and necessary fittings include: pressure-gauge; two safety-valves, two check-valves, and a blow-off cock. The feed water is normally supplied to the boiler by a plunger pump driven from the crank-shaft. The compound engine has all the valve motion completely enclosed and running in an oil-bath, and is provided with means whereby high-pressure steam can be supplied to the low-pressure cylinder, in order that extra power may momentarily be obtained. The change-speed gear pinions, cut from solid steel, are most often mounted on an extension of the crank-shaft, and mesh with machine-cut gear wheels which are mounted on the intermediate shaft, on which the differential gear is also mounted. The gears provide for two ratios of reduction from engine to road wheels; the higher one is for all ordinary running, and the lower one is for steep hills or for very bad roads. The outer ends of the differential shafts are fitted with chain sprockets, from which the drive is taken to the back wheels by means of chains.

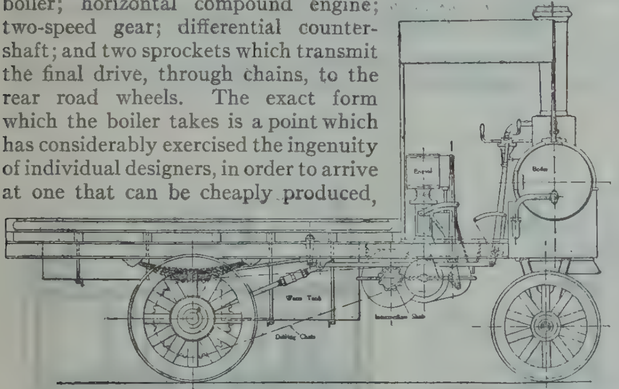


Fig. 10.—The Unique Type of Steam Wagon made by the Yorkshire Patent Steam Wagon Co.

The third type (fig. 9) of steam wagon is particularly business-like in appearance, and sound in construction and design. It is the outcome of many years' experience in the design of road locomotives, on the lines of which it is constructed. The loco-type of boiler is very economical in fuel consumption, and is a very efficient steamer. Comparing this type of boiler with the vertical type, the former can be made of a much lighter construction for a given rate of evaporation, and the smoke-box door at the forward end offers a most simple and easy means of access to the smoke tubes for cleaning purposes. No vertical boiler offers such ready means of effecting this operation. The engine, which is mounted over the boiler in this type, is in full view of the driver, and, should it become necessary to make any repair or adjustment when on the road, this can easily be effected without grovelling under the wagon or removing any of the load. Objection may be raised to the position of the engine, on the score of its necessitating such a long chain drive to the back axle; this objection has not been sustained in practice, as many wagons employing this form of drive have been running for lengthy periods without giving any trouble on that score. The engine, which is a compound one, is close up to the source from whence it is supplied with steam, and consequently receives the steam in a much drier condition; there is less condensation in the main steam-pipe, because the length of this is reduced to a minimum. The short steam-pipes should tend to lessen the risk of their being broken from the sagging or twisting of the frame, a fault which is not unknown with vehicles having the engine a considerable distance from the boiler. This type, like types 1 and 2, also has two change-speed pinions, mounted on an intermediate shaft. These pinions may be of the sliding type, or may be operated by means of dog-clutches. The pinions mesh with two wheels that are mounted on a countershaft, on which is also fixed a chain-sprocket, from which the drive is transmitted, through a long chain, to a chain-wheel surrounding the differential gear mounted on the back axle. Traction-engine type of steering gear, with revolving fore-carriage, is most generally adopted, and is rendered sufficiently rapid in its movement by suitable gear, operated by a diagonal shaft and wheel, from the driver's footplate.

Fig. 10 shows the general disposition of the main parts of a "Yorkshire" steam-wagon. This machine follows the general lines of those of type 3, so far as transmission gearing is concerned, but its boiler is of very distinctive construction, as may be seen from the sectional view in fig. 11; its engine is one of the vertical compound type, and is mounted directly behind the driver.

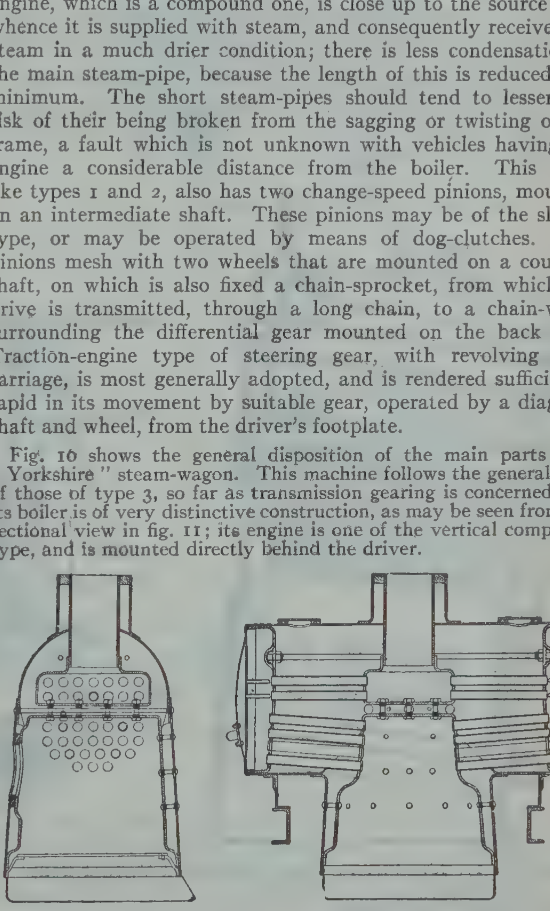
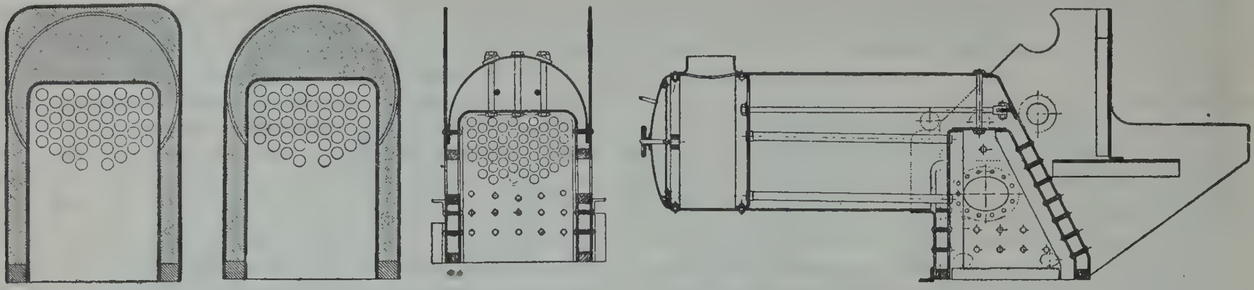


Fig. 11.—The Yorkshire Steam Wagon Co.'s ingenious Loco-type Transverse Boiler.

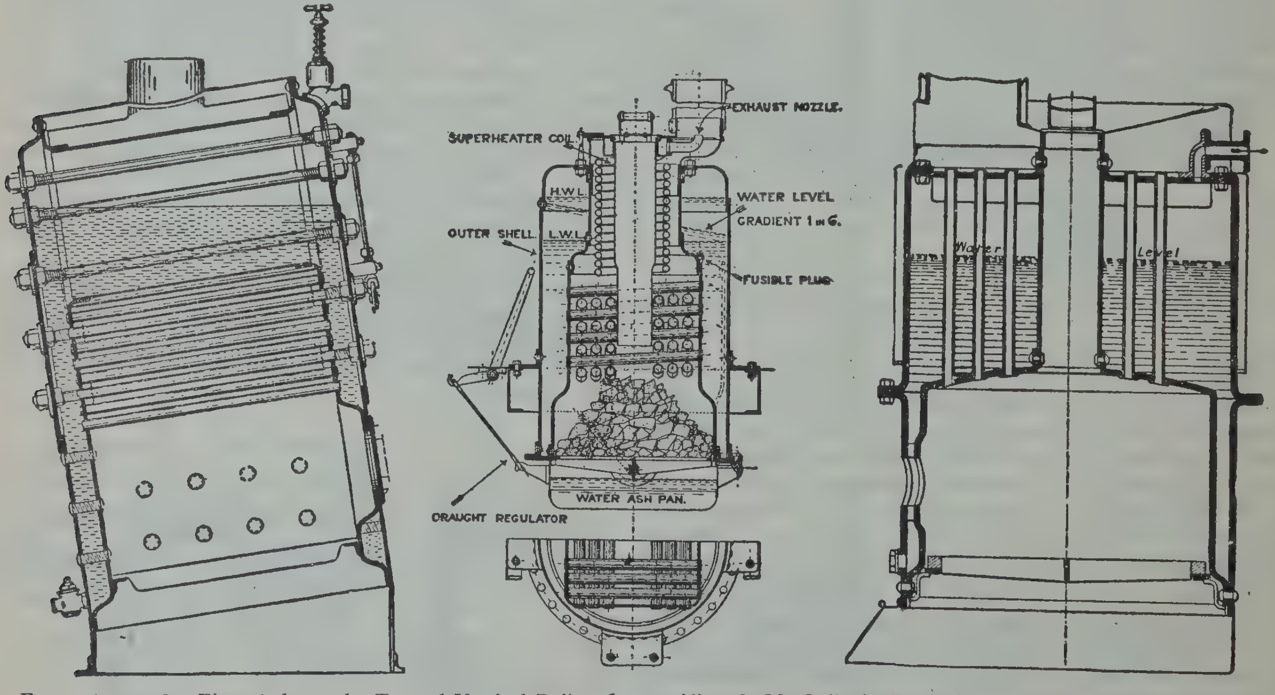
The Sheppee steam-wagon, or "steam-gas" vehicle as it is sometimes termed, on account of the high degree of superheat to which the steam is raised, and which superheat gives to the steam many of the characteristics of gas, is shown in fig. 24, and, it may be seen, this wagon is entirely dissimilar to any other machine with which this article deals. The generator and paraffin burner are housed within a "bonnet," and the temperature of the steam is controlled by a very simple form of thermostat. After leaving the engine, some of the heat in the exhaust steam is utilized to heat up the feed water before it is passed into the generator; the steam then passes in series through two condensers—one in front and one underneath the vehicle.

Another vehicle which embodies many novel and practical features is the new Leyland steamer, the construction of which includes one of the well-known Leyland fire-tube boilers, as shown in fig. 18, a three-cylinder, single-acting, vertical engine, and an all-gear drive to the rear wheels.

Boilers.—The locomotive type of boiler is shown diagrammatically in figs. 12–15. The first of these four diagrams illustrates the Belpaire type of fire-box outer shell, and, by its side fig. 13 shows the older form of construction. The Belpaire fire-box is a development of recent years, and its undoubted superiority over the older type is meeting with increasing recognition amongst boiler makers. The sloping back plates of the fire-box, as shown in fig. 15, are intended to give plenty of room for the housing of the change-speed gearing without undue lengthening of the vehicle or reduction of the area of the fire-grate.



FIGS. 12–15.—Fig. 12 shows the Belpaire type of fire-box construction as compared with the more usual type shown in fig. 13. Fig. 14 and fig. 15 show the form of locomotive boiler fitted by Sidney Straker & Squire, Ltd. The back of the fire-box is sloped so as to accommodate the gear shafts without unduly lengthening the frame.



FIGS. 16, 17, 18.—Fig. 16 shows the Toward Vertical Boiler, fig. 17 Alley & MacLellan's Sentinel Water-tube Boiler, and fig. 18 the Vertical Smoke-tube Boiler fitted on Leyland Steam Wagons. The smoke tubes in the last-named boiler are provided with copper sleeves to prevent corrosion.

Figs. 16, 17 and 18 show vertical boilers made, respectively, by Toward, of Newcastle, Alley & MacLellan, of Glasgow, and the Leyland Co., of Leyland. The smoke tubes of the last-named boiler are provided with copper sleeves, the object of which is the prevention of corrosion of the outer surfaces of the tubes. All-copper tubes have been tried, but they are too soft to withstand the abrasive action of the fine particles of coke which are ejected from the fire.

In flash or semi-flash boilers, or steam generators, such as are fitted by the Darracq-Serpollet Co., the Sheppee Motor Co., of York, and to the tractor made to the designs of Colonel Crompton, C.B. (fig. 26), only a very small volume of water is at any time in the tubes. The tubes are exceptionally strong and thick, and they are made of cold-drawn steel; the water is only forced into them stroke for stroke of the engine. The essential difference between this class of generator and any ordinary motor-wagon boiler, whether of the water-tube or fire-tube patterns, is that the reserve of heat is provided in the mass of the heated tubes, and the rapidity of flame application by the burner, and not in a mass of heated water. The steam, too, is very highly superheated, and necessitates the use of a specially-designed engine with mushroom valves.

Fig. 19 shows one form of paraffin burner, which type is used in conjunction with semi-flash boilers. The fuel is first vaporized, by being passed through a heated coil.

Steam Engines for Vehicles and Tractors.—The Bentley superheated steam engine, which is fitted to Colonel Crompton's tractor, is shown in fig. 20.

It has four high-pressure cylinders, and four in which low-pressure steam is operative. In a number of tests which were made

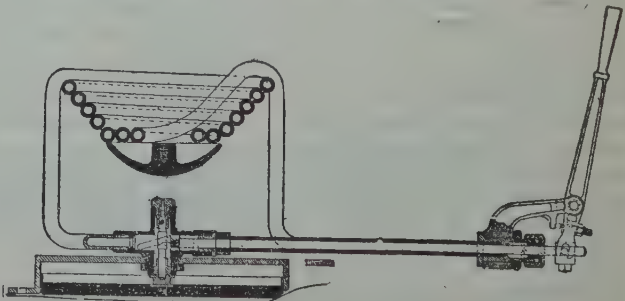


FIG. 19.—The Lune Valley Paraffin Burner.

with an engine of this type it was found possible to work it on an expenditure of 13 lb of water per brake-horse-power hour. Another interesting superheated steam engine is the two-cylinder, double-acting engine made by the Sheppee Co., and illustrated in fig. 21. In this engine the cam-shaft by which the steam and exhaust valves are operated is situated midway of the cylinders' length, and is driven by bevel gearing from the crank-shaft. Fig. 22 shows a combined steam and hand-operated water pump, for use in conjunction with either of the engines mentioned.

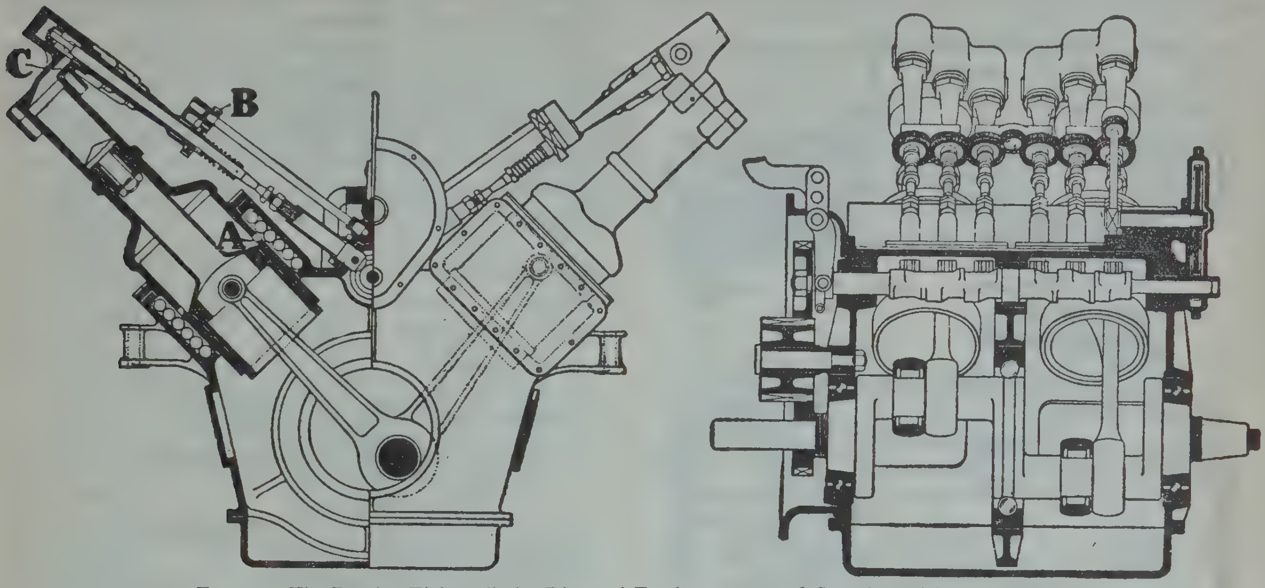


FIG. 20.—The Bentley Eight-cylinder Diagonal Tandem-compound Superheated-Steam Engine.[1]

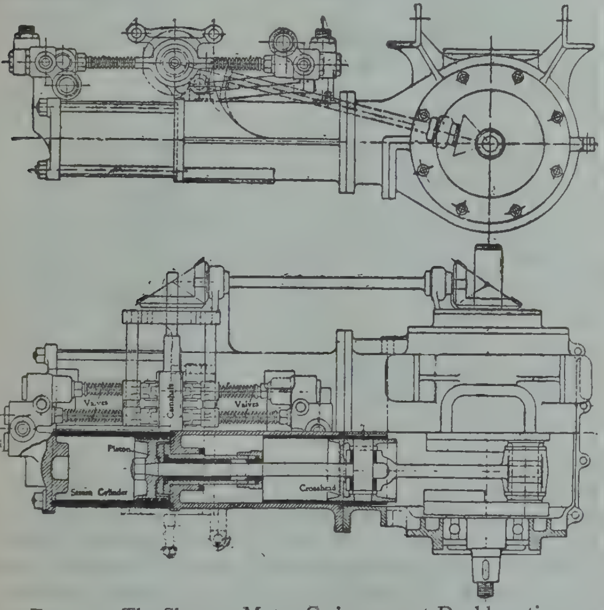


FIG. 21.—The Sheppee Motor Co.'s compact Double-acting Superheated "Steam-gas" Engine.

The Sentinel wagon, built by Alley & MacLellan, Ltd., is perhaps the only heavy steam wagon with a two-cylinder, simple, double-acting engine controlled by cam-actuated poppet valves; this engine is shown in section in fig. 23, and, in some respects, it greatly resembles the Sheppee engine.

The four special engines already named—those by Leyland, Bentley, Sheppee and Alley & MacLellan—differ totally from the type which is fitted most usually on steam-propelled commercial motors, yet they are very practical examples of special practice. The majority of steam vehicles are provided with two-cylinder compound engines, in which the steam distribution is effected and controlled by one or other of the proved link motions, such as the Joy, the Solms or the Stephenson. The first-named type does not necessitate the fitting of eccentrics; the second system entails the use of one eccentric for each cylinder; whilst Stephenson's system necessitates the provision of two eccentrics per **cylinder.**

Steam Tractors.—The great popularity which the light steam tractor enjoys is undoubtedly due to its extreme usefulness in cases where the employment of steam wagons could not prove remunerative. For brickmakers, builders, market gardeners and a host of others whose business demands that separate loads of heavy material must be moved from place to place without involving terminal delays, the tractor offers a simple and ready means of attaining the desired end. The first cost is comparatively low, and such a "steam horse" can be kept constantly at work if there is sufficient demand. A steam tractor is economical and efficient; it can be used on roads where a steam wagon would be impracticable on account of its great axle weight, and, when not used for hauling, it can be put to other work such as driving pumps or builders' machinery, or for a host of other purposes requiring a portable power installation. The fact that the motor is separate from the wagon, or trailer, which conveys the load, and can haul a loaded trailer to its destination, leave it, and return with, or for, another loaded trailer, without waiting for the first load to be unshipped, not only makes this class of motor extremely useful to agriculturists and others, but it makes for greater efficiency, in a large number of cases, because the power unit is not allowed to stand idle during the loading or unloading operations. Another vital point is the low annual cost of maintenance.

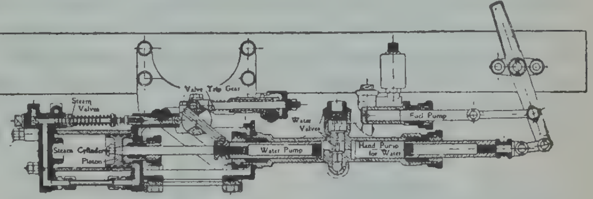


FIG. 22.—The Sheppee Combined Steam-driven or Hand-operated Water-pump.

Since the passing of the 1903 Motor Car Act, and the coming into force of the 1904 Heavy Motor Car Order, many of the well-known makers of road locomotives have turned their attention to the production of a machine which would come within the prescribed constructional limits, and would meet popular demand. These machines are built on proved traction-engine lines, but with all the parts of suitably reduced size so far as is consistent with strength and the work which the machines are called upon to perform. The locomotive type of boiler, with large fire-box, a heating surface of about 65 sq. ft., and a grate area of some 3 sq. ft., is used by the leading makers.

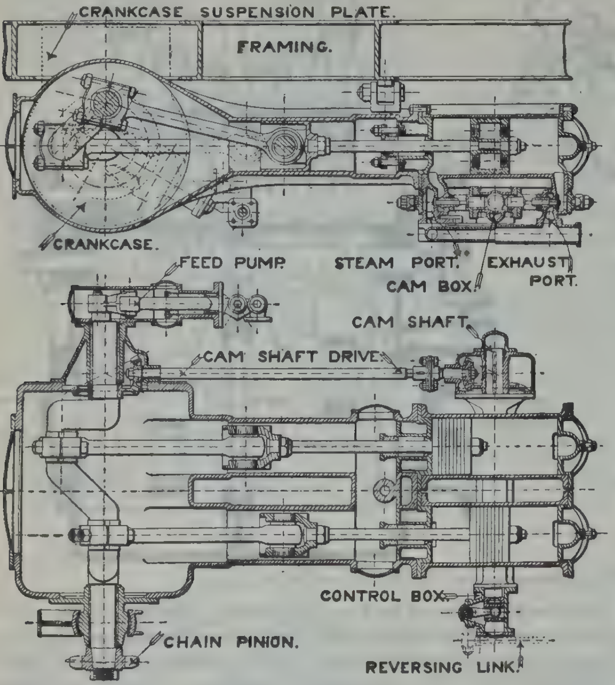


FIG. 23.—Alley & MacLellan's Twin-cylinder Steam-engine as fitted to the Sentinel wagons. The steam and exhaust ports are operated by a cam-shaft.

Some of the early tractors were fitted with single-cylinder engines, but, although this type is still supplied by several makers, the more general practice is to provide a compound engine, with a multiplying valve which admits high-pressure steam into the low-pressure cylinder, thus enabling the engine to develop considerably more than its normal power for short periods. The engine is mounted over the boiler, with its crank-shaft at right angles to the axis of the barrel. Two changes of gear ratio are usually provided; one for normal running, and a lower one for very soft ground or steep hills. The driving axle is of the differential or live type, and provided with means for locking the compensating gear and rendering it inoperative when necessary, as would be the case if one driving-wheel were on hard ground and the other one on soft or greasy ground. A winding-drum is fitted, and this may be driven by the engine without, at the same time, driving the tractor: this result is attained by making the drum free on the axle but providing means of securely locking it thereto when desired. A flywheel generally fitted to one end of the crank-shaft, and this may be used for driving external machinery.

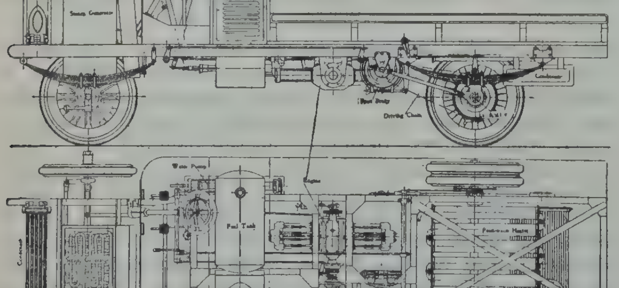


FIG. 24.—The Sheppee "Steam-gas" or Superheated Steam Vehicle.

Many makers have recently given much attention to the improvement of the spring-suspension systems of their respective machines, and chief amongst these is William Foster & Co., Ltd., of Lincoln, in which company's "Wellington" tractors the effective spring base has been so vastly increased that it may safely be termed the most stable of steam tractors. The life of all the working parts of a tractor may be considerably lengthened by the elimination of road shocks, or the prevention of their transmission, through the gearing, to the engine and the boiler plates. Foster's tractor is illustrated, in diagrammatic form, in fig. 25.

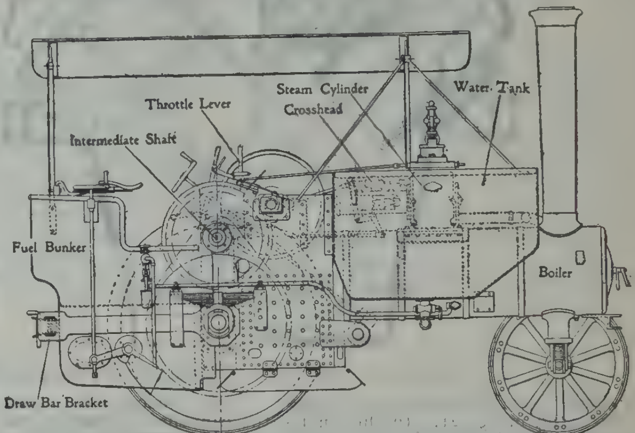


FIG. 25.—Foster's "Wellington" Compound Steam Tractor with outside spring suspension.

An ingenious machine of the tractor class is that built to the designs of Colonel Crompton, and shown in fig. 26. This machine is intended for military purposes, or for operation in undeveloped countries. Steam is generated in a "semi-flash" boiler, and is used expansively in a four-pair, diagonal-compound engine of the type shown in fig. 20. A two-speed epicyclic gear is enclosed by the flywheel casing, and the power is then transmitted, by worm gearing, to a differential countershaft, and from sprockets on the ends of this shaft the drive is finally transmitted to the 7 ft. diameter road wheels by means of side chains. In this tractor, very long bearing springs are employed, and these are situated below the axle, so that, instead of the springs resting on the axle boxes, the whole frame and the power plant is suspended from the axle boxes. When hauling a load, the winding cable is permanently secured to the drawbar, and, when the machine becomes "bogged" or is otherwise unable to haul its trailer directly by the drawbar, a single bolt may readily be removed from the drawbar, and the winding cable may then be paid out as the tractor proceeds alone. The trailer may then be hauled up by means of the cable. The average of a number of tests with this machine, made while hauling a gross load of 8 tons, showed that its burners consumed from ·65 to ·85 of a gallon of shale oil for each mile travelled, and that the consumption of water was at the rate of ·5 gallon per mile. The gross weight of the machine, with sufficient fuel and water for well over 100 m. of running, is about 7 tons.

Vehicles Driven by Internal-Combustion Engines.—The general principles of the working of a steam engine are better understood than are those of the gas or oil engine, owing to the wide use of the former class of prime mover since the early part of last century, but it is beginning to dawn upon the public at large that the internal-combustion engine, or the "petrol" motor, as it is more popularly termed by those who talk or write about motor vehicles, is even more simple than the steam engine.

The fundamental reason for the use of the words "internal combustion" is that the fuel, in the case of the petrol engine, is burnt (or fired) inside the working cylinder, whereas it is burnt externally in the case of a steam engine, *i.e.* underneath the boiler or generator. The number of units of heat which can be turned into useful work is very much greater in the case of internal combustion than of external combustion, the efficiency of the petrol engine in this respect being, on the average, about three times as great in practice as is found to be the case with typical steam engines other than those where highly-superheated steam is used, and where the whole of the parts are maintained in the best condition. The amount of petroleum spirit, or of paraffin, required to propel a steam vehicle 1 m. would, other conditions being equal, propel a vehicle fitted with an internal-combustion engine over a distance of 3 m.

The essential parts of any internal-combustion system are: the carburetter; the engine; the radiator; the clutch; the change-speed gears and the final transmission. The carburetter is a vessel in which the liquid fuel is converted into a combustible gas or vapour, for, as there is no connexion to any gas main, the ordinary petrol engine has to make its gas "on the premises." The production of the gas is automatic, and calls for practically no attention from the driver, because, once the engine is started, the necessary aspiration to draw through the correct quantities of air and fuel is provided by the action of the valves and pistons.

A smart turn of the starting handle is required to set the pistons and crankshaft in motion, so that an initial supply of the combustible mixture may reach one of the cylinders. This first charge of gas is automatically ignited by an electric spark, the current for which is furnished and controlled without the necessity for any hand regulation, and there is then nothing further for the driver to do, as regards power, except to move a convenient lever which opens or closes a "throttle" valve between the cylinders and the carburetter.

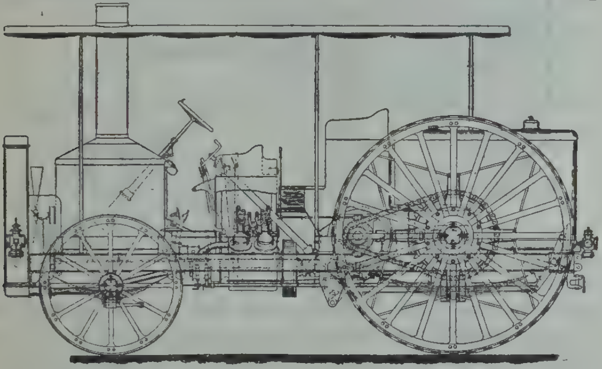


FIG. 26.—Colonel Crompton's Superheated Steam Tractor.

An internal-combustion engine would get very hot if no precaution were taken to cool it, and it is usual to surround the cylinder with water spaces. These spaces are called jackets, and the water is forced through them, either by a pump or by thermo-siphon (natural circulation) action. It is expedient to keep down the weight of water, and for that reason pipes, tubes or small boxes are built up in such a manner that a large cooling surface is exposed to the air. A fan, which is driven from the crankshaft of the engine by gear or a belt, is employed to aid this cooling by reason of the increased volume of air that passes round the outside of the components of the radiator members. The general scheme is the same, both for heavy and light motor-cars.

It is very important that the driver should have a convenient means of separating the engine from the driving mechanism, and of putting the two in connexion again, whenever it becomes necessary, without jar or shock. The common practice is to use a leather-faced, circular member with a coned face, and to control the amount of "grip" between this member and a corresponding enclosing member attached to the engine fly-wheel by means of a pedal and springs. When the driver wishes to disengage the two members, he has merely to depress the foot lever. It will be clear that a clutch of this description can be made to engage without any difficulty, there being no fixed positions or steps such as one associates with the ordinary jaw-clutch, and this gradual application of the load can only be accomplished by the aid of two or more surfaces in frictional contact, and by the holding together of these surfaces by the pressure of one or more strong springs. The Hele-Shaw multiple-disk clutch gives very good results, and is easy for drivers to use in traffic.

An internal-combustion engine cannot develop power unless the crank-shaft can rotate at a relatively high number of revolutions, and the rate of doing work is lowest when the angular velocity is at its minimum. It is, therefore, necessary to introduce a system of levers between the engine and the road wheels, in order to permit the number of revolutions of the crankshaft to be maintained when hill climbing, or when the vehicle is carrying a heavy load, and the common practice is to introduce three or four sets of different sizes of toothed wheels, any pair of which can be put into engagement by the movement of a single lever, which lever is placed near the driver's right hand as a rule. The lowest of these gear ratios, *i.e.* the one which allows the crankshaft to make the greatest number of revolutions to one revolution of the road wheels, is required for starting purposes, and the highest gear ratio, *i.e.* the one which allows the road wheels to make the greatest number of revolutions in relation to those of the crankshaft, is employed for high-speed travelling on the road. From the last change-speed shaft the power must be transmitted to the road wheels through a differential gear and through one or other of the types of final drive which are now employed by representative makers. The great distinction from the axle of a horse-drawn vehicle is that there must be both a mechanical connexion, yet a differential action, between the two back wheels. The wheels on horse vehicles revolve loosely on the axle, and one can overrun the other at curves, but the special device known as the "differential gear" has to be introduced into all motor vehicles between the change-speed gears and the driven road wheels. Such a device permits one of the two driving wheels to be driven round at a quicker angular speed than the other, the difference being determined by the radius of the curve around which the vehicle is turning.

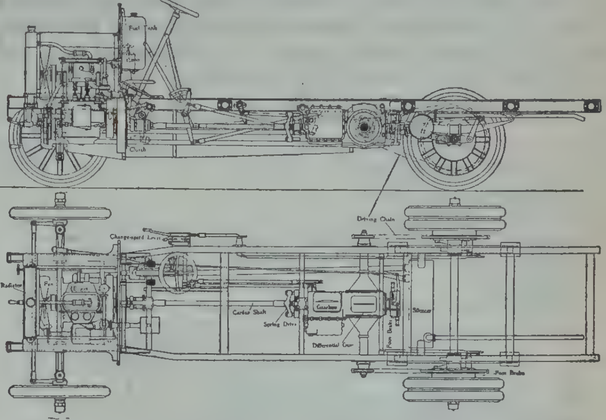


FIG. 27.—The well-known 16 h.p. Two-ton Albion Chassis.

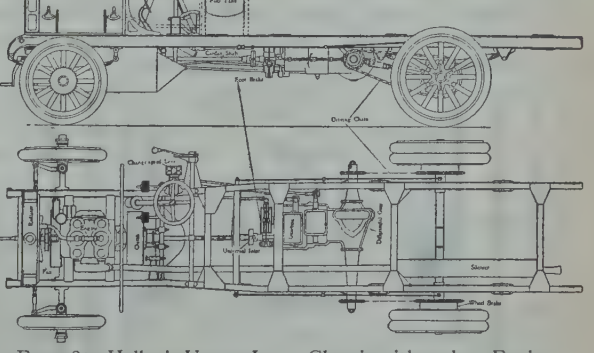


FIG. 28.—Halley's Van or Lorry Chassis with 20 h.p. Engine.

The most common form of final drive is, perhaps, that in which two "roller" or "silent" chains transmit the power from sprockets on the ends of the differential shaft to chain rings which are bolted to the rear road wheels. Figs. 27, 28 and 29 show typical vehicles, ranging in load capacity from 30 cwt. to 6 tons, on which the side-chain method of final drive is adopted. One of the chief advantages of the side-chain drive lies in the fact that there is, with it, less weight below the springs than with any other form of final drive. The only parts below the springs are: the fixed back axle; the chain rings (bolted to the road wheels); the road wheels themselves; the road-wheel brakes and part of the weight of the chains. The differential gear and chain sprockets are carried in a countershaft casing, which is securely bolted to the main frame.

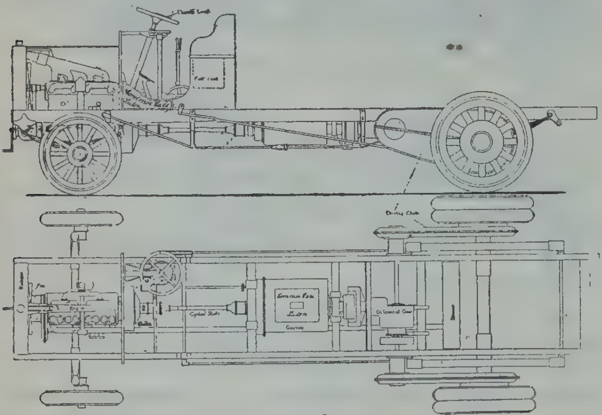


FIG. 29.—A typical Six-ton Petrol Wagon Chassis, by Commercial Cars, Ltd., Luton.

In a number of very successful vehicles the final drive is transmitted by means of spur pinions. These are mounted on the ends of bevel-driven differential shaft, and mesh with internally toothed or externally-toothed gear rings on the road wheels. Milnes-Daimler and De Dion commercial vehicles are amongst the machines on which the internally-toothed form of gear is employed, whilst Ryknield is the most representative vehicle embodying the externally-toothed form of final drive.

The direct drive, from the ends of the differential shaft, as is shown in fig. 30, is another type of final transmission that has met with a considerable amount of success, particularly on the Leyland machines of five-ton and six-ton capacity. The differential gear and the bevel-drive reducing gear are both enclosed within a casing that is bolted to a fixed back axle; the ends of the driving shaft pass through tunnels in the axle body; and claw pieces on the outer ends of the differential shaft engage with similar claws on the road-wheel hubs. The two last-named forms of gear are highly efficient, provided the pitch and shape of the teeth are carefully considered and the designs provide for the encasing of all the pinions and gear rings.

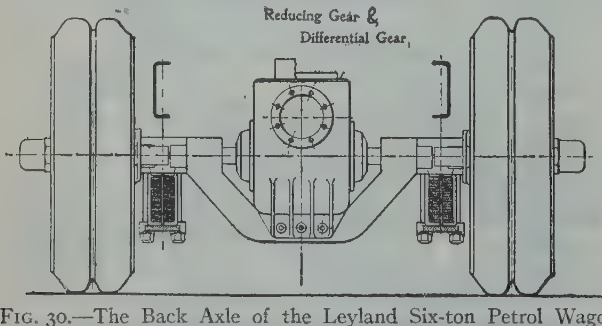


FIG. 30.—The Back Axle of the Leyland Six-ton Petrol Wagon.

The only other type of final drive which is used to any great extent for commercial motors is that which employs a hardened and ground steel worm meshing with a machine-cut phosphor-bronze worm wheel which is bolted to the differential-gear cage of a live back axle. The employment of this type of gear for the final transmission on commercial motors generally leads to increased efficiency, on account of the ease with which all the parts can be enclosed in an oil-tight casing. It also gives silence of running. The strongest advocate of the worm drive for heavy vehicles is the Guildford manufacturer, Dennis Bros., Ltd., one of which company's machines is illustrated in fig. 31. Although there are many difficulties in the matter of the manufacture of worm gearing, they are not insurmountable, and, given proper attention at the hands of the designer, followed by accurate workmanship, probably no other mechanical means of transmitting power can approach it for smooth and silent operation. Both thrust bearings on the worm shaft should be on one side of the worm, to avoid lack of truth in meshing if any heating occurs between the worm and the wheel. There are many examples of the worm drive to be found in London on public-service passenger vehicles, and also on delivery vans. One of the great charms of this type of transmission is that a very large gear reduction may be obtained without making the worm wheel unduly large in diameter; this is an important factor in the design of a back axle, as every inch of road clearance is of value for operating on rough country roads. As a large gear reduction is thus rendered possible on the back axle, it will readily be understood that the change-speed gear-box may be made considerably smaller than would be necessary for a bevel-driven live axle, where a large gear reduction is not permissible, both on account of its size and because such a gear would be very noisy in its working.

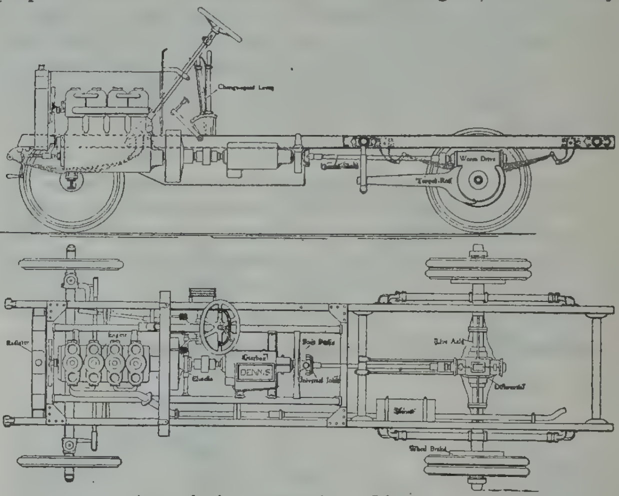


FIG. 31.—A typical Worm-driven Live-axle Chassis, by Dennis Bros., Ltd., of Guildford.

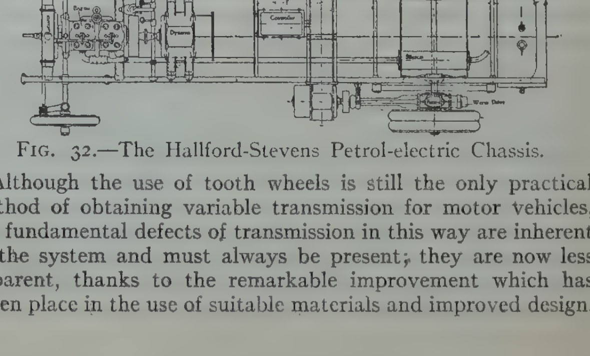


FIG. 32.—The Hallford-Stevens Petrol-electric Chassis.

Although the use of tooth wheels is still the only practical method of obtaining variable transmission for motor vehicles, the fundamental defects of transmission in this way are inherent to the system and must always be present; they are now less apparent, thanks to the remarkable improvement which has taken place in the use of suitable materials and improved design.

It is still the hope of some manufacturers that a form of infinitely variable change-speed device will be produced, which will replace the step-by-step movement of toothed gearing; the two chief directions in which this has been attempted are electrical and hydraulic. Of these two, electrical devices are really step by step, and the hydraulic method is apparently the only one that permits of infinite variation. Enormous sums of money have been spent in the search for an effective hydraulic gear; the work of Hall, Pittler, Jannay, Hele-Shaw, Renault and others is, perhaps, the best known. It must be confessed, however, that in 1910 none of these gears could be said to be on the market for motor vehicles, although hydraulic gears were being successfully applied in connexion with other problems, such as the steering of ships, the movement of turrets, &c.

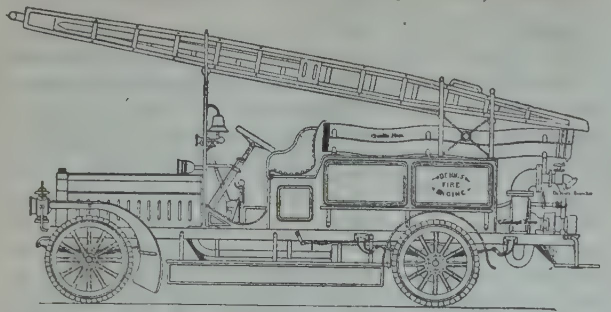


Fig. 33.—70 h.p. Six-cylinder Dennis Fire-engine with Gwynne Centrifugal Pump.

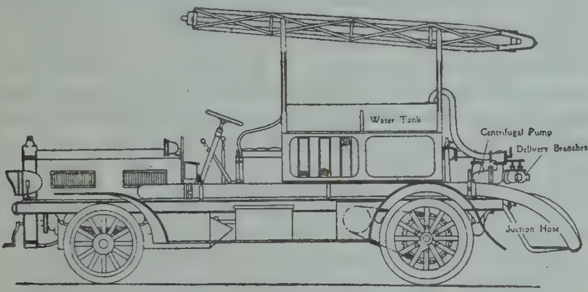


Fig. 34.—60 h.p. Six-cylinder Halley Fire-engine with Centrifugal Pump.

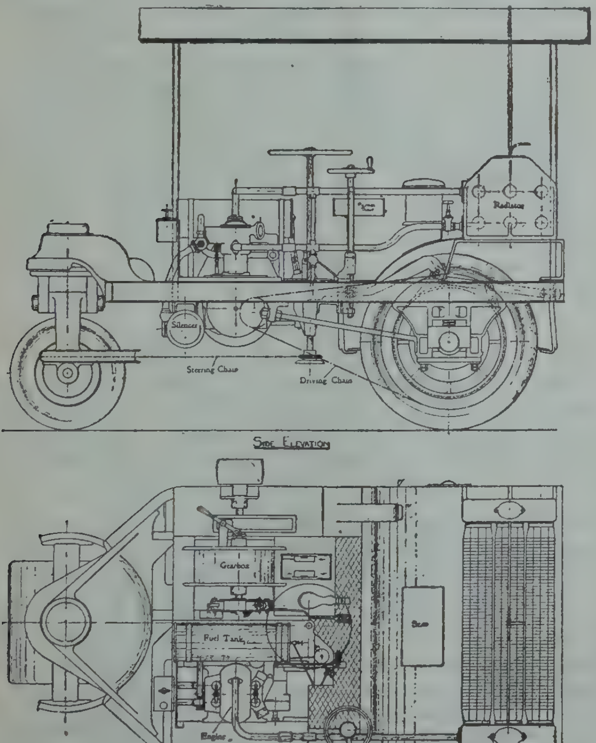


Fig. 35.—One of Barford & Perkins's Water-ballast Rollers.

Electrical transmission systems, too, have been tried, and appear to have been attended with more success than those of the hydraulic type. Such systems include vehicles which carry heavy batteries of accumulators, the current from which is utilized for the driving of the vehicle by means of electric motors. Other variations include the Hallford-Stevens system, shown in fig. 32, in which it may be seen the petrol engine drives a dynamo, and the current is then caused to drive an electric motor at each side of the chassis. Each motor drives one of the back road wheels, through a worm and worm wheel. The changes of vehicle speed are effected by altering the method of grouping the electrical windings of the dynamo and motor field-magnets and armatures. This system of control is known as the series-parallel, and is effected by a single lever, which actuates a mechanical switch, or "controller."

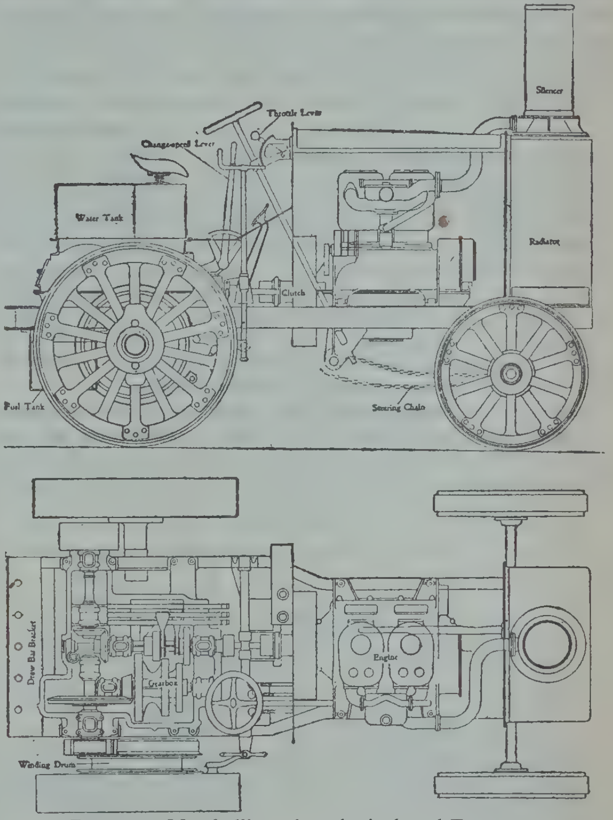


Fig. 36.—Marshall's 30 h.p. Agricultural Tractor.

In one of the most-recently-introduced petrol-electric systems—the "K.P.L." system, as worked by the Daimler Co., of Coventry—each of the rear road wheels is provided with a separate power unit, consisting of a four-cylinder petrol engine, which is direct coupled to a dynamotor, the armature of the latter being coupled to a worm which meshes with a worm wheel attached to the road wheel. A small electrical storage battery forms part of the system, and this receives the excess of current from the dynamotors when the whole power of the engine is not required for the propulsion of the vehicle. When the machine is being driven up a steep incline, or when it is required to travel in a reverse direction, the battery may be called upon to supply current to the dynamotor, and, in this manner, the power of the engine is augmented by the dynamotors' working as electric motors.

Still another petrol-electric system is that invented by Mr Thomas. In this system, which is at the same time the simplest and most practical form of petrol-electric transmission, two dynamotors and an epicyclic gear are employed so that the electrical load is at no time greater than one half of the total load; consequently, the risk of a "burn out" of the windings, as the result of sudden and unforeseen periods of overload, is materially minimized.

Special Applications.—Amongst the special applications of the petrol-engined commercial vehicle is the motor fire-engine, which has brought to the front in this branch several enterprising motor manufacturers, amongst whom Dennis Bros., of Guildford, Halley, of Glasgow, and Leyland, of Preston, are prominent. The general construction of the chassis closely follows the lines of other petrol vehicles of equal load capacity, but the gear-box tail-shaft is prolonged to the after-end of the machine, and is direct-coupled to the rotary member of a multi-stage centrifugal pump. In the Dennis fire-engine, the vacuum which is necessary in order to lift the water in the suction hose is obtained by means of priming the pump chamber, further assisted by a water ejector and a small water tank which is carried on the machine. This machine is shown in fig. 33, whilst fig. 34 shows the successful motor fire-engine built by Halley's Industrial Motors, Ltd., of Yoker, Glasgow. In the latter machine, as also in the Leyland and other fire-engines which employ centrifugal pumps, the vacuum is created by means of reciprocating air pumps. These machines have given very satisfactory results in the hands of practical firemasters, in various parts of the United Kingdom and abroad. Merryweather and Shand-Mason, who were formerly builders of steam fire-engines, now also build petrol-engined machines, these makers favouring reciprocating water pumps.

Other special applications of the internal-combustion motor are for grass mowing and rolling, and for road mending and rolling gravel paths, &c. One of the latter type of machines is shown in fig. 35. In this machine a petrol or paraffin engine drives a water-ballast roller through the medium of a clutch, a simple form of change-speed gear-box, and a single roller chain. The leading roller, by which steering is effected, is also filled with water, in order to obtain the dead weight necessary for rolling. Marshall, Sons & Co., Ltd., of Gainsborough, Thornycroft, of Basingstoke, and Broom & Wade, of High Wycombe, have also produced special machines for agricultural and military purposes, and one of the smallest tractors built by the first-named maker is shown in fig. 36. The engine is one of the two-cylinder type, consuming paraffin fuel, and driving the live back axle through a substantial gear-box and a final drive of the externally-toothed type. Such a machine is well below the weight limit for heavy motor-cars. Fig. 37 shows a more powerful oil tractor by Thornycroft. This machine is the same type which was so successful in the tractor trials promoted by the British War Department in March 1909. It is capable of hauling a gross load of seven tons practically anywhere, and even of lifting that load vertically by means of its winding cable. The engine has four cylinders, and the fuel may be paraffin, alcohol or crude oil. (E. S. S.)

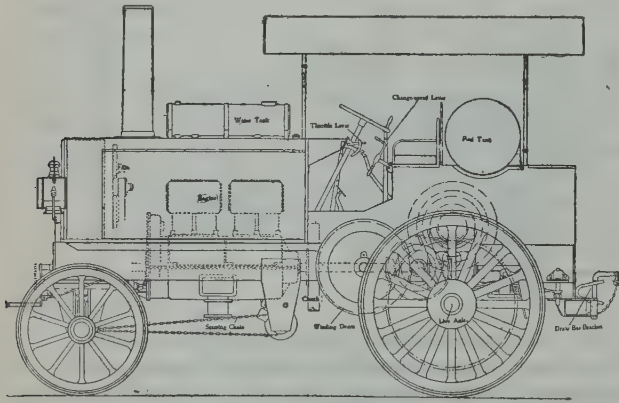


FIG. 37.—45 h.p. Thornycroft Military Oil Tractor.

MOTRIL, a town of southern Spain in the province of Granada, at the foot of an offshoot of the Sierra Nevada and on the edge of a rich alluvial plain, about 1 m. from the Mediterranean and 40 m. S.S.E. of Granada, with which it is connected by a good carriage road. Pop. (1900), 18,528. The climate is semi-tropical, and the *vega* or plain of Motril has been found peculiarly adapted for the culture of sugar-cane and sugar-beet. In the district, and especially at Salobreña, 3 m. west, there are numerous sugar-factories; cotton is also grown and manufactured, and alcohol, flour, soap, iron goods and cotton stuffs are among the other industrial products. The neighbourhood is rich in zinc and lead; and copper is also found. Motril itself is a port of the second class, but the anchorage at Calahonda, 4½ m. south-east, is much better. Grapes, barley, esparto grass, dry figs, almonds and zinc are exported.

MOTT, LUCRETIA [COFFIN] (1793–1880), American reformer, was born at Nantucket, Massachusetts, on the 3rd of January 1793. She was descended on her mother's side from Peter Folger, one of the first settlers of Nantucket, and the grandfather of Benjamin Franklin; her father's ancestors, also, were among the first settlers of Nantucket. At thirteen she was sent to a Friends' boarding school, at Nine Partners, near Poughkeepsie, New York, where James Mott (1788–1868), who like her was of old Quaker stock and whom she married in 1811, was then a teacher. In 1810 James Mott entered the employ of Lucretia's father in Philadelphia, but the business was not successful and in 1817 Lucretia opened a small school under the care of the Pine Street Monthly Meeting, but gave it up a year afterwards and in the same year was recognized by the Friends as an "acknowledged minister." Her husband had as early as 1822 espoused the cause of Elias Hicks against the "Orthodox" Friends, and in 1827, when the Society divided, Lucretia joined the Hicksites. Hicks's teachings on slavery had impressed both James and Lucretia; in 1830 James gave up a lucrative cotton commission business that he might not profit from the products of slave labour; and both took an active part in the campaign against slavery. About 1840 Mrs Mott also took up the cause of woman's rights. On lecturing tours she and her husband travelled as far west as Indiana and into Maryland and Virginia. In 1848 she addressed the Anti-Sabbath Convention in Boston, and with Elizabeth Cady Stanton, whom she had first met in London in 1840, called a convention "to discuss the social, civil and religious condition and rights of women," which met at Seneca Falls and passed a "Declaration of Sentiments," modelled on the Declaration of Independence. Her husband, who was prominent among the founders of Swarthmore College (1864), died in Brooklyn, New York, on the 26th of January 1868; and Mrs Mott died on the 11th of November 1880 near Philadelphia.

See *James and Lucretia Mott: Life and Letters* (Boston, 1884), edited by their granddaughter, Mrs Anna Davis Hallowell.

MOTT, VALENTINE (1785–1865), American surgeon, was born at Glen Cove, New York, on the 20th of August 1785. He graduated at Columbia College, studied under Sir Astley Cooper in London, and also spent a winter in Edinburgh. After acting as demonstrator of anatomy he was appointed professor of surgery in Columbia College in 1809. From 1811 to 1834 he was in very extensive practice as a surgeon, and most successful as a teacher and operator. He tied the innominate artery in 1818; the patient lived twenty-six days. He performed a similar operation on the carotid forty-six times with good results; and in 1827 he was also successful in the case of the common iliac. He is said to have performed one thousand amputations and one hundred and sixty-five lithotomies. After spending seven years in Europe (1834–1841) Mott returned to New York and founded the university medical college of that city. He translated A. A. L. M. Velpeau's *Operative Surgery*, and was foreign associate of the Imperial Academy of Medicine of Paris. He died on the 26th of April 1865.

MOTTEUX, PIERRE ANTOINE (1663–1718), English translator and dramatist, of French parentage, was born at Rouen on the 25th of February 1663. After the revocation of the Edict of Nantes he settled in London with his kinsman and godfather, Paul Dominique Motteux. He acted as an auctioneer of pictures, and in 1706 he had a shop in Leadenhall Street for the sale of lace, stuffs, Chinese and Japanese commodities, duly advertised in the *Spectator* by his friend Richard Steele. He had not been six years in England when he obtained sufficient mastery of the language to edit the monthly *The Gentleman's Journal*, which contained verses by himself and by the chief wits of the day. In 1693 he edited the third book, hitherto unpublished, of Sir Thomas Urquhart's translation of Rabelais, and in the next year printed the first and second books of Urquhart's translation. In 1694 he completed Urquhart's work by a translation of the fourth and fifth books, which, although not to be compared with the racy, nervous writing of Urquhart, shows a perfect mastery of colloquial English and an intimate and adequate sense of Rabelais's meaning. The complete translation appeared in five volumes in 1693–1694, and was reprinted as *The Whole Works of Francis Rabelais, M.D.* (2 vols., 1708), described as the work of "Sir T. Urchard, Knight, Mr Motteux and others." His first play, a comedy in five acts entitled *Love's Jest*, was produced at Lincoln's Inn Fields in 1696, and next year followed *The Loves of Mars and Venus*. He wrote other works for the stage of no great consequence. More important than his dramatic work is his *History of the Renowned Don Quixote de la Mancha* (4 vols., 1701; 2nd ed., 1712), "translated from the original by many hands and published by Peter Motteux," one of the most masterly and spirited translations in English. His later years appear to have been given to the shop in Leadenhall Street. He was murdered on the 18th of February 1718 at a house of ill fame in Star Court, near St Clement's Church, London, under circumstances which have never come to light. The manner of his death was no criterion of his life, which appears to have been sober and decent.

An excellent life by Henri van Laun is prefixed to the 1880 reprint (4 vols.) of J. G. Lockhart's edition of Motteux's *Don Quixote*. See also a prefatory note by Charles Whibley in vol. iii. of Sir T. Urquhart's *Rabelais* (Tudor Translations, 1900), reprinted from a rare 1693–1694 edition.

MOTTEVILLE, FRANÇOISE BERTAUT DE (*c.* 1621–1689), French memoir writer, was the daughter of Pierre Bertaut, a gentleman of the king's chamber, and niece of the bishop-poet Jean Bertaut. Her mother, a Spaniard, was the friend and private secretary of Anne of Austria, wife of Louis XIII. At the age of seven Françoise was also made a member of the queen's household and given a pension. The influence of Richelieu, however, who wished to separate the queen from her Spanish connexions, exiled mother and daughter to Normandy, where in 1639 the young girl was married to Nicolas Langlois, seigneur de Motteville, president of the Chambre des Comptes of Rouen. He died two years later at the age of eighty-two, and in 1642 the queen summoned Mme de Motteville to court, being now her own mistress by the death of Richelieu and Louis XIII. Through all the intrigues and troubles of the Fronde Mme de Motteville preserved the honourable reputation of being devoted to her mistress without any party ties or interests. Some letters of hers are preserved—especially a curious correspondence with "La Grande Mademoiselle" on marriage, but her chief work is her *Mémoires*, which are in effect a history of Anne of Austria, written briefly till the date of Mme de Motteville's return to court, and then with fullness. They give a faithful picture of the life of the court at that time.

The best edition of her *Mémoires* is that of M. F. Riaux (2nd ed., Paris, 1891, 4 vols.), containing the essay by Sainte-Beuve from vol. v. of his *Causeries du lundi.* The *Memoirs* were translated into English in 1726 and again by K. P. Wormeley in 3 vols., 1902. For details concerning her family see *Recherches sur Madame de Motteville et sur sa famille*, by Charles de Beaurepaire (Rouen, 1900).

MOTTL, FELIX (1856–), German conductor and composer, was born near Vienna, and had a successful career at the Vienna Conservatoire. He became known as a gifted conductor of Wagner's music, and in 1876 was engaged for the *Ring des Nibelungen* at Bayreuth. From 1881 to 1903 he was conductor at the Carlsruhe Opera, and made a wide reputation for his activity there, particularly in producing the works of Wagner and Berlioz. In 1886 he directed the performance of *Tristan und Isolde* at Bayreuth. In later years he visited London and New York, and became known as one of the most brilliant conductors of his day; and in 1904 he was made a director of the Academy of Music at Berlin. He composed some operas, of which *Agnes Bernauer* (Weimar, 1880) was the most successful, and numerous songs and other music.

MOTTO (an Italian word, from Late Lat. *muttum*, a low sound, a mutter or murmur, cf. *mutere*, to mutter; the Latin word also gives Fr. *mot*, word), a "legend" consisting of a significant phrase or sentence, sometimes even of a single word attached to an emblem or device, and, in heraldry, placed on a scroll below the achievement or above the crest. Mottoes express sometimes a sentiment, a favourite principle, emphasize the meaning or symbolism of the emblem or device, and, in heraldry, often allude to one or more of the "charges" in the coat of arms, &c.

There are many publications which give lists of some of the best-known mottoes, such as Fairbairn, *Book of Family Crests*, 1856; Wachbourne, *Book of Family Crests* (2 vols., 1882); Chassant and Tansin, *Dictionnaire des devises historiques et héraldiques, &c.* (1878); Dielitz, *Die Wahl- und Denksprüche, Feldgeschreie, Losungen, Schlacht- und Volksrufe, besonders des Mittelalters und der Neuzeit* (4 vols., 1888). Gatfield's *Guide to Printed Books and MSS. relating to Heraldry* (1892) contains a bibliography.

MOTYA, an ancient Phoenician settlement in Sicily, on a low island [mod. *S. Pantaleo*], 5 m. north of Lilybaeum [mod. *Marsala*]. It was the centre of the Phoenician trade in Sicily. It was accessible from the mainland by a mole, which is still used as a track for wagons. The line of the city wall, of rough rectangular blocks of stone without mortar, may still be traced all round the coast, with two gates, one on the north towards the mole, which is still in part preserved, and one on the south. The date of its foundation is uncertain. In 398 B.C. it was taken after a desperate struggle (which, owing to the height and strength of the houses, continued even after a breach had been made in the city wall) by Dionysius of Syracuse, but recovered in the next year: it was, however, abandoned by the Carthaginians, and its place taken by Lilybaeum on the mainland. (T. As.)

MOUCHEZ, AMÉDÉE ERNEST BARTHÉLÉMY (1821–1892), French astronomer, was born at Madrid of French parents on the 24th of August 1821. At the age of sixteen he entered the naval school at Brest, and after serving with distinction in various ships, was appointed in 1856 to the command of the "Bisson." Towards the close of the Franco-Prussian War he made an admirable defence of Brest, and his organization of the French expedition to the island of St Paul to observe the transit of Venus in 1874 obtained his election to the Academy of Sciences and his promotion as commander of the Legion of Honour. On the 27th of June 1878 he succeeded Urbain Leverrier as director of the National Observatory of Paris, and was raised to the rank of rear-admiral. The fourteen years of his directorship were marked by a great increase in the activity of the institution. The observatory grounds were enlarged; two powerful instruments of the novel kind known as *coudé* equatorials were installed; a spectroscopic department was established, and the gigantic task of re-observing all Lalande's stars was completed. He published twenty-one volumes of *Annales*, as well as the first two volumes of the great *Catalogue de l'observatoire de Paris*; founded the *Bulletin astronomique*, and set on foot two schools of practical astronomy, one at Paris, the other at Montsouris, for the special instruction of naval and military officers, explorers and surveyors. His most memorable work, however, was the inauguration of international operations for charting the heavens. The advances in stellar photography made by Paul and Prosper Henry and others suggested to him the magnificent idea of obtaining, through the collaboration of astronomers in all parts of the world, an autographic picture of the entire sphere containing more than fifty million stars, which should faithfully record in future ages the state of the sky at the end of the 19th century. Although he did not live to see its completion, he had the satisfaction of knowing that the ultimate success of this vast scheme was assured. He died suddenly at his country seat at Wissous, near Antony, on the 25th of June 1892.

See *Month. Notices Roy. Astr. Society*, liii. 226; *Observatory*, xv. 305 (D. Klumpke); *Nature*, xlvi. 253; *Rapport annuel sur l'observatoire de Paris pour l'année 1892*. (A. M. C.)

MOUFLON, or Muflon, the wild sheep (*Ovis musimon*) of Corsica and Sardinia, where it is now very local. The ewes are either hornless or provided with quite small horns, the hornless form being probably characteristic of one island and the horned of the other. The rams carry good horns, and in summer show a conspicuous light saddle-shaped mark on the otherwise dark-coloured coat. The Armenian mouflon (*O. orientalis*), of Persia, Armenia, and the Tröodos range of Cyprus, is typically a larger and redder sheep, with the horns curving in the reverse direction; but the Cyprian race is small. (See Sheep.)

MOULD. (1) (O. Eng. *molde*, from a Teutonic root meaning to grind, reduce to powder, cf. "meal"), loose fine earth, rich in organic matter, on the surface of cultivated ground, especially the made garden soil suitable for the growth of plants. In the sense of a furry growth, consisting of minute fungi found on animal or vegetable substances exposed to damp, the word may be either an extension of "mould," earth, or an adaptation of an early "moul," with an additional *d* due to "mould." "Moul" is a Scandinavian word, cf. Swed. *mögla*, to grow musty, and the Eng. colloquial "muggy." (2) A form or pattern, particularly one by means of which plastic materials may be made into shapes, whence "moulding," the form which the material so shaped takes. The word comes through the O. Fr. *modle*, *molle*, from Lat. *modulus*, a measure, or standard. The English "model" is another derivative of the same word.

MOULDINGS, the term in architecture for the decorative treatment given to projecting or receding features in stone, wood and other materials, by means of curved forms, whereby those features are accentuated and varied owing to the play of light and shade on the surfaces. The principal characteristics of all the European styles are to be found in the mouldings employed in them and in their ornamental decoration. In some of the earlier styles, such as the Assyrian and the Persian, there are no mouldings: coloured bands in brick, enamelled tiles or beton, were deemed sufficient to mark the divisions of their storeys or to decorate their buildings. The Egyptians employed two mouldings only, the *cavetto* (fig. 1), a deep moulding sometimes of great dimensions which crowned their pylons, temples and decorative shrines, and the *torus*, a semicircular projecting moulding which was carried above the architrave and down the quoins of their buildings. The Greeks were the first to recognize, in their temples, the special value possessed by mouldings which, occupying an intermediate position between the ornamental sculptures and the simple architectural lines of the main structure, gave a richly decorative effect to the latter without interference with the beauty of the former.

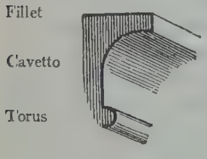


Fig. 1.

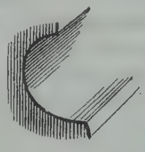


Fig 2.

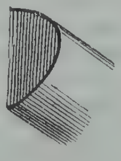


Fig. 3.

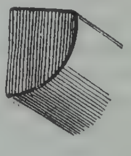


Fig. 4.

The Classic mouldings may be divided into two classes, simple and compound; to the former belong the cavetto (of small dimensions when compared with the Egyptian cavetto) and the Scotia (fig. 2), employed for the bases of columns, which are seen below the eye, both concave mouldings, whilst the ovolo or echinus—Fr. *ove* or *quart de rond*—(figs. 3 and 4) and the torus are convex mouldings. The compound mouldings are those composed of curves of contrary flexure, such as the cymarecta or cymatium (fig. 5), of which the upper part is concave and the lower convex, a moulding constantly employed for the upper member of the cornice, and the cyma-reversa or ogee (fig. 6)—Fr. *talon*—in which the upper portion is convex.

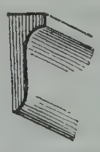


Fig. 5.

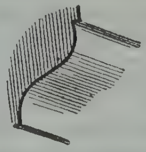


Fig. 6.

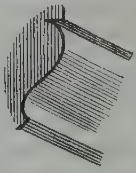


Fig. 7.

The Greeks sometimes varied the ogee moulding, the upper portion of which is turned back and the lower portion brought forward, and to this the term quirked ogee (fig. 7) is given. Another Greek moulding of compound form is the bird's beak (fig. 8), employed as a drip moulding above the corona. Of smaller dimensions is the astragal (fig. 9), a moulding invariably carved with the bead and reel, which in Greek work is constantly used in conjunction with the enriched echinus and cyma-reversa mouldings (figs. 18, 20) and below the necking of Ionic capitals; and the listel or fillet, employed chiefly in the separation of curved mouldings one from the other; in the cymatium constituting its upper termination (fig. 5), and in the Scotia (fig. 2) its upper and lower border. In Classic work generally the cavetto is only employed for the apophyge under the capital and over the base, but in Roman work, as in the theatre of Marcellus, it sometimes took the place of the cymatium of the cornice. Although extremely simple in its form, the finest Greek moulding, and the one to which the Greeks apparently attached the greatest value, was the echinus under the abacus of the Doric capital. The earliest archaic example exists in the capital of the shafts flanking the tomb of Agamemnon at Mycenae (*a*, fig. 10), where it consisted of a large torus decorated with the chevron (see Capitals), and an apophyge carved with the petals of a flower; a similar decoration of the apophyge is found in two or three early Doric capitals, as at Paestum and Metapontum, but this is the only example known in which the echinus of the Doric capital was carved, though traces of painting and gilding have been found on them. Other examples showing the gradual development of the echinus are shown in fig. 10; *b* being from the temple at Corinth, *c* from the Parthenon at Athens, *d* from the portico at Delos, *e* an early Roman example (*c.* 60 B.C.) of the temple at Cori, and *f* from the theatre of Marcellus, where it nearly approaches the quarter round always employed in late Roman work and in the Renaissance.

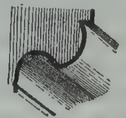


Fig. 8.

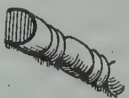


Fig. 9.

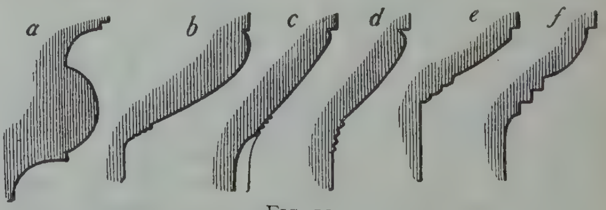


Fig. 10.

There is one other important decorative feature which forms the most characteristic feature of the bedmould of the Ionic cornice, viz. the dentil cornice (fig. 11), derived originally from the ends of the squared timbers which carried the cornice of the primitive Ionic temple, and in the earlier stone examples copied more or less literally; it subsequently in the 4th century was introduced as a part of the bedmould of the cornice of the Ionic Order, the temple of Minerva Polias at Priene in Asia Minor being one of the best examples. It consists of a series of projecting blocks with intervals between them equal to half the width of the block. In the Greek Corinthian Order it was first introduced into the Choragic monument of Lysicrates. It was constantly employed by the Romans in their temples of the Ionic and Corinthian Orders, the finest example being in the bedmould of the temple of Castor in Rome, where it is twice the height of the other mouldings.

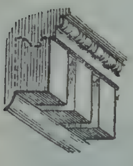


FIG. 11.

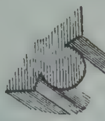


FIG. 12.

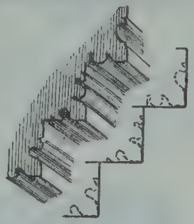


FIG. 13.

In the Romanesque style the mouldings consist almost entirely of rounds and hollows, the former known as the bowtel, and in England, France, Spain and Germany employed to decorate or soften the angle of an arch mould. As the Romanesque arch frequently consisted of two or more rings of arches, projecting one in front of the other, to which rings the term "order" is sometimes given, the repetition of this simple moulding constituted an ample decoration by itself, but in the Norman work in England and the north of France there is found the constant recurrence of mouldings broken into zigzag lines and other decorations coming under the head of ornamental mouldings described below. The simple bowtel (fig. 12) was retained in France far into the Gothic period, but in the Early English style the mouldings (fig. 13) became lighter, being more boldly cut than in the Romanesque styles. Here again, as in the earlier style, each ring or order is enriched with a succession of alternate rounds and hollows, the latter very deeply cut, and a few small fillets. The bowtel also is brought cut to an angle which is sometimes emphasized by a small fillet; this is sometimes called the keel moulding from its resemblance in section to the bottom of a ship. Sometimes the angle of the ring is splayed, and the mouldings are worked on the splay, and this is very often found in the mouldings of the ribs of a vault (fig. 13*a*), giving greater lightness to the rib. The mouldings of the Decorated period (fig. 14) are more diversified than those of the Early English, and the hollows towards the end of the period become shallower and broader, ogees being frequently employed. One of the chief characteristics of the Perpendicular period (fig. 15) is the prevalence of large shallow hollows and the employment of two ogees in close contact with the convex sides next each other.

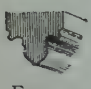


FIG. 13*a*.

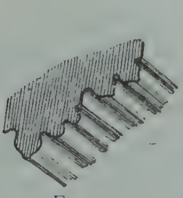


FIG. 14.

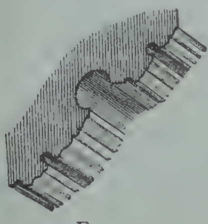


FIG. 15.

The French mouldings of the Gothic period in Normandy and adjacent parts follow very much on the same lines as those in England, but in the south of France and in Germany they are very much simpler, and one rarely finds the deep hollow which forms the chief characteristic of English mouldings. In French flamboyant and late German Gothic work the mouldings run through, penetrating one another; these in Germany were sometimes cut off, having the appearance of the smaller stems of a tree from which some of the boughs have been lopped.

Ornamental Mouldings.—Although the mouldings in Greek and Roman architectural works are in general form much the same, they vary materially in their profiles and also in the refinement of their enrichment with carving. It is probable that the earliest decoration of mouldings was confined to the painting only of their surfaces, and in one or two of the more archaic examples traces of painting only are found on them. The desire to accentuate the ornament would seem to have led the Greeks at a very early date to incise or raise in relief the decorative designs which originally were painted only; at first this was done very sparingly, and in the earlier buildings but few mouldings were employed; in course of time they increased in number, and in the Augustan period in Rome the carving extended to the flat surfaces of the corona, and the fascia and soffits of the architrave.

The four principal Classic mouldings, so far as their enrichment with carving is concerned, were the cyma-recta or cymatium; the cyma-reversa or ogee; the echinus or ovolo; and the torus. The cymatium was almost always decorated with a conventional treatment of the flower of the acanthus plant, known generally as the anthemion and sometimes as the honeysuckle; the finest example is that which is found in the cornice of the north doorway of the Erechtheum (fig. 16). Although in some cases the flower of the acanthus is repeated in the Roman cymatium, the rigidity of the other lines does not seem to have appealed to the Roman sculptor, who preferred more foliage, such as is shown in the cymatium of the Forum of Nerva (fig. 17), there being endless variety of design in Roman examples. The ogee-moulding in Greek work was always carved (fig. 18) with the Lesbian leaf (Fr. *rais-de-cœur*; Ger. *Herzlaub*), which in Roman work received a peculiar interpretation of the original design; not understanding the modelling of the leaf and requiring a deeper shadow, the Roman drilled holes in it and evolved another composition of two leaves, so that the outer edge of the Lesbian leaf formed a trefoil cusp (Fr. *talon trèflé*), constituting a new description of border, as shown in fig. 19, from the temple of Castor at Rome.

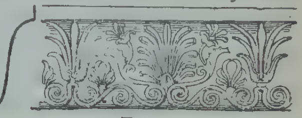


FIG. 16

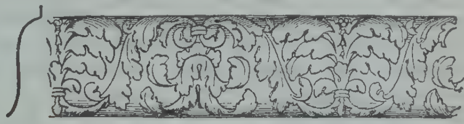


FIG. 17.

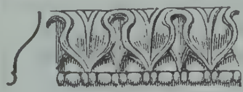


FIG. 18.

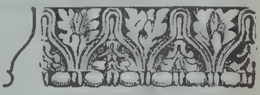


FIG. 19.

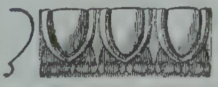


FIG. 20.

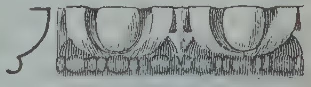


FIG. 21.

The ovolo moulding, whether employed in the bedmould of a cornice, on the capital of an anta, or in the Ionic capital, was always carved (fig. 20) with the egg and dart enrichment (Fr. *ove et dard*; Ger. *Eierstab*), which was spread out wider by the Roman carver, while holes pierced on each side of the tongue changed its design into that of the egg and tongue (fig. 21). In both the enriched ogee and the carved ovolo the design was never complete without the bead and reel underneath (figs. 20 and 21), there being always two beads and four reels to each leaf or egg. When employed as the crowning moulding of an architrave, the ogee is always capped by a fillet; and the same applies to the cymatium of the cornice. When the ogee moulding was of small size and employed in a subordinate position, as is constantly done in Roman work, crowning the modillion or subdividing the fascia of the architrave, a simpler leaf pattern was employed.

Though not a moulding, the modillion, which was invented by the Romans to give additional support to the corona, forms part of the bedmould of the cornice, and may therefore be described here. It consists of a small bracket (fig. 22), the design of which was probably derived from the vertical console bracket which carried the cornice of the Greek doorways, but which in the Roman cornice was employed horizontally. The design of the outer side is that of an Ionic volute with its cushion; on the inner side the volute is reversed and is of greater size, the soffit being masked by a leaf.

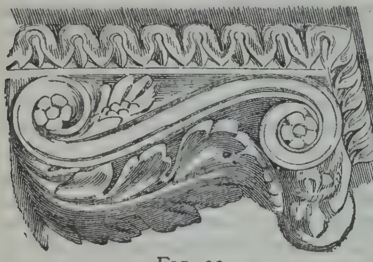


FIG. 22.

The torus moulding of the base in early examples was fluted but not carved, and the earliest example so treated is that found in the base of the columns of the Erechtheum, where it was enriched with the triple guilloche. In the temple of Apollo Branchidae, near Miletus in Asia Minor, where they would seem to have attempted to rival the figure decoration of the temple of Diana at Ephesus, the torus mouldings were elaborately carved with the acanthus plant and the laurel leaf; but it was in the Augustan age in Rome that the greatest elaboration was given to the torus of the base; in the Ara Pacis, set up in A.D. 13, it was carved with the double guilloche; the finest Roman example of an enriched torus being that of the base of the Trajan column in Rome, which is carved with laurel leaves tied at intervals with bands.

The principal enriched Byzantine moulding is that known as the Venetian dentil (fig. 23), in consequence of its constant employment in Venice and the towns in its vicinity. Its earliest appearance, however, is in Sta Sophia at Constantinople (A.D. 537). The other carved Byzantine mouldings are those which throughout Syria form richly carved string-courses, taking the place of the Classic cornice, and the hood moulds of arches. The Byzantine string-course, which is found in St Mark's, Venice, and in most of the towns bordering on the Adriatic, is a cyma-recta carved with the acanthus leaf.

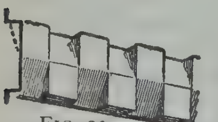


FIG. 23.

The enrichments of the mouldings of the Romanesque style are of great variety; in parts of Italy and in the south of France they were largely influenced by Byzantine work; but in Sicily, Apulia, Normandy and England the Normans introduced a series of purely geometrical forms in which the chief peculiarity is the rare occurrence of foliage. The most characteristic example is that of the zigzag or chevron (figs. 24, 25), of which there are many varieties; then follow the single and double billet (fig. 26), the double cube, the indented, the beakhead (fig. 27), &c. In the transition period in England, flowers and foliage begin to be introduced, and the rosette (fig. 28), the dog-tooth (fig. 29), which develops into a four-leaf flower, and the ball flower (fig. 30) follow, these being all carved in the hollow of cavetto mouldings. In the Decorated and Perpendicular styles, the flowers and foliage introduced in mouldings become more natural, till one reaches the Tudor rose (fig. 31), a precise copy of the flower, beyond which it was difficult to go.

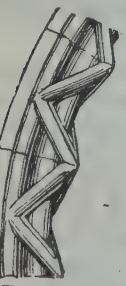


FIG. 24.

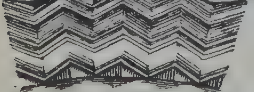


FIG. 25.

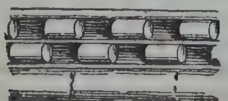


FIG. 26.

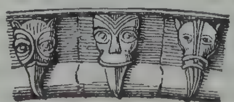


FIG. 27.

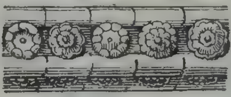


FIG. 28.

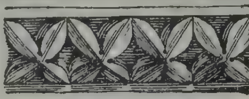


FIG. 29.

In the 16th century the enrichment of mouldings passed through a transitional stage, being half Gothic and half Classic, and on the introduction of the purer Italian style Roman profiles and decoration were again employed. The Greek revival at the commencement, and the Gothic revival in the middle, of the 19th century naturally brought about a reaction in favour either of purer Classic forms or of Gothic work, but the vernacular types could not be displaced by the passing fashion, and the influence of Robert Adam is again paramount to-day. (R. P. S.)

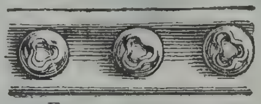


FIG. 30.

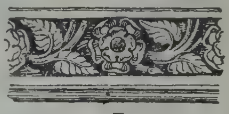


FIG. 31.

MOULIN (Fr. *moulin*, a mill), in physical geography, the name given to the swirling cascades which are formed by glacier streams pouring into crevasses, and result in the formation of giant's kettles.

MOULIN QUIGNON, a quarry near Abbeville, France, celebrated for the discovery in 1863 by Boucher de Perthes of a human jaw-bone believed to be referable to the Quaternary period. By his collection of flints Boucher de Perthes had been the first to attempt to establish the existence of man in remote ages; but it had been objected that if the flints were indeed the work of man, human remains would have been found in association with them. Considerable excitement therefore was created both in England and France by the "find" of bones at Moulin Quignon, and a commission of inquiry was appointed. The report was favourable to the genuineness of the relics, but latterly doubts have arisen as to whether they can be regarded as earlier than the Neolithic age.

MOULINS, a town of central France, capital of the department of Allier, 121 m. by rail N.W. of Lyons. Pop. (1906), 18,997. The town is situated on the right bank of the Allier, which is here crossed by a remarkable bridge of the 18th century about 1000 ft. in length. Moulins did not attain any importance till the 14th century, before which it consisted chiefly of some mills belonging to the dukes of Bourbon. The medieval town occupied a small area, the boundaries of which are marked on the N.E. and S. by the central boulevards occupying the site of the old moats. The modern town, expanding from this nucleus, is limited on the east and south by the railway, the southern portion being traversed by agreeable promenades. To the north is the spacious avenue known as the Cours de Bercy, close by the hospital and the lycée. The more interesting buildings lie within the old enceinte. The chief of these is the cathedral, which consists of a huge choir of the 15th and 16th centuries, and a nave in the early Gothic style but modern in construction and terminated by two towers with stone spires rising to a height of 312 ft. The church possesses a fine triptych attributed to Domenico Ghirlandajo (d. 1494), and fine windows of the 15th and 16th centuries. Among the oldest buildings in the town are the square tower of the 14th century (used as a prison) which is the chief relic of the château of the dukes of Bourbon, and a belfry of the 15th century. Part of an old Jesuit college serves as the court-house, which contains an archaeological museum. The library, which possesses a valuable Bible of 1115, is part of the hôtel-de-ville. Numerous mansions of the 15th and 16th centuries border the streets of the old quarter of the town. There is a statue of the poet Théodore de Banville, born at Moulins in 1823. The town is the seat of a prefect, a bishop, and a court of assizes, and has tribunals of first instance and commerce, and a branch of the Bank of France. Yzeure, 1¼ m. E. of Moulins, has an interesting Romanesque church (12th century); 7½ m. W.S.W. of Moulins is Souvigny, formerly famous for its Cluniac priory. Its church, a fine building of the 11th and 12th centuries, restored in the 15th century, contains the splendid tombs of Louis II. and Charles I., dukes of Bourbon in the 15th century, and other tombs of the Bourbon family, now in ruins.

Moulins became the residence of the dukes of Bourbon about the middle of the 14th century, and capital of the duchy towards the end of the 15th century. In 1566, under Charles IX., an important assembly of notables was held in the town, at which the judicial system of France was reorganized.

MOULMEIN (or MAULMEIN), the port and headquarters of Amherst district and Tenasserim division of Lower Burma. The population in 1901 was 58,346, and the increase in the last quarter of a century has been very slight. Ship-building, which formerly was an important industry, has now been given up, but there is still a considerable export of teak and rice, and there are several steam rice- and saw-mills. The total exports average more than a million sterling. Three steamers run weekly to Rangoon. Germany and Siam are represented by consuls; Persia, Denmark, and Norway and Sweden by vice-consuls; and Italy and the United States of America by consular agents. The garrison of Madras native infantry, formerly stationed in the town, was withdrawn in 1898. The town, which has the appearance of being on a river, the Salween, is really on the sea, with the island of Bilugyun in front. It is one of the most picturesque ports in the East. There is a branch of the Bank of Bengal, and two newspapers are published—one in English and one in Burmese.

MOULT, a term for the shedding of feathers at the periodic renewal of the plumage by birds, and so transferred to the periodic shedding of the old skin, shell, &c., by other animals. The word is seen in O. Eng. in the verb *bimūtian*, to exchange; from Lat. *mutare*, to change; cf. mod. Ger. *mausen, mausern*; the earlier forms in English are *mout, mute*; the insertion of the *l*, as in "fault," dates from the 16th century.

MOULTON, LOUISE CHANDLER (1835–1908), American poet, story-writer and critic, daughter of Lucius L. Chandler, was born in Pomfret, Connecticut, in 1835. In 1855 she married a Boston publisher, William U. Moulton (d. 1898), under whose auspices her earliest literary work had appeared in *The True Flag*. Her first volume of collected verse and prose, *This, That and the Other* (1854), was followed by a story, *Juno Clifford* (1855), and by *My Third Book* (1859); her literary output was then interrupted until 1873 when she resumed activity with *Bed-time Stories*, the first of a series of volumes, including *Firelight Stories* (1883) and *Stories told at Twilight* (1890). Meanwhile she had taken an important place in American literary society, writing regular critiques for the *New York Tribune* from 1870 to 1876 and a weekly literary letter for the Sunday issue of the *Boston Herald* from 1886 to 1892. In 1876 she published a volume of notable *Poems* (renamed *Swallow-flights* in the English edition of 1877) and visited Europe, where she began close and lasting friendships with leading men and women of letters. Thenceforward she spent the summers in London and the rest of the year in Boston, where her salon was one of the principal resorts of literary talent. In 1889 another volume of verse, *In the Garden of Dreams*, confirmed her reputation as a poet. She also wrote several volumes of prose fiction, including *Miss Eyre from Boston and Other Stories*, and some descriptions of travel, including *Lazy Tours in Spain* (1896). She was well known for the extent of her literary influence, the result of a sympathetic personality combined with fine critical taste. She died in Boston on the 10th of August 1908.

See Lilian Whiting, *Louise Chandler Moulton* (Boston, 1910).

MOULTRIE, JOHN (1799–1874), English poet, was born in London on the 30th of December 1799. He was educated at Eton, and many of his best verses were contributed to the *Etonian*. He entered Trinity College, Cambridge, in 1819, and in 1822 began to reside at the Middle Temple. Three years later he was ordained, and was presented to the living of Rugby by Lord Craven. At Rugby he became intimate with Thomas Arnold, to whom two of his best sonnets are addressed. He died at Rugby on the 26th of December 1874. He published several volumes of verse during his lifetime, and a complete edition of his poems was published (2 vols., 1876) with a memoir by Derwent Coleridge. They include, amongst much that is dull, some popular pieces, "Godiva," "Three Minstrels," an account of meetings with Wordsworth, Coleridge and Tennyson, "My Brother's Grave," and some excellent hymns.

MOULTRIE, WILLIAM (1730–1805), American soldier, was born in Charleston, South Carolina, on the 23rd of November 1730. His father, a physician, and a graduate of the University of Edinburgh, migrated to Charleston before 1729. The son was elected to the Commons House of the Assembly in 1754, 1769 and 1772; and in 1760 he was captain of a provincial regiment in the expedition under Governor William H. Lyttelton against the Cherokees. Although he was connected by many ties to the British, he espoused the American cause on the outbreak of the War of Independence, and was a member of the first provincial congress (1775) of South Carolina, which in June made him a colonel of the Second South Carolina regiment; and he was a member of the second provincial congress (1775–1776). On Fort Johnson, on James Island in Charleston harbour, he raised what is said to have been the first American battle-flag—blue, with a white crescent in the dexter corner, inscribed with the word "Liberty"; the flag was devised by him in September 1775. In March 1776 he took command of a palmetto fort which he had built on Sullivan's Island, off Charleston, which he held against the attack of Admiral Sir Peter Parker on the 28th of June, and which soon after the battle was renamed Fort Moultrie by the General Assembly. He was thanked by Congress, was made a brigadier-general in the continental army in September 1776, and was placed in command of the department of Georgia and South Carolina. He dislodged the British from Beaufort, South Carolina, in February 1779, and in April made it possible for the city of Charleston to put itself into a state of defence by delaying the advance of General Augustine Prevost. He was one of those who advised against the surrender of Charleston, where he commanded the garrison until the arrival of General Benjamin Lincoln. His imprisonment after the surrender of Charleston (May 1780) lasted until his exchange with others for General Burgoyne in February 1782. In October 1782 he was made a major-general. He was governor of South Carolina in 1785–1787 and in 1792–1794. He died in Charleston on the 27th of September 1805.

He wrote *Memoirs of the Revolution so far as it Related to the States of North and South Carolina* (2 vols., 1802).

MOUND, now used in the sense of a pile or heap of earth, artificial or natural, especially such a pile raised over a grave or burial-place, a tumulus, or as a means of defence, and so used to translate Lat. *agger*. The earliest use in English is for a hedge or other boundary between adjoining lands; this only survives dialectically. The word is obscure in origin, but was early influenced by "mount," *i.e.* hill; Lat. *mons, montis*. A connexion with O. Eng. *mund*, guardianship, hand, has been suggested. The "orb," *i.e.* a globe of gold surmounted by a cross, as forming part of the regalia (*q.v.*), is often known as a "mound"; this is a translation of Fr. *monde;* Lat. *mundus*, world.

MOUND-BUILDERS, in North America, the name given to the prehistoric inhabitants who chiefly centred in the valleys of the Mississippi and Ohio, and who seem to have possessed a measure of civilization far in excess of that of the North American Indians when first met by the whites. The remarkable mounds, which have given occasion for the name, are fortified enclosures and tumuli of the most varied appearance, round, conical, or in the shape of animals. They are scattered over an immense tract of country from the great lakes to the Gulf of Mexico, and from the Rockies to the Atlantic, but are specially frequent in the valley of the Mississippi, along its left tributaries, in Arkansas, Kansas and the basin of the Ohio. But the old theory that the mound-builders were a distinct race of highly civilized agriculturists, who had lived from remote antiquity in the regions of the mounds and were eventually exterminated by the nomadic hordes coming from the northward, represented to-day by the present Indians, is no longer supported by the principal American ethnologists, who hold that the Indians are their descendants.

In Ohio there are thousands of mounds, some in the form of circles, others four-sided, and in a few cases eight-sided. Sometimes a square and a circle are united. Altar-mounds, small rounded heaps of earth, are found in Ohio. At their centre is a basin-shaped mass of hard clay showing effects of fire. These basins are 3 or 4 ft. across, and contain ashes and charcoal. Upon these altars are found many objects.

The most famous mound in Ohio is the "Great-Serpent," in Adams county. It lies upon a narrow ridge between three streams which unite. It is a gigantic serpent made in earth. Across the widely-opened jaws it measures 75 ft.; the body just behind the head measures 30 ft. across and is 5 ft. high; and, following the curves, the length is 1348 ft. The tail is in a triple coil. In front of the monster is an elliptical enclosure with a heap of stones at its centre. Beyond this is a form somewhat indistinct, thought by some to be a frog.

In Wisconsin the most interesting mounds are the effigy mounds—earthen forms of mammals, birds and reptiles—usually in groups and of gigantic size. Among them are buffalo, moose, elk, deer, fox, wolf, panther and lynx. Some panthers have tails 350 ft. long, and some eagles measure 1000 ft. from tip to tip of outspread wings. Occasionally the figures are cut or sunk in the earth, and near them are hundreds of simple burial mounds. It seems most probable that the purpose of these effigy mounds are totemic, and that they were objects of worship as guardians of the villages.

Further south in west Tennessee another class of mound is found. This contains graves made of slabs of stone set on edge. The simplest have six stones, two at the sides, two at the ends, one at the top and one at the bottom. Sometimes there is one of these graves in a mound, sometimes many. In one, 12 m. from Nashville, 45 ft. across and 12 ft. high, were found a hundred skeletons, mostly in stone graves ranged one above the other. The skeletons in the upper graves had been buried stretched at full length. The lower graves were short and square, and the bones in them had been cleaned and piled in little heaps.

The mound-builders were Stone-Age men, and made many beautiful objects of stone, shell, bone and beaten metals, but they had no knowledge of smelting. That they were not one race is proved by a study of the skulls from the mounds.

AUTHORITIES.—E. G. Squier and E. H. Davis, *Ancient Monuments of the Mississippi Valley* (1847); I. A. Lapham, *Antiquities of Wisconsin* (1855); Stephen D. Peet, *Emblematic Mounds*; Cyrus Thomas, "Burial Mounds of the Northern Sections of the United States," in the *Fifth Report* (Washington, 1887), and "Mound Explorations" in the *Twelfth Report* (1894) of the Bureau of American Ethnology.

MOUNDSVILLE, a city and the county-seat of Marshall county, West Virginia, U.S.A., on the Ohio river, 12 m. S. of Wheeling. Pop. (1900) 5632; (1910) 8918. It is served by the Baltimore & Ohio railroad, by an electric line to Wheeling, and by boats to Pittsburg, Cincinnati and intermediate ports. Near Moundsville, at the mouth of Grave Creek, is Grave Creek Mound, one of the largest relics of the "American mound-builders"; it is in the form of a regular cone, and is about 320 ft. in diameter at the base and 70 ft. in height. Two sepulchral chambers were discovered in it in 1838. In the upper chamber, about half-way between the centre of the base and the apex, was a single skeleton, adorned with beads, copper bracelets and plates of mica; in the lower chamber, directly under the upper and partly in the natural earth, were two skeletons, one adorned with beads and the other without ornament. On the sides and top of the lower chamber was a framework of timbers, which seems to indicate that the mound is of comparatively recent date. The city of Moundsville was formed in 1866 by the consolidation of the town of Moundsville (laid out on the Ohio river in 1831, and incorporated in 1832), and the town of Elizabethtown (laid out, about ½ m. from the river, in 1798, and incorporated in 1830).

MOUNET-SULLY, JEAN (1841–), French actor, was born at Bergerac, on the 28th of February, 1841. He entered the Conservatoire at the age of twenty-one, and took the first prize for tragedy. In 1868 he made his début at the Odéon without attracting much attention. His career was interrupted by the Franco-Prussian War, and the liking he developed for soldiering had almost decided him to give up the stage, when he was offered the opportunity of playing the part of Oreste in Racine's *Andromaque* at the Comédie Française in 1872. His striking presence and voice and the passionate vigour of his acting made an immediate impression, and the eventual result was his election as *sociétaire* in 1874. He became one of the mainstays of the Comédie Française, and distinguished himself in a great variety of tragic and romantic parts. Perhaps his most famous impersonation was that of Oedipus in *L'Oedipe roi*, a French version by Jules Lacroix of Sophocles's drama. This was first performed in the old Roman amphitheatre at Orange in 1888. Other prominent parts in Mounet-Sully's *répertoire* were Achille in Racine's *Iphigénie en Aulide*, Hippolyte in *Phèdre*, Hamlet, the title parts in Victor Hugo's *Hernani* and *Ruy Blas*, Francis I. in *Le Roi s'amuse*, and Didier in *Marion Delorme*. He was created chevalier of the Legion of Honour in 1889. He also wrote a play, *La Buveuse de larmes*, and in 1906, in collaboration with Pierre Barbier, *La Vieillesse de Don Juan* in verse.

MOUNIER, JEAN JOSEPH (1758–1806), French politician, was born at Grenoble (Isère) on the 12th of November 1758. He studied law, and in 1783 obtained a judgeship at Grenoble. He took part in the struggle between the parlements and the court in 1788, and promoted the meeting of the estates of Dauphiné at Vizille (July 20, 1788), which on the eve of the Revolution created an immense stir. He was secretary of this assembly, and drafted the *cahiers* of grievances and remonstrances presented by it to the king. Thus brought into prominence, Mounier was unanimously elected deputy of the third estate to the states general of 1789. There, and in the Constituent Assembly, he was at first an upholder of the new ideas, pronouncing himself in favour of the union of the Third Estate with the two privileged orders, proposing the famous oath of the Tennis Court, assisting in the preparation of the new constitution, and demanding the return of Necker. On the 28th of September 1789 he was elected president of the Constituent Assembly. Being unable, however, to approve the proceedings which followed, Mounier withdrew to Dauphiné, gave in his resignation as deputy, and, becoming suspect, took refuge in Switzerland in 1790. He returned to France in 1801, was named by Bonaparte prefect of the department of Ille-et-Vilaine, which he reorganized, and in 1805 was appointed councillor of state. He died in Paris on the 28th of January 1806. His principal writings are *Considérations sur les gouvernements* (1789); *Recherches sur les causes qui ont empêché les Français de devenir libres* (1792), and *De l'Influence attribuée aux philosophes, aux francs-maçons et aux illuminés sur la révolution de la France* (1801).

See F. A. Aulard, *Les Orateurs de l'assemblée constituante* (2nd ed., Paris, 1905); De Lanzac de Laborie, *Un Royaliste libéral en 1789; J. J. Mounier* (Paris, 1887); A. Rochas, *Biographie du Dauphiné* (Paris, 1856); Berriat St Prix, *Éloge historique de M. Mounier* (1806); F. Boïanovski, "Quelques lettres inédites de J. J. Mounier," in the *Revue historique* (1898).

MOUNT, WILLIAM SIDNEY (1807–1868), American artist, was born at Setauket, Long Island, New York, on the 26th of November 1807. He studied in the schools of the National Academy of Design, New York, and in 1832 was made a full Academician. Among his better-known works are "Turning the Grindstone" and "Farmer's Nooning," Jonathan Sturgis collection; "Turn of the Leaf," Lenox Library, New York; "Bargaining for a Horse," New York Historical Society; "Raffling for a Goose," M. O. Robert's collection; "Long Story," Corcoran Art Gallery, Washington; and "War News," Metropolitan Museum of Art, New York. He died at Setauket, Long Island, on the 19th of November 1868. His brother, Shepard Alonzo Mount (1804–1868), also an artist, best known as a portrait painter, became a National Academician in 1842.

MOUNTAIN (O. Fr. *montaigne*; popular Lat. *montanea*, an adjectival form from the classical *mons*, *montis*, whence Eng. "mount," a form usually used along with the name of an individual mountain, *e.g.* Mt Everest), a natural elevation of the earth's surface. The term properly connotes height superior to that of a hill (O. Eng. *hyll*, cognate with Lat. *collis*); but the distinction depends on the prominence of a given elevation in relation to its surroundings, and in some degree to the bold or gentle character of its outline.

For the classification of mountains according to the various processes of their formation, see GEOGRAPHY, § *Principles of Geography*; and for further details GEOLOGY, § viii.

MOUNTAIN, THE (*La Montagne*), the name applied during the French Revolution to a political group, whose members, called *Montagnards*, sat on the highest benches in the Assembly. The term, which was first used during the session of the Legislative Assembly, did not come into general use until 1793. At the opening of the Convention the Montagnard group comprised men of very diverse shades of opinion, and such cohesion as it subsequently acquired was due rather to the opposition of its leaders to the Girondist leaders than to any fundamental hostility between the two groups. The chief point of distinction was that the Girondists were mainly theorists and thinkers, whereas the Mountain was composed almost entirely of uncompromising men of action. During their struggle with the Girondists, the Montagnards gained the upper hand in the Jacobin Club, and for a time Jacobin and Montagnard were synonymous terms. The Mountain was successively under the sway of such men as Marat, Danton, and Robespierre, and the group finally disappeared after Robespierre's death and the successes of the French arms.

See also the articles JACOBINS, GIRONDISTS and FRENCH REVOLUTION.

MOUNTAIN ASH, an urban district of Glamorganshire, south Wales, in the Aberdare valley on the Cynon, a west bank tributary of the Taff, with stations on the Taff Vale and Great Western railways, 18 m. N.E. of Cardiff. Pop. (1901), 31,093. A branch of the Glamorganshire canal passes through the place. At the beginning of the 19th century Mountain Ash was a small village known only by its Welsh name of Aberpenar, but from 1850, with the development of its collieries, the population rapidly increased. The district has an area of 10,504 acres and comprises; besides Mountain Ash proper, a string of villages, the chief being Cwmpenar, Penrhiwceiber, Abercynon or Aberdare Junction (at the confluence of the Cynon with the Taff) and Ynysybwl, 3 m. to the west on the Clydach. The public buildings include St Margaret's (1862) and St Winifred's (1883), the parish churches of Mountain Ash and Penrhiwceiber respectively; old and new town halls (1864 and 1904), cottage hospital (1896), and a library institute and public hall erected in 1899, at a cost of £8000, by the workmen of Nixon's Navigation collieries. There is a park of 7 acres given in 1897, by Lord Aberdare, whose residence, Duffryn, is in the district. There are also a workmen's institute and a public hall at Penrhiwceiber. The older part of the urban district is included in the parliamentary borough of Merthyr Tydfil, and also shares with Merthyr and Aberdare the services of a stipendiary magistrate.

MOUNTAINEERING, the art of moving about safely in mountain regions, avoiding the dangers incidental to them, and attaining high points difficult of access. It consists of two main divisions, rock-craft and snow-craft. Rock-craft consists in the intelligent selection of a line of route and in gymnastic skill to follow the line chosen. In snow-craft the choice of route is the result of a full understanding of the behaviour of snow under a multitude of varying conditions; it depends largely upon experience, and much less upon gymnastic skill. The dangers which the craft of climbing has been developed to avoid are of two main kinds: the danger of things falling on the traveller and the danger of his falling himself. The things that may fall are rocks, ice and snow; the traveller may fall from rocks, ice or snow, or into crevasses in ice or snow. There are also dangers from weather. Thus in all there are eight chief dangers: falling rocks, falling ice, snow-avalanches, falls from difficult rocks, falls from ice slopes, falls down snow slopes, falls into crevasses, dangers from weather. To select and follow a route avoiding these dangers is to exercise the climber's craft.

Falling Rocks.—Every rock mountain is falling to pieces, the process being specially rapid above the snow-line. Rock-faces are constantly swept by falling stones, which it is generally possible to dodge. Falling rocks tend to form furrows in a mountain face, and these furrows (*couloirs*) have to be ascended with caution, their sides being often safe when the middle is stone-swept. Stones fall more frequently on some days than on others, according to the recent weather. Local experience is a valuable help on such a question. The direction of the dip of rock strata often determines whether a particular face is safe or dangerous; the character of the rock must also be considered. Where stones fall frequently débris will be found below, whilst on snow slopes falling stones cut furrows visible from a great distance. In planning an ascent of a new peak such traces must be looked for. When falling stones get mixed in considerable quantity with slushy snow or water a mud avalanche is formed (common in the Himalaya). It is necessary to avoid camping in their possible line of fall.

Falling Ice.—The places where ice may fall can always be determined beforehand. It falls in the broken parts of glaciers (*seracs*) and from overhanging cornices formed on the crests of narrow ridges. Large icicles are often formed on steep rock-faces, and these fall frequently in fine weather following cold and stormy days. They have to be avoided like falling stones. Seracs are slow in formation, and slow in arriving (by glacier motion) at a condition of unstable equilibrium. They generally fall in or just after the hottest part of the day, and their débris seldom goes far. A skilful and experienced ice-man will usually devise a safe route through a most intricate ice-fall, but such places should be avoided in the afternoon of a hot day. Hanging glaciers (*i.e.* glaciers perched on steep slopes) often discharge themselves over steep rock-faces, the snout breaking off at intervals. They can always be detected by their débris below. Their track should be avoided.

Snow Avalanches.—These mainly occur on steep slopes when the snow is in bad condition, early in the year, or after a recent fresh fall. Days when snow is in bad condition are easily recognized; on such days it may be inadvisable to traverse snow-slopes which at another time may be as safe as a high-road. Beds of snow collected on rock-ledges in bad weather fall off when a thaw comes, and are dangerous to rock-climbers. Snow that has recently fallen upon ice slopes is always liable to slip off bodily. Such falling masses generally make the lower part of their descent by couloirs. Snow avalanches never fall in unexpected places, but have their easily recognizable routes, which can be avoided in times of danger by experienced mountaineers.

Falls from Rocks.—The skill of a rock-climber is shown by his choice of handhold and foothold, and his adhesion to those he has chosen. Much depends on a correct estimate of the firmness of the rock where weight is to be thrown upon it. Many loose rocks are quite firm enough to bear a man's weight, but experience is needed to know which can be trusted, and skill is required in transferring the weight to them without jerking. On all difficult rocks the rope is the greatest safeguard for all except the first man in the ascent, the last in the descent. In such places a party of three or four men roped together, with a distance of 15 to 20 ft. between one and another, will be able to hold up one of their number (except the top man) if one only moves at a time and the others are firmly placed and keep the rope tight between them, so that a falling individual may be arrested before his velocity has been accelerated. In very difficult places help may be obtained by throwing a loose rope round a projection above and pulling on it; this method is specially valuable in a difficult descent. The rope usually employed is a strong Manila cord called Alpine Club rope, but some prefer a thinner rope used double. On rotten rocks the rope must be handled with special care, lest it should start loose stones on to the heads of those below. Similar care must be given to handholds and footholds, for the same reason. When a horizontal traverse has to be made across very difficult rocks, a dangerous situation may arise unless at both ends of the traverse there be firm positions. Even then the end men gain little from the rope. Mutual assistance on hard rocks takes all manner of forms: two, or even three, men climbing on one another's shoulders, or using for foothold an ice-axe propped up by others. The great principle is that of co-operation, all the members of the party climbing with reference to the others, and not as independent units; each when moving must know what the man in front and the man behind are doing. After bad weather steep rocks are often found covered with a veneer of ice (*verglas*), which may even render them inaccessible. Climbing-irons (crampons, *steigeisen*) are useful on such occasions.

Ice Slopes.—Climbing-irons are also most useful on ice or hard snow, as by them step-cutting can sometimes be avoided, and the footing at all times rendered more secure. True ice slopes are rare in Europe, though common in tropical mountains, where newly-fallen snow quickly thaws on the surface and becomes sodden below, so that the next night's frost turns the whole into a mass of solid ice. An ice slope can only be surmounted by step-cutting. For this an ice-axe is needed, the common form being a small pick-axe on the end of a pole as long as from the elbow of a man to the ground. This pole is used also as a walking-stick, and is furnished with a spike at the foot.

Snow Slopes are very common, and usually easy to ascend. At the foot of a snow or ice slope is generally a big crevasse, called a *bergschrund*, where the final slope of the mountain rises from a snow-field or glacier. Such *bergschrunds* are generally too wide to be strided, and must be crossed by a snow bridge, which needs careful testing and a painstaking use of the rope. A steep snow slope in bad condition may be dangerous, as the whole body of snow may start as an avalanche. Such slopes are less dangerous if ascended directly than obliquely, for an oblique or horizontal track cuts them across and facilitates movement of the mass. New snow lying on ice is specially dangerous. Experience is needful for deciding on the advisability of advancing over snow in doubtful condition. Snow on rocks is usually rotten unless it be thick; snow on snow is likely to be sound. A day or two of fine weather will usually bring new snow into sound condition. Snow cannot lie at a very steep angle, though it often deceives the eye as to its slope. Snow slopes seldom exceed 40°. Ice slopes may be much steeper. Snow slopes in early morning are usually hard and safe, but the same in the afternoon are quite soft and possibly dangerous; hence the advantage of an early start.

Crevasses.—These are the slits or deep chasms formed in the substance of a glacier as it passes over an uneven bed. They may be open or hidden. In the lower part of a glacier the crevasses are open. Above the snow-line they are frequently hidden by arched-over accumulations of winter snow. The detection of hidden crevasses requires care and experience. After a fresh fall of snow they can only be detected by sounding with the pole of the ice-axe, or by looking to right and left where the open extension of a partially hidden crevasse may be obvious. The safeguard against accident is the rope, and no one should ever cross a snow-covered glacier unless roped to one, or better to two, companions.

Weather.—The main group of dangers caused by bad weather centre round the change it effects in the condition of snow and rock, making ascents suddenly perilous which before were easy, and so altering the aspect of things as to make it hard to find the way or retrace a route. In storm the man who is wont to rely on a compass has great advantage over a merely empirical follower of his eyes. In large snow-fields it is, of course, easier to go wrong than on rocks, but a trained intelligence is the best companion and the surest guide.

History.—The first recorded mountain ascent after Old Testament times is Trajan's ascent of Etna to see the sun rise. The Roche Melon (11,600 ft.) was climbed in 1358. Peter III. of Aragon climbed Canigou in the Pyrenees in the last quarter of the 13th century. In 1339 Petrarch climbed Mt Ventou near Vaucluse. In 1492 the ascent of Mt Aiguille was made by order of Charles VIII. of France. The Humanists of the 16th century adopted a new attitude towards mountains, but the disturbed state of Europe nipped in the bud the nascent mountaineering of the Zürich school. Leonardo da Vinci climbed to a snow-field in the neighbourhood of the Val Sesia and made scientific observations. Konrad Gesner and Josias Simler of Zürich visited and described mountains, and made regular ascents. The use of axe and rope were locally invented at this time. No mountain expeditions of note are recorded in the 17th century. In 1744 the Titlis was climbed—the first true snow-mountain. Pococke and Windham's historic visit to Chamonix was made in 1741, and set the fashion of visiting the glaciers. The first attempt to ascend Mont Blanc was made in 1775 by a party of natives. In 1786 Dr Michel Paccard and Jacques Balmat gained the summit for the first time. De Saussure followed next year. The Jungfrau was climbed in 1811, the Finsteraarhorn in 1812, and the Zermatt Breithorn in 1813. Thenceforward tourists showed a tendency to climb, and the body of Alpine guides began to come into existence in consequence. Systematic mountaineering, as a sport, is usually dated from Sir Alfred Wills's ascent of the Wetterhorn in 1854. The first ascent of Monte Rosa was made in 1855. The Alpine Club was founded in London in 1857, and soon imitated in most European countries. Edward Whymper's ascent of the Matterhorn in 1865 marks the close of the main period of Alpine conquest, during which the craft of climbing was invented and perfected, the body of professional guides formed and their traditions fixed. Passing to other ranges, the exploration of the Pyrenees was concurrent with that of the Alps. The Caucasus followed, mainly owing to the initiative of D. W. Freshfield; it was first visited by exploring climbers in 1868, and most of its great peaks were climbed by 1888. Trained climbers turned their attention to the mountains of North America in 1888, when the Rev. W. S. Green made an expedition to the Selkirks. From that time exploration has gone on apace, and many English and American climbing parties have surveyed most of the highest groups of snow-peaks; Pike's Peak (14,147 ft.) having been climbed by Mr E. James and party in 1820, and Mt Saint Elias (18,024 ft.) by the duke of the Abruzzi and party in 1897. The exploration of the highest Andes was begun in 1879–1880, when Whymper climbed Chimborazo and explored the mountains of Ecuador. The Cordillera between Chile and Argentina was attacked by Dr Güssfeldt in 1883, who ascended Maipo (17,752 ft.) and attempted Aconcagua (23,393 ft.). That peak was first climbed by the Fitzgerald expedition in 1897. The Andes of Bolivia were explored by Sir Martin Conway in 1898. Chilean and Argentine expeditions revealed the structure of the southern Cordillera in the years 1885–1898. Sir Martin Conway visited the mountains of Tierra del Fuego in 1898. The Alps of New Zealand were first attacked in 1882 by the Rev. W. S. Green, and shortly afterwards a New Zealand Alpine Club was founded, and by their activities the exploration of the range was pushed forward. In 1895 Mr E. A. Fitzgerald made an important journey in this range. Of the high African peaks, Kilimanjaro was climbed in 1889 by Dr Hans Meyer, Mt Kenya in 1889 by J. E. S. Mackinder, and a peak of Ruwenzori by H. J. Moore in 1900. The Asiatic mountains have as yet been little climbed, though those that lie within the British Empire have been surveyed. In 1892 Sir Martin

Conway explored the Karakoram Himalayas, and climbed a peak of 23,000 ft. In 1895 A. F. Mummery made a fatal attempt to ascend Nanga Parbat, whilst in 1899 D. W. Freshfield took an expedition to the snowy regions of Sikkim. In 1899, 1903, 1906 and 1908 Mrs Fannie Bullock Workman made ascents in the Himalayas, including one of the Nun Kun peaks (23,300 ft.). A body of Gurkha sepoys were trained as expert mountaineers by Major the Hon. C. G. Bruce, and a good deal of exploration has been accomplished by them. The only mountains of the northern polar region that have been explored are those of Spitzbergen by Sir Martin Conway's expeditions in 1896 and 1897, and the peaks in the north of Norway and the Lofotens by various Alpine Club and Norwegian parties. (W. M. C.)

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MOUNT BARKER, a town of Hindmarsh county, South Australia, at the foot of the mountain of the same name, 34½ m. by rail E. of Adelaide. It has an extremely fine climate and is much frequented as a health resort in summer. It is the centre of a populous and fertile district producing quantities of fruit, wheat and dairy produce; important cattle sales are held weekly, and there are several engineering works, flour mills and tanneries in the town, which also is the seat of a wattle-bark industry. Pop. about 2000; but the inhabitants of the Mount Barker district number over 34,000.

MOUNT CARMEL, a borough of Northumberland county, Pennsylvania, U.S.A., at the head of Shamokin Creek, about 50 m. N.N.E. of Harrisburg. Pop. (1890), 8254; (1900), 13,179, of whom 3772 were foreign-born; (1910 census) 17,532. It is served by the Lehigh Valley, the Philadelphia & Reading, and the Shamokin Division of the Northern Central (Pennsylvania system) railways. Anthracite coal abounds here, and the mining and shipping of it, together with the manufacture of mining machinery and miners' supplies are the borough's principal industries. This locality was settled late in the 18th century. About 1848 Mount Carmel was laid out as a town, and in 1862 was chartered as a borough.

MOUNT CLEMENS, a city and the county seat of Macomb county, Michigan, U.S.A., on Clinton river, about 5 m. (about 2 m. in direct line) from its entrance into Lake Saint Clair, and 20 m. N. by E. of Detroit. Pop. (1890) 4748; (1900) 6576 (1194 foreign-born); (1904, state census) 7108; (1910) 7707. It is served by the Grand Trunk railway and by two electric lines to Detroit. The mineral waters of Mount Clemens are beneficial to patients suffering from rheumatism, blood diseases and nervous disorders. The city's principal manufactures are beet sugar, barrels and other cooperage products, wagons, carriages, sleighs and agricultural implements. Mount Clemens was settled in 1802, was incorporated as a village in 1837, and was chartered as a city in 1879.

MOUNT DESERT, an island in Hancock county, Maine, U.S.A. It is about 16 m. long and 10 m. wide in its widest part, with an approximate area of 100 sq. m. and a population (1910) of 8014. The Maine Central railroad runs a ferry from its nearest station on the mainland (Mount Desert Ferry), and the island is also accessible during the warmer months by steamship lines from New York, Boston, Portland, and several other ports. On the north across Mount Desert Narrows, a bridge connects the island with the mainland. Eagle Lake, at the north-east base of Green Mountain, is a beautiful sheet of water about 2½ m. long, and ½ m. wide, and Great Pond, 4 m. long, lies near Somesville between Beech Hill and Western Mountain. There are numerous outlying rocky islets. The surface of Mount Desert is generally so rocky that the greater part of it has never been inhabited or cultivated, but wherever there is a thin soil the hills are wooded with spruce, alder, birch, maple and mountain ash. The hilly scenery, the cool summer climate, and the facilities for boating and fishing attract many thousands of visitors each summer, and the maintenance of the permanent population is derived very largely from the summer residents. The Penobscot and Passamaquoddy Indians come here in the season to sell their basket-work, toy canoes, moccasins, bows and arrows, &c. The villages most frequented by summer visitors are Bar Harbor (*q.v.*) on the north-east coast; Northeast Harbor, Southwest Harbor and Seal Harbor on the south coast; and Somesville, at the head of Somes Sound. Along the western shore are several quaint old hamlets.

Mount Desert Island was discovered and named by Samuel de Champlain on the 5th of September 1604. French Jesuits established a settlement, St Sauveur, at the entrance to Somes Sound in 1609, but this was destroyed four years later by Samuel Argall. In 1688 the island was granted by Louis XIV. to Sieur de la Mothe Cadillac, but no permanent settlement was established until 1762, when the general court of Massachusetts granted one-half of the island to Governor Francis Bernard and under his encouragement a settlement was begun at Southwest Harbor. During the War of Independence all the American estates of Bernard were confiscated, but in 1785 his former interest in Mount Desert was conveyed to his son, John, and two years later heirs of Cadillac, among them his granddaughter, Mme de Gregoire, who had come to Maine in 1786, received from the general court a grant for the remaining portion. Until the summer visitors came, the settlers gained only a scanty livelihood, chiefly by fishing, lumbering, boat building and farming. Practically all of them lived along the shore; they had boats, but few horses, and the roads were only rough trails. There is no record of any mail service until 1820, and as late as 1870 the only means of reaching the island was by stage from Bangor or by steamboat twice a week from Portland.

See George E. Street, *Mount Desert, a History* (Boston, 1905).

MOUNTEBANK (Ital. *montambanco*, *montimbanco*, from *montare*, to climb up on, mount, and *banco*, bench, cf. *saltimbanco*, an acrobat or dancer, one who dances or leaps on a bench), a wandering juggler, story-teller, seller of quack medicines, &c., who performs his entertainment on a platform or raised bench, hence any charlatan or quack.

MOUNTED INFANTRY, infantry soldiers who ride instead of marching on foot from one place to another. As combatants they are infantry pure and simple, being neither armed nor trained to fight on horseback, and their special characteristic is the power to move from one point to another with great rapidity. They are therefore useful (*a*) in wars, such as colonial wars, in which cavalry proper finds no scope for its activity, and (*b*) in performing duties for which mounted troops, but not necessarily troops that can fight mounted, are required. In these two rôles mounted infantry is obviously a substitute for cavalry. As cavalry is both a most expensive arm and one which cannot be improvised, there is an ever-recurring tendency in all armies to consider it as being more ornamental than useful, and in consequence to substitute mounted infantry under one name or another (the original dragoons for example were mounted infantry) for "shock action" cavalry. In recent times, owing to the development of the long-ranging magazine rifle, this tendency has been intensified to such a degree that Russia, for example, converted the whole of her cavalry into dragoons—the term being used in its old sense—and trained it to act dismounted in large bodies. It is however significant of the failure of this wholesale conversion that after the Russo-Japanese War the regiments that were formerly hussars and lancers were reorganized as such and ceased to be styled and trained as dragoons.

It is difficult, but at the same time important, to differentiate between dragoons or "mounted rifles," as they are often called to-day, and mounted infantry in a narrower sense of the word.

Mounted rifles are half cavalry, mounted infantry merely specially mobile infantry. The American cavalry in the Civil War, the Boers in the South African War, the Russians in the Manchurian campaign, were mounted rifles, and the question of their advantages and disadvantages, as compared with what is generally called "regular" cavalry, is purely a cavalry one. The main question as regards mounted infantry is whether its existence as a special arm is justified by the kind and degree of assistance which it is peculiarly qualified to give to the other arms in war. If this be answered in the affirmative for a particular army, then that army, having raised mounted infantry, may require of it such additional services as it would be more or less uneconomical to assign to regular cavalry. Mounted infantry in this case may and in fact does assume the rôle of mounted rifles; for example, in the British regular army the duties of divisional mounted troops are performed by mounted infantry, while in the territorial army the same duties are performed by yeomanry mounted rifles.

In the British mounted infantry, which is the only force in any army specially trained as such,[1] the course of instruction lasts four months and is based on the assumption that officers and men under instruction are already fully trained as infantry (*M.I. Training*, 1909). All words of command, bugle sounds, formations, &c., are similar to those used in the infantry, and as a rule spurs are forbidden. The mounted infantry horse is a handy cob (14·2 to 15). The organization adopted is by battalions and companies, each company having 6 officers and 153 men, and the battalion consisting of three such companies and a machine-gun section. Mounted infantry battalions and companies do not exist in peace, but are formed on mobilization from the qualified men available who can be spared from the infantry. Since many more men are trained than would be required for the 24 or 26 companies forming part of the expeditionary force, the arm is capable of considerable expansion, while the men first selected for the service are in every way picked men. As already mentioned its duties are (*a*) with respect to the cavalry, first to assist and secondly to supplement or replace it—by the judicious use of the rifle, and (*b*) with respect to the infantry to relieve the unmounted man as far as possible of reconnoitring and orderly duties, and above all of the necessity of hurried and exhausting movements to seize points of support.

Cyclists.—The application of the bicycle to military purposes was first suggested in Great Britain, and military cycling became the special and almost exclusive property of the volunteer force, in which, when cycling became universally popular and the machines cheap, practically all battalions had sections and most of them companies of cyclists. In those days, however, the want of a common organization separated the yeomanry from the volunteers, and the latter, possessing no mounted troops of its own, employed its numerous cyclists in reconnoitring, protective and orderly work indifferently. Provisional battalions were frequently formed, and in spite of their heterogeneous composition and inadequate staff they proved capable of manœuvring as units. Movements in brigade were practised at Aldershot in 1901, the brigade composed of 3 battalions of about 650 rifles each, drawn from some forty volunteer infantry units under training at the time, being trained in combined movements by parallel roads and night marching, as well as in field operations. When the fusion of the yeomanry and volunteers in the territorial force (1907–1908) released cyclists from the duties of mounted troops which had hitherto been imposed on them, the cyclist companies in the infantry battalions were disbanded, and their place taken by 10 cyclist battalions specially trained for protective work in large tactical bodies. The regular army, which is generally employed in almost roadless countries, only maintains a few cyclists for orderly work.

Amongst the regular armies that of France was certainly the pioneer in the matter of cycling. Infantry support for cavalry is a fundamental principle of the French doctrine of tactics, and this infantry support in so well-roaded a country as France naturally takes the form of strong cyclist groups. The French military cyclists are equipped with a folding bicycle, which allows of cross-country movement being undertaken without leaving the bicycles unguarded. In Germany very few military cyclists are maintained—one small section in each infantry or cavalry regiment. The field service regulations permit the grouping of these sections for united action as a company, but only under special circumstances. In Italy, however, whole battalions of the fast-moving light troops, *Bersaglieri*, have been within recent years provided with the cycle.

Cyclists are mounted infantry in the strictest possible sense of the phrase. They possess over all horsemen the incalculable advantages of being able to make longer marches; for they can cover 80 or 90 m. a day for several days;[2] of exemption from forage anxieties; of freedom from the necessity in action of leaving one-third or one-quarter of the men to hold the horses; and of actual speed, an ordinary cyclist being able to move faster along a good road than a staff officer mounted on a thoroughbred. On the other hand cyclist troops can never be as free to move across country as horsemen; a cyclist column, owing to its speed and great length in proportion to its numbers, is peculiarly liable to surprise; and the condition of the roads or a strong head wind materially reduces its rate of marching.

MOUNTFORT, WILLIAM (c. 1664–1692), English actor and dramatic writer, was the son of a Staffordshire gentleman. His first stage appearance was with the Dorset Garden company about 1678, and by 1682 he was taking important parts, usually those of the fine gentleman. Mountfort wrote a number of plays, wholly or in part, and many prologues and epilogues. He married, in 1686, Susanna Percival (see VERBRUGGEN, MRS), the actress. Owing to jealousy of Mrs Bracegirdle's supposed interest in Mountfort, Captain Richard Hill, an adventurer, who had annoyed her with persistent attentions, accompanied by Charles, fifth Baron Mohun, murdered Mountfort in Howard Street, Strand, on the 9th of December 1692. Hill made his escape. Lord Mohun was tried by his peers and acquitted by a vote of 69 to 14.

MOUNT GAMBIER, a town of Grey county, South Australia, 305 m. by rail S.E. of Adelaide. It stands on the northern base of the mountain of the same name, an extinct volcano. It is a handsome town with many fine buildings of white limestone and grey and red dolomite, which abound in the neighbourhood, the church of St Paul being the finest edifice of its kind outside Adelaide. The agricultural society has a good showground where two shows are held annually. Two splendid lakes lie near the town—Blue Lake, 160 acres in extent, and Valley Lake, 97 acres, from the first of which the water-supply of the town is derived. Mount Gambier is the centre of one of the richest grain-growing districts in Australia. Pop. (1901), 3162; and including the suburbs, about 8000.

MOUNT HOLYOKE COLLEGE, the pioneer institution in America for the higher education of women, situated in the village of South Hadley, Massachusetts, near Mount Holyoke. It was founded by Mary Lyon (*q.v.*), and was chartered as Mount Holyoke Female Seminary in 1836 (opened in 1837), but the name was changed to Mount Holyoke College in 1893. Besides the recitation halls and laboratories there are the Dwight Memorial art building (1901), a library building (1905), the John Payson Williston observatory, botanical gardens (1901), a gymnasium, a hospital, and seven residence halls. For undergraduates the college offers two years of work in prescribed courses in Latin, Greek, French, German, English, history, Biblical literature, profane literature, physics, and chemistry, and two years of work in elective courses; for graduates it offers one year of advanced work, including courses in education designed for those preparing to teach. To make college expenses lighter and to "promote a spirit of democracy and of consideration for others" every student helps either in housework or in the academic departments. In 1908–1909 the college had 110 instructors and 748 students.

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[1] The infantry "mounted scouts" of the Russian and French armies are simply auxiliaries and have no existence apart from their regiments.

[2] The loss of men by accidents to the machines, punctures, &c., has been shown in manœuvres to be nearly negligible.

MOUNTJOY (or MONTJOY), **BARONS AND VISCOUNTS.** Sir Walter Blount (d. 1474), of Elvaston, Derbyshire, grandson of Sir Walter Blount, who was an adherent of John of Gaunt, succeeded his father, Sir Thomas Blount, as treasurer of Calais in 1460, becoming governor a year later as a reward for service rendered to King Edward IV. at the battle of Towton. Edward conferred on him rich estates forfeited by the earl of Devon; and in 1465 Blount was made lord high treasurer and created Baron Mountjoy. This creation is noteworthy as one of the earliest examples of a baronial title not being of a territorial character; nor the title of a dignity already existing. Blount's great-grandfather had married Isolda, daughter and heiress of Sir Thomas de Mountjoy, and the title was probably chosen to commemorate this alliance.

WILLIAM BLOUNT, 4th Baron Mountjoy (*c.* 1478–1534), was famous as a scholar and patron of learning. He was a pupil of Erasmus, who called him *inter nobiles doctissimus*. His friends included Colet, More and Grocyn. He held a command in the force sent to suppress Perkin Warbeck's rebellion in 1497. In 1513 he was appointed governor of Tournai, and his letters to Wolsey and Henry VIII. describing his vigorous government of the town are preserved in the British Museum. He was present with Henry VIII. at the Field of the Cloth of Gold in 1520, and at the meeting with Charles V. in 1522. He had been master of the mint since 1509, and chamberlain to Catherine of Aragon since 1512. It fell to him in this office to announce to the queen Henry's intention to divorce her; he also signed the letter to the pope conveying the king's threat to repudiate the papal supremacy unless the divorce were granted. Mountjoy, who was one of the wealthiest English nobles of his time, died in 1534. His son Charles, 5th Baron Mountjoy (1516–1544), was also a patron of learning.

CHARLES BLOUNT, earl of Devonshire and 8th Baron Mountjoy (1563–1606), lord-lieutenant of Ireland, grandson of the preceding, was the most notable of the later holders of the title. The favour which his youthful good looks procured for him from Queen Elizabeth excited the jealousy of the earl of Essex, and led to a duel between the two courtiers, who, however, soon became close friends. Between 1586 and 1598 he was much on the continent, serving in the Netherlands and in Brittany. He joined Essex and Sir Walter Raleigh in their expedition to the Azores in 1597, his brother, Sir Christopher Blount (1565–1601), who was afterwards executed for complicity in Essex's treason, being also of the party. In 1600 Mountjoy went to Ireland as lord deputy in succession to Essex, where he succeeded in suppressing the rebellion of Hugh O'Neill, earl of Tyrone, whom Essex had failed to subdue. In July 1601 Mountjoy made himself master of Lough Foyle, and in the following December he defeated O'Neill's Spanish auxiliaries at Kinsale, and drove them out of the country. In 1602 the earl of Tyrone made his submission to Mountjoy in Dublin (see O'NEILL); and on the accession of James I. Mountjoy was continued in his office with the more distinguished title of lord-lieutenant. Returning to England, he was one of Sir Walter Raleigh's judges in 1603; and in the same year he was made master of the ordnance and created earl of Devonshire, extensive estates being also granted to him. He died in London on the 3rd of April 1606. About 1590 Mountjoy took as his mistress Penelope, wife of Lord Rich and sister of the earl of Essex. After the death of her brother in 1601, Lady Rich was divorced from her husband in the ecclesiastical courts. Mountjoy, by whom she had already had several children, was married to the lady in 1605 by his chaplain, William Laud, afterwards archbishop of Canterbury. As he left no legitimate children the earl's titles became extinct at his death.

His eldest natural son by Lady Rich, MOUNTJOY BLOUNT (*c.* 1597–1666), inherited a large property by his father's will, and was a favourite with James I. The family title was revived in his favour in 1618, when he was created Baron Mountjoy, of Mountjoy Fort, Co. Tyrone, in the peerage of Ireland; and Baron Mountjoy of Thurveston, Derbyshire, in the peerage of England. In 1628 he was further created earl of Newport in the Isle of Wight. In the same year he was appointed to command, with the rank of rear-admiral, the expedition for the relief of Rochelle; in 1634 he was made master of the ordnance. He took the popular side at the beginning of the trouble between Charles I. and the parliament, and was an eager opponent of Strafford. When the Civil War broke out, however, Newport served in the royalist army, and took part in the second battle of Newbury in 1644. In January 1646 he was taken prisoner and confined in London on parole. He died at Oxford on the 12th of February 1666, leaving two surviving sons, who in turn succeeded to the earldom of Newport and barony of Mountjoy. Both titles became extinct on the death of Henry, the younger of these sons, in 1681.

In 1683 SIR WILLIAM STEWART (1653–1692), who owned large property in the counties of Donegal and Tyrone, and whose grandfather was created a baronet in 1623, was raised to the peerage of Ireland as Baron Stewart of Ramelton, Co. Donegal, and Viscount Mountjoy. Having served abroad, Mountjoy returned to Ireland in 1687, where he became brigadier-general. At the revolution he remained loyal to James II.; but being a Protestant he was distrusted by Tyrconnel, the viceroy, and was removed with his troops from Londonderry to Dublin. When the gates of Londonderry were closed against James's representative, Tyrconnel sent Mountjoy and Robert Lundy with a force to the north. After negotiations which resulted in Lundy being admitted as governor to the city, Mountjoy was sent with Sir Stephen Rice to Paris to report on the state of affairs to James II. On their arrival, Rice acting on secret instructions, denounced Mountjoy as a traitor, and the latter was thrown into the Bastille, where he remained till 1692. He then went over to William III., and was killed at Steinkirk on the 3rd of August 1692.

WILLIAM, 3rd Viscount Mountjoy (1709–1769), was in 1745 created earl of Blesington, his mother having been sister and sole heiress of Charles, 2nd and last Viscount Blesington. On his death without issue in 1769 all his titles became extinct. Anne Stewart, daughter and heiress of Alexander Stewart, second son of the above-mentioned William, 1st Viscount Mountjoy, married Luke Gardiner, vice-treasurer of Ireland; and her grandson, Luke Gardiner (1745–1798), who inherited a large portion of the Mountjoy family estates, was created Baron Mountjoy of Mountjoy, Co. Tyrone (1789), and Viscount Mountjoy (1795), both in the peerage of Ireland; but on the death without male issue in 1829 of his son Charles John, who in 1816 was created earl of Blesington, all these titles again became extinct.

THOMAS WINDSOR, or HICKMAN-WINDSOR (*c.* 1670–1738), second son of Thomas, Lord Windsor de Stanwell, 1st earl of Plymouth, was in 1699 created Viscount Windsor of Blackcastle, in the peerage of Ireland. In 1712 he was created a peer of Great Britain with the title of Baron Mountjoy of the Isle of Wight, being descended in the female line from Sir Andrew Windsor (*c.* 1475–1543), 1st Baron Windsor de Stanwell, who married Elizabeth Blount, sister and co-heir of Edward, 2nd Baron Mountjoy of the first creation, who died an infant in 1475. On the death of Thomas's son Herbert in 1758 the title of Mountjoy again became extinct; but it was revived in favour of John Stuart, earl of Bute, who married Charlotte Jane Hickman-Windsor, Herbert's daughter and sole heiress, and who in 1796 was created Viscount Mountjoy of the Isle of Wight, earl of Windsor, and marquess of the county of Bute, all of which titles are held by his descendant, the present marquess of Bute.

See Sir Alexander Croke, *The Genealogical History of the Croke family, originally named Le Blount* (2 vols., Oxford, 1823). For the Irish lord deputy, see also W. B. Devereux, *Lives and Letters of the Devereux, Earls of Essex* (2 vols., London, 1853); Fynes Moryson, *Itinerary* (London, 1617). Also, G. E. C., *The Complete Peerage* (London, 1889).

MOUNTMELLICK, a market town of Queen's county, Ireland, pleasantly situated on the Owenass (an affluent of the Barrow) which nearly encircles it. Pop. (1901), 2407. It is the terminus of a branch of the Great Southern & Western railway, 7½ m. N. of Maryborough and 58½ W.S.W. of Dublin. A branch of the Grand Canal also reaches the town, providing water communication with Dublin, and with Waterford by the river Barrow. There are industries of malting, tanning, woollen and salt manufactures, and iron-founding. A settlement of Quakers has contributed largely to the prosperity of the town. A provincial school of the Leinster Society of Friends was founded here in 1796.

MOUNT MORGAN, a municipality of Raglan county, Queensland, Australia, 28 m. by rail S.S.W. of Rockhampton. Pop. (1901), 6280. Railway communication was opened in 1898. The town has been considered to stand on the richest gold site in Australia, the gold being very fine and pure.

MOUNT SORREL, a market town in the Loughborough (Mid) parliamentary division of Leicestershire, on the river Soar, 7 m. N. of Leicester. Pop. (1901), 2417. The Sileby station on the Midland main line lies 1½ m. E. The position is beautiful, a steep hill, once crowned by a castle, rising above the well-wooded valley. At Barrow-upon-Soar, 2½ m. N. (pop. 2409; Barrow and Quorn railway station), lime is worked extensively. The village of Quorndon or Quorn, 1½ m. N.W., is the headquarters of the well-known Quorn hunt. Quorndon is an urban district (pop. 2173).

MOUNTSTEPHEN, GEORGE STEPHEN, Baron (1829–), Canadian financier, was born on the 5th of June 1829 at Dufftown, Banffshire, Scotland, the son of William Stephen and Elspeth Smith. He was educated at the parish school, after which he was for a time a herd boy. In 1850 he went to Canada and soon became a prominent business man in Montreal. In 1878 he joined with his cousin, Donald Smith (afterwards Lord Strathcona), in the purchase of the St Paul & Pacific railway. This led to his interest in the development of western Canada, and from 1881 onwards he was associated with his cousin in the construction of the Canadian Pacific railway, for his services in connexion with which he was in 1886 made a baronet, in 1891 raised to the peerage; and in 1905 made G.C.V.O. In 1888 he left Canada, and thereafter lived in England and Scotland. He gave lavishly to charity and education, and with Lord Strathcona built and endowed the Royal Victoria hospital at Montreal.

MOUNT-TEMPLE, WILLIAM FRANCIS COWPER-TEMPLE, Baron (1811–1888), English politician, second son of the 5th Earl Cowper, was born at Brocket Hall, Hertfordshire, on the 13th of December 1811. He was educated at Eton, and entered the Royal Horse Guards, attaining the rank of brevet-major in 1852. His mother, Emily Mary, was sister to the prime minister, Lord Melbourne, whose secretary William Cowper became in 1835; in this year he entered parliament as member for Hertford, which he continued to represent until 1863. As commissioner of works (1860–1866) he carried the bills for the Thames Embankment (1862), and for the new law courts (1863); but he is best known for the amendment, known as the "Cowper-Temple clause," which he introduced into the second reading of the Education Bill of 1870, that no catechism nor denominational teaching of any kind should be included in the religious instruction given in rate-aided schools. His mother, who married Lord Palmerston as her second husband, died in 1869, and under his stepfather's will William Cowper succeeded to some of the Palmerston estates in Ireland and Hampshire, and assumed the additional name of Temple. He was M.P. for South Hampshire from 1868 until 1880 when he was raised to the peerage as Baron Mount-Temple of Mount-Temple, Sligo. He died at Broadlands, near Romsey, on the 16th of October 1888. He was twice married, but left no children, the Palmerston estates descending to the Right Hon. Evelyn Ashley (1836–1907), who was under-secretary of state for the colonies from 1882 to 1885.

MOUNT VERNON, a city and the county-seat of Jefferson county, Illinois, U.S.A., about 75 m. E. by S. of St Louis. Pop. (1890), 3233; (1900), 5216 (111 foreign-born); (1910), 8007. It is served by the Chicago & Eastern Illinois, the Louisville & Nashville, the Wabash, Chester & Western, and the Southern railways. It is the headquarters of the fourth appellate court district of the state. Mount Vernon was settled in 1819, incorporated as a village in 1837 and chartered as a city in 1872. Many of its buildings were destroyed by a cyclone on the 19th of February 1888.

MOUNT VERNON, a city and the county-seat of Posey county, Indiana, U.S.A., on the Ohio river, in the extreme south-west corner of the state. Pop. (1890) 4705; (1900), 5132, including 892 negroes and 262 foreign-born; (1910), 5563. It is served by the Evansville & Terre Haute, the Louisville & Nashville, and the Evansville & Mount Vernon (electric) railways. The city is a trading centre for the surrounding farming region. It has a valuable river trade, and various manufactures. The first settlement here was made in 1803, and in 1819 a town was laid out and named Mount Vernon. It became the county-seat in 1825, and was incorporated as a town in 1846 and chartered as a city in 1865.

MOUNT VERNON, a town of Linn county, Iowa, U.S.A., 16 m. E. of Cedar Rapids. Pop. (1900), 1629; **(1910, U.S.** census), **1532.** Mount Vernon is served by the Chicago & North Western railway. It is the seat of Cornell College (Methodist Episcopal; coeducational), which was opened as the Iowa Conference Seminary in 1853, and was chartered in 1857 under its present name, adopted in honour of William W. Cornell (1823–1870), an iron manufacturer of New York City and a benefactor of the institution. Cornell College includes a collegiate department, an academy, a conservatory of music, a school of art, a school of oratory and a summer school; in 1907–1908 it had 40 instructors and 755 students. Mount Vernon was settled in 1842, was laid out in 1847, and was incorporated as a town in 1869.

MOUNT VERNON, a city of Westchester county, in south-eastern New York, U.S.A., on the Bronx river and Eastchester Creek, 13 m. from the Grand Central station, New York City. Pop. (1890), 10,830; (1900), 20,346, of whom 5265 were foreign-born (many being Italians) and 516 negroes; (1910, census), 30,919. It is served by the New York Central & Hudson River and the New York, New Haven & Hartford railways, and by electric lines to New York City, Yonkers, New Rochelle, &c. The city has various manufactures, but in the main is a residential suburb of New York; the finest residences are in the eastern, central and north-eastern sections, the last being known as Chester Hill; the foreign-born element is largely concentrated in the western part. Mount Vernon is in the township of Eastchester, which was settled from Connecticut in 1664, possibly in the hope of pushing Connecticut's boundary nearer the Hudson. It was called "Ten Farms" or East Chester. A parish of the same name was established in 1693, but was disallowed in England. About 1682 the "Ten Farmers" established a free school. In 1764 the foundations were laid of the present St Paul's (Protestant Episcopal), which was used through a part of the American War of Independence as a British military hospital. St Paul's churchyard dates back to the close of the 17th century. Along the White Plains road (now Lincoln Avenue) Washington retreated, pursued by General Henry Clinton, before the battle of White Plains in 1776. The city of Mount Vernon was founded in 1851 by several realty companies. The postal authorities objected to the name Monticello, originally used, and Mount Vernon was adopted instead. Mount Vernon was incorporated as a village in 1853 and was first chartered as a city in 1892. West Mount Vernon was founded by the Teutonic Homestead Association and was annexed to Mount Vernon in 1869.

See William S. Coffey, "East Chester," pp. 720–764 of vol. ii. of J. T. Scharf's *History of Westchester County, N.Y.* (2 vols., Philadelphia, 1886).

MOUNT VERNON, a city and the county-seat of Knox county, Ohio, U.S.A., on the Kokosing river, about 45 m. N.E. of Columbus. Pop. (1890), 6027; (1900), 6633, including 359 foreign-born and 239 negroes; (1910), 9087. Mount Vernon is served by the Baltimore & Ohio and the Cleveland, Akron & Columbus, railways. The city is the seat of the state hospital for tuberculosis, has a fine court-house, a public library, and various manufacturing establishments. Natural gas is found in the vicinity. Mount Vernon was laid out in 1805; it became the county-seat in 1807, was incorporated as a town in 1845, and became a city in 1853.

MOUNT VERNON, the former home of George Washington, in Fairfax county, Virginia, U.S.A., on the Potomac river, 15 m. below Washington, D.C., reached by steamer from Washington and by electric railway from Alexandria, Virginia. The mansion-house, which is the centre of interest, stands on a bluff overlooking the river. The house is built of wood, but the siding is of wide thick boards so panelled as to give the appearance of cut and dressed stonework. The rooms contain much of the furniture which was in them when they were occupied by General Washington and his family; and the furniture that had been lost has been in part replaced by other furniture of historic interest and of the style in use in Washington's day. In the main hall hangs a glass casket containing the key to the Bastille which Washington received from Lafayette in 1790. From each end of the house a curved colonnade and a pavement lead westerly to a row of out-buildings which partially enclose a bowling green and spacious lawn with shaded drives and walks, and beautiful gardens (with trees planted by Washington, Franklin, Jefferson, Lafayette and others). A short distance south-west of the mansion-house and between it and the wharf is a plain brick tomb, which was built by Washington's direction on a site chosen by himself, and contains the remains of Washington and Mrs Washington (removed to this tomb from the old family vault in 1831), and of about thirty relatives —members of the Washington, Blackburn, Corbin, Bushrod, Lewis and Custis families.

The estate, originally called "Little Hunting Creek Plantation," was devised in 1676 by John Washington (the first of the family in America) to his son, Lawrence, who in turn devised it to his daughter, Mildred, by whom (and her husband Roger Gregory) it was deeded in 1726 to her brother Augustine (George Washington's father). On Augustine's death (1743) it passed to Lawrence (George's half-brother), who built in 1743 the villa which forms the middle portion of the present mansion-house and named the estate Mount Vernon, in honour of his former commander, Admiral Edward Vernon (1684–1757). Lawrence left it (1752) to his widow Anne Fairfax (who in the same year married George Lee) with the proviso that it should pass at her death to George Washington, who meanwhile rented the estate, gaining full possession at her death in 1761. In 1784–1785 he enlarged the villa into the mansion-house with its present dimensions by building an addition at each end, erected several of the out-buildings, and adorned the grounds, all according to his own plans and specifications. At General Washington's death (1799) Mount Vernon passed to his widow; at her death (1802) it passed to his nephew, Bushrod Washington, and at Bushrod Washington's death (1829) to his nephew John Augustine Washington, who devised it in 1832 to his widow, by whom it was devised in 1835 to their son John A. Washington. This last was authorized by his father's will to sell the estate to the United States government, and in 1847 offered the property for $100,000, but the offer was refused. In 1860 the mansion-house and 200 acres of the original estate, fast falling into decay, were bought for $200,000 (much of which had been raised through the efforts of Edward Everett) by the Mount Vernon Ladies' Association of the Union. This association under its charter (1856) bound itself to restore the estate as far as possible to the condition in which it was in the lifetime of Washington and to keep it sacred to his memory, and Virginia agreed to exempt it from taxation as long as these terms were fulfilled.

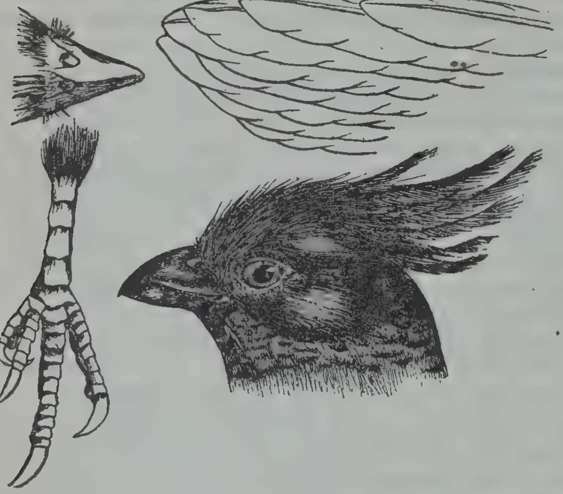
See B. J. Lossing, *The Home of Washington: or Mount Vernon and its Associations* (Hartford, 1870).

MOURNING (from the verb "to mourn," to be sorrowful, O. Eng. *murnan*; cf. O.H.G. *mornēn*, Goth. *maurnan*, to be anxious, O.N. *morna*, to pine away; by some referred to root seen in Gr. *μέριμνα*, sorrow, by others to root *mer-*, to die), the expression of grief or sorrow particularly for the dead; more specifically the outward or conventional signs of such grief. The public exhibition of this grief for the dead has taken various forms among different races and in different ages, from shaving of the head, or allowing the beard and hair to grow, from disfiguring the face and uttering loud wailing cries, to the wearing of clothes of a particular colour, now among Western races usually black, and to the purely conventional custom of using black-edged note-paper, cards, &c. (See further FUNERAL RITES.)

MOUSE, in its original sense probably the name of the semi-domesticated house-mouse (*Mus musculus*), the type of the genus *Mus* and of the family *Muridae*. Zoologically, there is no distinction between mice and rats; these names being employed respectively for most or all of the smaller and larger "mouse-like" and "rat-like" representatives of the *Muridae*, whether they belong to the genus *Mus* or not. It is true indeed that in zoological nomenclature some of these are distinguished as "voles" (see VOLE), but this is not in accord with popular usage, where such creatures come under the designation either of water-rats or field-mice. The distinctive characters of the typical mice (and rats), *i.e.* those included in the genus *Mus*, are dealt with in the article RODENTIA. With the exception of Madagascar, the genus *Mus* ranges over practically the whole of the Old World, having indigenous representatives even in Australasia; while the house-mouse, with man's involuntary aid, has succeeded in establishing itself throughout the civilized world. The following is a brief notice of the species of true mice (that is to say, those generally included in the genus *Mus*) inhabiting the British Isles. These are three in number. *M. musculus*, the house-mouse, originally a native of Central Asia, has spread to all the inhabited parts of the globe. *M. sylvaticus*, the wood or long-tailed field-mouse, is a species common in many parts of England, often taking to barns and out-houses for shelter during the winter. It is of about the same size and proportions as *M. musculus*, but of a bright reddish-grey colour, with a pure white belly. *M. minutus*, the harvest-mouse, is the smallest of the European mice, seldom exceeding 2½ or 3 in. in length; and of a yellowish-red colour, with comparatively short ears and tail. It lives entirely away from houses, commonly taking up its abode in wheat or hay fields, where it builds a round grass nest about the size of a cricket-ball, in which it brings up its young. Its range extends from England to Japan. In regard to the first it is noteworthy that house-mice isolated on a small sandbank near Dublin have developed a special colouring of their own; also that distinct local varieties, *M. musculus muralis* and *M. m. faeröensis*, inhabit respectively St Kilda and the Faeroes. In Central Asia there exists a wild mouse (*M. bactrianus*), and likewise a second species (*M. wagneri*), with the habits of a house-mouse, both of which are closely allied to *M. musculus*; while there is a third kind (*M. gentilis*), also nearly related, in the deserts of North Africa. According to Major G. E. H. Barrett-Hamilton it is probable that *M. bactrianus* and *M. musculus* are respectively desert and house modifications descended from some Central Asian ancestor more or less nearly allied to *M. wagneri*. As regards the other two British species, it must suffice to say that there are several local races of each; *Mus sylvaticus* being represented by several in the British Isles, although there is but one British representative of *M. minutus*. It may be added that by some naturalists both *M. sylvaticus* and *M. minutus* are separated from *Mus* as *Micromys*.

See G. E. H. Barrett-Hamilton, "Note on the Harvest-Mice of the Palaearctic Region," *Annals and Magazine of Nat. History* (April 1899); "On the Species of the genus *Mus* inhabiting St Kilda," *Proc. Zool. Soc.* (London, 1899); "On Geographical and Individual Variation in *Mus sylvaticus* and its Allies," *op. cit.* (1900); W. E. Clarke, "On Forms of *Mus musculus*, with Description of a New Subspecies from the Faeroe Islands," *Proc. Roy. Phys. Soc.* (Edinburgh, 1904), vol. xv. (R. L.*)

MOUSE-BIRD (Du. *Muisvogel*), the name by which in Cape Colony and Natal the members of the genus *Colius* of M. J. Brisson are known—probably from their singular habit of creeping along the boughs of trees with the whole tarsus applied to the branch. By the earlier systematists, *Colius* was placed among the *Fringillidae*; but the investigations of J. Murie and A. H. Garrod on its internal structure showed that it was not a true Passerine, and it is now placed in a separate family, *Coliidae*, amongst Coraciiform birds, near the trogons and swifts (*q.v.*). The *Coliidae* are small birds, with a rather finch-like bill, a more or less crested head, a very long tail, and generally of a dun or slate-coloured plumage that sometimes brightens into blue or is pleasingly diversified with white or chestnut. They feed almost wholly on fruits, but occasionally take insects, in quest of which they pass in bands of fifteen or twenty from tree to tree. Seven species are believed to exist, all belonging to the Ethiopian region (of which the Family is one of the most characteristic), and ranging from Abyssinia southwards. Three species inhabit Cape Colony. (A. N.)



Mouse-Bird.

MOUSSORGSKY, MODESTE PETROVICH (1835–1881), Russian composer, was born at Karevo, government of Pskov, in March 1835, and entered the army at an early age. He came of a musical family, and was himself a talented amateur, and an acquaintance with Balakirev and Dargomijsky led him to more serious study of composition, so that in 1857 he left the army and devoted himself to music, though this step entailed his earning his living as a government clerk and a prolonged period of poverty. His greatest opera, *Boris Godounov*, based on Pushkin's drama, was produced in St Petersburg in 1874, and on it his reputation stands as one of the finest creative composers in the ranks of the modern Russian school. He also wrote a number of songs and orchestral works, of a realistic national type. In later life he suffered much from ill-health, and died in St Petersburg on the 16th (28th) of March 1881.

MOUSTACHE, or MUSTACHIO, the hair worn unshaven on the upper lip (see BEARD). The spelling "moustache," now the most common in English usage, is the French form of Ital. *mustachio*, an adaptation of a Doric dialectical *μύσταξ*, upper lip, also hair on the lip; this is generally taken to be a variant of *μάσταξ*, jaws, mouth, connected with *μάσασθαι*, to chew; cf. "mastic," chewing-gum, and "masticate," to chew.

MOUSTERIAN, the name given by the French anthropologist G. de Mortillet to the second epoch of the Quaternary Age, and to the earliest in his system of cave-chronology. It is so named from a cave (Le Moustier), on the right bank of the Vézère, an affluent of the Dordogne, above Les Eyzies and Tayac, which has yielded typical palaeolithic implements. The epoch was characterized by cold wet climate, by the supposed existence of Man of the Olom type, that is, nearly as dolichocephalous as the Neanderthal type, but with superciliary ridges flat, and frontal bones high, and by the occurrence of the musk-ox, the horse, the cave-bear, *Rhinoceros tichorhinus* and the mammoth. The typical implements are flint points or spear-heads, left smooth and flat on one side, as struck from the cave, pointed and edged from the other side; a scraper treated in the same way, but with edge rather upon the side than at the end, as in the succeeding Solutrian and Madelenian epochs. Relics of the Mousterian age have been also found in Belgium, southern Germany, Bohemia and southern England, some of the "finds" including human remains.

MOUTH AND SALIVARY GLANDS. The mouth (A.S. *múð*), in anatomy, is an oval cavity at the beginning of the alimentary canal in which the food is masticated. The opening is situated between the lips, and at rest its width reaches to the first premolar tooth on each side.

The lips (A.S. *lippa*) are fleshy folds, surrounding the opening of the mouth, and are formed, from without inward, by skin, superficial fascia, orbicularis oris muscle, submucous tissue, containing numerous labial glands about the size of a small pea, and mucous membrane. In the deeper part of each lip lies the coronary artery, while in the mid-line is a reflection of the mucous membrane on to the gum forming the fraenum labii.

The cheeks (A.S. *céace*) form the sides of the mouth and are continuous with the lips, with which their structure is almost identical save that the buccinator muscle replaces the orbicularis oris and the buccal glands the labial. In the subcutaneous fascia is a distinct mass of fat, specially large in the infant, which is known as the sucking pad. On the buccal surface of the cheek, opposite the second upper molar tooth, is the papilla which marks the opening of the parotid duct, while, just behind, are four or five molar glands, larger than the buccal, the ducts of which open opposite the last molar tooth. The mucous membrane of the cheek, like that of the rest of the mouth, is of the stratified squamous variety (see EPITHELIAL TISSUES) and is reflected on to the gums.

The gums (A.S. *góma*) consist of mucous membrane connected by thick fibrous tissue to the periosteum of the jaws. Round the base of the crown of each tooth the membrane rises up into a little collar.

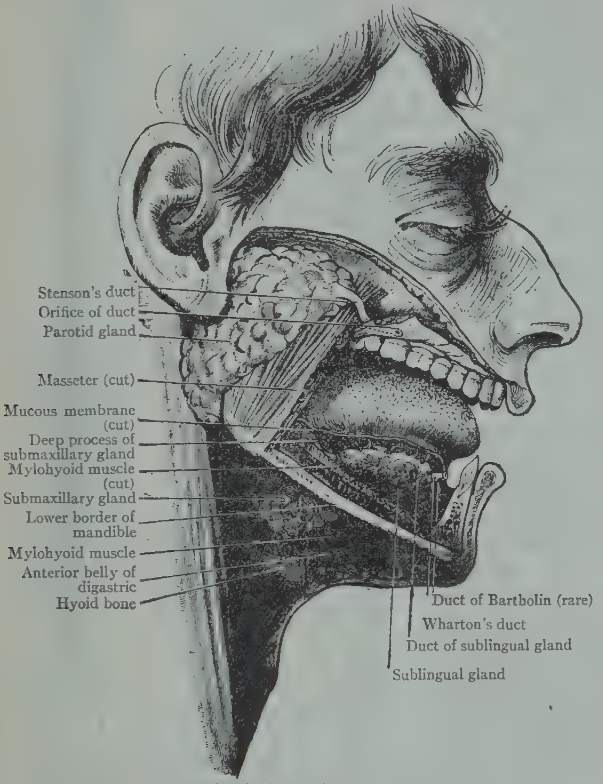
The vestibule of the mouth is the space between the lips and cheeks superficially and the gums and teeth deeply. It communicates with the true cavity of the mouth by the clefts between the teeth and by the space behind the last molar teeth.

The roof of the mouth is concave transversely and anteroposteriorly, and is formed by the *hard* and *soft palate*. The hard palate consists of mucous membrane continuous with that of the gums and bound to the periosteum of the palatine processes of the maxillae and palate bones by firm fibrous tissue. In the mid-line is a slight ridge, the palatine raphe, which ends in front in a little eminence called the palatine papilla, marking the position of the anterior palatine canal. From the anterior part of the raphe five or six transverse ridges or rugae of the mucous membrane run outward. (For a description of the soft palate see PHARYNX.)

The floor of the mouth can only be seen when the tongue is raised, then the reflection of the mucous membrane from the gums to it is exposed. In the mid-line is a prominent fold called the *fraenum linguae*, and on each side of this a *sublingua papilla*, on to the summit of which the duct of the submaxillary gland opens. Running outward and backward from this is a ridge called the *plica sublingualis*, which marks the upper edge of the sublingual gland, and on to which most of the ducts of that gland open. (For a description of the TONGUE and the TEETH see special articles on those structures.)

The salivary glands are the *parotid*, *submaxillary* and *sublingual*, though the small scattered glands such as the labial, buccal, molar, lingual, &c., probably have a similar function.

The parotid gland (Gr. *παρά* beside, *οὖς* ear), is the largest of these glands, and is situated between the ear and the ramus of the mandible. In a transverse section through the head about the level of the mouth the gland looks more or less triangular, its outer wall or base being bounded by the parotid fascia, its anterior by the jaw, and its posterior by the mastoid process and sterno mastoid muscle. Where the anterior and posterior walls meet to form the apex is the styloid process. Above the gland reaches to the zygoma, and below to the level of the angle of the jaw, where a strong process of the deep cervical fascia, called the *stylo-mandibular ligament*, separates it from the submaxillary gland; indeed the parotid is often described as lying in a bag formed by deep cervical fascia. The outline of the gland is obscured by several processes, one of which, the *facial lobe*, runs forward, superficial to the masseter muscle, accompanying the duct. A separate part of this is called the *socia parotidis*; another, known as the *pterygoid lobe*, passes forward, deep to the ramus of the jaw, to the space between the two pterygoid muscles. A third wraps round the front of the styloid process and may be termed the *pre-styloid lobe*, while a fourth, the *post-styloid*, insinuates itself behind that process. The upper part of the prestyloid lobe sometimes reaches the back part of the glenoid cavity, and is then called the *glenoid lobe*. All these processes, however, are very variable, and depend a good deal on the position of the head and neck. The facial nerve, the temporo-maxillary vein, and the termination of the external carotid artery, among other structures, are embedded in the gland. The *parotid duct* (Stensen's duct) crosses the upper part of the masseter and then pierces the buccinator on its way to the mouth; it is about 2 in. long. Its position is described in the article on ANATOMY (*Superficial and Artistic*), and its opening in the earlier part of this article.



From A. Birmingham Cunningham's *Text Book of Anatomy.*

FIG. 1.—THE SALIVARY GLANDS AND THEIR DUCTS.

The greater portion of the body of the mandible has been removed to expose the sublingual and the deeper parts of the submaxillary glands. Four ducts of the sublingual gland are shown opening on the floor of the mouth over the gland, a fifth is shown opening into the anterior end of Wharton's duct. The course of Wharton's duct is shown by a dotted line.

The *submaxillary gland* lies deep to the posterior half of the body of the lower jaw; it is about the size of a walnut, and has an external, internal and inferior surface. The external surface rests against the submaxillary fossa in the jaw, the internal is in contact with the mylohyoid and hyoglossus muscles, while the inferior is subcutaneous. The whole gland is enclosed in a sac of deep cervical fascia, while a process, from which the duct arises, passes deep to the mylohyoid. The facial artery is embedded in the upper part of the gland. The *submaxillary duct* (Wharton's duct) runs forward to the sublingual papilla already mentioned.

The *sublingual gland* is placed further forward than the submaxillary; it is like an almond in shape though larger; its outer flattened surface rests against the sublingual fossa in the lower jaw, while the inner one is in contact with the genio-hyoglossus muscle, the submaxillary duct and the lingual nerve. Its upper edge forms the sublingual fold (*plica sublingualis*) in the mucous membrane of the mouth, and along this its ducts, which are small and numerous, open; these are sometimes called the *ducts of Rivini*, but the term "sublingual ducts" is simpler and more expressive. Occasionally an *anterior sublingual duct* (*duct of Bartholin*) opens with or into the submaxillary duct.

Embryology.

The fore-gut (see ALIMENTARY CANAL) at first ends blindly, ventral to the region of the hind brain, while in front of it is the overhanging fore-brain. When the heart develops, ventral to the fore-gut, it also projects forward toward the fore-brain, so that a transverse cleft, without any lateral boundaries and lined by ectoderm, is left between these two structures. This is the *stomatodaeum* or primitive mouth, the ectoderm of which rests against the entoderm of the fore-gut to form the *bucco-pharyngeal membrane*, and so separates the two chambers. The position of this membrane does not correspond to the fauces or hinder limits of the adult mouth, but is much more oblique, so that the front part of the roof of the pharynx is formed by stomatodaeum while the greater part of the floor of the permanent mouth is fore-gut. During the third week the membrane disappears, and it is probable that to its early atrophy is due the fact that no traces of it can be seen in the adult. Growing down from the region of the fore-brain is the fronto-nasal process, which forms the nose and the middle piece of the upper lip, while the lateral parts of the mouth are closed in by two processes, on each side of which the lower or mandibular process rapidly meets its fellow in the mid-line to form the lower jaw and lip, thus separating the heart from the mouth cavity. The upper or maxillary process grows inward more slowly, but at last joins with the fronto-nasal process, and in the adult the lines of union are seen on each side as ridges of skin which run down from the nostril to the margin of the lip, and enclose that slightly depressed vertical gutter to which the term *philtrum* is given. Besides forming the philtrum the fronto-nasal process is responsible for that part of the roof of the mouth which corresponds to the premaxillary bones, an area marked out by lines drawn on each side from between the lateral incisor and canine teeth to the palatine papilla. At first the cavities of the mouth and nose are one, but they are later divided by the *palatal processes*, which grow in like shelves from the maxillary processes and meet in the mid-line. The submaxillary and sublingual salivary glands develop as solid outgrowths of the buccal epithelium which are canalized later, while the parotid according to Hammar (*Archiv. f. mikr. Anat.* LXI., 1902) appears first as a groove. The parotid is ectodermal in origin, all the others entodermal.

For further details and literature see *Quain's Anat.* vol. i. (London, 1908); J. P. McMurrich *Development of the Human Body* (London, 1907); O. Hertwig, *Handbuch der Entwickelungslehre Th. II.*, (Jena).

Comparative Anatomy.

In the acrania (amphioxus) the mouth is developed on the left side and gradually shifts to the mid-line; later an extra chamber, the *oral hood*, is formed in front of it, the external opening of which is provided with bristle-like cirrhi, so that in the adult the mouth is merely an aperture in the velum or membrane which separates the oral hood from the pharynx.

In the cyclostomata (lampreys and hags) the mouth is a suctorial organ, and resembles a funnel, the narrow end of which opens into the pharynx. It is always open and is provided with horny teeth and a tongue. At this low stage of the vertebrate scale no jaws have yet appeared, but in the larval lamprey (ammocoetes) an oral hood, resembling that of amphioxus, is present. In the fishes jaws are present and the mouth can be closed at will. In the elasmobranchs (sharks and rays) the opening is crescentic and situated well on the ventral surface of the head, but in other fishes it is at the anterior end of the body. Until the dipnoi (mud-fish) are reached there is no communication between the mouth and the nose, but in these fishes the internal or posterior nares open into the front part of the roof of the mouth, thus adapting them to air-breathing. In the Amphibia the mouth has usually an enormous gape, and the position of the posterior nares resembles that of the dipnoi. It will be noticed that at this stage of phylogeny the condition resembles that of the ontogeny of man before the palatal processes appear. The premaxillary part of the fronto-nasal process separates the nasal cavity from the mouth in front, but behind that the cavity is the rudiment of the mouth and nose which no palate has yet appeared to separate. In Reptiles the hard palate appears, and henceforward the digestive and respiratory tracts only form one passage in the pharynx. In mammals definite lips provided with muscles first appear, though the Monotremes have such specialized mouths that lips are not found in that order. Many monkeys have the vestibule enlarged to form the cheek pouches. (F. G. P.)

Surgery of the Mouth.

In surgical operations upon the interior of the mouth which are likely to be accompanied with much bleeding, it is much the custom now to have the patient lying upon his back, with the head hanging over the end of the table, so that the blood may sink into the dome of the pharynx and escape by the nostrils, instead of running the risk of finding its way into the windpipe and lungs. (See Cleft Palate.)

Mumps.—Inflammation of the parotid gland is apt to occur as an epidemic, children being chiefly attacked. The disease, which is highly infectious, is called mumps, and is associated with much swelling below and in front of the ear, or ears. There is stiffness of the jaw and there is a difficulty in swallowing. There is slight local tenderness, and the temperature may, perhaps, run up a degree or two. For the sake of others, the child should be kept away from school for three or four weeks.

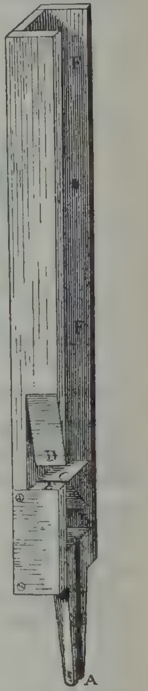
Salivary Calculus.—Sometimes a deposit of phosphate and carbonate of lime slowly takes place from the saliva, and gives rise to the formation of a small concretion in the duct of one of the salivary glands. When the concretion blocks the duct, so that the saliva is unable to find its way into the mouth, a fluid swelling forms behind the blockage, giving rise to inconvenience and unsightliness. The swelling is at its greatest during a meal, when the secretion of the saliva is necessarily rapid; subsequently it disappears, recurring, however, at the next meal-time. In many cases the patient is conscious of the fact of there being a hard, movable "kernel," the size, perhaps, of a barleycorn, a cherry-stone or even of a small almond, in the course of the duct. In the removal of the calculus every endeavour should be made to effect its escape into the mouth, as, if the skin were incised for its extraction, the wound might refuse to heal, a *salivary fistula* resulting. (E. O.*)

MOUTHPIECE (Fr. *embouchure*; Ger. *Mundstück*; Ital. *bocchino*), in music, that part of a wind instrument into which the performer directs his breath in order to induce the regular series of vibrations to which musical sounds are due. The mouthpiece is either taken into the mouth or held to the lips; by an extension of the meaning of the word, mouthpiece is also applied to the corresponding part of an organ-pipe through which the compressed wind is blown, and containing the sharp edge known as "lip," or the reed necessary for the production of sound. The quality of a musical tone is due primarily to the form or method of vibration by means of which sound-waves of a distinctive character are generated, each consisting of a pulse or half-wave of compression and of a pulse of rarefaction; the variety in the quality of tone, or "timbre," obtainable in various wind instruments is in a great measure due to the form and construction of the mouthpiece, taken in combination with the form of the column of air within the tube and consequently of the bore of the latter. The principal functions of the mouthpiece are (1) to facilitate the production of the natural harmonic scale of the instrument; (2) to assist in correcting errors in pitch as the ear directs; (3) to enable the performer to obtain the dynamic variations whereby he translates his emotional interpretation of the music into sound. Mouthpieces, therefore, serve as a means of classifying wind instruments. They fall into the following divisions:—

1. The *syrinx* or *pan-pipe* mouthpiece consists merely of the open end of the tube *across* (not *into*) which the player directs his breath in a current which impinges obliquely against the sharp edge of the pipe, producing the series of shocks or pulses required in the air stream from his lips; this in turn, when in a state of vibration, serves to generate the sound-waves within the pipe. This principle was embodied in the *nay*, or long oblique flute of the ancient Egyptians, which was probably the first mouthpiece discovered and put into practical use by prehistoric man. A modification of this principle has been applied to the transverse flute (*q.v.*), in which the air stream or exciting current is directed across a lateral hole in the head joint of the instrument.

2. The *whistle* mouthpiece is based on that of the flute with this modification, that the air current, instead of being compressed by the lips of the performer and then directed through ambient air to break against the sharp edge of the lateral hole, is compressed mechanically in passing through a narrow channel so constructed within the mouthpiece that the stream of air impinges with force against the sharp edge of a lip cut into the pipe below the channel. The principle of the whistle mouthpiece has been applied with slight modifications to a variety of instruments such as the recorder (*q.v.*) family in England (Fr. *flûte à bec*, *flûte douce*, *flûte anglaise*; Ger. *Schnabelflöte*, *Plockflöte*; Ital. *flauto dolce*, in which the channel assumes the form of a beak, the flageolet (*q.v.*), the penny whistle, &c. All these whistle or fipple pipes have at all times enjoyed great popularity owing to the ease with which they can be played.[1]

The flute or flue-work of an organ is the result of the adaptation of the same principle to both open and stopped pipes (fig. 1). Compressed air is fed in at an even pressure through the foot AB, and passing through the slit or channel EC, impinges with force against the lip D, producing the requisite series of pulsations in the pipe FF. By this elimination of the human element in the organ, all possibility of communicating the emotion of the performer becomes impossible. With a rigid mouthpiece any increase in wind pressure would affect the pitch, causing the note to become unsteady or to jump to the harmonics; the result could in no case be a crescendo.



From V. Mahillon, *Eléments d'acoustique*, by permission of C. Mahillon.

Fig. 1.—Diagram of a flue-pipe.

3. *Reed Mouthpieces.*—There are three kinds of reed mouthpieces: the double, the single or beating, and the free reed. The function of the reed, a term originally applied to part of a stalk of the *Arundo donax* or *sativa*, but now extended to any vibrating tongue of wood or metal, is to break up an exciting current of air, otherwise flowing in an uninterrupted even stream, into regular beats or pulses, corresponding with the beats or vibrations of the reed. Reeds proper or wooden vibrators, being flexible, are compelled to vibrate synchronously with the column of air within the tube and to accommodate their frequency of vibration to the length of the tube as it varies according to the lateral holes which remain open.[2]

A. The *double* reed is the most primitive and probably the oldest of the reed mouthpieces; it was used by the ancient Egyptians.[3] A straw flattened at one end and inserted into a pipe having at the mouthpiece end the same diameter as the straw contains all the rudimentary features of the double-reed mouthpiece common to the members of the oboe family, *i.e.* cor anglais, bassoon, contra-fagotto, to the sarrusophone, and to the chaunter of the bagpipe. The earliest Greek aulos (*q.v.*) was probably played by means of a double reed, since the mouthpiece was known as ζεῦγος, signifying a pair of like things. The oboe reed (fig. 2) is made from two pieces of reed stalk, flattened and thinned at the end and bound together with waxed thread, thus forming a tube with a constriction in the middle, above which the section is oval and below circular.

A double-reed mouthpiece may be enclosed in an air-chamber or reservoir, as in the 16th-century cromorne (*q.v.*), in the chaunter of the bagpipe (*q.v.*), in the reeds of organ-pipes and in certain instruments popular in France during the 17th century known as "hautbois de Poitou." In all of these the air-chamber is supplied with compressed air by the mouth of the performer, whose lips do not come into contact with the reed, a method which makes the production of harmonics impossible, and thus restricts the natural scale. As soon as the practice of over-blowing, *i.e.* the production of harmonics by increased pressure of breath accompanied by a proportional tension of the lips, became known, the air-chamber of the oboe was discarded and the reed taken directly into the mouth. It is certain that the ancient Greeks obtained the full compass of the aulos by overblowing, since the process by which a modern performer on the oboe or clarinet obtains the harmonics is described by Aristotle[1] and others.[2]

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[1] See Rev. F. W. Galpin, "The Whistles and Reed Instruments of the American Indians of the North-West Coast," *Proc. Musical Assoc.* (1903–1904), p. 115, with illustrations.

[2] See Victor Mahillon, *Éléments d'acoustique musicale* (Paris, 1873), pp. 167 and 83.

[3] A case excavated in Egypt was found to contain two pipes, and in addition five pieces of reed without bore or holes, and three pieces of straw suitable for making double-reed mouthpieces. See Victor Loret, "Les Flûtes égyptiennes antiques," *Journal asiatique* (Paris, 1889), [8], xiv. pp. 119, 200, 201 (note), 207, 211 and 217.

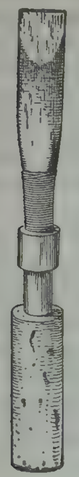
Rudall, Carte & Co.

FIG. 2.—Oboe double-reed mouthpiece.

The vibrating length of the reed is controlled by taking the latter more or less deeply into the mouth and by varying the pressure of the lips upon it; the shorter the free end the higher the pitch of the note or harmonic obtained. The action of the lips on the reed is imitated to some extent in reed organ-pipes by means of a tuning-wire, with the difference that, the lips being mobile, different notes can be obtained from the same pipe, whereas in the organ each reed is adapted to its own pipe and gives one note only.

B. The *beating-* or *single-reed* mouthpiece, also known as the clarinet mouthpiece, is likewise of great antiquity; the principle is the same as that of the modern Egyptian *arghoul* (*q.v.*), which has been traced once at least in the hieroglyphics and in a fresco from the tombs at Saqqara.[3] The mouthpiece of the arghoul is the primitive form of beating-reed known popularly in rural districts as a "squeaker." A lateral slit is made in a piece of reed and a little tongue is detached by slitting the reed back from the slit towards a knot. The breath causes the reed-tongue to close and open the aperture at regular intervals, and the exciting agent here acts by means of a series of concussions. The metal vibrator known as the beating-reed of organ reed-pipes is similarly constructed, except that the tongue is a separate piece of metal fixed by means of nuts over an aperture, the vibrating length being regulated by means of a tuning-wire (see FREE REED VIBRATOR). The clarinet mouthpiece (fig. 3) has the appearance of a beak with the point bevelled and thinned at the edge to correspond with the end of the reed, shaped like a spatula. The underpart of the mouthpiece is flattened in order to form a table for the support of the reed, which is adjusted thereon with great nicety by means of a ligature or metal band fastened by screws. A longitudinal aperture 1 in. long and $\frac{1}{2}$ in. wide, communicating with the bore, is cut in the table and covered by the reed, so that the only opening is at the point, where for the distance of $\frac{1}{8}$ to $\frac{1}{4}$ in. the reed is thinned and the table curves backwards, leaving a gap of about 1 mm. between itself and the reed-tongue (for the B♭ clarinet). The curve of the table and the dimensions of the gap are therefore of considerable importance. The reed is set in vibration by the breath of the performer, and being flexible it beats against the table, alternately opening and closing the gap, and producing, as already mentioned above, a series of concussions in harmony with the vibrations of the air-column within the tube, according to the length determined by the opening of the lateral holes and keys.

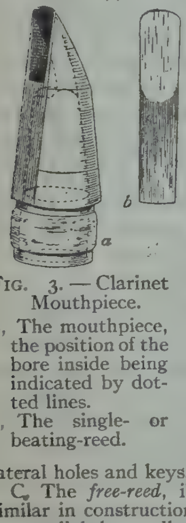

FIG. 3.—Clarinet Mouthpiece.
a, The mouthpiece, the position of the bore inside being indicated by dotted lines.
b, The single- or beating-reed.

C. The *free-reed*, illustrated under FREE REED VIBRATOR, is similar in construction to the beating-reed, but the metal vibrator is cut slightly smaller than the aperture, through which it passes freely, alternately opening and closing it without concussion and with complete elasticity. The main difference in practice between these two outwardly similar reeds is a very important one. The reed being free remains uncontrolled, and increased pressure of wind therefore produces not an harmonic overtone but a crescendo. The principal use of the free-reed is in the harmonium (*q.v.*) and in the reed-work of organs on the continent of Europe. In English organs the beating-reed is almost universal. The free-reed is further used in the Chinese cheng (*q.v.*), through which it became known in Europe in the 18th century, and in the accordion, concertina and mouth-organ, under which headings its acoustic properties are more fully discussed.

4. *Cup-Mouthpieces.*—Brass wind instruments are played by means of cup or funnel-shaped mouthpieces, generally made of silver. The principal feature of the cup is the shape of the aperture in the bottom, where it communicates with the bore of the tube (known as the "gruin" or "throat"), and its distance from the rim. The shallower the cup the more suitable it is for producing the higher harmonics. The lips of the performer rest lightly but firmly against the rim of the mouthpiece, vibrating like double reeds from the force of the breath and communicating these vibrations in the form of pulses to the breath as it issues from them in a stream. This stream or exciting current passes into the cup ready to generate sound-waves in the air column contained within the main tube. If, as in the trumpet and in a lesser degree in the trombone, the curve of the bottom of the cup terminates at the hole in an abrupt angle, the quality of the tone developed is brilliant and blaring, being broken up by the sharp edge of the throat. In the horn, which has a funnel-shaped mouthpiece, the timbre is in complete contrast when the instrument is properly played,[4] being elastic, sonorous and very mellow, qualities which may be attributed to the absence of angle or bottom to the cup, the sides gradually sloping and converging insensibly into the bore of the tube. (K. S.)

MOVERS, FRANZ KARL (1806–1856), German Roman Catholic divine and Orientalist, was born at Koesfeld in Westphalia, on the 17th of July 1806. He studied theology and Oriental languages at Münster, was parish priest at Berkum near Bonn from 1833 to 1839, and professor of Old Testament theology in the Catholic faculty at Breslau from 1839 to his death on the 28th of September 1856. His elaborate works, *Die Phönizier* (1841–1850) and *Phönizische Texte, erklärt* (1845–1847), attained a high reputation. Of his other writings two biblical studies were of some importance, his *Kritische Untersuchungen über die alttestamentliche Chronik* (1834), and his Latin essay on the two recensions of the text of Jeremiah, *De utriusque recensionis vaticiniorum Jeremiae . . . indole et origine* (1837).

MOW. (1) To cut down standing hay or corn with a scythe or with machinery drawn by a horse or mechanical power (see REAPING). The word in O.Eng. is *mawan*, a verb common to the West German languages, cf. Du. *maaien*, Ger. *mähen*; the root is also seen in "meadow," Gr. ἀμᾶν and Lat. *metere*, to reap, cut, cf. *messis*, harvest. (2) A stack or rick of hay, corn, and sometimes also of beans, peas or other crops. The word in O.Eng. is *múga*, *múha*, and is cognate with Swedish and Norwegian *muga*, heap, cf. Swedish *allmoge*, crowd of people, Danish *almuc*. "Mow" is chiefly dialectal in England, where it is a common name, *e.g.* the Barley Mow, on the sign-boards of country inns. From these two words must be distinguished (3) "mow," a grimace, now obsolete or purely literary, and generally found in combination with "mop," cf. "mopping and mowing" in *King Lear*, iv. 1. 64. This is the same word as the modern Fr. *moue*, pout, which is of obscure origin.

MOWAT, SIR OLIVER (1820–1903), Canadian judge and statesman (Q.C. 1856, LL.D. 1872, K.C.M.G. 1892, G.C.M.G. 1897), was the son of John Mowat, who fought in the Peninsular War under Sir Arthur Wellesley (afterwards duke of Wellington). Born at Kingston, Ontario, on the 22nd of July, 1820, he was educated by private tuition and in 1836 began the study of law under Mr (afterwards the Rt Hon. Sir) John A. Macdonald. Called to the bar in 1841, he soon became a leading Chancery counsel and in 1856 "took silk." He entered parliament in 1858 as a Liberal and in 1863 became postmaster-general. He took a prominent part in the proceedings of the Quebec Conference of 1864, which settled the terms of the Confederation of the British North American provinces, and in the same year was appointed vice-chancellor of Upper Canada. Eight years afterwards (1872) the Hon. Edward Blake resigned the premiership of the province of Ontario, and Mowat was called to fill the vacant post. He continued to be premier of Ontario until the 13th of July 1896. Assisted by able colleagues and holding always a strong majority in the house, he gave to Ontario a body of laws many of which have been copied by other provinces of the dominion and by several states of the American Union. In eight important cases which he argued before the Judicial Committee of H.M. Privy Council, he established, as against the contention of Sir John A. Macdonald, the proposition that the provincial legislatures were co-ordinate with and not subordinate to the parliament of Canada. To weaken his influence the Conservatives at Ottawa attempted to extend the boundaries of Manitoba, thereby reducing the area of Ontario; but Mr Mowat again appealed to the Judicial Committee and was again successful. According to Sir John A. Macdonald, Ontario contained under the "Quebec Act" only 116,782 sq. m.; but Mr Mowat gave it an area of 260,862 sq. m. When he returned home after this great victory he received an ovation unparalleled in the history of any Canadian statesman. One of his prominent characteristics was his loyalty to Britain. Between 1886 and 1896 Canadian trade was depressed, and men were leaving the country in thousands for the United States. Dr Goldwin Smith and other prominent men advocated commercial union with the United States, viz. that the two countries should maintain a uniform tariff against the rest of the world, with free trade as between themselves. Sir Oliver Mowat saw in this "veiled annexation," and by letters, speeches and pamphlets he crushed the movement so completely as to make his party more imperialist than the Conservatives had ever been. In July 1896 he was called to the senate of Canada and made minister of justice. In November 1897 he was appointed lieutenant-governor of his native province, and this office he held until he died at Government House, Toronto, on the 19th of April 1903.

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[1] See *De audib.* p. 804*a*.

[2] Porphyrius (ed. Wallis), pp. 249 and 252.

[3] See Victor Loret, *L'Egypte au temps des Pharaons* (Paris, 1889), illustrated on pp. 139 and 143. The author gives no information as to this fresco except that it is in the Musée Guimet; it is probably identical with the second of the mural paintings described on p. 190 of the *Petit guide illustré du Musée Guimet* (Paris, 1890).

[4] The horn may be so played, by forcing the breath in a certain manner, that its timbre approximates to that of the trumpet.

See C. R. W. Biggar, *Sir Oliver Mowat, a Biographical Sketch* (Toronto, 1905). (C. R. W. B.)

MOWBRAY, the name of an Anglo-Norman baronial house, derived from Montbray (Manche) in Normandy south of St Lo. It was founded at the Conquest by Geoffrey (de Montbray), bishop of Coutances. His brother's son Robert, who rebelled with him against William Rufus on the Conqueror's death, was made, after their reconciliation, earl of Northumberland, as his uncle's heir but was forfeited and imprisoned for life on rebelling again in 1095. A sister of Bishop Geoffrey was mother by Roger d'Aubigny (of Aubigny in the Cotentin) of two sons, Nigel and William, who were ardent supporters of Henry I., and were rewarded by him with great estates in England. William was made king's butler, and was father of William d'Aubigny ("de Albini"), first earl of Arundel (see ARUNDEL); Nigel was rewarded with the escheated fief of Geoffrey de la Guerche, of which Melton (Mowbray) was the head, and with forfeited lands in Yorkshire. Nigel married, by dispensation, the wife of his cousin, the imprisoned earl, but afterwards divorced her, and by another wife was father of a son Roger, who took the name of Mowbray.

Roger, a great lord with a hundred knights' fees, was captured with King Stephen at the battle of Lincoln, joined the rebellion against Henry II. (1173), founded abbeys, and went on crusade. His grandson William, a leader in the rising against King John, was one of the 25 barons of the Great Charter, as was his brother Roger, and was captured fighting against Henry III. at the rout of Lincoln (1217). His grandson Roger (1266–1298), who was summoned to parliament by Edward I., was father of John (1286–1322), a warrior and warden of the Scottish March, who, joining in Thomas of Lancaster's revolt, was captured at Boroughbridge and hanged. His wife, a Braose heiress, added Gower in South Wales and the Bramber lordship in Sussex to the great possessions of his house. Their son John (d. 1361) was father, by a daughter of Henry earl of Lancaster, of John, Lord Mowbray (*c.* 1328–1368), whose fortunate alliance with the heiress of Lord Segrave, by the heiress of Edward I.'s son Thomas, earl of Norfolk and marshal of England, crowned the fortunes of his race. In addition to a vast accession to their lands, the earldom of Nottingham and the marshalship of England were bestowed on them by Richard II., and the dukedom of Norfolk followed (see NORFOLK, THOMAS MOWBRAY, 1st duke of).

The 1st duke left two sons, of whom Thomas the elder was only recognized as earl marshal. Beheaded for joining in Scrope's conspiracy against Henry IV. (1405), he was succeeded by his brother John, who was restored to the dukedom of Norfolk in 1424. His son John, the third duke, was father of John, 4th and last duke, who was created earl of Warrenne and Surrey in his father's lifetime (1451). At his death (1475) his vast inheritance devolved on his only child Anne, who was married as an infant to Edward IV.'s younger son Richard (created duke of Norfolk and earl of Nottingham and Warrenne), but died in 1481.

The next heirs of the Mowbrays were then the Howards and the Berkeleys, representing the two daughters of the first duke. Between them were divided the estates of the house, the Mowbray dukedom of Norfolk and earldom of Surrey being also revived for the Howards (1483), and the earldom of Nottingham (1483) and earl marshalship (1485) for the Berkeleys. Both families assumed the baronies of Mowbray and Segrave, but Henry Howard was summoned in his father's lifetime (1640) as Lord Mowbray, which was deemed a recognition of the Howards' right; their co-heirs, from 1777, were the Lords Stourton and the Lords Petre, and in 1878 Lord Stourton was summoned as Lord Mowbray and Segrave. The former dignity is claimed as the premier barony, though De Ros ranks before it. Lord Stourton's son claimed, but unsuccessfully, in 1901–1906 the earldom of Norfolk (1312), also through the Mowbrays. Of the Mowbray estates the castle and lordship of Bramber is still vested in the dukes of Norfolk. The heraldic badge of the house was a mulberry-tree. (J. H. R.)

MOWBRAY, HARRY SIDDONS (1858–), American artist, was born of English parents at Alexandria, Egypt, on the 5th of August 1858. Left an orphan, he was taken to America by an uncle, who settled at North Adams, Mass. After a year at the United States Military Academy at West Point, he went to Paris and entered the atelier of Léon Bonnat, his first picture, "Aladdin," bringing him to public notice. He was made a full member of the National Academy of Design in 1891. Subsequently he was best known for his decorative work, especially "The Transmission of the Law," Appellate Court House; ceiling for the residence of F. W. Vanderbilt; and the ceiling and walls of the library of the University Club—all in New York. This last was executed in Rome, where, in 1903, he was made director of the American Academy.

MOWBRAY, ROBERT (d. 1125), a Norman who was appointed earl of Northumberland between 1080 and 1082. In 1088 he and his uncle Geoffrey, bishop of Coutances, sided with Robert, duke of Normandy, against William Rufus, but they were pardoned at the close of the rebellion. In 1091 Mowbray defeated Malcolm Canmore of Scotland, who had invaded England, and in 1093 surprised and slew this king near Alnwick; soon after this event he succeeded to his uncle's vast estates. In 1095 he led a rebellion which had for its object the transference of the crown from the sons of the Conqueror to Stephen of Aumale. Rufus marched against the earl in person, and Mowbray shut himself up in Bamborough Castle, but he was captured by treachery, escaped, and was captured again. He was then deprived of his possessions and kept a prisoner for the rest of his life, nearly thirty years.

See E. A. Freeman, *William Rufus*, especially Appendices C. C. F. F. (Oxford, 1882).

MOXON, EDWARD (1801–1858), British poet and publisher, was born at Wakefield in 1801. In 1826 he published a volume of verse, entitled *The Prospect, and other Poems*, which was received with some favour. In 1830 Moxon was started by Samuel Rogers as a London publisher in New Bond Street. The first volume he issued was Charles Lamb's *Album Verses*. Removing to Dover Street, Piccadilly, Moxon published an illustrated edition of Rogers's *Italy*, £10,000 being spent upon the illustrations. Wordsworth entrusted him with the publication of his works from 1835 onwards, and in 1839 he issued the first complete edition of Shelley's poems. Some passages in *Queen Mab* were the cause of a charge of blasphemy being made against Moxon in 1841. The case was tried before Lord Denman. Serjeant Talfourd defended Moxon, but the jury returned a verdict of guilty, and the offensive passages were for a time eliminated. In 1840 he published Browning's *Sordello*; and in succeeding years works by Lord Houghton, Tom Hood, Barry Cornwall, Lord Lytton, Browning and Tennyson appeared. Edward Moxon died on the 3rd of June 1858, his business being continued by Mr J. B. Payne and Mr Arthur Moxon, who in 1865 published Swinburne's *Atalanta in Calydon*; but in 1871 it was taken over by Messrs Ward, Lock & Tyler.

MOXOS, Mojos, Mohos, a tribe of South American Indians living around the head-waters of the Madeira river, northern Bolivia, particularly on both banks of the Mamoré. They submitted to Inca domination, but in 1564 gallantly repulsed the Spaniards. A century later, however, the Jesuits were welcomed, and the Moxos became devout Catholics. They number some 30,000.

MOZAMBIQUE [São Sebastiao de Moçambique], a town of Portuguese East Africa, seat of a Roman Catholic bishopric in the province of Goa, in 15° 4′ S., 40° 44′ E. The town occupies the whole of a small coral island at the mouth of Mossoril Bay. The name Mozambique, used first to designate the island, was also given to the town and extended to the whole of the Portuguese possessions on the east coast of Africa. There are three forts, of which the principal, St Sebastian, at the northern extremity of the island was built in 1510 entirely of stone brought from Portugal. It is quadrangular, and has bastioned walls nearly 70 ft. high. In it are mounted some modern guns. The harbour is small, but deep enough to admit vessels drawing 25 feet.

The inhabitants, who number about 7000, consist chiefly of Mahommedan negroes of mixed descent speaking a dialect of the Makwa language. There are Parsee, Banyan, Goanese and Arab traders, and about 300 Europeans, besides half-caste Portuguese. The annual average value of the imports for the three years 1904–1906 was £97,035, of the exports £71,636. The import trade is chiefly with Great Britain and India, the articles in chief demand being cotton, coloured shawls and hardware. The exports are chiefly groundnuts, rubber of inferior quality, sesamum and other oil seeds, tortoise-shell and ebony. Germany has a large share of the exports.

Mozambique was discovered by Vasco da Gama in 1498. There was then a flourishing Arab town on the island, of which no trace exists. The history of the Portuguese town is closely identified with that of the province, for which see Portuguese East Africa. The commercial and political importance of Mozambique has been eclipsed by Lourenço Marques.

MOZARAB [Spanish *Mozárabe*, a corruption of the Arabic *Musta'rib*, coll. *Musta'riba*], a general term for persons not Arab by race who have assimilated themselves to the Arabs. It was applied by the Moslems in Spain to the Christian communities existing among them, in Cordova, Seville, Toledo and other large cities, in the exercise of their own laws and religion. The ancient liturgy used by the Christians of Toledo is commonly known as Mozarabic.

MOZART, WOLFGANG AMADEUS[1] (1756–1791), German composer, was born at Salzburg on the 27th of January 1756. He was educated by his father, Leopold Mozart, a violinist of high repute in the service of the archbishop of Salzburg. When only three years old he shared the harpsichord lessons of his sister Maria, five years his senior. A year later he played minuets, and composed little pieces, some of which are still preserved in Maria's music-book. When five years old he performed in public for the first time, in the hall of the university. In 1762 Leopold Mozart took Wolfgang and Maria on a musical tour, during the course of which they played before most of the sovereigns of Germany. The little "Wolferl's"[2] charming appearance and disposition endeared him to every one; and so innocent and natural were his manners that at Vienna he sprang upon the empress's lap and kissed her. The emperor Francis I. sat by his side while he played, and called him his "little magician." When he slipped one day on the polished floor the archduchess Marie Antoinette, afterwards queen of France, lifted him up, whereupon he said, "You are very kind; when I grow up I will marry you." Yet, in spite of the petting he received at court, he remained as gentle and docile as ever, and so amenable to parental authority that he used to say, "Next after God comes my father." In 1763 the whole family started again. Wolferl now sang, composed, and played on the harpsichord, the organ and the violin, winning golden opinions everywhere. At every court he visited he was loaded with caresses and presents; but the journeys were expensive, and the family terribly poor. In Paris they lodged at the Bavarian embassy, giving performances on a grand scale both there and at Versailles, where Wolferl's organ-playing was even more admired than his performance on the harpsichord. Here, also, he published his first compositions—two sets of sonatas for the harpsichord and violin.

On the 10th of April 1764 Leopold Mozart brought his family to England, engaging a lodging in Cecil Court, St Martin's Lane, whence he afterwards removed to Frith Street, Soho. On the 27th of April and the 19th of May Wolferl played before the royal family with immense success, accompanying the queen in a song and playing at sight anything that the king set before him. He now made his first attempt at the composition of a symphony; published a third set of sonatas, dedicated to the queen; and wrote an anthem for four voices entitled *God is our Refuge*, for presentation to the British Museum.[3] On the 17th of September 1765 the family left England for the Hague, where they remained some time, and where in March 1766 the young composer made his first attempt at an oratorio, commanding in Holland a success as great as that he had already attained in London, and astonishing his hearers at Haarlem by performing on what was at that time the largest organ in the world. In September 1767 he paid a second visit to Vienna, and at the suggestion of the emperor Joseph II. composed an opera buffa, *La Finta semplice*, which, though acknowledged by the company for which it was written to be "an incomparable work," was suppressed by a miserable cabal. The archbishop of Salzburg hearing of this commanded a representation of the rejected work in his palace, and appointed the young composer his "maestro di capella." The office, however, was merely an honorary one, and, since it did not involve compulsory residence, Leopold Mozart determined to complete his son's education in Italy, to which country he himself accompanied him in December 1769.

Wolfgang, now nearly fourteen years old, was already an accomplished musician, needing experience rather than instruction, and gaining it every day. At Milan he received a commission to write an opera for the following Christmas. Arriving in Rome on the Wednesday in Holy Week, he went at once to the Sistine Chapel to hear the celebrated *Miserere* of Gregorio Allegri, which, on returning to his hotel, he wrote down from memory note for note—a feat which created an immense sensation, for at that time the singers were forbidden to transcribe the music on pain of excommunication. Returning to Rome towards the end of June, he was invested by the pope with the order of "The Golden Spur," of which he was made a cavaliere,[4] an honour which he prized the more highly because, not many years before, it had been conferred upon Gluck. In July he paid a second visit to Bologna, when the Accademia Filarmonica, after subjecting him to a severe examination, admitted him to the rank of "compositore," notwithstanding a statute restricting this preferment to candidates of at least twenty years old. The exercise which gained him this distinction is a four-part composition (Köchel's Catalogue, No. 86) in strict counterpoint on the antiphon *Quaerite primum*, written in the severe ecclesiastical style of the 16th century and abounding in points of ingenious imitation and device.

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[1] In the baptismal register his name stands, *Joannes Chrysostomus Wolfgangus Theophilus* (Lat. *Amadeus*, Ger. *Gottlieb*).

[2] The German diminutive of Wolfgang.

[3] The original autograph is numbered "Select Case C, 21, d."

[4] *Auratae militiae eques.*

In October 1770 Wolfgang and his father returned to Milan for the completion and production of the new opera. The libretto, entitled *Mitridate, Re di Ponto*, was furnished by an obscure poet from Turin, to the great disappointment of the young maestro, who had hoped to set a drama by Metastasio. The progress of the work was interrupted from time to time by the miserable intrigues which seem inseparable from the lyric stage, exacerbated in this particular case by the jealousy of the resident professors, who refused to believe either that an Italian opera could be written by a native of Germany, or that a boy of fourteen could manage the orchestra of La Scala, at that time the largest in Europe. Fortunately the detractors were effectively silenced at the first full rehearsal; and on the 26th of December Wolfgang took his seat at the harpsichord and directed his work amidst a storm of genuine applause. The success of the piece was unprecedented. It had a continuous run of twenty nights, and delighted even the most captious critics.

Wolfgang's triumph was now complete. After playing with his usual success in Turin, Verona, Venice, Padua and other Italian cities, he returned with his father to Salzburg in March 1771, commissioned to compose a grand dramatic serenata for the approaching marriage of the archduke Ferdinand, and an opera for La Scala, to be performed during the season of 1773. The wedding took place at Milan on the 21st of October; and the serenata, *Ascanio in Albâ*, was produced with an effect which completely eclipsed the new opera of Hasse, *Ruggiero*, composed for the same festivity. Hasse generously uttered the often-quoted prophecy, "This boy will cause us all to be forgotten."[1]

During the absence of Wolfgang and his father the good archbishop of Salzburg died; and in the spring of the year 1772 Hieronymus, count of Colloredo, was elected in his stead, to the horror of all who were acquainted with his real character. The Mozart family did their best to propitiate their new lord, for whose installation Wolfgang, after his return from Milan, composed an opera, *Il Sogno di Scipione*; but the newly-elected prelate had no taste for art, and was utterly incapable of appreciating the charm of any intellectual pursuit whatever. For a time, however, things went on smoothly. In October the father and son once more visited Milan for the preparation and production of the new opera, *Lucio Silla*, which was produced at Christmas with a success quite equal to that of *Mitridate*, and ran between twenty and thirty nights.

In the meantime Wolfgang continued to produce new works with incredible rapidity. In 1775 he composed an opera for Munich, *La Finta giardiniera*, produced on the 13th of January. In the following March he set to music Metastasio's dramatic cantata, *Il Re pastore*. Concertos, masses, symphonies, sonatas and other important works, both vocal and instrumental, followed each other without a pause. And this fertility of invention, instead of exhausting his genius, seemed only to stimulate it to still more indefatigable exertions. But the pecuniary return was so inconsiderable that in 1777 Leopold Mozart asked the archbishop for leave of absence for the purpose of making a professional tour. This was refused on the ground of the prelate's dislike to "that system of begging." Wolfgang then requested permission to resign his appointment, which was only an honorary one, for the purpose of making the tour with his mother. The archbishop was furious; but the plan was carried out at last, and on the 23rd of September the mother and son started for Munich. The results were not encouraging. Leopold hoped that his son, now twenty-one years old, might obtain some profitable court appointment; but in this he was disappointed. And, worse still, poor Wolfgang fell in love at Mannheim with Aloysia Weber, a promising young vocalist, whose father, the prompter of the theatre (uncle of the great composer Weber), was very nearly penniless. On hearing of this Leopold ordered his wife and son to start instantly for Paris, where they arrived on the 23rd of March 1778. Wolfgang's usual success, however, seemed on this occasion to have deserted him. His reception was a cold one; and, to add to his misery, his mother fell seriously ill and died on the 3rd of July. Reduced almost to despair by this new trouble, he left Paris in September, rested for a while on his way home in Mannheim and Munich, was received by Aloysia Weber with coldness almost amounting to contempt, and in June 1779 returned to Salzburg, hoping against hope that he might make some better terms with the archbishop, who relented so far as to attach a salary of 500 florins (about £50) to his "concertmeister's" appointment, with leave of absence in case he should be engaged to write an opera elsewhere.

Two years later the desired opportunity presented itself. He was engaged to compose an opera for Munich for the carnival of 1781. The libretto was furnished by the abbate Varesco, court chaplain at Salzburg. On the 29th of January 1781 the work was produced under the title of *Idomeneo, re di Creta*, with triumphant success, and thenceforth Mozart's position as an artist was assured; for this was not only the finest work he had ever written but incontestably the finest opera that had ever yet been placed upon the stage in any age or country.

And now the archbishop's character exhibited itself in its true colours. Art for its own sake he utterly disdained; but it flattered his vanity to retain a famous artist in his service with the power of insulting him at will. On hearing of the success of *Idomeneo* he instantly summoned the composer to Vienna, where he was spending the season. Mozart lost not a moment in presenting himself, but he soon found his position intolerable. That he should be condemned to dine with his patron's servants was the fault of the age, but the open disrespect with which the lowest menials treated him was due to the archbishop's example. His salary was reduced from 500 to 400 florins, he was left to pay his own travelling expenses, and he was not permitted to add to his means by giving a concert on his own account or to play anywhere but at the archiepiscopal palace. Archbishop Hieronymus was hated at court, and most of all by the emperor Joseph, who, on retiring to Laxenburg for the summer, did not place his name on the list of invited guests. This offended him so deeply that he left Vienna in disgust. The household were sent on to Salzburg, but Mozart was left to find lodgings at his own expense. Thereupon he sent in his resignation; and for this act of contumacy was insulted by the archbishop in terms too vulgar for translation. He persevered, however, in his resolution, taking lodgings in a house rented by his old friends the Webers, and vainly hoping for pupils, since Vienna at this season was perfectly empty. Happily he had a sincere though not a generous well-wisher in the emperor, and a firm friend in the archduke Maximilian. By the emperor's command he wrote a German opera, *Die Entführung aus dem Serail*, which on the 16th of July 1782 was received with acclamation, and not long afterwards was performed with equal success at Prague. This great work raised the national "Singspiel" to a level commensurate with that which *Idomeneo* had already attained for the Italian "opera seria."

The next great event in Mozart's life was not what one would have wished for him. Though Aloysia Weber had long since rejected him, his renewed intimacy with the family led to an imprudent marriage with her younger sister, Constance, a woman neither his equal in intellect nor his superior in prudence. The wedding took place at St Stephen's on the 16th of August 1782. By the end of the year the thriftless pair were deeply in debt. Mozart composed incessantly, played at numberless concerts, and was in greater favour than ever at court and with the nobility; but to the last day of his life his purse was empty. He had, however, many kind friends, not the least affectionate of whom was the veteran Haydn, who was sincerely attached to him. With Gluck he was on terms of courteous intercourse only. Salieri detested him, and made no secret of his dislike.

Mozart's next dramatic venture was a German singspiel in one act, *Der Schauspieldirektor*, produced at Schönbrunn, on the 7th of February 1786. Not quite three months later, on the 1st of May, he produced his marvellous *Le Nozze di Figaro*, the libretto for which was adapted from Beaumarchais by the abbé da Ponte. The reception of this magnificent work was enthusiastic. But Vienna was a hotbed of intrigue. Everything that could be done by jealous plotters to mar the composer's success was done, and that so effectively that Mozart declared he would never bring out another opera in the city which treated him so meanly. Fortunately, *Figaro*, like *Die Entführung*, was repeated with brilliant success at Prague. Mozart went there to hear it, and received a commission to write an opera for the next season, with a fee of 100 ducats. Da Ponte furnished a libretto, founded on Tirso de Molina's tale, *El Convidado de piedra*, and entitled *Il Don Giovanni*. By the 28th of October 1787 the whole was ready with the exception of the overture, not a note of which was written. This circumstance has led to the idea that it was composed in haste, but it is certain that Mozart knew it all by heart and transcribed it during the night from memory, while his wife told fairy tales to keep him awake.

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[1] "*Questo ragazzo ci farà dimenticar tutti.*"

The opera was produced on the 29th of October with extraordinary effect, and the overture, though played without rehearsal, was as successful as the rest of the music.[1] Yet, when reproduced in Vienna, *Don Giovanni* pleased less than Salieri's comparatively worthless *Tarare*.

On returning to Vienna Mozart was appointed kammercompositor to the emperor, with a salary of 800 gulden (£80). In April 1789 he accompanied Prince Lichnowski to Berlin, where King Frederick William II. offered him the post of "kapellmeister" with a salary of 3000 thalers (£450). Though most unwilling to quit the emperor's service, he informed him of the offer and requested leave to resign his appointment in Vienna. "Are you going to desert me, then?" asked the emperor; and Mozart, wounded by the reproach, remained, to starve. The emperor now commissioned Mozart to compose another Italian opera, which was produced on the 26th of January 1790 under the title of *Così fan tutte*. Though the libretto by Da Ponte was too stupid for criticism, the music was delicious, and the opera would probably have had a long run but for the emperor's death on the 20th of February. In March 1791 Mozart consented to write a German opera upon an entirely new plan for Schikaneder, the manager of the little theatre in the Wieden suburb. The piece was to be addressed especially to the Freemasons, and to contain ceaseless allusions both in the words and music to the secrets of the brotherhood. Deeply interested in the affairs of a body of which he was himself a member, Mozart excelled himself in this new work, which took shape as *Die Zauberflöte*. He was rewarded for his labours by a brilliant artistic success, but Schikaneder alone reaped the financial benefit of the speculation.

Before the completion of *Die Zauberflöte* a stranger called on Mozart, requesting him to compose a *Requiem* and offering to pay for it in advance. He began the work under the influence of superstitious fear, believing that the messenger had been sent from the other world to forewarn him of his own approaching death. Meanwhile he received a commission to compose an opera, *La Clemenza di Tito*, for the coronation of the emperor Leopold II. at Prague. He worked incessantly and far beyond his strength. The coronation took place on the 6th of September, and its splendours threw the opera very much into the shade. *Die Zauberflöte* was produced on the 30th of September and had a splendid run. But the *Requiem* still remained unfinished; the stranger therefore made another appointment, paying a further sum in advance. Mozart worked at it unremittingly, hoping to make it his greatest work. In the *Requiem* he surpassed himself, but he was not permitted to finish it. When the stranger called the third time the composer was no more. The score of the *Requiem* was reverently completed by Süssmayer, whose task may have been simplified by instructions received from Mozart on his deathbed. It is now known that the work was commissioned by Count Walsegg, who wished to perform it as his own.

Mozart died on the 5th of December 1791, apparently from typhus fever, though he believed himself poisoned. His funeral was a disgrace to the court, the emperor, the public, society itself. On the afternoon of the 6th his body was hurried to a pauper's grave; and because it rained, Van Swieten, Süssmayer, and three other "friends" turned back and left him to be carried to his last long home alone. (W. S. R.)

Mozart's work falls conveniently into three periods, though O. Jahn makes out, more accurately, five. Our first period may be said, in sober seriousness, to begin at the age of five and to merge into the second somewhere about the age of sixteen or seventeen. It was fortunate that the infancy of the sonataforms (*q.v.*) coincided with the infancy of Mozart; for while this coincidence gave his earliest attempts a marvellous resemblance to the work of the fully-grown masters of the time, it secured for his mental activity a healthy and normal relation to the musical world which infant prodigies can never attain in a modern artistic environment. The little pieces composed by Mozart in his fifth and sixth years are a fascinating study in the unswerving progress made by a child who masters every step, not by some miraculous intuition that enables him to dispense with learning, but by a hardly less miraculous directness of thought that prevents him from either making the same mistake twice or exactly repeating a form once mastered. The violin sonatas written in London and Paris at the age of seven in no way fall below the accepted standards of the period, while they already show that variety of invention and experiment which, by the time he was twelve, caused some sober-minded critics to regard him as a dangerous person. His studies in the severer contrapuntal forms speedily gave him the greatest technical mastery of choral music attained since Bach; and more than one stray piece of church music, or movement from a mass or litany, written before he was fifteen, deserves to take rank as a true masterpiece of which the date is immaterial. At the age of fifteen we see a loss of freshness, especially in the numerous operas which show at its worst that hopeless condition of operatic art from which only Gluck's most drastic reforms could rescue it. Fortunately, Mozart had at fifteen acquired more than enough technique to rest upon; and thus the growing boy could keep his spirits up, continuing his public successes and indulging his easy sense of mastery, without putting a strain upon his brain which nature need revenge then or afterwards.

Lucio Silla, though loaded with conventional bravura arias, nevertheless shows him approaching the age of seventeen with clear signs of a man's power, and in higher qualities than mere variety and fancy. Some of its recitatives and choruses strike a solemn dramatic note hitherto undreamt of in stage music, except by Gluck. *La Finta giardiniera* first gave Mozart scope for the exercise of his wonderful stage-craft and power of characterization. Though it has not kept the stage, yet it marks the beginning of Mozart's true operatic career, just as the Masses in F and D, written in the same year, mark the close of his first really representative period as a composer of church music. It is, however, difficult to draw such lines definitely; for there is no period of Mozart's career in which he did not practise all artforms at once; and the difficulty of drawing inferences as to the relative importance of different forms in his intellectual development is increased by his invariable mastery, which seems to depend neither on method nor on inspiration. Most of the pianoforte sonatas and many of the best-known violin sonatas belong to his early manhood. To the same period also belong those unfortunate masses which, together with several spurious works, were at one time so popular, and have since been accepted as evidence that he had not the depth of feeling and earnestness necessary for church music. *Idomeneo* and *Die Entführung* are currently regarded as quite early works, but they are later than any of the masses except the great unfinished work in C minor, and there is some really great church music of his later period in the shape of stray pieces, litanies and vespers (*i.e.* collections of psalms sung at evening service) which is almost totally neglected, and which shows a consistent solemnity and richness of style no less in keeping with Mozart's new artistic developments than worthy of the glories of Handel and Bach.

Idomeneo is the only opera of Mozart which unmistakably shows the influence of Gluck; because, with the exception of *La Clemenza di Tito*, it is the only *opera seria* by which Mozart is known; and only a serious opera on a classical subject could furnish occasion for Gluck's phraseology and range of feeling to appear at all. How profoundly and independently Mozart seizes Gluck's method and style may best be seen by comparing the oracle scenes in *Idomeneo* and *Alceste*. In the management of the chorus, however, Mozart has, as was to be expected, incomparably the advantage. He has all, or rather more than all, Gluck's power for portraying panic and managing, by the motion of his music, the flight of a crowd; but he also has an inexhaustible harmonic and contrapuntal invention which lay beyond Gluck's scope.

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[1] Michael Kelly, in his *Reminiscences*, has left a delightful account of the circumstances.

The problems of comic opera presented a far more fruitful field. In *Die Entführung* he speedily showed a dramatic grasp for which *opera seria*, in spite of all the influence of Gluck, gave him no scope. He had a wonderful feeling for character, and did not imagine, like many French and other disseminators of musical-dramatic ideas (including, in moments of weakness, even Gluck himself), that the expression of character in music was a mere matter of harping on special types of phrase. His melodic invention was clearly and subtly characteristic without mannerism. It is of hardly minor importance that his own literary sense was far higher than that of many a writer of ostensibly superior general culture; and that Osmin, the most living figure in *Die Entführung*, is Mozart's creation, words and all.

After *Die Entführung*, Mozart's record is a series of masterpieces, accompanied, but not interrupted, by a running commentary of *pièces d'occasion*. With rare exceptions, everything he writes illustrates the perfect solution of an art-problem, and he often achieves an artistic triumph with the most eccentric materials. The modern organist can find since Bach no grander piece in his repertory than the two fantasias which Mozart wrote for the barrel of a musical clock. Shortly before his death he wrote a beautiful adagio and rondo for the glass harmonica, to which he devised the curious but eminently natural accompaniment of flute, oboe, viola and violoncello. And when at an earlier period it occurred to him to write some processional music for two flutes, five trumpets and four drums, the result, although not artistically important, might well have seemed to indicate long experience in handling the combination. His work in the larger instrumental forms is further discussed in the articles SONATA FORMS and INSTRUMENTATION. While Mozart's treatment of form has often been attacked as conventional, and his range of thought despised as childish, his instrumentation and general sense of euphony are at the present day more unreservedly admired by the most progressive propagandists than anything else in classical art.

Mozart's later operas, from *Figaro* onwards, represent the nearest approach to a perfect art-form attainable in pre-Wagnerian opera. What he might have attained in serious opera had he been spared to see the solemn triumphs the French operatic stage realized in the austere sincerity of Cherubini and Méhul it is impossible to guess. But we cannot doubt that a Mozart of yet riper experience than we have known would have given tragic opera a history in which *Fidelio* did not stand in lonely splendour. For Mozart, however, serious opera was an Italian art form, only temporarily rescued from the tyranny of bravura singers by Gluck. After *Idomeneo* he handled it only once, at the very close of his career, and then, as if to seal its fate, in a *pièce d'occasion* with an impossibly dull and unsympathetic libretto (*La Clemenza di Tito*). For comedy, however, his harmonic and rhythmic range was perfectly adapted; and in *Figaro* he had the advantage of a libretto which was already a finished literary product of consummate stagecraft before it ever became an opera. The perpetual surprises of its absurdly complex intrigues impose no real strain, for no one attempts to follow them; but they keep every character on the stage in a state of excitement which is so heightened and differentiated by the music that, while Beaumarchais's *Mariage de Figaro* has its modest but definite place in literature, Mozart's *Figaro* is, with all its lightness of touch, one of the most ideal classics in all art. The subject is not edifying; but Mozart does not analyse it from that point of view. His characters are irresponsible, mischievous and fairy-like. Theirs is the world described by Lamb—" the Utopia of gallantry, where pleasure is duty and the manners perfect freedom."

In *Don Giovanni* the matter is less clear. Mozart rose, not only in the music of the ghostly statue, but also in the music of Donna Anna and Donna Elvira, to heights that can only be called sublime; yet he never lost sight of the true methods of that comedy of gallantry to which *Don Giovanni* stands in some sense as a grotesque tragic finale. It is the business of an artistic intellect to grasp the artistic possibility of a world in which the " Utopia of gallantry " is at war with a full-blooded and incipiently moral humanity until the critical moment determines, not the breaking up of the artistic unity, but the right conclusion of the story. If it is absurd to treat Donna Anna and Donna Elvira as Wagnerian heroines, and so to complain of the inadequacy and conventionality of much of their utterances and attitudes; so, also, is it no less absurd to regard them as " secretly rather gratified than otherwise to be on Don Giovanni's list." Donna Elvira has suffered more cruelly from stolidly tragic singers and no less stolidly flippant critics than she ever suffered from Don Giovanni himself. She comes upon the stage expressing herself in thoroughly conventional music, and we are told that the formulas of Italian opera are inadequate for the expression of her sorrows. Look at the *sforzando* in the second violins at the words *Ah se ritrovo l'empio*. Mozart is depicting a young girl facing a position she does not in the least understand; expressing herself in stereotyped phrases as much from inexperience of their meaning as from lack of anything that may better say what she really feels. What Mozart's music with exquisite humour and simplicity expresses is as yet nothing more serious than the wish to scratch Don Giovanni's eyes out; as soon as his character is revealed to her in Leporello's comic aria of the " catalogue," she determines that others at all events shall not suffer as she has suffered; and from that moment her character steadily develops in seriousness and dignity. She is not all strength, and Don Giovanni fools her to the top of her bent; but nevertheless Mozart realizes, on hints of which the librettist was hardly conscious, a consistent scheme of development as dramatic as it is in keeping with the most sublime possibilities of comic opera. Yet it is a common practice to insert Elvira's last confession of weakness, the aria *Mi tradì*, immediately after Leporello's catalogue aria! Perhaps the first place where an intelligent tradition of Mozart as a comic genius of the highest type has been restored is Munich, where the standard set under the conductorship of Richard Strauss will not soon be forgotten.

In *Così fan tutte* Mozart's struggles with an absurd libretto show even clearer evidence of the accuracy and power of his genius than when he is working under conditions where success is possible. Space forbids our dwelling further on this subject, nor can we do more than glance at his last great opera, *Die Zauberflöte*. Beethoven thought it his greatest work; for the simple literal-minded sincerity with which Beethoven regarded the question of operatic libretto made *Figaro* frivolous and *Don Giovanni* scandalous in his sight. Mozart's very serious interest in freemasonry, which in its solemn ritual furnished an edifying contrast to the frivolity and uncongeniality of the existing state of church music, inspired him with the most sublime ideas hitherto brought upon the operatic stage. He was further stimulated by the feeling that freemasonry was to some extent a persecuted institution; and the circumstance that his librettist was a skilful stage manager secured for him that variety of action and effectiveness of entry and exit, compared with which an intelligible plot is of almost negligible importance as a source of inspiration to the classical composer, or even as a means of retaining popular favour. Thus *Die Zauberflöte* is an achievement unique in opera; combining as it does the farcical gorgeousness of a pantomime with the solemnity of a ritual and the contemporary interest of a political satire.

From the solemnity of masonic ritual there is but one step to that most pathetic of unfinished monuments, Mozart's *Requiem*. The finished portions of this work contain the most sublime and perfect church music between Bach and the *Missa solemnis* of

Beethoven. The unauthentic portions, supplied by Süssmayer, are so well designed that even their comparative slightness of material hardly militates against the suggestion that he may have had some inkling of Mozart's intentions. In particular, the return of the first number at the words *Lux aeterna*, which enables Süssmayer to end with ten pages of authentic Mozart, is splendidly placed (though Mozart is reported to have contemplated an independent final number); while the latter part of the *Lacrimosa*, though not in Mozart's handwriting, must surely have been dictated by him. The instrumentation of the incomplete numbers is based for the most part on highly authentic evidence, though there are doubtful points; but that of the supplied numbers, especially the *Benedictus*, is far below the intellectual level of their design. In this, his last work, as in many wonderful polyphonic experiments immediately before it, Mozart showed unmistakable signs of the growth of a new style, which would undoubtedly have had an influence even more powerful on the history of music as being embodied in works surpassing his ripest known achievements as these surpass the marvellous productions of his childhood. Nevertheless, what he has given us is unique, and the intelligent love of Mozart's work is a liberal education in the meaning of art.

Mozart's extant works (as catalogued by Köchel in 626 items, beginning with minuets written at the age of four and ending with the *Requiem*) comprise 20 masses (including the *Requiem* and the great unfinished Mass in C minor); 8 sets of vesperae and litanies; 40 smaller Latin pieces of church music; 6 cantatas and oratorio works, of which the greatest, *Davidde penitente*, is adapted from the C minor Mass; 17 "organ sonatas" (*i.e.* little movements for organ and an organ-loft band, for use in church); 23 operas (including fragments and operettas); 66 arias and other pieces for insertion into operas or for concert use; 41 songs with pianoforte accompaniment; 23 canons (mostly rounds); 17 pianoforte sonatas; 5 fantasias and a Handelian suite (unfinished); 22 smaller pianoforte pieces; 36 cadenzas to his own pianoforte concertos; 11 works for pianoforte *à quatre mains*; 45 sonatas, including fragments and variations, for pianoforte and violin; 8 pianoforte trios; 2 pianoforte quartets and 1 quintet for pianoforte and wind; 2 duets for violin and viola; 2 string trios; 29 string quartets; 2 quartets for flute and strings; 1 quartet for oboe and strings; 9 string quintets, of which 1 is for the singular combination of 1 violin, 2 violas, violoncello and horn, and another is the famous clarinet quintet; 49 symphonies; 33 cassations, serenades and divertimenti, many for the oddest orchestral or solo combinations; 27 smaller orchestral and other pieces, also often for strange combinations of surprising beauty; 29 sets of orchestral dances; 6 violin concertos (the 6th is either quite spurious or extremely corrupt) and 4 single violin movements; 2 double concertos (one for 2 violins, the other for violin and viola); 10 concertos and concert pieces for various wind instruments (flute, horn, bassoon, clarinet, flute and harp); 27 pianoforte concertos (including one for 2 and one for 3 pianofortes) and a concert rondo. Then there is an enormous number of fragments, many of them peculiarly promising, as if Mozart was full of ideas that were in advance of even his mastery of form; there is, for example, a magnificent and comparatively early opening tutti for a double concerto for pianoforte and violin, and a very large string quartet movement in A (probably a finale), which breaks off at an exciting moment at the beginning of its development.

No composer's reputation has suffered more from forgeries and false attributions than Mozart's and the tale begun during the lifetime of his widow is not yet ended at the present day. The concertante for 4 wind instruments which recently went triumphantly round the orchestral societies of Europe as a long-lost work written during Mozart's visit to Paris (though it is not for the same instruments) is not so bad as the notorious forged masses, but it is, to any one acquainted with Mozart's style at any period of his career, almost as obviously spurious. Mozart often wrote without thought, but never, even when he was six years old, without mastery; and there is much genuine work that is as dull as this concertante, but none that is obviously constructed by a fool. A panegyric of the concertante has been inserted in the latest (posthumous) editions of Jahn's biography, which it is very difficult to believe would have met with that great scholar's approval.

On the other hand, twelve recently discovered divertimenti for 2 clarinets and bassoon are delightful little works which, with all their slightness, only Mozart, and Mozart in full maturity, could have written. A seventh violin concerto appeared in November 1907, and, though inferior to the earlier ones, is undoubtedly genuine, every detail and quality of its organization being exactly in keeping with Mozart's progress in 1777, its alleged date.

Many genuine works are known in spurious forms; thus the motet *Splendente te Deus* is an unauthorized arrangement of a chorus from *König Thamos*, and most of the flute-music mentioned in the article *Flute* in *Grove's Dictionary* (new ed.) consists of spurious arrangements, while several important genuine works are ignored.

(D. F. T.)

MOZDOK, a town of Russia, in Caucasia, and in the province of Terek, on the left bank of the river Terek, 605 ft. above sea-level, in 43° 41′ N. and 44° 39′ E., 50 m. N. of Vladikavkaz. The population, 8760 in 1863, numbered 14,583 in 1897, and consisted of Kabardians, Chechens, Ossetes, Georgians and Armenians. Built in 1763 by the prince of Kabardia, Mozdok soon became an important point in the Russian advance towards the Caucasus, and was fortified. In 1840 it was attacked by the Circassian patriot Shamyl and 5000 mountaineers. The melons and water-melons of Mozdok are widely famed; and vine-growing and silkworm breeding prosper.

MOZLEY, JAMES BOWLING (1813–1878), English theologian, was born at Gainsborough, Lincolnshire, on the 15th of September 1813, and was educated at Oriel College, Oxford. He was elected to a fellowship at Magdalen in 1840. He took an active part in the Oxford movement, but could no more follow Newman into the Roman communion "than fly." He was joint editor of the *Christian Remembrancer*, but withdrew from the position because of his substantial agreement with the famous Gorham decision. He was one of the earliest supporters of the *Guardian*. In 1856 he became vicar of Shoreham, in 1869 canon of Worcester, and in 1871 regius professor of divinity at Oxford. He died at Shoreham on the 4th of January 1878.

He wrote *A Treatise on the Augustinian Doctrine of Predestination* (1855); *The Primitive Doctrine of Baptismal Regeneration* (1856); *A Review of the Baptismal Controversy* (1862); *Subscription to the Articles: a Letter* (1863); *Lectures on Miracles*, being the Bampton Lectures for 1865; and *Ruling Ideas in Early Ages and their relation to the Old Testament Faith* (1877). *Essays, Historical and Theological*, appeared in 1878 (2 vols.), with a biographical preface by his sister Anne, who also edited some of his *Letters* (1884).

MOZLEY, THOMAS (1806–1893), English divine and writer, was born at Gainsborough in 1806, the son of a bookseller and publisher in that town. From Charterhouse school he proceeded to Oriel College, Oxford, where he became the pupil, and subsequently the intimate friend, of John Henry Newman. In 1831 he was ordained, and became, in 1836, rector of Cholderton, Wiltshire. He was, from its beginning, a strong supporter of the Tractarian movement, and after contributing for some time to the *British Critic*, the chief organ of the movement, succeeded Newman as editor in 1841. In 1843 he was on the point of joining the Roman Catholic Church. Newman, however, strongly advised him to take two years to reflect, and long before that period had elapsed Mozley had determined to remain an Anglican. In 1844 he began to write leading articles for *The Times*, and continued to do so regularly for many years. In 1847 he resigned his country living and settled in London, but in 1868 accepted the living of Plymtree, Devonshire. From 1876–1880 he was rural dean of Ottery St Mary's, Devon. He resigned his living in 1880, and removed to Cheltenham, where he died on the 17th of June 1893.

He was the author of *Reminiscences, chiefly of Oriel, and the Oxford Movement*, published in 1882.

MPONGWE (Pongos), a settled Bantu people of the Gabun, West Africa, constantly confused with the Mpangwe or Fang (*q.v.*). The Mpongwe, who call themselves Ayogo or "the Wise," have a rich collection of national songs, myths and traditions, and the tribal elders know the "Hidden Words," a kind of secret language of unknown origin. Their language, a Bantu dialect, has been the means of communication between the tribes of the interior and the Europeans. The family organization is intricate and very similar to the Roman *patria potestas*; wives, children and slaves being all subservient to the father, who alone is really free. They practise the poison ordeal, and reverence vague and malignant spirits who require propitiation by offerings and ceremonies. The ghosts of the dead are especially feared.

MTSENSK (popularly *Amchensk*), a town of Russia, in the government of Orel, on the navigable Zusha River, 17 m. from its confluence with the Oka, and on the Moscow & Kursk railway, 32 m. N.E. of the city of Orel. Pop. (1900), 9390. It is mentioned in the Russian chronicles as early as 1147. From 1320 to 1530 it was under the rule of Lithuania; in the latter year it was taken by Russia, and became one of her chief strongholds against the raids of the Tatars. It is now an important centre for trade in grain, hemp, hemp-seed oil, tobacco and spirits.

MTSKHET, a decayed town of Russian Transcaucasia, in the government of Tiflis, 13 m. by rail N.N.W. of the city of Tiflis, at the confluence of the Aragva with the Kura, at an altitude of 1515 ft. Pop. (1897), 1221. One of the oldest places in Georgia, it was the capital of that country until supplanted by Tiflis in the last year of the 5th century A.D. The most ancient seat of the Georgian kings was the castle of Arma-tsikhe, Armasis, or Harmozica, crowning a hill opposite to Mtskhet. The most memorable relic of the latter is the cathedral, said to have been originally founded in the 4th century, though the existing building dates from the 15th century and was restored in the 18th. In the graveyard attached to this convent graves have been opened which yielded objects of the Iron and Stone ages, and others of the era of the Roman emperor Augustus.

MUBARRAD, or MOBARRAD [Abū-l ‘Abbās Maḥommed ibn Yazīd ul-Azdī] (*c.* 826–898), Arabian grammarian, was born in Baṣra, and became the leader of the Baṣran grammarians against the Kufan school. His judgment, however, was independent, as is shown by his attack on some points in the grammar of Sibawaihi, the greatest writer of his own school. He died at Bagdad.

His main work is the grammatical one known as the *Kāmil* (*Perfect*), which has been edited by W. Wright (Leipzig, 1864 seq.), and published at Constantinople (1869) and Cairo (1891). Two or three other works exist in MS.; cf. C. Brockelmann, *Gesch. der arabischen Litteratur*, i. 109 (Weimar, 1898). (G. W. T.)

MUCH WENLOCK, a market town in the municipal borough of Wenlock (*q.v.*), and the Ludlow parliamentary division of Shropshire, England, 163 m. N.W. from London on the Great Western railway. It lies at the north end of Wenlock Edge, a range running south-west from the Severn valley. A priory was founded here as a nunnery by St Milburg, granddaughter of Penda, about 680, and after being destroyed by the Danes was refounded by Leofric in 1017. Afterwards it was remodelled by Roger de Montgomery for Cluniac monks. There are beautiful remains of the priory church, chiefly Early English; but there is a chapter-house of ornate Norman work. The prior's house, still inhabited, is a remarkable specimen of 15th-century work, adjoining and incorporating remains in earlier styles. The parish church of Holy Trinity, close to the ruins, is of mixed styles from Norman onwards. There is a picturesque half-timbered guildhall (1589). Trade is mainly agricultural, but there are limestone quarries in the neighbourhood. Wenlock received the grant of a market from Henry III. in 1224. It was incorporated by Edward IV. in 1448, when it also received the privilege of returning members to parliament, but in 1885 it ceased to have separate representation.

MUCIANUS, LICINIUS, Roman general and statesman, lived during the 1st century A.D. His name shows that he had passed by adoption from the Mucian to the Licinian gens. About A.D. 55 he was sent by Claudius, who had become suspicious of his intimacy with Messallina, to Armenia with Domitius Corbulo. Under Nero he regained the imperial favour. After the death of Galba (69), Mucianus and Vespasian (who was at the time in Judaea) both swore allegiance to Otho, but when the civil war broke out Mucianus persuaded Vespasian to take up arms against Vitellius, who had seized the throne. It was agreed that Vespasian should stay behind to settle affairs in the East, while Mucianus made his way through Asia Minor and Thrace to attack Vitellius. He reached Rome the day after the death of Vitellius, and found Domitian, Vespasian's son, at the head of affairs, but until the arrival of Vespasian the real master of Rome was Mucianus. But he never wavered in his allegiance to Vespasian, whose favour he retained in spite of his arrogance. As no mention is made of Mucianus during the reigns of Titus or Domitian, he probably died during the reign of Vespasian. He was a clever writer and historian. He made a collection of the speeches and letters of the Romans of the older republican period, probably including a corpus of proceedings of the senate (*Acta senatus*), and was the author of a work, chiefly dealing with the natural history and geography of the East, which is often quoted by Pliny as an authority, especially for fabulous statements.

See monograph by L. Brunn (Leipzig, 1870).

MUCIC ACID, $C_6H_{10}O_8$ or $HOOC\cdot(CHOH)_4\cdot COOH$, is obtained by the oxidation of milk, sugar, dulcite, galactose, quercite and most varieties of gum by nitric acid. It forms a crystalline powder which melts at 213° C. It is insoluble in alcohol, and nearly insoluble in cold water. When heated with pyridine to 140° C., it is converted into *allomucic acid*. When digested with fuming hydrochloric acid for some time it is converted into $\alpha\alpha'$ furfurane dicarboxylic acid (see FURFURANE); while on heating with barium sulphide it is transformed into α—thiophene carboxylic acid (see THIOPHENE). The ammonium salt yields on dry distillation carbon dioxide, ammonia, pyrrol and other substances. The acid when fused with caustic alkalies yields oxalic acid.

MUCILAGE (from Late Lat. *mucilago*, a mouldy juice, from *mucere*, to be mouldy), a term which denotes a viscid or glutinous mixture of water and any gummy vegetable substance (see GUM). Mucilages are useful in medicine as vehicles for various insoluble and other drugs, and in the arts as thickeners (in calico-printing, dyeing, &c.). The British pharmacopoeia contains the mucilages of acacia and tragacanth.

MUCKERS (Ger. *Muckern*, *i.e.* canting bigots, hypocrites), the nickname given to the followers of the teaching of Johann Heinrich Schönherr (1770–1826) and Johann Wilhelm Ebel (1784–1861). Schönherr, the son of a non-commissioned officer at Memel in Prussia, was educated at the university of Königsberg, where at that time the theological faculty, under the influence of Kantian idealism, was strongly rationalist in tendency. The lad, who was miserably poor, was dissatisfied with a philosophy which stopped short of an explanation of the "thing in itself," and, having been reared in the strictest orthodoxy, he set to work to develop, with the aid of the Bible, a philosophy of his own. In the end he believed himself to have reached ultimate knowledge, and became the prophet of a dualistic theosophy[1] so closely analogous to Gnosticism that it might have been taken for a deliberate revival, had not Schönherr's lack of education precluded any such idea. Among his converts was Ebel, who from 1810 onwards gained a great reputation in Königsberg as an earnest preacher of the orthodox doctrines of sin, grace and redemption, and in 1816 was appointed "archdeacon," *i.e.* principal pastor, at the old church in Königsberg. In the pulpit he was orthodox; but he gathered about him a select circle of the initiated, to whom in private he taught Schönherr's doctrines. Schönherr himself sank into the background, and eventually died in 1826. But Ebel continued his teaching, and was joined in 1827 by Heinrich Diestel, also a Lutheran pastor of Königsberg. They became father confessors to a wide circle of silly fashionable people in the Prussian capital. In view of their peculiar teaching as to "the purification of the flesh," which involved the minute regulation of the intercourse of married people, scandal was inevitable. Matters came to a head in 1835, when Count Finckenstein, himself formerly an initiate, denounced the two pastors and accused them of immorality. Diestel wrote two violent tirades against the count, who brought an action for slander and won it. The evidence taken in the case was then laid before the consistory, and proceedings followed which became famous as the "Königsberger Religionsprozess" (1835–1841),[1] ending in sentences of deprivation on both Ebel and Diestel. The charges of actual immorality were dismissed; but there is no doubt that some of their followers established practices akin to those of the Agapemone and the Perfectionists. Some of them migrated to Brazil, where in 1874 at Porto Alegre a company of them came into collision with the military.

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[1] Schönherr distinguished two primal powers or principles—one male and active, the other female and passive—having both personality and volition; he called them Light and Darkness, Fire and Water. They moved freely in the void, and from their ultimate contact God and the world sprang into being. Evil came into existence owing to the fall of Lucifer, a Light-being created by God, who in revenge lent his aid to the powers of Darkness. Sin came with the Fall of Man; and this infection, inherited with the blood, necessitated redemption in order to restore the harmony of the primal powers. This was the work of Christ, who descended into a world the inhabitants of which are divided into children of Light and children of Darkness. The power of the Holy Ghost, emanating from Christ, perfects the higher natures in whom Christ's "law of righteousness" is represented and who to a certain extent share in his being; it becomes their duty to obtain control over the lower natures so as to struggle against the powers of Darkness in them—powers which can be overcome by prayer, fasting and self-mortification generally. The end was near and the triumph of the Light assured. Anti-christ (Napoleon) had already appeared, and when Christ came he would find no faith on the earth (Luke xviii. 8) because faith would be swallowed up in knowledge.

See J. I. Mombert, *Faith Victorious* (London, 1882); Hepworth Dixon, *Spiritual Wives* (1868); and, more especially, the article on Schönherr, by P. Tschackert, in Herzog-Hauck, *Realencyklopädie* (3rd. ed., Leipzig, 1906), xvii. 676.

MUCUNA, a genus of twining plants, belonging to the natural order Leguminosae, and natives of the tropics. *M. pruriens* is popularly known as cowhage or cowitch, a corruption of the Hindu *Kiwach*. It is a tall annual climber with large dark purple pea-like flowers, and golden-brown velvety pods recalling those of the sweet pea, the hairs or bristles on which often raise blisters on the skin. It is common in the tropical regions of India, Africa and America, and the hairs on the pod have long been used in medicine as a vermifuge.

MUDANIA (anc. *Apamea Myrlea*), a town of Asia Minor, on the south coast of the Sea of Marmora, and the port of Brusa. It is connected with Brusa by a railway and a carriage road, and with Constantinople by steamers. Olive oil is produced. Pop., 5900, of which two-thirds are Greeks.

MUDHOL, a native state of India in the southern division of Bombay. Area, 368 sq. m.; pop. (1901), 63,001; revenue, £20,000. It was a Mahratta principality dating from Mahommedan rule before the rise of Sivaji. The family name of the chief is Ghorpade. The town of Mudhol stands on the left bank of the Ghatprabha; pop. (1901), 8359.

MUDIE, CHARLES EDWARD (1818–1890), English publisher and founder of Mudie's Lending Library, was born at Chelsea on the 18th of October 1818, the son of a secondhand bookseller and newsagent. In 1840 he established a stationery and bookselling business in Bloomsbury, London. He was the first publisher of James Russell Lowell's poems in England, and of Emerson's *Man Thinking*. In 1842 he began to lend books. This department proved so successful that in 1852 he moved his "Select Library" to larger premises in New Oxford Street, London. In 1860 these premises were substantially enlarged, and branches of the business established, and in 1864 "Mudie's" was converted into a limited company. Mudie himself died on the 28th of October 1890.

MUFF, an article of outdoor apparel, open at either end, for holding the hands in and keeping them warm, generally made of fur, but also of velvet, silk, &c. Muffs are now only used in England by women, but in the 17th and 18th centuries were fashionable for men. In Roman times the place of the glove was taken by long sleeves (*manicae*) reaching to the hand, and in winter special sleeves of fur were worn (cf. Cic. *Phil.* ii. 11, 26). In Medieval Latin we find the word *muffulae*, defined by Du Cange (*Gloss., s.v.*) as *chirothecae pellitae et hibernae*. He quotes from a cartulary of the year 817, of the issuing to monks of sheepskin coverings to be used during the winter. These may have been, as the Roman certainly were, separate coverings for each hand, although the cartulary cited also distinguishes the glove for summer from the *muffulae* for winter wear. The O. Fr. *moufle* meant a thick glove or mitten, and from this the Du. *mof*, Walloon *mouffe*, and thence Eng. "muff," are probably derived. From the Fr. *moufle* have come the various uses, verbal and substantival, of "muffle," viz. to wrap round for protection, for deadening sound &c., and for a chamber or receptacle in a furnace to protect objects from contact with fire while exposed to heat. The slang use of "muff" for a clumsy, awkward person is of late origin. It appears in the middle of the 19th century.

MÜFFLING, FRIEDRICH KARL FERDINAND, FREIHERR VON, called **WEISS** (1775–1851), Prussian general field marshal, was born on the 12th of June 1775, and entered the Prussian army in 1790. In 1799 he contributed to a military dictionary edited by Lieutenant W. von Leipziger, and in the winter of 1802–1803, being then a subaltern, he was appointed to the newly-formed general staff as "quartermaster-lieutenant." He had already done survey work, and was now charged with survey duties under the astronomer F. X. von Zach (1754–1832). In 1805, when in view of a war with France the army was placed on a war footing, Müffling was promoted captain and assigned to the general staffs, successively, of General von Wartensleben, Prince Hohenlohe and Blücher. In 1806 he served under Hohenlohe, the duke of Saxe-Weimar, and Blücher, and was included in the capitulation of the latter's corps at Rattkau, after which he entered the civil service of the duke of Weimar. He rejoined the army on the outbreak of the War of Liberation in 1813, and was placed on the headquarters staff of the army of Silesia. His business qualities and common sense were greatly valued, though the temperamental differences between Müffling and Gneisenau often led to friction, especially as the former was in a measure the representative of the antiquated "topographical" school of strategists, to whom (rightly in the main) the disaster of Jena was attributed. In the interval between the first occupation of Paris and the Hundred Days, Müffling served as chief of the staff to the Russian general Barclay de Tolly and to General Kleist von Nollendorf. He was Prussian commissioner at the duke of Wellington's headquarters in the Waterloo campaign, and was involved in the various controversies which centred round the events of the 16th of June 1815. After the final fall of Napoleon he served on the staff of the army of occupation in France and was for some months military governor of Paris. He spent a part of his time on the Rhine in survey work, and was employed by Frederick William III. in various diplomatic missions. In 1821 he became chief of the general staff at Berlin, and though he has been accused of indulging his taste for topographical work at the expense of training for war, his work was not wasted, for he gave an excellent organization to the general staff, and executed elaborate and useful surveys. In 1829 he visited Constantinople and St Petersburg in connexion with negotiations for peace between Russia and Turkey. He took a prominent part in the military and civil history of Prussia, and from 1838–1847 was governor of Berlin. Failing health compelled his retirement in the latter year, and he died on the 16th of January 1851, at his estate of Ringhofen near Berlin.

Under the initials of C(arl) von W(eiss), he wrote various important works on military art and history: *Operationsplan der preuss-sächs. Armee 1806* (Weimar, 1807); marginalia on the archduke Charles's *Grundsätze der höheren Kriegskunst für die Generäle der oesterr. Armee*, and on Rühle von Lilienstern's *Bericht über die Vorgänge bei der Hohenloheschen Armee 1806*; *Die preussisch-russische Kampagne bis zum Waffenstillstande 1813* (Berlin, 1813); *Geschichte der Armeen unter Wellington und Blücher 1815* (Stuttgart, 1817); *Zur Kriegsgesch. der Jahre 1813–1814: die Feldzüge der schlesischen Armee von der Beendigung des Waffenstillstandes bis zur Eroberung von Paris* (Berlin, 1824); *Betrachtungen über die grossen Operationen und Schlachten 1813–1815 (Berlin,* 1825); *Napoleons Strategie 1813* (Berlin, 1827); and an essay on the Roman roads on the lower Rhine (Berlin, 1834). Müffling was also the inventor of a system of hachuring for maps. His reminiscences, *Aus meinem Leben*, were published at Berlin in 1851.

MUFTĪ,[2] a consulting canon-lawyer in Islām, who, upon application, gives *fatwās* (*fetvas*) or legal opinions on points of canon law (see MAHOMMEDAN LAW). These are asked and given in strictly impersonal form, but the cadi, or judge, then applies them to the case and decides in accordance with them. In theory, any learned man whose opinion is respected and whose advice is sought can give fatwās. But generally in a Muslim state there are muftīs specifically appointed by the government, one for each school of canon law in each place. Each of these renders opinions in accordance with the law-books of his school;

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[1] The contemptuous designation *Muckern* dates from this time.

[2] The use of the word for plain or civilian clothes worn instead of uniform is originally Anglo-Indian. It may have been suggested by the loose flowing robes of the stage "muftī," and thus implied any easy dress worn by an officer when out of uniform.

he has no scope for free interpretation; everything is fixed there, and he must follow the precedents of the elders. In Turkey there is a chief muftī, called the Sheikh al-Islām, whose office was created by the Ottoman sultan, Mahommed II., in 1453, after the capture of Constantinople. He is, in a sense, the head of the ecclesiastical side of the state, that controlled by canon law; while the grand vizier is at the head of secular matters. Although his powers are delegated by the sultan-caliph, and he is appointed and can be dismissed by him, yet in his fatwā-issuing power he is independent. The sultan may dismiss him before he has a chance to issue a fatwā; but if he once issues it the result is legally automatic, even though it means the deposition of the sultan himself. Thus it was by a fatwā of the Sheikh al-Islām that the sultan Abdul Hamid was deposed.

See Juynboll, *De mohammedaansche Wet.*, 40 sqq.; De Slane's trans. of Ibn Khaldūn's *Prolégomènes*, I. lxxviii. 447 seq.; *Turkey in Europe*, by "Odysseus," 131 seq.; Young, *Corps de droit ottoman*, I. x., 285, 289. (D. B. Ma.)

MUGGLETON, LODOWICKE (1609–1698), English sectarian, was born in Bishopsgate Street, London. His father was a farrier, but he himself was bred to be a tailor. In 1651 he began to have revelations, and to proclaim himself and his cousin John Reeve, whose journeyman he was, as the two witnesses mentioned in Rev. xi. 3. In 1652 they put out their "commission book" under the title *The Transcendent Spirituall Treatise*. An exposition of their doctrines was published in 1656 under the title of *The Divine Looking-Glass*. Among other views (besides the doctrine of the divine mission of the authors) this work taught that the distinction of the three persons in the Trinity is merely nominal, that God has a real human body, and that He left Elijah as His vicegerent in heaven when He Himself descended to die on the cross. Muggleton's opinions gained some notable adherents, but also called forth much opposition. In 1653 he was imprisoned for blasphemy, and twice (1660 and 1670) his own followers temporarily repudiated him. His attack on the Quakers drew forth William Penn's book, *The New Witnesses proved old Heretics* (1672). In 1677 Muggleton was tried at the Old Bailey, convicted of blasphemy, and fined £500. Reeve died in 1658, but Muggleton survived till 1698.

His collected works, including the posthumous *Acts of the Witnesses*, were published in 1756; and in 1832 some sixty Muggletonians subscribed to bring out a new edition of *The Works of J. Reeve and L. Muggleton* (in 3 vols. 4to). Even as late as 1846 *The Divine Looking-Glass* was reprinted by members of the then almost extinct sect. See A. Jessopp, *The Coming of the Friars* (1888).

MUGWUMP, in American political slang, a name applied to any independent voter, and especially to those independents in the Republican party who refused to support James G. Blaine, when nominated by that party for the presidency in 1884; as since adopted in England it usually means one who stays neutral and votes for no party. Originally "mugwump" (*mogkiomp*) was a North American Indian word, in the Massachusett dialect of the Algonquian, meaning "great man" (*mogki*, great; *omp*, man); and in New England it was used of self-conceited politicians.

MUHAMRAH (Mohammerah), a town of Persia, in the province of Arabistan, in 30° 26′ N., 48° 11′ E., on the Hafar canal, which joins the Karun with the Shatt el Arab, and flows into the latter 40 m. above its mouth at Fao and about 20 m. below Basra. It has post and telegraph offices, and a population of about 5000. With the opening of the Karun river, as far as Ahvaz, to international navigation in 1889, Muhamrah acquired greater importance, and its customs, which until then were leased to the governor for £1500 per annum, rose considerably, and paid £8000 until taken over by the central customs department under Belgian officials in 1902. It is estimated that the value of the imports and exports into and from Muhamrah, excluding specie, is about £300,000 per annum, paying customs amounting to about £18,000. Until 1847, when it definitely became Persian territory in accordance with art. ii. of the treaty of Erzerum, Muhamrah was alternately claimed and occupied by Persia and Turkey, its ruler, an Arab sheikh, helping either power as he found it convenient. Since then the governor of the town and adjoining district has been a sheikh of the K'ab or Chaab Arabs, a powerful tribe of the Shi'ah branch of Islam. At the close of the Anglo-Persian campaign in 1857 Muhamrah was taken by a British force.

MÜHLBERG, a town of Germany, in Prussian Saxony, on the left bank of the Elbe, 8 m. below Riesa. Pop. (1905), 3380. It carries on a considerable trade by water in timber and corn. Mühlberg is famous for the victory gained here, on the 24th of April 1547, by the emperor Charles V. over the elector of Saxony, John Frederick.

See Lenz. *Die Schlacht bei Mühlberg* (Gotha, 1879); and Bertram, *Chronik der Stadt Mühlberg* (Torgau, 1864).

MUHLENBERG, HENRY MELCHIOR (1711–1787), German-American Lutheran clergyman, was born in Einbeck, Hanover, on the 6th of September 1711. When he was twelve years old his father, a member of the city council, died. The son entered the university of Göttingen in 1735, and his work among the poor of Göttingen led to the establishment of the present orphan house there. In 1738 he went to Halle to finish his theological studies; he was a devoted worker in the Franckesche Stiftung, which later served as a partial model for his great-grandson's community at St Johnland, Long Island. He was deacon at Grosshennersdorf, in Upper Lusatia, in 1739–1741. In 1742, in reply to a call from the Lutheran churches of Pennsylvania, he went to Philadelphia, and was joined from time to time, especially in 1745, by students from Halle. Muhlenberg occupied himself more particularly with the congregation at New Providence (now Trappe), though he was practically overseer of all the Lutheran churches from New York to Maryland. In 1748 he organized the first Lutheran synod in America. Muhlenberg married in 1745 Anna Maria Weiser, daughter of J. Conrad Weiser, a well-known Indian interpreter, and herself said to have had Indian blood in her veins; by her he had eleven children. Throughout the War of Independence he and his sons (see below) were prominent patriots. He died at Trappe on the 7th of October 1787. The importance of his work in organizing and building up the American Lutheran Church, of which he has been called the Patriarch, can hardly be exaggerated; but his example in preaching in English as well as in German was, unfortunately for the growth of the Lutheran Church, not followed by his immediate successors. He had no sympathy with the Old Lutherans and their strict orthodoxy—on the contrary he was friendly with the Reformed congregations, and with George Whitefield and the Tennents.

See *Life and Times* by William J. Mann (Philadelphia, 1887).

MUHLENBERG, JOHN PETER GABRIEL (1746–1807), American preacher and soldier, son of H. M. Muhlenberg (*q.v.*), was born at Trappe, Pennsylvania, on the 1st of October 1746. With his two brothers he was educated in Germany. He entered the Lutheran ministry, had charge of churches at New Germantown and Bedminster, New Jersey, and after 1772 of a church in Woodstock, Virginia, and there in 1775 raised the 8th Virginia (German) regiment, of which he was made colonel; in February 1777 he became a brigadier-general in the Continental Army; and in September 1783 was breveted major-general. He took part in the battles of Brandywine, Germantown and Monmouth, and at Yorktown commanded the first brigade of light infantry. After the war he removed to Pennsylvania. He was a member of the Virginia convention of 1776, was vice-president of the supreme-executive council of Pennsylvania in 1787–1788, and was a representative in Congress in 1789–1791, in 1793–1795, and in 1799–1801. In 1801 he was elected as a Democratic-Republican to the United States Senate, but immediately resigned to become supervisor of revenue for the district of Pennsylvania. He became collector of the port of Philadelphia in 1803. He was a friend of Thomas Jefferson and of James Monroe.

See *Life* by Henry A. Muhlenburg (Philadelphia, 1849).

His brother, Frederick Augustus Conrad Muhlenberg (1750–1801), became his father's assistant in Philadelphia in 1770; was pastor of the Christ (or Swamp) German Lutheran Church of New York City from 1773 to 1776; and in 1777–1779 was assistant to his father at New Hanover. In 1779–1780 he was a member of the Continental Congress, in 1780–1783 of the Pennsylvania general assembly (then consisting of only one house), and in 1789–1790 of the state constitutional convention. He was president of the Pennsylvania convention which ratified the federal constitution, and was a member in 1789–1797 of the national House of Representatives, of which he was speaker in 1789–1791 and 1793–1795. On the 29th of April 1796, as chairman of the committee of the whole, he cast the deciding vote for the laws necessary to carry out Jay's treaty.

Another brother, GOTTHILF HENRY ERNEST MUHLENBERG (1753–1815), was a prominent Lutheran clergyman, and was pastor of a church in Lancaster, Pennsylvania, from 1779 to his death; but he is best known as a botanist, and published *Catalogus plantarum Americae septentrionalis* (1813) and *Descriptio uberior graminum et plantarum calamariarum Americae septentrionalis indignarum et circurum* (1817).

See John M. Maisch, *G. H. E. Muhlenberg als Botaniker* (1886).

Gotthilf's son, HENRY AUGUSTUS MUHLENBERG (1782–1844), was pastor of a Lutheran Church in Reading, Pennsylvania, in 1802–1828, was a Democratic representative in Congress in 1829–1838, and was United States minister to Austria in 1838–1840.

MUHLENBERG, WILLIAM AUGUSTUS (1796–1877), American philanthropist and Protestant Episcopal clergyman, great-grandson of H. M. Muhlenberg and grandson of F. A. C. Muhlenberg, was born in Philadelphia, Pennsylvania, on the 16th of September 1796. He graduated at the university of Pennsylvania in 1815. In 1817 he was ordained a deacon in the Protestant Episcopal Church, and became assistant to Bishop William White (1748–1836) in the rectorship of Christ Church, St Peter's and St James's, Philadelphia. In 1820 he was ordained priest and until 1826 was rector of St James's Church, Lancaster, Pennsylvania. Largely owing to his efforts, Lancaster was the second public school district created in the state. His interest in church music and hymnody prompted his pamphlet of 1821, *A Plea for Christian Hymns*; he drew up for the use of his own parish a collection of *Church Poetry* (1823); and in 1823 he was appointed by the General Convention a member of the committee on psalms and hymns, whose collection, approved in 1826, contained several of Muhlenberg's own compositions, including "I would not live alway," "Shout the glad tidings," and "Saviour, who thy flock art feeding." From 1826 to 1845 he was rector of St George's, Flushing, Long Island, where in 1827 he became head of the Flushing Institute, probably the first Protestant Episcopal "church school" in the United States. He founded a St Paul's College, to include the institute, but the panic of 1837 and the refusal of a charter by the state legislature brought it to an end; and the property was sold a few years after Muhlenberg left Flushing. The methods of this institute were however copied widely; church schools sprang up everywhere; and St Paul's School, Concord, New Hampshire, and the Groton School in Massachusetts were established in accordance with his ideas. In 1845 he removed to New York City, where in 1846 he became rector of the Church of the Holy Communion, a "free" church built by his sister, Mrs Mary A. Rogers. Here Muhlenberg founded the first American order of Protestant Episcopal deaconesses, the Sisterhood of the Church of the Holy Communion, begun in 1845 and formally organized in 1852. The work of the sisterhood led to Muhlenberg's establishment of St Luke's Hospital (opened in 1858), for which his congregation made offerings each St Luke's Day after 1846. In 1866 he founded on Long Island the Church Industrial Community of St Johnland. He bought 535 acres (mostly wooded), with a shore front of 1½ m. on Long Island Sound, near King's Park, 45 m. from New York City, to be a home for the aged and for young children, especially cripples.[1] The plan was not reformatory nor purely charitable, and a moderate rent was charged for the cottages. In the St Johnland cemetery is the grave of Dr Muhlenberg, who died on the 8th of April 1877 in St Luke's Hospital, New York City. His ideal of the church was that it was missionary and evangelical as well as catholic with formal government and ritual; hence he called himself an "evangelical Catholic" and wrote the *Evangelical Catholic Papers*, which were collected and published by Anne Ayres in 1875–1877.

See Anne Ayres, *Life and Work of William Augustus Muhlenberg* (New York, 1880), and W. W. Newton, *Dr Muhlenberg* (Boston, 1890), in the "American Religious Leaders" series.

MÜHLHAUSEN, a town of Germany, in Prussian Thuringia, on the right bank of the Unstrut, 25 m. N.W. of Gotha by rail. Pop. (1905), 34,359. It consists of a new and an old town, surrounded by five suburbs, and has numerous old churches and towers. The most interesting churches are those of St Mary and of St Blasius, dating respectively from the 14th and the 12th century; the town-hall is also a fine medieval structure. The chief industries are the spinning and weaving of woollen and cotton. Other manufactures include needles, machinery, cigars, soap, hosiery, furniture and shoes. There are also establishments for dyeing, tanning, lime-burning, iron-making, brewing and the preparation of liqueurs.

Mühlhausen is one of the oldest towns in Thuringia, and is said to have been fortified in 925. Its early importance is shown by the grant of privileges made to it by the German King Henry I., and by the diet held here in 1135. During the Reformation period Mühlhausen became notorious as one of the chief seats of the Anabaptists. Thomas Münzer, one of their leaders, was captured in the vicinity and executed in the town. Internal dissensions and injuries received during the Thirty Years' War and the Seven Years' War afterwards reduced Mühlhausen to unimportance. In 1802 it lost its independence and passed to Prussia, in 1807 it was attached to the kingdom of Westphalia, but in 1815 it again became Prussian. The Teutonic Order established itself at Mühlhausen in 1200.

See E. Heydenreich, *Aus der Geschichte der Reichsstadt Mühlhausen* (Halle, 1900); Nebelsieck, *Reformationsgeschichte der Stadt Mühlhausen* (Magdeburg, 1905); Herquet, *Urkundenbuch der ehemaligen freien Reichsstadt Mühlhausen* (Halle, 1874); F. Stephan, *Verfassungsgeschichte der Reichsstadt Mühlhausen* (Sondershausen, 1886); Jordan, *Chronik der Stadt Mühlhausen* (Mühlhausen, 1900–1906); and *Führer durch Mühlhausen und Umgegend* (1901).

MUIR, JOHN (1810–1882), Scottish Orientalist, was born on the 5th of February 1810 in Glasgow, where his father, William Muir (d. 1821), was a merchant. He was educated at the grammar school of Irvine, the university of Glasgow, and the East India Company's College at Haileybury. He went to India in 1829, and served with distinction in various offices, as assistant secretary to the board of revenue, Allahabad, as collector at Azimgarh, as principal of the Victoria College, Benares, and as civil and session judge at Fatehpur. He encouraged the study of Sanskrit, and furthered schemes for the enlightenment and amelioration of the Hindus. In 1853 he retired and settled in Edinburgh, where he continued his Indian labours. In 1862 he endowed the chair of Sanskrit in the university of Edinburgh, and was the main agent in founding the Shaw fellowship in moral philosophy. He was a D.C.L. of Oxford, LL.D. of Edinburgh and Ph.D. of Bonn, and was one of the first to receive the distinction of C.I.E. He died on the 7th of March 1882.

In 1858 appeared vol. i. of his *Original Sanskrit Texts* (2nd ed., 1868); it was on the origin of caste, an inquiry intended to show that it did not exist in the Vedic age. Vol. ii. (1st ed., 1860; 2nd, 1871) was concerned with the origin and racial affinities of the Hindus, exhibiting all the then available evidences of their connexion, their linguistic, social and political kinship, with the other branches of the Indo-European stock. Vol. iii. (1st ed., 1861; 2nd, 1868) was on the Vedas, a full inquiry as to the ideas of their origin, authority and inspiration held both by the Vedic and later Indian writers. Vol. iv. (1st ed., 1863; 2nd, 1873) was a comparison of the Vedic with the later representations of the principal Indian deities, an exhibition of the process by which three gods hardly known to the Vedic hymns became the deities of the former Hindu Trimurti. Vol. v. (1870) was on the Vedic mythology. Dr Muir was also the author of a volume of *Metrical Translations from the Sanskrit*, an anonymous work on *Inspiration*, several works in Sanskrit, and many essays in the *Journal of the Royal Asiatic Society* and elsewhere.

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[1] The Society of St Johnland, incorporated in 1870, has a chapel, the Church of the Testimony of Jesus (1869), St John's Inn, the home for old men (also built in 1869), Sunset Cottage, a home for twelve aged couples, Muhlenberg House for old women, the Fabbri Home, the Sunbeam Cottage (given by Mr and Mrs Cornelius Vanderbilt in 1881) Lawrence House, for babies, a library and village hall, a kindergarten, a school house, and the "mansion," Dr Muhlenberg's home at St Johnland and later the home of Sister Anne Ayres, his biographer, during her superintendence of the society.

MUIR, SIR WILLIAM (1819–1905), Scottish Orientalist, brother of the preceding, was born at Glasgow on the 27th of April 1819. He was educated at Kilmarnock Academy, at Glasgow and Edinburgh Universities, and at Haileybury College, and in 1837 entered the Bengal Civil Service. He served as secretary to the governor of the North-West Provinces, and as a member of the Agra revenue board, and during the Mutiny he was in charge of the intelligence department there. In 1865 he was made foreign secretary to the Indian Government. In 1867 he was knighted (K.C.S.I.), and in 1868 he became lieutenant-governor of the North-West Provinces. In 1874 he was appointed financial member of the Council, and retired in 1876, when he became a member of the Council of India in London. He had always taken an interest in educational matters, and it was chiefly through his exertions that the central college at Allahabad, known as Muir's College, was built and endowed. In 1885 he was elected principal of Edinburgh University in succession to Sir Alexander Grant, and held the post till 1903, when he retired. Sir William Muir was a profound Arabic scholar, and made a careful study of the history of the time of Mahomet and the early caliphate. His chief books are a *Life of Mahomet and History of Islam to the Era of the Hegira*; *Annals of the Early Caliphate*; *The Caliphate*, an abridgment and continuation of the *Annals*, which brings the record down to the fall of the caliphate on the onset of the Mongols; *The Koran: its Composition and Teaching*; and *The Mohammedan Controversy*, a reprint of five essays published at intervals between 1885 and 1887. In 1881 he delivered the Rede lecture at Cambridge on *The Early Caliphate and Rise of Islam*. He married in 1840 Elizabeth Huntly Wemyss (d. 1897), and had five sons and six daughters; four of his sons served in India, and one of them, Colonel A. N. Muir (d. 1899), was acting resident in Nepal.

MUḲADDASI[1] [the appellation of Shams ad Din Abu Abdallah Mahommed ibn Aḥmad] (*fl.* 967–985), Arabian traveller, author of a *Description of the Lands of Islam* which is the most original and among the most important of Arabic geographies of the middle ages. His family name was Al Bashari. His paternal grandfather was an architect who constructed many public works in Palestine, especially at Acre, and his mother's family was opulent. His maternal grandfather, a man of artistic and literary tastes, migrated to Jerusalem from Jurjan province in Persia, near the frontier of Khorasan. His descriptions rest on extensive travels through a long series of years. His first pilgrimage was made at the age of twenty (in A.H. 356 = A.D. 967), but his book was not published till A.H. 375 (A.D. 985–986), when he was forty years old.

The two MSS. (at Berlin and Constantinople) represent a later recension (A.H. 378). The book became known in Europe through the copy brought from India by Sprenger, and was edited by Professor M. J. de Goeje as the third part of his *Bibliotheca Geographorum Arabicorum* (Leiden, 1877). See also the English translation (unfinished) by G. S. A. Ranking and R. F. Azoo, in *Bibliotheca Indica*, New Series, Nos. 899, 952, 1001 (Bengal Asiatic Society, 1897–1901); Muḳaddasi's Syrian chapter has been separately translated and edited in English by Guy le Strange (London, Palestine Pilgrims Text Society, 1886); in German by J.Gildemeister in *Zeitschrift des deutschen Palästina-Vereins*, vol. vii. (1884).

MUKDEN (Chinese *Shêngking*), the capital of Manchuria, on the Hun-ho, 110 m. N.E. of Niuchwang, in 41° 51′ N., 123° 38′ E., with a population of 250,000. It is a centre for trade and also for missionary enterprise. It was formerly the headquarters of the Manchu dynasty, and their tombs lie within its confines. Mukden is a fine town, with splendid walls, about a mile long each way. The suburbs extend a considerable distance from the city and are surrounded by mud walls. In the centre of the town stands a small palace surrounded by an inner wall and roofed with yellow tiles. The boots and pack of Nurhachu, the founder of the present Chinese dynasty, who was a pedlar, are preserved there. Nurhachu's son, the emperor T'ien-tsung (1627–1636), built temples to heaven and earth in the neighbourhood of the city in imitation of those at Peking. These are much dilapidated. Four or five miles to the east of the town stands the Fu-ling or "happy tomb," where the remains of Nurhachu rest, the outer gates of which are adorned with a green majolica representation of an imperial dragon. The Emperor K'ien lung (1726–1796) wrote a poem on Mukden, which was translated into French by Père Amiot and attracted the attention of Voltaire. During the Russo-Japanese War in 1905 some of the heaviest fighting took place before Mukden, what is known as the "battle of Mukden" covering operations from the 19th of February till the Japanese occupied Mukden on the 10th of March and the Russians retreated northward on the 12th.

MUKDISHU (*Magodoxo*), a seaport of Italian Somaliland, East Africa, in 2° 1′ N., 45° 24′ E. It is built on the sandy coast which separates the Webi Shebeli from the sea. The harbour is open. Mukdishu, formerly extensive, is largely in ruins; it consists of two villages, Hamarhwin to the south and Shingani to the north. There are some houses in the Moorish style and a mosque among the ruins bears date 636 A.H. (*i.e.* A.D. 1238). Between the two settlements is the governor's palace and north of the town is a massive square tower built by the Portuguese in the 16th century. The population, about 5000, is mainly composed of descendants of negro slaves known as Abesh. There are also Somali, Arab and Hindu settlers. Mukdishu is mentioned by Marco Polo and described by Ibn Batuta as an "immense" city. This was in the early part of the 14th century. It was a flourishing port and had many fine mosques when captured by the Portuguese (about 1510). Under Portugal the place fell into decay. It passed in the 17th century into the possession of the imams of Muscat, but in the 18th century became practically independent. It was reconquered by Seyyid Said *c.* 1830, and on the division of his dominions fell to Zanzibar. In 1892 it was transferred to Italy (see SOMALILAND, *Italian*). The name of the town is spelt in a great variety of ways, including Madeigascar, whence the name of the island of Madagascar. Alfred Grandidier points out that the Portuguese, misled by Marco Polo's description of Mukdishu as an island, fancied they had discovered the land of which he wrote when they touched at Madagascar.

MULA, a town of eastern Spain, in the province of Murcia; on the left bank of the Mula, a small right-hand tributary of the Segura, periodically liable to destructive floods. Pop. (1900), 12,731. The Sierra Espuña rises on the south to a height of nearly 5200 ft. Mula has a small trade in agricultural produce, wine and olive oil. About 4 m. east are two groups of houses known as the Baños de Mula, with warm sulphurous springs of considerable local repute.

MULATTO (Span. and Port. *mulato*, diminutive of *mulo*, Lat. *mulus*, a mule, used as denoting a hybrid origin), a person one of whose parents is of a white race and the other a negro. In Latin America such half-breeds are sometimes called *mestizos*.

MULBERRY[2] (botanically *Morus*; nat. ord. *Moraceae*), a genus of about ten species growing in the temperate regions of the northern hemisphere and in the mountains of the tropics. They are deciduous trees or shrubs with alternate, toothed, often three-lobed leaves and unisexual flowers in catkin-like inflorescences.

The black mulberry (*Morus nigra*), a native of western Asia, spread westwards in cultivation at an early period; it was cultivated by the Greeks and Romans, and in northern Europe by the 9th and 10th centuries. Up to the 15th century it was extensively grown in Italy for rearing silkworms, but has since been superseded by *M. alba*. It is now mainly cultivated for its oblong purplish-black compound fruit—the so-called *sorosis*, formed from the whole female inflorescence in which the perianth leaves of the single flowers have become fleshy—which is wholesome and palatable if eaten fresh before acetous fermentation has set in. The mulberry succeeds as a standard in the warmer parts of England, especially in sheltered situations, but in the north of England and the less favoured parts of Scotland it requires the assistance of a wall. The standard trees require no other pruning or training than an occasional thinning out of the branches, and are generally planted on lawns, to prevent the fruit being damaged when it falls. The tree succeeds best in a rich, deep, and somewhat moist loam, but grows well in any good garden ground. It is usually propagated either by cuttings or layers, which latter, if made from the older branches of the tree, come sooner into bearing. Cuttings planted in the spring should consist of well-ripened shoots of the preceding year, with a joint of two-year-old wood at their base, or if planted in autumn should have the shoots well matured, and furnished with a heel of two-year-old wood. The branches and even stout limbs are sometimes employed as cuttings instead of the younger shoots, especially when the object is to obtain a bearing tree quickly. The branch should be planted deeply in autumn in good soil, and if necessary supported in an upright position by a stake. The most common mode of propagation, however, is by layering the young branches. The mulberry may be grown in pots, and gently forwarded in an orchard house, and under these conditions the fruit acquires a richness of flavour unknown in the fruit ripened out of doors. If cultivated in this way it requires abundance of water while the fruit is swelling, and also frequent dressings of artificial fertilizers.

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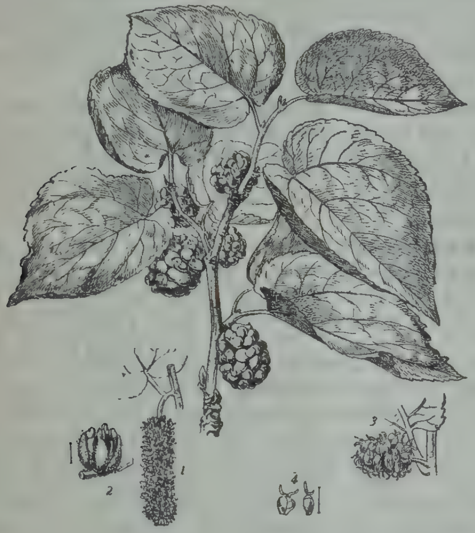
[1] Al Muḳaddasi = "the Jerusalemite."

[2] *Mulberry* stands for *murberry* or *morberry*, *i.e.* *morus* and "berry," cf. Ger. *maulbeere*, O.H.G. *mûlberi*, *mûrberi*.



Mulberry (*Morus nigra*) Shoot bearing Fruit.

1, Catkin of male flowers.
2, A male flower.
3, Cluster of female flowers.
4, Two female flowers.

The white mulberry (*M. alba*), so called from its nearly white fruit, is the one mainly employed in sericulture. It is a native of China and has been cultivated from the earliest times in Asia and since the 12th century in Europe, especially in the Mediterranean region. There are many varieties, among which the Philippine mulberry (var. *multicaulis*) is perhaps most highly esteemed. The Indian species, *M. indica* (not to be confounded with *Morinda citrifolia*, a rubiaceous tree, sometimes also called Indian mulberry), is also cultivated for the same purpose.

M. rubra, the North American red mulberry, is the largest of the genus, often reaching a height of 70 ft. It produces dark red berries much inferior in flavour, however, to those of *M. nigra*.

Broussonetia papyrifera, a member of a closely allied genus, is the paper mulberry, a native of Burma, China and Polynesia, and widely cultivated in Japan, where the bark is used for paper-making. The Tapa-cloth of the South Sea Islands is also made from it. The plant is a shrub or small tree with large mulberry-like lobed or entire hairy leaves. Several forms are cultivated, differing chiefly in the shape of the leaves.

MULDE, a river of Germany, a left-bank tributary of the Elbe. It is formed by the confluence, just below Kolditz, of the Zwickauer Mulde, which rising in the Vogtland of Saxony passes Zwickau, Glauchau and Rochlitz, and the Freiberger Mulde, which, rising in the Bohemian Erzgebirge, touches Freiberg, Döbeln and Leisnig. The united river flows north to Grimma and thence past Wurzen, Eilenburg and Bitterfeld to Dessau, where it joins the Elbe. The total length of the united river is 75 m.

MULE (Lat. *mulus*), a term not unfrequently applied to the produce of any two creatures of different species, and synonymous with hybrid, but in its ordinary acceptation employed to designate the offspring or "cross" between the equine and asinine species. There are two kinds of mule—the *Mule* proper (*Equus asinus*, var. γ; *Mulus*; Fr. *Mulet* or *Grand mulet*; Ger. *Grosser Maulesel*), which is the hybrid produce of a male ass with a mare, and the *Hinny* (*Equus asinus*, var. δ; *Hinnus*; Fr. *Bardot* or *Petit mulet*; Ger. *Kleiner Maulesel*), the offspring of the stallion and female ass. The mule is the more valuable of the two, and to its production the attention of breeders is entirely directed.

In its short thick head, long ears, thin limbs, small narrow hoofs, short mane, absence of chestnuts (horny growths) inside the hocks, and tail destitute of hair at the root the mule is asinine; while in height and body, shape of neck and croup, uniformity of coat, and in teeth it is equine. It has the voice neither of the ass nor of the horse, but emits a feeble hoarse noise. The most common colour of the mule is a brown or bay-brown—bay, or bright bay, or piebald being rare; a chestnut tint is sometimes noticed. It possesses the sobriety, patience, endurance and sure-footedness of the ass, and the vigour, strength and courage of the horse. As a beast of burden it is preferable to the horse, being less impatient under the pressure of heavy weights, while the skin being harder and less sensitive renders it more capable of resisting sun and rain.

The mule has been in use from early times; the inhabitants of Mysia and Paphlagonia are said to have been the first breeders. With the Greeks and Romans, the latter especially, the mule was valued, being employed to draw carriages and carry loads. In modern times it has been largely used for military transport.

The principal mule countries in Europe are the south of France, Spain, Portugal and Italy, where they are used for pack and draught. The French mules are most numerous on the borders of the Pyrenees, in Gascony, and in Poitou. In Spain mules are used in the Catalan provinces, in the mountainous districts of Andalusia, and in the province of Alicante. Good draught-mules are bred in La Mancha and in the districts on the slopes of the Pyrenees, where they are employed to carry loads. But in Spain, Italy, and some other countries they are also extensively used in carriages; in Spain particularly, where large, fine mules are bred for this purpose, a pair of these animals will often cost more than a pair of horses. The mules of Asia Minor, Syria, Cyprus, Egypt and Algeria, as well as those of the district between the Tigris and the Persian frontier and in North China, are good. In the Punjab provinces of British India many excellent mules are bred, breeding being promoted by the government. Good mules are reared in North and South America, the principal districts for breeding them in the United States being Texas, Missouri, Mississippi, Tennessee, Alabama, Georgia, Arkansas and Kentucky. The Kentucky mules are well shaped and showy, being derived from nearly thoroughbred mares known as Kentucky trotters, while those reared in Missouri are hardy. The Mexican mule, bred by a male ass out of a mustang mare, is also a hardy, strong and useful animal.

France is perhaps the most important mule-raising country in Europe, four centres being more particularly devoted to this kind of industry: Poitou, the mountainous districts of central France, the Pyrenees and Dauphiné. The mules of these different parts differ chiefly in height; those of Poitou are large, powerful, and long in the body, and are mainly exported to the departments of Languedoc and Provence, as well as to Spain, Italy and America; those of Dauphiné are of medium height, with a short, thick body; while those of the centre and the Pyrenees are lighter and smaller, but more active.

Mule-breeding in Poitou is supposed to date from the time of Philip V. of Spain, when the particular breeds of horses and asses were imported into that region and Gascony. But there is evidence to show that as early as the 10th century the mules of Poitou were of excellent quality.

MULGRAVE, EARLDOM OF, a title dating from 1626, when Edmund Sheffield, 3rd Baron Sheffield of Butterwicke, was created earl of Mulgrave. He was succeeded by his grandson Edmund, the 2nd earl, who was one of the nine true peers who sat in Oliver Cromwell's House of Lords. Edmund's son John, 3rd earl, was created marquess of Normanby in 1694, and duke of Buckingham and Normanby in 1703; but on the death of his son, the 2nd duke, without heirs in 1735, the titles became extinct. The 2nd duke devised the estates of the Sheffield family to his mother Catherine, a natural daughter of James II., who had married as her first husband the 3rd earl of Annesley, by whom she had a daughter Catherine, who married William Phipps and had a son Constantine Phipps. The latter succeeded to the estate of Mulgrave in Yorkshire in 1743 on the death of his grandmother, and in 1767 he was created Baron Mulgrave of New Ross in the peerage of Ireland. His son was created a peer of Great Britain in 1790 with the title of Baron Mulgrave of Mulgrave; and the latter's brother Henry, the next in succession, who was secretary of state for foreign affairs in 1805 and held other high government offices, was created Viscount Normanby and earl of Mulgrave in 1812. The 2nd earl of this creation, who like his father held several high cabinet offices, was advanced in the peerage at the coronation of Queen Victoria, being created marquess of Normanby in 1838.

MÜLHAUSEN (Fr. *Mulhouse*), a town of Germany, in Upper Alsace, on the Ill, an affluent of the Rhine, and the Rhine-Rhone canal, about 56 m. S. of Strassburg and 21 m. N.W. of Basel by rail. The old town, surrounded by arms of the Ill, has narrow and irregular streets, while to the south, on the canal, lie the handsome villas and promenades of the new town. Most of the older buildings have made way for factories, so that the town-hall, dating from 1551, is an almost solitary witness to the town's medieval prosperity. The most important interest of Mülhausen centres in the making of cotton goods. This industry was introduced in 1746, and has since prospered in the hands of several wealthy families which are closely connected by intermarriage, and lend each other support. A large proportion of the inhabitants of the town and the neighbourhood is engaged in woollen and other textile manufactures, the products of which are exported to all parts of the world. The manufactures of machinery, especially locomotives and railway plant, chemicals, and hardware are also important. A noteworthy feature is the attention paid by the manufacturers to the well-being of their workpeople. In 1853, Johann Heinrich Dollfus (1800–1887), mayor of the town, founded the "artisans' town" (*cité ouvrière*) to the north-east of the old town, consisting of about 1200 model dwellings with public bath-, wash- and bake-houses, and library. The houses were let on a system by which the occupant became the owner after the payment of a certain number of instalments. Of recent years, however, the operatives have moved into the suburbs, leaving the model houses of the "artisans' town" to small tradesmen. A "société industrielle" for the encouragement of original discovery and invention among the workmen has existed since 1825, and there are various benevolent societies. Mülhausen carries on an active trade in grain, wine, colonial produce and timber, which is facilitated by its river harbour. After the annexation of Alsace to Germany in 1871 the French sympathies of the inhabitants were shown by the extraordinary decrease in their number. The population has since increased, amounting in 1905 to 94,514, of whom about two-thirds are Roman Catholics.

Mentioned as early as 717, Mülhausen was raised to the rank of a free town of the empire in 1198, and received very extensive privileges from Rudolph of Hapsburg in 1273. It suffered considerably in the various wars of the middle ages, but generally managed to maintain its independence. In 1466 it formed an alliance with the Swiss, and this became a permanent union in 1515. By the peace of Westphalia (1648) it was recognized as an independent ally of the Swiss League. In 1797 it sought incorporation with France from motives of commercial policy, and in 1871 it passed to Germany.

See A. Metzger, *La République de Mulhouse 717–1798* (Basel, 1884); Schall, *Das Arbeiterquartier von Mülhausen* (Berlin, 1877); Herkner, *Die ober-elsässische Baumwollindustrie und ihre Arbeiter* (Strassburg, 1887); and E. Tournier, *Mülhausen im 16. Jahrhundert* (Illyach, 1894).

MÜLHEIM-AM-RHEIN, a town of Germany, in the Prussian Rhine province, on the right bank of the Rhine, 2 m. below Cologne, of which it is practically a suburb, and on the main lines of railway Cologne-Düsseldorf and Cologne-Elberfeld. Pop. (1905), 50,807. There are important manufactures of silk, ribbons, velvet, sailcloth, tobacco, vinegar, yarn and chemicals, in addition to rolling-mills, boiler works, telegraph works, breweries, tanneries and a ship-building yard. Mülheim also carries on a brisk trade by rail and river.

Of ancient foundation, Mülheim received municipal rights in 1322. Its industrial prosperity is in great part due to the influx of Protestants expelled from Cologne at the beginning of the 17th century. In 1784 the town suffered severely from an inundation caused by the rapid breaking-up of the ice on the Upper Rhine.

MÜLHEIM-AN-DER-RUHR, a town of Germany, in the Prussian Rhine province, on the Ruhr, an affluent of the Rhine, about 7 m. W. from Essen and at the intersection of several railways. Pop. (1905), 93,598. It has a parish church dating from the 12th century. Like most of the towns in this district, Mülheim finds its chief industry in iron-working, and contains numerous blast-furnaces, rolling-mills, foundries and engine-works; it also carries on manufactures of leather, wool, cotton, calico, tobacco, paper, beer, and other miscellaneous goods. An enormous traffic, by river and rail, is carried on in coal, and there is also a considerable trade in timber and colonial produce. In the neighbourhood are important sandstone quarries, glass-works, and a carpet manufactory. Mülheim was formerly included in the duchy of Berg, and became a town in 1508. In 1815 it passed to Prussia.

MULJI, KURSENDAS (1832–1875), Indian journalist and social reformer, was born on the 25th of July 1832, of a family belonging to the Bhatia or trading caste of western India. Being repudiated by his family on account of his views on widow remarriage, he became a vernacular schoolmaster, and started a weekly paper in Gujarati called *The Satya Prakash*. In this he attacked the immoralities of the Maharajas or hereditary high priests of the Vallabhacharya sect of Vaishnavism to which the Bhatias belong. In a suit for libel brought against him in the High Court at Bombay in 1862, he won a victory on the main issue. After a visit to England on business in connexion with the cotton trade, which was not successful and brought on him excommunication from his caste, he was appointed in 1874 to administer a native state in Kathiawar during the minority of the chief; and there he died in August 1875.

See *History of the Sect of Maharajas or Wallabhacharyas of Western India* (1865).

MULL, the largest island of the Inner Hebrides, Argyllshire, Scotland. Pop. (1901), 4334. It is bounded on the W. and S. by the Atlantic, on the N. and N.E. by the Sound of Mull, and on the E. and S.E. by the Firth of Lorne. It has an area of about 367 sq. m., its greatest length being 27 m. and its greatest breadth 20 m. The coast is much indented, the principal sea-lochs being Loch Mingary, Loch Cuan, Loch Tua, Loch-na-Keal, Loch Scridain, Loch Buy, Loch Spelve and Loch Don. Among several freshwater lakes Loch Frisa, Loch Ba and Loch Uisg are the chief. The principal mountains are Ben More (3185 ft.), Ben Buy (2354 ft.) and Ben Creach (2289 ft.). In the basaltic cliffs near Carsaig are numerous arches and caverns. The prevailing rocks are igneous (generally basaltic, gabbro in the mountains in the south-east, granite in the Ross). The valleys are filled up with lava flows and volcanic ashes of Miocene age. At a few places there are gneissose rocks, chalk, sandstone, lias and quartz porphyry. Sheep and cattle are raised, and barley, oats and potatoes grown. Owing to the damp climate the island is better suited for grazing than for cultivation.

Granite and freestone are quarried. Ben More deer forest and the excellent fishing and shooting attract many sportsmen. There are several ancient castles, the principal being those of Duart and Aros. Close to the former is a lighthouse erected in memory of William Black, the novelist (d. 1898). About midway between Mull and Lismore is the Lady Rock, visible at low water, on which, in 1523, Lachlan Maclean of Duart exposed his wife, a daughter of the second earl of Argyll, expecting that she would be drowned by the flowing tide. She was, however, saved by her clansfolk and her husband was afterwards slain by her brother. Joanna Baillie (1762–1851) made the incident the leading theme of her drama of *The Family Legend*. TOBERMORY ("the Well of Mary," so called from a spring of local celebrity) is the only town (pop. 1175). It is placed on a pretty bay, the houses standing on tree-clad heights. It was founded in 1788 as a station for fishing-boats, and the herring fishery is still of some consequence. It has regular communication by steamer with Stornoway, Oban and Glasgow. Off the north-western shore of Mull, separated by a narrow strait, lies the isle of ULVA, 4¾ m. long and 2½ m. broad, whose inhabitants are mostly engaged in fishing and kelp-gathering. Close to Ulva, and practically one with it at low tide, is the isle of GOMETRA, about 1½ m. long and 2 m. broad, the people of which are chiefly occupied with fishing. LITTLE COLONSAY lies about 2 m. south of Ulva. Farther west is the small group of the TRESHNISH ISLES.

MULL. (1) A soft plain muslin exported largely from England to India, &c., and used also in some qualities for summer dresses in the home trade. The name is an abbreviation of the Hindu *mulmul*. (2) A word, derived from the same root as seen in "meal" and "mill," meaning that which is ground or reduced in other ways to powder or small particles Thus a snuff-box is in Scotland called a "mull," from the early machines in which the tobacco was ground. Large snuff-mulls, which remained stationary on a table, as opposed to the small portable boxes, often took the form of a ram's head ornamented in silver. Possibly from the ground or grated spices with which ale or wine is flavoured when heated, comes the expression "mulled," as applied to such a beverage. The colloquial expression "to make a mull," *i.e.* to muddle or make a failure of something, also perhaps connected with "to mull," to reduce to powder. (3) The Scots word "mull," meaning a promontory or headland, as the Mull of Galloway, the Mull of Kintyre, represents the Gaelic *maol*, cf. Icelandic *mūli* in the same sense; this may be the same as *mūli*, snout, cf. Ger. *Maul*.

MULLAH (Arabic *maula*, a term which originally expresses the legal bond connecting a former owner with his manumitted slave, both patron and client being called *maula*, and thus suggests the idea of patronage), in Mahommedan countries, a learned man, a teacher, a doctor of the law, In India the term is applied to the man who reads the Koran, and also to a Mussulman schoolmaster. In countries like Afghanistan the mullahs exert an influence over the populace which sometimes rivals that of the amir himself, and they have been responsible for many disturbances in Kabul. Among the democratic tribes of the north-west frontier of India they almost take the place of a secular chief. In the Indian frontier risings of 1897–98 the "mad mullah" of Swat led the attack upon the Malakand, while the Hadda mullah was largely responsible for the risings amongst the Mohmands, Afridis and Orakzais. The leader of the risings in Somaliland in 1899–1910 was similarly known as the "mad mullah."

MÜLLER, FERDINAND VON, BARON (1825–1896), German botanist and explorer, was born at Rostock on the 30th of June 1825, and was educated, after the early death of his parents, in Schleswig. He studied the flora of Schleswig and Holstein from 1840 to 1847, when he emigrated to South Australia and travelled through the colony from 1848 to 1852, discovering and describing a large number of plants previously unknown. In 1852 he was appointed government botanist for Victoria, and examined its flora, and especially the Alpine vegetation of Australia, which was previously unknown. Then, as phytographic naturalist, he joined the expedition sent out under Augustus Gregory by the duke of Newcastle, secretary of state for the colonies. He explored the river Victoria and other portions of North Australia, was one of the four who reached Termination Lake in 1856, and accompanied Gregory's expedition overland to Moreton Bay. From 1857 to 1873 he was director of the Botanical Gardens, Melbourne, and not only introduced many plants into Victoria, but made the excellent qualities of the blue gum tree (*Eucalyptus globulus*) known all over the world, and succeeded in introducing it into the south of Europe, North and South Africa, California, and the extra-tropical portions of South America. For these services he was decorated by many foreign countries, including France, Spain, Denmark and Portugal; was created K.C.M.G. in 1879, baron of the kingdom of Würtemberg in 1871, and F.R.S. in 1861. He published eleven volumes of *Fragmenta phytographica Australiae* (1862–1881), two volumes of the *Plants of Victoria* (1860–1865), and other books on the Eucalyptus, Myoporaceae, Acacias, and Salsolaceae, all profusely illustrated. He also co-operated in the production of G. Bentham's *Flora Australiensis*. He took a leading part in promoting Australian exploration, especially the Burke and Wills expedition, which was the first to cross the continent, and in the various attempts to unravel the mystery which attended the fate of his fellow-countryman Ludwig Leichhardt (1813–1848). He died at Melbourne on the 9th of October 1896.

MÜLLER, FRIEDRICH (1749–1825), German poet, dramatist and painter, usually known as Maler (*i.e.* painter) Müller, was born at Kreuznach on the 13th of January 1749. He studied painting at Zweibrücken, and in 1774–1775 settled in Mannheim, where in 1777 he was appointed court painter. In 1778 he was enabled by a public subscription to visit Italy, which remained his home for the rest of his life. In 1780 he became a Roman Catholic. He was unfavourably influenced by the study of Italian models, and gradually gave up painting and devoted himself to the study of the history of art; his services as cicerone were especially in demand among German visitors to Rome. Before he left Mannheim he had tried his hand at literature, under the influence of the *Sturm und Drang* movement. A lyric drama, *Niobe* (1778), attracted little attention; but *Fausts Leben dramatisiert* (1778) appealed to the turbulent spirit of the time, and *Golo und Genoveva* (begun in 1776, but not published till 1811) was an excellent imitation of Goethe's *Götz von Berlichingen*. He struck out a more independent path in his idylls, notably *Die Schafschur* (1775) and *Das Nusskernen* (1811), in which, emancipating himself from the artificiality of Gessner, he reproduced scenes—not without a touch of satire—from the German peasant life of his day. He died at Rome on the 23rd of April 1825.

Maler Müller's *Werke* appeared in 3 vols. (1811–1825); in 1868 H. Hettner published two volumes of *Dichtungen von Maler Müller*, which contain most of his writings. *Gedichte von Maler Friedrich Müller; eine Nachlese zu dessen Werken* appeared in 1873, and his *Fausts Leben* was reprinted by B. Seuffert in 1881. See A. Sauer, "Stürmer und Dränger," vol. iii. (Kurschner's *Deutsche Nationalliteratur*, vol. 81, 1883); and B. Seuffert, *Maler Müller* (1877).

MÜLLER, GEORGE (1805–1898), English preacher and philanthropist, was born near Halberstadt, Germany, on the 27th of September 1805, the son of an exciseman. He subsequently became a naturalized British subject. Educated in Germany, he resolved in 1826 to devote himself to missionary work, and in 1828 went to London to prepare for an appointment offered him by the Society for promoting Christianity among the Jews. In 1830 however he gave up the idea of missionary work, and became minister of a small congregation at Teignmouth, Devonshire. He contended that the temporal as well as the spiritual needs of life could be supplied by prayer, and on this principle abolished pew rents and refused to take a fixed salary. After two years at Teignmouth, Müller removed to Bristol, where he spent the rest of his life. He devoted himself particularly to the care of orphan children. He began by taking a few under his charge, but in course of time their number increased to 2000, settled in five large houses erected for the purpose at Ashley Down, near Bristol. The money required for the carrying on of this work was voluntarily contributed, mainly as a result of the wide circulation of Müller's narrative *The Lord's Dealings with George Müller*. When he was over seventy he started on a preaching mission, which lasted nearly seventeen years and included Europe, America, India, Australia and China. He died at Bristol on the 10th of March 1898.

See A. T. Pierson, *George Müller of Bristol* (1899).

MÜLLER, JOHANNES PETER (1801–1858), German physiologist and comparative anatomist, was born at Coblenz on the 14th of July 1801. In 1819 he entered Bonn University, where he became privatdocent in 1824, extraordinary professor of physiology in 1826, and ordinary professor in 1830. In 1883 he removed to the university of Berlin, where he filled the chair of anatomy and physiology with great distinction until his death on the 28th of April 1858. Müller made numerous researches in various departments of physiology, and in particular he extended knowledge as to the mechanism of voice, speech and hearing, and as to the chemical and physical properties of lymph, chyle and blood. The appearance of his *Handbuch der Physiologie des Menschen* between 1833 and 1840 (translated into English by Dr William Baly, and published in London in 1842) marked the beginning of a new period in the study of physiology. In it, for the first time, the results of human and comparative anatomy, as well as of chemistry and other departments of physical science, were brought to bear on the investigation of physiological problems. The most important portion of the work was that dealing with nervous action and the mechanism of the senses. Here he stated the principle, not before recognized, that the kind of sensation following stimulation of a sensory nerve does not depend on the mode of stimulation but upon the nature of the sense-organ. Thus light, pressure, or mechanical stimulation acting on the retina and optic nerve invariably produces luminous impressions. This he termed the law of the specific energy of sense substances. In the later part of his life he chiefly devoted himself to comparative anatomy. Fishes and marine invertebrata were his favourite subjects. Müller numbered such distinguished physiologists as H. von Helmholtz, E. Du Bois Reymond and K. F. W. Ludwig among his pupils.

In addition to his *Handbuch der Physiologie*, his publications include *Zur vergleichenden Physiologie des Gesichtssinns* (1826); *Über die phantastischen Gesichtserscheinungen* (1826); *Bildungsgeschichte der Genitalien* (1830), in which he traced the development of the Müllerian duct; *De glandularum secernentium structura* (1830); *Vergleichende Anatomie der Myxinoiden* (1834–1843); *Systematische Beschreibung der Plagiostomen* (1841) with F. G. J. Henle; *System der Asteriden* (1842) with F. H. Troschel; and *Horae ichthyologicae* (1845–1849) with the same. After the death of J. F. Meckel (1781–1833) he edited the *Archiv für Anatomie und Physiologie*.

MÜLLER, JOHANNES VON (1752–1809), Swiss historian, was born on the 3rd of January 1752 at Neunkirch, near Schaffhausen, where his father was pastor. In 1760 the family removed to Schaffhausen. In his youth his maternal grandfather, Schoop (d. 1757), roused in him an interest in the history of his country. At the age of eight he is said to have written a history of Schaffhausen, and at eleven he knew the names and dates of all the kings of the four great monarchies. His ardour for historical studies was further stimulated by Schlözer, when Müller went (1769) to the university of Göttingen, nominally to study theology. In July 1771 he undertook a sketch of Swiss history (no detailed history of Switzerland having so far been written) for a publisher of Halle, but his theological studies and the preparation of a Latin dissertation on the *Bellum cimbricum* (publ. in 1772) prevented much progress. In April 1772 he passed his theological examination, and soon after became professor of Greek at the Collegium Humanitatis. Early in 1774, on the advice of his friend Charles Victor de Bonstetten, he gave up this post and became tutor in the Tronchin family at Geneva. But in 1775 he resigned this position also, and passed his time with various friends in Geneva and Vaud, engaged in carrying his historical scheme into effect. Having accumulated much material, he began the actual composition of his work in the spring of 1776, and the printing in the summer of 1777. But difficulties arose with the censor, and matters came to a standstill. In 1778–1779 Müller delivered a brilliant set of lectures on general history, which were not published till 1839 under the title of *Vierundzwanzig Bücher allgemeiner Geschichte*. In 1780 the first volume (extending to 1388) of his *Geschichten der Schweizer* appeared, nominally at Boston (to avoid the censor), though really at Bern; and it was well received. In 1781 he published at Berlin, in French, his *Essais historiques*. He was on his way back to Switzerland when the landgrave of Hesse Cassel named him professor of history. He stayed at Cassel till 1783, publishing in 1782 his *Reisen der Päpste*, a book wherein certain leanings towards Romanism are visible. On his return to Geneva (1783) he accepted the post of reader to the brother of his old patron, Tronchin, and occupied himself with remodelling his published work of 1780. In order to improve his financial position, he accepted early in 1786 the post of librarian to the elector-archbishop of Mainz, who bestowed many important offices upon him and obtained his elevation to nobility from the emperor in 1791. In June 1786 he issued vol. i. (reaching to 1412) and two years later vol. ii. (to 1436) of the definitive form of his Swiss history, which was received with great praise. In 1787 he issued an important political tract, *Zur Darstellung des Fürstenbundes*. But in October 1792 Mainz was taken by the French, so that Müller had to seek for another post. In February 1793 he entered the service of the emperor as an imperial aulic councillor. At Vienna he spent many years, becoming chief librarian of the imperial library in 1800, and in 1795 he issued vol. iii. (to 1443) of his Swiss history. In 1804 he became historiographer, war councillor, and member of the Academy at Berlin. In 1805 vol. iv. (to 1475) appeared. But in 1806 he became strongly inclined towards Napoleon, by whom he was received in audience (Nov. 1806), and from whom he accepted (end of 1807) the office of secretary of state for the kingdom of Westphalia, exchanging this position early in 1808 for the posts of privy councillor and general director of public instruction. At the end of 1808 he published vol. v. (to 1489) of his great work. He died at Cassel on the 29th of May 1809. His *Swiss History* now possesses a literary value only, but it was an excellent work in every way for the 18th century.

Müller's works were published under the care of his brother at Tübingen, in 27 vols. (1810–1819), and re-issued, in 40 vols., at Stuttgart (1831–1835). The *Swiss History* was re-issued at Leipzig and Zürich, in 15 vols. (1824–1853), with continuations by Glutz-Blozheim (to 1517), Hottinger (to 1531), Vulliemin (to 1712), and Monnard (to 1815). A French translation of the German edition (as above) appeared, in 18 vols., at Paris and Geneva (1837–1851).

See the biographies by Heeren (1809), Döring (1835) and Monnard (1839); also in G. v. Wyss's *Geschichte der Historiographie in der Schweiz* (Zürich, 1895), pp. 305–311, and in the *Festschrift der Stadt Schaffhausen* (Schaffhausen, 1891), pt. v. pp. 83–99. F. Schwarz's pamphlet, *J. von Müller und seine Schweizergeschichte* (Bâle, 1884), traces the genesis of the *History*. Müller's letters to Füsslin (1771–1807) were issued at Zürich (1812), and those to Ch. Bonnet, &c., at Stuttgart (1835). Those addressed to him by various friends were published by Maurer-Constant, in 6 vols. (Schaffhausen, 1839–1840); and those written to him (1789–1809) by his brother, J. G. Müller, appeared, under the editorship of E. Haug, at Frauenfeld, in 2 vols. (1891–1892). (W. A. B. C.)

MÜLLER, JULIUS (1801–1878), German Protestant theologian, was born at Brieg on the 10th of April 1801. He studied at Breslau, Göttingen and Berlin, first law, then theology; and in 1839 became professor ordinarius of theology at Halle (1839). In 1848 he helped to found the *Deutsch-evang. Kirchentag*, and two years later founded and edited (1850–1861), with Neander and K. I. Nitzsch, the *Deutsche Zeitschrift für christliche Wissenschaft und christliches Leben*. He died at Halle on the 27th of September 1878. A disciple of Neander and friend of Richard Rothe, Müller bitterly opposed the philosophy of Hegel and the criticism of F. C. Baur. His book, *Über den Gegensatz des Protestantismus und des Catholicismus* (1833), called forth a reply from Baur, and he was one of those who attacked D. Strauss's *Life of Jesus*. In 1846 he had been deputed to attend the General Evangelical Synod at Berlin. Here he supported the Consensus-Union, and afterwards defended himself in the pamphlets *Die erste Generalsynode der evang. Landeskirche Preussens* (1847) and *Die evangelische Union, ihr Wesen und göttliches Recht* (1854). His chief work, however, was *Die christliche Lehre der Sünde* (2 vols., 1839; 5th ed., 1867; Eng. trans. from 5th ed.), in which he carried scholasticism so far as "to revive the ancient Gnostic theory of the fall of man before all time, a theory which found no favour amongst his theological friends" (Otto Pfleiderer).

Müller's other works include *Dogmat. Abhandlungen* (1870), and *Das christliche Leben* (3rd ed., 1847). See M. Kähler, *Julius Müller* (1878); L. Schultze, *Julius Müller* (1879) and *Julius Müller als Ethiker* (1895).

MÜLLER, KARL OTFRIED (1797–1840), German scholar, was born at Brieg in Silesia on the 28th of August 1797. He was educated partly in Breslau, partly in Berlin, where his enthusiasm for the study of Greek literature, art and history was fostered by the influence of Böckh. In 1817, after the publication of his first work, *Aegineticorum liber*, he received an appointment at the Magdaleneum in Breslau, and in 1819 he was made adjunct professor of ancient literature in the university of Göttingen, his subject being the archaeology and history of ancient art. His aim was to form a vivid conception of Greek life as a whole; and his books and lectures marked an epoch in the development of Hellenic studies. Müller's position at Göttingen being rendered unpleasant by the political troubles which followed the accession of Ernest Augustus (duke of Cumberland) to the throne of Hanover in 1837, he applied for permission to travel; and in 1839 he left Germany. In April of the following year he reached Greece, having spent the winter in Italy. He investigated the remains of ancient Athens, visited many places of interest in Peloponnesus, and finally went to Delphi, where he began excavations. He was attacked by intermittent fever, of which he died at Athens on the 1st of August 1840.

Among his historical works the foremost place belongs to his *Geschichten hellenischer Stämme und Städte: Orchomenos und die Minyer* (1820), and *Die Dorier* (1824; Eng. trans. by H. Tufnell and Cornewall Lewis, 1830, including the essay *Über die Makedonier*, on the settlements, origin and early history of the Macedonians). He introduced a new standard of accuracy in the cartography of ancient Greece. In 1828 he published *Die Etrusker*, a treatise on Etruscan antiquities. His *Prolegomena zu einer wissenschaftlichen Mythologie* (1825; Eng. trans., J. Leitch, 1844), in which he avoided the extreme views of G. F. Creuzer and C. A. Lobeck, prepared the way for the scientific investigation of myths; while the study of ancient art was promoted by his *Handbuch der Archäologie der Kunst* (1830; Eng. trans., J. Leitch, 1847), and *Denkmäler der alten Kunst* (1832), which he wrote in association with C Osterley. In 1840 appeared in England his *History of the Literature of Ancient Greece*; the original German work from which it had been translated being issued in Germany in 1841 (4th ed. by E. Heitz, 1882). Chapters i.–xxii. were translated by Sir George Cornewall Lewis; chapters xxiii.–xxxvi. by J. W. Donaldson, who carried the work down to the taking of Constantinople by the Turks. It is still one of the best books on the subject. Müller also published an admirable translation of the *Eumenides* of Aeschylus with introductory essays (1833), and new editions of *Varro* (1833) and *Festus* (1839).

See memoir of his life by his brother Eduard, prefixed to the posthumous edition of K. O. Müller's *Kleine deutsche Schriften* (1847); F. Lücke, *Erinnerungen an K. O. Müller* (Göttingen, 1841); F. Ranke, *K. O. Müller, ein Lebensbild* (Berlin, 1870); C. Bursian, *Geschichte der klassischen Philologie in Deutschland* (1883), ii. 1007–1028; C. Dilthey, *Otfried Müller* (Göttingen, 1898); E. Curtius, *Altertum und Gegenwart*; and J. W. Donaldson's essay *On the Life and Writings of Karl Otfried Müller* in vol. i. of the English translation of the history of Greek literature. A biography composed from his letters was published by O. and E. Kern, *K. O. Müller, Lebensbild in Briefen an seine Eltern* (1908); see also J. E. Sandys, *Hist. of Classical Scholarship*, iii. (1908), 213–216.

MÜLLER, LUCIAN (1836–1898), German scholar, was born at Merseburg in Prussian Saxony on the 17th of March 1836. Having studied at Berlin and Halle, he resided for five years in Holland, where he collected the materials for his *Geschichte der klassischen Philologie in den Niederlanden* (1869). Unable to obtain a university appointment in Germany, he accepted (1870) the professorship of Latin at the Imperial Historico-Philological Institute in St Petersburg. There he died on the 24th of April 1898. Müller was a disciple of the methods of Bentley and Lachmann. His *De re metrica poetarum latinorum* (1861; 2nd ed., 1894) represents a landmark in the investigation of the metrical system of the Roman poets (the dramatists excepted), and his *Metrik der Griechen und Römer* (2nd ed., 1885) is an excellent treatise in a small compass (Eng. trans. by S. B. Platner, Boston, Mass., 1892).

His other chief publications were: *C. Lucili saturarum reliquiae* (1872), including the fragments of Accius and Sueius; *Leben und Werke des Gaius Lucilius* (1876; suppt. *Luciliana*, 1884); text of Horace (1869; 3rd ed., 1897); *Quintus Horatius Flaccus, eine litterarhistorische Biographie* (1880); *Quintus Ennius* (1884), an introduction to the study of Roman poetry; *Q. Enni carminum reliquiae* (1884); *Livi Andronici et Cn. Naevi fabularum reliquiae* (1885); *Der saturnische Vers und seine Denkmäler* (1885); *Noni Marcelli compendiosa doctrina* (1888); *De Pacuvii fabulis* (1889); *De Accii fabulis disputatio* (1890).

MÜLLER, WILHELM (1794–1827), German lyric poet, was born at Dessau on the 7th of October 1794, the son of a shoemaker. He was educated at the gymnasium of his native town and at the university of Berlin, where he devoted himself to philological and historical studies. In 1813–1814 he took part, as a volunteer, in the national rising against Napoleon. In 1817 he visited Italy, and in 1820 published his impressions in *Rom, Römer und Römerinnen.* In 1818 he was appointed teacher of classics in the Dessau school, and in 1820 librarian to the ducal library. He died at Dessau on the 30th of September 1827. Müller's earliest lyrics are contained in a volume of poems, *Bundesblüten*, by several friends, which was published in 1816. His literary reputation was made by the *Gedichte aus den hinterlassenen Papieren eines reisenden Waldhornisten* (2 vols., 1821–1824), and the *Lieder der Griechen* (1821–1824). The latter collection was Germany's chief tribute of sympathy to the Greeks in their struggle against the Turkish yoke, a theme which inspired many poets of the time. Two volumes of *Neugriechische Volkslieder*, and *Lyrische Reisen und epigrammatische Spaziergänge*, followed in 1825 and 1827. Müller also wrote a book on the *Homerische Vorschule* (1824; 2nd. ed., 1836), translated Marlowe's *Faustus*, and edited a *Bibliothek der Dichtungen des 17. Jahrhunderts* (1822–1827; 10 vols.). His poetic genius was kindred to that of the composer Schubert, who set many of his lyrics to music.

Wilhelm Müller's *Gedichte* were first collected in 1837 (4th ed., 1858); edited by his son, F. Max Müller (1868); there are also numerous more recent editions, notably one in Reclam's *Universalbibliothek* (1894); critical edition by J. T. Hatfield (1906). Müller's *Vermischte Schriften* were edited with a biography by G. Schwab (3 vols., 1830). See F. Max Müller's article in the *Allgemeine deutsche Biographie*; O. Franck, "Zur Biographie des Dichters W. Müller" (*Mitteilungen des Vereins für anhaltische Geschichte*, 1887); J. T, Hatfield, "W. Müllers unveröffentlichtes Tagebuch und seine ungedruckten Briefe" (*Deutsche Rundschau*, 1902).

MÜLLER, WILLIAM JAMES (1812–1845), English landscape and figure painter, was born at Bristol on the 28th of June 1812, his father, a Prussian, being curator of the museum. He first studied painting under J. B. Pyne. His early subjects deal mainly with the scenery of Gloucestershire and Wales, and he learned much from his study of Claude, Ruysdael, and earlier landscape-painters. In 1833 he figured for the first time in the Royal Academy with his "Destruction of Old London Bridge—Morning," and next year he made a tour through France, Switzerland and Italy. Four years later he visited Athens, extending his travels to Egypt, and in the sketches executed during this period and the paintings produced from them his power and individuality are apparent. Shortly after his return he left Bristol and settled in London, where he exhibited regularly. In 1840 he again visited France, where he executed a series of sketches of Renaissance architecture, twenty-five of which were lithographed and published in 1841, in a folio entitled *The Age of Francis I. of France.* In 1843 he accompanied, at his own request and his own charges, the government expedition to Lycia, where he made a number of masterly sketches. He died at Bristol on the 8th of September 1845.

The print room of the British Museum possesses, through the bequest of Mr John Henderson, a rich collection of Müller's sketches. A biography by N. Neal Solly was published in 1875.

MULLET, the name of two different kinds of fishes, distinguished as red mullets and grey mullets.

Red mullets (genus *Mullus*, the name given by the ancient Romans) are marine fishes, with two short dorsal fins remote from each other: the first is composed of feeble spines, the second of branched rays; the anal fin is similar to the second dorsal. The body is covered with large thin scales. The form of the head is peculiar; its anterior profile slopes downwards to the small mouth, which has very small and feeble teeth, and from which two cylindrical barbels are suspended. These organs of touch are generally laid backwards and hidden in a groove between the branches of the lower jaw, but can be erected and called into action independently. About forty different species of red mullets are known, chiefly from the tropical and subtropical parts of the Indo-Pacific ocean. In European waters two forms are known which have received different specific names, *Mullus surmuletus* and *Mullus barbatus*. The former in addition to the general red colour has three to five bright yellow bands along the sides from head to tail; these are absent in the other form. It has been proved that this is not a sexual difference, the two forms are varieties or species. The striped form is usually found on the coasts of England, where the plain form is rare or absent. In the Mediterranean both kinds occur, but it is probable that the striped form, which is larger, is more common in the Atlantic and the plain form in Mediterranean and southern waters.

Red mullets do not attain any considerable size, the largest of the tropical species weighing only two or three pounds. They are ground-feeders, evidently using their barbels in discovering their food, which consists of crustacea, worms, and, in the larger species, of small fishes; that they feed on putrid flesh is not borne out by the evidence drawn from their feeble jaws and dentition, but it is probable that they are attracted to a decomposing body by the presence of the small crustaceans which feast upon it. Although the colours of these fishes are brilliant, they are simple and evanescent; only a few of the tropical species exhibit ornamentations in the form of black spots or bands. In many, as also in the European species, red colour prevails, and its preservation after death is considered to enhance the fitness of the fish for the table, and consequently its market value. To produce the intensity of this red colour, fishermen scale the red mullet immediately before its death, a process by which the red pigment cells or chromatophores are excited to expand; fishes which are allowed to die in the water show little red, and therefore red mullets caught by the trawl are less valuable than those obtained in a trammel-net, by which the majority are secured alive. All the species are esteemed as food; but none equals the European species, which was held in exaggerated esteem by the gourmands of Rome. They exhibited the living fish and allowed them to die at the table immediately before they were consigned to the cook; they kept them in large reservoirs until they were wanted, and paid fabulous prices for fishes somewhat above the average size. Little is known about the habits of red mullets; during winter they retire into deep water, late in spring and during summer they approach the coasts and enter even brackish water, but the state of their sexual organs shows that they do not come towards the shore to breed. At Naples they spawn from May to August, and their ova are buoyant and transparent. In June, July and August the young are about an inch long, and already furnished with the two barbels.

The grey mullets form a widely different and distinct family, *Mugilidae.* They are not exclusively marine, but enter brackish water, live always close to the shore, and some of the tropical forms inhabit the pure fresh water of streams and rivulets, without, however, penetrating far inland. Their body is elegantly formed, wedge-shaped, and covered with scales of moderate size, firmly adherent to the skin. The two short dorsal fins are remote from each other, and the anterior is composed of four stiff spines. The anal fin is similar to the second dorsal; the caudal fin strong and bilobed. The form of the snout is peculiar; the mouth narrow, transverse in the true *Mugil*, and without, or with but feeble, teeth. About seventy different species are known, from almost every coast of the temperate and tropical zones; they swim in small schools and are abundant wherever they occur. Two species are found on the British coasts—*Mugil capito* and *Mugil chelo*, the first being the more common. Some of the fresh-water grey mullets of the tropics, especially those of the West Indian and Indo-Pacific islands, have the mouth more lateral or have distinct though minute teeth; they therefore have been formed into separate genera, *Agonostoma* and *Myxus*.

Grey mullets, at least some of the species, grow to a weight of 10 or 12 ℔; but the fish which usually come into the market rarely exceed half that weight. Those in which distinct teeth are developed feed principally on small aquatic animals, whilst the diet of those without teeth consists of animalcules or minute organic substances mixed with the mud or sand which they swallow in large quantities; also confervoid growths to which small shells adhere are freely taken. To prevent the gills from being clogged by sand or mud, a peculiar apparatus separates these organs from the pharynx. Each branchial arch is provided on each side, in its whole length, with a series of closely-set gill-rakers, each series fitting into the series of the adjoining arch; they constitute together a sieve permitting the passage of the water, while retaining other substances in the cavity destined for mastication. The structure of the intestinal tract is also adapted to the diet of these fishes. One portion of the stomach is globular and surrounded by a thick mass of muscles, the cavity being small and coated with a tough epithelium. This structure reminds us of the stomach of birds, in which it also serves for the trituration of hard substances. The intestine itself is six or seven times as long as the fish. Grey mullets are plainly coloured, generally greenish on the upper parts and more or less silvery on the side. They are wholesome food, well flavoured when taken out of clean water. In the fish-farms of western Italy grey mullets are among the principal fish cultivated. (J. T. C.)

MULLIGATAWNY, the name, derived from the Tamil *milagu-tannir* (*i.e.* pepper water), given to a favourite hot East Indian soup, made with curry-powder and otherwise highly seasoned, and served usually with rice.

MULLINGAR, a market-town, and the county town of county Westmeath, Ireland, near the river Brosna and on the Royal canal, 50 m. W. by N. of Dublin. Pop. (1901), 4500. It is a junction on the Midland Great Western railway where the branch for Longford, Sligo and Cavan leaves the main line. The principal churches are the parish church (1813) with tower and spire, and the Roman Catholic cathedral for the diocese of Meath. Tanning, brewing, and the manufacture of coarse woollens are carried on, and the town is the centre for the agricultural trade of the district. Mullingar was one of the ancient palatinate towns, but its present appearance is modern. It possessed an Augustine convent founded in 1227, and a Dominican convent founded in 1239, but both were dissolved by Elizabeth. The town was the headquarters of William III. before the siege of Athlone. It formerly returned two members to parliament, but was disfranchised at the Union in 1800. Mullingar is a centre for the trout-fishing in the Westmeath loughs, being in proximity to Loughs Ennell and Owel.

MULLION (corrupted from "munnion"; this is derived from Fr. *moignon*, stump), in architecture, the English term for the perpendicular pieces of stone, sometimes like columns, sometimes like slender piers, which divide the bays or lights of windows or screen work from each other; equivalents are Fr. *meneau*, Ital. *regolo*, Ger. *Fensterpfoste*. H. Wedgwood (*Dict. of Eng. Etym.*) points out that the mullion is "the stump of the division before it breaks out into the tracery of the window." In all styles, in less important work, the mullions are often simply plain chamfered, and more commonly have a flat hollow on each side. In larger buildings there is often a bead or bowtel on the edge, and often a single small column with a capital; these are more frequent in foreign work than in English. Instead of the bowtel they often finish with a sort of double ogee. As tracery grew richer, the windows were divided by a larger order of mullion, between which came a lesser or subordinate set of mullions, which ran into each other.

MÜLLNER, AMANDUS GOTTFRIED ADOLF (1774–1829), German dramatic poet, nephew of Gottfried August Bürger, (*q.v.*), was born at Langendorf near Weissenfels on the 18th of October 1774. After studying law at Leipzig he established himself as advocate at Weissenfels and made his début as an author with the novel *Incest, oder der Schutzgeist von Avignon* (1799). He next wrote a few comedies for an amateur theatre in Weissenfels; these were followed by more pretentious pieces: *Der angolische Kater* (1809) and *Der Blitz* (1814, publ. 1818), after French models. With his tragedies, however, *Der neunund-zwanzigste Februar* (1812), and especially *Die Schuld* (1813; publ. 1816), Müllner became the representative of the so-called *Schicksalsdramatiker*, and for several years "fate-tragedies" on the model of *Die Schuld* dominated the German stage. His later plays, *König Yngurd* (1817) and *Die Albaneserin* (1820), were less important. Notwithstanding his literary success, Müllner did not neglect his profession, and was given the title of Hofrat; he also edited various journals, and had a reputation as a vigorous if somewhat acrimonious critic. He died at Weissenfels on the 11th of June 1829.

Müllner's *Vermischte Schriften* appeared in 2 vols. (1824–1826); his *Dramatische Werke* in 8 vols. (1828; 2nd ed., 1832). In 1830 four supplementary volumes were published containing mainly criticism. See F. K. J. Schütz, *Müllners Leben, Charakter und Geist* (1830); J. Minor, *Die Schicksalstragödie in ihren Hauptvertretern* (1883), and the same author's volume, "Das Schicksalsdrama" (1884), in Kürschner's *Deutsche Nationalliteratur*, vol. 151.

MULOCK, SIR WILLIAM (1843–), Canadian statesman and jurist, was born at Bond Head, Ontario, on the 19th of January 1843, the son of T. H. Mulock, M.D. From 1882 to 1905 he was a prominent member of the Liberal party in the Federal house; postmaster-general from 1896 to 1905, and minister of labour from 1900 to 1905. He introduced many improvements into the Canadian postal service, and in 1898 in face of much opposition induced the Inter-Imperial Postal Conference to adopt the principle of penny postage within the British Empire. In 1905 he resigned office, and was appointed chief justice of the exchequer division of the High Court of the province of Ontario. From 1881 to 1900 he was vice-chancellor of the university of Toronto, and was largely responsible for the success of the movement leading to the federation between that body and the Victoria University (Methodist).

MULREADY, WILLIAM (1786–1863), English subject painter, was born at Ennis, Co. Clare, on the 30th of April 1786. When he was about five years old his father, a leather-breeches maker by trade, removed to London, where the son received a tolerable education, chiefly under Catholic priests. He was fond of reading, and fonder still of drawing.[1] When eleven years old Mulready was employed by an artist named Graham as the model for a figure in his picture of "Solomon Blessed by his Father David." The painter's interest in the lad did much to confirm his artistic proclivities; and, having studied at home for two years, Mulready applied for advice to Banks the sculptor, who sent him to a drawing school and permitted him to work in his own studio. In 1800 he was admitted a student of the Academy, and two years later he gained the silver palette of the Society of Arts. About this time he was associated with John Varley, the eccentric water-colour painter and drawing-master, whom he assisted in the tuition of his pupils, who included Cox, Fielding, Linnell, William Hunt, and Turner of Oxford. At eighteen he married a sister of Varley's, and at twenty-four he was the father of four sons. The marriage was unhappy, and the pair separated before many years. He "tried his hand at everything," as he said, "from a miniature to a panorama." He painted portraits, taught drawing, and up till 1809 designed illustrations to a series of children's penny books. His first pictures were classical and religious subjects of no great merit, and the early works which he sent to the Academy were mainly landscapes; but he soon discovered his special aptitude for genre-painting, and in 1809 produced the "Carpenter's Shop," and in 1811 the "Barber's Shop," pictures influenced by the example of Wilkie and the Dutch painters. In 1813 he exhibited his "Punch," a more original and spontaneous work, which brought the artist into notice, and two years later his "Idle Boys" procured his election as associate. Next year he received full academic honours, and the election was justified by the "Fight Interrupted" which he then exhibited. It was followed by the "Wolf and the Lamb" (1820), the "Convalescent" (1822), "Interior of an English Cottage" (1828), "Dogs of Two Minds" (1830), the "Seven Ages" (1838), and in 1839 and 1840 by the "Sonnet and First Love," two of the most perfect and poetical of the artist's works. In 1840 he designed an allegorically covered postal envelope (the "Mulready envelope," soon discontinued[2]) for Rowland Hill, and a set of illustrations to *The Vicar of Wakefield*, which were succeeded by his paintings of the "Whistonian Controversy" (1844), "Choosing the Wedding Gown" (1846), and "Sophia and Burchell Haymaking" (1849). His later works, like the "Bathers" (1849), "Mother teaching her Children" (1859), and the "Toy Seller" (1862), show declining powers, mainly attributable to failing health. The last evening of his life was spent at a meeting of the Academy, of which, for nearly fifty years, he had been a most active and efficient member. He died of heart disease on the 7th of July 1863.

MULTAN, or MOOLTAN, a city, district and division of British India, in the Punjab. The city is 4 m. from the left bank of the Chenab, near the ancient confluence of the Ravi with that river. It has a station on the North-Western railway. Pop. (1901), 87,394. The city is enclosed on three sides by a wall, but open towards the south, where the dry bed of the old Ravi intervenes between the houses and citadel. Large and irregular suburbs have grown up outside the wall since the annexation in 1849. Within the city proper, narrow and tortuous streets, often ending in *culs de sac*, fill almost the whole space; but one broad bazaar runs from end to end. The principal buildings include the shrines of two Mahommedan saints and the remains of an ancient Hindu temple. The cantonments form the headquarters of a brigade in the 3rd division of the northern army. Multan has manufactures of carpets, silk and cotton goods, shoes, glazed pottery and enamel work, and an annual horse fair. It is moreover one of the most important trade-centres in the Punjab. It is a station of the Church Missionary Society.

The DISTRICT OF MULTAN occupies the lower angle of the Bari Doab, or tract between the Sutlej and the Chenab, with an extension across the Ravi. Area, 6107 sq. m. The population in 1901 was 710,626, showing an increase of 11·7% in the preceding decade, due to the extension of irrigation. The principal crops are wheat, millets, pulse, oil-seeds, cotton and indigo. There are factories for ginning and pressing cotton. Indigo is made only by native processes. Irrigation is largely conducted by inundation channels from the boundary rivers, but the centre of the district is barren. The district is traversed by the main line of the North-Western railway from Lahore, which crosses the Sutlej by the Empress Bridge opposite Bahawalpur. It is also entered by the branch from Lyallpur to Khanewal junction, crossing the Ravi.

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[1] Some reproductions of his early attempts in this direction are given, along with details of his life, in a scarce volume for the young, entitled *The Looking-Glass*, written by William Godwin under the *nom de plume* of Theophilus Marcliffe, and published in 1805.

[2] "Considerable diversion was created in the city to-day [May 1, 1840] by the appearance of the new penny-post devices for envelopes, half-sheet letters, and bits of sticking-plaster for dabbing on to letters. . . . [The elephants on the Mulready cover] are symbolic of the lightness and rapidity with which Mr Rowland Hill's penny-post is to be carried on. . . . Withal the citizens are rude enough to believe that these graphic embellishments will not go down at the price of 1s. 3d. per dozen for the envelopes, . . . and of 1s. 1d. per dozen for the . . . sticking-plaster." This banter is from the money article of an eminent daily paper.

The early Arab geographers mention Multan as forming part of the kingdom of Sind, which was conquered for the caliphate by Mahommed bin Kasim in the middle of the 8th century. On the dismemberment of the Mogul Empire in the middle of the 18th century, Multan fell to the Afghans, who held it with difficulty against the Sikhs. At length, in 1818, Ranjit Singh after a long siege carried the capital by storm; and in 1821 he made over the administration of Multan with five neighbouring districts to Sawan Mal, who raised the province to a state of prosperity by excavating canals and inducing new inhabitants to settle. After the establishment of the council of regency of Lahore, difficulties arose between Mulraj, son and successor of Sawan Mal, and the British officials, which led to his rebellion, and culminated in the second war and the annexation of the whole of the Punjab. The city of Multan, after a stubborn defence, was carried by storm in January 1849. The district at once passed under direct British rule, and order was not disturbed even during the Mutiny.

The Division of Multan is the south-western division of the Punjab. It was abolished in 1884, but reconstituted in 1901. Its area is 29,516 sq. m. and its population in 1901 was 3,014,675. It includes the six districts of Mianwali, Jhang, Lyallpur, Multan, Muzaffargarh, and Dera Ghazi Khan.

MULTIPLEPOINDING, in Scots law, the technical term for a form of action by which conflicting claims to the same fund or property are determined. The action is brought either by the holder or by a claimant in his name. All who have any claims in the fund or property in question are ordered to appear and give in their claims; the court then prefers them according to their respective rights, and the holder of the fund or property in dispute on payment or delivery is absolved from any further claim in regard to it. It corresponds to the process of *inter-pleader* in English law.

MULTITUBERCULATA, a group of extinct mammals, mostly of small size, whose remains are met with in strata ranging from the Trias to the Eocene, both in Europe and in North America. They are mostly known by their lower jaws, and take their name from the fact that the grinding teeth (fig. 2, *m.* 1 and 2; and fig. 3 *a. b. c.*) bear two or three longitudinal rows of tubercles, or are provided with tubercles round the edges. From this feature these otherwise unknown animals are believed to be related to the existing egg-laying mammals (duck-billed platypus and spiny ant-eater), constituting the order Monotremata, and are therefore provisionally placed near that group. The largest representative of the Multituberculata is *Polymastodon* from the Lower Eocene of New Mexico; the same beds also yield the smaller *Ptilodus*; while from corresponding strata at Rheims, in France, has been obtained the nearly allied *Neoplagiaulax*. The latter takes its name from its resemblance to *Plagiaulax* (figs. 1 and 2) from the Purbeck strata of Swanage, Dorsetshire, which was one of the first-known members of the group. These have cutting teeth in front and multituberculate molars behind. *Allodon* and *Ctenacodon* represent the group in the Cretaceous of North America; and the English Purbeck genus *Bolodon*, in which all the cheek-teeth are multituberculate, also belongs here. *Stereognathus* (fig. 3) is another English Upper Oolitic type. Single teeth from the Rhaetic of England and Württemberg described as *Microlestes* apparently indicate the earliest member of the group. A skull from the Upper Triassic Karoo beds of South Africa described as *Tritylodon longaevus*, which has multituberculate molar teeth, was also at first placed in this group, but has been subsequently regarded as a reptile, although Dr R. Broom considers that the original determination is correct. Possibly a fore-limb from the same formation described as *Theriodesmus phylarchus* indicates a similar or allied animal. Not improbably *Tritylodon* indicates a direct link between the multituberculate mammals and the anomodont reptiles of the Permian and Trias. (R. L.*)

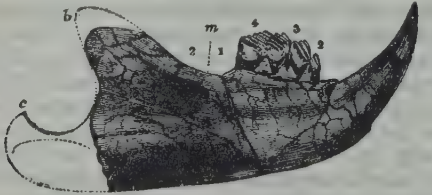

Fig. 1.—Lower Jaw of *Plagiaulax becclesi*, from the Purbeck Strata of Swanage.

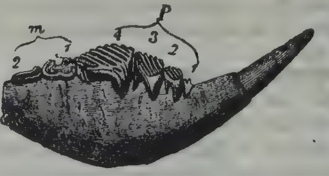

Fig. 2.—Lower Jaw of *Plagiaulax minor*, from Swanage. *p.* 1-4 premolars; *m.* 1 and 2 molars.

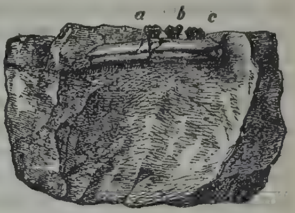

Fig. 3.—Fragment of Jaw of *Stereognathus oolithicus* in matrix. *a b c*, molars.

MUMMERS, bands of men and women in medieval and later England and elsewhere, who, during periods of public festivity, particularly at Christmas, dressed in fantastic clothes and wearing masks or disguised as animals, serenaded the people outside their houses or joined in the revels within. In a more restricted sense the term is applied to the actors in the old English rural folk-plays of St George, &c.; and "mumming" thus becomes a contemptuous synonym for any form of stage-playing. The origin of the word mummer (older spelling "mommer," Fr. *momeur*) is not satisfactorily explained; but the verb "to mum" means both to mutter and to be silent, and "mummer" apparently comes from one or both of these senses. Mumming seems to have been a survival of the Roman custom of masquerading during the annual orgies of the Saturnalia. "The disguisyng and mummyng that is used in Christemase tyme," Langley writes in his synopsis of Polydore Virgil, "in the Northe partes came out of the feasts of Pallas, that were done with visars and painted visages, named Quinqatria of the Romaynes." Aubanus, writing of mumming in Germany, says that "in the Saturnalia there were frequent and luxurious feastings amongst friends, presents were mutually sent, and changes of dress made: that Christians have adopted the same customs, which continue to be used from the Nativity to the Epiphany: that exchanges of dress too, as of old among the Romans, are common, and neighbours by mutual invitation visit each other in the manner which the Germans call mummery." Christmas was the grand season for mumming in England. Some were disguised as bears, others as unicorns, or wore deer's hide and antler's or ram's horns. Mumming led to such outrages that Henry VIII. issued a proclamation declaring the wearing of a mask or disguise a misdemeanour. Stow gives an account of an elaborate mummery held in 1377 by the London citizens to amuse the son of the Black Prince, then living at Kennington (*Survey*, 1603, p. 97). In Scotland, where mumming still exists at Christmas, Hogmanay, New Year's Day and Handsel Monday, mummers are called "guisards." They usually present on these four nights a rude drama called *Galatian*, which, in various versions, is common throughout the Lowlands of Scotland (see Chambers's *Popular Rhymes*, p. 170).

MUMMIUS, LUCIUS (2nd century B.C.), surnamed Achaïcus, Roman statesman and general. Consul in 146 B.C. Mummius was appointed to take command of the Achaean War, and having obtained an easy victory over the incapable Diaeus, entered Corinth unopposed. All the men, women, and children were put to the sword, the statues, paintings and works of art were seized and shipped to Rome, and then the place was reduced to ashes. The apparently needless cruelty of Mummius in Corinth, by no means characteristic of him, is explained by Mommsen as due to the instructions of the senate, prompted by the mercantile party, which was eager to get rid of a dangerous commercial rival. According to Polybius, his inability to resist the pressure of those around him was responsible for In the subsequent settlement of affairs, Mummius exhibitensiderable administrative powers and a high degree ofstice and integrity, which gained him the respect of the inhants. He specially abstained from offending their religiousceptibilities. On his return to Rome he was honoured wa triumph. In 142 he was censor with the younger Scipio Aanus, whose severity frequently brought him into collision h his more lenient colleague. Mummius was the first *nc homo* of plebeian origin who received a distinctive cognomior military services. His indifference to works of art and ignnce of their value is shown by his well-known remark to th who contracted for the shipment of the treasures of Corinth Rome, that "if they lost or damaged them, they would h: to replace them." For the theatrical pageants exhibited him he erected a theatre with improved acoustical condits and seats after the Greek model, thus marking a distinct adve in the construction of places of entertainment.

His brother, Spurius Mummius, a maf greater refinement and intellectual powers, accompanied Lius as his legate to Achaea, whence he sent letters to his frie at Rome, describing his experiences in humorous verse. Th letters, which were still popular a hundred years later, werne first example of a distinct class of Roman poetry—the pic epistle. Both he and his brother are alluded to by Ciceas mediocre orators, whose style was simple and old-fashion although Lucius, as a Stoic, was more concise.

MUMMY (from the Persian *mumiai*, ph or asphalt), a dead body, as preserved by the ancient Egypti method of embalming. The preservative climate of UppeEgypt and the belief of the Egyptians in life after death mu be the causes which led them to take unusual care for preserng the bodies of their dead. In prehistoric times in Egypt thdead were laid in the graves on mats in the crouching positionmmon in the burials of primitive peoples, and were supplied ith jars of food, flint instruments, &c. Perhaps the attemptvas already made to preserve the bodies by drying or otherwi: In a few instances, such bodies, probably more than five thsand years old, have been found with skin and hair well preseed though dried and shrunken; usually everything but the bors has decayed. With the advent of the Dynasties the bodies osome of the principal people are found lying extended at full lgth. By the time of the VIth Dynasty it was usual to lay thcorpse on its left side in the attitude of sleep, and a wooden con was often provided upon which were inscribed magic formae that had already been employed for ages in ritual. In he Middle Kingdom necropolis of Beni Hasan, Garstang foud many intact interments in coffins, and in one case the bov was well preserved. Several were accompanied by boxes divied into four compartments and inscribed with the names ofthe four deities who represented the internal organs of the ody. This indicates that the custom of taking out these orgas and wrapping them separately was already in vogue in the most lavish form of burial. But the parcels, examined by a expert, contained no trace of organic remains, proving how much the Egyptians depended on magic imitations and mak-believe. It was not until the New Kingdom that the processesof embalming reached a high degree of elaboration. Later still, in the last millennium B.C., it seems that even the bodies of the poor were pickled. The embalmers were accustomed to keep the corpse in all for seventy days before burial (cf. Gen. l. 3; Herod. ii. 86), to be soaked, wrapped in linen bandages, and put in the coffin. This is confirmed by the monuments as far back as the age of Rameses II. (*c.* 1300 B.C.) and may be conjectured to have been established still earlier.

The Egyptians did not stop at the mummification of the human body; sacred animals, birds, reptiles, fishes, and even insects were treated in a similar way, and the meat offerings deposited with the wealthy dead were likewise "preserved." Vast cemeteries of animals which belonged to the revered species have been discovered; more especially may be mentioned that of the cats at Bubastis, the remains of which, charred by some great fire, until recently filled numberless chambers of crude brick in the ruins at Zagazig. In the hawk cemeteries birds were pickled and buried in long bundles, forming sometimes an assortment that is not without incongruities from the naturalist's point of view. From a few of these bundles may be extracted not only numbers of raptorial birds, large and small, including owls, but also the hawk-like cuckoo, the shrike, and even the swallow. The larger animals were represented in mummies by the head and a selection of the bones. Bones of bulls and male calves, especially crania, were collected and formed into huge ox-like mummies.

What the Egyptians really thought of mummification can only be partially guessed. Custom, changing in some degree from century to century, governed their practice, and no doubt was regulated by the priests. At first the luxury of mummification was reserved for the king, who was identified with Osiris and was buried with an abundance of ritual and magic words. But the king required his courtiers, and his courtiers in turn needed their servants in permanent attendance. Partly in consequence of this, the deification of the king, with all its concomitants, was gradually extended through the ranks of the noble and wealthy until it came within the reach of the humblest, and even animals shared the honour of deification after death. Finally, in a papyrus of the Roman age, the word "god" is practically defined as "buried," *i.e.* with due rites. Beliefs regarding the gods and life after death were self-contradictory and variable, but none interfered with the custom of preserving the body. It was always the prayer that the soul (*bai*) should be able to revisit the corpse (*khat*), and some inscriptions show an expectation of the body itself being revivified, "the mouth speaking," "the legs walking," and everything conforming with its previous terrestrial life. At the same time the *ko* ("life," "activity," and almost "ghost,") which clung to the neighbourhood of the tomb and enjoyed the ghosts of offerings in ghostly fashion, had some of the independent enterprise which the *bai* possessed in abundance. The mummified corpse as a divine thing—not the mere *khat*—was called the *sahu* (an old word meaning "noble") or *ikh*, which in the latter period meant a spirit or demon. As the corpse was found generally to disappear and decay in spite of preservative magic, especially in the early ages, various substitutes were resorted to; statues and statuettes were thought efficacious, but, apart from their costliness, even these were subject to decay or destruction by violence, and in the absence of anything more substantial the Egyptians doubtless reflected that magic words alone in the last resort made everything right.

Under the Old Kingdom the attendance on and services for a dead magnate—the sacrifices and libations at his tomb—were left, together with endowments, to a staff of priests, called "servants of the *ko*(*ka*)," whose offices were hereditary. This system led to disputes and neglect, and was so unworkable that we find in the texts of the Middle Kingdom the whole responsibility put upon one well-endowed "ko-servant," who passed on his office to a single heir. How these things were managed during the New Kingdom we do not know. In the last thousand years B.C. the life of the Egyptians consisted largely in every kind of religious and superstitious observances. Papyri of the Ptolemaic age or somewhat earlier afford much information about the people of the necropolis. In this age the *choachytae*, as the Greeks called them ("libation priests," or "shrine-openers" in Egyptian), belonged to an inferior grade of the priesthood, equivalent to the *pastophori* of the deities, and were organized in gilds for the different cemeteries. A single choachyte would have an interest, not always the sole interest, in a large number of mummies, and these interests could be disposed of by will or contract, bought and sold. The *taricheutae*, or embalmers, had no permanent interest in the mummies they prepared.

Thanks to the great care expended on the preservation of the royal dead, although the mummies of all the other kings have disappeared, a wonderful series of the Theban kings and queens of the New Kingdom from the XVIIth Dynasty to the XXIst

Dynasty has come down to us. It comprises some of the most notable figures in Egyptian history—Āhmosi (Amasis) I., who freed Egypt from the Hyksos, Tethmosis I. and III., the conquerors of Syria and makers of the empire, Amenophis III., the great builder, whose likeness is preserved in the colossi of Memnon, probably also his son, Amenophis IV. (Akhenaton), the heretic king, and Seti (Sethos) I. and his son Rameses II. The mummy of Seti I. is in the finest possible preservation, but others, after being brutally plundered, were rewrapped by the piety of later generations.

In Lower Egypt practically all the mummies have perished; but in Upper Egypt, as they were put out of reach of the inundation, the cemeteries, in spite of rifling and burning, yield immense numbers of preserved bodies and skeletons; attention has from time to time been directed to the scientific examination of these in order to ascertain race, cause of death, traces of accident or disease, and the surgical or medical processes which they had undergone during life, &c. This department of research has been greatly developed by Dr Elliott Smith in Cairo. He has examined not only the more recently found of the royal mummies, but also multitudes of skeletons, &c., which have been brought from the official excavations of the government and from other work. His researches, in particular instances, prove their high importance for the history of disease, for characterization of the races inhabiting Egypt, and in other ways. The cemeteries just south of the First Cataract on a first examination reveal a prehistoric race of Egyptian type, a group of male negro mercenaries, a group of male prisoners executed by hanging during the New Kingdom, while from a necropolis of Christian foreigners of about the 6th century comes the first instance of gout in an ancient body from Egypt. Among the prehistoric people are many female skeletons with a fractured right ulna sustained in warding off blows, and some of these women had died while still wearing splints. Circumcision is traceable on all the male bodies which are in a state to show its effects. The royal mummies furnish evidence of age at death as well as of health and physical character. A series of forty-four mummies of priests and priestesses of the XXIst Dynasty furnished the material for an important monograph. Earlier, the processes of mummification produced a skeleton merely clothed in a dry and shrunken skin. At this time, however, the flesh was replaced by a stuffing of sawdust, sand, or other lasting material, introduced with great skill through a few incisions and apertures, so that the natural forms were completely restored. The heart was left in place, but the liver, lungs, stomach and intestines were pickled and wrapped separately and then restored to the body cavity. Later, the form was reproduced by elaborate external wrappings of the different parts of the body before the final swathing; later still, in the Ptolemaic age, by coarse padding with plenty of linen and pitch. The XXIst Dynasty marks the highest level of the art. The Christians of the early centuries, looking for corporeal resurrection, avoided the incisions, extraction of organs, &c., practised by their pagan forefathers, and buried the body entire after pickling it in salt. Their stricter leaders, however, objected to a custom which so easily led to the worship of relics and the continuance of pagan observances; and with the advent of Islām embalming fell into disuse.

Outside Egypt mummification was practised amongst the ancient Peruvians, who took advantage of the desiccating atmosphere and salt of their caves for preserving the dead in good condition wut any embalming process. Among the Guanches of the nary Islands, however, the Egyptian methods of emptying body and padding he skin were closely paralleled.

A word may be ad about the use of mummy in medicine. The name, as has be ointed out above, is derived from the Persian *mumiai*, meag pitch or asphalt, which substance occurs frequently in t prescriptions of the Greek and Roman medical writers. Meval physicians in the East conceived the happy idea that t ighest virtue would exist in that which had been already empld by the Egyptian priests in preserving the human body. Ts the bituminous and fatty matters found about the munes and their wrappings were employed as a sovereign remedy articularly for wounds and contusions, and a brisk trade be in these "exudations" of mummies. This led further to medicinal use of fragments of the mummies themselves ad, finally, the starting-point was lost sight of, so that th dried or prepared flesh of criminals became one of the stard forms of mummy in the pharmacopoeia. It was not the 18th century that the importance of mummy in all its rms waned, and in some of the least progressive quarters central Europe it survived even to the middle of the 19th.

See T. J. Pettigrew, *History of Egyptian Mummies* (London, 1834); G. Elliott Smith, *Contribution to the Study of Mummification in Egypt* (Cairo, 1906); *e Archaeological Survey of Nubia Bulletins* (Cairo, 1908 seq.); Dr tet and M. C. Gaillard, *La Faune momifiée de l'ancienne Egypte* (ons, 1905); A. Wiedemann, "Mumie als Heilmittel," in *Zeitschr des Vereins für rheinische und westfälische Volkskunde* (1906). (F. Ll. G.)

MUMPS (syn. *Cynche parotidaea, parotitis*; also, "The Branks"), a specific ectious disease characterized by inflammatory swelling of th parotid and other salivary glands, frequently occurring as epidemic, and affecting mostly young persons. The name "umps" (O. Eng. "to mump," meaning to sulk) originated, no ubt, in the patient's appearance. The disease generally sets n with symptoms of a cold or catarrh accompanied with slht febrile disturbance; but soon the nature of the ailment announced by the occurrence of swelling and stiffening in the gion of the parotid gland in front of the ear. The swelling spdily increases in size and spreads downwards towards the ck and under the jaw, involving the numerous glands in at locality. The effect is to produce much disfigurement, hich becomes still greater should the inflammation spread, s often happens, to the glands on the other side of the face nd neck. Pain is present in the swollen parts, but it is seldo severe, nor is there much redness or any tendency to suppration. There is, however, considerable interference with the ats of mastication and swallowing. After continuing for four or ve days the swelling and other symptoms abate, and the parts ae soon restored to their normal condition. During the period o convalescence there occasionally occur some swelling and tnderness in other glands, such as the testicles in males (*orchtis*), and the mammae or ovaries (*oöpheritis*) in females, and ossibly involvement of the pancreas, but these are of short duraion and usually of no serious significance. Mumps is in general amild disease, and requires little treatment beyond a gentle laxave, the application of warm fomentations to the swollen and painful parts, the use of soft food, and rest

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